MEASUREMENT REPORT

FCC PART 15.247

FCC ID:	QB8LT5GT
APPLICANT:	DragonWave Inc.
Application Type:	Certification
Product:	Microwave Outdoor Unit
Model No.:	Harmony Lite 5GHz
Brand Name:	DragonWave
FCC Classification:	Digital Transmission System (DTS)
FCC Rule Part(s):	Part 15.247
Test Procedure(s):	ANSI C63.10-2009, KDB 558074 D01v03r01 KDB 662911 D01v02r01, KDB 662911 D02v01
Test Date:	January 13 ~ 21, 2014

Reviewed By : Robin Wu
(Robin Wu)

Approved By : Marlin Chen
(Marlin Chen)

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 558074 D01v03r01. Test results reported herein relate only to the item(s) tested.

Revision History

Report No.	Version	Description	Issue Date
1405RSU03501	Rev. 01	Initial report	05-30-2014

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Description Page

§2.1033 General Information

Applicant:	DragonWave Inc.
Applicant Address:	600-411 Legget Drive, Kanata ON K2K 3C9, CANADA
Manufacturer:	DragonWave Inc.
Manufacturer Address:	600-411 Legget Drive, Kanata ON K2K 3C9, CANADA
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
FCC Rule Part(s):	Part 15.247
Model No.:	Harmony Lite 5GHz
FCC ID:	QB8LT5GT
Test Device Serial No.:	N/A ☐ Production ☒ Pre-Production ☐ Engineering
FCC Classification:	Digital Transmission System (DTS)
Date(s) of Test:	January 13 ~ 21, 2014
Test Report S/N:	1405RSU03501

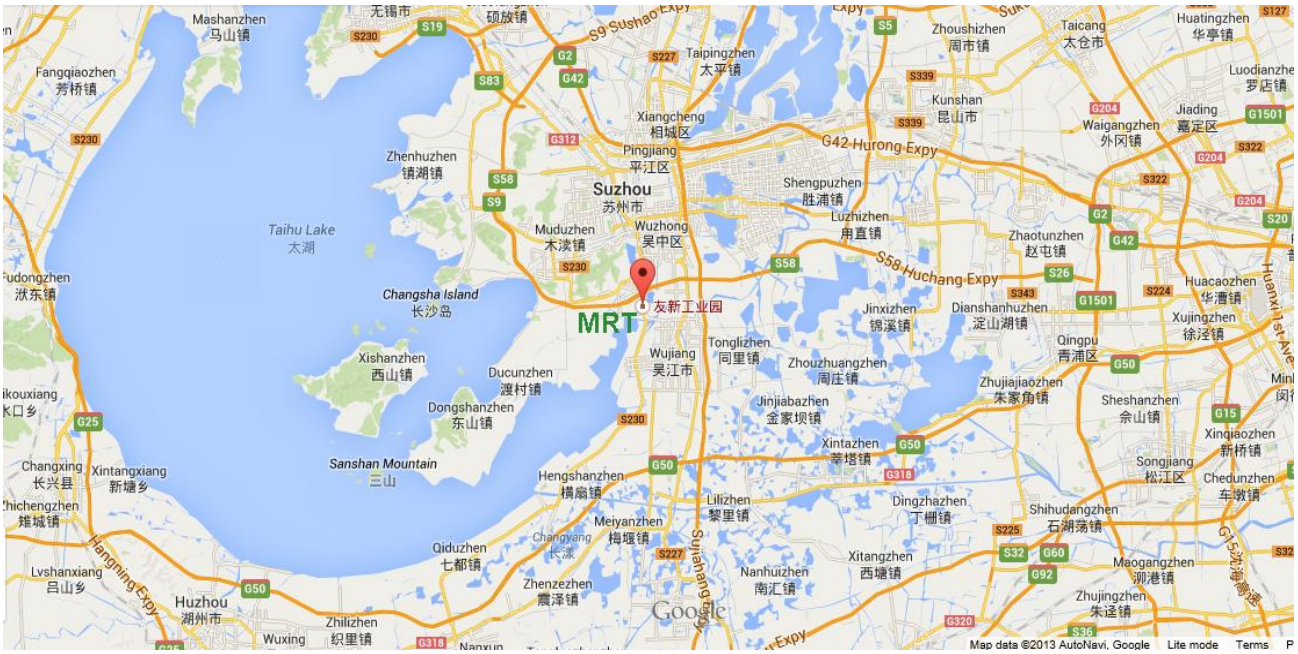
1. INTRODUCTION

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 C63.4-2009 on September 30, 2013.



2. PRODUCT INFORMATION

2.1. Equipment Description

Product Name	Microwave Outdoor Unit
Model No.	Harmony Lite 5GHz
Frequency Range	For 20MHz Channel Bandwidth: 5745~5825MHz For 40MHz Channel Bandwidth: 5755~5795MHz
Maximum Output Power	20MHz Channel Bandwidth: 29.48dBm 40MHz Channel Bandwidth: 29.39dBm
Type of Modulation	OFDM

2.2. Description of Available Antennas and Configurations

Antenna list:

Integrated Antenna	Manufacturer	Model	Freq. (GHz)	Type	Tx Paths	Correlated Gain (dBi)
190mm	MTI	MT-485053/SVH/A	5.8	Cross-polarized antennas	2	19.5
190mm	Rosenberger	S-Wave 51-17-19D			2	19.5
305mm	MTI	MT–465017/SVH/B			2	23.5
305mm	Rosenberger	S-Wave 55-10-22D-SMA			2	23.5

Note:

1. The Antenna (yellow marker) was used this test report.
2. The EUT supports transmit Beam Forming mode, transmit Beam Forming signals are correlated.
3. The transmitter output signals are correlated as defined in attachment KDB 662911 D01, which don't support a 90-degree phase-shifted replica for MIMO antennas. Cross-polarized antennas with NANT = 2. In the case of a transmitter with only two outputs driving a pair of antennas that are cross-polarized (e.g., vertical and horizontal or left-circular and right-circular), directional gain is the gain of an individual antenna. If the two antennas have different gains, the larger gain applies.

Six configurations description and code number:

Harmony Lite 5.x GHz Integrated	
Code	**Description**
T561LT5G190.00	5.x GHz Lite with P+E and integrated 190mm dual-pol flat antenna
T561LT5G305.00	5.x GHz Lite with P+E and integrated 305mm dual-pol flat antenna
T561LT5G190.01	5.x GHz Lite with PoE+ and integrated 190mm dual-pol flat antenna
T561LT5G305.01	5.x GHz Lite with PoE+ and integrated 305mm dual-pol flat antenna
Harmony Lite 5.x GHz External	
Code	**Description**
T561LT5GSAN.00	5.x GHz Lite with P+E and box cover for external antenna
T561LT5GSAN.01	5.x GHz Lite with PoE+ and box cover for external antenna

Note: The yellow markers were used to testing for Radiated and Conducted.

2.3. Frequency / Channel Opreation

Channels for 20MHz Channel Bandwidth

Channel	Frequency	Channel	Frequency	Channel	Frequency
149	5745 MHz	153	5765 MHz	157	5785 MHz
161	5805 MHz	165	5825 MHz	N/A	N/A

Channels for 40MHz Channel Bandwidth

Channel	Frequency	Channel	Frequency	Channel	Frequency
151	5755 MHz	159	5795 MHz	N/A	N/A

2.4. Data Rate Verification

N_{Tx}	Modulation type	Coding rate	Data Rate (Mbps)			
			20MHz Bandwidth		40MHz Bandwidth	
			800ns GI	400ns GI	800ns GI	400ns GI
2	BPSK	1/2	13.0	14.4	27.0	30.0
2	QPSK	1/2	26.0	28.9	54.0	60.0
2	QPSK	3/4	39.0	43.3	81.0	90.0
2	16-QAM	1/2	52.0	57.8	108.0	120.0
2	16-QAM	3/4	78.0	86.7	162.0	180.0
2	64-QAM	2/3	104.0	115.6	216.0	240.0
2	64-QAM	3/4	117.0	130.0	243.0	270.0
2	64-QAM	5/6	130.0	144.0	270.0	300.0

Note: Power output test was verified over all data rates of each mode shown as above, and then choose the maximum power output (yellow marker) for final test of each channel.

2.5. Device Capabilities

This device contains the following capabilities:

5GHz (DTS/NII)

Note: 5GHz (DTS/NII) operation is possible in 20MHz and 40MHz channel bandwidths. The maximum achievable duty cycles for all modes were determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak per the guidance of Section 6.0 b) of KDB 558074 D01v03r01. 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 cycles are as follows:

20MHz Bandwidth – 93.75%

40MHz Bandwidth – 91.40%

2.6. Test Configuration

The Microwave Outdoor Unit FCC ID: QB8LT5GT was tested per the guidance of KDB 558074 D01v03r01. ANSI C63.10-2009 was used to reference the appropriate EUT setup for radiated spurious emissions testing and AC line conducted testing.

2.7. Test Software

The test utility software used during testing was ART2 Version 2.28.6.

Power Parameter Value of the test software setting:

Channel Bandwidth	Test Frequency (MHz)	Power Setting (dBm)	Channel Bandwidth	Test Frequency (MHz)	Power Setting (dBm)
20MHz	5745	17	40MHz	5755	17
	5785	17		5795	17
	5825	17		--	--

Note: The device just supports 2x2 MIMO.

2.8. EMI Suppression Device(s)/Modifications

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

2.9. 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 trade name and 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 C63.10-2009), and the guidance provided in KDB 558074 D01v03r01 were used in the measurement of the **Microwave Outdoor Unit FCC ID: QB8LT5GT.**
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. If the EUT is a DC-powered device, power will be derived from the source power supply it normally will be powered from and this supply line(s) will be connected to 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 resolution, clock or data exchange speed, scrolling H pattern to the EUT and/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 is used for final measurements on the same test site.
Line conducted emissions test results are shown in Section 7.7.

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 1GH 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. An 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 was placed on top of the 0.8 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, mode of operation, 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 Beamwidth 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 Microwave Outdoor Unit is temporarily attached and it must be installed according to the professional installation manual.

Conclusion:
The **Microwave Outdoor Unit FCC ID: QB8LT5GT** unit complies with the requirement of §15.203.

5. TEST EQUIPMENT CALIBRATION DATA

AC Conducted Emissions Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cali. Due Date
EMI Test Receiver	R&S	ESR7	101209	2014/11/08
Two-Line V-Network	R&S	ENV216	101683	2014/11/08
Two-Line V-Network	R&S	ENV216	101684	2014/11/08
Temperature/ Meter Humidity	Anymetre	TH101B	SR2-01	2014/11/15

Radiated Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cal. Date
Spectrum Analyzer	Agilent	N9010A	MY51440164	2015/01/04
Preamplifier	MRT	AP01G18	1310002	2014/12/14
Loop Antenna	Schwarzbeck	FMZB1519	1519-041	2014/11/24
Bilog Period Antenna	Schwarzbeck	VULB9162	9162-047	2014/11/24
Horn Antenna	Schwarzbeck	BBHA9120D	9120D-1167	2014/11/24
Horn Antenna	Schwarzbeck	BBHA9170	9170-549	2014/12/11
Temperature/Humidity Meter	Anymetre	TH101B	AC1-01	2014/11/15

Conducted Test Equipment

Instrument	Manufacturer	Type No.	Serial No.	Cali. Due Date
Spectrum Analyzer	Agilent	N9010A	MY51440164	2015/01/04
Power Meter	Agilent	U2021XA	MY52450003	2014/12/14
Temperature/Humidity Meter	Anymetre	TH101B	TR3-01	2014/11/15

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: ±3.5dB
Radiated Emission Measurement
Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)): Horizontal: 30MHz~300MHz: 4.07dB 300MHz~1GHz: 3.63 dB 1GHz~18GHz: 4.16 dB Vertical: 30MHz~300MHz: 4.18 dB 300MHz~1GHz: 3.60 dB 1GHz~18GHz: 4.76 dB

7. TEST RESULT

7.1. Summary

Company Name: **DragonWave Inc.**

FCC ID: **QB8LT5GT**

FCC Classification: **Digital Transmission System (DTS)**

Data Rate(s) Tested: **13.0/14.4Mbps ~ 130.0/144.0Mbps (20MHz BW);**
27.0/30.0Mbps ~ 270.0/300.0Mbps (40MHz BW);

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Test Result	Reference
15.247(a)(2)	6dB Bandwidth	≥ 500kHz	Conducted	Pass	Section 7.2
15.247(b)(3)	Output Power	≤ 1Watt		Pass	Section 7.3
15.247(e)	Power Spectral Density	≤ 8dBm / 3kHz Band		Pass	Section 7.4
15.247(d)	Band Edge / Out-of-Band Emissions	≥ 20dBc(Peak)		Pass	Section 7.5
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	Emissions in restricted bands must meet the radiated limits detailed in 15.209	Radiated	Pass	Section 7.6
15.207	AC Conducted Emissions 150kHz - 30MHz	< FCC 15.207 limits	Line Conducted	N/A	Section 7.7

Notes:

1) All modes of operation and data rates were investigated. 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. 6dB Bandwidth Measurement *§15.247(a)(2)*

