# **TEST REPORT**

# DT&C Co., Ltd.

42, Yurim-ro, 154Beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea,17042 Tel : 031-321-2664, Fax : 031-321-1664

1. Report No : DRTFCC1904-0074(1)

**Dt&C** 

- 2. Customer
  - Name : LG Electronics USA, Inc.
  - Address : 1000 Sylvan Ave. Englewood Cliffs, New Jersey, United States 07632
- 3. Use of Report : FCC Original Grant
- 4. Product Name / Model Name : Mobile Phone / LM-X525BAW FCC ID : ZNFX525HA
- 5. Test Method Used : KDB558074 D01v05r01, ANSI C63.10-2013 Test Specification : FCC Part 15 Subpart C.247
- 6. Date of Test : 2019.03.04 ~ 2019.03.13
- 7. Testing Environment : Refer to appended test report.
- 8. Test Result : Refer to the attached test result.

Affirmation	Tested by	Reviewed by	Ata				
Ammadon	Name : JaeHyeok Bang	Name : Geunki Son	(Signature)				
The test r	results presented in this test report are limited or	nly to the sample supplied b	y applicant and				
the use of this	s test report is inhibited other than its purpose. T	This test report shall not be i	reproduced except				
	in full, without the written approva	of DT&C Co., Ltd.					
	2019.04.09.						
DT&C Co., Ltd.							
If this report is required to confirmation of authenticity, please contact to report@dtnc.net							

# **Test Report Version**

Test Report No.	Date	Description
DRTFCC1904-0074	Apr. 02, 2019	Initial issue
DRTFCC1904-0074(1)	Apr. 09, 2019	Revised the KDB558074 Version

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# **1. General Information**

### 1.1 Testing Laboratory

### DT&C Co., Ltd.

The 3 m test site and conducted measurement facility used to collect the radiated data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 17042. The test site complies with the requirements of § 2.948 according to ANSI C63.4-2014.

### - FCC MRA Accredited Test Firm No. : KR0034

www.dtnc.net		
Telephone	:	+ 82-31-321-2664
FAX	:	+ 82-31-321-1664

# **1.2 Test Environment**

Ambient Condition	
<ul> <li>Temperature</li> </ul>	+20 °C ~ +22 °C
<ul> <li>Relative Humidity</li> </ul>	38 % ~ 41 %

### **1.3 Measurement Uncertainty**

The measurement uncertainties shown below were calculated in accordance with requirements of ANSI C63.4-2014 and ANSI C63.10-2013. All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

Test items	Measurement uncertainty
Transmitter Output Power	0.7 dB (The confidence level is about 95 %, $k = 2$ )
Conducted spurious emission	0.9 dB (The confidence level is about 95 %, k = 2)
AC conducted emission	2.4 dB (The confidence level is about 95 %, k=2)
Radiated spurious emission (1 GHz Below)	5.1 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (1 GHz ~ 18 GHz)	5.4 dB (The confidence level is about 95 %, k = 2)
Radiated spurious emission (18 GHz Above)	5.3 dB (The confidence level is about 95 %, k = 2)



# **1.4 Details of Applicant**

Applicant	:	LG Electronics USA, Inc.
Address	:	1000 Sylvan Ave. Englewood Cliffs, New Jersey, United States 07632
Contact person	:	Kyung-Su Han

# 1.5 Description of EUT

EUT	Mobile Phone	
Model Name	LM-X525BAW	
Add Model Name	LMX525BAW, X525BAW, LM-X525HA, LMX525HA, X525HA, LM-X520HM, LMX520HM, X520HM, LM-X520BMW, LMX520BMW, X520BMW	
Serial Number	Identical prototype	
Power Supply	DC 4.0 V	
Frequency Range	2402 MHz ~ 2480 MHz	
Max. RF Output Power	-1.7 dBm	
Modulation Technique	GFSK	
Antenna Specification	Antenna Type: PIFA Antenna Gain: -1.52 dBi (PK)	

# 1.6 Declaration by the applicant / manufacturer

N/A

# 1.7 Test Equipment List

Туре	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal.Date (yy/mm/dd)	S/N
Spectrum Analyzer	Agilent Technologies	N9020A	18/12/19	19/12/19	MY50410357
Spectrum Analyzer	Agilent Technologies	N9020A	18/12/19	19/12/19	MY48011700
DC Power Supply	Agilent Technologies	66332A	18/07/02	19/07/02	MY43000211
Multimeter	FLUKE	17B	18/12/18	19/12/18	26030065WS
Signal Generator	Rohde Schwarz	SMBV100A	18/12/19	19/12/19	255571
Signal Generator	ANRITSU	MG3695C	18/12/10	19/12/10	173501
Thermohygrometer	BODYCOM	BJ5478	18/12/27	19/12/27	120612-1
Thermohygrometer	SATO	PC-5000TRH-II	18/07/18	19/07/18	N/A
Thermohygrometer	BODYCOM	BJ5478	18/07/09	19/07/09	N/A
HYGROMETER	TESTO	608-H1	19/01/31	20/01/31	34862883
Loop Antenna	Schwarzbeck	FMZB1513	18/01/30	20/01/30	1513-128
BILOG ANTENNA	Schwarzbeck	VULB 9160	18/07/13	20/07/13	3359
Horn Antenna	ETS-Lindgren	3115	19/01/11	21/01/11	9202-3820
Horn Antenna	Schwarzbeck	BBHA 9120C	17/12/04	19/12/04	9120C-561
Horn Antenna	A.H.Systems Inc.	SAS-574	17/07/31	19/07/31	155
PreAmplifier	tsj	MLA-0118-J01-45	18/12/19	19/12/19	17138
PreAmplifier	tsj	MLA-1840-J02-45	18/07/06	19/07/06	16966-10728
PreAmplifier	tsj	MLA-10K01-B01-27	18/10/31	19/10/31	2005354
Attenuator	SMAJK	SMAJK-2-3	18/07/02	19/07/02	3
Attenuator	Aeroflex/Weinschel	56-3	18/07/02	19/07/02	Y2370
Attenuator	SRTechnology	F01-B0606-01	18/07/02	19/07/02	13092403
Attenuator	Hefei Shunze	SS5T2.92-10-40	18/07/03	19/07/03	16012202
High Pass Filter	Wainwright Instruments	WHNX8.0/26.5-6SS	18/07/03	19/07/03	3
High Pass Filter	Wainwright Instruments	WHKX12-935-1000-	18/07/02	19/07/02	8
High Pass Filter	Wainwright Instruments	15000-40SS WHKX10-2838-3300-	18/07/02	19/07/02	1
Power Meter &	Anritsu	18000-60SS ML2496A	18/12/19	19/12/19	1338004
Wide Bandwidth Sensor EMI Receiver	ROHDE&SCHWARZ	MA2411B ESW44	18/08/06	19/08/06	1306053 101645
	Rohde Schwarz				
EMI Test Receiver		ESCI7 ESH3-Z2	19/01/30	20/01/30	100910
PULSE LIMITER	Rohde Schwarz	E3H3-22	18/03/20	19/09/27 19/03/20	
LISN	SCHWARZBECK	NNLK 8121	19/03/19	20/03/19	- 06183
Cable	HUBER+SUHNER	SUCOFLEX	18/12/21	19/12/21	C-1
Cable	HUBER+SUHNER	SUCOFLEX	18/12/21	19/12/21	C-2
Cable	HUBER+SUHNER	SUCOFLEX	18/12/21	19/12/21	C-3
Cable	HUBER+SUHNER	SUCOFLEX	18/12/21	19/12/21	C-4
Cable	Junkosha	MWX241	18/06/25	19/06/25	G-04
Cable	Junkosha	MWX241	18/06/25	19/06/25	G-07
Cable	DT&C	Cable	18/07/06	19/07/06	G-13
Cable	DT&C	Cable	18/07/06	19/07/06	G-14
Cable	HUBER+SUHNER	SUCOFLEX 104	18/07/06	19/07/06	G-15
Cable	DT&C	CABLE	18/07/05	19/07/05	RF-82

Note1: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2017. Note2: The cable is not a regular calibration item, so it has been calibrated by DT & C itself.

