

**DATE: 28 June 2007**

**I.T.L. (PRODUCT TESTING) LTD.**  
**FCC EMC/Radio Test Report**  
for  
**Hi-G-Tek Ltd.**

**Equipment under test:**

**Compact Reader and Power  
Supply & Communication**

**IG-CR46D-916 (CR)    IG-PS-4RI (PSC)**

Written by: D. Shidlowsky

D. Shidlowsky, Documentation

Approved by: E. Pitt

E. Pitt, Test Engineer

Approved by: I. Raz

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:

### Compact Reader and Power Supply & Communication

**FCC ID: OB6-IGCR46D916**

**DATE: 28 June 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

Applicant for this device:

prepared by:

(different from "prepared by")

Ishaiahou Raz

Yossi Hershko

ITL (Product Testing) Ltd.

Hi-G-Tek Ltd.

1 Batsheva St. P.O.B. 87

16 Hacharoshet St.

Lod 71100

Or Yehuda 60375

Israel

Israel

Tel: +972-8-915-3100

Tel: +972-3-533-9359

Fax: +972-8-915-3101

Fax: +972-3-533-8225

Email: sraz@itl.co.il

Email: yossih@higtek.com

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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):	Compact Reader and Power Supply & Communication
Equipment Model No.:	IG-CR46D-916 (CR) IG-PS-4RI (PSC)
Equipment Serial No.:	Not Designated
Date of Receipt of E.U.T:	19.03.07
Start of Test:	19.03.07
End of Test:	15.05.07
Test Laboratory Location:	I.T.L (Product Testing) Ltd. Kfar Bin Nun, ISRAEL 99780
Test Specifications:	FCC Part 15, Subparts B, 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 Compact Reader is a component of Hi-G-Tek's wireless monitoring system use for outdoor installations. It allows coverage and protection of secured cargoes or assets in large storage yards and ports.

The Compact Reader utilizes RFID technology to communicate with the RFID sensors (data tags /seals) over the 916MHz UHF channel. It interrogates their ID, status and user data. Correspondingly, each tag/seal reports its unique identification and anti-tamper alarm status in a short beacon transmission over the high-frequency channel.

Each reader is able to communicate with a numerous sensors simultaneously, verifying their presence and status, any changes in status are immediately reported. Using an isolated RS-485 interface, multiple readers can be easily networked together into a single controlling computer. This allows enlarging even further the coverage area of the readers while keeping them synchronized within the field of application.

The Compact Reader powered from an indoor power supply & comm. unit (PSC unit) that provides both protected and isolated power and serial communication lines. Equipped with RS-232 to RS-485 bi-directional serial communication converter, the PSC unit easily forwards any real-time RFID transaction from the Reader (RS-485) to the controlling computer (RS-232)

### Technical spec.

#### RF Characteristics

UHF Tx/Rx Channel (Operating Frequency)	916.5 MHz Modulation : FSK with 40KHz deviation Data rate : 16KHz
Range	Up to 100m ( within open space)

#### Interfaces

Serial comm.	RS232 channel, RS485 (2000V isolated lines)
Antenna	50 ohm, $\lambda/4$ , whip type (supplied)
I/O's	Isolated 3 Outputs & 1 Input (active low)

#### Power Requirements

Power supply type:	24V or 48V (different models) powered from PSC Unit.
Power Consumption	1W Max

#### Physical Characteristics

Dimensions	150x150x80mm (5.9"x5.9"x 3.15" inch)
Weight	1580gr (3.4 Lb)

## Environmental

Operating Temperature	-40°C to +70°C
Storage Temperature	-40°C to +80°C
Protection Class.	IP 65

The product has two configurations: 24VDC, 48 VDC, both configurations use the same antenna, PCB, enclosure, radio circuitry, and non-radio circuitry. They differ only by the DC/DC converter. Each configuration has a corresponded power supply unit (PSC) that provides the required operation power.

