

Global EMC Inc. Labs

EMC & RF Test Report

As per

RSS 210 Issue 8:2010

&

FCC Part 15 Subpart C:2015
Unlicensed Intentional Radiators

on the

Watts Water Quality UV SMARTSTREAM



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Testing produced for



See Appendix A for full customer & EUT details.



Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

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Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Report Scope

This report addresses the EMC testing and test results of the Watts Water Quality UV SMARTSTREAM water treatment system. This unit is herein referred to as EUT (Equipment Under Test). Testing is performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:

RSS 210 Issue 8:2010
FCC Part 15 Subpart C:2015

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

The results contained in this report relate only to the item(s) tested.

This report does not imply product endorsement by A2LA or any other accreditation agency, any government, or Global EMC Inc.


Opinions/interpretations expressed in this report, if any, are outside the scope of Global EMC Inc accreditation. Any opinions expressed do not necessarily reflect the opinions of Global EMC Inc, unless otherwise stated.

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Summary

The results contained in this report relate only to the item(s) tested.

EUT FCC Certification #, FCC ID:	2AFJT-SMARTSTREAM
EUT Industry Canada Certification #, IC:	20623-SMARTSTREAM
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Raymond Lee Au

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Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass <i>See Justifications</i>
FCC 15.205 RSS-GEN (Table 6)	Restricted Bands for intentional operation	Quasi-Peak Average	Pass
FCC 15.207 RSS-GEN (Table 3)	Power Line Conducted Emissions	Quasi-Peak Average	Pass
FCC 15.209 RSS-GEN (Tables 4.5)	Spurious Radiated emissions	Quasi-Peak Average	Pass
Overall Result			PASS

All tests were performed by Raymond Lee Au.

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties. A 'PASS' / 'FAIL' grade within measurement uncertainty is marked with a '*'.

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Justifications, Descriptions, Deviations & Notes

The following justifications for tests not performed or deviations from the above listed specifications apply:

For the antenna requirement specified in FCC 15.203, the antenna is a PCB trace antenna located inside a compartment screwed to the chassis of the unit. The antenna is connected to the PCB using U.FL connectors, which are secured with heatshrink tubing at the antenna end, and glued at the PCB end to prevent unauthorized antenna replacement.


The EUT consists of a family of similar products. The family is separated into two series by the manufacturer, called “Series C” and “Series D.” All of the units in both series have the same PCB and transmitter located in the same locations. Their only difference is the “Series D” units have an LCD display connected, and the “Series C” units have a 7-segment LED display, and 2 buttons, instead of the LCD. The location on the PCB for the LCD connector is depopulated on the “Series C” units, while the locations for the 7-segment LED module and the buttons are depopulated in the “Series D” units. The non-common parts between the two series do not have wireless capabilities. All other components on the control boards are identical.

Within each series there are 6 units, each controlled by the same PCB. The differences among the units in a series are the size and power of the UV lamp it drives, and the size of the plumbing pipe containing the lamp. Units are available in each series with 38, 45, 55, 6, 95, and 112W lamps.


For the Restricted Bands of operation, the 15.209 transmitter is designed to operate at 13.56 MHz.

The terms “Series C” and “Series D” units are used interchangeably with “C-Series,” and “D-Series” respectively in this report.

To cover the range of products in the product family, full testing is performed on a Series C, 45W, unit (model WC016), and a Series D, 112W unit (WD050), as representative of the PCB and lamp combinations of the maximally and minimally configured units. See the table below for a summary of the Series C and Series D units.

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Summary of Product Family							
Series	Model	Tested Unit?	LCD Screen or 7-segment numerical LED display?	Power (W)	Water volume rating (gpm)	Chamber Length (Inches)	Chamber Diameter (Inches)
Series C	WC012	No. To be listed as part of family.	7-segment	38	12	21.3	3.5
	WC016	Yes. Meets 15.209 limits	7-segment	45	16	18.9	4.0
	WC020	Yes. Meets 15.209 limits	7-segment	55	20	22.8	4.0
	WC025	No. To be listed as part of family.	7-segment	64	25	26.4	4.0
	WC040	No. To be listed as part of family.	7-segment	95	40	38.8	4.0
	WC050	No. To be listed as part of family.	7-segment	112	50	44.9	4.0
Series D	WD012	No. To be listed as part of family.	LCD	38	12	23.2	4.0
	WD016	No. To be listed as part of family.	LCD	45	16	18.9	4.0
	WD020	Yes. Meets 15.209 limits.	LCD	55	20	22.8	4.0
	WD025	No. To be listed as part of family.	LCD	64	25	26.4	4.0
	WD040	No. To be listed as part of family.	LCD	95	40	38.2	4.0
	WD050	Yes. Meets 15.209 limits	LCD	112	50	44.9	4.0

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Applicable Standards, Specifications and Methods

ANSI C63.4:2009	- Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.4:2014	- American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2009	- American national standard for testing unlicensed wireless devices
ANSI C63.10:2013	- American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
CFR 47 FCC 15:2015	- Code of Federal Regulations – Radio Frequency Devices
CISPR 22:2008	- Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
ICES-003:2010	- Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
ISO 17025:2005	- General Requirements for the competence of testing and calibration laboratories
RSS-GEN:2014	- Issue 4: General Requirements for Compliance of Radio Apparatus
RSS 210:2010	- Issue 8: Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

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Sample calculation(s)


Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)

Margin = 50.5dBuV/m – (50dBuV + 10dB + 2.5dB – 20dB)

Margin = 8 dB

Document Revision Status

Release 1 - November 13, 2015
 - Initial release.

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Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

AE – Auxillary Equipment.

BW – Bandwidth. Unless otherwise stated, this refers to the 6 dB bandwidth.

EMC – Electro-Magnetic Compatibility

EMI – Electro-Magnetic Immunity

EUT – Equipment Under Test

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line impedance stabilization network

NCR – No Calibration Required

RF – Radio Frequency


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Testing Facility

Testing for EMC on the EUT was carried out at Global EMC labs in Toronto, Ontario, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog, and Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN.

Calibrations and Accreditations

The measurement site used is registered with Federal Communications Commission (FCC) and Industry Canada (IC). This site is calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”. The semi-anechoic chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

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Testing Environmental Conditions and Dates


Following were the environmental conditions in the facility during time of testing –

Date	Test	Init.	Temperature (°C)	Humidity (%)	Pressure (kPa)
Oct. 7, 2015	RE	RA	20-25°C	30-45%	100 -103kPa
Oct. 9, 2015	CE	RA	20-25°C	30-45%	100 -103kPa
Oct.12, 2015	BW	RA	20-25°C	30-45%	100 -103kPa

RE = Radiated Emissions
CE = Conducted Emissions
BW = Bandwidth Measurements

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Detailed Test Results Section

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Radiated Emissions – Spurious

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limit(s) and Method

The method is as defined in ANSI C63.4:2009.


The limits are as defined in FCC Part 15, Section 15.209:

0.009 MHz – 0.490 MHz:	2400/ F uV/m ($67.6-20\log F$ dBuV/m) at 300 m ⁽¹⁾ ($147.6-20\log(F)$ at 3 m) ⁽¹⁾
0.490 MHz – 1.705 MHz:	24000/ F uV/m ($87.6-20\log(F)$ dBuV/m) at 30 m ⁽¹⁾ ($127.6-20\log(F)$ at 3 m) ⁽¹⁾
1.705 MHz – 30.0 MHz:	30 uV/m (29.5 dBuV/m) at 30 m ⁽¹⁾ , (69.5 dBuV/m at 3m) ⁽¹⁾
30 MHz – 88 MHz:	100 uV/m (40.0 dBuV/m ¹) at 3 m ⁽¹⁾
88 MHz – 216 MHz:	150 uV/m (43.5 dBuV/m ¹) at 3 m ⁽¹⁾
216 MHz – 960 MHz:	200 uV/m (46.0 dBuV/m ¹) at 3 m ⁽¹⁾
Above 960 MHz:	500 uV/m (54.0 dBuV/m ¹) at 3 m ⁽¹⁾
Above 1000 MHz:	500 uV/m (54 dBuV/m ²) at 3m ⁽²⁾
Above 1000 MHz:	500 uV/m (74 dBuV/m ³) at 3m ⁽³⁾

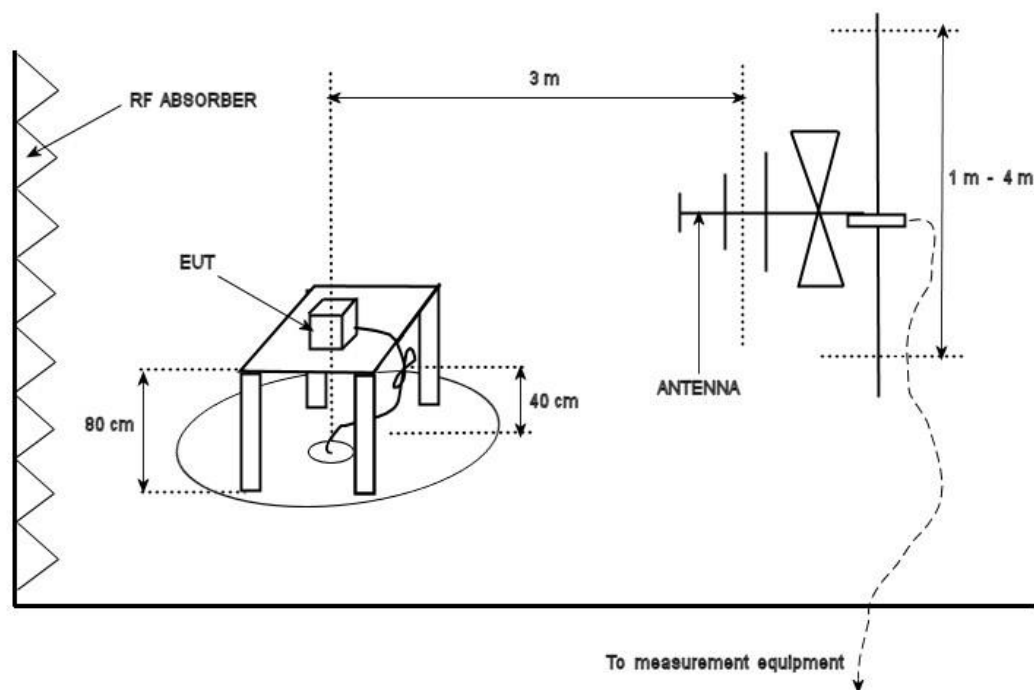
⁽¹⁾ Limit is with Quasi Peak detector with bandwidths as defined in CISPR-16-1-1.

⁽²⁾ Limit is with 1 MHz measurement bandwidth and using an Average detector.

⁽³⁾ Limit is with 1 MHz measurement bandwidth and using a Peak detector

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Typical Radiated Emissions Setup



Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ± 4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graphs shown below are maximized peak measurement graphs, measured with a resolution bandwidth greater than or equal to, the final required detector and over a full 0-360° rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to the 10th harmonic.

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Devices may be scanned at alternate test distances, and in accordance with FCC Part 15, Subpart A, Section 15.31, an extrapolation factor of 20 dB/decade was used above 30 MHz and 40 dB/decade below 30 MHz. For example for 1 meter measurements, an extrapolation factor 9.5 dB from 20 Log (1m/3m) is applied.


See final measurement section for all measurements.

The EUT was scanned with the transmitter on and transmitting continuous modulated data at maximum power

Plots and measurements are made at a 3 meter distance.

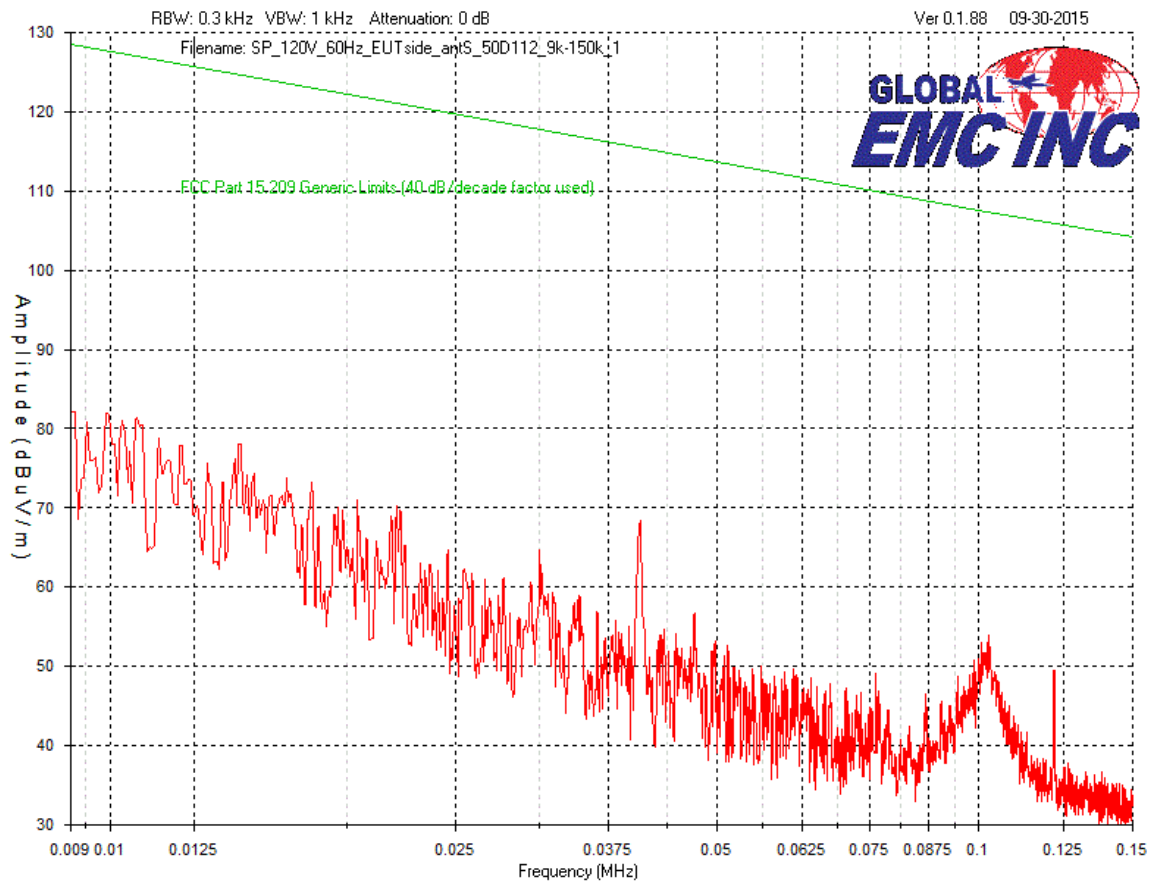
The EUT was scanned in the 3 orthogonal positions, and results from the worst case position are presented in this report.


Models WD020 and WC020, which have the same water chamber, are also tested as a spot check to confirm that units incorporating an intermediate size of the water chamber would produce emissions similar to those with water chamber sizes at the extremes of the size spectrum, and not produce emissions that would fail.

