

FCC EMI TEST REPORT

**Test Laboratory:**

SK Tech Co., Ltd.
820-2, Wolmoon-ri, Wabu-up,
Namyangju-si, Kyunggi-do
472-905 South Korea
TEL: +82-31-576-2204
FAX: +82-31-576-2205

Test Report Number: SKTEFC-130829-082**Date of issue: August 29, 2013****Applicant:**

SAMSUNG ELECTRONICS CO., LTD.
19 Chapin Rd., Building D Pine Brook, NJ07058

Manufacturer:

SAMSUNG ELECTRO-MECHANICS THAILAND CO., LTD.
WELLGROW INDUSTRIAL ESTATE, 93 MOO 5 T.BANGSAMAK,
A.BANGPAKONG, CHACHOENGSAO 24180 THAILAND

Product:

ZigBee to IP Bridge

Model:

HNSLLBRA098B0

(please see P5 for all the model numbers)

File number:

SKTEU13-1141

EUT received:

August 14, 2013

Applied standards:

ANSI C63.4-2009

Rule parts:

FCC Part 15 Subpart B - Unintentional radiators
ICES-003, Issue 5, August 2012

Equipment Class:

Class B digital devices

Remarks to the standards: None

The above equipment has been tested by SK Tech Co., Ltd., and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product or system, which was tested.



Y.G. Lee / **Testing Engineer**



J.S. Yoon / **Technical Manager**

This report shall not be reproduced except in full, without the written approval of SK Tech Co., Ltd. The client should not use it to claim product endorsement by any government agencies.



Revision History of Report

Rev.	Revisions	Effect page	Reviewed by	Date
-	Initial issue	All	J.S. Yoon	Aug. 29, 2013



TABLE OF CONTENTS

1	Summary of test results	4
2	Description of equipment under test (EUT)	5
3	Test and measurement conditions	7
	3.1. Operating modes	7
	3.2. Description of support units (accessory equipment).....	7
	3.3. Interconnection and I/O cables.....	7
	3.4. Test configuration (arrangement of EUT)	8
	3.5. Test date and environmental conditions	8
4	Facilities and accreditations	9
	4.1. Facilities.....	9
	4.2. Accreditations	9
	4.3. List of test and measurement instruments.....	9
	4.4. Measurement uncertainty	10
5	Test and measurements	11
	5.1. AC power line conducted emission.....	11
	5.2. Radiated emission	14
6	Photographs of the test set-up	17
7	Photographs of EUT	20



1 Summary of test results

☒ class B equipment

Requirement	Rule section	Result
AC Power line conducted emission	FCC Part 15, Subpart B, Section 15.107(a) ICES-003, Section 6.1, Table 2	Meets the requirements
Radiated emissions below 1 GHz	FCC Part 15, Subpart B, Section 15.109(a) ICES-003, Section 6.2.1, Table 5	Meets the requirements
Radiated emissions above 1 GHz	FCC Part 15, Subpart B, Section 15.109(a) ICES-003, Section 6.2.2, Table 7	Meets the requirements



2 Description of equipment under test (EUT)

Product: ZigBee to IP Bridge
Model: HNSLLBRA098B0
Serial number: None (prototype)

Model differences:

Model name	Difference	Tested (checked)
HNSLLBRA098B0	Original	☒

Note: All the differences were compared with the test sample.

Technical data:

Rated voltage	5 V
Rated frequency	-
Voltage during the Test	AC 120 V (applied to input port of AC power adapter)
Frequency during the Test	60 Hz
AC power input cord type	2 terminals without the earth ground

I/O port	Type	Q'ty	Remark
DC input	USB	1	
LAN	RJ45	1	

Internal clock frequency	-
--------------------------	---

Note: The information on the internal clock frequency mentioned above was supplied by the applicant.



The EUT incorporated the wireless transceiver (ZigBee module), and this test report did not contain the test results for the transmitter portion under FCC Part 15, Subpart C. The following information had been supplied by the applicant.

Item	Description
Processor	ARM926EJ-S(ARM 9)
RAM Memory Size	32MBytes
Flash Memory Size	16MBytes
System OS	Linux Kernel 2.6
Input Power Supply	5V ± 8%
Wireless communication	IEEE802.15.4 2.4GHz ISM Band
LAN	IEEE 802.3 / 802.3u (10BASE-T/100BASE-TX)
Wireless Distance	Radius 50m (Indoor, Line of Sight)
Operating Temperature	0 ~ 70 °C
Size	73 × 120 × 26 mm



3 Test and measurement conditions

3.1. Operating modes

Operating modes of the sample:

No.	Description
1	Normal operating mode: control the LED Lamp via wired LAN and/or wireless ZigBee

Operating modes used for the Test:

No.	Operating mode
1	Normal operating mode: A. The communication between the EUT and the Notebook was established via LAN interface, and then Ping tests was performed while the traffic was exceeding 10 % using the traffic generator software. B. The radio communication links between the EUT and the LED Lamp was established.

3.2. Description of support units (accessory equipment)

The following support units or accessories were used to form a representative test configuration during the tests.

#	Equipment	Manufacturer	Model No.	Serial No.
1	AC Adapter #1	Dongguan Samsung Electro-mechanics Co., Ltd.	ETA-U90KWK	SE1CC18AS/B-E
2	LED Lamp	SAMSUNG	SI-I8W132UL0EU	N/A
3	Notebook	SAMSUNG	NT530U4C	HXL991FD301789E
4	AC Adapter #2 (Notebook)	LITE-ON TECHNOLOGY (CHANGZHOU) Co., Ltd.	PA-1600-66	CNBA4400242AD2VH 32103VI

Note: 1) The AC Adapter #1 and LED Lamp were provided by the applicant for the purpose of testing.

3.3. Interconnection and I/O cables

The following support units or accessories were used to form a representative test configuration during the tests.

