



**FCC 47 CFR PART 15 SUBPART B**

**TEST REPORT**

**FOR**

**WIRELESS FLOW SENSOR (RECEIVER)**

**MODEL NUMBER: WFS-R**

**FCC ID: M3UWFSR**

**REPORT NUMBER: 16U23274-E9V1**

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	6/14/2016	Initial Issue	D. Corona

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## 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** HUNTER INDUSTRIES  
**EUT DESCRIPTION:** WIRELESS FLOW SENSOR (RECEIVER)  
**MODEL:** WFS-R  
**SERIAL NUMBER:** 003  
**DATE TESTED:** MAY 18-19, 2016

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC 47 CFR PART 15 SUBPART B	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.

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## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2009.

## 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
<input type="checkbox"/> Chamber A	<input type="checkbox"/> Chamber D
<input type="checkbox"/> Chamber B	<input type="checkbox"/> Chamber E
<input checked="" type="checkbox"/> Chamber C	<input type="checkbox"/> Chamber F
	<input type="checkbox"/> Chamber G
	<input type="checkbox"/> Chamber H

The above test sites and facilities are covered under FCC Test Firm Registration # 208313.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

Chambers A through H are covered under Industry Canada company address code 2324B with site numbers 2324B -1 through 2324B-8, respectively.

## 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:

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

#### 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	$\pm 3.52$ dB
Radiated Disturbance, 30 to 1000 MHz	$\pm 4.94$ dB
Radiated Disturbance, 1 to 18 GHz	$\pm 3.86$ dB

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

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a receiver wireless flow sensor unit. Model WFS-R is powered by an irrigation controller that connects to AC Mains.

#### GENERAL INFORMATION

Power Requirements	100-240VAC
Highest frequency generated or used by the EUT	920 MHz

### 5.2. TEST CONFIGURATIONS

The following configuration was tested configurations were investigated:

EUT Configuration	Description
Typical	Receiving Unit with irrigation controller.

### 5.3. MODE(S) OF OPERATION

Mode	Description
Normal	Receive mode

### 5.4. SOFTWARE AND FIRMWARE

The firmware used during testing was Hunter rev: 4.00.06.

### 5.5. MODIFICATIONS

No modifications were made during testing.

## 5.6. DETAILS OF TESTED SYSTEM

### SUPPORT EQUIPMENT & PERIPHERALS

SUPPORT EQUIPMENT & PERIPHERALS LIST			
Description	Manufacturer	Model	Serial Number
Flow Simulator	Hunter Industries	N/A	N/A
Controller	Hunter Industries	IC-600-PL	279103
AC Adapter	Hunter Industries	WT1-157-029R	2100161