# 1.8 Summary of Test Results

FCC Part	RSS Std.	Parameter	Parameter Limit		Status Note 1	
15.247(a)	RSS-247 [5.2]	6 dB Bandwidth	> 500 kHz		С	
15.247(b)	RSS-247 [5.4]	Transmitter Output Power	< 1 Watt		С	
15.247(d)	RSS-247 [5.5]	Out of Band Emissions / Band Edge	20 dBc in any 100 kHz BW	Conducted	с	
15.247(e)	RSS-247 [5.2]	Transmitter Power Spectral Density	< 8 dBm/3 kHz		с	
-	RSS-Gen [6.7]	Occupied Bandwidth (99 %)	NA		NA	
15.247(d) 15.205 15.209	RSS-247 [5.5] RSS-GEN [8.9] RSS-GEN [8.10]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	FCC 15.209 limits	Radiated	C Note 3	
15.207	RSS-Gen [8.8]	AC Line Conducted Emissions	FCC 15.207 limits	AC Line Conducted	С	
15.203	-	Antenna Requirements	FCC 15.203	-	С	
Note 1: C=Comply NC=Not Comply NT=Not Tested NA=Not Applicable Note 2: For radiated emission tests below 30 MHz were performed on semi-anechoic chamber which is correlated with OATS. Note 3: This test item was performed in each axis and the worst case data was reported.						



# 2. Test Methodology

The measurement procedures described in the ANSI C63.10-2013 and the guidance provided in KDB558074 D01v05r01 were used in measurement of the EUT.

The EUT was tested per the guidance of KDB558074 D01v05r01. 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.

### 2.1 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.

### 2.2 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.

### 2.3 General Test Procedures

### **Conducted Emissions**

The power-line conducted emission test procedure is not described on the KDB558074 D01v05r01.

So this test was fulfilled with the requirements in Section 6.2 of ANSI C63.10-2013.

The EUT is placed on the wooden table, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and Average detector.

### **Radiated Emissions**

Basically the radiated tests were performed with KDB558074 D01v05r01. But some requirements and procedures like test site requirements, EUT setup and maximizing procedure were fulfilled with the requirements in Section 5 and 6 of the ANSI C63.10-2013 as stated on section 12.1 of the KDB558074 D01v05r01.

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. 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 the EUT were rotated through three orthogonal axes.

### 2.4 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 with below low, middle and high channels were tested

		Frequency [MHz]			
Test Mode	Description	Lowest Frequency	Middle Frequency	Highest Frequency	
TM 1	BT LE(1Mbps)	2402	2440	2480	
TM 2	BT LE(2Mbps)	2402	2440	2480	

### 2.5 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 equipment, which is traceable to recognized national standards.



# 3. Test Result

### 3.1 Maximum Peak Conducted Output Power

### Test Requirements and limit, §15.247(b) & RSS-247 [5.4]

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.

### 3.1.1 Test Setup

Refer to the APPENDIX I.

### **3.1.2 Test Procedures**

- KDB558074 D01v05r01 Section 8.3.1.3
- ANSI C63.10-2013 Section 11.9.1.1
- 1. Set the RBW ≥ DTS bandwidth. Actual RBW = 2 MHz & 2.4 MHz

### 2. Set VBW $\ge$ 3 x RBW. Actual VBW = 6 MHz & 8 MHz

- 3. Set span ≥ 3 x 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.

### 3.1.3 Test Results

Test mode	Tested Channel	Burst Average Output Power	Peak Output Power	
Test mode	Tested Channel	dBm	dBm	
	Lowest	-3.29	-2.80	
TM 1	Middle	-2.19	-1.72	
	Highest	-3.33	-2.78	
	Lowest	-3.29	-2.80	
TM 2	Middle	-2.18	-1.70	
	Highest	-3.33	-2.73	

Note 1 : The Burst average output power was tested using an average power meter for reference only. Note 2 : See next pages for actual measured spectrum plots.

of S Frequency ALIGN OFF Avg Type: Log-Pwr Center Freq 2.402000000 GHz GHz PNO: Fast IFGain:Low Trig: Free Run Atten: 20 dB Auto Tune Mkr1 2.401 967 GHz -2.80 dBm 10 dB/div Ref 10.00 dBm **Center Freq** 2.402000000 GHz Start Freq 2.397000000 GHz Stop Freq 2.407000000 GHz **CF Step** 1.000000 MHz Man Auto Freq Offset 0 Hz Center 2.402000 GHz #Res BW 2.0 MHz Span 10.00 MHz Sweep 1.000 ms (3001 pts) #VBW 6.0 MHz 1 STATU

### **Peak Output Power**

TM 1 Test Channel : Middle



### TM 1 Test Channel : Lowest

TM 1 Test Channel : Highest



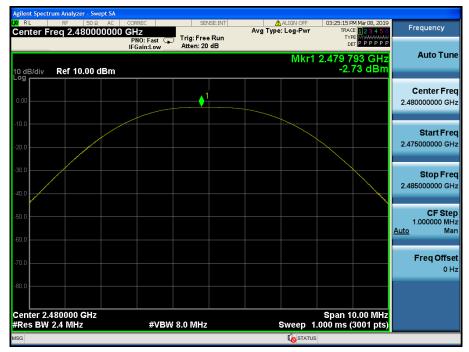
### TM 2 Test Channel : Lowest



### **Peak Output Power**

TM 2 Test Channel : Middle R 03:23:17 PM Mar 08, 2019 TRACE 1 2 3 4 5 6 TYPE MWWWWW DET P P P P P SENSE: INT ALIGN OFF Frequency Center Freq 2.440000000 GHz PNO: Fast IFGain:Low Atten: 20 dB Auto Tune Mkr1 2.439 823 GHz -1.70 dBm 10 dB/div Ref 10.00 dBm **Center Freq** 2.440000000 GHz Start Freq 2.435000000 GHz Stop Freq 2.445000000 GHz CF Step 1.000000 MHz Auto Man Freq Offset 0 Hz Span 10.00 MHz Sweep 1.000 ms (3001 pts) Center 2.440000 GHz #Res BW 2.4 MHz #VBW 8.0 MHz

TM 2 Test Channel : Highest





### 3.2 6 dB Bandwidth Measurement

### Test Requirements and limit, §15.247(a) & RSS-247 [5.2]

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

The minimum permissible 6 dB bandwidth is 500 kHz.

### 3.2.1 Test Setup

Refer to the APPENDIX I.

### **3.2.2 Test Procedures**

- KDB558074 D01v05r01 Section 8.2
- ANSI C63.10-2013 Section 11.8
- 1. Set resolution bandwidth (RBW) = 100 kHz
- 2. Set the video bandwidth (VBW)  $\ge$  3 x RBW.
- (<u>RBW : 100 kHz / VBW : 300 kHz</u>)
- 3. Detector = **peak**.
- 4. Trace mode = **max hold**.
- 5. Sweep = auto couple.
- 6. Allow the trace to stabilize.
- 7. Option 1 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.

Option 2 - The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW  $\ge$  3 × RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be  $\ge$  6 dB.

