MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE ● BALTIMORE, MARYLAND 21230-3432 ● PHONE (410) 354-3300 ● FAX (410) 354-3313
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3162 BELICK STREET ● SANTA CLARA, CALIFORNIA 95054 ● PHONE (408 748-3585 ● FAX (510) 489-6372

May 26, 2009

Ubiquiti Networks, Inc.
495-499 Montague Expwy.
Milpitas, CA 95035

Dear Robert Pera,

Enclosed is the EMC test report for compliance testing of the Ubiquiti Networks, Inc., M2, tested to the requirements of ETSI EN 301 489-1 V1.6.1 (2005-09) 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 Warnell
Documentation Department

Reference: (\Ubiquiti Networks, Inc. \ EMCS81509A-ETS489)

MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
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Electromagnetic Compatibility
Test Report

For the

Ubiquiti Networks, Inc.
Model: M2

Tested under

ETSI EN 301 489-1 V1.6.1 (2005-09)
with ETSI EN 301 489-17 V1.2.1 (2002-08)

MET Report: EMCS81509A-ETS489

May 26, 2009

Prepared For:

Ubiquiti Networks, Inc.
495-499 Montague Expwy.
Milpitas, CA 95035

Prepared By:
MET Laboratories, Inc.
914 W. Patapsco Ave.
Baltimore, MD 21230

Electromagnetic Compatibility Criteria
Test Report

For the

Ubiquiti Networks, Inc.
Model: M2

Tested under

ETSI EN 301 489-1 V1.6.1 (2005-09)
with ETSI EN 301 489-17 V1.2.1 (2002-08)

MET Report: EMCS81509A-ETS489

Anderson Soungpanya, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Warnell
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 V1.6.1 (2005-09) with ETSI EN 301 489-17 V1.2.1 (2002-08) under normal use and maintenance.

Shawn McMillen,
Wireless Manager, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	May 26, 2009	Initial Issue.

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**C**alibration
d	Measurement Distance
dB	Decibels
dBμA	Decibels above one microamp
dBμV	Decibels above one microvolt
dBμA/m	Decibels above one microamp per meter
dBμV/m	Decibels above one microvolt per meter
DC	**D**irect **C**urrent
E	Electric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectrostatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	Frequency
CISPR	**C**omite **I**nternational **S**pecial des **P**erturbations **R**adioelectriques (International Special Committee on Radio Interference)
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	Hertz
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	kilohertz
kPa	kilopascal
kV	kilovolt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	Megahertz
μH	microhenry
μF	microfarad
μs	micro**s**econds
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts per **m**eter
VCP	**V**ertical **C**oupling **P**lane

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 V1.6.1 (2005-09).

ETSI EN 301 489-1 V1.6.1 (2005) Section and Test Description	Compliance			Comments
	Yes	No	N/A	
Section 8.2: Enclosure of ancillary equipment intended to be used in other than telecommunication center measured on a stand alone basis			✓	There are no ancillary apparatus' associated with the EUT.
Section 8.3: DC power input/output ports, conducted emissions of equipment intended to be used in other than telecommunication center			✓	EUT is AC Powered.
Section 8.4: AC mains power input/output ports, conducted emissions of equipment intended to be used in other than telecommunication center	✓			The EUT met this requirement.
Section 8.5: Harmonic current emissions (AC mains input port)	✓			The EUT met this requirement.
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)	✓			No anomalies observed.
Section 9.3: Electrostatic Discharge	✓			No anomalies observed.
Section 9.4: Fast transients, common mode	✓			No anomalies observed.
Section 9.5: Radio frequency, common mode	✓			No anomalies observed.
Section 9.6: Transients and surges in the vehicular environment			✓	EUT is a fixed base station.
Section 9.7: Voltage dips and interruptions	✓			No anomalies observed.
Section 9.8: Surge	✓			No anomalies observed.

Table 1. Summary of EMC ETSI EN 301 489-1 V1.6.1 (2005-09)

II. Equipment Configuration

Model(s) Tested:	M2
Model(s) Covered:	M2
EUT Specifications:	Primary Power: 15 VDC
	Secondary Power: N/A
	Equipment Emissions: D7D
Analysis:	The results obtained relate only to the item(s) tested.
Evaluated by:	Anderson Soungpanya

A. Overview

The purpose of this series of tests was to verify compliance of the Ubiquiti Networks, Inc., M2 with the limits of ETSI EN 301 489-1 V1.6.1 (2005-09).

B. References

ETSI EN 301 489-1 V1.6.1 (2005-09)	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

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, Inc. M2, Equipment Under Test (EUT), is a an outdoor radio b/g/n.

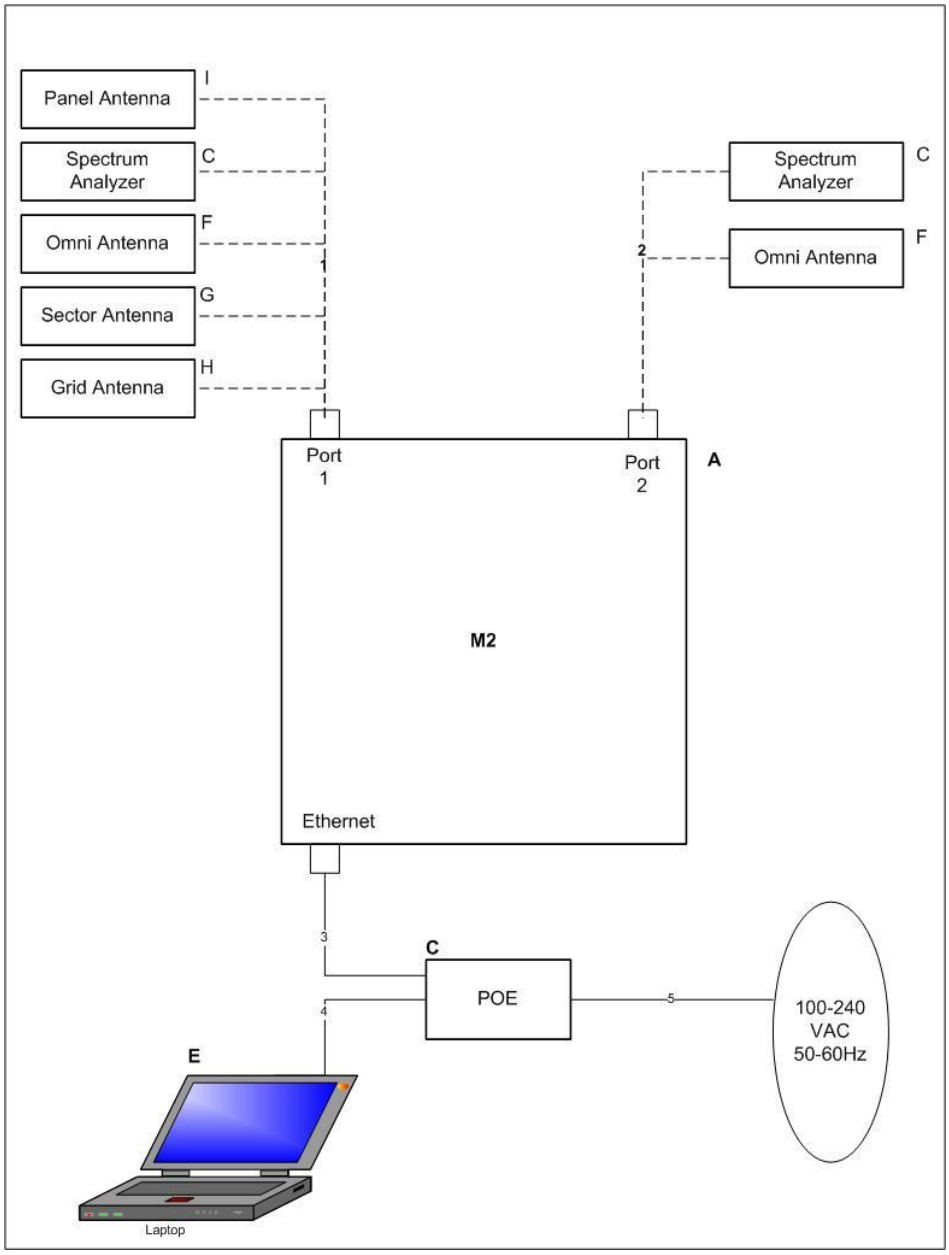


Figure 1. Block Diagram of Test Configurations

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	Part Number	Serial Number
A	M2	M2	M2	4-16-09
C	POWER OVER ETHERNET (UBIQUITI NETWORKS)	UB1-POE-15-8	NA	0901-0004848

Table 2. Equipment Configuration

F. Support Equipment

Ubiquiti Networks, Inc. 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	*Customer Supplied Calibration Data
M2				
N	SPECTRUM ANALYZER	AGILENT	E4447A	N/A
E	LAPTOP	DELL	VOSTRO 1000	N/A
F	6 DBI OMNI ANTENNAS	UBIQUITI	O-2G-6	N/A
G	16 DBI SECTOR ANTENNA	UBIQUITI	AMS-2G-16	N/A
H	18 DBI GRID ANTENNA	UBIQUITI	RP-2G-18	N/A
I	25 DBI PANEL ANTENNA	UBIQUITI	AG-2G-25	N/A

Table 3. Support Equipment

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 Name
M2						
1	A, ANTENNA PORT1	COAXIAL CABLE	1	3	Y	F OR G OR H OR I
2	A, ANTENNA PORT2	COAXIAL CABLE	1	3	Y	F OR G OR H OR I
3	A, ETHERNET	CAT 5	1	3	Y	C
4	C, DATA	CAT 5	1	3	N	E, LAPTOP
5	C, POE	POWER CORD	1	.5	N	100-240V AC POWER

Table 4. Ports and Cabling Information

H. Mode of Operation

Using Atheros Radio Test Software.

I. Method of Monitoring EUT Operation

Ping Times out and doesn't return. Unit locks up requires power down is a fail.

J. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

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, Inc. upon completion of testing.

III. Electromagnetic Compatibility Emission Criteria

Electromagnetic Compatibility Emission Criteria

3.1 AC Mains Power Input/Output Ports: Limits for Conducted Emissions

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

In accordance with *EN 55022 Clause 5.1*, the EUT shall meet the Class A limits shown in Table 5:

Limits for Conducted Emissions of Equipment				
Frequency Range (MHz)	**intended for use in telecommunication centres only [EN 55022Class A Limits] (dBµV)**		**[EN 55022 Class B Limits] (dBµV)**	
	Quasi-Peak	**Average**	**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

Table 5. Limits of Conducted Disturbance at AC Mains Power Input/Output Ports

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

Test Procedure: The EUT was placed on a non-metallic table located in a shielded enclosure (See Photograph 1). The measurement was 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 µH as the input transducer to an EMC field intensity meter. The tests were conducted in a RF-shielded enclosure.

Test Results: The EUT was compliant with the specified requirements of Clause 8.4.

