Report Status Sheet

Revision	Report Date	Reason for Revision
_	June 4, 2007	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 V1.4.1 (2002-08).

ETSI EN 301 489-1 V1.4.1 (2002) 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				Measured emissions were below applicable limits.
Section 8.3: DC power input/output ports, conducted emissions of equipment intended to be used in other than telecommunication center				The EUT requires 5 VDC from the PC Host.
Section 8.4: AC mains power input/output ports, conducted emissions of equipment intended to be used in other than telecommunication center				Measured emissions were below applicable limits.
Section 8.5: Harmonic current emissions (AC mains input port)				Measured emissions were below applicable limits.
Section 8.6: Voltage fluctuations and flicker (AC mains input port)				Measured emissions were below applicable limits.
Section 9.2: Radio frequency electromagnetic field (80 MHz to 1000 MHz and 1400 MHz to 2000 MHz)				No anomalies were observed.
Section 9.3: Electrostatic Discharge				The EUT does not have an enclosure.
Section 9.4: Fast transients, common mode				No anomalies were observed.
Section 9.5: Radio frequency, common mode				No anomalies were observed.
Section 9.6: Transients and surges in the vehicular environment				The EUT is not intended to be used in a vehicular environment.
Section 9.7: Voltage dips and interruptions				No anomalies were observed.
Section 9.8: Surge				No anomalies were observed.

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

II. Equipment Configuration

Model(s) Tested:	SR5
Model(s) Covered:	SR5
EUT Specifications:	Primary Power from laptop: 5V DC
	Secondary Power from HP DC PWR Supply: 3.3V DC
	Equipment Emissions 230V AC 50Hz
Analysis:	The results obtained relate only to the item(s) tested.
Evaluated by:	Billy Kwan

A. Overview

The purpose of this series of tests was to verify compliance of the Ubiquiti Networks, SR5with the limits of ETSI EN 301 489-1 V1.4.1 (2002-08).

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

C. Test Site

All testing was performed at MET Laboratories, Inc., 4855 Patrick Henry Drive, Building 6, 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

Ubiquiti Networks, SR5, Equipment Under Test (EUT), is a 5.8 GHz modular wireless device (PCMCIA).

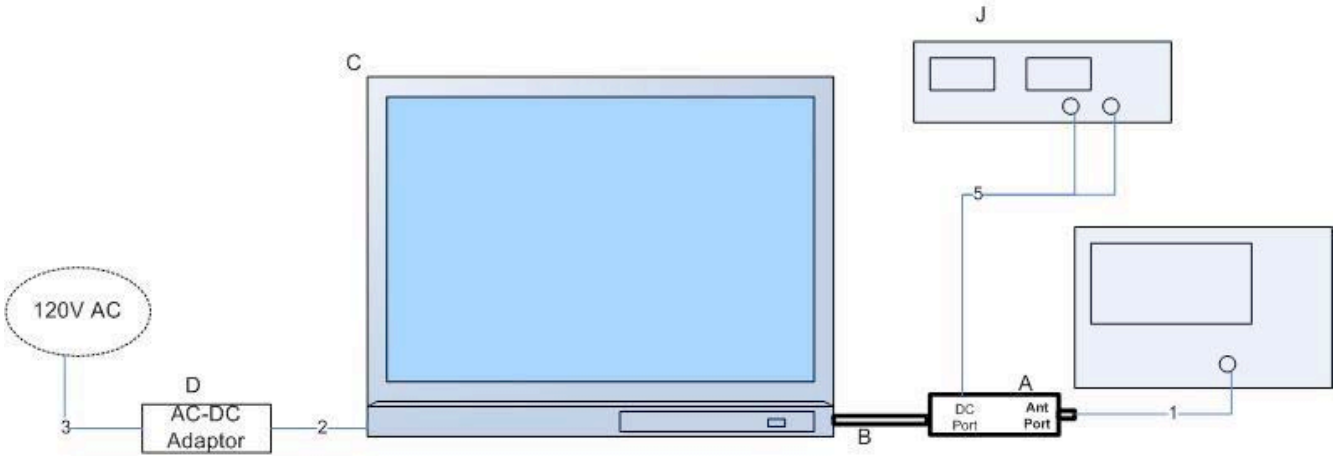


Figure 1. Block Diagram of Immunity Test Configurations

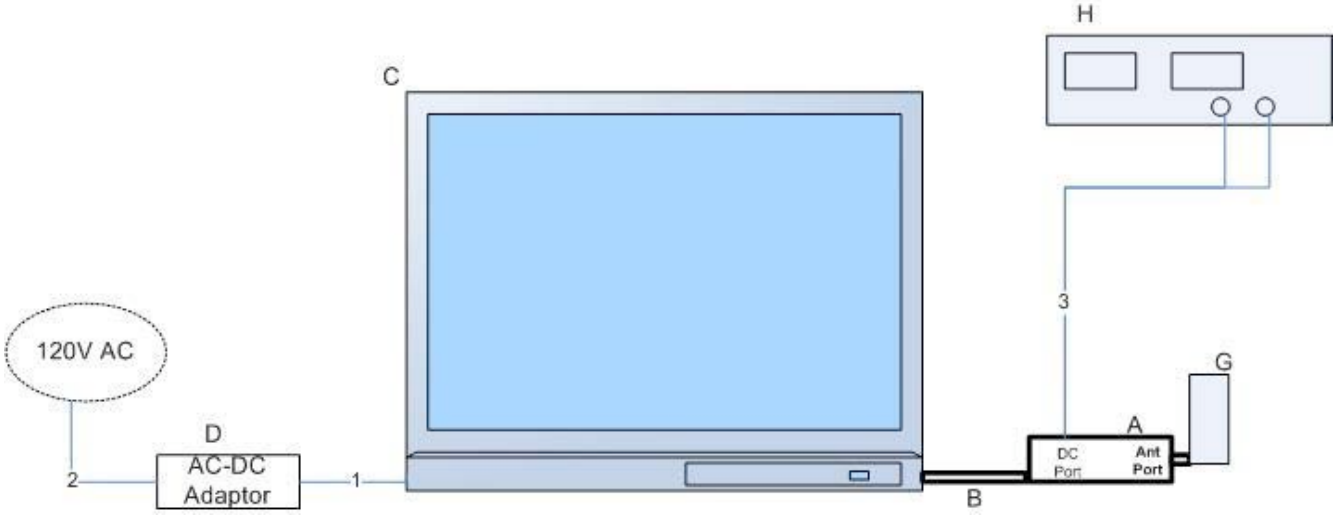


Figure 2. Block Diagram of Emission Test Configurations

Equipment Configuration

The EUT was set up as outlined in Figure 1 and Figure 2, 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
A	5.8GHz mini-PCI 802.11a	SR5C	Proto 1

Table 2. Equipment Configuration

E. 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
B	PCMCIA Extension Card	Accurite Technologies	307507
C	Laptop	Dell	Latitude
D	AC-DC PWR Adaptor	Dell	PA-2
F	Spectrum Analyzer	HP	E4407B
G	50ohms terminator	N/A	N/A
H	DC Power Supply	HP	6236B

Table 3. 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.

F. Ports and Cabling

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded (Yes/No)	Termination Box ID & Port ID
Conducted Measurement						
1	A, Antenna	Coax	1	1.5	Yes	F, Input
2	C, PWR	DC Power Cord	1	1.5	No	D, DC Output
3	D, AC Input	AC Cable	1	1.5	No	AC PWR Outlet
5	A, DC Input	DC Power	2	0.2	No	H, Output
Spurious Emission, REE and CEV						
1	C, PWR	DC Power Cord	1	1.5	No	D, DC Output
2	D, AC Input	AC Cable	1	1.5	No	AC PWR Outlet
3	A, DC input	DC Power	2	0.2	No	H, DC Output

Table 4. Ports and Cabling Information

G. Mode of Operation

The EUT's mode of operation is in OFDM continuous transmit.

H. Method of Monitoring EUT Operation

The EUT was monitored by a laptop with Atheros radio test software and output is being monitored on spectrum analyzer.

I. 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.

J. 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 5.

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

Table 5. Radiated Emissions limits from Clause 6 of EN 55022

Environmental Conditions for Radiated Emission	
Ambient Temperature:	22_C
Relative Humidity:	39 %
Atmospheric Pressure:	102 kPa

Test Procedure: The EUT was placed on a 0.8m-high wooden table inside a semi-anechoic chamber (See Photograph 1). The measurement was performed using normal operation of the equipment. The method of testing, test conditions, and test procedures of *Clause 10* of *EN 55022* 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): Billy Kwan

