MRT Technology (Suzhou) Co., Ltd
Phone: +86-512-66308358
Fax: +86-512-66308368
Web: www.mrt-cert.com

Report No.: 1601RSU00302
Report Version: V01
Issue Date: 01-14-2016

MEASUREMENT REPORT
FCC PART 15.407 & RSS-247

FCC ID:	2ABX8SH-000000013
IC:	12219A-00000000013
APPLICANT:	Zhejiang shenghui lighting Co., Ltd. Shanghai Branch

Application Type:	Certification
Product:	Pulse Link
Model No.:	C01-BR30NA LINK
Brand Name:	Sengled
FCC Classification:	Unlicensed National Information Infrastructure (UNII)
FCC Rule Part(s):	Part 15.407
IC Rule(s):	RSS-247 Issue 1, RSS-Gen Issue 4
Test Procedure(s):	ANSI C63.10-2013, KDB 789033 D02v01r01
Test Date:	June 06, 2015 ~ January 12, 2016

Reviewed By : Robin Wu
(Robin Wu)

Approved By : Marlin Chen
(Marlin Chen)

ACCREDITED
TESTING LABORATORY
CERTIFICATE #3628.01

The test results relate only to the samples tested.
This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in KDB 789033 D02v01r01. Test results reported herein relate only to the item(s) tested.

Revision History

Report No.	Version	Description	Issue Date
1601RSU00302	Rev. 01	Initial report	01-14-2016

CONTENTS

Description Page

§2.1033 General Information

Applicant:	Zhejiang shenghui lighting Co., Ltd. Shanghai Branch
Applicant Address:	Rm. 801, 1st Xinye Building,388 Tianlin Rd., Caohejing Development Zone, Shanghai, 200233, China
Manufacturer:	ZHEJIANG SHENGHUI LIGHTING Co., Ltd
Manufacturer Address:	South Jiachuang Rd., Xiuzhou Industrial Park Jiaxing, Zhejiang 314015 P.R. China
Test Site:	MRT Technology (Suzhou) Co., Ltd
Test Site Address:	D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China
MRT FCC Registration No.:	809388
MRT IC Registration No.:	11384A
FCC Rule Part(s):	Part 15.407
IC Rule(s):	RSS-247 Issue 1, RSS-Gen Issue 4
Model No.:	C01-BR30NA LINK
FCC ID:	2ABX8SH-000000013
IC:	12219A-00000000013
Test Device Serial No.:	N/A ☐ Production ☒ Pre-Production ☐ Engineering
FCC Classification:	Unlicensed National Information Infrastructure (UNII)

Test Facility / Accreditations

Measurements were performed at MRT Laboratory located in Tian'edang Rd., Suzhou, China.

- **MRT facility is a FCC registered (MRT Reg. No. 809388) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules.**
- **MRT facility is an IC registered (MRT Reg. No. 11384A-1) test laboratory with the site description on file at Industry Canada.**
- **MRT facility is a VCCI registered (R-4179, G-814, C-4664, T-2206) test laboratory with the site description on file at VCCI Council.**
- **MRT Lab is accredited to ISO 17025 by the American Association for Laboratory Accreditation (A2LA) under the American Association for Laboratory Accreditation Program (A2LA Cert. No. 3628.01) in EMC, Telecommunications and Radio testing for FCC, Industry Canada, EU and TELEC Rules.**

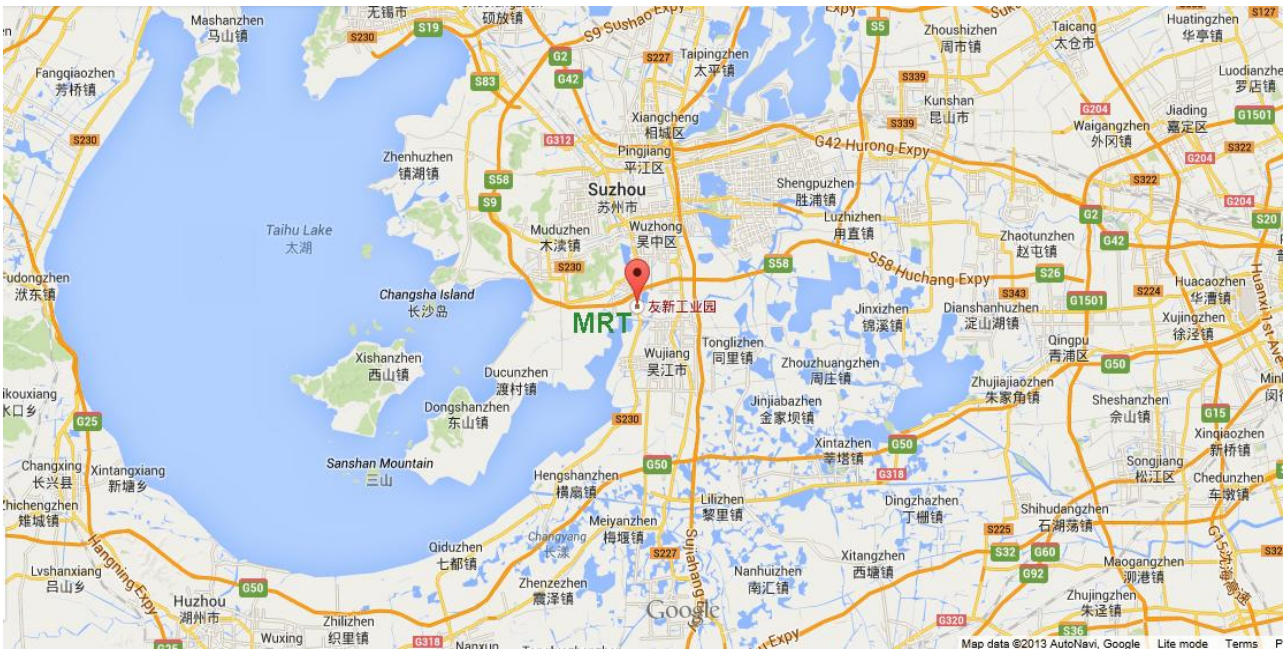
1. INTRODUCTION

1.1. Scope

Measurement and determination of electromagnetic emissions (EMC) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission and the Industry Canada Certification and Engineering Bureau.

1.2. MRT Test Location

The map below shows the location of the MRT LABORATORY, its proximity to the Taihu Lake. These measurement tests were conducted at the MRT Technology (Suzhou) Co., Ltd. Facility located at D8 Building, Youxin Industrial Park, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4-2014 on September 30, 2013.



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	Pulse Link
Model No.	C01-BR30NA LINK
Brand Name	Sengled
Wireless Specification	Using QPSK modulation and UNII-1/UNII-3 channel
Bluetooth Specification	v2.1 + EDR

2.2. Product Specification Subjective to this Standard

Product Specification Subjective to this Standard	
Frequency Range	5180 ~ 5240, 5745 ~ 5825MHz
Number of Channels	6
Type of Modulation	QPSK
Maximum Output Power	13.18dBm

Note: For other features of this EUT, test report will be issued separately.

2.3. Operation Frequency / Channel list

Channel	Frequency	Channel	Frequency	Channel	Frequency
01	5180 MHz	02	5210 MHz	03	5240 MHz
04	5736 MHz	05	5762 MHz	06	5814 MHz

2.4. Description of Available Antennas

Antenna No.	Antenna Type	Frequency Band (MHz)	Manufacturer	Tx Paths	Max Peak Gain (dBi)
Antenna A	PCB Antenna	5180 ~ 5240	SMSC Inc.	1	3.0
		5736 ~ 5814		1	3.2
Antenna B	PCB Antenna	5180 ~ 5240	SMSC Inc.	1	3.0
		5736 ~ 5814		1	3.2

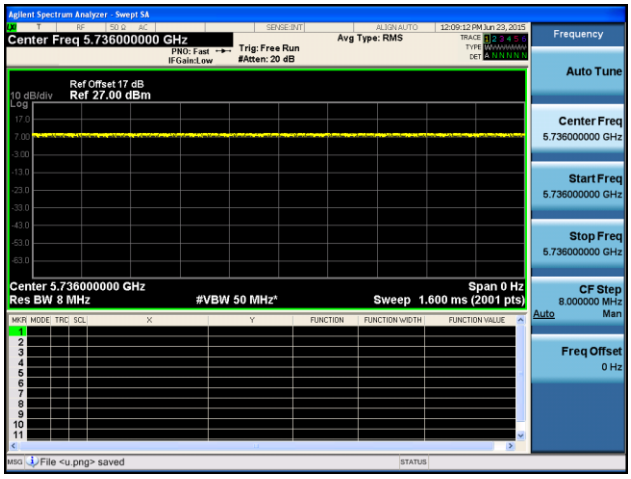
Note: For the wireless module, it has two diversity antennas which are used to avoid dropouts due to multipath fading. Only one antenna is selected for use at any time through the on-board RF switch.

2.5. Device Capabilities

This device contains the following capabilities:

Bluetooth (v2.1 + EDR) and 5GHz Wireless (UNII)

Note: 5GHz (NII) operation is possible in 20MHz channel bandwidth. The maximum achievable duty cycle was determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = average per the guidance of Section B)2)b) of KDB 789033 D02v01r01. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycle is as follow:

Duty Cycle (100%)


2.6. Test Configuration

The **Pulse Link FCC ID: 2ABX8SH-000000013** was tested per the guidance of KDB 789033 D02v01r01. ANSI C63.10-2013 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

2.7. EMI Suppression Device(s)/Modifications

No EMI suppression device(s) were added and/or no modifications were made during testing.

2.8. Labeling Requirements

Per 2.1074 & 15.19; Docket 95-19

The label shall be permanently affixed at a conspicuous location on the device; instruction manual or pamphlet supplied to the user and be readily visible to the purchaser at the time of purchase. However, when the device is so small wherein placement of the label with specified statement is not practical, only the FCC ID must be displayed on the device per Section 15.19(a)(5). Please see attachment for FCC ID label and label location.

3. DESCRIPTION OF TEST

3.1. Evaluation Procedure

The measurement procedures described in the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013), and the guidance provided in KDB 789033 D02v01r01 were used in the measurement of the **Pulse Link FCC ID: 2ABX8SH-000000013.**

Deviation from measurement procedure…….....None

3.2. AC Line Conducted Emissions

The line-conducted facility is located inside an 8'x4'x4' shielded enclosure. A 1m x 2m wooden table 80cm high is placed 40cm away from the vertical wall and 80cm away from the sidewall of the shielded room. Two 10kHz-30MHz, 50Ω/50uH Line-Impedance Stabilization Networks (LISNs) are bonded to the shielded room floor. Power to the LISNs is filtered by external high-current high-insertion loss power line filters. These filters attenuate ambient signal noise from entering the measurement lines. These filters are also bonded to the shielded enclosure.

