# Test Report

| | |
|---|---|
| Report No | EF0364-2 |
| Client | Colubris Networks<br>Gerrett Durling |
| Address | 200 West Street<br>Waltham, MA 02451 |
| Phone | 781-547-0378 |
| Items tested<br>FCC ID<br>IC | MAP200<br>RTP-550-10016-4<br>4891A-0100164 |
| Standards | 47 CFR 15.247, 15E, RSS-210 Issue 5 |
| Test Dates | May 13 through 16, 2005 |
| Results | As detailed within this report |
| Prepared by | Mairaj Hussain – Test Engineer |
| Authorized by | Michael Buchholz – EMC Manager |
| Issue Date | 6/14/05 |
| Conditions of Issue | This Test Report is issued subject to the conditions stated in the '*Terms and Conditions*' section on page 29 of this report. |

Curtis-Straus LLC is accredited by the American Association for Laboratory Accreditation for the specific scope of accreditation under Certificate Number 1627-01. This report may contain data which is not covered by the A2LA accreditation.

ACCREDITED
Cert No. 1627-01

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Form Final Report REV 28-APR-05 (DW)

## *Summary*

This report is intended to demonstrate Class II permissive change to CN200, previously tested under CS work order E1000.

Class II permissive change to CN200 is requested because of the following reasons:

1. CN200 is now known as MAP200
2. MAP200 has a different enclosure compared to the previously used enclosure of CN200.

Spurious emissions testing was performed on the product in the frequency range of 30 – 2000MHz.

Release Control Record

| Issue No. | Reason for change | Date Issued |
|---|---|---|
| 1 | Original Release | June 14, 2005 |

## *Product Tested - Configuration Documentation*

### EUT Configuration (AC/DC option)

**Work Order:** F0364
**Company:** Colubris Networks
**Company Address:** 200 West Street
Waltham, MA 02451
**Contact:** Gerrett Durling
**Person Present:** Gerrett Durling

| | MN | SN |
|---|---|---|
| **EUT:** | MAP200 | 4321FF55AA |
| FSP power supply | FSP015-1AD201A | H00002781 |

**EUT Description:** Wireless access point
**EUT Max Frequency:** <500MHz

| *Support Equipment:* | MN | SN |
|---|---|---|
| Dell laptop | Inspiron 1100 | - |
| Netgear hub | DS104 | - |
| Colubris CN330 | 330 | - |

| *EUT Cables:* | Qty | Shielded? | Length | Ferrites |
|---|---|---|---|---|
| Ethernet | 1 | Yes | 5 m | None |
| DC power | 1 | No | 0.8 m | None |
| AC to power supply | 1 | No | 1.5 m | None |

| *Unpopulated EUT Ports:* | Qty | Reason |
|---|---|---|
| dB-9 | 1 | Diag (craft port) |

***Software / Operating Mode Description:***

Two separate routines were run simultaneously. A ping routine verified the wired connection between the laptop and the MAP200. Diagnostic software on the CN330 was used to monitor the status of the wireless connection. CN330 was monitored through a connection to the laptop.
MAP200 was operated in automatic channel select mode during the testing.

# EUT Configuration (POE option)

**Work Order:** F0364
**Company:** Colubris Networks
**Company Address:** 200 West Street
Waltham, MA 02451
**Contact:** Gerrett Durling
**Person Present:** Gerrett Durling

| | MN | SN |
|---|---|---|
| **EUT:** | MAP200 | 4321FF55AA |
| **EUT Description:** | Wireless access point | |
| **EUT Max Frequency:** | <500MHz | |

| ***Support Equipment:*** | **MN** | **SN** |
|---|---|---|
| POE module | 3001 | B04386050407621 |
| Dell laptop | Inspiron 1100 | - |
| Netgear hub | DS104 | - |
| PowerDsine POE adapter | PD-3001/AC | B04386050407621700 |
| Colubris CN330 | 330 | - |

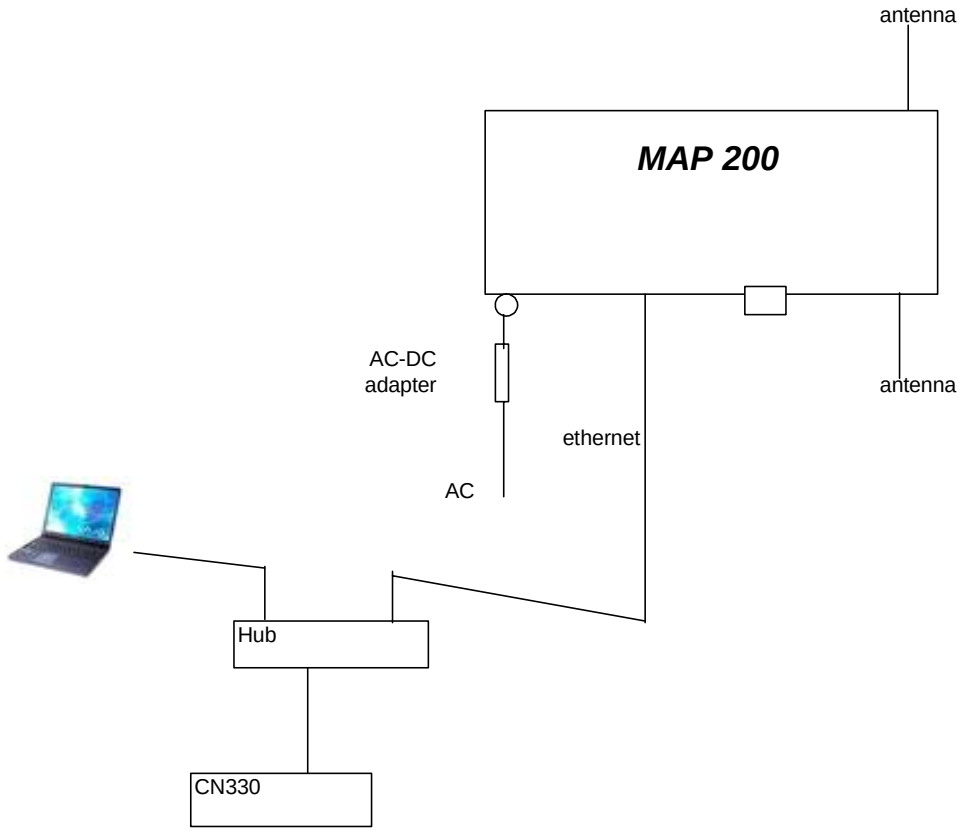
| ***EUT Cables:*** | **Qty** | **Shielded?** | **Length** | **Ferrites** |
|---|---|---|---|---|
| Ethernet | 1 | Yes | 5 m | None |

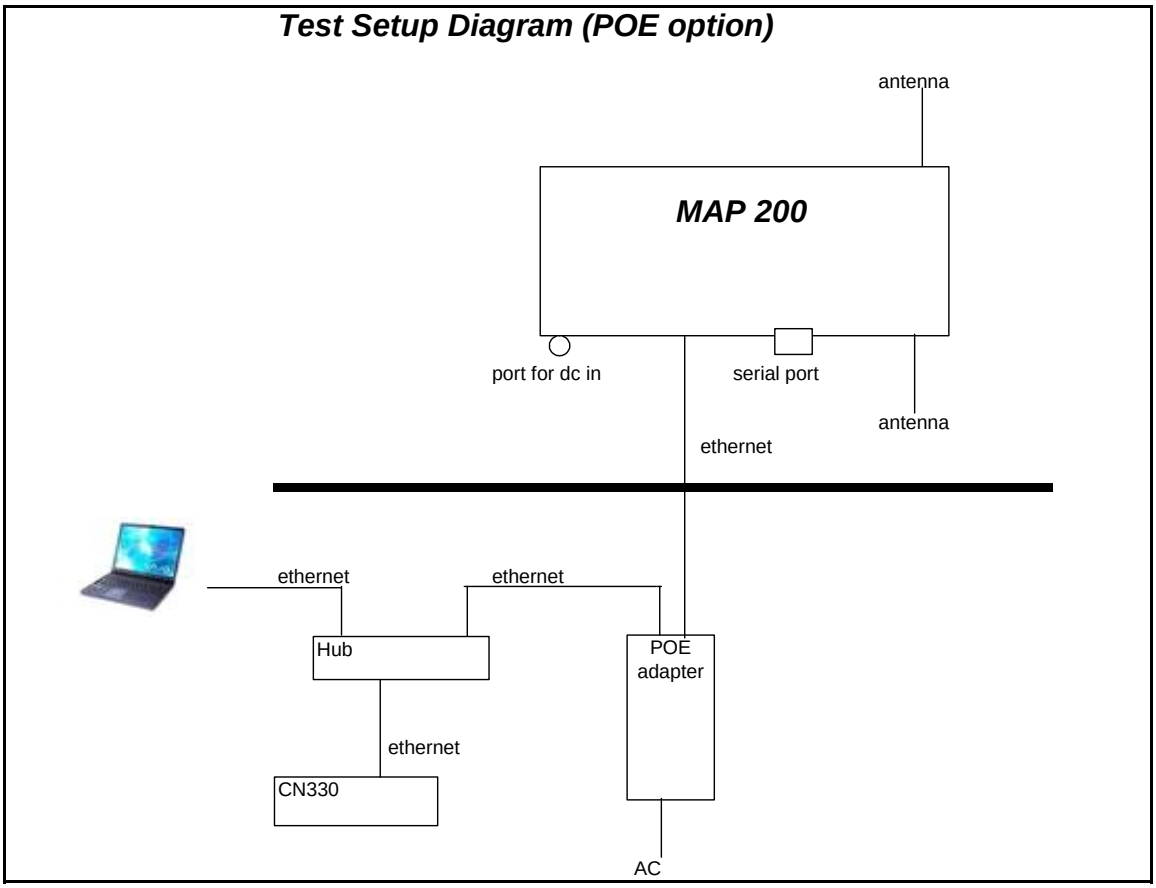
| ***Unpopulated EUT Ports:*** | **Qty** | **Reason** |
|---|---|---|
| dB-9 | 1 | Diag (craft port) |
| DC input | 1 | Not used with POE option |

***Software / Operating Mode Description:***

Two separate routines were run simultaneously. A ping routine verified the wired connection between the laptop and the MAP200. Diagnostic software on the CN330 was used to monitor the status of the wireless connection. CN330 was monitored through a connection to the laptop.
MAP200 was operated in automatic channel select mode during the testing.

***Test setup Diagram (power supply option)***




Test Setup Diagram (POE option)
antenna
MAP 200
port for dc in
serial port
antenna
ethernet
ethernet
ethernet
Hub
POE
adapter
ethernet
CN330
AC

### *Compliance Statement*

| TEST | RESULT | STANDARD | TEST LEVEL | MARGIN | COMMENTS |
|---|---|---|---|---|---|
| ***Radiated Emissions*** | PASS | FCC CFR 47 Part 15 /ICES-003/ RSS-210 Issue 5 | Class B | 2.4dB @ 450MHz | Margin to FCC limit; Power supply option |
| ***AC Mains Conducted Emissions*** | PASS | FCC CFR 47 Part 15 /ICES-003/ RSS-210 Issue 5 | Class B | 6.3dB @ 0.16MHz | Test done on AC side of AC/DC adapter |

### *Modifications Required for Compliance*

For EMI the following modifications were done:

The product was failing radiated emissions at 225MHz and 450MHz. These modifications were made to improve the emissions coupling onto DC power and Ethernet cable.

C578 through C581 on dc power were removed.
Paint removed from the Ethernet connector on the face plate.

Modifications (i) and (ii) listed in report EE1000-3 do not apply to MAP200.
Modifications (iii) through (vii) listed in report EE1000-3 apply to MAP200 and are listed below:

a) Switch to lower gain antennas (2dBi)
b) Max value for PCDAC must be set at 44 for 5.15 - 5.25 GHz UNI band.
c) Max value for PCDAC must be set at 30 for 5.725 – 5.825 GHz UNI band.
d) Max value for PCDAC must be set at 44 for 15.247 operation.