Test Engineer(s): Anderson Soungpanya

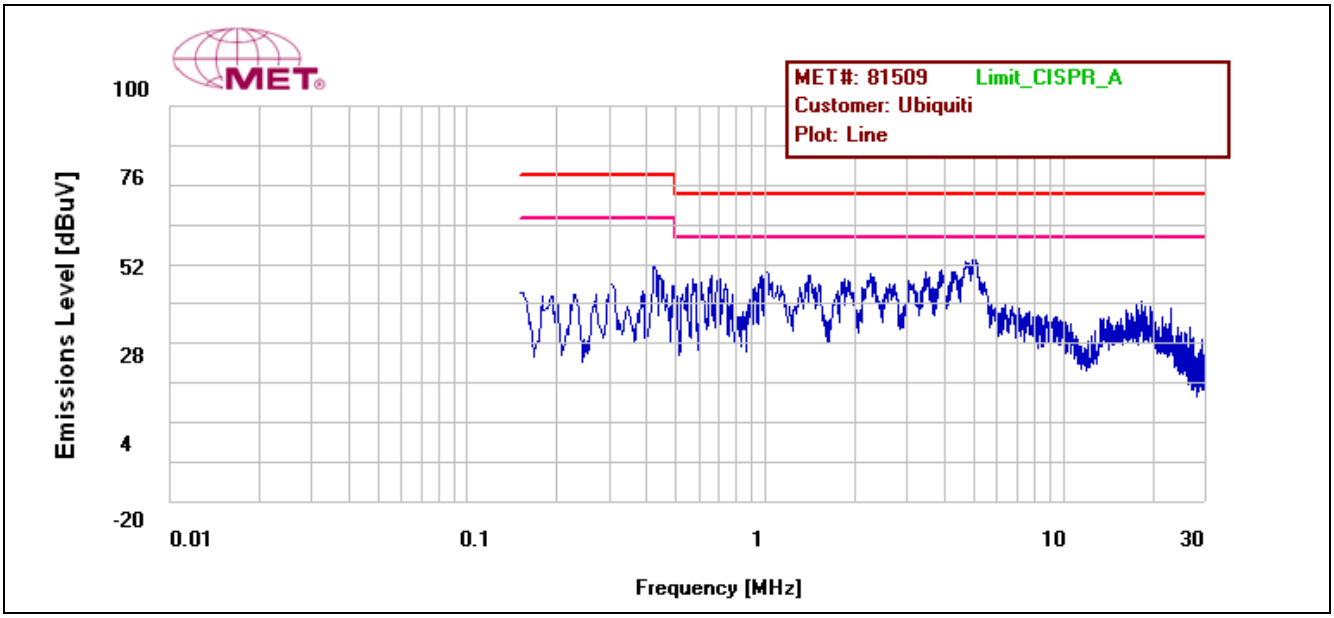
Test Date(s): 04/23/09

Electromagnetic Compatibility Emission

AC Mains Power Input/Output Ports: Limits for Conducted Emissions

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Line	.427	49.26	79	-29.74	Pass	35.64	66	-30.36	Pass
Line	5.09	49.83	73	-23.17	Pass	42.1	60	-17.9	Pass
Line	1.04	45.05	73	-27.95	Pass	28.29	60	-31.71	Pass

Table 6. Conducted Emissions - Voltage, Worst Case Emissions, AC Power, Phase Line, 230VAC 50Hz



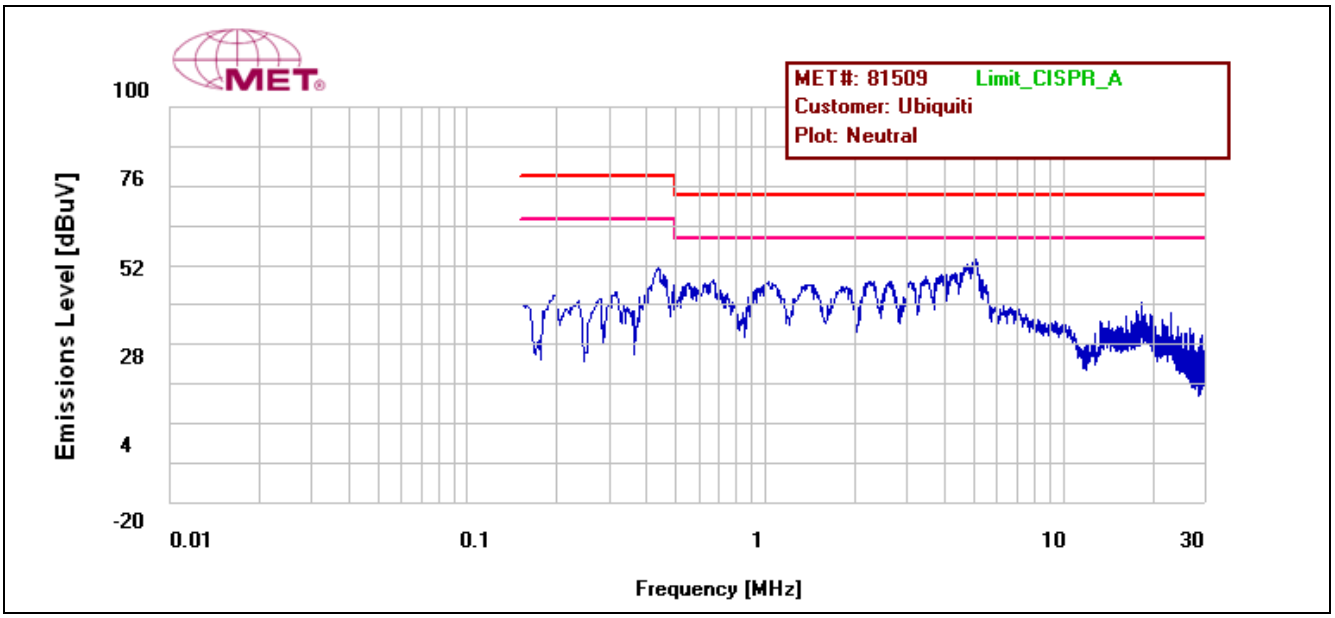
Plot 1. Conducted Emission Limits, Phase Line Plot

Electromagnetic Compatibility Emission

AC Mains Power Input/Output Ports: Limits for Conducted Emissions

Line	Freq (MHz)	QP Amplitude	QP Limit	Delta	Pass	Average Amplitude	Average Limit	Delta	Pass
Neutral	5.09	50.24	73	-22.76	Pass	42.11	60	-17.89	Pass
Neutral	.441	47.27	79	-31.73	Pass	32.89	66	-33.11	Pass
Neutral	.659	44.51	73	-28.49	Pass	34.42	60	-25.58	Pass

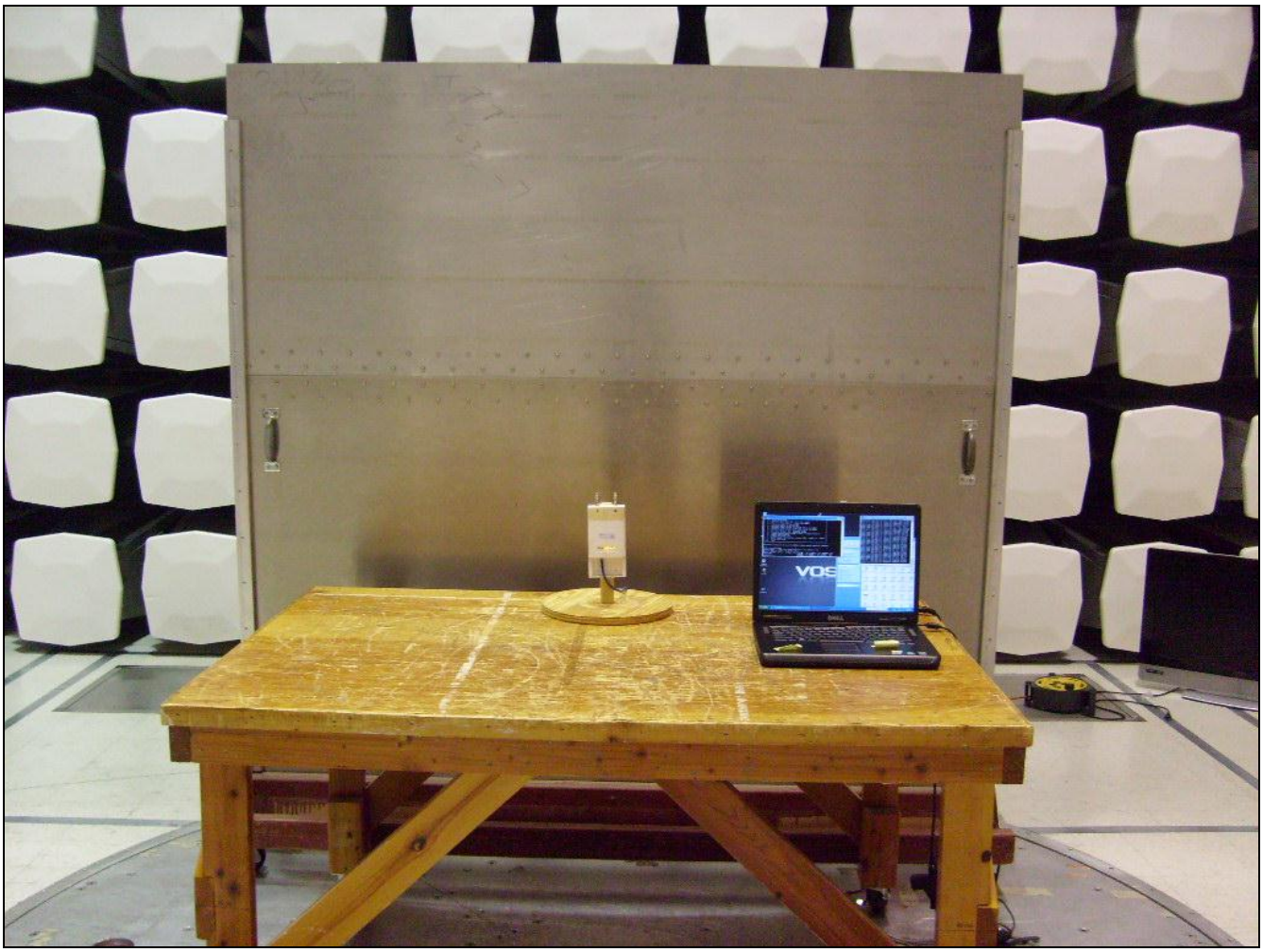
Table 7. Conducted Emissions - Voltage, Worst Case Emissions, AC Power, Neutral Line, 230VAC 50Hz



Plot 2. Conducted Emission Limits, Neutral Line Plot

Electromagnetic Compatibility Emission

AC Mains Power Input/Output Ports: Limits for Conducted Emissions



Photograph 1. AC Mains Power, Conducted Disturbance, Test Setup

Electromagnetic Compatibility Emission

3.2 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 8.

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 Harmonics	
2	1.08
4	0.43
6	0.30
8< n <40	0.23 - 8/n

Table 8. Harmonic Current Emission Limits from Section 7 of EN 61000-3-2

Test Procedure: The EUT was placed on a non-metallic table located atop a ground reference plane (See Photograph 2). 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 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.

