



**FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-GEN ISSUE 4**

CERTIFICATION TEST REPORT

FOR

RFID TRANSCEIVER 3D-HD CAMERA HEAD

MODEL NUMBER: HD-3

REPORT NUMBER: 14U19050-E1, REVISION B

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	02/24/2015	Initial Issue	T. Chu
A	04/22/2015	Add power table on Section 5.2 and 99% BW	C. Pang
B	05/2/2015	Address TCB's Questions	C. Pang

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: INTUITIVE SURGICAL INC.
1266 KIFER ROAD
SUNNYVALE
CA, 94086, U.S.A

EUT DESCRIPTION: RFID TRANSCEIVER 3D-HD CAMERA HEAD

MODEL: HD-3

SERIAL NUMBER: SF0929009

DATE TESTED: JANUARY 12 TO JANUARY 27, 2015

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 15 SUBPART C	Pass
INDUSTRY CANADA RSS-GEN Issue 4	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Approved & Released For
UL Verification Services Inc. By:



CHIN PANG
SENIOR ENGINEER
UL VERIFICATION SERVICES INC.

Tested By:



TINA CHU
LAB TECHNICIAN
UL VERIFICATION SERVICES INC

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10: 2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15 and RSS-GEN Issue 4.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
☐ Chamber A	☐ Chamber D
☐ Chamber B	☐ Chamber E
☐ Chamber C	☒ Chamber F
	☒ Chamber G
	☐ Chamber H

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-8, respectively

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

$$\begin{aligned}\text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamplifier Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m}\end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	± 3.52 dB
Radiated Disturbance, 30 to 1000 MHz	± 4.94 dB
Radiated Disturbance, 1 to 6 GHz	± 3.86 dB
Radiated Disturbance, 6 to 18 GHz	± 4.23 dB
Radiated Disturbance, 18 to 26 GHz	± 5.30 dB
Radiated Disturbance, 26 to 40 GHz	± 5.23 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a 125kHz RFID transceiver 3D-HD camera head.

5.2. MAXIMUM OUTPUT POWER

The transmitter has maximum peak radiated electric field strength at 300m distance as follows:

Frequency Range (KHz)	Mode	E field (300m distance) (dBuV/m)
125	Operating	-29.80

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an 125 kHz ferrite core based inductor antenna with a maximum gain of 5 dBi.

5.4. SOFTWARE AND FIRMWARE

The test utility software used during testing was build A60_P8_L1_B213.

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power and the natural orientation of the device which is laydown position.

5.6. MODIFICATIONS

No modifications were made during testing.

5.7. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Endoscopic Instrument Control System	Intuitive Surgical	DC3000	M0443720190108	DoC
AC power cord	Longwell	E55333	152192	DoC
Laptop	Dell	E6410	GYN8XJN1	DoC

