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TEST REPORT

FCC/ISED Zigbee Test for SZB23W
Certification

APPLICANT
LG Electronics Inc.

REPORT NO.
HCT-RF-2210-FI004

DATE OF ISSUE
October 27, 2022

Tested by
Kyung Jun Woo

Technical Manager
Kwon Jeong

Accredited by KOLAS, Republic of KOREA

HCT CO., LTD.
BongJai Huh / CEO

HCT CO., LTD.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si,
Gyeonggi-do, 17383 KOREA
Tel. +82 31 634 6300 Fax. +82 31 645 6401

HCT Co., Ltd.
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA
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Additional Model
-

Applicant	**LG Electronics Inc.** 222, LG-ro, Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do, 451-713, Republic of Korea
Eut Type Model Name	RF Module SZB23W
FCC ID IC	BEJSZB23W 2703H-SZB23W
Peak Output Power	7.052 dBm (5.07 mW)
Modulation type	O-QPSK
FCC Classification	Digital Transmission System(DTS)
FCC Rule Part(s)	Part 15.247
ISED Rule Part(s)	RSS-247 Issue 2 (February 2017) RSS-Gen Issue 5_Amendment 2 (February 2021)

The result shown in this test report refer only to the sample(s) tested unless otherwise stated.
This test results were applied only to the test methods required by the standard.

REVISION HISTORY

The revision history for this test report is shown in table.

Revision No.	Date of Issue	Description
0	October 27, 2022	Initial Release

Engineering Statement:
The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC / ISED Rules under normal use and maintenance.

KOLAS Statement:
The above Test Report is the accredited test result by (KS Q) ISO/IEC 17025 and KOLAS(Korea Laboratory Accreditation Scheme), which signed the ILAC-MRA. (KOLAS Accreditation No. KT197)

If this report is required to confirmation of authenticity, please contact to www.hct.co.kr

CONTENTS

1. EUT DESCRIPTION

Model	SZB23W
EUT Type	RF Module
Manufacturer Name Address	**LG Electronics Inc.** 222, LG-ro, Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do, 451-713, Republic of Korea
Factory Name Address	**LG Innotek Indonesia PT** Bekasi International Industrial Estate Blok C8 No. 12-12A Desa Cibatu, Cikarang, Indonesia
Power Supply	DC 3.30 V
Frequency Range	2405 MHz ~ 2480 MHz
Max. RF Output Power (Peak)	7.052 dBm (5.07 mW)
Modulation Type	O-QPSK
Number of Channels	16 Channels
Antenna Specification	Antenna type: PCB Printed PIFA type Peak Gain : 1.46 dBi
Date(s) of Tests	October 07, 2022~ October 27, 2022
PMN (Product Marketing Number)	RF Module
HVIN (Hardware Version Identification Number)	SZB23W
FVIN (Firmware Version Identification Number)	1.0
HMN (Host Marketing Name)	N/A
EUT serial numbers	Radiated : ETWZBSUC01-01 Conducted : ETWZBSUC01-02

2. TEST METHODOLOGY

FCC KDB 558074 D01 15.247 Meas Guidance v05 dated August 24, 2018 entitled “guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices and the measurement procedure described in ANSI C63.10(Version : 2013) ‘the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices’.

EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C. / RSS-Gen issue 5, RSS-247 issue 2.

GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30 MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1 GHz. Above 1 GHz with 1.5 m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3.75 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013)

Conducted Antenna Terminal

See Section from 8.3.(KDB 558074 v05)

DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

3. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.
Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

4. FACILITIES AND ACCREDITATIONS

FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil,
Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.
The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.
Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).
For ISED, test facility was accepted dated February 14, 2019 (CAB identifier: KR0032).

EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.
Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

5. ANTENNA REQUIREMENTS

According to FCC 47 CFR § 15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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."

(1) The antennas of this E.U.T are permanently attached.

(2) The E.U.T Complies with the requirement of § 15.203

According to RSS-GEN(Issue 5) Section 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotopically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

6. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of $k = 2$ to indicate a 95 % level of confidence.

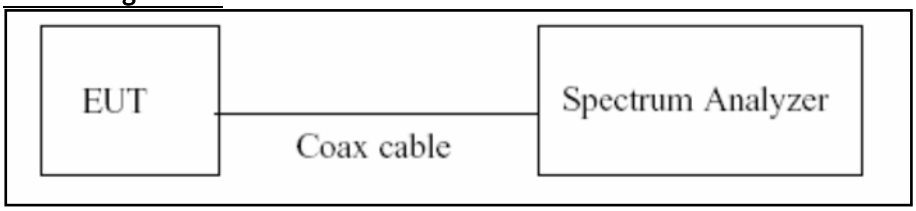
The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	2.00 (Confidence level about 95 %, k=2)
Radiated Disturbance (9 kHz ~ 30 MHz)	4.40 (Confidence level about 95 %, k=2)
Radiated Disturbance (30 MHz ~ 1 GHz)	5.74 (Confidence level about 95 %, k=2)
Radiated Disturbance (1 GHz ~ 18 GHz)	5.51 (Confidence level about 95 %, k=2)
Radiated Disturbance (18 GHz ~ 40 GHz)	5.92 (Confidence level about 95 %, k=2)
Radiated Disturbance (Above 40 GHz)	5.48 (Confidence level about 95 %, k=2)

7. DESCRIPTION OF TESTS

7.1. Duty Cycle

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.
We tested according to the zero-span measurement method, 6.0)b) in KDB 558074 v05.
The largest available value of RBW is 8 MHz and VBW is 50 MHz.
The zero-span method of measuring duty cycle shall not be used if T ≤ 6.25 microseconds. (50/6.25 = 8)
The zero-span method was used because all measured T data are > 6.25 microseconds and both RBW and VBW are > 50/*T*.

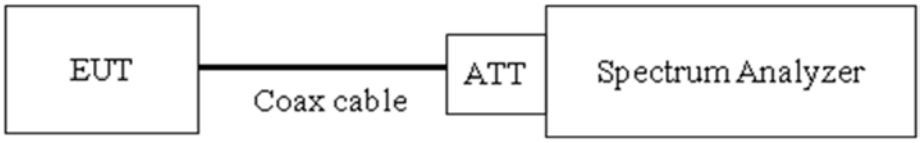
1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz (≥ RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on}/ T_{total} and Duty Cycle Factor = 10log(1/Duty Cycle)

7.2. 6 dB Bandwidth & 99 % Bandwidth

Limit

The minimum permissible 6 dB bandwidth is 500 kHz.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

The Spectrum Analyzer is set to (Procedure 11.8.1 in ANSI 63.10-2013)

1) RBW = 100 kHz
2) VBW ≥ 3 x RBW
3) Detector = Peak
4) Trace mode = max hold
5) Sweep = auto couple
6) Allow the trace to stabilize
7) We tested 6 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 6 dB.

Test Procedure (99 % Bandwidth for ISED)

The transmitter output is connected to the spectrum analyzer.

RBW = 1 % ~ 5 % of the occupied bandwidth

VBW ≒ 3 x RBW

Detector = Peak

Trace mode = max hold

Sweep = auto couple

Allow the trace to stabilize

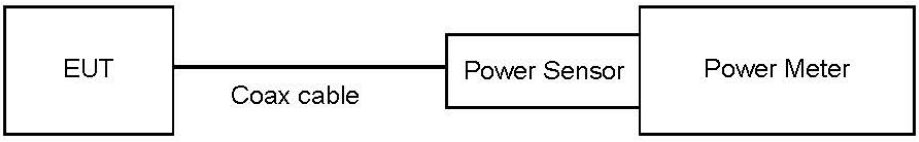
Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

7.3. Output Power

Limit

The maximum permissible conducted output power is 1 Watt.

Test Configuration



Test Procedure

The transmitter output is connected to the Power Meter.

- Peak Power (Procedure 11.9.1.3 in ANSI 63.10-2013)
  : Measure the peak power of the transmitter.

- Average Power (Procedure 11.9.2.3 in ANSI 63.10-2013)
  1) Measure the duty cycle.
  2) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
  3) Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Sample Calculation

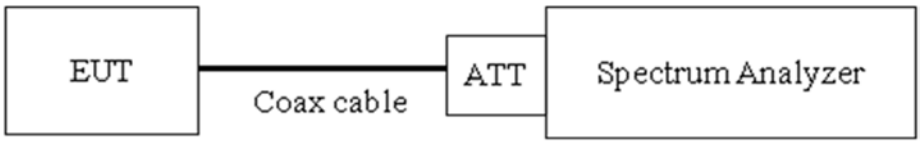
- Conducted Output Power(Peak) = Measured Value + ATT loss + Cable loss
- Conducted Output Power(Average) = Measured Value + ATT loss + Cable loss + Duty Cycle Factor

7.4. Power Spectral Density

Limit

The transmitter power density average over 1-second interval shall not be greater than 8dBm in any 3 kHz BW.

Test Configuration



Test Procedure

The transmitter output is connected to the Spectrum Analyzer.

We tested according to Procedure 8.4 in KDB 558074 v05r02, Procedure 11.10.2 in ANSI 63.10-2013.

The spectrum analyzer is set to :

1) Set analyzer center frequency to DTS channel center frequency.
2) Span = 1.5 times the DTS channel bandwidth.
3) RBW = 3 kHz ≤ RBW ≤ 100 kHz.
4) VBW ≥ 3 x RBW.
5) Sweep = auto couple
6) Detector = peak
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.
   If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Sample Calculation

- Power Spectral Density = Measured Value + ATT loss + Cable loss

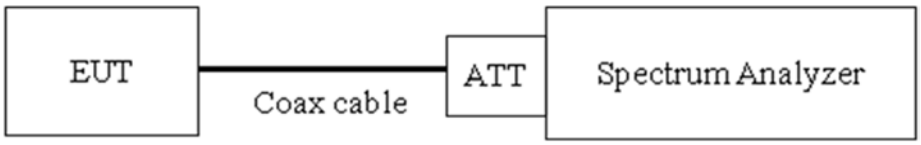
7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

Limit

The maximum conducted (Peak) output power was used to demonstrate compliance, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz.

[Conducted > 20 dBc]

Test Configuration



Test Procedure

The transmitter output is connected to the spectrum analyzer.

(Procedure 11.11 in ANSI 63.10-2013)

1) RBW = 100 kHz
2) VBW ≥ 3 x RBW
3) Set span to encompass the spectrum to be examined
4) Detector = Peak
5) Trace Mode = max hold
6) Sweep time = auto couple
7) Ensure that the number of measurement points ≥ 2 x Span/RBW
8) Allow trace to fully stabilize.
9) Use peak marker function to determine the maximum amplitude level.

Measurements are made over the 30 MHz to 25 GHz range with the transmitter set to the lowest, middle, and highest channels.

Factors for frequency

Freq(MHz)	Factor(dB)
30	10.35
100	10.39
200	10.44
300	10.48
400	10.54
500	10.54
600	10.54
700	10.57
800	10.58
900	10.59
1 000	10.64
2 000	10.79
2 400	10.85
2 412	10.85
2 437	10.85
2 462	10.85
2 500	10.83
3 000	10.95
4 000	11.01
5 000	11.10
5 700	11.17
5 800	11.17
6 000	11.38
7 000	11.50
8 000	11.49
9 000	11.58
10 000	11.68
11 000	11.77
12 000	11.86
13 000	11.87
14 000	11.91
15 000	12.00
16 000	12.09
17 000	12.28
18 000	12.42
19 000	12.34
20 000	12.01
21 000	12.14
22 000	12.13
23 000	12.10
24 000	12.15
25 000	12.26

Note : 1. 2400 ~ 2500 MHz is fundamental frequency range.

