# FCC PART 15C
# TEST REPORT

## BLUETOOTH LOW ENERGY (BLE) PART

## No. 23T04Z80421-25

**for**

**TCL Communication Ltd.**

**GSM/UMTS/LTE/NR Mobile phone**

**Model Name: T614D**

**FCC ID: 2ACCJH179**

**with**

**Hardware Version: 06**

**Software Version: 3CSF**

**Issued Date: 2023-12-25**

**Note:**

The test results in this test report relate only to the devices specified in this report.This report shall not be reproduced except in full without the written approval of CTTL.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S.Government.

**Test Laboratory:**

**CTTL, Telecommunication Technology Labs, CAICT**

No.52, HuayuanNorth Road, Haidian District, Beijing, P. R. China 100191.

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# REPORT HISTORY

| Report Number | Revision | Description | Issue Date |
|---|---|---|---|
| 23T04Z80421-25 | Rev.0 | 1st edition | 2023-12-25 |

Note: the latest revision of the test report supersedes all previous version.

# CONTENTS

# 1. Test Laboratory

## 1.1. Introduction &Accreditation

**Telecommunication Technology Labs, CAICT** is an ISO/IEC 17025:2017 accredited test laboratory under American Association for Laboratory Accreditation (A2LA) with lab code 7049.01, and is also an FCC accredited test laboratory (CN1349), and ISED accredited test laboratory (CAB identifier:CN0066). The detail accreditation scope can be found on A2LA website.

## 1.2. Testing Location

Conducted testing Location: CTTL(huayuan North Road)

Address: No. 52, Huayuan North Road, Haidian District, Beijing, P. R. China100191

Radiated testing Location: CTTL(huayuan North Road)

Address: No. 52, Huayuan North Road, Haidian District, Beijing, P. R. China100191

## 1.3. Testing Environment

Normal Temperature: 20-27℃

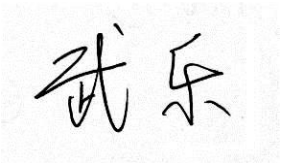
Relative Humidity: 20-50%

## 1.4. Project data

Testing Start Date: 2023-11-2

Testing End Date: 2023-12-25

## 1.5. Signature



**Wu Le**

**(Prepared this test report)**

**Sun Zhenyu**

**(Reviewed this test report)**

**Hu Xiaoyu**

**(Approved this test report)**

# 2. Client Information

## 2.1. Applicant Information

| | |
|---|---|
| Company Name: | TCL Communication Ltd. |
| Address /Post: | 5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong |
| City: | Hong Kong |
| Postal Code: | / |
| Country: | China |
| Telephone: | +86 755 3661 1621 |
| Fax: | +86 755 3661 2000-81722 |

## 2.2. Manufacturer Information

| | |
|---|---|
| Company Name: | TCL Communication Ltd. |
| Address /Post: | 5/F, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, NT, Hong Kong |
| City: | Hong Kong |
| Postal Code: | / |
| Country: | China |
| Telephone: | +86 755 3661 1621 |
| Fax: | +86 755 3661 2000-81722 |

# 3. Equipment Under Test (EUT) and Ancillary Equipment (AE)

## 3.1. About EUT

| | |
|---|---|
| Description | GSM/UMTS/LTE/NR Mobile phone |
| Model Name | T614D |
| FCC ID | 2ACCJH179 |
| Frequency Band | ISM 2400MHz~2483.5MHz |
| Type of Modulation(LE mode) | GFSK (Bluetooth Low Energy) |
| Number of Channels(LE mode) | 40 |
| Power Supply | 3.85V DC by Battery |
| Antenna gain | -4.75dBi |

## 3.2. Internal Identification of EUT

| EUT ID* | SN or IMEI | HW Version | SW Version | Date of receipt |
|---|---|---|---|---|
| EUT1 | 016499000012464/ 016499000012498 | 06 | 3CSF | 2023-11-2 |
| EUT2 | 016499000013298/ 016499000013314 | 06 | 3CSF | 2023-11-2 |

*EUT ID: is used to identify the test sample in the lab internally.

## 3.3. Internal Identification of AE

| AE ID* | Description | Model | Manufacture |
|---|---|---|---|
| AE1 | Battery1 | TLp049FA | TMB |
| AE2 | Battery2 | TLp049F7 | Veken |
| AE3 | Charger1 | QC13US | JUWEI |
| AE4 | USB Cable1 | CDA0000256C1 | JUWEI |
| AE5 | USB Cable2 | CDA0000256C2 | SHENGHUA |

*AE ID: is used to identify the test sample in the lab internally.

## 3.4. Normal Accessory setting

Fully charged battery is used during the test.

## 3.5. General Description

The Equipment Under Test (EUT) is a model of GSM/UMTS/LTE/NR Mobile phone with integrated antenna. It consists of normal options: lithium battery, charger. Manual and specifications of the EUT were provided to fulfill the test. Samples undergoing test were selected by the Client.

# 4. Reference Documents

## 4.1. Documents supplied by applicant

EUT parameters, referring to Annex A for detailed information, is supplied by the client or manufacturer, which is the basis of testing.

## 4.2. Reference Documents for testing

The following documents listed in this section are referred for testing.

| Reference | Title | Version |
|---|---|---|
| FCC Part15 | FCC CFR 47, Part 15, Subpart C:<br>15.205 Restricted bands of operation;<br>15.209 Radiated emission limits, general requirements;<br>15.247 Operation within the bands 902–928MHz, 2400–2483.5 MHz, and 5725–5850 MHz. | 2021 |
| ANSI C63.10 | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices | June,2013 |

# 5. Test Results

## 5.1. Summary of EUT Mode

Two modes are provided:

| Mode | Conditions |
|---|---|
| Mode A | 1Mbps |
| Mode B | 2Mbps |

*For the test results, the EUT had been tested all conditions. But only the worst case(Mode A) was shown in test report except the " Peak Output Power " test was shown all conditions.

## 5.2. Summary of Test Results

Abbreviations used in this clause:

**P** Pass, The EUT complies with the essential requirements in the standard.

**F** Fail, The EUT does not comply with the essential requirements in the standard

**NA** Not Applicable, The test was not applicable

**NP** Not Performed, The test was not performed by CTTL

| SUMMARY OF MEASUREMENT RESULTS | Sub-clause | Verdict |
|---|---|---|
| Peak Output Power | 15.247 (b)(1) | **P** |
| Frequency Band Edges- Conducted | 15.247 (d) | **P** |
| Transmitter Spurious Emission - Conducted | 15.247 (d) | **P** |
| Radiated Unwanted Emission | 15.247, 15.205, 15.209 | **P** |
| 6dB Bandwidth | 15.247 (a)(2) | **P** |
| Maximum Power Spectral Density Level | 15.247(e) | **P** |
| AC Powerline Conducted Emission | 15.107, 15.207 | **P** |
| Antenna Requirement | 15.203 | **P** |

Please refer to **ANNEX A** for detail.

The measurement is made according to ANSI C63.10.

## 5.3. Statements

CTTL has evaluated the test cases requested by the applicant /manufacturer as listed in section 5.1 of this report for the EUT specified in section 3 according to the standards or reference documents listed in section 4.2

## 6. Test Facilities Utilized

### Conducted test system

| No. | Equipment | Model | Serial Number | Manufacturer | Calibration Period | Calibration Due date |
|---|---|---|---|---|---|---|
| 1 | Vector Signal Analyzer | FSQ26 | 100024 | R&S | 1 year | 2024-03-09 |
| 2 | Test Receiver | ESCI | 100344 | R&S | 13 Months | 2024-02-21 |
| 3 | LISN | ENV216 | 101200 | R&S | 13 Months | 2024-06-05 |
| 4 | Shielding Room | S81 | / | ETS-Lindgren | / | / |

### Radiated emission test system

| No. | Equipment | Model | Serial Number | Manufacturer | Calibration Period | Calibration Due date |
|---|---|---|---|---|---|---|
| 1 | Test Receiver | ESW44 | 103023 | R&S | 13 Months | 2024-07-08 |
| 2 | EMI Antenna | VULB 9163 | 01222 | SCHWARZBECK | 13 Months | 2024-02-28 |
| 3 | EMI Antenna | 3115 | 6914 | ETS-Lindgren | 13 Months | 2024-04-25 |

# 7. Measurement Uncertainty

## 7.1. Peak Output Power - Conducted

**Measurement Uncertainty:**

| | |
|---|---|
| Measurement Uncertainty (k=2) | 0.66dB |

## 7.2. Frequency Band Edges - Conducted

**Measurement Uncertainty:**

| | |
|---|---|
| Measurement Uncertainty (k=2) | 0.66dB |

## 7.3. Transmitter Spurious Emission - Conducted

**Measurement Uncertainty:**

| Frequency Range | Uncertainty (k=2) |
|---|---|
| 30 MHz ~ 8 GHz | 1.22dB |
| 8 GHz ~ 12.75 GHz | 1.51dB |
| 12.7GHz ~ 26 GHz | 1.51dB |

## 7.4. Radiated Unwanted Emission

**Measurement Uncertainty:**

| Frequency Range | Uncertainty(dBm) (k=2) |
|---|---|
| 9kHz-30MHz | 4.92 |
| 30MHz ≤ f ≤ 1GHz | 4.72 |
| 1GHz ≤ f ≤18GHz | 4.84 |
| 18GHz ≤ f ≤40GHz | 5.12 |

## 7.5. 6dB Bandwidth

**Measurement Uncertainty:**

| | |
|---|---|
| Measurement Uncertainty (k=2) | 61.936Hz |

## 7.6. Maximum Power Spectral Density Level

**Measurement Uncertainty:**

| | |
|---|---|
| Measurement Uncertainty (k=2) | 0.66dB |

## 7.7. AC Powerline Conducted Emission

**Measurement Uncertainty:**

| | |
|---|---|
| Measurement Uncertainty (k=2) | 3.08dB |

# ANNEX A: EUT parameters

Disclaimer: The antenna gain provided by the client may affect the validity of the measurement results in this report, and the client shall bear the impact and consequences arising therefrom.

# ANNEX B: Detailed Test Results

## B.1. Measurement Method

### B.1.1. Conducted Measurements

The measurement is made according to ANSI C63.10.

1). Connect the EUT to the test system correctly.

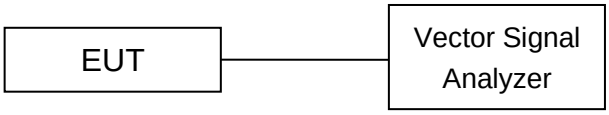
2). Set the EUT to the required work mode (Transmitter, receiver or transmitter & receiver).

3). Set the EUT to the required channel.

4). Set the EUT hopping mode (hopping or hopping off).

5). Set the spectrum analyzer to start measurement.

6). Record the values. Vector Signal Analyzer




### B.1.2. Radiated Emission Measurements

The measurement is made according to ANSI C63.10

The radiated emission test is performed in semi-anechoic chamber. The EUT was placed on a non-conductive table with 80cm above the ground plane for measurement below 1GHz and 1.5m above the ground plane for measurement above 1GHz. The measurement antenna was placed at a distance of 3 meters from the EUT. The test is carried out on both vertical and horizontal polarization and only maximization result of both polarizations is kept. During the test, the turntable is rotated from 0° to 360°and the measurement antenna is moved from 1m to 4m to get the maximization result. The maximization process was repeated with the EUT positioned in each of its three orthogonal orientations.

## B.2. Peak Output Power

### B.2.1. Peak Output Power – Conducted

**Method of Measurement: See ANSI C63.10-clause 11.9.1.1**

a) Set the RBW = 3 MHz.
b) Set VBW = 10 MHz.
c) Set span = 10 MHz.
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

**Measurement Limit：**

| Standard | Limit (dBm) |
|---|---|
| FCC Part 15.247(b)(3) | < 30 |

**Measurement Results:**

**For GFSK**

| Sample Rate | Channel No. | Frequency (MHz) | Peak Conducted Output Power (dBm) | Conclusion |
|---|---|---|---|---|
| 1Mbps | 0 | 2402 | -1.59 | P |
| | 19 | 2440 | 0.36 | P |
| | 39 | 2480 | 0.33 | P |
| 2Mbps | 1 | 2404 | -1.58 | P |
| | 19 | 2440 | 0.29 | P |
| | 38 | 2478 | 0.45 | P |

**Conclusion: PASS**

### B.2.2. E.I.R.P.

**The radiated E.I.R.P. is listed below:**

Antenna gain = -4.75dBi

**For GFSK**

| Sample Rate | Channel No. | Frequency (MHz) | E.I.R.P. (dBm) | Conclusion |
|---|---|---|---|---|
| 1Mbps | 0 | 2402 | -6.34 | P |
| | 19 | 2440 | -4.39 | P |
| | 39 | 2480 | -4.42 | P |
| 2Mbps | 1 | 2404 | -6.33 | P |
| | 19 | 2440 | -4.46 | P |
| | 38 | 2478 | -4.30 | P |

Note: E.I.R.P. are calculated with the antenna gain.

**Conclusion: PASS**

## B.3. Frequency Band Edges - Conducted

**Method of Measurement: See ANSI C63.10-clause 6.10.4**

Connect the spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described below.

a) Set Span = 8MHz
b) Sweep Time: Auto
c) Set the RBW= 100 kHz
c) Set the VBW= 300 kHz
d) Detector: Peak
e) Trace: Max hold

Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not an absolute field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band edge relative to the highest fundamental emission level.

