# **TEST REPORT**

# **Dt&C**

# 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: DRTFCC1708-0159
- 2. Customer
  - Name : Sena Technologies, Inc.
  - Address : 19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, South Korea
- 3. Use of Report : FCC & IC Original Grant
- 4. Product Name / Model Name : Momentum\_INC / SP44 FCC ID : S7A-SP44 / IC : 8154A-SP44
- 5. Test Method Used : KDB 558074 D01 v04

Test Specification : FCC Part 15 Subpart C.247

RSS-247 Issue 2 (2017-02), RSS-GEN Issue 4 (2014-11)

- 6. Date of Test : 2017.07.03 ~ 2017.07.31
- 7. Testing Environment : See appended test report.
- 8. Test Result : Refer to the attached test result.

Affirmation	Tested by	Technical Manager						
	Name : JungWoo Kim (SQUre)	Name : GeunKi Son (Signature)						
The test r	results presented in this test report are limited o	nly to the sample supplied by applicant and						
the use of this	s test report is inhibited other than its purpose.	This test report shall not be reproduced except						
	in full, without the written approva	l of DT&C Co., Ltd.						
	2017.08.24.							
	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
DRTFCC1708-0159	Aug. 24, 2017	Initial issue



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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 site is constructed in conformance with the requirements.

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

- IC Test site No. : 5740A-3					
www.dtnc.net	www.dtnc.net				
Telephone	:	+ 82-31-321-2664			
FAX	:	+ 82-31-321-1664			

#### **1.2 Test Environment**

Ambient Condition	
Temperature	+23 °C ~ +24 °C
<ul> <li>Relative Humidity</li> </ul>	38 % ~ 42 %

#### **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	0.92 dB (The confidence level is about 95 %, $k = 2$ )		
Conducted spurious emission	0.94 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	:	Sena Technologies,Inc.
Address	:	19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, South Korea
Contact person	:	Seunghyun Kim

# **1.5 Description of EUT**

EUT	Momentum_INC
Model Name	SP44
Add Model Name	NA
Serial Number	Identical prototype
Hardware version	1.0
Software version	1.0
Power Supply	DC 3.7 V
Frequency Range	2402 MHz ~ 2480 MHz
Max. RF Output Power	5.45 dBm
Modulation Technique	GFSK
Antenna Type /Antenna Gain (Module 0)	Chip Antenna / PK : 0.3 dBi
Antenna Type /Antenna Gain     PCB Antenna / PK : 1.0 dBi	

# 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	16/09/09	17/09/09	MY50200834
Spectrum Analyzer	Agilent Technologies	N9020A	16/10/11	17/10/11	MY46471251
Digital Multimeter	Agilent Technologies	34401A	17/01/04	18/01/04	US36099541
DC Power Supply	SM techno	SDP30-5D	17/01/05	18/01/05	305DLJ204
Signal Generator	Rohde Schwarz	SMBV100A	17/01/04	18/01/04	255571
Signal Generator	Rohde Schwarz	SMF100A	17/04/21	18/04/21	102341
Thermohygrometer	BODYCOM	BJ5478	17/04/11	18/04/11	120612-2
Loop Antenna	Schwarzbeck	FMZB1513	16/04/22	18/04/22	1513-128
Bilog Antenna	Schwarzbeck	VULB9160	16/08/05	18/08/05	9160-3362
Horn Antenna	ETS-LINDGREN	3117	16/05/03	18/05/03	00140394
Horn Antenna	A.H.Systems Inc.	SAS-574	15/09/03	17/09/03	155
PreAmplifier	Agilent	8449B	16/10/19	17/10/19	3008A002108
PreAmplifier	tsj	MLA-010K01- B01-27	17/03/06	18/03/06	1844539
	Rohde Schwarz	ESU	16/07/18	17/07/18	
EMI TEST RECEIVER			17/07/06	18/07/06	- 100469
Highpass Filter	Wainwright Instruments	WHKX12-2580- 3000-18000- 80SS	16/09/09	17/09/09	3
Highpass Filter	Wainwright Instruments	WHNX6-6320- 8000-26500- 40CC	16/09/13	17/09/13	1
Attenuator	SMAJK	SMAJK-50-10	16/09/08	17/09/08	15081902
Power Meter & Wide Bandwidth	Austinus	ML2495A	17/04/11	18/04/11	1306007
Sensor	Anritsu	MA2490A	17/04/11	18/04/11	1249001

Note: The measurement antennas were calibrated in accordance to the requirements of ANSI C63.5-2006.

# 1.8 Summary of Test Results

FCC Part	RSS Std.	Parameter	Limit	Test Condition	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 [6.6]	Occupied Bandwidth (99 %)	RSS-Gen(6.6)		С
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 2
15.207	RSS-Gen [8.8]	AC Line Conducted Emissions FCC 15.207 limits		AC Line Conducted	NA Note 3
15.203	RSS-Gen[8.3]	Antenna Requirements FCC 15.203		-	С
Nate 1: C. Comply, NC Net Comply, NT, Net Tested, NA, Net Applicable					

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 supply of this device is only DC (Internal Battery) and Bluetooth function is disabled in charging status.

# 2. Test Methodology

Generally the tests were performed according to the KDB558074 D01 v04. 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 D01v04.

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 D01v04. 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 D01v04.

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 and reported.

		Frequency [MHz]			
	Test Mode	Lowest Frequency	Middle Frequency	Highest Frequency	
TM 1	BT LE	2402	2440	2480	
TM 2	-	-	-	-	
TM 3	-	-	-	-	
TM 4	-	-	-	-	

#### 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

Maximum Peak Conducted Output Power is measured using Measurement Procedure Option 1 of KDB558074

#### 1. Set the RBW ≥ DTS bandwidth. Actual RBW = 2 MHz

- 2. Set  $VBW \ge 3 \times RBW$ . Actual VBW = 6 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

#### <Module 0>

Test mode	Tested Channel	Frame Average Output Power	Peak Output Power	
Test mode	Testeu Ghanner	dBm	dBm	
	Lowest	0.84	3.91	
TM 1	Middle	1.98	5.52	
	Highest	-0.40	3.07	

#### <Module 1>

Test mode	Tested Channel	Frame Average Output Power	Peak Output Power	
	icsted ondinier	dBm	dBm	
TM 1	Lowest	-1.74	1.43	
	Middle	2.21	5.45	
	Highest	1.94	4.91	

Note 1 : The frame average output power was tested using an average power meter for reference only.

