





Curtis-Straus LLC, a wholly owned subsidiary of BV CPS

Test Report

Report No	EM2102-14
Client	Balluff, Inc. Jim Ramler
Address	8125 Holton Drive Florence, KY 41042
Phone	(859) 727 - 2200
Items tested	BIS L-400-035-001-00-S115
Standards	47 CFR FCC Part 15.207, 47 CFR FCC Part 15.209, RSS GEN
Test Dates	June 13, July 11 and August 2, 2013
Results	As detailed within this report
Prepared by	 Tuyen Truong A. – Test Engineer
Authorized by	 Arik Zwirner – EMC Senior Engineer
Issue Date	June 27, 2014
Conditions of Issue	This Test Report is issued subject to the conditions stated in the 'Conditions of Testing' section on page 26 of this report.

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



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REV 14-AUG-13 (SC)

Regulatory Information

FRN number	0006334478
FCC ID	HLH-BISL40000
IC	NA

Issue No.	Reason for change	Date Issued
1	Original Release	June 27, 2014

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Summary

On June 13, July 11 and August 2, 2013 we tested the BIS L-400-035-001-00-S115 for compliance with the following requirements:

EMC Emissions:

- CFR 47 FCC Part 15.207 – Conducted limits
- CFR 47 FCC Part 15.209 - Radiated emission limits; general requirements
- RSS GEN - General Requirements and Information for the Certification of Radio Apparatus

Product is an RFID system which operates at 125 KHz. EUT emissions were maximized by rotating product around its axis and around 3 orthogonal axes. EUT antenna could not be maximized separately.

AC Mains conducted emissions was performed on AC side of AC/DC power supply (support equipment) power supply.

We found that the product met the above requirements without modification. The test sample was received in good condition. The sample was received on June 13, 2013.

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Product Tested**Configuration Documentation**

EUT Configuration														
Work Order: M2102 Company: Balluff, Inc. Company Address: 8125 Holton Drive Florence, KY 41042 Contact: Jim Ramler														
MN					SN									
EUT: BIS L-400-035-001-00-S115 EUT Description: Non-Contact Read/Write System EUT Max Frequency: <108MHz EUT TX Frequency: 125KHz					Sample 1									
Support Equipment:					MN					SN				
Sunny Switching Adapter					SYS1357-2424					--				
Dell PC					1116					Not Labeled				
Dell Monitor					E773c					Not Labeled				
IBM Keyboard					SK8815					00613630				
Lenovo Mouse					M-UAE119					Not Labeled				
Tag					BIS C-150-32/A					--				
EUT Ports:														
Port Label	Port Type	No. of ports	No. Populated	Cable Type	Shielded	Ferrites	Length	Max Length	In/Out NEBS Type	Unpopulated Reason				
Power/COM	8-pin Power/COM	1	1	8-wires to DB9	yes	None	1m	na	indoor					
Software / Operating Mode Description:														
Powered on at 24VDC and transmits in 100-150kHz range														

Compliance Statement

TEST	RESULT	STANDARD	TEST LEVEL	MARGIN	COMMENTS
Radiated Emissions	PASS	47 CFR FCC Part 15.209, RSS GEN Section 7.2.5	FCC 15.209	-5.2dB @ 82.65MHz	
AC Mains Conducted Emissions	PASS	47 CFR FCC Part 15.207, RSS GEN Section 7.2.4	FCC 15.207	-16.7dB @ 0.539MHz	AC side of support DC Power Supply tested
Occupied Bandwidth	DONE	Industry Canada	RSS 210		

Modifications Required for Compliance

There were no modifications required for compliance.

RADIATED EMISSIONS**Test Method:**

In accordance with the following:

- CFR 47 FCC Part 15.209
- RSS GEN Section 7.2.5

Results:

TEST	RESULT	TEST LEVEL	MARGIN	COMMENTS
<i>Radiated Emissions</i>	PASS	FCC 15.209	-5.2dB @ 82.65MHz	

Radiated Emissions Data Table(s):

Radiated Emissions Table												
Date: 02-Aug-13			Company: Balluff, Inc.						Work Order: M2102			
Engineer: Arik Zwimer			EUT Desc: BIS L-400-035-001-00-S115						EUT Operating Voltage/Frequency: 24VDC			
Temp: 24°C			Humidity: 42%			Pressure: 1010mBar						
Frequency Range: 125kHz - Fundamental Frequency								Measurement Distance: 1 m				
Notes:												
Antenna Polarization (0° - 90°)	Frequency (MHz)	Reading (dBμV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBμV/m)	---			FCC 15.209		
							Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)
							0	0.125	44.5	0.0	50.0	0.1
90	0.125	43.7	0.0	50.0	0.1	93.8	---	---	---	124.7	-30.9	Pass
Table Result: Pass						by -30.1 dB		Worst Freq: 0.125 MHz				
Test Site: 1DCC-OATS-3M-II				Cable 1: EMIR-13				Cable 2: ---			Cable 3: ---	
Analyzer: Gold				Preamp: none				Antenna: Lg Loop			Preselector: ---	

Rev.7/25/2013

Spectrum Analyzers / Receivers / Preselectors		Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Gold		100Hz-26.5 GHz	E4407B	Agilent	MY45113816	1284	I	3/18/2014
Radiated Emissions Sites		FCC Code	IC Code	VCCI Code	Range		Cat	Calibration Due
1DCC-OATS-3M-II		719150	2762A-10	A-0015	30-1000MHz		II	5/11/2015
Antennas		Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Large Loop		20Hz-5MHz	6511	EMCO	9704-1154	67	I	4/27/2014
Cables		Range		Mfr			Cat	Calibration Due
REMI-13		9kHz - 2GHz		C-S			II	10/15/2013
Meteorological Meters			MN	Mfr	SN	Asset	Cat	Calibration Due
Temp./Humidity/Atm. Pressure Gauge			7400 Perception II	Davis	N/A	965	I	5/29/2014

