

# FCC BT LE REPORT

## Certification

**Applicant Name:**

SAMSUNG Electronics Co., Ltd.

**Address:**

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**Date of Issue:**

May 26, 2022

**Test Site/Location:**

74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383 KOREA

**Report No.:** HCT-RF-2205-FC012-R1

**FCC ID:**

**A3LSMG990U2**

**APPLICANT:**

**SAMSUNG Electronics Co., Ltd.**

**Model:**

SM-G990U2

**Additional Model:**

SM-G990U3/DS

**EUT Type:**

Mobile Phone

**Average Output Power:**

10.25 dBm (10.58 mW)

**Frequency Range:**

2 402 MHz ~ 2 480 MHz

**Modulation type**

GFSK

**FCC Classification:**

Digital Transmission System(DTS)

**FCC Rule Part(s):**

Part 15.247

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 Rules under normal use and maintenance.

Report No.: HCT-RF-2205-FC012-R1

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REVIEWED BY



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Report prepared by : Jin Gwan Lee  
Engineer of Telecommunication Testing Center

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Report approved by : Jong Seok Lee  
Manager of Telecommunication Testing Center

This test results were applied only to the test methods required by the standard.

This laboratory is not accredited for the test results marked \*.

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. (HCT Accreditation No.: KT197)

\* The report shall not be reproduced except in full(only partly) without approval of the laboratory.

## Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-2205-FC012	May 13, 2022	- First Approval Report
HCT-RF-2205-FC012-R1	May 26, 2022	- Page 23, Revised radiated test note. - Added data for Channel 1 ~ 4 (Page 40, 42 ~ 44, 46)

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**1. EUT DESCRIPTION**

<b>Model</b>	SM-G990U2	
<b>Additional Model</b>	SM-G990U3/DS	
<b>EUT Type</b>	Mobile Phone	
<b>Power Supply</b>	DC 3.88 V	
<b>Frequency Range</b>	2 402 MHz ~ 2 480 MHz	
<b>Max. RF Output Power (Normal)</b>	Peak (For information only)	1 M Bit/s : 10.353 dBm (10.85 mW) 2 M Bit/s : 10.586 dBm (11.44 mW) 125 k Bit/s : 10.255 dBm (10.60 mW) 500 k Bit/s : 10.330 dBm (10.79 mW)
	Average	1 M Bit/s : 10.18 dBm (10.42 mW) 2 M Bit/s : 10.25 dBm (10.58 mW) 125 k Bit/s : 10.10 dBm (10.23 mW) 500 k Bit/s : 10.09 dBm (10.21 mW)
<b>Modulation Type</b>	GFSK	
<b>Bluetooth Version</b>	5.0	
<b>Number of Channels</b>	40 Channels	
<b>Date(s) of Tests</b>	April 06, 2022 ~ May 10, 2022 1~4 ch test: May 26, 2022	
<b>Serial number</b>	Radiated: R3CT30Q0R8W Conducted : R3CT30Q0RYR	

## **2. TEST METHODOLOGY**

FCC KDB 558074 D01 15.247 Meas Guidance v05r02 dated April 02, 2019 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.

## **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 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 6.6.5 of ANSI C63.10. (Version: 2013)

## **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's, 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).

### **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

**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.

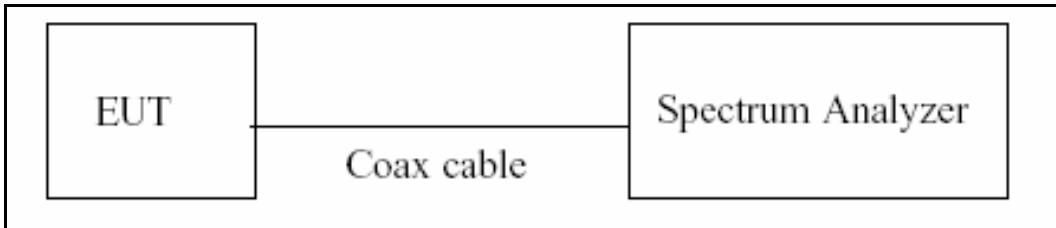
Parameter	Expanded Uncertainty (dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	2.00 ( Confidence level about 95 %, $k=2$ )
Radiated Disturbance (9 kHz ~ 30 MHz)	4.40 ( Confidence level about 95 %, $k=2$ )
Radiated Disturbance (30 MHz ~ 1 GHz)	5.74 ( Confidence level about 95 %, $k=2$ )
Radiated Disturbance (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 v05r02.

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  $T \leq 6.25$  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  $> 50/T$ .

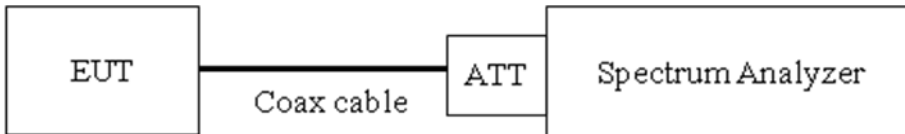
1. RBW = 8 MHz (the largest available value)
2. VBW = 8 MHz ( $\geq$  RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep  $> 100$
6. Trace mode = Clear write
7. Measure  $T_{total}$  and  $T_{on}$
8. Calculate Duty Cycle =  $T_{on} / T_{total}$  and Duty Cycle Factor =  $10\log(1/\text{Duty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

## 7.2. 6 dB 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 8.2 in KDB 558074 v05r02, Procedure 11.8.1 in ANSI 63.10-2013)

- 1) RBW = 100 kHz
- 2) VBW  $\geq 3 \times$  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.

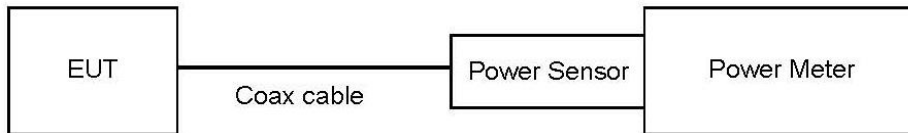
Note : We tested OBW using the automatic bandwidth measurement capability of a spectrum analyzer.

### 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 8.3.2.3 in KDB 558074 v05r02, 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

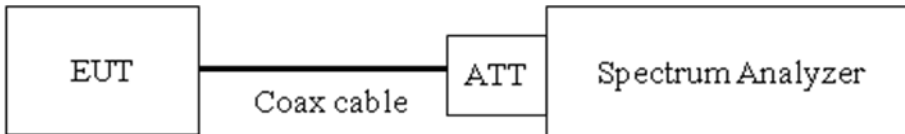
- Conducted Output Power(Peak) = Measured Value + ATT loss + Cable loss
- Conducted Output Power(Average) = Measured Value + ATT loss + Cable loss + Duty Cycle Factor

## 7.4. Power Spectral Density

### Limit

The transmitter power density average over 1-second interval shall not be greater than 8 dBm 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 in ANSI 63.10-2013.

The spectrum analyzer is set to :

- 1) Set analyzer center frequency to DTS channel center frequency.
- 2) Set span to at least 1.5 times the OBW.
- 3)  $RBW = 3 \text{ kHz} \leq RBW \leq 100 \text{ kHz}$ .
- 4)  $VBW \geq 3 \times RBW$ .
- 5) Sweep = auto couple
- 6) Detector = power averaging (rms) or sample detector (when rms not available).
- 7) Ensure that the number of measurement points in the sweep  $\geq [2 \times \text{span} / RBW]$ .
- 8) Employ trace averaging (rms) mode over a minimum of 100 traces
- 9) Use the peak marker function to determine the maximum amplitude level.
- 10) 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.
- 11) if then duty factor shall be added to adjust the result if the duty cycle is less than 98 %

### Sample Calculation

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

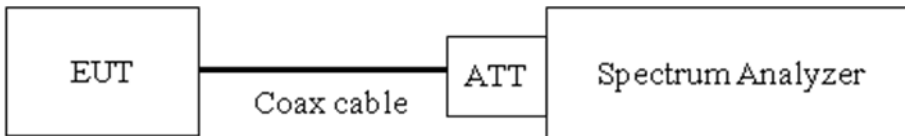
## 7.5. Conducted Band Edge(Out of Band Emissions) & Conducted Spurious Emissions

### Limit

The maximum conducted (average) 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 30 dB relative to the maximum in-band peak PSD level in 100 kHz.

[ Conducted > 30 dBc ]

### Test Configuration



### Test Procedure

The transmitter output is connected to the spectrum analyzer.

(Procedure 8.5 in KDB 558074 v05r02, Procedure 11.11 in ANSI 63.10-2013)

- 1) RBW = 100 kHz
- 2) VBW  $\geq 3 \times$  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  $\geq 2 \times$  Span/VBW
- 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	10.37
100	10.43
200	10.44
300	10.46
400	10.50
500	10.69
600	10.70
700	10.72
800	10.75
900	10.76
1 000	10.77
2 000	10.86
<b>2 400</b>	<b>10.92</b>
<b>2 480</b>	<b>10.92</b>
2 500	10.93
3 000	11.15
4 000	11.21
5 000	11.35
5 150	11.69
5 850	11.69
6 000	11.70
7 000	11.82
8 000	11.81
9 000	11.90
10 000	12.00
11 000	12.09
12 000	12.18
13 000	12.19
14 000	12.23
15 000	12.32
16 000	12.41
17 000	12.60
18 000	12.74
19 000	12.66
20 000	12.33
21 000	12.46
22 000	12.45
23 000	12.42
24 000	12.47

Note : 1. 2 400 ~ 2 500 MHz is fundamental frequency range.

2. Factor = Attenuator loss(10 dB) + Cable loss(1 ea) + EUT Cable loss(1 ea)

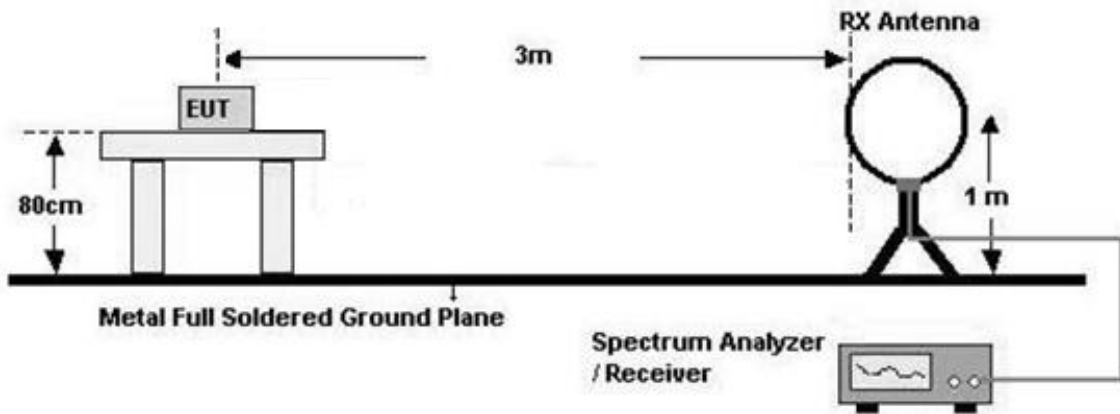
**7.6. Radiated Test**

**Limit**

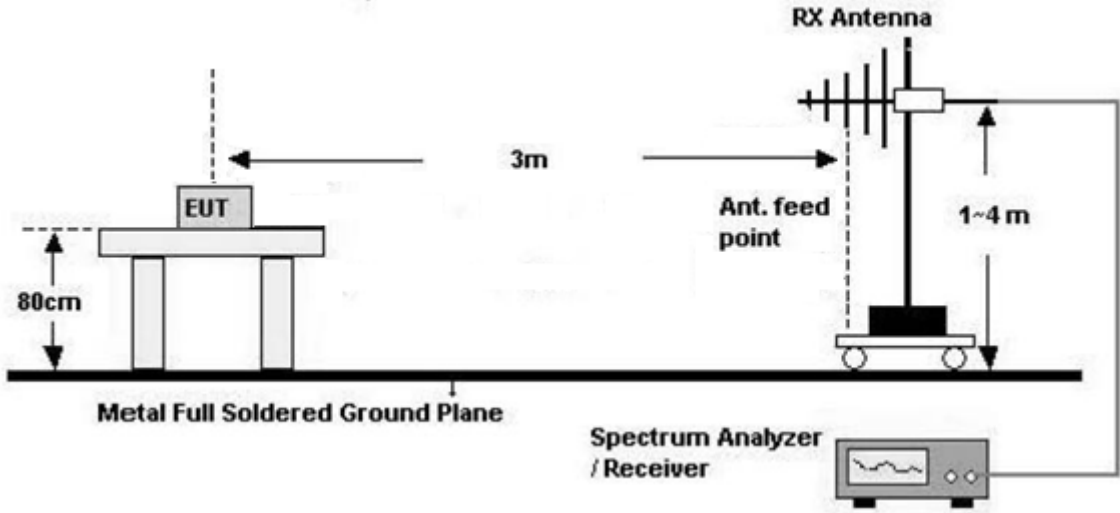
Frequency (MHz)	Field Strength ( $\mu\text{V/m}$ )	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

**Test Configuration**

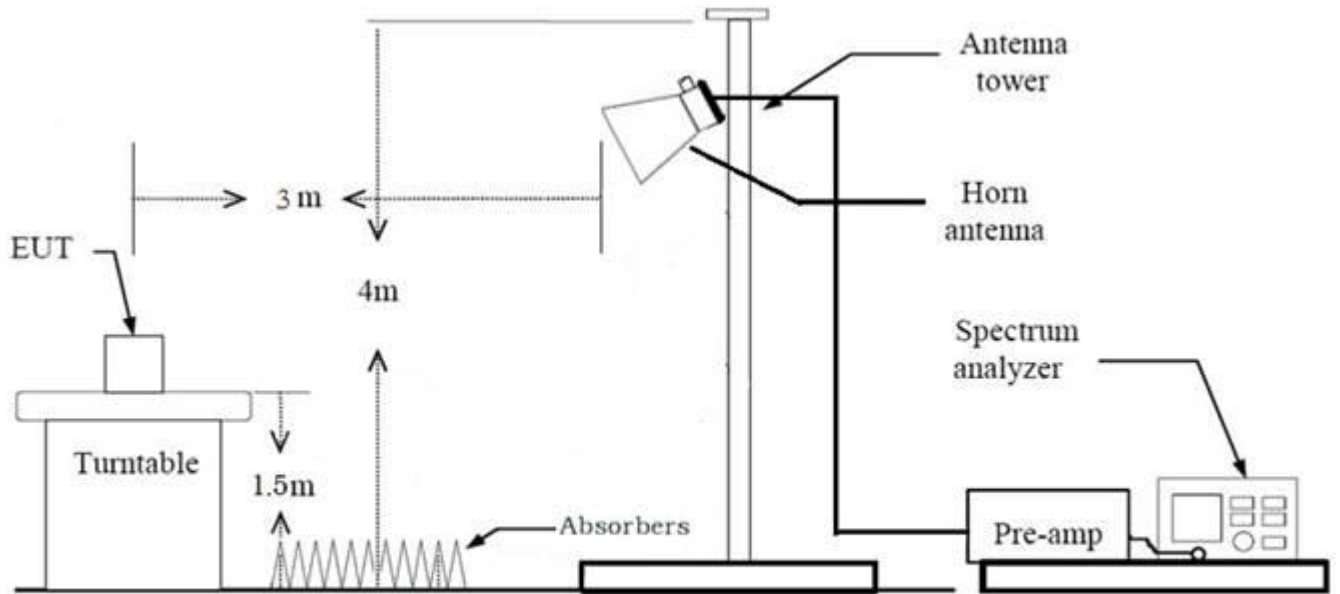
Below 30 MHz



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) =  $40\log(3\text{ m}/300\text{ m}) = - 80\text{ dB}$   
Measurement Distance : 3 m
7. Distance Correction Factor(0.490 MHz – 30 MHz) =  $40\log(3\text{ m}/30\text{ m}) = - 40\text{ dB}$   
Measurement Distance : 3 m
8. Spectrum Setting
  - Frequency Range = 9 kHz ~ 30 MHz
  - Detector = Peak
  - Trace = Maxhold
  - RBW = 9 kHz
  - VBW  $\geq 3 \times$  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 1m 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  $\geq$  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. The unit was tested with its standard battery.
8. Spectrum Setting (Method 8.6 in KDB 558074 v05r02, Procedure 11.12 in ANSI 63.10-2013)
  - (1) Measurement Type(Peak):
    - Measured Frequency Range : 1 GHz – 25 GHz
    - Detector = Peak
    - Trace = Max hold
    - RBW = 1 MHz
    - VBW  $\geq$  3 x RBW
  - (2) Measurement Type(Average):
    - Duty cycle < 98 %, duty cycle variations are less than  $\pm 2$  %
    - Measured Frequency Range : 1 GHz – 25 GHz
    - Detector = RMS
    - Averaging type = power (*i.e.*, RMS)
    - RBW = 1 MHz
    - VBW  $\geq$  3 x RBW
    - Sweep time = auto.
    - Trace mode = average (at least 100 traces).
    - Correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle.
- Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1
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 =  $20\log$  (test distance / specific distance) (dB)
11. Total (Measurement Type : Peak)
  - = Peak Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G)
  - + Distance Factor(D.F)

