

FCC Part 15 EMI TEST REPORT

of

E.U.T. : Wireless Power Switch(US)
FCC ID. : XBTWPW-220
Model No. : WPW-220;MW100

for

APPLICANT : United Integrated Services CO., LTD
ADDRESS : 5F, No 3, Lane 7, Paokao Road, Hsintien District,
New Taipei city, Taiwan

Test Performed by

ELECTRONICS TESTING CENTER, TAIWAN

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Report Number : 15-10-RBF-006-01

TEST REPORT CERTIFICATION

Applicant : United Integrated Services CO., LTD
5F, No 3, Lane 7, Paokao Road, Hsintien District, New Taipei city,
Taiwan

Manufacturer : United Integrated Services CO., LTD
5F, No 3, Lane 7, Paokao Road, Hsintien District, New Taipei city,
Taiwan

Description of EUT

- a) Type of EUT : Wireless Power Switch(US)
b) Trade Name : UIS;ASUS
c) Model No. : WPW-220;MW100
d) Power Supply : 100~120VAC 50/60Hz

Regulation Applied : FCC Rules and Regulations Part 15 Subpart C

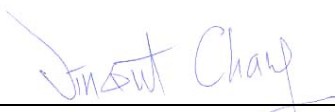
I HEREBY CERTIFY THAT: The data shown in this report were made in accordance with the procedures given in ANSI C63.10-2013, and the energy emitted by the device was founded to be within the limits applicable. I assume full responsibility for accuracy and completeness of these data.

- Note: 1. The result of the testing report relate only to the item tested.
2. The testing report shall not be reproduced expect in full, without the written approval of ETC


Summary of Tests

Test	Results
Radiated Emission	Pass
Conducted Emission	Pass
Emission Bandwidth	Pass
Output Power	Pass
100 kHz Bandwidth of Band Edges	Pass
Power Density	Pass
Out-of-Band Conducted Emission	Pass
Duty Cycle	N.A.

Date Test Item Received : Oct. 05, 2016
Date Test Campaign Completed : Oct. 21, 2016
Date of Issue : Oct. 27, 2016

Test Engineer : 

(Vincent Chang , Engineer)

Approve & Authorized Signer : 

Shang-Sheng Liou, Section Manager
EMC Dept. II of ELECTRONICS
TESTING CENTER, TAIWAN

Table of Contents	Page
1 GENERAL INFORMATION.....	1
1.1 Product Description.....	1
1.2 Characteristics of Device	1
1.3 Test Methodology	3
1.4 Test Facility.....	3
2 PROVISIONS APPLICABLE.....	4
2.1 Definition	4
2.2 Requirement for Compliance	5
2.3 Restricted Bands of Operation	7
2.4 Labeling Requirement.....	7
2.5 User Information	8
3. SYSTEM TEST CONFIGURATION.....	9
3.1 Justification	9
3.2 Devices for Tested System.....	9
4 RADIATED EMISSION MEASUREMENT	10
4.1 Applicable Standard.....	10
4.2 Measurement Procedure.....	10
4.3 Measuring Instrument	12
4.4 Radiated Emission Data	13
4.5 Field Strength Calculation	21
4.6 Photos of Radiation Measuring Setup.....	22
5 CONDUCTED EMISSION MEASUREMENT.....	24
5.1 Standard Applicable	24
5.2 Measurement Procedure.....	24
5.3 Conducted Emission Data	25
5.4 Result Data Calculation	27
5.5 Conducted Measurement Equipment	27
5.6 Photos of Conduction Measuring Setup.....	28
6 ANTENNA REQUIREMENT	29
6.1 Standard Applicable	29
6.2 Antenna Construction.....	29
7 EMISSION BANDWIDTH MEASUREMENT.....	30
7.1 Standard Applicable	30
7.2 Measurement Procedure.....	30

7.3 Measurement Equipment	30
7.4 Measurement Data	31
8 OUTPUT POWER MEASUREMENT	35
8.1 Standard Applicable	35
8.2 Measurement Procedure.....	35
8.3 Measurement Equipment	35
8.4 Measurement Data	36
9 100 kHz BANDWIDTH OF BAND EDGES MEASUREMENT	37
9.1 Standard Applicable	37
9.2 Measurement Procedure.....	37
9.3 Measurement Equipment	37
9.4 Measurement Data	38
10 POWER DENSITY MEASUREMENT	40
10.1 Standard Applicable	40
10.2 Measurement Procedure.....	40
10.3 Measurement Equipment	40
10.4 Measurement Data	41
11. OUT-OF-BAND CONDUCTED EMISSION MEASUREMENT	45
11.1 Standard Applicable	45
11.2 Measurement Procedure.....	45
11.3 Measurement Equipment	45
11.4 Measurement Data	46
12. DUTY CYCLE	53
12.1 Standard Applicable	53
12.2 Measurement Equipment	53
12.3 Measurement Data	53

1 GENERAL INFORMATION

1.1 Product Description

- a) Type of EUT : Wireless Power Switch(US)
 b) Trade Name : UIS;ASUS
 c) Model No. : WPW-220;MW100
 d) Power Supply : 100~120VAC 50/60Hz
 e) Model Difference : Serial models are the same with main model and the only difference is the brand and model name designation.

1.2 Characteristics of Device

UIS/Wireless Power Switch	
Model No.	WPW-220 MW100
Electrical Specification	
Transmit Frequency	2.4GHz ISM band, IEEE802.15.4: 2405 ~ 2480MHz
Channel N .	16 Channel (2405MHz to 2480MHz)
Operation Range	Up to 200 meters (LOS)
RF Nominal output power	15 ± 1 dBm
RF Receiver sensitivity	-97 dBm(typ)
Power Consumption	Working: ~1.87W Standby: ~1.32W
LED Indicator	Blue 1PC/Red 1PC LED Status: Relay (ON/OFF)
Operation Interface	Push button switch for setting on the side Push button switch for Relay on/off in front
Operating Voltage	100~120VAC 50/60 Hz
Resistive Load	10A/120VAC, 1200W max.
Inductive Load (Single Face)	0.5HP/120VAC

Over Current Protection	11A
Measure Voltage Range	100~130VAC
Measure Current Range	0.3A~10A± 10%
Measure Power Range	30~1300W± 10%
Software Protocol Version	ZHA1.2x
Reconnect scenario	<p>Reconnect scenario will be implement when device in ORPHAN state</p> <p>STEP 1 : Reconnect to original network 3 times every 5min. If not success, enter STEP-2</p> <p>STEP 2 : Reconnect to original network 3 times every 30min. If not success, enter STEP-3</p> <p>STEP 3 : Reconnect to original network every 60min repeatedly.</p>
Environmental Requirement	
Operating Temperature	-10°C to 50°C
Storage Temperature	-10°C to 70°C
Humidity	90% RH Max., Non-Condensing
Mechanical Specification	
Dimension (WxHxD, mm)	82 x 45x 36
Weight	70g

1.3 Test Methodology

Both conducted and radiated emissions were performed according to the procedures illustrated in ANSI C63.10-2013. Other required measurements were illustrated in separate sections of this test report for details. For RF test the measurement procedure was referred to FCC KDB 558074 D01 DTS Meas Guidance v03r02.

The EUT set for test with the continuous transmission mode and the duty cycle >98%.

Measurement Software

Software	Version	Note
e3	Version 6.100618b	Radiated Emission Test
e3	Version 6.100421	Conducted Emission Test

1.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is located on the roof top of Building at No.34, Lin 5, Dingfu Vil., Linkou Dist., New Taipei City, Taiwan 24442, R.O.C.

This site is FCC 2.948 listed and accepted in a letter dated Jan. 29, 2014.

Registration Number: 90589

2 PROVISIONS APPLICABLE

2.1 Definition

Unintentional radiator:

A device that intentionally generates and radio frequency energy for use within the device, or that sends radio frequency signals by conduction to associated equipment via connecting wiring, but which is not intended to emit RF energy by radiation or induction.

Class A Digital Device:

A digital device which is marketed for use in commercial or business environment; exclusive of a device which is market for use by the general public, or which is intended to be used in the home.

Class B Digital Device :

A digital device which is marketed for use in a residential environment notwithstanding use in a commercial, business of industrial environment. Example of such devices that are marketed for the general public.

Note : A manufacturer may also qualify a device intended to be marketed in a commercial, business, or industrial environment as a Class B digital device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B Digital Device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B Digital Device, Regardless of its intended use.

Intentional radiator:

A device that intentionally generates and emits radio frequency energy by radiation or induction.

2.2 Requirement for Compliance

(1) Conducted Emission Requirement

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

Frequency MHz	Quasi Peak dB μ V	Average dB μ V
0.15 - 0.5	66-56*	56-46*
0.5 - 5.0	56	46
5.0 - 30.0	60	50

* Decreases with the logarithm of the frequency

(2) Radiated Emission Requirement

For unintentional device, according to §15.109(a), except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

Frequency MHz	Distance Meters	Radiated dB μ V/m	Radiated μ V/m
30 - 88	3	40.0	100
88 - 216	3	43.5	150
216 - 960	3	46.0	200
Above 960	3	54.0	500

For intentional device, according to §15.209(a), the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the above table.

(3) Antenna Requirement

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

(4) Bandwidth Requirement

For direct sequence system, according to 15.247(a)(2), the minimum 6dB bandwidth shall be at least 500 kHz.

(5) Output Power Requirement

For direct sequence system, according to 15.247(b), the maximum peak output power of the transmitter shall not exceed 1 Watt. If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(6) 100 kHz Bandwidth of Frequency Band Edges Requirement

According to 15.247(c), if any 100 kHz bandwidth outside these frequency bands, the radio frequency power that is produced by the modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that in any 100 kHz bandwidth within the band that contains the highest level of the desired power or shall not exceed the general levels specified in §15.209(a), whichever results in the lesser attenuation.

(7) Power Density Requirement

According to 15.247(d), for direct sequence systems, the transmitted power density averaged over any 1 second interval shall not be greater than 8 dBm in any 3 kHz bandwidth within these bands.

2.3 Restricted Bands of Operation

Only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42-16.423	399.9-410	4.5-5.15
0.495 - 0.505 **	16.69475 - 16.69525	608-614	5.35-5.46
2.1735 - 2.1905	16.80425 - 16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475 - 156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3360-4400	Above 38.6
13.36-13.41			

** : Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz

2.4 Labeling Requirement

The device shall bear the following statement in a conspicuous location on the device :

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions : (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2.5 User Information

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

For a Class B digital device or peripheral, the instructions furnished the user shall include the following or similar statement, placed in a prominent location in the text of the manual.

The Federal Communications Commission Radio Frequency Interference Statement includes the following paragraph.

This equipment has been tested and found to comply with the limits for a Class B Digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction may cause harmful interference to radio communication. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio / TV technician for help.

3. SYSTEM TEST CONFIGURATION

3.1 Justification

For both radiated and conducted emissions below 1 GHz, the system was configured for testing in a typical fashion as a customer would normally use it. The peripherals other than EUT were connected in normally standing by situation. Measurement was performed under the condition that a computer program was exercised to simulate data communication of EUT, and the transmission rate was set to maximum allowed by EUT. Three highest emissions were verified with varying placement of the cables connected to EUT to maximize the emission from EUT.

For conducted and radiated spurious emissions, whichever RF channel is operated, the digital circuits function identically. As the reason, measurement of radiated emissions from digital circuits is only performed with channel 7 by transmitting mode.

3.2 Devices for Tested System

Device	Manufacture	Model	Cable Description
Wireless Power Switch(US) *	United Integrated Services CO., LTD	WPW-220; MW100	----

Remark “*” means equipment under test.

4 RADIATED EMISSION MEASUREMENT

4.1 Applicable Standard

For unintentional radiator, the radiated emission shall comply with §15.109(a).

