FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8

CERTIFICATION TEST REPORT

FOR

Dolphin CT50

MODEL NUMBER: CT50L0N
FCC ID: HD5-CT50L0N
IC ID: 1693B-CT50L0N

REPORT NUMBER: 15U20259-E12
ISSUE DATE: JUNE 08, 2015

Prepared for
HONEYWELL INTERNATIONAL INC
HONEYWELL SCANNING & MOBILITY
9680 OLD BAILES ROAD
FORT MILL, SOUTH CAROLINA 29715, USA

Prepared by
UL VERIFICATION SERVICES INC.
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
-	06/08/15	Initial Issue	C.S.OOI

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS 4

2. TEST METHODOLOGY 5

3. FACILITIES AND ACCREDITATION 5

4. CALIBRATION AND UNCERTAINTY 6

4.1. MEASURING INSTRUMENT CALIBRATION 6

4.2. SAMPLE CALCULATION 6

4.3. MEASUREMENT UNCERTAINTY 6

5. EQUIPMENT UNDER TEST 7

5.1. DESCRIPTION OF EUT 7

5.2. MAXIMUM OUTPUT POWER 7

5.3. WORST-CASE CONFIGURATION AND MODE 7

5.4. MODIFICATIONS 7

5.5. DESCRIPTION OF TEST SETUP 8

6. TEST AND MEASUREMENT EQUIPMENT 10

7. OCCUPIED BANDWIDTH 11

8. RADIATED EMISSION TEST RESULTS 13

8.1. LIMITS AND PROCEDURE 13

8.1.1. FUNDAMENTAL AND SPURIOUS EMISSIONS (0.15 – 30 MHz) 15

8.1.2. TX SPURIOUS EMISSION 30 TO 1000 MHz 16

9. AC MAINS LINE CONDUCTED EMISSIONS 18

10. FREQUENCY STABILITY 23

SETUP PHOTOS 24

1. ATTESTATION OF TEST RESULTS

COMPANY NAME: HONEYWELL INTERNATIONAL INC
HONEYWELL SCANNING & MOBILITY

EUT DESCRIPTION: Dolphin CT50

MODEL: CT50L0N

SERIAL NUMBER: 15099404C4

DATE TESTED: May 31 – June 8, 2015

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 15 SUBPART C	Pass
INDUSTRY CANADA RSS-210 ISSUE 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	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:

CHOON OOI
CONSUMER TECHNOLOGY DIVISION
WiSE PROJECT LEAD
UL Verification Services Inc.

Tested By:

STEVEN TRAN
CONSUMER TECHNOLOGY DIVISION
WiSE LAB ENGINEER
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2009, FCC CFR 47 Part 2 and FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

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(IC: 2324B-1)	☐ Chamber D(IC: 2324B-4)
☐ Chamber B(IC: 2324B-2)	☐ Chamber E(IC: 2324B-5)
☒ Chamber C(IC: 2324B-3)	☐ Chamber F(IC: 2324B-6)
	☐ Chamber G(IC: 2324B-7)
	☐ Chamber H(IC: 2324B-8)

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:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)
36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

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

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

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is a Dolphin CT50 Mobile Computer (Terminal).

The model CT50L0N shares the same enclosure and circuit board as model CT50LFN. The unlicensed radios (WLAN/BT/NFC) including antenna, are identical between the two units.

Difference is CT50L0N has only unlicensed radio but CT50LFN has unlicensed radio and licensed radio.

After confirming through preliminary radiated emissions that the performance of the CT50LFN data remains representative of this model (CT50L0N), CT50L0N leveraged test data from CT50LFN.

5.2. MAXIMUM OUTPUT POWER

The testing was performed at 3 meters. The transmitter maximum E-field at 30m distance is 21.06 dBuV/m which convert from the 3 meters data.

5.3. WORST-CASE CONFIGURATION AND MODE

The NFC function was tested at its' fundamental and only operational frequency of 13.56 MHz. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that the Z-orientation was the worst-case orientation; therefore all final radiated testing was performed with the EUT in the Y-orientation while generating continuous emissions.