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Peak Emissions Graph
9 kHz to 150 kHz
3 meter test distance

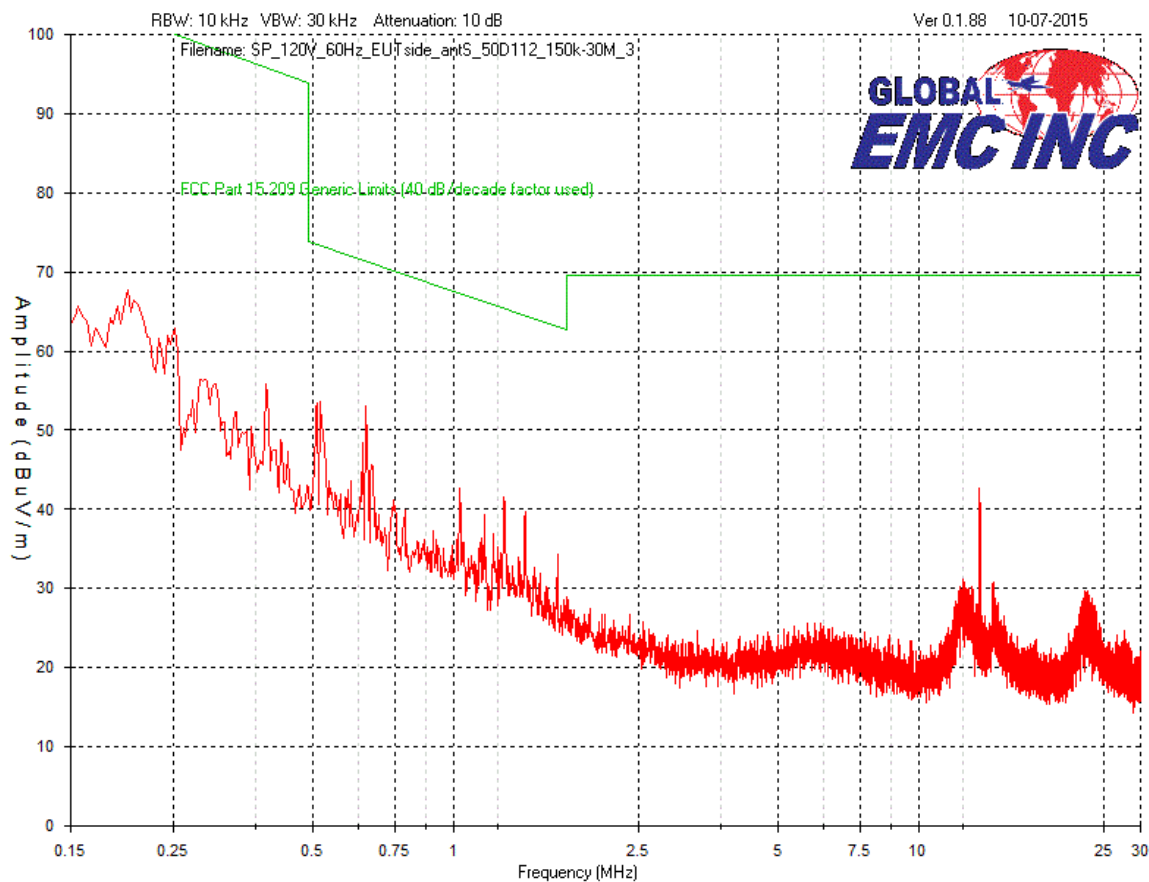
WD050 (D-Series, 112W lamp)




Client	Watts Water Quality	
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Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Peak Emissions Graph
150 kHz to 30 MHz
3 meter test distance

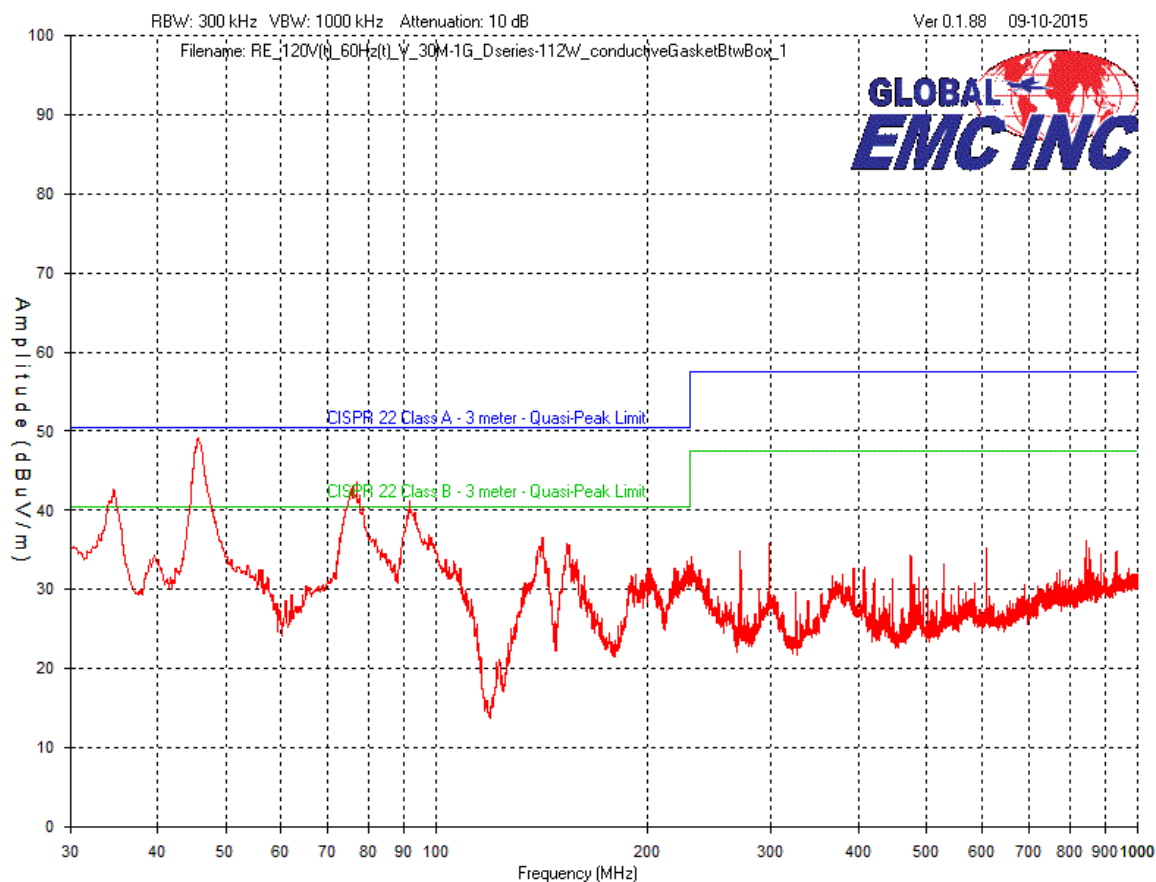
WD050 (D-Series, 112W lamp)




Client	Watts Water Quality	
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Peak Emissions Graph
Vertical Antenna Polarity
30 MHz to 1 GHz
3 meter test distance

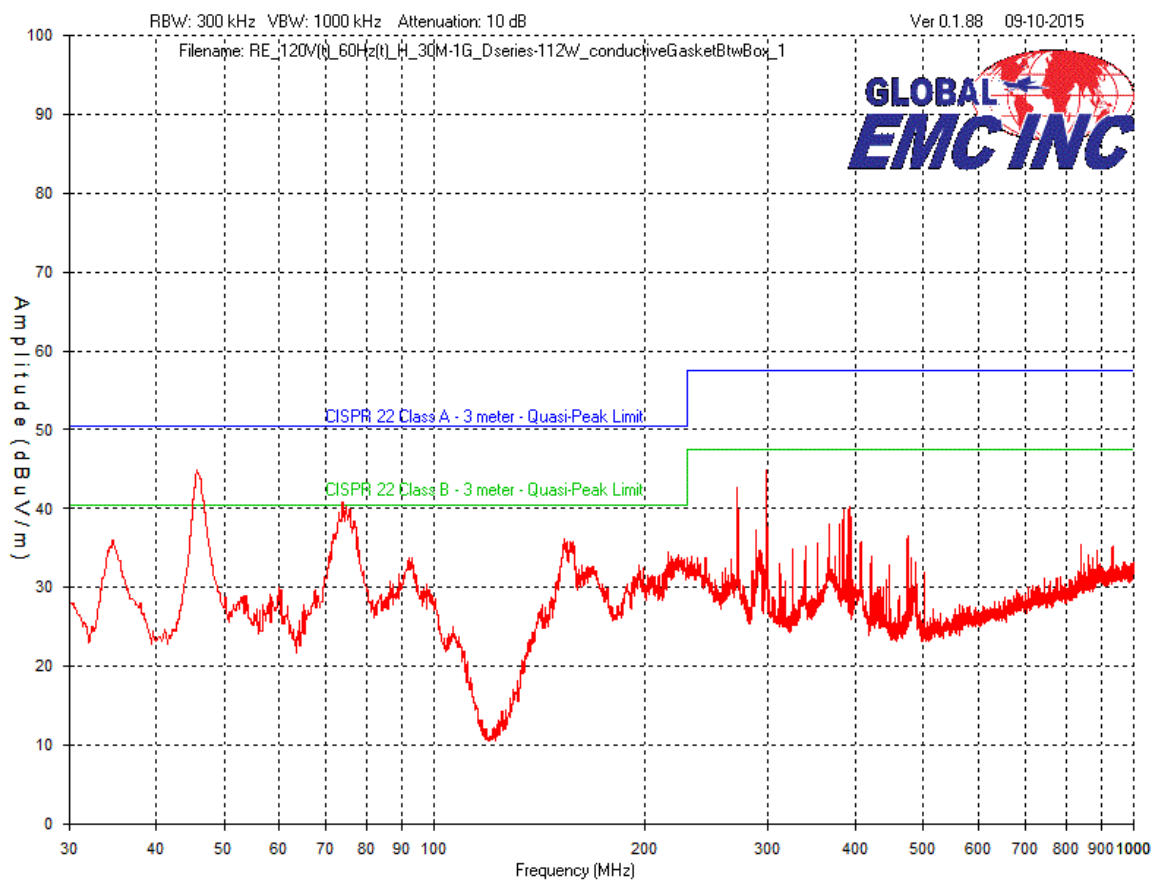
WD050 (D-Series, 112W lamp)




Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Peak Emissions Graph
Horizontal Antenna Polarity
30 MHz to 1 GHz
3 meter test distance

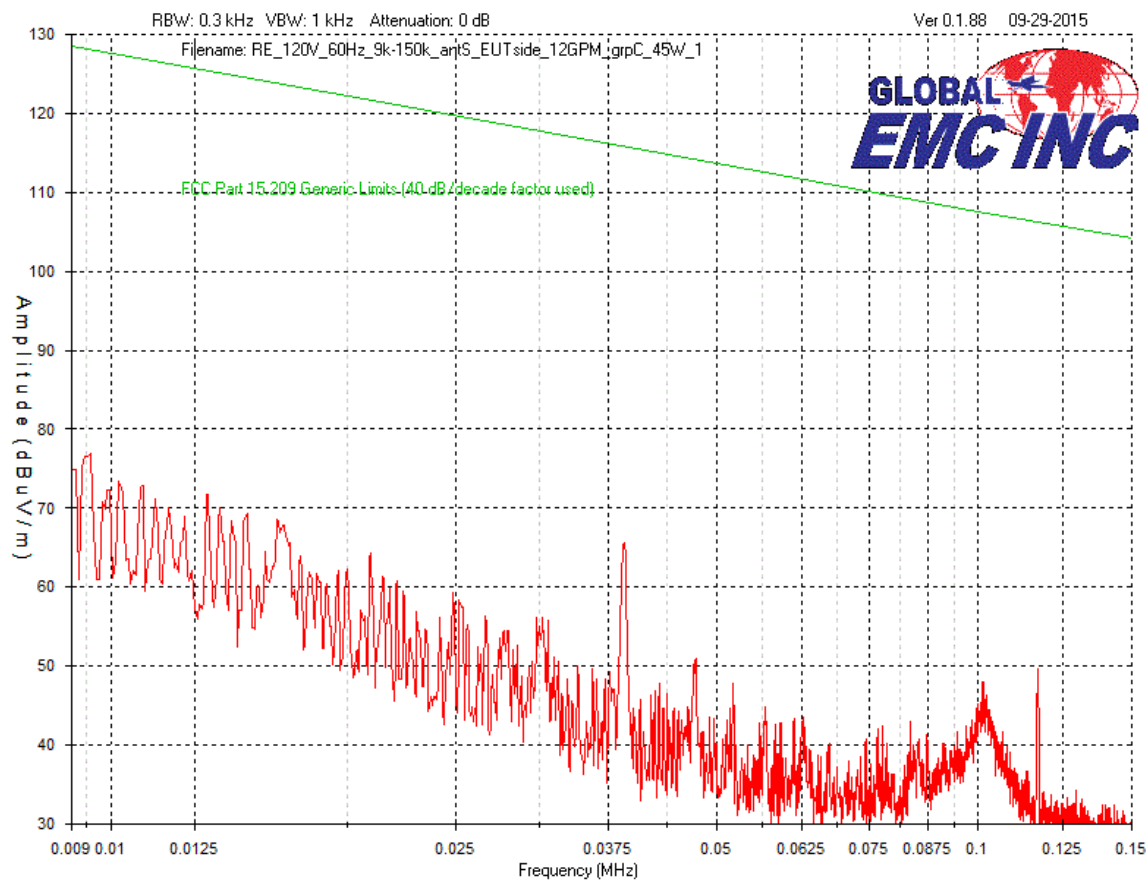
WD050 (D-Series, 112W lamp)




Client	Watts Water Quality	
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Peak Emissions Graph
9 kHz to 150 kHz
3 meter test distance

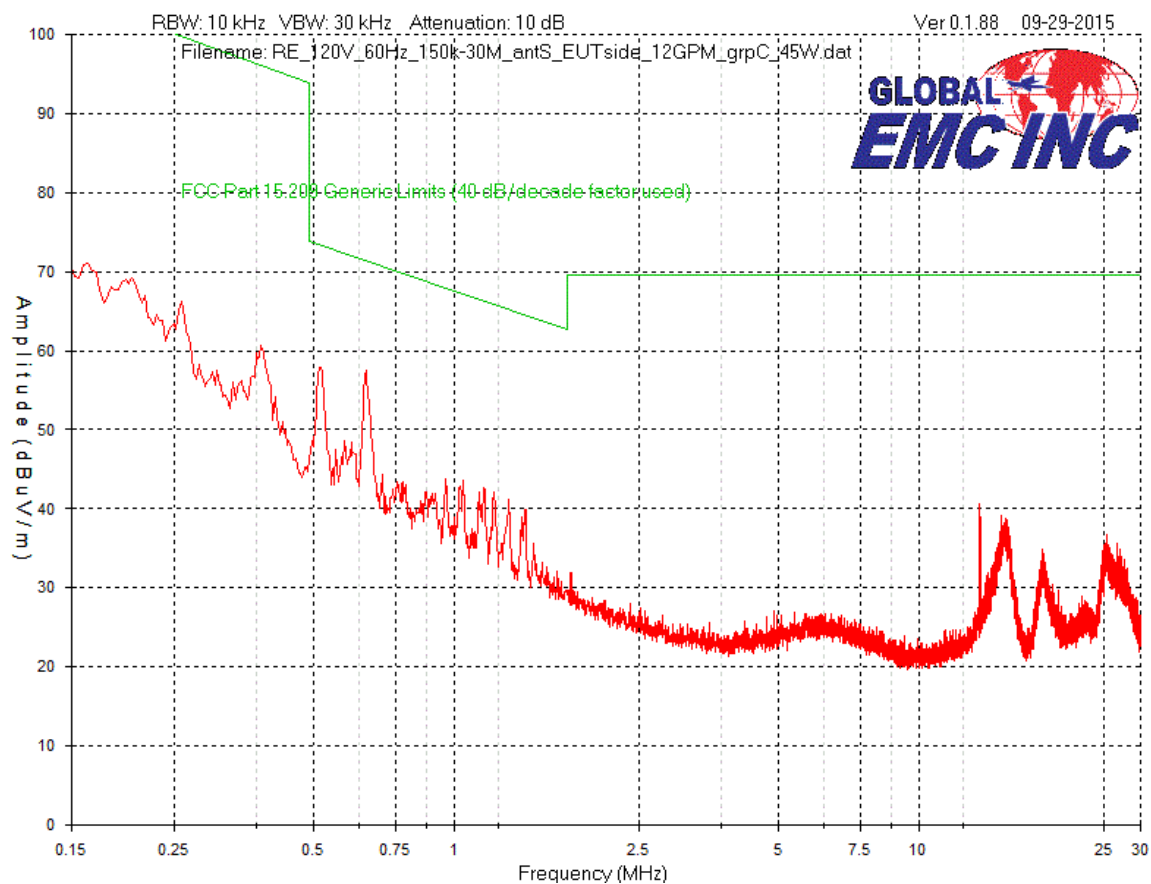
WC016 (C-Series, 45W lamp)




Client	Watts Water Quality	
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Peak Emissions Graph
150 kHz to 30 MHz
3 meter test distance

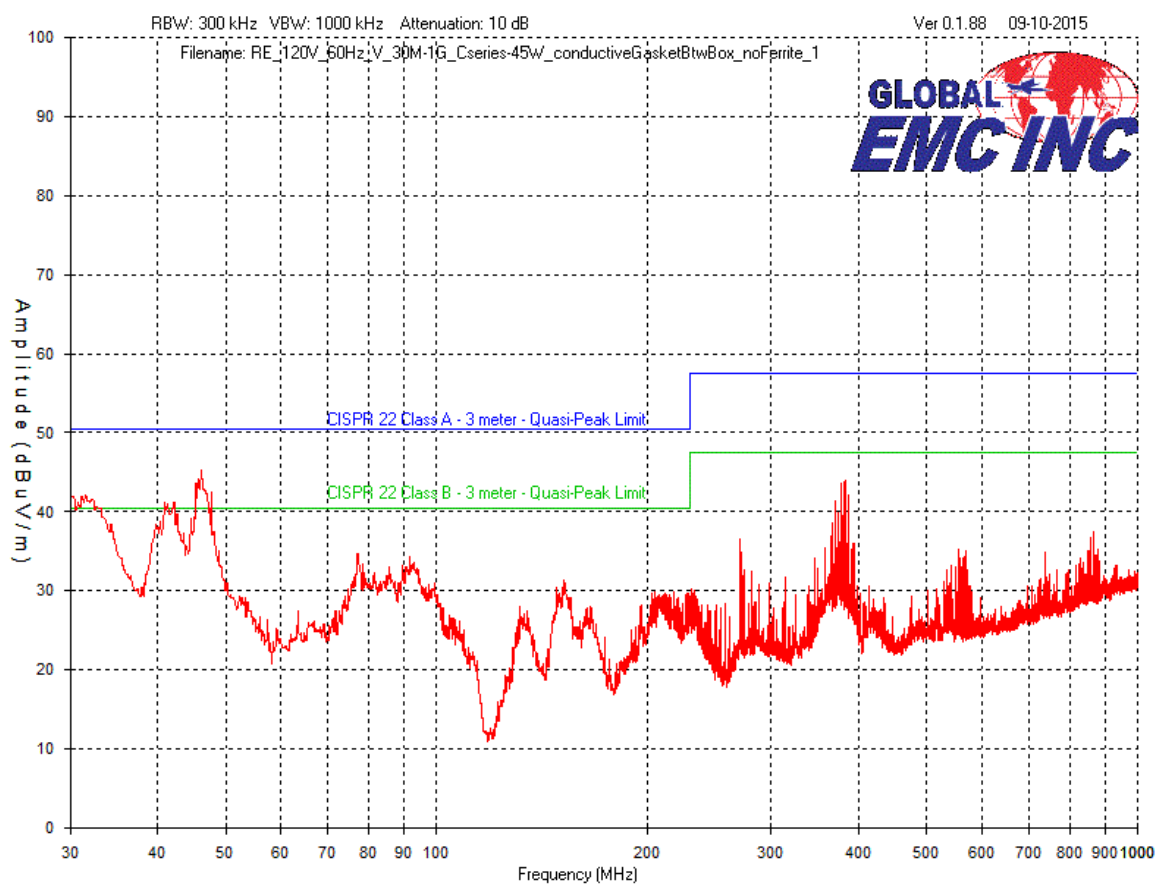
WC016 (C-Series, 45W lamp)