**Measurement Limit:**

| Standard | Limit (dBc) |
|---|---|
| FCC 47 CFR Part 15.247 (d) | < -20 |

**Measurement Result:**

**For GFSK**

| Channel No. | Frequency (MHz) | Hopping | Band Edge Power ( dBc) | | Conclusion |
|---|---|---|---|---|---|
| 0 | 2402 | Hopping OFF | Fig.1 | -51.69 | P |
| 39 | 2480 | Hopping OFF | Fig.2 | -53.89 | P |

**Conclusion: PASS**

**Test graphs as below**

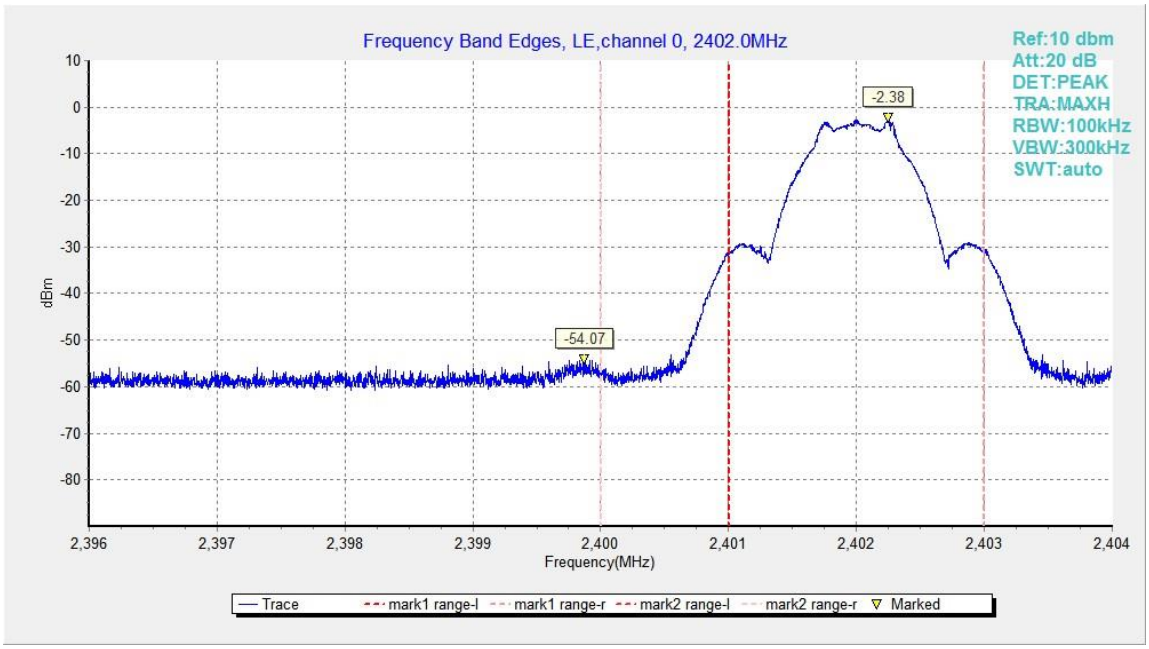



**Fig.1.** Frequency Band Edges: GFSK, 2402 MHz**,** Hopping Off

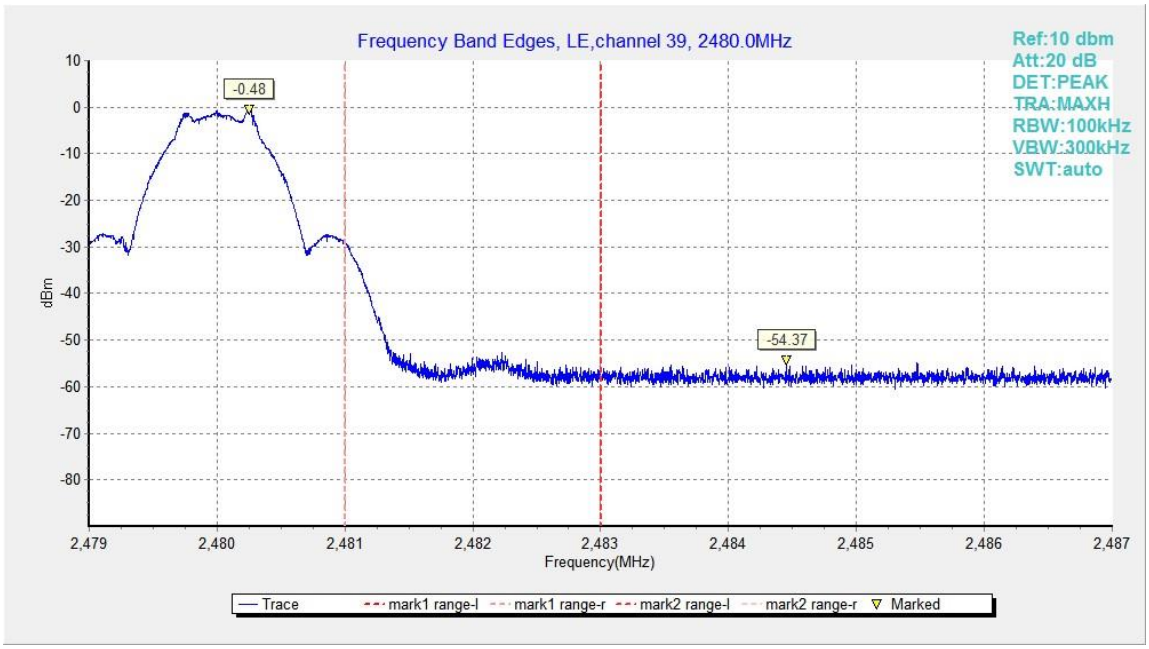



**Fig.2.** Frequency Band Edges: GFSK, 2480 MHz, Hopping Off

## B.4. Transmitter Spurious Emission - Conducted

**Method of Measurement: See ANSI C63.10-clause 11.11.2 and clause 11.11.3**

**Measurement Procedure – Reference Level**

1. Set the RBW = 100 kHz.
2. Set the VBW = 300 kHz.
3. Set the span to ⩾1.5 times the DTS bandwidth.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum PSD level. Next, determine the power in 100 kHz band segments outside of the authorized frequency band using the following measurement:

**Measurement Procedure - Unwanted Emissions**

1. Set RBW = 100 kHz.
2. Set VBW = 300 kHz.
3. Set span to encompass the spectrum to be examined.
4. Detector = peak.
5. Trace Mode = max hold.
6. Sweep = auto couple.
7. Allow the trace to stabilize (this may take some time, depending on the extent of the span).

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements specified above.

**Measurement Limit:**

| Standard | Limit |
|---|---|
| FCC 47 CFR Part 15.247 (d) | 20dB below peak output power in 100 kHz bandwidth |

**Measurement Results:**

**For GFSK**

| Channel No. | Frequency (MHz) | Frequency Range | Test Results | Conclusion |
|---|---|---|---|---|
| 0 | 2402 | Center Frequency | Fig.3 | P |
| | | 30 MHz ~ 1 GHz | Fig.4 | P |
| | | 1 GHz ~ 3 GHz | Fig.5 | P |
| | | 3 GHz ~ 10 GHz | Fig.6 | P |
| | | 10GHz ~ 26 GHz | Fig.7 | P |
| 19 | 2440 | Center Frequency | Fig.8 | P |
| | | 30 MHz ~ 1 GHz | Fig.9 | P |
| | | 1 GHz ~ 3 GHz | Fig.10 | P |
| | | 3 GHz ~ 10 GHz | Fig.11 | P |
| | | 10GHz ~ 26 GHz | Fig.12 | P |
| 39 | 2480 | Center Frequency | Fig.13 | P |
| | | 30 MHz ~ 1 GHz | Fig.14 | P |
| | | 1 GHz ~ 3GHz | Fig.15 | P |
| | | 3 GHz ~ 10 GHz | Fig.16 | P |
| | | 10 GHz ~ 26 GHz | Fig.17 | P |

