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**SENA**

Dates of Tests: August 01 ~ 05, 2011  
 Test Report S/N: LR500111108A  
 Test Site : LTA CO., LTD.

**CLASS II PERMISSIVE CHANGE TEST REPORT**

FCC ID  
 IC  
 APPLICANT

**S7A-SP01**  
**8154A-SP01**  
**Sena Technologies, Inc.**

**Equipment Class** : **Part 15 Spread Spectrum Transmitter (DSS)**  
**Manufacturing Description** : **Bluetooth Stereo Motorcycle Headset**  
**Manufacturer** : **Sena Technologies, Inc.**  
**Model name** : **SPH10**  
**Test Device Serial No.:** : **Identical prototype**  
**Rule Part(s)** : **FCC Part 15.247 Subpart C; ANSI C-63.4-2003**  
**RSS-210 and ISSUE No. :8 Date :2010**  
**Frequency Range** : **2402 ~ 2480MHz**  
**RF power** : **Max 11.47dBm - Conducted**  
**Data of issue** : **August 09, 2011**

This test report is issued under the authority of:

The test was supervised by:

Hyun-Chae You, Manager

Ki-Hun Cho, Test Engineer

**This test result only responds to the tested sample. It is not allowed to copy this report even partly without the allowance of the test laboratory. The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.**



NVLAP LAB Code.: 200723-0

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## TABLE OF CONTENTS

1. GENERAL INFORMATION'S .....	3
2. INFORMATION'S ABOUT TEST ITEM .....	4
3. TEST REPORT .....	5
3.1 SUMMARY OF TESTS .....	5
3.2 TECHNICAL CHARACTERISTICS TEST .....	6
3.2.1 BAND – EDGE & SPURIOUS .....	6
3.2.2 FIELD STRENGTH OF HARMONICS-Transmitter .....	9
3.2.3 FIELD STRENGTH OF HARMONICS-Receiver .....	12
3.2.4 AC CONDUCTED EMISSIONS .....	14
<b>APPENDIX</b>	
APPENDIX TEST EQUIPMENT USED FOR TESTS .....	17

## 1. General information's

### 1-1 Test Performed

Company name : LTA Co., Ltd.  
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Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the “General requirements for the competents of calibration and testing laboratory”.

### 1-2 Accredited agencies

LTA Co., Ltd. is approved to perform EMC testing by the following agencies:

Agency	Country	Accreditation No.	Validity	Reference
NVLAP	U.S.A	200723-0	2011-09-30	ECT accredited Lab.
KCC	KOREA	KR0049	2013-04-24	EMC accredited Lab.
FCC	U.S.A	610755	2014-04-27	FCC filing
FCC	U.S.A	649054	2013-04-13	FCC CAB
VCCI	JAPAN	R2133(10m), C2307	2014-06-21	VCCI registration
VCCI	JAPAN	T-2009	2013-12-23	VCCI registration
IC	CANADA	IC5799	2012-05-14	IC filing

## 2. Information's about test item

### 2-1 Client & Manufacturer

Company name : Sena Technologies, Inc.  
 Address : 210 Yangjae-dong Seocho-gu Seoul 137-130 Korea  
 Telephone / Facsimile : +82-2-571-8283/ +82-2-573-7710

### 2-2 Equipment Under Test (EUT)

Trade name : Bluetooth Stereo Motorcycle Headset  
 Model name : SPH10  
 Serial number : Identical prototype  
 Date of receipt : July 27, 2011  
 EUT condition : Pre-production, not damaged  
 Antenna type : PCB pattern antenna (M/N: SENA\_D02) Max Gain 0.2 dBi  
 Frequency Range : 2402 ~ 2480MHz  
 RF output power : Max. 11.47dBm - Conducted  
 Number of channels : 79  
 Duty cycle : 80.90 %  
 Channel spacing : 1MHz  
 Channel Access Protocol : Frequency Hopping Spread Spectrum (FHSS)  
 Type of Modulation : Basic Mode(GFSK), EDR Mode(Pi/4 DQPSK, 8DPSK)  
 Power Source : 3.7 Vdc from Internal Battery (Li-Ion Polymer Battery)  
 Firmware Version : V1.0.0

