

Test Report				
1. Client				
Name :Address :	Sena Technologies Co., Ltd. 19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea			
2. Use of Report :	FCC & IC Approval			
3. Sample Description				
Product Name: OUTRUSH M Model Name: SP148				
4. Date of Receipt :	2023-07-13			
5. Date of Test :	2023-08-01 ~ 2023-08-08			
6. Test Method :	FCC Part 15 Subpart C 15.247 RSS-247 Issue 3(2023-08), RSS-GEN Issue 5(2019-03)			
7. Test Results :	Refer to the test results			
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Affirmation Dae-Se	by eong, Choi Technical Manager Jong-Myoung, Shin			
	Aug 10, 2023			

EMC Labs Co., Ltd.

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<u>Version</u>

TEST REPORT NO.	DATE	DESCRIPTION
KR0140-RF2308-002	Aug 10, 2023	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	
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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
Laboratory Address	Korea
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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	OUTRUSH M
Model Name	SP148
FCC ID	S7A-SP148
IC	8154A-SP148
Rated Voltage	DC 3.7 V

2.2 Additional Information

Operating Frequency	2 402 MHz ~ 2 480 MHz
Number of channel	40
Modulation Type	GFSK
Antenna Type	Chip Antenna
Antenna Gain	0.3 dBi
Firmware Version	1.0
Hardware Version	1.0
Test software	Lab Test Tool V2.9.1

2.3 Test Frequency

Test mode	Test Frequency (MHz)		
	Low Frequency	Middle Frequency	High Frequency
BLE	2 402	2 442	2 480

2.4 Used Test Software Setting Value

Test Mode	Setting Item	
Test Mode	Power	
BLE	47	

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%)		С	
	15.247(b)	RSS-247 (5.4)	Maximum Peak Output Power	Conducted	С	
	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	
\square	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	2023.12.15
CONTROLLER	AMWON TECHNOLOGY	TEMI2500	S7800VK191 0707	2023.12.15
PSA SERIES SPECTRUM ANALYZER	AGILENT	E4440A	MY45304057	2023.12.15
MXG ANALOG SIGNAL GENERATOR	AGILENT	N5183A	MY50141890	2023.12.14
SYSTEM DC POWER SUPPLY	AGILENT	6674A	MY53000118	2023.12.14
VECTOR SIGNAL GENERATOR	ROHDE & SCHWARZ	SMBV100A	257524	2023.12.14
BLUETOOTH TESTER	TESCOM	TC-3000A	3000A480088	2023.12.14
DIRECTIONAL COUPLER	AGILENT	773D	2839A01855	2023.12.14
ATTENUATOR	AGILENT	8493C	73193	2023.12.14
TERMINATIOM	HEWLETT PACKARD	909D	07492	2023.12.14
POWER DIVIDER	HEWLETT PACKARD	11636A	06916	2023.12.14
SLIDE-AC	DAEKWANG TECH	SV-1023	NONE	2023.11.15
DIGITAL MULTIMETER	HUMANTECHSTORE	15B+	50561541WS	2023.12.14
ATTENUATOR	ACE RF COMM	ATT SMA 20W 20dB 8GHz	A-0820.SM20.2	2024.04.04
DC POWER SUPPLY	AGILENT	E3634A	MY40012120	2024.02.23
USB Peak Power Sensor	Anritsu	MA24408A	12321	2023.11.15
High Pass Filter	WT Microwave INC.	WT-A3314-HS	WT22111804-1	2023.12.14
High Pass Filter	WT Microwave INC.	WT-A1935-HS	WT22111804-2	2023.12.14
SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSU26	200444	2024.02.22
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	2023.11.29
Horn ANT	Schwarzbeck	BBHA9120D	1497	2024.01.09
Amplifier	TESTEK	TK-PA18H	200104-L	2024.03.14
Horn ANT	Schwarzbeck	BBHA9170	01188	2024.03.16
Horn ANT	Schwarzbeck	BBHA9170	01189	2024.03.16
AMPLIFIER	TESTEK	TK-PA1840H	220105-L	2024.03.14
EMI TEST RECEIVER	ROHDE & SCHWARZ	ESW44	101952	2024.03.14
Test Receiver	ROHDE & SCHWARZ	ESR7	101616	2024.06.27
LISN	ROHDE & SCHWARZ	ENV216	100409	2024.01.09
PULSE LIMITER	lignex1	EPL-30	NONE	2024.01.09

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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 & Occupied Bandwidth (99%)

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.

