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Order No.: 10307460
Report No.: 14-10307460-FCC-RF1
Date: Aug. 21, 2014
Model No.: GB8WH9013AWxyz
FCC ID.: A3LGB8WH9013AW
IC .: 649E- GB8WH9013AW0

FCC Test Report
in accordance with
FCC Part 15 Subpart C Section 15.247 and IC RSS-210 Issue 8
for
LED Lamp

SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEOTONG-GU, SUWON-SI, GYEONGGI-DO, 443-742, KOREA

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Summary of Test Results:

The following tests were performed on a sample submitted for evaluation of compliance with FCC Part 15 Subpart C Section 15.247 and RSS-210 i8

No	Reference Clause No.	Conformance Requirements	Verdict	Remark
1	15.205(a) 15.209(a) 15.247(d) A8.5	Transmitter radiated spurious emissions and Conducted spurious emission	Complied	-
2	15.247(a)(2) A8.2(a) Gen 4.6.1	6 dB Bandwidth / 99% Bandwidth	Complied	-
3	15.247(b)(3) A8.4	Maximum peak output power	Complied	-
4	15.247(e) A8.2(b)	Power spectral density	Complied	-
5	15.207 Gen 7.2.2	Transmitter AC power line conducted emission	Complied	-

Conclusion:

The tests listed in the Summary of Testing section of this report have been performed and the results recorded by UL Korea Ltd. in accordance with the procedures stated in each test requirement and specification. The test list was determined by the Applicant as being applicable to the Equipment Under Test. As a result, the subject product has been verified to comply or not comply as noted in the Summary of Testing with each test specification. The test results relate only to the items tested.



Witness tested by
Changmin, Kim WiSE Engineer
UL Verification Services- 3014ASEO
UL Korea Ltd.
Aug. 21, 2014



Reviewed by
Jeawoon, Choi, WiSE Operations Manager
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Aug. 21, 2014

Test Report Details

Witnessed By: UL Korea Ltd.
26th FL. GFC Bldg. 737 Yeoksam-dong,
Gangnam-gu, Seoul, 135-984, Korea

Test Site: CTK Co., Ltd.
(Ho-dong), 113, Yejik-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, 449-100, Korea
The test facility was deemed to have the environment and capabilities necessary to perform the tests included in the test package.

Applicant: SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEOTONG-GU, SUWON-SI, GYEONGGI-DO, 443-742, KOREA

Manufacturer: SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEOTONG-GU, SUWON-SI, GYEONGGI-DO, 443-742, KOREA

Applicant Contact: Jonghyun, Song

Phone: 82-31-277-9253

E-mail: jhyun.song@samsung.com

Product Type: LED Lamp

Model Number: GB8WH9013AWxyz

Additional Model Name: 'x' indicates 0-9 stand for business type,
'y' and 'z' indicates A-Z stand for national type
The manufacturer has declared to all the multiple model names into the basic model without any further evaluation by UL.

Trademark

The Samsung logo is displayed, consisting of the word "SAMSUNG" in a bold, sans-serif font, followed by a blue oval containing the word "SAMSUNG" in white.

Product standards: FCC Part 15 Subpart C Section 15.247 and IC RSS-210 Issue 8
Operation within the band 2400–2483.5 MHz,

Sample Serial Number: N/A

Sample Receive Date: Aug. 13, 2014

Testing Start Date: Aug. 13, 2014

Date Testing Complete: Aug. 21, 2014

Overall Results: Pass

UL Korea Ltd. reports apply only to the specific test samples and test results submitted for UL's review. All samples tested were in good operating condition throughout the entire test program. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. UL Korea Ltd. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from UL Korea Ltd. issued reports. This report shall not be used to claim, constitute or imply product certification, approval, or any agency of the National Authorities. This report may contain test results that are not covered by the NVLAP or KOLAS accreditation.

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1. General Product Information

1.1. Equipment Description

GB8WH9013AWxyz is a LED Lamp with Zigbee module.

1.2. Details of Test Equipment (EUT)

- Equipment Type : LED Lamp
- Model No. : GB8WH9013AWxyz
- Type of Radio communication : SRD
- Operating characteristic : Short range wireless device operating in the 2400 – 2483.5 ISM frequency band

1.3. Equipment Configuration

The EUT is consisted of the following component provided by the manufacturer.

Use*	Product Type	Manufacturer	Model	Comments
EUT	LED Lamp	SAMSUNG ELECTRONICS CO., LTD.	GB8WH9013AWxyz	-
Note: Use = EUT - Equipment Under Test, AE - Auxiliary/Associated Equipment. SIM - Simulator (Not Subjected to Test)				

1.4. Technical Data

Item	Type of LED Bulb
Frequency Ranges	2400 – 2483.5 MHz
Output power	Typical : 15.28 dBm
Kind of modulation (s)	DSSS
Channel	15 channel
Antenna Gain	Max. 1.08 dBi
Working temperature	-20 ~ 70 °C
Supply Voltage	AC 120 V, 60 Hz

Note ;

1. All the technical data described above were provided by the manufacturer.

1.5. Antenna Information

Antenna Model Name : ODBTP3015
Antenna Type : Chip Antenna
Manufacturer : PARTRON Co., Ltd.
Transmit Gain dBi : Max. 1.08 dBi
Azimuth Beam Pattern : Linear

1.6. Equipment Type :

- ☒ Radio and ancillary equipment for fixed or semi-fixed use
☐ Radio and ancillary equipment for vehicular mounted use
☐ Radio and ancillary equipment for portable or handheld use
- ☒ Stand alone ☐ Host connected
- ☐ Self contained single unit ☐ Module with associated connection or interface

1.7. Technical descriptions and documents

The following documents was provided by the manufacturer.

No.	Document Title and Description
1	User Manual

1.8. Description of additional model name

-	Model	Description	Comment
1	GB8WH9013AWxyz	'x' indicates 0-9 stand for business type, 'y' and 'z' indicates A-Z stand for national type	-
*Note: The manufacturer has declared to all the multiple model names into the basic model without any further evaluation by UL.			

2. Test Specification

The following test specifications and standards have been applied and used for testing.