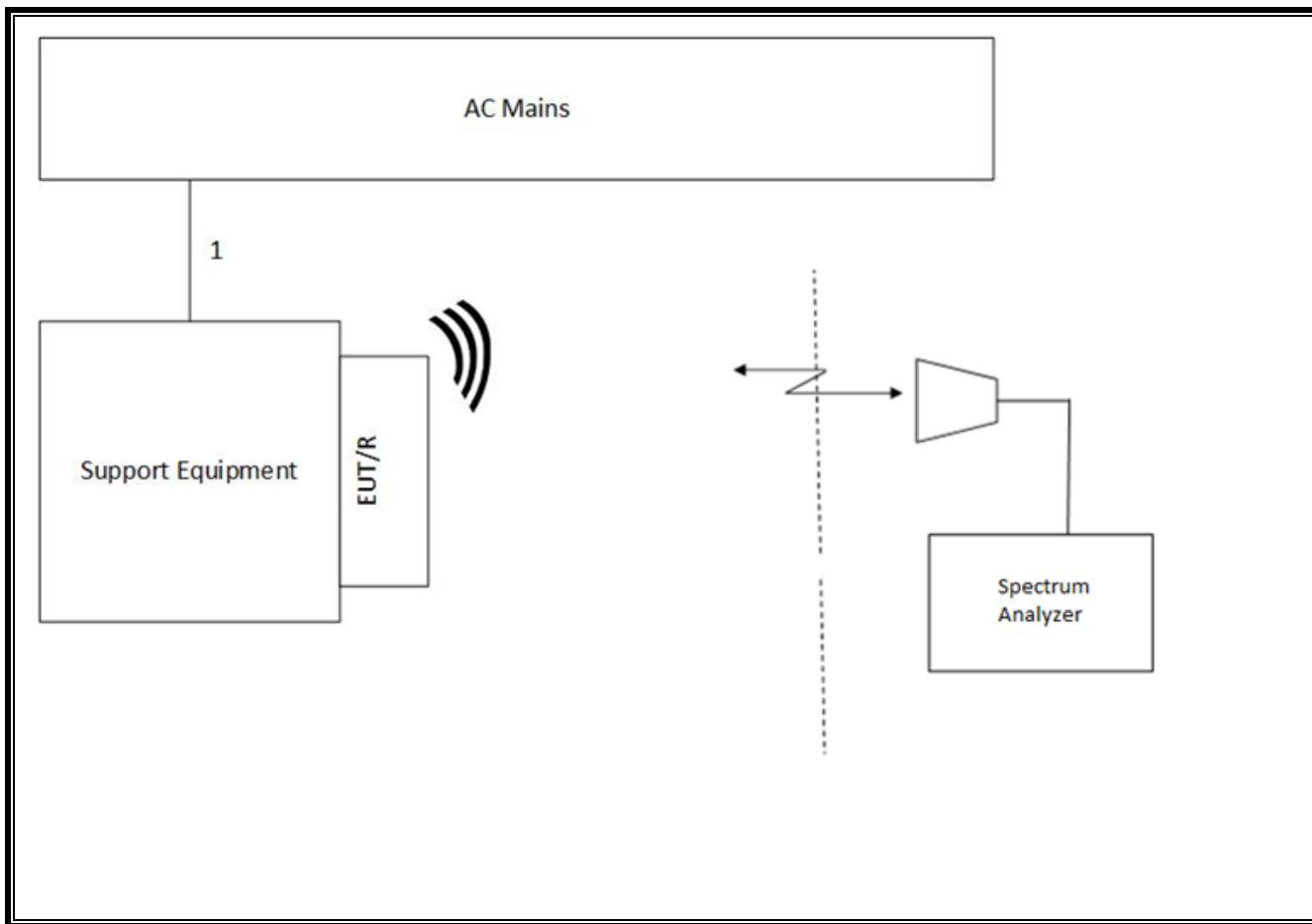
### I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length m	Remarks
1	AC	1	2-Prong	Unshielded	1.5	Simulator Power

### TEST SETUP

The EUT (RX) was installed in a typical configuration and test software exercise the EUTs during test. Refer to the following diagram.

**SETUP DIAGRAM**



## 6. APPLICABLE EMISSIONS LIMITS AND TEST RESULTS

### 6.1. EMISSIONS TEST AND MEASUREMENT EQUIPMENT

#### Radiated Emissions

Test Equipment List					
Description	Manufacturer	Model	Local ID (T No.)	Cal Date	Cal Due
PXA	Agilent	N9030A	908	5/26/2015	5/26/2016
Antenna, Biconolog, 30MHz-1 GHz	Sunol Sciences	JB3	T130	04/04/16	04/04/17
Antenna, Horn, 18GHz	ETS Lindgren	3117	T345	03/07/16	03/07/17
RF Preamplifier, 30MHz - 1GHz	Sonoma	310N	T173	06/09/15	06/09/16
Radiated Software	UL	UL EMC	Ver 9.5, April 26, 2016		

#### Line Conducted Emissions

Test Equipment List					
Description	Manufacturer	Model	Local ID (T No.)	Cal Date	Cal Due
9KHz-10MHz LISN	FCC-LISN	50/250	24	2/9/2016	2/9/2017
LISN 50µH	SOLAR ELECTRIC CO	8012-50-R-24-BNC	29	6/11/2015	6/11/2016
EMI Test Receiver	R&S	ESR	1436	12/16/2015	12/16/2016
Conducted Software	UL	UL EMC	Ver 9.5, May 26, 2015		

