SHURE

ELECTROMAGNETIC COMPATIBILITY LABORATORY
TEST REPORT

TEST REPORT TITLE: Electromagnetic Compatibility tests for a Shure PSM300 Transmitter

TEST ITEM DESCRIPTION:

The P3T is a UHF-band personal stereo monitor transmitter designed for stereo transmission from a line-level or Aux audio input. The product operates in the UHF TV band (470 to 698 MHz) with individual models for specific regional bands. The transmitter features a half-rack metal enclosure, external switching power supply, and an RF output power of 30mW into 50Ω. This product is designed to be used primarily by stage musicians and performers.

For: Shure Incorporated
5800 West Touhy Avenue
Niles, IL 60714

Project ID Number: SEL-017

Date Tested: September 10, 2015 – November 23, 2015

Test Personnel: Alex Stelmaszczyk

Test Specification: FCC "Code of Federal Regulations" Title 47 Part 74
Industry Canada RSS-210
Industry Canada RSS-Gen

TEST REPORT BY:	SIGNATURE	Engineer II, Global Compliance POSITION	12-7-2015 DATE
APPROVED BY:	SIGNATURE	Project Engineer, Global Compliance POSITION	12-7-2015 DATE

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REPORT REVISION HISTORY

Revision	Date	Description
0	12/07/2015	Initial Release

Report Title:

1. INTRODUCTION

1.1. Scope of Tests

This document presents the results of a series of electromagnetic compatibility (EMC) tests performed on the Shure PSM300 transmitter. The test item was manufactured and submitted for testing by Shure Incorporated located in Niles, IL. The data was taken following the measurement methods as described in the test specifications listed in the individual appendices of this document. Provided is the data for the test samples which also includes a summary of the measurements made and a description of the measurement setup. The EUT contained a transmitter that was designed to transmit in the following UHF frequency bands using an external, removable dipole antenna:

Band	Frequency (MHz)	Output Power (mW)
H20	518-542	30

1.2. Purpose

This series of tests was performed to determine if the test item would meet the conducted and radiated RF emission specifications of the FCC "Code of Federal Regulations" Title 47 Part 74, Subpart H, Section 74.861. The test series was also performed to determine if the test items meet the radiated and conducted RF emission specifications of Industry Canada RSS-210, Amendment 1, Sections 5 and 6. Testing was performed in accordance with ANSI C63.4-2014 and RSS-GEN.

1.3. Deviations, Additions and Exclusions

None.

1.4. EMC Laboratory Identification

The electromagnetic compatibility tests were performed at the Shure Electromagnetic Laboratory, Shure Incorporated, 5800 West Touhy Ave, Niles, Illinois 60714-4608. This laboratory is registered with Industry Canada as Site # 616A-1. The Shure Electromagnetic Laboratory is accredited by the National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP). The NVLAP Lab Code is: 200946-0.

1.5. Summary of Tests Performed

The following electromagnetic compatibility tests (Table 1) were performed on the EUT in accordance with FCC "Code of Federal Regulations" Title 47 Part 74 and Industry Canada RSS-210 specifications:

Table 1: Summary of tests performed

Test Spec (STD)	Description	Tested Range	Described in Appendix	Test Results
FCC Part 74 (74.861) RSS-210, A1 (6.1)	**Conducted RF Power Output**	**518 – 542MHz**	**A**	PASS
FCC Part 74 (74.861) RSS-210, A1 (6.3)	**Frequency Stability**	**518 – 542MHz -30 deg. C to 50C**	**B**	PASS
FCC Part 74 (74.861) RSS-210, A1 (6.2)	**Occupied Bandwidth**	**518 – 542MHz**	**C**	PASS

FCC Part 74 (74.861) RSS-GEN (8.9)	**Radiated Spurious Emissions**	**30MHz – 6GHz**	**D**	PASS
FCC Part 74 (74.861) RSS-GEN (8.8)	**Conducted RF Emissions – AC Mains**	**150kHz - 30MHz**	**E**	PASS
FCC Part 74 (74.861) RSS-GEN (7.1.3)	**Spurious Emissions** at **Antenna Terminal**	**30MHz – 6GHz**	**F**	PASS
FCC Part 74 (74.861) RSS-210, A1 (5.3.2)	**Modulation Characteristics**	**518 – 542MHz**	**G**	PASS

2. APPLICABLE DOCUMENTS

The following documents of the exact issue designated form part of this document to the extent specified herein:

- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 74, dated 1 October 2010
- Federal Communications Commission "Code of Federal Regulations", Title 47, Part 2, dated 1 October 2010
- RSS-210, Issue 8 (Dec., 2010) - License-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
- RSS-210, Amendment 1 (Feb., 2015)— License-Exempt, Low-Power Radio Apparatus Operating in the Television Bands
- RSS-Gen, “Spectrum Management and Telecommunications Radio Standards Specification General Requirements and Information for the Certification of Radiocommunication Equipment”, Issue 4, November 2014
- 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"
- TIA-603-C-2004, “Land Mobile FM or PM Communications Equipment Measurement and Performance Standard”

3. EUT SET-UP AND OPERATION

3.1. General Description

The EUT is a wireless bodypack transmitter, model no. P3T H20. The EUT arrangement in which the testing was conducted can be found in the individual appendices.

3.2. Test Samples

The following product sample was tested:

Model	Band	Frequency (MHz)	Serial #
P3T	H20	518-542	#1

3.3. Test Setup

3.3.1. Power Input

The EUT was powered with 12VDC from a Shure Incorporated PS24 external switching DC power supply. The input to the external power supply was 120VAC 60Hz.

3.3.2. Signal Input /Output Leads
Four ¼" plug shielded audio cables (1 meter long each) were connected to both the Audio Input and Loop Output ports of the EUT. The end of each cable was terminated with a representative test load for all radiated emissions tests.

3.3.3. Antenna Ports
The antenna port was terminated with the supplied ¼ wave antenna.

3.3.4. Test Frequency Range
Per FCC Part 2.1057 and IC RSS-GEN section 6.13, for spurious radiated emissions measurements the frequency spectrum shall be investigated from 30 MHz to 6 GHz to accommodate 10x the highest frequency.

3.3.5. Grounding Considerations
The EUT was not grounded during testing.

3.4. Operational Mode
Frequency and Power Output:
All emissions tests were performed separately in the following transmit frequency and output power modes:

Tx @ 518.125MHz, 30mW (Low)
Tx @ 530.150MHz, 30mW (Mid)
Tx @ 541.875MHz, 30mW (High)

4. TEST INSTRUMENTATION

A list of the test equipment used can be found in table 10-1. All equipment used was within calibration terms during and throughout the duration of the tests. All calibrations are traceable to the National Institute of Standards and Technology (NIST).

5. TEST PROCEDURES

The specific test procedures are presented in the individual appendices.

6. OTHER TEST CONDITIONS

6.1. Test Personnel
All EMC tests were performed by qualified personnel from the Shure EMC Laboratory.

6.2. Disposition of the EUT
The EUTs and all associated equipment were returned to Shure Incorporated upon completion of the tests.

7. RESULTS OF TESTS

The results are presented in the individual test appendices. In general, it was found that the Shure Incorporated P3T met the radiated and conducted RF emission specifications of the FCC "Code of Federal Regulations" Title 47, Part 74, Subpart H, Section 74.861. It was also found that the P3T met the radiated and conducted RF emissions specifications of Industry Canada RSS-GEN, Sections (7.1.3), (8.8), (8.9) and RSS-210 Amendment 1.

8. CONCLUSIONS

It was determined that the Shure Incorporated P3Tdid fully comply with the radiated and conducted RF emissions requirements of both the FCC "Code of Federal Regulations" Title 47 Part 74, Subpart H, Section 74.861 and Industry Canada RSS-210, RSS-GEN, Sections (7.1.3), (8.8), (8.9) and RSS-210 Amendment 1.

CERTIFICATION

Shure EMC Laboratory certifies that the information contained in this report was obtained under conditions which meet or exceed those specified in the test specifications.

The data presented in this test report pertains to the EUTs at the test date. Any electrical or mechanical modification made to the EUTs subsequent to the specified test date will serve to invalidate the data and void this certification.

This report must not be used to claim product endorsement by NVLAP or any agency of the US Government.

9. EQUIPMENT LIST

Table 10-1: Test Equipment

L# or ID	Description	Manufacturer	Model #	Serial #	Range	Cal Date	Due Date
L23-011-01	3 meter RF Chamber	ETS Lindgren	FACT-3	AJ640	25MHz - 18GHz	6/5/2015	6/5/2016
L23-011-02	Electric Powered Turntable	ETS Lindgren	2088	N/A	N/A	N/A	N/A
L23-011-08	Controller	EMCO	2090	29799	N/A	N/A	N/A
L23-011-09	Antenna Positioner	ETS Lindgren	2071-2	35500	N/A	N/A	N/A
L23-011-15	BiConiLog Antenna	ETS Lindgren	3142C	34790	25MHz-1GHz	4/6/2015	4/6/2016
L23-011-16	Waveguide Horn Ant	ETS Lindgren	3115	29851	1-18 GHz	9/24/2015	9/24/2016
L23-011-41	Waveguide Horn Antenna	EMCO	3117	123511	1GHz -18GHz	11/7/2014	11/7/2015
L23-011-53	Waveguide Horn Ant w/ Pre-Amp	ETS Lindgren	3117 - PA	200363	1-18 GHz	5/14/2015	5/14/2016
L23-011-31	EMI/EMS Test Software	Rohde & Schwarz	EMC32	Ver. 3.0 SP2 100061	20Hz - 40GHz	N/A	N/A
L23-011-54	EMI Test Receiver	Rohde & Schwarz	ESR26	101347	9kHz - 26.5GHz	5/20/2015	5/20/2016
L23-022-01	Spectrum Analyzer	R&S	FSU 1166.1660. K26	201043	20Hz – 26.5GHz	5/12/2015	5/12/2016
L23-040-04	20dB Attenuator	Mini Circuits	BW-N20W5+	0952	DC-18GHz	5/4/2015	5/4/2016
L23-031-01	Power Meter	AR	PM2003	0335363	10kHz – 40GHz	5/6/2015	5/6/2016

L23-032-01	Power Head	AR	PH2008	336213	100 kHz - 18GHz -40 to +33 dBm	5/6/2015	5/6/2016
L19-06-01	Temp. Chamber	ESPEC	SU-24	91004211	-40C - +130C	4/29/2015	4/29/2016
L23-034-08	Thermometer -- K Type	Extech	TM100	13018733	N/A	9/23/2015	9/23/2016
L05-068-02	Modulation Analyzer	Boonton	8200	24602BH	N/A	10/15/2014	10/15/2016
L23-021-01	Audio Analyzer	Audio Precision	2722-192K	SYS2-32230	N/A	10/15/2014	10/15/2016
L23-41-47	Cable	Huber & Suhner Inc	Sucoflex 104E (	263340 002	N/A	12/19/2014	12/19/2015
L23-41-26	BNC to BNC RF Cable, 36" long	Pomona	2249-C-36, RG 58 C/U	N/A	N/A	8/16/2013	12/16/2015
L23-023-01	Signal Generator	Rohde & Schwarz	SMF100A	101553	100kHz-22GHz	5/16/2015	5/16/2016
L23-11-37	High Pass Filter 940MHz	K&L	11SH10-940/X10000-O/O	1	940MHz-10000GHz	10/15/2014	10/15/2016
L23-41-3	N to N RF Cable	Huber & Suhner Inc	Sucoflex 104E	189318 005	N/A	8/16/2013	12/16/2015
L23-41-48	90° N to N RF Cable	Huber & Suhner Inc	Sucoflex 104E (SF104E/16N/11N/0.4)	263329 001	N/A	12/18/2014	12/18/2015
L23-26-1	Tunable Notch Filter	Trilithic	3VNF500/1000-50-AA	200908026	500-1000 MHz	10/6/2014	10/6/2016
L23-11-26	Artificial Mains 9kHz - 30MHz	Rohde & Schwarz	ESH3-Z5	100324	9kHz - 30MHz	4/8/2015	4/8/2016

A. RF POWER OUTPUT MEASUREMENTS

A.1. PURPOSE:

This test was performed to determine if the EUT meets the RF power output requirements of the FCC Part 74.861(e)(1)(ii) and the RSS-210, Amendment 1, Section 6.1 specifications over the EUT operating frequency range of 518MHz to 542MHz.

A.2. REQUIREMENTS:

As stated in paragraph 74.861(e)(1)(ii), for low power auxiliary stations operating in the bands allocated for TV broadcasting, the power of the measured unmodulated carrier power at the output of the transmitter power amplifier (antenna input power) may not exceed 250 milliwatts in the 470-608 and 614-806MHz bands. Per the requirements set out in Section 6.1 and Table 1 of Industry Canada RSS-210, Amendment 1, the RF power output shall not exceed 250mW average power.

A.3. MEASUREMENT UNCERTAINTY

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence):

Measurement Type	U_{lab}
RF Power Output	***0.354 dB***

U_{lab} = Determined for Shure EMC Laboratory

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

A.4. TEST SETUP AND INSTRUMENTATION:

Photographs of the test setup are shown as Figure A-1. The test instrumentation can be determined from Table 10-1.

A.5. EUT OPERATION:

The EUT was powered up and the transmit frequency of the transmitter was selected using a laptop computer. The EUT was powered at 12VDC by a Shure Incorporated PS24 external switching DC power supply. The EUT was checked for proper operation after it was setup for the test. Testing was conducted with the EUT set to transmit at 518.125, 530.150MHz and 541.875MHz at output power levels of 30mW.

A.6. TEST PROCEDURES:

a. The EUT was connected to an RF power meter through a calibrated power head.

b. The frequency of the power meter was set to the operating frequency of the EUT.

c. The RF power meter was allowed to stabilize and then the output power measurement was recorded.

A.7. RESULTS:

The output power measurement data is presented below on page 11. As shown by the test data, the power output of the EUT is within the requirements of Part 74.861 and RSS-210.

Figure A-1 - Test Setup for RF Power Output

Test Information

EUT Name:	P3T Band H20
Serial Number:	#1
Test Description:	FCC pt.74 and RSS-210 RF Power Output – Antenna Conducted
Operating Conditions:	Low, Mid and High Frequencies at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	PM2003 Power Meter and PH2008 Power Head
Test Date:	September 16, 2015

Checked By:__Craig Kozokar 12-3-2015_____

Frequency (MHz)	Nominal Power (mW)	Measured Power (dBm)	Measured Power (mW)	Limit (mW)
518.125	30mW	14.67	29.31	250
530.150	30mW	14.82	30.34	250
541.875	30mW	14.77	29.99	250

B. FREQUENCY STABILITY

B.1. PURPOSE:

This test was performed to determine if the EUT meets the frequency stability requirements of the FCC Part 74.861(e)(4) and the RSS-210 paragraph 6, table 1 specifications over the EUT operating frequency range of 534MHz to 598MHz.

B.2. REQUIREMENTS:

As stated in paragraph 74.861(e)(4) and paragraph 6 of RSS-210 Table 1, for low power auxiliary stations operating in the bands allocated for TV broadcasting, the frequency tolerance of the transmitter shall be 0.005 percent.

B.3 MEASUREMENT UNCERTAINTY:

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence):

Measurement Type	U_{lab}
Frequency Error (Stability)	.0000000397 ppm

U_{lab} = Determined for Shure EMC Laboratory

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

B.4. TEST SETUP AND INSTRUMENTATION:

The EUT was heated and cooled in an ESPEC temperature chamber over a temperature range of -30C to +50C. The temperature around the EUT was measured and monitored by a K-Type thermocouple connected to an Extech thermometer. The EUTs frequency was measured with a spectrum analyzer set to measure signal count at 0.1Hz resolution. The center frequency of the spectrum analyzer was set to the selected transmit frequency of the EUT (Low, Mid or High). Photographs of the test setup are shown as Figure B-1. The test instrumentation can be determined from Table 10-1.

B.5. EUT OPERATION:

The antenna port of the EUT was connected to the 50 Ohm input of a spectrum analyzer. The EUT was operated at 30mW. The EUT was set to transmit at a low, mid or high frequency within its operating band of 518 – 542MHz.

B.6. TEST PROCEDURES:

a. The temperature chamber was set to -30C with the EUT inside and powered off.

b. The EUT was allowed to soak for ~15 minutes after the temperature chamber reached the set temperature.

c. The EUT was then powered on and allowed to stabilize for ~ 1 minute.

d. The measured frequency of the transmitter was plotted with the screen capture function of the spectrum analyzer.

e. Steps a. through d. were repeated at -20C through +50C in ten degree increments for representative low, mid and high frequencies within the EUTs operational band.

B.7 RESULTS:

The frequency stability measurements are presented in table C-1 on page 14. As shown by the test data, the test frequency deviation was within the 0.005 percent limit set out in the FCC Part 74.861 and the RSS-210 specifications.

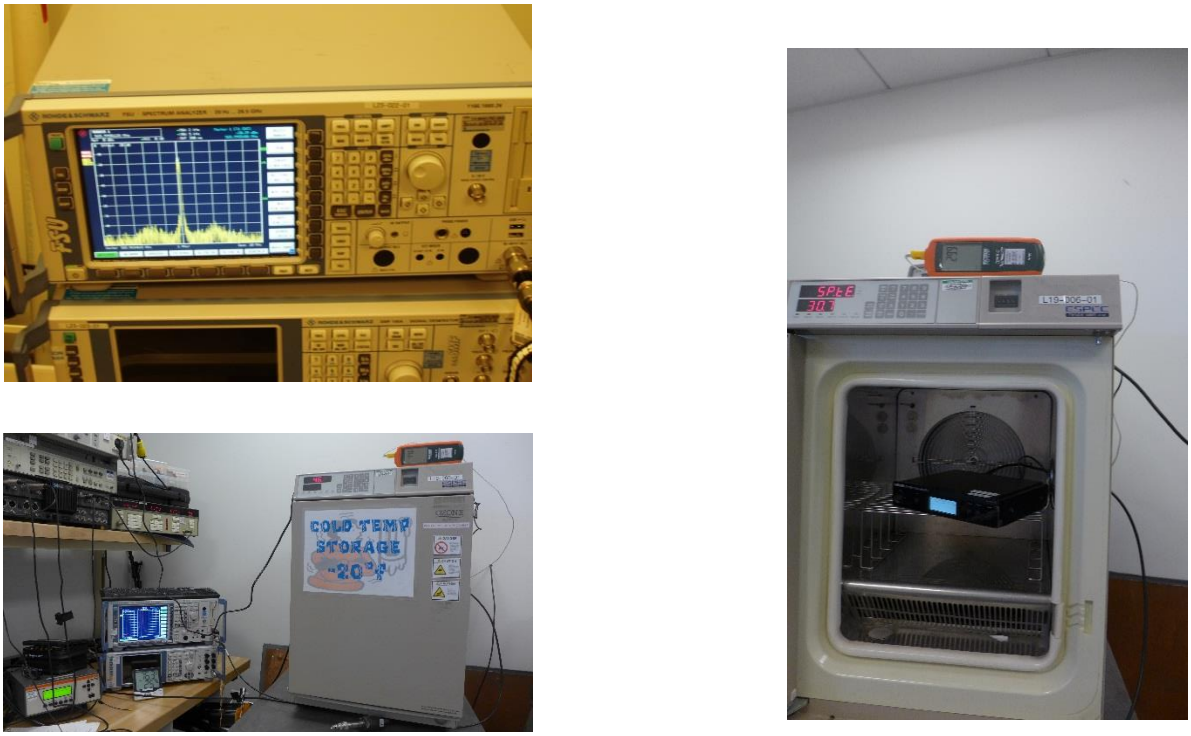


Figure B-1 - Test Setup for Frequency Stability

Appendix B

Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Frequency Stability
Operating Conditions:	Low, Mid and High Frequencies at 30mW, -30C to +50C
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer and ESPEC Temp Chamber
Test Date:	October 12 - 13, 2015

Checked By: Craig Kozokar 12-3-2015

Temp °C	Nominal Frequency (MHz)	Measured Frequency (MHz)	Deviation (%)	Frequency Stability (%)	Deviation (Hz)	Frequency Stability (Hz)	Pass Or Fail
-30	518.125	518.1240530	-0.0001828	0.005	-947	25906.25	PASS
-20	518.125	518.1243571	-0.0001241	0.005	-643	25906.25	PASS
-10	518.125	518.1246131	-0.0000747	0.005	-387	25906.25	PASS
0	518.125	518.1248135	-0.0000360	0.005	-187	25906.25	PASS
10	518.125	518.1248648	-0.0000261	0.005	-135	25906.25	PASS
20	518.125	518.1249214	-0.0000152	0.005	-79	25906.25	PASS
30	518.125	518.1249230	-0.0000149	0.005	-77	25906.25	PASS
40	518.125	518.1248769	-0.0000238	0.005	-123	25906.25	PASS
50	518.125	518.1248258	-0.0000336	0.005	-174	25906.25	PASS
-30	530.150	530.1491537	-0.0001596	0.005	-846	26507.5	PASS
-20	530.150	530.1492733	-0.0001371	0.005	-727	26507.5	PASS
-10	530.150	530.1495005	-0.0000942	0.005	-499	26507.5	PASS
0	530.150	530.1498684	-0.0000248	0.005	-132	26507.5	PASS
10	530.150	530.1499392	-0.0000115	0.005	-61	26507.5	PASS
20	530.150	530.1499190	-0.0000153	0.005	-81	26507.5	PASS
30	530.150	530.1498440	-0.0000294	0.005	-156	26507.5	PASS
40	530.150	530.1498517	-0.0000280	0.005	-148	26507.5	PASS
50	530.150	530.1498055	-0.0000367	0.005	-195	26507.5	PASS
-30	541.875	541.8741420	-0.0001583	0.005	-858	27093.75	PASS
-20	541.875	541.8745233	-0.0000880	0.005	-477	27093.75	PASS
-10	541.875	541.8746770	-0.0000596	0.005	-323	27093.75	PASS
0	541.875	541.8748684	-0.0000243	0.005	-132	27093.75	PASS
10	541.875	541.8749154	-0.0000156	0.005	-85	27093.75	PASS
20	541.875	541.8749900	-0.0000018	0.005	-10	27093.75	PASS
30	541.875	541.8749251	-0.0000138	0.005	-75	27093.75	PASS
40	541.875	541.8748844	-0.0000213	0.005	-116	27093.75	PASS
50	541.875	541.8747767	-0.0000412	0.005	-223	27093.75	PASS

Appendix C

C. OCCUPIED BANDWIDTH MEASUREMENTS

C.1. PURPOSE:

This test was performed to determine if the EUT meets the occupied bandwidth requirements of the FCC Part 74.861(e)(3) and the RSS-210 paragraph 6, table 1 specifications over the EUT operating frequency range of 518MHz to 542MHz.