- 1) FCC Part 15 Subpart C Section 15.247 : Operation within the band 2400–2483.5 MHz
- 2) ANSI C63.4:2009 : American National Standard for Methods of Measurement of Radio- Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
- 3) ANSI C63.10:2009 : American National Standard for Testing Unlicensed Wireless Devices
- 4) KDB 558074 : Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

3. Test Conditions

3.1. Equipment Used During Test

Use*	Product Type	Manufacturer	Model	Comments
EUT	LED Lamp	SAMSUNG ELECTRONICS CO., LTD.	GB8WH9013AWxyz	-
AE	Note PC	DELL INC.	Inspiron 6400	-
Note: Use = EUT - Equipment Under Test, AE - Auxiliary/Associated Equipment. SIM - Simulator (Not Subjected to Test)				

3.2. Input/Output Ports

No	Port Name	Type*	Cable Max. >3m (Y/N)	Cable Shielded (Y/N)	Comments
1	Power Input	AC	3 m	N	Connected to AC Power supply
2	Radio Antenna	I/O	N	-	-
Note: *AC = AC Power Port DC = DC Power Port N/E = Non-Electrical I/O = Signal Input or Output Port (Not Involved in Process Control) TP = Telecommunication Ports					

3.3. Power Interface

Mode #	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
Rated	AC 120 V	-	12.5	60 Hz	-	Rating of EUT
1	120 V	-	-	60 Hz	-	-

3.4. Operating Frequencies

Mode #	Frequency tested
1	2 405 MHz ~ 2 475 MHz - Low : 2405 MHz / CH = 11 - Mid : 2440 MHz / CH = 18 - Top : 2475 MHz / CH= 25

3.5. Operation Modes

Mode #	Description
1	Carrier on mode: Signal from the RF module was generated continuously for the representative channels (Low, Mid, High) by the test program incorporated
2	Carrier off (Idle) mode: RF carrier was not activated by the RF module
Note : 1. The measurements of the spurious emissions for transmitter on stand-by mode were performed as the receiver spurious emissions. 2. The worst-case condition is determined by the baseline measurement of rf output power out of various modulations and data rates. The worst-case channel was determined as the channel with highest output power.	

3.6. Environment Conditions

Parameters	Normal condition
Temperature	+ 15°C ~ +35°C
Humidity	20% ~ 75%
Supply voltage	AC 120 V (Rated nominal voltage)
Note ; - The extreme condition is applied to the boundary limits of the declared operational environmental condition by the manufacturer. - The operating condition for humidity requirement has not been declared in the manufacturer's specification. - Test has been carried out for three frequencies specified above under the normal condition and for the extreme condition, minimum and maximum frequencies has been tested.	

3.7. Test Configurations

Mode #	Description
1	The diagram shows a shield room enclosure with a horizontal power line at the top. A LISN is connected to this power line. A vertical line from the LISN goes down to a 'to Test Receiver' label. The EUT is connected to the LISN and is placed on a table. The table height is labeled as 0.8m. The distance from the top power line to the EUT is labeled as 0.4m. A legend indicates that a thick line represents the Power Line.
2	The diagram shows the EUT and Test Receiver both equipped with Zigbee Antennas. The EUT is connected to a power line. A legend indicates that a thick line represents the Power Line.
3	The diagram shows a linear connection between four components: AC Power Supply, EUT, Attenuator, and Power meter or Spectrum Analyzer.

3.8. List of Test Equipment

No	Description	Manufacturer	Model	Identifier	Cal. Due
1	Signal Analyzer	Agilent	N9020A	MY48011598	2014-11-08
2	EMI Test Receiver	Rohde & Schwarz	ESCI7	100814	2014-12-06
3	EMI Test Receiver	Rohde & Schwarz	ESCI3	100032	2015-02-04
4	EMI Test Receiver	Rohde & Schwarz	ESU40	100336	2015-05-15
5	Bilog Antenna	Schaffner	CBL6111C	2551	2016-05-08
6	Double Ridged Hone Antenna	ETS-Lindgren	3116	00062916	2015-03-20
7	Double Ridged Guide Antenna	ETS-Lindgren	3117	00154525	2015-07-03
8	Attenuator	Rohde & Schwarz	DNF	272.4110.50	2014-11-12
9	PREAMPLIFIER	Agilent	8449B	3008A02307	2014-11-08
10	AMPLIFIER	Sonoma Instrument Co.	310	291721	2015-02-06
11	LISN	Rohde & Schwarz	ENV216	101151	2014-11-08
12	LISN	Rohde & Schwarz	ESH3-Z5	100207	2014-11-08
13	Signal Generator	Rohde & Schwarz	SMB100A	175528	2015-01-24
14	AC Power supply	NF	KP3000GS	9166666	2015-02-06

4. Overview of Technical requirements

The following essential requirements and test specifications are relevant to the presumption of conformity FCC Part 15 Subpart C Section 15.247 and IC RSS-210 Issue 8			Reported
Reference Clause No.		Essential technical requirements	
FCC Rule	IC Rule		
15.247(a) (2)	A8.2(a)	6 dB Bandwidth	[X]
-	Gen 4.6.1	99% Bandwidth Measurement	[X]
15.247(b)(3)	A8.4	Maximum peak output power	[X]
15.247(e)	A8.2(b)	Power spectral density	[X]
15.205(a) 15.209(a) 15.247(d)	A8.5	Transmitter radiated spurious emissions and Conducted spurious emission	[X]
15.207	Gen 7.2.2	Transmitter AC power line conducted emission	[X]

5. Test Results

5.1. 6 dB Bandwidth & Occupied Bandwidth

TEST: 6 dB Bandwidth		
Method	The transmitter output is connected to the Spectrum analyzer. 6 dB Bandwidth from the EUT was measured under the below setting condition. 1. Set resolution bandwidth (RBW) = 100 kHz 2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW. 3. Detector = Peak. 4. Trace mode = max hold. 5. Sweep = auto couple. 7. 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.	
Reference Clause	Part15 Subpart C Section 15.247 (a)(2)	
Parameters recorded during the test	Laboratory Ambient Temperature	27 °C
	Relative Humidity	53 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	2405 MHz - 2475 MHz	Antenna port

Configuration Settings

Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
1	1	3
Supplementary information: None		

Limits

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902 ~928 MHz, 2400 ~ 2483.5 MHz, and 5725 ~ 5825 MHz bands. The minimum of 6 dB Bandwidth shall be at least 500 kHz.