## 6.2. RADIATED EMISSIONS LIMITS AND RESULTS

### LIMIT

FCC Part 15 Subpart B Class B

#### Class B Limits below 1 GHz

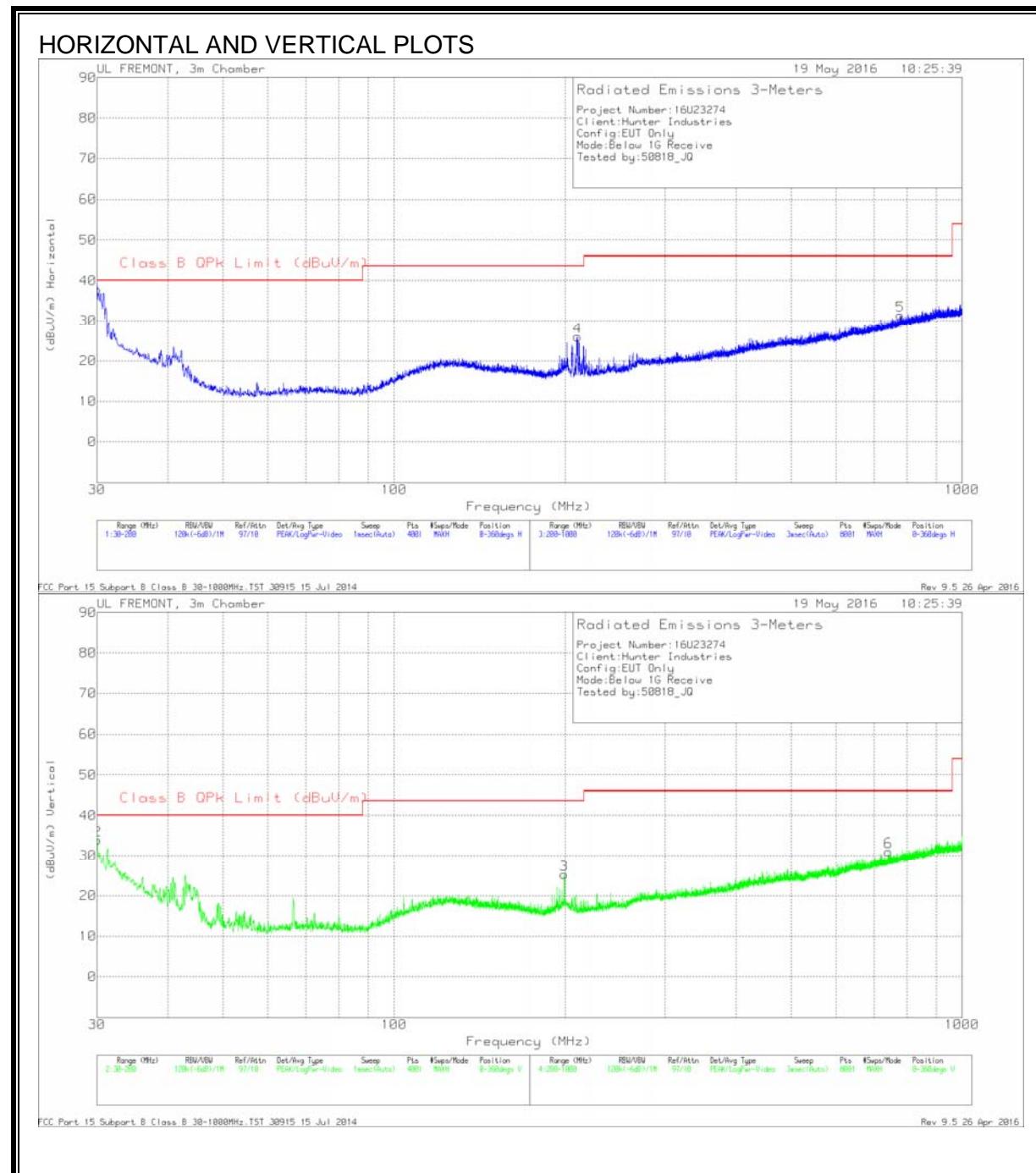
Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