#### 3.2.3 Test Results

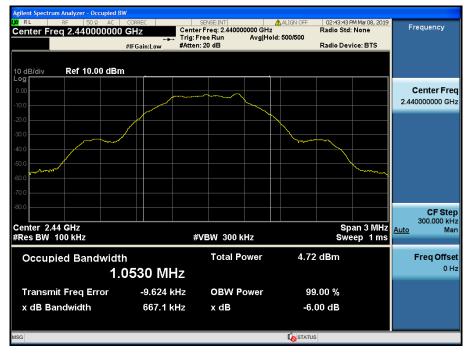
Test Mode	Tested Channel	Test Results [MHz]
	Lowest	0.661
TM 1	Middle	0.667
	Highest	0.667
	Lowest	1.167
TM 2	Middle	1.193
	Highest	1.249

TM 1 Test Channel : Lowest



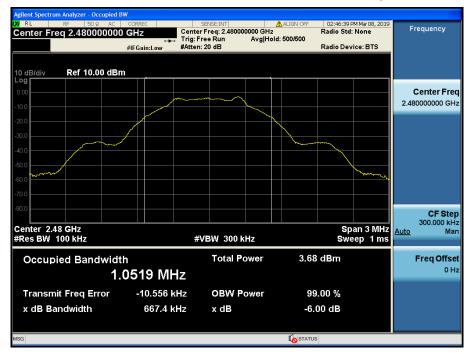
6 dB Bandwidth

TM 1 Test Channel : Middle



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### TM 1 Test Channel : Highest



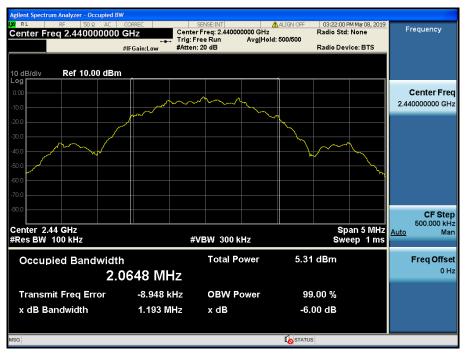
🛈 Dt&C



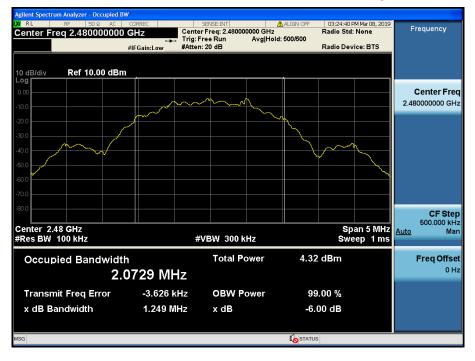


6 dB Bandwidth

TM 2 Test Channel : Middle



TM 2 Test Channel : Highest





### 3.3 Maximum Power Spectral Density.

### Test requirements and limit, §15.247(e) & RSS-247 [5.2]

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**

The power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission

### 3.3.1 Test Setup

Refer to the APPENDIX I.

### **3.3.2 Test Procedures**

- KDB558074 D01v05r01 Section 8.4
- ANSI C63.10-2013 Section 11.10.2

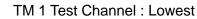
#### Method PKPSD (peak PSD)

- 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 : 3 kHz  $\leq$  RBW  $\leq$  100 kHz.
- 4. Set the VBW  $\geq$  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.

### 3.3.3 Test Results

Test Mode	Tested Channel	PKPSD [dBm]
	Lowest	-19.33
TM 1	Middle	-18.30
	Highest	-19.04
	Lowest	-21.44
TM 2	Middle	-20.32
	Highest	-21.66

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### Maximum PKPSD

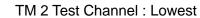
TM 1 Test Channel : Middle

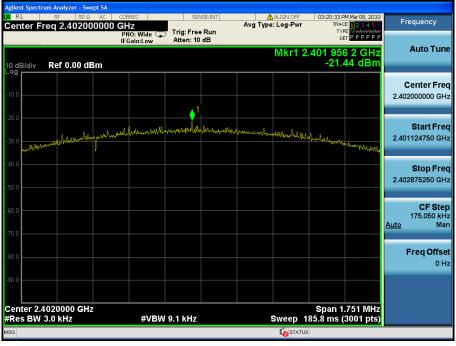


TM 1 Test Channel : Highest



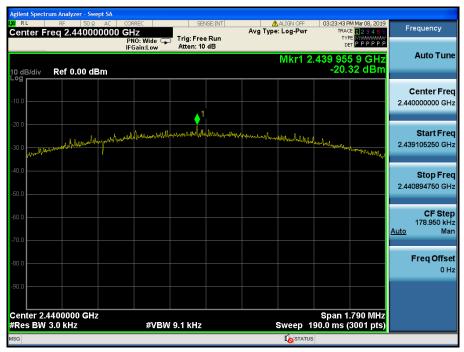
🛈 Dt&C



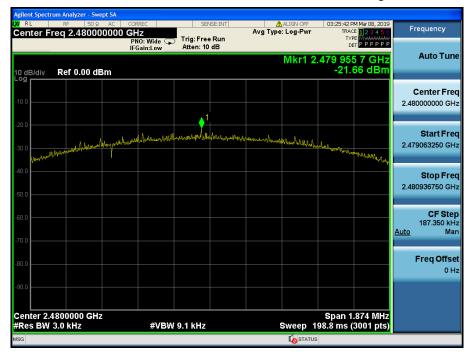


### Maximum PKPSD

TM 2 Test Channel : Middle



TM 2 Test Channel : Highest





### 3.4 Unwanted Emissions (Conducted)

### Test requirements and limit, §15.247(d) & RSS-247 [5.5]

**§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.

### 3.4.1 Test Setup

Refer to the APPENDIX I including path loss

### 3.4.2 Test Procedures

- KDB558074 D01v05r01 Section 8.5
- ANSI C63.10-2013 Section 11.11

### **Reference level measurement**

1. Set instrument center frequency to DTS channel center frequency.

- 2. Set the span to  $\geq$  1.5 times the DTS bandwidth.
- 3. Set the RBW = 100 kHz.
- 4. Set the VBW  $\geq$  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 PSD level LIMIT LINE = 20 dB below of the reference level.

### **Emission level measurement**

- 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 ≥ 3 x RBW.(Actual 3 MHz, See below note)
- 4. Detector = **peak**.
- 5. Ensure that the number of measurement points ≥ 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	RBW	VBW	Detector	Trace	Sweep Point
9 kHz ~ 30 MHz	100 kHz	300 kHz			
30 MHz ~ 10 GHz	1 MHz	3 MHz	Peak	Max Hold	40001
10 GHz ~ 25 GHz	1 MHz	3 MHz	]		

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.

### FCC ID: ZNFX525HA

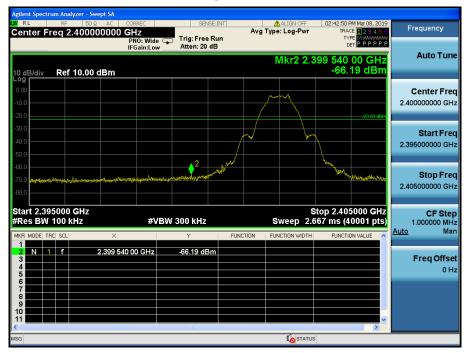
### 3.4.3 Test Results

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RL RF	50 Ω AC 2.402000000	CORREC GHZ	SENSE:		ALIGN OFF		M Mar 08, 2019 E 1 2 3 4 5 6 E M Marada	Frequency
ionter i req	2.40200000	PNO: Wide G	Trig: Free Ru Atten: 20 dB	un –		TYF De	E MWWWWW T P P P P P P	
0 dB/div Re	f 10.00 dBm				Mkr1 2	2.402 239 -3.9	9 3 GHz 03 dBm	Auto Tun
0.00	- Marine Marine	~~~~~			1	k.		<b>Center Fre</b> 2.402000000 GH
0.0								<b>Start Fre</b> 2.401504250 GH
0.0								<b>Stop Fre</b> 2.402495750 G⊦
0.0								CF Ste 99.150 kH <u>Auto</u> Ma
0.0								Freq Offse 0 ⊦
0.0								
enter 2.4020 Res BW 100		#VBW	/ 300 kHz		Sweep	9 Span 1.000 ms (	91.5 kHz 3001 pts)	
G					<b>I</b> statu			