Client	Watts Water Quality	
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Graph
Vertical Antenna Polarity
30 MHz to 1 GHz
3 meter test distance

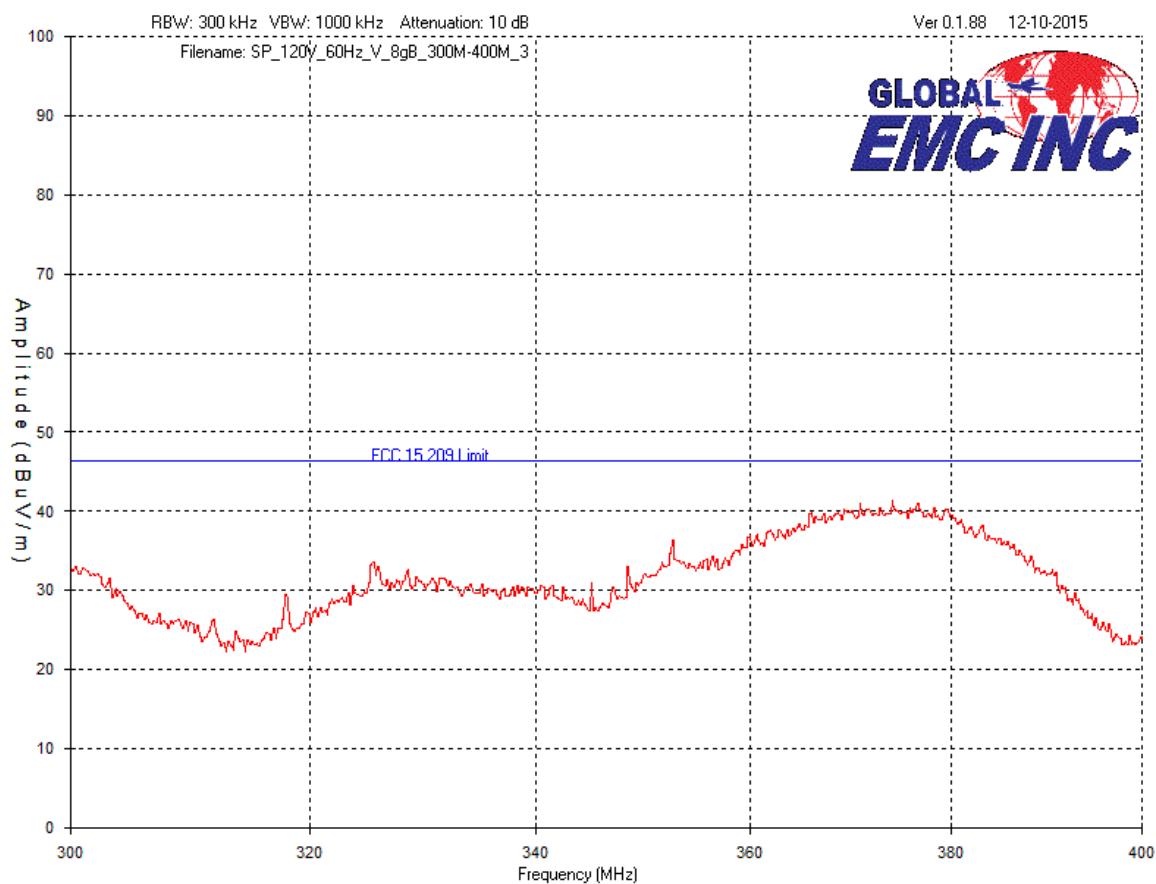
WC016 (C-Series, 45W lamp)




Client	Watts Water Quality	
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Graph
Vertical Antenna Polarity
300 MHz to 400 GHz
3 meter test distance

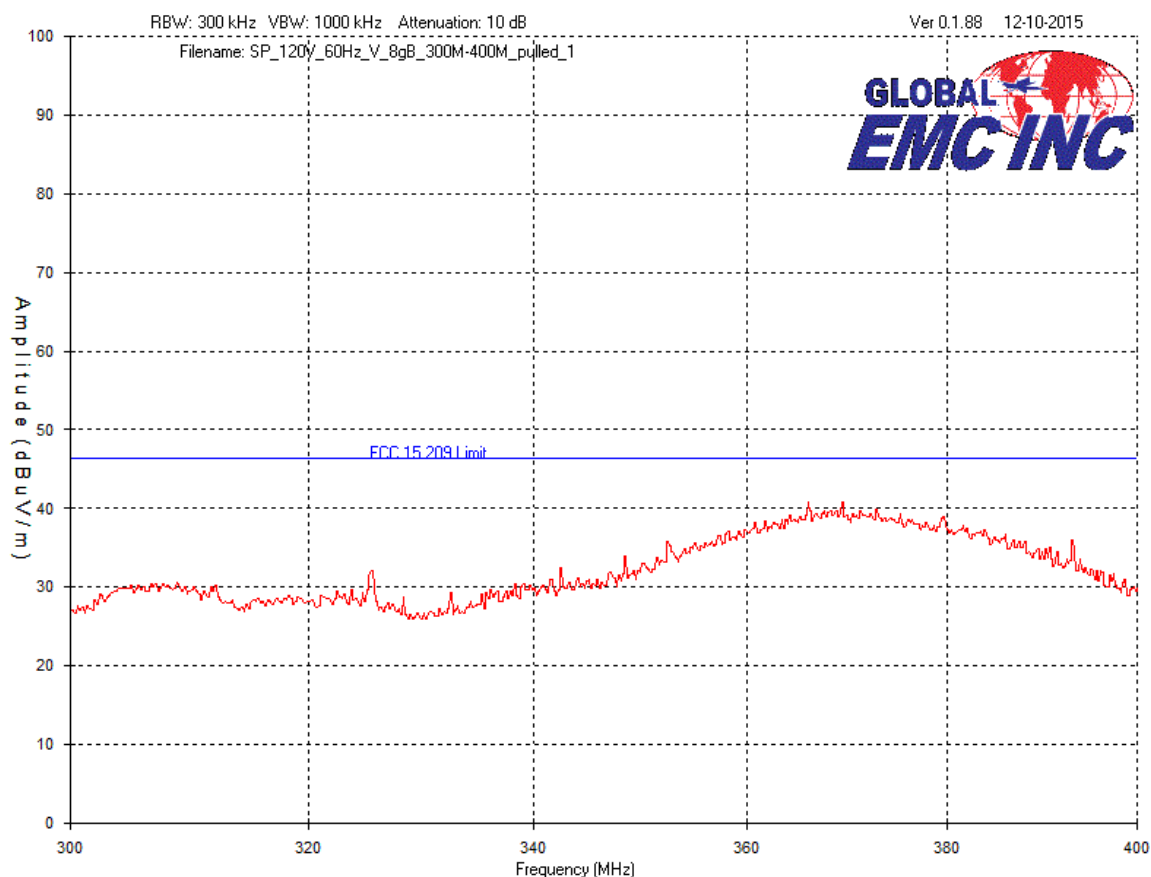
WC016 (C-Series, 45W lamp)
Active RFID




Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Graph
Vertical Antenna Polarity
300 MHz to 400 MHz
3 meter test distance

WC016 (C-Series, 45W lamp)
Pulled RFID

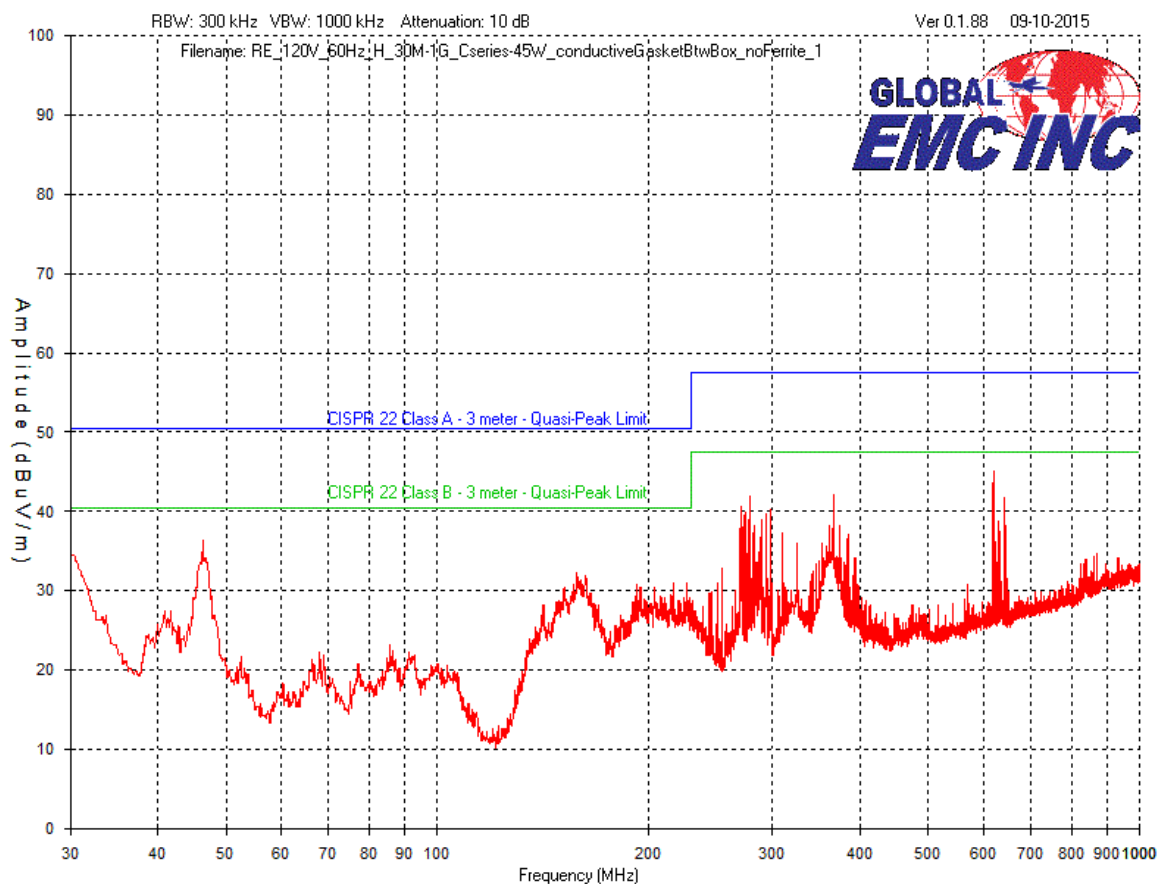



The previous 2 graphs are used to further investigate whether the peaks observed between 300 – 400 MHz are occurring due to the wireless transmitter, or from elsewhere in the EUT. The spikes observed are noise present with and without the wireless component active. They come from the elsewhere on the EUT, and not the wireless component.

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Peak Emissions Graph
Horizontal Antenna Polarity
30 MHz to 1 GHz
3 meter test distance

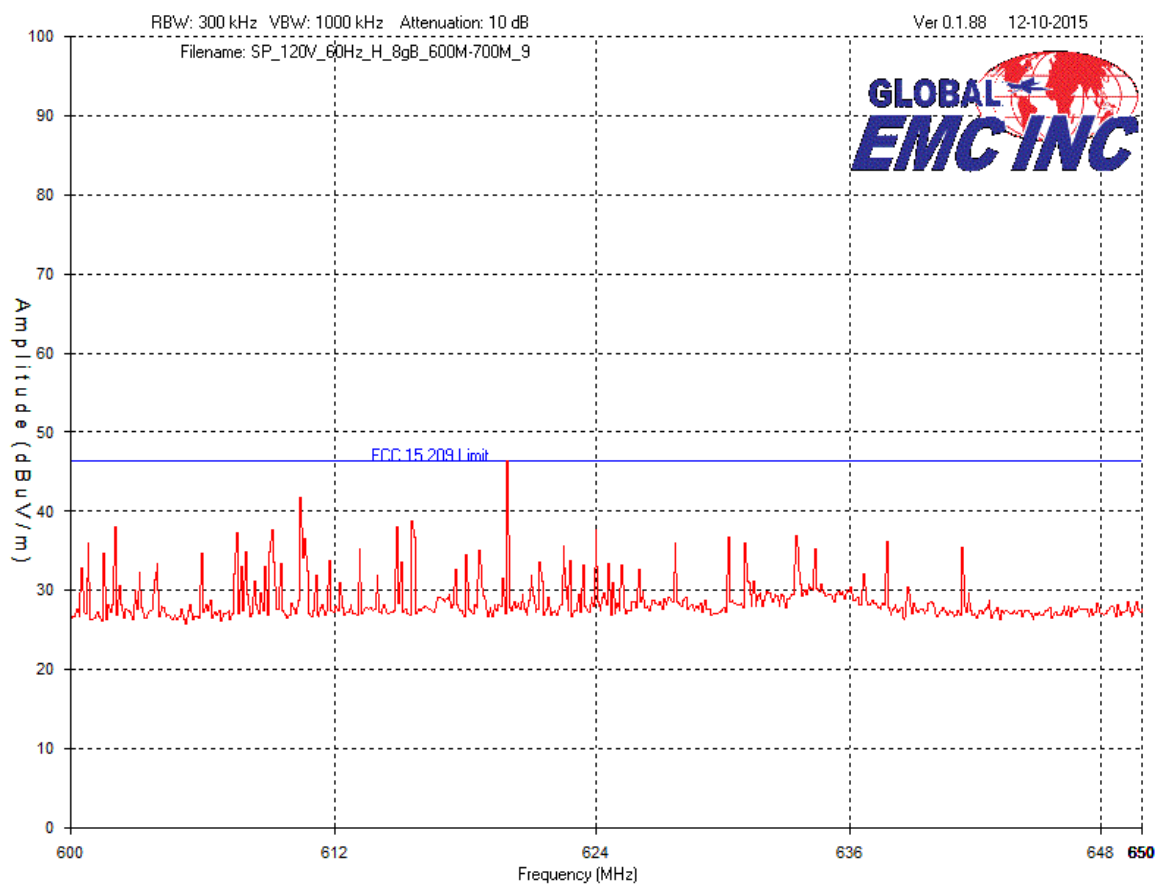
WC016 (C-Series, 45W lamp)




Client	Watts Water Quality	
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Graph
Horizontal Antenna Polarity
600 MHz to 650 MHz
3 meter test distance