The EUT is powered from one LISN and the support equipment is powered from the second LISN. All interconnecting cables more than 1 meter were shortened to a 1 meter length by non-inductive bundling (serpentine fashion) and draped over the back edge of the test table. All cables were at least 40cm above the horizontal reference ground-plane. Power cables for support equipment were routed down to the second LISN while ensuring that that cables were not draped over the second LISN.

Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the receiver and exploratory measurements were made to determine the frequencies producing the maximum emission from the EUT. The receiver was scanned from 150kHz to 30MHz. The detector function was set to peak mode for exploratory measurements while the bandwidth of the analyzer was set to 9kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Each emission was also maximized by varying: power lines, the mode of operation or data exchange speed, or support equipment whichever determined the worst-case emission. Once the worst case emissions have been identified, the one EUT cable configuration/arrangement and mode of operation that produced these emissions are used for final measurements on the same test site. The analyzer is set to CISPR quasi-peak and average detectors with a 9kHz resolution bandwidth for final measurements.

An extension cord was used to connect to a single LISN which powered by EUT. The extension cord was calibrated with LISN, the impedance and insertion loss are compliance with the requirements as stated in ANSI C63.10-2013.

Line conducted emissions test results are shown in Section 7.10.

3.3. Radiated Emissions

The radiated test facilities consisted of an indoor 3 meter semi-anechoic chamber used for final measurements and exploratory measurements, when necessary. The measurement area is contained within the semi-anechoic chamber which is shielded from any ambient interference. For measurements above 1GHz absorbers are arranged on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1GHz, the absorbers are removed. A MF Model 210SS turntable is used for radiated measurement. It is a continuously rotatable, remote controlled, metallic turntable and 2 meters (6.56 ft.) in diameter. The turn table is flush with the raised floor of the chamber in order to maintain its function as a ground plane. An 80cm high PVC support structure is placed on top of the turntable.
For all measurements, the spectrum was scanned through all EUT azimuths and from 1 to 4 meter receive antenna height using a broadband antenna from 30MHz up to the upper frequency shown in 15.33(b)(1) depending on the highest frequency generated or used in the device or on which the device operates or tunes. For frequencies above 1GHz, linearly polarized double ridge horn antennas were used. For frequencies below 30MHz, a calibrated loop antenna was used. When exploratory measurements were necessary, they were performed at 1 meter test distance inside the semi-anechoic chamber using broadband antennas, broadband amplifiers, and spectrum analyzers to determine the frequencies and modes producing the maximum emissions. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The test set-up for frequencies below 1GHz was placed on top of the 0.8 meter high, 1 x 1.5 meter table; and test set-up for frequencies 1-40GHz was placed on top of the 1.5 meter high, 1 x 1.5 meter table. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each emission. Appropriate precaution was taken to ensure that all emissions from the EUT were maximized and investigated. The system configuration, clock speed, mode of operation or video resolution, if applicable, turntable azimuth, and receive antenna height was noted for each frequency found.
Final measurements were made in the semi-anechoic chamber using calibrated, linearly polarized broadband and horn antennas. The test setup was configured to the setup that produced the worst case emissions. The spectrum analyzer was set to investigate all frequencies required for testing to compare the highest radiated disturbances with respect to the specified limits. The turntable containing the EUT was rotated through 360 degrees and the height of the receive antenna was varied 1 to 4 meters and stopped at the azimuth and height producing the maximum emission. Each emission was maximized by changing the orientation of the EUT through three orthogonal planes and changing the polarity of the receive antenna, whichever produced the worst-case emissions. According to 3dB Beam-Width of horn antenna, the horn antenna should be always directed to the EUT when rising height.

4. ANTENNA REQUIREMENTS

Excerpt from §15.203 of the FCC Rules/Regulations:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

- The antenna of the **Pulse Link** is **permanently attached.**
- There are no provisions for connection to an external antenna.

Conclusion:

The **Pulse Link FCC ID: 2ABX8SH-000000013** unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATE

Conducted Emissions - SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2016/11/03
Two-Line V-Network	R&S	ENV216	MRTSUE06002	1 year	2016/11/03
Two-Line V-Network	R&S	ENV216	MRTSUE06003	1 year	2016/11/03
Temperature/ Meter Humidity	Yuhuaze	N/A	MRTSUE06180	1 year	2016/12/20

Radiated Emission - AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9010A	MRTSUE06124	1 year	2016/06/23
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2016/11/03
Preamplifier	Agilent	83017A	MRTSUE06076	1 year	2016/03/29
Preamplifier	Schwarzbeck	BBV 9721	MRTSUE06121	1 year	2016/04/15
Loop Antenna	Schwarzbeck	FMZB1519	MRTSUE06025	1 year	2016/12/14
TRILOG Antenna	Schwarzbeck	VULB9162	MRTSUE06022	1 year	2016/11/07
Broad-Band Horn Antenna	Schwarzbeck	BBHA9120D	MRTSUE06023	1 year	2016/11/07
Broadband Horn Antenna	Schwarzbeck	BBHA9170	MRTSUE06024	1 year	2017/01/04
Temperature/ Meter Humidity	Yuhuaze	N/A	MRTSUE06183	1 year	2016/12/20

Conducted Test Equipment - TR3

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2016/05/08
USB Wideband Power Sensor	Boonton	55006	MRTSUE06109	1 year	2016/05/08
Temperature/ Meter Humidity	Yuhuaze	N/A	MRTSUE06180	1 year	2016/12/20

Software	Version	Function
e3	V8.3.5	EMI Test Software

6. MEASUREMENT UNCERTAINTY

Where relevant, the following test uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

AC Conducted Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 150kHz~30MHz: 3.46dB
Radiated Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): 9kHz ~ 1GHz: 4.18dB 1GHz ~ 40GHz: 4.76dB

7. TEST RESULT

7.1. Summary

Company Name: **Zhejiang shenghui lighting Co., Ltd. Shanghai Branch**

FCC ID: **2ABX8SH-000000013**

IC **12219A-00000000013**

Data Rate(s) Tested: **22Mbps**

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.407(a)	26dB Bandwidth	N/A	Conducted	Pass	Section 7.2
15.407(e)	6dB Bandwidth	≥ 500kHz		Pass	Section 7.3
15.407(a)(1)(ii), (3)	Maximum Conducted Output Power	≤ 30 dBm U-NII-1 ≤ 30 dBm U-NII-3		Pass	Section 7.5
15.407(a)(1)(ii), (3), (5)	Peak Power Spectral Density	≤ 17 dBm/MHz U-NII-1 ≤ 30 dBm/500kHz U-NII-3		Pass	Section 7.6
15.407(g)	Frequency Stability	N/A		Pass	Section 7.7
15.407(b)(1), (4)	Undesirable Emissions	≤ -27dBm/MHz EIRP ≤ -17dBm/MHz EIRP	Radiated	Pass	Section 7.8 & 7.9
15.205, 15.209 15.407(b)(5), (6), (7)	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		Pass	
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	Pass	Section 7.10

RSS Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
RSS-247 §6.2	99% Bandwidth	N/A	Conducted	Pass	Section 7.2
RSS-247 §6.2.4	6dB Bandwidth	>500kHz		Pass	Section 7.3
RSS-247 §6.2.1	Operation Frequency Range of 26dB BW	26dBc frequency range above 5250MHz		Pass	Section 7.4
RSS-247 §6.2.1, §6.2.4	Max Conducted Output Power	5725~5850MHz, ≤ 30 dBm		Pass	Section 7.5
	Maximum E.I.R.P	5150~5250MHz ≤ 23 dBm or 10 + 10 log10(99% B)			
RSS-247 §6.2.1, §6.2.4	Peak Power Spectral Density	5150~5250MHz ≤ 10 dBm/MHz 5725~5850MHz, ≤ 30 dBm/500kHz		Pass	Section 7.6
RSS-Gen [8.11]	Frequency Stability	N/A		Pass	Section 7.7
RSS-247 §6.2.1,§6.2.4	Out-of-Band Emissions	≤ -27dBm/MHz EIRP ≤ -17dBm/MHz EIRP	Radiated	Pass	Section 7.8 & 7.9
RSS-247 §6.2.1, §6.2.4	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in RSS-Gen [8.9]		Pass	
RSS-Gen [8.8]	AC Conducted Emissions 150kHz - 30MHz	< RSS-Gen [8.8] limits	Line Conducted	Pass	Section 7.10

Notes:

1) All channels, modes, and modulations/data rates were investigated among all UNII bands. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst case emissions.
2) The analyzer plots shown in this section were all taken with a correction table loaded into the analyzer. The correction table was used to account for the losses of the cables and attenuators used as part of the system to connect the EUT to the analyzer at all frequencies of interest.
3) All antenna port conducted emissions testing was performed on a test bench with the antenna port of the EUT connected to the spectrum analyzer through calibrated cables and attenuators.

7.2. 26dB Bandwidth Measurement

7.2.1. Test Limit

N/A

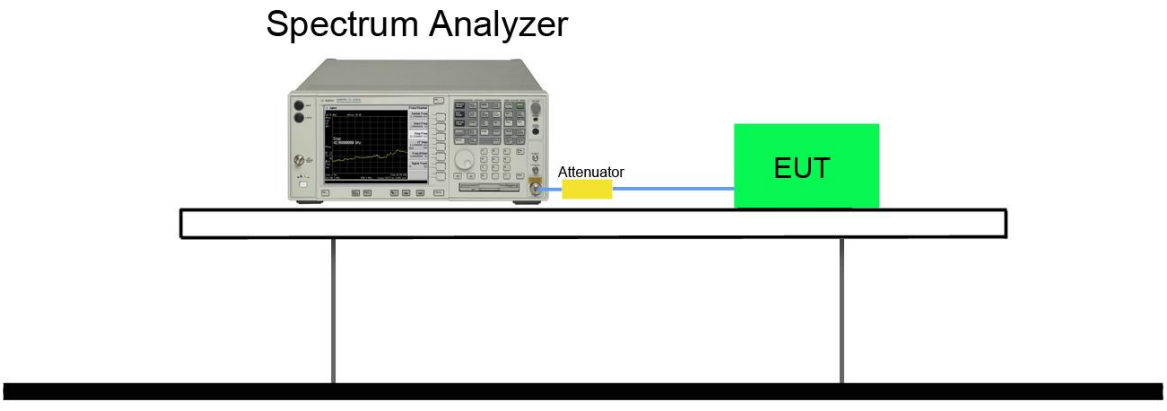
7.2.2. Test Procedure used

KDB 789033 D02v01r01 – Section C.1

7.2.3. Test Setting

1. The analyzers' automatic bandwidth measurement capability was used to perform the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 26. The automatic bandwidth measurement function also has the capability of simultaneously measuring the 99% occupied bandwidth. The bandwidth measurement was not influenced by any intermediated power nulls in the fundamental emission.
2. RBW = approximately 1% of the emission bandwidth.
3. VBW ≥ 3 × RBW.
4. Detector = Peak.
5. Trace mode = max hold.

