Company: Itron Networked Solutions, Inc

Test of: NIC 531-0601

To: FCC 15.247 & ISED RSS-247 (900 MHz FHSS)

Report No.: ITRO18-U2 Rev A

# COMPLETE TEST REPORT

FROM

MiCOM Labs
opening wireless markets

Test of: Itron Networked Solutions, Inc NIC 531-0601

To: FCC 15.247 & ISED RSS-247

Test Report Serial No.: ITRO18-U2 Rev A

This report supersedes: NONE

Applicant: Itron Networked Solutions, Inc.
230 West Tasman Drive
San Jose, California 95134
USA

Product Function: Plug in radio device, mesh network

Issue Date: 29th April 2019

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

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

A2LA ACCREDITED
TESTING CERT #2381.01

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

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# 1. ACCREDITATION, LISTINGS & RECOGNITION

## 1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2005. 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 April 2017*).

Presented this 14th day of May 2018.

President and CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2019

*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 14th day of May 2018

President and CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2019

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 | 17th April 2019 | Draft report for client review. |
| Draft 2 | 24th April 2019 | Draft 2 for client review. |
| Draft 3 | 29th April 2019 | Draft 3 for client review. |
| Rev A | 29th April 2019 | Initial release. |
| . | | |
| . | | |
| . | | |

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

# 3. TEST RESULT CERTIFICATE

| | | | |
|---|---|---|---|
| **Manufacturer:** | Itron Networked Solutions, 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 531-0601 | **Telephone:** | +1 925 462 0304 |
| **Type Of Equipment:** | Plug in radio device, mesh network | **Fax:** | +1 925 462 0306 |
| **S/N's:** | 00:13:50:07:00:00:1A:CA | | |
| **Test Date(s):** | 25th March 2019 | **Website:** | www.micomlabs.com |

| STANDARD(S) | TEST RESULTS |
|---|---|
| FCC 15.247 & ISED RSS-247 (900 MHz FHSS) | 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 | KDB 558074 D01 v05 | 24th August 2018 | Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices operating under section 15.247 of the FCC Rules. |
| II | A2LA | August 2018 | R105 - Requirement's When Making Reference to A2LA Accreditation Status |
| 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 | CISPR 32 | 2015 | Electromagnetic compatibility of multimedia equipment - Emission requirements |
| VI | 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 |
| VII | FCC 47 CFR Part 15, Subpart B | 2014 | Title 47: Telecommunication PART 15—RADIO FREQUENCY DEVICES, SubPart B; Unintentional Radiators |
| VIII | FCC 47 CFR Part 15.247 | 2016 | Radio Frequency Devices; Subpart C – Intentional Radiators |
| IX | FCC Public Notice DA 00-705 | March 2000 | Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems |
| X | ICES-003 | Issue 6 Jan 2016; Updated April 2017 | Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement. |
| XI | M 3003 | Edition 3 Nov.2012 | Expression of Uncertainty and Confidence in Measurements |
| XII | RSS-247 Issue 2 | Feb 2017 | Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices |
| XIII | RSS-Gen Issue 5 | April 2018 | General Requirements for Compliance of Radio Apparatus |
| XIV | FCC 47 CFR Part 2.1033 | 2016 | FCC requirements and rules regarding photographs and test setup diagrams. |

## 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.



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

# 5. PRODUCT DETAILS AND TEST CONFIGURATIONS

## 5.1. Technical Details

| Details | Description |
|---|---|
| Purpose: | Test of the Itron Networked Solutions, Inc. NIC 531-0601 to FCC 15.247 & ISED RSS-247.<br>Radio Frequency Devices; Subpart C – Intentional Radiators: & ISED RSS-247; Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices. |
| Applicant: | Itron Networked Solutions, Inc.<br>230 West Tasman Drive<br>San Jose<br>California 95134, USA |
| Manufacturer: | Itron Networked Solutions, Inc. |
| Laboratory performing the tests: | MiCOM Labs, Inc.<br>575 Boulder Court<br>Pleasanton California 94566 USA |
| Test report reference number: | ITRO18-U2 Rev A |
| Date EUT received: | 25th March 2019 |
| Standard(s) applied: | FCC 15.247 & ISED RSS-247 |
| Dates of test (from - to): | 25th March 2019 |
| No of Units Tested: | 2 |
| Product Family Name: | NIC 531-0601 |
| Model(s): | NIC 531-0601, NIC 531-0601-12, NIC 531-0601-13 |
| Location for use: | Both |
| Declared Frequency Range(s): | 902 - 928 MHz |
| Type of Modulation: | FHSS |
| EUT Modes of Operation: | 902 - 928 MHz:<br>50 kbps/FSK; 100 kbps/FSK; 150 kbps/FSK;<br>150 kbps/GFSK; 200 kbps/GFSK; 300 kbps/GFSK;<br>6.25 kbps/OQPSK;<br>600kbps/OFDM3 |
| Declared Nominal Output Power: | 902 - 928 MHz: 30 dBm. |
| Transmit/Receive Operation: | Transceiver – Half Duplex |
| Rated Input Voltage and Current: | 24 VDC |
| Operating Temperature Range: | -40 to +85°C |
| ITU Emission Designator: | FSK 117KF1D<br>FSK 162KF1D<br>OQPSK 115KF1D |
| Equipment Dimensions: | 4.2in X 0.75in 3.75in |
| Weight: | 0.2 Lb |
| Hardware Rev: | 173-0972-00 |
| Software Rev: | 4.6.0 |

## 5.2. Scope Of Test Program

**Itron Networked Solutions, Inc NIC 531-0601**

The scope of the test program was to test the Itron Networked Solutions, Inc NIC 531-0601 FHSS configurations in the frequency ranges 902 - 928 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 EUT supports the following modes of operation:-

100 kbps/FSK
50 kbps/FSK
150 kbps/FSK
150 kbps/GFSK
200 kbps/GFSK
300 kbps/GFSK
6.25 kbps/OQPSK
600 kbps/OFDM

Only the lowest and highest data rates were tested to cover extreme ranges of the device.

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

NIC 531-0601 is a plug-in radio device, will communicate over mesh and HAN networks. The NIC 531-0601 may be integrated into Itron Centron II meters and may support standard and extended last gasp (ELG).

NIC 531-0601 products include the following model numbers/configurations:

NIC 531-0601: 900+2.4, INT ANT, HW1
NIC 531-0601-12: 900+2.4, INT ANT, HW1, 15s ELG
NIC 531-0601-13: 900+2.4, INT ANT, HW1, 75s ELG

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

| Equipment | Equipment Type | Manufacturer | Model | Serial Number |
|---|---|---|---|---|
| NIC 531-0601 | EUT | Itron Networked Solutions, Inc | NIC 531-0601 | 00:13:50:07:00:00:1A:CA |
| Laptop Computer | Support | Dell | Latitude E6410 | N/A |

## 5.4. Antenna Details

| Type | Manufacturer | Model | Family | Gain (dBi) | BF Gain | Dir BW | X-Pol | Frequency Band (MHz) |
|---|---|---|---|---|---|---|---|---|
| integral | Tai Sheng Cheng | 155-0184-00 | f type | 1.0 | - | 360 | - | 902 - 928 |
| integral | Tai Sheng Cheng | 155-0184-00 | f type | 0.0 | - | 360 | - | 2400 - 2483.5 |