## Models:

<i>Compact Reader</i>	
IG-CR-46D-916	Power : 24VDC, Operating Freq: 916.5MHz
IG-CR-86D-916	Power : 48VDC, Operating Freq: 916.5MHz
<i>PSC unit (Power supply &amp; communication unit)</i>	
IG-PS-4RI	Input: 100 ~ 240VAC, Output:24VDC, 14.4W
IG-PS-8RI	Input: 100 ~ 240VAC, Output:48VDC, 14.4W



#### **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  $\pm 4$  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

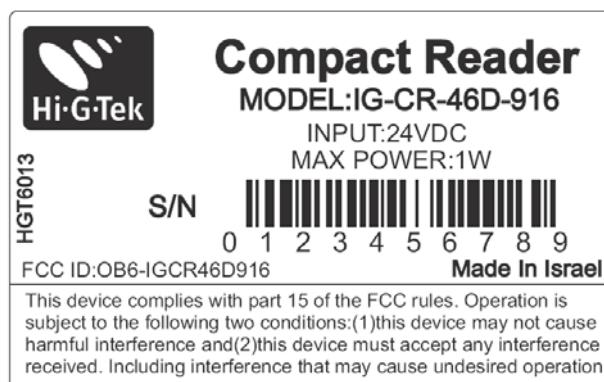


Figure 1. FCC Label IG-CR-46D-916



Figure 2. FCC Label IG-CR-86D-916



**Figure 3. 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 horizontal 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*

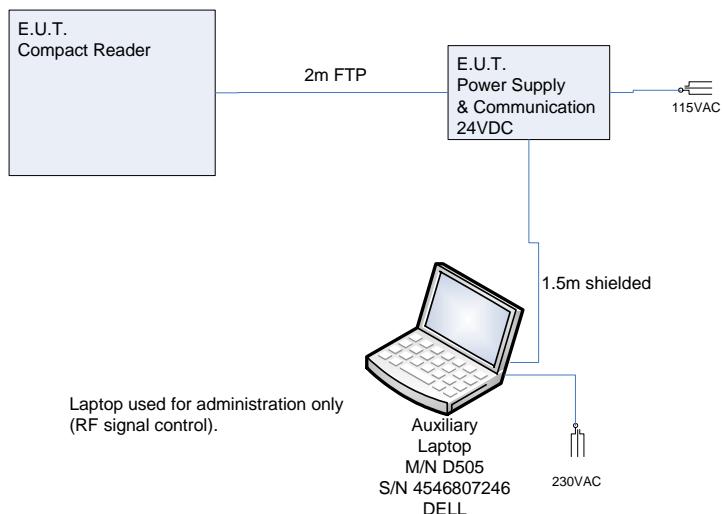
No special accessories were needed to achieve compliance.