7.2.4. Test Setup

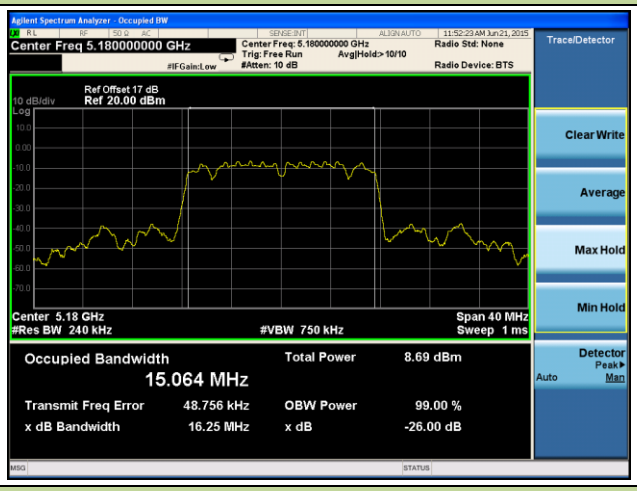


7.2.5. Test Result

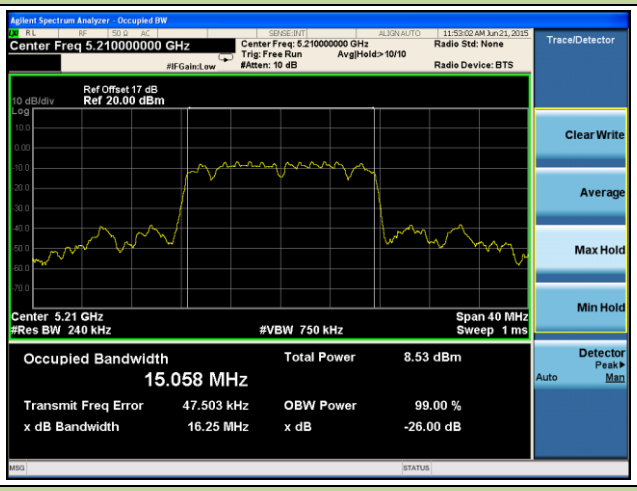
Type of Modulation	Data Rate (Mbps)	Channel No.	Frequency (MHz)	26dB Bandwidth (MHz)	99% Bandwidth (MHz)	Result
Ant A						
QPSK	22	01	5180	16.25	15.06	Pass
	22	02	5210	16.25	15.06	Pass
	22	03	5240	16.25	15.06	Pass
QPSK	22	04	5736	16.64	13.85	Pass
	22	05	5762	16.67	13.85	Pass
	22	06	5814	16.66	13.83	Pass
Ant B						
QPSK	22	01	5180	16.25	15.06	Pass
	22	02	5210	16.25	15.06	Pass
	22	03	5240	16.25	15.05	Pass
QPSK	22	04	5736	16.66	13.84	Pass
	22	05	5762	16.68	13.85	Pass
	22	06	5814	16.68	13.84	Pass

26dB Bandwidth & 99% Bandwidth - Ant A

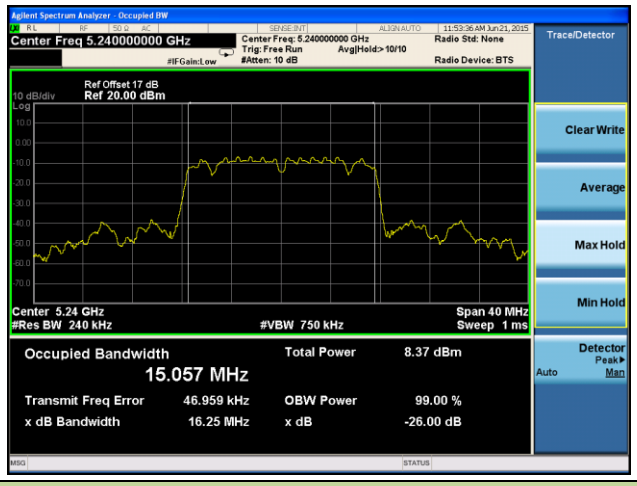
Channel 01 (5180MHz)



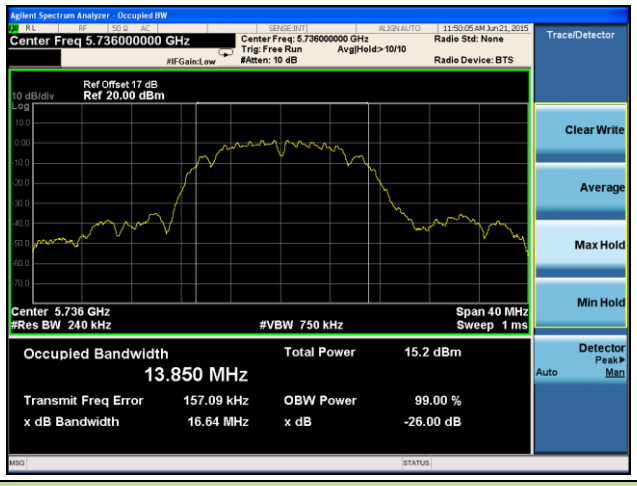
Channel 02 (5210MHz)



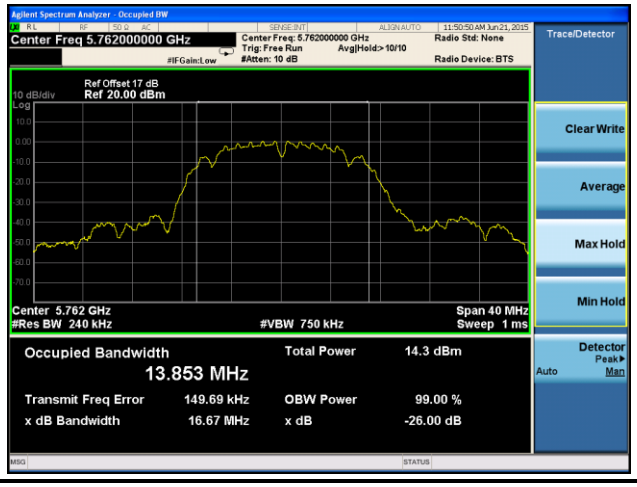
Channel 03 (5240MHz)



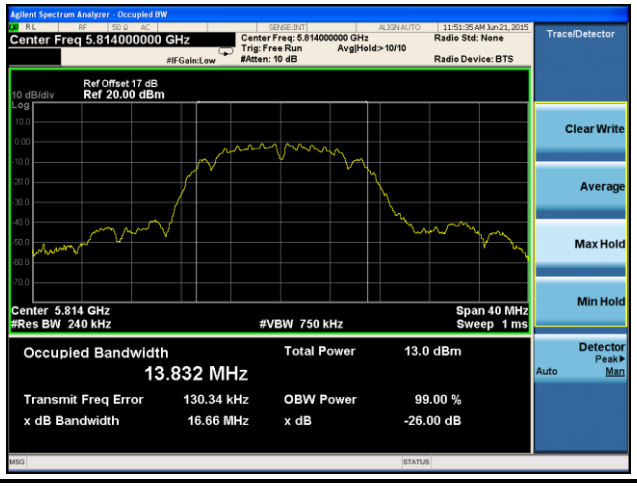
Channel 04 (5736MHz)



Channel 05 (5762MHz)

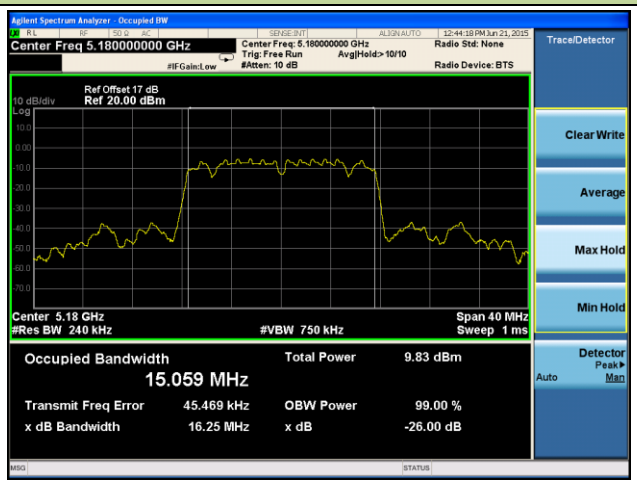


Channel 06 (5814MHz)

