Company: Itron, Inc.

Test of: NIC 510-06

To: FCC CFR 47 Part C 15.247 (FHSS); RSS-247

Report No.: ITRO01-U5 Rev A

**COMPLETE TEST REPORT**

# TEST REPORT

FROM

Test of: Itron, Inc. NIC 510-06

To: FCC CFR 47 Part C 15.247 (FHSS); RSS-247

Test Report Serial No.: ITRO01-U5 Rev A

This report supersedes: NONE

| | |
|---|---|
| Applicant: | Itron, Inc.<br>230 West Tasman Drive<br>San Jose, California<br>95134<br>USA |
| Product function: | Plug in Radio Device |
| Issue Date: | 9th May 2018 |

**This Test Report is Issued Under the Authority of:**

**MiCOM Labs, Inc.**
575 Boulder Court
Pleasanton California 94566
USA
Phone: +1 (925) 462-0304
Fax: +1 (925) 462-0306
www.micomlabs.com

TESTING CERT #2381.01

**MiCOM Labs is an ISO 17025 Accredited Testing Laboratory**

# Table of Contents

# 1. ACCREDITATION, LISTINGS & RECOGNITION

## 1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2005. 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

ilac-MRA A2LA

**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 17025:2005 *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 8 January 2009*).

Presented this 4th day of February 2016.

President and CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to May 31, 2018
Revised April 25, 2018

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

## 1.2. RECOGNITION

MiCOM Labs, Inc has widely recognized wireless testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA countries. MiCOM Labs test reports are accepted globally.

| Country | Recognition Body | Status | Phase | Identification No. |
|---|---|---|---|---|
| USA | Federal Communications Commission (FCC) | TCB | - | US0159<br>Listing #: 102167 |
| Canada | Industry Canada (IC) | FCB | APEC MRA 2 | US0159<br>Listing #: 4143A-2<br>4143A-3 |
| Japan | MIC (Ministry of Internal Affairs and Communication) | CAB | APEC MRA 2 | RCB 210 |
| | VCCI | -- | -- | A-0012 |
| Europe | European Commission | NB | EU MRA | NB 2280 |
| Australia | Australian Communications and Media Authority (ACMA) | CAB | APEC MRA 1 | US0159 |
| Hong Kong | Office of the Telecommunication Authority (OFTA) | CAB | APEC MRA 1 | |
| Korea | Ministry of Information and Communication Radio Research Laboratory (RRL) | CAB | APEC MRA 1 | |
| Singapore | Infocomm Development Authority (IDA) | CAB | APEC MRA 1 | |
| Taiwan | National Communications Commission (NCC)<br>Bureau of Standards, Metrology and Inspection (BSMI) | CAB | APEC MRA 1 | |
| Vietnam | Ministry of Communication (MIC) | CAB | APEC MRA 1 | |

EU MRA – European Union Mutual Recognition Agreement.
NB – Notified Body
APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement. Recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.

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

**Accredited Product Certification Body**

A2LA has accredited

**MICOM LABS**

*Pleasanton, CA*

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 *Requirements for bodies certifying products, processes and services*. This product certification body also meets the *A2LA R322 – Specific Requirements – Notified Body Accreditation Requirements* and *A2LA R308 - Specific Requirements - ISO-IEC 17065 - Telecommunication Certification Body Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.

Presented this 4th day of February 2016.

President and CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to May 31, 2018
Revised April 25, 2018

*For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.*

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

## 2. DOCUMENT HISTORY

| Document History | | |
|---|---|---|
| Revision | Date | Comments |
| Draft | 16th April 2018 | Draft report for client review. |
| Rev A | 9th May 2018 | Initial release. |
| . | | |
| . | | |
| . | | |
| . | | |
| . | | |

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

# 3. TEST RESULT CERTIFICATE

| | | | |
|---|---|---|---|
| **Manufacturer:** | Itron, Inc.<br>230 West Tasman Drive<br>San Jose<br>California 95134 USA | **Tested By:** | MiCOM Labs, Inc.<br>575 Boulder Court<br>Pleasanton<br>California 94566 USA |
| **Model:** | NIC 511-0603-13 | **Telephone:** | +1 925 462 0304 |
| **Type Of Equipment:** | Modular radio device | **Fax:** | +1 925 462 0306 |
| **S/N's:** | 0013500700001592<br>00135007000013D5 | | |
| **Test Date(s):** | 26 March - 03 April 2018 | **Website:** | www.micomlabs.com |

| STANDARD(S) | TEST RESULTS |
|---|---|
| FCC CFR 47 Part C 15.247 (FHSS); RSS-247 | 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.

A2LA ACCREDITED
TESTING CERT #2381.01

**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 | FCC 47 CFR Part 15.247 | 2016 | Radio Frequency Devices; Subpart C – Intentional Radiators |
| II | FCC Public Notice DA 00-705 | March 2000 | Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems |
| III | ANSI C63.10 | 2013 | American National Standard for Testing Unlicensed Wireless Devices |
| IV | ANSI C63.4 | 2014 | American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| V | ETSI TR 100 028 | 2001-12 | Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics |
| VI | FCC 47 CFR Part 15, Subpart B | 2014 | Title 47: Telecommunication PART 15—RADIO FREQUENCY DEVICES, SubPart B; Unintentional Radiators |
| VII | ICES-003 | Issue 6 Jan 2016; Updated April 2017 | Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement. |
| VIII | M 3003 | Edition 3 Nov.2012 | Expression of Uncertainty and Confidence in Measurements |
| IX | RSS-247 Issue 2 | Feb 2017 | Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices |
| X | RSS-Gen Issue 4; Amendment 1 | March 2018 | General Requirements for Compliance of Radio Apparatus |
| XI | FCC 47 CFR Part 2.1033 | 2016 | FCC requirements and rules regarding photographs and test setup diagrams. |
| XII | A2LA | August 2017 | R105 - Requirement's When Making Reference to A2LA Accreditation Status |

## 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 Itron, Inc. NIC 510-06 to FCC CFR 47 Part C 15.247 (FHSS); Radio Frequency Devices; Subpart C – Intentional Radiators; RSS-247. |
| Applicant: | Itron, Inc.<br>230 West Tasman Drive<br>San Jose California 95134 USA |
| Manufacturer: | Itron, Inc. |
| Laboratory performing the tests: | MiCOM Labs, Inc.<br>575 Boulder Court<br>Pleasanton California 94566 USA |
| Test report reference number: | ITRO01-U5 Rev A |
| Date EUT received: | 26th March 2018 |
| Standard(s) applied: | FCC CFR 47 Part C 15.247 (FHSS); RSS-247 |
| Dates of test (from - to): | 27 March - 03 April 2018 |
| No of Units Tested: | 3 |
| Product Family Name: | NIC 510-06 |
| Model(s): | NIC 511-0603-13; NIC 511-0602-14 (for USB testing) |
| Location for use: | Indoor/Outdoor |
| Declared Frequency Range(s): | 2400 - 2483.5 MHz; |
| Type of Modulation: | FHSS |
| EUT Modes of Operation: | 2400 - 2483.5 MHz:<br>300 kbps/GFSK; 600 kbps/OFDM; |
| Declared Nominal Output Power | 30 dBm |
| Transmit/Receive Operation: | Transceiver – Half Duplex |
| Rated Input Voltage and Current: | 4VDC |
| Operating Temperature Range: | -40 to +85 degrees C. |
| ITU Emission Designator: | 800KF1D, 400KF1D |
| Equipment Dimensions: | 110 mm x 45mm x 15mm |
| Weight: | 50g |
| Hardware Rev: | 173-0870-00 |
| Software Rev: | 4.4.0 |

## 5.2. Scope Of Test Program

**Itron, Inc. NIC 511-0603-13**

The scope of the test program was to test the Itron, Inc. NIC 511-0603-13, NIC 510-06 configurations in the frequency ranges 2400 - 2483.5 MHz; for compliance against the following specification:

**FCC CFR 47 Part 15.247 (FHSS);** Radio Frequency Devices; Subpart C – Intentional Radiators

**Industry Canada RSS-247**
Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices

**The following product description was provided by Itron Inc.**

The NIC 510-06 is a plug-in radio device, will communicate over mesh and HAN networks. May be integrated into host devices (i.e., FSU 5.0, IOTR 5, energy meters, etc.) to be used in Itron Smart Energy Networks (SEN). NIC 510-06 may be configured for host applications on USB or Serial data communications and may support standard or extended last gasp (ELG). The NIC 510-06 family supports basic meter types including single phase meters and three phase meters.

This report is intended to cover the NIC 510-06 family of products which includes the NIC 511-0603-13 and NIC 511-0602-14 and represents a worst case configuration of the product family.

NIC 510-06 products include the following model numbers/configurations:

NIC 511-0603: 900+2.4,INT/EXT ANT, HW1
NIC 511-0602: 900+2.4, EXT ANT,HW1
NIC 511-0601: 900+2.4, INT ANT, HW1
NIC 511-0601-13 : 900+2.4, INT ANT, HW1, 75s ELG
NIC 511-0602-13 : 900+2.4, EXT ANT, HW1, 75s ELG
NIC 511-0602-13 : 900+2.4, INT/EXT ANT,HW1, 75s ELG
NIC 511-0602-14 : 900+2.4, EXT ANT,HW1, USB

**Itron, Inc. NIC 511-0603-13**

## 5.3. Equipment Model(s) and Serial Number(s)

| Type (EUT | Equipment Description | Serial Number |
|---|---|---|
| EUT | NIC 511-0603-13 | 0013500700001592 |
| EUT | NIC 511-0602-14 | 00135007000013D5 |
| Support | IOTR5 SBC | Proto1 |

## 5.4. Antenna Details

| Type | Manufacturer | Model | Family | Gain (dBi) | BF Gain | Dir BW | X-Pol | Frequency Band (MHz) |
|---|---|---|---|---|---|---|---|---|
| integral | Tai Sheng Chen | 155-0010-00 | f type | 5.0 | - | 360 | - | 2400 - 2483.5 |
| external | WP | WPANT30017-CA | OMNI | 4.5 | - | 360 | - | 2400 - 2483.5 |
| external | WP | WPANT40020-SA | Wrap Around | 3.5 | - | 360 | - | 2400 - 2483.5 |

BF Gain - Beamforming Gain
Dir BW - Directional BeamWidth
X-Pol - Cross Polarization

## 5.5. Cabling and I/O Ports

| Port Type | Max Cable Length | # of Ports | Screened | Conn Type | Data Type |
|---|---|---|---|---|---|
| RS232 | 0 (direct plug) | 1 | No | 12-PIN | Packet Data |
| USB | 0 (direct plug) | 1 | No | 4-PIN | Packet Data |

## 5.6. Test Configurations

Results for the following configurations are provided in this report:

| Operational Mode(s) (802.11a/b/g/n/ac) | Data Rate with Highest Power MBit/s | Channel Frequency (MHz) | | |
|---|---|---|---|---|
| | | Low | Mid | High |
| **2400 - 2483.5 MHz** | | | | |
| 300 kbps/GFSK | 300 | 2400.8 | 2440.00 | 2472.8 |
| 600 kbps/OFDM | 600 | 2400.4 | 2440.00 | 2454.4 |

## 5.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:
1. NONE

## 5.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:
1. NONE

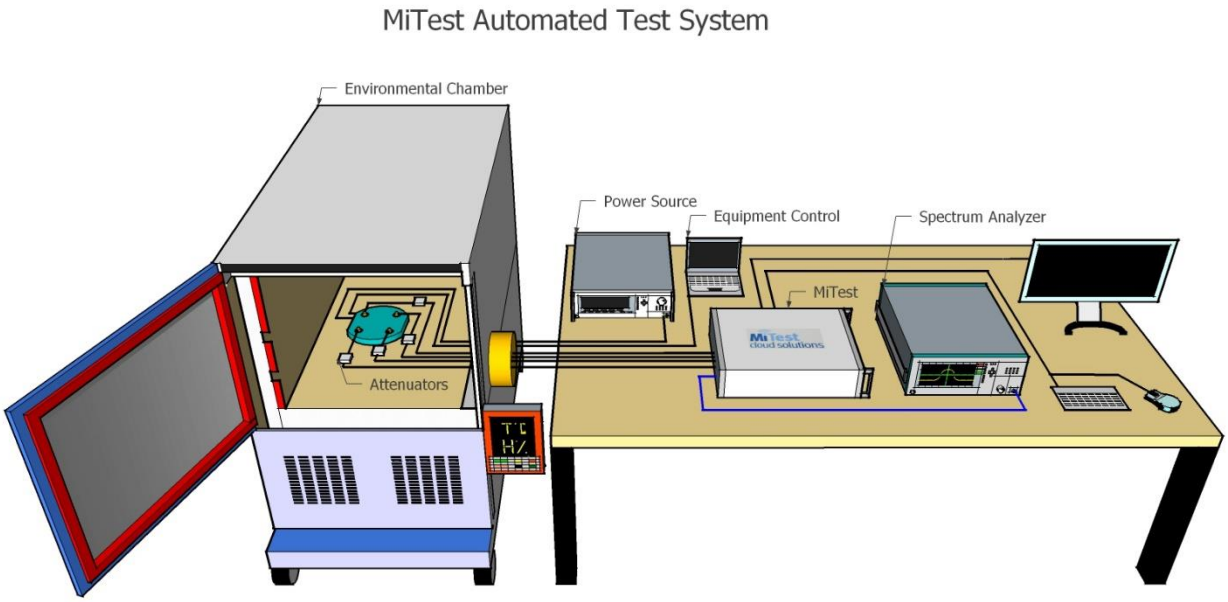
# 6. TEST SUMMARY

List of Measurements

| Test Header | Result | Data Link |
|---|---|---|
| 20 dB & 99% Bandwidth | Complies | View Data |
| Frequency Hopping Tests | Complies | View Data |
| Number of Hopping Channels | Complies | View Data |
| Channel Separation | Complies | View Data |
| Dwell Time | Complies | View Data |
| Channel Occupancy | Complies | View Data |
| Output Power | Complies | View Data |
| Emissions | Complies | View Data |
| (1) Conducted Emissions | Complies | View Data |
| (i) Conducted Unwanted Spurious Emissions | Complies | View Data |
| (ii) Conducted Band-Edge Emissions | Complies | View Data |
| (2) Radiated Emissions | Complies | View Data |
| (i) TX Spurious & Restricted Band Emissions | Complies | View Data |
| (ii) Restricted Edge & Band-Edge Emissions | Complies | View Data |
| (3) Digital Emissions (0.03 - 1 GHz) | Complies | View Data |
| (4) AC Wireline Emissions | Not Tested | View Data |

# 7. TEST EQUIPMENT CONFIGURATION(S)

## Conducted

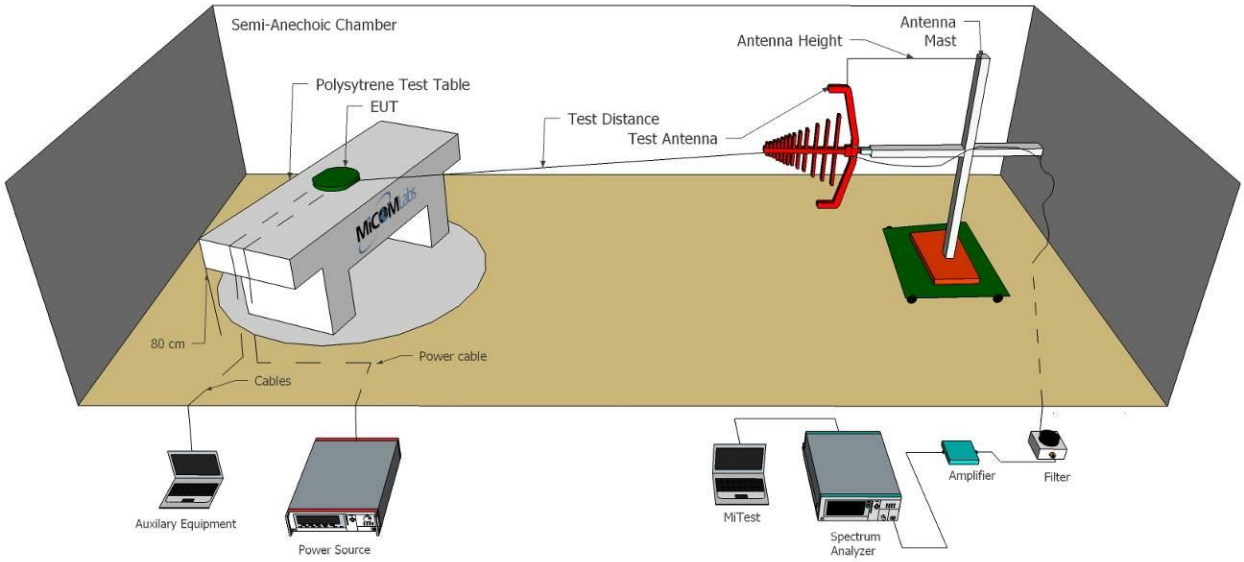



A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

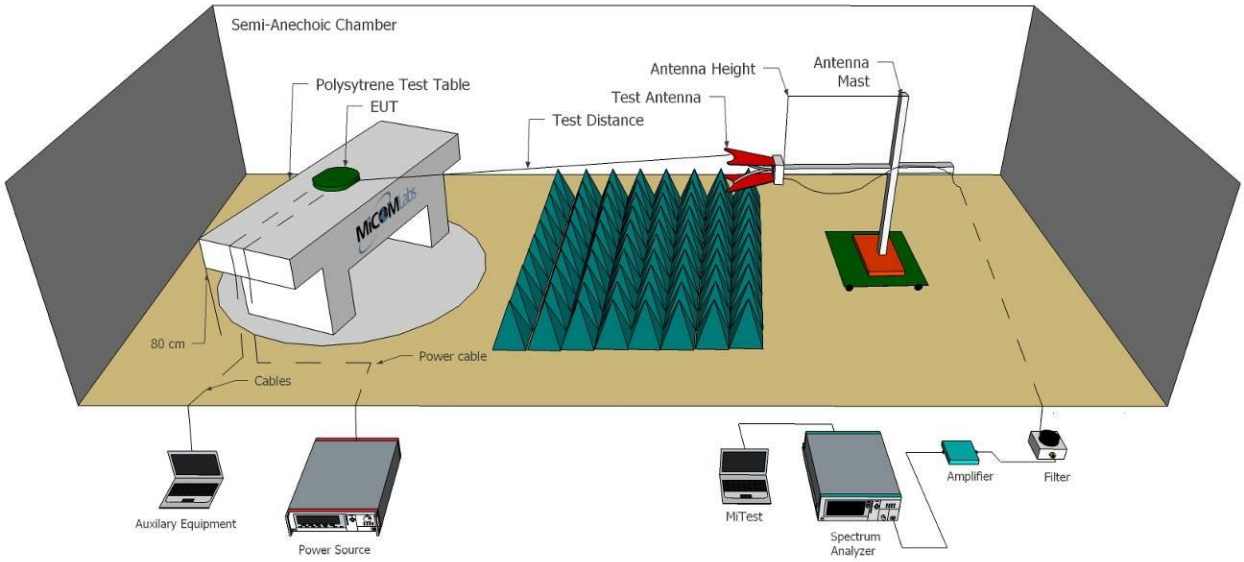
| Asset# | Description | Manufacturer | Model# | Serial# | Calibration Due Date |
|---|---|---|---|---|---|
| #3 SA | MiTest Box to SA | Fairview Microwave | SCA1814-0101-72 | #3 SA | 8 May 2018 |
| #3P1 | EUT to MiTest box port 1 | Fairview Microwave | SCA1814-0101-72 | #3P1 | 8 May 2018 |
| #3P2 | EUT to MiTest box port 2 | Fairview Microwave | SCA1814-0101-72 | #3P2 | 8 May 2018 |
| #3P3 | EUT to MiTest box port 3 | Fairview Microwave | SCA1814-0101-72 | #3P3 | 8 May 2018 |
| #3P4 | EUT to MiTest box port 4 | Fairview Microwave | SCA1812-0101-72 | #3P4 | 8 May 2018 |
| 249 | Resistance Thermometer | Thermotronics | GR2105-02 | 9340 #2 | 30 Oct 2018 |
| 287 | Rohde & Schwarz 40 GHz Receiver | Rhode & Schwarz | ESIB40 | 100201 | 2 May 2018 |
| 361 | Desktop for RF#1, Labview Software installed | Dell | Vostro 220 | WS RF#1 | Not Required |
| 390 | USB Power Head 50MHz - 24GHz -60 to +20dBm | Agilent | U2002A | MY50000103 | 17 Dec 2018 |
| 398 | MiTest RF Conducted Test Software | MiCOM | MiTest ATS | Version 4.1 | Not Required |
| 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 |
| 436 | USB Wideband Power Sensor | Boonton | 55006 | 8731 | 14 Sep 2018 |
| 441 | USB Wideband Power Sensor | Boonton | 55006 | 9179 | 20 Sep 2018 |
| 443 | 4x4 RF Switch Box | MiCOM Labs | MiTest 4X4 RF Switch Box | MIC003 | 8 May 2018 |
| 445 | PoE Injector | D-Link | DPE-101GL | QTAH1E2000625 | Not Required |
| 461 | Spectrum Analyzer | Agilent | E4440A | MY46185537 | 20 Sep 2018 |
| 510 | Barometer/Thermometer | Control Company | 68000-49 | 170871375 | 11 Dec 2018 |
| 75 | Environmental Chamber | Thermatron | SE-300-2-2 | 27946 | 24 Dec 2018 |

## Radiated Emissions - 3m Chamber

Radiated Emissions Below 1GHz Test Setup




Radiated Emissions Above 1GHz Test Setup

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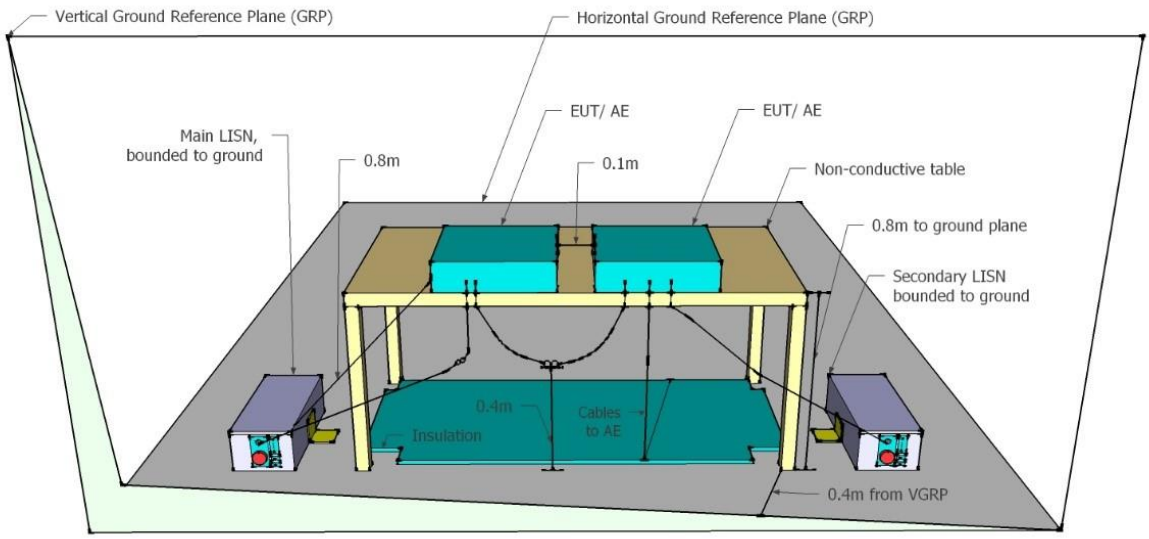
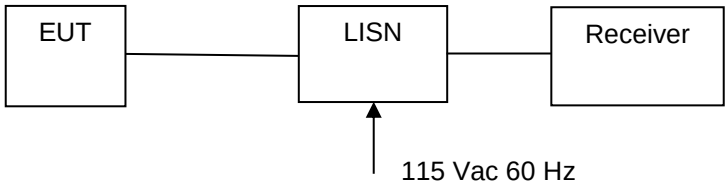
| Asset# | Description | Manufacturer | Model# | Serial# | Calibration Due Date |
|---|---|---|---|---|---|
| 170 | Video System Controller for Semi Anechoic Chamber | Panasonic | WV-CU101 | 04R08507 | Not Required |
| 287 | Rohde & Schwarz 40 GHz Receiver | Rhode & Schwarz | ESIB40 | 100201 | 2 May 2018 |
| 298 | 3M Radiated Emissions Chamber Maintenance Check | MiCOM | 3M Chamber | 298 | 28 Apr 2018 |
| 338 | Sunol 30 to 3000 MHz Antenna | Sunol | JB3 | A052907 | 5 Oct 2018 |
| 342 | 2.4 GHz Notch Filter | EWT | EWT-14-0203 | H1 | 6 Oct 2018 |
| 397 | Amp 10 - 2500MHz | MiCOM Labs | Amp 10 - 2500 MHz | NA | 12 Oct 2018 |
| 399 | ETS 1-18 GHz Horn Antenna | ETS | 3117 | 00154575 | 12 Oct 2018 |
| 406 | Amplifier for Radiated Emissions | MiCOM Labs | 40dB 1 to 18GHz Amp | 0406 | 12 Oct 2018 |
| 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 |
| 415 | Turntable Controller | Sunol Sciences | Turntable Controller | 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 | 4 Oct 2018 |
| 463 | Schwarzbeck cable from Amplifier to Bulkhead. | Schwarzbeck | AK 9513 | 463 | 4 Oct 2018 |
| 464 | Schwarzbeck cable from Bulkhead to Receiver | Schwarzbeck | AK 9513 | 464 | 4 Oct 2018 |
| 465 | Low Pass Filter DC-1000 MHz | Mini-Circuits | NLP-1200+ | VUU01901402 | 6 Oct 2018 |
| 466 | Low Pass Filter DC-1500 MHz | Mini-Circuits | NLP-1750+ | VUU10401438 | 6 Oct 2018 |
| 480 | Cable - Bulkhead to Amp | SRC Haverhill | 157-3050360 | 480 | 6 Oct 2018 |
| 481 | Cable - Bulkhead to Receiver | SRC Haverhill | 151-3050787 | 481 | 6 Oct 2018 |
| 482 | Cable - Amp to Antenna | SRC Haverhill | 157-3051574 | 482 | 6 Oct 2018 |
| 510 | Barometer/Thermometer | Control Company | 68000-49 | 170871375 | 11 Dec 2018 |
| CC05 | Confidence Check | MiCOM | CC05 | None | 19 Jul 2018 |
| VLF-1700 | Low pass filter DC-1700 MHz | Mini Circuits | VLF-1700 | None | 6 Oct 2018 |

## AC Wireline Emissions

The ac Wireline Conducted Emissions test was performed using the conducted test set-up shown in the diagram below.

**Test Measurement Set up**



**Assets Utilized for ac Wireline Emission Testing**

| Asset# | Description | Manufacturer | Model# | Serial# | Calibration Due Date |
|---|---|---|---|---|---|
| 158 | Barometer/Thermometer | Control Company | 4196 | E2846 | 30 Nov 2018 |
| 184 | Pulse Limiter | Rhode & Schwarz | ESH3Z2 | 357.8810.52 | 6 Oct 2018 |
| 190 | LISN (two-line V-network) | Rhode & Schwarz | ESH3Z5 | 836679/006 | 18 Oct 2018 |
| 287 | Rohde & Schwarz 40 GHz Receiver | Rhode & Schwarz | ESIB40 | 100201 | 2 May 2018 |
| 307 | BNC-CABLE | Megaphase | 1689 1GVT4 | 15F50B002 | 6 Oct 2018 |
| 316 | Dell desktop computer workstation | Dell | Desktop | WS04 | Not Required |
| 372 | AC Variable PS | California Instruments | 1251P | L06951 | Cal when used |
| 388 | LISN (3 Phase) 9kHz - 30MHz | Rohde & Schwarz | ESH2-Z5 | 892107/022 | 20 Oct 2018 |
| 496 | MiTest Conducted Emissions test software. | MiCOM | Conducted Emissions Test Software Version 1.0 | 496 | Not Required |
| CCEMC01 | Confidence Check. | MiCOM | CCEMC01 | None | 2 Jul 2018 |

# 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. 20 dB & 99% Bandwidth

| Conducted Test Conditions for 20 dB and 99% Bandwidth | | | |
|---|---|---|---|
| **Rules and Sections:** | FCC CFR 47:15.247<br>ISED RSS-247:5.1 | **Ambient Temp. (ºC):** | 24.0 - 27.5 |
| **Test Heading:** | 20 dB and 99 % Bandwidth | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | ANSI C63.10:2013: 7.8.7<br>Public Notice DA 00-705 | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

**Test Procedure for 20 dB and 99% Bandwidth Measurement**

The bandwidth at 20 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.

### 20 dB Bandwidth

Use the following spectrum analyzer settings:
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel
RBW = 1% of the 20 dB bandwidth
VBW = RBW
Sweep = auto
Detector function = peak
Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

### Occupied bandwidth—Power bandwidth (99%) measurement procedure[30]

The OBW is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring (99%) power bandwidth:31

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of 1.5 × OBW is sufficient).

b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.

NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

d) Set the detection mode to peak, and the trace mode to max-hold.

e) If the instrument does not have a 99% OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5% of the total is reached and record that frequency as the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.

f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).

| Equipment Configuration for 20 dB 99% Bandwidth | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 300.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | GFSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Measured 20 dB Bandwidth (MHz) Port(s) | | | | 20 dB Bandwidth (MHz) | | Limit | Lowest Margin |
|---|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | Highest | Lowest | MHz | MHz |
| 2400.8 | 0.378 | | | | 0.378 | 0.378 | | |
| 2440.0 | 0.378 | | | | 0.378 | 0.378 | | |
| 2472.8 | 0.375 | | | | 0.375 | 0.375 | | |

| Test Frequency | Measured 99% Bandwidth (MHz) Port(s) | | | | Maximum 99% Bandwidth (MHz) | | |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | | | |
| 2400.8 | 0.330 | | | | 0.330 | | |
| 2440.0 | 0.330 | | | | 0.330 | | |
| 2472.8 | 0.330 | | | | 0.330 | | |

| 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 20 dB 99% Bandwidth | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 600.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OFDM | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Measured 20 dB Bandwidth (MHz) Port(s) | | | | 20 dB Bandwidth (MHz) | | Limit | Lowest Margin |
|---|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | Highest | Lowest | MHz | MHz |
| 2400.4 | 0.372 | | | | 0.372 | 0.372 | | |
| 2440.0 | 0.396 | | | | 0.396 | 0.396 | | |
| 2472.0 | 0.407 | | | | 0.407 | 0.407 | | |

| Test Frequency | Measured 99% Bandwidth (MHz) Port(s) | | | | Maximum 99% Bandwidth (MHz) | | |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | | | |
| 2400.4 | 0.317 | | | | 0.317 | | |
| 2440.0 | 0.330 | | | | 0.330 | | |
| 2472.0 | 0.356 | | | | 0.356 | | |

| 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. Frequency Hopping Tests

| Conducted Test Conditions for Frequency Hopping Measurements | | | |
|---|---|---|---|
| **Rules and Sections:** | FCC CFR 47:15.247 (a)(1)(i)/(iii)<br>ISED RSS-247:5.1 | **Ambient Temp. (ºC):** | 24.0 - 27.5 |
| **Test Heading:** | Frequency Hopping Tests | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | Public Notice DA 00-705 | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References, FCC Public Notice DA 00-705 | | |

**Test Procedure for Frequency Hopping Measurements**

These tests cover the following measurements:

i) channel separation
ii) channel occupancy
iii) dwell time
iv) number of hopping frequencies

Frequency hopping testing was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency or hopping mode.