### TM 1 Reference (Test Channel : Lowest)

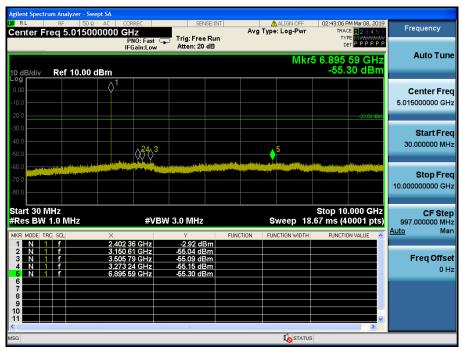
TM 1 Low Band-edge (Test Channel : Lowest)



RL	RF 50	Ω 🔔 DC	CORREC		SENSE:INT		\rm ALIGN OFF	02:42:58	PM Mar 08, 2019	_
enter Fr	eq 15.00	4500 M	Hz PNO: Fast IFGain:Lov		Free Run n: 20 dB	Avg Typ	e: Log-Pwr	TY	CE 123456 PE MWWWWW ET P P P P P P	Frequency
0 dB/div	Ref 10.0	) dBm	IP Galil.EUV		1. 20 QB		Ν		1.9 kHz 00 dBm	Auto Tun
<b>°g</b> 0.00										Center Fre 15.004500 MH
0.0										<b>Start Fre</b> 9.000 kH
	etherinality entited particular	s.topollogogit)	goingdon billen felinen og	المعاملة والمعارية	unga Jaha waana	niasian) Juantoni (Joca)) (h	ะโต่ะทั่ง <sub>เ</sub> ราไสรีรับไรกล่างเทร่าง	الموسطوراوير ويافعونى	alut a chisteachaine	
0.0 0.0 tart 9 kH:	z	antona (franski)		indulumedu) BW 300 I			Sweep 5.3	Stop 3	0.00 MHz	30.000000 M⊦ CF Ste 2.999100 M⊦
art 9 kH: Res BW 1	z 100 kHz c scl		#V 281.9 kHz	'BW 300 I	KHz D0 dBm			Stop 3 33 ms (4	0.00 MHz	30.000000 MF CF Ste 2.999100 MF
tart 9 kH: Res BW 7 Res BW 7 R MODE TR 1 N 1 2 N 1 3 4 5	z 100 kHz		#V	'BW 300 I	<b>KHZ</b>		Sweep 5.3	Stop 3 33 ms (4	0.00 MHz 0001 pts)	30.000000 MH CF Ste 2.999100 MH <u>Auto</u> Ma Freq Offs
tart 9 kH: Res BW 7 KR MODE TR 1 N 1 2 N 1 3 4 5 5 5 5 5 5 6 6 7 7	z 100 kHz c scl		#V 281.9 kHz	'BW 300 I	KHz D0 dBm		Sweep 5.3	Stop 3 33 ms (4	0.00 MHz 0001 pts)	Stop Fre 30.000000 MH CF Ste 2.999100 MH Auto Freq Offse 0 H
tart 9 kH: Res BW 1 KR MODE TRI 1 N 1 2 N 1 3 4 5 5 6 6	z 100 kHz c scl		#V 281.9 kHz	'BW 300 I	KHz D0 dBm		Sweep 5.3	Stop 3 33 ms (4	0.00 MHz 0001 pts)	30.000000 M⊢ CF Ste 2.999100 M⊢ <u>Auto</u> Ma Freq Offse

### TM 1 Conducted Spurious Emissions 1 (Test Channel : Lowest)

TM 1 Conducted Spurious Emissions 2 (Test Channel : Lowest)



RL RF 50Ω A		SENSE:INT	ALIGN OFF	02:43:14 PM Mar 08, 2019	Frequency
enter Freq 17.500000	PNO: Fast IFGain:Low	Trig: Free Run Atten: 20 dB	Avg Type: Log-Pwr	TRACE 123456 TYPE MWWWWWW DET PPPPP	
dB/div Ref 10.00 dB	n		Mkr3 2	4.716 125 GHz -44.58 dBm	Auto Tun
og 				-23.03 dBm	Center Fre 17.500000000 G⊦
				 	<b>Start Fre</b> 10.000000000 GF
D.0					<b>Stop Fre</b> 25.00000000 GF
tart 10.000 GHz Res BW 1.0 MHz		V 3.0 MHz		Stop 25.000 GHz 00 ms (40001 pts)	<b>CF St</b> e 1.500000000 GF Auto Mi
2 N 1 f 24 3 N 1 f 24 4	× 1.007 000 GHz 1.007 000 GHz 1.716 125 GHz	-44.49 dBm -44.49 dBm -44.58 dBm	UNCTION FUNCTION WIDTH	FUNCTION VALUE	Freq Offs
5 6 7 8 9 9					
0				~	

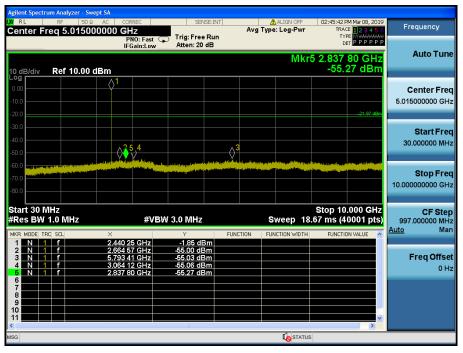
# TM 1 Conducted Spurious Emissions 3 (Test Channel : Lowest)



### TM 1 Reference (Test Channel : Middle)

TM 1 Conducted Spurious Emissions 1 (Test Channel : Middle)

Agilent Spectrum Analyzer - Swe LXI R L RF 50 Ω 2		SENSE: IN		ALIGN OFF	02:45:33 PM Mar 08, 2019	E
Center Freq 15.0045	OO MHz PNO: Fast IFGain:Low	<ul> <li>Trig: Free Rui</li> <li>Atten: 20 dB</li> </ul>		Type: Log-Pwr	TRACE 123456 TYPE MAAAAAAA DET PPPPP	Frequency
10 dB/div Ref 10.00 d	Bm			Γ	//kr2 281.9 kHz -67.23 dBm	Auto Tune
Log 0.00 -10.0 -20.0					-21.97 dBm	Center Freq 15.004500 MHz
-30.0						Start Freq 9.000 kHz
-60.0 2	or the light discription of providence of the	han properties of the stand of the stand	tetter and a second and a second second	ylogenigi gi gatteylik ji kontakty al tyrka	ten freuhlifsten stirefen des freuhtungen syn	Stop Freq 30.000000 MHz
Start 9 kHz #Res BW 100 kHz	#VB	W 300 kHz	FUNCTION	Sweep 5.3	Stop 30.00 MHz 33 ms (40001 pts)	CF Step 2.999100 MHz <u>Auto</u> Man
1 N 1 F 2 N 1 F 3 4 4 4 5 6 7	281.9 kHz 281.9 kHz	-67.23 dBm -67.23 dBm				Freq Offset 0 Hz
8 9 10 11 11		illi			×	
MSG					L Coupled	



### TM 1 Conducted Spurious Emissions 2 (Test Channel : Middle)

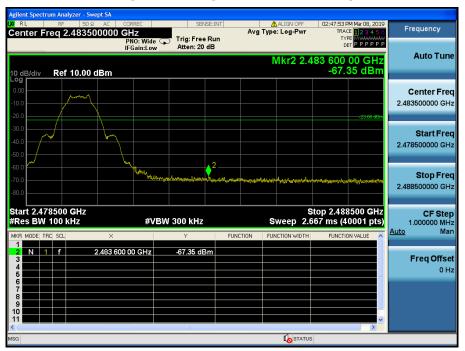
TM 1 Conducted Spurious Emissions 3 (Test Channel : Middle)





