

Test Report				
1. Client				
<ul> <li>Name :</li> <li>Address :</li> </ul>	SENA TECHNOLOGIES.Inc 19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea			
2. Use of Report :	FCC & IC Approval			
3. Sample Description				
Product Name: HelmLink     Model Name: SP124				
<b>4. Date of Receipt :</b> 2022-07-01				
5. Date of Test :	2022-09-08 ~ 2022-09-22			
6. Test Method : FCC Part 15 Subpart C 15.247 RSS-247 Issue 2(2017-02), RSS-GEN Issue 5(2019-03)				
7. Test Results : Refer to the test results				
This test report must not be reproduced or reproduced in any way. The results shown in this test report are the results of testing the samples provided. This test report is prepared according to the requirements of ISO / IEC 17025.				
Affirmation	y Technical Manager			
Dae-Se	ong, Choi Yong-Min, Won			

Sep 26, 2022

EMC Labs Co., Ltd.



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# <u>Version</u>

TEST REPORT NO.	DATE	DESCRIPTION
KR0140-RF2209-017	Sep 26, 2022	Initial Issue

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# 1. Applicant & Manufacturer & Test Laboratory Information

#### 1.1 Applicant Information

Applicant	SENA TECHNOLOGIES.Inc
Applicant Address 19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea	
Contact Person Seunghyun Kim	
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## 1.2. Manufacturer Information

Manufacturer SENA TECHNOLOGIES.Inc	
Manufacturer Address	19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea

### 1.3 Test Laboratory Information

LaboratoryEMC Labs Co., Ltd.		
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FCC Designation No.	KR0140	
FCC Registration No.	58000	
IC Site Registration No.	28751	



# 2. Equipment under Test(EUT) Information

## 2.1 General Information

Product Name	HelmLink
Model Name	SP124
FCC ID	S7A-SP124
IC	8154A-SP124
Power Supply	DC 3.8 V

#### 2.2 Additional Information

Operating Frequency	2 410 MHz ~ 2 475 MHz			
Number of channel 14				
Modulation Type OQPSK				
Antenna Type         PCB Pattern Antenna				
Antenna Gain 0.68 dBi				
Firmware Version 1.0				
Hardware Version 1.0				
Test software         CMD v10.0.19044.1889				

#### 2.3 Test Frequency

Test mode	Test Frequency (MHz)		
	Low Frequency	Middle Frequency	High Frequency
MESH	MESH 2 410		2 475

#### 2.4 Used Test Software Setting Value

Test Mode	Setting Item	
Test Mode	Power	
MESH	12	

#### 2.5 Mode of operation during the test

- The EUT continuous transmission mode during the test with set at Low Channel, Middle Channel, and High Channel. To get a maximum radiated emission levels from the EUT, the EUT was moved throughout the XY, YZ, XZ planes.

# 2.6 Modifications of EUT

- None



# 3. Test Summary

Applied	FCC Rule	IC Rule	Test Items	Test Condition	Result
$\square$	15.203	-	Antenna Requirement		С
$\square$	15.247(a)	RSS-247 (5.2)	6 dB Bandwidth		С
$\square$	_	RSS GEN (6.7)	Occupied Bandwidth (99%)	Conducted	С
$\square$	15.247(b)	RSS-247 (5.4)	Maximum Peak Output Power	Conducted	С
$\square$	15.247(e)	RSS-247 (5.2)	Peak Power Spectral Density		С
	15.247(d)	RSS-247 (5.5)	Conducted Spurious Emission		С
	15.247(d) 15.205 & 15.209	RSS-247 (5.5) RSS-GEN (8.9 & 8.10)	Radiated Spurious Emission	Radiated	С
$\square$	15.207	RSS-GEN (8.8)	Conducted Emissions	AC Line Conducted	С
<u>Note 1</u> : C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable					

The sample was tested according to the following specification: ANSI C63.10:2013.

Compliance was determined by specification limits of the applicable standard according to customer requirements.



## 4. Used equipment on test

Description	Manufacturer	Model Name	Serial Name	Next Cal.
TEMP & HUMID CHAMBER	JFM	JFMA-001	20200929-01	2022.12.17
CONTROLLER	AMWON TECHNOLOGY	TEMI2500	S7800VK191 0707	2022.12.17
PSA SERIES SPECTRUM ANALYZER	AGILENT	E4440A	MY45304057	2022.12.15
MXG ANALOG SIGNAL GENERATOR	AGILENT	N5183A	MY50141890	2022.12.15
SYSTEM DC POWER SUPPLY	AGILENT	6674A	MY53000118	2022.12.15
VECTOR SIGNAL GENERATOR	ROHDE & SCHWARZ	SMBV100A	257524	2022.12.15
BLUETOOTH TESTER	TESCOM	TC-3000A	3000A480088	2022.12.15
DIRECTIONAL COUPLER	AGILENT	773D	2839A01855	2022.12.15
ATTENUATOR	AGILENT	8493C	73193	2022.12.15
ATTENUATOR	ACE RF COMM	ATT SMA 20W 20dB 8GHz	A-0820.SM20.2	2023.04.11
TERMINATIOM	HEWLETT PACKARD	909D	07492	2022.12.15
POWER DIVIDER	HEWLETT PACKARD	11636A	06916	2022.12.15
SLIDE-AC	DAEKWANG TECH	SV-1023	_	_
DIGITAL MULTIMETER	HUMANTECHSTORE	15B+	50561541WS	2022.12.15
ACTIVE LOOP ANTENNA	TESEQ	HLA 6121	55685	2022.12.30
Biconilog ANT	Schwarzbeck	VULB 9160	3260	2023.02.03
Biconilog ANT	Schwarzbeck	VULB9168	902	2023.01.14
Horn Ant.	Schwarzbeck	BBHA9120D	974	2023.01.08
Horn Ant.	S/B	BBHA9120D	1497	2023.01.25
Amplifier	TESTEK	TK-PA18H	200104-L	2023.03.17
EMI TEST RECEIVER	ROHDE& SCHWARZ	ESW44	101952	2023.04.07
PROGRAMMABLE DC POWER SUPPLY	ODA	OPE-305Q	oda-01-09-23-1831	2023.01.10
DC POWER SUPPLY	AGILENT	E3634A	MY40012120	2023.02.03
POWER SENSOR	AGILENT	U2001H	MY51140028	2023.02.19
Test Receiver	ROHDE & SCHWARZ	ESR7	101616	2023.06.28
LISN	ROHDE & SCHWARZ	ENV216	100409	2023.01.10
PULSE LIMITER	lignex1	EPL-30	NONE	2023.01.24

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# 5. Antenna Requirement

Accoding to §15.203 An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall 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 manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

Accoding to §15.247(b)(4) e conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

#### 5.1 Result

#### Complies

(The transmitter has a PCB Pattern Antenna. The directional peak gain of the antenna is 0.68 dBi.)



