



KSIGN (Guangdong) Testing Co., Ltd.

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TEST REPORT

Report No...... : **KS2011S02128E**

FCC ID..... : **2AO94-MK14**

Applicant..... : **MOKO TECHNOLOGY LIMITED**

Address..... : 2F, Building1, No. 37 Xiaxintang Xintang village, Fucheng Street,
Longhua District, Shenzhen, Guangdong Province, China

Manufacturer..... : **MOKO TECHNOLOGY Ltd**

Address..... : 2F, Building1, No. 37 Xiaxintang Xintang village, Fucheng Street,
Longhua District, Shenzhen, Guangdong Province, China

Factory..... : **MOKO TECHNOLOGY Ltd**

Address..... : 2F, Building1, No. 37 Xiaxintang Xintang village, Fucheng Street,
Longhua District, Shenzhen, Guangdong Province, China

Product Name..... : **Bluetooth Low Energy Module**

Trade Mark..... : /

Model/Type reference..... : MK14A

Listed Model(s)..... : MK14B

Standard..... : **FCC CFR Title 47 Part 15 Subpart C Section 15.247**

Date of Receipt..... : Nov. 26, 2020

Date of Test Date..... : Nov. 26, 2020~Dec. 21, 2020

Date of issue..... : Dec. 21, 2020

Test result..... : **Pass**

Compiled by:

(Printed name+signature)

Rory Huang

Supervised by:

(Printed name+signature)

Eder Zhan

Approved by:

(Printed name+signature)

Cary Luo



Testing Laboratory Name..... : **KSIGN(Guangdong) Testing Co., Ltd.**

Address..... :

West Side of 1/F., Building C, Zone A, Fuyuan New Factory, Jiujiu Industrial Park, Minzhu, Shatou, Shajing, Bao'an District, Shenzhen, Guangdong, People's Republic of China

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1. TEST SUMMARY

1.1. Test Standards

The tests were performed according to following standards:

FCC Rules Part 15.247: Operation within the bands of 902-928MHz, 2400-2483.5MHz, and 5725-5850MHz.

KDB 558074 D01 : The measurement guidance provided herein is applicable only to Digital Transmission System (DTS) devices operating in the 902-928 MHz. 2400-2483.5 MHz and/or 5725-5850 MHz bands under § 15.247 of the FCC rules (Title 47 of the Code of Federal Regulations)

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices.

1.2. Report version

| Revised No. | Date of issue | Description |
|-------------|---------------|-------------|
| 01 | Dec. 21, 2020 | Original |

1.3. Test Description

| FCC Part 15 Subpart C(15.247) | | | |
|--------------------------------|------------------|--------|---------------|
| Test Item | Standard Section | Result | Test Engineer |
| | FCC | | |
| Antenna Requirement | 15.203 | Pass | Rory Huang |
| Conducted Emission | 15.207 | Pass | Rory Huang |
| Restricted Bands | 15.205 | Pass | Rory Huang |
| Peak Output Power | 15.247(b) | Pass | Rory Huang |
| Band Edge Emissions | 15.247(d) | Pass | Rory Huang |
| Power Spectral Density | 15.247(e) | Pass | Rory Huang |
| Radiated Emission | 15.205&15.209 | Pass | Rory Huang |
| 6dB Bandwidth | 15.247(a)(2) | Pass | Rory Huang |
| Spurious RF Conducted Emission | 15.247(d) | Pass | Rory Huang |

Note:

1. The measurement uncertainty is not included in the test result.
2. The Two models have been tested, only the worst test model MK14A data is recorded in the report.

1.4. Test Facility

Address of the report laboratory

KSIGN(Guangdong) Testing Co., Ltd.

West Side of 1/F., Building C, Zone A, Fuyuan New Factory, Jiujiu Industrial Park, Minzhu, Shatou, Shajing, Bao'an District, Shenzhen, Guangdong, People's Republic of China

Laboratory accreditation

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L13261

KSIGN(Guangdong) Testing Co., Ltd. has been assessed and proved to be in Compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2017 General Requirements) for the Competence of Testing and Calibration Laboratories.

A2LA-Lab Cert. No.: 5457.01

KSIGN(Guangdong) Testing Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

IC Registration No.: CN0096

The 3m alternate test site of KSIGN(Guangdong) Testing Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: CN0096

FCC-Registration No.: CN1272

KSIGN(Guangdong) Testing Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files.

1.5. Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01" Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the KSIGN(Guangdong) Testing Co., Ltd. system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device. Below is the best measurement capability for KSIGN(Guangdong) Testing Co., Ltd.

| Test Items | Measurement Uncertainty | Notes |
|---|-------------------------|-------|
| Transmitter power conducted | 0.42 dB | (1) |
| Transmitter power Radiated | 2.14 dB | (1) |
| Conducted spurious emissions 9kHz~40GHz | 1.60 dB | (1) |
| Radiated spurious emissions 9kHz~40GHz | 2.20 dB | (1) |
| Conducted Emissions 9kHz~30MHz | 3.20 dB | (1) |
| Radiated Emissions 30~1000MHz | 4.70 dB | (1) |
| Radiated Emissions 1~18GHz | 5.00 dB | (1) |
| Radiated Emissions 18~40GHz | 5.54 dB | (1) |
| Occupied Bandwidth | 2.80 dB | (1) |

Note (1): This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

1.6. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

| | |
|--------------------|-------------|
| Temperature: | 15~35°C |
| Relative Humidity: | 30~60 % |
| Air Pressure: | 950~1050mba |

2. GENERAL INFORMATION

2.1. General Description of EUT

| | |
|------------------------|---|
| Test Sample Number 1: | 1-1-1(Normal Sample),1-1-2(Engineering Sample) For MK14A |
| Test Sample Number 2: | 1-1-3(Normal Sample),1-1-4(Engineering Sample) For MK14B |
| Product Name: | Bluetooth Low Energy Module |
| Trade Mark: | / |
| Model/Type reference: | MK14A |
| Listed Model(s): | MK14B |
| Model Difference: | The difference between product models only depends and the model naming,Type of antenna is different. Other power supply methods, safety structure and key components are the same, which do not affect the safety and electromagnetic compatibility performance. |
| Power supply(Work) | Input:DC 3.3V |
| Hardware version: | V1.0 |
| Software version: | V1.0.0 |
| Bluetooth V5.0 | |
| Modulation: | GFSK |
| Operation frequency: | 2402MHz~2480MHz |
| Max Peak Output Power: | -0.65dBm |
| Channel number: | 40 |
| Channel separation: | 2MHz |
| Antenna type: | PCB Antenna for MK14A External Antenna for MK14B |
| Antenna gain: | 1.20dBi for MK14A Max. 2.0dBi for MK14B |

2.2. Operation state

Operation Frequency List: The EUT has been tested under typical operating condition. The Applicant provides communication tools software to control the EUT for staying in continuous transmitting and receiving mode for testing. BT BLE, 40 channels are provided to the EUT. Channels 00/19/39 were selected for testing.

Operation Frequency List:

| Channel | Frequency (MHz) |
|-----------|-----------------|
| 00 | 2402 |
| 01 | 2404 |
| : | : |
| 19 | 2440 |
| 20 | 2442 |
| 21 | 2444 |
| : | : |
| 38 | 2478 |
| 39 | 2480 |

Note: The display in grey were the channel selected for testing.

Test mode

| |
|--|
| For RF test items: |
| The engineering test program was provided and enabled to make EUT continuous transmit. |
| For AC power line conducted emissions: |
| The EUT was set to connect with the Bluetooth instrument under large package sizes transmission. |
| For Radiated spurious emissions test item: |
| The engineering test program was provided and enabled to make EUT continuous transmit. The EUT in each of three orthogonal axis emissions had been tested, but only the worst case (X axis) data recorded in the report. |

2.3. Measurement Instruments List

| Tonscend JS0806-2 Test system | | | | | |
|-------------------------------|-------------------------------------|--------------|-----------|------------|------------|
| Item | Test Equipment | Manufacturer | Model No. | Serial No. | Cal. Until |
| 1 | Spectrum Analyzer | R&S | FSV40-N | 101798 | 04/07/2021 |
| 2 | Vector Signal Generator | Agilent | N5182A | MY50142520 | 04/07/2021 |
| 3 | Analog Signal Generator | HP | 83752A | 3344A00337 | 04/07/2021 |
| 4 | Power Sensor | Agilent | E9304A | MY50390009 | 04/07/2021 |
| 5 | Power Sensor | Agilent | E9300A | MY41498315 | 04/07/2021 |
| 6 | Wideband Radio Communication Tester | R&S | CMW500 | 157282 | 04/07/2021 |
| 7 | Climate Chamber | Angul | AGNH80L | 1903042120 | 04/07/2021 |
| 8 | Dual Output DC Power Supply | Agilent | E3646A | MY40009992 | 04/07/2021 |
| 9 | RF Control Unit | Tonscend | JS0806-2 | / | 04/07/2021 |

| Transmitter spurious emissions & Receiver spurious emissions | | | | | |
|--|--|---------------------|--------------|------------|------------|
| Item | Test Equipment | Manufacturer | Model No. | Serial No. | Cal. Until |
| 1 | EMI Test Receiver | R&S | ESR | 102525 | 04/07/2021 |
| 2 | High Pass Filter | Chengdu E-Microwave | OHF-3-18-S | 0E01901038 | 03/27/2021 |
| 3 | High Pass Filter | Chengdu E-Microwave | OHF-6.5-18-S | 0E01901039 | 03/27/2021 |
| 4 | Spectrum Analyzer | HP | 8593E | 3831U02087 | 04/07/2021 |
| 5 | Ultra-Broadband logarithmic period Antenna | Schwarzbeck | VULB 9163 | 01230 | 03/29/2023 |
| 6 | Loop Antenna | Beijin ZHINAN | ZN30900C | 18050 | 03/25/2021 |
| 7 | Spectrum Analyzer | R&S | FSV40-N | 101798 | 04/07/2021 |
| 8 | Horn Antenna | Schwarzbeck | BBHA 9120 D | 2023 | 03/29/2023 |
| 9 | Pre-Amplifier | Schwarzbeck | BBV 9745 | 9745#129 | 04/07/2021 |
| 10 | Pre-Amplifier | EMCI | EMC051835SE | 980662 | 04/07/2021 |

| Item | Test Equipment | Manufacturer | Model No. | Serial No. | Cal. Until |
|------|-------------------|--------------|-----------|--------------|------------|
| 1 | LISN | R&S | ENV432 | 1326.6105.02 | 03/27/2021 |
| 2 | EMI Test Receiver | R&S | ESR | 102524 | 04/07/2021 |
| 3 | Manual RF Switch | JS TOYO | / | MSW-01/002 | 04/07/2021 |

Note:

1)The Cal. Interval was one year.