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

## 5.5. Cabling and I/O Ports

NONE

## 5.6. Test Configurations

Results for the following configurations are provided in this report:

| Operational Mode(s) | Data Rate with Highest Power KBit/s | Channel Frequency (MHz) | | |
|---|---|---|---|---|
| | | Low | Mid | High |
| **902 - 928 MHz** | | | | |
| FSK | 100 | 902.3 | 915.2 | 926.9 |
| FSK | 50 | 902.4 | 915.2 | 926.8 |
| FSK | 150 | 902.4 | 915.2 | 926.8 |
| GFSK | 150 | 902.3 | 915.2 | 926.9 |
| GFSK | 200 | 902.3 | 915.2 | 926.9 |
| GFSK | 300 | 902.4 | 915.2 | 926.8 |
| OQPSK | 6.25 | 902.4 | 915.2 | 926.8 |
| OFDM | 600 | 902.4 | 915.2 | 926.8 |

## 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

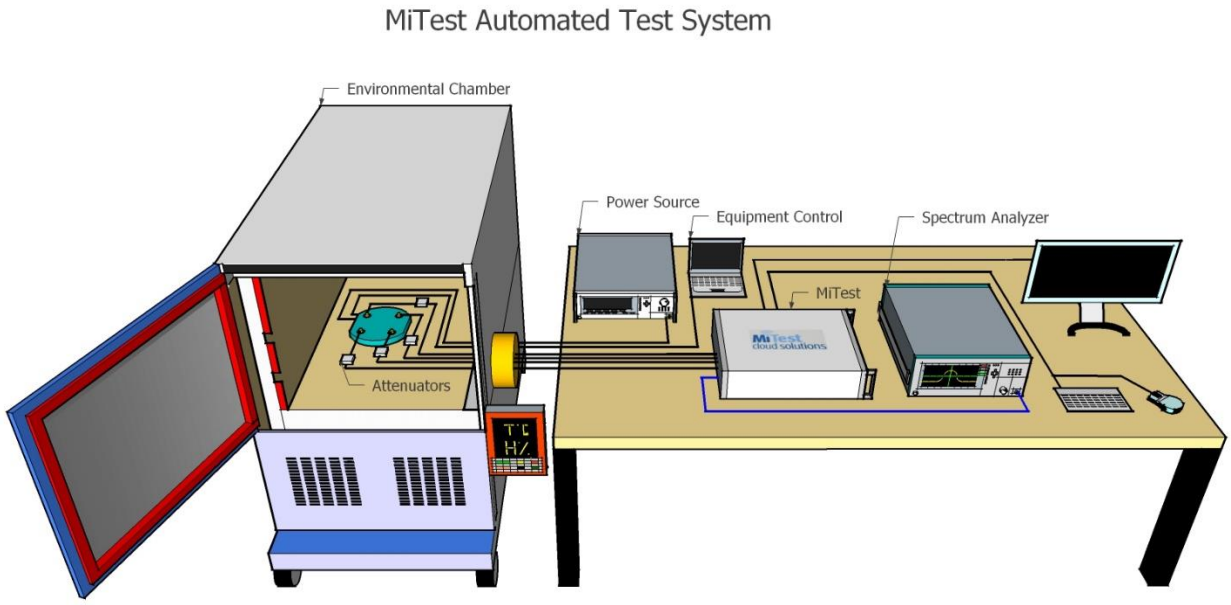
# 6. TEST SUMMARY

List of Measurements

| Test Header | Result | Data Link |
|---|---|---|
| 20 dB & 99% Bandwidth | Complies | View Data |
| Frequency Hopping Tests | Complies | - |
| 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 | - |
| (1) Conducted Emissions | Complies | - |
| (i) Conducted Unwanted Spurious Emissions | Complies | View Data |
| (ii) Conducted Band-Edge Emissions | Complies | View Data |
| (2) Radiated Emissions | Complies | - |
| (i) TX Spurious & Restricted Band Emissions | Complies | View Data |
| (3) Digital Emissions (0.03 - 1 GHz) | Complies | View Data |

# 7. TEST EQUIPMENT CONFIGURATION(S)

## 7.1. Conducted RF Emission Test Setup with Environmental Chamber




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.

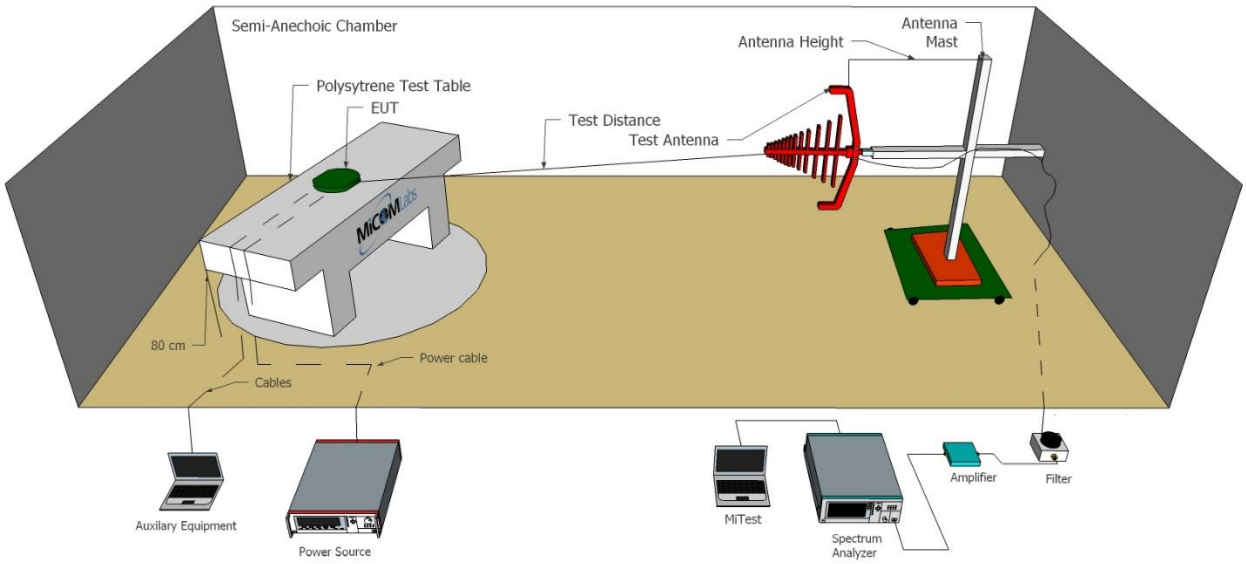
| Asset# | Description | Manufacturer | Model# | Serial# | Calibration Due Date |
|---|---|---|---|---|---|
| #3 SA | MiTest Box to SA | Fairview Microwave | SCA1814-0101-72 | #3 SA | 20 Jul 2019 |
| #3P1 | EUT to MiTest box port 1 | Fairview Microwave | SCA1814-0101-72 | #3P1 | 20 Jul 2019 |
| #3P2 | EUT to MiTest box port 2 | Fairview Microwave | SCA1814-0101-72 | #3P2 | 20 Jul 2019 |
| #3P3 | EUT to MiTest box port 3 | Fairview Microwave | SCA1814-0101-72 | #3P3 | 20 Jul 2019 |
| #3P4 | EUT to MiTest box port 4 | Fairview Microwave | SCA1812-0101-72 | #3P4 | 20 Jul 2019 |
| 249 | Resistance Thermometer | Thermotronics | GR2105-02 | 9340 #2 | 30 Oct 2019 |
| 361 | Desktop for RF#1, Labview Software installed | Dell | Vostro 220 | WS RF#1 | Not Required |
| 378 | Rohde & Schwarz 40 GHz Receiver with Generator | Rhode & Schwarz | ESIB40 | 100107/040 | 12 Oct 2019 |
| 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 2019 |
| 440 | USB Wideband Power Sensor | Boonton | 55006 | 9178 | 22 Sep 2019 |
| 441 | USB Wideband Power Sensor | Boonton | 55006 | 9179 | 20 Sep 2019 |
| 442 | USB Wideband Power Sensor | Boonton | 55006 | 9181 | 6 Oct 2019 |
| 445 | PoE Injector | D-Link | DPE-101GL | QTAH1E2000625 | Not Required |
| 461 | Spectrum Analyzer | Agilent | E4440A | MY46185537 | 20 Sep 2019 |
| 510 | Barometer/Thermometer | Control Company | 68000-49 | 170871375 | 11 Dec 2019 |
| 515 | MiTest Cloud Solutions RF Test Box | MiCOM | 2nd Gen with DFS | 515 | 20 Jun 2019 |
| 75 | Environmental Chamber | Thermatron | SE-300-2-2 | 27946 | 24 Feb 2020 |