## *Test Results*

Table 1

**Radiated Emissions Table** *Curtis-Straus LLC*

**Date:** 13-May-05 **Company:** Colubris Networks **Work Order:** F0364
**Engineer:** Mairaj Hussain **EUT Desc:** MAP200

**Frequency Range:** 30 -2000 MHz **Measurement Distance:** 3 m

**Notes:** Removed caps (C579, C578, C580, C581) from the dc power (before and after CM choke) **EUT Max Freq:** <500MHz
**Power supply config** Removed paint from ethernet port on the face plate

| Antenna Polarization (H / V) | Frequency (MHz) | Reading (dBµV) | Preamp Factor (dB) | Antenna Factor (dB/m) | Cable Factor (dB) | Adjusted Reading (dBµV/m) | CISPR Class B Limit (dBµV/m) | CISPR Class B Margin (dB) | CISPR Class B Result (Pass/Fail) | FCC Class B Limit (dBµV/m) | FCC Class B Margin (dB) | FCC Class B Result (Pass/Fail) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| v | 84.5 | 33.7 | 22.4 | 8.3 | 1.1 | 20.7 | 40.5 | -19.8 | Pass | 40.0 | -19.3 | Pass |
| v | 88.0 | 36.0 | 22.4 | 8.1 | 1.1 | 22.8 | 40.5 | -17.7 | Pass | 40.0 | -17.2 | Pass |
| v | 89.99 | 46.7 | 22.4 | 8.0 | 1.1 | 33.4 | 40.5 | -7.1 | Pass | 43.5 | -10.1 | Pass |
| v | 112.0 | 29.0 | 22.5 | 12.7 | 1.3 | 20.5 | 40.5 | -20.0 | Pass | 43.5 | -23.0 | Pass |
| v | 132.0 | 35.0 | 22.2 | 14.5 | 1.5 | 28.8 | 40.5 | -11.7 | Pass | 43.5 | -14.7 | Pass |
| v | 180.0 | 41.4 | 21.9 | 11.5 | 1.7 | 32.7 | 40.5 | -7.8 | Pass | 43.5 | -10.8 | Pass |
| v | 202.6 | 37.7 | 21.5 | 13.1 | 1.8 | 31.1 | 40.5 | -9.4 | Pass | 43.5 | -12.4 | Pass |
| h | 213.7 | 29.7 | 21.2 | 11.3 | 1.9 | 21.7 | 40.5 | -18.8 | Pass | 43.5 | -21.8 | Pass |
| h | 225.0 | 41.2 | 21.2 | 11.6 | 2.0 | 33.6 | 40.5 | -6.9 | Pass | 46.0 | -12.4 | Pass |
| h | 270.0 | 41.4 | 21.6 | 13.5 | 2.2 | 35.5 | 47.5 | -12.0 | Pass | 46.0 | -10.5 | Pass |
| h | 450.0 | 45.5 | 22.0 | 17.1 | 3.0 | 43.6 | 47.5 | -3.9 | Pass | 46.0 | -2.4 | Pass |
| h | 720.0 | 30.5 | 21.6 | 20.5 | 4.0 | 33.4 | 47.5 | -14.1 | Pass | 46.0 | -12.6 | Pass |
| h | 900.0 | 32.2 | 21.4 | 23.0 | 4.7 | 38.5 | 47.5 | -9.0 | Pass | 46.0 | -7.5 | Pass |

***Table Result:*** Pass by -2.4 dB ***Worst Freq:*** 450.0 MHz

**Test Site:** "F" **Pre-Amp:** Blue-Blk **Cable:** 65 ft RG8A/U **Analyzer:** Green **Antenna:** Red-Black

Table 2

**Radiated Emissions Table** *Curtis-Straus LLC*

**Date:** 13-May-05 **Company:** Colubris Networks **Work Order:** F0364
**Engineer:** Mairaj Hussain **EUT Desc:** MAP200

**Frequency Range:** 30 -2000 MHz **Measurement Distance:** 3 m

**Notes:** Removed caps from the dc power (before and after CM choke) **EUT Max Freq:** <500MHz
**POE option** (remove paint from ethernet port)

| Antenna Polarization (H / V) | Frequency (MHz) | Reading (dBµV) | Preamp Factor (dB) | Antenna Factor (dB/m) | Cable Factor (dB) | Adjusted Reading (dBµV/m) | CISPR Class B Limit (dBµV/m) | CISPR Class B Margin (dB) | CISPR Class B Result (Pass/Fail) | FCC Class B Limit (dBµV/m) | FCC Class B Margin (dB) | FCC Class B Result (Pass/Fail) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| v | 90.0 | 41.4 | 22.4 | 8.0 | 1.1 | 28.1 | 40.5 | -12.4 | Pass | 43.5 | -15.4 | Pass |
| v | 213.7 | 42.0 | 21.2 | 11.3 | 1.9 | 34.0 | 40.5 | -6.5 | Pass | 43.5 | -9.5 | Pass |
| v | 213.7 | 30.0 | 21.2 | 11.3 | 1.9 | 22.0 | 40.5 | -18.5 | Pass | 43.5 | -21.5 | Pass |
| h | 225.0 | 26.6 | 21.2 | 11.6 | 2.0 | 19.0 | 40.5 | -21.5 | Pass | 46.0 | -27.0 | Pass |
| h | 270.0 | 39.3 | 21.6 | 13.5 | 2.2 | 33.4 | 47.5 | -14.1 | Pass | 46.0 | -12.6 | Pass |
| h | 450.0 | 34.0 | 22.0 | 17.1 | 3.0 | 32.1 | 47.5 | -15.4 | Pass | 46.0 | -13.9 | Pass |
| h | 720.0 | 28.3 | 21.6 | 20.5 | 4.0 | 31.2 | 47.5 | -16.3 | Pass | 46.0 | -14.8 | Pass |
| h | 900.0 | 30.3 | 21.4 | 23.0 | 4.7 | 36.6 | 47.5 | -10.9 | Pass | 46.0 | -9.4 | Pass |

***Table Result:*** Pass by -6.5 dB ***Worst Freq:*** 213.7 MHz

**Test Site:** "F" **Pre-Amp:** Blue-Blk **Cable:** 65 ft RG8A/U **Analyzer:** Green **Antenna:** Red-Black

Table 3

**AC Mains Conducted Emissions** — *Curtis-Straus LLC*

**Date:** 16-May-05 **Company:** Colubris Netrworks **Work Order:** F0364
**Engineer:** Mairaj Hussain **EUT Desc:** MAP200 **Test Site:** EMI2
**Notes:** Power supply option
**LISN(s):** Brown Green
**Range:** 0.15-30Mhz **Other Equipment:** --- **Spectrum Analyzer:** Red

| Frequency (MHz) | Q.P. Readings QP1 (dBµV) | Q.P. Readings QP2 (dBµV) | Ave. Readings AV1 (dBµV) | Ave. Readings AV2 (dBµV) | Impedance Factor (dB) | --- Limit (dBµV) | --- Margin dB | FCC/CISPR B qp Limit (dBµV) | FCC/CISPR B qp Margin dB | FCC/CISPR B AVE Limit (dBµV) | FCC/CISPR B AVE Margin dB | Overall Result (Pass/Fail) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.16 | 29.2 | 25.9 | | | 20.0 | --- | --- | 65.5 | -16.3 | 55.5 | -6.3 | Pass |
| 0.21 | 21.5 | 25.4 | | | 20.0 | --- | --- | 63.2 | -17.8 | 53.2 | -7.8 | Pass |
| 0.27 | 19.0 | 19.6 | | | 20.0 | --- | --- | 61.1 | -21.5 | 51.1 | -11.5 | Pass |
| 0.37 | 20.5 | 16.4 | | | 20.0 | --- | --- | 58.5 | -18.0 | 48.5 | -8.0 | Pass |
| 0.64 | 9.0 | 11.2 | | | 20.0 | --- | --- | 56.0 | -24.8 | 46.0 | -14.8 | Pass |
| 0.79 | 11.0 | 9.0 | | | 20.0 | --- | --- | 56.0 | -25.0 | 46.0 | -15.0 | Pass |

***Table Result:*** Pass by -6.30 dB ***Worst Freq:*** 0.16 MHz

Table 4

**AC Mains Conducted Emissions** — *Curtis-Straus LLC*

**Date:** 16-May-05 **Company:** Colubris Netrworks **Work Order:** F0364
**Engineer:** Mairaj Hussain **EUT Desc:** MAP200 **Test Site:** EMI2
**Notes:** POE Option
**LISN(s):** Brown Green
**Range:** 0.15-30Mhz **Other Equipment:** --- **Spectrum Analyzer:** Red

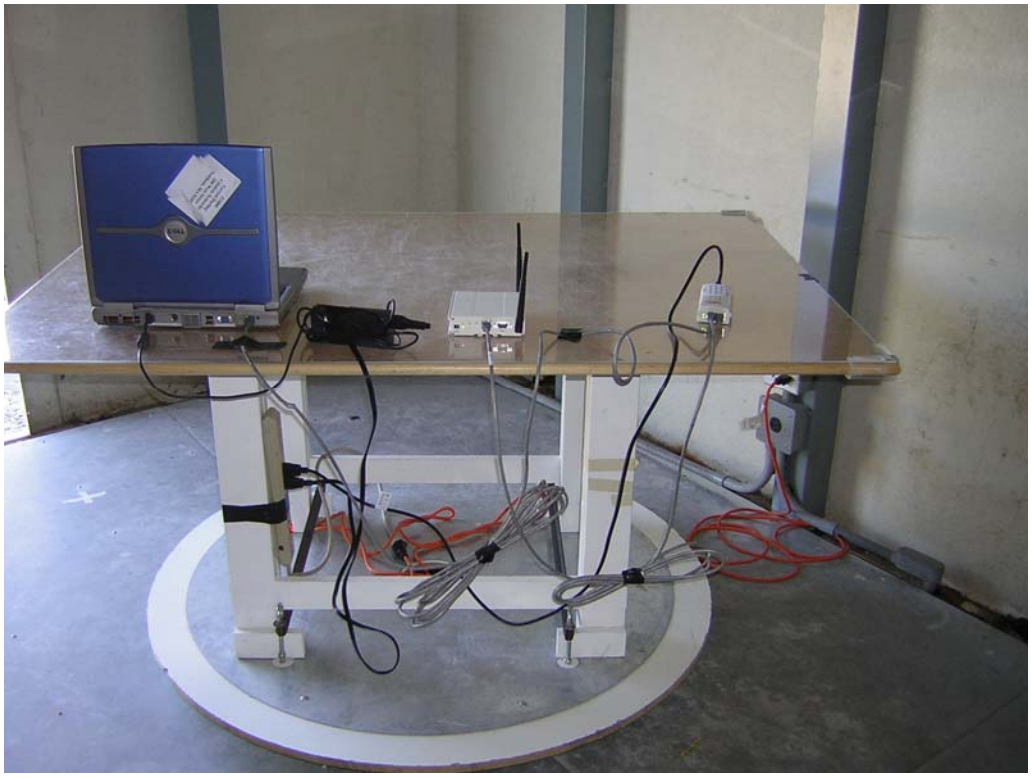
| Frequency (MHz) | Q.P. Readings QP1 (dBµV) | Q.P. Readings QP2 (dBµV) | Ave. Readings AV1 (dBµV) | Ave. Readings AV2 (dBµV) | Impedance Factor (dB) | --- Limit (dBµV) | --- Margin dB | FCC/CISPR B qp Limit (dBµV) | FCC/CISPR B qp Margin dB | FCC/CISPR B AVE Limit (dBµV) | FCC/CISPR B AVE Margin dB | Overall Result (Pass/Fail) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.18 | 31.3 | 25.2 | 14.7 | 20.4 | 20.0 | --- | --- | 64.5 | -13.2 | 54.5 | -14.1 | Pass |
| 0.35 | 15.4 | 15.7 | | | 20.0 | --- | --- | 59.0 | -23.3 | 49.0 | -13.3 | Pass |
| 0.53 | 12.2 | 11.6 | | | 20.0 | --- | --- | 56.0 | -23.8 | 46.0 | -13.8 | Pass |
| 0.80 | 17.1 | 11.7 | | | 20.0 | --- | --- | 56.0 | -18.9 | 46.0 | -8.9 | Pass |
| 1.15 | 11.3 | 12.2 | | | 20.0 | --- | --- | 56.0 | -23.8 | 46.0 | -13.8 | Pass |
| 1.68 | 11.0 | 11.1 | | | 20.0 | --- | --- | 56.0 | -24.9 | 46.0 | -14.9 | Pass |
| 3.53 | 16.0 | 15.2 | | | 20.0 | --- | --- | 56.0 | -20.0 | 46.0 | -10.0 | Pass |
| 3.80 | 18.2 | 9.4 | | | 20.0 | --- | --- | 56.0 | -17.8 | 46.0 | -7.8 | Pass |
| 24.20 | 16.0 | 14.6 | | | 20.0 | --- | --- | 60.0 | -24.0 | 50.0 | -14.0 | Pass |

***Table Result:*** Pass by -7.80 dB ***Worst Freq:*** 3.80 MHz

## *Test Configuration Photographs*

Radiated Emissions

Radiated Emissions



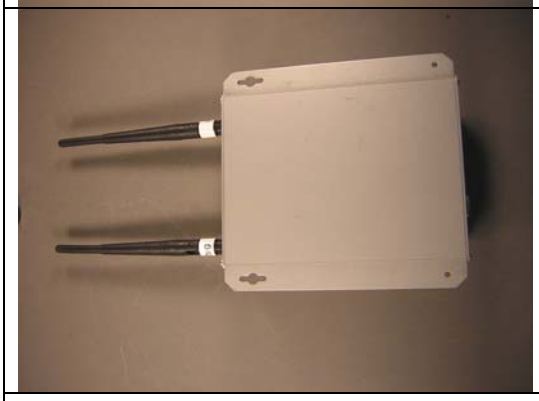
Radiated Emissions (POE option)