2)The cable loss has calculated in test result which connection between each test instruments.

2.5. Test Software

| Software name | Model | Version |
|---|----------|---------------|
| Conducted emission Measurement Software | EZ-EMC | EMC-Con 3A1.1 |
| Radiated emission Measurement Software | EZ-EMC | FA-03A.2.RE |
| Bluetooth and WIFI Test System | JS1120-3 | 2.5.77.0418 |

3. TEST ITEM AND RESULTS

3.1. Antenna requirement

Requirement

FCC CFR Title 47 Part 15 Subpart C Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1)(i):

(i) Systems operating in the 2400~2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

Test Result

The directional gain of the antenna less than 6dBi, please refer to the EUT internal photographs antenna photo.

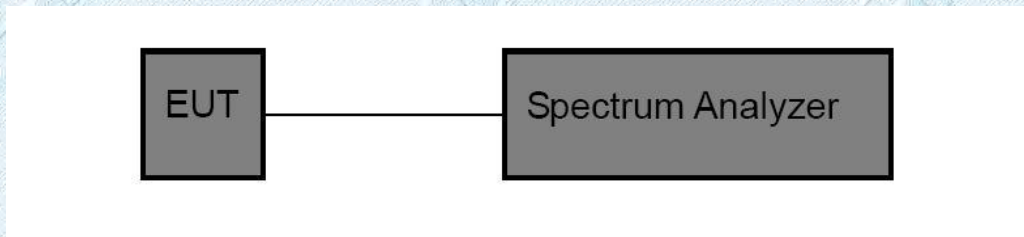
Note: The antenna is permanently fixed to the EUT

3.2. Peak Output Power

Limit

| Test Item | Limit | Frequency Range(MHz) |
|-------------------|------------------|----------------------|
| Peak Output Power | 1 Watt or 30 dBm | 2400~2483.5 |

Test Configuration



Test Procedure

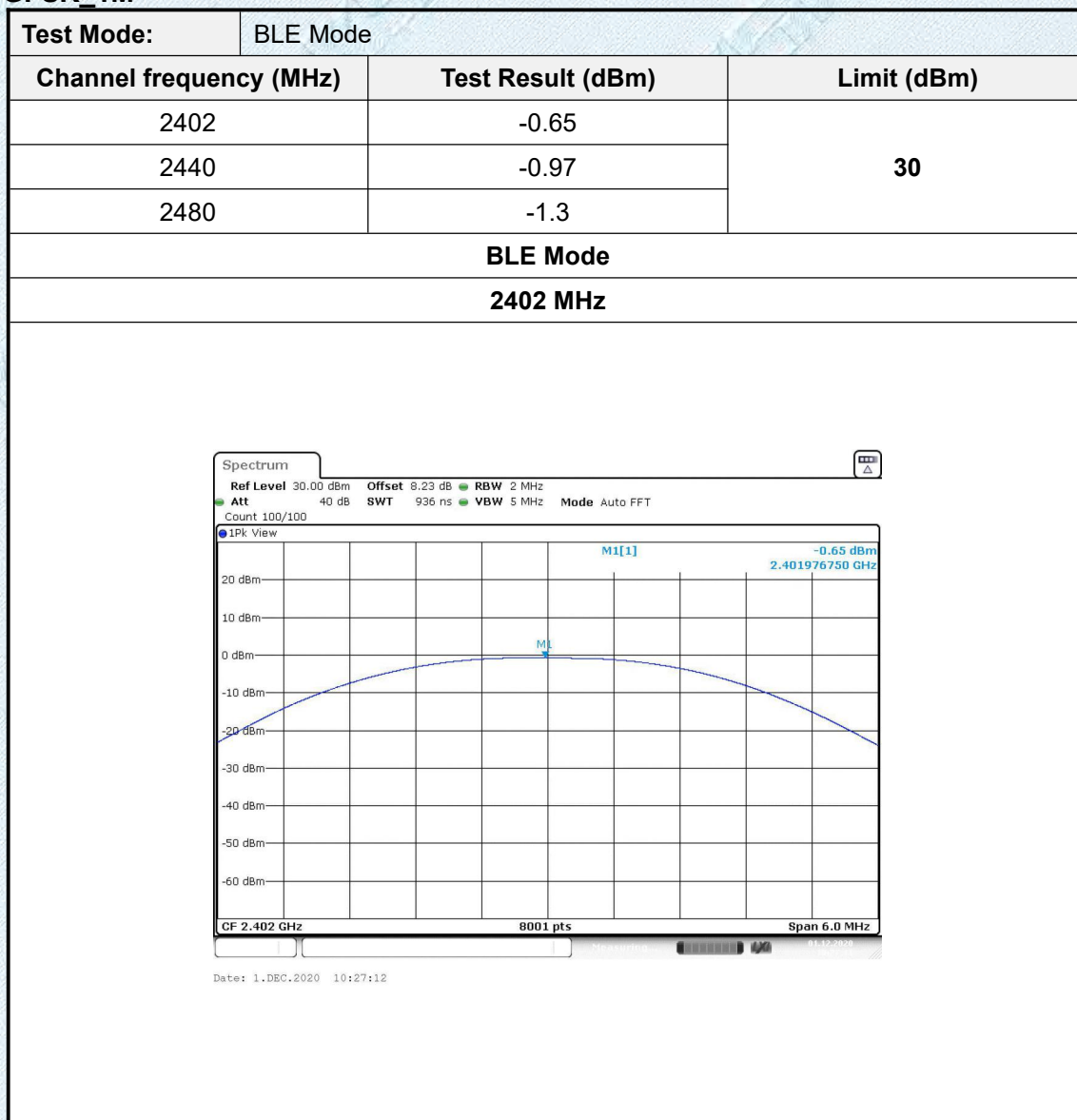
1. Connect EUT RF Output port to the Spectrum Analyzer through an RF attenuator..
2. Spectrum Setting:
 Peak Detector: $RBW \geq DTS \text{ Bandwidth}$, $VBW \geq 3 * RBW$.
 Sweep time=Auto.
 Detector= Peak.
 Trace mode= Maxhold.
 Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

Test Mode

Please refer to the clause 2.3.

