Cert. No. 1152.01
Electrical (EMC)

**DATE: 03 June 2004**

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

# FCC EMC Test Report

**for**

# Celletra Ltd.

**Equipment under test:**

# Cellular CellEnhancer Unit (TDA)

813011900

Written by: _____
D. Shidlowsky, Documentation

Approved by: _____
E. Pitt, Test Engineer

Approved by: _____
I. Raz, EMC Laboratory Manager

Cert. No. 1152.01
Electrical (EMC)

# Measurement/Technical Report for

Celletra Ltd.

Cellular CellEnhancer Unit (TDA)

**(For Transmitter Section)**

813011900

**FCC ID:PNQ-C-ENCR-CBS021**

03 June 2004

This report concerns: Original Grant x Class II change

Class B verification ___ Class A verification_____Class I change

Equipment type: Cellular CellEnhancer Unit (TDA)
FCC Form 731 Class: AMP

Request Issue of Grant:
**x** Immediately upon completion of review

Limits used:
CISPR 22 _____ Parts 15; 22 x

Measurement procedure used is ANSI C63.4-2001.
Substitution Method used as in ANSI/TIA-603-B: 2002


Application for Certification
prepared by:
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Applicant for this device:
(different from "prepared by")
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P.O.B. 106, Tavor Building
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e-mail: rdishon@celletra.com

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# 1. General Information

## *1.1 Administrative Information*

| | |
|---|---|
| Manufacturer: | Celletra Ltd. |
| Manufacturer's Address: | Tavor Building<br>P.O. Box 106<br>Yoqne'am Ilit 20692<br>Israel<br>Tel: +972-4-959-2522<br>Fax: +972-4-959-2644 |
| Manufacturer's Representative: | Ram Dishon |
| Equipment Under Test (E.U.T): | Cellular CellEnhancer Unit (TDA) |
| Equipment Model No.: | 813011900 |
| Equipment Serial No.: | 010421180001 |
| Date of Receipt of E.U.T: | 25.01.2004 |
| Start of Test: | 25.01.2004 |
| End of Test: | 09.02.2004 |
| Test Laboratory Location: | I.T.L (Product Testing) Ltd.<br>Kfar Bin Nun,<br>ISRAEL 99780 |
| Test Specifications: | FCC Part 15, Sub-part B,<br>FCC Part 22, Sub-part H |

### *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 Celletra Cellular CellEnhancer Unit, Model 813011900, is an add-on unit, to be incorporated into a cellular transmission BTS (Base Transmit Station).

Its purpose is to enhance the coverage of the BTS by transmitting the same signal created by the BTS, processed in order to improve the coverage throughput of the BTS.

The Unit takes a coupled signal from the BTS, processes it and transmits it through an antenna positioned close to the main antenna. No frequency generation, shifting, or mixing is performed in the process.

The Unit is fed by a low-voltage power supply.

The antenna and the power supply do not constitute part of the Unit.

## 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 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 C63.4-2001. 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

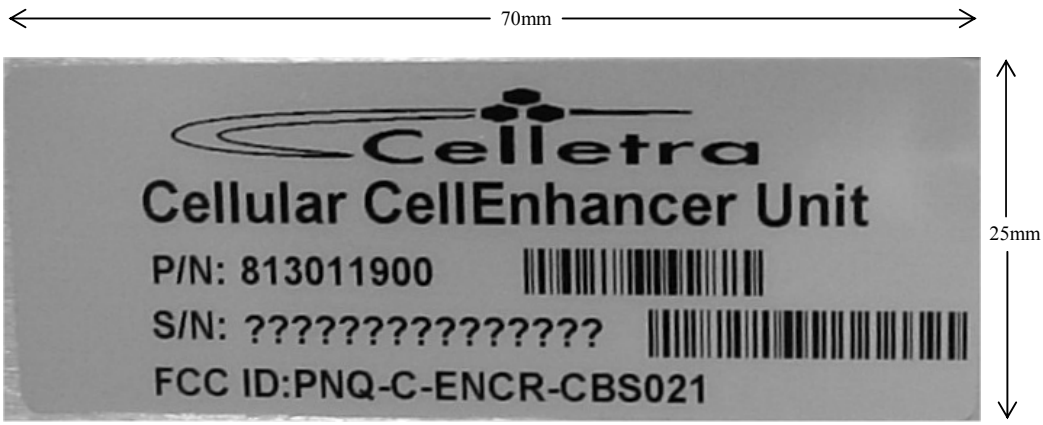


**Figure 1. FCC Label**

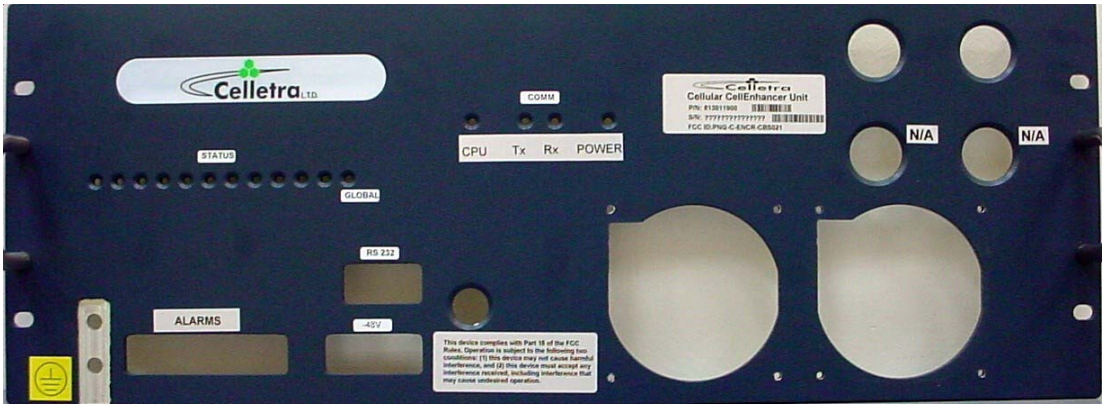


**Figure 2. Location of Label on EUT**

# 3. System Test Configuration

### *3.1 Justification*

The Unit was configured for testing by replacing the signal coupled from the BTS by a signal generator. The signal generator generates a CDMA test signal at the frequency of 881 MHz. The signal generator amplitude was adjusted to drive the Unit to the 20W maximum RF output power. The maximum gain for the antenna used is 14dBi.

### *3.2 EUT Exercise Software*

The internal software in the Unit is identical to the actual one.

### *3.3 Special Accessories*

No special accessories were needed to achieve compliance.

### *3.4 Equipment Modifications*

No modifications were needed to achieve compliance.

## *3.5 Configuration of Tested System*

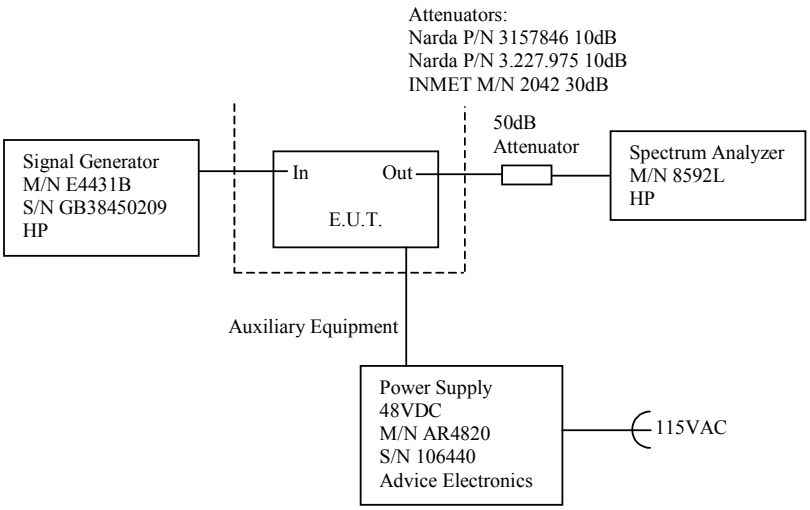


**Figure 3. Effective Radiated Power, Occupied Bandwidth, and Out of Band emissions at Antenna Terminals Tests Set-up**

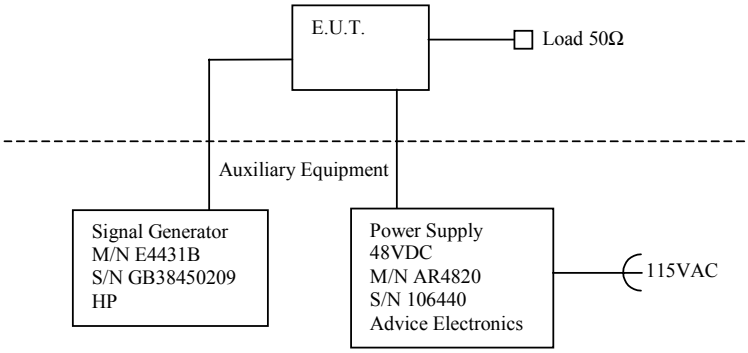


**Figure 4. Radiated Emissions Test Set-up**

# 4. Block Diagram

## *4.1 Schematic Block/Connection Diagram*

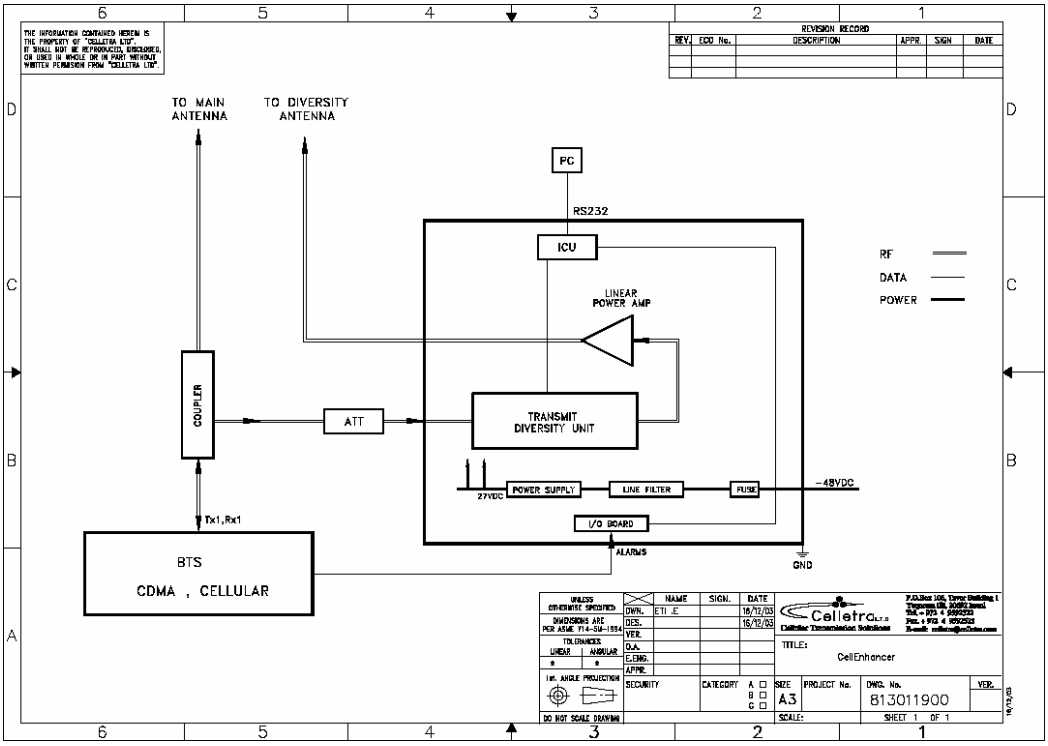


**Figure 5. E.U.T. Block Diagram**

## *4.2 Theory of Operation*

The Download (Distribution) signal is coupled through a directional coupler into the system. It is then subjected to a processor, the purpose of which is to provide diversity signal in order to enhance the reception by the handset.