7.2.1. Test Limit

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

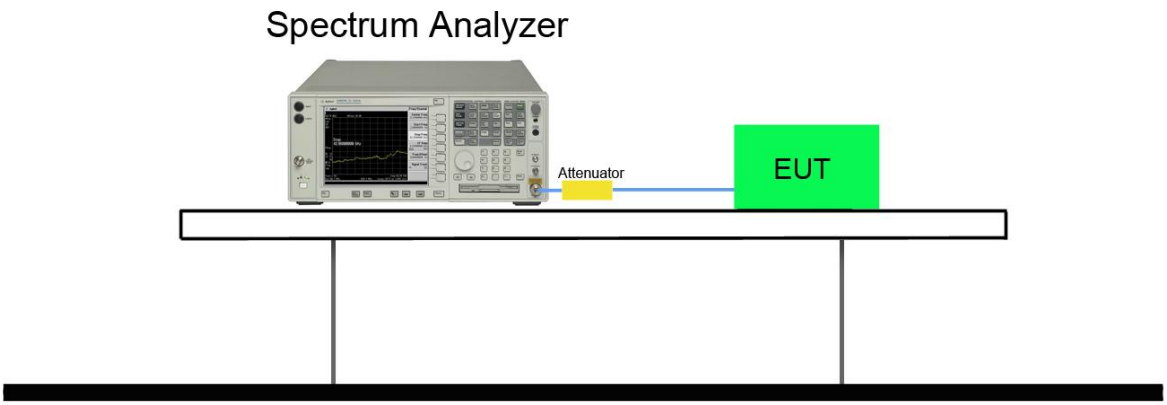
7.2.2. Test Procedure used

KDB 558074 D01v03r01 – Section 8.2 Option 2

7.2.3. Test Setting

1. The Spectrum's automatic bandwidth measurement capability was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. Set RBW = 100 kHz
3. VBW ≥ 3 × RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. Allow the trace was allowed to stabilize

7.2.4. Test Setup

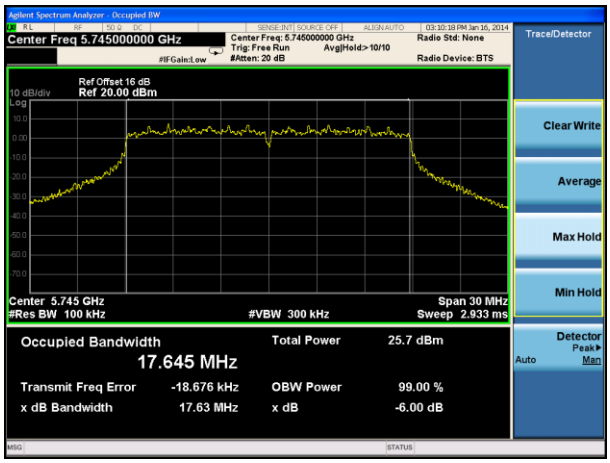


7.2.5. Test Result

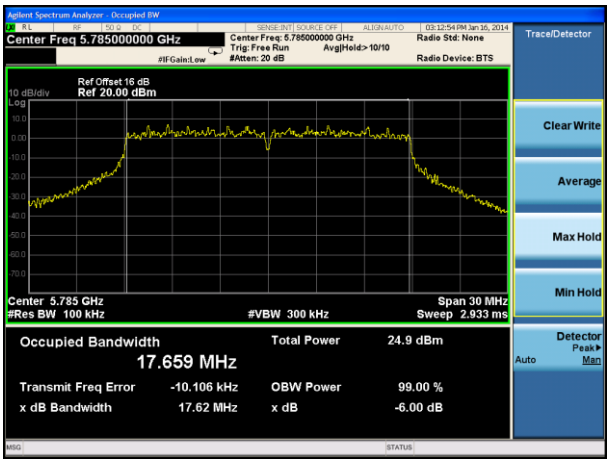
Channel Bandwidth	Data Rate (Mbps)	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	99% Bandwidth (MHz)	Result
Chain 0							
20MHz	13.0	149	5745	17.63	≥0.5	17.65	Pass
20MHz	13.0	157	5785	17.62	≥0.5	17.66	Pass
20MHz	13.0	165	5825	17.65	≥0.5	17.67	Pass
Chain 1							
20MHz	13.0	149	5745	17.58	≥0.5	17.64	Pass
20MHz	13.0	157	5785	17.57	≥0.5	17.61	Pass
20MHz	13.0	165	5825	17.62	≥0.5	17.63	Pass

20MHz Channel Bandwidth 6dB Bandwidth – Chain 0

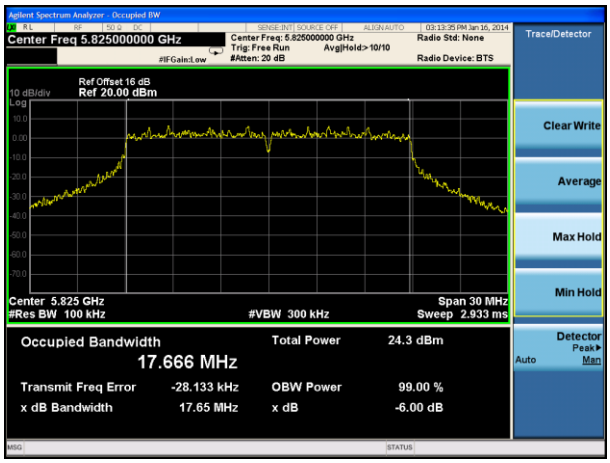
Channel 149 (5745MHz)

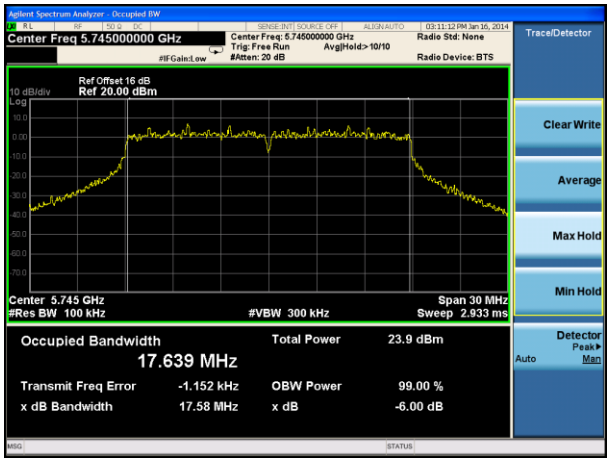
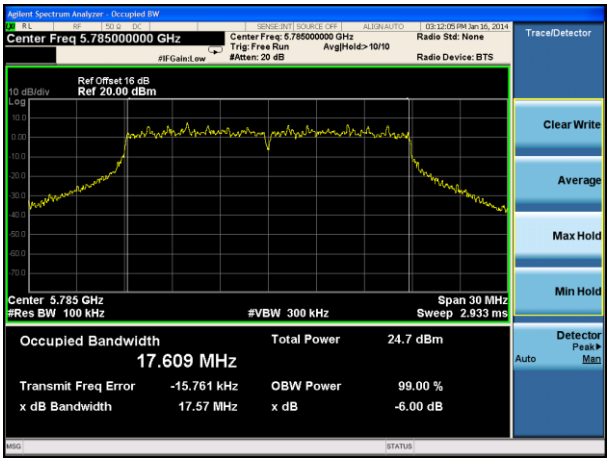
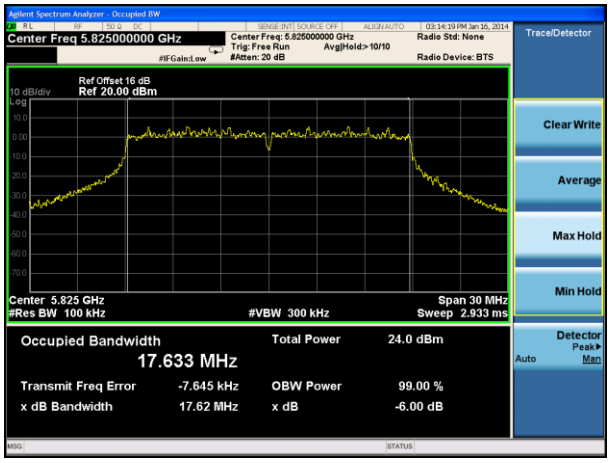


Channel 157 (5785MHz)



Channel 165 (5825MHz)

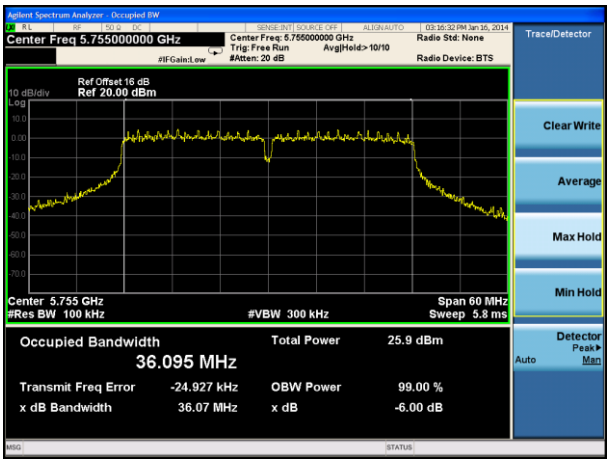


20MHz Channel Bandwidth 6dB Bandwidth – Chain 1	
Channel 149 (5745MHz)	**Channel 157 (5785MHz)**
	
Channel 165 (5825MHz)	
	

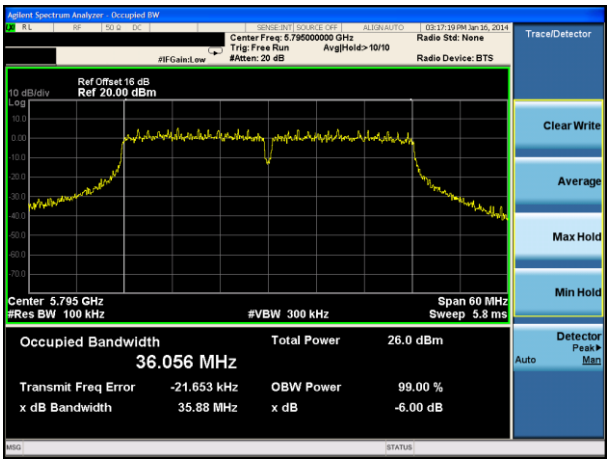
Channel Bandwidth	Data Rate (Mbps)	Channel No.	Frequency (MHz)	6dB Bandwidth (MHz)	Limit (MHz)	99% Bandwidth (MHz)	Result
Chain 0							
40MHz	27.0	151	5755	36.07	≥0.5	36.10	Pass
40MHz	27.0	159	5795	35.88	≥0.5	36.06	Pass
Chain 1							
40MHz	27.0	151	5755	35.70	≥0.5	36.00	Pass
40MHz	27.0	159	5795	35.84	≥0.5	36.07	Pass

40MHz Channel Bandwidth 6dB Bandwidth – Chain 0

Channel 151 (5755MHz)

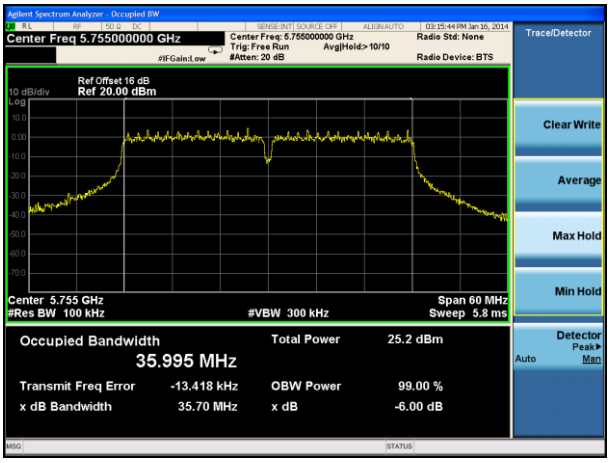


Channel 159 (5795MHz)

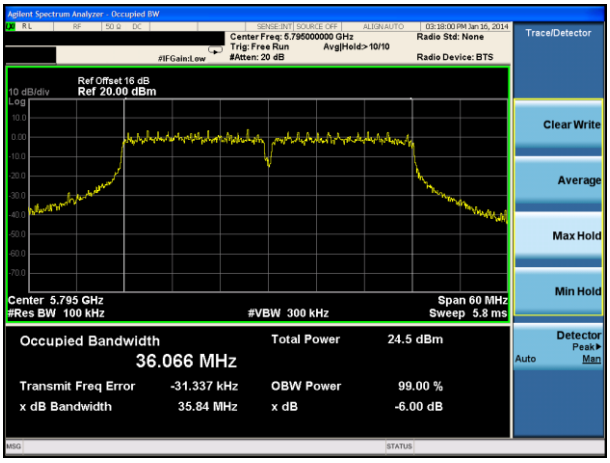


40MHz Channel Bandwidth 6dB Bandwidth – Chain 1

Channel 151 (5755MHz)



Channel 159 (5795MHz)



7.3. Output Power Measurement *§15.247(c)(1)*

7.3.1. Test Limit

The maximum out power shall be less 1 Watt (30dBm). As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

