Curtis-Straus

Test Report

Report No	EF0918-1
Client	Colubris Networks 200 West Street Waltham, MA 02451
Phone	781-547-0378
Fax	781-684-0009
FRN	0010292464
Models	CM9-C1
FCC ID	RTP550-10016-7
IC ID	4891A-0100167
Equipment Type	Low Power Communication Device Transmitter
Equipment Code	DTS and NII
Application Type	New Authorization – Limited Modular Approval
Rule Part	FCC 15.247, & 15E, and RSS-210
Emissions Designator	2.4GHz band --12M6F1D 5.8GHz band -- 29M9F1D
Results	As detailed within this report
Prepared by	Josh LeBlanc – Test Engineer
Authorized by	Michael Buchholz – EMC Manager
Issue Date	5/8/06
Conditions of issue	This Test Report is issued subject to the conditions stated in 'terms and conditions' section of this

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Summary

This report is an application for limited modular certification of a transmitter operating under 47 CFR 15.247 and 15.407 and RSS-210 provided for operation of digital transmission systems and U-NII transmitters. The product covered by this report is the CM9-C1 modular radio. The product was tested using the methods outlined in ANSI C63.4 (2003). The manufacturer intends to use the following antennas with the product.

Antenna	Gain (dBi)	Frequency of Operation
Miltope p/n: 901167-2	2.6dBi@ 2.45GHz, 1.2dBi@ 5.25GHz, 1.2dBi@ 5.8GHz	2.39 – 2.49GHz 4.9 – 5.9GHz
Miltope p/n: 901563-2	4.75dBi@ 2.45GHz, 4.85dBi@ 2.50GHz, 5.0dBi@ 4.8GHz, 5.0dBi@ 5.25GHz, 4.0dBi@ 5.875GHz	1.9GHz – 2.5GHz 4.8GHz – 5.875GHz
Miltope p/n: 901058-1	5.0dBi@ 2.35GHz	2.2-2.5GHz
Miltope p/n: 901167-1	3.5dBi@ 2.45GHz, 2.5dBi@ 5.0GHz 3.5dBi@ 5.25GHz, 3.5dBi@ 5.8GHz	2.39 – 2.49GHz 4.9 – 5.9GHz
Gore GSC10-82701-XX (XX signifies antenna length)		1.9GHz – 2.5GHz 4.8GHz – 5.875GHz

All antennas are less than have less than 6dBi of gain making a drop in the conducted output power limits unnecessary. The CM9-C1 is essentially the same radio as the CM9 (previously certified under FCC ID: NKRCM9). The CM9-C1 has an additional filter added on the 5GHz RF line prior to the power amplifier. The filter was added to meet FAA requirements. This report contains data covering radiated spurious emissions in the pass band of each antenna. Conducted spurious emissions at the antenna port were tested during 5GHz operation for 15.247. It was determined from the manufacturer's datasheets that the addition of the filter on the 5GHz RF line should only lower the emissions in the band reject range and has no effect on the 5GHz output due to the filter being ahead of the power amplifier feed back leveling (see F0918 Filter Spec.pdf for details). New conducted power readings for 2.4GHz operation are unnecessary due to no changes in the 2.4GHz RF path. The original application exhibits (FCC ID: NKRCM9) will be used to provide test data for the remainder of the tests not affected by the addition of the antennas and band pass filter.

Antenna	Channels Allowed	Indoor or Outdoor Operation
Miltope p/n: 901058-1	All channels	Outdoor
Miltope p/n: 901563-2	All channels	Outdoor
Miltope p/n: 901167-2	All channels	Indoor
Miltope p/n: 901167-1	All channels	Indoor
GORE Leaky Line antenna	All channels	Indoor

Note: Spurious emissions were not tested with the leaky line antennas since they provide a significant loss (-30dBi) in output and cannot practically be tested on a test site (antennas are 20-50m long).

Statement of Conformity

The CM9-C1 has been found to conform to the following parts of the 47 CFR, RSS-210, and RSS-GEN as detailed below:

RSS-GEN	RSS-210	47 CFR Part #	Comments
5.3		15.15(b)	The product contains no user accessible controls that increase transmission power above allowable levels.
5.2		15.19	The label is shown in the label exhibit.
7.1.5		15.21	Information to the user is shown in the instruction manual exhibit.
		15.27	No special accessories are required for compliance.
		15.31(e)	The voltage was varied to ±15% of the rated voltage. (see note 1)
7.1.4		15.203	The device is professionally installed.
7.1.4		15.204	See attached documentation describing the antennas.
7.2.3	2.6	15.205 15.209	The fundamental is not in a restricted band and the spurious emissions in the restricted bands comply with the general emission limits of 15.209.
		15.247(a)	The EUT is digitally modulated.
		15.247(a)(2)	The minimum 6dB bandwidth is greater than 500kHz. (see note 1)
		15.247(b)(3)	The EUT meets the conducted power limit at the fundamental. (see note 1)
		15.247(b)(4)	Antenna gains are less than 6dBi. See antenna exhibits for details.
		15.247(c)	Antenna gains are less than 6dBi. See antenna exhibits for details.
7.2.3	2.2, 2.3	15.247(d)	The EUT meets the spurious emissions requirements.
		15.247(e)	The PSD conducted to the antenna is less than 8dBm. (see note 1)
		15.247(i)	See MPE report for details
		15.407(a)(1)(2)(3)	The EUT meets the conducted output power and PSD limits at the fundamental. (see note 1)

		15.407(a)(6)	The EUT meets the peak excursion requirements. (see note 1)
		15.407(b)	The EUT meets the unwanted emissions requirements.
7.2.2		15.407(b)(6) 15.207	The EUT meets the AC power line conducted limits. (see note 1)
		15.407(f)	See MPE report for details
	2.1	15.407(g)	The EUT meets the frequency stability requirements. (see note 1)

Note 1: Test data is included in the files labeled “NKRMCM9 part a.pdf” thru “NKRMCM9 part o.pdf”

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Test Methodology

The EUT was maximized around three orthogonal axes. EUT antennas were maximized within their range of motion. Spurious emissions were checked from 30MHz – 18GHz with Miltope antenna 901167-1. Spurious emissions were also checked from 1GHz to 10GHz with the other three Miltope antennas.