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.

### Carrier Frequency Separation

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
Span = wide enough to capture the peaks of two adjacent channels
Resolution (or IF) Bandwidth (RBW) □ 1% of the span
Video (or Average) Bandwidth (VBW) □ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

### Number of Hopping Frequencies

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:
Span = the frequency band of operation
RBW = 1% of the span
VBW = RBW
Sweep = auto
Detector function = peak
Trace = max hold

Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

### Time of Occupancy (Dwell Time)

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = zero span, centered on a hopping channel
RBW = 1 MHz

VBW = RBW
Sweep = as necessary to capture the entire dwell time per hopping channel
Detector function = peak
Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section.
Submit this plot(s). An oscilloscope may be used instead of a spectrum analyzer.

### 9.2.1. Number of Hopping Channels

| Equipment Configuration for Number of Hopping Channels | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Antenna:** | Not Applicable |
| **Data Rate:** | 300.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | GFSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **Duty Cycle (%):** | 99.0 | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Frequency Range (MHz) | Number of Hopping Channels | Limit (Minimum) | Pass / Fail |
|---|---|---|---|
| 2400.0-2483.5 | 91 | **15** | **Pass** |

| 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 Number of Hopping Channels | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Antenna:** | Not Applicable |
| **Data Rate:** | 600.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OFDM | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **Duty Cycle (%):** | 99.0 | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Frequency Range (MHz) | Number of Hopping Channels | Limit Limit (Minimum | Pass / Fail |
|---|---|---|---|
| 2400.0-2483.5 | 136 | **15** | **Pass** |

| 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).

## 9.2.2. Channel Separation

| Equipment Configuration for Channel Separation | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Antenna:** | Not Applicable |
| **Data Rate:** | 300.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | GFSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **Duty Cycle (%):** | 99.0 | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Center Frequency (MHz) | Chan Separation (MHz) | Limit (MHz) | Pass / Fail |
|---|---|---|---|
| 2440.0 | 0.800 | 0.375 | Pass |

| 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 Channel Separation | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Antenna:** | Not Applicable |
| **Data Rate:** | 600.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OFDM | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **Duty Cycle (%):** | 99.0 | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Center Frequency (MHz) | Chan Separation (MHz) | Limit (MHz) | Pass / Fail |
|---|---|---|---|
| 2440.0 | 0.400 | 0.372 | Pass |

| 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).

### 9.2.3. Dwell Time & Channel Occupancy

| Equipment Configuration for Dwell Time & Channel Occupancy | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Antenna:** | Not Applicable |
| **Data Rate:** | 300.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | GFSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **Duty Cycle (%):** | 99.0 | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Channel Frequency(MHz) | Dwell Time (Single Burst) (S) | Channel Occupancy (mS) | Observation Period (S) | Channel Occupancy Limit (mS) | Pass / Fail |
|---|---|---|---|---|---|
| 2440.0 | 0.003 | 33.570 | 20.00 | 400.000 | Pass |

| Traceability to Industry Recognized Test Methodologies | |
|---|---|
| Work Instruction: | |
| Measurement Uncertainty: | |

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

| Equipment Configuration for Dwell Time & Channel Occupancy | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Antenna:** | Not Applicable |
| **Data Rate:** | 600.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OFDM | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **Duty Cycle (%):** | 99.0 | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Channel Frequency(MHz) | Dwell Time (Single Burst) (S) | Channel Occupancy (mS) | Observation Period (S) | Channel Occupancy Limit (mS) | Pass / Fail |
|---|---|---|---|---|---|
| 2440.0 | 0.003 | 129.370 | 20.00 | 400.000 | Pass |

| Traceability to Industry Recognized Test Methodologies | |
|---|---|
| Work Instruction: | |
| Measurement Uncertainty: | |

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

## 9.3. Output Power

| Conducted Test Conditions for Fundamental Emission Output Power | | | |
|---|---|---|---|
| **Rules and Sections:** | FCC CFR 47: 15.247 (a)(1), (b)(1)/(2)/(3)<br>ISED RSS-247:5.4 | **Ambient Temp. (ºC):** | 24.0 - 27.5 |
| **Test Heading:** | Output Power | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | Public Notice DA 00-705 | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

**Output power test procedure for frequency-hopping spread-spectrum (FHSS) devices**

### Peak Output Power

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power. The limit is specified in one of the subparagraphs of this Section. Submit this plot. A peak responding power meter may be used instead of a spectrum analyzer

| Equipment Configuration for Output Power Peak |
|---|

| | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 300.00 KBit/s | **Antenna Gain (dBi):** | 3.50 |
| **Modulation:** | GFSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**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 | |
| **2400.8** | 24.39 | | | | 24.39 | 30.00 | -5.61 | 21.00 |
| **2440.0** | 24.17 | | | | 24.17 | 30.00 | -5.83 | 21.00 |
| **2472.8** | 24.60 | | | | 24.60 | 30.00 | -5.40 | 21.00 |

| 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 Output Power Peak |
|---|

| | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 600.00 KBit/s | **Antenna Gain (dBi):** | 3.50 |
| **Modulation:** | OFDM | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**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 | |
| **2400.4** | 24.71 | | | | 24.71 | 30.00 | -5.29 | 21.00 |
| **2440.0** | 24.33 | | | | 24.33 | 30.00 | -5.67 | 21.00 |
| **2472.0** | 24.41 | | | | 24.41 | 30.00 | -5.59 | 21.00 |

| 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.

## 9.4. Emissions

### 9.4.1. Conducted Emissions

| Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions | | | |
|---|---|---|---|
| **Rules and Sections:** | FCC CFR 47:15.247 (d)<br>ISED RSS-247:5.5 | **Ambient Temp. (ºC):** | 24.0 - 27.5 |
| **Test Heading:** | Transmitter Conducted Spurious and Band-Edge Emissions | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | Public Notice DA 00-705 | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

**Test Procedure for Conducted Spurious and Band-Edge Emissions**

Conducted Spurious and Band-Edge Emissions were measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate frequency. Band-Edge Emissions were also tested with the EUT in hopping mode.

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

**Band-edge Compliance of RF Conducted Emissions**

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge.

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section. Submit this plot. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit. Submit this plot.

**Spurious RF Conducted Emissions**

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions.

RBW = 100 kHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section. Submit these plots.

### 9.4.1.1. Conducted Unwanted Spurious Emissions

| Equipment Configuration for Unwanted Emissions Peak | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 300.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | GFSK | **Beam Forming Gain (Y):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Frequency Range | Unwanted Emissions Peak (dBm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Port a | | Port b | | Port c | | Port d | |
| MHz | MHz | SE | Limit | SE | Limit | SE | Limit | SE | Limit |
| **2400.8** | 30.0 - 26000.0 | -40.289 | 2.96 | | | | | | |
| **2440.0** | 30.0 - 26000.0 | -40.233 | 1.83 | | | | | | |
| **2472.8** | 30.0 - 26000.0 | -40.017 | 1.75 | | | | | | |

| 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 Unwanted Emissions Peak | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 600.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OFDM | **Beam Forming Gain (Y):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Frequency Range | Unwanted Emissions Peak (dBm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Port a | | Port b | | Port c | | Port d | |
| MHz | MHz | SE | Limit | SE | Limit | SE | Limit | SE | Limit |
| **2400.4** | 30.0 - 26000.0 | -39.677 | 0.03 | | | | | | |
| **2440.0** | 30.0 - 26000.0 | 20.048 | 0.05 | | | | | | |
| **2472.0** | 30.0 - 26000.0 | -40.662 | 0.29 | | | | | | |

| 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

| Equipment Configuration for Conducted Low Band-Edge Emissions (Hopping) Peak |
|---|

| | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 300.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | GFSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

| Test Measurement Results |
|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 2400.8 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** | -25.46 | 3.92 | 2400.50 | | | -0.500 |

| 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 (Hopping) Peak |
|---|

| | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 600.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OFDM | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 2400.4 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** | -8.84 | 1.52 | 2400.00 | | | **0.000** |

| 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).

M1 is the highest emission measured with respect to the emissions limit at or below the Band Edge.

| Equipment Configuration for Conducted Low Band-Edge Emissions (Static) Peak |
|---|

| | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 300.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | GFSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 2400.8 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** | -28.49 | 2.82 | 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 Low Band-Edge Emissions (Static) Peak |
|---|

| | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 600.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OFDM | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 2400.4 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** | -2.30 | 1.53 | 2400.00 | | | **0.000** |

| 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).

M1 is the highest emission measured with respect to the emissions limit at or below the Band Edge.

| Equipment Configuration for Conducted Upper Band-Edge Emissions (Hopping) Peak |
|---|

| | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 300.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | GFSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 2472.8 MHz | | | | | |
| **Band-Edge Frequency:** | 2483.5 MHz | | | | | |
| **Test Frequency Range:** | 2470.0 - 2534.0 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** | -38.51 | 3.44 | 2473.10 | | | -10.400 |

| 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 Upper Band-Edge Emissions (Hopping) Peak |
|---|

| | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 600.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OFDM | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 2454.4 MHz | | | | | |
| **Band-Edge Frequency:** | 2483.5 MHz | | | | | |
| **Test Frequency Range:** | 2453.0 - 2534.0 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** | -45.21 | 0.59 | 2454.60 | | | -28.900 |

| 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 Upper Band-Edge Emissions (Static) Peak | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 300.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | GFSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 2472.8 MHz | | | | | |
| **Band-Edge Frequency:** | 2483.5 MHz | | | | | |
| **Test Frequency Range:** | 2470.0 - 2533.0 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** | -39.53 | 2.33 | 2473.20 | | | -10.300 |

| 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 Upper Band-Edge Emissions (Static) Peak |
|---|

| | | | |
|---|---|---|---|
| **Variant:** | FHSS | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 600.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OFDM | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 2454.4 MHz | | | | | |
| **Band-Edge Frequency:** | 2483.5 MHz | | | | | |
| **Test Frequency Range:** | 2453.0 - 2533.0 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** | -45.13 | 1.97 | 2454.80 | | | -28.700 |

| 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) | | | |
|---|---|---|---|
| **Rules and Sections:** | FCC CFR 47: Part 15.205<br>ISED RSS-GEN:8.9, 8.10 | **Ambient Temp. (ºC):** | 20.0 - 24.5 |
| **Test Heading:** | Radiated Spurious and Band-Edge Emissions | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | ANSI C63.10: 6.3, 6.5 & 6.6, 6.10 | **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.

Limits for Restricted Bands
Peak emission: 74 dBuV/m
Average emission: 54 dBuV/m

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 dBmV/m

Conversion between dBmV/m (or dBmV) and mV/m (or mV) are as follows:
Level (dBmV/m) = 20 * Log (level (mV/m))

40 dBmV/m = 100 mV/m
48 dBmV/m = 250 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.

### 9.4.2.3. TX Spurious & Restricted Band Emissions

**Antenna:** Tai Sheng Chen 155-0010-00

| Equipment Configuration for TX Spurious & Restricted Band Emissions | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Chen 155-0010-00 | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 5.00 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2400.80 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 2400.82 | 55.59 | 2.24 | -12.41 | 45.42 | Fundamental | Vertical | 100 | 76 | -- | -- | |
| #2 | 7202.23 | 49.64 | 3.46 | -7.38 | 45.72 | Peak (NRB) | Vertical | 200 | 190 | -- | -- | Pass |
| #3 | 12004.01 | 54.03 | 4.77 | -7.02 | 51.78 | Max Peak | Horizontal | 192 | 115 | 74.0 | -22.2 | Pass |
| #4 | 12004.01 | 45.55 | 4.77 | -7.02 | 43.30 | Max Avg | Horizontal | 192 | 115 | 54.0 | -10.7 | Pass |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

**Equipment Configuration for TX Spurious & Restricted Band Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Chen 155-0010-00 | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 5.00 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2440.00 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

**1000.00 - 18000.00 MHz**

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| #1 | 2439.96 | 65.93 | 2.27 | -12.08 | 56.12 | Fundamental | Horizontal | 100 | 0 | -- | -- | |
| #2 | 7320.15 | 53.42 | 3.49 | -7.86 | 49.05 | Max Peak | Vertical | 111 | 177 | 74.0 | -25.0 | Pass |
| #3 | 7320.15 | 46.28 | 3.49 | -7.86 | 41.91 | Max Avg | Vertical | 111 | 177 | 54.0 | -12.1 | Pass |
| #4 | 12200.23 | 54.01 | 4.66 | -4.76 | 53.91 | Max Peak | Horizontal | 182 | 113 | 74.0 | -20.1 | Pass |
| #5 | 12200.23 | 45.88 | 4.66 | -4.76 | 45.78 | Max Avg | Horizontal | 182 | 113 | 54.0 | -8.2 | Pass |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

**Equipment Configuration for TX Spurious & Restricted Band Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Chen 155-0010-00 | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 5.00 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2472.80 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

**1000.00 - 18000.00 MHz**

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| #1 | 2472.70 | 63.31 | 2.26 | -11.92 | 53.65 | Fundamental | Vertical | 151 | 121 | -- | -- | |
| #2 | 7418.60 | 52.97 | 3.54 | -8.00 | 48.51 | Max Peak | Vertical | 176 | 180 | 74.0 | -25.5 | Pass |
| #3 | 7418.60 | 45.45 | 3.54 | -8.00 | 40.99 | Max Avg | Vertical | 176 | 180 | 54.0 | -13.0 | Pass |
| #4 | 12364.36 | 54.57 | 4.65 | -4.86 | 54.36 | Max Peak | Horizontal | 180 | 84 | 74.0 | -19.6 | Pass |
| #5 | 12364.36 | 46.08 | 4.65 | -4.86 | 45.87 | Max Avg | Horizontal | 180 | 84 | 54.0 | -8.1 | Pass |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

**Equipment Configuration for TX Spurious & Restricted Band Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Chen 155-0010-00 | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 5.00 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | Hopping | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 2461.61 | 63.65 | 2.29 | -11.95 | 53.99 | Fundamental | Horizontal | 100 | 0 | -- | -- | Pass |
| #2 | 7421.08 | 49.06 | 3.54 | -8.05 | 44.55 | Max Peak | Vertical | 112 | 274 | 74.0 | -29.5 | Pass |
| #3 | 7421.08 | 35.50 | 3.54 | -8.05 | 30.99 | Max Avg | Vertical | 112 | 274 | 54.0 | -23.0 | Pass |
| #4 | 12348.38 | 49.04 | 4.58 | -4.56 | 49.06 | Max Peak | Horizontal | 115 | 247 | 74.0 | -24.9 | Pass |
| #5 | 12348.38 | 35.62 | 4.58 | -4.56 | 35.64 | Max Avg | Horizontal | 115 | 247 | 54.0 | -18.4 | Pass |
| Test Notes: EUT powered by 4V DC. 2.4 GHz Notch in front of amp to prevent overload. Hopping | | | | | | | | | | | | |

**Antenna: WP WPANT30017-CA**

| Equipment Configuration for TX Spurious & Restricted Band Emissions | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT30017-CA | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 4.50 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2400.80 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 2400.92 | 53.14 | 2.24 | -12.41 | 42.97 | Fundamental | Vertical | 100 | 161 | -- | -- | |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

**Equipment Configuration for TX Spurious & Restricted Band Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT30017-CA | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 4.50 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2440.00 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 2440.01 | 54.80 | 2.27 | -12.08 | 44.99 | Fundamental | Vertical | 100 | 154 | -- | -- | |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

**Equipment Configuration for TX Spurious & Restricted Band Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT30017-CA | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 4.50 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2472.80 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

**1000.00 - 18000.00 MHz**

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| #1 | 2472.92 | 59.41 | 2.26 | -11.92 | 49.75 | Fundamental | Vertical | 100 | 42 | -- | -- | |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

**Equipment Configuration for TX Spurious & Restricted Band Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT30017-CA | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 4.50 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | Hopping | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 2466.35 | 59.96 | 2.27 | -11.97 | 50.26 | Fundamental | Vertical | 200 | 0 | -- | -- | Pass |
| #2 | 9836.61 | 49.25 | 4.45 | -6.34 | 47.36 | Peak (NRB) | Vertical | 200 | 86 | -- | -- | Pass |
| #3 | 12355.99 | 48.48 | 4.61 | -4.68 | 48.41 | Max Peak | Vertical | 170 | 92 | 74.0 | -25.6 | Pass |
| #4 | 12355.99 | 35.25 | 4.61 | -4.68 | 35.18 | Max Avg | Vertical | 170 | 92 | 54.0 | -18.8 | Pass |
| Test Notes: EUT powered by 4V DC. 2.4 GHz Notch filter in front of amp to prevent overload. Hopping | | | | | | | | | | | | |

## Antenna: WP WPANT40020-SA

**Equipment Configuration for TX Spurious & Restricted Band Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT40020-SA | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 3.50 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2400.80 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

**1000.00 - 18000.00 MHz**

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| #1 | 2400.70 | 56.75 | 2.24 | -12.41 | 46.58 | Fundamental | Horizontal | 200 | 95 | -- | -- | |
| #2 | 4801.61 | 58.63 | 2.96 | -12.43 | 49.16 | Max Peak | Vertical | 101 | 214 | 74.0 | -24.8 | Pass |
| #3 | 4801.61 | 53.13 | 2.96 | -12.43 | 43.66 | Max Avg | Vertical | 101 | 214 | 54.0 | -10.3 | Pass |
| #4 | 9603.08 | 50.22 | 4.54 | -6.67 | 48.09 | Peak (NRB) | Horizontal | 200 | 175 | -- | -- | Pass |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

**Equipment Configuration for TX Spurious & Restricted Band Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT40020-SA | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 3.50 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2440.00 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

**1000.00 - 18000.00 MHz**

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| #1 | 2439.94 | 62.92 | 2.27 | -12.08 | 53.11 | Fundamental | Horizontal | 100 | 60 | -- | -- | |
| #2 | 9759.74 | 51.66 | 4.37 | -5.95 | 50.08 | Peak (NRB) | Horizontal | 100 | 185 | -- | -- | Pass |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

**Equipment Configuration for TX Spurious & Restricted Band Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT40020-SA | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 3.50 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2472.80 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

**1000.00 - 18000.00 MHz**

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| #1 | 2472.92 | 60.09 | 2.26 | -11.92 | 50.43 | Fundamental | Vertical | 100 | 114 | -- | -- | |
| #2 | 7418.47 | 54.77 | 3.54 | -8.00 | 50.31 | Max Peak | Horizontal | 151 | 188 | 74.0 | -23.7 | Pass |
| #3 | 7418.47 | 48.20 | 3.54 | -8.00 | 43.74 | Max Avg | Horizontal | 151 | 188 | 54.0 | -10.3 | Pass |
| #4 | 9891.22 | 50.89 | 4.48 | -6.76 | 48.61 | Peak (NRB) | Horizontal | 100 | 175 | -- | -- | Pass |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

**Equipment Configuration for TX Spurious & Restricted Band Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT40020-SA | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 3.50 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | Hopping | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 2464.16 | 65.34 | 2.28 | -11.96 | 55.66 | Peak (NRB) | Horizontal | 151 | 150 | -- | -- | Pass |
| #2 | 7365.89 | 51.31 | 3.52 | -7.81 | 47.02 | Max Peak | Vertical | 160 | 153 | 74.0 | -27.0 | Pass |
| #3 | 7365.89 | 35.60 | 3.52 | -7.81 | 31.31 | Max Avg | Vertical | 160 | 153 | 54.0 | -22.7 | Pass |
| #4 | 9856.23 | 52.55 | 4.41 | -6.57 | 50.39 | Peak (NRB) | Horizontal | 151 | 279 | -- | -- | Pass |
| Test Notes: EUT powered by 4V DC. 2.4 GHz Notch in front of amp to prevent overload. Hopping | | | | | | | | | | | | |

### 9.4.2.4. Restricted Edge & Band-Edge Emissions

| Tai Sheng Chen 155-0010-00 | | Band-Edge Freq | Limit 74.0dBµV/m | Limit 54.0dBµV/m | Power Setting |
|---|---|---|---|---|---|
| Operational Mode | Operating Frequency (MHz) | MHz | dBµV/m | dBµV/m | |
| GFSK | 2400.80 | 2390.00 | 62.30 | 49.46 | 21 |
| GFSK | 2472.80 | 2483.5 | 65.57 | 53.58 | 21 |

| Antenna: WP WPANT30017-CA | | Band-Edge Freq | Limit 74.0dBµV/m | Limit 54.0dBµV/m | Power Setting |
|---|---|---|---|---|---|
| Operational Mode | Operating Frequency (MHz) | MHz | dBµV/m | dBµV/m | |
| GFSK | 2400.80 | 2390.00 | 59.74 | 46.73 | 21 |
| GFSK | 2472.80 | 2483.5 | 61.63 | 49.14 | 21 |

| Antenna: WP WPANT40020-SA | | Band-Edge Freq | Limit 74.0dBµV/m | Limit 54.0dBµV/m | Power Setting |
|---|---|---|---|---|---|
| Operational Mode | Operating Frequency (MHz) | MHz | dBµV/m | dBµV/m | |
| GFSK | 2400.80 | 2390.00 | 60.98 | 48.01 | 21 |
| GFSK | 2472.80 | 2483.5 | 63.13 | 50.79 | 21 |

## Antenna: Tai Sheng Chen 155-0010-00

**Equipment Configuration for Radiated - Lower Restricted Band-Edge Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Chen 155-0010-00 | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2400.80 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

| 2310.00 - 2422.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 2389.78 | 28.08 | 2.26 | 31.96 | 62.30 | Max Peak | Horizontal | 130 | 80 | 74.0 | -11.7 | Pass |
| #2 | 2390.00 | 15.24 | 2.26 | 31.96 | 49.46 | Max Avg | Horizontal | 130 | 80 | 54.0 | -4.5 | Pass |
| #3 | 2390.00 | -- | -- | -- | -- | Restricted-Band | -- | -- | -- | -- | -- | -- |
| Test Notes: EUT powered by 4 volt DC, | | | | | | | | | | | | |

**Equipment Configuration for Radiated - Upper Restricted Band-Edge Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Chen 155-0010-00 | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 5.00 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2472.80 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

| 2470.00 - 2550.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 2483.50 | 19.00 | 2.25 | 32.33 | 53.58 | Max Avg | Horizontal | 130 | 80 | 54.0 | -0.4 | Pass |
| #3 | 2483.66 | 30.99 | 2.25 | 32.33 | 65.57 | Max Peak | Horizontal | 130 | 80 | 74.0 | -8.4 | Pass |
| #2 | 2483.50 | -- | -- | -- | -- | Restricted-Band | -- | -- | -- | -- | -- | -- |
| Test Notes: EUT powered by 4 volt DC, | | | | | | | | | | | | |

## Antenna: WP WPANT30017-CA

**Equipment Configuration for Radiated - Lower Restricted Band-Edge Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT30017-CA | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2400.80 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

| 2310.00 - 2422.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 2389.01 | 25.53 | 2.26 | 31.95 | 59.74 | Max Peak | Vertical | 193 | 348 | 74.0 | -14.3 | Pass |
| #2 | 2390.00 | 12.51 | 2.26 | 31.96 | 46.73 | Max Avg | Vertical | 193 | 348 | 54.0 | -7.3 | Pass |
| #3 | 2390.00 | -- | -- | -- | -- | Restricted-Band | -- | -- | -- | -- | -- | -- |
| Test Notes: EUT powered by 4 volt DC, | | | | | | | | | | | | |

**Equipment Configuration for Radiated - Upper Restricted Band-Edge Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT30017-CA | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 4.50 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2472.80 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

| 2470.00 - 2550.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 2483.50 | 14.56 | 2.25 | 32.33 | 49.14 | Max Avg | Vertical | 193 | 348 | 54.0 | -4.9 | Pass |
| #3 | 2485.90 | 27.05 | 2.25 | 32.33 | 61.63 | Max Peak | Vertical | 193 | 348 | 74.0 | -12.4 | Pass |
| #2 | 2483.50 | -- | -- | -- | -- | Restricted-Band | -- | -- | -- | -- | -- | -- |
| Test Notes: EUT powered by 4 volt DC, | | | | | | | | | | | | |

## Antenna: WP WPANT40020-SA

**Equipment Configuration for Radiated - Lower Restricted Band-Edge Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT40020-SA | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2400.80 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

| 2310.00 - 2422.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 2389.33 | 26.77 | 2.26 | 31.95 | 60.98 | Max Peak | Horizontal | 200 | 153 | 74.0 | -13.0 | Pass |
| #2 | 2390.00 | 13.79 | 2.26 | 31.96 | 48.01 | Max Avg | Horizontal | 200 | 153 | 54.0 | -6.0 | Pass |
| #3 | 2390.00 | -- | -- | -- | -- | Restricted-Band | -- | -- | -- | -- | -- | -- |
| Test Notes: EUT powered by 4 volt DC | | | | | | | | | | | | |

**Equipment Configuration for Radiated - Upper Restricted Band-Edge Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT40020-SA | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2472.80 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

**Test Measurement Results**

| 2470.00 - 2550.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 2483.50 | 16.21 | 2.25 | 32.33 | 50.79 | Max Avg | Horizontal | 183 | 159 | 54.0 | -3.2 | Pass |
| #3 | 2485.74 | 28.55 | 2.25 | 32.33 | 63.13 | Max Peak | Horizontal | 183 | 159 | 74.0 | -10.9 | Pass |
| #2 | 2483.50 | -- | -- | -- | -- | Restricted-Band | -- | -- | -- | -- | -- | -- |
| Test Notes: EUT powered by 4 volt DC | | | | | | | | | | | | |

### 9.4.3. Digital Emissions (0.03 - 1 GHz)

| Radiated Test Conditions for Radiated Digital and Receiver Emissions (0.03 – 18 GHz) | | | |
|---|---|---|---|
| **Rules and Sections:** | FCC CFR 47:15.209,<br>ICES-003: 6.2<br>RSS-GEN: 7 | **Ambient Temp. (ºC):** | 20.0 - 24.5 |
| **Test Heading:** | Digital Emissions, | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | ANSI C63.4: 8.3 | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

**Test Procedure for Radiated Digital Emissions and Receiver Emissions (0.03 – 18 GHz)**

Testing 30 – 18,000 MHz was performed in an anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver in peak hold mode.

Emissions nearest the limits were chosen for maximization and formal measurement using a CISPR Compliant receiver. Emissions from 30 MHz – 1000 MHz are measured utilizing a CISPR compliant quasi-peak detector with a tuned receiver, using a bandwidth of 120 kHz. Emissions above 1000 MHz are measured utilizing a CISPR compliant average detector with a tuned receiver, using a bandwidth of 1 MHz. Only the highest emissions relative to the limit are listed.

Test configuration and setup for Radiated Digital and Receiver Emissions Measurement were per the Radiated Test Set-up specified in this document.

**Field Strength Calculation**

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

FS = R + AF + CORR

where:
FS = Field Strength
R = Measured Receiver Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain

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

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3dBmV/m

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

Level (dBmV/m) = 20 * Log (level (mV/m))

40 dBmV/m = 100mV/m
48 dBmV/m = 250mV/m

**Limits for Radiated Digital Emissions (0.03 – 18 GHz)**
(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field Strength | | Field Strength μV/m (microvolts/meter) |
|---|---|---|---|
| | μV/m (microvolts/meter) | μV/m (microvolts/meter) | |
| 0.009-0.490 | 2400/F(kHz) | 2400/F(kHz) | 2400/F(kHz) |
| 0.490-1.705 | 24000/F(kHz) | 24000/F(kHz) | 24000/F(kHz) |
| 1.705-30.0 | 30 | 30 | 30 |
| 30-88 | 100** | 100** | 100** |
| 88-216 | 150** | 150** | 150** |
| 216-960 | 200** | 200** | 200** |
| Above 960 | 500 | 500 | 500 |

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241. (b) In the emission table above, the tighter limit applies at the band edges. (c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency. (d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. (e) The provisions in §§15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part. (f) In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device. (g) Perimeter protection systems may operate in the 54-72 MHz and 76-88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.

USB Active and Downloading, Connected to SBC Computer

**Equipment Configuration for Radiated Digital Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | WP WPANT30017-CA | **Variant:** | OFDM |
| **Antenna Gain (dBi):** | 3.00 | **Modulation:** | OFDM |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | |
| **Channel Frequency (MHz):** | 0.00 | **Data Rate:** | |
| **Power Setting:** | NA | **Tested By:** | JMH |

**Test Measurement Results**

| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 39.02 | 43.91 | 3.47 | -17.37 | 30.01 | MaxQP | Vertical | 104 | 71 | 40.0 | -10.0 | Pass |
| #2 | 431.96 | 49.59 | 4.99 | -14.31 | 40.27 | MaxQP | Horizontal | 204 | 154 | 46.0 | -5.7 | Pass |
| #3 | 443.99 | 49.98 | 5.02 | -14.21 | 40.79 | MaxQP | Horizontal | 101 | 356 | 46.0 | -5.2 | Pass |
| #4 | 456.01 | 50.18 | 5.04 | -13.93 | 41.29 | MaxQP | Horizontal | 282 | 349 | 46.0 | -4.7 | Pass |
| #5 | 468.02 | 47.67 | 5.07 | -13.37 | 39.37 | MaxQP | Horizontal | 101 | 301 | 46.0 | -6.6 | Pass |
| #6 | 503.99 | 48.65 | 5.20 | -13.23 | 40.62 | MaxQP | Horizontal | 159 | 160 | 46.0 | -5.4 | Pass |
| Test Notes: Powered by AC/DC PS. Digital Communications over USB. Connected to SBC. | | | | | | | | | | | | |

| Equipment Configuration for Radiated Digital Emissions | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Chen 155-0010-00 | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 5.00 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 2440.00 | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

| Test Measurement Results |
|---|
| Click here to view measurement data... |
| Test Notes: EUT powered by 4V DC |

| Equipment Configuration for Radiated Digital Emissions | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Chen 155-0010-00 | **Variant:** | FHSS |
| **Antenna Gain (dBi):** | 5.00 | **Modulation:** | GFSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | Hopping | **Data Rate:** | 300.00 KBit/s |
| **Power Setting:** | 21 | **Tested By:** | JMH |

| Test Measurement Results |
|---|
| Click here to view measurement data... |
| Test Notes: EUT powered by 4V DC. Hopping |

### 9.4.4. AC Wireline Emissions

| Test Conditions for ac Wireline Emissions (0.15 – 30 MHz) | | | |
|---|---|---|---|
| **Rules and Sections:** | FCC CFR 47:15.207<br>ICES-003:6.1 | **Ambient Temp. (ºC):** | 20.0 - 24.5 |
| **Test Heading:** | Conducted (ac Wireline Emissions) | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | ANSI C63.4: 7.3 | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

Test Procedure for ac Wireline Emissions (0.15 – 30 MHz)
The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

Test configuration and setup for ac Wireline Emission Measurement were per the ac Wireline Test Set-up specified in this document.