5.725-5.850GHz: Limit (dBm) = 30dBm

7.3.2. Test Procedure Used

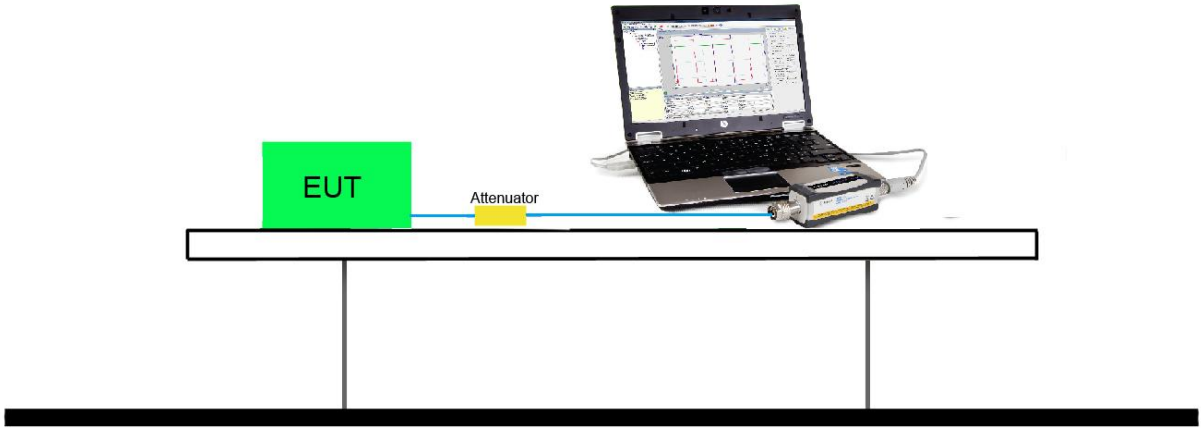
KDB 558074 D01v03r01 - Section 9.1.3 PKPM1 Peak Power Method (for signals with BW ≤ 50MHz)

7.3.3. Test Setting

Method PKPM1 (Peak Power Measurement of Signals with DTS BW ≤ 50MHz)

Peak power measurements were performed only when the EUT was transmitting at its maximum power control level using a broadband power meter with a pulse sensor. The pulse sensor employs a VBW = 50MHz so this method was only used for signals whose DTS bandwidth was less than or equal to 50MHz.

7.3.4. Test Setup



7.3.5. Test Result of Peak Output Power

Output power at various data rates for Chain 0:

Channel Bandwidth	Frequency (MHz)	Channel	Data Rate (Mbps)	Peak Power (dBm)
20MHz	5785	157	13.0	26.58
			78.0	26.17
			130.0	26.25
40MHz	5755	151	27.0	26.61
			162.0	26.51
			270.0	26.54

Channel Bandwidth	N_{Tx}	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Chain 0 Peak Power (dBm)	Chain 1 Peak Power (dBm)	Total Peak Power (dBm)	Limit (dBm)	Result
20MHz	2	13.0	149	5745	26.51	26.10	29.32	≤30.0	Pass
20MHz	2	13.0	157	5785	26.58	26.35	29.48	≤30.0	Pass
20MHz	2	13.0	165	5825	26.41	26.30	29.37	≤30.0	Pass
40MHz	2	27.0	151	5755	26.61	26.13	29.39	≤30.0	Pass
40MHz	2	27.0	159	5795	26.31	26.21	29.27	≤30.0	Pass

7.3.6. Test Result of Average Output Power (Reporting Only)

Channel Bandwidth	N_{Tx}	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Chain 0 Average Power (dBm)	Chain 1 Average Power (dBm)	Total Average Power (dBm)	Limit (dBm)	Result
20MHz	2	13.0	149	5745	16.42	15.88	19.17	≤30.0	Pass
20MHz	2	13.0	157	5785	16.41	16.20	19.32	≤30.0	Pass
20MHz	2	13.0	165	5825	16.10	15.78	18.95	≤30.0	Pass
40MHz	2	27.0	151	5755	16.20	15.98	19.10	≤30.0	Pass
40MHz	2	27.0	159	5795	16.32	15.86	19.11	≤30.0	Pass

7.4. Power Spectral Density Measurement *§15.247(e)*

7.4.1. Test Limit

The maximum permissible power spectral density is 8 dBm in any 3 kHz band.

Systems operating in the 5725-5850 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted output power.

Limit (dBm/3kHz) = 8dBm/3kHz

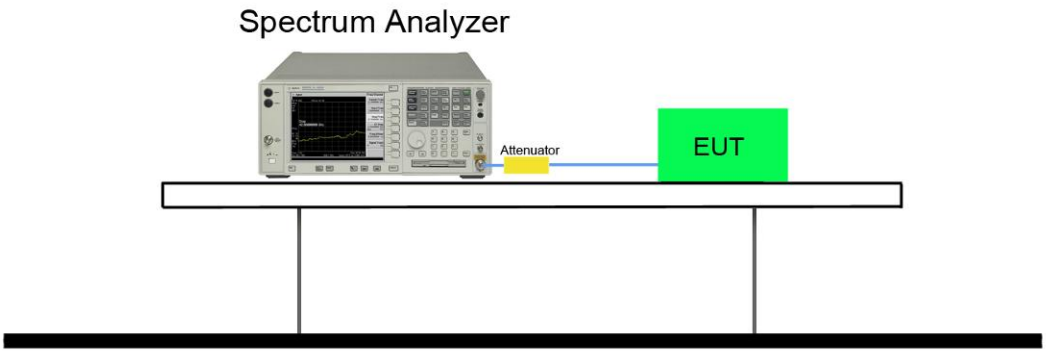
7.4.2. Test Procedure Used

KDB 558074 D01v03r01 - Section 10.2 Method PKPSD

7.4.3. Test Setting

1. Analyzer was set to the center frequency of the DTS channel under investigation
2. Span = 1.5 times the DTS channel bandwidth
3. RBW = 3kHz~100kHz
4. VBW = 3×RBW
5. Detector = peak
6. Sweep time = auto couple
7. Trace mode = max hold
8. Trace was allowed to stabilize

7.4.4. Test Setup

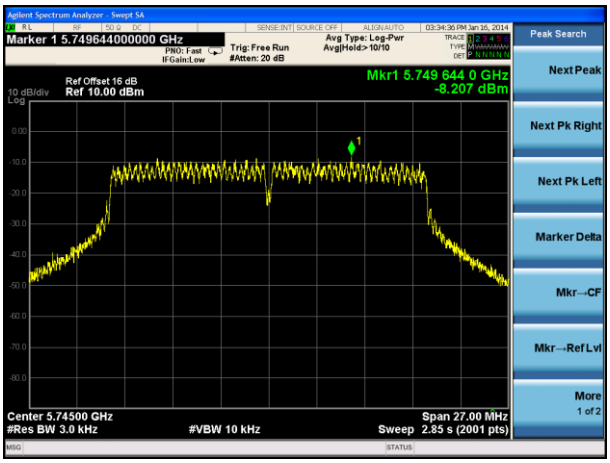


7.4.5. Test Result

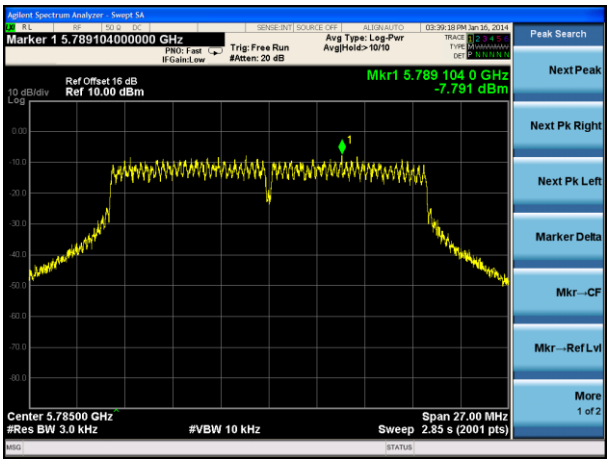
Channel Bandwidth	N_{Tx}	Data Rate (Mbps)	Channel No.	Freq. (MHz)	Chain 0 PSD (dBm)	Chain 1 PSD (dBm)	Total PSD (dBm)	Limit (dBm / 3kHz)	Result
20MHz	2	13.0	149	5745	-8.207	-8.108	-5.15	≤8.0	Pass
20MHz	2	13.0	157	5785	-7.791	-7.895	-4.83	≤8.0	Pass
20MHz	2	13.0	165	5825	-8.719	-8.919	-5.81	≤8.0	Pass
40MHz	2	27.0	151	5755	-10.298	-10.944	-7.60	≤8.0	Pass
40MHz	2	27.0	159	5755	-10.566	-11.065	-7.80	≤8.0	Pass

20MHz Channel Bandwidth PSD – Chain 0

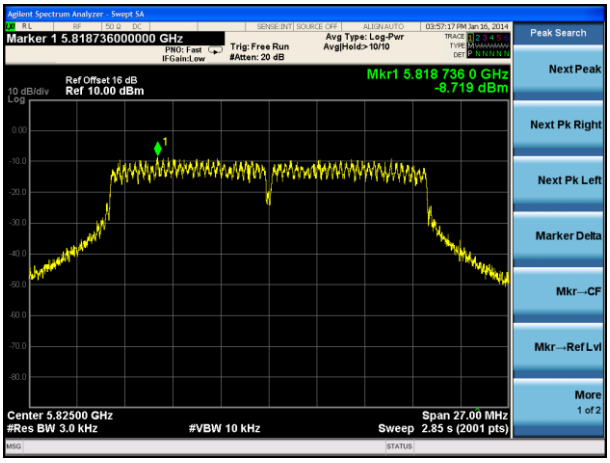
Channel 149 (5745MHz)

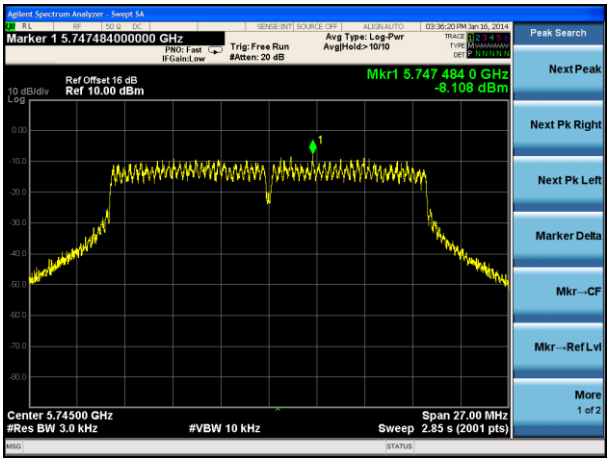
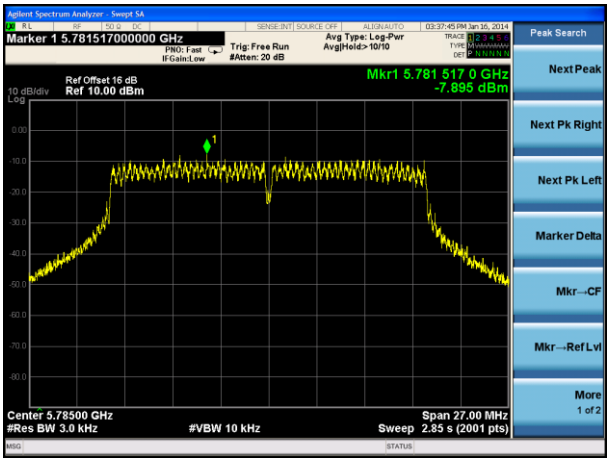
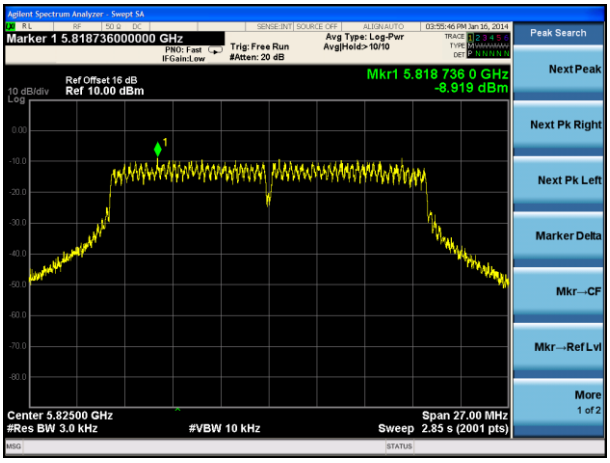
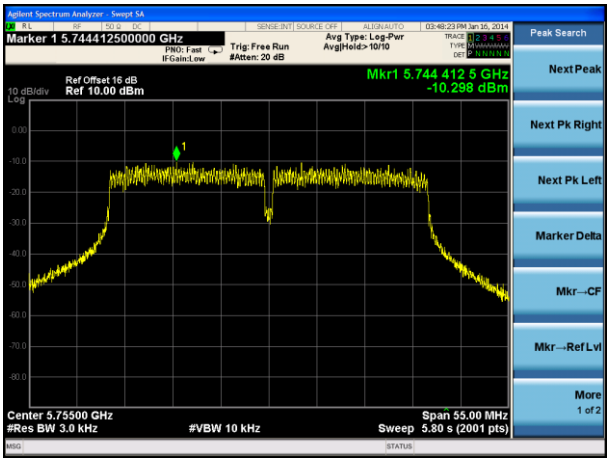
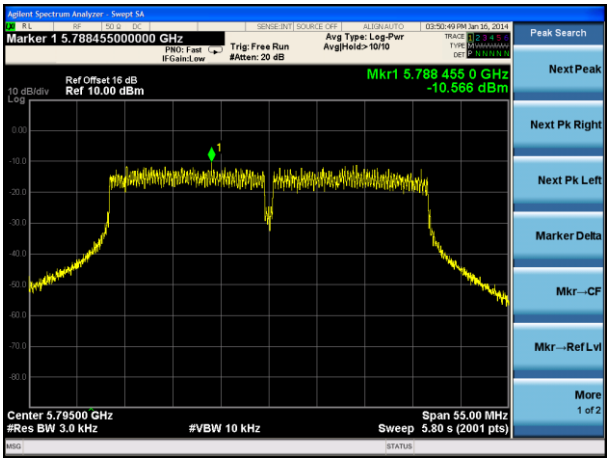