#### 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 4. Configuration of Tested System**

## 4. Block Diagram

### 4.1 Schematic Block/Connection Diagram

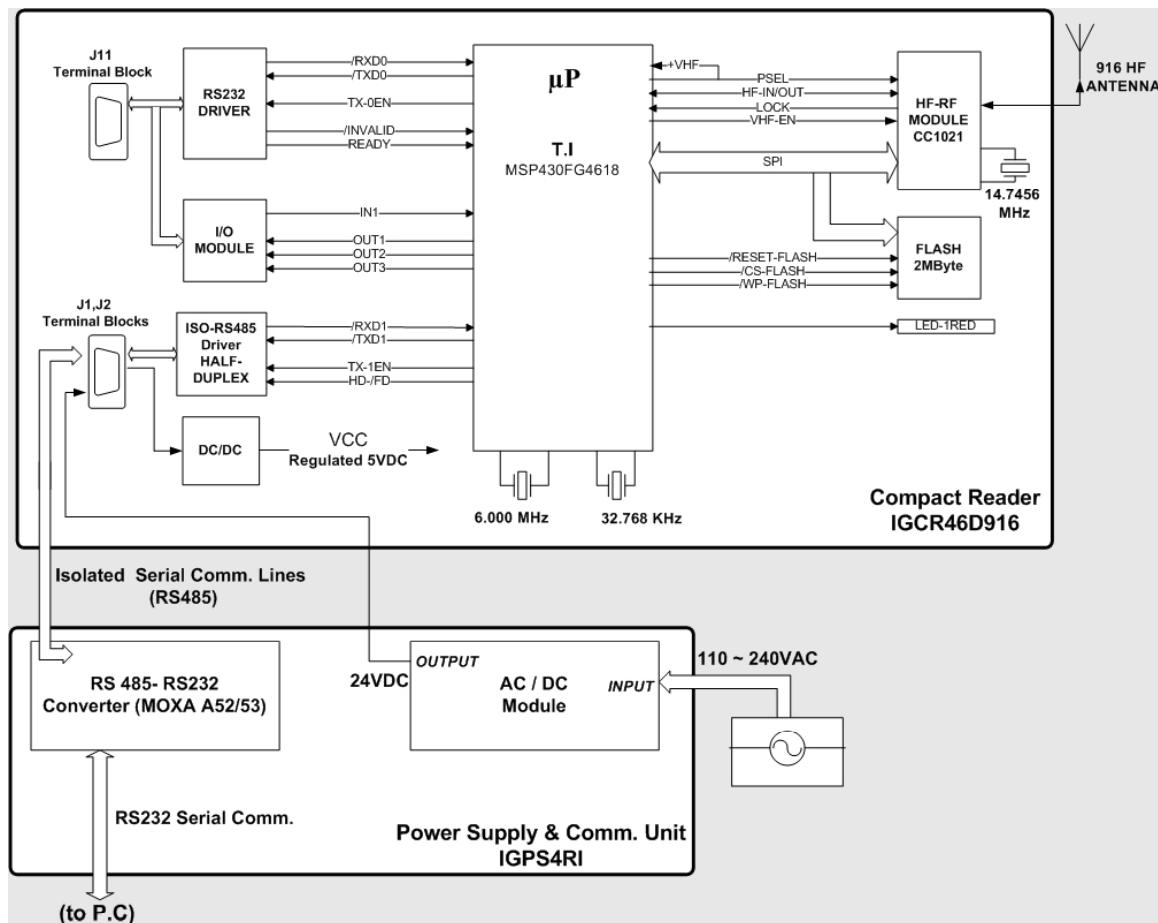


Figure 5. Block Diagram

## 4.2 *Theory of Operation*

The Compact Reader consists of a single PCB that essentially contains a Control unit, UHF transceiver module, serial communication interfaces and I/O's drivers.

The UHF module is a Chipcon's RF Transceiver -model CC1021 (Complies with FCC CFR47 part 15) The module, oscillated from a 14.7456 MHz crystal oscillator, provides operational frequency (transmit/receive) at 916.5MHz, it is FSK modulated with 40kHz deviation and 16kHz data rate. Typically, the UHF receiver is constantly open for burst messages coming from the sensors in order to obtain continuously "listening".

In Tx mode - the reader interrogates the sensors for their ID, status and user data. It writes information into the sensors and retrieves logged information (events) into its Flash memory module.

The demodulated data coming from the UHF transceiver transferred to the control unit (Texas Instruments MSP430 16-bit Microcontroller) via the SPI channel for processing & decoding. The microcontroller fed from two clocks: 32.678 kHz for internal real-time clock and a 6MHz crystal for its operation.

Two serial communication interfaces (RS232, RS485) used to exchange data between the reader and the user (controlling PC) the I/O module provides one external interrupt input (active low, isolated) as well as three isolated outputs for general purpose.

The Reader powered from an indoor power supply & comm. unit (PSC unit) that provides both protected and isolated power and serial communication lines. The PSC unit contains AC/DC adapter providing protective and isolated operation DC power (24VDC or 48VDC depends on model) for the outdoor compact reader. It also equipped with RS-232 to RS-485 converter module for standard bi-directional serial communication between the outdoor compact reader (RS-485 interface) and controlling PC (RS-232 interface).

## 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 1.17 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 6*.

TEST PERSONNEL:

Tester Signature:  Date: 01.07.07

Typed/Printed Name: E. Pitt

## Field Strength of Fundamental

E.U.T Description      Compact Reader and Power Supply &  
 Communication  
 Model Number            IG-CR46D-916 (CR) IG-PS-4RI (PSC)  
 Serial Number:          Not Designated

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 (*)	Specification (dB $\mu$ V/m)	Margin (dB)
916.50	H	84.89	94.0	-9.11
916.50	V	92.83	94.0	-1.17

**Figure 6. 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      Compact Reader and Power Supply &  
 Communication  
 Model Number            IG-CR46D-916 (CR) IG-PS-4RI (PSC)  
 Serial Number:          Not Designated