### 2-4 Tested frequency

	LOW	MID	HIGH
Frequency (MHz)	2402	2441	2480

### 2-5 Ancillary Equipment

Equipment	Model No.	Serial No.	Manufacturer
-	-	-	-

### 2-6 Model Descripton

Model No.	SPH10
Basic ANT	Chip Antenna (SENA_009), Max Gain: 0.5dBi
ADD ANT	Pattern Antenna(SENA_D02), Max Gain : 0.2dBi

### 3. Test Report

#### 3.1 Summary of tests

FCC Part Section(s)	Parameter	Limit	Test Condition	Status (note 1)
15.247(a)	Carrier Frequency Separation	> 25 kHz	Conducted	NA <sup>note4</sup>
15.247(a)	Number of Hopping Frequencies	> 15 hops		NA <sup>note4</sup>
15.247(a)	20 dB Bandwidth 99% Bandwidth	> 1.5 MHz		NA <sup>note4</sup>
15.247	Dwell Time	< 0.4 seconds		NA <sup>note4</sup>
15.247(b)	Transmitter Output Power	< 250 mWatt		NA <sup>note4</sup>
15.247(d)	Conducted Spurious emission	> 20 dBc		NA <sup>note4</sup>
15.247(d)	Band Edge	> 20 dBc		C
15.249 / 15.209	Field Strength of Harmonics	< 54 dBuV (at 3m)	Radiated	C
15.109	Field Strength	-		C
15.207 /15.107	AC Conducted Emissions	EN 55022	Line Conducted	C
15.203	Antenna requirement	-	-	C

Note 1: C=Complies NC=Not Complies NT=Not Tested NA=Not Applicable

Note 2: The data in this test report are traceable to the national or international standards.

Note 3: This device is only operated by DC

Note 4: Class II permissive change

#### Note 1: Antenna Requirement

→ The Sena Technologies, Inc. SPH10 unit complies with the requirement of §15.203.

The antenna type is the PCB Pattern antenna

**Note 2:** The sample was tested according to the following specification:

FCC Parts 15.247; ANSI C-63.4-2003

RSS-210 and ISSUE No.: 8 Date: 2010

## 3.2 Transmitter requirements

### 3.2.6 Band Edge

#### Procedure:

The bandwidth at 20dB down from the highest inband spectral density is measured with a spectrum analyzer connected to the antenna terminal, while EUT had its hopping function disabled at the highest, middle and the lowest available channels.

After the trace being stable, Use the marker-to-peak function to measure 20 dB down both sides of the intentional emission.

The spectrum analyzer is set to:

Center frequency = the highest, middle and the lowest channels

RBW = 100 kHz

VBW = 100 kHz

Span = 10~30 MHz

Detector function = peak

Trace = max hold

Sweep = auto

#### Measurement Data: Complies

- All conducted emission in any 100kHz bandwidth outside of the spread spectrum band was at least 20dB lower than the highest inband spectral density. Therefore the applying equipment meets the requirement.
- See next pages for actual measured spectrum plots.