This signal is amplified by the power amplifier. The gain of the amplifier is adjusted so that the main and diversity signal are of the same level, and the signal is fed to the antenna.

# 5. Effective Radiated Power

## *5.1 Test procedure*

Effective Radiated Power (ERP) must not exceed 500 Watts (57dBm). The maximum gain for the antenna used is 14dBi. Therefore RF power output must not exceed 43dBm (57dBm – 14 dB).

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through a 50dB external attenuator and an appropriate coaxial cable. The E.U.T. RF output was CDMA modulated. Special attention was taken to prevent Spectrum Analyzer RF input overload. The Spectrum Analyzer was set to 3.0 MHz resolution BW. The output power level was measured at 881 MHz.

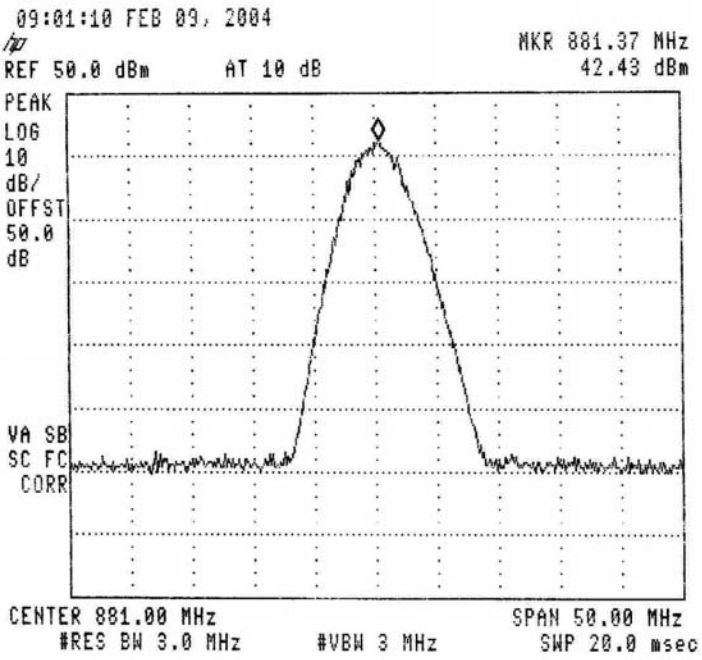


**Figure 6.— 881.00 MHz**

### 5.2 Results table

E.U.T. Description: Cellular CellEnhancer Unit (TDA)
Model No.: 813011900
Serial Number: 010421180001
Specification: FCC Part 22, Sub-part H, Section 913 (a),FCC Part 2, Section 1046

| Operation Frequency (MHz) | Reading (dBm) | Specification (dBm) | Margin (dB) |
|---|---|---|---|
| 881.00 | 42.43 | 43 | -0.57 |

**Figure 7 Effective Radiated Power**

JUDGEMENT: Passed by 0.57 dB

TEST PERSONNEL:
Tester Signature:  Date: 11.05.04
Typed/Printed Name: E. Pitt

### 5.3 Test Equipment Used.

Effective Radiated Power

| Instrument | Manufacturer | Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Calibr. | Period |
| Spectrum Analyzer | HP | 8592L | 3826A01204 | January 31, 2003 | 1 year |
| Cable | Avnet | MTS | N/A | September 9, 2003 | 1 year |
| Attenuator | Narda | 10dB | 3157846 | January 25, 2004 | 1 year |
| Attenuator | Narda | 10dB | 3157846 | January 25, 2004 | 1 year |
| Attenuator | INMET | 2042-30dB | N/A | January 25, 2004 | 1 year |

**Figure 8 Test Equipment Used**

# 6. Occupied Bandwidth

## *6.1 Test Procedure*

The E.U.T. was set to the applicable test frequency with CDMA modulation.
The E.U.T. antenna terminal was connected to the spectrum analyzer through a 50 dB external attenuator and appropriate coaxial cable. The spectrum analyzer was set to 30 kHz resolution B.W.
The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limit, the mean powers radiated are each equal to 0.5% of the total mean power radiated by a given emission.
The occupied bandwidth of the E.U.T. at the points of 23 dB below maximum peak power was measured and recorded.
Occupied bandwidth measured was repeated in the input terminal of the E.U.T.

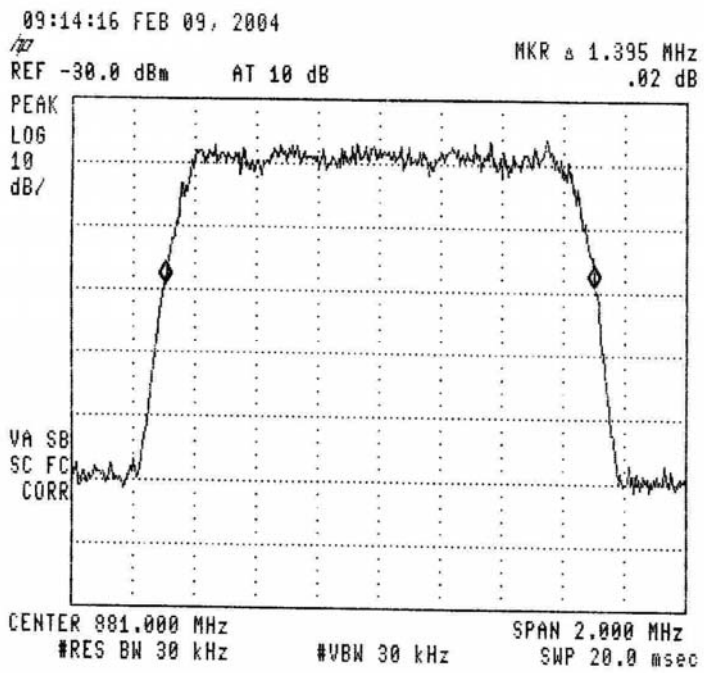


**Figure 9.— Input**

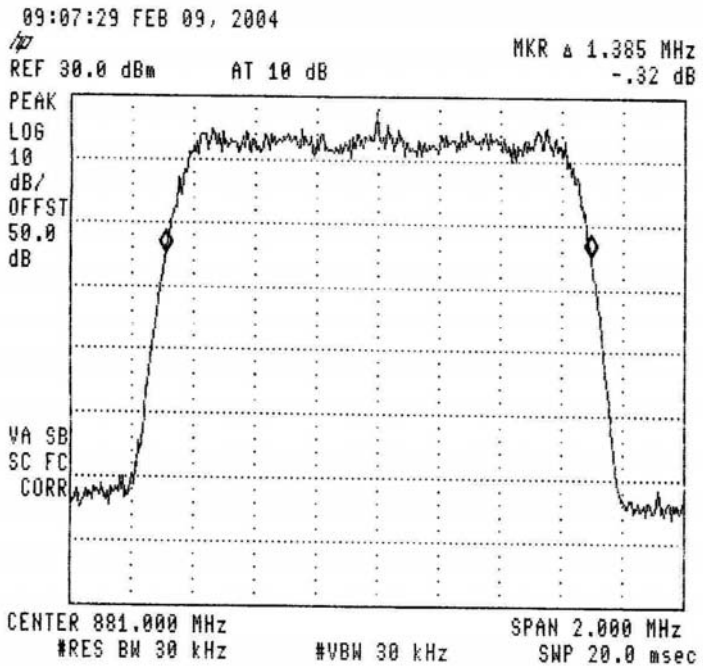


**Figure 10.— Output**

### *6.2 Results Table*

E.U.T. Description: Cellular CellEnhancer Unit (TDA)
Model No.: 813011900
Serial Number: 010421180001
Specification: FCC Part 2, Section 1049

| | Reading (MHz) |
|---|---|
| Input | 1.395 |
| Output | 1.385 |

**Figure 11 Occupied Bandwidth**

TEST PERSONNEL:

Tester Signature: _____ Date: 11.05.04

Typed/Printed Name: E. Pitt

### *6.3 Test Equipment Used.*

Occupied Bandwidth

| Instrument | Manufacturer | Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Calibr. | Period |
| Spectrum Analyzer | HP | 8592L | 3826A01204 | January 31, 2003 | 1 year |
| Cable | Avnet | MTS | N/A | September 9, 2003 | 1 year |
| Attenuator | Narda | 10dB | 3157846 | January 25, 2004 | 1 year |
| Attenuator | Narda | 10dB | 3157846 | January 25, 2004 | 1 year |
| Attenuator | INMET | 2042-30dB | N/A | January 25, 2004 | 1 year |

**Figure 12 Test Equipment Used**

# 7. Out of Band Emissions (Radiated)

## *7.1 Test Specification*

FCC, Part 22, Sub-Part H, .917a, FCC Part 2.1053

## *7.2 Test Procedure*

The test method was based on ANSI/TIA-603-B: 2002, Section 2.2.12 Unwanted Emissions: Radiated Spurious.
The power of any emission outside of the authorized operating frequency ranges (880-890 MHz) must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB, yielding –13dBm.

