

Radio Testing of a Wireless Visual Alert Device

Model(s): SVRS Pulse

In accordance with
47 CFR FCC Part 15C

Prepared for:
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EXECUTIVE SUMMARY

A sample of this product was tested and found to be in compliance with the mentioned standard(s).



LA-2007-0380-A
LA-2007-0381-F
LA-2007-0382-B
LA-2007-0383-G
LA-2007-0384-G
LA-2007-0385-E
LA-2007-0386-C
LA-2010-0464-D

The results reported herein have been performed in accordance with the terms of accreditation under the Singapore Accreditation Council. Inspections/Calibrations/Tests marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our inspection body/laboratory.



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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	18 Apr 2018

1.2 Introduction

Applicant	:	Venture International Pte Ltd
Manufacturer	:	Venture International Pte Ltd
Factory	:	Venture International Pte Ltd
Model Number(s)	:	SVRS Pulse
Serial Number(s)	:	C1822CA0000006
Number of Samples Tested	:	1
Quotation Reference	:	2191079521
Test Specification/Issue/Date	:	FCC 47 CFR Part 15C
Start of Test	:	23 Mar 2018
Finish of Test	:	04 Apr 2018



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with specifications as shown below.

Specification Clause	Test Description	Result	Comments/Base Standard
<i>47 CFR FCC Part 15</i>			
15.107(a), 15.207	Conducted Emissions	Pass	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V04: 2017
15.109(a), 15.205, 15.209	Radiated Emissions (Spurious Emissions Inclusive Restricted Bands Requirement)	Pass	ANSI C63.4: 2014 ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V04: 2017
15.247(a)(2)	Spectrum Bandwidth (6dB Bandwidth Measurement)	Pass	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V04: 2017
15.247(b)(3)	Maximum Peak Power	Pass	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V04: 2017
15.247(d)	RF Conducted Spurious Emissions (Non-Restricted Bands)	Pass	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V04: 2017
15.247(d)	RF Conducted Spurious Emissions (Restricted Bands)	Pass	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V04: 2017
15.247(d)	Band Edge Compliance (Conducted)	Pass	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V04: 2017
15.247(d)	Band Edge Compliance (Radiated)	Pass	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V04: 2017
15.247(e)	Peak Power Spectral Density	Pass	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V04: 2017
15.35(c)	Duty Cycle Factor Computation	Not Applicable <small>*See Note 3</small>	ANSI C63.10: 2013 KDB 558074 D01 DTS Measurement Guidance V04: 2017
2.1091	Maximum Permissible Exposure	Pass	



Notes

1. All the measurements in section 15.247 were done based on conducted measurements except Band Edge Compliance (Radiated) test.
2. The EUT is a Class B device when in non-transmitting state and meets the 47 CFR FCC Part15B Class B requirements.
3. The maximum measured RF power of the Equipment Under Test is 4.40dBm.
4. The EUT was operated in continuous transmission, ie 100% duty cycle.



1.4 Product Information

1.4.1 Technical Description

Description	:	The Equipment Under Test(s) (EUT(s)) is a Wireless visual alert device for the deaf called SVRS Pulse . The SVRS Pulse has 18 white alert LEDs that are positioned to flash against the desk or wall the unit is mounted on. These alert LEDs attract the attention of the deaf person. The face of the unit has 8 RGB LEDs forming a LightRing to provide indicator patterns. There is also missed call and SignMail indicator LEDs on the face as well.
Microprocessor	:	Nordic nRF52832
Operating Frequency	:	64MHz processor, 2.4GHz radio
Clock / Oscillator Frequency	:	32.768K Hz and 32 MHz
Modulation	:	Gaussian Frequency Shift Keying (GFSK) 0.5 modulation index
Antenna Gain	:	0dBm
Port / Connectors	:	1 DC Inlet
Rated Power	:	Input 5V DC 4A
Accessories	:	DC power supply (100-240V 50/60 Hz 0.5A input) (5V DC 4A output)



1.4.2 Test Configuration and Modes of Operation

Mode(s)	Description								
Maximum RF power transmission	<p>The EUT was exercised in the mode, transmitting at lower, middle and upper channels as shown below one at a time with all supported modulation schemes were evaluated. For Band Edge Compliance, only lower and upper channels were evaluated.</p> <table border="1"> <thead> <tr> <th><u>Transmit Channel</u></th> <th><u>Frequency (GHz)</u></th> </tr> </thead> <tbody> <tr> <td>Channel 1 (Lower Channel)</td> <td>2.402</td> </tr> <tr> <td>Channel 39 (Middle Channel)</td> <td>2.440</td> </tr> <tr> <td>Channel 79 (upper Channel)</td> <td>2.480</td> </tr> </tbody> </table>	<u>Transmit Channel</u>	<u>Frequency (GHz)</u>	Channel 1 (Lower Channel)	2.402	Channel 39 (Middle Channel)	2.440	Channel 79 (upper Channel)	2.480
<u>Transmit Channel</u>	<u>Frequency (GHz)</u>								
Channel 1 (Lower Channel)	2.402								
Channel 39 (Middle Channel)	2.440								
Channel 79 (upper Channel)	2.480								

1.5 Test Facilities Registrations

Requirements	Registration Numbers
FCC	994109 (Test Firm Registration Number) SG0002 (Designation Number)
ISED	<p><u>Science Park</u> 2932I-1 (3m and 10m Semi-Anechoic Chamber)</p> <p><u>International Business Park</u> 2932N-1 (10m Semi-Anechoic Chamber)</p>
VCCI	<p><u>Science Park</u> R-1335 (10m ANC), G-29 (10m ANC) C-2306 (C.E @ Lab 3) T-1471 (Telecom Ports @ Lab 3)</p> <p><u>International Business Park</u> R-3324 (10m ANC), G-203 (10mANC) C-4933 (C.E @ CEIBP) T-2403 (Telecom Ports @ CEIBP)</p>
BSMI	<p>SL2-IS-E-6001R [CNS-13803 (ISM Equipment)] SL2-IN-E-6001R [CNS-13438 (IT Equipment)] SL2-R1/R2-E-6001R [CNS-13439 (Broadcast Receivers)] SL2-A1-E-6001R [CNS-13783-1 (Household Appliances)] SL2-L1-E-6001R [CNS-14115 (Lighting Equipment)]</p>



1.6 Supporting Equipment

Equipment Description (Including Brand Name)	Model, Serial & FCC ID Number	Cable Description (List Length, Type & Purpose)
Dell Laptop	M/N: P38G S/N: Nil FCC ID: DoC	1.80m unshielded power cable
Power Adapter for Laptop	M/N: LA90PM130 S/N: CN-06C3W2-72438-38J-73A1-A00 FCC ID: Nil	1.80m unshielded power cable



2 Test Details

2.1 Conducted Emissions

2.1.1 Test Limits

Frequency Range (MHz)	Limit Values (dB μ V)	
	Quasi-peak (Q-P)	Average (AV)
0.15 - 0.5	66 – 56 *	56 – 46 *
0.5 - 5.0	56	46
5.0 - 30.0	60	50

* Decreasing linearly with the logarithm of the frequency



2.1.2 Test Setup

- 2.1.2.1 The EUT and supporting equipment were set up in accordance with the requirements of the standard as shown in the setup photos.
- 2.1.2.2 The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains.
- 2.1.2.3 The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
- 2.1.2.4 All other supporting equipment were powered separately from another LISN.

2.1.3 Test Method

- 2.1.3.1 The EUT was switched on and allowed to warm up to its normal operating condition.
- 2.1.3.2 A scan was made on the NEUTRAL line over the required frequency range using an EMI test receiver.
- 2.1.3.3 High peaks, relative to the limit line, were then selected.
- 2.1.3.4 The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 9kHz. Both Quasi-peak and Average measurements were made.
- 2.1.3.5 The measurements were then repeated for the LIVE line .

Sample Calculation Example

At 20 MHz

Q-P limit = 60.0 dBμV

Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.2 dB

Q-P reading obtained directly from EMI Receiver = 40.0 dBμV

(Calibrated for system losses)

Therefore, Q-P margin = 60.0 - 40.0 = 20.0

i.e. 20.0 dB below Q-P limit



2.1.4 Test Results

Test Input Power	120V 60Hz	Temperature	23°C
Line Under Test	AC Mains	Relative Humidity	58%
Mode	Transmission	Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

Frequency (MHz)	Q-P Value (dBµV)	Q-P Limit (dBµV)	Q-P Margin (dB)	AV Value (dBµV)	AV Limit (dBµV)	AV Margin (dB)	Line	Channel
0.2093	46.4	63.2	16.8	35.4	53.2	17.8	Live	1
0.2506	44.7	61.7	17.0	35.7	51.7	16.0	Neutral	1
0.2536	45.0	61.6	16.6	37.2	51.6	14.4	Live	1
0.7736	31.4	56.0	24.6	27.0	46.0	19.0	Live	1
8.0820	33.7	60.0	26.3	30.3	50.0	19.7	Neutral	1
8.3388	35.7	60.0	24.3	30.7	50.0	19.3	Live	1

Notes

1.	All possible modes of operation were investigated from 150kHz to 30MHz. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2.	A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a "negative" margin indicates a FAIL.
3.	EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings: <u>9kHz - 30MHz</u> RBW: 9kHz VBW: 30kHz



2.2 Radiated Emissions (Spurious Emissions Inclusive Restricted Bands Requirement)

2.2.1 Test Limits

Frequency Range (MHz)	Quasi-Peak Limit Values (dBµV/m)
0.009 - 0.490 *	20 log [2400 / F (kHz)] @ 300m
0.490 - 1.705	20 log [24000 / F (kHz)] @ 30m
1.705 - 30.0	30.0 @ 30m
30 – 88	40.0 @ 3m
88 – 216	43.5 @ 3m
216 – 960	46.0 @ 3m
Above 960 *	54.0 @ 3m

* For frequency bands 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, average detector was used. A peak limit of 20dB above the average limit does apply.

Restricted Bands

MHz		MHz		MHz		GHz					
0.090	-	0.110	16.42	-	16.423	399.9	-	410	4.5	-	5.15
0.495	-	0.505	16.69475	-	16.69525	608	-	614	5.35	-	5.46
2.1735	-	2.1905	16.80425	-	16.80475	960	-	1240	7.25	-	7.75
4.125	-	4.128	25.5	-	25.67	1300	-	1427	8.025	-	8.5
4.17725	-	4.17775	37.5	-	38.25	1435	-	1626.5	9.0	-	9.2
4.20725	-	4.20775	73	-	74.6	1645.5	-	1646.5	9.3	-	9.5
6.215	-	6.218	74.8	-	75.2	1660	-	1710	10.6	-	12.7
6.26775	-	6.26825	108	-	121.94	1718.8	-	1722.2	13.25	-	13.4
6.31175	-	6.31225	123	-	138	2200	-	2300	14.47	-	14.5
8.291	-	8.294	149.9	-	150.05	2310	-	2390	15.35	-	16.2
8.362	-	8.366	156.52475	-	156.52525	2483.5	-	2500	17.7	-	21.4
8.37625	-	8.38675	156.7	-	156.9	2690	-	2900	22.01	-	23.12
8.41425	-	8.41475	162.0125	-	167.17	3260	-	3267	23.6	-	24.0
12.29	-	12.293	167.72	-	173.2	3332	-	3339	31.2	-	31.8
12.51975	-	12.52025	240	-	285	3345.8	-	3358	36.43	-	36.5
12.57675	-	12.57725	322	-	335.4	3600	-	4400	Above 38.6		
13.36	-	13.41									



2.2.2 Test Setup

- 2.2.2.1 The EUT and supporting equipment were set up in accordance with the requirements of the standard as shown in the setup photos.
- 2.2.2.2 The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
- 2.2.2.3 The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

2.2.3 Test Method

- 2.2.3.1 The EUT was switched on and allowed to warm up to its normal operating condition.
- 2.2.3.2 A prescan was carried out to pick the worst emission frequencies from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which altitude and equipment arrangement produces such emissions.
- 2.2.3.3 The test was carried out at the selected frequency points obtained from the pre-scan. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
 - a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
 - b. The EUT was then rotated to the direction that gave the maximum emission.
 - c. Finally, the antenna height was adjusted to the height that gave the maximum emission
- 2.2.3.4 A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz. For frequency point in range of 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, both Peak and Average measurements were carried out.
- 2.2.3.5 The measurements were repeated for the next frequency point, until all selected frequency points were measured.
- 2.2.3.6 The frequency range covered was from the lowest radio frequency signal generated from the EUT, without going below 9kHz to 10th harmonics of the EUT fundamental frequency, using the loop antenna for frequency below 30MHz, Bi-log antenna for frequencies from 30MHz up to 1GHz, and the Horn antenna above 1GHz.

Sample Calculation Example

At 300 MHz

Q-P limit = 46.0 dB μ V/m

Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB

Q-P reading obtained directly from EMI Receiver = 40.0 dB μ V/m

(Calibrated level including antenna factors & cable losses)

Therefore, Q-P margin = 46.0 - 40.0 = 6.0

i.e. 6.0 dB below Q-P limit



2.2.5 Test Results

Test Input Power	120V 60Hz	Temperature	23°C
Test Distance	3m (<30MHz) 3m (≥30MHz – 25GHz)	Relative Humidity	58%
Mode	Transmission Mode	Atmospheric Pressure	1030mbar
		Tested By	Narulhizat

Spurious Emissions ranging from 9kHz – 30MHz (for 9kHz – 90kHz, 110kHz – 490kHz) *See Notes 2 and 3

Freq (GHz)	Peak Value (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	AV Value (dBμV/m)	AV Limit (dBμV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
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Spurious Emissions ranging from 9kHz – 30MHz *See Notes 2 and 3

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Limit (dBμV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel
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Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Limit (dBμV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel
32.2000	28.4	40.0	11.6	100	69	V	1
55.9720	30.9	40.0	9.1	101	82	V	79
113.4840	25.7	43.5	17.8	237	118	V	79
130.7780	26.1	43.5	17.4	207	23	H	1
600.0050	41.5	46.0	4.5	102	74	H	1
798.0850	26.5	46.0	19.5	237	120	V	1



Spurious Emissions above 1GHz - 25GHz

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m)	AV Limit (dBµV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	PoI (H/V)	Ch
1.7934	51.7	74.0	22.3	-- *See Note 4	54.0	-- *See Note 4	300	353	V	1
2.2751	52.6	74.0	21.4	-- *See Note 4	54.0	-- *See Note 4	101	201	V	1
7.2022	52.0	74.0	22.0	-- *See Note 4	54.0	-- *See Note 4	300	350	V	1
7.4816	53.4	74.0	20.6	-- *See Note 4	54.0	-- *See Note 4	200	8	V	1
17.1491	56.6	74.0	17.4	-- *See Note 4	54.0	-- *See Note 4	300	67	V	1
17.7806	56.4	74.0	17.6	-- *See Note 4	54.0	-- *See Note 4	101	41	V	1

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m)	AV Limit (dBµV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	PoI (H/V)	Ch
1.7974	53.4	74.0	20.6	-- *See Note 4	54.0	-- *See Note 4	399	358	V	39
4.8823	52.5	74.0	21.5	-- *See Note 4	54.0	-- *See Note 4	200	333	H	39
5.9935	49.9	74.0	24.1	-- *See Note 4	54.0	-- *See Note 4	101	76	V	39
7.3115	51.4	74.0	22.6	-- *See Note 4	54.0	-- *See Note 4	300	341	V	39
7.4694	52.6	74.0	21.4	-- *See Note 4	54.0	-- *See Note 4	101	350	V	39
14.1859	51.9	74.0	22.1	-- *See Note 4	54.0	-- *See Note 4	101	134	V	39

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m)	AV Limit (dBµV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	PoI (H/V)	Ch
1.7934	53.6	74.0	20.4	-- *See Note 4	54.0	-- *See Note 4	399	26	V	78
7.4330	52.3	74.0	21.7	-- *See Note 4	54.0	-- *See Note 4	200	41	H	78
7.4694	51.3	74.0	22.7	-- *See Note 4	54.0	-- *See Note 4	200	25	V	78
9.9590	49.5	74.0	24.5	-- *See Note 4	54.0	-- *See Note 4	101	341	V	78
14.1981	51.8	74.0	22.2	-- *See Note 4	54.0	-- *See Note 4	300	8	V	78
17.7079	56.3	74.0	17.7	-- *See Note 4	54.0	-- *See Note 4	300	351	V	78



Notes

1.	All possible modes of operation were investigated. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2.	"--" indicates no emissions were found and shows compliance to the limits.
3.	The measurement was done at 10m. The measured results were extrapolated to the specified test limits as specified in § 15.209 (a) based on 40dB/decade.
4.	As the measured peak shows compliance to the average limit, as such no average measurement was required.
2.	A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a "negative" margin indicates a FAIL.
3.	EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings: <u>30MHz - 1GHz</u> RBW: 120kHz VBW: 1MHz <u>>1GHz</u> RBW: 1MHz VBW: 3MHz
4.	Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
5.	The upper frequency of radiated emission investigations was according to requirements stated in Section 15.33 (a) for intentional radiators & Section 15.33 (b) for unintentional radiators.
6.	The channel in the table refers to the transmit channel of the EUT.

