Curtis-Straus Test Report

Report No	EE0056-3
Client	Voxware, Inc. 185 Alewife Brook Parkway Cambridge, MA 02138
Phone Fax FRN	617-497-0200 617-576-2123 0010250033
Model	VLS-410 w/ 100mW Symbol card
FCC ID	SC6VLS410S241
Equipment Type Equipment Code	Spread Spectrum Transmitter DSS
Results	As detailed within this report
Prepared by	Evan Gould – Test Engineer
Authorized by	Michael Buchholz – EMC Manager
Issue Date	
Conditions of issue	This Test Report is issued subject to the conditions stated in 'terms and conditions' section of this report.

Table Of Contents

Summary

This test report supports an application for certification of a transmitter operating pursuant to 47 CFR 15.247. The product is the Voxware VLS-410 with the Symbol LA-3021-100-US card. It is a frequency hopper that operates in the range 2400-2483.5MHz. It utilizes a hopping table of 79 channels. The LA-3021-100-US card has previously been certified as FCC ID H9PLA3021-100. The purpose of this application is to certify the VLS-410 which utilizes this radio with a new antenna (Proxim 7742 0dBi omnidirectioinal antenna) in a body worn configuration.

Test Methodology

Radiated emissions testing is performed according to the procedures specified in ANSI C63.4 (2003). Public Notice DA 00-705 *"Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems"* was followed for testing as well. Emissions were maximized by rotating the EUT (including external antenna) around three orthogonal axes as well as varying the test antenna's height and polarity. The external antenna can not be maximized separately. Fresh batteries were used throughout testing.

Frequency range investigated:	30MHz – 26.5GHz	
Measurement distance:	30 - 1000MHz	3m
	1 – 26.5GHz	1m

Statement of Conformity

The VLS-410 has been found to conform to the following parts of 47 CFR as detailed below:

Part 2	Part 15	Comments
	15.15(b)	There are no controls on this device that adjust the power level.
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.
	15.203	The external antenna connector is a unique connector type: reverse MCX.
	15.205 15.209	The fundamental is not in a Restricted band and the spurious and harmonic emissions in the Restricted bands comply with the general emission limits of 15.209.
	15.207	The unit is battery powered.
	15.247	The unit complies with the frequency hopper requirements of 15.247

EUT Configuration

EUT Configuration

Work Order: E0056
Company: Voxware, Inc.
Company Address: 185 Alewife Brook Parkway
Cambridge, MA 02138
Contact: Fred Earthrowl
Person Present: Fred Earthrowl

	MN	SN	FCC ID
EUT:			
Hopping sample	VLS410	6033-0181	
Non-hopping sample	VLS410	59580192	
100mW Symbol Tx/Rx card:	LA-3021-100-US	-	H9PLA3021-100
Antenna type:	Proxim 7742 0dBi omnidirectional antenna		
EUT Max Frequency:	2.483GHz		

Support Equipment:	MN	SN	FCC ID
Head set	1108-XXQDS	03061031	-
Metrologic Scanner	IS4220	1603390165	-

EUT Cables:	Qty	Shielded?	Length	Ferrites
Head set cable	1	No	4 feet	None
Scanner cable	1	Yes	5 feet	None

Unpopulated EUT Ports:	Qty	Reason
None		

Software / Operating Mode Description:

Conducted Measurements: Running diagnostic software in order to set the frequency, modulation, data sequence, etc.
Radiated Measurements: continuously transmitting or receiving a file to/from a support laptop.

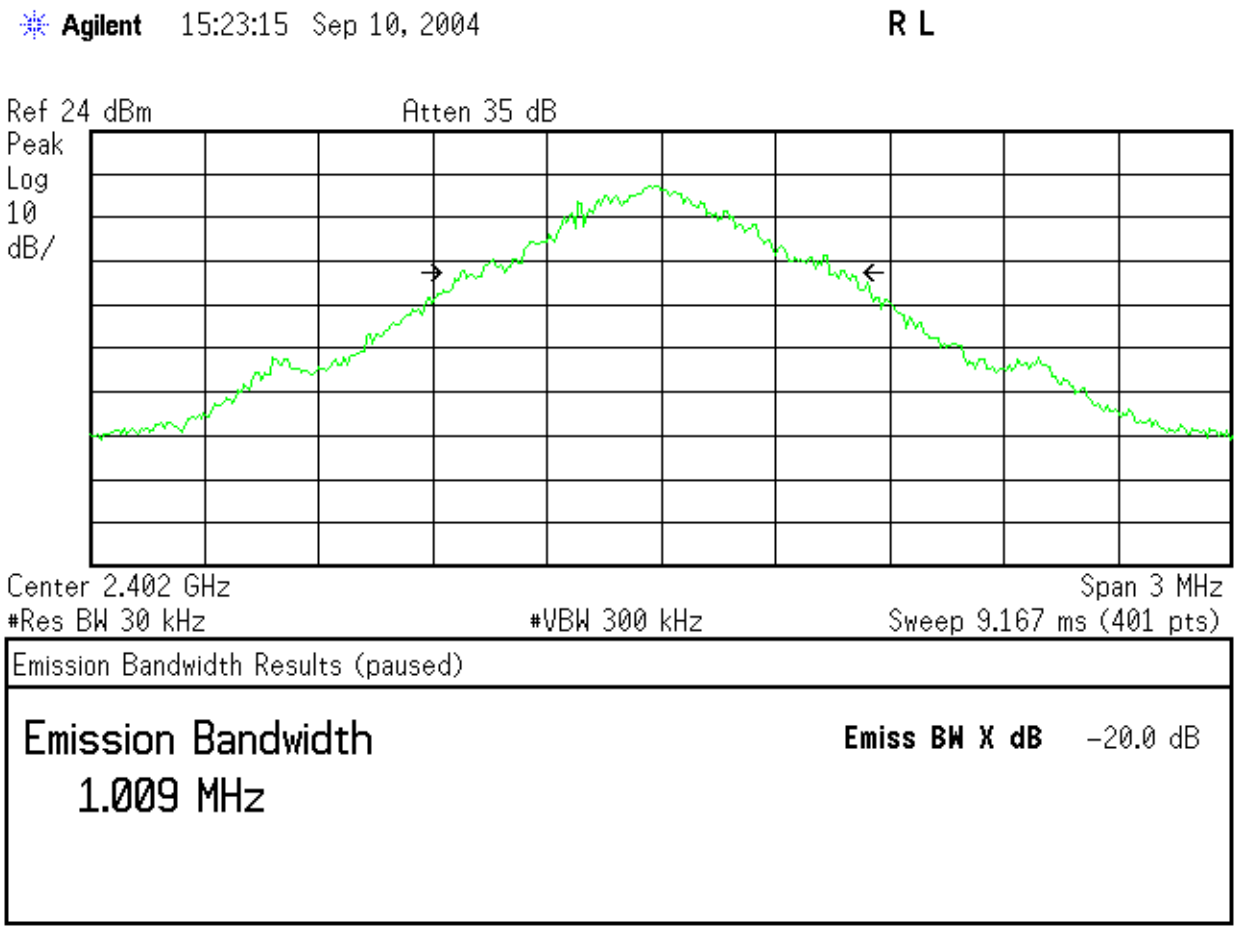
20dB Bandwidth

MEASUREMENT

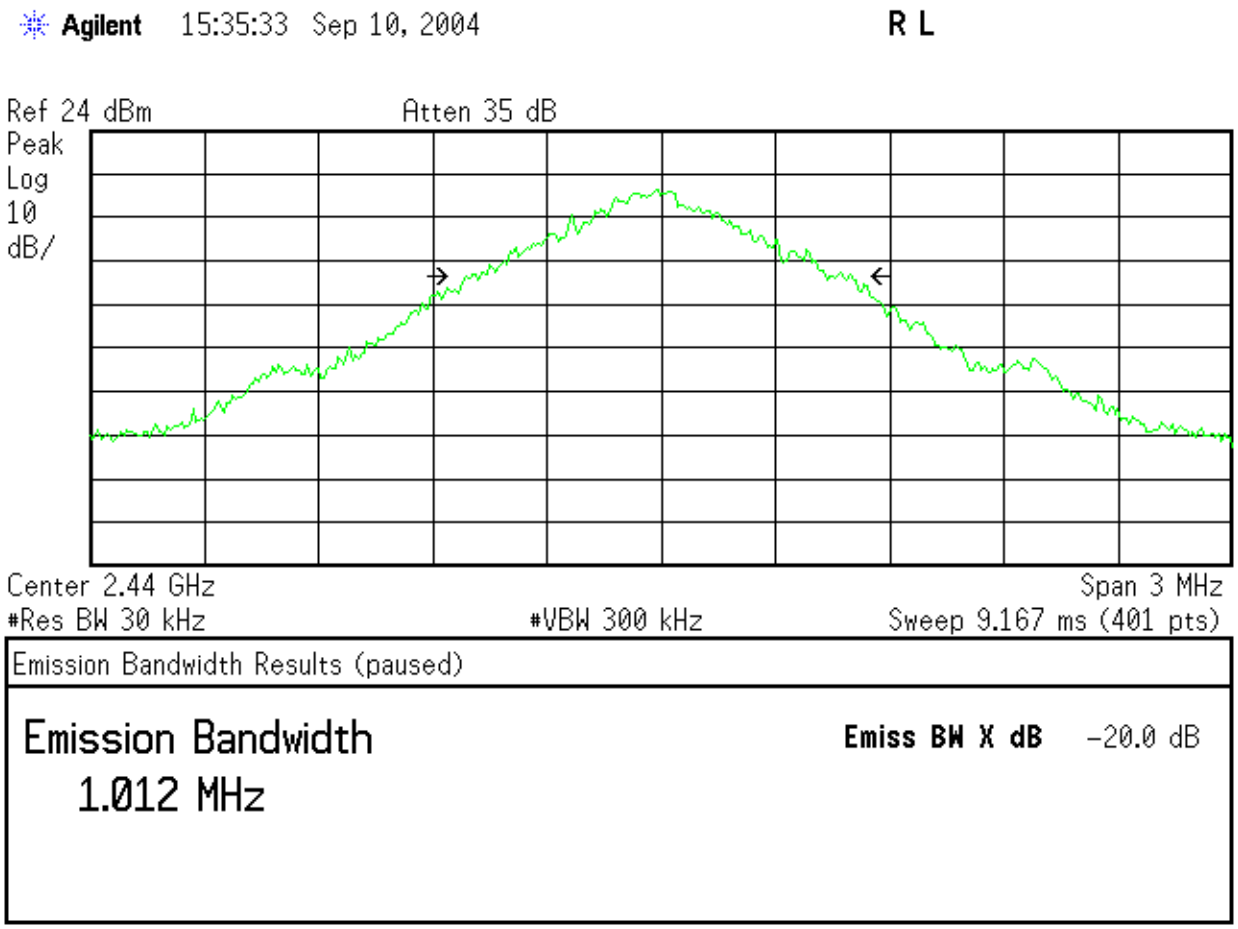
The 20dB bandwidths were measured for frequencies 2402, 2440, and 2480MHz. The maximum 20dB bandwidth measured was **1.01MHz**. This value was used as the limit for the channel separation requirement.