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

Antenna Polarization: Horizontal

Test Distance: 3 meters

Detector: Peak

10:22:41 MAY 15, 2007

ACTV DET: PEAK  
 MEAS DET: PEAK QP AVG  
 MKR 916.500 MHz  
 84.89 dB $\mu$ V/m

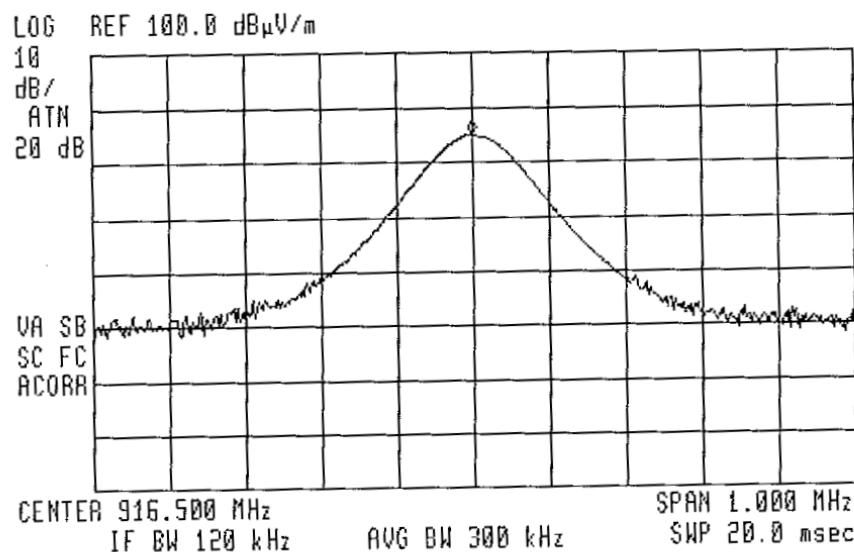


Figure 7. Field Strength of Fundamental Antenna Polarization: HORIZONTAL  
Detector: Peak

## Field Strength of Fundamental

E.U.T Description      Compact Reader and Power Supply &  
 Communication  
 Model Number            IG-CR46D-916 (CR) IG-PS-4RI (PSC)  
 Serial Number:          Not Designated

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

Antenna Polarization: Vertical

Test Distance: 3 meters

Detector: Peak

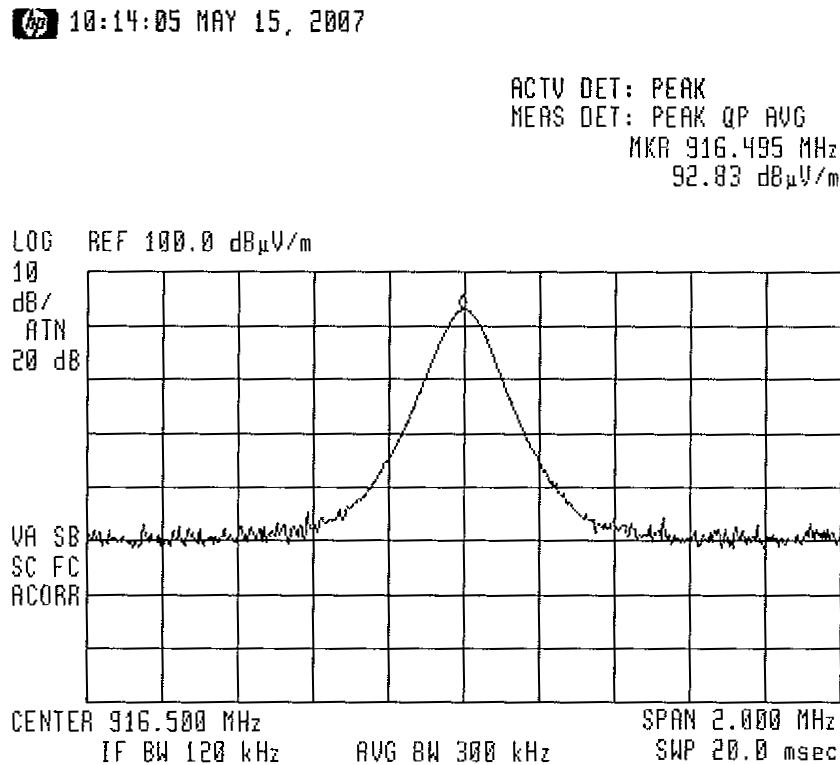


Figure 8. Field Strength of Fundamental Antenna Polarization: VERTICAL.  
 Detector: Peak

#### 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. Conducted and Radiated Measurement Photos



Figure 9. Conducted Emission Test



Figure 10. Radiated Emission Test

## 7. Conducted Emission Test Data

### 7.1 Test Specification

0.15 - 30 MHz, FCC Part 15, Subpart B, CLASS B, Subpart C

### 7.2 Test Procedure

The E.U.T operation mode and test configuration are as described in Sections 3 and 4. In order to minimize background noise interference, the conducted emission testing was performed inside a shielded room, with the E.U.T placed on an 0.8 meter high wooden table, 0.4 meter from the room's vertical wall.