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

Radiated Emissions Table												
Date: 11-Jul-13			Company: Balluff, Inc.						Work Order: M2102			
Engineer: Nirak So			EUT Desc: BIS L-400-035-001-00-S115						EUT Operating Voltage/Frequency: 24VDC			
Temp: 24°C			Humidity: 33%			Pressure: 1005mBar						
Frequency Range: 9KHz to 1MHz								Measurement Distance: 3 m				
Notes:								EUT Max Freq: 125KHz				
Antenna Polarization (0° - 90°)	Frequency (MHz)	Reading (dBμV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBμV/m)	---			FCC 15.209		
							Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)
0	0.125	44.5	22.5	50.0	0.1	72.1				105.7	-33.6	pass
0	0.065	38.0	21.9	52.7	0.0	68.8				111.3	-42.5	pass
0	0.1	28.8	22.4	50.3	0.1	56.8				107.6	-50.8	pass
90	0.125	43.3	22.5	50.0	0.1	70.9				105.7	-34.8	pass
90	0.0684	39.0	22.0	52.4	0.0	69.4				111.0	-41.6	pass
Table Result: Pass by -33.6 dB Worst Freq: 0.125 MHz												
Test Site: EMI Chamber 2			Cable 1: Asset #1781				Cable 2: Asset #1785			Cable 3: ---		
Analyzer: Asset #1328			Preamp: Blue				Antenna: Lq Loop			Preselector: ---		



Rev.6/16/2013

Spectrum Analyzers / Receivers / Preselectors SA EMI Chamber (1328)	Range 9kHz-13.2 GHz	MN E4405B	Mfr Agilent	SN MY44210241	Asset 1328	Cat I	Calibration Due 12/19/2013
Radiated Emissions Sites EMI Chamber 2	FCC Code 719150	IC Code 2762A-7	VCCI Code A-0015	Range 30-1000MHz		Cat II	Calibration Due 2/15/2014
Preamps / Couplers Attenuators / Filters Blue	Range 0.009-2000MHz	MN ZFL-1000-LN	Mfr CS	SN N/A	Asset 759	Cat II	Calibration Due 5/31/2014
Antennas Large Loop	Range 20Hz-5MHz	MN 6511	Mfr EMCO	SN 9704-1154	Asset 67	Cat I	Calibration Due 4/27/2014
Cables Asset #1781 Asset #1785	Range 9kHz - 18GHz 9kHz - 18GHz		Mfr Florida RF Florida RF			Cat II II	Calibration Due 3/6/2014 3/14/2014
Meteorological Meters Weather Clock (Pressure Only) CHAMBER2 Thermohygrometer		MN BA928 35519-044	Mfr Oregon Scientific Control Company	SN C3166-1 72457639	Asset 831 1347	Cat I II	Calibration Due 3/20/2014 8/19/2013

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

Radiated Emissions Table

Date: 11-Jul-13			Company: Balluff Inc.			Work Order: M2102							
Engineer: Nirak So			EUT Desc: BIS L-400-035-001-00-S115			EUT Operating Voltage/Frequency: 24VDC							
Temp: 24°C			Humidity: 33%			Pressure: 1005mBar							
Frequency Range: 1 - 30MHz						Measurement Distance: 3 m							
Notes:						EUT Max Freq: <108MHz							
Antenna Polarization (0° - 90°)	Frequency (MHz)	Reading (dBμV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBμV/m)	---			FCC 15.209			
							Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBμV/m)	Margin (dB)	Result (Pass/Fail)	
0	6.72	14.3	22.5	42.2	0.2	34.2	---	---	---	69.5	-35.3	pass	
90	14.55	22.6	22.5	38.8	0.3	39.2	---	---	---	69.5	-30.3	pass	
0	24.63	13.0	22.5	37.8	0.4	28.7	---	---	---	69.5	-40.8	pass	
90	28.11	22.6	22.5	37.0	0.4	37.5	---	---	---	69.5	-32.0	pass	
Table Result: Pass						by -30.3 dB		Worst Freq: 14.55 MHz					
Test Site: EMI Chamber 2			Cable 1: Asset #1781			Cable 2: Asset #1785			Cable 3: ---				
Analyzer: Asset #1328			Preamp: Blue			Antenna: Sm Loop (high)			Preselector: ---				

Rev.6/16/2013

Spectrum Analyzers / Receivers / Preselectors SA EMI Chamber (1328)	Range 9kHz-13.2 GHz	MN E4405B	Mfr Agilent	SN MY44210241	Asset 1328	Cat I	Calibration Due 12/19/2013
Radiated Emissions Sites EMI Chamber 2	FCC Code 719150	IC Code 2762A-7	VCCI Code A-0015	Range 30-1000MHz		Cat II	Calibration Due 2/15/2014
Preamps / Couplers Attenuators / Filters Blue	Range 0.009-2000MHz	MN ZFL-1000-LN	Mfr CS	SN N/A	Asset 759	Cat II	Calibration Due 5/31/2014
Antennas Small Loop	Range 10kHz-30MHz	MN PLA-130/A	Mfr ARA	SN 1024	Asset 755	Cat I	Calibration Due 4/27/2014
Cables Asset #1781 Asset #1785	Range 9kHz - 18GHz 9kHz - 18GHz		Mfr Florida RF Florida RF			Cat II II	Calibration Due 3/6/2014 3/14/2014
Meteorological Meters Weather Clock (Pressure Only) CHAMBER2 Thermohygrometer		MN BA928 35519-044	Mfr Oregon Scientific Control Company	SN C3166-1 72457639	Asset 831 1347	Cat I II	Calibration Due 3/20/2014 8/19/2013

