



REGULATORY COMPLIANCE TEST REPORT

**FCC CFR 47 Part 15 Subpart C (15.247 DTS)
ISED RSS-247 Issue 3**

Report No.: CATA18 – U7 Rev A

Company: Catapult Sports Pty Ltd

Model Name: WD-S8-08-V1

REGULATORY COMPLIANCE TEST REPORT

Company Name: Catapult Sports Pty Ltd

Model Name: WD-S8-08-V1

To: FCC CFR 47 Part 15 Subpart C (15.247 DTS) & ISED RSS-247 Issue 3

Test Report Serial No.: CATA18 – U7 Rev A

This report supersedes: NONE

Applicant: Catapult Sports Pty Ltd
10 Post Office Square, Floor 9
Boston, Massachusetts 02109
USA

Issue Date: 31st March 2025

This Test Report is Issued Under the Authority of:

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MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2017. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-01.pdf>



Accredited Laboratory

A2LA has accredited

MICOM LABS

Pleasanton, CA

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 28th day of February 2024.



Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2025

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

1.2. RECOGNITION

MiCOM Labs, Inc. is widely recognized for its wireless testing and certification capabilities. In addition to being recognized for Testing and Certification under Phase 2 Mutual Recognition Agreements (MRA) with Canada, Europe, United Kingdom and Japan, our international recognition includes Conformity Assessment Body (CAB) designation status under agreements with Asia Pacific (APEC) MRA Phase 1 countries giving acceptance of MiCOM Labs test reports. MiCOM Labs test reports are accepted globally.

| Country | Recognition Body | Status | MRA Phase | Identification No. |
|----------------|--|--------|--------------|---|
| USA | Federal Communications Commission (FCC) | TCB | - | US0159 Test Firm Designation#: US1084 |
| Canada | Industry Canada (ISED) | FCB | APEC MRA 2 | US0159 ISED#: 4143A |
| Japan | MIC (Ministry of Internal Affairs and Communication) | CAB | Japan MRA 2 | RCB 210 |
| | Japan Approvals Institute for Telecommunication Equipment (JATE) | | | |
| | VCCI | -- | -- | A-0012 |
| Europe | European Commission | NB | EU MRA 2 | NB 2280 |
| United Kingdom | Department for Business, Energy & Industrial Strategy (BEIS) | AB | UK MRA 2 | AB 2280 |
| Mexico | Instituto Federal de Telecomunicaciones (IFT) | CAB | Mexico MRA 1 | US0159 |
| Australia | Australian Communications and Media Authority (ACMA) | CAB | APEC MRA 1 | US0159 |
| Hong Kong | Office of the Telecommunication Authority (OFTA) | | | |
| Korea | Ministry of Information and Communication Radio Research Laboratory (RRL) | | | |
| Singapore | Infocomm Development Authority (IDA) | | | |
| Taiwan | National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI) | | | |
| Vietnam | Ministry of Communication (MIC) | | | |

TCB – Telecommunications Certification Bodies (TCB)

FCB – Foreign Certification Body

CAB – Conformity Assessment Body

NB – Notified Body

AB – Approved Body

MRA – Mutual Recognition Agreement

MRA Phase I - recognition for product testing

Phase II – recognition for both product testing and certification

1.3. PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065:2012. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-02.pdf>



United States of America – Telecommunication Certification Body (TCB)
Industry Canada – Certification Body, CAB Identifier – US0159
Europe – Notified Body (NB), NB Identifier - 2280
UK – Approved Body (AB), AB Identifier - 2280
Japan – Recognized Certification Body (RCB), RCB Identifier – 210

2. DOCUMENT HISTORY

| Document History | | |
|------------------|-----------------------------|-------------------------|
| Revision | Date | Comments |
| Draft | 17 th March 2025 | Draft for client review |
| Rev A | 31 st March 2025 | Initial Release |
| | | |
| | | |
| | | |
| | | |

In the above table the latest report revision will replace all earlier versions.

3. TEST RESULT CERTIFICATE

| | |
|--|---|
| Manufacturer: Catapult Sports Pty Ltd. 10 Post Office Square, Floor 9 Boston, Massachusetts 02109 USA | Tested By: MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA |
| Model: WD-S8-08-V1 | Telephone: +1 925 462 0304 |
| Type Of Equipment: Wearable athlete tracking device | Fax: +1 925 462 0306 |
| S/N's: 000094, 000409 | |
| Test Date(s): 7 th , 10 th – 11 th , 13 th , 20 th – 21 st February 2025, 10 th March 2025 | Website: www.micomlabs.com |

| STANDARD(S) | TEST RESULTS |
|--|--------------------|
| FCC CFR 47 Part 15 Subpart C 15.247 ISSED RSS-247 Issue 3 | EQUIPMENT COMPLIES |

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:



Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

| REF. | PUBLICATION | YEAR | TITLE |
|------|--------------------------|--|---|
| I | KDB 662911 D01, D02, D03 | D01 Oct 2013, D02 Oct 2011, D03 Oct 2020 | Guidance for measurement of output emission of devices that employ single transmitter with multiple outputs or systems with multiple transmitters operating simultaneously in the same frequency band. 662911 D01 Multiple Transmitter Output v02r01, 662911 D02 MIMO with Cross Polarized Antenna v01, 662911 D03 MIMO Antenna Gain Measurement v01, OET 13TR1003 Directional Gain of 802 11 MIMO with CDD 04 05 2013 |
| II | KDB 558074 D01 v05r02 | Apr 2019 | Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices operating under section 15.247 of the FCC Rules. |
| III | A2LA | 16 th April 2024 | R105 – Requirement's When Making Reference to A2LA Accreditation Status |
| IV | ANSI C63.10 | 2020 | American National Standard for Testing Unlicensed Wireless Devices |
| V | ANSI C63.4 | 2014 + 2017 Amendment | American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9kHz to 40GHz |
| VI | FCC 47 CFR Part 15.247 | Apr 2020 | Radio Frequency Devices; Subpart C – Intentional Radiators |
| VII | ICES-003 | Issue 7; Oct 2020 | Information Technology Equipment (Including Digital Apparatus) |
| VIII | RSS-247 Issue 3 | Aug 2023 | Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and License-Exempt Local Area Network (LE-LEN) Devices |
| IX | RSS-Gen Issue 5 | Amendment 1,2 (Feb 2021) | General Requirements for Compliance of Radio Apparatus. With Amendments 1: March 2019 and 2: Feb 2021 |
| X | FCC 47 CFR Part 2.1033 | Feb 2023 | FCC requirements and rules regarding photographs and test setup diagrams |
| XI | KDB 789033 D02 V02r01 | Dec 2017 | Guidelines for Compliance Testing Of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E |

4.2. Test and Uncertainty Procedure

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

5. PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1. Technical Details

| Details | Description |
|---|---|
| Purpose: | Test of the Catapult Sports Pty Ltd WD-S8-08-V1 to FCC CFR 47 Part 15 Subpart C 15.247 and ISED RSS-247 Issue 3 |
| Applicant: | Catapult Sports Pty Ltd 10 Post Office Square, Floor 9 Boston, Massachusetts 02109 |
| Manufacturer: | Catapult Sports Pty Ltd |
| Laboratory performing the tests: | MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA |
| Test report reference number: | CATA18-U7 |
| Date EUT received: | 30 th January 2025, 28 th February 2025 |
| Standard(s) applied: | FCC CFR 47 Part 15 Subpart C 15.247 |
| Dates of test (from - to): | 7 th , 10 th – 11 th , 13 th , 20 th – 21 st February 2025, 10 th March 2025 |
| No of Units Tested: | 1 |
| Product Family Name: | WD-S8-08-V1 |
| Model(s): | WD-S8-08-V1 |
| Location for use: | Indoor and Outdoor |
| Declared Frequency Range(s): | 2400 - 2483.5 MHz; |
| Type of Modulation: | GFSK |
| EUT Modes of Operation: | BLE-1M/BLE-2M |
| Declared Nominal Output Power: | +4 dBm |
| Transmit/Receive Operation: | Transmitter |
| Rated Input Voltage and Current: | 3.7V _{DC} 0.5A |
| Operating Temperature Range: | 0°C to +50°C |
| ITU Emission Designator: | 1M Variant; 517KF1D 2M Variant; 625KF1D |
| Equipment Dimensions: | 81.8mm x 44.78mm x 16.3mm |
| Weight: | 56.4g |
| Hardware Rev: | B1 |
| Software Rev: | V0.3.2 |

5.2. Scope Of Test Program

Catapult Sports Pty Ltd, WD-S8-08-V1

The scope of the test program was to test the Catapult Sports Pty Ltd WD-S8-08-V1, WD-S8-08-V1 WD-S8-08-V1 configurations in the frequency ranges 2400 - 2483.5 MHz; for compliance against the following specification:

FCC 47 CFR Part 15.247

Radio Frequency Devices; Subpart C – Intentional Radiators

ISSED RSS-247

Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and License-Exempt Local Area Network (LE-LAN) Devices

5.3. Antenna Details

| Type | Manufacturer | Model | Family | Gain (dBi) | BF Gain | Dir BW | X-Pol | Frequency Band (MHz) |
|--|--------------|-------------------|--------|------------|---------|--------|-------|----------------------|
| Integral | Yageo | ANT2012LL13R2400A | Chip | 2.72 | - | - | - | 2400 - 2483.5 |
| BF Gain - Beamforming Gain Dir BW - Directional BeamWidth X-Pol - Cross Polarization | | | | | | | | |

5.4. Cabling and I/O Ports

1. NONE

5.5. Test Configurations

Results for the following configurations are provided in this report:

| Operational Mode(s) | Data Rate with Highest Power MBit/s | Channel Frequency (MHz) | | |
|---------------------|-------------------------------------|-------------------------|----------|----------|
| | | Low | Mid | High |
| 2400 - 2483.5 MHz | | | | |
| GFSK | 1 | 2,402.00 | 2,440.00 | 2,480.00 |
| GFSK | 2 | 2,402.00 | 2,440.00 | 2,480.00 |

5.6. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

5.7. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

6. TEST SUMMARY

List of Measurements

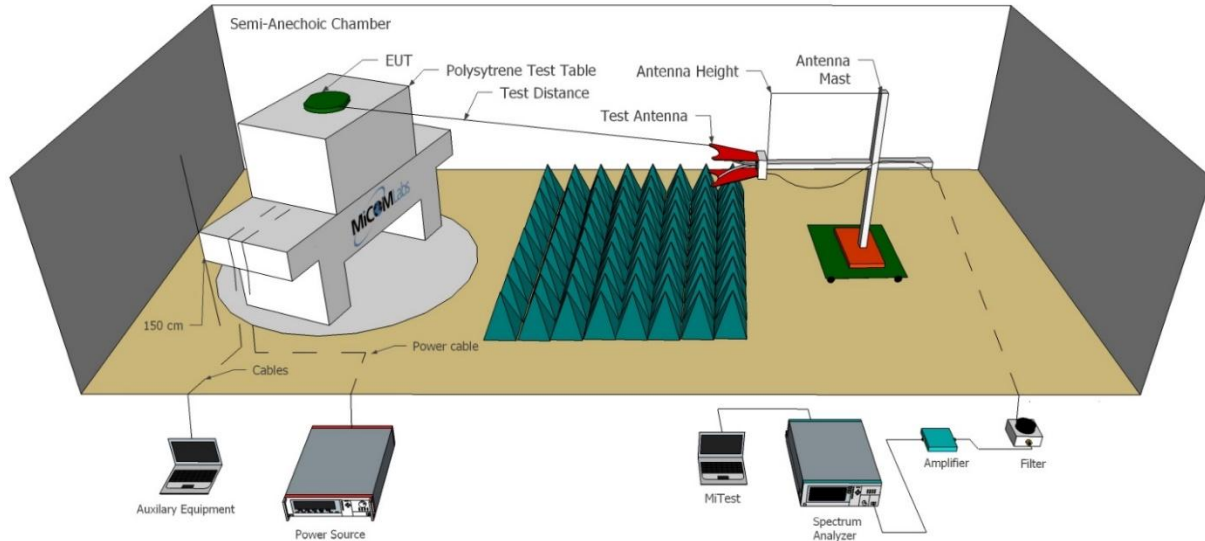
| Test Header | Result | Data Link |
|--|----------|--------------------------------------|
| 6 dB & 99% Bandwidth | Complies | View Data |
| Conducted Output Power | Complies | View Data |
| Power Spectral Density | Complies | View Data |
| Emissions | Complies | - |
| (1) Conducted Emissions | Complies | - |
| (i) Conducted Spurious Emissions | Complies | View Data |
| (ii) Conducted Band-Edge Emissions | Complies | View Data |
| (2) Radiated Emissions | Complies | - |
| (i) TX Spurious & Restricted Band Emission | Complies | View Data |
| (ii) Restricted Edge & Band-Edge Emission | Complies | View Data |
| (iii) Digital Emissions | Complies | See MiCOM Labs test report CATA18-U3 |

7. TEST EQUIPMENT CONFIGURATION(S)

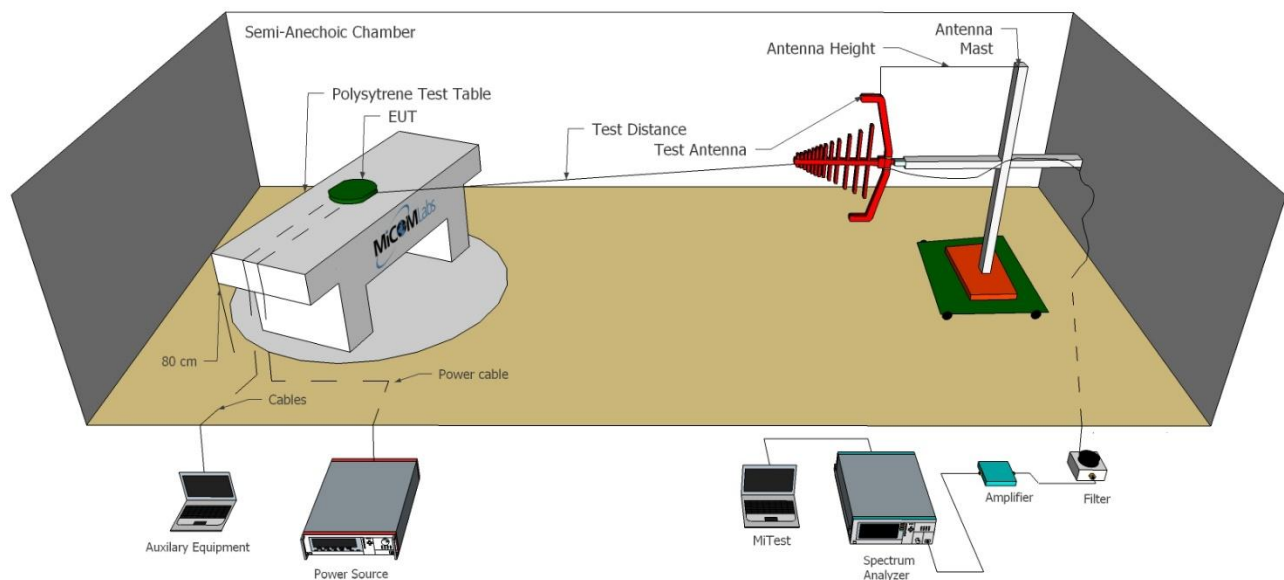
7.1. Radiated

Radiated emissions above and below 1GHz.

Radiated Emissions Above 1GHz Test Setup



Radiated Emissions Below 1GHz Test Setup

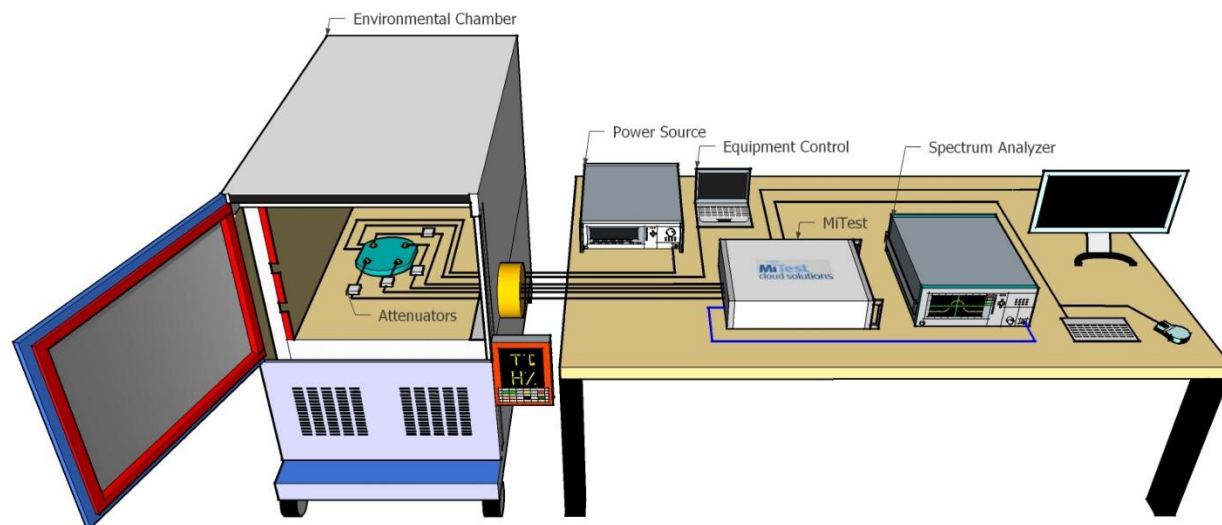


| Asset# | Description | Manufacturer | Model# | Serial# | Calibration Due Date |
|--------|---|----------------------|---|-------------|----------------------|
| 170 | Video System Controller for Semi Anechoic Chamber | Panasonic | WV-CU101 | 04R08507 | Not Required |
| 266 | 10 Hz to 50GHz MXA Signal Analyzer | Keysight | N9020B | MY60110791 | 25 Jul 2025 |
| 285 | DC Power Supply | Keysight | E36155A | MY63000156 | 4 Dec 2025 |
| 298 | 3M Radiated Emissions Chamber Maintenance Check | MiCOM | 3M Chamber | 298 | 20 Jul 2025 |
| 330 | Variac 0-280 Vac | Staco Energy Co | 3PN1020B | 0546 | Cal when used |
| 336 | Active loop Ant 10kHz to 30 MHz | EMCO | EMCO 6502 | 00060498 | 7 Dec 2025 |
| 338 | Sunol 30 to 3000 MHz Antenna | Sunol | JB3 | A052907 | 5 Dec 2025 |
| 373 | 26III RMS Multimeter | Fluke | Fluke 26 series III | 76080720 | 29 Sep 2025 |
| 377 | Band Rejection Filter 5150 to 5880MHz | Microtronics | BRM50716 | 034 | 13 Apr 2025 |
| 396 | 2.4 GHz Notch Filter | Microtronics | BRM50701 | 001 | 13 Apr 2025 |
| 397 | Amp 10 - 2500MHz | MiCOM Labs | Amp 10 - 2500 MHz | NA | 27 May 2025 |
| 399 | ETS 1-18 GHz Horn Antenna | ETS | 3117 | 00154575 | 7 Dec 2025 |
| 406 | Amplifier for Radiated Emissions | MiCOM Labs | 40dB 1 to 18GHz Amp | 0406 | 2 Apr 2025 |
| 410 | Desktop Computer | Dell | Inspiron 620 | WS38 | Not Required |
| 411 | Mast/Turntable Controller | Sunol Sciences | SC98V | 060199-1D | Not Required |
| 412 | USB to GPIB Interface | National Instruments | GPIB-USB HS | 11B8DC2 | Not Required |
| 413 | Mast Controller | Sunol Science | TWR95-4 | 030801-3 | Not Required |
| 414 | DC Power Supply 0-60V | HP | 6274 | 1029A01285 | Cal when used |
| 415 | Turntable Controller | Sunol Sciences | Turntable Controller | None | Not Required |
| 416 | Gigabit ethernet filter | ETS-Lingren | Gigafoil 260366 | None | Not Required |
| 447 | MiTest Rad Emissions Test Software | MiCOM | Rad Emissions Test Software Version 1.0 | 447 | Not Required |
| 462 | Schwarzbeck cable from Antenna to Amplifier. | Schwarzbeck | AK 9513 | 462 | 18 Apr 2025 |
| 463 | Schwarzbeck cable from Amplifier to Bulkhead. | Schwarzbeck | AK 9513 | 463 | 18 Apr 2025 |
| 464 | Schwarzbeck cable from Bulkhead to Receiver | Schwarzbeck | AK 9513 | 464 | 16 Apr 2025 |
| 465 | Low Pass Filter DC-1000 MHz | Mini-Circuits | NLP-1200+ | VUU01901402 | 14 Apr 2025 |
| 480 | Cable - Bulkhead to Amp | SRC Haverhill | 157-3050360 | 480 | 18 Apr 2025 |
| 481 | Cable - Bulkhead to Receiver | SRC Haverhill | 151-3050787 | 481 | 18 Apr 2025 |

| | | | | | |
|------|--|--------------------|-------------------|-------------|---------------|
| 510 | Barometer/Thermometer | Digi Sense | 68000-49 | 170871375 | 4 Jan 2026 |
| 554 | Precision SMA Cable | Fairview Microwave | SCE18060101-400CM | 554 | 18 Apr 2025 |
| 555 | Rhode & Schwarz Receiver (Firmware Version : 3.10 SP1) | Rhode & Schwarz | ESW 44 | 101893 | 28 Jun 2025 |
| 87 | Uninterruptible Power Supply | Falcon Electric | ED2000-1/2LC | F3471 02/01 | Cal when used |
| CC05 | Confidence Check | MiCOM | CC05 | None | 20 Jul 2025 |

7.2. Conducted

MiTest Automated Test System



A full system calibration was performed on the test station and any resulting system losses (or gains) were considered in the production of all final measurement data.

| Asset# | Description | Manufacturer | Model# | Serial# | Calibration Due Date |
|--------|------------------------------------|-----------------------------|-------------------------|-----------------|----------------------|
| #3 SA | MiTest Box to SA | Fairview Microwave | SCA1814-0101-72 | #3 SA | 11 Jul 2025 |
| #3P1 | EUT to MiTest box port 1 | Fairview Microwave | SCA1814-0101-72 | #3P1 | 11 Jul 2025 |
| #3P2 | EUT to MiTest box port 2 | Fairview Microwave | SCA1814-0101-72 | #3P2 | 11 Jul 2025 |
| #3P3 | EUT to MiTest box port 3 | Fairview Microwave | SCA1814-0101-72 | #3P3 | 11 Jul 2025 |
| #3P4 | EUT to MiTest box port 4 | Fairview Microwave | SCA1812-0101-72 | #3P4 | 11 Jul 2025 |
| 580 | Paperless Chart Recorder | Yokogawa Corporation | GP20-1E1D | S51411978 | Not required |
| 581 | Analog Input Module | Yokogawa Corporation | GX90XA-10-U2N-3N Module | S51513026 | 28 May 2026 |
| 266 | 10 Hz to 50GHz MXA Signal Analyzer | Keysight | N9020B | MY60110791 | 25 Jul 2025 |
| 285 | DC Power Supply | Keysight | E36155A | MY63000156 | 4 Dec 2025 |
| 382 | Tunable Notch Filter | Wainwright Instruments GmbH | WRCT800/960-0.2/40-8EEK | 64 | Cal when used |
| 398 | MiTest RF Conducted Test | MiCOM | MiTest ATS | Version 4.2.3.0 | Not Required |

| | Software | | | | |
|-----|--|----------------------|-------------|---------------|---------------|
| 405 | DC Power Supply 0-60V | Agilent | 6654A | MY4001826 | Cal when used |
| 408 | USB to GPIB interface | National Instruments | GPIB-USB HS | 14C0DE9 | Not Required |
| 441 | USB Wideband Power Sensor | Boonton | 55006 | 9179 | 4 Dec 2025 |
| 442 | USB Wideband Power Sensor | Boonton | 55006 | 9181 | 12 Dec 2025 |
| 445 | PoE Injector | D-Link | DPE-101GL | QTAH1E2000625 | Not Required |
| 461 | Spectrum Analyzer | Agilent | E4440A | MY46185537 | 27 Sep 2025 |
| 493 | USB Wideband Power Sensor | Boonton | 55006 | 9634 | 8 Oct 2025 |
| 494 | USB Wideband Power Sensor | Boonton | 55006 | 9726 | 12 Dec 2025 |
| 510 | Barometer/Thermometer | Digi Sense | 68000-49 | 170871375 | 4 Jan 2026 |
| 512 | MiTest Cloud Solutions RF Test Box | MiCOM | 2nd Gen | 512 | 11 Jul 2025 |
| 516 | USB Wideband Power Sensor | Boonton | RTP5006 | 10511 | 4 Dec 2025 |
| 555 | Rhode & Schwarz Receiver (Firmware Version : 3.10 SP1) | Rhode & Schwarz | ESW 44 | 101893 | 28 Jun 2025 |
| 592 | Harmonic Mixer, 140 GHz to 220 GHz | Radiometer Physics | RPG FS-Z220 | 101105 | 7 Jun 2026 |
| 593 | Harmonic Mixer, 90 GHz to 140 GHz | Radiometer Physics | RPG FS-Z140 | 101197 | 2 Aug 2026 |
| 75 | Environmental Chamber | Theratron | SE-300-2-2 | 27946 | 20 Nov 2025 |

8. MEASUREMENT AND PRESENTATION OF TEST DATA

The measurement and graphical data presented in this test report was generated automatically using state-of-the-art technology creating an easy to read report structure. Numerical measurement data is separated from supporting graphical data (plots) through hyperlinks. Numerical measurement data can be reviewed without scrolling through numerous graphical pages to arrive at the next data matrix.