Total (Measurement Type : Average)

= Average Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) - Amp Gain(A.G)  
+ Distance Factor(D.F) + Duty Cycle Factor

#### **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 = Max hold
    - RBW = 1 MHz
    - VBW  $\geq$  3 x RBW
  - (2) Measurement Type(Average):
    - Duty cycle < 98 %, duty cycle variations are less than  $\pm 2$  %
    - Measured Frequency Range : 2310 MHz ~ 2390 MHz/ 2483.5 MHz ~ 2500 MHz
    - Detector = RMS
    - Averaging type = power (*i.e.*, RMS)
    - RBW = 1 MHz
    - VBW  $\geq$  3 x RBW
    - Sweep time = auto.
    - Trace mode = average (at least 100 traces).
    - Correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle.
    - Duty Cycle Factor (dB) : Please refer to the please refer to section 9.1.
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 =  $20\log$  (test distance / specific distance) (dB)

11. Total(Measurement Type : Peak)

= Peak Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

Total(Measurement Type : Average)

= Average Measured Value + Antenna Factor(A.F) + Cable Loss(C.L) + Distance Factor(D.F)

+ Duty Cycle Factor

## 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  $\mu$ H/50 ohms line impedance stabilization network (LISN).

Frequency Range (MHz)	Limits (dB $\mu$ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56 <sup>(a)</sup>	56 to 46 <sup>(a)</sup>
0.50 to 5	56	46
5 to 30	60	50

<sup>(a)</sup>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. 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, Stand alone + External accessories(Earphone, etc)
  - Worstcase : Stand alone
2. EUT Axis:
  - Radiated Spurious Emissions : X, Z
  - Radiated Restricted Band Edge : X
3. All packet length of operation were investigated and the test results are worst case.  
(Worst case :1M Bit/s 37 Byte, 2M Bit/s 255 Byte)  
(125k, 500k, 1M Bit/s all have the same 1MHz Band width and only Worst result is attached.)
4. All datarate of operation were investigated and the worst case configuration results are reported.
  - Worst case : 1 M, 2 M
5. Low Channel 0 ~ 4 were investigated and the worst case configuration results are reported.  
(Worst case : Channel 0)
6. All position of loop antenna were investigated and the test result is a no critical peak found at all positions.
  - Position : Horizontal, Vertical, Parallel to the ground plane
7. SM-G990U2, SM-G990U3/DS were tested and the worst case results are reported. (Worst case : SM-G990U2)

### AC Power line Conducted Emissions

1. All modes of operation were investigated and the worst case configuration results are reported.
  - Mode : Stand alone + External accessories(Earphone, etc) + Travel Adapter, Stand alone + Travel Adapter
  - Worstcase : Stand alone + Travel Adapter
2. SM-G990U2, SM-G990U3/DS were tested and the worst case results are reported. (Worst case : SM-G990U2)

### Conducted test

1. The EUT was configured with packet length of highest power.
  - Worst case :1M Bit/s 37 Byte, 2M Bit/s 255 Byte
2. SM-G990U2, SM-G990U3/DS were tested and the worst case results are reported. (Worst case : SM-G990U2)

**8. SUMMARY TEST OF RESULTS**

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§15.247(a)(2)	> 500 kHz	Conducted	PASS
Conducted Maximum Output Power	§15.247(b)(3)	< 1 Watt		PASS
Power Spectral Density	§15.247(e)	< 8 dBm / 3 kHz Band		PASS
Band Edge (Out of Band Emissions)	§15.247(d)	Conducted > 30 dBc		PASS
AC Power line Conducted Emissions	§15.207	cf. Section 7.7		PASS
Radiated Spurious Emissions	§15.247(d), 15.205, 15.209	cf. Section 7.6	Radiated	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209	cf. Section 7.6		PASS



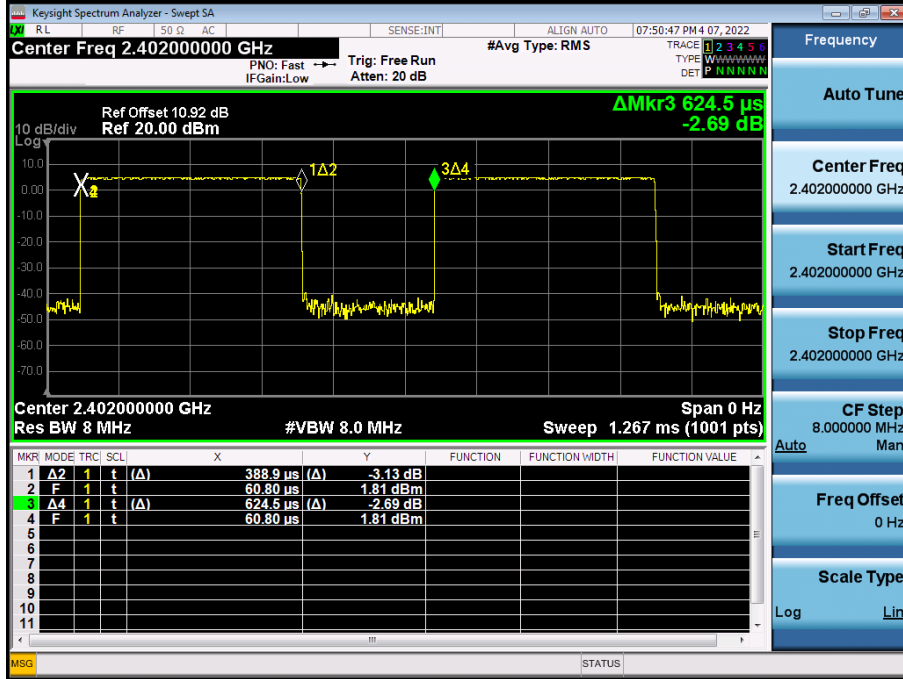
## 9. TEST RESULT

### 9.1 DUTY CYCLE

Data rate (Bit/s)	Packet length (Byte)	T <sub>on</sub> (ms)	T <sub>total</sub> (ms)	Duty Cycle	Duty Cycle Factor (dB)
125k	37	0.389	0.624	0.6227	2.06
	255	2.135	2.500	0.8540	0.69
500k	37	0.205	0.624	0.3286	4.83
	255	1.074	1.874	0.5734	2.42
1M	37	3.100	3.750	0.8267	0.83
	255	17.067	17.500	0.9752	0.11
2M	37	1.067	1.874	0.5695	2.45
	255	4.550	5.000	0.9100	0.41

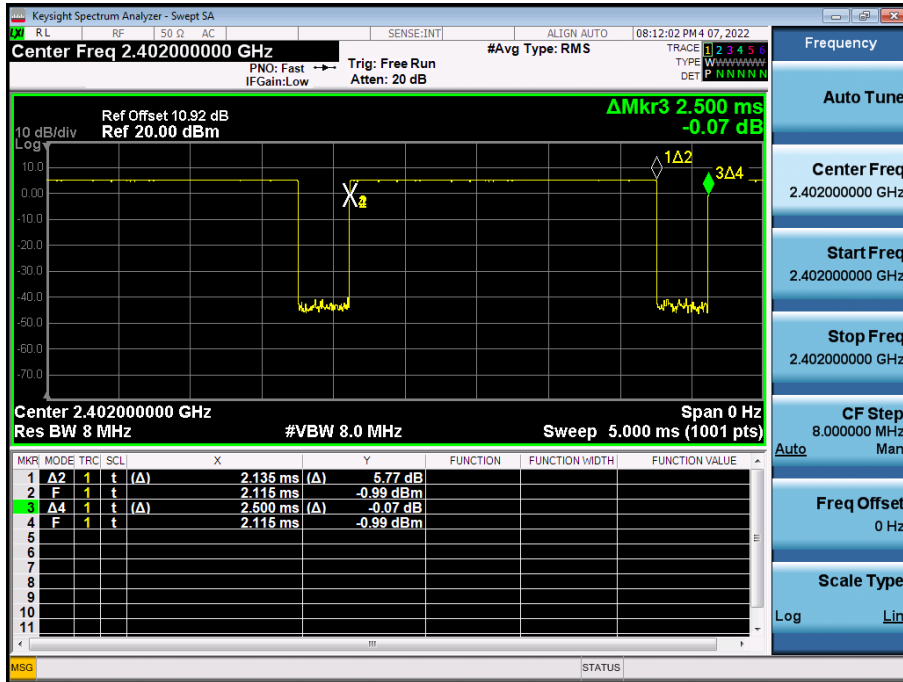
1 M Bit/s (37 Byte) Test Plots

Duty Cycle (Low-CH 0)



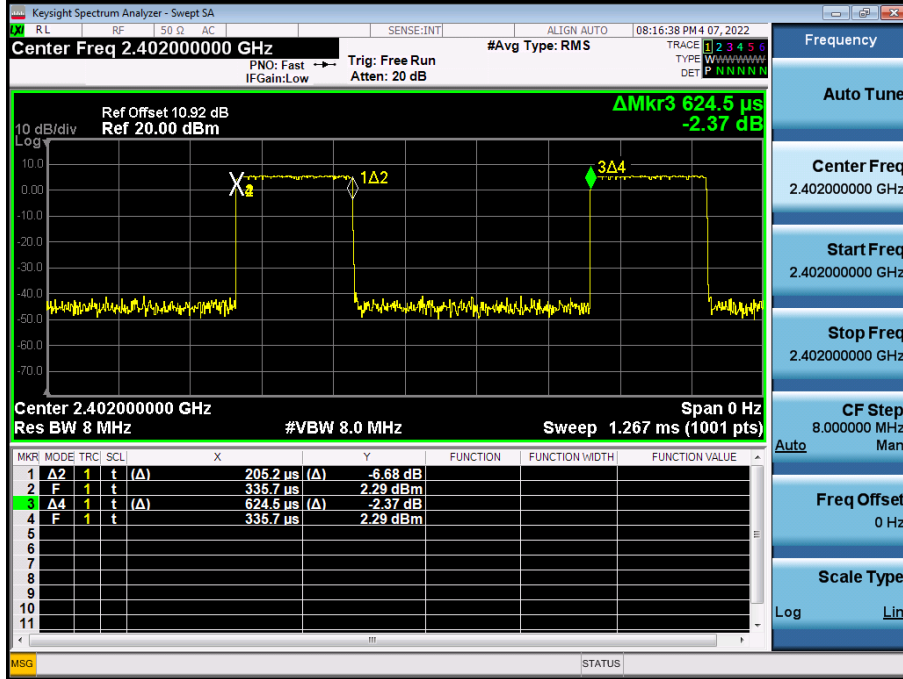
1 M Bit/s (255 Byte) Test Plots

Duty Cycle (Low-CH 0)



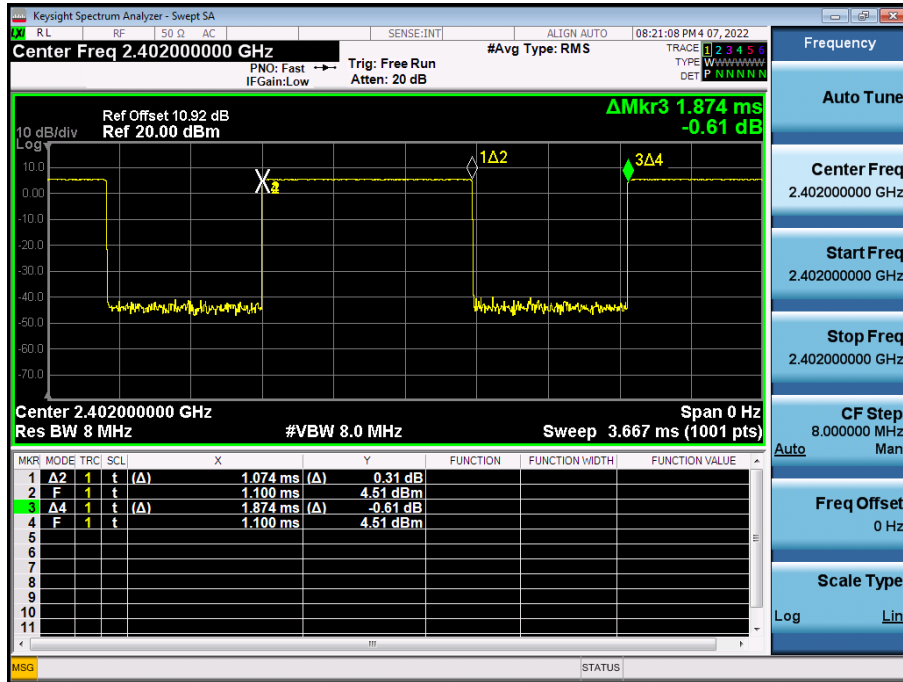
2 M Bit/s (37 Byte) Test Plots

Duty Cycle (Low-CH 0)



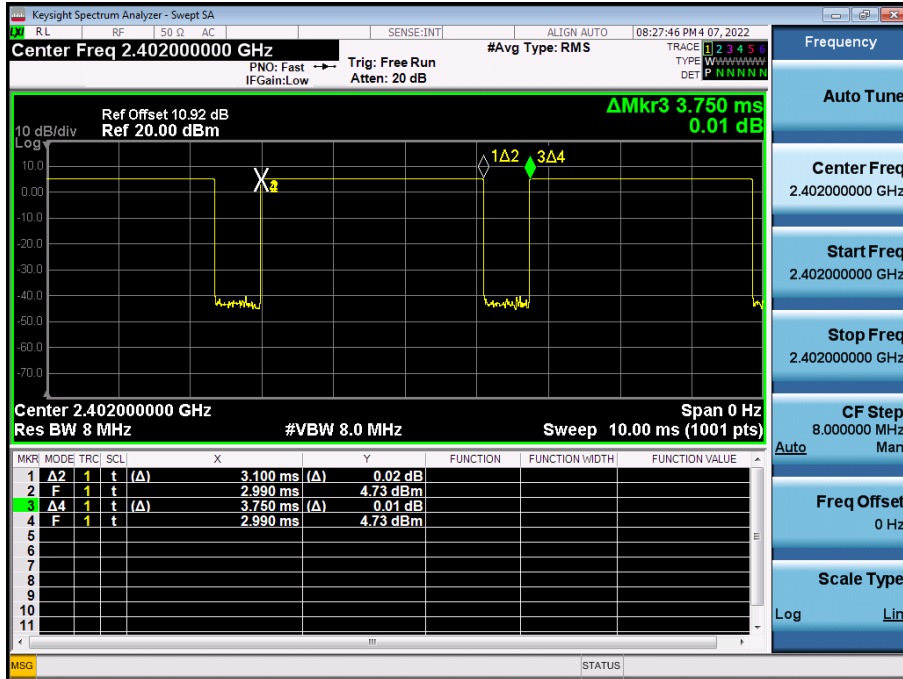
2 M Bit/s (255 Byte) Test Plots

Duty Cycle (Low-CH 0)