### TM 1 Reference (Test Channel : Highest)

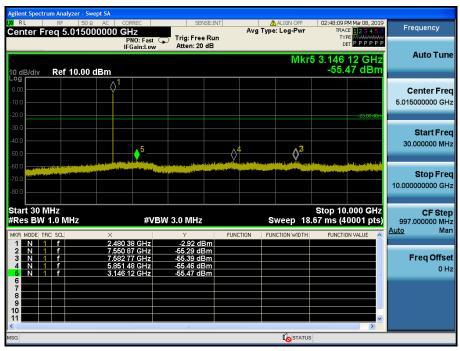
TM 1 High Band-edge (Test Channel : Highest)



		ctru		alyzer - Sw															
ux/⊪ Cer		Fre	RF Q 1	5.004	± 100		REC			ISE:INT		Avg		ALIGN OF : Log-Pv		TRA	PM Mar 08, 2 CE <mark>1 2 3 4</mark>	5.6	Frequency
							10: Fast Sain:Low		Trig: Free Atten: 20							C	ET P P P P	ΡP	
															Ν	/lkr2 28	1.9 kl	Iz	Auto Tune
10 c Log	IB/di∖	/	Ref	10.00	dBm								_		_	-66.	49 dB	m	
0.00																			Center Freq
-10.0	) <u> </u>																		15.004500 MHz
-20.0																	-23.061	:IDm	
-30.0	) —																		Start Freq
-40.0	)																		9.000 kHz
-50.0																			
-60.0	2.																		Stop Freq
-70.0	104	theory is	i diji	holicomplex		1004 Constitute		Million	, he faith the star a fait		مەربەندە	handystate	Historia	understand an	est the	approximitation	radio ha gent and a static for	n, N	30.000000 MHz
-80.0																			
Sta	rt 9	kНz														Stop 3	0.00 MI	Hz	CF Step
#Re	es Bl	W 1	00	kHz			#V	BW	300 kHz				S	weep	5.3	33 ms (4	0001 p	ts)	2.999100 MHz
MKR	MODE				×				Y		FUNC	TION	FUN	CTION WIE	TH	FUNCTI	ON VALUE	^	<u>Auto</u> Man
1 2	N N	1	f f				9 kHz 9 kHz		-66.49 dl -66.49 dl	3m 3m									
3		-																	Freq Offset 0 Hz
5																		=	0 Hz
7																			
9																			
10 11																		~	
<			_						1111					~					
MSG															ATUS	L DC Co	upled		

### TM 1 Conducted Spurious Emissions 1 (Test Channel : Highest)

TM 1 Conducted Spurious Emissions 2 (Test Channel : Highest)



RL RF 50 S		SENSE:INT	ALIGN OFF	02:48:17 PM Mar 08, 2019 TRACE 1 2 3 4 5 6	Frequency
enter Freq 17.500	PNO: Fast C IFGain:Low	Trig: Free Run Atten: 20 dB	Avg Type. Log-rwi		
dB/div Ref 10.00	dBm		Mkr3 2	4.741 625 GHz -44.64 dBm	Auto Tur
<b>0</b> 0 0.0 0.0				~23.00 dDm	Center Fre 17.500000000 GH
0.0 0.0 0.0					<b>Start Fre</b> 10.000000000 GF
					<b>Stop Fr</b> 25.00000000 GI
art 10.000 GHz Res BW 1.0 MHz		W 3.0 MHz		Stop 25.000 GHz 00 ms (40001 pts)	CF Ste 1.50000000 GI Auto Mi
KR         MODE         TRC         SCL           1         N         1         f           2         N         1         f           3         N         1         f           4	× 24.841 375 GHz 24.841 375 GHz 24.741 625 GHz	Y FU -43.98 dBm -43.98 dBm -44.64 dBm	NCTION FUNCTION WIDTH	FUNCTION VALUE	Freq Offs
1				×	

# TM 1 Conducted Spurious Emissions 3 (Test Channel : Highest)



### TM 2 Reference (Test Channel : Lowest)

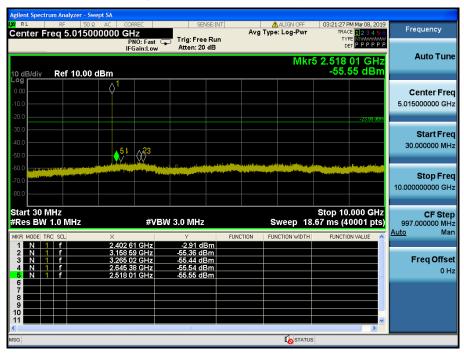
TM 2 Low Band-edge (Test Channel : Lowest)



		ctrur		lyzer - Sv																
<mark>ιχ/</mark> ℝ Cen	ter	Fre	RF	50 s 5.004	2 <u>A</u> DO 500		RREC			VSE:INT		Avg T		LOG-PW		TRA	PM Mar 08, 2 CE <mark>1 2 3 4</mark>	56	Frequ	ency
						Р	NO: Fast Gain:Lov	t 🖵	Trig: Free Atten: 20							TY	РЕ МИЛИИ ЕТ РРРР	P P		
							oumieo	-							M	kr2 30	8.2 kl	Z	Au	to Tune
10 d	B/div		Ref	10.00	dBn	n										-67.	85 dB	m		_
Log 0.00																			0	
-10.0																				e <b>r Freq</b> 500 MHz
-20.0																			15.004	300 WIHZ
-30.0																	-23.99 (	i Bm		
-40.0																				art Freq
-50.0																			9	.000 kHz
-60.0	2																			
-70.0																				op Freq
-80.0		-	with the	(Here All Alls)	herdinge	ant-labolita	and the second	-lane	مروار مراجع المراجع ال المراجع المراجع ا	eat-splitter;	18MM	a a second a	etta (pro	adullionation	in a shift first	vinitation	and the second second		30.000	000 MHz
Star #Re				447			#\	/B)A(	300 kHz				<b>C</b> 1	veen	5 33	Stop 3 3 ms (4	0.00 M			CF Step
_	MODE			NI 12			<i>"</i> •			_	FUNC	TION				<u>`</u>	DN VALUE	_	2.999 Auto	Man
мкн 1	N	1 HC	f				2 kHz		۲ -67.85 dl		FUNC	TIUN	FUNU	CTION WID	н	FUNCT	UN VALUE	â		
2	Ν	1	f			308	.2 kHz		-67.85 di	Зm									Free	Offset
4																				0 Hz
6																				
7																				
9 10																				
11																		~		
< MSG	_	-	-		_	_	_	_			_	_	-	T STA	TUS	DC Co	unled			
								_									apicu			

### TM 2 Conducted Spurious Emissions 1 (Test Channel : Lowest)

TM 2 Conducted Spurious Emissions 2 (Test Channel : Lowest)



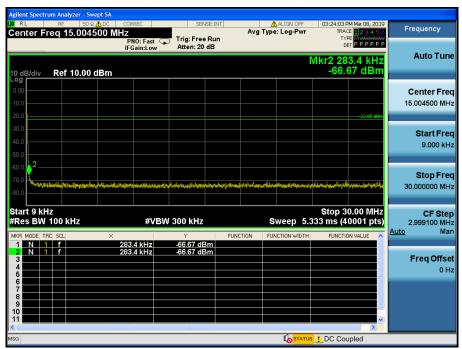
RL RF 50		SENSE:INT			Frequency
enter Freq 17.500	1000000 GHz PNO: Fas IFGain:Lo	t 🎧 Trig: Free Run w Atten: 20 dB	Avg Type: Log-Pw	ИГ TRACE 123456 ТҮРЕ МУЖИЛИМ DET РРРРР	
dB/div Ref 10.00	dBm		Mkr	3 24.173 125 GHz -44.84 dBm	Auto Tun
<b>9</b> .00 0.0				-23.99 dBm	Center Fre 17.500000000 GH
0.0 0.0		sa kay makaning baharyi ng mgabaga			<b>Start Fre</b> 10.000000000 GF
0.0 <b></b>					<b>Stop Fre</b> 25.000000000 GF
art 10.000 GHz Res BW 1.0 MHz		/BW 3.0 MHz	-	Stop 25.000 GHz 40.00 ms (40001 pts)	CF Sto 1.50000000 G Auto M
Image: N         1         F           1         N         1         F           2         N         1         F           3         N         1         F           4	× 24.600 250 GHz 24.600 250 GHz 24.173 125 GHz	-44.49 dBm	FUNCTION FUNCTION WID	TH FUNCTION VALUE	Freq Offs
5 5 5 7					
0					