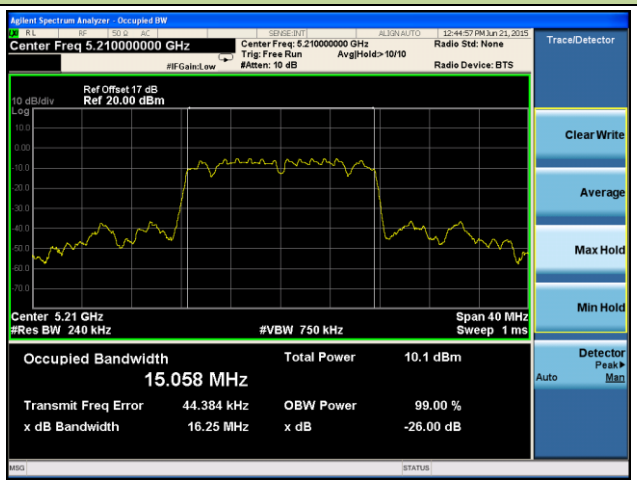


26dB Bandwidth & 99% Bandwidth - Ant B

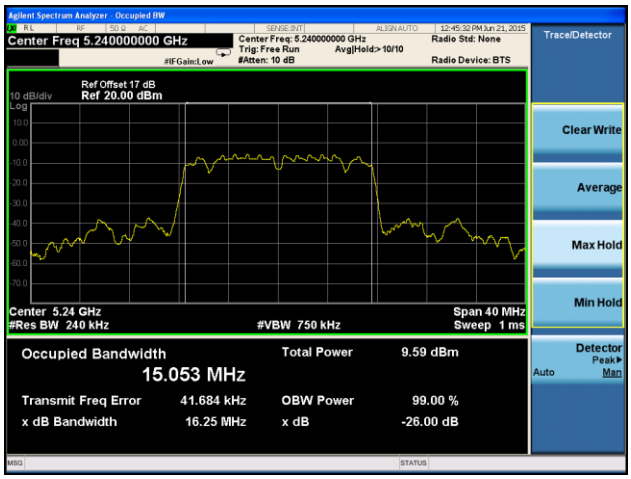
Channel 01 (5180MHz)



Channel 02 (5210MHz)

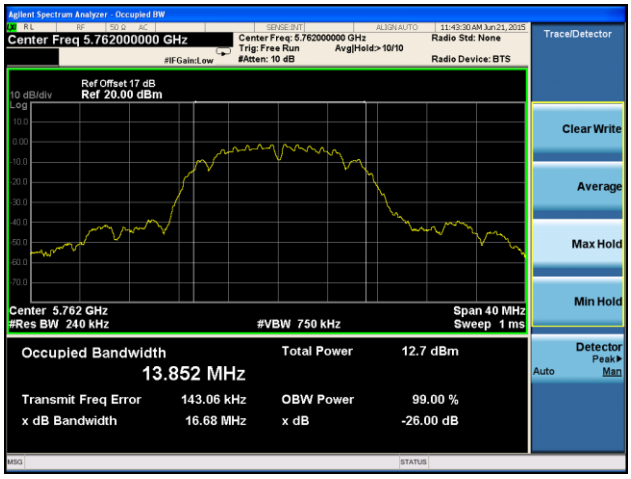


Channel 03 (5240MHz)



Channel 04 (5736MHz)

Channel 05 (5762MHz)



Channel 06 (5814MHz)

7.3. 6dB Bandwidth Measurement

7.3.1. Test Limit

The minimum 6dB bandwidth shall be at least 500 kHz.

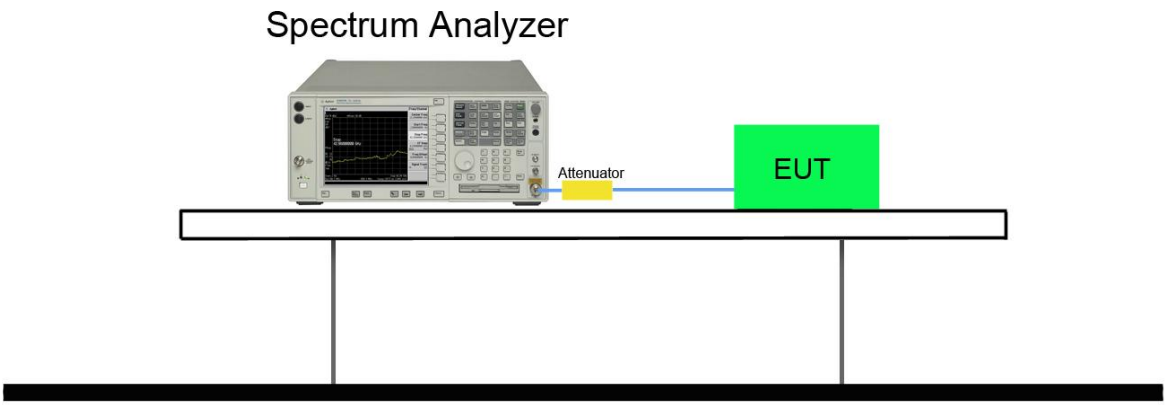
7.3.2. Test Procedure used

KDB 789033 D02v01r01 – Section C.2

7.3.3. Test Setting

1. Set center frequency to the nominal EUT channel center frequency.
2. RBW = 100 kHz.
3. VBW ≧ 3 × RBW.
4. Detector = Peak.
5. Trace mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize.
8. 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.

7.3.4. Test Setup

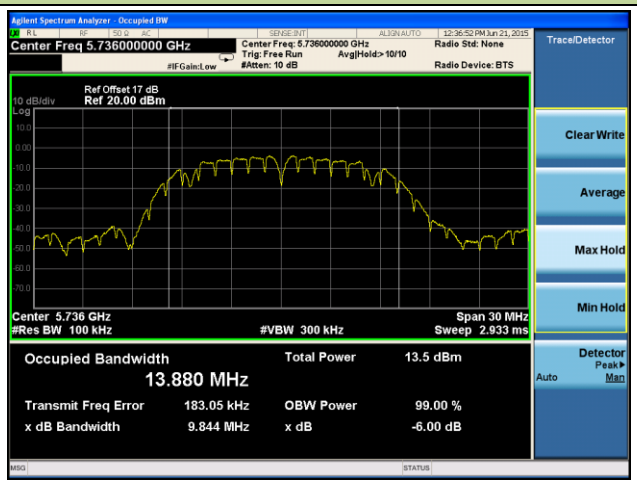


7.3.5. Test Result

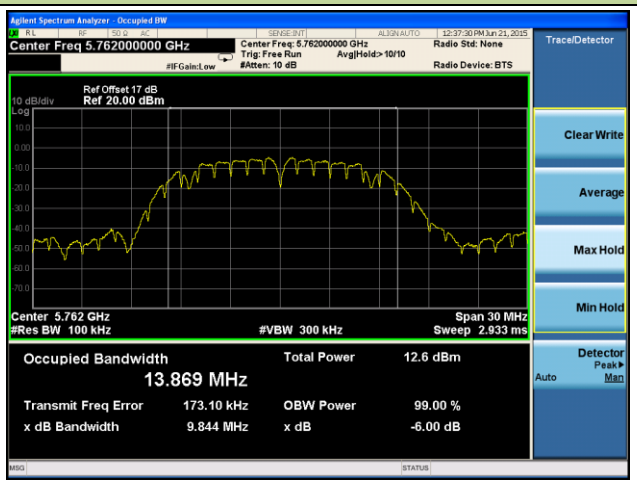
Type of Modulation	Data Rate (Mbps)	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	Result
Ant A						
QPSK	22	04	5736	9.84	≥ 0.5	Pass
	22	05	5762	9.84	≥ 0.5	Pass
	22	06	5814	9.85	≥ 0.5	Pass
Ant B						
QPSK	22	04	5736	9.84	≥ 0.5	Pass
	22	05	5762	9.85	≥ 0.5	Pass
	22	06	5814	9.84	≥ 0.5	Pass

6dB Bandwidth - Ant A

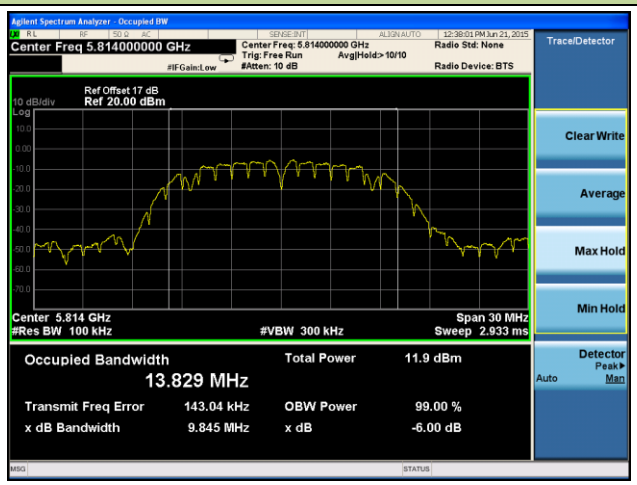
Channel 04 (5736MHz)

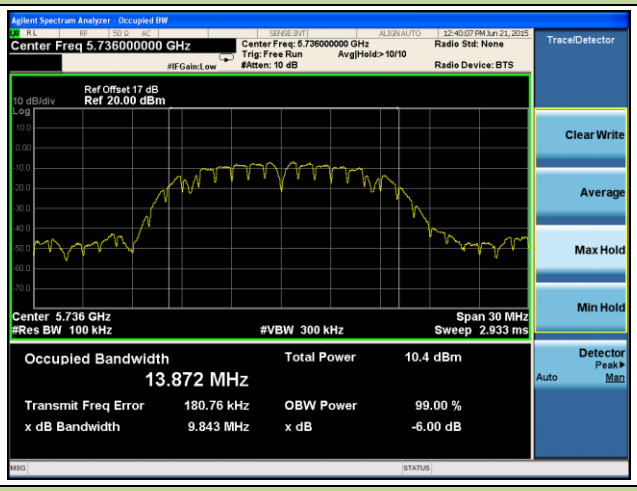
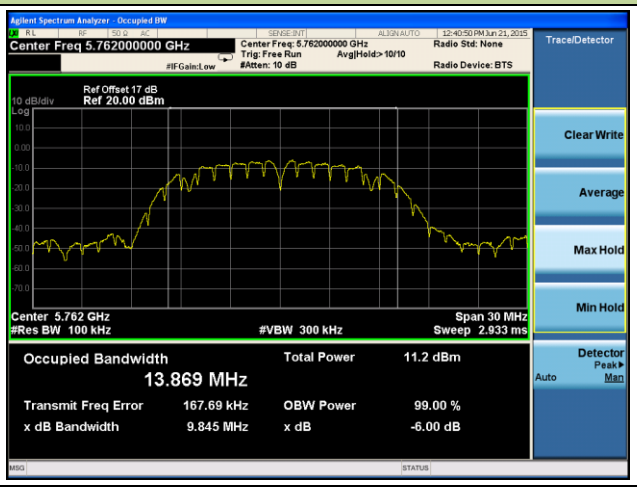


Channel 05 (5762MHz)



Channel 06 (5814MHz)



6dB Bandwidth - Ant B	
Channel 04 (5736MHz)	**Channel 05 (5762MHz)**
	
Channel 06 (5814MHz)	
	

7.4. Operation Frequency Range of 26dBc Bandwidth Measurement

7.4.1. Test Limit

For transmitters operating in the band 5150-5250 MHz, all emissions outside the band 5150-5350 MHz shall not exceed -27dBm/MHz e.i.r.p. However, any unwanted emissions that fall into the band 5250-5350 MHz must be 26 dBc, when measured using a resolution bandwidth between 1 and 5% of the occupied bandwidth, above 5.25 GHz.