ANALYZER PLOTS

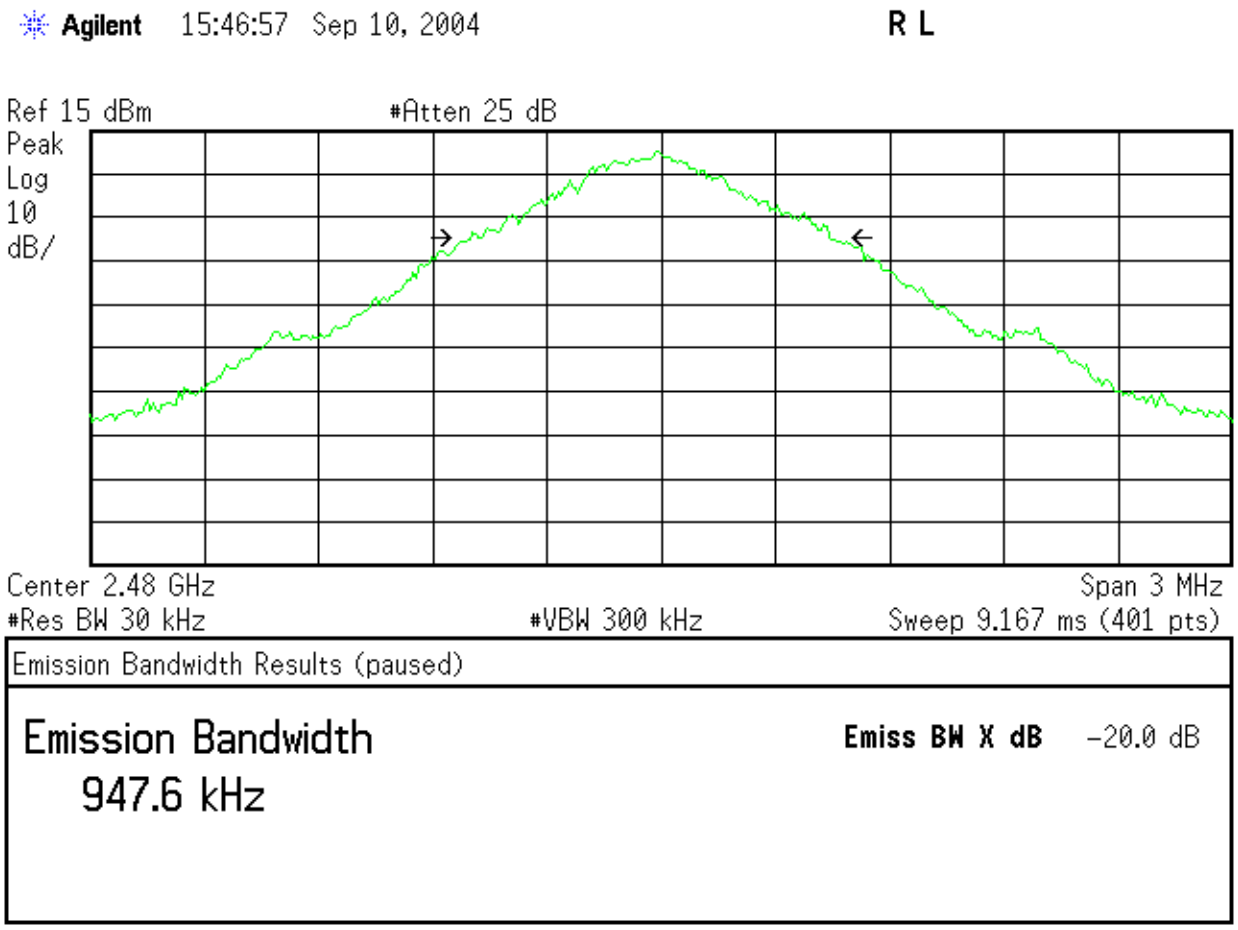
2402MHz 20dB Bandwidth



2440MHz 20dB Bandwidth



2480MHz 20dB Bandwidth



Channel Separation

REQUIREMENT

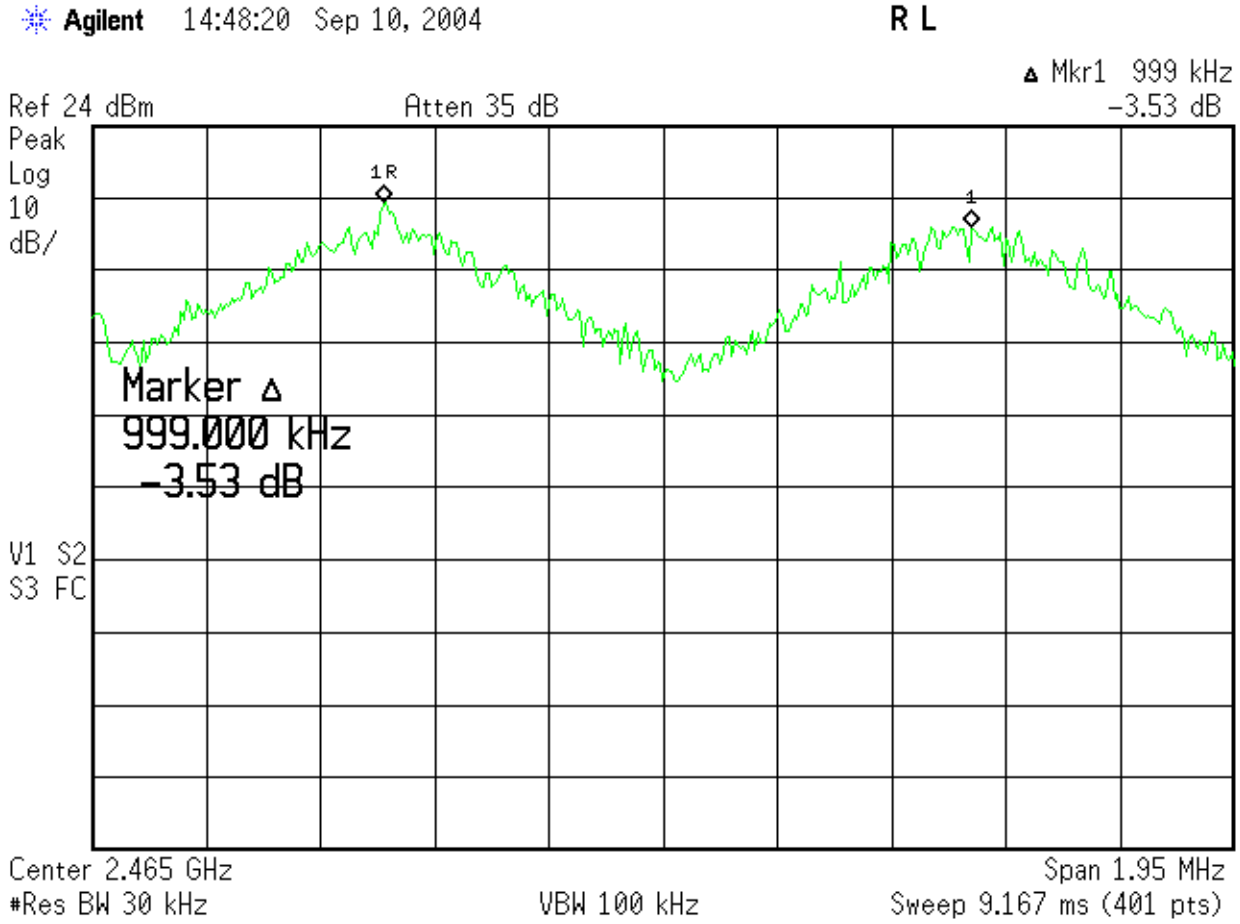
"Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater." [15.247(a)(1)}

20dB bandwidth = 1.01MHz (see "20dB Bandwidth" section)

MEASUREMENT

Channel separation = 1MHz

ANALYZER PLOT



Number of Hopping Frequencies

REQUIREMENT

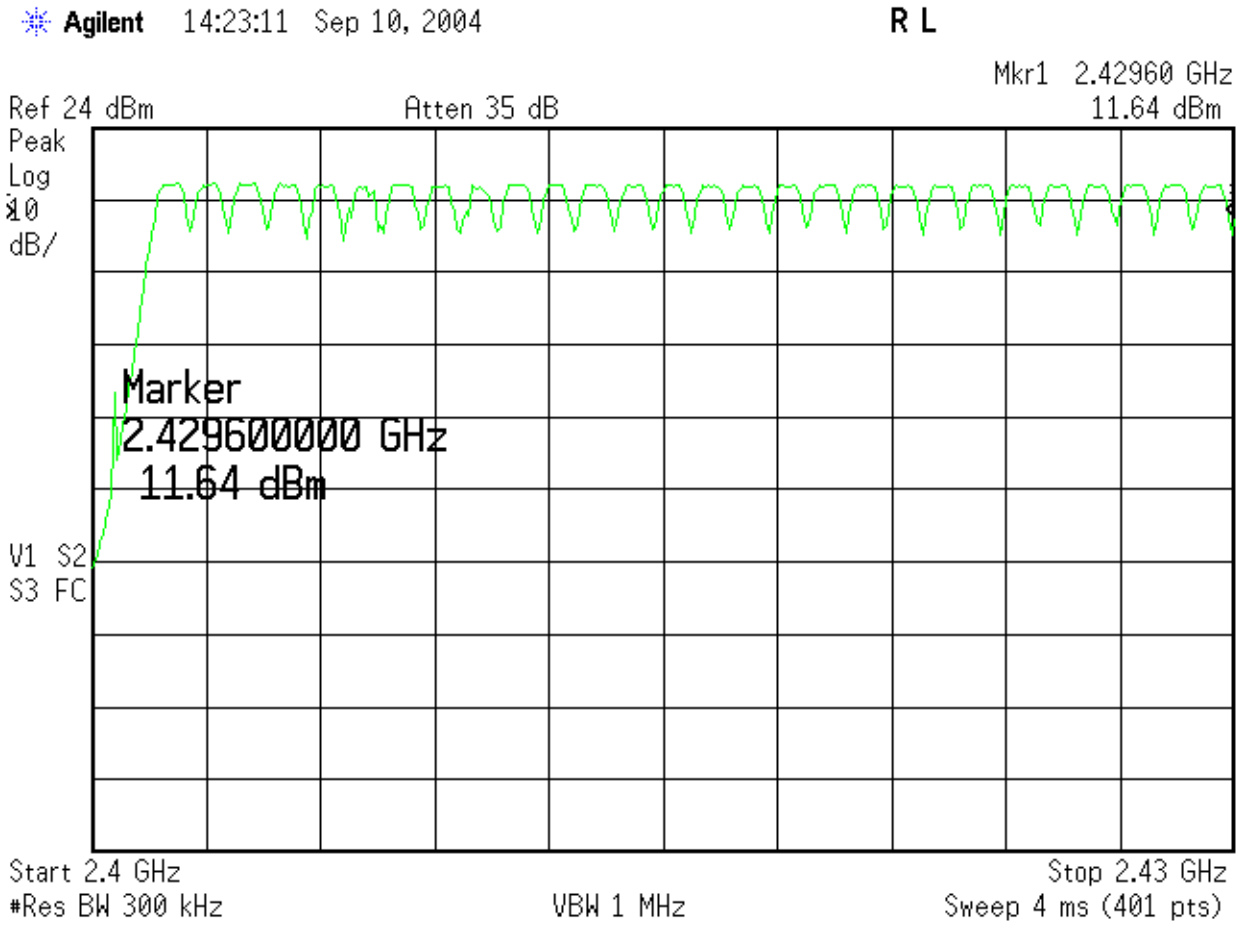
"Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 non-overlapping channels." [15.247(a)(1)(iii)]

