

Test Report			
1. Client			
• Name: • Address:	SENA TECHNOLOGIES.Inc 19, Heolleung-ro 569-gil, Gangnam-gu, Seoul, Korea		
2. Use of Report	FCC & IC Approval		
3. Sample Descri	ption		
Product Name Model Name :			
4. Date of Receip	ot: 2022-11-15		
5. Date of Test :	2022-11-29 ~ 2022-12-13		
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 :			
The results shown	ust not be reproduced or reproduced in any way. in this test report are the results of testing the samples provided. prepared according to the requirements of ISO / IEC 17025.		
Affirmation	Tested by Technical Manager		
	Yong-Min, Won		
	Dec 29, 2022		
	EMC Labs Co., Ltd.		

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APPENDIX II UNCERTAINTY



<u>Version</u>

TEST REPORT NO.	DATE	DESCRIPTION
KR0140-RF2212-004	Dec 29, 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

Laboratory	EMC Labs Co., Ltd.
Laboratory Address	100, Jangjateo-ro, Hobeop-myeon, Icheon-si, Gyeonggi-do, Republic of 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	S1
Model Name	SP140
FCC ID	S7A-SP140
IC	8154A-SP140
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	0.5 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	43	

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		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 Radia		С	
\square	15.207	RSS-GEN (8.8)	Conducted Emissions AC Lin Conduct		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
ATTENUATOR	ACE RF COMM	ATT SMA 20W 20dB 8GHz	A-0820.SM20.2	2023.04.11
TERMINATIOM	HEWLETT PACKARD	909D	07492	2023.12.14
POWER DIVIDER	HEWLETT PACKARD	11636A	06916	2023.12.14
SLIDE-AC	DAEKWANG TECH	SV-1023	_	2023.11.15
DIGITAL MULTIMETER	HUMANTECHSTORE	15B+	50561541WS	2023.12.14
ACTIVE LOOP ANTENNA	TESEQ	HLA 6121	55685	2024.12.22
Biconilog ANT	Schwarzbeck	VULB 9160	3260	2023.02.03
Biconilog ANT	Schwarzbeck	VULB9168	902	2023.11.30
Horn Ant.	Schwarzbeck	BBHA9120D	974	2023.11.29
Horn Ant.	S/B	BBHA9120D	1497	2023.01.25
Amplifier	TESTEK	TK-PA18H	220104-L	2023.03.17
EMI TEST RECEIVER	ROHDE& SCHWARZ	ESW44	101952	2023.04.07
PROGRAMMABLE DC POWER SUPPLY	ODA	OPE-305Q	oda-01-0923-01831	2023.01.10
DC POWER SUPPLY	AGILENT	E3634A	MY40012120	2023.02.03
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 Chip Antenna. The directional peak gain of the antenna is 0.5 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.

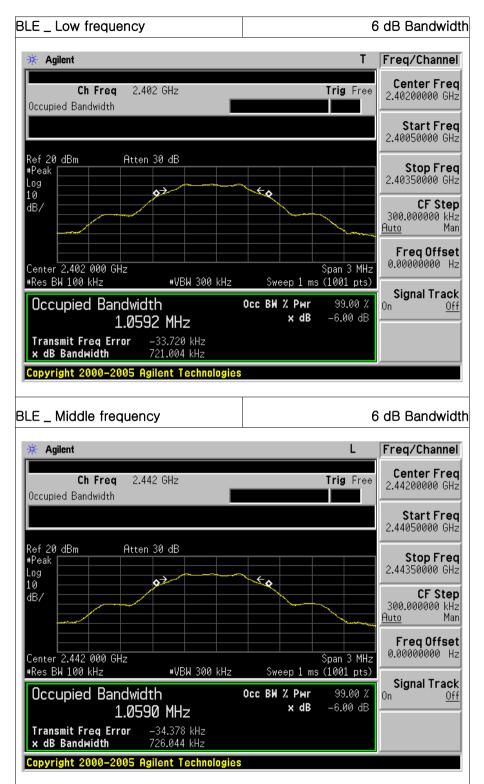
6.4 Test Result

Test Mode	Test Frequency	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)
	Low	0.721	1.044
BLE	Middle	0.726	1.044
	High	0.722	1.043

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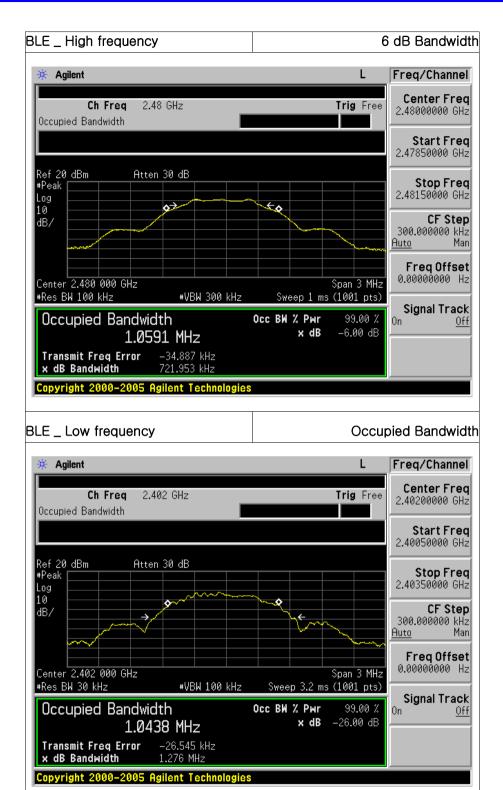