The EUT was tested on a non-conductive table 80cm above the ground plane. The receiving antenna was placed at a distance of 3m from the product. The radio output power was set to the maximum level. The CM9-C1 was supplied 3.3Vdc by a host board which in turn was either powered over ethernet or by an external AC/DC supply. The ambient environmental conditions were as follows:

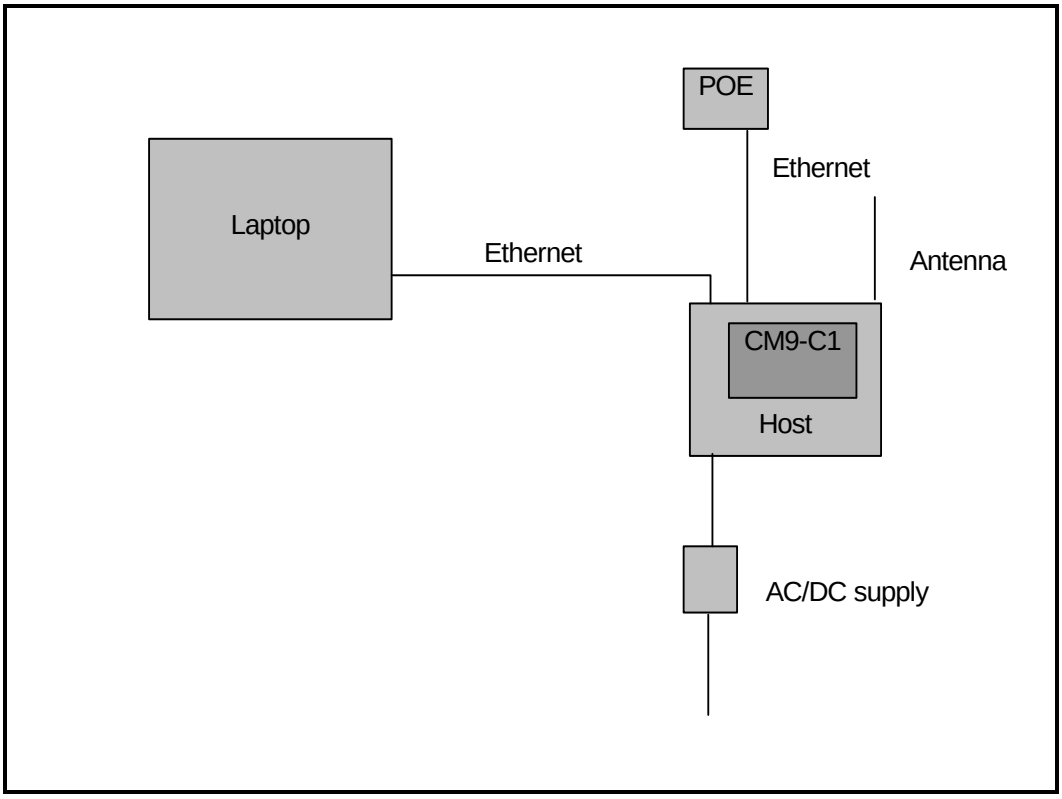
Date	Temperature	Humidity
7/28/05	25.5°	36%
11/11/05	23.7°	19%
1/9/06	22.8°	18%
3/24/06	24.7°	17%
4/3/06	23.8°	19%

Frequency range investigated:	30MHz – 18GHz

All readings are peak unless otherwise noted.

EUT Configuration

EUT Configuration					
Work Order:	F0918				
Company:	Colubris Netgworks				
Company Address:	200 West Street Waltham, Ma 02451				
Contact:	Gerrett Durling				
	MN	**SN**			
EUT:	CM9-C1	C0D853700050C01			
EUT Description:	802.11a, b, and g WLAN access point				
Support Equipment:	**MN**	**SN**			
PowerDesign POE	3001	B05146050005820601			
Host system	50-00-0008-02	B001-04462			
AC/DC adapter	FSP015-1AD201A	Test Sample 1			
Dell laptop	PP07L	Not labeled			
Host Cables:	**Qty**	**Shielded?**	**Length**	**Ferrites**	
Ethernet	2	Yes	10 ft	None	
AC power	1	no	1.5m	None	
Unpopulated EUT Ports:	**Qty**	**Reason**			
none					
Software / Operating Mode Description:					
The EUT was tested in 802.11a, and 802.11b/g modes.					



Test Data and Plots

Spurious Emissions

Miltope 901563-1

2.4GHz Operation

Table 1

Spurious Emissions — *Curtis-Straus LLC*

Date: 28-Jul-05 **Company:** Colubris Networks **Work Order:** F0285
Engineer: Mairaj Hussain **EUT Desc:** CM9

Frequency Range: 1 - 10GHz **Measurement Distance:** 3 m
Notes: Antenna: S65-5366-712 for boeing HPF at the input of PA **EUT Max Freq:** 5825MHz

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)				FCC Class B Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
Vpk	2871.0	50.0	39.3	31.3	2.5	44.5				54.0	-9.5	Pass

Table Result: Pass by -9.5 dB ***Worst Freq:*** 2871.0 MHz

Test Site: "T" **Pre-Amp:** Brown **Cable:** EMIR-HIGH 11 **Analyzer:** White **Antenna:** Orange Horn

Table 2

Band Edges — *Curtis-Straus LLC*

Date: 28-Jul-05 **Company:** Colubris Networks **Work Order:** F0285
Engineer: Mairaj Hussain **EUT Desc:** CM9

Measurement Distance: 3 m
Notes: Antenna: S65-5366-712 for boeing

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)				FCC Class B Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
At CH1, 2412MHz, 54mbps												
Vpk	2400.0	78.1										
Vavg	2400.0	66.0										
For delta:												
Vpk	2400.0	76.4										
Vbe	2390.0	29.0										
delta:		47.4										
mkr delta pk	2390.0	30.7	0.0	29.7	2.2	62.6				74.0	-11.4	Pass
mkr delta avg	2390.0	18.6	0.0	29.7	2.2	50.5				54.0	-3.5	Pass
At CH11, 2462MHz, 54mbps												
Vpk	2454.0	75.0										
Vavg	2455.0	63.7										
For delta:												
Vpk	2456.0	70.3										
Vbe	2483.5	26.8										
delta:		43.5										
mkr delta pk	2483.5	31.5	0.0	30.0	2.4	63.9				74.0	-10.1	Pass
mkr delta avg	2483.5	20.2	0.0	30.0	2.4	52.6				54.0	-1.4	Pass
At CH11, 2462MHz, 1mbps Non Cont Tx mode												
Vpk	2460.0	78.2										
Vavg	2459.0	28.0										
For delta:												
Vpk	2461.0	75.1										
Vbe	2483.5	25.0										
delta:		50.1										
mkr delta pk	2483.5	28.1	0.0	30.0	2.4	60.5				74.0	-13.5	Pass
mkr delta avg	2483.5	-22.1	0.0	30.0	2.4	10.3				54.0	-43.7	Pass

Test Site: "T" **Pre-Amp:** none **Cable:** EMIR-HIGH 11 **Analyzer:** White **Antenna:** Orange Horn

5GHz Operation

Table 3

Band Edges — *Curtis-Straus LLC*

Date: 28-Jul-05 **Company:** Colubris Networks **Work Order:** F0285
Engineer: Mairaj Hussain **EUT Desc:** CM9
Measurement Distance: 3 m