2.3 Spectrum Bandwidth (6db Bandwidth Measurement)

2.3.1 Test Limits

The EUT shows compliance to the requirements of this section, which states that the minimum bandwidth of the EUT employing digital modulation techniques shall be at least 500kHz.

2.3.2 Test Setup

2.3.2.1 The EUT and supporting equipment were set up as shown in the set up photo.

2.3.2.2 The power supply for the EUT was connected to a filtered mains.

2.3.2.3 The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

2.3.2.4 The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 3 times of RBW.

2.3.2.5 All other supporting equipment were powered separately from another filtered mains.

2.3.3 Test Method

2.3.3.1 The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode at lower channel.

2.3.3.2 The center frequency of the spectrum analyser was set to the transmitting frequency with the frequency span wide enough to capture the 6dB bandwidth of the transmitting frequency.

2.3.3.3 The spectrum analyser was set to max hold to capture the transmitting frequency. The signal capturing was continuous until no further changes were observed.

2.3.3.4 The peak of the transmitting frequency was detected with the marker peak function of the spectrum analyser. The frequencies below the 6dB peak frequency at lower (f_L) and upper (f_H) sides of the transmitting frequency were marked and measured by using the marker-delta function of the spectrum analyser.

2.3.3.5 The 6dB bandwidth of the transmitting frequency is the frequency difference between the marked lower and upper frequencies, $|f_H - f_L|$.

2.3.3.6 The measurements were repeated if the EUT supports more than one modulation and data rate.

2.3.3.7 The measurements were repeated with the transmitting frequency was set to middle and upper channel respectively.



2.3.4 Test Results

Test Input Power	120V 60Hz	Temperature	23°C
Attached Plots	1 – 3	Relative Humidity	58%
		Atmospheric Pressure	1030mbar
		Tested By	Chelmin Li

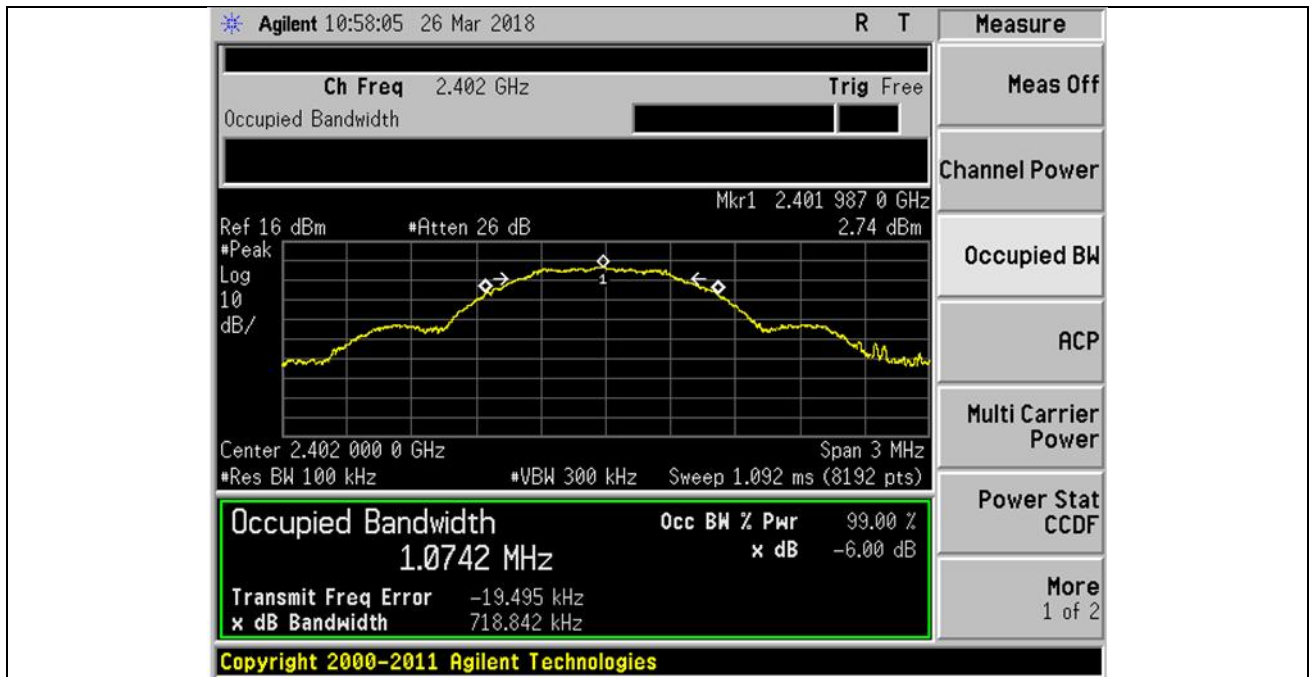
Channel	Channel Frequency (GHz)	6dB Bandwidth (MHz) <small>*See Note 1</small>	Limit (MHz)
Lower	2.402	1.0742	≥ 500
Middle	2.440	1.0816	≥ 500
Upper	2.480	1.0780	≥ 500

Notes

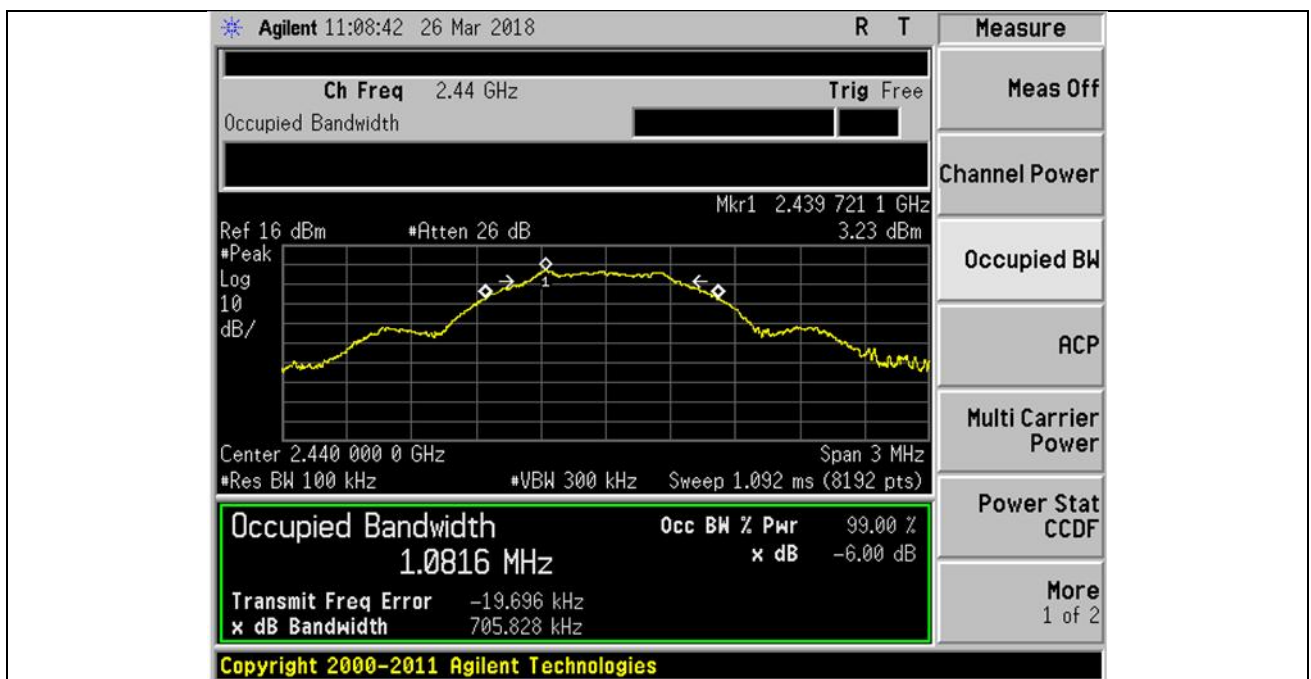
1.	Only the largest measured bandwidths were reported. Refer to plots for all measured bandwidth.
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Spectrum Bandwidth (6dB Bandwidth Measurement) Plots



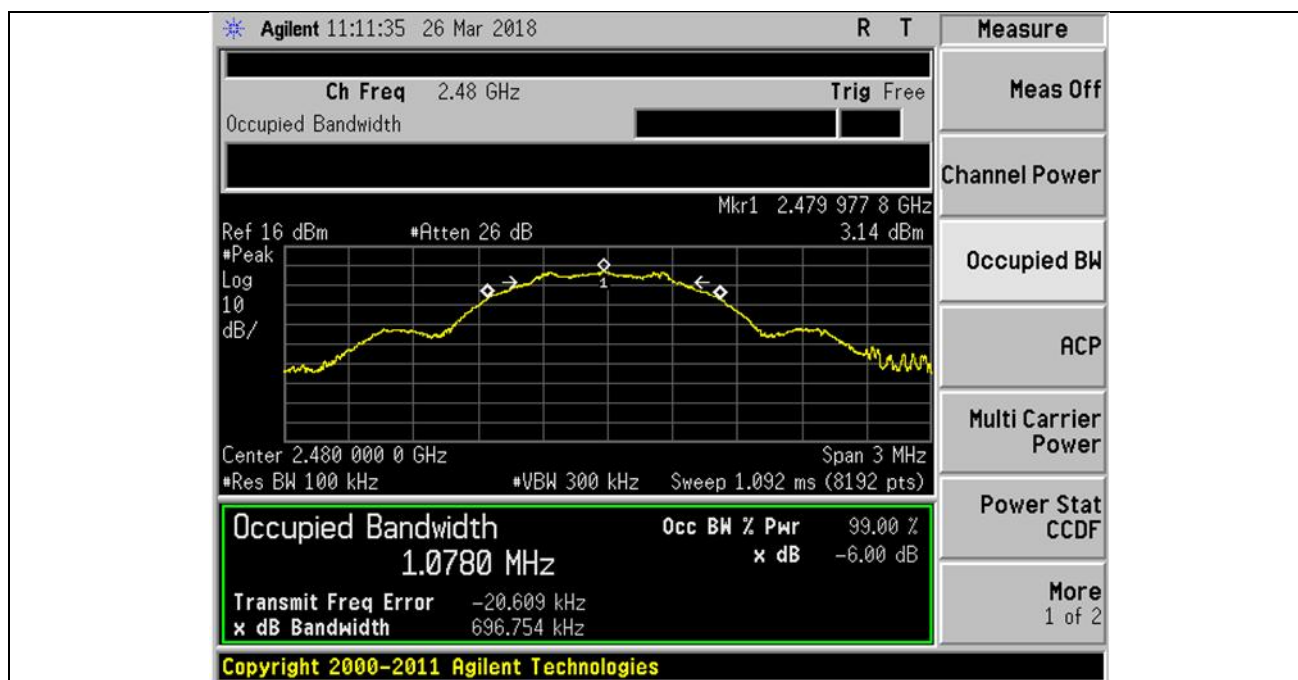
Plot 1 – Lower Channel (Channel 1)



Plot 2 – Middle Channel (Channel 39)



Spectrum Bandwidth (6dB Bandwidth Measurement) Plots



Plot 3 – Upper Channel (Channel 79)



2.4 Maximum Peak Power

2.4.1 Test Limits

The EUT shows compliance to the requirements of this section, which states the maximum peak power of the EUT employing digital modulation shall not exceed 1W (30dBm).

2.4.2 Test Setup

2.4.2.1 The EUT and supporting equipment were set up as shown in the setup photo.

2.4.2.2 The power supply for the EUT was connected to a filtered mains.

2.4.2.3 The RF antenna connector was connected to a power meter.

2.4.2.4 All other supporting equipment were powered separately from another filtered mains.

2.4.3 Test Method

2.4.3.1 The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode at lower channel.

2.4.3.2 The maximum peak power of the transmitting frequency was detected and recorded.

2.4.3.3 The measurements were repeated if the EUT supports more than one modulation and data rate.

2.4.3.4 The measurement was repeated with the transmitting frequency was set to middle channel and upper channel respectively.



2.4.4 Test Results

Test Input Power	120V 60Hz	Temperature	23°C
Antenna Gain	0 dBi	Relative Humidity	58%
		Atmospheric Pressure	1030mbar
		Tested By	Chelmin Li

Channel	Channel Frequency (GHz)	Maximum Peak Power (W) <small>*See Note 1</small>	Limit (W)
Lower	2.402	0.0027	1.0
Middle	2.440	0.0027	1.0
Upper	2.480	0.0026	1.0

Notes

1.	Only the highest measured peak power were reported.
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2.5 RF Conducted Spurious Emissions (Non-Restricted Bands)

2.5.1 Test Limits

The EUT shows compliance to the requirements of this section, which states in any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator (EUT) is operating, the radio frequency power that is produced by the EUT shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

2.5.2 Test Setup

2.5.2.1 The EUT and supporting equipment were set up as shown in the setup photo.

2.5.2.2 The power supply for the EUT was connected to a filtered mains.

2.5.2.3 The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

2.5.2.4 The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 3 times of RBW.

2.5.2.5 All other supporting equipment were powered separately from another filtered mains.

2.5.3 Test Method

2.5.3.1 The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, with transmitting frequency at lower channel.

2.5.3.2 The start and stop frequencies of the spectrum analyser were set to 30MHz and 10GHz.

2.5.3.3 The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.

2.5.3.4 The measurements were repeated with frequency span was set from 10GHz to 25GHz.

2.5.3.5 The measurements were repeated if the EUT supports more than one modulation and data rate.

2.5.3.6 The measurements were repeated with the transmitting frequency was set to middle channel and upper channel respectively.