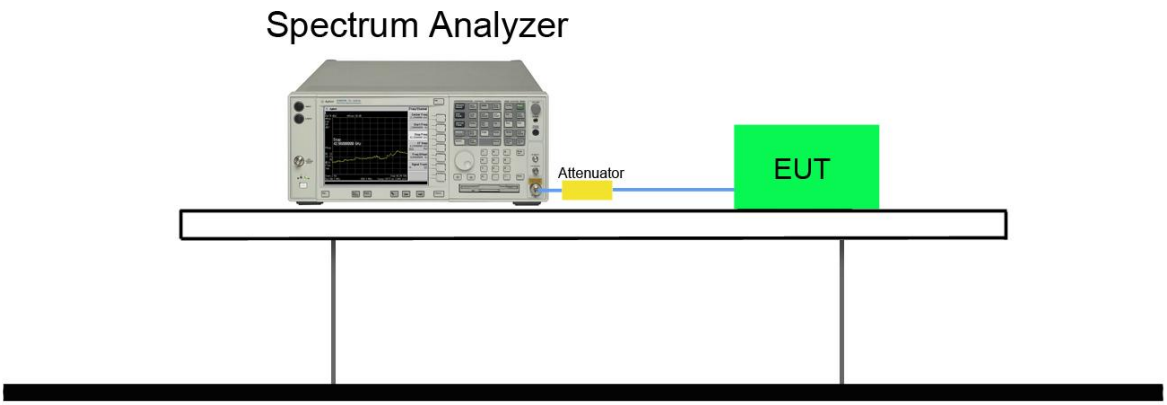
7.4.2. Test Procedure used

N/A

7.4.3. Test Setting

1. Set center frequency to the nominal EUT channel center frequency.
2. Span = 1.5 times to 5.0 times the OBW.
3. RBW = 1 % to 5 % of the OBW.
4. VBW ≥ 3 × RBW.
5. Detector = Peak.
6. Trace mode = max hold.
7. Allow the trace to stabilize and set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).
8. Determine the “−26 dB down amplitude” using [(reference value) − 26].
9. Using the marker function of the instrument to show 5250MHz frequency level.

7.4.4. Test Setup



7.4.5. Test Result

Type of Modulation	Data Rate (Mbps)	Channel No.	Frequency (MHz)	Result
Ant A				
QPSK	22	03	5240	Pass
Ant B				
QPSK	22	03	5240	Pass

Operation Frequency Range of 26dBc Bandwidth - Ant A	
Channel 03 (5240MHz)	
	

Operation Frequency Range of 26dBc Bandwidth - Ant B	
Channel 03 (5240MHz)	
	

7.5. Output Power Measurement

7.5.1. Test Limit

For FCC

For the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W (30dBm).

For IC

For the band 5.15-5.25 GHz, the maximum e.i.r.p. shall not exceed 200 mW (23.01dBm) or 10 + 10 $\log_{10}$ B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

For the 5.725-5.85 GHz band, the maximum conducted output power shall not exceed 1 W.

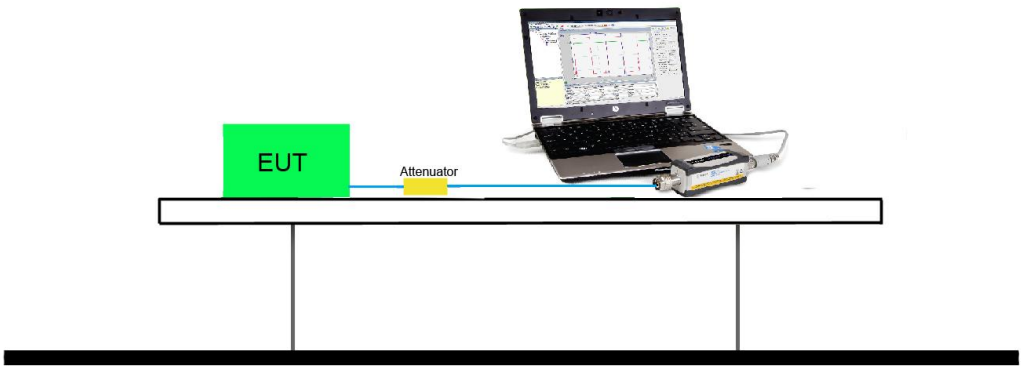
7.5.2. Test Procedure Used

KDB 789033 D02v01r01 - Section E) 3) b) Method PM-G

7.5.3. Test Setting

Average power measurements were perform only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The power meter implemented triggering and gating capabilities which were set up such that power measurements were recorded only during the ON time of the transmitter. The trace was averaged over 100 traces to obtain the final measured average power.

7.5.4. Test Setup



7.5.5. Test Result

Type of Modulation	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Output Power (dBm)	Output Power Limit (dBm)	EIRP (dBm)	EIRP Limit (dBm)	Result
Ant A								
QPSK	22	01	5180	8.20	≤ 30	11.20	≤ 21.78	Pass
	22	02	5210	8.05	≤ 30	11.05	≤ 21.78	Pass
	22	03	5240	7.92	≤ 30	10.92	≤ 21.78	Pass
QPSK	22	04	5736	10.52	≤ 30	---	---	Pass
	22	05	5762	10.45	≤ 30	---	---	Pass
	22	06	5814	12.34	≤ 30	---	---	Pass
Ant B								
QPSK	22	01	5180	9.46	≤ 30	12.46	≤ 21.78	Pass
	22	02	5210	9.29	≤ 30	12.29	≤ 21.78	Pass
	22	03	5240	8.86	≤ 30	11.86	≤ 21.78	Pass
QPSK	22	04	5736	11.35	≤ 30	---	---	Pass
	22	05	5762	11.07	≤ 30	---	---	Pass
	22	06	5814	13.18	≤ 30	---	---	Pass

Note: Max EIRP (dBm) = RMS Power (dBm) + Antenna Gain.

For 5150-5250MHz, EIRP Limit: $10 + 10 \log_{10}$ (15.05MHz) = 21.78dBm < 23.01dBm.

7.6. Power Spectral Density Measurement

7.6.1. Test Limit

For FCC

For the band 5.15-5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

For the band 5.725-5.85 GHz, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

For IC

For the band 5.15-5.25 GHz, the e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

For the 5.725-5.85 GHz band, the power spectral density shall not exceed 30 dBm in any 500 kHz band.

7.6.2. Test Procedure Used

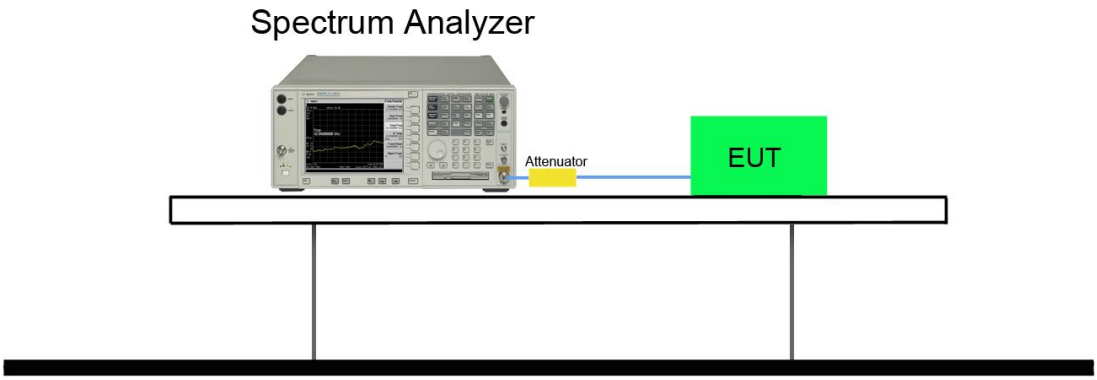
KDB 789033 D02v01r01 - Section F

7.6.3. Test Setting

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire 26dB EBW of the signal.
3. RBW = 1MHz, if measurement bandwidth of Maximum PSD is specified in 500 kHz, RBW = 100 kHz
4. VBW = 3MHz
5. Number of sweep points ≥ 2 × (span / RBW)
6. Detector = power averaging (RMS)
7. Sweep time = auto
8. Trigger = free run
9. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
10. Add 10*log(1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission). For example, add 10*log(1/0.25) = 6 dB if the duty cycle is 25 percent.

11. When the measurement bandwidth of Maximum PSD is specified in 500 kHz, add a constant factor 10*log(500kHz/100kHz) = 7 dB to the measured result

7.6.4. Test Setup



7.6.5. Test Result

Type of Modulation	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Reading PSD (dBm/ MHz)	Duty Cycle (%)	PSD Limit (dBm/ MHz)	EIRP PSD (dBm/ MHz)	EIRP PSD Limit (dBm/ MHz)	Result
Ant A									
QPSK	22	01	5180	-5.26	100	≤ 17	-2.26	≤ 10	Pass
	22	02	5210	-5.44	100	≤ 17	-2.44	≤ 10	Pass
	22	03	5240	-5.55	100	≤ 17	-2.55	≤ 10	Pass
Ant B									
QPSK	22	01	5180	-5.03	100	≤ 17	-2.03	≤ 10	Pass
	22	02	5210	-4.94	100	≤ 17	-1.94	≤ 10	Pass
	22	03	5240	-5.34	100	≤ 17	-2.34	≤ 10	Pass

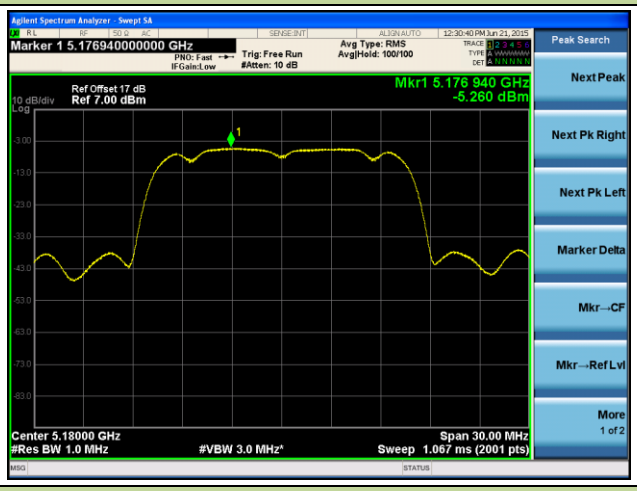
Note: EIRP PSD Level (dBm/MHz) = Reading PSD Level (dBm/MHz) + Antenna Gain.