# 6. 6 dB Bandwidth

#### 6.1 Test Setup

Refer to the APPENDIX I.

# 6.2 Limit

The minimum permissible 6 dB bandwidth is 500 kHz.

## 6.3 Test Procedure

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.

- 1. Set resolution bandwidth (RBW) = 100 kHz
- 2. Set the video bandwidth (VBW)  $\geq$  3 x RBW.
- 3. Detector = Peak.
- 4. Trace mode = Max Hold.
- 5. Sweep = Auto
- 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 ≥ 3 x 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 ≥ 6 dB.

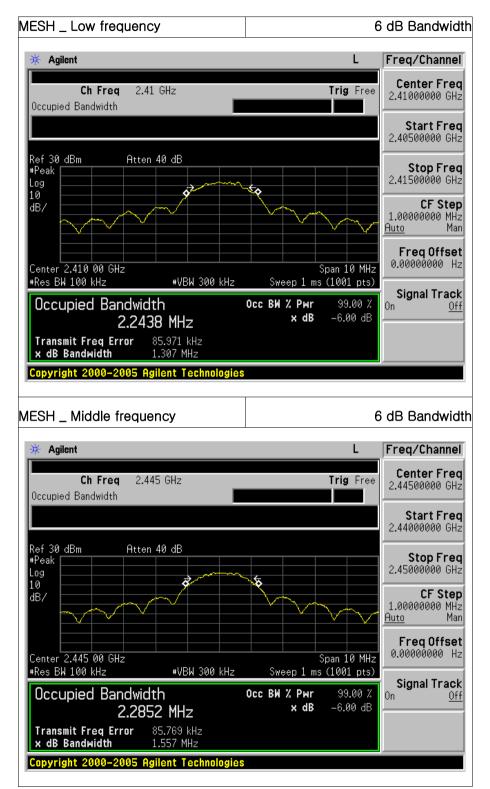
#### 6.4 Test Result

Test Mode	Test Frequency	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
	Low	1.307	2.267
MESH	Middle	1.557	2.303
	High	1.334	2.322

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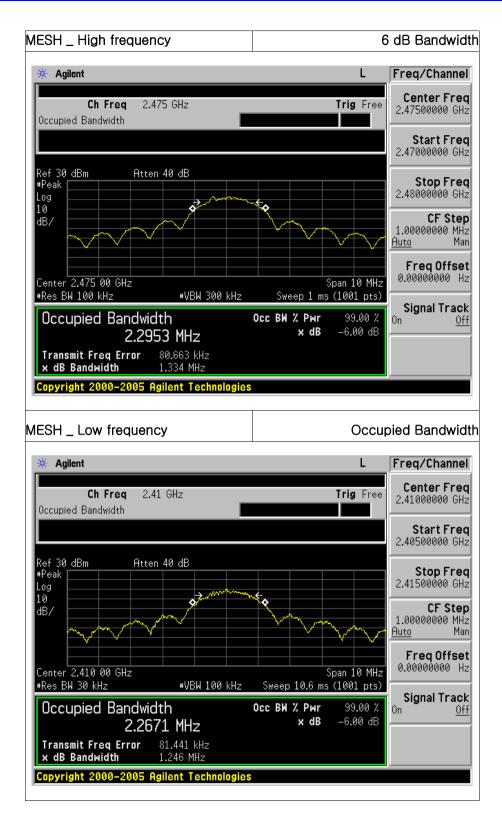


#### 6.5 Test Plot



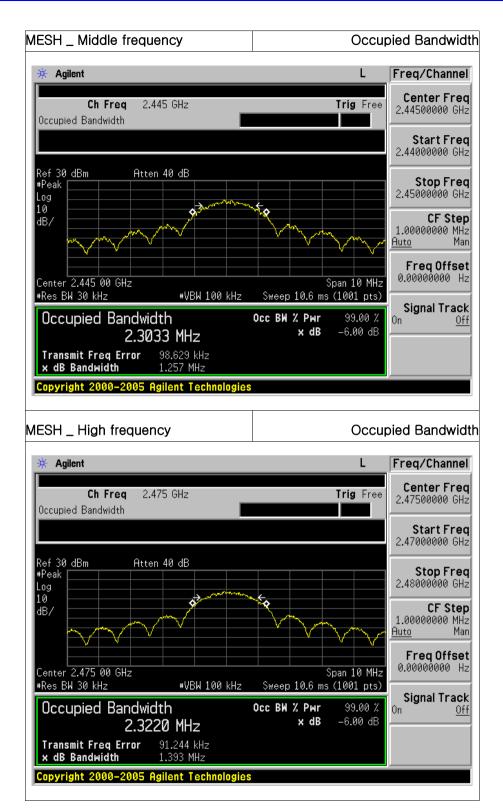
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# 7. Maximum Peak Output Power

#### 7.1 Test Setup

Refer to the APPENDIX I.

## 7.2 Limit

The maximum permissible conducted output power is 1 Watt.

#### 7.3 Test Procedure

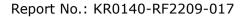
A transmitter antenna terminal of EUT is connected to the input of a spectrum analyzer. Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.

- 1. Set the RBW  $\geq$  DTS bandwidth
- 2. Set VBW  $\geq$  3 x RBW
- 3. Set span  $\geq$  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 search function to determine the peak amplitude level.