(a) 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 3.1.
The frequency range 30 MHz-9000 MHz was scanned, and the list of the highest emissions was verified and updated accordingly.
The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

(b) The E.U.T. was replaced by a substitution antenna (dipole 30MHz-1GHz, Horn Antenna above 1GHz) driven by a signal generator. The height was readjusted for maximum reading. The signal generator level was adjusted to obtain the same reading on the EMI receiver as in step (a).
The signals observed in step (a) were converted to radiated power using:
$P_d$(dBm) = $P_g$(dBm) – Cable Loss (dB) + Substitution Antenna Gain (dB)
$P_d$ = Dipole equivalent power (result).
$P_g$ = Signal generator output level.

### *7.3 Test Data*

JUDGEMENT: Passed by 19.6 dB

The E.U.T met the requirements of the FCC, Part 22, Sub-part H, Section 917a, FCC Part 2.1053 specifications.

The margin between the emission level and the specification limit is 19.6 dB in the worst case at the frequency of 1762 MHz.

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

TEST PERSONNEL:

Tester Signature: _____ Date: 03.06.04

Typed/Printed Name: E. Pitt

# Out of Band Emission (Radiated)

| | |
|---|---|
| E.U.T Description | Cellular CellEnhancer Unit (TDA) |
| Type | 813011900 |
| Serial Number: | 010421180001 |

| Freq. (MHz) | Pol. (V/H) | Field Strength (dBµV/m) | Signal Generator Power $P_g$ (dBm) | Cable Loss (dB) | Sub. Antenna Gain (dB) | Result (dBm) | Limit (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 1762.00 | V | 60.3 | -37.5 | 5.5 | 10.4 | -32.6 | -13.0 | -19.6 |

**Figure 13. Out of Band Emissions (Radiated)**

### *7.4 Test Instrumentation Used, 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 |
| Active Loop Antenna | EMCO | 6502 | 9506-2950 | October 17, 2003 | 1 year |
| Antenna Log Periodic | A.H. Systems | SAS-200/511 | 253 | January 31, 2003 | 2 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 |
| Spectrum Analyzer | HP | 8592L | 3926A01204 | January 31, 2003 | 1 year |
| Amplifier | Narda | DBS0411N313 | 013 | October 14, 2003 | 1 year |
| Signal Generator | HP | 8648C | 3623A04126 | February 18, 2004 | 1 year |
| Double Ridged Waveguide Horn Antenna | EMCO | 3115 | 9702-5111 | May 1, 2003 | 1 year |
| Double Ridged Waveguide Horn Antenna | EMCO | 3115 | 29845 | March 17, 2004 | 1 year |

# 8. Out of Band Emissions at Antenna Terminals

## *8.1 Test procedure*

The power of any emission outside of the authorized operating frequency ranges (880-890 MHz) must be attenuated below the transmitting power (P) by a factor of at least 43 + log (P) dB, yielding –13dBm.
The E.U.T. antenna terminal was connected to the spectrum analyzer through a 50 dB external attenuator and an appropriate coaxial cable. The spectrum analyzer was set to 100 kHz resolution B.W. except for the low frequency range 9 kHz – 1 MHz, and the 1 MHz band immediately outside 879-880 MHz, where the resolution bandwidth was reduced to 30 kHz, which is greater than 1% of the emission bandwidth of the fundamental emission of the E.U.T.