**Limits for ac Wireline Emissions**

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

| Frequency of Emission (MHz) | Conducted Limit (dBmV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency

The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 μV within the frequency band 535-1705 kHz, as measured using a 50 μH/50 ohms LISN.

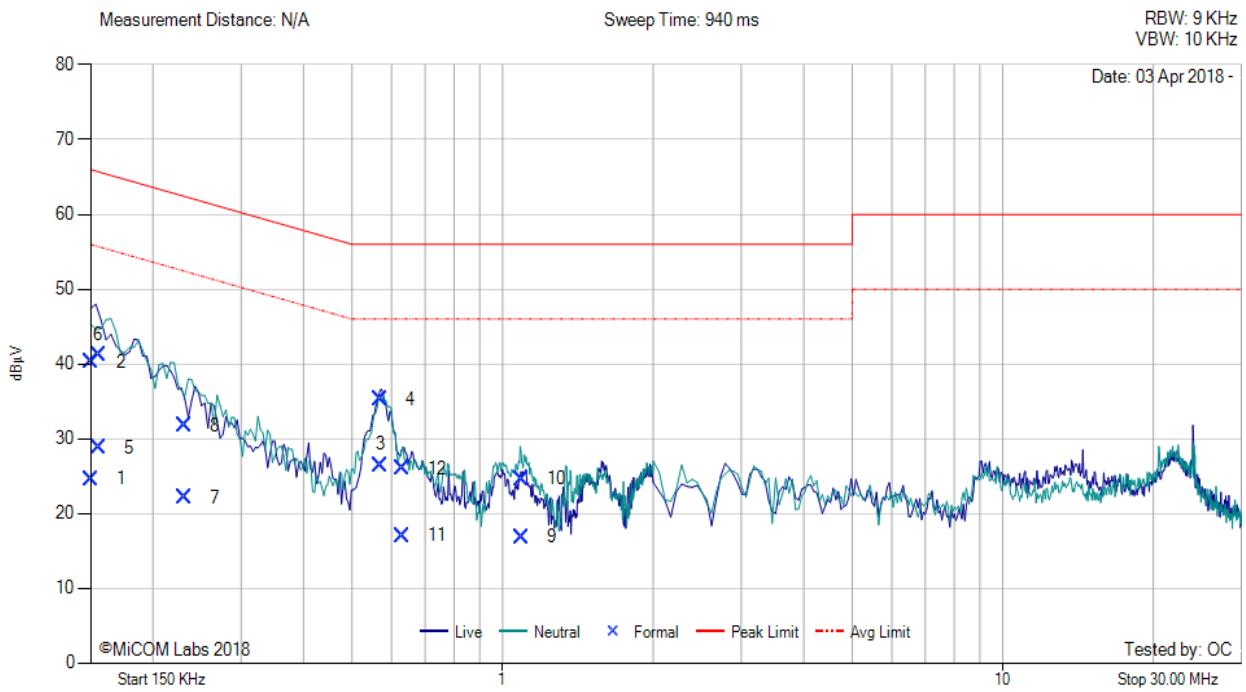
(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, or §15.227, as appropriate.

Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

## Measurement Results

| | | | |
|---|---|---|---|
| Model: | NIC-510-06 | Configuration tested: | AC/DC POWERED |
| Input power: | 120$V_{AC}$/60Hz | Standard: | FCC 15B |

Variant: AC Wireline, Test Freq: 0.15 - 30 MHz




| Num | Frequency MHz | Raw dBµV | Cable Loss dB | Factor dB | Total Correction dBµV | Corrected Value dBµV | Measurement Type | Line | Limit dBµV/m | Margin dB | Pass /Fail |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.150 | 14.64 | 0.05 | 9.92 | 9.97 | 24.61 | Max Avg | Live | 56.0 | -31.4 | Pass |
| 2 | 0.150 | 30.27 | 0.05 | 9.92 | 9.97 | 40.24 | Max Qp | Live | 66.0 | -25.8 | Pass |
| 3 | 0.570 | 16.43 | 0.10 | 9.92 | 10.02 | 26.45 | Max Avg | Live | 46.0 | -19.6 | Pass |
| 4 | 0.570 | 25.29 | 0.10 | 9.92 | 10.02 | 35.31 | Max Qp | Live | 56.0 | -20.7 | Pass |
| 5 | 0.156 | 18.81 | 0.05 | 9.92 | 9.97 | 28.78 | Max Avg | Neutral | 55.8 | -27.1 | Pass |
| 6 | 0.156 | 31.21 | 0.05 | 9.92 | 9.97 | 41.18 | Max Qp | Neutral | 65.8 | -24.7 | Pass |
| 7 | 0.231 | 12.13 | 0.07 | 9.92 | 9.99 | 22.12 | Max Avg | Live | 53.7 | -31.6 | Pass |
| 8 | 0.231 | 21.76 | 0.07 | 9.92 | 9.99 | 31.75 | Max Qp | Live | 63.7 | -31.9 | Pass |
| 9 | 1.091 | 6.83 | 0.08 | 9.94 | 10.02 | 16.85 | Max Avg | Neutral | 46.0 | -29.2 | Pass |
| 10 | 1.091 | 14.61 | 0.08 | 9.94 | 10.02 | 24.63 | Max Qp | Neutral | 56.0 | -31.4 | Pass |
| 11 | 0.631 | 6.98 | 0.11 | 9.93 | 10.04 | 17.02 | Max Avg | Neutral | 46.0 | -29.0 | Pass |
| 12 | 0.631 | 15.94 | 0.11 | 9.93 | 10.04 | 25.98 | Max Qp | Neutral | 56.0 | -30.0 | Pass |

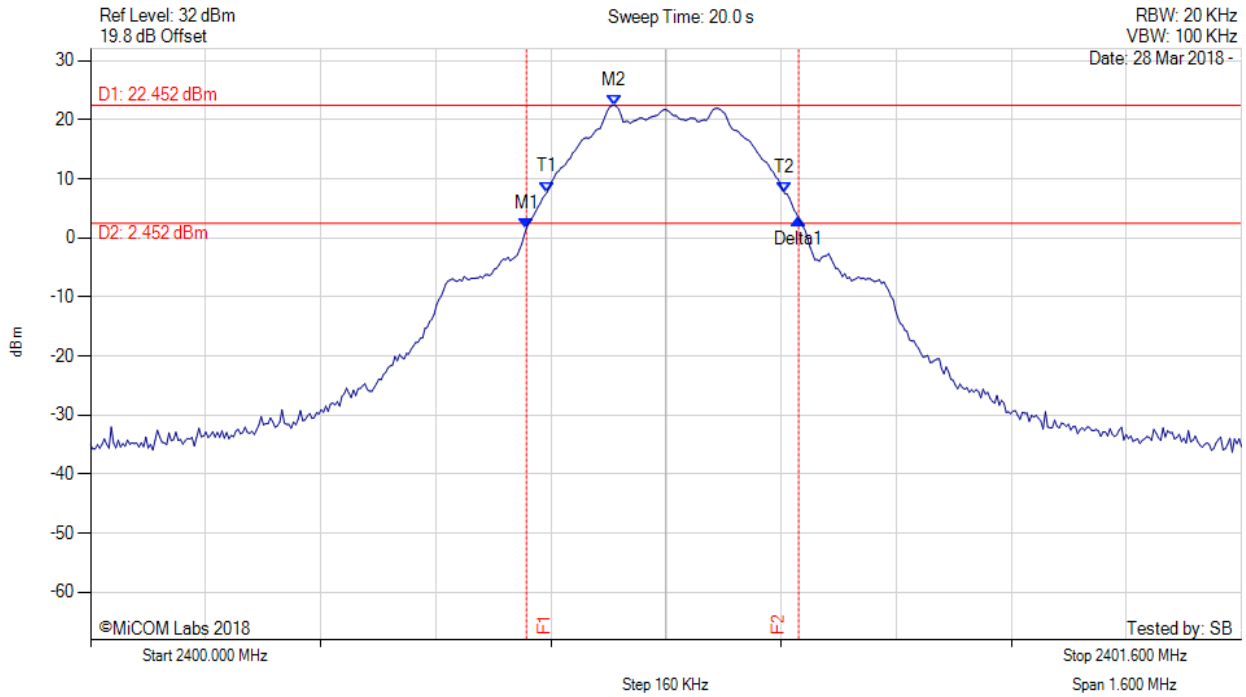
**Test Notes:** Model: NIC 510-06-06. AC/DC powered at 120Vac, 60Hz.

# A. APPENDIX - GRAPHICAL IMAGES

## A.1. 20 dB & 99% Bandwidth

20 dB 99% BANDWIDTH

Variant: 300 kbps_GFSK, Channel: 2400.80 MHz, Chain a, Temp: 20, Voltage: Vdc

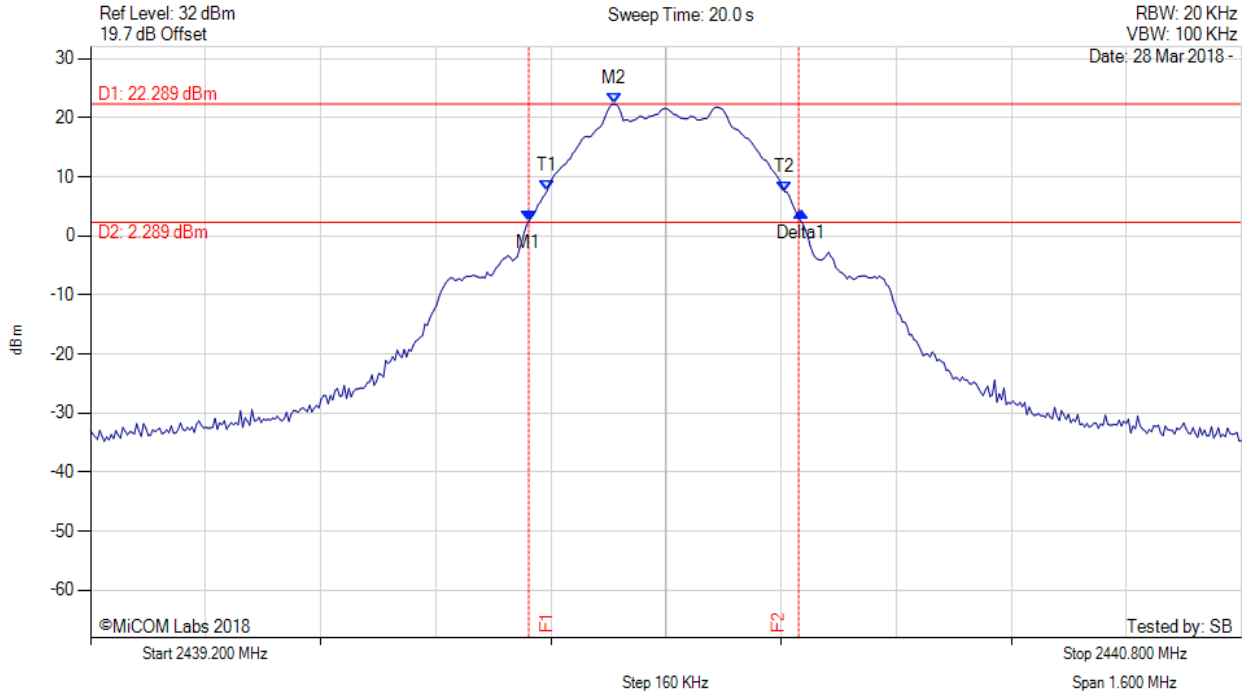



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 2400.606 MHz : 1.616 dBm<br>M2 : 2400.728 MHz : 22.452 dBm<br>Delta1 : 378 KHz : 1.641 dB<br>T1 : 2400.635 MHz : 7.756 dBm<br>T2 : 2400.965 MHz : 7.538 dBm<br>OBW : 330 KHz | Measured 20 dB Bandwidth: 0.378 MHz<br>Margin: #VALUE! MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc

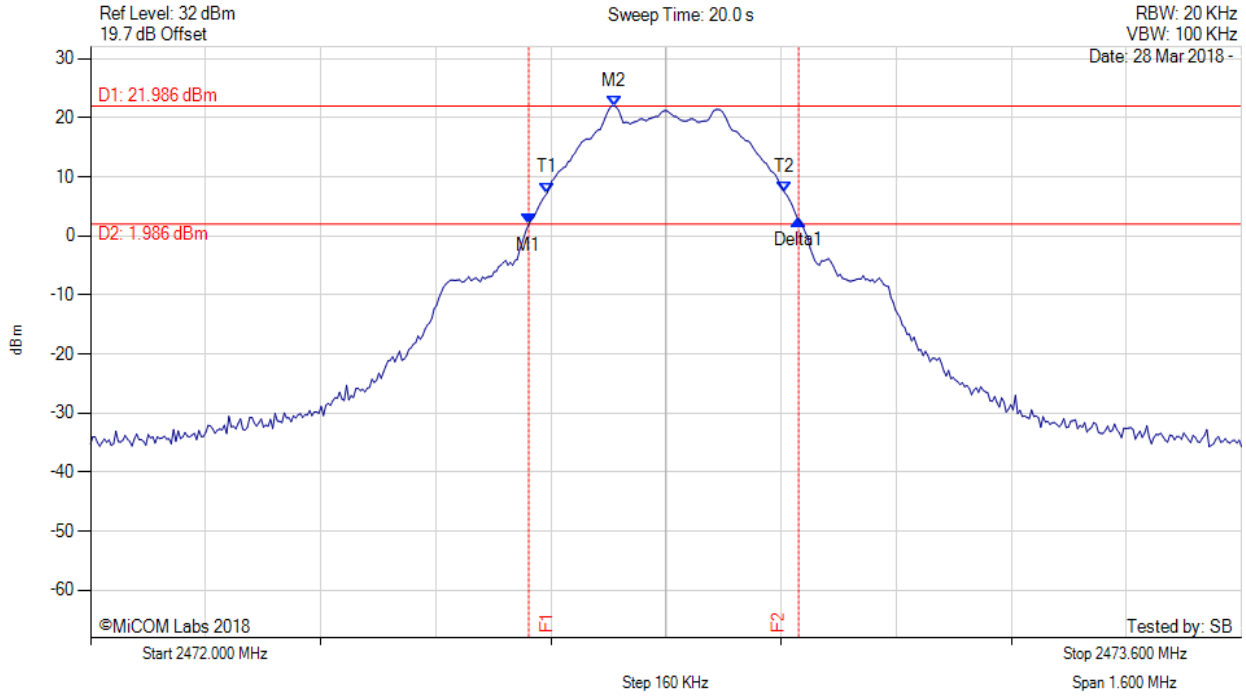



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 2439.809 MHz : 2.480 dBm<br>M2 : 2439.928 MHz : 22.289 dBm<br>Delta1 : 378 KHz : 1.640 dB<br>T1 : 2439.835 MHz : 7.656 dBm<br>T2 : 2440.165 MHz : 7.473 dBm<br>OBW : 330 KHz | Measured 20 dB Bandwidth: 0.378 MHz<br>Margin: #VALUE! MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: 300 kbps_GFSK, Channel: 2472.80 MHz, Chain a, Temp: 20, Voltage: Vdc

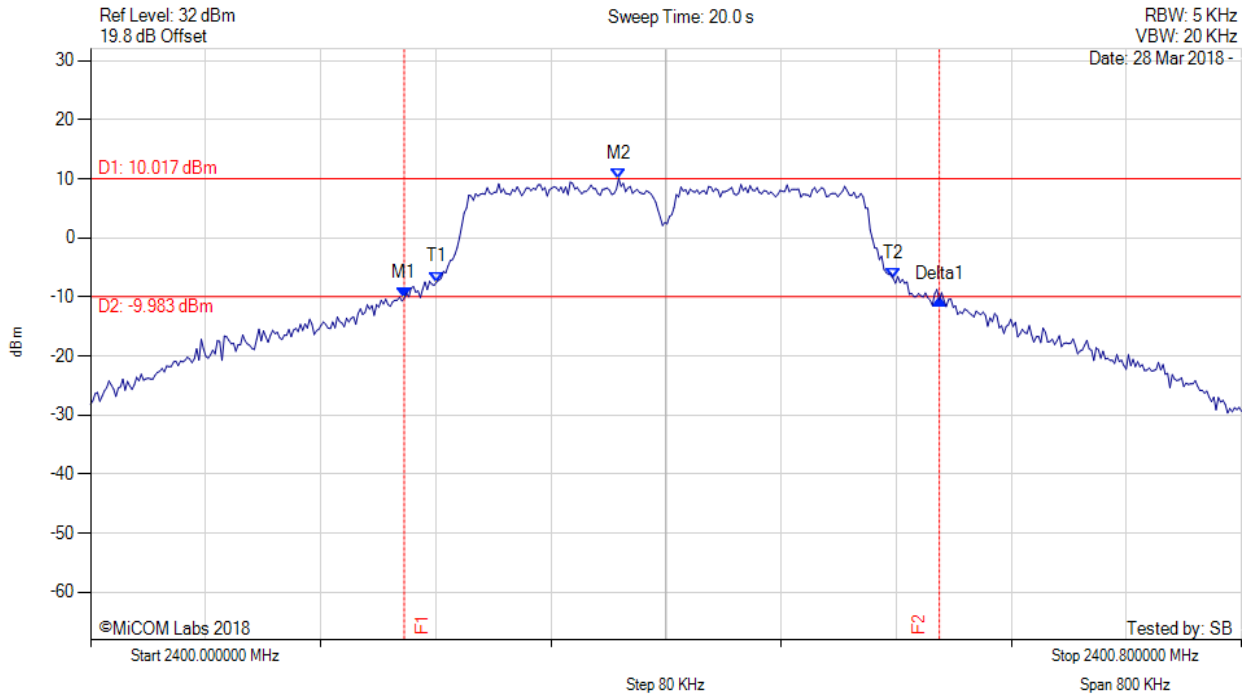



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 2472.609 MHz : 1.972 dBm<br>M2 : 2472.728 MHz : 21.986 dBm<br>Delta1 : 375 KHz : 0.775 dB<br>T1 : 2472.635 MHz : 7.274 dBm<br>T2 : 2472.965 MHz : 7.296 dBm<br>OBW : 330 KHz | Measured 20 dB Bandwidth: 0.375 MHz<br>Margin: #VALUE! MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: 600 kbps_OFDM, Channel: 2400.40 MHz, Chain a, Temp: 20, Voltage:  Vdc

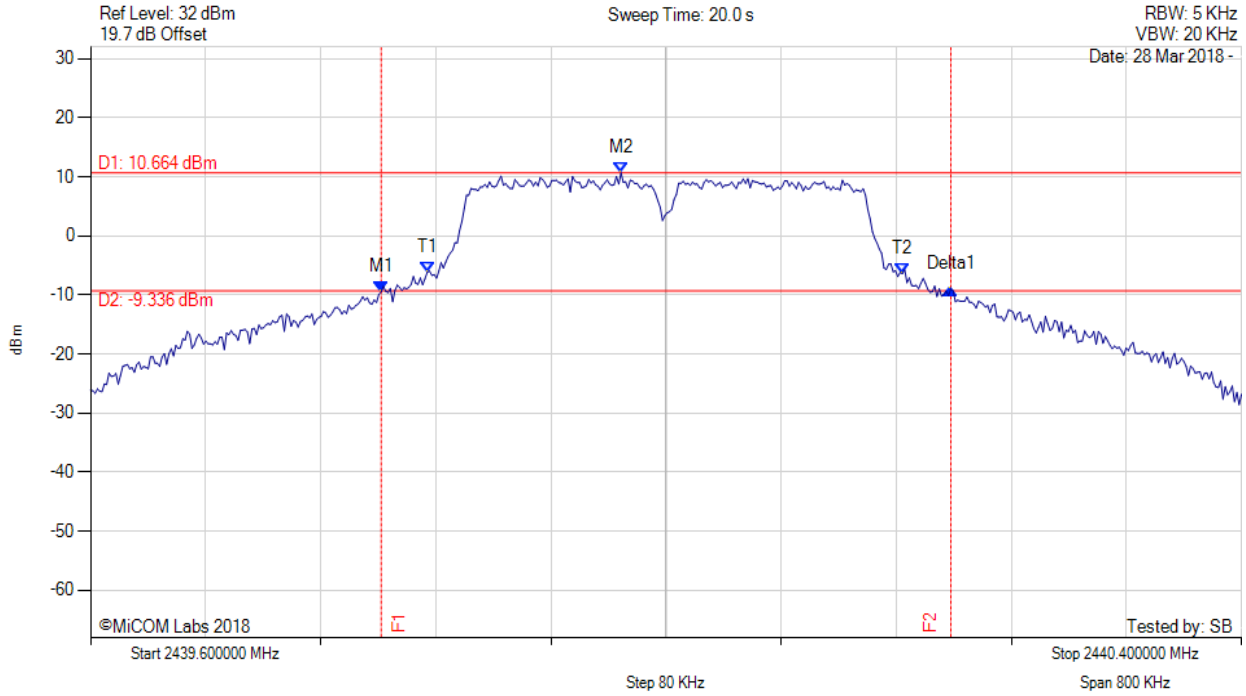



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 2400.218 MHz : -10.253 dBm<br>M2 : 2400.367 MHz : 10.017 dBm<br>Delta1 : 372 KHz : -0.209 dB<br>T1 : 2400.240 MHz : -7.475 dBm<br>T2 : 2400.558 MHz : -6.889 dBm<br>OBW : 317 KHz | Measured 20 dB  Bandwidth: 0.372 MHz<br>Margin: #VALUE! MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage:  Vdc

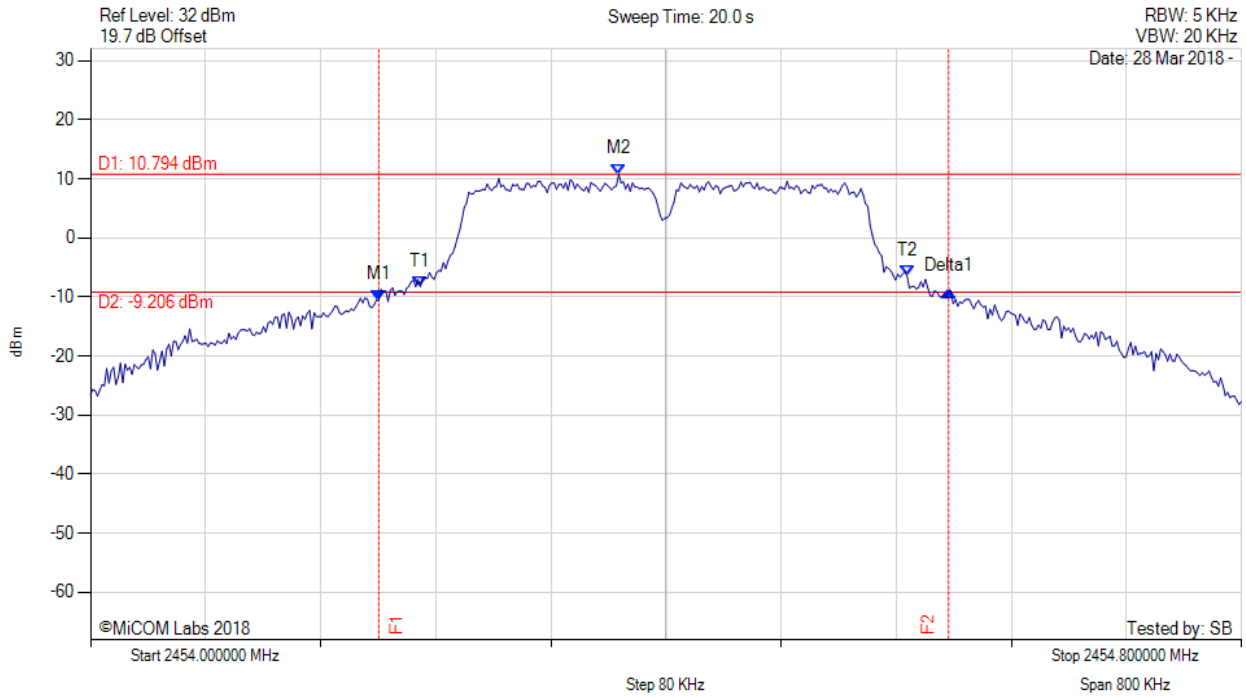



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 2439.802 MHz : -9.486 dBm<br>M2 : 2439.969 MHz : 10.664 dBm<br>Delta1 : 396 KHz : 0.502 dB<br>T1 : 2439.834 MHz : -6.141 dBm<br>T2 : 2440.164 MHz : -6.399 dBm<br>OBW : 330 KHz | Measured 20 dB  Bandwidth: 0.396 MHz<br>Margin: #VALUE! MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: 600 kbps_OFDM, Channel: 2454.40 MHz, Chain a, Temp: 20, Voltage:  Vdc

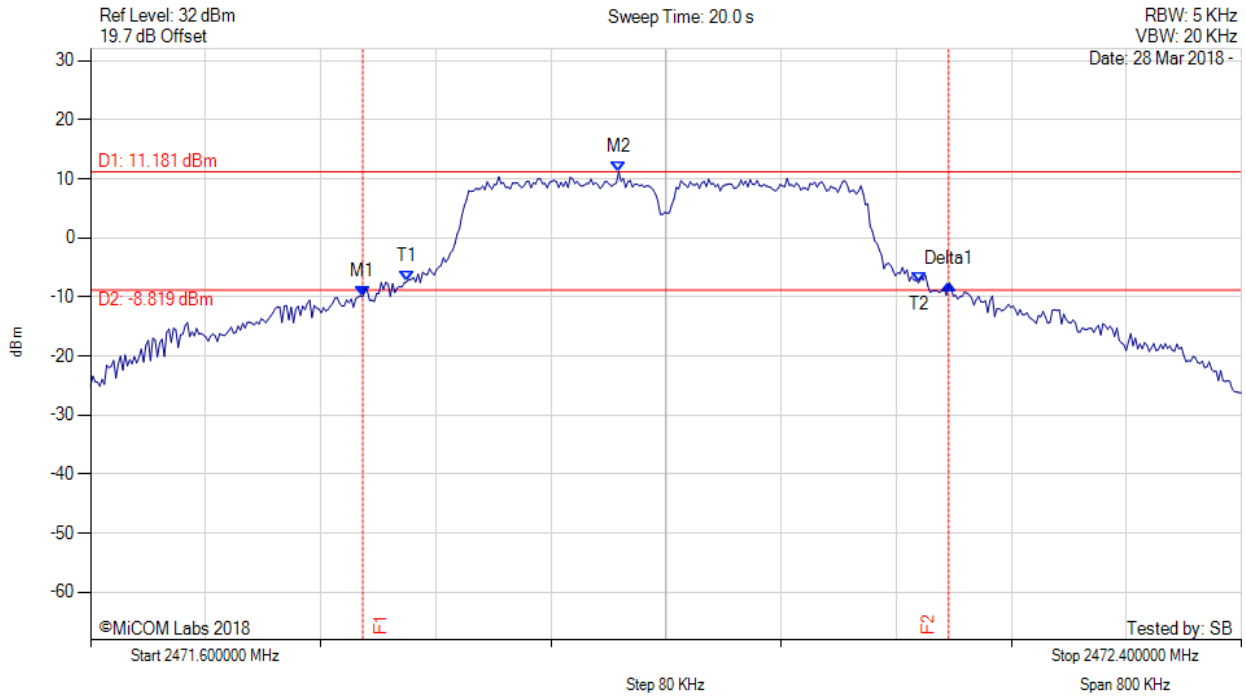



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 2454.200 MHz : -10.522 dBm<br>M2 : 2454.367 MHz : 10.794 dBm<br>Delta1 : 396 KHz : 1.550 dB<br>T1 : 2454.229 MHz : -8.250 dBm<br>T2 : 2454.568 MHz : -6.348 dBm<br>OBW : 338 KHz | Channel Frequency: 2454.40 MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: 600 kbps_OFDM, Channel: 2472.00 MHz, Chain a, Temp: 20, Voltage:  Vdc




| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 2471.789 MHz : -9.977 dBm<br>M2 : 2471.967 MHz : 11.181 dBm<br>Delta1 : 407 KHz : 2.085 dB<br>T1 : 2471.820 MHz : -7.447 dBm<br>T2 : 2472.176 MHz : -7.607 dBm<br>OBW : 356 KHz | Measured 20 dB  Bandwidth: 0.407 MHz<br>Limit:  kHz<br>Margin: #VALUE! MHz |