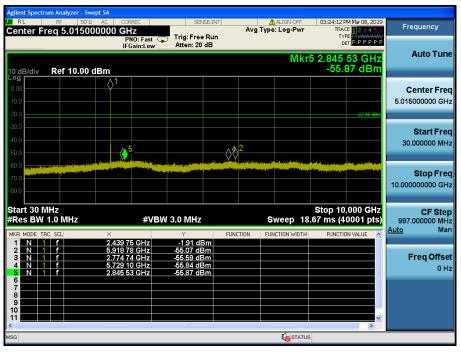
# TM 2 Conducted Spurious Emissions 3 (Test Channel : Lowest)



### TM 2 Reference (Test Channel : Middle)

TM 2 Conducted Spurious Emissions 1 (Test Channel : Middle)





## TM 2 Conducted Spurious Emissions 2 (Test Channel : Middle)

TM 2 Conducted Spurious Emissions 3 (Test Channel : Middle)





### TM 2 Reference (Test Channel : Highest)

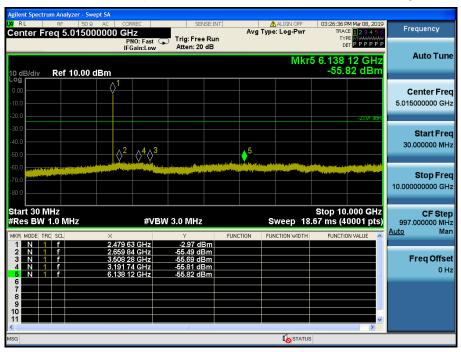
TM 2 High Band-edge (Test Channel : Highest)



		ctru		lyzer - Sw																	
uxv ⊪ Cer		Fre	RF	5.004	2 🔔 DC 500		REC			ISE:INT		Avg 1		ALIGN OFF : Log-Pw		TRA	PM Mar 08, 2 CE <mark>1 2 3 4</mark>	5 6	I	requency	
						Р	10: Fast Gain:Lov		Trig: Free Atten: 20							T) E	PE MWWW ET P P P P	PP			
							Junieo								М	kr2 31	5.7 kl	17		Auto Tun	е
	IB/div		Ref	10.00	dBm												10 dB				
Log																					
-10.0																				Center Fre 15.004500 MH	- 1 I
-20.0																				13.004300 MIH	12
-30.0																	-23.91	dBm			
-40.0																				Start Fre	- 1 H
-50.0																				9.000 kH	JZ
-60.0																					-
-70.0	K.												_		_					Stop Fre	
-80.0		<b>See 1</b> /4	an.uu	<i>hitten h</i> it	way way a	dige by the second	PARA MARA		helender)://www.	idees,70%,8%	ALL MAD	harden yn die de fa	eres picks		10.100	and the state of the	A STREET, STREE	Why I	1	80.000000 MH	z
																		_			
	rt9 sB			kH7			#\	/BW	300 kHz				S	veep :	5.33		0.00 M			CF Step 2.999100 MH	
_	MODE			NITE .	>	,		1 14	Y		FUNC	TION		CTION WID		<u> </u>	ON VALUE	~	Auto	2.999100 MA	
1	Ν	1	f			315	7 kHz		-67.10 di		TORC	TION	TON			TORCH	ON WALCE				
23	Ν	1	f			315	7 kHz		-67.10 di	3m										Freq Offse	et
4																		=		он	Iz
6																					
8																					
9 10																					
11																	3	~			
MSG		-	-		_		_	_			_	_	_		TUS /	DC Co	upled				-
				-	-	-				-	-		-		_			-			_

# TM 2 Conducted Spurious Emissions 1 (Test Channel : Highest)

TM 2 Conducted Spurious Emissions 2 (Test Channel : Highest)



RL			RREC	SEN	SE:INT		ALIGN OFF		Mar 08, 2019	Frequency
enter Fr	eq 17.50	0000000 G P	NO: Fast C Gain:Low	Trig: Free Atten: 20		Avgiy	e. Log-rwi	TYPE	123450 Mwwwww PPPPPP	
0 dB/div	Ref 10.0	) dBm					Mkr3 2	4.742 75 -44.3	i0 GHz 0 dBm	Auto Tun
0.00									2481 KEm	Center Fre 17.500000000 GH
30.0 10.0 50.0			and provided a second				ر دارد در در از			<b>Start Fre</b> 10.00000000 GF
i0.0 <b></b> i0.0 <b></b>										<b>Stop Fre</b> 25.00000000 GF
tart 10.0 Res BW	1.0 MHz		#VB	W 3.0 MHz			Sweep 40		001 pts)	<b>CF Ste</b> 1.50000000 GF Auto Ma
MKR         MODE         TF           1         N         1           2         N         1           3         N         1           4         5         5	f f	× 24.202 75 24.202 75 24.742 75	0 GHz	44.29 dE -44.29 dE -44.30 dE	m	NCTION FL	JNCTION WIDTH	FUNCTION	VALUE	Freq Offso 0 ⊦
6 7 8 9 10										
				Ш					>	

# TM 2 Conducted Spurious Emissions 3 (Test Channel : Highest)

### 3.5 Unwanted Emissions (Radiated)

#### **I** Test Requirements and limit,

### §15.247(d), §15.205, §15.209 & RSS-247 [5.5], RSS-Gen [8.9], RSS-Gen [8.10]

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) : On	ly 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.



### 3.5.1 Test Setup

Refer to the APPENDIX I.

### 3.5.2 Test Procedures

- 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.

- KDB558074 D01v05r01 Section 8.6
- ANSI C63.10-2013 Section 11.12
- 1. Frequency Range Below 1 GHz

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

- 2. Frequency Range > 1 GHz
  - Peak Measurement > 1 GHz

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

Average Measurement> 1GHz

- 1. RBW = 1 MHz (unless otherwise specified).
- 2. VBW  $\geq$  3 x RBW.
- 3. Detector = RMS (Number of points ≥ 2 x Span / RBW)
- 4. Averaging type = power (i.e., RMS).
- 5. Sweep time = auto.
- 6. Perform a trace average of at least 100 traces.
- 7. A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
- 1) If power averaging (RMS) mode was used in step 4, then the applicable correction factor is 10 log(1/x), where x is the duty cycle.
- 2) If linear voltage averaging mode was used in step 4, then the applicable correction factor is 20 log(1/x), where x is the duty cycle.
- 3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

Test Mode	Duty Cycle (%)	T <sub>on</sub> (ms)	T <sub>on</sub> + T <sub>off</sub> (ms)	DCF = 10 log(1/Duty) (dB)
TM 1	85.20	2.130	2.500	0.70
TM 2	56.84	1.064	1.872	2.45

Note : Refer to appendix II for duty cycle measurement procedure and plots



# 3.5.3 Test Results

# Frequency Range : 9 kHz ~ 25 GHz \_TM 1\_Normal

## Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2389.10	V	Z	PK	52.77	2.76	N/A	N/A	55.53	74.00	18.47
2388.77	V	Z	AV	41.40	2.76	0.70	N/A	44.86	54.00	9.14
4804.18	V	Z	PK	49.69	1.63	N/A	N/A	51.32	74.00	22.68
4804.09	V	Z	AV	39.13	1.63	0.70	N/A	41.46	54.00	12.54

### Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4880.19	V	Z	PK	50.68	1.61	N/A	N/A	52.29	74.00	21.71
4879.99	V	Z	AV	39.74	1.61	0.70	N/A	42.05	54.00	11.95

### Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2484.04	V	Z	PK	53.25	3.27	N/A	N/A	56.52	74.00	17.48
2484.13	V	Z	AV	41.21	3.27	0.70	N/A	45.18	54.00	8.82
4960.01	V	Z	PK	50.19	1.75	N/A	N/A	51.94	74.00	22.06
4959.75	V	Z	AV	39.57	1.75	0.70	N/A	42.02	54.00	11.98

#### Note.

1. The radiated emissions were investigated 9kHz to 25GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, the test distance might be reduced from 3 m to 1 m. In this case, the distance factor (-9.54 dB) is applied to the result.