Notes: Antenna: S65-5366-712 for boeing
RBW: 1MHz, VBW: 1MHz and 10Hz

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)				FCC Class B Limit (dBµV/m)	FCC Class B Margin (dB)	FCC Class B Result (Pass/Fail)
At CH36, 5180MHz, 54mbps												
Vpk	5180	69.8										
Vavg	5180	57.7										
300KHz RBW:												
Vpk	5180	64.0										
Vbe	5150	18.0										
delta:		46.0										
mkr delta pk	5150.0	23.8	0.0	36.0	3.1	62.9				74.0	-11.1	Pass
avg mkr delta	5150.0	11.7	0.0	36.0	3.1	50.8				54.0	-3.2	Pass
At CH64, 5320MHz, 54mbps												
Vpk	5318.0	64.3										
Vavg	5313.0	49.9										
300KHz RBW:												
Vpk	5323.0	60.0										
Vbe	5350.0	20.3										
delta:		39.7										
mkr delta pk	5350.0	24.6	0.0	36.3	3.2	64.1				74.0	-9.9	Pass
avg mkr delta	5350.0	10.2	0.0	36.3	3.2	49.7				54.0	-4.3	Pass

Test Site: "T" **Pre-Amp:** none **Cable:** EMIR-HIGH 11 **Analyzer:** White **Antenna:** Orange Horn

Table 4

Radiated Emissions Table — *Curtis-Straus LLC*

Date: 09-Jan-06 **Company:** Colubris Networks **Work Order:** F0918
Engineer: Josh LeBlanc **EUT Desc:** CM9-C1

Frequency Range: 1-10GHz **Measurement Distance:** 3 m

Notes: Miltope antenna 901563-2
TX/RX modes checked in 2.4GHz and 5GHz operation

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
No emissions were found.												

Test Site: "F" **Pre-Amp:** Yel-Blk **Cable:** EMIR-HIGH 2 **Analyzer:** White **Antenna:** Black Horn

Miltope 901058-1
2.4GHz Operation

Table 5

Radiated Emissions Table — *Curtis-Straus LLC*

Date: 24-Mar-06 **Company:** Colubris Networks **Work Order:** F0918
Engineer: Josh LeBlanc **EUT Desc:** CM9-C1

Frequency Range: 1-10GHz **Measurement Distance:** 3 m

Notes: Miltope antenna 901058-1
TX/RX modes checked in 2.4GHz operation

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)
No emissions were found			---	---	---	---	---	---	---	---	---	---

Test Site: "T" **Pre-Amp:** White **Cable:** EMIR-HIGH 10 **Analyzer:** Orange **Antenna:** Black Horn

Table 6

Bandedges — *Curtis-Straus LLC*

Date: 03-Apr-06 **Company:** Colubris Networks **Work Order:** F0918
Engineer: Josh LeBlanc **EUT Desc:** CM9-C1

Measurement Distance: 3 m

Notes: Miltope 901058-1 antenna
2.4GHz operation

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	FCC Class B Limit (dBµV/m)	FCC Class B Margin (dB)	FCC Class B Result (Pass/Fail)
Channel 1, 54Mbps,												
Hpk	2400.0	43.4	19.0	29.7	2.4	56.5	---	---	---	74.0	-17.5	Pass
Havg	2400.0	26.0	19.0	29.7	2.4	39.1	---	---	---	54.0	-14.9	Pass
Channel 11, 54Mbps												
Hpk	2483.5	33.7	18.8	30.0	2.5	47.4	---	---	---	74.0	-26.6	Pass
Havg	2483.5	20.5	18.8	30.0	2.5	34.2	---	---	---	54.0	-19.8	Pass

Table Result: Pass by -14.9 dB ***Worst Freq:*** 2400.0 MHz

Test Site: "F" **Pre-Amp:** White **Cable:** EMIR-HIGH 8 **Analyzer:** Orange **Antenna:** Orange Horn

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Miltope 901167-2
2.4GHz and 5GHz Operation

Table 7

Radiated Emissions Table *Curtis-Straus LLC*

Date: 09-Jan-06 **Company:** Colubris Networks **Work Order:** F0918
Engineer: Josh LeBlanc **EUT Desc:** CM9-C1

Frequency Range: 1-10GHz **Measurement Distance:** 3 m

Notes: Miltope antenna 901167-2
TX/RX modes checked in 2.4GHz and 5GHz operation

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	--- Limit (dBµV/m)	--- Margin (dB)	--- Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
No emissions were found.												

Test Site: "F" **Pre-Amp:** Yel-Blk **Cable:** EMIR-HIGH 2 **Analyzer:** White **Antenna:** Black Horn

Miltope 901167-1
2.4GHz and 5GHz operation

Table 8

Radiated Emissions Table *Curtis-Straus LLC*

Date: 11-Nov-05 **Company:** Colubris Networks **Work Order:** F0918
Engineer: Mairaj Hussain **EUT Desc:** CM9-C1

Frequency Range: 30 - 1000MHz **Measurement Distance:** 3 m

Notes: **EUT Max Freq:** 5825MHz

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)				FCC Class B Limit (dBµV/m)	FCC Class B Margin (dB)	FCC Class B Result (Pass/Fail)
v	86.6	45.2	24.6	8.0	1.1	29.7				40.0	-10.3	Pass
v	132.1	45.4	24.5	14.4	1.4	36.7				43.5	-6.8	Pass
v	150.0	44.7	24.4	13.0	1.5	34.8				43.5	-8.7	Pass
h	200.0	49.9	24.3	12.5	1.8	39.9				43.5	-3.6	Pass
h	225.0	42.3	24.3	11.6	1.9	31.5				46.0	-14.5	Pass
h	250.0	49.0	24.2	12.3	2.0	39.1				46.0	-6.9	Pass
h	257.0	44.7	24.2	12.5	2.1	35.1				46.0	-10.9	Pass
h	275.0	42.7	24.2	13.7	2.2	34.4				46.0	-11.6	Pass
h	300.0	50.0	24.1	14.0	2.3	42.2				46.0	-3.8	Pass
h	321.2	41.1	24.1	14.2	2.4	33.6				46.0	-12.4	Pass
h	325.0	40.6	24.1	14.4	2.4	33.3				46.0	-12.7	Pass
h	350.0	41.4	24.0	15.0	2.5	34.9				46.0	-11.1	Pass
h	385.4	50.6	24.0	15.8	2.6	45.0				46.0	-1.0	Pass
h	750.0	38.1	23.8	21.5	4.1	39.9				46.0	-6.1	Pass
h	800.0	40.5	23.9	21.7	4.2	42.5				46.0	-3.5	Pass
h	899.2	30.0	23.1	22.9	4.5	34.3				46.0	-11.7	Pass
h	999.9	34.2	22.9	24.3	4.9	40.5				54.0	-13.5	Pass