2. Factor = Attenuator loss + Cable loss

7.6. Radiated Test

Limit

FCC

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30

ISED

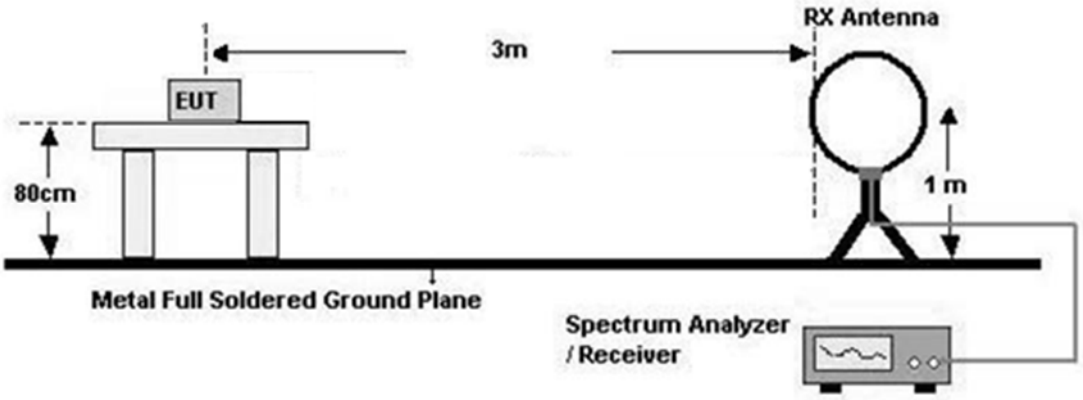
Frequency (MHz)	Field Strength (μA/m)	Measurement Distance (m)
0.009 – 0.490	6.37/F(kHz)	300
0.490 – 1.705	63.7/F(kHz)	30
1.705 – 30	0.08	30

FCC&ISED

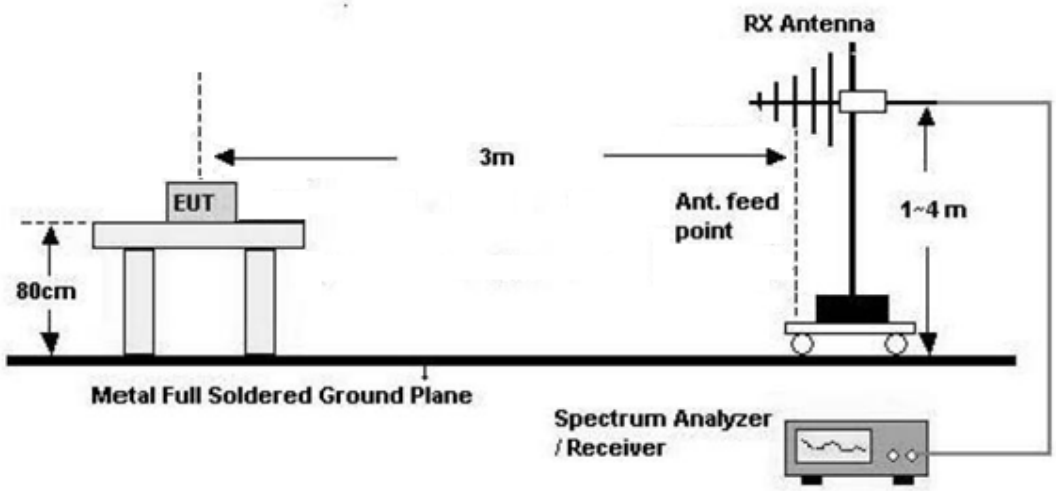
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Test Configuration

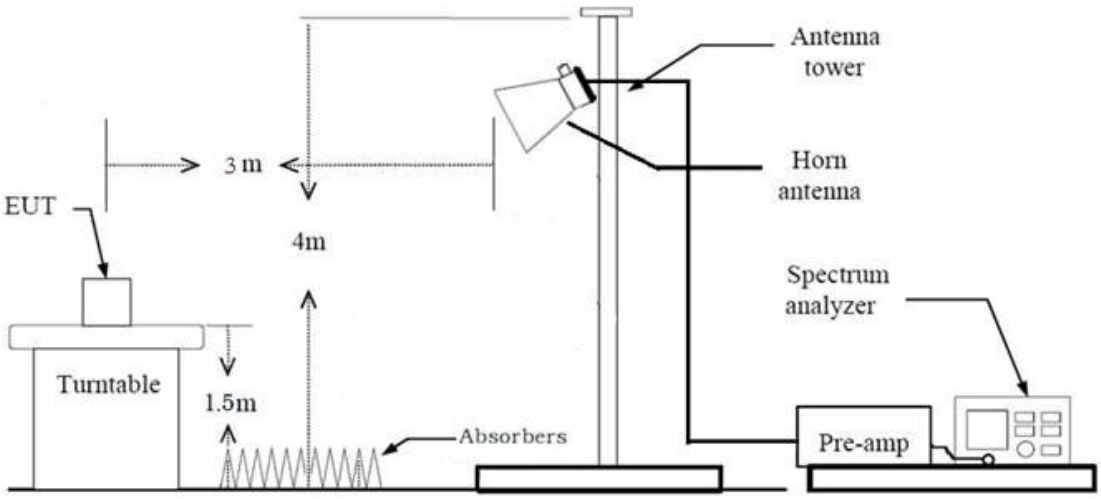
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



Test Procedure of Radiated spurious emissions(Below 30 MHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The loop antenna was placed at a location 3 m from the EUT
3. The EUT is placed on a turntable, which is 0.8 m above ground plane.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization and Parallel to the ground plane in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Distance Correction Factor(0.009 MHz – 0.490 MHz) = 40log(3 m/300 m) = - 80 dB
   Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) = 40log(3 m/30 m) = - 40 dB
   Measurement Distance : 3 m
8. Spectrum Setting
   - Frequency Range = 9 kHz ~ 30 MHz
   - Detector = Peak
   - Trace = Maxhold
   - RBW = 9 kHz
   - VBW ≥ 3 x RBW
9. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

10. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

KDB 414788 OFS and Chamber Correlation Justification

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.
OFS and chamber correlation testing had been performed and chamber measured test result is the worst case test result.

Test Procedure of Radiated spurious emissions(Below 1 GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8 m above ground plane.
3. The Hybrid antenna was placed at a location 3 m from the EUT, which is varied from 1 m to 4 m to find out the highest emissions.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 30 MHz – 1 GHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 100 kHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Quasi-peak):
      - Measured Frequency Range : 30 MHz – 1 GHz
      - Detector = Quasi-Peak
      - RBW = 120 kHz

   ※In general, (1) is used mainly
7. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L)
8. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.

Test Procedure of Radiated spurious emissions (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Spectrum Setting
   (1) Measurement Type(Peak):
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Average):
      - Average value of pulsed emissions
      - Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determine from the peak field strength after correcting for the worst-case duty cycle as described in Number.12 (On Page. 21)
9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
10. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
11. Total
   (1) Measurement (Peak)
      = Measured Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) – Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F)
   (2) Measurement (Avg)
      = Measured Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) – Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F) + D.C.C.F
12. Duty Cycle Correction Factor
   a. One period of the pulse train = 3.44 ms, where τ = pulse width

b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' = 3

c. All of the pulses within the pulse train= τ [ms] x H ' = 10.32 ms

d. Duty Cycle Correction = 20log (All of the pulses within the pulse train/ 100ms) dB = -19.73 dB

Test Procedure of Radiated Restricted Band Edge

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 2310 MHz ~ 2390 MHz/ 2483.5 MHz ~ 2500 MHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Average):
      - Average value of pulsed emissions
      - Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determine from the peak field strength after correcting for the worst-case duty cycle as described in Number.12 (On Page. 22)
9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
10. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
11. Total
   (1) Measurement (Peak)
      = Measured Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) – Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F)

(2) Measurement (Avg)

= Measured Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) – Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F) + D.C.C.F

12. Duty Cycle Correction Factor

a. One period of the pulse train = 3.44 ms, where τ = pulse width

b. 100 ms/ Δt [ms] = H → Round up to next highest integer, H ' = 3

c. All of the pulses within the pulse train= τ [ms] x H ' = 10.32 ms

d. Duty Cycle Correction = 20log (All of the pulses within the pulse train/ 100ms) dB = -19.73 dB

7.7. AC Power line Conducted Emissions

Limit

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 μH/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56[a]	56 to 46[a]
0.50 to 5	56	46
5 to 30	60	50

[a]Decreases with the logarithm of the frequency.

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs attached in Annex A for the actual connections between EUT and support equipment.

Test Procedure

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors : Quasi Peak and Average Detector.

Sample Calculation

Quasi-peak(Final Result) = Measured Value + Correction Factor

7.8. Receiver Spurious Emissions

Limit

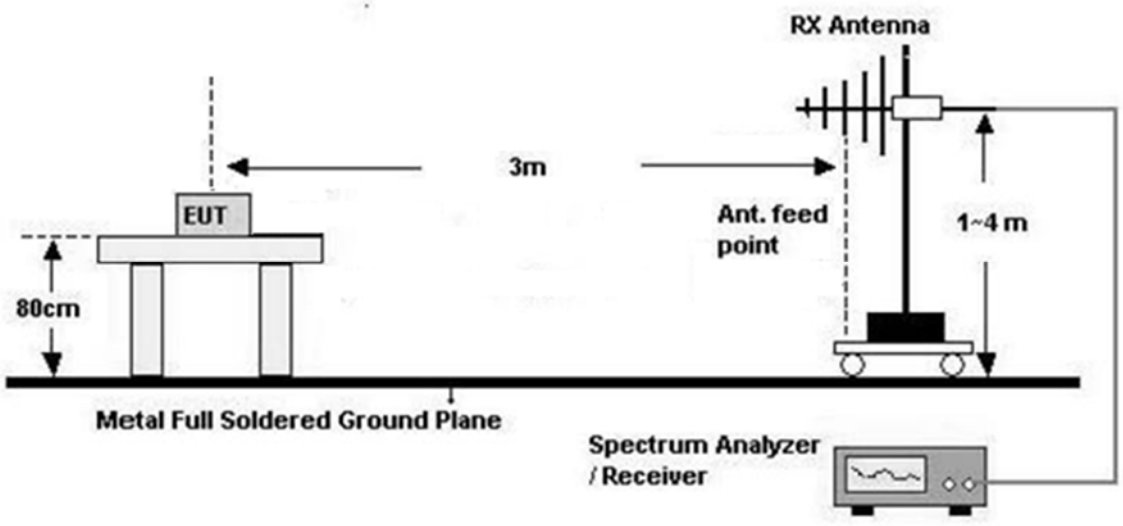
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

Measurements for compliance with the limits in table may be performed at distances other than 3 metres.