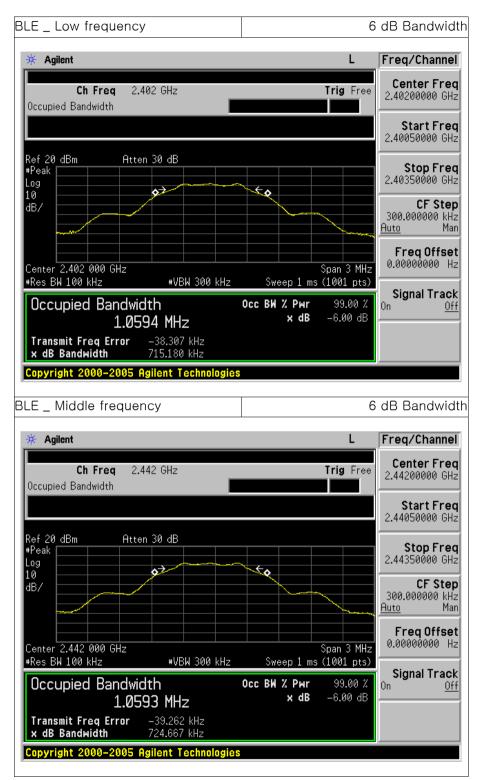
6.4 Test Result

Test Mode	Test Frequency	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)	
	Low	0.715	1.044	
BLE	Middle	0.725	1.044	
	High	0.725	1.044	

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6.5 Test Plot



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BLE _ Middle frequency	Occup	oied Bandwidth
* Agilent	L	Freq/Channel
Ch Freq 2.442 GHz Occupied Bandwidth	Trig Free	Center Freq 2.44200000 GHz Start Freq 2.44050000 GHz
Ref 20 dBm Atten 30 dB #Peak Log 10 dB/	***	Stop Freq 2.44350000 GHz CF Step 300.000000 kHz <u>Auto</u> Man
Center 2.442 000 GHz *Res BW 30 kHz	Span 3 MHz Sweep 3.2 ms (1001 pts)	Freq Offset 0.00000000 Hz
Occupied Bandwidth 1.0443 MHz Transmit Freq Error -31.046 kHz × dB Bandwidth 1.275 MHz	Осс В₩ % Рพг 99.00 % × dB −26.00 dB	On <u>Off</u>
Copyright 2000–2005 Agilent Technologies		,
BLE _ High frequency	Occur	oied Bandwidth
* Agilent	L	Freq/Channel
Ch Freq 2.48 GHz Occupied Bandwidth	Trig Free	Center Freq 2.48000000 GHz Start Freq 2.47850000 GHz
Ref 20 dBm Atten 30 dB #Peak		
Log 10 dB/	× Em	Stop Freq 2.48150000 GHz CF Step 300.000000 kHz <u>Auto</u>
Log 10 dB/ Center 2.480 000 GHz #Res BW 30 kHz #VBW 100 kHz	Span 3 MHz Sweep 3.2 ms (1001 pts) Occ BW Z Pwr 99.00 %	2.48150000 GHz CF Step 300.000000 kHz <u>Auto</u> Man Freq Offset 0.00000000 Hz Signal Track
Log 10 dB/ Center 2.480 000 GHz	Span 3 MHz Sweep 3.2 ms (1001 pts) Occ BW % Pwr 99.00 % x dB -26.00 dB	2.48150000 GHz CF Step 300.000000 kHz <u>Auto</u> Man Freq Offset 0.00000000 Hz Signal Track

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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

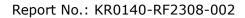
A transmitter antenna terminal of EUT is connected to the input of a spectrum analyzer. Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.

- 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

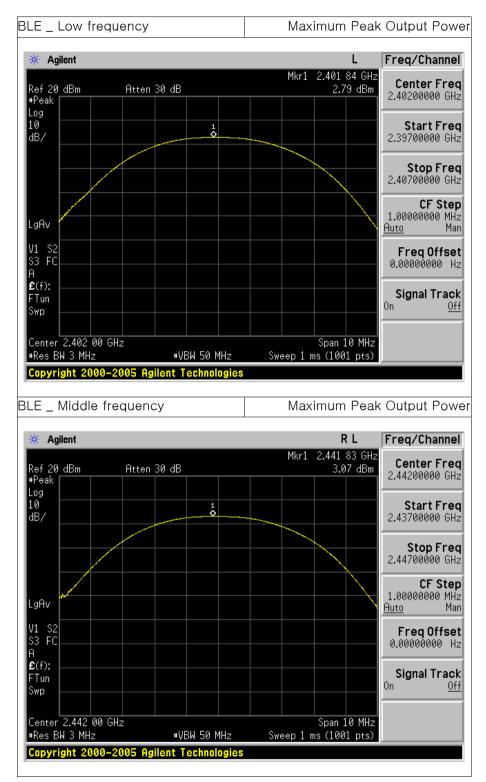
Test Mode	Tost Fraguanay	Peak Output Power				
Test Mode	Test Frequency	dBm	mW			
	Low	2.79	1.90			
BLE	Middle	3.07	2.03			
	High	2.89	1.95			

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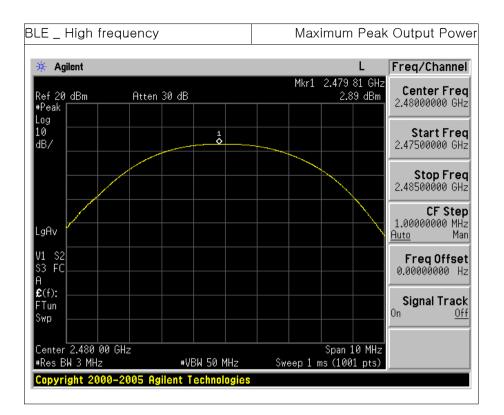


7.5 Test Plot



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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.