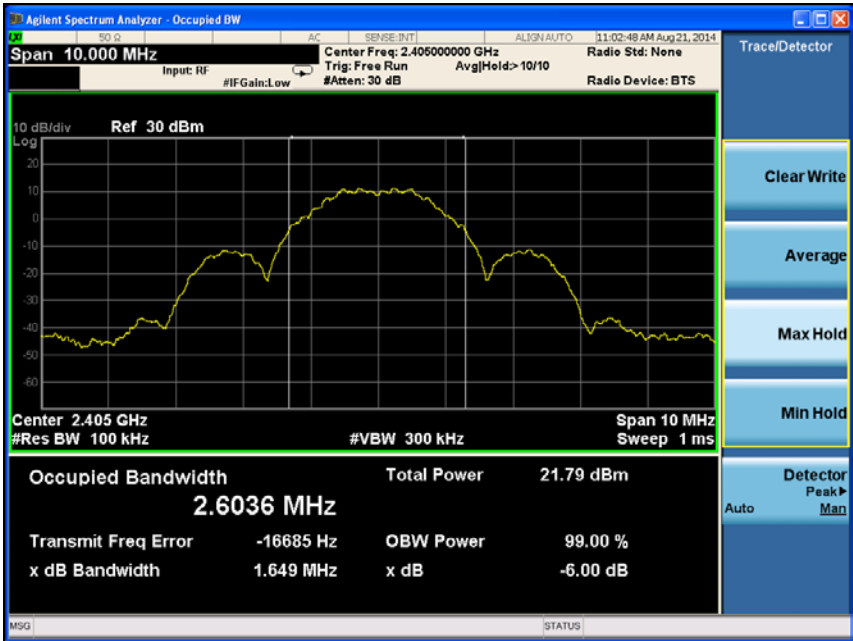
5.1.1. Measurement Results

Table 1. Data Table of 6 dB Bandwidth

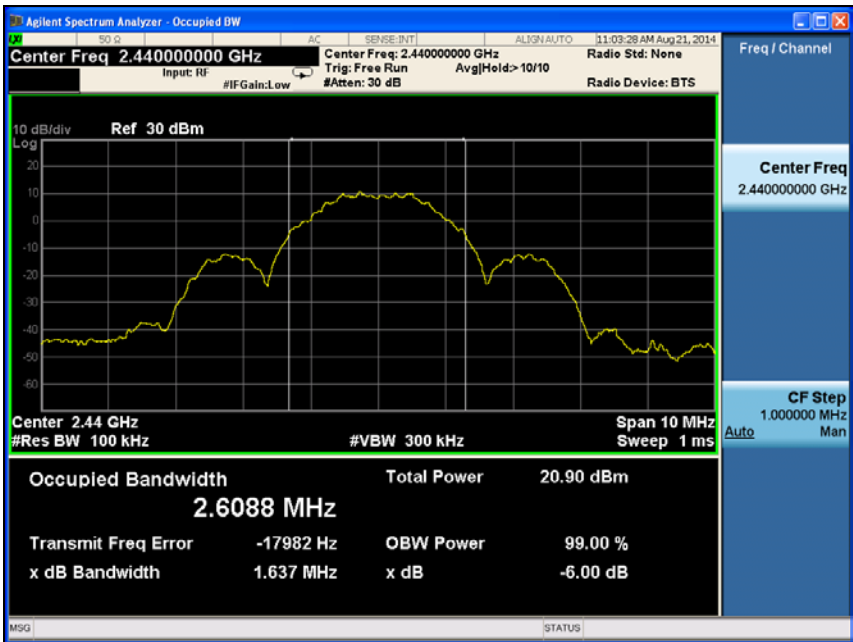
Operating Mode	Channel	Channel Frequency (MHz)	6 dB Bandwidth (MHz)	99% Bandwidth (MHz)	Minimum Limit (MHz)
1	Low	2405	1.649	2.604	> 0.5
	Middle	2440	1.637	2.610	
	High	2475	1.637	2.611	

Figure 1. Plots of 6 dB Bandwidth

Low

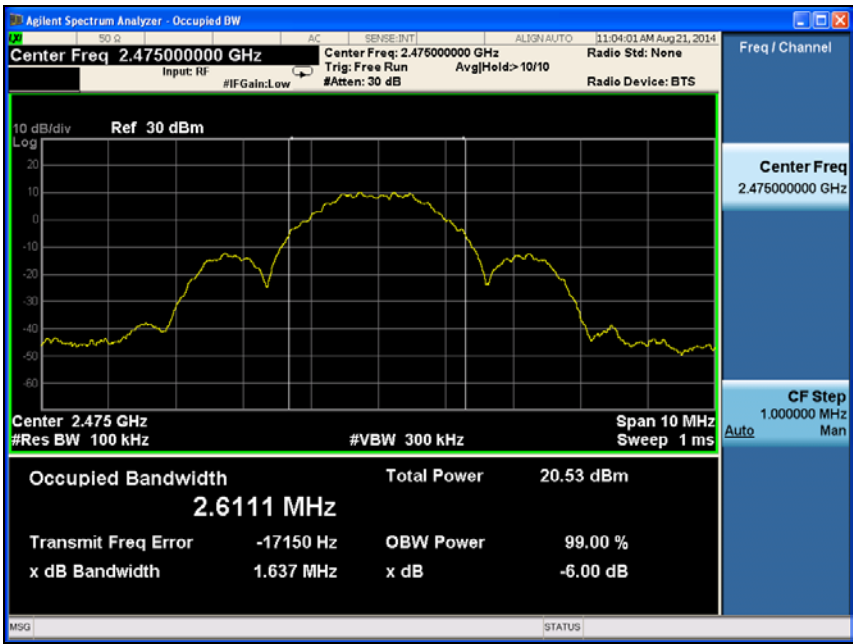


Middle



Order Number: 10307460
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High



5.2. Maximum Peak Output Power

TEST: Maximum Peak Output Power		
Method	Maximum Peak Output Power from the EUT were measured according to the dictates Integrated band power measurement procedure in section 9.1.1 of KDB 558074 1. This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth. 2. Set the RBW $\geq$ DTS bandwidth. 3. Set the VBW $\geq$ 3 x RBW. 4. Set the span $\geq$ 3 x RBW. 5. Detector = peak. 6. Sweep time = auto couple. 7. Trace mode = max hold. 8. Allow trace to fully stabilize. 9. Use the peak marker function to determine the peak amplitude level.	
Reference Clause	Part15 Subpart C Section 15.247 (b)(3)	
Parameters recorded during the test	Laboratory Ambient Temperature	27 °C
	Relative Humidity	53 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	2405 MHz - 2475 MHz	Antenna port

Configuration Settings

Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
1	1	3
Supplementary information: None		

Limits

According to §15.247(b)(3), for systems using digital modulation in the 902 ~ 928 MHz, 2400 ~2483.5 MHz, and 5725 ~ 5850 MHz band: 1 Watt. As an alternative to a peak power measurement, compliance with the one watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antenna elements. The average must not include any intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(4), the conducted output power limit specified in paragraph(b) of this section is based on the use of antenna with directional gains that do not exceed 6 dBi. Except as shown in paragraph(c) of this section, if transmitting antenna 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 paragraph (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.