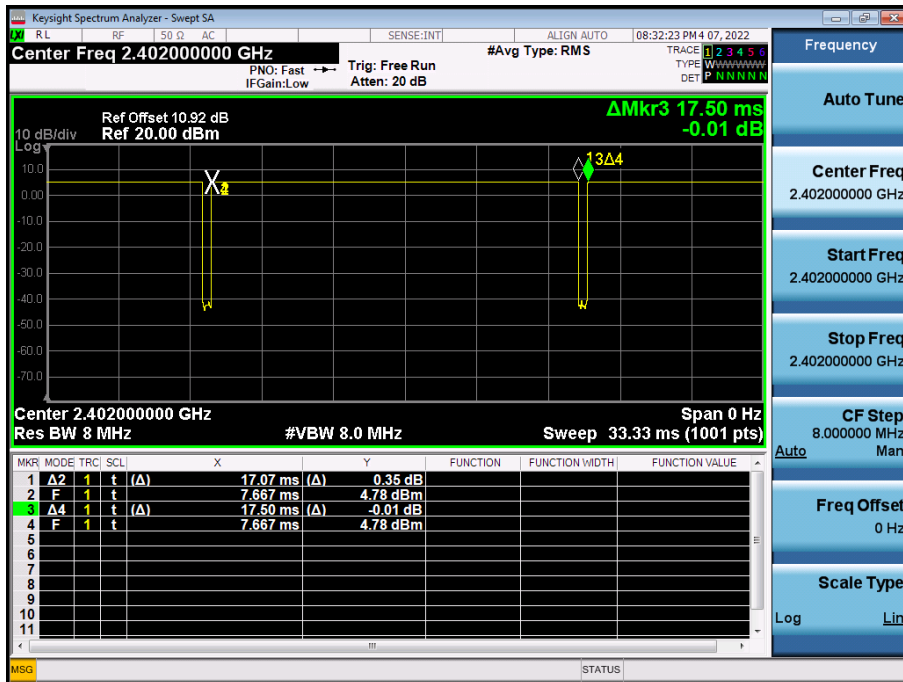
125 k Bit/s(37 Byte) Test Plots

Duty Cycle (Low-CH 0)



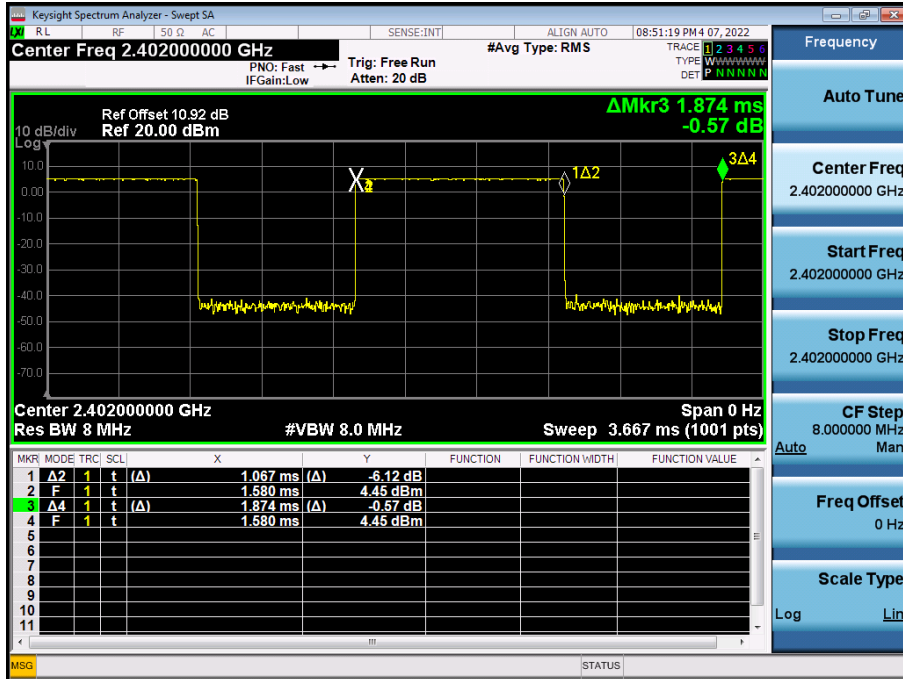
125 k Bit/s(255 Byte) Test Plots

Duty Cycle (Low-CH 0)



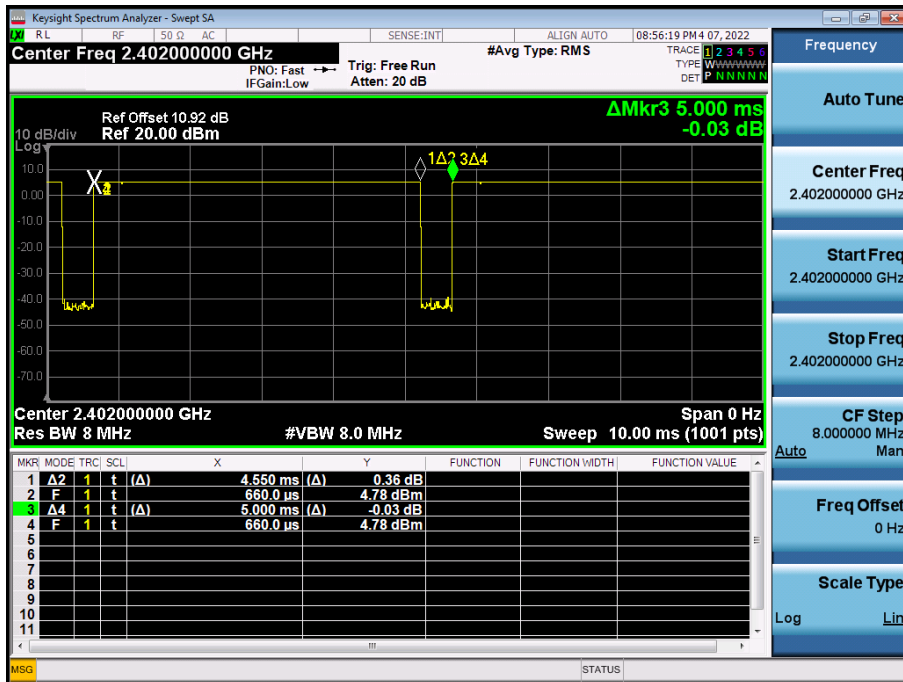
500 k Bit/s(37 Byte) Test Plots

Duty Cycle (Low-CH 0)



500 k Bit/s(255 Byte) Test Plots

Duty Cycle (Low-CH 0)



**9.2 6 dB BANDWIDTH**

Mode (Bit/s)	Channel	6 dB Bandwidth (kHz)	Limit (kHz)
1M(37)	0	685.0	> 500
	19	674.4	
	39	671.4	
1M(255)	<b>0</b>	<b>660.2</b>	> 500
	19	667.0	
	39	668.4	
2M(37)	0	1146	> 500
	<b>19</b>	<b>1142</b>	
	39	1147	
2M(255)	0	1143	> 500
	19	1162	
	39	1159	
125k(37)	0	628.0	> 500
	19	626.8	
	<b>39</b>	<b>626.7</b>	
125k(255)	0	627.8	> 500
	19	626.9	
	39	641.7	
500k(37)	0	678.3	> 500
	19	666.3	
	<b>39</b>	<b>663.9</b>	
500k(255)	0	678.9	> 500
	19	665.8	
	39	666.1	

**Note:**

Worst case test Plot Only

1M Bit/s: 255 Bytes

2M Bit/s: 37 Bytes

125k Bit/s: 37 Bytes

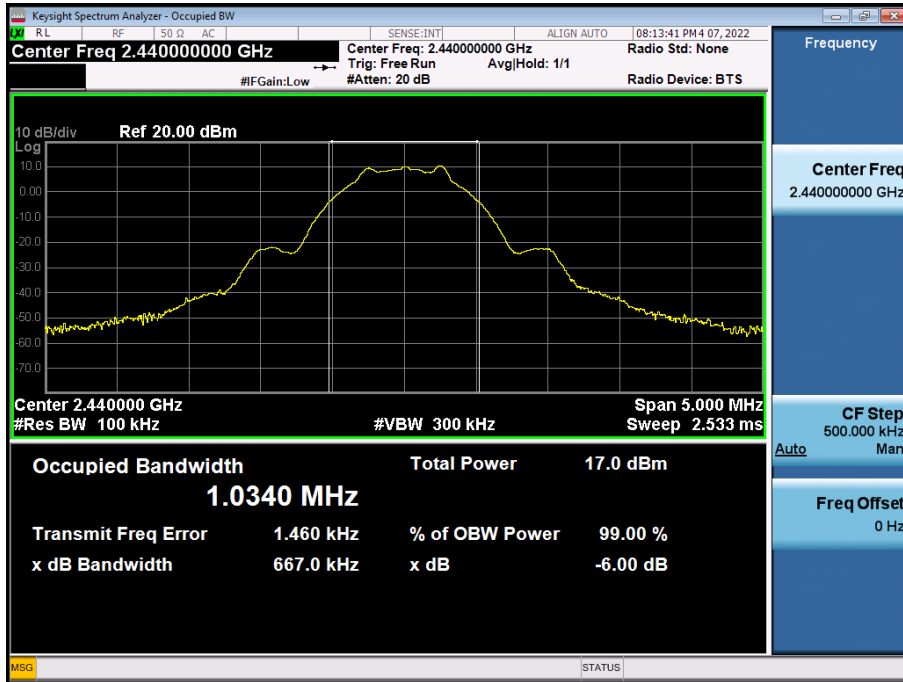
500k Bit/s: 37 Bytes

1 MBit/s (255 Byte) Test Plots

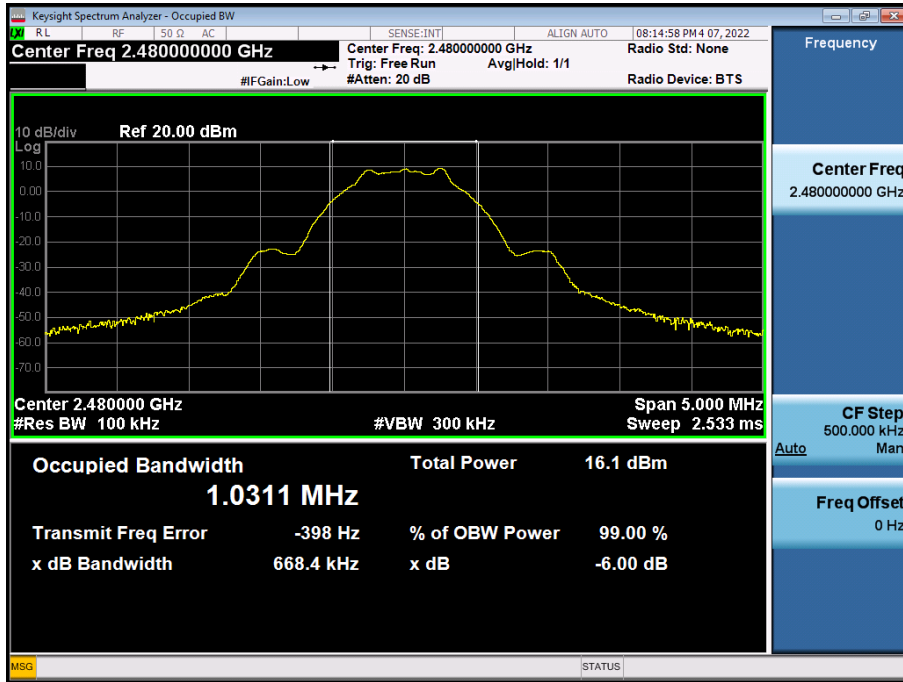
6 dB Bandwidth plot (Low-CH 0)



6 dB Bandwidth plot (Mid-CH 19)



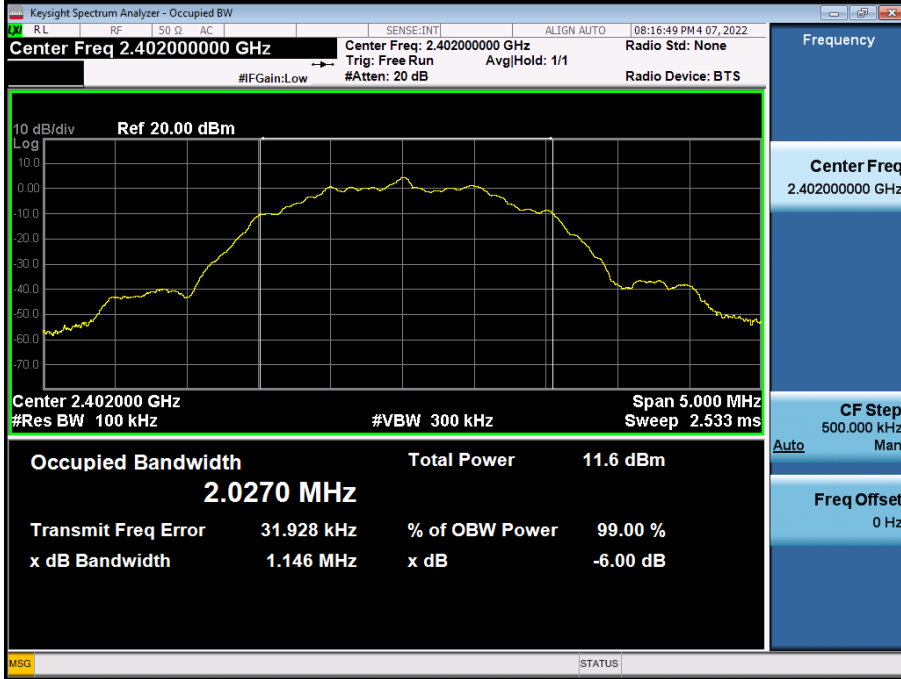
6 dB Bandwidth plot (High-CH 39)



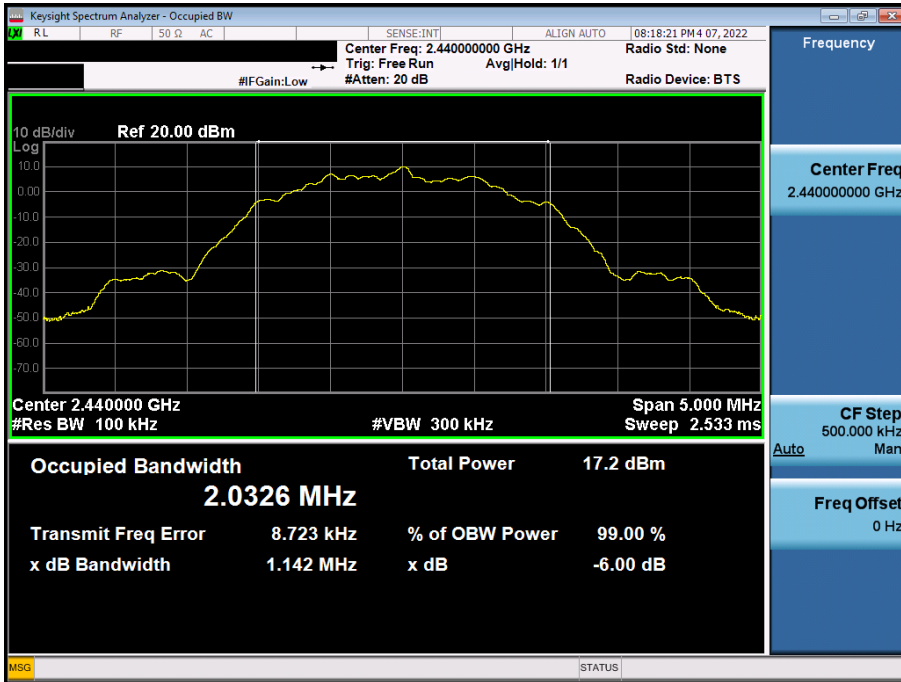


2 MBit/s (37 Byte) Test Plots

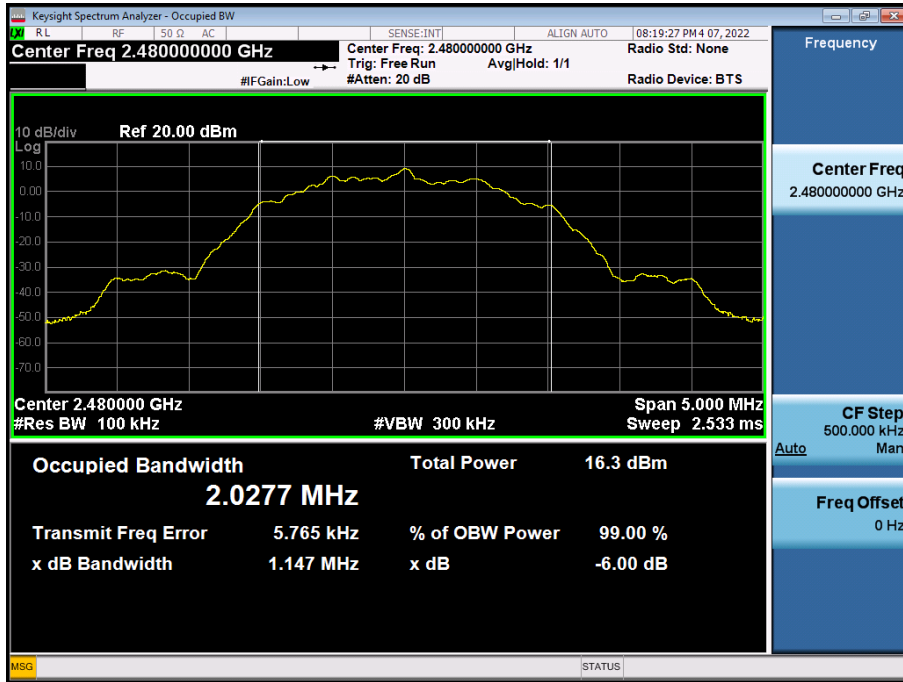
6 dB Bandwidth plot (Low-CH 0)