5.4. MODIFICATIONS

No modifications were made during testing.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
AC Adapter	PHIHONG	PSA10F-050Q	N/A	N/A
USB CUP Adapter	Honeywell	N/A	N/A	N/A

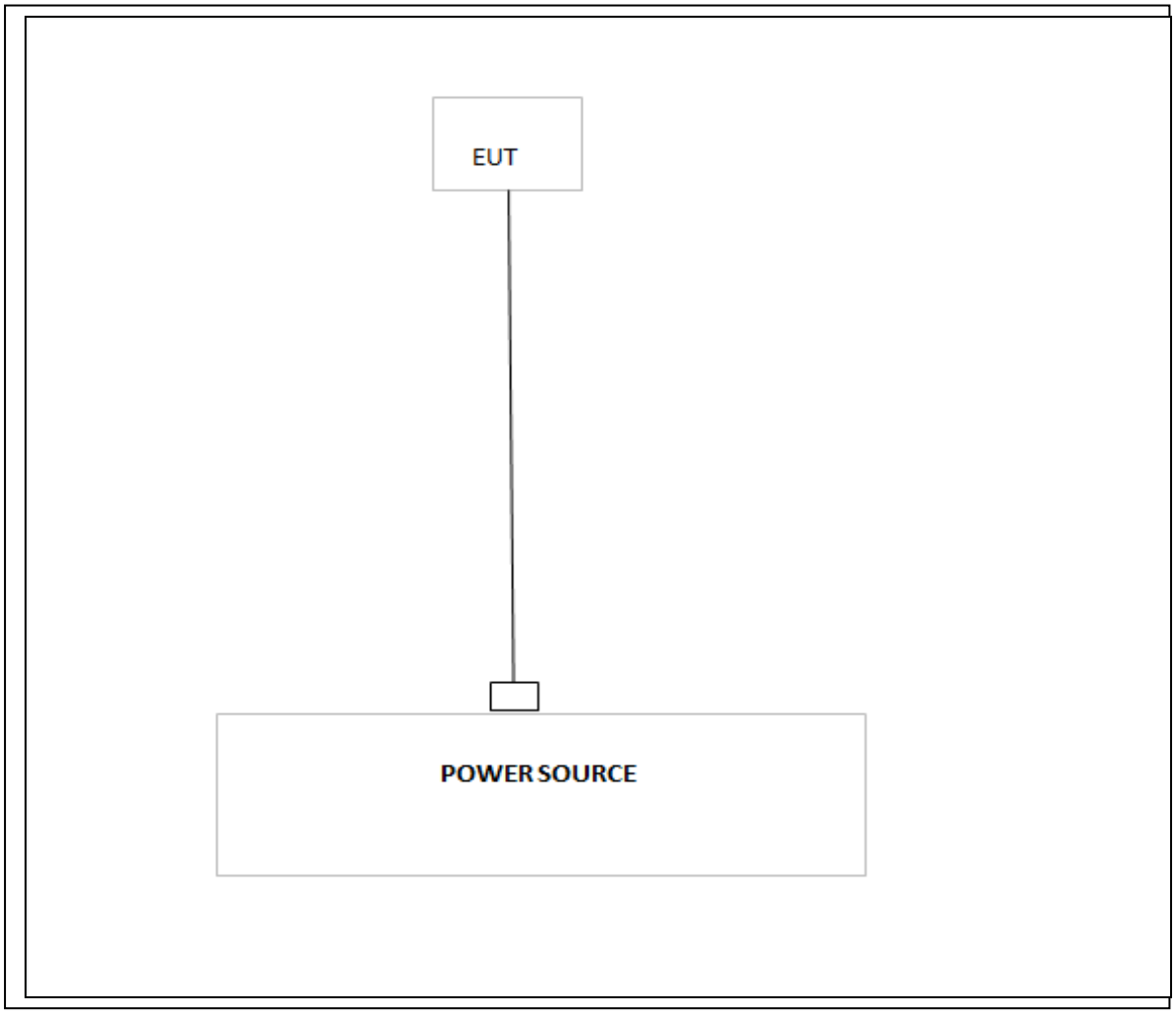
I/O CABLES

N/A

TEST SETUP

The EUT is a stand-alone device configured and tested in a worst-case setup.