#### Note 2 : See next pages for actual measured spectrum plots.

#### <Module 0>

#### **Peak Output Power**

# 



#### **Peak Output Power**

#### Test Channel : Middle



#### **Peak Output Power**

Test Channel : Highest





#### <Module 1>

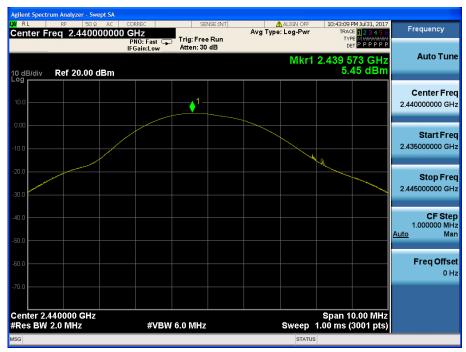
#### **Peak Output Power**



#### **Peak Output Power**

Test Channel : Middle

Test Channel : Lowest



#### **Peak Output Power**

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

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)  $\ge$  3 x 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. 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

#### <Module 0>

Test Mode	Tested Channel	Test Results [MHz]
	Lowest	0.692
TM 1	Middle	0.732
	Highest	0.682

#### <Module 1>

Test Mode	Tested Channel	Test Results [MHz]		
	Lowest	0.686		
TM 1	Middle	0.691		
	Highest	0.692		



#### <Module 0>

#### 6 dB Bandwidth



#### 6 dB Bandwidth

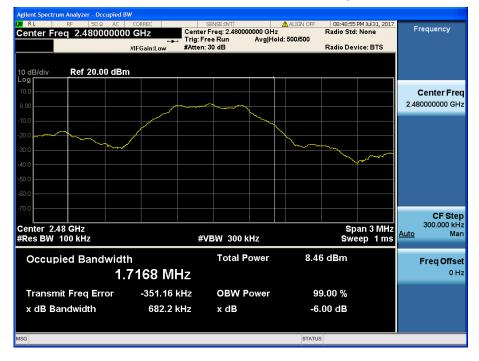
#### Test Channel : Middle

Test Channel : Lowest



#### 6 dB Bandwidth

Test Channel : Highest





#### <Module 1>

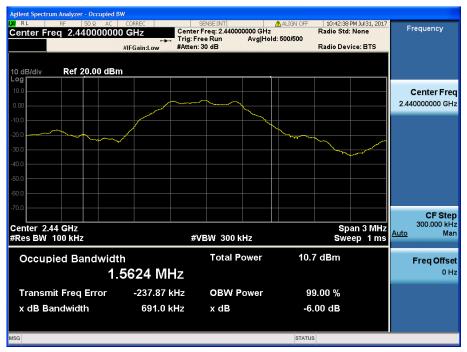
#### 6 dB Bandwidth



#### 6 dB Bandwidth

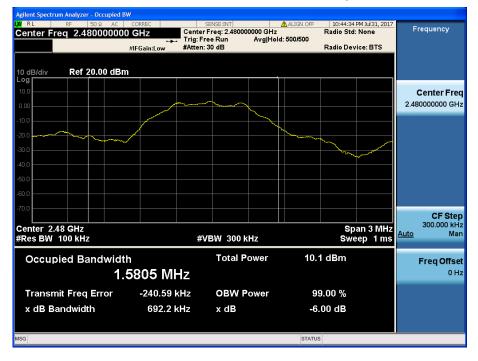
#### Test Channel : Middle

Test Channel : Lowest



#### 6 dB Bandwidth

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

#### 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 : 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

<Module 0>

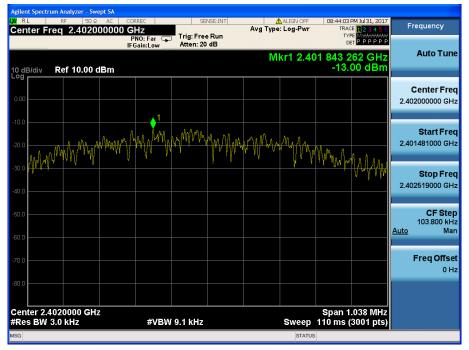
Test Mode	Tested Channel	PKPSD [dBm]
	Lowest	-13.00
<b>TM</b> 1	Middle	-11.48
	Highest	-13.77

<Module 1>

Test Mode	Tested Channel	PKPSD [dBm]
	Lowest	-15.40
TM 1	Middle	-11.47
	Highest	-12.01

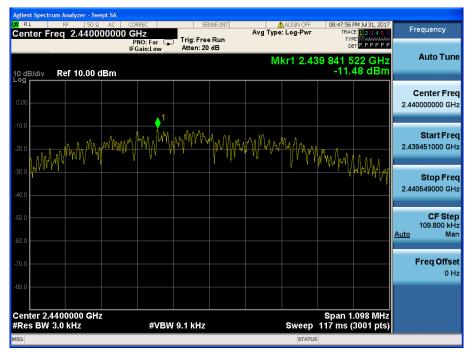
#### <Module 0>

#### Maximum PKPSD



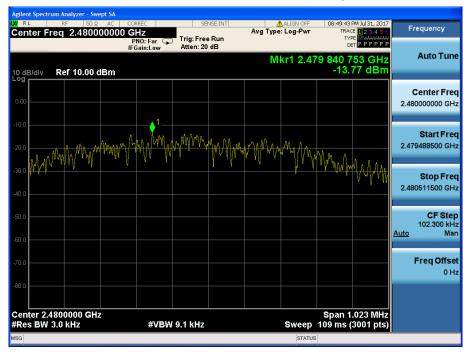
#### Maximum PKPSD

Test Channel : Middle



#### Maximum PKPSD

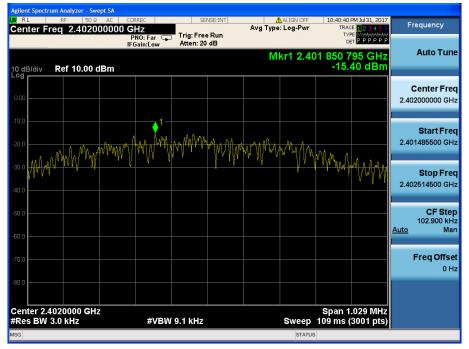
Test Channel : Highest





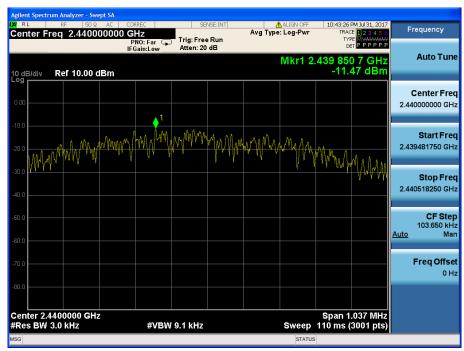
#### <Module 1>

#### Maximum PKPSD



#### Maximum PKPSD

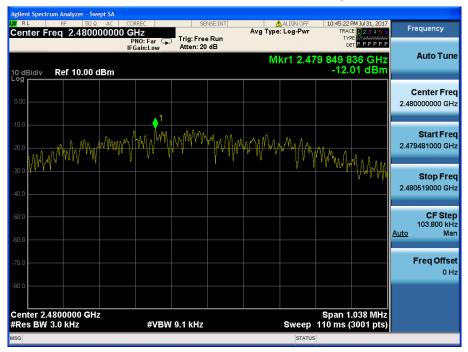
#### Test Channel : Middle



# Test Channel : Lowest

#### Maximum PKPSD

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 hand shall be attenuated by at least 20 dB relative to the maximum measured in hand peak B

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

#### 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  $\geq$  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.