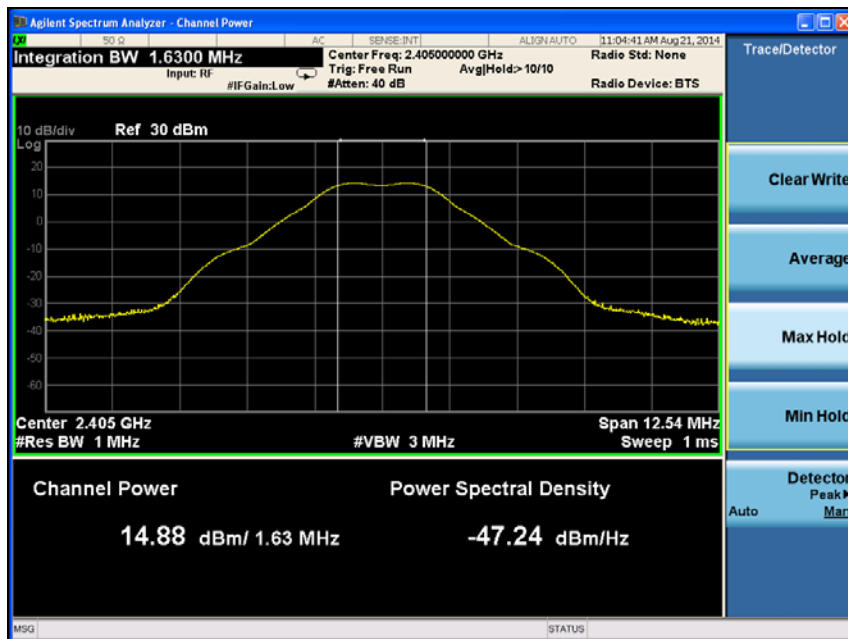
Measurement Results

Table 2. Data Table of Maximum Peak Output Power

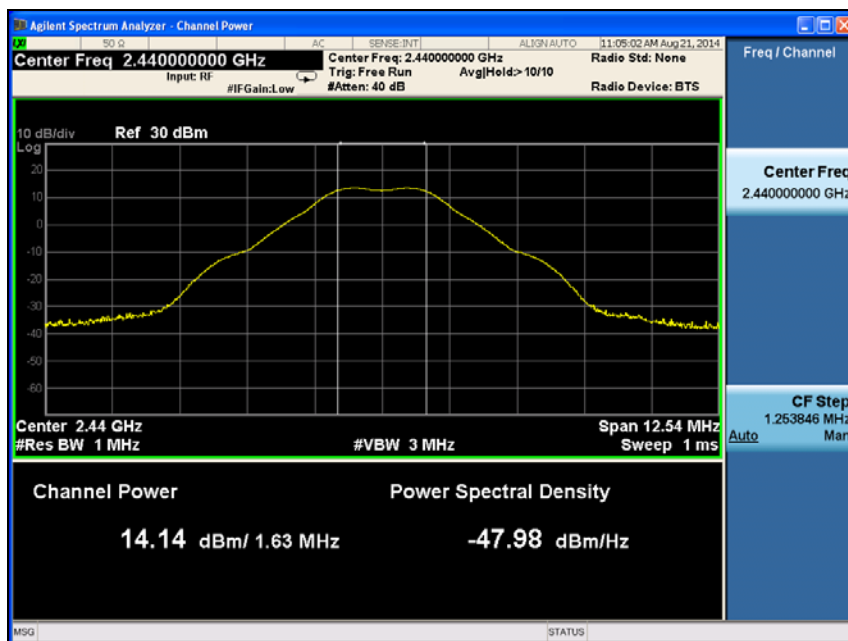
Operating Mode	Channel	Channel Frequency (MHz)	Measurement data (dBm)	Cable loss (dB)	Peak Power Result (dBm)	Limit (dBm)
1	Low	2405	14.88	0.4	15.28	< 30
	Middle	2440	14.14	0.4	14.54	
	High	2475	13.73	0.4	14.13	

Figure 2. Plots of Maximum Peak Output Power

Low

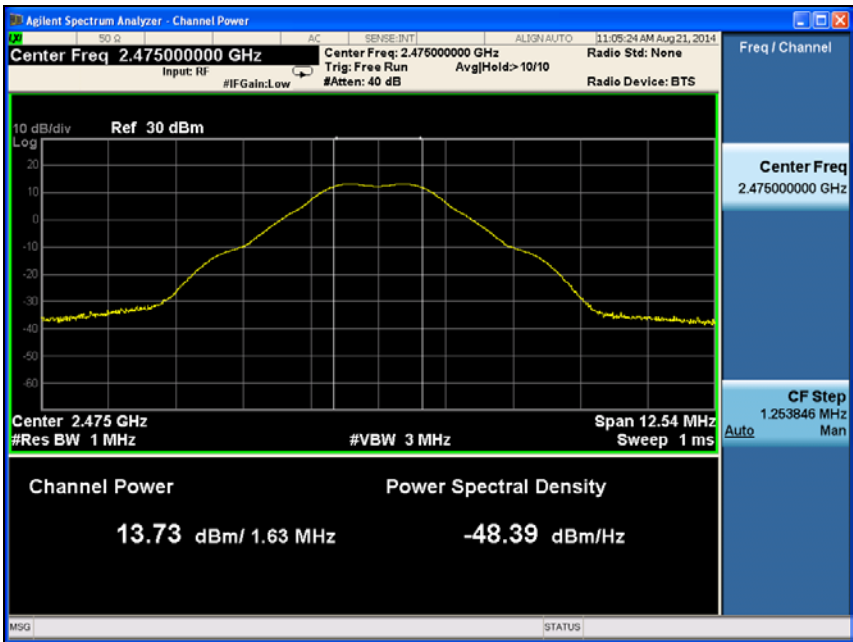


Middle



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High



5.3. Power Spectral Density

TEST: Power Spectral Density		
Method	Power Spectral Density from the EUT were measured according to the dictates PKPSD measurement procedure in section 10.2 of KDB 558074 1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance. 2. Set the RBW to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$. 3. Set the VBW $\geq 3 \times \text{RBW}$. 4. Set the span to 1.5 times the DTS bandwidth. 5. Detector = peak. 6. Sweep time = auto couple. 7. Trace mode = max hold. 8. Allow trace to fully stabilize. 9. Use the peak marker function to determine the maximum power level within the RBW. 10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat 11. The resulting peak PSD level must be $\leq 8 \text{ dBm}$.	
Reference Clause	Part15 Subpart C Section 15.247 (e)	
Parameters recorded during the test	Laboratory Ambient Temperature	27 °C
	Relative Humidity	53 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	2405 MHz - 2475 MHz	Antenna port

Configuration Settings

Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
1	1	3
Supplementary information: None		

Limits

§15.247(e) For digitally modulated system, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dB m in any 3 kHz band any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Measurement Result

Table 3. Data Table of Power Spectral Density

Operating Mode	Channel	Channel Frequency (MHz)	Measured PSD (dBm)	Result PSD (dBm)	Limit (dBm)
1	Low	2405	-0.643	-0.643	< 8
	Middle	2440	-1.515	-1.515	
	High	2475	-2.188	-2.188	

Figure 3. Plots of Power Spectral Density

Low



Middle



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High



5.4. Conducted spurious emission Measurement

TEST: Conducted spurious emission measurement		
Method	Transmitter output is connected to a spectrum analyzer and emissions from the EUT were measured according to the dictates in section 11.0 of KDB 558074. The peak output power procedure is used to measure the fundamental emission power and unwanted emissions. Measurement Procedure – Reference Level 1. Set the RBW = 100 kHz., VBW $\geq 3 \times$ RBW. 2. Set the span to 1.5 times the DTS bandwidth. 4. Detector = peak. 5. Sweep time = auto couple. 6. Trace mode = max hold. 8. Use the peak marker function to determine the maximum PSD level. Measurement Procedure - Unwanted Emissions 1. Set RBW, VBW, detector as same with above 2. Set span to encompass the spectrum to be examined.	
Reference Clause	Part15 Subpart C Section 15.247 (d)	
Parameters recorded during the test	Laboratory Ambient Temperature	27 °C
	Relative Humidity	53 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	30 MHz – 40 GHz	Antenna port

Configuration Settings

Test Item	Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
Conducted Spurious emission	1	1	3
Supplementary information: None			