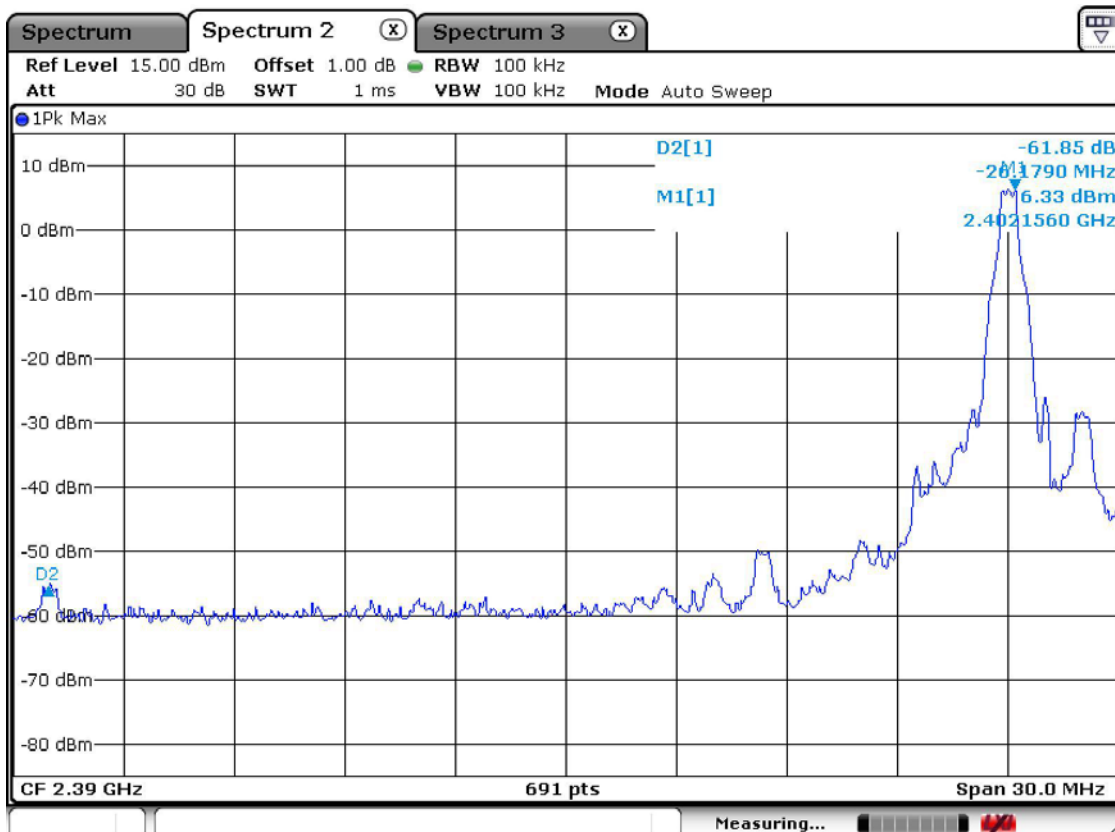
<b>Minimum Standard:</b>	> 20 dBc
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#### Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

**Band – edge**

**Lower edge**



**Upper edge**



**Band-edges in the restricted band 2310-2390 MHz measurement**

Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak			Antenna	Amp. Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
2376.0	44.6	55.9	H	25.4	37.1	4.0	54.0	74.0	36.9	48.2	17.2	25.9

**Band-edges in the restricted band 2483.5-2500 MHz measurement**

Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak			Antenna	Amp. Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
2483.5	49.7	61.2	H	25.4	37.1	4.0	54.0	74.0	42.0	53.5	12.1	20.6

**Note : This EUT was tested in 3 orthogonal positions and the worst-case data was presented.**



### 3.2.1 Field Strength of Harmonics - Transmitter

#### Procedure:

The EUT was placed on a 0.8m high wooden table inside a shielded enclosure. An antenna was placed near the EUT and measurements of frequencies and amplitudes of field strengths were recorded for reference during final measurements. For final radiated testing, measurements were performed in OATS. Measurements were performed with the EUT oriented in 3 orthogonal axis and rotated 360 degrees to determine worst-case orientation for maximum emissions. In case of the air temperature of the test site is out of the range is 10 to 40°C before the testing proceeds the warm-up time of EUT maintain adequately

#### The spectrum analyzer is set to:

Center frequency = the worst channel

Frequency Range = 30 MHz ~ 10<sup>th</sup> harmonic.

RBW = 100 kHz ( 30MHz ~ 1 GHz)

= 1 MHz (1 GHz ~ 10<sup>th</sup> harmonic )

Span = 100 MHz

Trace = max hold

Peak:VBW  $\geq$  RBW

Average:VBW=10Hz

Detector function = Peak and Average

Sweep = auto

#### Measurement Data: Complies

- Refer to the next page.
- No other emissions were detected at a level greater than 20dB below limit.

#### Minimum Standard: FCC Part 15.209(a)

Frequency (MHz)	Limit (uV/m) @ 3m
30 ~ 88	100 **
88 ~ 216	150 **
216 ~ 960	200 **
Above 960	500

\*\* 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, 76-88MHz, 174-216MHz or 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

## Measurement Data:

Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor			D.C.F	Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak			Antenna	Amp.Gain	Cable		AV/Peak		AV/Peak		AV / Peak	
4804.00	47.7	55.4	H	31.4	36.5	5.7	-30.33	54.0	74.0	18.0	25.7	36.0	48.3
4882.0	47.1	54.3	H	31.4	36.5	5.7	-30.33	54.0	74.0	17.4	24.6	36.6	49.4
4960.2	51.6	58.8	H	31.4	36.5	5.7	-30.33	54.0	74.0	21.9	29.1	32.1	44.9

- No other emissions were detected at a level greater than 20dB below limit.