MEASUREMENT

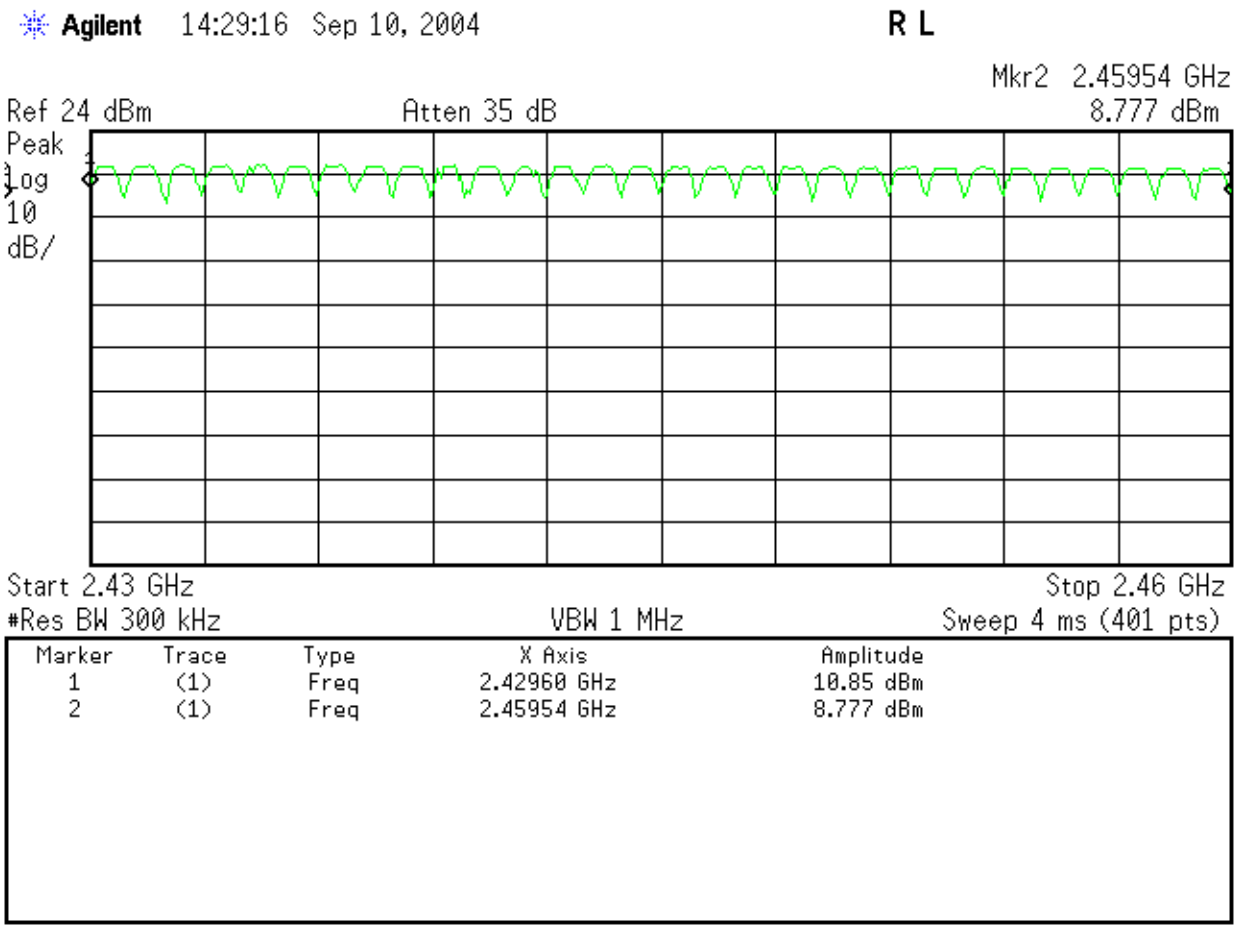
79 hopping frequencies can be counted in the following three analyzer plots.

ANALYZER PLOTS

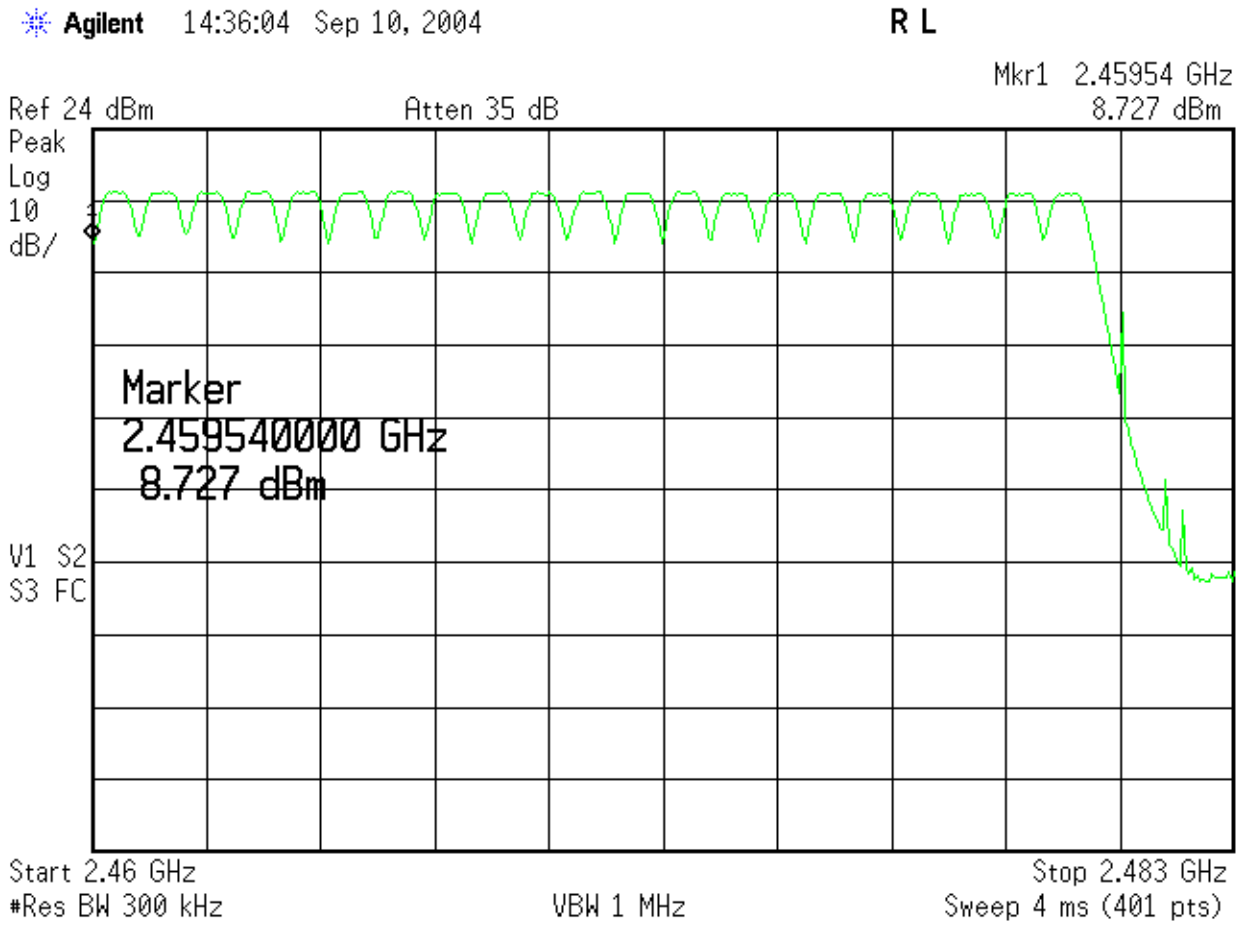
2400-2429.6MHz



2429.6-2459.5MHz



2459.5-2483.5MHz



Time of Occupancy (Dwell Time)

