

TEST REPORT

100, Jangjateo-ro, Hobeop-myeon, Icheon-si, Gyeonggi-do, 17396, Korea Tel: 031-637-8898 / Fax: 0505-116-8895

1. Client				
• Name	: Sena Technologies Co., Ltd.			
Address.	19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea			
2. Use of Repo	ort: FCC Approval			
3. Sample Des	scription			
Product I	Name : BIKOM(NAUTITALK RACER)			
 Model Na 	ame: SP155			
4. Date of Rec	ceipt:: 2024-05-02			
5 Data of Too	t: 2024-05-29 ~ 2024-06-14			
5. Date of Tes				
6. Test Method	d: FCC Part 15 Subpart C 15.247			
7. Test Results : Refer to the test results				
ℜ The results sh	nown in this test report are the results of testing the samples provided.			
% This test repo	ort is prepared according to the requirements of ISO / IEC 17025.			
	Tested by Technical Manager			
Affirmation	Joonyoung, Jeon (Sign) Jong-Myoung, Shin (Sign)			
	June 19, 2024			
	EMC Labs Co., Ltd.			



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<u>Version</u>

TEST REPORT NO.	DATE	DESCRIPTION	
KR0140-RF2406-003	June 19, 2024	Initial Issue	

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1. Applicant & Manufacturer & Test Laboratory Information

1.1 Applicant Information

Applicant	Sena Technologies Co., Ltd.
Applicant Address	19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea
Contact Person Seunghyun Kim	
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E-mail	shkim77@sena.com

1.2. Manufacturer Information

Manufacturer Sena Technologies Co., Ltd.	
Manufacturer Address	19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea

1.3 Test Laboratory Information

Laboratory	EMC Labs Co., Ltd.		
Laboratory Address	100, Jangjateo-ro, Hobeop-myeon, Icheon-si, Gyeonggi-do, Republic of Korea		
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Fax No.	+82-505-116-8895		
FCC Designation No.	KR0140		
FCC Registration No.	580000		
IC Site Registration No.	28751		



2. Equipment under Test(EUT) Information

2.1 General Information

Product Name BIKOM(NAUTITALK RACER)	
Model Name SP155	
FCC ID S7A-SP155	
IC 8154A-SP155	
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 Chip Antenna	
Antenna Gain	0.3 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	2 410 2 445 2 475			

2.4 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.

2.5 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%)		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	
\square	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	
	15.207	RSS-GEN (8.8)	Conducted Emissions	AC Line Conducted	С	
Note 1: 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	2024.12.07
CONTROLLER	AMWON TECHNOLOGY	TEMI2500	S7800VK191 0707	2024.12.07
PSA SERIES SPECTRUM ANALYZER	AGILENT	E4440A	MY45304057	2024.12.08
MXG ANALOG SIGNAL GENERATOR	AGILENT	N5183A	MY50141890	2024.12.08
SYSTEM DC POWER SUPPLY	AGILENT	6674A	MY53000118	2024.12.11
VECTOR SIGNAL GENERATOR	ROHDE & SCHWARZ	SMBV100A	257524	2024.12.08
BLUETOOTH TESTER	TESCOM	TC-3000A	3000A480088	2024.12.08
DIRECTIONAL COUPLER	AGILENT	773D	2839A01855	2024.12.08
ATTENUATOR	AGILENT	8493C	73193	2024.12.08
TERMINATIOM	HEWLETT PACKARD	909D	07492	2024.12.08
POWER DIVIDER	HEWLETT PACKARD	11636A	06916	2024.12.08
SLIDE-AC	DAEKWANG TECH	SV-1023	NONE	2024.11.10
DIGITAL MULTIMETER	HUMANTECHSTORE	15B+	50561541WS	2024.12.08
ATTENUATOR	ACE RF COMM	ATT SMA 20W 20dB 8GHz	A-0820.SM20.2	2025.04.04
DC POWER SUPPLY	AGILENT	E3634A	MY40012120	2025.02.22
USB Peak Power Sensor	Anritsu	MA24408A	12321	2024.11.09
High Pass Filter	WT Microwave INC.	WT-A3314-HS	WT22111804-1	2024.12.08
High Pass Filter	WT Microwave INC.	WT-A1935-HS	WT22111804-2	2024.12.08
SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSU26	200444	2025.02.22
ACTIVE LOOP ANTENNA	TESEQ	HLA 6121	55685	2024.12.22
Biconilog ANT	Schwarzbeck	VULB 9160	3260	2025.01.09
Biconilog ANT	Schwarzbeck	VULB9168	902	2024.11.30
Horn ANT	Schwarzbeck	BBHA9120D	974	2024.11.30
Horn ANT	Schwarzbeck	BBHA9120D	1497	2025.01.04
Amplifier	TESTEK	TK-PA18H	200104-L	2025.03.14
Horn ANT	Schwarzbeck	BBHA9170	01188	2025.03.19
Horn ANT	Schwarzbeck	BBHA9170	01189	2025.03.19
AMPLIFIER	TESTEK	TK-PA1840H	220105-L	2025.03.14
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW44	101952	2025.03.14
Test Receiver	ROHDE & SCHWARZ	ESR7	101616	2024.06.27
LISN	ROHDE & SCHWARZ	ENV216	100409	2025.01.04
PULSE LIMITER	lignex1	EPL-30	NONE	2025.01.04

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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 Chip Antenna. The directional peak gain of the antenna is 0.3 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

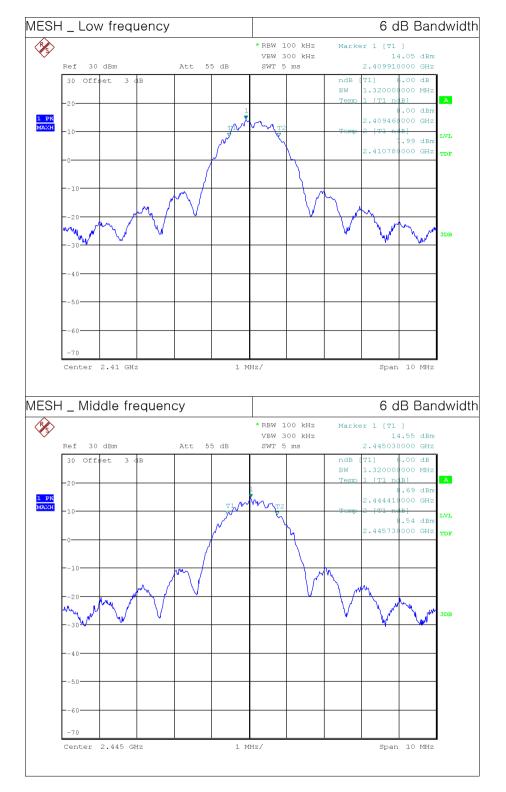
Test Mode	Test Frequency	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
	Low	1.320	2.290
MESH	Middle	1.320	2.290
	High	1.360	2.320