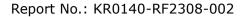
(ANSI C63.10-2013 _ Section 11.10.2 - Method PKPSD)

- 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	-12.46				
BLE	Middle	-12.26				
	High	-12.43				

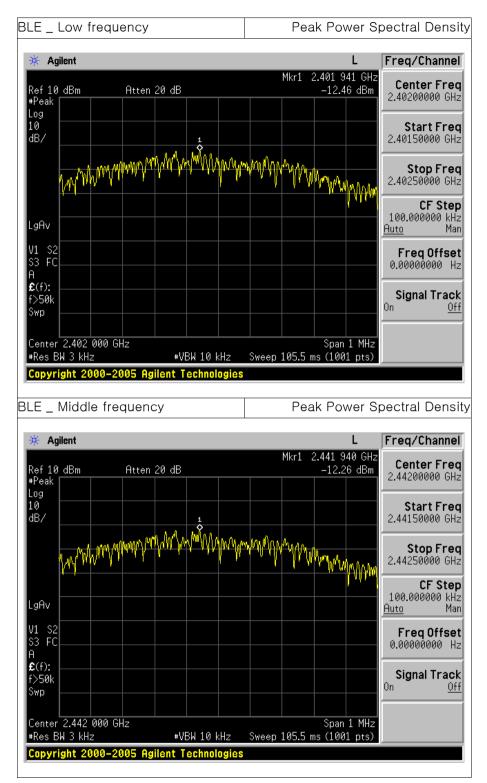
8.4 Test Result

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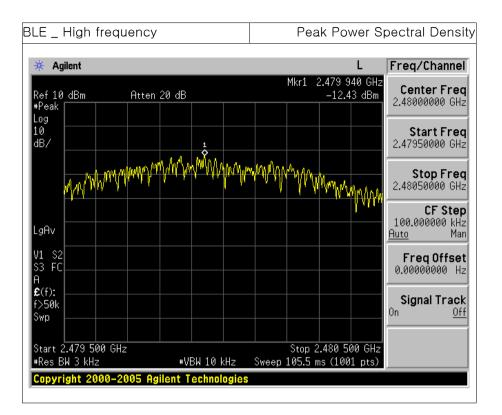


8.5 Test Plot



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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

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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.

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

nequency bands listed			
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			
10.00 10.41			