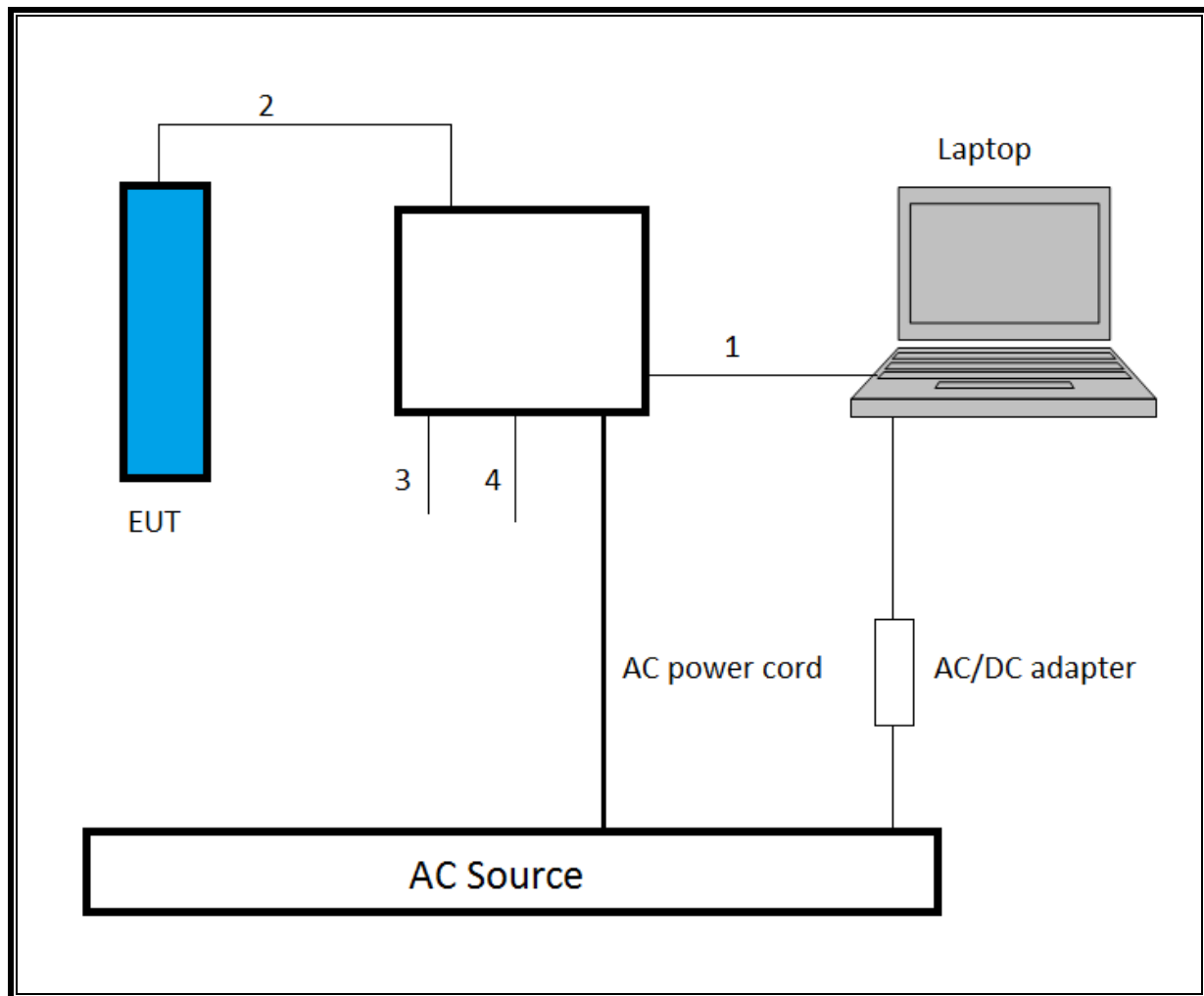
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	Ethernet	1	RJ45	un-shielded	0.9	connect to control system
2	Camera out	1	Multiwire	shielded	6	connect to EUT
3	Component Video Out (L)	6	BNC	shielded	1	50-ohm terminator
4	DoCo Illuminator Control	2	9 pin serial cable	shielded	1	N/A

TEST SETUP

The EUT is supported by a control system while during the test. It is only connected to the support laptop computer to make any parameter change

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment List					
Description	Manufacturer	Model	T No.	Cal Due	Cal Date
Radiated Software	UL	UL EMC	Ver 9.5, July 22, 2014		
Conducted Software	UL	UL EMC	Ver 9.5, May 17 2012		
Antenna, Broadband Hybrid, 30MHz to 2000MHz	Sunol Sciences	JB1	T122	2/13/2016	2/13/2015
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T173	6/7/2015	6/7/2014
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	T341	2/20/2016	2/20/2015
Amplifier, 10KHz to 1GHz, 32dB	Sonoma	310N	T834	6/5/2015	6/5/2014
Spectrum Analyzer, PXA, 3Hz to 44GHz	Agilent	N9030A	T908	5/17/2015	5/17/2014
Antenna, Active Loop 9KHz to 30MHz	Emco	6502	T35	12/18/2015	12/18/2014

7. OCCUPIED BANDWIDTH

The emission bandwidth ($\times$ dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated $\times$ dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least $3\times$ the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