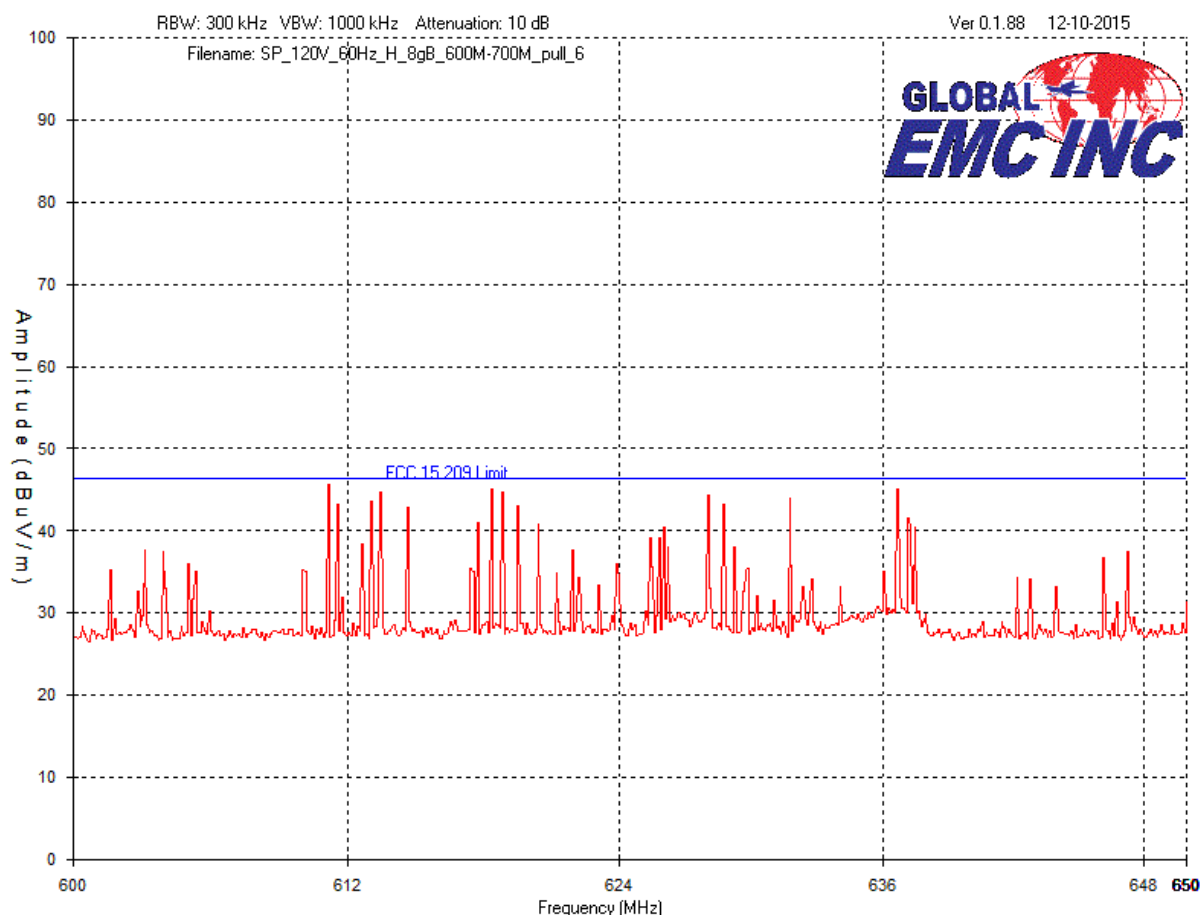
WC016 (C-Series, 45W lamp)
Active RFID




Client	Watts Water Quality	
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Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Graph
Horizontal Antenna Polarity
600 MHz to 650 MHz
3 meter test distance

WC016 (C-Series, 45W lamp)
Pulled RFID

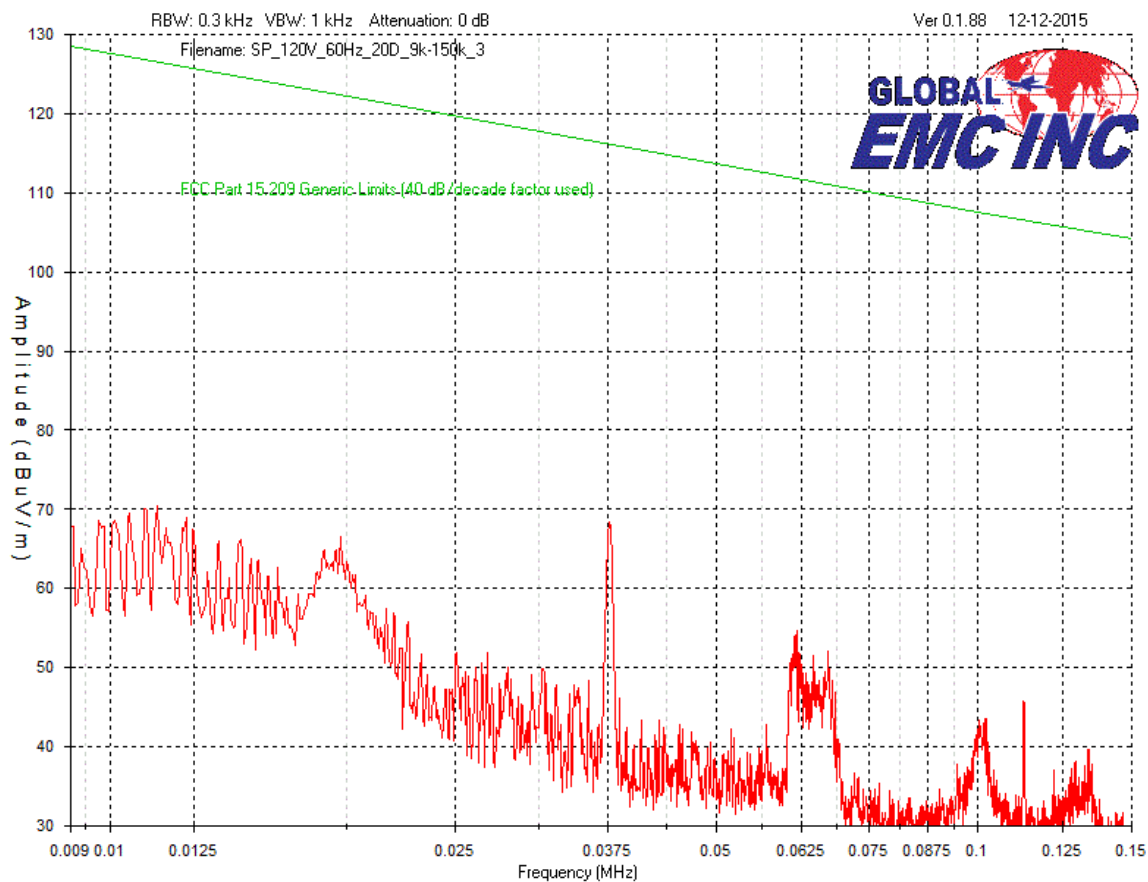



The previous 2 graph are used to further investigate whether the peaks observed between 600 – 650 MHz are occurring due to the wireless transmitter, or from elsewhere in the EUT. The spikes observed are all transient noise present with and without the wireless component active. They come from the elsewhere on the EUT, and not the wireless component.

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Peak Emissions Graph
9 kHz to 150 kHz
3 meter test distance

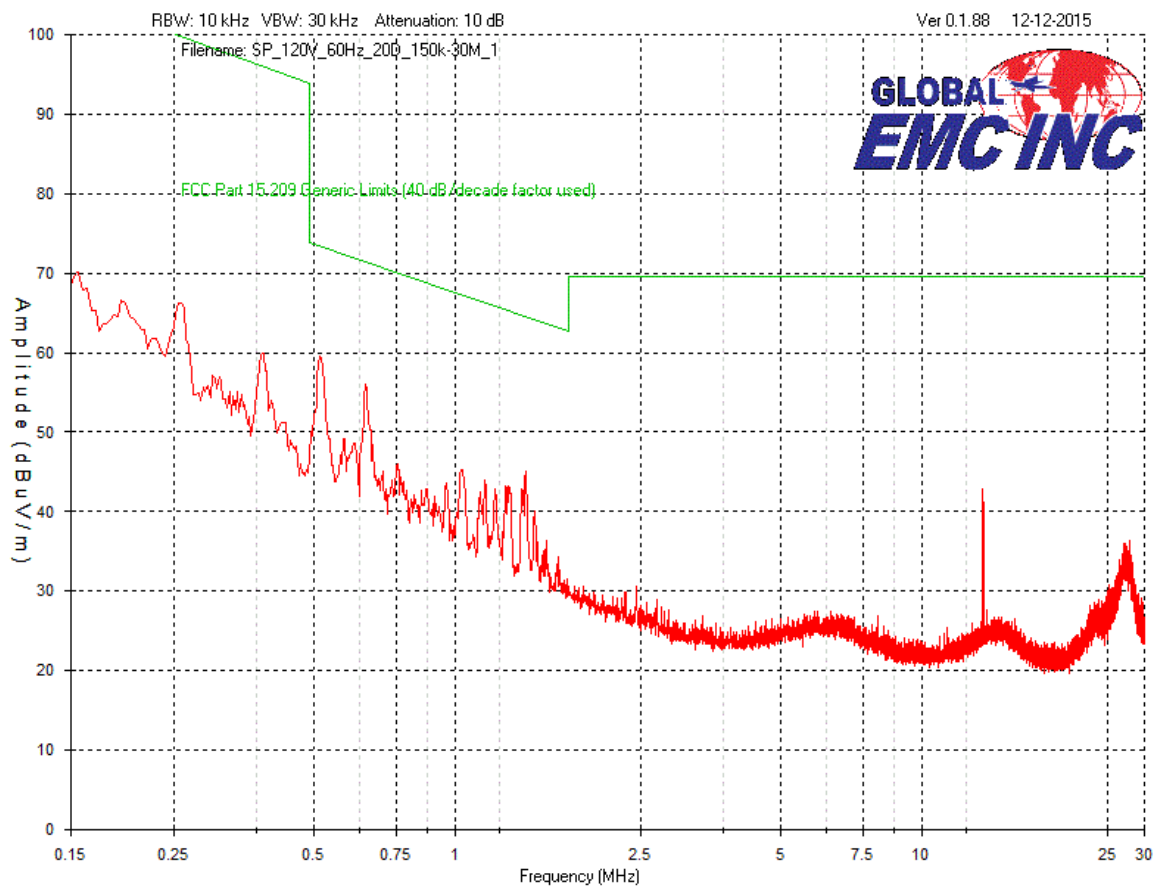
WD020 (D-Series, 55W lamp)




Client	Watts Water Quality	
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Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Peak Emissions Graph
150 kHz to 30 MHz
3 meter test distance

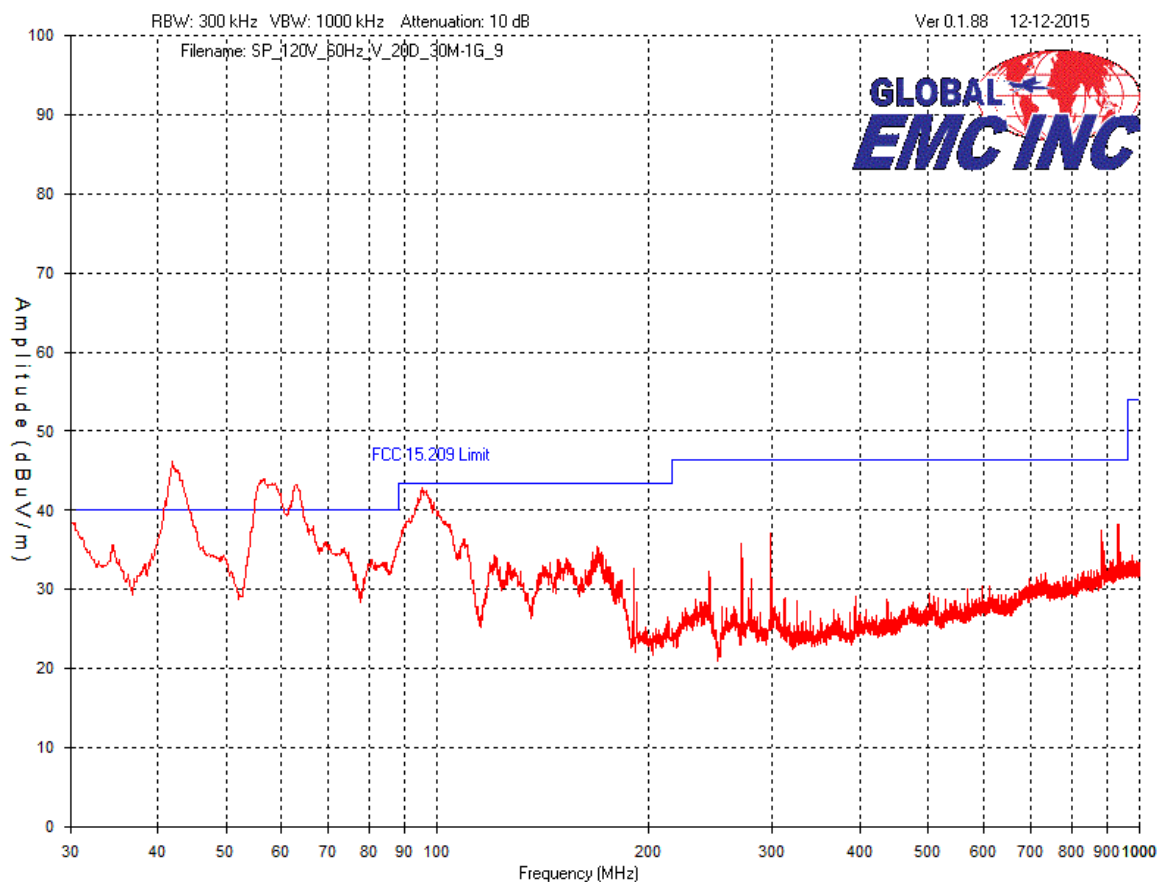
WD020 (D-Series, 55W lamp)




Client	Watts Water Quality	
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Peak Emissions Graph
Vertical Antenna Polarity
30 MHz to 1 GHz
3 meter test distance

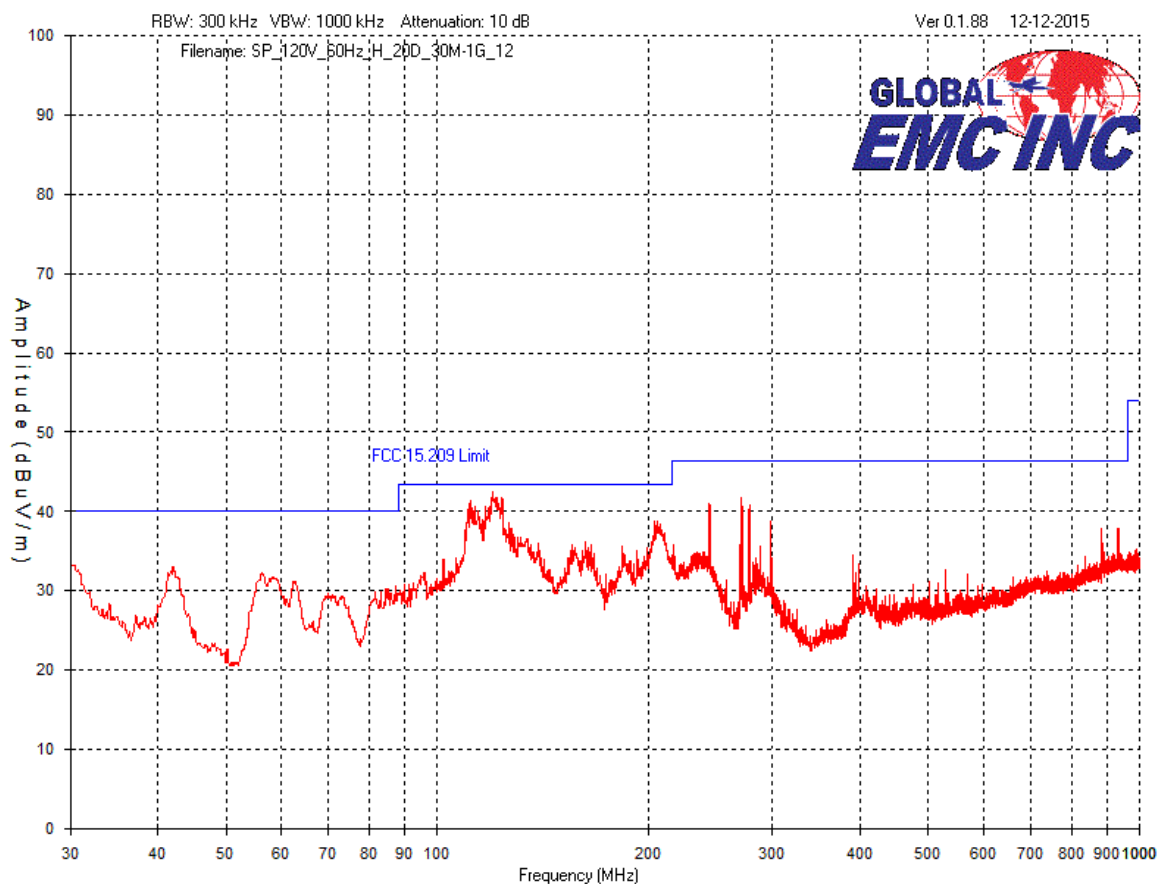
WD020 (D-Series, 55W lamp)




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Peak Emissions Graph
Horizontal Antenna Polarity
30 MHz to 1 GHz
3 meter test distance