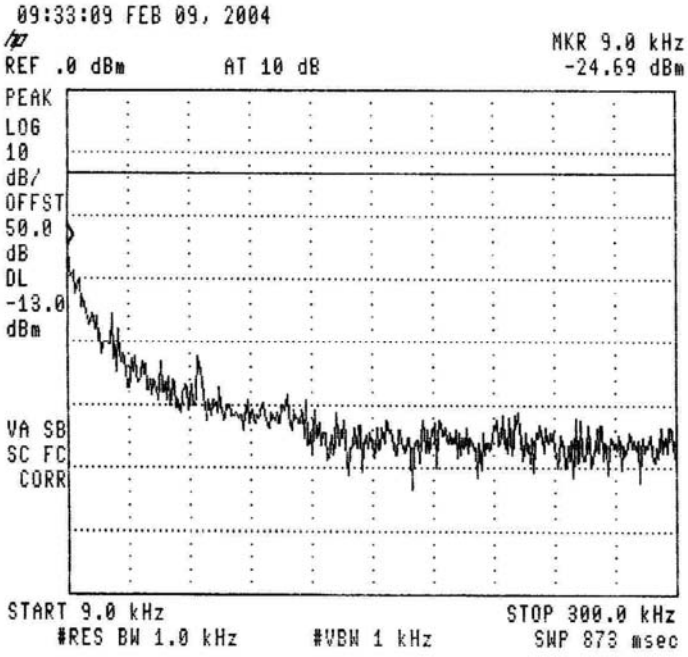


**Figure 14.— Out of Band Emission**

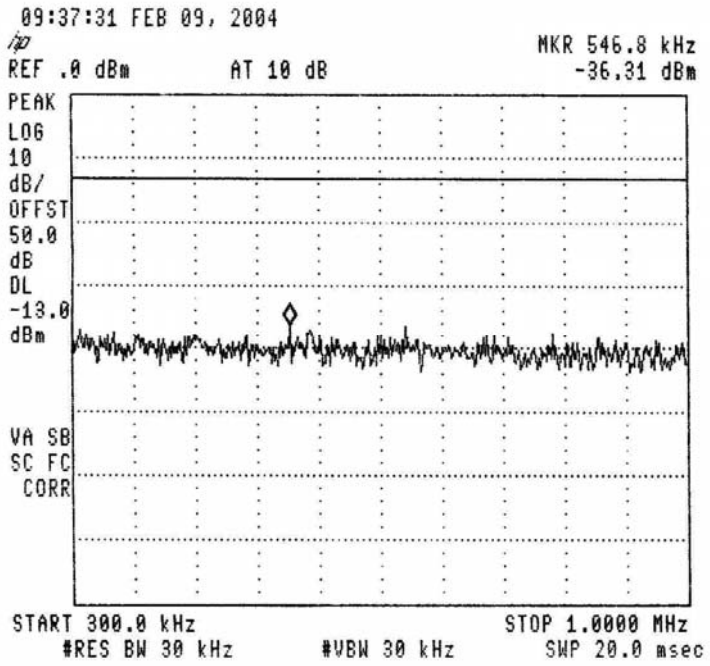


**Figure 15.— Out of Band Emission**

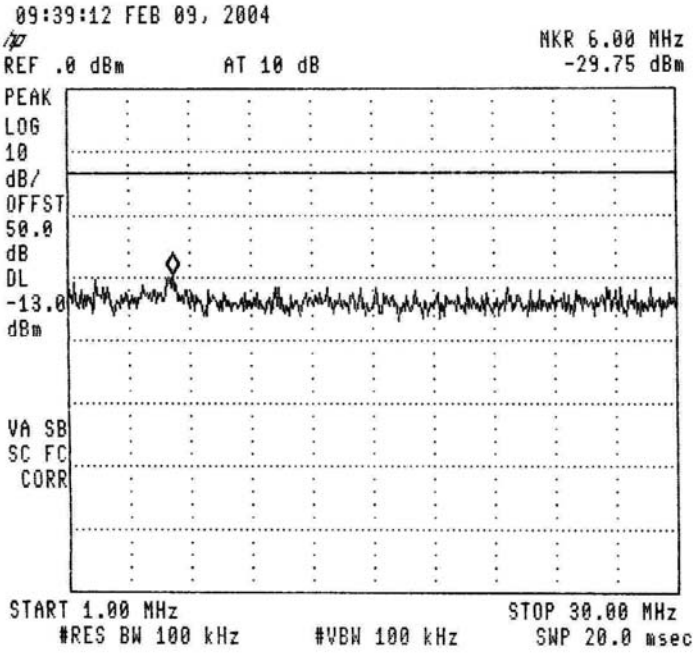


**Figure 16.— Out of Band Emission**

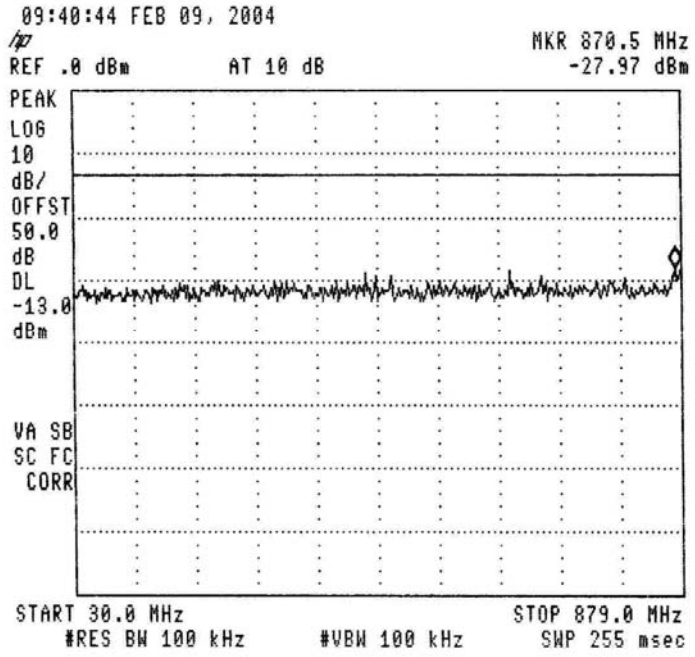


**Figure 17.— Out of Band Emission**

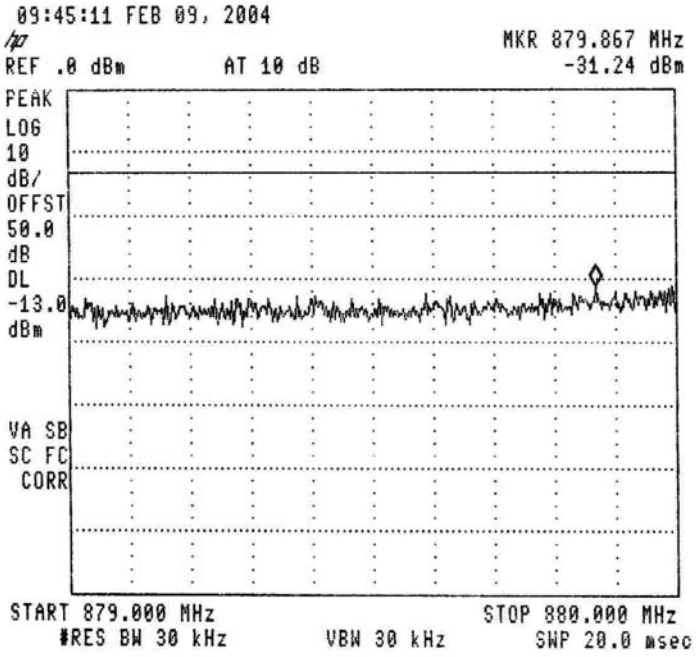


**Figure 18.— Out of Band Emission**

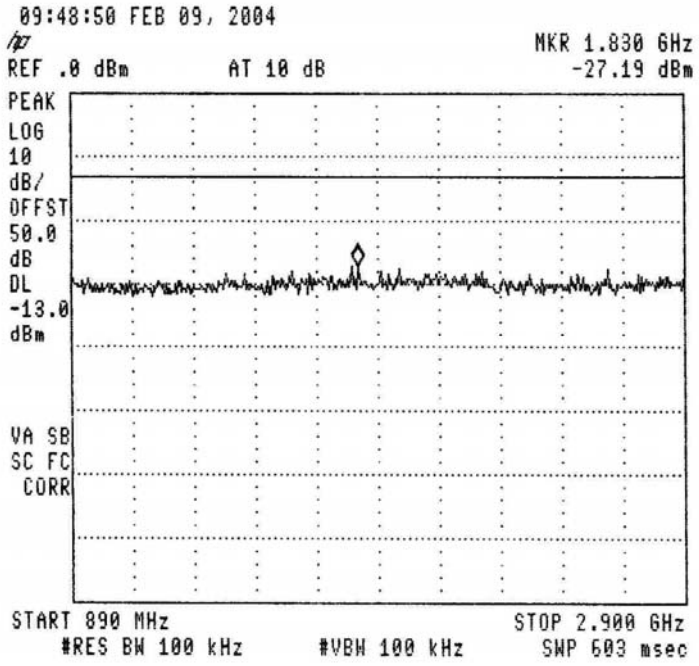


**Figure 19.— Out of Band Emission**

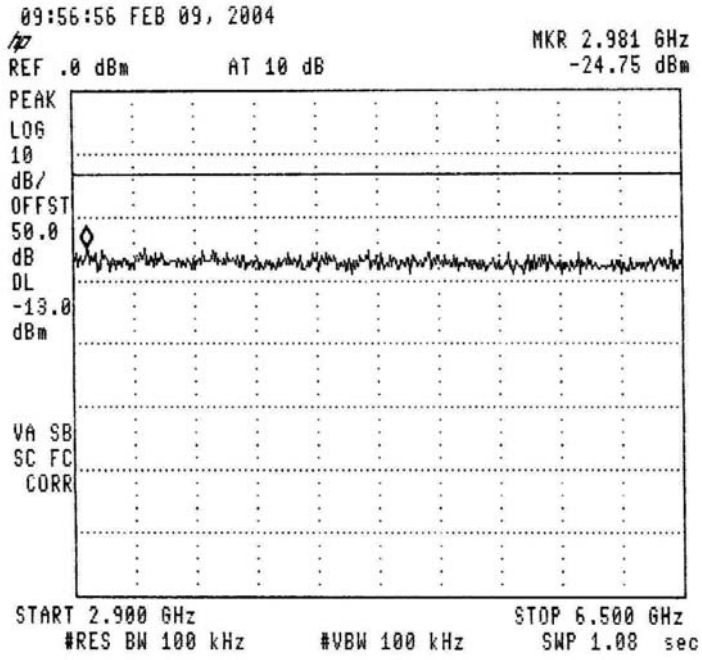


**Figure 20.— Out of Band Emission**

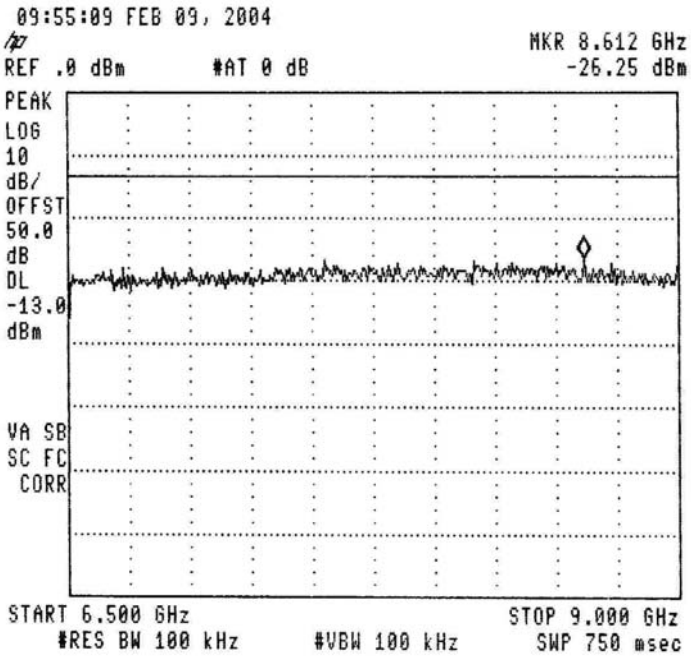


**Figure 21.— Out of Band Emission**

### *8.2 Results table*

E.U.T. Description: Cellular CellEnhancer Unit (TDA)
Model No.: 813011900
Serial Number: 010421180001
Specification: FCC Part 22, Sub-part H, Section 917 (a)

| Operation Frequency (MHz) | Reading (dBc) | Specification (dBm) | Margin (dB) |
|---|---|---|---|
| 870.5 | -27.97 | -13 | -14.97 |

**Figure 22 Out of Band Emission Results**

JUDGEMENT: Passed by 14.97 dB

TEST PERSONNEL:

Tester Signature: _____ Date: 11.05.04

Typed/Printed Name: E. Pitt

### *8.3 Test Equipment Used.*

Out of Band Emission at Antenna Terminals

| Instrument | Manufacture | Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Calibr. | Period |
| Spectrum Analyzer | HP | 8592L | 3826A01204 | January 31, 2003 | 1 year |
| Cable | Avnet | MTS | N/A | September 20, 2003 | 1 year |
| Attenuator | Narda | 10dB | 3157846 | January 25, 2004 | 1 year |
| Attenuator | Narda | 10dB | 3157846 | January 25, 2004 | 1 year |
| Attenuator | INMET | 2042-30dB | N/A | January 25, 2004 | 1 year |

**Figure 23 Test Equipment Used**

# 9. Radiated Emission, per FCC Part 15

## *9.1 Test Specification*

30kHz-1000 MHz, FCC, Part 15, Subpart B

## *9.2 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 configuration tested is shown in Figure 36. Radiated Emission Part 15 Test Setup.

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.

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.

The emissions were measured at a distance of 3 meters.

### *9.3 Test Data*

JUDGEMENT: Passed by 12.8 dB

The E.U.T met the requirements of the FCC Part 15, Subpart B ,Class B specification.

The margin between the emission level and the specification limit is 5.1 dB in the worst case at the frequency of 59.63 MHz, vertical polarization.

The details of the highest emissions are given in *Figure 24* to *Figure 31*.

TEST PERSONNEL:

Tester Signature: _____ Date: 11.05.4

Typed/Printed Name: E. Pitt

# Radiated Emission

| | |
|---|---|
| E.U.T Description | Cellular CellEnhancer Unit (TDA) |
| Type | 813011900 |
| Serial Number: | 010421180001 |

Specification: FCC Part 15, Subpart B, Class B

Antenna Polarization: Horizontal
Antenna: 3 meters distance
Frequency range: 30 MHz to 300 MHz
Detectors: Peak, Quasi-peak

| Frequency (MHz) | Peak Amp (dBµV/m) | QP Amp (dBµV/m) | Correction (dB) | Specification (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|
| 50.54 | 38.3 | 33.7 | 11.5 | 49.5 | -15.8 |
| 50.97 | 39.5 | 35.8 | 11.4 | 49.5 | -13.7 |
| 51.58 | 39.3 | 35.6 | 11.4 | 49.5 | -13.9 |
| 51.98 | 38.7 | 35.1 | 11.3 | 49.5 | -14.4 |
| 52.43 | 37.7 | 33.2 | 11.3 | 49.5 | -16.3 |
| 53.24 | 36.7 | 32.0 | 11.2 | 49.5 | -17.5 |

**Figure 24. Radiated Emission. Antenna Polarization: HORIZONTAL. Detectors: Peak, Quasi-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.*

# Radiated Emission

| | |
|---|---|
| E.U.T Description | Cellular CellEnhancer Unit (TDA) |
| Type | 813011900 |
| Serial Number: | 010421180001 |

Specification: FCC Part 15, Subpart B, Class B

Antenna Polarization: Horizontal
Antenna: 3 meters distance
Frequency range: 30 MHz to 300 MHz
Detectors: Peak, Quasi-peak

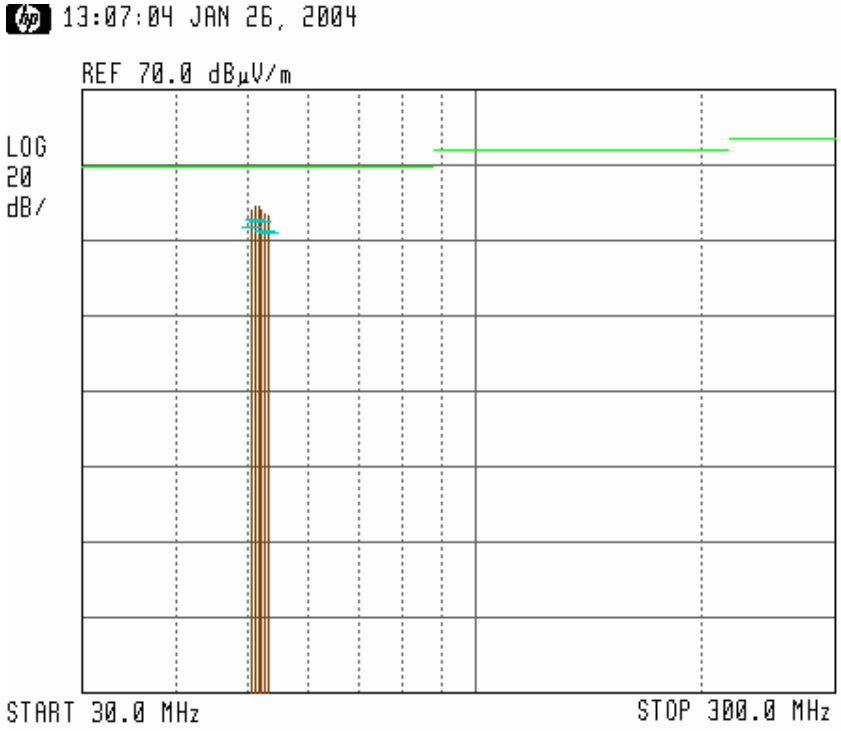


**Figure 25. Radiated Emission. Antenna Polarization: HORIZONTAL Detectors: Peak, Quasi-peak**

*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 | Cellular CellEnhancer Unit (TDA) |
| Type | 813011900 |
| Serial Number: | 010421180001 |