#### - 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 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.

### 3.4.3 Test Results

#### <Module 0>

t Spectrum Analyzer - Swept SA Center Freq 2.402000000 CHz PRO: Far IFGain:Low Trig: Free Run Atten: 30 dB Frequency 08:44:14 ul 31, 20 Avg Type: Log-Pwr TYPE MWAAAAAAA DET P P P P P F Mkr1 2.401 970 936 GHz 2.60 dBm Auto Tune 0 dB/div Ref 20.00 dBm **Center Freq** 2.402000000 GHz ٠ Start Freq 2.401481000 GHz Stop Freq 2.402519000 GHz **CF Step** 103.800 kHz Man <u>Auto</u> Freq Offset 0 Hz Center 2.4020000 GHz #Res BW 100 kHz Span 1.038 MHz Sweep 1.00 ms (3001 pts) #VBW 300 kHz

#### **Reference** (Test Channel : Lowest)

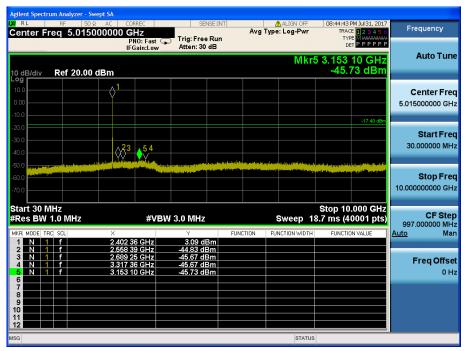
#### Low Band-edge (Test Channel : Lowest)



#### Agurenzation OF RL RF SO A DS Utweet Center Freq 15.004500 MHz PN0: Fast IFGain:Low Trig: Free Run Atten: 30 dB Avg Type: Log-Pwr Frequency Auto Tune Mkr2 283.4 kHz -55.76 dBm 10 dB/div Ref 20.00 dBm Center Freq 15.004500 MHz Start Freq 9.000 kHz Stop Freq 30.000000 MHz Stop 30.00 MHz Sweep 5.33 ms (40001 pts) Start 9 kHz #Res BW 100 kHz **CF Step** 2.999100 MHz Man #VBW 300 kHz Auto N 1 f N 1 f 283.4 kHz 283.4 kHz -55.76 dBm -55.76 dBm Freq Offset 0 Hz 10 1 DC Coupled

# Conducted Spurious Emissions 1 (Test Channel : Lowest)

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



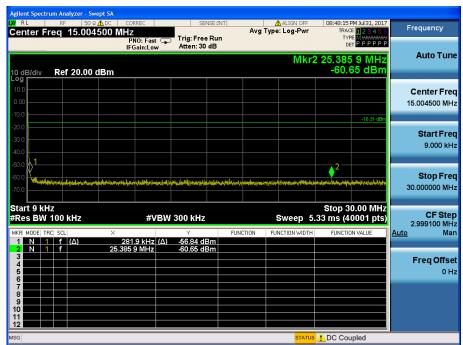
# Conducted Spurious Emissions 3 (Test Channel : Lowest)

Agilent Spectrum Analyzer - Sw					
ଅଜ୍ୟାର ଅକ୍ୟ ଅନ୍ୟ ଅନ୍ୟ Marter Freq 17.500	AC CORREC 0000000 GHz PNO: Fast C IFGain:Low	Trig: Free Run Atten: 30 dB	Avg Type: Log-Pwr	08:44:51 PM Jul 31, 2017 TRACE 123456 TYPE M WWWWW DET PPPPP	Frequency
10 dB/div Ref 20.00		Atten. oo tab	Mkr3 2	4.661 000 GHz -38.83 dBm	Auto Tune
10.0 0.00					<b>Center Free</b> 17.500000000 GH
20.0 30.0 40.0			الله المعارية المالية والمراجعة المراجع المراجع المراجع المراجع	-17.40 dBm	<b>Start Free</b> 10.000000000 GH
50.0 month (ministration) 60.0					<b>Stop Fre</b> 25.000000000 GH
Start 10.000 GHz Res BW 1.0 MHz	#VB\	N 3.0 MHz	Sweep 40	Stop 25.000 GHz 0.0 ms (40001 pts)	<b>CF Ste</b> 1.500000000 GH Auto Ma
1 N 1 f 2 N 1 f 3 N 1 f 4 5 6	24.860 875 GHz 24.469 375 GHz 24.661 000 GHz	-38.02 dBm -38.42 dBm -38.83 dBm			Freq Offse
7 8 9 10 11 12					
SG			STATUS		