Electromagnetic Compatibility Emission

Harmonic Current Emissions

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

Class (A, B, C, D)	Voltage (V)	Current (mA)	Frequency (Hz)	Total Harmonic Distortion (%)
A	242.82	58.0	49.998	211.93

Harmonic #	Measured (A)	Limit(A)✧	Results	Notes
3	0.0247	2.300	Pass	NA
5	0.0234	1.140	Pass	NA
7	0.0216	0.770	Pass	NA
9	0.0194	0.400	Pass	NA
11	0.0169	0.330	Pass	NA
13	0.0141	0.21	Pass	NA
15-39	0.0115	0.150- 0.058	Pass	NA
2	0.0015	1.080	Pass	NA
4	0.0015	0.430	Pass	NA
6	0.0015	0.300	Pass	NA
8-40	0.0014	0.230- 0.046	Pass	NA

Table 9. Harmonic Current Emissions, Test Results

Test Engineer(s): Anderson Soungpanya

Test Date(s): 04/24/09

Electromagnetic Compatibility Emission

Harmonic Current Emissions

combinova ANALYZER 300 2093.09.13 13:53:48

Fluctuating Current Harmonics

Next measure

Setup: DEFAULT_H Gen setting: 1(1) U : 242.82 V fu: 49.998 Hz
Live Analysed periods: 16 I : 58.0 mA P: 5.9 W
Module: M1 Limit: Class A (EN61000_A14) I1: 24.5 mA
LP-filter Note:

THD=211.93 % (PF=0.422) PASSED

No	Mean A	Max A	Limit A	No	Mean A	Max A	Limit A
1	0.0243	0.0253		2	0.0012	0.0015	1.0800
3	0.0237	0.0247	2.3000	4	0.0012	0.0015	0.4300
5	0.0225	0.0234	1.1400	6	0.0012	0.0015	0.3000
7	0.0209	0.0216	0.7700	8	0.0011	0.0014	0.2300
9	0.0188	0.0194	0.4000	10	0.0011	0.0014	0.1840
11	0.0165	0.0169	0.3300	12	0.0010	0.0013	0.1533
13	0.0139	0.0141	0.2100	14	0.0010	0.0013	0.1314
15	0.0113	0.0115	0.1500	16	0.0009	0.0012	0.1150
17	0.0087	0.0089	0.1324	18	0.0009	0.0012	0.1022
19	0.0063	0.0065	0.1184	20	0.0009	0.0011	0.0920

(Next page, Press 'arrow down' > 1 s)

Select module

Voltage check

Measurement completed (600s) Appl: DEFAULT (1215_00)

Chart 1. Fluctuating Current Harmonics, 1

combinova ANALYZER 300 2093.09.13 13:54:48

Fluctuating Current Harmonics

Next measure

Setup: DEFAULT_H Gen setting: 1(1) U : 242.82 V fu: 49.998 Hz
Live Analysed periods: 16 I : 58.0 mA P: 5.9 W
Module: M1 Limit: Class A (EN61000_A14) I1: 24.5 mA
LP-filter Note:

THD=211.93 % (PF=0.421)
(Previous page, Press 'arrow up' > 1 s)

No	Mean A	Max A	Limit A	No	Mean A	Max A	Limit A
21	0.0043	0.0042	0.0043	22	0.0007	0.0008	0.0010
23	0.0026	0.0025	0.0027	24	0.0006	0.0008	0.0009
25	0.0017	0.0016	0.0018	26	0.0006	0.0007	0.0009
27	0.0018	0.0017	0.0021	28	0.0005	0.0006	0.0008
29	0.0022	0.0022	0.0026	30	0.0005	0.0005	0.0007
31	0.0025	0.0025	0.0028	32	0.0004	0.0005	0.0006
33	0.0026	0.0026	0.0028	34	0.0004	0.0004	0.0005
35	0.0025	0.0024	0.0026	36	0.0003	0.0004	0.0004
37	0.0022	0.0021	0.0022	38	0.0003	0.0003	0.0004
39	0.0017	0.0017	0.0018	40	0.0002	0.0003	0.0004

Select module

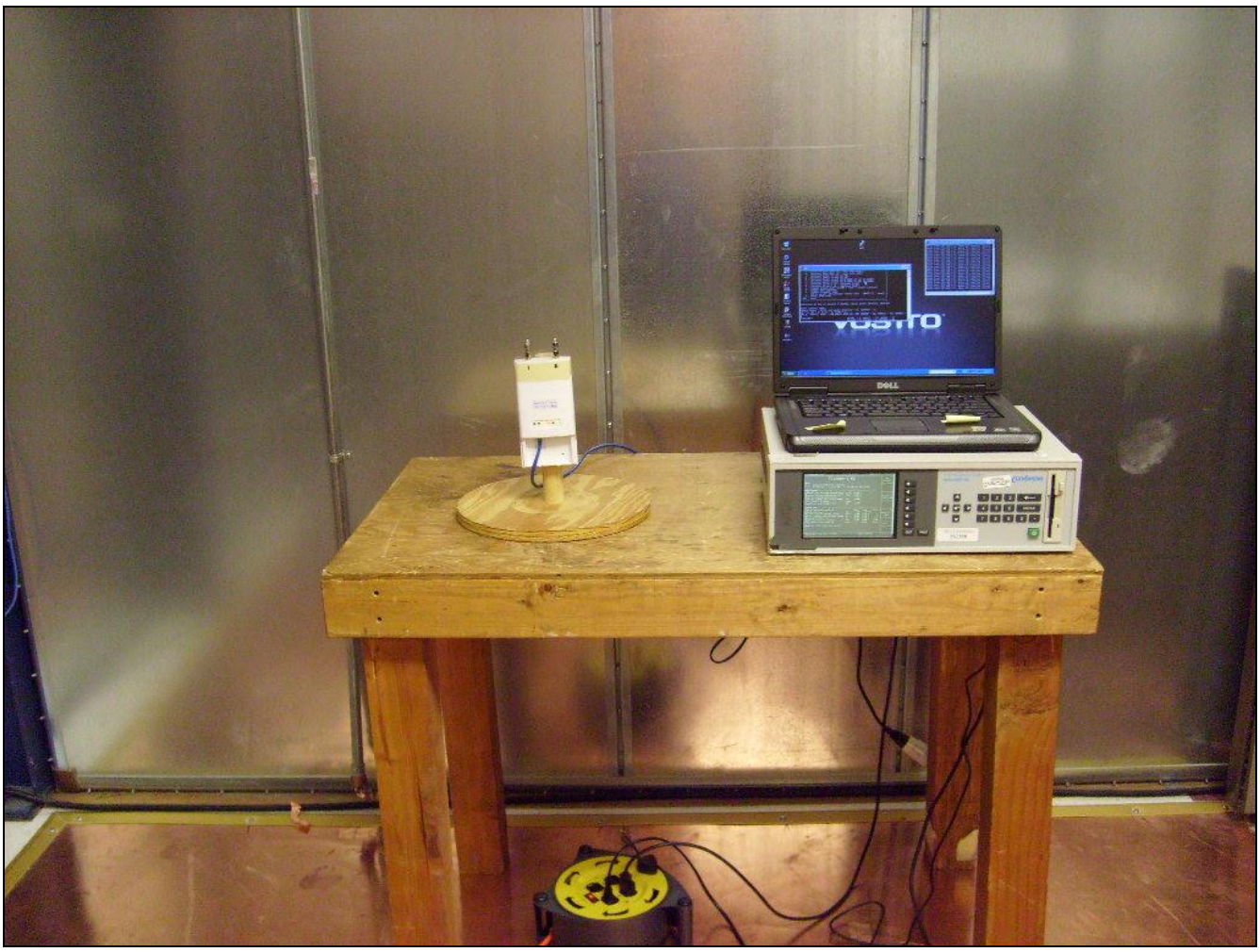
Voltage check

Measurement completed (600s) Appl: DEFAULT (1215_01)

Chart 2. Fluctuating Current Harmonics, 2

Electromagnetic Compatibility Emission

Harmonic Current Emissions



Photograph 2. Harmonic Current Emissions, Test Setup

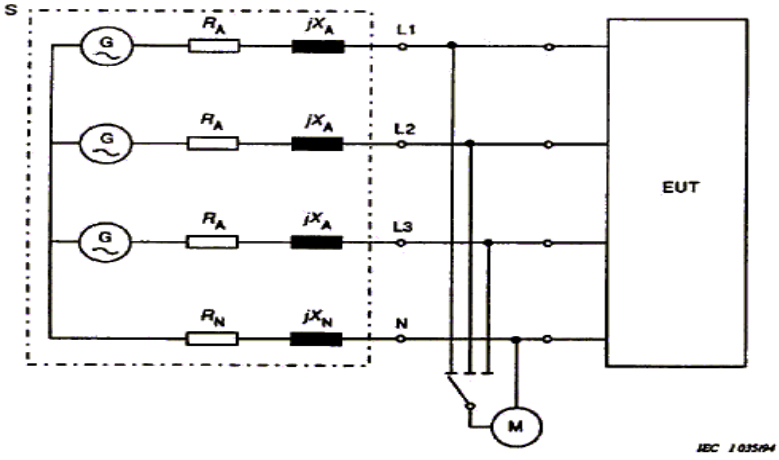
Electromagnetic Compatibility Emission

3.3 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 non-metallic table located atop a ground reference plane (See Photograph 3). 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. The test voltage was maintained within 2% of the nominal value. The frequency was 50 Hz 0.5%. 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.



EUT equipment under test

M measuring equipment

S supply source consisting of the supply voltage generator G and reference impedance Z with the elements:

R_A = 0,24 Ω; jX_A = 0,15 Ω at 50 Hz;

R_N = 0,16 Ω; jX_N = 0,10 Ω at 50 Hz.

The elements include the actual generator impedance.

When the source impedance is not well defined, see 6.2.

G voltage source in accordance with 6.3.

NOTE – In general, three-phase loads are balanced, and R_N and X_N can be neglected, as there is no current in the neutral wire.