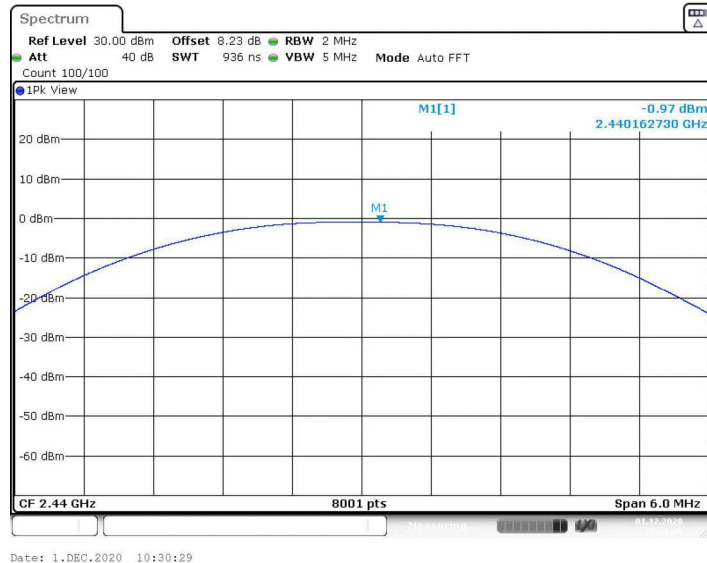
Test Result

GFSK_1M



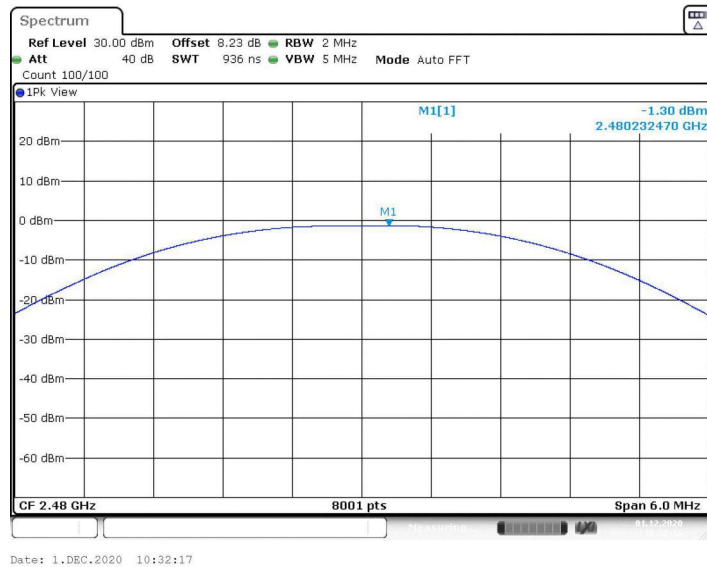
BLE Mode

2440 MHz

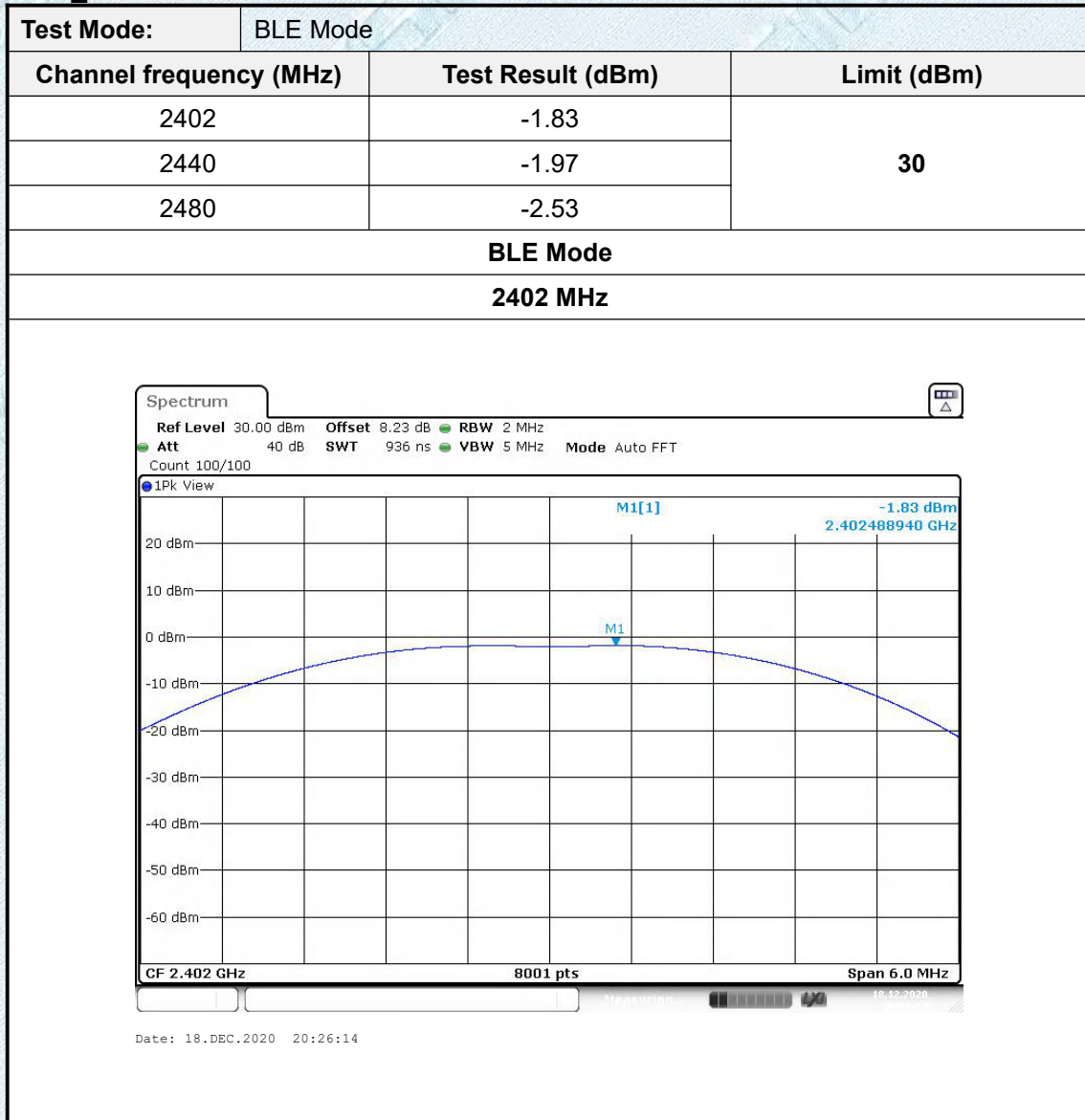


BLE Mode

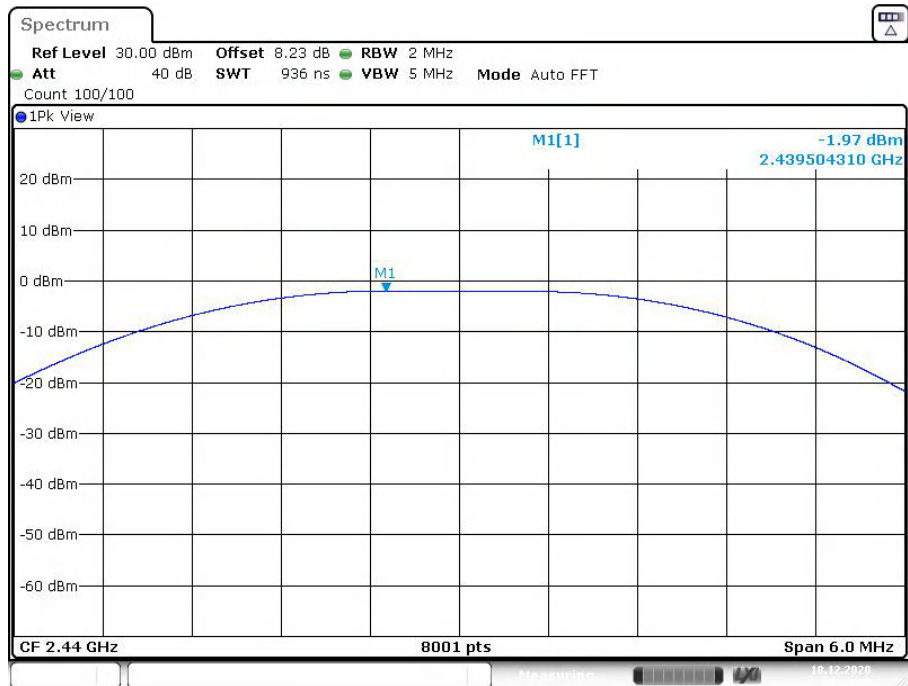
2480 MHz



GFSK_2M

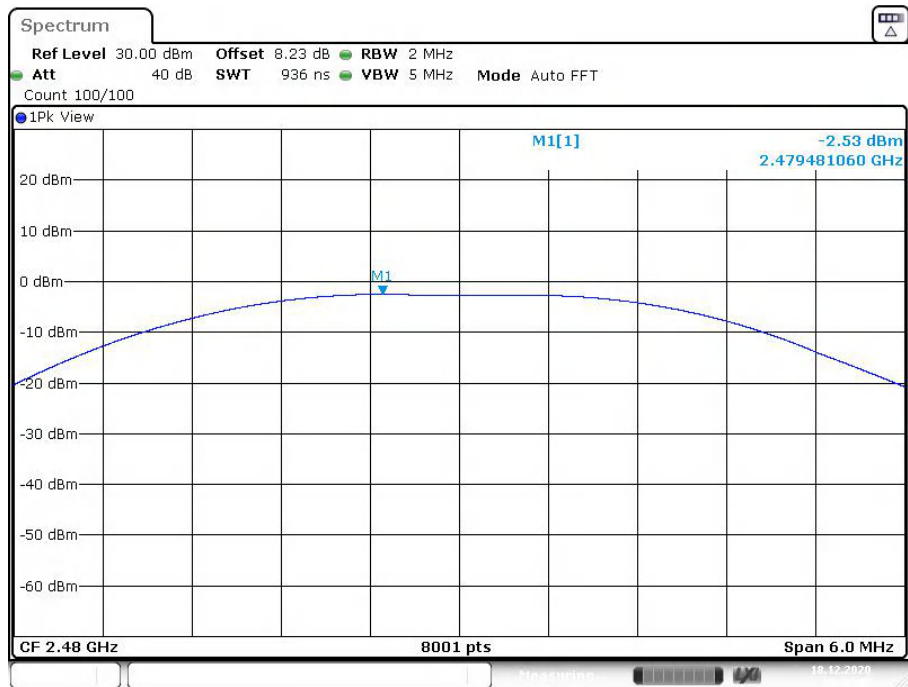


2440 MHz



Date: 18.DEC.2020 20:29:48

2480MHz



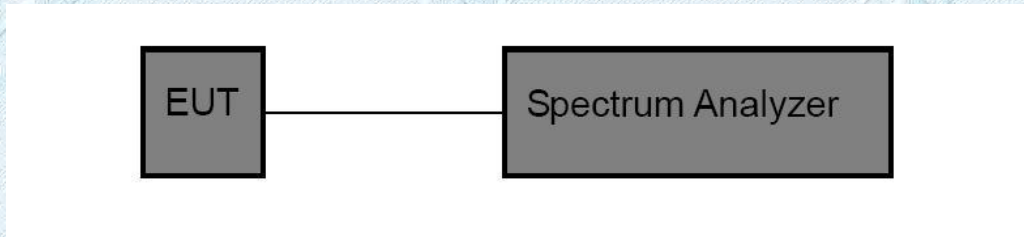
Date: 18.DEC.2020 20:32:48

3.3. 6dB Bandwidth

Limit

| Test Item | Limit | Frequency Range(MHz) |
|-----------|-----------------------------------|----------------------|
| Bandwidth | ≥ 500 KHz (6dB bandwidth) | 2400~2483.5 |

Test Configuration



Test Procedure

1. Connect EUT RF Output port to the Spectrum Analyzer through an RF attenuator.
2. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.
3. The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.
4. Spectrum Setting:
6dB bandwidth:
 - (1) Set RBW = 100 kHz.
 - (2) Set the video bandwidth (VBW) ≥ 3 RBW.
 - (3) Detector = Peak.
 - (4) Trace mode = Max hold.
 - (5) Sweep = Auto couple.
 - (6) Allow the trace to stabilize.
- (7) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

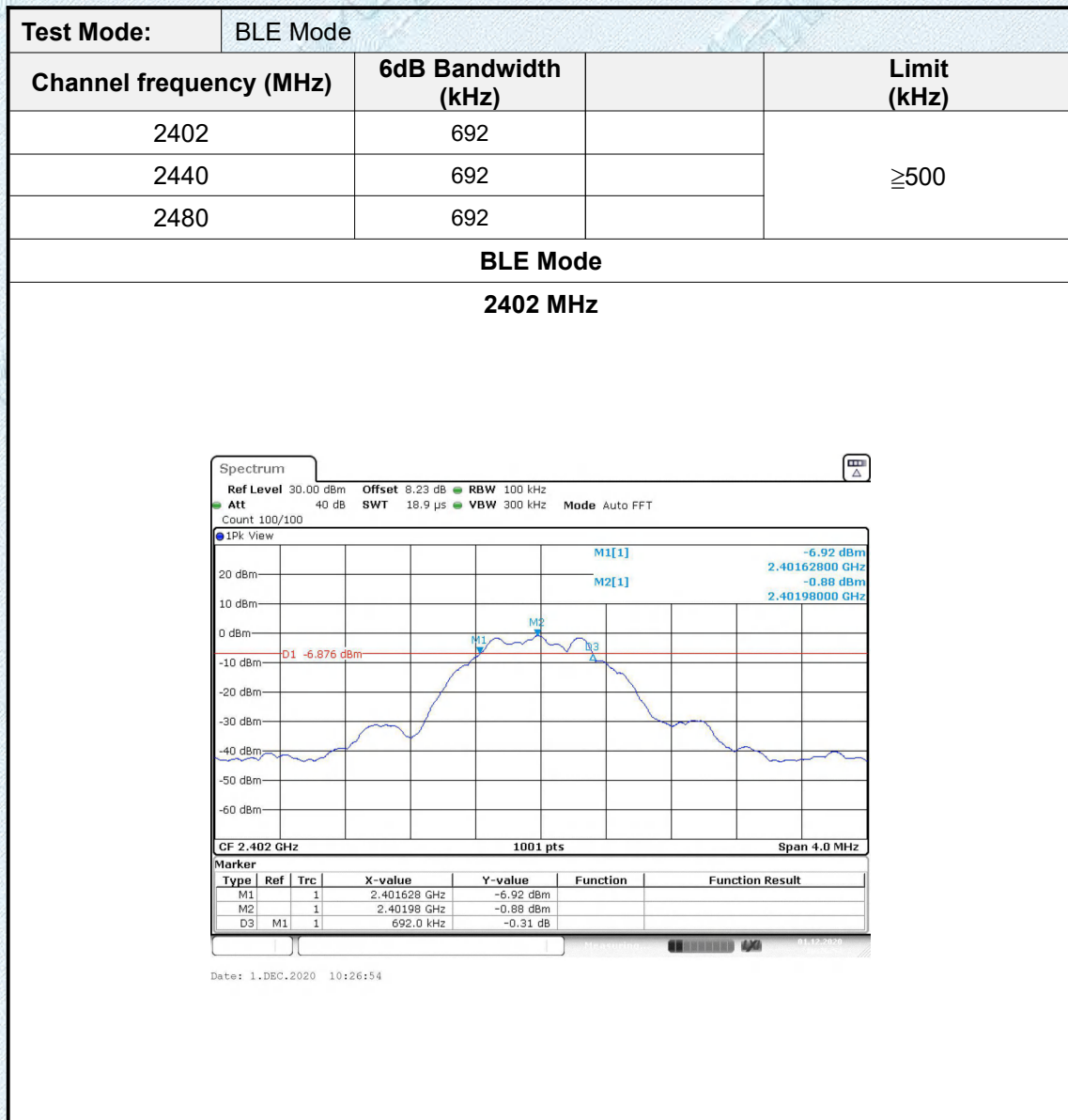
NOTE: The EUT was set to continuously transmitting in each mode and low, Middle and high channel for the test.

