

Report No	EE0977-1
Client	Sensicast Systems
Phone	781-453-2555
Fax	781-453-0601
Models	
FCC ID	RNB-OEM100
FRN	0009860149
Equipment Type	Low Power Communication Device Transmitter
Equipment Code	DSS
Results	As detailed within this report
Prepared by	 Mairaj Hussain – Test Engineer
Authorized by	 Michael Buchholz – EMC Manager
Issue Date	12/10/04
Conditions of issue	This Test Report is issued subject to the conditions stated in ‘terms and conditions’ section of this

Summary	3
Test Methodology	3
EUT Configuration	4
Statement of Conformity	5
Test Data and Plots	6
<i>Channel Separation - Node</i>	6
<i>Number of Hopping Frequencies - Node</i>	7
<i>Time of Occupancy (Dwell Time) - Node</i>	7
<i>Peak Output Power - Node</i>	10
<i>Conducted Spurious Emissions - Node</i>	11
<i>Conducted Band Edges - Node</i>	12
<i>Antenna Gains</i>	14
<i>Radiated Spurious Emissions</i>	14
Section 15.31(e)	15
AC Line Conducted Emission Measurements	16
Test Equipment Used	17
Terms And Conditions	21
A2LA Accreditation	21

Summary

This report is an application for modular certification of a transmitter operating under 47 CFR F15.247 of the FCC rules provided for operation of frequency hopping spread spectrum transmitters. The product covered by this report is OEM 100. The product was tested using the methods outlined in FCC public notice DA 00-705 (FHSS), released March 30, 2000, FCC public notice DA 00-1407 (modular) released June 26, 2000 and ANSI C63.4 (2003).

The RF circuitry in OEM 100 is similar to the Node which was tested previously under FCC ID: RNBF19D8MN9LQ2WFA. OEM 100 was tested with all available options. Therefore, OEM100 testing also covers all other OEM series models, please see attached exhibit describing the differences among the OEM models.

This report presents the data obtained during the testing of Node for compliance with FCC 15.247. Furthermore, additional testing was done to ensure that spurious emissions from the product comply with FCC 15.209 limits when product is operated without an enclosure.

Test Methodology

All testing was performed according to the procedures specified in ANSI C63.4 (2003).

Frequency range investigated:	150KHz – 10GHz
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Measurement Distance:		
<i>Frequency (MHz)</i>	<i>Distance (m)</i>	<i>Comments</i>
0.15MHz – 30MHz	-	Conducted
30MHz – 10GHz	-	Conducted
30MHz – 10GHz (restricted band)	3 m	Spurious

The EUT was maximized around three orthogonal axes.

This product can be powered via battery or DC provided by the host unit. All testing was performed using an external DC source. AC line conducted emissions were performed using a 50 Ω /50 μ H LISN on the AC side of support power supply.

All readings are peak unless otherwise noted.

EUT Configuration

EUT Configuration				
Work Order: E0977				
Company: Sensicast Systems				
Company Address: 220 Reservoir St. #9 Needham, MA 02494				
Contact: John O Brien				
Person Present: John O Brien				
MN		SN		
EUT: OEM100		K66567		
EUT Description: Wireless Integration Module				
EUT Max Frequency: 928MHz				
Support Equipment:	MN	SN		
DC power supply	E3610A	-		
EUT Cables:	Qty	Shielded?	Length	Ferrites
DC cable	1	No	1 m	None
Unpopulated EUT Ports:	Qty	Reason		
None				
Software / Operating Mode Description:				
Transmitting packets; channel hopping; exercising all board functions				
Switching to receive mode in between transmissions.				

Statement of Conformity

The 915 MHz FHSS RF Module has been found to conform with the following parts of the 47 CFR as detailed below:

47 CFR Part #	47 CFR Part #	Comments
	15.15(b)	The product contains no user accessible controls that increase transmission power above allowable levels.
2.925	15.19	The label is shown in the label exhibit.
	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 input power was varied from its nominal value to $\pm 15\%$. The respective radiated power was measured see table 1.
	15.203	The device utilizes antenna permanently attached to the board.
	15.204	See attached documentation describing the antenna(s).
	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.
	15.207	Unit is DC powered. Conducted EMI data is provided in this report, table 9.
	15.247	The unit complies with the frequency hopping requirements of 15.247

Test Data and Plots

Channel Separation - Node

REQUIREMENT

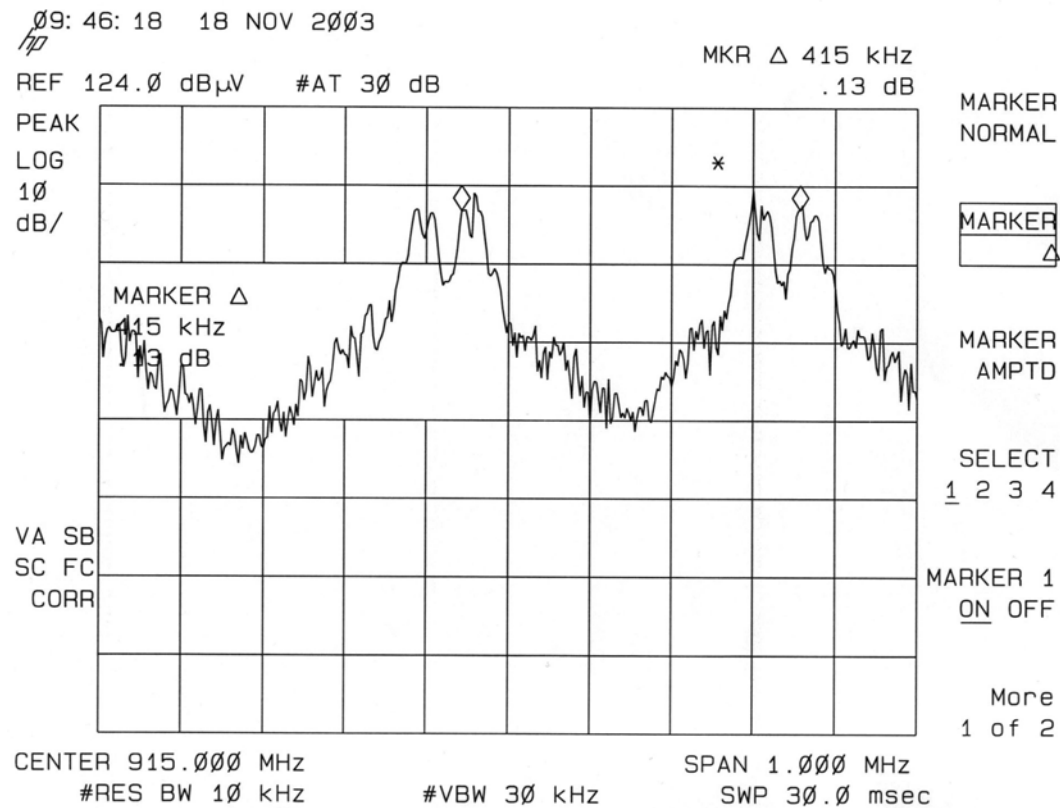
"Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater." [15.247(a)(1)]

20dB bandwidth = 165kHz (see "20dB Bandwidth" section)

