

March 11, 2008

Ubiquiti Networks 495-499 Montague Expressway Milpitas, CA 95035

Dear Robert Pera,

Enclosed is the EMC test report for compliance testing of the Ubiquiti Networks, NS5, tested to the requirements of ETSI EN 301 489-1 V1.4.1 (2002-08) with ETSI EN 301 489-17 V1.2.1 (2002-08).

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours, MET LABORATORIES, INC.

Jennifer Janohez

Jennifer Sanchez Documentation Department

Reference: (\Ubiquiti Networks \ EMCS80544B-EN489)

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DOC-EMC602 4/30/2004



Electromagnetic Compatibility Test Report

For the

Ubiquiti Networks NS5

Tested under

ETSI EN 301 489-1 V1.4.1 (2002-08) with ETSI EN 301 489-17 V1.2.1 (2002-08)

MET Report: EMCS80544B-EN489

March 11, 2008

Prepared For:

Ubiquiti Networks 495-499 Montague Expressway Milpitas, CA 95035



Electromagnetic Compatibility Criteria Test Report

For the

Ubiquiti Networks NS5

Tested under

ETSI EN 301 489-1 V1.4.1 (2002-08) with ETSI EN 301 489-17 V1.2.1 (2002-08)

MET Report: EMCS80544B-EN489

Saulto n. A

Savitha Ramesh, Project Engineer Electromagnetic Compatibility Lab

Jennifer Sanchez Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of ETSI EN 301 489-1 V1.4.1 (2002-08) with ETSI EN 301 489-17 V1.2.1 (2002-08) under normal use and maintenance.

Tony Permsombut, Lab Manager Electromagnetic Compatibility Lab



Report Status Sheet

| Revision | Report Date | Reason for Revision | |
|----------|----------------|---------------------|--|
| Ø | March 11, 2008 | Initial Issue. | |



NS5

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| AC | Alternating Current | | |
|------------|--|--|--|
| ACF | Antenna Correction Factor | | |
| Cal | Calibration | | |
| d | Measurement Distance | | |
| dB | Decibels | | |
| dВФА | Decibels above one microamp | | |
| dBΦV | Decibels above one microvolt | | |
| dВФА/m | Decibels above one microamp per meter | | |
| dBΦV/m | Decibels above one microvolt per meter | | |
| DC | Direct Current | | |
| Е | Electric Field | | |
| DSL | Digital Subscriber Line | | |
| ESD | Electrostatic Discharge | | |
| EUT | Equipment Under Test | | |
| f | Frequency | | |
| CISPR | Comite International Special des Perturbations Radioelectriques (International Special Committee on Radio Interference) | | |
| GRP | Ground Reference Plane | | |
| Н | Magnetic Field | | |
| НСР | Horizontal Coupling Plane | | |
| Hz | Hertz | | |
| IEC | International Electrotechnical Commission | | |
| kHz | kilohertz | | |
| kPa | kilopascal | | |
| kV | kilovolt | | |
| LISN | Line Impedance Stabilization Network | | |
| MHz | Megahertz | | |
| ФН | microhenry | | |
| ΦF | microfarad | | |
| Φs | microseconds | | |
| PRF | Pulse Repetition Frequency | | |
| RF | Radio Frequency | | |
| RMS | Root-Mean-Square | | |
| | R oot- M ean-Square | | |
| TWT | Traveling Wave Tube | | |
| TWT V/m | Traveling Wave Tube Volts per meter | | |

List of Terms and Abbreviations



I. Executive Summary



A. Requirements Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with ETSI EN 301 489-1 V1.4.1 (2002-08).

| ETSI EN 301 489-1 V1.4.1 (2002) Section and Test Description | | omplia | nce | Comments |
|--|--------------|--------|-----|---|
| | | No | N/A | Comments |
| Section 8.2: Enclosure of ancillary equipment intended to be used in other than telecommunication center measured on a stand alone basis | \checkmark | | | Measured emissions below applicable limits. |
| Section 8.3: DC power input/output ports, conducted emissions of equipment intended to be used in other than telecommunication center | | | 1 | Not Applicable |
| Section 8.4: AC mains power input/output ports, conducted emissions of equipment intended to be used in other than telecommunication center | | | | Measured emissions below applicable limits. |
| Section 8.5: Harmonic current emissions (AC mains input port) | | | | Measured emissions below applicable limits. |
| Section 8.6: Voltage fluctuations and flicker (AC mains input port) | | | | |
| Section 9.2: Radio frequency electromagnetic field (80 MHz to 1000 MHz and 1400 MHz to 2000 MHz) | \checkmark | | | No anomalies observed. |
| Section 9.3: Electrostatic Discharge | \checkmark | | | |
| Section 9.4: Fast transients, common mode | \checkmark | | | |
| Section 9.5: Radio frequency, common mode | \checkmark | | | |
| Section 9.6: Transients and surges in the vehicular environment | | | | No anomalies observed |
| Section 9.7: Voltage dips and interruptions | | | | |
| Section 9.8: Surge | | | | |

Table 1. Summary of EMC ETSI EN 301 489-1 V1.4.1 (2002-08)



II. Equipment Configuration



A. Overview

The purpose of this series of tests was to verify compliance of the Ubiquiti Networks, NS5with the limits of ETSI EN 301 489-1 V1.4.1 (2002-08).

| Model(s) Tested: | NS5 |
|---------------------|---|
| Model(s) Covered: | NS5 |
| EUT Specifications: | Primary Power from laptop: 230V/50Hz |
| - | Secondary Power: N/A |
| Analysis: | The results obtained relate only to the item(s) tested. |
| Evaluated by: | Savitha Ramesh |

 Table 2. EUT Summary Table



B. References

| ETSI EN 301 489-1 V1.4.1 (2002-08) | Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services: Part 1: Common technical requirements, 2002 |
|--|---|
| ETSI EN 301 489-17 V1.2.1 (2002-08) | Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for 2.4GHz wideband transmission systems and 5 GHz high performance RLAN equipment, 2002 |
| EN 55022 (CISPR 22) | Limits and methods of measurement of radio disturbance characteristics of information technology equipment, 1998 w/A1: 2000 & A2: 2003 |
| EN 61000-3-2 | Electromagnetic compatibility (EMC) Part 3: Limits — Section 2: Limits for harmonic current Emissions (equipment input current #16 A per phase), 1995 with A1 & A2: 2000 and A14: 2000 |
| EN 61000-3-3 | Electromagnetic compatibility (EMC) Part 3: Limits — Section 3: Limitation of voltage fluctuations and flicker in low-voltage supply systems for equipment with rated current # 16 A, 1994 with A1: 2001 |
| EN 61000-4-2 | Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 2: Electrostatic discharge immunity test, 1995 with A1: 1998 and A2: 2001 |
| EN 61000-4-3 | Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 3: Radiated, radio-frequency, electromagnetic field immunity test, 2002 |
| EN 61000-4-4 | Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 4: Electrical fast transient/burst immunity test, 1995 w/ A1 & A2: 2001 |
| EN 61000-4-5 | Electromagnetic compatibility (EMC) Part 4: Testing and measurement techniques Section 5: Surge immunity test, 1995 with A1: 2001 |
| EN 61000-4-6 | Electromagnetic compatibility - Part 4: Testing and measurement techniques Section 6.1: Immunity and conducted disturbances, induced by radio- frequency fields, 1996 with A1: 2001 |
| EN 61000-4-11 | Electromagnetic compatibility - Part 4: Testing and measurement techniques Section 11: Voltage Dips, short interruptions and voltage variations immunity tests, 1994 A1: 2001 |
| ISO 7637-1 | Road vehicles – Electrical disturbance by conduction and coupling – Part 1: Passenger cars and light commercial vehicles with nominal 12 V supply voltage – Electrical transient conduction along supply lines only, 1990 |

 Table 3. Test References



C. Test Site

All testing was performed at MET Laboratories, Inc., 3162 Belick Street, Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

D. Description of Test Sample

The Ubiquiti Networks NS5, is a high performance 802.11 outdoor CPE device specifically designed for optimized performance at 5GHz.