For intentional radiators, according to §15.247 (a), operation under this provision is limited to frequency hopping and direct sequence spread spectrum, and the out band emission shall be comply with §15.247 (c)

4.2 Measurement Procedure

A. Preliminary Measurement For Portable Devices

For portable devices, the following procedure was performed to determine the maximum emission axis of EUT:

1. With the receiving antenna is H polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
2. With the receiving antenna is V polarization, rotate the EUT in turns with three orthogonal axes to determine the axis of maximum emission.
3. Compare the results derived from above two steps. So, the axis of maximum emission from EUT was determined and the configuration was used to perform the final measurement.

B. Final Measurement

1. Setup the configuration per figure 1 and 2 for frequencies measured below and above 1 GHz respectively. Turn on EUT and make sure that it is in normal function.
2. For emission frequencies measured below 1 GHz, a pre-scan is performed in a shielded chamber to determine the accurate frequencies of higher emissions will be checked on a open test site. As the same purpose, for emission frequencies measured above 1 GHz, a pre-scan also be performed with a 1 meter measuring distance before final test.
3. For emission frequencies measured below and above 1 GHz, set the spectrum analyzer on a 100 kHz and 1 MHz resolution bandwidth respectively for each frequency measured in step 2. (VBW = 1MHz for peak / 10Hz for average measurement above 1GHz)
4. The search antenna is to be raised and lowered over a range from 1 to 4 meters in horizontally polarized orientation. Position the highness when the highest value is indicated on spectrum analyzer, then change the orientation of EUT on test table over a range from 0 ° to 360 ° with a speed as slow as possible, and keep the azimuth that highest emission is indicated on the spectrum analyzer. Vary the antenna position again and record the highest value as a final reading. A RF test receiver is also used to confirm emissions measured.

5. Repeat step 4 until all frequencies need to be measured were complete.
6. Repeat step 5 with search antenna in vertical polarized orientations.
7. Check the three frequencies of highest emission with varying the placement of cables (if any) associated with EUT to obtain the worst case and record the result.

Figure 1 : Frequencies measured below 1 GHz configuration

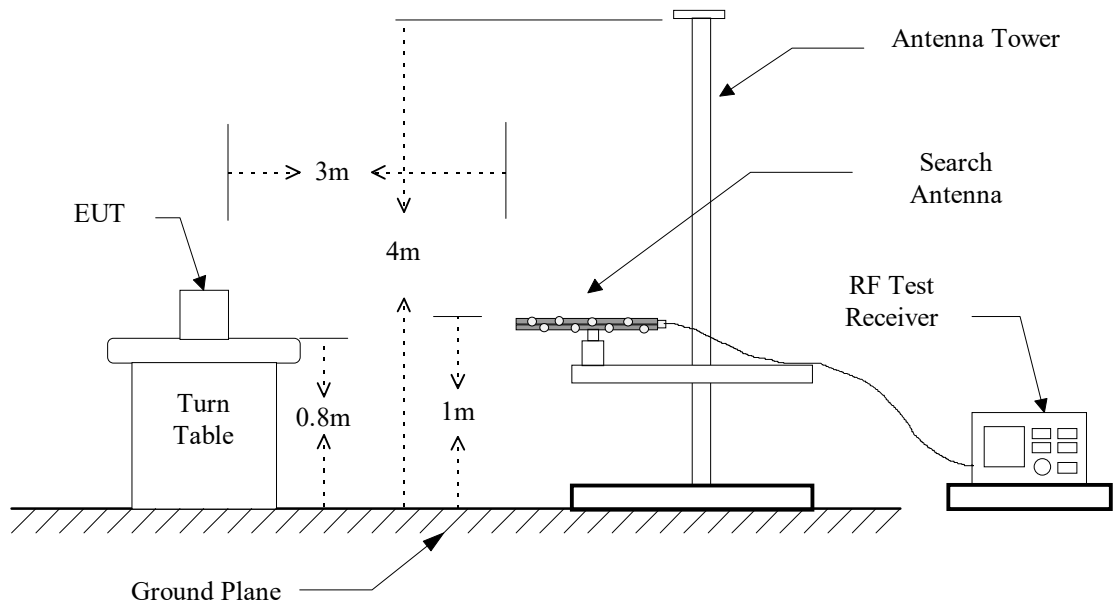
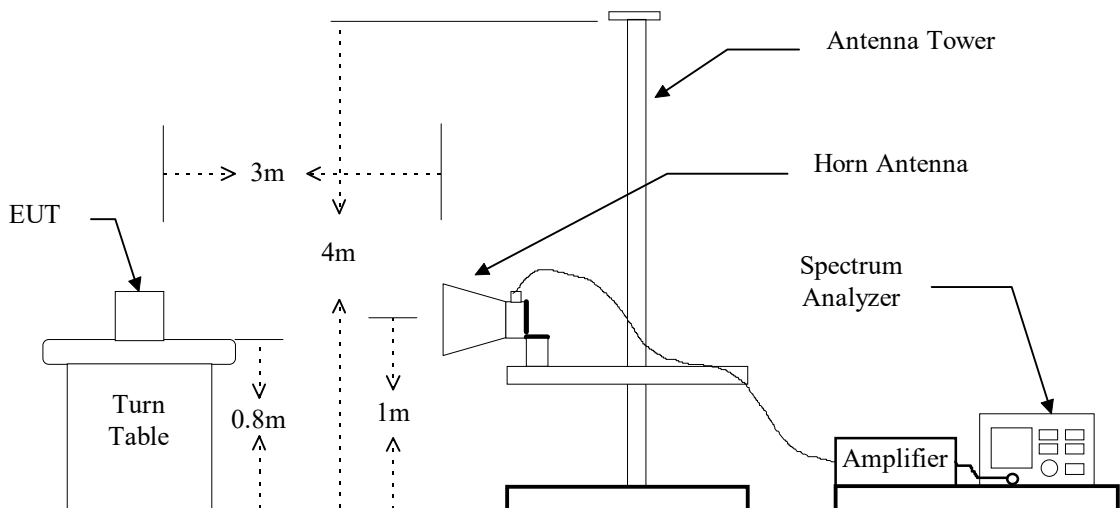


Figure 2 : Frequencies measured above 1 GHz configuration



4.3 Measuring Instrument

The following instrument are used for radiated emissions measurement:

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Test Receiver	Rohde & Schwarz	ESVS30	2015/12/05	2016/12/04
EMI Test Receiver	Rohde & Schwarz	ESL	2016/03/26	2017/03/25
Bi-Log Antenna	ETC	MCTD 2786	2016/07/15	2017/07/14
Log-periodic Antenna	EMCO	3146	2015/11/17	2016/11/16
Double Ridged Guide Horn Antenna	EMCO	3116	2015/10/12	2016/10/11
Biconical Antenna	EMCO	3110	2015/11/17	2016/11/16
Double Ridged Antenna	EMCO	3115	2015/10/08	2016/10/07
Double Ridged Antenna	EMCO	3115	2015/10/06	2016/10/05
Amplifier	HP	8449B	2016/07/18	2017/07/17
Amplifier	HP	83051A	2015/12/17	2016/12/16
Amplifier	HP	8447D	2015/10/07	2016/10/06
EMI Test Receiver	Rohde & Schwarz	ESU 40	2015/12/05	2016/12/04
LOOP Antenna	EMCO	6512	2015/10/01	2016/09/30

Measuring instrument setup in measured frequency band when specified detector function is used :

Frequency Band (MHz)	Instrument	Function	Resolution bandwidth	Video Bandwidth
30 to 1000	RF Test Receiver	Quasi-Peak	120 kHz	N/A
	Spectrum Analyzer	Peak	100 kHz	100 kHz
Above 1000	Spectrum Analyzer	Peak	1 MHz	1 MHz
	Spectrum Analyzer	Average	1 MHz	10 Hz or $\geq 1/T$ (Note 1)

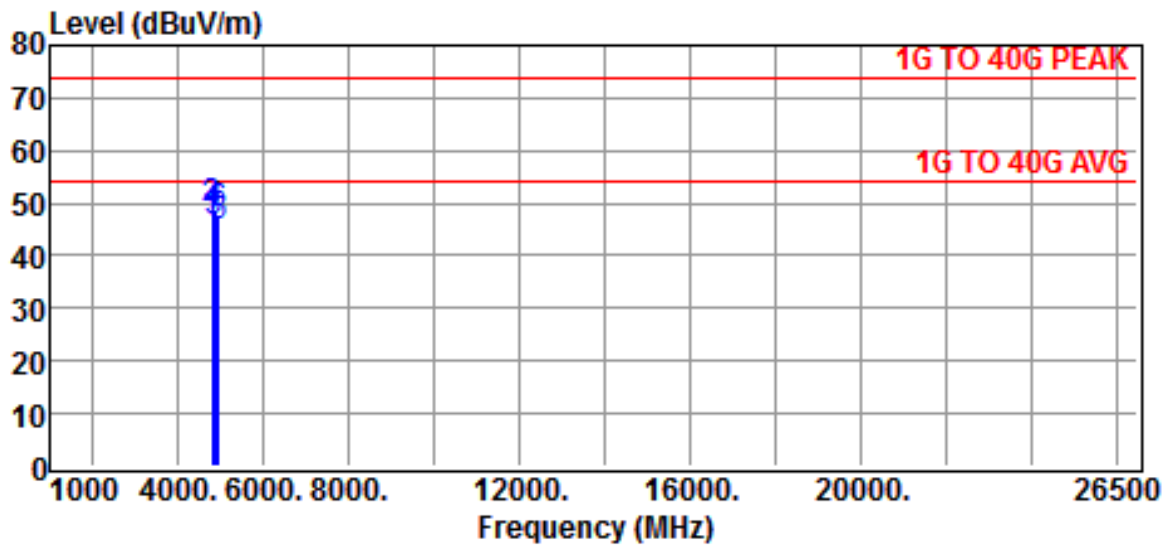
Note 1:

VBW = 10 Hz, when the duty cycle is no less than 98%.

VBW $\geq 1/T$, when duty cycle is less than 98% where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

4.4 Radiated Emission Data

4.4.1 RF Portion

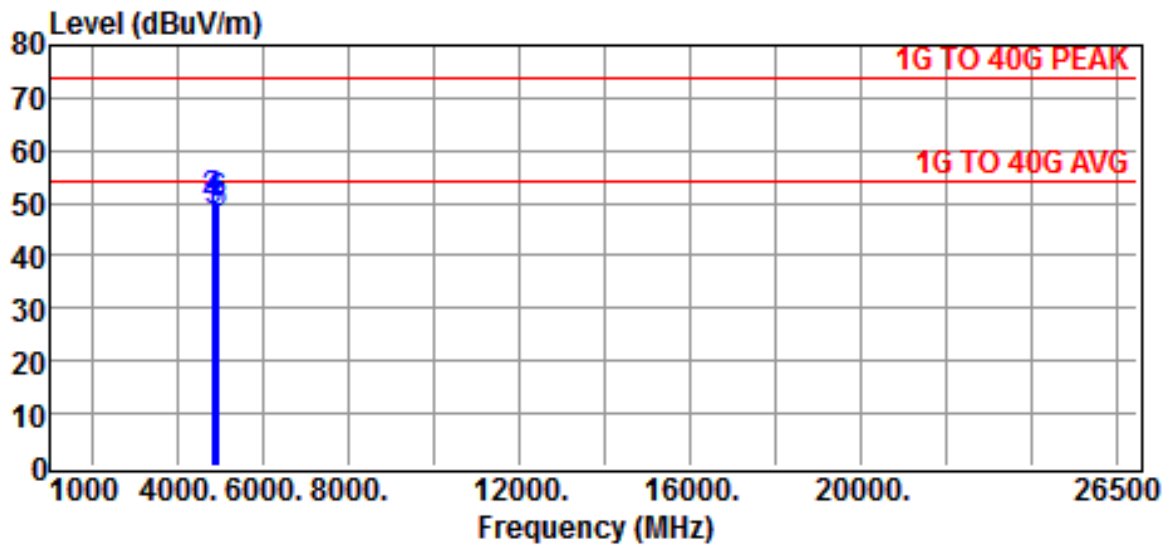


Site	:CHAMBER #2	Date	:2016-10-21
Limit	:1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:Wireless Power Switch(US)	Model	:WPW-220
Power Rating	:120V 60Hz	Temp.	:28 °C
Engineer	:VC	Humi.	:68 %
Test Mode	:TXRX-CH LO 2405 - MI 2440 - HI 2480MHz		