C.2. REQUIREMENTS:

As stated in paragraph 74.861(e)(5) and (6), for low power auxiliary stations operating in the bands allocated for TV broadcasting, the following technical requirements apply:

a) The operating bandwidth shall not exceed 200 kHz.

b) The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

i. On any frequency removed from the operating frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: at least 25 dB;

ii. On any frequency removed from the operating frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: at least 35 dB;

iii. On any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least 43+10log10 (mean output power in watts) dB.

Per the specifications set out in RSS-210, A1 paragraph 6.2 and 6.4.1, the following technical requirements apply:

a) The authorized bandwidth shall not exceed 200kHz.

b) The power of unwanted emissions shall be attenuated below the mean transmitter power in accordance with the following schedule:

i. On any frequency removed from the carrier frequency by more than 50% up to and including 100% of the authorized bandwidth: at least 25 dB.

ii. On any frequency removed from the carrier frequency by more than 100% up to and including 250% of the authorized bandwidth: at least 35 dB.

iii. On any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth: at least 55 + 10 Log (P) dB.

Appendix C

C.3. TEST SETUP AND INSTRUMENTATION:

A photographs of the test setup is shown in Figure C-1. The test instrumentation can be determined from Table 10-1.

C.4. MEASUREMENT UNCERTAINTY

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence):

Measurement Type	U_{LAB}
Occupied Bandwidth	**±0.130 %**

U_{lab} = Determined for Shure EMC Laboratory

Since U_{LAB} is less than or equal to U_{ETSI}:

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

C.5. EUT OPERATION:

The EUT was powered up and the transmit frequency of the transmitter was selected using laptop computer. The EUT was powered at 12VDC by a Shure Incorporated PS24 external switching DC power supply with an input of 120VAC 60Hz. The EUT was checked for proper operation after it was setup for the test. Testing was conducted with the EUT set to transmit at 518.125MHz, 530.150MHz and 541.875MHz at an output power level of 30mW. The volume pot on the front of the EUT was set to the maximum level. The Audio Input ports were connected to an audio signal source using shielded cables.

C.6. TEST PROCEDURES:

a) The EUT was connected to the 50 ohm input of a spectrum analyzer through 20dB of attenuation; the reference offset of the spectrum analyzer was set to the measured value of the attenuation path.

b) The unmodulated carrier signal level was recorded and used to set the reference level on the spectrum analyzer.

c) The spectrum analyzer span was then set to 1.5 MHz and the resolution bandwidth set to 2 kHz (1% of Authorized BW).

d) The FCC and RSS-210 emission limits were overlaid on the spectrum analyzer display and the trace was recorded.

e) The test item was modulated with a 2500 Hz sine wave at an input level 16 dB greater than that necessary to produce 50% of the rated system deviation.

f) The test item was modulated with a 15 kHz sine wave at an input level necessary to produce 85% of the rated system deviation.

g) Steps (a) through (f) were repeated at the medium and high frequencies of the EUT's frequency band.

C.7. RESULTS:

The occupied bandwidth data is presented on pages 18-29. Data is shown on the figures at each frequency (Low, Mid, or High) of a specific band. The first figure shows the reference carrier power while the remaining figures show the maximum relative level within the emission mask (with and without modulation). The limits, shown on the plots, are referenced to the power measured from the un-modulated carrier.

The operating bandwidth was determined using Carson's rule:
Bn = 2M + 2DK where Bn = bandwidth, M= Maximum modulating frequency and D = Peak Deviation. With K = 1, M = 8kHz and D = 74kHz resulting in an operating bandwidth of 164kHz.

The maximum Industry Canada 99% bandwidth measurement was 122.600 kHz.

As shown by the test data, the occupied bandwidth of the EUT meets the requirements of FCC Part 74.861 and RSS-210, A1. A photograph of the test set-up is shown in Figure C-1.

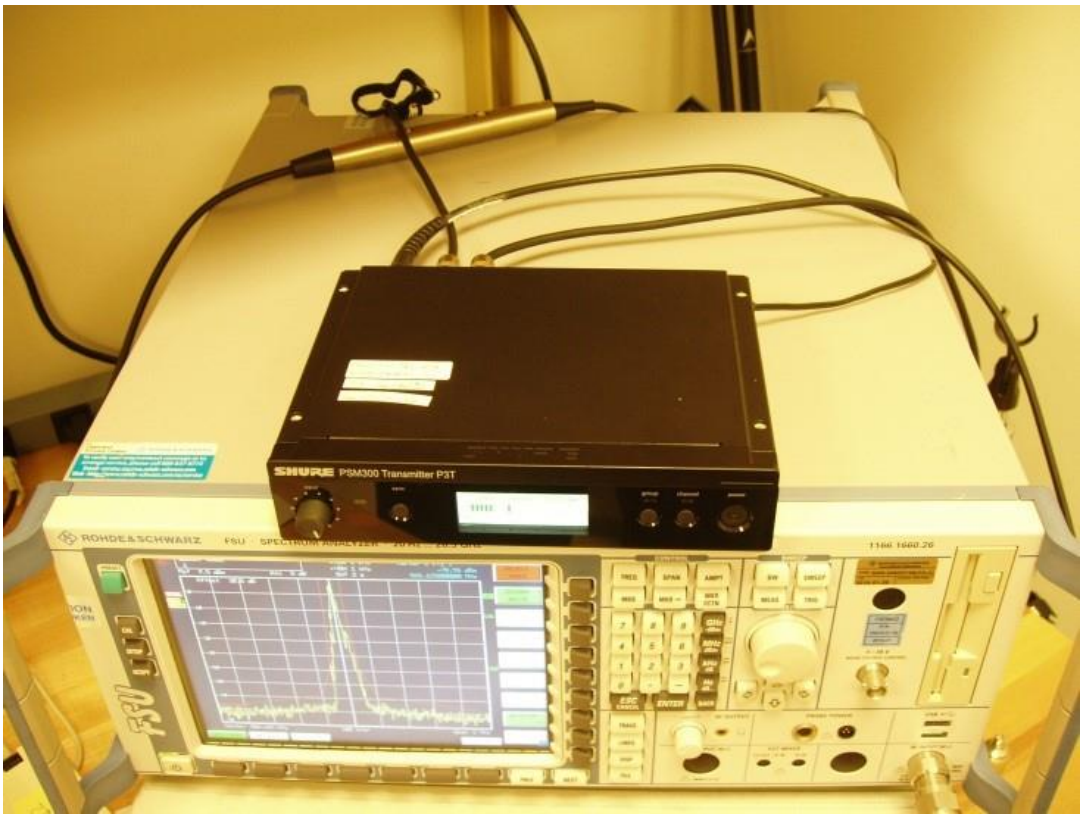
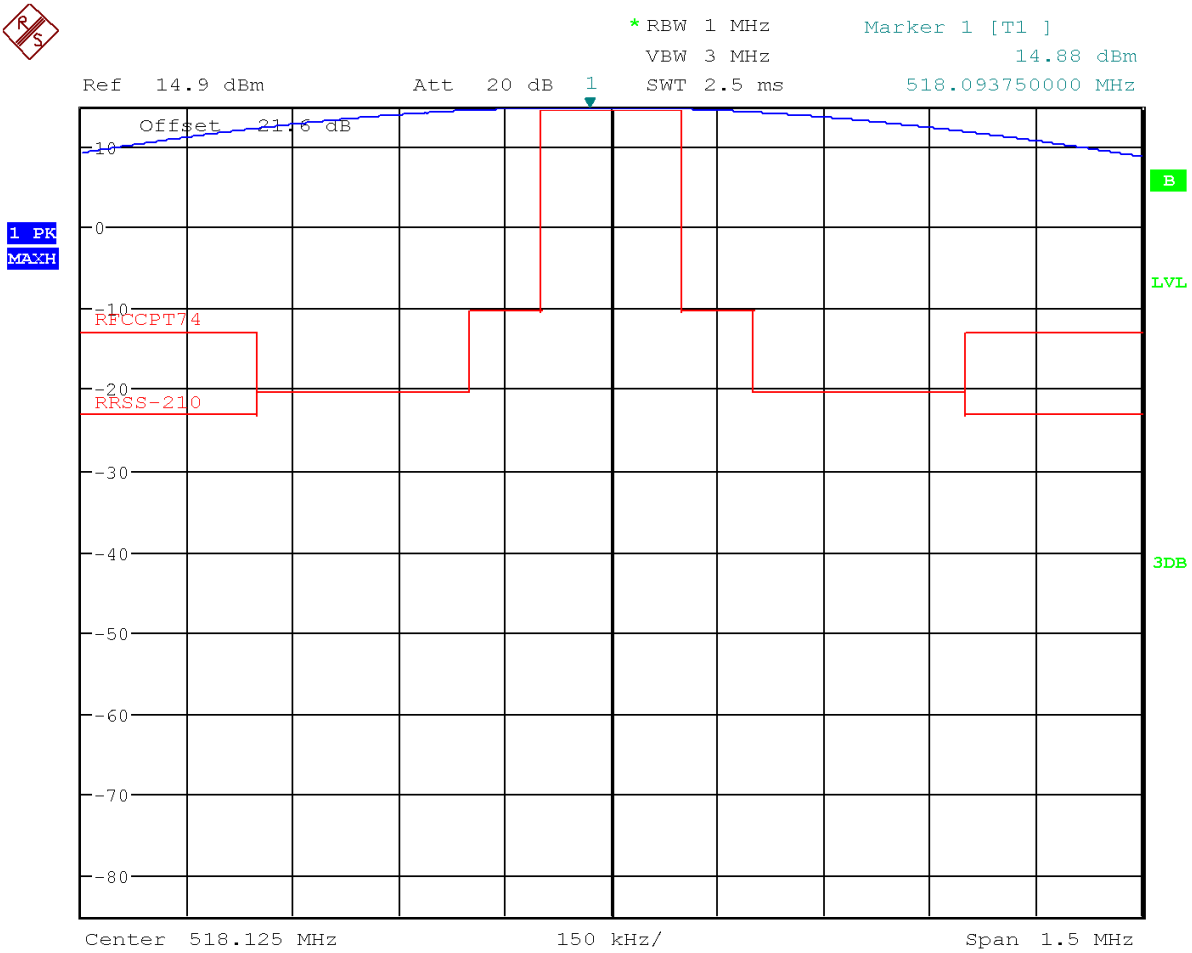


Figure C-1 - Test Setup for Occupied Bandwidth

Appendix C

Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Occupied Bandwidth Output Power Reference
Operating Conditions:	Low Frequency (518.125MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer
Test Date:	October 8, 2015

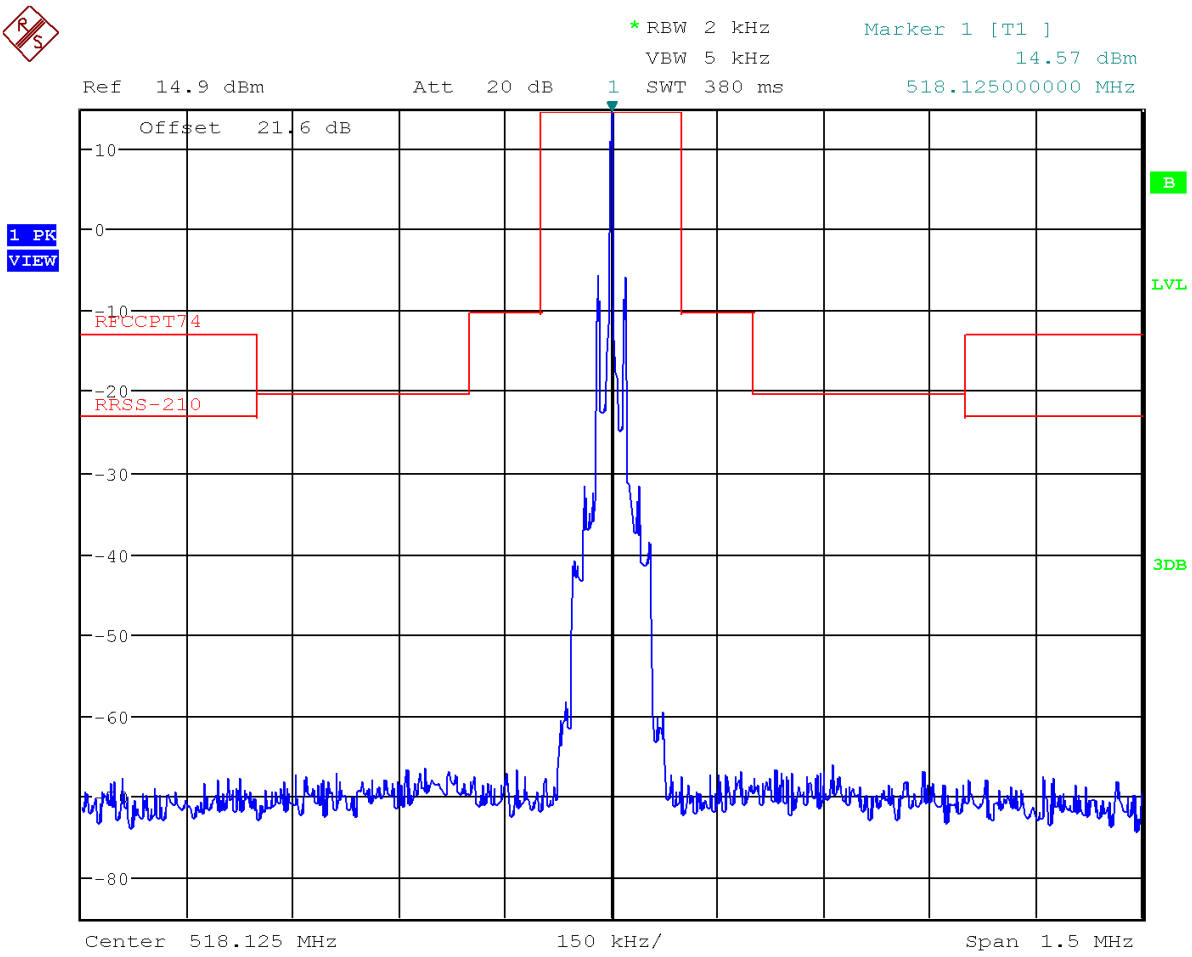


Date: 8.OCT.2015 16:25:29

Appendix C

Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Occupied Bandwidth Unmodulated Carrier
Operating Conditions:	Low Frequency (518.125MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer
Test Date:	October 8, 2015

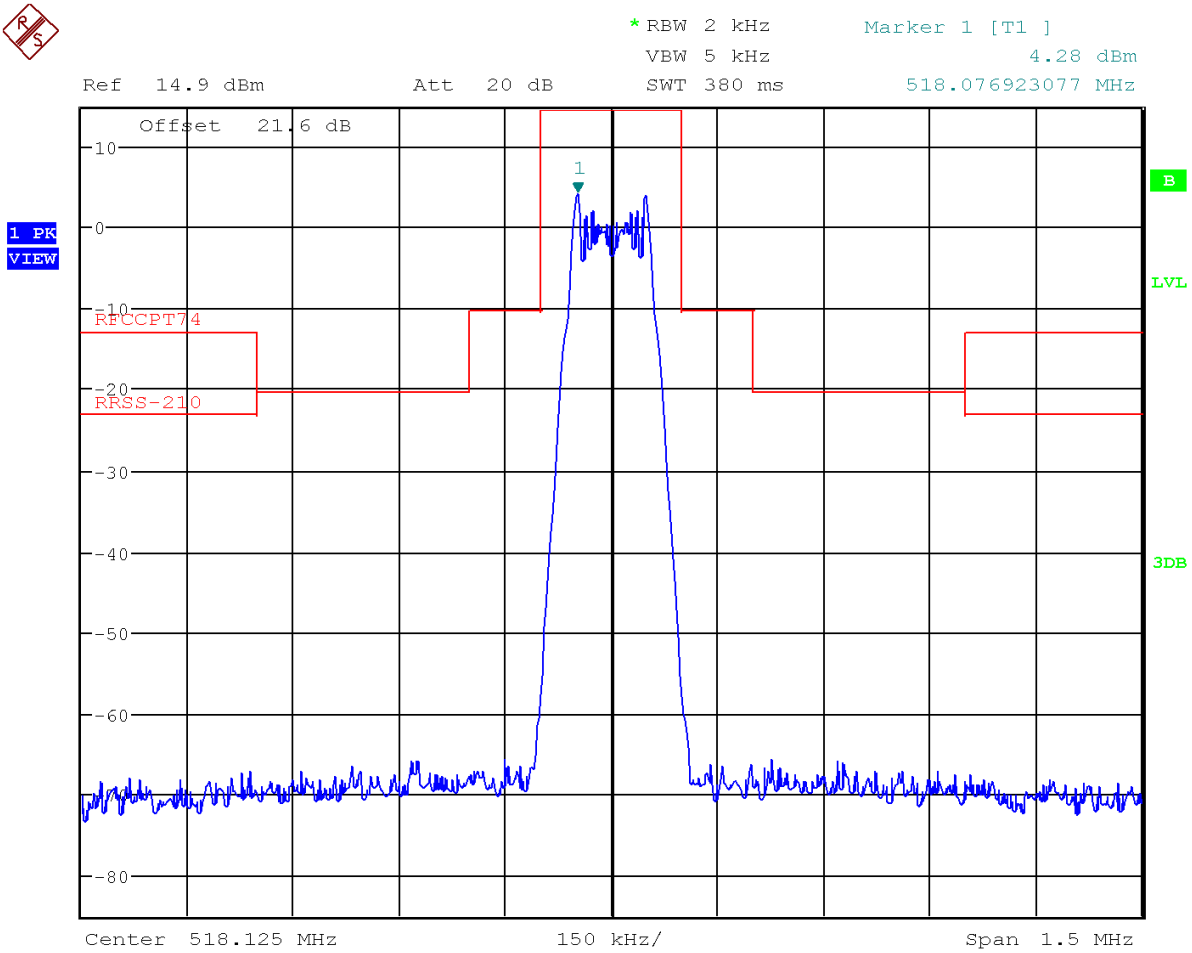


Date: 8.OCT.2015 16:27:03

Appendix C

Test Information

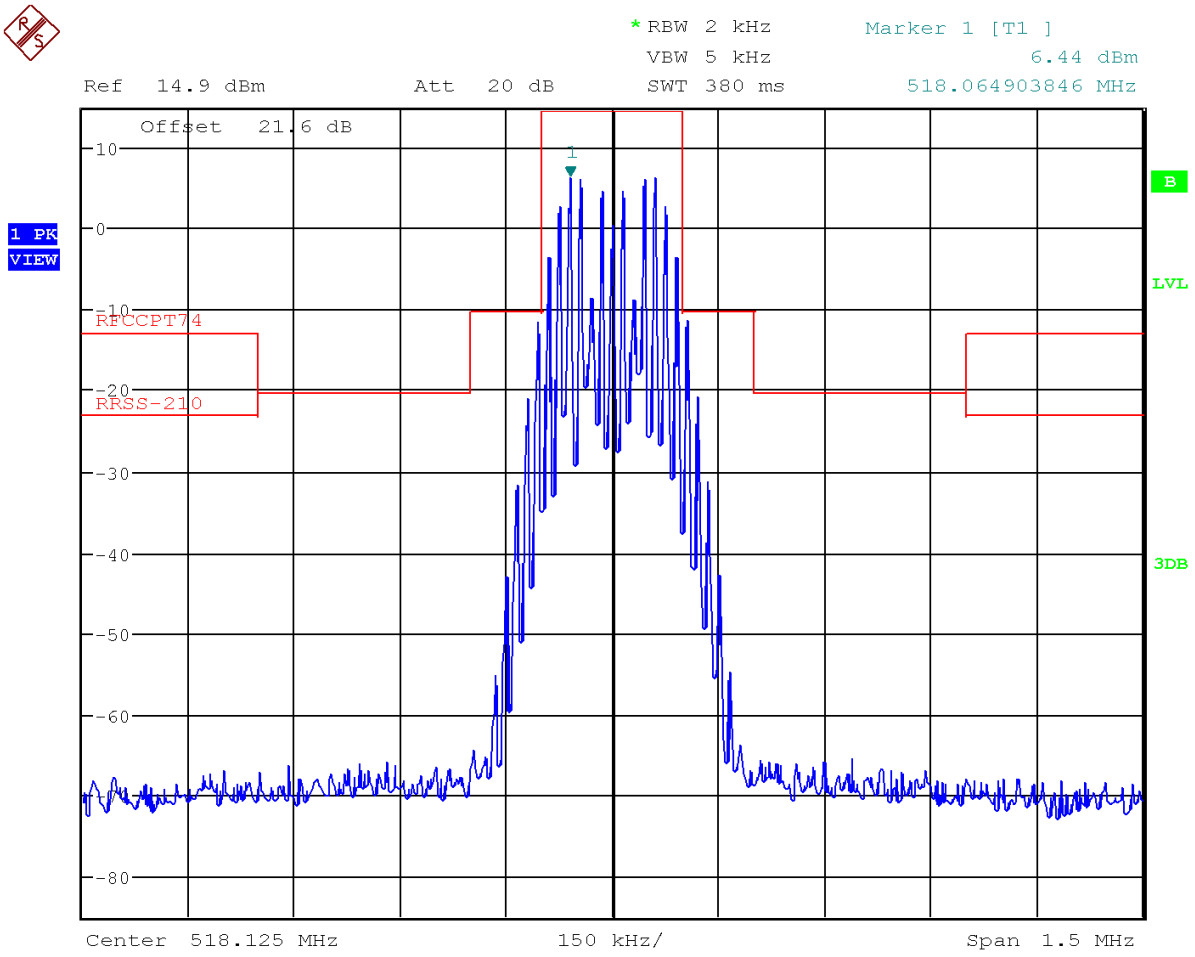
EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Occupied Bandwidth 2500Hz @ 16dB over 50% Deviation
Operating Conditions:	Low Frequency (518.125MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer
Test Date:	October 8, 2015