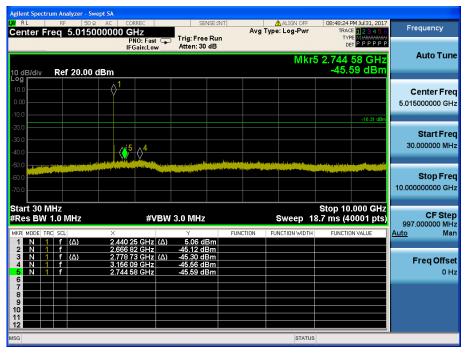




#### Conducted Spurious Emissions 1 (Test Channel : Middle)



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



#### Conducted Spurious Emissions 3 (Test Channel : Middle)





#### **Reference** (Test Channel : Highest)

#### High Band-edge (Test Channel : Highest)

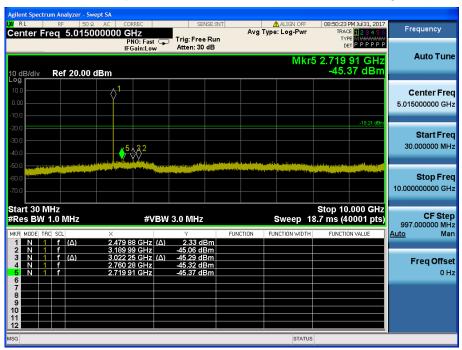




#### Conducted Spurious Emissions 1 (Test Channel : Highest)

LXI RL	um Analyzer - Sw RF 50 Ω req 15.004	ADC COF					ALIGN OFF	TRAC	PM Jul 31, 2017 1 <b>2 3 4 5 6</b> 76 M WAAAAAA	Frequency
10 dB/div	Ref 20.00	IFG	IO: Fast 🕞 iain:Low	Atten: 30			ſ	DE Mkr2 29	6.2 kHz 62 dBm	Auto Tune
Log 10.0 0.00 -10.0										Center Freq 15.004500 MHz
-20.0 -30.0 -40.0									-18.21 dBm	Start Freq 9.000 kHz
-60.0	and and an proceeding to be addressed	hining the statistic for	qar biyirishançabalışla	han taraan ah	antiplication whomas	ji jelowa ta jejili	eta angenetati atalari ayan			Stop Freq 30.000000 MHz
Start 9 kH #Res BW MKR MODE TR 1 N 1	100 kHz C SCL f (Δ)		2 kHz (Δ)	300 kHz -56.62 dE	3m		Sweep 5	.33 ms (4	0.00 MHz 0001 pts) <sup>DN VALUE</sup>	<b>CF Step</b> 2.999100 MHz <u>Auto</u> Man
2 N 1 3 4 5 6 7		296	2 kHz	-56.62 dE	5m					Freq Offset 0 Hz
8 9 10 11 12										
MSG							STATUS	L DC Cou	upled	

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



# Conducted Spurious Emissions 3 (Test Channel : Highest)

Agilent Spectr	rum Analyzer - S		0055	051100	- 10 LINE	ALIGN OFF		
	req 17.50	0000000	'NO: Fast 🗔	Trig: Free R Atten: 30 dB	Avş un	Type: Log-Pwr	08:50:30 PM Jul 31, 2017 TRACE 1 2 3 4 5 6 TYPE MWWWWWW DET P P P P P	Frequency
10 dB/div	Ref 20.00		Gain:Low	Atten: 30 dr	J	Mkr3 2	4.797 875 GHz -38.66 dBm	Auto Tune
10.0 0.00								Center Freq 17.50000000 GHz
-20.0		. I slällele			And adding (1) a tailer (1)		-18.21 dBm	Start Freq 10.000000000 GHz
-50.0 46.000 -60.0			e damé are e					Stop Fred 25.000000000 GHz
Start 10.0 #Res BW	1.0 MHz	X	#VBW	3.0 MHz Y -37.33 dBr	FUNCTION	Sweep 4	Stop 25.000 GHz 0.0 ms (40001 pts) FUNCTION VALUE	<b>CF Step</b> 1.500000000 GH: <u>Auto</u> Mar
1 N 1 2 N 1 3 N 1 4 5 6	f f f (Δ)	24.790 00	00 GHZ (Δ) 00 GHZ 75 GHZ (Δ)	-38.28 dBn -38.66 dBn				Freq Offset 0 Hz
7 8 9 9 10 11 11 11 11 11 11 11 11 11 11 11 11								
12 MSG						STATUS		



#### <Module 1>

Reference (Test Channel : Lowest)



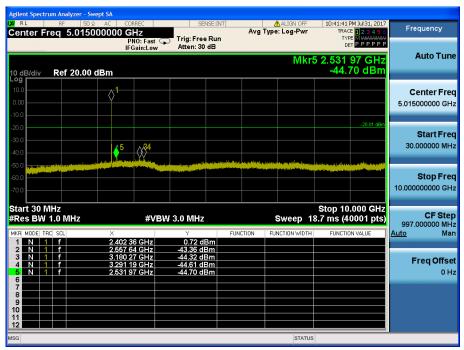
#### Low Band-edge (Test Channel : Lowest)



#### Center Freq 15.004500 MHz PNO:Fast C IFGain:Low Atten: 30 dB Avg Type: Log-Pwr Frequency Auto Tune Mkr2 290.2 kHz -55.93 dBm I0 dB/div Ref 20.00 dBm Center Freq 15.004500 MHz Start Freq 9.000 kHz Stop Freq 30.000000 MHz Stop 30.00 MHz Sweep 5.33 ms (40001 pts) Start 9 kHz #Res BW 100 kHz **CF Step** 2.999100 MHz Man #VBW 300 kHz Auto N 1 f N 1 f 290.2 kHz 290.2 kHz -55.93 dBm -55.93 dBm Freq Offset 0 Hz 10 1 DC Coupled

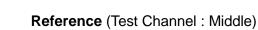
# Conducted Spurious Emissions 1 (Test Channel : Lowest)

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



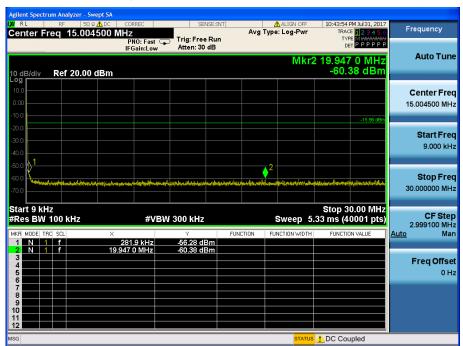
# Conducted Spurious Emissions 3 (Test Channel : Lowest)

Agilent Spectrum Analyzer - Swept S/ (X) RL RF 50 Ω AC Center Freq 17.500000		SENSE:INT	ALIGN OFF Avg Type: Log-Pwr	10:42:23 PM Jul 31, 2017 TRACE 1 2 3 4 5 6 TYPE 1	Frequency
10 dB/div Ref 20.00 dBm	PNO: Fast 🆵 IFGain:Low	#Atten: 30 dB	Mkr3 2	<sub>рет</sub> Р РРРРРР 1.873 250 GHz -39.92 dBm	Auto Tune
10.0 0.00 -10.0					Center Freq 17.500000000 GHz
-20.0	وي من المحمد محمد المحمد محمد المحمد المحمد محمد المحمد المحمم محمد المحمم محمد محمد محمد محمد المحمم محمد محمد محمد محمد محمد محمد محمد			-20.01 dBm 32 12	<b>Start Freq</b> 10.000000000 GHz
-50.0 -60.0 -70.0					<b>Stop Freq</b> 25.000000000 GHz
	#VBW × 304 750 GHz	3.0 MHz Y FL -38.07 dBm	Sweep 40	Stop 25.000 GHz 0.0 ms (40001 pts) FUNCTION VALUE	<b>CF Step</b> 1.50000000 GHz <u>Auto</u> Man
2 N 1 f 23. 3 N 1 f 21. 4 5 6 6	839 750 GHz 873 250 GHz	-39.11 dBm -39.92 dBm			<b>Freq Offset</b> 0 Hz
7 8 9 10 11 12					
MSG			STATUS		