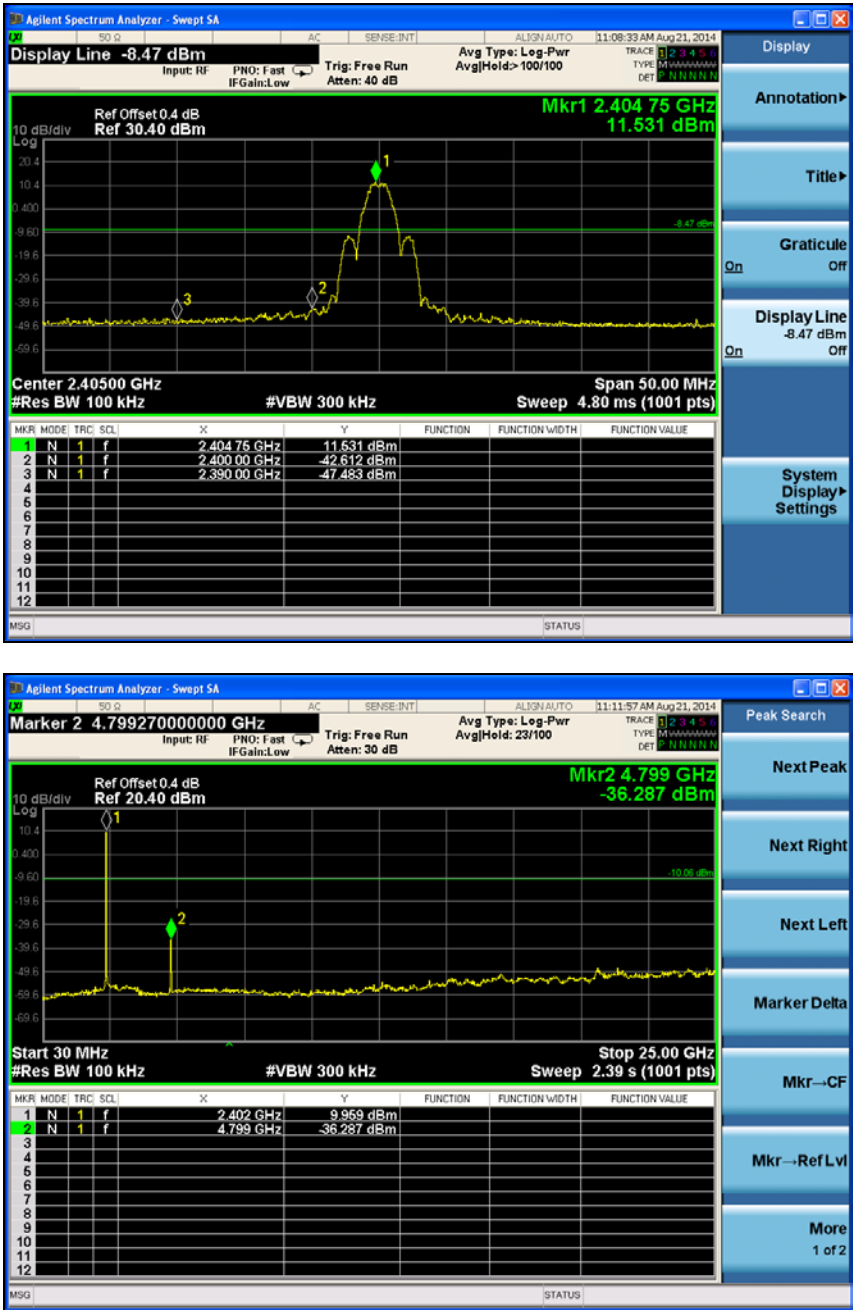
Limits

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. 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))

Measurement Results

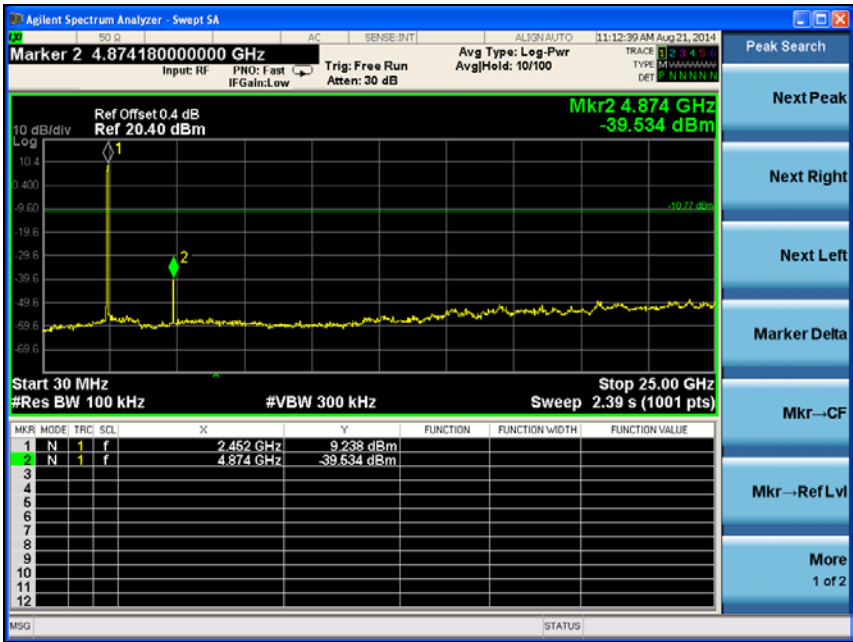
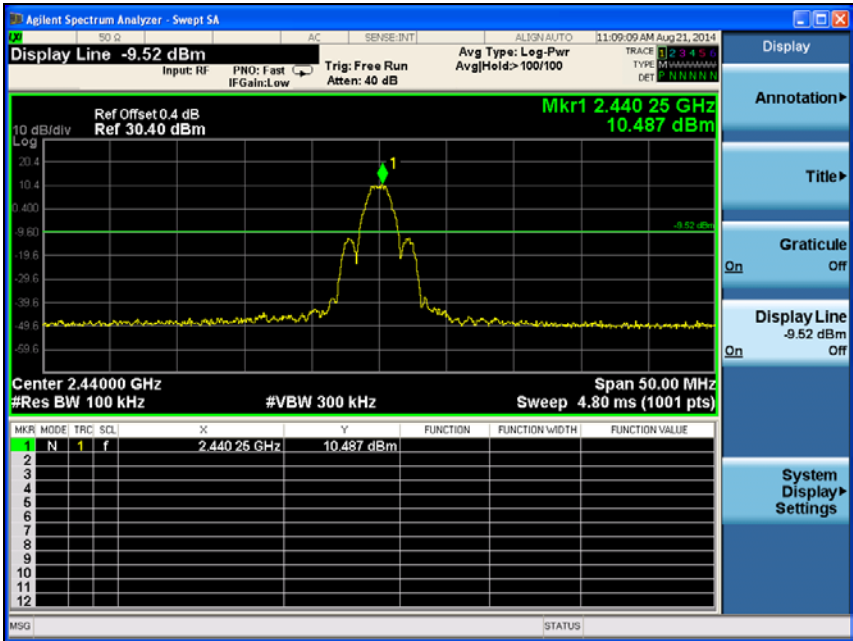
Figure 4. Plots of Band-Edge and Restricted / Non-Restricted frequency bands