6 dB Bandwidth plot (Mid-CH 19)

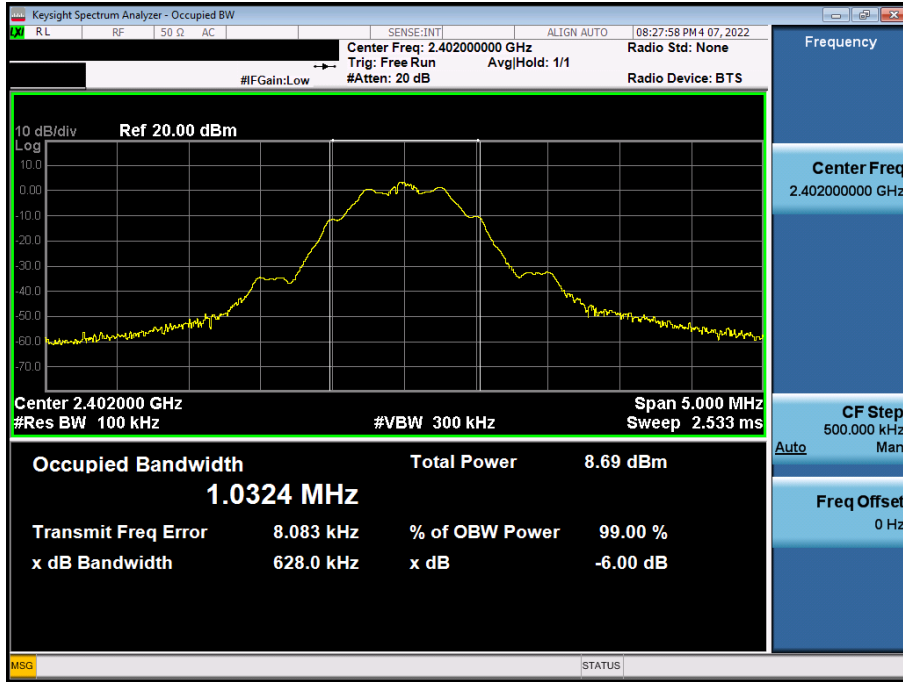


6 dB Bandwidth plot (High-CH 39)



125k Bit/s(37 Byte) Test Plots

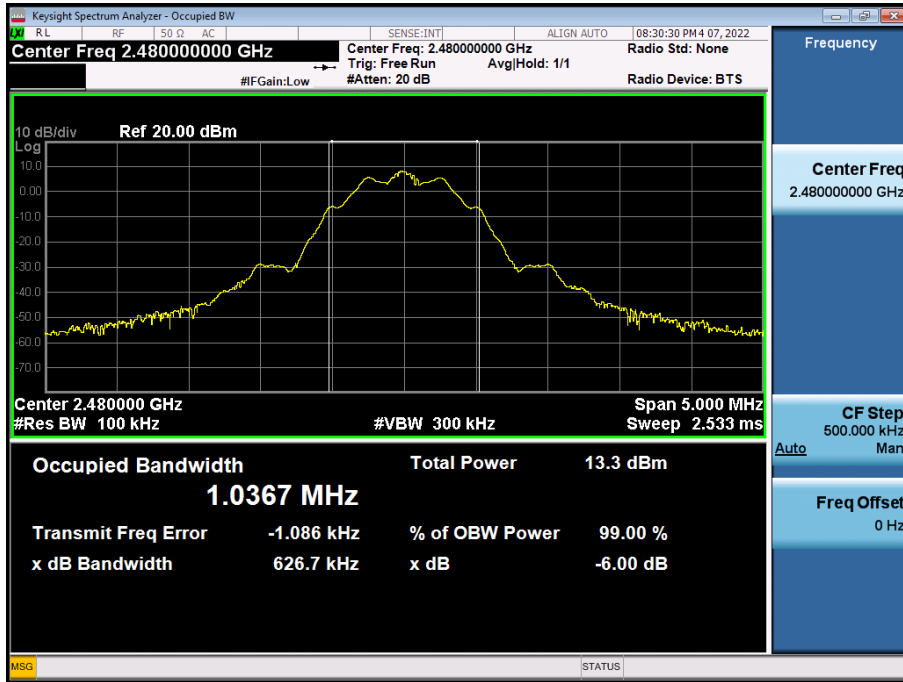
6 dB Bandwidth plot (Low-CH 0)



6 dB Bandwidth plot (Mid-CH 19)

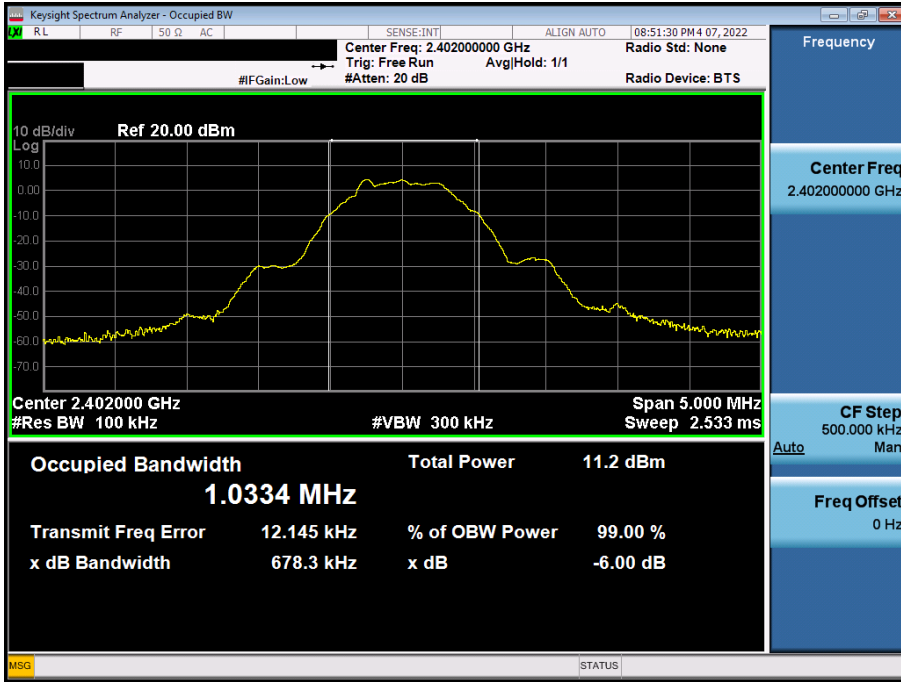


6 dB Bandwidth plot (High-CH 39)

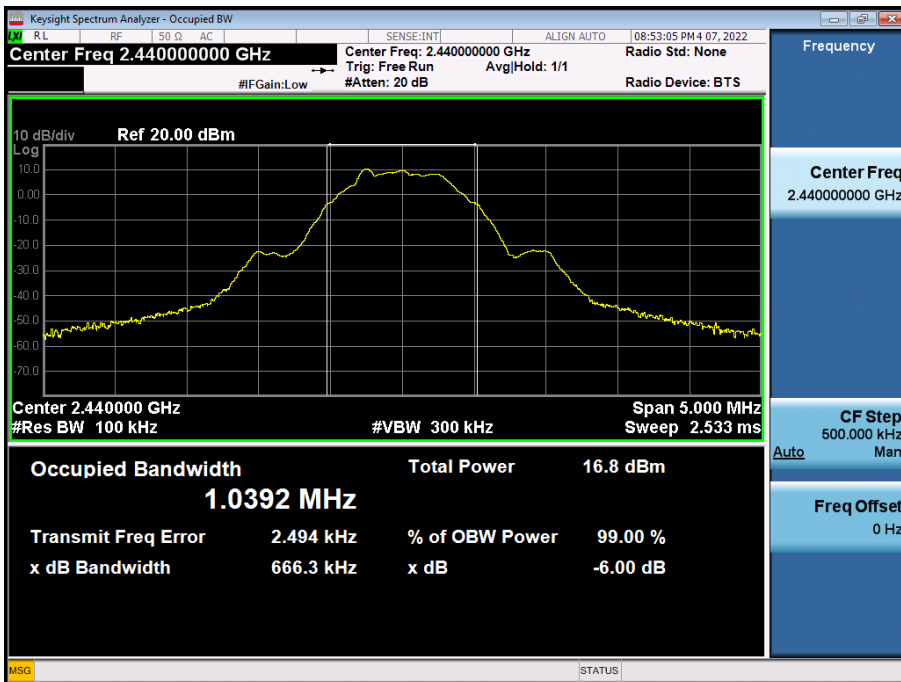


500k Bit/s(37 Byte) Test Plots

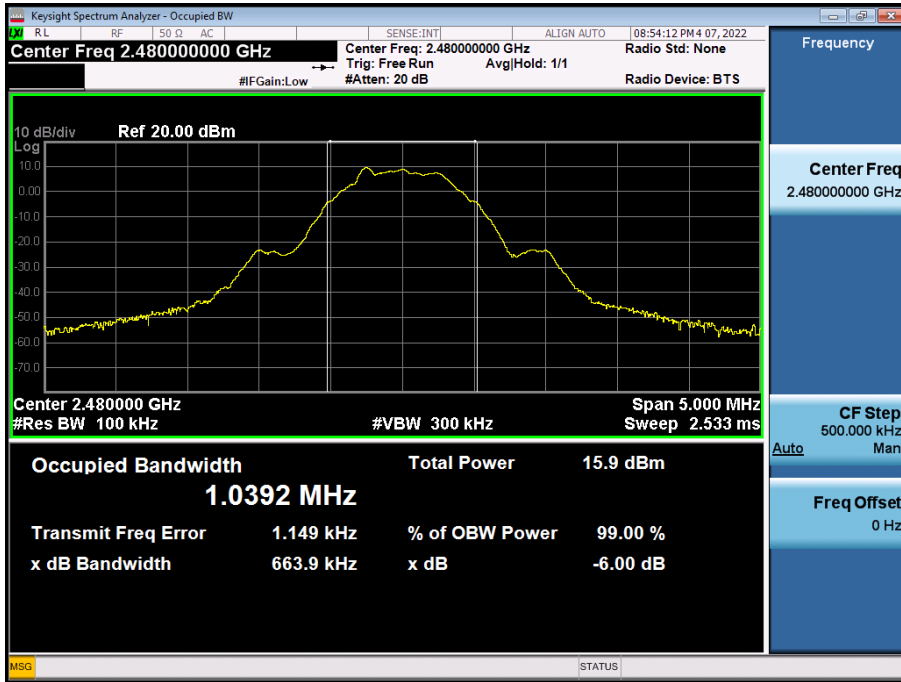
6 dB Bandwidth plot (Low-CH 0)



6 dB Bandwidth plot (Mid-CH 19)



6 dB Bandwidth plot (High-CH 39)



### 9.3 OUTPUT POWER

#### Peak Power

Data rate (Bit/s)	Packet length (Byte)	LE Mode		Measured Power(dBm)	Limit (dBm)
		Frequency [MHz]	Channel		
1M	37	2402	0	4.782	30
		2440	19	10.353	
		2480	39	9.508	
	255	2402	0	5.120	
		2440	19	10.303	
		2480	39	9.455	
2M	37	2402	0	5.419	
		2440	19	10.586	
		2480	39	9.702	
	255	2402	0	5.472	
		2440	19	10.510	
		2480	39	9.638	
125k	37	2402	0	5.138	
		2440	19	10.255	
		2480	39	9.402	
	255	2402	0	5.171	
		2440	19	10.225	
		2480	39	9.377	
500k	37	2402	0	5.091	
		2440	19	10.330	
		2480	39	9.513	
	255	2402	0	5.173	
		2440	19	10.267	
		2480	39	9.407	

Data rate (Bit/s)	Packet length (Byte)	LE Mode		Measured Power(dBm)	Limit (dBm)
		Frequency [MHz]	Channel		
1M	37	2404	1	6.947	30
		2408	2	8.024	
		2410	3	8.602	
		2412	4	9.502	
	255	2404	1	6.942	
		2408	2	8.023	
		2410	3	8.807	
		2412	4	9.417	
2M	37	2404	1	7.089	
		2408	2	8.114	
		2410	3	8.777	
		2412	4	9.502	
	255	2404	1	7.368	
		2408	2	8.035	
		2410	3	8.694	
		2412	4	9.419	
125k	37	2404	1	7.153	
		2408	2	8.084	
		2410	3	8.791	
		2412	4	9.374	
	255	2404	1	7.163	
		2408	2	8.134	
		2410	3	8.674	
		2412	4	9.356	
500k	37	2404	1	7.282	
		2408	2	8.088	
		2410	3	8.755	
		2412	4	9.520	
	255	2404	1	7.303	
		2408	2	8.146	
		2410	3	8.686	
		2412	4	9.475	

**Note :**

1. Power meter offset = Attenuator loss + Cable loss
2. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB.  
So, 10.92 dB is offset for 2.4 GHz Band.



**Average Power**

Data rate (Bit/s)	Packet length (Byte)	LE Mode		Measured Power (dBm)	Duty Cycle Factor (dB)	Result (dBm)	Limit (dBm)
		Frequency [MHz]	Channel				
1M	37	2402	0	2.23	2.06	4.29	30
		2440	19	8.12	2.06	10.18	
		2480	39	7.24	2.06	9.30	
	255	2402	0	3.98	0.69	4.67	
		2440	19	9.48	0.69	10.17	
		2480	39	8.51	0.69	9.20	
2M	37	2402	0	-0.56	4.83	4.27	
		2440	19	5.36	4.83	10.19	
		2480	39	4.39	4.83	9.22	
	255	2402	0	2.21	2.42	4.63	
		2440	19	7.83	2.42	10.25	
		2480	39	6.73	2.42	9.15	
125k	37	2402	0	3.90	0.83	4.73	
		2440	19	9.27	0.83	10.10	
		2480	39	8.32	0.83	9.15	
	255	2402	0	4.60	0.11	4.71	
		2440	19	9.98	0.11	10.09	
		2480	39	9.06	0.11	9.17	
500k	37	2402	0	2.08	2.45	4.53	
		2440	19	7.50	2.45	9.95	
		2480	39	6.75	2.45	9.20	
	255	2402	0	4.28	0.41	4.69	
		2440	19	9.68	0.41	10.09	
		2480	39	8.76	0.41	9.17	

Data rate (Bit/s)	Packet length (Byte)	LE Mode		Measured Power (dBm)	Duty Cycle Factor (dB)	Result (dBm)	Limit (dBm)
		Frequency [MHz]	Channel				
1M	37	2404	1	4.43	2.06	6.49	30
		2408	2	5.71	2.06	7.77	
		2410	3	6.45	2.06	8.51	
		2412	4	7.31	2.06	9.37	
	255	2404	1	5.95	0.69	6.64	
		2408	2	7.00	0.69	7.69	
		2410	3	8.01	0.69	8.70	
		2412	4	8.53	0.69	9.22	
2M	37	2404	1	1.84	4.83	6.67	
		2408	2	2.81	4.83	7.64	
		2410	3	3.62	4.83	8.45	
		2412	4	4.45	4.83	9.28	
	255	2404	1	4.46	2.42	6.88	
		2408	2	5.39	2.42	7.81	
		2410	3	6.22	2.42	8.64	
		2412	4	6.73	2.42	9.15	
125k	37	2404	1	5.85	0.83	6.68	
		2408	2	6.96	0.83	7.79	
		2410	3	7.88	0.83	8.71	
		2412	4	8.44	0.83	9.27	
	255	2404	1	6.99	0.11	7.10	
		2408	2	7.69	0.11	7.80	
		2410	3	8.49	0.11	8.60	
		2412	4	9.11	0.11	9.22	
500k	37	2404	1	4.28	2.45	6.73	
		2408	2	5.46	2.45	7.91	
		2410	3	6.15	2.45	8.60	
		2412	4	7.02	2.45	9.47	
	255	2404	1	6.51	0.41	6.92	
		2408	2	7.50	0.41	7.91	
		2410	3	8.10	0.41	8.51	
		2412	4	8.91	0.41	9.32	

**Note :**

1. Power meter offset = Attenuator loss + Cable loss
2. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB.  
So, 10.92 dB is offset for 2.4 GHz Band.