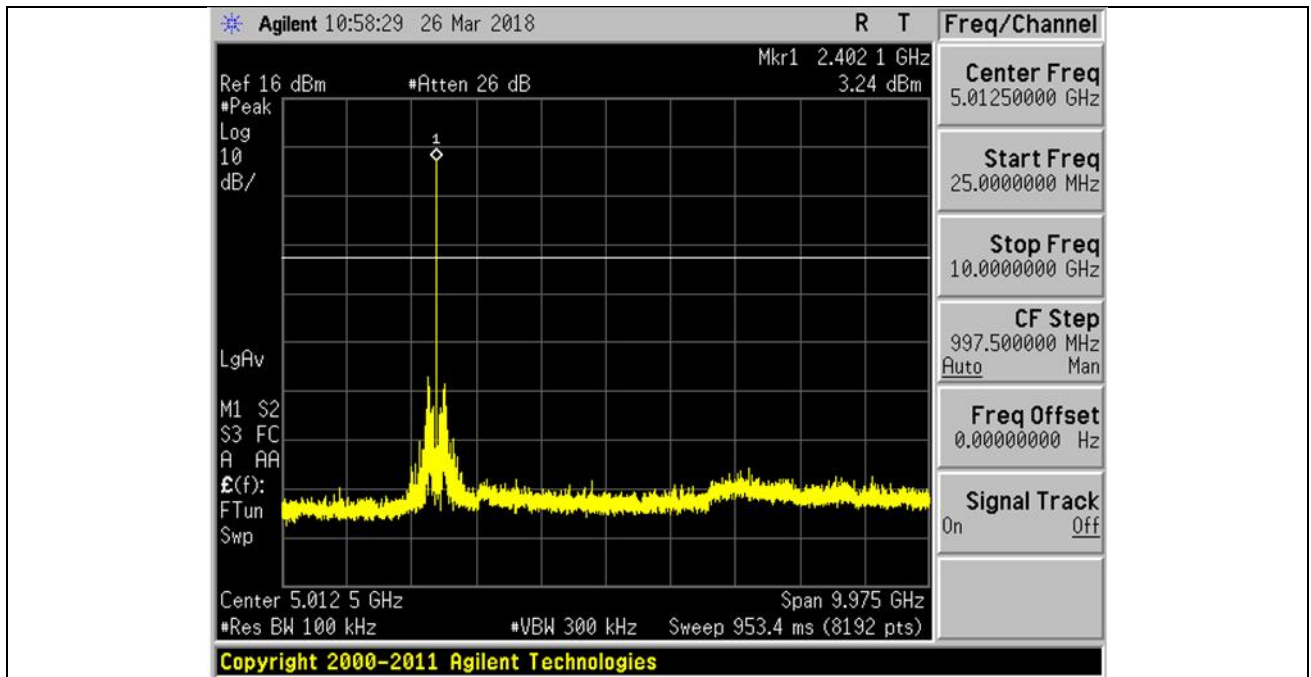


2.5.4 Test Results

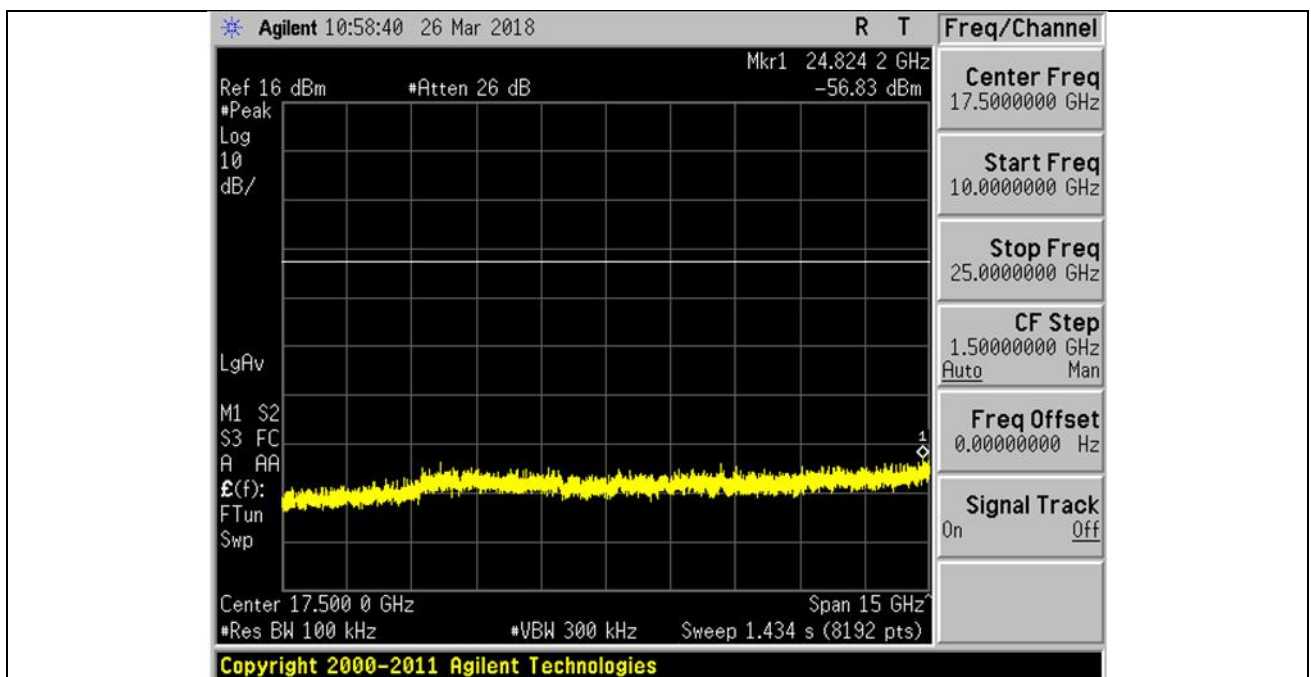
Test Input Power	120V 60Hz	Temperature	23°C
Attached Plots	4 - 9	Relative Humidity	58%
		Atmospheric Pressure	1030mbar
		Tested By	Chelmin Li

All spurious signals found were below the specified limit. Please refer to the attached plots.

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots

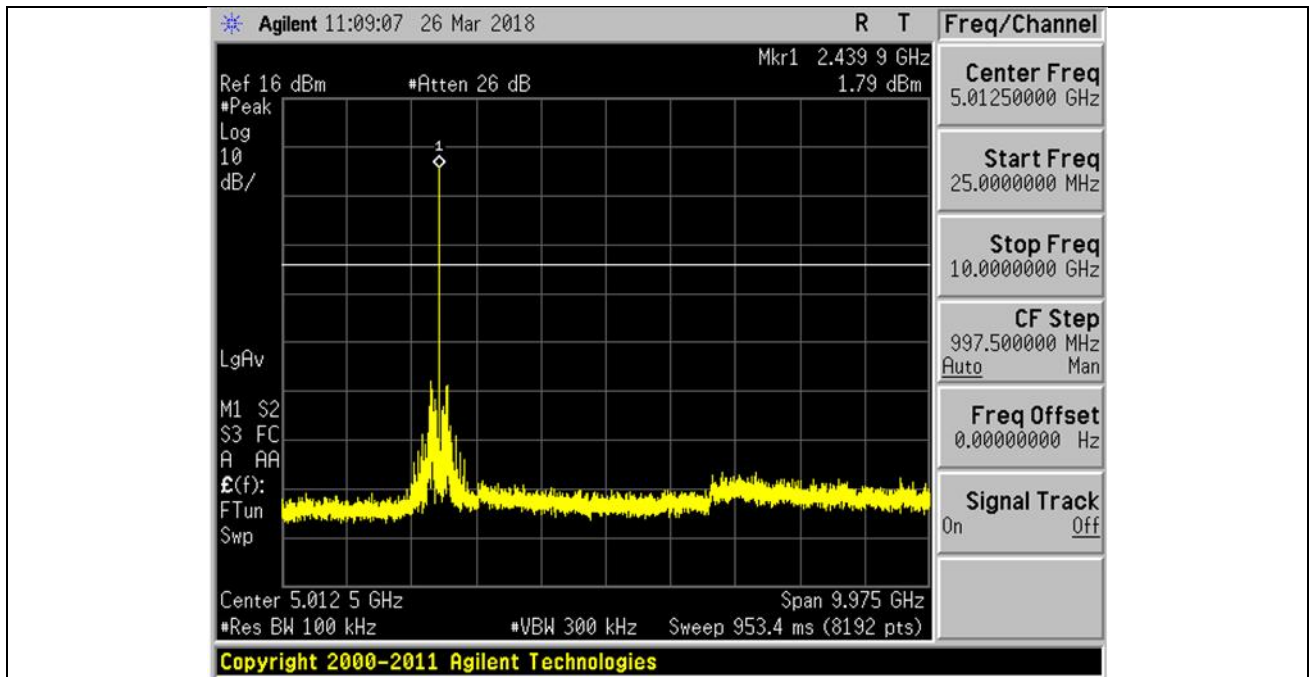


Plot 4 – Lower Channel

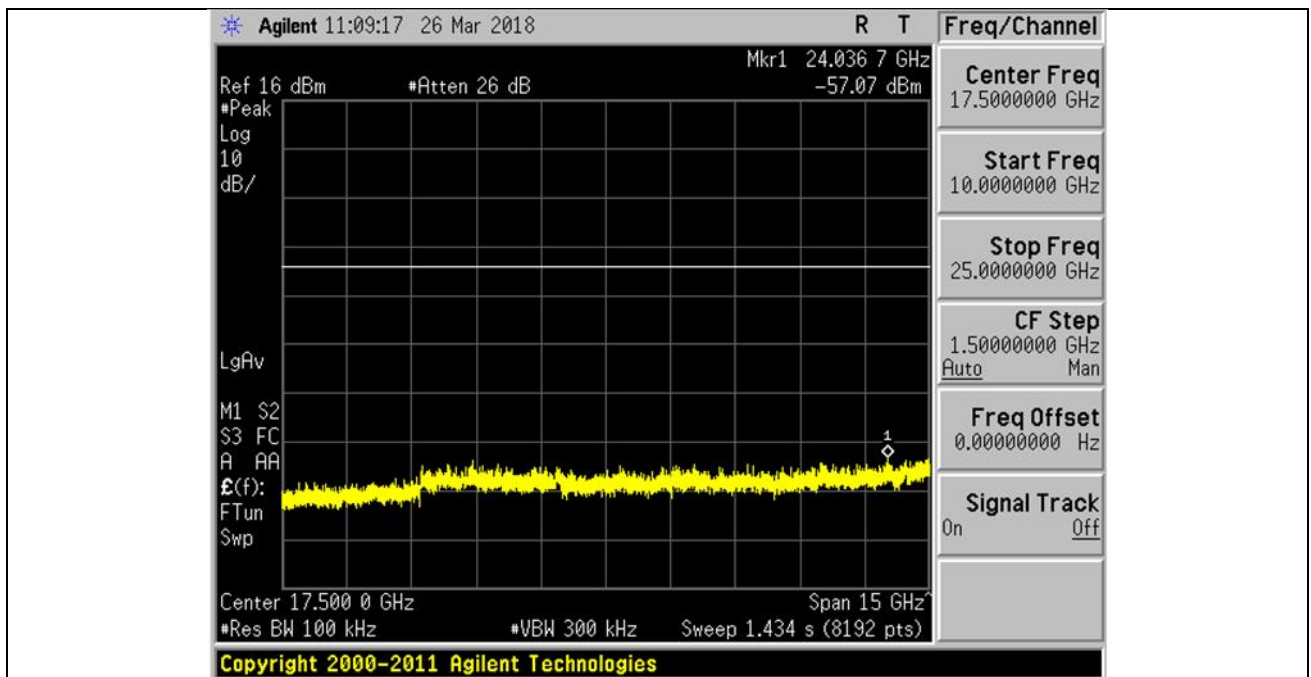


Plot 5 – Lower Channel

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots

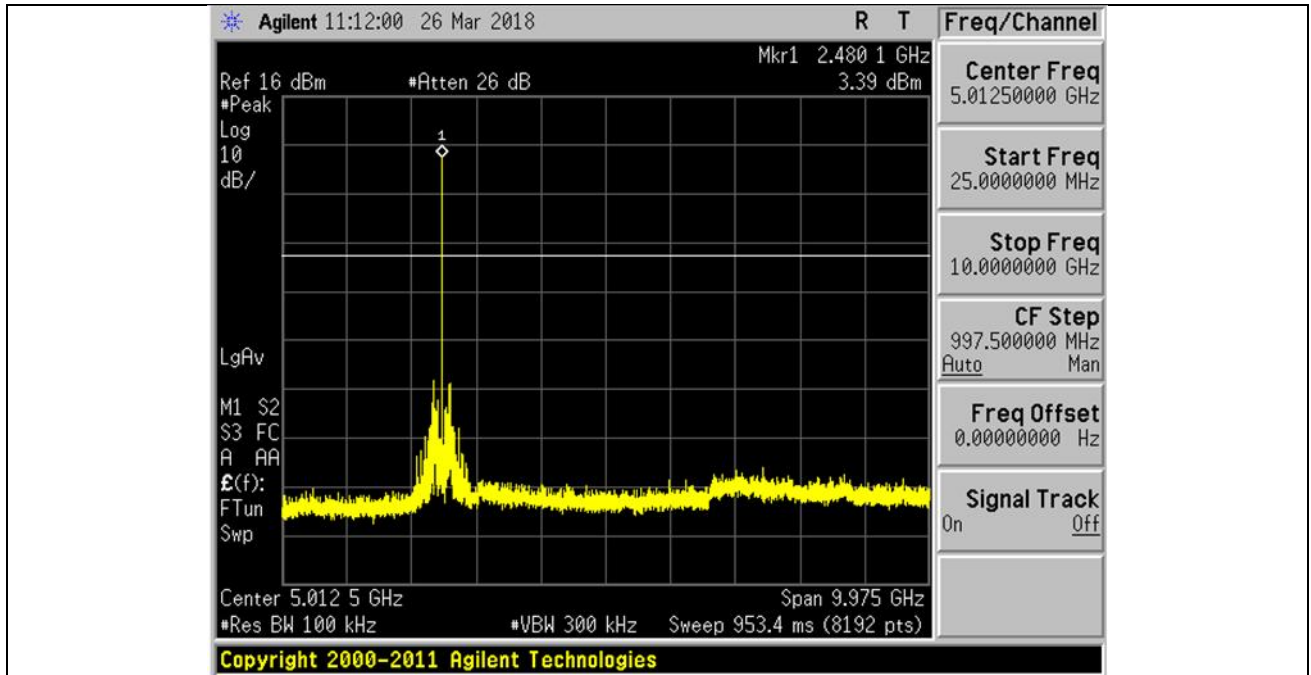


Plot 6 – Middle Channel

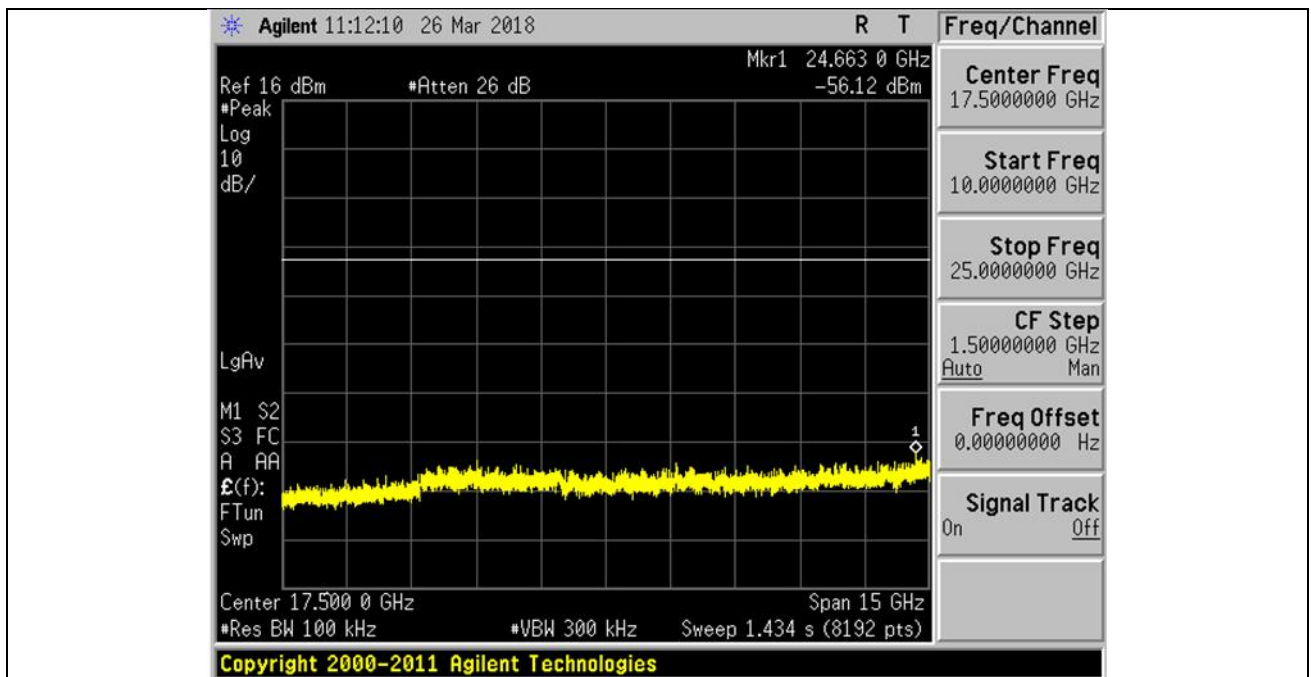


Plot 7 – Middle Channel

RF Conducted Spurious Emissions (Non-Restricted Bands) Plots



Plot 8 – Upper Channel



Plot 9 – Upper Channel

2.6 RF Radiated Spurious Emissions (Restricted Bands)

2.6.1 Test Limits

The EUT shows compliance to the requirements of this section, which states in any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator (EUT) is operating, the radio frequency power that is produced by the EUT shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

2.6.2 Test Setup

2.6.2.1 The EUT and supporting equipment were set up as shown in the setup photo.

2.6.2.2 The power supply for the EUT was connected to a filtered mains.

2.6.2.3 The RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.

2.6.2.4 The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 3 times of RBW.

2.6.2.5 All other supporting equipment were powered separately from another filtered mains.

2.6.3 Test Method

2.6.3.1 The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode, with transmitting frequency at lower channel.

2.6.3.2 The start and stop frequencies of the spectrum analyser were set to 30MHz and 10GHz.

2.6.3.3 The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.

2.6.3.4 The measurements were repeated with frequency span was set from 10GHz to 25GHz.

2.6.3.5 The measurements were repeated if the EUT supports more than one modulation and data rate.

2.6.3.6 The measurements were repeated with the transmitting frequency was set to middle channel and upper channel respectively.