AC conducted emissions

AC conducted emissions

AC conducted emissions (POE option)

## *External / Internal Pictures of CN200 and MAP200*

| CN200 | MAP200 |
|---|---|
| | |
|  | |
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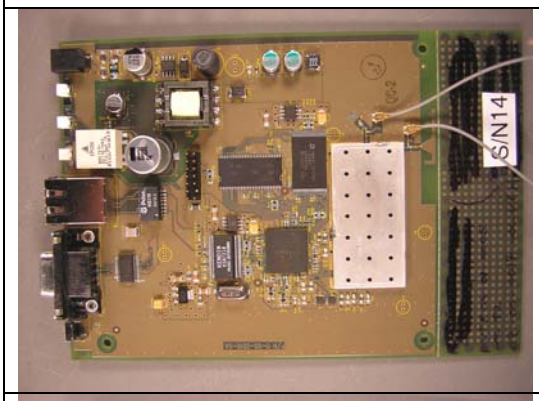
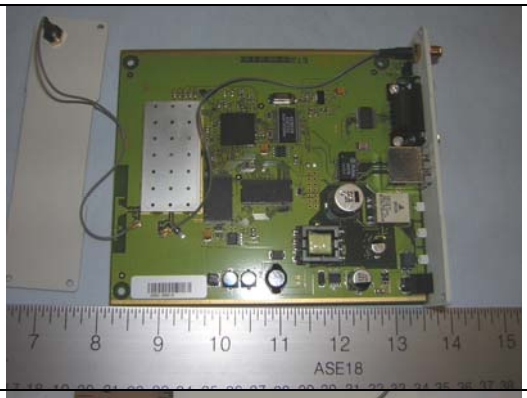
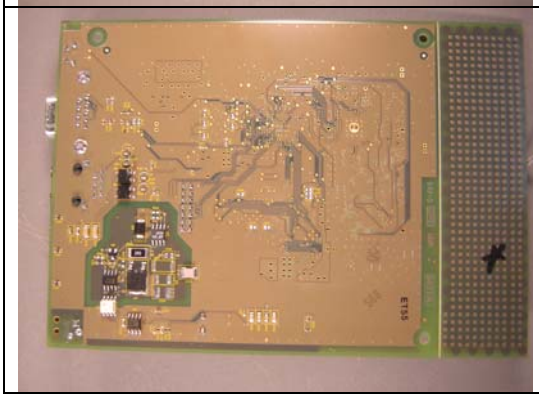
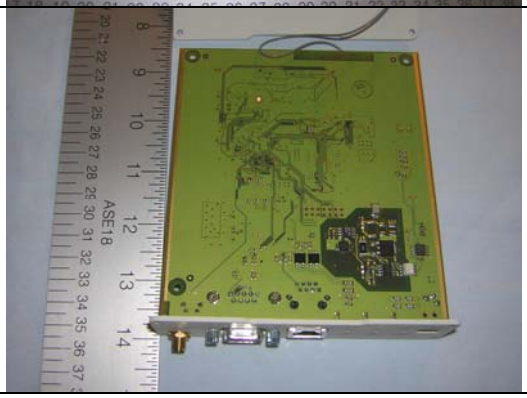
|   |   |
|  |   |

## *Test Descriptions*

### Radiated Emissions Testing Overview

REV 17-FEB-04

Digital and microprocessor based devices use radio frequency (RF) digital signals for timing purposes. An unintentional consequence of this signal usage is that a certain amount of RF energy is radiated from the device into the local environment. This radiated RF energy has the potential to interfere with constructive uses of the RF spectrum such as television broadcasting, police and fire radio, and the like. In order to reduce the likelihood that a device will interfere with these services, it is required that the amplitudes of radiated RF signals from the device are kept below an allowable level.

These RF signals decrease in strength as the distance from the source increases. Thus if the potential victim of interference, e.g. a TV receiver, is far enough from the radiator, e.g. a computer, then no interference will occur. For certain environments it is appropriate to expect that potential interference victims will be located at least a minimum distance from the radiator. For the residential environment this distance is generally accepted to be 10 meters while in the commercial environment the accepted distance is 30 meters. The allowable emissions levels are therefore specified to protect equipment which is located further than that distance from the radiator. In general, radiation from the Equipment Under Test (EUT) is measured at 3 or 10 meters to insure that it is at or below allowable levels.

Measurements of the radiated energy are made by recording the field strength indicated by an antenna placed at a specific distance from the device. Most devices do not radiate the RF energy in a predictable manner. The emitted energy may vary with changes in operating mode, physical configuration, or orientation. During the measurement process these parameters are varied to confirm that the emissions will remain below the allowable levels in the range of typical installations.

The extent of annoyance experienced by a person who is being affected by interference is related to the persistence of the interfering signal. For example, a low level steady whine from a receiver is considered to be more annoying than brief, loud, intermittent pops or clicks. This “human factor” is accounted for by the use of a “quasi-peak” detector in the receiver or spectrum analyzer which measures the signal from the measurement antenna. The detector is a weighted averaging filter with a fast charge time and a slow discharge time. Thus steady continuous signals will charge the quasi-peak detector fully while intermittent signals (those with pulse repetition rates less than 1kHz) are reported at a level which can be significantly below their peak level. It should be noted that most RF signals produced by digital devices are continuous in nature and thus the quasi-peak reading will be identical to the peak signal reading. To reduce the test time, the peak emission level is recorded for continuous wave signals as it is the same as the quasi-peak signal level.

Testing is performed according to test methods from ANSI C63.4 and CISPR 22.

The test site used for measuring radiated emissions follows the format developed internationally for a weather protected Open Area Test Site (OATS). An antenna mast is

installed at the specified distance from a rotating table and is used to raise and lower the measuring antenna. The reference site is clear of reflecting objects, such as metal fences and buildings for an ellipse of twice the measurement test distance. Measuring equipment and personnel are present within the ellipse to facilitate cable manipulation, but measures are taken to minimize the effects. Often preliminary radiated emissions measurements are made at alternate test sites which do not meet the clear space reference criteria. The data collected at alternate test sites is not considered conclusive unless the alternate site also complies with a volumetric site attenuation survey performed over the area that the EUT occupies. The EUT and measuring antenna mark the two foci of the ellipse. The ground plane is made of a combination of galvanized steel sheets and tight wire mesh electrically connected along the seams. This metal ground plane extends 1 meter beyond the furthest extent of the EUT and the measuring antenna. It also covers the area between the EUT and the measuring antenna. The hardware cloth is connected to the utility ground or to stakes driven into the earth for safety.

In order for accurate emissions measurements to be made the test site must possess propagation characteristics which fall within accepted norms. The site has been checked for suitability using techniques specified in American National Standards Institute (ANSI) document C63.4. This document details a procedure which measures the attenuation of the site which is the chief indicator of site acceptability. The theory behind site attenuation is quite simple. A transmitting antenna is set up at a fixed location at one end of the site with a receiving antenna at the other end. If a signal of some arbitrary amplitude is fed into the transmitting antenna, a lesser amount of signal ought to be measured at the receiving antenna. This difference in signal amplitude is known as the site attenuation, which should follow a predicted curve. Data that does not correspond to the predicted site attenuation curve points to a problem with either the equipment being used or the physical characteristics of the site.

Actual emissions measurements are taken with broadband biconical-log-periodic hybrid antennas calibrated in accordance with the standard site method detailed in ANSI C63.5. Emissions are measured with the receiving antenna oriented in horizontal and vertical polarization with respect to the ground plane. If measurements are made at other than the limit distance, then the readings obtained are scaled to the limit distance using an inverse relationship. The actual test distance used is noted in the report.

The antenna mast is capable of a varying the antenna height between 1 and 4 meters above the ground plane. The receiving antenna is moved over this range at each emission frequency in order to record the maximum observed signal. The mast is non-conductive and remotely controllable. The test distance is measured from the antenna center (marked during calibration) and the periphery of the EUT.

The Equipment Under Test (EUT) is rotated in order to maximize emissions during the test. For equipment intended to operate on a tabletop or desk radiated tests are conducted on a 0.8 meter high, non-conductive platform. Larger floor standing equipment is tested on a floor mounted rotatable platform. In some cases, large equipment on its own casters may be tested without a platform.

Since radiated emissions are a function of cable placement, the cable placement is varied to encompass typical configurations that an end user might encounter to determine the configuration resulting in maximum emissions. At least one cable for each I/O port type is

attached to the EUT. If peripherals or modules are available, at least one of each available type is installed and noted in the report. Excess cable length beyond one meter is bundled in the center into a 30 to 40 cm bundle. Cables requiring non-standard lead dress are recorded in the report.

Network connections are simulated if necessary. Any simulator used matches the expected real network connection in terms of both functionality and impedance. For distributed systems, the support equipment may be placed at such a distance that it does not influence the measured emissions. If this option is used, such placement is noted in the test report.

The possible operating modes of the EUT are explored to determine the configuration which maximizes emissions. Software is investigated as well as different methods of displaying data if available. Data is recorded in the worst case operating mode.

At least the six highest emissions with respect to the limit are recorded. If less than six emissions are visible above the noise floor of the instrumentation, then noise floor measurements at six representative frequencies are recorded. The test report will document if noise floor readings are reported.

**FCC and European Norms Radiated Emissions Limits at 10 meters**

| Frequency (MHz) | FCC Class A | FCC Class B | CISPR Class A | CISPR Class B | Frequency (MHz) |
|---|---|---|---|---|---|
| 30-88 | 39.1 | 29.5 | 40 | 30 | 30-88 |
| 88-216 | 43.5 | 33.1 | 40 | 30 | 88-216 |
| 216-230 | 46.4 | 35.6 | 40 | 30 | 216-230 |
| 230-960 | 46.4 | 35.6 | 47 | 37 | 230-960 |
| 960-1000 | 49.5 | 43.5 | 47 | 37 | 960-1000 |
| 1000+ | 49.5 | 43.5 | N/A | N/A | 1000+ |

At the transitions, the lower limit applies.
Simple inverse scaling utilized to convert limits where appropriate.

**FCC and European Norms Radiated Emissions Limits at 3 meters**

| Frequency (MHz) | FCC Class A | FCC Class B | CISPR Class A | CISPR Class B | Frequency (MHz) |
|---|---|---|---|---|---|
| 30-88 | 49.5 | 40 | 50.5 | 40.5 | 30-88 |
| 88-216 | 54 | 43.5 | 50.5 | 40.5 | 88-216 |
| 216-230 | 56.9 | 46 | 50.5 | 40.5 | 216-230 |
| 230-960 | 56.9 | 46 | 57.5 | 47.5 | 230-960 |
| 960-1000 | 60 | 54 | 57.5 | 47.5 | 960-1000 |
| 1000+ | 60 | 54 | N/A | N/A | 1000+ |

At the transitions, the lower limit applies.
Simple inverse scaling utilized to convert limits where appropriate.

For CISPR and EU standards measurements are usually made over the frequency range of 30 MHz to 1GHz. Deviations are noted in the test report. For the FCC, the measurement range is based on the highest frequency signal present or used in the device. The following table details the frequency range of measurements performed.

| FCC frequency range of radiated emissions measurements | |
|---|---|
| Highest frequency generated or used in the device or on which the device operates or tunes (MHz) | Upper frequency of measurement range (MHz) |
| Below 1.705 | 30 (No radiated measurements) |
| 1.705-108 | 1000 |
| 108-500 | 2000 |
| 500-1000 | 5000 |
| Above 1000 | $5^{th}$ harmonic of the highest frequency or 40 GHz, whichever is lower. |

The test data is derived from the voltage on the spectrum analyzer. First the reading is corrected for gain factors associated with the use of preamps and loss in the cable. A factor in dB is subtracted from the reading to account for preamp gain, while a factor in dB is added to the signal to account for cable loss. A conversion is performed from the resulting voltage to field strength by multiplying the voltage by the antenna factor. Since antenna factor is expressed as a logarithm (dB/m), this operation takes the form of an addition (to multiply logarithmic numbers, you add them together). Thus:

Field Strength (dBuV/m) = Voltage Reading (dBuV) - Preamp Gain (dB) + Cable Loss (dB) + Antenna Factor (dB/m)

When the levels of ambient radio signals such as local television stations are within 6 dB of the appropriate limit, the following steps may be taken to assure compliance:

1. The measurement bandwidth may be reduced. A check is made to see that peak readings are not affected. The use of a narrower bandwidth allows examination of emissions close to local ambient signals.
2. The antenna may be brought closer to the EUT to increase signal-to-ambient signal strength.
3. For horizontally polarized signals the axis of the test site may be rotated to discriminate against local ambients.