Photograph 1. Ubiquiti Networks NS5





Figure 1. Block Diagram of Test Configurations



E. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

| Ref. ID | Name / Description | Model Number | Serial Number |
|---------|--------------------|--------------|---------------|
| А | NanoStation5 | NS5 | - |

Table 4. Equipment Configuration

F. Support Equipment

Ubiquiti Networks supplied support equipment necessary for the operation and testing of the NPM-100-2100. All support equipment supplied is listed in the following Support Equipment List.

| Ref. ID | Name / Description | Manufacturer | Model Number |
|---------|--------------------|---------------|---------------|
| В | AC/DC Adaptor | GME Switching | GFP121U-1210B |
| С | Laptop | DELL | Inspiron-630m |

Table 5. Support Equipment

* The 'Customer Supplied Calibration Data' column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer.

G. Ports and Cabling Information

| Ref. ID | Port name on EUT | Cable Description or reason for no cable | Qty. | Length (m) | Shielded (Y/N) | Termination Box ID & Port ID |
|------------|---------------------|---|------|---------------|-------------------|---------------------------------|
| 1 | A,1 | Ethernet | 1 | 2 mts | Y | B, POE |
| 2 | B, LAN | Ethernet | 1 | 2 mts | Y | C, Laptop |
| 3 | B, DC POWER | Power Cable | 1 | 2 mts | Ν | 230V/110V Power Supply |
| 4 | A, 4 | Terminated with 50 ohm load | 1 | N/A | N/A | N/A |

Table 6. Ports and Cabling Information



H. Mode of Operation

The EUT operates in OFDM mode.

I. Method of Monitoring EUT Operation

A Spectrum Analyzer and a Power Meter was use to monitor the EUT's transmitter channel and power output.

J. Modifications

- a) Modifications to EUT No modifications were made to the EUT.
- b) Modifications to Test Standard No modifications were made to the EUT.

K. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Ubiquiti Networks upon completion of testing.



III. Electromagnetic Compatibility Emission Criteria



Electromagnetic Compatibility Emission Criteria

Radiated Emission: Test Methods and Limits

Test Requirement(s): ETSI EN 301 489-1 Clause 8.2, ETSI EN 301 489-17 Clause 7.1, (per EN 55022 Clause 6): For Radiated Emission in the frequency range 30 MHz - 1000 MHz, the EUT shall meet the requirements as specified in *EN 55022 [6]*. The EUT shall meet the limits shown in Table 7.

| Frequency Band (MHz) | Quasi-Peak limits for ancillary equipment intended for use in telecommunication centers only 10 m measurement distance (dBµV/m) | Quasi-Peak limits for ancillary equipment intended for use in other than telecommunication centers 10 m measurement distance (dBµV/m) | | | | |
|--|---|---|--|--|--|--|
| 30 to 230 | 40 | 30 | | | | |
| 230 to 1000 | 47 | 37 | | | | |
| Notes redicted emissions from encillems excinment some measured on a stand along basis | | | | | | |

Note: radiated emissions from ancillary equipment were measured on a stand alone basis.

| Fable 7. Radiated Emissions limits from Clause 6 of EN | 55022 |
|---|-------|
|---|-------|

| Environmental Conditions for Radiated Emission | | | | |
|---|---------|--|--|--|
| Ambient Temperature: | 23°C | | | |
| Relative Humidity: | 45 % | | | |
| Atmospheric Pressure: | 102 kPa | | | |

| Test Procedure: | The EUT was placed on a 0.8m-high wooden table inside a semi-anechoic chamber (See |
|-------------------|--|
| | Photograph 2). The measurement was performed using normal operation of the |
| | equipment. The method of testing, test conditions, and test procedures of <i>Clause 10</i> of |
| | <i>EN 55022</i> were used. The frequencies and amplitudes of field strengths were recorded |
| | for reference during final measurements. Final radiated measurements were made in the |
| | semi-anechoic chamber. Unless otherwise specified, measurements were made using a |
| | quasi-peak detector with a 120 kHz bandwidth. |
| | For pre-scanning, the spectrum analyzer scanned the frequency range from 30 MHz to 1000 MHz to obtain an Emission profile of the EUT. For each point of measurement, the |
| | turntable was rotated the positions of the interface cables were varied and the antenna |
| | height was varied between 1 m and 4 m in order to find the maximum radiated |
| | emissions Measurements were taken at 10 meter distance using this technique with the |
| | antenna in two polarizations: horizontal and vertical. |
| Test Results: | The EUT was found compliant with the requirements of Clause 8.2 of ETSI EN 301 489- |
| | 1, radiated emissions from ancillary equipment intended for use in other than |
| | telecommunication center, measured on a stand-alone basis. |
| Test Engineer(s): | Minh Ly |
| 8 | |
| Test Date(s): | November 10, 2007 |



Margin (dB)

> -5.86 -7.70 -7.20 -3.45 -9.25 -14.06

Electromagnetic Compatibility Emission Criteria

| Frequency (MHz) | Antenna Polarity (H/V) | EUT Azimuth (Degrees) | Antenna Height (m) | Uncorrected Amplitude QP Detector (dBuV) | Antenna Correction Factor (dB/m) (+) | Cable Loss (dB) (+) | Corrected Amplitude (dBuV/m) | Limit (dBuV/m) | |
|--------------------|------------------------------|-----------------------------|--------------------------|---|---|---------------------------|------------------------------------|-------------------|---|
| 52.64 | V | 81 | 2.54 | 25.68 | 7.27 | 1.18 | 34.14 | 40.00 | |
| 58.72 | V | 271 | 2.87 | 24.50 | 6.54 | 1.26 | 32.30 | 40.00 | |
| 90.36 | V | 70 | 1.97 | 22.06 | 9.17 | 1.58 | 32.80 | 40.00 | |
| 111.6 | V | 99 | 1.1 | 23.00 | 11.70 | 1.86 | 36.55 | 40.00 | |
| 159.64 | V | 214 | 1.07 | 18.82 | 9.64 | 2.30 | 30.75 | 40.00 | |
| 298.64 | Н | 67 | 32 | 16 79 | 13 23 | 2 92 | 32 94 | 47.00 | [|

Radiated Emission: Test Methods and Limits

| Table 8. Radiated Emissions Test Resu |
|---------------------------------------|
|---------------------------------------|



Plot 1. Radiated Emissions Test Plot



Electromagnetic Compatibility Emission Criteria

Radiated Emission: Test Methods and Limits



Photograph 2. Radiated Emission, Test Setup



Ubiquiti Networks NS2 ETSI EN 301 48 Electromagnetic Compatibility Emission Criteria

Electromagnetic Compatibility Emission Criteria Conducted Emission AC Power Interfaces: Test Methods and Limits

Test Requirement(s): ETSI EN 301 489-1 Clause 8.4, ETSI EN 301 489-17 Clause 7.1 (per EN 55022 Clause 5.1) AC power port:

Clause 5.1, AC power port: For conducted emission on AC power port in the frequency range 0.15 MHz to 30 MHz, the test method specified in *EN 55022* shall apply.