**Conclusion: PASS**

**Test graphs as below**

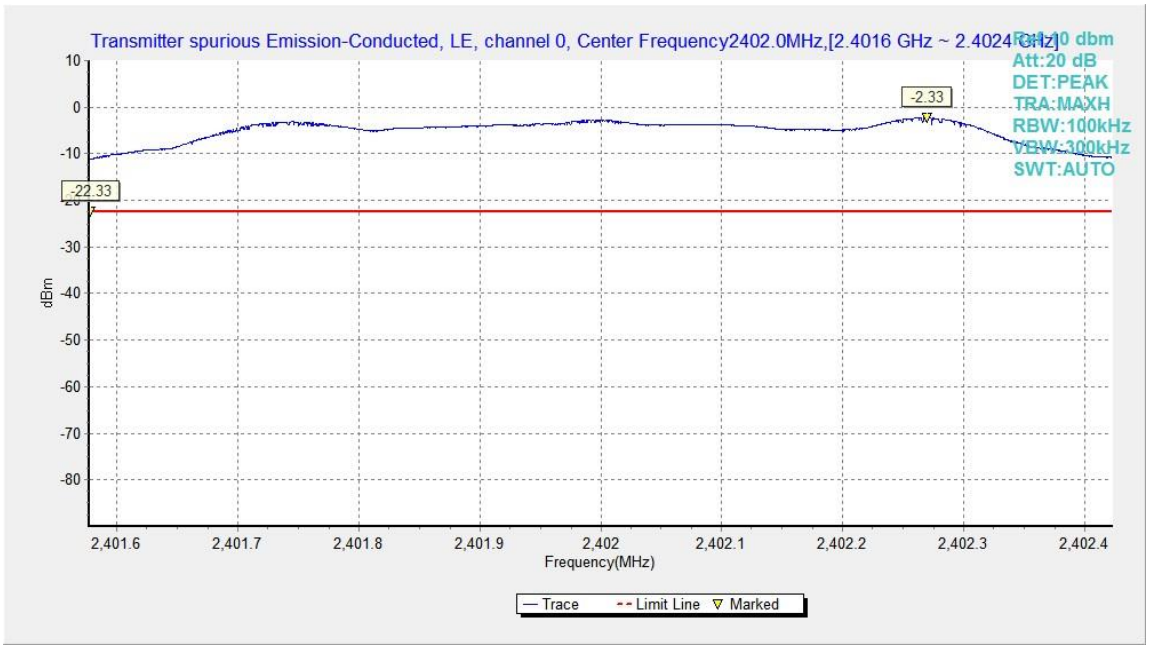



**Fig.3.** Transmitter Spurious Emission - Conducted: GFSK,2402MHz

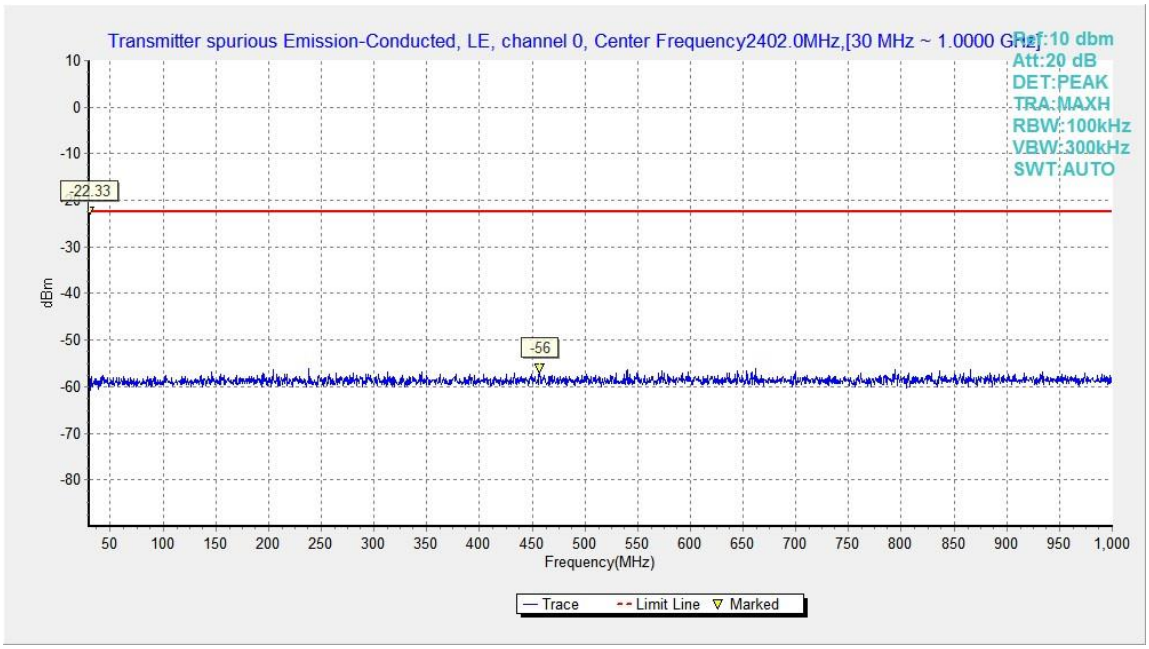



**Fig.4.** Transmitter Spurious Emission - Conducted: GFSK, 2402 MHz, 30MHz - 1GHz

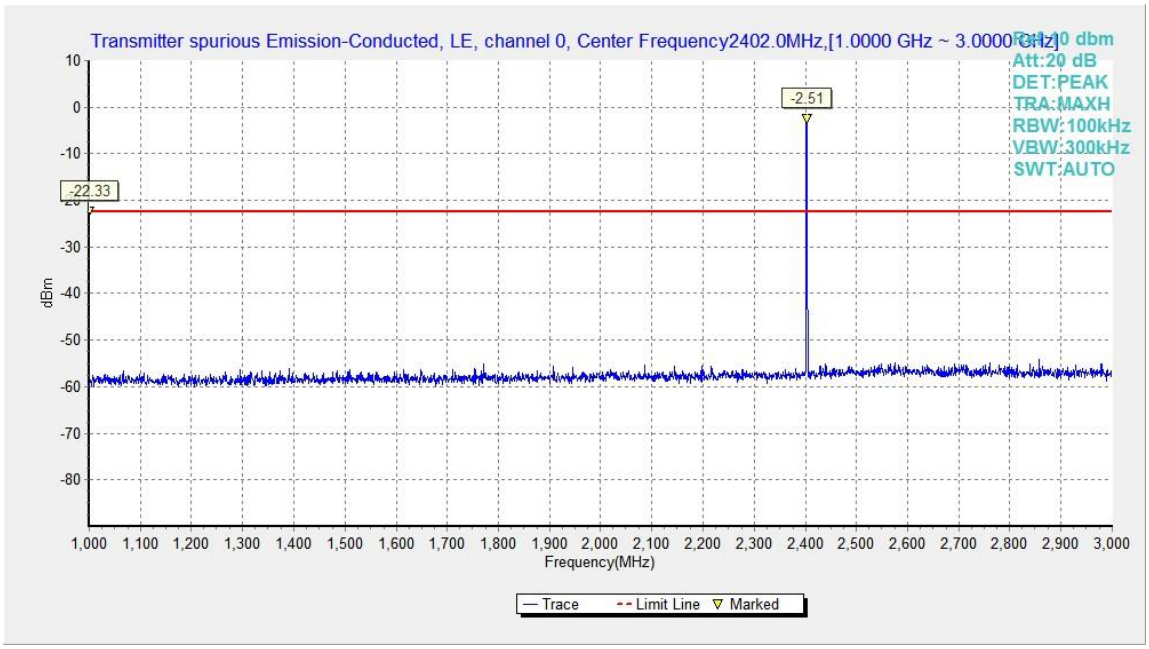



**Fig.5.** Transmitter Spurious Emission - Conducted: GFSK, 2402 MHz,1GHz - 3GHz

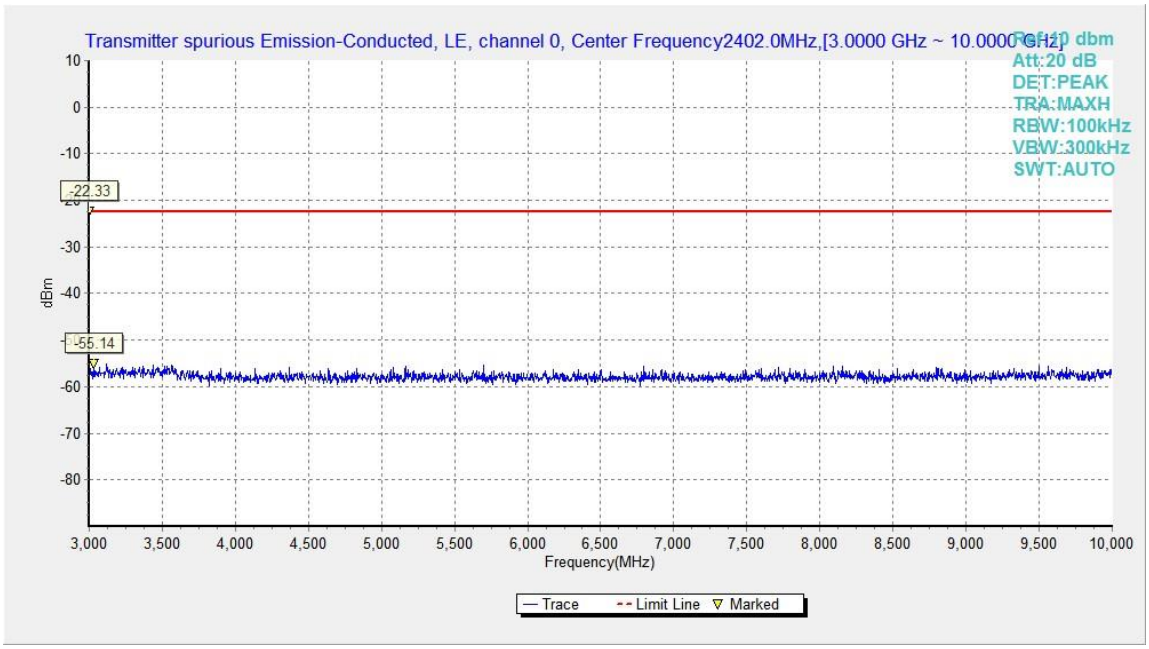



**Fig.6.** Transmitter Spurious Emission - Conducted: GFSK, 2402 MHz,3GHz - 10GHz

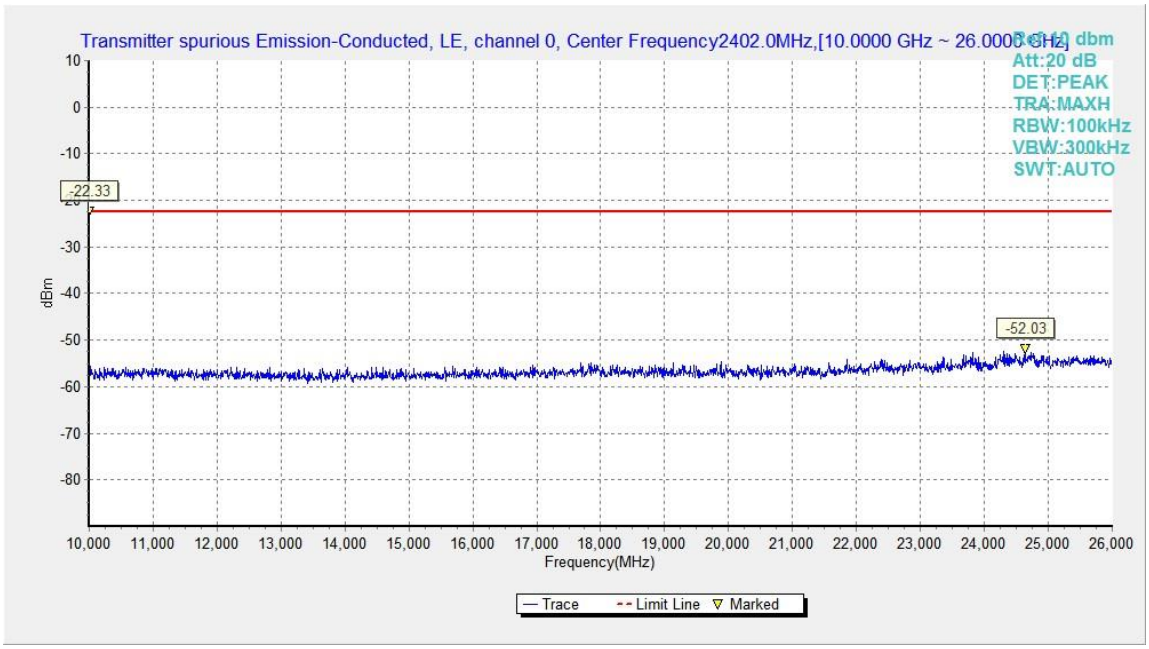



**Fig.7.** Transmitter Spurious Emission - Conducted: GFSK, 2402 MHz,10GHz - 26GHz

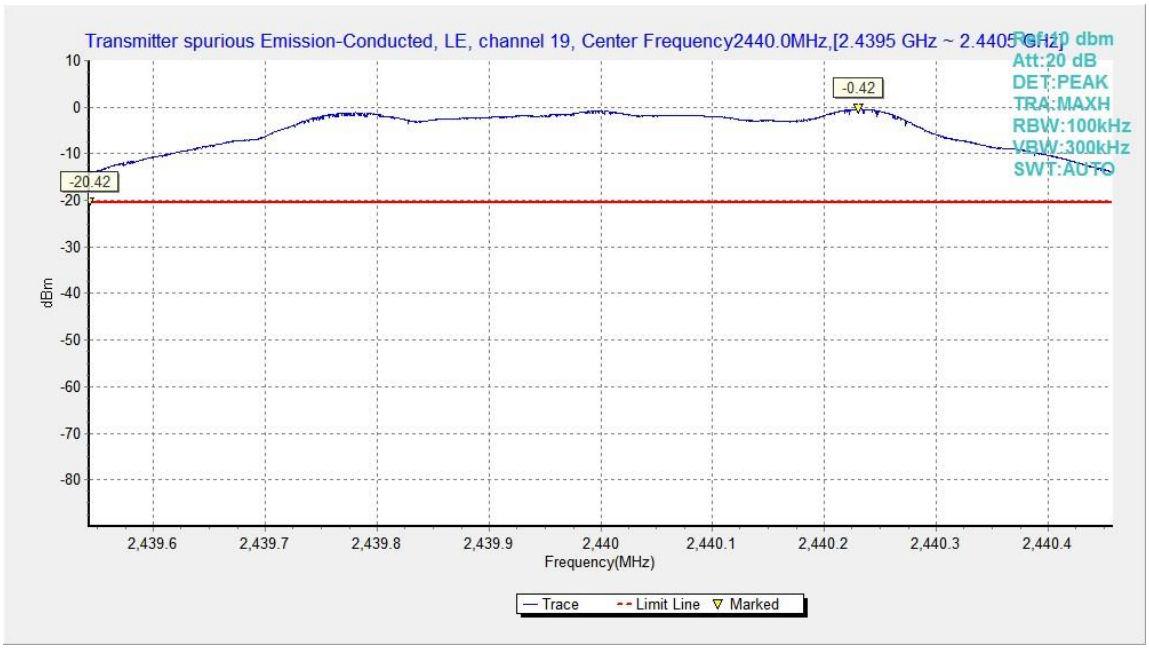



**Fig.8.** Transmitter Spurious Emission - Conducted: GFSK, 2440MHz

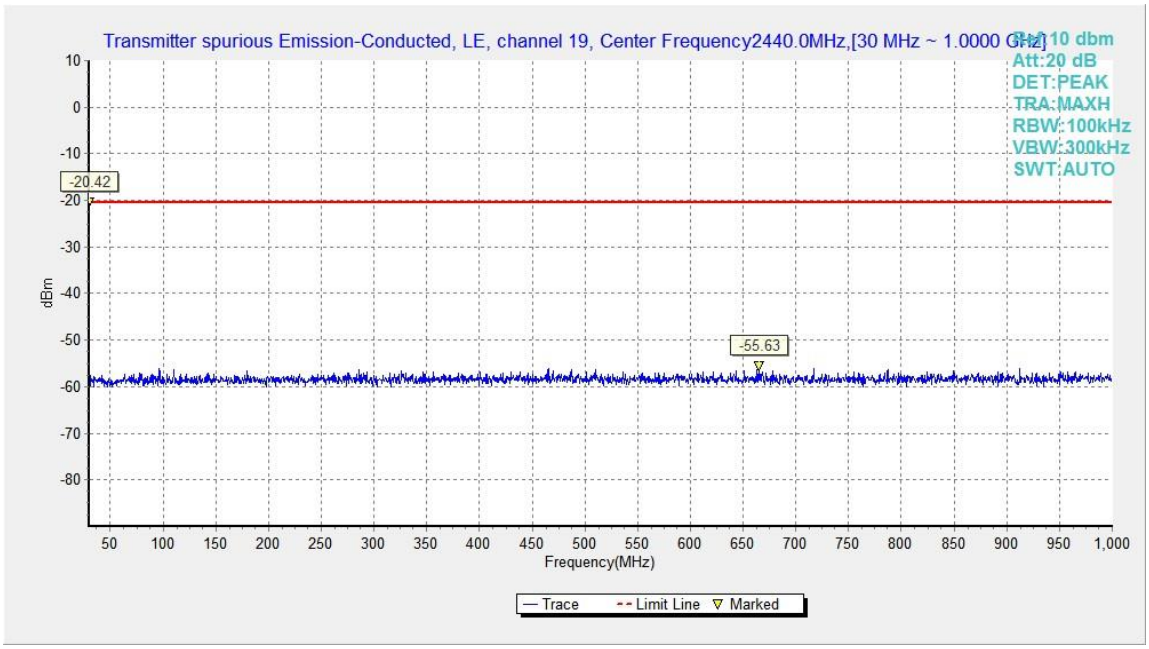



**Fig.9.** Transmitter Spurious Emission - Conducted: GFSK, 2440 MHz, 30MHz - 1GHz

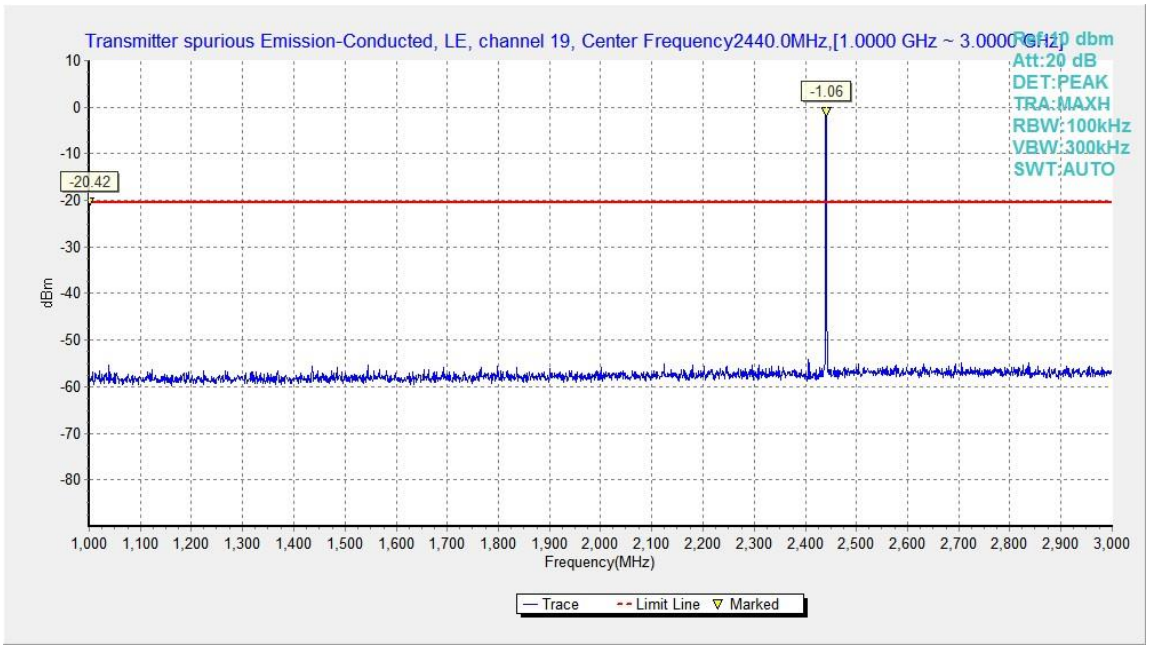



**Fig.10.** Transmitter Spurious Emission - Conducted: GFSK, 2440 MHz, 1GHz – 3GHz

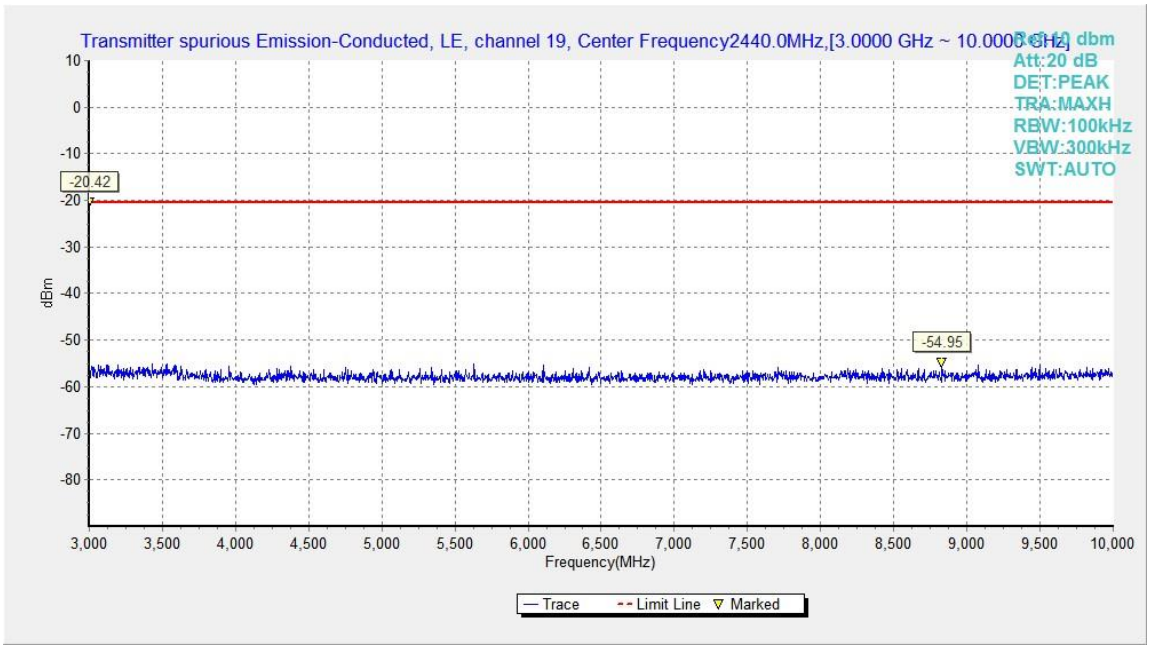



**Fig.11.** Transmitter Spurious Emission - Conducted: GFSK, 2440 MHz, 3GHz – 10GHz

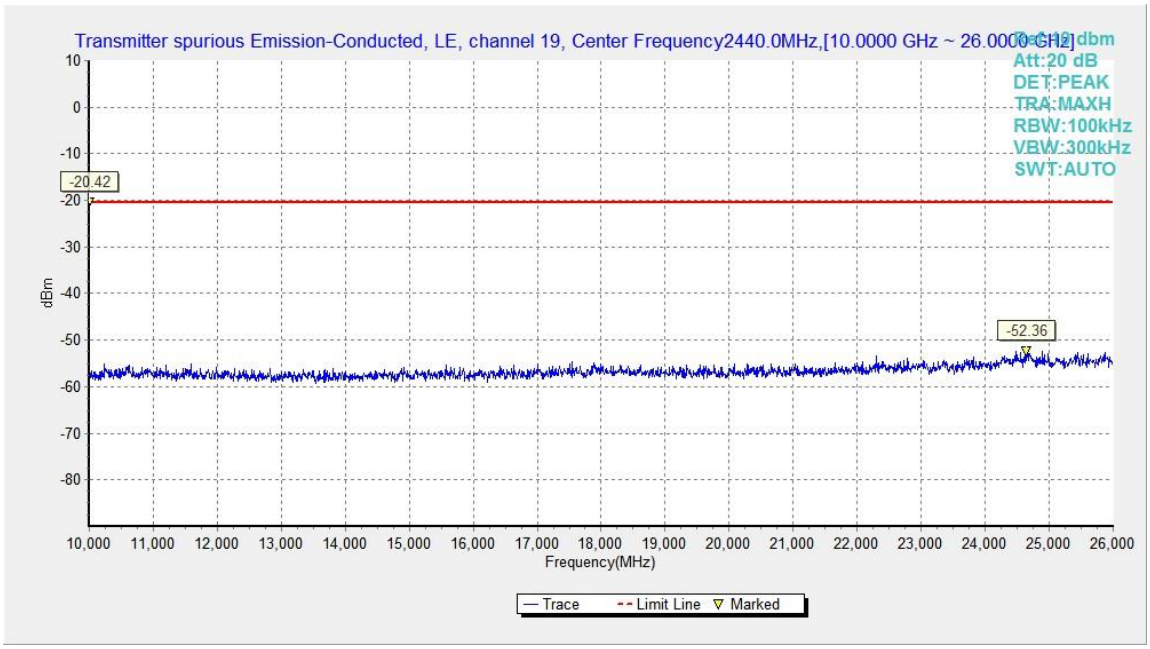



**Fig.12.** Transmitter Spurious Emission - Conducted: GFSK, 2440 MHz, 10GHz – 26GHz

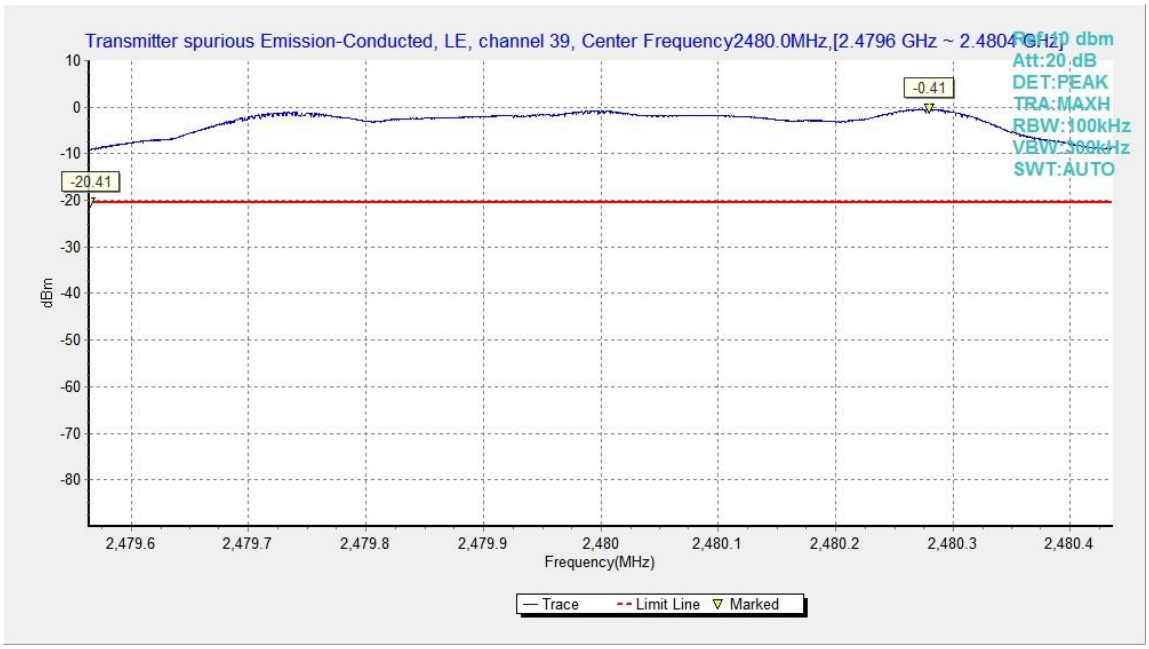