Appendix C

Test Information

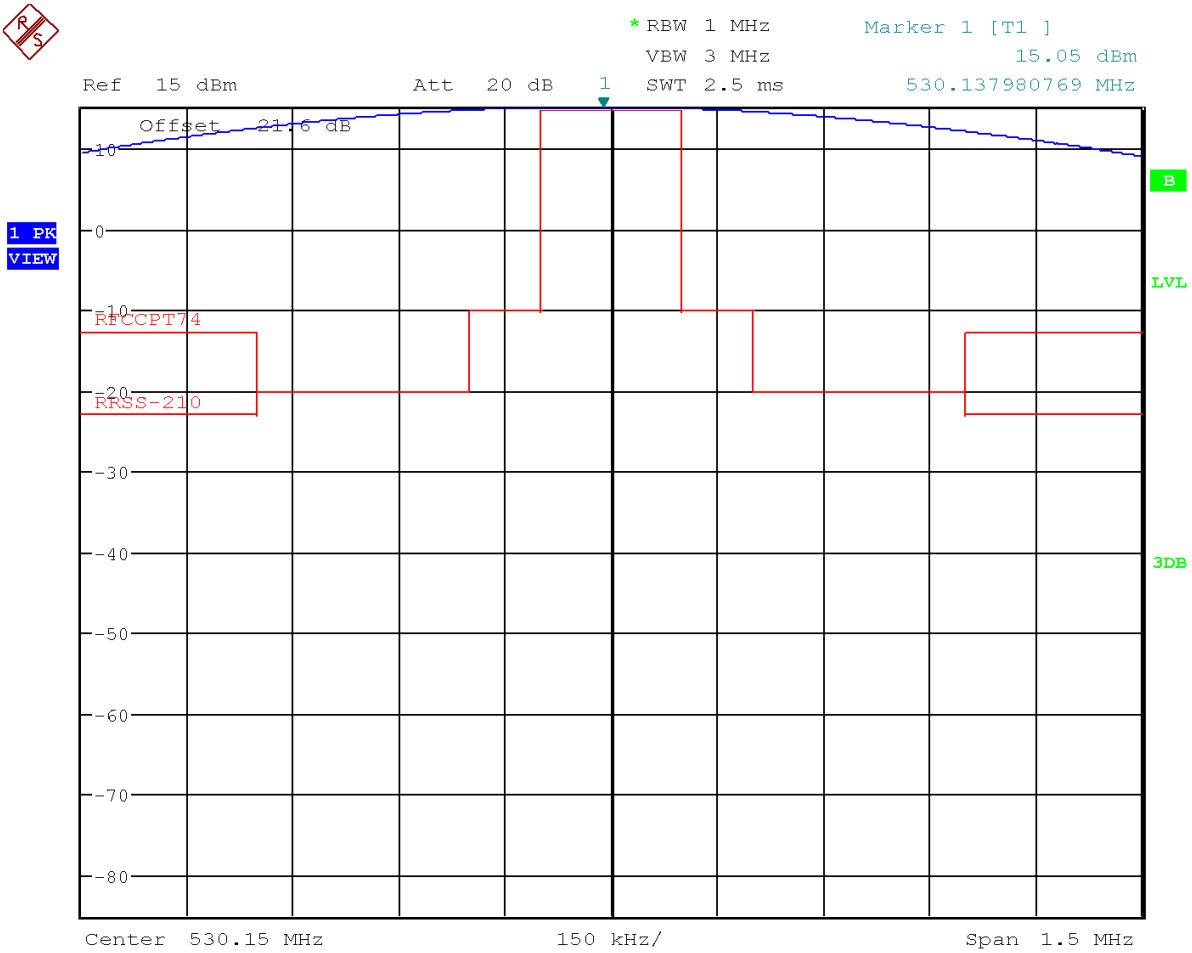
EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Occupied Bandwidth 15000Hz @ 85% Modulation
Operating Conditions:	Low Frequency (518.125MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer
Test Date:	October 8, 2015



Date: 8.OCT.2015 16:34:13

Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Occupied Bandwidth Output Power Reference
Operating Conditions:	Low Frequency (530.150MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer
Test Date:	October 8, 2015

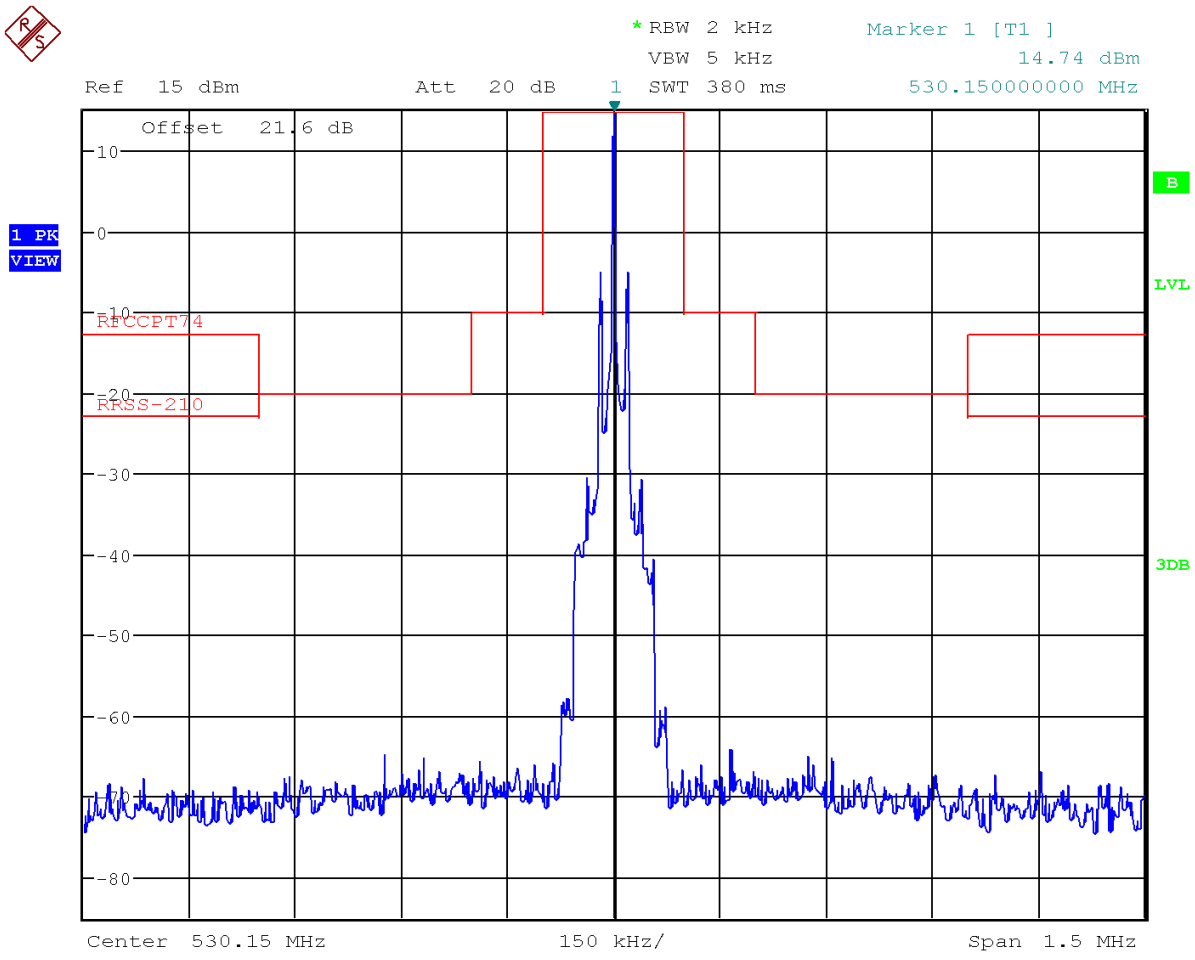


Date: 8.OCT.2015 16:00:58

Appendix C

Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Occupied Bandwidth Unmodulated Carrier
Operating Conditions:	Low Frequency (530.150MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer
Test Date:	October 8, 2015

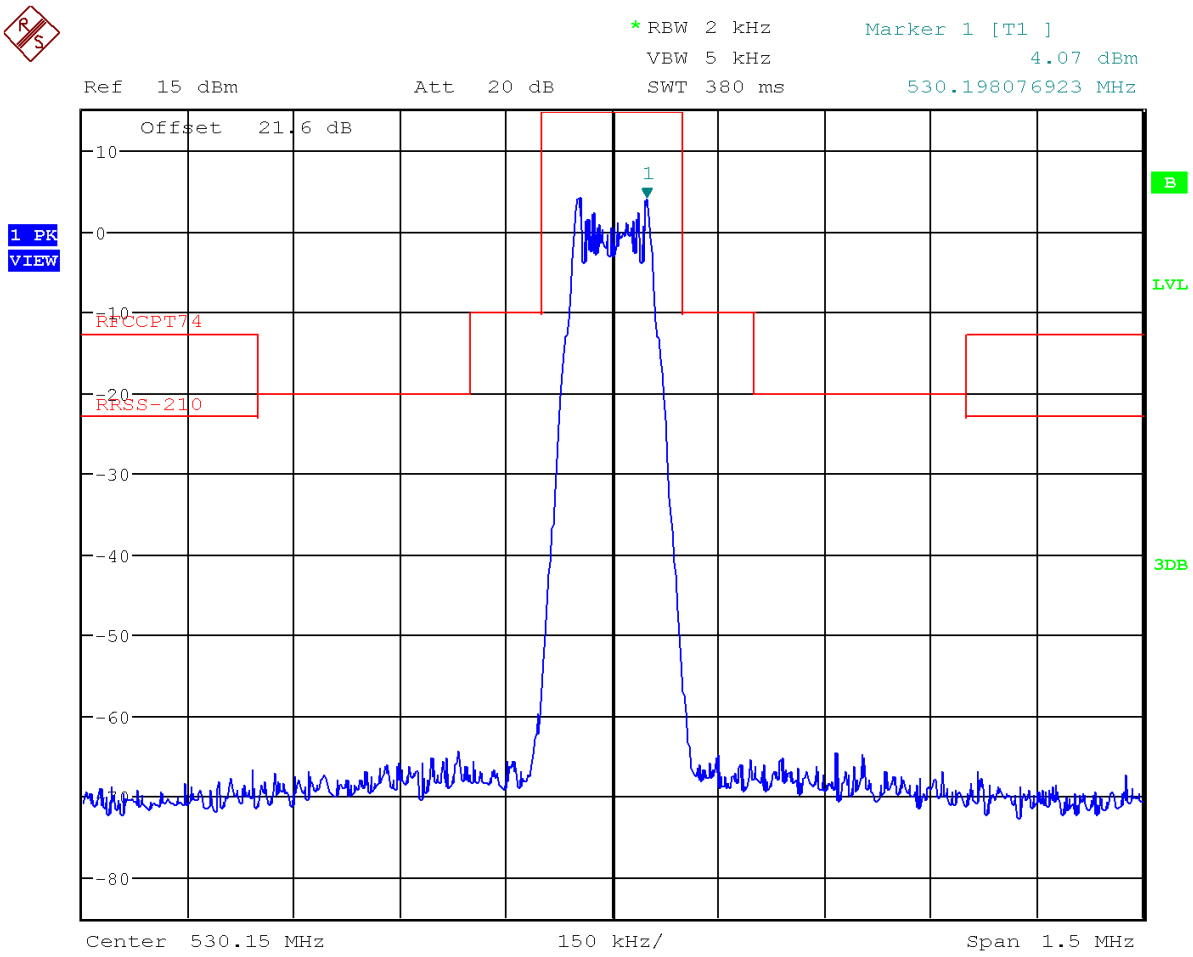


Date: 8.OCT.2015 16:03:28

Appendix C

Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Occupied Bandwidth 2500Hz @ 16dB over 50% Deviation
Operating Conditions:	Low Frequency (530.150MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer
Test Date:	October 8, 2015

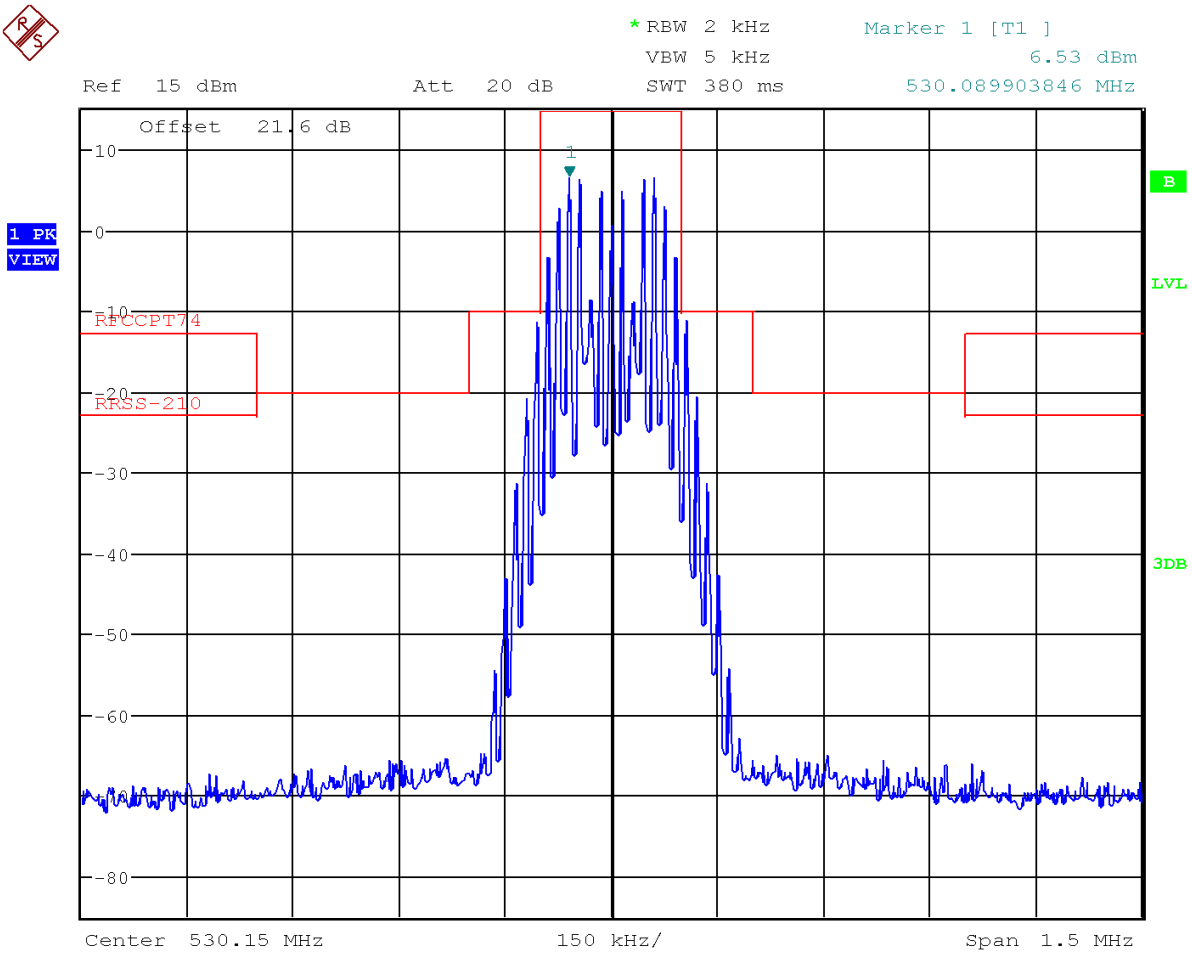


Date: 8.OCT.2015 16:11:55

Appendix C

Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Occupied Bandwidth 15000Hz @ 85% Modulation
Operating Conditions:	Low Frequency (530.150MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer
Test Date:	October 8, 2015

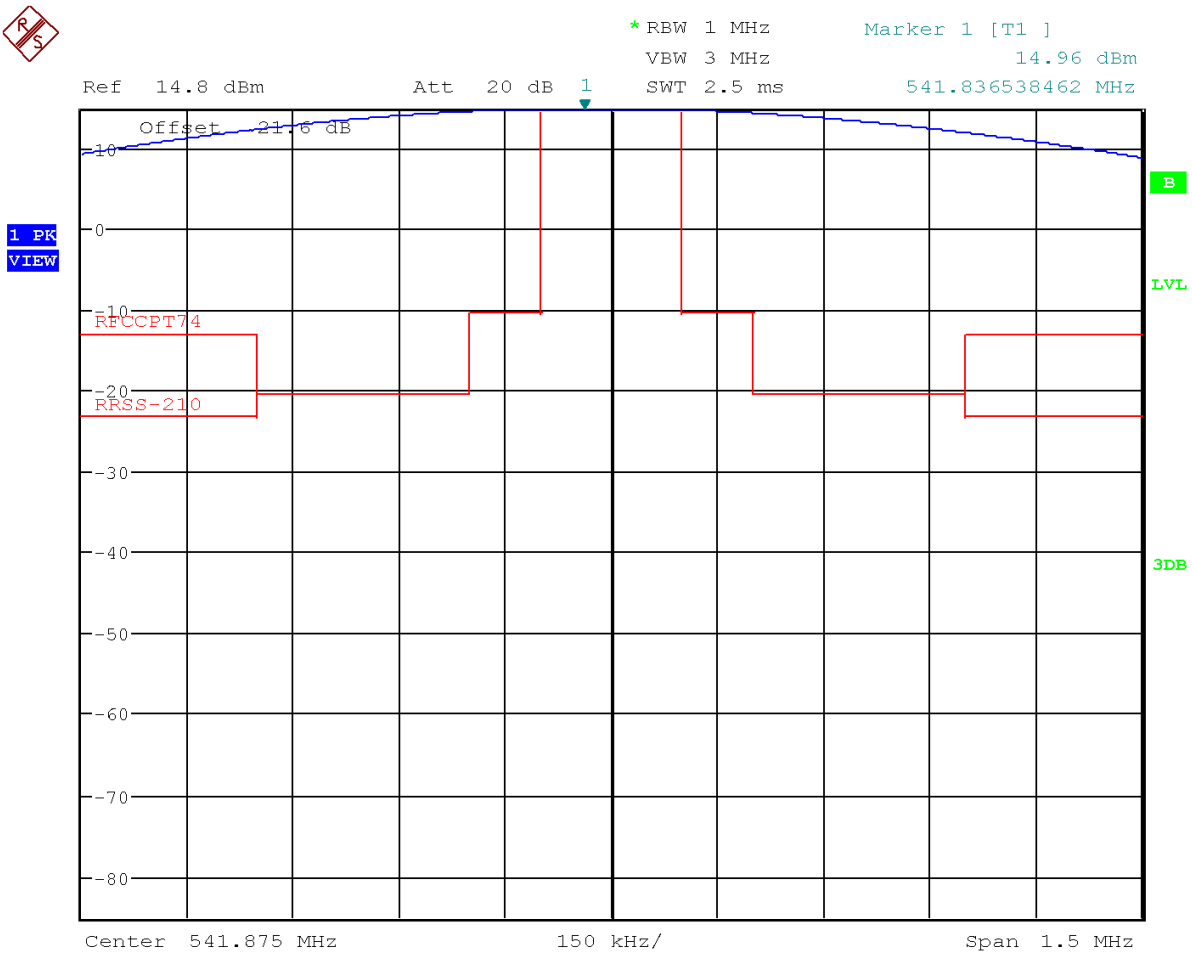


Date: 8.OCT.2015 16:20:33

Appendix C

Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Occupied Bandwidth Output Power Reference
Operating Conditions:	Low Frequency (541.875MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer
Test Date:	October 8, 2015

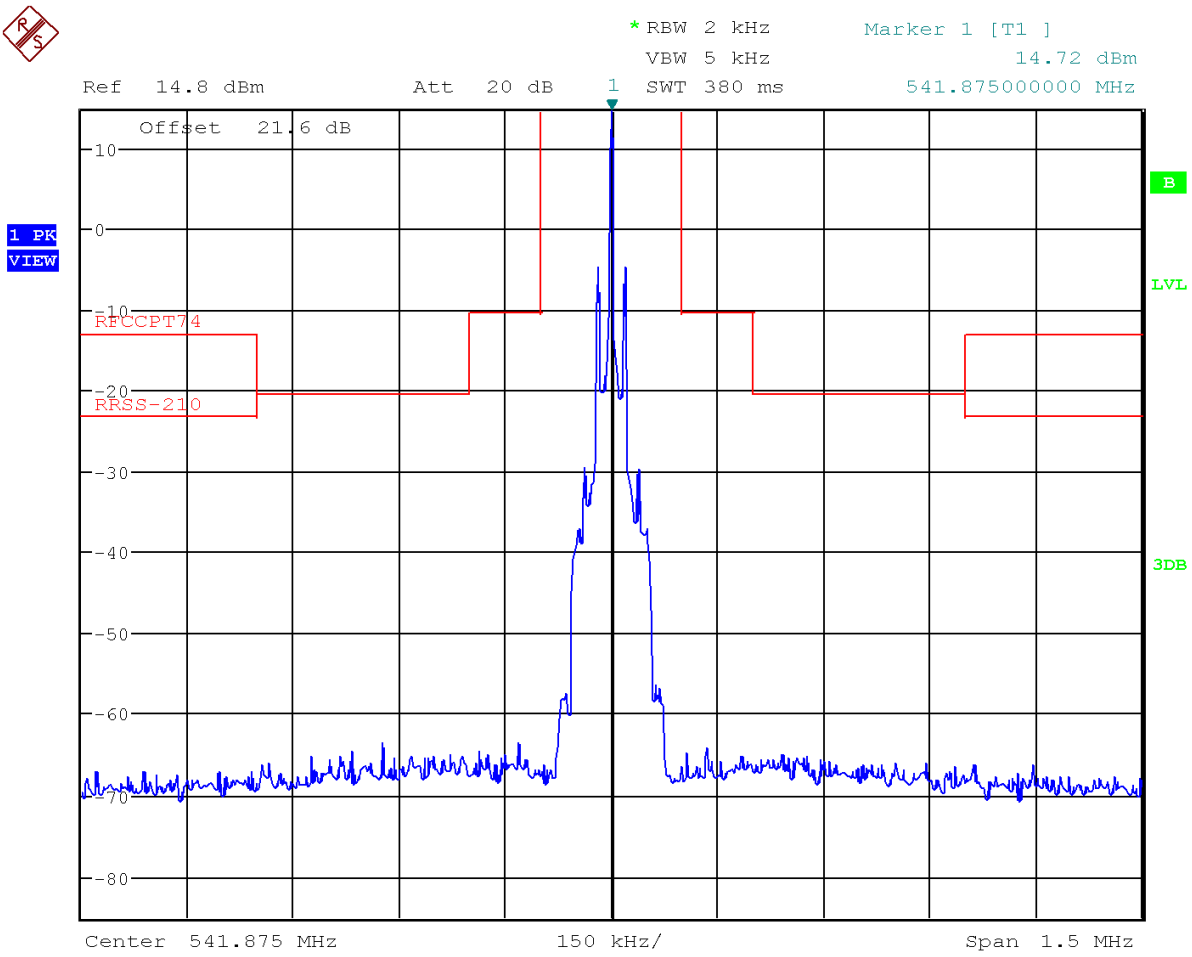


Date: 8.OCT.2015 16:41:16

Appendix C

Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Occupied Bandwidth Unmodulated Carrier
Operating Conditions:	Low Frequency (541.875MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer
Test Date:	October 8, 2015