REQUIREMENT

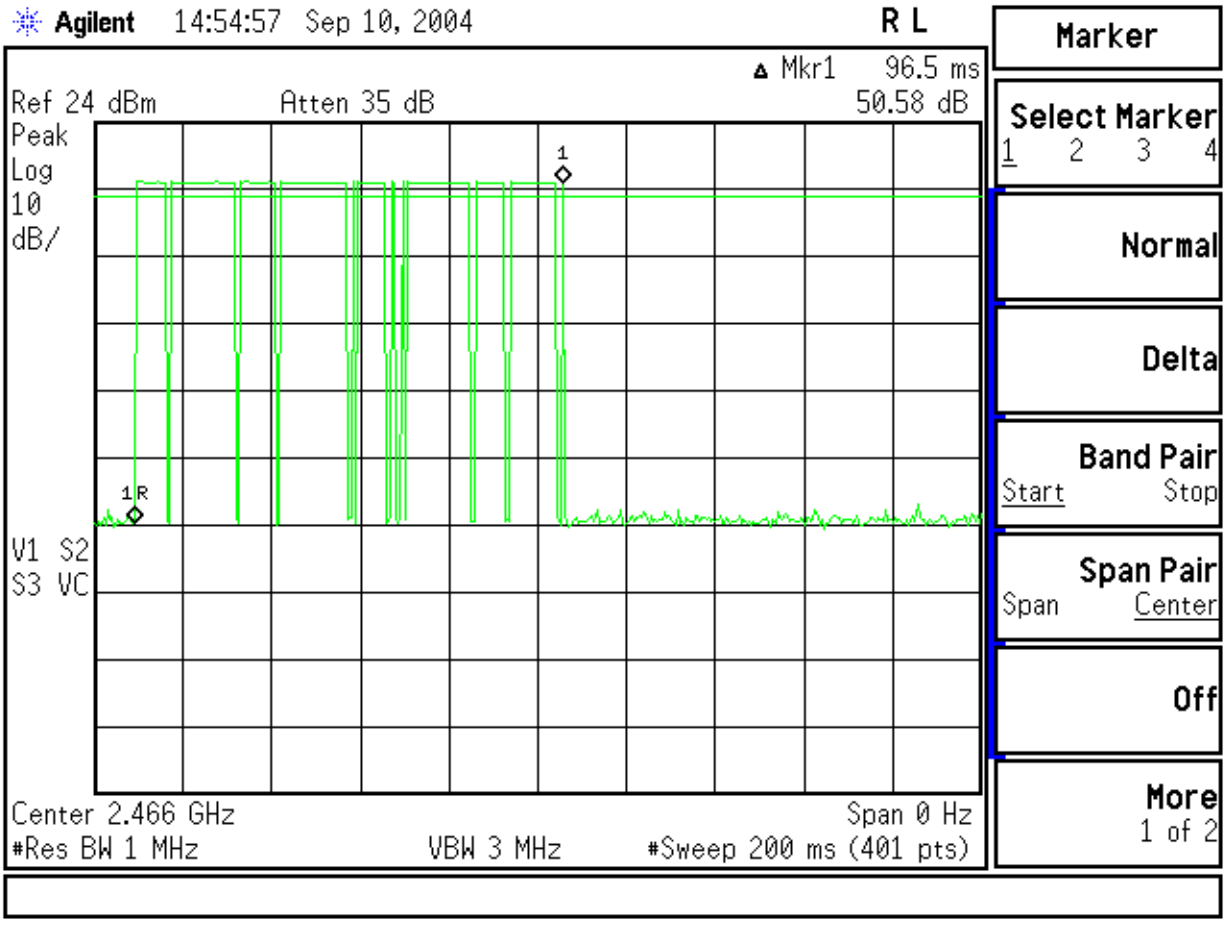
"The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed" [15.247(a)(1)(iii)]

MEASUREMENTS

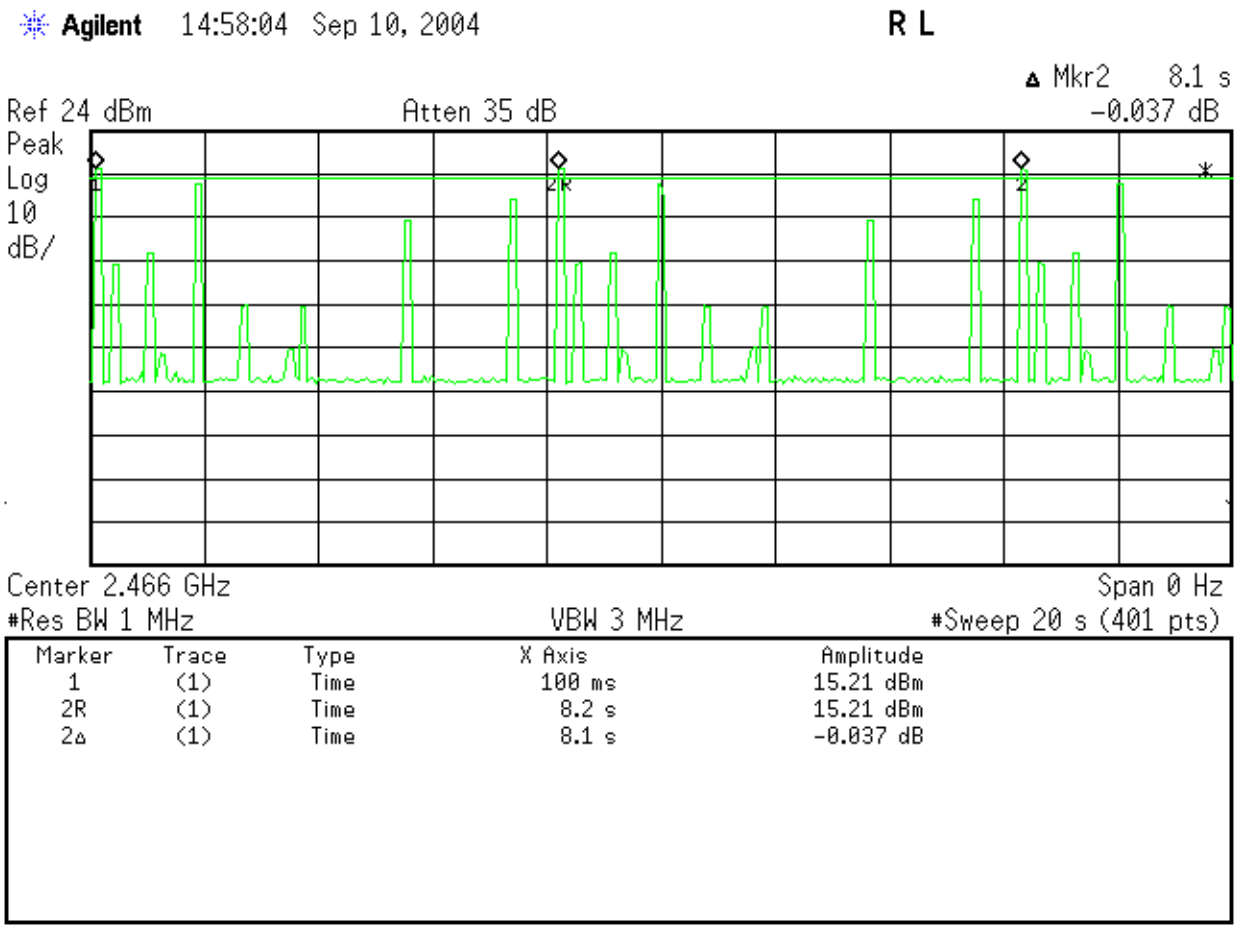
Individual dwell time: 0.1s
Time to return to the same channel: 8.1s (see second plot below)
Number of dwells within 31.6s (0.4s*79): 31.6/8.1 ≤ 4
Worst case dwell time within 31.6s: 4*0.1s = 0.4s

ANALYZER PLOTS

Individual Dwell Time



20s Window


Agilent 14:58:04 Sep 10, 2004
R L
Mkr2 8.1 s
-0.037 dB
Ref 24 dBm
Atten 35 dB
Peak
Log
10
dB/
Center 2.466 GHz
Span 0 Hz
#Res BW 1 MHz
VBW 3 MHz
#Sweep 20 s (401 pts)
Marker Trace Type X Axis Amplitude
1 (1) Time 100 ms 15.21 dBm
2R (1) Time 8.2 s 15.21 dBm
2Δ (1) Time 8.1 s -0.037 dB

Peak Output Power

LIMIT

"The maximum peak output power of…systems in the 2400-2483.5 MHz band employing at least 75 hopping channels...: 1 Watt." [15.247(b)(1)]

Since the maximum directional gain of the antenna is less than 6dBi, there is no corresponding reduction in the peak output power limit. [15.247(b)(4)]

MEASUREMENTS

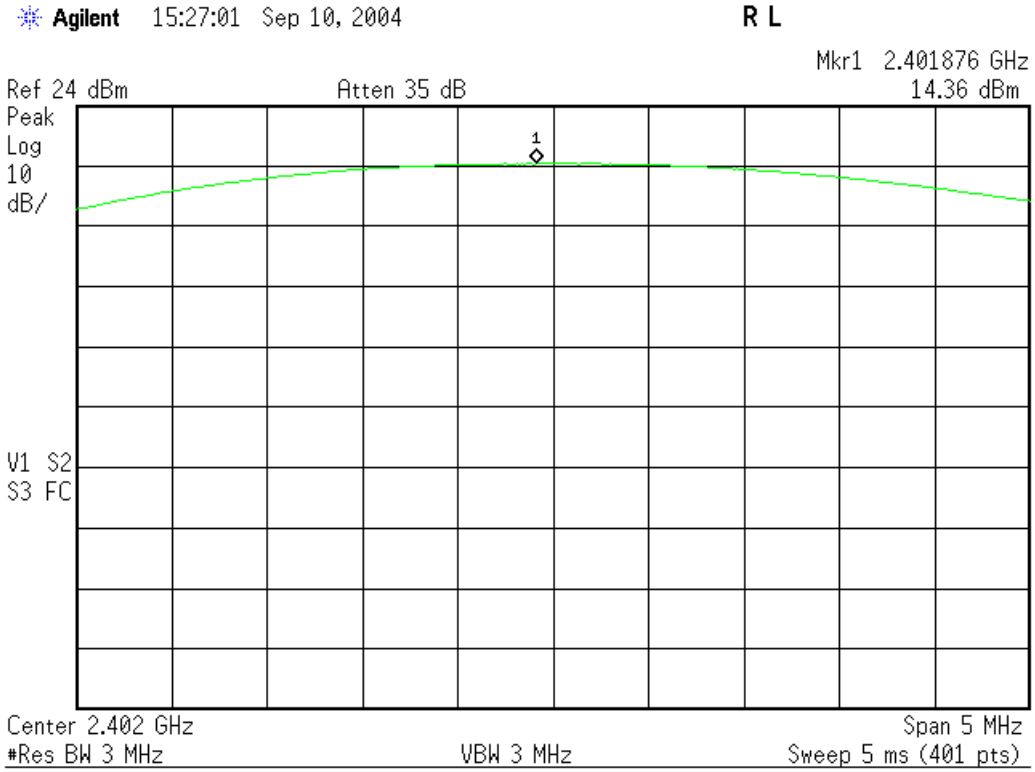
Peak Output Power — *Curtis-Straus LLC*

Date: 10-Sep-04	**Engineer:** Evan Gould	**Work Order:** E0056	
Company: Voxware	**EUT:** VLS-410	**Fundamental Frequencies:** 2400-2483.5MHz	
Test Site: "T"		**Cable:** Microflex #8	
Attenuator: N/A		**Analyzer:** Orange	
Measurement: Max Hold		**Resolution BW:** 3MHz	
Detector Type: Peak		**Video BW:** 3MHz	
Notes:			

Channel	Frequency (MHz)	Reading (dBm)	Cable Factor (dB)	Attenuator Factor (dB)	Adjusted Reading (dBm)	47 CFR 15.247(b)(1) Limit (dBm)	Margin (dB)	Result (Pass/Fail)
low	2402	14.4	1.0	0	15.4	30.0	-14.6	Pass
mid	2440	14.1	1.0	0	15.1	30.0	-14.9	Pass
high	2480	12.8	1.0	0	13.8	30.0	-16.2	Pass