**Fig.13.** Transmitter Spurious Emission - Conducted: GFSK, 2480 MHz

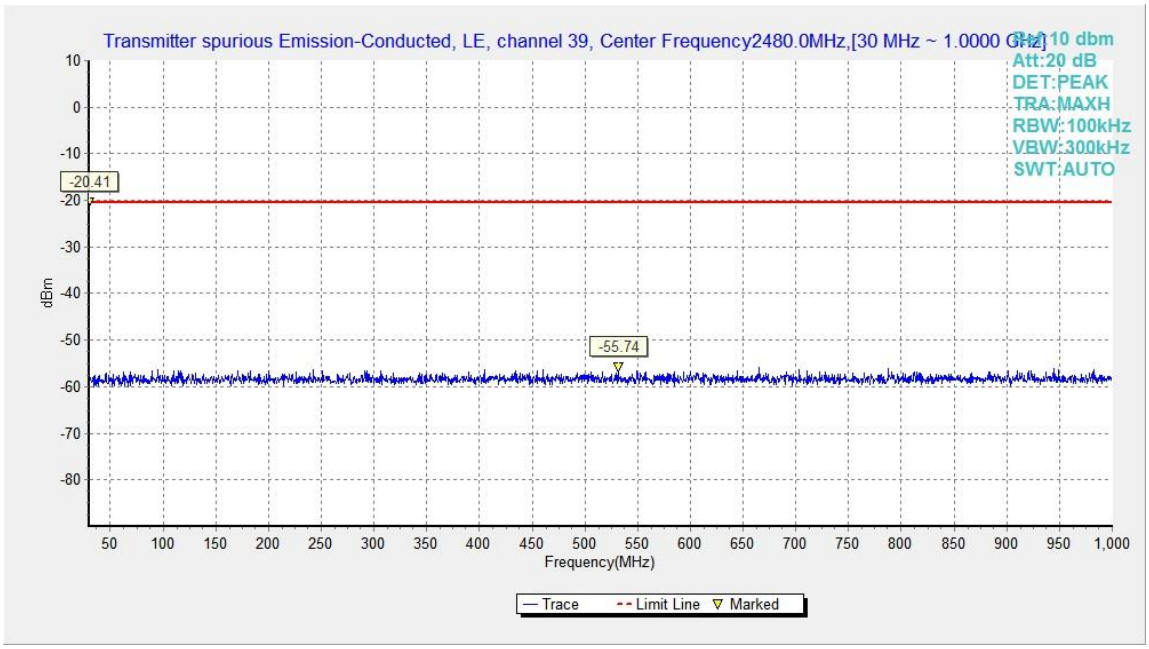



**Fig.14.** Transmitter Spurious Emission - Conducted: GFSK, 2480 MHz, 30MHz - 1GHz

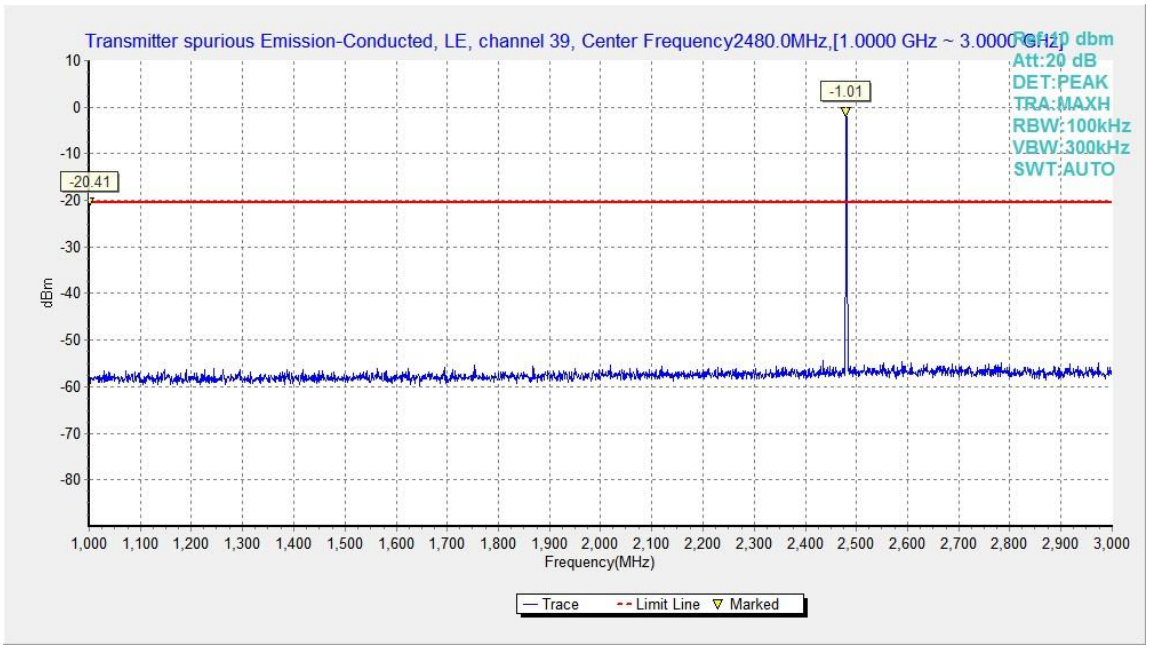



**Fig.15.** Transmitter Spurious Emission - Conducted: GFSK, 2480 MHz, 1GHz - 3GHz

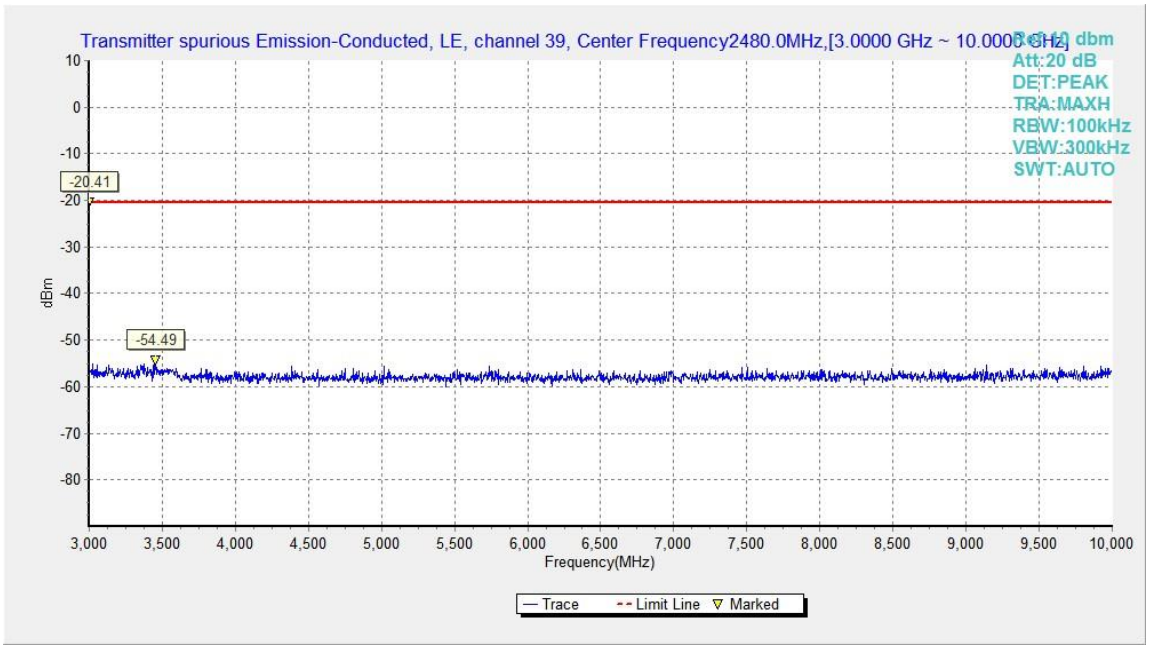



**Fig.16.** Transmitter Spurious Emission - Conducted: GFSK, 2480 MHz, 3GHz - 10GHz

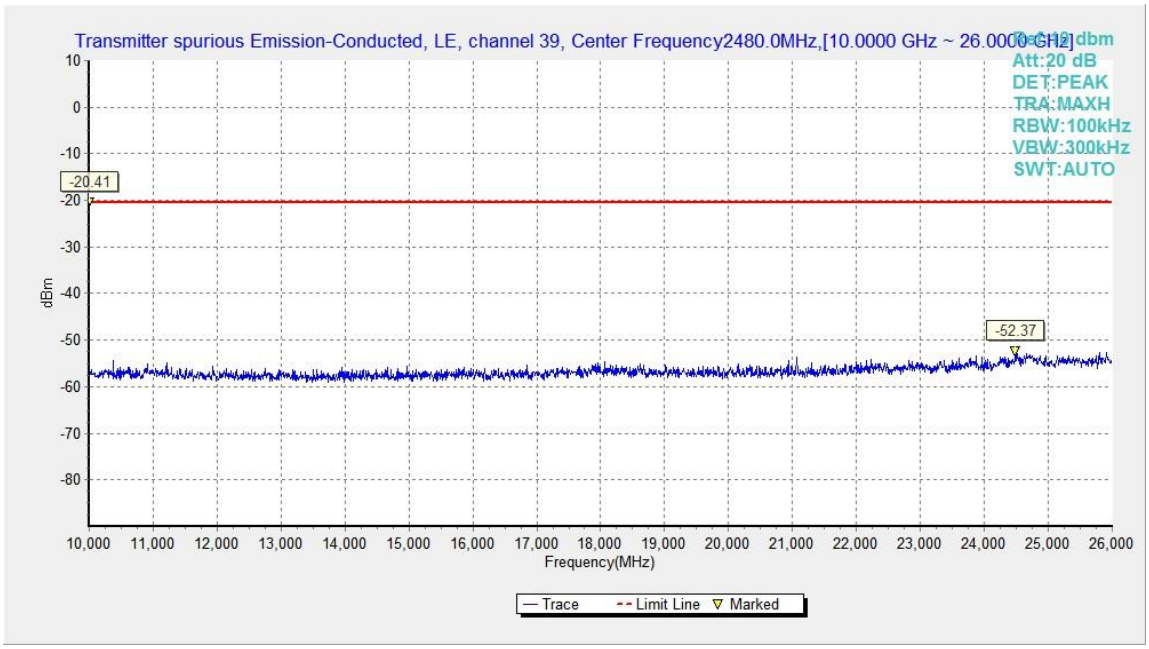



**Fig.17.** Transmitter Spurious Emission - Conducted: GFSK, 2480 MHz, 10GHz - 26GHz

## B.5. Radiated Unwanted Emission

### Limits

Measurement Limit

| Standard | Limit |
|---|---|
| FCC 47 CFR Part 15.247, 15.205, 15.209 | 20dB below peak output power |

In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

Limit in restricted band

| 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 – 30.0 | 30 | 30 |

| Frequency of emission (MHz) | Field strength (uV/m) | Field strength (dBuV/m) | Measurement distance (m) |
|---|---|---|---|
| 30-88 | 100 | 40 | 3 |
| 88-216 | 150 | 43.5 | 3 |
| 216-960 | 200 | 46 | 3 |
| Above 960 | 500 | 54 | 3 |

Note: When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor.

### Test setup

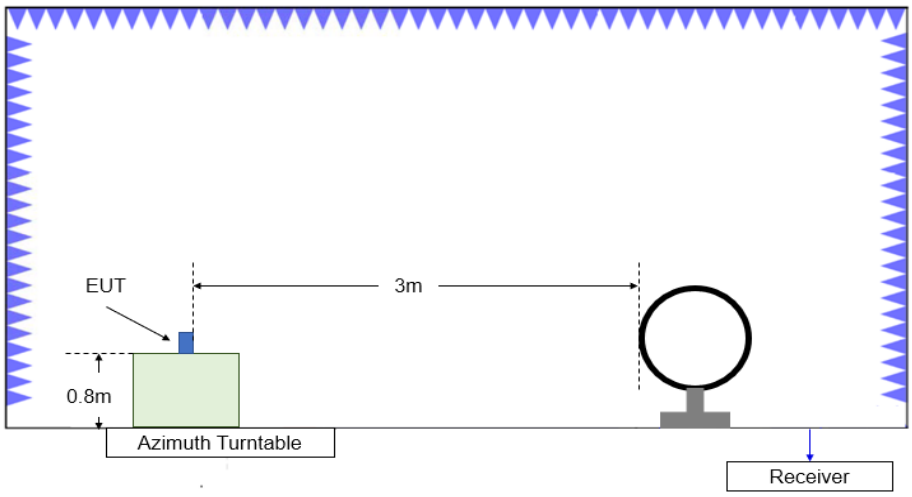



**Figure B.5.1. Test Site Diagram (9kHz-30MHz)**

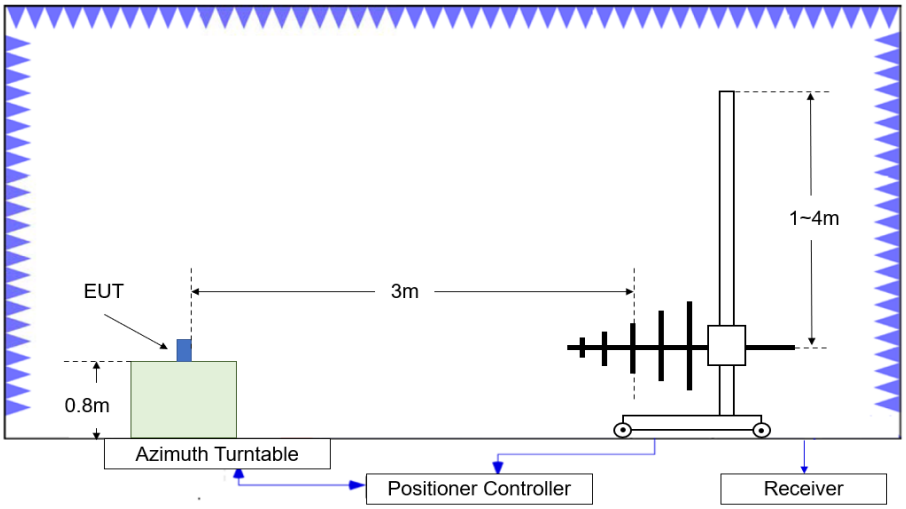



