

RF TEST REPORT

Test item : ESL Graphic TAG
Model No. : ST-GM22XXF
Order No. : DTNC1507-03804
Date of receipt : 2015-07-30
Test duration : 2015-08-09 ~ 2015-08-28
Date of issue : 2015-09-16
Use of report : FCC Original Grant

Applicant : Samsung Electro Mechanics
314 Maetan-3 Dong Pal Dal-Ku Kyungki-Do, Suwon-City, Korea, 442-743

Test laboratory : DT&C Co., Ltd.
42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 449-935

Test specification : FCC Part 15 Subpart C 247
Test environment : See appended test report
Test result : ☒ Pass ☐ Fail

The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DT&C Co., Ltd.

Tested by :



Engineer
HoonPyo Lee

Reviewed by :



Technical Manager
WonJung Lee

Test Report Version

Test Report No.	Date	Description
DRTFCC1508-0182	Aug. 25, 2015	Initial issue
DRTFCC1508-0182(1)	Aug. 28, 2015	Update Radiated Spurious Emissions and Appendix II
DRTFCC1508-0182(2)	Sep. 16, 2015	Update Radiated Spurious Emissions and Appendix III

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1. EUT Description

Product	ESL Graphic TAG
Model Name	ST-GM22XXF
Add Model Name	NA
Power Supply	DC 3.0V (Not rechargeable battery)
Frequency Range	2405 ~ 2480MHz (16 channels)
Modulation Type	OQPSK (ZIGBEE)
Antenna Specification	Antenna Type: Internal Antenna Antenna Gain: 0.23 dBi(PK)

2. Summary of Tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status Note 1
I. Transmitter Mode (TX)				
15.247(a)	6 dB Bandwidth	> 500 kHz	Conducted	C
15.247(b)	Transmitter Output Power	< 1 Watt		C
15.247(d)	Out of Band Emissions / Band Edge	20 dBc in any 100 kHz BW		C
15.247(e)	Transmitter Power Spectral Density	< 8 dBm/3kHz		C
15.205 15.209	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	FCC 15.209 limits	Radiated	C ^{Note2}
15.207	AC Conducted Emissions	FCC 15.207 limits	AC Line Conducted	NA ^{Note3}
15.203	Antenna Requirements	FCC 15.203	-	C
Note 1 : C=Comply NC=Not Comply NT=Not Tested NA=Not Applicable Note 2: This test item was performed in each axis and the worst case data was reported. Note 3: The power of this device is only DC(Not rechargeable Battery).				

3. Test Methodology

Generally the tests were performed according to the KDB558074 v03r03. And ANSI C63.10-2013 was used to reference appropriate EUT setup and maximizing procedures of radiated spurious emission and AC line conducted emission testing.

3.1 EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT Exercise

The EUT was operated in the test mode to fix the TX frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3 General Test Procedures

Conducted Emissions

According to the requirements in Section 6.2 of ANSI C63.10, the EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT are measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and Average detector.

Radiated Emissions

The EUT is placed on a non-conductive table. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the highest emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 6.3 of ANSI C63.10

3.4 Description of Test Modes

The EUT has been tested with the operating condition for maximizing the emission characteristics. A test program is used to control the EUT for staying in continuous transmitting. The Bluetooth low energy mode and below low, middle and high channels were tested and reported.

Test Mode	Channel	Frequency [MHz]
ZIGBEE	Lowest	2405
	Middle	2440
	Highest	2480

4. Instrument Calibration

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

5. Facilities and Accreditations

5.1 Facilities

The open area test site(OATS) or semi anechoic chamber and conducted measurement facility used to collect the radiated and conducted test data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 449-935. The site is constructed in conformance with the requirements.

- Semi anechoic chamber registration Number : 165783 (FCC)

5.2 Equipment

Radiated emissions are measured with one or more of the following types of Linearly polarized Antennas : tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and peak, quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

6. Antenna Requirements

According to FCC 47 CFR §15.203 :

"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 this E.U.T is PCB type. Therefore the antenna is permanently attached.

Please refer to the internal photo. Therefore this E.U.T Complies with the requirement of §15.203

7. Test Result

7.1 6 dB Bandwidth Measurement

Test Requirements and limit, §15.247(a)

The bandwidth at 6 dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

The minimum permissible 6 dB bandwidth is 500 kHz.

■ Test Configuration

Refer to the APPENDIX I.

■ Test Procedure

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of **KDB558074**

1. Set resolution bandwidth (RBW) = 100 KHz
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
(RBW : 100 KHz / VBW : 300 KHz)
3. Detector = **Peak**.
4. Trace mode = **max hold**.
5. Sweep = **auto couple**.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

■ Test Results: **Comply**

Test Mode	Frequency [MHz]	Test Results [MHz]
ZIGBEE	Lowest	1.496
	Middle	1.621
	Highest	1.571

TEST PLOTS

6 dB Bandwidth

Test Frequency : 2405 MHz



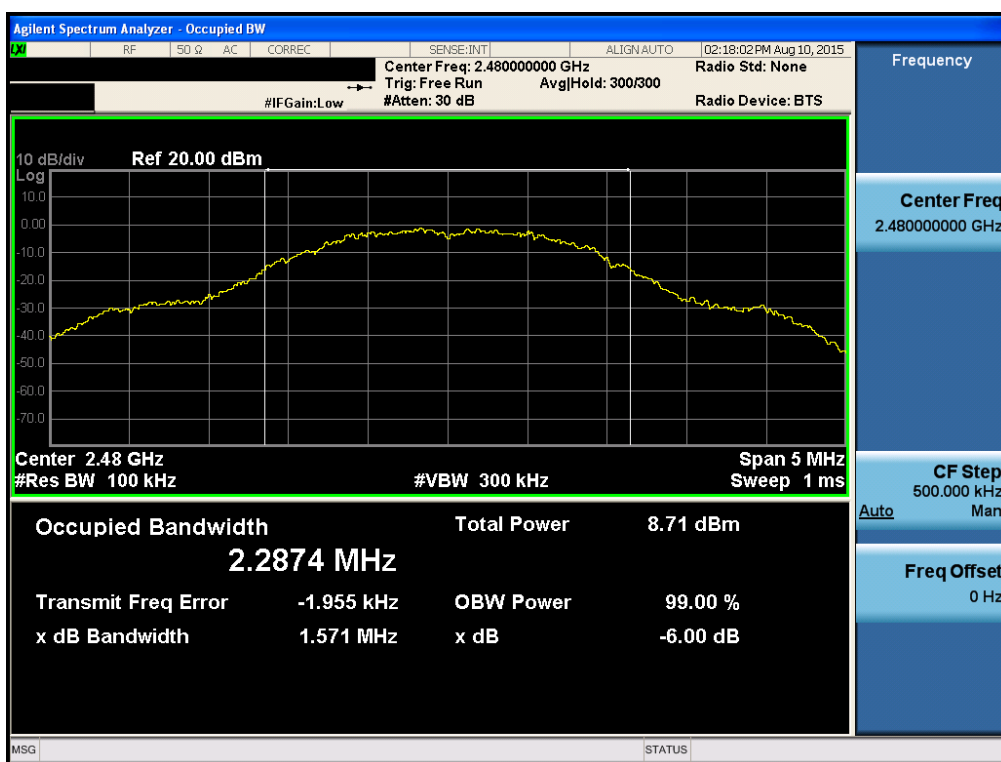
6 dB Bandwidth

Test Frequency : 2440 MHz



6 dB Bandwidth

Test Frequency : 2480 MHz



7.2 Maximum Peak Conducted Output Power

Test Requirements and limit, §15.247(b)

A transmitter antenna terminal of EUT is connected to the input of a spectrum analyzer.

Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

■ Test Configuration

Refer to the APPENDIX I.

■ Test Procedure :

Maximum Peak Conducted Output Power is measured using Measurement Procedure Option1 of KDB558074

1. Set the RBW $\geq$ DTS bandwidth. **Actual RBW = 2 MHz**
2. Set VBW $\geq 3 \times$ RBW. **Actual VBW = 6 MHz**
3. Set span $\geq 3 \times$ RBW.
4. Sweep time = **auto couple**
5. Detector = **peak**
6. Trace mode = **max hold**
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level.