Test Mode

Please refer to the clause 2.3.

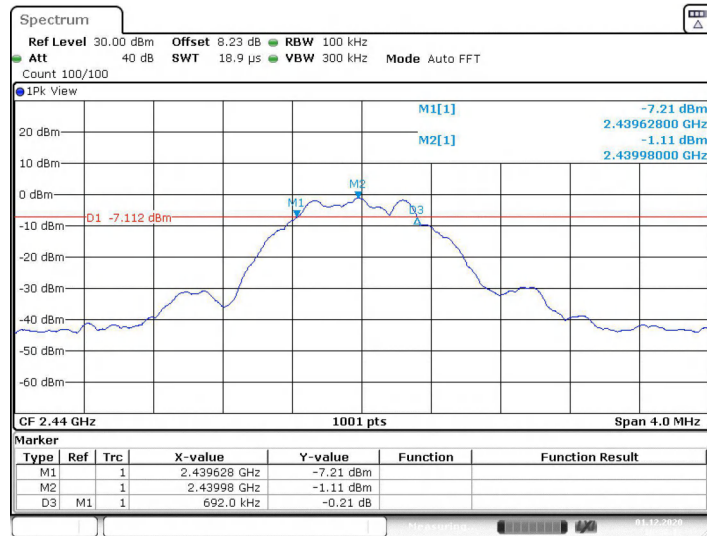
Test Results

GFSK_1M



BLE Mode

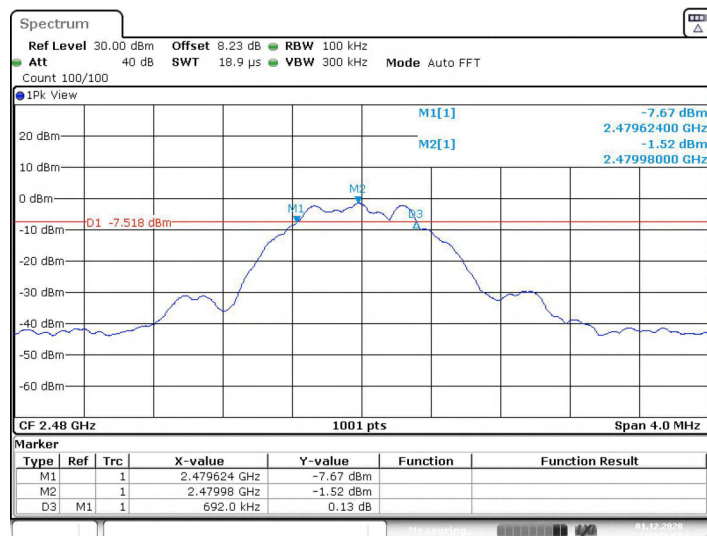
2440 MHz



Date: 1.DEC.2020 10:30:12

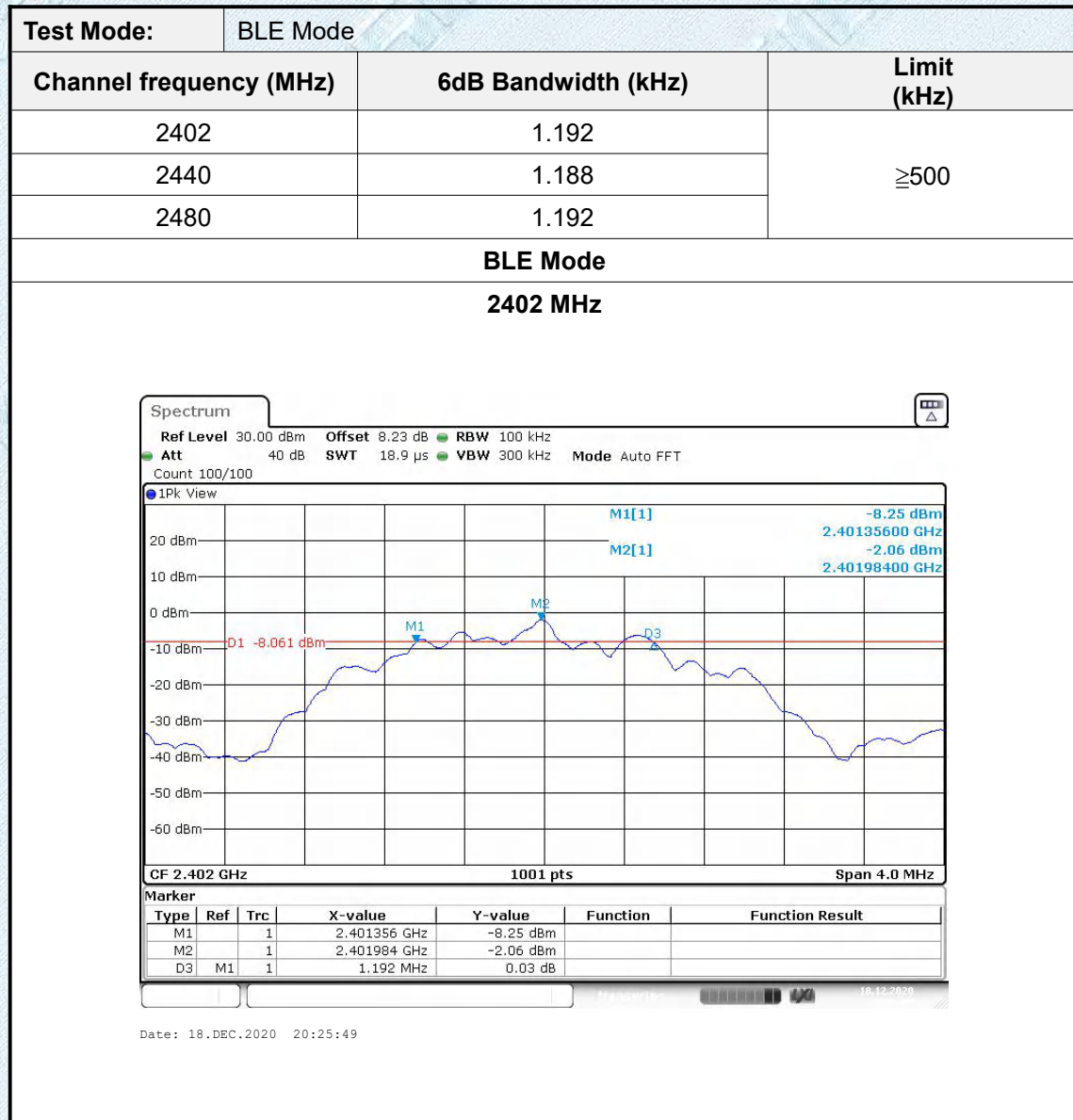
BLE Mode

2480 MHz

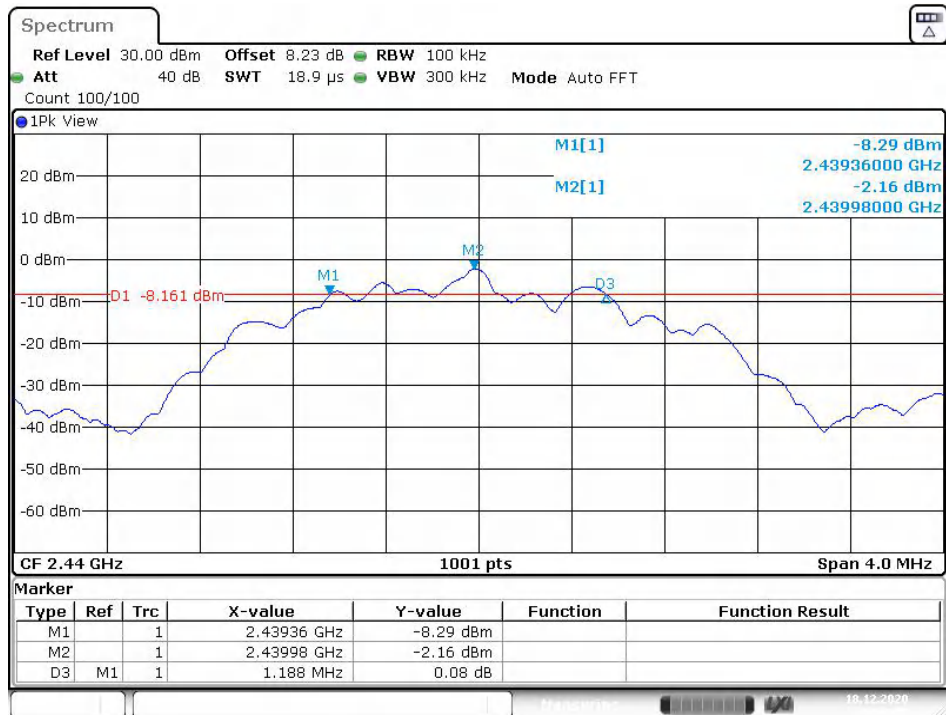


Date: 1.DEC.2020 10:31:59

GFSK_2M

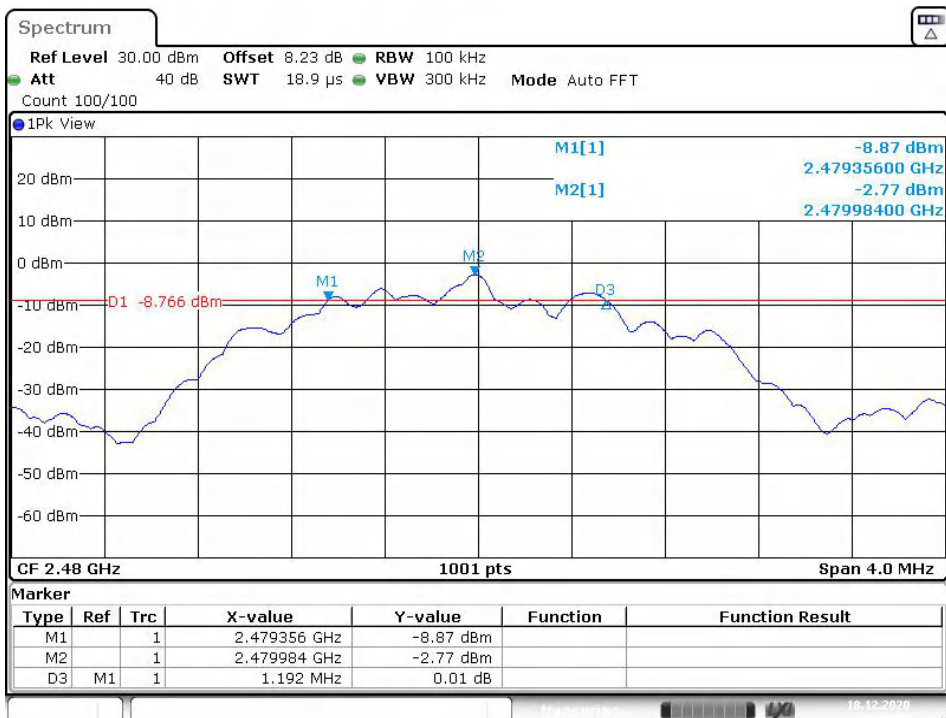


2440 MHz



Date: 18.DEC.2020 20:29:23

2480 MHz



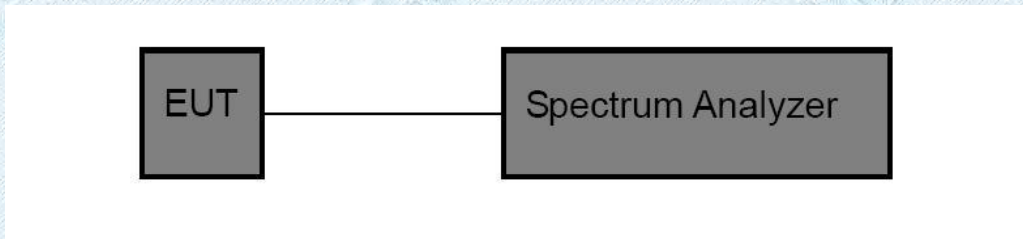
Date: 18.DEC.2020 20:32:22

3.4. Power Spectral Density

Limit

| FCC Part 15 Subpart C(15.247) | | |
|-------------------------------|--------------------|----------------------|
| Test Item | Limit | Frequency Range(MHz) |
| Power Spectral Density | 8dBm(in any 3 kHz) | 2400~2483.5 |

Test Configuration



Test Procedure