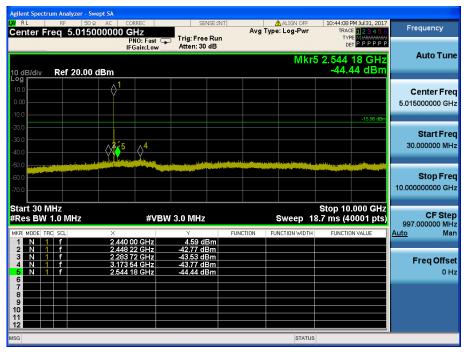




# Conducted Spurious Emissions 1 (Test Channel : Middle)



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



#### Conducted Spurious Emissions 3 (Test Channel : Middle)





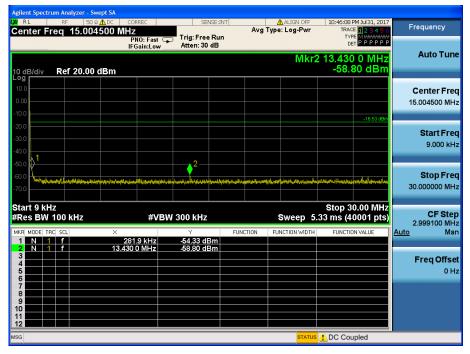
### **Reference** (Test Channel : Highest)

### High Band-edge (Test Channel : Highest)

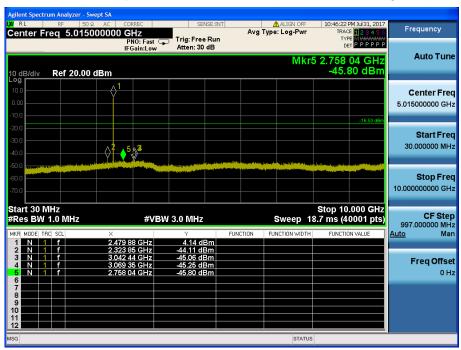




### Conducted Spurious Emissions 1 (Test Channel : Highest)



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



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

enter Fi	req 17.50	0000000	ORREC GHZ PNO: Fast Gain:Low	Trig: Free R Atten: 30 dE	Av; un	ALIGN OFF	10:46:34 PM Jul TRACE 1 2 TYPE MW DET P P	2456	Frequency
0 dB/div	Ref 20.00	0 dBm				Mkr3 2	3.590 750 ( -39.88 c		Auto Tuno
10.0 									<b>Center Fre</b> 17.500000000 GH
20.0 30.0 40.0		Notice of a			er vers typical in our different of the		3	2-1	<b>Start Fre</b> 10.000000000 GH
50.0 <b>Manual</b> a 50.0 70.0									<b>Stop Fre</b> 25.000000000 GH
tart 10.0 Res BW	1.0 MHz	× 24.989 12		V 3.0 MHz Y -37.59 dBm	FUNCTION	Sweep 40	Stop 25.000 0.0 ms (40001 FUNCTION VAL	l pts)	<b>CF Ste</b> 1.500000000 G⊢ <u>tuto</u> Ma
2 N 1 3 N 1 4 5 6	f	24.363 12 24.159 62 23.590 76	25 GHz	-39.88 dBm -39.88 dBm					Freq Offse 0 H
7 200 8 200 9 200 10 200 11 200									
12 66						STATUS			

### 3.5 Unwanted Emissions (Radiated)

#### 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) : 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.



## 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.

### 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.
- 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.

#### <Module 0>

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	61.54	0.400	0.650	2.11

#### <Module 1>

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	61.23	0.398	0.650	2.13	

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



## 3.5.3 Test Results

#### <Module 0>

### Frequency Range : 9 kHz ~ 25 GHz

### Lowest Channel

Frequency (MHz)	ANT Pol	The worst case 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)
2388.61	Н	Z	PK	49.04	0.70	N/A	N/A	49.74	74.00	24.26
2389.27	Н	Z	AV	38.52	0.70	2.11	N/A	41.33	54.00	12.67
4803.97	Н	Y	PK	49.95	4.77	N/A	N/A	54.72	74.00	19.28
4803.88	Н	Y	AV	41.90	4.77	2.11	N/A	48.78	54.00	5.22

#### Middle Channel

Frequency (MHz)	ANT Pol	The worst case 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)
4879.58	Н	Y	PK	51.57	5.10	N/A	N/A	56.67	74.00	17.33
4879.96	Н	Y	AV	44.04	5.10	2.11	N/A	51.25	54.00	2.75

#### Highest Channel

Frequency (MHz)	ANT Pol	The worst case 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)
2483.51	Н	Z	PK	55.90	1.07	N/A	N/A	56.97	74.00	17.03
2483.55	Н	Z	AV	45.23	1.07	2.11	N/A	48.41	54.00	5.59
4960.43	Н	Y	PK	50.93	5.34	N/A	N/A	56.27	74.00	17.73
4959.82	Н	Y	AV	44.06	5.34	2.11	N/A	51.51	54.00	2.49

#### Note.

1. The radiated emissions were investigated up 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.

#### <Module 1>

### Frequency Range : 9 kHz ~ 25 GHz

### Lowest Channel

Frequency (MHz)	ANT Pol	The worst case 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)
2376.53	Н	Z	PK	46.26	0.70	N/A	N/A	46.96	74.00	27.04
2376.41	Н	Z	AV	35.83	0.70	2.13	N/A	38.66	54.00	15.34
4804.09	Н	Y	PK	44.64	4.77	N/A	N/A	49.41	74.00	24.59
4803.69	Н	Y	AV	33.84	4.77	2.13	N/A	40.74	54.00	13.26

#### Middle Channel

Frequency (MHz)	ANT Pol	The worst case 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)
4880.05	Н	Y	PK	44.75	5.10	N/A	N/A	49.85	74.00	24.15
4879.61	Н	Y	AV	34.14	5.10	2.13	N/A	41.37	54.00	12.63

#### Highest Channel

Frequency (MHz)	ANT Pol	The worst case 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)
2483.51	Н	Z	PK	57.62	1.07	N/A	N/A	58.69	74.00	15.31
2483.63	Н	Z	AV	48.30	1.07	2.13	N/A	51.50	54.00	2.50
4959.98	Н	Y	PK	44.54	5.34	N/A	N/A	49.88	74.00	24.12
4960.12	Н	Y	AV	33.47	5.34	2.13	N/A	40.94	54.00	13.06