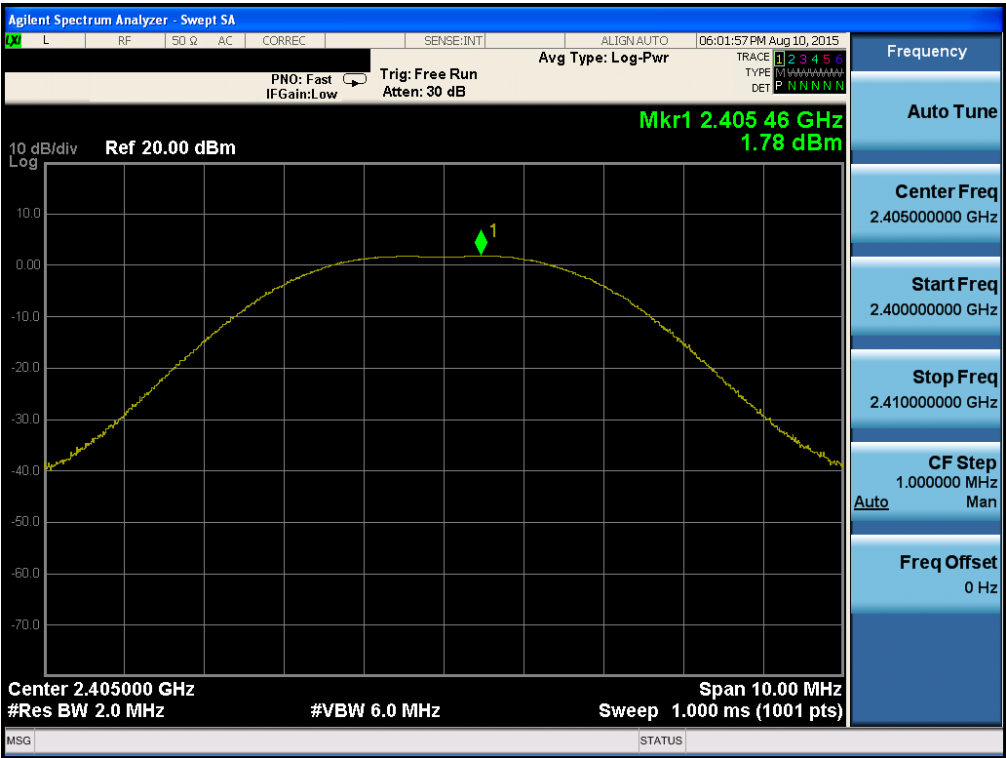
■ Test Results : **Comply**

Test Mode	Test Results [dBm]		
	Lowest	Middle	Highest
ZIGBEE	1.78	1.61	2.62

TEST PLOTS

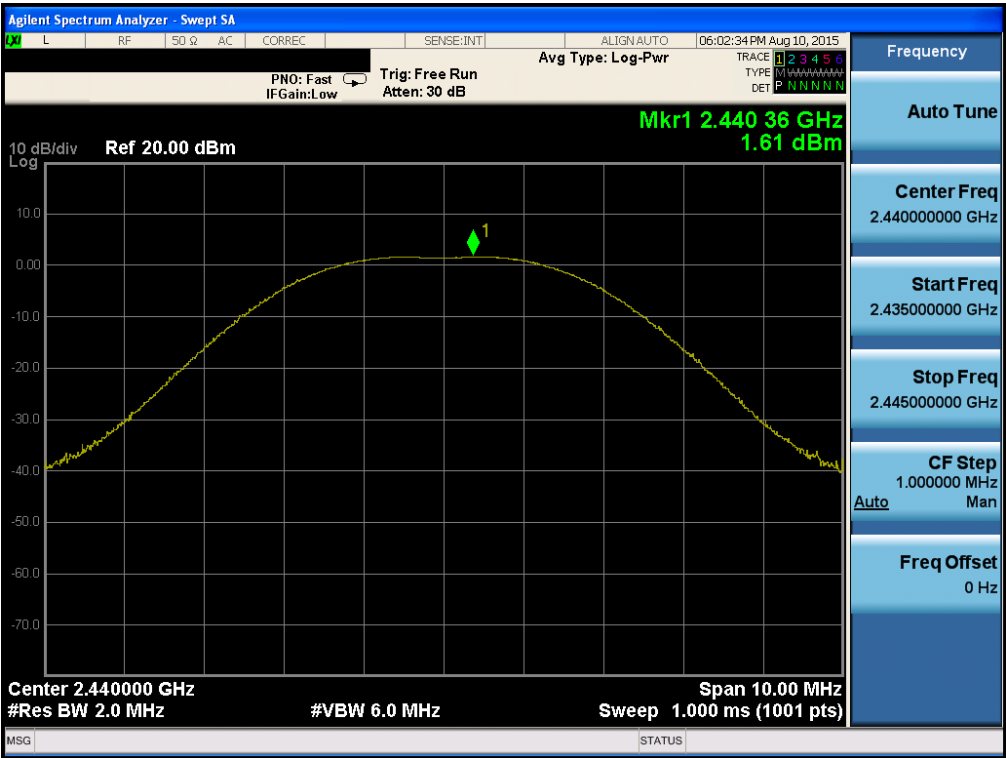
Peak Output Power

Test Frequency : 2405 MHz



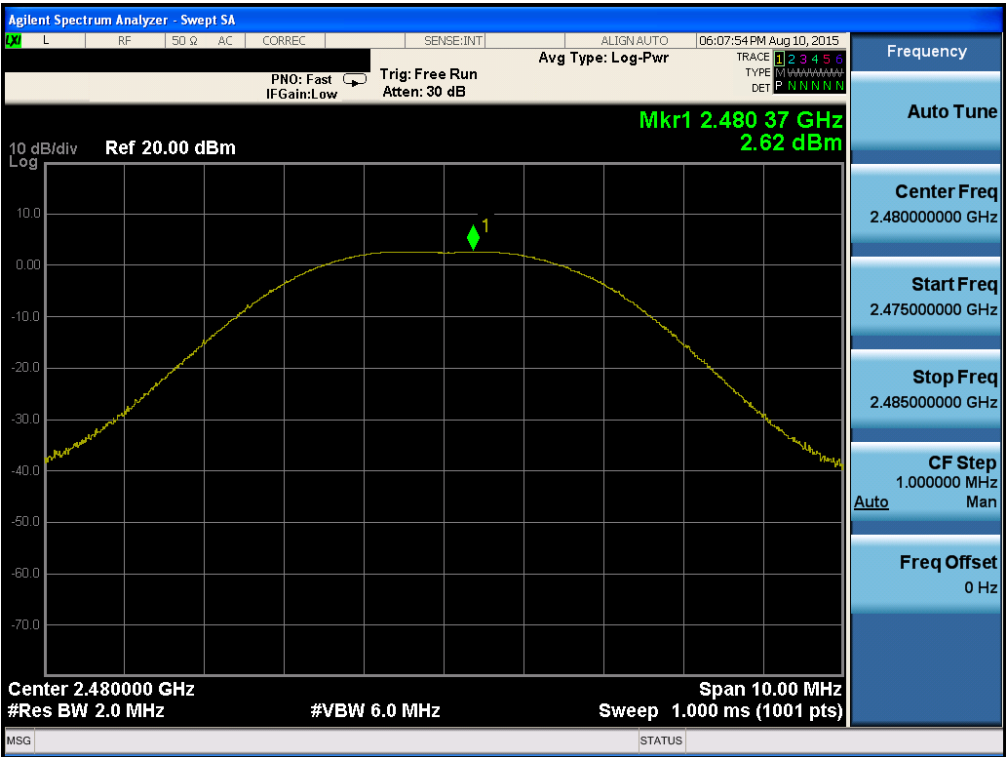
Peak Output Power

Test Frequency : 2440 MHz



Peak Output Power

Test Frequency : 2480 MHz



7.3 Maximum Power Spectral Density.

Test requirements and limit, §15.247(e)

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Minimum Standard – specifies a conducted power spectral density (PSD) limit of 8 dBm in any 3 kHz Band segment within the fundamental EBW during any time interval of continuous transmission.

■ Test Configuration

Refer to the APPENDIX I.

■ Test Procedure :

Method PKPSD of KDB558074 is used.

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to **1.5 times** the DTS bandwidth.
3. Set the RBW to : **3 kHz ≤ RBW ≤ 100 kHz**.
4. Set the VBW ≥ **3 x RBW**.
5. Detector = **peak**.
6. Sweep time = **auto couple**.
7. Trace mode = **max hold**.
8. Allow trace to fully stabilize.
9. Use the **peak marker function** to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

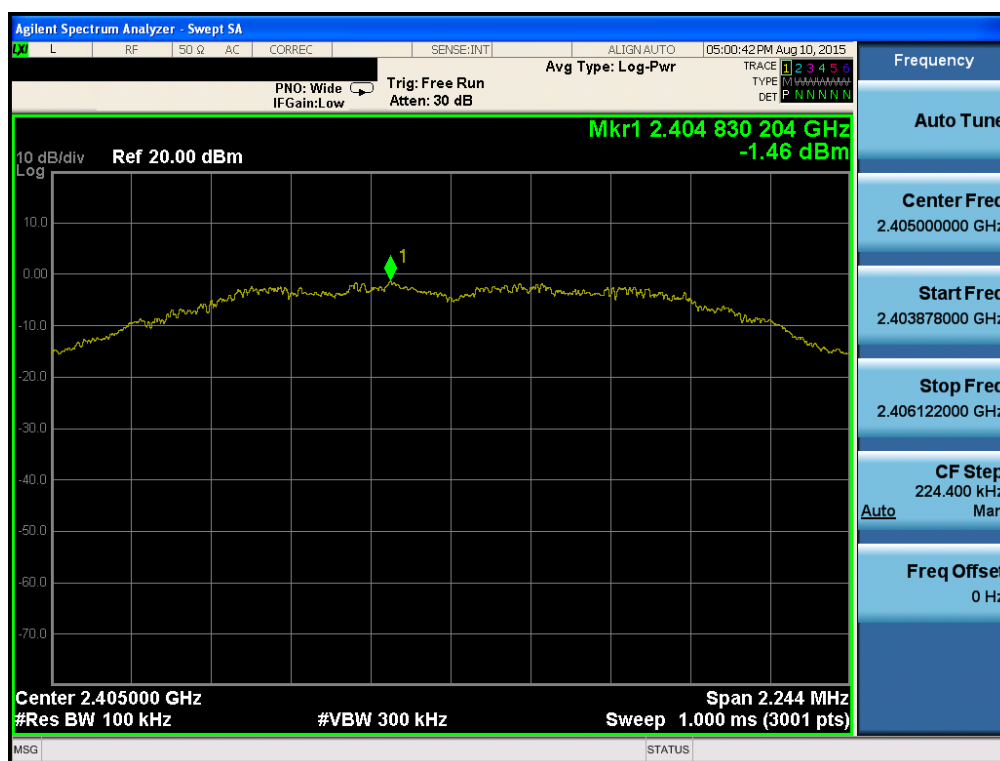
■ TEST RESULTS : **Comply**

Test Mode	Frequency [MHz]	PKPSD [dBm]
ZIGBEE	Lowest	-1.46
	Middle	-2.43
	Highest	-0.98