Plots have been relegated into the Appendix 'Graphical Data'.

Test and report automation was performed by [MiTest](#). [MiTest](#) is an automated test system developed by MiCOM Labs. [MiTest](#) is the first cloud based modular test system enabling end-to-end automation of regulatory compliance testing for conducted RF testing.



The MiCOM Labs “[MiTest](#)” Automated Test System“ (Patent Pending)

9. TEST RESULTS

9.1. 6 dB & 99% Bandwidth

| Conducted Test Conditions for 6 dB and 99% Bandwidth | | | |
|--|----------------------------------|---------------------|-------------|
| Standard: | FCC CFR 47:15.247, ISSED RSS-247 | Ambient Temp. (°C): | 24.0 - 27.5 |
| Test Heading: | 6 dB and 99 % Bandwidth | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.247 (a)(2), RSS-247 5.2 (a) | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure for 6 dB and 99% Bandwidth Measurement

The bandwidth at 6 dB and 99 % was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

Testing was performed under ambient conditions at nominal voltage. Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured and reported.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Limits for 6 dB and 99% Bandwidth

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(2) Systems using digital modulation techniques may operate in the 902-928 MHz and 2400-2483.5 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Equipment Configuration for 6 dB & 99% Bandwidth

| | | | |
|--|----------------|-----------------------------------|----------------|
| Variant: | 1M | Duty Cycle (%): | 99 |
| Data Rate: | 1.00 MBit/s | Antenna Gain (dBi): | Not Applicable |
| Modulation: | GFSK | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | MN |
| Engineering Test Notes: 2402MHz, GFSK, pwr 35 | | | |

Test Measurement Results

| Test Frequency | Measured 6 dB Bandwidth (MHz) | | | | 6 dB Bandwidth (MHz) | | Limit | Lowest Margin |
|----------------|-------------------------------|----|----|----|----------------------|--------|--------|---------------|
| | Port(s) | | | | Highest | Lowest | | |
| MHz | a | b | c | d | | | KHz | MHz |
| 2402.0 | 0.505 | -- | -- | -- | 0.505 | 0.505 | ≥500.0 | -0.01 |
| 2440.0 | 0.505 | -- | -- | -- | 0.505 | 0.505 | ≥500.0 | -0.01 |
| 2480.0 | 0.517 | -- | -- | -- | 0.517 | 0.517 | ≥500.0 | -0.02 |

| Test Frequency | Measured 99% Bandwidth (MHz) | | | | Maximum 99% Bandwidth (MHz) |
|----------------|------------------------------|----|----|----|-----------------------------|
| | Port(s) | | | | |
| MHz | a | b | c | d | |
| 2402.0 | 1.599 | -- | -- | -- | 1.599 |
| 2440.0 | 1.539 | -- | -- | -- | 1.539 |
| 2480.0 | 1.659 | -- | -- | -- | 1.659 |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|----------------------------------|
| Work Instruction: | WI-03 MEASURING RF SPECTRUM MASK |
| Measurement Uncertainty: | ±2.81 dB |

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for 6 dB & 99% Bandwidth

| | | | |
|--------------------------------|-----------------------|-----------------------------------|----------------|
| Variant: | 2M | Duty Cycle (%): | 99 |
| Data Rate: | 2.00 MBit/s | Antenna Gain (dBi): | Not Applicable |
| Modulation: | GFSK | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | MN |
| Engineering Test Notes: | 2402MHz, GFSK, pwr 35 | | |

Test Measurement Results

| Test Frequency | Measured 6 dB Bandwidth (MHz) | | | | 6 dB Bandwidth (MHz) | | Limit | Lowest Margin |
|----------------|-------------------------------|----|----|----|----------------------|--------|--------|---------------|
| | Port(s) | | | | Highest | Lowest | KHz | MHz |
| MHz | a | b | c | d | | | | |
| 2402.0 | 0.541 | -- | -- | -- | 0.541 | 0.541 | ≥500.0 | -0.04 |
| 2440.0 | 0.613 | -- | -- | -- | 0.613 | 0.613 | ≥500.0 | -0.11 |
| 2480.0 | 0.625 | -- | -- | -- | 0.625 | 0.625 | ≥500.0 | -0.13 |

| Test Frequency | Measured 99% Bandwidth (MHz) | | | | Maximum 99% Bandwidth (MHz) |
|----------------|------------------------------|----|----|----|-----------------------------|
| | Port(s) | | | | |
| MHz | a | b | c | d | |
| 2402.0 | 2.164 | -- | -- | -- | 2.164 |
| 2440.0 | 2.188 | -- | -- | -- | 2.188 |
| 2480.0 | 2.212 | -- | -- | -- | 2.212 |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|----------------------------------|
| Work Instruction: | WI-03 MEASURING RF SPECTRUM MASK |
| Measurement Uncertainty: | ±2.81 dB |

Note: click the links in the above matrix to view the graphical image (plot).

9.2. Output Power

| Conducted Test Conditions for Fundamental Emission Output Power | | | |
|---|--------------------------------------|----------------------------|-------------|
| Standard: | FCC CFR 47:15.247, ISSED RSS-247 | Ambient Temp. (°C): | 24.0 - 27.5 |
| Test Heading: | Output Power | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.247 (b) & (c), RSS-247 5.4 (d) | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure for Fundamental Emission Output Power Measurement

In the case of average power measurements an average power sensor was utilized.

For peak power measurements the spectrum analyzer built-in power function was used to integrate peak power over the 20 dB bandwidth.

Testing was performed under ambient conditions at nominal voltage only. Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured, summed (Σ) and reported.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Supporting Information

Calculated Power = $A + G + Y + 10 \log (1/x)$ dBm

A = Total Power [$10 \cdot \log_{10} (10^{a/10} + 10^{b/10} + 10^{c/10} + 10^{d/10})$]

G = Antenna Gain

Y = Beamforming Gain

x = Duty Cycle (average power measurements only)

Limits for Fundamental Emission Output Power

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following for non-frequency hopping systems:

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

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(c) Operation with directional antenna gains greater than 6 dBi.

(1) Fixed point-to-point operation:

(i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi 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 6 dBi.

(iii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) and (c)(1)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

(2) In addition to the provisions in paragraphs (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

(B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming.

(iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.

(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

Equipment Configuration for Peak Output Power

| | | | |
|--------------------------------|-----------------------|-----------------------------------|----------------|
| Variant: | 1M | Duty Cycle (%): | 99.0 |
| Data Rate: | 1.00 MBit/s | Antenna Gain (dBi): | 2.72 |
| Modulation: | GFSK | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | MN |
| Engineering Test Notes: | 2402MHz, GFSK, pwr 35 | | |

Test Measurement Results

| Test Frequency | Measured Output Power (dBm) | | | | Calculated Total Power Σ Port(s) | Limit | Margin | EUT Power Setting |
|----------------|-----------------------------|----|----|----|-------------------------------------|-------|--------|-------------------|
| | Port(s) | | | | | | | |
| MHz | a | b | c | d | dBm | dBm | dB | |
| 2402.0 | 4.63 | -- | -- | -- | 4.63 | 30.00 | -25.37 | 35.00 |
| 2440.0 | 4.05 | -- | -- | -- | 4.05 | 30.00 | -25.95 | 35.00 |
| 2480.0 | 3.97 | -- | -- | -- | 3.97 | 30.00 | -26.03 | 35.00 |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|---------------------------------|
| Work Instruction: | WI-01 MEASURING RF OUTPUT POWER |
| Measurement Uncertainty: | ± 1.33 dB |

The above measurements are true pulse readings and therefore a Duty Cycling correction factor is not required.

Equipment Configuration for Peak Output Power

| | | | |
|--|----------------|-----------------------------------|----------------|
| Variant: | 2M | Duty Cycle (%): | 99.0 |
| Data Rate: | 2.00 MBit/s | Antenna Gain (dBi): | 2.72 |
| Modulation: | GFSK | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | MN |
| Engineering Test Notes: 2402MHz, GFSK, pwr 35 | | | |

Test Measurement Results

| Test Frequency | Measured Output Power (dBm) | | | | Calculated Total Power Σ Port(s) | Limit | Margin | EUT Power Setting |
|----------------|-----------------------------|----|----|----|-------------------------------------|-------|--------|-------------------|
| | Port(s) | | | | | | | |
| MHz | a | b | c | d | dBm | dBm | dB | |
| 2402.0 | 2.32 | -- | -- | -- | 2.32 | 30.00 | -27.68 | |
| 2440.0 | 1.83 | -- | -- | -- | 1.83 | 30.00 | -28.17 | |
| 2480.0 | 1.79 | -- | -- | -- | 1.79 | 30.00 | -28.21 | |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|---------------------------------|
| Work Instruction: | WI-01 MEASURING RF OUTPUT POWER |
| Measurement Uncertainty: | ± 1.33 dB |

The above measurements are true pulse readings and therefore a Duty Cycling correction factor is not required.

9.3. Power Spectral Density

| Conducted Test Conditions for Power Spectral Density | | | |
|--|-------------------------------------|----------------------------|-------------|
| Standard: | FCC CFR 47:15.247, ISSED RSS-247 | Ambient Temp. (°C): | 24.0 - 27.5 |
| Test Heading: | Power Spectral Density | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.247 (e) RSS-247 5.2 (b) | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure for Power Spectral Density

The transmitter output was connected to a spectrum analyzer and the measured made in a 3 kHz resolution bandwidth using the analyzer auto-coupled sweep-time. A peak value was found over the full emission bandwidth and the spectrum downloaded for post processing purposes.

Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured separately. The Peak Power Spectral Density is the highest level found across the emission bandwidth. With multiple antenna port measurements the numerical analyzer data from each port is summed (â) and a link to this additional graphic is provided.

Testing was performed under ambient conditions at nominal voltage only.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Measure and sum the spectra across the outputs. With this technique, spectra are measured at each output of the device at the required resolution bandwidth. The individual spectra are then summed mathematically in linear power units. Unlike in-band power measurements, in which the sum involves a single measured value (output power) from each output, measurements for compliance with PSD limits involve summing entire spectra across corresponding frequency bins on the various outputs. Consistency is maintained for any device with multiple transmitter outputs to be certain the individual outputs are all aligned with the same span and same number of points. In this instance, the linear power spectrum value within the first spectral bin of output 0 is summed with that in the first spectral bin of output 1, and the first spectral bin of output 2, and so on up to the Nth output to obtain the true value for the first frequency bin of the summed spectrum. The summed spectrum value for each frequency bin is computed in this fashion. These summed spectral values were post processed and the resulting numerical and graphical data presented.

NOTE:

It may be observed that the spectrum in some antenna port plots break the limit line however this in itself does NOT constitute a failure. In all cases a spectrum summation plot is provided in order to prove compliance. A failure occurs only after the summation of all spectrum plots have been summed and are found to be greater than the limit line.

Supporting Information

Calculated Power = $A + 10 \log (1/x)$ dBm

A = Total Power Spectral Density [$10 \log_{10} (10^{a/10} + 10^{b/10} + 10^{c/10} + 10^{d/10})$]

x = Duty Cycle

Limits Power Spectral Density

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

Equipment Configuration for Power Spectral Density - Peak

| | | | |
|--------------------------------|----------------|-----------------------------------|----------------|
| Variant: | 1M | Duty Cycle (%): | 99.0 |
| Data Rate: | 1.00 MBit/s | Antenna Gain (dBi): | 2.72 |
| Modulation: | GFSK | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | MN |
| Engineering Test Notes: | | | |

Test Measurement Results

| Test Frequency | Measured Power Spectral Density | | | | Amplitude Summation | Limit | Margin |
|----------------|---------------------------------|----|----|----|------------------------|----------|--------|
| | Port(s) (dBm/3KHz) | | | | | | |
| MHz | a | b | c | d | dBm/3KHz | dBm/3KHz | dB |
| 2402.0 | -2.307 | -- | -- | -- | -2.307 | 8.0 | -10.3 |
| 2440.0 | -3.455 | -- | -- | -- | -3.455 | 8.0 | -11.5 |
| 2480.0 | -2.658 | -- | -- | -- | -2.658 | 8.0 | -10.7 |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|----------------------------------|
| Work Instruction: | WI-03 MEASURING RF SPECTRUM MASK |
| Measurement Uncertainty: | ±2.81 dB |

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Power Spectral Density - Peak

| | | | |
|--------------------------------|----------------|-----------------------------------|----------------|
| Variant: | 2M | Duty Cycle (%): | 99.0 |
| Data Rate: | 2.00 MBit/s | Antenna Gain (dBi): | 2.72 |
| Modulation: | GFSK | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | MN |
| Engineering Test Notes: | | | |

Test Measurement Results

| Test Frequency | Measured Power Spectral Density | | | | Amplitude Summation | Limit | Margin |
|----------------|---------------------------------|----|----|----|------------------------|----------|--------|
| | Port(s) (dBm/3KHz) | | | | | | |
| MHz | a | b | c | d | dBm/3KHz | dBm/3KHz | dB |
| 2402.0 | -5.567 | -- | -- | -- | -5.567 | 8.0 | -13.6 |
| 2440.0 | -5.659 | -- | -- | -- | -5.659 | 8.0 | -13.7 |
| 2480.0 | -6.069 | -- | -- | -- | -6.069 | 8.0 | -14.1 |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|----------------------------------|
| Work Instruction: | WI-03 MEASURING RF SPECTRUM MASK |
| Measurement Uncertainty: | ±2.81 dB |

Note: click the links in the above matrix to view the graphical image (plot).

9.4. Emissions

9.4.1. Conducted Emissions

9.4.1.1. Conducted Spurious Emissions

| Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions | | | |
|--|------------------------------------|---------------------|-------------|
| Standard: | FCC CFR 47:15.247, ISED RSS-247 | Ambient Temp. (°C): | 24.0 - 27.5 |
| Test Heading: | Max Unwanted Emission Levels | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | FCC 15.247 (d), RSS-247 5.5 | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure for Transmitter Conducted Spurious and Band-Edge Emissions Measurement

Transmitter Conducted Spurious and Band-Edge emissions were measured at a limit of 30 dBc (average detector) or 20 dBc (peak detector) below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Measurements were made while EUT was operating in transmit mode of operation at the appropriate centre frequency closest to the band-edge. Emissions were maximized during the measurement and limits derived from the peak spectral power and drawn on each plot.

Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured separately. Testing was performed under ambient conditions at nominal voltage only.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Limits Transmitter Conducted Spurious and Band-Edge Emissions

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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)).

Equipment Configuration for Conducted Spurious Emissions - Peak

| | | | |
|--------------------------------|-----------------------|-------------------------------|----------------|
| Variant: | 1M | Duty Cycle (%): | 99 |
| Data Rate: | 1.00 MBit/s | Antenna Gain (dBi): | Not Applicable |
| Modulation: | GFSK | Beam Forming Gain (Y): | Not Applicable |
| TPC: | Not Applicable | Tested By: | MN |
| Engineering Test Notes: | 2402MHz, GFSK, pwr 35 | | |

Test Measurement Results

| Test Frequency | Frequency Range | Conducted Spurious Emissions - Peak (dBm) | | | | | | | |
|----------------|-----------------|---|--------|--------|-------|--------|-------|--------|-------|
| | | Port a | | Port b | | Port c | | Port d | |
| MHz | MHz | SE | Limit | SE | Limit | SE | Limit | SE | Limit |
| 2402.0 | 30.0 - 26000.0 | -40.045 | -21.87 | -- | -- | -- | -- | -- | -- |
| 2440.0 | 30.0 - 26000.0 | -37.855 | -22.17 | -- | -- | -- | -- | -- | -- |
| 2480.0 | 30.0 - 26000.0 | -38.985 | -25.20 | -- | -- | -- | -- | -- | -- |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|---|
| Work Instruction: | WI-05 MEASUREMENT OF SPURIOUS EMISSIONS |
| Measurement Uncertainty: | <=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB |

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Conducted Spurious Emissions - Peak

| | | | |
|--------------------------------|-----------------------|-------------------------------|----------------|
| Variant: | 2M | Duty Cycle (%): | 99 |
| Data Rate: | 2.00 MBit/s | Antenna Gain (dBi): | Not Applicable |
| Modulation: | GFSK | Beam Forming Gain (Y): | Not Applicable |
| TPC: | Not Applicable | Tested By: | MN |
| Engineering Test Notes: | 2402MHz, GFSK, pwr 35 | | |

Test Measurement Results

| Test Frequency | Frequency Range | Conducted Spurious Emissions - Peak (dBm) | | | | | | | |
|----------------|-----------------|---|--------|--------|-------|--------|-------|--------|-------|
| | | Port a | | Port b | | Port c | | Port d | |
| MHz | MHz | SE | Limit | SE | Limit | SE | Limit | SE | Limit |
| 2402.0 | 30.0 - 26000.0 | -40.258 | -21.07 | -- | -- | -- | -- | -- | -- |
| 2440.0 | 30.0 - 26000.0 | -38.895 | -23.68 | -- | -- | -- | -- | -- | -- |
| 2480.0 | 30.0 - 26000.0 | -38.891 | -27.38 | -- | -- | -- | -- | -- | -- |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|---|
| Work Instruction: | WI-05 MEASUREMENT OF SPURIOUS EMISSIONS |
| Measurement Uncertainty: | <=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB |

Note: click the links in the above matrix to view the graphical image (plot).

9.4.1.2. Conducted Band-Edge Emissions

| Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions | | | |
|--|------------------------------------|---------------------|-------------|
| Standard: | FCC CFR 47:15.247, ISED RSS-247 | Ambient Temp. (°C): | 24.0 - 27.5 |
| Test Heading: | Max Unwanted Emission Levels | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | FCC 15.247 (d), RSS-247 5.5 | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure for Transmitter Conducted Spurious and Band-Edge Emissions Measurement

Transmitter Conducted Spurious and Band-Edge emissions were measured at a limit of 30 dBc (average detector) or 20 dBc (peak detector) below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Measurements were made while EUT was operating in transmit mode of operation at the appropriate centre frequency closest to the band-edge. Emissions were maximized during the measurement and limits derived from the peak spectral power and drawn on each plot.

Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured separately. Testing was performed under ambient conditions at nominal voltage only.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Limits Transmitter Conducted Spurious and Band-Edge Emissions

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. 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)).