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



Radiated Emissions Table

Date: 14-Jun-13		Company: Balluff, Inc.				Work Order: M2102						
Engineer: Chris Bramley		EUT Desc: BIS L-400-035-001-00-S115				EUT Operating Voltage/Frequency: 24Vdc						
Temp: 24.8°C		Humidity: 23%		Pressure: 998mBar								
Frequency Range: 30-1000MHz						Measurement Distance: 3 m						
Notes:						EUT Max Freq: 125KHz						
Antenna Polarization (H/V)	Frequency (MHz)	Reading (dBµV)	Preamp Factor (dB)	Antenna Factor (dB/m)	Cable Factor (dB)	Adjusted Reading (dBµV/m)	---			FCC 15.209		
							Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)	Limit (dBµV/m)	Margin (dB)	Result (Pass/Fail)
v	30.0	32.7	25.5	21.2	0.5	28.9	---	---	---	40.0	-11.1	Pass
v	30.63	34.4	25.5	20.6	0.5	30.0	---	---	---	40.0	-10.0	Pass
v	43.67	37.6	25.5	11.2	0.5	23.8	---	---	---	40.0	-16.2	Pass
v	55.52	42.3	25.5	7.1	0.6	24.5	---	---	---	40.0	-15.5	Pass
v	82.65	51.9	25.3	7.5	0.7	34.8	---	---	---	40.0	-5.2	Pass
h	184.1	49.5	25.1	10.6	0.9	35.9	---	---	---	43.5	-7.6	Pass
h	222.6	48.2	25.2	10.5	1.1	34.6	---	---	---	46.0	-11.4	Pass
h	260.1	49.3	25.1	12.0	1.3	37.5	---	---	---	46.0	-8.5	Pass
h	286.6	49.4	25.1	13.2	1.2	38.7	---	---	---	46.0	-7.3	Pass
h	317.4	48.0	25.1	13.7	1.2	37.8	---	---	---	46.0	-8.2	Pass
h	372.4	42.2	25.1	15.0	1.4	33.5	---	---	---	46.0	-12.5	Pass
Table Result: Pass						by	-5.2 dB			Worst Freq: 82.65 MHz		
Test Site: EMI Chamber 1		Cable 1: Asset #1781				Cable 2: Asset #1785						
Analyzer: Asset #1328		Preamp: Red				Antenna: Red-Black						

Rev.6/3/2013

Spectrum Analyzers / Receivers / Preselectors		Range	MN	Mfr	SN	Asset	Cat	Calibration Due
SA EMI Chamber (1328)		9kHz-13.2 GHz	E4405B	Agilent	MY44210241	1328	I	12/19/2013
Radiated Emissions Sites		FCC Code	IC Code	VCCI Code	Range		Cat	Calibration Due
EMI Chamber 1		719150	2762A-6	A-0015	30-1000MHz		II	2/16/2014
Preamps / Couplers Attenuators / Filters		Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Red		0.009-2000MHz	ZFL-1000-LN	CS	N/A	798	II	2/2/2014
Antennas		Range	MN	Mfr	SN	Asset	Cat	Calibration Due
Red-Black Bilog		30-2000MHz	JB1	Sunol	A091604-2	1106	I	1/28/2015
Cables		Range		Mfr			Cat	Calibration Due
Asset #1781		9kHz - 18GHz		Florida RF			II	3/6/2014
Asset #1785		9kHz - 18GHz		Florida RF			II	3/14/2014
Meteorological Meters			MN	Mfr	SN	Asset	Cat	Calibration Due
Weather Clock (Pressure Only)			BA928	Oregon Scientific	C3166-1	831	I	3/20/2014
CHAMBER1 Thermohygrometer			35519-044	Control Company	72457642	1345	II	8/19/2013

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

Radiated Emissions Modifications:

None



Radiated Emissions Testing Overview

REV 10-APR-09

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

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

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

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

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

The test site used for measuring radiated emissions follows the format developed internationally for a weather protected Open Area Test Site (OATS). The test site used for measuring radiated emissions above 1GHz for CISPR limits is a Free Space Open Area Test Site (FSOATS). An antenna mast is installed at the specified distance from a rotating table and



is used to raise and lower the measuring antenna. The reference site is clear of reflecting objects, such as metal fences and buildings for an ellipse of twice the measurement test distance. Measuring equipment and personnel are present within the ellipse to facilitate cable manipulation, but measures are taken to minimize the effects. Often preliminary radiated emissions measurements are made at alternate test sites which do not meet the clear space reference criteria. The data collected at alternate test sites is not considered conclusive unless the alternate site also complies with a volumetric site attenuation survey performed over the area that the EUT occupies. The EUT and measuring antenna mark the two foci of the ellipse. The ground plane is made of a combination of galvanized steel sheets and tight wire mesh electrically connected along the seams. This metal ground plane extends 1 meter beyond the furthest extent of the EUT and the measuring antenna. It also covers the area between the EUT and the measuring antenna. The hardware cloth is connected to the utility ground or to stakes driven into the earth for safety. The site configuration for CISPR testing above 1GHz is a semi-anechoic chamber. The ground plane in the test volume is covered by an absorbing material between the antenna and the EUT. In the case of table top equipment, the absorbing material is also placed under the table. In the case of floor-standing equipment the absorbing material extends up from the ground plane 30cm into the test volume, and surrounds the EUT by at most 10cm from the footprint of the equipment.

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

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

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

The Equipment Under Test (EUT) is rotated in order to maximize emissions during the test. For equipment intended to operate on a tabletop or desk radiated tests are conducted on a 0.8 meter high, non-conductive platform. Larger floor standing equipment is tested on a floor



mounted rotatable platform. In some cases, large equipment on its own casters may be tested without a platform.