Test Date(s): 3/19/2007

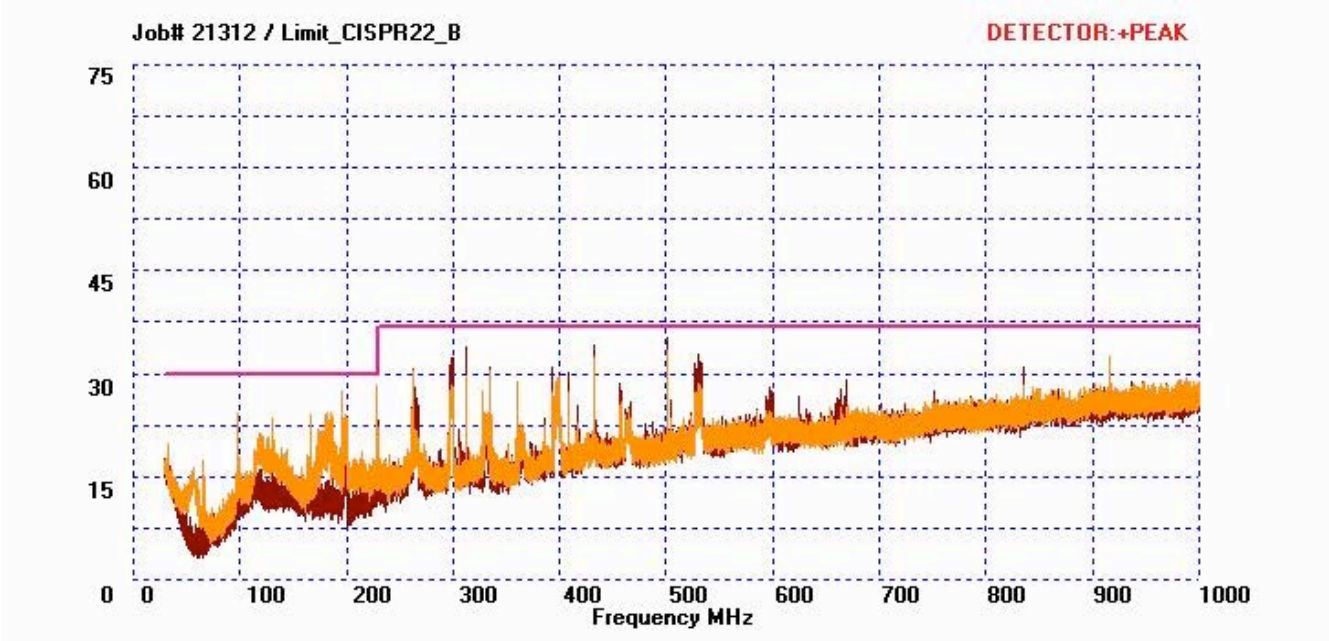
Electromagnetic Compatibility Emission Criteria

Radiated Emission: Test Methods and Limits

Radiated Emission Test Results

Frequency (MHz)	Antenna Polarity (H/V)	EUT Azimuth (Degrees)	Antenna Height (m)	Uncorrected Amplitude QP Detector (dBuv)	Antenna Correction Factor (dB/m) (+)	Pre Amp Gain (dB) (-)	Cable Loss (dB) (+)	Corrected Amplitude (dBuV/m)	Limit (dBuV/m)	Margin (dB)
196.32	V	0	1.00	12.64	9.48	0.00	2.51	24.63	30.00	-5.37
***229.08**	**V**	**0**	**1.00**	**14.67**	**10.75**	**0.00**	**2.57**	**29.98**	**30.00**	**-2.00**
312.04	H	199	2.82	17.75	13.24	0.00	3.00	33.99	37.00	-3.01
432.00	H	1	2.53	12.03	17.18	0.00	3.66	32.87	37.00	-4.13
***501.08**	**H**	**0**	**1.93**	**15.01**	**17.80**	**0.00**	**4.04**	**36.85**	**37.00**	**-0.15**
***916.32**	**V**	**334**	**1.27**	**8.24**	**21.60**	**0.00**	**5.99**	**35.83**	**37.00**	**-1.17**

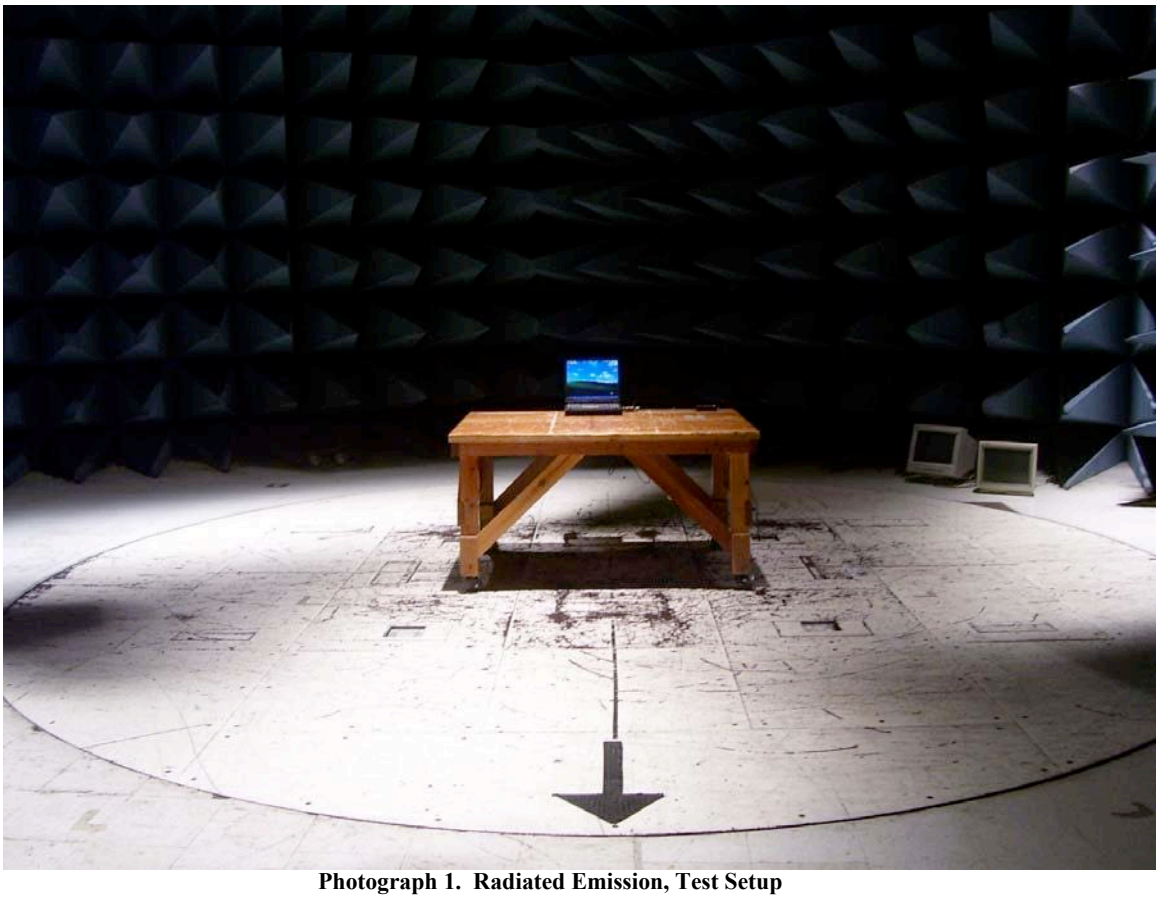
Note 1: * - At this frequency, the measured electric-field strength exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, have at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.



= vertical polarization
= horizontal polarization

Electromagnetic Compatibility Emission Criteria

Radiated Emission: Test Methods and Limits



Photograph 1. Radiated Emission, Test Setup

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 Table 6.

Frequency Range (MHz)	Limits for equipment intended to be used in telecommunication centers only (dB:V)		Limits for equipment intended to be used in other than telecommunication centers (dB:V)	
	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
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.				

Table 6. 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 2). 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): Billy Kwan

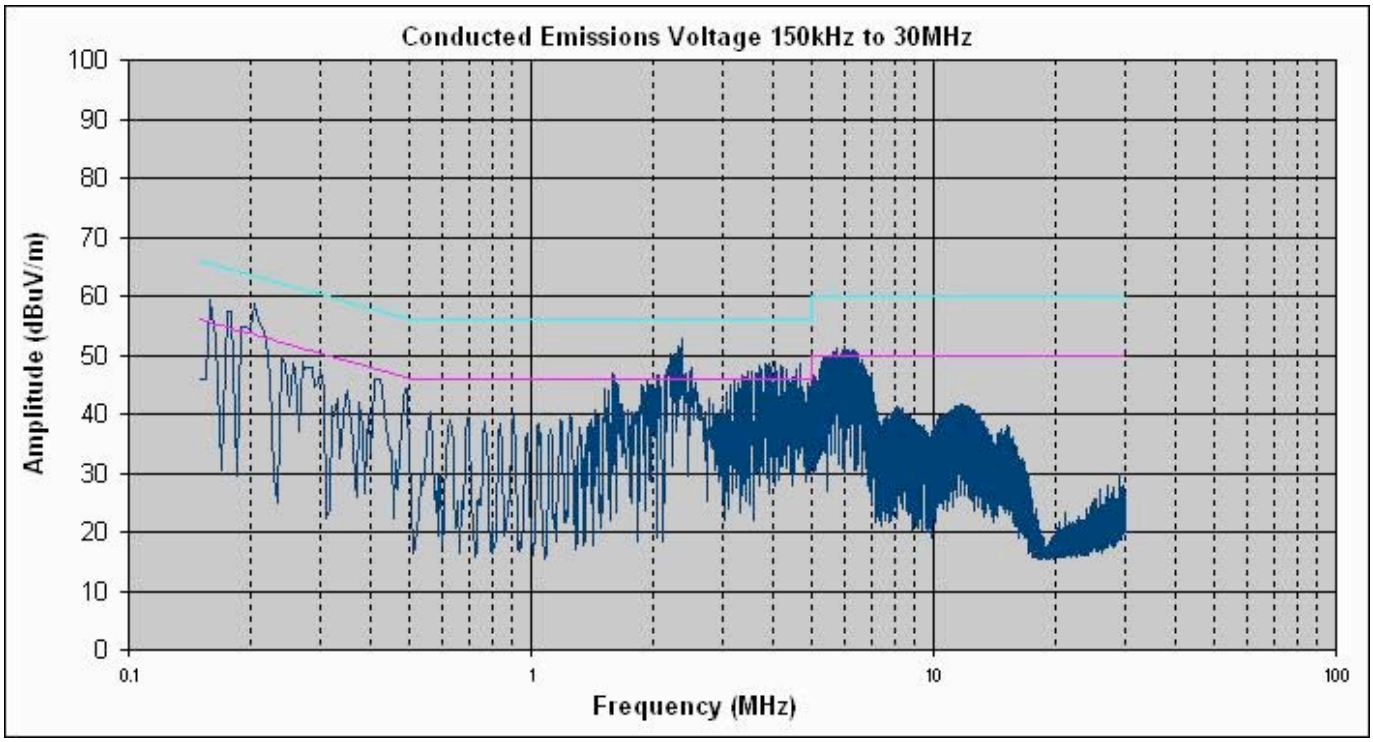
Test Date(s): 3/5/2007

Electromagnetic Compatibility Emission Criteria

Conducted Emission AC Power Interfaces: Test Methods and Limits

Freq. (MHz)	Corrected Amplitude (dBuV) QP	Limit (dBuV) QP	Pass/Fail QP	Margin (dB) QP	Corrected Amplitude (dBuV) AVG	Limit (dBuV) AVG	Pass/Fail AVG	Margin (dB) AVG
0.208	53.34	63.29	Pass	-9.95	43.97	53.29	Pass	-9.32
1.662	38.16	56.00	Pass	-17.84	34.82	46.00	Pass	-11.18
1.732	33.96	56.00	Pass	-22.04	25.86	46.00	Pass	-20.14
2.355	37.64	56.00	Pass	-18.36	26.42	46.00	Pass	-19.58
4.016	44.11	56.00	Pass	-11.89	39.47	46.00	Pass	-6.53
6.231	47.95	60.00	Pass	-12.05	45.94	50.00	Pass	-4.06