Specification: FCC Part 15, Subpart B, Class B

Antenna Polarization: Horizontal
Antenna: 3 meters distance
Frequency range: 300 MHz to 1 GHz
Detectors: Peak, Quasi-peak

| Frequency (MHz) | Peak Amp (dBµV/m) | QP Amp (dBµV/m) | Correction (dB) | Specification (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|
| 302.00 | 22.0 | 16.1 | 14.8 | 56.9 | -40.8 |
| 320.00 | 23.8 | 17.4 | 15.5 | 56.9 | -39.5 |
| 340.00 | 22.7 | 17.6 | 16.3 | 56.9 | -39.3 |
| 356.00 | 23.4 | 18.5 | 16.9 | 56.9 | -38.4 |
| 382.00 | 24.7 | 19.4 | 17.8 | 56.9 | -37.5 |
| 408.00 | 26.5 | 20.3 | 18.6 | 56.9 | -36.6 |

**Figure 26. Radiated Emission. Antenna Polarization: HORIZONTAL. Detectors: Peak, Quasi-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.*

# Radiated Emission

| | |
|---|---|
| E.U.T Description | Cellular CellEnhancer Unit (TDA) |
| Type | 813011900 |
| Serial Number: | 010421180001 |

Specification: FCC Part 15, Subpart B, Class B

Antenna Polarization: Horizontal
Antenna: 3 meters distance
Frequency range: 300 MHz to 1 GHz
Detectors: Peak, Quasi-peak

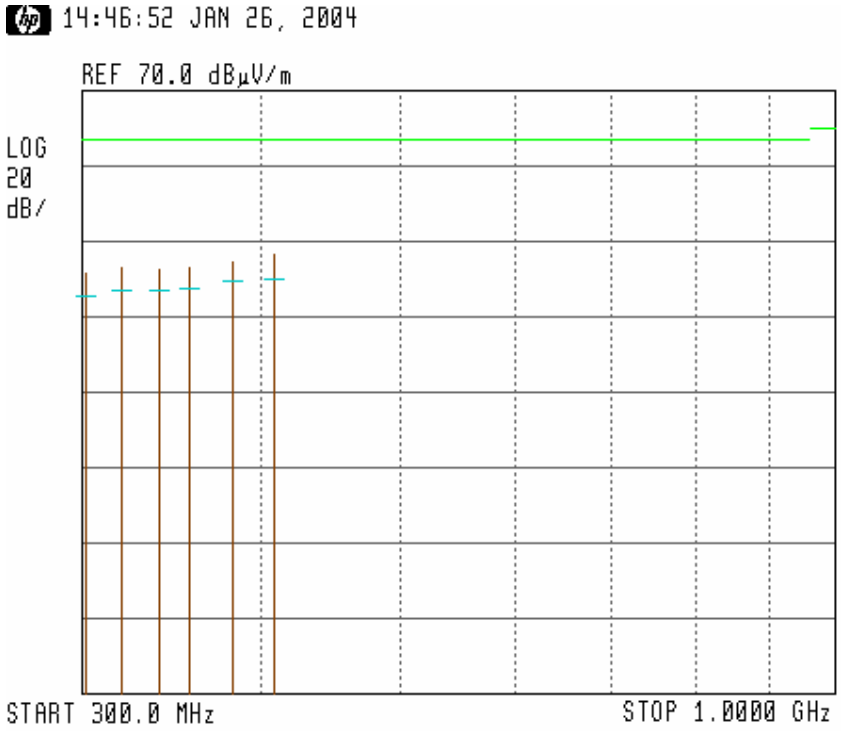


**Figure 27. Radiated Emission. Antenna Polarization: HORIZONTAL Detectors: Peak, Quasi-peak**

*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 | Cellular CellEnhancer Unit (TDA) |
| Type | 813011900 |
| Serial Number: | 010421180001 |

Specification: FCC Part 15, Subpart B, Class B

Antenna Polarization: Vertical
Antenna: 3 meters distance
Frequency range: 30 MHz to 300 MHz
Detectors: Peak, Quasi-peak

| Frequency (MHz) | Peak Amp (dBµV/m) | QP Amp (dBµV/m) | Correction (dB) | Specification (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|
| 52.72 | 45.6 | 43.4 | 11.3 | 49.5 | -6.1 |
| 55.99 | 45.9 | 43.7 | 11.0 | 49.5 | -5.8 |
| 59.63 | 46.6 | 44.4 | 10.6 | 49.5 | -5.1 |
| 63.91 | 46.2 | 43.2 | 10.4 | 49.5 | -6.3 |
| 67.16 | 43.8 | 40.4 | 10.2 | 49.5 | -9.1 |
| 72.83 | 42.2 | 38.1 | 10.2 | 49.5 | -11.4 |

**Figure 28. Radiated Emission. Antenna Polarization: VERTICAL. Detectors: Peak, Quasi-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.*

# Radiated Emission

| | |
|---|---|
| E.U.T Description | Cellular CellEnhancer Unit (TDA) |
| Type | 813011900 |
| Serial Number: | 010421180001 |

Specification: FCC Part 15, Subpart B, Class B

Antenna Polarization: Vertical
Antenna: 3 meters distance
Frequency range: 30 MHz to 300 MHz
Detectors: Peak, Quasi-peak

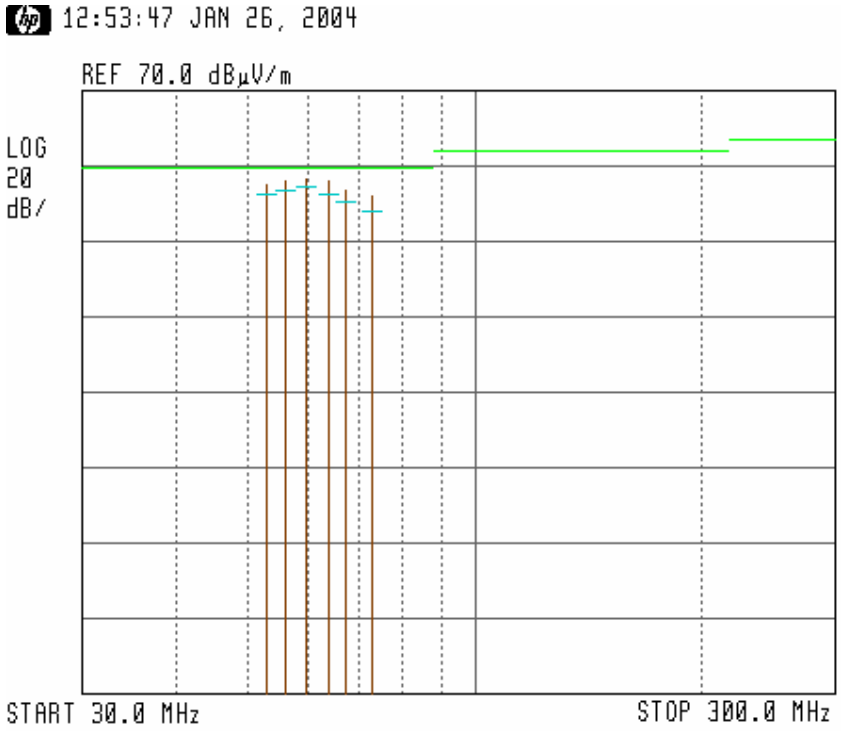


**Figure 29. Radiated Emission. Antenna Polarization: VERTICAL. Detectors: Peak, Quasi-peak**

*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.*

# Radiated Emission

| | |
|---|---|
| E.U.T Description | Cellular CellEnhancer Unit (TDA) |
| Type | 813011900 |
| Serial Number: | 010421180001 |

Specification: FCC Part 15, Subpart B, Class B

Antenna Polarization: Vertical
Antenna: 3 meters distance

Frequency range: 300 MHz to 1 GHz
Detectors: Peak, Quasi-peak

| Frequency (MHz) | Peak Amp (dBµV/m) | QP Amp (dBµV/m) | Correction (dB) | Specification (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|
| 304.91 | 20.8 | 16.2 | 14.9 | 56.9 | -40.7 |
| 322.00 | 22.1 | 17.0 | 15.6 | 56.9 | -39.9 |
| 342.00 | 23.5 | 17.9 | 16.3 | 56.9 | -39.0 |
| 360.00 | 24.0 | 18.7 | 17.0 | 56.9 | -38.2 |
| 386.00 | 24.8 | 19.5 | 18.0 | 56.9 | -37.4 |
| 413.80 | 26.1 | 20.3 | 18.7 | 56.9 | -36.6 |

**Figure 30. Radiated Emission. Antenna Polarization: VERTICAL. Detectors: Peak, Quasi-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.*

# Radiated Emission

| | |
|---|---|
| E.U.T Description | Cellular CellEnhancer Unit (TDA) |
| Type | 813011900 |
| Serial Number: | 010421180001 |

Specification: FCC Part 15, Subpart B, Class B

Antenna Polarization: Vertical
Antenna: 3 meters distance
Frequency range: 300 MHz to 1 GHz
Detectors: Peak, Quasi-peak

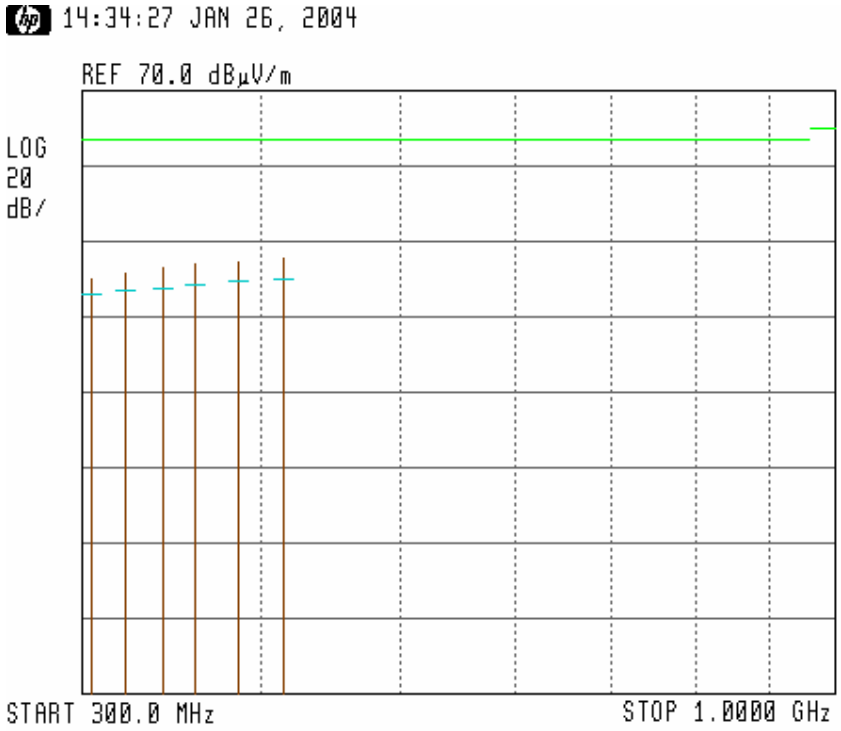


**Figure 31. Radiated Emission. Antenna Polarization: VERTICAL. Detectors: Peak, Quasi-peak**

*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.*

### *9.4 Test Instrumentation Used, 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 Log Periodic | A.H. Systems | SAS-200/511 | 253 | January 31, 2003 | 2 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 |
| AC Power Source | Behlman | ACP | | N/A | N/A |
| Printer | HP | ThinkJet 2225 | 2738508357.0 | N/A | N/A |

## *9.5 Field Strength Calculation*

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

$$FS = RA + AF + CF$$

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

No external pre-amplifiers are used.