**Figure B.5.2. Test Site Diagram (30MHz-1GHz)**

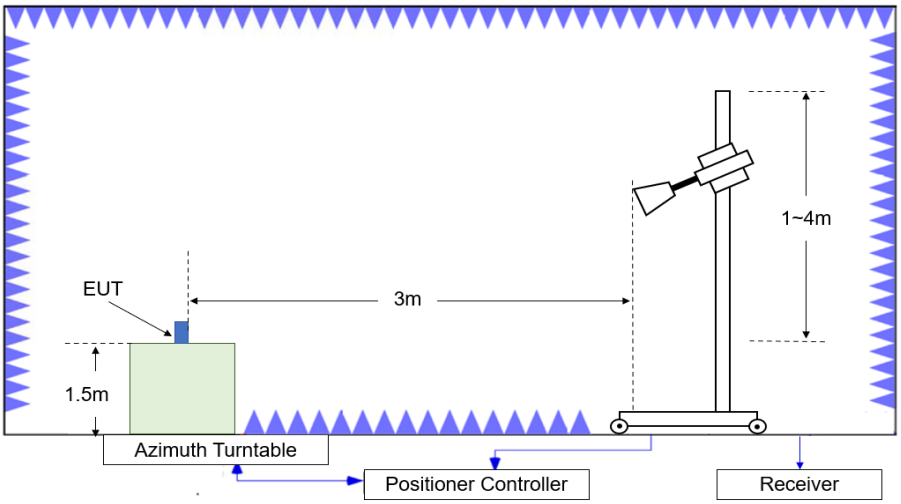



**Figure B.5.3. Test Site Diagram (1GHz-40GHz)**

**Test Procedures**

Radiated unwanted emissions from the EUT were measured according to ANSI C63.10-2013 (ANSI C63.10-2020).

Test setting

| Frequency of emission (MHz) | RBW/VBW | Sweep Time(s) |
|---|---|---|
| 30-1000 | 100kHz/300kHz | 5 |
| 1000-3000 | 1MHz/3MHz | 15 |
| 3000-18000 | 1MHz/3MHz | 40 |
| 18000-26500 | 1MHz/3MHz | 20 |

**Sample Calculation**

A "reference path loss" is established and the $A_{Rpl}$ is the attenuation of “reference path loss”, and including the gain of receive antenna, the gain of the preamplifier, the cable loss.

$P_{Mea}$ is the field strength recorded from the instrument.

The measurement results are obtained as described below:

Result=$P_{Mea}$+$A_{Rpl=}$ $P_{Mea}$+Cable Loss+Antenna Factor

**Test note**

1. Investigation has been done on all modes and modulations/data rates. Only the radiated emissions of the configuration that produced the worst case emissions are reported in this section.
2. Spurious emissions for all channels were investigated and almost the same below 1GHz. According to FCC 47 CFR §15.31, emission levels are not report much lower than the limit by over 20dB
3. Measurement frequencies were performed from 9 kHz to the $10^{th}$ harmonic of highest fundamental frequency or 40GHz, whichever is lower.