SAMPLE ANALYZER PLOT

2402MHz Peak Output Power



Conducted Spurious Emissions

LIMIT

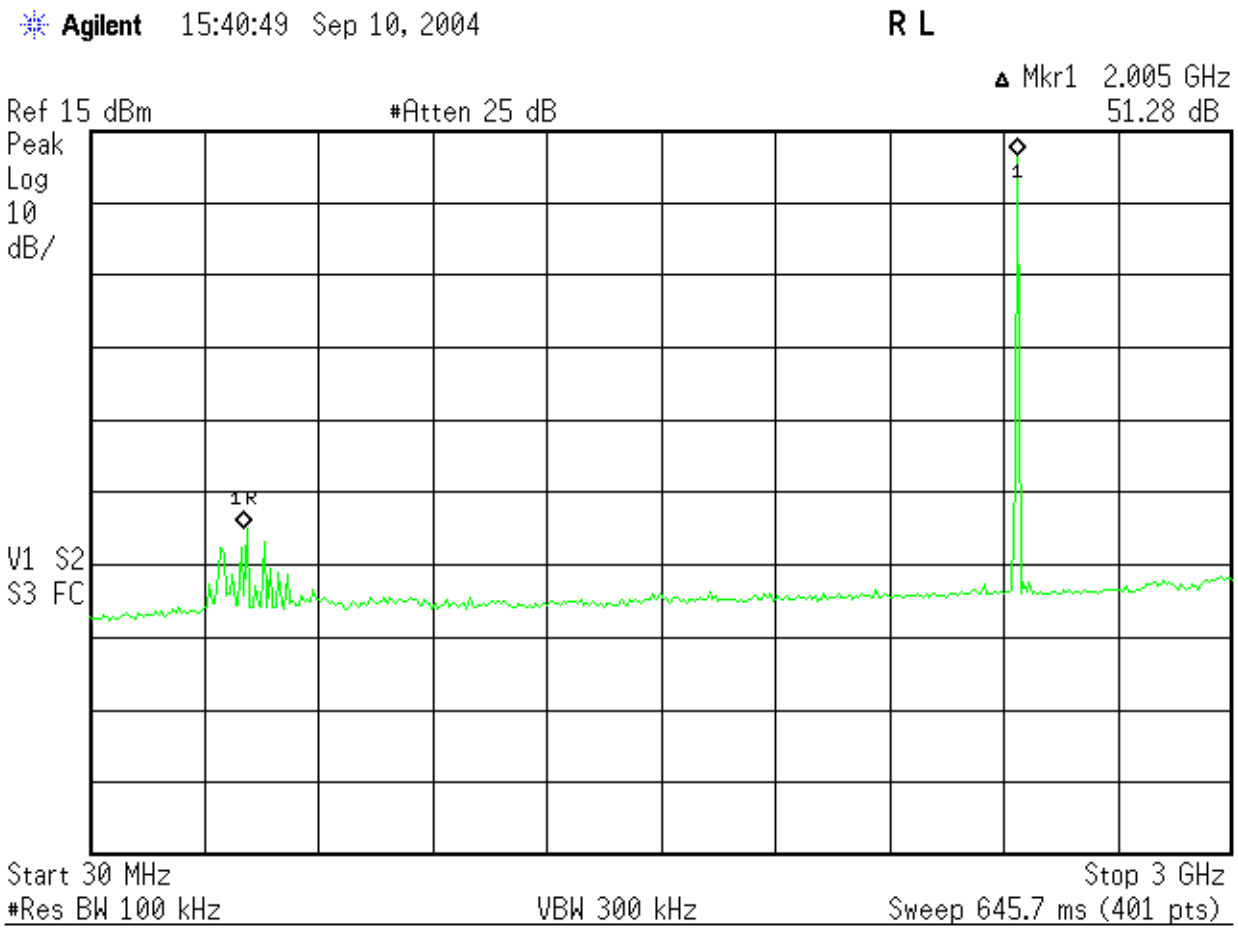
Peak: 20dB down from fundamental [15.247(c)]

MEASUREMENTS

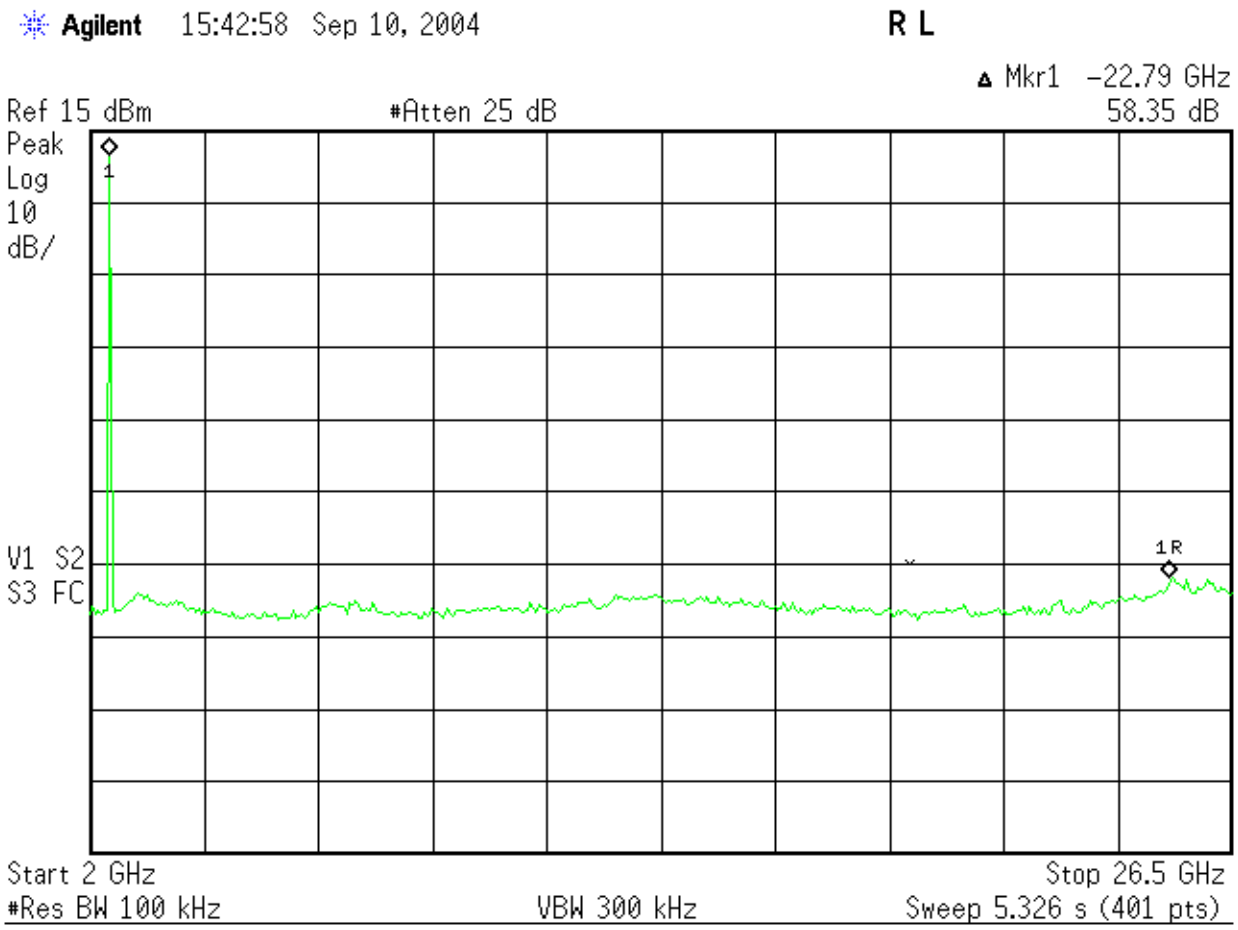
No failing conducted spurious emissions were detected. See the plots below.

ANALYZER PLOT

30MHz – 3GHz



2GHz – 26.5GHz


Agilent 15:42:58 Sep 10, 2004
R L
Mkr1 -22.79 GHz
58.35 dB
Ref 15 dBm
#Atten 25 dB
Peak
Log
10
dB/
1
1R
V1 S2
S3 FC
Start 2 GHz
#Res BW 100 kHz
VBW 300 kHz
Stop 26.5 GHz
Sweep 5.326 s (401 pts)

Conducted Band Edges

LIMITS

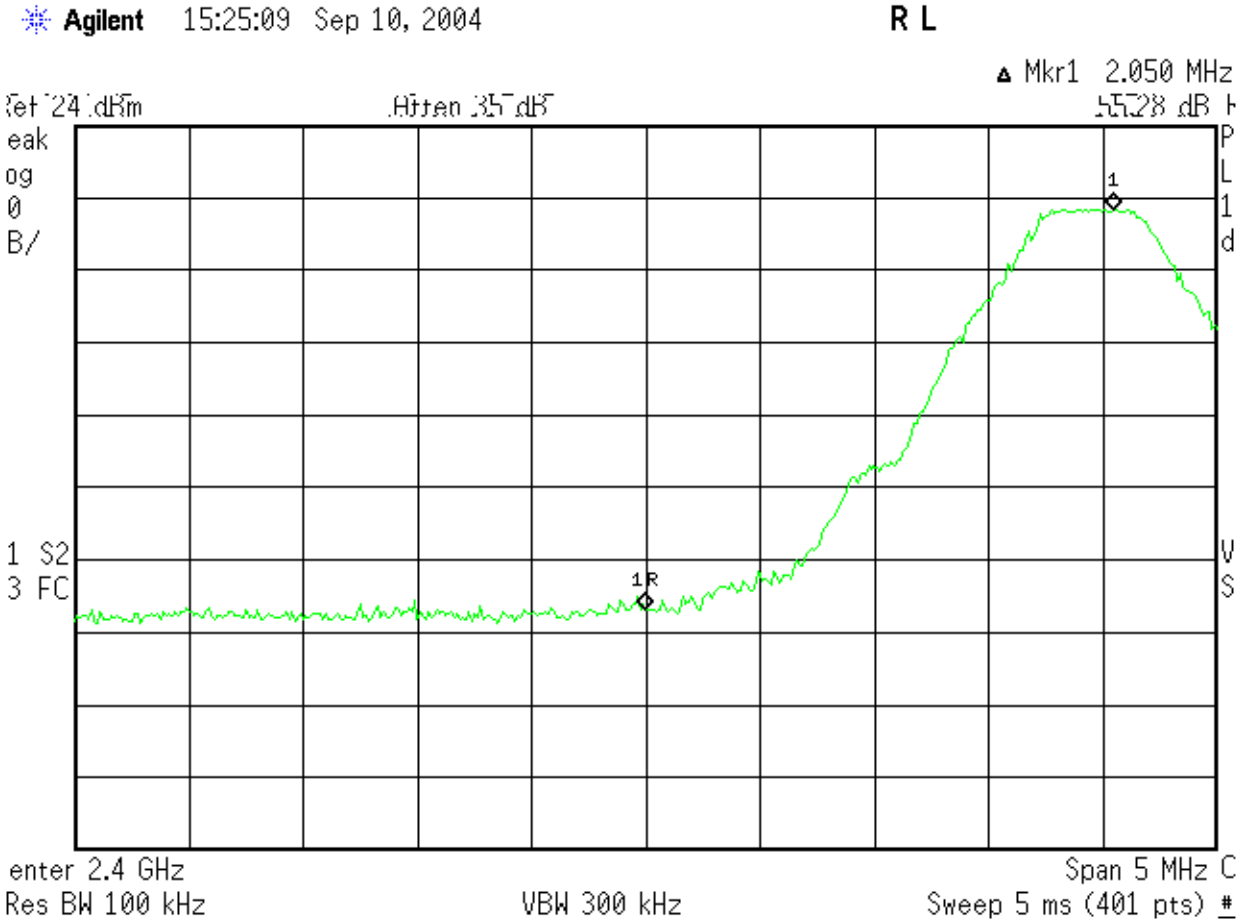
Peak: 20dB down from fundamental [15.247(c)]