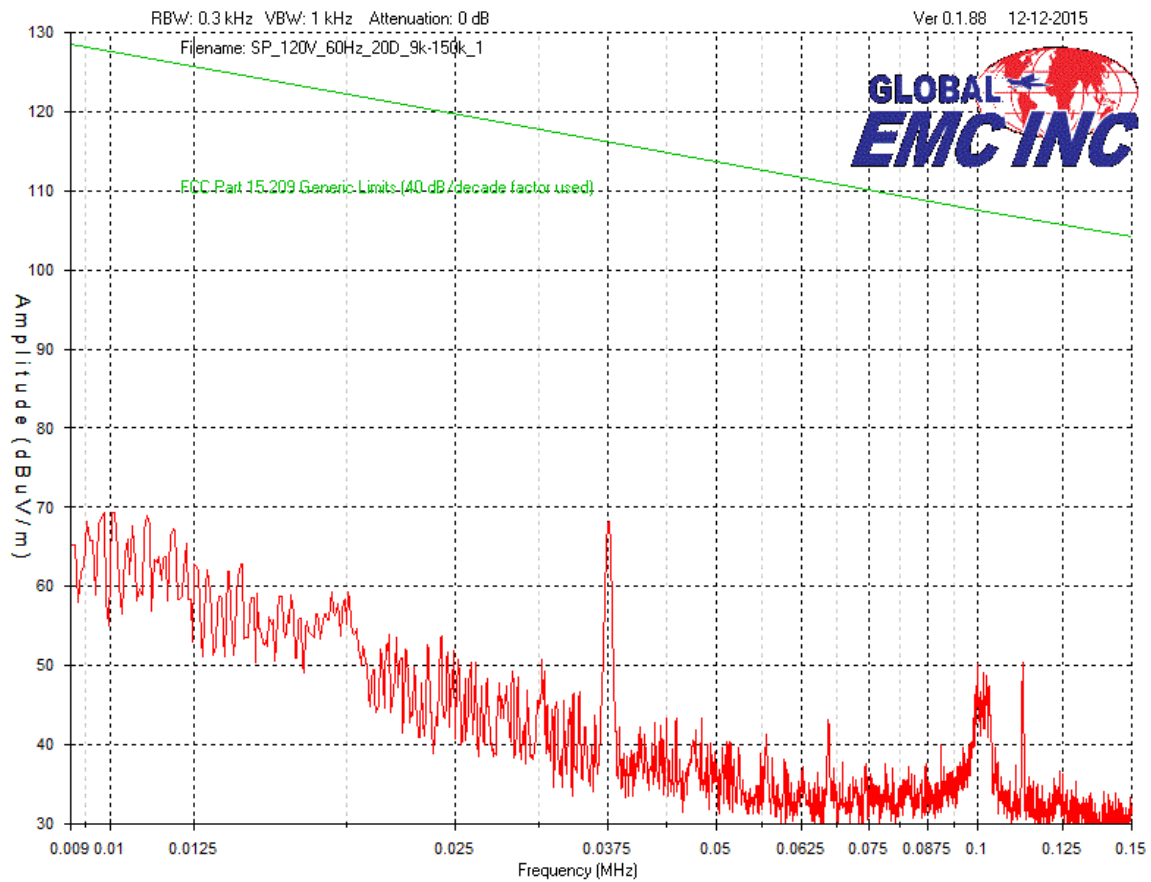
WD020 (D-Series, 55W lamp)




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Peak Emissions Graph
9 kHz to 150 kHz
3 meter test distance

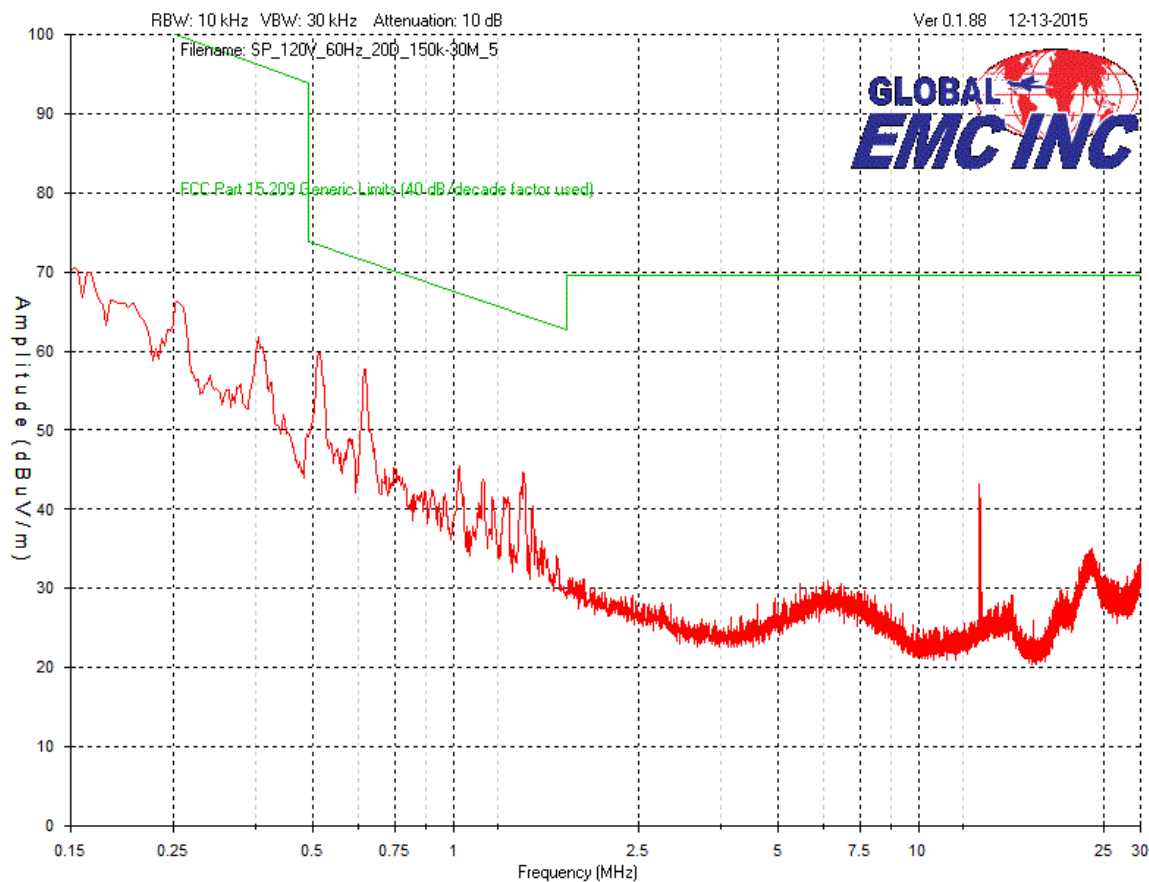
WC020 (C-Series, 55W lamp)




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Peak Emissions Graph
150 kHz to 30 MHz
3 meter test distance

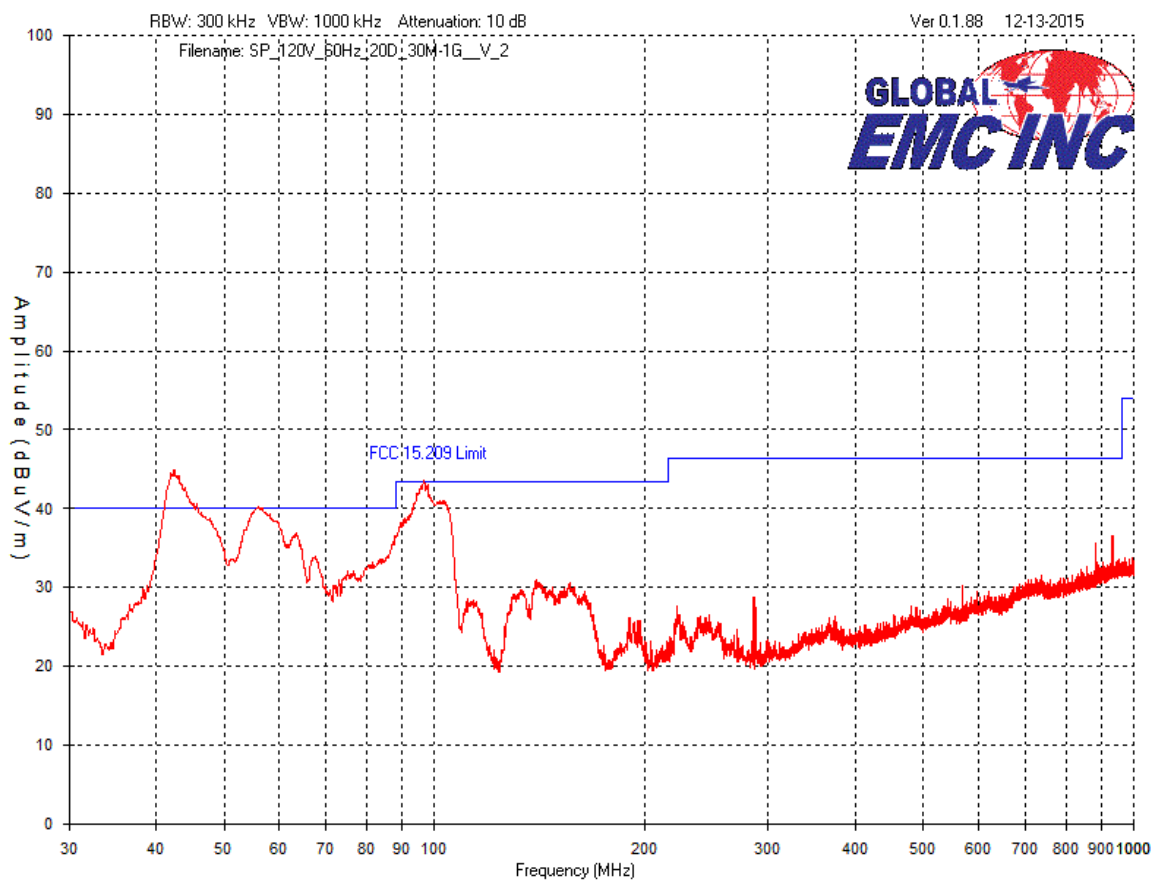
WC020 (C-Series, 55W lamp)




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Peak Emissions Graph
Vertical Antenna Polarity
30 MHz to 1 GHz
3 meter test distance

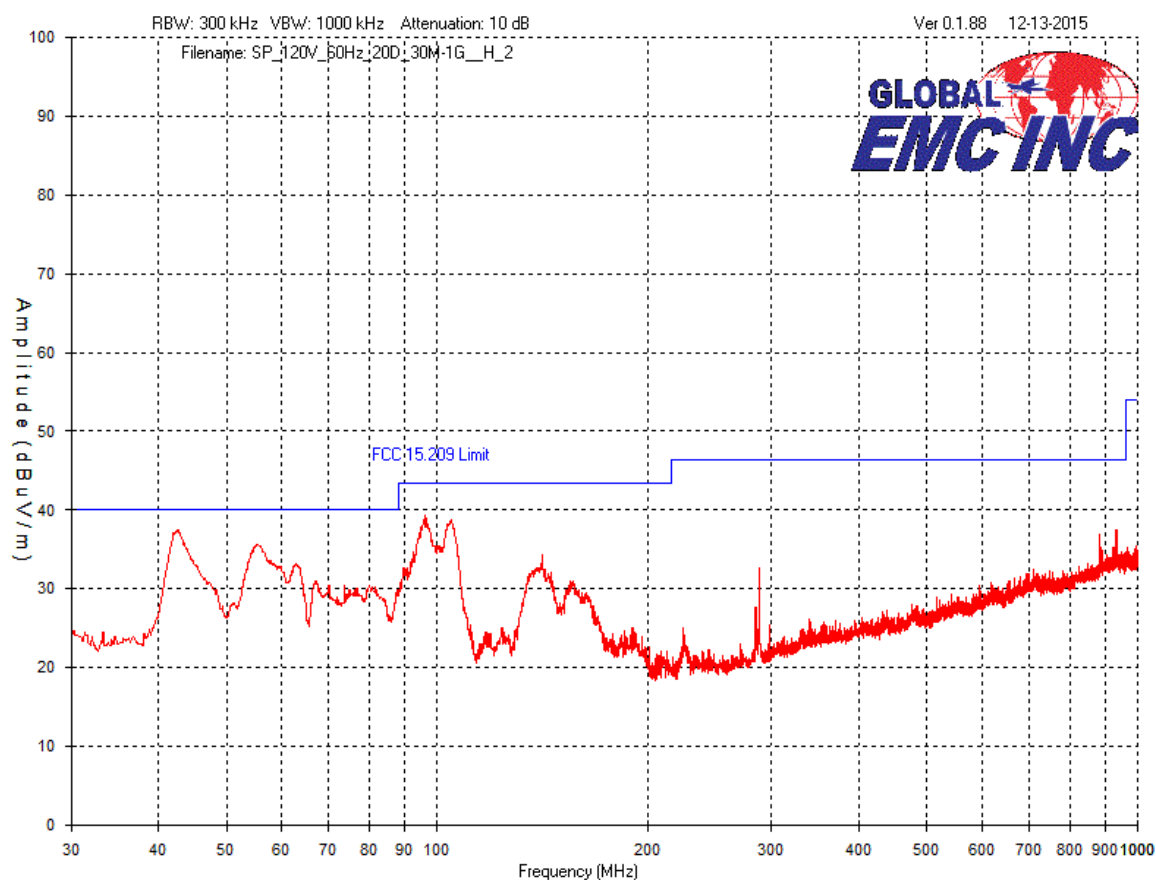
WC020 (C-Series, 55W lamp)




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Peak Emissions Graph
Horizontal Antenna Polarity
30 MHz to 1 GHz
3 meter test distance

WC020 (C-Series, 55W lamp)




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Final Measurements

Radiated Emissions
Spurious measurements
3m test distance

WD050 (D-Series, 112W lamp)

Test Frequency (MHz)	Detection mode	Raw signal dB(μV)	Antenna factor (dB)	Cable loss + Pre-selector (dB)	Pre-Amp Gain dB	Received signal dB(μV/m)	Emission limit dB(μV/m)	Margin dB(μV)	Result
Vertical Antenna Polarity									
45.7	QP	61.03	8.9	0.6	-33.1	37.43	40	2.57	Pass
77.0	QP	56.71	5.8	0.7	-33.2	30.01	40	9.99	Pass
34.7	QP	48.27	13.5	0.5	-33.1	29.17	40	10.83	Pass
91.6	QP	50.89	8.4	0.8	-33.2	26.89	43.5	16.61	Pass
141.6	Peak	60.9	8.1	0.9	-33.3	36.6	43.5	6.9	Pass
153.3	Peak	58.6	9.5	0.9	-33.3	35.7	43.5	7.8	Pass
Horizontal Antenna Polarity									
45.7	QP	59.12	10.6	0.6	-33.1	37.22	40	2.78	Pass
73.9	QP	58.69	6.7	0.7	-33.2	32.89	40	7.11	Pass
298.2	QP	56.3	13.9	1.3	-33.7	37.8	46.4	8.6	Pass
153.3	Peak	59.1	9.3	0.9	-33.3	36	43.5	7.5	Pass
34.7	Peak	52.8	15.8	0.5	-33.1	36	40	4	Pass
271.1	Peak	61.4	13.2	1.3	-33.6	42.3	46.4	4.1	Pass


Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Radiated Emissions
Spurious measurements
3m test distance

WC016 (C-Series, 45W lamp)

Test Frequency (MHz)	Detection mode	Raw signal dB(μV)	Antenna factor (dB)	Attenuator (dB)	Cable loss + Pre-selector (dB)	Pre-Amp Gain dB	Received signal dB(μV/m)	Emission limit dB(μV/m)	Margin dB(μV)	Result
Vertical Antenna Polarity										
46.1	QP	53.3	8.7	0	0.6	-33.1	29.5	40	10.5	Pass
31.6	QP	45.66	15.5	0	0.5	-33.1	28.56	40	11.44	Pass
40.9	QP	50.43	10.4	0	0.5	-33.1	28.23	40	11.77	Pass
382.2	QP	46.12	15.5	0	1.5	-33.9	29.22	46.4	17.18	Pass
377.0	QP	48.29	15.4	0	1.5	-33.8	31.39	46.4	15.01	Pass
378.0	Peak	60.4	15.5	0	1.5	-33.8	43.6 ^a	46.4	2.8	Pass
386.1	Peak	58.9	15.5	0	1.5	-33.9	42 ^a	46.4	4.4	Pass
Horizontal Antenna Polarity										
620.1	QP	52.7	20.7	0	1.9	-33.7	41.6	46.4	4.8	Pass
610.5	QP	23.94	20.4	3	1.9	-33.7	15.54	46.4	30.86	Pass
618.0	QP	27.26	20.7	3	1.9	-33.7	19.16	46.4	27.24	Pass
618.3	Peak	54.7	20.7	0	1.9	-33.7	43.6 ^a	46.4	2.8	Pass
46.3	Peak	58.6	10.4	0	0.6	-33.1	36.5	40.0	3.5	Pass
365.9	Peak	58.7	15.9	0	1.5	-33.8	42.3 ^a	46.4	4.1	Pass
278.1	Peak	61.2	13	0	1.3	-33.6	41.9 ^a	46.4	4.5	Pass
639.9	Peak	52.9	20.5	0	1.9	-33.7	41.6 ^a	46.4	4.8	Pass


^a Emissions were investigated and observed to be derived from elsewhere in the EUT and not from the wireless components.