Low



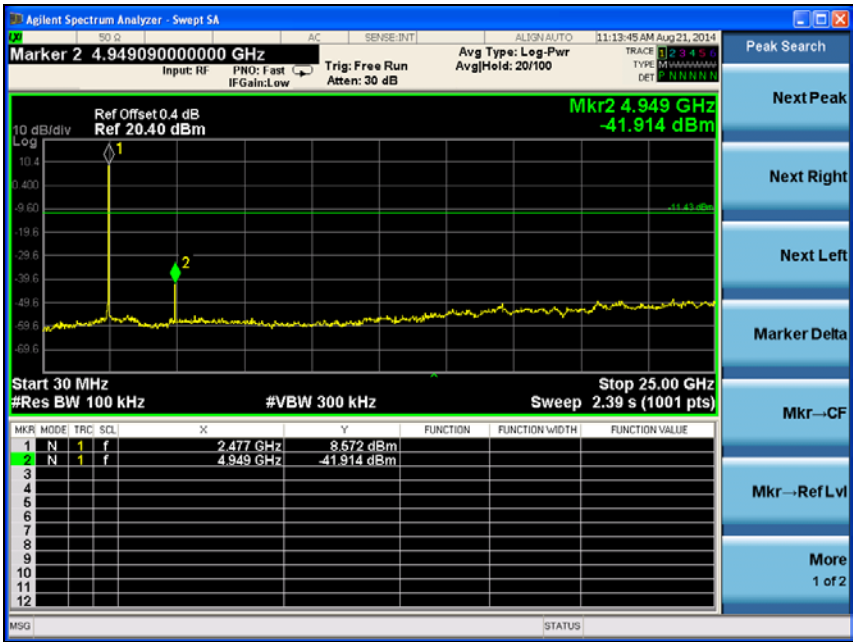
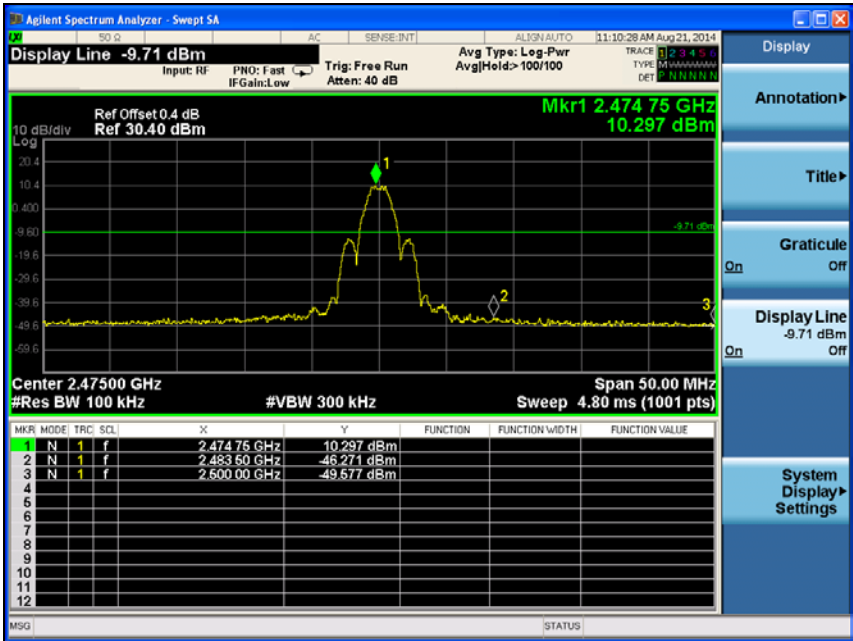
Order Number: 10307460
Model Number: GB8WH9013AWxyz

Middle



Order Number: 10307460
Model Number: GB8WH9013AWxyz

High



5.5. Radiated Spurious Emissions Measurement

TEST: Radiated spurious emissions measurement		
Method	Radiated emissions from the EUT were measured according to ANSI C63.4 procedure. - The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation. The antenna is varied from 1 to 4 meters above the ground to find the maximum field strength. Measurement are made with both horizontal and vertical polarizations For fundamental investigation, the EUT was positioned for 3 orthogonal orientations. - For measurement below 1GHz, the resolution bandwidth is set to 100 kHz for peak detection or 120kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak. - For measurement above 1GHz, the resolution bandwidth is set to 1 MHz and video bandwidth is set to 1 MHz for peak measurement and 10 Hz for average measurement. - For 2.4GHz transmitter measurement, the spectrum from 30 MHz to 26GHz is investigated for Low, Mid and High channels. - For 5 GHz transmitter measurement, the spectrum from 30 MHz to 40GHz is investigated for Low, Mid and High channels.	
Reference Clause	Part15 Subpart C Section 15.247 (d)	
Parameters recorded during the test	Laboratory Ambient Temperature	25 °C
	Relative Humidity	52 %
	Frequency range	Measurement Point
Fully configured sample scanned over the following frequency range	30 MHz – 25 GHz	3 meter chamber

Configuration Settings

Test Item	Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
Radiated Spurious emission	1	1	2
Supplementary information: None			

Limits

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. 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))

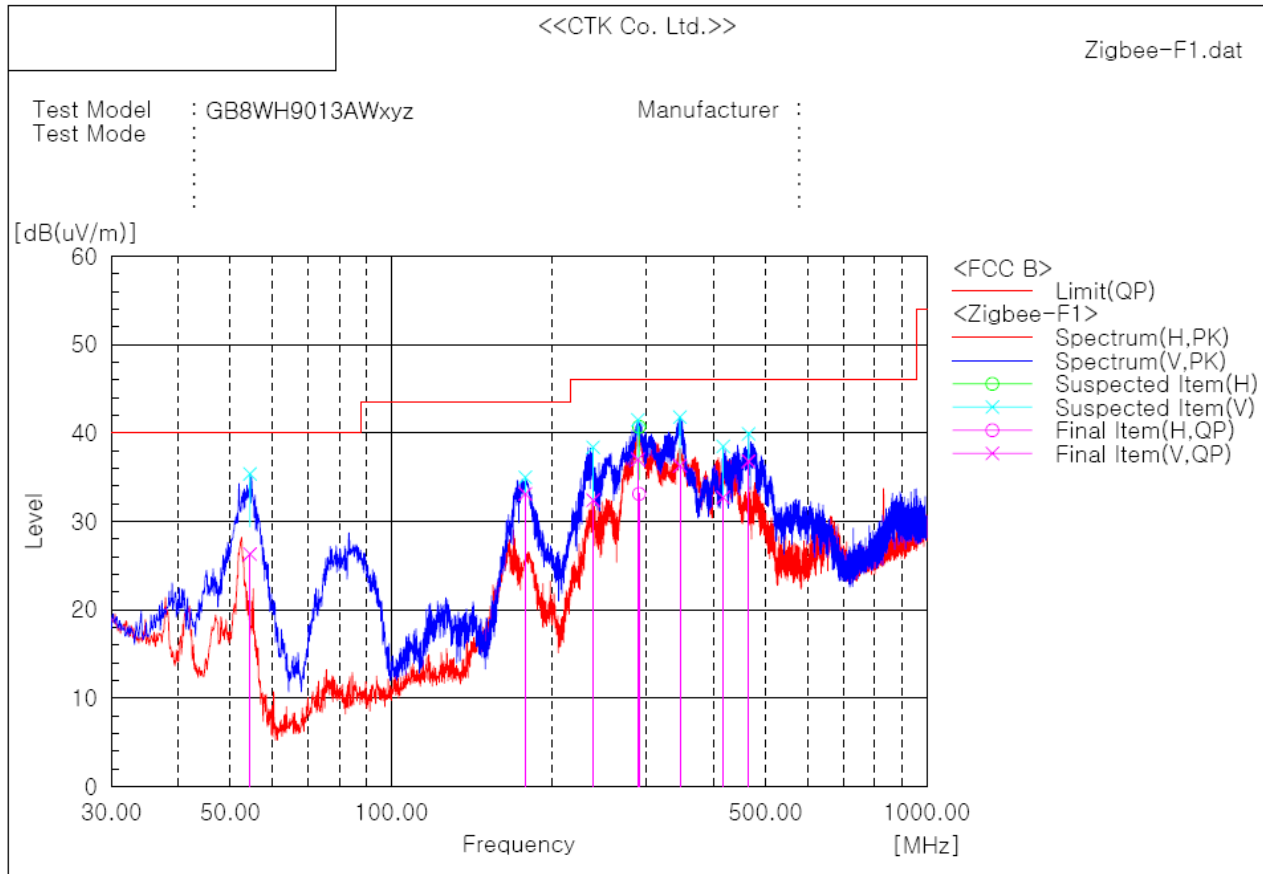
According to § 15.209(a), the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Distance (meters)	Field Strength (dBuV/m)	Field Strength (uV/m)
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