**Test Result**

**EUT ID: EUT1**

**Average Measurement results**

**GFSK 2402MHz LE 1M**

| Frequency (MHz) | Measurement Result (dBuV/m) | Cable Loss (dB) | Antenna Factor (dB/m) | Receiver Reading (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Pol. (H/V) |
|---|---|---|---|---|---|---|---|
| 17997.500 | 44.05 | -29.40 | 46.00 | 27.45 | 54.00 | 9.95 | H |
| 14157.500 | 39.22 | -30.80 | 41.70 | 28.32 | 54.00 | 14.78 | V |
| 12664.000 | 35.34 | -31.80 | 39.40 | 27.74 | 54.00 | 18.66 | V |
| 9841.000 | 32.84 | -34.10 | 37.90 | 29.04 | 54.00 | 21.16 | V |
| 7325.500 | 31.39 | -35.40 | 36.60 | 30.19 | 54.00 | 22.61 | V |
| 2368.200 | 44.13 | -19.60 | 28.20 | 35.53 | 54.00 | 9.87 | V |

**GFSK 2440MHz LE 1M**

| Frequency (MHz) | Measurement Result (dBuV/m) | Cable Loss (dB) | Antenna Factor (dB/m) | Receiver Reading (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Pol. (H/V) |
|---|---|---|---|---|---|---|---|
| 17954.000 | 43.84 | -29.40 | 46.00 | 27.24 | 54.00 | 10.16 | H |
| 14181.000 | 39.29 | -30.20 | 41.70 | 27.79 | 54.00 | 14.71 | V |
| 12775.000 | 35.42 | -31.50 | 39.80 | 27.12 | 54.00 | 18.58 | V |
| 9521.500 | 33.29 | -33.80 | 37.60 | 29.49 | 54.00 | 20.71 | H |
| 7989.500 | 31.50 | -35.40 | 36.90 | 30.00 | 54.00 | 22.50 | H |
| 3748.500 | 28.79 | -37.70 | 32.30 | 34.19 | 54.00 | 25.21 | H |

**GFSK 2480MHz LE 1M**

| Frequency (MHz) | Measurement Result (dBuV/m) | Cable Loss (dB) | Antenna Factor (dB/m) | Receiver Reading (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Pol. (H/V) |
|---|---|---|---|---|---|---|---|
| 17982.500 | 44.27 | -29.40 | 46.00 | 27.67 | 54.00 | 9.73 | V |
| 14568.500 | 39.34 | -29.00 | 41.90 | 26.44 | 54.00 | 14.66 | H |
| 12688.000 | 35.20 | -31.90 | 39.50 | 27.60 | 54.00 | 18.80 | V |
| 8983.000 | 33.16 | -34.70 | 37.70 | 30.16 | 54.00 | 20.84 | V |
| 7967.000 | 31.71 | -35.40 | 36.80 | 30.31 | 54.00 | 22.29 | H |
| 2491.500 | 44.30 | -19.70 | 28.20 | 35.80 | 54.00 | 9.70 | H |

**GFSK 2404MHz LE 2M**

| Frequency (MHz) | Measurement Result (dBuV/m) | Cable Loss (dB) | Antenna Factor (dB/m) | Receiver Reading (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Pol. (H/V) |
|---|---|---|---|---|---|---|---|
| 17999.000 | 44.17 | -29.40 | 46.00 | 27.57 | 54.00 | 9.83 | H |
| 14570.000 | 39.66 | -29.00 | 41.90 | 26.76 | 54.00 | 14.34 | V |
| 12787.500 | 35.52 | -31.50 | 39.80 | 27.22 | 54.00 | 18.48 | H |
| 9729.500 | 33.18 | -34.50 | 37.80 | 29.88 | 54.00 | 20.82 | V |
| 7988.500 | 31.83 | -35.40 | 36.90 | 30.33 | 54.00 | 22.17 | V |
| 2379.500 | 44.31 | -19.80 | 28.20 | 35.91 | 54.00 | 9.69 | H |

**GFSK 2440MHz LE 2M**

| Frequency (MHz) | Measurement Result (dBuV/m) | Cable Loss (dB) | Antenna Factor (dB/m) | Receiver Reading (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Pol. (H/V) |
|---|---|---|---|---|---|---|---|
| 17970.000 | 44.31 | -29.40 | 46.00 | 27.71 | 54.00 | 9.69 | H |
| 14677.500 | 39.31 | -30.00 | 41.50 | 27.81 | 54.00 | 14.69 | V |
| 11898.000 | 35.50 | -32.40 | 39.10 | 28.80 | 54.00 | 18.50 | H |
| 9428.500 | 33.04 | -33.60 | 37.90 | 28.74 | 54.00 | 20.96 | H |
| 7966.500 | 31.96 | -35.40 | 36.80 | 30.56 | 54.00 | 22.04 | V |
| 4861.500 | 28.94 | -37.50 | 33.40 | 33.04 | 54.00 | 25.06 | V |

**GFSK 2478MHz LE 2M**

| Frequency (MHz) | Measurement Result (dBuV/m) | Cable Loss (dB) | Antenna Factor (dB/m) | Receiver Reading (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Pol. (H/V) |
|---|---|---|---|---|---|---|---|
| 17980.000 | 43.84 | -29.40 | 46.00 | 27.24 | 54.00 | 10.16 | H |
| 14153.000 | 39.43 | -30.80 | 41.70 | 28.53 | 54.00 | 14.57 | V |
| 12774.500 | 35.62 | -31.50 | 39.80 | 27.32 | 54.00 | 18.38 | V |
| 9128.000 | 33.32 | -34.30 | 37.70 | 29.92 | 54.00 | 20.68 | H |
| 7441.000 | 31.68 | -35.50 | 36.50 | 30.68 | 54.00 | 22.32 | V |
| 2486.200 | 44.42 | -19.70 | 28.20 | 35.92 | 54.00 | 9.58 | V |

**Peak Measurement results**

**GFSK 2402MHz LE 1M**

| Frequency (MHz) | Measurement Result (dBuV/m) | Cable Loss (dB) | Antenna Factor (dB/m) | Receiver Reading (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Pol. (H/V) |
|---|---|---|---|---|---|---|---|
| 17953.500 | 53.58 | -29.40 | 46.00 | 36.98 | 74.00 | 20.42 | H |
| 14246.500 | 48.70 | -30.60 | 41.80 | 37.60 | 74.00 | 25.30 | H |
| 11765.500 | 45.00 | -32.90 | 39.20 | 38.70 | 74.00 | 29.00 | V |
| 9000.500 | 42.64 | -34.70 | 37.70 | 39.64 | 74.00 | 31.36 | H |
| 7256.500 | 41.94 | -35.60 | 36.40 | 41.14 | 74.00 | 32.06 | V |
| 2354.400 | 56.69 | -19.60 | 28.20 | 48.09 | 74.00 | 17.31 | V |

**GFSK 2440MHz LE 1M**

| Frequency (MHz) | Measurement Result (dBuV/m) | Cable Loss (dB) | Antenna Factor (dB/m) | Receiver Reading (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Pol. (H/V) |
|---|---|---|---|---|---|---|---|
| 17976.000 | 53.30 | -29.40 | 46.00 | 36.70 | 74.00 | 20.70 | H |
| 14519.500 | 48.64 | -30.60 | 41.90 | 37.34 | 74.00 | 25.36 | V |
| 12023.000 | 44.58 | -32.70 | 39.00 | 38.28 | 74.00 | 29.42 | H |
| 9867.000 | 42.66 | -33.90 | 37.90 | 38.66 | 74.00 | 31.34 | V |
| 7925.000 | 41.81 | -35.40 | 36.80 | 40.41 | 74.00 | 32.19 | V |
| 4696.000 | 38.15 | -37.50 | 32.80 | 42.85 | 74.00 | 35.85 | V |

**GFSK 2480MHz LE 1M**

| Frequency (MHz) | Measurement Result (dBuV/m) | Cable Loss (dB) | Antenna Factor (dB/m) | Receiver Reading (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Pol. (H/V) |
|---|---|---|---|---|---|---|---|
| 17960.500 | 53.60 | -29.40 | 46.00 | 37.00 | 74.00 | 20.40 | H |
| 14178.000 | 49.43 | -30.20 | 41.70 | 37.93 | 74.00 | 24.57 | V |
| 12672.000 | 45.17 | -31.80 | 39.40 | 37.57 | 74.00 | 28.83 | V |
| 9512.000 | 42.39 | -33.80 | 37.60 | 38.59 | 74.00 | 31.61 | V |
| 7325.000 | 41.71 | -35.40 | 36.60 | 40.51 | 74.00 | 32.29 | H |
| 2492.200 | 56.06 | -19.70 | 28.20 | 47.56 | 74.00 | 17.94 | H |

**GFSK 2404MHz LE 2M**

| Frequency (MHz) | Measurement Result (dBuV/m) | Cable Loss (dB) | Antenna Factor (dB/m) | Receiver Reading (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Pol. (H/V) |
|---|---|---|---|---|---|---|---|
| 17993.500 | 53.27 | -29.40 | 46.00 | 36.67 | 74.00 | 20.73 | V |
| 14673.000 | 48.98 | -30.00 | 41.50 | 37.48 | 74.00 | 25.02 | V |
| 11813.000 | 44.99 | -32.00 | 39.20 | 37.79 | 74.00 | 29.01 | H |
| 9806.000 | 42.46 | -34.10 | 37.90 | 38.66 | 74.00 | 31.54 | V |
| 7525.500 | 41.02 | -35.50 | 36.30 | 40.22 | 74.00 | 32.98 | V |
| 2347.900 | 55.80 | -19.60 | 28.20 | 47.20 | 74.00 | 18.20 | V |

**GFSK 2440MHz LE 2M**

| Frequency (MHz) | Measurement Result (dBuV/m) | Cable Loss (dB) | Antenna Factor (dB/m) | Receiver Reading (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Pol. (H/V) |
|---|---|---|---|---|---|---|---|
| 17942.500 | 53.39 | -29.40 | 46.00 | 36.79 | 74.00 | 20.61 | V |
| 14693.000 | 48.94 | -30.00 | 41.50 | 37.44 | 74.00 | 25.06 | H |
| 11891.500 | 45.08 | -32.40 | 39.10 | 38.38 | 74.00 | 28.92 | V |
| 8955.500 | 42.63 | -33.90 | 37.70 | 38.83 | 74.00 | 31.37 | V |
| 7946.500 | 41.92 | -35.40 | 36.80 | 40.52 | 74.00 | 32.08 | V |
| 4808.000 | 38.88 | -37.70 | 33.00 | 43.58 | 74.00 | 35.12 | V |

**GFSK 2478MHz LE 2M**

| Frequency (MHz) | Measurement Result (dBuV/m) | Cable Loss (dB) | Antenna Factor (dB/m) | Receiver Reading (dBuV) | Limit (dBuV/m) | Margin (dB) | Antenna Pol. (H/V) |
|---|---|---|---|---|---|---|---|
| 17985.500 | 53.32 | -29.40 | 46.00 | 36.72 | 74.00 | 20.68 | V |
| 14592.000 | 49.40 | -29.00 | 41.90 | 36.50 | 74.00 | 24.60 | H |
| 12872.000 | 44.80 | -31.50 | 40.00 | 36.30 | 74.00 | 29.20 | V |
| 9229.000 | 42.78 | -34.30 | 37.60 | 39.48 | 74.00 | 31.22 | V |
| 7164.000 | 41.65 | -35.60 | 35.90 | 41.35 | 74.00 | 32.35 | V |
| 2496.400 | 56.57 | -19.70 | 28.20 | 48.07 | 74.00 | 17.43 | H |

**Conclusion: PASS**

Note: the spurious emission above 18G is noise only and did not show on the report.

**Band edge compliance**

| Mode | Channel | Frequency Range | Test Results | Conclusion |
|---|---|---|---|---|
| GFSK 1M | 0 | 2.31GHz ~2.43GHz | Fig.18 | P |
| | 39 | 2.45GHz ~2.5GHz | Fig.19 | P |
| GFSK 2M | 1 | 2.31GHz ~2.43GHz | Fig.20 | P |
| | 38 | 2.45GHz ~2.5GHz | Fig.21 | P |