Table Result: Pass by -1.0 dB ***Worst Freq:*** 385.4 MHz

Test Site: "F" **Pre-Amp:** Orange **Cable:** EMIR-04 **Analyzer:** White **Antenna:** Red-White

Table 9

Spurious Emissions *Curtis-Straus LLC*

Date: 11-Nov-05 **Company:** Colubris Networks **Work Order:** F0918
Engineer: Mairaj Hussain **EUT Desc:** CM9 C1

Frequency Range: 1 - 18GHz **Measurement Distance:** 3 m

Notes: 2.4 and 5GHz operations investigated **EUT Max Freq:** 5825MHz

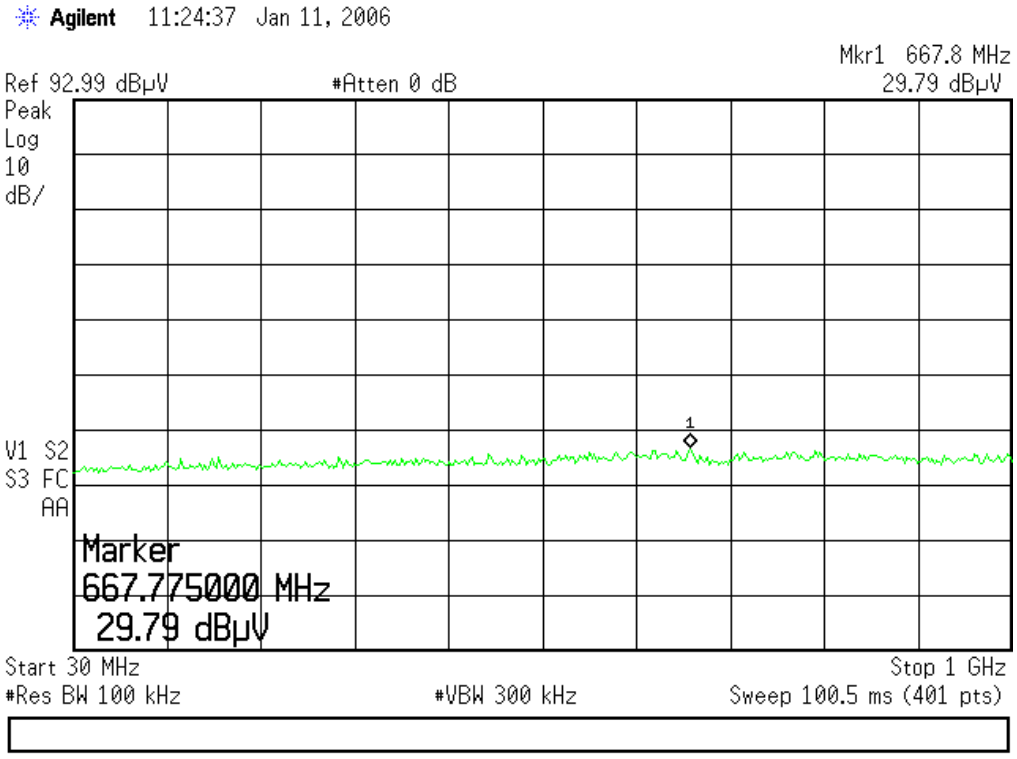
Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)				FCC Class B Limit (dBµV/m)	FCC Class B Margin (dB)	FCC Class B Result (Pass/Fail)
Hpk	4893.0	45.2	19.0	35.6	4.4	66.2				74.0	-7.8	Pass
Havg	4893.0	30.2	19.0	35.6	4.4	51.2				54.0	-2.8	Pass

Table Result: Pass by -2.8 dB ***Worst Freq:*** 4893.0 MHz

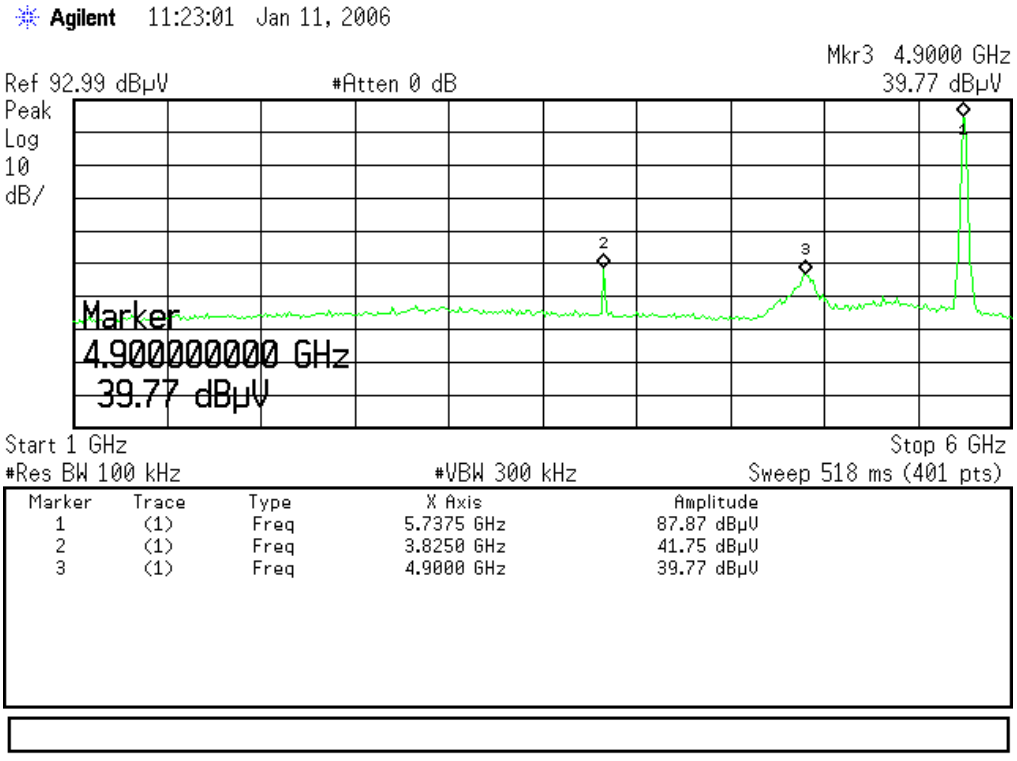
Test Site: "F" **Pre-Amp:** Yel-Blk **Cable:** EMIR-HIGH 5 **Analyzer:** White **Antenna:** Yellow Horn