MEASUREMENT

Channel separation = 415kHz

ANALYZER PLOT



Number of Hopping Frequencies - Node

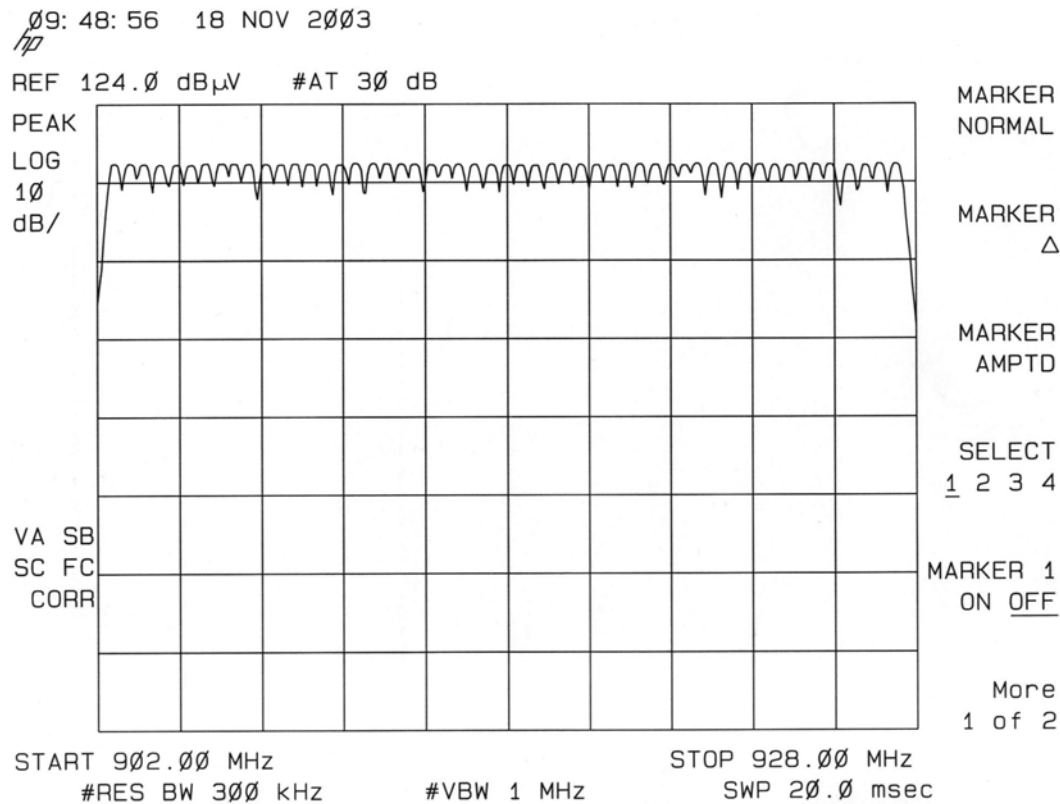
REQUIREMENT

"For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250kHz, the system shall use at least 50 hopping frequencies..." [15.247(a)(1)(i)]

MEASUREMENT

Number of hopping frequencies = 53

ANALYZER PLOT



Time of Occupancy (Dwell Time) - Node

REQUIREMENT

"...the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period;" [14.247(a)(1)(i)]

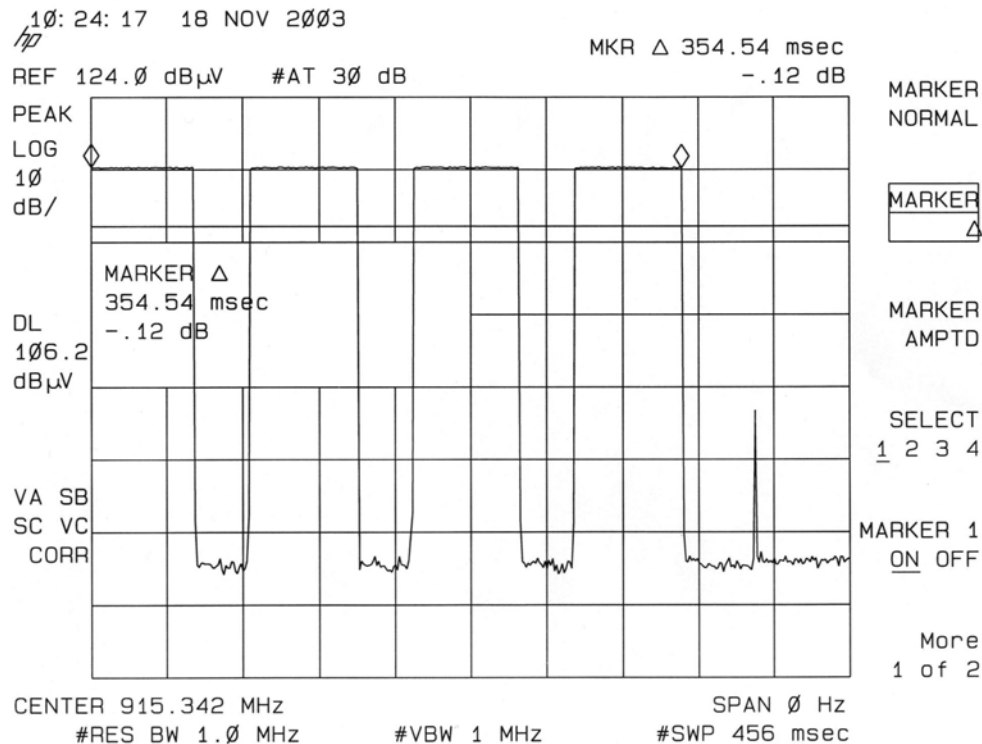
MEASUREMENTS

Plots of the dwell time were taken for three different data rates: 19.2, 38.4, and 76.8kbaud. Every 400ms, the EUT hops to the next channel in the pseudorandom hopping table. Since the hopping table is comprised of 53 different channels, the EUT will not return to the same channel twice in any 20s interval. The measured dwell times are as follows:

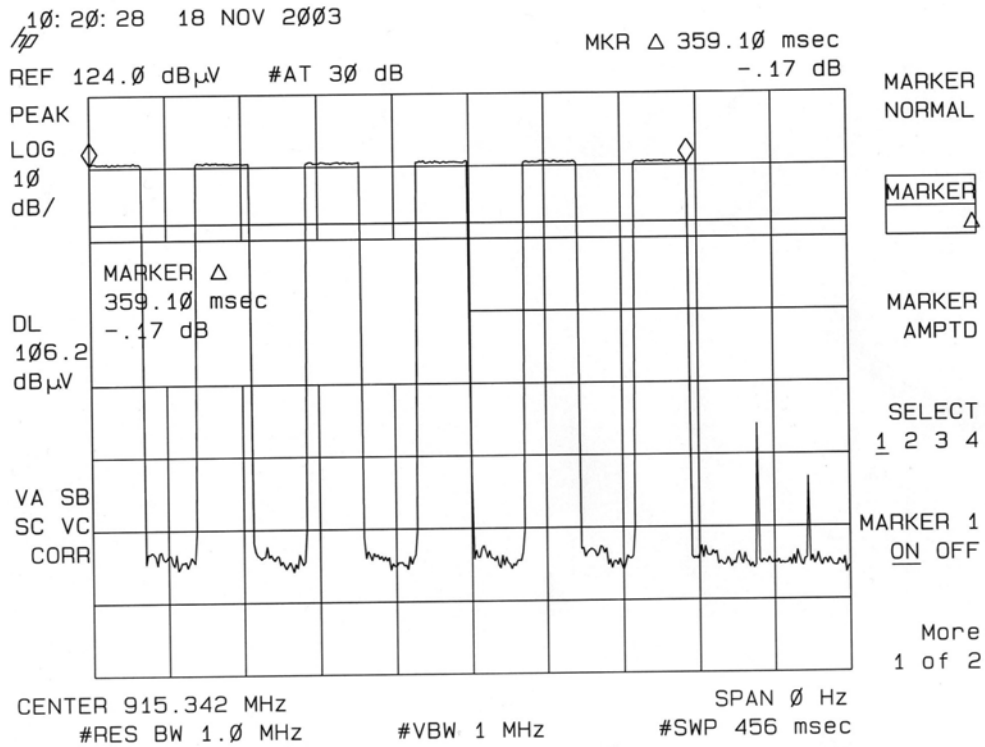
19.2kbaud – 354.5ms

38.4kbaud – 359.1ms

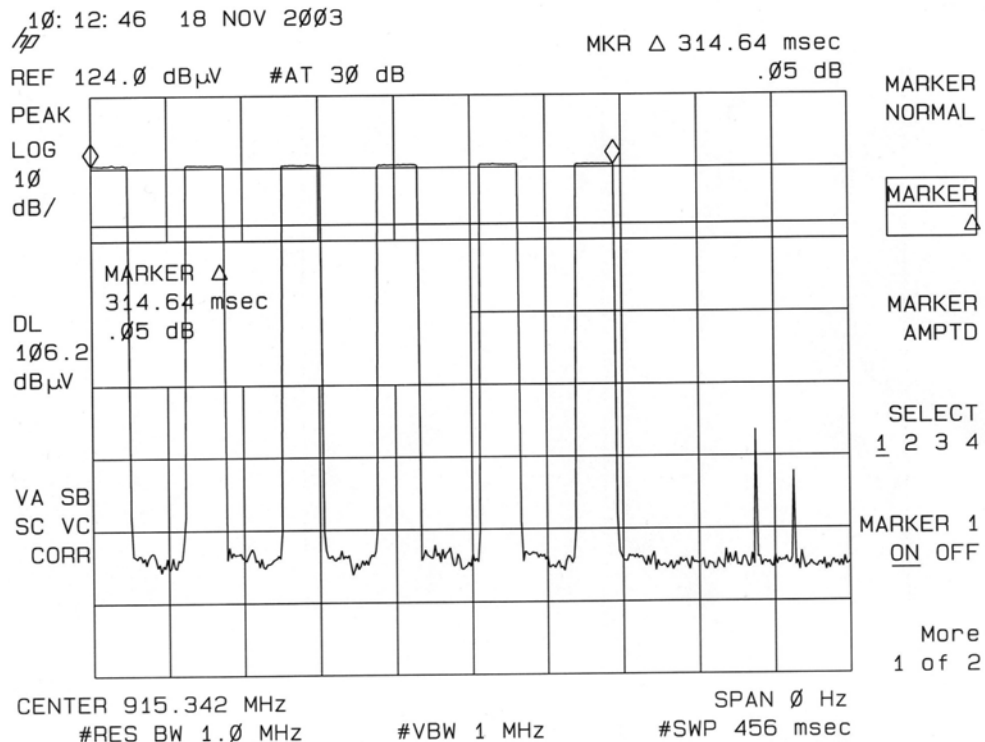
76.8kbaud – 314.6ms

ANALYZER PLOTS**Dwell Time - 19.2kbaud**

Dwell Time - 38.4kbaud



Dwell Time - 76.8kbaud

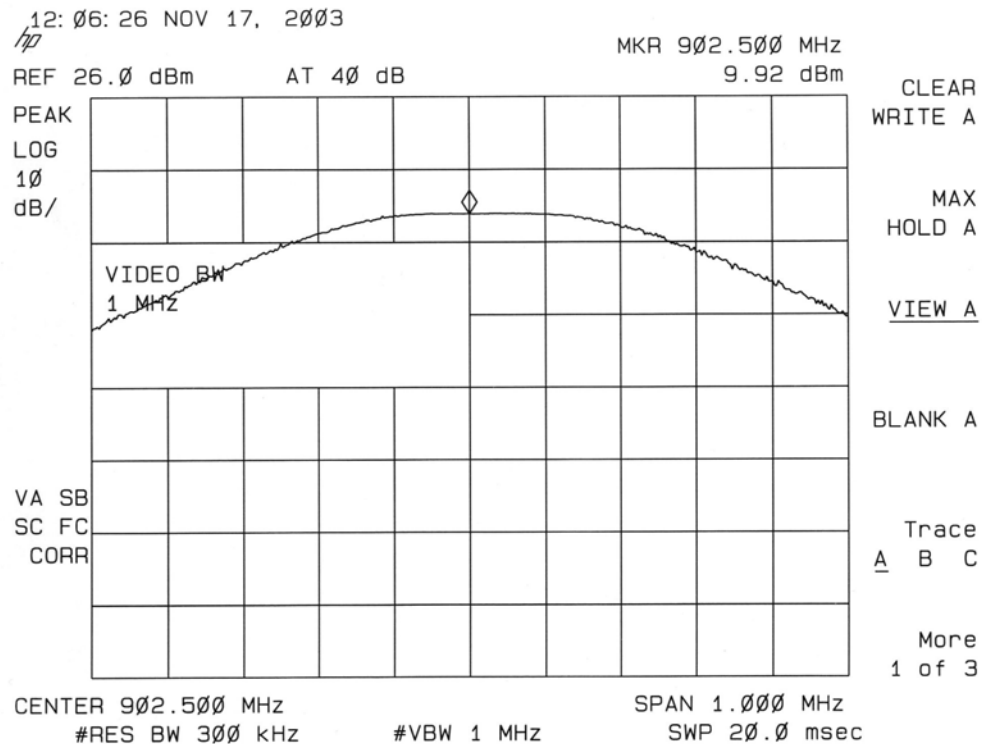


Peak Output Power - Node**LIMIT**

"The maximum peak output power of...systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels." [15.247(b)(2)]

MEASUREMENTS

Peak Output Power						Curtis-Straus LLC		
Date: 17-Nov-03			Engineer: Evan Gould			Work Order: D0894		
Company: Sensicast			EUT: node			Fundamental Frequencies: 902.5-927.3MHz		
Test Site: "T"						Cable: N/A*		
Attenuator: N/A						Analyzer: Green		
Measurement: Conducted						Resolution BW: 300kHz		
Detector Type: Peak						Video BW: 1MHz		
Notes: *EUT was connected directly to the analyzer								
Channel Number	Frequency (MHz)	Reading (dBm)	Attenuator Factor (dB)	Cable Factor (dB)	Adjusted Reading (dBm)	47 CFR 15.247(b)(2)		
						Limit (dBm)	Margin (dB)	Result (Pass/Fail)
0	902.5	9.9	0.0	0.0	9.9	30.0	-20.1	Pass
26	914.9	9.7	0.0	0.0	9.7	30.0	-20.3	Pass
52	927.2	9.8	0.0	0.0	9.8	30.0	-20.2	Pass

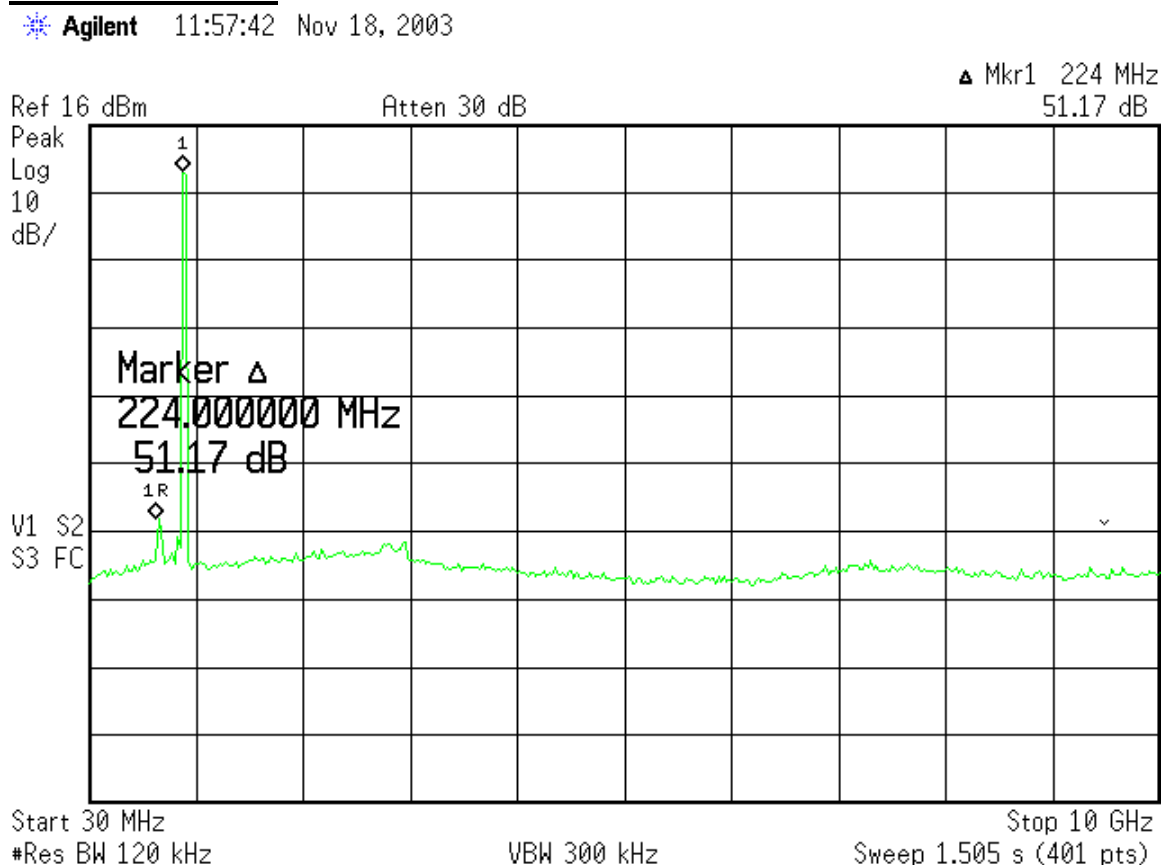
SAMPLE ANALYZER PLOT**Channel 0**

Conducted Spurious Emissions - Node**LIMIT**

Peak: 20dB down from fundamental [15.247(c)]

MEASUREMENTS

No conducted spurious emissions within 20dB of the fundamental were detected.
See plot below.