The EUT shall meet limits shown in Error! Reference source not found.

| Frequency Range (MHz) | Limits for equipment intended to be used in telecommunication centers only (dB:V) Quasi-Peak Average | | equency Range (MHz) Limits for equipmintended to be use telecommunication only (dB:V) | | Limits for intended to be than telecon cen (dB | equipment e used in other munication ters :V) |
|---------------------------|---|----|---|----------|--|---|
| | | | Quasi- Peak | Average | | |
| 0.15 - 0.5 | 79 | 66 | 66 to 56 | 56 to 46 | | |
| 0.5 - 5 | 73 | 60 | 56 | 46 | | |
| 5 - 30 | 73 | 60 | 60 | 50 | | |
| Note: The lower limit sha | Note: The lower limit shall apply at the transition frequencies. The limits decrease linearly with the logarithm | | | | | |

Note: The lower limit shall apply at the transition frequencies. The limits decrease linearly with the loga of the frequency in the range of 0.15 MHz to 0.5 MHz.

Table 9. Mains Terminal Disturbance Voltage Limits from Section 5.1 of EN 55022

Test Procedure: The EUT was placed on a 0.8m-high wooden table above a GRP (See Photograph 3). The measurements were performed using normal operation of the equipment. The method of testing, test conditions, and test procedures of *Clause 9* of *EN 55022* were used. The EMC receiver scanned the frequency range from 0.15 MHz to 30 MHz. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 ohm/50 µH LISN and an EMI Receiver.
 Test Results: The EUT was found compliant with the specified requirements of Clause 8.4 of ETSI EN 301 489-1, conducted emissions AC power interfaces of equipment intended to be used in other than telecommunication center..
 Test Engineer(s): Minh Ly

Test Date(s): November 10, 2007



Electromagnetic Compatibility Emission Criteria Conducted Emission AC Power Interfaces: Test Methods and Limits

| Freq. (MHz) | Corrected Amplitude (dBuV) QP | Limit (dBuV) QP | Results QP | Margin (dB) QP | Corrected Amplitude (dBuV) AVG | Limit (dBuV) AVG | Results AVG | Margin (dB) AVG |
|----------------|--|-----------------------|---------------|-------------------|---|------------------------|----------------|-----------------------|
| 0.16 | 61.41 | 79 | PASS | -17.59 | 34.98 | 66 | PASS | -31.02 |
| 2.653 | 35.21 | 73 | PASS | -37.79 | 15.97 | 60 | PASS | -44.03 |
| 24.96 | 40.45 | 73 | PASS | -32.55 | 35.85 | 60 | PASS | -24.15 |

Table 10. Conducted Emissions - Voltage, Worst Case Emissions, AC Power – Phase Line, 230 VAC/50 Hz



Conducted Emission Limits, Phase Line Plot



Electromagnetic Compatibility Emission Criteria Conducted Emission AC Power Interfaces: Test Methods and Limits

| Freq. (MHz) | Corrected Amplitude (dBuV) QP | Limit (dBuV) QP | Results QP | Margin (dB) QP | Corrected Amplitude (dBuV) AVG | Limit (dBuV) AVG | Results AVG | Margin (dB) AVG |
|----------------|--|-----------------------|---------------|-------------------|---|------------------------|----------------|-----------------------|
| 0.161 | 62.37 | 79 | PASS | -16.63 | 34.31 | 66 | PASS | -31.69 |
| 2.576 | 30.53 | 73 | PASS | -42.47 | 13.36 | 60 | PASS | -46.64 |
| 25.58 | 34.13 | 73 | PASS | -38.87 | 30.95 | 60 | PASS | -29.05 |

Table 11. Conducted Emissions - Voltage, Worst Case Emissions, AC Power – Neutral Line, 230 VAC/50 Hz



Conducted Emission Limits, Neutral Line Plot



Electromagnetic Compatibility Emission Criteria Conducted Emission AC Power Interfaces: Test Methods and Limits



Photograph 3. Conducted Emission Mains Interface: Test Method and Limits, Test Setup



| Ibianiti Networks | Emission Criteria |
|-------------------|--|
| NS2 | ETSI EN 301 489-1 V1.4.1 and ETSI EN 301 489-17 V1.2.1 |
| | |

L. Limits for Conducted Disturbance at Telecommunication Ports

ETSI EN 301 489-1, Clause 8.4: **Test Requirement(s):**

The EUT shall meet the Conducted Common Mode limits shown in Table 12:

| Frequency Range | Voltage Lin | nits (dBµV) | Current Limits (dBµA) | | | |
|---|-------------|-------------|-----------------------|----------|--|--|
| (MHz) | Quasi-Peak | Average | Quasi- Peak | Average | | |
| 0.15 - 0.5 | 97 to 87 | 84 to 74 | 53 to 43 | 40 to 30 | | |
| 5 - 30 | 87 | 74 | 43 | 30 | | |
| Note: The limits decrease linearly with the logarithm of the frequency in the range of 0.15 MHz to 0.5 MHz. The current and voltage disturbnace limits are derived for use with an ISN which presents a common | | | | | | |

mode (asymetric mode) impedance of 150Σ to the telecommunication port under test (conversion factor is 20 $Log_{10} 150/1 = 44 dB$)

Table 12. Limits of Conducted Common Mode (Asymmetric Mode) Disturbance at **Telecommunication Ports from Clause 5.2 of EN 55022 Class A**

The EUT was located in a shielded enclosure (See Photograph 4). The measurements **Test Procedure:** were performed using normal operation of the equipment. The method of testing, test conditions, and test procedures of Clause 9 of EN 55022 were used. The EMC receiver scanned the frequency range from 150 kHz to 30 MHz. The measurements were performed over the frequency range of 0.15 MHz to 30 MHz using a 50 Ω /50 μ H LISN as the input transducer to an EMC field intensity meter. The tests were conducted in a RF-shielded enclosure.

| Environmental Conditions for Conducted Emission | | | | |
|--|-------|--|--|--|
| Ambient Temperature: | 22 °C | | | |
| Relative Humidity: | 48 % | | | |

Test Results: The EUT was found to comply with the requirement(s) of this section.

Test Engineer(s): Savitha Ramesh

Test Date(s): January 31, 2008 **Electromagnetic Compatibility**



Limits for Conducted Disturbance at Telecommunication Ports

| Freq. (MHz) | RAW (dBuV) QP | Limit (dBuV) QP | Results QP | Margin (dB) QP | RAW (dBuV) AVG | Limit (dBuV) AVG | Results AVG | Margin (dB) AVG |
|----------------|---------------------|-----------------------|---------------|-------------------|----------------------|------------------------|----------------|-----------------------|
| 1.371 | 26.99 | 43 | PASS | -16.01 | 24.37 | 30 | PASS | -5.63 |
| 1.17 | 18.65 | 43 | PASS | -24.35 | 14.88 | 30 | PASS | -15.12 |
| 0.81 | 16.02 | 43 | PASS | -26.98 | 14.32 | 30 | PASS | -15.68 |
| 0.178 | 20.61 | 51.58 | PASS | -30.97 | 15.12 | 38.58 | PASS | -23.46 |
| 0.362 | 10.96 | 45.68 | PASS | -34.72 | 2.48 | 32.68 | PASS | -30.2 |
| 0.278 | 13.48 | 47.88 | PASS | -34.4 | 9.2 | 34.88 | PASS | -25.68 |

