

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

S7A-SP01

IC

8154A-SP01

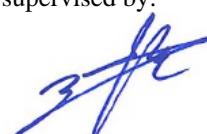
APPLICANT

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

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NVLAP LAB Code.: 200723-0

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

APPENDIX

APPENDIX TEST EQUIPMENT USED FOR TESTS -----	17
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1. General information's

1-1 Test Performed

Company name : LTA Co., Ltd.
 Address : 243, Jubug-ri, Yangji-Myeon, Youngin-Si, Kyunggi-Do, Korea. 449-822
 Web site : <http://www.ltalab.com>
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 Telephone : +82-31-323-6008
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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 ^{note4}
15.247(a)	Number of Hopping Frequencies	> 15 hops		NA ^{note4}
15.247(a)	20 dB Bandwidth 99% Bandwidth	> 1.5 MHz		NA ^{note4}
15.247	Dwell Time	< 0.4 seconds		NA ^{note4}
15.247(b)	Transmitter Output Power	< 250 mWatt		NA ^{note4}
15.247(d)	Conducted Spurious emission	> 20 dBc		NA ^{note4}
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.

Note3: This device is only operated by DC

Note4: 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

Span = 10~30 MHz Detector function = peak

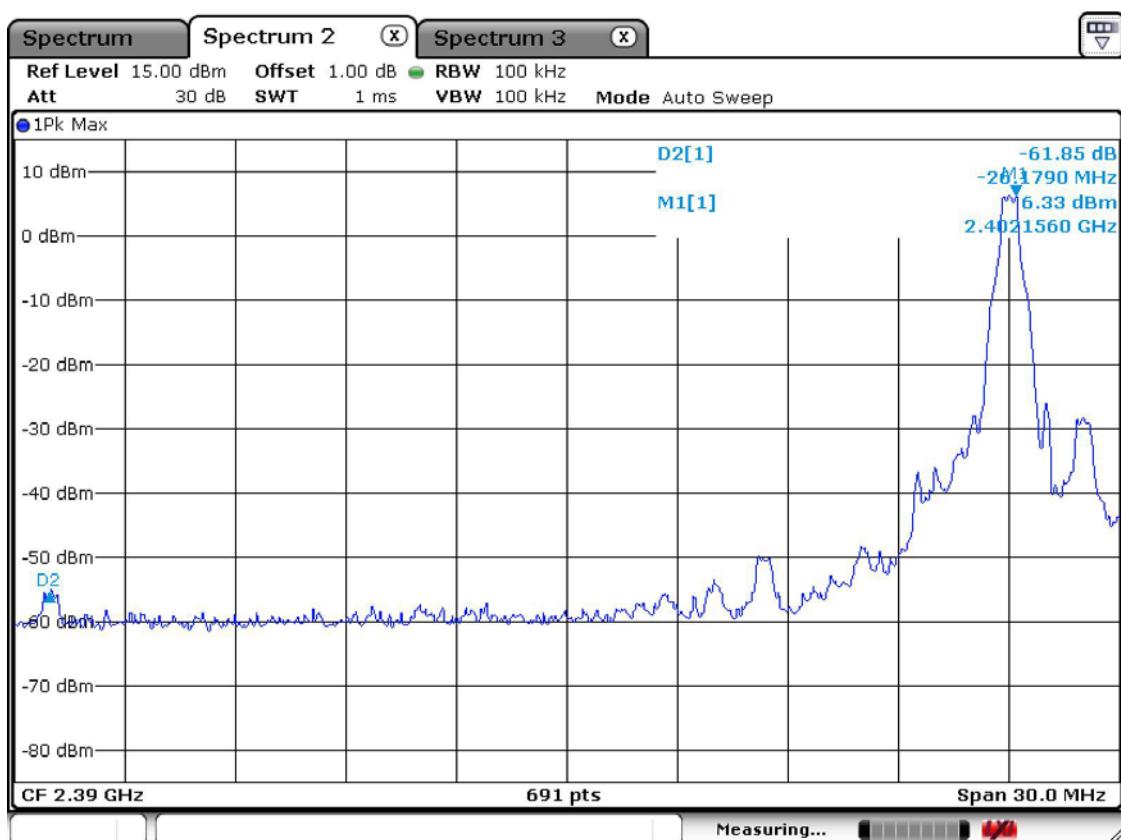
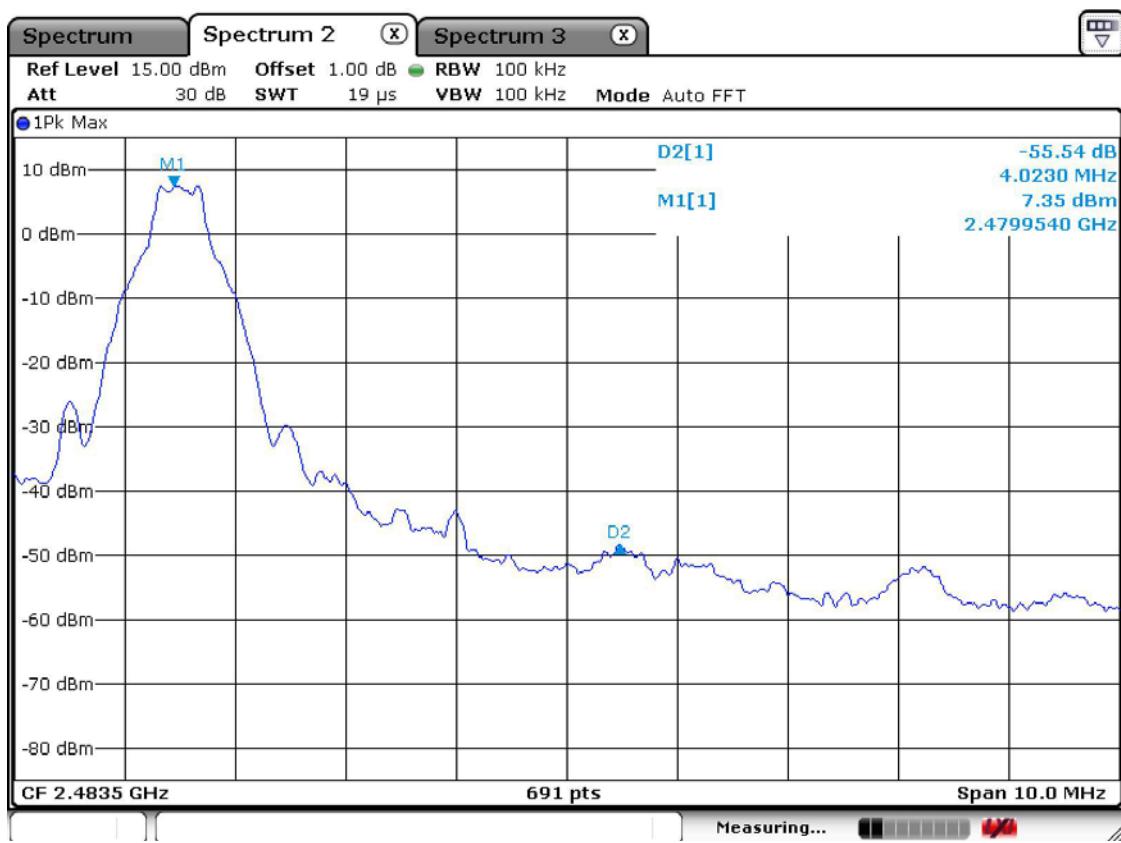
Measurement Data: Complies

- 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.

Minimum Standard:	> 20 dBc
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Measurement Setup

Same as the Chapter 3.2.1 (Figure 1)

Band – edgeLower edgeUpper edge

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

Frequency [MHz]	Reading [dBuV/m] AV / Peak	Pol.	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
			Antenna	Amp. Gain	Cable	AV / Peak	AV / Peak	AV / Peak	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] AV / Peak	Pol.	Correction Factor			Limits [dBuV/m]		Result [dBuV/m]		Margin [dB]	
			Antenna	Amp. Gain	Cable	AV / Peak	AV / Peak	AV / Peak	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 ~ 10th harmonic.