# 10. Test Set-up Photos

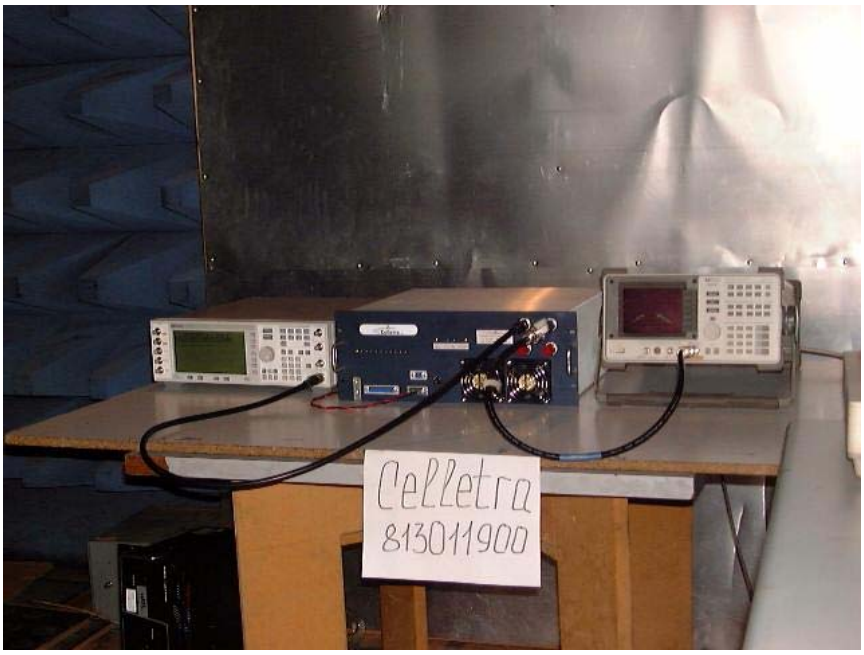


**Figure 32. Effective Radiated Power Test Setup**

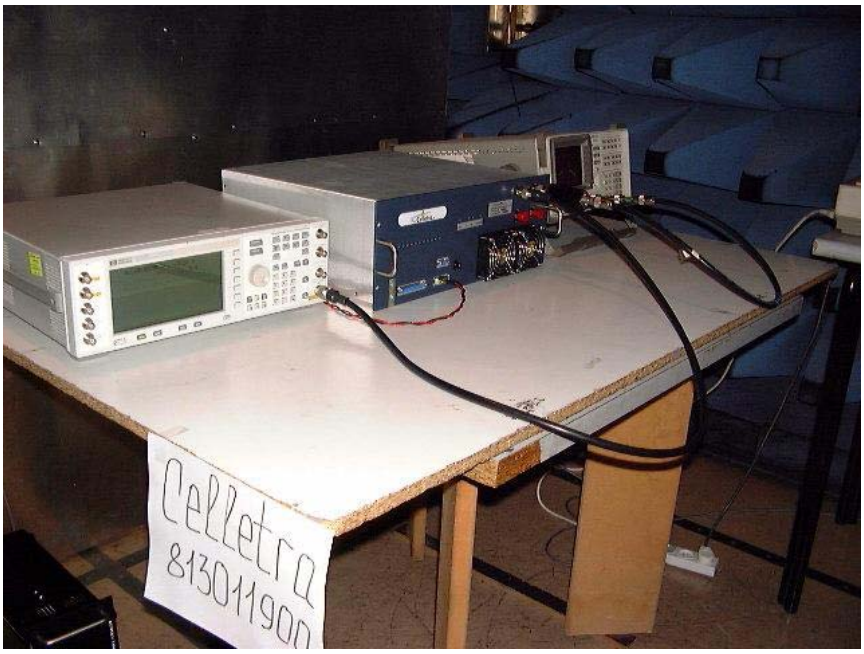


**Figure 33. Occupied Bandwidth Test Setup**


**Figure 34. Out of Band Emission (Radiated) Test Setup**

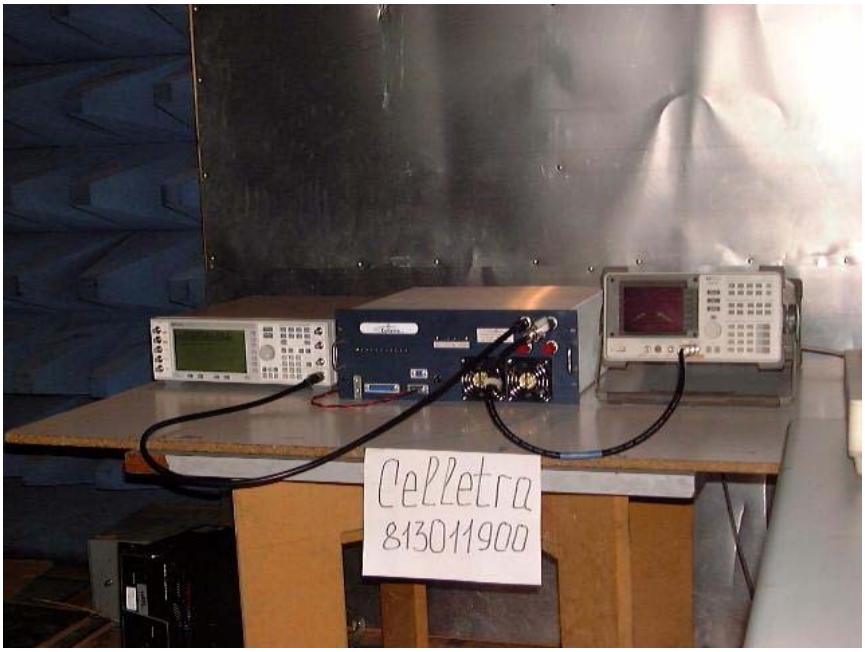


**Figure 35. Out of Band Emissions at Antenna Terminals Test Setup**

**Figure 36. Radiated Emission Part 15 Test Setup**

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


**Figure 37 Front Panel**

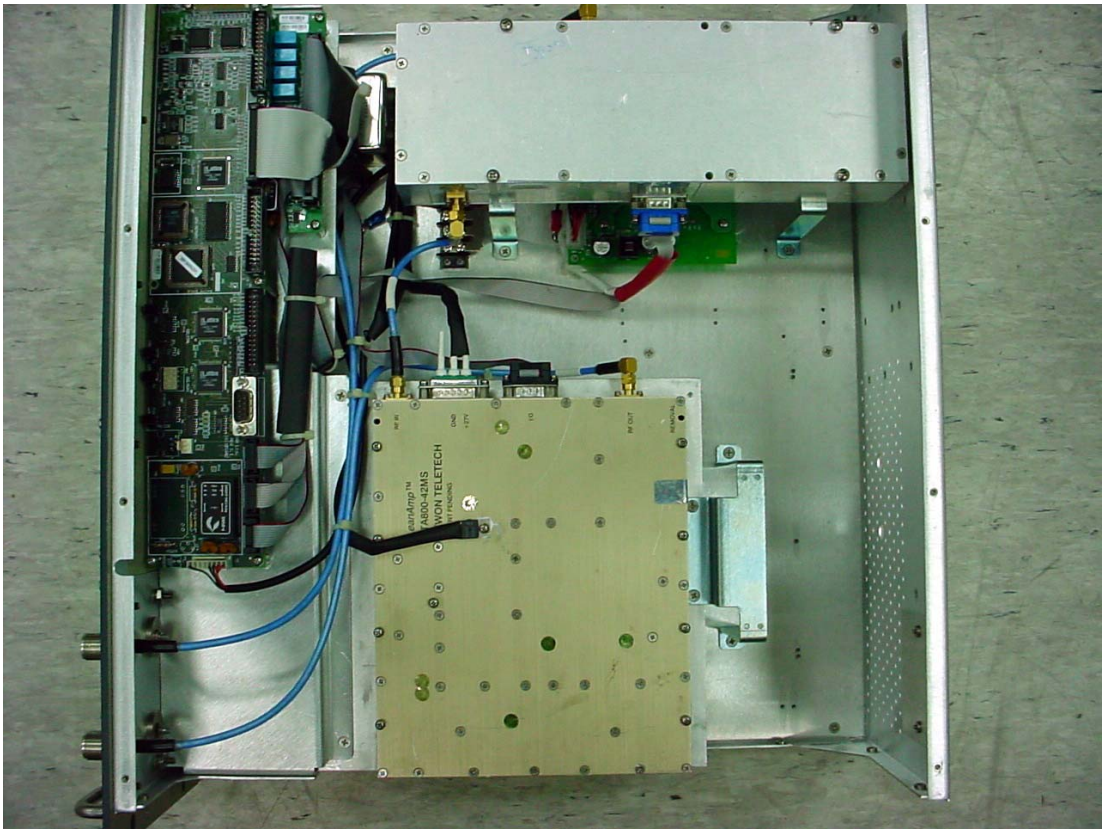


**Figure 38 Internal View**

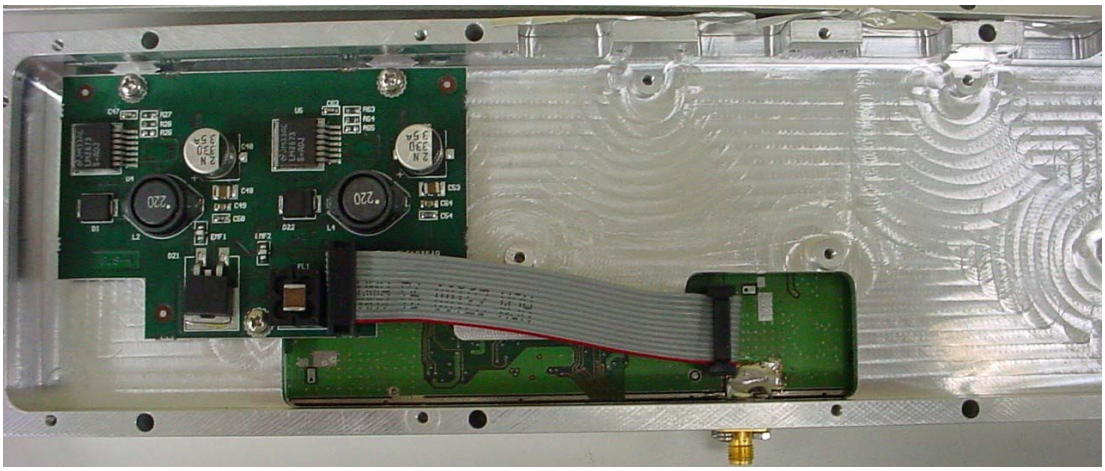

**Figure 39 PCB 1 Side 1**

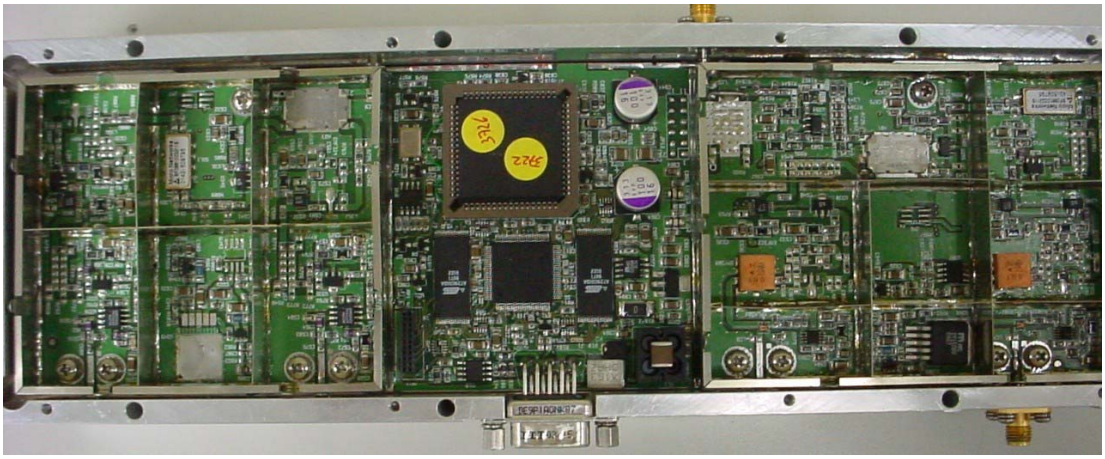

**Figure 40 PCB 1 Side 2**

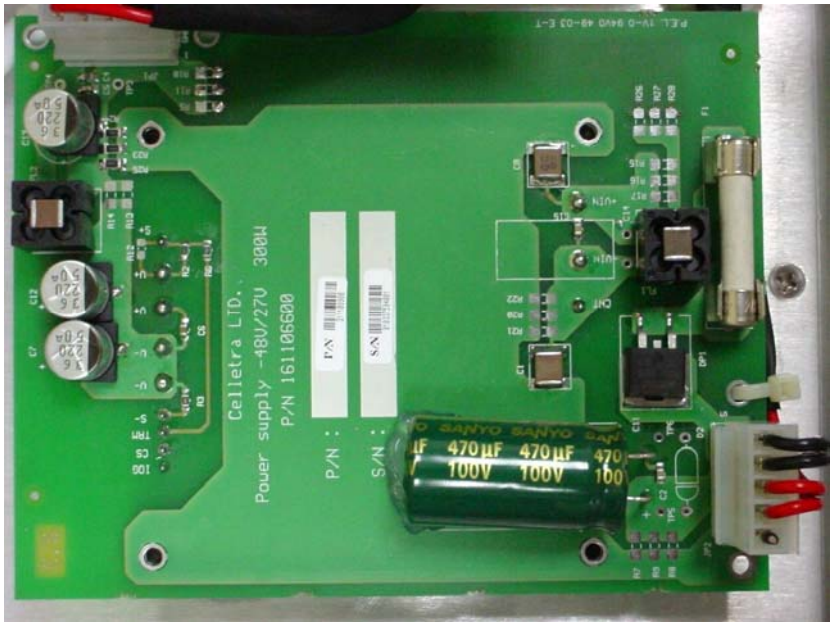


**Figure 41 PCB 2 Side 1**

**Figure 42 PCB 2 Side 2**

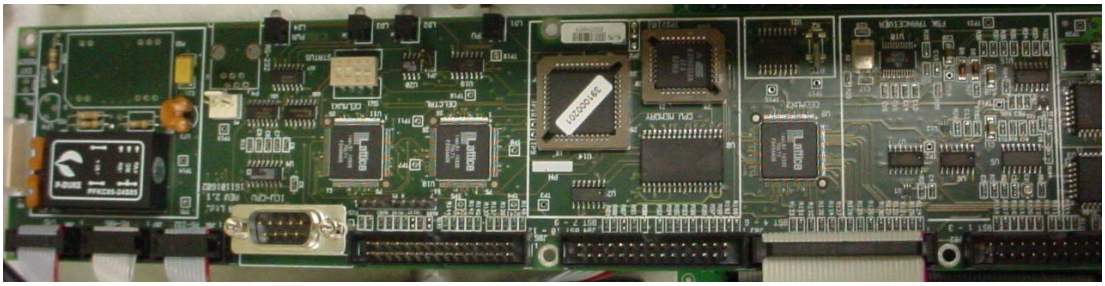