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 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
```

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.
- If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than tuning 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 BLE

• Low frequency

Frequency	Rea	ding		ŦĊ	2.05	Limits		Result		Margin	
Trequency	(dBuV/m)		Pol. (dB)		DCF (dB)	(dBuV/m)		(dBuV/m)		(dB)	
(MHz)	AV /	[/] Peak		(00)	(00)	AV / Peak		AV / Peak		AV / Peak	
2 389.00	15.98	30.09	Н	9.48	2.20	54.0	74.0	27.7	39.6	26.3	34.4
4 803.95	32.21	41.83	Н	-0.56	2.20	54.0	74.0	33.8	41.3	20.2	32.7

• Middle frequency

Fraguaday	Rea	ding			0.05	Limits		Result		Margin	
Frequency	(dBuV/m)		Pol.	T.F (dB)	DCF (dB)	(dBu	IV/m)	(dBu	ıV/m)	(d	B)
(MHz)	AV ,	/ Peak		(00)	(00)	AV / Peak		AV / Peak		AV / Peak	
4 883.94	32.88	42.07	Н	-0.60	2.20	54.0	74.0	34.5	41.5	19.5	32.5

• High frequency

	Rea	ding	.		0.05	Limits		Result		Margin		
Frequency	(dBu	V/m)	Pol.	Pol.	T.F (dB)	DCF (dB)	(dBuV/m)		(dBuV/m)		(dB)	
(MHz)	AV /	/ Peak	(06)		(00)	AV /	Peak	AV / Peak		AV / Peak		
2 483.76	16.45	36.64	Н	10.21	2.20	54.0	74.0	28.9	46.9	25.1	27.2	
4 959.90	31.81	40.70	Н	-0.42	2.20	54.0	74.0	33.6	40.3	20.4	33.7	

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: DCF(Duty Cycle Factor)

- T_{on} = 0.377 ms / T_{off} = 0.248 ms

- Duty Cycle = T_{on} / ($T_{on}+T_{off}$) = 0.377 / (0.377+0.248) = 0.603

- DCF = $10 \times \log(1/\text{Duty Cycle}) dB = 10 \times \log(1/0.603) dB = 2.20 dB$

Note 3: Sample Calculation.

Margin = Limit - Result / Peak Result = Peak Reading + TF / Average Result = Average Reading + TF + DCF

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

• BLE _ Low frequency

						F	Restricte	ed Bano	d – Peak
MultiView 🗄 Sp	ectrum	Spectrur	n 2 🕅	Spectrum 3	Spectru	um 4 🕅 🕱			∇
Ref Level 87.00 Att Input	dBµV 0 dB SWT : 1 AC PS	● RB₩ 1.01 ms ● VB₩ On Note		e Auto Sweep			Fre	equency 2.35	500000 GHz
1 Frequency Swe	ep							M1[1]	 1Pk Мах 30.09 dBµV
80 dBµV								2	.3890010 GHz
70 dBµV									
60 dBµV									
50 dBµV									
40 dBµV									M1
30 dBµV	un and the state of the state o	unintwenter	nowwww	operson	helman	whenter	Marganardah	mahamman	manshell
20 dBµV				(
10 dBµV									
0 dBµV									
-10 dBµV 2.31 GHz			1001 pt:	s	8	.0 MHz/			2.39 GHz
						Rest	ricted (Band –	Average
MultiView 🗄 Sp	ectrum	X Spectrum	m 2 🕱	Spectrum 3					
Ref Level 87.00					X Snectri	Im 4 🛛 🕅 🕅			_ ▽
Att	dBµV 0 dB SWT :	● RBW 1.01 ms ● VBW	/ 1 MHz / 3 MHz Mod		SGL Count 100/100		Fre	equency 2.35	
 Att Input Frequency Swe 	dBµV 0 dB SWT : 1 AC PS	⊖ RB₩	/ 1 MHz / 3 MHz Mod		SGL		Fre		000000 GHz
Input	dBµV 0 dB SWT : 1 AC PS	● RBW 1.01 ms ● VBW	/ 1 MHz / 3 MHz Mod		SGL		Fra	M1[1]	600000 GHz
Input 1 Frequency Swe	dBµV 0 dB SWT : 1 AC PS	● RBW 1.01 ms ● VBW	/ 1 MHz / 3 MHz Mod		SGL		Fra	M1[1]	000000 GHz 18m Avg 15.98 dBµV
Input 1 Frequency Swe	dBµV 0 dB SWT : 1 AC PS	● RBW 1.01 ms ● VBW	/ 1 MHz / 3 MHz Mod		SGL		Fra	M1[1]	000000 GHz 18m Avg 15.98 dBµV