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



Conducted Emission Limits, Phase Line Plot

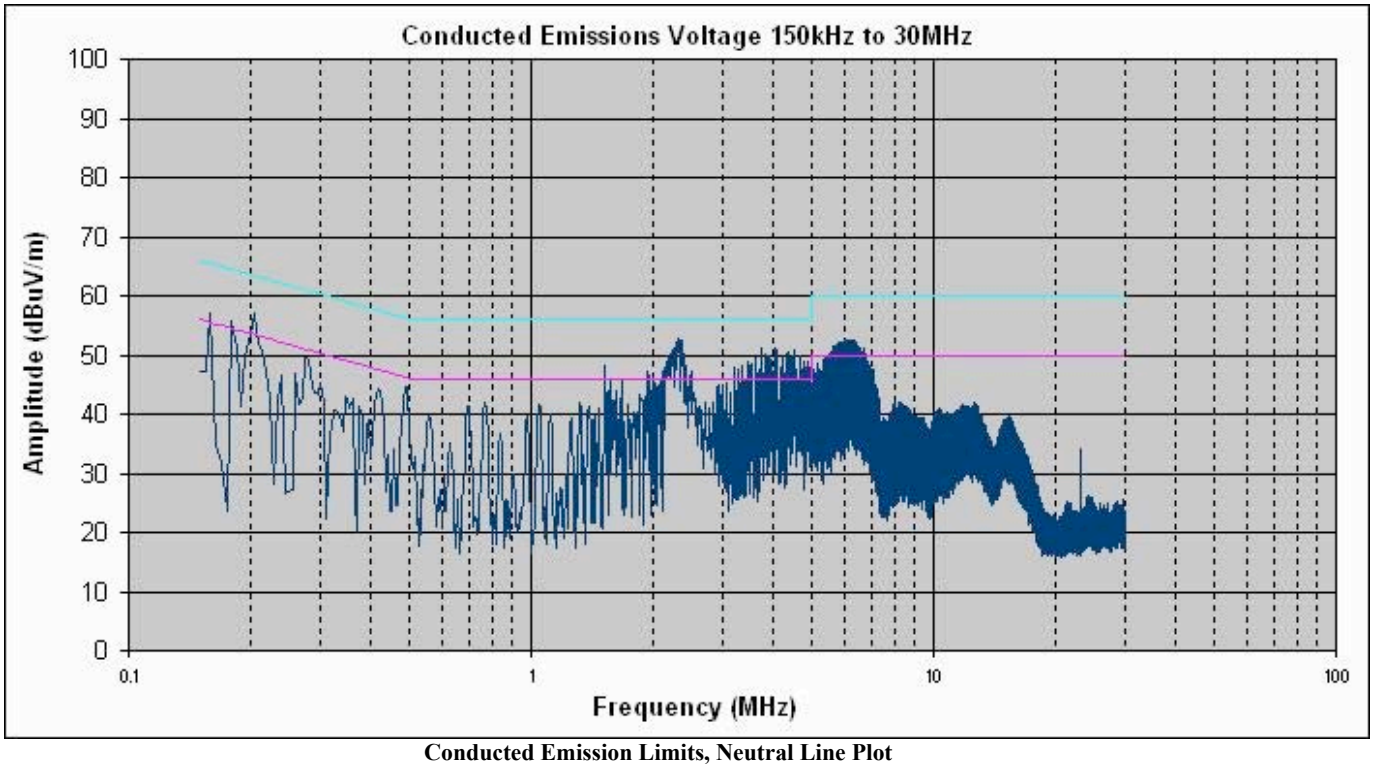
Electromagnetic Compatibility Emission Criteria

Conducted Emission AC Power Interfaces: Test Methods and Limits

FREQ. (MHz)	Corrected Amplitude (dBuV) QP	Limit (dBuV) QP	Pass/Fail QP	Margin (dB) QP	Corrected Amplitude (dBuV) AVG	Limit (dBuV) AVG	Pass/Fail AVG	Margin (dB) AVG
0.208	51.70	63.29	Pass	-11.59	40.82	53.29	Pass	-12.47
1.525	37.25	56.00	Pass	-18.75	32.92	46.00	Pass	-13.08
2.356	44.08	56.00	Pass	-11.92	39.96	46.00	Pass	-6.04
***2.423**	**46.67**	**56.00**	**Pass**	**-9.33**	**44.24**	**46.00**	**Pass**	**-1.76**
3.809	45.57	56.00	Pass	-10.43	41.85	46.00	Pass	-4.15
6.302	48.11	60.00	Pass	-11.89	45.12	50.00	Pass	-4.88

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

Note: * - At this frequency, the measured electric-field strength exhibits a margin of compliance that is less than 3 dB below the specification limit. We recommend that every emission measured, have at least a 3 dB margin to allow for deviations in the emission characteristics that may occur during the production process.



Conducted Emission Limits, Neutral Line Plot

Electromagnetic Compatibility Emission Criteria

Conducted Emission AC Power Interfaces: Test Methods and Limits

Photograph 2. Conducted Emission Mains Interface: Test Method and Limits, Test Setup

Electromagnetic Compatibility Emission Criteria

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 7.

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 7. 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 located in a shielded enclosure (See Photograph 3). The measurement was performed using normal operation of the equipment. The method of testing, test conditions, and test procedures of *EN 61000-3-2*.

Electromagnetic Compatibility Emission Criteria

Harmonic Current Emissions

Test Procedure (Continued): 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.

Test Results: The EUT was found compliant with the specified requirements of Clause 8.5. Measured emissions were below applicable limits.

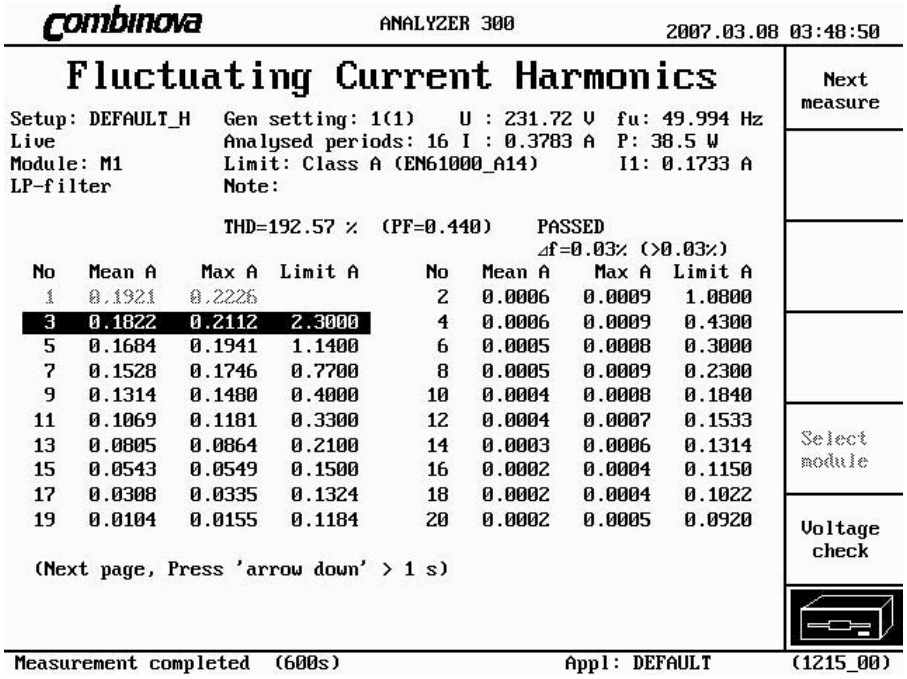
Class (A, B, C, D)	Voltage (V)	Current (I)	Frequency (Hz)	Total Harmonic Distortion (%)
D	231.72	.3783 A	49.994	192.57

Harmonic #	Measured (Amps)	Limit (Amps)	Results
2	.0006	1.080	Pass
3	.1822	2.300	Pass
4	.0006	0.430	Pass
5	.1684	1.140	Pass
6	.0005	0.300	Pass
7	.1528	0.770	Pass
8	.0005	0.230	Pass
9	.1314	0.400	Pass
10	.0004	0.184	Pass
11	.1069	0.330	Pass
12	.0004	0.153	Pass
13	.0805	0.210	Pass
14	.0003	0.131	Pass
15	.0543	0.150	Pass
16	.0002	0.115	Pass
17	.0308	0.132	Pass
18	.0002	0.102	Pass
19	.0104	0.118	Pass
20	.0002	0.092	Pass
21	.0106	0.107	Pass
22	.0002	0.084	Pass
23	.0240	0.098	Pass
24	.0003	0.077	Pass
25	.0328	0.090	Pass
26	.0003	0.071	Pass
27	.0450	0.083	Pass
28	.0003	0.066	Pass