Standard Uncertainty per NIST Technical Note 1297 1994 for this test is estimated to be 2.8dB. This test method is covered by our A2LA accreditation.

## Line Conducted Emissions Overview

REV 25-OCT-02

Digital and microprocessor based devices use radio frequency (RF) digital techniques for timing purposes and in applications such as switching power supplies. An unintentional consequence of this for AC powered devices is that a certain amount of the RF energy is impressed upon the AC power mains in the form of a conducted noise voltage. These conducted emissions have the potential to interfere with constructive uses of the RF spectrum

such as AM radio and may also interfere with other devices attached to the same AC mains circuit. In order to reduce the likelihood that a device will interfere it is required that the conducted RF signals from the device are below an allowable level.

Testing is performed according to test methods from ANSI C63.4 and CISPR 22.

Line conducted emissions are measured from the device over the frequency range of 0.15 to 30 MHz. The EUT is powered from a Line Impedance Stabilization Network (LISN). The purpose of the LISN is to provide a calibrated impedance across which to measure the conducted emissions. The RF noise voltage produced by the EUT across the LISN is measured and compared to the limit. In order for the LISN to perform properly it is attached to a ground plane at least 2 meters by 2 meters in size. For tabletop equipment the measurement is performed with the equipment 40 cm from a vertical conducting surface bonded to a ground plane under the product. The ground plane extends 0.5 meters beyond the product and is 2.5mx3.7m in size. The vertical surface is 2.5mx2.5m.

As with radiated emissions, the “human factor” is accounted for by the use of a “quasi-peak” detector in the receiver or spectrum analyzer that measures the signal from the LISN. For certain tests (such as EN55022), both an average and a quasi-peak limit are specified. Emissions from a device must be below both limits when measured with the appropriate detector. If the emission level is below the average limit when measured with the quasi-peak detector, the EUT is presumed to pass both limits.

The possible operating modes of the EUT are explored to determine the configuration that maximizes emissions. Software is investigated as well as different methods of displaying data if available. Data is recorded in the worst case operating mode.

As of September 9, 2002, the FCC has harmonized it’s conducted emission limits with CISPR. The following table displays the limits applicable to both FCC and CISPR.

| **Line Conducted Emissions Limits: Class A (dBµV)** | | |
|---|---|---|
| Frequency (MHz) | Quasi-Peak | Average |
| 0.15 - 0.5 | 79 | 66 |
| 0.5 - 30 | 73 | 60 |
| **Line Conducted Emissions Limits: Class B (dBµV)** | | |
| Frequency (MHz) | Quasi-Peak | Average |
| 0.15 - 0.5 | 66 - 56* | 56 - 46* |
| 0.5 - 5 | 56 | 46 |
| 5 - 30 | 60 | 50 |
| Note 1: The lower limit applies at the transition frequencies | | |
| *Note 2: The limit decreases linearly with the logarithm of the frequency | | |

Although the FCC is now accepting the limits shown above, it should be noted that the former FCC limits may be used until July 11, 2005 for any equipment authorized prior to July 12, 2004. At least the six highest emissions with respect to the limit are recorded. If less than six emissions are visible above the noise floor of the instrumentation, then the noise floor at six

representative frequencies is recorded. The test report will document if noise floor readings are reported.

Standard Uncertainty per NIST Technical Note 1297 1994 for this test is estimated to be 2dB.

All testing is performed within the framework of a laboratory quality system modeled on ISO/IEC 17025 *General requirements for the competence of calibration and testing laboratories* and is subject to our terms and conditions. This test method is covered by our A2LA accreditation.

## *Test Equipment Used*

REV. 11-MAY-2005

| *SPECTRUM ANALYZERS / RECEIVERS* | RANGE | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|---|
| RED | 9kHz-1.8GHz | 8591E | HP | 3441A03559 | 00024 | 13-JAN-2006 |
| WHITE | 9kHz-22GHz | 8593E | HP | 3547U01252 | 00022 | 08-MAR-2006 |
| BLUE | 9kHz-1.8GHz | 8591E | HP | 3223A00227 | 00070 | 03-NOV-2005 |
| YELLOW | 9kHz-2.9GHz | 8594E | HP | 3523A01958 | 00100 | 20-APR-2006 |
| GREEN | 9kHz-26.5GHz | 8593E | HP | 3829A03618 | 00143 | 02-AUG-2005 |
| BLACK | 9kHz-12.8GHz | 8596E | HP | 3710A00944 | 00337 | 27-DEC-2005 |
| YELLOW-BLACK | 20Hz-40.0MHz | 3585A | HP | 2504A05219 | 00030 | 08-OCT-2005 |
| TELECOM 3585A | 20Hz-40.0MHz | 3585A | HP | 1750A02762 | 01067 | 04-FEB-2006 |
| ORANGE | 9kHz-26.5GHz | E4407B | HP | US39440975 | 00394 | 05-NOV-2005 |
| EMI TEST RECEIVER | 20-1000MHz | ESVS30 | R&S | 827957/001 | 01098 | 27-OCT-2005 |

| *LISNS/MEASUREMENT PROBES* | RANGE | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|---|
| RED | 10kHz-30MHz | 8012-50-R-24-BNC | SOLAR | 956348 | 00753 | 15-APR-2006 |
| BLUE (DC) | 10kHz-30MHz | 8012-50-R-24-BNC | SOLAR | 956349 | 00752 | 02-MAY-2006 |
| YELLOW-BLACK | 10kHz-30MHz | 8012-50-R-24-BNC | SOLAR | 984735 | 00248 | 15-APR-2006 |
| ORANGE | 10kHz-30MHz | 8012-50-R-24-BNC | SOLAR | 903707 | 00754 | 02-MAY-2006 |
| GOLD (DC) | 10kHz-30MHz | 8012-50-R-24-BNC | SOLAR | 984734 | 00247 | 02-MAY-2006 |
| BROWN | 10kHz-30MHz | 8012-50-R-24-BNC | SOLAR | 0411656 | 00986 | 04-MAY-2006 |
| GREEN | 10kHz-30MHz | 8012-50-R-24-BNC | SOLAR | 0411657 | 00987 | 04-MAY-2006 |
| YELLOW | 10kHz-30MHz | 8012-50-R-24-BNC | SOLAR | 0411658 | 1080 | 04-MAY-2006 |
| WHITE-BLACK | 10kHz-30MHz | 8610-50-TS-100-N | SOLAR | 972019 | 00678 | 15-APR-2006 |
| BLACK | 10kHz-30MHz | 8610-50-TS-100-N | SOLAR | 972017 | 00675 | 15-APR-2006 |
| RED-BLACK | 10kHz-30MHz | 8610-50-TS-100-N | SOLAR | 972016 | 00677 | 15-APR-2006 |
| BLUE-BLACK | 10kHz-30MHz | 8610-50-TS-100-N | SOLAR | 972018 | 00676 | 15-APR-2006 |
| BLUE MONITORING PROBE | 0.01-150MHz | 91550-2 | TEGAM | 12350 | 00807 | 21-MAY-2005 |
| YELLOW MONITORING PROBE | 0.01-150MHz | 91550-2 | ETS | 50972 | 00493 | 24-NOV-2005 |
| GREEN CURRENT TRANSFORMER | 40Hz-20MHz | 150 | PEARSON | 10226 | 00793 | 07-APR-2007 |
| CISPR LINE PROBE | 150kHz-30MHz | N/A | C-S | 01 | 00805 | 06-MAY-2007 |
| CISPR TELCO VOLTAGE PROBE | 10kHz-30MHz | CS A/C-10 | C-S | CS01 | 00296 | 28-SEP-2005 |
| CISPR 22 TELCO ISN | 9kHz-30MHz | FCC-TLISN-T4 | FISCHER | 20115 | 00746 | 26-OCT-2006 |

| *OPEN AREA TEST SITE (OATS)* | FCC CODE | IC CODE | VCCI CODE | CALIBRATION DUE |
|---|---|---|---|---|
| SITE F | 93448 | IC 2762-F | R-1688 | 04-APR-2007 |
| SITE T | 93448 | IC 2762-T | R-905 | 20-MAR-2007 |
| SITE A | 93448 | IC 2762-A | R-903 | 20-MAR-2007 |
| SITE M | 93448 | IC 2762-M | R-904 | 19-MAR-2007 |
| SITE J | | | | 09-MAY-2007 |

| *LINE CONDUCTED TEST SITES* | FCC CODE | IC CODE | VCCI CODE | CALIBRATION DUE |
|---|---|---|---|---|
| EMI 1 | 93448 | N/A | C-1801 | 01-MAY-2006 |
| EMI 2 | 93448 | N/A | C-1802 | 01-MAY-2006 |
| EMI 3 | 93448 | N/A | C-1803 | 01-MAY-2006 |

| *MIXERS/DIPLEXERS* | RANGE | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|---|
| MIXER / HORN | 26.5-40 GHz | 11970A/28-442-6 | HP/ATM | 2332A01695/A046903-01 | 1087 | 23-AUG-2005 |
| MIXER / HORN | 26.5-40 GHz | 11970A/28-442-6 | HP/ATM | 3003A07825/A046903-01 | 1086 | 23-AUG-2005 |
| MIXER / HORN | 40-60 GHz | M19HW/A | OML | U30110-1 | 00821 | 02-MAR-2007 |
| MIXER / HORN | 60-90 GHz | M12HW/A | OML | E30110-1 | 00822 | 03-MAR-2007 |
| MIXER / HORN | 90-140 GHz | MO8HW/A | OML | F21206-1 | 00811 | 03-MAR-2007 |
| MIXER / HORN | 140-220 GHz | MO5HW/A | OML | G21206-1 | 00812 | 05-JAN-2005 |
| DIPLEXER | | DPL.26 | OML | N/A | 00813 | 03-MAR-2007 |

| *ABSORBING CLAMPS* | RANGE | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|---|
| FISCHER CLAMP | 30-1000MHz | F-201-23MM | FISCHER | 10 | 00081 | 16-JAN-2006 |

| PREAMPS / ATTENUATORS / FILTERS | RANGE | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|---|
| RED | 0.10-2000MHz | ZFL-1000-LN | C-S | N/A | 00798 | 08-APR-2006 |
| BLUE | 0.01-2000MHz | ZFL-1000-LN | C-S | N/A | 00759 | 26-JUL-2005 |
| BLUE-BLACK | 0.01-2000MHz | ZFL-1000-LN | C-S | N/A | 00800 | 10-FEB-2006 |
| GREEN | 0.01-2000MHz | ZFL-1000-LN | C-S | N/A | 00802 | 10-FEB-2006 |
| BLACK | 0.01-2000MHz | ZFL-1000-LN | C-S | N/A | 00799 | 10-FEB-2006 |
| ORANGE | 0.01-2000MHz | ZFL-1000-LN | C-S | N/A | 00765 | 10-FEB-2006 |
| WHITE | 1-20GHz | SMC-12A | C-S | 426643 | 00760 | 21-JUL-2005 |
| BROWN | 1-20GHz | PM2-38-218-4R5-17-15-SFF | C-S | PL1655 | 1132 | 02-MAY-2006 |
| YELLOW-BLACK | 1-20GHz | SMC-12A | C-S | 535055 | 00801 | 21-JUL-2005 |
| ORANGE-BLACK | 1-20GHz | SMC-12A | C-S | 637367 | 00761 | 21-JUL-2005 |
| HF (YELLOW) | 18-26.5GHz | AFS4-18002650-60-8P-4 | C-S | 467559 | 00758 | 20-JUL-2005 |
| HIGH PASS FILTER | 1-18 GHz | SPA-F-55204 | K&L | 36 | 00817 | 06-JAN-2006 |
| LOW PASS FILTER | 1-9 GHz | 11SL10-4100/X4400-O/O | K&L | 4 | 00816 | 06-JAN-2006 |
| HF 20DB 50W ATTENUATOR | 0.03-20 GHz | PE 7019-20 | PASTERNACK | 01 | 00791 | 10-MAY-2006 |
| HF 30DB 50WATTENUATOR | 0.03-20 GHz | PE 7019-30 | PASTERNACK | 02 | | 10-MAY-2006 |
| LOW FREQ LPF | 10-100KHZ | L200K1G1 | MICROWAVE CIRCUITS | 4460-01 DC0432 | 1019 | 30-AUG-2005 |
| LOW FREQ LPF | 10-100KHZ | L200K1G1 | MICROWAVE CIRCUITS | 4777-01 DC0434 | 1088 | 30-AUG-2005 |