RBW = 100 kHz (30MHz ~ 1 GHz)

Peak:VBW ≥ RBW

= 1 MHz (1 GHz ~ 10th harmonic)

Average:VBW=10Hz

Span = 100 MHz

Detector function = Peak and Average

Trace = max hold

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] AV/Peak		Result [dBuV/m] AV/Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable							
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
Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor			D.C.F	Limits [dBuV/m] AV/Peak		Result [dBuV/m] AV/Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable							
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
Frequency [MHz]	Reading [dBuV/m]		Pol.	Correction Factor			D.C.F	Limits [dBuV/m] AV/Peak		Result [dBuV/m] AV/Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable							
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

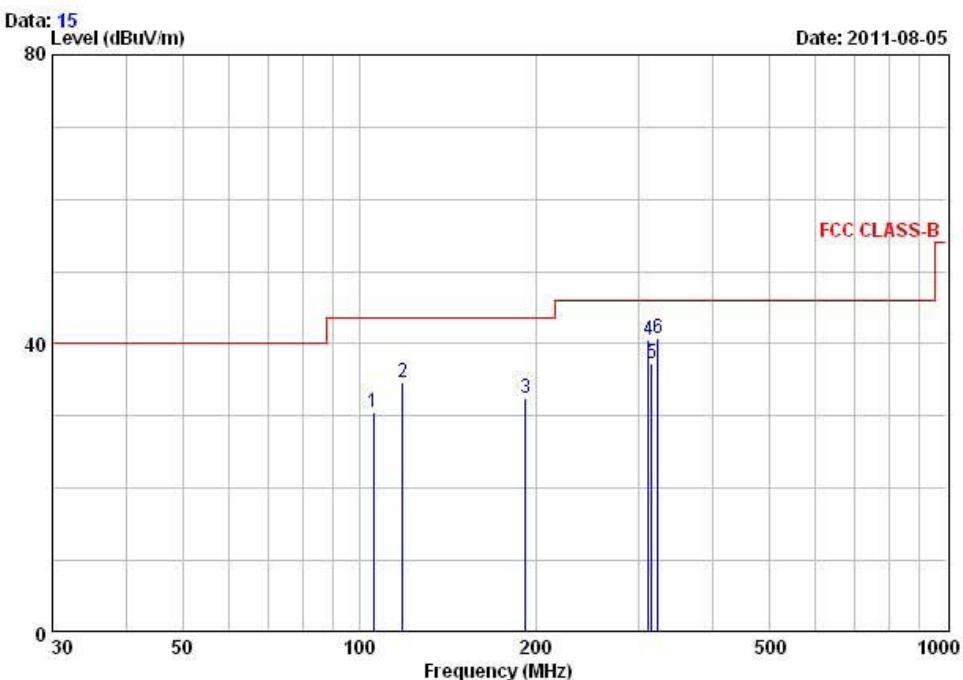
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EUT/Model No.: SPH10(SENA_D02)

TEST MODE: BT + CHARGING

Temp Humi : 23 / 65

Tested by: PARK.H.W



Freq MHz	Reading dBuV/m	C.F dB/m	Result dBuV/m	Limit QP		Margin dB	Height cm	Angle deg	Polarity
				dBuV/m	dB				
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 th harmonic.
Bandwidth	: 120 kHz (F < 1GHz) 1 MHz (F > 1GHz)
Distance of antenna	: 3 meters
Test mode	: Rx mode
Result	: Complies

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] AV / Peak		Pol.	Correction Factor			Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable						
1497.0	43.6	52.8	H	25.7	38.4	1.6	54.0	74.0	32.5	41.7	21.5	32.3
Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable						
1495.5	42.2	55.4	H	25.7	38.4	1.6	54.0	74.0	31.1	44.3	22.9	29.7
Frequency [MHz]	Reading [dBuV/m] AV / Peak		Pol.	Correction Factor			Limits [dBuV/m] AV / Peak		Result [dBuV/m] AV / Peak		Margin [dB] AV / Peak	
				Antenna	Amp.Gain	Cable						
1494.80	45.1	57.5	H	25.7	38.4	1.6	54.0	74.0	34.0	46.4	20.0	27.6