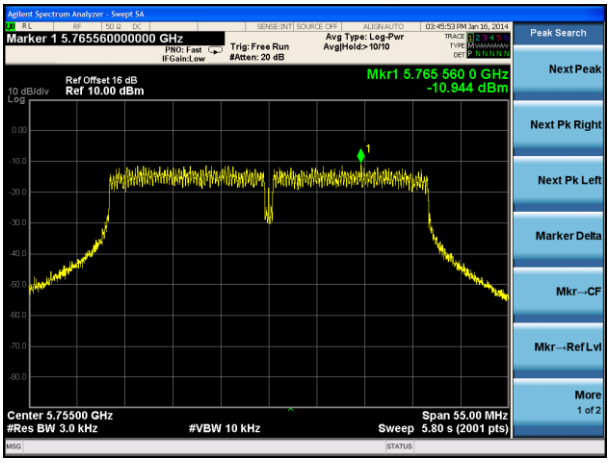
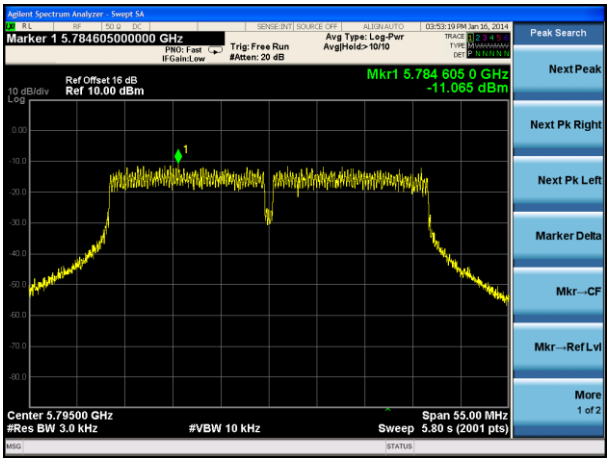
Channel 157 (5785MHz)



Channel 165 (5825MHz)



20MHz Channel Bandwidth PSD – Chain 1	
Channel 149 (5745MHz)	**Channel 157 (5785MHz)**
	
Channel 165 (5825MHz)	
	
40MHz Channel Bandwidth PSD – Chain 0	
Channel 151 (5755MHz)	**Channel 159 (5795MHz)**
	

40MHz Channel Bandwidth PSD – Chain 1	
Channel 151 (5755MHz)	**Channel 159 (5795MHz)**
	

7.5. Conducted Band Edge and Out-of-Band Emissions *§15.247(d)*

7.5.1. Test Limit

The limit for out-of-band spurious emissions at the band edge is 20dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100kHz bandwidth per the PSD procedure.

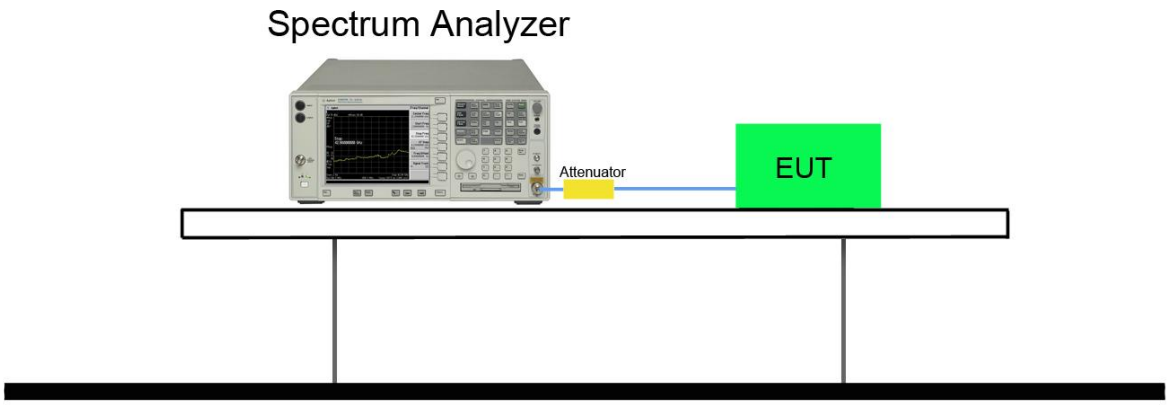
7.5.2. Test Procedure Used

KDB 558074 D01v03r01 – Section 11.3

7.5.3. Test Settitng

1. RBW = 100kHz
2. VBW = 300kHz
3. Detector = Peak
4. Trace mode = max hold
5. Sweep time = auto couple
6. The trace was allowed to stabilize

7.5.4. Test Setup



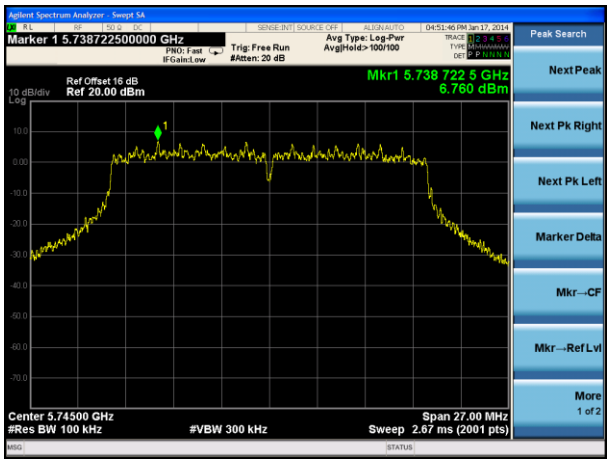
7.5.5. Test Result

Channel Bandwidth	N_{Tx}	Data Rate	Channel No.	Frequency (MHz)	Limit	Result
20MHz	2	13.0	149	5745	20dBc	Pass
20MHz	2	13.0	157	5785	20dBc	Pass
20MHz	2	13.0	165	5825	20dBc	Pass

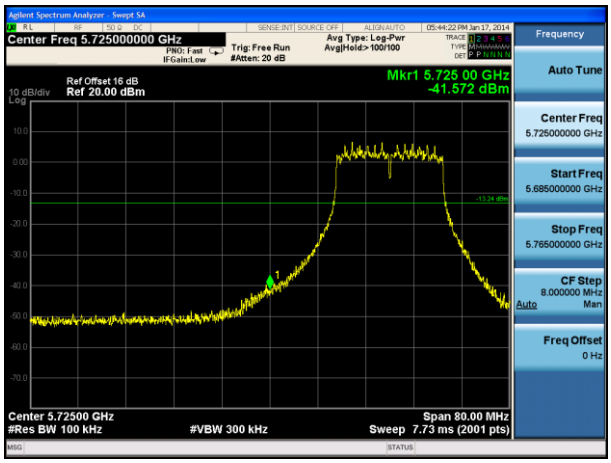
20MHz Channel Bandwidth Out-of-Band Emissions – Chain 0

Channel 149 (5745MHz)

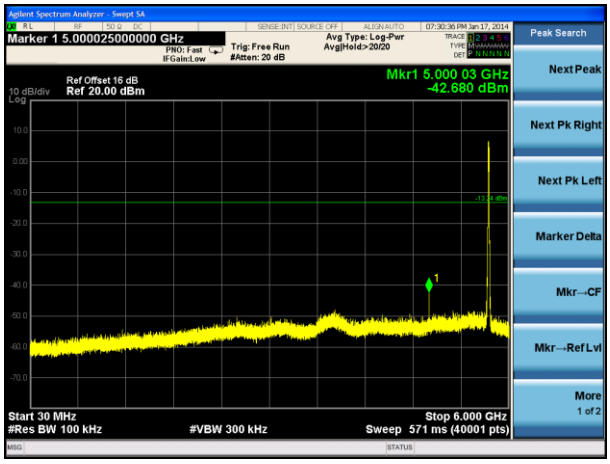
100kHz PSD reference Level



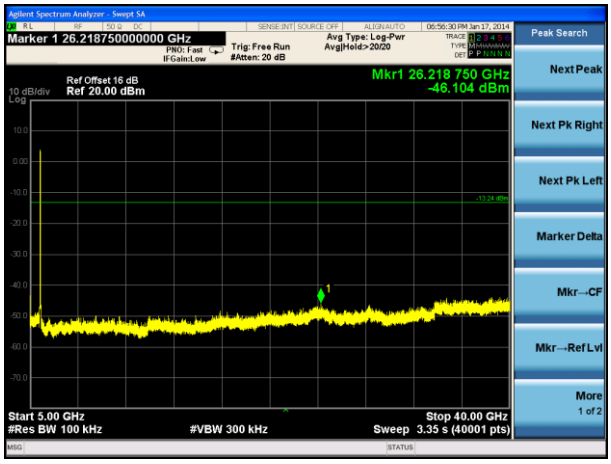
Low Band Edge

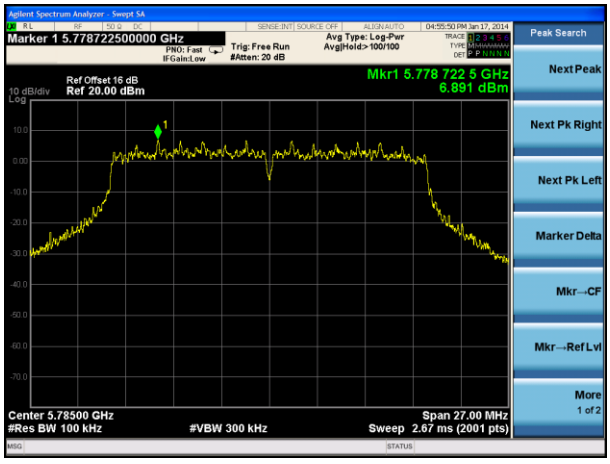
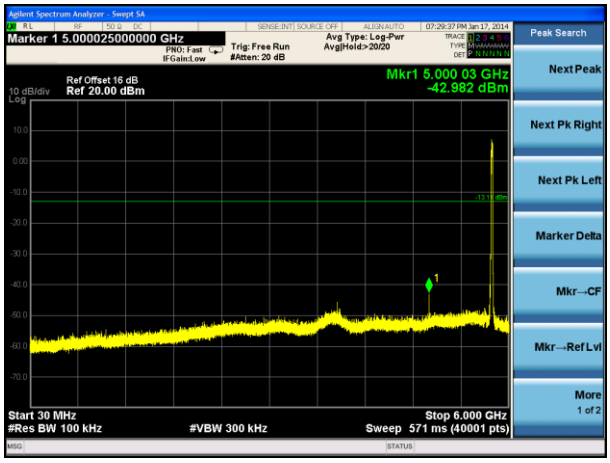
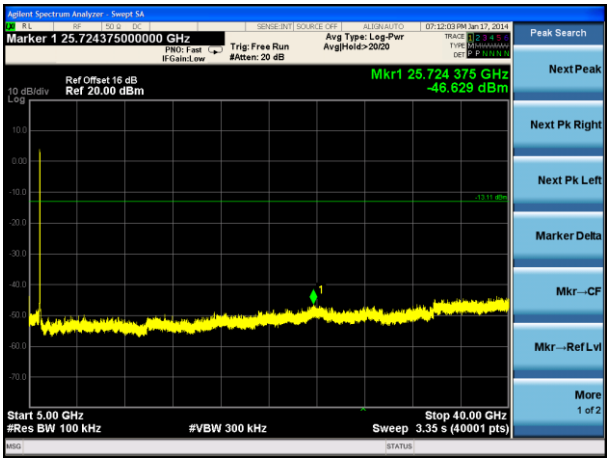
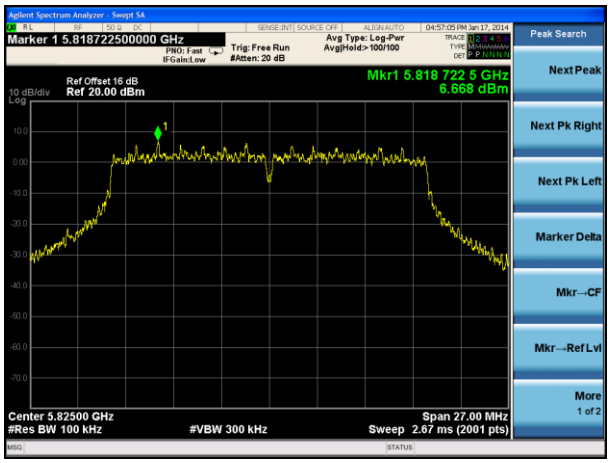
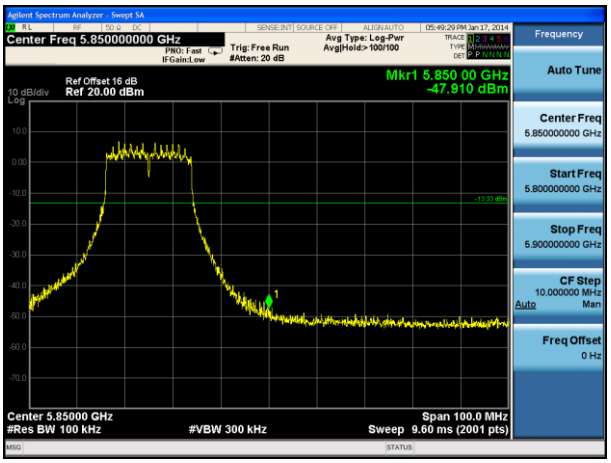