29	.0440	0.078	Pass
30	.0003	0.061	Pass
31	.0392	0.073	Pass
32	.0003	0.058	Pass
33	.0325	0.068	Pass
34	.0003	0.054	Pass
35	.0267	0.064	Pass
36	.0002	0.051	Pass
37	.0211	0.061	Pass
38	.0002	0.048	Pass
39	.0156	0.058	Pass
40	.0001	0.046	Pass

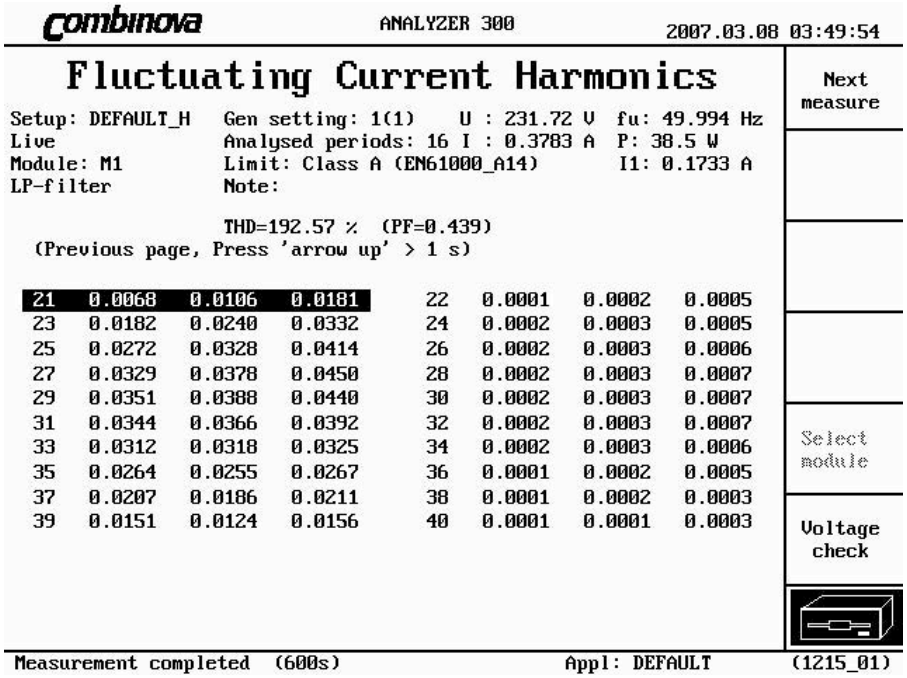
Test Engineer(s): Anderson Soungpanya

Test Date(s): 3/7/2007



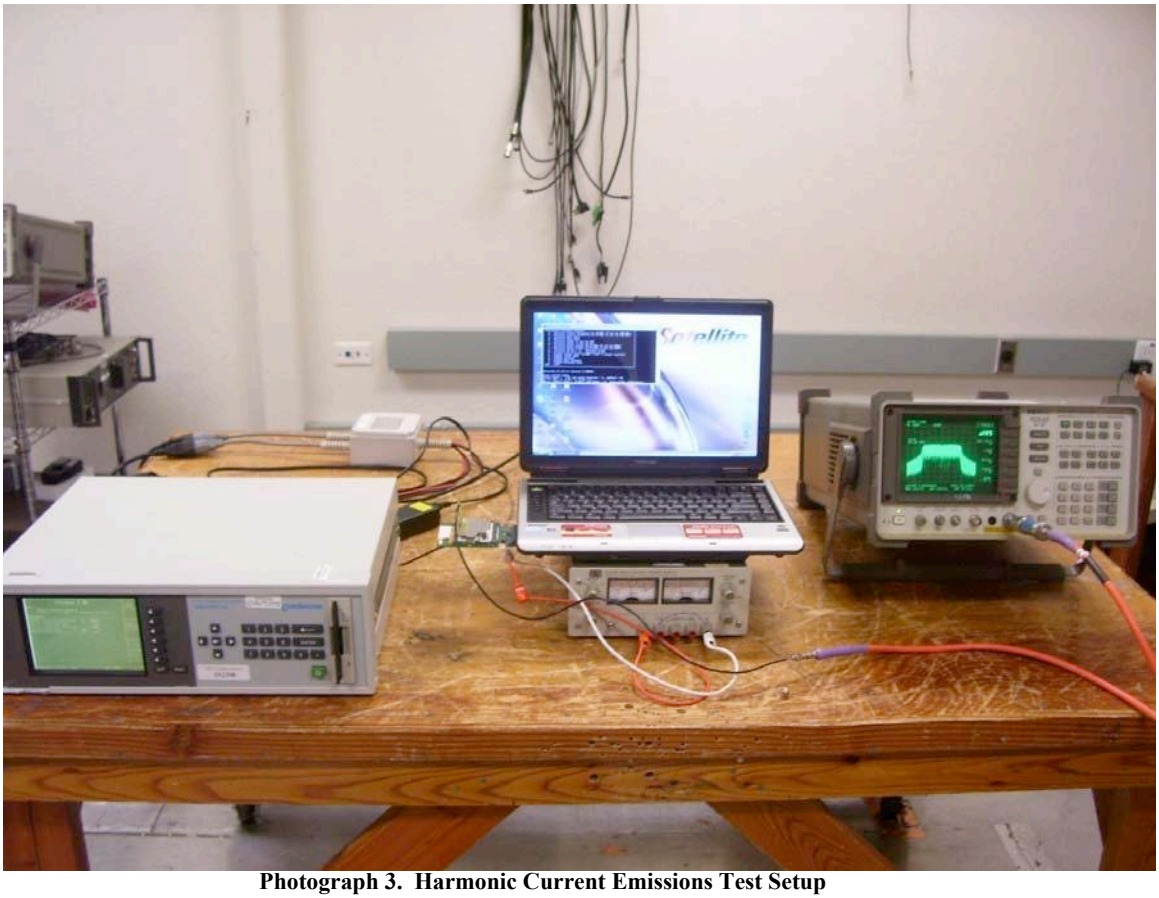
Electromagnetic Compatibility Emission Criteria

Harmonic Current Emissions



Electromagnetic Compatibility Emission Criteria

Harmonic Current Emissions



Photograph 3. Harmonic Current Emissions Test Setup

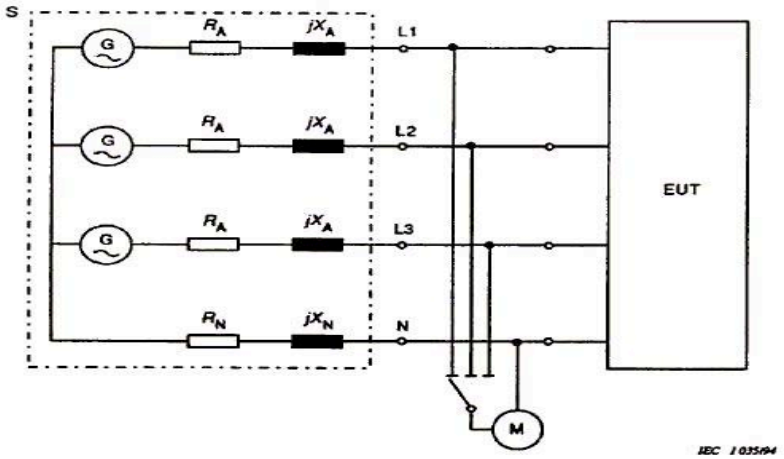
Electromagnetic Compatibility Emission Criteria

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 located inside a shielded enclosure (See Photograph 4). The EUT was situated such that the sides of the EUT were no closer than 2.0 m from the walls of the shielded enclosure. 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 3 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 3. Test Circuit for EN 61000-3-3

Electromagnetic Compatibility Emission Criteria

Voltage Fluctuations (Flicker)

Test Results: The EUT was found compliant with the specified requirements of Clause 8.6. Measured emissions were below applicable limits.

Voltage (V)	Current (I)	Frequency (Hz)	Total Harmonic Distortion (%)
231.8	0.214A	50.003	.398

Average (Is) relative voltage Drop	**d(t)**	.012%
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)	**Pp**	0.00

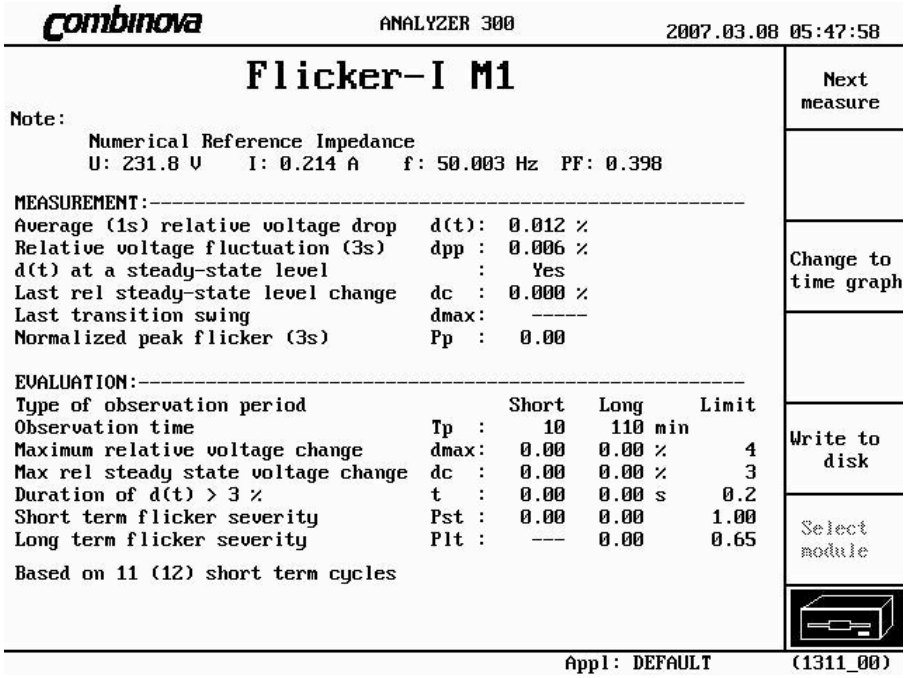
Parameter		Observation Period		Limit
		Short	Long	
Observation Time	**Tp**	10 min	120 min	
Maximum relative voltage change	**dmax**	0.00 %	0.00 %	4
Max rel. steady-state voltage change	**dc**	0.00 %	0.00 %	3
Duration of d(t) > 3 %	**t**	0.00 s	0.00 s	0.2
Short term flicker severity	**Pst**	0.00	0.00	1.00
Long term flicker severity	**Plt**	NA	0.00	0.65