- D.C.F ( Duty Cycle Correction Factor) =  $20\log(\text{The worst Case DWELL Time}/100\text{ms})$

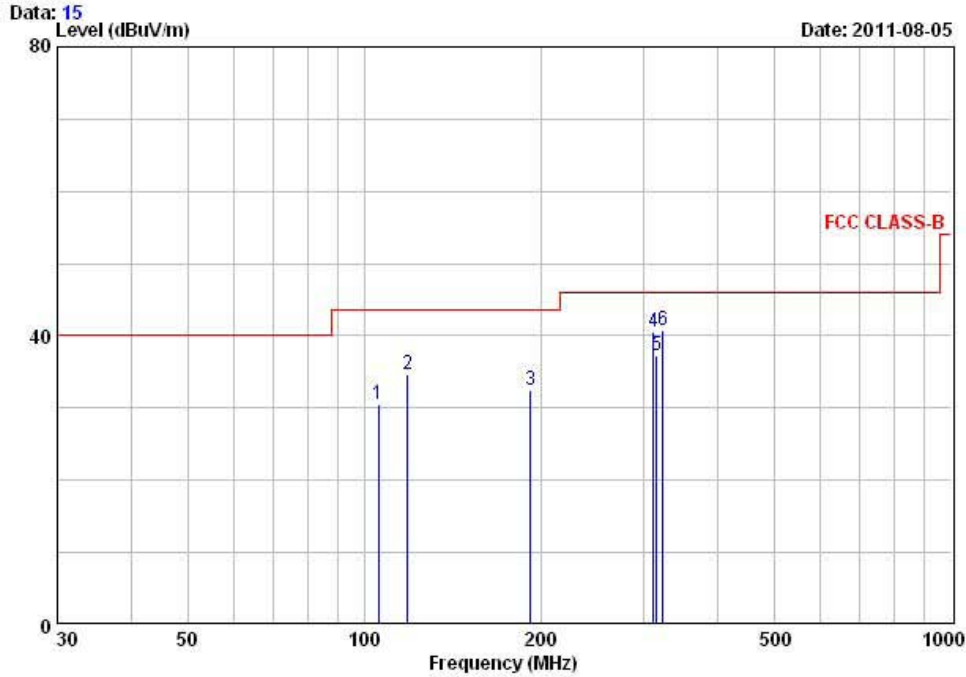
$$= 20\log(3.043\text{ms}/100\text{ms}) = -30.33$$

**Radiated Emissions – Charging + BT**



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EUT/Model No.: SPH10(SENA\_D02) TEST MODE: BT + CHARGING  
Temp Humi : 23 / 65 Tested by: PARK.H.W



Freq	Reading	C.F	Result	Limit	Margin	Height	Angle	Polarity
MHz	dBuV/m	dB/m	dBuV/m	dBuV/m	dB	cm	deg	
1	105.75	43.60	-13.08	30.52	43.50	12.98	112	183 VERTICAL
2	118.60	47.00	-12.43	34.57	43.50	8.93	100	176 VERTICAL
3	192.40	43.50	-11.00	32.50	43.50	11.00	125	283 HORIZONTAL
4	311.60	47.50	-6.93	40.57	46.00	5.43	100	264 HORIZONTAL
5	314.70	44.20	-6.86	37.34	46.00	8.66	116	234 HORIZONTAL
6	323.40	47.50	-6.67	40.83	46.00	5.17	117	177 HORIZONTAL

Remarks: C.F (Correction Factor) = Antenna factor + Cable loss - Preamp gain

### 3.2.2 Field Strength of Harmonics - Receivers

#### Definition:

The field strength of emissions from intentional radiators was measured. In case of the air temperature of the test site is out of the range is 10 to 40°C before the testing proceeds the warm-up time of EUT maintain adequately

Test method	: FCC Part 15.209
Frequency Range	: 30 MHz ~ 10 <sup>th</sup> harmonic.
Bandwidth	: 120 kHz (F < 1GHz)    1 MHz (F > 1GHz)
Distance of antenna	: 3 meters
Test mode	: Rx mode
Result	: <b>Complies</b>

#### Measurement Data:

- Refer to the next page.
- No other emissions were detected at a level greater than 20dB below limit
- It gave the worse case emissions.