■ TEST PLOTS

Maximum PKPSD

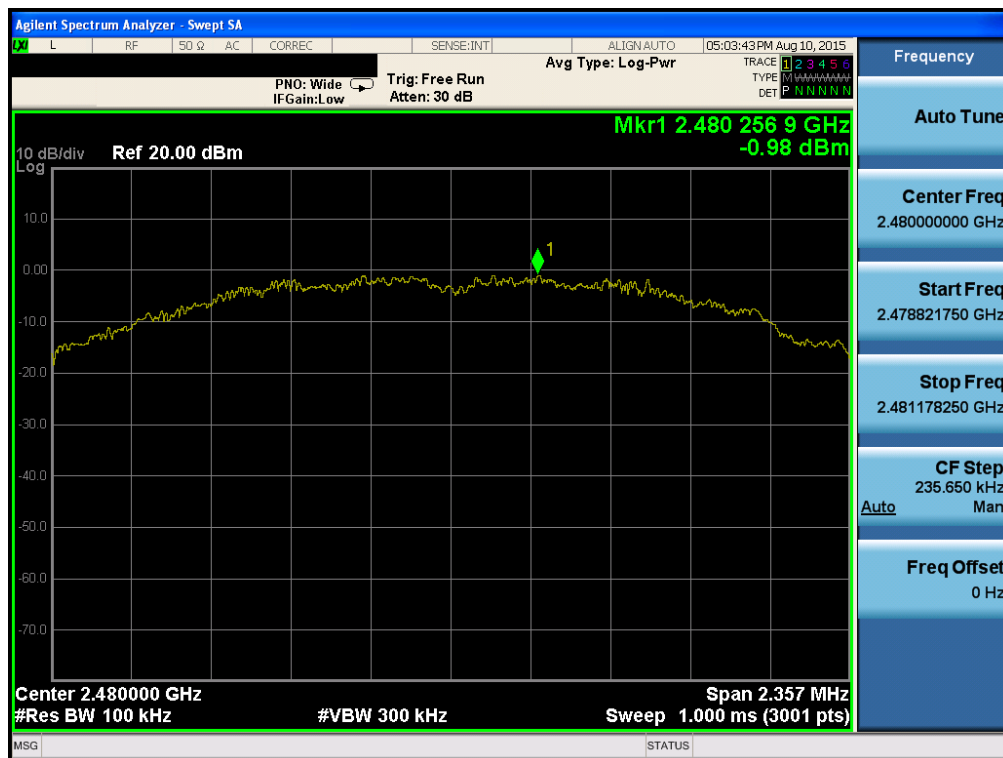
Test Frequency : 2405 MHz



Maximum PKPSD

Test Frequency : 2440 MHz





7.4 Out of Band Emissions at the Band Edge / Conducted Spurious Emissions

Test requirements and limit, §15.247(d)

§15.247(d) specifies that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions :

If **the peak output power procedure** is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated **by at least 20 dB** relative to the maximum measured in-band peak PSD level.

If the average output power procedure is used to measure the fundamental emission power to demonstrate compliance to **15.247(b)(3)** requirements, then the power in any 100 kHz outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum measured inband average PSD level.

In either case, attenuation to levels below the general emission limits specified in **§15.209(a)** is not required.

■ Test Configuration

Refer to the APPENDIX I.

■ Test Procedure :

The transmitter output is connected to a spectrum analyzer.

- Measurement Procedure 1 – Reference Level

1. Set instrument center frequency to DTS channel center frequency.
2. Set the span to ≥ 1.5 times the DTS bandwidth.
3. Set the RBW = 100 kHz.
4. Set the VBW $\geq 3 \times$ RBW.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum PSD level

- Measurement Procedure 2 - Unwanted Emissions

1. Set the center frequency and span to encompass frequency range to be measured.
2. Set the RBW = **100 kHz.(Actual 1 MHz , See below note)**
3. Set the VBW $\geq 3 \times$ RBW.(Actual 3 MHz, See below note)
4. Detector = **peak**.
5. Ensure that the number of measurement points $\geq$ span/RBW
6. Sweep time = **auto couple**.
7. Trace mode = **max hold**.
8. **Allow the trace to stabilize** (this may take some time, depending on the extent of the span).
9. Use the peak marker function to determine the maximum amplitude level.

Note : The conducted spurious emission was tested with below settings.

Frequency range : 9 kHz ~ 30 MHz

RBW = 100 kHz, VBW = 300 kHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT : 40001

Frequency range : 30 MHz ~ 10 GHz, 10 GHz ~ 25 GHz

RBW = 1 MHz, VBW = 3 MHz, SWEEP TIME = AUTO, DETECTOR = PEAK, TRACE = MAX HOLD, SWEEP POINT: 40001

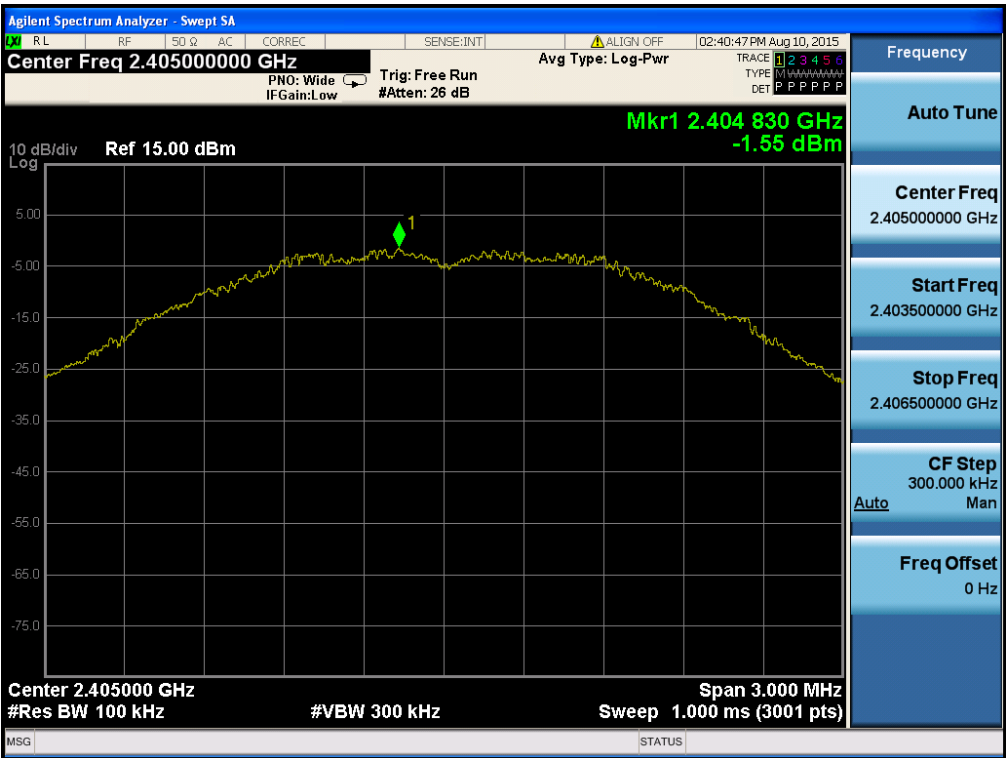
LIMIT LINE = 20 dB below of the reference level of above measurement procedure Step 2. (RBW = 100 KHz, VBW = 300 KHz)

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 KHz, VBW = 300 kHz, SPAN = 100 MHz and BINS = 2001 to get accurate emission level within 100 KHz BW.

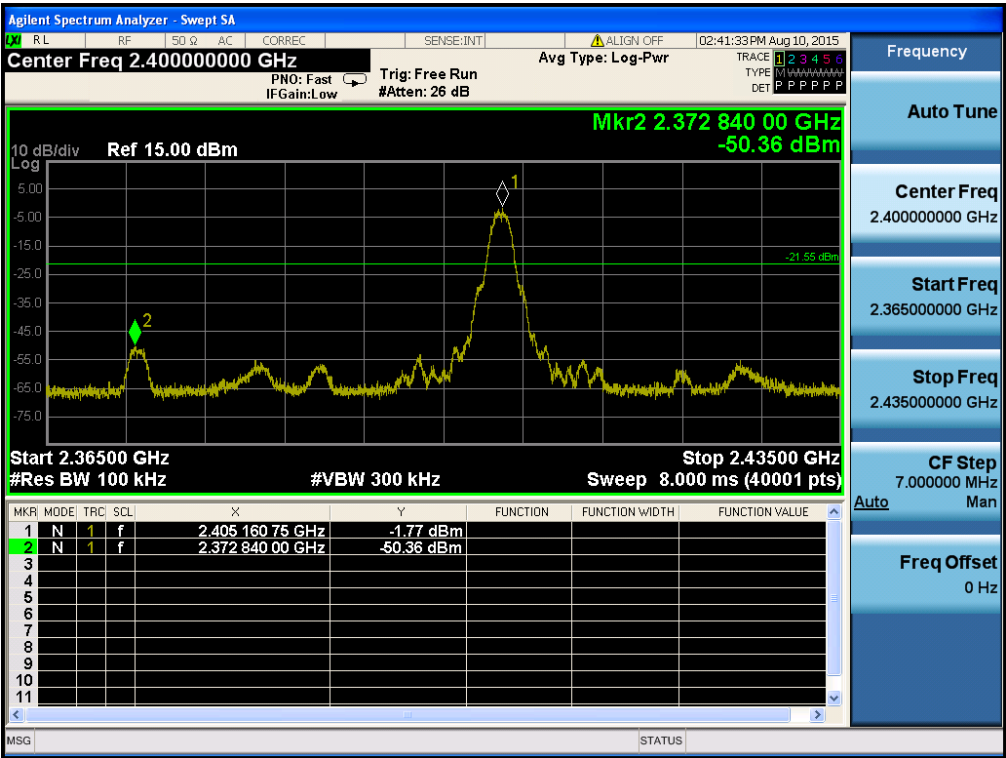
Also the path loss for conducted measurement setup was used as described on the Appendix I of this test report.