Test Configuration

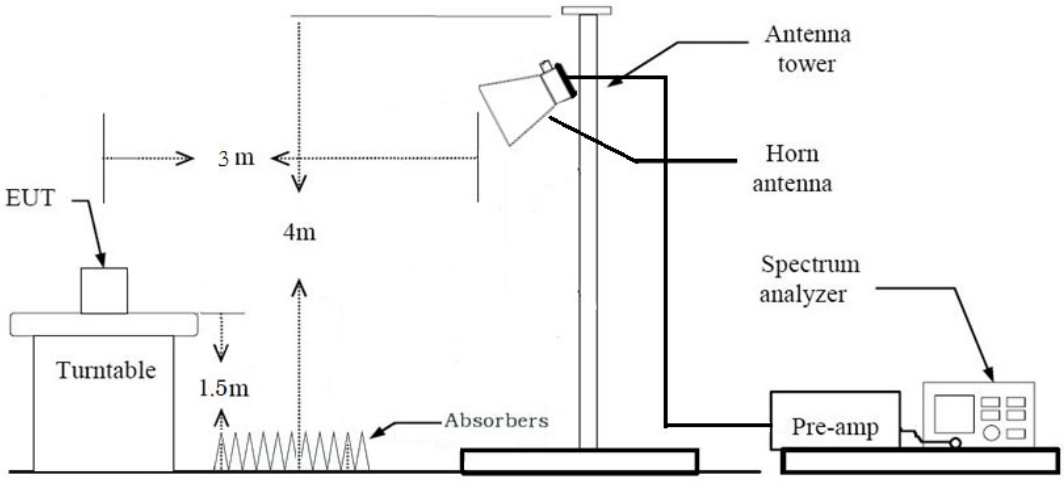
30 MHz - 1 GHz



Test Procedure of Receiver Spurious Emissions (Below 1GHz)

1. The EUT was placed on a non-conductive table located on semi-anechoic chamber.
2. The EUT is placed on a turntable, which is 0.8m above ground plane.
3. The Hybrid antenna was placed at a location 3m from the EUT, which is varied from 1 m to 4 m to find out the highest emissions.
4. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
6. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 30 MHz – 1 GHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 100 kHz
      - VBW ≥ 3 x RBW
   (2) Measurement Type(Quasi-peak):
      - Measured Frequency Range : 30 MHz – 1 GHz
      - Detector = Quasi-Peak
      - RBW = 120 kHz
7. Total = Measured Value + Antenna Factor(A.F) + Cable Loss(C.L)

Above 1 GHz



Test Procedure of of Receiver spurious emissions (Above 1 GHz)

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
3. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
4. EUT is set 3 m away from the receiving antenna, which is varied from 1 m to 4 m to find out the highest emissions.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. Each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. The unit was tested with its standard battery.
8. Spectrum Setting
   (1) Measurement Type(Peak):
      - Measured Frequency Range : 1 GHz – 25 GHz
      - Detector = Peak
      - Trace = Maxhold
      - RBW = 1 MHz
      - VBW ≥ 3 x RBW

(2) Measurement Type(Average):

- Average value of pulsed emissions
- Unless otherwise specified, when the radiated emission limits are expressed in terms of the average value of the emission and pulsed operation is employed, the average measurement shall determine from the peak field strength after correcting for the worst-case duty cycle as described in Number.12 (On Page. 27)

9. Measurement value only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
10. Distance extrapolation factor = 20log (test distance / specific distance) (dB)
11. Total

(1) Measurement (Peak)

= Measured Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) – Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F)

(2) Measurement (Avg)

= Measured Value(Peak) + Antenna Factor(A.F) + Cable Loss(C.L) – Amp Gain(A.G) + Attenuator(ATT) + Distance Factor(D.F) + D.C.C.F

12. Duty Cycle Correction Factor

a. One period of the pulse train = 3.44 ms, where τ = pulse width

b. 100 ms/ Δt [ms] = H $\rightarrow$ Round up to next highest integer, H ' = 3

c. All of the pulses within the pulse train= τ [ms] x H ' = 10.32 ms

d. Duty Cycle Correction = 20log (All of the pulses within the pulse train/ 100ms) dB = -19.73 dB

7.9. Worst case configuration and mode

Radiated test

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone
   - Worstcase : Stand alone
2. EUT Axis:
   - Radiated Spurious Emissions : Z
   - Radiated Restricted Band Edge : Y
3. Duty cycle Correction factor applies Radiated Restricted band edges and Radiated Spurious Emissions.
4. All data rate of operation were investigated and the test results are worst case in lowest data rate of each mode.
   - Zigbee Mode
5. EUT were tested and the worst case results are reported.

AC Power line Conducted Emissions

1. All modes of operation were investigated and the worst case configuration results are reported.
   - Mode : Stand alone

Conducted test

1. The EUT was configured with data rate of highest power.
   - ALL Mode Test
2. Test was performed with continuous Tx.

8. SUMMARY OF TEST RESULTS

Test Description	FCC Part Section(s)	ISED Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§ 15.247(a)(2)	RSS-247, 5.2.(a)	> 500 kHz	Conducted	PASS
Occupied Bandwidth	N/A	RSS-GEN, 6.7	N/A		N/A
Conducted Maximum Peak Output Power	§ 15.247(b)(3)	RSS-247, 5.4.(d)	< 1 Watt		PASS
Power Spectral Density	§ 15.247(e)	RSS-247, 5.2.(b)	< 8 dBm / 3 kHz Band		PASS
Band Edge (Out of Band Emissions)	§ 15.247(d)	RSS-247, 5.5	Conducted > 20 dBc		PASS
AC Power line Conducted Emissions	§ 15.207	RSS-GEN, 8.8	cf. Section 7.7		PASS
Radiated Spurious Emissions	§ 15.247(d), 15.205, 15.209	RSS-GEN, 8.9	cf. Section 7.6	Radiated	PASS
Radiated Restricted Band Edge	§ 15.247(d), 15.205, 15.209	RSS-GEN, 8.9 RSS-GEN, 8.10	cf. Section 7.6		PASS
Receiver Spurious Emissions	N/A	RSS-GEN, 7.3	cf. Section 7.8		PASS

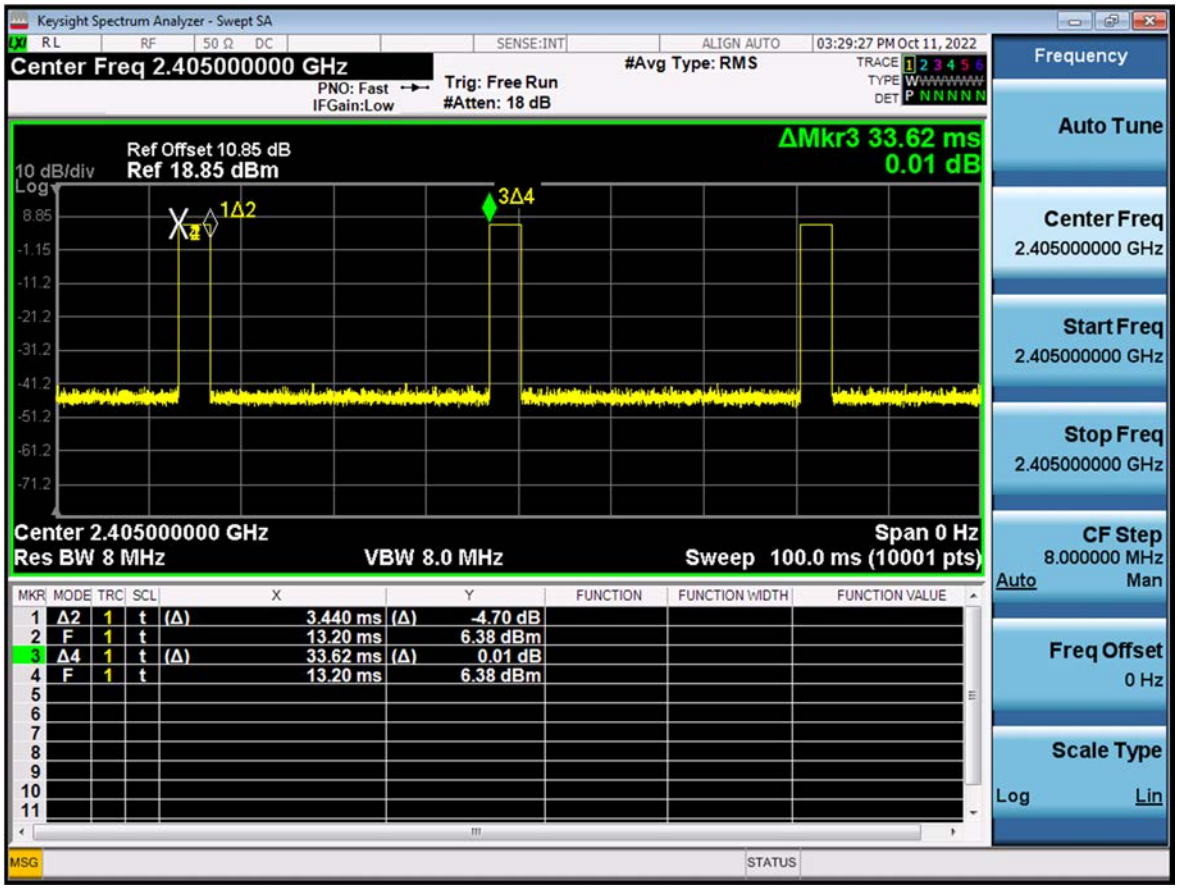
9. TEST RESULT

9.1 DUTY CYCLE & DCCF

Zigbee Mode	T_{on} (ms)	T_{total} (ms)	Duty Cycle	VBW(1/T) Hz
	-	-	-	-

Note : Test was performed with continuous Tx.

DCCF Plot



DCCF = 20log10(Pulse width / Period of the pulse train)

=20log[(3.44 ms x 3) / 100 ms] = -19.7264 dB

Duty Cycle Correction Factor	-19.73 dB

Note : ※ Duty cycle correction factor used (ANSI C63.10-2013 Section 7.5)

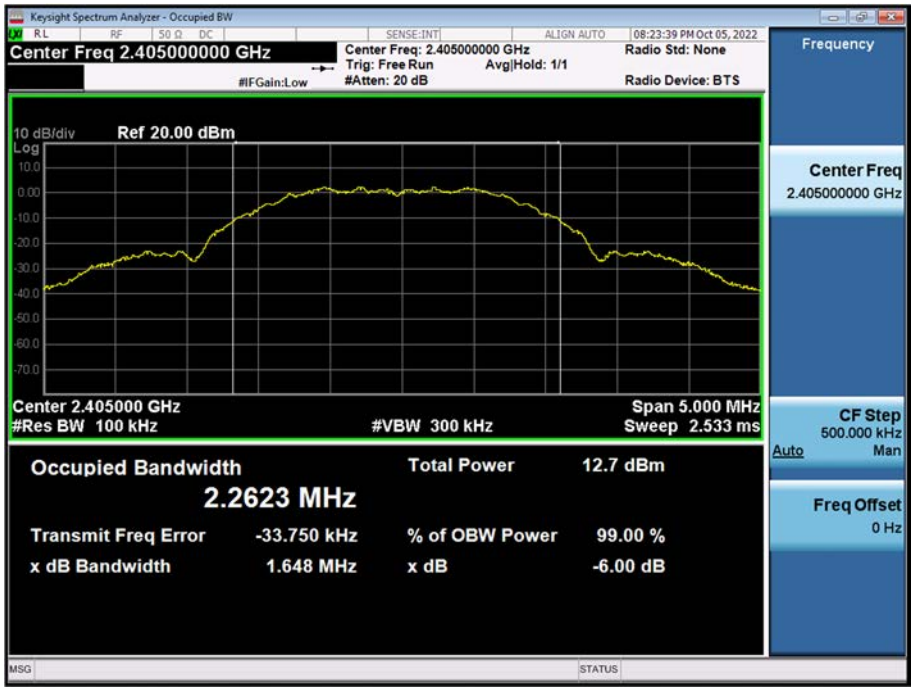
9.2 6 dB BANDWIDTH & 99 % BANDWIDTH

6 dB Bandwidth Measurements (FCC)

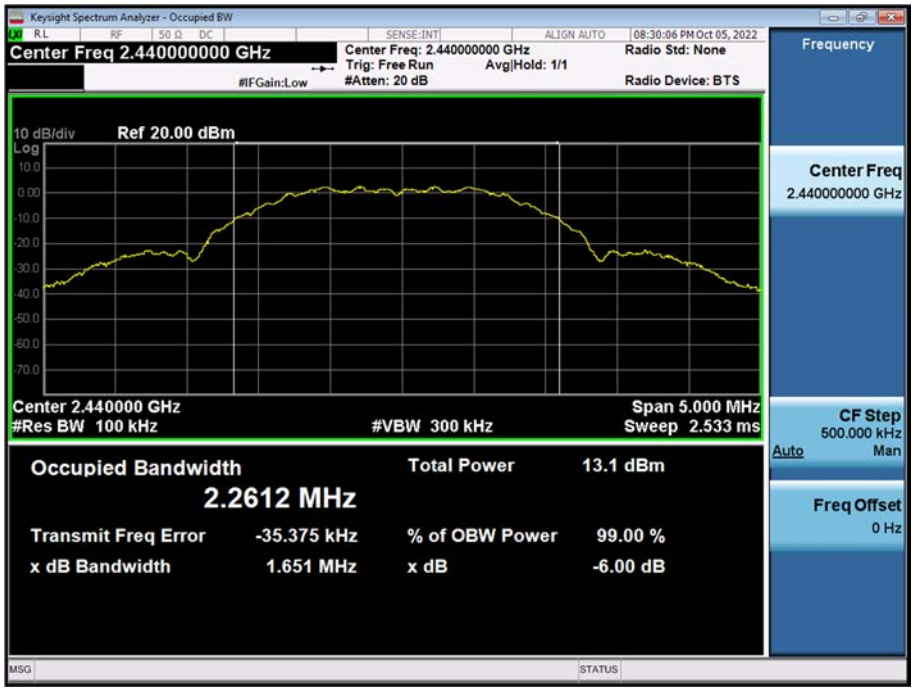
Zigbee Mode		6 dB Bandwidth [MHz]	Occupied Bandwidth [MHz]	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.			
2 405	11	1.648	2.2623	0.5
2 440	18	1.651	2.2612	0.5
2 480	26	1.648	2.2695	0.5