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**	**Asset**	**Cal Due**
Spectrum Analyzer, 44 GHz	Agilent / HP	E4446A	C01069	12/20/15
Antenna, Loop, 30 MHz	EMCO	6502	C00593	02/20/16
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB1	T243	12/08/15
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00580	01/21/16
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/08/15
LISN, 30 MHz	FCC	50/250-25-2	C00626	01/14/16
DMM	Fluke	77-11	N02303	10/31/15
Digital Thermometer	Tektronix	DTM920	None	10/21/15
Temperature Chamber	CSZ	2PHS-8-3	T267	03/04/16

7. OCCUPIED BANDWIDTH

RULE PART(S)

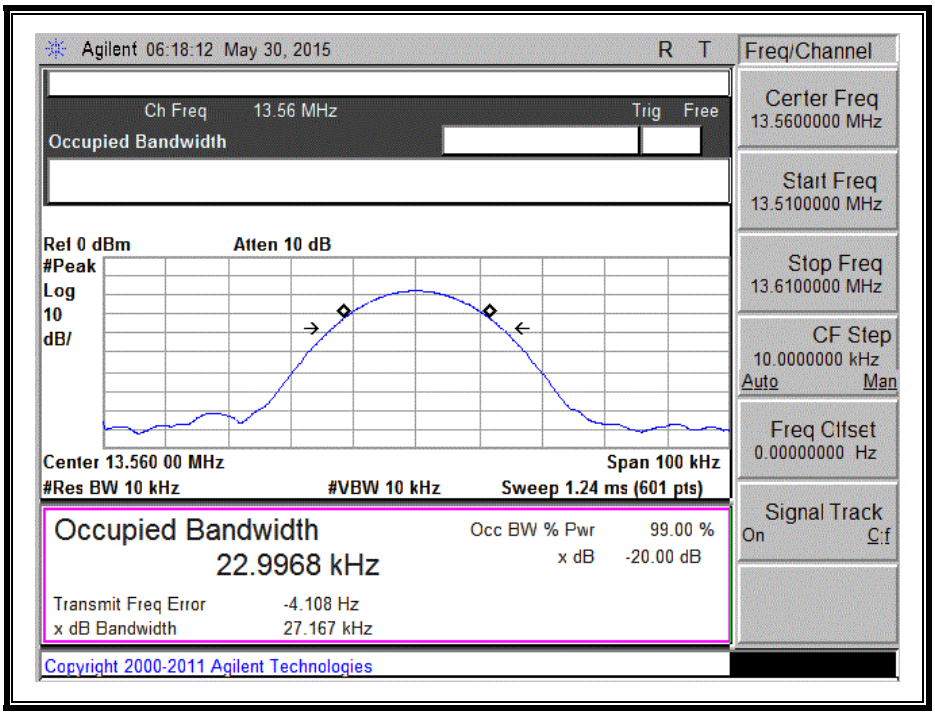
IC RSS 210 Issue 8

LIMITS

For reporting purposes only

RESULTS

Channel	Frequency (KHz)	99% Bandwidth (KHz)
Low	13.56	22.997



8. RADIATED EMISSION TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMIT

§15.225
IC RSS-210, Annex 2, Section A2.6 (Transmitter)
IC RSS-GEN, Section 6 (Receiver)

(a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15,848 microvolts/ meter at 30 meters.

(b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110– 14.010 MHz and shall not exceed the general radiated emission limits in § 15.209 as follows:
§15.209 (a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Limits for radiated disturbance of an intentional radiator		
Frequency range (MHz)	Limits (µV/m)	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 - 216	150**	3
216 – 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g. §§ 15.231 and 15.241.
§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

Formula for converting the filed strength from uV/m to dBuV/m is:
Limit (dBuV/m) = 20 log limit (uV/m)

In addition:

§15.209 (d) The emission limits shown the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector.