- Calculation of distance factor = 20 log( applied distance / required distance ) = 20 log( 1 m / 3 m ) = -9.54 dB

When distance factor is "N/A", the distance is 3 m and distance factor is not applied.

3. Sample Calculation.

Margin = Limit - Result / Result = Reading + T.F + D.C.F / T.F = AF + CL - AG

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

DCF = Duty Cycle Correction Factor.



# Frequency Range : 9 kHz ~ 25 GHz \_TM 2\_Normal

### Lowest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2388.12	V	Z	PK	53.00	2.75	N/A	N/A	55.75	74.00	18.25
2388.12	V	Z	AV	41.67	2.75	2.45	N/A	46.87	54.00	7.13
4804.47	V	Z	PK	49.96	1.63	N/A	N/A	51.59	74.00	22.41
4803.86	V	Z	AV	39.29	1.63	2.45	N/A	43.37	54.00	10.63

# Middle Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
4880.25	V	Z	PK	49.36	1.61	N/A	N/A	50.97	74.00	23.03
4879.68	V	Z	AV	39.72	1.61	2.45	N/A	43.78	54.00	10.22

# Highest Channel

Frequency (MHz)	ANT Pol	EUT Position (Axis)	Detector Mode	Reading (dBuV)	T.F (dB/m)	D.C.F (dB)	Distance Factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2485.59	V	Z	PK	53.36	3.27	N/A	N/A	56.63	74.00	17.37
2485.39	V	Z	AV	41.35	3.27	2.45	N/A	47.07	54.00	6.93
4960.35	V	Z	PK	50.21	1.75	N/A	N/A	51.96	74.00	22.04
4960.14	V	Z	AV	39.42	1.75	2.45	N/A	43.62	54.00	10.38

Note.

1. The radiated emissions were investigated 9kHz to 25GHz. And no other spurious and harmonic emissions were found above listed frequencies.

2. Information of Distance Factor

For finding emissions, the test distance might be reduced from 3 m to 1 m. In this case, the distance factor (-9.54 dB) is applied to the result.

- Calculation of distance factor = 20 log( applied distance / required distance ) = 20 log( 1 m / 3 m ) = -9.54 dB

When distance factor is "N/A", the distance is 3 m and distance factor is not applied.

3. Sample Calculation.

Margin = Limit - Result / Result = Reading + T.F + D.C.F / T.F = AF + CL - AG

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

DCF = Duty Cycle Correction Factor.



### 3.6 Power line Conducted Emissions

### Test Requirements and limit, §15.207 & RSS-Gen [8.8]

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  $\mu$ H/50 ohms line impedance stabilization network (LISN).

	Conducted Limit (dBuV)			
Frequency Range (MHz)	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.

### 3.6.1 Test Setup

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

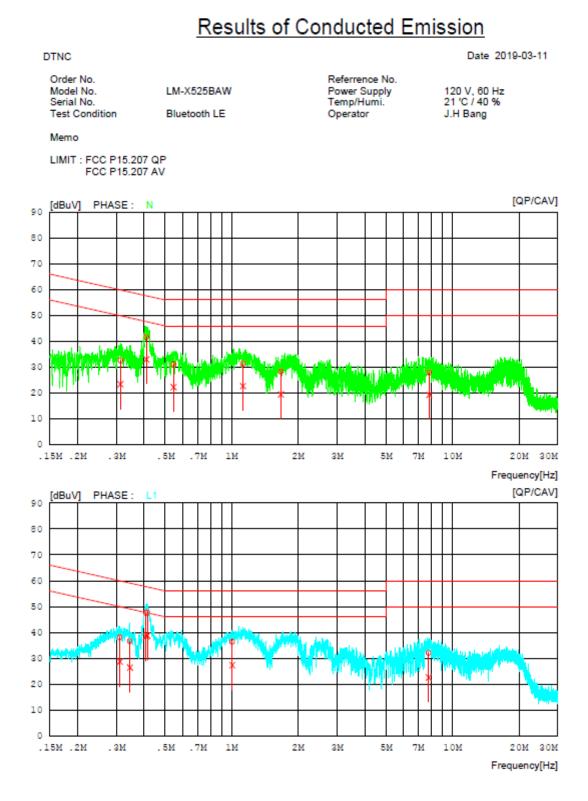
### 3.6.2 Test Procedures

Conducted emissions from the EUT were measured according to the ANSI C63.10-2013.

- The test procedure is performed in a 6.5 m × 3.5 m × 3.5 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m (W) × 1.5 m (L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
- 2. The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room.
- 3. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room.
- 4. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

### 3.6.3 Test Results

# AC Line Conducted Emissions (Graph)



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# AC Line Conducted Emissions (List)

# Results of Conducted Emission

DTNC							Date	2019-03-11	
Serial No.			LM-X525BAW Bluetooth LE		Referrence No. Power Supply Temp/Humi. Operator			120 V, 60 Hz 21 'C / 40 % J.H Bang	
Memo	Memo								
LIMIT	LIMIT : FCC P15.207 QP FCC P15.207 AV								
NO	FREQ	READING QP CAV	C.FACTOR	RESULT QP CAV		IMIT CAV	MARGIN QP CAV	PHASE	
	[MHz]	[dBuV][dBuV]	] [dB]	[dBuV][dBu	-	7] [dBuV	] [dBuV][dBuV	73	
1	0.31317	22.6713.44	9.99	32.66 23.4	3 59.89	49.89	27.2326.46	N	
2	0.41051	31.68 23.07	9.99	41.67 33.00	6 57.64	47.64	15.9714.58	N	
3	0.54504	21.2112.29	9.99	31.20 22.20	8 56.00	46.00	24.80 23.72	N	
4	1.12360	21.37 12.72	10.01	31.38 22.73	3 56.00	46.00	24.6223.27	N	
5	1.67040	18.25 9.40	10.05	28.30 19.49	5 56.00	46.00	27.7026.55	N	
6	7.84360	17.68 9.05	10.29	27.97 19.34	4 60.00	50.00	32.03 30.66	N	
7	0.31093	28.10 18.73	9.95	38.05 28.60	8 59.95	49.95	21.90 21.27	L1	
8	0.34550	26.6116.42	9.95	36.56 26.3	7 59.07	49.07	22.51 22.70	L1	
9	0.40858	37.4728.37	9.96	47.43 38.33	3 57.68	47.68	10.25 9.35	Ll	
10	0.41458	37.7528.79	9.96	47.71 38.78	5 57.56	47.56	9.85 8.81	L1	
11	1.00540	26.3417.34	9.98	36.32 27.33	2 56.00	46.00	19.6818.68	L1	
12	7.78940	21.70 12.28	10.25	31.95 22.53	3 60.00	50.00	28.0527.47	L1	



### 3.7 Occupied Bandwidth

### Test Requirements, RSS-Gen [6.7]

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 % emission bandwidth, as calculated or measured.