The E.U.T was powered from 115 V AC / 60 Hz via 50 Ohm / 50  $\mu$ Hn Line Impedance Stabilization Network (LISN) on the phase and neutral lines. The LISN's were grounded to the shielded room ground plane (floor), and were kept at least 0.8 meters from the nearest boundary of the E.U.T

The center of the E.U.T.'s AC cable was folded back and forth, in order to form a bundle less than 0.40 meters and a total cable length of 1 meter.

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 the photograph, Figure 9. Conducted Emission Test.

The emission voltages at the LISN's outputs were measured using a computerized receiver, complying to CISPR 16 requirements. The specification limits are loaded to the receiver via a 3.5" floppy disk and are displayed on the receiver's spectrum display.

A frequency scan between 0.15 and 30 MHz was performed at 9 kHz I.F. band width, using peak detection.

The spectral components having the highest level on each line were measured using a quasi-peak and average detector.

### 7.3 Test Data

JUDGEMENT: Passed by 8.7 dB

The E.U.T met the requirements of the FCC Part 15, Subpart B, Class B ; Sub-part C specification.

The margin between the emission levels and the specification limit is, in the worst case, 8.7 dB for the phase line at 0.58 MHz and 12.1 dB at 0.57 MHz for the neutral line.

The details of the highest emissions are given in *Figure 11* to *Figure 14*.

TEST PERSONNEL:

Tester Signature: 

Date: 01.07.07

Typed/Printed Name: E. Pitt

## Conducted Emission

E.U.T Description      Compact Reader and Power Supply & Communication

Type                      IG-CR46D-916 (CR) IG-PS-4RI (PSC)

Serial Number:              Not Designated

Specification: FCC Part 15, Subpart B, Class **B**; Sub-part C

Lead:                      Phase

Detectors:                Peak, Quasi-peak, Average

Signal Number	Frequency (MHz)	Peak (dBuV)	QP (dBuV)	QP Delta L 1 (dB)	Avg (dBuV)	Av Delta L 2 (dB)	Corr (dB)
1	0.194000	51.2	50.6	-13.3	38.4	-15.4	0.0
2	0.291000	45.8	45.2	-15.4	36.5	-14.1	0.0
3	0.582430	40.9	40.4	-15.6	37.3	-8.7	0.0
4	0.873345	35.5	34.8	-21.2	33.0	-13.0	0.0
5	1.553250	33.4	32.2	-23.8	30.6	-15.4	0.0
6	17.579000	41.0	35.6	-24.4	29.4	-20.6	0.0

**Figure 11. Detectors: Peak, AVERAGE .**

*Note: QP Delta/Av Delta refer 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.*

## Conducted Emission

E.U.T Description      Compact Reader and Power Supply &  
 Communication  
 Type                      IG-CR46D-916 (CR) IG-PS-4RI (PSC)  
 Serial Number:           Not Designated

Specification: FCC Part 15, Subpart B, Class **B**; Sub-part C

Lead:                      Phase

Detectors:                Peak, Quasi-peak, Average

08:24:54 MAY 15, 2007

ACTV DET: PEAK  
 MEAS DET: PEAK QP AVG  
 MKR 200 kHz  
 46.03 dB $\mu$ V

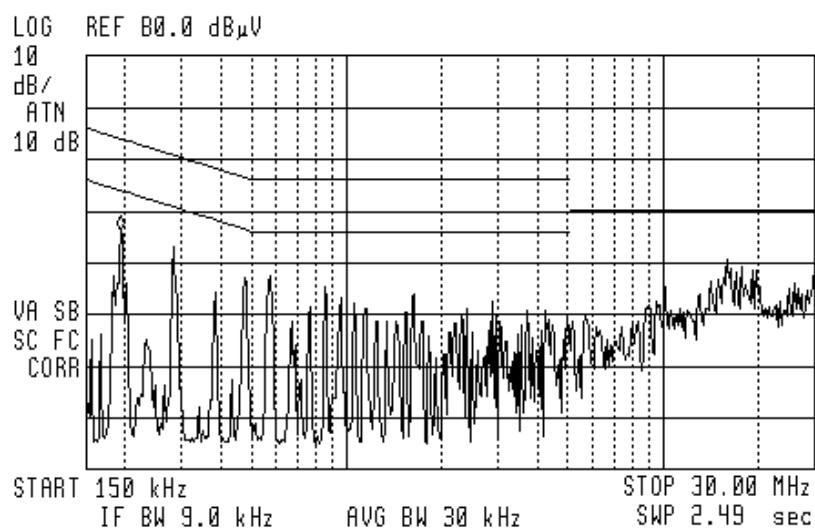


Figure 12. Detectors: Peak, Quasi-peak, Average

## Conducted Emission

E.U.T Description: Compact Reader and Power Supply & Communication  
 Type: IG-CR46D-916 (CR) IG-PS-4RI (PSC)  
 Serial Number: Not Designated