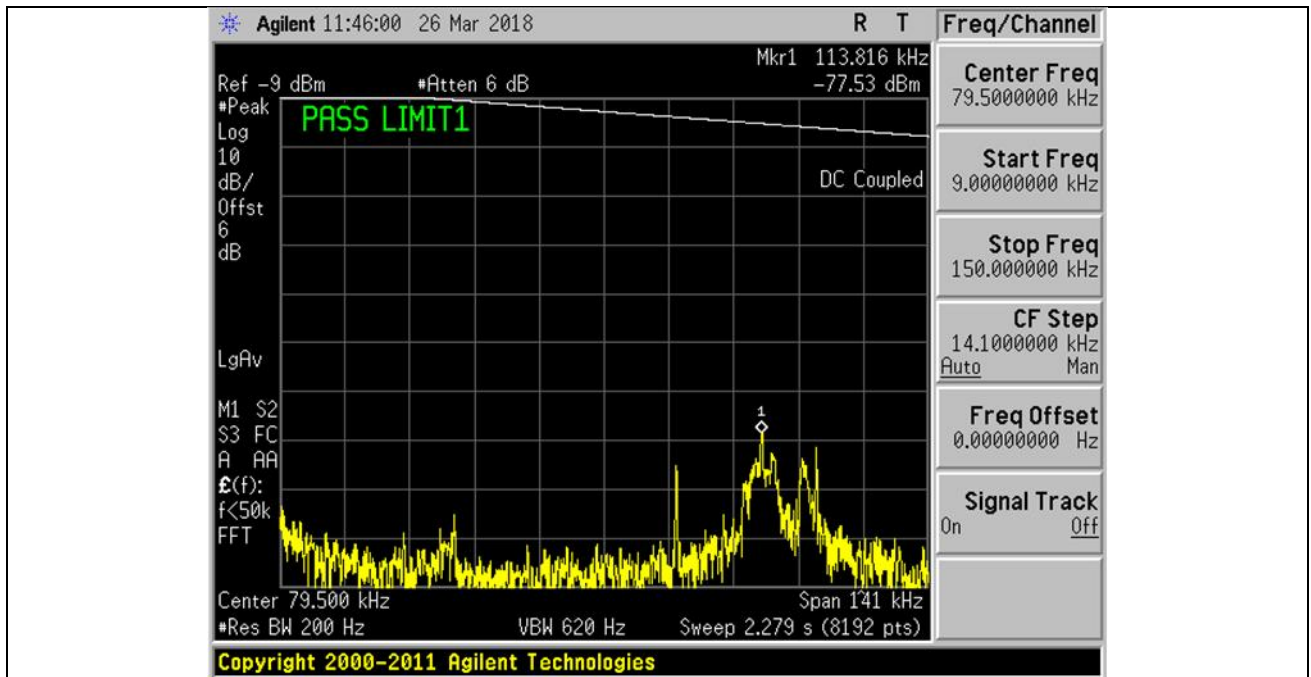


2.6.4 Test Results

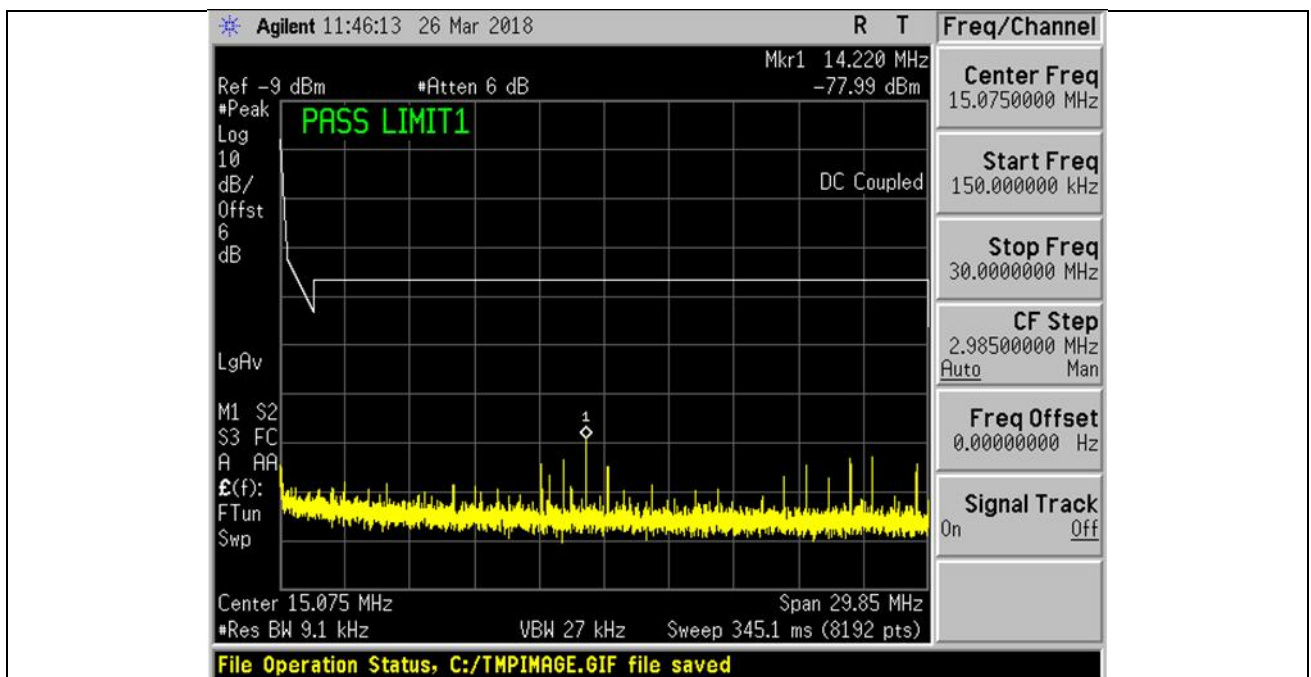
Test Input Power	120V 60Hz	Temperature	23°C
Attached Plots	10 - 27	Relative Humidity	58%
		Atmospheric Pressure	1030mbar
		Tested By	Chelmin Li

All spurious signals found were below the specified limit. Please refer to the attached plots.