#	Start		End		Cable	
	Name	I/O port	Name	I/O port	length (m)	shielded (Y/N)
1	EUT	LAN (RJ45)	Notebook	LAN (RJ45)	3.0	N
2	EUT	DC Input	AC Adapter #1	DC Output	1.5	N
3	Notebook	DC Input	AC Adapter #2	DC Output	1.8	N
4	LED Lamp	AC Input	AC Mains	AC Mains	1.85	N
5	AC Adapter #1	AC Input	AC Mains	AC Mains	1.0	N
6	AC Adapter #2	AC Input	AC Mains	AC Mains	1.6	N

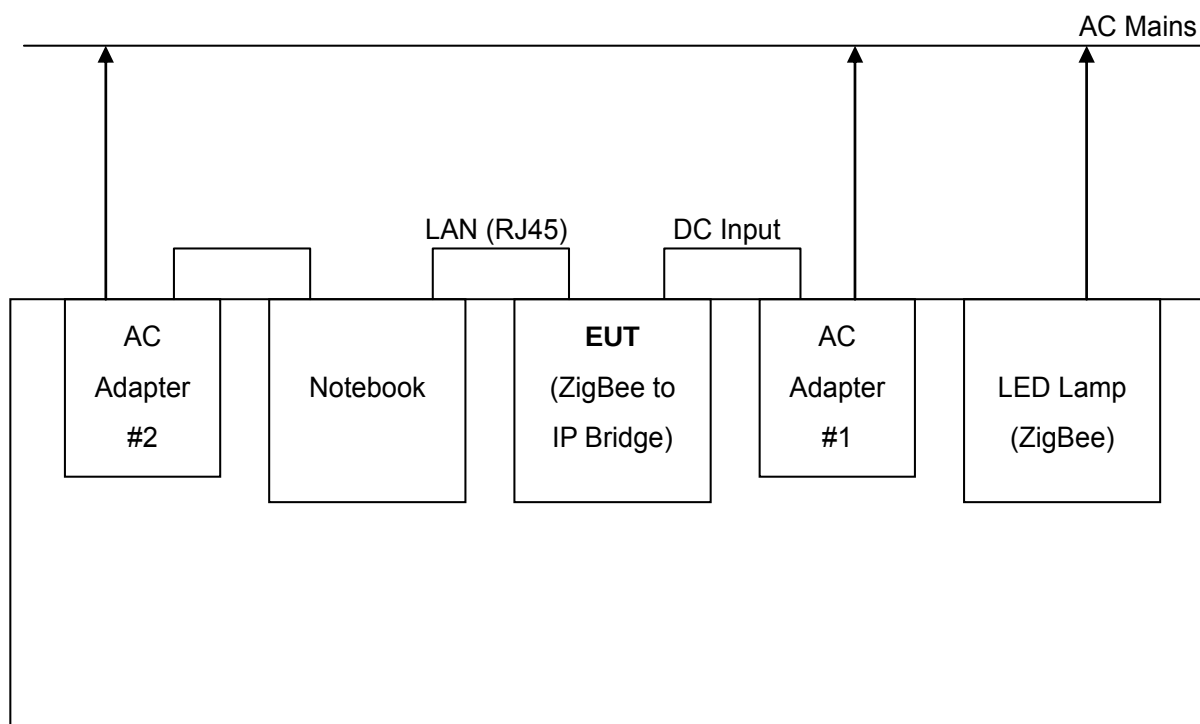
Note: 1) All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.

2) Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.



3.4. Test configuration (arrangement of EUT)

The drawing of the test configuration was shown below, and the photographs of the test setup were attached



3.5. Test date and environmental conditions

Test suites	Test date (YYYY.MM.DD)	Ambient temperature (°C)	Relative humidity (%)	Atmospheric pressure (kPa)
AC power line conducted emission	2013.08.22	27	56	-
Radiated emissions below 1 GHz	2013.08.22	26	54	-
Radiated emissions above 1 GHz	2013.08.22	27	55	-



4 Facilities and accreditations

4.1. Facilities

All of the measurements described in this report were performed at SK Tech Co., Ltd

Site I: 820-2, Wolmoon-ri, Wabu-up, Namyangju-si, Kyunggi-do, Korea

Site II: 688-8, Wolmoon-ri, Wabu-up, Namyangju-si, Kyunggi-do, Korea

The sites are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-4. The sites comply with the Normalized Site Attenuation requirements given in ANSI C63.4, and site VSWR requirements specified in CISPR 16-1-4. The measuring apparatus and ancillary equipment conform to CISPR 16-1 series.

4.2. Accreditations

Our testing laboratory is accredited by the following accreditation bodies in accordance with ISO/IEC 17025.

Korea	KOLAS No.191
Germany	DAkks D-PL-12162-01-01

The laboratory has been also notified to FCC by RRA as a Conformity Assessment Body, and designated to perform compliance testing on equipment subject to Declaration of Conformity (DOC) and Certification under Parts 15 and 18 of the FCC Rules.