Test Results : **Comply**

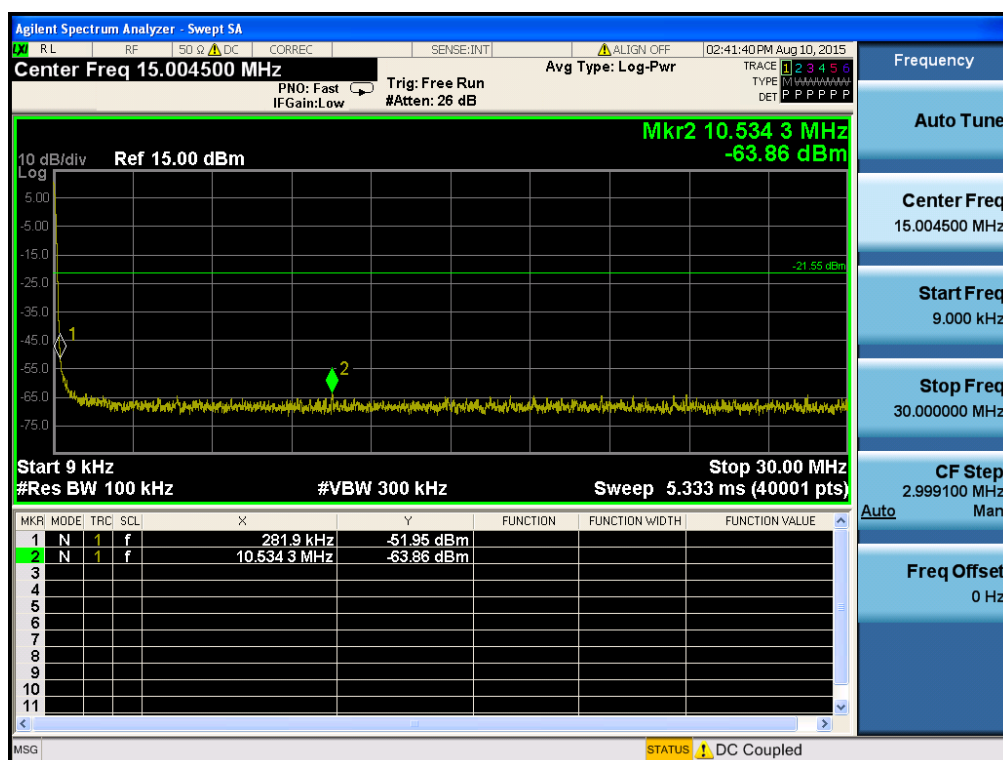
Reference (Test Frequency : 2405 MHz)



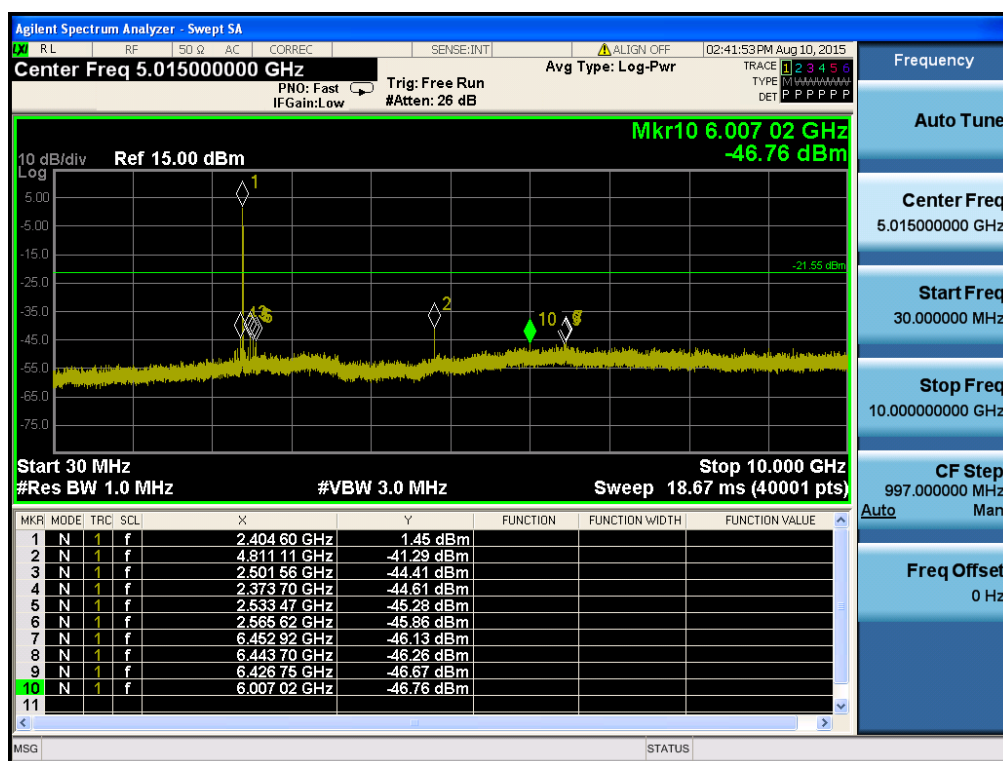
Low Band-edge



Conducted Spurious Emissions 1 (Test Frequency : 2405 MHz)



Conducted Spurious Emissions 2 (Test Frequency : 2405 MHz)



Agilent Spectrum Analyzer - Swept SA

RL RF 50 Ω AC CORREC SENSE:INT ALIGN OFF 02:42:02 PM Aug 10, 2015

Center Freq 17.50000000 GHz PNO: Fast IF Gain: Low Trig: Free Run #Atten: 26 dB Avg Type: Log-Pwr

TRACE 1 2 3 4 5 6
TYPE M M M M M M M M
DET P P P P P P

10 dB/div Ref 15.00 dBm

Mkr5 24.589 750 GHz
-39.58 dBm

-21.55 dBm

Start 10.000 GHz Stop 25.000 GHz
#Res BW 1.0 MHz #VBW 3.0 MHz Sweep 40.00 ms (40001 pts)

MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	24.942 625 GHz	-39.72 dBm			
2	N	1	f	24.294 250 GHz	-39.93 dBm			
3	N	1	f	24.775 375 GHz	-39.01 dBm			
4	N	1	f	24.158 125 GHz	-39.07 dBm			
5	N	1	f	24.589 750 GHz	-39.58 dBm			
6								
7								
8								
9								
10								
11								