RF Radiated Spurious Emissions (Non-Restricted and Restricted Bands) Plots



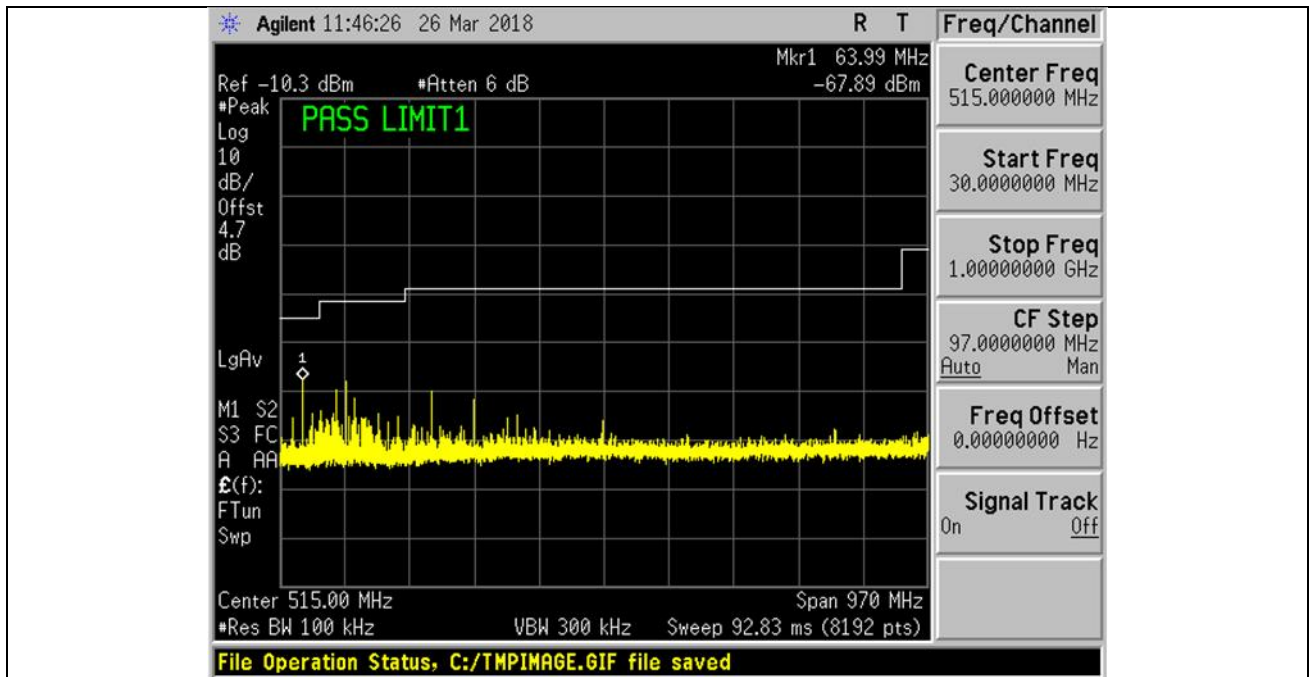
Plot 10 – Lower Channel



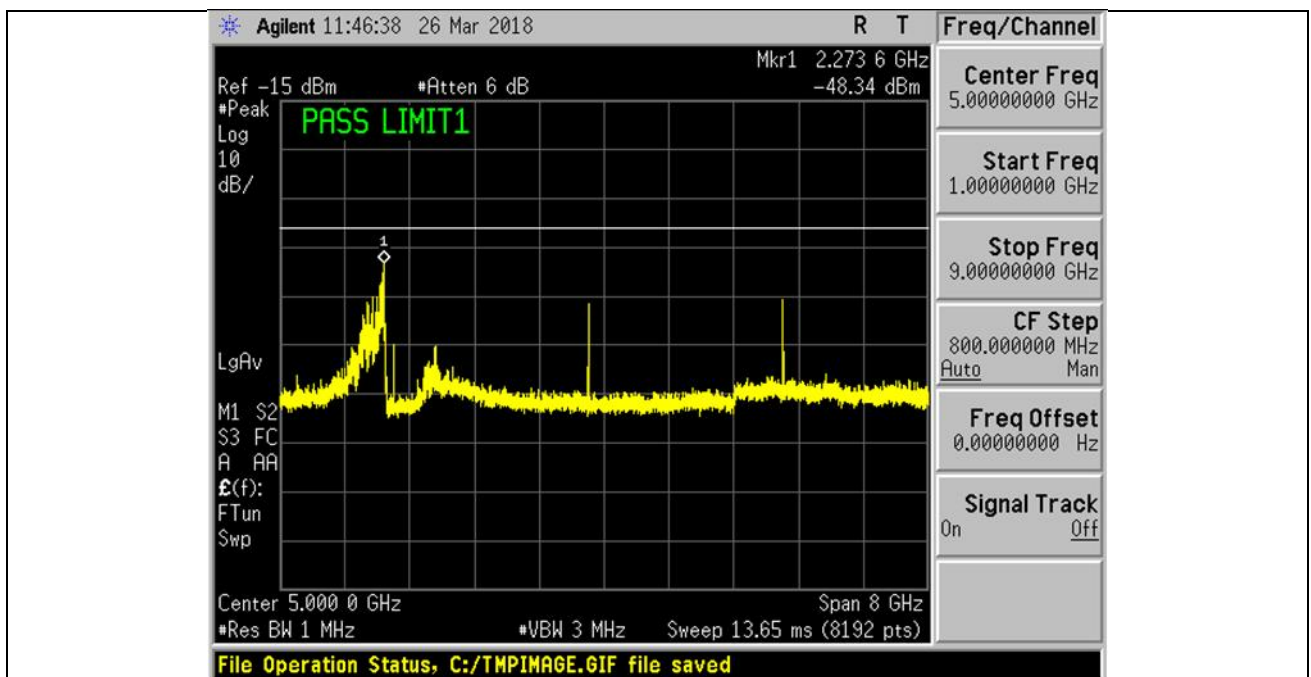
Plot 11 – Lower Channel



RF Radiated Spurious Emissions (Non-Restricted and Restricted Bands) Plots



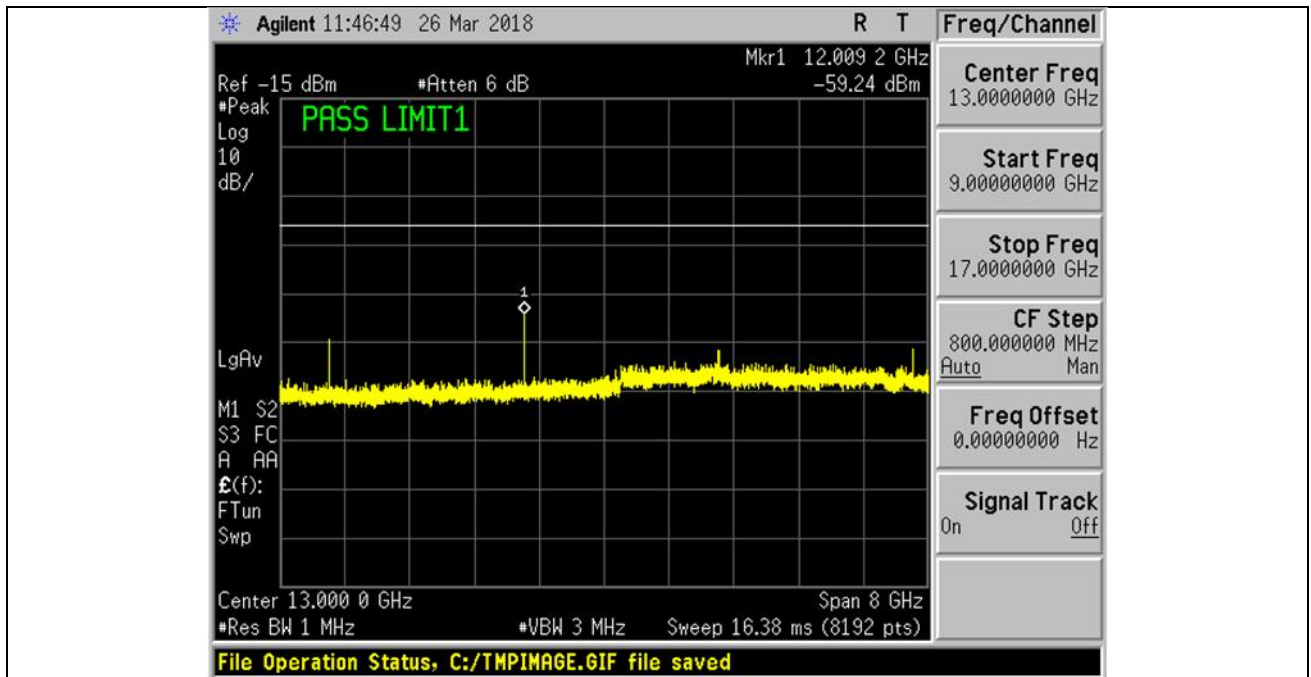
Plot 12 – Lower Channel



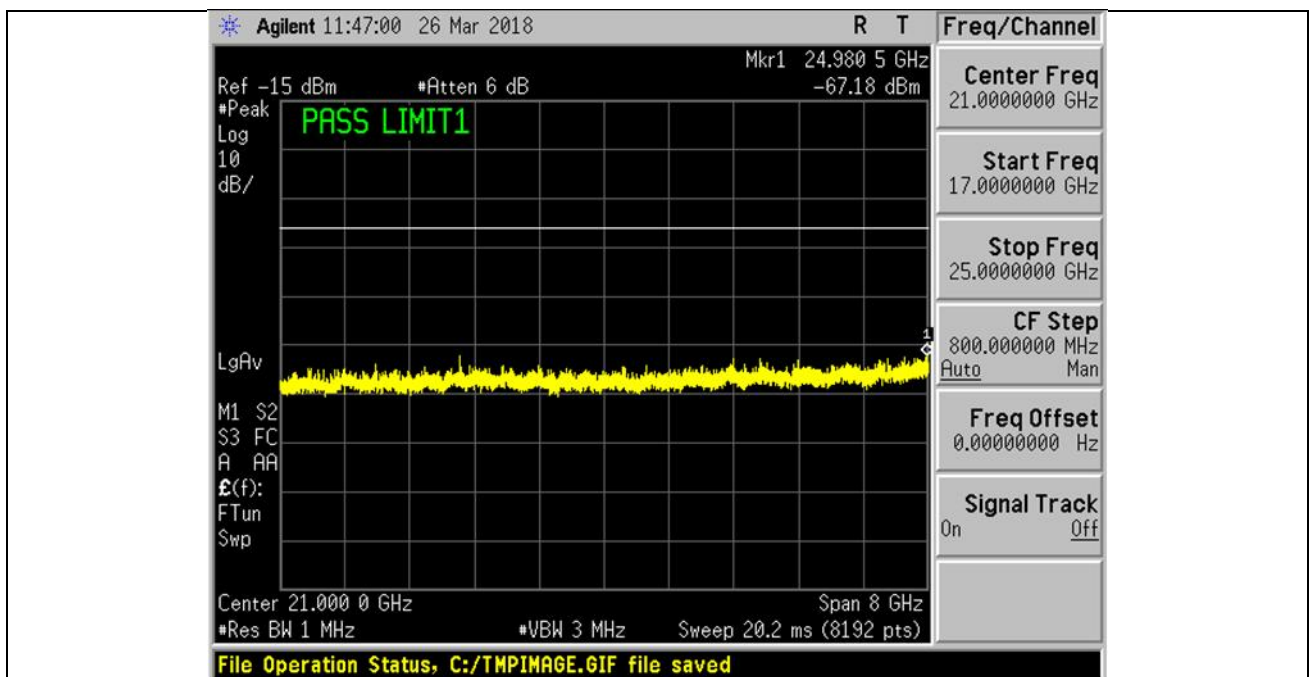
Plot 13 – Lower Channel



RF Radiated Spurious Emissions (Non-Restricted and Restricted Bands) Plots

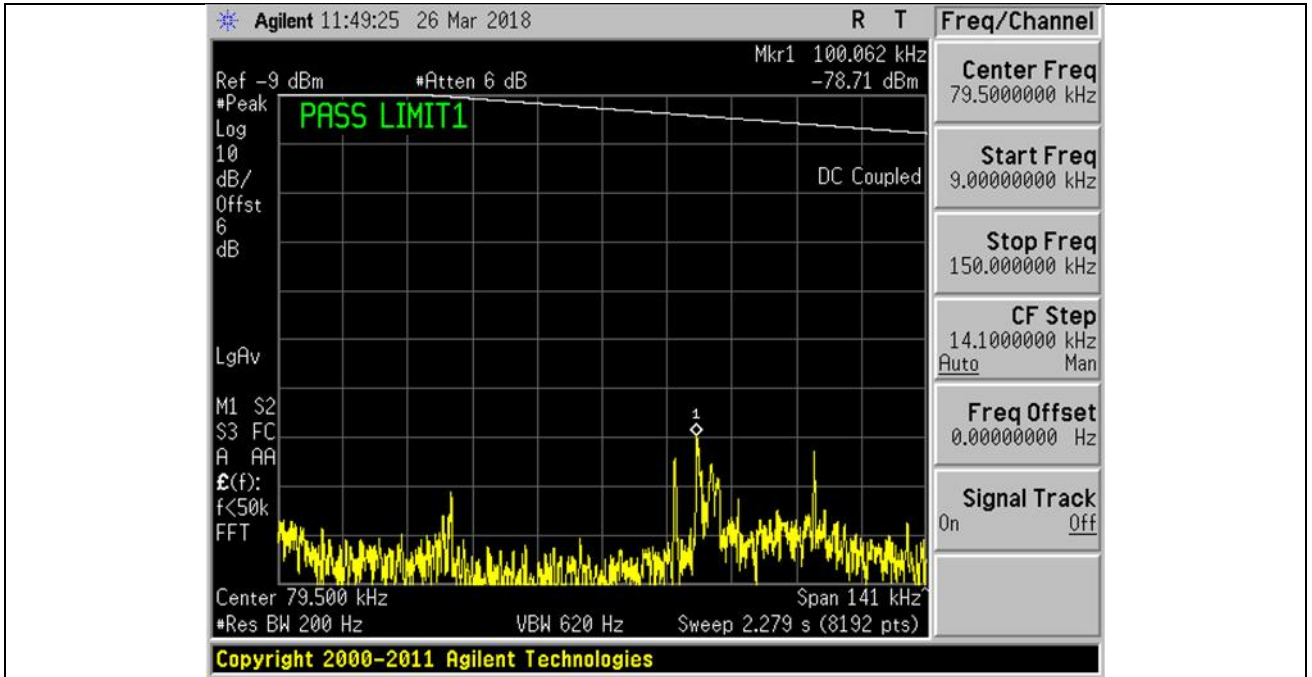


Plot 14 – Lower Channel

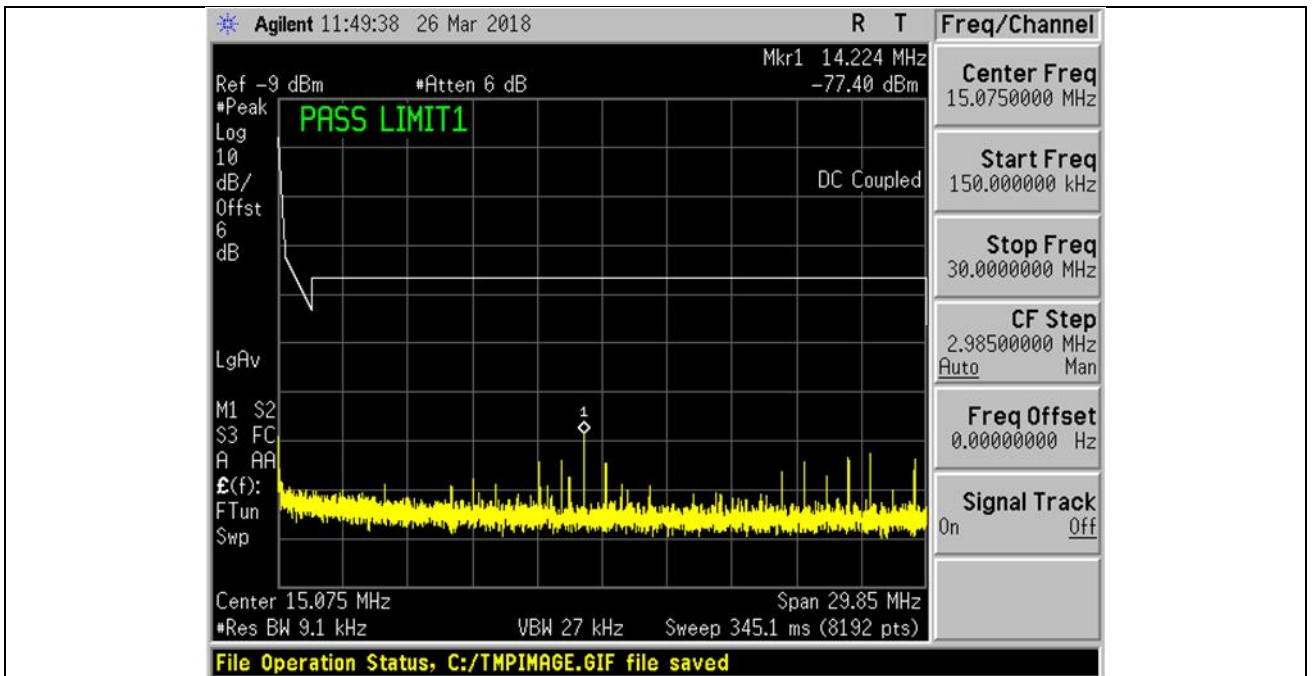


Plot 15 – Lower Channel

RF Radiated Spurious Emissions (Non-Restricted and Restricted Bands) Plots

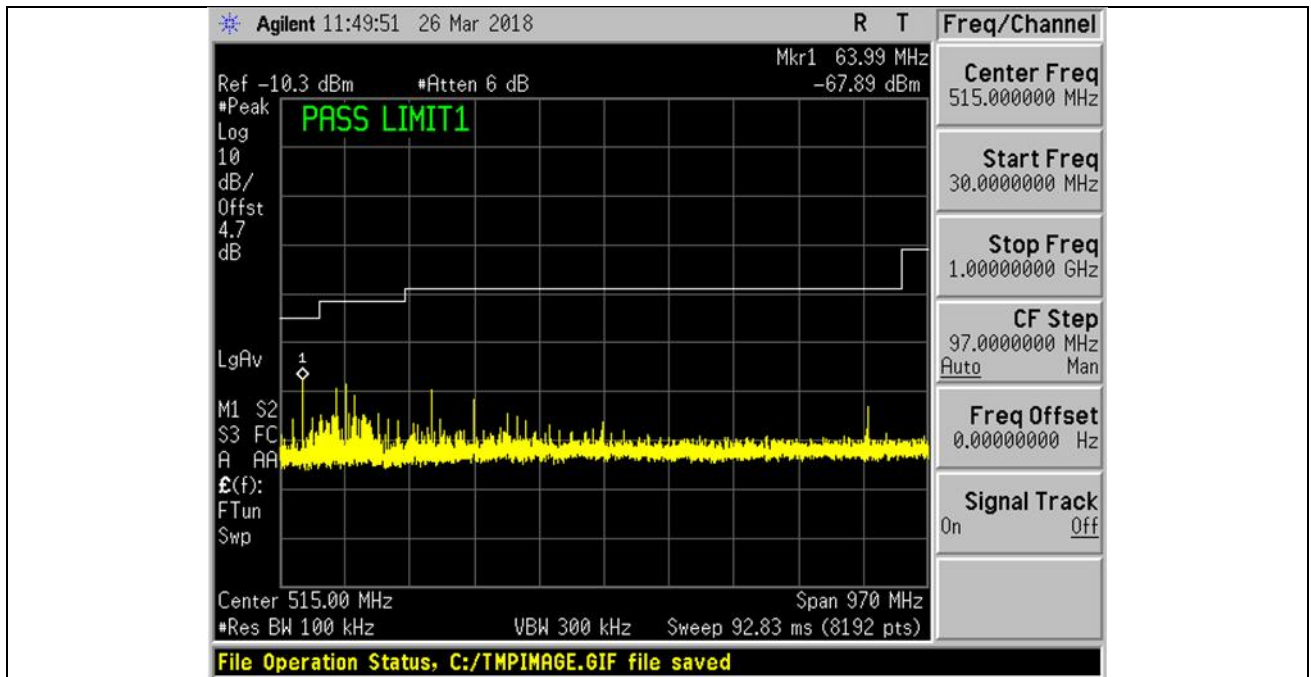


Plot 16 – Middle Channel

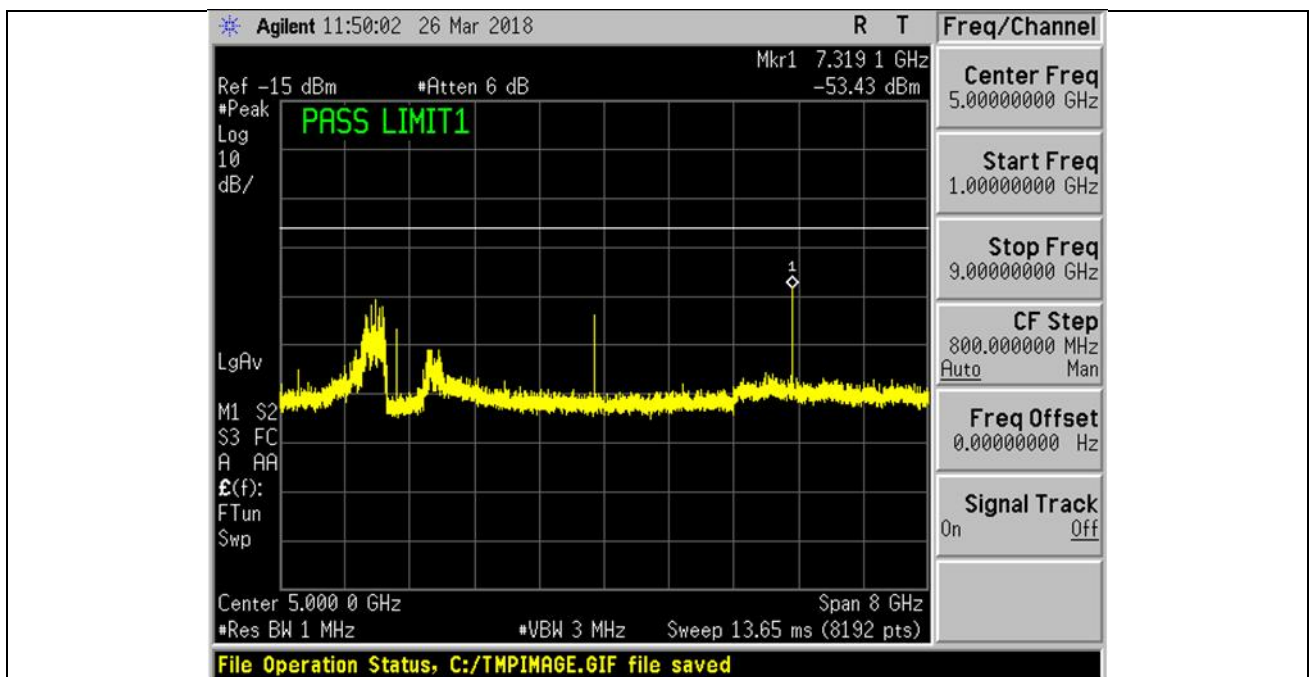


Plot 17 – Middle Channel

RF Radiated Spurious Emissions (Non-Restricted and Restricted Bands) Plots



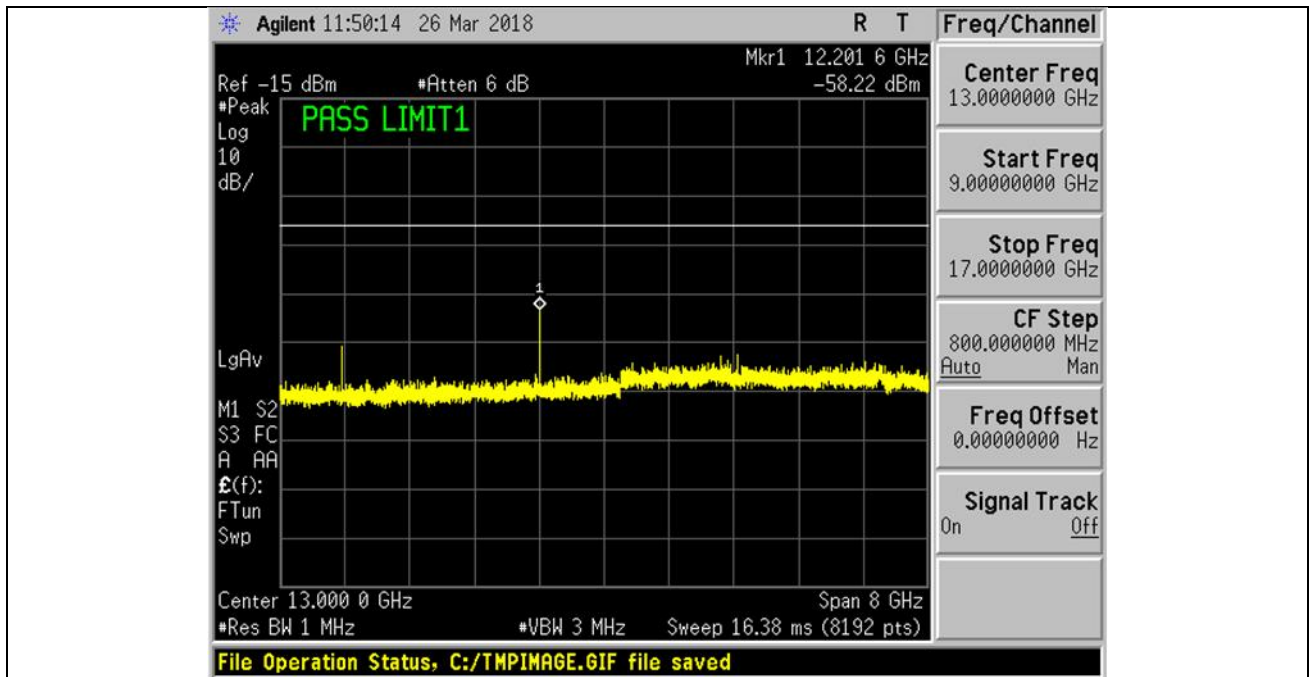
Plot 18 – Middle Channel



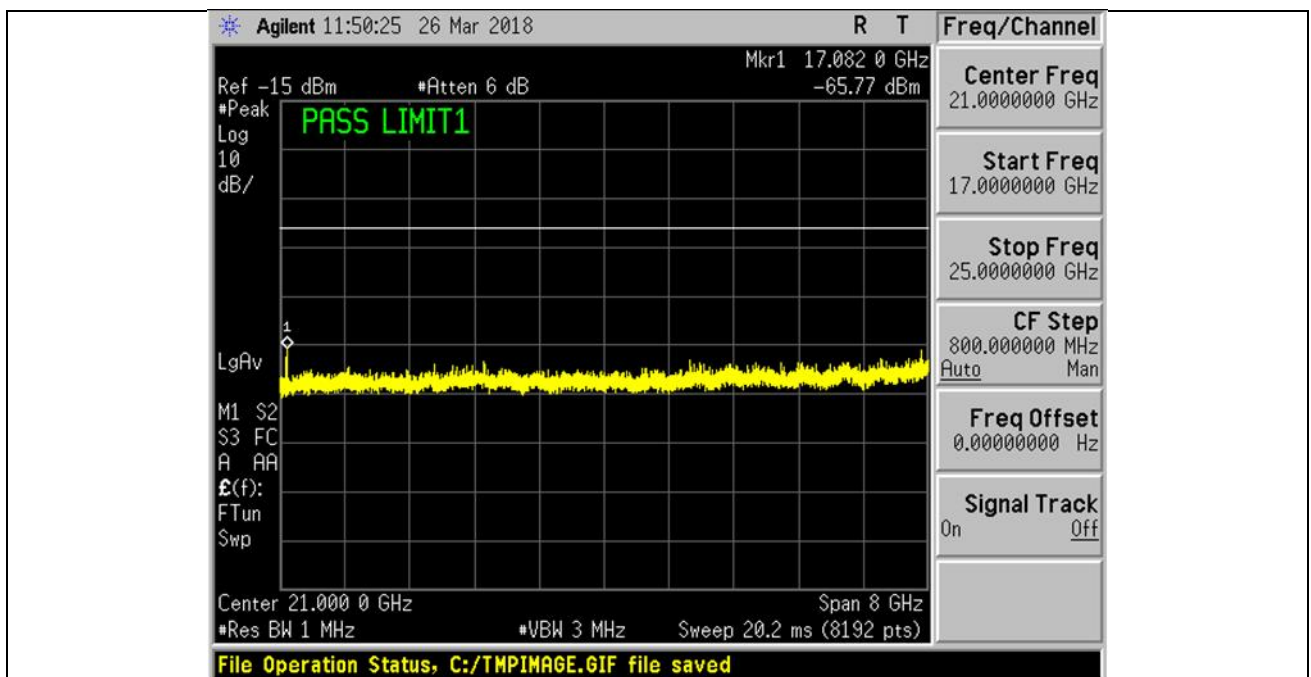
Plot 19 – Middle Channel



RF Radiated Spurious Emissions (Non-Restricted and Restricted Bands) Plots



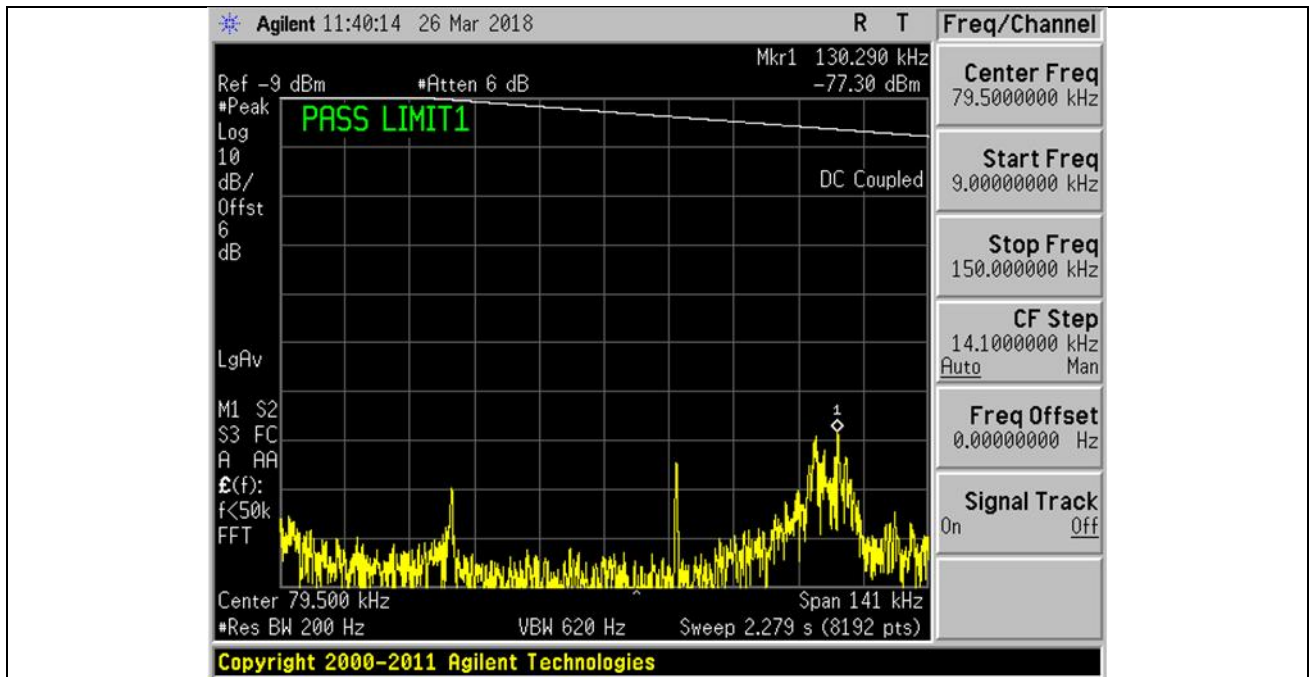
Plot 20 – Middle Channel



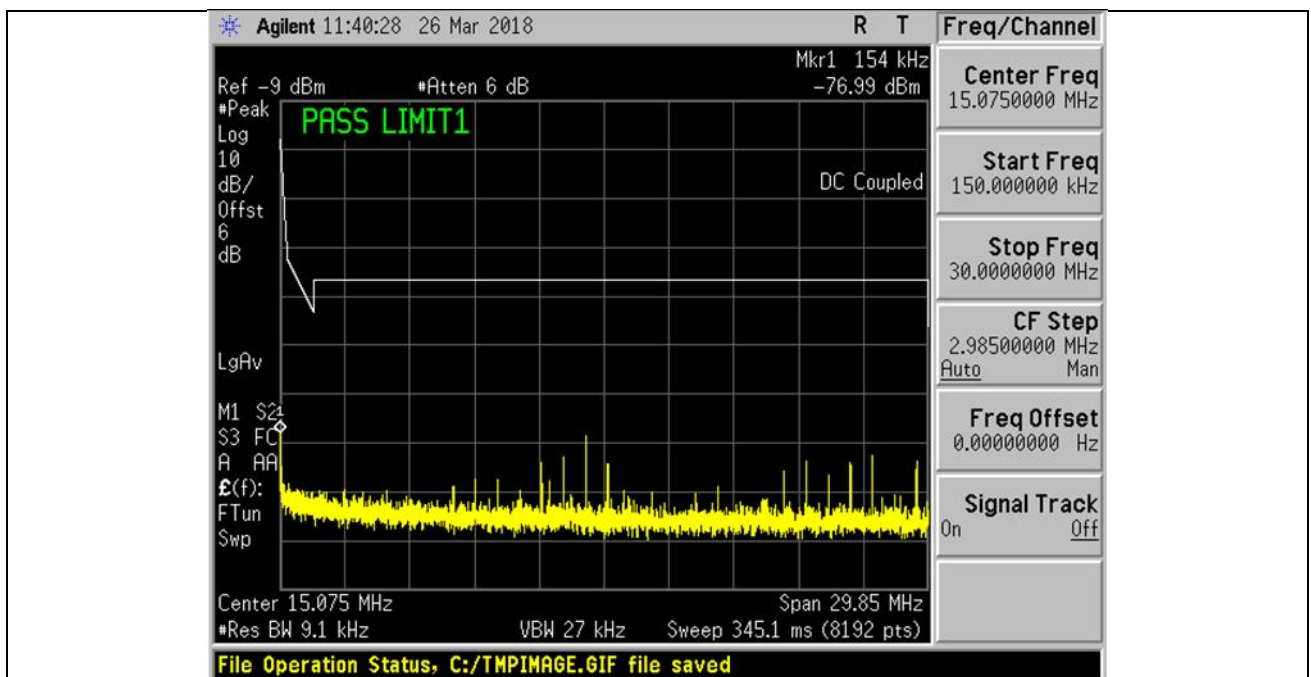
Plot 21 – Middle Channel



RF Radiated Spurious Emissions (Non-Restricted and Restricted Bands) Plots