Conducted Spurious Plots – 15.247

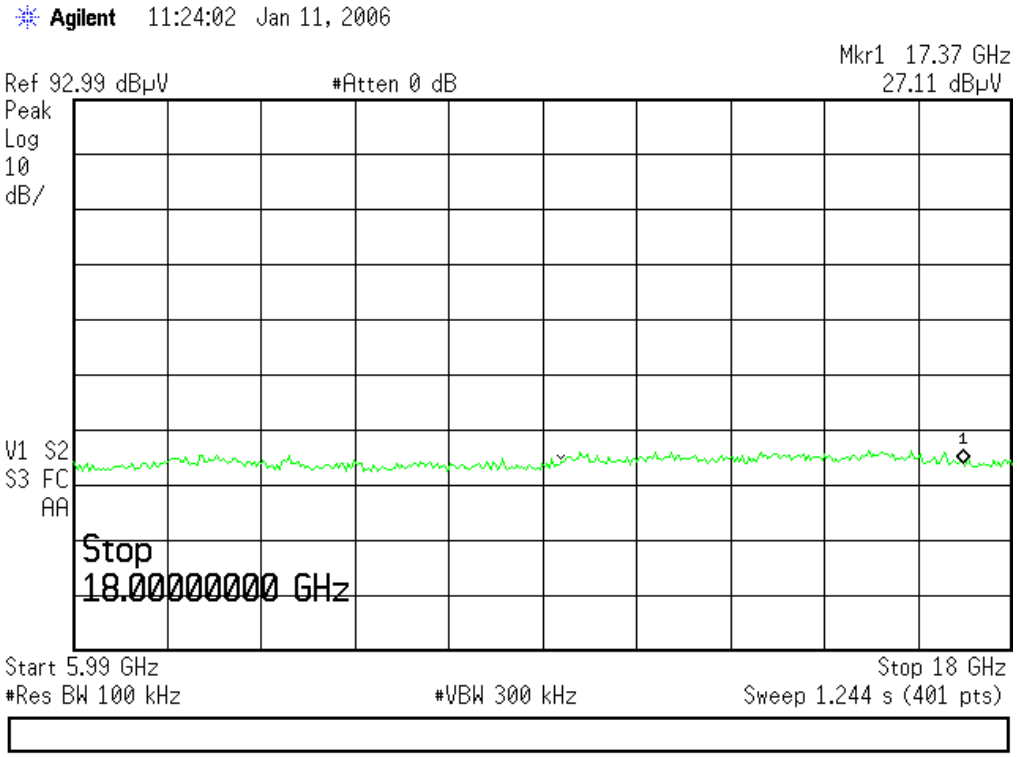
5GHz operation TX mode 30-1000MHz



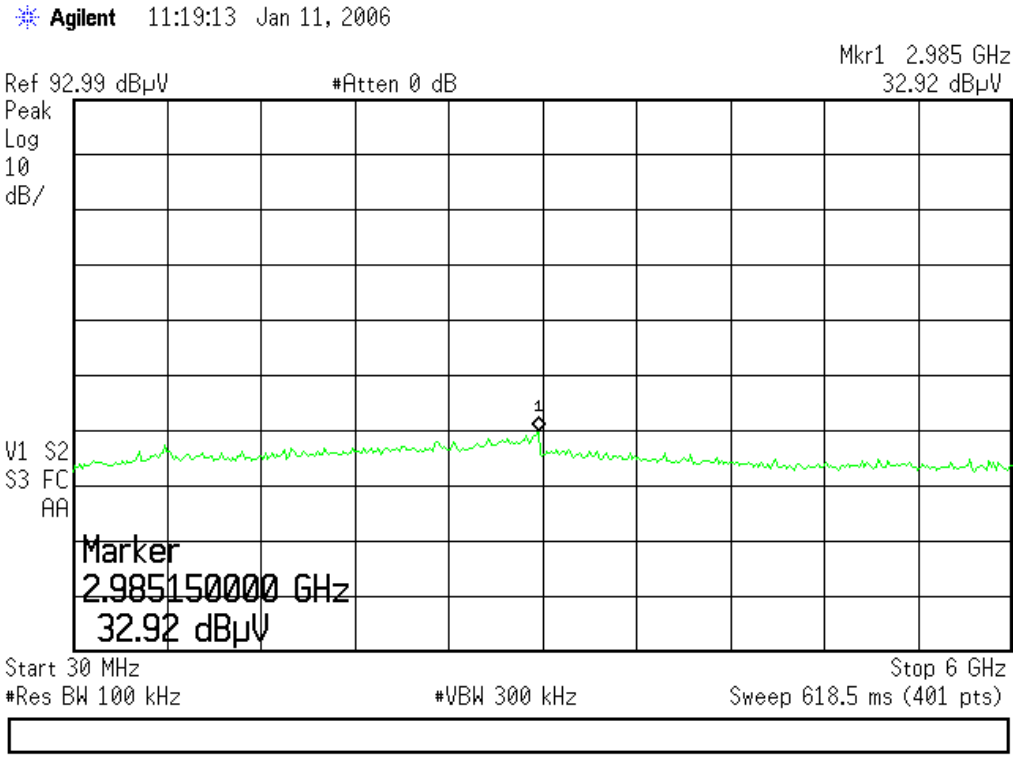
5GHz operation TX mode 1-6GHz



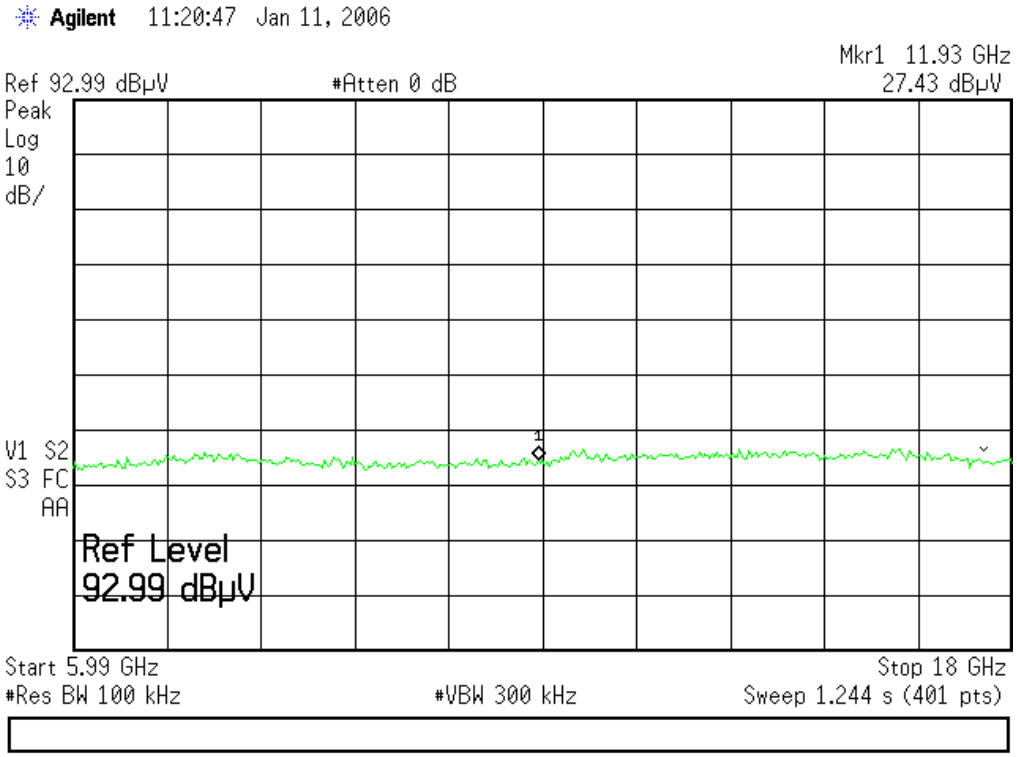
5GHz operation TX mode 6-18GHz



5GHz operation RX mode 30-6000MHz



5GHz operation RX mode 6-18GHz



Conclusion: All emissions in the above plots are a minimum of 20dB below the peak of the fundamental.

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. 10-MAR-2006

SPECTRUM ANALYZERS / RECEIVERS	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
WHITE	9kHz-22GHz	8593E	HP	3547U01252	00022	I	08-MAR-2006
YELLOW	9kHz-2.9GHz	8594E	HP	3523A01958	00100	I	20-APR-2006
ORANGE	9kHz-26.5GHz	E4407B	HP	US39440975	00394	I	01-DEC-2006
BROWN (RENTAL)	9kHz-26.5GHz	E4407B	HP	SG44210511	Rental	1	05-JAN-2007

OPEN AREA TEST SITE (OATS)	FCC CODE	IC CODE	VCCI CODE	CAT	CALIBRATION DUE
SITE F	93448	IC 2762-F	R-1688	II	04-APR-2007
SITE T	93448	IC 2762-T	R-905	II	14-AUG-2007

PREAMPS / ATTENUATORS / FILTERS	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
ORANGE	0.01-2000MHz	ZFL-1000-LN	C-S	N/A	00765	II	28-DEC-2006
GREEN	0.01-2000MHz	ZFL-1000-LN	C-S	N/A	00802	II	21-JUL-2006
BROWN	1-20GHz	PM2-38-218-4R5-17-15-SFF	C-S	PL1655	1132	II	02-DEC-2006
YELLOW-BLACK	1-20GHz	SMC-12A	C-S	535055	00801	II	25-AUG-2006

ANTENNAS	RANGE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
RED-WHITE BILOG	30-2000MHz	JB1	SUNOL	A091604-1	01105	II	28-SEP-2006
YELLOW-BLACK BILOG	20-2000MHz	CBL6140A	CHASE	1112	00126	II	06-MAY-2007(EMI) / 12-AUG-2006(RFI)
YELLOW HORN	1-18GHz	3115	EMCO	9608-4898	00037	I	27-MAY-2007(EMI) / 05-JUN-2006 (RFI)
BLACK HORN	1-18GHz	3115	EMCO	9703-5148	00056	I	17-JUN-2007
ORANGE HORN	1-18GHz	3115	EMCO	0004-6123	00390	I	09-JUN-2007

CHAMBERS AND STRIPLINE	MN	MFR	SN	ASSET	CAT	CALIBRATION DUE