Since radiated emissions are a function of cable placement, the cable placement is varied to encompass typical configurations that an end user might encounter to determine the configuration resulting in maximum emissions. At least one cable for each I/O port type is attached to the EUT. If peripherals or modules are available, at least one of each available type is installed and noted in the report. Excess cable length beyond one meter is bundled in the center into a 30 to 40 cm bundle. Cables requiring non-standard lead dress are recorded in the report.

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

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

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

FCC and European Norms Radiated Emissions Limits at 10 meters					
Frequency (MHz)	FCC Class A	FCC Class B	CISPR Class A	CISPR Class B	Frequency (MHz)
30-88	39.1	29.5	40	30	30-88
88-216	43.5	33.1	40	30	88-216
216-230	46.4	35.6	40	30	216-230
230-960	46.4	35.6	47	37	230-960
960-1000	49.5	43.5	47	37	960-1000
1000-3000	Avg: 49.5 Peak: 69.5	Avg: 43.5 Peak: 63.5	Not defined	Not defined	1000-3000
3000+	Avg: 49.5 Peak: 69.5	Avg: 43.5 Peak: 63.5	Not defined	Not defined	3000+
<p>At the transitions, the lower limit applies. Simple inverse scaling utilized to convert limits where appropriate.</p>					

FCC and European Norms Radiated Emissions Limits at 3 meters					
Frequency (MHz)	FCC Class A	FCC Class B	CISPR Class A	CISPR Class B	Frequency (MHz)
30-88	49.5	40	50.5	40.5	30-88
88-216	54	43.5	50.5	40.5	88-216
216-230	56.9	46	50.5	40.5	216-230

230-960	56.9	46	57.5	47.5	230-960
960-1000	60	54	57.5	47.5	960-1000
1000-3000	Avg: 60 Peak: 80	Avg: 54 Peak: 74	Avg: 56 Peak: 76	Avg: 50 Peak: 70	1000-3000
3000+	Avg: 60 Peak: 80	Avg: 54 Peak: 74	Avg: 60 Peak: 80	Avg: 54 Peak: 74	3000+
At the transitions, the lower limit applies. Simple inverse scaling utilized to convert limits where appropriate.					

The measurement range is based on the highest frequency signal present or used in the device. The following table details the frequency range of measurements performed.

Frequency range of radiated emissions measurements		
Highest frequency generated or used in the device or on which the device operates or tunes (MHz)	Upper frequency of measurement range (MHz)	
	FCC	EU/CISPR
Below 1.705	30 (No radiated measurements)	1000
1.705-108	1000	1000
108-500	2000	2000
500-1000	5000	5000
Above 1000	5 th harmonic of the highest frequency 40 GHz whichever is lower.	5 th harmonic of the highest frequency 6 GHz whichever is lower.

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

$$\text{Field Strength (dBuV/m)} = \text{Voltage Reading (dBuV)} - \text{Preamp Gain (dB)} + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

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

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



CONDUCTED EMISSIONS**Test Method:**

In accordance with the following:

- CFR 47 FCC Part 15.207
- RSS GEN Section 7.2.4

Results:

TEST	RESULT	TEST LEVEL	MARGIN	COMMENTS
<i>AC Mains Conducted Emissions</i>	PASS	FCC 15.207	-16.7dB @ 0.539MHz	AC side of support DC Power Supply tested
<i>DC Mains Conducted Emissions</i>	N/A	FCC 15.207	N/A	EUT support Power Supply is AC powered

Conducted Emissions Data Table(s):

AC Conducted Emissions Data Table														
Date: 19-Sep-13						Company: Balluff, Inc.				Work Order: M2102				
Engineer: Doug Cormier						EUT Desc: BIS L-303-S115				Pressure: 1008 mBar				
Temp: 20.2 °C						Humidity: 45%								
Notes: BIS004Y L-303-S115														
Frequency Range: .15-30MHz										EUT Input Voltage/Frequency: 24Vdc				
Frequency (MHz)	Quasi-Peak Readings		Average Readings		LISN Factors		Cable Factor	ATTN Factor	FCC 15.207			FCC 15.207		
	QP1 (dBµV)	QP2 (dBµV)	AVG1 (dBµV)	AVG2 (dBµV)	L1 (dB)	L2 (dB)			OP Limit (dBµV)	Margin (dB)	Result (Pass/Fail)	AVG Limit (dBµV)	Margin (dB)	Result (Pass/Fail)
0.18	11.2	16.0	9.8	10.1	-0.1	-0.1	-0.2	-20.2	64.5	-28.0	Pass	54.5	-23.9	Pass
0.54	9.6	13.0	8.6	8.9	0.0	0.0	-0.2	-20.2	56.0	-22.6	Pass	46.0	-16.7	Pass
0.88	9.6	12.0	8.0	8.3	0.0	0.0	-0.2	-20.2	56.0	-23.6	Pass	46.0	-17.3	Pass
2.79	8.0	13.0	7.1	7.8	0.0	0.0	-0.2	-20.2	56.0	-22.5	Pass	46.0	-17.7	Pass
15.30	2.3	4.8	-2.0	-2.2	-0.1	-0.1	-0.3	-20.2	60.0	-34.6	Pass	50.0	-31.4	Pass
25.30	2.1	6.6	-2.5	-2.4	-0.1	-0.1	-0.3	-20.2	60.0	-32.8	Pass	50.0	-31.8	Pass
Result: Pass						Worst Margin: -16.7 dB				Frequency: 0.539 MHz				
Measurement Device: LISN ASSET 1729(Line 1) LISN ASSET 1730(Line 2)						Cable: CEMI-02				Spectrum Analyzer: Blue				
						Attenuator: 20dB ATTEN-03				Site: CEMI3				
C-S CEMi Calculator Version 3.0.12														
Equipment Factor Sheet rev: 9/11/2013														