Input 1 Frequency Sweet 80 d8μν 70 d8μν 60 d8μν	dBµV 0 dB SWT : 1 AC PS	● RBW 1.01 ms ● VBW	/ 1 MHz / 3 MHz Mod		SGL		Fra	M1[1]	000000 GHz 18m Avg 15.98 dBµV
Input 1 Frequency Swe 80 dBμV 70 dBμV	dBµV 0 dB SWT : 1 AC PS	● RBW 1.01 ms ● VBW	/ 1 MHz / 3 MHz Mod		SGL		Fre	M1[1]	000000 GHz 18m Avg 15.98 dBµV
Input 1 Frequency Sweet 80 d8μν 70 d8μν 60 d8μν	dBµV 0 dB SWT : 1 AC PS	● RBW 1.01 ms ● VBW	/ 1 MHz / 3 MHz Mod		SGL		Fre	M1[1]	000000 GHz 18m Avg 15.98 dBµV
Input 1 Frequency Sweet 80 d8μv 70 d8μv 60 d8μv 50 d8μv	dBµV 0 dB SWT : 1 AC PS	● RBW 1.01 ms ● VBW	/ 1 MHz / 3 MHz Mod		SGL		Fre	M1[1]	000000 GHz 18m Avg 15.98 dBµV
Input 1 Frequency Sweet 80 dBµv 70 dBµv 60 dBµv 50 dBµv	dBµV 0 dB SWT : 1 AC PS	● RBW 1.01 ms ● VBW	/ 1 MHz / 3 MHz Mod		SGL		Fre	M1[1]	000000 GHz 18m Avg 15.98 dBµV
Input 1 Frequency Sweet 80 dBµV 70 dBµV 60 dBµV 50 dBµV 30 dBµV	dBµV 0 dB SWT : 1 AC PS	● RBW 1.01 ms ● VBW	/ 1 MHz / 3 MHz Mod		SGL		Fre	M1[1]	000000 GHz 18m Avg 15.98 dBµV
Input 1 Frequency Sweet 80 dBµV 80 dBµV 70 dBµV 60 dBµV 50 dBµV 40 dBµV 20 dBµV 20 dBµV	dBµV 0 dB SWT : 1 AC PS	● RBW 1.01 ms ● VBW	/ 1 MHz / 3 MHz Mod		SGL		Fr	M1[1]	000000 GHz 18m Avg 15.98 dBµV
Input 1 Frequency Sweet 80 dBµV 80 dBµV 70 dBµV 60 dBµV 50 dBµV 40 dBµV 30 dBµV	dBµV 0 dB SWT : 1 AC PS	● RBW 1.01 ms ● VBW	/ 1 MHz / 3 MHz Mod		SGL		Fre	M1[1]	000000 GHz 18m Avg 15.98 dBµV

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							C C	Spuriou	s – Peak
MultiView	# Spectrum	x Sp	ectrum 2	X Spect	rum 3 🛛 🕱	,			▽
Ref Level 80. Att	.00 dBµV		/ 1 MHz	Auto Sweep		1			
Input I Frequency S	1 AC PS	Off Note	sh Off	Auto Sweep			FI	equency 4.0	040000 GHz
								M1[1] 4	41.83 dBµV 80395005 GHz
70 dBµV									
60 dBµV									
50 dBµV−−−−									
40 dBµV		and the state		Marine and Marine	M. March Marcana				
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30 dBµV									
20 dBµV									
10 dBµV									
0 dBµV									
10 In 11									
-10 dBµV									
CF 4.804 GHz			1001 pt	s	1	.0 MHz/			Span 10.0 MHz
							Spu	rious -	Average
						_	0,00		
MultiView Ref Level 80.	Spectrum		ectrum 2	X Spect	rum 3 🛛 🗐 SGL				∇
Att Input	0 dB SWT 1 AC PS	1.01 ms ● VBW Off Note	/ 3 MHz Mode		Count 100/100		Fr	equency 4.80	040000 GHz
1 Frequency S	Sweep							M1[1]	 1Rm Avg 32.21 dBμV
70 dBµV								4	80381019 GHz
60 dBµV									
50 dBµV									
40 dBµV				M1					
30 dBµV	and returns the set	a share by the state of	السعرية والمراجع	- and and and a street of the street	man and the second second	Marked and store			
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20 dBµV									
10 dBµV									
0 dBµV									
o anh i									
-10 dBµV									
-10 dBµV СF 4.804 GHz			1001 pt			.0 MHz/			Span 10.0 MHz

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• BLE _ Middle frequency

						S	Spuriou	s – Pea
4ultiView ⊞ S	nectrum	Spectrum 2	X Spectr	um 3 🛛 🕱	2			
Ref Level 80.00 dB	·	/ RBW 1 MHz	Auto Sweep		1	En		240000 CH-