§15.209 (d) The provisions in §§ 15.225, measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part.

TEST PROCEDURE

ANSI C63.4-2009

The EUT is an intentional radiator that incorporates a digital device. The highest fundamental frequency generated or used in the device is 13.56 MHz. The frequency range was investigated from 0.15 MHz to the 10^{th} harmonic of the highest fundamental frequency, or 1000 MHz, whichever is greater (1000MHz)

RESULTS

No non-compliance noted:

8.1.1. FUNDAMENTAL AND SPURIOUS EMISSIONS (0.15 – 30 MHz)

FCC Part 15, Subpart B & C **1 Meter Distance Measurement At Emissions Chamber**

Company: Honeywell
Project #: 115U20259
Tester: R.Alegre
Date: 5/30/15

Frequency (MHz)	PK (dBu/V)	QP (dBu/V)	AV (dBuV)	AF dB/m	Distance (m)	Distance Correction (dB)	PK Corrected Reading (dBuV/m)	AV Corrected Reading (dBuV/m)	QP Limit (dBuV/m)	AV Limit (dBuV/m)	PK Margin (dB)	AV Margin (dB)	Notes
Loop Antenna Face On: Y Position													
Fundamental Field Strength & Within Bands:													
13.56	69.5		--	10.64	1	-59.08	21.06	--	84.00	--	-62.9	--	Fundamental @ 30m Dist
13.553	59.86		--	10.64	1	-59.08	11.42	--	50.48	--	-39.1	--	13.41-13.553MHz Spurious @ 30m
13.567	59.36		--	10.64	1	-59.08	10.92	--	50.48	--	-39.6	--	13.567-13.710MHz Spurious @ 30m
13.4	33.7		--	10.66	1	-59.08	-14.72	--	40.51	--	-55.2	--	13.110-13.410MHz Spurious @ 30m
13.71	39.7		--	10.63	1	-59.08	-8.76	--	40.51	--	-49.3	--	13.710-14.010MHz Spurious @ 30m
Loop Antenna Face Off: Y Position													
Fundamental Field Strength & Within Bands:													
13.56	57.24		--	10.64	1	-59.08	8.80	--	84.00	--	-75.2	--	Fundamental @ 30m Dist
13.553	40.26		--	10.64	1	-59.08	-8.18	--	50.48	--	-58.7	--	13.41-13.553MHz Spurious @ 30m
13.567	45.74		--	10.64	1	-59.08	-2.70	--	50.48	--	-53.2	--	13.567-13.710MHz Spurious @ 30m
13.4	30.39		--	10.66	1	-59.08	-18.03	--	40.51	--	-58.5	--	13.110-13.410MHz Spurious @ 30m
13.71	25.96		--	10.63	1	-59.08	-22.50	--	40.51	--	-63.0	--	13.710-14.010MHz Spurious @ 30m
Loop Antenna Face On: Y Position													
Spurious Emissions 9kHz - 490kHz:													
0.01	27.67	--		18.9	1	-99.08	-52.51	-52.51	67.60	47.60	-120.1	-100.1	9kHz-10kHz Spurious @ 30m
0.1	28.2	--		11.8	1	-99.08	-59.08	-59.08	47.60	27.60	-106.7	-86.7	10kHz-100kHz Spurious @ 30m
0.109	27.46	--		11.8	1	-99.08	-59.83	-59.83	46.86	26.86	-106.7	-86.7	100kHz-489kHz Spurious @ 30m
Spurious Emissions 490kHz - 30MHz:													
0.49	28.32		--	11.7	1	-59.08	-19.06	--	33.80		-52.9	--	489kHz-490kHz Spurious @ 30m
1	31.68		--	11.8	1	-59.08	-15.60	--	27.60		-43.2	--	490kHz-1MHz Spurious @ 30m
1.28	31.12		--	11.8	1	-59.08	-16.16	--	25.46		-41.6	--	1MHz-1.705MHz Spurious @ 30 m
1.749	28.42		--	11.8	1	-59.08	-18.86	--	29.54		-48.4	--	1.705MHz-5MHz Spurious @ 30m
7.23	22.4		--	11.28	1	-59.08	-25.41	--	29.54		-55.0	--	5-10MHz Spurious @ 30m
24.98	34.34		--	9.103	1	-59.08	-15.64	--	29.54		-45.2	--	20-30MHz Spurious @ 30m