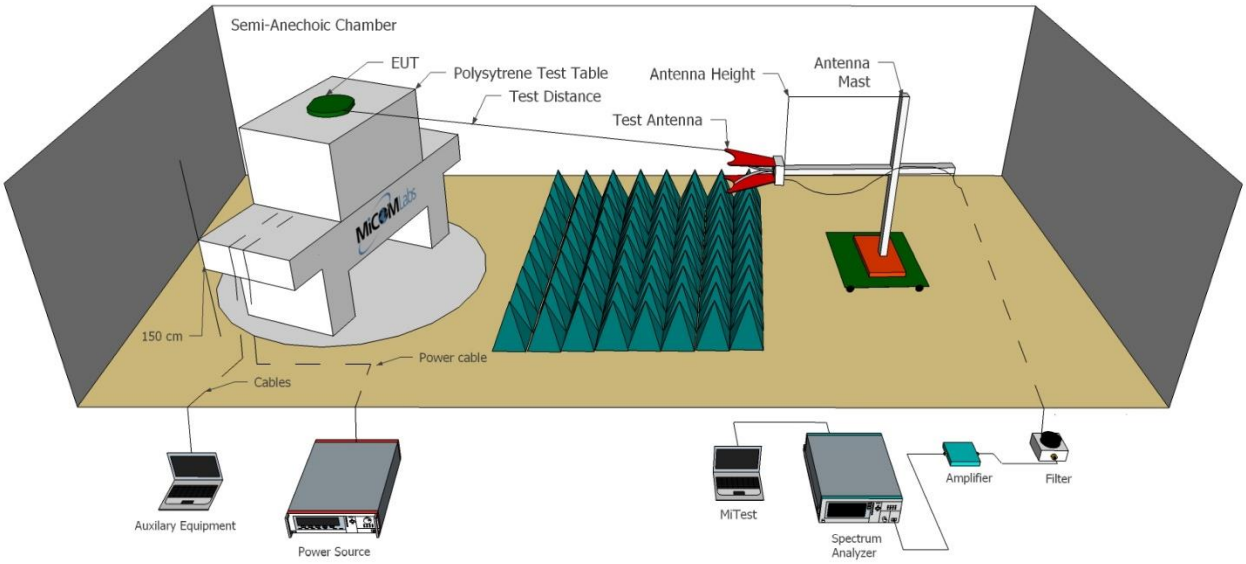
## 7.2. Radiated Emissions 3M Chamber

The following tests were performed using the radiated test set-up shown in the diagram below. Radiated emissions below 1GHz.Radiated Emissions above 1GHz.

Radiated Emissions Below 1GHz Test Setup




Radiated Emissions Above 1GHz Test Setup




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 |
|---|---|---|---|---|---|
| 170 | Video System Controller for Semi Anechoic Chamber | Panasonic | WV-CU101 | 04R08507 | Not Required |
| 298 | 3M Radiated Emissions Chamber Maintenance Check | MiCOM | 3M Chamber | 298 | 21 Apr 2019 |
| 338 | Sunol 30 to 3000 MHz Antenna | Sunol | JB3 | A052907 | 4 Apr 2020 |
| 341 | 900MHz Notch Filter | EWT | EWT-14-0199 | H1 | 8 Oct 2019 |
| 346 | 1.6 TO 10GHz High Pass Filter | EWT | EWT-57-0112 | H1 | 8 Oct 2019 |
| 373 | 26III RMS Multimeter | Fluke | Fluke 26 series III | 76080720 | 21 Sep 2019 |
| 378 | Rohde & Schwarz 40 GHz Receiver with Generator | Rhode & Schwarz | ESIB40 | 100107/040 | 12 Oct 2019 |
| 397 | Amp 10 - 2500MHz | MiCOM Labs | Amp 10 - 2500 MHz | NA | 12 Jun 2019 |
| 399 | ETS 1-18 GHz Horn Antenna | ETS | 3117 | 00154575 | 12 Oct 2019 |
| 406 | Amplifier for Radiated Emissions | MiCOM Labs | 40dB 1 to 18GHz Amp | 0406 | 12 Jun 2019 |
| 410 | Desktop Computer | Dell | Inspiron 620 | WS38 | Not Required |
| 411 | Mast/Turntable Controller | Sunol Sciences | SC98V | 060199-1D | Not Required |
| 412 | USB to GPIB Interface | National Instruments | GPIB-USB HS | 11B8DC2 | Not Required |
| 413 | Mast Controller | Sunol Science | TWR95-4 | 030801-3 | Not Required |
| 414 | DC Power Supply 0-60V | HP | 6274 | 1029A01285 | Cal when used |
| 415 | Turntable Controller | Sunol Sciences | Turntable Controller | None | Not Required |
| 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 | 9 Oct 2019 |
| 463 | Schwarzbeck cable from Amplifier to Bulkhead. | Schwarzbeck | AK 9513 | 463 | 9 Oct 2019 |
| 464 | Schwarzbeck cable from Bulkhead to Receiver | Schwarzbeck | AK 9513 | 464 | 9 Oct 2019 |
| 465 | Low Pass Filter DC-1000 MHz | Mini-Circuits | NLP-1200+ | VUU01901402 | 9 Oct 2019 |
| 480 | Cable - Bulkhead to Amp | SRC Haverhill | 157-3050360 | 480 | 24 Aug 2019 |
| 481 | Cable - Bulkhead to Receiver | SRC Haverhill | 151-3050787 | 481 | 24 Aug 2019 |
| 510 | Barometer/Thermometer | Control Company | 68000-49 | 170871375 | 11 Dec 2019 |
| 518 | Cable - Amp to Antenna | SRC Haverhill | 157-3051574 | 518 | 24 Aug 2019 |

| | | | | | |
|---|---|---|---|---|---|
| 87 | Uninterruptible Power Supply | Falcon Electric | ED2000-1/2LC | F3471 02/01 | Cal when used |
| VLF-1700 | Low pass filter DC-1700 MHz | Mini Circuits | VLF-1700 | None | 8 Oct 2019 |

# 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 | | | |
|---|---|---|---|
| **Standard:** | 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):** | 15.247 (a)(1)(i)/(ii) | **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.