Freq MHz	Reading dBµV	Correction Factor dB	Result dBµV/m	Limits dBµV/m	Over limit dB	Detector
4810.0000	45.6	1.3	46.9	54.0	-7.1	Average
4810.0000	47.4	1.3	48.7	74.0	-25.3	Peak
4880.0000	44.9	1.4	46.3	54.0	-7.7	Average
4880.0000	46.8	1.4	48.2	74.0	-25.8	Peak
4960.0000	43.9	1.8	45.7	54.0	-8.3	Average
4960.0000	46.0	1.8	47.8	74.0	-26.2	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit – Result



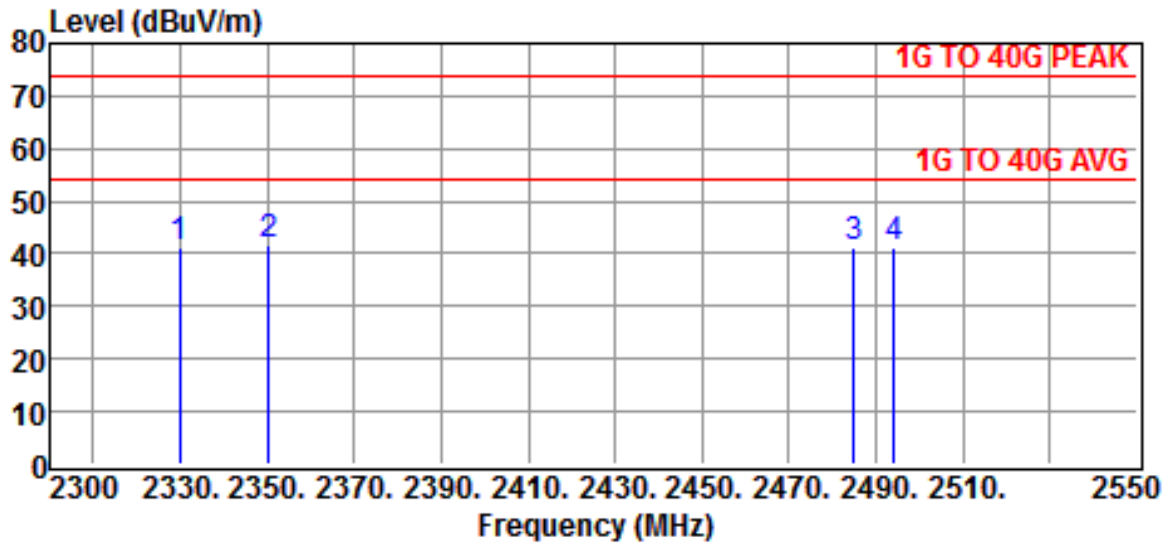
Site	:CHAMBER #2	Date	:2016-10-21
Limit	:1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:Wireless Power Switch(US)	Model	:WPW-220
Power Rating	:120V 60Hz	Temp.	:28°C
Engineer	:VC	Humi.	:68%
Test Mode	:TXRX-CH LO 2405 - MI 2440 - HI 2480MHz		

Freq MHz	Reading dBµV	Correction Factor dB	Result dBµV/m	Limits dBµV/m	Over limit dB	Detector
4810.0000	47.6	1.3	48.9	54.0	-5.1	Average
4810.0000	49.2	1.3	50.5	74.0	-23.5	Peak
4880.0000	47.1	1.4	48.5	54.0	-5.5	Average
4880.0000	48.7	1.4	50.1	74.0	-23.9	Peak
4960.0000	46.2	1.8	48.0	54.0	-6.0	Average
4960.0000	47.9	1.8	49.7	74.0	-24.3	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit – Result

4.4.2 Radiated Emission of Restricted bands

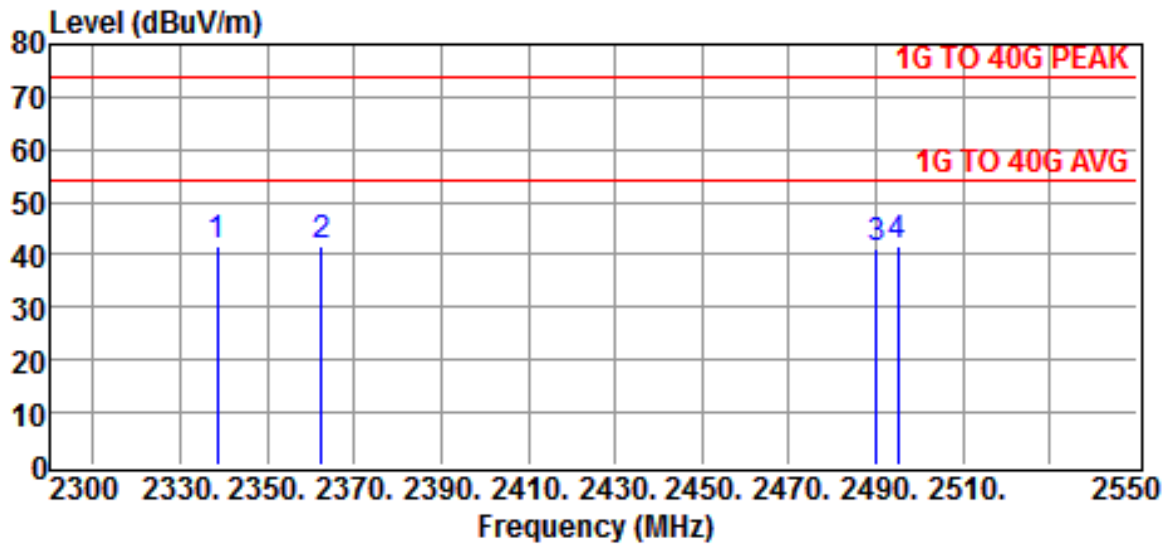


Site	:CHAMBER #2	Date	:2016-10-21
Limit	:1G TO 40G PEAK	Ant. Pol.	:HORIZONTAL
EUT	:Wireless Power Switch(US)	Model	:WPW-220
Power Rating	:120V 60Hz	Temp.	:28 °C
Engineer	:VC	Humi.	:68 %
Test Mode	:CH LO & HI - Restricted Bands		

Freq MHz	Reading dBµV	Correction Factor dB	Result dBµV/m	Limits dBµV/m	Over limit dB	Detector
2329.7500	47.4	-6.1	41.3	74.0	-32.7	Peak
2350.5000	47.6	-6.1	41.5	74.0	-32.5	Peak
2485.0000	46.9	-5.8	41.1	74.0	-32.9	Peak
2494.0000	46.9	-5.8	41.1	74.0	-32.9	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit – Result
4. Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.



Site	:CHAMBER #2	Date	:2016-10-21
Limit	:1G TO 40G PEAK	Ant. Pol.	:VERTICAL
EUT	:Wireless Power Switch(US)	Model	:WPW-220
Power Rating	:120V 60Hz	Temp.	:28°C
Engineer	:VC	Humi.	:68 %
Test Mode	:CH LO & HI - Restricted Bands		

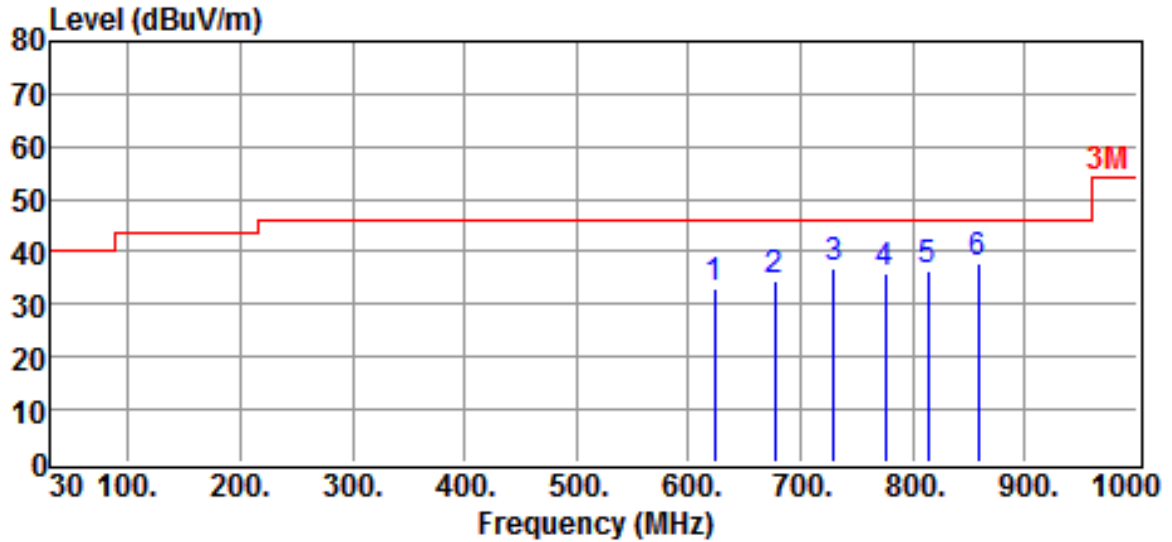
Freq MHz	Reading dBµV	Correction Factor dB	Result dBµV/m	Limits dBµV/m	Over limit dB	Detector
2338.5000	47.6	-6.1	41.5	74.0	-32.5	Peak
2362.5000	47.8	-6.1	41.7	74.0	-32.3	Peak
2490.0000	46.8	-5.8	41.0	74.0	-33.0	Peak
2495.0000	47.4	-5.8	41.6	74.0	-32.4	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss - Amplifier Gain (if any)
3. The margin value=Limit – Result
4. Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.

4.4.3 Other Emission

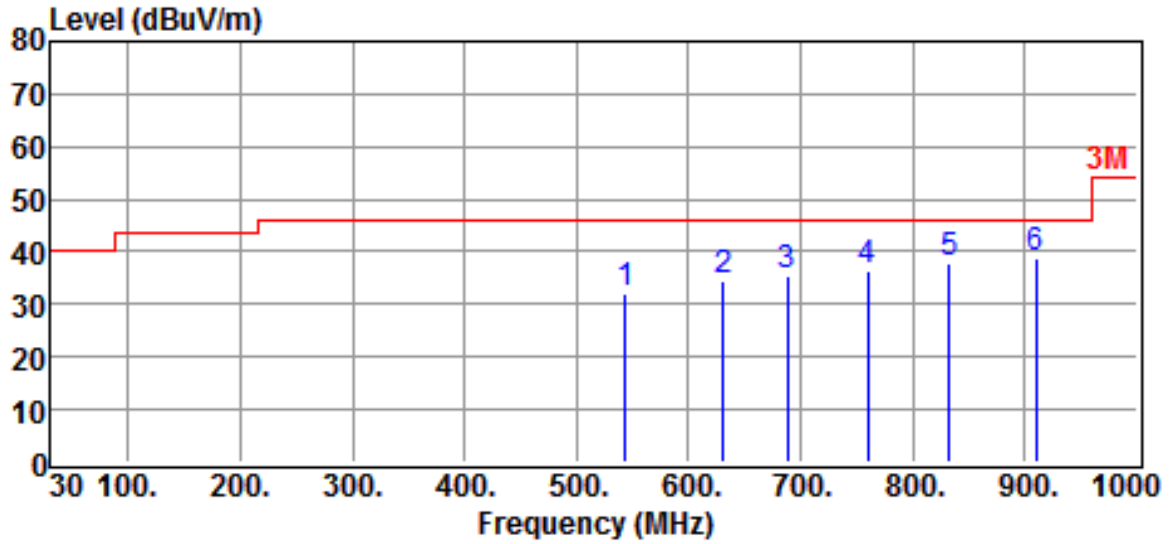
a) Emission frequencies below 1 GHz



Site	:OPEN SITE	Date	:2016-10-21
Limit	:3M	Ant. Pol.	:HORIZONTAL
EUT	:Wireless Power Switch(US)	Model	:WPW-220
Power Rating	:120V 60Hz	Temp.	:28 °C
Engineer	:VC	Humi.	:68 %
Test Mode	:OPERATION MODE		