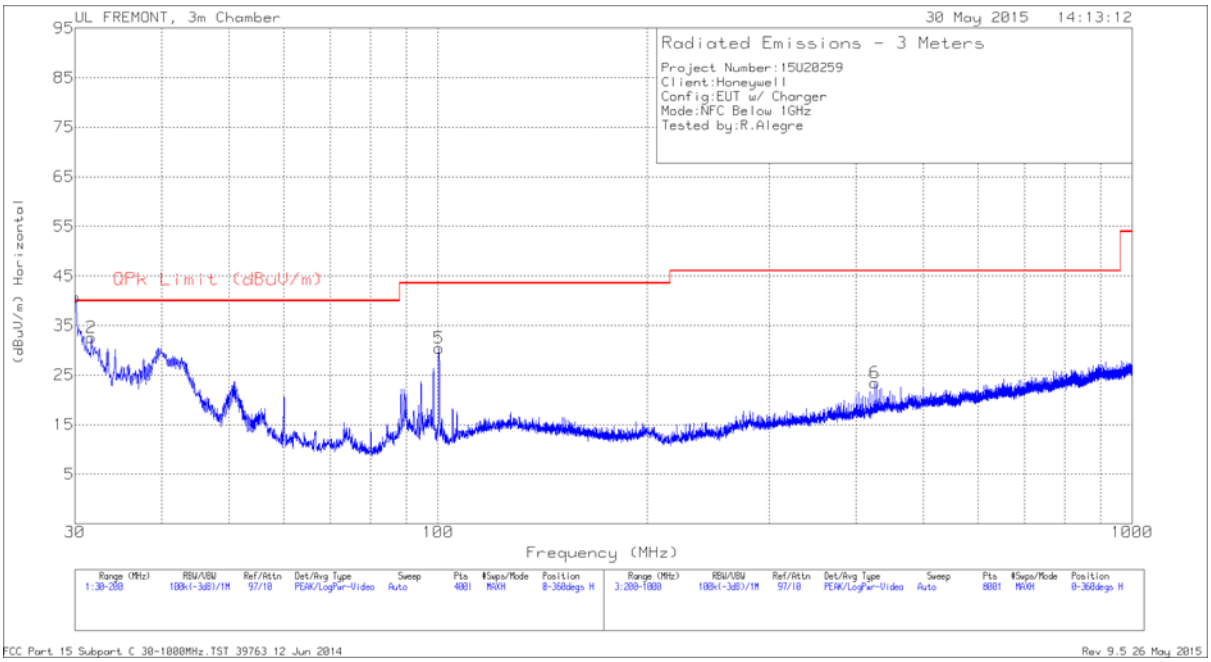
* No more emissions were found up to 30MHz