Type of Modulation	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Reading PSD (dBm/ 100kHz)	Duty Cycle (%)	Constant Factor	Max PSD (dBm/ 500kHz)	Limit (dBm/ 500kHz)	Result
Ant A									
QPSK	22	04	5736	-5.20	100	7	1.80	≤ 30	Pass
	22	05	5762	-7.23	100	7	-0.23	≤ 30	Pass
	22	06	5814	-7.08	100	7	-0.08	≤ 30	Pass
Ant B									
QPSK	22	04	5736	-6.94	100	7	0.06	≤ 30	Pass
	22	05	5762	-6.70	100	7	0.30	≤ 30	Pass
	22	06	5814	-6.43	100	7	0.57	≤ 30	Pass

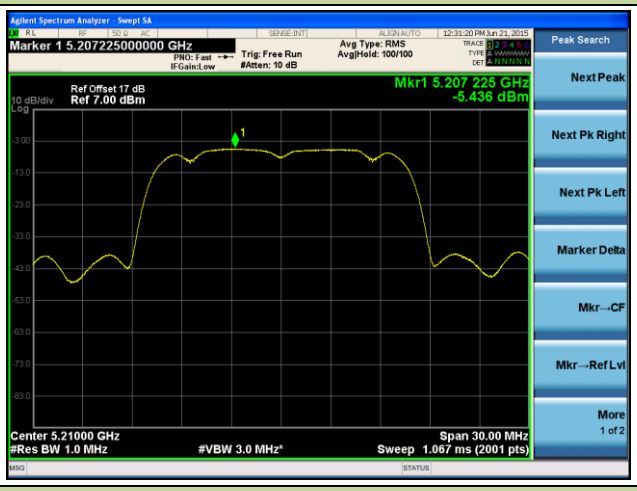
Note: The Max PSD Level = Reading PSD Level + Constant Factor.

Power Spectral Density - Ant A

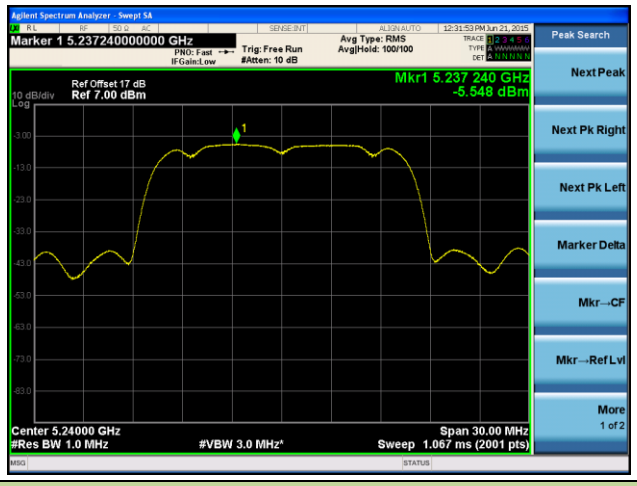
Channel 01 (5180MHz)



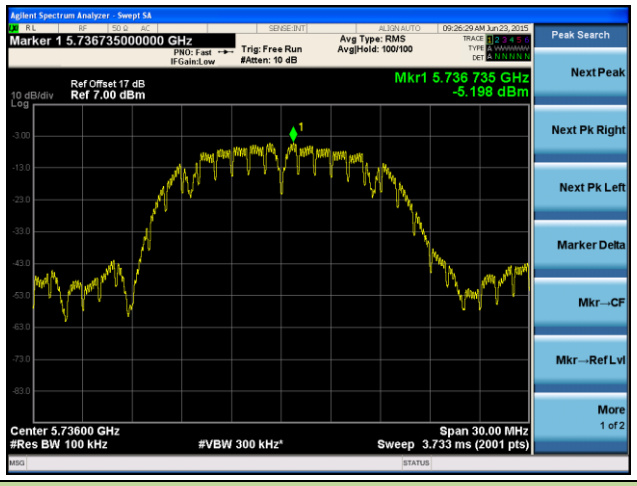
Channel 02 (5210MHz)



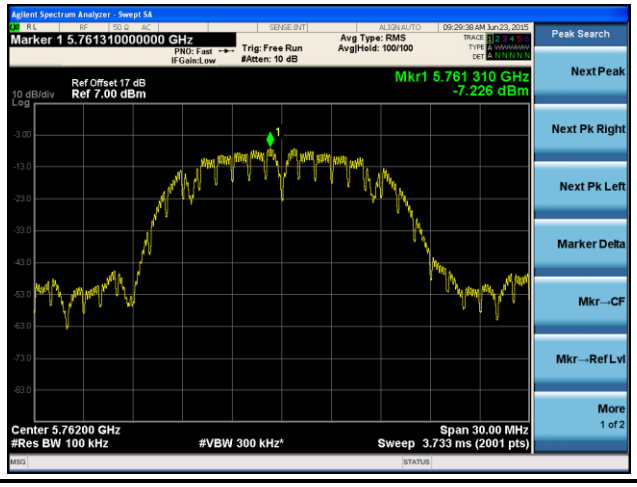
Channel 03 (5240MHz)



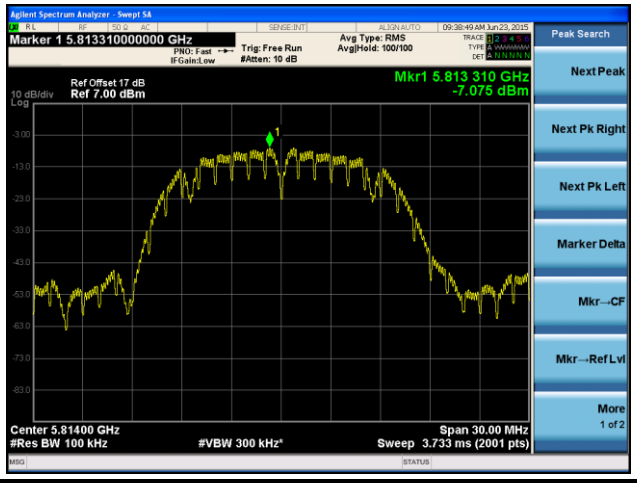
Channel 04 (5736MHz)

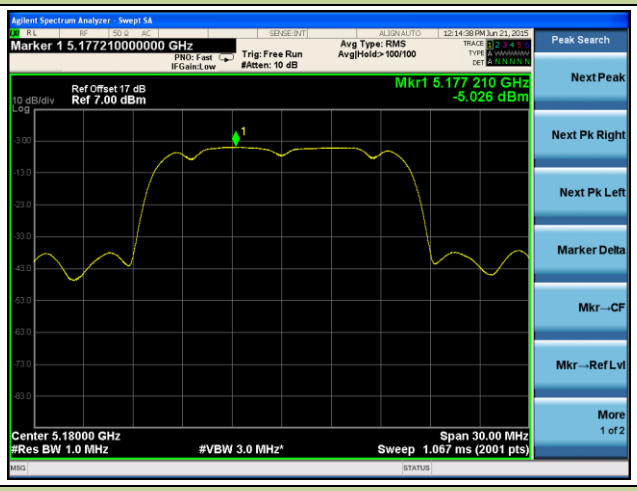
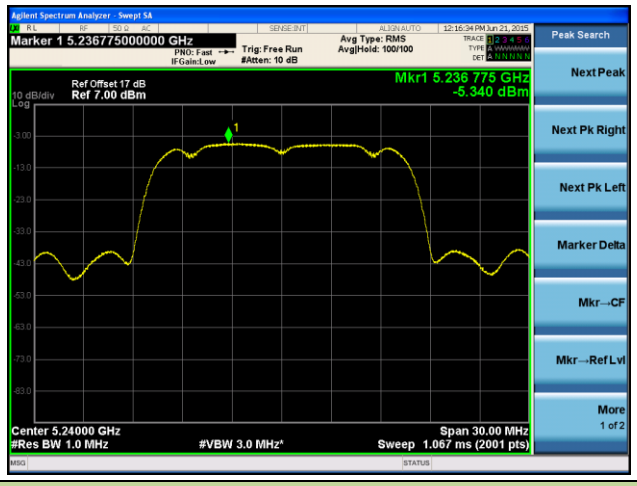
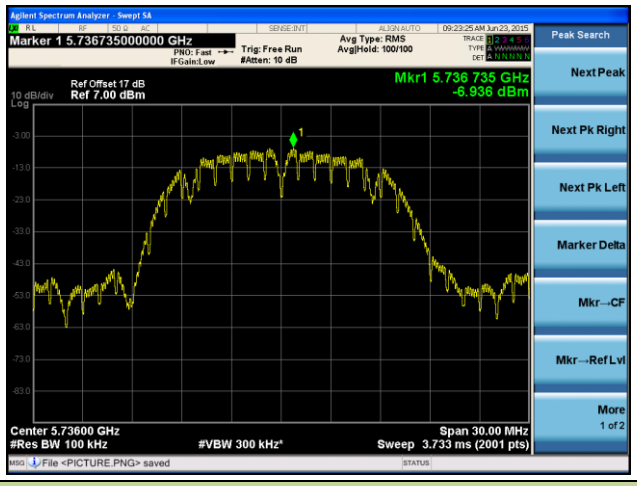
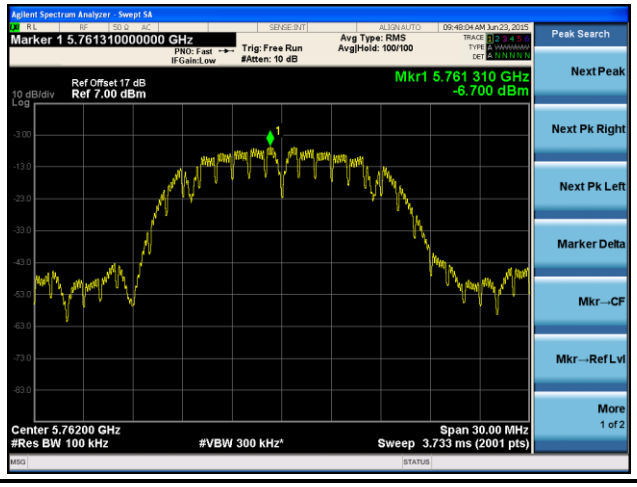
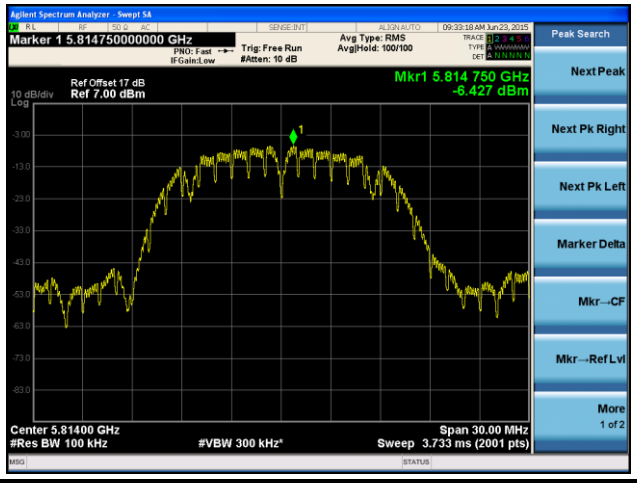