C-S CEMI Calculator Version 3.0.12

Equipment Factor Sheet rev: 9/11/2013

Rev.9/10/2013

Spectrum Analyzers / Receivers / Preselectors

Blue

Range	MN	Mfr	SN	Asset	Cat	Calibration Due
0.009-2000MHz	ZFL-1000-LN	CS	N/A	759	II	5/31/2014

LISNs/Measurement Probes

LISN Asset 1729

LISN Asset 1730

Range	MN	Mfr	SN	Asset	Cat	Calibration Due
150kHz-30MHz	LI-150A	Com-Power	201085	1729	I	1/28/2014
150kHz-30MHz	LI-150A	Com-Power	201090	1730	I	2/14/2014

Conducted Test Sites (Mains / Telco)

CEMI-03

FCC Code	VCCI Code	Cat	Calibration Due
9kHz - 2GHz	C-S	II	10/13/2013

Cables

CEMI-02

Range	Mfr	Cat	Calibration Due
9kHz - 2GHz	C-S	II	3/26/2014

Attenuators

20dB ATTEN-03

Range	MN	Mfr	SN	Asset	Cat	Calibration Due
9kHz-2GHz			N/A		II	12/3/2013

Meteorological Meters

Temp./Humidity/Atm. Pressure Gauge

MN	Mfr	SN	Asset	Cat	Calibration Due
7400 Perception II	Davis	N/A	965	I	5/29/2014

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

Conducted Emissions Modifications:

None



Line Conducted Emissions Overview:

REV 9-MAY-06

Digital and microprocessor based devices use radio frequency (RF) digital techniques for timing purposes and in applications such as switching power supplies. An unintentional consequence of this for AC powered devices is that a certain amount of the RF energy is impressed upon the AC power mains in the form of a conducted noise voltage. These conducted emissions have the potential to interfere with constructive uses of the RF spectrum such as AM radio and may also interfere with other devices attached to the same AC mains circuit. In order to reduce the likelihood that a device will interfere it is required that the conducted RF signals from the device are below an allowable level.

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

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

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

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

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

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

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

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

OCCUPIED BANDWIDTH**Test Method:**

In accordance with the following:

- RSS 210 – License - exempt Radio Apparatus (All Frequency Bands): Category I Equipment

Results:

TEST	RESULT	TEST LEVEL	MARGIN	COMMENTS
<i>Occupied Bandwidth</i>	DONE	RSS 210	N/A	

Occupied Bandwidth Plot(s):

Agilent

R L

Ref -30 dBm

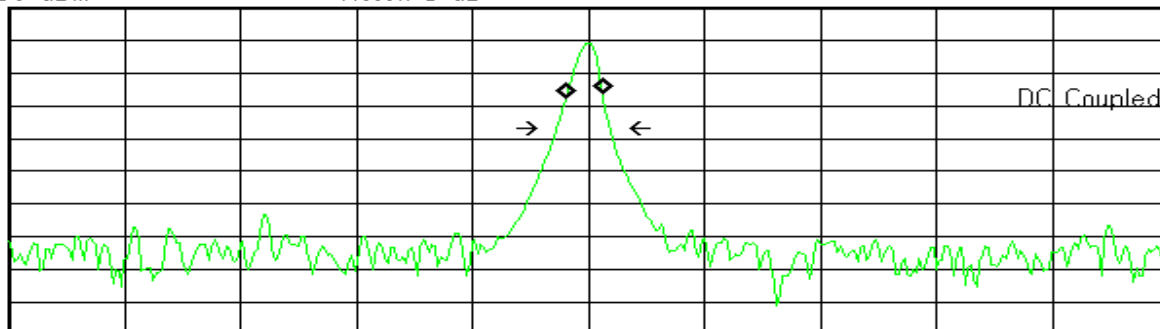
Atten 5 dB

#Peak

Log

10

dB/



Center 125 kHz

#Res BW 1 kHz

#VBW 3 kHz

Span 100 kHz

Sweep 103.6 ms (401 pts)

Occupied Bandwidth
3.2082 kHz

Occ BW % Pwr 99.00 %
x dB -26.00 dB

Transmit Freq Error -382.598 Hz
x dB Bandwidth 4.638 kHz*

Measurement Uncertainty

The listed uncertainties are the worst case uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Expanded Uncertainty k=2	Maximum allowable uncertainty
Radiated Emissions (30-1000MHz)		
NIST	5.6dB	N/A
CISPR	4.6dB	5.2dB (Ucisp)
Radiated Emissions (1-26.5GHz)	4.6dB	N/A
Radiated Emissions (above 26.5GHz)	4.9dB	N/A
Magnetic Radiated Emissions	5.6dB	N/A
Conducted Emissions		
NIST	3.9dB	N/A
CISPR	3.6dB	3.6dB (Ucisp)
Telco Conducted Emissions (Current)	2.9dB	N/A
Telco Conducted Emissions (Voltage)	4.4dB	N/A
Electrostatic Discharge	11.5%	N/A
Radiated RF Immunity (Uniform Field)	1.6dB	N/A
Electrical Fast Transients	23.1%	N/A
Surge	23.1%	N/A
Conducted RF Immunity	3dB	N/A
Magnetic Immunity	12.8%	N/A
Dips and Interrupts	2.3V	N/A
Harmonics	3.5%	N/A
Flicker	3.5%	N/A
Radio frequency (@ 2.4GHz)	3.23×10^{-8}	1×10^{-7}
RF power, conducted	0.40dB	0.75dB
Maximum frequency deviation:		
• Within 300Hz and 6kHz of audio frequency / Within 6kHz and 25kHz of audio frequency	3.4% 0.3dB	5% 3dB
Adjacent channel power	1.9dB	3dB
Conducted spurious emission of transmitter, valid up to 12.75GHz	2.39dB	3dB
Conducted emission of receivers	1.3dB	3dB
Radiated emission of transmitter, valid up to 26.5GHz	3.9dB	6dB
Radiated emission of transmitter, valid up to 80GHz	3.3dB	6dB
Radiated emission of receiver, valid up to 26.5GHz	3.9dB	6dB
Radiated emission of receiver, valid up to 80GHz	3.3dB	6dB
Humidity	2.37%	5%
Temperature	0.7°C	1.0°C
Time	4.1%	10%
RF Power Density, Conducted	0.4dB	3dB
DC and low frequency voltages	1.3%	3%
Voltage (AC, <10kHz)	1.3%	2%
Voltage (DC)	0.62%	1%
The above reflects a 95% confidence level		