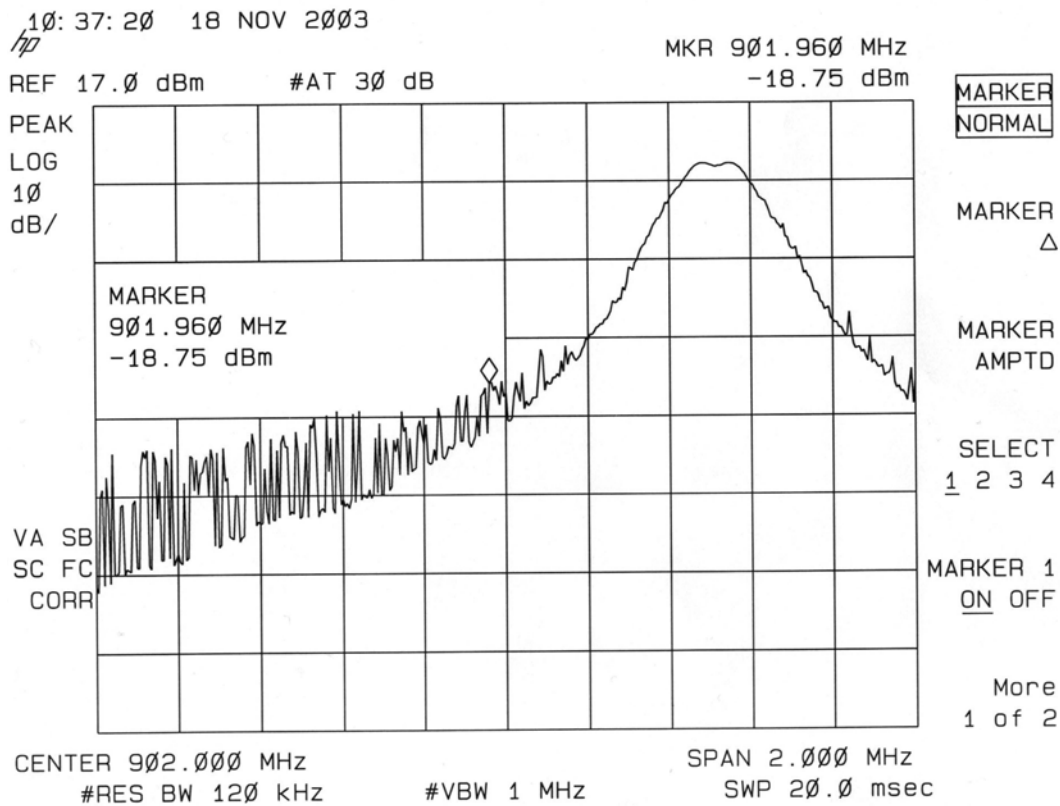
ANALYZER PLOT

Conducted Band Edges - Node**LIMITS**

Peak: 20dB down from fundamental [15.247(c)]

RESULTS

It can easily be seen in the plots shown below that the conducted band edges are at least 20dB down from the peak of the fundamental.

ANALYZER PLOTS**Channel 0 - Low Band Edge**

Channel 52 – High Band Edge

10:39:59 18 NOV 2003

10

MKR 928.040 MHz

REF 17.0 dBm

#AT 30 dB

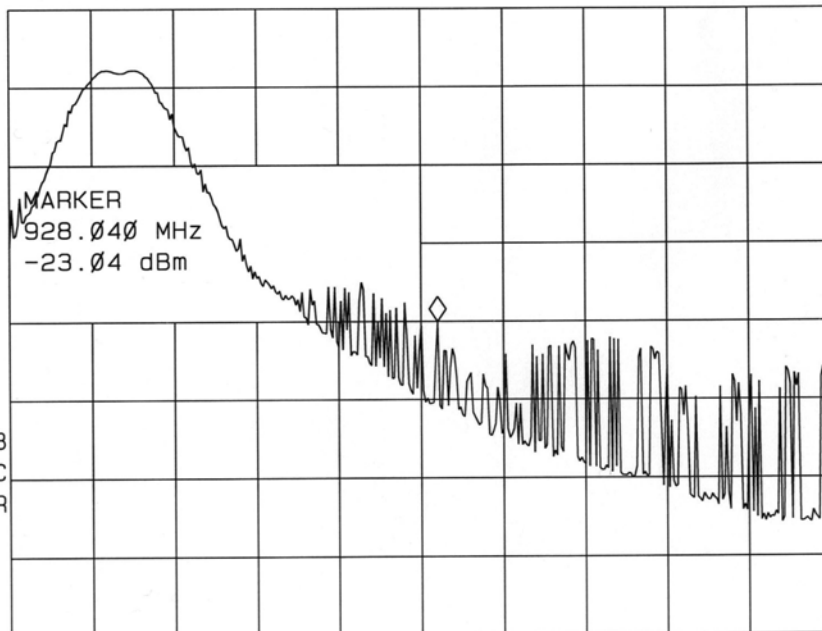
-23.04 dBm

PEAK

LOG

10

dB/



CLEAR

WRITE A

MAX

HOLD A

VIEW A

BLANK A

VA SB

SC FC

CORR

Trace

A B C

More

1 of 3

CENTER 928.000 MHz

#RES BW 120 kHz

#VBW 1 MHz

SPAN 2.000 MHz

SWP 20.0 msec

Antenna Gains**REQUIREMENT**

This purpose of this section is to demonstrate that the actual directional gain of the antenna is no larger than 6dBi.

MEASUREMENTS

EIRP/Directional Gain							Curtis-Straus LLC		
Date: 19-Nov-03			Company: Sensicast				Work Order: D0894		
Engineer: Evan Gould			EUT Desc: H900 series						
Frequency Range: 902-928MHz							Measurement Distance: 3.75 m		
Notes:							EUT Max Freq: 927.2MHz		
Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBμV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBμV/m)	EIRP (dBm)	Conducted Output Power (dBm)	Directional Gain (dBi)
Coordinator									
Hpk	902.5	96.7	19.8	24.3	4.9	106.1	12.8	9.4	3.4
Hpk	914.9	96.7	19.7	24.2	5.0	106.2	12.9	9.6	3.3
Hpk	927.2	96.3	19.7	24.2	5.0	105.8	12.5	9.4	3.1
Node									
Vpk	902.5	96.4	19.8	24.3	4.9	105.8	12.5	9.9	2.6
Vpk	915.0	95.1	19.7	24.2	5.0	104.6	11.3	9.7	1.6
Vpk	927.3	93.6	19.7	24.2	5.0	103.1	9.8	9.8	0.0
Test Site: "T"		Pre-Amp: Green		Cable: 65 ft RG8A/U		Analyzer: Green		Antenna: Blue	

Radiated Spurious Emissions

Radiated Emissions Table										Curtis-Straus LLC		
Date: 23-Nov-04			Company: Sensicast Systems						Work Order: E0977			
Engineer: Mairaj Hussain			EUT Desc: OEM100									
Frequency Range: 30 -10000MHz							Measurement Distance: 3 m					
Notes: RBW:120KHz, VBW: 300KHz for frequencies<=1000MHz RBW: 1MHz, VBW: 3MHz for frequencies > Ghz												
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)	Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)
v	268.2	25.0	22.3	12.8	2.3	17.8	---	---	---	46.0	-28.2	Pass
v	279.8	26.6	22.3	13.1	2.3	19.7	---	---	---	46.0	-26.3	Pass
Table Result:		Pass	by	-26.3 dB				Worst Freq:		279.8 MHz		
Test Site: "A"		Pre-Amp: Blue, Org-Blk		Cable: 65 ft RG8A/U,#3		Analyzer: White		Antenna: Blue-White, Black horn				

Section 15.31(e)

FCC 15.31(e)		
Work Order: E0977		
Date: 11/23/2004		
Engineer: Mairaj Hussain		
EUT: E0977		
Company: Sensicast Systems		
Spectrum Analyzer:	White	
Antenna:	Blue-White	
RBW: 120KHz	VBW:	1MHz
Operating range 1.8V DC -- 3.6V DC		
	Vol	Reading
	(DC)	(dBuV)
Nominal	3.6	81.3
	1.8	73.5
-15%	1.53	Tx turns off
	1.598	70.5
	3.677	Tx turns off
15%	4.14	Tx turns off

Conclusion:

The peak output power does not change with input voltage.