6.5 Test Plot



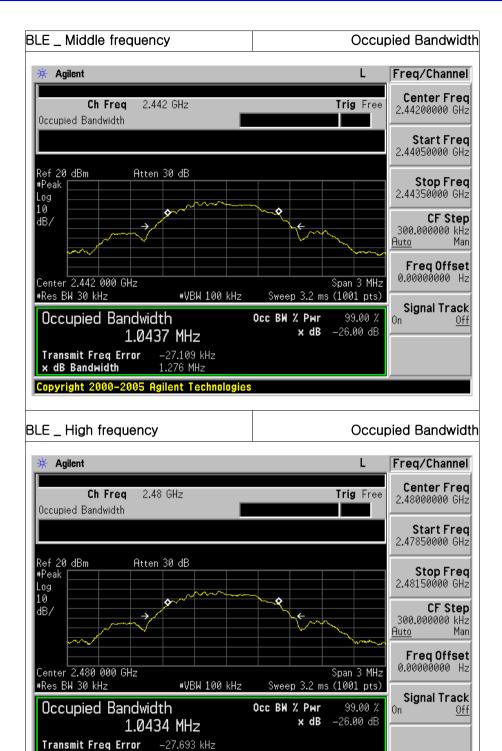
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x dB Bandwidth

Copyright 20

1.276 MHz

Agilent Techn



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

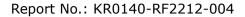
A transmitter antenna terminal of EUT is connected to the input of a spectrum analyzer. Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.

- 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

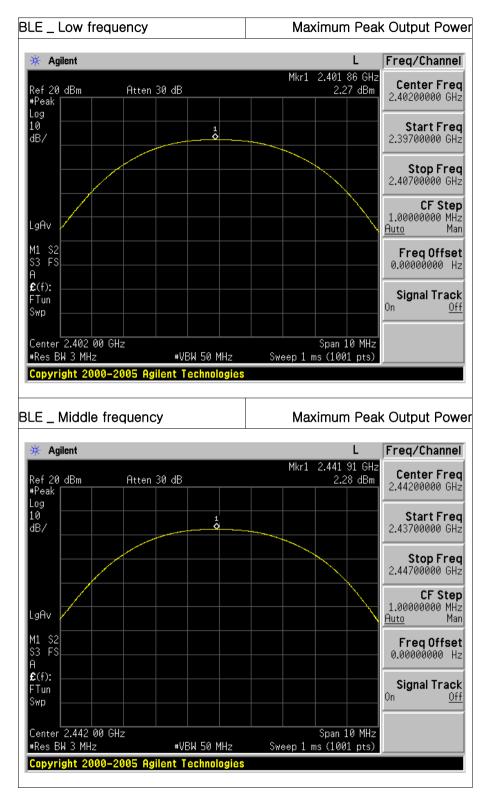
Test Mode	Tost Fraguanay	Peak Out	out Power
Test Mode	Test Frequency	dBm	mW
	Low	2.27	1.69
BLE	Middle	2.28	1.69
	High	2.18	1.65

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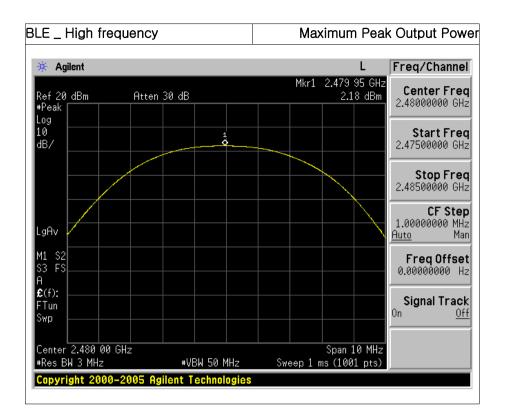


7.5 Test Plot



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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.