Specification: FCC Part 15, Subpart B, Class **B**; Sub-part C

Lead: Neutral

Detectors: Peak, Quasi-peak, Average

Signal Number	Frequency (MHz)	Peak (dBuV)	QP (dBuV)	QP Delta L 1 (dB)	Avg (dBuV)	Av Delta L 2 (dB)	Corr (dB)
1	0.196250	48.0	47.4	-16.4	36.0	-17.8	0.0
2	0.488500	41.8	40.3	-15.9	33.4	-12.9	0.0
3	0.565250	34.4	33.9	-22.1	33.9	-12.1	0.0
4	2.934250	35.1	33.3	-22.7	31.3	-14.7	0.0
5	8.021675	37.6	36.0	-24.0	34.8	-15.2	0.0
6	17.523000	40.5	36.9	-23.1	32.2	-17.8	0.0

**Figure 13. Detectors: Peak, AVERAGE**

Note: *QP Delta/Av Delta refer 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.*

## Conducted Emission

E.U.T Description: Compact Reader and Power Supply &  
 Communication  
 Type: IG-CR46D-916 (CR) IG-PS-4RI (PSC)  
 Serial Number: Not Designated

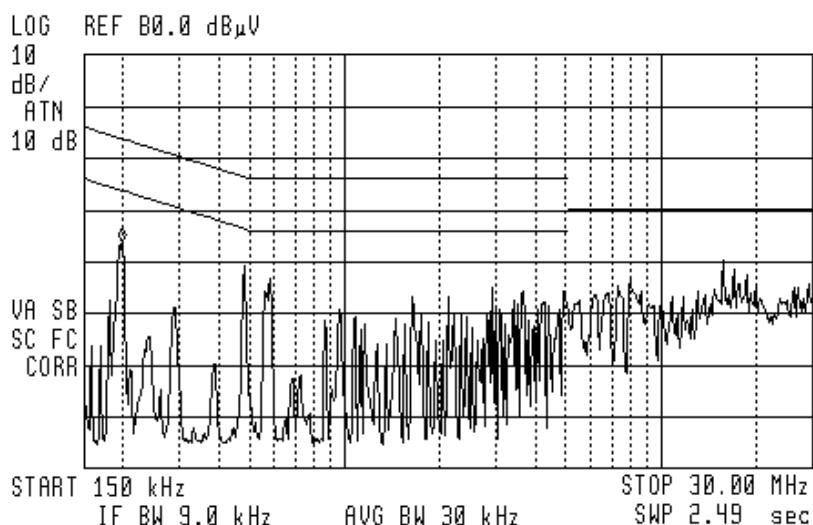
Specification: FCC Part 15, Subpart B, Class **B**; Sub-part C

Lead: Neutral

Detectors: Peak, Quasi-peak, Average

08:38:54 MAY 15, 2007

ACTV DET: PEAK  
 MEAS DET: PEAK QP AVG  
 MKR 200 kHz  
 43.83 dB $\mu$ V



**Figure 14** Conducted Emission: NEUTRAL  
 Detectors: Peak, Quasi-peak, Average



#### **7.4 Test Instrumentation Used, Conducted Measurement**

<b>Instrument</b>	<b>Manufacturer</b>	<b>Model</b>	<b>Serial No.</b>	<b>Calibration</b>	<b>Period</b>
LISN	Fischer	FCC-LISN-2A	127	March 8, 2007	1 Year
LISN	Fischer	FCC-LISN-2A	128	March 8, 2007	1 Year
EMI Receiver	HP	85422E	3906A00276	November 22, 2006	1 Year
RF Filter Section	HP	85420E	3705A00248	November 22, 2006	1 Year
Printer	HP	LaserJet 2200	JPKG C19982	N/A	N/A

## 8. Spurious Radiated Emission 30MHz-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 4*.

The frequency range 30-1000 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 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 4.7dB

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

The margin between the emission level and the specification limit is 4.7 dB in the worst case at the frequency of 52.39 MHz, vertical polarization.

The EUT met the requirements of the F.C.C. Part 15, Subparts B; C, Section 15.249 specification.