**9.4 POWER SPECTRAL DENSITY**

Frequency (MHz)	Channel No.	Mode	Test Result			Limit (dBm)
			Measured Power(dBm)	Duty Cycle Factor(dB)	Measured Power + Duty Cycle Factor(dB)	
2402	0	1 MBit/s 37 Byte	<b>-3.084</b>	<b>2.06</b>	<b>-1.027</b>	8 dBm / 3 kHz
2410	4		<b>0.718</b>	<b>2.06</b>	<b>2.775</b>	
2440	19		<b>2.366</b>	<b>2.06</b>	<b>4.423</b>	
2480	39		<b>1.082</b>	<b>2.06</b>	<b>3.139</b>	
2402	0	1 MBit/s 255 Byte	-2.439	0.69	-1.754	
2410	4		2.164	0.69	2.849	
2440	19		3.225	0.69	3.910	
2480	39		1.959	0.69	2.644	
2402	0	2 MBit/s 37 Byte	-6.733	4.83	-1.900	
2410	4		-2.341	4.83	2.492	
2440	19		-1.709	4.83	3.124	
2480	39		-3.330	4.83	1.503	
2402	0	2 MBit/s 255 Byte	-6.534	2.42	-4.118	
2410	4		-1.759	2.42	0.656	
2440	19		-0.348	2.42	2.068	
2480	39		-2.317	2.42	0.099	
2402	0	125k 37 Byte	-1.788	0.83	-0.961	
2410	4		2.919	0.83	3.746	
2440	19		3.349	0.83	4.176	
2480	39		2.482	0.83	3.309	
2402	0	125k 255 Byte	-1.071	0.11	-0.962	
2410	4		3.179	0.11	3.288	
2440	19		4.126	0.11	4.235	
2480	39		3.094	0.11	3.203	
2402	0	500k 37 Byte	-4.658	2.45	-2.213	
2410	4		1.064	2.45	3.509	
2440	19		1.256	2.45	3.701	
2480	39		0.102	0.41	0.512	
2402	0	500k 255 Byte	-2.269	0.41	-1.859	
2410	4		2.357	0.41	2.767	
2440	19		2.921	0.41	3.331	
2480	39		2.165	0.41	2.575	

**Note :**

1. Spectrum measured Value not plot data.

The PSD results in plot is already including the actual values of loss for the attenuator and cable combination.

2. Spectrum offset = Attenuator loss + Cable loss

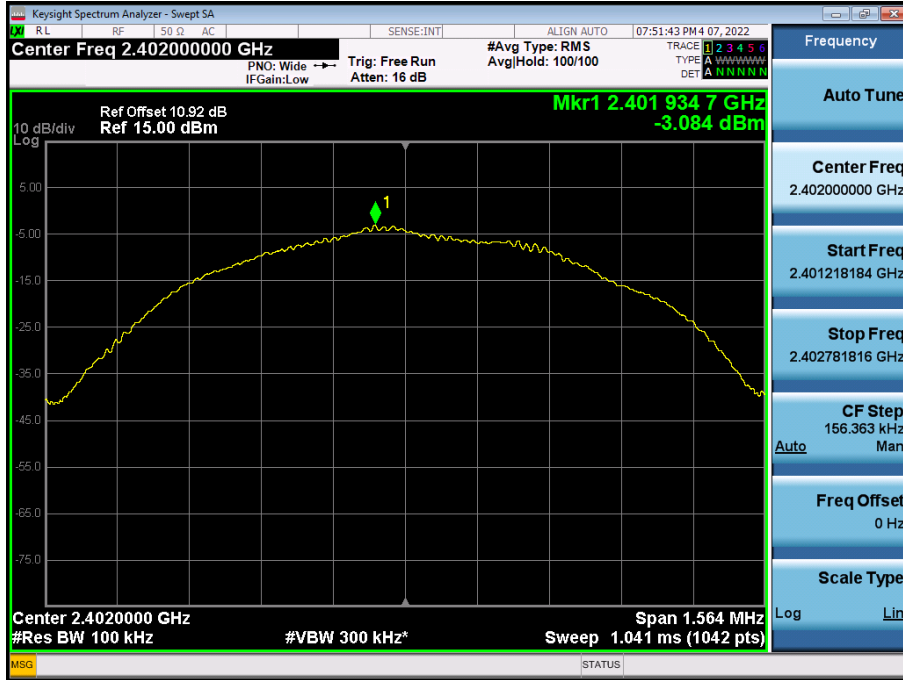
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB.

So, 10.92 dB is offset for 2.4 GHz Band.

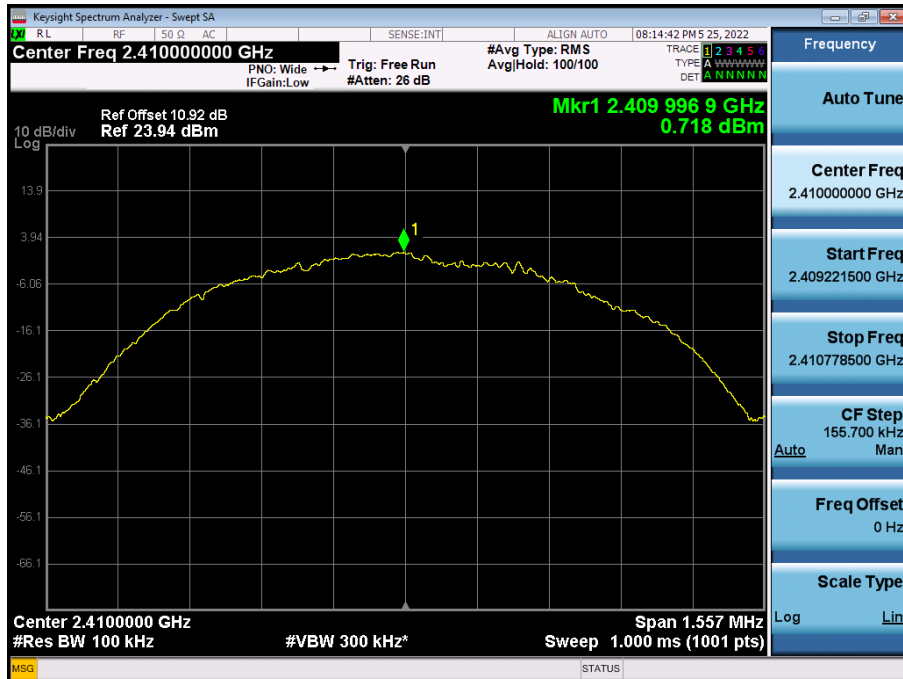
4. Worst case test Plot Only : 1 M Bit/s (37 Byte)

▣ 1MBit/s (37 Byte) Test Plots

Power Spectral Density (Low-CH 0)



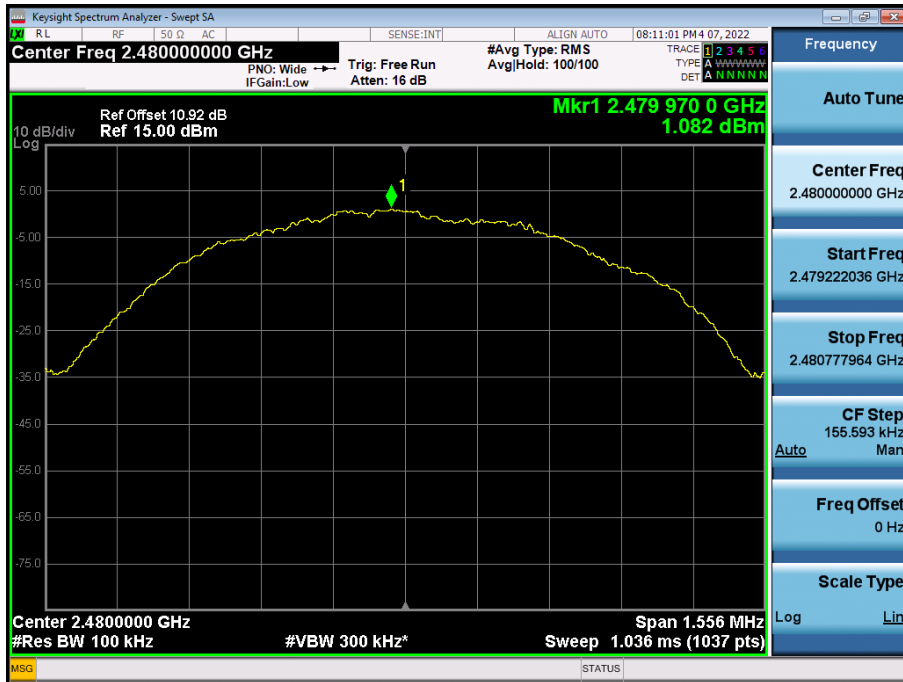
Power Spectral Density (Low-CH 4)



Power Spectral Density (Mid-CH 19)



Power Spectral Density (High-CH 39)



### 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.

#### [BAND EDGE]

Frequency (MHz)	Mode	Channel No.	Position	Test Result	
				Measured Level (dB)	Limit (dBc)
2402	1M Bit/s 37 Byte	0	Lower	60.915	30
2410		4	Lower	67.429	
2480		39	Upper	66.165	
2402	1M Bit/s 255 Byte	0	Lower	61.510	
2410		4	Lower	66.970	
2480		39	Upper	67.220	
2402	2M Bit/s 37 Byte	0	Lower	47.201	
2410		4	Lower	67.582	
2480		39	Upper	65.796	
2402	2M Bit/s 255 Byte	<b>0</b>	<b>Lower</b>	<b>46.930</b>	
2410		4	Lower	66.663	
2480		<b>39</b>	<b>Upper</b>	<b>64.805</b>	
2402	125k Bit/s 37 Byte	0	Lower	60.762	
2410		4	Lower	66.201	
2480		39	Upper	65.731	
2402	125k Bit/s 255 Byte	0	Lower	61.058	
2410		4	Lower	64.597	
2480		39	Upper	66.043	
2402	500k Bit/s 37 Byte	0	Lower	60.963	
2410		4	Lower	67.061	
2480		39	Upper	66.837	
2402	500k Bit/s 255 Byte	0	Lower	61.061	
2410		4	Lower	67.805	
2480		39	Upper	65.370	

**Note :**

1. Worst case test Plot  
Lower 2M Bit/s (255 Bytes)

#### [CONDUCTED SPURIOUS EMISSIONS]

**Note :**

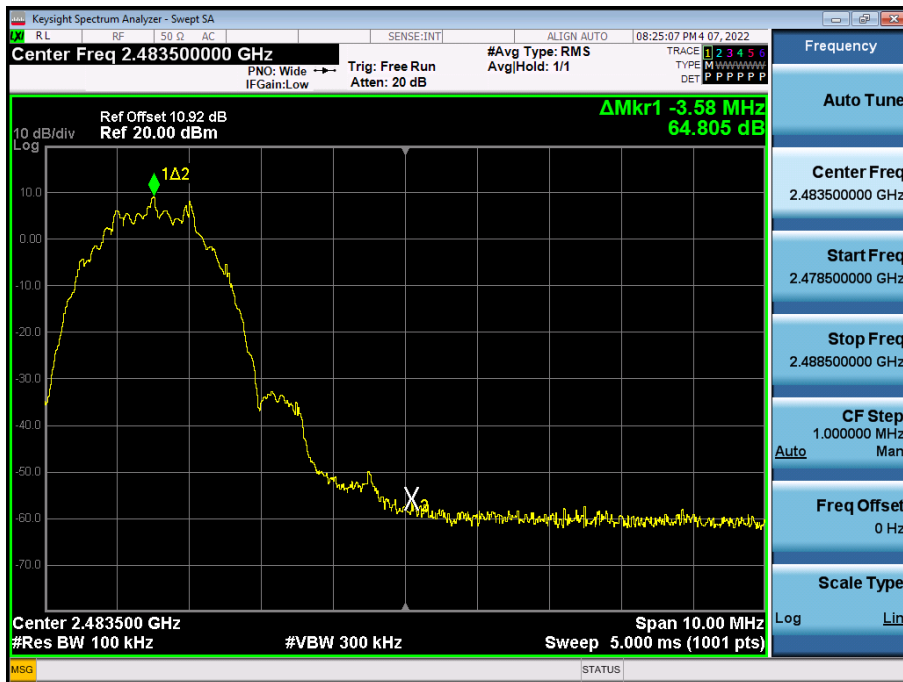
1. Worst case test Plot  
2M Bit/s (255 Byte)

2M Bit/s (255 Byte) Test Plots –Band Edge

Low-CH 0



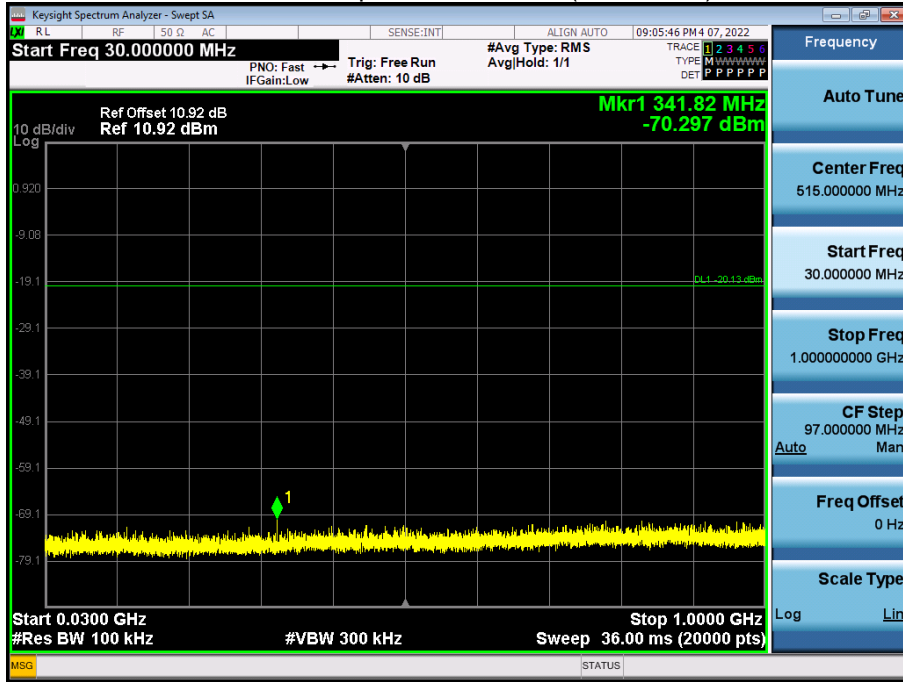
High-CH 39



**2M Bit/s (255 Byte) Test Plots -Conducted Spurious Emission**

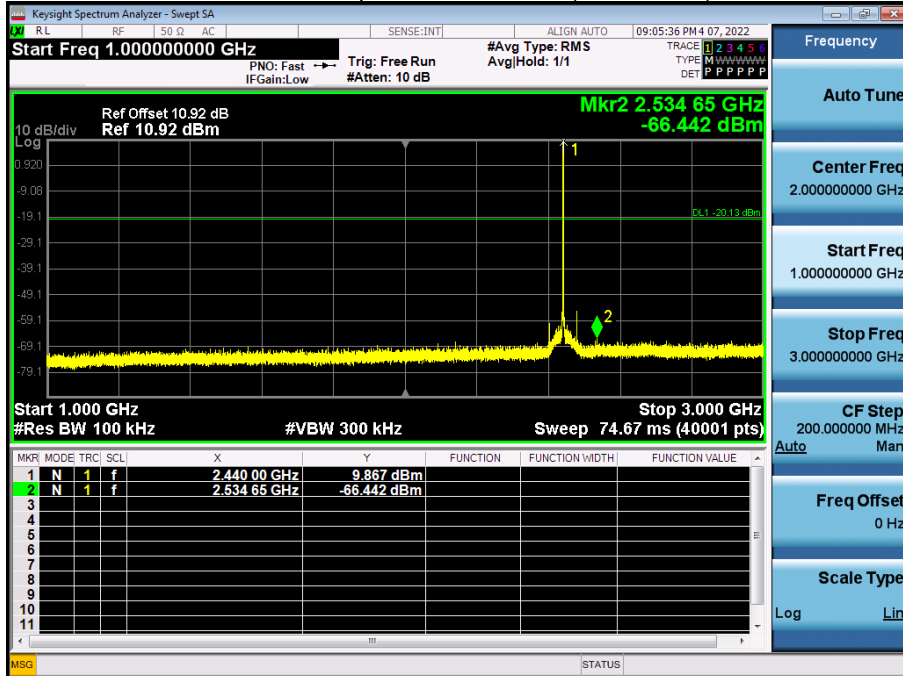
30 MHz ~ 1 GHz

Conducted Spurious Emission (Mid-CH 19)