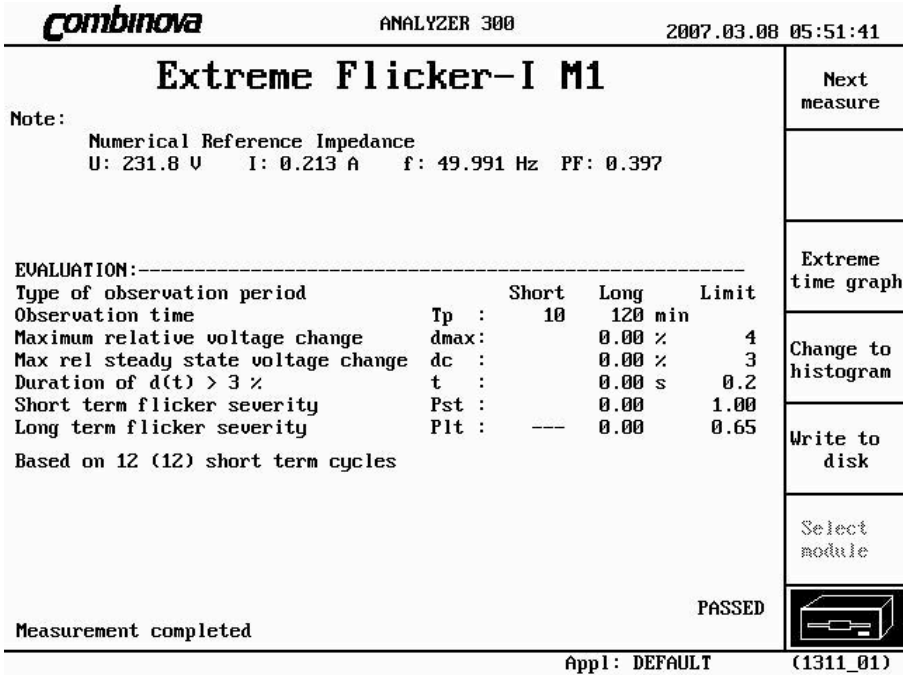
Test Engineer(s): Anderson Soungpanya

Test Date(s): 3/7/2007

Electromagnetic Compatibility Emission Criteria

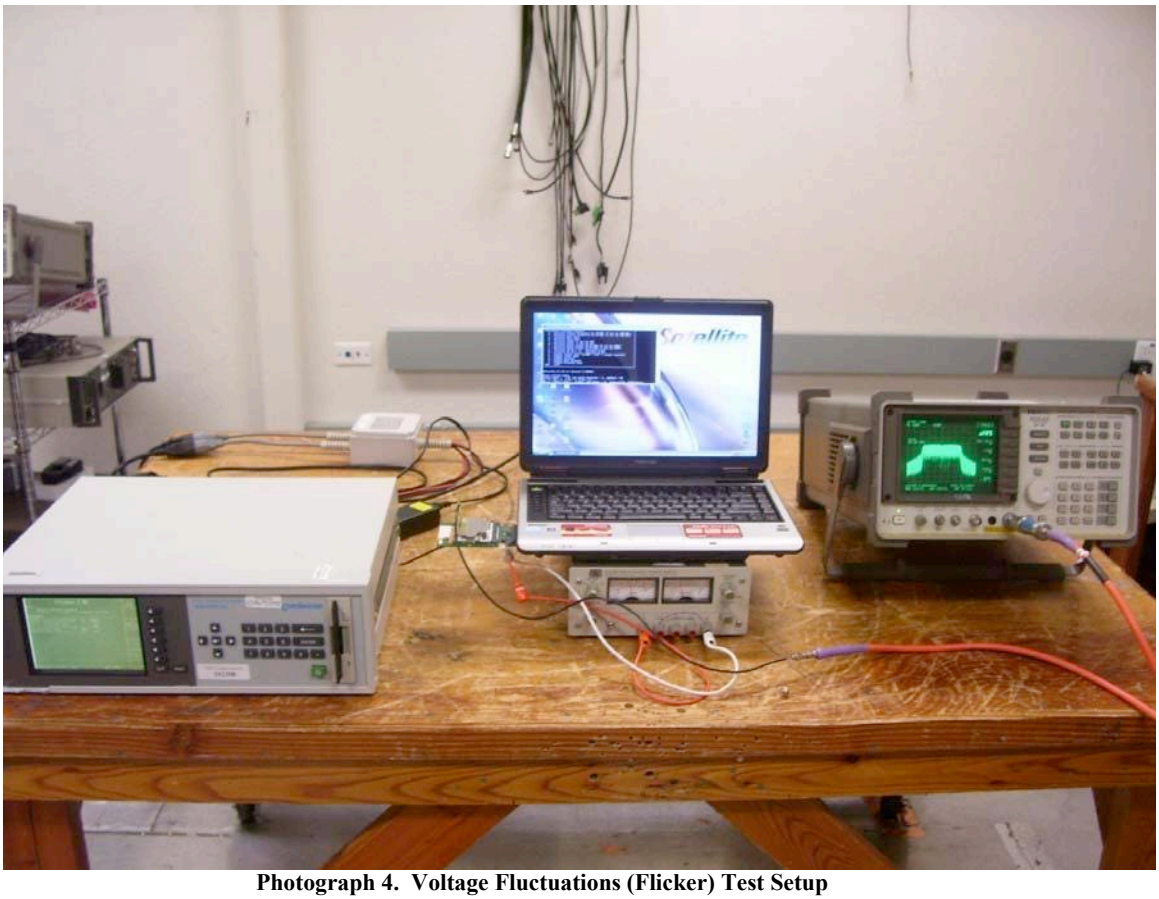
Voltage Fluctuations (Flicker)





Electromagnetic Compatibility Emission Criteria

Voltage Fluctuations (Flicker)



Photograph 4. 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:	45%

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.

Electromagnetic Compatibility Immunity Criteria

Radio Frequency Electromagnetic Field

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*.

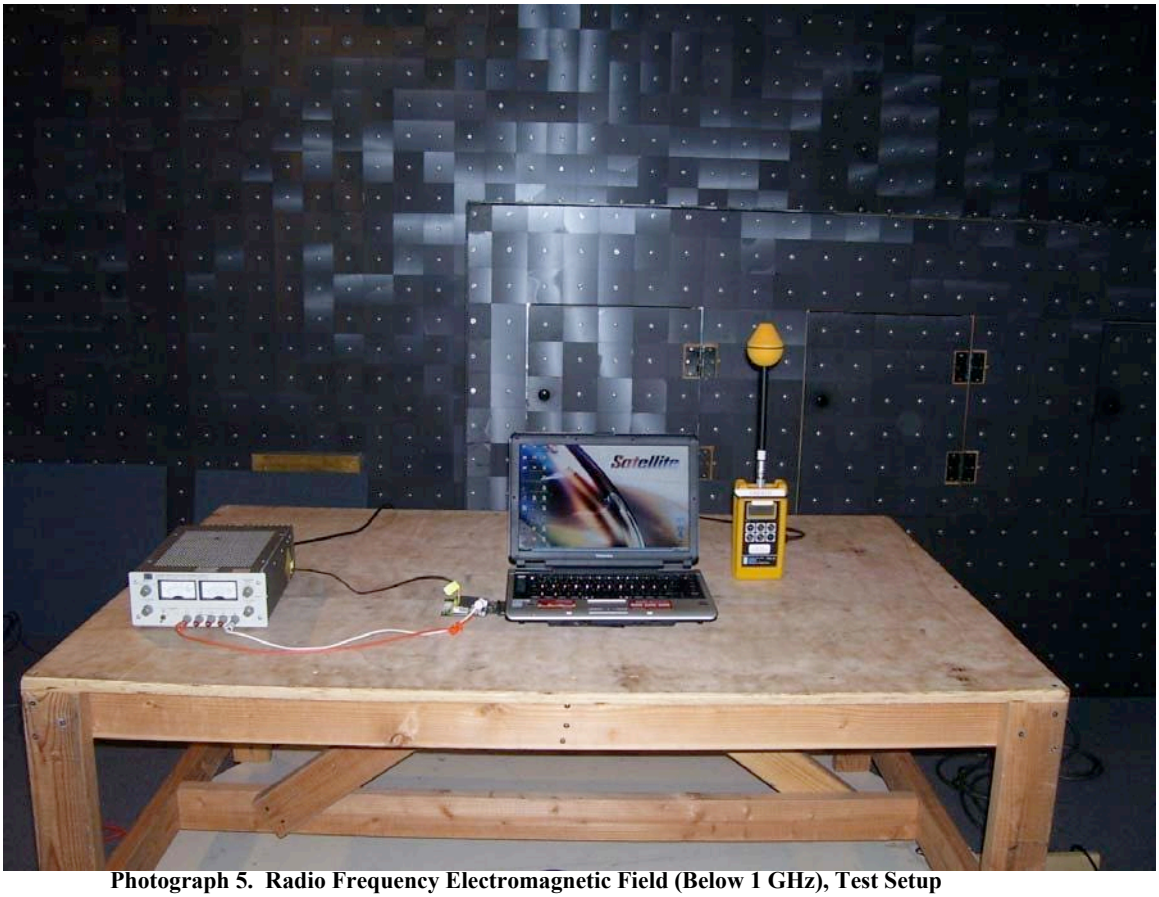
Severity (V/m)	Polarity (H/V)	Start Frequency (MHz)	Stop Frequency (MHz)	Modulation (Freq & Type)	Results			
					Front	Back	Right	Left
3	V	80	1000	1 kHz AM 80%	Pass	Pass	Pass	Pass
3	H	80	1000	1 kHz AM 80%	Pass	Pass	Pass	Pass
3	V	1400	2000	1 kHz AM 80%	Pass	Pass	Pass	Pass
3	H	1400	2000	1 kHz AM 80%	Pass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

Test Engineer(s): Anderson

Test Date(s): 2/23/2007

Electromagnetic Compatibility Immunity Criteria

Radio Frequency Electromagnetic Field



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

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 4, having an amplitude of ± 1 kV applied to the AC power cables (plug type). Only cables that could potentially exceed 3 m in length in real-world application of the EUT need be tested. Performance criterion A applies for all tests.