TEST PERSONNEL:

Tester Signature: E. Pitt

Date: 01.07.07

Typed/Printed Name: E. Pitt

## Radiated Emission

E.U.T Description      Compact Reader and Power Supply &  
 Communication  
 Type                      IG-CR46D-916 (CR) IG-PS-4RI (PSC)  
 Serial Number:           Not Designated

Specification: FCC Part 15, Subparts B; 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)	Av Delta L 2 (dB)	Corr (dB)
1	112.000000	29.9	24.9	-18.6		13.1
2	128.600000	28.8	23.3	-20.2		13.9
3	160.000000	33.5	26.6	-16.9		15.3
4	172.750000	34.7	26.0	-17.5		15.7
5	287.000000	39.2	27.6	-18.4		22.5
6	320.359400	40.5	23.8	-22.2		23.6

**Figure 15. 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

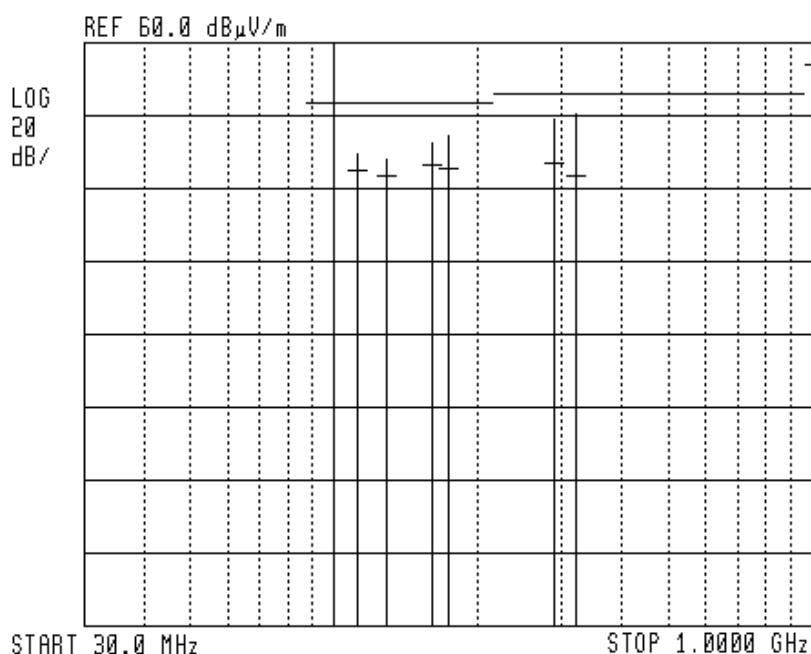
E.U.T Description      Compact Reader and Power Supply & Communication  
 Type                      IG-CR46D-916 (CR) IG-PS-4RI (PSC)  
 Serial Number:           Not Designated

Specification: FCC Part 15, Subpart C

Antenna Polarization: Horizontal  
 Antenna: 3 meters distance

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

⌚ 11:57:43 MAY 15, 2008



**Figure 16. 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  $\mu$ V/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      Compact Reader and Power Supply &  
 Communication  
 Type                      IG-CR46D-916 (CR) IG-PS-4RI (PSC)  
 Serial Number:           Not Designated

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)	Av Delta L 2 (dB)	Corr (dB)
1	52.390000	40.8	35.3	-4.7		11.3
2	144.003500	31.2	26.0	-17.5		14.6
3	160.005000	33.9	28.2	-15.3		15.3
4	288.003000	38.3	32.6	-13.4		22.5
5	375.932500	36.0	30.9	-15.1		18.8
6	388.511831	35.7	30.7	-15.3		19.2

**Figure 17. 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

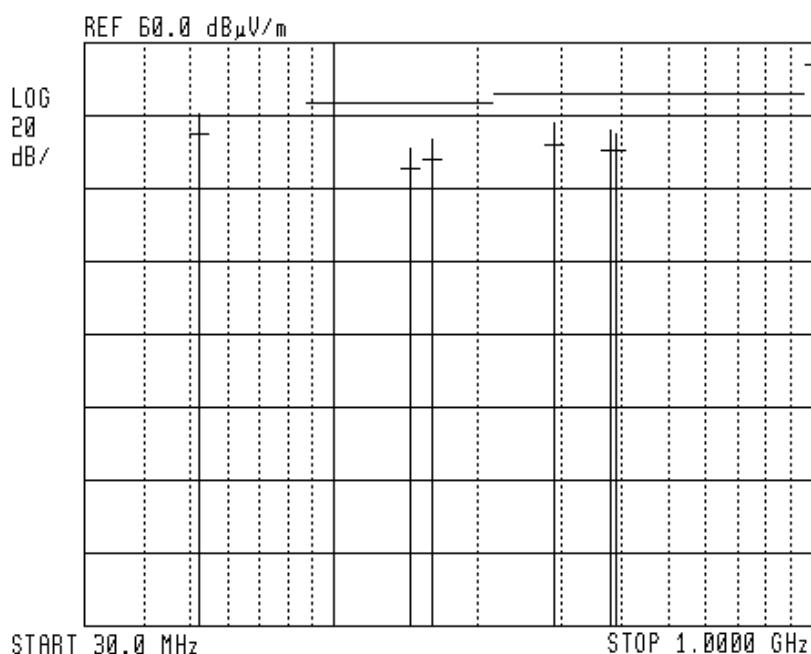
E.U.T Description      Compact Reader and Power Supply &  
 Communication  
 Type                      IG-CR46D-916 (CR) IG-PS-4RI (PSC)  
 Serial Number:           Not Designated