Figure 2. Test Circuit for EN 61000-3-3

Electromagnetic Compatibility Emission

Voltage Fluctuations (Flicker)

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

Voltage (V)	Current (mA)	Frequency (Hz)	Power Factor
242.8	68.8	50.001	0.440

Average (Is) relative voltage Drop	**d(t)**	0.005
Relative voltage fluctuation (3s)	**Dpp**	0.001
d(t) at steady - state level	**YES /NO**	Yes
Last relative steady - state level change	**Dc**	0
Last transition swing	**Dmax**	--
Normalized peak flicker (3s)	**Pp**	0

Parameter		Observation Period		Limit
		Short	Long	
Observation Time	**Tp**	10 min	120 min	--
Maximum relative voltage change	**dmax**	0	0	4
Max rel. steady-state voltage change	**dc**	0	0	3
Duration of d(t) > 3 %	**t**	0	0	0.2
Short term flicker severity	**Pst**	0	0	1.0
Long term flicker severity	**Plt**	NA	0	0.65

Table 10. Voltage Fluctuations (Flicker), Test Results

Test Engineer(s): Anderson Soungpanya

Test Date(s): 04/24/09

Electromagnetic Compatibility Emission

Voltage Fluctuations (Flicker)

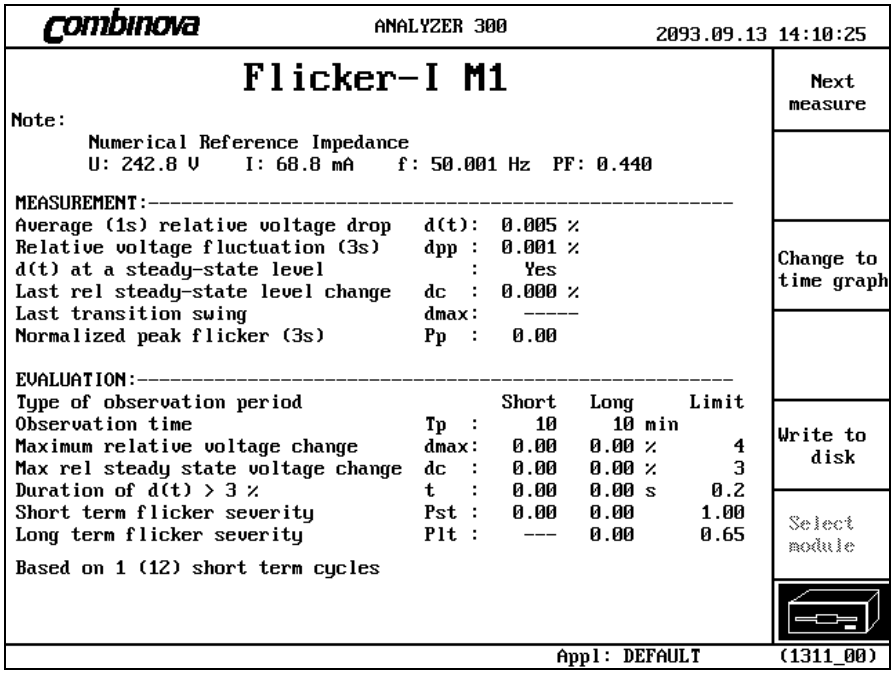


Chart 3. Flicker-I, M1

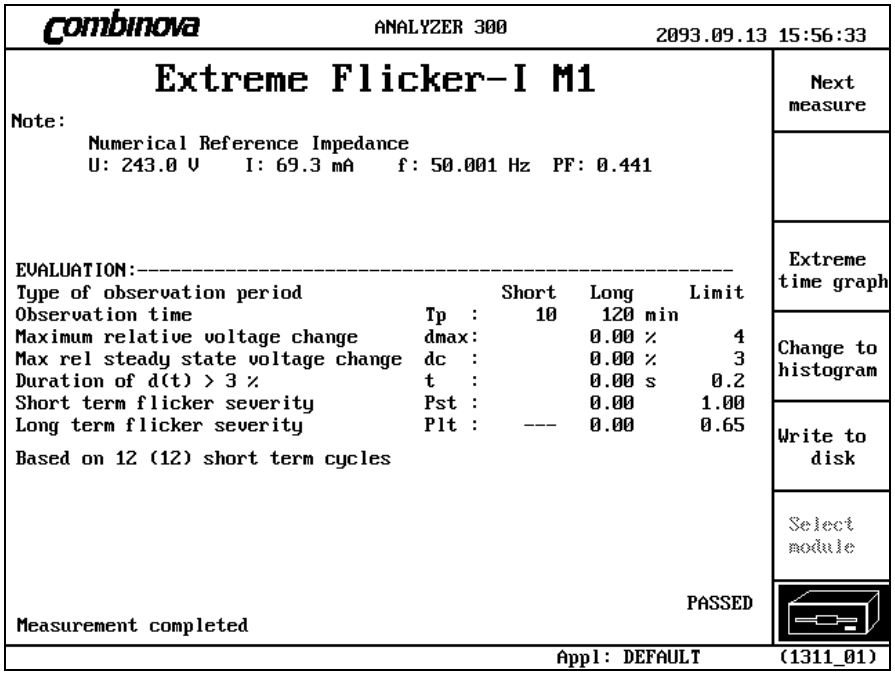
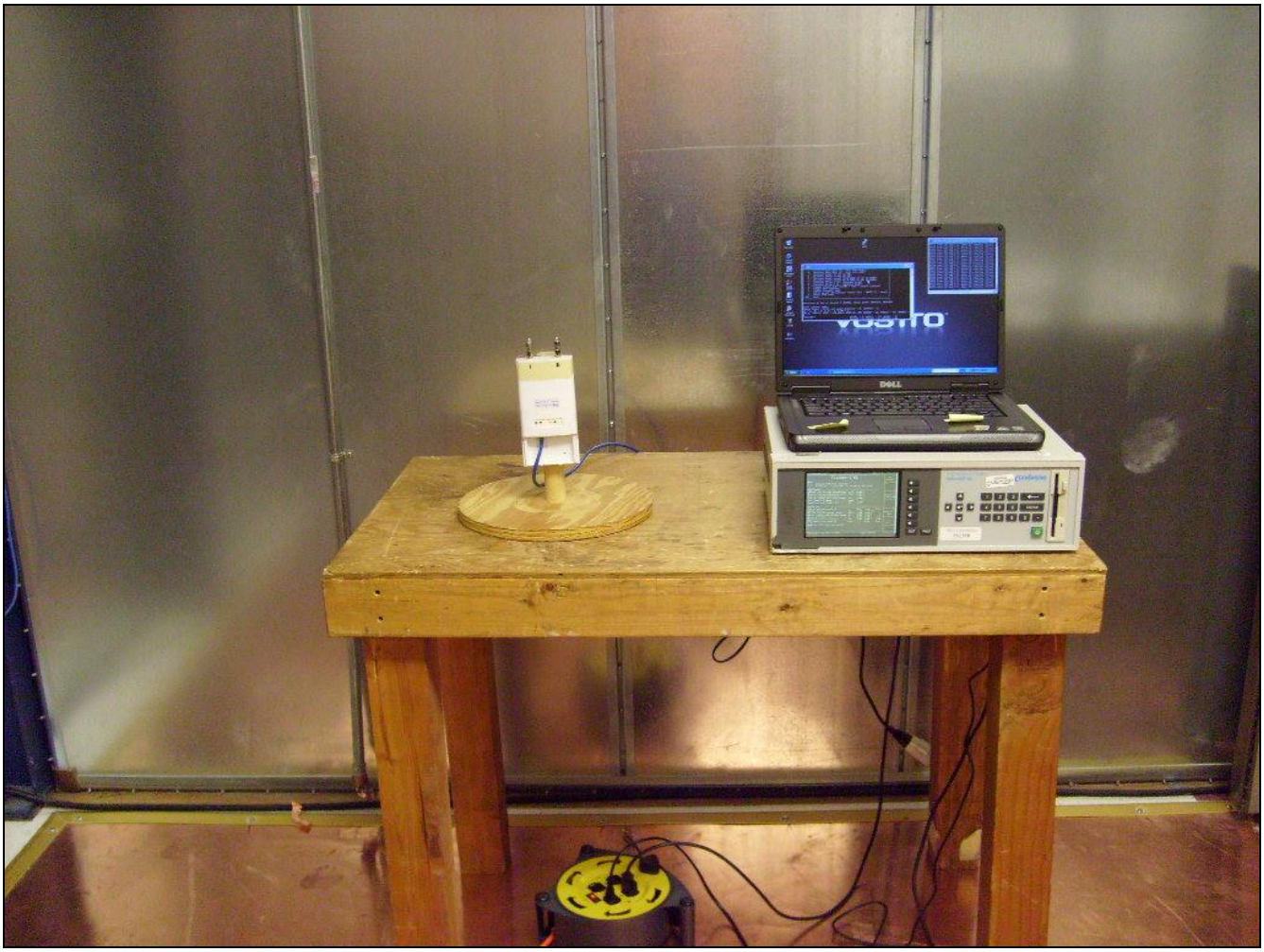


Chart 4. Extreme Flicker-I, M1

Electromagnetic Compatibility Emission

Voltage Fluctuations (Flicker)



Photograph 3. 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 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 from the range or 80 MHz - 1 GHz and 1 m in front of the EUT from the range of 1400 MHz – 2000 MHz (See Photograph 4 and Photograph 5). 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:	22°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): Anderson Soungpanya

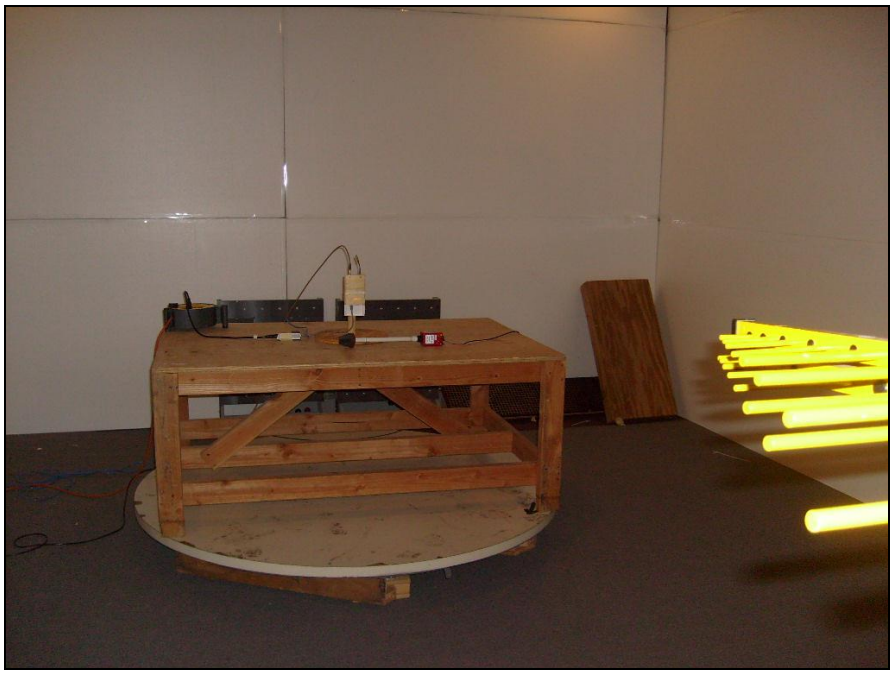
Test Date(s): 05/19/09

Start Frequency (MHz)	Stop Frequency (MHz)	Severity (V/m)	Polarity (H/V)	Modulation (Freq & Type)	Results			
					Front	Back	Left	Right
80	1000	3	V	1 kHz, 80%AM	Pass	Pass	Pass	Pass
80	1000	3	H	1 kHz, 80%AM	Pass	Pass	Pass	Pass
1400	2000	3	V	1 kHz, 80%AM	Pass	Pass	Pass	Pass
1400	2000	3	H	1 kHz, 80%AM	Pass	Pass	Pass	Pass