Conducted Emissions - Voltage for Telecommunication Ports, Worst Case Emissions, POE Line

 Table 13. Limits for Conducted Disturbance at Telecommunication Ports Test Results, POE



Plot 2. Conducted Emission Limits for Telecommunications Ports, POE Plot



Limits for Conducted Disturbance at Telecommunication Ports

| Conducted Emissions - Voltage for Telecommunication Ports | s, Worst Case Emissions, LAN Line |
|--|-----------------------------------|
|--|-----------------------------------|

| Freq. (MHz) | RAW (dBuV) QP | Limit (dBuV) QP | Results QP | Margin (dB) QP | RAW (dBuV) AVG | Limit (dBuV) AVG | Results AVG | Margin (dB) AVG |
|----------------|---------------------|-----------------------|---------------|-------------------|----------------------|------------------------|----------------|-----------------------|
| 1.37 | 28.1 | 43 | PASS | -14.9 | 25.22 | 30 | PASS | -4.78 |
| 1.499 | 24.62 | 43 | PASS | -18.38 | 22.9 | 30 | PASS | -7.1 |
| 0.809 | 19.44 | 43 | PASS | -23.56 | 15.56 | 30 | PASS | -14.44 |
| 0.68 | 8.96 | 43 | PASS | -34.04 | 4.67 | 30 | PASS | -25.33 |
| 12.19 | 6.35 | 43 | PASS | -36.65 | 0.56 | 30 | PASS | -29.44 |
| 1.17 | 25.87 | 43 | PASS | -17.13 | 23.8 | 30 | PASS | -6.2 |

Table 14. Limits for Conducted Disturbance at Telecommunication Ports Test Results, LAN



Plot 3. Conducted Emission Limits for Telecommunications Ports, LAN Plot



Limits for Conducted Disturbance at Telecommunication Ports



Photograph 4. Limits for Conducted Disturbance at Telecommunication Ports



Electromagnetic Compatibility Emission Criteria

8.5 Harmonic Current Emissions

Test Requirement(s): ETSI EN 301 489-1, Clause 8.5:

Per *EN 61000-3-2, Clause 8*, the EUT must not produce harmonic currents, which exceed the limits expressed in Table 15.

| Harmonic Order | Maximum Permissible Harmonic Current (in Amperes) | | | | | | |
|----------------|--|--|--|--|--|--|--|
| Odd Harmonics | | | | | | | |
| 3 | 2.30 | | | | | | |
| 5 | 1.14 | | | | | | |
| 7 | 0.77 | | | | | | |
| 9 | 0.40 | | | | | | |
| 11 | 0.33 | | | | | | |
| 13 | 0.21 | | | | | | |
| 15 < n < 39 | 0.15 - 15/n | | | | | | |
| Harmonic Order | Maximum Permissible Harmonic Current (in Amperes) | | | | | | |
| Even H | larmonics | | | | | | |
| 2 | 1.08 | | | | | | |
| 4 | 0.43 | | | | | | |
| 6 | 0.30 | | | | | | |
| 8< n <40 | 0.23 - 8/n | | | | | | |

Table 15. Harmonic Current Emission Limits from Section 7 of EN 61000-3-2

Test Procedure:The EUT was placed on a 0.8m-high wooden table above a GRP (See Photograph 1).
The measurement was performed using normal operation of the equipment. The method
of testing, test conditions, and test procedures of *EN 61000-3-2*.ITE is tested with the equipment configured to its rated current. In this case, the
equipment, if necessary, may be configured with its power supplies loaded with

equipment, if necessary, may be configured with its power supplies loaded with additional load (resistive) boards to simulate rated current conditions. For ITE systems designed for use with a manufacturer-supplied power distribution system, e.g. transformers, UPS, power conditioner, etc., compliance with the limits of this standard shall be met at the input to the power distribution system.

Test Results: The EUT was found compliant with the specified requirements of Clause 8.5.

Test Engineer(s):Savitha Ramesh

Test Date(s): January 25, 2008



Electromagnetic Compatibility Emission Criteria, Harmonic Current Emissions

| Class (A, B, C, D) | Voltage (V) | Curre | ent Freq | uency Iz) | Total Harmonic Distortion (%) |
|-----------------------|--------------------|------------|-----------------|--------------|----------------------------------|
| A | 240.26V | 94.2m | A 49.9 | 9 Hz | 238.94% |
| | 210.201 | , <u>-</u> | | <i>,</i> | 2000 170 |
| Harmonic # | Measured (Amps) | l | Limit (Amps) | | Results |
| 2 | 0.0049 | | 1.080 | | Pass |
| 3 | 0.0357 | | 2.300 | | Pass |
| 4 | 0.0047 | | 0.430 | | Pass |
| 5 | 0.0345 | | 1.140 | | Pass |
| 6 | 0.0046 | | 0.300 | | Pass |
| 7 | 0.0328 | | 0.770 | | Pass |
| 8 | 0.0043 | | 0.230 | | Pass |
| 9 | 0.0307 | | 0.400 | | Pass |
| 10 | 0.0041 | | 0.184 | | Pass |
| 11 | 0.0282 | | 0.330 | | Pass |
| 12 | 0.0038 | | 0.153 | | Pass |
| 13 | 0.0253 | | 0.210 | | Pass |
| 14 | 0.0035 | | 0.131 | | Pass |
| 15 | 0.0223 | | 0.150 | | Pass |
| 16 | 0.0031 | | 0.115 | | Pass |
| 17 | 0.0191 | | 0.132 | | Pass |
| 18 | 0.0027 | | 0.102 | | Pass |
| 19 | 0.0160 | | 0.118 | | Pass |
| 20 | 0.0024 | | 0.092 | | Pass |
| 21 | 0.0130 | | 0.107 | | Pass |
| 22 | 0.0020 | | 0.084 | | Pass |
| 23 | 0.0101 | | 0.098 | | Pass |
| 24 | 0.0017 | | 0.077 | | Pass |
| 25 | 0.0076 | | 0.090 | | Pass |
| 26 | 0.0015 | | 0.071 | | Pass |
| 27 | 0.0053 | | 0.083 | | Pass |
| 28 | 0.0012 | | 0.066 | | Pass |
| 29 | 0.0036 | | 0.078 | | Pass |
| 30 | 0.0010 | | 0.061 | | Pass |
| 31 | 0.0025 | | 0.073 | | Pass |
| 32 | 0.0008 | | 0.058 | | Pass |
| 33 | 0.0023 | | 0.068 | | Pass |
| 34 | 0.0007 | | 0.054 | | Pass |
| 35 | 0.0026 | | 0.064 | | Pass |
| 36 | 0.0006 | | 0.051 | | Pass |
| 37 | 0.0029 | | 0.061 | | Pass |
| 38 | 0.0006 | | 0.048 | | Pass |
| 39 | 0.0031 | | 0.058 | | Pass |
| 40 | 0.0005 | | 0.046 | | Pass |

 Table 16. Harmonic Current Emissions Test Results



Electromagnetic Compatibility Emission Criteria

8.5 Harmonic Current Emissions



Photograph 1. 8.5 Harmonic Current Emissions, Test Setup



Electromagnetic Compatibility Emission Criteri

8.6 Voltage Fluctuations (Flicker)

Test Requirement(s): ETSI EN 301 489-1, Clause 8.6:

The EUT must not produce voltage fluctuations and/or flicker at the supply terminals as measured or calculated according to clause 4, according to limits expressed in *Clause 5*, under test conditions described in *Clause 6* and *Annex A* of *EN 61000-3-3*.