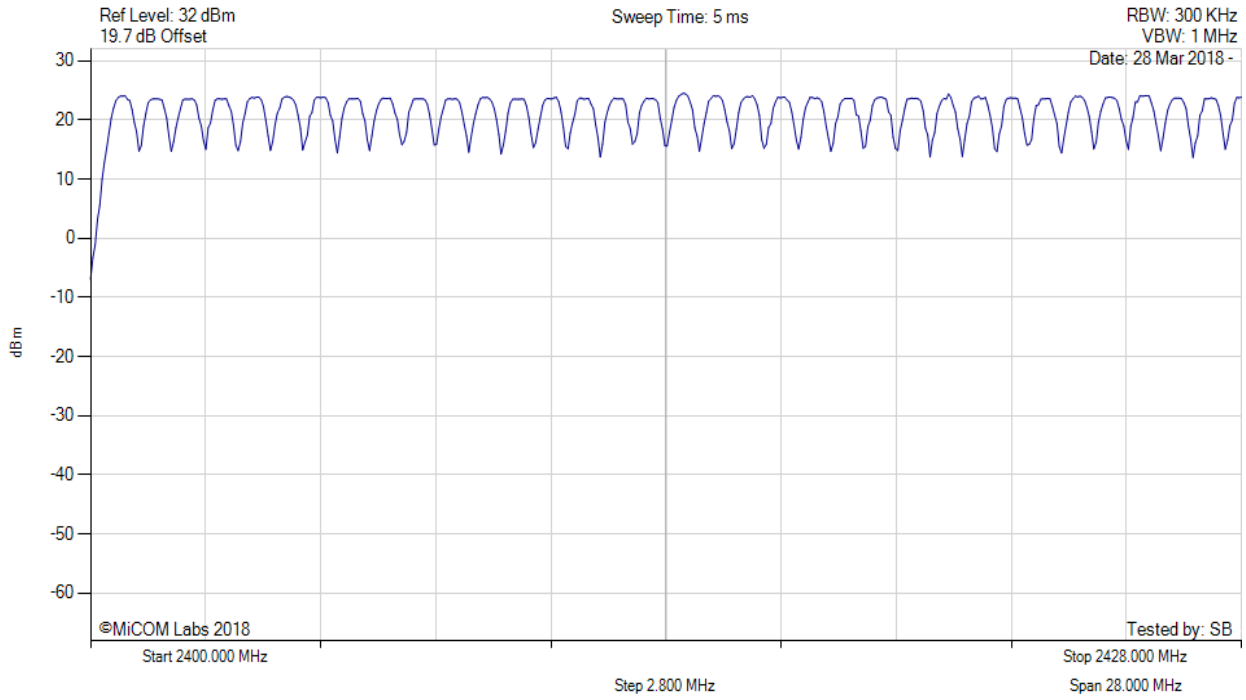
back to matrix

## A.2. Frequency Hopping Tests

### A.2.1. Number of Hopping Channels

NUMBER OF HOPPING CHANNELS

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc

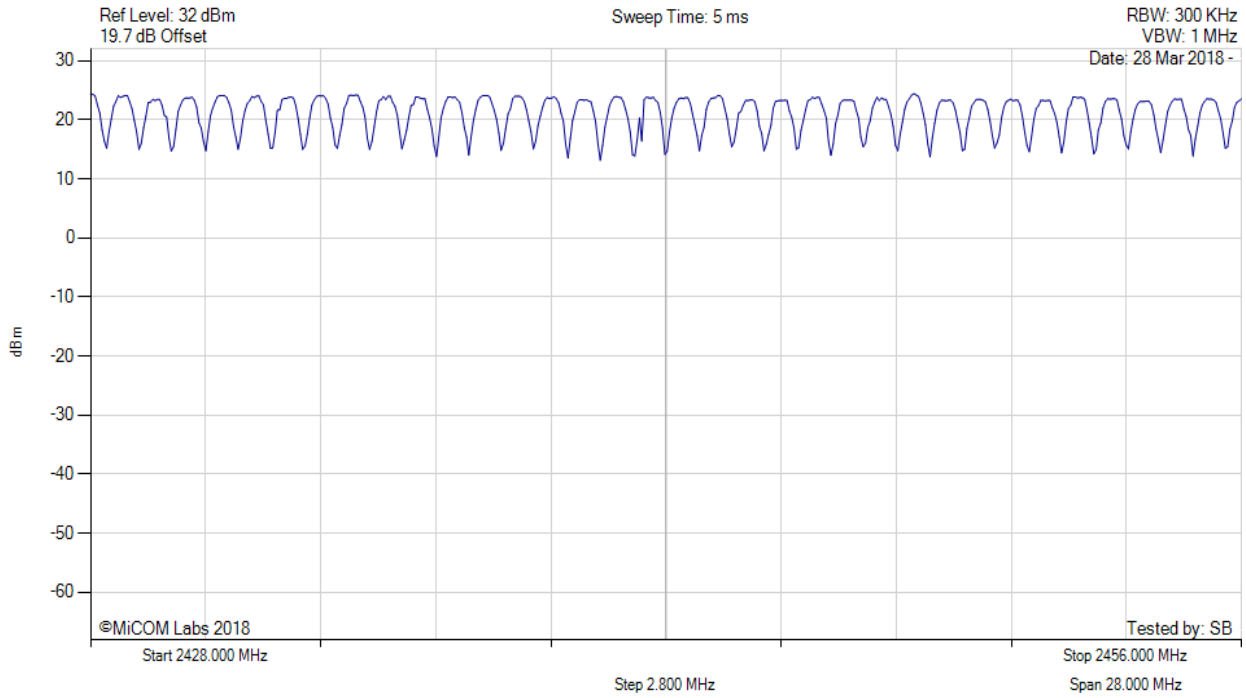



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | | Channel Frequency: 2440.00 MHz |

back to matrix

NUMBER OF HOPPING CHANNELS

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc




| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | | Channel Frequency: 2440.00 MHz |

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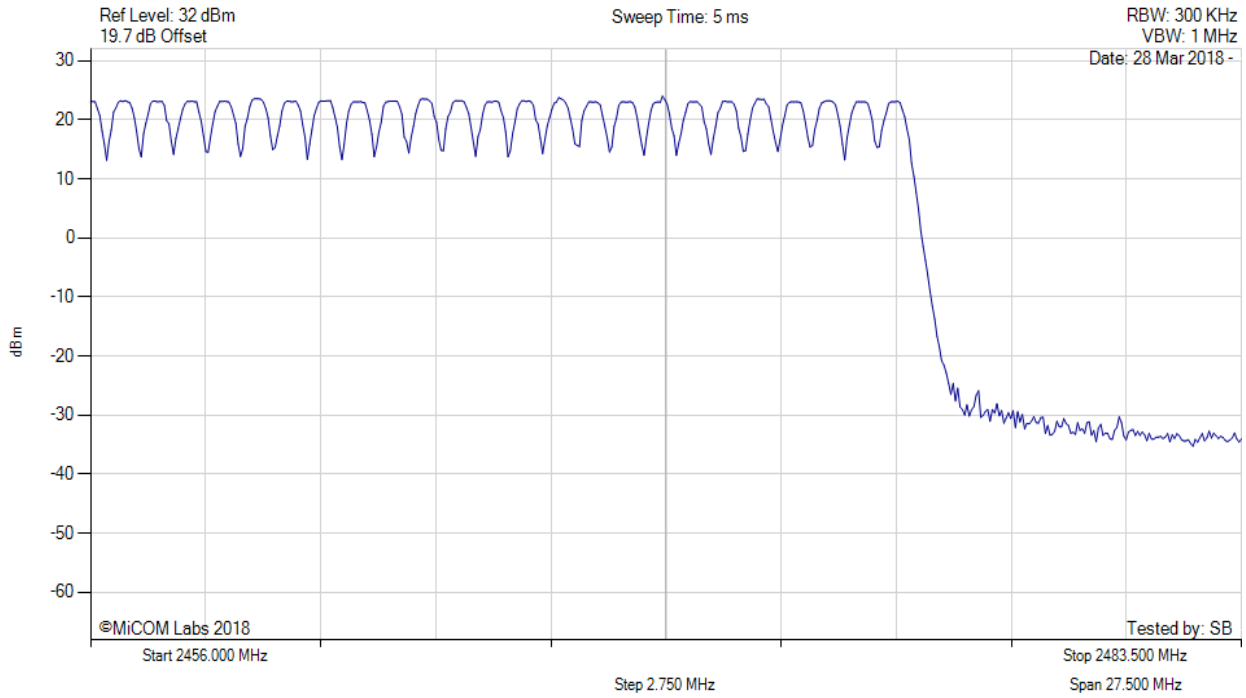
NUMBER OF HOPPING CHANNELS

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc




| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | | Channel Frequency: 2440.00 MHz |

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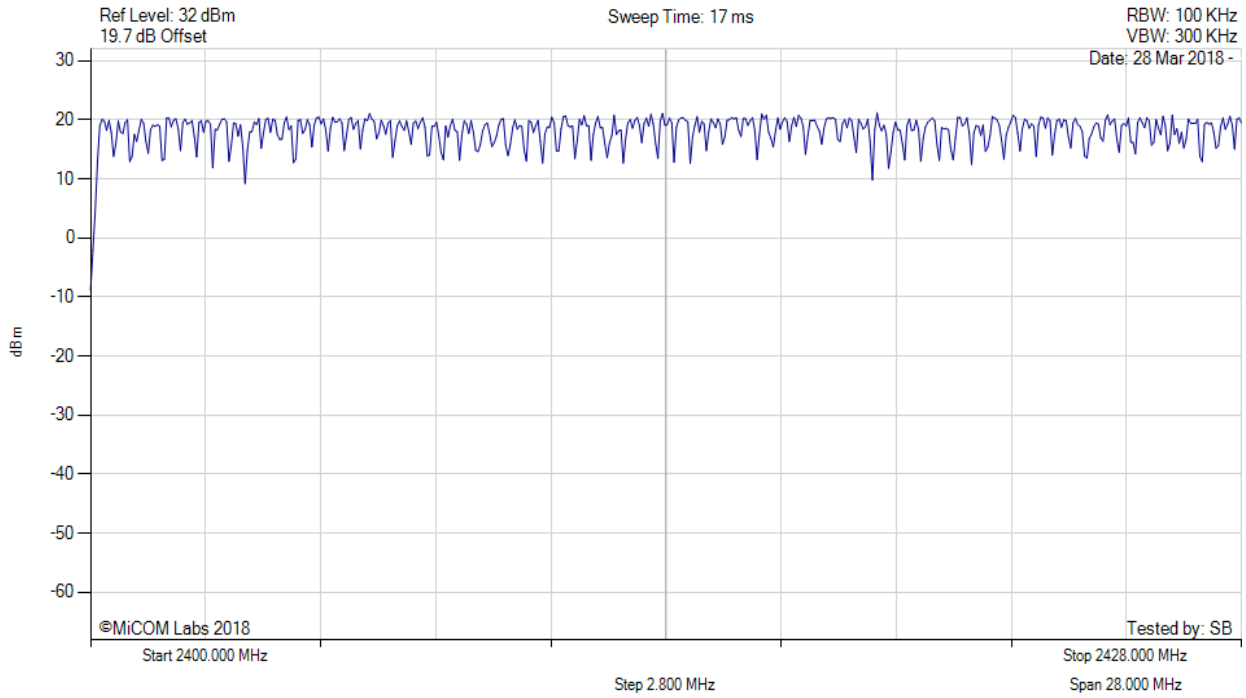
NUMBER OF HOPPING CHANNELS

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage:  Vdc

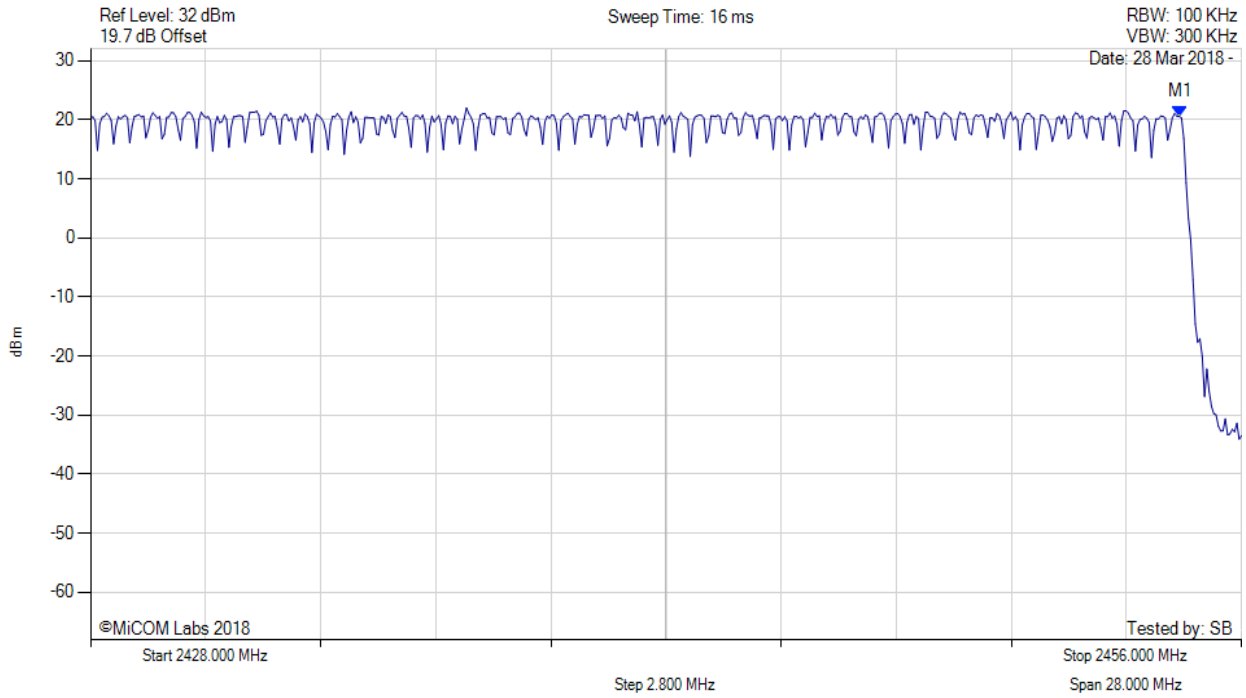



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = AUTOPEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | | Channel Frequency: 2440.00 MHz |

back to matrix

NUMBER OF HOPPING CHANNELS

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage:  Vdc



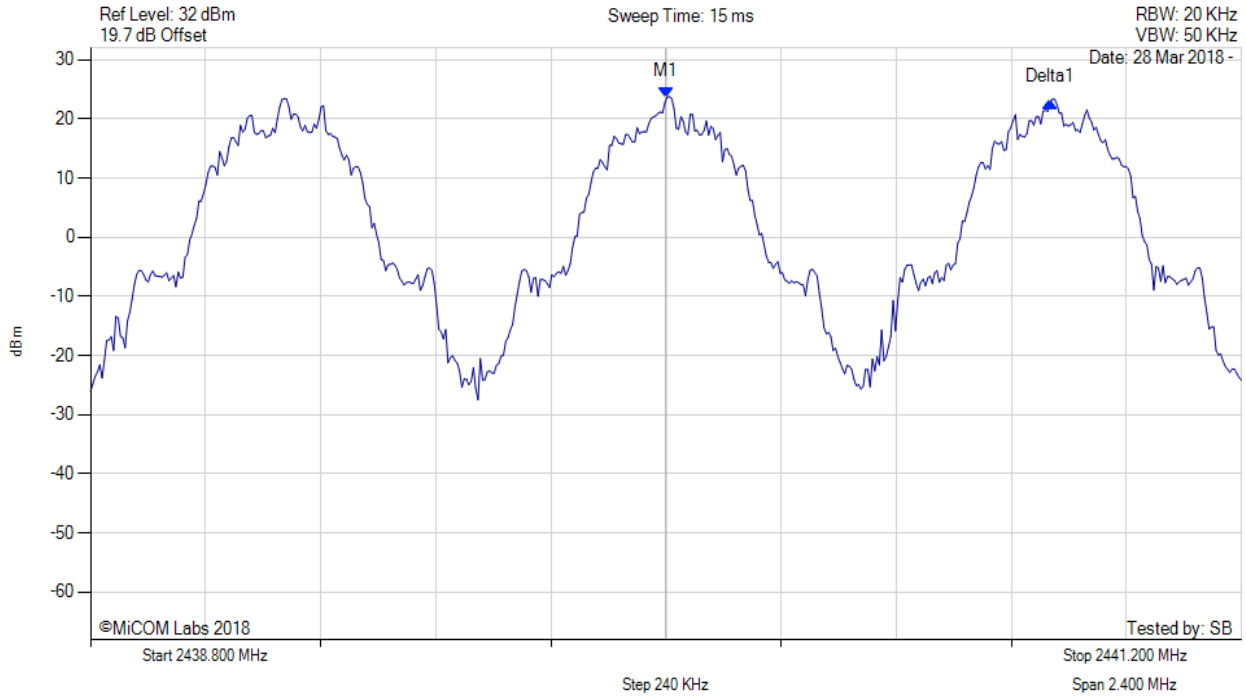

| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = AUTOPEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1 : 2454.505 MHz : 20.550 dBm | Channel Frequency: 2440.00 MHz |

back to matrix

## A.2.2. Channel Separation

CHANNEL SEPARATION

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc

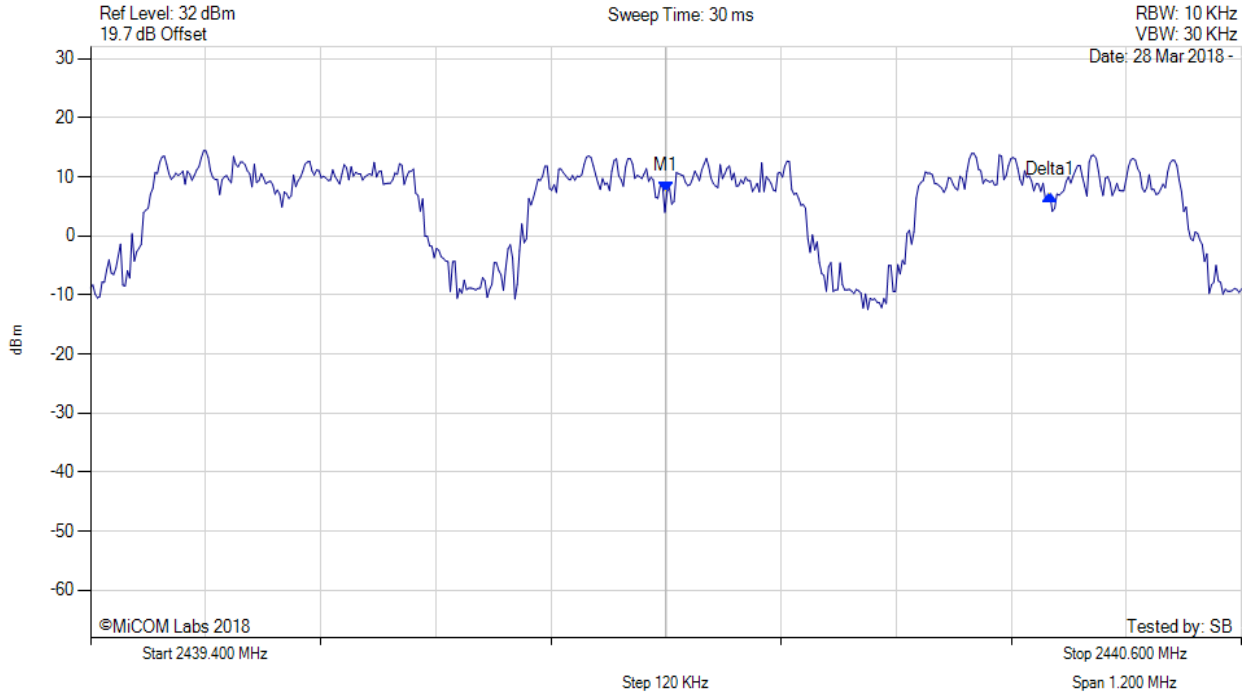



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1 : 2440.000 MHz : 23.686 dBm<br>Delta1 : 800 KHz : -0.915 dB | Channel Frequency: 2440.00 MHz |

back to matrix

CHANNEL SEPARATION

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage:  Vdc




| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1 : 2440.000 MHz : 7.518 dBm<br>Delta1 : 400 KHz : -0.571 dB | Channel Frequency: 2440.00 MHz |

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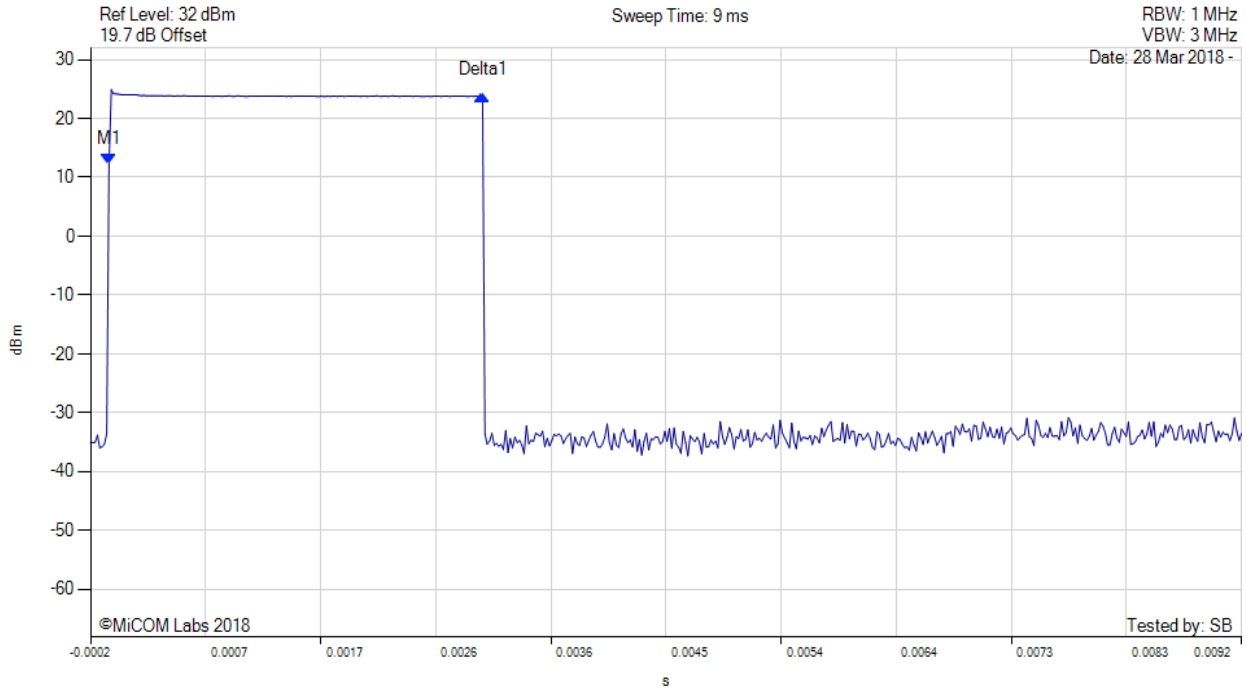
## A.2.3. Dwell Time

DWELL TIME

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc




| Analyzer Setup | Marker:Time:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1(2440.00 MHz) : 0.000 s : 12.130 dBm<br>Delta1(2440.00 MHz) : 0.003 s : 11.960 dB | Channel Frequency: 2440.00 MHz |

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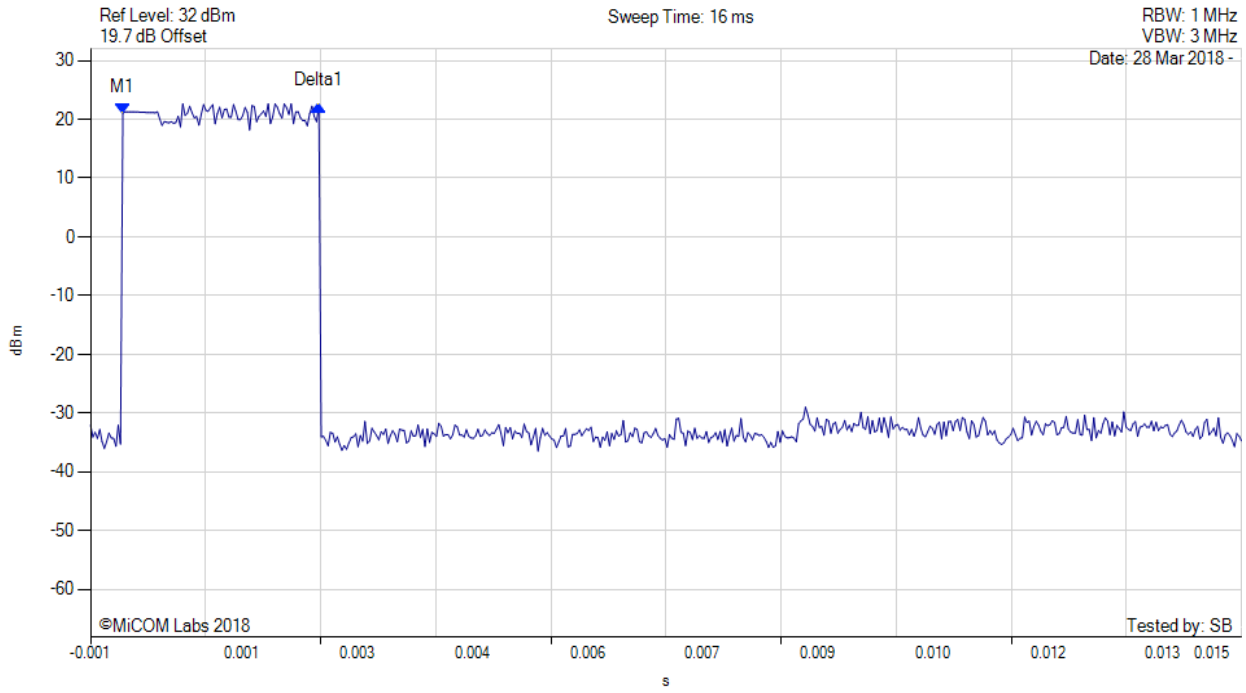
DWELL TIME

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage:  Vdc



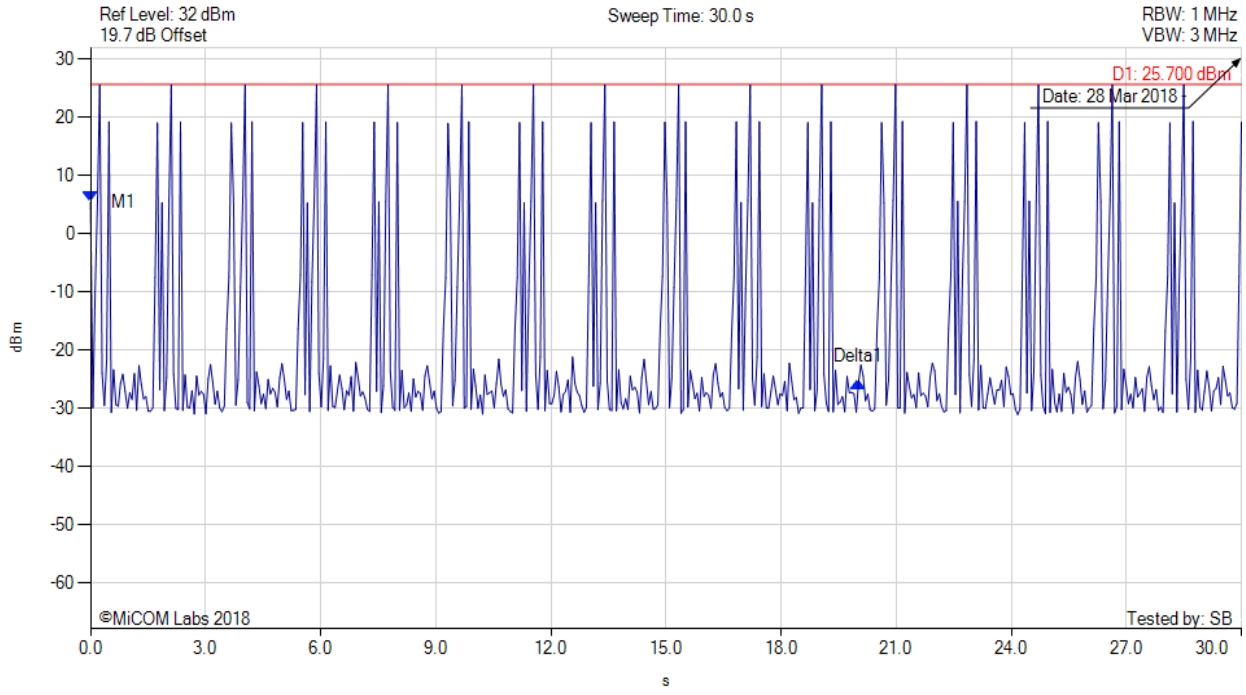

| Analyzer Setup | Marker:Time:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1(2440.00 MHz) : 0.000 s : 21.050 dBm<br>Delta1(2440.00 MHz) : 0.003 s : 1.194 dB | Channel Frequency: 2440.00 MHz |

back to matrix

## A.2.4. Channel Occupancy

CHANNEL OCCUPANCY

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc




| Analyzer Setup | Marker:Time:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1(2440.00 MHz) : 0.000 s : 5.494 dBm<br>Delta1(2440.00 MHz) : 20.000 s : -30.972 dB | Channel Frequency: 2440.00 MHz |

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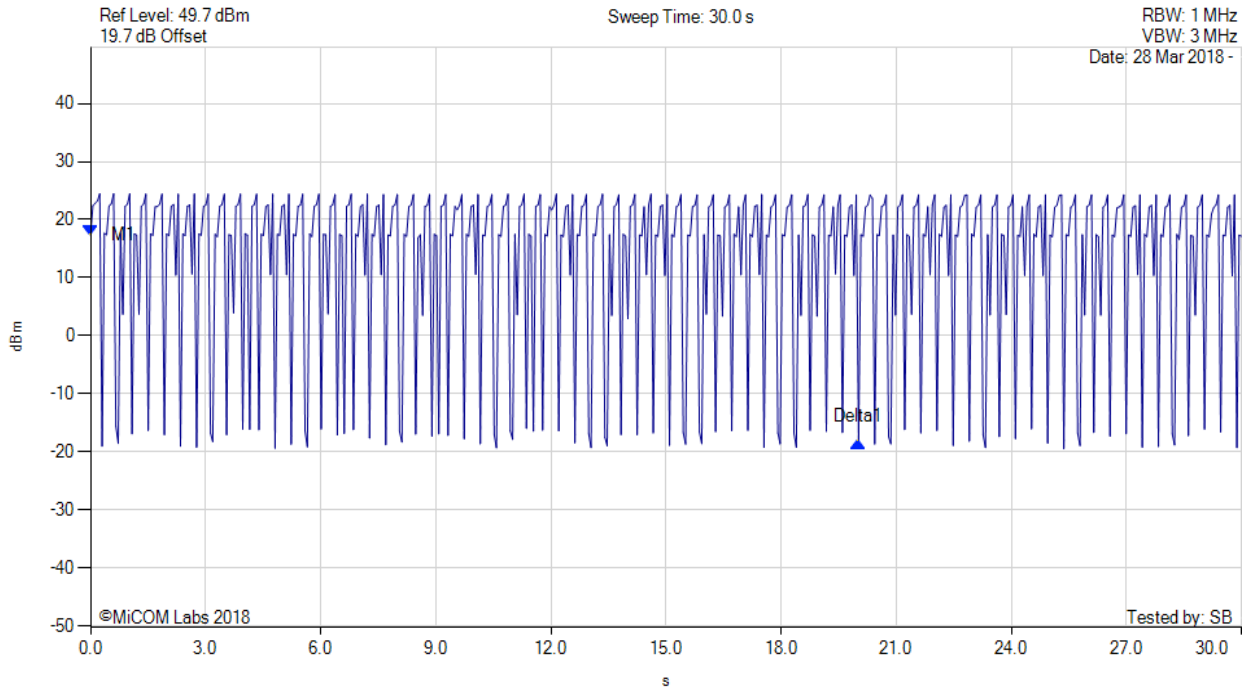
CHANNEL OCCUPANCY