| ANTENNAS | RANGE | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|---|
| GREEN BILOG | 30-2000MHz | CBL6112B | CHASE | 2742 | 00620 | 06-APR-2006 |
| GREEN-BLACK BILOG | 30-2000MHz | CBL6112B | CHASE | 2412 | 00127 | 06-JAN-2006 |
| GREEN-RED BILOG | 30-2000MHz | CBL6112B | CHASE | 2435 | 00990 | 06-APR-2006 |
| BLUE BILOG | 30-1000MHz | 3143 | EMCO | 1271 | 00803 | 06-MAY-2007 |
| GRAY BILOG | 26-2000MHz | 3141 | EMCO | 9703-1038 | 00066 | 06-MAY-2007(EMI) / 21-JUN-2005(RFI) |
| YELLOW-BLACK BILOG | 20-2000MHz | CBL6140A | CHASE | 1112 | 00126 | 06-MAY-2007(EMI) / 25-JUN-2005(RFI) |
| RED-WHITE BILOG | 30-2000MHz | JB1 | SUNOL | A091604-1 | 01105 | 28-SEP-2006 |
| RED-BLACK BILOG | 30-2000MHz | JB1 | SUNOL | A091604-2 | 01106 | 28-SEP-2006 |
| YELLOW HORN | 1-18GHz | 3115 | EMCO | 9608-4898 | 00037 | 22-MAY-2005(EMI) / 29-NOV-2005 (RFI) |
| BLACK HORN | 1-18GHz | 3115 | EMCO | 9703-5148 | 00056 | 12-JUN-2005 |
| ORANGE HORN | 1-18GHz | 3115 | EMCO | 0004-6123 | 00390 | 04-JUN-2005 |
| HF (WHITE) HORN | 18-26.5GHz | 801-WLM | WAVELINE | 00758 | 00758 | 15-JUL-2005 |
| SMALL LOOP (RENTAL) | 10KHZ-30MHZ | PLA-130/A | ARA | 1009 | TELOGY | 11-FEB-2006 |
| SMALL LOOP | 9KHZ-30MHZ | PLA-130/A | ARA | 1024 | 00755 | 23-FEB-2006 |
| LARGE LOOP | 20HZ-5MHZ | 6511 | EMCO | 9704-1154 | 00067 | 12-NOV-2005 |
| ACTIVE MONOPOLE | 30HZ-30MHZ | 3301B | EMCO | 3824 | 00068 | 04-MAY-2006 |
| INDUCTION COIL | 50-60HZ | 1000-4-8 | C-S | N/A | 00778 | 13-SEP-2006 |
| ADJUSTABLE DIPOLE | 30-1000MHz | 3121C | EMCO | 1370 | 00757 | 18-MAR-2007 |
| ADJUSTABLE DIPOLE | 30-1000MHz | 3121C | EMCO | 1371 | 00756 | 18-MAR-2007 |
| RE101 LOOP SENSOR | 30HZ-100KHZ | RE101-13.3CM | C-S | N/A | 00818 | 13-MAR-2007 |
| RS101 RADIATING LOOP | 30HZ-100KHZ | RS101-12CM | C-S | N/A | 00819 | 13-MAR-2007 |
| RS101 LOOP SENSOR | 30HZ-100KHZ | RS101-4CM | C-S | N/A | 00820 | 13-MAR-2007 |

| EFT | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|
| EFT DIRECT COUPLING CAP | N/A | C-S | 01 | 00794 | 29-JAN-2006 |

| ESD GENERATORS | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|
| GREEN | NSG435 | SCHAFFNER | 000839 | 00763 | 17-FEB-2006 |
| RED | NSG435 | SCHAFFNER | 001625 | 00762 | 29-DEC-2005 |
| YELLOW | 930D | ETS | 201 | 00673 | 16-JUN-2005 |

| BEST EMC-2 | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|
| BLUE | 711-1100 | SCHAFFNER | 199824-002SC | 00117 | 28-JUL-2005 (SURGE/D+I/EFT) |
| RED | 711-1100 | SCHAFFNER | 200122-074SC | 00623 | 24-JUN-2005 (SURGE) / 28-JUL-2005 (D+I) / 03-DEC-2005 (EFT) |

| Harmonic & Flicker Analyzer | MN | Mfr | SN | Asset | Calibration Due |
|---|---|---|---|---|---|
| HFTS | HP6842A | HP | 3531A-00169 | 00738 | 03-DEC-2005 |
| 10001I/2 AC POWER SYSTEM | (2) 500I | CALIFORNIA INSTRUMENTS | HK53687/HK53688 | 00376 | 20-JAN-2006 |

| Chambers and Stripline | MN | Mfr | SN | Asset | Calibration Due |
|---|---|---|---|---|---|
| RFI 1 Chamber | 3 Meter Compact | Panashield | N/A | 00797 | 25-JUN-2005 |
| RFI 2 Chamber | 04' x 07' Shielding System | Lindgren | 13329 | 00795 | 21-JUN-2005 |
| RFI 3 Stripline | N/A | C-S | N/A | 00796 | 22-JUL-2005 |
| Environmental (Safety) | ECL5 | B-M-A Inc. | 2041 | 00029 | 12-JAN-2006 |
| Environmental (Safety) | SGTH-31S | B-M-A Inc. | 2245 | 00321 | 12-JAN-2006 |

| Amplifiers | Range | MN | Mfr | SN | Asset | Calibration Due |
|---|---|---|---|---|---|---|
| Red | 0.5-1000MHz | 10W1000B | AR | 18708 | 00032 | 23-JUN-2005 |
| Green | 0.5-1000MHz | 10W1000B | AR | 23423 | 00123 | 01-JUN-2005 |
| Blue | 0.01-250MHz | 75A250 | AR | 19165 | 00039 | 10-FEB-2006(CRFI) / 23-JUN-2005 (RFI) |
| Black | 0.01-250MHz | 75A250 | AR | 23411 | 00122 | 10-FEB-2006 (CRFI)/ 25-JUN-2005(RFI) |
| Orange | 0.01-250MHz | 75A250 | AR | 26827 | 00367 | 10-FEB-2006 (CRFI) / 02-JUN-2005(RFI) |
| HP489A | 1.0-2.0GHz | HP489A | HP | 449-00762 | 00971 | 28-SEP-2005 |
| Hughes 10W | 1.0-2.0GHz | 1177H09 | Hughes | 143 | Rental | 29-NOV-2005 |
| HP491C | 2.0-4.0GHz | HP491C | HP | 449-00638 | 00764 | 29-NOV-2005 |
| Hughes 10W | 4.0-8.0GHz | 1177H02 | Hughes | 092 | Rental | 23-NOV-2005 |
| HP493A #1 | 4.0-8.0GHz | HP493A | HP | 171402242 | 00085 | 28-SEP-2005 |
| HP493A #2 | 4.0-8.0GHz | HP493A | HP | 449-00562 | 00771 | 28-SEP-2005 |
| HP495A | 7.0-12.0GHz | HP495A | HP | 904-00237 | 00086 | 29-NOV-2005 |

| Field Probes | Range | MN | Mfr | SN | Asset | Calibration Due |
|---|---|---|---|---|---|---|
| Red | 0.01-1000MHz | HI-4422 | Holaday | 90369 | 00031 | 11-OCT-2005 |
| Green | 0.01-1000MHz | HI-4422 | Holaday | 97363 | 00136 | 05-AUG-2005 |
| Blue | 0.01-1000MHz | HI-4422 | Holaday | 95696 | 01100 | 27-OCT-2005 |

| Signal Generators | Range | MN | Mfr | SN | Asset | Calibration Due |
|---|---|---|---|---|---|---|
| Red | 0.09-2000MHz | HP8648B | HP | 3847U02192 | 00366 | 15-FEB-2006 |
| Blue | 0.1-1000MHz | HP8648A | HP | 3426A00548 | 00034 | 20-JUL-2005 |
| Green | 0.09-2000MHz | HP8648B | HP | 3623A02072 | 00125 | 12-OCT-2005 |
| Orange | 0.1-1000MHz | HP8648B | HP | 3537A01210 | 00025 | 26-MAY-2005 |
| Black (Telecom) | 15MHz | HP33120A | HP | US36004674 | 00766 | 21-OCT-2005 |
| Yellow | 15MHz | HP33120A | HP | US36014119 | 00249 | 26-MAY-2005 |
| Blue-White | 0.1Hz-13MHz | HP3312A | HP | 1432A07632 | 00775 | 11-MAR-2006 |
| Sweeper | 0.01-20.0GHz | HP83752A | HP | 3610A01133 | 00087 | 03-MAY-2006 |
| AM/FM Stereo Sig. Gen. | 0.1-170MHz | LG3236 | Leader | 3687301 | 00959 | 03-SEP-2005 |

| Bulk Injection Clamps | Range | MN | Mfr | SN | Asset | Calibration Due |
|---|---|---|---|---|---|---|
| Green | 0.01-100MHz | 95236-1 | ETS | 50215 | 00118 | 10-FEB-2006 |
| Red | 0.01-100MHz | 95236-1 | ETS | 34026 | 1020 | 10-FEB-2006 |

| CDN Networks | Range | MN | Mfr | Asset | Calibration Due |
|---|---|---|---|---|---|
| Black | 0.10-100MHz | 20A M-2 | C-S | 00783 | 22-JUN-2005 |
| Blue | 0.10-100MHz | 15A M-3 | C-S | 00806 | 09-FEB-2006 |
| Orange | 0.10-100MHz | 15A M-2 | C-S | 00786 | 22-JUN-2005 |
| Red | 0.10-100MHz | 15A M-3 | C-S | 00780 | 09-FEB-2006 |
| White | 0.10-100MHz | 15A M-3 | C-S | 00782 | 09-FEB-2006 |
| Yellow-Black | 0.10-100MHz | 15A M-3 | C-S | 00784 | 09-FEB-2006 |
| Blue-Black | 0.10-100MHz | 15A M-3 | C-S | 00781 | 22-JUN-2005 |
| Green | 0.10-100MHz | 30A M-3 | C-S | 00779 | 22-JUN-2005 |
| Yellow | 0.10-100MHz | 30A M-5 | C-S | 00804 | 22-JUN-2005 |
| Blue-White | 0.10-100MHz | 15A M-5 | C-S | 00788 | 22-JUN-2005 |
| Yellow (res) | 0.10-100MHz | 100Ω Resistor Nwk | C-S | 00810 | 28-SEP-2005 |
| Green (res) | 0.10-100MHz | 100Ω Resistor Nwk | C-S | NA | 17-JAN-2006 |

| OSCILLOSCOPES | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|
| OSCILLOSCOPE 100MHZ | TDS 220 | TEKTRONIX | B068748 | 00885 | 02-JUN-2005 |
| OSCILLOSCOPE 100MHZ (SAFETY) | TDS 340 | TEKTRONIX | B012357 | 00737 | 05-OCT-2005 |
| OSCILLOSCOPE 100MHZ (TELECOM) | 54645A | HP | US36320452 | 00103 | 02-JUL-2005 |

| RMS VOLTMETERS/CURRENT CLAMP | MN | MNFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|
| TRUE-RMS MULTIMETER | 79III | FLUKE | 71700298 | 00769 | 21-OCT-2005 |
| TRUE-RMS MULTIMETER | 177 | FLUKE | 83390024 | 00973 | 10-MAR-2006 |
| TRUE-RMS MULTIMETER (REFERENCE) | 177 | FLUKE | 83390025 | 00974 | 10-MAR-2006 |
| TRUE-RMS MULTIMETER (TELECOM) | 177 | FLUKE | 83430419 | 00975 | 10-MAR-2006 |
| TRUE-RMS CLAMP METER (SAFETY) | 36 | FLUKE | 68805882 | 00700 | 05-MAR-2005 |

| SURGE GENERATORS | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|
| TRANSIENT WAVEFORM MONITOR | TWM-5 | CDI | 003982 | 00323 | 17-JUN-2005 |
| UNIVERSAL SURGE GENERATOR | M5 | CDI | 003966 | 00324 | 09-JUN-2005 |
| THREE PHASE COUPLING NWK | 3CN | CDI | 003455 | 00325 | 09-JUN-2005 |
| 1.2X50US PLUGIN MODULE | 1.2X50US PLUGIN | CDI | N/A | 00842 | 09-JUN-2005 |
| 10X160US PLUGIN MODULE | 10X160US PLUGIN | C-S | N/A | 00843 | 09-JUN-2005 |
| 10X560US PLUGIN MODULE | 10X560US PLUGIN | C-S | N/A | 00841 | 09-JUN-2005 |
| PSURGE CONTROLLER MODULE | PSURGE 8000 | HAEFELY | 150267 | 00879 | 11-JUN-2005 |
| COUPLING/DECOUPLING MODULE | PSD 900 | HAEFELY | 149213 | 00880 | 11-JUN-2005 |
| IMPULSE MODULE | PIM 900 | HAEFELY | 149202 | 00881 | 11-JUN-2005 |
| HIGH VOLTAGE CAP NWK 5KVDC, 18µF | CS-HVCC | C-S | 01 | 00772 | 28-SEP-2006 |
| NEBS SURGE GENERATOR | N/A | C-S | N/A | 00088 | 17-JUN-2005 |
| 2X10US SURGE GENERATOR | 2X10US | C-S | N/A | 00846 | 23-JUN-2005 |
| 10X700US SURGE GENERATOR | 10X700US | C-S | N/A | 00847 | 17-JUN-2005 |
| 12 PAIR SURGE RESISTOR MODULE | N/A | C-S | N/A | 00768 | 28-SEP-2005 |