Equipment Configuration for Conducted Low Band-Edge Emissions - Peak

| | | | |
|--------------------------------|-----------------------|-----------------------------------|----------------|
| Variant: | 1M | Duty Cycle (%): | 99.0 |
| Data Rate: | 1.00 MBit/s | Antenna Gain (dBi): | Not Applicable |
| Modulation: | GFSK | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | MN |
| Engineering Test Notes: | 2402MHz, GFSK, pwr 35 | | |

Test Measurement Results

| Channel Frequency: | 2402.0 MHz | | | | | |
|------------------------------|-----------------------------|---------------------|-----------------------|--------------------|------------------------|-----------------|
| Band-Edge Frequency: | 2400.0 MHz | | | | | |
| Test Frequency Range: | 2350.0 - 2405.0 MHz | | | | | |
| Port(s) | Band-Edge Markers and Limit | | | Revised Limit | | Margin (MHz) |
| | M1 Amplitude (dBm) | Plot Limit (dBm) | M2 Frequency (MHz) | Amplitude (dBm) | M2A Frequency (MHz) | |
| a | -45.35 | -21.90 | 2401.30 | -- | -- | -1.300 |

Traceability to Industry Recognized Test Methodologies

| | |
|---------------------------------|---|
| Work Instruction: | WI-05 MEASUREMENT OF SPURIOUS EMISSIONS |
| Measurement Uncertainty: | <=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB |

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Conducted Low Band-Edge Emissions - Peak

| | | | |
|--------------------------------|-----------------------|-----------------------------------|----------------|
| Variant: | 2M | Duty Cycle (%): | 99.0 |
| Data Rate: | 2.00 MBit/s | Antenna Gain (dBi): | Not Applicable |
| Modulation: | GFSK | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | MN |
| Engineering Test Notes: | 2402MHz, GFSK, pwr 35 | | |

Test Measurement Results

| Channel Frequency: | 2402.0 MHz | | | | | |
|------------------------------|-----------------------------|------------------|--------------------|-----------------|---------------------|--------|
| Band-Edge Frequency: | 2400.0 MHz | | | | | |
| Test Frequency Range: | 2350.0 - 2405.0 MHz | | | | | |
| Port(s) | Band-Edge Markers and Limit | | | Revised Limit | | Margin |
| | M1 Amplitude (dBm) | Plot Limit (dBm) | M2 Frequency (MHz) | Amplitude (dBm) | M2A Frequency (MHz) | (MHz) |
| a | -31.34 | -21.05 | 2400.90 | -- | -- | -0.900 |

Traceability to Industry Recognized Test Methodologies

| | |
|---------------------------------|---|
| Work Instruction: | WI-05 MEASUREMENT OF SPURIOUS EMISSIONS |
| Measurement Uncertainty: | <=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB |

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Conducted High Band-Edge Emissions - Peak

| | | | |
|--------------------------------|-----------------------|-----------------------------------|----------------|
| Variant: | 1M | Duty Cycle (%): | 99.0 |
| Data Rate: | 1.00 MBit/s | Antenna Gain (dBi): | Not Applicable |
| Modulation: | GFSK | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | MN |
| Engineering Test Notes: | 2480MHz, GFSK, pwr 35 | | |

Test Measurement Results

| Channel Frequency: | 2480.0 MHz | | | | | |
|------------------------------|-----------------------------|------------------|--------------------|-----------------|---------------------|--------------|
| Band-Edge Frequency: | 2483.5 MHz | | | | | |
| Test Frequency Range: | 2475.0 - 2524.0 MHz | | | | | |
| Port(s) | Band-Edge Markers and Limit | | | Revised Limit | | Margin (MHz) |
| | M3 Amplitude (dBm) | Plot Limit (dBm) | M2 Frequency (MHz) | Amplitude (dBm) | M2A Frequency (MHz) | |
| a | -46.06 | -30.66 | 2480.60 | | | -2.900 |

Traceability to Industry Recognized Test Methodologies

| | |
|---------------------------------|---|
| Work Instruction: | WI-05 MEASUREMENT OF SPURIOUS EMISSIONS |
| Measurement Uncertainty: | <=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB |

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Conducted High Band-Edge Emissions - Peak

| | | | |
|--------------------------------|-----------------------|-----------------------------------|----------------|
| Variant: | 2M | Duty Cycle (%): | 99.0 |
| Data Rate: | 2.00 MBit/s | Antenna Gain (dBi): | Not Applicable |
| Modulation: | GFSK | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | MN |
| Engineering Test Notes: | 2480MHz, GFSK, pwr 35 | | |

Test Measurement Results

| Channel Frequency: | 2480.0 MHz | | | | | |
|------------------------------|-----------------------------|------------------|--------------------|-----------------|---------------------|--------|
| Band-Edge Frequency: | 2483.5 MHz | | | | | |
| Test Frequency Range: | 2475.0 - 2524.0 MHz | | | | | |
| Port(s) | Band-Edge Markers and Limit | | | Revised Limit | | Margin |
| | M3 Amplitude (dBm) | Plot Limit (dBm) | M2 Frequency (MHz) | Amplitude (dBm) | M2A Frequency (MHz) | (MHz) |
| a | -45.07 | -21.64 | 2481.20 | -- | -- | -2.300 |

Traceability to Industry Recognized Test Methodologies

| | |
|---------------------------------|---|
| Work Instruction: | WI-05 MEASUREMENT OF SPURIOUS EMISSIONS |
| Measurement Uncertainty: | <=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB |

Note: click the links in the above matrix to view the graphical image (plot).

9.4.2. Radiated Emissions

| Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions (Restricted Bands) | | | |
|---|--|----------------------------|-------------|
| Standard: | FCC CFR 47 Part 15 Subpart C 15.247 ISSED RSS-247 | Ambient Temp. (°C): | 20.0 - 24.5 |
| Test Heading: | Radiated Spurious and Band-Edge Emissions | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.205, 15.209 RSS-247:5.5 | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure for Radiated Spurious and Band-Edge Emissions (Restricted Bands)

Radiated emissions for restricted bands above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned. Measurements on any restricted band frequency or frequencies above 1 GHz are based on the use of measurement instrumentation employing peak and average detectors. All measurements were performed using a resolution bandwidth of 1 MHz.

Test configuration and setup for Radiated Spurious and Band-Edge Measurement were per the Radiated Test Set-up specified in this document.

Orientation testing of the EUT was performed and the EUT standing upright was determined to be the worst case for Spurious and Band Edge emissions with the integral antennas attached.

Limits for Restricted Bands

Peak emission: 74 dBµV/m

Average emission: 54 dBµV/m

Average Measurements were performed following ANSI C63.10 section 11.12.2.5.2 Trace averaging across on and off times of the EUT transmissions followed by a duty cycle correction.

RMS detector used, DCCF of $10\log(1/D)$ where D is the Duty Cycle.

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

$$FS = R + AF + CORR - FO$$

where:

FS = Field Strength

R = Measured Spectrum analyzer Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain

FO = Distance Falloff Factor

NFL = Notch Filter Loss or Waveguide Loss

Example:

Given receiver input reading of 51.5 dBmV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength (FS) of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 \text{ dBmV/m}$$

Conversion between dBmV/m (or dBmV) and mV/m (or mV) are as follows:

$$\text{Level (dBmV/m)} = 20 * \log(\text{level (mV/m)})$$

$$40 \text{ dBmV/m} = 100 \text{ mV/m}$$

$$48 \text{ dBmV/m} = 250 \text{ mV/m}$$

Restricted Bands of Operation (15.205)

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| Frequency Band | | | |
|-------------------|---------------------|---------------|-------------|
| MHz | MHz | MHz | GHz |
| 0.090-0.110 | 16.42-16.423 | 399.9-410 | 4.5-5.15 |
| 0.495-0.505 | 16.69475-16.69525 | 608-614 | 5.35-5.46 |
| 2.1735-2.1905 | 16.80425-16.80475 | 960-1240 | 7.25-7.75 |
| 4.125-4.128 | 25.5-25.67 | 1300-1427 | 8.025-8.5 |
| 4.17725-4.17775 | 37.5-38.25 | 1435-1626.5 | 9.0-9.2 |
| 4.20725-4.20775 | 73-74.6 | 1645.5-1646.5 | 9.3-9.5 |
| 6.215-6.218 | 74.8-75.2 | 1660-1710 | 10.6-12.7 |
| 6.26775-6.26825 | 108-121.94 | 1718.8-1722.2 | 13.25-13.4 |
| 6.31175-6.31225 | 123-138 | 2200-2300 | 14.47-14.5 |
| 8.291-8.294 | 149.9-150.05 | 2310-2390 | 15.35-16.2 |
| 8.362-8.366 | 156.52475-156.52525 | 2483.5-2500 | 17.7-21.4 |
| 8.37625-8.38675 | 156.7-156.9 | 2690-2900 | 22.01-23.12 |
| 8.41425-8.41475 | 162.0125-167.17 | 3260-3267 | 23.6-24.0 |
| 12.29-12.293 | 167.72-173.2 | 3332-3339 | 31.2-31.8 |
| 12.51975-12.52025 | 240-285 | 3345.8-3358 | 36.43-36.5 |
| 12.57675-12.57725 | 322-335.4 | 3600-4400 | Above 38.6 |
| 13.36-13.41 | | | |

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e) of this section, regardless of the field strength limits specified elsewhere in this subpart, the provisions of this section apply to emissions from any intentional radiator.

(d) The following devices are exempt from the requirements of this section:

- (1) Swept frequency field disturbance sensors operating between 1.705 and 37 MHz provided their emissions only sweep through the bands listed in paragraph (a) of this section, the sweep is never stopped with the fundamental emission within the bands listed in paragraph (a) of this section, and the fundamental emission is outside of the bands listed in paragraph (a) of this section more than 99% of the time the device is actively transmitting, without compensation for duty cycle.
- (2) Transmitters used to detect buried electronic markers at 101.4 kHz which are employed by telephone companies.
- (3) Cable locating equipment operated pursuant to §15.213.
- (4) Any equipment operated under the provisions of §15.253, 15.255, and 15.256 in the frequency band 75-85 GHz, or §15.257 of this part.
- (5) Biomedical telemetry devices operating under the provisions of §15.242 of this part are not subject to the restricted band 608-614 MHz but are subject to compliance within the other restricted bands.
- (6) Transmitters operating under the provisions of subparts D or F of this part.
- (7) Devices operated pursuant to §15.225 are exempt from complying with this section for the 13.36-13.41 MHz band only.
- (8) Devices operated in the 24.075-24.175 GHz band under §15.245 are exempt from complying with the requirements of this section for the 48.15-48.35 GHz and 72.225-72.525 GHz bands only, and shall not exceed the limits specified in §15.245(b).
- (9) Devices operated in the 24.0-24.25 GHz band under §15.249 are exempt from complying with the requirements of this section for the 48.0-48.5 GHz and 72.0-72.75 GHz bands only, and shall not exceed the limits specified in §15.249(a).

(e) Harmonic emissions appearing in the restricted bands above 17.7 GHz from field disturbance sensors operating under the provisions of §15.245 shall not exceed the limits specified in §15.245(b).

9.4.2.1. TX Spurious & Restricted Band Emissions

Equipment Configuration for FCC SPURIOUS 1 - 18 GHz

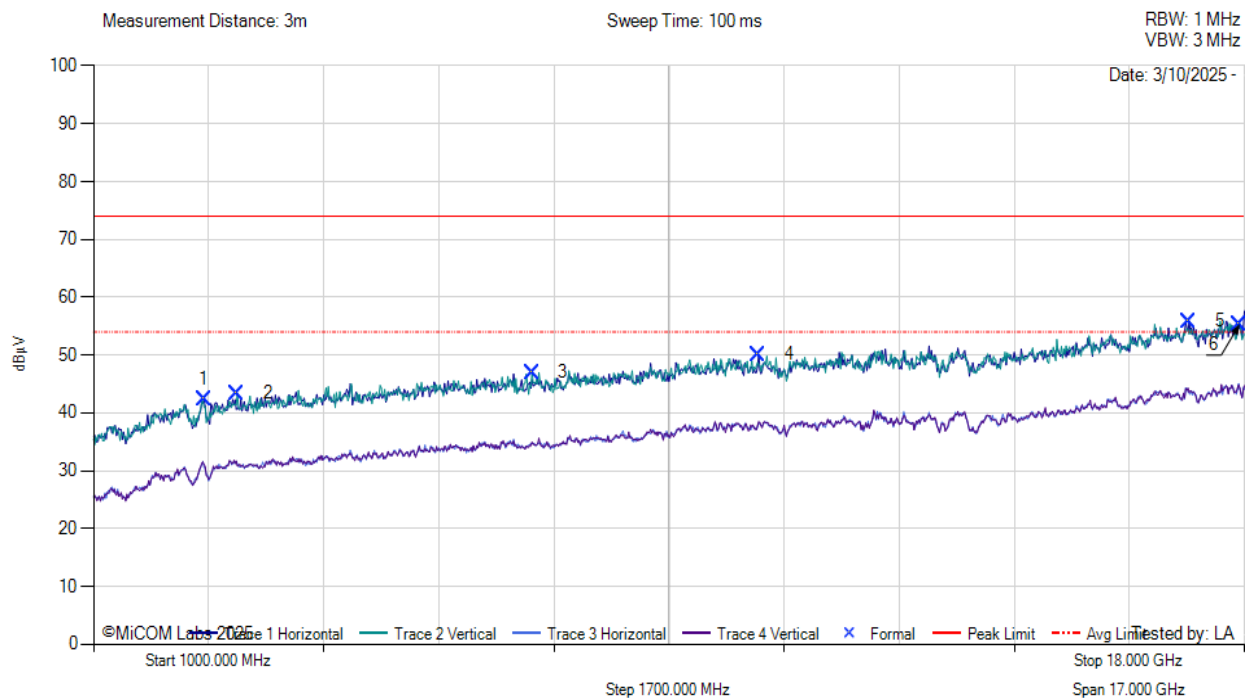
| | | | |
|---------------------------------|----------------|------------------------|-------|
| Antenna: | Integral | Variant: | BLE |
| Antenna Gain (dBi): | 2.72 | Modulation: | GFSK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | - |
| Channel Frequency (MHz): | 2402 | Data Rate: | 1Mb/s |
| Power Setting: | Max | Tested By: | LA |

Test Measurement Results



FCC Spurious 1 GHz -18 GHz

Antenna: Integral



| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|------------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBμV | Cable Loss dB | AF dB/m | Level dBμV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBμV/m | Margin dB | Pass /Fail |
| 1 | 2632.00 | 51.92 | 2.06 | 32.51 | 42.29 | MaxP | Horizontal | 199 | 210 | 74.0 | -31.7 | Pass |
| 2 | 3125.00 | 52.39 | 2.23 | 33.06 | 43.39 | MaxP | Vertical | 150 | 209 | 74.0 | -30.6 | Pass |
| 3 | 7477.00 | 51.18 | 3.84 | 35.85 | 47.01 | MaxP | Vertical | 199 | 59 | 74.0 | -27.0 | Pass |
| 4 | 10826.00 | 49.78 | 4.91 | 37.76 | 50.13 | MaxP | Horizontal | 199 | 120 | 74.0 | -23.9 | Pass |
| 5 | 17184.00 | 49.82 | 6.40 | 41.35 | 55.85 | MaxP | Horizontal | 199 | 0 | 74.0 | -18.2 | Pass |
| 6 | 17932.00 | 48.01 | 6.50 | 41.53 | 55.42 | MaxP | Vertical | 150 | 119 | 74.0 | -18.6 | Pass |

Test Notes: FCC Tx Spurious. Channel 0: 2402MHz. Low data rate. BW 1MHz. Max power.

Equipment Configuration for FCC SPURIOUS 1 - 18 GHZ

| | | | |
|---------------------------------|----------------|------------------------|-------|
| Antenna: | Integral | Variant: | BLE |
| Antenna Gain (dBi): | 2.72 | Modulation: | GFSK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | - |
| Channel Frequency (MHz): | 2440 | Data Rate: | 1Mb/s |
| Power Setting: | Max | Tested By: | LA |

Test Measurement Results



FCC Spurious 1 GHz -18 GHz

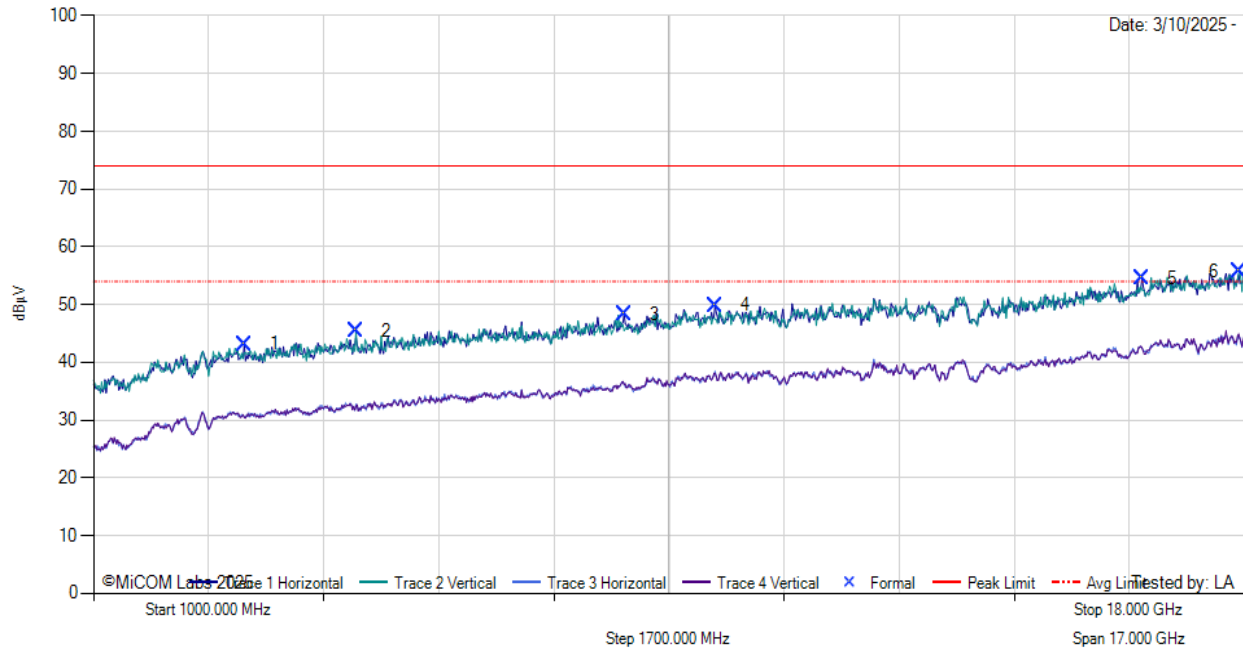
Antenna: Integral

Measurement Distance: 3m

Sweep Time: 100 ms

RBW: 1 MHz
VBW: 3 MHz

Date: 3/10/2025 -



1000.00 - 18000.00 MHz

| Num | Frequency MHz | Raw dBμV | Cable Loss dB | AF dB/m | Level dBμV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBμV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| 1 | 3227.00 | 52.35 | 2.31 | 33.00 | 43.16 | MaxP | Horizontal | 150 | 150 | 74.0 | -30.8 | Pass |
| 2 | 4876.00 | 52.40 | 3.14 | 34.01 | 45.40 | MaxP | Vertical | 150 | 330 | 74.0 | -28.6 | Pass |
| 3 | 8837.00 | 52.10 | 4.10 | 36.01 | 48.31 | MaxP | Horizontal | 150 | 90 | 74.0 | -25.7 | Pass |
| 4 | 10180.00 | 50.55 | 4.42 | 37.45 | 49.89 | MaxP | Horizontal | 199 | 30 | 74.0 | -24.1 | Pass |
| 5 | 16487.00 | 49.04 | 6.19 | 41.07 | 54.53 | MaxP | Horizontal | 150 | 60 | 74.0 | -19.5 | Pass |
| 6 | 17932.00 | 48.34 | 6.50 | 41.53 | 55.75 | MaxP | Vertical | 150 | 89 | 74.0 | -18.3 | Pass |

Test Notes: FCC Tx Spurious. Channel 19: 2440MHz. Low data rate. BW 1MHz. Max power.

Equipment Configuration for FCC SPURIOUS 1 - 18 GHZ

| | | | |
|---------------------------------|----------------|------------------------|-------|
| Antenna: | Integral | Variant: | BLE |
| Antenna Gain (dBi): | 2.72 | Modulation: | GFSK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | - |
| Channel Frequency (MHz): | 2480 | Data Rate: | 1Mb/s |
| Power Setting: | Max | Tested By: | LA |

Test Measurement Results



FCC Spurious 1 GHz -18 GHz

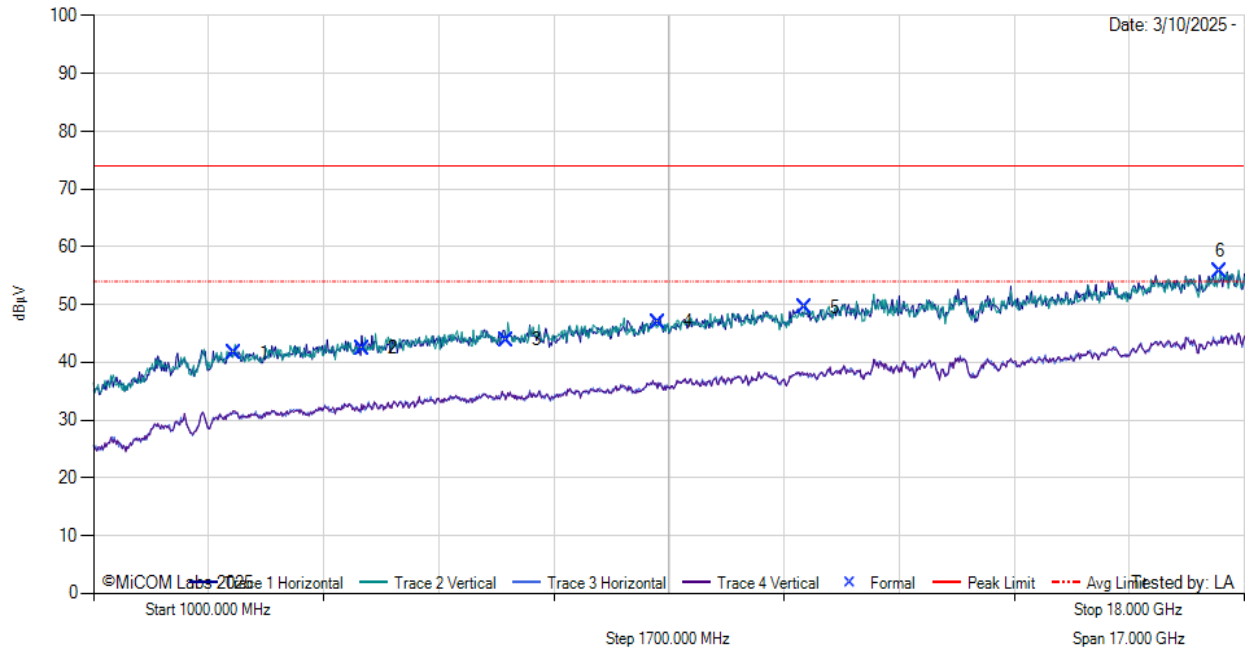
Antenna: Integral

Measurement Distance: 3m

Sweep Time: 100 ms

RBW: 1 MHz
VBW: 3 MHz

Date: 3/10/2025 -



1000.00 - 18000.00 MHz

| Num | Frequency MHz | Raw dBμV | Cable Loss dB | AF dB/m | Level dBμV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBμV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| 1 | 3074.00 | 50.77 | 2.21 | 33.07 | 41.67 | MaxP | Vertical | 150 | 299 | 74.0 | -32.3 | Pass |
| 2 | 4978.00 | 51.63 | 2.94 | 34.02 | 42.48 | MaxP | Horizontal | 199 | 210 | 74.0 | -31.5 | Pass |
| 3 | 7103.00 | 48.52 | 3.52 | 35.95 | 43.91 | MaxP | Vertical | 150 | 299 | 74.0 | -30.1 | Pass |
| 4 | 9347.00 | 49.48 | 4.30 | 36.40 | 47.00 | MaxP | Horizontal | 150 | 300 | 74.0 | -27.0 | Pass |
| 5 | 11506.00 | 50.38 | 4.95 | 38.22 | 49.49 | MaxP | Vertical | 150 | 209 | 74.0 | -24.5 | Pass |
| 6 | 17643.00 | 49.77 | 6.27 | 41.66 | 55.73 | MaxP | Vertical | 150 | 179 | 74.0 | -18.3 | Pass |

Test Notes: FCC Tx Spurious. Channel 39: 2480MHz. Low data rate. BW 1MHz. Max power.