RESULTS

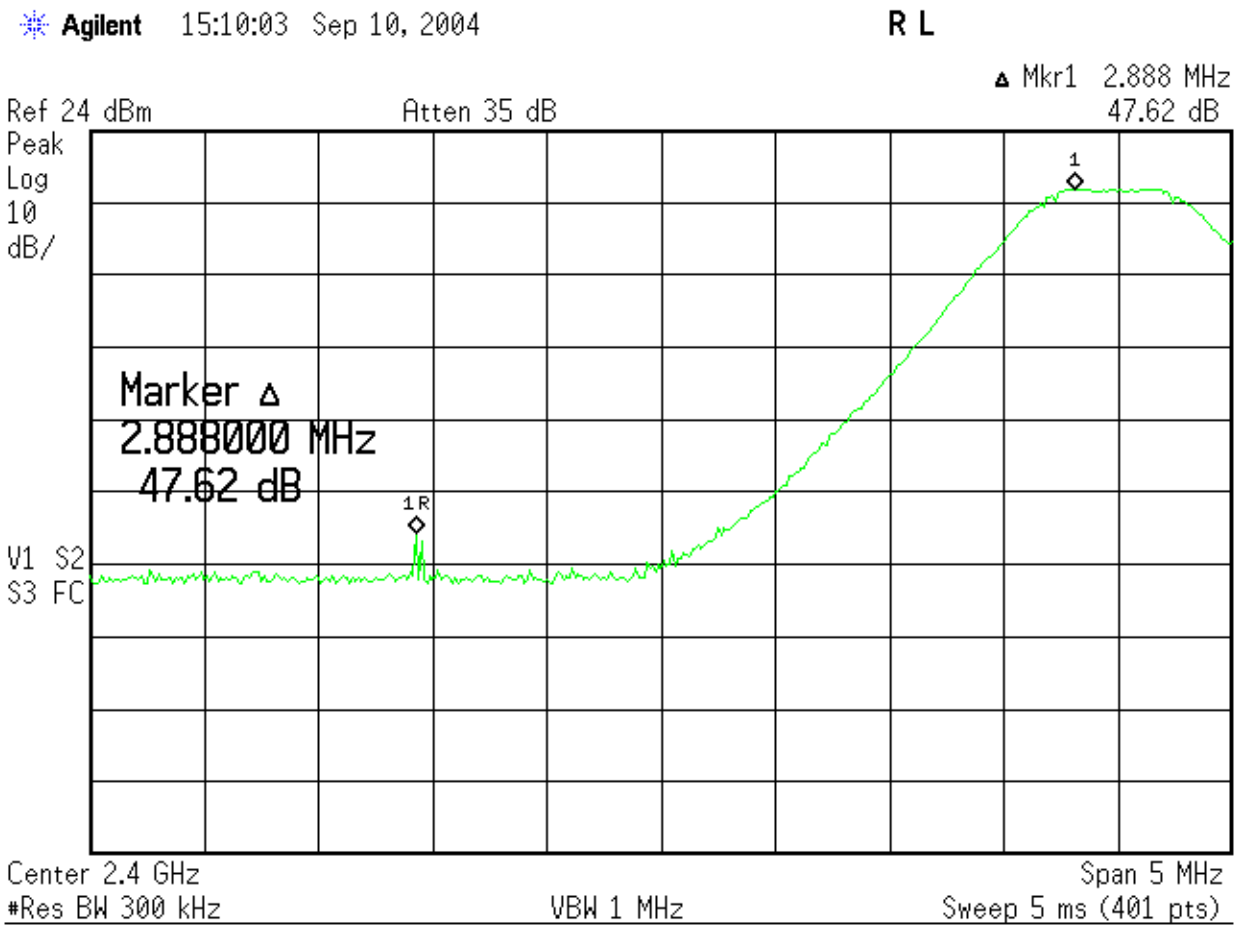
It can easily be seen in the plots shown below that the conducted band edges are at least 20dB down from the peak of the fundamental.