| POWER/NOISE METERS | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|
| POWER METER | 435B | HP | 2445A11012 | 00773 | 06-APR-2006 |
| POWER METER | 437B | HP | 2912A01367 | 01099 | 27-OCT-2005 |
| POWER SENSOR | 8481A | HP | 2702A61351 | 00774 | 05-APR-2006 |
| PSOPHOMETER | 2429 | BRUEL & KJAER | 1237642 | 00585 | 14-FEB-2007 |
| TRANSMISSION LINE TESTER (DBRNC) | 185T | AMREL | 998658 | 00823 | 07-MAR-2006 |

| OVERVOLTAGE CHAMBERS | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|
| 72KW POWER FAULT SIMULATOR | OV1 | C-S | N/A | 00792 | 31-MAR-2007 |
| POWER FAULT SIMULATOR | OV2 | C-S | N/A | 00116 | 31-MAR-2007 |

| DIPOLE TAPE MEASURES | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|
| 26FT TAPE #1 | 2338CME | LUFKIN | C3166-1 | 00776 | 13-MAR-2007 |
| 26FT TAPE #2 | 2338CME | LUFKIN | C3166-2 | 00777 | 13-MAR-2007 |

| METEOROLOGICAL METERS | MN | MFR | SN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|
| TEMP./HUMIDITY/ATM. PRESSURE GAUGE | 7400 PERCEPTION II | DAVIS | N/A | 00965 | 08-FEB-2007 |
| TEMPERATURE /HUMIDITY GAUGE | THG-912 | HUGER | 4000562 | 00789 | 01-FEB-2007 |
| WEATHER CLOCK (PRESSURE ONLY) | BA928 | OREGON SCIENTIFIC | C3166-1 | 00831 | 02-FEB-2007. |

| CONSUMABLES | SPEC. | MFR | STOCK/MN | ASSET | CALIBRATION DUE |
|---|---|---|---|---|---|
| NEBS CHEESECLOTH | 26-28M/KG | ED&D | ACC-01 | N/A | N/A |
| NEBS CARBON BLOCK | 3-MIL-GAP 1KV SURGE | RELIABLE | 3AB | N/A | N/A |

All equipment is calibrated using standards traceable to NIST or other nationally recognized calibration standard.

## *Jurisdictional Labeling and Required Instruction Manual Inserts*

### FCC Requirements

### Required Equipment Authorization for Device Type

| Type of Device | Equipment Authorization Required |
|---|---|
| TV broadcast receiver | Verification |
| FM broadcast receiver | Verification |
| CB receiver | Declaration of Conformity or Certification |
| Superregenerative receiver | Declaration of Conformity or Certification |
| Scanning receiver | Certification |
| All other receivers subject to part 15 | Declaration of Conformity or Certification |
| TV interface device | Declaration of Conformity or Certification |
| Cable system terminal device | Declaration of Conformity |
| Stand-alone cable input selector switch | Verification |
| Class B personal computers and peripherals | Declaration of Conformity or Certification |
| CPU boards and internal power supplies used with Class B personal computers | Declaration of Conformity or Certification |
| Class B personal computers assembled using authorized CPU boards or power supplies | Declaration of Conformity |
| Class B external switching power supplies | Verification |
| Other Class B digital devices & peripherals | Verification |
| Class A digital devices, peripherals & external switching power supplies | Verification |
| All other devices | Verification |

### FCC Required labeling for Verified Devices 47 CFR Part 15.19

Verified devices must have the following label permanently affixed in a location accessible to the user:

*This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*

No distinction is made between Class A or Class B devices on the label.

When the device is so small or for such use that it is not practicable to place label on it, the information may be shall be placed in a prominent location in the instruction manual supplied to the user or, alternatively, shall be placed on the container in which the device is marketed.

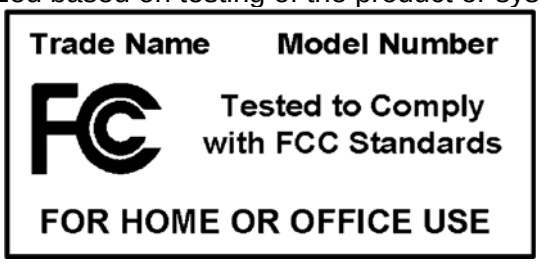
Where a device is constructed in two or more sections connected by wires and marketed together, the label is only required to be affixed to the main control unit.

### FCC Required labeling for Class B Personal Computers and Peripherals Devices 47 CFR Part 15.19 subject to Declaration of Conformity

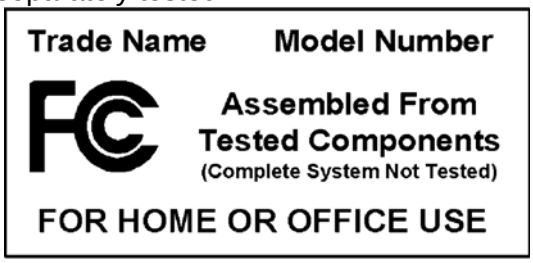
Personal computers and peripherals subject to authorization under a Declaration of Conformity shall be labeled as follows:

(1) The label shall be located in a conspicuous location on the device and shall contain the unique identification described in Section 2.1074 and the following logo:

(i) If the product is authorized based on testing of the product or system:




(ii) If the product is authorized based on assembly using separately authorized components and the resulting product is not separately tested:




(2) When the device is so small or for such use that it is not practicable to place the statement specified under paragraph (b)(1) of this section on it, such as for a CPU board or a plug-in circuit board peripheral device, the text associated with the logo may be placed in a prominent location in the instruction manual or pamphlet supplied to the user. However, the unique identification (trade name and model number) and the logo must be displayed on the device.

(3) The label shall not be a stick-on, paper label. The label on these products shall be permanently affixed to the product and shall be readily visible to the purchaser at the time of purchase, as described in Section 2.925(d). "Permanently affixed" means that the label is etched, engraved, stamped, silk-screened, indelibly printed, or otherwise permanently marked on a permanently attached part of the equipment or on a nameplate of metal, plastic, or other material fastened to the equipment by welding, riveting, or a permanent adhesive. The label must be designed to last the expected lifetime of the equipment in the environment in which the equipment may be operated and must not be readily detachable.

## FCC Required Instruction Manual Inserts CFR 47 Part 15.21 and 15.105

The user's manual must caution the user that changes or modifications not expressly approved by the manufacturer could void the user's FCC granted authority to operate the equipment. In addition the following information should be inserted:

(a) For a Class A digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

*Note: this equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.*

(b) For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual:

*Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:*

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

(c ) The provisions of paragraphs (a) and (b) of this section do not apply to digital devices exempted from the technical standards under the provisions of § 15.103.

(d ) For systems incorporating several digital devices, the statement shown in paragraph (a) or (b) of this section needs to be contained only in the instruction manual for the main control unit.

## *Terms and Conditions*

**Paragraph 1.** SERVICES. LABORATORY will:

1.1 Use the degree of care and skill ordinarily exercised by and consistent with the standards of the profession.
1.2 Perform all technical services in substantial accordance with the generally accepted laboratory principles and practices.
1.3 Retain all pertinent records relating to the services performed for a period of three (3) years following submission of the report describing such services, during which period the records will be made available to CLIENT upon reasonable request.

**Paragraph 2**. CLIENT'S RESPONSIBILITIES. CLIENT or his authorized representative will:

2.1 Provide LABORATORY with all plans, schematics, specifications, addenda, change orders, drawings and other information for the proper performance of technical services.
2.2 Designate a person to act as CLIENT's representative with respect to LABORATORY's services to be performed on behalf of the CLIENT; such person or firm to have complete authority to transmit instructions, receive information and data, interpret and define CLIENT's policies and decisions with respect to the LABORATORY's work on behalf of the CLIENT and to order, at CLIENT's expense, such technical services as may be required.
2.3 Designate a person who is authorized to receive copies of LABORATORY's reports.
2.4 Undertake the following:
(a) Secure and deliver to LABORATORY, without cost to LABORATORY, preliminary representative samples of the equipment proposed to require technical services, together with any relevant data.
(b) Furnish such labor and equipment needed by LABORATORY to handle samples at the LABORATORY and to facilitate the specified technical services.

**Paragraph 3.** GENERAL CONDITIONS:

3.1 LABORATORY, by the performance of services covered hereunder, does not in any way assume any of those duties or responsibilities customarily vested in the CLIENT, its employees, or any other party, agency or authority.
3.2 LABORATORY shall not be responsible for acts of omissions of any other party or parties involved in the design, manufacture or maintenance of the equipment or the failure of any employee, contractor or subcontractor to undertake any aspect of equipment's design, manufacture or maintenance.
3.3 LABORATORY is not authorized to revoke, alter, release, enlarge or release any requirement of the equipment's design, manufacture or maintenance unless specifically authorized by CLIENT or his authorized representative.
3.4 THE ONLY WARRANTY MADE BY LABORATORY IN CONNECTION WITH ITS SERVICE PERFORMED HEREUNDER IS THAT IT WILL USE THAT DEGREE OF CARE AND SKILL AS SET FORTH IN PARAGRAPH 1 ABOVE. NO OTHER WARRANTY, EXPRESS OR IMPLIED, IS MADE OR INTENDED FOR SERVICES PROVIDED HEREUNDER.
3.5 Where the LABORATORY indicates that additional testing is advisable to obtain more valid or useful data, and where such testing has not been authorized, CLIENT agrees to view such test reports as inconclusive and preliminary.
3.6 The LABORATORY will supply technical service and prepare a report based solely on the sample submitted to the LABORATORY by the CLIENT. The CLIENT understands that application of the data to other devices is highly speculative and should be applied with extreme caution.
3.7 The LABORATORY agrees to exercise ordinary care in receiving, preserving and shipping (F.O.B. Littleton, MA) any sample to be tested, but assumes no responsibility for damages, either direct or consequential, which arise from loss, damage or destruction of the samples due to the act of examination, modification or testing, or technical services or circumstances beyond LABORATORY's control.
3.8 The LABORATORY will hold samples for thirty (30) days after tests are completed, or until the CLIENT's outstanding debts to the LABORATORY are satisfied, whichever is later.
3.9 The CLIENT recognizes that generally accepted error variances apply and agrees to consider such error variances in its use of test data.
3.10 It is agreed between LABORATORY and CLIENT that no distribution of any tests, reports or analysis other than that described below shall be made to any third party without the prior written consent of both parties unless such distribution is mandated by operation of law. It is agreed that tests, reports, or analysis results may be disclosed to third party auditors of the laboratory at the laboratory facility in the course of accreditation maintenance audits. No reference to reports or technical services of the LABORATORY shall be made in any advertising or promotional literature without the express written permission of the LABORATORY.
3.11 The CLIENT acknowledges that all employees of LABORATORY operate under employment contracts with the LABORATORY and CLIENT agrees not to solicit employment of such employees or to solicit information related to other clients from said employees.
3.12 In recognition of the relative risks and benefits of the project to both CLIENT and LABORATORY, the risks have been allocated such that the CLIENT agrees, to the fullest extent permitted by law, to limit the liability of the LABORATORY to the CLIENT for any and all claims, losses, costs, damages of any nature whatsoever or claims expenses from any cause or causes, including attorneys' fees and costs and expert witness fees and costs, so that the total aggregate liability of the LABORATORY to the CLIENT shall not exceed $100,000, or the LABORATORY'S total fee for services rendered on this project, whichever is greater. It is intended that this limitation apply to any and all liability or cause of action however alleged or arising, unless otherwise prohibited by law.

**Paragraph 4.** INSURANCE:

4.1 LABORATORY shall secure and maintain throughout the full period of the services provided to the CLIENT adequate insurance to protect it from claims under applicable Workmen's Compensation Acts and also shall maintain one million dollars of general liability coverage to cover claims for bodily injury, death or property damage as may arise from the performance of its services.
4.2 The CLIENT hereby warrants that it has sufficient insurance to protect its employees adequately under applicable Workmen's Compensation Acts and for bodily injury, death, or property damage.
4.3 No insurance of whatever kind or type, which may be carried by either party is to be considered as in any way limiting any other party's responsibility for damages resulting from their operations or for furnishing work and materials.