1 GHz ~ 3 GHz

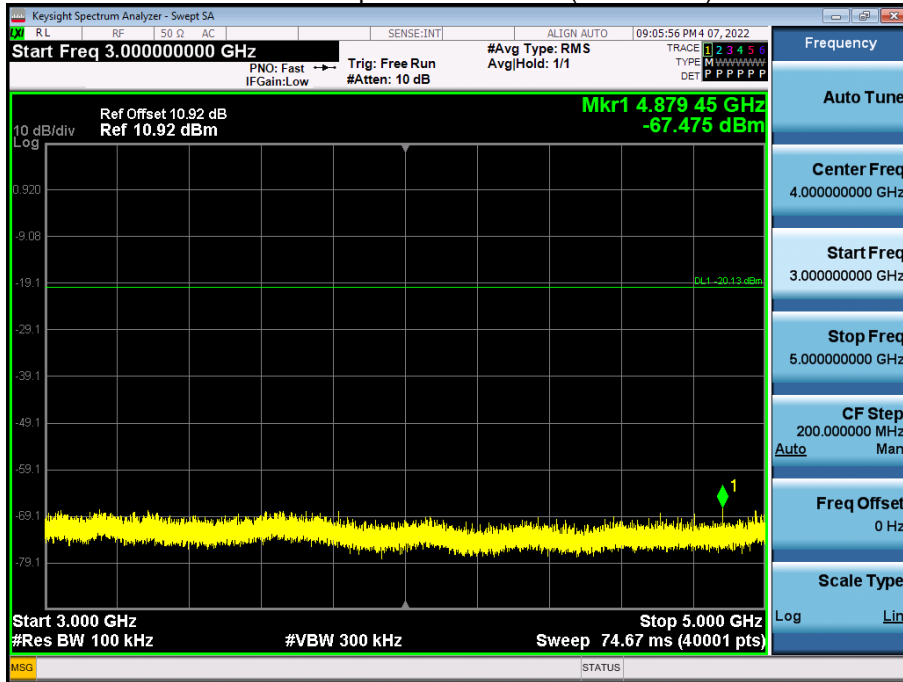
Conducted Spurious Emission (Mid-CH 19)





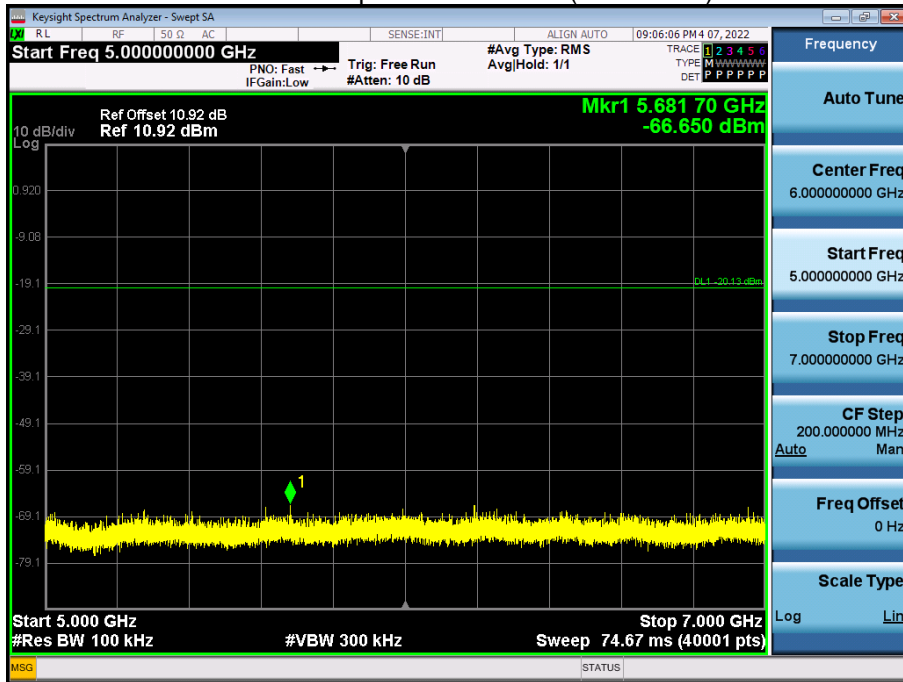
3 GHz ~ 5 GHz

Conducted Spurious Emission (Mid-CH 19)



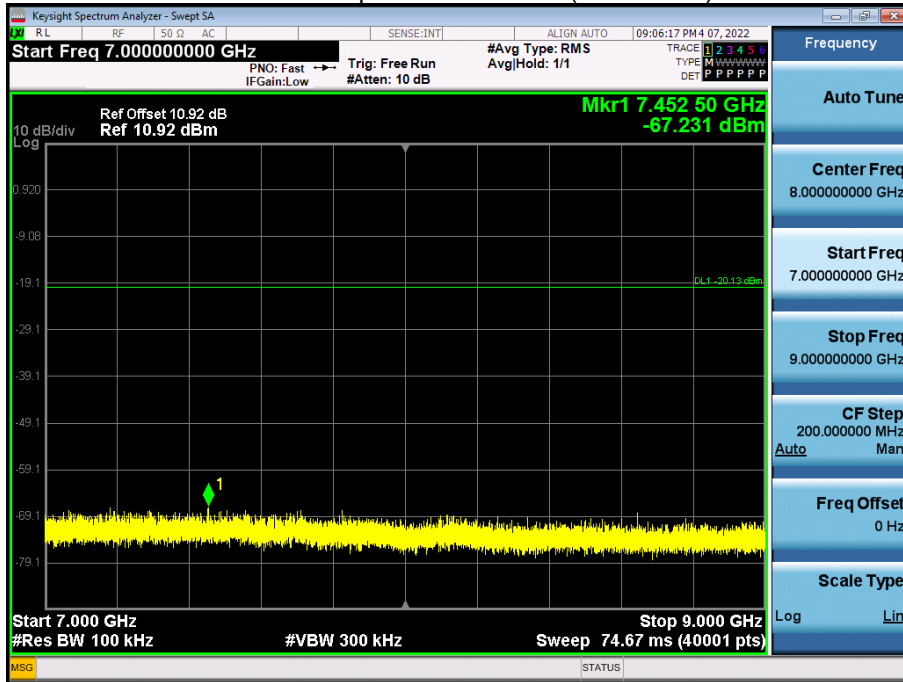
5 GHz ~ 7 GHz

Conducted Spurious Emission (Mid-CH 19)



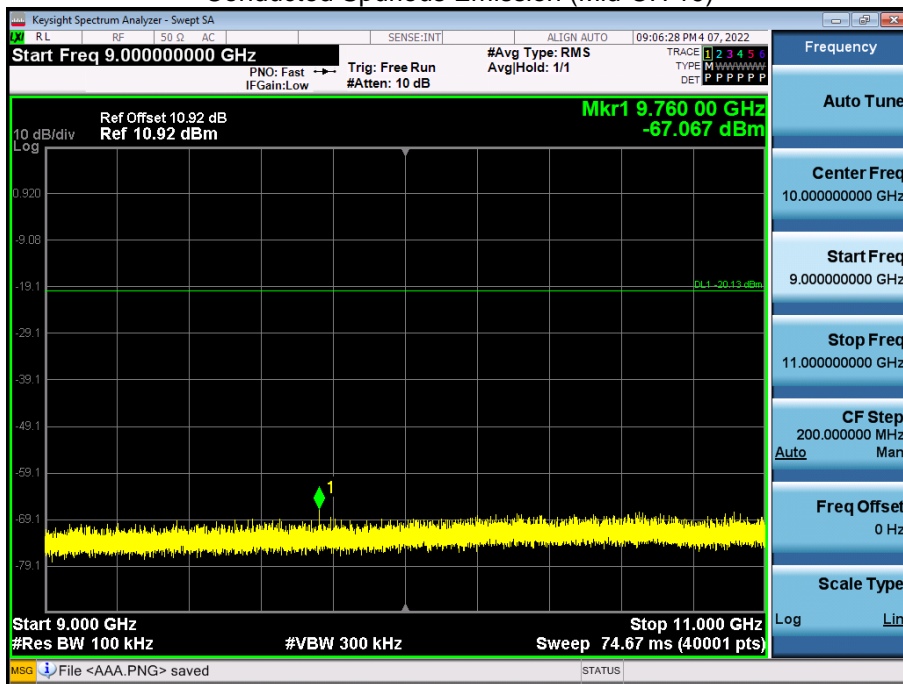
7 GHz ~ 9 GHz

Conducted Spurious Emission (Mid-CH 19)



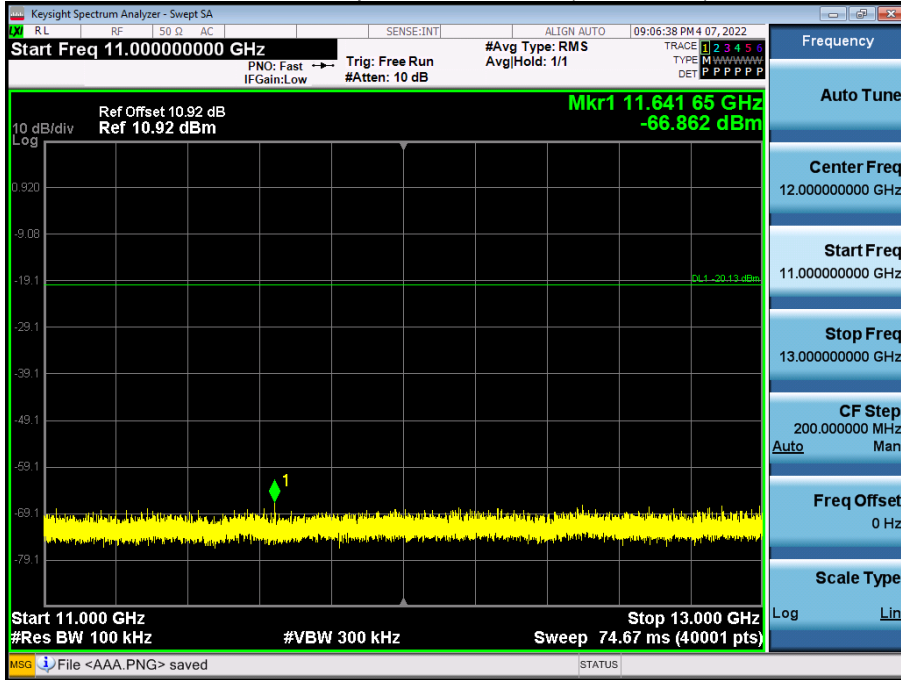
9 GHz ~ 11 GHz

Conducted Spurious Emission (Mid-CH 19)



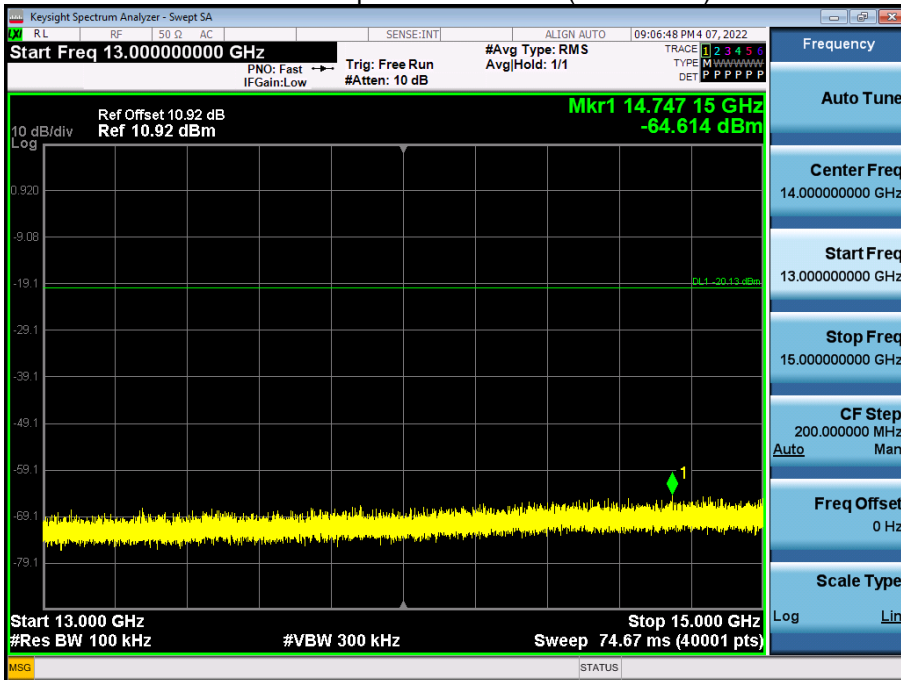
11 GHz ~ 13 GHz

Conducted Spurious Emission (Mid-CH 19)



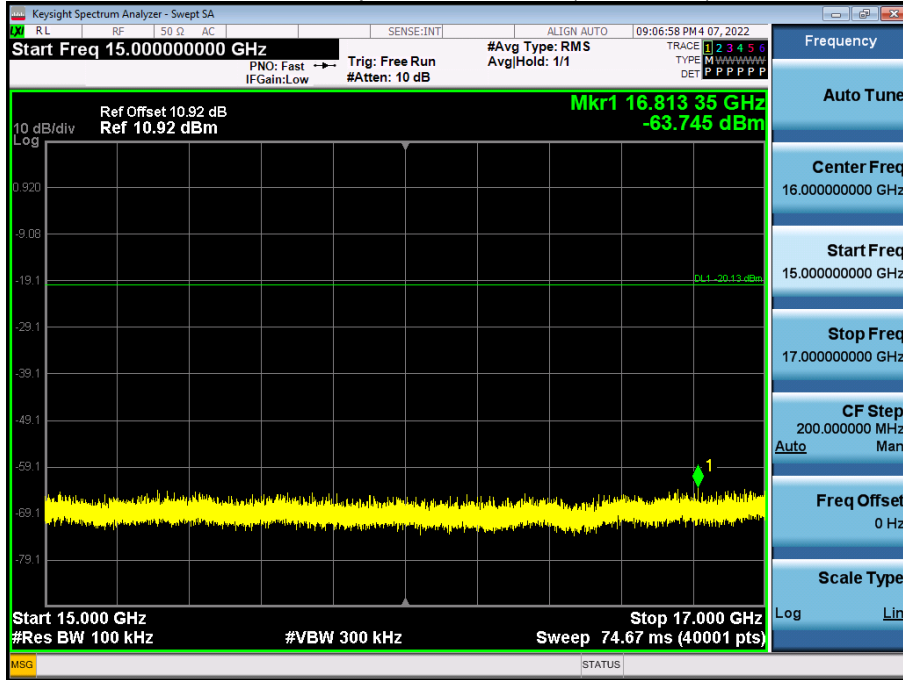
13 GHz ~ 15 GHz

Conducted Spurious Emission (Mid-CH 19)



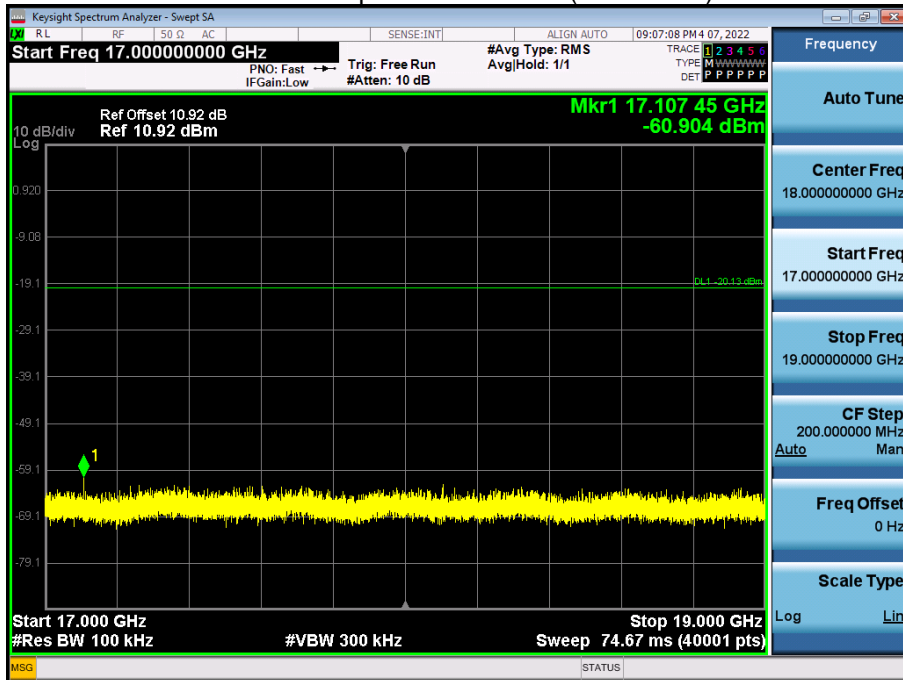
15 GHz ~ 17 GHz

Conducted Spurious Emission (Mid-CH 19)