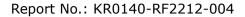
(ANSI C63.10-2013 _ Section 11.10.2 - Method PKPSD)

- 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	-13.11
BLE	Middle	-13.02
	High	-13.22

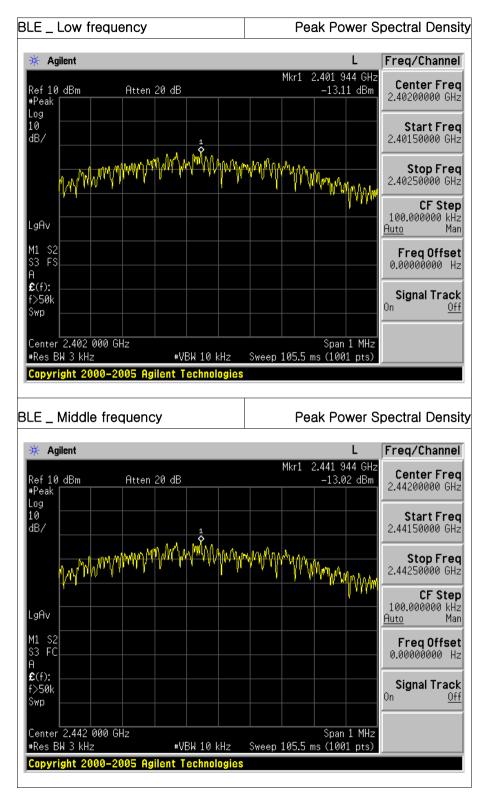
8.4 Test Result

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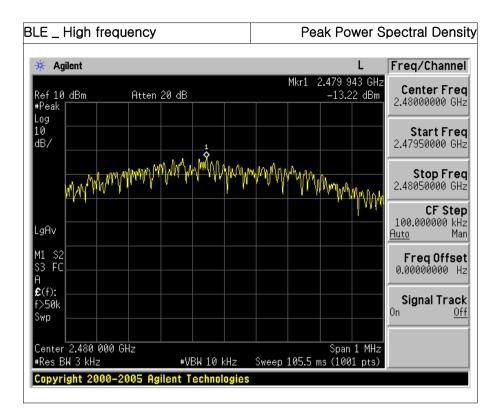


8.5 Test Plot



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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

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 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		Ŧc	0.05	Lin	nits	Re	sult	Mai	rgin						
Frequency	(dBu	V/m)	Pol.	Pol.	Pol.	Pol.	Pol.	Pol.	Pol.	Pol. T.F (dB)	DCF (dB)	(dBuV/m)		(dBuV/m)		(dB)	
(MHz)	AV /	/ Peak	(06)		(00)	AV /	Peak	AV / Peak		AV / Peak							
4 804.14	30.67	41.60	Н	6.24	2.22	54.0	74.0	39.1	47.8	14.9	26.2						

• Middle frequency

Fraguanay	Rea	ding			0.05	Lin	nits	Re	sult	Mai	rgin	
Frequency	(dBu	(dBuV/m)	Pol.	Pol.	T.F (dB)	DCF (dB)	(dBu	IV/m)	(dBu	IV/m)	(d	в)
(MHz)	AV /	/ Peak		(42)	(ub)	AV /	Peak	AV / Peak		AV / Peak		
4 883.73	30.29	40.59	Н	5.98	2.22	54.0	74.0	38.5	46.6	15.5	27.4	

• High frequency

Fraguanay	Rea	ding			0.05	Lin	nits	Re	sult	Mai	rgin
Frequency	(dBuV/m)		Pol.	T.F (dB)	DCF (dB)	(dBu	IV/m)	(dBu	ıV/m)	(d	в)
(MHz)	AV /	/ Peak	(dB)			AV /	Peak	AV / Peak		AV / Peak	
4 960.04	29.34	40.73	Н	6.15	2.22	54.0	74.0	37.7	46.9	16.3	27.1

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: DCF(Duty Cycle Factor)

- T_{on} = 0.375 ms / T_{off} = 0.250 ms

- Duty Cycle = T_{on} / (T_{on}+T_{off}) = 0.375 / (0.375+0.250) = 0.625

- DCF = $10 \times \log(1/\text{Duty Cycle}) dB = 10 \times \log(1/0.625) dB = 2.22 dB$