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage:  Vdc




| Analyzer Setup | Marker:Time:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 40<br>Trace Mode = VIEW | M1(2440.00 MHz) : 0.000 s : 17.323 dBm<br>Delta1(2440.00 MHz) : 20.000 s : -35.641 dB | Channel Frequency: 2440.00 MHz |

back to matrix

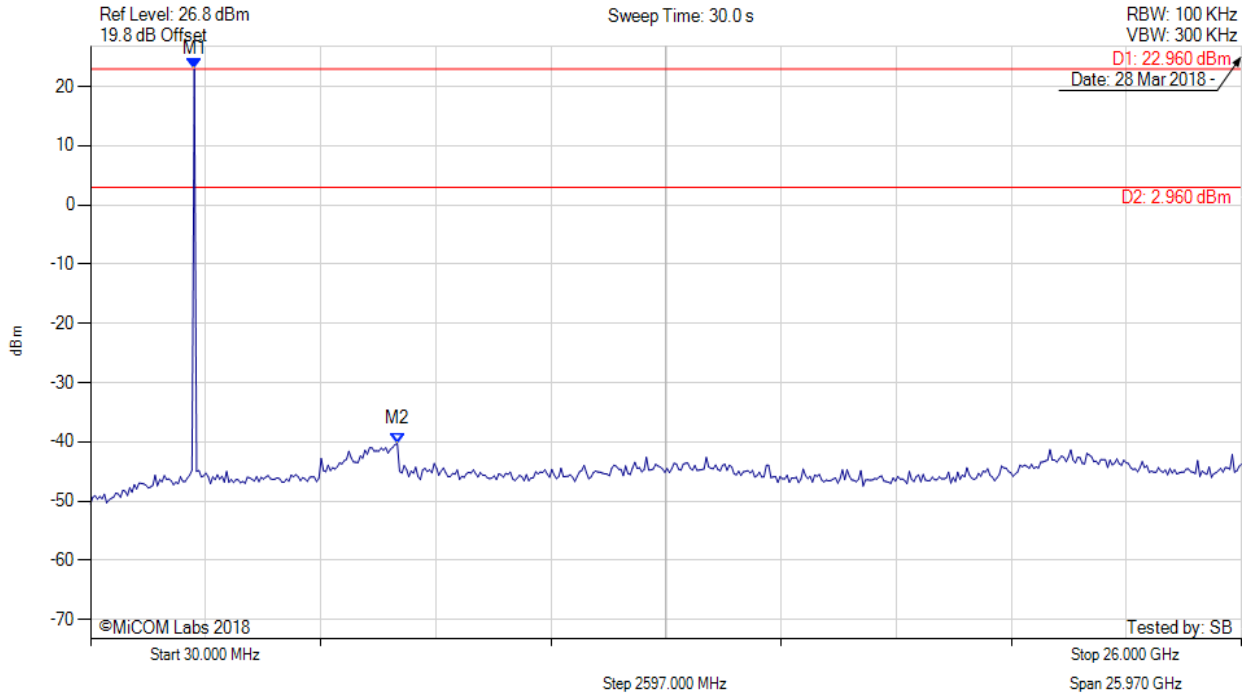
# A.3. Emissions

## A.3.1. Conducted Emissions

### A.3.1.1. Conducted Unwanted Spurious Emissions

UNWANTED EMISSIONS PEAK

Variant: 300 kbps_GFSK, Channel: 2400.80 MHz, Chain a, Temp: 20, Voltage: Vdc

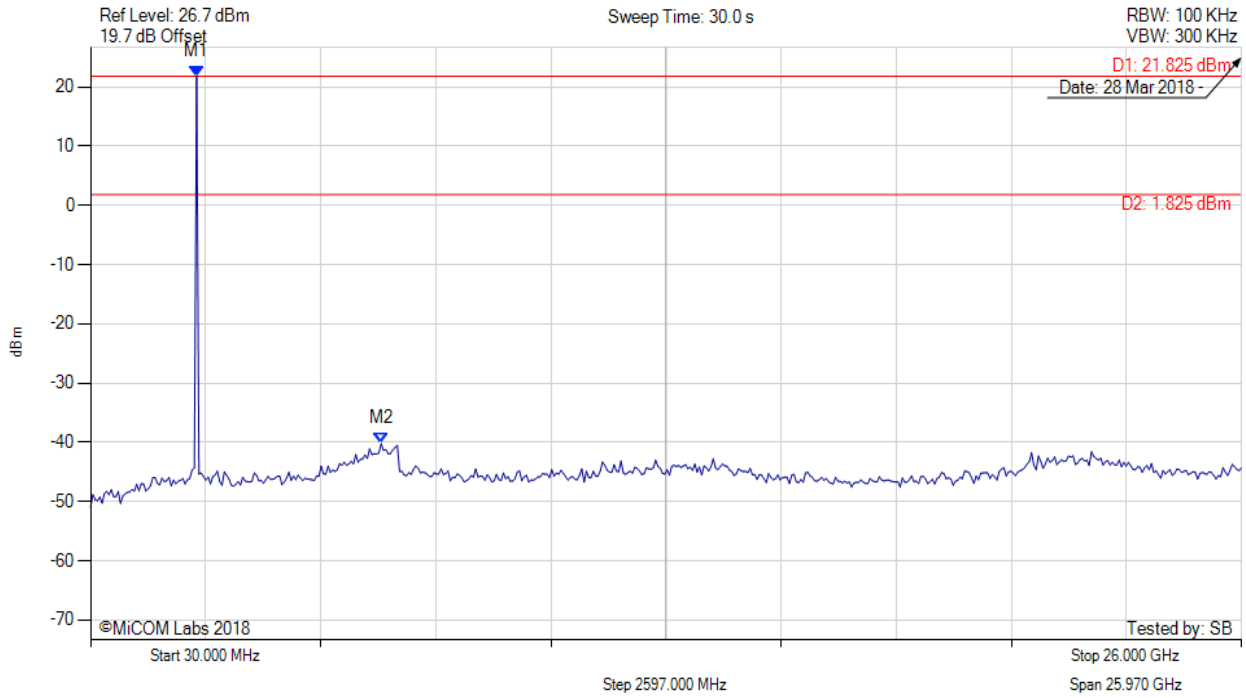



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = MAX HOLD | M1 : 2371.984 MHz : 22.958 dBm<br>M2 : 6951.864 MHz : -40.289 dBm | Limit: 2.96 dBm<br>Margin: -43.25 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc

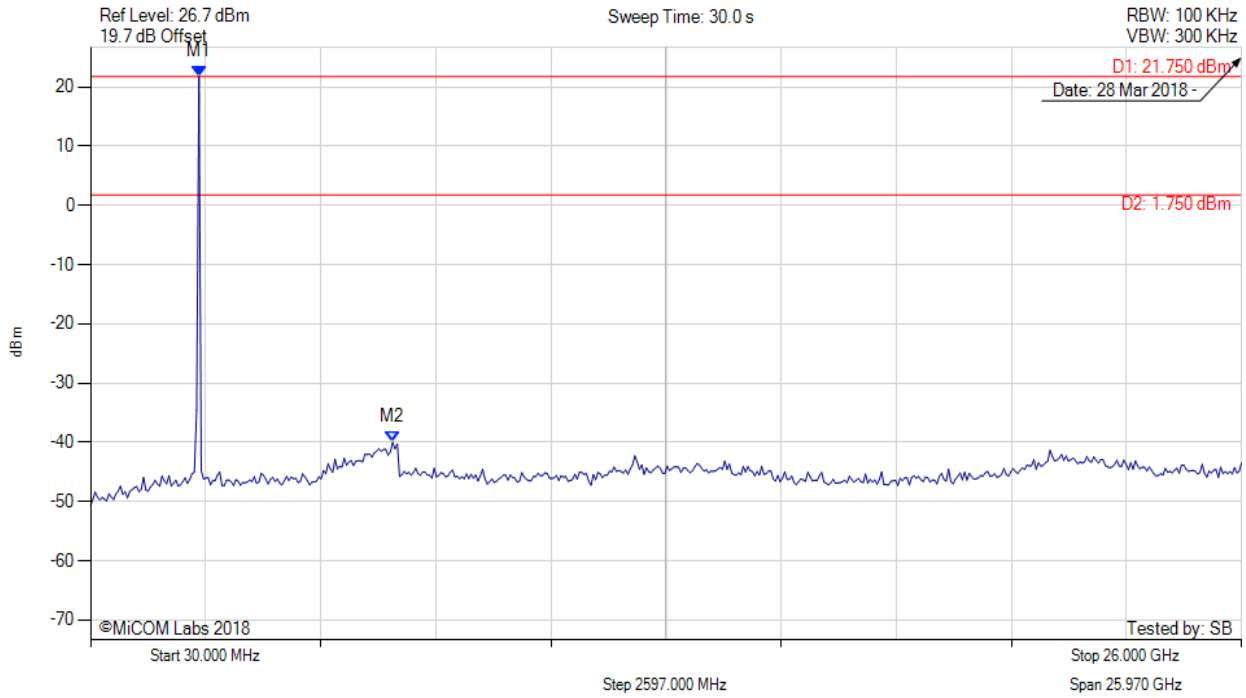



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2424.028 MHz : 21.825 dBm<br>M2 : 6587.555 MHz : -40.233 dBm | Limit: 1.83 dBm<br>Margin: -42.06 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: 300 kbps_GFSK, Channel: 2472.80 MHz, Chain a, Temp: 20, Voltage: Vdc

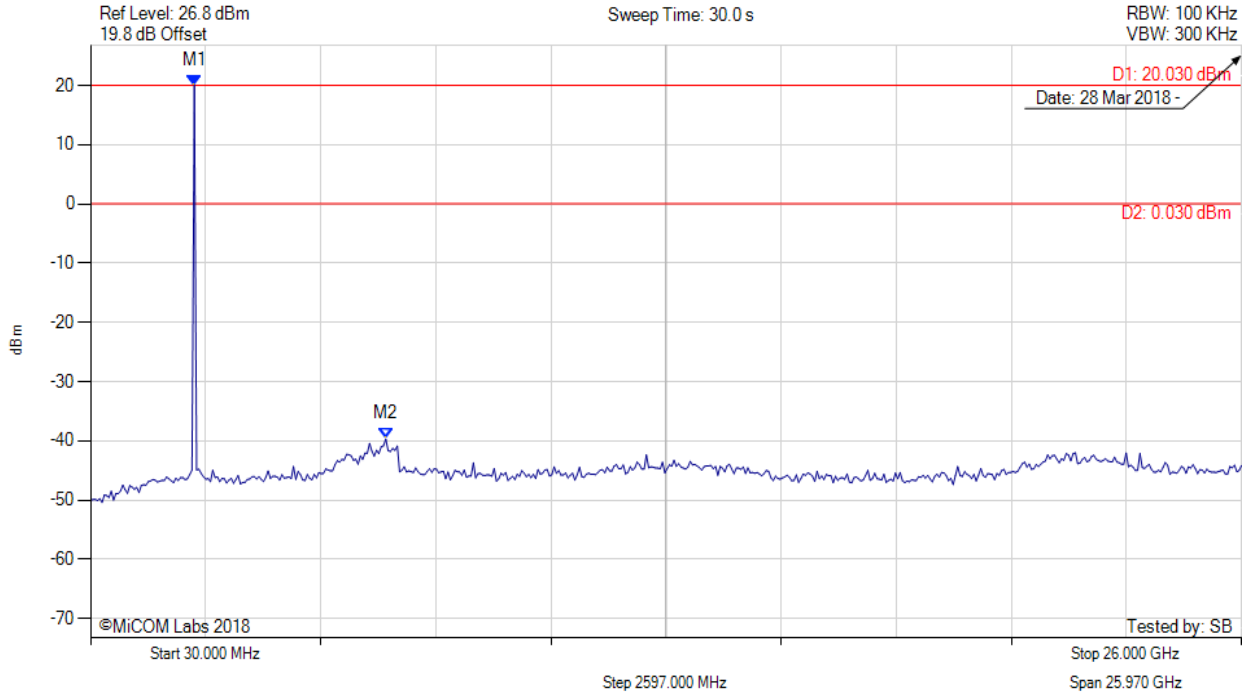



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2476.072 MHz : 21.750 dBm<br>M2 : 6847.776 MHz : -40.017 dBm | Limit: 1.75 dBm<br>Margin: -41.77 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: 600 kbps_OFDM, Channel: 2400.40 MHz, Chain a, Temp: 20, Voltage:  Vdc

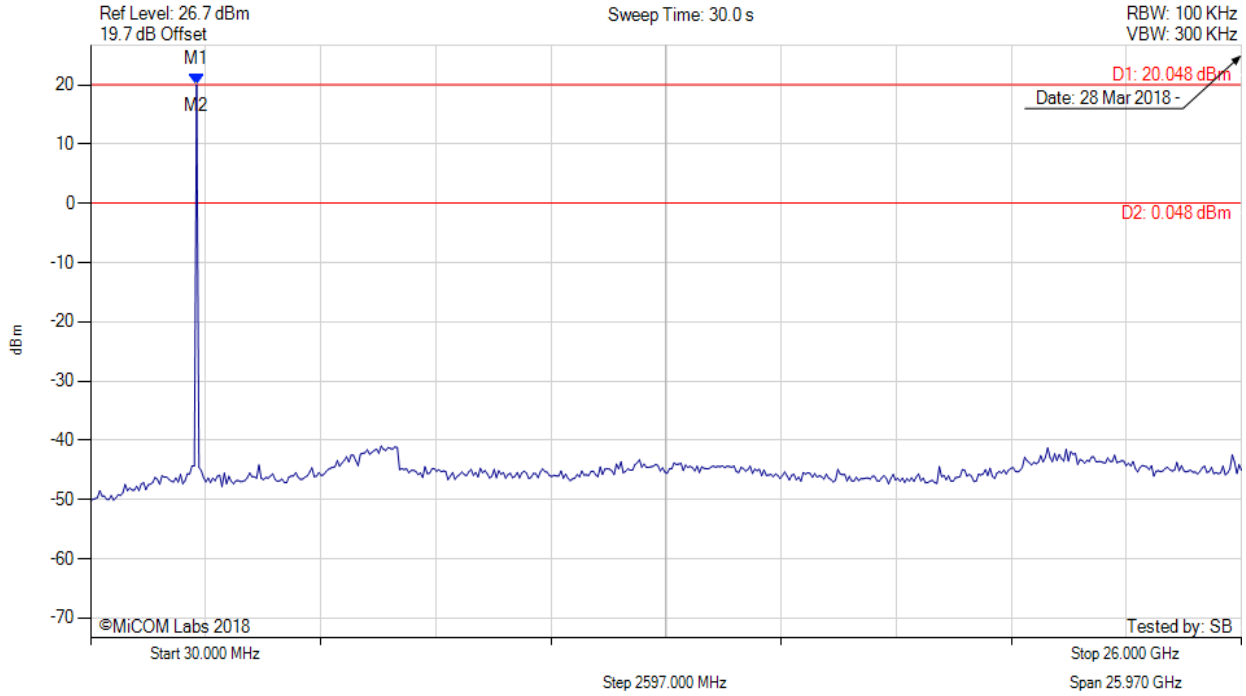



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2371.984 MHz : 20.030 dBm<br>M2 : 6691.643 MHz : -39.677 dBm | Limit: 0.03 dBm<br>Margin: -39.71 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage:  Vdc

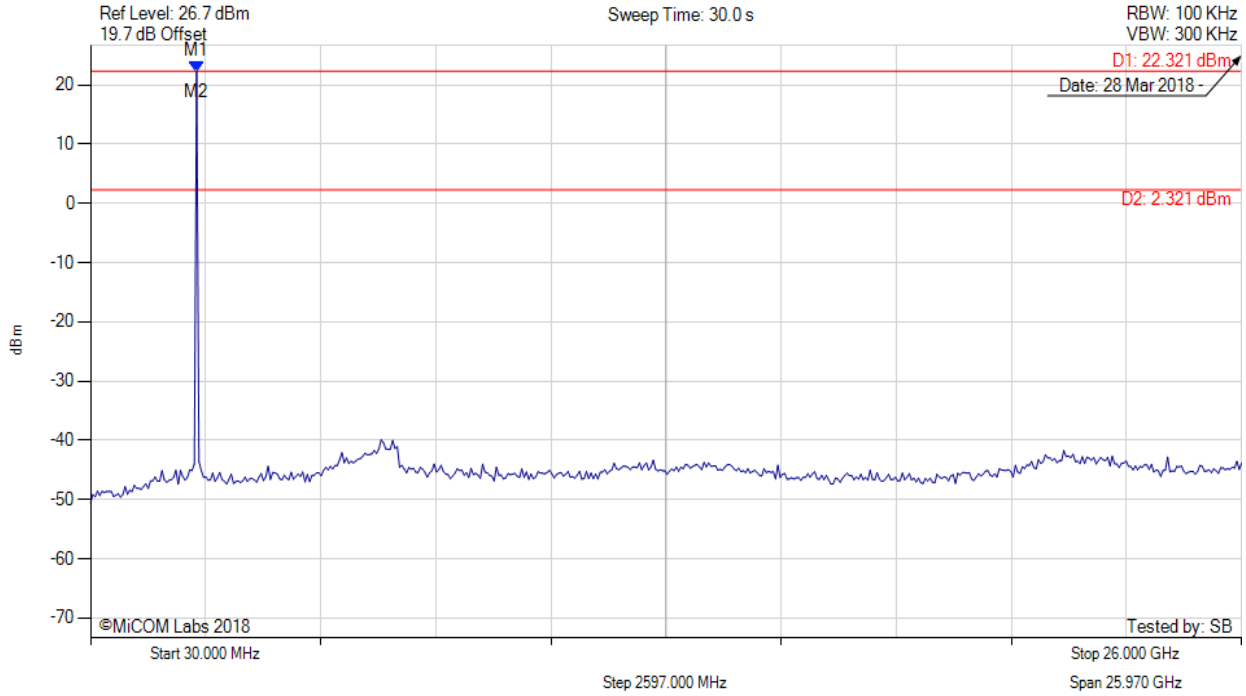



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2424.028 MHz : 20.048 dBm<br>M2 : 2424.028 MHz : 20.048 dBm | Limit: 0.05 dBm<br>Margin: 20.00 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: 600 kbps_OFDM, Channel: 2454.40 MHz, Chain a, Temp: 20, Voltage:  Vdc

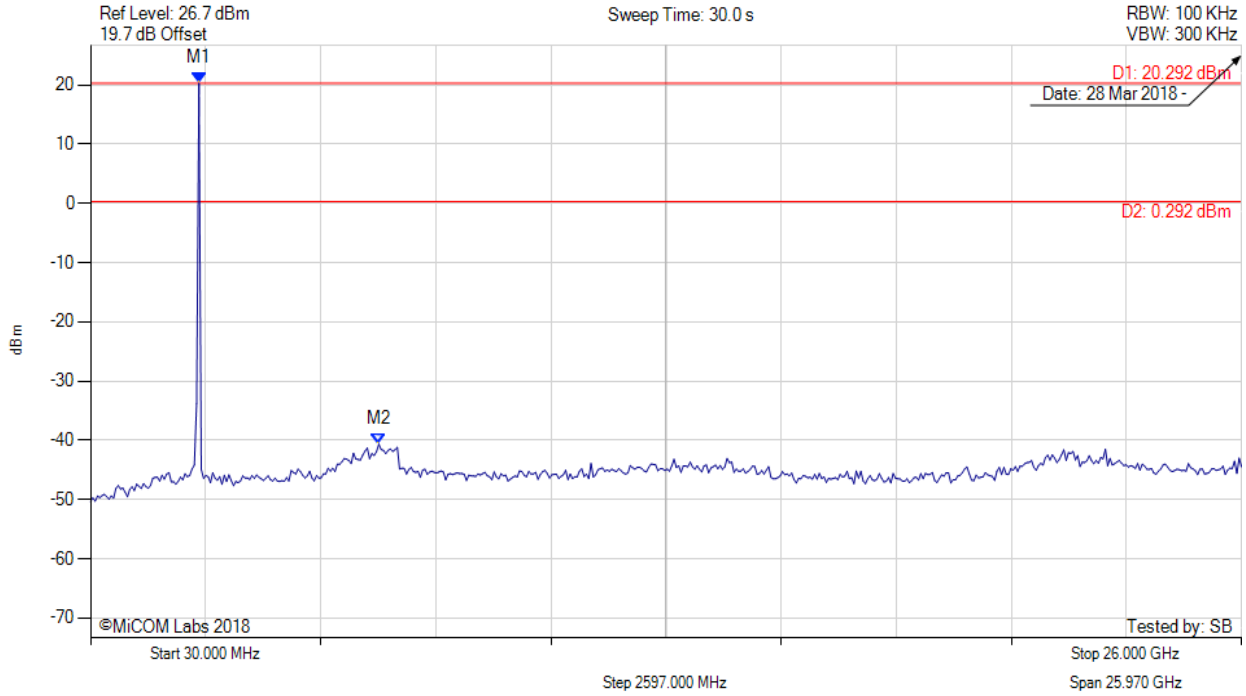



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2424.028 MHz : 22.321 dBm<br>M2 : 2424.028 MHz : 22.321 dBm | Channel Frequency: 2454.40 MHz |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: 600 kbps_OFDM, Channel: 2472.00 MHz, Chain a, Temp: 20, Voltage:  Vdc




| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2476.072 MHz : 20.292 dBm<br>M2 : 6535.511 MHz : -40.662 dBm | Limit: 0.29 dBm<br>Margin: -40.95 dB |

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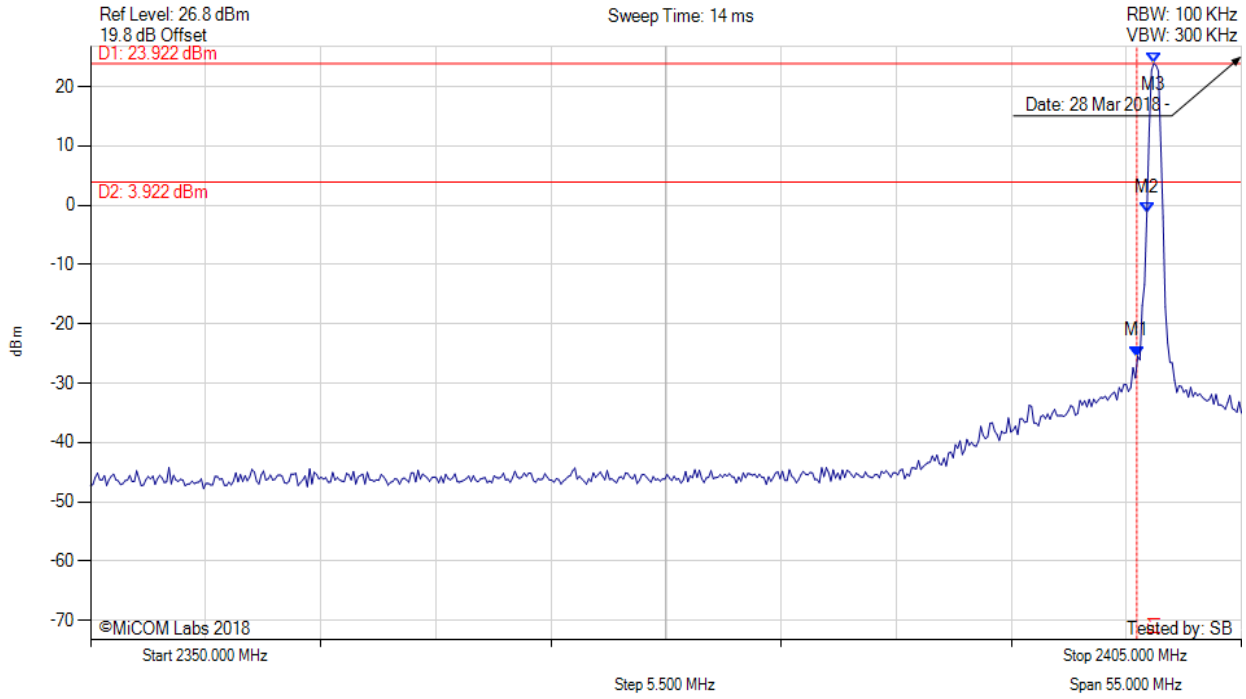
### A.3.1.2. Conducted Band-Edge Emissions

CONDUCTED LOW BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: 300 kbps_GFSK, Channel: 2400.80 MHz, Chain a, Temp: 20, Voltage: Vdc




| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2400.000 MHz : -25.461 dBm<br>M2 : 2400.481 MHz : -1.207 dBm<br>M3 : 2400.812 MHz : 23.922 dBm | Channel Frequency: 2400.80 MHz |

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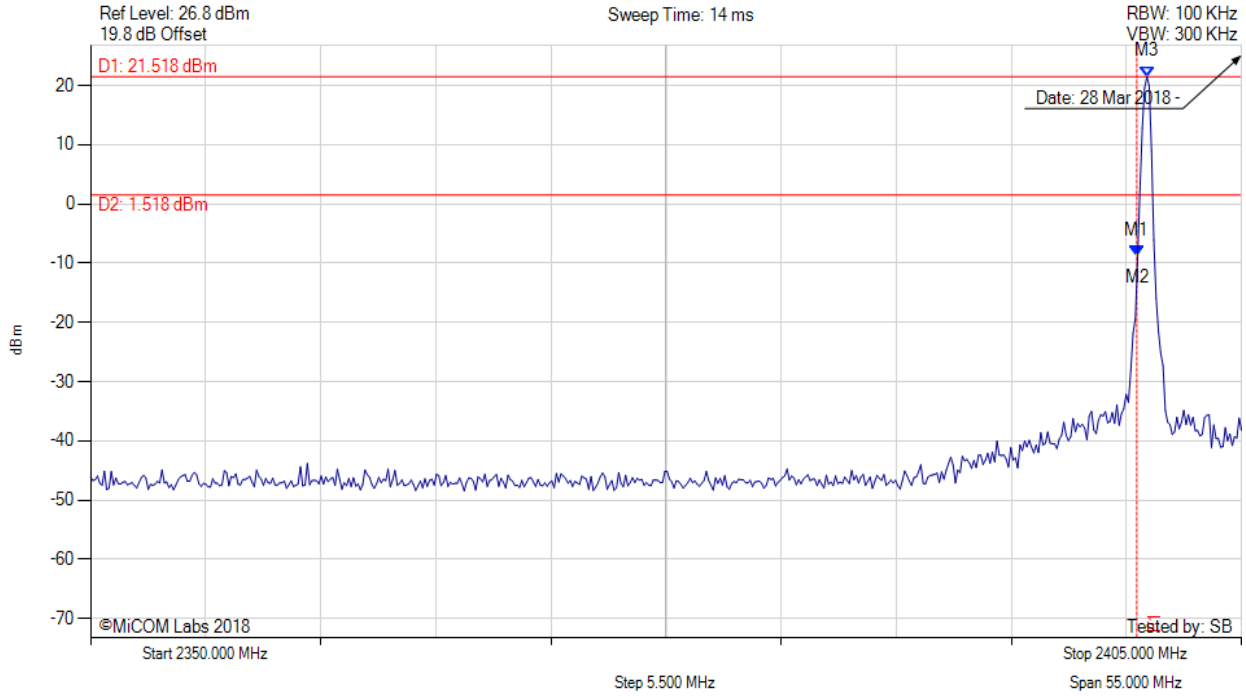
CONDUCTED LOW BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: 600 kbps_OFDM, Channel: 2400.40 MHz, Chain a, Temp: 20, Voltage:  Vdc

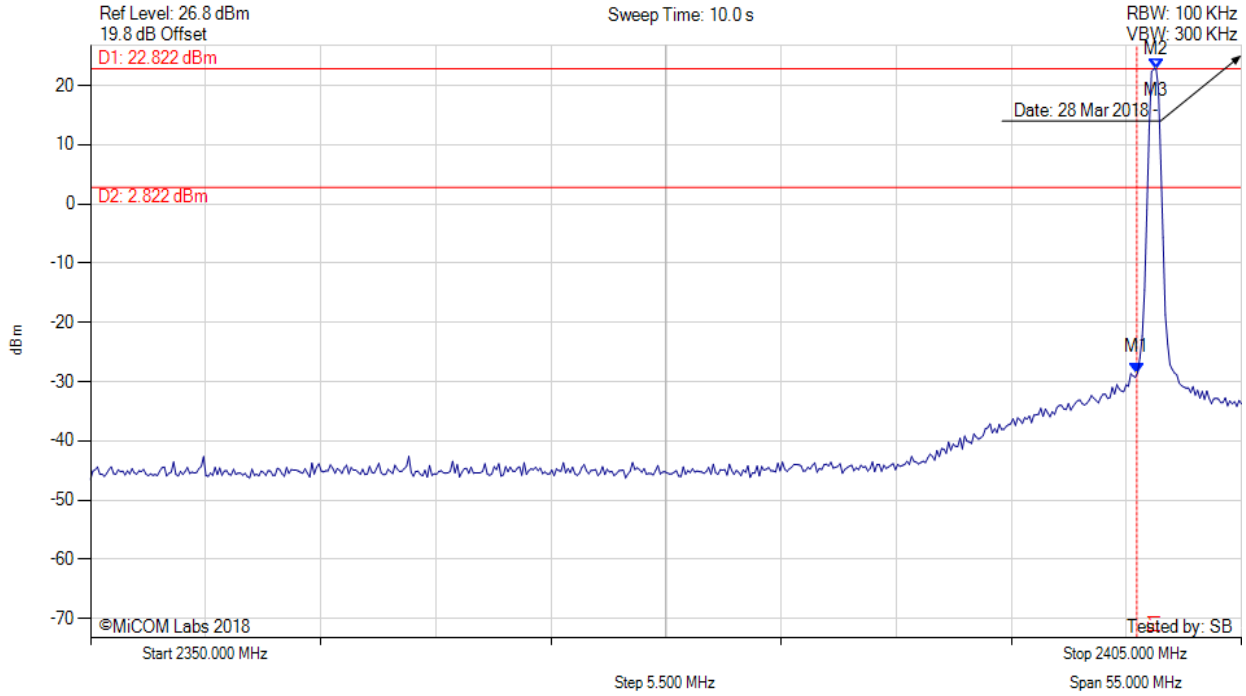



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2400.000 MHz : -8.839 dBm<br>M2 : 2400.040 MHz : -8.839 dBm<br>M3 : 2400.481 MHz : 21.518 dBm | Channel Frequency: 2400.40 MHz |

back to matrix

CONDUCTED LOW BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: 300 kbps_GFSK, Channel: 2400.80 MHz, Chain a, Temp: 20, Voltage: Vdc

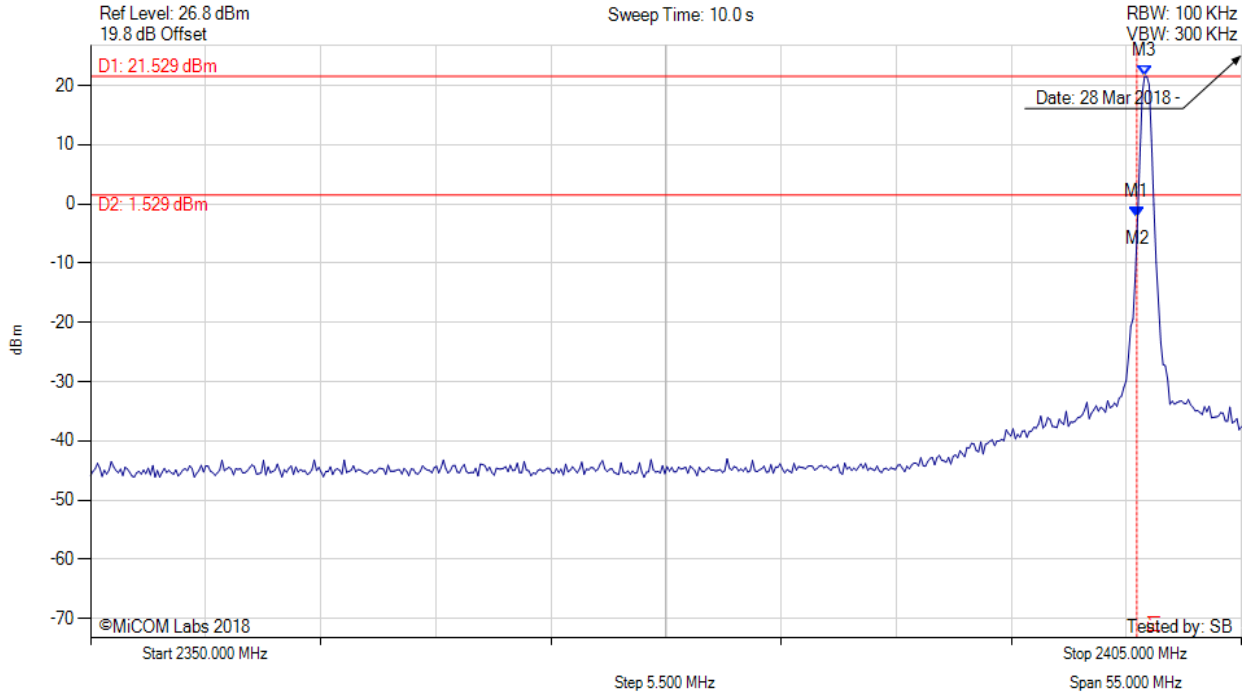



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2400.000 MHz : -28.493 dBm<br>M2 : 2400.922 MHz : 22.822 dBm<br>M3 : 2400.922 MHz : 22.822 dBm | Channel Frequency: 2400.80 MHz |

back to matrix

CONDUCTED LOW BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: 600 kbps_OFDM, Channel: 2400.40 MHz, Chain a, Temp: 20, Voltage: Vdc