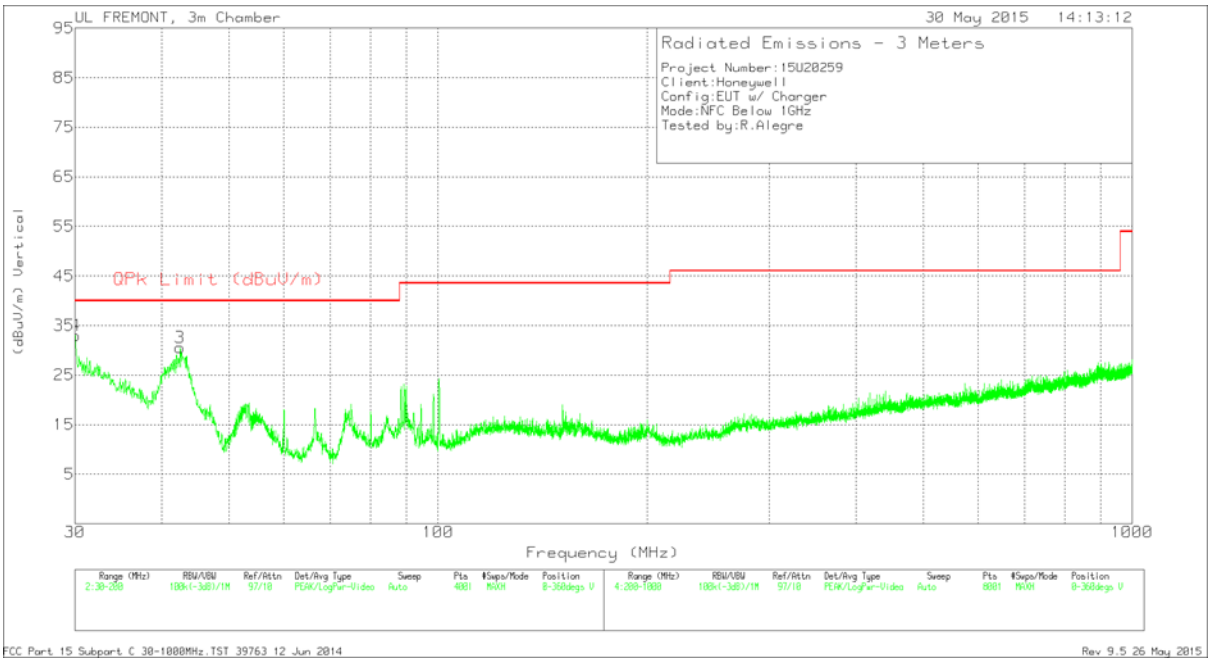
Note: The emission limits are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9–90 kHz, 110–490 kHz and above 10000Mhz. Radiated emission limits in these three bands are based on measurements employing an average detector.

P.K. = Peak
Q.P. = Quasi Peak Readings
A.F. = Antenna factor

Rev. 05.27.15

8.1.2. TX SPURIOUS EMISSION 30 TO 1000 MHz





Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T185 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	30.0425	46.37	Pk	21.8	-27.5	40.67	40	.67	0-360	100	H
4	30.0425	38.69	Pk	21.8	-27.5	32.99	40	-7.01	0-360	100	V
2	31.6575	39.54	Pk	20.6	-27.5	32.64	40	-7.36	0-360	100	H
3	42.495	45.51	Pk	12.4	-27.4	30.51	40	-9.49	0-360	100	V
5	100.38	47.48	Pk	9.8	-26.8	30.48	43.52	-13.04	0-360	300	H
6	425.6	33.06	Pk	16.1	-25.7	23.46	46.02	-22.56	0-360	100	H

Pk - Peak detector

Radiated Emissions

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T185 (dB/m)	Amp/Cbl (dB/m)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
30.0128	40.55	Qp	21.8	-27.5	34.85	40	-5.15	347	170	H
30.0425	38.99	Qp	21.8	-27.5	33.29	40	-6.71	347	170	H
30.0425	39.32	Qp	21.8	-27.5	33.62	40	-6.38	347	170	H

Qp - Quasi-Peak detector

9. AC MAINS LINE CONDUCTED EMISSIONS

LIMITS

§15.207
IC RSS-GEN, Section 7.2.2

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

Frequency range (MHz)	Limits (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
Notes: 1. The lower limit shall apply at the transition frequencies 2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.		