Freq MHz	Reading dBμV	Correction Factor dB	Result dBμV/m	Limits dBμV/m	Over limit dB	Detector
623.6400	9.3	23.8	33.1	46.0	-12.9	QP
676.9900	9.5	25.0	34.5	46.0	-11.5	QP
729.3700	10.9	25.8	36.7	46.0	-9.3	QP
774.9600	9.7	26.4	36.1	46.0	-9.9	QP
813.7600	9.5	26.9	36.4	46.0	-9.6	QP
858.3800	9.9	27.8	37.7	46.0	-8.3	QP

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss
3. The margin value=Limit - Result



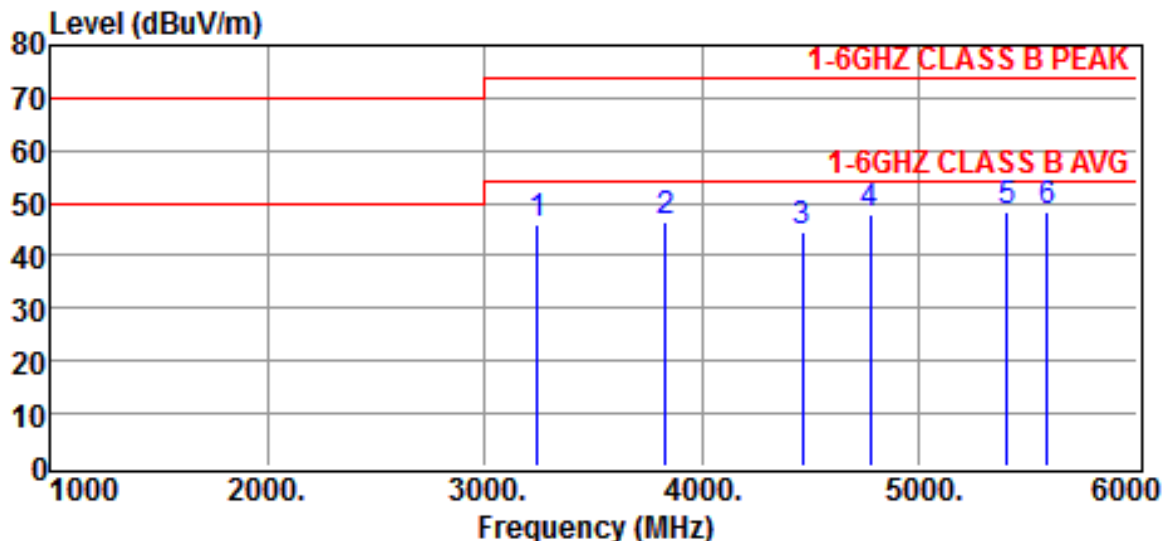
Site	:OPEN SITE	Date	:2016-10-21
Limit	:3M	Ant. Pol.	:VERTICAL
EUT	:Wireless Power Switch(US)	Model	:WPW-220
Power Rating	:120V 60Hz	Temp.	:28°C
Engineer	:VC	Humi.	:68%
Test Mode	:OPERATION MODE		

Freq MHz	Reading dBμV	Correction Factor dB	Result dBμV/m	Limits dBμV/m	Over limit dB	Detector
543.1300	9.7	22.6	32.3	46.0	-13.7	QP
631.4000	10.3	24.0	34.3	46.0	-11.7	QP
687.6600	10.3	25.3	35.6	46.0	-10.4	QP
759.4400	10.3	26.2	36.5	46.0	-9.5	QP
832.1900	10.6	27.3	37.9	46.0	-8.1	QP
909.7900	10.3	28.5	38.8	46.0	-7.2	QP

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss
3. The margin value=Limit - Result

b) Emission frequencies Above 1GHz

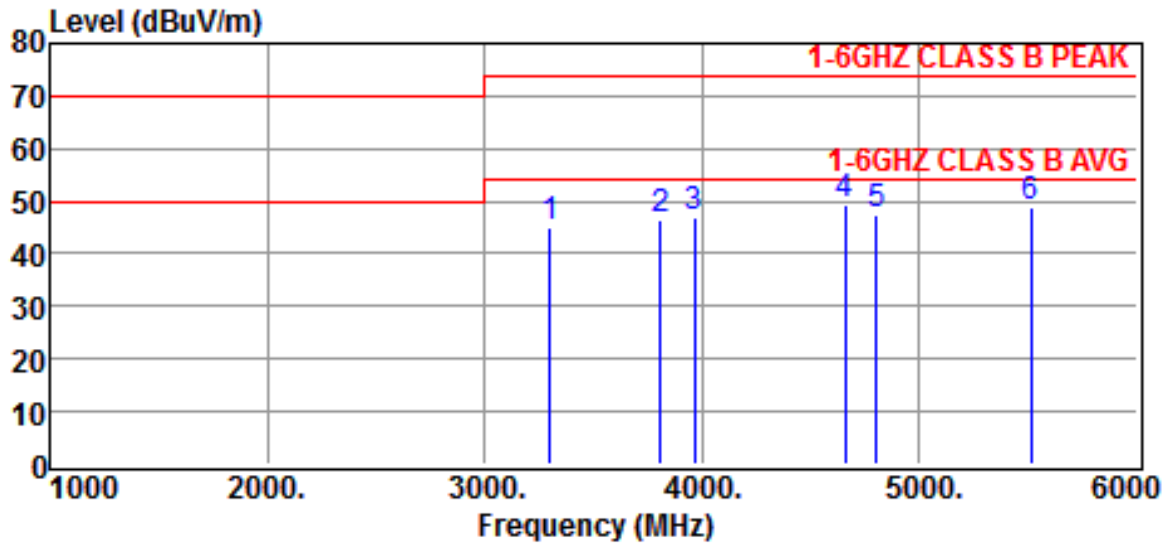


Site	:CHAMBER #2	Date	:2016-10-21
Limit	:1-6GHZ CLASS B PEAK	Ant. Pol.	:HORIZONTAL
EUT	:Wireless Power Switch(US)	Model	:WPW-220
Power Rating	:120V 60Hz	Temp.	:28 °C
Engineer	:VC	Humi.	:68 %
Test Mode	:OPERATION MODE		

Freq MHz	Reading dBµV	Correction Factor dB	Result dBµV/m	Limits dBµV/m	Over limit dB	Detector
3245.0000	48.7	-2.8	45.9	74.0	-28.1	Peak
3830.0000	47.1	-0.5	46.6	74.0	-27.4	Peak
4460.0000	44.2	0.2	44.4	74.0	-29.6	Peak
4775.0000	46.7	1.2	47.9	74.0	-26.1	Peak
5400.0000	45.5	2.9	48.4	74.0	-25.6	Peak
5590.0000	45.3	3.2	48.5	74.0	-25.5	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss
3. The margin value=Limit – Result
4. Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.



Site	:CHAMBER #2	Date	:2016-10-21
Limit	:1-6GHZ CLASS B PEAK	Ant. Pol.	:VERTICAL
EUT	:Wireless Power Switch(US)	Model	:WPW-220
Power Rating	:120V 60Hz	Temp.	:28 °C
Engineer	:VC	Humi.	:68 %
Test Mode	:OPERATION MODE		

Freq MHz	Reading dBμV	Correction Factor dB	Result dBμV/m	Limits dBμV/m	Over limit dB	Detector
3300.0000	47.7	-2.7	45.0	74.0	-29.0	Peak
3810.0000	47.5	-0.8	46.7	74.0	-27.3	Peak
3965.0000	47.3	-0.2	47.1	74.0	-26.9	Peak
4660.0000	48.7	0.7	49.4	74.0	-24.6	Peak
4800.0000	46.0	1.3	47.3	74.0	-26.7	Peak
5510.0000	46.0	3.1	49.1	74.0	-24.9	Peak

Note :

1. Result = Reading + Corrected Factor
2. Corrected Factor = Antenna Factor + Cable Loss
3. The margin value=Limit – Result
4. Peak measurements are compared to the average limit - as peak measurements are below the average limit, they also comply with the peak limit.

4.5 Field Strength Calculation

The field strength is calculated by adding the Antenna Factor, High Pass Filter Loss(if used) and Cable Loss, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation calculation is as follows:

$$\mathbf{Result = Reading + Corrected Factor}$$

where

$$\text{Corrected Factor} = \text{Antenna FACTOR} + \text{Cable Loss} + \text{High Pass Filter Loss} - \text{Amplifier Gain}$$

4.6 Photos of Radiation Measuring Setup





5 CONDUCTED EMISSION MEASUREMENT

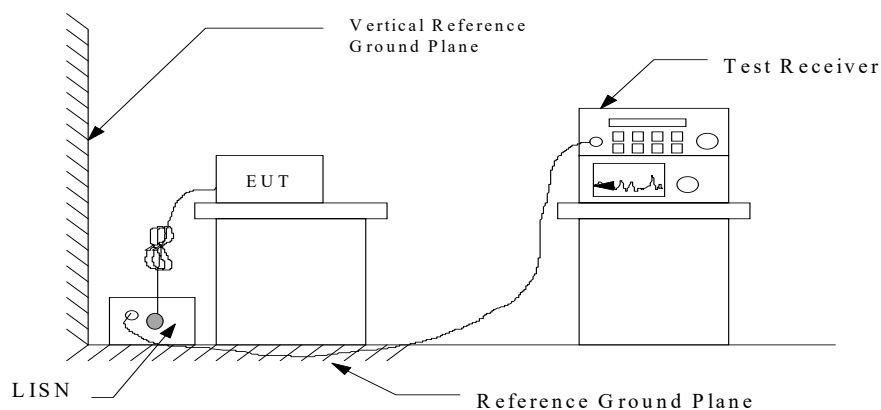
5.1 Standard Applicable

For unintentional and intentional device, Line Conducted Emission Limits are in accordance to §15.107(a) and §15.207(a) respectively. Both Limits are identical specification.

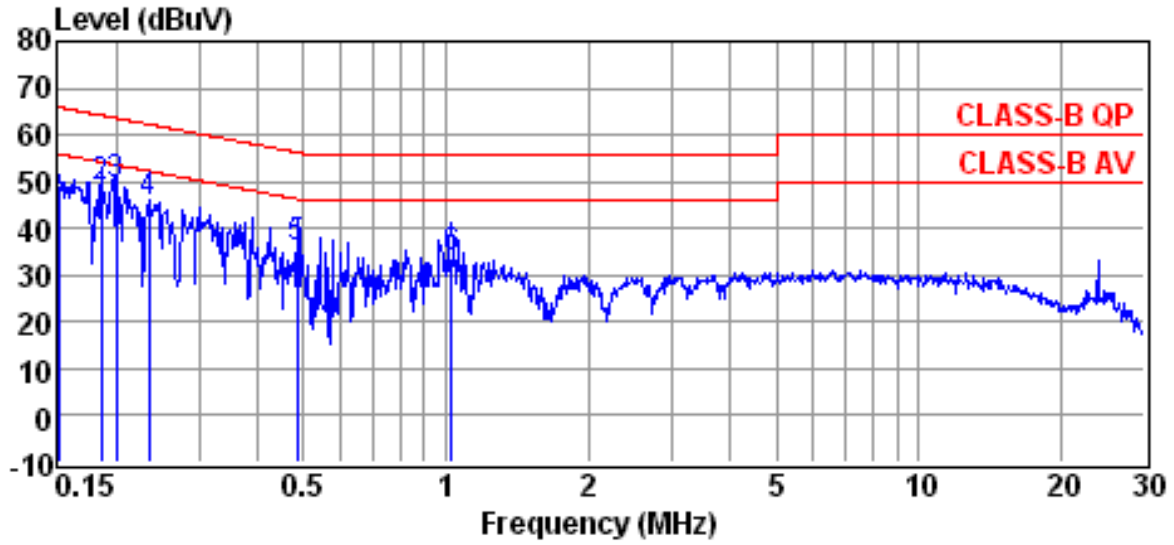
5.2 Measurement Procedure

1. Setup the configuration per figure 3.
2. A preliminary scan with a spectrum monitor is performed to identify the frequency of emission that has the highest amplitude relative to the limit by operating the EUT in selected modes of operation, typical cable positions, and with a typical system configuration.
3. Record the 6 or 8 highest emissions relative to the limit.
4. Measure each frequency obtained from step 3 by a test receiver set on quasi peak detector function, and then record the accuracy frequency and emission level. If all emissions measured in the specified band are attenuated more than 20 dB from the limit, this step would be ignored, and the peak detector function would be used.
5. Confirm the highest three emissions with variation of the EUT cable configuration and record the final data.
6. Repeat all above procedures on measuring each operation mode of EUT.