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

								Spuriou	5 - Fe
	Spectrum								
Ref Level 87.0 Att Input	10 dB SWT 10 dB SWT 1 AC PS	RB 1.01 ms VB Off Not	W 1 MHz N 3 MHz Mode ach Off	Auto Sweep			Fr	requency 4.80	040000 GH
Frequency Sv	weep							M1[1]	 1Pk Max 41.60 dBj
0 dBµV								4	80414000 GI
0 dBµV									
0 dBµV									
0 dBµV									
) dBµV					M1 T				
Marth Martha Martha	www.autralityd	nupertien	in milan malen alan	and the second second	and and a strandy	manhalananga	mannon	Maunhann	manner
0 dBµV									
0 dBµV									
dust-									
) dBμV									
dBµV									
10 dBµV									
F 4.804 GHz			1001 pt	s	1	.0 MHz/			Span 10.0 M⊦
							Spi	urious –	Avera
							Spi	urious –	Avera
							Spi	urious –	_
Ref Level 87.0	Spectrum	- RB	₩ 1 MHz		SGL				
Ref Level 87.0 Att Input	10 dBµV 10 dB SWT 1 AC PS	● RB 1.01 ms ● VB Off Not	W 1.MHz W 3.MHz Mode Ch Off	e Auto Sweep	SGL Count 100/100			urious — requency 4.84	040000 GF
Ref Level 87.0 Att Input Frequency Sy	10 dBµV 10 dB SWT 1 AC PS	e BB 1.01 ms e VB Off Not	W 1 MHz W 3 MHz Mode ch Off	a Auto Sweep	SGL Count 100/100			requency 4.8 (040000 Gł 1Rm Avg 30.67 dbj
Ref Level 87.0 Att Input Frequency St	10 dBµV 10 dB SWT 1 AC PS	* RB 1.01 ms * VB Off Not	W 1 MHz W 3 MHz Mode ch Off	e Auto Sweep	SGL Count 100/100			requency 4.8 (040000 Gł 1Rm Avg 30.67 dbj
Ref Level 87.0 Att Input Frequency Sy 0 dBµV	10 dBµV 10 dB SWT 1 AC PS	• R8 1.01 ms = V8V Off Not	W 1 MHz W 3 MHz Mode ch Off	Auto Sweep	SGL Count 100/100			requency 4.8 (040000 Gł 1Rm Avg 30.67 dbj
Ref Level 87.0 Att Input Frequency SV 0 dBµV 0 dBµV	10 dBµV 10 dB SWT 1 AC PS	• B8 1.01 ms • #V8 Off Not	W 1 MHz 3 MHz Mode ch Off	Auto Sweep	SGL Count 100/100			requency 4.8 (040000 Gł 1Rm Avg 30.67 dbj
Ref Level 37.0 Att Input Frequency St 0 dBµV 0 dBµV	10 dBµV 10 dB SWT 1 AC PS	e RB 1.01 ms # VB Off Not	W 1 MHz W 3 MHz Mode ch Off	Auto Sweep	SGL Count 100/100			requency 4.8 (040000 Gł 1Rm Avg 30.67 dbj
Ref Level 37.0 Att Input Input Irrequency St 0 dBµV 0 dBµV 0 dBµV	10 dBµV 10 dB SWT 1 AC PS	* RB 1.01 ms * VB Off Not	W 1 MHz W 3 MHz Mode ch Off	Auto Sweep	SGL Count 100/100			requency 4.8 (
Ref Level 37.0 Att Input Input 0 dBµV 0 dBµV 0 dBµV 0 dBµV	10 dBµV 10 dB SWT 1 AC PS	• B8 1.01 ms + VB Off Not	W 1 MHz W 3 MHz Mode	Auto Sweep	SGL Count 100/100			requency 4.8 (040000 Gł 1Rm Avg 30.67 dbj
Ref Level 97.0 Att Input ifrequency St 0 d8µV 0 d8µV 0 d8µV 0 d8µV 0 d8µV 0 d8µV	10 dBµV 10 dB SWT 1 AC PS	0ff Not	W 1 MHz W 3 MHz Mode	e Auto Sweep	SGL Count 100/100			requency 4.8 (040000 Gł 1Rm Avg 30.67 dbj
Ref Level 87.0 Att Input Frequency St 0 dbpv	10 dBµV 10 dB SWT 1 AC PS		W 1 MHz 3 MHz Mode ch Off	Auto Sweep	SGL Count 100/100			requency 4.8 (040000 Gł 1Rm Avg 30.67 dbj
Ref Level 87.0 Att Input Frequency St 0 dbpv	10 dBµV 10 dB SWT 1 AC PS		W 1 MHz Mode	Auto Sweep	SGL Count 100/100			requency 4.8 (040000 Gł 1Rm Avg 30.67 dbj
Ref Level 87.0.0 Att Input Director 0 dBµv	10 dBµV 10 dB SWT 1 AC PS	e RB	W 1 MHz W 3 MHz Mode Off	Auto Sweep	SGL Count 100/100			requency 4.8 (040000 Gł 1Rm Avg 30.67 dbj
Ref Level 87.0 Att Input Frequency SX 0 d8µv	10 dBµV 10 dB SWT 1 AC PS	RBB 1.01 ms = VB Off Not	W 1 MHz W 3 MHz Mode Off	Auto Sweep	SGL Count 100/100			requency 4.8 (040000 Gł 1Rm Avg 30.67 dbj
Ref Level 87.0 Att Input Frequency SX 0 dbµv	10 dBµV 10 dB SWT 1 AC PS		W 1 MHz Mode Off Off	e Auto Sweep	SGL Count 100/100			requency 4.8 (040000 Gł 1Rm Avg 30.67 dbj
Multiview B Ref Level 87.0 Att Input Frequency S 0 d8µv 0 10 d8µv F 4.804 GHz	10 dBµV 10 dB SWT 1 AC PS		W 1 MHz 3 MHz Mode Off	a A A A A A A A A A A A A A A A A A A A		.0 MHz/		equency 4.8(040000 Gł 1Rm Avg 30.67 dbj