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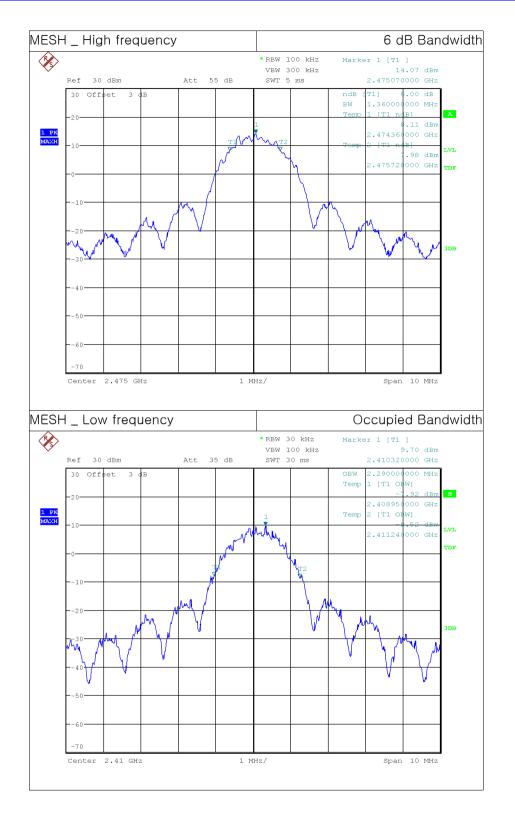


6.5 Test Plot



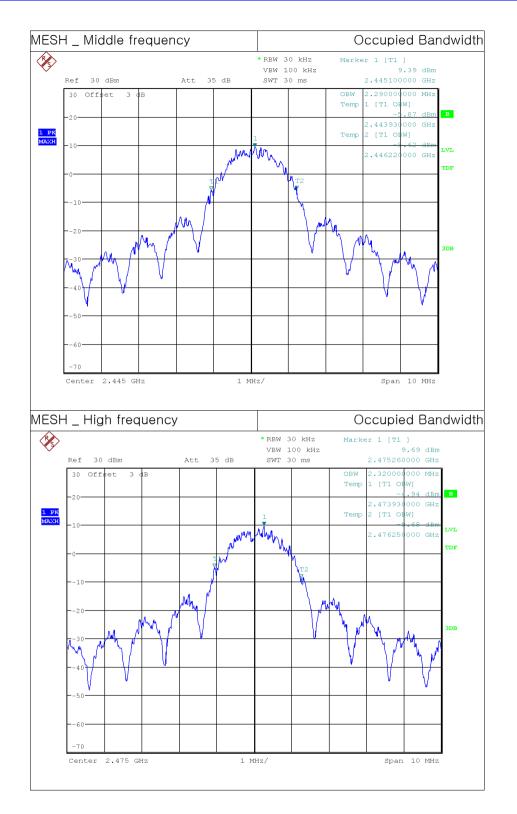
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7. Maximum Peak Output Power

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.

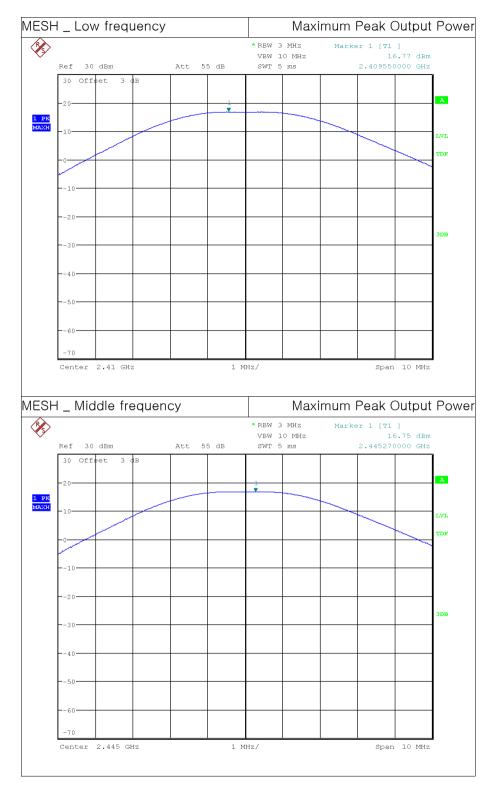
7.4 Test Result

Test Mode	Test Frequency	Peak Out	out Power
Test Mode	Test Frequency	dBm	mW
	Low	16.77	47.53
MESH	Middle	16.75	47.32
	High	16.43	43.95



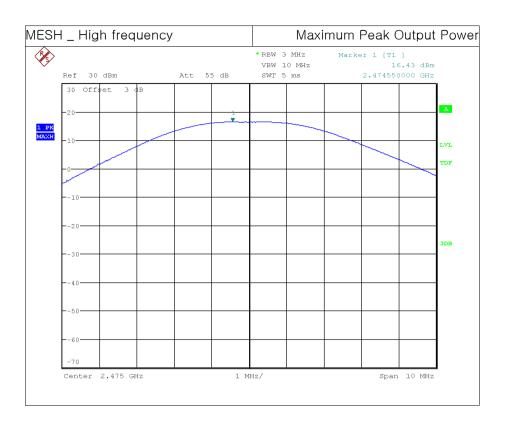


7.5 Test Plot



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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.

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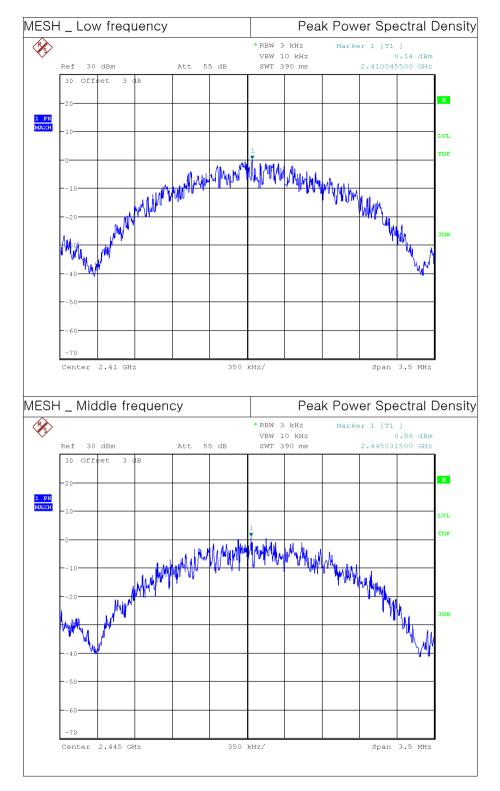
Test Mode	Test Frequency	Peak Power Spectral Density (dBm)
	Low	0.14
MESH	Middle	0.86
	High	-1.01