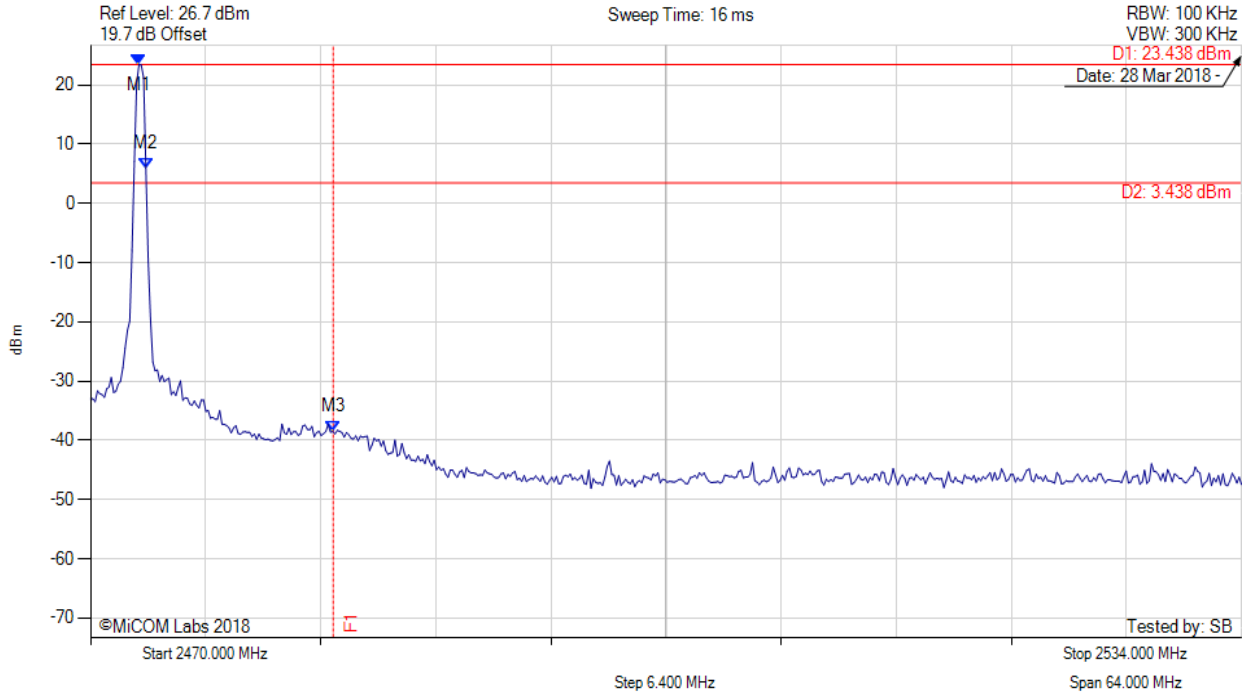



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2400.000 MHz : -2.295 dBm<br>M2 : 2400.040 MHz : -2.295 dBm<br>M3 : 2400.371 MHz : 21.529 dBm | Channel Frequency: 2400.40 MHz |

back to matrix

CONDUCTED UPPER BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: 300 kbps_GFSK, Channel: 2472.80 MHz, Chain a, Temp: 20, Voltage: Vdc

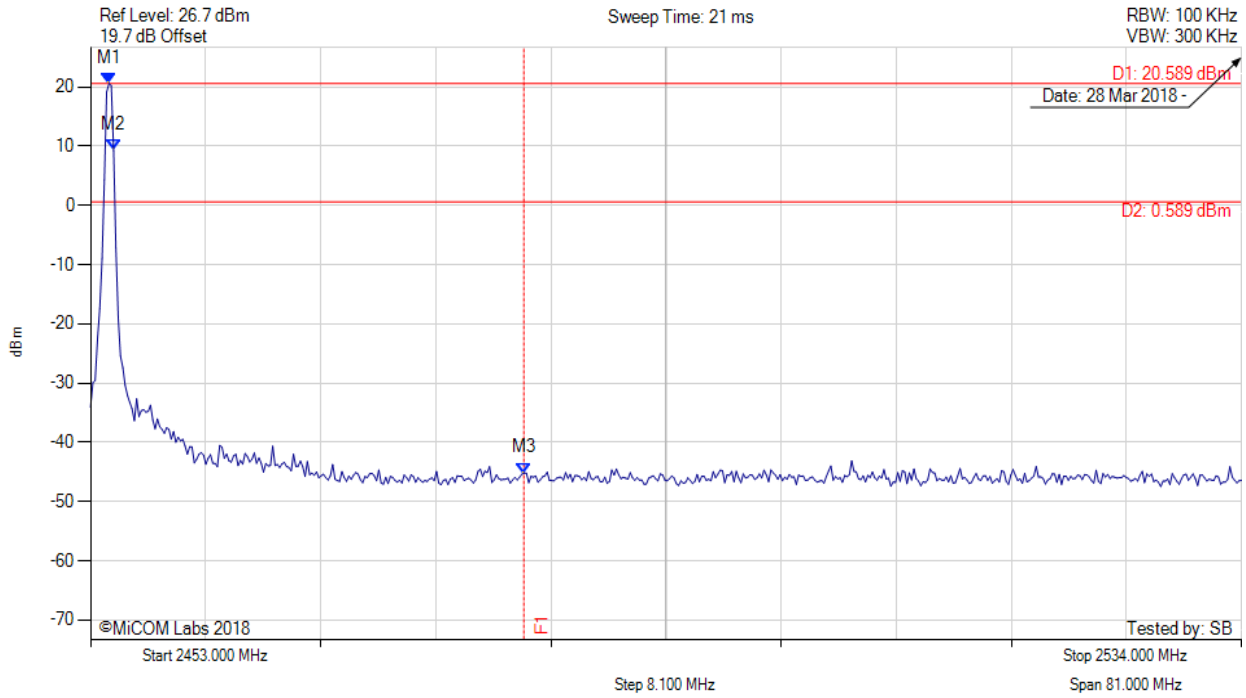



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2472.693 MHz : 23.438 dBm<br>M2 : 2473.078 MHz : 5.889 dBm<br>M3 : 2483.500 MHz : -38.506 dBm | Channel Frequency: 2472.80 MHz |

back to matrix

CONDUCTED UPPER BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: 600 kbps_OFDM, Channel: 2454.40 MHz, Chain a, Temp: 20, Voltage: Vdc

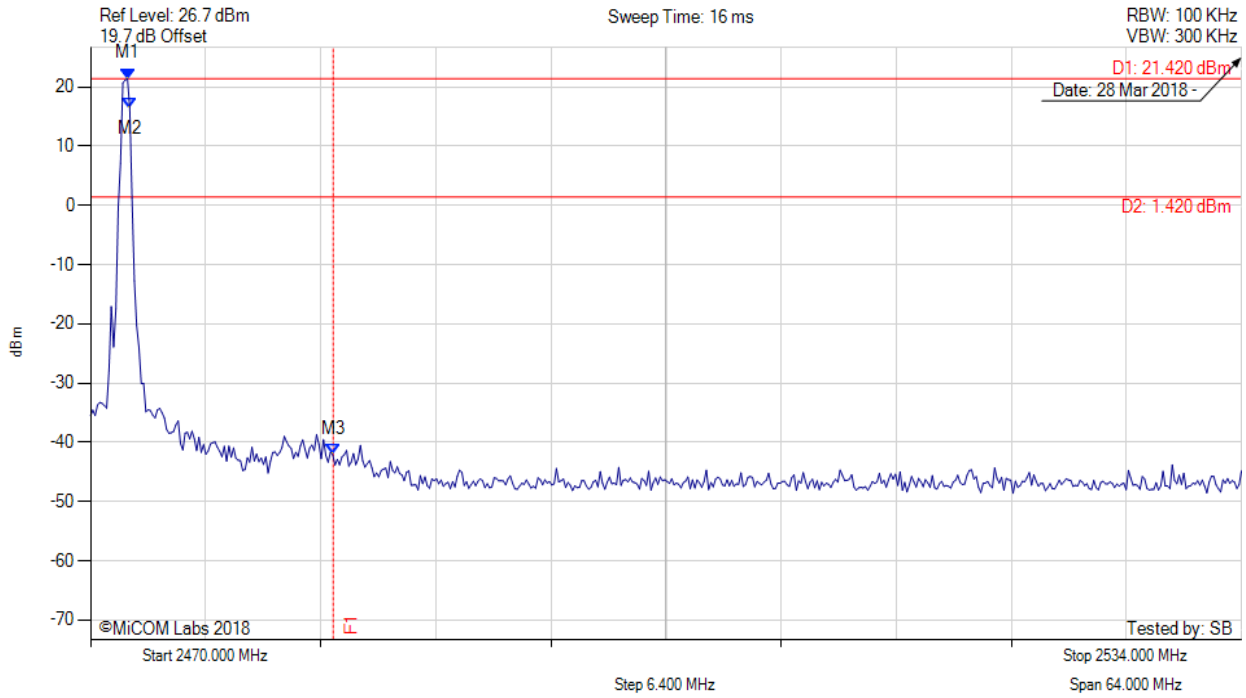



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2454.299 MHz : 20.589 dBm<br>M2 : 2454.623 MHz : 9.283 dBm<br>M3 : 2483.500 MHz : -45.207 dBm | Channel Frequency: 2454.40 MHz |

back to matrix

CONDUCTED UPPER BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: 600 kbps_OFDM, Channel: 2472.00 MHz, Chain a, Temp: 20, Voltage: Vdc

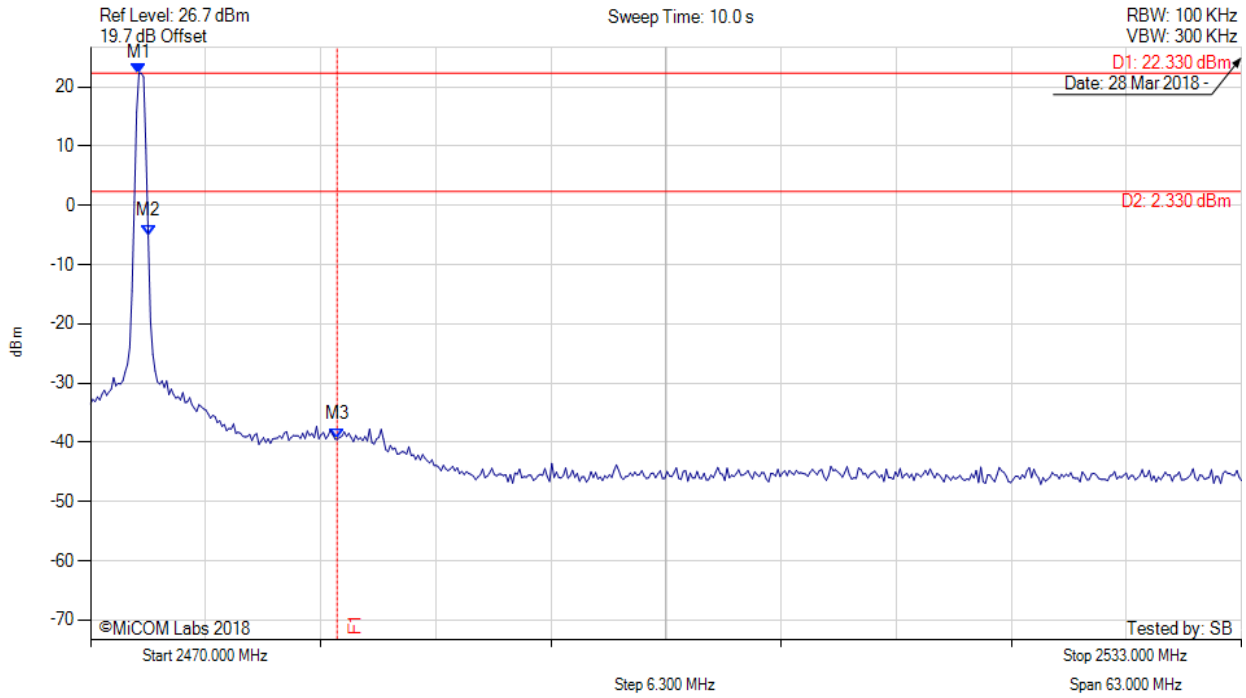



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2472.052 MHz : 21.420 dBm<br>M2 : 2472.180 MHz : 16.456 dBm<br>M3 : 2483.500 MHz : -42.091 dBm | Channel Frequency: 2472.00 MHz |

back to matrix

CONDUCTED UPPER BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: 300 kbps_GFSK, Channel: 2472.80 MHz, Chain a, Temp: 20, Voltage: Vdc

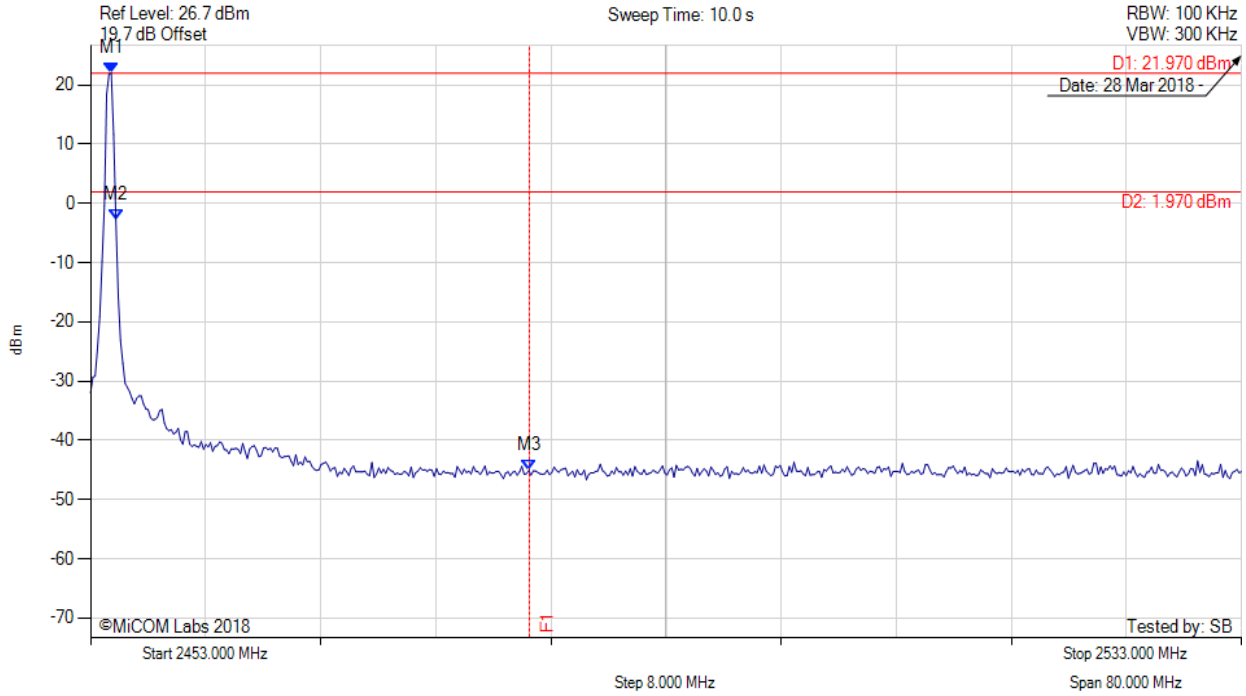



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = VIEW | M1 : 2472.651 MHz : 22.332 dBm<br>M2 : 2473.156 MHz : -5.214 dBm<br>M3 : 2483.500 MHz : -39.531 dBm | Channel Frequency: 2472.80 MHz |

back to matrix

CONDUCTED UPPER BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: 600 kbps_OFDM, Channel: 2454.40 MHz, Chain a, Temp: 20, Voltage: Vdc

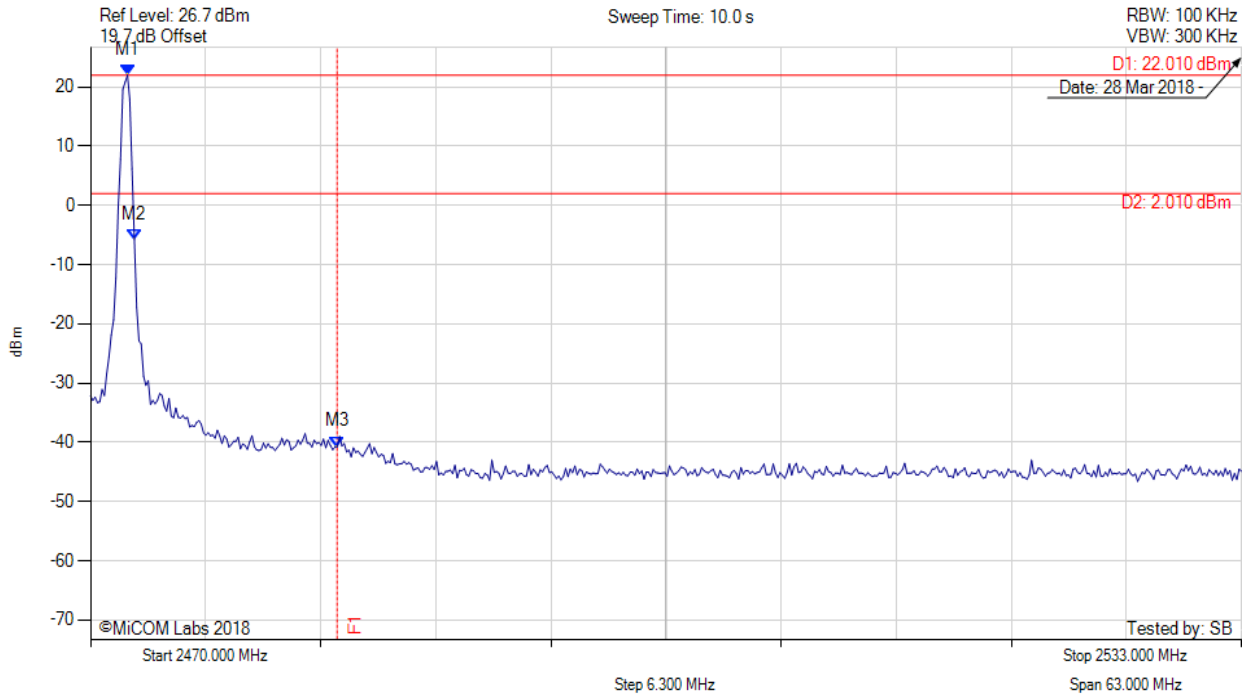



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = MAX HOLD | M1 : 2454.443 MHz : 21.972 dBm<br>M2 : 2454.764 MHz : -2.812 dBm<br>M3 : 2483.500 MHz : -45.132 dBm | Channel Frequency: 2454.40 MHz |

back to matrix

CONDUCTED UPPER BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: 600 kbps_OFDM, Channel: 2472.00 MHz, Chain a, Temp: 20, Voltage: Vdc



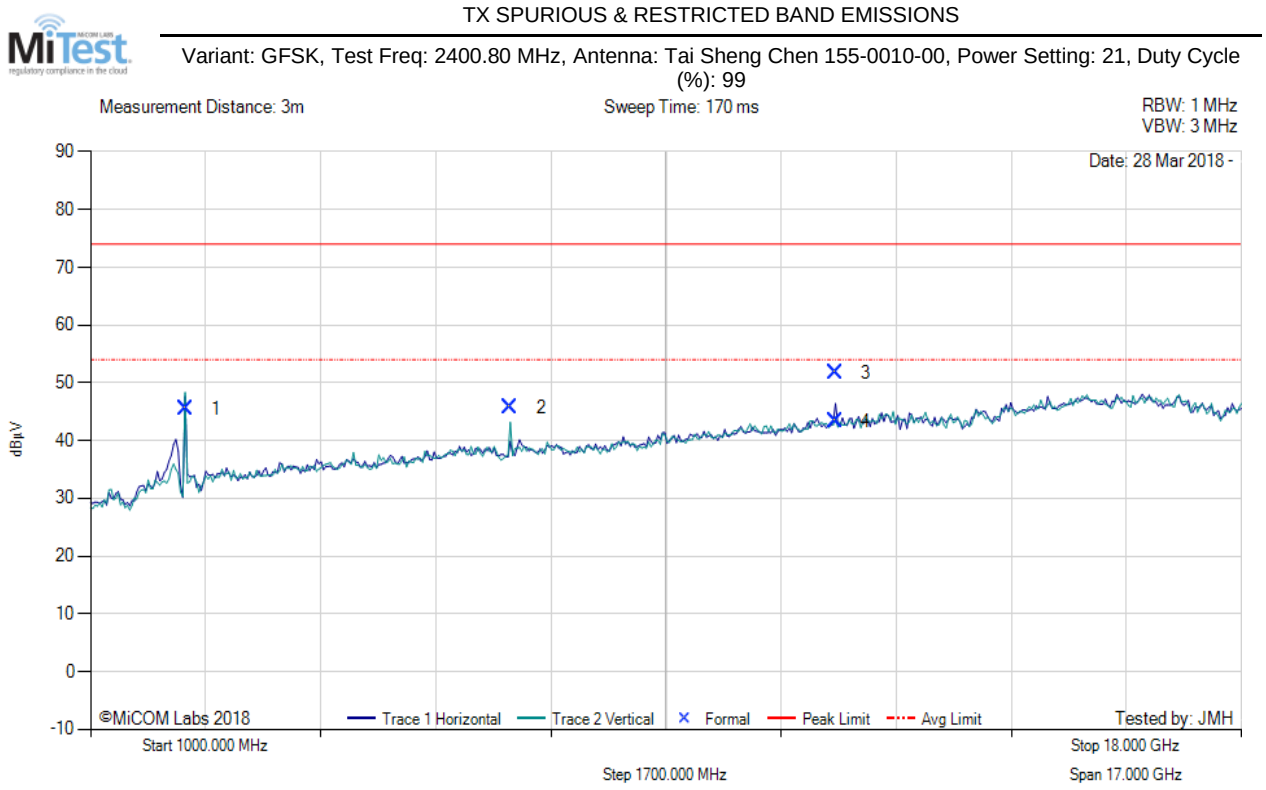

| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = MAX HOLD | M1 : 2472.020 MHz : 22.008 dBm<br>M2 : 2472.399 MHz : -5.720 dBm<br>M3 : 2483.500 MHz : -40.765 dBm | Channel Frequency: 2472.00 MHz |

back to matrix

## A.3.2. Radiated Emissions

### A.3.2.3. TX Spurious & Restricted Band Emissions

**Antenna:** Tai Sheng Chen 155-0010-00



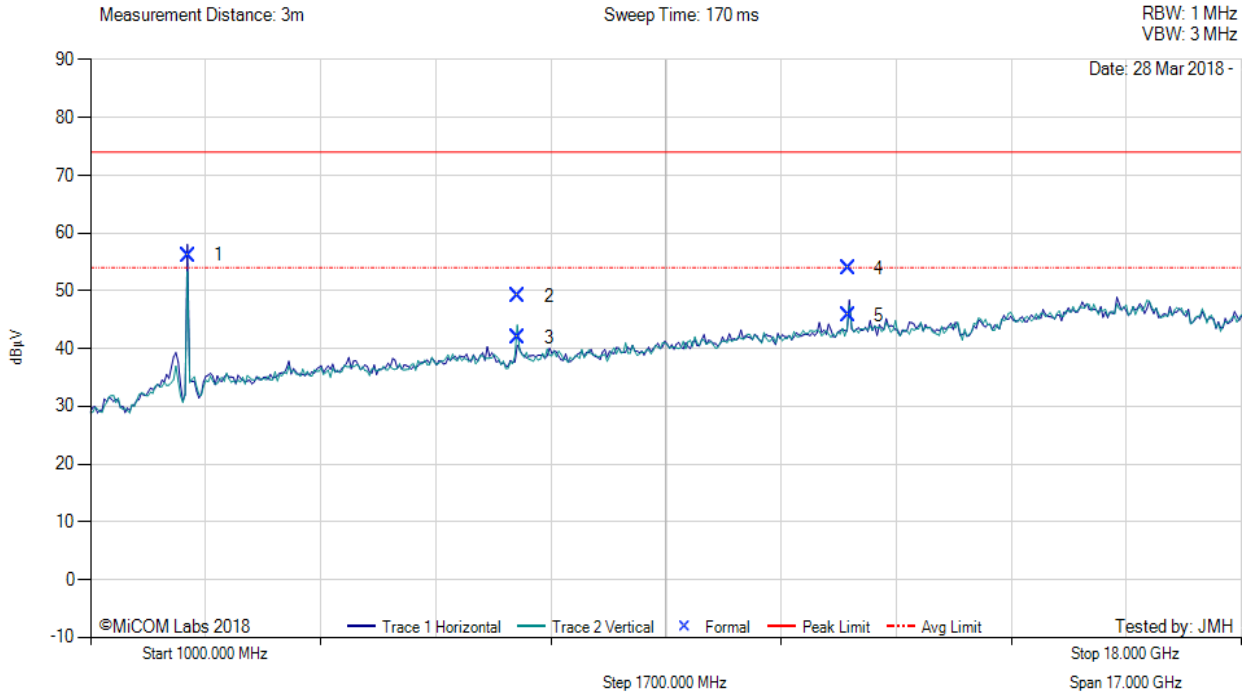

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2400.82 | 55.59 | 2.24 | -12.41 | 45.42 | Fundamental | Vertical | 100 | 76 | -- | -- | |
| 2 | 7202.23 | 49.64 | 3.46 | -7.38 | 45.72 | Peak (NRB) | Vertical | 200 | 190 | -- | -- | Pass |
| 3 | 12004.01 | 54.03 | 4.77 | -7.02 | 51.78 | Max Peak | Horizontal | 192 | 115 | 74.0 | -22.2 | Pass |
| 4 | 12004.01 | 45.55 | 4.77 | -7.02 | 43.30 | Max Avg | Horizontal | 192 | 115 | 54.0 | -10.7 | Pass |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2440.00 MHz, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99



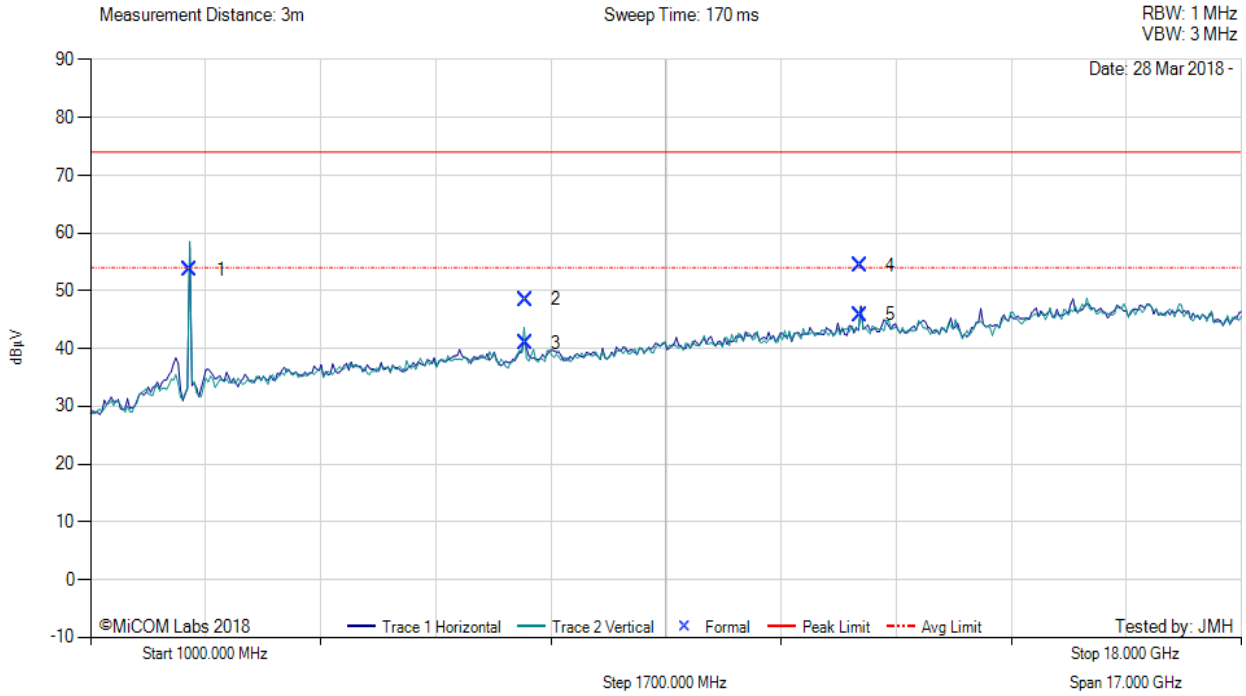

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2439.96 | 65.93 | 2.27 | -12.08 | 56.12 | Fundamental | Horizontal | 100 | 0 | -- | -- | |
| 2 | 7320.15 | 53.42 | 3.49 | -7.86 | 49.05 | Max Peak | Vertical | 111 | 177 | 74.0 | -25.0 | Pass |
| 3 | 7320.15 | 46.28 | 3.49 | -7.86 | 41.91 | Max Avg | Vertical | 111 | 177 | 54.0 | -12.1 | Pass |
| 4 | 12200.23 | 54.01 | 4.66 | -4.76 | 53.91 | Max Peak | Horizontal | 182 | 113 | 74.0 | -20.1 | Pass |
| 5 | 12200.23 | 45.88 | 4.66 | -4.76 | 45.78 | Max Avg | Horizontal | 182 | 113 | 54.0 | -8.2 | Pass |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2472.80 MHz, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99