Test Procedure: The EUT was placed on a 0.8m-high wooden table above a GRP (See Photograph 2). The EUT was situated such that the sides of the EUT were no closer than 2.0 m from the walls. The EUT was operated with an AC main source at 220 V. Tests to prove the compliance of the EUT with the limits of *EN 61000-3-3, Section 5* were made using the test circuit provided in Figure 2 of *EN 61000-3-3*. The test circuit consisted of the test power supply, the reference impedance, the EUT, and a flickermeter. The test supply voltage (open-circuit voltage) was the rated voltage of the equipment. 2% ofThe test voltage was maintained within the nominal value. The frequency was 50 0.5%.Hz The total harmonic distortion of the supply voltage was less than 3%. The limits applicable to voltage fluctuations and flicker at the supply terminals of the EUT were automatically measured with the analyzer.







Electromagnetic Compatibility Emission Criteria

8.6 Voltage Fluctuations (Flicker)

Test Results:

The EUT was found compliant with the specified requirements of Clause 8.6.

| Voltage | Current | Frequency | Total Harmonic Distortion |
|---------|---------|-----------|---------------------------|
| (V) | (I) | (Hz) | (%) |
| 240.26V | 94.2mA | 49.99Hz | 238.94% |

| Average (Is) relative voltage Drop | d(t) | 0.006% |
|---|---------|--------|
| Relative voltage fluctuation (3s) | dpp | 0.001% |
| d(t) at steady - state level | Yes /No | Yes |
| Last relative steady - state level change | dc | 0.000% |
| Last transition swing | dmax | |
| Normalized peak flicker (3s) | Рр | 0.00 |

| Daramatar | Observat | I imit | | |
|--------------------------------------|----------|--------|---------|------|
| rarameter | Short | Long | Liiiit | |
| Observation Time | Тр | 30 min | 120 min | |
| Maximum relative voltage change | dmax | 0.00% | 0.05% | 4 |
| Max rel. steady-state voltage change | dc | 0.00% | 0.01% | 3 |
| Duration of $d(t) > 3 \%$ | t | 0.00s | 0.00s | 0.2 |
| Short term flicker severity | Pst | 0.00 | 0.00 | 1.00 |
| Long term flicker severity | Plt | 0.00 | 0.00 | 0.65 |

Test Engineer(s): Savitha Ramesh

Test Date(s): January 25, 2008



Electromagnetic Compatibility Emission Criteria

8.6 Voltage Fluctuations (Flicker)



Photograph 2. 8.6 Voltage Fluctuations (Flicker), Test Setup



IV. Electromagnetic Compatibility Immunity Criteria



Electromagnetic Compatibility Immunity Criteria

Radio Frequency Electromagnetic Field

Test Requirement(s): ETSI EN 301 489-1 Clause 9.2, ETSI EN 301 489-4 17 Clause 7.2:

The test method shall be in accordance with EN 61000-4-3 [9].

The EUT must not be susceptible to a radiated electromagnetic field 80% amplitude modulated with 1 kHz in the frequency range of 80 MHz to 1000 MHz and 1400 MHz to 2000 MHz at 3 V/m. If the wanted signal is modulated at 1000 Hz, then an audio signal of 400 Hz shall be used. Performance Criterion ETSI 301 489-17 Clause 6.3 and 6.5 apply.

Test Procedure: The EUT was placed on a 0.8m-high wooden table in the center of an anechoic chamber, and the radiating antenna was placed 3 m in front of the EUT (See Photograph 5 and Photograph 6). Support equipment for the EUT was located outside of the test room. The EUT was exposed to the required immunity fields. The amplitude and frequency of the radiated interference was set by an automated, computer controlled system.

| Environmental Conditions for Radio Frequency Electromagnetic Field | | | | | |
|--|-----|--|--|--|--|
| Ambient Temperature: 21°C | | | | | |
| Relative Humidity: | 35% | | | | |

The chamber and signal generation/amplification system is calibrated to insure a uniform RF field with no EUT present. The recorded signal is played back by the controlling computer with the EUT placed in the area of uniform field. The signal source was stepped through the applicable frequency range at a rate no faster than 1% of the fundamental, as recommended in *EN 61000- 4-3*. The amplitude of the signal was modulated 80% with frequency of 1 kHz over the frequency range of 80 MHz to 1000 MHz and 1400 MHz to 2000 MHz at 3 V/m. Field presence was monitored during testing via a field probe placed in close proximity to the EUT. Throughout testing, the EUT was closely monitored for signs of susceptibility. The test was performed with the antenna oriented in both a horizontal and vertical polarization.

- **Test Results:** The EUT was found compliant with the specified Radio Frequency Electromagnetic Field Immunity limits of *ETSI EN 301 489-1 Clause 9.2*.
- Test Engineer(s): Savitha Ramesh
- Test Date(s): January 23, 2008



Electromagnetic Compatibility Immunity Criteria

Radio Frequency Electromagnetic Field

| Severity | Polarity | Start Frequency | Stop frequency | op frequency Modulation | | Results | | | |
|----------|----------|-----------------|----------------|-------------------------|-------|---------|-------|------|--|
| (V/m) | (H/V) | (MHz) | (MHz) | (Freq & Type) | Front | Back | Right | Left | |
| 3 | V | 80 | 1000 | 1 KHz AM 80% | Pass | Pass | Pass | Pass | |
| 3 | Н | 80 | 1000 | 1 KHz AM 80% | Pass | Pass | Pass | Pass | |
| 3 | V | 1400 | 2000 | 1 KHz AM 80% | Pass | Pass | Pass | Pass | |
| 3 | Н | 1400 | 2000 | 1 KHz AM 80% | Pass | Pass | Pass | Pass | |

Table 17. Radiated Immunity Test Results



Radio Frequency Electromagnetic Field – Test Setup Photograph



Photograph 5. Radio Frequency Electromagnetic Field (Below 1 GHz), Test Setup



Electromagnetic Compatibility Immunity Criteria

Radio Frequency Electromagnetic Field



Photograph 6. Radio Frequency Electromagnetic Field (Above 1 GHz), Test Setup



Electromagnetic Compatibility Immunity Criteria

9.3 Electrostatic Discharge

Test Requirement(s): ETSI EN 300 489-1 Clause 9.3:

Per *EN 61000-4-2*, the EUT was tested with 8 kV, applied to non-conductive surfaces, and toair discharges of up to \pm contact discharges of up to \pm 4 kV, applied to conductive surfaces of the EUT and the VCP. Performance Criterion B applies.

The EUT was placed on a 0.8m-high wooden table located above a ground reference plane (GRP) (See Photograph 3), with a thickness of at least 0.25 mm, thus satisfying the requirements of *IEC 61000-4-2*:

It [the GRP] shall be a metallic sheet (copper or aluminum) of 0.25 mm minimum thickness.... The minimum size of the reference plane is 1 m2, the exact size depending on the dimensions of the EUT. It shall project beyond the EUT or coupling plane by at least 0.5 m on all sides....

A horizontal coupling plane (HCP), 1.6 m x 0.8 m, shall be placed on the table. The EUT and cables shall be isolated from the coupling plane by an insulating support 0.5 mm thick.