Note: Above PoP readings are off of spectrum analyzer and do not take in account for cables loss and any attenuator used.

AC Line Conducted Emission Measurements

AC Mains Conducted Emissions										Curtis-Straus LLC			
Date: 23-Nov-04				Company: Sensicast Systems						Work Order: E0977			
Engineer: Mairaj Hussain				EUT Desc: OEM100						Test Site: EMI2			
Notes: AC side of DC supply RBW: 9KHz, VBW 30KHz													
LISN(s): Yellow-Black													
Range: 0.15-30Mhz				Other Equipment: ---				Spectrum Analyzer: White					
Frequency (MHz)	Q.P. Readings		Ave. Readings		Impedance Factor (dB)	---		FCC/CISPR B		FCC/CISPR B		Overall Result (Pass/Fail)	
	QP1 (dBµV)	QP2 (dBµV)	AV1 (dBµV)	AV2 (dBµV)		Limit (dBµV)	Margin dB	qp Limit (dBµV)	qp Margin dB	AVE Limit (dBµV)	AVE Margin dB		
0.15	20.9	20.3			20.0	---	---	66.0	-25.1	56.0	-15.1	Pass	
0.18	17.6	12.6			20.0	---	---	64.5	-26.9	54.5	-16.9	Pass	
0.68	11.6	10.6			20.0	---	---	56.0	-24.4	46.0	-14.4	Pass	
1.49	5.9	8.3			20.0	---	---	56.0	-27.7	46.0	-17.7	Pass	
14.40	-1.8	-1.2			20.0	---	---	60.0	-41.2	50.0	-31.2	Pass	
20.00	-1.8	-0.8			20.0	---	---	60.0	-40.8	50.0	-30.8	Pass	
Table Result: Pass by -14.40 dB Worst Freq: 0.68 MHz													

LIMITS

Quasi-Peak: 250µV = 47.9dBµV in the range 450kHz to 30MHz

[47 CFR 15.207(a) Revised as of October 1, 2001]

Note: On July 12, 2004, FCC adopts the conducted emissions limits of the European CISPR 22 standard as outlined below

Frequency of emission (MHz)	Quasi-peak limit (dBµV)	Average limit (dBµV)
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

[47 CFR 15.207(a) Revised as of October 1, 2002; amended by ET Docket 98-80; FCC 02-157, published in the Federal Register Vol. 67, No. 132, on Wednesday, July 10, 2002]

Test Equipment Used

REV. 16-NOV-2004

SPECTRUM ANALYZERS / RECEIVERS	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
RED	9kHz-1.8GHz	8591E	HP	3441A03559	00024	26-MAY-2005
WHITE	9kHz-22GHz	8593E	HP	3547U01252	00022	04-MAR-2005
BLUE	9kHz-1.8GHz	8591E	HP	3223A00227	00070	03-NOV-2005
YELLOW	9kHz-2.9GHz	8594E	HP	3523A01958	00100	11-AUG-2005
GREEN	9kHz-26.5GHz	8593E	HP	3829A03618	00143	02-AUG-2005
BLACK	9kHz-12.8GHz	8596E	HP	3710A00944	00337	18-AUG-2005
YELLOW-BLACK	20Hz-40.0MHz	3585A	HP	2504A05219	00030	08-OCT-2005
TELECOM 3583A	20Hz-40.0MHz	3585A	HP	1750A02762	01067	03-SEP-2005
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	02-APR-2005
BLUE	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	956349	00752	02-APR-2005
YELLOW-BLACK	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	984735	00248	02-APR-2005
ORANGE	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	903707	00754	02-APR-2005
GOLD	10kHz-30MHz	8012-50-R-24-BNC	SOLAR	984734	00247	02-APR-2005
WHITE-BLACK	10kHz-30MHz	8610-50-TS-100-N	SOLAR	972019	00678	02-APR-2005
BLACK	10kHz-30MHz	8610-50-TS-100-N	SOLAR	972017	00675	02-APR-2005
RED-BLACK	10kHz-30MHz	8610-50-TS-100-N	SOLAR	972016	00677	02-APR-2005
BLUE-BLACK	10kHz-30MHz	8610-50-TS-100-N	SOLAR	972018	00676	02-APR-2005
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-2004
GREEN CURRENT TRANSFORMER	40Hz-20MHz	150	PEARSON	10226	00793	03-APR-2005
CISPR LINE PROBE	150kHz- 30MHz	N/A	C-S	01	00805	20-DEC-2004
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	25-MAR-2005
SITE T	93448	IC 2762-T	R-905	25-MAR-2005
SITE A	93448	IC 2762-A	R-903	25-MAR-2005
SITE M	93448	IC 2762-M	R-904	25-MAR-2005
BUBBLE (HP FACILITY)	N/A	N/A	R-1467	16-MAY-2005

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
BUBBLE (HP FACILITY)	N/A	N/A	C-1556	16-MAY-2005

PREAMPS / ATTENUATORS / FILTERS	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
RED	0.10-2000MHz	ZFL-1000-LN	C-S	N/A	00798	31-MAR-2005
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	31-MAR-2005
GREEN	0.01-2000MHz	ZFL-1000-LN	C-S	N/A	00802	27-FEB-2005
BLACK	0.01-2000MHz	ZFL-1000-LN	C-S	N/A	00799	27-FEB-2005
ORANGE	0.01-2000MHz	ZFL-1000-LN	C-S	N/A	00765	27-FEB-2005
WHITE	1-20GHz	SMC-12A	C-S	426643	00760	21-JUL-2005
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 ATTENUATOR	0.03-20 GHz	PE 7019-20	PASTERNAK	01	00791	21-MAY-2005
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
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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-WHITE BILOG	30-2000MHz	3142B	EMCO	1527	TELOGY RENTAL	03-AUG-2006
RED BILOG	30-1000MHz	3143	EMCO	1270	00042	17-MAR-2005
BLUE BILOG	30-1000MHz	3143	EMCO	1271	00803	17-MAR-2005
GRAY BILOG	26-2000MHz	3141	EMCO	9703-1038	00066	19-MAY-2005(EMI) / 21-JUN-2005(RFI)
YELLOW-BLACK BILOG	20-2000MHz	CBL6140A	CHASE	1112	00126	19-MAY-2005(EMI) / 25-JUN-2005(RFI)
RED-WHITE BILOG	30-2000MHz	JB1	SUNOL	A091604-1	01105	28-SEP-2005
RED-BLACK BILOG	30-2000MHz	JB1	SINOL	A091604-2	01106	28-SEP-2005
YELLOW HORN	1-18GHz	3115	EMCO	9608-4898	00037	22-MAY-2005(EMI) / 28-SEP-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	05-MAY-2005
INDUCTION COIL	50-60Hz	1000-4-8	C-S	N/A	00778	13-SEP-2006
ADJUSTABLE DIPOLE	30-1000MHz	3121C	EMCO	1370	00757	26-JUN-2005
ADJUSTABLE DIPOLE	30-1000MHz	3121C	EMCO	1371	00756	26-JUN-2005
RE101 LOOP SENSOR	30Hz-100kHz	RE101-13.3cm	C-S	N/A	00818	07-JAN-2005
RS101 RADIATING LOOP	30Hz-100kHz	RS101-12cm	C-S	N/A	00819	07-JAN-2005
RS101 LOOP SENSOR	30Hz-100kHz	RS101-4cm	C-S	N/A	00820	07-JAN-2005

MIXERS/DIPLEXERS	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
MIXER / HORN	26.5-40 GHz	11970A/28-442-6	HP/ATM	2332A00900/A046903-01	00369	N/A
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	03-JAN-2005
MIXER / HORN	60-90 GHz	M12HW/A	OML	E30110-1	00822	03-JAN-2005
MIXER / HORN	90-140 GHz	MO8HW/A	OML	F21206-1	00811	05-DEC-2004
MIXER / HORN	140-220 GHz	MO5HW/A	OML	G21206-1	00812	05-DEC-2004
DIPLEXER		DPL.26	OML	N/A	00813	05-DEC-2004