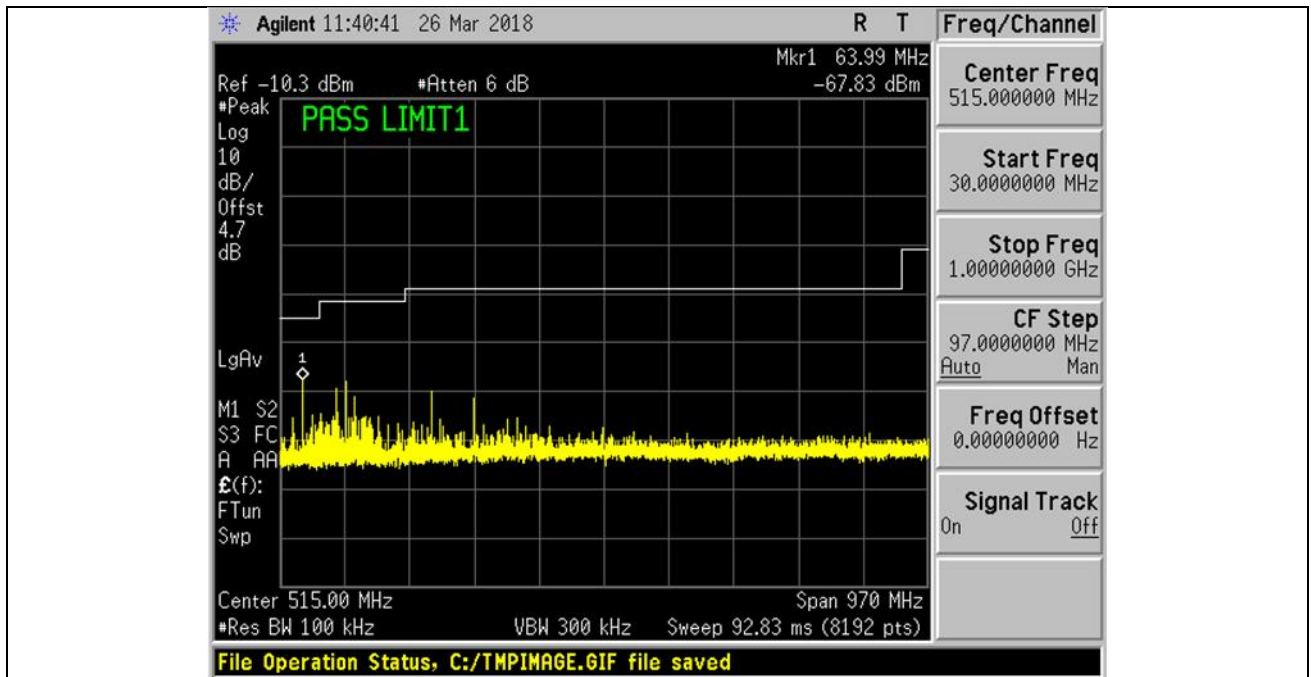
Plot 22 – Upper Channel



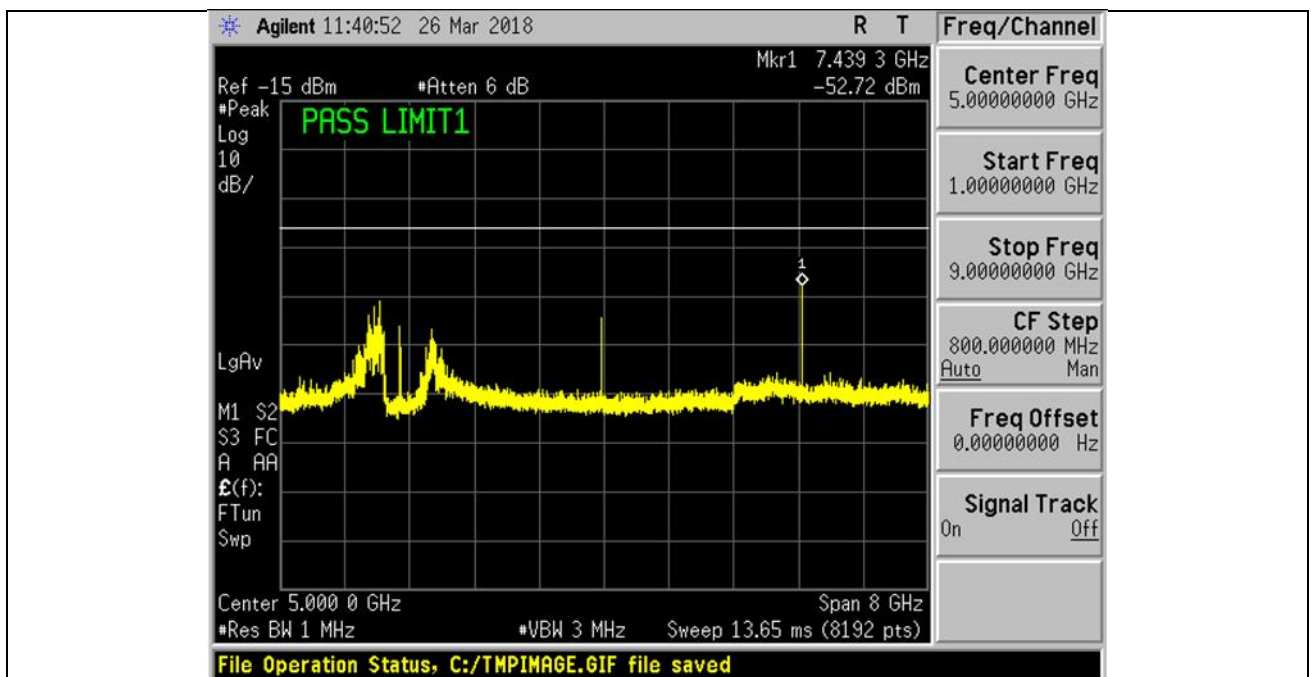
Plot 23 – Upper Channel



Radiated Spurious Emissions (Non-Restricted and Restricted Bands) Plots



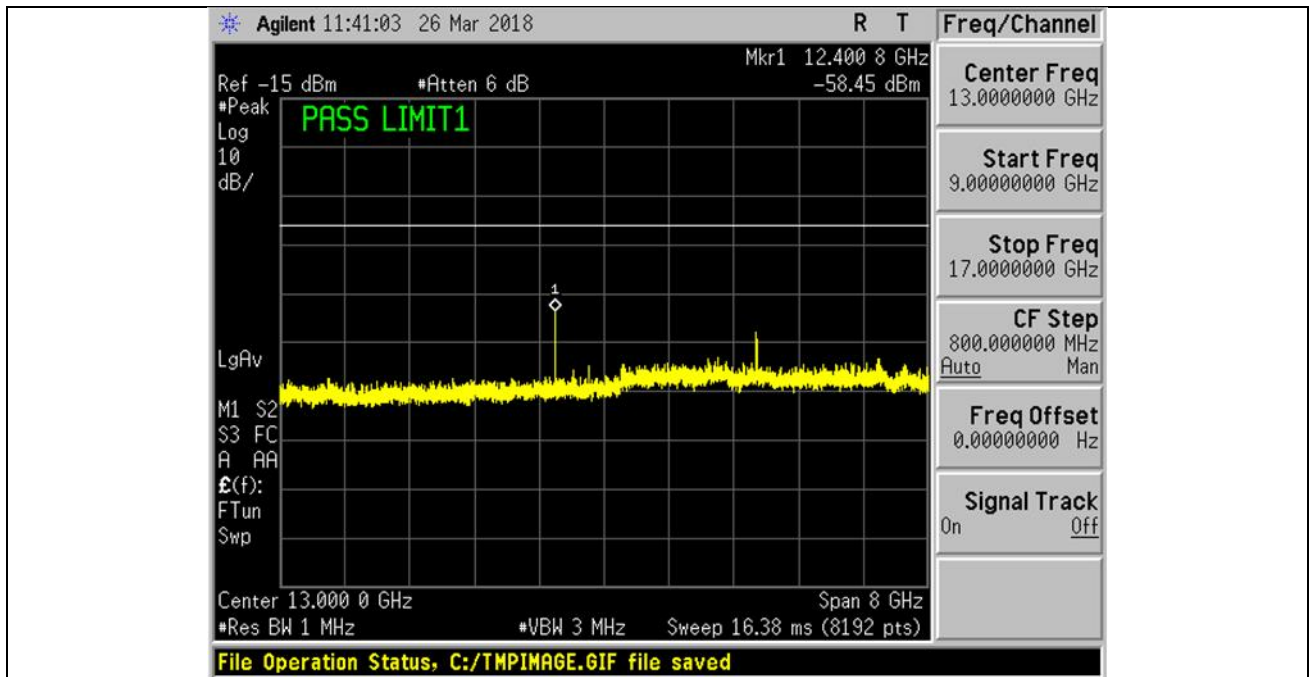
Plot 24 – Upper Channel



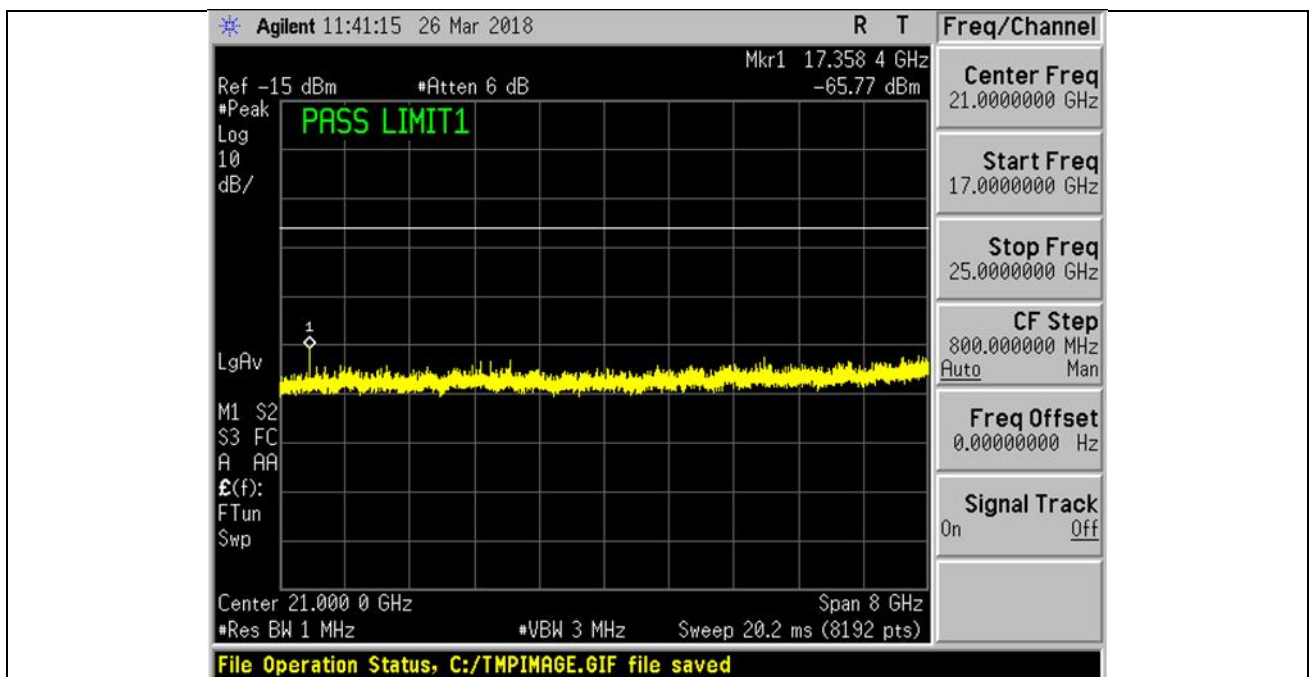
Plot 25 – Upper Channel



Radiated Spurious Emissions (Non-Restricted and Restricted Bands) Plots



Plot 26 – Upper Channel



Plot 27 – Upper Channel

2.7 Band Edge Compliance (Radiated)

2.7.1 Test Limits

The EUT shows compliance to the requirements of this section, which states in any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator (EUT) is operating, the radio frequency power that is produced by the EUT shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands shall comply to the radiated emission limits specified in 15.209.

2.7.2 Test Setup

2.7.2.1 The EUT and supporting equipment were set up as shown in the setup photo.

2.7.2.2 The power supply for the EUT was connected to a filtered mains.

2.7.2.3 The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz to show compliance of spurious at band edges are at least 20dB below the carriers. For restricted band spurious at band edges, peak and average measurement plots were taken using the following setting:

- a. Peak Plot:
RBW = 1MHz, VBW = 3RBW
- b. Average Plot
RBW = 1MHz, VBW = 10Hz