#### 7.4 Test Result

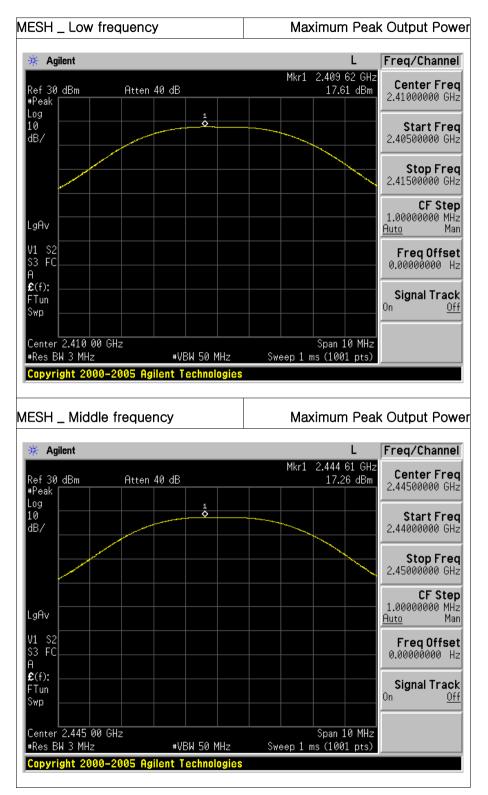
Test Mode	Test Frequency	Peak Out	out Power
Test Mode	Test Frequency	dBm	mW
	Low	17.61	57.68
MESH	Middle	17.26	53.21
	High	16.64	46.13

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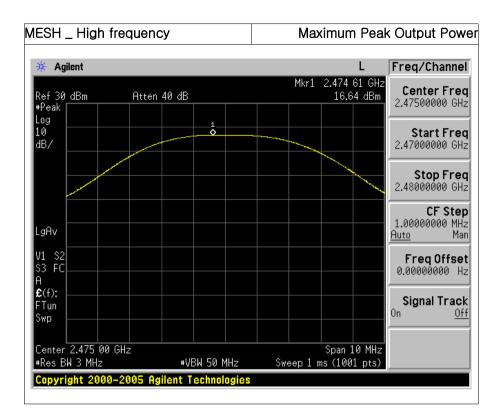


## 7.5 Test Plot



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# 8. Peak Power Spectral Density

## 8.1 Test Setup

Refer to the APPENDIX I.

## 8.2 Limit

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

## 8.3 Test Procedure

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.

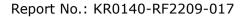
(ANSI C63.10-2013 \_ Section 11.10.2 - Method PKPSD)

- 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
- 7. Trace mode = Max Hold.
- 8. Allow trace to fully stabilize.
- 9. Use the peak marker function to determine the maximum amplitude level within the RBW.
- 10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Test Mode	Test Frequency	Peak Power Spectral Density (dBm)
	Low	-0.22
MESH	Middle	-0.93
	High	-1.20

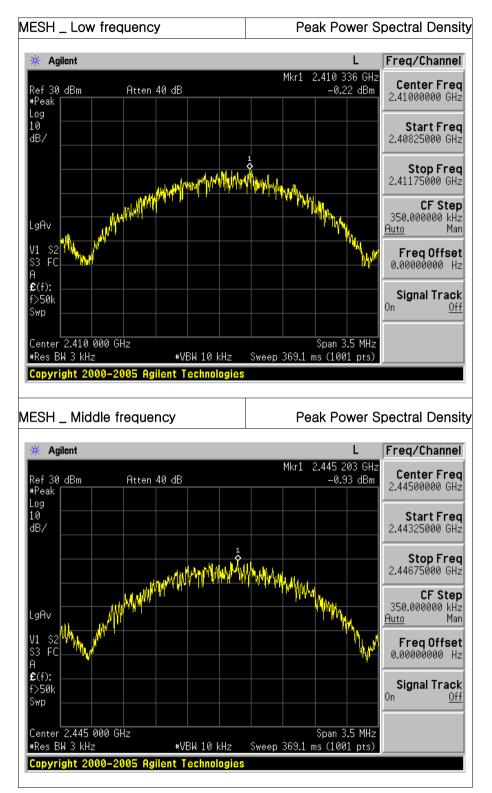
#### 8.4 Test Result

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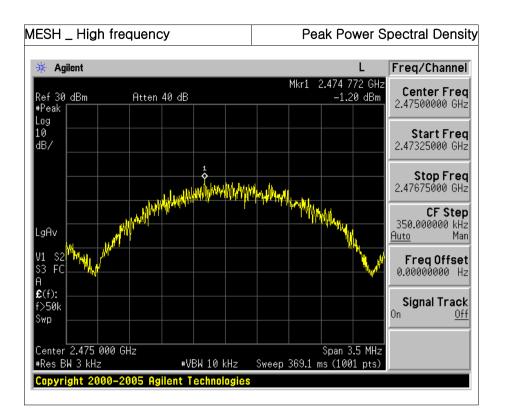


#### 8.5 Test Plot



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# 9. TX Radiated Spurious Emission and Conducted Spurious Emission

## 9.1 Test Setup

Refer to the APPENDIX I.

# 9.2 Limit

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional

	na otronigti iovolo opocinica in i	the following table
Frequency (MHz)	Limit (uV/m)	Measurement Distance (meter)
0.009 ~ 0.490	2400/F (kHz)	300
0.490 ~ 1705	24000/F (kHz)	30
1705 ~ 30.0	30	30
30 ~ 88	100 **	3
88 ~ 216	150 **	3
216 ~ 960	200 **	3
Above 960	500	3

radiator shall not exceed the field strength levels specified in the following table

\*\* 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.