RFI 1 CHAMBER	3 METER COMPACT	PANASHIELD	N/A	00797	II	12-AUG-2006

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

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

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, 2007 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*; Power Cross Overvoltage testing*;

Test Type	Test Method(s)
Emissions	
Radiated and Conducted Emissions	FCC 47 CFR Parts 15 & 18; C63.4; CISPR 22; EN55022; SABS CISPR 22; AS/NZS CISPR 22; AS/NZS 3548; Canada ICES-003; CNS13438; KN 22 (RRL No. 2005-82, September 29, 2005); CISPR 11; EN 55011; SABS CISPR 11; AS/NZS CISPR 11; AS/NZS 2064; Canada ICES-001; CNS13803; CISPR 13; EN 55013; SABS CISPR 13; AS/NZS CISPR 13; AS/NZS 1053; CISPR 14-1; EN 55014-1; SABS CISPR 14; AS/NZS CISPR 14; AS/NZS 1044; CNS 13439; CISPR 15; EN 55015; GR-1089-CORE; CSA C108.8-M1983;
Harmonics	EN 61000-3-2; AS/NZS 61000.3.2
Flicker	EN 61000-3-3; AS/NZS 61000.3.3

1 Note: This accreditation covers testing performed at the laboratory listed above and the satellite facility located at 168 Ayer Rd, Littleton, MA 01460 and, for test types marked with an asterisk, at other sites as defined in *"A2LA specific criteria for the accreditation of site testing and site calibration laboratories."*

Immunity	RRL No. 2005-130 (December 27, 2005)
Electrostatic Discharge (ESD)	EN 61000-4-2; AS/NZS 61000.4.2; KN61000-4-2
Radiated Immunity (RFI)	EN 61000-4-3, AS/NZS 61000.4.3; KN61000-4-3
Electrical Fast Transient Bursts (EFT)	EN 61000-4-4; AS/NZS 61000.4.4; KN61000-4-4
Surge	EN 61000-4-5, AS/NZS 61000.4.5; KN61000-4-5
Conducted Immunity	EN 61000-4-6, AS/NZS 61000.4.6; KN61000-4-6
Magnetic Immunity	EN 61000-4-8; AS/NZS 61000.4.8; KN61000-4-7
Voltage Dips and Interrupts	EN 61000-4-11; KN61000-4-11
Low Frequency Conducted Disturbances	EN 61000-2-2