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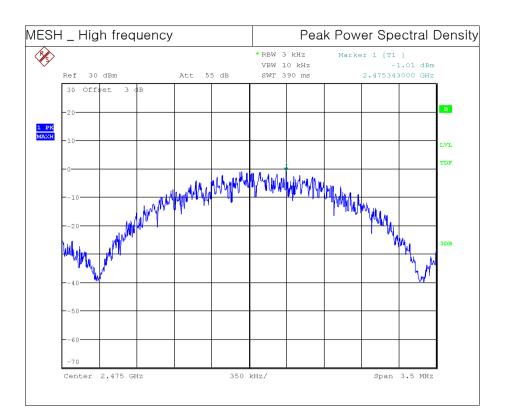


8.5 Test Plot



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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

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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:

0610101		
MHz	MHz	GHz
16.42 ~ 16.423	399.90 ~ 410	4.5 ~ 5.15
16.69475 ~ 16.69525	608 ~ 614	5.35 ~ 5.46
16.80425 ~ 16.80475	960 ~ 1240	7.25 ~ 7.75
25.5 ~ 25.67	1300 ~ 1427	8.025 ~ 8.5
37.5 ~ 38.	1435 ~ 1626.5	9.0 ~ 9.2
25 73 ~ 74.6	1645.5 ~ 1646.5	9.3 ~ 9.5
74.8 ~ 75.2	1660 ~ 1710	10.6 ~ 12.7
108 ~ 121.94	1718.8 ~ 1722.2	13.25 ~ 13.4
149.9 ~ 150.05	2200 ~ 2300	14.47 ~ 14.5
156.52475 ~ 156.52525	2310 ~ 2390	15.35 ~ 16.2
156.7 ~ 156.9	2483.5 ~ 2500	17.7 ~ 21.4
162.0125 ~ 167.17	2690 ~ 2900	22.01 ~ 23.12
3345.8 ~ 3358	3260 ~ 3267	23.6 ~ 24.0
3600 ~ 4400	3332 ~ 3339	31.2 ~ 31.8
3345.8 ~ 3358	240 ~ 285	36.43 ~ 36.5
3600 ~ 4400	322 ~ 335.4	Above 38.6
	$\begin{array}{r} \mbox{MHz} \\ 16.42 \sim 16.423 \\ 16.69475 \sim 16.69525 \\ 16.80425 \sim 16.80475 \\ 25.5 \sim 25.67 \\ 37.5 \sim 38. \\ 25.73 \sim 74.6 \\ 74.8 \sim 75.2 \\ 108 \sim 121.94 \\ 149.9 \sim 150.05 \\ 156.52475 \sim 156.52525 \\ 156.7 \sim 156.9 \\ 162.0125 \sim 167.17 \\ 3345.8 \sim 3358 \\ 3600 \sim 4400 \\ 3345.8 \sim 3358 \\ \end{array}$	MHzMHz $16.42 \sim 16.423$ $399.90 \sim 410$ $16.69475 \sim 16.69525$ $608 \sim 614$ $16.80425 \sim 16.80475$ $960 \sim 1240$ $25.5 \sim 25.67$ $1300 \sim 1427$ $37.5 \sim 38.$ $1435 \sim 1626.5$ $25.73 \sim 74.6$ $1645.5 \sim 1646.5$ $74.8 \sim 75.2$ $1660 \sim 1710$ $108 \sim 121.94$ $1718.8 \sim 1722.2$ $149.9 \sim 150.05$ $2200 \sim 2300$ $156.52475 \sim 156.52525$ $2310 \sim 2390$ $156.7 \sim 156.9$ $2483.5 \sim 2500$ $162.0125 \sim 167.17$ $2690 \sim 3267$ $3600 \sim 4400$ $3332 \sim 3339$ $3345.8 \sim 3358$ $240 \sim 285$

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 3.75 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
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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 for MESH

• Low frequency

	Rea	ding			0.005	Lin	nits	Re	sult	Ма	rgin
Frequency	(dBu	V/m)	Pol.	T.F (dB)	DCCF (dB)	(dBu	V/m)	(dBu	ıV/m)	(d	B)
(MHz)	AV ,	/ Peak		(00)	(00)	AV /	Peak	AV /	Peak	AV /	Peak
2 389.48	N/A	37.85	Н	9.04	-29.66	54.0	74.0	17.2	46.9	36.8	27.1
4 819.22	N/A	61.05	Н	-1.14	-29.66	54.0	74.0	30.2	59.9	23.8	14.1
7 231.69	N/A	62.62	Н	8.41	-29.66	54.0	74.0	41.4	71.0	12.6	3.0
9 638.34	N/A	47.91	Н	10.75	-29.66	54.0	74.0	29.0	58.7	25.0	15.3

• Middle frequency

	Rea	ding				Lin	nits	Re	sult	Mar	rgin
Frequency	(dBu	V/m)	Pol.	T.F (dB)	DCCF (dB)	(dBu	V/m)	(dBu	V/m)	(d	B)
(MHz)	AV ,	/ Peak		(48)	(48)	AV /	Peak	AV /	Peak	AV /	Peak
4 889.20	N/A	55.06	Н	-1.14	-29.66	54.0	74.0	24.3	53.9	29.7	20.1
7 336.80	N/A	62.83	Н	8.63	-29.66	54.0	74.0	41.8	71.5	12.2	2.5
9 778.38	N/A	44.68	Н	11.24	-29.66	54.0	74.0	26.3	55.9	27.7	18.1

• High frequency

Frequency	Rea	ding			0.005	Lin	nits	Re	sult	Ма	rgin
Frequency	(dBu	V/m)	Pol.	T.F (dB)	DCCF (dB)	(dBu	V/m)	(dBu	V/m)	(d	B)
(MHz)	AV ,	/ Peak		(00)	(00)	AV /	Peak	AV /	Peak	AV /	Peak
2 483.61	N/A	51	Н	9.87	-29.66	54.0	74.0	31.2	60.9	22.8	13.1
4 949.32	N/A	55.49	Н	-1.04	-29.66	54.0	74.0	24.8	54.5	29.2	19.6
7 423.77	N/A	62.45	Н	8.76	-29.66	54.0	74.0	41.5	71.2	12.5	2.8
9 898.33	N/A	41.56	Н	11.32	-29.66	54.0	74.0	23.2	52.9	30.8	21.1