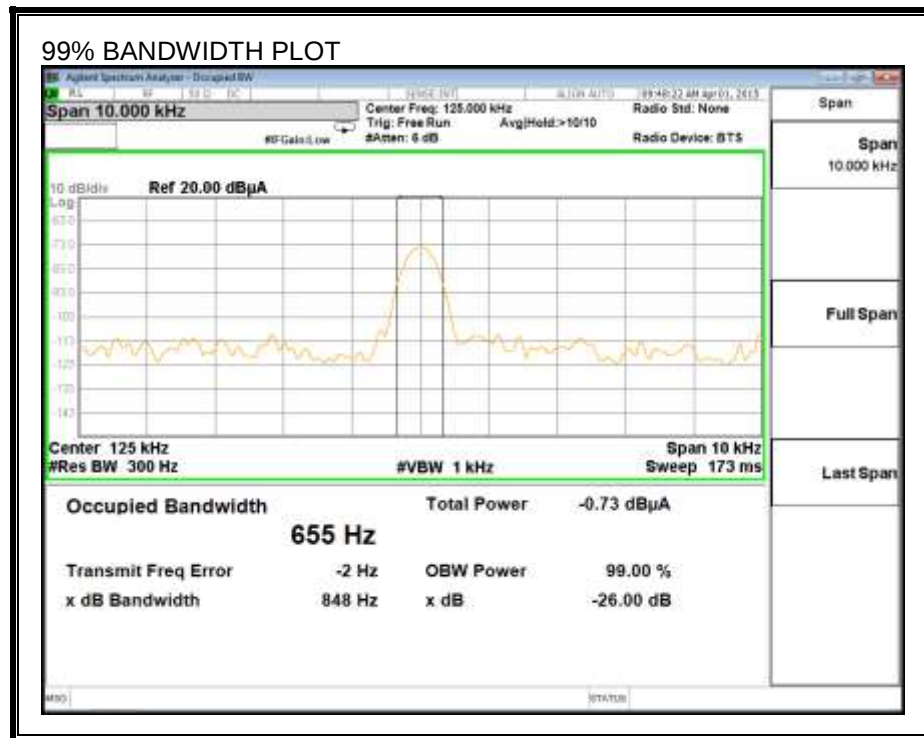
- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately $3\times$ RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.