MSG STATUS

Auto Tune

Center Freq 17.50000000 GHz

Start Freq 10.00000000 GHz

Stop Freq 25.00000000 GHz

CF Step 1.50000000 GHz

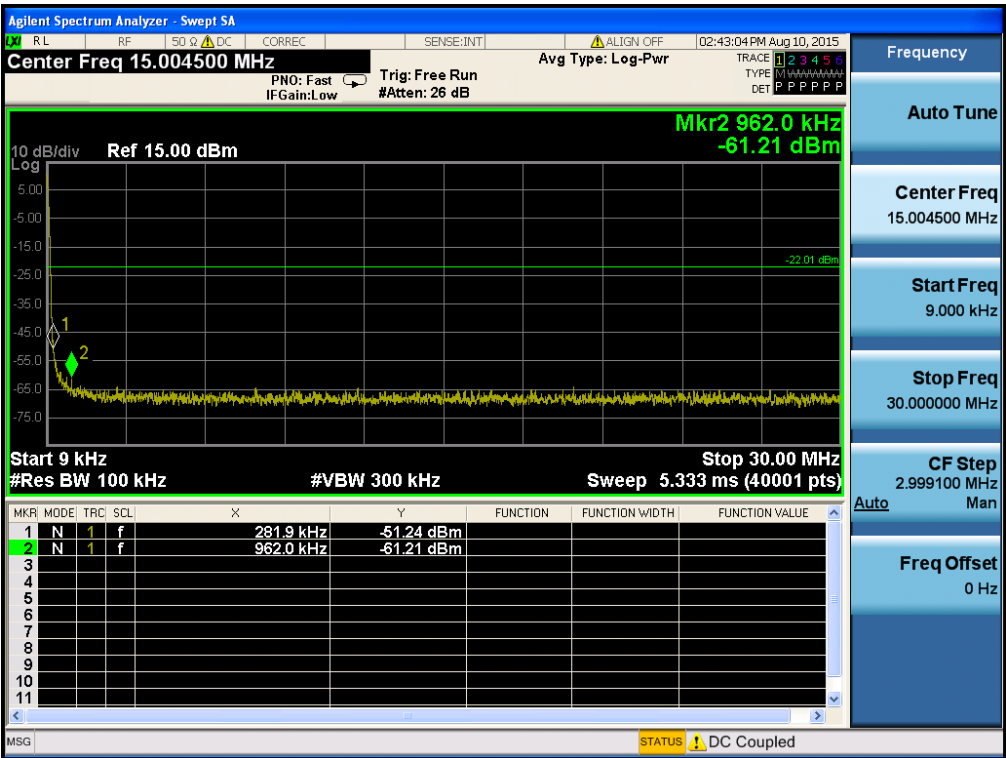
Auto Man

Freq Offset 0 Hz

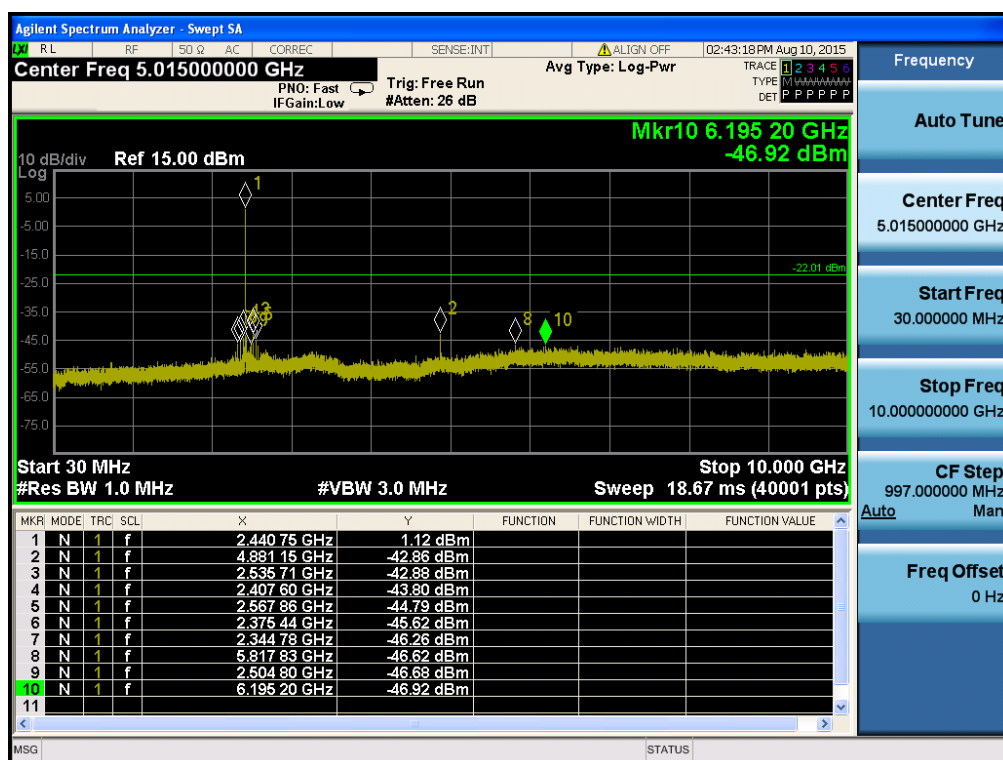
Reference (Test Frequency : 2440 MHz)



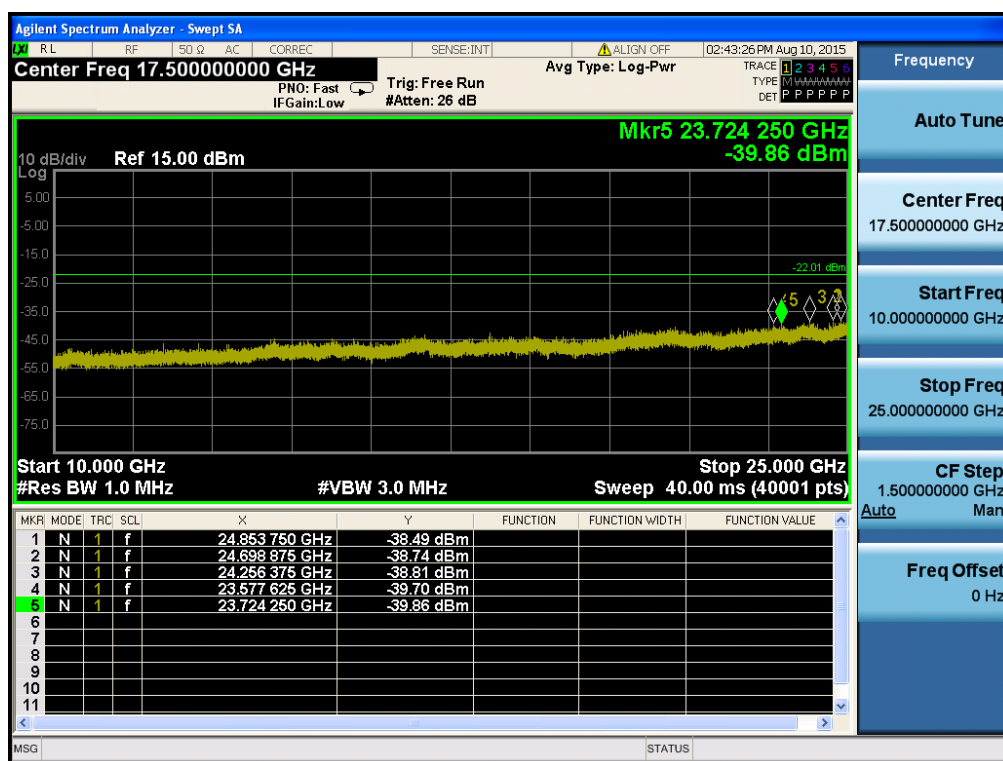
Conducted Spurious Emissions 1 (Test Frequency : 2440 MHz)



Conducted Spurious Emissions 2 (Test Frequency : 2440 MHz)



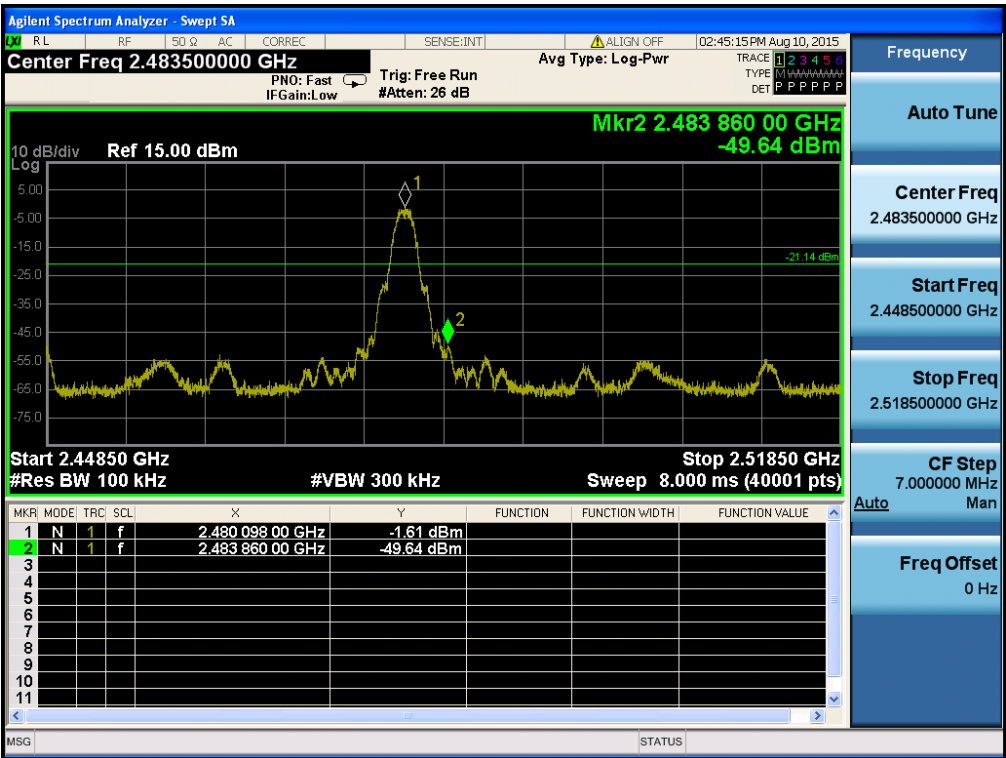
Conducted Spurious Emissions 3 (Test Frequency : 2440 MHz)