Figure 3 : Conducted emissions measurement configuration



5.3 Conducted Emission Data

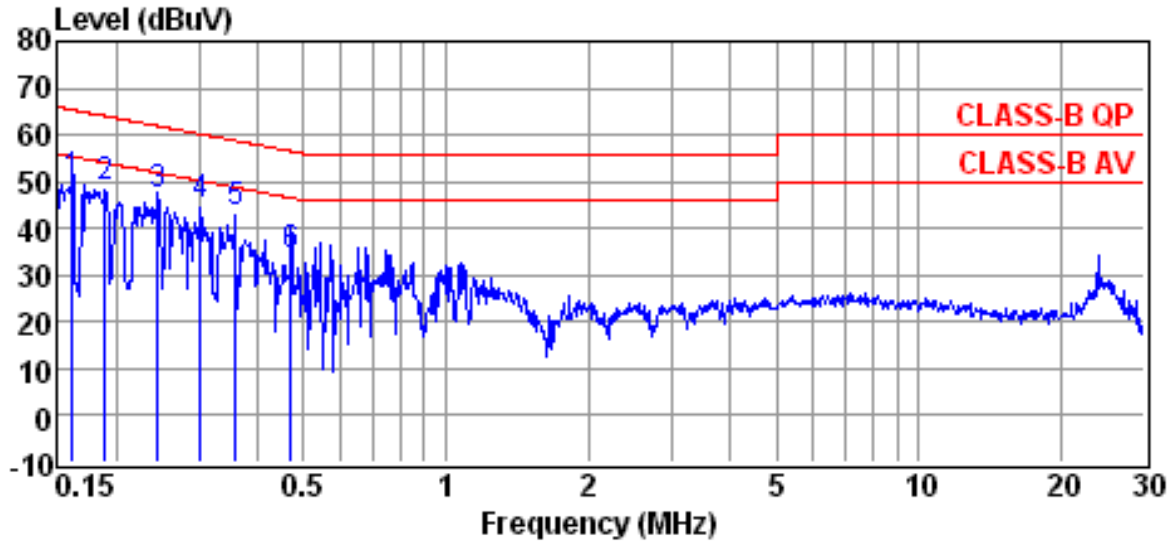


Site	: conducted #1	Date	: 10-21-2016
Condition	: CLASS-B QP	LISN	: NEUTRAL
Tem / Hum	: 25 °C / 68%	Test Mode	: OPERATION MODE
EUT	: Wireless Power Switch(US)	Power Rating	: 120V 60Hz
Memo	:	Memo	:

Freq (MHz)	Reading (dBμV)	Factor (dB)	Emission Level (dBμV)	Limit Line (dBμV)	Over Limit (dB)	Remark
0.1516	39.08	10.18	49.26	65.91	-16.65	QP
0.1864	38.37	10.18	48.55	64.20	-15.65	QP
0.2008	38.87	10.18	49.05	63.58	-14.53	QP
0.2353	35.08	10.18	45.26	62.26	-17.00	QP
0.4838	25.72	10.22	35.94	56.27	-20.33	QP
1.0270	23.53	10.25	33.78	56.00	-22.22	QP

Note :

1. Result = Reading + Factor
2. Factor = LISN Factor + Cable Loss



Site	: conducted #1	Date	: 10-21-2016
Condition	: CLASS-B QP	LISN	: LINE
Tem / Hum	: 25 °C / 68%	Test Mode	: OPERATION MODE
EUT	: Wireless Power Switch(US)	Power Rating	: 120V 60Hz
Memo	:	Memo	:

Freq (MHz)	Reading (dBμV)	Factor (dB)	Emission Level (dBμV)	Limit Line (dBμV)	Over Limit (dB)	Remark
0.1624	39.74	10.17	49.91	65.34	-15.43	QP
0.1904	38.51	10.17	48.68	64.02	-15.34	QP
0.2455	36.71	10.18	46.89	61.91	-15.02	QP
0.3019	34.93	10.18	45.11	60.19	-15.08	QP
0.3577	33.22	10.20	43.42	58.78	-15.36	QP
0.4686	23.81	10.21	34.02	56.54	-22.52	QP

Note :

1. Result = Reading + Factor
2. Factor = LISN Factor + Cable Loss

5.4 Result Data Calculation

The result data is calculated by adding the LISN Factor to the measured reading. The basic equation with a sample calculation is as follows:

$$\mathbf{RESULT = READING + LISN FACTOR}$$

Assume a receiver reading of 22.5 dB μ V is obtained, and LISN Factor is 0.1 dB, then the total of disturbance voltage is 22.6 dB μ V.

$$\text{RESULT} = 22.5 + 0.1 = 22.6 \text{ dB } \mu \text{ V}$$

$$\begin{aligned} \text{Level in } \mu \text{ V} &= \text{Common Antilogarithm}[(22.6 \text{ dB } \mu \text{ V})/20] \\ &= 13.48 \mu \text{ V} \end{aligned}$$

5.5 Conducted Measurement Equipment

The following test equipment are used during the conducted test .

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
EMI Test Receiver	Rohde & Schwarz	ESCI	2015/12/05	2016/12/04
LISN	EMCO	3625/2	2015/10/28	2016/10/26
LISN	Rohde & Schwarz	ESH2-Z5	2016/05/05	2017/05/04

5.6 Photos of Conduction Measuring Setup



6 ANTENNA REQUIREMENT

6.1 Standard Applicable

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

6.2 Antenna Construction

The antenna is integrated on the device. No consideration of replacement. Please refer to the construction Photo for details.

7 EMISSION BANDWIDTH MEASUREMENT

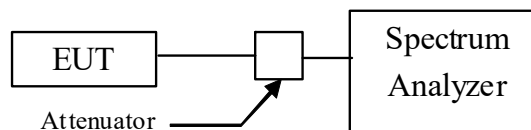
7.1 Standard Applicable

According to 15.247(a)(2), for direct sequence system, the minimum 6dB bandwidth shall be at least 500 kHz.

7.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value. The settings of spectrum analyzer is as followings.
 - 1) Set RBW = 100 kHz.
 - 2) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
 - 3) Detector = Peak.
 - 4) Trace mode = max hold.
 - 5) Sweep = auto couple.
 - 6) Allow the trace to stabilize.
 - 7) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.
3. Repeat above procedures until all frequencies measured were complete.

Figure 4: Emission bandwidth measurement configuration.



7.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP40	2015/07/06	2016/07/05

7.4 Measurement Data

Test Date : Oct. 21, 2016 Temperature : 23 °C Humidity : 54 %

- a) Channel Low: 6 dB Emission Bandwidth is 1.60 MHz
- b) Channel Mid: 6 dB Emission Bandwidth is 1.62 MHz
- c) Channel High: 6 dB Emission Bandwidth is 1.61 MHz

Note : The expanded uncertainty: $frequency \times 1.65 \times 10^{-6}$ ($1\text{ GHz} < f \leq 18\text{ GHz}$).