1. Connect EUT RF Output port to the Spectrum Analyzer through an RF attenuator.
2. The EUT was directly connected to the Spectrum Analyzer and antenna output port as show in the block diagram above. The measurement according to section 10.2 of KDB 558074 D01 DTS Meas Guidance v04.
3. Spectrum Setting:
 - Set analyser center frequency to DTS channel center frequency.
 - Set the span to 1.5 times the DTS bandwidth.
 - Set the RBW to: 10 kHz
 - Set the VBW to: 30 kHz
 - Detector: peak
 - Sweep time: auto
 - Allow trace to fully stabilize. Then use the peak marker function to determine the maximum amplitude level.

Test Mode

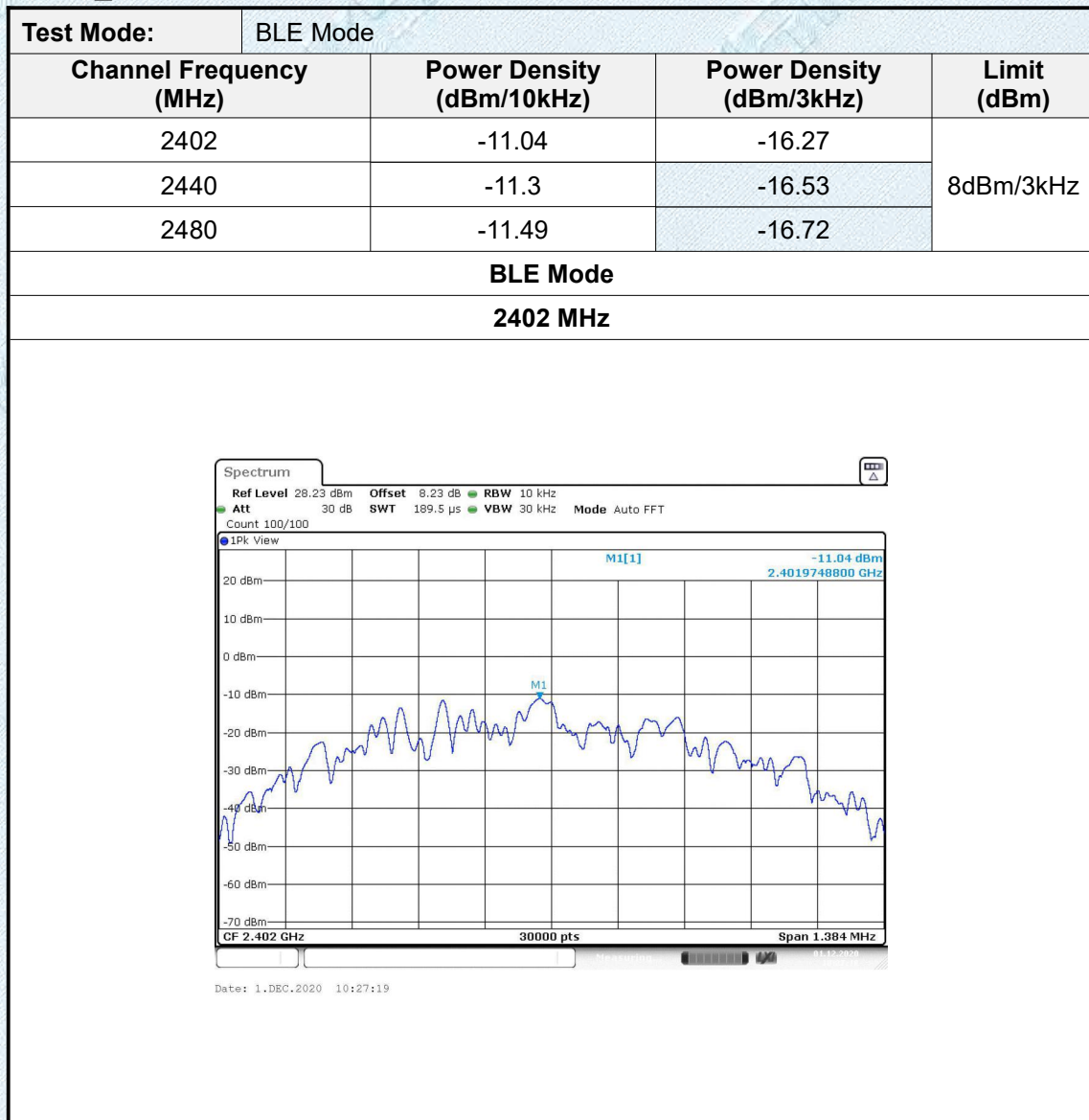
Please refer to the clause 2.3.

Test Result

Note:

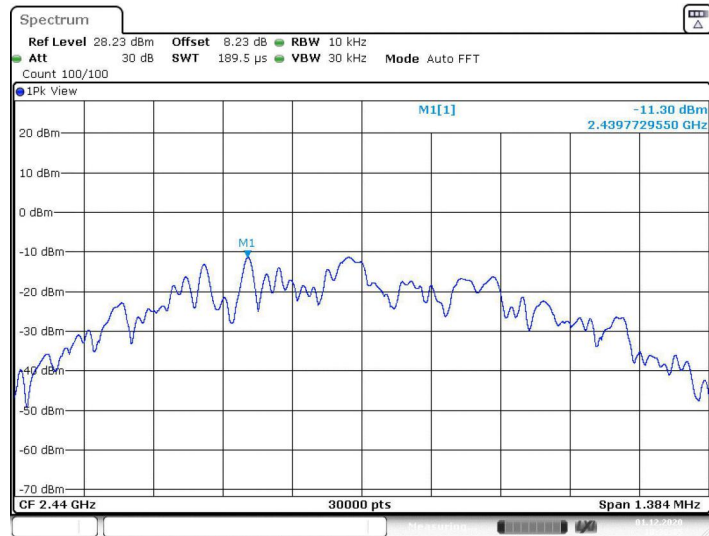
Power Density(dBm/3kHz)=Power Density(dBm/10kHz)-10*Log(10/3)