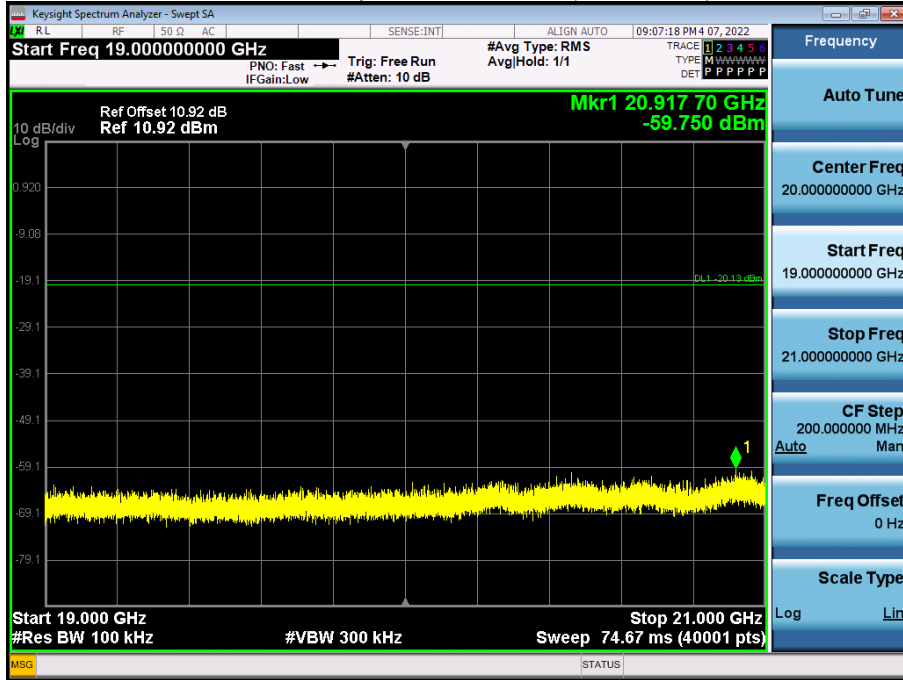
17 GHz ~ 19 GHz

Conducted Spurious Emission (Mid-CH 19)



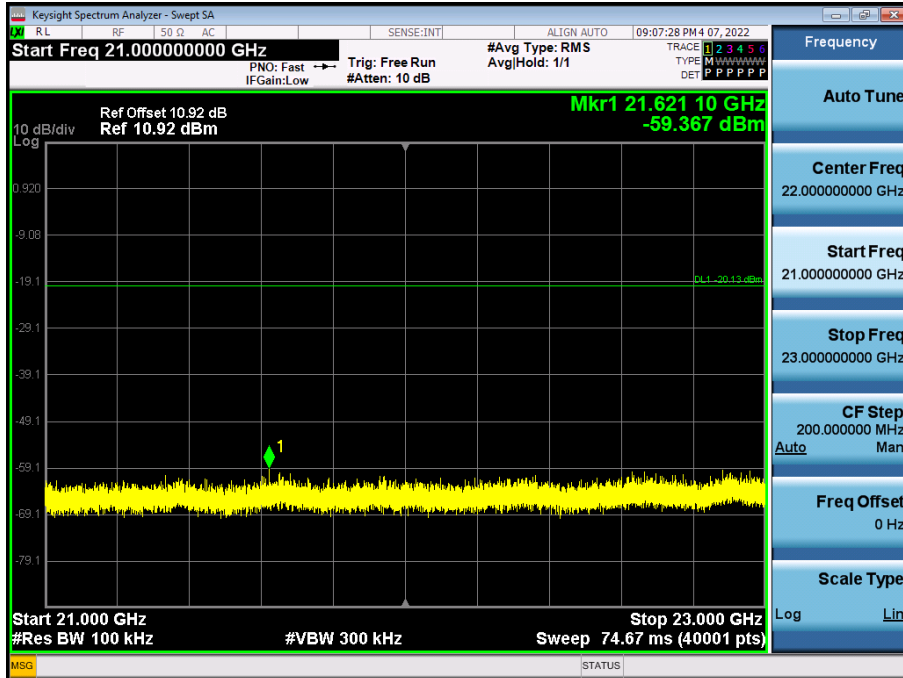
19 GHz ~ 21 GHz

Conducted Spurious Emission (Mid-CH 19)



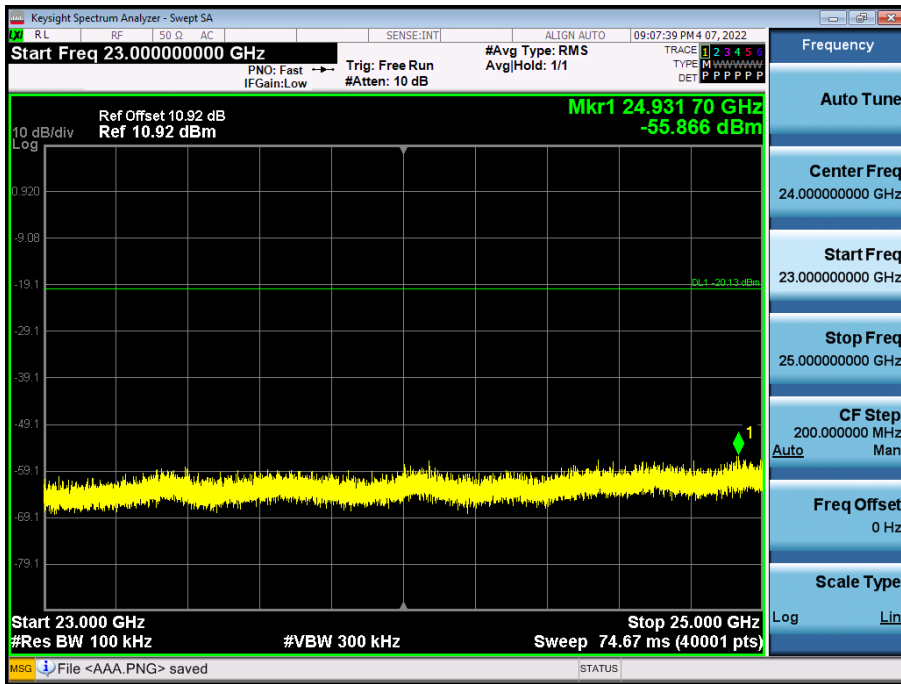
21 GHz ~ 23 GHz

Conducted Spurious Emission (Mid-CH 19)



23 GHz ~ 25 GHz

Conducted Spurious Emission (Mid-CH 19)



**9.6 RADIATED SPURIOUS EMISSIONS**

**Frequency Range : 9 kHz – 30 MHz**

Frequency	Measured Value	A.F+C.L+D.F	POL	Total	Limit	Margin
[MHz]	[dBµV]	[dB/m]	[H/V]	[dBµV/m]	[dBµV/m]	[dB]
No Critical peaks found						

**Note:**

1. The Measured 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 =  $40\log(\text{specific distance} / \text{test distance})$  (dB)
3. Limit line = specific Limits (dBµV) + Distance extrapolation factor

**Frequency Range : Below 1 GHz**

Frequency	Measured Value	A.F + C.L + D.F	POL	Total	Limit	Margin
[MHz]	[dBµV]	[dB/m]	[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**
**Mode : 1 M Bit/s (37 Bytes)**

Operation Mode: CH Low

Frequency [MHz]	Measured Value [dB $\mu$ V]	Duty Cycle Factor [dB]	A.F + C.L - A.G + D.F [dB/m]	Pol. [H/V]	Total [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Measurement Type
4804	44.02	0.00	2.76	V	46.78	73.98	27.20	PK
4804	32.55	2.06	2.76	V	37.36	53.98	16.62	AV
7206	39.17	0.00	8.96	V	48.13	73.98	25.85	PK
7206	28.24	2.06	8.96	V	39.25	53.98	14.73	AV
4804	43.72	0.00	2.76	H	46.48	73.98	27.50	PK
4804	32.12	2.06	2.76	H	36.93	53.98	17.05	AV
7206	40.09	0.00	8.96	H	49.05	73.98	24.93	PK
7206	28.48	2.06	8.96	H	39.49	53.98	14.49	AV

Operation Mode: CH Mid

Frequency [MHz]	Measured Value [dB $\mu$ V]	Duty Cycle Factor [dB]	A.F + C.L - A.G + D.F [dB/m]	Pol. [H/V]	Total [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Measurement Type
4880	42.51	0.00	3.15	V	45.66	73.98	28.32	PK
4880	30.52	2.06	3.15	V	35.72	53.98	18.26	AV
7320	40.73	0.00	9.45	V	50.18	73.98	23.80	PK
7320	28.48	2.06	9.45	V	39.99	53.98	13.99	AV
4880	41.89	0.00	3.15	H	45.04	73.98	28.94	PK
4880	29.85	2.06	3.15	H	35.05	53.98	18.93	AV
7320	39.08	0.00	9.45	H	48.53	73.98	25.45	PK
7320	27.34	2.06	9.45	H	38.85	53.98	15.13	AV



Operation Mode: CH High

Frequency [MHz]	Measured Value [dBμV]	Duty Cycle Factor [dB]	A.F + C.L - A.G + D.F [dB/m]	Pol. [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
4960	42.42	0.00	2.23	V	44.65	73.98	29.33	PK
4960	30.34	2.06	2.23	V	34.62	53.98	19.36	AV
7440	39.95	0.00	10.35	V	50.30	73.98	23.68	PK
7440	27.76	2.06	10.35	V	40.17	53.98	13.81	AV
4960	41.98	0.00	2.23	H	44.21	73.98	29.77	PK
4960	29.98	2.06	2.23	H	34.26	53.98	19.72	AV
7440	38.96	0.00	10.35	H	49.31	73.98	24.67	PK
7440	27.33	2.06	10.35	H	39.74	53.98	14.24	AV

**Mode : 2 M Bit/s (255 Bytes)**

Operation Mode: CH Low

Frequency [MHz]	Measured Value [dBμV]	Duty Cycle Factor [dB]	A.F + C.L - A.G + D.F [dB/m]	Pol. [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
4804	43.60	0.00	2.76	V	46.36	73.98	27.62	PK
4804	31.33	2.42	2.76	V	36.50	53.98	17.48	AV
7206	40.45	0.00	8.96	V	49.41	73.98	24.57	PK
7206	28.17	2.42	8.96	V	39.55	53.98	14.43	AV
4804	42.06	0.00	2.76	H	44.82	73.98	29.16	PK
4804	31.12	2.42	2.76	H	36.29	53.98	17.69	AV
7206	40.19	0.00	8.96	H	49.15	73.98	24.83	PK
7206	27.36	2.42	8.96	H	38.74	53.98	15.24	AV

Operation Mode: CH Mid

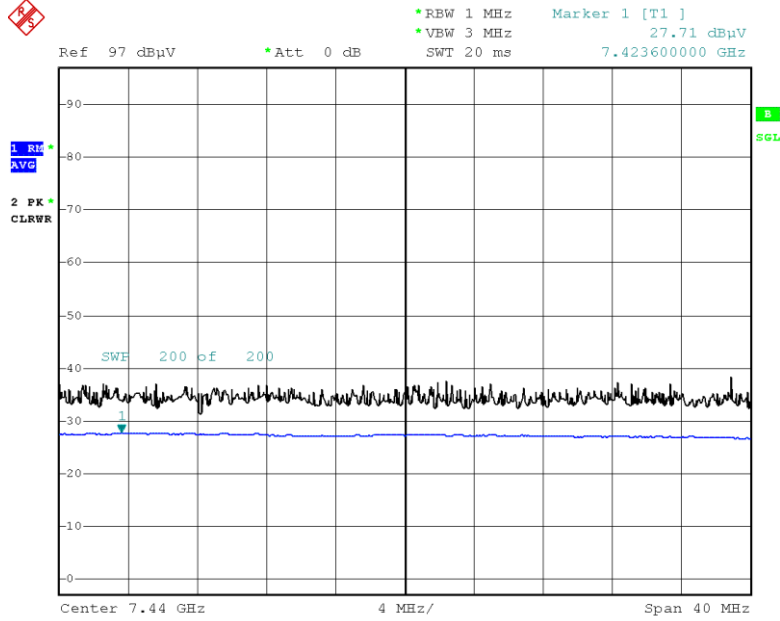
Frequency [MHz]	Measured Value [dBμV]	Duty Cycle Factor [dB]	A.F + C.L - A.G + D.F [dB/m]	Pol. [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
4880	42.22	0.00	3.15	V	45.37	73.98	28.61	PK
4880	30.14	2.42	3.15	V	35.70	53.98	18.28	AV
7320	41.24	0.00	9.45	V	50.69	73.98	23.29	PK
7320	28.18	2.42	9.45	V	40.05	53.98	13.93	AV
4880	41.89	0.00	3.15	H	45.04	73.98	28.94	PK
4880	28.66	2.42	3.15	H	34.22	53.98	19.76	AV
7320	40.58	0.00	9.45	H	50.03	73.98	23.95	PK
7320	27.16	2.42	9.45	H	39.03	53.98	14.95	AV

Operation Mode: CH High

Frequency [MHz]	Measured Value [dBμV]	Duty Cycle Factor [dB]	A.F + C.L - A.G + D.F [dB/m]	Pol. [H/V]	Total [dBμV/m]	Limit [dBμV/m]	Margin [dB]	Measurement Type
4960	43.25	0.00	2.23	V	45.48	73.98	28.50	PK
4960	30.08	2.42	2.23	V	34.72	53.98	19.26	AV
<b>7440</b>	<b>39.52</b>	<b>0.00</b>	<b>10.35</b>	<b>V</b>	<b>49.87</b>	<b>73.98</b>	<b>24.11</b>	<b>PK</b>
<b>7440</b>	<b>27.71</b>	<b>2.42</b>	<b>10.35</b>	<b>V</b>	<b>40.48</b>	<b>53.98</b>	<b>13.50</b>	<b>AV</b>
4960	42.94	0.00	2.23	H	45.17	73.98	28.81	PK
4960	29.94	2.42	2.23	H	34.58	53.98	19.40	AV
7440	38.99	0.00	10.35	H	49.34	73.98	24.64	PK
7440	27.47	2.42	10.35	H	40.24	53.98	13.74	AV

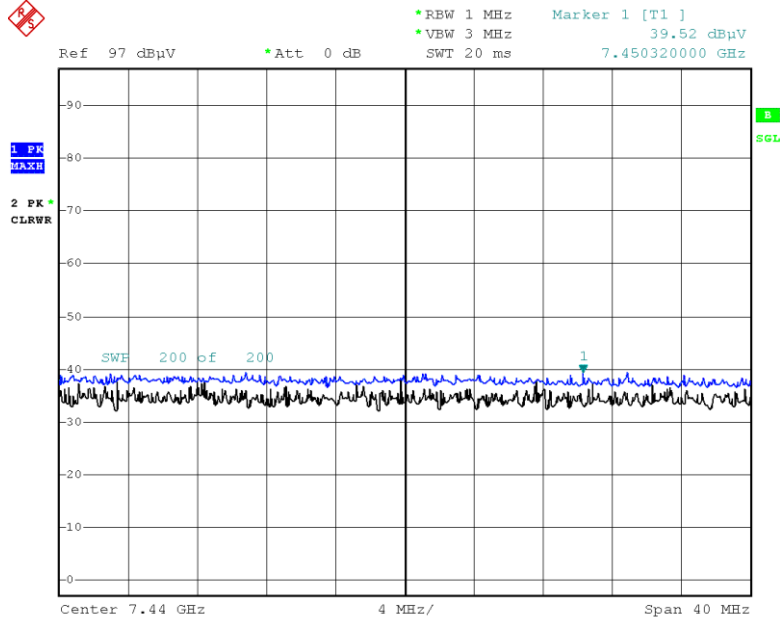
▣ 2 M Bit/s 255 Bytes Test Plots (Worst case : V)

Radiated Spurious Emissions plot – Average Result (Ch.39 3rd Harmonic)



Date: 16.APR.2022 15:41:43

Radiated Spurious Emissions plot – Peak Result (Ch.39 3rd Harmonic)



Date: 16.APR.2022 15:41:55

**Note:**

Plot of worst case are only reported.