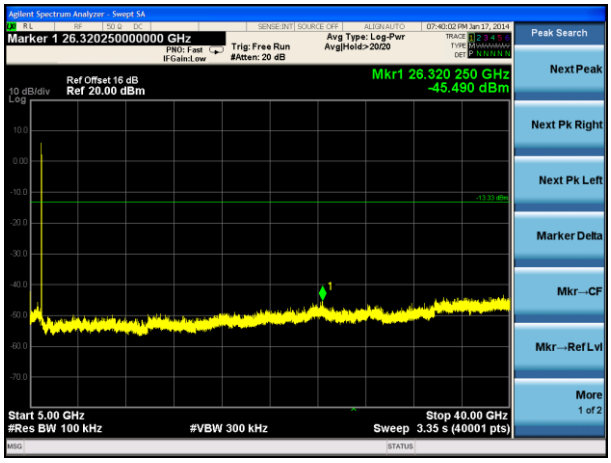
Spurious Emission 30MHz ~ 6GHz

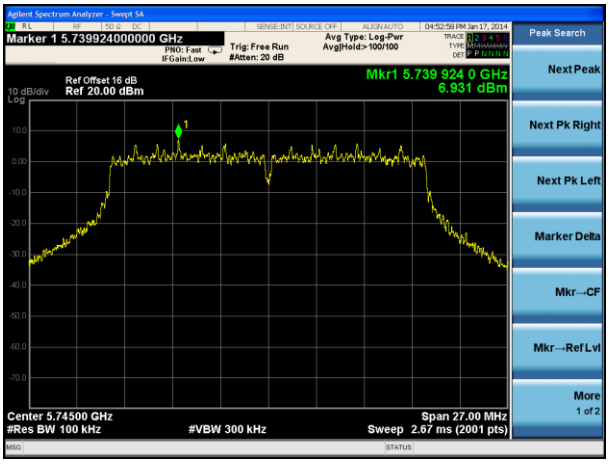
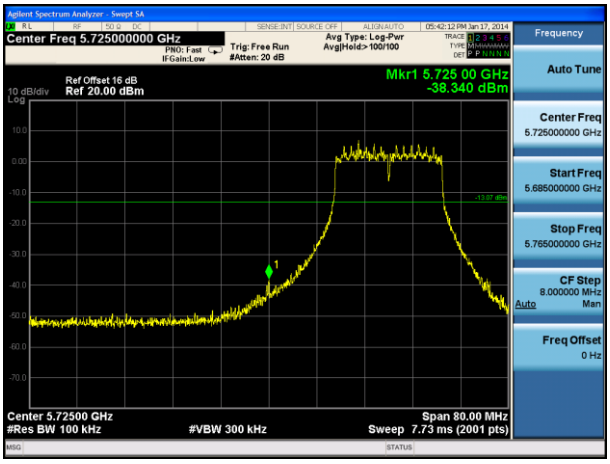
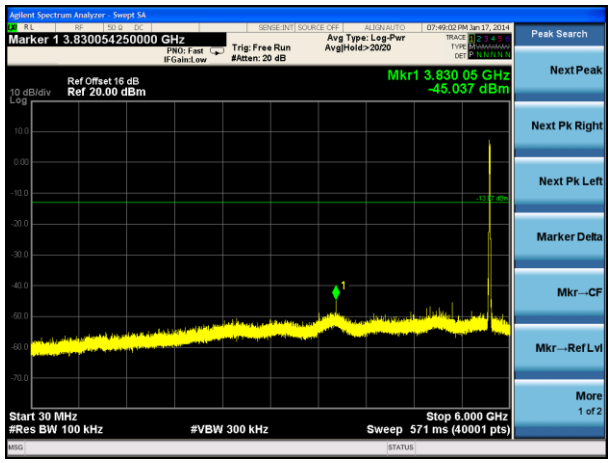
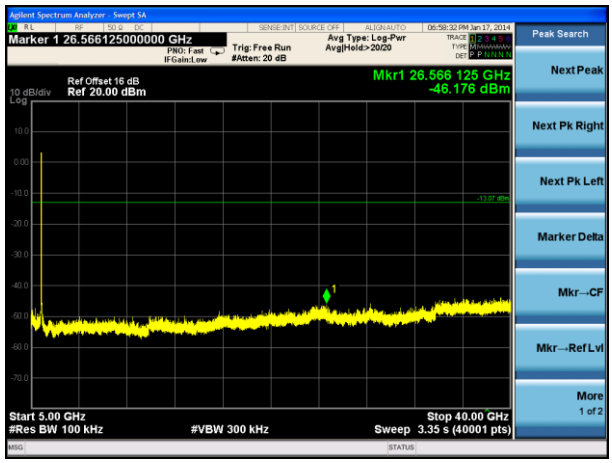


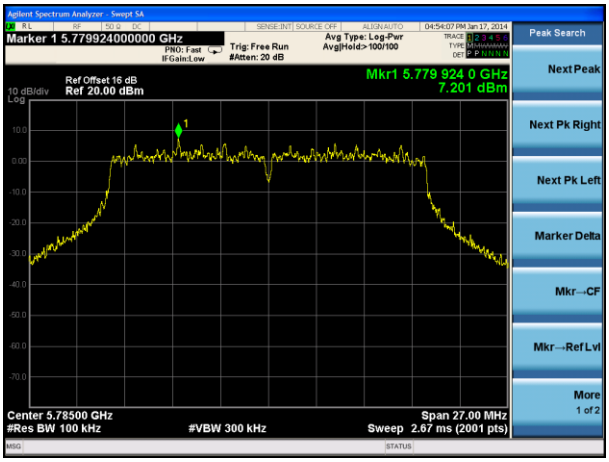
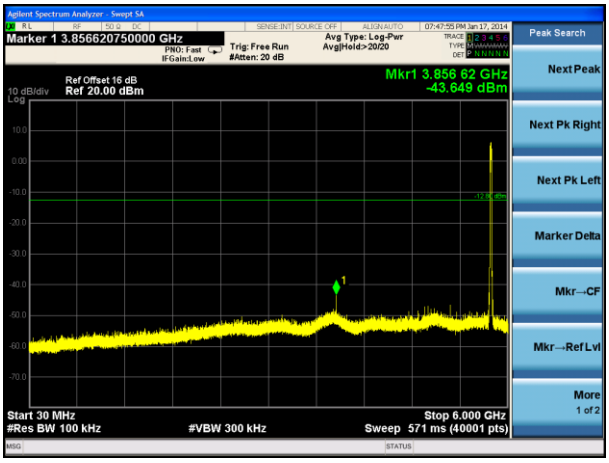
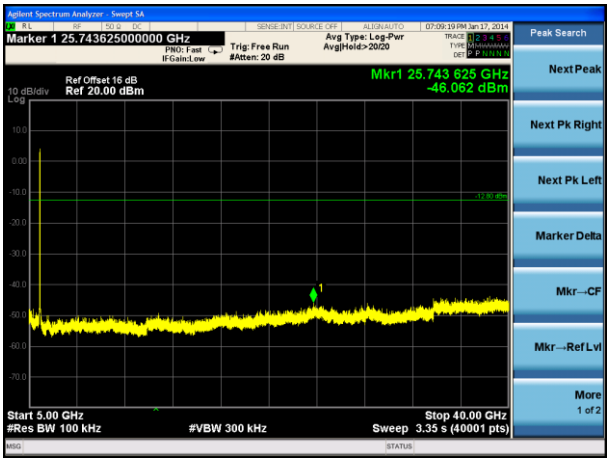
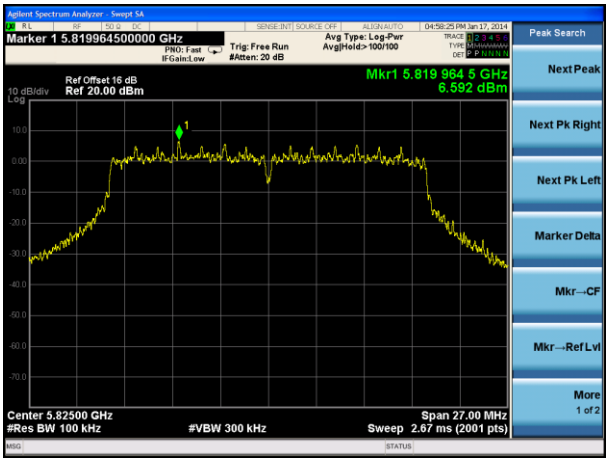
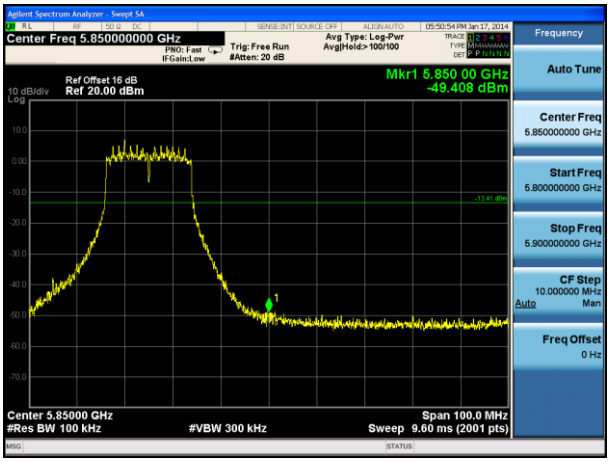
Spurious Emission 5GHz ~ 40GHz

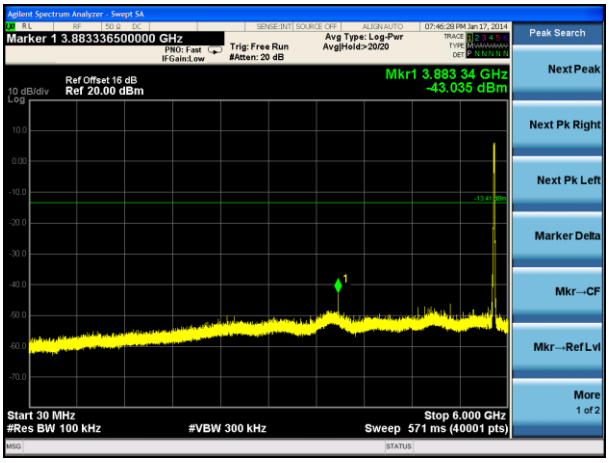
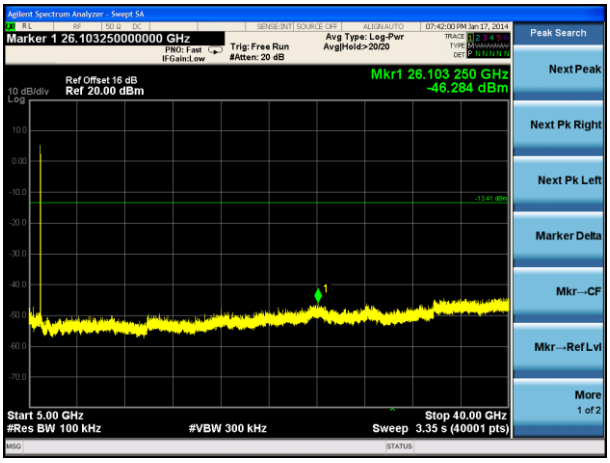


Channel 157 (5785MHz)	
100kHz PSD reference Level	
	
Spurious Emission 30MHz ~ 6GHz	**Spurious Emission 5GHz ~ 40GHz**
	
Channel 165 (5825MHz)	
100kHz PSD reference Level	**High Band Edge**
	

Spurious Emission 30MHz ~ 6GHz	Spurious Emission 5GHz ~ 40GHz
	

20MHz Channel Bandwidth Out-of-Band Emissions – Chain 1	
Channel 149 (5745MHz)	
100kHz PSD reference Level	Low Band Edge
	