Mode: Channel Low

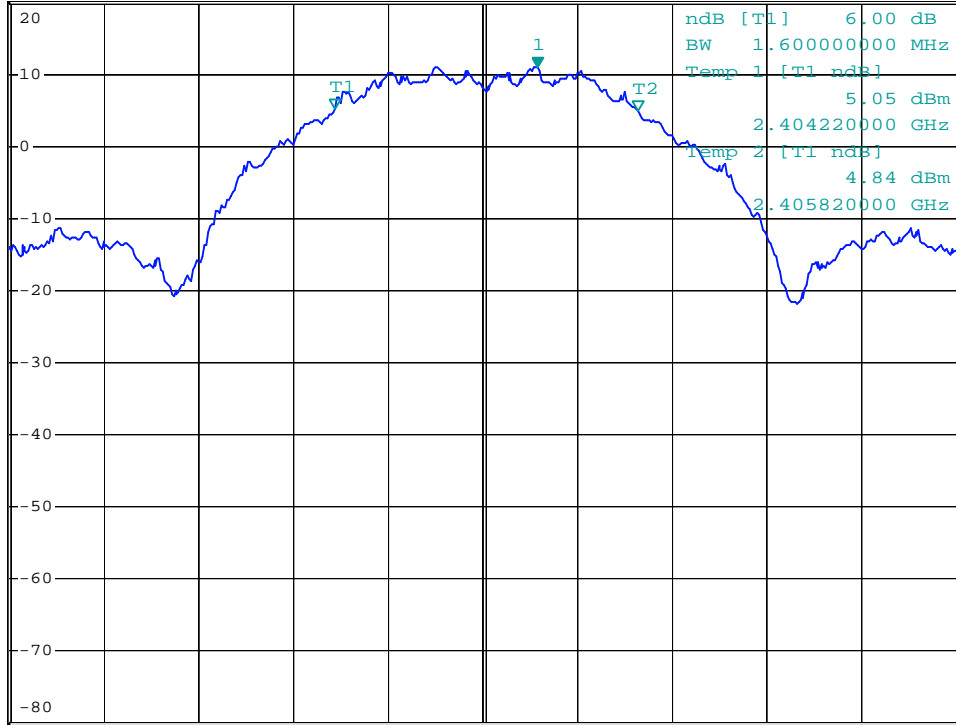


*RBW 100 kHz Marker 1 [T1]
VBW 300 kHz 10.90 dBm
SWT 2.5 ms 2.405290000 GHz

Ref 20 dBm

Att 50 dB

1 PK
VIEW



A

Center 2.405 GHz

500 kHz/

Span 5 MHz

Mode:Channel Middle

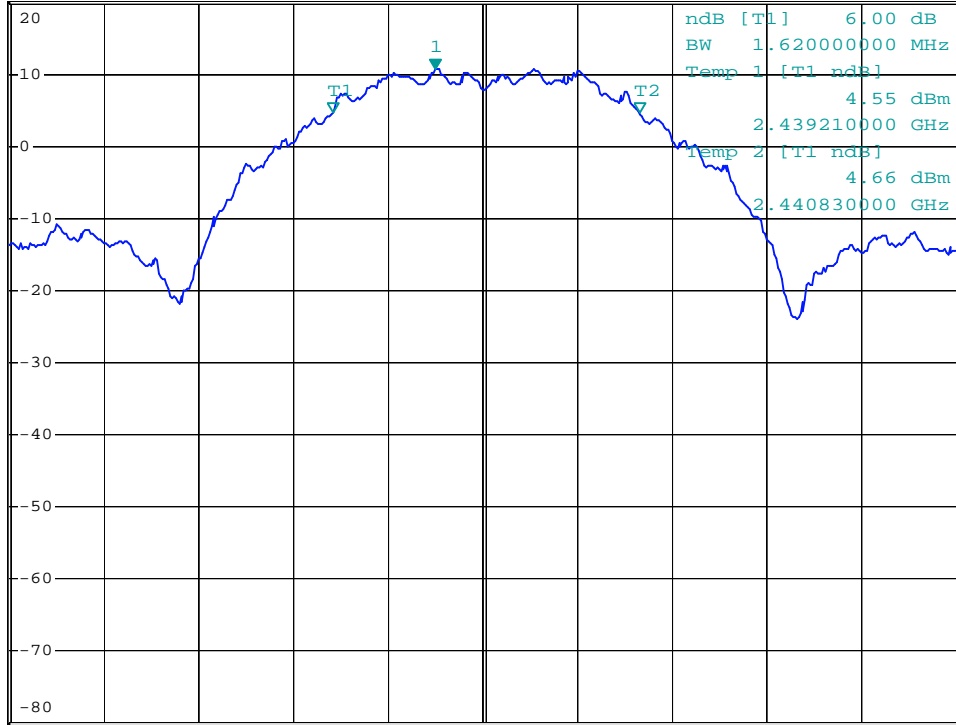


1 PK
VIEW

*RBW 100 kHz Marker 1 [T1]
VBW 300 kHz 10.76 dBm
SWT 2.5 ms 2.439750000 GHz

Ref 20 dBm

Att 50 dB



Center 2.44 GHz

500 kHz/

Span 5 MHz

A

Mode: Channel High

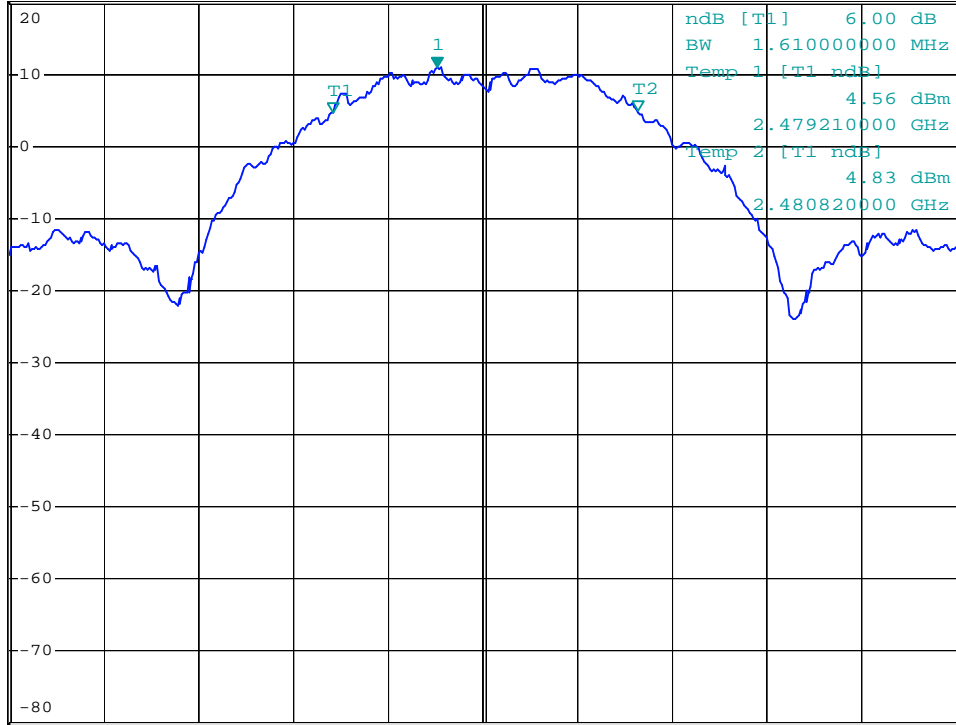


*RBW 100 kHz Marker 1 [T1]
VBW 300 kHz 10.95 dBm
SWT 2.5 ms 2.479760000 GHz

Ref 20 dBm

Att 50 dB

1 PK
VIEW



Center 2.48 GHz

500 kHz/

Span 5 MHz

8 OUTPUT POWER MEASUREMENT

8.1 Standard Applicable

For direct sequence system, according to 15.247(b), the maximum peak output power of the transmitter shall not exceed 1 Watt. If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

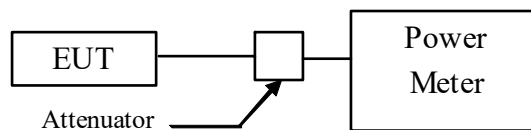
8.2 Measurement Procedure

Measurement Procedure:

9.1.2 PKPM1 Peak power meter method

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 5 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable.
3. Record the readings on the instrument and add a compensat factor of the attenuator.
4. Repeat above procedures until all frequencies measured were complete.

Figure 5: Output power and measurement configuration.



8.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
POWER METER +SENSOR	ANRITSU	ML2487A +MA2491A	2015/01/14	2016/01/13

8.4 Measurement Data

Test Date : Oct. 21, 2016 Temperature : 23 °C Humidity : 54 %

Measurement Procedure: PKPM1

Output Peak Power		dBm	mW
Operation	Channel Low:2405MHz	14.70	29.512
	Channel Mid:2440MHz	14.58	28.708
	Channel High:2480MHz	14.70	29.512

Note : The expanded uncertainty: 2dB.

9 100 kHz BANDWIDTH OF BAND EDGES MEASUREMENT

9.1 Standard Applicable

According to 15.247(c), if any 100 kHz bandwidth outside these frequency bands, the radio frequency power that is produced by the modulation products of the spreading sequence, the information sequence and the carrier frequency shall be either at least 20 dB below that in any 100 kHz bandwidth within the band that contains the highest level of the desired power or shall not exceed the general levels specified in §15.209(a), whichever results in the lesser attenuation.

9.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Set both RBW of spectrum analyzer to 100kHz and VBW to 300kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

9.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP40	2015/07/06	2016/07/05

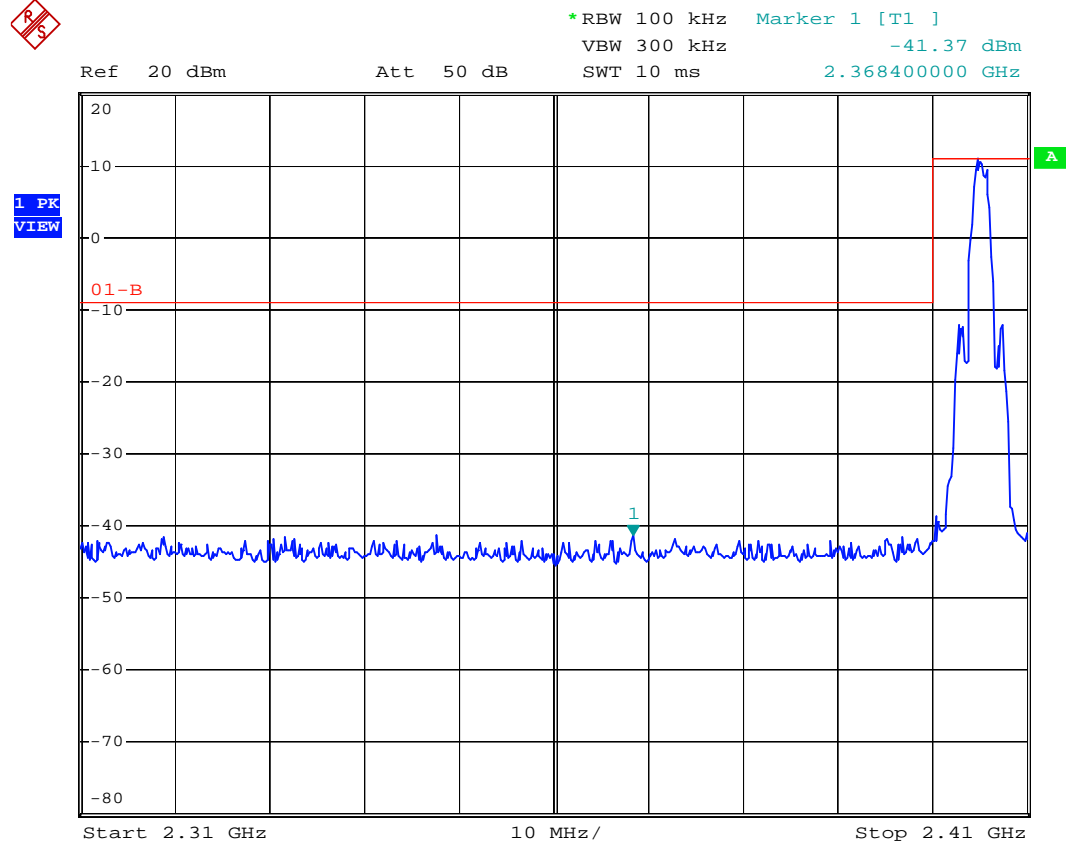
9.4 Measurement Data

Test Date : Oct. 21, 2016 Temperature : 23 °C Humidity : 54 %

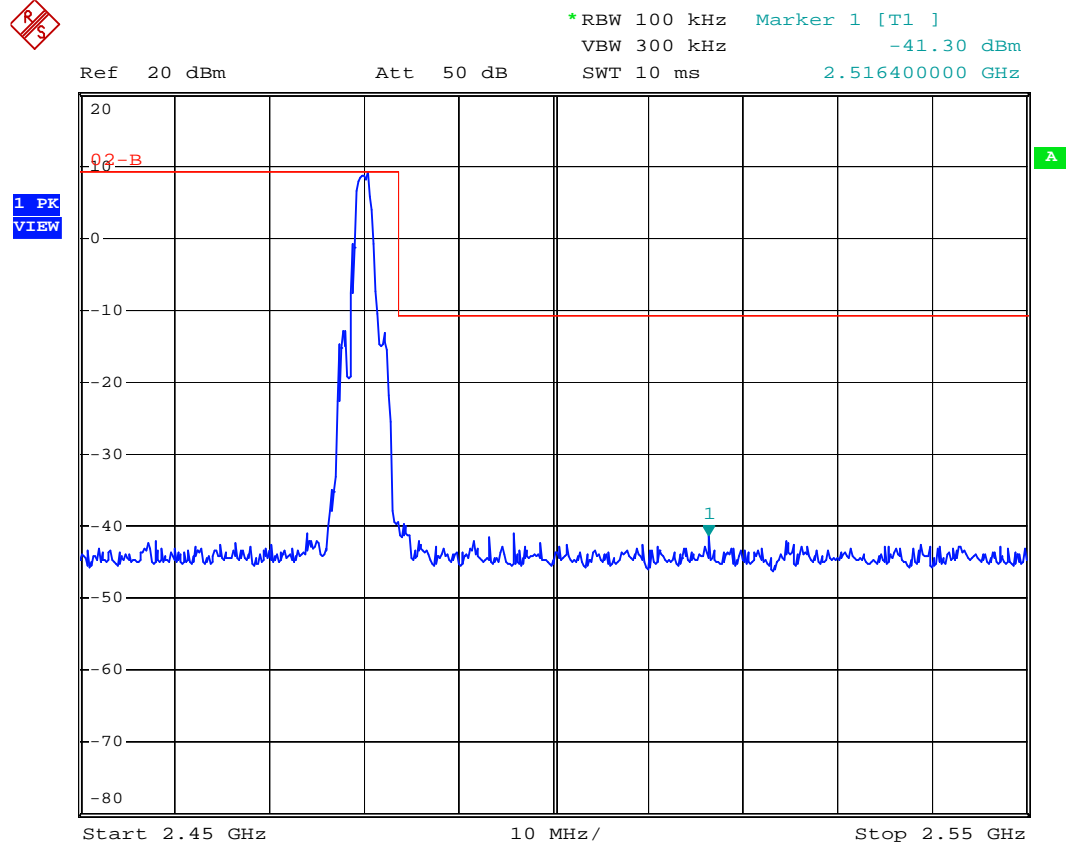
- a) Lower Band Edge : All emissions in this 100kHz bandwidth are attenuated more than 20dB from the carrier.
- b) Upper Band Edge : All emissions in this 100kHz bandwidth are attenuated more than 20dB from the carrier.