9.4.3. Restricted Edge & Band-Edge Emissions

9.4.3.1. Lower Band-Edge

| WD-S8-08-V1 | | Band-Edge Freq | Limit 74.0dBμV/m | Limit 54.0dBμV/m | Power Setting |
|------------------|---------------------------|----------------|-----------------------|-----------------------|---------------|
| Operational Mode | Operating Frequency (MHz) | MHz | dBμV/m | dBμV/m | |
| BLE 1M | 2402.00 | 2390.00 | 60.01 | 48.62 | Max |
| BLE 2M | 2402.00 | 2390.00 | 60.18 | 48.65 | Max |

9.4.3.2. Upper Band-Edge

| WD-S8-08-V1 | | Band-Edge Freq | Limit 74.0dBμV/m | Limit 54.0dBμV/m | Power Setting |
|------------------|---------------------------|----------------|-----------------------|-----------------------|---------------|
| Operational Mode | Operating Frequency (MHz) | MHz | dBμV/m | dBμV/m | |
| BLE 1M | 2480.00 | 2483.50 | 62.21 | 49.16 | Max |
| BLE 2M | 2480.00 | 2483.50 | 62.73 | 49.19 | Max |

Equipment Configuration for BE 2400 MHz

| | | | |
|---------------------------------|----------|--------------------|--------|
| Antenna: | Integral | Variant: | BLE 1M |
| Antenna Gain (dBi): | 2.72 | Modulation: | GFSK |
| Channel Frequency (MHz): | 2402 | Data Rate: | 1Mb/s |
| Power Setting: | Max | Tested By: | LA |

Test Measurement Results



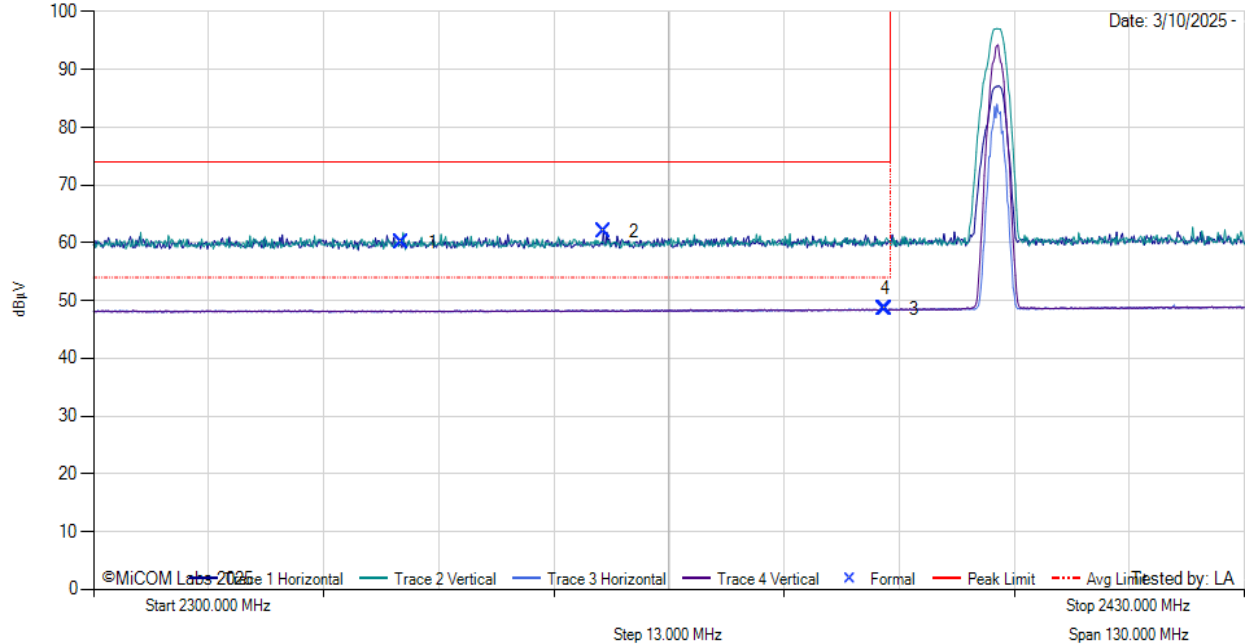
BE 2400 MHz

Antenna: Integral

Measurement Distance: 3m

Sweep Time: 1.0 s

RBW: 1 MHz
VBW: 3 MHz



2300.00 - 2430.00 MHz

| Num | Frequency MHz | Raw dBμV | Cable Loss dB | AF dB/m | Level dBμV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBμV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| 1 | 2334.84 | 26.66 | 1.93 | 31.92 | 60.01 | MaxP | Vertical | 101 | 0 | 74.0 | -14.0 | Pass |
| 2 | 2357.59 | 28.50 | 1.97 | 31.99 | 61.96 | MaxP | Horizontal | 100 | 210 | 74.0 | -12.0 | Pass |
| 3 | 2389.31 | 15.01 | 1.96 | 32.14 | 48.62 | AVG | Horizontal | 149 | 150 | 54.0 | -5.4 | Pass |
| 4 | 2389.44 | 14.95 | 1.96 | 32.14 | 48.55 | AVG | Vertical | 100 | 29 | 54.0 | -5.4 | Pass |

Test Notes: BE BLE BW: 1M. Channel 0: 2402MHz

Equipment Configuration for BE 2400 MHz

| | | | |
|---------------------------------|----------|--------------------|--------|
| Antenna: | Integral | Variant: | BLE 2M |
| Antenna Gain (dBi): | 2.72 | Modulation: | GFSK |
| Channel Frequency (MHz): | 2402 | Data Rate: | 2Mb/s |
| Power Setting: | Max | Tested By: | LA |

Test Measurement Results



BE 2400 MHz

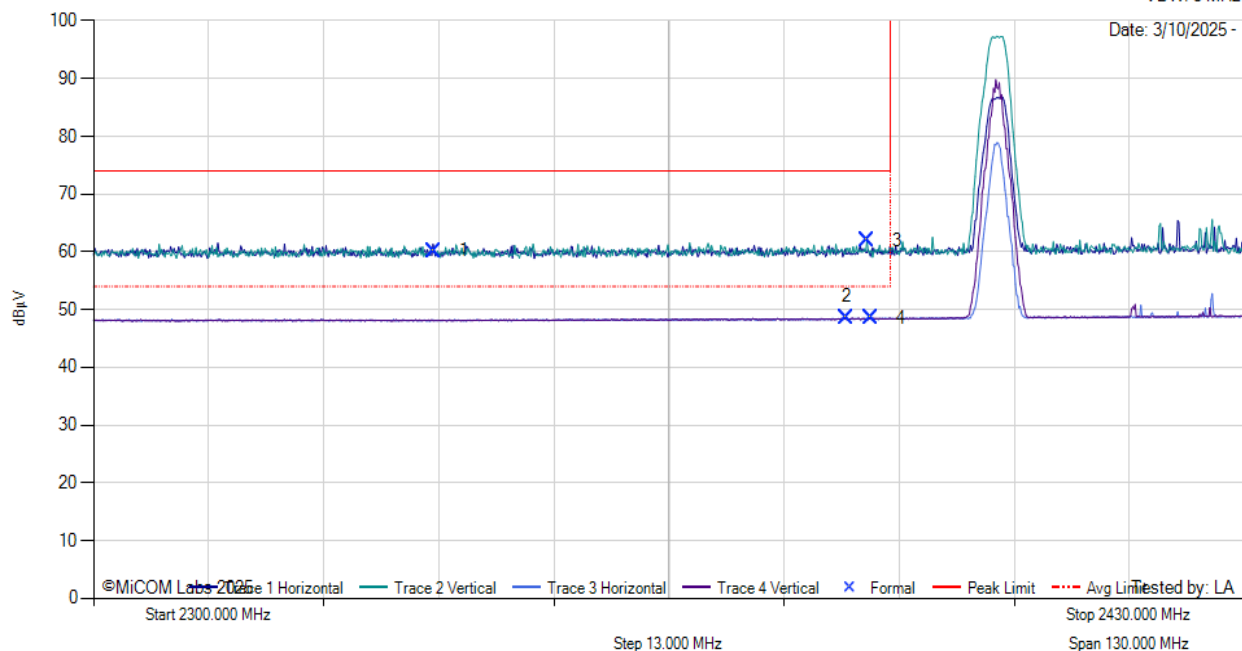
Antenna: Integral

Measurement Distance: 3m

Sweep Time: 1.0 s

RBW: 1 MHz
VBW: 3 MHz

Date: 3/10/2025



2300.00 - 2430.00 MHz

| Num | Frequency MHz | Raw dBμV | Cable Loss dB | AF dB/m | Level dBμV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBμV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| 1 | 2338.48 | 26.82 | 1.93 | 31.93 | 60.18 | MaxP | Horizontal | 99 | 300 | 74.0 | -13.8 | Pass |
| 2 | 2385.02 | 15.06 | 1.97 | 32.12 | 48.65 | AVG | Horizontal | 149 | 300 | 54.0 | -5.4 | Pass |
| 3 | 2387.36 | 28.32 | 1.97 | 32.13 | 61.91 | MaxP | Vertical | 149 | 90 | 74.0 | -12.1 | Pass |
| 4 | 2387.75 | 14.96 | 1.96 | 32.13 | 48.56 | AVG | Vertical | 99 | 59 | 54.0 | -5.4 | Pass |

Test Notes: BE BLE BW: 2M. Channel 0: 2402MHz

Equipment Configuration for BE 2483.5 MHZ

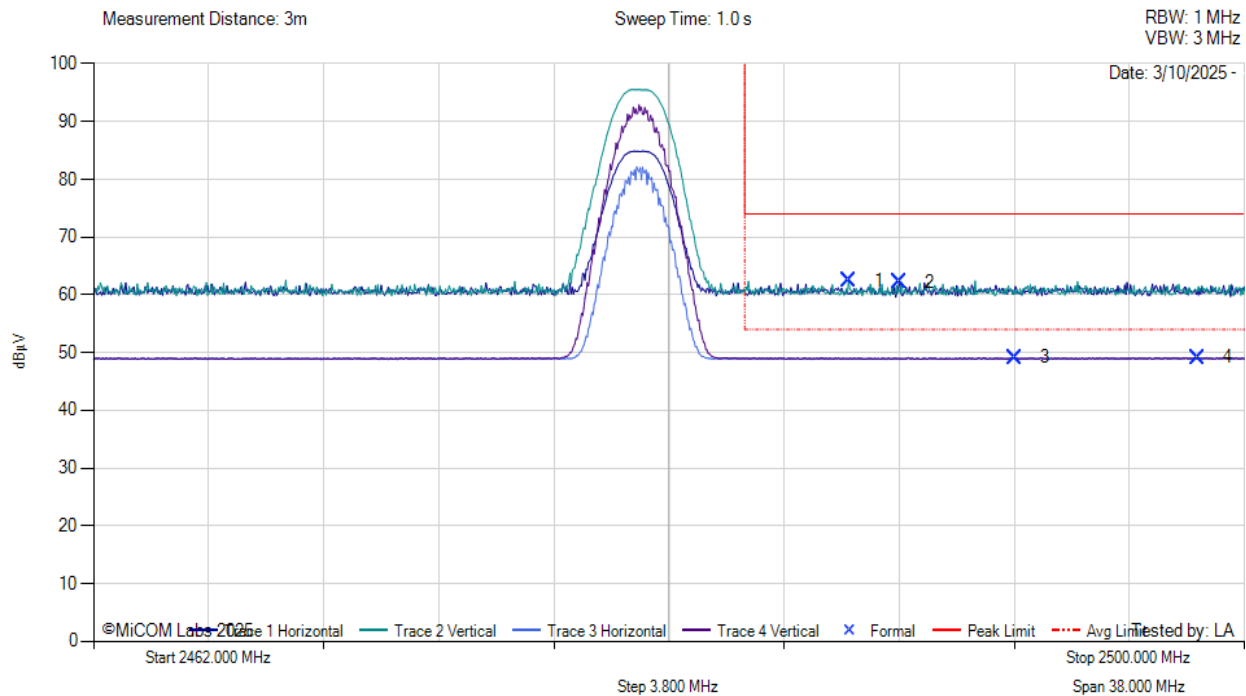
| | | | |
|---------------------------------|----------|--------------------|--------|
| Antenna: | Integral | Variant: | BLE 1M |
| Antenna Gain (dBi): | 2.72 | Modulation: | GFSK |
| Channel Frequency (MHz): | 2480 | Data Rate: | 1Mb/s |
| Power Setting: | Max | Tested By: | LA |

Test Measurement Results



BE 2483.5 MHz

Antenna: Integral



2462.00 - 2500.00 MHz

| Num | Frequency MHz | Raw dBμV | Cable Loss dB | AF dB/m | Level dBμV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBμV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| 1 | 2486.93 | 28.60 | 1.98 | 32.42 | 62.50 | MaxP | Vertical | 149 | 239 | 74.0 | -11.5 | Pass |
| 2 | 2488.60 | 28.30 | 1.98 | 32.42 | 62.21 | MaxP | Horizontal | 149 | 150 | 74.0 | -11.8 | Pass |
| 3 | 2492.40 | 15.19 | 2.01 | 32.45 | 49.16 | AVG | Vertical | 100 | 330 | 54.0 | -4.8 | Pass |
| 4 | 2498.44 | 15.22 | 2.01 | 32.45 | 49.18 | AVG | Horizontal | 100 | 270 | 54.0 | -4.8 | Pass |

Test Notes: BE BLE BW: 1M. Channel 39: 2480MHz

Equipment Configuration for BE 2483.5 MHZ

| | | | |
|---------------------------------|----------|--------------------|--------|
| Antenna: | Integral | Variant: | BLE 2M |
| Antenna Gain (dBi): | 2.72 | Modulation: | GFSK |
| Channel Frequency (MHz): | 2480 | Data Rate: | 1Mb/s |
| Power Setting: | Max | Tested By: | LA |

Test Measurement Results



BE 2483.5 MHz

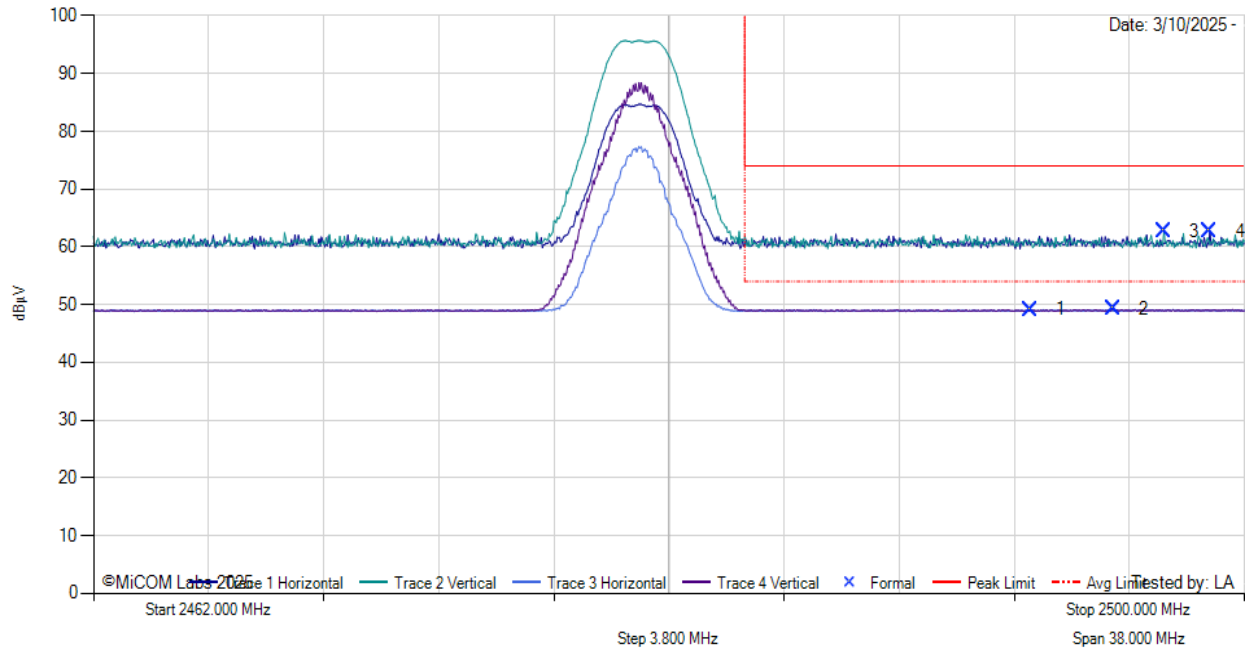
Antenna: Integral

Measurement Distance: 3m

Sweep Time: 1.0 s

RBW: 1 MHz
VBW: 3 MHz

Date: 3/10/2025



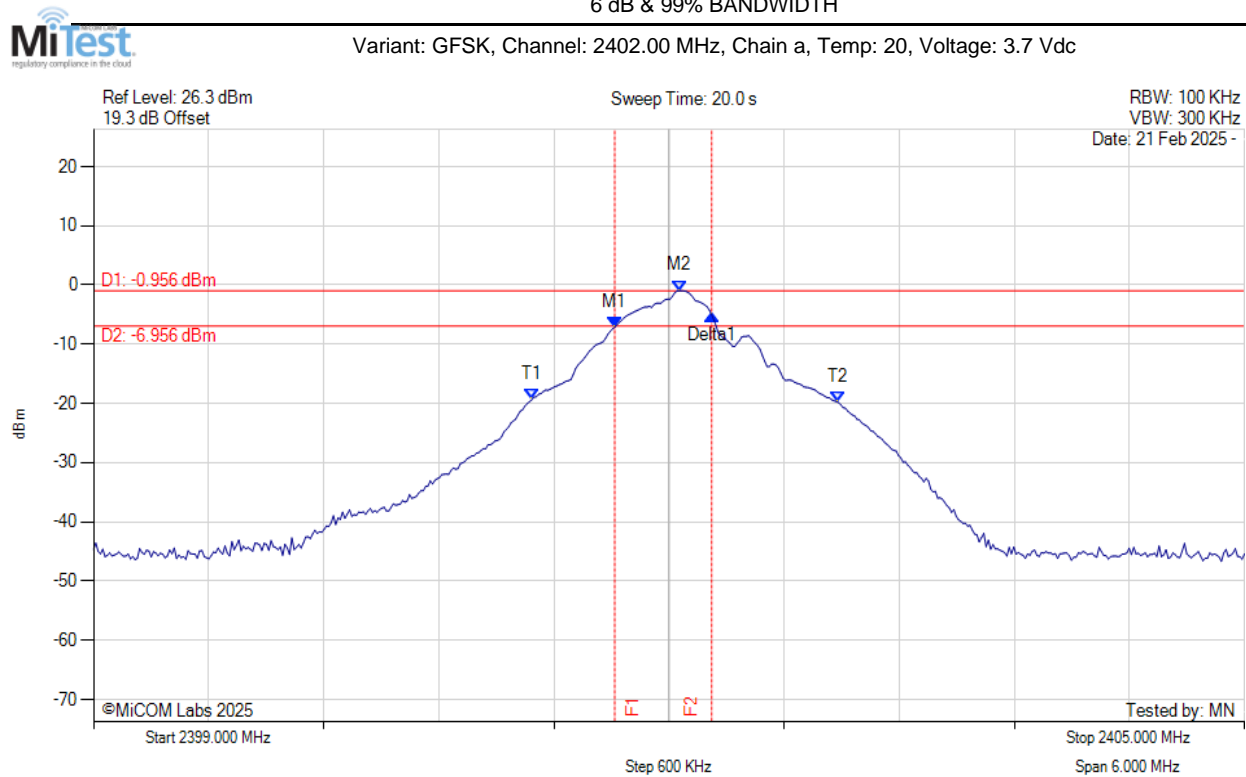
2462.00 - 2500.00 MHz

| Num | Frequency MHz | Raw dBμV | Cable Loss dB | AF dB/m | Level dBμV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBμV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| 1 | 2492.93 | 15.27 | 1.99 | 32.43 | 49.19 | AVG | Horizontal | 149 | 210 | 54.0 | -4.8 | Pass |
| 2 | 2495.67 | 15.27 | 2.00 | 32.44 | 49.21 | AVG | Vertical | 99 | 209 | 54.0 | -4.8 | Pass |
| 3 | 2497.34 | 28.78 | 2.00 | 32.44 | 62.73 | MaxP | Vertical | 99 | 119 | 74.0 | -11.3 | Pass |
| 4 | 2498.86 | 28.78 | 2.01 | 32.45 | 62.74 | MaxP | Horizontal | 149 | 120 | 74.0 | -11.3 | Pass |

Test Notes: BE BLE BW: 2M. Channel 39: 2480MHz

A. APPENDIX - GRAPHICAL IMAGES

A.1. 6 dB & 99% Bandwidth



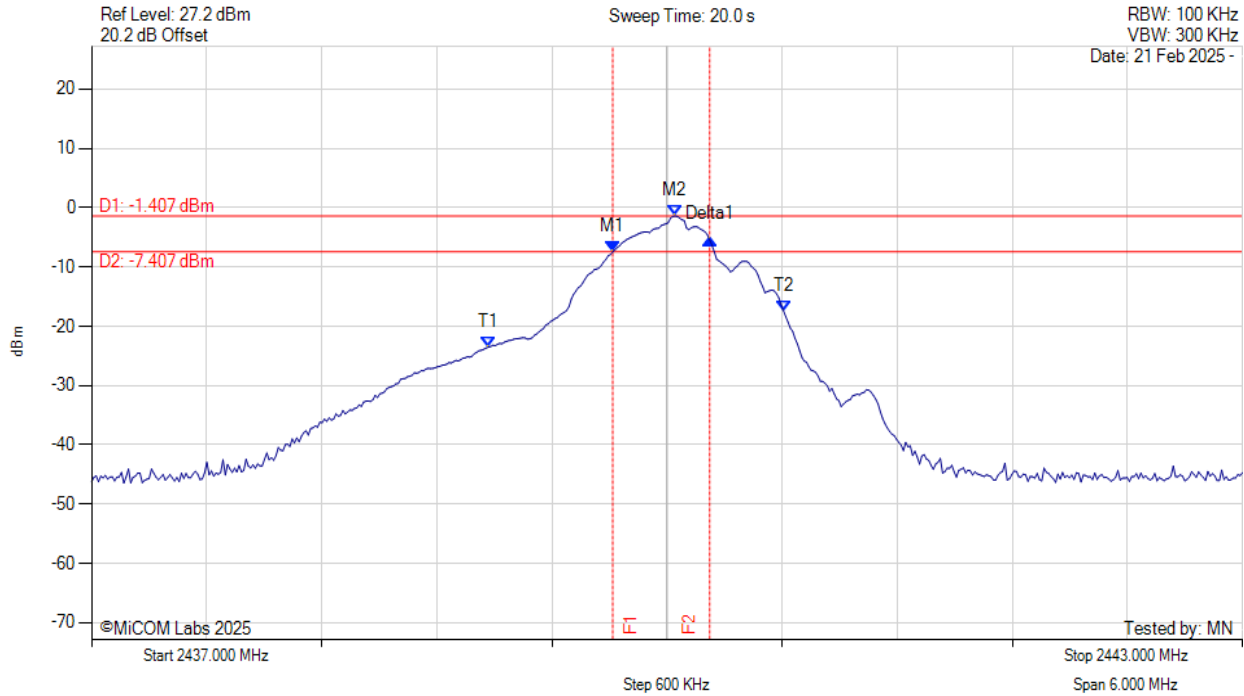
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD | M1 : 2401.717 MHz : -7.123 dBm M2 : 2402.054 MHz : -0.956 dBm Delta1 : 505 KHz : 2.119 dB T1 : 2401.285 MHz : -19.374 dBm T2 : 2402.884 MHz : -19.840 dBm OBW : 1.599 MHz | Measured 6 dB Bandwidth: 0.505 MHz Limit: ≥500.0 kHz Margin: -0.01 MHz |