**Limits for 20 dB and 99% Bandwidth**

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

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

## Equipment Configuration for 20 dB 99% Bandwidth

| | | | |
|---|---|---|---|
| **Variant:** | FSK | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 100.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **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 |
| 902.3 | 0.130 | | | | 0.130 | 0.130 | 0.5 | -0.37 |
| 915.2 | 0.129 | | | | 0.129 | 0.129 | 0.5 | -0.37 |
| 926.9 | 0.127 | | | | 0.127 | 0.127 | 0.5 | -0.37 |

| Test Frequency | Measured 99% Bandwidth (MHz) Port(s) | | | | Maximum 99% Bandwidth (MHz) | | |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | | | |
| 902.3 | 0.116 | | | | 0.116 | | |
| 915.2 | 0.117 | | | | 0.117 | | |
| 926.9 | 0.115 | | | | 0.115 | | |

| 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:** | FSK | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 150.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **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 |
| 902.4 | 0.180 | | | | 0.180 | 0.180 | 0.5 | -0.32 |
| 915.2 | 0.180 | | | | 0.180 | 0.180 | 0.5 | -0.32 |
| 926.8 | 0.180 | | | | 0.180 | 0.180 | 0.5 | -0.32 |

| Test Frequency | Measured 99% Bandwidth (MHz) Port(s) | | | | Maximum 99% Bandwidth (MHz) | | |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | | | |
| 902.4 | 0.162 | | | | 0.162 | | |
| 915.2 | 0.162 | | | | 0.162 | | |
| 926.8 | 0.162 | | | | 0.162 | | |

| 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:** | OQPSK | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 6.25 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OQPSK | **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 |
| 902.4 | 0.123 | | | | 0.123 | 0.123 | 0.5 | -0.38 |
| 915.0 | 0.128 | | | | 0.128 | 0.128 | 0.5 | -0.37 |
| 926.8 | 0.125 | | | | 0.125 | 0.125 | 0.5 | -0.38 |

| Test Frequency | Measured 99% Bandwidth (MHz) Port(s) | | | | Maximum 99% Bandwidth (MHz) | | |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | | | |
| 902.4 | 0.114 | | | | 0.114 | | |
| 915.0 | 0.115 | | | | 0.115 | | |
| 926.8 | 0.114 | | | | 0.114 | | |

| 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:** | 2FSK | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 50.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | 2FSK | **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 |
| **902.4** | 0.084 | | | | 0.084 | 0.084 | 0.5 | -0.416 |
| **915.2** | 0.087 | | | | 0.087 | 0.087 | 0.5 | -0.413 |
| **926.8** | 0.084 | | | | 0.084 | 0.084 | 0.5 | -0.416 |

| 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:** | GFSK | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 150.00 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 |
| **902.3** | 0.179 | | | | 0.179 | 0.179 | 0.5 | -0.321 |
| **915.2** | 0.182 | | | | 0.182 | 0.182 | 0.5 | -0.318 |
| **926.9** | 0.181 | | | | 0.181 | 0.181 | 0.5 | -0.319 |

| 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:** | GFSK | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 200.00 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 |
| **902.3** | 0.232 | | | | 0.232 | 0.232 | 0.5 | -0.268 |
| **915.2** | 0.238 | | | | 0.238 | 0.238 | 0.5 | -0.262 |
| **926.9** | 0.232 | | | | 0.232 | 0.232 | 0.5 | -0.268 |

| 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:** | GFSK | **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 |
| **902.4** | 0.367 | | | | 0.367 | 0.367 | 0.5 | -0.133 |
| **915.2** | 0.360 | | | | 0.360 | 0.360 | 0.5 | -0.140 |
| **926.8** | 0.363 | | | | 0.363 | 0.363 | 0.5 | -0.137 |

| 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:** | OFDM3 | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 600.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OFDM3 | **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 |
| **902.4** | 0.335 | | | | 0.335 | 0.335 | 0.5 | -0.165 |
| **915.2** | 0.332 | | | | 0.332 | 0.332 | 0.5 | -0.168 |
| **926.8** | 0.366 | | | | 0.366 | 0.366 | 0.5 | -0.134 |

| 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 | | | |
|---|---|---|---|
| **Standard:** | FCC CFR 47:15.247<br>(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):** | 15.247 (a)(1)(i)/(ii) | **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.

**Limits for Frequency Hopping Measurements**

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

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

## 9.2.1. Number of Hopping Channels

| Equipment Configuration for Number of Hopping Channels | | | |
|---|---|---|---|
| **Variant:** | FSK | **Antenna:** | Not Applicable |
| **Data Rate:** | 100.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **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 | Pass / Fail |
|---|---|---|---|
| 902.0-910.0 | 26 | -- | -- |
| 910.0-920.1 | 34 | -- | -- |
| 920.0-928.0 | 23 | -- | -- |
| **Total number of Hops** | **83** | **50** | **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:** | FSK | **Antenna:** | Not Applicable |
| **Data Rate:** | 150.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **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 | Pass / Fail |
|---|---|---|---|
| 902.0-910.0 | 20 | -- | -- |
| 910.0-920.0 | 25 | -- | -- |
| 920.0-928.0 | 18 | -- | -- |
| **Total number of Hops** | **63** | **50** | **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:** | OQPSK | **Antenna:** | Not Applicable |
| **Data Rate:** | 6.25 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OQPSK | **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 | Pass / Fail |
|---|---|---|---|
| 902.0-910.0 | 37 | -- | -- |
| 910.0-920.0 | 50 | -- | -- |
| 920.0-928.0 | 36 | -- | -- |
| **Total number of Hops** | **123** | **50** | **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:** | FSK | **Antenna:** | Not Applicable |
| **Data Rate:** | 100.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **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 |
|---|---|---|---|
| 915.2 | 0.300 | 0.127 | 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:** | FSK | **Antenna:** | Not Applicable |
| **Data Rate:** | 150.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **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 |
|---|---|---|---|
| 915.2 | 0.400 | 0.180 | 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).



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| Equipment Configuration for Channel Separation | | | |
|---|---|---|---|
| **Variant:** | OQPSK | **Antenna:** | Not Applicable |
| **Data Rate:** | 6.25 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OQPSK | **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 |
|---|---|---|---|
| 915.0 | 0.400 | 0.125 | 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).



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## 9.2.3. Channel Occupancy & Dwell Time

| Equipment Configuration for Channel Occupancy |
|---|

| | | | |
|---|---|---|---|
| **Variant:** | FSK | **Antenna:** | Not Applicable |
| **Data Rate:** | 100.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **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 |
|---|---|---|---|---|---|
| 915.20 | 0.101 | 201.040 | 20.00 | 400.000 | 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).



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| Equipment Configuration for Channel Occupancy | | | |
|---|---|---|---|
| **Variant:** | FSK | **Antenna:** | Not Applicable |
| **Data Rate:** | 150.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **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 |
|---|---|---|---|---|---|
| 915.20 | 0.055 | 165.330 | 20.00 | 400.000 | 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 Occupancy | | | |
|---|---|---|---|
| **Variant:** | OQPSK | **Antenna:** | Not Applicable |
| **Data Rate:** | 6.25 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OQPSK | **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 |
|---|---|---|---|---|---|
| 915.00 | 0.136 | 136.170 | 20.00 | 400.000 | 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).

## 9.3. Output Power

| Conducted Test Conditions for Fundamental Emission Output Power | | | |
|---|---|---|---|
| **Standard:** | 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):** | 15.247 (a)(1), (b)(1)/(2)/(3) | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

**Test Procedure for Fundamental Emission Output Power Measurement**

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

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

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

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.
Supporting Information
Calculated Power = A + G + Y+ 10 log (1/x) dBm

A = Total Power [10*Log10 ($10^{a/10}$ + $10^{b/10}$ + $10^{c/10}$ + $10^{d/10}$)]
G = Antenna Gain
Y = Beamforming Gain
x = Duty Cycle (average power measurements only)

**Limits for Fundamental Emission Output Power**

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

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

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

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time

intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

| Equipment Configuration for Output Power Peak | | | |
|---|---|---|---|
| **Variant:** | FSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 100.00 KBit/s | **Antenna Gain (dBi):** | 1.00 |
| **Modulation:** | FSK | **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) Port(s) | | | | Calculated Total Power Σ Port(s) | Limit | Margin |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dB |
| **902.3** | 29.61 | | | | 29.61 | 30.00 | -0.39 |
| **915.2** | 29.88 | | | | 29.88 | 30.00 | -0.12 |
| **926.9** | 29.09 | | | | 29.09 | 30.00 | -0.91 |

| 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.