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

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	02-DEC-2004
RED	NSG435	SCHAFFNER	001625	00762	09-DEC-2004
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+/EFT)
RED	711-1100	SCHAFFNER	200122-074SC	00623	24-JUN-2005 (SURGE) / 28-JUL-2005 (D+) / 05-DEC-2004 (EFT)

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)	SGTH-31S	B-M-A INC.	2245	00321	31-DEC-2004

HARMONIC ANALYZER		MN	MFR	SN	ASSET	CALIBRATION DUE
HFTS		HP6842A	HP	3531A-00169	00738	03-DEC-2005
FREQUENCY COUNTER		MN	MFR	SN	ASSET	CALIBRATION DUE
5340A		HP5340A	HP	1440A02320	00787	30-JUL-2004
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	19-JAN-2005(CRFI) / 23-JUN-2005 (RFI)
BLACK	0.01-250MHz	75A250	AR	23411	00122	22-JUN-2005(CRFI)/ 25-JUN-2005(RFI)
ORANGE	0.01-250MHz	75A250	AR	26827	00367	19-JAN-2005(CRFI) / 02-JUN-2005(RFI)
HP489A	1.0-2.0GHz	HP489A	HP	449-00762	00971	28-SEP-2005
HP491C	2.0-4.0GHz	HP491C	HP	449-00638	00764	28-SEP-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	28-SEP-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-JAN-2005
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	09-MAR-2005
SWEeper	0.01-20.0GHz	HP83752A	HP	3610A01133	00087	04-APR-2005
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	22-JUN-2005
RED	0.01-100MHz	95236-1	ETS	34026	1020	07-JUL-2005
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	22-JUN-2005	
ORANGE	0.10-100MHz	15A M-2	C-S	00786	22-JUN-2005	
RED	0.10-100MHz	15A M-3	C-S	00780	22-JUN-2005	
WHITE	0.10-100MHz	15A M-3	C-S	00782	22-JUN-2005	
YELLOW-BLACK	0.10-100MHz	15A M-3	C-S	00784	22-JUN-2005	
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	00785	09-MAR-2005	
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	08-MAR-2005	
TRUE-RMS MULTIMETER (REFERENCE)	177	FLUKE	83390025	00974	08-MAR-2005	
TRUE-RMS MULTIMETER (TELECOM)	177	FLUKE	83430419	00975	08-MAR-2005	
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
10x700US PLUGIN MODULE W/ EXTENSION BOX	10x700US PLUGIN	C-S	N/A	00844/845	23-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 SUPPLIES	MN	MFR	SN	ASSET	CALIBRATION DUE
10001I/2 AC POWER SYSTEM	(2) 500i	CALIFORNIA INSTRUMENTS	HK53687/HK53688	00376	16-JUL-2005

POWER/NOISE METERS	MN	MFR	SN	ASSET	CALIBRATION DUE
POWER METER	435B	HP	2445A11012	00773	07-APR-2005
POWER METER	437B	HP	2912A01367	01099	27-OCT-2005
POWER SENSOR	8481A	HP	2702A61351	00774	07-APR-2005
PSOPHOMETER	2429	BRUEL & KJAER	1237642	00585	18-FEB-2005
TRANSMISSION LINE TESTER (dBRNC)	185T	AMREL	998658	00823	08-MAR-2005

OVERVOLTAGE CHAMBERS	MN	MFR	SN	ASSET	CALIBRATION DUE
72kW POWER FAULT SIMULATOR	OV1	C-S	N/A	00792	31-MAR-2005
POWER FAULT SIMULATOR	OV2	C-S	N/A	00116	31-MAR-2005

DIPLOLE TAPE MEASURES	MN	MFR	SN	ASSET	CALIBRATION DUE
26FT TAPE #1	2338CME	LUFKIN	C3166-1	00776	26-FEB-2005
26FT TAPE #2	2338CME	LUFKIN	C3166-2	00777	26-FEB-2005

METEOROLOGICAL METERS	MN	MFR	SN	ASSET	CALIBRATION DUE
TEMP./HUMIDITY/ATM. PRESSURE GAUGE	7400 PERCEPTION II	DAVIS	N/A	00965	19-JAN-2005
TEMPERATURE /HUMIDITY GAUGE	THG-912	HUGER	4000562	00789	08-JAN-2005

TRACEABLE CLOCKS	MN	MFR	SN	ASSET	CALIBRATION DUE
5003	5003	CONTROL COMPANY	99026940	00808	09-DEC-2004

CONSUMABLES	SPEC.	MFR	STOCK/MN	ASSET	CALIBRATION DUE
NEBS CHEESE CLOTH	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.