A copper vertical coupling plane (VCP) measuring 0.5 m X 0.5 m was placed 0.1 m from the EUT. The VCP was connected to the GRP through two series 470 k Ω resistors. The GRP was connected to safety ground. The EUT was connected to the grounding system through its power cable only, in accordance with *EN* 61000-4-2, Section 7.1, paragraph 4:

The EUT shall be connected to the grounding system in accordance with its installation specifications. No additional grounding connections are allowed.

| Ambient Temperature: | 22°C | | |
|---------------------------|-----------|--|--|
| Relative Humidity: | 38% | | |
| Atmospheric Pressure: | 102.03kPa | | |

Environmental Conditions during EN 61000-4-2 Testing

Test Procedure:8kV were applied to non-conductive Air discharges of up to \pm surfaces. \pm Contact discharges of
up to 4 kV were applied to conductive surfaces of the EUT. 4 kV were applied toContact
discharges of \pm the VCP. Negative and positive discharges were applied at least ten times to
each selected discharge point. The functionality of the EUT was determined during and after
each discharge in accordance with Performance Criterion B.

- **Test Results:** The EUT as tested was found compliant with the requirements of Clause 9.3
- **Test Engineer(s):** Savitha Ramesh
- Test Date(s): January 25, 2008



Electromagnetic Compatibility Immunity Criteria

9.3 Electrostatic Discharge

| | Volts (+/-) | Surface/Location | Results | Anomalies |
|----------------------|----------------------|------------------|---------|-----------------------|
| | 2 kV | Front | Pass | No anomalies observed |
| | 2 kV | Back | Pass | No anomalies observed |
| | 2 kV | Right | Pass | No anomalies observed |
| Vertical Coupling | 2 kV | Left | Pass | No anomalies observed |
| Plane | 4 kV | Front | Pass | No anomalies observed |
| | 4 kV | Back | Pass | No anomalies observed |
| | 4 kV | Right | Pass | No anomalies observed |
| | 4 kV | Left | Pass | No anomalies observed |
| | 2 kV | Front | Pass | No anomalies observed |
| | 2 kV | Back | Pass | No anomalies observed |
| | 2 kV | Right | Pass | No anomalies observed |
| HCP (for Table Ton) | 2 kV | Left | Pass | No anomalies observed |
| fier (for fusic rop) | 4 kV | Front | Pass | No anomalies observed |
| | 4 kV | Back | Pass | No anomalies observed |
| | 4 kV | Right | Pass | No anomalies observed |
| | 4 kV | Left | Pass | No anomalies observed |
| | | 1 | | |
| | 2 kV | Front | Pass | No anomalies observed |
| | 2 kV | Back | Pass | No anomalies observed |
| | 2 kV | Right | Pass | No anomalies observed |
| Contact Discharge | 2 kV | Left | Pass | No anomalies observed |
| g- | 4 kV | Front | Pass | No anomalies observed |
| | 4 kV | Back | Pass | No anomalies observed |
| | 4 kV | Right | Pass | No anomalies observed |
| | 4 kV | Left | Pass | No anomalies observed |
| | | | | |
| | 2 kV | Front | N/A | - |
| | 2 kV | Back | Pass | No anomalies observed |
| | 2 kV | Right | N/A | - |
| | 2 kV | Left | N/A | - |
| | 4 kV | Front | N/A | - |
| | 4 kV | Back | Pass | No anomalies observed |
| Air Discharge | 4 kV | Right | N/A | - |
| | 4 kV | Left | N/A | - |
| | 8 kV | Front | N/A | - |
| | 8 kV | Back | Pass | No anomalies observed |
| | 8 kV | Right | N/A | - |
| | 8 kV | Left | N/A | - |

Table 18. ESD Test Results



Electromagnetic Compatibility Immunity Criteria

9.3 Electrostatic Discharge



Photograph 3. 9.3 Electrostatic Discharge, Test Setup



Electromagnetic Compatibility Immunity Criteria

9.4 Fast Transient, Common Mode

Test Requirement(s): ETSI EN 300 489-1, Clause 9.4:

Per *EN 61000-4-4*, The EUT was tested with the electrical fast transients shown in Figure 3, having an amplitude of ± 1 kV applied to the AC power cables (plug type); ± 0.5 kV applied to I/O and data lines. Only cables that could potentially exceed 3 m in length in real-world application of the EUT need be tested. Performance criterion B applies for all tests.

Test Procedure: The EUT was placed on a 0.8m-high wooden table above a GRP extending at least 1 m beyond all sides of the EUT (See Photograph 4). The Electrical Fast Transient/Burst (EFT/B) generator and the coupling clamp were mounted to the ground plane. For application of the fast transients to the power lines, power was supplied to the EUT through the EFT/B generator. For application of the fast transients to I/O, data and control lines, the cables were individually placed in the coupling clamp, which was also connected to the EFT/B generator.

The EFT/B generator was operated to couple the required transient bursts to each line of the power input in common mode. Transient bursts were applied for a period not less than one minute with both positive transients and negative transients.

The EUT was then powered from an isolated circuit, and selected I/O, data and control cables were placed one at a time in the capacitive coupling clamp. The EFT/B generator was operated to inject the required bursts onto each selected cable via the coupling clamp.

Throughout testing, the EUT was monitored closely for signs of susceptibility.



Electromagnetic Compatibility Immunity Criteria

9.4 Fast Transient, Common Mode



Figure 3. EN 61000-4-4 Test Waveform



Electromagnetic Compatibility Immunity Criteria

9.4 Fast Transient, Common Mode

Test Results: The EUT as tested was found compliant with the requirements of Clause 9.4.

| Port Name | Slot/EUT Side | Test Level | Results | Anomalies | | | |
|------------------|------------------------------|------------|---------|-----------------------|--|--|--|
| | AC Power / Differential Mode | | | | | | |
| Phase | Back | ±1.0 kV | Pass | No Anomalies Observed | | | |
| Phase to Neutral | Back | ±1.0 kV | Pass | No Anomalies Observed | | | |
| | AC Power / Common Mode | | | | | | |
| Phase to Ground | Back | ±1.0 kV | | Not Applicable | | | |
| I/O & DC Power | | | | | | | |
| Ethernet | Back | ±500 V | Pass | No Anomalies Observed | | | |

Table 19. EFT Test Results

Test Engineer(s): Savitha Ramesh

Test Date(s): January 30, 2008



Electromagnetic Compatibility Immunity Criteria

9.4 Fast Transient, Common Mode



Photograph 4. 9.4 Fast Transient, Common Mode, Test Setup



Electromagnetic Compatibility Immunity Criteria

9.5 Radio Frequency, Common Mode

| Test Requirement(s): | ETSI EN 300 489-1, Clause 9.5: |
|----------------------|---|
| | Per <i>EN 61000-4-6</i> , all interconnecting cables on the EUT including AC power lines, data and control lines shall be tested for immunity to conducted radio frequencies in the range 0.15 MHz - 80 MHz. Using the bulk current injection method, I/O and data cables must be tested to a level of 3 Vrms. The injection voltage shall be amplitude modulated at 80% by a 1 kHz tone. Performance Criterion A applies for all tests. |
| Test Procedure: | The EUT was placed on a 0.8m-high wooden table above a GRP extending at least 1 m beyond all sides of the EUT (See Photograph 5). For power line cables, a Coupling Decoupling Network (CDN) was used. The CDN was initially calibrated in a calibration jig with a 50 Ω RF load and a 100 Ω matching resistor on one side, and a 100 Ω matching resistor and the receiver (spectrum analyzer) on the other. The injection voltage level was adjusted to maintain a monitored voltage of 3 Vrms across the frequency range (0.15 MHz to 80 MHz). |
| | For cables other than the power line in the frequency range 0.15 MHz - 80 MHz, the BCI was initially calibrated in a calibration jig with a 50 Ω RF load and a 100 Ω matching resistor on one side, and a 100 Ω matching resistor and the receiver (spectrum analyzer) on the other. The injection voltage level was adjusted to maintain a monitored voltage of 3 Vrms across the frequency range (0.15 MHz to 80 MHz). The BCI was clamped around the cable under test at a distance of 0.1 to 0.3 m from the EUT. |