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• BLE _ Middle frequency

tef Level 87.00 dBµV	trum	RBW 1 MHz					
Att 10 dB	SWT 1.01 ms 🖷	VBW 3 MHz Mode Notch Off	Auto Sweep		Fr	equency 4.8	3840000 GH
						M1[1]	40.59 dBj 4.88373000 GF
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dBµV							
dBµV							
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			M1				
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dBµV							
dBµV							1
IBµV							
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dBµV							
4.884 GHz	I	1001 pts	I	1.0 MHz/			Span 10.0 M
					Spi	irious -	- Avera
					Spu	irious -	- Avera
					Spi	irious -	- Avera
ultiView 🕬 Spe	trum				Spu	irious -	- Avera
of Level 87.00 dBuV	swi 101 ms •	RBW 11MHz VEW 31MHz Mode	Auto Sween Coun	100/100			7
ef Level 87.00 dBµV tt 10 dB put 1 AC	_	RBW 1 MHz VBW 3 MHz Voth Off	Auto Sweep Coun	t 100/100		equency 4.8	3840000 GH
ef Level 87.00 dBµV tt 10 dB put 1 AC requency Sweep	_	RBW 1 MHz VBW 3 MHz Notch Off	Auto Sweep Coun	t 100/100		equency 4.8	• 1Rm Ave 30,29 dB
ef Level 87.00 dBµV tt 10 dB put 1 AC requency Sweep	_	RBW 1 MHz VBW 3 MHz Notch Off	Auto Sweep Coun	t 100/100		equency 4.8	• 1Rm Ave 30,29 dB
st Level 87.00 dBµV t 10 dB put 1 AC requency Sweep	_	RBW 1 MHz VBW 3 MHz Mode Notch Off	Auto Sweep Coun	t 100/100		equency 4.8	• 1Rm Ave 30,29 dB
af Level 87.00 dBµV t 10 dB put 1 AC requency Sweep iвµV	_	RBW 1 MHz VBW 3 MHz Mode Notch Off	SGL Auto Sweep Coun	t 100/100		equency 4.8	▼ 3840000 GH • 18m Avg 30,29 dB
9f Level 87.00 dBµV tt 10 dB put 1 AC requency Sweep dBµV	_	RBW 1 MHz VBW 3 MHz Mode Notch Off	Auto Sweep Coun	t 100/100		equency 4.8	▼ 3840000 GH • 18m Avg 30,29 dB
ef Level 87.00 dBμV t 10 dB put 1 AC requency Sweep JBμV JBμV JBμV	_	RBW 1 MHz VBW 3 MHz Mode Notch Off	Auto Sweep Coun	t 100/100		equency 4.8	▼ 3840000 GH • 18m Avg 30,29 dB
ft Level 87.00 dBµ/t 10 dB put 10 dB put 1 AC rèquency Sweep	_	RBW 1 MHz VBW 3 NHz Mode Notch Off	Auto Sweep Coun	t 100/100		equency 4.8	• 1Rm Ave 30,29 dB
ft Level 87.00 dBµ/t 10 dB put 10 dB put 1 AC rèquency Sweep	_	RBW 1 MHz VSW 3 MHz Mode Off	Auto Sweep Coun	t 100/100		equency 4.8	▼ 3840000 GH • 18m Avg 30,29 dB
fl Level 87.00 dBµV 10 dB put 10 dB put 1AC requency Sweep 38µV 38µV 38µV 38µV 38µV 38µV 38µV 38µV 38µV 38µV 38µV	_	RBW 1MHz VBW 3MHz Mode Notch Off	Auto Sweep Coun	t 100/100		equency 4.8	▼ 3840000 GH • 18m Avg 30,29 dB
fl Level 87.00 dBµV 10 dB put 10 dB put 1AC requency Sweep 38µV 38µV 38µV 38µV 38µV 38µV 38µV 38µV 38µV 38µV 38µV	_	RBW 1 MHz VEW 3 MHz Mode Notch Off	Auto Sweep Coun	E 100/100		equency 4.8	▼ 3840000 GH • 18m Avg 30,29 dB
ft Level 87.00 dBµV 00 dB put 10 dB put 1 AC requency Sweep 38µV J8µV 38µV J8µV 38µV J8µV 38µV J8µV 38µV J8µV 38µV J8µV 38µV	_	RBW 1 MHz VEW 3 MHz Mode Notch Off	Auto Sweep Coun	E 100/100		equency 4.8	- Avera
ft Level 87.00 dBµ/v 10 dB put 10 dB put 1 AC requency Sweep dBµ/v	_	RBW 1 MHz VEW 3 MHz Mode Notch Off	Auto Sweep Coun	t 100/100		equency 4.8	▼ 3840000 GH • 18m Avg 30,29 dB
ft Level 87.00 dBµ/v jo dB put 10 dB put 1 AC requency Sweep JBµ/v	_	RBW 1 MHz VEW 3 MHz Mode Notch Off	Auto Sweep Coun	E 100/100		equency 4.8	▼ 3840000 GH • 18m Avg 30,29 dB
f Level 87.00 dBµV 10 dB 10 dB 10 dB tput 1 AC requency Sweep 48µV dBµV 48µV	_	RBW 1 MHz VEW 3 MHz Mode Notch Off	Auto Sweep Coun	E 100/100		equency 4.8	▼ 3840000 GH • 18m Avg 30,29 dB
ef Level 87.00 dBuV	_	RBW 1 MHz VEW 3 MHz Mode Notch Off	Auto Sweep Coun	E 100/100		equency 4.8	▼ 3840000 GH • 18m Avg 30,29 dB