#### FCC Class B Limits above 1 GHz, FCC

Limits for radiated disturbance of Class B ITE at measuring distance of 3 m		
Frequency range (MHz)	Average limit (dB $\mu$ V/m)	Peak limit (dB $\mu$ V/m)
Above 1000	54	74

### RESULTS

**3 m RADIATED EMISSIONS 30 TO 1000 MHz**



**3 m WORST CASE EMISSIONS – DATA FOR 30 TO 1000 MHz**

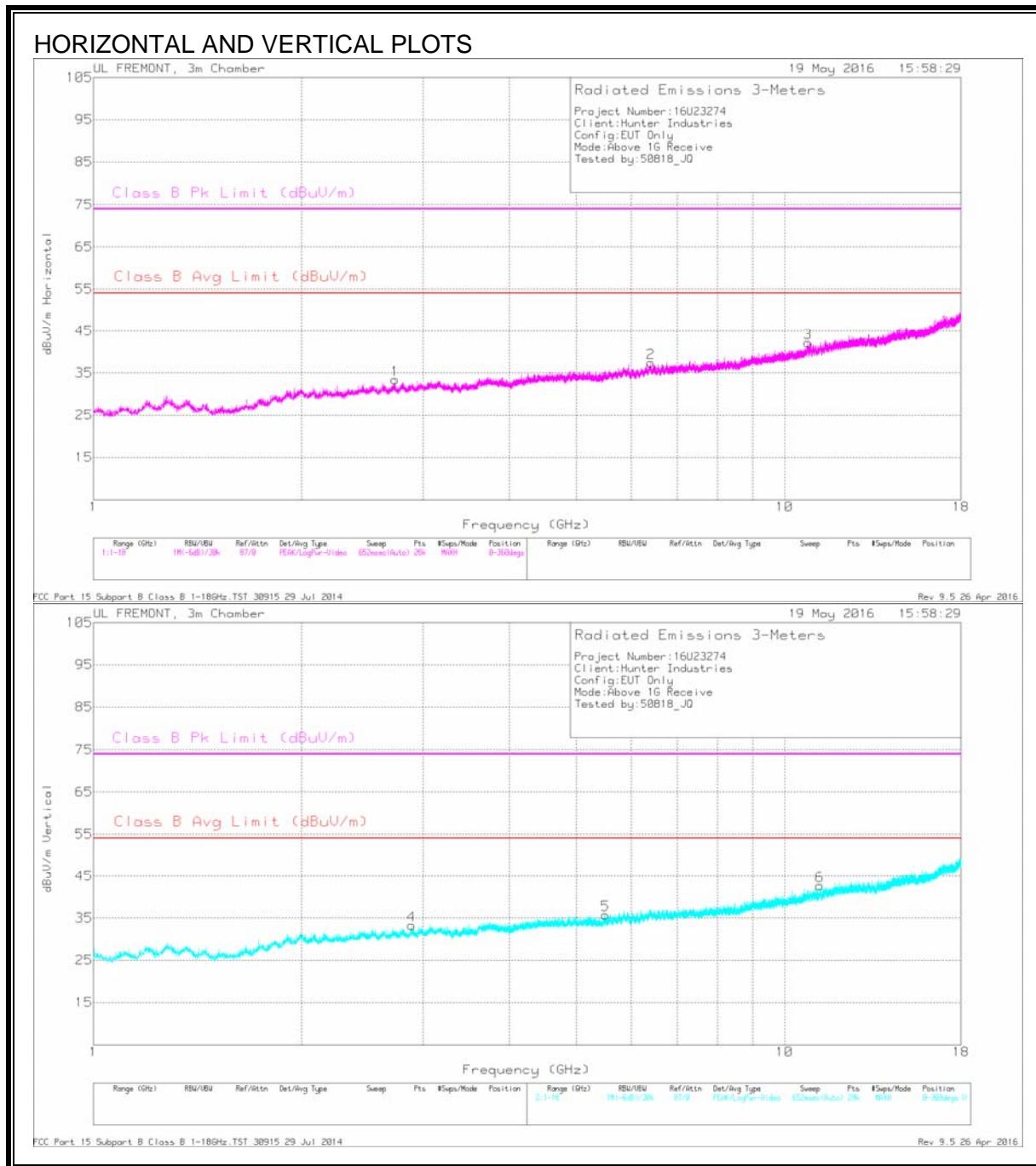
Trace Markers

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AF T122 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	30.0425	39.75	Pk	25.3	-27.3	37.75	40	-2.25	0-360	400	H
		24.49	Qp	25.3	-27.3	22.49	40	-17.51	88	194	
2	30.0425	35.97	Pk	25.3	-27.3	33.97	40	-6.03	0-360	100	V
3	199.5325	34.04	Pk	16.5	-25.2	25.34	43.52	-18.18	0-360	100	V
4	210.3	36.8	Pk	14.3	-25.1	26	43.52	-17.52	0-360	100	H
6	742	30.37	Pk	24.5	-23.8	31.07	46.02	-14.95	0-360	200	V
5	779	29.78	Pk	25.2	-23.6	31.38	46.02	-14.64	0-360	100	H

Pk - Peak detector

Qp - Quasi-Peak detector

**3 m RADIATED EMISSIONS 1000 TO 18,000 MHz**



For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak and average measurements.