5.5.1. Radiated Spurious Emissions Below 1 GHz

Measurement method : ☒ Radiated ☐ Conducted
Mode of operation : Continuous Wave
Power setting : 0x75 (Register Value)
Worst case configuration : Low Channel
EUT direction : x-axis

Table 4. Test data for Radiated emission Below 1 GHz



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin [dB]	Height [cm]	Angle [deg]
1	54.493	V	43.5	-17.2	26.3	40.0	13.7	100.0	47.0
2	178.046	V	47.3	-14.2	33.1	43.5	10.4	100.0	10.0
3	238.186	V	42.8	-10.4	32.4	46.0	13.6	100.0	10.0
4	288.869	V	46.1	-9.1	37.0	46.0	9.0	195.0	162.0
5	290.445	H	42.2	-9.1	33.1	46.0	12.9	307.0	125.0
6	346.220	V	43.7	-7.4	36.3	46.0	9.7	100.0	236.0
7	416.909	V	37.7	-5.0	32.7	46.0	13.3	100.0	273.0
8	465.045	V	40.6	-3.8	36.8	46.0	9.2	100.0	311.0

Supplementary information:

- The frequency spectrum from 30 MHz to 1 000 MHz was investigated. Emission levels of 30 dB below than the limit is not reported.
- The worst case is x-axis and reported.
- Result = Reading + c.f (c.f : Antenna factor, Cable loss, Amp. Gain)
- Margin = Limit (dBuV/m) - Result (dBuV/m)
- The measurements for above 1 GHz, Average measurements are recorded using the RBAVG1 measurement procedure of KDB 558074. Peak measurements are recorded using RBW = 1 MHz, VBW = 3 MHz

5.5.2. Radiated Spurious Emissions Above 1 GHz

Measurement method : ☒ Radiated ☐ Conducted
Mode of operation : Continuous Wave
Power setting : 0x75 (Register Value)

Table 5. Low Channel

Radiated emissions			Ant	Correction factors (dB/m)	Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.			Result (dBuV/m)	Margin (dB)
4810	35.98	Average	V	12.88	54.00	48.86	5.14
4810	47.48	Peak	V	12.88	74.00	60.36	13.64
*2390	31.96	Average	V	8.01	54.00	39.97	14.03
*2390	45.18	Peak	V	8.01	74.00	53.19	20.81

Table 6. Mid Channel

Radiated emissions			Ant	Correction factors (dB/m)	Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.			Result (dBuV/m)	Margin (dB)
4880	34.18	Average	V	12.88	54.00	47.06	6.94
4880	45.94	Peak	V	12.88	74.00	58.82	15.18

Table 7. High Channel

Radiated emissions			Ant	Correction factors (dB/m)	Limit (dBuV/m)	Total	
Frequency (MHz)	Reading (dBuV)	Detect Mode	Pol.			Result (dBuV/m)	Margin (dB)
4950	33.52	Average	V	12.81	54.00	46.33	7.67
4950	45.60	Peak	V	12.81	74.00	58.41	15.59
*2483.5	32.52	Average	V	8.18	54.00	40.70	13.30
*2483.5	45.89	Peak	V	8.18	74.00	54.07	19.93

Supplementary information:

- The frequency spectrum from 30 MHz to 1 000 MHz was investigated. Emission levels of 30 dB below than the limit is not reported.
- The worst case is x-axis and reported.
- Result = Reading + c.f (c.f : Antenna factor, Cable loss, Amp. Gain)
- Margin = Limit (dBuV/m) - Result (dBuV/m)
- The measurements for above 1 GHz, Average measurements are recorded using the RBAVG1 measurement procedure of KDB 558074. Peak measurements are recorded using RBW = 1 MHz, VBW = 3 MHz
- * Restricted Band.

5.6. Transmitter AC Power Line Conducted Emission

TEST: Transmitter AC Power Line Conducted Emission		
Method	AC line conducted emissions from the EUT were measured according to the dictates of ANSI C63.4-2003. 1. The test procedure is performed in a 5.05m × 4.0m× 3.0m (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. The excess power cable between the EUT and the LISN was bundled. All connecting cables of EUT were moved to find the maximum emission.	
Basic Standard	FCC Part 15.207(a)	
Parameters recorded during the test	Laboratory Ambient Temperature	25 °C
	Relative Humidity	52 %
-	Frequency range on each side of line	Measurement Point
Fully configured sample scanned over the following frequency range	150 kHz to 30 MHz	A.C. Input port of A.C. to D.C. adapter.

Configuration Settings

Power Interface Mode # (See Section 3.3)	EUT Operation Mode # (See Section 3.5)	Test Configurations Mode # (See Section 3.7)
1	1	1
Supplementary information: None		

Limits

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.

Frequency of Emission (MHz)	Conducted limit (dB µV)	
	Quasi-peak	Average
0.15 – 0.5	66 - 56*	56 - 46*
0.5 – 5	56	46
5 – 30	60	50

* Decreases with the logarithm of the frequency.