### 3.7.1 Test Setup

-NA

### 3.7.2 Test Procedures

The 99 % power bandwidth was measured with a calibrated spectrum analyzer.

The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3 × RBW.

Spectrum analyzer plots are included on the following pages.

3.7.3 Test Results

-NA

# 4. ANTENNA REQUIREMENTS

### According to FCC 47 CFR §15.203

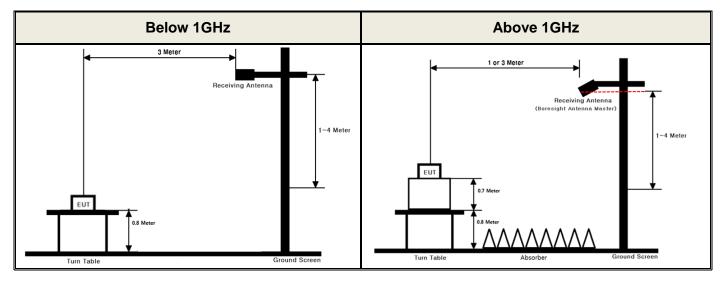
"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient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

The antenna is attached on the device by means of unique coupling method (Spring Tension). Therefore this E.U.T Complies with the requirement of §15.203

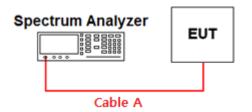
# **APPENDIX I**

# Test set up diagrams

### Radiated Measurement



### Conducted Measurement



### Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	0.58	15	4.00
1	0.70	20	5.00
2.402 & 2.440 & 2.480	1.10	25	5.20
5	1.60	-	-
10	3.00	-	-

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

# **APPENDIX II**

## Duty cycle plots

### Test Procedure

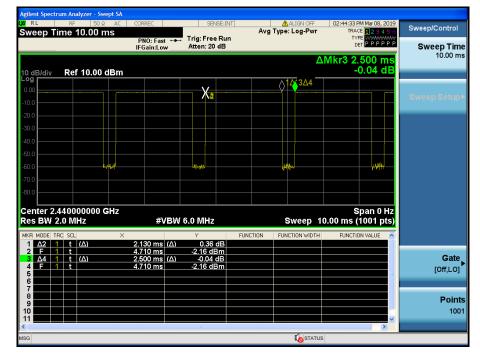
### Duty Cycle was measured using Section 6.0 b) of KDB558074 D01v05r01 :

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** 

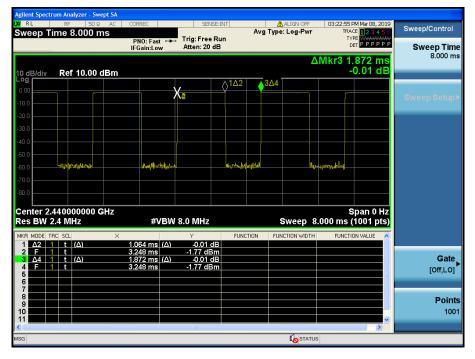
TM 1 Test Channel : Middle





### Duty Cycle

### TM 2 Test Channel : Middle



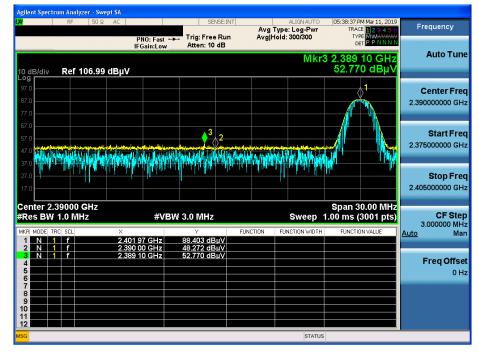
# **APPENDIX III**

# Unwanted Emissions (Radiated) Test Plot\_Normal

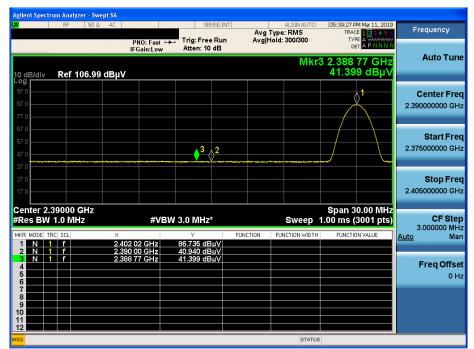


**Detector Mode : PK** 

**Detector Mode : AV** 



### TM1 & Lowest & Z & Ver

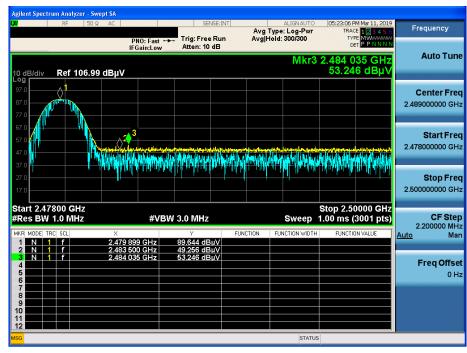


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### TM1 & Highest & Z & Ver

### **Detector Mode : PK**



# TM1 & Highest & Z & Ver

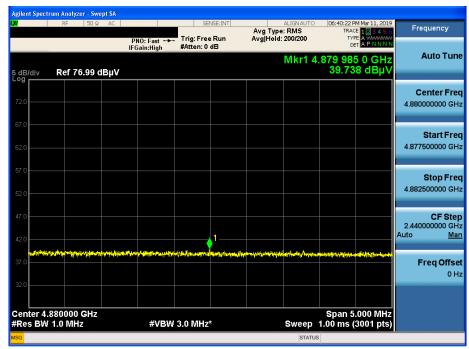
### **Detector Mode : AV**





### **Detector Mode : AV**

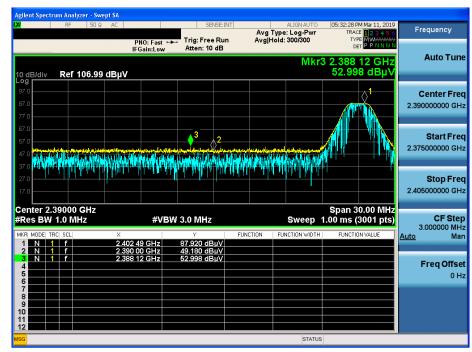
### TM1 & Middle & Z & Ver





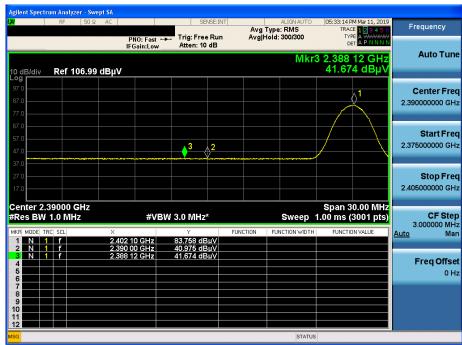
#### TM2 & Lowest & Z & Ver

### **Detector Mode : PK**



### **Detector Mode : AV**

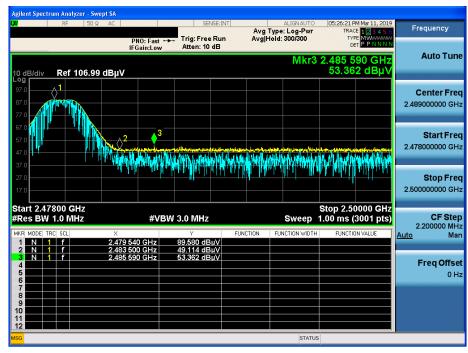
### TM2 & Lowest & Z & Ver





### TM2 & Highest & Z & Ver

### **Detector Mode : PK**



### TM2 & Highest & Z & Ver

# **Detector Mode : AV**





### **Detector Mode : AV**

### TM2 & Middle & Z & Ver