▣ Test Plots

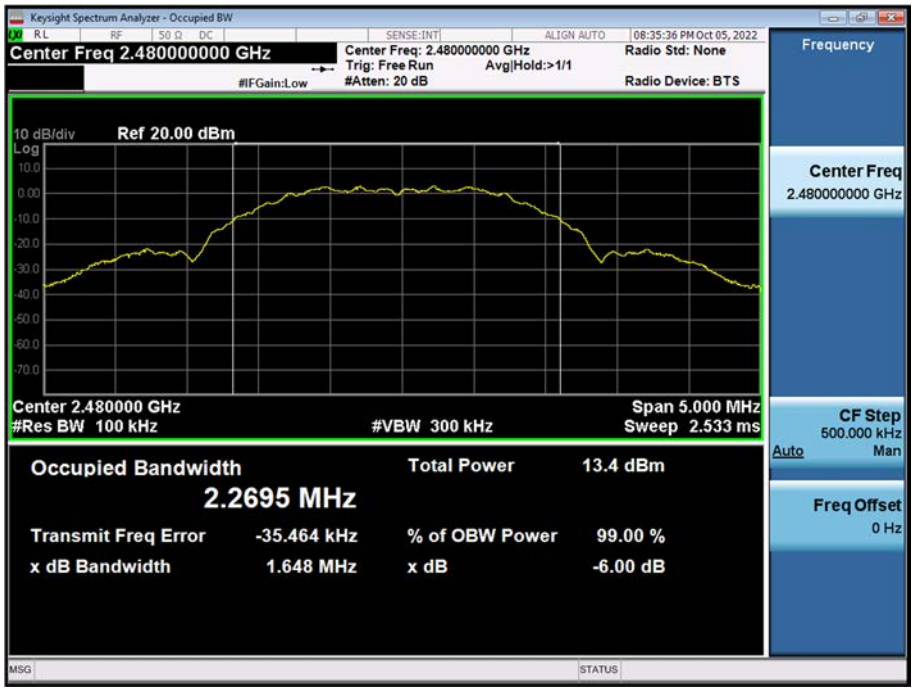
6 dB Bandwidth plot (CH 11)



6 dB Bandwidth plot (CH 18)



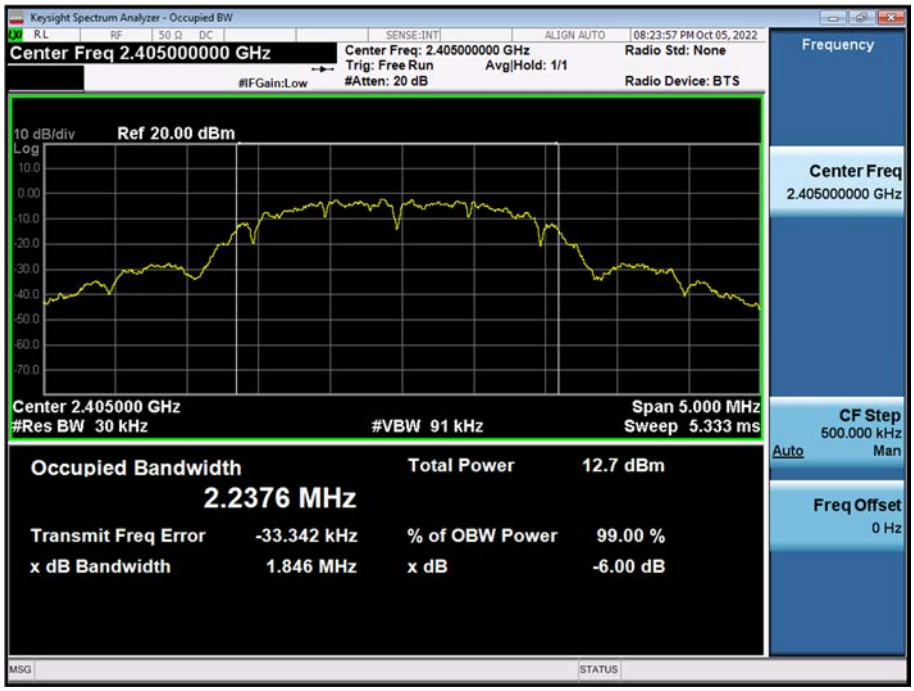
6 dB Bandwidth plot (CH 26)



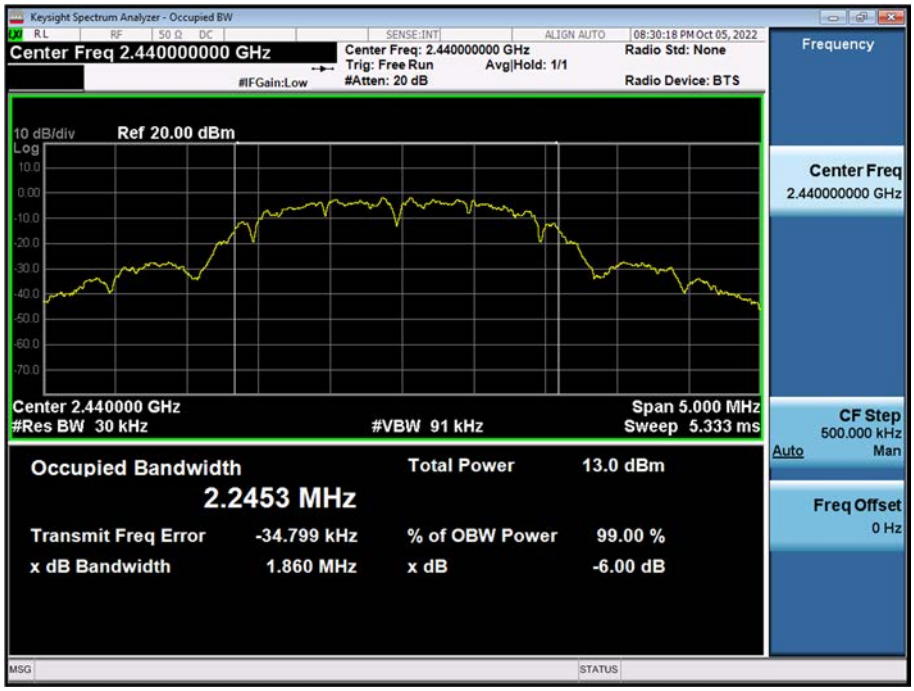
99 % Bandwidth Measurements (ISED)

Zigbee Mode		Measured Bandwidth [MHz] (99 % BW)	Minimum Bandwidth [MHz]
Frequency [MHz]	Channel No.		
2 405	11	2.2376	N/A
2 440	18	2.2453	N/A
2 480	26	2.2481	N/A

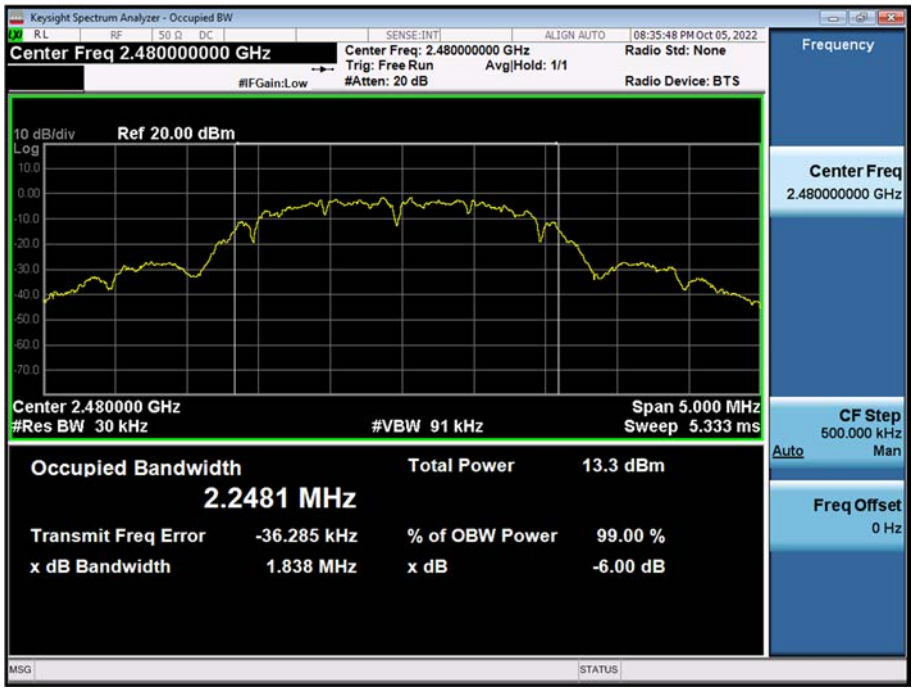
99 % Bandwidth plot (CH 11)



99 % Bandwidth plot (CH 18)



99 % Bandwidth plot (CH 26)



9.3 OUTPUT POWER

Peak Conducted Output Power (2 405 ~ 2 480 MHz)

Mode	Frequency (MHz)	Channel No.	Output Power (dBm)	Limit (dBm)
ZigBee	2 405	11	6.695	30
	2 440	18	6.706	
	2 480	26	7.052	

9.4 POWER SPECTRAL DENSITY

Mode	Frequency (MHz)	Channel No.	PSD (dBm/3 kHz)	Limit (dBm/3 kHz)
ZigBee	2 405	11	-9.650	8
	2 440	18	-9.325	
	2 480	26	-9.284	

▣ Test Plots

Power Spectral Density (CH 11)

Power Spectral Density (CH 18)

Power Spectral Density (CH 26)

9.5 BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

Test Result : please refer to the plot below.

In order to simplify the report, attached plots were only the worst case channel and data rate.

▣ Test Plots

Band Edge

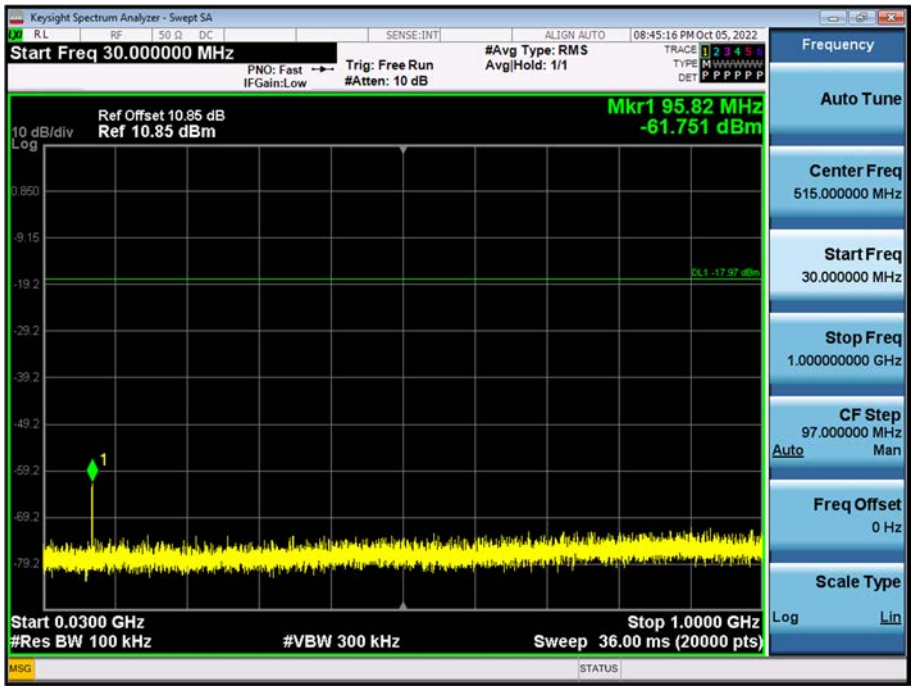
Band Edge (CH 11)