ANALYZER PLOT

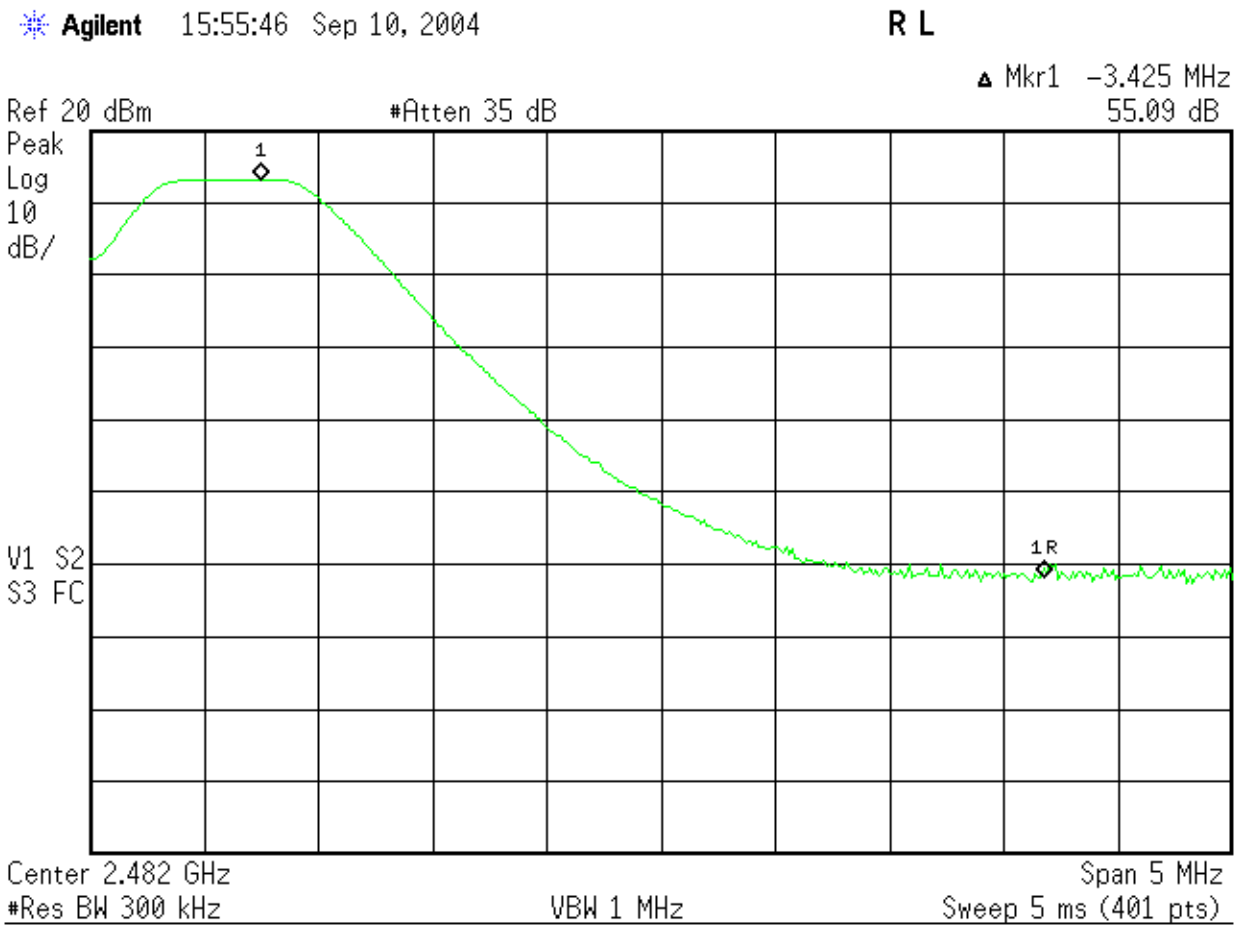
Low Band Edge – Hopping Disabled



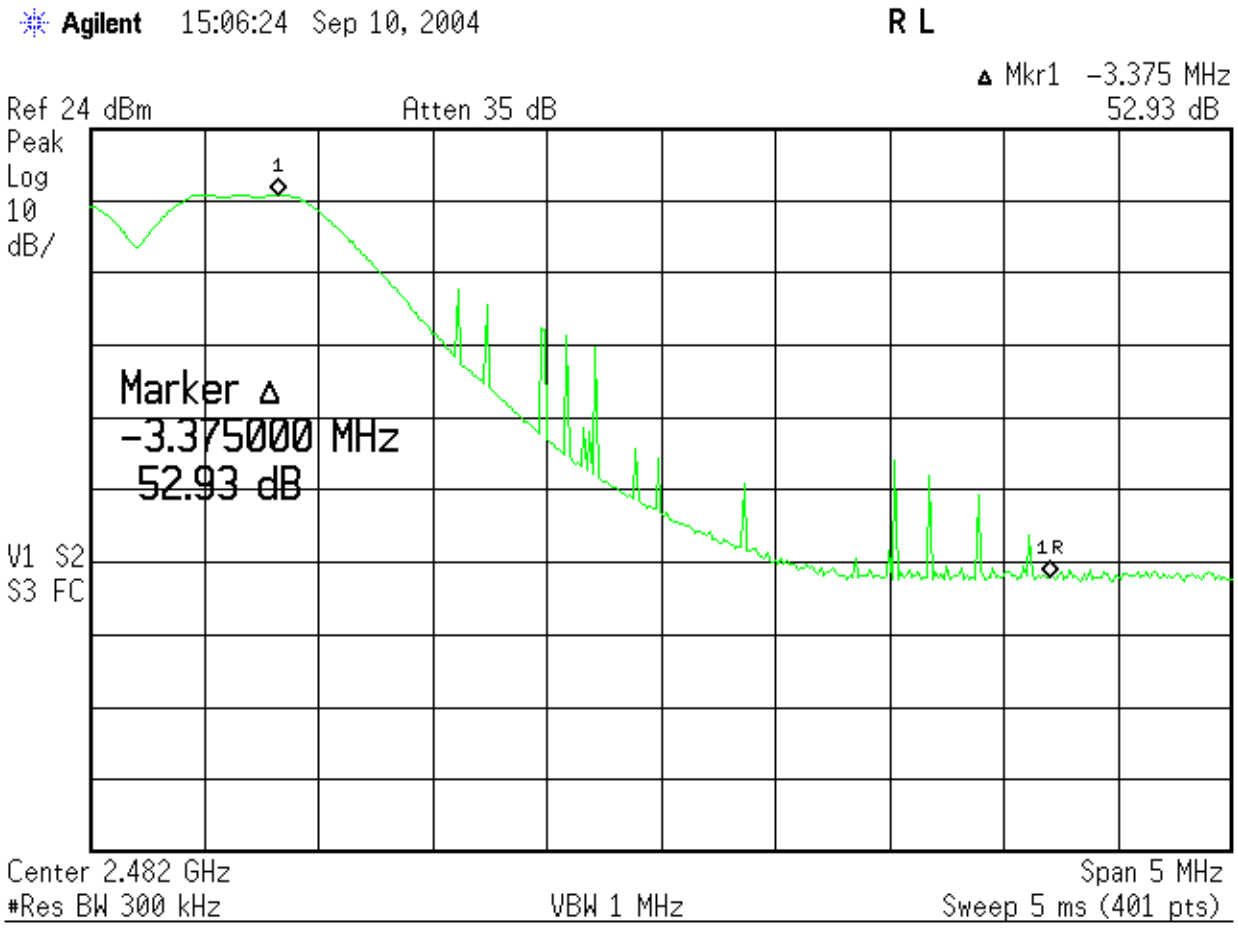
Low Band Edge – Hopping Enabled



High Band Edge – Hopping Disabled



High Band Edge – Hopping Enabled



Radiated Band Edge

LIMIT

"…radiated emissions which fall in the restricted bands, as defined in §15.209(a), must also comply with the radiated emission limits specified in §15.209(a)" [15.247(c)]

MEASUREMENTS

Radiated Band Edge (Restricted Band) — *Curtis-Straus LLC*

Date: 08-Sep-04 **Company:** Voxware **Work Order:** E0056
Engineer: Evan Gould **EUT Desc:** VLS-410 w/ Symbol card

Frequency Range: 2483.5MHz **Measurement Distance:** 1 m
Detector: Peak **RBW:** 1MHz
Notes: the marker-delta method was used for these measurements **VBW:** 3MHz (10Hz for average)

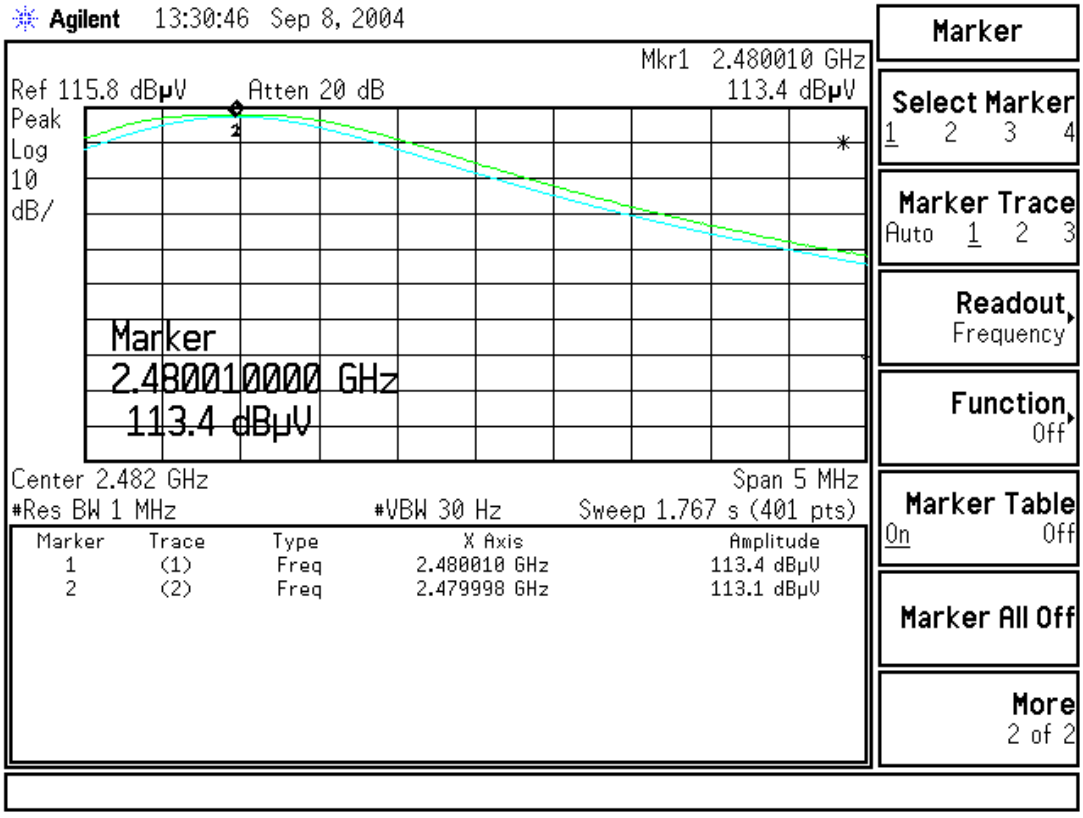
Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	47 CFR 15.209 Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
Hpk	2483.5	44.2	18.4	29.8	2.0	57.6	83.5	-25.9	Pass
Hav	2483.5	43.9	18.4	29.8	2.0	57.3	63.5	-6.2	Pass

Table Result: Pass by -6.2 dB ***Worst Freq:*** 2483.5 MHz

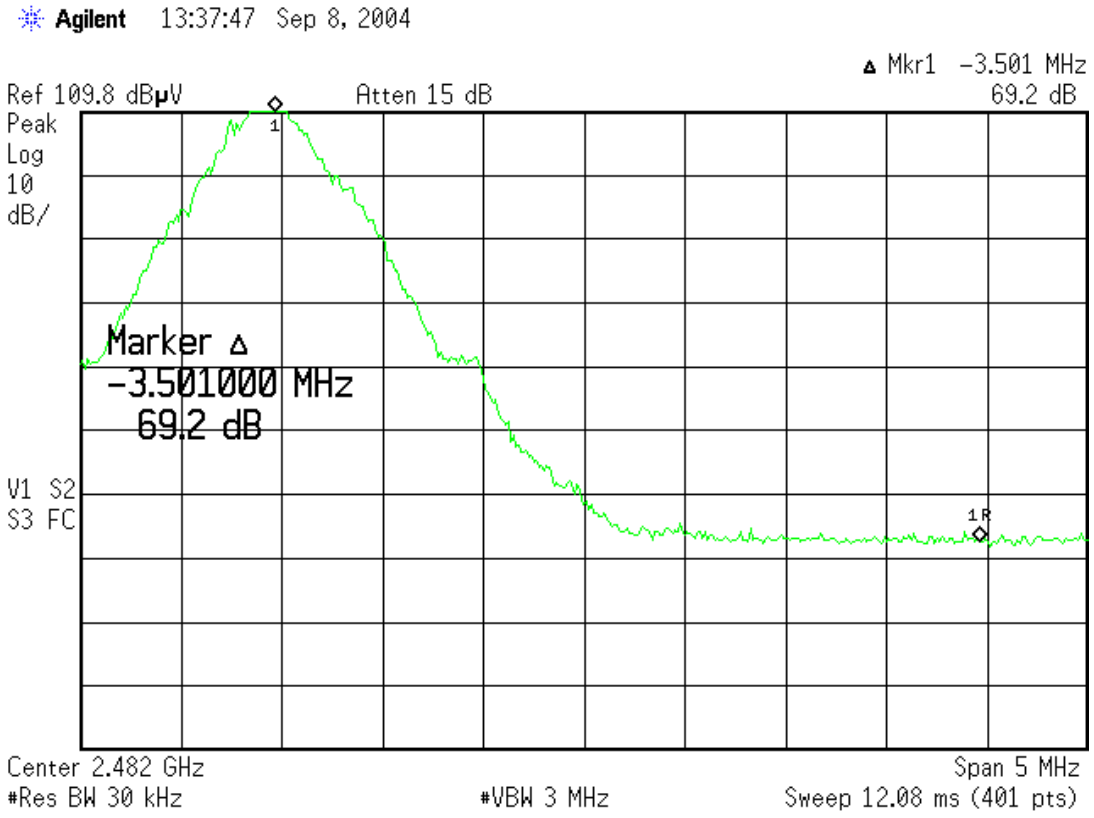
Test Site: "T" **Pre-Amp:** White **Cable:** 6 RG142LL **Analyzer:** Orange **Antenna:** Orange Horn

ANALYZER PLOTS

Peak Values



Marker-Delta



Radiated Spurious Emissions

LIMITS

"…radiated emissions which fall in the restricted bands, as defined in §15.209(a), must also comply with the radiated emission limits specified in §15.209(a)" [15.247(c)]

MEASUREMENTS

Radiated Emissions Table — *Curtis-Straus LLC*

Date: 09-Sep-04 9/17/2004 **Company:** Voxware **Work Order:** E0056
Engineer: Evan Gould **EUT Desc:** VLS-410 w/ 100mW Symbol card

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

Notes: hopping is enabled **RBW:** 120kHz
EUT is transmitting and receiving **VBW:** 300kHz

Antenna Polarization (H / V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	47 CFR 15.209 Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
Vbb	129.0	40.3	22.2	8.0	1.5	27.6	43.5	-15.9	Pass
Vbb	145.1	38.6	22.3	10.3	1.6	28.2	43.5	-15.3	Pass
V	165.9	51.3	22.2	9.4	1.7	40.2	43.5	-3.3	Pass
Hopping Disabled									
transmitting on 2402MHz									
V	169.0	45.8	22.3	10.1	1.7	35.3	43.5	-8.2	Pass
transmitting on 2440MHz									
V	169.0	45.7	22.3	10.1	1.7	35.2	43.5	-8.3	Pass
transmitting on 2480MHz									
V	169.0	47.5	22.3	10.1	1.7	37.0	43.5	-6.5	Pass
Hopping Enabled									
V	184.3	38.6	22.1	9.6	1.8	27.9	43.5	-15.6	Pass
Hbb	360.0	38.6	21.9	15.6	2.7	35.0	46.0	-11.0	Pass
H	420.0	46.7	21.9	16.9	3.0	44.7	46.0	-1.3	Pass

Table Result: Pass by -1.3 dB ***Worst Freq:*** 420.0 MHz

Test Site: "T" **Pre-Amp:** Black **Cable:** 65 ft RG8A/U **Analyzer:** Yellow **Antenna:** Blue
Test Site: "A" **Pre-Amp:** Blue **Cable:** 66 ft RG8A/U **Analyzer:** Green **Antenna:** Blue-Wht

Note: No radiated spurious emissions were detected in the range 1 – 26.5GHz.