Note : The expanded uncertainty: 2dB.

Mode: Channel Lowest



Mode: Channel Highest



10 POWER DENSITY MEASUREMENT

10.1 Standard Applicable

According to 15.247(d), for direct sequence systems, the transmitted power density averaged over any 1 second interval shall not be greater than 8 dBm in any 3 kHz bandwidth within these bands.

10.2 Measurement Procedure

Measurement Method: PKPSD

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 5 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set EUT to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.
3. Set analyzer center frequency to DTS channel center frequency.
4. Set the span to 1.5 times the DTS bandwidth.
5. Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
6. Set the VBW $\geq 3 \times \text{RBW}$.
7. Detector = peak.
8. Sweep time = auto couple.
9. Trace mode = max hold.
10. Allow trace to fully stabilize.
11. Use the peak marker function to determine the maximum amplitude level within the RBW.
12. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
13. Repeat above procedures until all measured frequencies were complete.

10.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP40	2015/07/06	2016/07/05

10.4 Measurement Data

Test Date : Oct. 21, 2016 Temperature : 23 °C Humidity : 54 %

- a) Channel Low: Maximun PSD is -0.34 dBm
- b) Channel Mid: Maximun PSD is -1.32 dBm
- c) Channel High: Maximun PSD is -1.38 dBm

Note : The expanded uncertainty: 2dB.

Mode: Channel Low

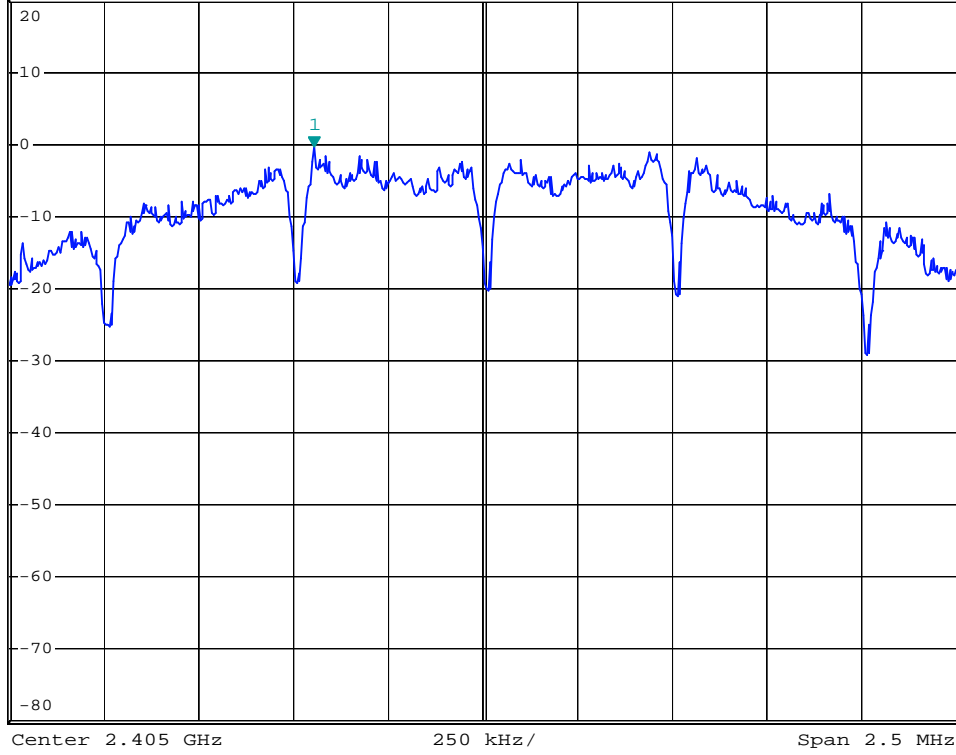


*RBW 3 kHz Marker 1 [T1]
VBW 10 kHz -0.34 dBm
SWT 280 ms 2.404555000 GHz

Ref 20 dBm

Att 50 dB

1 PK
VIEW



A

Mode: Channel Middle

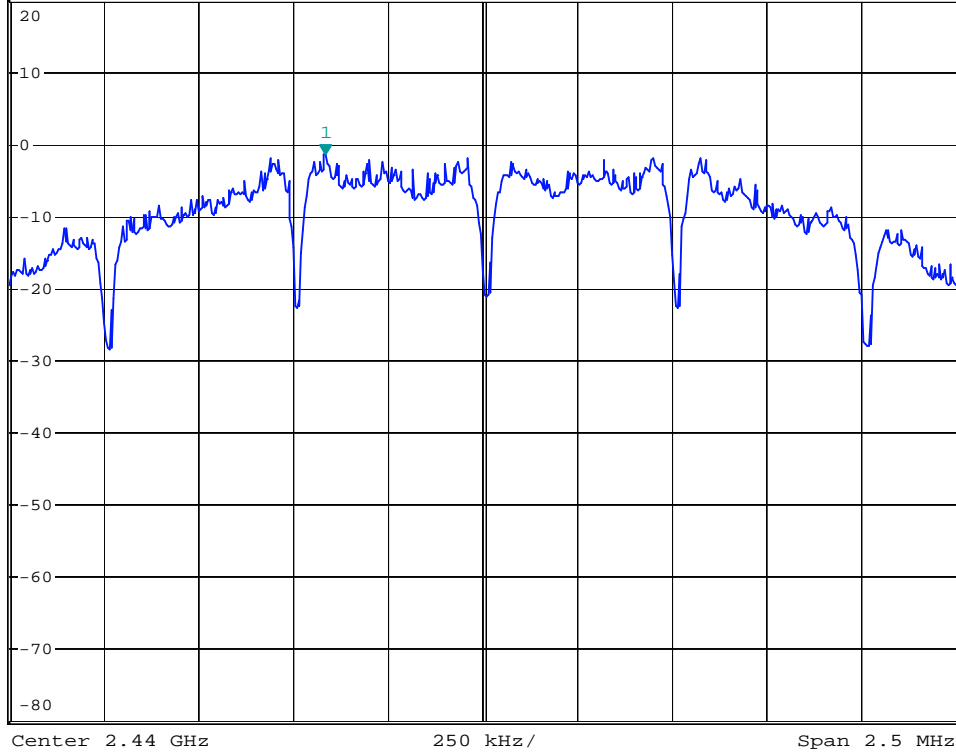


*RBW 3 kHz Marker 1 [T1]
VBW 10 kHz -1.32 dBm
SWT 280 ms 2.439585000 GHz

Ref 20 dBm

Att 50 dB

1 PK
VIEW



Mode: Channel High

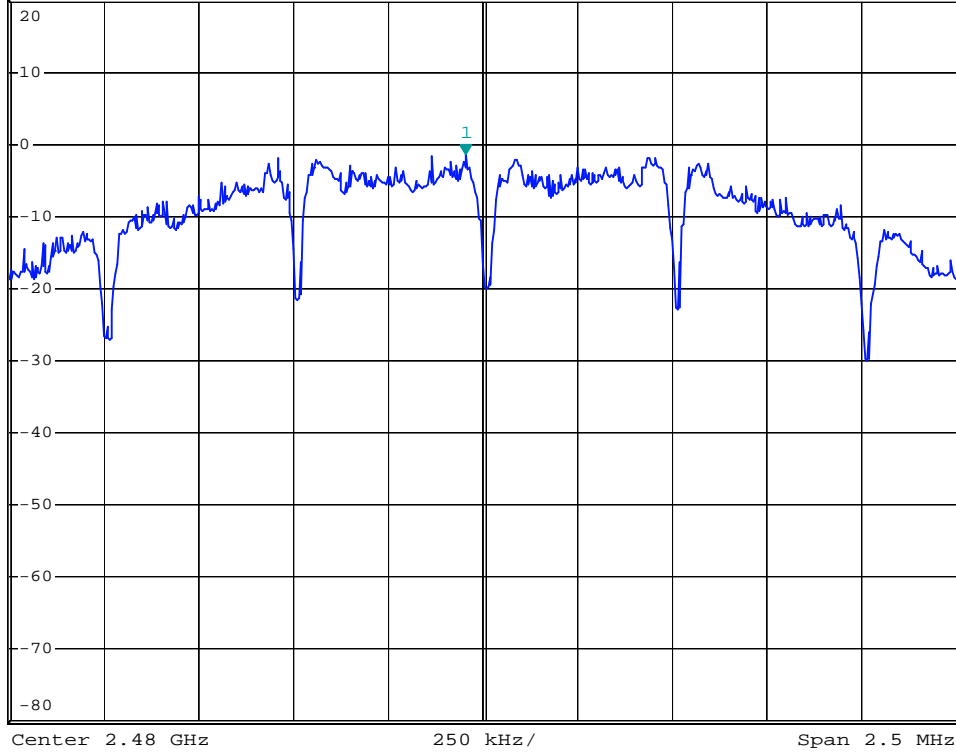


*RBW 3 kHz Marker 1 [T1]
VBW 10 kHz -1.38 dBm
SWT 280 ms 2.479955000 GHz

Ref 20 dBm

Att 50 dB

1 PK
VIEW



11. OUT-OF-BAND CONDUCTED EMISSION MEASUREMENT

11.1 Standard Applicable

According to 15.247(c), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required.

11.2 Measurement Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT as shown in figure 4 without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range and make sure the instrument is operated in its linear range.

3. Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold.

4. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. Plot the result on the screen of spectrum analyzer.
5. Repeat above procedures until all measured frequencies were complete.

11.3 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP40	2015/07/06	2016/07/05

11.4 Measurement Data

Test Date : Oct. 21, 2016 Temperature : 23 °C Humidity : 54 %

Mode: Channel Low, Mid, High

(a) 30 MHz to 1 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.

(b) 1 GHz to 25 GHz frequency band: All emissions are attenuated more than 20dB from the carrier.

Note : The expanded uncertainty: 2dB.