8. RADIATED EMISSION TEST RESULTS

8.1. LIMITS AND PROCEDURE

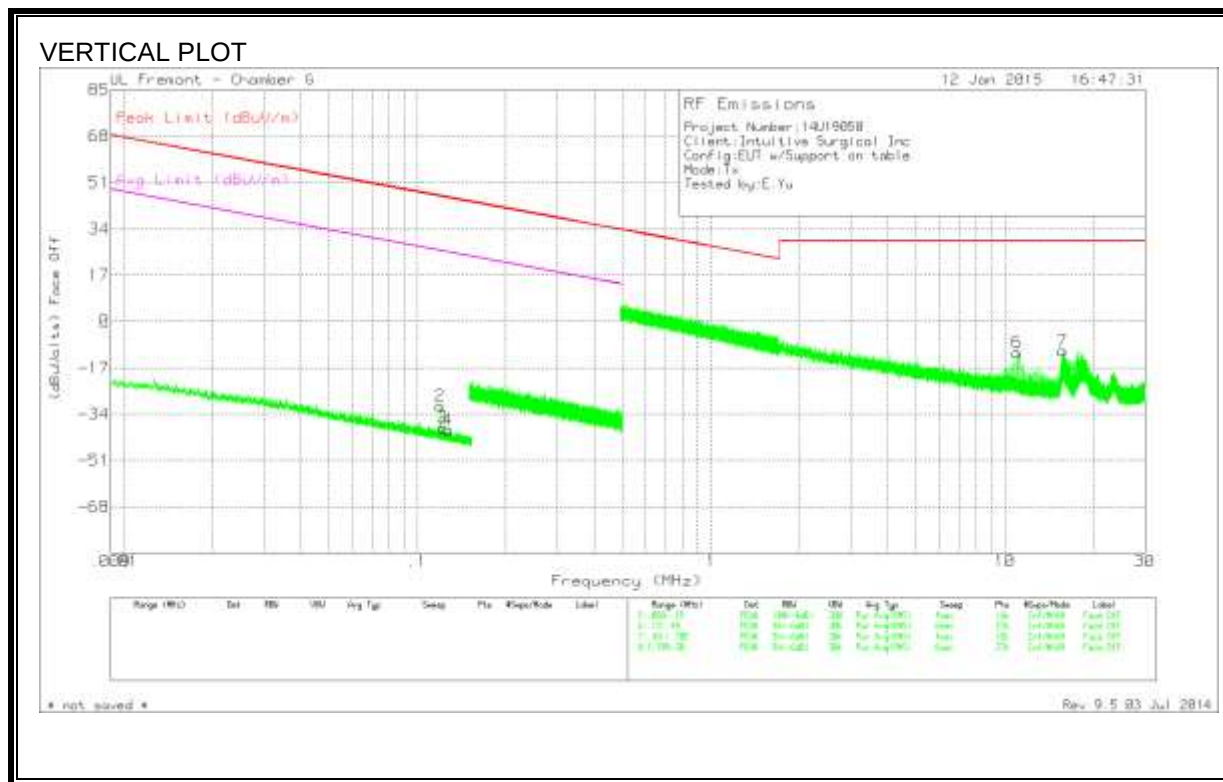
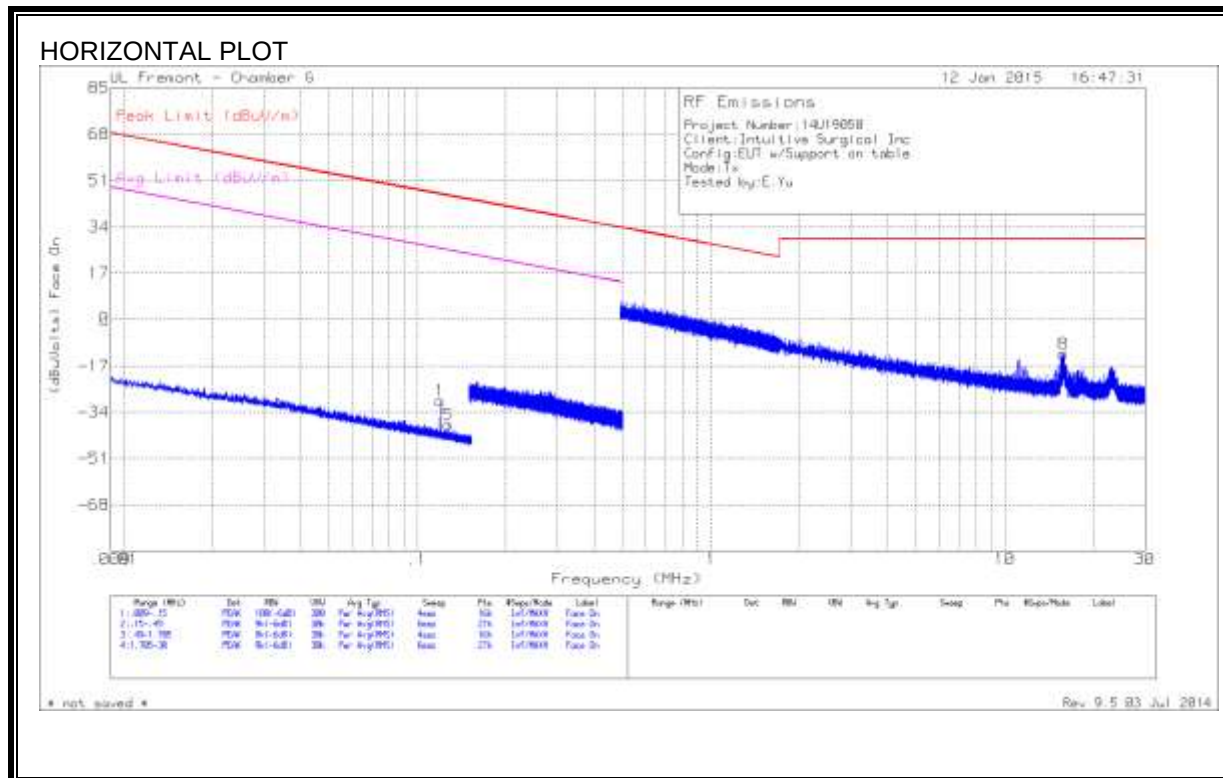
LIMITS

FCC §15.209 (a)
IC RSS-GEN, Section 8.9 and 8.10.
IC RSS-GEN, Section 7 (Receiver)

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (m)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100	3
88 to 216	150	3
216 to 960	200	3
Above 960 MHz	500	3
Note: The lower limit shall apply at the transition frequency.		