Input 1 Frequency Swee	AC PS Off I	Notch Off	Auto Sweep			FIG.	equency 4.88	• 1Pk Max
							M1[1]	42.07 dBµV 88394006 GHz
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0 dBµV								
) dBµV								
			M					
) dBµV MMMMMMM	www.mannews.	manumuhaman	mathandrawath	and an and the first of the state of the sta	- Andrew - March	newmidthmail	malehonen	upul when me
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dBµV								
dBµV								
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- 4.884 GHz		1001 pts	;	1	.0 MHz/		9	pan 10.0 MHz
						2011	rious -	Avorac
						opu	nous	Averag
1ultiView 🖽 S	·		X Spectr					▽
RefLevel 80.00 dE Att 0 Input 1	μV = dB SWT 1.01 ms = AC PS Off	RBW 1 MHz VBW 3 MHz Mode		GL Count 100/100		Fre	equency 4.88	840000 GHz
Frequency Swee							M1[1]	 1Rm Avg 32.88 dBµV
								88381019 GHz
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I dBµV								
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			M1	m .				
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) dBµV								
) dBµV								
dвµV								
10 dBμV								
F 4.884 GHz	1	1001 pts		1	.0 MHz/			pan 10.0 MHz

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• BLE _ High frequency

Thequency			Restricted Ban	d – Peak
MultiView 🗄 Spectrum 🕱 Spec	trum 2 X Spectrum 3	X Spectrum 4)	▽
Ref Level 87.00 dBµV • I	RBW 1 MHz VBW 3 MHz Mode Auto Sweep		Frequency 2.4	917500 GHz
	Notch Off			• 1Pk Max
80 dBµV			M1[1]	36.64 dBµV 2.4837555 GHz
00 00µv				
70 dBµV				
60 dBµV				
50 dBµV				
49.08pv				
ky ninya ka ka ka ka na ka Se delaya ka	Nederland (1914) of the Artifician	A A A A A A A A A A A A A A A A A A A	HANNER , HAR AND MARKEN	A AND A DRIVE
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20 dBµV				
10 dBµV				
0.40-01				
0 dBµV				
-10 dBµV				
2.4835 GHz	1001 pts	1.65 MHz/		2.5 GHz
		Res	tricted Band -	Average
MultiView 🗄 Spectrum 🕱 Spec	trum 2 X Spectrum 3	X Spectrum 4	n.	
Ref Level 87.00 dBµV • I	RBW 1 MHz VBW 3 MHz Mode Auto Sweep	SGL	1	
	Notch Off	Count 1007100	Frequency 2.4	• 1Rm Avg
			M1[1]	16.45 dBµV 2.4835412 GHz
80 dBµV				
70 dBµV				
60 dBµV				
50 dBµV				
40 dBµV				
30 dBµV				
20 dByV	and the second second second	man mark and a second and a s	ورا المراجع الم	an and the second
10 dBµV				
0 dBµV				
-10 dBµV				
2.4835 GHz	1001 pts	1.65 MHz/		2.5 GHz

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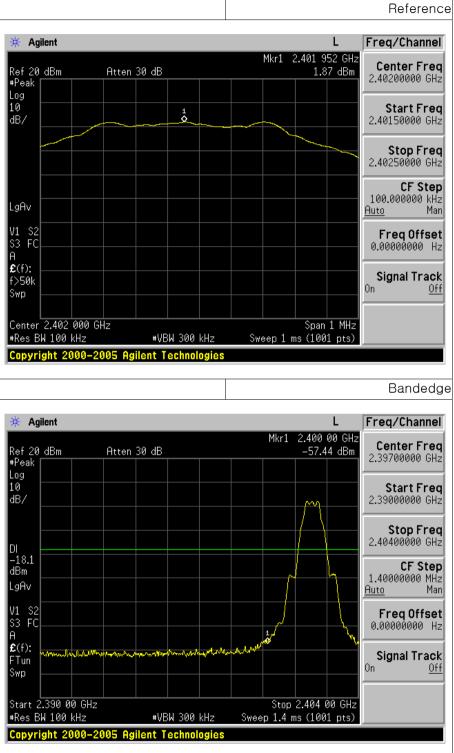
							5	Spuriou	s – Peal
MultiView	Spectrum	x Sp	ectrum 2	X Spect	rum 3 🛛 🕱	,			_ ▽
Ref Level 80.0	DO dBµV	• RBW	1 MHz	<u> </u>		<u> </u>	-		
Att Input 1 Frequency S	1 AC PS	1.01 ms ● VBW Off Note	n off node	e Auto Sweep			Fr	equency 4.9	500000 GHz
1 Hoquency 5	weep							M1[1]	40.70 dBµV 95990010 GHz
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co. 40-41									
60 dBµV									
50 dBµV									
40 dBµV				м					
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20 dBµV									
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05 4 04 011			1001		<u> </u>	<u></u>			10.0141