**Conclusion: PASS**

**Test graphs as below**

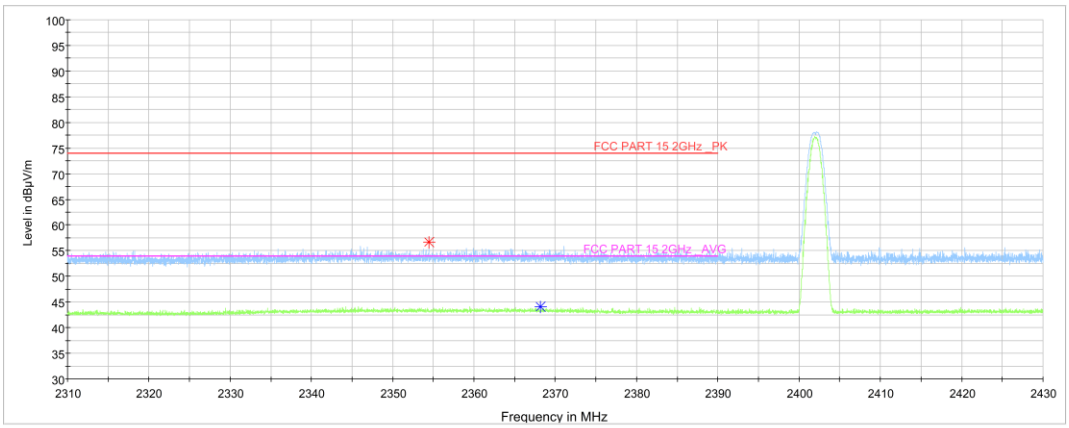



**Fig.18. Frequency Band Edges: GFSK, 2402 MHz, Hopping Off, 2.31 GHz – 2.43GHz**

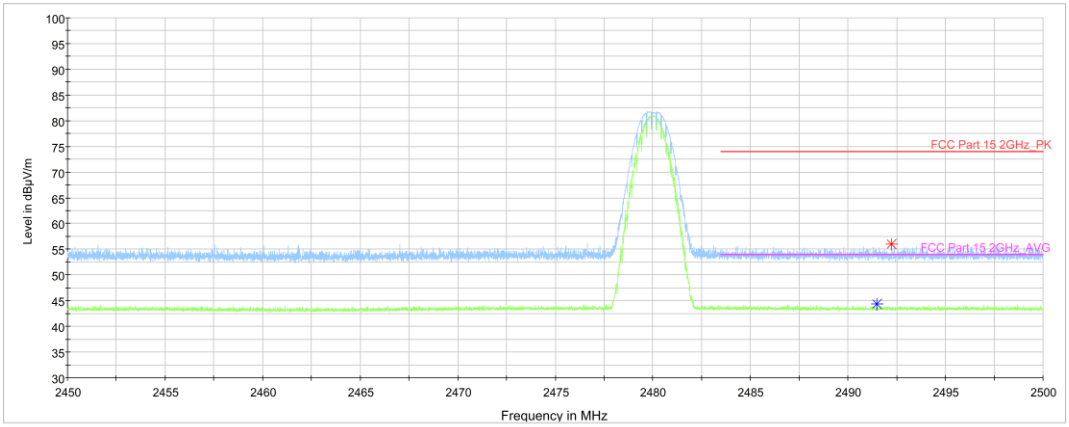



**Fig.19. Frequency Band Edges: GFSK, 2480 MHz, Hopping Off , 2.45 GHz - 2.50GHz**

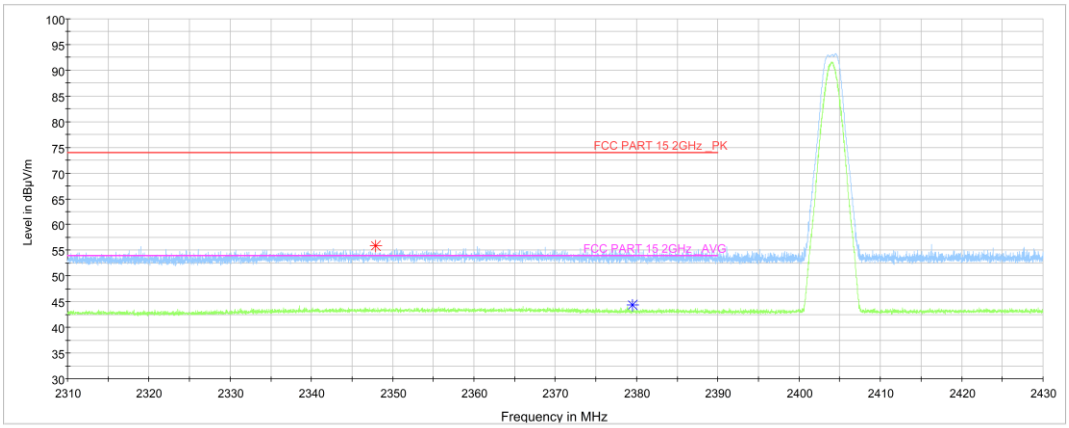



**Fig.20. Frequency Band Edges: GFSK, 2404 MHz, Hopping Off, 2.31 GHz – 2.43GHz**

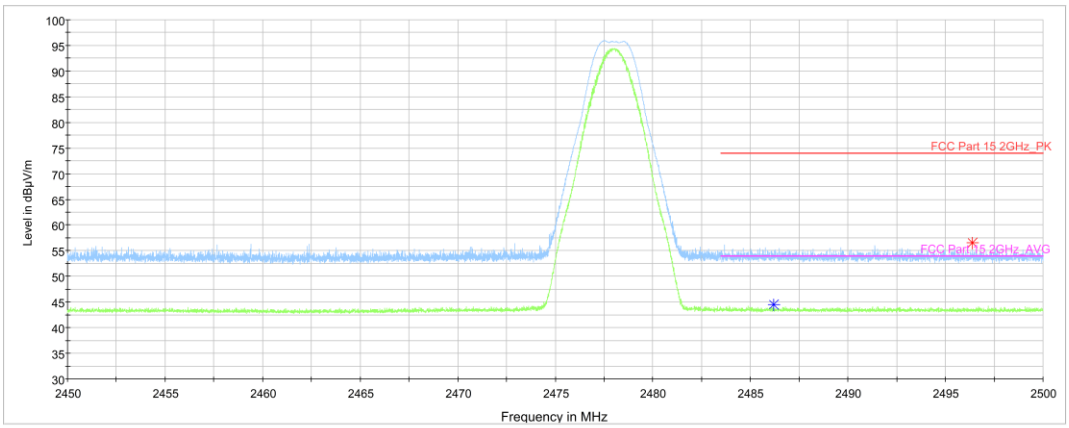



**Fig.21. Frequency Band Edges: GFSK, 2478 MHz, Hopping Off , 2.45 GHz - 2.50GHz**

## B.6. 6dB Bandwidth

**Method of Measurement:**

The measurement is made according to ANSI C63.10 clause 11.8.1
1.Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) = 300 kHz.
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.

**Measurement Limit:**

| Standard | Limit |
|---|---|
| FCC 47 CFR Part 15.247(a)(2) | >= 500KHz |

**Measurement Results:**

**For GFSK**

| Channel No. | Frequency (MHz) | 6dB Bandwidth (kHz) | | Conclusion |
|---|---|---|---|---|
| 0 | 2402 | Fig.22 | 662.50 | P |
| 19 | 2440 | Fig.23 | 664.50 | P |
| 39 | 2480 | Fig.24 | 664.50 | P |

**Conclusion: PASS**

**Test graphs as below:**

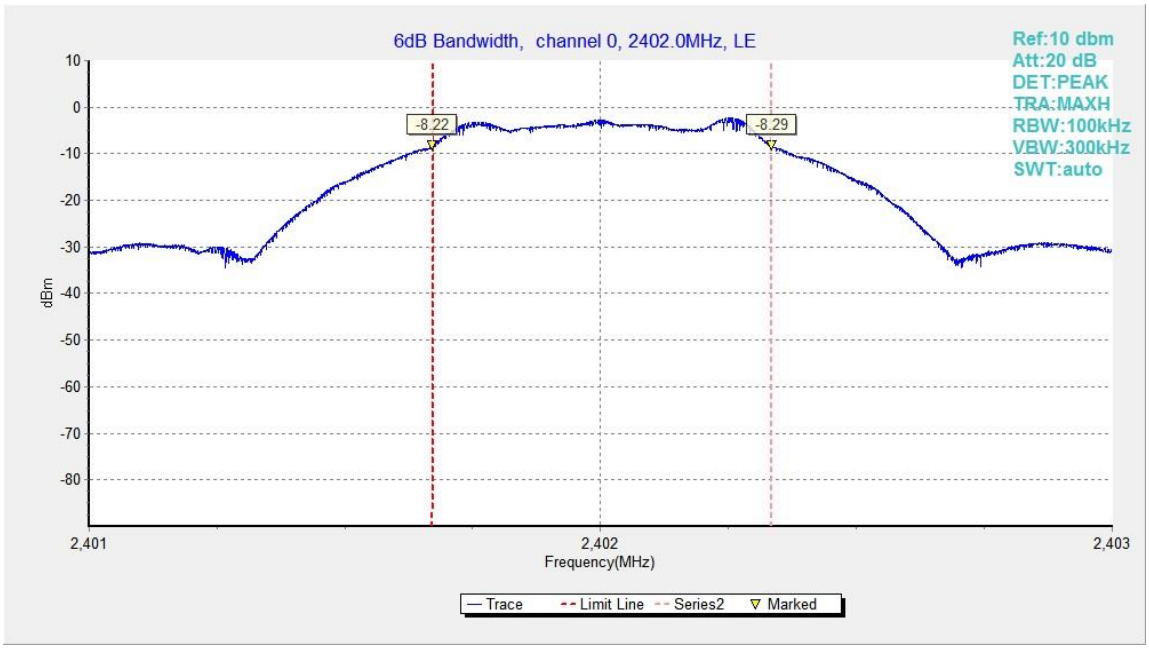



**Fig.22.** 6dB Bandwidth: GFSK, 2402 MHz

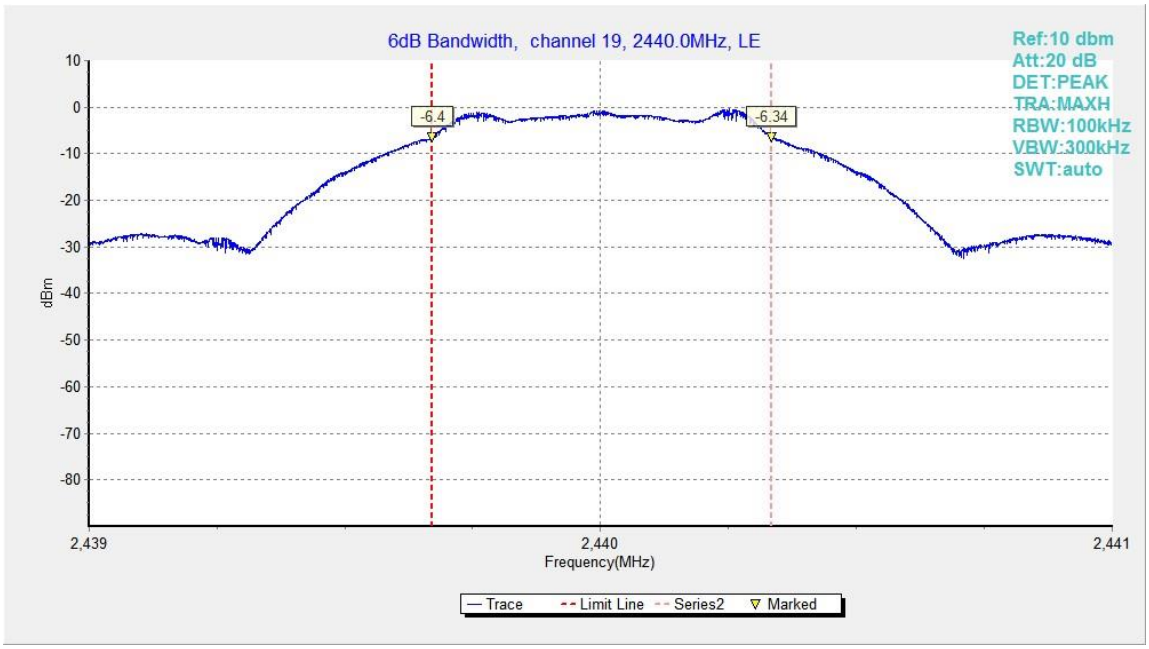



**Fig.23.** 6dB Bandwidth: GFSK, 2440 MHz

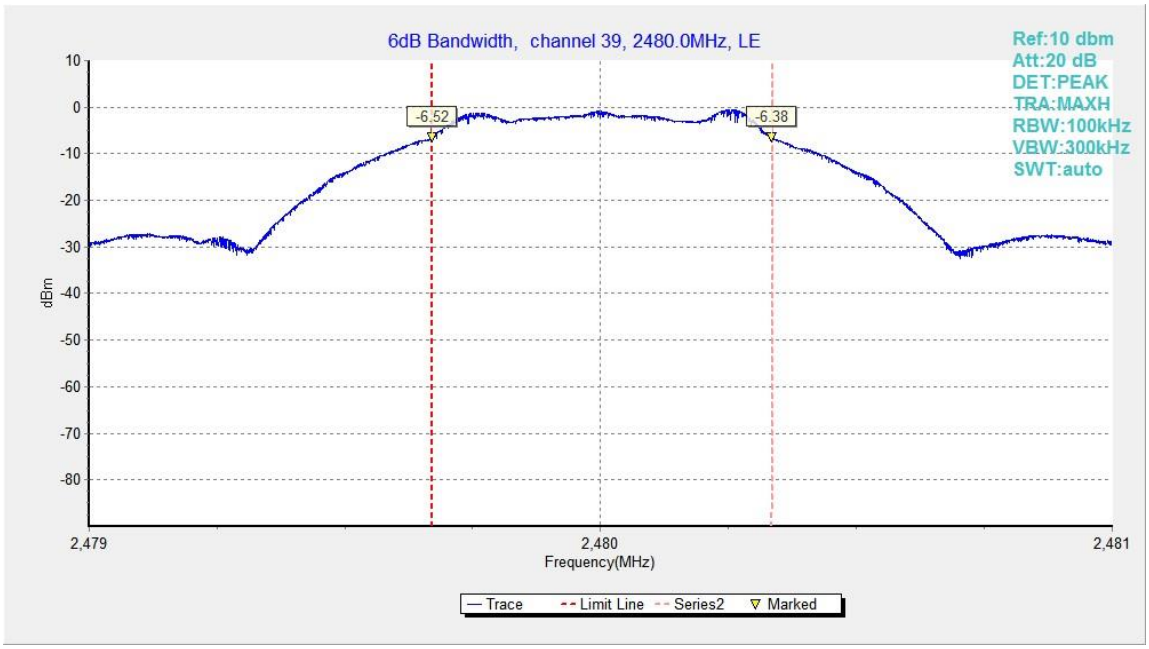



**Fig.24.** 6dB Bandwidth: GFSK, 2480 MHz

## B.7. Maximum Power Spectral Density Level

**Method of Measurement:**

The measurement is made according to ANSI C63.10 clause 11.10.2

1. Set the RBW = 3 kHz.
2. Set the VBW = 10 kHz.
3. Set the span to 2 times the DTS bandwidth.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum amplitude level within the RBW.