**Figure 43 PCB 3 Side 1**

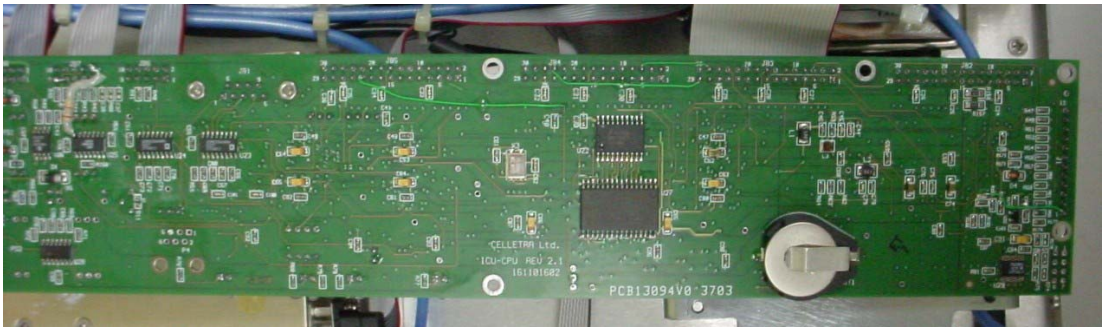


**Figure 44 PCB 3 Side 2**

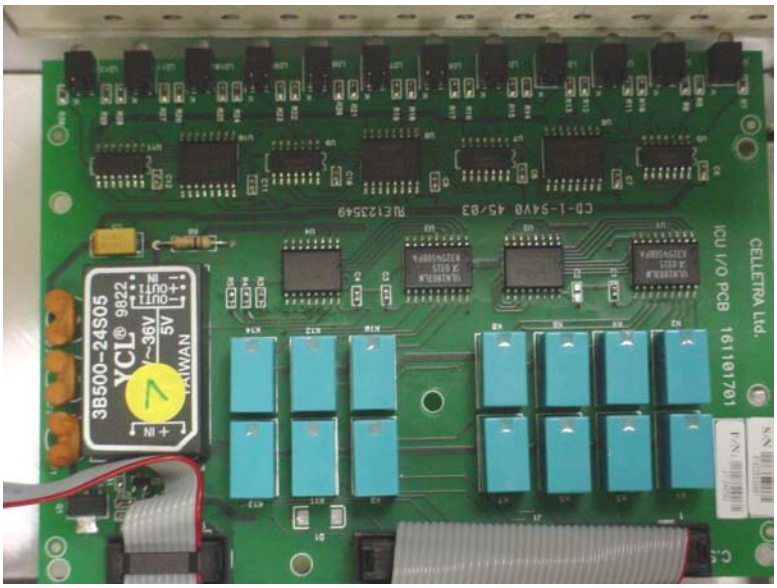


**Figure 45 PCB 4 Side 1**

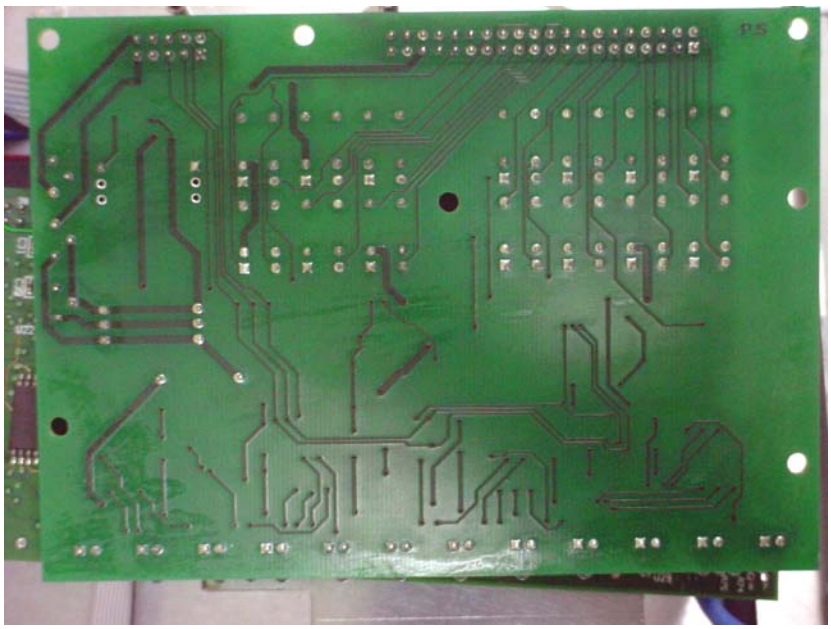

**Figure 46 PCB 4 Side 2**

# 12. APPENDIX A - CORRECTION FACTORS

## *12.1 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".*

### *12.2 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.*

### *12.3 Correction factors for CABLE*

**from EMI receiver to test antenna**

| FREQUENCY (MHz) | CORRECTION FACTOR (dB) |
|---|---|
| 10.0 | 0.1 |
| 20.0 | 0.1 |
| 30.0 | 0.2 |
| 40.0 | 0.2 |
| 50.0 | 0.2 |
| 60.0 | 0.2 |
| 70.0 | 0.3 |
| 80.0 | 0.3 |
| 90.0 | 0.3 |
| 100.0 | 0.3 |
| 150.0 | 0.4 |
| 200.0 | 0.4 |
| 250.0 | 0.4 |
| 300.0 | 0.5 |
| 350.0 | 0.6 |
| 400.0 | 0.6 |
| 450.0 | 0.6 |
| 500.0 | 0.7 |
| 600.0 | 0.8 |
| 700.0 | 0.8 |
| 800.0 | 1.0 |
| 900.0 | 1.1 |
| 1000.0 | 1.1 |