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Radiated Emissions
Spurious measurements
3m test distance

WD020 (D-Series, 55W lamp)


Test Frequency (MHz)	Detection mode	Raw signal dB(μV)	Antenna factor (dB)	Attenuator (dB)	Cable loss + Pre-selector (dB)	Pre-Amp Gain dB	Received signal dB(μV/m)	Emission limit dB(μV/m)	Margin dB(μV)	Result
Vertical Antenna Polarity										
41.8	QP	58.0	9.8	3	0.6	-33.1	38.3	40	1.7	Pass
56.7	QP	58.8	8.2	3	0.6	-33.1	37.5	40	2.5	Pass
58.6	QP	58.13	7.9	3	0.6	-33.1	36.53	40	3.47	Pass
62.8	QP	56.81	6	3	0.7	-33.1	33.41	40	6.59	Pass
95.1	QP	57.41	9	3	0.8	-33.2	37.01	43.5	6.49	Pass
30.4	Peak	52.7	15.3	3	0.5	-33.1	38.4	40	1.6	Pass
Horizontal Antenna Polarity										
120.0	QP	51.85	7.7	3	0.9	-33.3	30.15	43.5	13.35	Pass
111.2	QP	44.67	8.4	3	0.8	-33.2	23.67	43.5	19.83	Pass
205.9	Peak	57.6	10.6	3	1.1	-33.4	38.9	43.5	4.6	Pass
271.1	Peak	57.9	13.1	3	1.3	-33.6	41.7	46.4	4.7	Pass
244.0	Peak	58.1	12.3	3	1.2	-33.5	41.1	46.4	5.3	Pass
278.1	Peak	57.1	13	3	1.3	-33.6	40.8	46.4	5.6	Pass

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Radiated Emissions
Spurious measurements
3m test distance

WC020 (C-Series, 55W lamp)


Test Frequency (MHz)	Detection mode	Raw signal dB(μV)	Antenna factor (dB)	Attenuator (dB)	Cable loss + Pre-selector (dB)	Pre-Amp Gain dB	Received signal dB(μV/m)	Emission limit dB(μV/m)	Margin dB(μV)	Result
Vertical Antenna Polarity										
42.4	QP	58.77	9.6	3	0.6	-33.1	38.87	40	1.13	Pass
56.1	QP	56.86	7.9	3	0.6	-33.1	35.26	40	4.74	Pass
96.6	QP	58.91	9	3	0.8	-33.2	38.51	43.5	4.99	Pass
140.1	Peak	52.6	7.7	3	0.9	-33.3	30.9	43.5	12.6	Pass
189.9	Peak	45.3	10.2	3	1.1	-33.4	26.2	43.5	17.3	Pass
286.2	Peak	45.4	12.7	3	1.3	-33.6	28.8	46.4	17.6	Pass
Horizontal Antenna Polarity										
42.6	Peak	55.9	11.2	3	0.6	-33.1	37.6	40	2.4	Pass
96.0	Peak	60.3	8.4	3	0.8	-33.2	39.3	43.5	4.2	Pass
55.2	Peak	56.8	8.3	3	0.6	-33.1	35.6	40	4.4	Pass
141.2	Peak	55.7	8	3	0.9	-33.3	34.3	43.5	9.2	Pass
288.0	Peak	48.9	13.1	3	1.3	-33.6	32.7	46.4	13.7	Pass
636.7	Peak	37.4	20.5	3	1.9	-33.7	29.1	46.4	17.3	Pass

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	May 21, 2014	May 21, 2016	GEMC 193
Quasi-Peak Adapter	85650A	HP	May 22, 2014	May 22, 2016	GEMC 194
Loop Antenna 30Hz – 1MHz	EM 6871	Electro-Metrics	Feb. 3, 2015	Feb. 3, 2017	GEMC 70
Loop Antenna 100kHz – 30MHz	EM 6872	Electro-Metrics	Feb. 3, 2015	Feb. 3, 2017	GEMC 71
BiLog Antenna	3142-C	ETS	Feb. 10, 2015	Feb. 10, 2017	GEMC 137
Preamplifier	CPA9231A	Chase	Sept. 9, 2014	Sept. 9, 2016	GEMC 6403
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29

This report module is based on GEMC template "FCC - 15.209 - Radiated Emissions_Rev1.doc"

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Radiated Emissions – Fundamental

Purpose

The purpose of these tests is to ensure that the RF energy emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference. RF energy unintentionally emitted from the EUT, and the intentionally emitted fundamental and its harmonics, have limits as shown below.

Limit(s) and Method

The method is as defined in ANSI C63.4:2009 and as per applicable standards.

For the fundamental and harmonics, the limits are as defined in FCC Part 15, Section 15.209 (at 3m):

Fundamental frequency	Field strength limits	Field strength limit of fundamental
1.705-30.0 MHz ⁴	30 μ V/m at 30m	At 13.56 MHz: 69.54 dB μ V/m at 3m

For other spurious emissions, the limits are as defined in FCC Part 15, Section 15.209:

0.009 MHz – 0.490 MHz, 2400/F(kHz) μ V/m ^{(3),(4)} at 300m

0.490 MHz – 1.705 MHz, 24000/F(kHz) μ V/m ⁽⁴⁾ at 30 m

30 MHz – 88 MHz, 100 μ V/m (40.0 dB μ V/m ⁽¹⁾) at 3 m

88 MHz – 216 MHz, 150 μ V/m (43.5 dB μ V/m ⁽¹⁾) at 3 m

216 MHz – 960 MHz, 200 μ V/m (46.4 dB μ V/m ⁽¹⁾) at 3 m


Above 960 MHz, 500 μ V/m (54.0 dB μ V/m ⁽¹⁾) at 3 m

Above 1000 MHz, 500 μ V/m (54 dB μ V/m ⁽²⁾) at 3m

⁽¹⁾ Limit is with 120 kHz measurement bandwidth and a using a Quasi Peak detector.

⁽²⁾ Limit is with 1 MHz measurement bandwidth and using an Average detector. A peak limit of 20 dB higher additionally applies.

⁽³⁾ In the frequency bands 9 – 90 kHz, and 110 – 490 kHz, limit is defined using an Average detector. A peak limit of 20 dB higher additionally applies. Otherwise it is a using a Quasi Peak detector.

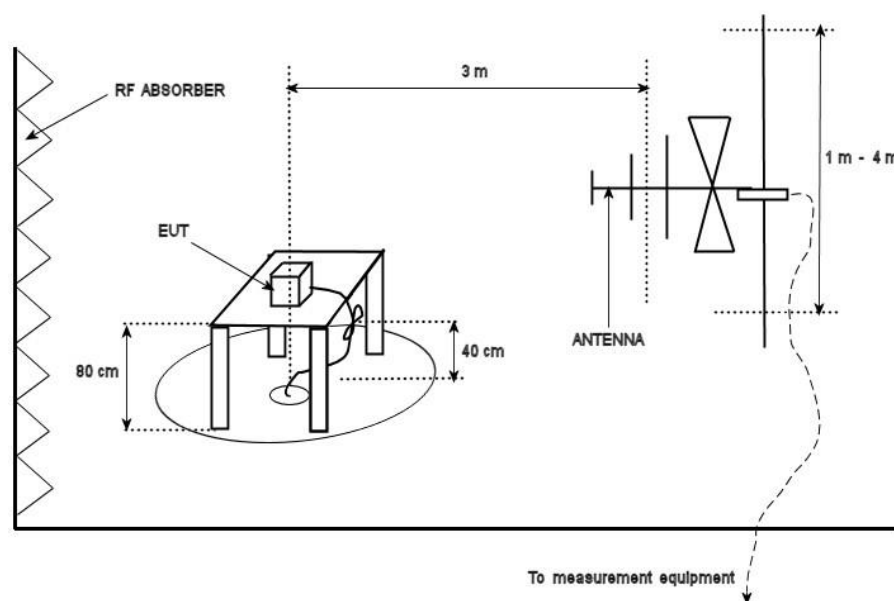
Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

⁽⁴⁾ In the frequency bands 9 – 150 kHz, and 150 kHz – 30 MHz, limit is defined with a 200 Hz and 9 kHz measurement bandwidths respectively.

Peak field strengths are limited to be at most 20 dB above the average limits where defined at the corresponding frequencies.

To obtain the maximum emission, the loop antenna is positioned with its plane vertical and rotated about its vertical axis at the maximum azimuth position. This is then repeated with its plane horizontal, and rotated about the horizontal axis. The maximum obtained emission is presented.

Typical Radiated Emissions Setup



Measurement Uncertainty


The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a 95% confidence level.

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Preliminary Graphs

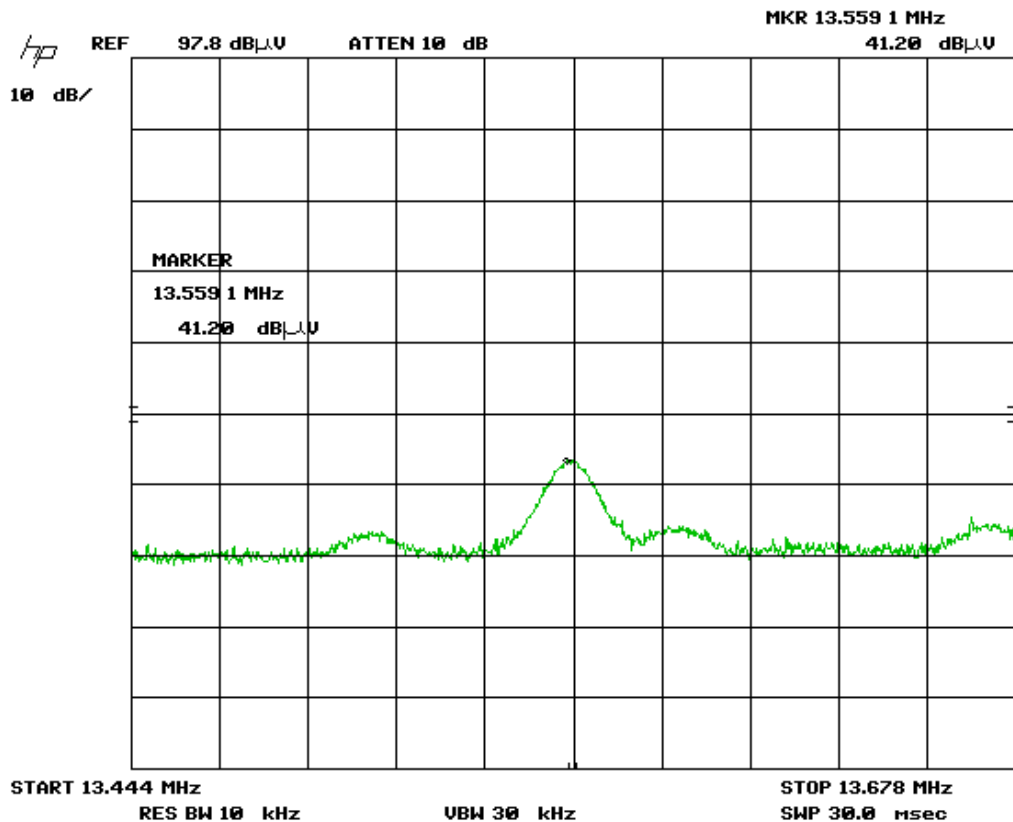
The graphs shown below are peak scans for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater than or equal to, the final required detector and over a full 0-360° rotation. This peaking process is done as a worst case measurement.


Models WD020 and WC020, which have the same water chamber, are also tested as a spot check to confirm that units incorporating an intermediate size of the water chamber would produce emissions similar to those with water chamber sizes at the extremes of the size spectrum, and not produce emissions that would fail.

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Peak Fundamental Emissions Plot
3m test distance
(Factors not incorporated. See *Final Measurements*.)

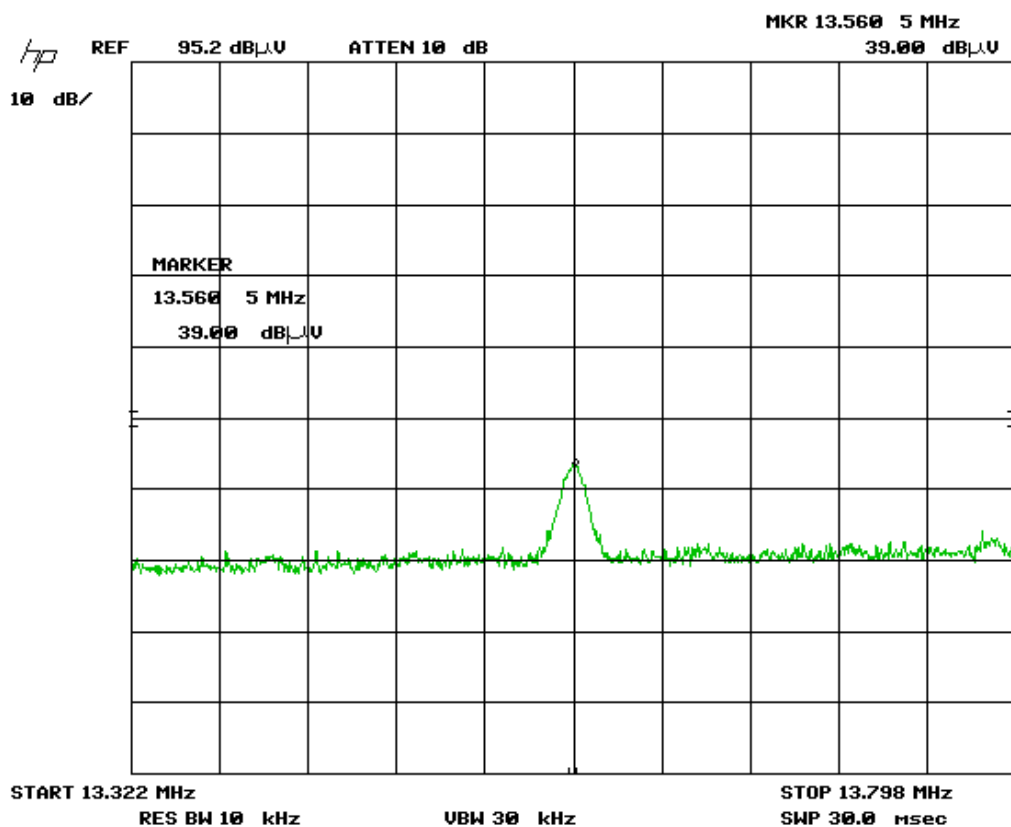
WD050 (D-Series, 112W lamp)




Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Peak Fundamental Emissions Plot
3m test distance
(Factors not incorporated. See *Final Measurements*.)

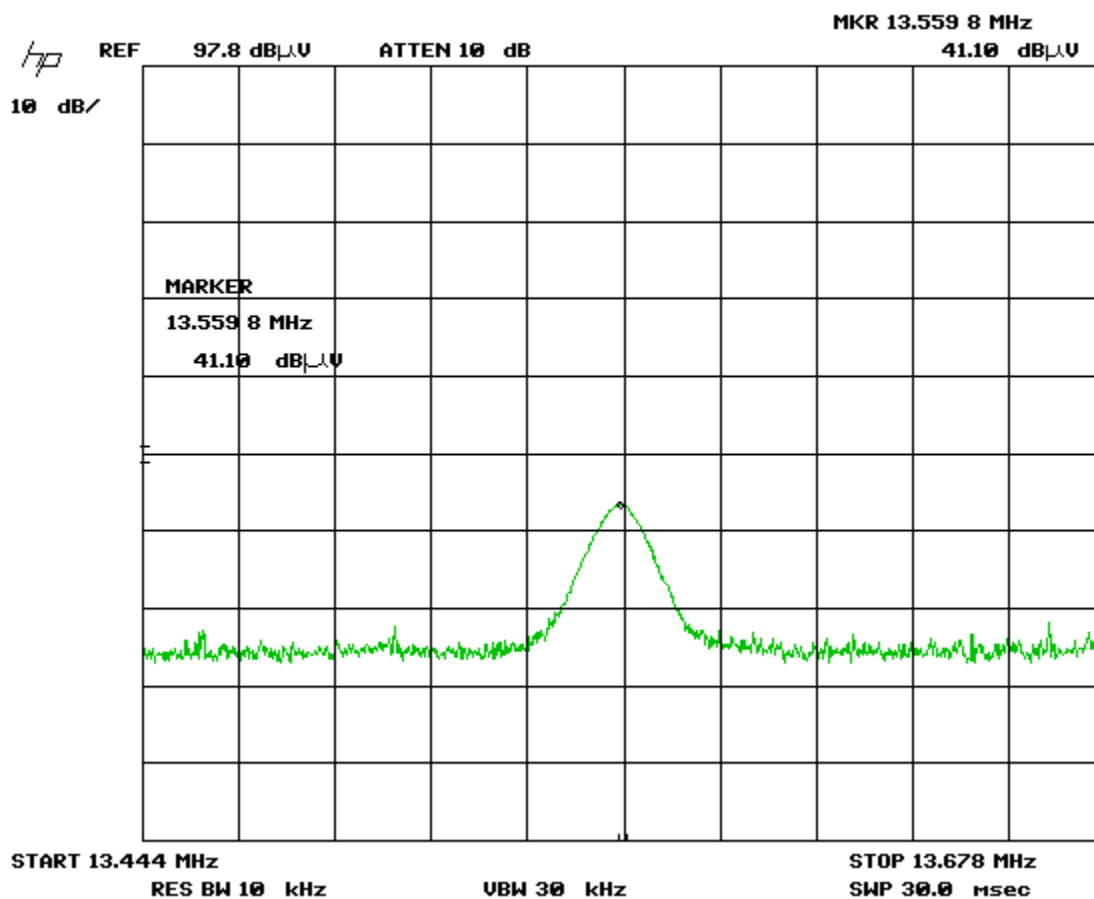
WC016 (C-Series, 45W lamp)




Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Peak Fundamental Emissions Plot
3m test distance
(Factors not incorporated. See *Final Measurements*.)