Designation No.	KR0007
-----------------	--------

4.3. List of test and measurement instruments

Description	Model	Manufacturer	Serial No.	Cal. due	Use
Conducted emission					
EMI test receiver	ESHS10	Rohde & Schwarz	862970/019	2014-07-09	☒
AMN (LISN)	ESH3-Z5	Rohde & Schwarz	836679/018	2014-07-09	☒
AMN (LISN)	NNLK8129	Schwarzbeck	8129-215	2014-03-07	☒
ISN	ISN T8	TESEQ	24806	2014-02-13	
ISN	ISN ST08	TESEQ	24800	2014-01-19	
EMI test receiver	ESHS10	Rohde & Schwarz	835871/002	2014-07-08	
AMN (LISN)	ESH2-Z5	Rohde & Schwarz	834549/011	2014-07-09	
AMN (LISN)	KNW-407	Kyoritsu	8-929-19	2014-03-08	
ISN	CAT 5 8158	Schwarzbeck	8158-0050	2014-07-16	
ISN	NTFM 8158	Schwarzbeck	8158-0045	2014-07-18	
Radiated emission					
EMI test receiver	ESPI7	Rohde & Schwarz	101206	2014-07-08	
EMI test receiver	ESVS10	Rohde & Schwarz	825120/013	2014-03-08	
Pre-amplifier (30 MHz - 1 GHz)	8447F	HP	3113A05153	2014-07-08	
Bilog broadband antenna	VULB9168	Schwarzbeck	9168-189	2014-05-21	
Bilog broadband antenna	VULB9168	Schwarzbeck	9168-230	2014-03-29	
EMI test receiver	ESIB40	Rohde & Schwarz	100277	2014-03-07	☒
Pre-amplifier (30 MHz - 1 GHz)	8447D	HP	2944A07994	2014-07-08	☒
Pre-amplifier (1 GHz - 18 GHz)	MLA-100M18-B02-38	TSJ	1359546	2014-03-07	☒
Bilog broadband antenna	JB1	Sunol Sciences	A060910	2013-10-10	☒
Horn antenna (1 GHz - 18 GHz)	BBHA 9120D	Schwarzbeck	9120D-816	2014-02-28	☒
Horn antenna (1 GHz - 18 GHz)	3115	ETS-LINDGREN	00056768	2013-08-13	
Band reject filter	WRCGV2400/2483	Wainwright	5	2014-01-31	☒



4.4. Measurement uncertainty

The following measurement uncertainty levels have been estimated according to CISPR 16-4-2.

Measurement	Frequency	Uncertainty	$U_{\text{cisp}}r$
Conducted emissions	150 kHz to 30 MHz	± 3.14 dB	± 3.4 dB
Radiated emissions	30 MHz to 1000 MHz	± 4.20 dB	± 6.3 dB
	1000 MHz to 6000 MHz	± 5.06 dB	± 5.2 dB

This measurement uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of $k = 2$.

If the measurement value is lower or equal to the limit, the EUT is considered to pass the test.

When the measured emission is positioned within the range of the measurement uncertainty from the emission limit, compliance or non-compliance with a disturbance limit is determined in the following manner.

- 1) If U_{lab} is less than or equal to $U_{\text{cisp}}r$
 - compliance is deemed to occur if no measured disturbance exceeds the disturbance limit;
 - non-compliance is deemed to occur if any measured disturbance exceeds the disturbance limit.
- 2) If U_{lab} is greater than $U_{\text{cisp}}r$
 - compliance is deemed to occur if no measured disturbance, increased by $(U_{\text{lab}} - U_{\text{cisp}}r)$, exceeds the disturbance limit;
 - non-compliance is deemed to occur if any measured disturbance, increased by $(U_{\text{lab}} - U_{\text{cisp}}r)$, exceeds the disturbance limit.



5 Test and measurements

5.1. AC power line conducted emission

5.1.1. Limits for AC power line conducted emission

Equipment class	Frequency range (MHz)	Limits (dB μ V)	
		Quasi-peak	Average
class A equipment	0.15 to 0.5	79	66
	0.5 to 30	73	60
class B equipment	0.15 to 0.5	66 to 56 *	56 to 46 *
	0.50 to 5	56	46
	5 to 30	60	50

* Decreases with the logarithm of the frequency

5.1.2. Test procedure

- The EUT and supporting equipment including all I/O cables were set up as per the test configuration to simulate typical usage. If the EUT is a table top system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane. If the EUT is a floor standing equipment, it is placed on the ground plane, which has about 10 mm non-conductive covering to insulate the EUT from the ground plane.
- Each current-carrying conductor of the EUT power cord(s), except the ground (safety) conductor(s) was individually connected through a 50 Ω /50 μ H line impedance stabilization network (LISN) to the input power mains. Emissions were measured on each current carrying line of the EUT using an EMI Test Receiver connected to the LISN powering the EUT.
- Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
- The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment in the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
- The measurements were made with the detector set to peak mode within a bandwidth of 10 kHz or to quasi-peak mode and average mode within a bandwidth of 9 kHz.



5.1.3 Test results

Test set-up:	Refer to the test configuration and photographs of the test setup.
	frequency range: 150 kHz to 30 MHz
	frequency step size: 50 % of the IF bandwidth
	IF bandwidth: 9 kHz (10 kHz)
	measurement time: 1 second
LIMIT	Class ☐ A ☒ B