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)

 $- T_{on} = 1.096 \text{ ms} / T_{off} = 38.92 \text{ ms}$

- DCCF = $20 \times \log(\text{The Worst Case Dwell Time / 100 ms}) dB = <math>20 \times \log(3.288 / 100) dB = -29.66 dB$ 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 + Distance Factor

Distance Factor = 20log(applied distance/required distance) = 20log(3.75m/3m) = 1.94



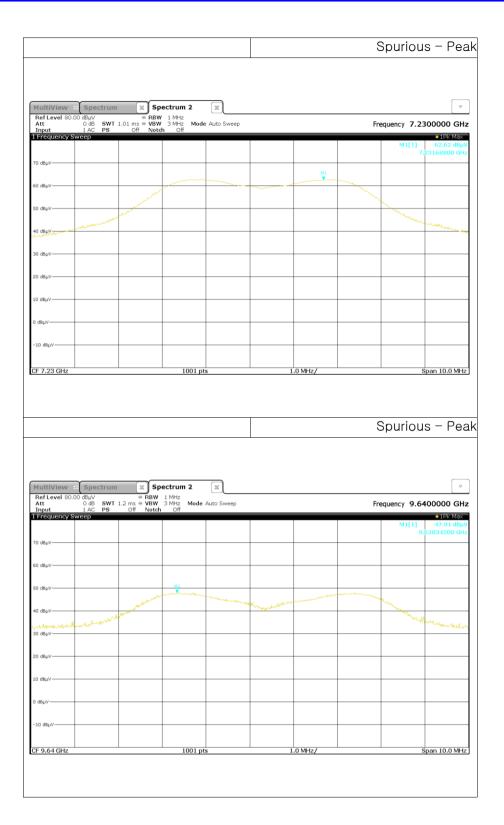
9.6 Test Plot for Radiated Spurious Emission MESH

• MESH _ Low frequency

AultiView Spectrum Ref Level 97.00 dBµV	Spectrum 2	MHz Spectrum 3	X Spectrum 4		∇
Att 0 dB SV Input 1 AC PS	● RBW 1 WT 1.01 ms ● VBW 3 S On Notch	MHz Mode Auto Sweep Off		Frequenc	2.3500000 GH
Frequency Sweep					• 1Pk Max M1[1] 37.85 dBμ
0 dBµV					2.3894810 GH
) dBµV					
) dBµV					
) dBµV					
1 4844					
) dBµV					
) dBµV					N
					a second and a
) dBµV		Munder view and mar war	have marked to mander where	Warney and and and and	hy water water
Maaroon Mar Mar Mar Maharoon day	nannann	- and the state of the second s			
) dBµV					
dBµV					
.31 GHz		1001 pts	8.0 MHz/		2.39 GH:
				Spu	
				Spu	rious – Pe
RefLevel 80.00 dBµ∨ Att 0 dB SW	● RBW 11 T 1.01 ms ● VBW 31	VHz VHz Mode Auto Sweep			rious – Pea
RefLevel 80.00 dBµV Att 0 dB SW	● RBW 11 T 1.01 ms ● VBW 31	MHz		Frequenc	rious – Pea v 4.820000 GH
Ref Level 80.00 dBµV Att 0 dB SW Input 1 AC PS Frequency Sweep	● RBW 11 T 1.01 ms ● VBW 31	VHz VHz Mode Auto Sweep		Frequenc	rious – Pea v x 4.8200000 GH
Ref Level 80.00 dBµV Att 0 dB SW Input 1 AC PS Frequency Sweep	● RBW 11 T 1.01 ms ● VBW 31	VIHz Mode Auto Sweep		Frequenc	rious – Pea v v xy 4.8200000 GH 41% MBX M1(1) 61.05 dbp
Ref Level 80.00 dBµV Att 0 dB SW input 1 AC PS Frequency Sweep	● RBW 11 T 1.01 ms ● VBW 31	VHz VHz Mode Auto Sweep		Frequenc	rious – Pea v v xy 4.8200000 GH 41% MBX M1(1) 61.05 dbp
tel Level 80.00 dBj// Att 0 dB SW input 1 AC PS Frequency Sweep	● RBW 11 T 1.01 ms ● VBW 31	VIHz Mode Auto Sweep		Frequenc	rious – Pea v v xy 4.8200000 GH 41% MBX M1(1) 61.05 dbp
Level 80.00 dB ₁ // Ntt 0 dB 5// 0 dB 5// Frequency Sweep b dB ₄ /v 0 b dB ₄ /v 0	off Notch	VIHz Mode Auto Sweep		Frequenc	rious – Pea v v xy 4.8200000 GH 41% MBX M1(1) 61.05 dbp
Level 80.00 dB ₁ // Ntt 0 dB 5// 0 dB 5// Frequency Sweep b dB ₄ /v 0 b dB ₄ /v 0	● RBW 11 T 1.01 ms ● VBW 31	VIHz Mode Auto Sweep		Frequenc	rious – Pea v v xy 4.8200000 GH 41% MBX M1(1) 61.05 dbp
Level 80.00 dB// St 1 0 dB Y input 0 dB Y input 1 AC PS input 0 dB/Y 0 dB/Y 0 dB/Y 0 dB/Y 0 dB/Y 0 dB/Y 0 dB/Y 0 dB/Y 0 dB/Y	off Notch	VIHz Mode Auto Sweep		Frequenc	rious – Pea v 4.8200000 GH
tet Level 30.00 dBj// Nt 0 dB SW not 1 AC PS PS Frequency Sweep 0 0 dBj// 0	off Notch	VIHz Mode Auto Sweep		Frequenc	rious – Pea v 4.8200000 GH
Ref Level 80.00 dBj// Att 0 dB SW/ 0 dB SW Inc PS Frequency Sweep 0 0 dBj// 0	off Notch	VIHz Mode Auto Sweep		Frequenc	rious – Pea v 4.8200000 GH
2d Level 80.00 dB// Att 0 dB SW Ipput 1 AC PS Frequency Sweep 0 95 96 0 dB//v 0 0 96 97 0 dB//v 0 0 96 97 97 0 dB//v 0 0 98 97	off Notch	VIHz Mode Auto Sweep		Frequenc	rious – Pea v 4.8200000 GH
Input 1AC PS Frequency Sweep 0 dbµv 0 dbµv 0 d	off Notch	VIHz Mode Auto Sweep		Frequenc	rious – Pea v 4.8200000 GH
2d Level 80.00 dB// Att 0 dB SW pout 1 AC PS Frequency Sweep 0 95 95 0 dB//v 0 0 96 97 0 dB//v 0 0 96 97 0 dB//v 0 98 97 97 0 dB//v 0 98 97 97 0 dB//v 0 98 97 97 97 0 dB//v 0 97<	off Notch	VIHz Mode Auto Sweep		Frequenc	rious – Pea v 4.8200000 GH
Ref Level 80.00 dBj// Att 0 dB SW Not 0 dB SW Inc. PS Frequency Sweep 0 dBj// 0 dBj//	off Notch	VIHz Mode Auto Sweep		Frequenc	rious – Pea v 4.8200000 GH
Ref Level 80.00 dBj// Att 0 dB SW/ 0 dB SW IAC PS PS Frequency Sweep 0 0 dBj// 0	off Notch	VIHz Mode Auto Sweep		Frequenc	rious – Pea v 4.8200000 GH