Jurisdictional Labeling and Required Instruction Manual Inserts**FCC Requirements****Required Equipment Authorization for Device Type**

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

FCC Required labeling for Verified Devices 47 CFR Part 15.19

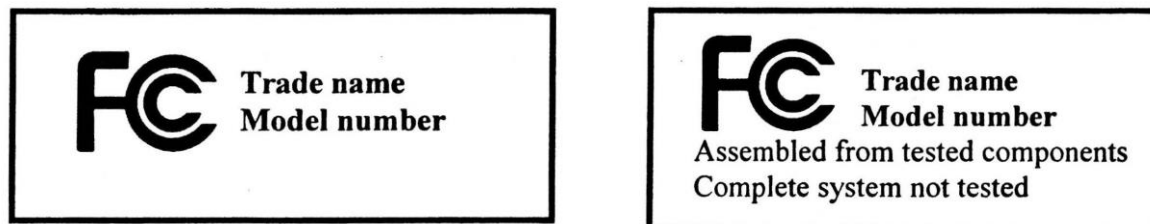
The specific labeling requirements for a device subject to the Verification or Certification procedure are contained in Section 15.19(a). These labelling requirements are:

- One of three compliance statements specified in Section 15.19(a);
- If the device is subject only to Verification include a label bearing a unique identifier - Section 2.954;
- If the device is subject to Certification (1) Section 2.925 contains information on identification of the equipment; (2) include a label bearing an FCC Identifier (FCC ID) - Section 2.926.

If the labeling area for the device is so small, and / or it is not practical to place the required statement on the device, then the statement can be placed in the user manual or product packaging - Section 15.19(a)(5). Generally, devices smaller than the palm of the hand are considered small. However, the device must still be labeled with the unique identifier (Verification) or the FCC ID (Certification).

Declaration of Conformity (DoC):

The labeling requirements for a device subject to the Declaration of Conformity (DoC) procedure are specified in Section 15.19(b). The label should include the FCC logo along with the Trade Name and Model Number, which satisfies the unique identifier requirement of Section 2.1074 if it represents the identical equipment tested for DoC compliance. For personal computers assembled from authorized components, the following additional text must also be included: "Assembled from tested components," "Complete system not tested." When the device is so small and / or when it is not practical to place the required additional text on the device, the text may be placed in the user manual or pamphlet supplied to the user. However, the FCC logo, Trade Name, and Model Number must still be displayed on the device - Section 15.19(b)(3).



Part 15 Declaration of Conformity (DoC) Label Examples

FCC Required Instruction Manual Inserts CFR 47 Part 15.21 and 15.105

Section 15.21 requires that in the user manual, the user shall be cautioned that changes / modifications not approved by the responsible party could void the user's authority to operate the equipment. The acceptable formats for user information dissemination are paper, computer disk or over the Internet. Where special accessories, such as shielded cables and/or special connectors, are required to comply with the emission limits, the instruction manual shall include appropriate instructions on the first page of the text describing the installation of the device (Section 15.27(a)).

For a Class A or Class B digital device (unintentional radiator), as well as any composite device that is both an intentional and unintentional radiator, the text specified in Section 15.105 must be placed in the user manual.

Devices authorized under the Declaration of Conformity (DoC) procedure must also include a compliance information statement (in the user manual or on a separate sheet) as required by Section 2.1077. The objective of this compliance statement is to allow the FCC to associate the equipment with the party responsible for compliance with the DoC requirements.

Devices certified as software defined radio that use an electronic labeling method to display the FCC ID must provide instructions in the user manual on how to access the electronic display (Section 2.925(e)).

Additional statements and information may be required for compliance to specific or general rule parts. The following is an example of some additional user information requirements. The party responsible for compliance must provide any additional statement(s) required.

- Kits - TV interface and Cable system terminal device marketed as Kits: Section 15.25 (d);
- TV interface devices, including cable system terminal devices: Section 15.115 (c) (5);
- Labeling of digital cable ready products: Section 15.123 - use of the term cable ready/compatible;
- External power amplifiers and antenna modifications: Section 15.204 (d) (2) – 1 notice of authorized amplifiers;

- Cordless telephones: Section 15.214 (c) & (d) (3) - privacy statement & security code statement;
- Cordless telephones: Section 15.233 (b) (2) (ii) - interference to TV;
- Cordless telephones: Section 15.233 (h) - cordless phones without digital security (Section 15.214);
- Professionally installed systems: Section 15.247 (c) (1) (iii);
- Operation within the Band 92-95 GHz: Section 15.257 (a) (4) - indoor use only;
- Unlicensed PCS: Section 15.311 - notification and coordination with UTAM, Inc.;
- RF exposure statements: Section 2.1091 (d) (3) - Mobile devices (a minimum separation distance may be required).