Spurious Emission 30MHz ~ 6GHz	Spurious Emission 5GHz ~ 40GHz
	

Channel 157 (5785MHz)	
100kHz PSD reference Level	
	
Spurious Emission 30MHz ~ 6GHz	**Spurious Emission 5GHz ~ 40GHz**
	
Channel 165 (5825MHz)	
100kHz PSD reference Level	**High Band Edge**
	

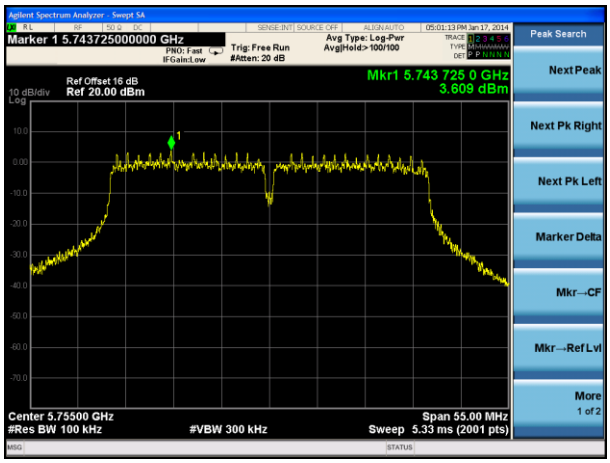
Spurious Emission 30MHz ~ 6GHz	Spurious Emission 5GHz ~ 40GHz
	

Channel Bandwidth	N_{Tx}	Data Rate	Channel No.	Frequency (MHz)	Limit	Result
40MHz	2	27.0	151	5755	20dBc	Pass
40MHz	2	27.0	159	5795	20dBc	Pass

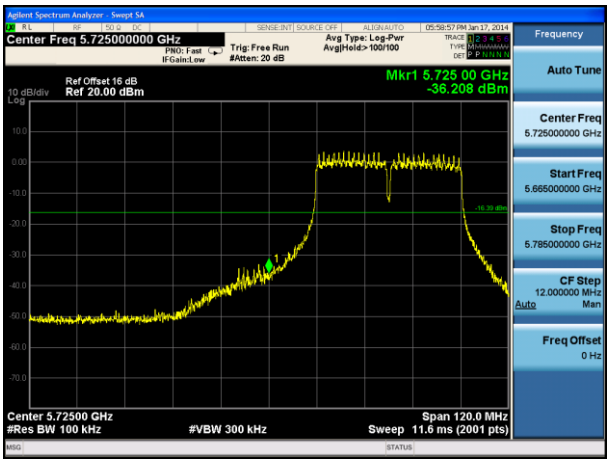
40MHz Channel Bandwidth Out-of-Band Emissions – Chain 0

Channel 51 (5755MHz)

100kHz PSD reference Level

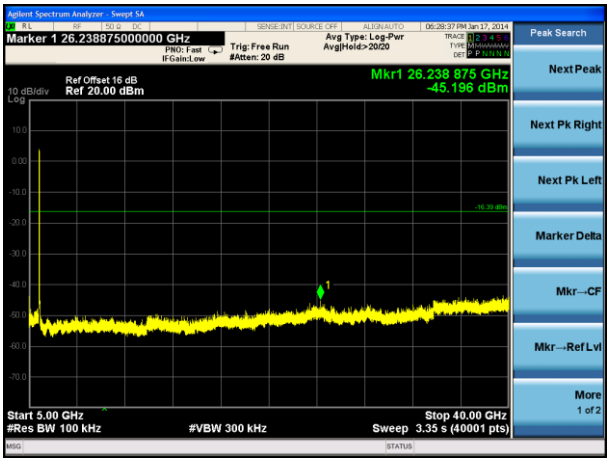


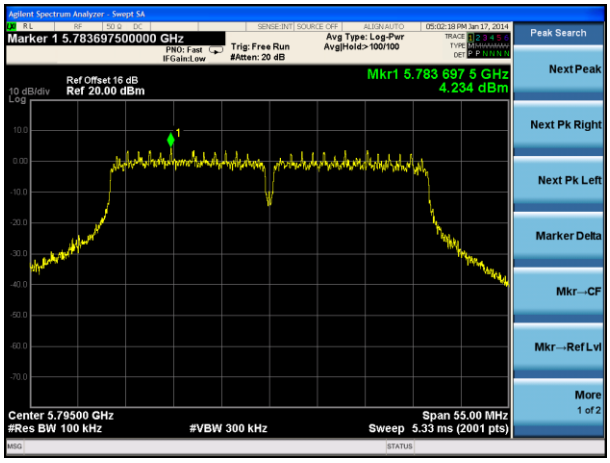
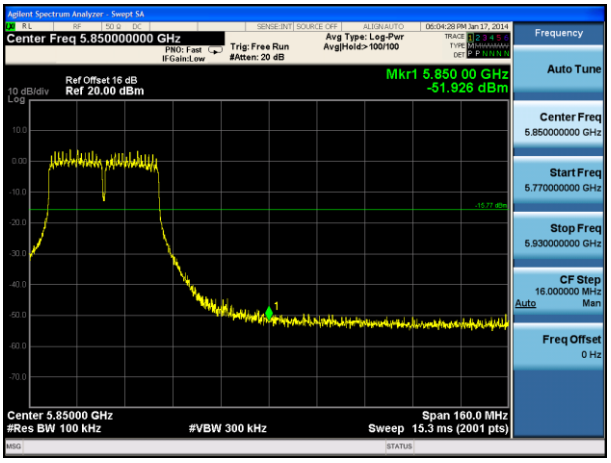
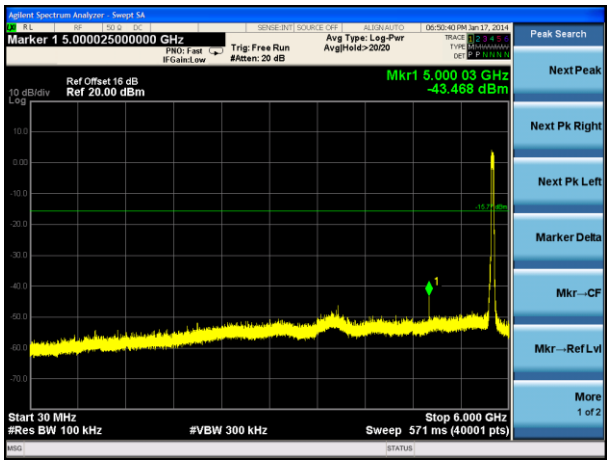
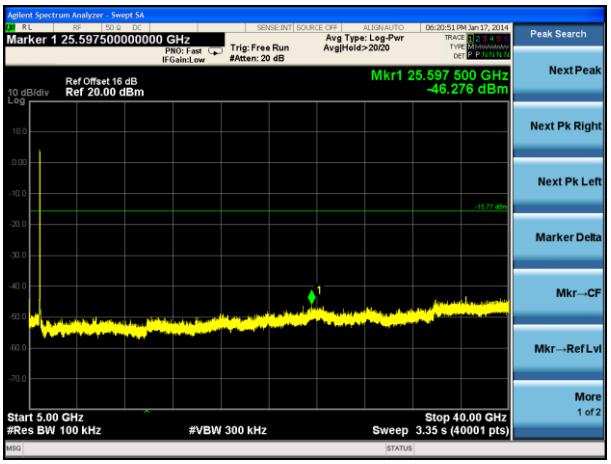
Low Band Edge

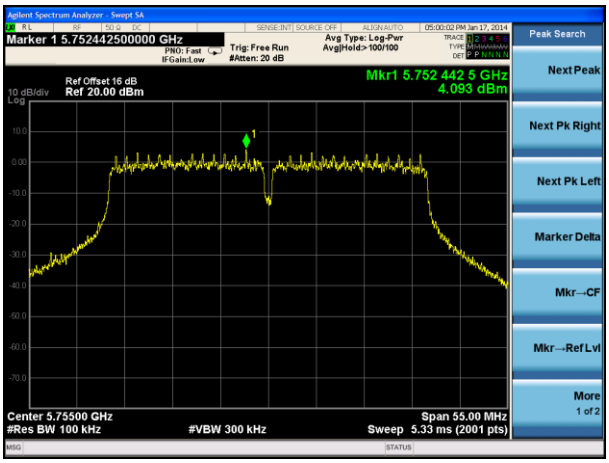
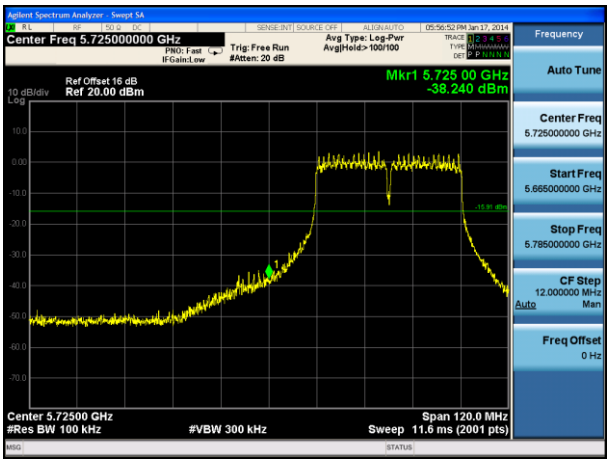
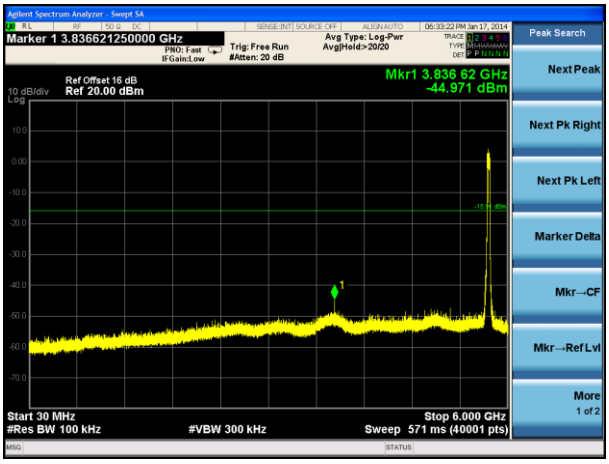
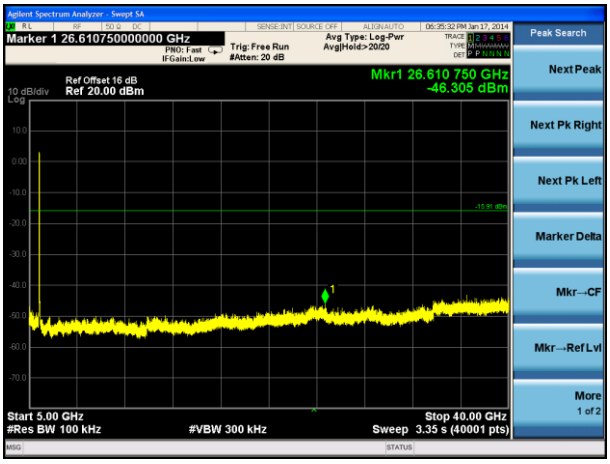
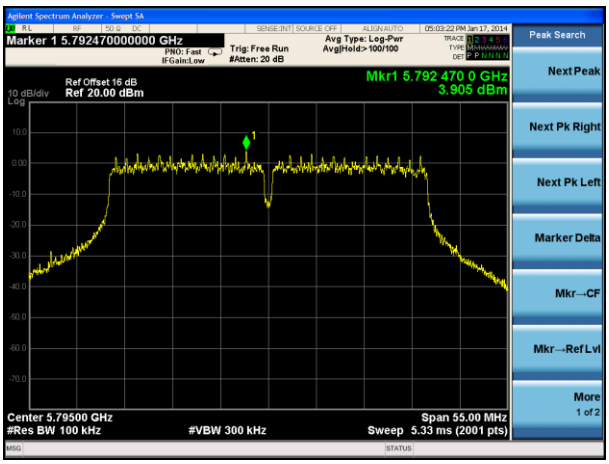
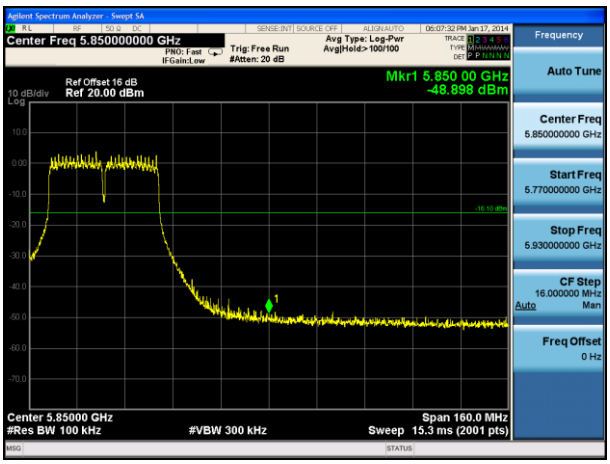