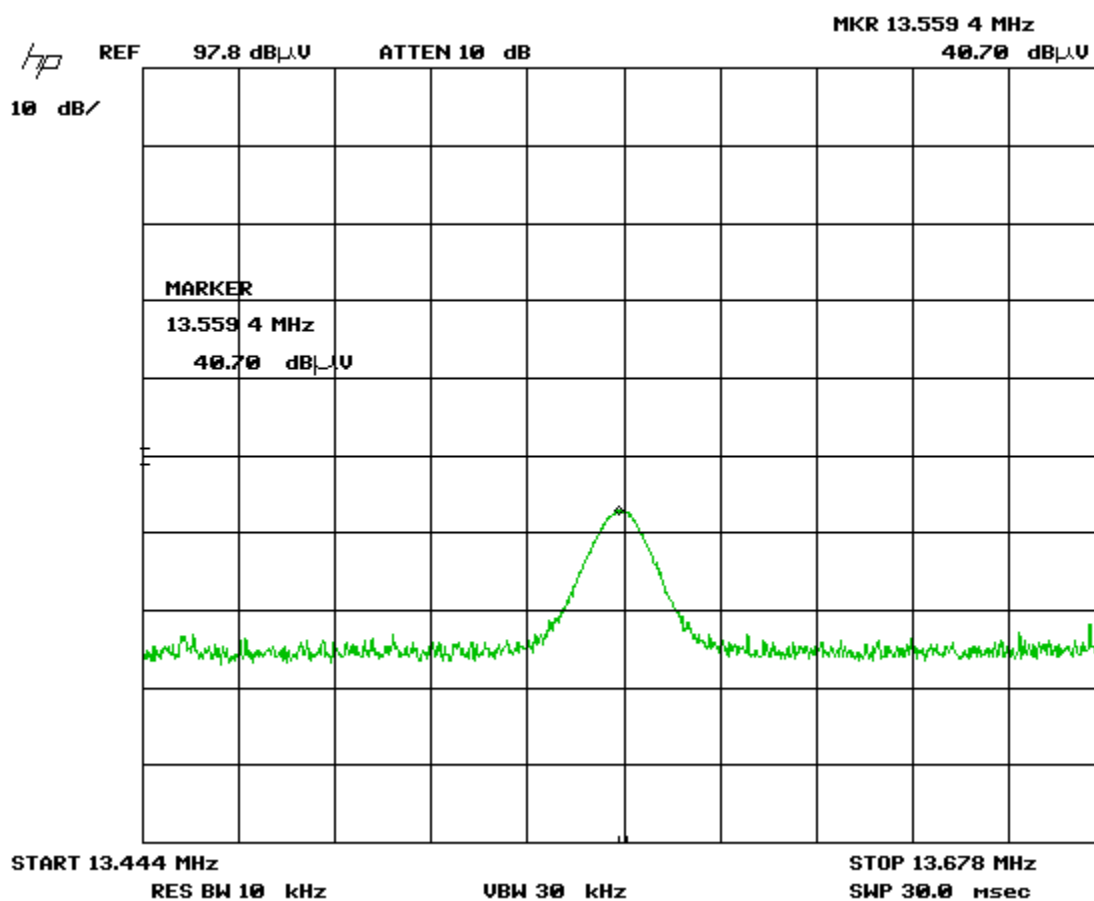
WD020 (D-Series, 55W lamp)




Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Peak Fundamental Emissions Plot
3m test distance
(Factors not incorporated. See *Final Measurements*.)

WC020 (C-Series, 55W lamp)



Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	


Final Measurements

Radiated Emissions - 15.209

Test Frequency (MHz)	Detection mode	Raw signal dB(μA)	dBμA to dBμV conversion factor	Antenna factor dB	Cable loss + Pre-selector dB	Attenuator dB	Pre-Amp Gain dB	Received signal dB(μV/m)	Emission limit dB(μV/m)	Margin dB(μV)	Result
WD050 (D-Series, 112W lamp)											
13.56	Peak	41.2	51.5	-16.2	0.3	0.0	33.0	43.8	69.5	25.7	Pass
WC016 (C-Series, 45W lamp)											
13.56	Peak	39.0	51.5	-16.2	0.3	0.0	33.0	41.6	69.5	27.9	Pass
WD020 (D-Series, 55W lamp)											
13.56	Peak	41.1	51.5	-16.2	0.3	0.0	33.0	43.7	69.5	25.8	Pass
WC020 (C-Series, 55W lamp)											
13.56	Peak	40.7	51.5	-16.2	0.3	0.0	33.0	43.3	69.5	26.2	Pass


See *Radiated Emissions – Spurious* section in this report for spurious emissions test results.

Peak emissions meet the general emission limit requirements.

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	May 21, 2014	May 21, 2016	GEMC 193
Quasi-Peak Adapter	85650A	HP	May 22, 2014	May 22, 2016	GEMC 194
Loop Antenna 100kHz – 30MHz	EM 6872	Electro-Metrics	Feb. 3, 2015	Feb. 3, 2017	GEMC 71
Preamp	CPA9231A	Chase	Sept. 9, 2014	Sept. 9, 2016	GEMC 6403
RF Cable 7m	LMR-400-7M- 50OHM-MN- MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M- 50OHM-MN- MN	LexTec	NCR	NCR	GEMC 29

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

20 dB Bandwidth

Purpose

The purpose of this test is to find the 20 dB bandwidth of the emission. This is the bandwidth which is attenuated 20 dB from the peak of the intentional transmission.

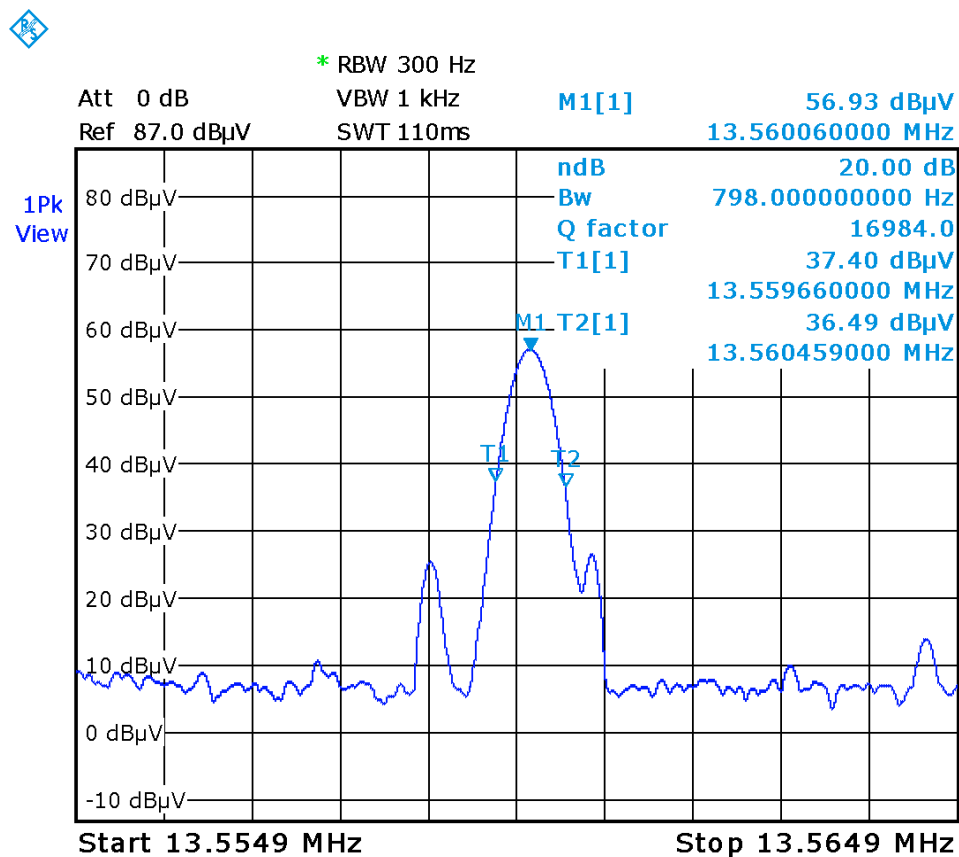
Limit(s) and Method


The method is as defined in ANSI C63.10.

There are no applicable limits for this test. Its results are for informational purposes only.

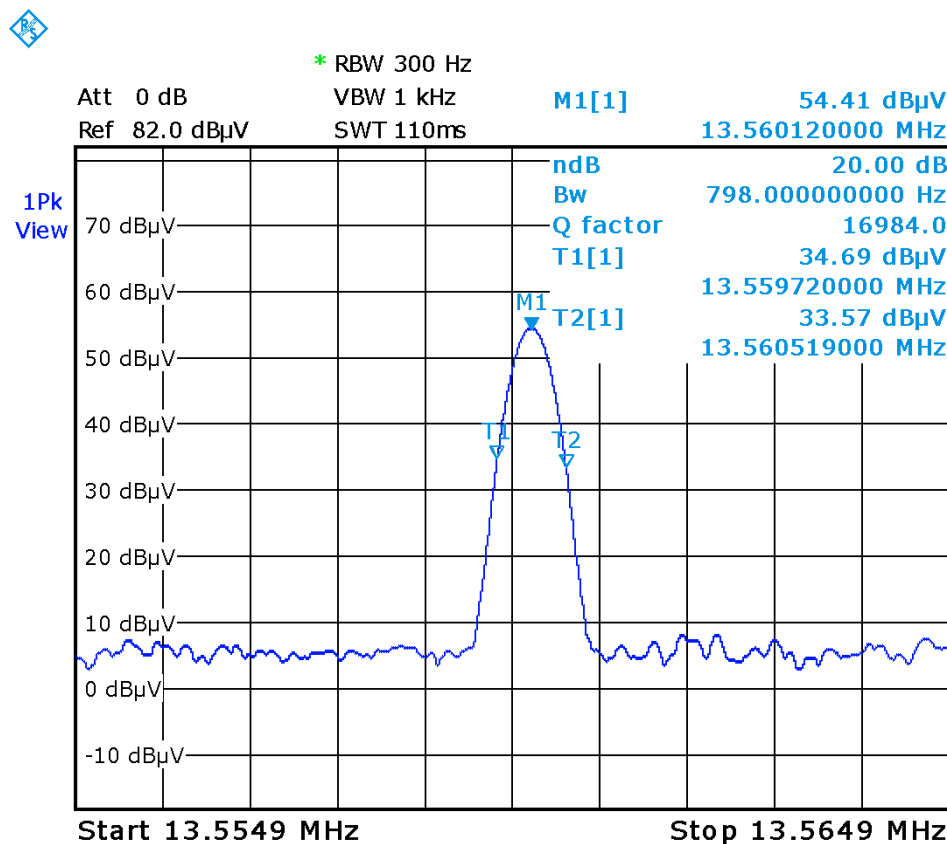
Preliminary Graphs

20 dB Bandwidth for 13.56 MHz Transmission
WD050 (D-Series, 112W lamp)



Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

20 dB Bandwidth for 13.56 MHz Transmission
WC016 (C-Series, 45W lamp)




Results

The 20 dB bandwidth for the 13.56 MHz transmission is 798 Hz.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	FSU	Rohde & Schwarz	Jan. 19, 2015	Jan. 19, 2017	GEMC 198
Loop Antenna 100kHz – 30MHz	EM 6872	Electro-Metrics	Feb. 3, 2015	Feb. 3, 2017	GEMC 71
Preamp	CPA9231A	Chase	Sept. 9, 2014	Sept. 9, 2016	GEMC 6403

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

Limits & Method


The limits and method are as defined in 47 CFR FCC Part 15 Section 15.207, RSS-GEN 8.8, and ANSI C64:2009.

Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

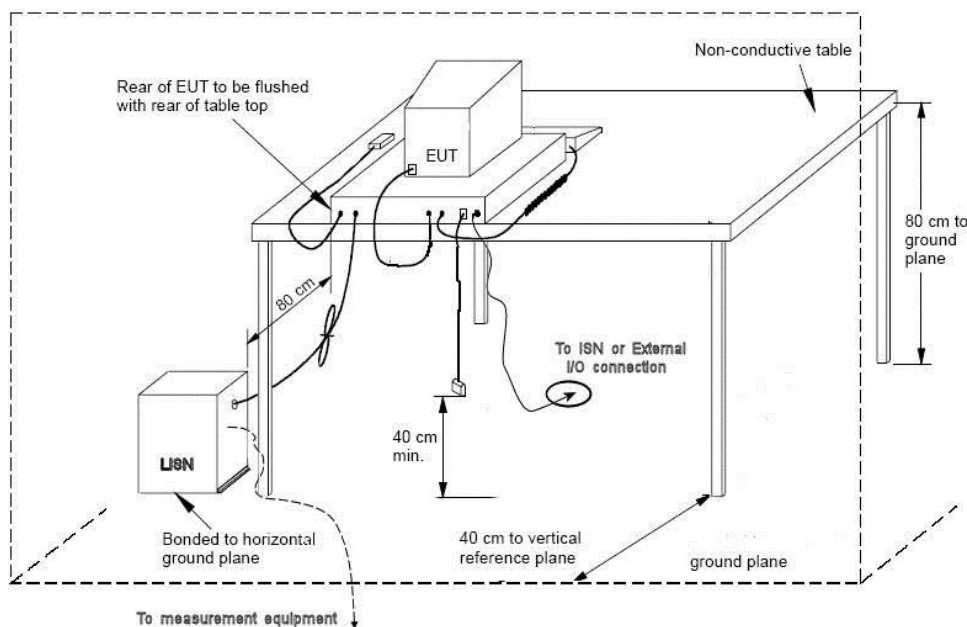
The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth.

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Typical Setup Diagram




Measurement Uncertainty

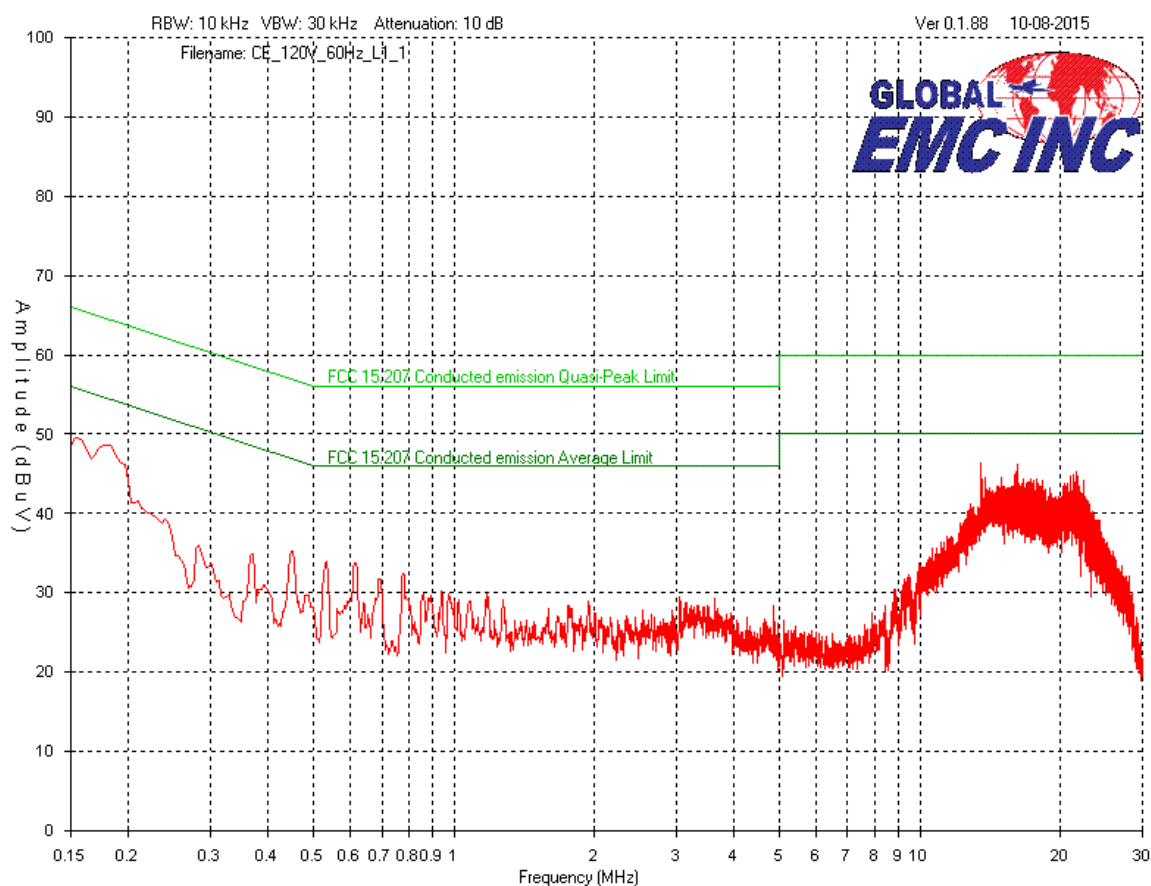
The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is ± 3.6 dB with a 'k=2' coverage factor and a 95% confidence level.


Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector where applicable, please refer to the table. The graphs shown below are peak measurement graphs, measured with a resolution bandwidth greater than or equal to the final required detector. These graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings. Power line conducted emissions is performed with the transmitter transmitting with constant modulated data at maximum output power.

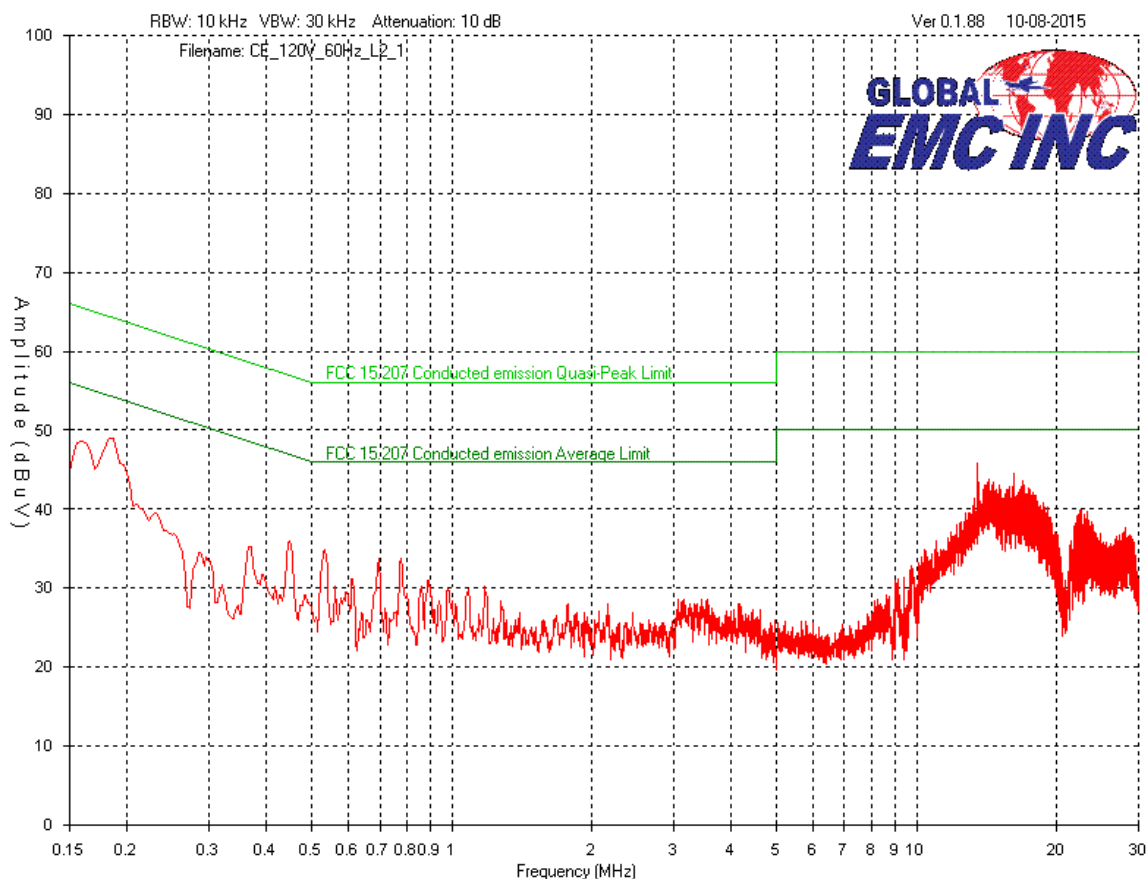
Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	


Peak Emissions Graph - Line 1
120V, 60Hz
WD050 (D-Series, 112W lamp)



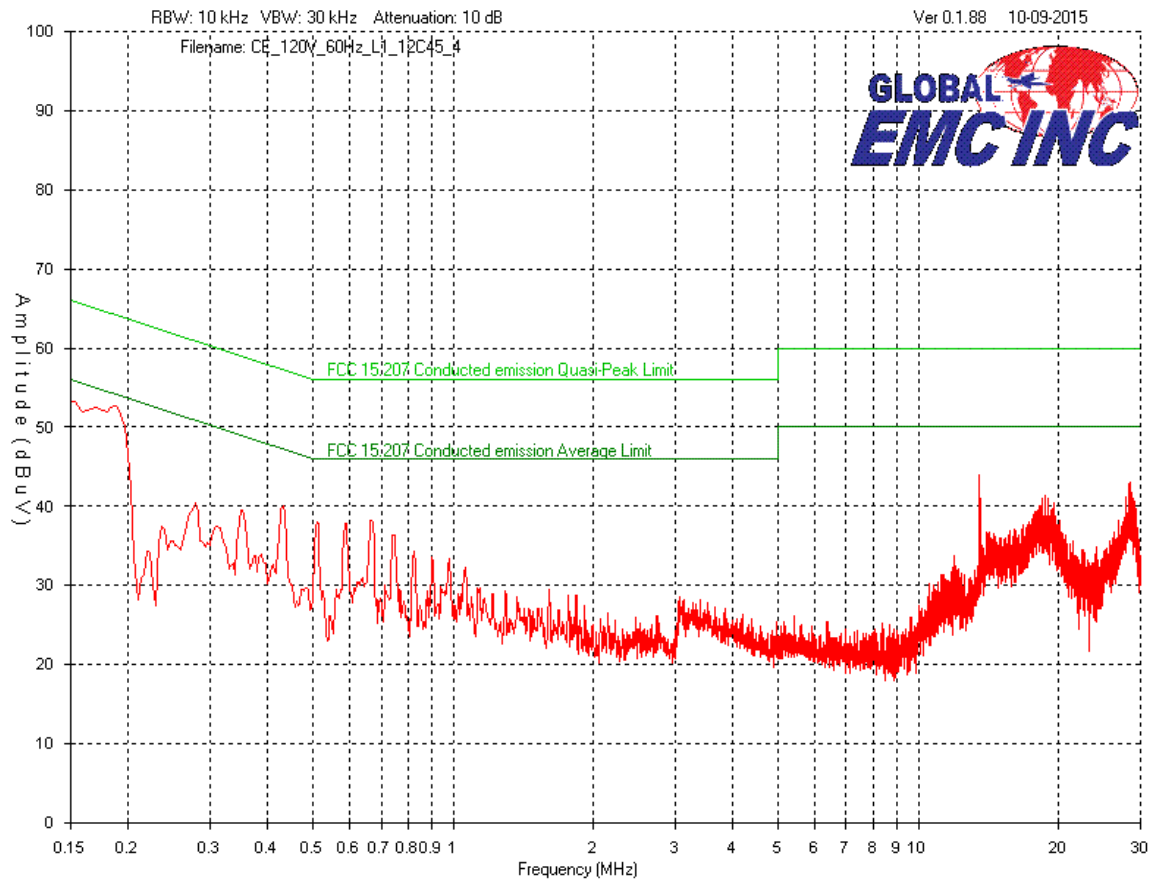
Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	


Peak Emissions Graph - Line 2
120V, 60Hz
WD050 (D-Series, 112W lamp)



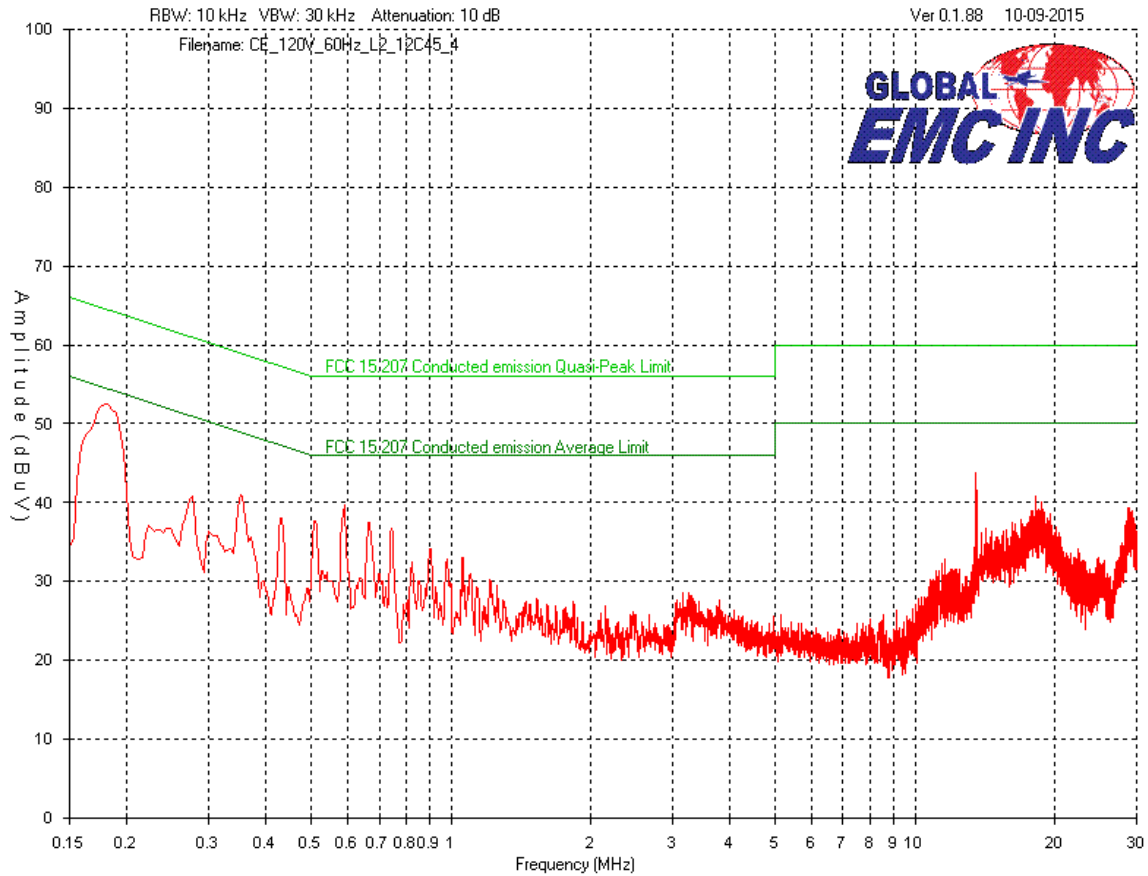
Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	


Peak Emissions Graph - Line 1
120V, 60Hz
WC016 (C-Series, 45W lamp)



Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Peak Emissions Graph - Line 2
120V, 60Hz
WC016 (C-Series, 45W lamp)




Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Final Measurements

Emissions Table
120V, 60Hz
WD050 (D-Series, 112W lamp)

Test Frequency (MHz)	Detector	Received signal (dBμV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBμV)	Quasi-Peak Emission limit (dBμV)	Average Emission limit (dBμV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
Phase Line											
13.6	Peak	36	10	0.2	0.1	46.3	60	50	13.7	3.7	Pass
16.2	Peak	35.9	10	0.2	0.1	46.2	60	50	13.8	3.8	Pass
16.1	Peak	35	10	0.2	0.1	45.3	60	50	14.7	4.7	Pass
21.7	Peak	34.9	10	0.2	0.1	45.2	60	50	14.8	4.8	Pass
21.3	Peak	34.7	10	0.2	0.1	45	60	50	15	5	Pass
16.0	Peak	34.6	10	0.2	0.1	44.9	60	50	15.1	5.1	Pass
Neutral Line											
13.6	Peak	35.5	10	0.2	0.1	45.8	60	50	14.2	4.2	Pass
0.183	Peak	38.8	10	0.1	0	48.9	64.3	54.3	15.4	5.4	Pass
16.2	Peak	34.3	10	0.2	0.1	44.6	60	50	15.4	5.4	Pass
14.3	Peak	33.4	10	0.2	0.1	43.7	60	50	16.3	6.3	Pass
16.9	Peak	33.4	10	0.2	0.1	43.7	60	50	16.3	6.3	Pass
15.1	Peak	32.8	10	0.2	0.1	43.1	60	50	16.9	6.9	Pass

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Emissions Table
120V, 60Hz
WC016 (C-Series, 45W lamp)


Test Frequency (MHz)	Detector	Received signal (dBμV)	Attenuator (dB)	Cable loss (dB)	LISN factor (dB)	Emission Level (dBμV)	Quasi-Peak Emission limit (dBμV)	Average Emission limit (dBμV)	Quasi-Peak Margin (dB)	Average Margin (dB)	Result
Phase Line											
0.180	Peak	42.4	10	0.1	0	52.5	64.5	54.5	12	2	Pass
13.6	Peak	33.6	10	0.2	0.1	43.9	60	50	16.1	6.1	Pass
0.589	Peak	29.6	10	0.1	0	39.7	56	46	16.3	6.3	Pass
0.353	Peak	30.9	10	0.1	0	41	58.9	48.9	17.9	7.9	Pass
0.506	Peak	27.5	10	0.1	0	37.6	56	46	18.4	8.4	Pass
0.665	Peak	27.5	10	0.1	0	37.6	56	46	18.4	8.4	Pass
18.2	Peak	30.6	10	0.2	0.1	40.9	60	50	19.1	9.1	Pass
Neutral Line											
0.180	Peak	42.4	10	0.1	0	52.5	64.5	54.5	12	2	Pass
13.6	Peak	33.6	10	0.2	0.1	43.9	60	50	16.1	6.1	Pass
0.589	Peak	29.6	10	0.1	0	39.7	56	46	16.3	6.3	Pass
0.353	Peak	30.9	10	0.1	0	41	58.9	48.9	17.9	7.9	Pass
0.506	Peak	27.5	10	0.1	0	37.6	56	46	18.4	8.4	Pass
0.665	Peak	27.5	10	0.1	0	37.6	56	46	18.4	8.4	Pass

Notes:

Peak = Peak readings

Where peak readings are under quasi-peak and/or average limits, the EUT passes the respective requirements, and no quasi-peak or average measurements are required.

See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	May 21, 2014	May 21, 2016	GEMC 193
Quasi-Peak Adapter	85650A	HP	May 22, 2014	May 22, 2016	GEMC 194
LISN	FCC-LISN-50/250-16-2-01	FCC	Jan. 15, 2015	Jan. 15, 2017	GEMC 65
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
Attenuator 10 dB	FP-50-10	Trilithic	NCR	NCR	GEMC 42

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Appendix A – EUT Summary

For further details for filing purposes, refer to filing package.

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

General EUT Description

Client / Manufacturer Details	
Organization / Address	Watts Water Quality 8716 W. Ludlow Dr., Suite 1 Peoria, AZ 85381
Contact	Craig Schmitt
Phone	480-675-7995 ext 530
Email	Craig.schmitt@wattswater.com
EUT (Equipment Under Test) Details	
EUT Name	Watts Water Quality UV SMARTSTREAM
EUT Models	WC012, WC016, WC020, WC025, WC040, WC050, WD012, WD016, WD020, WD025, WD040, WD050
Input voltage range(s) (V)	90-250 Vac
Frequency range(s) (Hz)	60/50 Hz
Basic EUT functionality description	UV water treatment system
Test operation	RFID is modulated and continuously transmitting during testing upon power up.
Frequency of all clocks present in EUT	12 MHz, 13.56 MHz, 48 MHz
Peripherals required to exercise EUT	None

Note:

The EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. See 'Appendix B – EUT & Test Setup Photographs' for pictures.

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	

Appendix B – EUT and Test Setup Photographs


Note: These photos are for information purposes only.
Also refer to .PDF files separate from this test report.

Test setups for WD050 and WC016 are similar.
1 test setup is shown as representative.

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	




Radiated emissions, 9 kHz – 30 MHz

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	



Radiated emissions, 30 MHz – 1 GHz

Client	Watts Water Quality	
Product	UV SMARTSTREAM	
Standard(s)	RSS 210 Issue 8:2010 / FCC Part 15 Subpart C 15:2015	



Conducted emissions