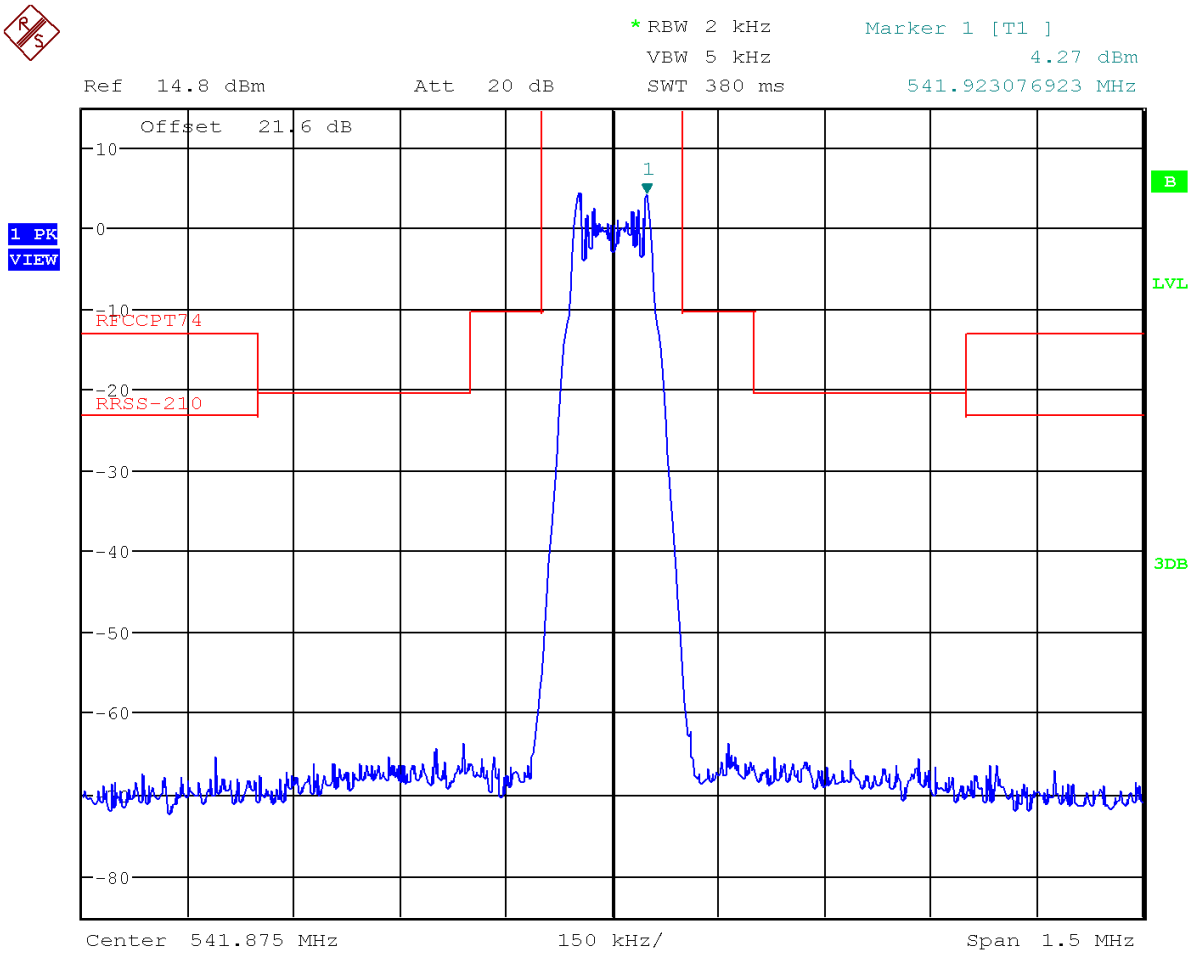


Date: 8.OCT.2015 16:43:15

Test Information

Appendix C

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Occupied Bandwidth 2500Hz @ 16dB over 50% Deviation
Operating Conditions:	Low Frequency (541.875MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer
Test Date:	October 8, 2015



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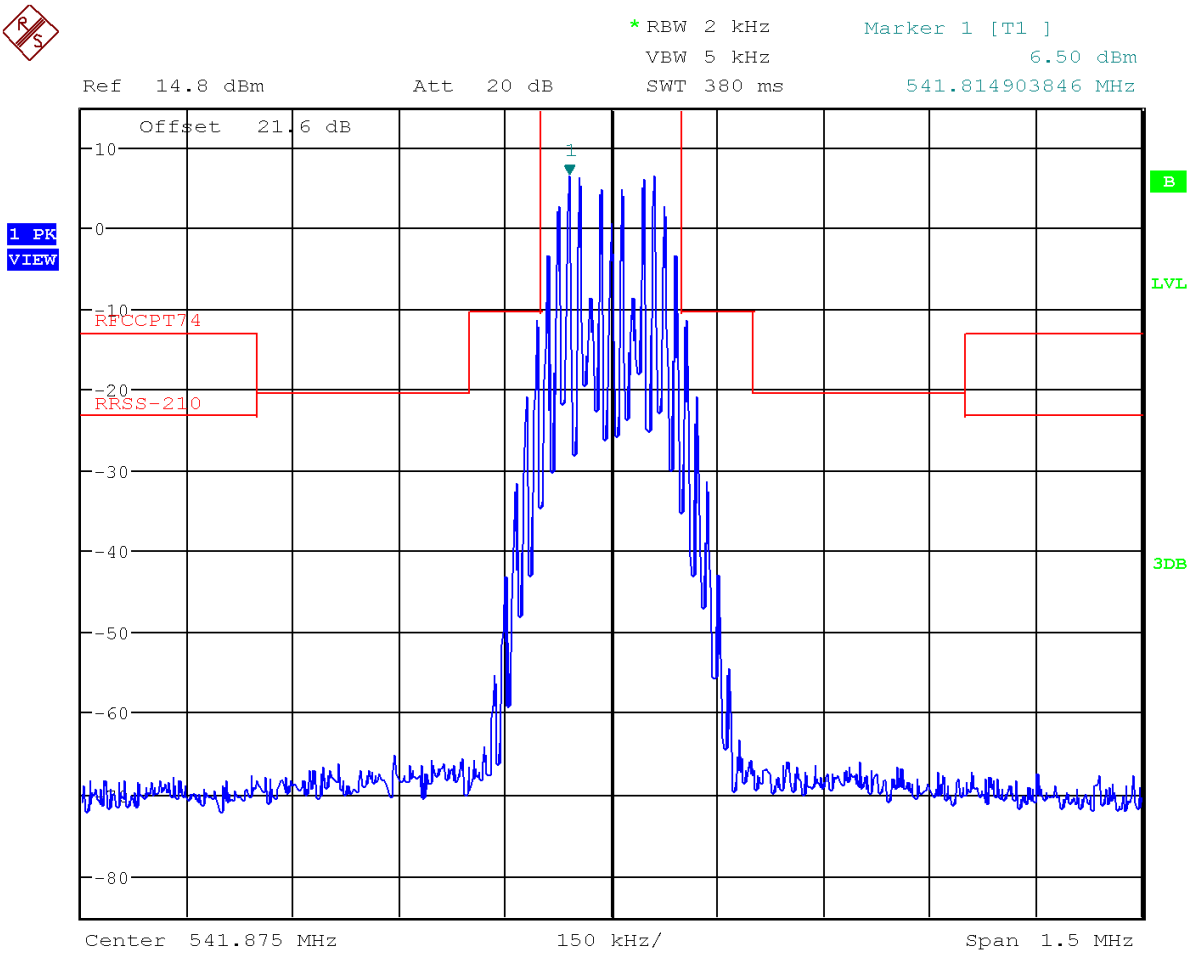
Appendix C

Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	FCC Part 74.861 and RSS-210 Occupied Bandwidth 15000Hz @ 85% Modulation
Operating Conditions:	Low Frequency (541.875MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	R & S FSU Spectrum Analyzer
Test Date:	October 8, 2015



Date: 8.OCT.2015 16:48:07

Appendix D

D. FIELD STRENGTH OF SPURIOUS EMISSIONS – 30 MHz TO 6000 MHz

D.1. PURPOSE:

This test was performed to determine if the ULXD1 (EUT) meets the radiated RF emission requirements of the FCC Part 74.861(e)(6)(iii), and the RSS-210, A1 Section 6.4.1 specifications, over the frequency range from 30MHz to 6GHz.

D.2. REQUIREMENTS:

As stated in paragraph 74.861 for low power auxiliary stations operating in the bands allocated for TV broadcasting, the mean power of emissions shall be attenuated by at least 43 + 10 log (P) dB below the mean output power on any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth.

As stated in RSS-210, A1 Section 6.4.1 for low power auxiliary equipment, the power of unwanted emissions shall be attenuated by at least 55 + 10 log (P) dB below the mean output power on any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth.

D.3. MEASUREMENT UNCERTAINTY:

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence):

Measurement Type	U_{lab}
Radiated disturbance (electric field strength on an open area test site or alternative test site) (30 MHz – 1000 MHz)	4.12 dB
Radiated disturbance (electric field strength on an open area test site or alternative test site) (1 GHz – 12.75 GHz)	4.55 dB

U_{lab} = Determined for Shure EMC Laboratory

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

D.4. TEST SETUP AND INSTRUMENTATION:

Photographs of the test setup are shown in Figures D-1, D-2, D-3 and D-4 on pages 33 - 34. The test instrumentation can be determined from Table 10-1.

D.5. EUT OPERATION:

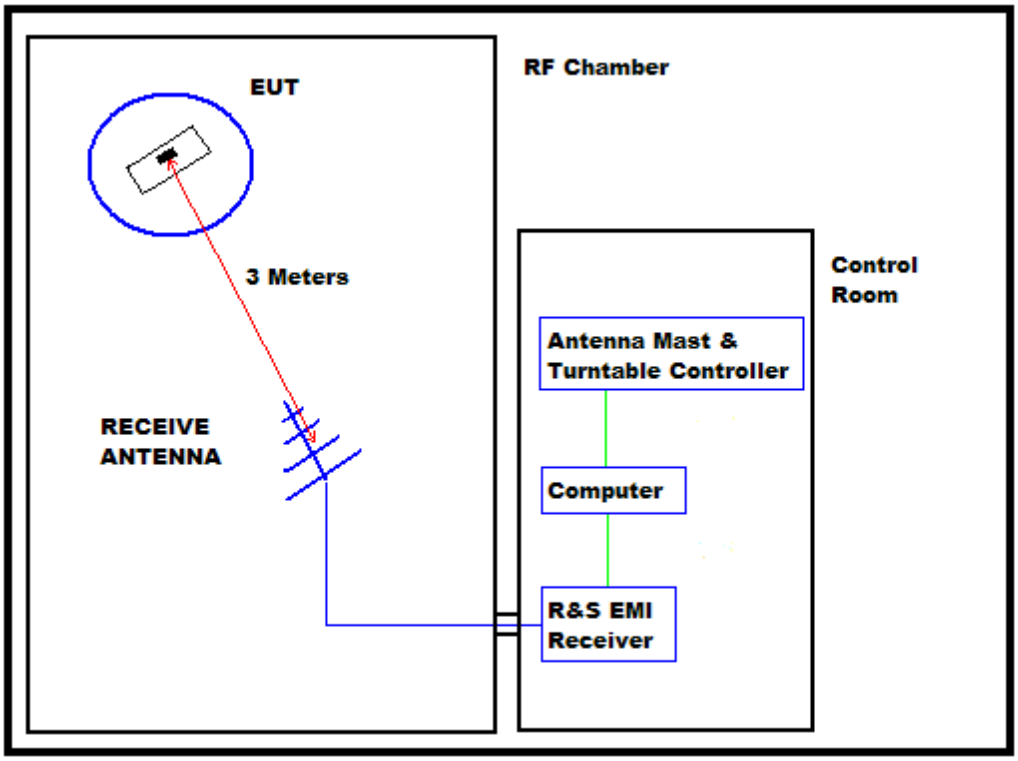
The EUT was powered up at 12VDC by a Shure Incorporated PS24 external switching DC power supply with an input of 120VAC 60Hz and the frequency of the transmitter was selected using a laptop computer. The EUT was checked for proper operation after it was setup on the table. Testing was conducted with the EUT set to the Low, Mid and High frequency within the operating frequency range. The volume pot on the front of the EUT was set to the maximum level. Four ¼" phono plug shielded audio cables (1 meter long each) were

connected to both the Audio Input and Loop Output ports of the EUT. The end of each cable was terminated with a representative test load.

D.6. SPECIFIC TEST PROCEDURES:

All tests were performed in a 28ft. x 20ft. x 18.5ft. 3m semi-anechoic test chamber. The walls and ceiling of the shielded chamber are lined with ferrite tiles. Anechoic absorber material is installed over the ferrite tile. The floor of the chamber is used as the ground plane. The chamber complies with ANSI C63.4-2014 for site attenuation.

The shielded enclosure prevents emissions from other sources, such as radio and TV stations from interfering with the measurements. All power lines and signal lines entering the enclosure pass through filters on the enclosure wall. The power line filters prevent extraneous signals from entering the enclosure on these leads.



BLOCK DIAGRAM OF SHIELDED ENCLOSURE

Preliminary radiated measurements were performed to determine the frequencies where the significant emissions might be found. The broadband measuring antenna was positioned at a 3 meter distance from the EUT. The frequency range from 30MHz to 1GHz was investigated using a peak detector function with the BiConiLog antenna at horizontal and vertical polarization, and with several different orientations of the EUT with respect to the antenna. The maximum levels measured for each antenna polarization were then automatically plotted. The resultant field strength (FS) is a summation in decibels (dB) of the EMI receiver measurement (ERM), the antenna correction factor (AF), and the cable loss factor (CF). If an external pre-amplifier is used, the total is reduced by its gain (-PA).

Formula 1: FS (dBµV/m) = MTR (dBµV) + AF (dB/m) + CF (dB) + (- PA (dB))

To convert the Field Strength dBµV/m term to µV/m, the dBµV/m is first divided by 20. The Base 10 Antilog is taken of this quotient. The result is the Field Strength value in µV/m terms.

Formula 2: FS (µV/m) = AntiLog [(FS (dBµV/m))/20]

Final radiated RF emissions were performed on all significant broadband and narrowband emissions found in the preliminary sweeps using the following methods:

1) Measurements of all significant broadband and narrowband signals from 30MHz to 1GHz were made using a quasi-peak detector and a BiConiLog antenna. Measurements above 1GHz were made using an average detector and a broadband double ridged waveguide antenna.

2) To ensure that maximum or worst case, emission levels were measured, the following steps were taken:

i. The EUT was rotated so that all of its sides were exposed to the receiving antenna.
ii. Since the measuring antenna is linearly polarized, both horizontal and vertical field components were measured.
iii. The measuring antenna was raised and lowered from 1 to 4 meters for each antenna polarization to maximize the readings.

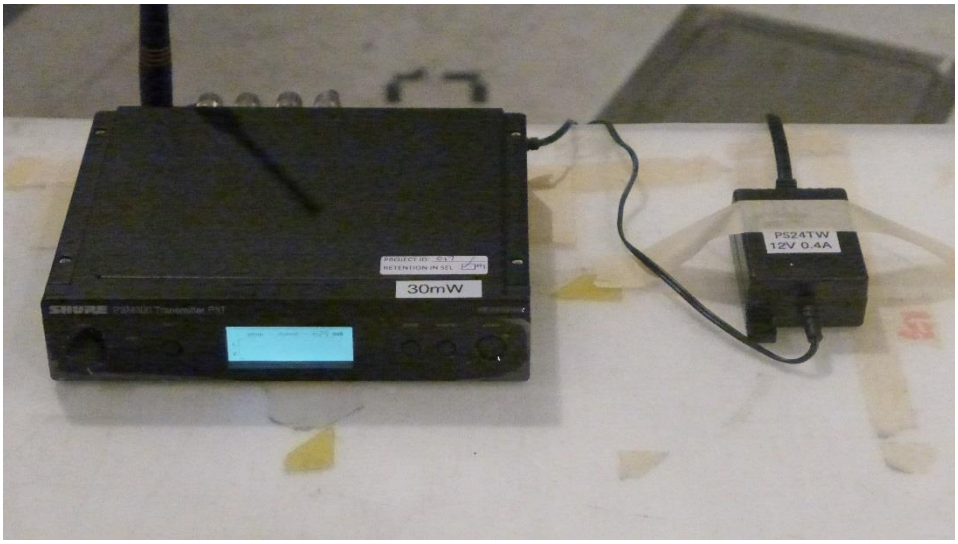
3) Once the significant narrowband emissions were defined and their measurements maximized, the measurement s were confirmed by matching the field strength of the maximized signal from the EUT by substituting the EUT with a dipole antenna below 1GHz and a waveguide horn antenna above 1GHz and reproducing the field strength measurement.

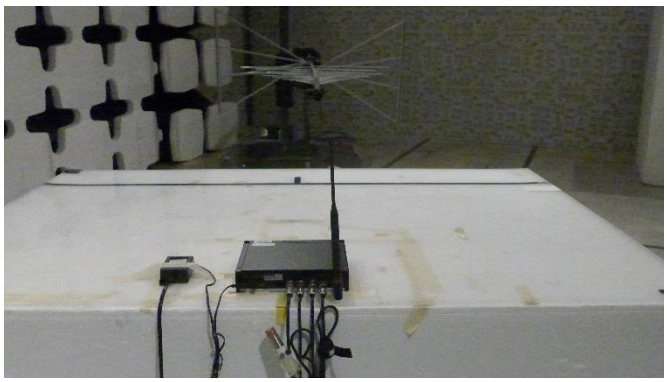
i. The substitution antenna was positioned in the same orientation as the EUT.
ii. The output of a signal generator set at the same frequency as the significant narrow band emission was fed into the substitution antenna.
iii. The test antenna was raised or lowered as necessary to ensure that the maximum signal was still received.
iv. The output power level (in dBm) of the signal generator was increased until the corresponding reading on the test receiver matched the maximized field strength measurement.
v. The output power level of the signal generator was recorded as the absolute level of the spurious radiated emission in dBm taking into account any cable loss and antenna gain inherent in the substitution test setup.

D.7. RESULTS:

The plots of the peak preliminary radiated voltage levels are presented on pages 35 through 45. The maximized peak radiated voltage level results are presented on pages 38, 42, and 46. All emissions measured from the P3T H20 were within both the FCC “Code of Federal Regulations” Title 47 Part 74, Subpart H and Industry Canada RSS-210, A1 Sections 6 specification limits.

Appendix D





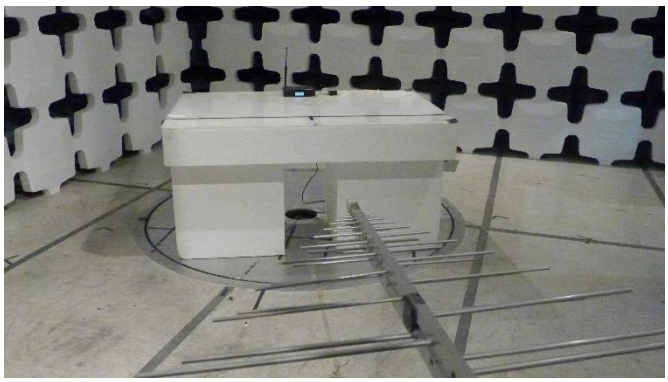
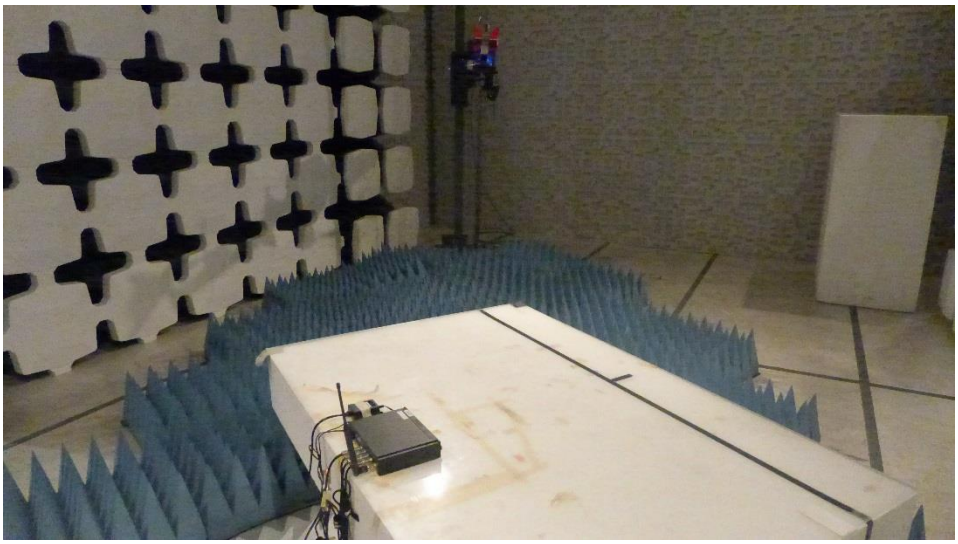