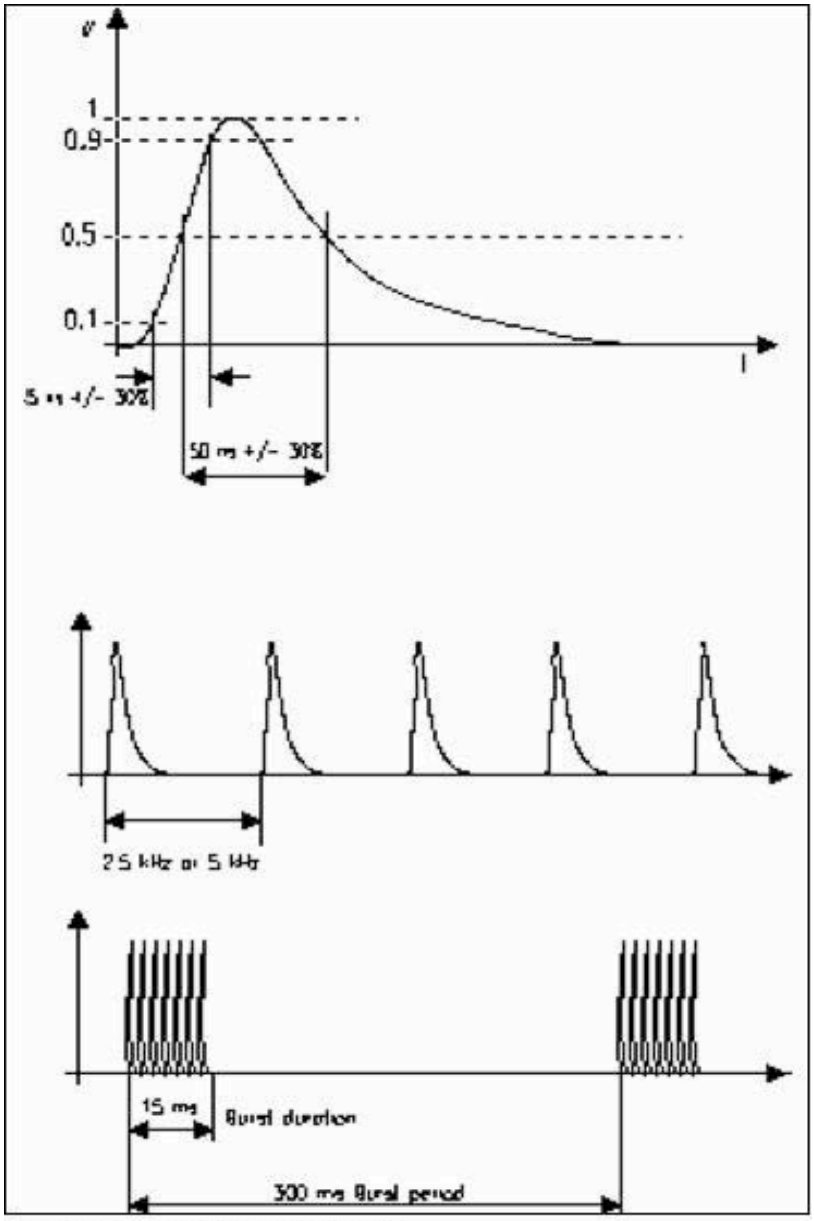
Test Procedure: The EUT was placed on a 0.8m-high wooden table located above a GRP extending at least 1 m beyond all sides of the EUT (See Photograph 7). The Electrical Fast Transient/Burst (EFT/B) generator and the coupling clamp were mounted to the ground plane. For application of the fast transients 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.

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

Electromagnetic Compatibility Immunity Criteria

Fast Transient, Common Mode



Test Waveform for EN 61000-4-4

Figure 4. EN 61000-4-4 Test Waveform

Electromagnetic Compatibility Immunity Criteria

Fast Transient, Common Mode

Test Results: The EUT as tested was found compliant with the requirements of Clause 9.4. No anomalies were observed.

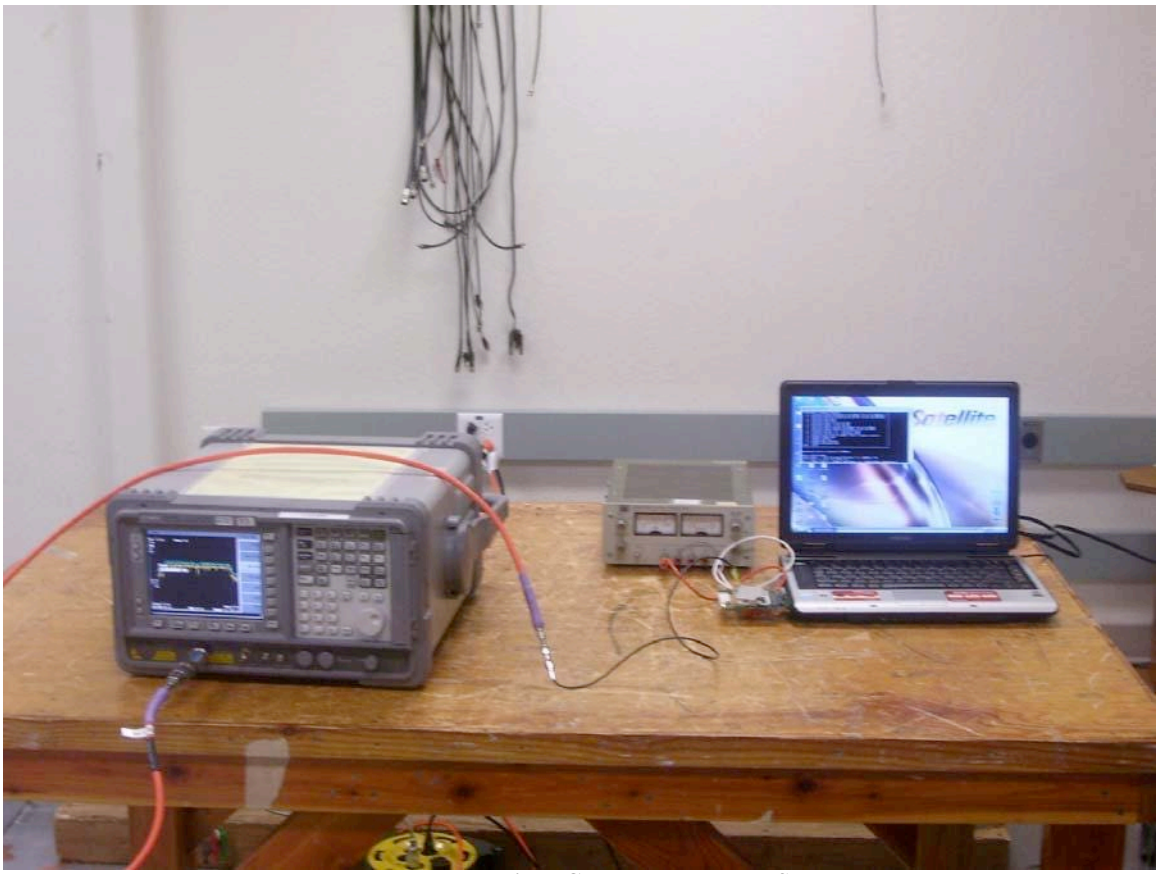
Port Name	Slot/EUT Side	Test Level	Results	Anomalies
AC Power / Differential Mode				
Phase to Neutral	Back	±1.0 kV	Pass	No anomalies were observed.

Test Engineer(s): Anderson Soungpanya

Test Date(s): 2/23/2007

Electromagnetic Compatibility Immunity Criteria

Fast Transient, Common Mode



Photograph 7. Fast Transient, Common Mode Test Setup

Electromagnetic Compatibility Immunity Criteria

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 0.1m-high wooden block located above a GRP extending at least 1 m beyond all sides of the EUT (See Photograph 8). 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.