2.7.2.4 All other supporting equipment were powered separately from another filtered mains.

2.7.3 Test Method

2.7.3.1 The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode.

2.7.3.2 The frequency span of the spectrum analyser was set to wide enough to capture the lower band edge of the transmission band, 2.400GHz and any spurious emissions at the band edge.

2.7.3.3 The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.

2.7.3.4 The measurements were repeated if the EUT supports more than one modulation and data rate.

2.7.3.5 The measurements were repeated with the frequency span of the spectrum analyser was set to wide enough to capture the upper band edge frequency of the transmission band, 2.4835GHz and the any spurious emissions at the band-edge.

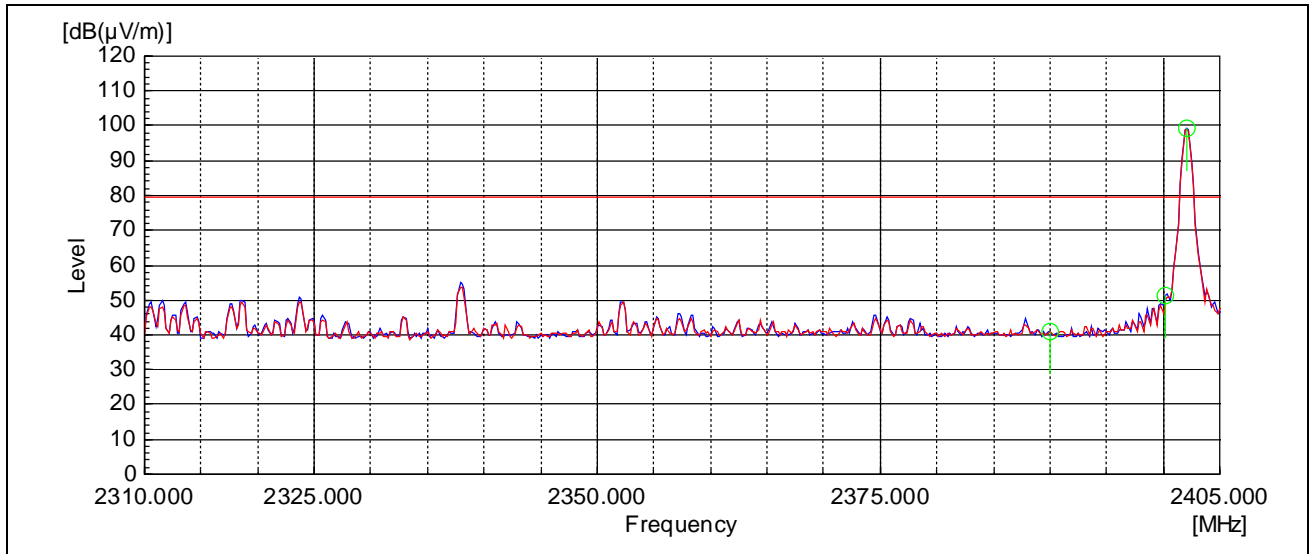


2.7.4 Test Results

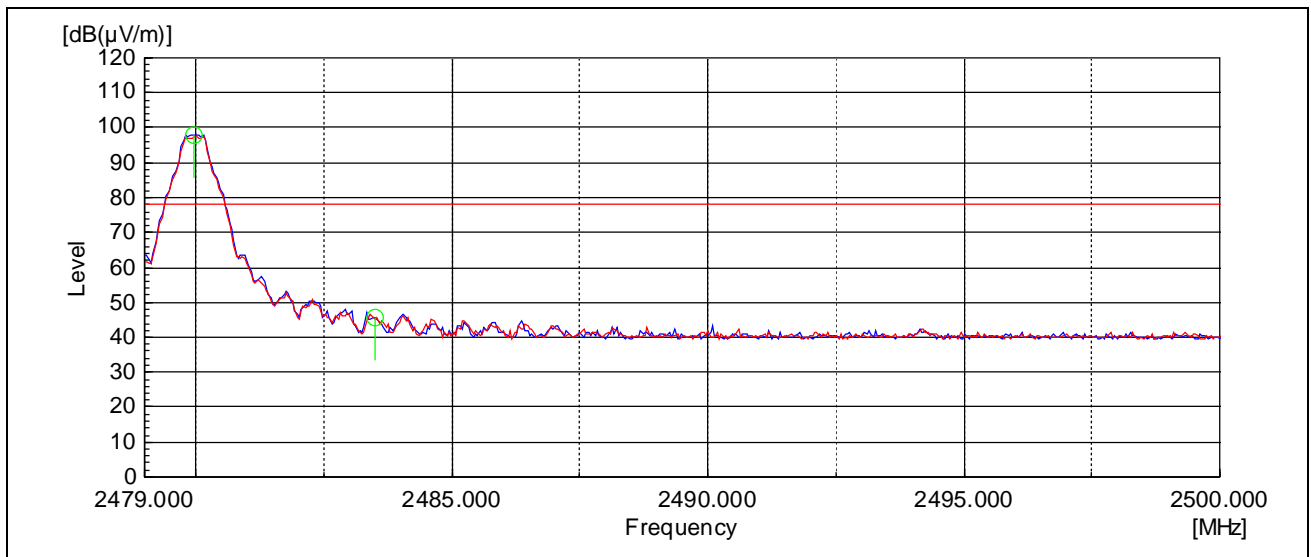
Test Input Power	120V 60Hz	Temperature	23°C
Attached Plots	28 - 33	Relative Humidity	58%
		Atmospheric Pressure	1030mbar
		Tested By	Dylan Lin

No significant signal was found and they were below the specified limit.

Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge)

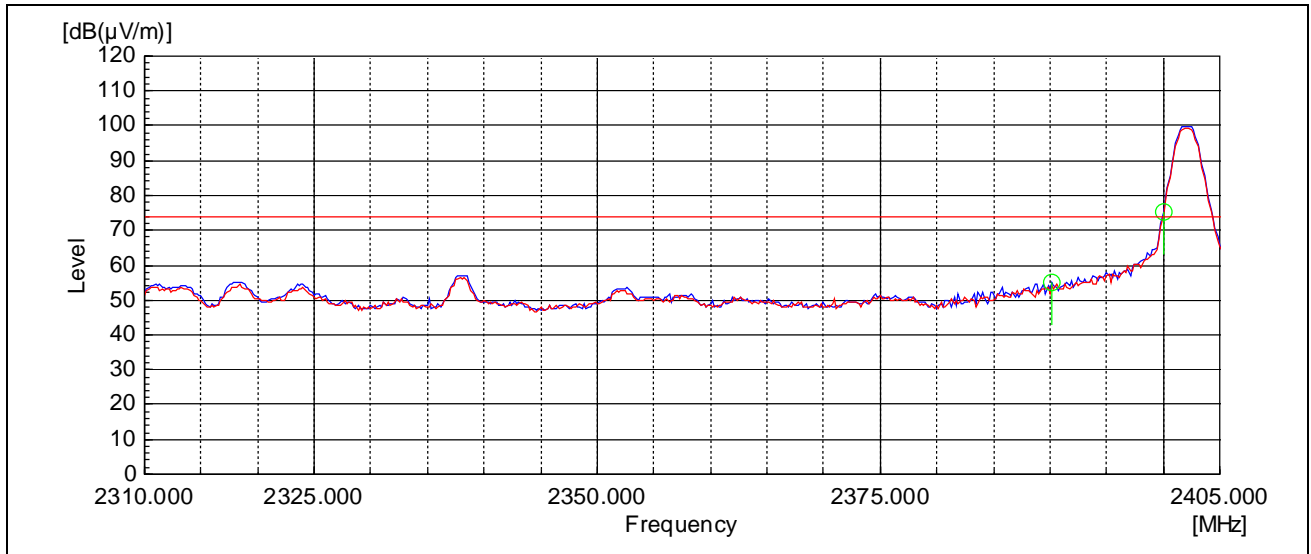


Plot 28 – Lower Band Edge at 2.4000GHz

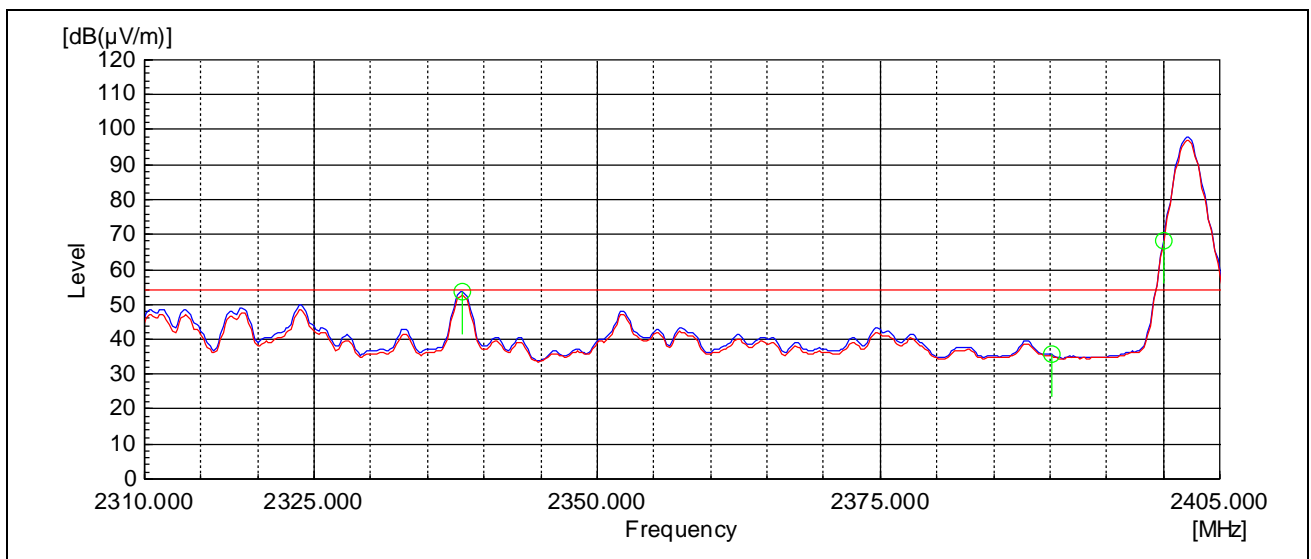


Plot 29 – Upper Band Edge at 2.4835GHz

Band Edge Compliance (Radiated) Plots (Restricted Band)