30 MHz to 1 GHz/ Channel Low

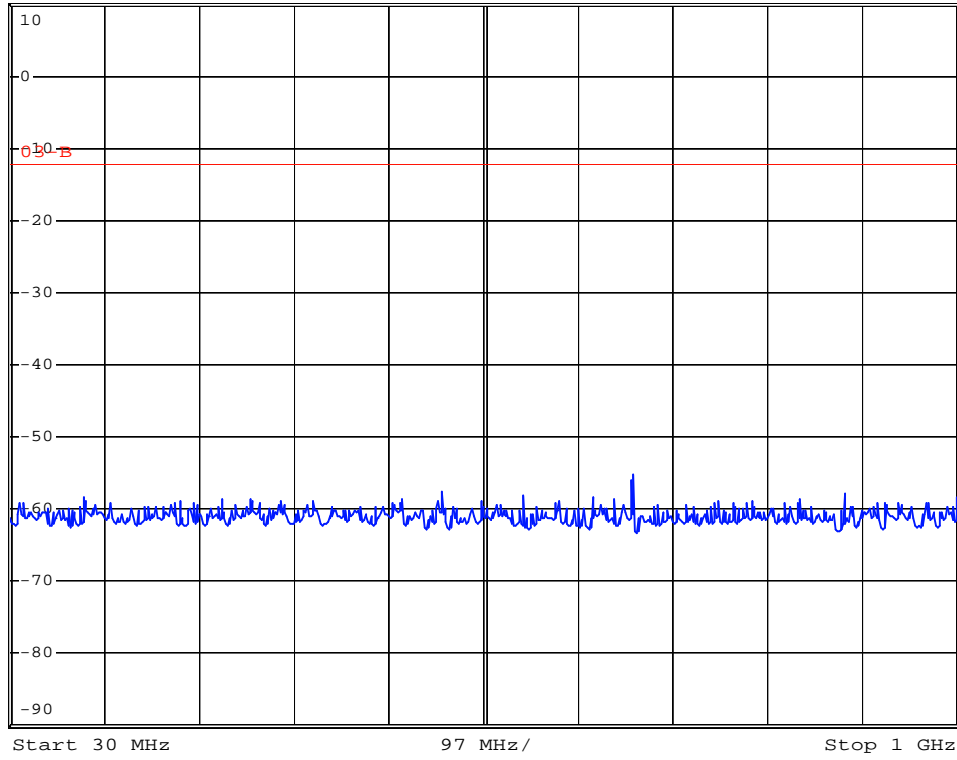


*RBW 100 kHz
VBW 300 kHz
SWT 100 ms

Ref 10 dBm

*Att 30 dB

1 PK
VIEW



30 MHz to 1 GHz/ Channel Mid

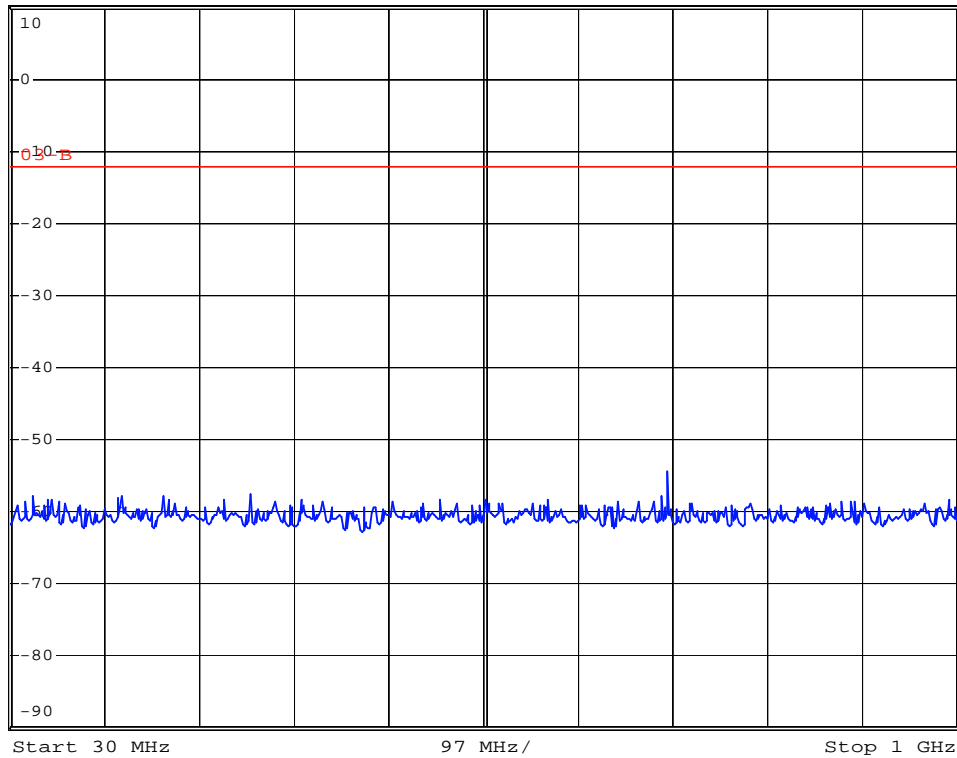


*RBW 100 kHz
VBW 300 kHz
SWT 100 ms

Ref 10 dBm

*Att 30 dB

1 PK
VIEW



30 MHz to 1 GHz/ Channel High

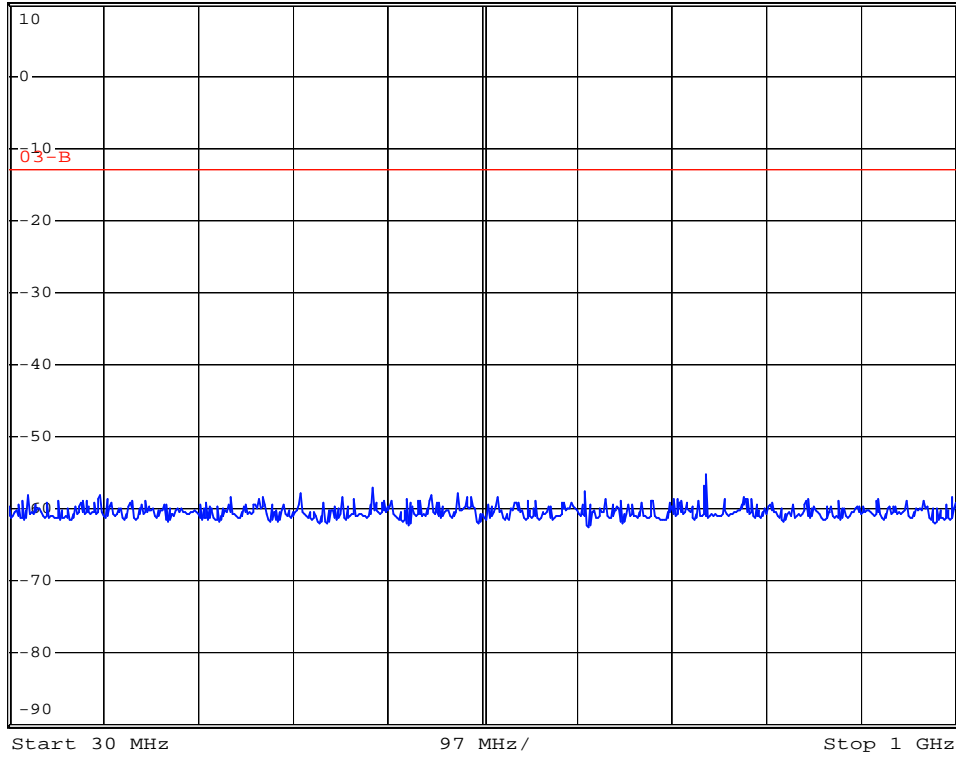


*RBW 100 kHz
VBW 300 kHz
SWT 100 ms

Ref 10 dBm

*Att 30 dB

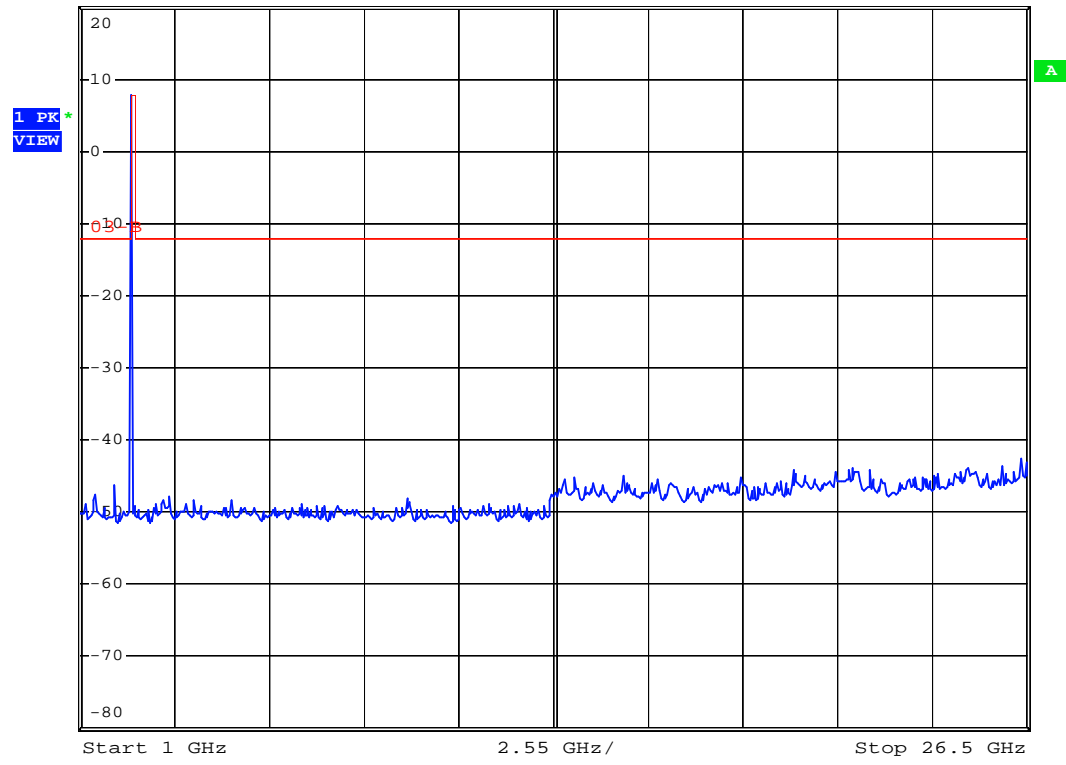
1 PK
VIEW



Above 1 GHz / Channel Low



Ref 20 dBm *Att 30 dB *RBW 100 kHz
VBW 300 kHz
SWT 2.6 s



12. DUTY CYCLE

12.1 Standard Applicable

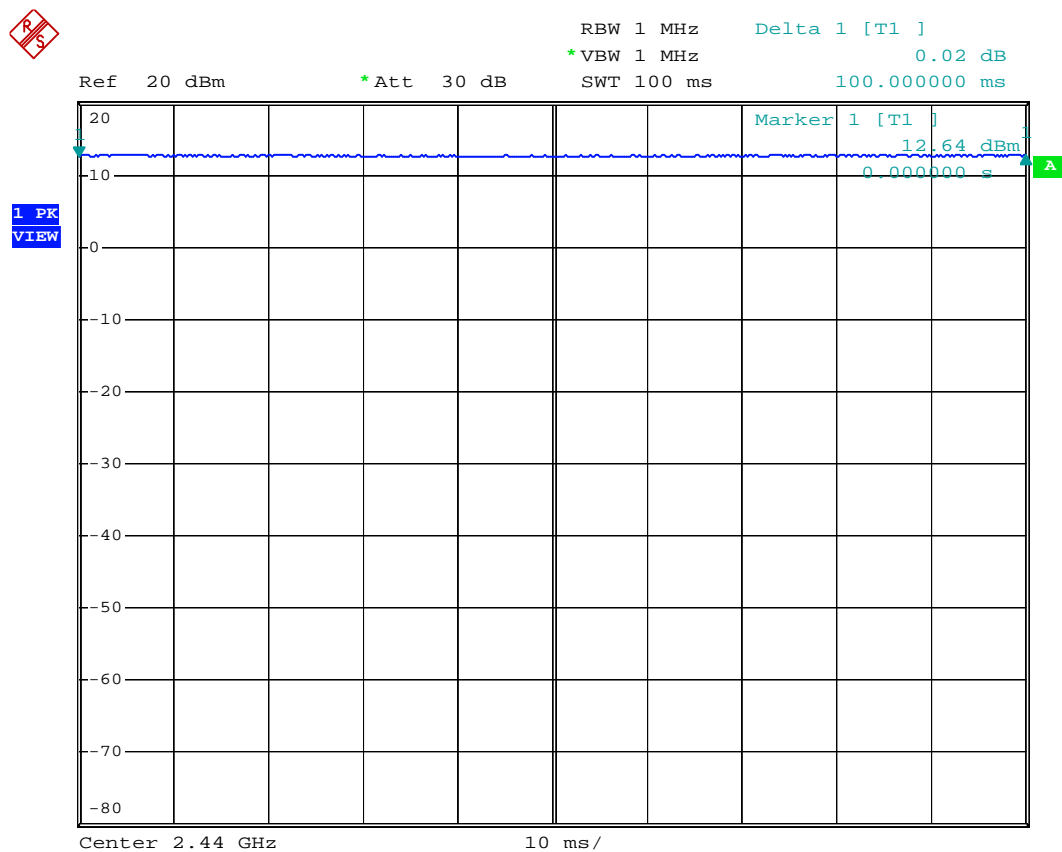
None. Reference only.

12.2 Measurement Equipment

Equipment	Manufacturer	Model No.	Calibration Date	Next Cal. Date
Spectrum Analyzer	Rohde & Schwarz	FSP40	2015/07/06	2016/07/05

12.3 Measurement Data

Test Date : Oct. 21, 2016 Temperature : 23 °C Humidity : 54 %



The EUT set for test with the continuous transmission mode and the duty cycle >98%.