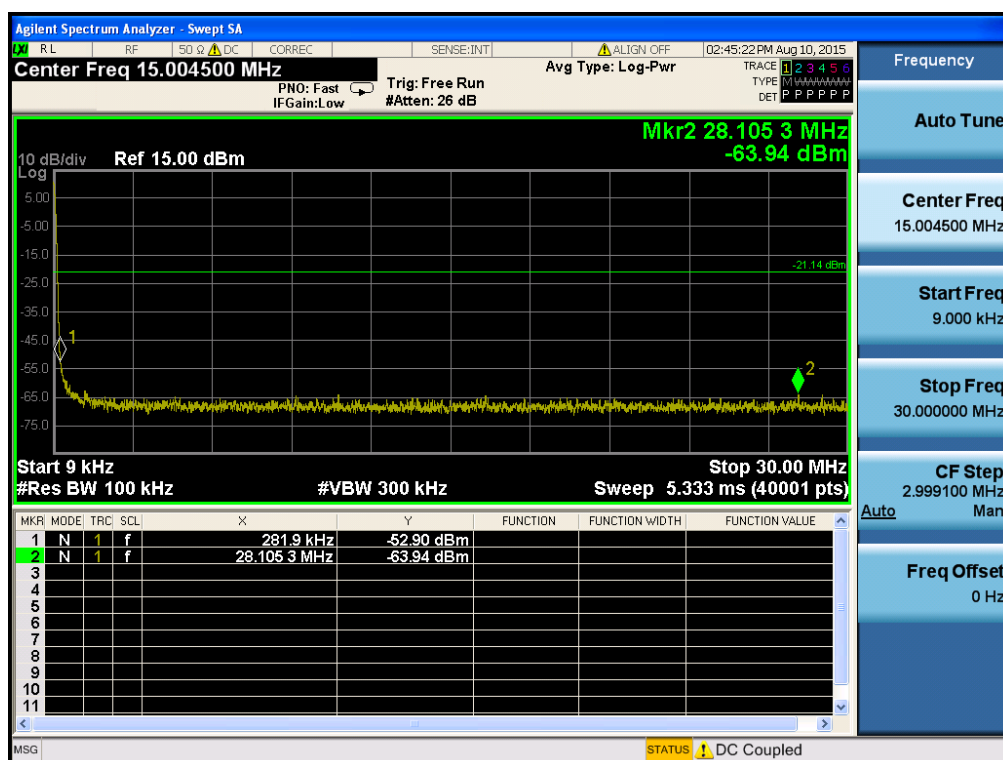
Reference (Test Frequency : 2480 MHz)



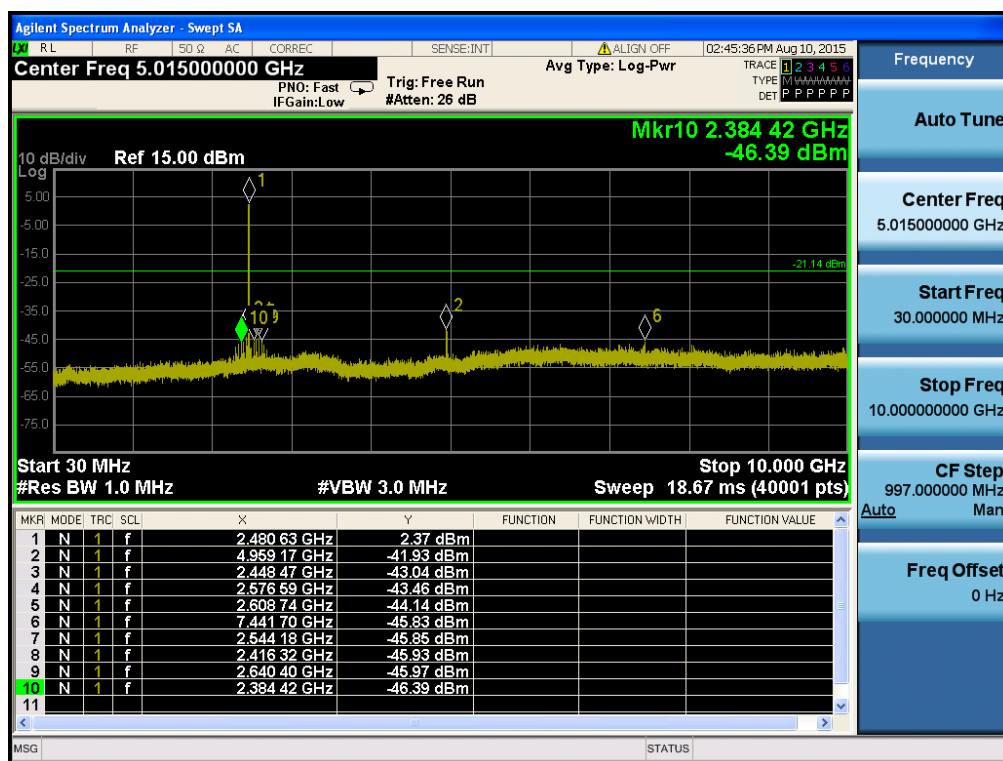
High Band-edge (Test Frequency : 2480 MHz)



Conducted Spurious Emissions 1 (Test Frequency : 2480 MHz)



Conducted Spurious Emissions 2 (Test Frequency : 2480 MHz)



Agilent Spectrum Analyzer - Swept SA

RL RF 50 Ω AC CORREC SENSE:INT ALIGN OFF 02:45:44 PM Aug 10, 2015

Center Freq 17.50000000 GHz PNO: Fast IF Gain: Low Trig: Free Run #Atten: 26 dB Avg Type: Log-Pwr

TRACE 1 2 3 4 5 6
TYPE M M M M M M M M
DET P P P P P P

10 dB/div Ref 15.00 dBm

Mkr5 23.214 625 GHz
-39.51 dBm

-21.14 dBm

Start 10.000 GHz Stop 25.000 GHz
#Res BW 1.0 MHz #VBW 3.0 MHz Sweep 40.00 ms (40001 pts)

MKR	MODE	TRC	SCL	X	Y	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE
1	N	1	f	24.101 125 GHz	-39.39 dBm			
2	N	1	f	24.806 125 GHz	-39.51 dBm			
3	N	1	f	24.698 500 GHz	-39.67 dBm			
4	N	1	f	23.774 500 GHz	-39.42 dBm			
5	N	1	f	23.214 625 GHz	-39.51 dBm			
6								
7								
8								
9								
10								
11								

MSG STATUS

Frequency

Auto Tune

Center Freq 17.50000000 GHz

Start Freq 10.00000000 GHz

Stop Freq 25.00000000 GHz

CF Step 1.50000000 GHz

Auto Man

Freq Offset 0 Hz

7.5 Radiated Measurement.

7.5.1 Radiated Spurious Emissions.

Test Requirements and limit,

§15.247(d), §15.205, §15.209

In any 100 kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a) and (b), then the 15.209(a) limit in the table below has to be followed

▪ FCC Part 15.209(a) and (b)

Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 – 0.490	2400/F (KHz)	300
0.490 – 1.705	24000/F (KHz)	30
1.705 – 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

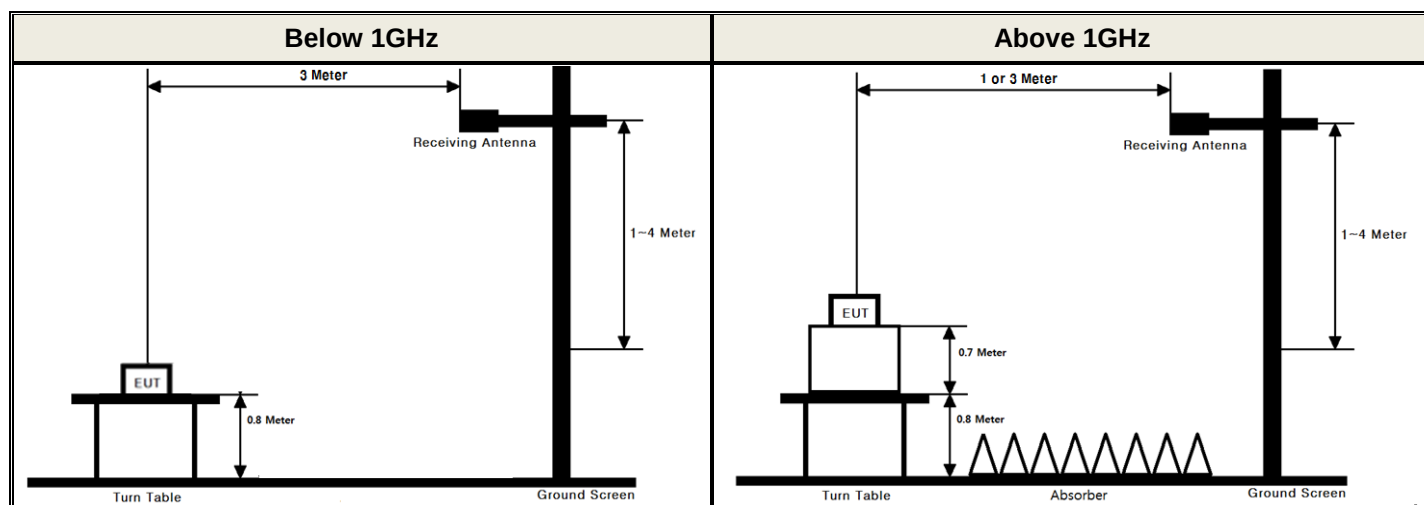
** Except as provided in 15.209(g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

▪ FCC Part 15.205 (a) : Only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.52025	156.52475 ~	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	12.57675 ~	156.52525	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	12.57725	156.7 ~ 156.9	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	13.36 ~ 13.41	162.0125 ~ 167.17	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.42 ~ 16.423	167.72 ~ 173.2	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	16.69475 ~	240 ~ 285	2655 ~ 2900		
8.291 ~ 8.294	16.69525	322 ~ 335.4	3260 ~ 3267		
8.362 ~ 8.366	16.80425 ~	399.90 ~ 410	3332 ~ 3339		
8.37625 ~ 8.38675	16.80475	608 ~ 614	3345.8 ~ 3358		
	25.5 ~ 25.67	960 ~ 1240	3600 ~ 4400		
	37.5 ~ 38.25				
	73 ~ 74.6				
	74.8 ~ 75.2				

▪ **FCC Part 15.205(b)** : The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

■ Test Configuration



■ Test Procedure :

1. The EUT is placed on a non-conductive table. For emission measurements at or below 1 GHz, the table height is 80 cm. For emission measurements above 1 GHz, the table height is 1.5 m.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

Note: Measurement Instrument Setting for Radiated Emission Measurements.