#### Field Strength Limit

##### Part 15.209 LIMIT:

Frequency (MHz)	Limit (uV/m) @ 3m
30 ~ 88	100**
88 ~ 216	150**
216 ~ 960	200**
Above 960	500

\*\* 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, 76-88MHz, 174-216MHz or 470-806MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g. 15.231 and 15.241.

## Measurement Data:

Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak			Antenna	Amp.Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
	1497.0	43.6		52.8	H	25.7	38.4	1.6	54.0	74.0	32.5	41.7
Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak			Antenna	Amp.Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
	1495.5	42.2		55.4	H	25.7	38.4	1.6	54.0	74.0	31.1	44.3
Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
	AV / Peak			Antenna	Amp.Gain	Cable	AV / Peak		AV / Peak		AV / Peak	
	1494.80	45.1		57.5	H	25.7	38.4	1.6	54.0	74.0	34.0	46.4

No other emissions were detected at a level greater than 20dB below limit.

### 3.2.9 AC Conducted Emissions

#### Procedure:

The conducted emissions are measured in the shielded room with a spectrum analyzer in peak hold. While the measurement, EUT had its hopping function disabled at the middle channels in line with Section 15.31(m). Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation and Exerciser operation. The highest emissions relative to the limit are listed.

#### Measurement Data: Complies

- Refer to the next page.
- No other emissions were detected at a level greater than 20dB below limit
- It gave the worse case emissions

#### Minimum Standard: FCC Part 15.207(a)/EN 55022

Frequency Range (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

\* Note: The limits will decrease with the frequency logarithmically within 0.15MHz to 0.5MHz

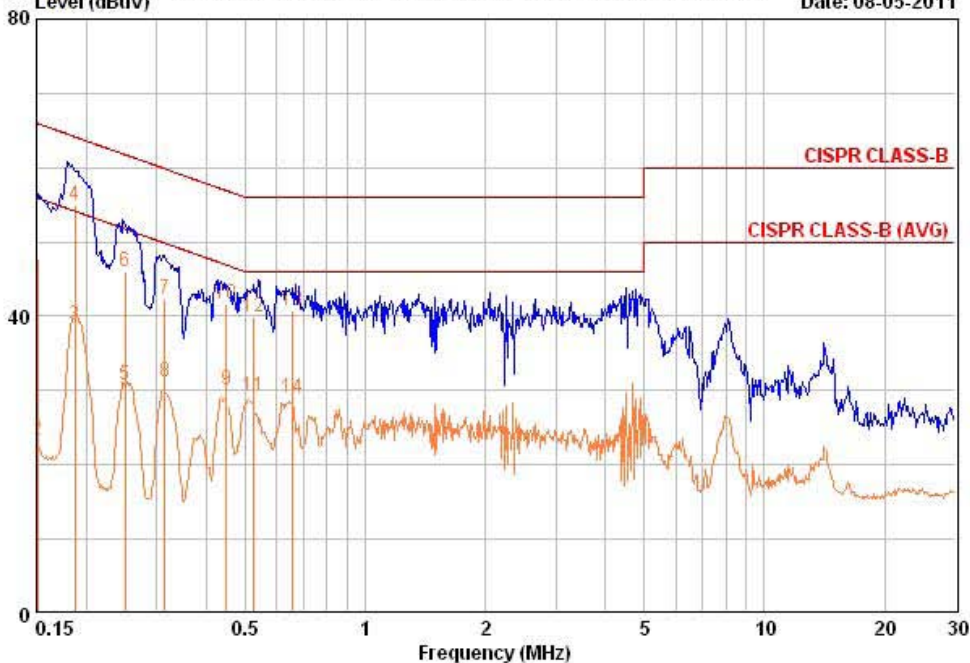
**Radiated Emissions – Charging + BT LINE**



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EUT / Model No. : SPH10(SENA\_002) Phase : NEUTRAL  
 Test Mode : BT charging Test Power : 120 / 60  
 Temp./Humi. : 25 / 64 Test Engineer : PARK H W