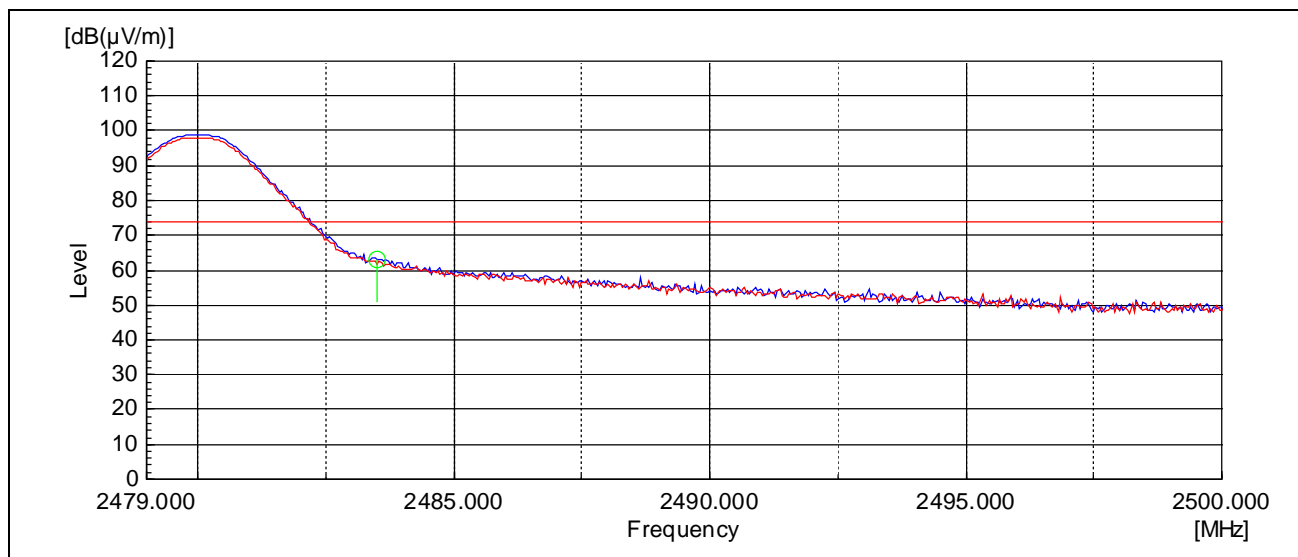
Plot 30 – Peak Plot at Lower Band Edge at 2.4000GHz



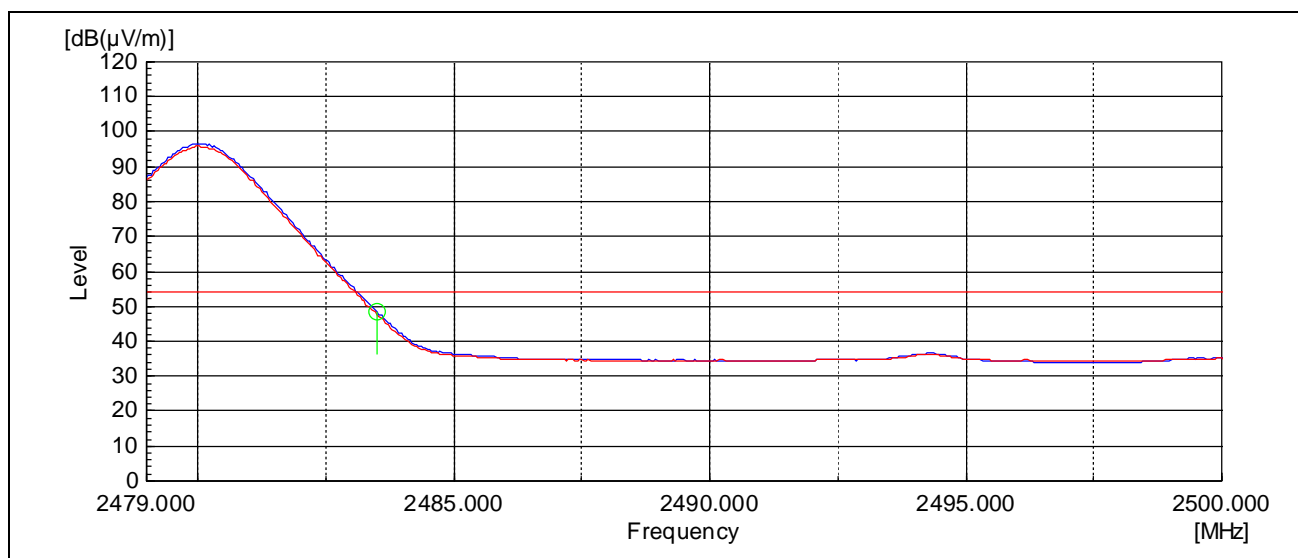
Plot 31 – Average Plot at Lower Band Edge at 2.4000GHz



Band Edge Compliance (Radiated) Plots (Restricted Band)



Plot 32 – Peak Plot at Upper Band Edge at 2.4835GHz



Plot 33 – Average Plot at Upper Band Edge at 2.4835GHz

2.8 Peak Power Spectral Density

2.8.1 Test Limits

The EUT shows compliance to the requirements of this section, which states the peak power spectral density conducted from the intentional radiator (EUT) to the antenna shall not be greater than 8dBm (6.3mW) in any 3kHz band during any time interval of continuous transmission.

2.8.2 Test Setup

2.8.2.1 The EUT and supporting equipment were set up as shown in the setup photo.

2.8.2.2 The power supply for the EUT was connected to a filtered mains.

2.8.2.3 The RF antenna connector was connected to the spectrum via a low-loss coaxial cable.

2.8.2.4 The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were set to the following:
RBW = 3kHz
VBW = 3RBW
Span = 1.5 times the channel bandwidth (6dB Bandwidth)
Sweep time = auto couple

2.8.2.5 All other supporting equipment were powered separately from another filtered mains.

2.8.3 Test Method

2.8.3.1 The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode at lower channel.

2.8.3.2 The peak of the transmitting frequency was detected with the marker peak function of the spectrum analyser.

2.8.3.3 The peak power density of the transmitting frequency was plotted and recorded.

2.8.3.4 The measurements were repeated if the EUT supports more than one modulation and data rate.

2.8.3.5 The measurement was repeated with the transmitting frequency was set to middle channel and upper channel respectively.



2.8.4 Test Results

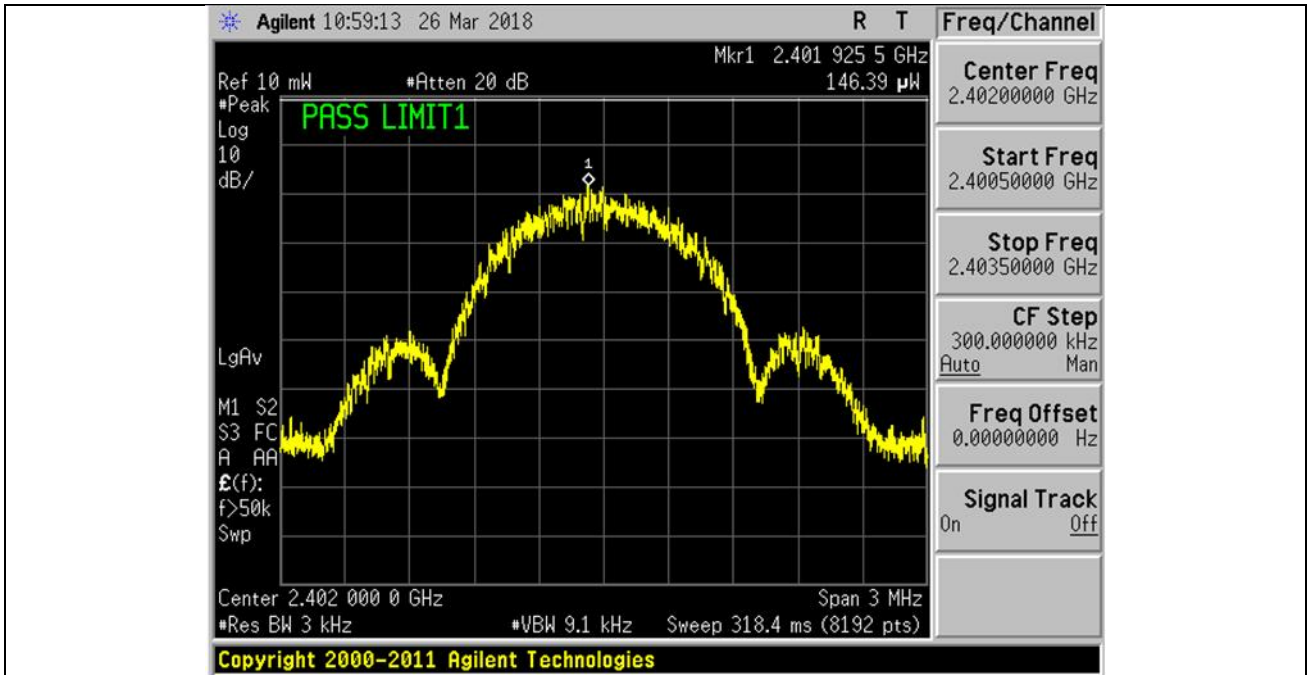
Test Input Power	120V 60Hz	Temperature	23°C
Attached Plots	34 - 36	Relative Humidity	58%
		Atmospheric Pressure	1030mbar
		Tested By	Dylan Lin

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW) <small>*See Note 1</small>	Limit (mW)
Lower	2.402	0.1463	6.3
Middle	2.440	0.1081	6.3
Upper	2.480	0.1524	6.3

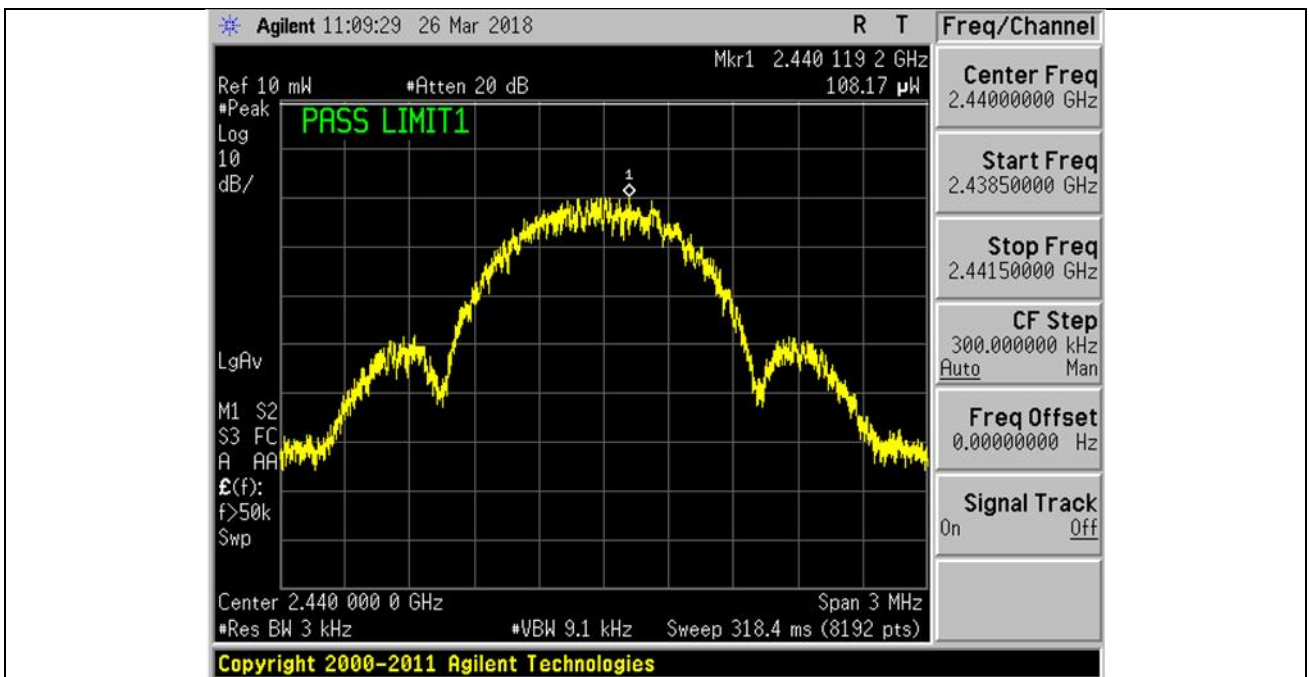
Notes

1.	Only the highest measured peak power spectral density was reported. Refer to plots for all measured peak power spectral density.
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Peak Power Spectral Density Plots



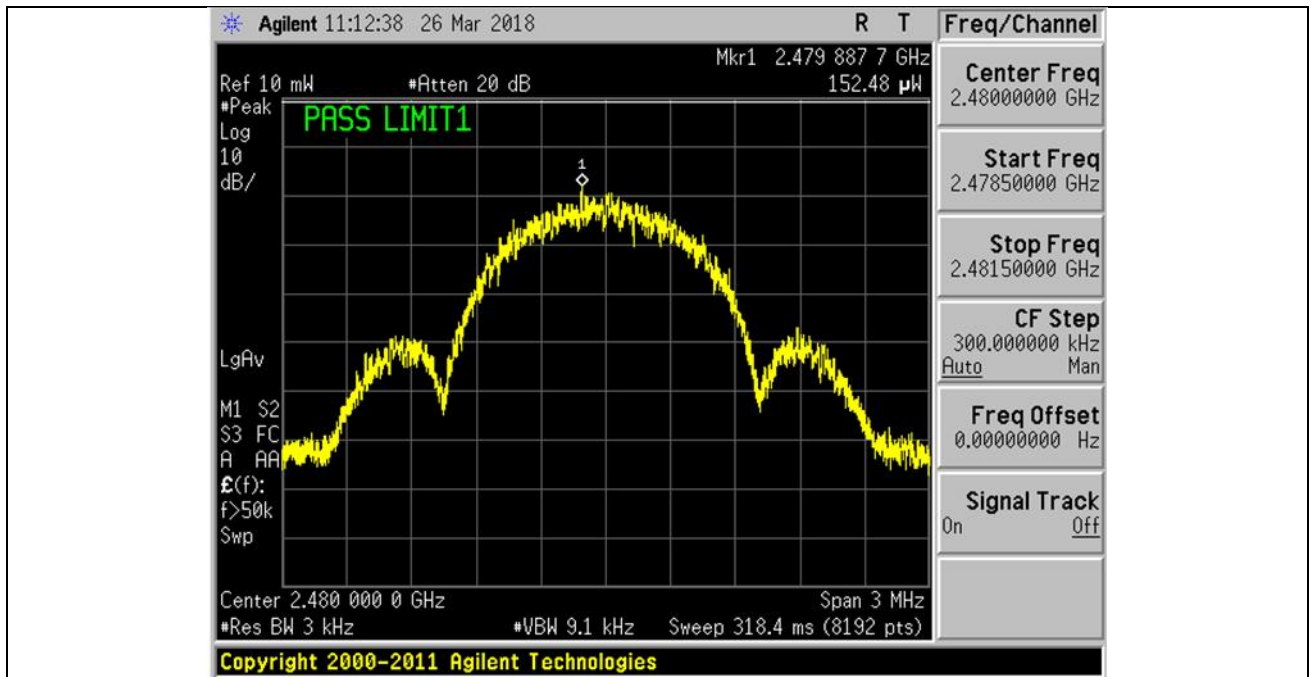
Plot 34 – Lower Channel



Plot 35 – Middle Channel



Peak Power Spectral Density Plots



Plot 36 – Upper Channel