Family Product or Industry Specific Specifications *including emissions and/or immunity*	GR-1089-CORE; GR-78-CORE (ESD) EN50081-1; EN50081-2; EN50082-2; EN50082-1; EN 61000-6-1; EN 61000-6-2; EN 61000-6-3; EN 61000-6-4; EN 50091-2; EN 55024; CISPR 24 EN 55103-1; EN 55103-2; EN 61326; EN 61547; EN 50130-4; EN 50083-2; EN 60601-1-2; EN 60601-2-2; EN 60601-2-24; EN 60601-2-32; EN 60601-2-38; EN 60601-2-47; IEC 1800-3; EN 61800-3; EN 55020; CISPR 20; EN 60555 Part 2; EN 60555 Part 3; ETS 300 386-1; EN 300 386-2; EN 300 386, ETS 300 132-1; ETS 300 132-2; EN 60669-2-1; AS/NZS 3200.1.2; CNS 13783-1; ETR 283; C62.41
Radiocommunications	
EU R&TTE Radio Standards;	EN 300 220-1; EN 300 220-3; EN 300 330-1; EN 300 330-2; EN 300 440-1; EN 300 440-2; EN 300 328; EN 300 385; EN 301 893
EU R&TTE EMC Standards	EN 300 339; EN 301 489-01; EN 301 489-03; EN 301 489-17
Canada Radio Standards	RSS-102; RSS-117; RSS-118; RSS-119; RSS-123; RSS-125; RSS-128; RSS-129; RSS-130; RSS-131; RSS-132; RSS-133; RSS-134; RSS-135; RSS-136; RSS-137; RSS-138; RSS-141; RSS-142; RSS-170; RSS-181; RSS-182; RSS-187; RSS-188; RSS-191; RSS-192; RSS-193; RSS-195; RSS-210; RSS-212; RSS-213; RSS-215; RSS-243; RSS-GEN; RSS-310; GL-36;
Australia/New Zealand Radio Standards	AS/NZS 4268; AS/NZS 4771; RFS29; Radiocommunications (Data Transmission Equipment Using Spread Spectrum Modulation Techniques); Radiocommunications (Spread Spectrum Devices); Radiocommunications (Short Range Devices); Radiocommunications (Low Interference Potential Devices);

Other Radio Standards	RTTE 01 (DGT-Taiwan);

FCC Standards and Test methods Support TCB Status--	
FCC Scope A – Unlicensed Radio Frequency Devices	
A1	1. 47 CFR Parts 11, 15 and 18 2. FCC MP-5, 3. ANSI C63.4-2003,
A2	1. 47 CFR Part 15, 2. ANSI C63.4-2003,
A3	1. 47 CFR Part 15, 2. ANSI C63.17-1998, 3. ANSI C63.4-2003,
A4	1. 47 CFR Part 15, 2. ANSI C63.4-2003,
FCC Scope B – Licensed Radio Service Equipment	
B1	1. 47 CFR Parts 2, 22, 24, 25, and 27 2. ANSI/TIA-603-C (2004)
B2	1. 47 CFR Parts 2, 22, 74, 90, 95, and 97 2. ANSI/TIA-603-C (2004)
B3	1. 47 CFR Parts 2, 80, and 87 2. ANSI/TIA-603-C (2004)
B4	1. 47 CFR Parts 2, 21, 74, and 101 2. ANSI/TIA-603-C (2004)

Country Specific Standards and Other	
ITU EMC Standards	K.20; K.21; K.41; K.44
Swedish EMC Standards	BAKOM 3336.3
South African EMC Standards other then CISPR equivalents	SABS 1718-1; SANS 211/SABS CISPR 11; SANS 224/SABS CISPR 24; SANS 213/SABS CISPR 13; SANS 2200; SANS214-1/SABS CISPR 14-1; SANS214-2/SABS CISPR 14-2; SANS 215/SABS CISPR 15; SANS 222/SABS CISPR 22
Hong Kong EMC Standards	HKTA 1006; HKTA 1007; HKTA 1008; HKTA 1010; HKTA 1015; HKTA 1026; HKTA 1035; HKTA 1039; HKTA 1041; HKTA 1042; HKTA 1045
Singapore EMC Standards	IDA TS SRD; IDA TS EMC
Japanese VCCI Standards	VCCI V-3, VCCI V-4

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
North American standards	
FCC 47 CFR Part 68 Telephone Terminal Equipment	Connection of terminal equipment to the telephone network. Analog and Digital Equipment. TCB Scope C1.
CS-03 Issue 9	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)
TIA-968-A, A1, A2, A3	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
Australia standards	
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 — Part 1: General Part 2: Broadband Part 3: DC, Low Frequency AC and Voice band
International standards	
ITU-T G.703	Physical/electrical characteristics of hierarchical Digital interfaces
Hong Kong standards	
HKTA 2011	Network Connection Specification for Connection of Customer Premises Equipment (CPE) to Direct Exchange Lines (DEL) of the Public Switched Telephone Network (PSTN) in Hong Kong
HKTA 2014	Network Connection Specification for Connection of Customer Premises Equipment (CPE) to the Public Telecommunications Network (PTN) in Hong Kong using ISDN Basic Rate Access (BRA) based on ITU-T Recommendations

Telecom Standards	Title
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
HKTA 2030	Network Connection Specification for Connection of Customer Premises Equipment (CPE) to the Public Telecommunications Network (PTN) in Hong Kong using Digital Leased Circuits at nx64 kbit/s
HKTA 2031	Network Connection Specification for Connection of Customer Premises Equipment (CPE) to the Public Telecommunications Network (PTN) in Hong Kong using Digital Leased Circuits below 64 kbit/s
HKTA 2032	Network Connection Specification for Connection of Customer Premises Equipment (CPE) to the Public Telecommunications Networks in Hong Kong using Asymmetric Digital Subscriber Lines (ADSL) based on ITU-T Recommendation G.992.1
HKTA 2033	Network Connection Specification for Connection of Customer Premises Equipment (CPE) to Fixed Telecommunications Networks in Hong Kong using Splitterless Asymmetric Digital Subscriber Lines (ADSL) based on ITU-T Recommendation G.992.2
European standards	
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
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

European standards (cont'd)	
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
Taiwan standards (DGT)	
ADSL01	Asymmetric Digital Subscriber Line Terminal Equipment and POTS Splitter Technical Specifications
ID0002	DS1 Equipment Type Approval Guidelines
IS6100	ISDN Terminal Equipment Technical Specifications
PSTN01 (non-voice only)	Technical Specifications for Terminal Equipment for Connection to Public Switched Telephone Network
New Zealand standards	
PTC 200 (non-voice only)	Requirements for Connection of Customer Equipment to Analogue Lines
PTC 217	Requirements for Bandwidth Management Devices
TNA 117	Telecom 2048 kbit/s Standard Network Interface
PTC 270	Interim arrangements for ADSL CPE
Singapore Standards	
IDA TS ADSL	Type Approval Specification for Asymmetric Digital Subscriber Line (Full-rate ADSL) Modems
IDA TS ADSL 2	Type Approval Specification for Asymmetric Digital Subscriber Line Splitterless (G-Lite) Modems
IDA TS DLCN 1	Type Approval Specification for Digital Interfaces based on hierarchical bit rates of 2048 kbit/s, 34 368 kbit/s and 139 264 kbit/s
IDA TS ISDN 1	Type Approval Specification for connection of Terminal Equipment to Integrated Services Digital Network (ISDN) Basic Access
IDA TS ISDN 2	Type Approval Specification for connection of Terminal Equipment to Integrated Services Digital Network (ISDN) Primary Rate Access (PRA)
IDA TS PSTN (non-voice only)	Type Approval Specification for connection of Terminal Equipment to Public Switched Telephone Network (PSTN)
South Africa standards	
TE-001 (non-voice only)	Standard for Telecommunication Line Terminal Equipment (TLTE) for Connection to the Public Switched Telephone Network (PSTN)