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• MESH _ Middle frequency

ultiView			pectrum 2	X				_ ▽
ef Level 80.0 tt iput	OdBµV OdB SWT: 1 AC PS	● RBV 1.01 ms ● VBV Off Not	V 1 MHz V 3 MHz Mode ch Off	Auto Sweep		Fre	equency 4.89	000000 GH
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dBµV				M1				
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dBµV								
івµ∨———								
3µV								
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			1001 pe		1.0 (Vii 12)	Ç	Spuriou	
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altiView a of Level 80.00 t t put requency Sv	0 dBµV 0 dB SWT : 1 AC PS		Dectrum 2	X			Spuriou	s – Pe s50000 Gł
af Level 80.0 :t put requency Sv	0 dBµV 0 dB SWT : 1 AC PS		Dectrum 2	X			Spuriou equency 7.33	s – Pe s50000 GH
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af Level 80.0 t put requency Sv d8μν d8μν	0 dBµV 0 dB SWT : 1 AC PS		Dectrum 2	X	MI		Spuriou equency 7.33	s – Pe s50000 Gł
ef Level 80.0 t put requency Sw /8μν /8μν	0 dBµV 0 dB SWT : 1 AC PS		Dectrum 2	X	MI		Spuriou equency 7.33	s – Pe s50000 Gł
ef Level 80.0 t put requency Sy JBµV JBµV JBµV JBµV JBµV	0 dBµV 0 dB SWT : 1 AC PS weep		Dectrum 2	X	MI		Spuriou equency 7.33	s – Pe s50000 Gł
ef Level 80.0 tt put requency Sv JBµV JBµV JBµV JBµV JBµV	0 dBµV 0 dB SWT : 1 AC PS weep		Dectrum 2	X	MI		Spuriou equency 7.33	s – Pe s50000 Gł
ft Level 80.0. f Level 80.0. put requency Sv ивµv ивµv ивµv ивµv ивµv ивµv ивµv ивµv ивµv	0 dBµV 0 dB SWT : 1 AC PS weep		Dectrum 2	X	MI		Spuriou equency 7.33	s – Pe s50000 Gł
f Level 80.0 t put requency Sy I8µV I8µV I8µV I8µV I8µV I8µV	0 dBµV 0 dB SWT : 1 AC PS weep		Dectrum 2	X	MI		Spuriou equency 7.33	s – Pe s50000 Gł
fLevel 80.0 fLevel 80.0 put put put	0 dBµV 0 dB SWT : 1 AC PS weep		Dectrum 2	X	MI		Spuriou equency 7.33	s – Pe s50000 Gł
fLevel 80.0 fLevel 80.0 put put put	0 dBµV 0 dB SWT : 1 AC PS weep		Dectrum 2	X	MI		Spuriou equency 7.33	s – Pe s50000 Gł
ef Level 80.0 It iput	0 dBµV 0 dB SWT : 1 AC PS weep		Dectrum 2	X	MI		Spuriou equency 7.33	s – Pe s50000 Gł

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	Spurious - Pe
IltiView : Spectrum X Spectrum 2 X	v.
fLevel 80.00 dBµV = RBW 1 MHz t 0 dB SWT 1.2 ms ⊌VBW 3 MHz Mode Auto Sweep out 1 AC PS Off Notch Off	Frequency 9.7800000 GH
equency Sweep	1Pk Ma: MI[1] 44.68 dB 9.77838200 GI
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вµу	
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Buv	and the second s
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sµv	
ph A	
3µV	
μγ	
dgµv	
9.78 GHz 1001 pts	1.0 MHz/ Span 10.0 MH