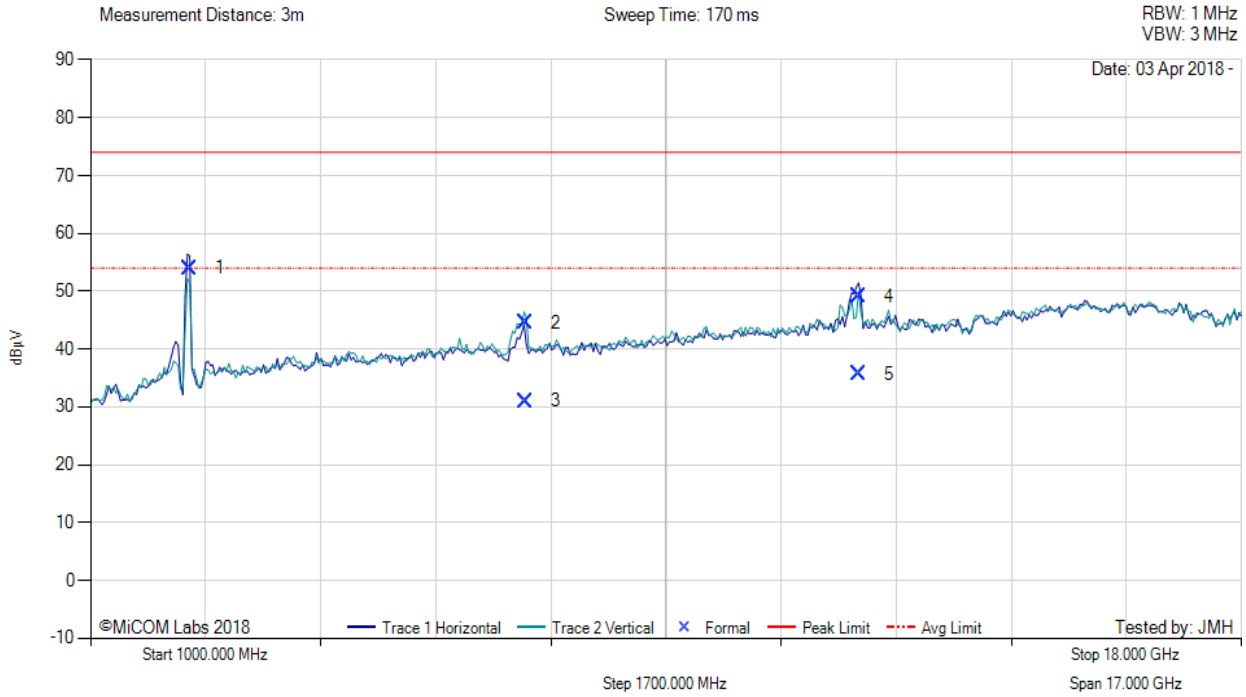

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2472.70 | 63.31 | 2.26 | -11.92 | 53.65 | Fundamental | Vertical | 151 | 121 | -- | -- | |
| 2 | 7418.60 | 52.97 | 3.54 | -8.00 | 48.51 | Max Peak | Vertical | 176 | 180 | 74.0 | -25.5 | Pass |
| 3 | 7418.60 | 45.45 | 3.54 | -8.00 | 40.99 | Max Avg | Vertical | 176 | 180 | 54.0 | -13.0 | Pass |
| 4 | 12364.36 | 54.57 | 4.65 | -4.86 | 54.36 | Max Peak | Horizontal | 180 | 84 | 74.0 | -19.6 | Pass |
| 5 | 12364.36 | 46.08 | 4.65 | -4.86 | 45.87 | Max Avg | Horizontal | 180 | 84 | 54.0 | -8.1 | Pass |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: Hopping, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99




| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2461.61 | 63.65 | 2.29 | -11.95 | 53.99 | Fundamental | Horizontal | 100 | 0 | -- | -- | Pass |
| 2 | 7421.08 | 49.06 | 3.54 | -8.05 | 44.55 | Max Peak | Vertical | 112 | 274 | 74.0 | -29.5 | Pass |
| 3 | 7421.08 | 35.50 | 3.54 | -8.05 | 30.99 | Max Avg | Vertical | 112 | 274 | 54.0 | -23.0 | Pass |
| 4 | 12348.38 | 49.04 | 4.58 | -4.56 | 49.06 | Max Peak | Horizontal | 115 | 247 | 74.0 | -24.9 | Pass |
| 5 | 12348.38 | 35.62 | 4.58 | -4.56 | 35.64 | Max Avg | Horizontal | 115 | 247 | 54.0 | -18.4 | Pass |

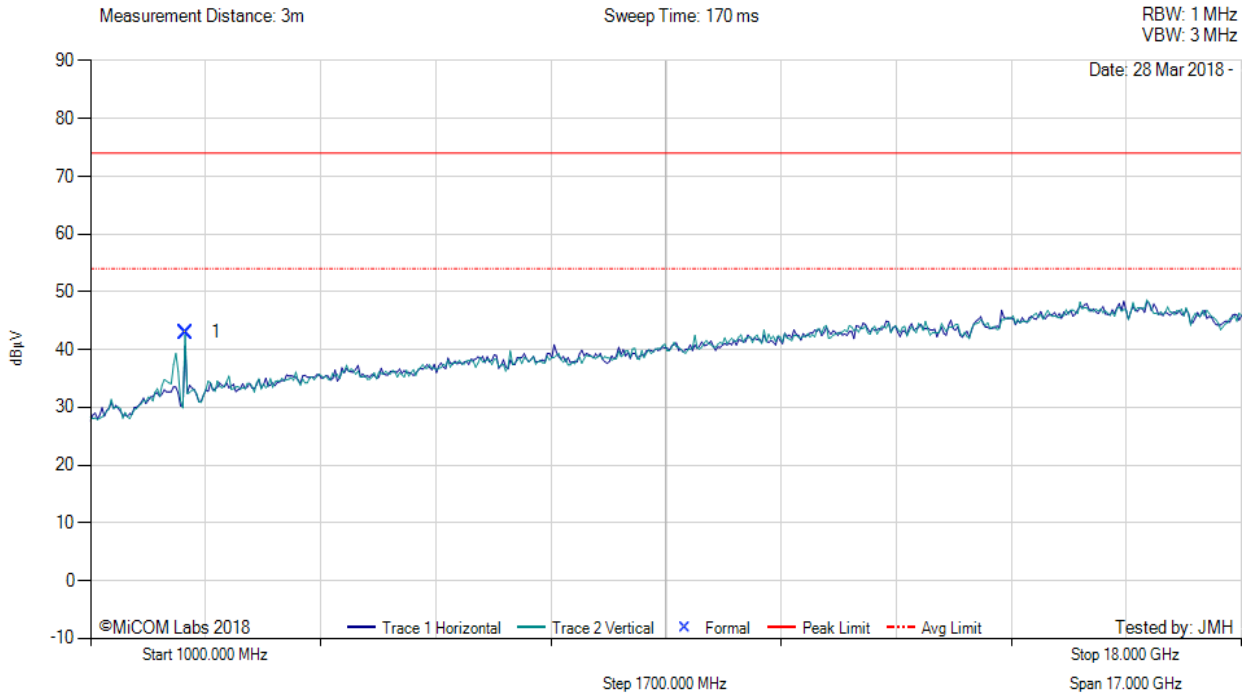
**Test Notes:** EUT powered by 4V DC. 2.4 GHz Notch filter in front of amp to prevent overload. Hopping

back to matrix

**Antenna: WP WPANT30017-CA**

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2400.80 MHz, Antenna: WP WPANT30017-CA, Power Setting: 21, Duty Cycle (%): 99



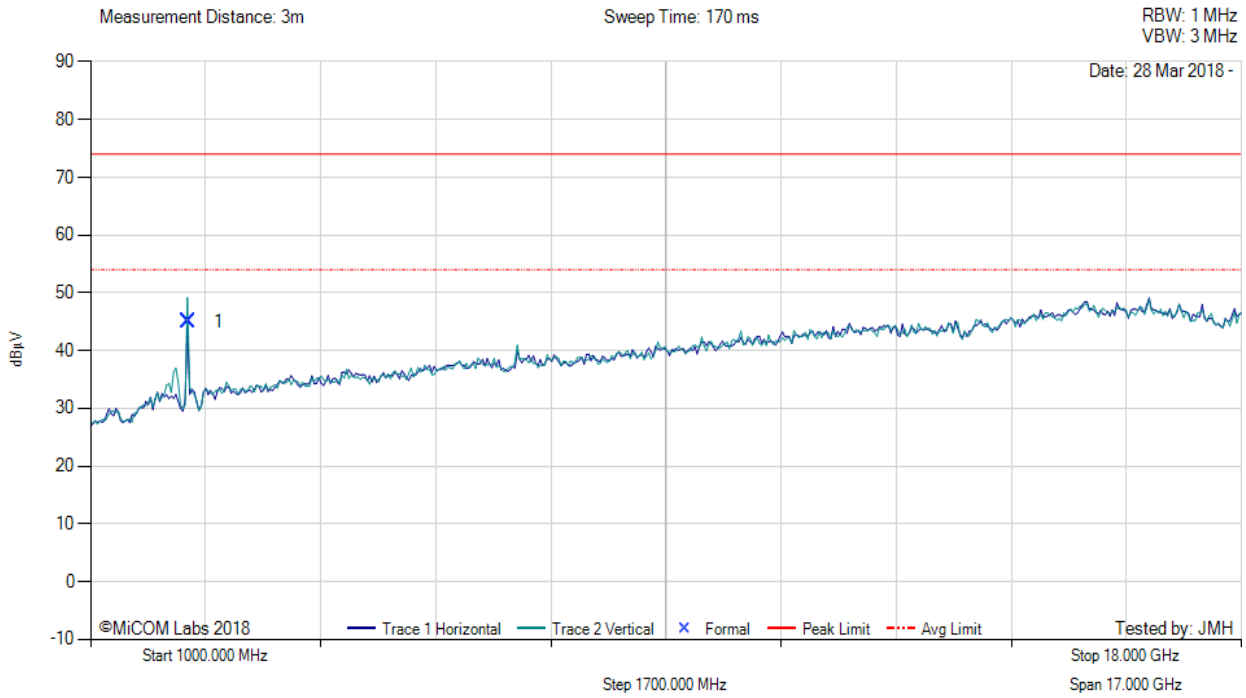

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2400.92 | 53.14 | 2.24 | -12.41 | 42.97 | Fundamental | Vertical | 100 | 161 | -- | -- | |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2440.00 MHz, Antenna: WP WPANT30017-CA, Power Setting: 21, Duty Cycle (%): 99



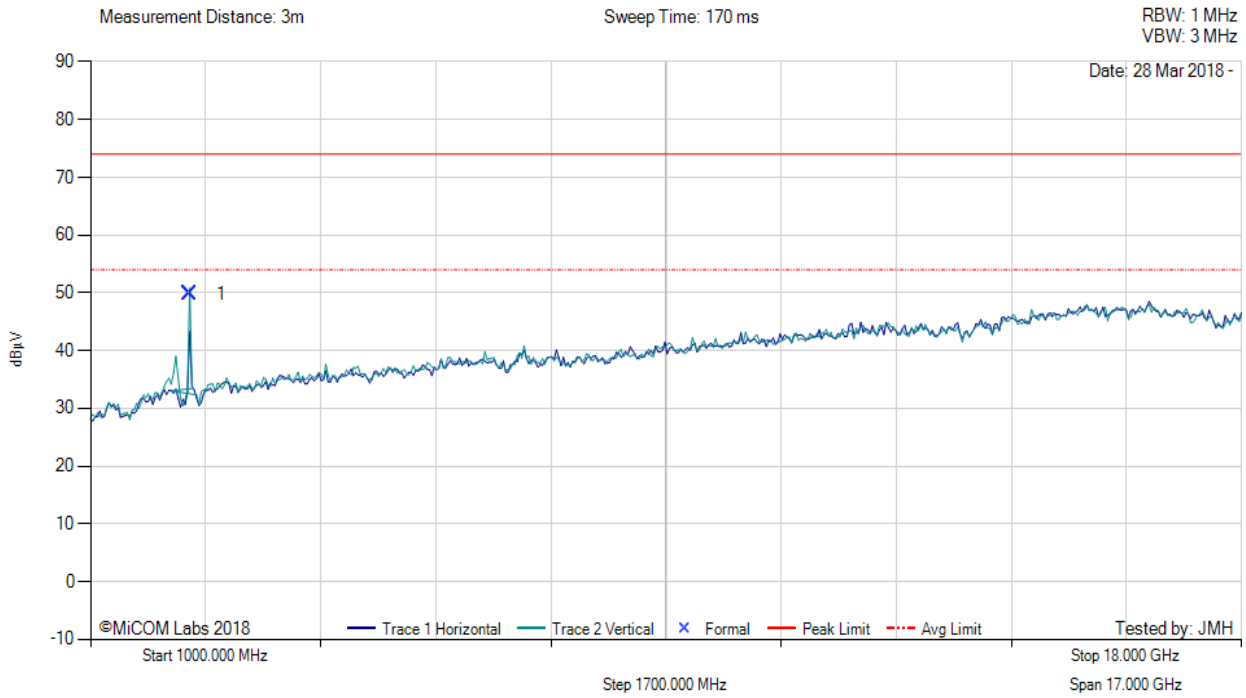

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2440.01 | 54.80 | 2.27 | -12.08 | 44.99 | Fundamental | Vertical | 100 | 154 | -- | -- | |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2472.80 MHz, Antenna: WP WPANT30017-CA, Power Setting: 21, Duty Cycle (%): 99



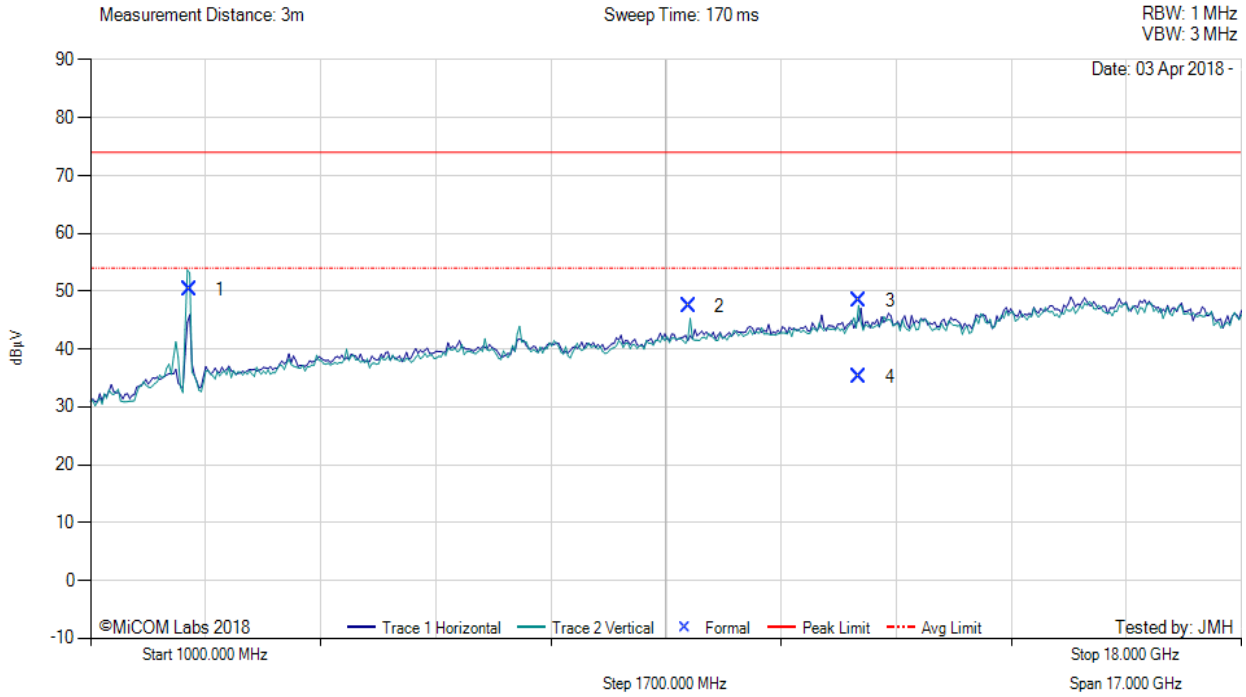

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2472.92 | 59.41 | 2.26 | -11.92 | 49.75 | Fundamental | Vertical | 100 | 42 | -- | -- | |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: Hopping, Antenna: WP WPANT30017-CA, Power Setting: 21, Duty Cycle (%): 99




| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2466.35 | 59.96 | 2.27 | -11.97 | 50.26 | Fundamental | Vertical | 200 | 0 | -- | -- | Pass |
| 2 | 9836.61 | 49.25 | 4.45 | -6.34 | 47.36 | Peak (NRB) | Vertical | 200 | 86 | -- | -- | Pass |
| 3 | 12355.99 | 48.48 | 4.61 | -4.68 | 48.41 | Max Peak | Vertical | 170 | 92 | 74.0 | -25.6 | Pass |
| 4 | 12355.99 | 35.25 | 4.61 | -4.68 | 35.18 | Max Avg | Vertical | 170 | 92 | 54.0 | -18.8 | Pass |

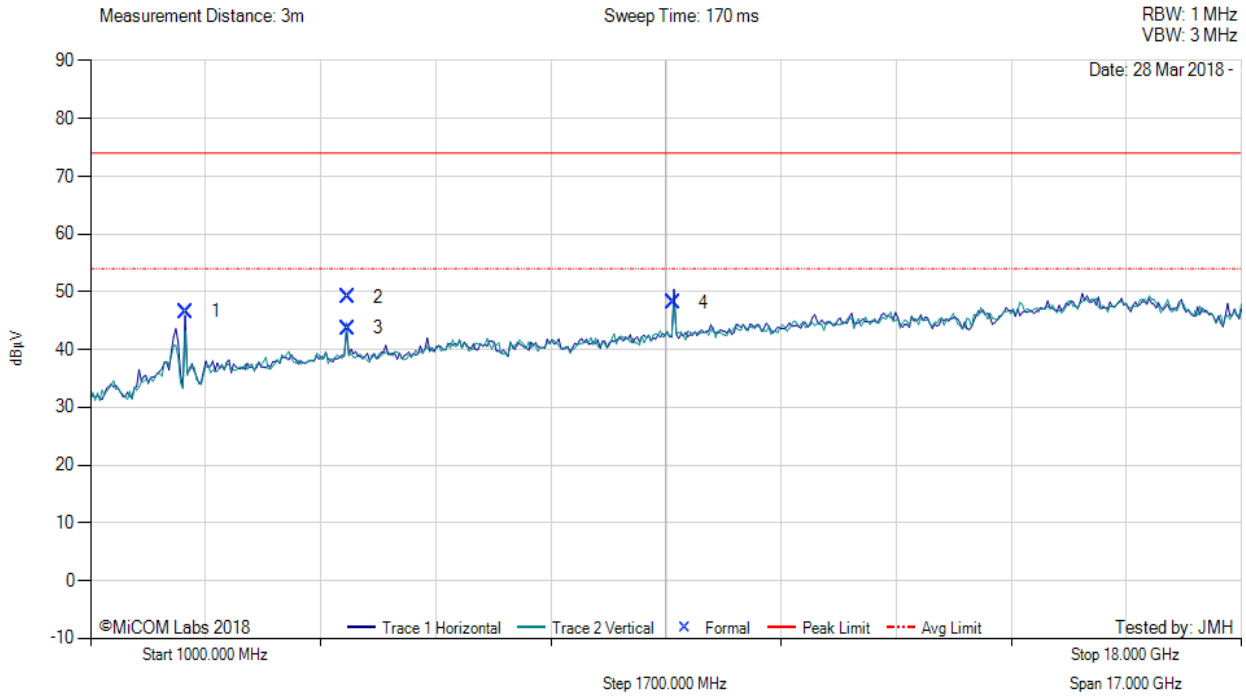
**Test Notes:** EUT powered by 4V DC. 2.4 GHz Notch filter in front of amp to prevent overload. Hopping

back to matrix

**Antenna: WP WPANT40020-SA**

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2400.80 MHz, Antenna: WP WPANT40020-SA, Power Setting: 21, Duty Cycle (%): 99



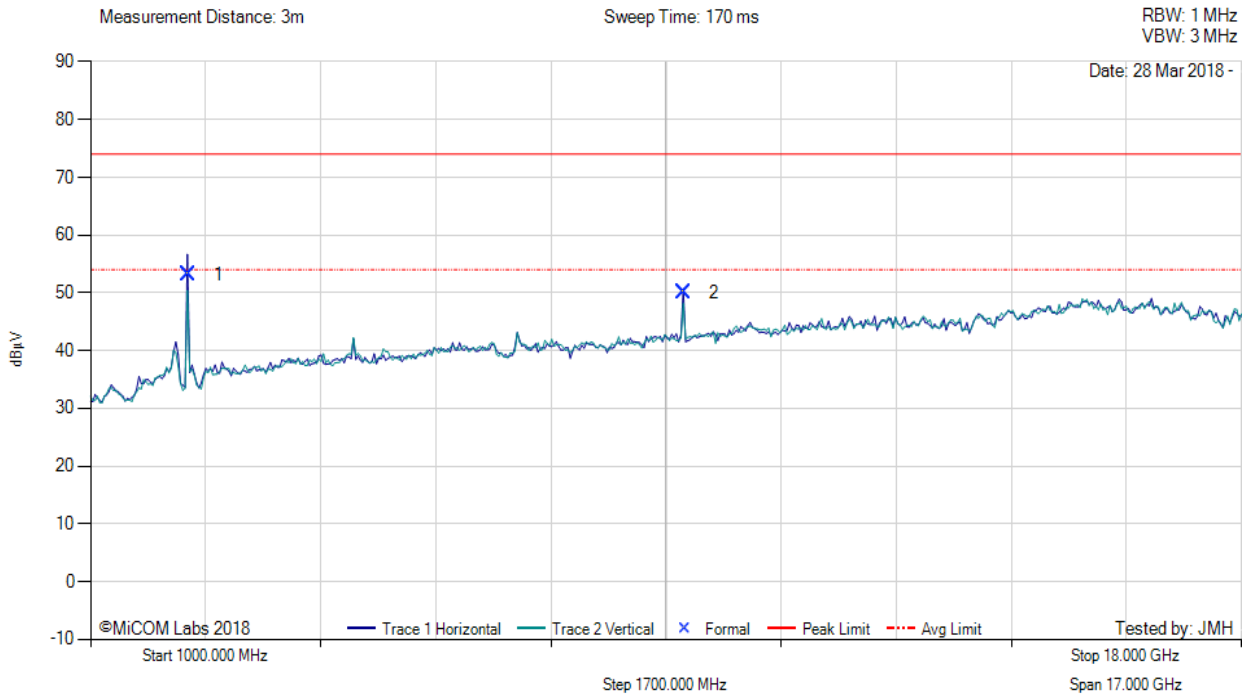

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2400.70 | 56.75 | 2.24 | -12.41 | 46.58 | Fundamental | Horizontal | 200 | 95 | -- | -- | |
| 2 | 4801.61 | 58.63 | 2.96 | -12.43 | 49.16 | Max Peak | Vertical | 101 | 214 | 74.0 | -24.8 | Pass |
| 3 | 4801.61 | 53.13 | 2.96 | -12.43 | 43.66 | Max Avg | Vertical | 101 | 214 | 54.0 | -10.3 | Pass |
| 4 | 9603.08 | 50.22 | 4.54 | -6.67 | 48.09 | Peak (NRB) | Horizontal | 200 | 175 | -- | -- | Pass |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2440.00 MHz, Antenna: WP WPANT40020-SA, Power Setting: 21, Duty Cycle (%): 99



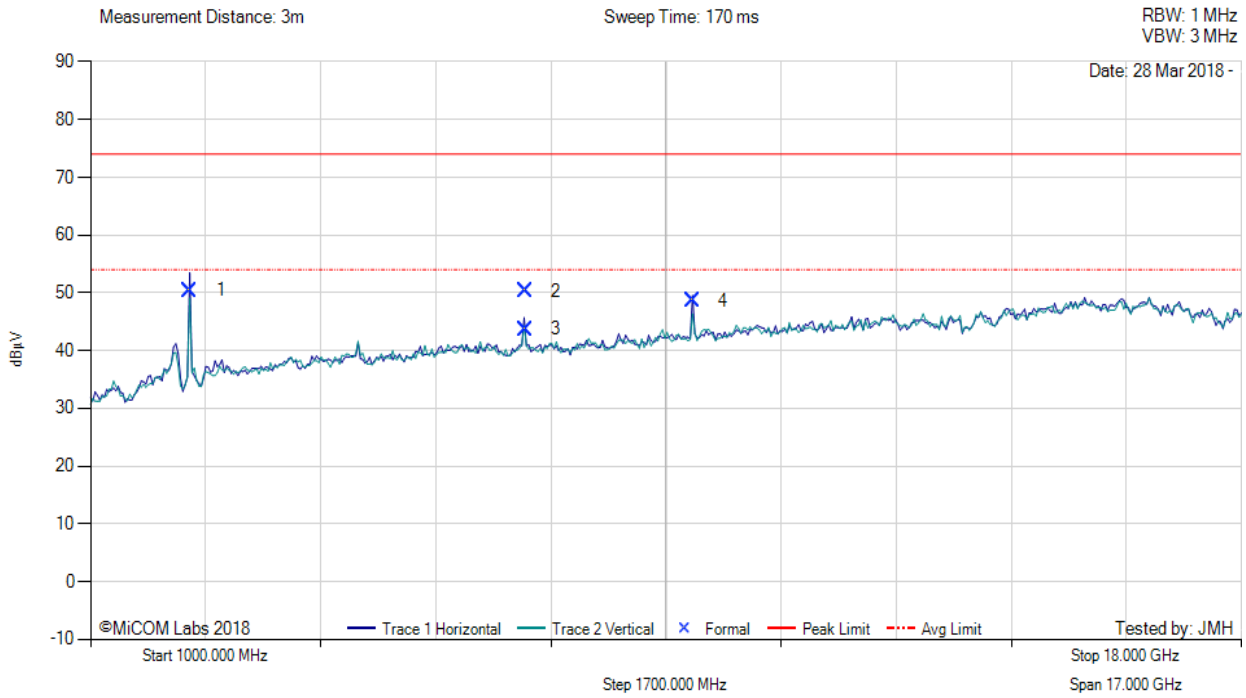

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2439.94 | 62.92 | 2.27 | -12.08 | 53.11 | Fundamental | Horizontal | 100 | 60 | -- | -- | |
| 2 | 9759.74 | 51.66 | 4.37 | -5.95 | 50.08 | Peak (NRB) | Horizontal | 100 | 185 | -- | -- | Pass |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2472.80 MHz, Antenna: WP WPANT40020-SA, Power Setting: 21, Duty Cycle (%): 99



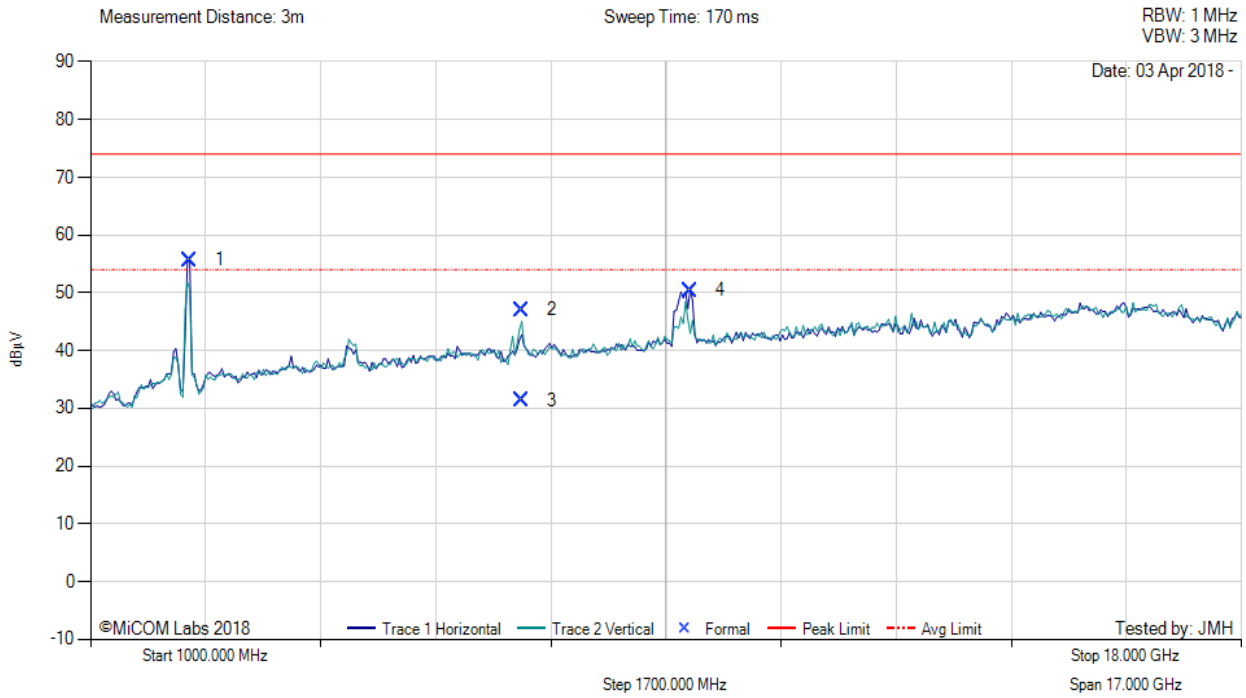

| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2472.92 | 60.09 | 2.26 | -11.92 | 50.43 | Fundamental | Vertical | 100 | 114 | -- | -- | |
| 2 | 7418.47 | 54.77 | 3.54 | -8.00 | 50.31 | Max Peak | Horizontal | 151 | 188 | 74.0 | -23.7 | Pass |
| 3 | 7418.47 | 48.20 | 3.54 | -8.00 | 43.74 | Max Avg | Horizontal | 151 | 188 | 54.0 | -10.3 | Pass |
| 4 | 9891.22 | 50.89 | 4.48 | -6.76 | 48.61 | Peak (NRB) | Horizontal | 100 | 175 | -- | -- | Pass |

**Test Notes:** EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: Hopping, Antenna: WP WPANT40020-SA, Power Setting: 21, Duty Cycle (%): 99




| 1000.00 - 18000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2464.16 | 65.34 | 2.28 | -11.96 | 55.66 | Peak (NRB) | Horizontal | 151 | 150 | -- | -- | Pass |
| 2 | 7365.89 | 51.31 | 3.52 | -7.81 | 47.02 | Max Peak | Vertical | 160 | 153 | 74.0 | -27.0 | Pass |
| 3 | 7365.89 | 35.60 | 3.52 | -7.81 | 31.31 | Max Avg | Vertical | 160 | 153 | 54.0 | -22.7 | Pass |
| 4 | 9856.23 | 52.55 | 4.41 | -6.57 | 50.39 | Peak (NRB) | Horizontal | 151 | 279 | -- | -- | Pass |