Figure D-1 - Test Setup for Spurious Emissions 30MHz to 1GHz

Appendix D



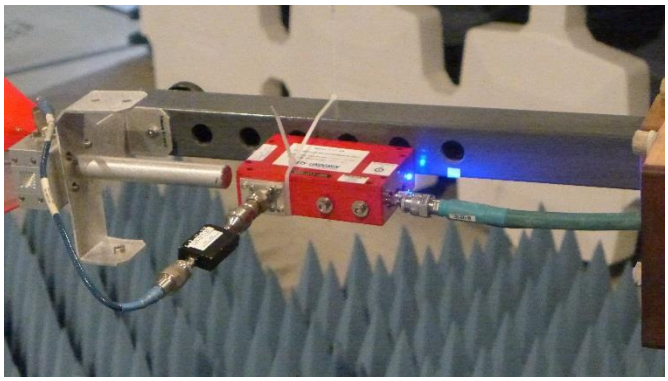


Figure D-2 - Test Setup for Spurious Emissions 1GHz to 6GHz

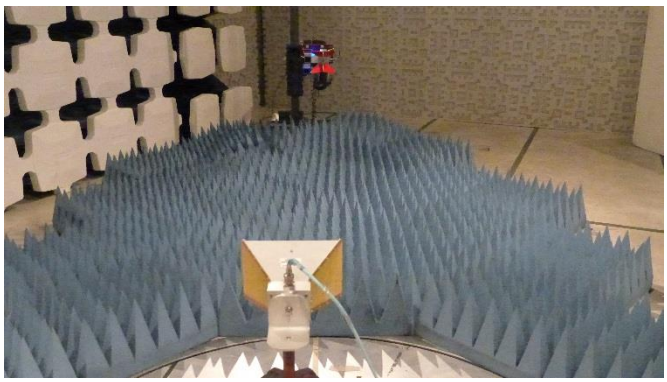


Figure D-3 - Test Setup for Matching 30MHz to 1GHz

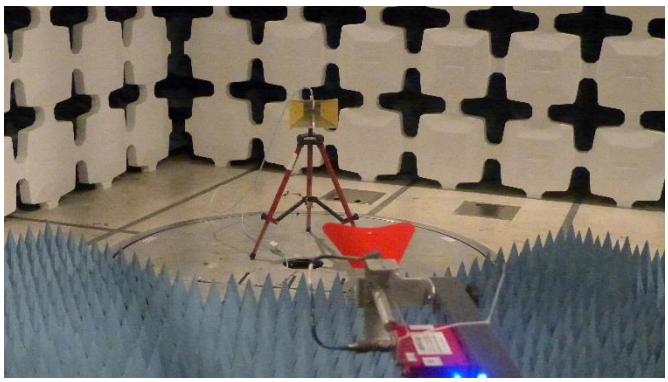


Figure D-4 - Test Setup for Matching 1GHz to 6GHz

Appendix D

Test Information

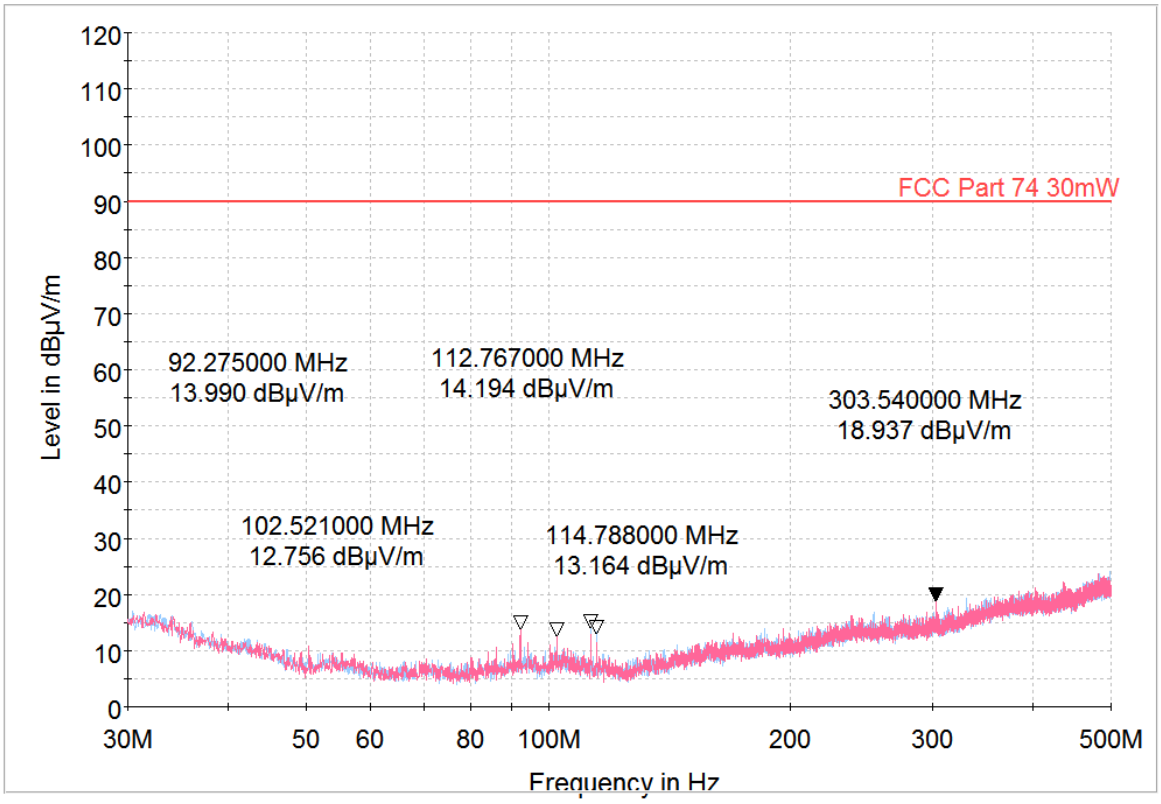
Test Description:	Radiated RF Emissions 30MHz to 500MHz
Operating Conditions:	120VAC 60Hz
EUT	P3T H20
Serial Number	#1
EUT Configuration	30mW @ 518.125MHz
Test Configuration	FCC pt74
Operator Name:	Alex Stelmaszczyk
Comment:	PS24, Notch
Test Date & Time	November 5, 2015 3:07:37 PM

EMI Auto Test Template:
COMPLIANCE TEST FCC 74 Transmitter 30MHz to 500MHz 34790

Hardware Setup:	Electric Field Strength TX 30-500MHz 34790 2015 04 06
Level Unit:	dBµV/m

Subrange	Step Size	Detectors	IF Bandwidth	Meas. Time	Preamp
30 MHz - 500	30 kHz	QPK	120 kHz	0.02 s	20 dB

Full Spectrum



Appendix D

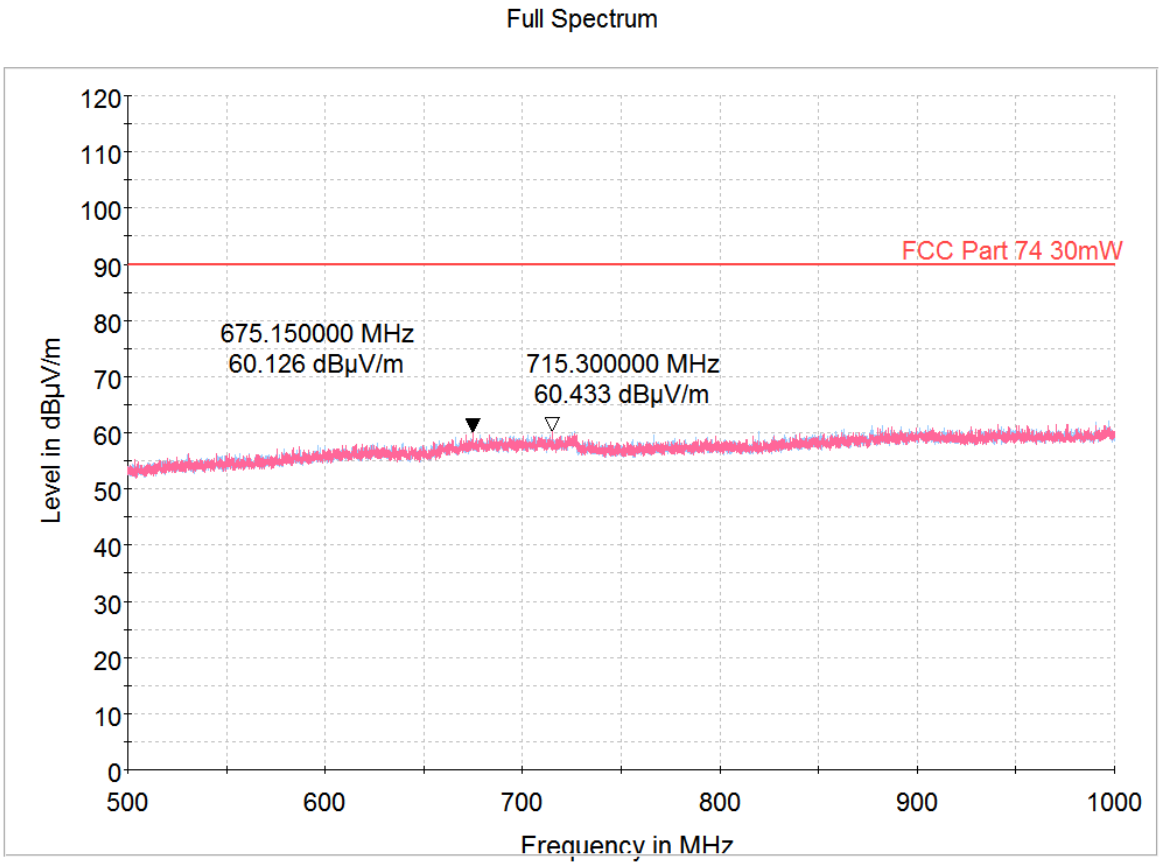
Test Information

Test Description:	Radiated RF Emissions 500MHz to 1GHz
Operating Conditions:	120VAC 60Hz
EUT	P3T H20
Serial Number	#1
EUT Configuration	30mW @ 518.125MHz
Test Configuration	FCC pt74
Operator Name:	Alex Stelmaszczyk
Comment:	PS24, High-Pass 940MHz
Test Date & Time	November 6, 2015 3:57:07 PM

Hardware Setup:
EMI radiated\Electric Field Strength TX 500-1GHz 34790 2015 04 06

Hardware Setup:	Electric Field Strength TX 500-1GHz 34790 2015 04 06
Level Unit:	dBµV/m

Subrange	Step Size	Detectors	IF Bandwidth	Meas. Time	Preamp
500 MHz - 1 GHz	30 kHz	QPK	120 kHz	0.02 s	20 dB



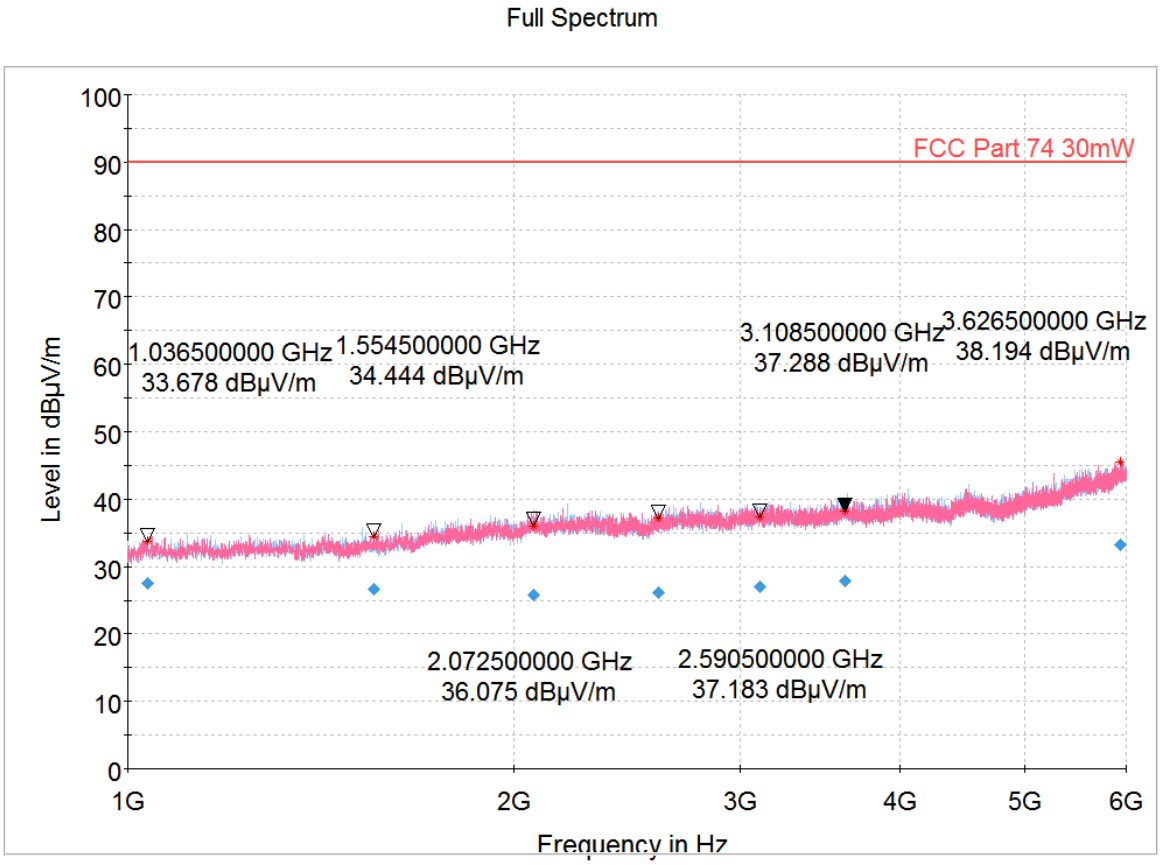
Test Information

Test Description:	Radiated RF Emissions 1GHz to 6GHz
Operating Conditions:	120VAC 60Hz
EUT	P3T H20
Serial Number	#1
EUT Configuration	30mW @ 518.125MHz
Test Configuration	FCC pt74
Operator Name:	Alex Stelmaszczyk
Comment:	PS24, High-Pass 940MHz
Test Date & Time	November 11, 2015 11:41:41 AM

Hardware Setup:
EMI radiated\Electric Field Strength TX 1-6GHz 3117-PA 2015 05 14

Hardware Setup:	Electric Field Strength TX 1-6GHz 3117-PA 2015 05 14
Level Unit:	dBµV/m

Subrange	Step Size	Detectors	IF Bandwidth	Meas. Time	Preamp
1 GHz - 6 GHz	250 kHz	AVG	1 MHz	0.02 s	20 dB



Appendix D

Test Information

Test Description:	Radiated RF Emissions - Matching Data
Operating Conditions:	120VAC 60Hz
EUT	P3T H20
Serial Number	#1
EUT Configuration	30mW @ 518.125MHz
Test Configuration	FCC pt74
Operator Name:	Alex Stelmaszczyk
Comment:	PS24
Test Date & Time	November 13, 2015

Checked By: Craig Kozokar 12-3-2015

Actual Freq (MHz)	Harmonics (MHz)	Polarity	30mW Scan (dBµV)	30mW Equivalent Measured from Sig Gen (dBm)	Cable Loss (dB)	Antenna Gain (dBi)	30 mW ERP Total (dBm)	Limit (dBm)	Status
518.125 (Low)	1036.500	H	33.678	-89.0	1.8	6.2	-84.6	-30.0	Pass
	1036.500	V		-99.0	1.8	6.2	-94.6	-30.0	Pass
	1554.500	H	34.444	-89.0	2.3	8.3	-83.0	-30.0	Pass
	1554.500	V		-99.0	2.3	8.3	-93.0	-30.0	Pass
	2072.500	H	36.075	-99.0	2.9	9.2	-92.7	-30.0	Pass
	2072.500	V		-99.0	2.9	9.2	-92.7	-30.0	Pass
	2590.500	H	37.183	-99.0	3.4	9.8	-92.6	-30.0	Pass
	2590.500	V		-82.0	3.4	9.8	-75.6	-30.0	Pass
	3108.500	H	37.288	-99.0	5.0	9.9	-94.1	-30.0	Pass
	3108.500	V		-100.0	5.0	9.9	-95.1	-30.0	Pass
	3626.500	H	38.194	-99.0	4.8	10.2	-93.6	-30.0	Pass
	3626.500	V		-100.0	4.8	10.2	-94.6	-30.0	Pass

ERP Total (dBm) = Matched Sig Gen (dBm) + Antenna Gain (dBi) – Cable Loss (dB)

Appendix D

Test Information

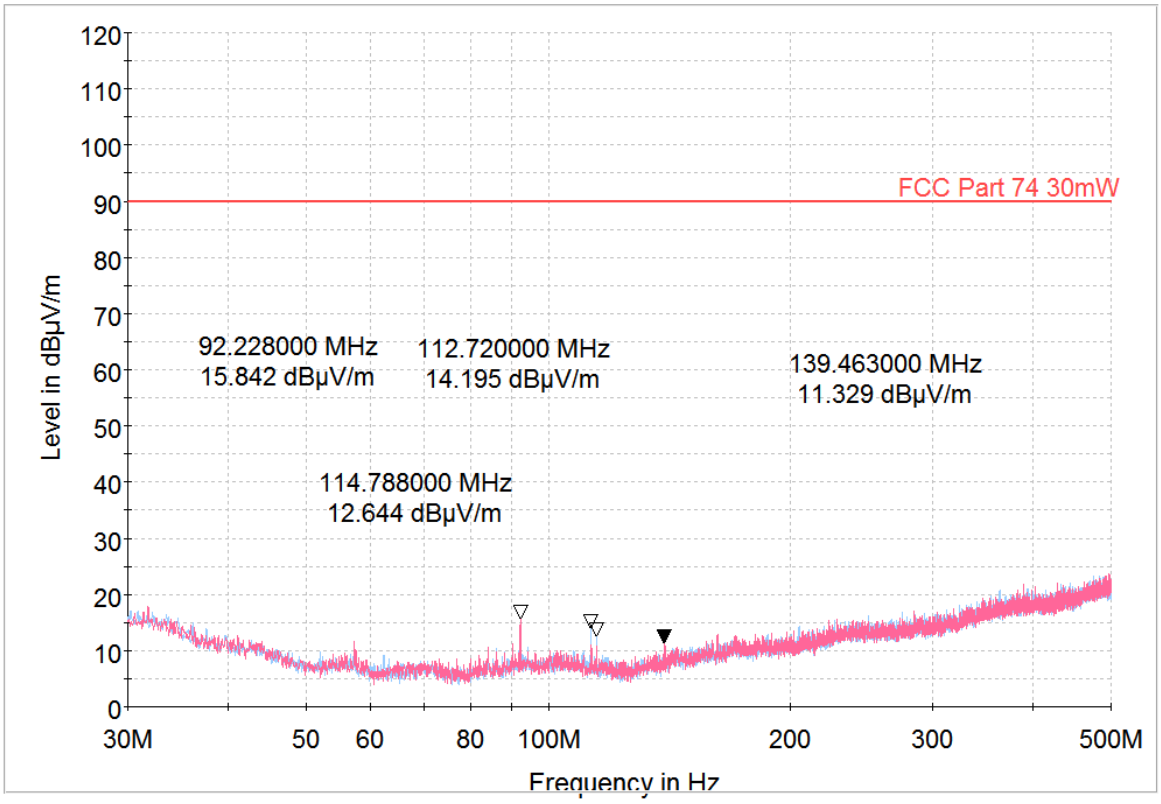
Test Description:	Radiated RF Emissions 30MHz to 500MHz
Operating Conditions:	120VAC 60Hz
EUT	P3T H20
Serial Number	#1
EUT Configuration	30mW @ 530.150MHz
Test Configuration	FCC pt74
Operator Name:	Alex Stelmaszczyk
Comment:	PS24, Notch
Test Date & Time	November 6, 2015 9:41:58 AM

EMI Auto Test Template:
COMPLIANCE TEST FCC 74 Transmitter 30MHz to 500MHz 34790

Hardware Setup:	Electric Field Strength TX 30-500MHz 34790 2015 04 06
Level Unit:	dBµV/m

Subrange	Step Size	Detectors	IF Bandwidth	Meas. Time	Preamp
30 MHz - 500	30 kHz	QPK	120 kHz	0.02 s	20 dB

Full Spectrum



Test Information

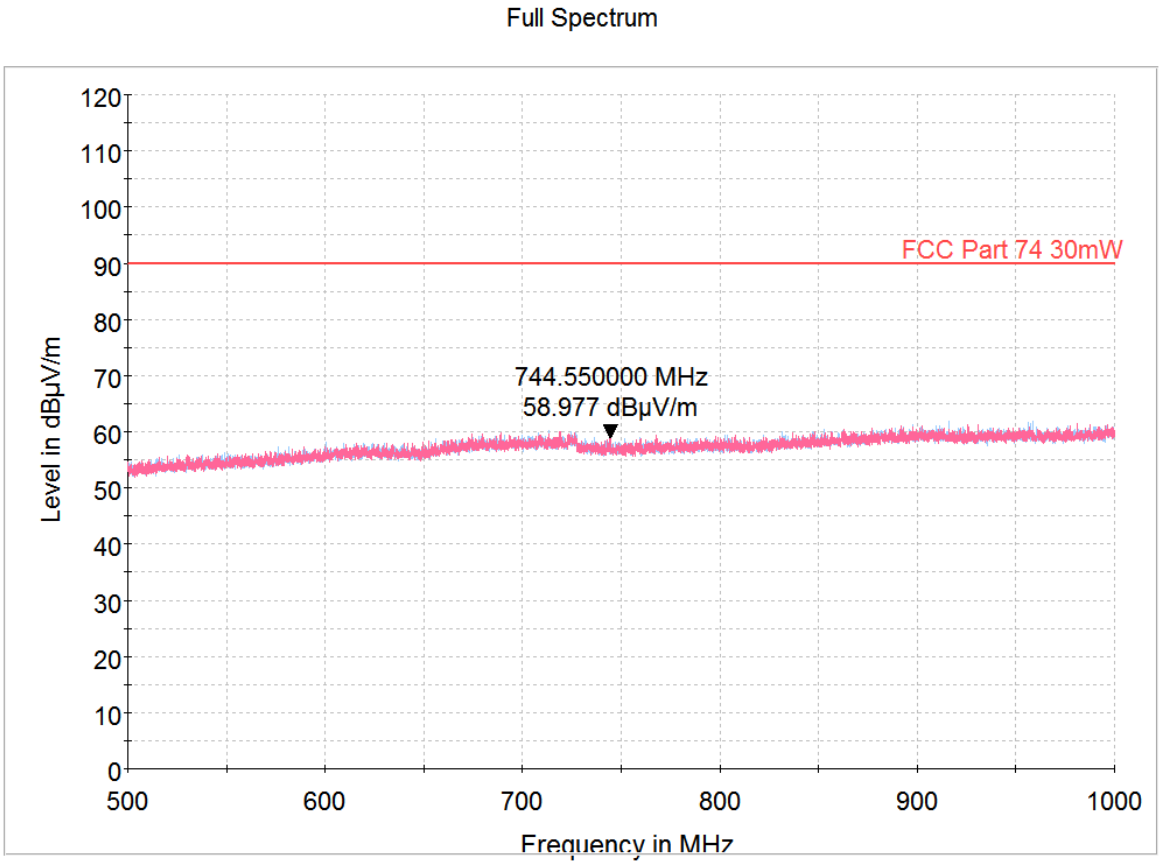
Appendix D

Test Description:	Radiated RF Emissions 500MHz to 1GHz
Operating Conditions:	120VAC 60Hz
EUT	P3T H20
Serial Number	#1
EUT Configuration	30mW @ 530.150MHz
Test Configuration	FCC pt74
Operator Name:	Alex Stelmaszczyk
Comment:	PS24, High-Pass 940MHz
Test Date & Time	November 6, 2015 1:50:12 PM

Hardware Setup:
EMI radiated\Electric Field Strength TX 500-1GHz 34790 2015 04 06

Hardware Setup:	Electric Field Strength TX 500-1GHz 34790 2015 04 06
Level Unit:	dBµV/m