Test Results: The EUT as tested was found compliant with the requirements of Clause 9.5.

| Slot/EUT Side | Port Name | Results | Anomalies |
|------------------------------|---------------|---------|-----------------------|
| AC Power Line/ AC/DC Adaptor | Power | Pass | No Anomalies observed |
| Ethernet (POE)/ EUT/Under | Ethernet Port | Pass | No Anomalies observed |
| Ethernet/AC/DC Adaptor | Ethernet Port | Pass | No Anomalies observed |

Table 20. Conducted Immunity Test Results

Test Engineer(s): Savitha Ramesh

Test Date(s): January 25, 2008



Electromagnetic Compatibility Immunity Criteria

9.5 Radio Frequency, Common Mode



Photograph 5. 9.5 Radio Frequency, Common Mode, Test Setup



Electromagnetic Compatibility Immunity Criteria

9.7 Voltage Dips and Short Interruptions

Test Requirement(s): ETSI EN 300 489-1, Clause 9.7:

Per *EN 61000-4-11*, the EUT shall be tested for the following voltage dips, interruptions and variations:

| 5.2.4.4 Voltage Dips and Short Interruptions | | | | | |
|--|------|---|--|--|--|
| Unit Test level and Characteristic Performance Criterion | | | | | |
| Voltage reduction % | 30 | B | | | |
| Duration ms | 10 | d | | | |
| Voltage reduction % | 60 | C | | | |
| Duration ms | 100 | C | | | |
| Voltage reduction % | >95 | C | | | |
| Duration ms | 5000 | C | | | |

Table 21. Voltage Dips and Short Interruptions Limits

Test Procedure: The EUT was placed on a 0.8m-high wooden table and situated in the center of a GRP. The EUT was provided with AC power via the programmable power supply (See Photograph 6). The power supply was programmed to perform the applicable set of voltage dips, interruptions and variations. Each sequence was repeated three times to verify the results.

Results: The EUT as tested was found compliant with the requirements of Clause 9.6.

| Test Type | Parameters | No of Repetitions | Results | Anomalies |
|------------------|------------------------|-------------------|---------|-----------------------|
| Voltage Dips | 30% drop for 10 ms | 3 | Pass | No anomalies observed |
| Voltage Dips | 60% drop for 100 ms | 3 | Pass | No anomalies observed |
| Short Interrupts | > 95% drop for 5000 ms | 3 | Pass | No anomalies observed |

Table 22. VDI Test Results

Test Engineer: Savitha Ramesh

Test Date: January 30, 2008



Electromagnetic Compatibility Immunity Criteria

9.7 Voltage Dips and Short Interruptions



Photograph 6. 9.7 Voltage Dips and Short Interruptions, Test Setup



Electromagnetic Compatibility Immunity Criteria

9.8 Surges

Test Requirement(s): ETSI EN 301 489-1, Clause 9.8:

The EUT was tested with the surge waveforms shown on the following page, having an open \pm 0.5 kV applied to the I/O interconnection cables.circuit amplitude of Performance criterion B applies for I/O cables.

The EUT was tested with the surge waveforms shown on the following page, having an open circuit amplitude of ± 0.5 kV (differential mode), and ± 1 kV (common mode) applied to the AC power cables. Performance Criterion B applies for AC power cables.

Test Procedure: The EUT was placed on a 0.8m-high wooden table above a GRP extending at least 1 m beyond all sides of the EUT (See Photograph 7). For I/O port surges, For application of the fast transients to I/O, data and control lines, the cables were individually placed in the coupling clamp, which was also connected to the EFT/B generator. These three tests were performed with positive surges and negative surges.

AC power [where applicable] was supplied to the EUT through the Combination Wave Generator. The combination wave generator was configured to produce the following output:

| Open Circuit Voltage: | Front Time = $1.2 \Phi s$ Time to Half = $50 \Phi s$ | | |
|--------------------------|---|--|--|
| Short Circuit Current: | Front Time = $8 \Phi s$ Time to Half = $20 \Phi s$ | | |
| Telecom wave parameters: | Front Time = $10 \Phi s$ Time to Half = $700 \Phi s$ | | |

Table 23. Combination Wave Generator Test Parameters for EN 61000-4-5



Electromagnetic Compatibility Immunity Criteria

9.8 Surges







Open Circuit V oltage Waveform for EN 61000-4-5





Figure 4. EN 61000-4-5 Surge Test Waveforms



Electromagnetic Compatibility Immunity Criteria

9.8 Surges

Test Procedure
(Continued):For AC power lines, the Combination Wave Generator was operated to couple the required
surges between each EUT input power phase and ground, and from line to line. These three tests
were performed with positive surges and negative surges, synchronized with the power input
phase at 0E, 90E, and 270E. Throughout testing, the EUT was monitored closely for signs of
susceptibility. For I/O port surges, surge waveforms were applied via a CDN, in accordance
with Section 7 of EN 61000-4-5.

Test Results: The EUT as tested was found compliant with the requirements of Clause 9.8.

| Port Name | Phase Test Level Results Anor | | Anomalies | | | |
|-----------------------|-------------------------------|---------|-----------|-----------------------|--|--|
| AC, Differential Mode | | | | | | |
| | 0 | ±1.0 kV | Pass | No anomalies observed | | |
| Phase to Neutral | 90 | ±1.0 kV | Pass | No anomalies observed | | |
| | 270 | ±1.0 kV | Pass | No anomalies observed | | |

 Table 24. Surge Test Results

| Test Engineer(s): | Savitha Ramesh |
|-------------------|----------------|
|-------------------|----------------|