According to § 15.205(a) and (b), only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.009 ~ 0.110	16.42 ~ 16.423	399.90 ~ 410	4.5 ~ 5.15
0.495 ~ 0.505	16.69475 ~ 16.69525	608 ~ 614	5.35 ~ 5.46
2.1735 ~ 2.1905	16.80425 ~ 16.80475	960 ~ 1240	7.25 ~ 7.75
4.125 ~ 4.128	25.5 ~ 25.67	1300 ~ 1427	8.025 ~ 8.5
4.17725 ~ 4.17775	37.5 ~ 38.	1435 ~ 1626.5	9.0 ~ 9.2
4.20725 ~ 4.20775	25 73 ~ 74.6	1645.5 ~ 1646.5	9.3 ~ 9.5
4.17725 ~ 4.17775	74.8 ~ 75.2	1660 ~ 1710	10.6 ~ 12.7
6.215 ~ 6.218	108 ~ 121.94	1718.8 ~ 1722.2	13.25 ~ 13.4
6.26775 ~ 6.26825	149.9 ~ 150.05	2200 ~ 2300	14.47 ~ 14.5
6.31175 ~ 6.31225	156.52475 ~ 156.52525	2310 ~ 2390	15.35 ~ 16.2
8.291 ~ 8.294	156.7 ~ 156.9	2483.5 ~ 2500	17.7 ~ 21.4
8.362 ~ 8.366	162.0125 ~ 167.17	2690 ~ 2900	22.01 ~ 23.12
8.37625 ~ 8.38675	3345.8 ~ 3358	3260 ~ 3267	23.6 ~ 24.0
8.41425 ~ 8.41475	3600 ~ 4400	3332 ~ 3339	31.2 ~ 31.8
12.51975 ~ 12.52025	3345.8 ~ 3358	240 ~ 285	36.43 ~ 36.5
12.57675 ~ 12.57725	3600 ~ 4400	322 ~ 335.4	Above 38.6
13.36 ~ 13.41			

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.



#### 9.3 Test Procedure for Radiated Spurious Emission

- 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. The table was rotated 360 degrees to determine the position of the highest radiation.
- 2. During performing radiated emission below 1 GHz, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable-height antenna tower. During performing radiated emission above 1 GHz, the EUT was set 1 or 3 meter away from the interference-receiving antenna.
- 3. For measurements above 1 GHz absorbers are placed on the floor between the turn table and the antenna mast in such a way so as to maximize the reduction of reflections. For measurements below 1 GHz, the absorbers are removed.
- 4. The antenna is a Broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading. (The EUT was pre-tested with three axes (X, Y, Z) and the final test was performed at the worst case.)
- 6. Repeat above procedures until the measurements for all frequencies are complete.

#### Measurement Instrument Setting

- 1. Frequency Range: Below 1 GHz RBW = 100 or 120 kHz, VBW = 3 x RBW, Detector = Peak or Quasi Peak
- 2. Frequency Range: Above 1 GHz

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

Average Measurement RBW = 1 MHz, VBW = 3 MHz, Detector = RMS (Number of points ≥ 2 x Span / RBW), Trace Mode = Average (Averaging type = power(i.e. RMS)), Sweep Time = Auto, Sweep Count = at least 100 traces

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:

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- 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 tuming on and off with the transmit cycle, then no duty cycle correction is required for that emission.

#### 9.4 Test Procedure for Conducted Spurious Emission

- 1. The transmitter output was connected to the spectrum analyzer.
- 2. The reference level of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 300 kHz.
- 3. The conducted spurious emission was tested each ranges were set as below. Frequency range: 30 MHz ~ 26.5 GHz
   RBW = 100 kHz, VBW = 300 kHz, Sweep Time = Auto, Detector = Peak, Trace = Max Hold

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



#### 9.5 Test Result

#### 9 kHz $\sim$ 25 GHz Data MESH

#### • Low frequency

Frequency	Rea	ding		<b>E</b>	2005	Lin	nits	Re	sult	Ma	rgin
Fiequency	(dBu	V/m)	Pol.	Factor (dB)	DCCF (dB)	(dBu	V/m)	(dBu	V/m)	(d	в)
(MHz)	AV ,	/ Peak		(48)	(00)	AV /	Peak	AV /	Peak	AV /	Peak
2 389.56	N/A	33.2	V	11.84	-34.28	54.0	74.0	10.8	45.0	43.2	29.0
4 821.10	N/A	56.13	Н	4.18	-34.28	54.0	74.0	26.0	60.3	28.0	13.7
7 228.64	N/A	44.58	V	20.20	-34.28	54.0	74.0	30.5	64.8	23.5	9.2

#### • Middle frequency

Frequency	Rea	ding		- ·	2005	Lin	nits	Re	sult	Mai	rgin
Frequency	(dBu	V/m)	Pol.	Factor (dB)	DCCF (dB)	(dBu	V/m)	(dBu	IV/m)	(d	в)
(MHz)	AV ,	/ Peak		(42)	(00)	AV /	Peak	AV /	Peak	AV /	Peak
4 889.15	N/A	53.6	Η	4.04	-34.28	54.0	74.0	23.4	57.6	30.6	16.4
7 333.69	N/A	42.69	V	20.53	-34.28	54.0	74.0	28.9	63.2	25.1	10.8

#### • High frequency

Fraguanay	Rea	ding				Lin	nits	Re	sult	Mai	rgin
Frequency	(dBu	V/m)	Pol.	Factor (dB)	DCCF (dB)	(dBu	IV/m)	(dBu	V/m)	(d	в)
(MHz)	AV /	Peak			(00)	AV /	Peak	AV /	Peak	AV /	Peak
2 483.62	N/A	47.46	V	12.21	-34.28	54.0	74.0	25.4	59.7	28.6	14.3
4 949.17	N/A	53.54	Η	4.11	-34.28	54.0	74.0	23.4	57.7	30.6	16.4
7 426.68	N/A	40.78	V	20.37	-34.28	54.0	74.0	26.9	61.2	27.1	12.9

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

Note 2: DCCF(Duty Cycle Correction Factor)

-  $T_{\text{on}}$  = 0.644 ms /  $T_{\text{off}}$  = 39.42 ms

- DCCF =  $20 \times \log(\text{The Worst Case Dwell Time / 100 ms}) dB = <math>20 \times \log(1.932 / 100) dB = -34.28 dB$ Note 3: Sample Calculation.