Band Edge (CH 26)

Conducted Spurious Emission

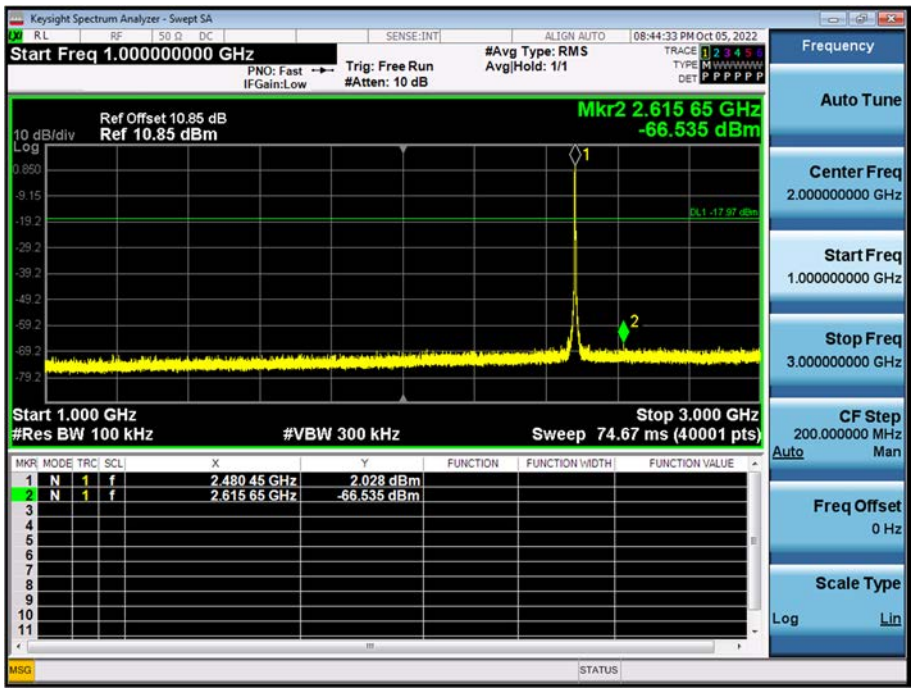
30 MHz ~ 1 GHz

Conducted Spurious Emission (CH 26)



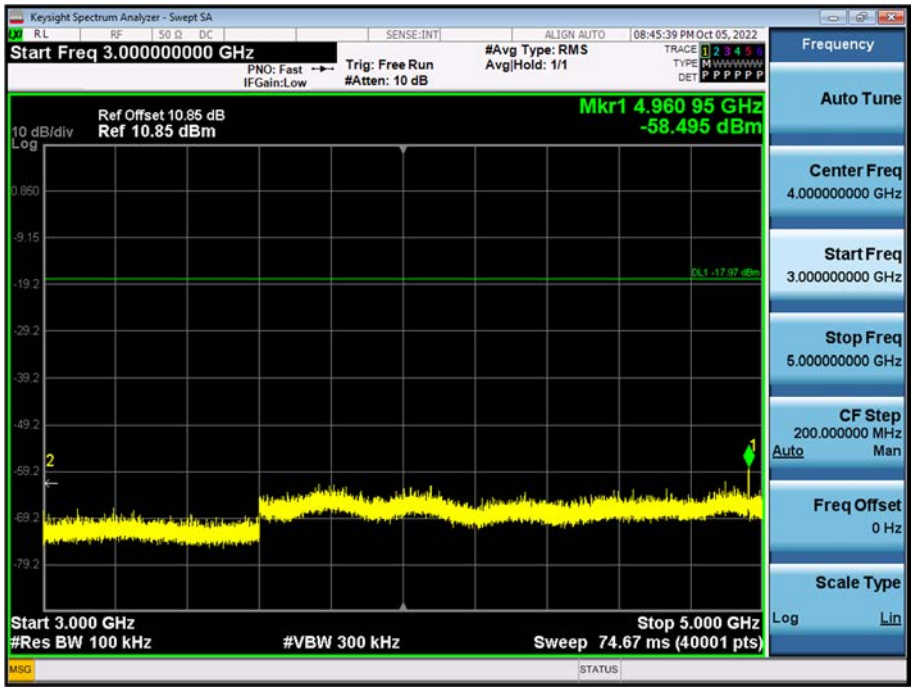
1 GHz ~ 3 GHz

Conducted Spurious Emission (CH 26)



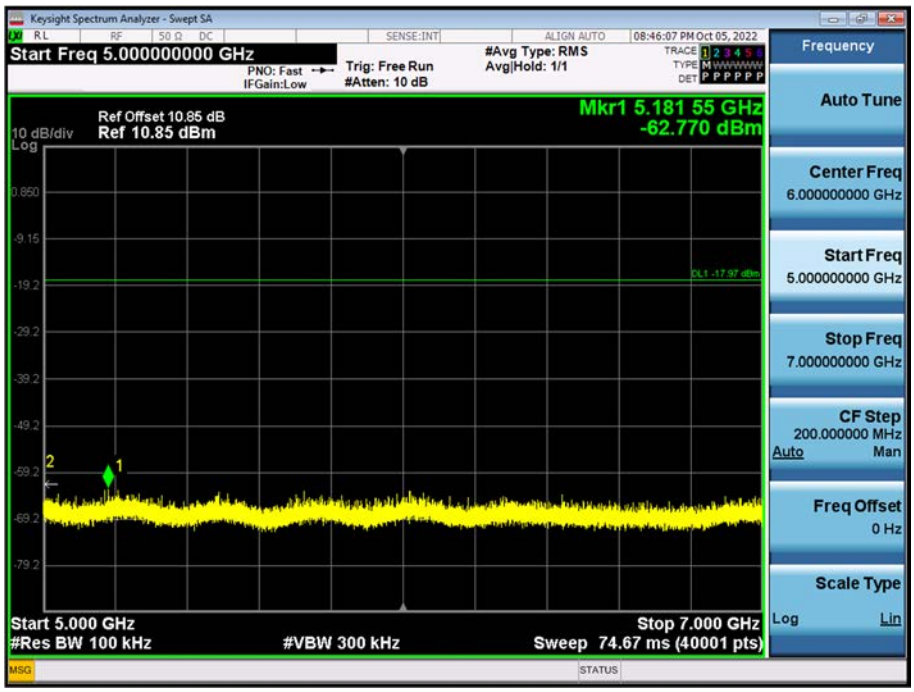
3 GHz ~ 5 GHz

Conducted Spurious Emission (CH 26)



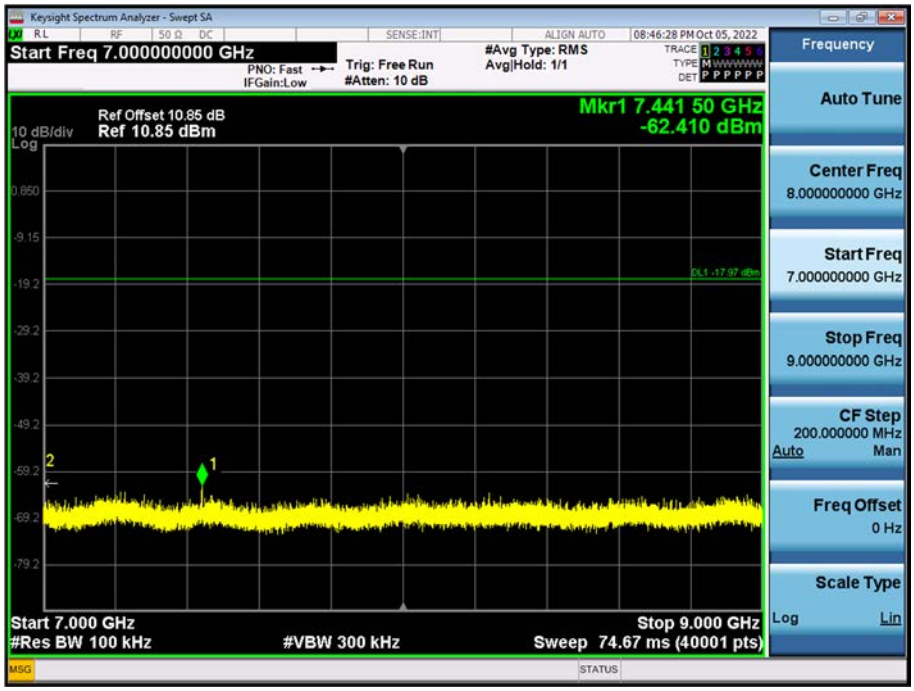
5 GHz ~ 7 GHz

Conducted Spurious Emission (CH 26)



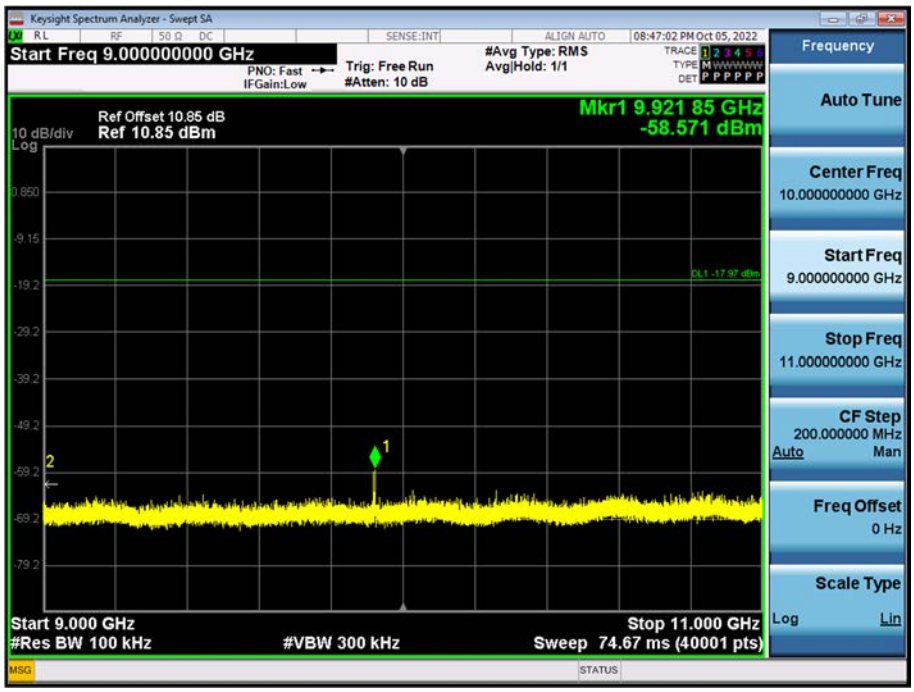
7 GHz ~ 9 GHz

Conducted Spurious Emission (CH 26)



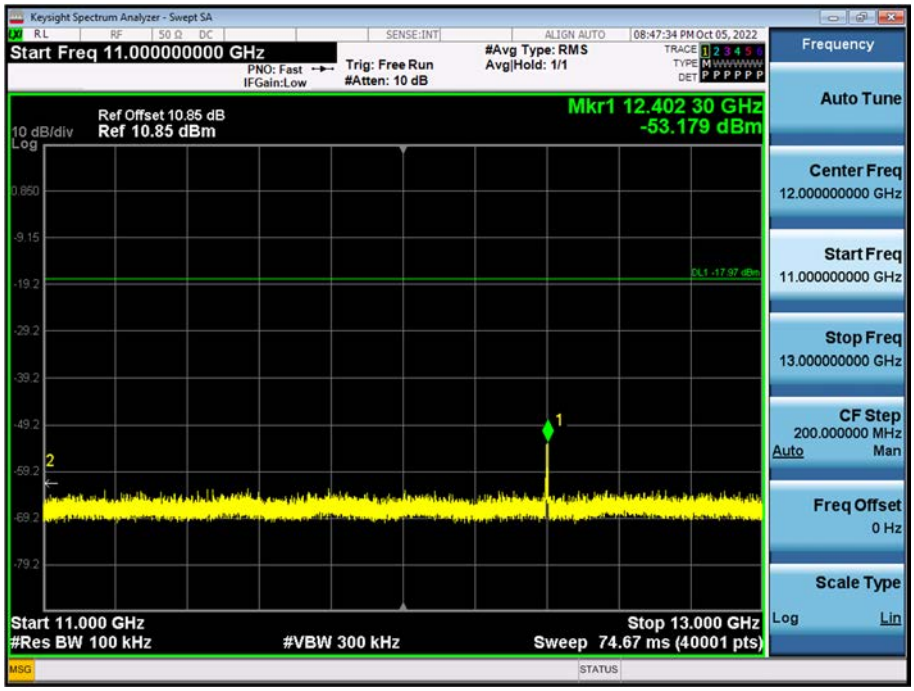
9 GHz ~ 11 GHz

Conducted Spurious Emission (CH 26)