EUT power settings are held on file.

| Equipment Configuration for Output Power Peak | | | |
|---|---|---|---|
| **Variant:** | FSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 150.00 KBit/s | **Antenna Gain (dBi):** | 1.00 |
| **Modulation:** | FSK | **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) Port(s) | | | | Calculated Total Power Σ Port(s) | Limit | Margin |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dB |
| **902.4** | 29.62 | | | | 29.62 | 30.00 | -0.38 |
| **915.2** | 29.55 | | | | 29.55 | 30.00 | -0.45 |
| **926.8** | 29.74 | | | | 29.74 | 30.00 | -0.26 |

| 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.

EUT power settings are held on file.

| Equipment Configuration for Output Power Peak | | | |
|---|---|---|---|
| **Variant:** | OQPSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 6.25 KBit/s | **Antenna Gain (dBi):** | 1.00 |
| **Modulation:** | OQPSK | **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) Port(s) | | | | Calculated Total Power Σ Port(s) | Limit | Margin |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dB |
| **902.4** | 29.83 | | | | 29.83 | 30.00 | -0.17 |
| **915.0** | 29.37 | | | | 29.37 | 30.00 | -0.63 |
| **926.8** | 29.60 | | | | 29.60 | 30.00 | -0.40 |

| 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.

EUT power settings are held on file.

| Equipment Configuration for Output Power Peak | | | |
|---|---|---|---|
| **Variant:** | 2FSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 50.00 KBit/s | **Antenna Gain (dBi):** | 1.00 |
| **Modulation:** | 2FSK | **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) Port(s) | | | | Calculated Total Power Σ Port(s) | Limit | Margin |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dB |
| **902.4** | 29.48 | | | | 29.48 | 30 | -0.52 |
| **915.2** | 29.55 | | | | 29.55 | 30 | -0.45 |
| **926.8** | 29.27 | | | | 29.27 | 30 | -0.73 |

| 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.

EUT power settings are held on file.

| Equipment Configuration for Output Power Peak | | | |
|---|---|---|---|
| **Variant:** | GFSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 150.00 KBit/s | **Antenna Gain (dBi):** | 1.00 |
| **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) Port(s) | | | | Calculated Total Power Σ Port(s) | Limit | Margin |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dB |
| **902.3** | 29.73 | | | | 29.73 | 30 | -0.27 |
| **915.2** | 29.56 | | | | 29.56 | 30 | -0.44 |
| **926.9** | 29.48 | | | | 29.48 | 30 | -0.52 |

| 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.

EUT power settings are held on file.

| Equipment Configuration for Output Power Peak | | | |
|---|---|---|---|
| **Variant:** | GFSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 200.00 KBit/s | **Antenna Gain (dBi):** | 1.00 |
| **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) Port(s) | | | | Calculated Total Power Σ Port(s) | Limit | Margin |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dB |
| **902.3** | 29.53 | | | | 29.53 | 30 | -0.47 |
| **915.2** | 29.36 | | | | 29.36 | 30 | -0.64 |
| **926.9** | 29.59 | | | | 29.59 | 30 | -0.41 |

| 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.

EUT power settings are held on file.

| Equipment Configuration for Output Power Peak | | | |
|---|---|---|---|
| **Variant:** | GFSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 300.00 KBit/s | **Antenna Gain (dBi):** | 1.00 |
| **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) Port(s) | | | | Calculated Total Power Σ Port(s) | Limit | Margin |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dB |
| **902.4** | 29.54 | | | | 29.54 | 30 | -0.46 |
| **915.2** | 29.78 | | | | 29.78 | 30 | -0.22 |
| **926.8** | 29.39 | | | | 29.39 | 30 | -0.61 |

| 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.

EUT power settings are held on file.

| Equipment Configuration for Output Power Peak | | | |
|---|---|---|---|
| **Variant:** | OFDM3 | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 600.00 KBit/s | **Antenna Gain (dBi):** | 1.00 |
| **Modulation:** | OFDM3 | **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) Port(s) | | | | Calculated Total Power Σ Port(s) | Limit | Margin |
|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dB |
| **902.4** | 29.17 | | | | 29.17 | 30 | -0.83 |
| **915.2** | 29.33 | | | | 29.33 | 30 | -0.67 |
| **926.8** | 29.19 | | | | 29.19 | 30 | -0.81 |

| 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.

EUT power settings are held on file.

# 9.4. Emissions

## 9.4.1. Conducted Emissions

| Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions | | | |
|---|---|---|---|
| **Standard:** | 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):** | 15.247 (d) | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

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

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

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

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

**Limits Transmitter Conducted Spurious and Band-Edge Emissions**

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

## 9.4.1.1. Conducted Unwanted Spurious Emissions

| Equipment Configuration for Unwanted Emissions Peak |
|---|

| | | | |
|---|---|---|---|
| **Variant:** | FSK | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 100.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **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 |
| **902.3** | 30.0 - 10000.0 | -32.622 | 8.26 | | | | | | |
| **915.2** | 30.0 - 10000.0 | -32.661 | 8.46 | | | | | | |
| **926.9** | 30.0 - 10000.0 | -33.600 | 5.05 | | | | | | |

| 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:** | FSK | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 150.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **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 |
| **902.4** | 30.0 - 10000.0 | -32.769 | 7.59 | | | | | | |
| **915.2** | 30.0 - 10000.0 | -33.029 | 6.79 | | | | | | |
| **926.8** | 30.0 - 10000.0 | -33.213 | 5.84 | | | | | | |

| 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:** | OQPSK | **Duty Cycle (%):** | 99 |
| **Data Rate:** | 6.25 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OQPSK | **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 |
| **902.4** | 30.0 - 10000.0 | -32.927 | 7.92 | | | | | | |
| **915.0** | 30.0 - 10000.0 | -32.960 | 6.71 | | | | | | |
| **926.8** | 30.0 - 10000.0 | -33.132 | 5.50 | | | | | | |

| 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:** | FSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 100.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | |
|---|---|
| **Channel Frequency:** | 902.3 MHz |
| **Band-Edge Frequency:** | 902.0 MHz |
| **Test Frequency Range:** | 875.0 - 905.0 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** | -11.75 | 4.97 | 902.10 | | | -0.100 |

| 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:** | FSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 150.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 902.4 MHz | | | | | |
| **Band-Edge Frequency:** | 902.0 MHz | | | | | |
| **Test Frequency Range:** | 875.0 - 905.0 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** | -18.38 | 8.77 | 902.20 | | | -0.200 |

| 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:** | OQPSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 6.25 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OQPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 902.4 MHz | | | | | |
| **Band-Edge Frequency:** | 902.0 MHz | | | | | |
| **Test Frequency Range:** | 875.0 - 905.0 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** | -29.17 | 8.58 | 902.60 | | | -0.600 |

| 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:** | FSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 100.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 902.3 MHz | | | | | |
| **Band-Edge Frequency:** | 902.0 MHz | | | | | |
| **Test Frequency Range:** | 875.0 - 905.0 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** | -8.72 | 8.47 | 902.10 | | | -0.100 |

| 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:** | FSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 150.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 902.4 MHz | | | | | |
| **Band-Edge Frequency:** | 902.0 MHz | | | | | |
| **Test Frequency Range:** | 875.0 - 905.0 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** | -18.59 | 7.85 | 902.20 | | | -0.200 |