#### Note.

1. The radiated emissions were investigated up 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

 $\label{eq:Where, T.F = Total Factor, \quad AF = Antenna \ Factor, \quad CL = Cable \ Loss, \quad AG = Amplifier \ Gain,$ 

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

#### NA

#### 3.6.2 Test Procedures

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

- 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

NA

## 3.7 Occupied Bandwidth

### Test Requirements, RSS-Gen [6.6]

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

### 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

#### <Module 0>

Test Mode	Tested Channel	Test Results (MHz)
	Lowest	1.634
TM 1	Middle	1.362
	Highest	1.692

#### <Module 1>

Test Mode	Tested Channel	Test Results (MHz)
	Lowest	1.510
TM 1	Middle	1.553
	Highest	1.558



#### <Module 0>

Occupied Bandwidth (99 %)

Test Channel : Lowest



### Occupied Bandwidth (99 %)

Test Channel : Middle



## Occupied Bandwidth (99 %)

Test Channel : Highest





#### <Module 1>

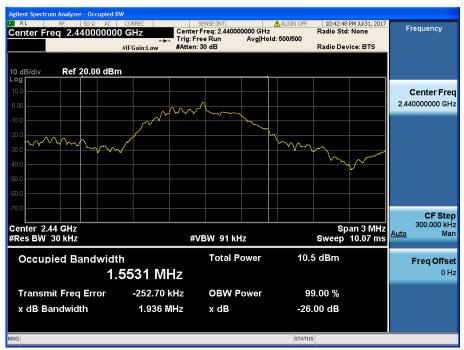
#### Occupied Bandwidth (99 %)

Test Channel : Lowest



#### Occupied Bandwidth (99 %)

Test Channel : Middle





### Occupied Bandwidth (99 %)

Test Channel : Highest



# 4. ANTENNA REQUIREMENTS

## According to FCC 47 CFR §15.203 & RSS-Gen [8.3]

"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."

#### Module 0

Model : SENA\_003 The antenna type is a Chip antenna.(Refer to Internal Photo file.)

#### Module 1

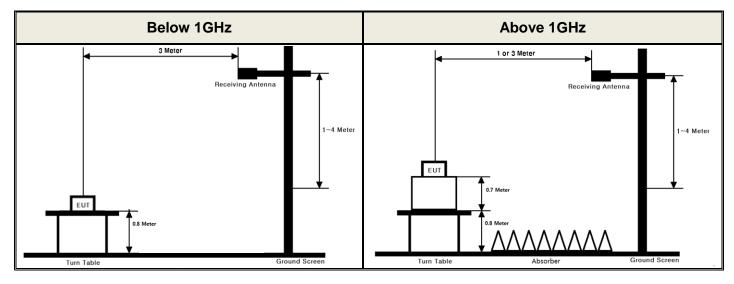
ANT1\_Model : SENA-DP02-19 The antenna is printed to the external PCB (Refer to Internal Photo file.)

Therefore this E.U.T Complies with the requirement of §15.203.

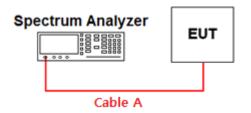
## **APPENDIX I**

### Test set up diagrams

### Radiated Measurement



#### Conducted Measurement



#### Path loss information

Frequency (GHz)	Path Loss (dB)	Frequency (GHz)	Path Loss (dB)
0.03	0.01	15	0.70
1	0.17	20	0.86
2.402 & 2.441 & 2480	0.29	25	0.88
5	0.31	ŀ	-
10	0.50	-	-

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.)

#### <Module 0>

### Duty Cycle

L RF		RREC	SENSE:I	Avg	ALIGN OFF	08:54:09 PM Jul 31, 2017 TRACE 1 2 3 4 5 6 TYPE WWWWWW	Frequency
0 dB/div Ref		Gain:Low	Atten: 30 dB		Δ	<sup>рет</sup> РРРРРР Mkr3 650.0 µs 0.61 dB	Auto Tu
og 10.0 10.0		Xa		1Δ2	3Δ4		<b>Center Fr</b> 2.440000000 G
20.0							<b>Start Fr</b> 2.440000000 G
50.0 <b> </b> 50.0 <b> </b> 70.0 <b> </b>	Children and Chi	WW.		notampediditytyte		Properties of the second s	<b>Stop Fr</b> 2.440000000 G
enter 2.44000 es BW 2.0 MI		#VBW	6.0 MHz	FUNCTION	-	Span 0 Hz 000 ms (1001 pts)	CF St 2.000000 M Auto M
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	(Δ) 40 67 (Δ) 65	00.0 μs (Δ) '2.0 μs 50.0 μs (Δ) '2.0 μs	1.23 dB 2.07 dBm 0.61 dB 2.07 dBm	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	Auto N Freq Offs 0
7 8 9 0							

#### Test Channel : Middle

### <Module 1>

## Duty Cycle

**Test Channel : Middle** 

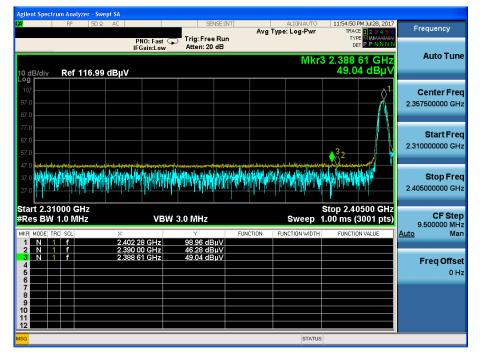
	RF	50 Ω	AC	CORREC		SEN	ISE:INT			ALIGN OFF		PM Jul 31, 2017	Frequency
				PNO: Fast IFGain:Lov	v	Trig: Free Atten: 30		Avg	Type: I	Log-Pwr	TY	<sup>СЕ</sup> 123456 РЕ W <del>WWWWW</del> ЕТ Р Р Р Р Р Р	requercy
) dB/div	Ref 2	0.00 d	Bm							Ĺ		650.0 μs 0.61 dB	Auto Tu
og 0.0 1.00 0.0			X			√ <sup>1∆2</sup>	3	Δ4			ſ		<b>Center Fr</b> 2.440000000 G
10.0 10.0 10.0													<b>Start Fr</b> 2.440000000 G
50.0 50.0 70.0	ita 	tutyorna	<b>MW</b>			w.	wyyyd			<u>Aprila</u>	hud and and		<b>Stop Fr</b> 2.440000000 G
enter 2. es BW :			Hz	#V	ΒW	6.0 MHz			SI	weep 2	s .000 ms (	Span 0 Hz (1001 pts)	CF St 2.000000 M
1.11	1 t (/	7)	Х	398.0 µs	(Δ)	۲ -2.11 د	3B	INCTION	FUNC	TION WIDTH	FUNCTI	ON VALUE	<u>Auto</u> N
2 F 3 Δ4 4 F 5	1 t 1 t (/ 1 t	7)		468.0 μs 650.0 μs 468.0 μs	(Δ)	3.63 dE 0.61 3.63 dE	dB						Freq Offs 0
6 7 8 9 0													