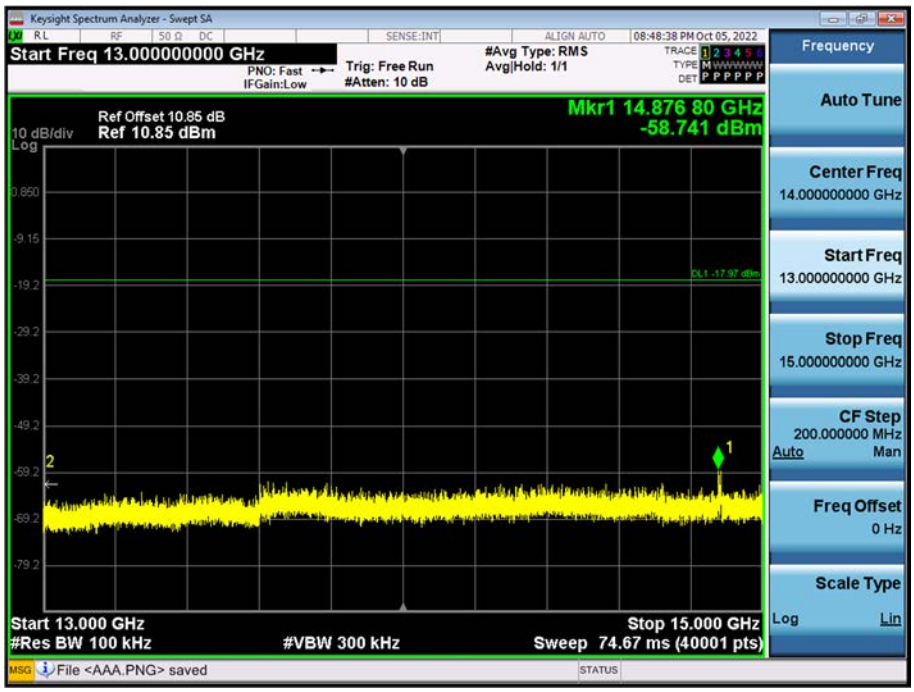
11 GHz ~ 13 GHz

Conducted Spurious Emission (CH 26)



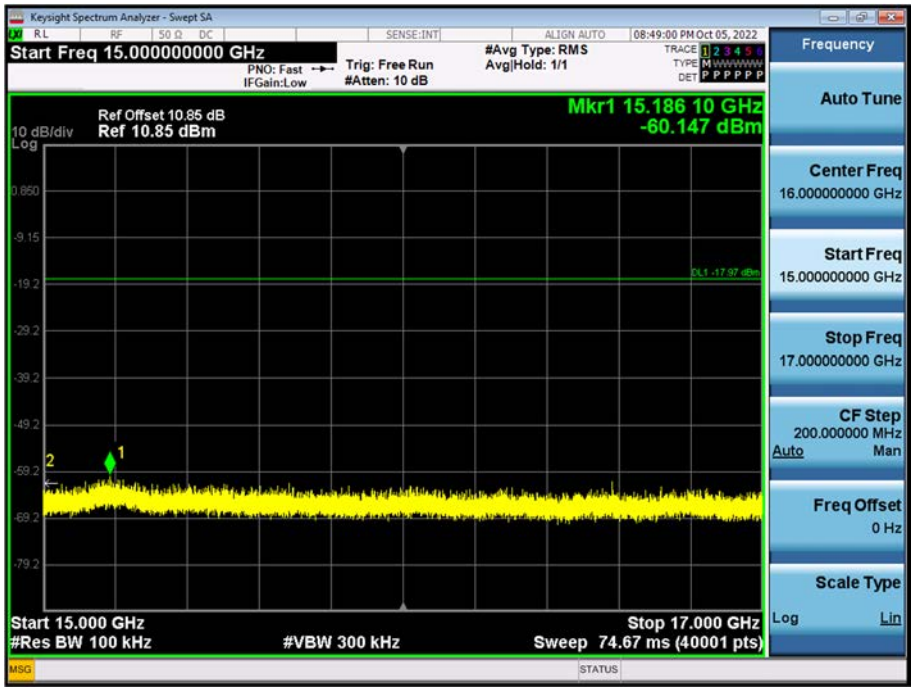
13 GHz ~ 15 GHz

Conducted Spurious Emission (CH 26)



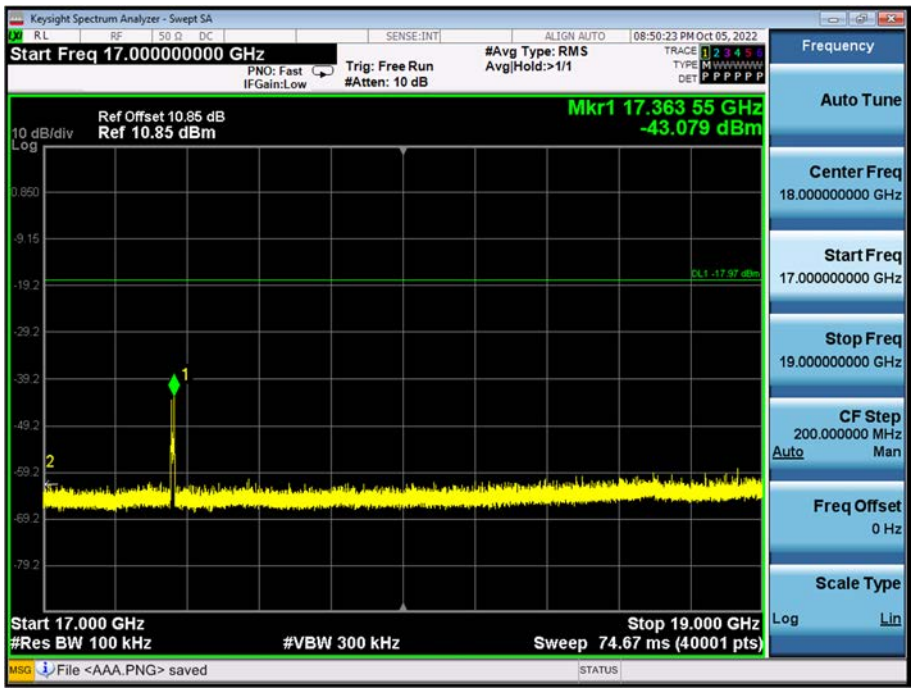
15 GHz ~ 17 GHz

Conducted Spurious Emission (CH 26)



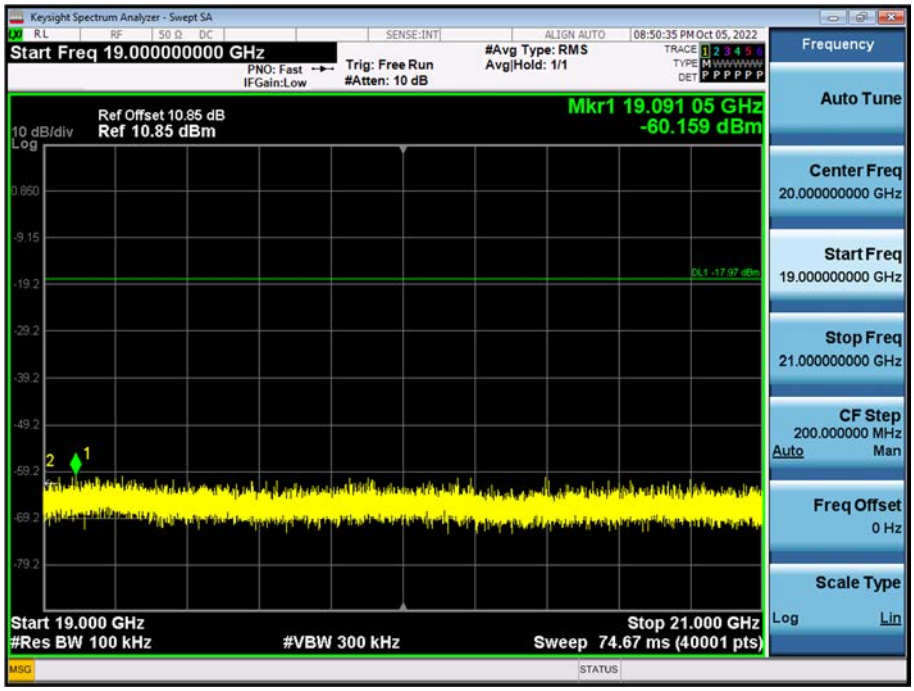
17 GHz ~ 19 GHz

Conducted Spurious Emission (CH 26)



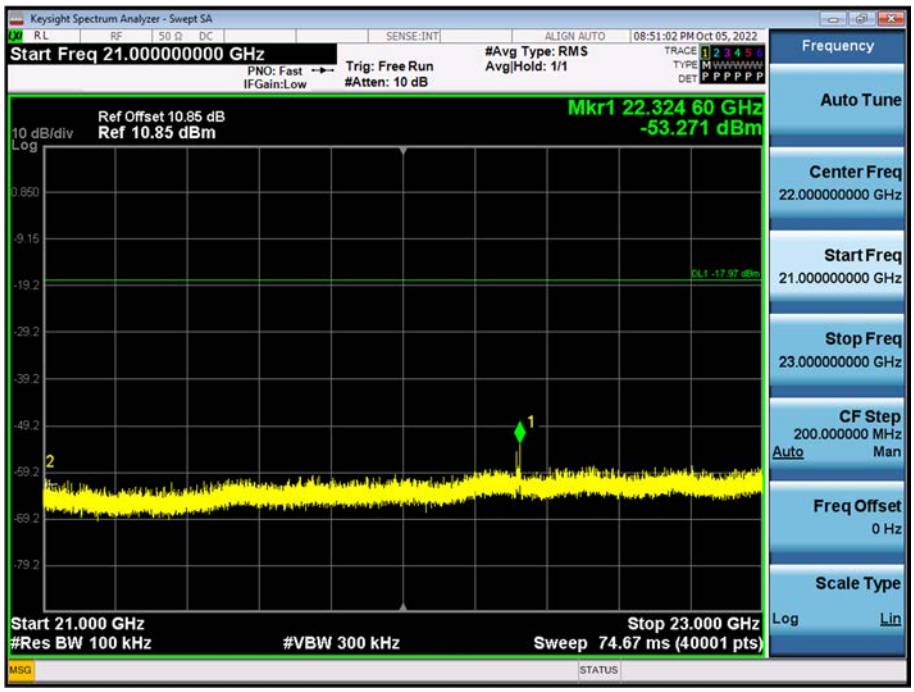
19 GHz ~ 21 GHz

Conducted Spurious Emission (CH 26)