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• BLE _ High frequency

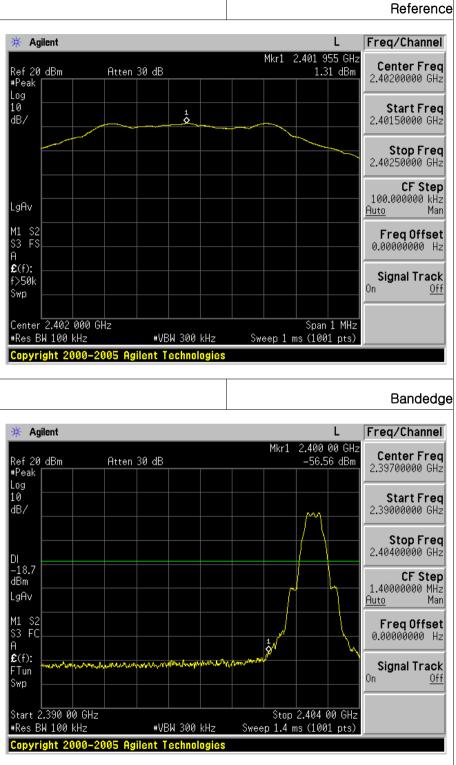
1ultiView 😑									
tef Level 87.00 tt nput	10 dB SWT 1 AC PS	● RBV 1.01 ms ● VBV Off Note	V 1 MHz V 3 MHz Mode ch Off	Auto Sweep			Fr	equency 4	.9600000 GH
Frequency Sw	veep							M1[1]	• 1Pk Max 40.73 dBµ
dBµV									4.96004000 GH
dBµV									
dBµV									
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4.90 GHz			1001 pts	3			Spu	irious	– Avera
4.96 GHz			1001 pts	<u></u>			Spi	irious	– Avera
ultiView 8	D dBuV	• RBV	V 1 MHz		SGL				V
ultiView 33 af Level 87.00 tt put	0 dBµV 10 dB SWT 1 AC PS	• RBV 1.01 ms • VEW Off Note	V 1 MHz						_⊽ .9600000 GH
IltiView ES f Level 87.00 tt put requency Sw	0 dBµV 10 dB SWT 1 AC PS	■ RBW 1.01 ms ● VBW Off Note	V 1 MHz		SGL				.9600000 GH ●1Rm Avg 29,34 dBp
IltiView ES f Level 87.00 tt put requency Sw	0 dBµV 10 dB SWT 1 AC PS	e RBM 1.01 ms + VBW Off Note	V 1 MHz		SGL			equency 4.	.9600000 GH ●1Rm Avg 29,34 dBp
ultiView S of Lovel 87.00 tt pput requency Sw d8µV	0 dBµV 10 dB SWT 1 AC PS	• RBW 1.01 ms = VBW Off Note	V 1 MHz		SGL			equency 4.	- Avera 9600000 GH 18/0 AV 29.34 dbp 4.95995000 GH
altiView est of Lovel 87.00 t put requency Sw J8µV	0 dBµV 10 dB SWT 1 AC PS	e RBW 1.01 ms = VBW Off Note	V 1 MHz		SGL			equency 4.	.9600000 GH ●1Rm Avg 29,34 dBp
ultiView РЭ of Level 87.00 t тациенску бу лвµv лвµv лвµv лвµv	0 dBµV 10 dB SWT 1 AC PS	.01 ms € VBW Off Note	V 1 MHz		SGL			equency 4.	.9600000 GH ●1Rm Avg 29,34 dBp
ultiView РЭ of Level 87.00 t тациенску бу лвµv лвµv лвµv лвµv	0 dBµV 10 dB SWT 1 AC PS	e RBW 1.01 ms = VBW Off Not	V 1 MHz		SGL			equency 4.	.9600000 GH ●1Rm Avg 29,34 dBp
altiView # of Level 87.00 # t put requency Sw # ##µv # ##µv # ##µv # ##µv #	0 dBµV 10 dB SWT 1 AC PS	• RB4 1.01 ms • VBW Off Note	V 1 MHz		SGL			equency 4.	.9600000 GH ●1Rm Avg 29,34 dBp
ultiView == of Level 87.00 t put requency SX I8µv I8µv I8µv I8µv I8µv	0 dBµV 10 dB SWT 1 AC PS	* RBV 1.01 ms * VBV Off Not	V 1 MHz		SGL			equency 4.	.9600000 GH ●1Rm Avg 29,34 dBp
ultiView == of Level 87.00 t put requency SX I8µv I8µv I8µv I8µv I8µv	0 dBµV 10 dB SWT 1 AC PS	• RBW 1.01 ms • VBW Off Note	V 1 MHz	Auto Sweep	SGL			equency 4.	.9600000 GH ●1Rm Avg 29,34 dBp
altiView РЭ af Level 87.000 Р transferred В transferred В tbµv В	0 dBµV 10 dB SWT 1 AC PS	• RBW 1.01 ms = VBW Off Not	V 1 MHz	Auto Sweep	SGL			equency 4.	.9600000 GH ●1Rm Avg 29,34 dBp
altiView В of Level В7.00 tt put requirincy SW лвµv В лвµv В	0 dBµV 10 dB SWT 1 AC PS	0 RBW Off Not	v 1 MHz	Auto Sweep	SGL			equency 4.	.9600000 GH ●1Rm Avg 29,34 dBp
altiView В of Level В7.00 tt put requirincy SW лвµv В лвµv В	0 dBµV 10 dB SWT 1 AC PS	I.01 ms = VBW Off Not	v 1 MHz	Auto Sweep	SGL			equency 4.	.9600000 GH ●1Rm Avg 29,34 dBp
ultiView E3 of Lovel 87.00 tt pput requency Sw d8µV	0 dBµV 10 dB SWT 1 AC PS	I.01 ms # VBW Off Not	v 1 MHz	Auto Sweep	SGL			equency 4.	.9600000 GH ●1Rm Avg 29,34 dBp