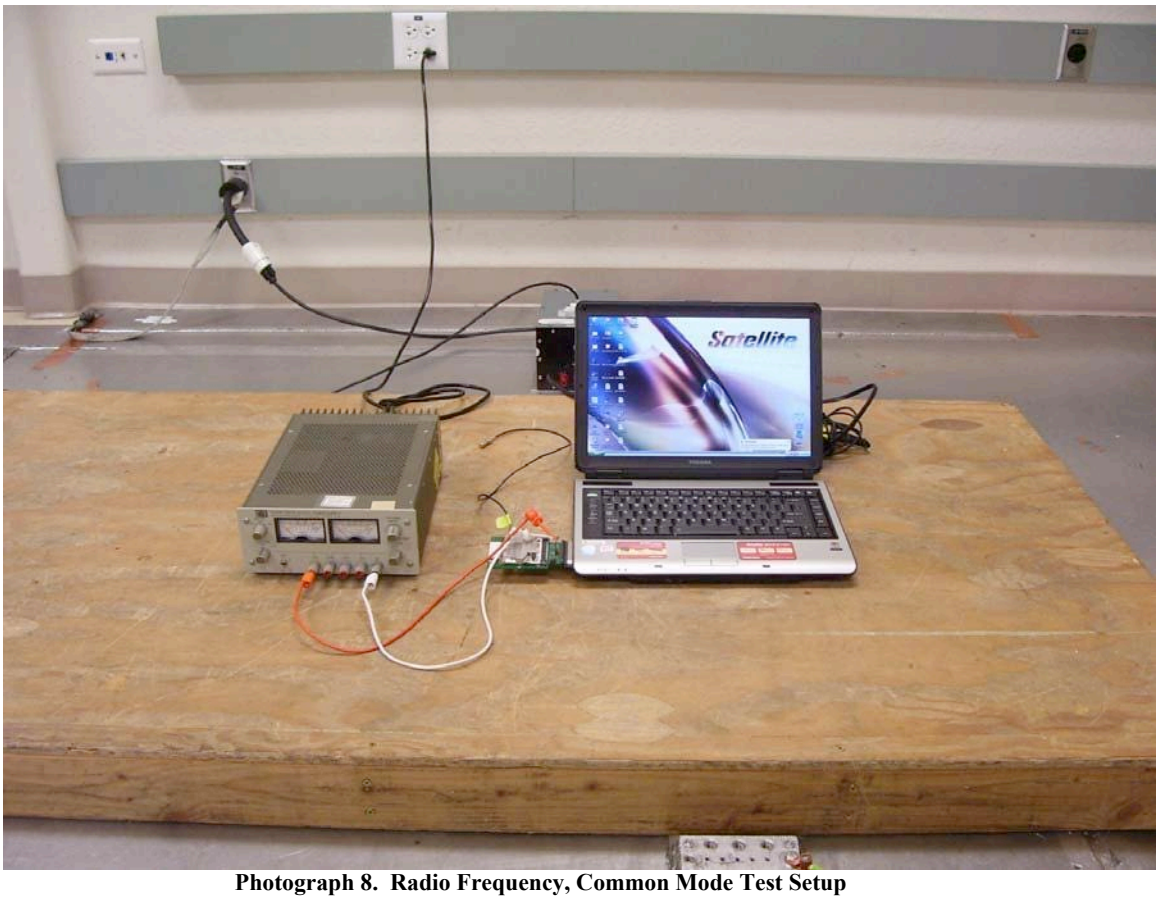
Test Results: The EUT as tested was found compliant with the requirements of Clause 9.5.

Slot/EUT Side	Port Name	Results	Anomalies
AC Power Line	Power	Pass	No anomalies were observed.

Test Date(s): 2/23/2007

Electromagnetic Compatibility Immunity Criteria

Radio Frequency, Common Mode



Photograph 8. Radio Frequency, Common Mode Test Setup

Electromagnetic Compatibility Immunity Criteria

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	B
Voltage reduction % Duration ms	>95 5000	B

Table 8. 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 9). 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.

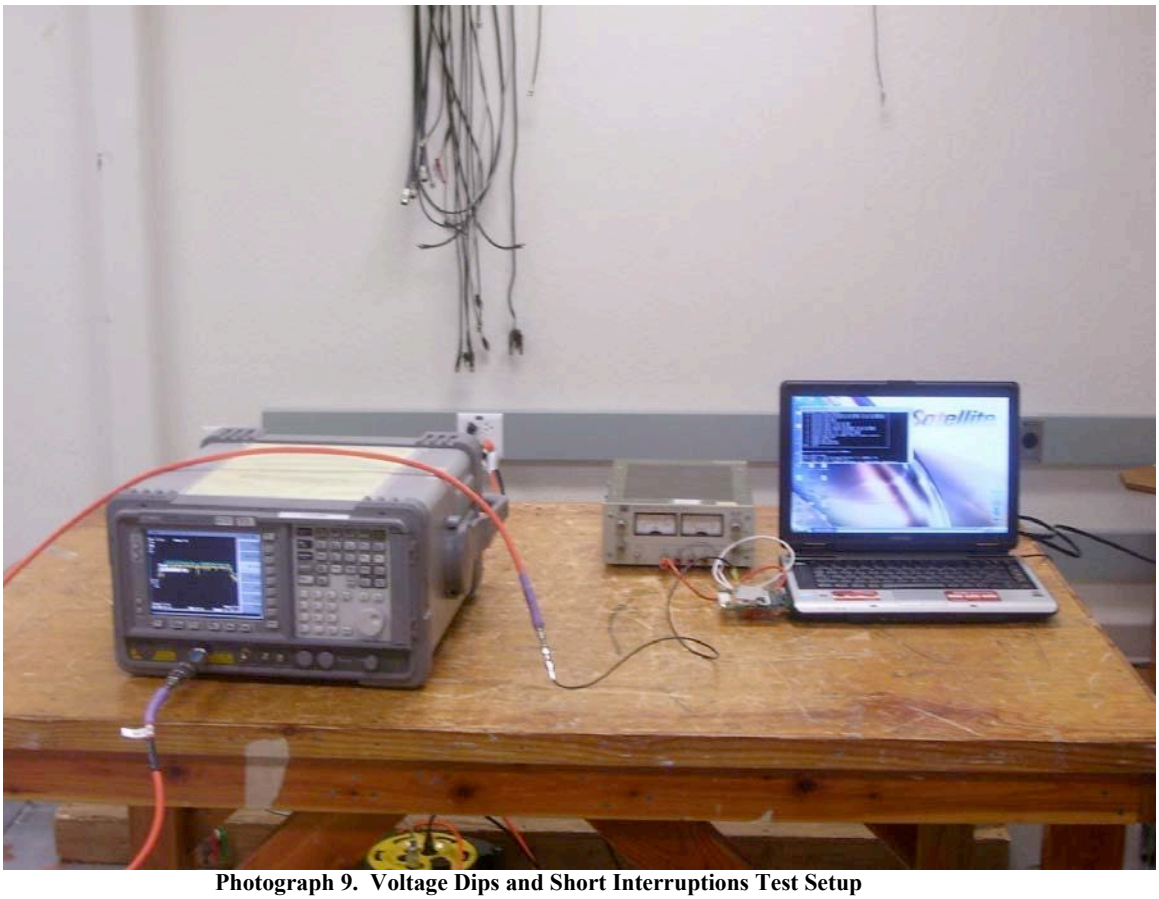
Results: The EUT as tested was found compliant with the requirements of Clause 9.6.

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

Test Date: 2/23/2007

Electromagnetic Compatibility Immunity Criteria

Voltage Dips and Short Interruptions



Photograph 9. Voltage Dips and Short Interruptions Test Setup

Electromagnetic Compatibility Immunity Criteria

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.

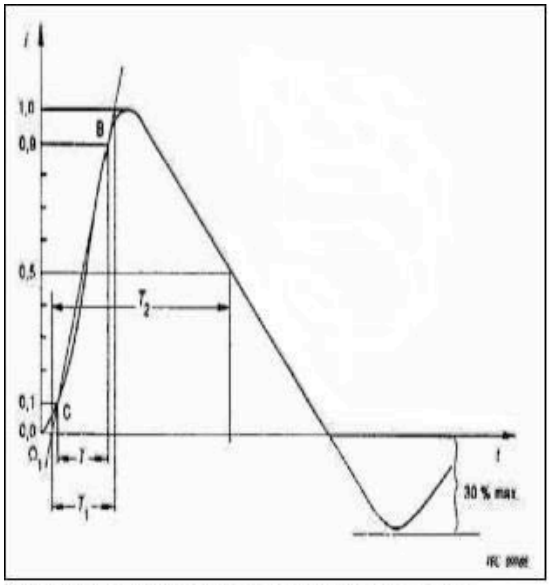
Test Procedure: The EUT was placed on a 0.8m-high wooden table above a GRP extending at least 1 m beyond all sides of the EUT (See Photograph 10). AC power [where applicable] was supplied to the EUT through the Combination Wave Generator. The combination wave generator was configured to produce the following output:

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

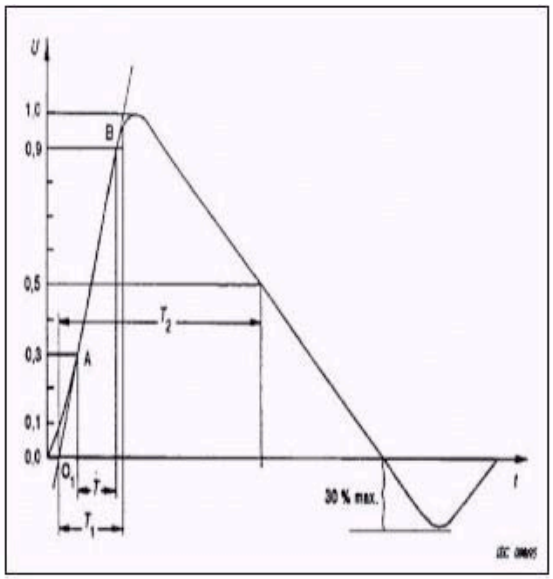
Table 9. Combination Wave Generator Test Parameters for EN 61000-4-5

Electromagnetic Compatibility Immunity Criteria

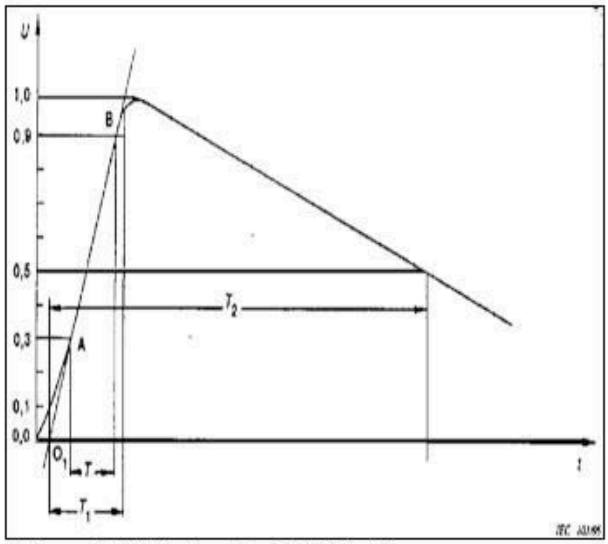
Surges



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 5. EN 61000-4-5 Surge Test Waveforms

Electromagnetic Compatibility Immunity Criteria

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.