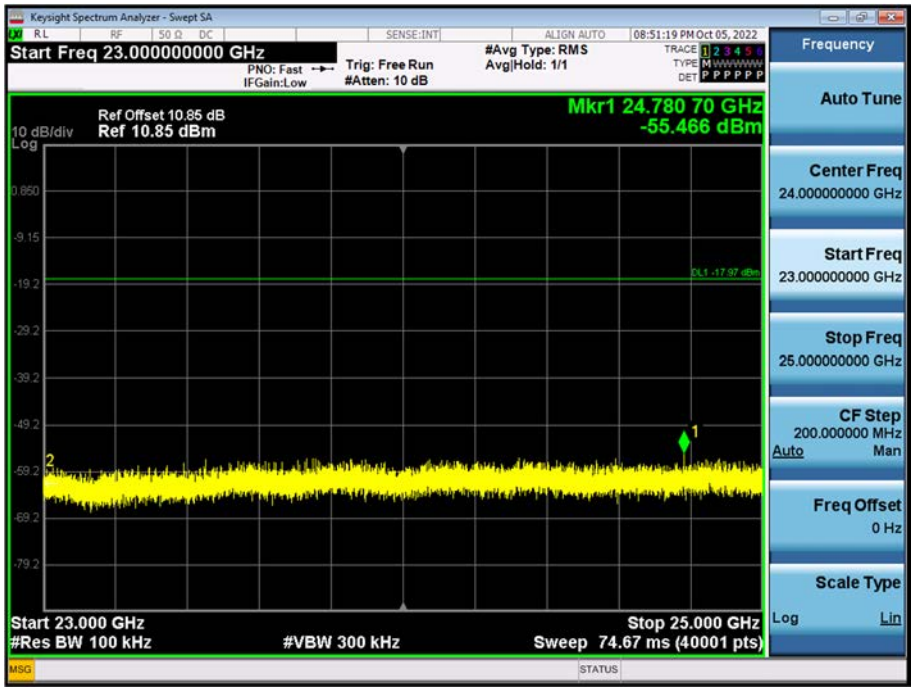
21 GHz ~ 23 GHz

Conducted Spurious Emission (CH 26)



23 GHz ~ 25 GHz

Conducted Spurious Emission (CH 26)



Limit : -17.97 dBm

9.6 RADIATED SPURIOUS EMISSIONS

Frequency Range : 9 kHz – 30 MHz

Frequency	Measured level	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBμV/m	dBm/m	dBm	(H/V)	dBμV/m	dBμV/m	dB
No Critical peaks found							

Note:

1. The Measured level of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
2. Distance extrapolation factor = 40log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBμV) + Distance extrapolation factor
4. The test results for below 30 MHz is correlated to an open site.
   The result on OATS is about 2 dB higher than semi-anechoic chamber(10 m chamber)

Frequency Range : Below 1 GHz

Frequency	Measured level	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBμV/m	dBm/m	dBm	(H/V)	dBμV/m	dBμV/m	dB
No Critical peaks found							

Note:

1. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.

Frequency Range : Above 1 GHz

Channel No. 11 [2 405 MHz]

Frequency	Measured Value	DCCF Factor	AF+CL +DF-AG	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBµV]	[dB/m]	[dB]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
4 810	45.37	0.00	2.56	V	47.93	73.98	26.05	PK
4 810	45.37	-19.73	2.56	V	28.20	53.98	25.78	AV
7 215	45.49	0.00	8.81	V	54.30	73.98	19.68	PK
7 215	45.49	-19.73	8.81	V	34.57	53.98	19.41	AV
9 620	38.58	0.00	13.39	V	51.97	73.98	22.01	PK
9 620	38.58	-19.73	13.39	V	32.24	53.98	21.74	AV
4 810	45.55	0.00	2.56	H	48.11	73.98	25.87	PK
4 810	45.55	-19.73	2.56	H	28.38	53.98	25.60	AV
7 215	45.21	0.00	8.81	H	54.02	73.98	19.96	PK
7 215	45.21	-19.73	8.81	H	34.29	53.98	19.69	AV
9 620	38.61	0.00	13.39	H	52.00	73.98	21.98	PK
9 620	38.61	-19.73	13.39	H	32.27	53.98	21.71	AV

Channel No. 18 [2 440 MHz]

Frequency	Measured Value	DCCF Factor	AF+CL +DF-AG	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBµV]	[dB/m]	[dB]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
4 880	45.34	0.00	2.72	V	48.06	73.98	25.92	PK
4 880	45.34	-19.73	2.72	V	28.33	53.98	25.65	AV
7 320	45.67	0.00	9.10	V	54.77	73.98	19.21	PK
7 320	45.67	-19.73	9.10	V	35.04	53.98	18.94	AV
9 760	38.17	0.00	14.67	V	52.84	73.98	21.14	PK
9 760	38.17	-19.73	14.67	V	33.11	53.98	20.87	AV
4 880	45.46	0.00	2.72	H	48.18	73.98	25.80	PK
4 880	45.46	-19.73	2.72	H	28.45	53.98	25.53	AV
7 320	45.23	0.00	9.10	H	54.33	73.98	19.65	PK
7 320	45.23	-19.73	9.10	H	34.60	53.98	19.38	AV
9 760	38.31	0.00	14.67	H	52.98	73.98	21.00	PK
9 760	38.31	-19.73	14.67	H	33.25	53.98	20.73	AV

Channel No. 26 [2 480 MHz]

Frequency	Measured Value	DCCF Factor	AF+CL +DF-AG	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBµV]	[dB/m]	[dB]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
4 960	47.59	0.00	2.31	V	49.90	73.98	24.08	PK
4 960	47.59	-19.73	2.31	V	30.17	53.98	23.81	AV
7 440	47.20	0.00	10.21	V	57.41	73.98	16.57	PK
7 440	47.20	-19.73	10.21	V	37.68	53.98	16.30	AV
9 920	38.21	0.00	14.21	V	52.42	73.98	21.56	PK
9 920	38.21	-19.73	14.21	V	32.69	53.98	21.29	AV
4 960	47.45	0.00	2.31	H	49.76	73.98	24.22	PK
4 960	47.45	-19.73	2.31	H	30.03	53.98	23.95	AV
7 440	46.58	0.00	10.21	H	56.79	73.98	17.19	PK
7 440	46.58	-19.73	10.21	H	37.06	53.98	16.92	AV
9 920	38.28	0.00	14.21	H	52.49	73.98	21.49	PK
9 920	38.28	-19.73	14.21	H	32.76	53.98	21.22	AV

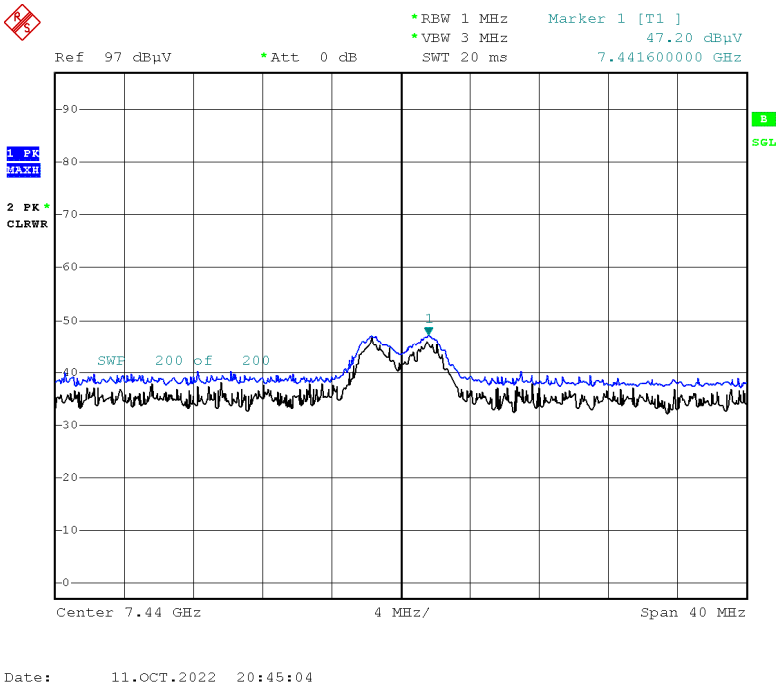
Note:

DCCF = 20xlog(3.44 ms/100 ms) = -19.7264 dB

DCCF = -19.73 dB

▣ Test Plots

Radiated Spurious Emissions plot – Average& Peak Result (CH.26 3rd Harmonic)



Note:

Plot of worst case are only reported.

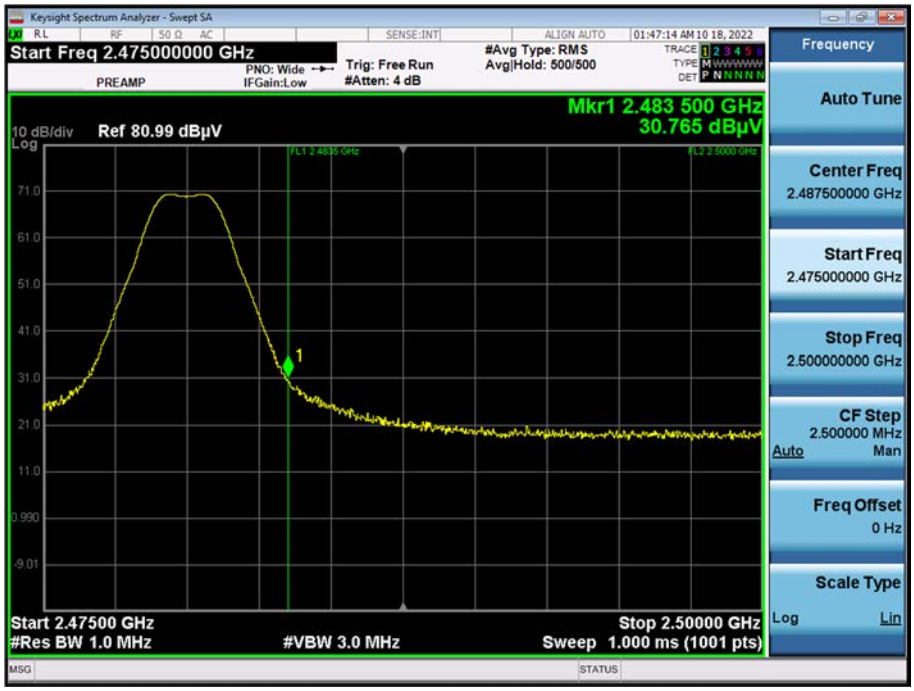
9.7 RADIATED RESTRICTED BAND EDGES

Operation Mode:	Zigbee
Operating Frequency	2 405 MHz & 2 480 MHz
Channel No.	11 Ch & 26 ch

Frequency	Measured Value	AF+CL+DF-AG	DCCF	ANT. POL	Total	Limit	Margin	Measurement Type
[MHz]	[dBµV]	[dB/m]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]	
2 390.0	20.17	35.43	0.00	H	55.59	73.98	18.39	PK
2 390.0	20.17	35.43	-19.73	H	35.86	53.98	18.12	AV
2 390.0	20.81	35.43	0.00	V	56.23	73.98	17.75	PK
2 390.0	20.81	35.43	-19.73	V	36.51	53.98	17.47	AV
2 483.5	30.29	35.57	0.00	H	65.86	73.98	8.12	PK
2 483.5	30.29	35.57	-19.73	H	46.13	53.98	7.85	AV
2 483.5	30.77	35.57	0.00	V	66.33	73.98	7.65	PK
2 483.5	30.77	35.57	-19.73	V	46.60	53.98	7.38	AV

▣ Test Plots

Radiated Restricted Band Edges plot – Average& Peak Result (CH.26: 2480 MHz)



Note:

Plot of worst case are only reported.

9.8 RECEIVER SPURIOUS EMISSIONS

Frequency Range : Below 1 GHz

Frequency	Measured level	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBμV/m	dBm/m	dBm	(H/V)	dBμV/m	dBμV/m	dB
No Critical peaks found							

Note:

1. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.