| 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:** | OQPSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 6.25 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OQPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 902.4 MHz | | | | | |
| **Band-Edge Frequency:** | 902.0 MHz | | | | | |
| **Test Frequency Range:** | 875.0 - 905.0 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** | -19.11 | 8.22 | 902.20 | | | -0.200 |

| 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:** | FSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 100.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 926.9 MHz | | | | | |
| **Band-Edge Frequency:** | 928.0 MHz | | | | | |
| **Test Frequency Range:** | 925.0 - 950.0 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** | -36.30 | 6.12 | 927.10 | | | -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 Upper Band-Edge Emissions (Hopping) Peak | | | |
|---|---|---|---|
| **Variant:** | FSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 150.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 926.8 MHz | | | | | |
| **Band-Edge Frequency:** | 928.0 MHz | | | | | |
| **Test Frequency Range:** | 925.0 - 950.0 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** | -32.72 | 8.80 | 927.10 | | | -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 Upper Band-Edge Emissions (Hopping) Peak | | | |
|---|---|---|---|
| **Variant:** | OQPSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 6.25 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OQPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 926.8 MHz | | | | | |
| **Band-Edge Frequency:** | 928.0 MHz | | | | | |
| **Test Frequency Range:** | 925.0 - 950.0 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** | -32.04 | 8.57 | 927.00 | | | -1.000 |

| 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).

| Equipment Configuration for Conducted Upper Band-Edge Emissions (Static) Peak | | | |
|---|---|---|---|
| **Variant:** | FSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 100.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 926.9 MHz | | | | | |
| **Band-Edge Frequency:** | 928.0 MHz | | | | | |
| **Test Frequency Range:** | 925.0 - 950.0 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** | -32.42 | 5.42 | 927.10 | | | -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 Upper Band-Edge Emissions (Static) Peak | | | |
|---|---|---|---|
| **Variant:** | FSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 150.00 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | FSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 926.8 MHz | | | | | |
| **Band-Edge Frequency:** | 928.0 MHz | | | | | |
| **Test Frequency Range:** | 925.0 - 950.0 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** | -32.33 | 6.18 | 927.00 | | | -1.000 |

| 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).

| Equipment Configuration for Conducted Upper Band-Edge Emissions (Static) Peak | | | |
|---|---|---|---|
| **Variant:** | OQPSK | **Duty Cycle (%):** | 99.0 |
| **Data Rate:** | 6.25 KBit/s | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | OQPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | SB |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Channel Frequency:** | 926.8 MHz | | | | | |
| **Band-Edge Frequency:** | 928.0 MHz | | | | | |
| **Test Frequency Range:** | 925.0 - 950.0 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** | -31.64 | 6.02 | 927.00 | | | -1.000 |

| 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).

## 9.4.2. Radiated Emissions

| Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions (Restricted Bands) | | | |
|---|---|---|---|
| **Standard:** | FCC CFR 47:15.247<br>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):** | 15.205, 15.209 | **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.

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

(1) Swept frequency field disturbance sensors operating between 1.705 and 37 MHz provided their emissions only sweep through the bands listed in paragraph (a) of this section, the sweep is never stopped with the fundamental emission within the bands listed in paragraph (a) of this section, and the fundamental emission is outside of the bands listed in paragraph (a) of this section more than 99% of the time the device is actively transmitting, without compensation for duty cycle.

(2) Transmitters used to detect buried electronic markers at 101.4 kHz which are employed by telephone companies.

(3) Cable locating equipment operated pursuant to §15.213.

(4) Any equipment operated under the provisions of §15.253, 15.255, and 15.256 in the frequency band 75-85 GHz, or §15.257 of this part.

(5) Biomedical telemetry devices operating under the provisions of §15.242 of this part are not subject to the restricted band 608-614 MHz but are subject to compliance within the other restricted bands.

(6) Transmitters operating under the provisions of subparts D or F of this part.

(7) Devices operated pursuant to §15.225 are exempt from complying with this section for the 13.36-13.41 MHz band only.

(8) Devices operated in the 24.075-24.175 GHz band under §15.245 are exempt from complying with the requirements of this section for the 48.15-48.35 GHz and 72.225-72.525 GHz bands only, and shall not exceed the limits specified in §15.245(b).

(9) Devices operated in the 24.0-24.25 GHz band under §15.249 are exempt from complying with the requirements of this section for the 48.0-48.5 GHz and 72.0-72.75 GHz bands only, and shall not exceed the limits specified in §15.249(a).

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

## 9.4.2.3. TX Spurious & Restricted Band Emissions

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

| | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Cheng 155-0184-00 | **Variant:** | FSK |
| **Antenna Gain (dBi):** | 1.00 | **Modulation:** | FSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 902.30 | **Data Rate:** | 100.00 KBit/s |
| **Power Setting:** | Max | **Tested By:** | JMH |

**Test Measurement Results**

| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 1804.71 | 64.79 | -1.55 | -14.44 | 48.80 | Peak (NRB) | Horizontal | 200 | 77 | -- | -- | Pass |
| #2 | 6316.09 | 66.56 | -2.91 | -9.12 | 54.53 | Peak (NRB) | Vertical | 200 | 212 | -- | -- | Pass |
| Test Notes: EUT powered by DC 24 V | | | | | | | | | | | | |

## Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Cheng 155-0184-00 | **Variant:** | FSK |
| **Antenna Gain (dBi):** | 1.00 | **Modulation:** | FSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 915.20 | **Data Rate:** | 100.00 KBit/s |
| **Power Setting:** | Max | **Tested By:** | JMH |

## Test Measurement Results

**1000.00 - 10000.00 MHz**

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| #1 | 1830.41 | 62.98 | -1.52 | -14.03 | 47.43 | Peak (NRB) | Horizontal | 200 | 81 | -- | -- | Pass |
| #2 | 2745.73 | 60.93 | -1.91 | -11.96 | 47.06 | Max Peak | Horizontal | 98 | 224 | 74.0 | -26.9 | Pass |
| #3 | 2745.73 | 54.87 | -1.91 | -11.96 | 41.00 | Max Avg | Horizontal | 98 | 224 | 54.0 | -13.0 | Pass |
| #4 | 6406.56 | 62.02 | -2.96 | -9.21 | 49.85 | Peak (NRB) | Vertical | 200 | 81 | -- | -- | Pass |

Test Notes: EUT powered by DC 24 V

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

| | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Cheng 155-0184-00 | **Variant:** | FSK |
| **Antenna Gain (dBi):** | 1.00 | **Modulation:** | FSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 926.90 | **Data Rate:** | 100.00 KBit/s |
| **Power Setting:** | Max | **Tested By:** | JMH |

**Test Measurement Results**

| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 1854.36 | 62.21 | -1.56 | -13.81 | 46.84 | Peak (NRB) | Horizontal | 200 | 19 | -- | -- | Pass |
| #2 | 2781.81 | 59.36 | -1.89 | -11.91 | 45.56 | Max Peak | Horizontal | 177 | 162 | 74.0 | -28.4 | Pass |
| #3 | 2781.81 | 52.77 | -1.89 | -11.91 | 38.97 | Max Avg | Horizontal | 177 | 162 | 54.0 | -15.0 | Pass |
| #4 | 3708.96 | 62.82 | -2.20 | -11.63 | 48.99 | Max Peak | Vertical | 134 | 98 | 74.0 | -25.0 | Pass |
| #5 | 3708.96 | 57.17 | -2.20 | -11.63 | 43.34 | Max Avg | Vertical | 134 | 98 | 54.0 | -10.7 | Pass |
| #6 | 4635.98 | 62.32 | -2.49 | -12.24 | 47.59 | Max Peak | Vertical | 179 | 155 | 74.0 | -26.4 | Pass |
| #7 | 4635.98 | 55.10 | -2.49 | -12.24 | 40.37 | Max Avg | Vertical | 179 | 155 | 54.0 | -13.6 | Pass |
| #8 | 6490.26 | 65.12 | -2.95 | -8.94 | 53.23 | Peak (NRB) | Horizontal | 200 | 282 | -- | -- | Pass |
| Test Notes: EUT powered by DC 24 V | | | | | | | | | | | | |

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

| Radiated Test Conditions for Radiated Digital Emissions (0.03 – 1 GHz) | | | |
|---|---|---|---|
| **Standard:** | 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):** | 15.209 | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

**Test Procedure for Radiated Digital Emissions (0.03 – 1 GHz)**

Testing 30M-1 GHz was performed in a 3-meter 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 closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed.