Note: The pre-scan measurements above 1GHz the VBW is set to 30 kHz.

**3 m WORST CASE EMISSIONS – DATA FOR 1000 TO 18000 MHz**

Radiated Emissions

Frequenc y (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl (dB)	Corrected Reading dBuV/m	Class B Avg Limit (dBuV/m)	Av(CISPR)Marg in (dB)	Class B Pk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2.731	38.98	Pk	32.6	-30	41.58	-	-	74	-32.42	200	210	H
2.733	24.69	Av	32.6	-30	27.29	54	-26.71	-	-	200	210	H
2.89	38.1	Pk	32.7	-29.8	41	-	-	74	-33	251	358	V
2.891	24.69	Av	32.7	-29.8	27.59	54	-26.41	-	-	251	358	V
5.507	36.94	Pk	34.6	-27.9	43.64	-	-	74	-30.36	17	239	V
5.508	23.83	Av	34.6	-27.8	30.63	54	-23.37	-	-	17	239	V
6.407	36.23	Pk	35.6	-26.7	45.13	-	-	74	-28.87	154	176	H
6.407	23.14	Av	35.6	-26.7	32.04	54	-21.96	-	-	154	176	H
10.81	32.65	Pk	37.8	-21.3	49.15	-	-	74	-24.85	178	366	H
10.809	20.01	Av	37.8	-21.3	36.51	54	-17.49	-	-	178	366	H
11.256	32.53	Pk	38.2	-21.1	49.63	-	-	74	-24.37	275	107	V
11.256	19.94	Av	38.2	-21.1	37.04	54	-16.96	-	-	275	107	V