Product Safety
General test methods:
Power input*, Permanence of marking*, Accessibility*, Permissibly limits*, Energy hazard measurement*, SELV circuits*, TNV limits*, Limited current*, Capacitor Discharge / voltage limitation*, Ring signal*, Humidity conditioning*, Creepage / Clearance / Distance thru Insulation (excluding CTI)*, Limited power measurement*, Ground Bond/Earthing*, Ground continuity*, Temperature*, Stability*, Applied force*, Steel sphere impact*, Mold stress*, Battery reverse current*, Ball pressure*, Leakage current*, Component abnormal*, Electric strength*, Impulse*, Overvoltage*, Acoustic sound pressure*, 130mm / 20mm flame*, Needle flame*, Hot flaming oil*, Locked rotor/motor armature*, Vibration, Bump, Drop*, Strain relief*, Torque*, Insulation resistance*, Sound level*, Handle loading*, Liquid overflow*, Spillage*, Liquid leakage*, Transformer shorts/overloads*, Rain test*, Wall mount*, Laser radiation (excluding x-ray)*, Voltage surge*, Functionality*, Protective impedance abnormal*, Capacitor short circuit abnormal*, Output abnormal*, Multi-supply abnormal*, Cooling abnormal*, Heating device abnormal*, Interlock abnormal*, Rigidity*, Cleaning*

Product Safety Standards	Title
Specific Product Safety Standards	
UL 60950 2000	Safety of information technology equipment
IEC 60950 1999	Safety of information technology equipment
EN 60950 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	
IEC 61010-1 1993	Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1: General requirements.
EN 61010-1 1993, 2001	Safety requirements for electrical equipment for measurement,
IEC 61010-1 2001	control and laboratory use, Part 1: General requirements.
UL 61010B-1 2003	
CAN/CSA 1010-1 1999 (*Including AM 2*)	Electrical equipment for laboratory use Part 1: General requirements.
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 Household,
CAN/CSA 60065-00	commercial and similar general use Australian/New Zealand
AS/NZS 60065 2000	Standard – Approval and test Specification – Mains operated electronic and related Equipment for household and similar general use
Canadian C22.2 No. 1-94 (1-98)	Audio, video and similar electronic equipment.
1994, 1998	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

Product Safety Standards	Title
IEC 60825-1 2001	Classification, requirements 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
21 CFR 1040.10	Performance standard for laser products
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	
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
EN 60950-1: 2001	Information Technology Equipment – Safety – Part1: General Requirements
AS/NZS 60950.1: 2003	Information Technology Equipment – Safety – General requirements
UL 61010 -1: 2004	Electrical Equipment for Measurement, Control and Laboratory Use; Part 1: General Requirements
UL 60601-1: 2003	Medical Electrical Equipment, Part 1: General Requirements for Safety
IEC 60601-1-1: 2000	Medical Electrical Equipment - Part 1: General Requirements For Safety 1: Collateral Standard: Safety Requirements For Medical Electrical Systems
EN 60601-1-1: 2001	Medical Electrical Equipment - Part 1: General Requirements for Safety – Section 1-1. Collateral Standard: Safety Requirements For Medical Electrical Systems
UL 60065: 2003	Audio, Video and Similar Electronic Apparatus – Safety Requirements
CSA 60065: 2003	Audio, Video and Similar Electronic Apparatus – Safety Requirements
IEC 60065: 2001	Audio, Video and Similar Electronic Apparatus – Safety Requirements
EN 60065: 2002	Audio, Video and Similar Electronic Apparatus – Safety Requirements
EN 60204 -1: 1998	Safety of Machinery – Electrical Equipment of Machines – Part 1: Specification for General Requirements
HKTA 2001	Compliance Test Specification – Safety and Electrical Protection Requirements for Subscriber Equipment Connected to the Public Telecommunications Networks In Hong Kong

Environmental Simulation

Test Technology	Test Standard	Supporting Standards
Accessibility*	IEC 60529	IP-0x thru IP-6x
Acoustic Noise*	GR-63-CORE Sec 4.6	
Airborne Contaminants	GR-63-CORE Sec 4.5	MFG & Hygroscopic Dust
Altitude	GR-63-CORE Sec 4.1.3	
Cold Start*	ETS 300 019	IEC 60068-2-1
Drip	IEC 60529	IP-x1 & IP-x2
Drops*	ETS 300 019	IEC 60068-2-32
	GR-63-CORE Sec 4.3	
Dust	IEC 60529	IP-5x & IP-6x
Firearms Resistance Testing	GR-487	
Fire Resistance	ANSI.T1.319	
	GR-63-CORE Sec 4.2	Fire & Needle Flame
Heat Dissipation*	GR-63-CORE Sec 4.1.4	
Illumination	GR-63-CORE Sec 4.7	
Operational Temperature & Humidity (OpTH)*	ETS 300 019	IEC 60068-2-1 IEC 60068-2-2 IEC 60068-2-14 IEC 60068-2-56
	GR-63-CORE Sec 4.1.2	
Salt Fog & Spray	ASTM B117	
Spatial*	GR-63-CORE Sec 2.0 & 3.0	
Spraying-Splashing	IEC 60529	IP-x3 & IP-x4
Storage (Temperature & Humidity)*	ETS 300 019	IEC 60068-2-1 IEC 60068-2-2 IEC 60068-2-14 IEC 60068-2-30 IEC 60068-2-56
	GR-63-CORE Sec 4.1.1	
Vibration	ETS 300 019	IEC 60068-2-6 IEC 60068-2-27 IEC 60068-2-29 IEC 60068-2-32 IEC 60068-2-57 IEC 60068-2-64 Earthquake, Office & Transportation
	GR-63-CORE Sec 4.4	
Water Immersion	IEC 60529	IP-x7 & IP-x8
Water Jet	IEC 60529	IP-x5 & IP-x6

Note 1. For standards or methods listed on the scope of accreditation without a revision date, laboratories are expected to be competent in the use of the current version within one year of the date of publication of the standard test method or upon the date specified by the standard test method originator when the originator has implementation authority. When a superseded standard or method is required for an accredited test, the scope will include the superseded date/version. For those that support the TCB/CB status of the organization acting as a certifier on behalf of the FCC or IC the expectation is currency within 30 days of Federal Register publication of changes for FCC and 30 days after IC website update. This note shall not be construed as an Accreditation Body implication to adopt a more current standard than is required in a regulation or code (i.e. the legal requirement) which is adopted by the lab under their responsibility.

** On-site test service is available for this technology, test, or method.*