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

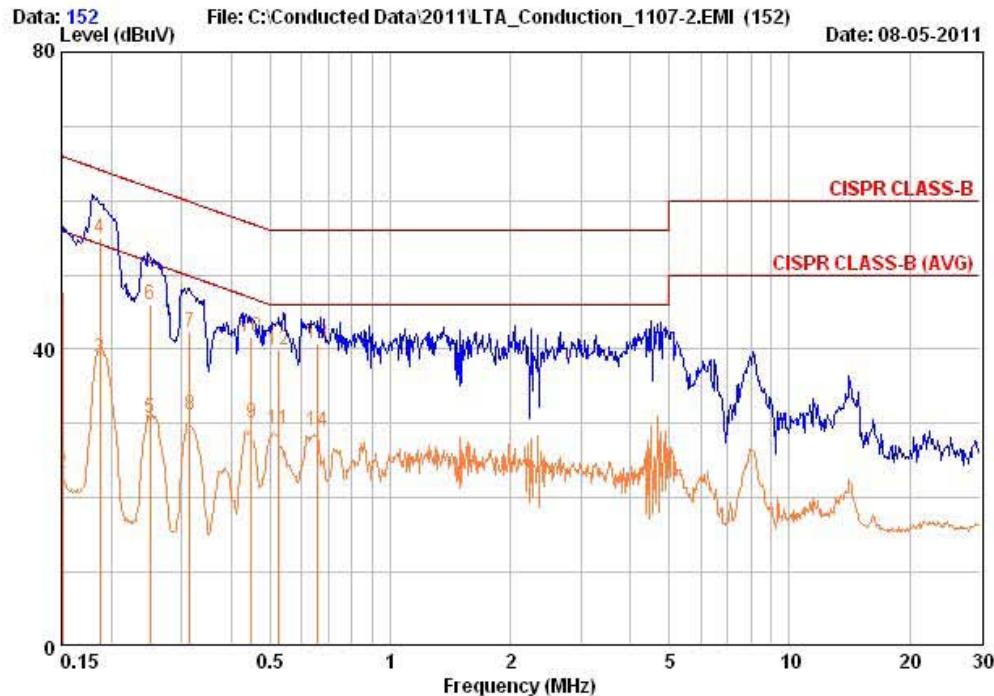
* Note: The limits will decrease with the frequency logarithmically within 0.15MHz to 0.5MHz

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



Freq MHz	RD QP dBuV	RD AV dBuV	C. F dB	Result QP dBuV	Result AV dBuV	Limit QP dBuV	Limit AV dBuV	Margin QP dB	Margin AV dB
	0.151	38.04	13.64	9.67	47.71	23.31	65.94	55.94	18.24
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

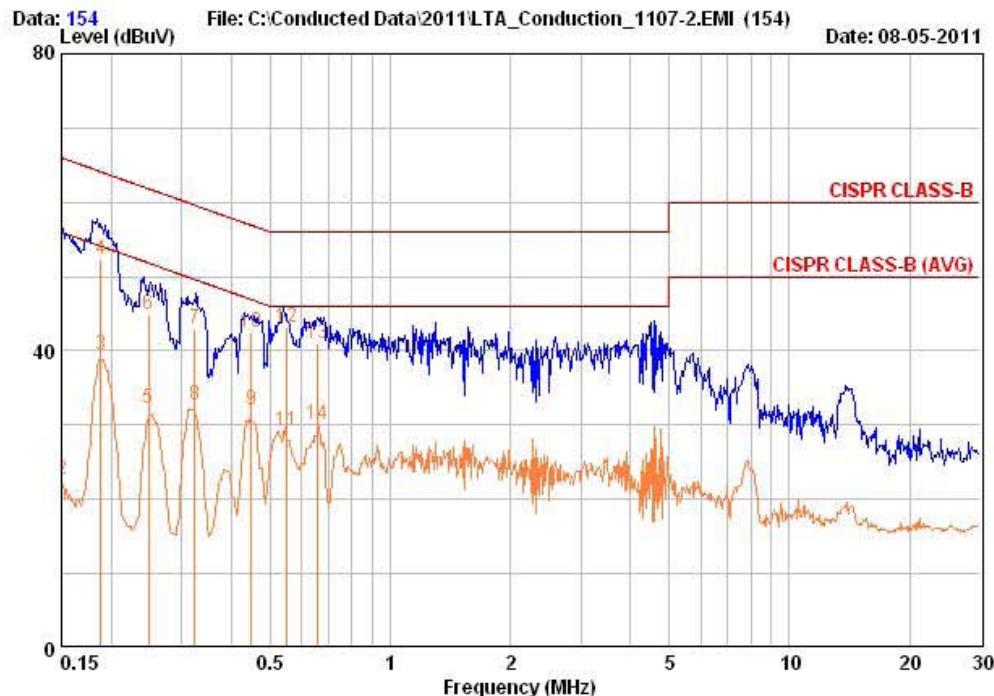
Laboratory for Test & Approval Co.,Ltd.

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Fax. +82-31-3236010

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



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