Our facility codes can be found in the test equipment lists in each emissions section of this report.

Canadian Requirements

Digital products and ISM products must be labeled by a notice in French and English. The notice **must** take the form of a label on the product. As an alternative, where it is not feasible to label the product due to product size or other consideration, the notice must be reproduced in the manual. Note that considerations such as product appearance are not considered to meet the feasibility test. The notice must state that the product is in compliance with Canadian Interference-Causing Equipment regulations and may be in your own words. A suggested text is:

For ITE products:

This Class A or B digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la classe A or B est conforme a la norme NMB-003 du Canada.

For ISM products:

This ISM apparatus meets all requirements of the Canadian Interference-Causing Equipment Regulations.

Ce generateur de frequence radio ISM respecte toutes les exigences du Reglement sur le materiel brouilleur du Canada.

Although the ITE limits are different from the FCC in some minor ways, equipment which complies with the FCC limits is considered by Industry Canada to be compliant with the Canadian rules. For ITE, equipment in compliance with either FCC Part 15 or CISPR 22 is considered to meet ICES-003. ISM equipment limits are the same as the EU EN55011 emission limits. Reports must be kept on file for review by the appropriate Canadian Minister for a period of five years.

Our facility codes can be found in the test equipment lists in each emissions section of this report.

Conditions Of Testing

[Bureau Veritas Consumer Products Services, Inc., a Massachusetts corporation], and/or its affiliates (collectively, the "Company") will conduct, at the request of the Submitter ("Client"), the tests specified on the submitted Test Request Form or equivalent in accordance with, and subject to, the following terms and conditions (collectively, "Conditions"):

1. All orders for tests are subject to acceptance by the Company, and no order will constitute a binding commitment of the Company unless and until such order is accepted by it, as evidenced by the issuance of a written report ("Test Report") by the Company. The Test Report is issued solely by the Company, is intended for the exclusive use of Client and shall not be published, used for advertising purposes, copied or replicated for distribution to any other person or entity or otherwise publicly disclosed without the prior written consent of the Company. By submitting a request for services to the Company, Client consents to the disclosure to accreditation bodies of those records of Client relevant to the accreditation body's assessment of the Company's competence and compliance with relevant accreditation criteria. The Company shall not be liable for any loss or damage whatsoever resulting from the failure of the Company to provide its services within any time period for completion estimated by the Company. If Client anticipates using the Test Report in any legal proceeding, arbitration, dispute resolution forum or other proceeding, it shall so notify the Company prior to submitting the Test Report in such proceeding. The Company has no obligation to provide a fact or expert witness at such proceeding unless the Company agrees in advance to do so for a separate and additional fee.
2. The Test Report will set forth the findings of the Company solely with respect to the test samples identified therein. Unless specifically and expressly indicated in the Test Report, the results set forth in such Test Report are not intended to be indicative or representative of the quality or characteristics of the lot from which a test sample is taken, and Client shall not rely upon the Test Report as being so indicative or representative of the lot or of the tested product in general. The Test Report will reflect the findings of the Company at the time of testing only, and the Company shall have no obligation to update the Test Report after its issuance. The Test Report will set forth the results of the tests performed by the Company based upon the written information provided to the Company. The Test Report will be based solely on the samples and written information submitted to the Company by Client, and the Company shall not be obligated to conduct any independent investigation or inquiry with respect thereto.
3. The Company may, in its sole discretion, destroy samples which have been furnished to the Company for testing and which have not been destroyed in the course of testing. The Company may delegate the performance of all or a portion of the services contemplated hereunder to an affiliate, agent or subcontractor of the Company, and Client consents to such delegation.
4. These Conditions and the Test Report represent the entire understanding of the parties hereto with respect to the subject matter hereof and of the Test Report, and no modification, variance or extrapolation with respect thereto shall be permitted without the prior written consent of the Company.
5. The names, service marks, trademarks and copyrights of the Company and its affiliates, including the names "BUREAU VERITAS," "BUREAU VERITAS CONSUMER PRODUCTS SERVICES," "BVCPS," "MTL," "ACTS," "MTL-ACTS" and CURTIS-STRAUS (collectively, the "Marks") are and shall remain the sole property of the Company or its affiliates and shall not be used by Client except solely to the extent that Client obtains the prior written approval of the Company and then only in the manner prescribed by the Company. Client shall not contest the validity of the Marks or take any action that might impair the value or goodwill associated with the Marks or the image or reputation of the Company or its affiliates.
6. Payment in full shall be due 30 days after the date of invoice. Interest shall be due on overdue amounts from the due date until paid at an interest rate of 1.5% per month or, if less, the maximum rate permitted by law. The Company reserves the right, at any time and from time to time, to revoke any credit extended to Client. Client shall reimburse the Company for any costs it incurs in collecting past due amounts, including court costs and fees and expenses of attorneys and collection agencies. The Test Report may not be used or relied upon by Client if and for so long as Client fails to pay when due any invoice issued by the Company or any affiliate of it to Client or any affiliate or subsidiary of Client together with interest and penalties, if any, accrued thereon.
7. The Company disclaims any and all responsibility or liability arising out of or in connection with e-mail transmissions of such information.
8. Client understands and agrees that the Company is neither an insurer nor a guarantor, that the Company does not take the place of Client or any designer, manufacturer, agent, buyer, distributor or transportation or shipping company, and that the Company disclaims all liability in such capacities. Client further understands that if it seeks assurance against loss or damage, it should obtain appropriate insurance.
9. Client agrees that the Company, by providing the services, does not take the place of Client nor any third party, nor does the Company release them from any of their obligations, nor does the Company otherwise assume, abridge, abrogate or undertake to discharge any duty of any third party to Client or any duty of Client or any third party to any other third party, and Client will not release any third party from its obligations and duties with respect to the tested goods.
10. Client shall, on a timely basis, (a) provide adequate instructions to the Company in order to enable the Company to perform properly its services, (b) provide, or cause Client's suppliers and contractors to provide, the Company with all documents necessary to enable the Company to perform its services, (c) furnish the Company with all relevant information regarding Client's intended use and purposes of the tested goods, (d) advise the Company of essential dates and deadlines relevant to the tested goods and (e) fully exercise all rights and remedies available to Client against third parties in respect of the tested goods.
11. The Company shall undertake due care and ordinary skill in the performance of its services to Client, and the Company shall accept responsibility only where such skill has not been exercised and, even in such event, only to the extent of the limitation of liability set forth herein.
12. If Client desires to assert a claim arising from or relating to (i) the performance, purported performance or non-performance of any services by the Company or (ii) the sale, resale, manufacture, distribution or use of any tested goods, it must submit that claim to the Company in a writing that sets forth with particularity the basis for such claim within 60 days from discovery of the potential claim and not more than six months after the date of issuance of the Test Report to Client. Client waives any and all such claims including, without limitation, claims that the Test Report is inaccurate, incomplete or misleading or that additional or