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9.7 Test Plot for Conducted Spurious Emission

• BLE _ Low frequency



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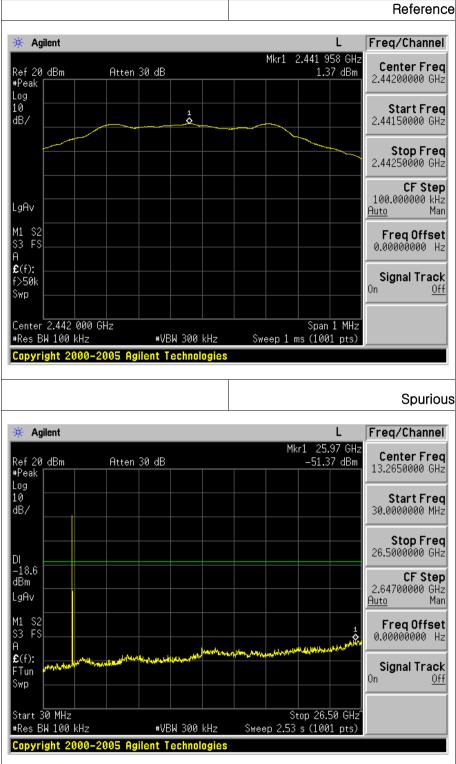


Agilent			1	Freq/Channe
ef 20 dBm	Atten 30 dB		– Mkr1 25.92 GHz –51.12 dBm	Center Fre
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(f): Tun chaudeale and the series	en un part of the Adaption of the Andrews	han the second	ner and the state of the second sec	Signal Trac
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tart 30 MHz				
cart 30 MHZ Res BW 100 kHz	#URU	300 kHz Sv	otup 20.50 GH2 weep 2.53 s (1001 pts)	

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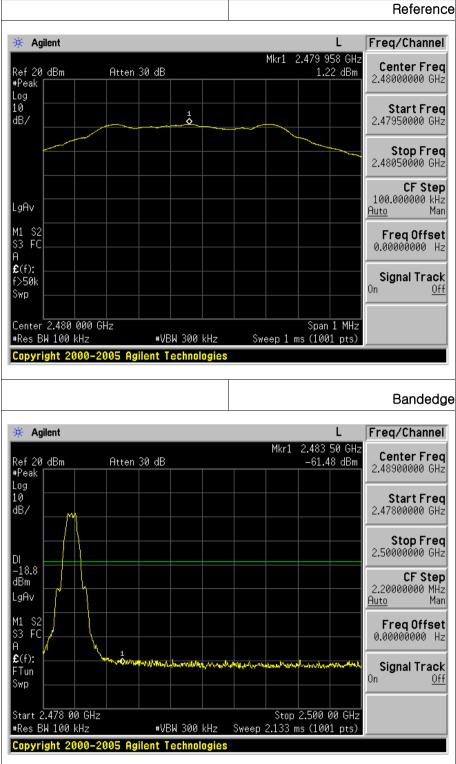
BLE _ Middle frequency



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BLE _ High frequency



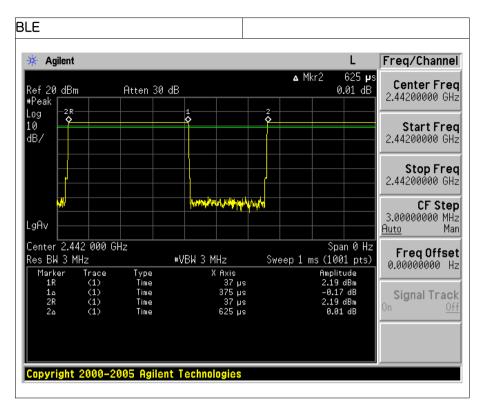
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K Agilent								L	Freq/Channe
ef 20 dBm Peak	Atten	30 dB				Mk		.24 GHz '7 dBm	Center Fred 13.2650000 GH:
og Ø B/									Start Fred 30.0000000 MH;
									Stop Fred 26.5000000 GH:
18.8 Bm gAv									CF Step 2.64700000 GH: <u>Auto</u> Mar
11 S2 3 FS					likt oct		h substants	1	Freq Offse 0.00000000 H:
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tart 30 MHz Res BW 100 k			W 300		<u> </u>	St p 2.53		50 GHz^	



9.8 Test Plot for Duty Cycle





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.