5.6.1. Transmitter AC Power Line Conducted Emission

Measurement method : ☐ Radiated ☒ Conducted
Mode of operation : Continuous Wave
Power setting : 0x75 (Register Value)

Table 8. Test data for conducted emission

[HOT]

Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.163500	24.3	1000.0	9.000	On	L1	9.8	41.0	65.3
0.208500	21.3	1000.0	9.000	On	L1	9.8	42.0	63.3
0.555000	19.6	1000.0	9.000	On	L1	9.9	36.4	56.0
0.811500	19.9	1000.0	9.000	On	L1	9.8	36.1	56.0
0.852000	19.5	1000.0	9.000	On	L1	9.8	36.5	56.0
1.239000	17.6	1000.0	9.000	On	L1	9.7	38.4	56.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.514500	13.6	1000.0	9.000	On	L1	9.9	32.4	46.0
0.555000	14.2	1000.0	9.000	On	L1	9.9	31.8	46.0
0.681000	14.3	1000.0	9.000	On	L1	9.8	31.7	46.0
0.942000	12.5	1000.0	9.000	On	L1	9.8	33.5	46.0
1.027500	13.0	1000.0	9.000	On	L1	9.8	33.0	46.0
1.279500	11.7	1000.0	9.000	On	L1	9.7	34.3	46.0

[NEUTRAL]

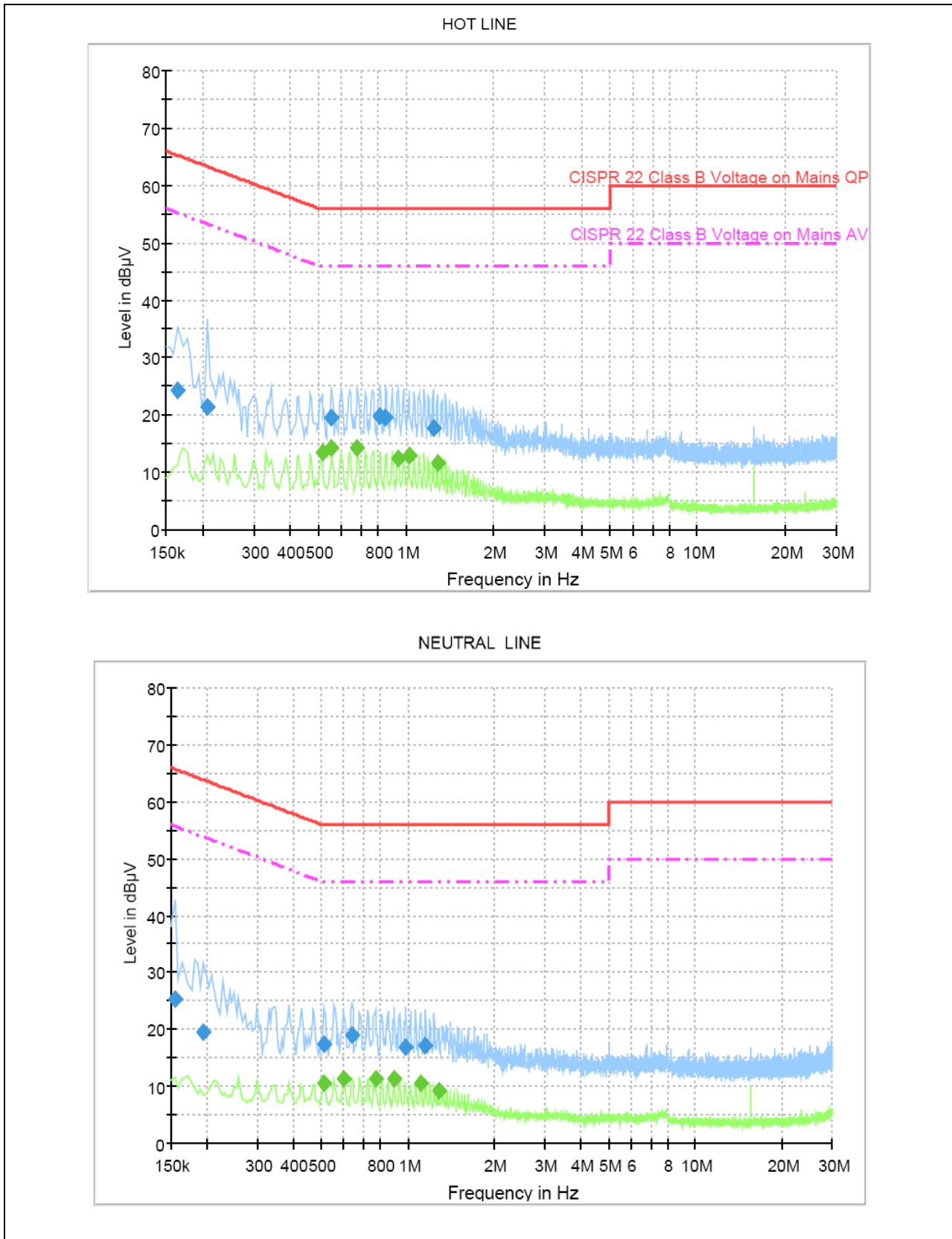
Final Result 1

Frequency (MHz)	QuasiPeak (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.154500	25.4	1000.0	9.000	On	N	9.7	40.3	65.8
0.195000	19.5	1000.0	9.000	On	N	9.8	44.3	63.8
0.510000	17.5	1000.0	9.000	On	N	9.9	38.5	56.0
0.640500	19.0	1000.0	9.000	On	N	9.9	37.0	56.0
0.982500	17.0	1000.0	9.000	On	N	9.7	39.0	56.0
1.153500	17.2	1000.0	9.000	On	N	9.7	38.8	56.0

Final Result 2

Frequency (MHz)	CAverage (dBμV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)
0.510000	10.7	1000.0	9.000	On	N	9.9	35.3	46.0
0.595500	11.3	1000.0	9.000	On	N	9.9	34.7	46.0
0.771000	11.4	1000.0	9.000	On	N	9.8	34.6	46.0
0.897000	11.5	1000.0	9.000	On	N	9.8	34.5	46.0
1.108500	10.6	1000.0	9.000	On	N	9.7	35.4	46.0
1.284000	9.3	1000.0	9.000	On	N	9.7	36.7	46.0

Figure 5. Graphical representation of Conducted Emission



5.7. Antenna Requirement

5.7.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §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. And according to FCC 47 CFR Section § 15.247 (b), if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in Db that the gain of the antenna exceeds 6 dBi.

5.7.2. Antenna Connected Construction

The antenna used of this product is Metal Stamping Antenna Assembly and peak max gain of each antennas as below . :

Band	2405 – 2480 MHz
Antenna Gain (dBi)	1.08

APPENDIX A. Accreditations and Authorizations

CTK has been accredited / filed / authorized by the agencies listed in the following table;

Certificate	Nation	Agency	Code	Mark
Accreditation	Korea	KOLAS	No. 119	ISO/IEC 17025
Site Filing	USA	FCC	805871	Test Facility list & NSA Data
	Japan	VCCI	C-986 R-3627 T-1843	Test Facility list & NSA Data
Certification	Korea	KC	KR0025	Test Facility list & NSA Data

Quality control in the testing laboratory is implemented as per ISO/IEC 17025 which is the “General requirements for the competent of calibration and testing laboratory”.