Margin = Limit - Result / Peak Result = Peak Reading + TF / Average Result = Peak Reading + TF + DCCF TF = Ant factor + Cable Loss + Filter Loss - Amp Gain



#### 9.6 Test Plot for Radiated Spurious Emission MESH

• MESH \_ Low frequency

AultiView 🗄 Spectrum	Spectrum 2	Spectrum 3	Spectrum 4	
Ref Level         87.00 dBµV           Att         0 dB         SV           Input         1 AC         PS	RBW 1 MHz     T 1.01 ms      VBW 3 MHz     On Notch Off	Mode Auto Sweep		Frequency 2.3500000 G
Frequency Sweep				• 1Pk Ma M1[1] 33.20 dB
) dBµV				2.3895604 6
dBµV				
dBµV				
dBµV				
dBµV				
dBµV	manunder	and when the way	manneyade	y shawn why my come
dвµV				
18µV				
ВμV				
	10	01 pts	8 0 MHz/	2 39 G
0 dBµV	10	01 pts	8.0 MHz/	2.39 G Spurious – Pe
31 GHz				
31 GHz ultiView C Spectru ef Level 80.00 dBµ/ tt 0 dB SW	m ☎ Spectrum			
31 GHz	m 🕱 Spectrum : • RBW 1 MHz T 1.01 ms • VBW 3 MHz	2 X Spectr		Spurious – Pe
31 GHz ultiView E Spectru ef Level 80.00 dBµV tt 0 dB SW iput 1AC PS requency Sweep	m ☎ Spectrum 3 ● RBW 1 MHz T 1.01 ms ● VBW 3 MHz	2 X Spectr		Spurious – Pe Frequency 4.8200000 G
altiView # Spectru sf Level 80.00 dBμ/ν tt 0 dB sW put 1 AC PS requency Sweep dBμ/ν	m ☎ Spectrum 3 ● RBW 1 MHz T 1.01 ms ● VBW 3 MHz	2 X Spectr		Spurious – Pe Frequency 4.8200000 G
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31 GHz         31 GHz           altiView #         Spectru           sf Level 80.00 dbµ/v         tt           tt         0 dB sW           put         1 AC PS           requency Sweep         dbµ/v           dbµ/v         dbµ/v	m ☎ Spectrum 3 ● RBW 1 MHz T 1.01 ms ● VBW 3 MHz	2 X Spectr	rum 3 🗐	Spurious – Pe Frequency 4.8200000 G
31 GHz         Spectru           altiView #         Spectru           sf Level 80.00 dBμ/V         0 dB sW           tt         0 dB sW           gt Level 80.00 dBμ/V         1 AC PS           requency Sweep         dBμ/V           dBμ/V         dBμ/V	m ☎ Spectrum 3 ● RBW 1 MHz T 1.01 ms ● VBW 3 MHz	2 X Spectr	rum 3 🗐	Spurious – Pe Frequency 4.8200000 G
31 GHz	m ☎ Spectrum 3 ● RBW 1 MHz T 1.01 ms ● VBW 3 MHz	2 X Spectr	rum 3 🗐	Spurious – Pe Frequency 4.8200000 G
31 GHz	m ☎ Spectrum 3 ● RBW 1 MHz T 1.01 ms ● VBW 3 MHz	2 X Spectr	rum 3 🗐	Spurious – Pe
31 GHz	m ☎ Spectrum 3 ● RBW 1 MHz T 1.01 ms ● VBW 3 MHz	2 X Spectr	rum 3 🗐	Spurious – Pe
31 GHz         Spectru           altiView #         Spectru           sf Level 80.00 dbµ/v         to db sV           tt         0 db sV           gbµv         1 AC PS           dbµv         dbµv           dbµv         dbµv           dbµv         dbµv           dbµv         dbµv           dbµv         dbµv	m ☎ Spectrum 3 ● RBW 1 MHz T 1.01 ms ● VBW 3 MHz	2 X Spectr	rum 3 🗐	Spurious – Pe
31 GHz	m ☎ Spectrum 3 ● RBW 1 MHz T 1.01 ms ● VBW 3 MHz	2 X Spectr	rum 3 🗐	Spurious – Pe
31 GHz         Image: Constraint of the sector of the	m ☎ Spectrum 3 ● RBW 1 MHz T 1.01 ms ● VBW 3 MHz	2 X Spectr	rum 3 🗐	Spurious – Pe
31 GHz	m ☎ Spectrum 3 ● RBW 1 MHz T 1.01 ms ● VBW 3 MHz	2 X Spectr	rum 3 🗐	Spurious – Pe
31 GHz           ultiView E         Spectru           ef Level 80.00 dbµ/ tt         0 dB sW           put         1 AC PS           requency Sweep         dbµv           dbµv         dbµv           dbµv         dbµv	Spectrum :     RBW 11Mtz     T 1.01 ms @ VBW 31Mtz     Off Notch Off	2 X Spectr	rum 3 🗐	Spurious – Pe

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MultiView 🗄 Spectrur	m X Spectrum 2 X Spec	ctrum 3 🔍			
Ref Level 80.00 dBµV	RBW 1 MHz     1.01 ms • VBW 3 MHz Mode Auto Sweep		Freq	iency 7.23	00000 GH
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#### • MESH \_ Middle frequency