Channel 05 (5762MHz)



Channel 06 (5814MHz)



Power Spectral Density - Ant B	
Channel 01 (5180MHz)	**Channel 02 (5210MHz)**
	
Channel 03 (5240MHz)	**Channel 04 (5736MHz)**
	
Channel 05 (5762MHz)	**Channel 06 (5814MHz)**
	

7.7. Frequency Stability Measurement

7.7.1. Test Limit

Manufactures of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

7.7.2. Test Procedure Used

Frequency Stability Under Temperature Variations:

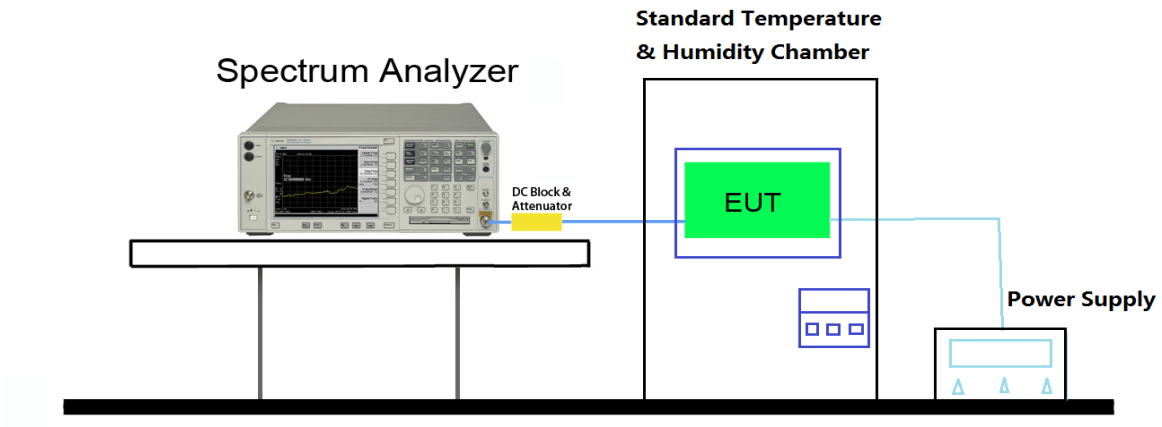
The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to highest. After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C decreased per stage until the lowest temperature reached.

Frequency Stability Under Voltage Variations:

Set chamber temperature to 20°C. Use a variable AC power supply / DC power source to power the EUT and set the voltage to rated voltage. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and recorded the frequency.

Reduce the input voltage to specify extreme voltage variation (±15%) and endpoint, record the maximum frequency change.

7.7.3. Test Setup



7.7.4. Test Result

Test Engineer	Milo Li	Temperature	-20 ~ 50°C
Test Time	06-20-2015	Relative Humidity	52%RH

Voltage (%)	Power (VAC)	Temp (°C)	Frequency Tolerance (ppm)			
			0 minutes	2 minutes	5 minutes	10 minutes
100%	120	- 20	4.09	4.12	4.20	4.19
		- 10	4.13	4.11	4.15	4.20
		0	4.11	4.07	4.05	4.10
		+ 10	4.21	4.11	4.15	4.13
		+ 20 (Ref)	4.31	4.31	4.35	4.30
		+ 30	4.32	4.35	4.29	4.31
		+ 40	4.33	4.31	4.34	4.25
		+ 50	4.28	4.31	4.35	4.29
115%	138	+ 20	4.30	4.31	4.33	4.30
85%	102	+ 20	4.35	4.37	4.23	4.31

Note: Frequency Tolerance (ppm) = {[Measured Frequency (Hz) – Declared Frequency (Hz)] / Declared Frequency (Hz)} *10^6.

7.8. Radiated Spurious Emission Measurement

7.8.1. Test Limit

All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47 CFR must not exceed the limits shown in Table per Section 15.209.

FCC Part 15 Subpart C Paragraph 15.209		
Frequency [MHz]	Field Strength [V/m]	Measured Distance [Meters]
0.009 – 0.490	2400/F (kHz)	300
0.490 – 1.705	24000/F (kHz)	30
1.705 - 30	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

7.8.2. Test Procedure Used

KDB 789033 D02v01r01 – Section G

7.8.3. Test Setting

Peak Measurements above 1GHz

1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Quasi-Peak Measurements below 1GHz

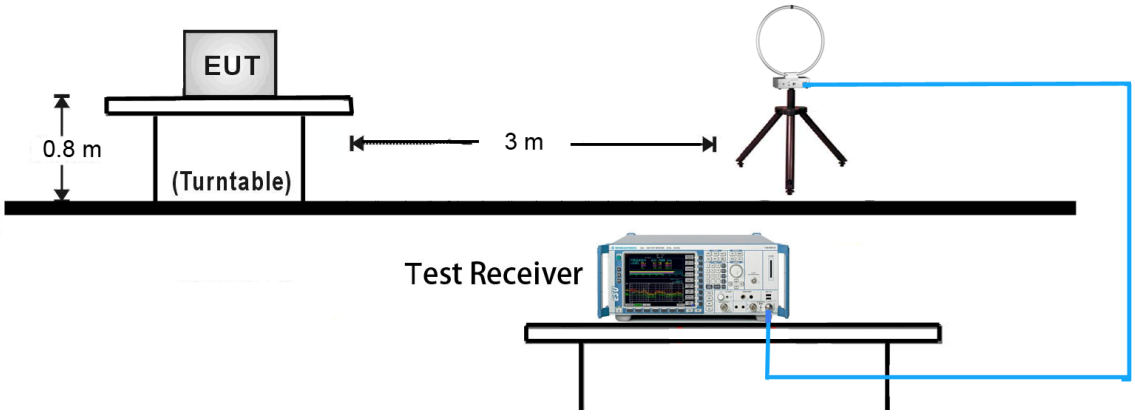
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. Span was set greater than 1MHz
3. RBW = 120 kHz
4. Detector = CISPR quasi-peak
5. Sweep time = auto couple
6. Trace was allowed to stabilize

Average Measurements above 1GHz (Method AD)

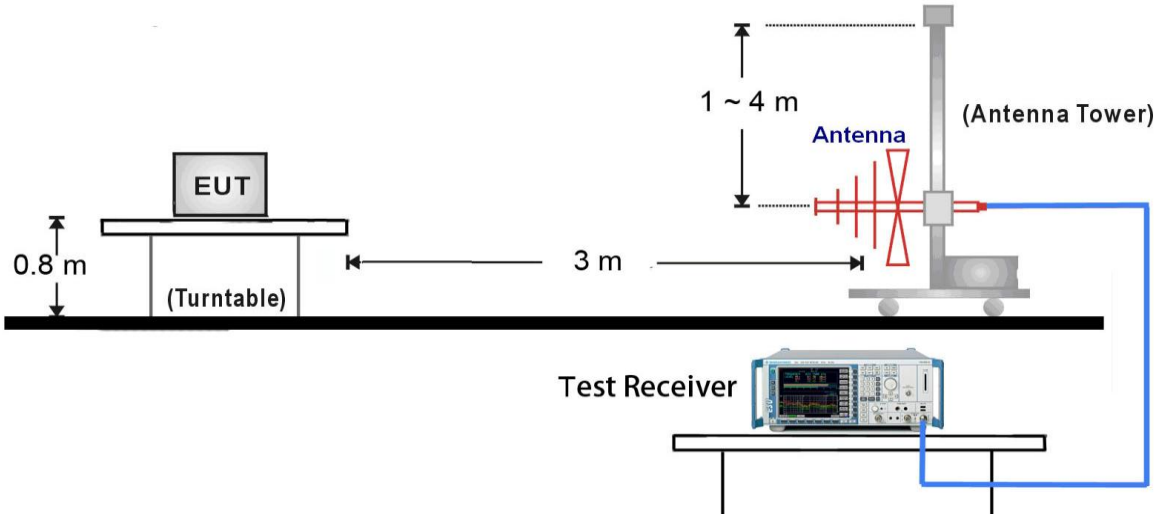
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be > 2 x span/RBW)
6. Sweep time = auto
7. Trace was averaged over at 100 sweeps

7.8.4. Test Setup

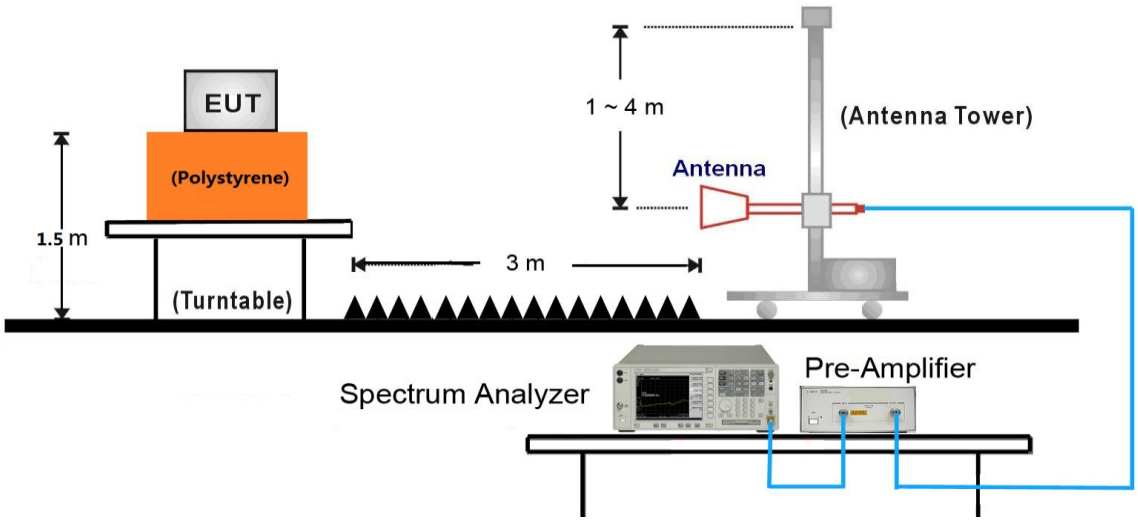
9kHz ~ 30MHz Test Setup:



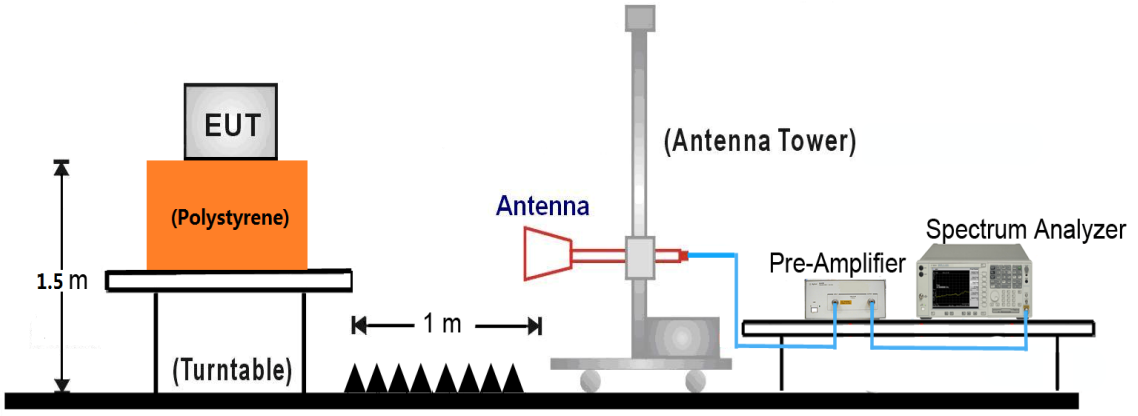
30MHz ~ 1GHz Test Setup:



1GHz ~18GHz Test Setup:



18GHz ~40GHz Test Setup:



7.8.5. Test Result

Test Mode:	Ant A	Test Site:	AC1
Test Channel:	01	Test Engineer:	Roy Cheng
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	7893.5	37.5	8.3	45.8	68.2	-22.4	Peak	Horizontal
*	8769.0	36.9	8.9	45.8	68.2	-22.4	Peak	Horizontal
	9491.5	36.9	10.6	47.5	74.0	-26.5	Peak	Horizontal
	11472.0	38.6	12.7	51.3	74.0	-22.7	Peak	Horizontal
*	7825.5	38.1	8.4	46.5	68.2	-21.7	Peak	Vertical
*	8718.0	36.2	9.0	45.2	68.2	-23.0	Peak	Vertical
	9423.5	36.5	10.6	47.1	74.0	-26.9	Peak	Vertical
	11472.0	37.7	12.7	50.4	74.0	-23.6	Peak	Vertical

Note 1: "*" is not in restricted band, its limit is -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a "conversion" factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Test Mode:	Ant B	Test Site:	AC1
Test Channel:	01	Test Engineer:	Roy Cheng
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	7834.0	37.1	8.4	45.5	68.2	-22.7	Peak	Horizontal
*	8624.5	36.8	8.8	45.6	68.2	-22.6	Peak	Horizontal
	9126.0	36.8	9.7	46.5	74.0	-27.5	Peak	Horizontal
	11472.0	36.6	12.7	49.3	74.0	-24.7	Peak	Horizontal
*	7987.0	36.2	8.7	44.9	68.2	-23.3	Peak	Vertical
*	8616.0	37.0	8.8	45.8	68.2	-22.4	Peak	Vertical
	9415.0	36.0	10.6	46.6	74.0	-27.4	Peak	Vertical
	11472.0	36.6	12.7	49.3	74.0	-24.7	Peak	Vertical

Note 1: “*” is not in restricted band, its limit is -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a “conversion” factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Test Mode:	Ant A	Test Site:	AC1
Test Channel:	02	Test Engineer:	Roy Cheng
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	7910.5	36.3	8.4	44.7	68.2	-23.5	Peak	Horizontal
*	8735.0	35.7	8.9	44.6	68.2	-23.6	Peak	Horizontal
	9415.0	36.0	10.6	46.6	74.0	-27.4	Peak	Horizontal
	11523.0	37.5	12.7	50.2	74.0	-23.8	Peak	Horizontal
*	7970.0	37.0	8.6	45.6	68.2	-22.6	Peak	Vertical
*	8786.0	37.1	8.9	46.0	68.2	-22.2	Peak	Vertical
	9406.5	35.6	10.6	46.2	74.0	-27.8	Peak	Vertical
	11514.5	37.0	12.8	49.8	74.0	-24.2	Peak	Vertical

Note 1: “*” is not in restricted band, its limit is -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a “conversion” factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Test Mode:	Ant B	Test Site:	AC1
Test Channel:	02	Test Engineer:	Roy Cheng
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	7885.0	37.2	8.3	45.5	68.2	-22.7	Peak	Horizontal
*	8760.5	37.7	9.0	46.7	68.2	-21.5	Peak	Horizontal
	9440.5	36.1	10.5	46.6	74.0	-27.4	Peak	Horizontal
	11523.0	36.8	12.7	49.5	74.0	-24.5	Peak	Horizontal
*	7953.0	37.4	8.6	46.0	68.2	-22.2	Peak	Vertical
*	8522.5	37.5	8.4	45.9	68.2	-22.3	Peak	Vertical
	9474.5	35.4	10.6	46.0	74.0	-28.0	Peak	Vertical
	11523.0	36.5	12.7	49.2	74.0	-24.8	Peak	Vertical

Note 1: “*” is not in restricted band, its limit is -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a “conversion” factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Test Mode:	Ant A	Test Site:	AC1
Test Channel:	03	Test Engineer:	Roy Cheng
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	7885.0	36.4	8.3	44.7	68.2	-23.5	Peak	Horizontal
*	8675.5	36.7	8.9	45.6	68.2	-22.6	Peak	Horizontal
	9457.5	36.2	10.5	46.7	74.0	-27.3	Peak	Horizontal
	11004.5	36.2	13.0	49.2	74.0	-24.8	Peak	Horizontal
*	7961.5	36.5	8.6	45.1	68.2	-23.1	Peak	Vertical
*	8718.0	36.6	9.0	45.6	68.2	-22.6	Peak	Vertical
	9134.5	36.5	9.7	46.2	74.0	-27.8	Peak	Vertical
	11472.0	36.6	12.7	49.3	74.0	-24.7	Peak	Vertical

Note 1: “*” is not in restricted band, its limit is -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a “conversion” factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Test Mode:	Ant B	Test Site:	AC1
Test Channel:	03	Test Engineer:	Roy Cheng
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	7961.5	36.9	8.6	45.5	68.2	-22.7	Peak	Horizontal
*	8811.5	35.7	9.0	44.7	68.2	-23.5	Peak	Horizontal
	9338.5	35.4	10.4	45.8	74.0	-28.2	Peak	Horizontal
	11055.5	35.8	12.9	48.7	74.0	-25.3	Peak	Horizontal
*	7927.5	37.0	8.5	45.5	68.2	-22.7	Peak	Vertical
*	8956.0	35.9	9.0	44.9	68.2	-23.3	Peak	Vertical
	9449.0	36.3	10.5	46.8	74.0	-27.2	Peak	Vertical
	11642.0	36.6	12.4	49.0	74.0	-25.0	Peak	Vertical

Note 1: “*” is not in restricted band, its limit is -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a “conversion” factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Test Mode:	Ant A	Test Site:	AC1
Test Channel:	04	Test Engineer:	Roy Cheng
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	6907.5	40.9	6.6	47.5	68.2	-20.7	Peak	Horizontal
*	7961.5	35.6	8.6	44.2	68.2	-24.0	Peak	Horizontal
	9168.5	35.9	9.9	45.8	74.0	-28.2	Peak	Horizontal
	15535.0	41.2	12.2	53.4	74.0	-20.6	Peak	Horizontal
*	6907.5	42.5	6.6	49.1	68.2	-19.1	Peak	Vertical
*	7987.0	35.2	8.7	43.9	68.2	-24.3	Peak	Vertical
	9415.0	34.6	10.6	45.2	74.0	-28.8	Peak	Vertical
	15535.0	41.3	12.2	53.5	74.0	-20.5	Peak	Vertical

Note 1: “*” is not in restricted band, its limit is -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a “conversion” factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)

Test Mode:	Ant B	Test Site:	AC1
Test Channel:	04	Test Engineer:	Roy Cheng
Remark:	1. Average measurement was not performed if peak level lower than average limit. 2. Other frequency was 20dB below limit line within 1-18GHz, there is not show in the report.		

Mark	Frequency (MHz)	Reading Level (dBμV)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	6907.5	40.2	6.6	46.8	68.2	-21.4	Peak	Horizontal
*	7859.5	37.1	8.4	45.5	68.2	-22.7	Peak	Horizontal
	9423.5	35.9	10.6	46.5	74.0	-27.5	Peak	Horizontal
	15543.5	40.7	12.2	52.9	74.0	-21.1	Peak	Horizontal
*	6907.5	40.2	6.6	46.8	68.2	-21.4	Peak	Vertical
*	7978.5	37.3	8.7	46.0	68.2	-22.2	Peak	Vertical
	9372.5	35.6	10.5	46.1	74.0	-27.9	Peak	Vertical
	15543.5	40.2	12.2	52.4	74.0	-21.6	Peak	Vertical

Note 1: “*” is not in restricted band, its limit is -27dBm/MHz. At a distance of 3 meters, the field strength limit in dBμV/m can be determined by adding a “conversion” factor of 95.2dB to the EIRP limit of -27dBm/MHz to obtain the limit for out of band spurious emissions.

Note 2: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m) – Pre_Amplifier Gain (dB)