Operating mode:	#1
Test results:	PASS

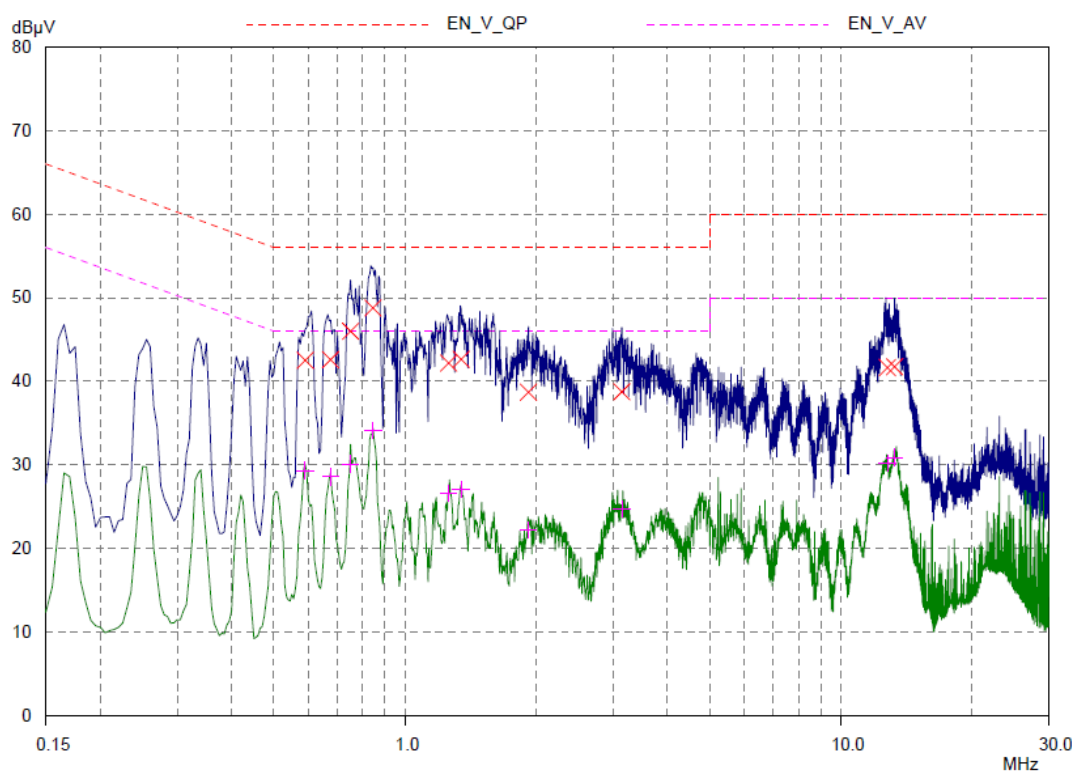
(The chart below shows the highest readings taken from the final data.)

Frequency (MHz)	Reading (dBμV)	Line (L/N)	CF (dB)	CL (dB)	Actual (dBμV)	Limit (dBμV)	Margin (dB)
Quasi-peak data							
0.590	42.51	L	0.25	0.02	42.78	56.00	13.22
0.675	42.57	L	0.26	0.02	42.85	56.00	13.15
0.750	45.99	L	0.26	0.03	46.28	56.00	9.72
0.760	42.68	N	0.12	0.03	42.83	56.00	13.17
0.845	48.78	L	0.27	0.03	49.08	56.00	6.92
1.260	42.17	L	0.29	0.04	42.50	56.00	13.50
1.345	42.63	L	0.29	0.04	42.96	56.00	13.04
1.920	38.69	L	0.32	0.06	39.07	56.00	16.93
2.105	35.14	N	0.19	0.06	35.39	56.00	20.61
3.110	40.91	N	0.21	0.05	41.17	56.00	14.83
3.145	38.74	L	0.36	0.05	39.15	56.00	16.85
4.825	38.91	N	0.28	0.07	39.26	56.00	16.74
12.810	41.62	L	0.76	0.11	42.49	60.00	17.51
13.300	41.74	L	0.79	0.11	42.64	60.00	17.36
13.515	39.44	N	0.64	0.11	40.19	60.00	19.81
Average data							
0.590	29.31	L	0.25	0.02	29.58	46.00	16.42
0.675	28.59	L	0.26	0.02	28.87	46.00	17.13
0.750	30.08	L	0.26	0.03	30.37	46.00	15.63
0.760	29.43	N	0.12	0.03	29.58	46.00	16.42
0.845	34.08	L	0.27	0.03	34.38	46.00	11.62
1.260	26.59	L	0.29	0.04	26.92	46.00	19.08
1.345	27.10	L	0.29	0.04	27.43	46.00	18.57
1.920	22.21	L	0.32	0.06	22.59	46.00	23.41
2.105	20.31	N	0.19	0.06	20.56	46.00	25.44
3.110	23.84	N	0.21	0.05	24.10	46.00	21.90
3.145	24.74	L	0.36	0.05	25.15	46.00	20.85
4.825	24.27	N	0.28	0.07	24.62	46.00	21.38
12.810	30.22	L	0.76	0.11	31.09	50.00	18.91
13.300	30.89	L	0.79	0.11	31.79	50.00	18.21
13.515	27.21	N	0.64	0.11	27.96	50.00	22.04

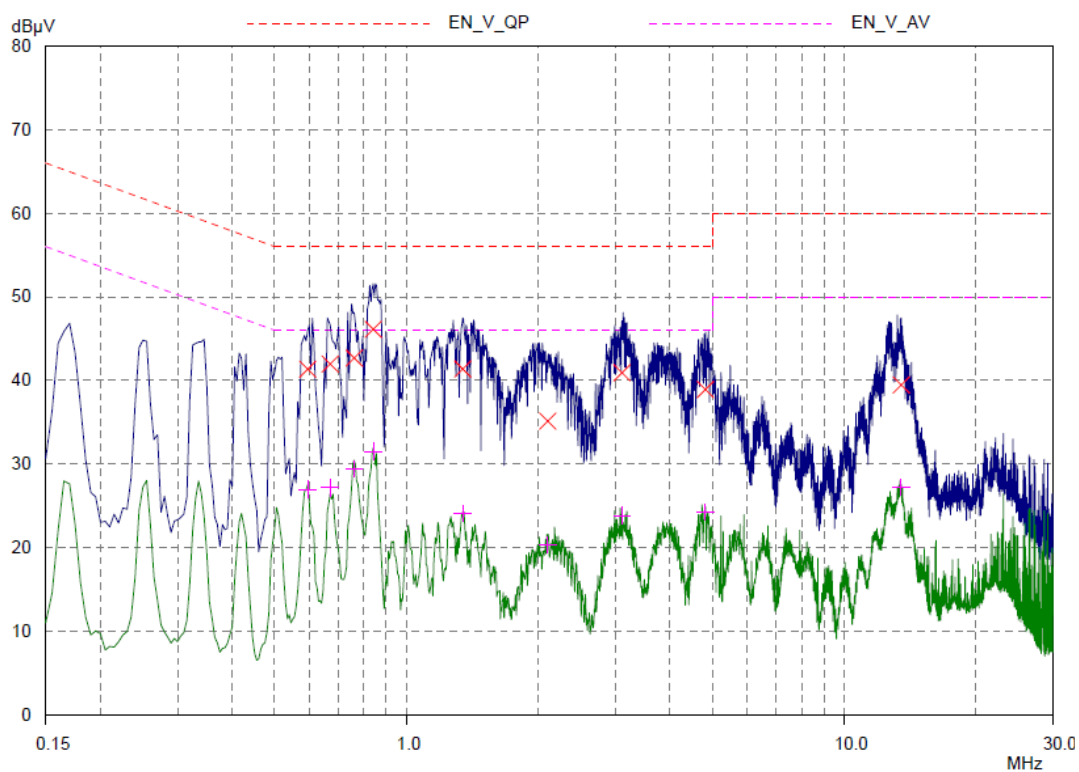
- Note:**
- 1) L/N: Line / Neutral
 - 2) CF and CL: correction factor (LISN) and cable loss
 - 3) Actual = Reading + CF + CL
 - 4) Margin = Limit - Actual