Data: 152 File: C:\Conducted Data\2011\LTA\_Conduction\_1107-2.EMI (152) Date: 08-05-2011



Freq MHz	RD		C.F	Result		Limit		Margin	
	QP dBuV	AV dBuV		QP dBuV	AV dBuV	QP dBuV	AV dBuV	QP dB	AV dB
0.151	38.04	13.64	9.67	47.71	23.31	65.94	55.94	18.24	32.64
0.187	45.24	29.24	9.65	54.89	38.89	64.17	54.17	9.28	15.28
0.250	36.43	21.13	9.65	46.08	30.78	61.76	51.76	15.68	20.98
0.314	32.63	21.53	9.65	42.28	31.18	59.86	49.86	17.58	18.68
0.448	31.92	20.52	9.66	41.59	30.19	56.91	46.91	15.33	16.73
0.526	30.32	19.62	9.67	39.99	29.29	56.00	46.00	16.01	16.71
0.654	31.02	19.42	9.66	40.68	29.08	56.00	46.00	15.32	16.92

Remarks: C.F (Correction Factor) = Insertion loss + Cable loss

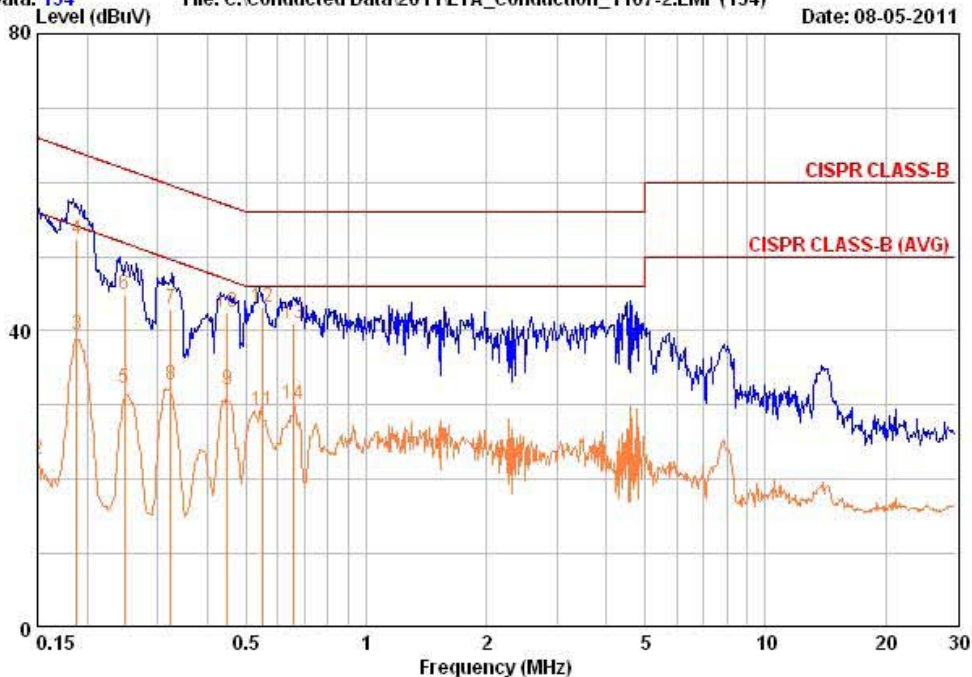
**Radiated Emissions – Charging + BT NEUTRAL**



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EUT / Model No. : SPH10(SENA\_D02) Phase : LINE  
 Test Mode : BT + charging Test Power : 120 / 60  
 Temp./Humi. : 25 / 64 Test Engineer : PARK H W

Data: 154 File: C:\Conducted Data\2011\LTA\_Conduction\_1107-2.EMI (154) Date: 08-05-2011