Test configuration and setup for Radiated Spurious and Band-Edge 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 – 1 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 | | Measurement Distance (m) |
|---|---|---|---|
| | µV/m (microvolts/meter) | dBµV/m (dB microvolts/meter) | |
| 0.009-0.490 | 2400/F(kHz) | -- | 300 |
| 0.490-1.705 | 24000/F(kHz) | -- | 30 |
| 1.705-30.0 | 30 | 29.5 | 30 |
| 30-88 | 100** | 40 | 3 |
| 88-216 | 150** | 43.5 | 3 |
| 216-960 | 200** | 46.0 | 3 |
| Above 960 | 500 | 54.0 | 3 |

**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.

## Equipment Configuration for Radiated Digital Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Cheng 155-0184-00 | **Variant:** | FSK |
| **Antenna Gain (dBi):** | 1.00 | **Modulation:** | FSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 902.30 | **Data Rate:** | 100.00 KBit/s |
| **Power Setting:** | Max | **Tested By:** | JMH |

## Test Measurement Results

| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 112.75 | 53.43 | 4.06 | -15.40 | 42.09 | MaxQP | Vertical | 99 | 138 | 43.0 | -0.9 | Pass |
| #2 | 291.54 | 46.84 | 4.80 | -14.70 | 36.94 | MaxQP | Horizontal | 98 | 212 | 46.0 | -9.1 | Pass |
| #3 | 880.25 | 31.79 | 6.59 | -5.20 | 33.18 | MaxQP | Horizontal | 98 | 209 | 46.0 | -12.8 | Pass |
| #4 | 902.29 | 54.55 | 6.65 | -5.10 | 56.10 | Fundamental | Horizontal | 100 | 0 | -- | -- | |
| #5 | 966.30 | 39.65 | 6.84 | -4.00 | 42.49 | MaxQP | Vertical | 107 | 343 | 53.0 | -10.5 | Pass |
| Test Notes: EUT powered by DC 24 V. 900 MHz notch in front of amp to prevent overload | | | | | | | | | | | | |

## Equipment Configuration for Radiated Digital Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Cheng 155-0184-00 | **Variant:** | FSK |
| **Antenna Gain (dBi):** | 1.00 | **Modulation:** | FSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 915.20 | **Data Rate:** | 100.00 KBit/s |
| **Power Setting:** | Max | **Tested By:** | JMH |

## Test Measurement Results

| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 118.18 | 51.04 | 4.09 | -14.80 | 40.33 | MaxQP | Vertical | 98 | 144 | 43.0 | -2.7 | Pass |
| #2 | 293.50 | 45.57 | 4.81 | -14.60 | 35.78 | MaxQP | Vertical | 132 | 173 | 46.0 | -10.2 | Pass |
| #3 | 446.59 | 36.90 | 5.34 | -11.20 | 31.04 | MaxQP | Horizontal | 101 | 176 | 46.0 | -15.0 | Pass |
| #4 | 915.18 | 48.13 | 6.67 | -4.70 | 50.10 | Fundamental | Vertical | 100 | 0 | -- | -- | |
| #5 | 979.17 | 38.00 | 6.88 | -3.80 | 41.08 | MaxQP | Vertical | 105 | 281 | 53.0 | -11.9 | Pass |
| Test Notes: EUT powered by DC 24 V. 900 MHz notch in front of amp to prevent overload | | | | | | | | | | | | |

## Equipment Configuration for Radiated Digital Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Tai Sheng Cheng 155-0184-00 | **Variant:** | FSK |
| **Antenna Gain (dBi):** | 1.00 | **Modulation:** | FSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 99 |
| **Channel Frequency (MHz):** | 926.90 | **Data Rate:** | 100.00 KBit/s |
| **Power Setting:** | Max | **Tested By:** | JMH |

## Test Measurement Results

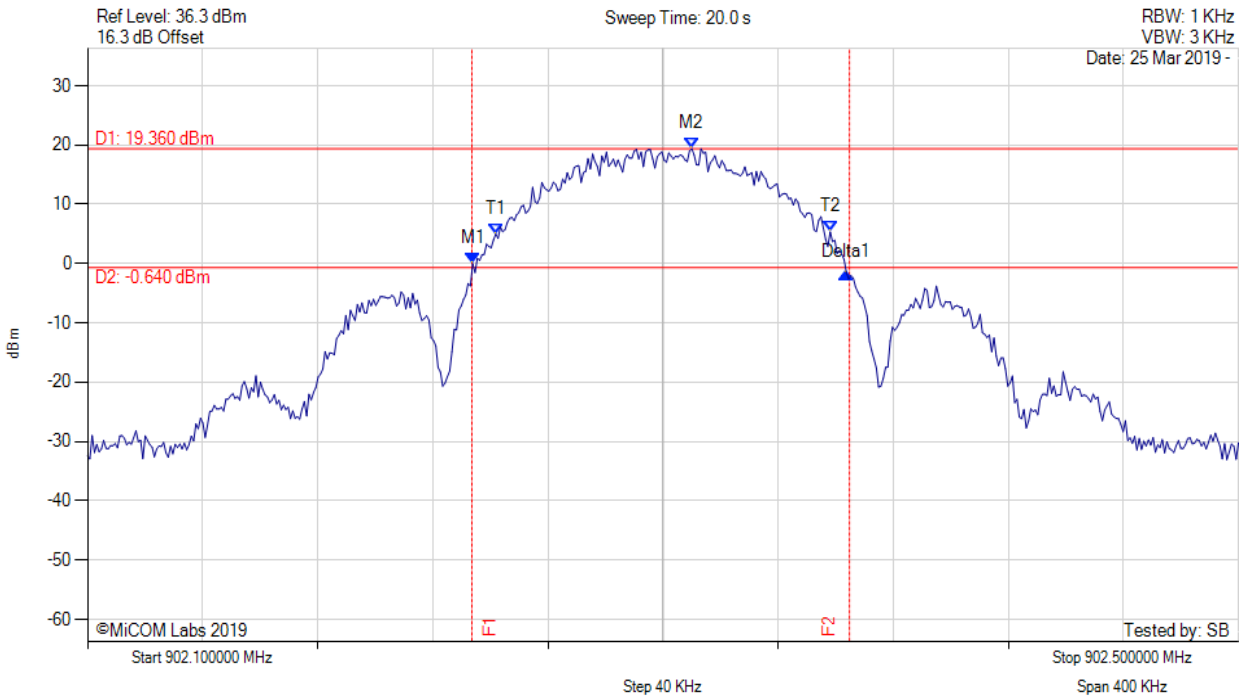
| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| #1 | 118.20 | 50.59 | 4.09 | -14.80 | 39.88 | MaxQP | Vertical | 99 | 148 | 43.0 | -3.1 | Pass |
| #2 | 293.17 | 44.82 | 4.81 | -14.60 | 35.03 | MaxQP | Vertical | 98 | 151 | 46.0 | -11.0 | Pass |
| #3 | 453.19 | 36.31 | 5.36 | -11.00 | 30.67 | MaxQP | Horizontal | 194 | 171 | 46.0 | -15.3 | Pass |
| #4 | 874.91 | 37.30 | 6.58 | -5.20 | 38.68 | MaxQP | Vertical | 124 | 13 | 46.0 | -7.3 | Pass |
| #5 | 926.93 | 53.30 | 6.72 | -4.60 | 55.42 | Fundamental | Vertical | 100 | 0 | -- | -- | |
| #6 | 978.86 | 37.63 | 6.87 | -3.90 | 40.60 | MaxQP | Vertical | 103 | 310 | 53.0 | -12.4 | Pass |
| Test Notes: EUT powered by DC 24 V. 900 MHz notch in front of amp to prevent overload | | | | | | | | | | | | |