[back to matrix](#)

6 dB & 99% BANDWIDTH



Variant: GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



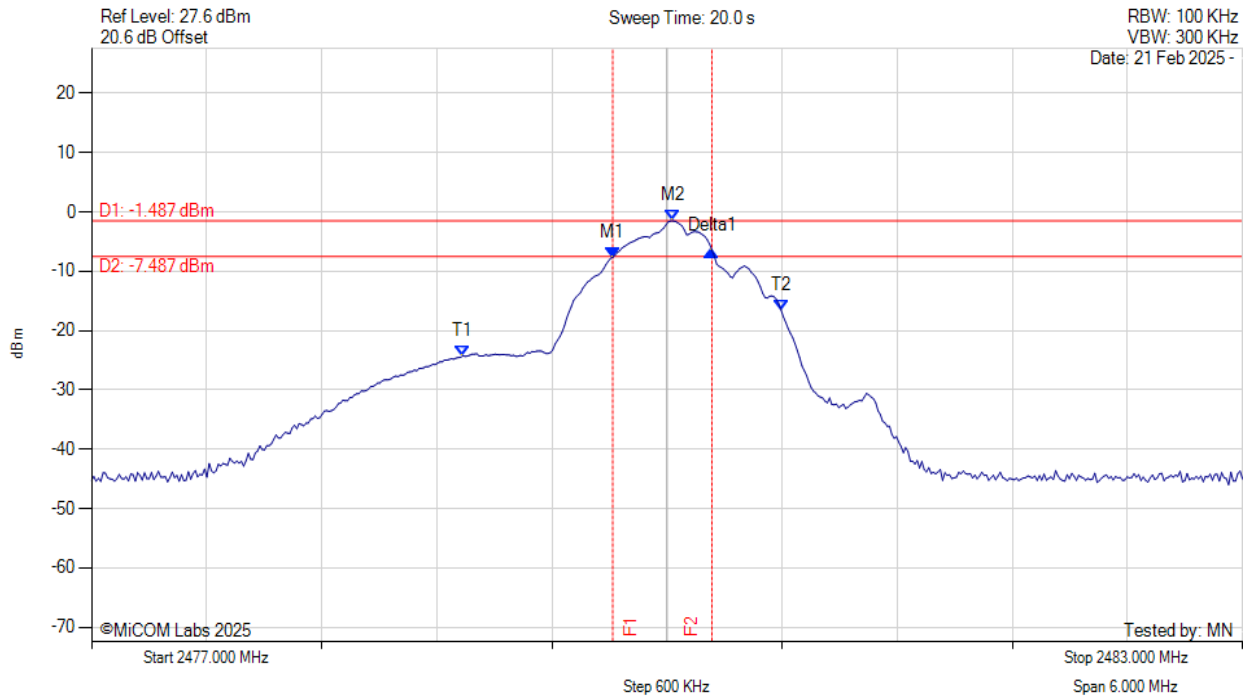
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD | M1 : 2439.717 MHz : -7.457 dBm M2 : 2440.042 MHz : -1.407 dBm Delta1 : 505 KHz : 2.056 dB T1 : 2439.068 MHz : -23.526 dBm T2 : 2440.607 MHz : -17.380 dBm OBW : 1.539 MHz | Measured 6 dB Bandwidth: 0.505 MHz Limit: ≥ 500.0 kHz Margin: -0.01 MHz |

[back to matrix](#)

6 dB & 99% BANDWIDTH



Variant: GFSK, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



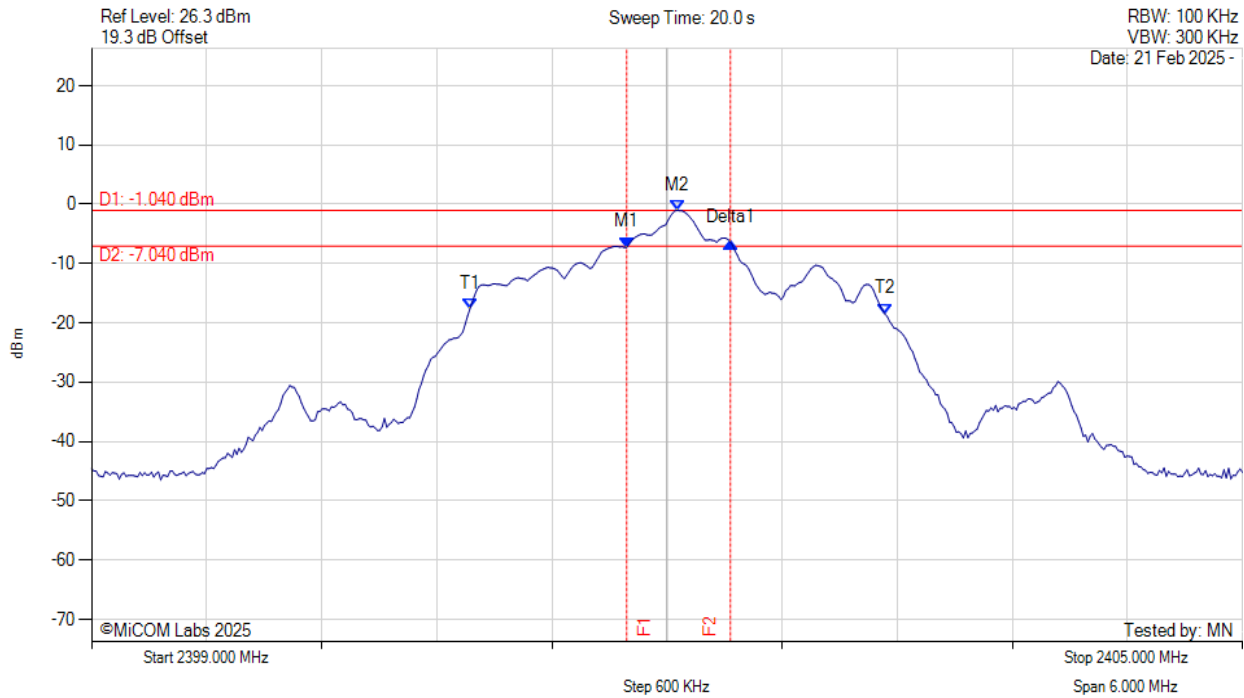
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD | M1 : 2479.717 MHz : -7.633 dBm M2 : 2480.030 MHz : -1.487 dBm Delta1 : 517 KHz : 1.180 dB T1 : 2478.936 MHz : -24.250 dBm T2 : 2480.595 MHz : -16.567 dBm OBW : 1.659 MHz | Measured 6 dB Bandwidth: 0.517 MHz Limit: ≥500.0 kHz Margin: -0.02 MHz |

[back to matrix](#)

6 dB & 99% BANDWIDTH



Variant: GFSK-2M, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



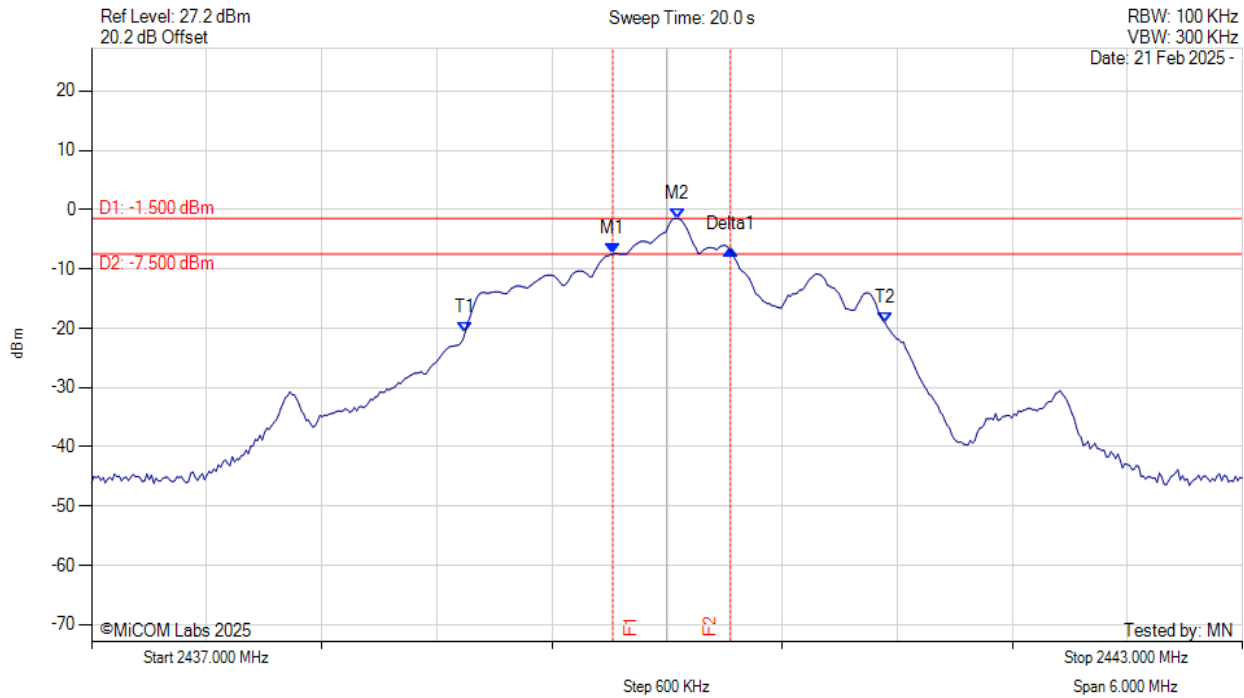
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD | M1 : 2401.790 MHz : -7.255 dBm M2 : 2402.054 MHz : -1.040 dBm Delta1 : 541 KHz : 0.899 dB T1 : 2400.972 MHz : -17.700 dBm T2 : 2403.136 MHz : -18.489 dBm OBW : 2.164 MHz | Measured 6 dB Bandwidth: 0.541 MHz Limit: ≥ 500.0 kHz Margin: -0.04 MHz |

[back to matrix](#)

6 dB & 99% BANDWIDTH



Variant: GFSK-2M, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



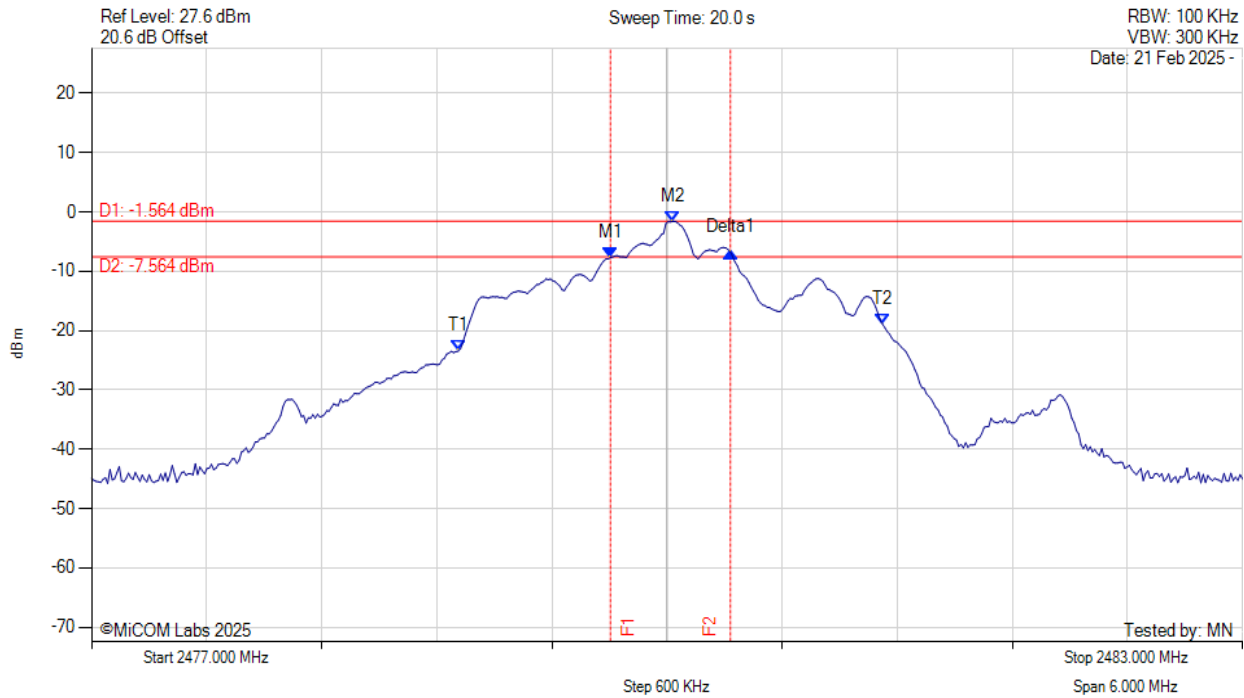
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD | M1 : 2439.717 MHz : -7.512 dBm M2 : 2440.054 MHz : -1.500 dBm Delta1 : 613 KHz : 0.702 dB T1 : 2438.948 MHz : -20.654 dBm T2 : 2441.136 MHz : -19.080 dBm OBW : 2.188 MHz | Measured 6 dB Bandwidth: 0.613 MHz Limit: ≥ 500.0 kHz Margin: -0.11 MHz |

[back to matrix](#)

6 dB & 99% BANDWIDTH



Variant: GFSK-2M, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD | M1 : 2479.705 MHz : -7.704 dBm M2 : 2480.030 MHz : -1.564 dBm Delta1 : 625 KHz : 0.972 dB T1 : 2478.912 MHz : -23.441 dBm T2 : 2481.124 MHz : -18.944 dBm OBW : 2.212 MHz | Measured 6 dB Bandwidth: 0.625 MHz Limit: ≥500.0 kHz Margin: -0.13 MHz |

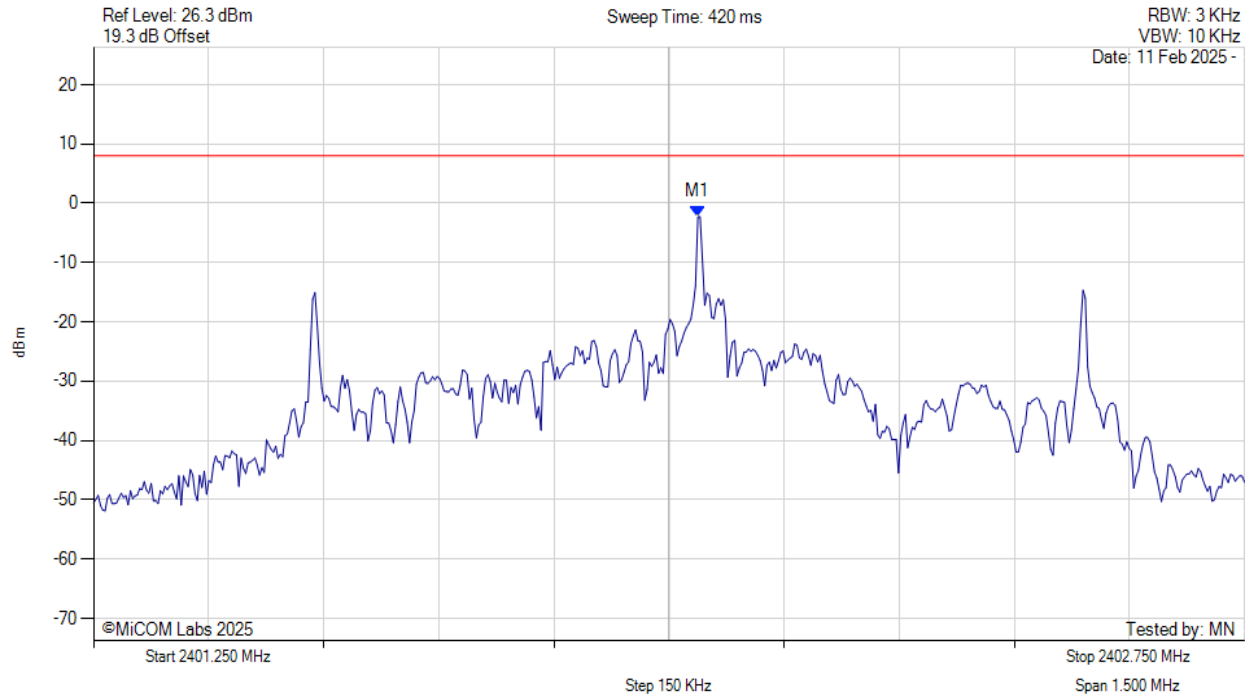
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A.2. Power Spectral Density



POWER SPECTRAL DENSITY - PEAK

Variant: GFSK, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



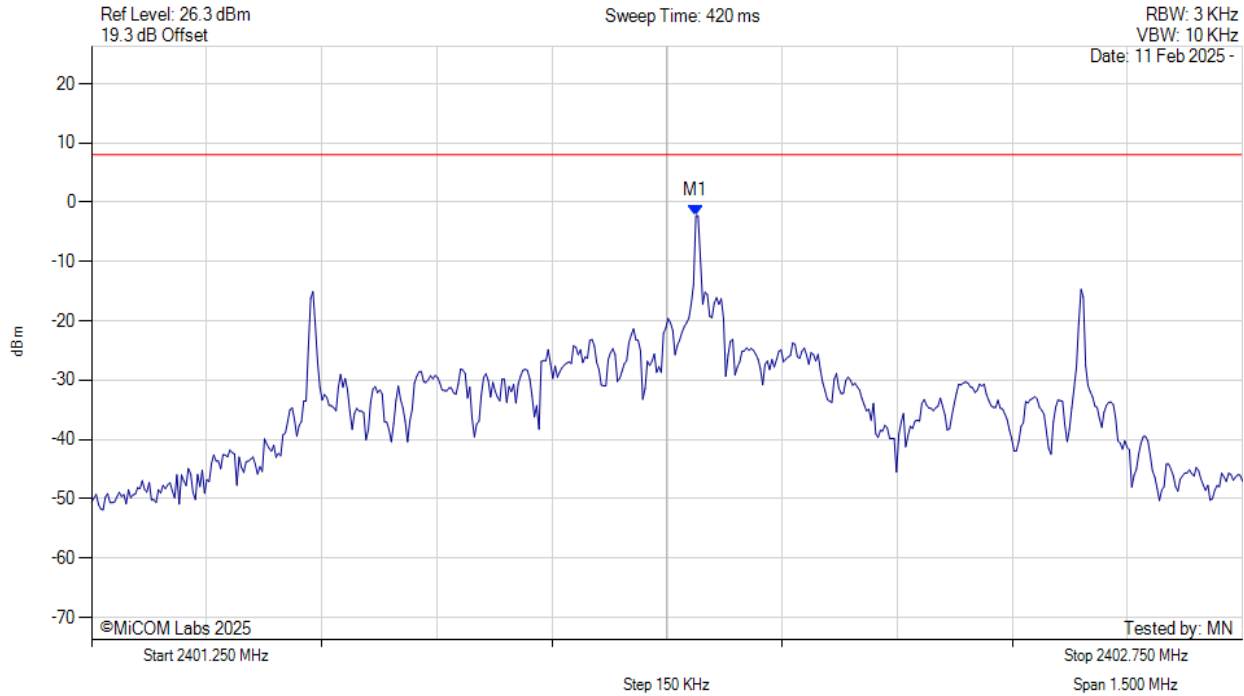
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--------------------------------|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2402.038 MHz : -2.307 dBm | Limit: ≤ 8.000 dBm Margin: 10.31 dB |

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POWER SPECTRAL DENSITY - PEAK



Variant: GFSK, Channel: 2402.00 MHz, SUM, Temp: 20, Voltage: 3.7 Vdc



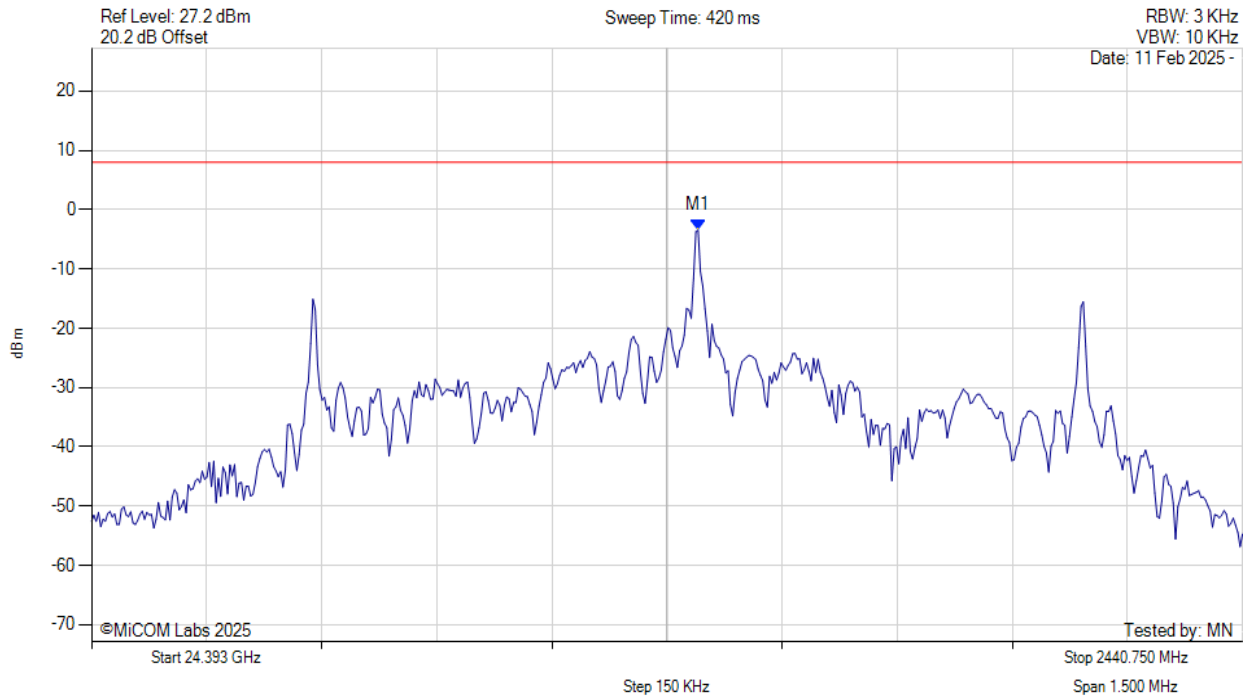
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--------------------------------|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2402.038 MHz : -2.307 dBm | Limit: ≤ 8.0 dBm Margin: -10.3 dB |