1. Frequency Range: ≤ 1 GHz

RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak

2. Frequency Range: > 1 GHz

Peak Measurement

RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Sweep time = Auto, Trace mode = Max Hold until the trace stabilizes

Average Measurement

The result of Average measurement is calculated using PK result and duty correction factor.

■ Test Plot:

Refer to the APPENDIX III

9 kHz ~ 25 GHz Data

▪ Lowest Channel

Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2373.73	H	X	PK	52.64	2.88	N/A	55.52	74.00	18.48
2373.73	H	X	AV	N/A	N/A	-28.18	27.34	54.00	26.66
4809.14	V	X	PK	56.57	5.70	N/A	62.27	74.00	11.73
4809.14	V	X	AV	N/A	N/A	-28.18	34.09	54.00	19.91
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

▪ Middle Channel

Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4878.85	H	Y	PK	53.77	5.83	N/A	59.60	74.00	14.40
4878.85	H	Y	AV	N/A	N/A	-28.18	31.42	54.00	22.58
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

▪ Highest Channel

Frequency (MHz)	ANT Pol	The worst case EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2483.52	H	Y	PK	57.86	3.36	N/A	61.22	74.00	12.78
2483.52	H	Y	AV	N/A	N/A	-28.18	33.04	54.00	20.96
4958.98	V	Y	PK	50.92	6.20	N/A	57.12	74.00	16.88
4958.98	V	Y	AV	N/A	N/A	-28.18	28.94	54.00	25.06
-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-

▪ Note.

1. This test item was performed in each axis.

And no other spurious and harmonic emissions were reported greater than listed emissions above table.

2. Sample Calculation.

$$\text{Margin} = \text{Limit} - \text{Result} \quad / \quad \text{Result} = \text{Reading} + \text{T.F} \quad / \quad \text{T.F} = \text{AF} + \text{CL} - \text{AG}$$

Where, T.F = Total Factor, AF = Antenna Factor, CL = Cable Loss, AG = Amplifier Gain,

3. The AV result was calculated using a duty correction factor (DCF).

And the Duty cycle information is declared by manufacturer.

$$\text{DCF} = 20 \log(t / 100 \text{ ms}), t = \text{Declared value of bursts on-time in 100 ms.}$$

$$20 \log(3.9 \text{ ms} / 100 \text{ ms}) = -28.18 \text{ dB} \quad / \quad \text{AV result} = \text{PK result} + \text{DCF}$$

7.6 POWERLINE CONDUCTED EMISSIONS

Test Requirements and limit, §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

■ Test Configuration :

See test photographs for the actual connections between EUT and support equipment.

■ Test Procedure

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below :
4. Detectors – Quasi Peak and Average Detector.

■ Test Results : **NA**

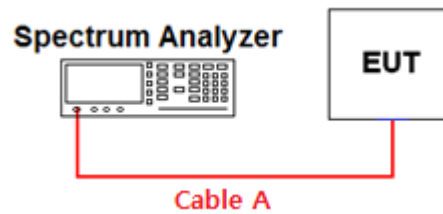
8. LIST OF TEST EQUIPMENT

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Signal Analyzer	Agilent Technologies	N9020A	15/01/19	16/01/19	MY48011146
Signal Generator	Rohde Schwarz	SMF100A	15/06/29	16/06/29	102341
Dynamic Measurement DC Source	Agilent Technologies	66332A	14/10/20	15/10/20	MY43000394
Multimeter	HP	34401A	15/02/25	16/02/25	3146A13475
Thermohygrometer	BODYCOM	BJ5478	15/05/08	16/05/08	120612-1
Signal Analyzer	Agilent Technologies	N9020A	14/09/23	15/09/23	MY46471248
Loop Antenna	Schwarzbeck	FMZB1513	14/04/29	16/04/29	1513-128
BILOG ANTENNA	SCHWARZBECK	VULB9160	14/06/24	16/06/24	3151
Double-Ridged Guide Antenna	ETS-LINDGREN	3117	14/05/12	16/05/12	00140394
Horn Antenna	A.H.Systems Inc.	SAS-574	15/04/30	17/04/30	154
Highpass Filter	Wainwright Instruments	WHKX12-2580-3000- 18000-80SS	14/10/17	15/10/17	3
PreAmplifier	Agilent	8449B	14/11/06	15/11/06	3008A02108
EMI TEST RECEIVER	R&S	ESR7	14/10/21	15/10/21	101109
Low Noise Pre Amplifier	tsj	MLA-010K01-B01-27	15/04/09	16/04/09	1844539

APPENDIX I

Conducted Test set up Diagram & Path loss Information

▪ Conducted Measurement



Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	0.12	15	5.17
1	0.23	20	5.78
2402 & 2440 & 2480	1.92	25	8.13
5	3.06	-	-
10	4.00	-	-

Note. 1 : The path loss from EUT to Spectrum analyzer was measured and used for test.

Path loss (S/A's correction factor)

= Cable A (Attenuator, Applied only when it was used externally)

APPENDIX II

Duty cycle plots

▪ Test Procedure

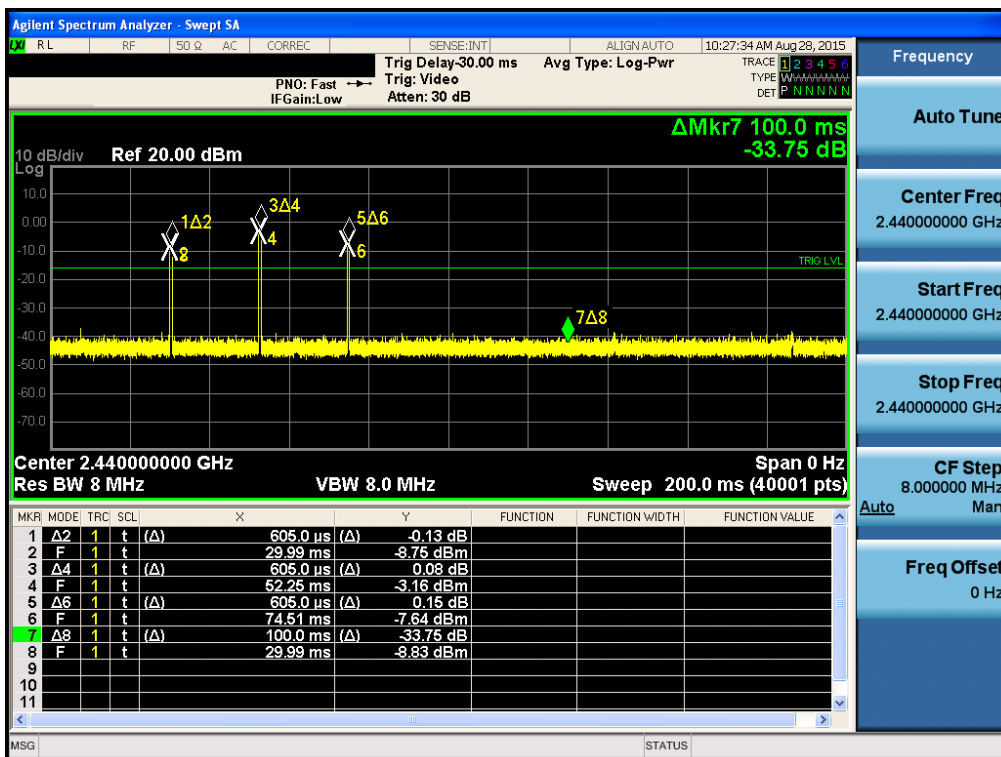
Duty Cycle was measured using **section 6.0 b)** of KDB558074 :

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set $RBW \geq OBW$ if possible; otherwise, set RBW to the largest available value. Set $VBW \geq RBW$. Set detector = peak or average.

The zero-span measurement method shall not be used unless both RBW and VBW are $> 50/T$ and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if $T \leq 16.7$ microseconds.)