GFSK_1M



BLE Mode

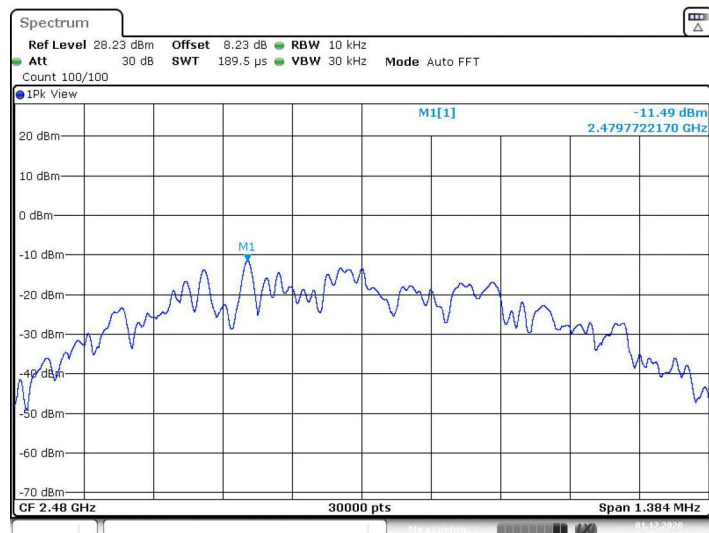
2440 MHz



Date: 1.DEC.2020 10:30:35

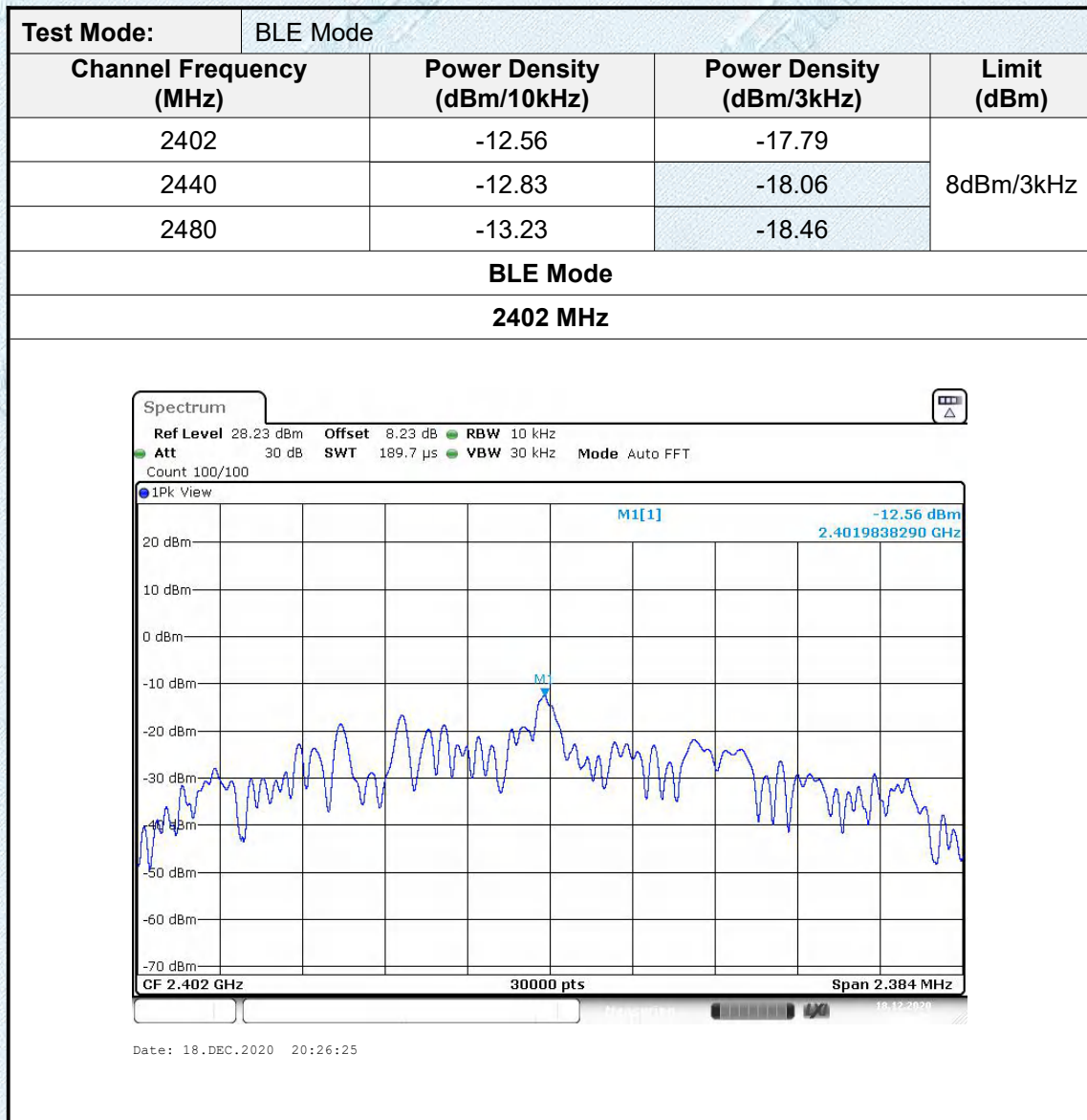
BLE Mode

2480 MHz

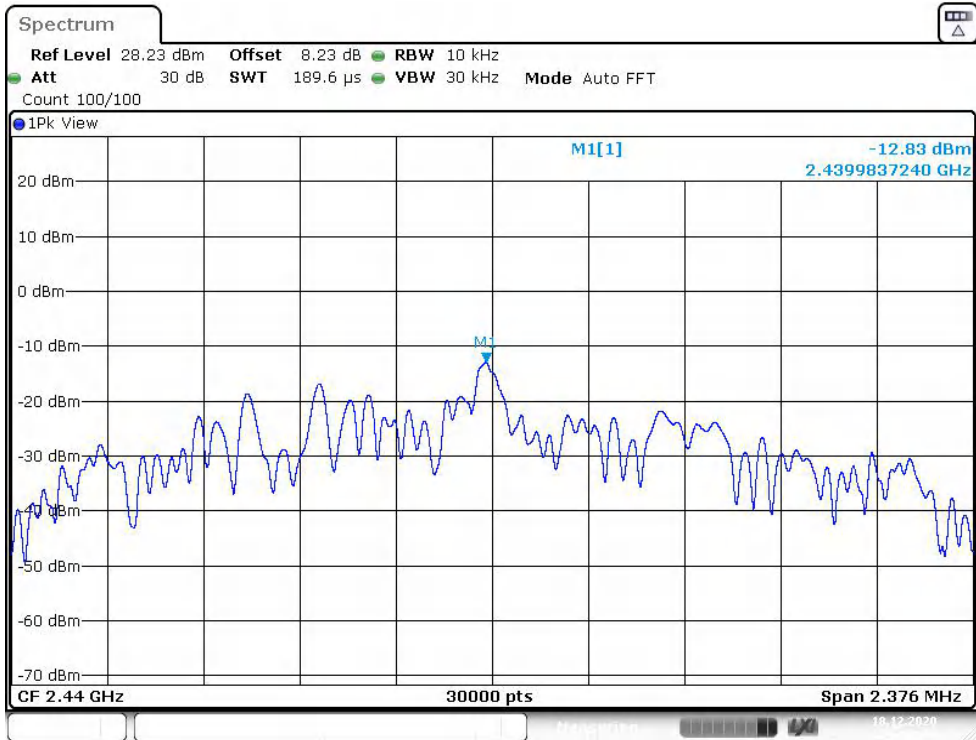


Date: 1.DEC.2020 10:32:23

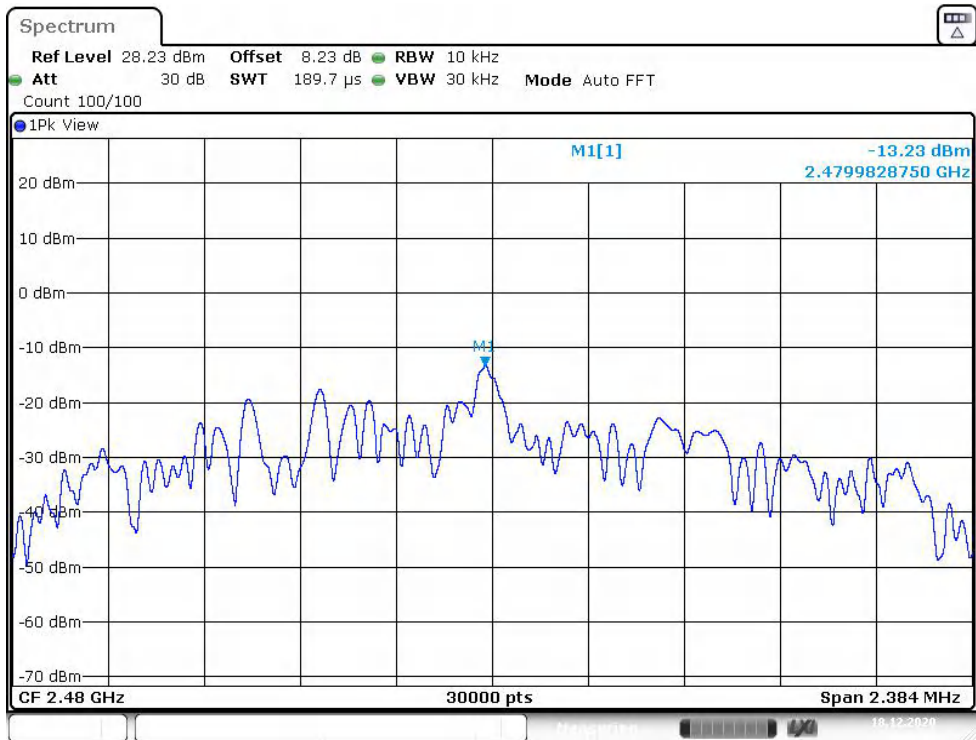
GFSK_2M



2440 MHz



2480 MHz



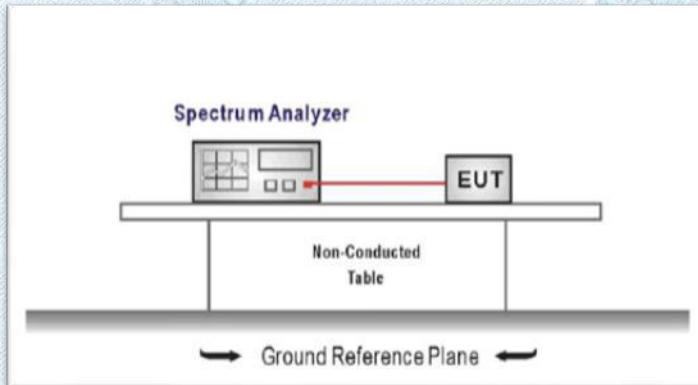
3.5. Band edge and Spurious Emission (conducted)

Limit

FCC CFR Title 47 Part 15 Subpart C Section 15.247 (d):

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Test Configuration



Test Procedure

1. Connect EUT RF Output port to the Spectrum Analyzer through an RF attenuator.
2. Spectrum Setting:
 RBW=100KHz
 VBW=300KHz.
 Detector function: Peak.
 Trace: Max hold.
 Sweep = Auto couple.