## APPENDIX III

## **Unwanted Emissions (Radiated) Test Plot**

#### <Module 0>

TM1 & Lowest & Z & Hor



#### TM1 & Lowest & Z & Hor

### **Detector Mode : AV**

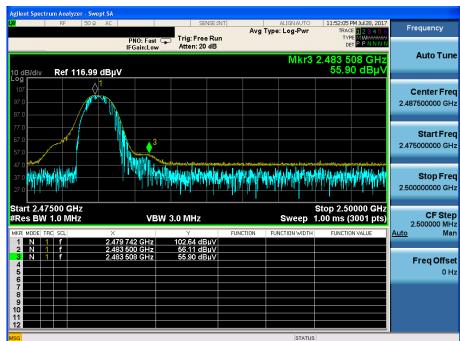
**Detector Mode : PK** 

C RF	50 Ω AC		SENSE	EINT	ALIGN AUTO	11:54:20 PM Jul 28, 2013	
			Trig: Free R		Type: Pwr(RMS) Iold: 200/200	TRACE 1 2 3 4 5 ( TYPE A WATAWAY	Frequency
		PNO: Fast ↔ IFGain:Low	Atten: 20 di		1010. 200/200	DET A P N N N I	
					Mkr	3 2.389 27 GHz	Auto Tun
10 dB/div Ref 11	6.99 dBµV					38.524 dBµ∖	
-og	0.00 000						
107						1	Center Fre
97.0						X	2.357500000 GI
87.0							
77.0							
67.0							Start Fre
57.0							2.310000000 GH
						2	
47.0	11. A. 11		ultre L				
to the bid to share be stated by	ans that the table differential bit	D. D. B. (Blacking)	i i dalla cal lintali co	de na <b>Lation (Li, Bul</b> andar B	and Mattalian Shift align	ا 👘 🖉 بالدية المعالية الج 😓 بالترج	04 F
NUMPER NOT STREET	na kalika di katika di di Mini Tinya Mini Katika	an nga angalakan Ang ngangalakan	l dahimi yang bergan ku				
37.0 1 4 1 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	un the public of	in <mark>k uhlin</mark> lin hi		in the transfer	and a state of the last		<b>Stop Fre</b> 2.405000000 GH
27.0	na tanakina taki	in under the disk	AURIA BINANA ANA A Auria Binana Ang Ang Ang Ang Ang Ang Ang Ang Ang Ang Ang Ang Ang Ang		ide hade he ok de.	Million Million A.	2.405000000 GI
27.0 27.0 Start 2.31000 GH	z 14 Tur Mali Mi	an a air an	nin in dia dia 19		ada da	Stop 2.40500 GHz	2.40500000 GI
27.0 Start 2.31000 GH #Res BW 1.0 MHz		an a	/ 3.0 MHz*	ALTILE A MALATIN	Sweep	Stop 2.40500 GHz 1.00 ms (3001 pts)	2.405000000 GF CF Ste 9.500000 MF
27.0 27.0 Start 2.31000 GH	z z ×	vbw	/ 3.0 MHz*	FUNCTION	ada da	Stop 2.40500 GHz	2.405000000 GF CF Ste 9.500000 MF
37.0         1         1         1         1           \$Z7.0         27.0         27.0         27.0         27.0         27.0         27.0         27.0         27.0         27.0         27.0         27.0         27.0         27.0         20.0         20.0         20.0         20.0         20.0         1         6         2         1 <td>z z 2.402 2.390</td> <td>VBW 2 02 GHz 0 00 GHz</td> <td>/ 3.0 MHz*</td> <td>FUNCTION</td> <td>Sweep</td> <td>Stop 2.40500 GHz 1.00 ms (3001 pts)</td> <td>2.405000000 GF CF Ste 9.500000 MF</td>	z z 2.402 2.390	VBW 2 02 GHz 0 00 GHz	/ 3.0 MHz*	FUNCTION	Sweep	Stop 2.40500 GHz 1.00 ms (3001 pts)	2.405000000 GF CF Ste 9.500000 MF
37.0         37.0           Start 2.31000 GH;           #Res BW 1.0 MHz           MKR MODE         TRC           1         N         1           2         N         1           3         N         1	z z 2.402 2.390	VBW	/ 3.0 MHz* 95.912 dBµ	FUNCTION	Sweep	Stop 2.40500 GHz 1.00 ms (3001 pts)	2.405000000 GI CF Ste 9.500000 Mi
Start 2.31000 GH;           Res BW 1.0 MH;           I         N           1         N           2         N           1         N	z z 2.402 2.390	VBW 2 02 GHz 0 00 GHz	/ 3.0 MHz*	FUNCTION	Sweep	Stop 2.40500 GHz 1.00 ms (3001 pts)	2.405000000 G CF Ste 9.500000 M <u>Auto</u> M Freq Offs
27.0         1	z z 2.402 2.390	VBW 2 02 GHz 0 00 GHz	/ 3.0 MHz*	FUNCTION	Sweep	Stop 2.40500 GHz 1.00 ms (3001 pts)	2.405000000 G CF Ste 9.500000 M <u>Auto</u> M Freq Offs
37.0         1	z z 2.402 2.390	VBW 2 02 GHz 0 00 GHz	/ 3.0 MHz*	FUNCTION	Sweep	Stop 2.40500 GHz 1.00 ms (3001 pts)	2.405000000 G CF Ste 9.500000 M <u>Auto</u> M
37.0         37.0 <td< td=""><td>z z 2.402 2.390</td><td>VBW 2 02 GHz 0 00 GHz</td><td>/ 3.0 MHz*</td><td>FUNCTION</td><td>Sweep</td><td>Stop 2.40500 GHz 1.00 ms (3001 pts)</td><td>2.405000000 G CF Ste 9.500000 M <u>Auto</u> M Freq Offs</td></td<>	z z 2.402 2.390	VBW 2 02 GHz 0 00 GHz	/ 3.0 MHz*	FUNCTION	Sweep	Stop 2.40500 GHz 1.00 ms (3001 pts)	2.405000000 G CF Ste 9.500000 M <u>Auto</u> M Freq Offs
3.0         1	z z 2.402 2.390	VBW 2 02 GHz 0 00 GHz	/ 3.0 MHz*	FUNCTION	Sweep	Stop 2.40500 GHz 1.00 ms (3001 pts)	2.405000000 G CF Ste 9.500000 M <u>Auto</u> M Freq Offs
3.0         1	z z 2.402 2.390	VBW 2 02 GHz 0 00 GHz	/ 3.0 MHz*	FUNCTION	Sweep	Stop 2.40500 GHz 1.00 ms (3001 pts)	2.405000000 G CF Str 9.500000 M <u>Auto</u> M Freq Offs