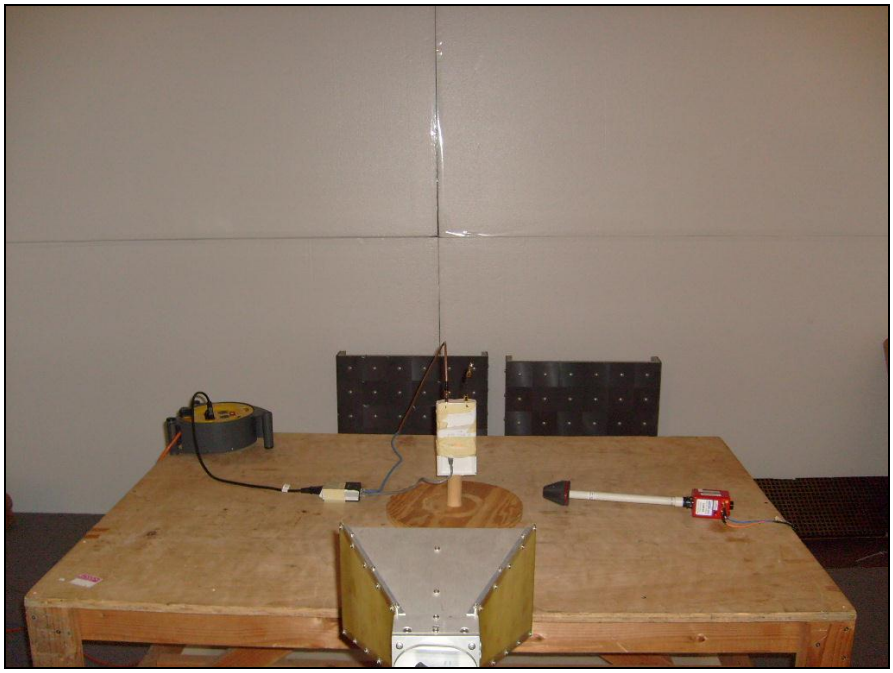
Table 11. Radiated Immunity, Test Results

Electromagnetic Compatibility Immunity Criteria

Radio Frequency Electromagnetic Field



Photograph 4. Radio Frequency Electromagnetic Field, Bilog



Photograph 5. Radio Frequency Electromagnetic Field, Horn

Electrostatic Discharge

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

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

The EUT was located above a ground reference plane (GRP) (See Photograph 6), 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:	35%
Atmospheric Pressure:	101.9 kPa

Environmental Conditions during EN 61000-4-2 Testing

Electromagnetic Compatibility Immunity

Electrostatic Discharge

Test Procedure: Air discharges of up to ± 8kV were applied to non-conductive surfaces. Contact discharges of up to ± 4 kV were applied to conductive surfaces of the EUT. Contact discharges of ± 4 kV were applied to 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 ETSI 301 489-22 Clause 6.

Test Results: The EUT as tested was compliant with the requirements of Clause 9.3

Test Engineer(s): Anderson Soungpanya

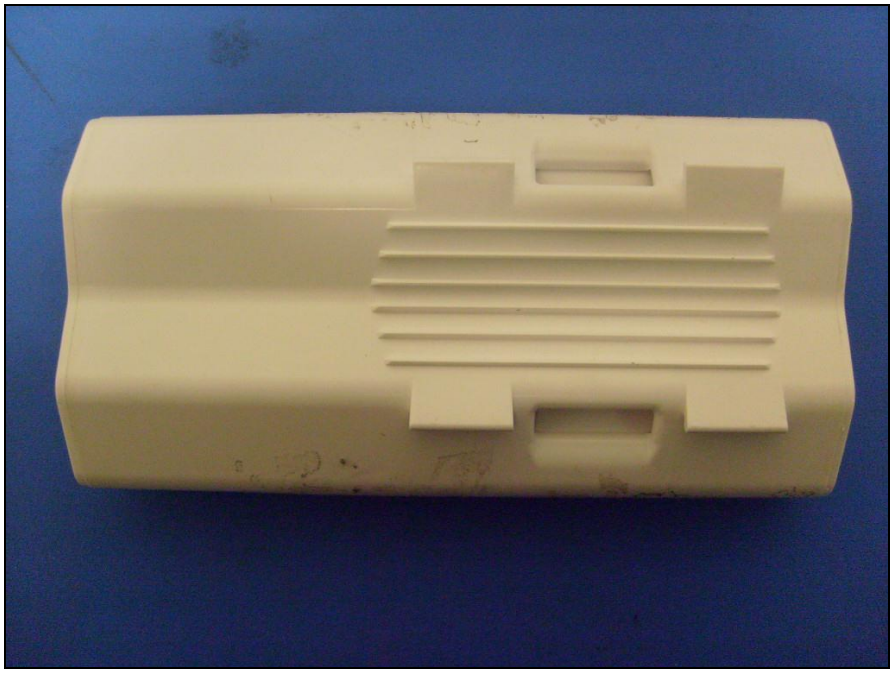
Test Date(s): 05/12/09

Discharge Type	Test Voltage (±kV)	Results				Anomalies
		Front	Back	Left	Right	
VCP	2	Pass	Pass	Pass	Pass	No anomalies noted.
	4	Pass	Pass	Pass	Pass	No anomalies noted.
HCP	2	Pass	Pass	Pass	Pass	No anomalies noted.
	4	Pass	Pass	Pass	Pass	No anomalies noted.
Contact Discharge	2	Pass	Pass	Pass	Pass	No anomalies noted.
	4	Pass	Pass	Pass	Pass	Communication from EUT to Laptop is interrupted. Communication restores on its own once ESD phenomena removed.
Air Discharge	2	Pass	Pass	Pass	Pass	No anomalies noted.
	4	Pass	Pass	Pass	Pass	No anomalies noted.
	6	Pass	Pass	Pass	Pass	No anomalies noted.
	8	Pass	Pass	Pass	Pass	No anomalies noted.

Table 12. Electrostatic Discharge, Test Results

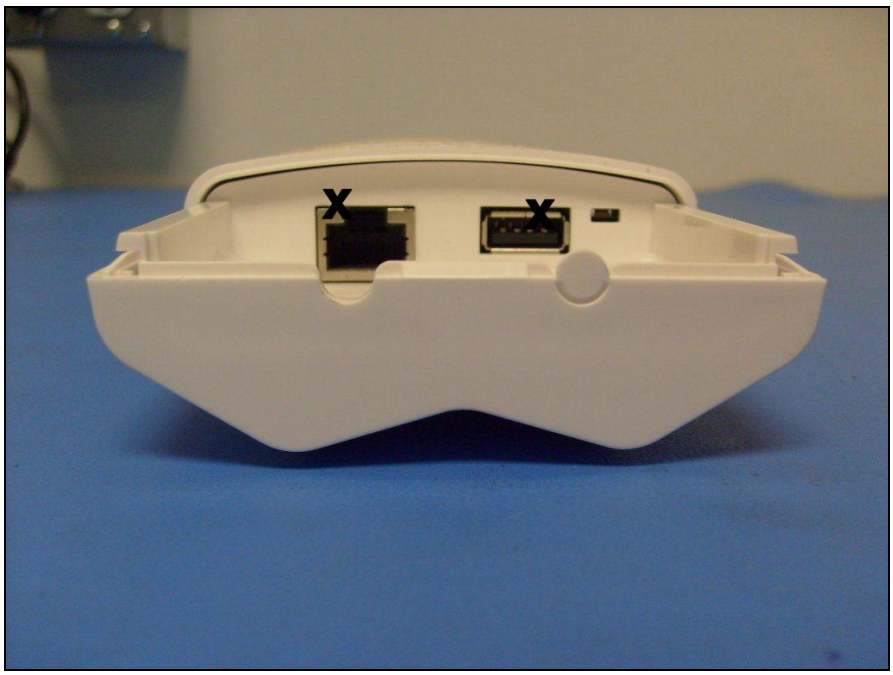
Electrostatic Discharge

Photograph 6. Electrostatic Discharge, Test Setup



Photograph 7. Electrostatic Discharge, Rear View

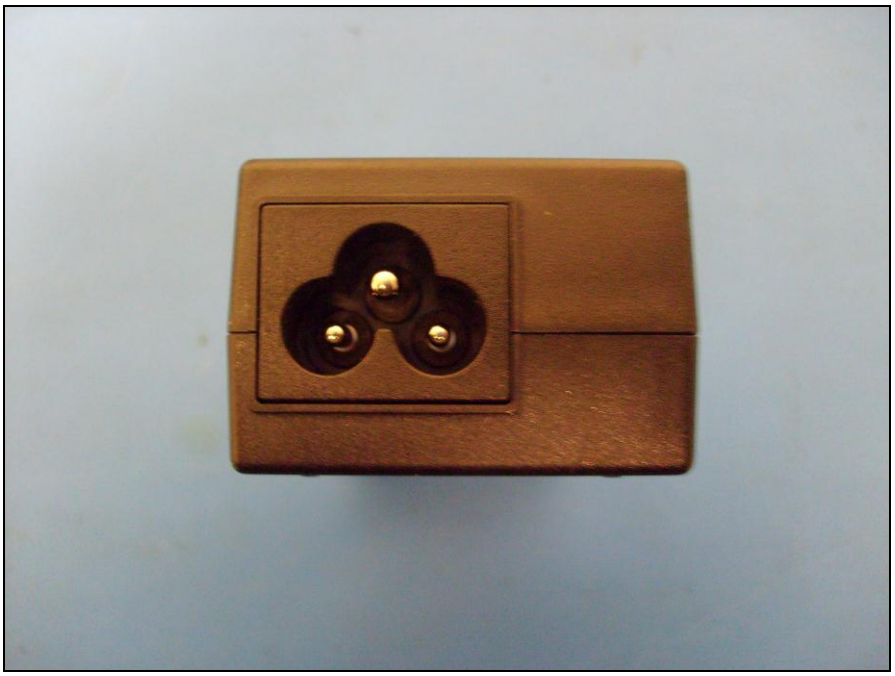
X = Contact Discharge Test Points
O = Air Discharge Test Points



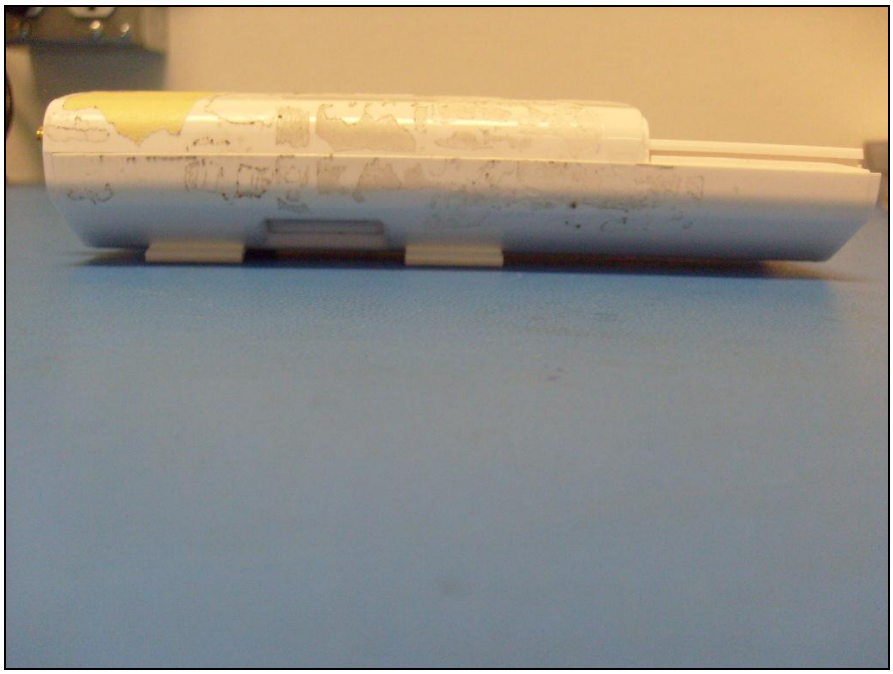
Photograph 8. Electrostatic Discharge, Bottom View