Duty Cycle

Test Channel : Middle



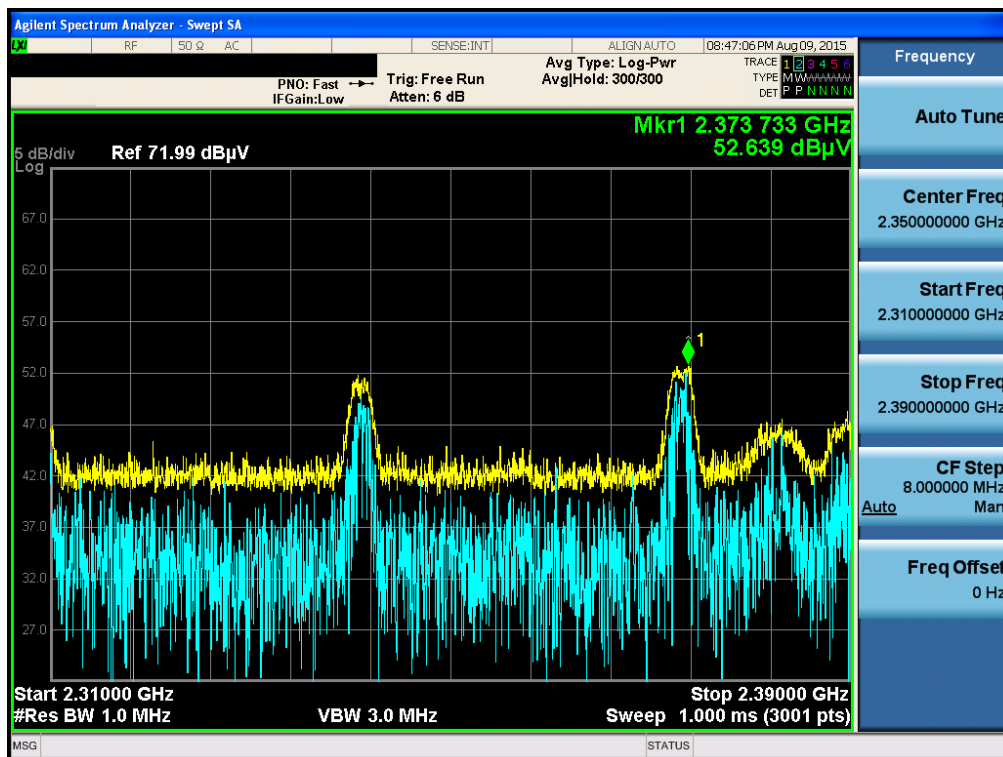
Note : Measure Duty Cycle = $T / 100 \text{ ms}$ (T = sum of the individual on-time in 100 ms)
 $= (0.605 \text{ ms} + 0.605 \text{ ms} + 0.605 \text{ ms}) / 100 \text{ ms} = 1.815 \%$
 Declared worst Duty Cycle = 3.9 %

APPENDIX III

Unwanted Emissions (Radiated) Test Plot

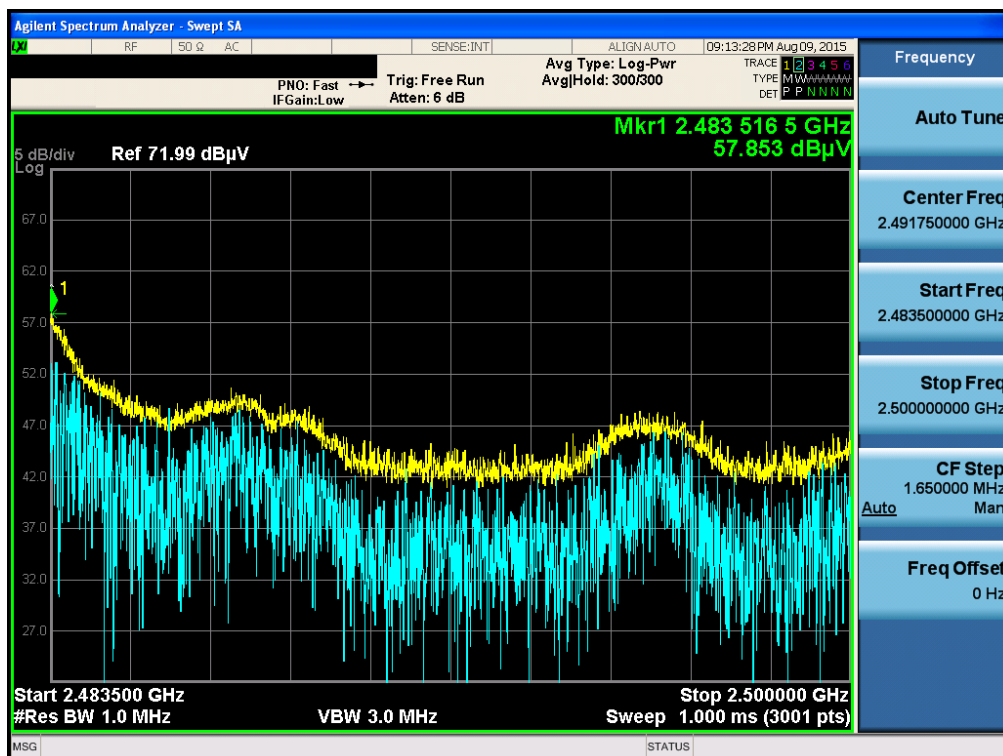
Lowest & X axis & Hor

Detector Mode : PK



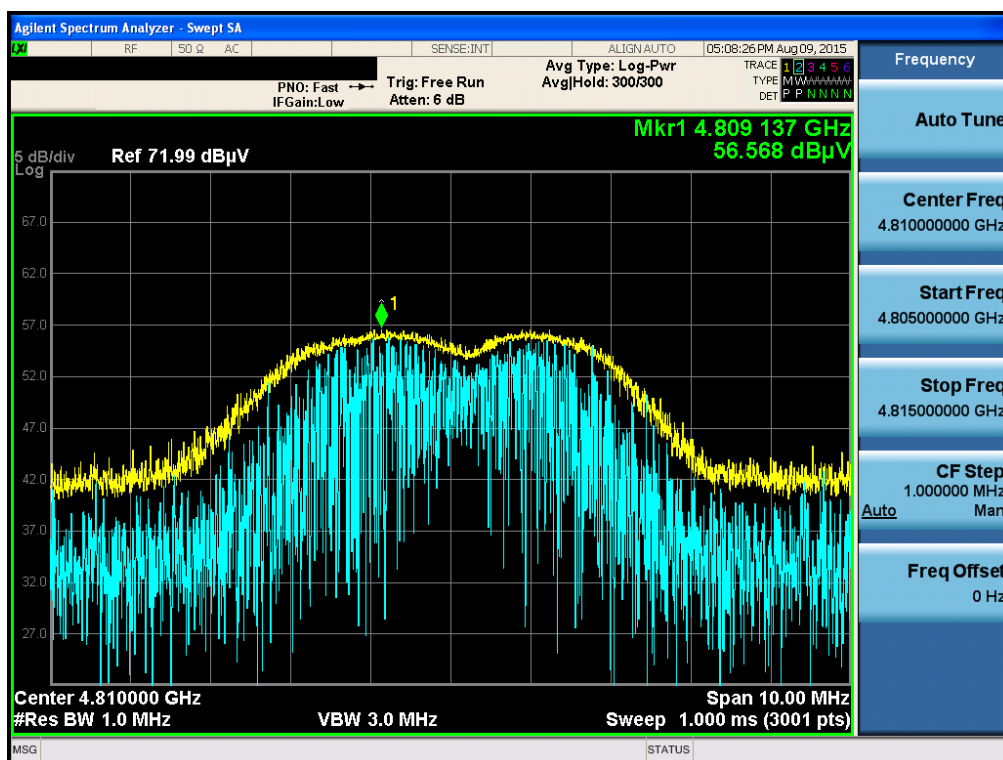
Highest & Y axis & Hor

Detector Mode : PK



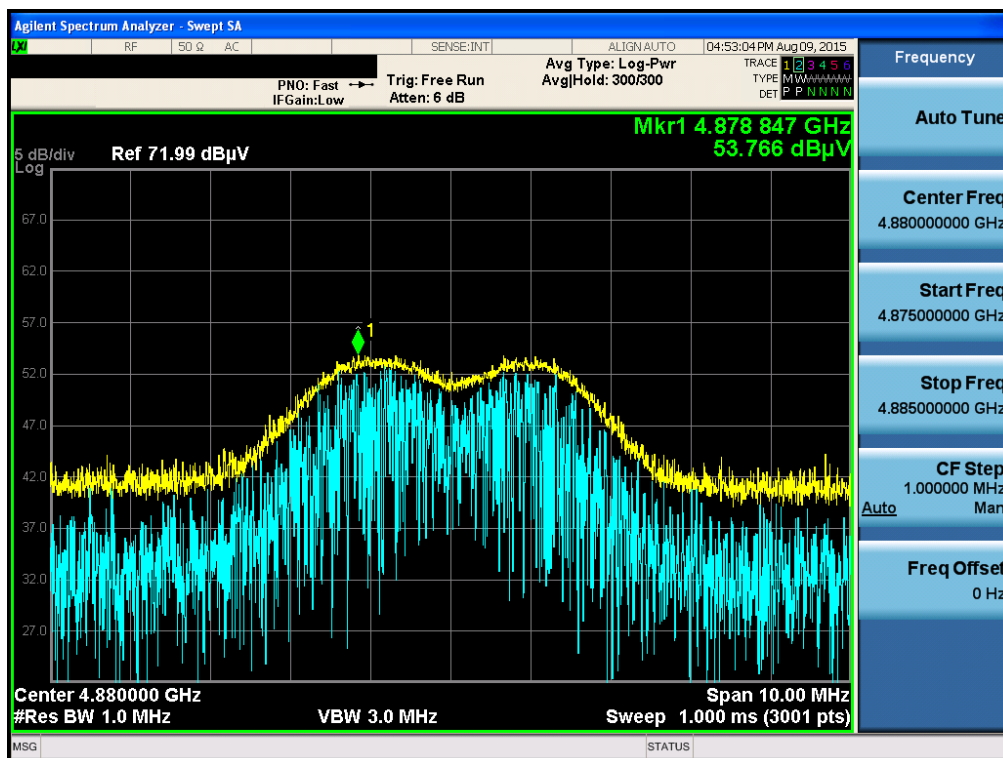
Lowest & X axis & Ver

Detector Mode : PK



Middle & Y axis & Hor

Detector Mode : PK



Highest & Y axis & Ver

Detector Mode : PK