Pk - Peak detector

Av - Average detection

## 7. AC POWER LINE CONDUCTED EMISSIONS

### LIMITS

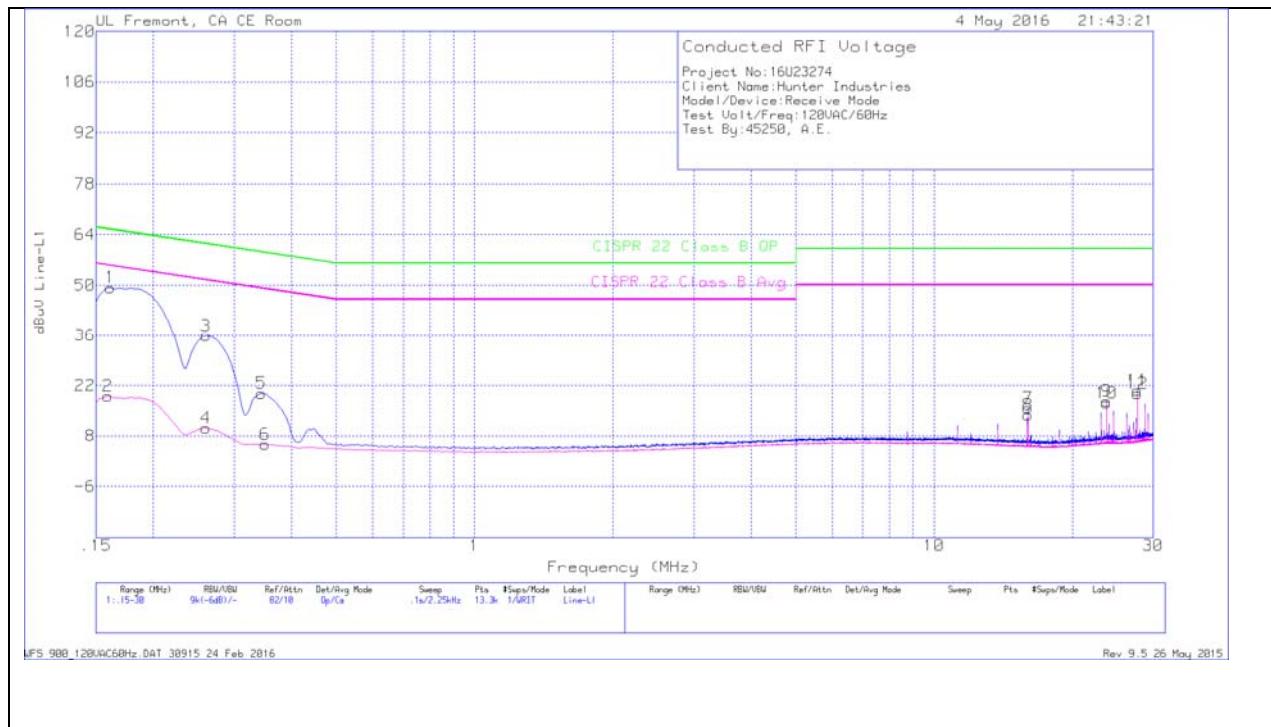
FCC §15.207 (a)

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 <sup>*</sup>	56 to 46 <sup>*</sup>
0.5-5	56	46
5-30	60	50

<sup>\*</sup> Decreases with the logarithm of the frequency.