Line to PE



Neutral to PE





5.2. Radiated emission

5.2.1. Limits for radiated emission

Limits for radiated emission below 1 GHz

Equipment class	Frequency range (MHz)	Quasi-peak limits (dB μ V/m)	Measurement distance (m)
class A equipment	30 to 88	39	10
	88 to 216	43.5	
	216 to 960	46.4	
	960 to 1000	49.5	
class B equipment	30 to 88	40	3
	88 to 216	43.5	
	216 to 960	46	
	960 to 1000	54	

Limits for radiated emission above 1 GHz

Equipment class	Frequency range (MHz)	Peak limits (dB μ V/m)	Average limits (dB μ V/m)	Measurement distance (m)
class A equipment	> 1000	69.5	49.5	10
class B equipment	> 1000	74	54	3

5.2.2. Test procedure

- (a) The EUT and supporting equipment including all I/O cables were set up as per the test configuration to simulate typical usage. If the EUT was a table top system, the EUT was placed on the top of the 0.8-meter height with non-metallic table. If the EUT was a floor standing equipment, the EUT was placed on the top of 10 mm height above the ground plane
- (b) The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber.
- (c) For the final measurements, each frequency found during preliminary measurements was re-examined and investigated. The EMI test receiver was set up to average, peak and quasi-peak detector with specified bandwidth. It was attempted to maximize the emission, by varying the configuration of the EUT and the cables routing.
- (d) Radiated emission measurements for the frequency up to 1 GHz (at OATS or SAC with ground plane)
 - (1) Bilog broadband antenna was placed at 10-m distance (or 3-m distance if applicable) from the EUT.
 - (2) The EUT was rotated about 360° and the receiving antenna was scanned from 1 m up to 4 m in order to capture the maximum emission.
 - (3) The measurements were conducted with both horizontal and vertical antenna polarization.
- (e) Radiated emission measurements for the frequency above 1 GHz (at absorber-lined SAC)
 - (1) Horn antenna was placed at a distance of 3 meters from the EUT.
 - (2) The EUT was rotated about 360 ° to capture the maximum emission.
 - (3) For the EUT with maximum dimensions greater than the beamwidth of the receiving antenna, the receiving antenna was scanned up to 4 m.
 - (4) The measurements were conducted with both horizontal and vertical antenna polarization.



5.2.3 Test results (radiated emission below 1 GHz)

Test set-up: Refer to the test configuration and photographs of the test setup.

Test site: ☐ OATS ☒ SAC

Antenna distance: ☐ 10 m ☒ 3 m

Rx antenna height: 1 m to 4 m

frequency range: 30 MHz to 1 GHz

IF bandwidth: 120 kHz

LIMIT

Class ☐ A ☒ B

Operating mode:

#1

Test results:

PASS

(The chart below shows the highest readings taken from the final data. The other emission levels were very low against the limit.)

Frequency (MHz)	Pol. (V/H)	Height (m)	Reading (dBμV)	AMP (dB)	AF (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
41.57	V	1.00	39.56	28.45	13.09	0.71	24.91	40.00	15.09
77.19	V	1.00	50.49	28.35	7.95	1.02	31.11	40.00	8.89
86.05	V	1.00	49.33	28.32	7.76	1.07	29.84	40.00	10.16
101.89	H	2.83	51.90	28.26	10.70	1.17	35.51	43.50	7.99
375.00	H	1.00	50.06	28.10	15.09	2.29	39.34	46.00	6.66
500.00	H	1.00	45.64	28.86	17.79	2.67	37.24	46.00	8.76

Note: 1) V/H: Vertical / Horizontal polarization

2) AMP, AF and CL: pre-amplifier gain, antenna factor and cable loss

3) Actual = Reading - AMP + AF + CL

4) Margin = Limit - Actual



5.2.4. Test results (radiated emission above 1 GHz)

Test set-up:	Refer to the test configuration and photographs of the test setup.
	Test site: absorber-lined SAC
	Antenna distance: 3 m
	Rx antenna height: 1 m (up to 4 m, if height scan is required)
	frequency range: 1 GHz to 6 GHz (or 5th harmonic of the highest internal frequency, whichever is higher)
	IF bandwidth: 1 MHz
LIMIT	Class ☐ A ☒ B
	When the EUT is Class A equipment, the limits were extrapolated to the 3 meter distance using an extrapolated factor of 20 dB/decade according to FCC Part 15, section 15.31(d)(1) / ICES-003, Issue 5, Section 6.2
Operating mode:	#1
Test results:	PASS

(The chart below shows the highest readings taken from the final data. The other emission levels were very low against the limit.)