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

<u>SCOPE OF ACCREDITATION TO ISO/IEC 17025:1999</u> CURTIS-STRAUS¹ 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 <u>Electromagnetic Compatibility (EMC), Telecommunications, and Product Safety tests</u>: 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 <table border="1"> <thead> <tr> <th>EMC Standards</th> <th>Title</th> </tr> </thead> <tbody> <tr> <td><i>Emissions</i> CISPR 22 1997 with amendments 1 and 2</td> <td>Limits and methods of measurement of radio disturbance characteristics of information technology equipment.</td> </tr> <tr> <td>CNS13438 1994</td> <td>Limits and methods of measurement of radio interference characteristics of information technology equipment.</td> </tr> <tr> <td>EN55022:1994 and 1998</td> <td>Limits and methods of measurement of radio disturbance characteristics of information technology equipment.</td> </tr> <tr> <td>SABS CISPR 22:1997</td> <td>Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement</td> </tr> <tr> <td>Canada ICES-003 1997 AS/NZS 3548 1995</td> <td>Digital apparatus Australian/New Zealand Standard Limits and methods of measurement of radio disturbance characteristics of technology equipment</td> </tr> <tr> <td>information CISPR 11 1990, 1997, 1999</td> <td>Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.</td> </tr> </tbody> </table> ¹ Note: This accreditation covers testing performed at the laboratory listed above and the satellite facility located at 168 Ayer Rd, Littleton, MA 01460 (A2LA Cert. No. 1627-01) 10/31/03 Page 1 of 11	EMC Standards	Title	<i>Emissions</i> 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 AS/NZS 3548 1995	Digital apparatus Australian/New Zealand Standard Limits and methods of measurement of radio disturbance characteristics of technology equipment	information CISPR 11 1990, 1997, 1999	Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.	EN 55011 1991, 1998 SABS CISPR 11:1997 Canada ICES-001 1998 CNS13803 AS/NZS 2064: 1997 CSA C108.8 – M1983 CISPR 13:1996, 1998, 2001 EN 55013: 1990, 2001 EN 55013 Amend 12 1994 SABS CISPR 13: 1996 CNS 13439 AS/NZS 1053: 1999 CISPR 14 1993 (<i>except discontinuous disturbances</i>) for EN 55014 1993, 1997 (<i>discontinuous disturbances</i>) for AS/NZS 1044: 1995 (<i>discontinuous disturbances</i>) for <i>Immunity</i> CNS13783-1 SABS CISPR 14-1 1993 SABS CISPR 14-2 1997 + A1:2001 (A2LA Cert. No. 1627-01) 10/31/03 Page 2 of 11 Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment. Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics Limits and methods of measurement Industrial, scientific and medical radio frequency generators Industrial, Scientific and Medical Instrument Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment. Electromagnetic Emission from Data Processing Equipment and Electronic Office Machines Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment. 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. Limits and methods of measurement of radio disturbance characteristics of broadcast receivers and associated equipment. Amendment 12 Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment. Broadcast receiver and associated equipment Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment. Limits and methods of measurement of radio disturbance characteristics of electrical motor- operated and thermal appliances household and similar purposes, electric tools and electric apparatus. Limits and methods of measurement of radio disturbance (<i>except</i> characteristics of electrical motor- operated and thermal appliances household and similar purposes, electric tools and similar electric apparatus. Limits and methods of measurement of radio disturbance (<i>except</i> characteristics of electrical motor- operated and thermal appliances household and similar purposes, electric tools and similar electric apparatus. Household Electrical Appliances Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus Part 1: Emission – Product family standard 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 CISPR 20: 1995, 2002 with amendment 3 characteristics (<i>associated group only</i>) EN 55020: 1995, 2002 (<i>associated group only</i>) CISPR 24 – SABS CISPR 24 1997 – AS/NZS 3200.1.2: 1995 <i>European Union Basic EMC Standards</i> EN 61000-4-2: 1995, 1999, 2001 EN 61000-4-3:1997, 1998, 2002 AS/NZS 61000.4.3 1999 EN 61000-4-4 1995 EN 61000-4-5 1995 AS/NZS 61000.4.5 1999 EN 61000-4-6 1996 AS/NZS 61000.4.6 1999 conducted EN 61000-4-8 1994 EN 61000-4-11 1994 11: ENV 61000-2-2 1993 <i>EU Product Family Standards</i> EN 50081-1 1992 1: EN 50081-2 1993 Part EN 50082-1 1992, 1998 Part EN 50082-2 1995 (A2LA Cert. No. 1627-01) 10/31/03 Page 3 of 11 Immunity requirements for household appliances, tools and similar apparatus. Limits and methods of measurement of immunity of sound and television broadcast receivers and associated equipment. Electromagnetic immunity of broadcast receivers and Associated equipment. Information technology equipment – Immunity characteristics Limits and methods of measurement Information technology equipment – Immunity characteristics Limits and methods of measurement Approval and test specification – Medical electrical Equipment – General requirements for safety – Collateral Standard: Electromagnetic compatibility – Requirements and tests. Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 2: Electrostatic discharge immunity test – Basic EMC Publication Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 3: Radiated, radio-frequency, electromagnetic field immunity test Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 4: Electrical fast transient/burst immunity test – Basic EMC publication (EMC) Part 4: Testing and measurement techniques. Section 5: Surge immunity test. Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 6: Immunity to disturbances, induce by radio-frequency fields. Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 8: Power frequency magnetic field immunity test. (EMC) Part 4: Testing and measurement techniques. Section Voltage dips, short interruptions and voltage Variations immunity tests. 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) Electromagnetic capability – Generic emission standard. Part Residential, commercial and light industry. (I.S.) Electromagnetic compatibility – Generic emission standard. 2. Industrial environment Electromagnetic compatibility – Generic emission standard. 1. Residential, commercial and light industry Electromagnetic compatibility – Generic immunity Standard. Part 2: Industrial environment	EN 61000-6-1: 1997, 2001 EN 61000-6-2: 1998, 2001 EN 50091-2 1996 EN 55024 1998 Limits EN 55103-1 1997 EN 55103-2 1997 (<i>excluding Annex A3</i>) use. EN 61326 1998 EN 61547 1996 EN 50130-4 1996 family EN 55104 1995 household EN 50083-2 1995 EN 60601-1-2: 1993, 2002 IEC 1800-3 1995 product EN 60555 Part 2 1987 EN 60555 Part 3 1987 EN 61000-3-2: 1995, 2000 Limits AS/NZS 61000.3.2 1998 EN 61000-3-3 1995 AS/NZS 61000.3.3 1999 ETS 300 386-1 1994 (A2LA Cert. No. 1627-01) 10/31/03 Page 4 of 11 Electromagnetic Compatibility (EMC)- Part 6: Generic standards-Section 1: Immunity for residential, commercial and light-industrial environments Electromagnetic Compatibility (EMC)- Part 6: Generic standards-Section 2: Immunity for industrial environments Specification for Uninterruptible Power Systems (UPS). Part 2: EMC requirements Information technology equipment – Immunity Characteristics – and methods of measurement. Electromagnetic Compatibility – Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use. Part 1: Emission Electromagnetic Compatibility – Product family standard for audio, video, audio-visual and entertainment lighting control professional Part 2: Immunity Electrical equipment for measurement, control and laboratory use – EMC requirements Equipment for general lighting purposes – EMC immunity requirements Alarm Systems. Part 4: Electromagnetic compatibility. Product standard: Immunity requirements for components of fire, intruder and social alarm systems. Electromagnetic compatibility immunity – requirements for appliances, tools and similar apparatus. Product family standard. Cabled distribution systems for television and sound signals. Part 2: Electromagnetic compatibility for equipment. Medical electrical equipment Part 1: general requirements for safety Section 2: Collateral standard: Electromagnetic compatibility – requirements and tests Adjustable speed electrical power drive systems. Part 3: EMC standard including specific test methods. Disturbances in supply systems caused by household appliances and similar electrical equipment. Part 2: Harmonics Disturbances in supply systems caused by household appliances and similar electrical equipment. Part 3: Voltage fluctuations. Electromagnetic compatibility (EMC). Part 3: Limits Section 2: for harmonic current emissions Electromagnetic compatibility (EMC). Part 3: Limits Section 2: Limitation of voltage fluctuations and flicker in low-voltage supply systems. Equipment Engineering (EE); Public telecommunication network equipment electro-magnetic compatibility (EMC) requirements Part 1: Product family overview, compliance criteria and test levels														

ETS EN 300 386-2 1997, 1998, ETS EN 300 386 2000 v1.2.1, 2001 v1.3.1 ETS 300 132-1 1996 ETS 300 132-2 1996 ETR 283 1997 <i>EU radio standards</i> (ETS) EN 300 385 v1.2.1: 1998, 1999 EN 300 330 v1.2.1: 1998, 1999 ETS 300 328 1996 ETS EN 300 440 v1.2.1 1999 EN 301 893:2002 v1.2.1 ETS 300 836-1:1998 EN301 489-17:2002 v1.2.1 (A2/LA Cert. No. 1627-01) 10/31/03	Electromagnetic compatibility and radio spectrum matters (ERM); Telecommunication network equipment; Electromagnetic compatibility (EMC) requirements; Part 2: Product family standard. 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 Equipment Engineering (EE); Power supply interface at the input to telecommunications equipment; Part 2: Operated by direct current (dc) Equipment Engineering (EE); Transient voltages at Interface A on telecommunications direct current (DC) power distributions. Electromagnetic compatibility and Radio spectrum matters (ERM); Electromagnetic Compatibility (EMC) standard for fixed radio links and ancillary equipment (ETS) 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 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 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 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 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 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 Page 5 of 11	EN 300 328-2:2001 v1.2.1 EN 301 489-1:2002 EN 60669-2-1:2002 <i>Canada Radio Standards</i> Canadian GL-36 1995 Canadian RSS-119 1999, 2000 Issue 6 Canadian RSS-134 1996 & 2000, Issue 1 Rev 1 Canadian RSS-210 2000 Issue 3, RFS29 1998 <i>FCC Standards</i> 47 CFR FCC low power transmitters operating on frequencies below 1 GHz, emergency alert systems, unintentional radiators and ISM devices. 47 CFR FCC low power transmitters operating on frequencies above 1 GHz, with the exception of spread spectrum devices. 47 CFR FCC Unlicensed Personal Scope Communications System (PCS) devices 47 CFR FCC Unlicensed National Scope Information Infrastructure devices and low power transmitters using spread spectrum techniques. 47 CFR FCC Personal mobile Scope Radio Services in the following FCC Rule Parts 22, 24, 25, 27. 47 CFR FCC General Mobile Radio Scope Services in the following FCC Rule Parts 22, 74, 90, 95, 97. 47 CFR FCC Maritime and Aviation Scope Radio Services in 47 CFR Parts 80 and 87 47 CFR FCC Microwave Radio Services Scope in 47 CFR Parts 21, 74 and 101. 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 Electromagnetic compatibility and Radio spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements Switches for household and similar fixed electrical installations -- Part 2-1: Particular requirements -- Electronic switches Industry Canada -- technical requirements for low power Devices in the 2400 -- 2483.5 MHz band. Industry Canada -- Land mobile and fixed radio Transmitters and receivers, 27.41 to 960.0 MHz Industry Canada -- 900 MHz narrowband personal communications services Industry Canada -- Low power license-exempt radio 2001 Issue 5 communication devices Specification for Restricted Radiation Radio Apparatus (New Zealand) Scope A1 Scope A2 A3 A4 B1 B2 B3 B4 (A2/LA Cert. No. 1627-01) 10/31/03 Page 6 of 11
FCC/OST MP-5 1986 GR-1089-CORE: 1997, 1999 issue 2/ 2002 Issue 3 <i>ANSI EMC Standards</i> ANSI C63.4: 1992, 1999, 2001, 2003 ANSI C63.5 1988 <i>IEEE EMC Standards</i> IEEE C62.41: 1980, 1991 <i>Swedish EMC Standards</i> BAKOM 3336.3 1995 <i>South African EMC standards other than CISPR equivalents</i> SABS 1718-1: 1996 <i>Japanese VCCI Standards</i> VCCI V-3/99.05 1999 VCCI V-4/99.05 1999 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 (<i>excluding volume control</i>); Protocol analysis and Jitter testing. <u>Telecom Standards</u> FCC 47 CFR Part 68 Telephone CS-03 Issue 8 1996 through amendment 5 TIA/EIA TSB31-B 1998 (A2/LA Cert. No. 1627-01) 10/31/03	FCC (Federal Communications Commission) methods Of measurement of radio noise emissions from industrial, scientific and medical equipment. Bellcore electromagnetic compatibility and electrical safety -- Generic criteria for network telecommunications equipment. 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. American National Standard for electromagnetic compatibility -- radiated emissions measurements in electromagnetic interference (EMI) control -- calibration of antennas. IEEE recommended practice on surge voltages in low-voltage AC power circuits Electromagnetic compatibility and electrical safety (EMC & S) for wired terminal equipment. Harmonization document information over the OFCOM requirements. South African Bureau of Standards: Specification for Gaming equipment. Part 1: Casino equipment. Technical Requirements Instruction for Test Conditions for Requirement under Test Connection of terminal equipment to the telephone Terminal Equipment network. Analog and Digital Equipment. TCB Scope C1. Specification for terminal equipment, terminal systems, Network protection devices, connection arrangements and hearing aids compatibility. Bulletin Part 68 Rationale and Measurement Guidelines (Feb 1998) Page 7 of 11	TIA/EIA-IS-968 TIA/EIA-IS-883 TIA-968-A T1.TRQ.6-2001 Canada VDSL Issue 1 January 2003 AS/ACIF S002-2001 AS/ACIF S016-2001 AS/ACIF S031-2001 AS/ACIF S038-2001 AS/ACIF S043-2001 ITU-T G.703 HKTA 2028 HKTA 2029 TBR 1 : 1995 TBR 2 : 1997 Telecommunications Telephone Terminal Equipment Technical Requirements for Connection of Terminal Equipment to the Telephone Network Telecommunications Telephone Terminal Equipment Supplemental Technical Requirements for Connection of Stutter Dial Tone Detection Devices and ADSL Modems to the Telephone Network Telecommunications Telephone Terminal Equipment Technical Requirements for Connection of Terminal Equipment to the Telephone Network Technical Requirements for SHDSL, HDSL2, HDSL4 Digital Subscriber Line Terminal Equipment to Prevent Harm to the Telephone Network Industry Terminal Attachment Program Requirements and Test Methods for Very-High-Bit-Rate Digital Subscriber Line (VDSL) Terminal Equipment Analogue interworking and non-interference requirements for Customer Equipment for connection to the Public Switched Telephone Network Requirements for Customer Equipment for connection to hierarchical digital interfaces Requirements for ISDN Basic Access Interface Requirements for ISDN Primary Rate Access Interface 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 Voiceband Physical/electrical characteristics of hierarchical Digital interfaces Network connection specification for connection of CPE to the PTNs in Hong Kong using digital leased circuits at data rate of 1544 kbit/s Network connection specification for connection of CPE to the PTNs in Hong Kong using digital leased circuits at data rate of 2048 kbit/s 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 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 10/31/03 Page 8 of 11