							Spuriou	s – Pe
MultiView ⊞ Sp	ectrum 🕱 S	pectrum 2	X Spectr	um 3 🛛 🕱	3			\
Ref Level 80.00 dBµ Att 0 di	B SWT 1.01 ms = VB	W 1 MHz W 3 MHz Mode	Auto Sweep		-	Fr	equency 4.82	200000 GH
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Ref Level 80.00 dBµ Att 0 d Input 1 Ad Frequency Sweep	V ● RB B SWT 1.01 ms ● VB C PS Off No	W 1 MHz			2		Spuriou equency 7.33	▼ 350000 GH ● 1Pk Max
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Ref Level 80.00 dBµ Att 0 di Input 1 A	V ● RB B SWT 1.01 ms ● VB C PS Off No	W 1 MHz			2		Spuriou equency 7.33	▼ 850000 GH ● 1Pk Max 42.69 dBµ
Ref Level 80.00 dBμ           Att 0 dl           Input 1 At           Input 2 At           0 dBμV           0 dBμV           0 dBμV	V ● RB B SWT 1.01 ms ● VB C PS Off No	W 1 MHz			2		Spuriou equency 7.33	▼ 850000 GH ● 1Pk Max 42.69 dBµ
Ref Level 80.00 dBμ           Att         0 dBμ           Input         1 At           Frequency Sweep           0 dBμV           0 dBμV	V RB B SWT 1.01 ms = VB C PS Off No	W 1 MHz Mode			2	Fr	Spuriou equency 7.33 M1[1] 7.	▼ 850000 GH ● 1Pk Max 42.69 dBµ
Ref Level 80.00 dBμ           Att 0 dl           Input 1 At           Input 2 At           0 dBμV           0 dBμV           0 dBμV           0 dBμV	V RB B SWT 1.01 ms = VB C PS Off No	W 1 MHz Mode			2	Fr	equency 7.33	▼ <b>350000 GH</b> • 1Pk Max 42,69 dBµ 33369131 GH
Ref Level 80.00 dBμ           Att         0 dBμ           Input         1 At           o dBμV         0           0 dBμV         0           0 dBμV         0           0 dBμV         0           0 dBμV         0	V RB B SWT 1.01 ms = VB C PS Off No	W 1 MHz Mode			2	Fr	equency 7.33	▼ 850000 GH ● 1Pk Max 42.69 dBµ
Ref Level 80.00 dBµ           Att 0 dl           Input 1 At           Frequency Sweep           0 dBµV	V RB B SWT 1.01 ms = VB C PS Off No	W 1 MHz Mode			2	Fr	equency 7.33	▼ <b>350000 GH</b> ● 1Pk Max 42.69 dBµ 33369131 GH
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Ref Level 80.00 dBµ           Att 0 dl           Input 1 At           Frequency Sweep           0 dBµV	V RB B SWT 1.01 ms = VB C PS Off No	W 1 MHz Mode			2	Fr	equency 7.33	▼ <b>350000 GH</b> ● 1Pk Max 42.69 dBµ 33369131 GH

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• MESH \_ High frequency

						ſ	Restrict	ed Ban	id – Pea
MultiView 🔠	Spectrum	Spectru	im 2 🛛	Spectrum 3	Spectru	um 4 🕅			
Ref Level 87 Att Input		T 1.01 ms . VB	WI1 MHz WI3 MHz MI	ode Auto Sweep			Fr	equency 2.4	917500 GH
Frequency S							N	1[1]	<ul> <li>1Pk Max</li> <li>47.46 dBµl</li> </ul>
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70 dBµV									1.2
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MultiView	Spectrum	n 🕱 Sp	Dectrum 2	pts				Spuriou	
Ref Level 80. Att	DO dBµV O dB SWI	● RBV 1.01 ms ● VBV	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr					ıs – Pea
Ref Level 80. Att Input	0 dBµV 0 dB SW1 1 AC PS	• RBV	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr				equency 4.8	IS – Pea ⊽ 200000 GH
Ref Level 80.4 Att Input Frequency S	0 dBµV 0 dB SW1 1 AC PS	● RBV 1.01 ms ● VBV	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr				equency <b>4.8</b>	IS - Pea ▼ 200000 GH ■1Pk Max 56.13 dBµ'
Ref Level 80.4 Att Input Frequency S	0 dBµV 0 dB SW1 1 AC PS	● RBV 1.01 ms ● VBV	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr				equency <b>4.8</b>	IS - Pea ▼ 200000 GH ■1Pk Max 56.13 dBµ'
Ref Level 80.4 Att Input Frequency S 0 dBpV	0 dBµV 0 dB SW1 1 AC PS	● RBV 1.01 ms ● VBV	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr				equency <b>4.8</b>	IS - Pea ▼ 200000 GH ■1Pk Max 56.13 dBµ'
Ref Level 80. Att Input Frequency S 0 dBµV	0 dBµV 0 dB SW1 1 AC PS	● RBV 1.01 ms ● VBV	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr				equency <b>4.8</b>	200000 GH
Ref Level 80.0           Att           Input           Frequency S           0 dBμV           0 dBμV           0 dBμV	0 dBµV 0 dB SW1 1 AC PS	● RBV 1.01 ms ● VBV	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr				equency <b>4.8</b>	IS - Pea ▼ 200000 GH ■1Pk Max 56.13 dBµ'
Ref Level 80./           Att           Input           Frequency S           0 d8μν           0 d8μν           0 d8μν           0 d8μν	00 dBµV 0 dB SW1 1 AC PS weep	RBV 1.01 ms VBV Off Not	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr				equency <b>4.8</b>	IS - Pea ▼ 200000 GH ■1Pk Max 56.13 dBµ 1.32109890 GH
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Ref Level 80.1 Att Input Frequency S 0 dbµv 0 dbµv 0 dbµv 0 dbµv 0 dbµv 0 dbµv	00 dBµV 0 dB SW1 1 AC PS weep	RBV 1.01 ms VBV Off Not	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr				equency <b>4.8</b>	IS - Pea ▼ 200000 GH ■1Pk Max 56.13 dBµ 1.32109890 GH
Ref Level 80./           Att           Input           Frequency S           0 d8μν           0 d8μν           0 d8μν           0 d8μν	00 dBµV 0 dB SW1 1 AC PS weep	RBV 1.01 ms VBV Off Not	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr				equency <b>4.8</b>	IS - Pea ▼ 200000 GH ■1Pk Max 56.13 dBµ 1.32109890 GH
Ref Level S0.1           Att           Input           Frequency S           0 dBµV           0 dBµV	00 dBµV 0 dB SW1 1 AC PS weep	RBV 1.01 ms VBV Off Not	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr				equency <b>4.8</b>	IS - Pea ▼ 200000 GH ■1Pk Max 56.13 dBµ 1.32109890 GH
Ref Level S0.1           Att           Input           Frequency S           0 dbµv	00 dBµV 0 dB SW1 1 AC PS weep	RBV 1.01 ms VBV Off Not	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr				equency <b>4.8</b>	IS - Pea ▼ 200000 GH ■1Pk Max 56.13 dBµ 1.32109890 GH
Ref Level S0.1           Att           Input           Frequency S           0 dBµV           0 dBµV	00 dBµV 0 dB SW1 1 AC PS weep	RBV 1.01 ms VBV Off Not	Dectrum 2 ¥ 1 MHz ¥ 3 MHz Mod	X Spectr				equency <b>4.8</b>	IS - Pea ▼ 200000 GH ■1Pk Max 56.13 dBµ 1.32109890 GH