Freq. (MHz)	Pol. (V/H)	Height (m)	Reading (dBμV)		AMP (dB)	AF (dB/m)	CL (dB)	Actual (dBμV/m)		Limit (dBμV/m)		Margin (dB)	
			PK	AV				PK	AV	PK	AV	PK	AV
1665.1	H	1.00	54.56	33.34	41.23	25.52	4.94	43.79	22.57	74.00	54.00	30.21	31.43

- Note:**
- 1) V/H: Vertical / Horizontal polarization
 - 2) PK/AV: Peak / Average values
 - 3) AMP, AF and CL: pre-amplifier gain, antenna factor and cable loss
 - 4) Actual = Reading - AMP + AF + CL
 - 5) Margin = Limit - Actual



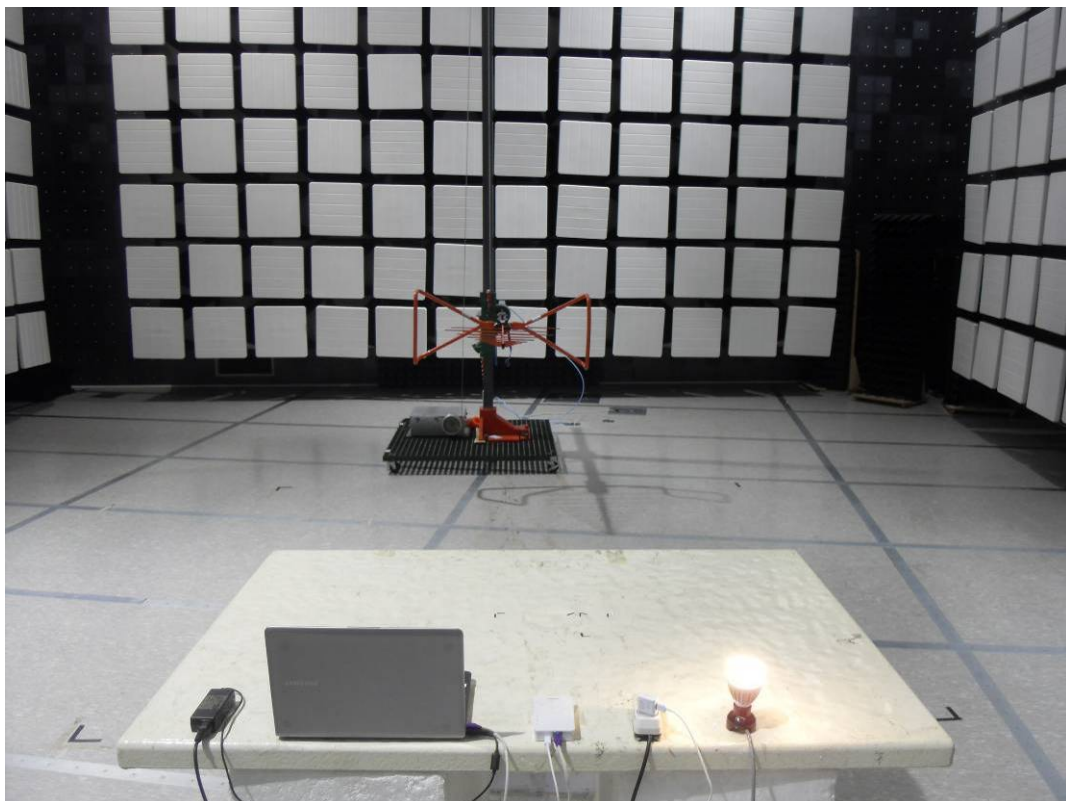
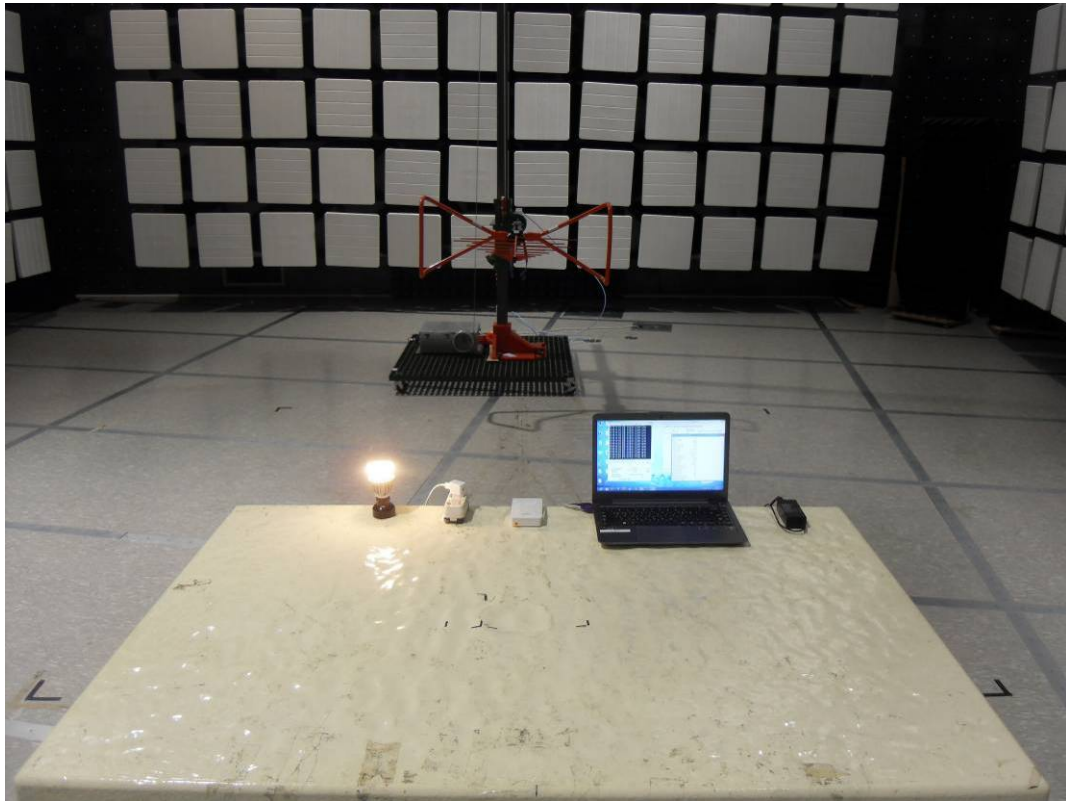
6 Photographs of the test set-up