Subrange	Step Size	Detectors	IF Bandwidth	Meas. Time	Preamp
500 MHz - 1 GHz	30 kHz	QPK	120 kHz	0.02 s	20 dB



Appendix D

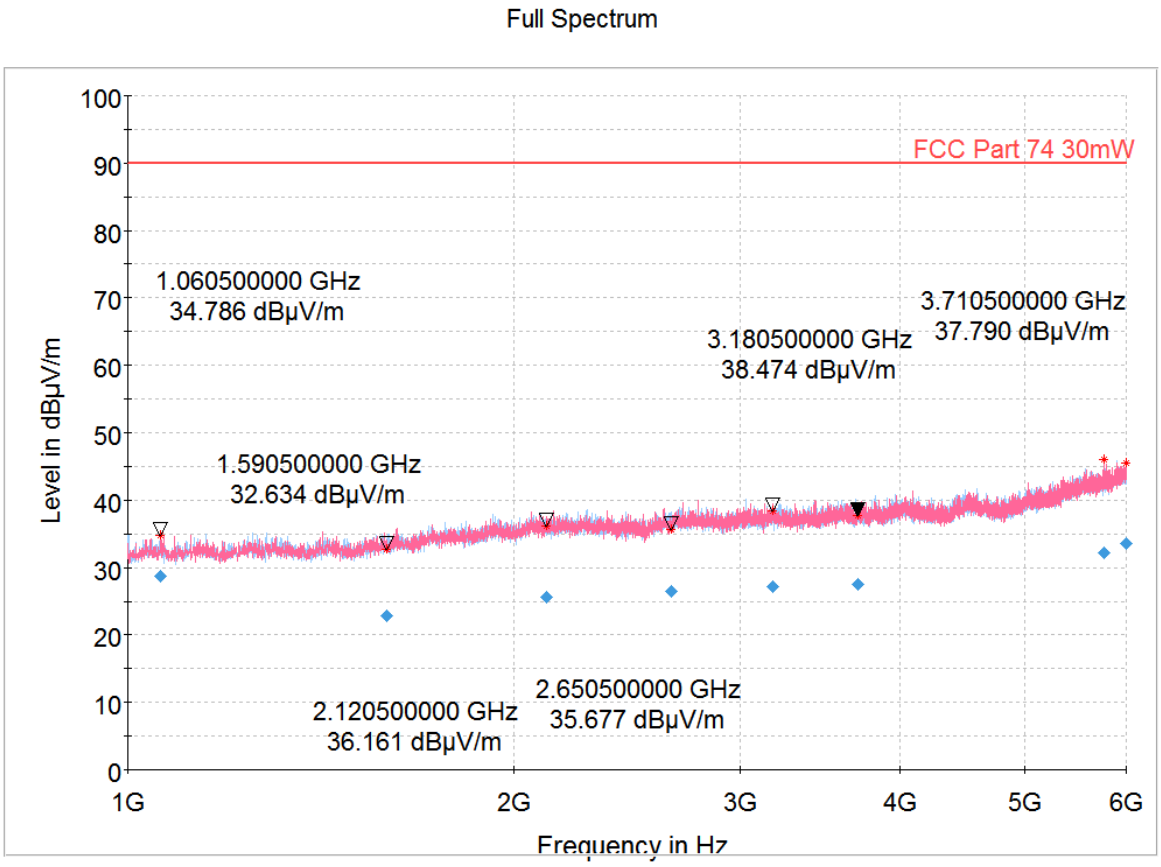
Test Information

Test Description:	Radiated RF Emissions 1GHz to 6GHz
Operating Conditions:	120VAC 60Hz
EUT	P3T H20
Serial Number	#1
EUT Configuration	30mW @ 530.150MHz
Test Configuration	FCC pt74
Operator Name:	Alex Stelmaszczyk
Comment:	PS24, High-Pass 940MHz
Test Date & Time	November 11, 2015 1:17:50 PM

Hardware Setup:
EMI radiated\Electric Field Strength TX 1-6GHz 3117-PA 2015 05 14

Hardware Setup:	Electric Field Strength TX 1-6GHz 3117-PA 2015 05 14
Level Unit:	dBµV/m

Subrange	Step Size	Detectors	IF Bandwidth	Meas. Time	Preamp
1 GHz - 6 GHz	250 kHz	AVG	1 MHz	0.02 s	20 dB



Appendix D

Test Information

Test Description:	Radiated RF Emissions - Matching Data
Operating Conditions:	120VAC 60Hz
EUT	P3T H20
Serial Number	#1
EUT Configuration	30mW @ 530.150MHz
Test Configuration	FCC pt74
Operator Name:	Alex Stelmaszczyk
Comment:	PS24
Test Date & Time	November 13, 2015

Checked By: Craig Kozokar 12-3-2015

Actual Freq (MHz)	Harmonics (MHz)	Polarity	30mW Scan (dBµV)	30mW Equivalent Measured from Sig Gen (dBm)	Cable Loss (dB)	Antenna Gain (dBi)	30 mW ERP Total (dBm)	Limit (dBm)	Status
530.150 (Mid)	1060.500	H	34.786	-85.0	1.8	6.2	-80.6	-30.0	Pass
	1060.500	V		-89.0	1.8	6.2	-84.6	-30.0	Pass
	1590.500	H	32.634	-99.0	2.4	8.3	-93.1	-30.0	Pass
	1590.500	V		-99.0	2.4	8.3	-93.1	-30.0	Pass
	2120.500	H	36.161	-99.0	3.0	9.2	-92.8	-30.0	Pass
	2120.500	V		-98.0	3.0	9.2	-91.8	-30.0	Pass
	2650.500	H	35.677	-99.0	3.4	9.8	-92.6	-30.0	Pass
	2650.500	V		-98.0	3.4	9.8	-91.6	-30.0	Pass
	3180.500	H	38.474	-92.0	4.5	9.9	-86.6	-30.0	Pass
	3180.500	V		-98.0	4.5	9.9	-92.6	-30.0	Pass
	3710.500	H	37.790	-98.0	4.4	9.9	-92.5	-30.0	Pass
	3710.500	V		-99.0	4.4	9.9	-93.5	-30.0	Pass

ERP Total (dBm) = Matched Sig Gen (dBm) + Antenna Gain (dBi) – Cable Loss (dB)

Test Information

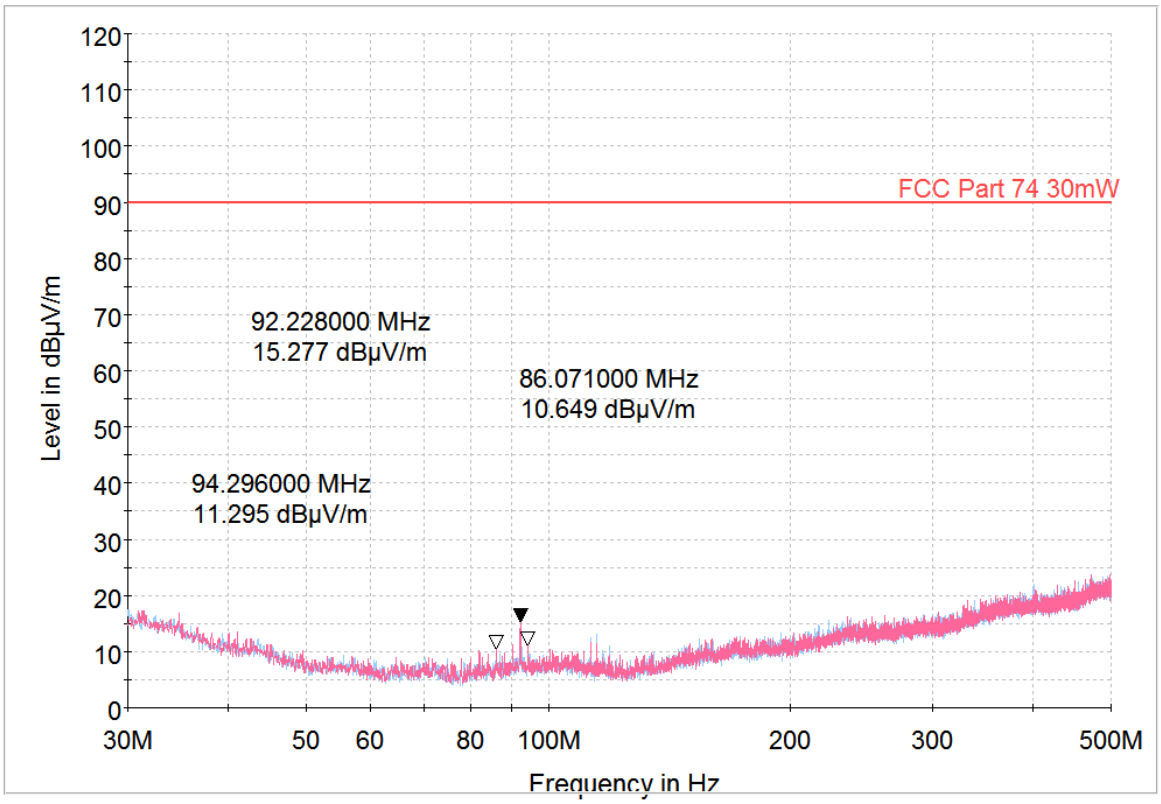
Test Description:	Radiated RF Emissions 30MHz to 500MHz
Operating Conditions:	120VAC 60Hz
EUT	P3T H20
Serial Number	#1
EUT Configuration	30mW @ 541.875MHz
Test Configuration	FCC pt74
Operator Name:	Alex Stelmaszczyk
Comment:	PS24, Notch
Test Date & Time	November 6, 2015 10:38:48 AM

EMI Auto Test Template:
COMPLIANCE TEST FCC 74 Transmitter 30MHz to 500MHz 34790

Hardware Setup:	Electric Field Strength TX 30-500MHz 34790 2015 04 06
Level Unit:	dBµV/m

Subrange	Step Size	Detectors	IF Bandwidth	Meas. Time	Preamp
30 MHz - 500	30 kHz	QPK	120 kHz	0.02 s	20 dB

Full Spectrum



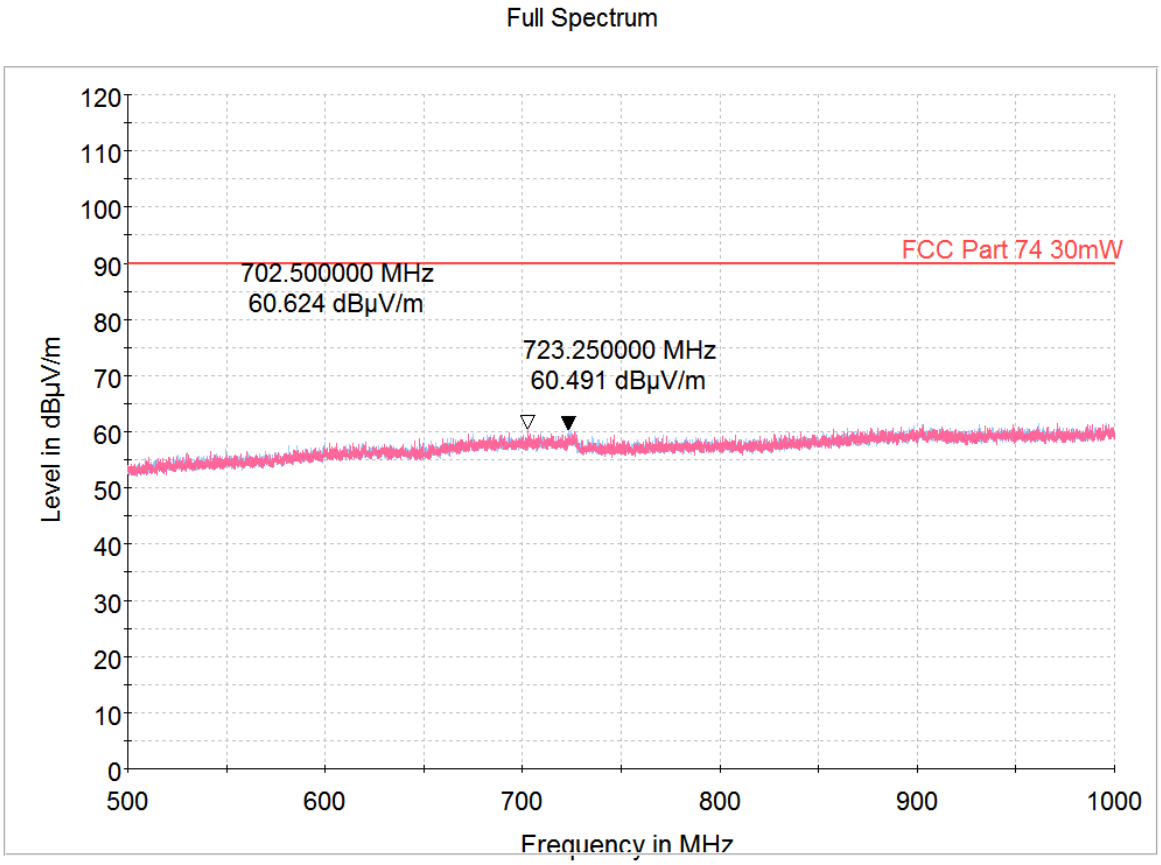
Test Information

Test Description:	Radiated RF Emissions 500MHz to 1GHz
Operating Conditions:	120VAC 60Hz
EUT	P3T H20
Serial Number	#1
EUT Configuration	30mW @ 541.875MHz
Test Configuration	FCC pt74
Operator Name:	Alex Stelmaszczyk
Comment:	PS24, High-Pass 940MHz
Test Date & Time	November 6, 2015 1:08:40 PM

Hardware Setup:
EMI radiated\Electric Field Strength TX 500-1GHz 34790 2015 04 06

Hardware Setup:	Electric Field Strength TX 500-1GHz 34790 2015 04 06
Level Unit:	dBµV/m

Subrange	Step Size	Detectors	IF Bandwidth	Meas. Time	Preamp
500 MHz - 1 GHz	30 kHz	QPK	120 kHz	0.02 s	20 dB



Appendix D

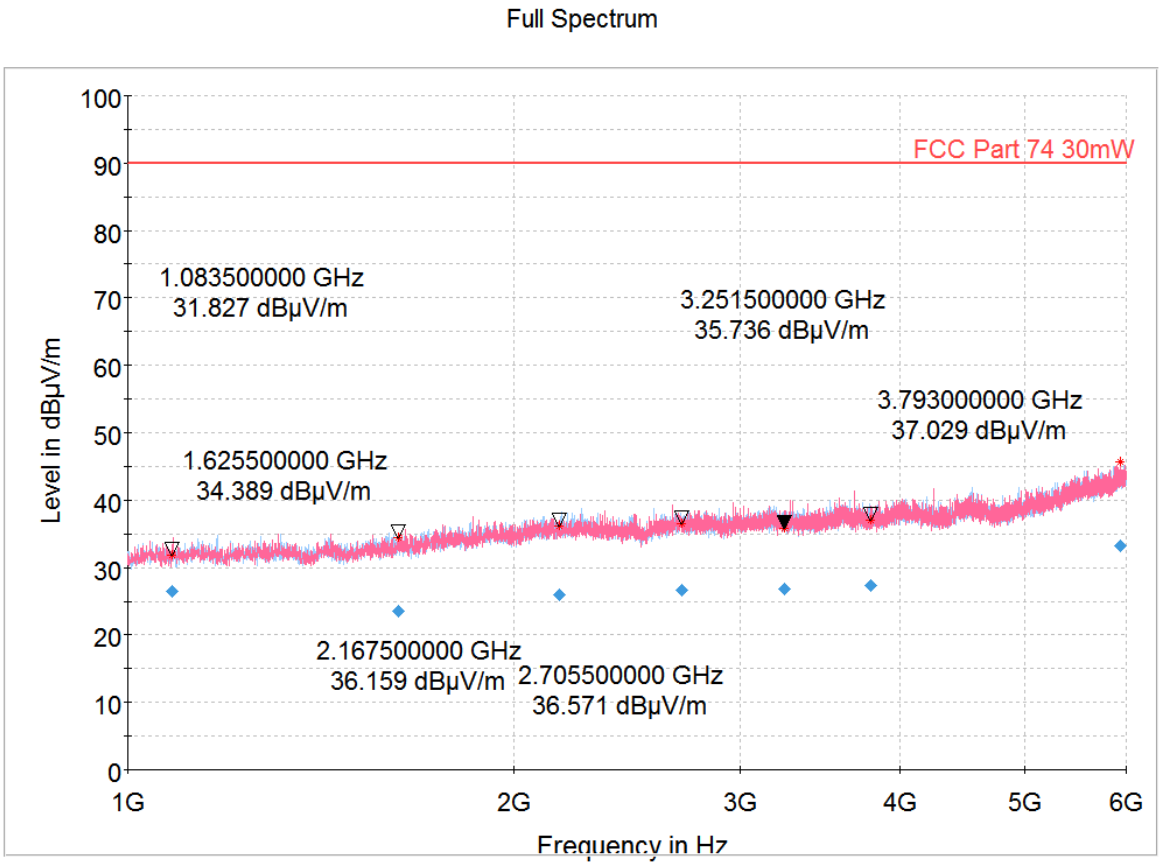
Test Information

Test Description:	Radiated RF Emissions 1GHz to 6GHz
Operating Conditions:	120VAC 60Hz
EUT	P3T H20
Serial Number	#1
EUT Configuration	30mW @ 541.875MHz
Test Configuration	FCC pt74
Operator Name:	Alex Stelmaszczyk
Comment:	PS24, High-Pass 940MHz
Test Date & Time	November 11, 2015 2:44:13 PM

Hardware Setup:
EMI radiated\Electric Field Strength TX 1-6GHz 3117-PA 2015 05 14

Hardware Setup:	Electric Field Strength TX 1-6GHz 3117-PA 2015 05 14
Level Unit:	dBµV/m

Subrange	Step Size	Detectors	IF Bandwidth	Meas. Time	Preamp
1 GHz - 6 GHz	250 kHz	AVG	1 MHz	0.02 s	20 dB



Test Information

Test Description:	Radiated RF Emissions - Matching Data
Operating Conditions:	120VAC 60Hz
EUT	P3T H20
Serial Number	#1
EUT Configuration	30mW @ 541.875MHz
Test Configuration	FCC pt74
Operator Name:	Alex Stelmaszczyk
Comment:	PS24
Test Date & Time	November 13, 2015

Checked By: Craig Kozokar 12-3-2015

Actual Freq (MHz)	Harmonics (MHz)	Polarity	30mW Scan (dBµV)	30mW Equivalent Measured from Sig Gen (dBm)	Cable Loss (dB)	Antenna Gain (dBi)	30 mW ERP Total (dBm)	Limit (dBm)	Status
541.875 (High)	1083.500	H	31.827	-99.0	1.8	6.2	-94.6	-30.0	Pass
	1083.500	V		-98.0	1.8	6.2	-93.6	-30.0	Pass
	1625.500	H	34.389	-99.0	2.5	8.3	-93.2	-30.0	Pass
	1625.500	V		-87.0	2.5	8.3	-81.2	-30.0	Pass
	2167.500	H	36.159	-99.0	3.0	9.2	-92.8	-30.0	Pass
	2167.500	V		-99.0	3.0	9.2	-92.8	-30.0	Pass
	2705.500	H	36.571	-99.0	3.5	9.8	-92.7	-30.0	Pass
	2705.500	V		-99.0	3.5	9.8	-92.7	-30.0	Pass
	3251.500	H	35.736	-98.0	4.2	9.9	-92.3	-30.0	Pass
	3251.500	V		-99.0	4.2	9.9	-93.3	-30.0	Pass
	3793.000	H	37.029	-99.0	4.6	9.6	-94.0	-30.0	Pass
	3793.000	V		-99.0	4.6	9.6	-94.0	-30.0	Pass

ERP Total (dBm) = Matched Sig Gen (dBm) + Antenna Gain (dBi) – Cable Loss (dB)

E. CONDUCTED RF EMISSIONS – AC Mains – 150 KHz TO 30 MHz

E.1. PURPOSE:

This test was performed to determine if the P3T meets the conducted RF emission requirements of the FCC Part 15, Subpart B and RSS-GEN Sections 8.8, Table 3 over the frequency range from 150 KHz to 30 MHz.

E.2. REQUIREMENTS:

All radio frequency voltages on the power lines of a EUT shall be below the values shown below when using a quasi-peak/average detector:

Frequency Range	Limits in dB(µV)	Limits in dB(µV)
In MHz	Quasi-Peak	Average
0.15 to 0.5	66-56*	56-46*
0.5 to 5	56	46
5 to 30	60	50

* - The limit decreases linearly with the logarithm of the frequency

Note 1: The lower limit shall apply at the transition frequency.

Note 2: If the levels measured using the QP detector meet both the QP and the Average limits, the EUT is considered to have met both requirements and measurements do not need to be performed using the Average detector.

E.3. MEASUREMENT UNCERTAINTY

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence)

Measurement Type	U_{lab}
Conducted disturbance on AC Mains port, 150 kHz to 30 MHz	1.90 dB

U_{lab} = Determined for Shure EMC Laboratory

E.4. TEST SETUP AND INSTRUMENTATION:

A photograph of the test setup are shown as Figure E.1. The test instrumentation can be determined from Table 10-1.

E.5. EUT OPERATION:

The EUT was powered up and the transmit frequency was selected using a PC. The line voltage to the EUT was 120VAC 60Hz. The EUT was checked for proper operation after it was setup on the table. Testing was conducted with the EUT set to a frequency. The volume pot on the front of the EUT was set to the maximum

level. Four ¼" plug shielded audio cables (1 meter long each) were connected to both the Audio Input and Loop Output ports of the EUT. The end of each cable was terminated with a shielded resistive load.

SPECIFIC TEST PROCEDURES:

The interference on the power line of the EUT was measured by connecting the measuring equipment to the "TO TEST RECEIVER" terminal of the Artificial Mains Network (AMN).

a) Measurements were first made on the Line Lead. The frequency of 150 KHz to 30 MHz was measured using a peak detector.
b) The data was then searched for a minimum of 10 of the highest levels. Any emissions levels that were within 10dB of the average limit were then measured again using both a quasi-peak detector and an average detector. (If no peak readings were within 10dB of the average limit, quasi-peak and average readings were taken on the highest emissions levels measured during the peak detector scan.). A table showing the quasi-peak and average readings was generated. This tabular data compares the quasi-peak and average conducted emissions to the applicable conducted emissions limits.
c) Measurements were then made on the Neutral Lead.