**Measurement Limit:**

| Standard | Limit |
|---|---|
| FCC 47 CFR Part 15.247(e) | <=8.0dBm/3kHz |

**Measurement Results:**

**For GFSK**

| Channel No. | Frequency (MHz) | Maximum Power Spectral Density Level(dBm/3kHz) | | Conclusion |
|---|---|---|---|---|
| 0 | 2402 | Fig.25 | -18.42 | P |
| 19 | 2440 | Fig.26 | -16.51 | P |
| 39 | 2480 | Fig.27 | -16.52 | P |

**Test graphs as below:**

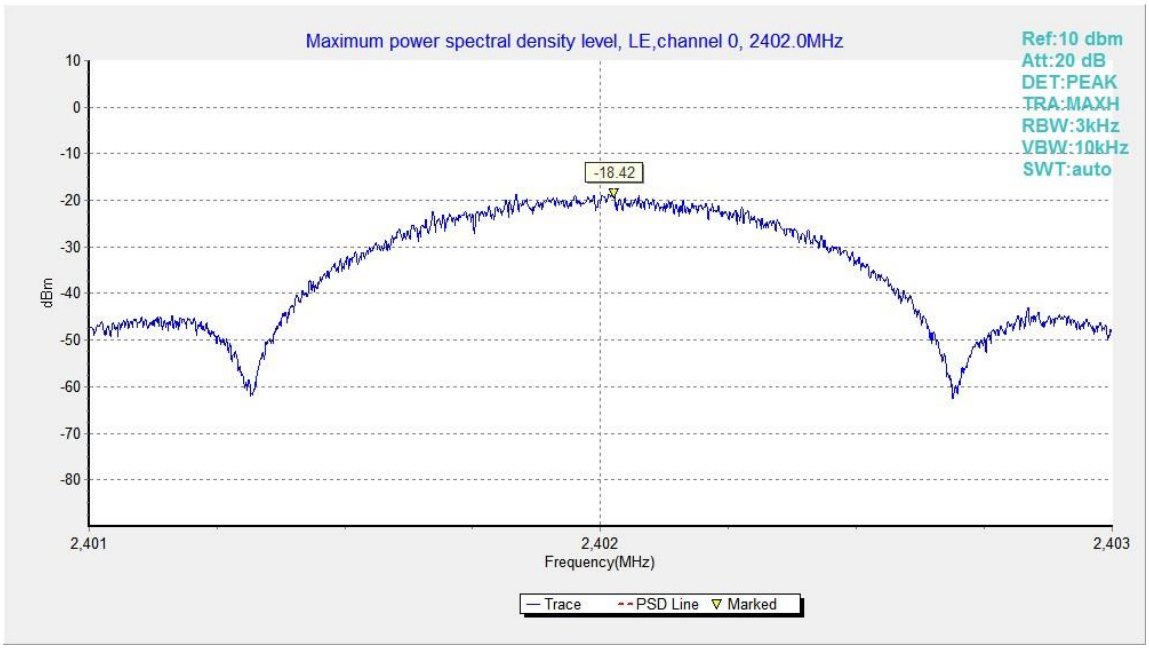



**Fig.25.** Maximum Power Spectral Density Level Function: GFSK, 2402 MHz


**Fig.26.** Maximum Power Spectral Density Level Function: GFSK, 2440 MHz


**Fig.27.** Maximum Power Spectral Density Level Function: GFSK, 2480 MHz

## B.8. AC Powerline Conducted Emission

**Summary**

All AC line conducted spurious emissions are measured with a receiver connected to a grounded LISN while the EUT is operating at its maximum duty cycle, at maximum power, and at the appropriate frequencies. All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section

**Method of Measurement:**

See Clause 6.2 of ANSI C63.10 specifically.

See Clause 4 and Clause 5 of ANSI C63.10 generally.

The conducted emissions from the AC port of the EUT are measured in a shielding room. The EUT is connected to a Line Impedance Stabilization Network (LISN). An overview sweep with peak detection was performed. The measurements were performed with a quasi-peak detector and if required, an average detector.

The conducted emission measurements were made with the following detector of the test receiver: Quasi-Peak / Average Detector.

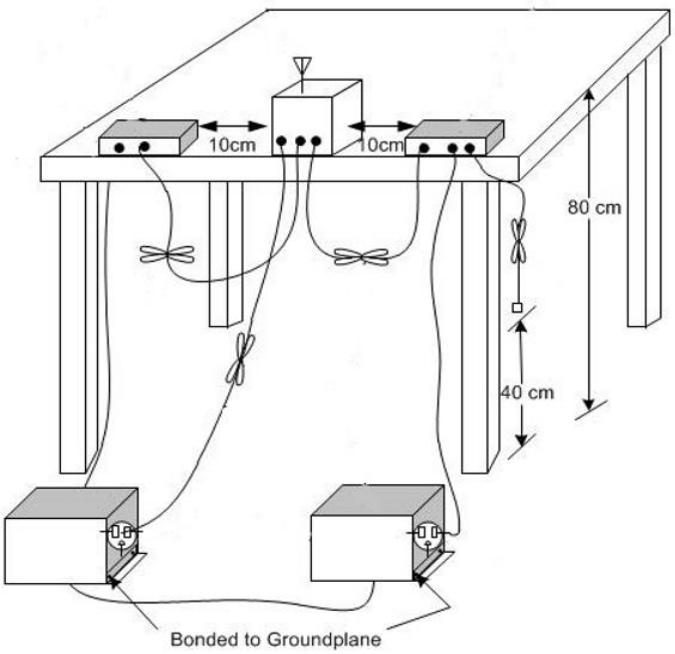
The measurement bandwidth is:

| Frequency of Emission (MHz) | RBW/IF bandwidth |
|---|---|
| 0.15-30 | 9kHz |

**Test Condition:**

| Voltage（V） | Frequency（Hz） |
|---|---|
| 120 | 60 |

**Test setup**



**Measurement Result and limit:**

Bluetooth (Quasi-peak Limit)

| Frequency range (MHz) | Quasi-peak Limit (dBμV) | Result (dBμV) | | Conclusion |
|---|---|---|---|---|
| | | With charger | | |
| | | bluetooth | Idle | |
| 0.15 to 0.5 | 66 to 56 | Fig.B.8.1 | Fig. B.8.2 | P |
| 0.5 to 5 | 56 | | | |
| 5 to 30 | 60 | | | |
| NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz. | | | | |

Bluetooth (Average Limit)

| Frequency range (MHz) | Average Limit (dBμV) | Result (dBμV) | | Conclusion |
|---|---|---|---|---|
| | | With charger | | |
| | | bluetooth | Idle | |
| 0.15 to 0.5 | 56 to 46 | Fig.B.8.1 | Fig. B.8.2 | P |
| 0.5 to 5 | 46 | | | |
| 5 to 30 | 50 | | | |
| NOTE: The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.5 MHz. | | | | |

**Conclusion: Pass**

**Test graphs as below:**

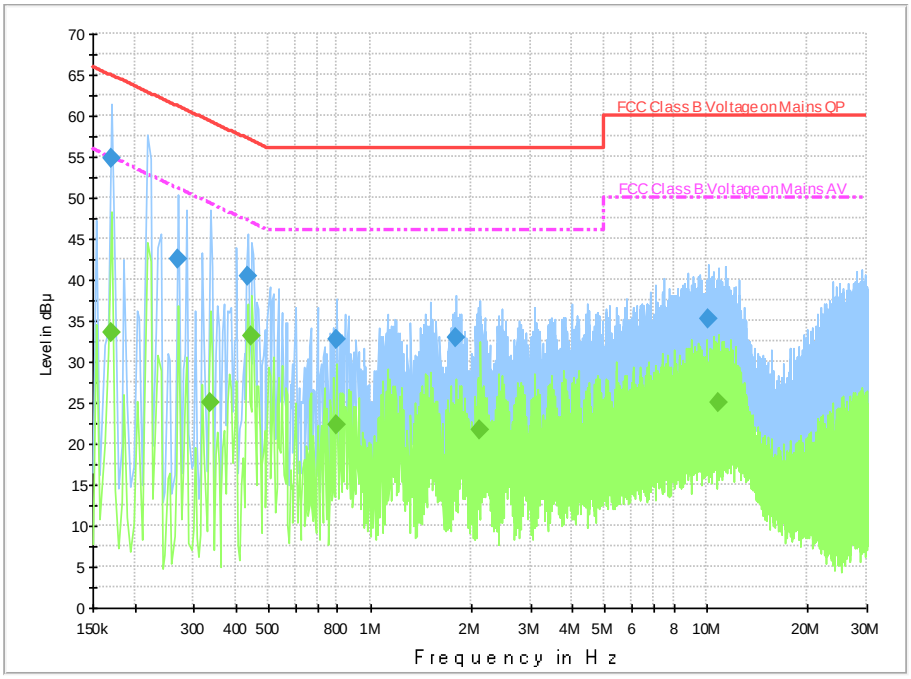



**Fig.B.8.1 AC Powerline Conducted Emission- bluetooth**

Note: The graphic result above is the maximum of the measurements for both phase line and neutral line.

**Final Result 1**

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|---|---|---|---|---|---|---|---|---|---|
| **0.170000** | **54.7** | **2000.0** | **9.000** | **On** | **N** | **19.7** | **10.2** | **65.0** | |
| **0.270000** | **42.4** | **2000.0** | **9.000** | **On** | **N** | **19.7** | **18.7** | **61.1** | |
| **0.434000** | **40.4** | **2000.0** | **9.000** | **On** | **L1** | **19.7** | **16.7** | **57.2** | |
| **0.794000** | **32.8** | **2000.0** | **9.000** | **On** | **L1** | **19.7** | **23.2** | **56.0** | |
| **1.802000** | **32.9** | **2000.0** | **9.000** | **On** | **L1** | **19.6** | **23.1** | **56.0** | |
| **10.154000** | **35.1** | **2000.0** | **9.000** | **On** | **L1** | **19.7** | **24.9** | **60.0** | |

**Final Result 2**

| Frequency (MHz) | CAverage (dBµV) | Meas. Time | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|---|---|---|---|---|---|---|---|---|---|
| **0.170000** | **33.5** | **2000.0** | **9.000** | **On** | **N** | **19.7** | **21.5** | **55.0** | |
| **0.334000** | **24.9** | **2000.0** | **9.000** | **On** | **L1** | **19.7** | **24.4** | **49.4** | |
| **0.446000** | **33.2** | **2000.0** | **9.000** | **On** | **L1** | **19.7** | **13.8** | **46.9** | |
| **0.794000** | **22.4** | **2000.0** | **9.000** | **On** | **L1** | **19.7** | **23.6** | **46.0** | |
| **2.130000** | **21.6** | **2000.0** | **9.000** | **On** | **L1** | **19.6** | **24.4** | **46.0** | |
| **10.922000** | **25.1** | **2000.0** | **9.000** | **On** | **L1** | **19.7** | **24.9** | **50.0** | |

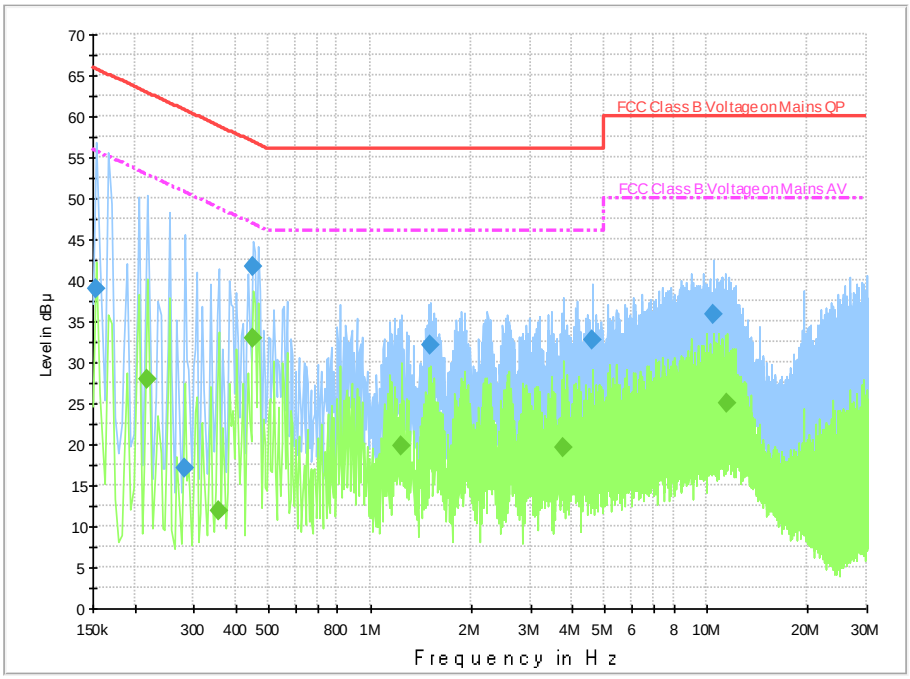



**Fig.B.8.2 AC Powerline Conducted Emission-Idle**

Note: The graphic result above is the maximum of the measurements for both phase line and neutral line.

**Final Result 1**

| Frequency (MHz) | QuasiPeak (dBµV) | Meas. Time | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|---|---|---|---|---|---|---|---|---|---|
| **0.154000** | **39.0** | **2000.0** | **9.000** | **On** | **L1** | **19.9** | **26.8** | **65.8** | |
| **0.282000** | **17.2** | **2000.0** | **9.000** | **On** | **N** | **19.7** | **43.6** | **60.8** | |
| **0.450000** | **41.7** | **2000.0** | **9.000** | **On** | **L1** | **19.7** | **15.1** | **56.9** | |
| **1.514000** | **32.1** | **2000.0** | **9.000** | **On** | **L1** | **19.6** | **23.9** | **56.0** | |
| **4.578000** | **32.8** | **2000.0** | **9.000** | **On** | **L1** | **19.6** | **23.2** | **56.0** | |
| **10.454000** | **35.8** | **2000.0** | **9.000** | **On** | **L1** | **19.7** | **24.2** | **60.0** | |

**Final Result 2**

| Frequency (MHz) | CAverage (dBµV) | Meas. Time | Bandwidth (kHz) | Filter | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) | Comment |
|---|---|---|---|---|---|---|---|---|---|
| **0.218000** | **27.9** | **2000.0** | **9.000** | **On** | **N** | **19.7** | **25.0** | **52.9** | |
| **0.354000** | **12.0** | **2000.0** | **9.000** | **On** | **L1** | **19.7** | **36.9** | **48.9** | |
| **0.450000** | **33.0** | **2000.0** | **9.000** | **On** | **L1** | **19.7** | **13.9** | **46.9** | |
| **1.246000** | **19.8** | **2000.0** | **9.000** | **On** | **L1** | **19.6** | **26.2** | **46.0** | |
| **3.762000** | **19.6** | **2000.0** | **9.000** | **On** | **L1** | **19.6** | **26.4** | **46.0** | |
| **11.562000** | **25.1** | **2000.0** | **9.000** | **On** | **L1** | **19.7** | **24.9** | **50.0** | |

## B.9. Antenna Requirement

The antenna of the device is permanently attached. There are no provisions for connection to an external antenna.
The unit complies with the requirement of FCC Part 15.203.

## ANNEX C: Accreditation Certificate

Accredited Laboratory

A2LA has accredited

TELECOMMUNICATION TECHNOLOGY LABS, CAICT

Beijing, People's Republic of China

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 26th day of June 2023.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 7049.01
Valid to July 31, 2024

*For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.*

*****END OF REPORT*****