Specification: FCC Part 15, Subpart C

Antenna Polarization: Vertical  
 Antenna: 3 meters distance

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

⌚ 12:10:14 MAY 15, 2008



**Figure 18. Radiated Emission. Antenna Polarization: VERTICAL  
Detectors: Peak, Quasi-peak**

*Note:*

1. Horizontal axis shows logarithmic frequency scale.
2. The vertical axis shows amplitude (in  $\text{dB } \mu\text{V/m}$ ).
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 22, 2007	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



### 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:

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

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]

## 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 9.9 dB

The margin between the emission level and the specification limit is 9.9 dB in the worst case at the frequency of 2749.50 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 19* to *Figure 20*.

TEST PERSONNEL:

Tester Signature:  Date: 01.07.07

Typed/Printed Name: E. Pitt



# Spurious Radiated Emission Above 1 GHz

E.U.T Description	Compact Reader and Power Supply & Communication
Model Number	IG-CR46D-916 (CR) IG-PS-4RI (PSC)
Serial Number:	Not Designated

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

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

<b>Freq.</b>	<b>Peak Result*</b>	<b>Polarization</b>	<b>Peak. Specification</b>	<b>Peak. Margin</b>
(MHz)	(dB $\mu$ V/m)	(H/L)	(dB $\mu$ V/m)	(dB)
1833.00	47.6	H	74.0	-26.4
2749.50	53.4	H	74.0	-20.6
1833.00	48.2	V	74.0	-25.8
2749.50	52.7	V	74.0	-21.3

**Figure 19. Spurious Radiated Emission. Antenna Polarization: HORIZONTAL/Vertical. Detector: Peak**

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 Result” includes correction factor.

“Correction Factor” = Antenna Factor + Cable Loss



# Spurious Radiated Emission Above 1 GHz

E.U.T Description	Compact Reader and Power Supply & Communication
Model Number	IG-CR46D-916 (CR) IG-PS-4RI (PSC)
Serial Number:	Not Designated

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

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

<b>Freq.</b>	<b>Average Result*</b>	<b>Polarization</b>	<b>Average Specification</b>	<b>Average Margin</b>
(MHz)	(dB $\mu$ V/m)	(H/L)	(dB $\mu$ V/m)	(dB)
1833.00	37.8	H	54.0	-16.2
2749.50	44.1	H	54.0	-9.9
1833.00	42.3	V	54.0	-11.7
2749.50	43.5	V	54.0	-10.5

**Figure 20. Spurious Radiated Emission. Antenna Polarization: HORIZONTAL/VERTICAL. Detector: Average**

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.

\*“Average Result” includes correction factor.

“Correction Factor” = Antenna Factor + Cable Loss

### 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
Antenna Bioconical	ARA	BCD 235/B	1041	March 22, 2007	1 Year
Antenna Log Periodic	ARA	LPD-2010/A	1038	November 30, 2006	1 Year
Antenna-Log Periodic	A.H.System	SAS-200/511	253	February 4, 2007	2 year
Spectrum Analyzer	HP	8592L	3926A01204	November 21, 2006	1 year
Low Noise Amplifier	DBS MICROWAVE	LNA-DBS-0411N313	013	November 2, 2006	1 year

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



**Figure 21 Front View**



**Figure 22 Rear View**



**Figure 23 Top View**



**Figure 24 Bottom View**



**Figure 25 Front Cover Internal View**



**Figure 26 PCB in Case**



## 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)	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".

## 11.2 Correction factors for

## CABLE from EMI receiver to test antenna at 3 meter range.

FREQUENCY CORRECTION FACTOR	
(GHz)	(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 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".

## 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".