RESULTS

8.2. TX SPURIOUS EMISSIONS 0.15 TO 30 MHz



DATA

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	Loop Antenna (dB/m)	Amp/Cbl (dB)	Dist Corr 300m	Corrected Reading (dBuVolts)	Peak Limit (dBuV/m)	Peak Margin (dB)	Avg Limit (dBuV/m)	Avg Margin (dB)	Azimuth (Degs)
1	.125	39.3	PK	10.9	0	-80	-29.8	46.06	-75.86	26.06	-55.86	0-360
2	.125	38.17	PK	10.9	0	-80	-30.93	46.06	-76.99	26.06	-56.99	0-360
3	.127	30.14	PK	10.9	0	-80	-38.96	45.84	-84.8	25.84	-64.8	0-360
5	.12747	30.61	PK	10.8	0	-80	-38.59	45.5	-84.09	25.5	-64.09	0-360
4	.12749	29.45	PK	10.8	0	-80	-39.75	45.49	-85.24	25.49	-65.24	0-360
6	11.00	18.46	PK	10.8	-.5	-40	-11.24	29.54	-40.78	-	-	0-360
7	15.75	19.4	PK	10.5	-.6	-40	-10.7	29.54	-40.24	-	-	0-360
8	15.875	17.52	PK	10.5	-.6	-40	-12.58	29.54	-42.12	-	-	0-360

8.3. TX SPURIOUS EMISSION 30 TO 1000 MHz

DATA

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T477 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarity	Comment
192.05	53.92	PK	11.5	-31.1	34.32	43.52	-9.2	0-360	100	H	
224	59.76	PK	10.9	-31	39.66	46.02	-6.36	0-360	100	H	
288	49.05	PK	13.3	-30.7	31.65	46.02	-14.37	0-360	100	H	
320	48.58	PK	13.9	-30.5	31.98	46.02	-14.04	0-360	100	H	
368	43.38	PK	14.9	-30.5	27.78	46.02	-18.24	0-360	100	H	
* 399.99	57.61	QP	15.5	-30.4	42.71	46.02	-3.31	66	116	V	
519.2	43.13	PK	17.8	-30.2	30.73	46.02	-15.29	0-360	100	V	
559.7	44.07	PK	18.4	-30	32.47	46.02	-13.55	0-360	100	V	
600	36.52	PK	18.4	-30	24.92	46.02	-21.1	0-360	100	V	
800	47.27	PK	21.4	-29.4	39.27	46.02	-6.75	0-360	100	V	

9. AC MAINS LINE CONDUCTED EMISSIONS

LIMITS

§15.207 (a)
IC RSS-GEN, Section 8.8

Frequency of emission (MHz)	Conducted Limit (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50
* Decreases with the logarithm of the frequency.		

TEST PROCEDURE

ANSI C63.10: 2013

RESULTS

No non-compliance noted:

6 WORST EMISSIONS

Line-L1 .15 - 30MHz

Trace Markers

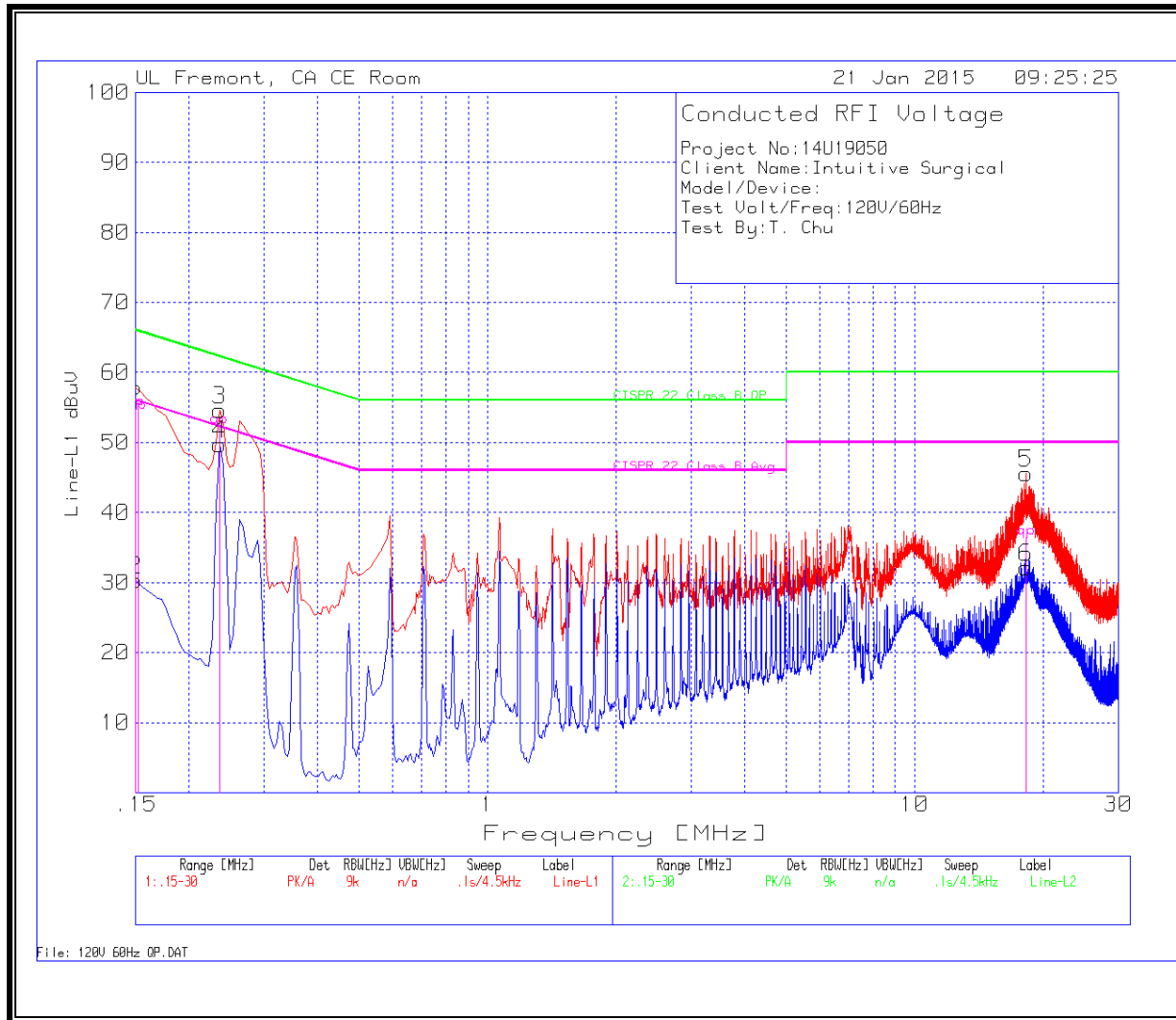
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1 (dB)	LC Cables 1&3 (dB)	Corrected Reading dBuV	CISPR 22 Class B QP	Margin to Limit (dB)	CISPR 22 Class B Avg	Margin to Limit (dB)
1	.15	56.53	PK	1.4	0	57.93	66	-8.07	-	-
2	.15	29	Av	1.4	0	30.4	-	-	56	-25.6
3	.2355	53.81	PK	.8	0	54.61	62.3	-7.69	-	-
4	.2355	48.97	Av	.8	0	49.77	-	-	52.3	-2.53
5	18.267	45.05	PK	.3	.2	45.55	60	-14.45	-	-
6	18.267	31.64	Av	.3	.2	32.14	-	-	50	-17.86

Line-L2 .15 - 30MHz

Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2 (dB)	LC Cables 2&3 (dB)	Corrected Reading dBuV	CISPR 22 Class B QP	Margin to Limit (dB)	CISPR 22 Class B Avg	Margin to Limit (dB)
7	.15	57.83	PK	1.5	0	59.33	66	-6.67	-	-
8	.15	29.95	Av	1.5	0	31.45	-	-	56	-24.55
9	.2625	55.54	QP	.7	0	56.24	61.4	-5.16	-	-
10	.2625	41.33	Av	.7	0	42.03	-	-	51.4	-9.37
11	.5865	44.34	PK	.3	0	44.64	56	-11.36	-	-
12	.5865	34.46	Av	.3	0	34.76	-	-	46	-11.24
13	18.5775	45.17	PK	.3	.2	45.67	60	-14.33	-	-
14	18.5775	32.43	Av	.3	.2	32.93	-	-	50	-17.07

LINE 1 RESULTS



LINE 2 RESULTS