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POWER SPECTRAL DENSITY - PEAK



Variant: GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



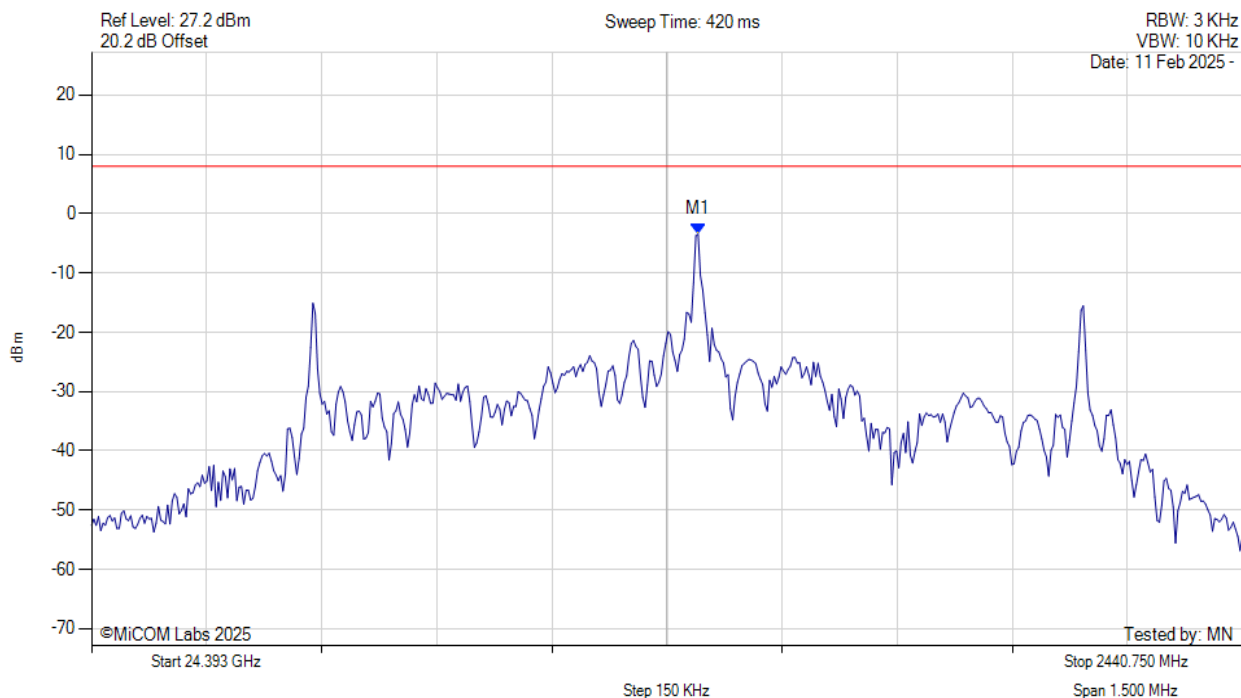
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--------------------------------|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2440.041 MHz : -3.455 dBm | Limit: ≤ 8.000 dBm Margin: 11.46 dB |

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POWER SPECTRAL DENSITY - PEAK



Variant: GFSK, Channel: 2440.00 MHz, SUM, Temp: 20, Voltage: 3.7 Vdc



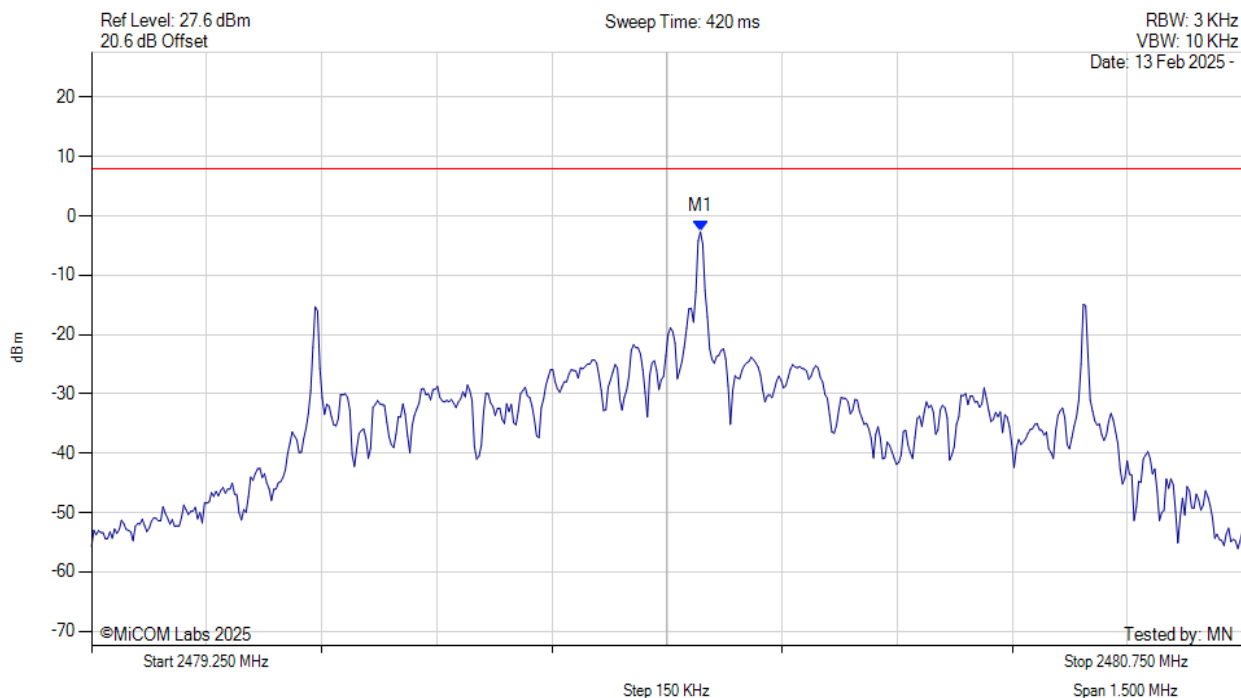
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--------------------------------|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2440.041 MHz : -3.455 dBm | Limit: ≤ 8.0 dBm Margin: -11.5 dB |

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POWER SPECTRAL DENSITY - PEAK



Variant: GFSK, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



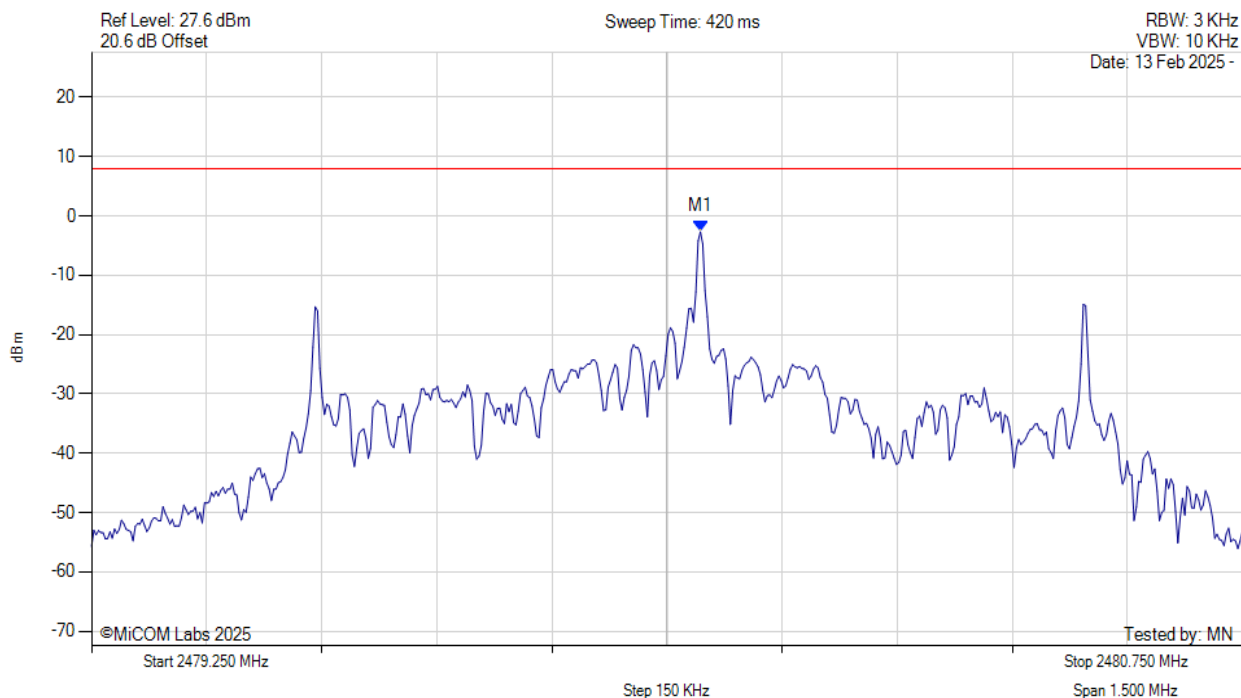
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--------------------------------|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2480.044 MHz : -2.658 dBm | Limit: ≤ 8.000 dBm Margin: 10.66 dB |

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POWER SPECTRAL DENSITY - PEAK



Variant: GFSK, Channel: 2480.00 MHz, SUM, Temp: 20, Voltage: 3.7 Vdc



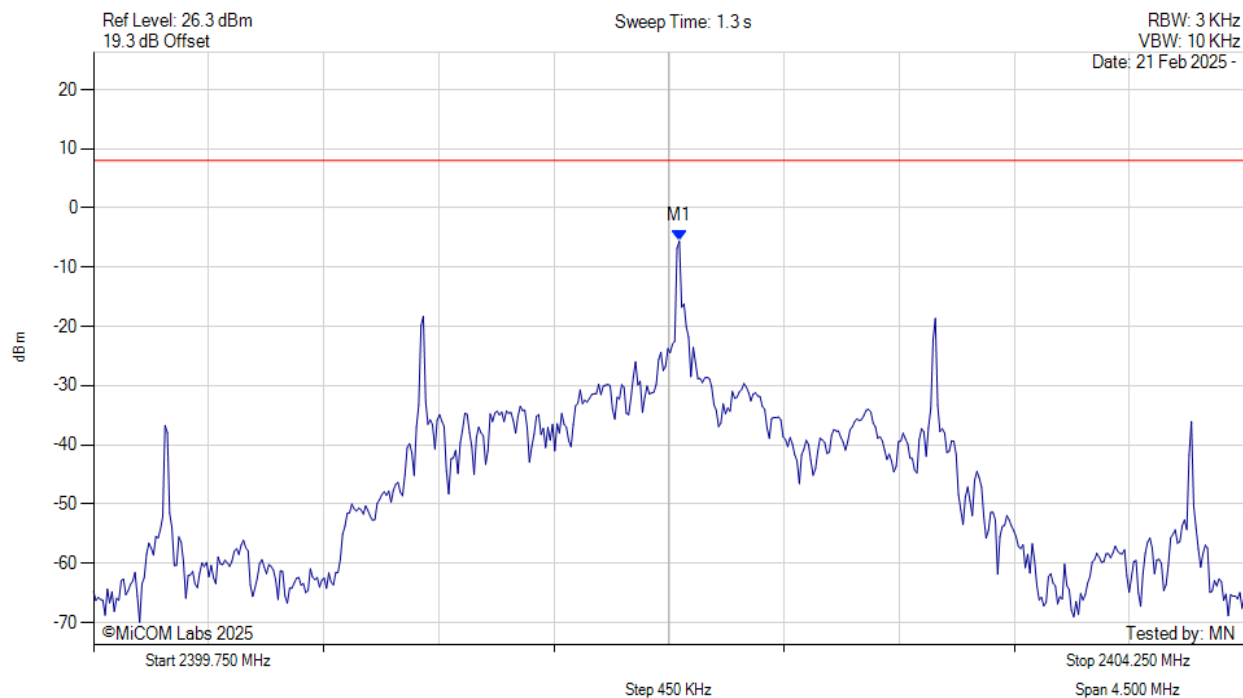
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--------------------------------|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2480.044 MHz : -2.658 dBm | Limit: ≤ 8.0 dBm Margin: -10.7 dB |

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POWER SPECTRAL DENSITY - PEAK



Variant: GFSK-2M, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



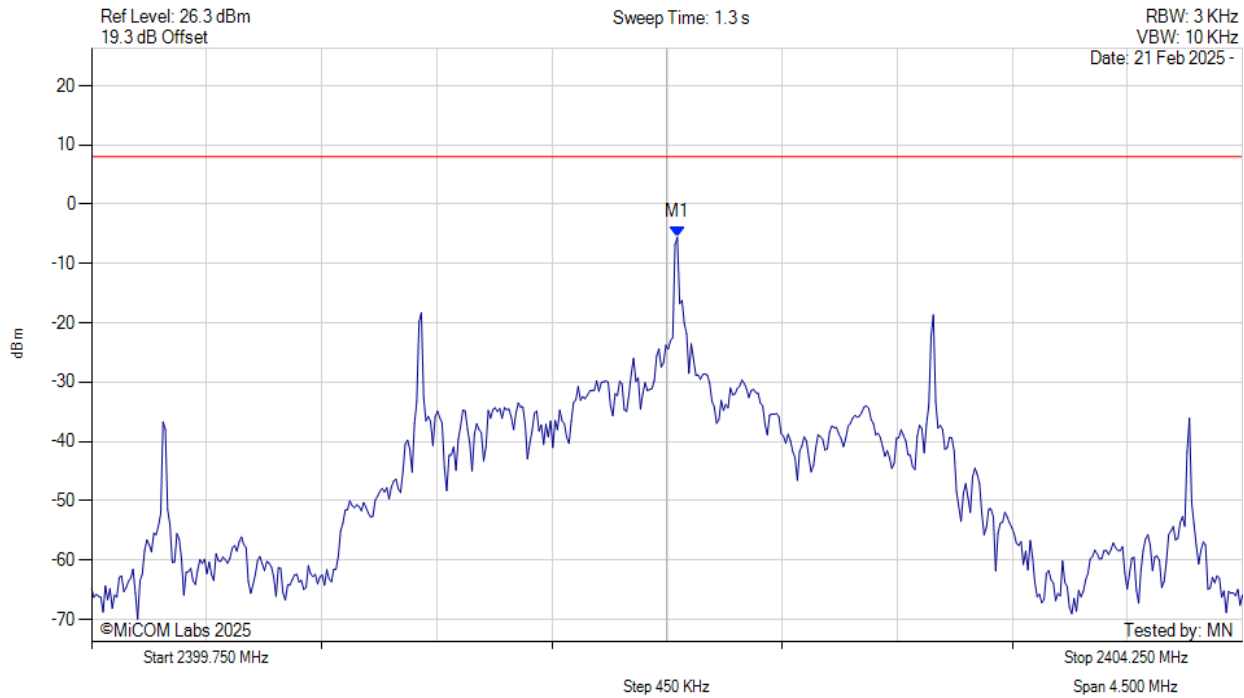
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--------------------------------|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2402.041 MHz : -5.567 dBm | Limit: ≤ 8.000 dBm Margin: 13.57 dB |

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POWER SPECTRAL DENSITY - PEAK



Variant: GFSK-2M, Channel: 2402.00 MHz, SUM, Temp: 20, Voltage: 3.7 Vdc



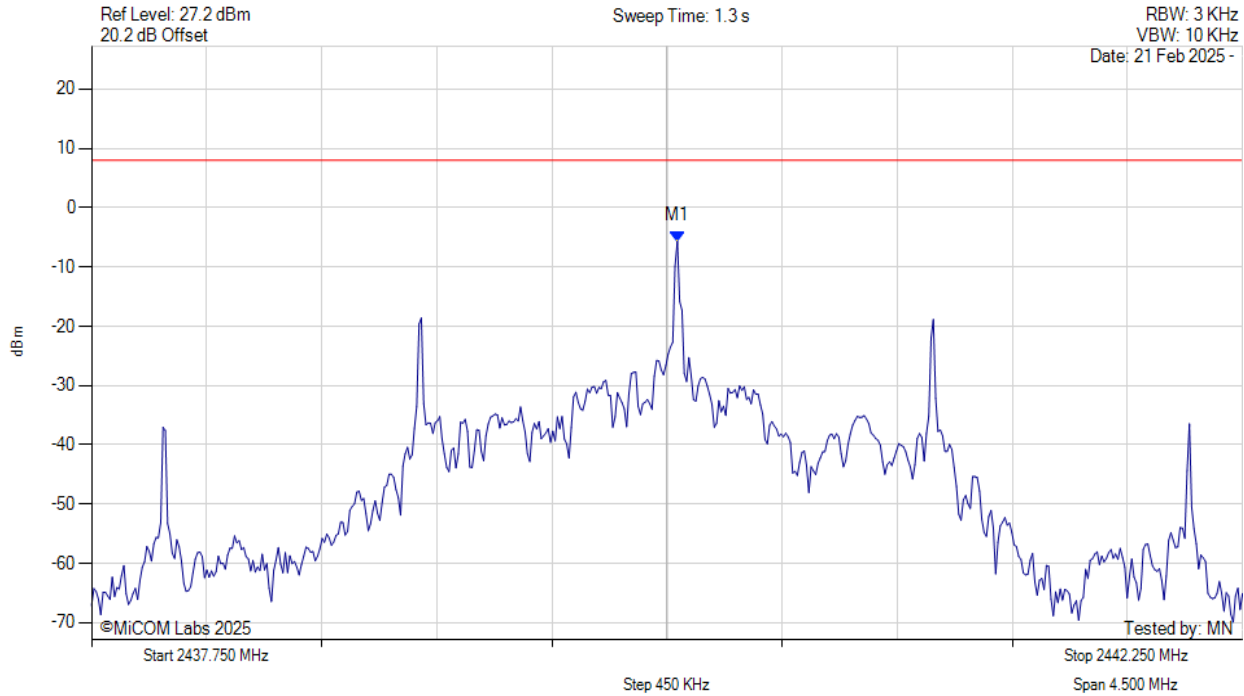
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--------------------------------|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2402.041 MHz : -5.567 dBm | Limit: ≤ 8.0 dBm Margin: -13.6 dB |

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POWER SPECTRAL DENSITY - PEAK



Variant: GFSK-2M, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



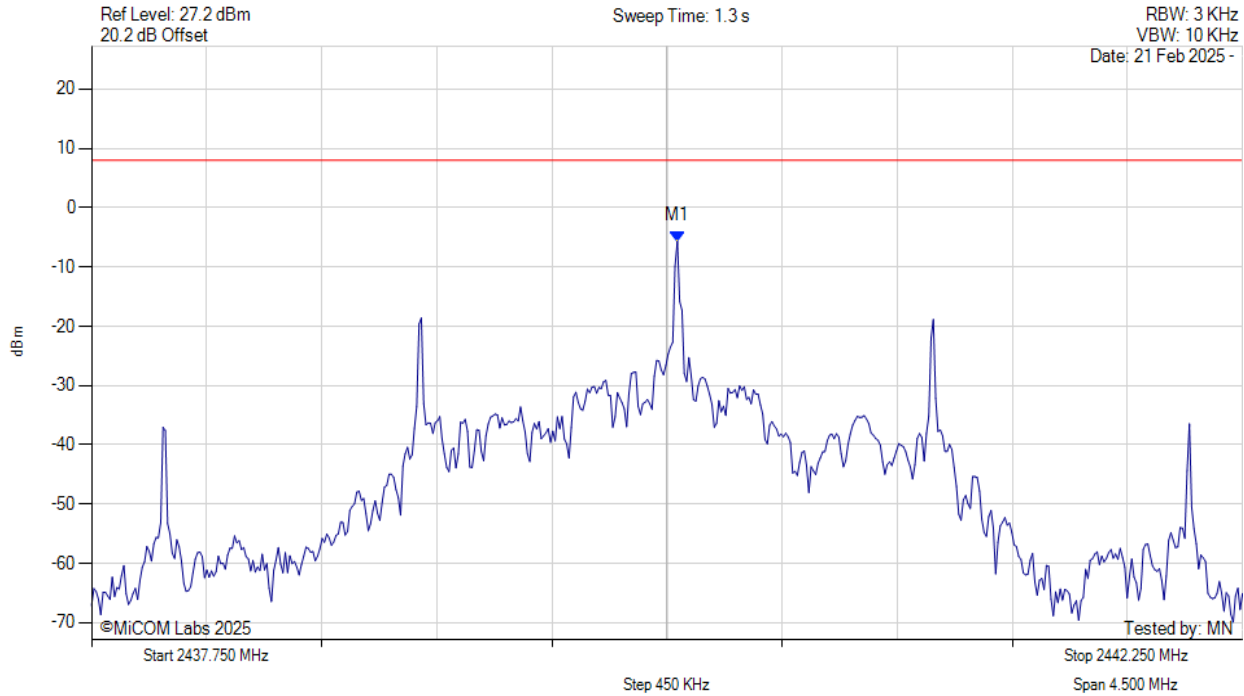
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--------------------------------|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2440.041 MHz : -5.659 dBm | Limit: ≤ 8.000 dBm Margin: 13.66 dB |

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POWER SPECTRAL DENSITY - PEAK