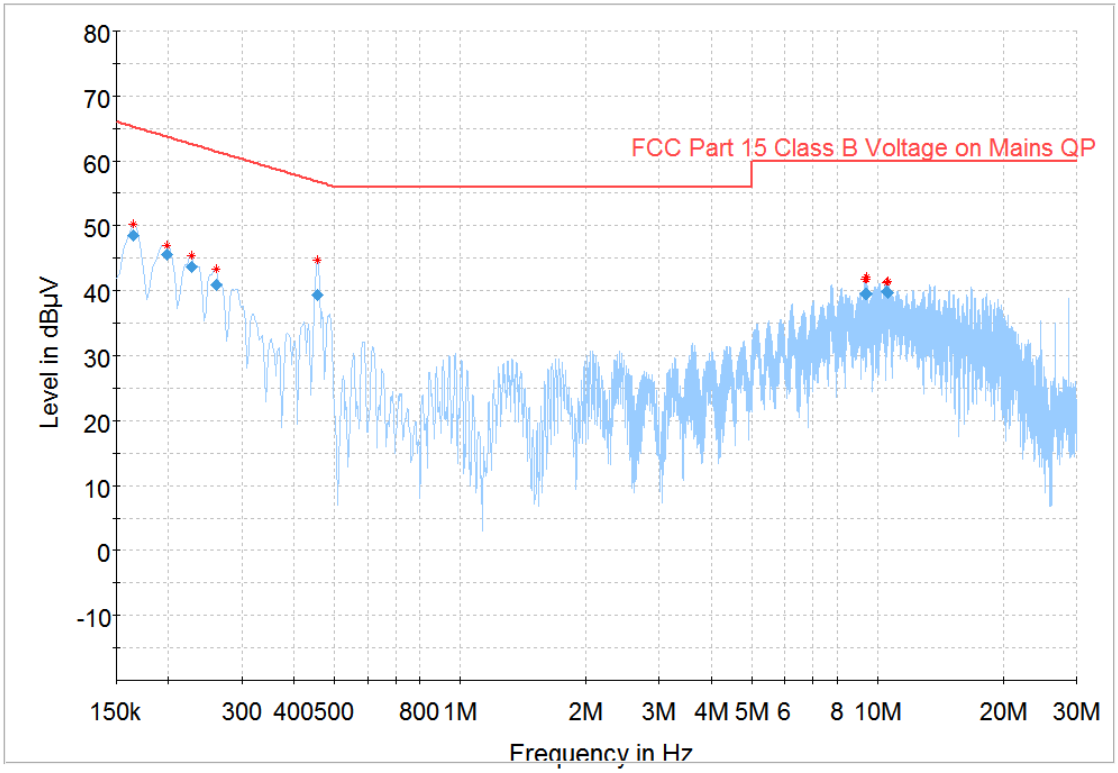
E.6. RESULTS:

The EUT plots of the peak conducted voltage levels acquired from each AC Mains line are shown on page 49. The tabular quasi-peak results from each AC Mains line are shown after each plot. All emissions measured from the P3T were within both the FCC "Code of Federal Regulations" Title 47 Part 15, Subpart B and Industry Canada RSS-GEN Sections 8.8, Table 3 specification limits.

Figure E-1 - Test Setup for Conducted Emissions 150kHz to 30MHz

Test Information

Test Description:	AC Mains Conducted RF Emissions
Operating Conditions:	120VAC 60Hz, 2-Wire Floating
EUT	P3T H20
Serial Number	#1
EUT Configuration	Line 1 and Neutral
Test Configuration	FCC Part15b
Operator Name:	Alex Stelmaszczyk
Comment:	PS24
Test Date & Time	November 16, 2015 4:05:26 PM



Frequency (MHz)	Quasi-Peak	Limit (dBµV)	Margin (dB)	Correction (dB)	Line	Comment
0.164925	48.46	65.21	16.76	0.2	N	4:06:02 PM - 11/16/2015
0.197760	45.55	63.70	18.16	0.2	N	4:06:07 PM - 11/16/2015
0.227610	43.62	62.54	18.91	0.1	L1	4:04:52 PM - 11/16/2015
0.260445	40.95	61.42	20.46	0.1	L1	4:04:57 PM - 11/16/2015
0.454470	39.37	56.79	17.42	0.1	L1	4:05:02 PM - 11/16/2015
9.358725	39.44	60.00	20.56	0.6	L1	4:05:07 PM - 11/16/2015
9.391560	39.48	60.00	20.52	0.6	L1	4:05:12 PM - 11/16/2015
9.424395	39.53	60.00	20.47	0.6	L1	4:05:17 PM - 11/16/2015
10.546755	39.78	60.00	20.22	0.7	L1	4:05:22 PM - 11/16/2015
10.579590	39.65	60.00	20.35	0.7	L1	4:05:26 PM - 11/16/2015

F. SPURIOUS EMISSIONS AT ANTENNA TERMINAL

F.1. PURPOSE:

This test was performed to determine if the P3T H20 meets the RF spurious emission requirements at the antenna terminal per FCC Part 74 and RSS-210, A1 over the frequency range from 30MHz to 6GHz.

F.2. REQUIREMENTS:

This test determines whether the test item produces excessive spurious emissions. In accordance with paragraph 74.861, any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth shall be attenuated by at least 43 + 10 log (P) dB which is equivalent to -13dBm. The emissions shall be measured from 30MHz up to the 10th harmonic of the fundamental frequency.

In accordance with RSS-210, A1 Section 6.4.1, on any frequency removed from the operating frequency by more than 250 percent of the authorized bandwidth: at least 55 + 10 log (P) dB which is equivalent to -25dBm. In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given in (a) and (b):

a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.

F.3. MEASUREMENT UNCERTAINTY

All measurements are an estimate of their true value. The measurement uncertainty characterizes, with a specified confidence level, the spread of values which may be possible for a given measurement system.

Values of Expanded Measurement Uncertainty (95% Confidence):

Measurement Type	U_{LAB}
Conducted Spurious Emission (25 MHz – 18000 MHz)	**1.23 dB**

U_{lab} = Determined for Shure EMC Laboratory

- Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
- Non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.

F.4. TEST SETUP AND INSTRUMENTATION:

Photographs of the test setup are shown as Figure F-8. The test instrumentation can be determined from Table 10-1.

F.5. EUT OPERATION:

The EUT was powered up and the transmit frequency the transmitter was selected using a PC. The line voltage to the EUT was checked after turn-on and adjusted to 120VAC 60Hz. The EUT was checked for proper operation after it was setup for the test. The EUT was set to transmit at a low, mid or high frequency within its operating band. The volume pot on the front of the EUT was set to the maximum level. The Audio Input ports were connected to an audio signal source using shielded cables.

The EUT was powered up at 12VDC by a Shure Incorporated PS24 external switching DC power supply with an input of 120VAC 60Hz and the frequency of the transmitter was selected using a laptop computer. The EUT was checked for proper operation after it was setup on the table. Testing was conducted with the EUT set to the Low, Mid and High frequency within the operating frequency range. The volume pot on the front of the EUT was set to the maximum level. The Audio Input ports were connected to an audio signal source using shielded cables.

F.6. TEST PROCEDURES:

a. The EUT was connected to the 50 ohm input of a spectrum analyzer through either a band-reject tunable filter (below 1GHz) or a high-pass filter (above 1GHz); the reference offset of the spectrum analyzer was set to the measured value of the attenuation path.
b. The spectrum analyzer frequency range was adjusted to cover the range to be tested and the resolution bandwidth set to that required by the specifications. For the FCC measurements the resolution bandwidth was set to 100 kHz for spurious emissions below 1GHz and 1MHz for spurious emissions above 1GHz. For the RSS-210 measurements, the resolution bandwidth was set to 30 kHz.
c. The antenna conducted emission limits were overlaid on the spectrum analyzer display and the trace was recorded.
d. The test item was modulated with a 2500 Hz sine wave at an input level as is specified by the requirements. For the FCC measurements the test item was modulated with a 2500 Hz sine wave at an input level 16dB greater than that necessary to produce 50% of rated system deviation. For the RSS-210 measurements the test item was modulated with signals representative of those encountered in a real system operation (2500Hz at 80% rated deviation).
e. Steps (a) through (d) were repeated at the high, medium, and low frequencies of the EUT's frequency band.

F.7. RESULTS:

The spurious emissions data found at the antenna terminals are presented on pages 52-57. Data is shown on the figures at each frequency (Low, Mid, or High) of a specific band. The figures show the spurious emissions levels found for each frequency tested. The limits, shown on the plots, are set for based on the requirements found in section F.2. As can be seen from the data presented in the section, the P3T did not produce spurious emissions in excess of the limits.

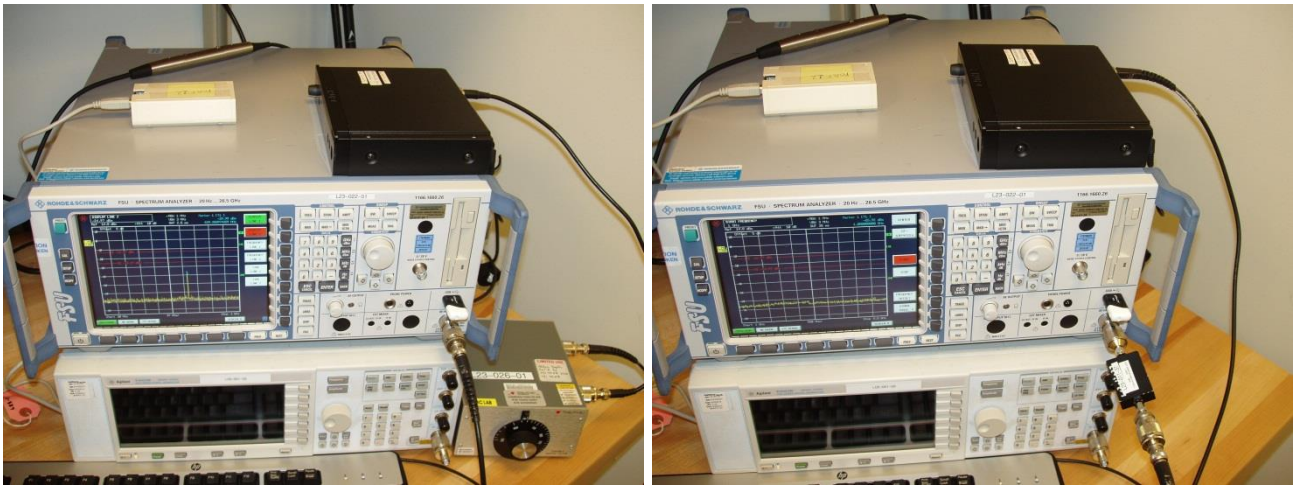
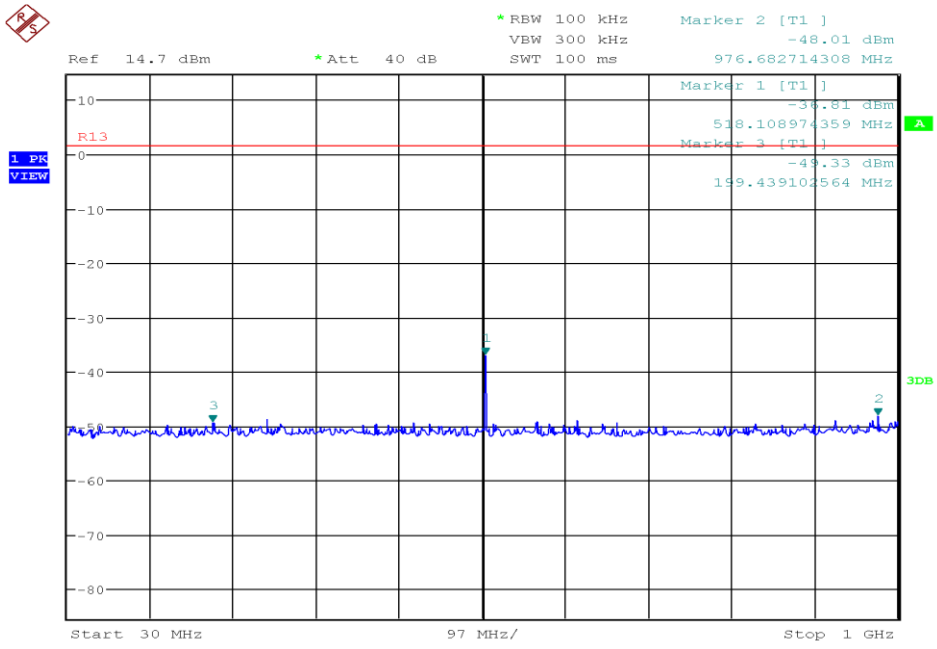


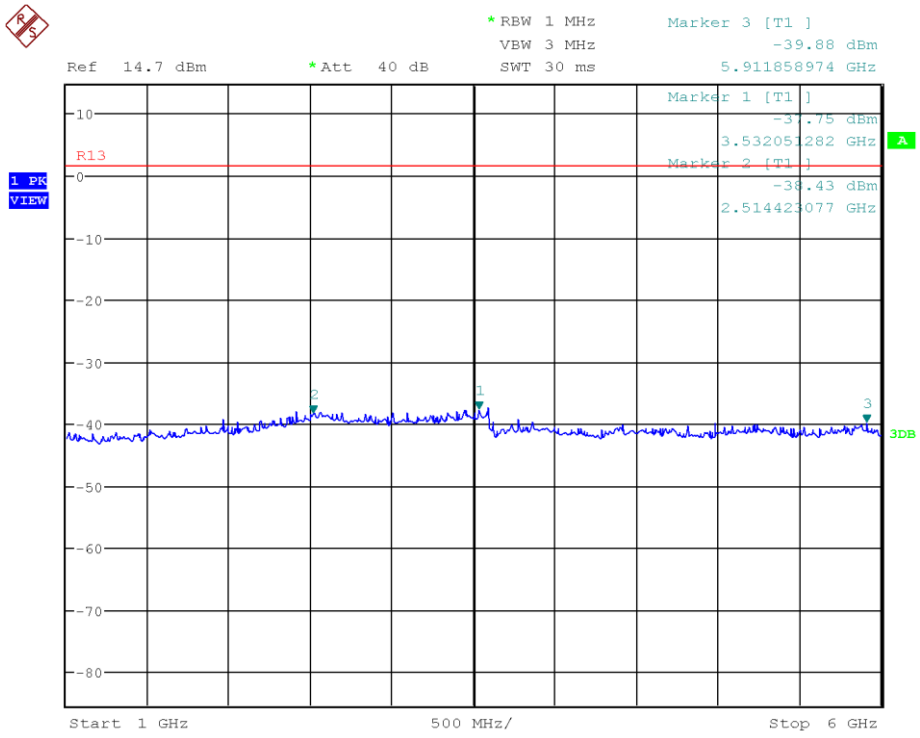
Figure F-8 Setup of Spurious Emissions at Antenna Terminals Measurement

Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	Antenna Conducted Emissions - FCC
Operating Conditions:	Low Frequency (518.125MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	2500 Hz at 16dB over 50% rated deviation

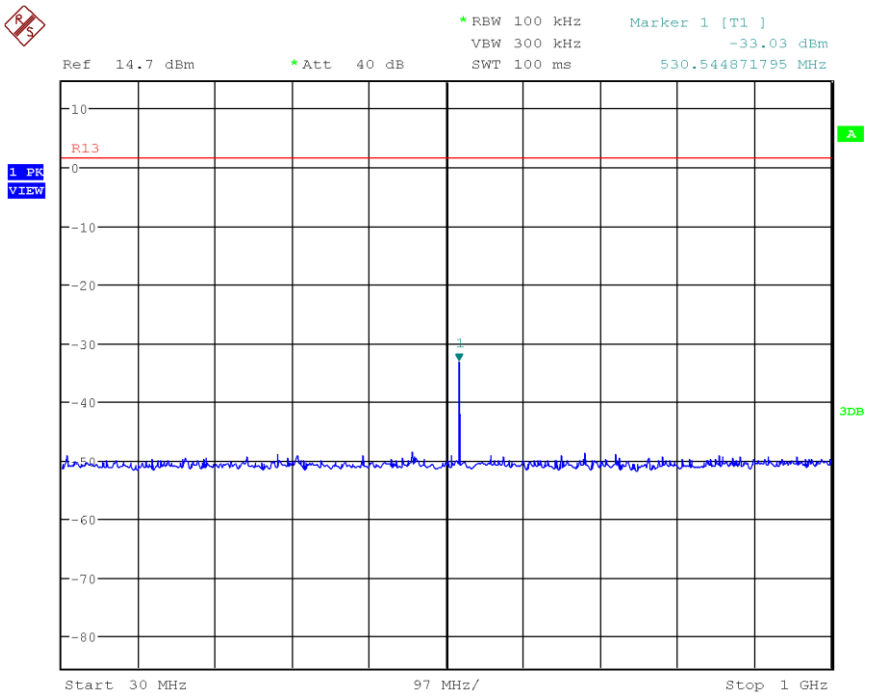
Test Date: October 30, 2015

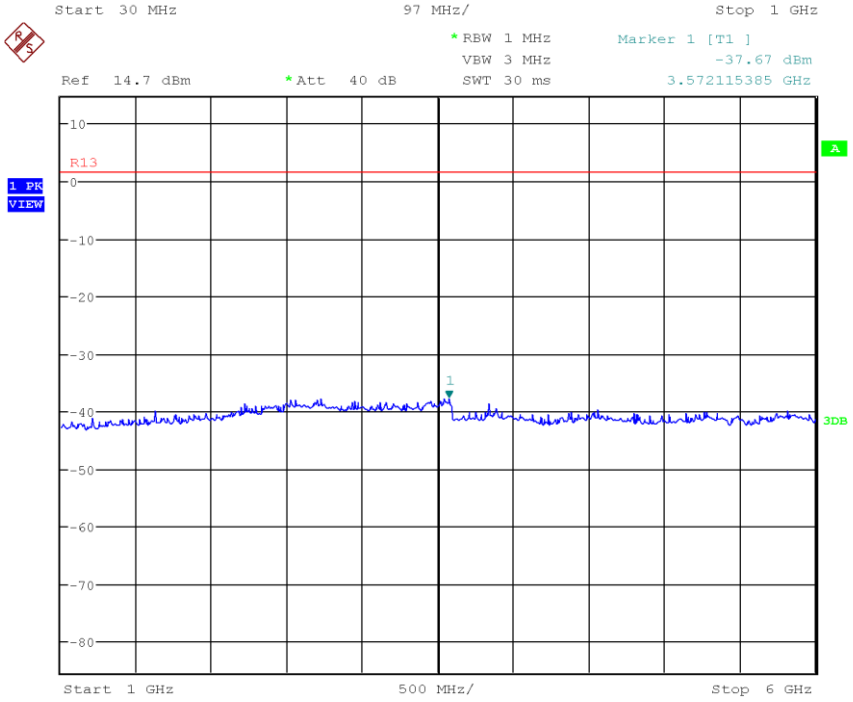




Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	Antenna Conducted Emissions - FCC
Operating Conditions:	Mid Frequency (530.150MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	2500 Hz at 16dB over 50% rated deviation
Test Date:	October 30, 2015

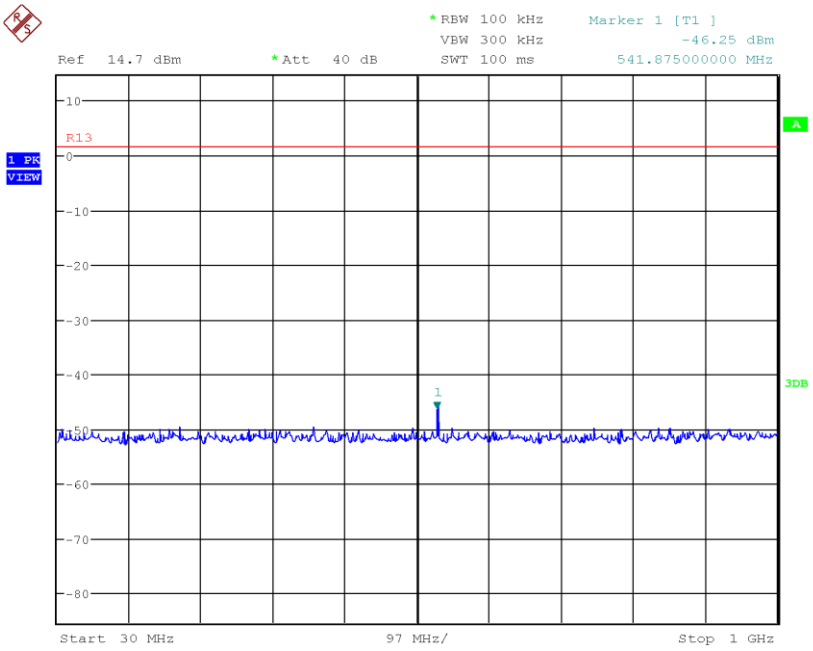


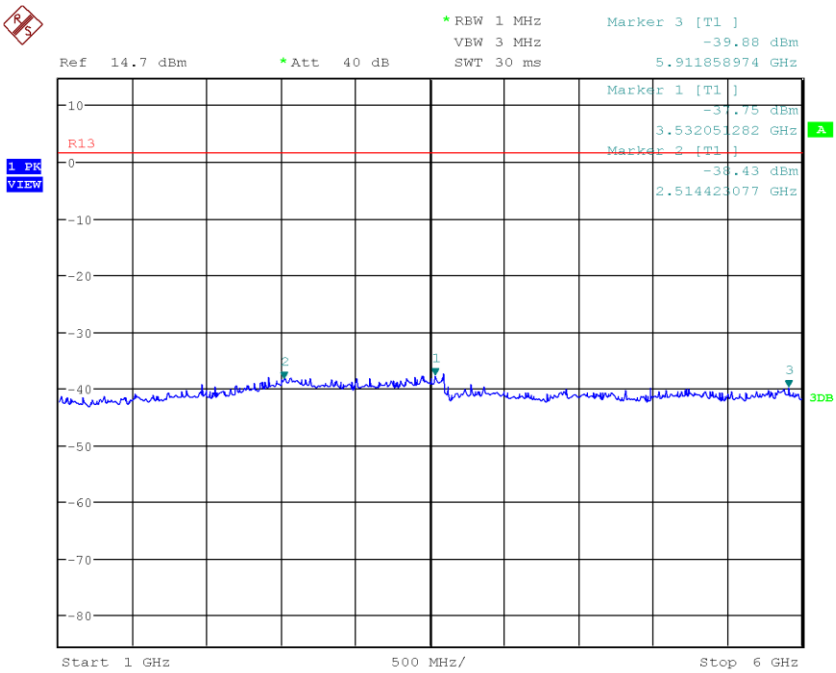


Appendix F

Test Information

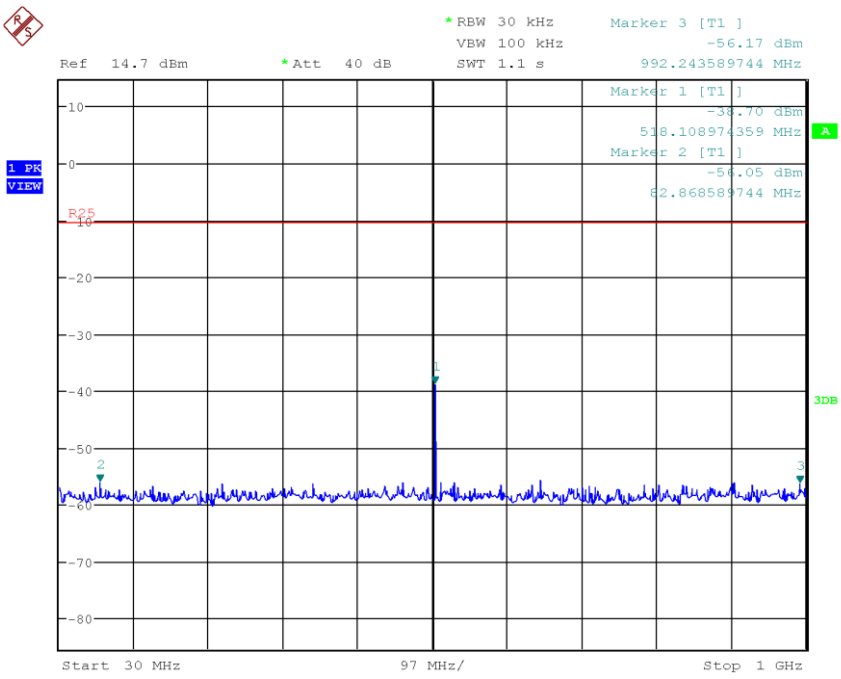
EUT Name:	P3T H20
Serial Number:	#1
Test Description:	Antenna Conducted Emissions - FCC
Operating Conditions:	High Frequency (541.875MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	2500 Hz at 16dB over 50% rated deviation
Test Date:	October 30, 2015