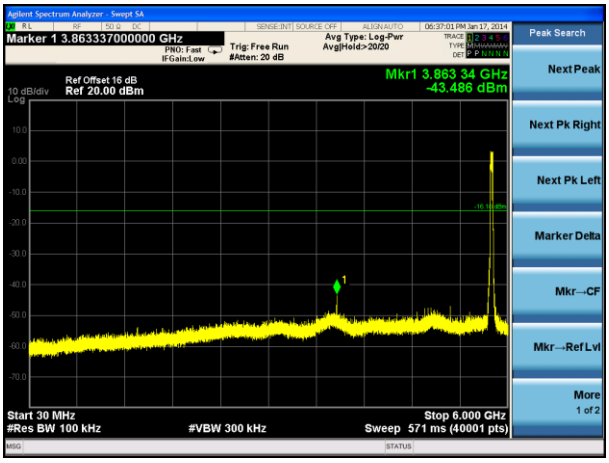
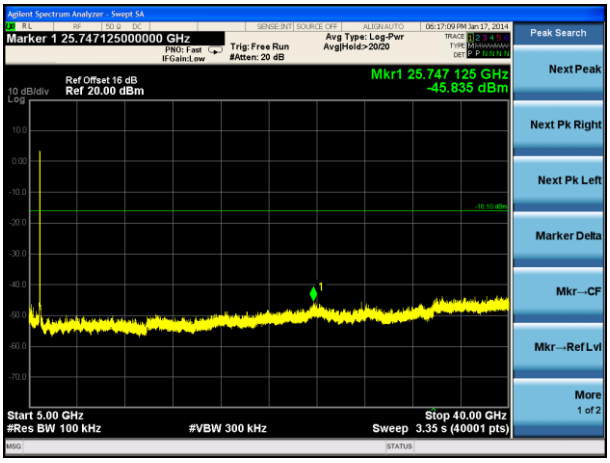
Spurious Emission 30MHz ~ 6GHz

Spurious Emission 5GHz ~ 40GHz



Channel 159 (5795MHz)	
100kHz PSD reference Level	**High Band Edge**
	
Spurious Emission 30MHz ~ 6GHz	**Spurious Emission 5GHz ~ 40GHz**
	

40MHz Channel Bandwidth Out-of-Band Emissions – Chain 1	
Channel 151 (5755MHz)	
100kHz PSD reference Level	Low Band Edge
	
Spurious Emission 30MHz ~ 6GHz	Spurious Emission 5GHz ~ 40GHz
	
Channel 159 (5795MHz)	
100kHz PSD reference Level	High Band Edge
	

Spurious Emission 30MHz ~ 6GHz	Spurious Emission 5GHz ~ 40GHz
	

7.6. Radiated Band Edge and Spurious Emission Measurement ***§15.247(d) / §15.205 & §15.209***

7.6.1. 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

7.6.2. Test Procedure Used

KDB 558074 D01v03r01 – Section 12.2.3 (quasi-peak measurements)

KDB 558074 D01v03r01 – Section 12.2.4 (peak power measurements)

KDB 558074 D01v03r01 – Section 12.2.5 (average power measurements)

7.6.3. Test Setting

Peak Field Strength Measurements per Section 12.2.4 of KDB 558074 D01v03r01

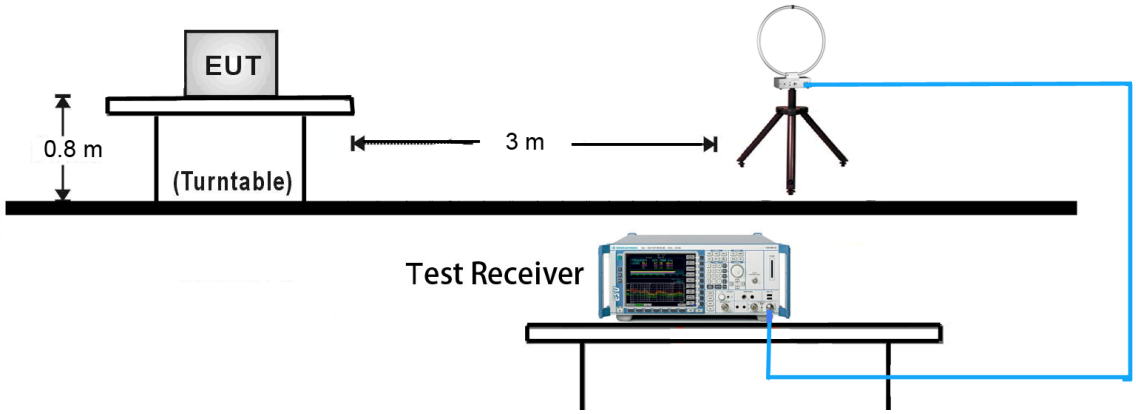
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

Average Field Strength Measurements per Section 12.2.5.1 of KDB 558074 D01v03r01

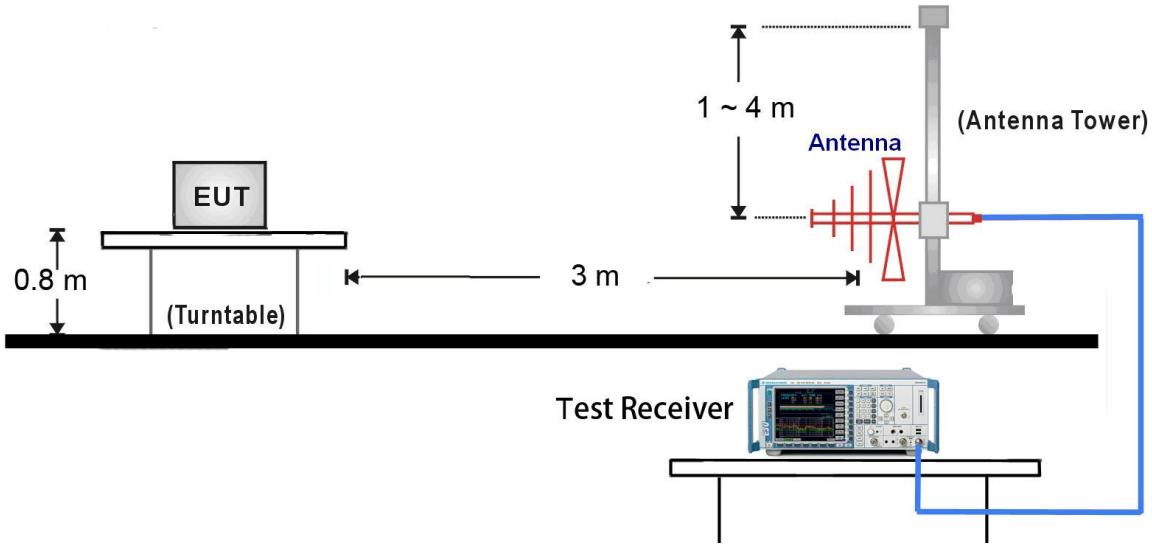
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = power average (RMS)
5. Number of measurement points = 1001 (Number of points must be > 2 x span/RBW)
6. Sweep time = auto
7. Trace (RMS) averaging was performed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

7.6.4. Test Setup

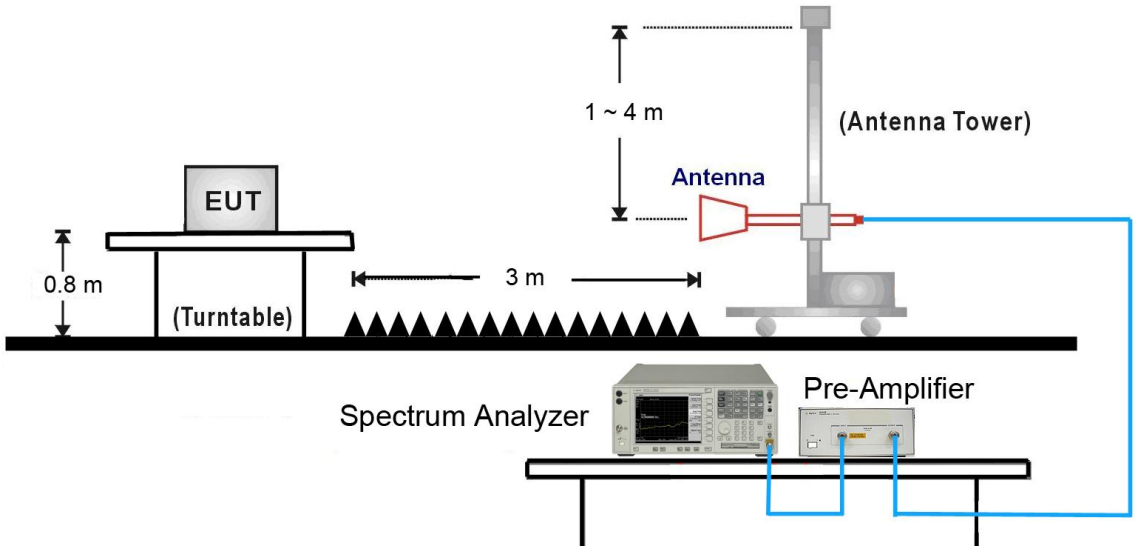
9kHz ~ 30MHz Test Setup:



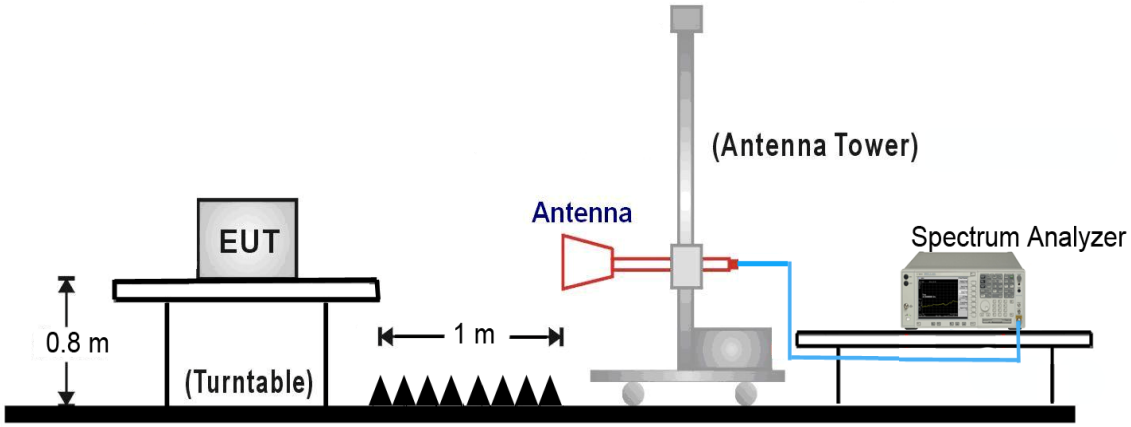
30MHz ~ 1GHz Test Setup:



1GHz ~18GHz Test Setup:



18GHz ~40GHz Test Setup:



7.6.5. Test Result of Radiated Spurious Emission

Channel Bandwidth:	20MHz	Test Site:	AC1
Test Channel:	149	Test Engineer:	Roy Cheng
Remark:	1. There is the ambient noise within frequency range 9kHz~30MHz and 18GHz~40GHz, the permissible value is not show in the report. 2. Average measurement was not performed if peak level lower than average limit.		

Mark	Frequency (MHz)	Reading Level (dBμV/m)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	2973.6	35.2	3.4	38.6	123.5	-84.9	Peak	Horizontal
*	3251.4	35.6	3.4	39.0	123.5	-84.5	Peak	Horizontal
	7263.9	36.0	13.9	49.9	74.0	-24.1	Peak	Horizontal
	9493.7	35.8	15.4	51.2	74.0	-22.8	Peak	Horizontal
*	4453.7	39.1	5.5	44.6	123.5	-78.9	Peak	Vertical
*	5231.2	34.0	6.8	40.8	123.5	-82.7	Peak	Vertical
	8102.3	34.9	15.1	50.0	74.0	-24.0	Peak	Vertical
	9490.5	36.4	15.4	51.8	74.0	-22.2	Peak	Vertical

Note 1: "*" is not in restricted band, its limit is 20dBc of the fundamental emission level (143.5dBμV/m).

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

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

Channel Bandwidth:	20MHz	Test Site:	AC1
Test Channel:	157	Test Engineer:	Roy Cheng
Remark:	1. There is the ambient noise within frequency range 9kHz~30MHz and 18GHz~40GHz, the permissible value is not show in the report. 2. Average measurement was not performed if peak level lower than average limit.		

Mark	Frequency (MHz)	Reading Level (dBμV/m)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	3300.2	35.5	3.2	38.7	119.9	-81.2	Peak	Horizontal
*	3562.4	35.9	4.1	40.0	119.9	-79.9	Peak	Horizontal
	7222.0	37.4	13.7	51.1	74.0	-22.9	Peak	Horizontal
	9421.4	35.9	15.5	51.4	74.0	-22.6	Peak	Horizontal
*	1261.3	36.6	-1.8	34.8	119.9	-85.1	Peak	Vertical
*	1429.7	37.1	-1.5	35.6	119.9	-84.3	Peak	Vertical
	8053.7	35.3	15.2	50.5	74.0	-23.5	Peak	Vertical
	9423.9	36.5	15.5	52.0	74.0	-22.0	Peak	Vertical

Note 1: “*” is not in restricted band, its limit is 20dBc of the fundamental emission level (139.9dBμV/m).

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

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

Channel Bandwidth:	20MHz	Test Site:	AC1
Test Channel:	165	Test Engineer:	Roy Cheng
Remark:	1. There is the ambient noise within frequency range 9kHz~30MHz and 18GHz~40GHz, the permissible value is not show in the report. 2. Average measurement was not performed if peak level lower than average limit.		