Variant: GFSK-2M, Channel: 2440.00 MHz, SUM, Temp: 20, Voltage: 3.7 Vdc



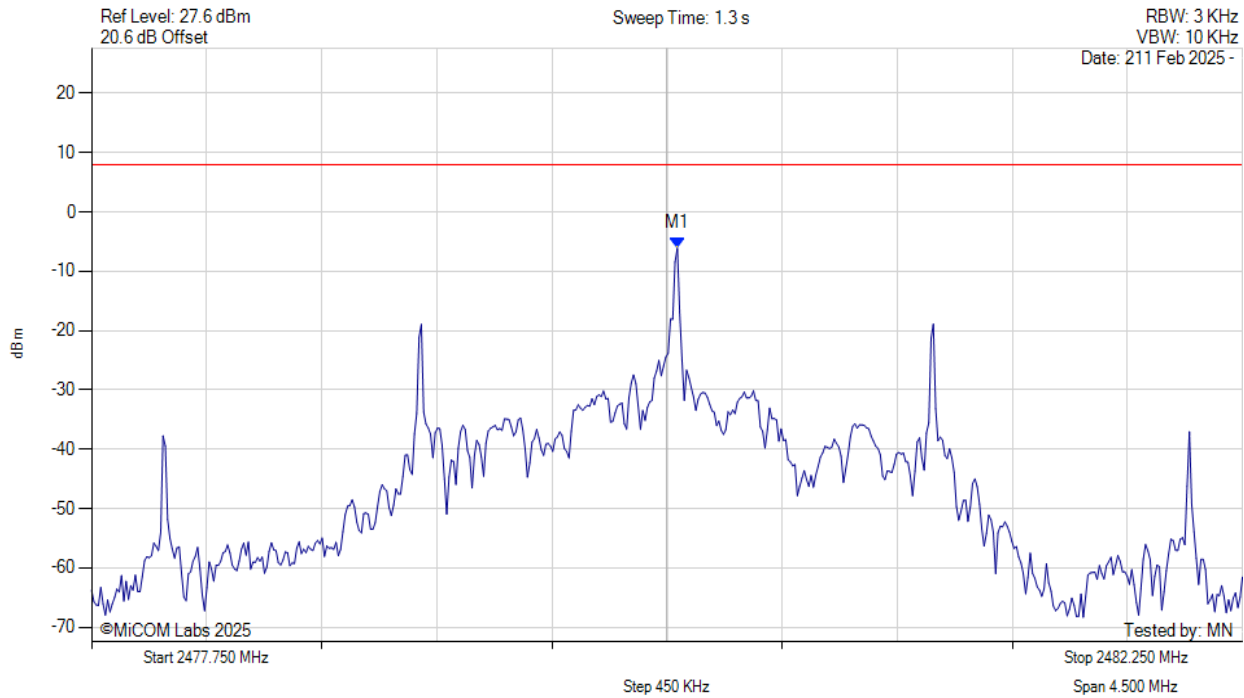
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--------------------------------|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2440.041 MHz : -5.659 dBm | Limit: ≤ 8.0 dBm Margin: -13.7 dB |

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POWER SPECTRAL DENSITY - PEAK



Variant: GFSK-2M, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



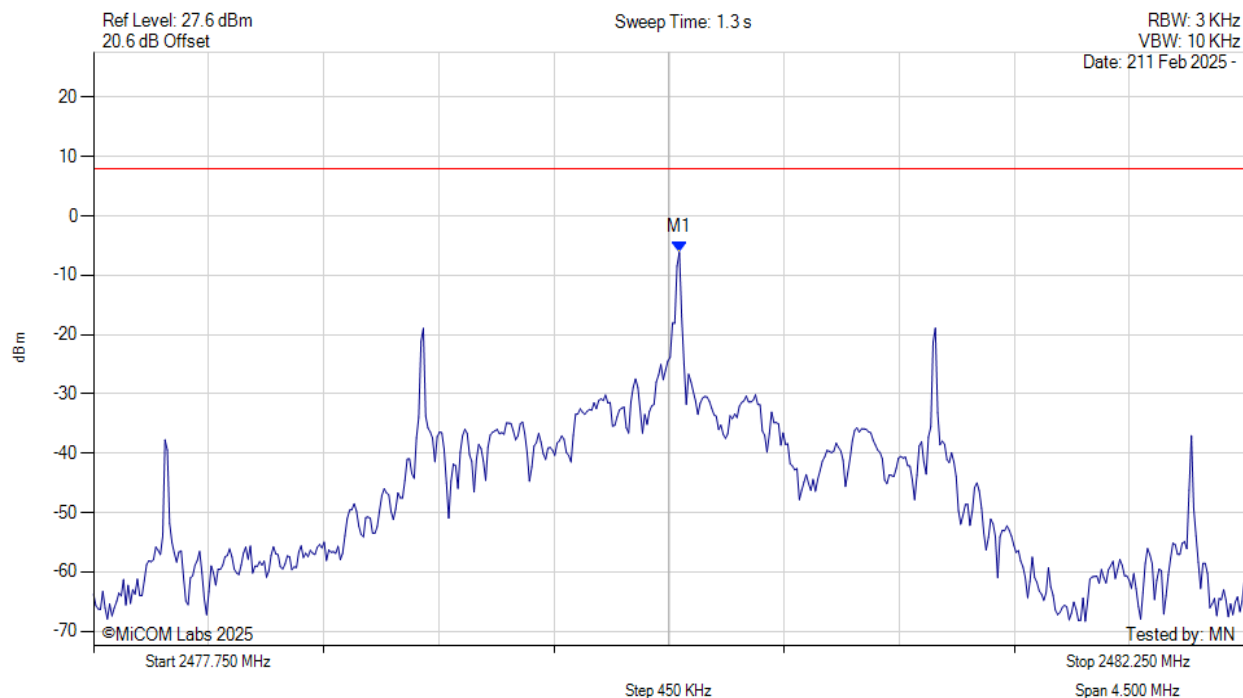
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--------------------------------|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2480.041 MHz : -6.069 dBm | Limit: ≤ 8.000 dBm Margin: 14.07 dB |

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POWER SPECTRAL DENSITY - PEAK



Variant: GFSK-2M, Channel: 2480.00 MHz, SUM, Temp: 20, Voltage: 3.7 Vdc



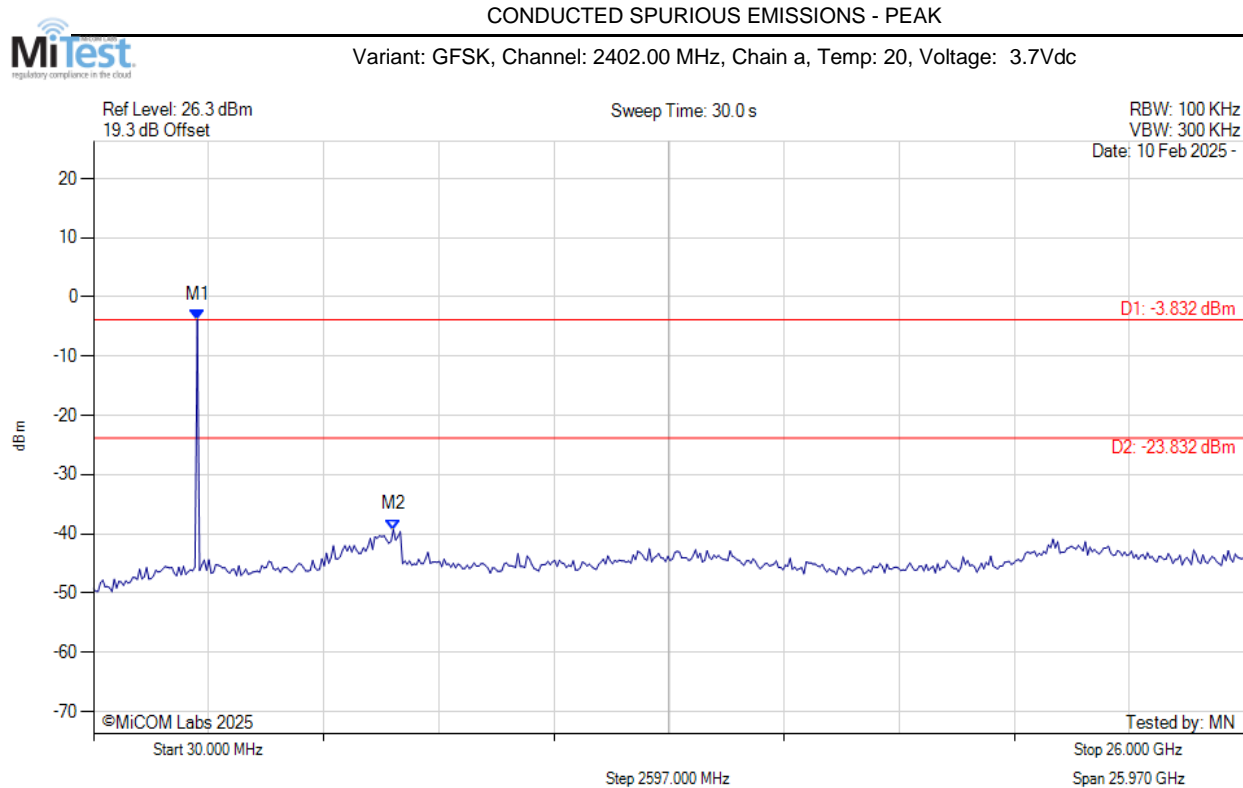
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--------------------------------|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2480.041 MHz : -6.069 dBm | Limit: ≤ 8.0 dBm Margin: -14.1 dB |

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A.3. Emissions

A.3.1. Conducted Emissions

A.3.1.1. Conducted Spurious Emissions



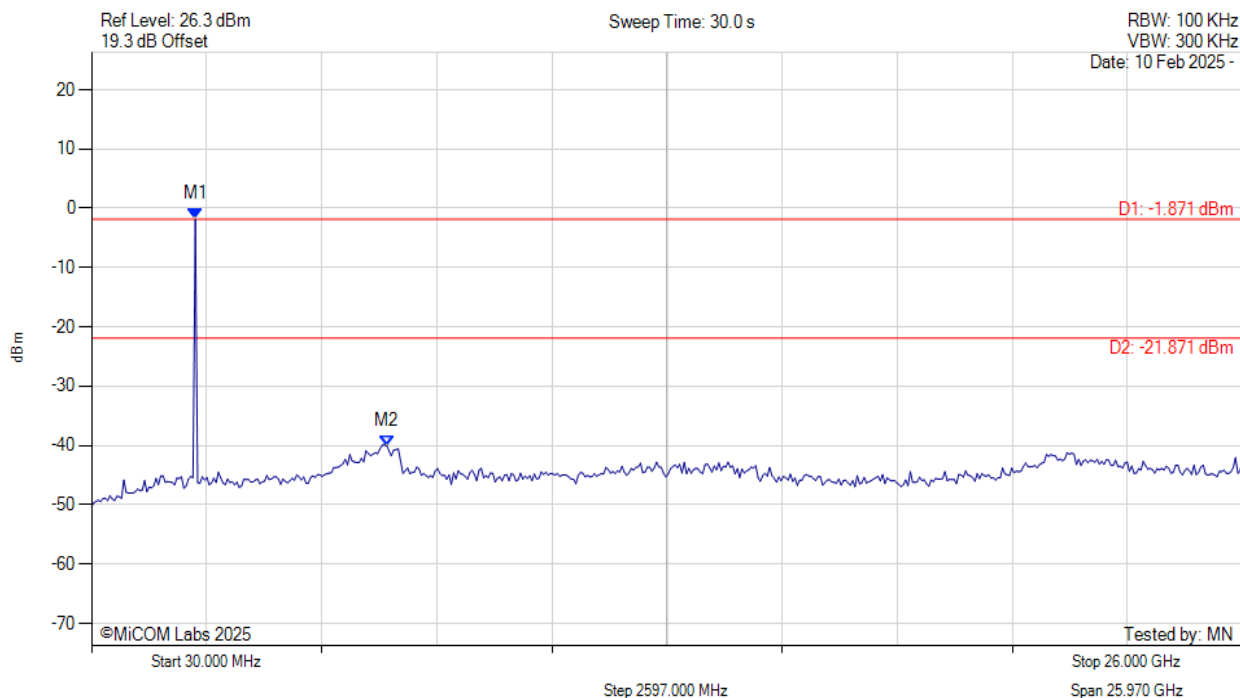
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|---|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2371.984 MHz : -3.832 dBm M2 : 6795.731 MHz : -39.288 dBm | Limit: -23.83 dBm Margin: -15.46 dB |

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CONDUCTED SPURIOUS EMISSIONS - PEAK



Variant: GFSK, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



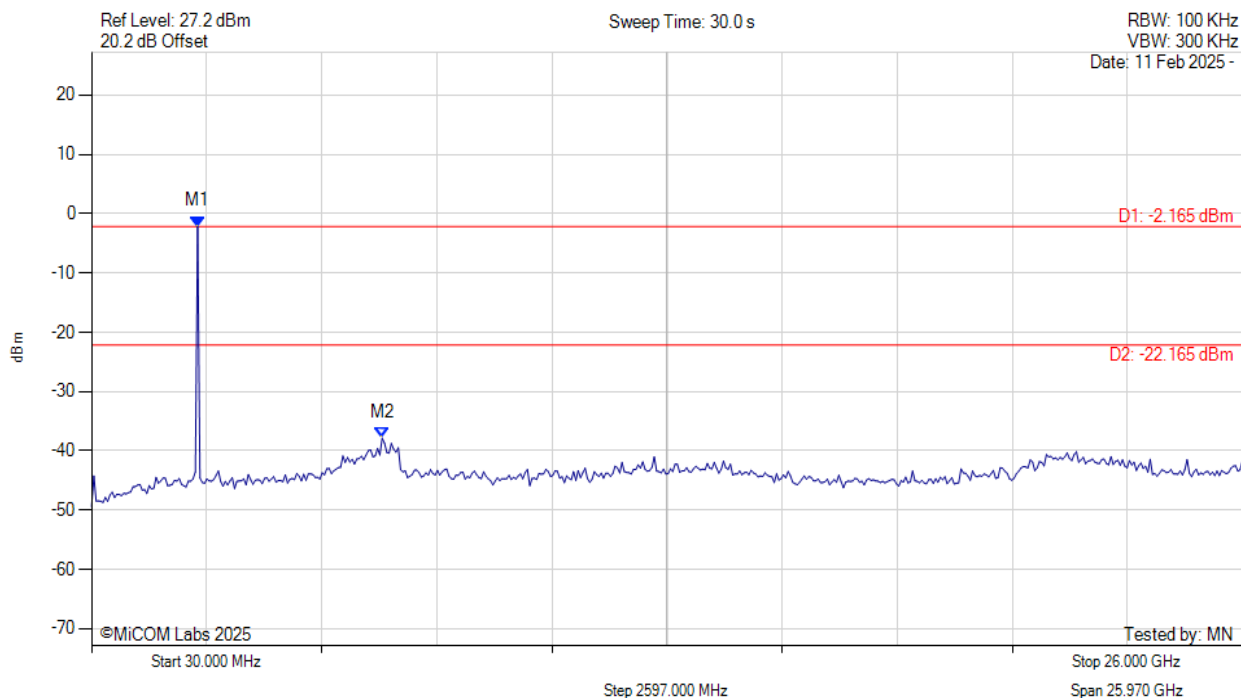
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|---|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2371.984 MHz : -1.871 dBm M2 : 6691.643 MHz : -40.045 dBm | Limit: -21.87 dBm Margin: -18.18 dB |

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CONDUCTED SPURIOUS EMISSIONS - PEAK



Variant: GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



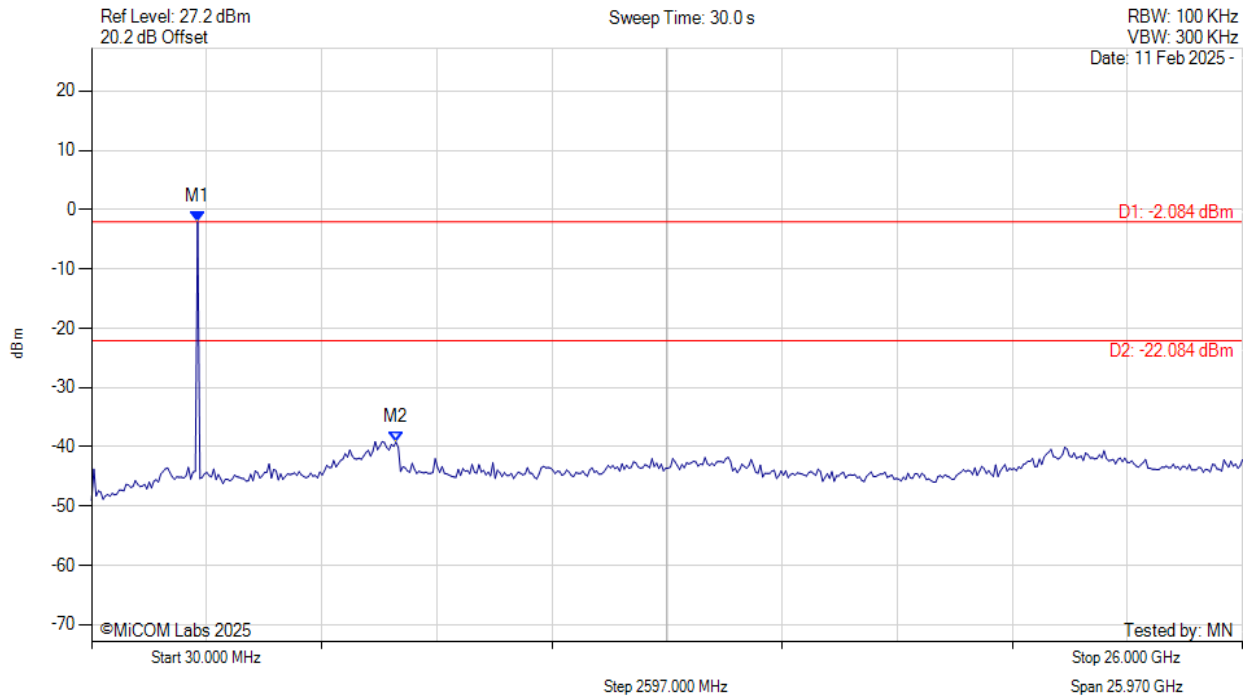
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|---|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2424.028 MHz : -2.165 dBm M2 : 6587.555 MHz : -37.855 dBm | Limit: -22.17 dBm Margin: -15.68 dB |

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CONDUCTED SPURIOUS EMISSIONS - PEAK



Variant: GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



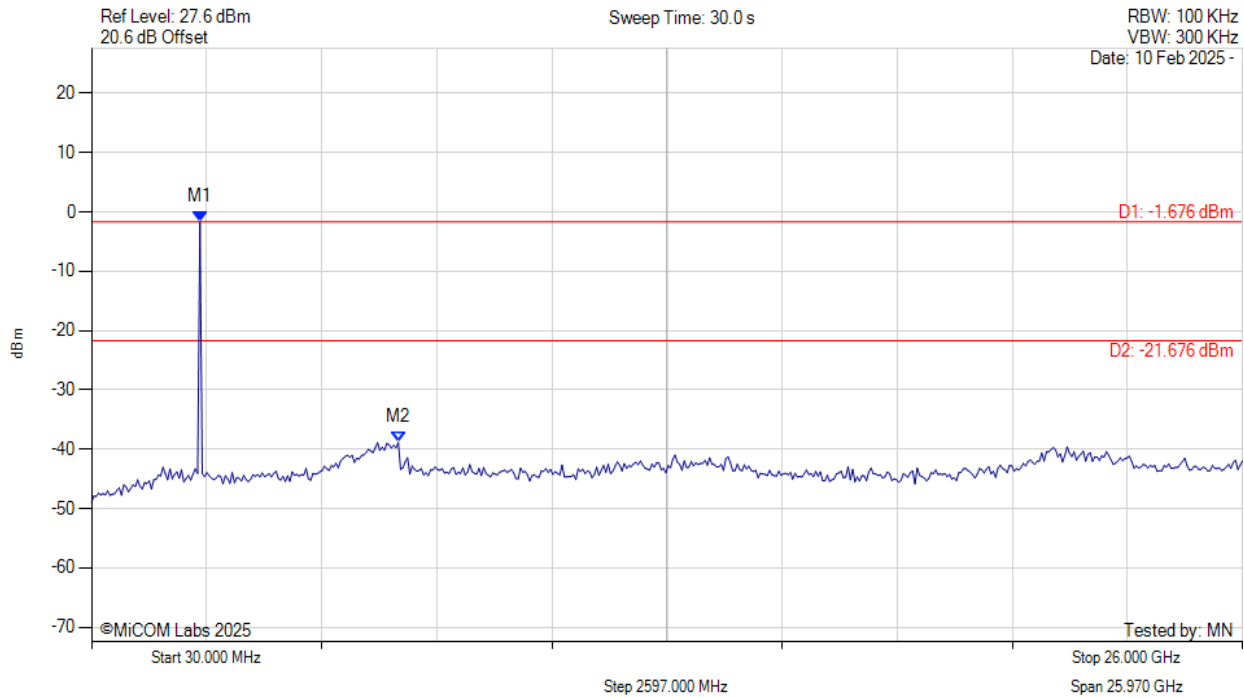
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|---|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2424.028 MHz : -2.084 dBm M2 : 6899.820 MHz : -39.190 dBm | Limit: -22.08 dBm Margin: -17.11 dB |

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CONDUCTED SPURIOUS EMISSIONS - PEAK



Variant: GFSK, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.7Vdc



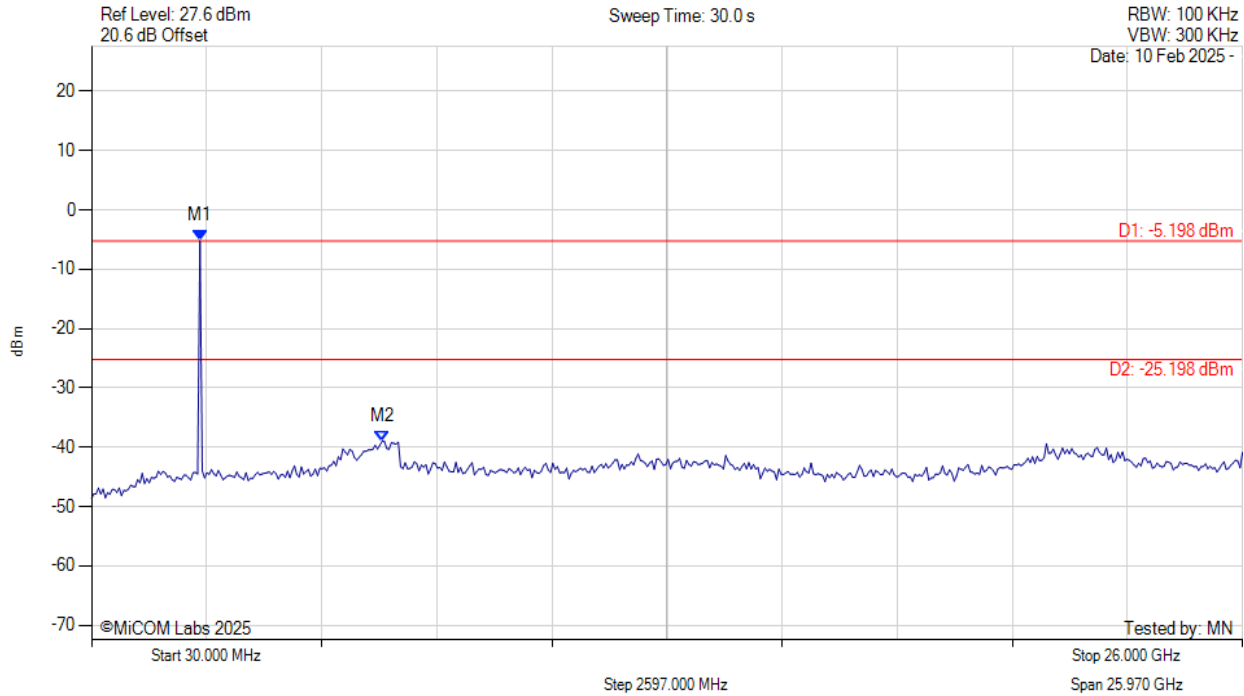
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|---|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2476.072 MHz : -1.676 dBm M2 : 6951.864 MHz : -38.859 dBm | Limit: -21.68 dBm Margin: -17.18 dB |