TBR 3 : 1995 + Amdt : 1997 TBR 4 : 1995 + Amdt : 1997 TBR 012 : 1993 + Amdt : 1996 TBR 013 : 1996 TBR 21 : 1998 TBR 24 : 1997 <i>Australia</i> TS 002 : 1997 TS 016 : 1997 TS 031 : 1997 TS 038 : 1997 AS/ACIF S043.2:2001 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 (<i>excluding x-ray tests</i>). <u>Product Safety Standards</u> Specific Product Safety Standards IEC 950 1991 UL 1950 1998 CSA C22.2 No.950-95 UL 60950 2000 (A2LA Cert. No. 1627-01) 10/31/03	Integrated Services Digital Network (ISDN); Attachment requirements for terminal equipment to connect to an ISDN using ISDN basic access Integrated Services Digital Network (ISDN); Attachment requirements for terminal equipment to connect to an ISDN using ISDN primary rate access Business Telecommunications (BT); Open Network Provision (ONP) technical requirements; 2 048 kbit/s digital unstructured leased line (D2048U) Attachment requirements for terminal equipment Business Telecommunications (BTC); 2 048 kbit/s digital structured leased lines (D2048S); Attachment requirements for terminal equipment interface 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 Business Telecommunications (BTC); 34 Mbit/s digital Unstructured and structured leased lines (D34U and D34S); Attachment requirements for terminal equipment interface Analogue Interworking and Non interference Requirements for Customer Equipment Connected to the Public Switched Telephone Network General Requirements for Customer Equipment Connected to Hierarchical Digital Interfaces Requirements for ISDN Basic Access Interface Requirements for ISDN Primary Rate Access Interface Requirements for Customer Equipment for connection to a metallic loop interface of a Telecommunications Network – Part 2 Broadband <u>Title</u> Safety of information technology equipment including Includes Amendments 1, 2, 3, and 4 electrical business equipment. Safety of information technology equipment, including lectrical business equipment. Safety of Information Technology Equipment (UL 1950) Safety of information technology equipment Page 9 of 11	IEC 60950 2000 EN 60950 1997, 1998, 2000 IEC 60950-1 2001 UL 60950-1 2003 CSA C22.2 No. 60950-00 CSA C22.2 No. 60950-1 03 AS/NZS 3260 1993 AS/NZS 3260 Supp 1 1996 ACA TS 001 1997 UL 1459 1995 IEC 1010-1 1990 IEC 61010-1 1993 EN 61010-1 1993, 2001 IEC 61010-1 2001 UL 61010B-1 2003 UL 3101-1 1993 CAN/CSA 1010-1 1999 (<i>Including AM 2</i>) UL 3111-1 1996 UL 3121-1 1995 IEC 60601-1 1995 EN 60601-1 1995 (<i>Including AM 2</i>) UL 2601-1 1997 IEC 60065 1998, 2000 ANSI/UL 6500: 1998 CAN/CSA 60065-00 AS/NZS 3250 1995 AS/NZS 60065 2000 Canadian C22.2 No. 1-94 (1-98) 1998 EN 60065 1994 IEC 60825 1990 EN 60825-1 1994 IEC 60825-1 2001 IEC 60825-2 2000-5 systems IEC 60825-4 1997-11 IEC 60335-1 1995 (<i>Including AM2 – 1997 & AM 12 – 1997</i>) EN 60335-1 2001 UL 60335-1 1998 CAN/CSA E335-1 1994 Safety of information technology equipment Safety of information technology equipment, including Electrical business equipment. Approval and test specification – Safety of information technology equipment including electrical business Equipment. 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) Australian Communications Authority – Safety requirements for customer equipment. Telephone Equipment Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1: General requirements. Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1: General requirements. Electrical equipment for laboratory use Part 1: General requirements. Electrical measuring and test equipment. Part 1: General requirements. Medical electrical equipment. Part 1: General requirements for safety. Medical electrical equipment Medical electrical equipment. Part 1: General Requirements for safety. Audio, video and similar electronic apparatus – Safety requirements Audio/video and musical instrument apparatus for Household, commercial and similar general use Australian/New Zealand Standard – Approval and test Specification – Mains operated electronic and related Equipment for household and similar general use Audio, video and similar electronic equipment. Consumer and 1994, commercial products Safety requirements for main operated electronic and related apparatus for household and similar general use. Radiation safety of laser products, equipment Classification, requirements and user's guide Safety of laser products Part 1: equipment Classification, requirements and user's guide. Safety of laser products – Part 2: Safety of optical communication Safety of laser products – Part 4: Laser guards Safety of household and similar electrical appliances Part 1: General requirements Page 10 of 11
UL 61010A-1 : 2002 EN 61010-1 : 2001 AS/NZS 60950 : 2000 Environmental² <u>Environmental Standards</u> GR-63-CORE ETS 300 019 (vibration up to 1000Hz) ² Environmental testing is performed at the satellite facility located at 168 Ayer Rd, Littleton, MA 01460 (A2LA Cert. No. 1627-01) 10/31/03 Page 11 of 11	Electrical equipment for laboratory use; part 1: General requirements Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements Safety information technology equipment <u>Title</u> NEBS Requirements: Physical Protection Environmental conditions and environmental tests For telecommunications equipment	