Mark	Frequency (MHz)	Reading Level (dBμV/m)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	1432.5	36.2	-1.5	34.7	121.4	-86.7	Peak	Horizontal
*	1652.4	35.7	-1.0	34.7	121.4	-86.7	Peak	Horizontal
	7263.2	36.0	13.9	49.9	74.0	-24.1	Peak	Horizontal
	9365.4	35.9	15.3	51.2	74.0	-22.8	Peak	Horizontal
*	1644.5	35.6	-1.1	34.5	121.4	-86.9	Peak	Vertical
*	1716.9	36.0	-0.7	35.3	121.4	-86.1	Peak	Vertical
	7392.4	34.2	14.1	48.3	74.0	-25.7	Peak	Vertical
	9451.3	36.0	15.5	51.5	74.0	-22.5	Peak	Vertical

Note 1: “*” is not in restricted band, its limit is 20dBc of the fundamental emission level (141.4dBμV/m).

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

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

Channel Bandwidth:	40MHz	Test Site:	AC1
Test Channel:	151	Test Engineer:	Roy Cheng
Remark:	1. There is the ambient noise within frequency range 9kHz~30MHz and 18GHz~40GHz, the permissible value is not show in the report. 2. Average measurement was not performed if peak level lower than average limit.		

Mark	Frequency (MHz)	Reading Level (dBμV/m)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	1269.8	36.1	-1.8	34.3	120.5	-86.2	Peak	Horizontal
*	1637.5	35.4	-1.1	34.3	120.5	-86.2	Peak	Horizontal
	7391.8	35.0	14.1	49.1	74.0	-24.9	Peak	Horizontal
	9364.4	36.1	15.3	51.4	74.0	-22.6	Peak	Horizontal
*	1712.0	35.5	-0.7	34.8	120.5	-85.7	Peak	Vertical
*	2183.7	34.8	2.9	37.7	120.5	-82.8	Peak	Vertical
	7318.5	34.6	14.0	48.6	74.0	-25.4	Peak	Vertical
	9352.2	36.2	15.4	51.6	74.0	-22.4	Peak	Vertical

Note 1: “*” is not in restricted band, its limit is 20dBc of the fundamental emission level (140.5dBμV/m).

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

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

Channel Bandwidth:	40MHz	Test Site:	AC1
Test Channel:	159	Test Engineer:	Roy Cheng
Remark:	1. There is the ambient noise within frequency range 9kHz~30MHz and 18GHz~40GHz, the permissible value is not show in the report. 2. Average measurement was not performed if peak level lower than average limit.		

Mark	Frequency (MHz)	Reading Level (dBμV/m)	Factor (dB)	Measure Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Polarization
*	1716.4	35.2	-0.7	34.5	121.7	-87.2	Peak	Horizontal
*	2105.7	34.4	2.1	36.5	121.7	-85.2	Peak	Horizontal
	7584.7	34.2	14.7	48.9	74.0	-25.1	Peak	Horizontal
	9368.3	36.5	15.3	51.9	74.0	-22.1	Peak	Horizontal
*	2309.7	35.5	3.0	38.5	121.7	-83.2	Peak	Vertical
*	5152.0	35.1	7.2	42.3	121.7	-79.4	Peak	Vertical
	7395.9	34.6	14.1	48.7	74.0	-25.3	Peak	Vertical
	9394.6	36.0	15.4	51.4	74.0	-22.6	Peak	Vertical

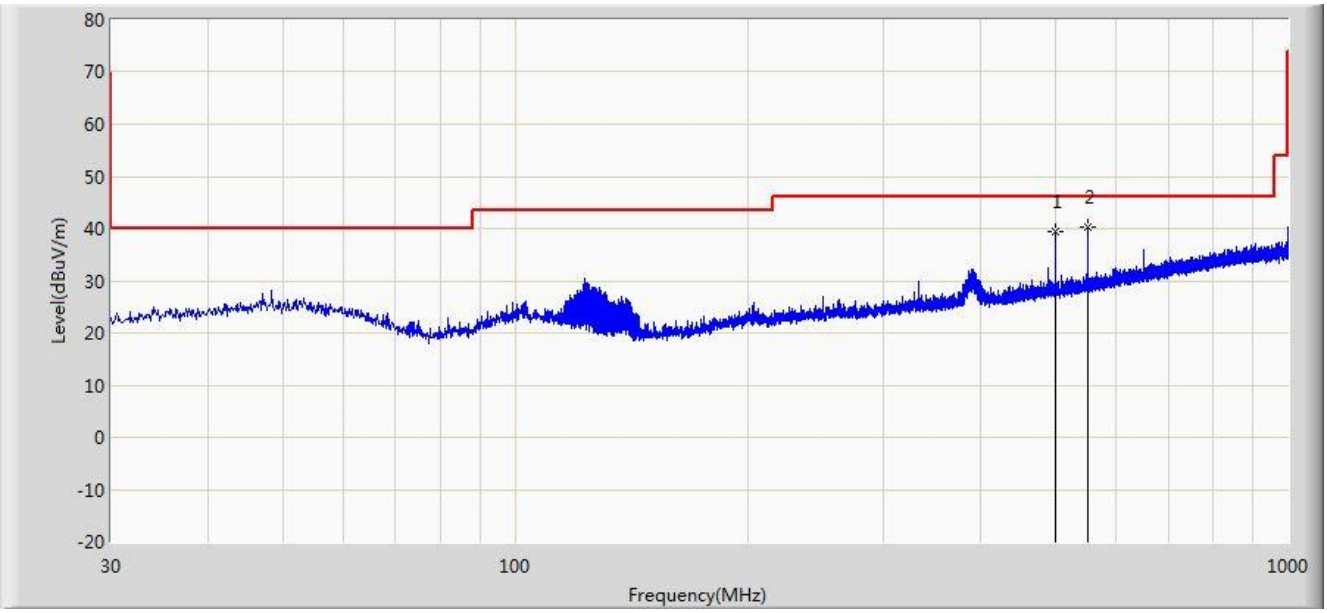
Note 1: “*” is not in restricted band, its limit is 20dBc of the fundamental emission level (141.7dBμV/m).

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

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

The worst case of Radiated Emission between 30MHz to 1GHz:

Test Engineer: Roy Cheng	
Test Site: AC1	Time: 2014/01/14 - 14:02
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: VULB9162_0.03-8GHz	Polarity: Horizontal
EUT Model: Lite 5GHz	Power: DC 48V
Worst Case Mode: 20MHz BW Channel 5500MHz	

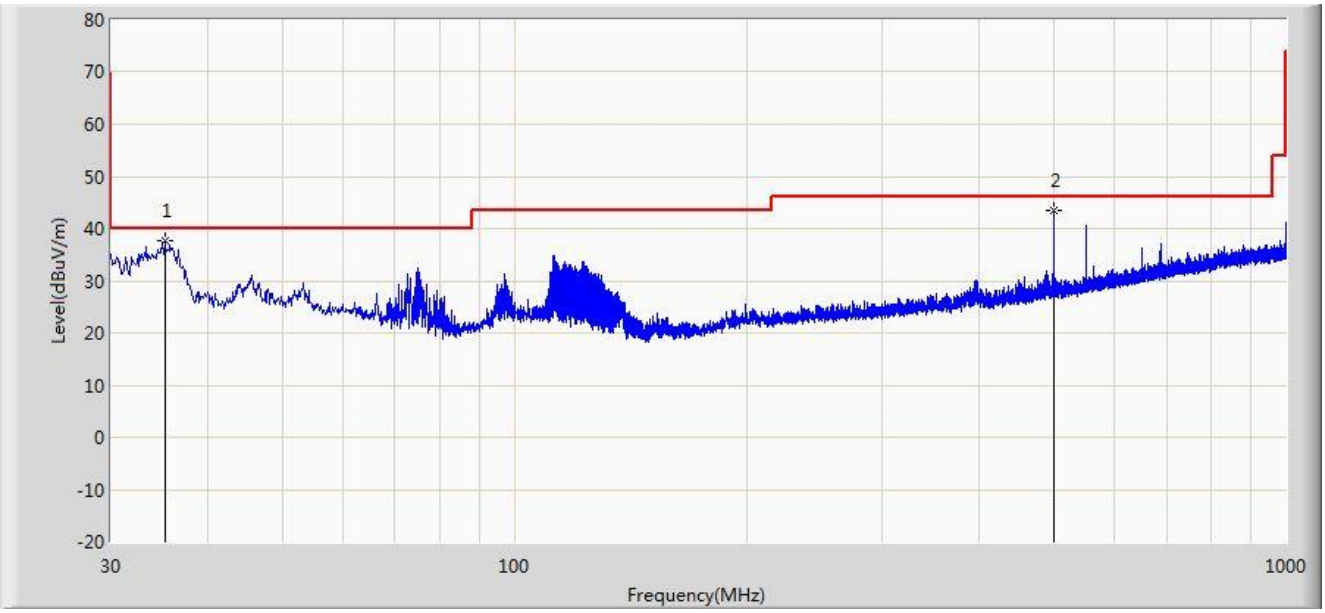


No	Mark	Frequency (MHz)	Measure Level (dBµV/m)	Reading Level (dBµV)	Over Limit (dB)	Limit (dBµV/m)	Factor	Type
1		499.965	39.531	21.789	-6.469	46.000	17.742	QP
2		549.920	40.146	21.622	-5.854	46.000	18.523	QP

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

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

Test Engineer: Roy Cheng	
Test Site: AC1	Time: 2014/01/14 - 14:02
Limit: FCC_Part15.209_RE(3m)	Margin: 0
Probe: VULB9162_0.03-8GHz	Polarity: Vertical
EUT Model: Lite 5GHz	Power: DC 48V
Worst Case Mode: 20MHz BW Channel 5500MHz	



No	Mark	Frequency (MHz)	Measure Level (dBµV/m)	Reading Level (dBµV)	Over Limit (dB)	Limit (dBµV/m)	Factor	Type
1		35.214	37.621	24.789	-2.379	40.000	12.833	QP
2		499.965	43.540	25.799	-2.460	46.000	17.742	QP

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

Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

7.7. AC Conducted Emissions Measurement *§15.207*

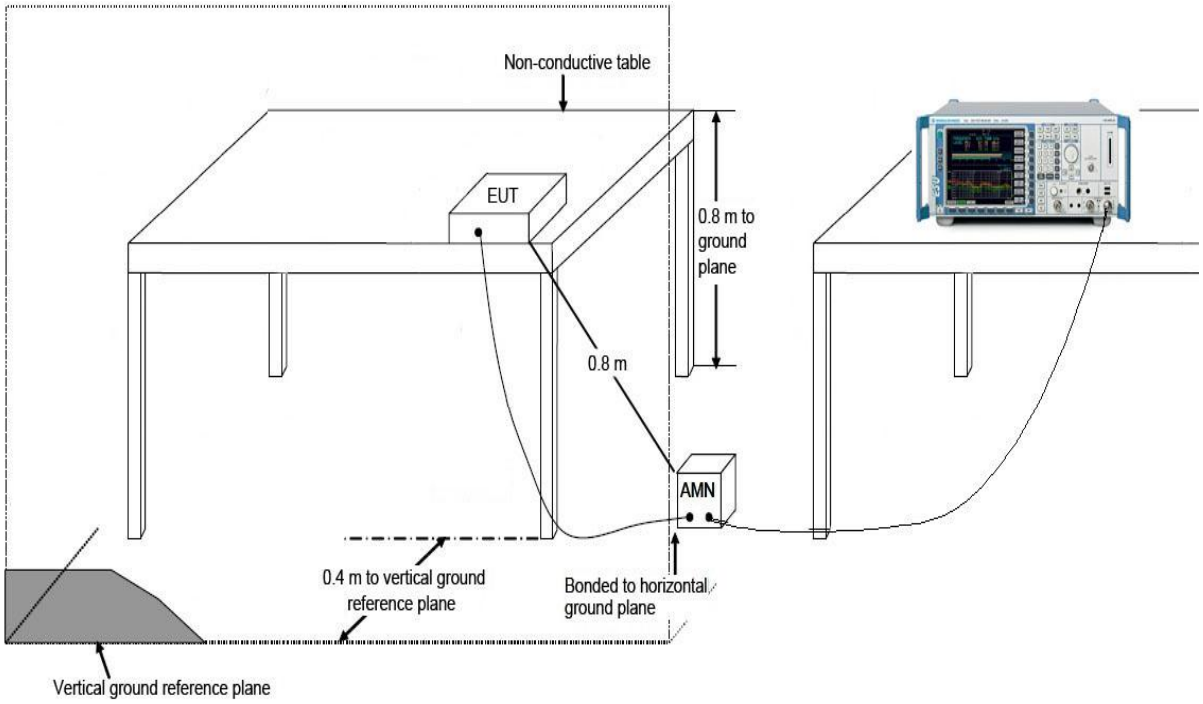
7.7.1. Test Limit

FCC Part 15 Subpart C Paragraph 15.207 Limits		
Frequency (MHz)	QP (dBμV)	Average (dBμV)
0.15 - 0.50	66 - 56	56 – 46
0.50 - 5.0	56	46
5.0 - 30	60	50

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

Note 2: The limit decreases linearly with the logarithm of the frequency in the range 0.15MHz to 0.5MHz.

7.7.2. Test Setup



7.7.3. Test Result

The EUT is powered by POE and worked in DC network. It's not applicable for conducted emission test.

8. CONCLUSION

The data collected relate only the item(s) tested and show that the **Microwave Outdoor Unit FCC ID: QB8LT5GT** is in compliance with Part 15C of the FCC Rules.

The End