Allow the trace to stabilize.

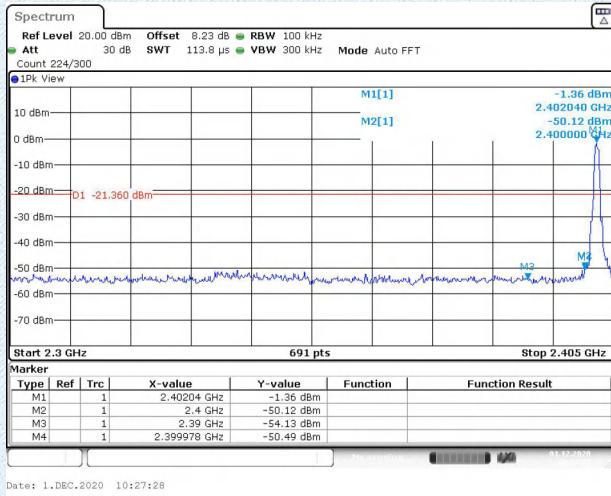
Test Mode

Please refer to the clause 2.3.

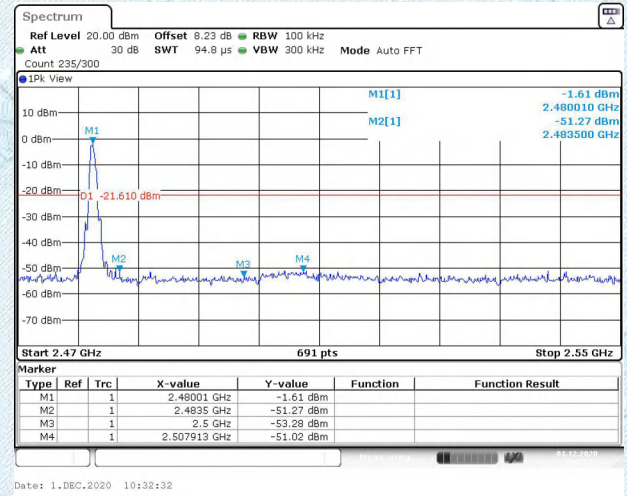
Test Results

GFSK_1M

CH00-Bandedge

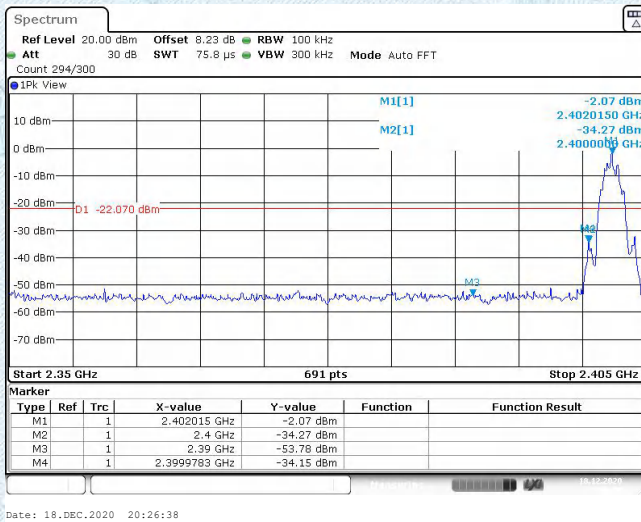


CH39-Bandedge

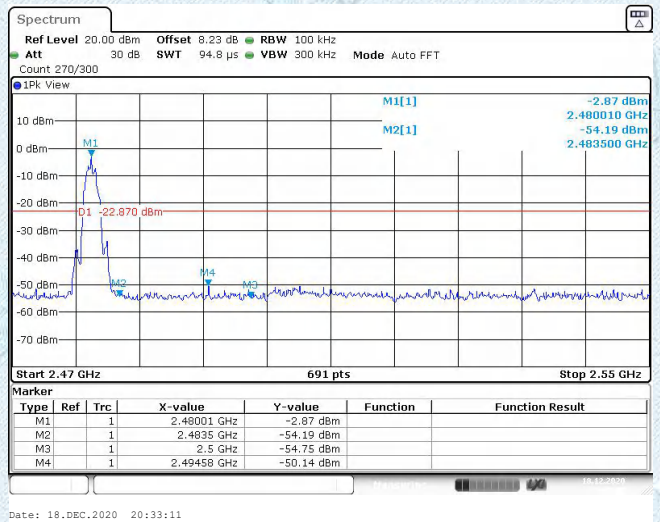


GFSK_2M

CH00-Bandedge

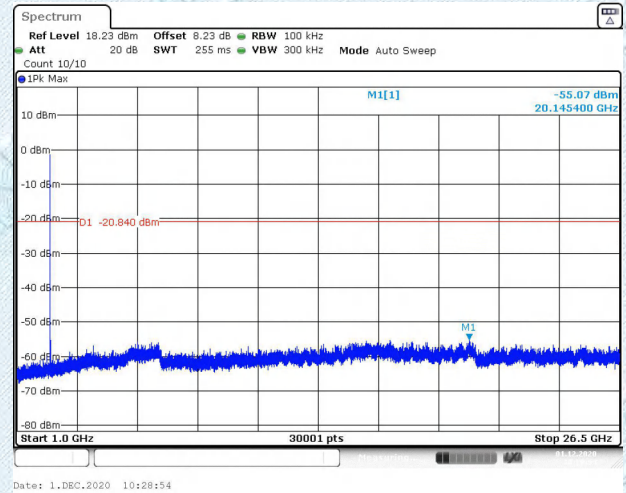
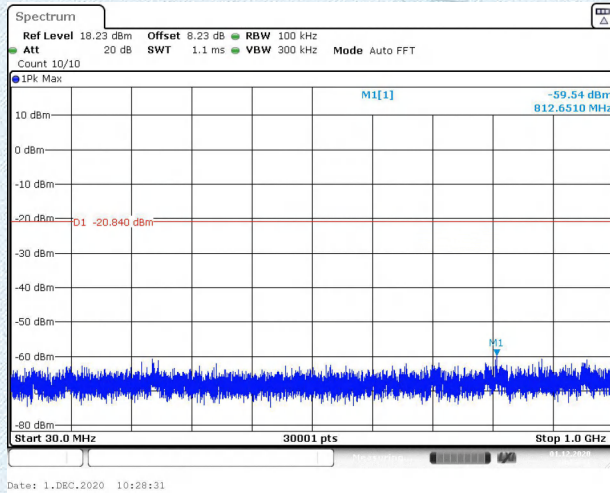


CH39-Bandedge

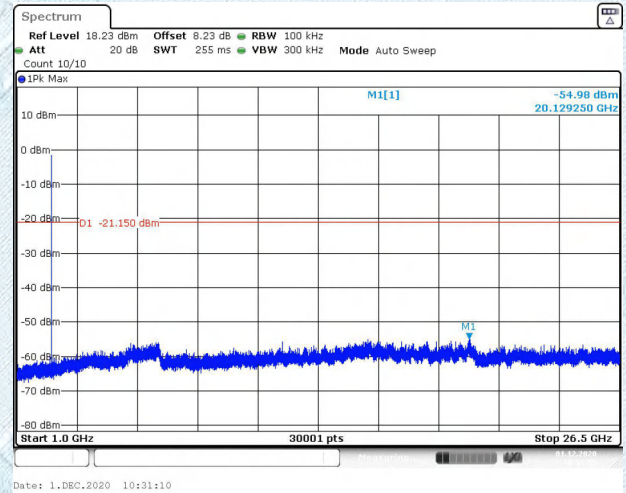
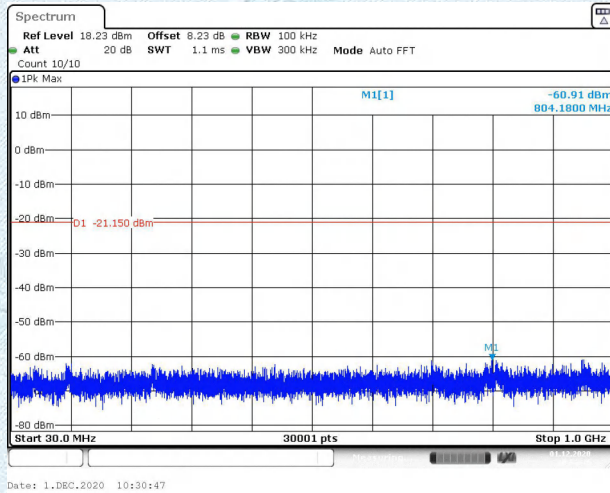


GFSK_1M

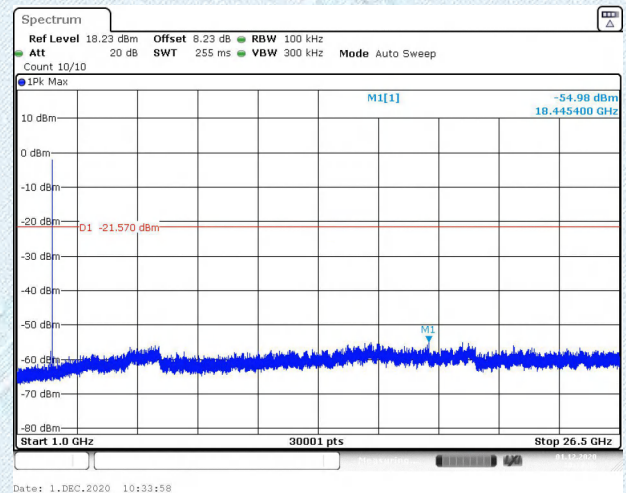
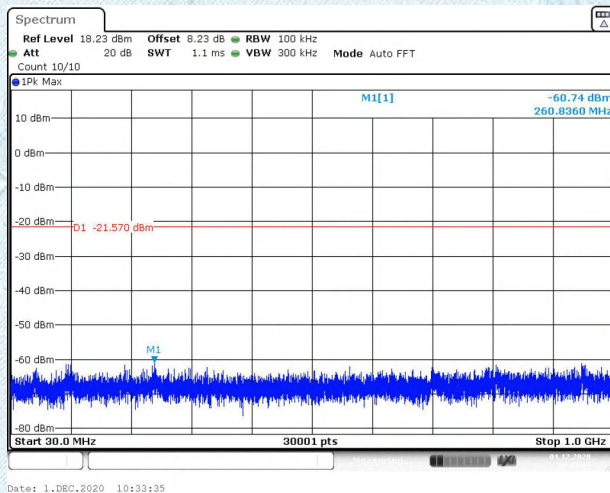
CH00-SE