Conducted emission test at AC mains port



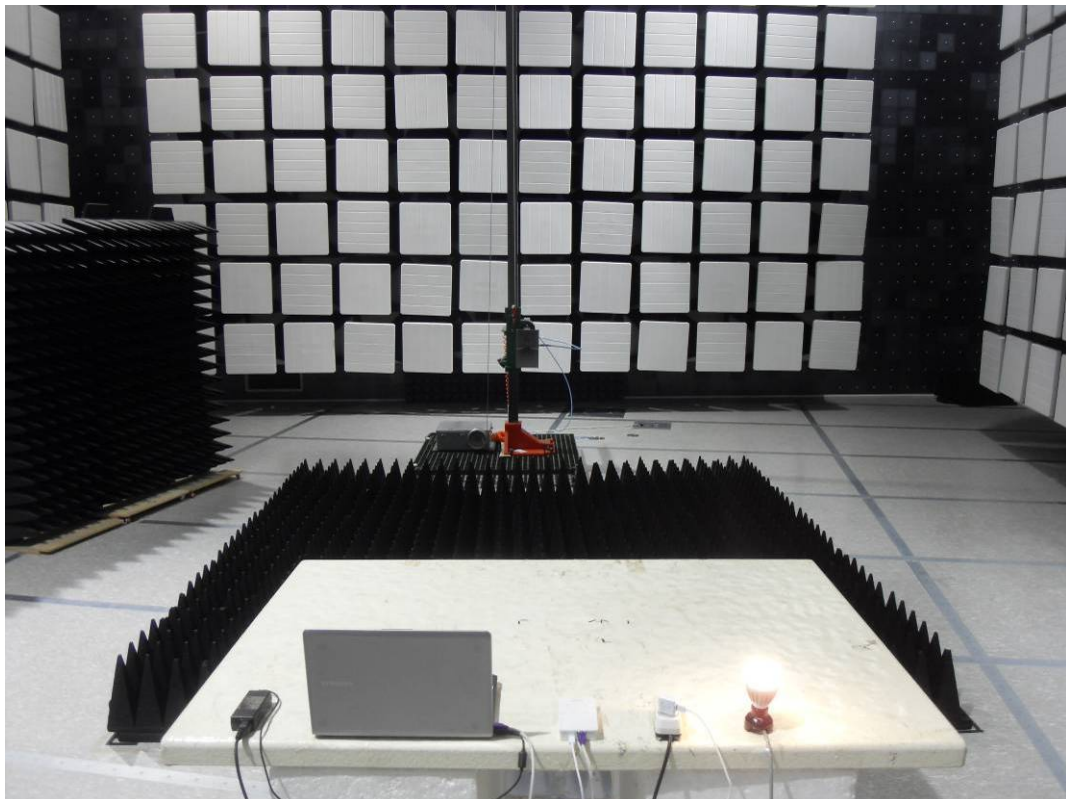
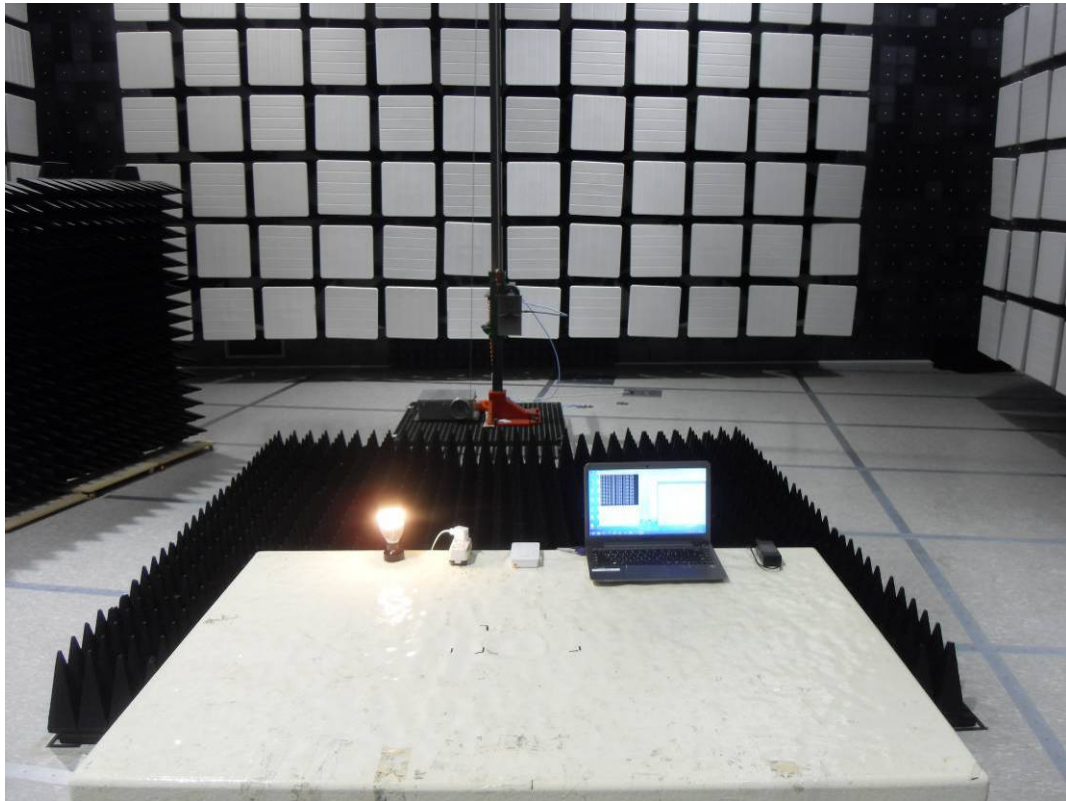