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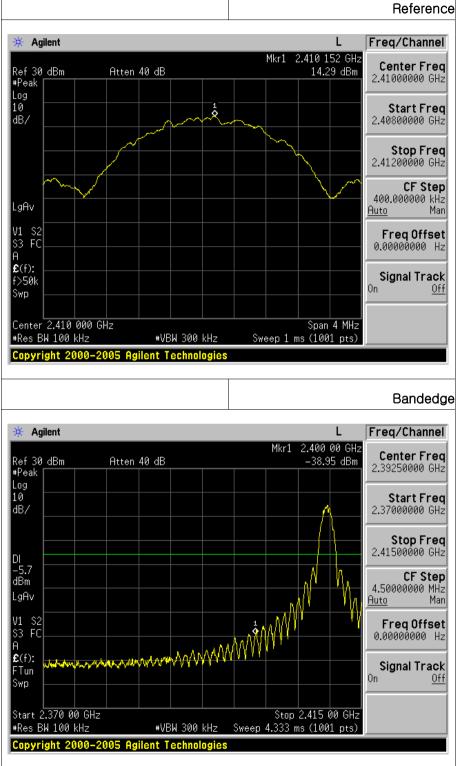
		K)	um 3	X Spect	rum 2	·	Spectrum	
equency 7.4250000 G	Fre			Auto Sweep	MHz MHz <b>Mode</b> Off	● RBW 1 01 ms ● VBW 3 Off Notch	0 dB SWT 1 1 AC PS	
• 1Pk Ma M1[1]      40.78 dB 7.42667832 G							weep	Frequency S
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#### 9.7 Test Plot for Conducted Spurious Emission

• MESH \_ Low frequency



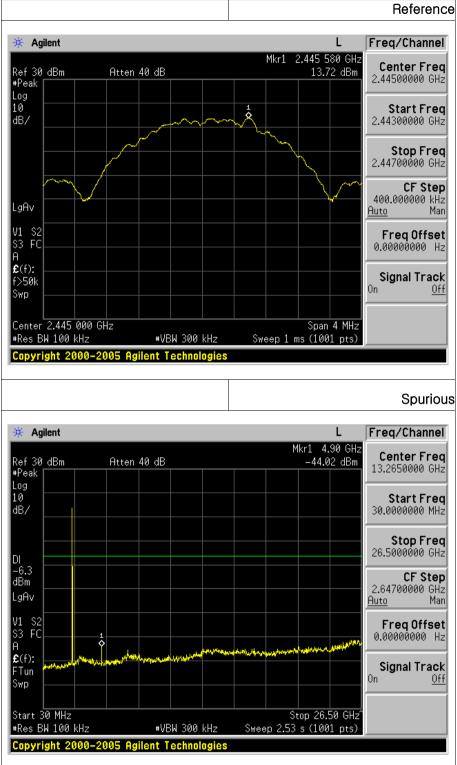
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Agilent									L	Freq/Channe
ef 30 dBm Peak □		Atten	40 dB				М		.82 GHz '9 dBm	Center Fre 13.2650000 GH
0g 0 B/										Start Fre 30.0000000 MH
										<b>Stop Fre</b> 26.5000000 GH
5.7 Bm gAv										<b>CF Ste</b> 2.64700000 GH <u>Auto</u> Ma
1 S2 3 FC					وروارساور سوار مروار م	uphreed 1 agent of the same	لمعدلين اجدا	he when an a start	timbuda	FreqOffse 0.00000000 H
(f): Tun wp	Log <sup>rad</sup> illo and an	payles and	لمساوره بعديلها المل							Signal Trac <sup>On <u>Ot</u></sup>
tart 30 MHz Res BW 100			^ #UE	W 300		Suez	St 9 2.53		50 GHz	



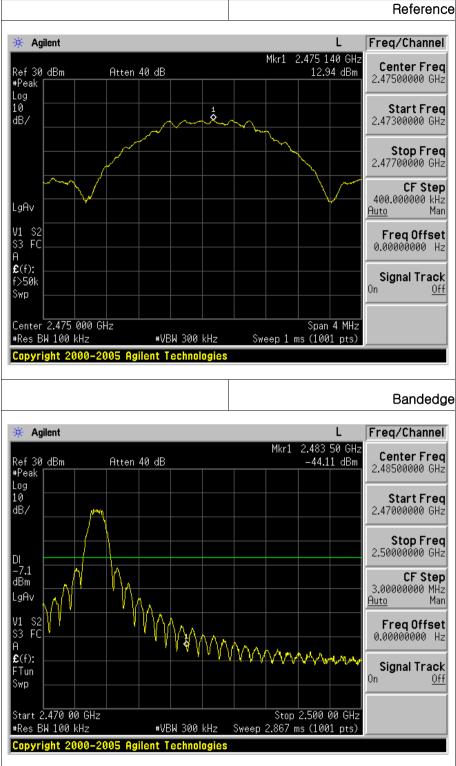
• MESH \_ Middle frequency



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MESH \_ High frequency



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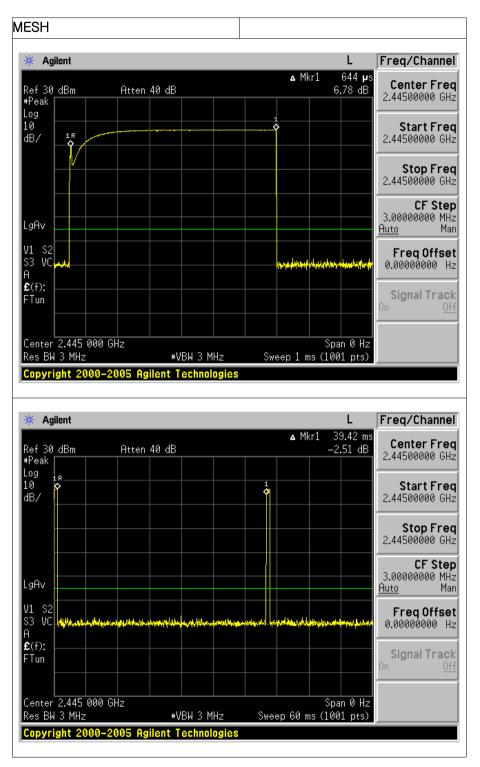