Test Equipment Used

REV. 17-SEP-2004

SPECTRUM ANALYZERS	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	30-SEP-2004
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	02-DEC-2004
ORANGE	9kHz-26.5GHz	E4407B	HP	US39440975	00394	03-JUN-2005

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

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	PASTERNACK	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

ANTENNAS	RANGE	MN	MFR	SN	ASSET	CALIBRATION DUE
GREEN BILOG	30MHz-2GHz	CBL6112B	CHASE	2742	00620	06-APR-2006
GREEN-BLACK BILOG	30MHz-2GHz	CBL6112B	CHASE	2412	00127	06-JAN-2006
GREEN-RED BILOG	30MHz-2GHz	CBL6112B	CHASE	2435	00990	06-APR-2006
BLUE-WHITE BILOG	30MHz-2GHz	3142B	EMCO	1527	TELOGY RENTAL	03-AUG-2006
RED BILOG	30MHz-1GHz	3143	EMCO	1270	00042	17-MAR-2005
BLUE BILOG	30MHz-1GHz	3143	EMCO	1271	00803	17-MAR-2005
GRAY BILOG	26MHz-2GHz	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)
YELLOW HORN	1-18GHz	3115	EMCO	9608-4898	00037	22-MAY-2005
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

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, 2005 Certificate Number: 1627-01

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

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

EMC Standards	Title
Emissions	
CISPR 22 1997 with amendments 1 and 2	Limits and methods of measurement of radio disturbance characteristics of information technology equipment.
CNS13438 1994	Limits and methods of measurement of radio interference characteristics of information technology equipment.
EN55022:1994 and 1998	Limits and methods of measurement of radio disturbance characteristics of information technology equipment.
SABS CISPR 22:1997	Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
Canada ICES-003 1997	Digital apparatus
AS/NZS 3548 1995	Australian/New Zealand Standard Limits and methods of measurement of radio disturbance characteristics of information technology equipment
CISPR 11 1990, 1997, 1999	Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.
EN 55011 1991, 1998	Limits and methods of measurement of radio disturbance
characteristics of	industrial, scientific and medical (ISM) radio-frequency equipment.
SABS CISPR 11:1997	Industrial, scientific and medical (ISM) radio-frequency equipment – Electromagnetic disturbance characteristics Limits and methods of measurement
Canada ICES-001 1998	Industrial, scientific and medical radio frequency generators
CNS13803	Industrial, Scientific and Medical Instrument
AS/NZS 2064: 1997	Limits and methods of measurement of electromagnetic disturbance characteristics of industrial, scientific and medical (ISM) radio-frequency equipment.
CSA C108.8 – M1983	Electromagnetic Emission from Data Processing Equipment and Electronic Office Machines
CISPR 13:1996, 1998, 2001	Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment.
EN 55013: 1990, 2001	Sound and television broadcast receivers and associated equipment: Electromagnetic compatibility. Part 1: Specification for limits and methods of measurement of radio disturbance characteristics of broadcast receivers and associated equipment.
EN 55013 Amend 12 1994	Limits and methods of measurement of radio disturbance characteristics of broadcast receivers and associated equipment. Amendment 12
SABS CISPR 13: 1996	Limits and methods of measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment.
CNS 13439	Broadcast receiver and associated equipment Limits and methods of
AS/NZS 1053: 1999	measurement of radio interference characteristics of sound and television broadcast receivers and associated equipment.
CISPR 14 1993	Limits and methods of measurement of radio disturbance
(*except discontinuous disturbances*)	characteristics of electrical motor- operated and thermal appliances for household and similar purposes, electric tools and electric apparatus.
EN 55014 1993, 1997	Limits and methods of measurement of radio disturbance (*except*
discontinuous disturbances)	characteristics of electrical motor- operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus.
AS/NZS 1044: 1995	Limits and methods of measurement of radio disturbance (*except*
discontinuous disturbances)	characteristics of electrical motor- operated and thermal appliances for household and similar purposes, electric tools and similar electric apparatus.
Immunity	
CNS13783-1	Household Electrical Appliances
SABS CISPR 14-1 1993	Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus Part 1: Emission – Product family standard
SABS CISPR 14-2 1997 + A1:2001	Electromagnetic compatibility – Requirements for household appliances, electric tools and similar apparatus Part 2: Immunity - Product family standard
CISPR 14-2 1996, 1997 + A1:2001	Immunity requirements for household appliances, tools and similar apparatus.
CISPR 20: 1995, 2002 with amendment 3	Limits and methods of measurement of immunity characteristics
(*associated group only*)	of sound and television broadcast receivers and associated equipment.
EN 55020: 1995, 2002	Electromagnetic immunity of broadcast receivers and
(*associated group only*)	Associated equipment.
CISPR 24	Information technology equipment – Immunity characteristics – Limits and methods of measurement
SABS CISPR 24 1997	Information technology equipment – Immunity characteristics – Limits and methods of measurement
AS/NZS 3200.1.2: 1995	Approval and test specification – Medical electrical Equipment – General requirements for safety – Collateral Standard: Electromagnetic compatibility – Requirements and tests.
European Union Basic EMC Standards	
EN 61000-4-2: 1995, 1999, 2001	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 2: Electrostatic discharge immunity test – Basic EMC Publication
EN 61000-4-3:1997, 1998, 2002	Electromagnetic compatibility (EMC). Part 4: Testing and
AS/NZS 61000.4.3 1999	measurement techniques. Section 3: Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4 1995	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 4: Electrical fast transient/burst immunity test – Basic EMC publication
EN 61000-4-5 1995	(EMC) Part 4: Testing and measurement techniques. Section 5:
AS/NZS 61000.4.5 1999	Surge immunity test.
EN 61000-4-6 1996	Electromagnetic compatibility (EMC). Part 4: Testing
AS/NZS 61000.4.6 1999	and measurement techniques. Section 6: Immunity to conducted disturbances, induce by radio-frequency fields.
EN 61000-4-8 1994	Electromagnetic compatibility (EMC). Part 4: Testing and measurement techniques. Section 8: Power frequency magnetic field immunity test.
EN 61000-4-11 1994	(EMC) Part 4: Testing and measurement techniques. Section 11: Voltage dips, short interruptions and voltage Variations immunity tests.
ENV 61000-2-2 1993	Electromagnetic compatibility (EMC). Part 2: Environment, Section 2: Compatibility levels for low-frequency conducted disturbances and signaling in public low-voltage power supply systems (IEC 1000-2-2:1990)
EU Product Family Standards	
EN 50081-1 1992	Electromagnetic capability – Generic emission standard. Part 1: Residential, commercial and light industry. (I.S.)
EN 50081-2 1993	Electromagnetic compatibility – Generic emission standard. Part 2: Industrial environment
EN 50082-1 1992, 1998	Electromagnetic compatibility – Generic emission standard. Part 1: Residential, commercial and light industry
EN 50082-2 1995	Electromagnetic compatibility – Generic immunity Standard. Part 2: Industrial environment
EN 61000-6-1: 1997, 2001	Electromagnetic Compatibility (EMC)- Part 6: Generic standards- Section 1: Immunity for residential, commercial and light-industrial environments
EN 61000-6-2: 1998, 2001	Electromagnetic Compatibility (EMC)- Part 6: Generic standards- Section 2: Immunity for industrial environments
EN 50091-2 1996	Specification for Uninterruptible Power Systems (UPS). Part 2: EMC requirements
EN 55024 1998	Information technology equipment – Immunity Characteristics – Limits and methods of measurement.
EN 55103-1 1997	Electromagnetic Compatibility – Product family standard for audio, video, audio-visual and entertainment lighting control apparatus for professional use. Part 1: Emission
EN 55103-2 1997	Electromagnetic Compatibility – Product family standard for audio,
(*excluding Annex A3*)	video, audio-visual and entertainment lighting control professional use. Part 2: Immunity
EN 61326 1998	Electrical equipment for measurement, control and laboratory use – EMC requirements
EN 61547 1996	Equipment for general lighting purposes – EMC immunity requirements
EN 50130-4 1996	Alarm Systems. Part 4: Electromagnetic compatibility. Product family standard: Immunity requirements for components of fire, intruder and social alarm systems.
EN 55104 1995	Electromagnetic compatibility immunity – requirements for household appliances, tools and similar apparatus. Product family standard.
EN 50083-2 1995	Cabled distribution systems for television and sound signals. Part 2: Electromagnetic compatibility for equipment.
EN 60601-1-2: 1993, 2002	Medical electrical equipment Part 1: general requirements for safety Section 2: Collateral standard: Electromagnetic compatibility – requirements and tests
IEC 1800-3 1995	Adjustable speed electrical power drive systems. Part 3: EMC product standard including specific test methods.
EN 60555 Part 2 1987	Disturbances in supply systems caused by household appliances and similar electrical equipment. Part 2: Harmonics
EN 60555 Part 3 1987	Disturbances in supply systems caused by household appliances and similar electrical equipment. Part 3: Voltage fluctuations.
EN 61000-3-2: 1995, 2000	Electromagnetic compatibility (EMC). Part 3: Limits Section 2: Limits
AS/NZS 61000.3.2 1998	for harmonic current emissions
EN 61000-3-3 1995	Electromagnetic compatibility (EMC). Part 3: Limits Section 2:
AS/NZS 61000.3.3 1999	Limitation of voltage fluctuations and flicker in low-voltage supply systems.
ETS 300 386-1 1994	Equipment Engineering (EE); Public telecommunication network equipment electro-magnetic compatibility (EMC) requirements Part 1: Product family overview, compliance criteria and test levels

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

ACCREDITED Cert No. 1627-01

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

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

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

Telecommunications

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

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

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

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

Product Safety

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

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

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

Environmental [2]

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

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