## 9.7 RADIATED RESTRICTED BAND EDGES

### Mode : 1 M Bit/s (37 Bytes)

Operating Frequency 2402 MHz, 2480 MHz

Channel No. 0 CH, 39 CH

Frequency [MHz]	Measured Value [dB $\mu$ V]	Duty Cycle Factor [dB]	A.F + C.L + D.F [dB/m]	Ant. Pol. [H/V]	Total [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Measurement Type
2390.0	19.94	0.00	33.78	H	53.72	73.98	20.26	PK
2390.0	8.21	2.06	33.78	H	44.05	53.98	9.93	AV
2390.0	19.07	0.00	33.78	V	52.84	73.98	21.14	PK
2390.0	8.17	2.06	33.78	V	44.00	53.98	9.98	AV
2483.5	19.06	0.00	34.10	H	53.16	73.98	20.82	PK
2483.5	8.21	2.06	34.10	H	44.37	53.98	9.61	AV
2483.5	18.75	0.00	34.10	V	52.85	73.98	21.13	PK
2483.5	8.05	2.06	34.10	V	44.20	53.98	9.78	AV

### Mode : 2 M Bit/s (255 Bytes)

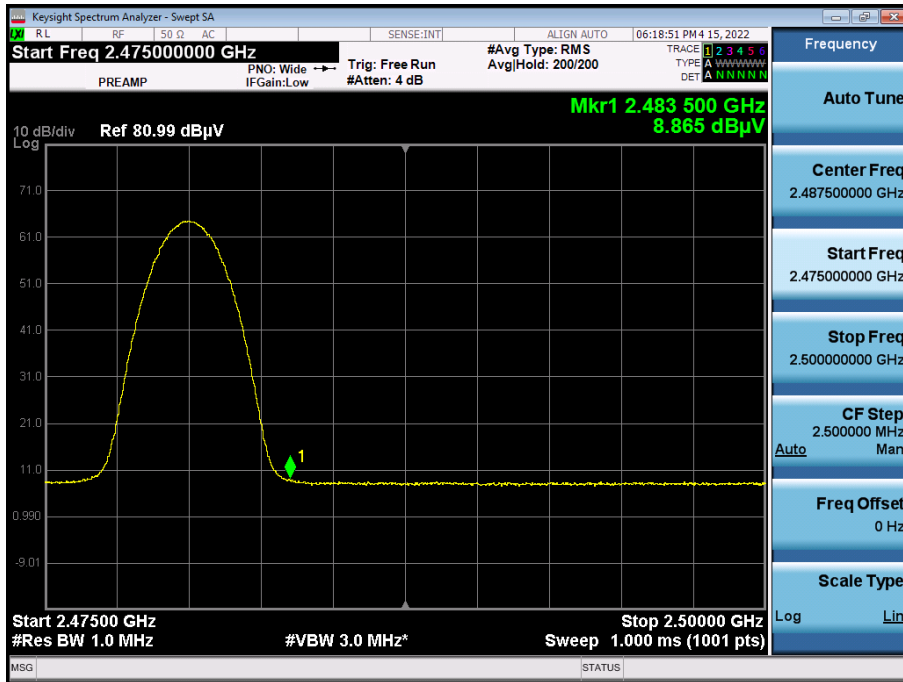
Operating Frequency 2402 MHz, 2480 MHz

Channel No. 0 CH, 39 CH

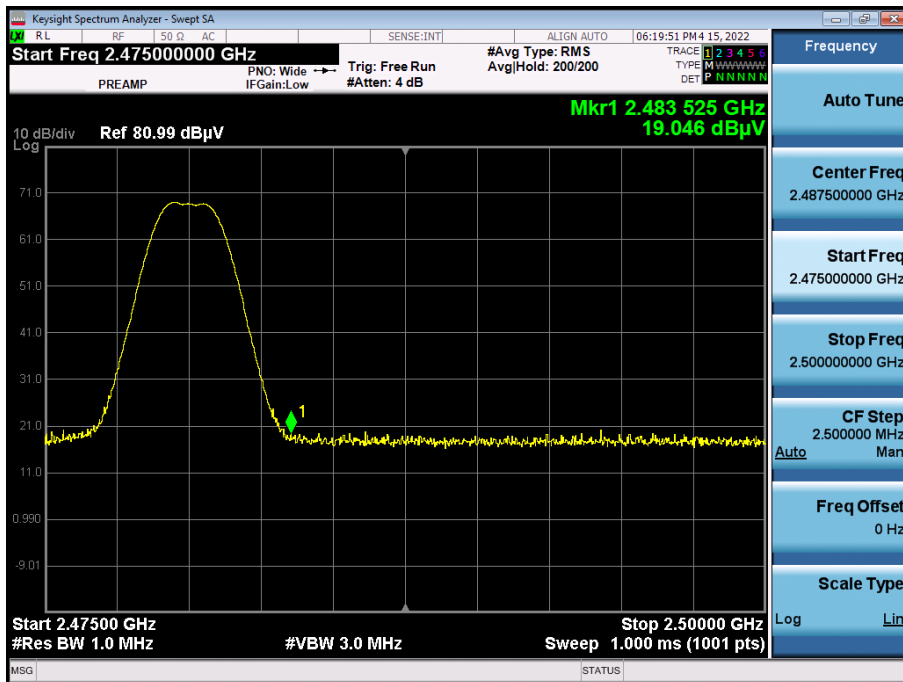
Frequency [MHz]	Measured Value [dB $\mu$ V]	Duty Cycle Factor [dB]	A.F + C.L + D.F [dB/m]	Ant. Pol. [H/V]	Total [dB $\mu$ V/m]	Limit [dB $\mu$ V/m]	Margin [dB]	Measurement Type
2390.0	19.73	0.00	33.78	H	53.51	73.98	20.47	PK
2390.0	7.81	2.42	33.78	H	44.00	53.98	9.98	AV
2390.0	19.02	0.00	33.78	V	52.80	73.98	21.18	PK
2390.0	7.66	2.42	33.78	V	43.85	53.98	10.13	AV
<b>2483.5</b>	<b>19.05</b>	<b>0.00</b>	<b>34.10</b>	<b>H</b>	<b>53.15</b>	<b>73.98</b>	<b>20.83</b>	<b>PK</b>
<b>2483.5</b>	<b>8.87</b>	<b>2.42</b>	<b>34.10</b>	<b>H</b>	<b>45.38</b>	<b>53.98</b>	<b>8.60</b>	<b>AV</b>
2483.5	18.57	0.00	34.10	V	52.67	73.98	21.31	PK
2483.5	8.20	2.42	34.10	V	44.72	53.98	9.26	AV

**Mode : 2 M Bit/s (255 Bytes) Test Plots**

Radiated Restricted Band Edges plot – Average Result (Ch.39, H)



Radiated Restricted Band Edges plot – Peak Result (Ch.39, H)



**Note:**

Plot of worst case are only reported.

**9.8 POWERLINE CONDUCTED EMISSIONS**

**Conducted Emissions (Line 1)**

Test

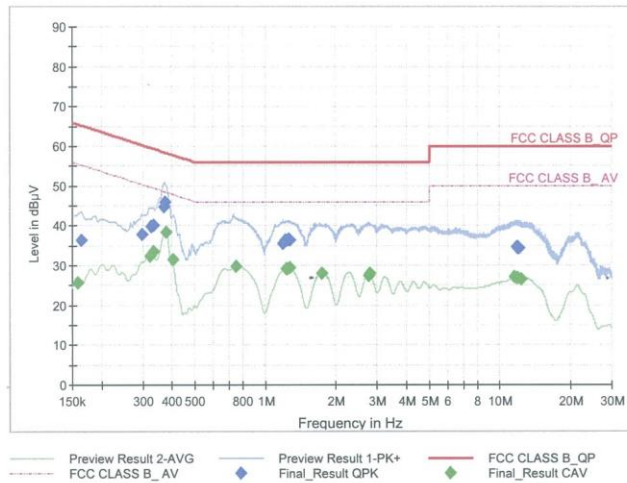
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**Test Report**

**Common Information**

EUT : SM-G990U2  
 Manufacturer : SAMSUNG Electronics Co., Ltd.  
 Test Site: SHIELD ROOM  
 Operating Conditions : BTLE\_L1  
 Operator Name:  
 Comment:

Full Spectrum



**Final Result QPK**

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1635	36.25	65.28	29.03	9.000	L1	OFF	9.6
0.2985	37.78	60.28	22.50	9.000	L1	OFF	9.6
0.3278	39.94	59.51	19.57	9.000	L1	OFF	9.6
0.3345	40.11	59.34	19.23	9.000	L1	OFF	9.6
0.3683	44.85	58.54	13.69	9.000	L1	OFF	9.6
0.3728	45.82	58.44	12.62	9.000	L1	OFF	9.6
1.1885	35.60	56.00	20.40	9.000	L1	OFF	9.7
1.2178	36.34	56.00	19.66	9.000	L1	OFF	9.7
1.2223	36.19	56.00	19.81	9.000	L1	OFF	9.7
1.2493	36.30	56.00	19.70	9.000	L1	OFF	9.7
1.2583	36.50	56.00	19.50	9.000	L1	OFF	9.7
1.2650	36.26	56.00	19.74	9.000	L1	OFF	9.7
11.8063	34.70	60.00	25.30	9.000	L1	OFF	10.1
11.8288	34.73	60.00	25.27	9.000	L1	OFF	10.1
11.8760	34.42	60.00	25.58	9.000	L1	OFF	10.1
11.9458	34.63	60.00	25.37	9.000	L1	OFF	10.1
11.9548	34.49	60.00	25.51	9.000	L1	OFF	10.1
12.0673	34.32	60.00	25.68	9.000	L1	OFF	10.1

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Test

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**Final Result CAV**

Frequency (MHz)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1590	25.73	55.52	29.79	9.000	L1	OFF	9.6
0.3210	32.34	49.68	17.35	9.000	L1	OFF	9.6
0.3323	33.32	49.40	16.07	9.000	L1	OFF	9.6
0.3773	38.31	48.34	10.03	9.000	L1	OFF	9.6
0.4020	31.49	47.81	16.32	9.000	L1	OFF	9.7
0.7453	29.64	46.00	16.36	9.000	L1	OFF	9.7
1.2335	29.09	46.00	16.91	9.000	L1	OFF	9.7
1.2470	29.19	46.00	16.81	9.000	L1	OFF	9.7
1.2673	29.32	46.00	16.68	9.000	L1	OFF	9.7
1.7465	27.90	46.00	18.10	9.000	L1	OFF	9.7
2.7635	27.36	46.00	18.64	9.000	L1	OFF	9.8
2.7793	27.89	46.00	18.11	9.000	L1	OFF	9.8
11.5498	26.98	50.00	23.02	9.000	L1	OFF	10.1
11.8063	26.86	50.00	23.14	9.000	L1	OFF	10.1
11.8288	26.95	50.00	23.05	9.000	L1	OFF	10.1
11.9188	26.79	50.00	23.21	9.000	L1	OFF	10.1
12.3440	26.63	50.00	23.37	9.000	L1	OFF	10.1
12.3643	26.61	50.00	23.39	9.000	L1	OFF	10.1

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**Conducted Emissions (Line 2)**

Test

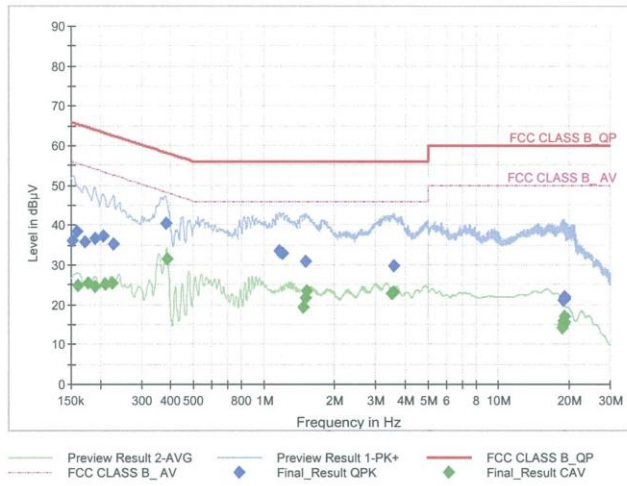
1 / 2

**Test Report**

**Common Information**

EUT : SM-G990U2  
 Manufacturer : SAMSUNG Electronics Co., Ltd.  
 Test Site: SHIELD ROOM  
 Operating Conditions : BTLE\_N  
 Operator Name:  
 Comment:

Full Spectrum



**Final Result\_QPK**

Frequency (MHz)	QuasiPeak (dBµV)	Limit (dBµV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1523	36.06	65.88	29.81	9.000	N	OFF	9.6
0.1590	38.23	65.52	27.28	9.000	N	OFF	9.6
0.1725	35.86	64.84	28.98	9.000	N	OFF	9.6
0.1905	36.68	64.02	27.34	9.000	N	OFF	9.6
0.2063	37.30	63.36	26.06	9.000	N	OFF	9.6
0.2265	35.27	62.58	27.31	9.000	N	OFF	9.6
0.3795	40.29	58.29	18.00	9.000	N	OFF	9.6
1.1593	33.45	56.00	22.55	9.000	N	OFF	9.7
1.1660	33.50	56.00	22.50	9.000	N	OFF	9.7
1.1705	33.26	56.00	22.74	9.000	N	OFF	9.7
1.2043	32.92	56.00	23.08	9.000	N	OFF	9.7
1.5125	30.85	56.00	25.15	9.000	N	OFF	9.7
3.5735	29.68	56.00	26.32	9.000	N	OFF	9.8
18.9905	21.17	60.00	38.83	9.000	N	OFF	10.4
19.0243	21.70	60.00	38.30	9.000	N	OFF	10.4
19.0558	21.28	60.00	38.72	9.000	N	OFF	10.4
19.0873	21.61	60.00	38.39	9.000	N	OFF	10.4
19.1188	21.79	60.00	38.21	9.000	N	OFF	10.4

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Test

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**Final Result CAV**

Frequency (MHz)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.1613	24.91	55.40	30.49	9.000	N	OFF	9.6
0.1770	25.34	54.63	29.28	9.000	N	OFF	9.6
0.1905	24.55	54.02	29.46	9.000	N	OFF	9.6
0.2108	25.12	53.18	28.06	9.000	N	OFF	9.6
0.2243	25.32	52.66	27.34	9.000	N	OFF	9.6
0.3840	31.47	48.19	16.73	9.000	N	OFF	9.6
1.4720	19.42	46.00	26.58	9.000	N	OFF	9.7
1.5058	21.73	46.00	24.27	9.000	N	OFF	9.7
1.5193	23.46	46.00	22.54	9.000	N	OFF	9.7
3.4925	22.65	46.00	23.35	9.000	N	OFF	9.8
3.5263	22.82	46.00	23.18	9.000	N	OFF	9.8
3.5915	22.94	46.00	23.06	9.000	N	OFF	9.8
18.7363	14.15	50.00	35.85	9.000	N	OFF	10.4
18.9275	15.92	50.00	34.08	9.000	N	OFF	10.4
18.9905	14.92	50.00	35.08	9.000	N	OFF	10.4
19.0850	16.93	50.00	33.07	9.000	N	OFF	10.4
19.1615	15.50	50.00	34.50	9.000	N	OFF	10.4
19.1818	15.56	50.00	34.44	9.000	N	OFF	10.4

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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	08/23/2022	Annual
EMI Test Receiver	ESR	Rohde & Schwarz	101910	06/17/2022	Annual
Temperature Chamber	SU-642	ESPEC	0093008124	03/04/2023	Annual
Signal Analyzer	N9030A	Keysight	MY55410508	09/07/2022	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)	5910-N-50-010	H+S	00801	10/29/2022	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	09/04/2022	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	06/24/2022	Annual
Band Reject Filter	WRCJV12-4900-5100-5900-6100-50SS	Wainwright Instruments	6	06/24/2022	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	WEINSCHL CERNEK	N/A	12/22/2022	Annual
ATT(10 dB) + LNA1(0.1~18 GHz)	56-10, CBLU1183540B-01	Api tech, CERNEK	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	CERNEK	22966	12/02/2022	Annual
Power Amplifier	CBL26405040	CERNEK	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	09/13/2022	Annual
Spectrum Analyzer	FSV40-N(9 kHz ~ 30 GHz)	Rohde & Schwarz	101068-SZ	09/15/2022	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-2205-FC012-P