Frequency Range : Above 1 GHz

Frequency	Measured level	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dBμV/m	dBm/m	dBm	(H/V)	dBμV/m	dBμV/m	dB
No Critical peaks found							

9.9 POWERLINE CONDUCTED EMISSIONS

Conducted Emissions (Line 1)

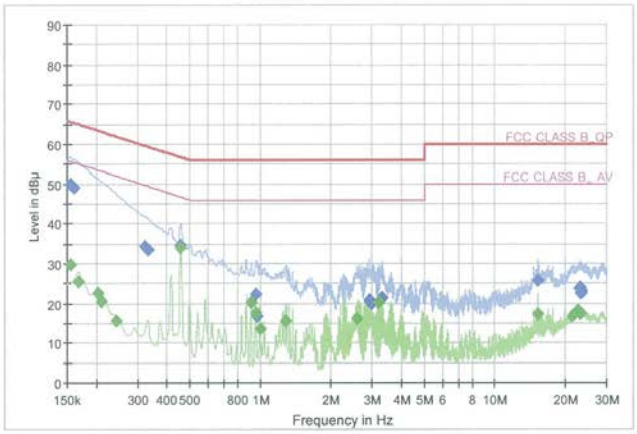
Test 1 / 2

Test Report

Common Information

EUT :	SZB23W
Manufacturer :	LGIT
Test Site :	SHIELD ROOM
Operating Conditions :	Zigbee L1

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment
0.1545	49.83	65.75	15.93	9.000	L1	OFF	9.6	
0.1613	49.17	65.40	16.22	9.000	L1	OFF	9.6	
0.3210	34.40	59.68	25.28	9.000	L1	OFF	9.6	
0.3278	33.98	59.51	25.53	9.000	L1	OFF	9.6	
0.3345	33.60	59.34	25.74	9.000	L1	OFF	9.6	
0.4583	34.51	56.72	22.22	9.000	L1	OFF	9.6	
0.9590	22.14	56.00	33.86	9.000	L1	OFF	9.6	
0.9748	16.66	56.00	39.34	9.000	L1	OFF	9.6	
2.9255	20.79	56.00	35.21	9.000	L1	OFF	9.7	
2.9323	20.43	56.00	35.57	9.000	L1	OFF	9.7	
2.9840	19.83	56.00	36.17	9.000	L1	OFF	9.7	
3.3238	21.36	56.00	34.64	9.000	L1	OFF	9.7	
15.3005	25.72	60.00	34.28	9.000	L1	OFF	9.9	
22.9753	23.65	60.00	36.35	9.000	L1	OFF	9.9	
23.0540	23.95	60.00	36.05	9.000	L1	OFF	9.9	
23.2025	22.54	60.00	37.46	9.000	L1	OFF	9.9	
23.2970	23.14	60.00	36.86	9.000	L1	OFF	9.9	
23.5468	22.55	60.00	37.45	9.000	L1	OFF	9.9	

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Test 2 / 2

Final_Result_CAV

Frequency (MHz)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment
0.1545	29.81	55.75	25.95	9.000	L1	OFF	9.6	
0.1680	25.41	55.06	29.65	9.000	L1	OFF	9.6	
0.2040	22.40	53.45	31.05	9.000	L1	OFF	9.6	
0.2108	20.34	53.18	32.84	9.000	L1	OFF	9.6	
0.2445	15.72	51.94	36.22	9.000	L1	OFF	9.6	
0.4583	34.01	46.72	12.71	9.000	L1	OFF	9.6	
0.9163	20.21	46.00	25.79	9.000	L1	OFF	9.6	
0.9590	17.57	46.00	28.43	9.000	L1	OFF	9.6	
0.9995	13.59	46.00	32.41	9.000	L1	OFF	9.6	
1.2920	15.52	46.00	30.48	9.000	L1	OFF	9.6	
2.5858	16.05	46.00	29.95	9.000	L1	OFF	9.7	
3.2090	20.18	46.00	25.82	9.000	L1	OFF	9.7	
15.3028	17.34	50.00	32.66	9.000	L1	OFF	9.9	
21.4295	16.83	50.00	33.17	9.000	L1	OFF	9.9	
22.7638	18.05	50.00	31.95	9.000	L1	OFF	9.9	
23.0608	17.36	50.00	32.64	9.000	L1	OFF	9.9	
23.2250	17.58	50.00	32.42	9.000	L1	OFF	9.9	
23.2678	17.56	50.00	32.44	9.000	L1	OFF	9.9	

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Conducted Emissions (Line 2)

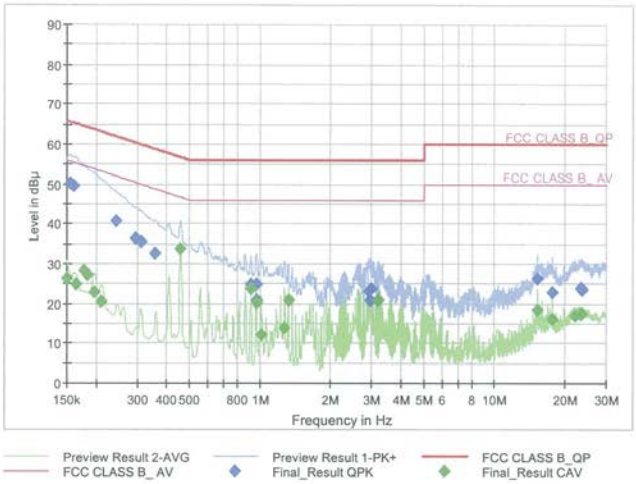
Test 1 / 2

Test Report

Common Information

EUT :	SZB23W
Manufacturer :	LGIT
Test Site :	SHIELD ROOM
Operating Conditions :	Zigbee N

Full Spectrum



Final_Result_QPK

Frequency (MHz)	QuasiPeak (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment
0.1545	50.22	65.75	15.53	9.000	N	OFF	9.5	
0.1613	49.48	65.40	15.92	9.000	N	OFF	9.5	
0.2423	40.82	62.02	21.20	9.000	N	OFF	9.6	
0.2963	36.43	60.35	23.92	9.000	N	OFF	9.6	
0.3120	35.38	59.92	24.54	9.000	N	OFF	9.6	
0.3570	32.61	58.80	26.19	9.000	N	OFF	9.6	
0.9185	24.78	56.00	31.22	9.000	N	OFF	9.6	
0.9658	24.80	56.00	31.20	9.000	N	OFF	9.6	
0.9725	20.90	56.00	35.10	9.000	N	OFF	9.6	
2.9300	23.11	56.00	32.89	9.000	N	OFF	9.7	
2.9570	20.91	56.00	35.09	9.000	N	OFF	9.7	
2.9885	23.53	56.00	32.47	9.000	N	OFF	9.7	
15.2960	26.17	60.00	33.83	9.000	N	OFF	9.8	
17.5865	22.82	60.00	37.18	9.000	N	OFF	9.9	
23.3105	23.87	60.00	36.13	9.000	N	OFF	9.9	
23.3870	23.76	60.00	36.24	9.000	N	OFF	9.9	
23.5040	24.00	60.00	36.00	9.000	N	OFF	9.9	
23.7920	23.30	60.00	36.70	9.000	N	OFF	9.9	

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Test 2 / 2

Final_Result_CAV

Frequency (MHz)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)	Comment
0.1500	26.16	56.00	29.84	9.000	N	OFF	9.5	
0.1635	24.67	55.28	30.62	9.000	N	OFF	9.5	
0.1770	28.33	54.63	26.30	9.000	N	OFF	9.6	
0.1838	27.13	54.31	27.18	9.000	N	OFF	9.6	
0.1973	22.81	53.73	30.91	9.000	N	OFF	9.6	
0.2108	20.52	53.18	32.65	9.000	N	OFF	9.6	
0.4583	33.86	46.72	12.87	9.000	N	OFF	9.6	
0.9185	23.57	46.00	22.43	9.000	N	OFF	9.6	
0.9658	20.25	46.00	25.75	9.000	N	OFF	9.6	
1.0153	12.19	46.00	33.81	9.000	N	OFF	9.6	
1.2785	13.90	46.00	32.10	9.000	N	OFF	9.6	
1.3280	20.75	46.00	25.25	9.000	N	OFF	9.6	
3.2135	20.74	46.00	25.26	9.000	N	OFF	9.7	
15.2938	18.58	50.00	31.42	9.000	N	OFF	9.8	
17.5888	16.01	50.00	33.99	9.000	N	OFF	9.9	
22.1788	17.15	50.00	32.85	9.000	N	OFF	9.9	
23.3758	17.74	50.00	32.26	9.000	N	OFF	9.9	
23.4275	17.45	50.00	32.55	9.000	N	OFF	9.9	

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10. LIST OF TEST EQUIPMENT

Conducted Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
LISN	ENV216	Rohde & Schwarz	102245	08/22/2023	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	06/07/2023	Annual
Temperature Chamber	SU-642	ESPEC	0093008124	03/04/2023	Annual
Signal Analyzer	N9030A	Keysight	MY55410508	09/06/2023	Annual
Power Meter	N1911A	Agilent	MY45100523	03/24/2023	Annual
Power Sensor	N1921A	Agilent	MY57820067	03/24/2023	Annual
Directional Coupler	87300B	Agilent	3116A03621	11/02/2022	Annual
Power Splitter	11667B	Hewlett Packard	10545	02/03/2023	Annual
DC Power Supply	E3646A	Agilent	MY40002937	12/14/2022	Annual
Attenuator(10 dB) (DC-26.5 GHz)	8493C-010	Agilent	08285	06/21/2023	Annual
Attenuator(20 dB)	18N-20dB	Rohde & Schwarz	8	03/07/2023	Annual
Software	EMC32	Rohde & Schwarz	N/A	N/A	N/A
FCC WLAN&BT&BLE Conducted Test Software v3.0	N/A	HCT CO., LTD.	N/A	N/A	N/A
Bluetooth Tester	CBT	Rohde & Schwarz	100808	02/22/2023	Annual

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.

Radiated Test

Equipment	Model	Manufacturer	Serial No.	Due to Calibration	Calibration Interval
Controller(Antenna mast)	CO3000	Innco system	CO3000-4p	N/A	N/A
Antenna Position Tower	MA4640/800-XP-EP	Innco system	N/A	N/A	N/A
Controller	EM2090	Emco	060520	N/A	N/A
Turn Table	N/A	Ets	N/A	N/A	N/A
Loop Antenna	FMZB 1513	Rohde & Schwarz	1513-333	03/17/2024	Biennial
Hybrid Antenna	VULB 9168	Schwarzbeck	9168-0895	08/16/2024	Biennial
Horn Antenna	BBHA 9120D	Schwarzbeck	9120D-1191	11/18/2023	Biennial
Horn Antenna (15 GHz ~ 40 GHz)	BBHA9170	Schwarzbeck	BBHA9170124	04/12/2023	Biennial
Amp & Filter Bank Switch Controller	FBSM-01A	TNM system	0	N/A	N/A
Band Reject Filter	WRCJV2400/2483.5-2370/2520-60/12SS	Wainwright Instruments	2	01/06/2023	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	5	06/13/2023	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	06/13/2023	Annual
Band Reject Filter	WRCJV5100/5850-40/50-8EEK	Wainwright Instruments	1	02/07/2023	Annual
ATT(3 dB) + LNA2(6~18 GHz)	18B-03, CBL06185030	WEINSCHEL CERNEX	N/A	12/22/2022	Annual
ATT(10 dB) + LNA1(0.1~18 GHz)	56-10, CBLU1183540B-01	Api tech, CERNEX	N/A	12/22/2022	Annual
High Pass Filter	WHKX10-2700-3000-18000-40SS	Wainwright Instruments	N/A	12/22/2022	Annual
High Pass Filter	WHKX8-6090-7000-18000-40SS	Wainwright Instruments	N/A	12/22/2022	Annual
Thru	COAXIAL ATTENUATOR	T&M SYSTEM	N/A	12/22/2022	Annual
Power Amplifier	CBL18265035	CERNEX	22966	12/02/2022	Annual
Power Amplifier	CBL26405040	CERNEX	25956	03/11/2023	Annual
Bluetooth Tester	TC-3000C	TESCOM	3000C000175	04/05/2023	Annual
Spectrum Analyzer	FSP(9 kHz ~ 30 GHz)	Rohde & Schwarz	836650/016	09/06/2023	Annual
Spectrum Analyzer	FSV40-N(9 kHz ~ 30 GHz)	Rohde & Schwarz	101068-SZ	09/07/2023	Annual

Note:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.
3. Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5(Version : 2017).

11. ANNEX A_ TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-2210-FI004-P