### RESULTS

## LINE 1 RESULTS



### Trace Markers

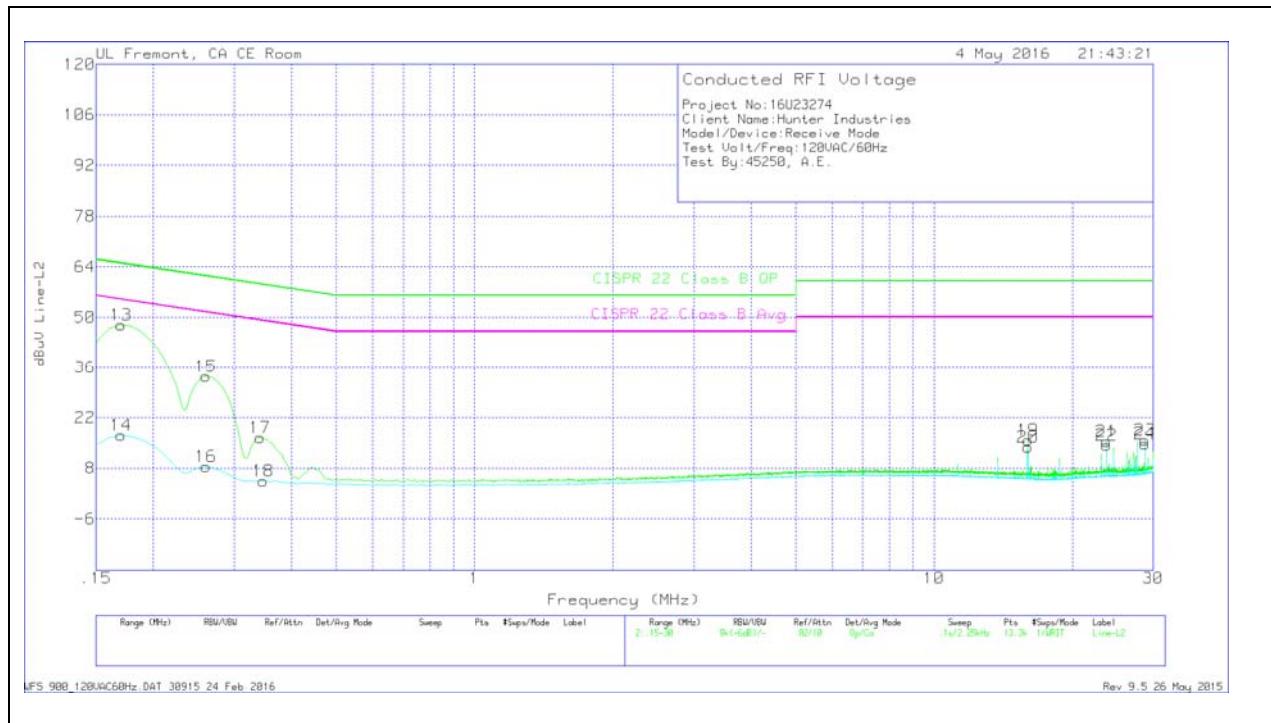
#### Range 1: Line-L1 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L1	LC Cables 1&3	Limiter (dB)	Corrected Reading dBuV	CISPR 22 Class B QP	Margin (dB)	CISPR 22 Class B Avg	Margin (dB)
1	.16125	37.99	Qp	1.3	0	10.1	49.39	65.4	-16.01	-	-
2	.159	7.73	Ca	1.3	0	10.1	19.13	-	-	55.52	-36.39
3	.26025	25.05	Qp	.7	0	10.1	35.85	61.42	-25.57	-	-
4	.26025	-.65	Ca	.7	0	10.1	10.15	-	-	51.42	-41.27
5	.3435	9.24	Qp	.5	0	10.1	19.84	59.12	-39.28	-	-
6	.35025	-4.9	Ca	.5	0	10.1	5.7	-	-	48.96	-43.26
7	16.026	4.94	Qp	.3	.2	10.3	15.74	60	-44.26	-	-
8	16.026	3.03	Ca	.3	.2	10.3	13.83	-	-	50	-36.17
9	23.75025	6.8	Qp	.3	.2	10.4	17.7	60	-42.3	-	-
10	23.75025	6.17	Ca	.3	.2	10.4	17.07	-	-	50	-32.93
11	27.69225	9.45	Qp	.3	.3	10.5	20.55	60	-39.45	-	-
12	27.69225	8.68	Ca	.3	.3	10.5	19.78	-	-	50	-30.22

Qp - Quasi-Peak detector

Ca - CISPR average detection

## LINE 2 RESULTS



Range 2: Line-L2 .15 - 30MHz

Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	T24 IL L2	LC Cables 2&3	Limiter (dB)	Corrected Reading dBuV	CISPR 22 Class B QP	Margin (dB)	CISPR 22 Class B Avg	Margin (dB)
13	.17025	36.63	Qp	1.2	0	10.1	47.93	64.95	-17.02	-	-
14	.17025	5.77	Ca	1.2	0	10.1	17.07	-	-	54.95	-37.88
15	.26025	22.68	Qp	.7	0	10.1	33.48	61.42	-27.94	-	-
16	.26025	-2.4	Ca	.7	0	10.1	8.4	-	-	51.42	-43.02
17	.34125	5.87	Qp	.5	0	10.1	16.47	59.17	-42.7	-	-
18	.34687	-6.12	Ca	.5	0	10.1	4.48	-	-	49.04	-44.56
19	16.026	4.92	Qp	.3	.2	10.3	15.72	60	-44.28	-	-
20	16.026	3.09	Ca	.3	.2	10.3	13.89	-	-	50	-36.11
21	23.75025	4.43	Qp	.3	.2	10.4	15.33	60	-44.67	-	-
22	23.75025	3.53	Ca	.3	.2	10.4	14.43	-	-	50	-35.57
23	28.74975	4.83	Qp	.3	.3	10.4	15.83	60	-44.17	-	-
24	28.74975	3.8	Ca	.3	.3	10.4	14.8	-	-	50	-35.2

## Qp - Quasi-Peak detector

## Ca - CISPR average detection