• MESH _ High frequency

1ultiView ⊞		Spectrur		Spectrum 3	X Spectru	um 4 🛛 🕱			∇
Ref Level 95.0 Att Input	0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW On Note	/ 1 MHz / 3 MHz Mod sh Off	e Auto Sweep			Fn	equency 2.4	917500 GH
Frequency Sv	veep						N	1[1]	1Pk Max 51.00 dBμ\
0 dBµV									2.4836070 GH
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) dBµV									
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т авну	and								
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dBµV									
.4835 GHz			1001 pt	s	1.	.65 MHz/			2.5 GHz
								Spuriou	ıs – Pea
	Ŷ							Spuriou	ıs – Pea
Ref Level 80.0 Att	Spectrum 0 dBµ/ 0 dB SWT 1 AC PS	RBW 1.01 ms VBW Off Nated	ectrum 2 1 MHz 3 MHz Mode	Auto Sweep					V
Ref Level 80.0 Att Input	0 dBµV 0 dB SWT : 1 AC PS	SP BBW 1.01 ms = VBW Off Notd	ectrum 2 1 MHz 3 MHz Mode h Off	Auto Sweep				equency 4.9	IS – Pea 500000 GH: 5549 dBh 54932100 GH:
Ref Level 80.0 Att Input Frequency Sv	0 dBµV 0 dB SWT : 1 AC PS	SP BBW 1.01 ms = VBW Off Noted	ectrum 2 1 MHz 3 MHz Mode h Off	Z Auto Sweep				equency 4.9	▼ 500000 GH: • 1Pk Max 55.49 dBpX
Ref Level 80.0 Att Input Frequency Sv 0 dBµV	0 dBµV 0 dB SWT : 1 AC PS	Sp BBW 1.01 ms = VBW Off Notel	ectrum 2 1 MHz 3 MHz Mode h Off	Auto Sweep				equency 4.9	▼ 500000 GH • 1Pk Max 55.49 dBp/
Ref Level 80.0 Att Input Frequency Sv 0 dBµV	0 dBµV 0 dB SWT : 1 AC PS	Sp RBW 1.01 ms VBW Off Note	ectrum 2 1 MHz 3 MHz Mode	Auto Sweep				equency 4.9	▼ 500000 GH: • 1Pk Max 55.49 dBpX
Ref Level 30.0 Att Input Frequency Sv 0 dBµV	0 dBµV 0 dB SWT : 1 AC PS	Sp RBW 1.01 ms = VBW Off Note	1 MHz 3 MHz Mode off	Auto Sweep				equency 4.9	▼ 500000 GH: • 1Pk Max 55.49 dBpX
Ref Level 30.0 Att Input Frequency Sv 0 dBµV 0 dBµV 0 dBµV	0 dBµV 0 dB SWT 1 AC PS Veep	Sp BBW 1.01 ms VBW Off Note	ectrum 2 1 MHz Mode 3 MHz Mode	Auto Sweep				M1[1] 4	• 5500000 GH: • 1Pk Max • 55.49 dBµ • 94932100 GH:
Ref Level 30.0 Att Input Frequency Sv 0 dBµV 0 dBµV 0 dBµV	0 dBµV 0 dB SWT : 1 AC PS	SP 1.01 ms = RBW Off = VBW Note	1 MHz 3 MHz Mode off	Auto Sweep				M1[1] 4	▼ 500000 GH: • 1Pk Max 55.49 dBpX
Ref Level 30.0 Att input Frequency SV 0 dBµV 0 dBµV 0 dBµV 0 dBµV 0 dBµV	0 dBµV 0 dB SWT 1 AC PS Veep	SP BBW 1.01 ms VBW Off Notel	1 MHz 3 MHz Mode off	Auto Sweep				M1[1] 4	• 5500000 GH: • 1Pk Max • 55.49 dBµ • 94932100 GH:
Ref Level 30.0 Att Imput Frequency Sy 0 dBµV	0 dBµV 0 dB SWT 1 AC PS Veep	SP BBW 1.01 ms = VBW Off Note	1 MHz 3 MHz Mode off	Auto Sweep				M1[1] 4	• 5500000 GH: • 1Pk Max • 55.49 dBµ • 94932100 GH:
Ref Level 80.0 Att Input Jagur	0 dBµV 0 dB SWT 1 AC PS Veep	Sp RBW 0ff VBW Off Note	1 MHz 3 MHz Mode off	Auto Sweep				M1[1] 4	• 5500000 GH: • 1Pk Max • 55.49 dBµ • 94932100 GH:
Ref Level 80.0 Att Input Jagur	0 dBµV 0 dB SWT 1 AC PS Veep	Sp RBW Off VBW Off Note	1 MHz 3 MHz Mode off	Auto Sweep				M1[1] 4	• 5500000 GH: • 1Pk Max • 55.49 dBµ • 94932100 GH:
Ref Level 80:0.0 Art Input Frequency Sy 0 dbjv	0 dBµV 0 dB SWT 1 AC PS Veep	SP RBW 0ff VBW Off Note	1 MHz 3 MHz Mode off	Auto Sweep				M1[1] 4	• 5500000 GH: • 1Pk Max • 55.49 dBµ • 94932100 GH:
Ref Level 00.0 Att Input Input Input 0 dbpv dbpv	0 dBµV 0 dB SWT 1 AC PS Veep	EX Sp RBW 1.01 ms VBW Off Note	1 MHz 3 MHz Mode off	Auto Sweep				M1[1] 4	• 5500000 GH: • 1Pk Max • 55.49 dBµ • 94932100 GH:
Ref Level 80.0 Art Input Brequency Sy 0 dbpv	0 dBµV 0 dB SWT 1 AC PS Veep	Sp RBW 1.01 ms = VBW Off Note	1 MHz 3 MHz Mode off	Auto Sweep				M1[1] 4	• 5500000 GH: • 1Pk Max • 55.49 dBµ • 94932100 GH:
AultiView Ref Level 80.0 AultiView 80.0 Autor 80.0 Autor <t< td=""><td>0 dBµV 0 dB SWT 1 AC PS Veep</td><td>Sp RBW 1.01 ms = VBW Off Note</td><td>1 MHz 3 MHz Mode off</td><td>M1 ¥</td><td></td><td>.0 MHz/</td><td></td><td>All (1)</td><td>• 5500000 GH: • 1Pk Max • 55.49 dBµ • 94932100 GH:</td></t<>	0 dBµV 0 dB SWT 1 AC PS Veep	Sp RBW 1.01 ms = VBW Off Note	1 MHz 3 MHz Mode off	M1 ¥		.0 MHz/		All (1)	• 5500000 GH: • 1Pk Max • 55.49 dBµ • 94932100 GH:

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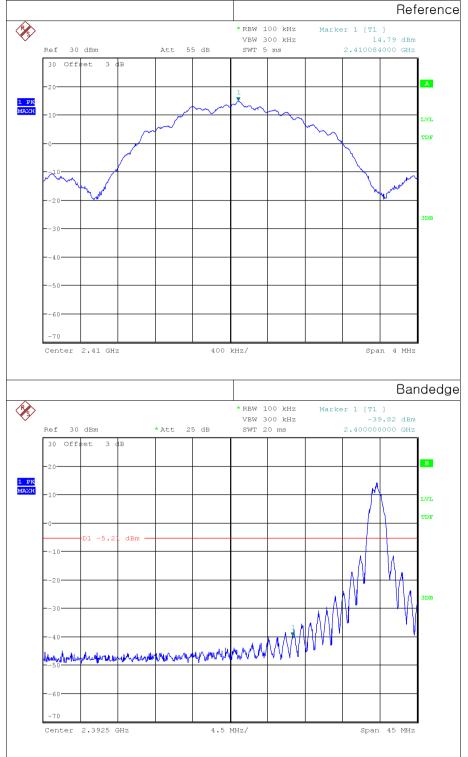
					2	Spurious	10
ultiView Spectru	m 🕱 Spect	trum 2 🕱	1				
ef Level 80.00 dBuV	● RBW 1 T 1.01 ms ● VBW 3	MHz	L		Fre	quency 7.4250	0000 GI
requency Sweep	On Noten					M1[1]	 1Pk Max 62.45 dBj
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7.425 GHz				1.0 WHZ/	S		– Pe
ultiView + Spectru	= RBW 1 N	trum 2 🕅	<u> </u>	1.0 MHZ/		opurious	,
altiView & Spectru of Level 80.00 dBaV tt 0.d5 SW pat 1.4C PS	● RBW 1 N T 1.2 ms ● VBW 3 N	trum 2 🕅	<u> </u>	1.0 MHZ/		Spurious	0000 GI
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altiView Spectru of Level 80.00 dbµ/ tt 0.db Sw uput 1.AC PS requency Sweep dbµ/ dbµ/ dbµ/ dbµ/ dbµ/	PBW 1N T 1.2 ms PW 3N Off Notch	trum 2 Z MHz MHz Mode Auto : Off	Sweep		Fre	quency 9.9000 M1[1] 9.391	0000 Gł 1Pk Maz 41.56 dbj
ultiView E Spectru f Level 80.00 dBµ/ 0 dB SW tt 0 dB SW i AC PS dBµ/ i AC dBµ/ dBµ/ dBµ/ dBµ/	● RBW 1 N T 1.2 ms ● VBW 3 N	trum 2 Z MHz MHz Mode Auto : Off	Sweep		Fre	Spurious	0000 Gł 1Pk Maz 41.56 dbj
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altiView Spectru ef Level 80.00 dBµV 0.dB SW yput 1.AC 1.AC PS requency Sweep dBµV dBµV dBµV dBµV dBµV dBµV dBµV dBµV dBµV dBµV	PBW 1N T 1.2 ms PW 3N Off Notch	trum 2 Z MHz MHz Mode Auto : Off	Sweep		Fre	quency 9.9000 M1[1] 9.391	
altiView Spectru ef Level 80.00 dBµ/ 0 dB µ/ i AC PS i AC PS dBµ/ i AC dBµ/ dBµ/ dBµ/ dBµ/ dBµ/ dBµ/ dBµ/ dBµ/ dBµ/ dBµ/ dBµ/ dBµ/	PBW 1N T 1.2 ms PW 3N Off Notch	trum 2 Z MHz MHz Mode Auto : Off	Sweep		Fre	quency 9.9000 M1[1] 9.391	0000 Gł 1Pk Maz 41.56 dbj
BitiView Spectru ef Level \$0.00 dBµV tt 0 dB SW yput 1 AC PS gbµV	PBW 1N T 1.2 ms PW 3N Off Notch	trum 2 Z MHz MHz Mode Auto : Off	Sweep		Fre	quency 9.9000 M1[1] 9.391	0000 Gł 1Pk Maz 41.56 dbj
ultiView : Spectru ef Level 80.00 dbµV tt 0 dB SW	PBW 1N T 1.2 ms PW 3N Off Notch	trum 2 Z MHz MHz Mode Auto : Off	Sweep		Fre	quency 9.9000 M1[1] 9.391	0000 Gł 1Pk Maz 41.56 dbj

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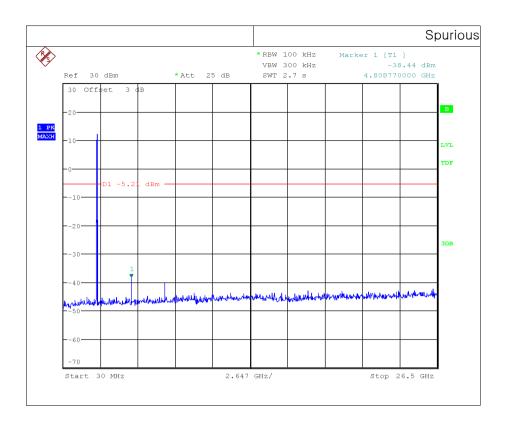
9.7 Test Plot for Conducted Spurious Emission

• MESH _ Low frequency



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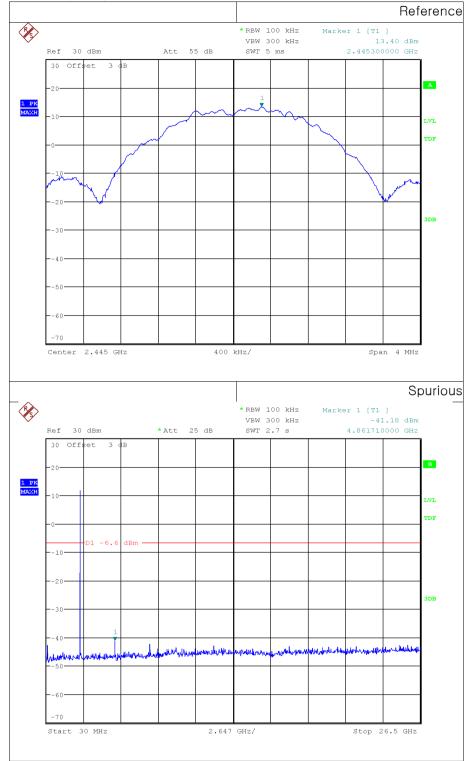




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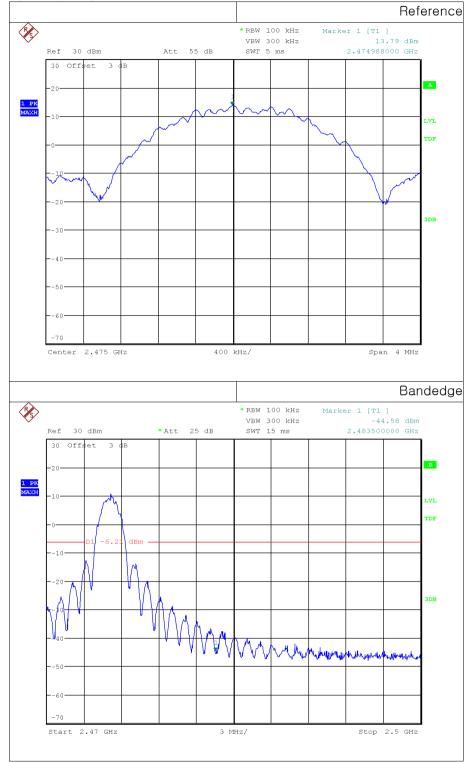
• MESH _ Middle frequency



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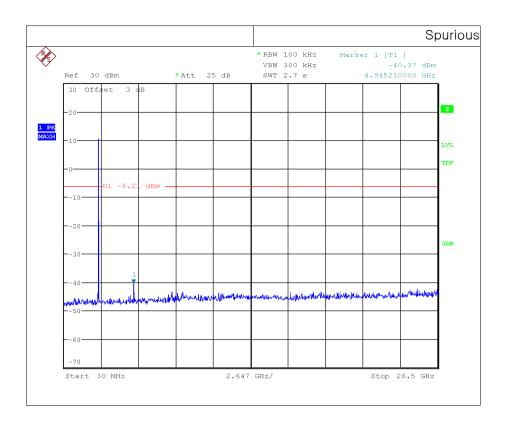