Test Date(s): January 30, 2008



Electromagnetic Compatibility Immunity Criteria

9.8 Surges



Photograph 7. 9.8 Surges, Test Setup



V. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

| Test Name: AC Conducted Emissions Voltage | | | Test Date(s): November 10, 2007 | | |
|--|-----------------------------------|-------------------|---------------------------------|------------------|----------------|
| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
| 1S2108 | EMI Receiver (RF Section) | HP | 85460A | 09/22/2006 | 09/22/2007 |
| 1S2109 | EMI Receiver (Receiver Section) | HP | 85462A | 09/22/2006 | 09/22/2007 |
| 182263 | 10 Meter Chamber | Rantec | N2-14 | 08/15/2006 | 08/15/2007 |
| 1S2464 | A/C LISN | Solar Electronics | 9252-50-R24-BNC | 9/1/2006 | 9/1/2007 |
| 182336 | Custom 100A DC LISN | FCC | 100A DC | 03/03/2006 | 03/03/2007 |
| 182337 | Custom 100A AC LISN | FCC | 100A AC | 03/03/2006 | 03/03/2007 |
| 1S2372 | Custom 50A A/C LISN | FCC | 50A A/C | 03/03/2006 | 03/03/2007 |
| 1S2108 | EMI Receiver (RF Section) | HP | 85460A | 09/22/2006 | 09/22/2007 |
| Test Name: Con | ducted Emissions I/O Ports | | Test Date(s): January 25, 2008 | | |
| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
| 1S2406 | Spectrum Analyzer | HP | 8591E | 10/1/2007 | 10/1/2008 |
| 1S2488 | Screen Room | Universal | N/A | 1/23/2008 | 1/22/2009 |
| 1S2096 | EM Injection clamp | FCC | F-2031 | See N | ote |
| 1U0029 | RF Current Probe | Solar Electronics | 6741-1 8/17/2007 8/17/200 | | 8/17/2008 |
| Test Name: Rad | iated Emissions | | Test Date(s): November 10, 2007 | | |
| | Antenna Bilog Chase Model | | | | |
| 1S2184 | CBL6112A | Chase | CBL6112A | 1/3/2007 | 1/3/2008 |
| 182263 | 10 Meter chamber | Rantec | N2-14 | 8/15/2006 | 8/15/2007 |
| 1S2466 | Digital Hygrometer/Thermometer | Fisher Scientific | 11-661-13 | 7/27/2006 | 7/27/2008 |
| 1S2421 | EMI Test Receiver (20Hz to 7 GHz) | Rohde & Schware | ESIB 7 | 3/27/2007 | 3/27/2008 |
| Test Name: EN 61000-3-2 Harmonic Current Emissions, EN 61000-3-3 Voltage Fluctuations (Flicker) | | | | Test Date(s): Ja | nuary 25, 2008 |
| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date |
| 1U0087 | Power measurement unit | Combinova | Analyzer 300 | 1/2/2008 | 1/2/2009 |
| 1S2468 | Digital Hygrometer/Thermometer | Fisher Scientific | 11-661-13 | 7/27/2006 | 7/26/2008 |
| 1S2488 | Screen Room | Universal | N/A | 10/23/2008 | 10/23/2009 |

Table 25. Emissions Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.



| Test Name: EN 61000-4-2 Electrostatic Discharge Immunity Test Date(s): January 25, 20 | | | | | anuary 25, 2008 | |
|---|--|--|-----------------|--------------------------------|-----------------|--|
| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date | |
| 1S2470 | ESD Simulator; Mini Zap Gun | Schaffner | NSG-435 | 6/16/2007 | 6/16/2008 | |
| 1S2467 | Digital Hygrometer/Thermometer | Fisher Scientific | 11-661-13 | 7/27/2006 | 7/26/2008 | |
| 1S2488 | Screen room | Universal | N/A | 1/23/2008 | 1/22/2009 | |
| Test Name: EN | 61000-4-3 Radiated Electromagnetic | Field | 1 | Test Date(s): J | anuary 23, 2008 | |
| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date | |
| 182153 | Amplifier (broadband and wide band) | Amplifier Research | 100W/100M1A | See N | ote | |
| 1S2198 | Horn Antenna | EMCO | 3115 | 8/31/2007 | 8/30/2008 | |
| 1S2208 | Horn Antenna (TX only) | EMCO | 3115 | See N | ote | |
| 1S2401 | Bilog Antenna (20 MHz-2 GHz) | Schaffner-Chase | CBL6140A | See N | ote | |
| 1S2409 | Synthesized RF Signal Generator | Gigatronics | 6062A | 10/9/2007 | 10/9/2008 | |
| 1S2410 | Electric Field Probe | Wandel & Goltermann | EMC-20 | 2/19/2007 | 2/19/2008 | |
| 1S2467 | Digital Hygrometer/Thermometer | Fisher Scientific | 11-661-13 | 7/27/2006 | 7/26/2008 | |
| 182264 | 3 Meter chamber | Lindgren | none | 12/17/2007 | 12/17/2008 | |
| 1S2460 | 1-26GHz Spectrum analyzer | Agilent | E4407B | 3/20/2007 | 3/20/2008 | |
| 1S2478 | TWT Amplifier (1-2.5GHz) | Communications and Power Industries | VZL6943J2 | See N | ote | |
| Test Name: EN | 61000-4-4 Fast Transients | | | Test Date(s): J | anuary 30, 2008 | |
| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date | |
| 1S2467 | Digital Hygrometer/Thermometer | Fisher Scientific | 11-661-13 | 7/27/2006 | 7/26/2008 | |
| 1S2486 | 5m Control Room | PanaSheild | N/A | 1/23/2008 | 1/22/2009 | |
| 182423 | Ultra Compact Simulator | Amplifier Research | UCS 500-M/6A | 1/25/2007 | 2/24/2008 | |
| 1S2104 | Capacitive Coupling Clamp | Haefely | N/A | See N | ote | |
| Test Name: EN 6 | 51000-4-5 Surges | | | Test Date(s): January 30, 2008 | | |
| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date | |
| 1S2486 | 5m Control Room | PanaSheild | 5m Control room | 1/23/2008 | 1/22/2009 | |
| 182423 | Ultra Compact Simulator | Amplifier Research | UCS 500-M/6A | 1/25/2007 | 2/24/2008 | |
| 1S2467 | Digital Hygrometer/Thermometer | Fisher Scientific | 11-661-13 | 7/27/2006 | 7/26/2008 | |
| Test Name: EN | 61000-4-6 Radio Frequency, Conduct | ted Continuous | | Test Date(s): J | anuary 25, 2008 | |
| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date | |
| 1S2020 | Wideband Amplifier (.01 – 1000 MHz) | IFI | M5500 | See N | ote | |
| 1S2079 | Probe RF Current injection | FCC | F-120-9B | See N | ote | |
| 1S2093 | Coupling Decoupling NET (150 kHz – 230 MHz) | FCC | 801-M3-25 | 11/28/2006 | 11/28/2007 | |
| 1S2488 | Screen Room | Universal | N/A | 1/23/2007 | 1/23/2008 | |
| 182390 | Synthesized RF Signal Generator | Gigatronics | 6061A | 5/4/2007 | 5/4/2008 | |
| 1S2467 | Digital Hygrometer/Thermometer | Fisher Scientific | 11-661-13 | 7/27/2006 | 7/26/2008 | |
| 1S2406 | Spectrum Analyzer | HP | 8591E | 10/1/2007 | 10/1/2008 | |
| 1S2092 | Coupling Decoupling NET (150 kHz – 230 MHz) | FCC | 801-M3-25 | 10/31/2007 | 10/30/2008 | |
| 1S2400 | RF Current Probe | Solar Electronics | 6741-1 | 1/5/2007 | 1/25/2008 | |
| 1S2079 | Probe RF Current injection | FCC | F-120-9B | 10/31/2007 | 10/30/2008 | |
| 1S2208 | Horn Antenna | EMCO | 3115 | See N | ote | |
| Test Name: EN | 61000-4-11 Voltage Dips and Short Ir | nterruptions | | Test Date(s): J | anuary 30, 2008 | |
| MET Asset # | Equipment | Manufacturer | Model | Last Cal Date | Cal Due Date | |
| 1S2467 | Digital Hygrometer/Thermometer | Fisher Scientific | 11-661-13 | 7/27/2006 | 7/26/2008 | |
| 1S2486 | 5m Control Room | PanaSheild | N/A | 1/23/2008 | 1/22/2009 | |
| 182423 | Ultra Compact Simulator | Amplifier Research | UCS 500-M/6A | 1/25/2007 | 2/24/2008 | |

Table 26. Immunity Test Equipment List

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.



Electromagnetic Compatibility End of Report ETSI EN 301 489-1 V1.4.1 and ETSI EN 301 489-17 V1.2.1

End of Report