**Paragraph 5.** PAYMENT:

5.1 CLIENT shall pay to LABORATORY such fees for services as previously agreed, orally or in writing, within 30 days of presentment of a bill for such services performed. In the event CLIENT ordered, orally or in writing, services but such services were not assigned a rate for billing, such services shall be billed at the LABORATORY's reasonable and customary rate.

5.2 CLIENT shall be responsible for all shipping, customs and other expenses related to services provided by LABORATORY to the CLIENT, and shall fully insure any test sample or other equipment provided to LABORATORY by the CLIENT.
5.3 Amounts overdue from CLIENT to LABORATORY shall be charged interest at a rate of 1½% per month.

**Paragraph 6.** ISO/IEC GUIDE 17025 ADDITIONS:

6.1 CLIENT agrees that this test report will not be reproduced except in full, without written approval from the LABORATORY.
6.2 CLIENT agrees that this test report shall not be used to claim product endorsement by A2LA or ANSI or any agency of the U.S. Government.
6.3 CLIENT agrees that test results presented herein relate only to the sample tested by the LABORATORY.

## A2LA Accreditation

SCOPE OF ACCREDITATION TO ISO/IEC 17025-1999

CURTIS-STRAUS[1]
527 Great Road
Littleton, MA 01460
Barry Quinlan Phone: 978-486-8880

ELECTRICAL

Valid until: July 31, 2005 Certificate Number: 1627-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following Electromagnetic Compatibility (EMC), Telecommunications, and Product Safety tests:

***Electromagnetic Compatibility (EMC)***
Radiated emissions testing (electric and magnetic fields); Conducted emissions testing (voltage and current); Electrostatic Discharge testing; Electrical Fast Transient testing; Radiated Immunity testing; Conducted Immunity testing; Lightning Immunity testing; Voltage Dips, Interrupts and Voltage Variations testing; Magnetic Immunity testing; RF Power measurements; Frequency Stability measurements; Longitudinal Induction measurements; Harmonic emissions testing; Light flicker testing; Low frequency disturbance voltage testing; Disturbance Power measurements

| EMC Standards | Title |
|---|---|
| *Emissions* | |
| CISPR 22 1997 with amendments 1 and 2 | Limits and methods of measurement of radio disturbance characteristics of information technology equipment. |
| CNS13438 1994 | Limits and methods of measurement of radio interference characteristics of information technology equipment. |
| EN55022:1994 and 1998 | Limits and methods of measurement of radio disturbance characteristics of information technology equipment. |
| SABS CISPR 22:1997 | Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement |
| Canada ICES-003 1997 | Digital apparatus |
| AS/NZS 3548 1995 | Australian/New Zealand Standard Limits and methods of measurement of radio disturbance characteristics of information technology equipment |
| CISPR 11 1990, 1997, 1999 | Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment. |

[1] Note: This accreditation covers testing performed at the laboratory listed above and the satellite facility located at 168 Ayer Rd, Littleton, MA 01460

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|---|---|
| EN 55011 1991, 1998 | Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment. |
| SABS CISPR 11:1997 | Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics Limits and methods of measurement |
| Canada ICES-001 1998 | Industrial, scientific and medical radio frequency generators |
| CNS13803 | Industrial, Scientific and Medical Instrument |
| AS/NZS 2064: 1997 | Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment. |
| CSA C108.8 – M1983 | Electromagnetic Emission from Data Processing Equipment and Electronic Office Machines |
| CISPR 13:1996, 1998, 2001 | Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment. |
| EN 55013: 1990, 2001 | Sound and television broadcast receivers and associated equipment: Electromagnetic compatibility. Part 1: Specification for limits and methods of measurement of radio disturbance characteristics of broadcast receivers and associated equipment. |
| EN 55013 Amend 12 1994 | Limits and methods of measurement of radio disturbance characteristics of broadcast receivers and associated equipment. Amendment 12 |
| SABS CISPR 13: 1996 | Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment. |
| CNS 13439 | Broadcast receiver and associated equipment Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment. |
| AS/NZS 1053: 1999 | |
| CISPR 14 1993 (*except discontinuous disturbances*) | Limits and methods of measurement of radio disturbance characteristics of electrical motor- operated and thermal appliances for household and similar purposes, electric tools and electric apparatus. |
| EN 55014 1993, 1997 *discontinuous disturbances*) | Limits and methods of measurement of radio disturbance (*except* characteristics of electrical motor- operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus. |
| AS/NZS 1044: 1995 *discontinuous disturbances*) | Limits and methods of measurement of radio disturbance (*except* characteristics of electrical motor- operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus. |
| *Immunity* | |
| CNS13783-1 | Household Electrical Appliances |
| SABS CISPR 14-1 1993 | Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus Part 1: Emission – Product family standard |
| SABS CISPR 14-2 1997 + A1:2001 | Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus Part 2: Immunity - Product family standard |

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|---|---|
| CISPR 14-2 1996, 1997 + A1:2001 | Immunity requirements for household appliances, tools and similar apparatus. |
| CISPR 20: 1995, 2002 with amendment 3 (*associated group only*) | Limits and methods of measurement of immunity characteristics of sound and television broadcast receivers and associated equipment. |
| EN 55020: 1995, 2002 (*associated group only*) | Electromagnetic immunity of broadcast receivers and Associated equipment. |
| CISPR 24 | Information technology equipment – Immunity characteristics – Limits and methods of measurement |
| SABS CISPR 24 1997 | Information technology equipment – Immunity characteristics – Limits and methods of measurement |
| AS/NZS 3200.1.2: 1995 | Approval and test specification – Medical electrical Equipment – General requirements for safety – Collateral Standard: Electromagnetic compatibility – Requirements and tests. |
| *European Union Basic EMC Standards* | |
| EN 61000-4-2: 1995, 1999, 2001 | Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 2: Electrostatic discharge immunity test – Basic EMC Publication |
| EN 61000-4-3:1997, 1998, 2002 AS/NZS 61000.4.3 1999 | Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 3: Radiated, radio-frequency, electromagnetic field immunity test |
| EN 61000-4-4 1995 | Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 4: Electrical fast transient/burst immunity test – Basic EMC publication |
| EN 61000-4-5 1995 AS/NZS 61000.4.5 1999 | (EMC) Part 4: Testing and measurement techniques. Section 5: Surge immunity test. |
| EN 61000-4-6 1996 AS/NZS 61000.4.6 1999 | Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 6: Immunity to conducted disturbances, induce by radio-frequency fields. |
| EN 61000-4-8 1994 | Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 8: Power frequency magnetic field immunity test. |
| EN 61000-4-11 1994 | (EMC) Part 4: Testing and measurement techniques. Section 11: Voltage dips, short interruptions and voltage Variations immunity tests. |
| ENV 61000-2-2 1993 | Electromagnetic compatibility (EMC). Part 2: Environment, Section 2: Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage power supply systems (IEC 1000-2-2:1990) |
| *EU Product Family Standards* | |
| EN 50081-1 1992 | Electromagnetic capability – Generic emission standard. Part 1: Residential, commercial and light industry. (I.S.) |
| EN 50081-2 1993 | Electromagnetic compatibility – Generic emission standard. Part 2: Industrial environment |
| EN 50082-1 1992, 1998 | Electromagnetic compatibility – Generic emission standard. Part 1: Residential, commercial and light industry |
| EN 50082-2 1995 | Electromagnetic compatibility – Generic immunity Standard. Part 2: Industrial environment |

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|---|---|
| EN 61000-6-1: 1997, 2001 | Electromagnetic Compatibility (EMC)- Part 6: Generic standards- Section 1: Immunity for residential, commercial and light-industrial environments |
| EN 61000-6-2: 1998, 2001 | Electromagnetic Compatibility (EMC)- Part 6: Generic standards- Section 2: Immunity for industrial environments |
| EN 50091-2 1996 | Specification for Uninterruptible Power Systems (UPS). Part 2: EMC requirements |
| EN 55024 1998 | Information technology equipment – Immunity Characteristics – Limits and methods of measurement. |
| EN 55103-1 1997 | Electromagnetic Compatibility – Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use. Part 1: Emission |
| EN 55103-2 1997 (*excluding Annex A3*) | Electromagnetic Compatibility – Product family standard for audio, video, audio-visual and entertainment lighting control professional use. Part 2: Immunity |
| EN 61326 1998 | Electrical equipment for measurement, control and laboratory use – EMC requirements |
| EN 61547 1996 | Equipment for general lighting purposes – EMC immunity requirements |
| EN 50130-4 1996 | Alarm Systems. Part 4: Electromagnetic compatibility. Product family standard: Immunity requirements for components of fire, intruder and social alarm systems. |
| EN 55104 1995 | Electromagnetic compatibility immunity – requirements for household appliances, tools and similar apparatus. Product family standard. |
| EN 50083-2 1995 | Cabled distribution systems for television and sound signals. Part 2: Electromagnetic compatibility for equipment. |
| EN 60601-1-2: 1993, 2002 | Medical electrical equipment Part 1: general requirements for safety Section 2: Collateral standard: Electromagnetic compatibility – requirements and tests |
| IEC 1800-3 1995 | Adjustable speed electrical power drive systems. Part 3: EMC product standard including specific test methods. |
| EN 60555 Part 2 1987 | Disturbances in supply systems caused by household appliances and similar electrical equipment. Part 2: Harmonics |
| EN 60555 Part 3 1987 | Disturbances in supply systems caused by household appliances and similar electrical equipment. Part 3: Voltage fluctuations. |
| EN 61000-3-2: 1995, 2000 AS/NZS 61000.3.2 1998 | Electromagnetic compatibility (EMC). Part 3: Limits Section 2: Limits for harmonic current emissions |
| EN 61000-3-3 1995 AS/NZS 61000.3.3 1999 | Electromagnetic compatibility (EMC). Part 3: Limits Section 2: Limitation of voltage fluctuations and flicker in low-voltage supply systems. |
| ETS 300 386-1 1994 | Equipment Engineering (EE); Public telecommunication network equipment electro-magnetic compatibility (EMC) requirements Part 1: Product family overview, compliance criteria and test levels |

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| | |
|---|---|
| ETS EN 300 386-2 1997, 1998, | Electromagnetic compatibility and radio spectrum matters (ERM); |
| ETS EN 300 386 2000 v1.2.1, 2001 v1.3.1 | Telecommunication network equipment; Electromagnetic compatibility (EMC) requirements; Part 2: Product family standard. |
| ETS 300 132-1 1996 | Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 1: Operated by alternating current (ac) derived from direct current (dc) sources |
| ETS 300 132-2 1996 | Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc) |
| ETR 283 1997 | Equipment Engineering (EE): Transient voltages at Interface A on telecommunications direct current (DC) power distributions. |
| *EU radio standards* | |
| (ETS) EN 300 385 v1.2.1: 1998, 1999 | Electromagnetic compatibility and Radio spectrum matters (ERM); Electromagnetic Compatibility (EMC) standard for fixed radio links and ancillary equipment (ETS) |
| EN 300 330 v1.2.1: 1998, 1999 | Electromagnetic compatibility and Radio spectrum matters (ERM); Short range devices (SRD); Technical characteristics and test methods for radio equipment in the range 9 kHz to 25 MHz and inductive loop systems in the frequency range 9 kHz to 30 MHz |
| ETS 300 328 1996 | Radio Equipment and Systems (RES); Wideband transmission systems; Technical characteristics and test conditions for data transmission equipment operating in the 2,4 GHz ISM band and using spread spectrum modulation techniques |
| ETS EN 300 440 v1.2.1 1999 | Electromagnetic compatibility and Radio spectrum matters (ERM); Short range devices; Technical characteristics and test methods for radio equipment to be used in the 1 Ghz to 40 Ghz frequency range |
| EN 301 893:2002 v1.2.1 | Broadband Radio Access Networks (BRAN); 5 GHz (draft) high performance RLAN; Harmonized EN covering Essential requirements of article 3.2 of the R&TTE Directive |
| ETS 300 836-1:1998 | Broadband Radio Access Networks (BRAN); High Performance Radio Local Area Network (HIPERLAN) Type 1; Conformance testing specification; Part 1: Radio Type approval and Radio Frequency (RF) conformance test specification |
| EN301 489-17:2002 v1.2.1 | Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for 2,4 GHz wideband transmission systems and 5 GHz high performance RLAN equipment |