CF 4.96 GHz			1001 pt	5	1	.0 MHz/			Span 10.0 MHz
							Sou	rious –	Average
							opu	nous	merage
MultiView	Spectrum	x Sp	ectrum 2	X Spect	rum 3 🕅]	opu	1000	- Two lage
MultiView Ref Level 80.0 Att		• RBW	ectrum 2		SGL				
Ref Level 80.0 Att Input	0 dBµV 0 dB SWT 1 AC PS		1 MHz 3 MHz Mode]			
Ref Level 80.0 Att Input	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL			equency 4.96	 500000 GHz
Ref Level 80.0 Att Input	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL]		equency 4.96	▼ 500000 GHz •1Rm Avg 31.81 dBµV
Ref Level 80.0 Att Input I Frequency S 70 dBµV-	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL			equency 4.96	v 500000 GHz • 1Rm Avg 31.81 dBµV
Ref Level 80.0 Att Input I Frequency S	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL			equency 4.96	v 500000 GHz • 1Rm Avg 31.81 dBµV
Ref Level 80.0 Att Input I Frequency S 70 dBµV-	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL			equency 4.96	v 500000 GHz • 1Rm Avg 31.81 dBµV
Ref Level 80.0 Att Input 1 Frequency S 70 dBµV 60 dBµV 50 dBµV	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL			equency 4.96	v 500000 GHz • 1Rm Avg 31.81 dBµV
Ref Level 80.0 Att Input Infequency S 70 dBμV 60 dBμV	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL			equency 4.96	v 500000 GHz • 1Rm Avg 31.81 dBµV
Ref Level 80.0 Att Input 1 Frequency S 70 dBµV 60 dBµV 50 dBµV	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL			equency 4.96	v 500000 GHz • 1Rm Avg 31.81 dBµV
Ref Level 80.0 Att Input Input I Frequency S 70 dBµV 60 dBµV 50 dBµV 40 dBµV 30 dBµV	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL		Fr	equency 4.96	v 500000 GHz • 1Rm Avg 31.81 dBµV
Ref Level 80.0 Att Input Input 1 Frequency S 60 dBµV 50 dBµV 40 dBµV 30 dBµV	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL		Fr	equency 4.96	The second sec
Ref Level 80.0 Att Input Input I Frequency S 70 dBµV 60 dBµV 50 dBµV 40 dBµV 30 dBµV	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL		Fr	equency 4.96	The second sec
Ref Level 80.0 Att Input Input 1 Frequency S 70 dBµV 60 dBµV 60 dBµV 50 dBµV 40 dBµV 30 dBµV 20 dBµV 10 dBµV	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL		Fr	equency 4.96	v 500000 GHz • 1Rm Avg 31.81 dBµV
Ref Level 80.0 Att Input Input 1 Frequency S 70 dBµV 60 dBµV 50 dBµV 40 dBµV 30 dBµV 20 dBµV	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL		Fr	equency 4.96	The second sec
Ref Level 80.0 Att Input Input 1 Frequency S 70 dBµV 60 dBµV 60 dBµV 50 dBµV 40 dBµV 30 dBµV 20 dBµV 10 dBµV	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode		SGL		Fr	equency 4.96	v 500000 GHz • 1Rm Avg 31.81 dBµV
Ref Level S0.1 Att Input Input 60 dbµv 60 dbµv 50 dbµv 40 dbµv 30 dbµv 10 dbµv 10 dbµv 10 dbµv 0 dbµv	0 dBµV 0 dB SWT 1 AC PS	● RBW 1.01 ms ● VBW	1 MHz 3 MHz Mode	Auto Sweep	SGL Count 100/100	.0 MHz/	Fr	equency 4.96	v 500000 GHz • 1Rm Avg 31.81 dBµV

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9.7 Test Plot for Conducted Spurious Emission