• MESH _ High frequency



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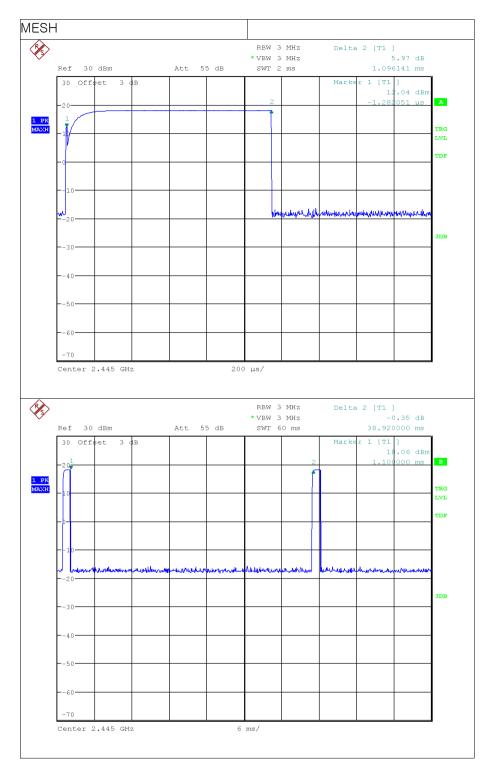


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9.8 Test Plot for Duty Cycle



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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.

Frequency Range (MHz)	Conducted Limit (dBuV)				
Flequency hange (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.

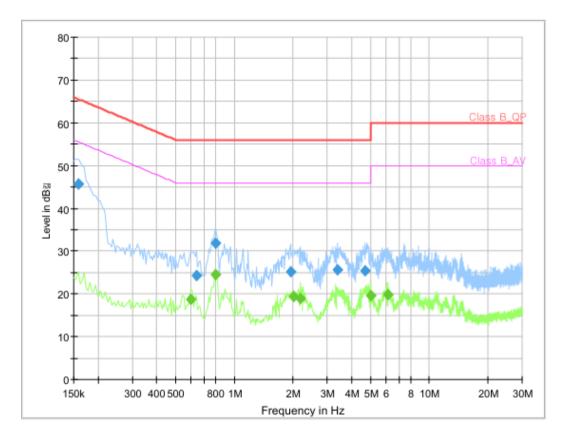
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10.4 Test Result

• AC Line Conducted Emission (Graph)

SP155_Charging Mode_L1



Conducted Emission

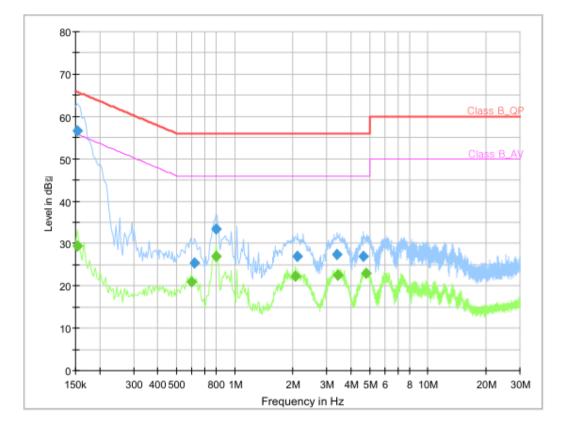
Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.158	45.71		65.57	19.85	9	L1	20.7
0.600		18.83	46.00	27.17	9	L1	20.7
0.640	24.23		56.00	31.77	9	L1	20.4
0.800		24.57	46.00	21.43	9	L1	20.0
0.800	31.80		56.00	24.20	9	L1	20.0
1.940	25.08		56.00	30.92	9	L1	19.9
2.010		19.28	46.00	26.72	9	L1	19.9
2.180		18.92	46.00	27.08	9	L1	19.9
3.380	25.63		56.00	30.37	9	L1	19.9
4.700	25.30		56.00	30.70	9	L1	19.9
5.000		19.59	46.00	26.41	9	L1	19.9
6.130		19.79	50.00	30.21	9	L1	19.9

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SP155_Charging Mode_N



Conducted Emission

Final_Result

Frequency	QuasiPeak	CAverage	Limit	Margin	Bandwidth	Line	Corr.
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dB)	(kHz)		(dB)
0.154		29.49	55.78	26.29	9	N	20.7
0.154	56.52		65.78	9.26	9	N	20.7
0.600		20.85	46.00	25.15	9	N	20.7
0.620	25.34		56.00	30.66	9	N	20.6
0.800		26.96	46.00	19.04	9	N	19.9
0.800	33.36		56.00	22.64	9	N	19.9
2.060		22.18	46.00	23.82	9	N	19.9
2.120	27.00		56.00	29.00	9	N	19.9
3.390	27.32		56.00	28.68	9	N	19.9
3.430		22.54	46.00	23.46	9	N	19.9
4.630	27.02		56.00	28.98	9	N	19.9
4.780		22.87	46.00	23.13	9	N	19.9

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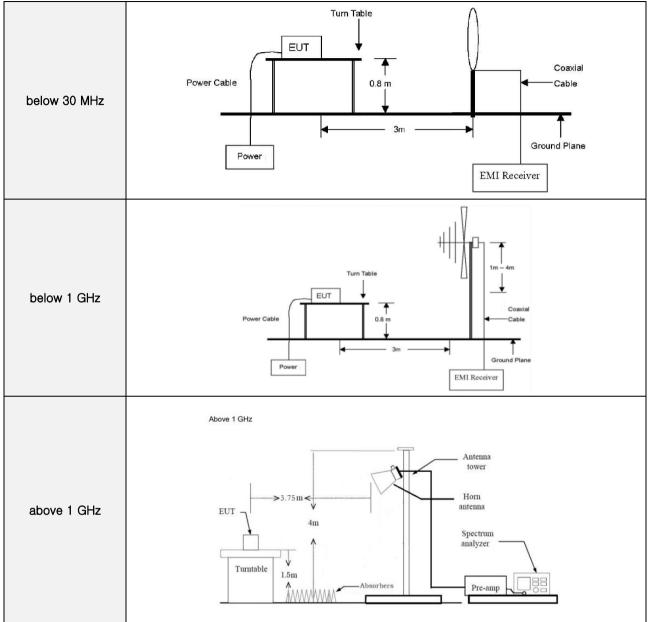
APPENDIX I

TEST SETUP

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• Radiated Measurement



• Conducted Measurement

		_			
Conducted	EUŢ		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	0.34 dB
Conducted Spurious Emissions	0.34 dB
Radiated Spurious Emissions	6.34 dB
Conducted Emissions	1.74 dB