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|---|---|
| EN 300 328-2:2001 v1.2.1 | Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband Transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using spread spectrum modulation techniques; Part 2: Harmonized EN covering essential requirements under article 3.2 of the R&TTE Directive |
| EN 301 489-1:2002 | Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements |
| EN 60669-2-1:2002 | Switches for household and similar fixed electrical installations -- Part 2-1: Particular requirements – Electronic switches |
| *Canada Radio Standards* | |
| Canadian GL-36 1995 | Industry Canada – technical requirements for low power Devices in the 2400 – 2483.5 MHz band. |
| Canadian RSS-119 1999, 2000 Issue 6 | Industry Canada – Land mobile and fixed radio Transmitters and receivers, 27.41 to 960.0 MHz |
| Canadian RSS-134 1996 & 2000, Issue 1 Rev 1 | Industry Canada – 900 MHz narrowband personal communications services |
| Canadian RSS-210 2000 Issue 3, | Industry Canada – Low power license-exempt radio 2001 Issue 5 communication devices |
| RFS29 1998 | Specification for Restricted Radiation Radio Apparatus (New Zealand) |
| *FCC Standards* | |
| 47 CFR FCC low power transmitters operating on frequencies below 1 GHz, emergency alert systems, unintentional radiators and ISM devices. | Scope A1 |
| 47 CFR FCC low power transmitters operating on frequencies above 1 GHz, with the exception of spread spectrum devices. | Scope A2 |
| 47 CFR FCC Unlicensed Personal Communications System (PCS) devices | Scope A3 |
| 47 CFR FCC Unlicensed National Information Infrastructure devices and low power transmitters using spread spectrum techniques. | Scope A4 |
| 47 CFR FCC Personal mobile Radio Services in the following FCC Rule Parts 22, 24, 25, 27. | Scope B1 |
| 47 CFR FCC General Mobile Radio Services in the following FCC Rule Parts 22, 74, 90, 95, 97. | Scope B2 |
| 47 CFR FCC Maritime and Aviation RadioServices in 47 CFR Parts 80 and 87 | Scope B3 |
| 47 CFR FCC Microwave Radio Services in 47 CFR Parts 21, 74 and 101. | Scope B4 |



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|---|---|
| FCC/OST MP-5 1986 | FCC (Federal Communications Commission) methods Of measurement of radio noise emissions from industrial, scientific and medical equipment. |
| GR-1089-CORE: 1997, 1999 issue 2/ 2002 Issue 3 | Bellcore electromagnetic compatibility and electrical safety – Generic criteria for network telecommunications equipment. |
| *ANSI EMC Standards* | |
| ANSI C63.4: 1992, 1999, 2001, 2003 | American National Standard for methods of measurement of radio-noise emissions for low-voltage electrical and electronic equipment in the range of 9 kHz to 40GHz. |
| ANSI C63.5 1988 | American National Standard for electromagnetic compatibility – radiated emissions measurements in electromagnetic interference (EMI) control – calibration of antennas. |
| *IEEE EMC Standards* | |
| IEEE C62.41: 1980, 1991 | IEEE recommended practice on surge voltages in low-voltage AC power circuits |
| *Swedish EMC Standards* | |
| BAKOM 3336.3 1995 | Electromagnetic compatibility and electrical safety (EMC & S) for wired terminal equipment. Harmonization document information over the OFCOM requirements. |
| *South African EMC standards other than CISPR equivalents* | |
| SABS 1718-1: 1996 | South African Bureau of Standards: Specification for Gaming equipment. Part 1: Casino equipment. |
| *Japanese VCCI Standards* | |
| VCCI V-3/99.05 1999 | Technical Requirements |
| VCCI V-4/99.05 1999 | Instruction for Test Conditions for Requirement under Test |

***Telecommunications***

Telecommunications Registration; General test methods; Lightning surge; Drop testing; Balance testing; Signal power (metallic and longitudinal); Frequency measurements; Pulse templates; Leakage testing; Impedance testing; Hearing Aid Compatibility testing (*excluding volume control*); Protocol analysis and Jitter testing.

| Telecom Standards | Title |
|---|---|
| FCC 47 CFR Part 68 Telephone | Connection of terminal equipment to the telephone Terminal Equipment network. Analog and Digital Equipment. TCB Scope C1. |
| CS-03 Issue 8 1996 through amendment 5 | Specification for terminal equipment, terminal systems, Network protection devices, connection arrangements and hearing aids compatibility. |
| TIA/EIA TSB31-B 1998 | Bulletin Part 68 Rationale and Measurement Guidelines (Feb 1998) |



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| TIA/EIA-IS-968 | Telecommunications Telephone Terminal Equipment Technical Requirements for Connection of Terminal Equipment to the Telephone Network |
| TIA/EIA-IS-883 | Telecommunications Telephone Terminal Equipment Supplemental Technical Requirements for Connection of Stutter Dial Tone Detection Devices and ADSL Modems to the Telephone Network |
| TIA-968-A | Telecommunications Telephone Terminal Equipment Technical Requirements for Connection of Terminal Equipment to the Telephone Network |
| T1.TRQ.6-2001 | Technical Requirements for SHDSL, HDSL2, HDSL4 Digital Subscriber Line Terminal Equipment to Prevent Harm to the Telephone Network Industry |
| Canada VDSL Issue 1 January 2003 | Terminal Attachment Program Requirements and Test Methods for Very-High-Bit-Rate Digital Subscriber Line (VDSL) Terminal Equipment |
| AS/ACIF S002-2001 | Analogue interworking and non-interference requirements for Customer Equipment for connection to the Public Switched Telephone Network |
| AS/ACIF S016-2001 | Requirements for Customer Equipment for connection to hierarchical digital interfaces |
| AS/ACIF S031-2001 | Requirements for ISDN Basic Access Interface |
| AS/ACIF S038-2001 | Requirements for ISDN Primary Rate Access Interface |
| AS/ACIF S043-2001 | Requirements for Customer Equipment for Connection to a Metallic Local Loop Interface of a Telecommunications Network —<br>Part 1: General<br>Part 2: Broadband<br>Part 3: DC, Low Frequency AC and Voiceband |
| ITU-T G.703 | Physical/electrical characteristics of hierarchical Digital interfaces |
| HKTA 2028 | Network connection specification for connection of CPE to the PTNs in Hong Kong using digital leased circuits at data rate of 1544 kbit/s |
| HKTA 2029 | Network connection specification for connection of CPE to the PTNs in Hong Kong using digital leased circuits at data rate of 2048 kbit/s |
| TBR 1 : 1995 | Attachment requirements for terminal equipment to be connected to circuit switched data networks and leased circuits using a CCITT Recommendation X.21 interface, or at an interface physically, functionally and electrically compatible with CCITT Recommendation X.21 but operating at any data signaling rate up to, and including, 1 984 kbit/s |
| TBR 2 : 1997 | Attachment requirements for Data Terminal Equipment (DTE) to connect to Packet Switched Public Data Networks (PSPDNs) for CCITT Recommendation X.25 interfaces at data signaling rates up to 1 920 kbit/s utilizing interfaces derived from CCITT Recommendations X.21 and X.21 bit |

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| TBR 3 : 1995 + Amdt : 1997 | Integrated Services Digital Network (ISDN); Attachment requirements for terminal equipment to connect to an ISDN using ISDN basic access |
| TBR 4 : 1995 + Amdt : 1997 | Integrated Services Digital Network (ISDN); Attachment requirements for terminal equipment to connect to an ISDN using ISDN primary rate access |
| TBR 012 : 1993 + Amdt : 1996 | Business Telecommunications (BT); Open Network Provision (ONP) technical requirements; 2 048 kbit/s digital unstructured leased line (D2048U) Attachment requirements for terminal equipment |
| TBR 013 : 1996 | Business TeleCommunications (BTC); 2 048 kbit/s digital structured leased lines (D2048S); Attachment requirements for terminal equipment interface |
| TBR 21 : 1998 | Terminal Equipment (TE); Attachment requirements for pan-European approval for connection to the analogue Public Switched Telephone Networks (PSTNs) of TE (excluding TE supporting the voice telephony service) in which network addressing, if provided, is by means of Dual Tone Multi Frequency (DTMF) signaling |
| TBR 24 : 1997 | Business TeleCommunications (BTC); 34 Mbit/s digital Unstructured and structured leased lines (D34U and D34S); Attachment requirements for terminal equipment interface |
| *Australia* | |
| TS 002 : 1997 | Analogue Interworking and Non interference Requirements for Customer Equipment Connected to the Public Switched Telephone Network |
| TS 016 : 1997 | General Requirements for Customer Equipment Connected to Hierarchical Digital Interfaces |
| TS 031 : 1997 | Requirements for ISDN Basic Access Interface |
| TS 038 : 1997 | Requirements for ISDN Primary Rate Access Interface |
| AS/ACIF S043.2:2001 | Requirements for Customer Equipment for connection to a metallic loop interface of a Telecommunications Network – Part 2 Broadband |

***Product Safety***

General test methods; Input tests; Electric strength tests; Impulse tests; Permanency of marking tests; Accessibility tests; Energy Hazard measurements; Capacitor discharge tests; Humidity conditioning; Earthing tests; Limited power source measurements; Stability tests; Steel ball tests; Lithium Battery Reverse Current measurements; Leakage current tests; Transformer abnormal tests; Telecom leakage tests; Over voltage/power cross tests (*excluding x-ray tests*).

| Product Safety Standards | Title |
|---|---|
| *Specific Product Safety Standards* | |
| IEC 950 1991 | Safety of information technology equipment including Includes Amendments 1, 2, 3, and 4 electrical business equipment. |
| UL 1950 1998 | Safety of information technology equipment, including electrical business equipment. |
| CSA C22.2 No.950-95 | Safety of Information Technology Equipment (UL 1950) |
| UL 60950 2000 | Safety of information technology equipment |



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| IEC 60950 2000 | Safety of information technology equipment |
| EN 60950 1997, 1998, 2000 | Safety of information technology equipment, including |
| IEC 60950-1 2001 | Electrical business equipment. |
| UL 60950-1 2003 | |
| CSA C22.2 No. 60950-00 | |
| CSA C22.2 No. 60950-1 03 | |
| AS/NZS 3260 1993 | Approval and test specification – Safety of information technology equipment including electrical business Equipment. |
| AS/NZS 3260 Supp 1 1996 | Approval and test specification – Safety of information technology equipment including electrical business equipment – Alphabetical reference index to IEC 950 (Supplement to AS/NZS 3260:1993) |
| ACA TS 001 1997 | Australian Communications Authority – Safety requirements for customer equipment. |
| UL 1459 1995 | Telephone Equipment |
| IEC 1010-1 1990 | Safety requirements for electrical equipment for measurement, control |
| IEC 61010-1 1993 | and laboratory use, Part 1: General requirements. |
| EN 61010-1 1993, 2001 | Safety requirements for electrical equipment for measurement, control |
| IEC 61010-1 2001 | and laboratory use, Part 1: General requirements. |
| UL 61010B-1 2003 | |
| UL 3101-1 1993 | Electrical equipment for laboratory use Part 1: General requirements. |
| CAN/CSA 1010-1 1999 (*Including AM 2*) | |
| UL 3111-1 1996 | Electrical measuring and test equipment. Part 1: General requirements. |
| UL 3121-1 1995 | |
| IEC 60601-1 1995 | Medical electrical equipment. Part 1: General requirements for safety. |
| EN 60601-1 1995 (*Including AM 2*) | Medical electrical equipment |
| UL 2601-1 1997 | Medical electrical equipment. Part 1: General Requirements for safety. |
| IEC 60065 1998, 2000 | Audio, video and similar electronic apparatus – Safety requirements |
| ANSI/UL 6500: 1998 | Audio/video and musical instrument apparatus for |
| CAN/CSA 60065-00 | Household, commercial and similar general use |
| AS/NZS 3250 1995 | Australian/New Zealand Standard – Approval and test |
| AS/NZS 60065 2000 | Specification – Mains operated electronic and related Equipment for household and similar general use |
| Canadian C22.2 No. 1-94 (1-98) 1994, 1998 | Audio, video and similar electronic equipment. Consumer and commercial products |
| EN 60065 1994 | Safety requirements for main operated electronic and related apparatus for household and similar general use. |
| IEC 60825 1990 | Radiation safety of laser products, equipment Classification, requirements and user's guide |
| EN 60825-1 1994 | Safety of laser products Part 1: equipment Classification, requirements |
| IEC 60825-1 2001 | and user's guide. |
| IEC 60825-2 2000-5 | Safety of laser products – Part 2: Safety of optical communication systems |
| IEC 60825-4 1997-11 | Safety of laser products – Part 4: Laser guards |
| IEC 60335-1 1995 | Safety of household and similar electrical appliances |
| (*Including AM2 – 1997 & AM 12 – 1997*) | Part 1: General requirements |
| EN 60335-1 2001 | |
| UL 60335-1 1998 | |
| CAN/CSA E335-1 1994 | |



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| UL 61010A-1 : 2002 | Electrical equipment for laboratory use; part 1: General requirements |
| EN 61010-1 : 2001 | Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements |
| AS/NZS 60950 : 2000 | Safety information technology equipment |

***Environmental*** [2]

| Environmental Standards | Title |
|---|---|
| GR-63-CORE | NEBS Requirements: Physical Protection |
| ETS 300 019 (vibration up to 1000Hz) | Environmental conditions and environmental tests For telecommunications equipment |

[2] Environmental testing is performed at the satellite facility located at 168 Ayer Rd, Littleton, MA 01460