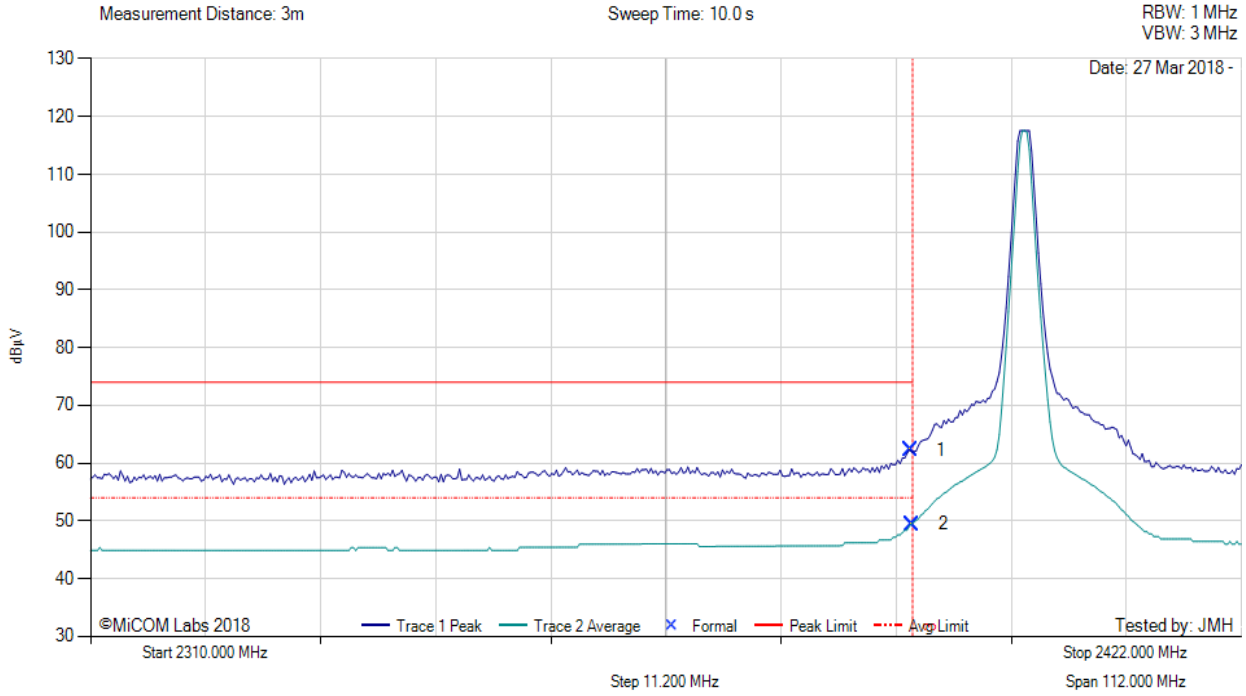
**Test Notes:** EUT powered by 4V DC. 2.4 GHz Notch in front of amp to prevent overload. Hopping

back to matrix

### A.3.2.4. Restricted Edge & Band-Edge Emissions

RADIATED - LOWER RESTRICTED BAND-EDGE EMISSIONS

Variant: GFSK, Test Freq: 2400.80 MHz, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99




| 2310.00 - 2422.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2389.78 | 28.08 | 2.26 | 31.96 | 62.30 | Max Peak | Horizontal | 130 | 80 | 74.0 | -11.7 | Pass |
| 2 | 2390.00 | 15.24 | 2.26 | 31.96 | 49.46 | Max Avg | Horizontal | 130 | 80 | 54.0 | -4.5 | Pass |
| 3 | 2390.00 | -- | -- | -- | -- | Restricted-Band | -- | -- | -- | -- | -- | -- |

**Test Notes:** EUT powered by 4 volt DC,

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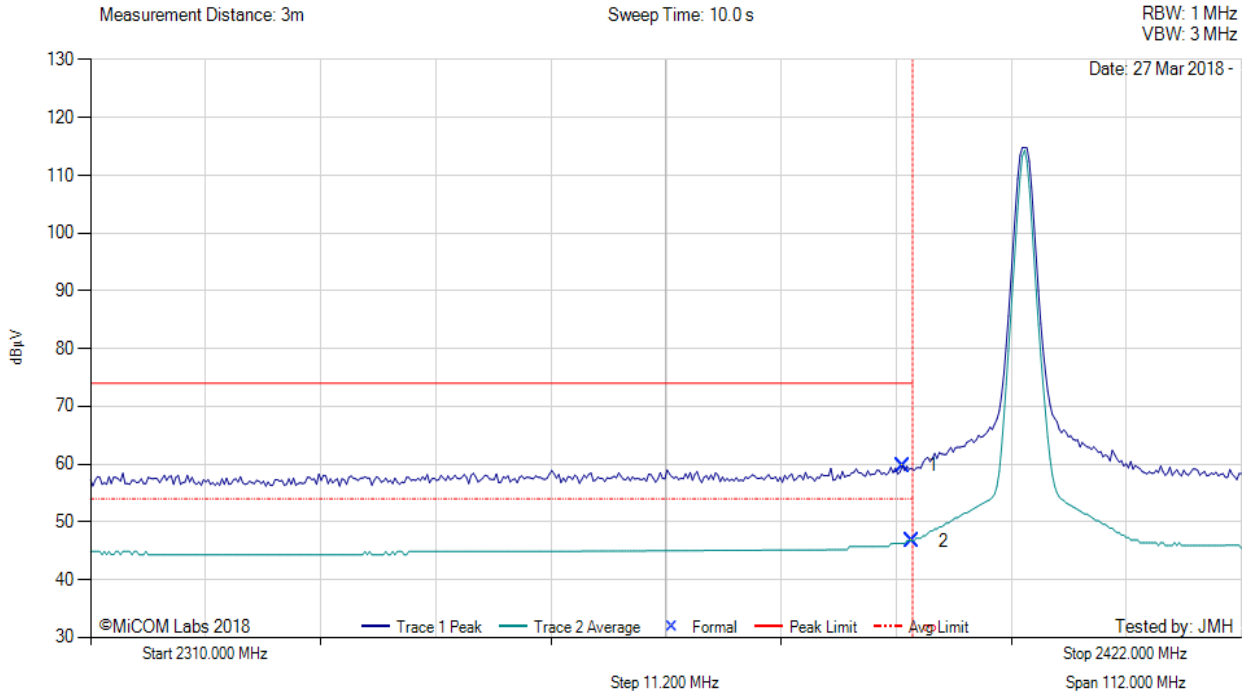
RADIATED - LOWER RESTRICTED BAND-EDGE EMISSIONS

Variant: GFSK, Test Freq: 2400.80 MHz, Antenna: WP WPANT30017-CA, Power Setting: 21, Duty Cycle (%): 99



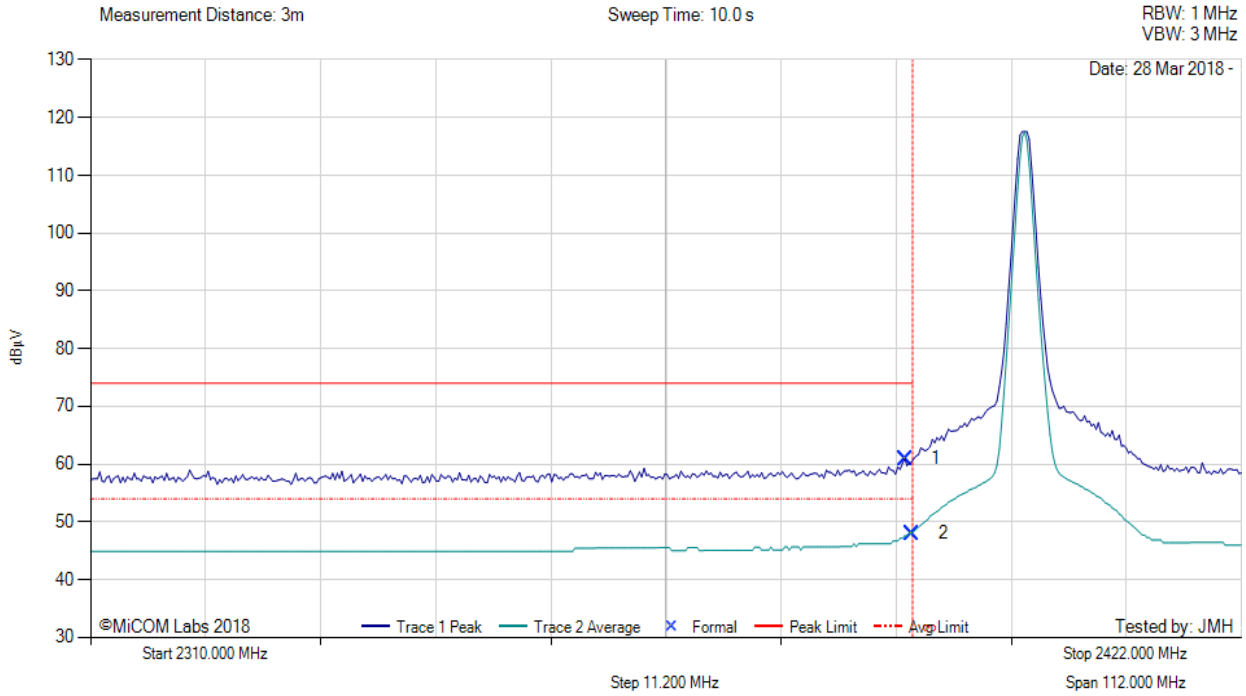

| 2310.00 - 2422.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2389.01 | 25.53 | 2.26 | 31.95 | 59.74 | Max Peak | Vertical | 193 | 348 | 74.0 | -14.3 | Pass |
| 2 | 2390.00 | 12.51 | 2.26 | 31.96 | 46.73 | Max Avg | Vertical | 193 | 348 | 54.0 | -7.3 | Pass |
| 3 | 2390.00 | -- | -- | -- | -- | Restricted-Band | -- | -- | -- | -- | -- | -- |

**Test Notes:** EUT powered by 4 volt DC,

back to matrix

RADIATED - LOWER RESTRICTED BAND-EDGE EMISSIONS

Variant: GFSK, Test Freq: 2400.80 MHz, Antenna: WP WPANT40020-SA, Power Setting: 21, Duty Cycle (%): 99



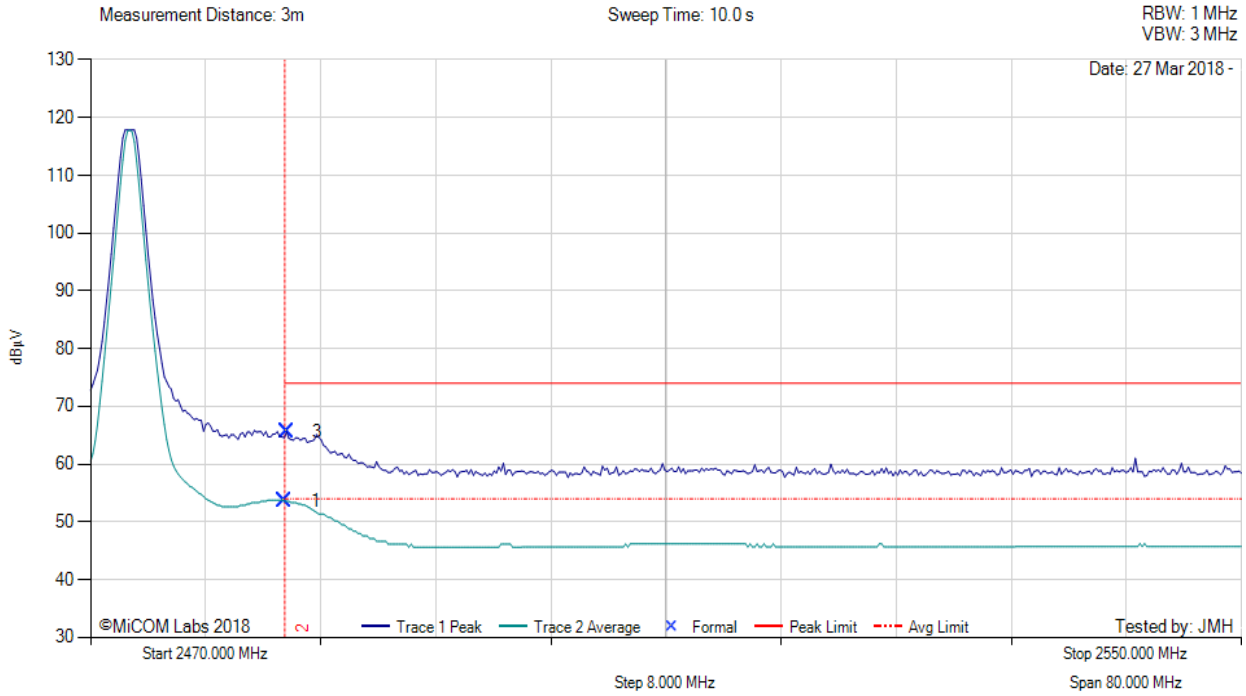

| 2310.00 - 2422.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2389.33 | 26.77 | 2.26 | 31.95 | 60.98 | Max Peak | Horizontal | 200 | 153 | 74.0 | -13.0 | Pass |
| 2 | 2390.00 | 13.79 | 2.26 | 31.96 | 48.01 | Max Avg | Horizontal | 200 | 153 | 54.0 | -6.0 | Pass |
| 3 | 2390.00 | -- | -- | -- | -- | Restricted-Band | -- | -- | -- | -- | -- | -- |

**Test Notes:** EUT powered by 4 volt DC

back to matrix

RADIATED - UPPER RESTRICTED BAND-EDGE EMISSIONS

Variant: GFSK, Test Freq: 2472.80 MHz, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99



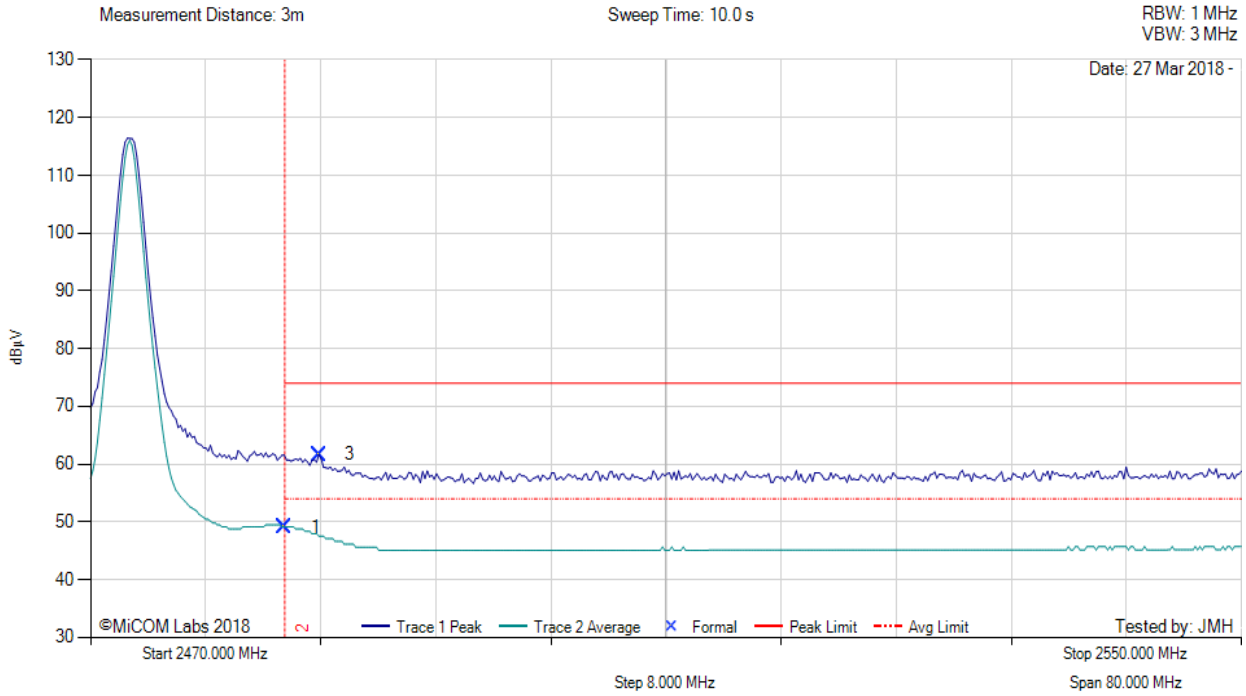

| 2470.00 - 2550.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2483.50 | 19.00 | 2.25 | 32.33 | 53.58 | Max Avg | Horizontal | 130 | 80 | 54.0 | -0.4 | Pass |
| 3 | 2483.66 | 30.99 | 2.25 | 32.33 | 65.57 | Max Peak | Horizontal | 130 | 80 | 74.0 | -8.4 | Pass |
| 2 | 2483.50 | -- | -- | -- | -- | Restricted-Band | -- | -- | -- | -- | -- | -- |

**Test Notes:** EUT powered by 4 volt DC,

back to matrix

RADIATED - UPPER RESTRICTED BAND-EDGE EMISSIONS

Variant: GFSK, Test Freq: 2472.80 MHz, Antenna: WP WPANT30017-CA, Power Setting: 21, Duty Cycle (%): 99



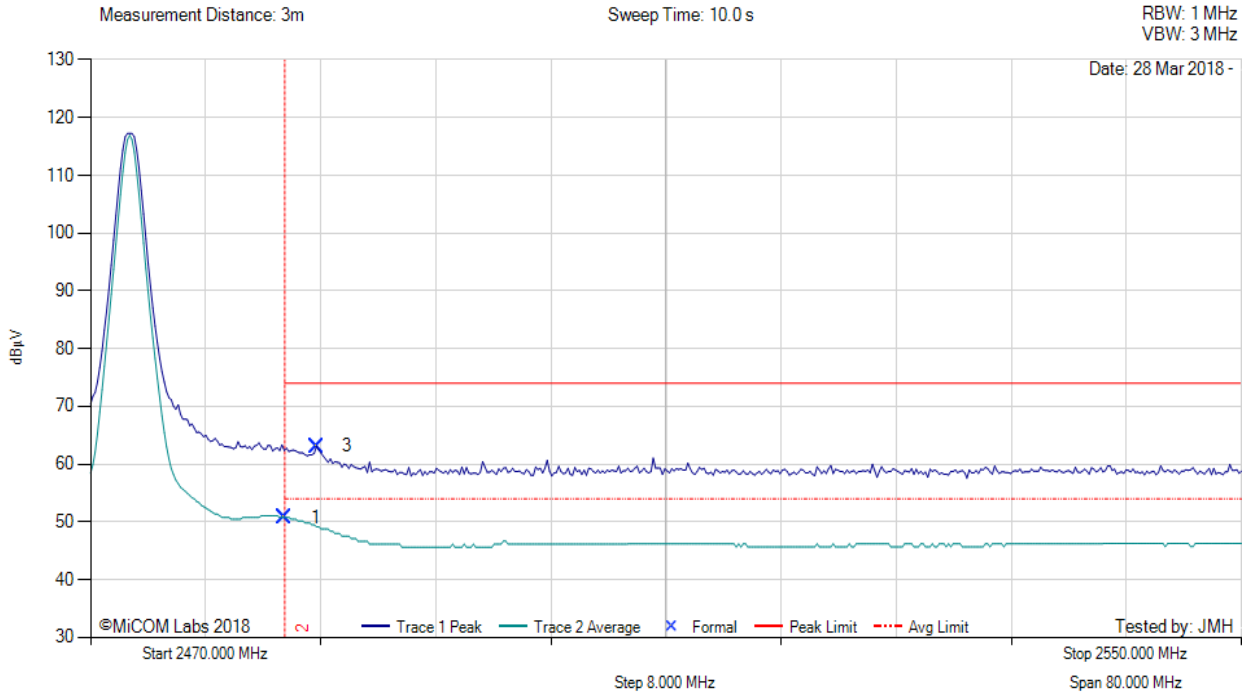

| 2470.00 - 2550.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2483.50 | 14.56 | 2.25 | 32.33 | 49.14 | Max Avg | Vertical | 193 | 348 | 54.0 | -4.9 | Pass |
| 3 | 2485.90 | 27.05 | 2.25 | 32.33 | 61.63 | Max Peak | Vertical | 193 | 348 | 74.0 | -12.4 | Pass |
| 2 | 2483.50 | -- | -- | -- | -- | Restricted-Band | -- | -- | -- | -- | -- | -- |

**Test Notes:** EUT powered by 4 volt DC,

back to matrix

RADIATED - UPPER RESTRICTED BAND-EDGE EMISSIONS

Variant: GFSK, Test Freq: 2472.80 MHz, Antenna: WP WPANT40020-SA, Power Setting: 21, Duty Cycle (%): 99



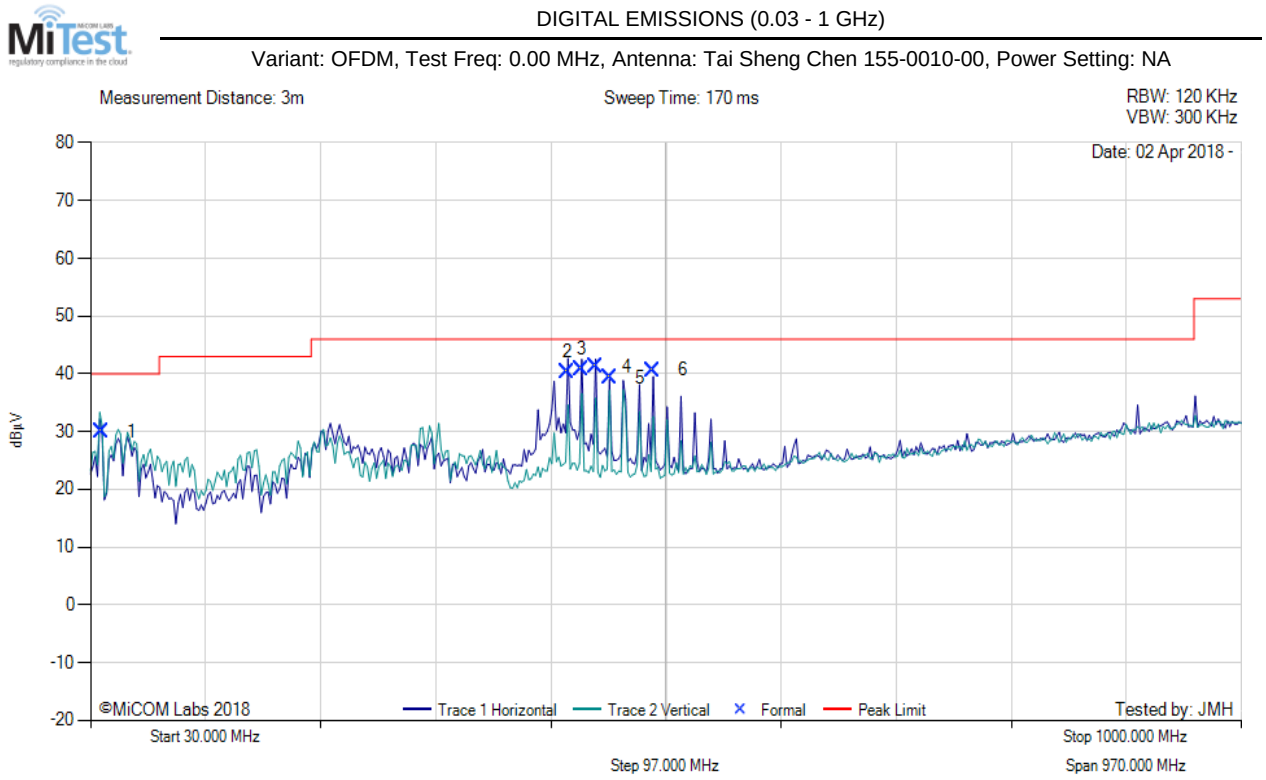

| 2470.00 - 2550.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 2483.50 | 16.21 | 2.25 | 32.33 | 50.79 | Max Avg | Horizontal | 183 | 159 | 54.0 | -3.2 | Pass |
| 3 | 2485.74 | 28.55 | 2.25 | 32.33 | 63.13 | Max Peak | Horizontal | 183 | 159 | 74.0 | -10.9 | Pass |
| 2 | 2483.50 | -- | -- | -- | -- | Restricted-Band | -- | -- | -- | -- | -- | -- |

**Test Notes:** EUT powered by 4 volt DC

back to matrix

## A.3.3. Digital Emissions (0.03 - 1 GHz)

USB Active and downloading, Connected to SBC computer




| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 39.02 | 43.91 | 3.47 | -17.37 | 30.01 | MaxQP | Vertical | 104 | 71 | 40.0 | -10.0 | Pass |
| 2 | 431.96 | 49.59 | 4.99 | -14.31 | 40.27 | MaxQP | Horizontal | 204 | 154 | 46.0 | -5.7 | Pass |
| 3 | 443.99 | 49.98 | 5.02 | -14.21 | 40.79 | MaxQP | Horizontal | 101 | 356 | 46.0 | -5.2 | Pass |
| 4 | 456.01 | 50.18 | 5.04 | -13.93 | 41.29 | MaxQP | Horizontal | 282 | 349 | 46.0 | -4.7 | Pass |
| 5 | 468.02 | 47.67 | 5.07 | -13.37 | 39.37 | MaxQP | Horizontal | 101 | 301 | 46.0 | -6.6 | Pass |
| 6 | 503.99 | 48.65 | 5.20 | -13.23 | 40.62 | MaxQP | Horizontal | 159 | 160 | 46.0 | -5.4 | Pass |

**Test Notes:** Powered by AC/DC PS. Digital Communications over USB. Connected to SBC.

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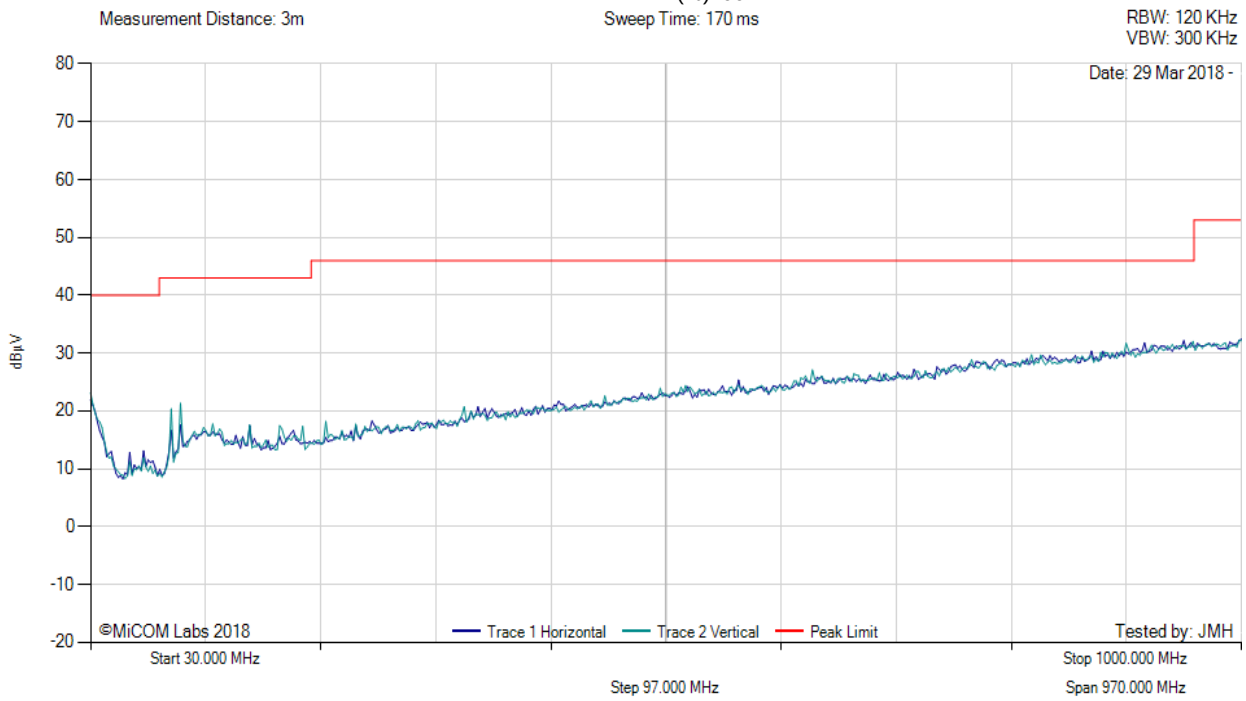
RADIATED DIGITAL EMISSIONS

Variant: GFSK, Test Freq: 2440.00 MHz, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99



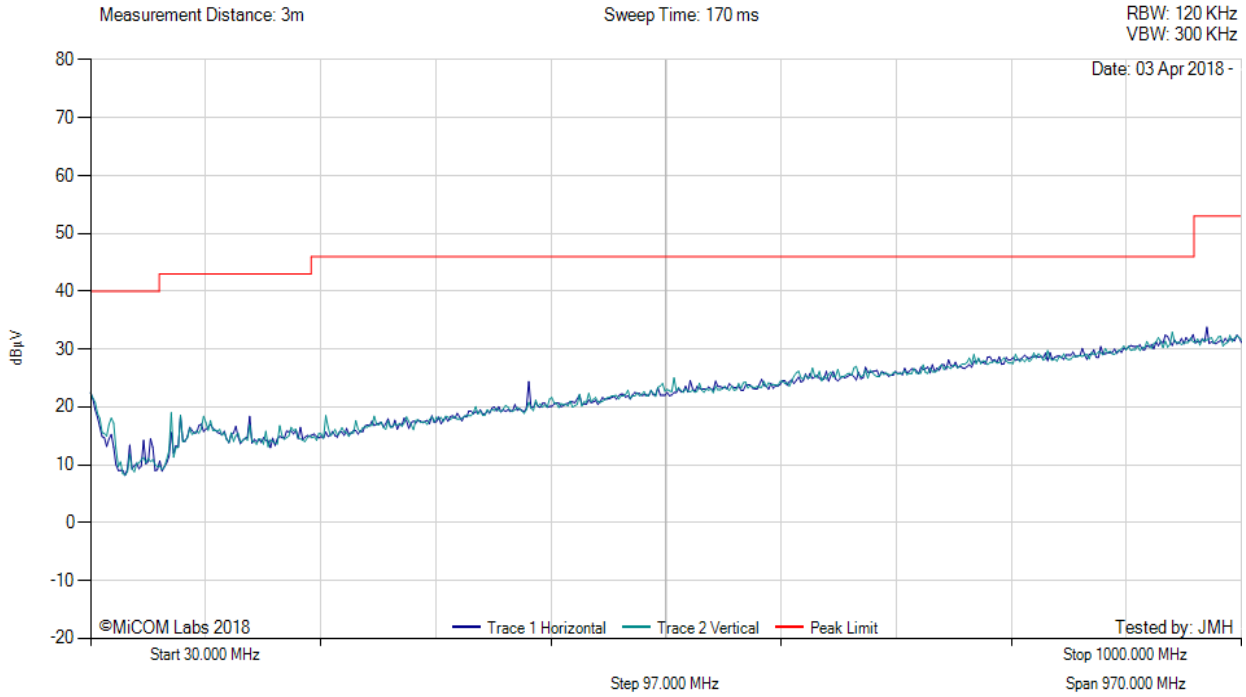

There are no emissions found within 6dB of the limit line.

**Test Notes:** EUT powered by 4V DC

back to matrix

RADIATED DIGITAL EMISSIONS

Variant: GFSK, Test Freq: Hopping, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99




There are no emissions found within 6dB of the limit line.

**Test Notes:** EUT powered by 4V DC. Hopping

back to matrix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