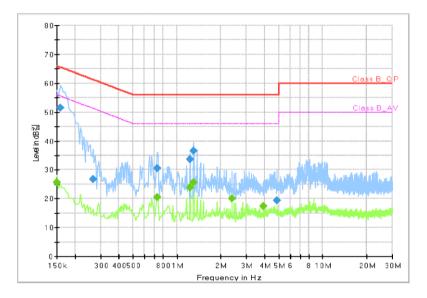
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10.4 Test Result

• AC Line Conducted Emission (Graph)

SP140_Charging Mode_L1

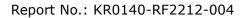


Conducted Emission

Final Result

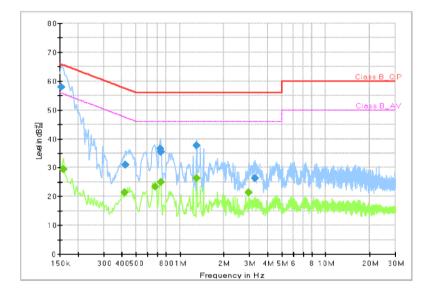
Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.150		25.61	56.00	30.39	9	L1	19.7
0.158	51.42		65.57	14.15	9	L1	19.8
0.266	26.77		61.24	34.47	9	L1	19.6
0.730		20.59	46.00	25.41	9	L1	19.8
0.730	30.51		56.00	25.49	9	L1	19.8
1.230		23.85	46.00	22.15	9	L1	19.7
1.230	33.57		56.00	22.43	9	L1	19.7
1.300		25.68	46.00	20.32	9	L1	19.7
1.300	36.59		56.00	19.41	9	L1	19.7
2.390		20.07	46.00	25.93	9	L1	19.7
3.910		17.45	46.00	28.55	9	L1	19.7
4.850	19.33		56.00	36.67	9	L1	19.7

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SP140_Charging Mode_N



Conducted Emission

Final	_Result

Frequency	QuasiPeak	CAverage	Limit	Margin	Bandwidth	Line	Corr.
(MHz)	(dBµV)	(dBµV)	(dBµV)	(dB)	(kHz)		(dB)
0.154	57.98		65.78	7.80	9	N	19.7
0.158		29.48	55.57	26.09	9	N	19.8
0.418		21.37	47.49	26.12	9	N	19.8
0.422	30.89		57.41	26.52	9	N	19.8
0.680		23.34	46.00	22.66	9	N	19.8
0.730	36.54		56.00	19.46	9	N	19.8
0.740	35.41		56.00	20.59	9	N	19.8
0.740		24.89	46.00	21.11	9	N	19.8
1.300	37.61		56.00	18.39	9	N	19.7
1.300		26.39	46.00	19.61	9	N	19.7
2.970		21.46	46.00	24.54	9	N	19.6
3.260	26.35		56.00	29.65	9	N	19.7

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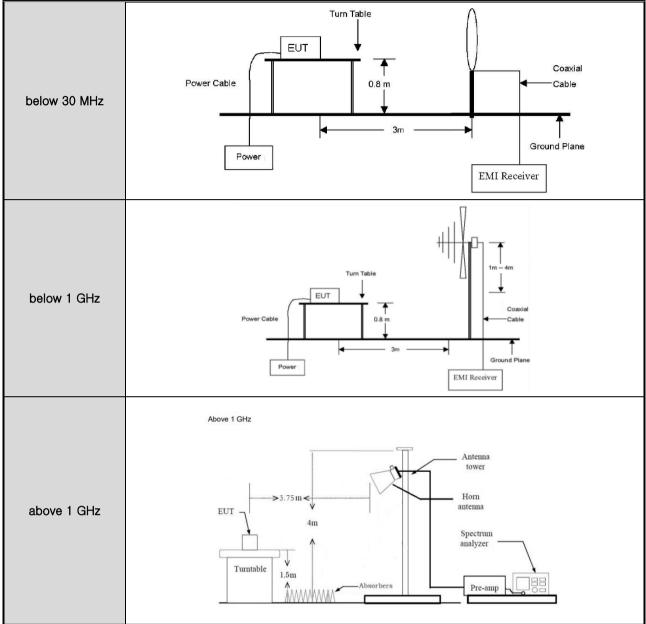
APPENDIX I

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