Agilent							L	Peak Search
ef 30 dBm Peak	Atten	40 dB			M		.95 GHz 13 dBm	Next Pea
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								Next Pk Lei
7.1 3m gAv								Min Searc
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art 30 MHz as BW 100 kH	_	#URU	300 kHz	Suo/	۶۱ p 2.53		50 GHz^	<b>Mor</b> 1 of

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# 9.8 Test Plot for Duty Cycle



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# 10. Conducted Emission

#### 10.1 Test Setup

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

# 10.2 Limit

According to §15.207(a) 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 uH/50 ohm line impedance stabilization network (LISN).

Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequency ranges.

	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			

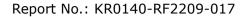
\* Decreases with the logarithm of the frequency

# 10.3 Test Procedure

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.

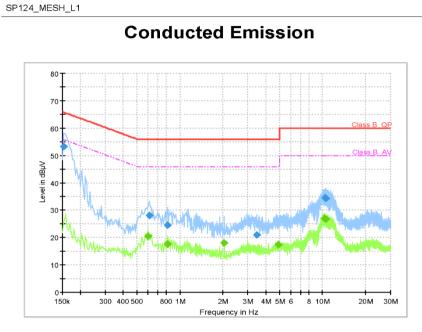
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#### 10.4 Test Result

• AC Line Conducted Emission (Graph)

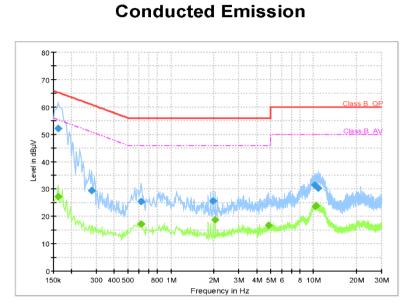


#### Final\_Result

Frequency	QuasiPeak	CAverage	Limit	Margin	Bandwidth	Line	Corr.
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dB)	(kHz)		(dB)
0.154	53.36		65.78	12.42	9	L1	19.3
0.600		20.54	46.00	25.46	9	L1	19.8
0.610	28.00		56.00	28.00	9	L1	19.8
0.820		17.64	46.00	28.36	9	L1	19.8
0.820	24.61		56.00	31.39	9	L1	19.8
2.050		18.12	46.00	27.88	9	L1	19.7
3.450	20.94		56.00	35.06	9	L1	19.7
4.900		17.30	46.00	28.70	9	L1	19.8
10.350		26.93	50.00	23.07	9	L1	20.0
10.390	34.62		60.00	25.38	9	L1	20.0
10.570	34.24		60.00	25.76	9	L1	20.0
10.580		26.71	50.00	23.29	9	L1	20.0

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#### **Final Result**

SP124\_MESH\_N

Frequency	QuasiPeak	CAverage	Limit	Margin	Bandwidth	Line	Corr.
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dB)	(kHz)		(dB)
0.162		27.18	55.36	28.18	9	N	19.4
0.162	52.12		65.36	13.24	9	N	19.4
0.278	29.35		60.88	31.53	9	N	19.4
0.620		17.18	46.00	28.82	9	N	19.8
0.620	25.36		56.00	30.64	9	N	19.8
1.980	25.67		56.00	30.33	9	N	19.7
2.050		18.70	46.00	27.30	9	N	19.7
4.830		16.69	46.00	29.31	9	N	19.8
10.180	31.45		60.00	28.55	9	N	20.0
10.320		23.60	50.00	26.40	9	N	20.0
10.400		23.78	50.00	26.22	9	N	20.0
10.740	30.39		60.00	29.61	9	N	20.0

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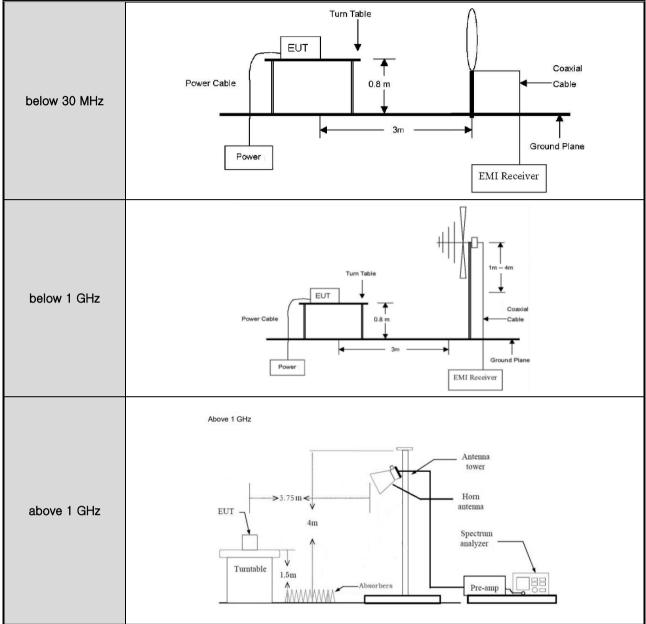
APPENDIX I

TEST SETUP

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#### Radiated Measurement



#### • Conducted Measurement

Conducted	EUT	Attenuator	Spectrum Analyzer

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APPENDIX II

UNCERTAINTY

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Measurement Item	Expanded Uncertainty U = <i>k</i> Uc ( <i>k</i> =2)		
Conducted RF power	0.32 dB		
Conducted Spurious Emissions	0.32 dB		
Radiated Spurious Emissions	6.34 dB		
Conducted Emissions	1.74 dB		