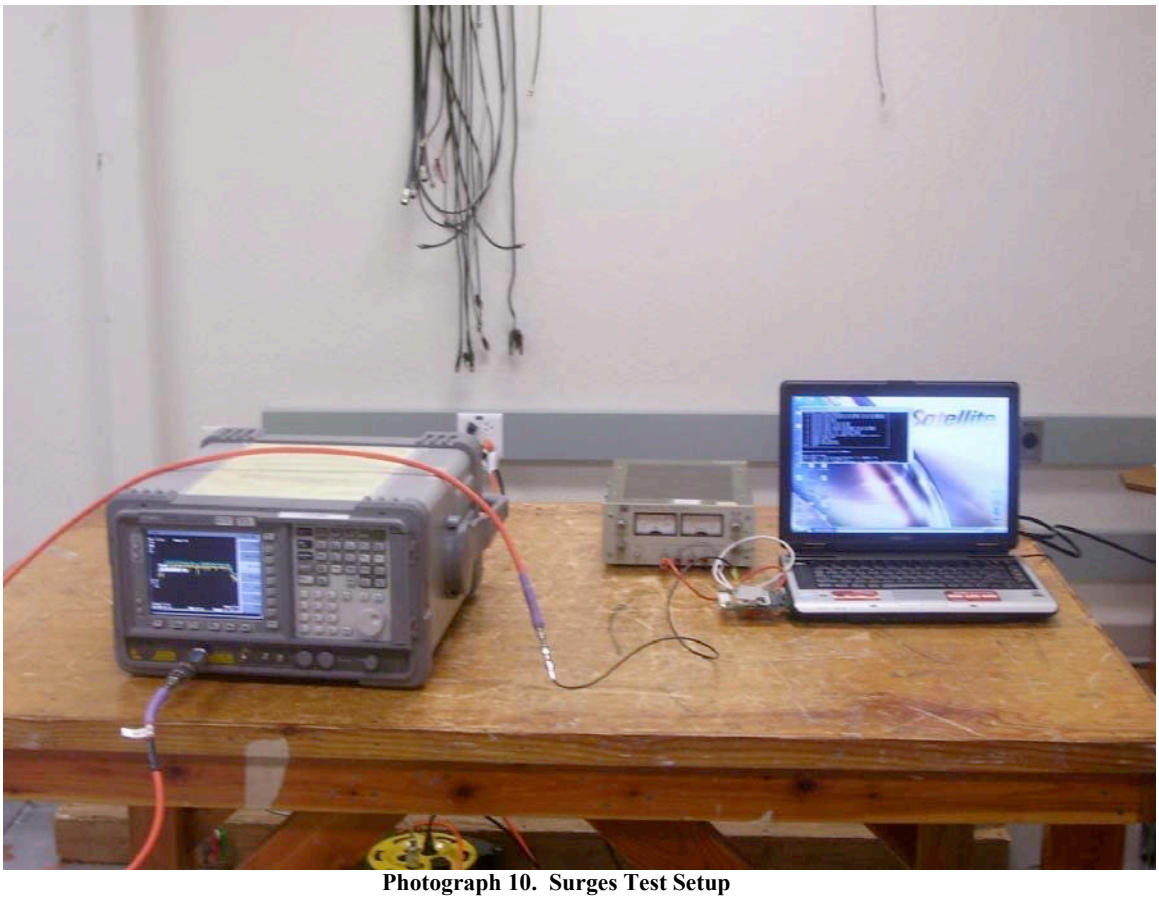
Test Results: The EUT as tested was found compliant with the requirements of Clause 9.8. No anomalies were observed.

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

Test Date(s): 2/23/2007

Electromagnetic Compatibility Immunity Criteria

Surges



Photograph 10. 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: Radiated Emissions Electric Field (Section 8.2)					Test Date(s): 3/19/2007
Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2184	Antenna Bilog	Chase	CBL6112A	01/03/2007	01/03/2008
1S2263	10 Meter chamber	Rantec	N2-14	08/15/2006	08/15/2007
1S2461	Digital Hygrometer/Thermometer	Fisher Scientific	11-661-13	05/25/2005	05/25/2007
1S2421	EMI Test Receiver (20Hz to 7 GHz)	Rohde & Schwarz	ESIB 7	03/22/2006	03/22/2007
Test Name: AC Conducted Emissions Voltage (Section 8.4)					**Test Date(s): 3/5/2007**
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
1S2263	10 Meter Chamber	Rantec	N2-14	08/15/2006	08/15/2007
1S2464	A/C LISN	Solar Electronics	9252-50-R24-BNC	09/01/2006	09/01/2007
Test Name: EN 61000-3-2 Harmonic Current Emissions					**Test Date(s): 3/7/2007**
Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2398	Harmonics Analyzer	Combinova	Analyzer 300	01/03/2007	01/06/2008
1S2398	Analyzer Input	Combinova	70-95	01/03/2007	01/06/2008
1S2468	Digital Hygrometer/Thermometer	Fisher Scientific	11-661-13	07/27/2006	07/26/2008
1S2378	ESD Area #1	TUV/BABT	N/A	07/26/2006	07/26/2007
Test Name: EN 61000-3-3 Voltage Fluctuations (Flicker)					**Test Date(s): 3/7/2007**
Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2398	Harmonics Analyzer	Combinova	Analyzer 300	01/03/2007	01/06/2008
1S2398	Analyzer Input	Combinova	70-95	01/03/2007	01/06/2008
1S2468	Digital Hygrometer/Thermometer	Fisher Scientific	11-661-13	07/27/2006	07/26/2008
1S2378	ESD Area #1	TUV/BABT	N/A	07/26/2006	07/26/2007
Test Name: Radiated Electromagnetic Field (Section 9.2)					**Test Date(s): 2/23/2007**
Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2401	Bilog Antenna (20 MHz-2 GHz)	Schaffner-Chase	CBL6140A	See Note	
1S2468	Digital Hygrometer/Thermometer	Fisher Scientific	11-661-13	07/27/2006	07/26/2007
1S2153	Amplifier (broadband and wide band)	Amplifier Research	100W/100M1A	See Note	
1S2410	Electric Field Probe	Wandel & Goltermann	EMC-20	02/19/2007	02/19/2008
1S2409	Synthesized RF Signal Generator	Gigatronics	6062A	09/29/2006	09/29/2007
1S2264	Anechoic Chamber	Lindgren RF Enclosures	N/A	10/13/2006	10/13/2007
1S2208	Horn Antenna (TX only)	Emco	3115	See Note	
1S2017	Amplifier	Hughes	1177H09F000	See Note	

Test Name: EN 61000-4-4 Fast Transients				Test Date(s): 2/23/2007	
Equipment #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2423	Ultra Compact Simulator	Amplifier Research	UCS 500-M/6A	01/25/2007	01/25/2008
1S2378	ESD Area #1	MET Laboratories	N/A	07/26/2005	07/26/2007
1S2468	Digital Hygrometer/Thermometer	Fisher Scientific	11-661-13	07/27/2006	07/26/2008
Test Name: EN 61000-4-5 Surges				**Test Date(s): 2/23/2007**	
Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2378	ESD Area #1	MET Laboratories	N/A	07/26/2006	07/26/2007
1S2423	Ultra Compact Simulator	Amplifier Research	UCS 500-M/6A	01/25/2007	01/25/2008
1S2468	Digital Hygrometer/Thermometer	Fisher Scientific	11-661-13	07/27/2006	07/26/2007
Test Name: EN 61000-4-6 Radio Frequency, Conducted Continuous				**Test Date(s): 2/23/2007**	
Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2020	Wideband Amplifier (.01 – 1000 MHz)	IFI	M5500	See Note	
1S2093	Coupling Decoupling NET (150 kHz – 230 MHz)	FCC	801-M3-25	11/28/2006	11/28/2007
1S2378	ESD Area #1	TUV/BABT	N/A	07/26/2006	07/26/2007
1S2400	RF Current Probe	Solar Electronics	6741-1	01/05/2007	01/05/2008
1S2406	Spectrum Analyzer	HP	8591E	09/26/2006	09/26/2007
1S2390	Synthesized RF Signal Generator	Gigatronics	6061A	04/28/2006	04/28/2007
1S2468	Digital Hygrometer/Thermometer	Fisher Scientific	11-661-13	07/27/2006	07/26/2007
Test Name: EN 61000-4-11 Voltage Dips and Short Interruptions				**Test Date(s): 2/23/2007**	
Asset #	**Equipment**	**Manufacturer**	**Model**	**Last Cal Date**	**Cal Due Date**
1S2468	Digital Hygrometer/Thermometer	Fisher Scientific	11-661-13	07/27/2006	07/26/2007
1S2378	ESD Area #1	MET Laboratories	N/A	07/26/2006	07/26/2007
1S2423	Ultra Compact Simulator	Amplifier Research	UCS 500-M/6A	01/25/2007	01/25/2008

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

End of Report