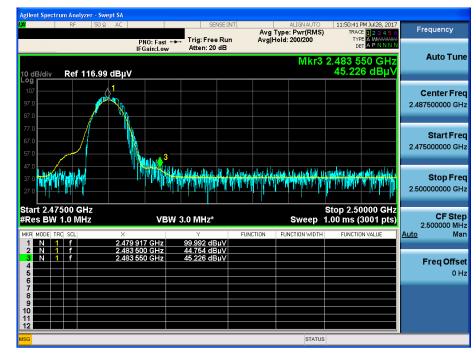
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### TM1 & Highest & Z & Hor

🛈 Dt&C



#### TM1 & Highest & Z & Hor



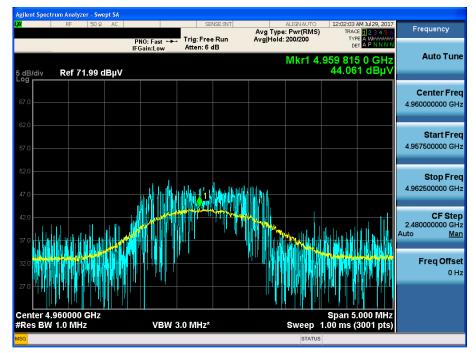
#### **Detector Mode : PK**

**Detector Mode : AV** 



#### TM1 & Highest & Y & Hor

## Detector Mode : AV



### TM1 & Lowest & Z & Hor

Agilent Spectrum Analyzer - Swept SA				
LXV RF 50Ω AC	SENSE:I	Avg Type: Log-Pwr	11:29:27 PM Jul 28, 2017 TRACE 1 2 3 4 5 6 TYPE M WARAANAA	Frequency
10 dB/div Ref 106.99 dBµV	IFGain:Low Atten: 10 dB		4 2.376 53 GHz 46.26 dBμV	Auto Tune
97.0 87.0 77.0				Center Freq 2.357500000 GHz
67.0 57.0 47.0 Jacobie Strategie Str		4		Start Freq 2.310000000 GHz
37.0 (1997)	dhrandainin an an bhaile de far an	NAVE ON DATABATI NORTHAN AND	Multur Hadai	<b>Stop Freq</b> 2.405000000 GHz
Start 2.31000 GHz #Res BW 1.0 MHz	VBW 3.0 MHz	Sweep	Stop 2.40500 GHz 1.00 ms (3001 pts)	CF Step 2.48000000 GHz Auto Man
1         N         1         f         2.40           2         N         1         f         2.33           3         N         1         f         2.33           4         N         1         f         2.37           5	02 28 GHz 95.26 dBµV 00 00 GHz 43.76 dBµV 19 53 GHz 45.34 dBµV 76 53 GHz 46.26 dBµV			Freq Offset 0 Hz
7 8 9 10 11 11				
MSG		STATUS		

#### TM1 & Lowest & Z & Hor

### **Detector Mode : AV**

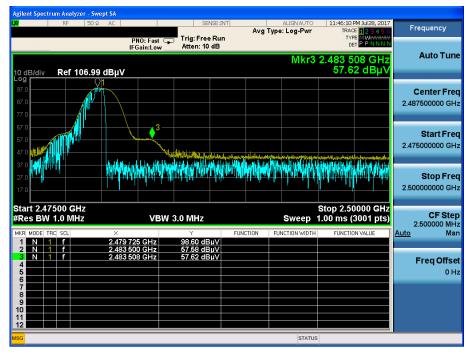
Agilent Spect <mark>XI</mark>	<mark>rum Ana</mark> RF	<mark>lyzer - Swept SA</mark> 50 Ω AC		SENS	Avg	ALIGN AUTO Type: Pwr(RMS)	11:28:18 PM Jul 28, 2017 TRACE 1 2 3 4 5 6	Frequency
10 dB/div	Ref	106.99 dBj	PNO: Fast IFGain:Low	Atten: 10 d		Hold: 200/200 Mkr4	TYPE A WAXWAW DET A P NNNN 4 2.376 41 GHz 35.827 dBµV	Auto Tun
- <b>og</b> 97.0 87.0 77.0								Center Fre 2.357500000 GI
67.0 57.0 47.0						4		<b>Start Fr</b> 2.310000000 G
37.0 <b>. 21) 41</b> 27.0 <b></b> 17.0 <b> </b>				elent et alle trading to the				<b>Stop Fr</b> 2.405000000 G
itart 2.3′ Res BW			VB	W 3.0 MHz*		Sweep ′	Stop 2.40500 GHz I.00 ms (3001 pts)	CF St 2.48000000 G
IKR MODE T	RC SCL	>	< 2.402.09 GHz	۲ 92,582 dBu	FUNCTION	FUNCTION WIDTH	FUNCTION VALUE	Auto <u>N</u>
2 N 3 N 4 N 5 6	f f f		2.390 00 GHz 2.389 72 GHz 2.376 41 GHz	34.255 dBµ 34.255 dBµ 34.923 dBµ 35.827 dBµ	V V			Freq Offs 0
7 8 8 9 9 10 10 10 10 10 10 10 10 10 10 10 10 10								
11 12 12 13 14 15 15 15 15 15 15 15 15 15 15 15 15 15						STATUS	 	

## Detector Mode : PK



### TM1 & Highest & Z & Hor

### **Detector Mode : PK**



#### TM1 & Highest & Z & Hor

#### Avg Type: Pwr(RMS) Avg|Hold: 200/200 Frequency Trig: Free Run Atten: 10 dB PNO: Fast +++ IFGain:Low Auto Tune Mkr3 2.483 633 GHz 48.295 dBµ\ Ref 106.99 dBµV 0 dB/div Center Fred 2.487500000 GHz Start Fred 3 2.475000000 GHz alailan an ing Kapang Kapang Kang Kang Pang Pang talla din tallanda ta a i s**ila** att att. Stop Freq 2.50000000 GHz Start 2.47500 GHz #Res BW 1.0 MHz Stop 2.50000 GHz 1.00 ms (3001 pts) CF Step 2.500000 MHz VBW 3.0 MHz\* Sweep Man Auto 48.295 dBµ 2.483 633 GHz Freq Offset 0 Hz STATUS

#### **Detector Mode : AV**



#### TM1 & Middle & Y & Hor

#### **Detector Mode : AV**