different testing is required, unless and then only to the extent that Client submits a written claim to the Company within both such time periods.

13. CLIENT SHALL, EXCEPT TO THE EXTENT OF COMPANY'S LIABILITY TO CLIENT HEREUNDER (WHICH IN NO EVENT SHALL EXCEED THE LIMITATION OF LIABILITY HEREIN), HOLD HARMLESS AND INDEMNIFY THE COMPANY, ITS AFFILIATES AND THEIR RESPECTIVE DIRECTORS, OFFICERS, EMPLOYEES, AGENTS AND SUBCONTRACTORS AGAINST ALL ACTUAL OR ALLEGED THIRD PARTY CLAIMS FOR LOSS, DAMAGE OR EXPENSE OF WHATSOEVER NATURE AND HOWSOEVER ARISING FROM OR RELATING TO (i) THE PERFORMANCE, PURPORTED PERFORMANCE OR NON-PERFORMANCE OF ANY SERVICES BY THE COMPANY OR (ii) THE SALE, RESALE, MANUFACTURE, DISTRIBUTION OR USE OF ANY TESTED GOODS.

14. EXCEPT AS MAY OTHERWISE BE EXPRESSLY AGREED TO IN WRITING BY THE COMPANY AND NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN OR IN ANY TEST REPORT, NO WARRANTY OR GUARANTEE, EXPRESS OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR USE, IS MADE.

15. (A) IN NO EVENT WHATSOEVER SHALL THE COMPANY BE LIABLE FOR ANY CONSEQUENTIAL, SPECIAL, INCIDENTAL, EXEMPLARY OR PUNITIVE DAMAGES IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE TEST REPORT OR THE SERVICES PROVIDED BY THE COMPANY HEREUNDER, INCLUDING WITHOUT LIMITATION LOSS OF OR DAMAGE TO PROPERTY; LOSS OF INCOME, PROFIT OR USE; OR ANY CLAIMS OR DEMANDS MADE AGAINST CLIENT OR ANY OTHER PERSON BY ANY THIRD PARTY IN CONNECTION WITH, RELATING TO OR ARISING OUT OF THE SERVICES PROVIDED BY THE COMPANY HEREUNDER.

(B) NOTWITHSTANDING ANY PROVISION TO THE CONTRARY CONTAINED HEREIN, AND IN RECOGNITION OF THE RELATIVE RISKS AND BENEFITS TO CLIENT AND THE COMPANY ASSOCIATED WITH THE TESTING SERVICES CONTEMPLATED HEREBY, THE RISKS HAVE BEEN ALLOCATED SUCH THAT UNDER NO CIRCUMSTANCES WHATSOEVER SHALL THE LIABILITY OF THE COMPANY TO CLIENT OR ANY THIRD PARTY IN RESPECT OF ANY CLAIM FOR LOSS, DAMAGE OR EXPENSE, OF WHATSOEVER NATURE OR MAGNITUDE, AND HOWSOEVER ARISING, EXCEED AN AMOUNT EQUAL TO FIVE (5) TIMES THE AMOUNT OF THE FEES PAID TO THE COMPANY FOR THE SPECIFIC SERVICES WHICH GAVE RISE TO SUCH CLAIM OR U.S.\$10,000, WHICHEVER IS THE LESSER AMOUNT.

16. The Company shall not be liable for any loss or damage resulting from any delay or failure in performance of its obligations hereunder resulting directly or indirectly from any event of force majeure or any event outside the control of the Company. If any such event occurs, the Company may immediately cancel or suspend its performance hereunder without incurring any liability whatsoever to Client.

Company's services, including these Conditions, shall be governed by, and construed in accordance with, the local laws of the country where the Company performs the tests or, in the case of tests performed in the United States of America, the laws of Massachusetts without regard to conflicts of laws principles. If any aspect(s) of these Conditions is found to be illegal or unenforceable, the validity, legality and enforceability of all remaining aspects of these Conditions shall not in any way be affected or impaired thereby. Any proceeding related to the subject matter hereof shall be brought, if at all, in the courts of the country where the Company performs the tests or, in the case of tests performed in the United States of America, in the courts of Massachusetts. Client waives the right to interpose any counterclaim or setoffs of any nature in any litigation arising hereunder.

The complete list of the Approved Subcontractors Curtis-Straus may use to delegate the performance of work can be provided upon request.

Appendix A: Non-Evaluated Data

This section contains information that Balluff, Inc. has requested accompany report. It has not been evaluated for accuracy by Curtis-Straus.