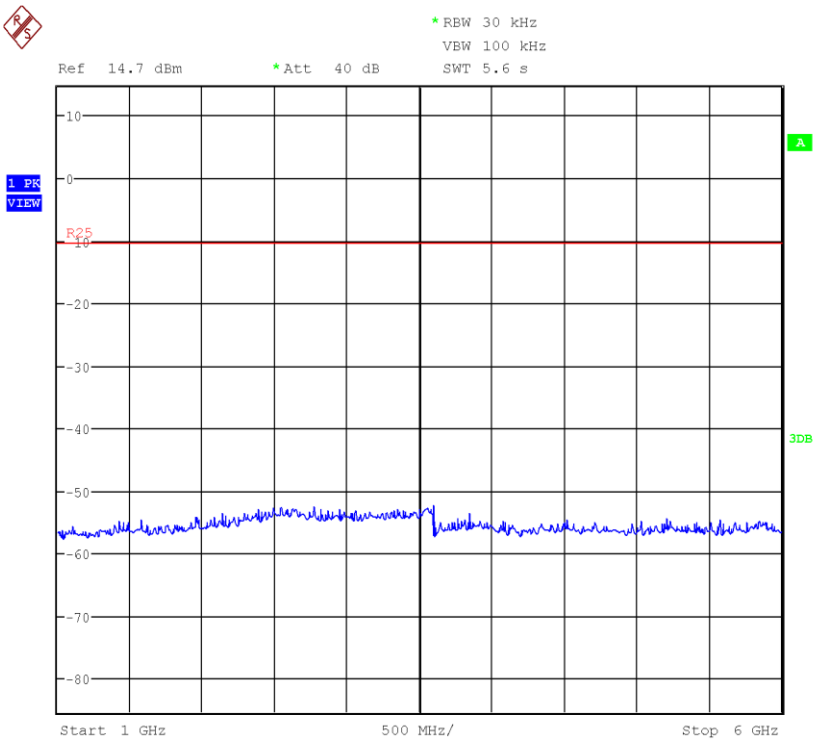




Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	Antenna Conducted Emissions - IC
Operating Conditions:	Low Frequency (518.125MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	2500 Hz at 80% rated deviation
Test Date:	October 30, 2015

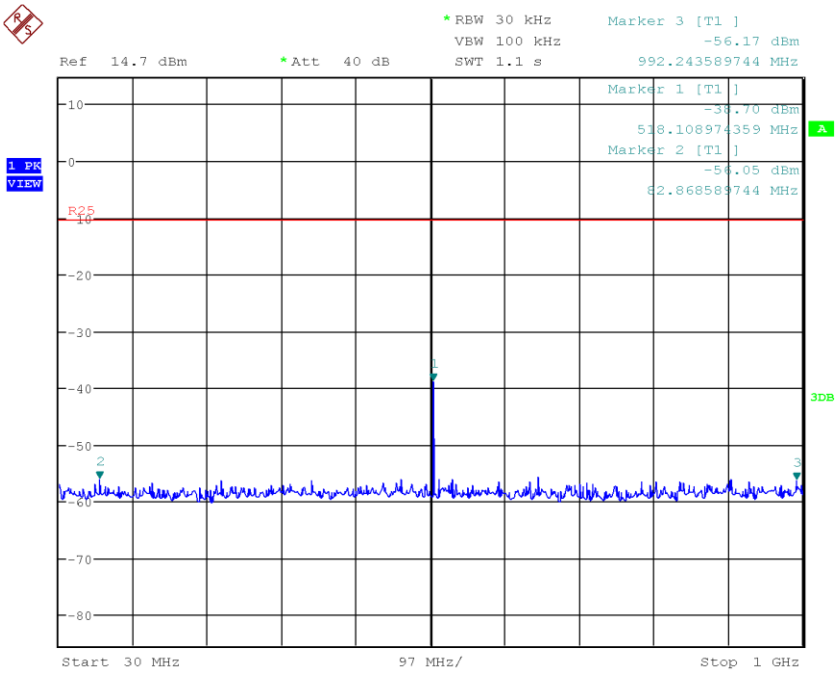


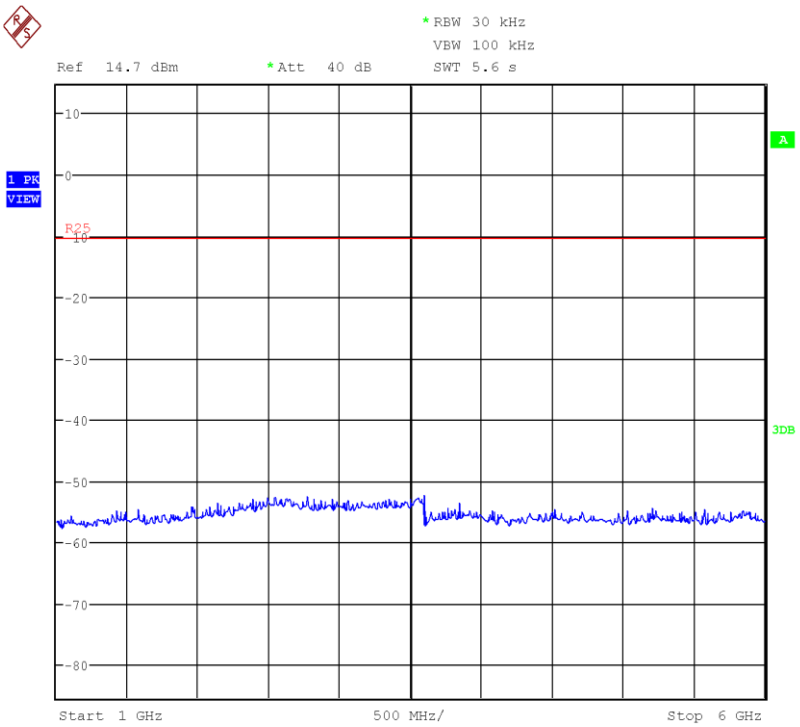


Appendix F

Test Information

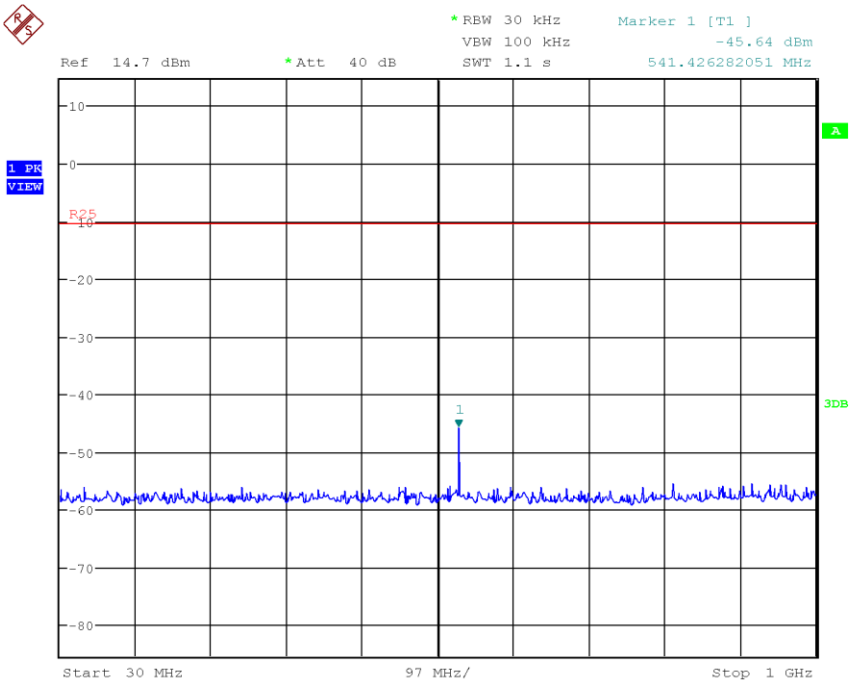
EUT Name:	P3T H20
Serial Number:	#1
Test Description:	Antenna Conducted Emissions - IC
Operating Conditions:	Mid Frequency (530.150MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	2500 Hz at 80% rated deviation
Test Date:	October 30, 2015

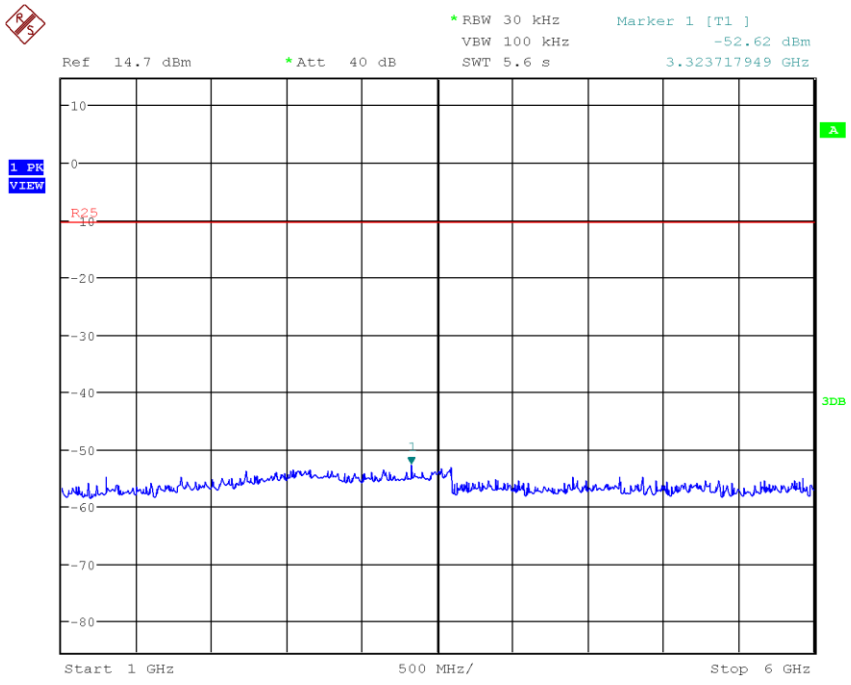




Test Information

EUT Name:	P3T H20
Serial Number:	#1
Test Description:	Antenna Conducted Emissions - IC
Operating Conditions:	High Frequency (541.875MHz) at 30mW
Operator Name:	Alex Stelmaszczyk
Comment:	2500 Hz at 80% rated deviation
Test Date:	October 30, 2015





G. MODULATION CHARACTERISTICS

G.1. PURPOSE:

This test was performed to determine if the P3T H20 meets the deviation requirements per FCC Part 74 and RSS-210, A1.

G.2. REQUIREMENTS:

As stated in paragraph 74.861(e)(3) and paragraph 6.6.2 of RSS-210, Amendment 1, for low power auxiliary stations operating in the bands allocated for TV broadcasting, any form of modulation may be used. A maximum deviation of ±75kHz is permitted when frequency modulation is employed.

G.3. TEST SETUP AND INSTRUMENTATION:

Photographs of the test setup are shown as Figure G-1. The test instrumentation can be determined from Table 10-1.

G.4. EUT OPERATION:

The EUT was powered up and the transmit frequency of the transmitter was selected using a PC. The line voltage to the EUT was checked after turn-on and adjusted to 120VAC 60Hz. The EUT was checked for proper operation after it was setup for the test. Each EUT was set to transmit at a low, mid or high frequency within its operating band. The volume pot on the front of the EUT was set to the maximum level. The Audio Input ports were connected to an audio signal source using shielded cables.

G.5. TEST PROCEDURES:

The output of the antenna port of the test item was connected to a modulation analyzer. An audio signal generator was connected to the audio input port of the test item.

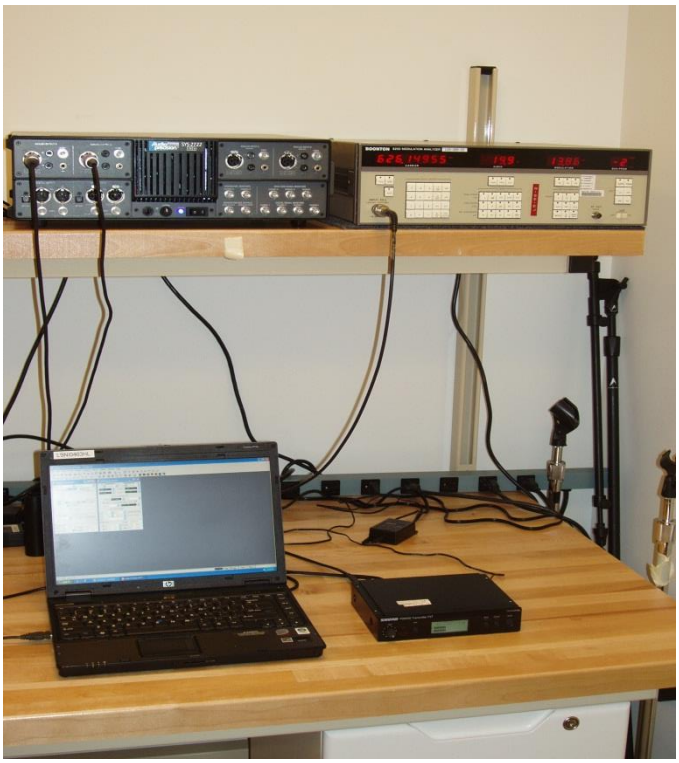
a) The test item was modulated with a 1000 Hz modulating signal at 60% of the test items rated frequency deviation.
b) With input level held constant the audio signal generator was varied from 20 Hz to 20 kHz.
c) The positive and negative peak deviations were recorded and plotted.

The output of the antenna port of the test item was connected to a modulation analyzer. An audio signal generator was connected to the audio input port of the test item.

a) The modulation response was measured separately for each of five frequencies (100Hz, 500Hz, 2500Hz, 10000Hz and 15000Hz).
b) The input voltage of the audio signal generator was varied and frequency deviation was observed on the modulation analyzer.
c) The frequency deviations were recorded and plotted.

G.6. RESULTS:

The plots of the modulation characteristics are presented on page 60. Data is shown on the figures at each band. As can be seen from the data presented in the section, the P3T did meet the permitted maximum deviation requirements.



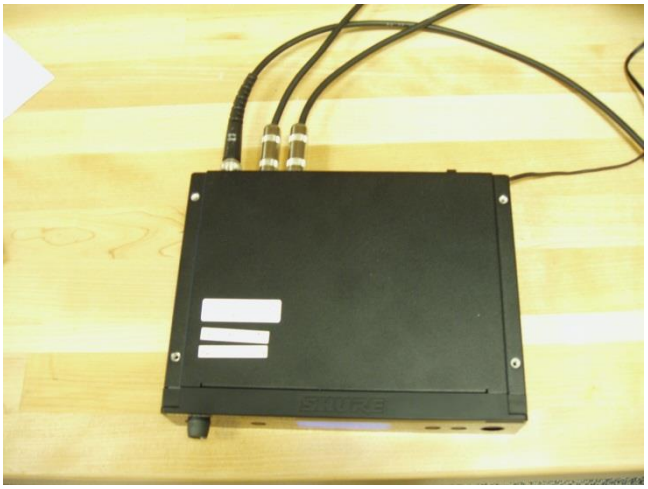
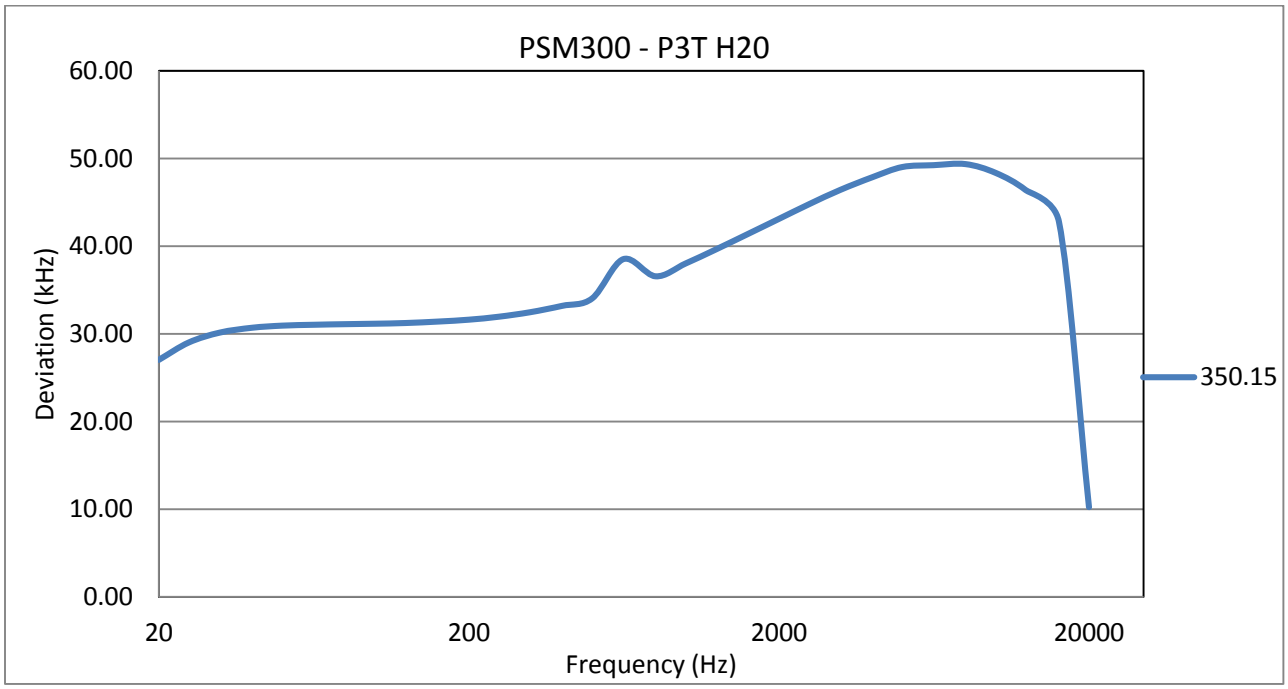
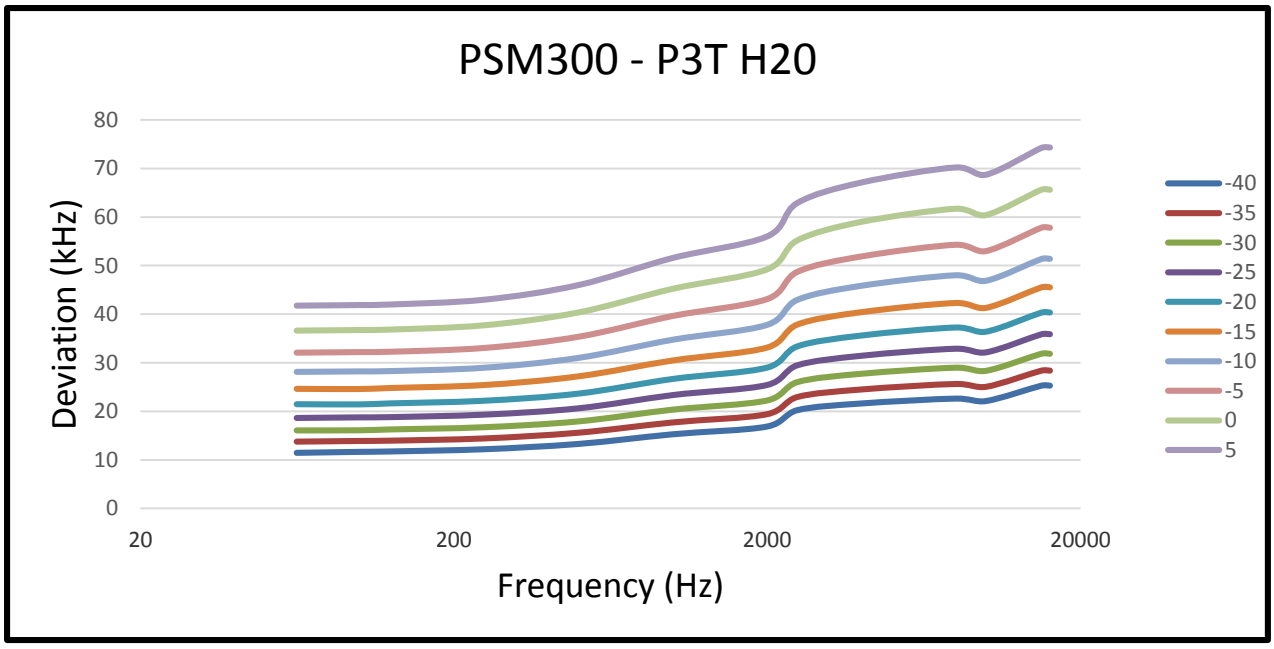


Figure G-1 Setup of Modulation Characteristic Measurements

Appendix G



Deviation vs Frequency



Deviation vs Input