Freq	RD	RD	C.F	Result	Result	Limit	Limit	Margin	Margin
MHz	QP	AV	dB	QP	AV	QP	AV	QP	AV
	dBuV	dBuV		dBuV	dBuV	dBuV	dBuV	dB	dB
0.150	37.94	13.04	9.66	47.60	22.70	66.00	56.00	18.40	33.30
0.188	42.64	29.74	9.64	52.28	39.38	64.12	54.12	11.84	14.74
0.248	35.23	22.53	9.64	44.87	32.17	61.82	51.82	16.95	19.65
0.324	33.33	23.03	9.66	42.99	32.69	59.60	49.60	16.62	16.92
0.448	32.92	22.32	9.67	42.59	31.99	56.91	46.91	14.32	14.92
0.548	33.42	19.52	9.67	43.09	29.19	56.00	46.00	12.91	16.81
0.658	31.32	20.52	9.66	40.98	30.18	56.00	46.00	15.02	15.82

Remarks: C.F (Correction Factor) = Insertion loss + Cable loss



## APPENDIX

### TEST EQUIPMENT USED FOR TESTS

	Description	Model No.	Serial No.	Manufacturer	Interval	Last Cal. Date
1	Spectrum Analyzer (~30GHz)	FSV-30	100757	R&S	1 year	2011-01-24
2	Spectrum Analyzer (~2.9GHz)	8594E	3710A04074	HP	2 year	2009-10-12
3	Signal Generator (~3.2GHz)	8648C	3623A02597	HP	1 year	2011-03-30
4	Signal Generator (1~20GHz)	83711B	US34490456	HP	1 year	2011-03-30
5	Attenuator (3dB)	8491A	37822	HP	2 year	2010-10-08
6	Attenuator (10dB)	8491A	63196	HP	2 year	2010-10-08
7	Attenuator (30dB)	8498A	3318A10929	HP	2 year	2011-01-05
8	Test Receiver (~30MHz)	ESHS10	828404/009	R&S	1 year	2011-03-30
9	EMI Test Receiver (~1GHz)	ESCI7	100722	R&S	1 year	2010-10-08
10	RF Amplifier (~1.3GHz)	8447D	2439A09058	HP	2 year	2010-10-08
11	RF Amplifier (1~18GHz)	8449B	3008A02126	HP	2 year	2010-03-29
12	Horn Antenna (1~18GHz)	BBHA 9120D	9120D122	SCHWARZBECK	2 year	2010-12-24
13	Horn Antenna (18 ~ 40GHz)	SAS-574	154	Schwarzbeck	2 year	2010-11-25
14	Horn Antenna (18 ~ 40GHz)	SAS-574	155	Schwarzbeck	2 year	2010-11-25
15	TRILOG Antenna	VULB 9160	9160-3172	SCHWARZBECK	2 year	2010-10-07
16	Dipole Antenna	VHA9103	2116	SCHWARZBECK	2 year	2010-11-25
17	Dipole Antenna	VHA9103	2117	SCHWARZBECK	2 year	2010-11-25
18	Dipole Antenna	VHA9105	2261	SCHWARZBECK	2 year	2010-11-25
19	Dipole Antenna	VHA9105	2262	SCHWARZBECK	2 year	2010-11-25
20	Hygro-Thermograph	THB-36	0041557-01	ISUZU	2 year	2010-04-12
21	Splitter (SMA)	ZFSC-2-2500	SF617800326	Mini-Circuits	-	-
22	Power Divider	11636A	6243	HP	2 year	2010-10-08
23	DC Power Supply	6622A	3448A03079	HP	-	-
24	Frequency Counter	5342A	2826A12411	HP	1 year	2011-03-30
25	Power Meter	EPM-441A	GB32481702	HP	1 year	2011-03-30
26	Power Sensor	8481A	US41030291	HP	1 year	2010-10-08
27	Audio Analyzer	8903B	3729A18901	HP	1 year	2010-10-08
28	Modulation Analyzer	8901B	3749A05878	HP	1 year	2010-10-08
29	TEMP & HUMIDITY Chamber	YJ-500	LTAS06041	JinYoung Tech	1 year	2010-10-08
30	Stop Watch	HS-3	601Q09R	CASIO	2 year	2010-03-31
31	LISN	ENV216	100408	R&S	1 year	2010-10-08
32	UNIVERSAL RADIO COMMUNICATION TESTER	CMU200	106243	R&S	2 year	2010-05-13
33	Highpass Filter	WHKX1.5/15G-10SS	74	Wainwright Instruments	-	-
34	Highpass Filter	WHKX3.0/18G-10SS	118	Wainwright Instruments	-	-