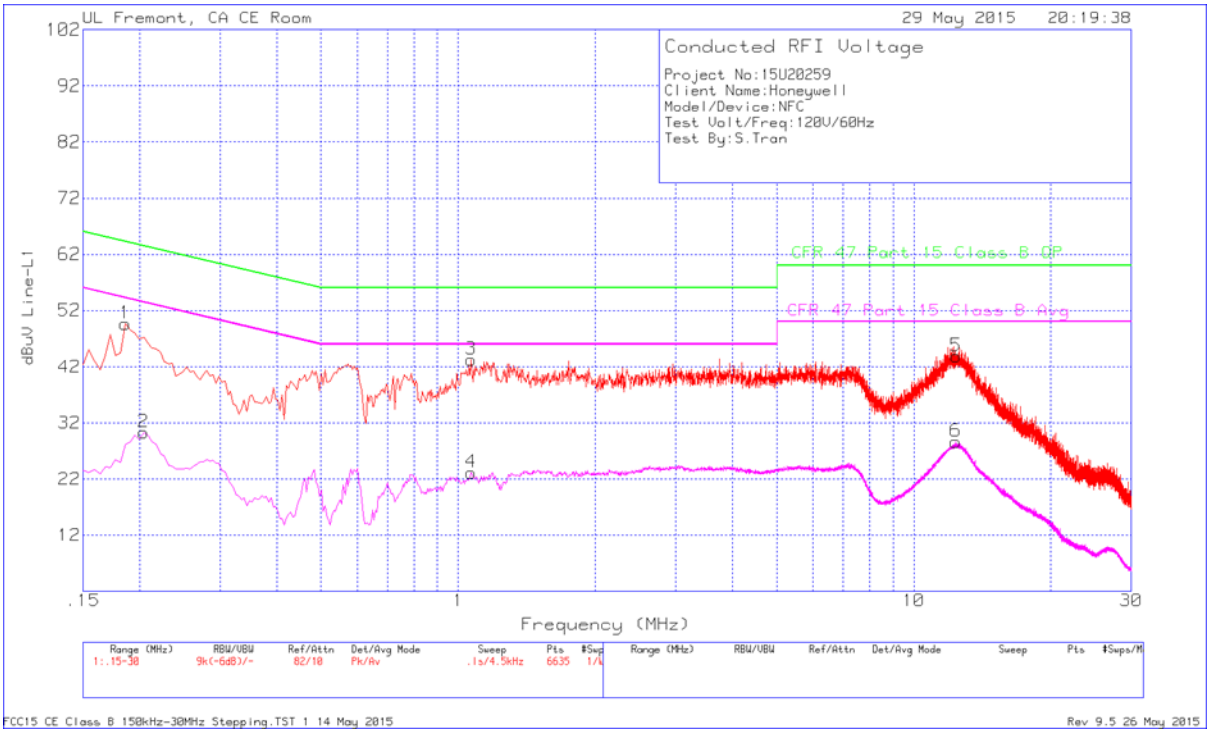
TEST PROCEDURE

ANSI C63.4-2009

RESULTS

No non-compliance noted:

LINE 1 RESULTS



Trace Markers

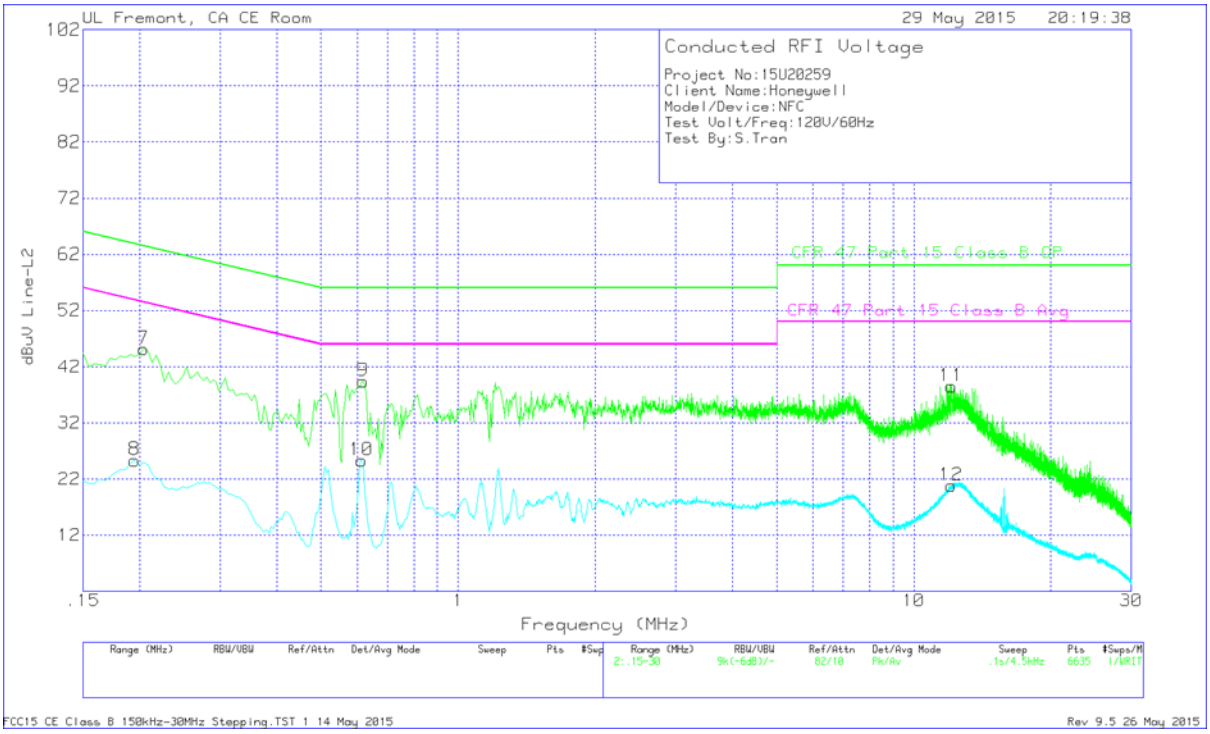
Range 1: Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1	LC Cables 1&3	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	Margin (dB)	CFR 47 Part 15 Class B Avg	Margin (dB)
1	.186	48.66	Pk	1	0	49.66	64.21	-14.55	54.21	-
2	.204	29.41	Av	.9	0	30.31	-	-	53.45	-23.14
3	1.068	43.06	Pk	.2	0	43.26	56	-12.74	46	-
4	1.068	22.96	Av	.2	0	23.16	-	-	46	-22.84
5	12.3855	43.45	Pk	.2	.2	43.85	60	-16.15	50	
6	12.3495	28.26	Av	.2	.2	28.66	-	-	50	-21.34

Pk - Peak detector

Av - Average detection

LINE 2 RESULTS



Trace Markers

Range 2: Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2	LC Cables 2&3	Corrected Reading dBuV	CFR 47 Part 15 Class B QP	Margin (dB)	CFR 47 Part 15 Class B Avg	Margin (dB)
7	.204	44.14	Pk	1	0	45.14	63.45	-18.31	53.45	-
8	.195	24.36	Av	1	0	25.36	-	-	53.82	-28.46
9	.618	39.13	Pk	.3	0	39.43	56	-16.57	46	-
10	.6135	25.03	Av	.3	0	25.33	-	-	46	-20.67
11	12.0975	38.09	Pk	.2	.2	38.49	60	-21.51	50	-
12	12.0795	20.44	Av	.2	.2	20.84	-	-	50	-29.16

Pk - Peak detector

Av - Average detection

10. FREQUENCY STABILITY

LIMIT

§15.225 (e) The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency, over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

TEST PROCEDURE

ANSI C63.4 Section 13

RESULTS

No non-compliance noted.

Reference Frequency: EUT Channel 13.5600000 MHz @ 20ºC Limit: ± 100 ppm = 1.356 kHz				
Power Supply (Vdc)	Environment Temperature (ºC)	Frequency Deviation Measureed with Time Elapse		
		(MHz)	Delta (ppm)	Limit (ppm)
3.90	50	13.5626500	-27.282	± 100
3.90	40	13.5627600	-35.392	± 100
3.90	30	13.5624800	-14.747	± 100
3.90	***25***	13.5622800	***0.000***	***± 100***
3.90	10	13.5618700	30.231	± 100
3.90	0	13.5621600	8.848	± 100
3.90	-10	13.5626800	-29.494	± 100
3.90	-20	13.5624500	-12.535	± 100
3.60	20	13.5622800	0.000	± 100
4.2	20	13.5622800	0.000	± 100