Photograph 9. Electrostatic Discharge, Front View

X = Contact Discharge Test Points
O = Air Discharge Test Points

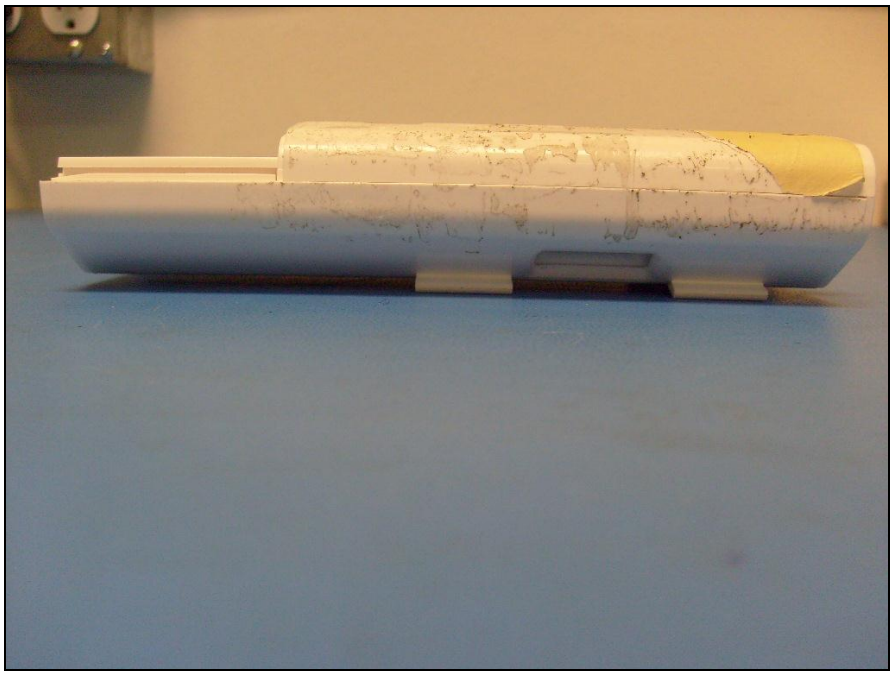


Photograph 10. Electrostatic Discharge, AC In

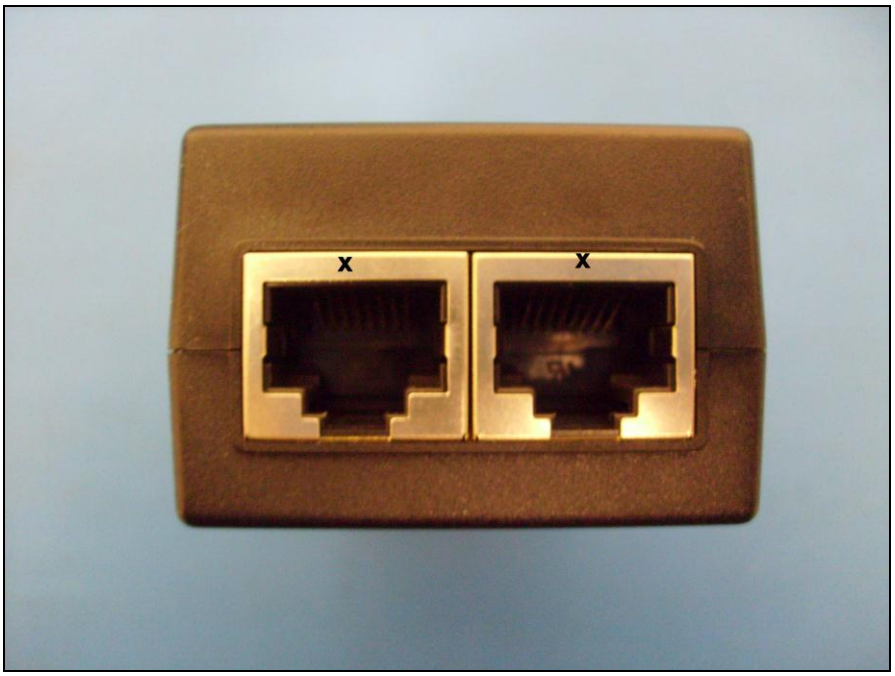


Photograph 11. Electrostatic Discharge, Left View

X = Contact Discharge Test Points
O = Air Discharge Test Points



Photograph 12. Electrostatic Discharge, Right View



Photograph 13. Electrostatic Discharge, POE and LAN View

X = Contact Discharge Test Points
O = Air Discharge Test Points

Photograph 14. Electrostatic Discharge, POE Bottom View

Photograph 15. Electrostatic Discharge, POE Front View

X = Contact Discharge Test Points
O = Air Discharge Test Points

Photograph 16. Electrostatic Discharge, Side View, 1

Photograph 17. Electrostatic Discharge, Side View, 2

X = Contact Discharge Test Points
O = Air Discharge Test Points

Electromagnetic Compatibility Immunity

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 the DC power cables. 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 non-metallic table above a GRP extending at least 1 m beyond all sides of the EUT (See Photograph 18 and Photograph 19). 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

Fast Transient, Common Mode

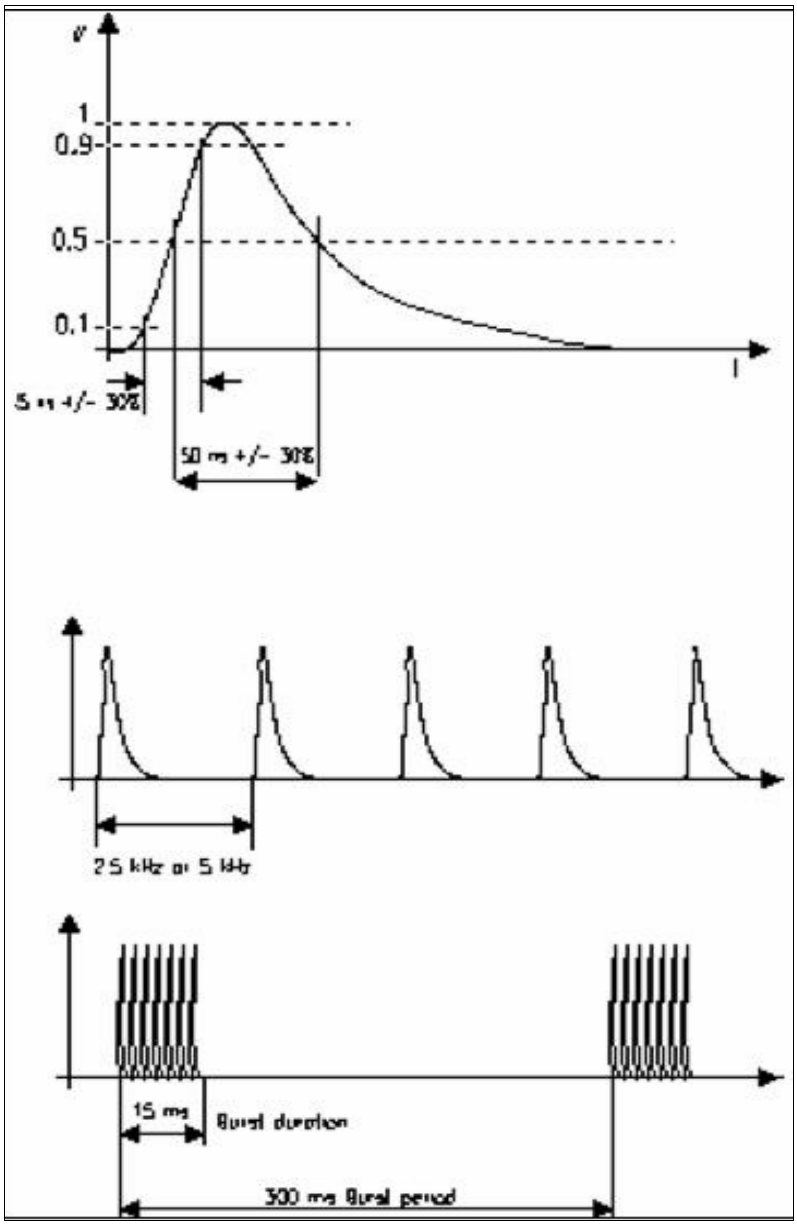


Figure 3. EN 61000-4-4 Test Waveform

Electromagnetic Compatibility Immunity

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	PASS	Anomalies
AC Power				
Phase	AC to DC Power supply	±1 kV	Yes	Communication between the laptop and EUT is lost during EFTB phenomena; after phenomena removed, communication is restored.
Neutral	AC to DC Power supply	±1 kV	Yes	
Ground	AC to DC Power supply	±1 kV	Yes	
I/O Lines				
POE Input	POE/LAN	±500 V	Yes	No anomalies observed.