CH19-SE

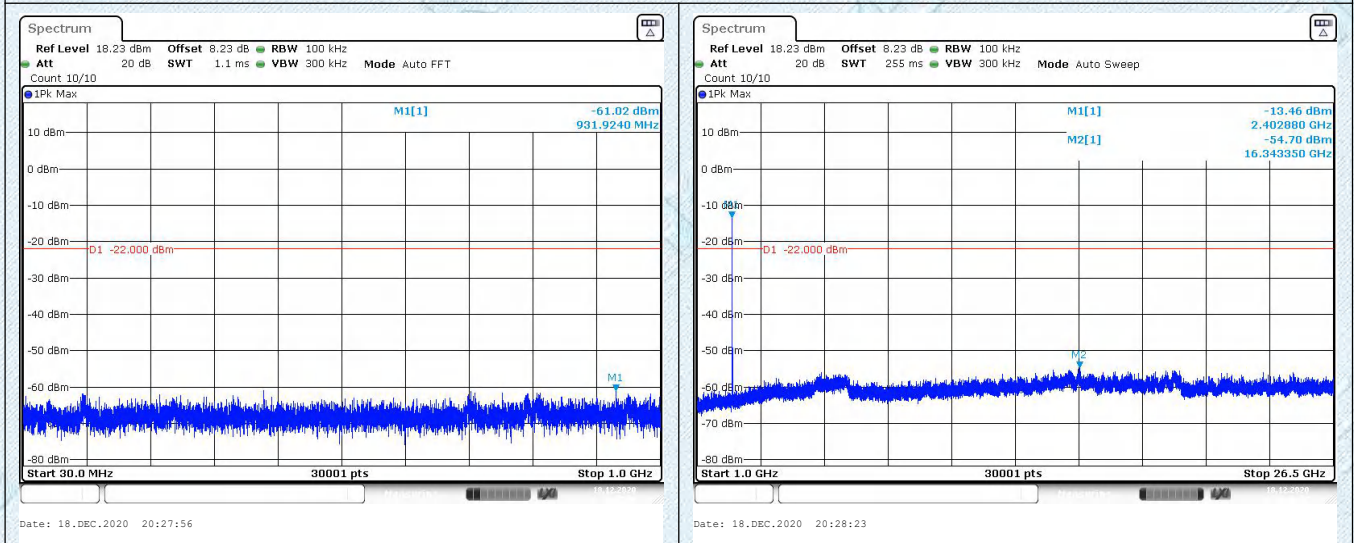


CH39-SE

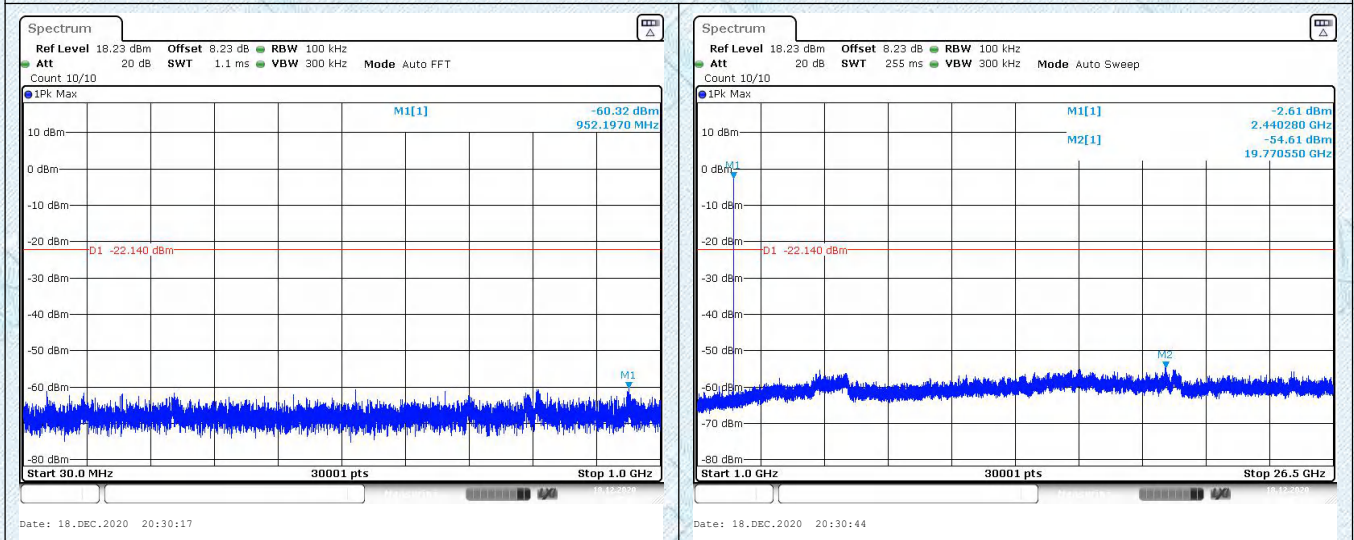


GFSK_2M

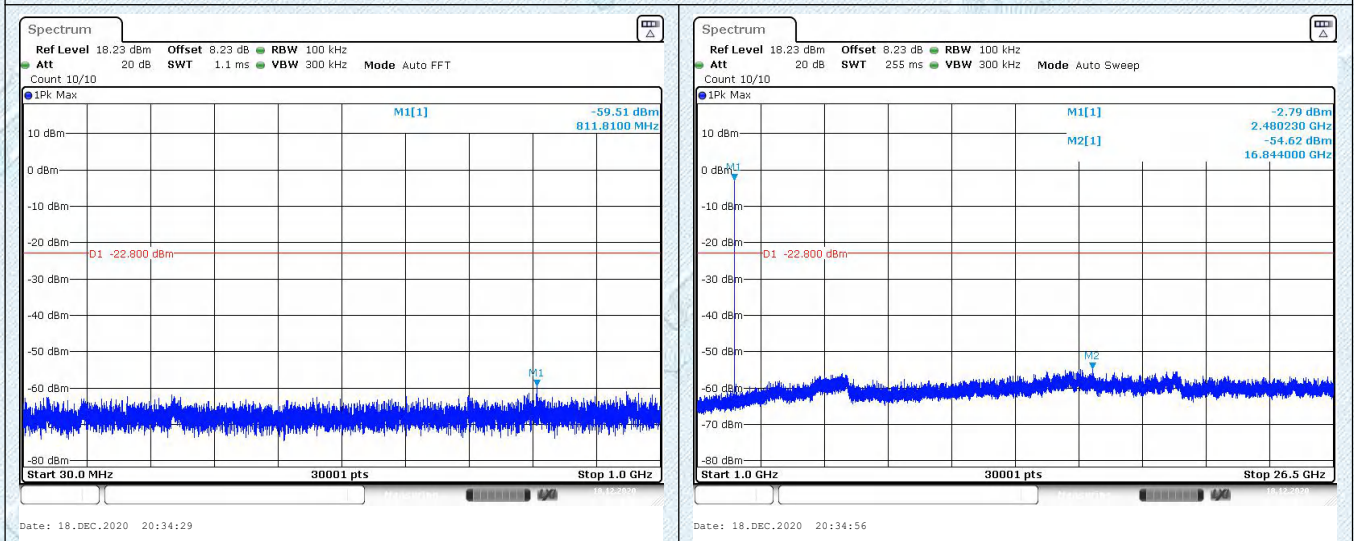
CH00-SE



CH19-SE



CH39-SE

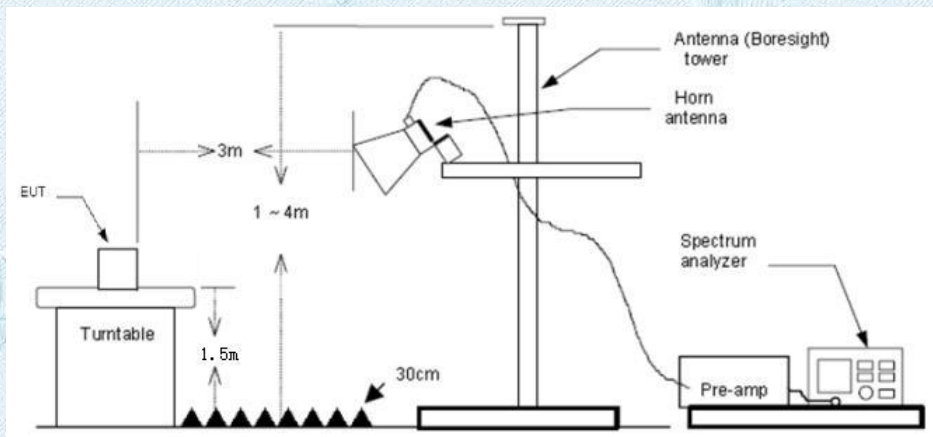


3.6. Band Edge Emissions(Radiated)

Limit

| Restricted Frequency Band (MHz) | (dBuV/m)(at 3m) | |
|---|-----------------|---------|
| | Peak | Average |
| 2310 ~2390 | 74 | 54 |
| 2483.5 ~2500 | 74 | 54 |
| Note: All restriction bands have been tested, only the worst case is reported. | | |

Test Configuration



Test Procedure

1. The EUT was setup and tested according to ANSI C63.10:2013 requirements.
2. The EUT is placed on a turn table which is 1.5 meter above ground. The turn table is rotated 360 degrees to determine the position of the maximum emission level.
3. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.
4. The antenna is scanned from 1 meter to 4 meters to find out the maximum emission level. This is repeated for both horizontal and vertical polarization of the antenna. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10:2013 on radiated measurement.
5. The receiver set as follow:
RBW=1MHz, VBW=3MHz PEAK detector for Peak value.
RBW=1MHz, VBW=10Hz with PEAK Detector for Average Value.

Test Mode

Please refer to the clause 2.2.

Test Results

Note:

- (1)Measurement = Reading level + Correct Factor
- (2)Correct Factor=Antenna Factor + Cable Loss -Preamplifier Factor
- (3)All modulation modes were tested, and only the worst data of GFSM_1M was recorded in the report.