| FREQUENCY (MHz) | CORRECTION FACTOR (dB) |
|---|---|
| 1200.0 | 1.4 |
| 1400.0 | 1.5 |
| 1600.0 | 1.5 |
| 1800.0 | 1.7 |
| 2000.0 | 1.7 |
| 2300.0 | 2.0 |
| 2600.0 | 2.1 |
| 2900.0 | 2.2 |

*NOTES:*

*1. The cable type is RG-214.*

*2. The overall length of the cable is 5.5 meters.*

### *12.4 Correction factors for CABLE*

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

| FREQUENCY (MHz) | CORRECTION FACTOR (dB) |
|---|---|
| 10.0 | 0.6 |
| 20.0 | 1.1 |
| 30.0 | 1.3 |
| 40.0 | 1.6 |
| 50.0 | 1.7 |
| 60.0 | 1.9 |
| 70.0 | 2.0 |
| 80.0 | 2.2 |
| 90.0 | 2.3 |
| 100.0 | 2.4 |
| 150.0 | 3.1 |
| 200.0 | 3.6 |
| 250.0 | 4.2 |
| 300.0 | 4.5 |
| 350.0 | 4.8 |
| 400.0 | 5.2 |
| 450.0 | 5.5 |
| 500.0 | 6.2 |
| 600.0 | 6.4 |
| 700.0 | 7.0 |
| 800.0 | 7.5 |
| 900.0 | 8.1 |
| 1000.0 | 8.6 |

| FREQUENCY (MHz) | CORRECTION FACTOR (dB) |
|---|---|
| 1200.0 | 9.7 |
| 1400.0 | 10.5 |
| 1600.0 | 11.5 |
| 1800.0 | 12.6 |
| 2000.0 | 13.5 |
| 2300.0 | 14.3 |
| 2600.0 | 15.5 |
| 2900.0 | 16.4 |

*NOTES:*

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

## *12.5 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".*

## *12.6 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".*

## *12.7 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".*

## *12.8 Correction factors for BICONICAL ANTENNA*

## Type BCD-235/B, 10 meter range

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

*NOTES:*

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

### *12.9 Correction factors for BICONICAL ANTENNA*

## Type 3109,
## 1.0 meter range

| FREQUENCY (MHz) | AFE (dB/m) |
|---|---|
| 20.0 | 11.1 |
| 30.0 | 12.0 |
| 40.0 | 12.0 |
| 50.0 | 11.4 |
| 60.0 | 10.3 |
| 70.0 | 10.7 |
| 80.0 | 8.3 |
| 90.0 | 9.0 |
| 100.0 | 10.0 |
| 110.0 | 11.6 |
| 120.0 | 13.6 |
| 130.0 | 14.2 |
| 140.0 | 13.5 |
| 150.0 | 12.7 |
| 160.0 | 12.7 |
| 170.0 | 13.6 |
| 180.0 | 15.3 |
| 190.0 | 14.6 |
| 200.0 | 14.7 |
| 210.0 | 15.3 |
| 220.0 | 15.8 |
| 230.0 | 17.0 |
| 240.0 | 18.0 |
| 250.0 | 18.1 |
| 260.0 | 18.0 |
| 270.0 | 17.5 |
| 280.0 | 18.2 |
| 290.0 | 19.7 |
| 300.0 | 21.8 |

*NOTES:*

*1. Antenna serial number is 3244.*

*2. The above list is located in file 44BIC10M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver"*

### *12.10 Correction factors for BICONICAL ANTENNA*

## Type 3109,
## 3 meter range

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

*NOTES:*

*1. Antenna serial number is 3244.*

*2. The above list is located in file 44BIC3M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver"*

### *12.11 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 |

### *12.12 Correction factors for Double-Ridged Waveguide Horn*

**Model: 3115, S/N 9702-5111**

**at 1 meter range.**

| FREQUENCY (GHz) | ANTENNA FACTOR (dB 1/m) |
|---|---|
| 1.0 | 25.0 |
| 2.0 | 28.0 |
| 3.0 | 29.0 |
| 4.0 | 33.0 |
| 5.0 | 34.0 |
| 6.0 | 34.9 |
| 7.0 | 36.0 |
| 8.0 | 37.0 |
| 9.0 | 38.0 |
| 10.0 | 39.5 |
| 11.0 | 39.0 |
| 12.0 | 39.5 |
| 13.0 | 40.0 |
| 14.0 | 42.0 |
| 15.0 | 39.8 |
| 16.0 | 38.5 |
| 17.0 | 41.0 |
| 18.0 | 46.5 |

| FREQUENCY (GHz) | ANTENNA Gain (dB) |
|---|---|
| 1.0 | 5.5 |
| 2.0 | 8.5 |
| 3.0 | 9.0 |
| 4.0 | 9.5 |
| 5.0 | 10.0 |
| 6.0 | 11.0 |
| 7.0 | 10.5 |
| 8.0 | 11.0 |
| 9.0 | 11.5 |
| 10.0 | 12.0 |
| 11.0 | 12.5 |
| 12.0 | 13.0 |
| 13.0 | 12.5 |
| 14.0 | 12.0 |
| 15.0 | 14.0 |
| 16.0 | 15.9 |
| 17.0 | 14.0 |
| 18.0 | 8.5 |

### *12.13 Correction factors for Double-Ridged Waveguide Horn*

**Model: 3115, S/N 29845**
**at 1 meter range.**

| FREQUENCY (GHz) | ANTENNA FACTOR (dB 1/m) | ANTENNA Gain (dBi) | FREQUENCY (GHz) | ANTENNA FACTOR (dB 1/m) | ANTENNA Gain (dBi) |
|---|---|---|---|---|---|
| 1.0 | 24.5 | 5.8 | 10.0 | 37.9 | 12.3 |
| 1.5 | 25.8 | 8.0 | 10.5 | 38.0 | 12.6 |
| 2.0 | 27.8 | 8.5 | 11.0 | 38.2 | 12.8 |
| 2.5 | 28.5 | 9.7 | 11.5 | 38.8 | 12.6 |
| 3.0 | 30.1 | 9.6 | 12.0 | 38.7 | 13.1 |
| 3.5 | 31.3 | 9.8 | 12.5 | 38.7 | 13.5 |
| 4.0 | 32.8 | 9.5 | 13.0 | 39.7 | 12.8 |
| 4.5 | 32.4 | 10.8 | 13.5 | 40.0 | 12.8 |
| 5.0 | 33.8 | 10.4 | 14.0 | 40.8 | 12.4 |
| 5.5 | 34.3 | 10.8 | 14.5 | 40.3 | 13.1 |
| 6.0 | 34.6 | 11.1 | 15.0 | 39.0 | 14.8 |
| 6.5 | 34.9 | 11.5 | 15.5 | 37.4 | 16.6 |
| 7.0 | 35.9 | 11.2 | 16.0 | 37.6 | 16.7 |
| 7.5 | 37.0 | 10.7 | 16.5 | 39.0 | 15.5 |
| 8.0 | 36.9 | 11.3 | 17.0 | 41.3 | 13.5 |
| 8.5 | 37.3 | 11.5 | 17.5 | 44.3 | 10.8 |
| 9.0 | 37.5 | 11.8 | 18.0 | 46.7 | 8.6 |
| 9.5 | 37.4 | 12.3 | | | |

### *12.14 Correction factors for Double-Ridged Waveguide Horn*

**Model: 3115, S/N 29845**
**at 3 meter range.**

| FREQUENCY (GHz) | ANTENNA FACTOR (dB 1/m) | ANTENNA Gain (dBi) | FREQUENCY (GHz) | ANTENNA FACTOR (dB 1/m) | ANTENNA Gain (dBi) |
|---|---|---|---|---|---|
| 1.0 | 24.8 | 5.4 | 10.0 | 38.8 | 11.4 |
| 1.5 | 26.1 | 7.6 | 10.5 | 38.9 | 11.8 |
| 2.0 | 28.6 | 7.7 | 11.0 | 39.0 | 12.1 |
| 2.5 | 29.8 | 8.4 | 11.5 | 39.6 | 11.8 |
| 3.0 | 31.4 | 8.4 | 12.0 | 39.8 | 12.0 |
| 3.5 | 32.4 | 8.7 | 12.5 | 39.6 | 12.5 |
| 4.0 | 33.7 | 8.6 | 13.0 | 40.0 | 12.5 |
| 4.5 | 33.4 | 9.9 | 13.5 | 39.8 | 13.0 |
| 5.0 | 34.5 | 9.7 | 14.0 | 40.2 | 13.0 |
| 5.5 | 35.1 | 9.9 | 14.5 | 40.6 | 12.9 |
| 6.0 | 35.4 | 10.4 | 15.0 | 41.3 | 12.4 |
| 6.5 | 35.6 | 10.8 | 15.5 | 39.5 | 14.6 |
| 7.0 | 36.2 | 10.9 | 16.0 | 38.8 | 15.5 |
| 7.5 | 37.3 | 10.4 | 16.5 | 40.0 | 14.6 |
| 8.0 | 37.7 | 10.6 | 17.0 | 41.4 | 13.4 |
| 8.5 | 38.3 | 10.5 | 17.5 | 44.8 | 10.3 |
| 9.0 | 38.5 | 10.8 | 18.0 | 47.2 | 8.1 |
| 9.5 | 38.7 | 11.1 | | | |