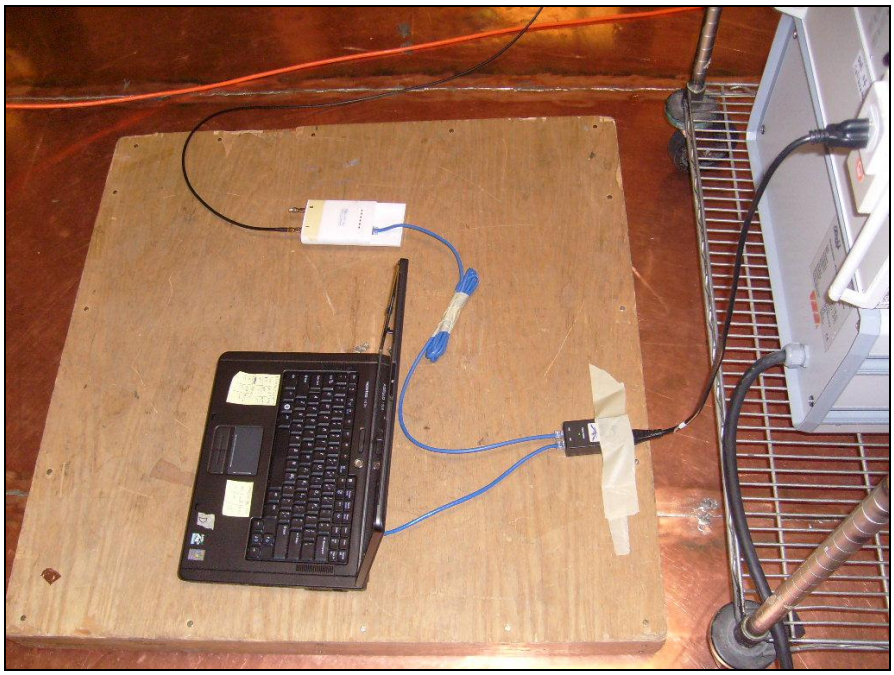
Table 13. Fast Transient, Comment Mode, Test Results

Test Engineer(s): Anderson Soungpanya

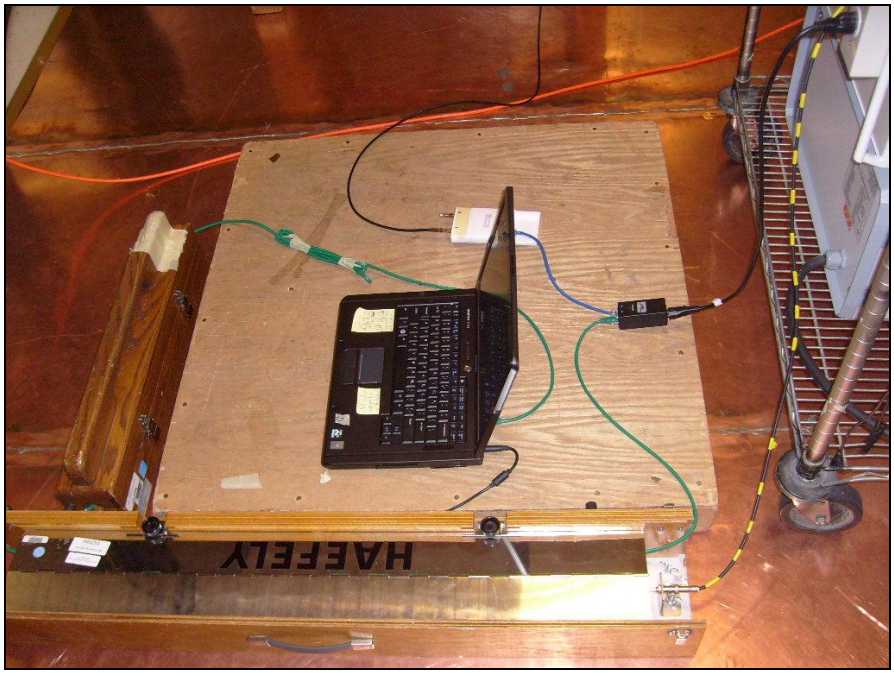
Test Date(s): 05/04/09

Electromagnetic Compatibility Immunity

Fast Transient, Common Mode



Photograph 18. Fast Transient, Common Mode, Test Setup, AC Power



Photograph 19. Fast Transient, Common Mode, Test Setup, I/O Lines

Electromagnetic Compatibility Immunity

Radio Frequency, Common Mode

Test Requirement(s): **ETSI EN 300 489-1, Clause 9.5:**

Per *EN 61000-4-6*, 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 non-metallic table above a GRP extending at least 1 m beyond all sides of the EUT (See Photograph 20 and Photograph 21). 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
N/A	AC Power Input	Pass
N/A	LAN	Pass

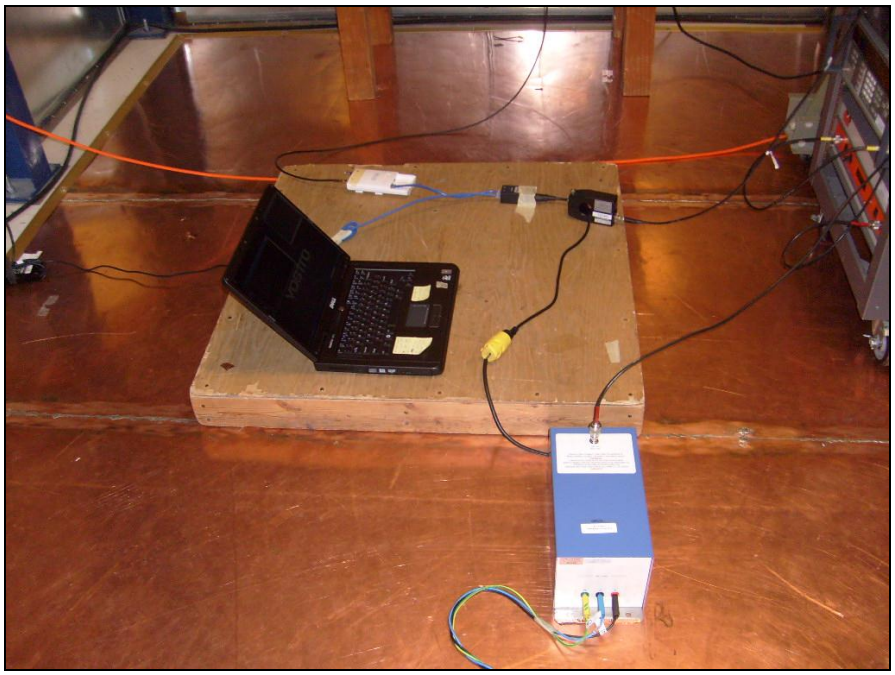
Table 14. Radio Frequency, Common Mode, Test Results

Test Engineer(s): Anderson Soungpanya

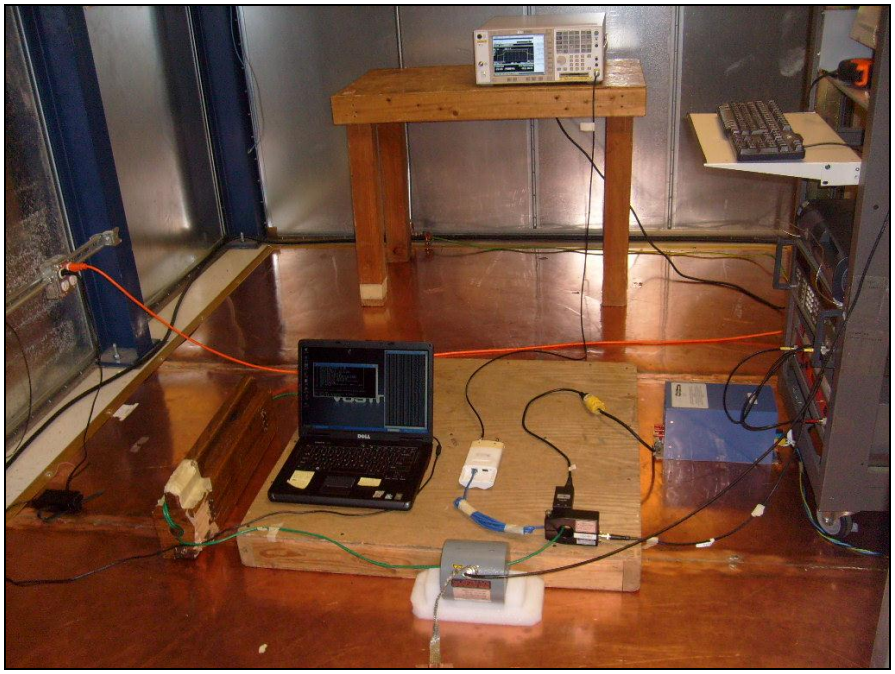
Test Date(s): 05/05/09

Electromagnetic Compatibility Immunity

Radio Frequency, Common Mode



Photograph 20. Radio Frequency, Common Mode, Test Setup, AC Power



Photograph 21. Radio Frequency, Common Mode, Test Setup, I/O Lines

Electromagnetic Compatibility Immunity

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 % Duration ms	30 10	B
Voltage reduction % Duration ms	60 100	C
Voltage reduction % Duration ms	>95 5000	C

Table 15. Voltage Dips and Short Interruptions Limits

Test Procedure: The EUT was placed on a non-metallic table and situated in the center of a GRP. The EUT was provided with AC power via the programmable power supply (See Photograph 22). 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 Rep.	P. Criteria	PASS	Anomalies
Voltage Dips	30% drop for 10 ms or 1/2 cycle	3	B	Yes	No anomalies observed.
Voltage Dips	60% drop for 100 ms or 5 cycles	3	C	Yes	No anomalies observed.
Short Interrupts	> 95% drop for 5000 ms or 250 cycles	3	C	Yes	No anomalies observed.

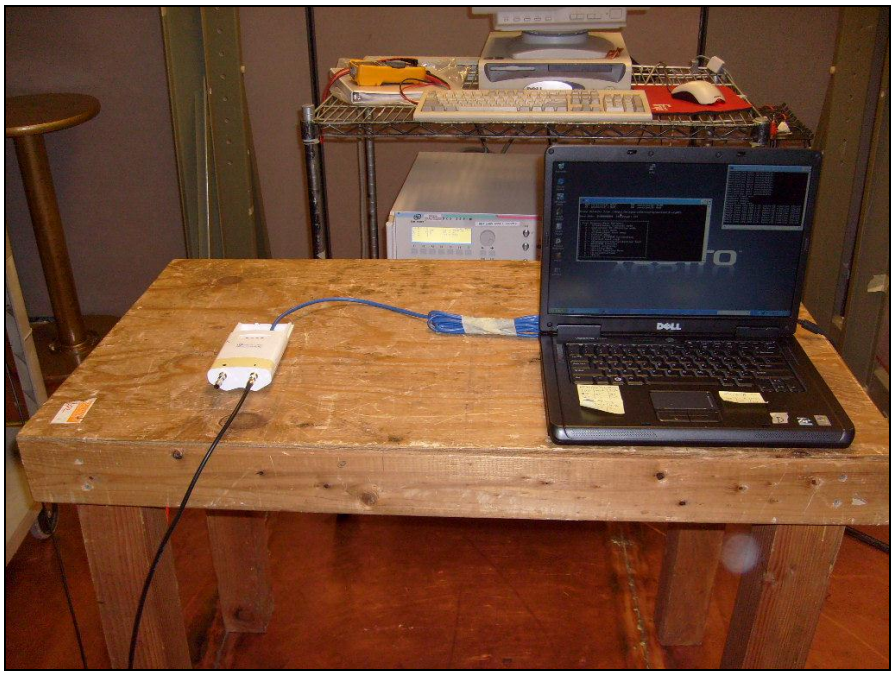
Table 16. Voltage Dips and Short Interruptions, Test Results

Test Engineer: Anderson Soungpanya

Test Date: 05/04/09

Electromagnetic Compatibility Immunity

Voltage Dips and Short Interruptions



Photograph 22. Voltage Dips and Short Interruptions, Test Setup

Electromagnetic Compatibility Immunity

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 circuit amplitude of ±. 1 kV (differential mode), and ±2 kV (common mode) applied to the AC power cables. Performance Criterion A applies for AC power cables.