• BLE _ Low frequency



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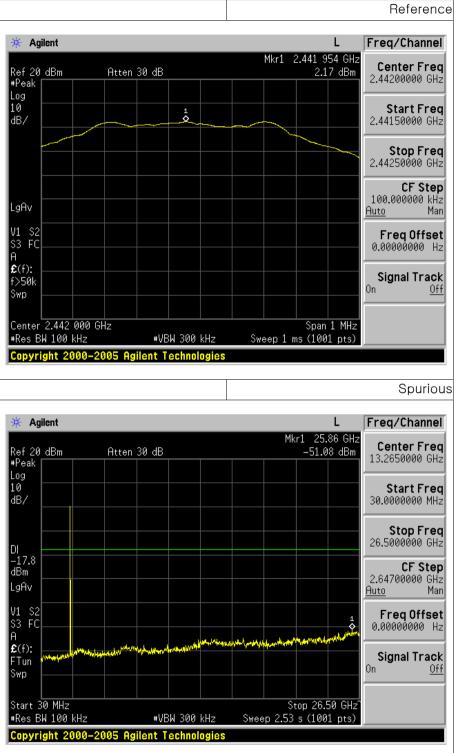


				-
🗧 Agilent			L	Freq/Channe
ef 20 dBm Peak	Atten 30 dB		Mkr1 26.26 GHz -51.33 dBm	Center Fre 13.2650000 GH
og 0 B/				Start Fre 30.0000000 MH
				Stop Fre 26.5000000 GH
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tart 30 MHz Res BW 100 kHz	#VBW 30	00 kHz Swe	Stop 26.50 GHz eep 2.53 s (1001 pts)	

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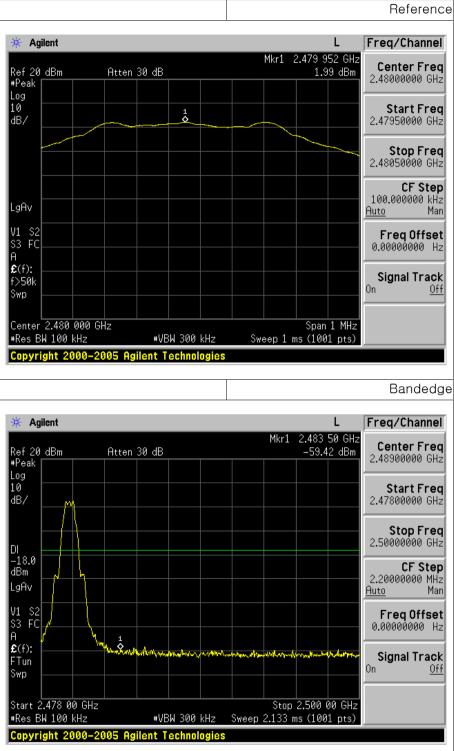
• BLE _ Middle frequency



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BLE _ High frequency



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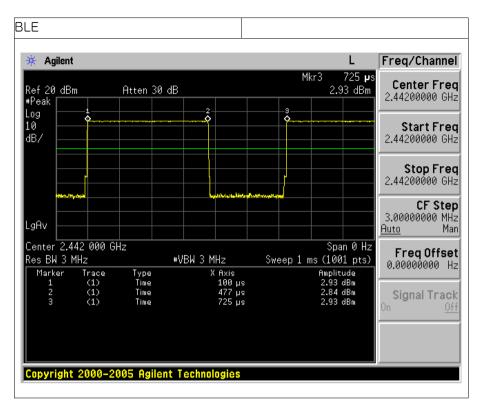


				Spurio
🗧 Agilent			L	Freq/Channe
ef 20 dBm Peak	Atten 30 dB		Mkr1 26.18 GHz -51.01 dBm	Center Fre 13.2650000 GH
og 0 B/				Start Free 30.0000000 MH
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tart 30 MHz Res BW 100 kHz	#VBW 30)0 kHz <u>Swee</u>	Stop 26.50 GHz^ pp 2.53 s (1001 pts)	

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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.

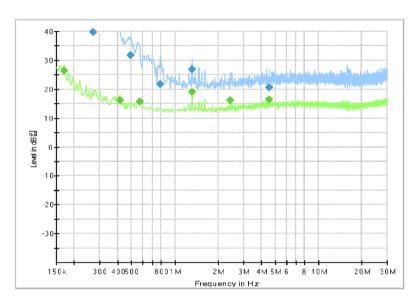
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10.4 Test Result

• AC Line Conducted Emission (Graph)

SP148_Charging Mode_L1

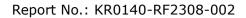


Power Interference

Final_Result

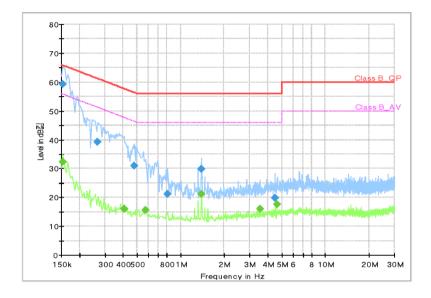
Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter
0.150	54.64		66.00	11.36	9	L1	ON
0.170		26.48	54.96	28.48	9	L1	ON
0.270	39.70		61.12	21.42	9	L1	ON
0.414		16.16	47.57	31.41	9	L1	ON
0.490	31.75		56.17	24.41	9	L1	ON
0.570		15.75	46.00	30.25	9	L1	ON
0.790	21.83		56.00	34.17	9	L1	ON
1.320		19.13	46.00	26.87	9	L1	ON
1.320	26.95		56.00	29.05	9	L1	ON
2.420		16.19	46.00	29.81	9	L1	ON
4.540		16.45	46.00	29.55	9	L1	ON
4.540	20.60		56.00	35.40	9	L1	ON

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SP148_Charging Mode_N



Power Interference

Final_Result

Frequency	QuasiPeak	CAverage	Limit	Margin	Bandwidth	Line	Filter
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dB)	(kHz)		
0.154		32.22	55.78	23.56	9	N	ON
0.154	59.18		65.78	6.60	9	N	ON
0.266	39.13		61.24	22.11	9	N	ON
0.410		16.03	47.65	31.62	9	N	ON
0.478	31.02		56.37	25.36	9	N	ON
0.570		15.56	46.00	30.44	9	N	ON
0.810	21.06		56.00	34.94	9	N	ON
1.390		21.18	46.00	24.82	9	N	ON
1.390	29.93		56.00	26.07	9	N	ON
3.520		16.14	46.00	29.86	9	N	ON
4.470	19.83		56.00	36.17	9	N	ON
4.620		17.68	46.00	28.32	9	N	ON

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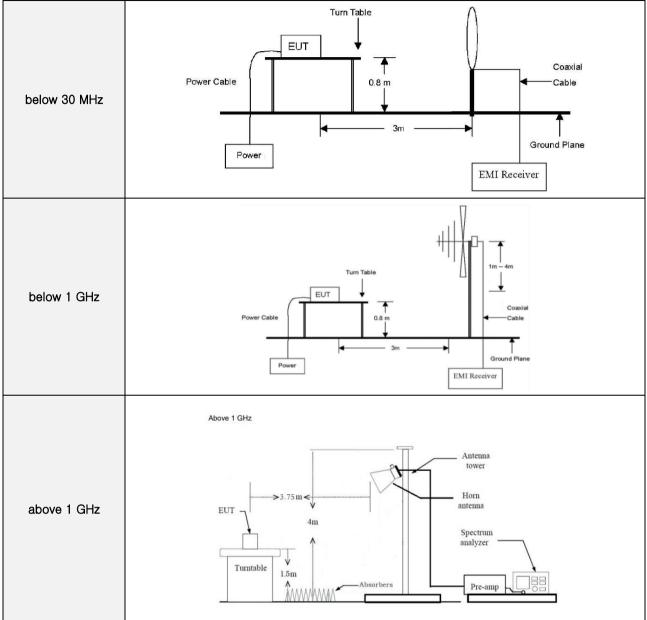
APPENDIX I

TEST SETUP

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Radiated Measurement



• Conducted Measurement

Conducted	EU	т —	Attenuator	Sp An	ectrum alyzer	

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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

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