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CONDUCTED SPURIOUS EMISSIONS - PEAK



Variant: GFSK, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



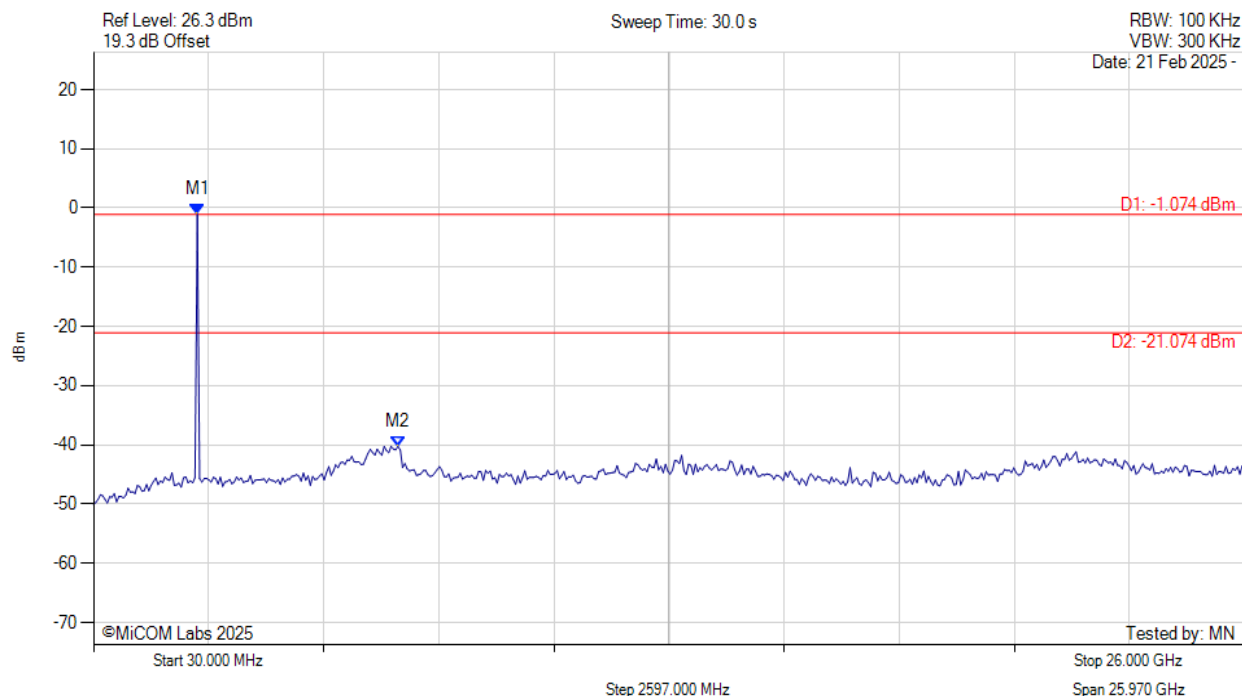
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|---|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2476.072 MHz : -5.198 dBm M2 : 6587.555 MHz : -38.985 dBm | Limit: -25.20 dBm Margin: -13.79 dB |

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CONDUCTED SPURIOUS EMISSIONS - PEAK



Variant: GFSK-2M, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



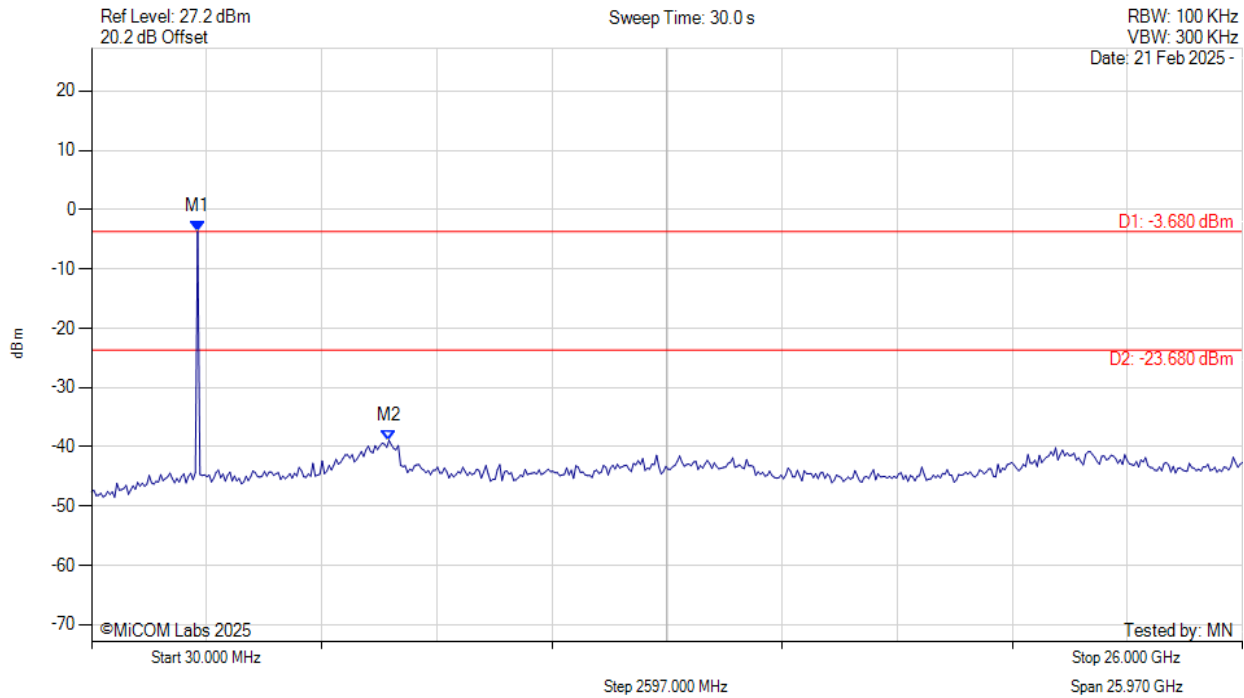
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|---|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2371.984 MHz : -1.074 dBm M2 : 6899.820 MHz : -40.258 dBm | Limit: -21.07 dBm Margin: -19.19 dB |

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CONDUCTED SPURIOUS EMISSIONS - PEAK



Variant: GFSK-2M, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



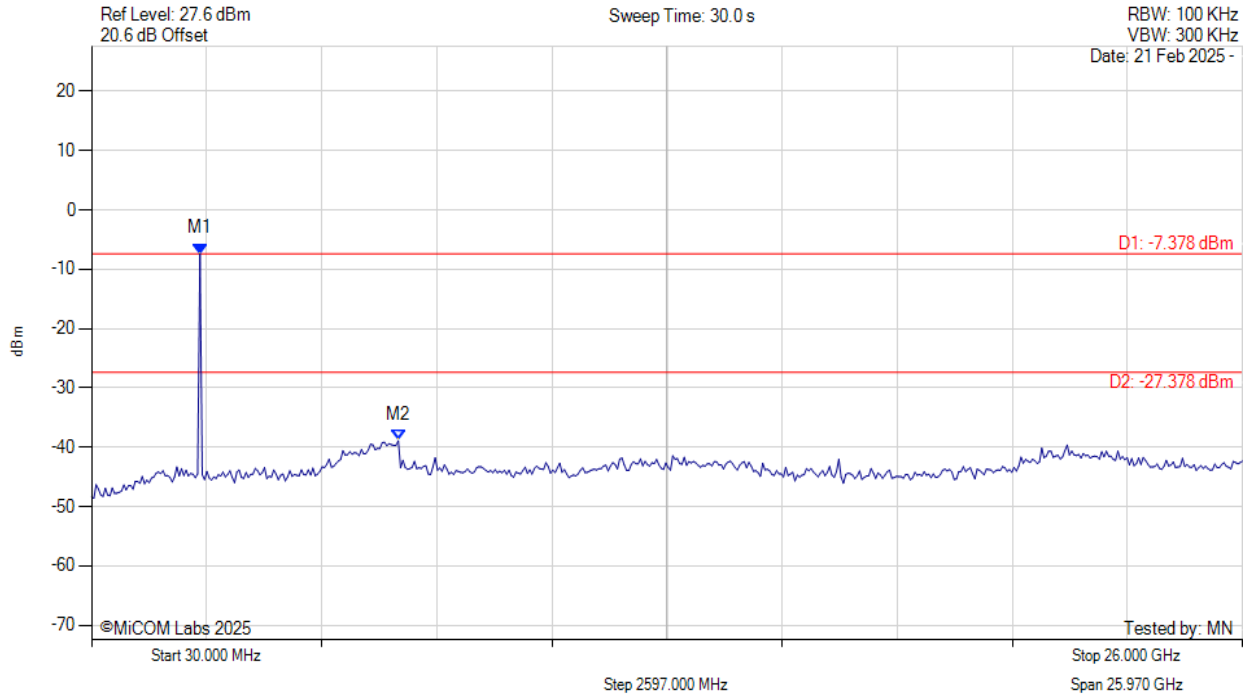
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|---|---------------------------------------|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2424.028 MHz : -3.680 dBm M2 : 6743.687 MHz : -38.895 dBm | Limit: -23.68 dB Margin: -15.22 dB |

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CONDUCTED SPURIOUS EMISSIONS - PEAK



Variant: GFSK-2M, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|---|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2476.072 MHz : -7.378 dBm M2 : 6951.864 MHz : -38.891 dBm | Limit: -27.38 dBm Margin: -11.51 dB |

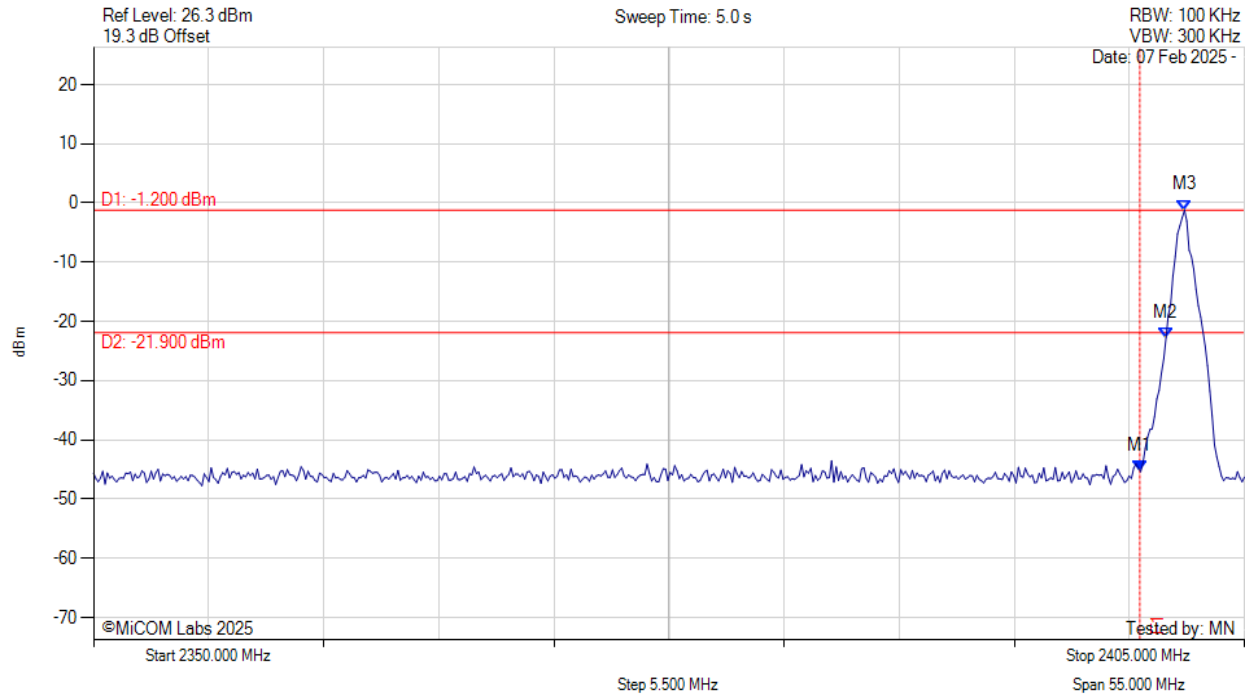
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A.3.1.2. Conducted Band-Edge Emissions



CONDUCTED LOW BAND-EDGE EMISSION - PEAK

Variant: GFSK, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



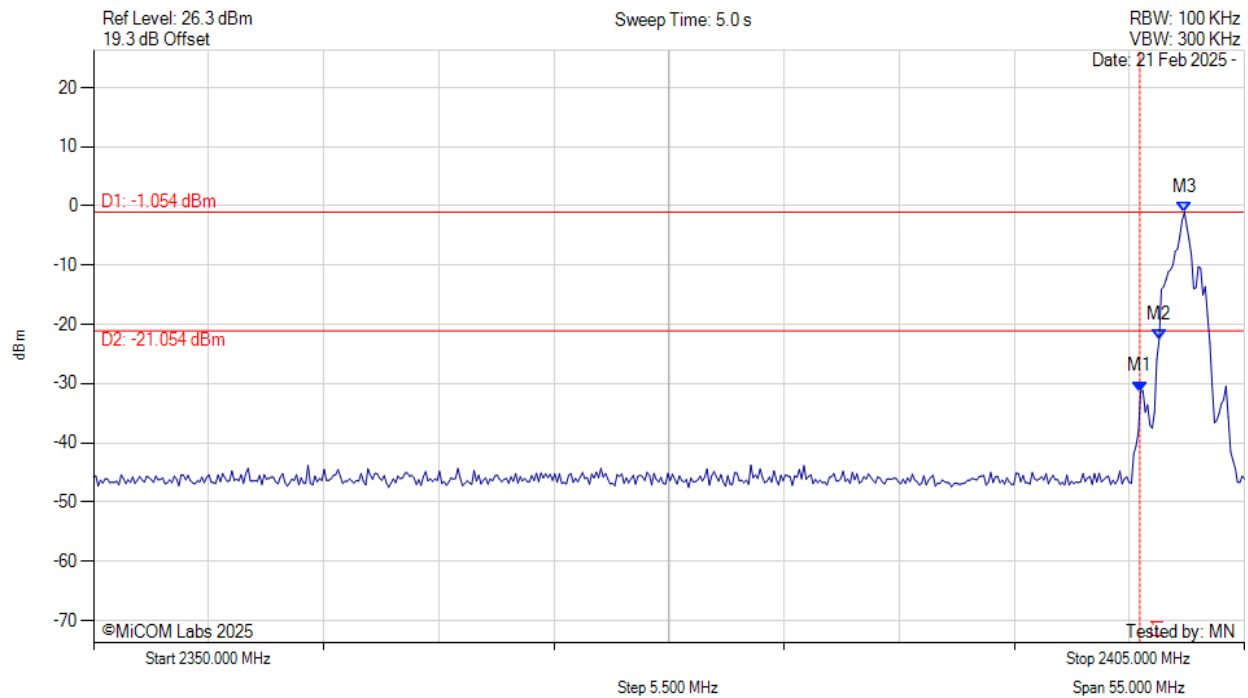
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--|--------------------------------|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2400.000 MHz : -45.345 dBm M2 : 2401.253 MHz : -22.760 dBm M3 : 2402.134 MHz : -1.200 dBm | Channel Frequency: 2402.00 MHz |

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CONDUCTED LOW BAND-EDGE EMISSION - PEAK



Variant: GFSK-2M, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



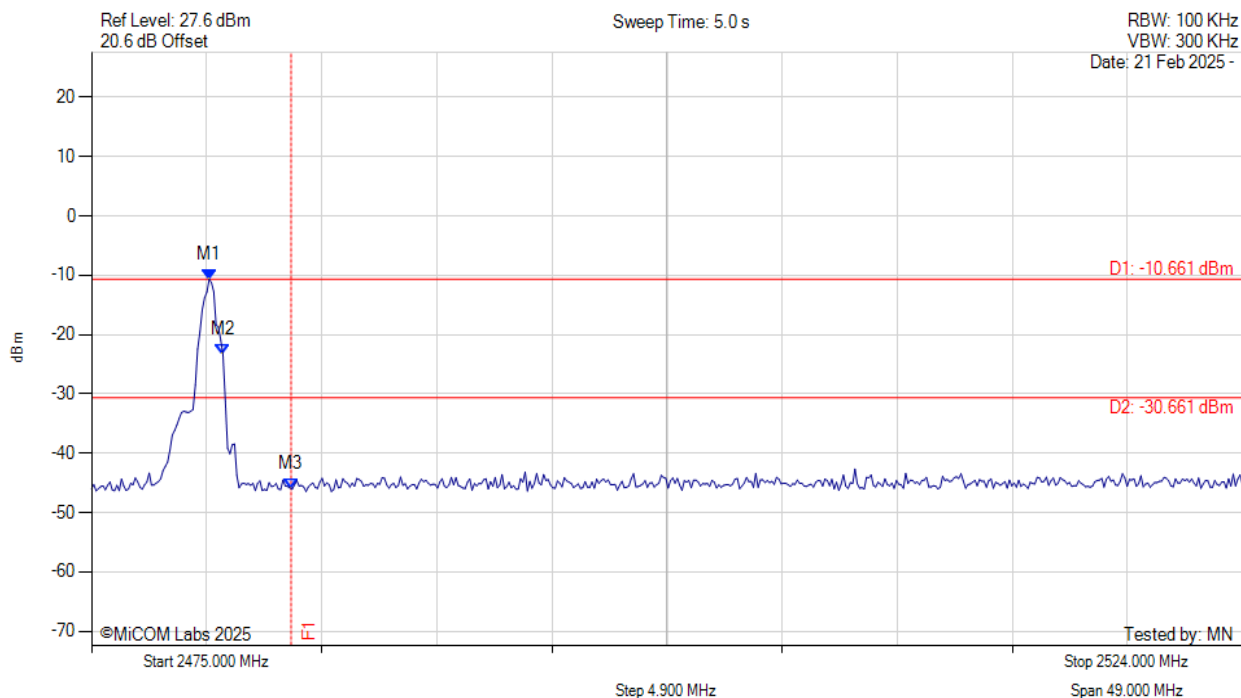
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--|--------------------------------|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2400.000 MHz : -31.336 dBm M2 : 2400.922 MHz : -22.581 dBm M3 : 2402.134 MHz : -1.054 dBm | Channel Frequency: 2402.00 MHz |

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CONDUCTED HIGH BAND-EDGE EMISSION - PEAK



Variant: GFSK, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



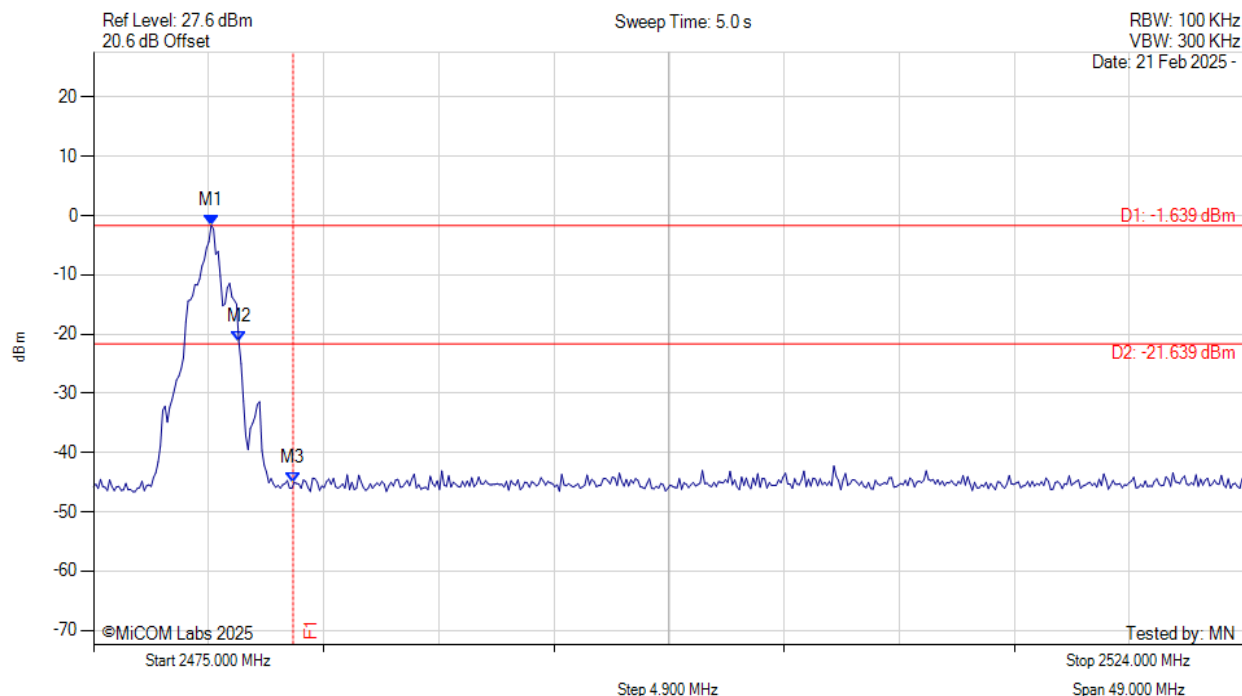
| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|---|--------------------------------|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2480.008 MHz : -10.661 dBm M2 : 2480.597 MHz : -23.427 dBm M3 : 2483.500 MHz : -46.060 dBm | Channel Frequency: 2480.00 MHz |

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CONDUCTED HIGH BAND-EDGE EMISSION - PEAK



Variant: GFSK-2M, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.7 Vdc



| Analyzer Setup | Marker: Frequency: Amplitude | Test Results |
|---|--|--------------------------------|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1 : 2480.008 MHz : -1.639 dBm M2 : 2481.186 MHz : -21.312 dBm M3 : 2483.500 MHz : -45.074 dBm | Channel Frequency: 2480.00 MHz |

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