Radiated emission test above 1 GHz





Radiated emission test above 1 GHz





7 Photographs of EUT

External view



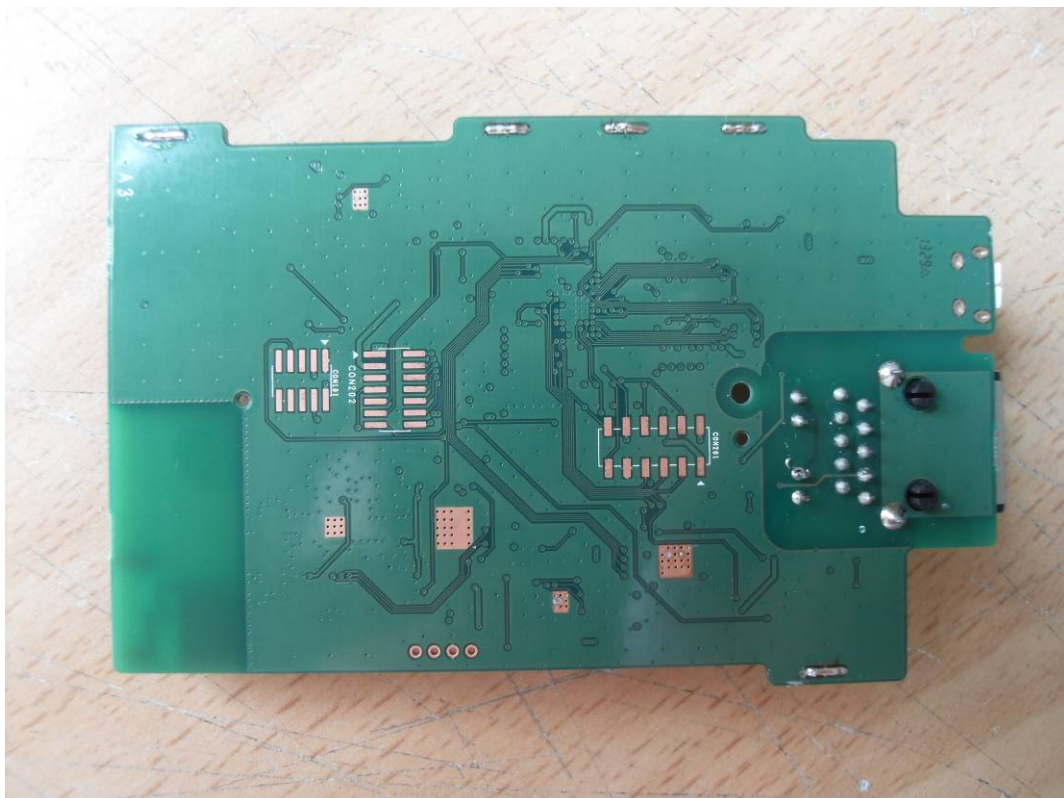
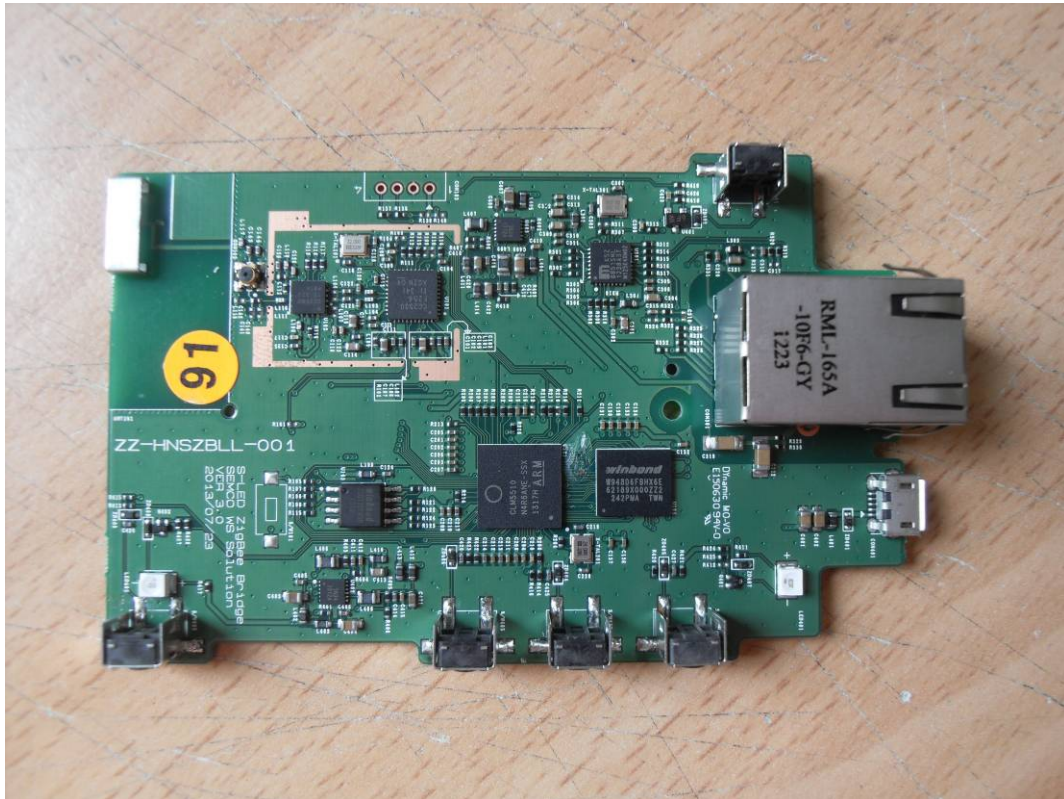


Cover opened





Main board





ZigBee Module