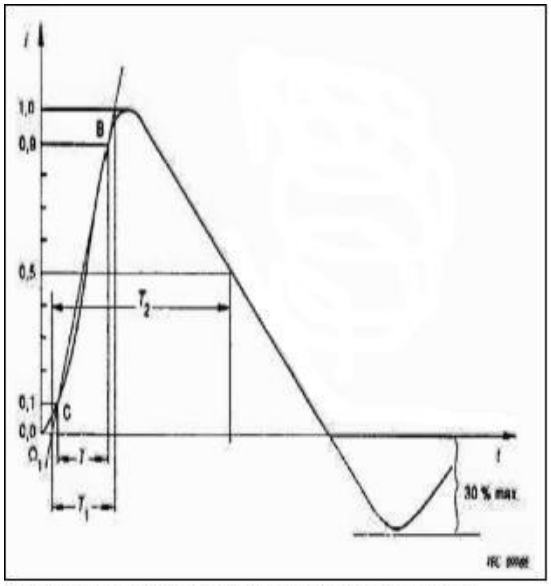
Test Procedure: The EUT was placed on a non-metallic table above a GRP extending at least 1 m beyond all sides of the EUT (See Photograph 23). AC power [where applicable] was supplied to the EUT through the Combination Wave Generator. The combination wave generator was configured to produce the following output:

Open Circuit Voltage:	Front Time = 1.2 μs Time to Half = 50 μs
Short Circuit Current:	Front Time = 8 μs Time to Half = 20 μs
Telecom wave parameters:	Front Time = 10 μs Time to Half = 700 μs

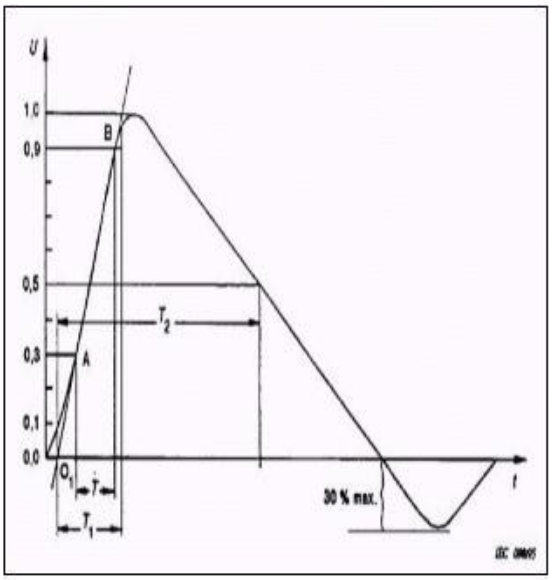
Table 17. Combination Wave Generator Test Parameters for EN 61000-4-5

Electromagnetic Compatibility Immunity

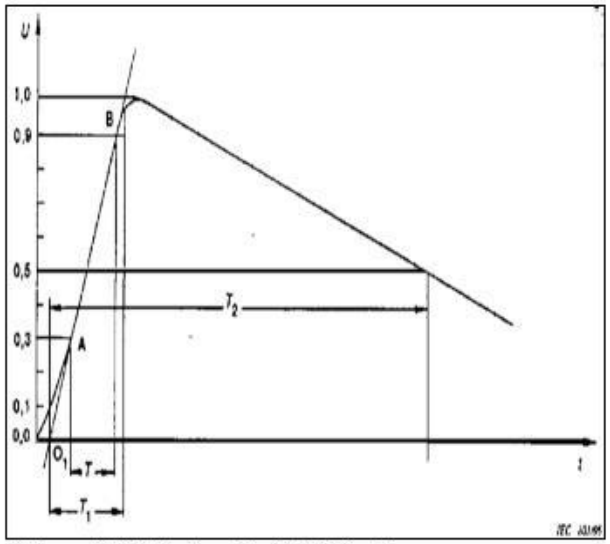
Surges



Short Circuit Current Waveform for EN 61000-4-5



Open Circuit Voltage Waveform for EN 61000-4-5



Telecom Test Waveform for EN61000-4-5

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

Electromagnetic Compatibility Immunity

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 0°, 90°, and 270°. Throughout testing, the EUT was monitored closely for signs of susceptibility.

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

Port Name	Phase	Test Level	Results	Anomalies
AC, Differential Mode				
Phase to Neutral	0	±1.0 kV	Pass	NA
	90	±1.0 kV	Pass	NA
	270	±1.0 kV	Pass	NA
AC, Common Mode				
Phase to Ground	0	±2.0 kV	Pass	NA
	90	±2.0 kV	Pass	NA
	270	±2.0 kV	Pass	NA

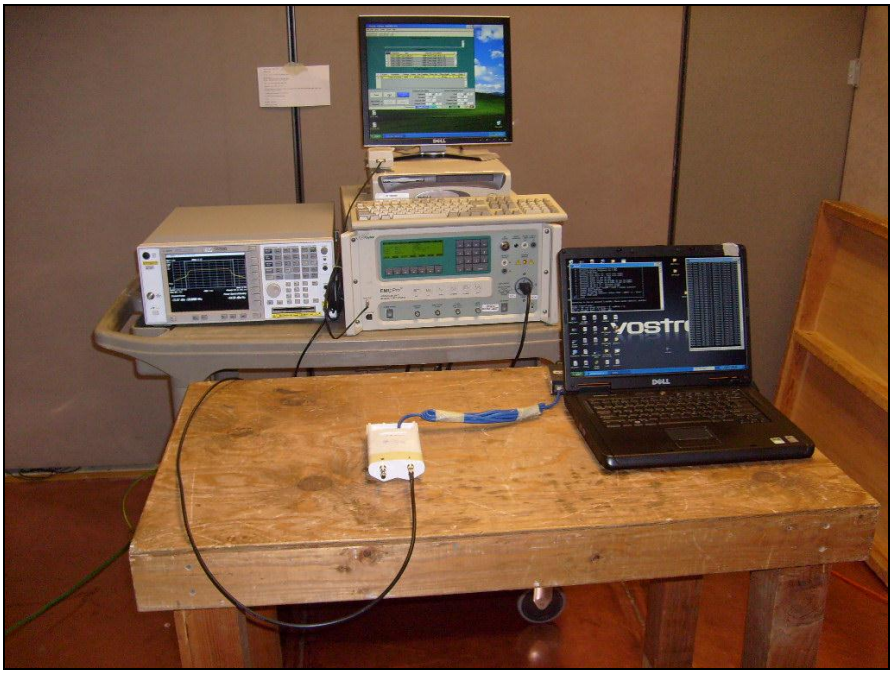
Table 18. Surges, Test Results

Test Engineer(s): Anderson Soungpanya

Test Date(s): 05/12/09

Electromagnetic Compatibility Immunity

Surges



Photograph 23. 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): 04/23/09**
MET Asset #	**Nomenclature**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2109	EMI RECEIVER RF SECTION	HEWLETT PACKARD	85462A	11/6/08	11/6/09
1S2108	RF FILTER SECTION	HEWLETT PACKARD	85460A	11/6/08	11/6/09
1S2438	TRANSIENT LIMITER	AGILENT	11947A	SEE NOTE	
1S2481	CHAMBER 10M	ETS-LINDGREN	DKE 8X8DBL	12/26/08	12/26/09
1S2370	AC LISN (230VAC 50HZ)	FCC	50A-AC	2/2/09	2/2/10
Test Name: EN 61000-3-2 Harmonic Current Emissions					**Test Date(s): 04/24/09**
MET Asset #	**Nomenclature**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2398	H&F ANALYZER	COMBINOVA	ANALYZER 300	2/10/09	2/10/10
1S2496	GROUND PLANE 4	MET LABS	NA	SEE NOTE	
Test Name: EN 61000-3-3 Voltage Fluctuations (Flicker)					**Test Date(s): 04/24/09**
MET Asset #	**Nomenclature**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2398	H&F ANALYZER	COMBINOVA	ANALYZER 300	2/10/09	2/10/10
1S2496	GROUND PLANE 4	MET LABS	NA	SEE NOTE	
Test Name: EN 61000-4-2 Electrostatic Discharge Immunity					**Test Date(s): 05/12/09**
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2518	HYGROMETER/THERMOMETER	FISCHER SCIENTIFIC	11-661-7D	1/21/08	1/21/10
1S2470	ESD GENERATOR	NOISEKEN	ESS-2000	4/12/09	4/12/10
1S2488	SCREEN ROOM 1	UNIVERSAL	CUSTOM	SEE NOTE	
Test Name: EN 61000-4-3 Radiated Electromagnetic Field					**Test Date(s): 05/19/09**
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2278	SIGNAL GENERATOR	AGILENT	E8350B	6/05/08	6/05/09
1S2576	AMPLIFIER	AR	500W1000A	SEE NOTE	
1S2264	3M IMMUNITY CHAMBER	LINDGREN ENCLOSURES	06X07	11/10/08	11/10/09
1S2568	SIGNAL GENERATOR	GIGATRONICS	6061A	11/17/08	11/17/09
1S2401	BILOG ANTENNA	SHAFFNER	CBL 6140A	SEE NOTE	
1S2208	HORN ANTENNA	EMCO	3115	SEE NOTE	
1S2579	FIELD PROBE	ETS-LINDGREN	HI-6053	9/10/08	9/10/09
1S2478	AMPLIFIER	CPI	VZL6943J2	SEE NOTE	
Test Name: EN 61000-4-4 Fast Transients					**Test Date(s): 05/04/09**
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1U0262	ULTRA COMPACT SIMULATOR	AMPLIFIER RESEARCH	UCS 500-M/6B	8/18/2008	8/18/2009
1S2104	CAPACITIVE COUPLING CLAMP	HEAFELY	NA	SEE NOTE	
1S2492	GROUND PLANE 2	MET LABS	NA	1/27/09	1/27/10
Test Name: EN 61000-4-5 Surges					**Test Date(s): 05/12/09**
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1U0010	SURGE GENERATOR	KEYTEK	EMC PRO	4/14/09	5/14/09
1S2496	GROUND PLANE 4	MET LABS	NA	SEE NOTE	

Test Name: EN 61000-4-6 Radio Frequency, Conducted Continuous					Test Date(s): 05/05/09
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2578	AMPLIFIER	AR	75A250A	SEE NOTE	
1S2390	SIGNAL GENERATOR	GIGATRONICS	6061A	5/21/08	5/21/09
1S2512	TRANSIENT LIMITER	AGILENT	11947A	SEE NOTE	
1S2569	SPECTRUM ANALYZER	AGILENT	E4401B	SEE NOTE	
1S2586	CDN	COM POWER	CDN M3-25	SEE NOTE	
1S2394	BCI PROBE	FCC	F-120-9A	9/25/08	9/25/09
1S2487	CURRENT PROBE	SOLAR ELECTRONICS	6471-1	1/28/08	7/28/09
Test Name: EN 61000-4-11 Voltage Dips and Short Interruptions					**Test Date(s): 05/04/09**
MET Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1U0262	ULTRA COMPACT SIMULATOR	AMPLIFIER RESEARCH	UCS 500-M/6B	8/18/2008	8/18/2009
1S2492	GROUND PLANE 2	MET LABS	NA	1/27/09	1/27/10

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

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End of Report