# A. APPENDIX - GRAPHICAL IMAGES

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

20 dB 99% BANDWIDTH

Variant: FSK, Channel: 902.30 MHz, Chain a, Temp: 20, Voltage:  Vdc

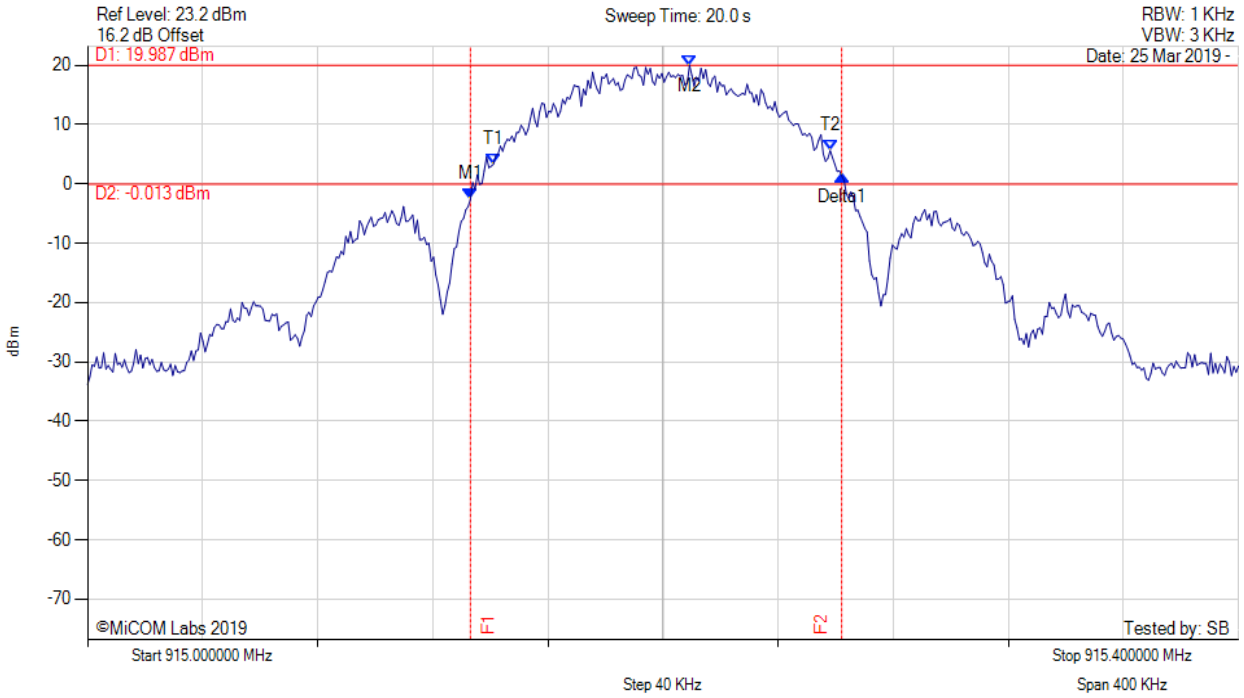



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 902.234 MHz : 0.000 dBm<br>M2 : 902.310 MHz : 19.363 dBm<br>Delta1 : 130 KHz : -1.460 dB<br>T1 : 902.242 MHz : 5.007 dBm<br>T2 : 902.358 MHz : 5.365 dBm<br>OBW : 116 KHz | Measured 20 dB  Bandwidth: 0.130 MHz<br>Limit: 0.5 kHz<br>Margin: 0.37 MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage:  Vdc

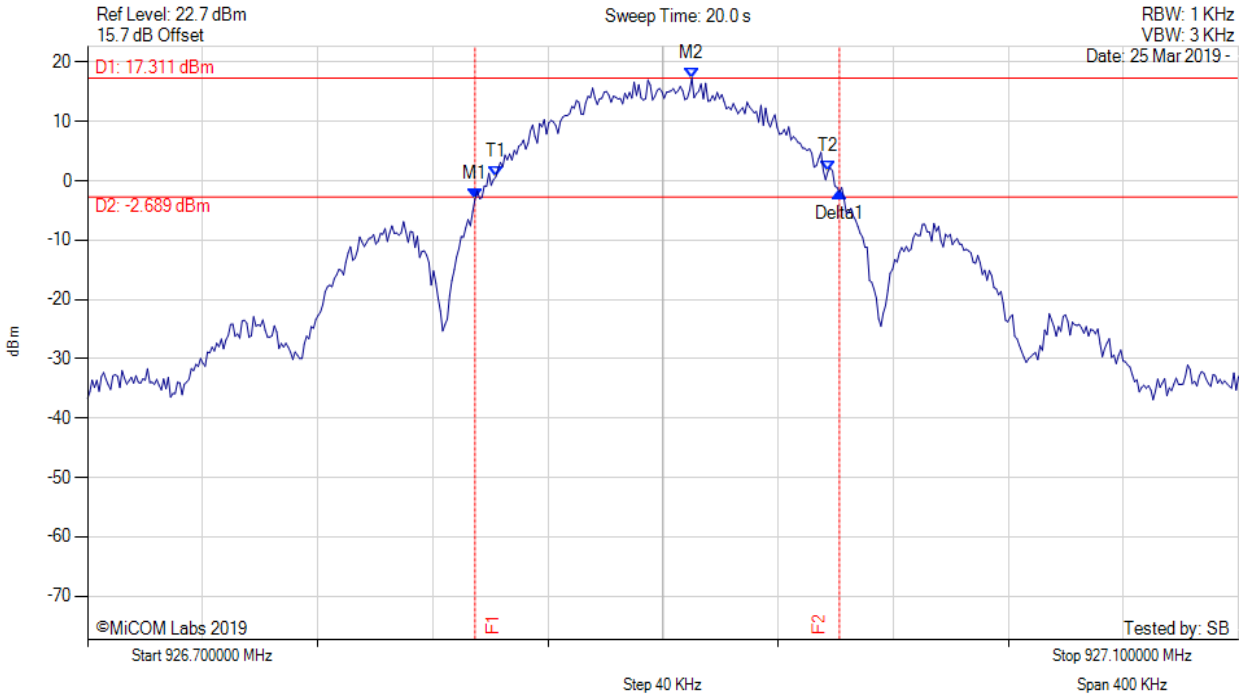



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = MAX HOLD | M1 : 915.133 MHz : -2.614 dBm<br>M2 : 915.209 MHz : 19.987 dBm<br>Delta1 : 129 KHz : 3.980 dB<br>T1 : 915.141 MHz : 3.310 dBm<br>T2 : 915.258 MHz : 5.616 dBm<br>OBW : 117 KHz | Measured 20 dB  Bandwidth: 0.129 MHz<br>Limit: 0.5 kHz<br>Margin: 0.37 MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: FSK, Channel: 926.90 MHz, Chain a, Temp: 20, Voltage:  Vdc

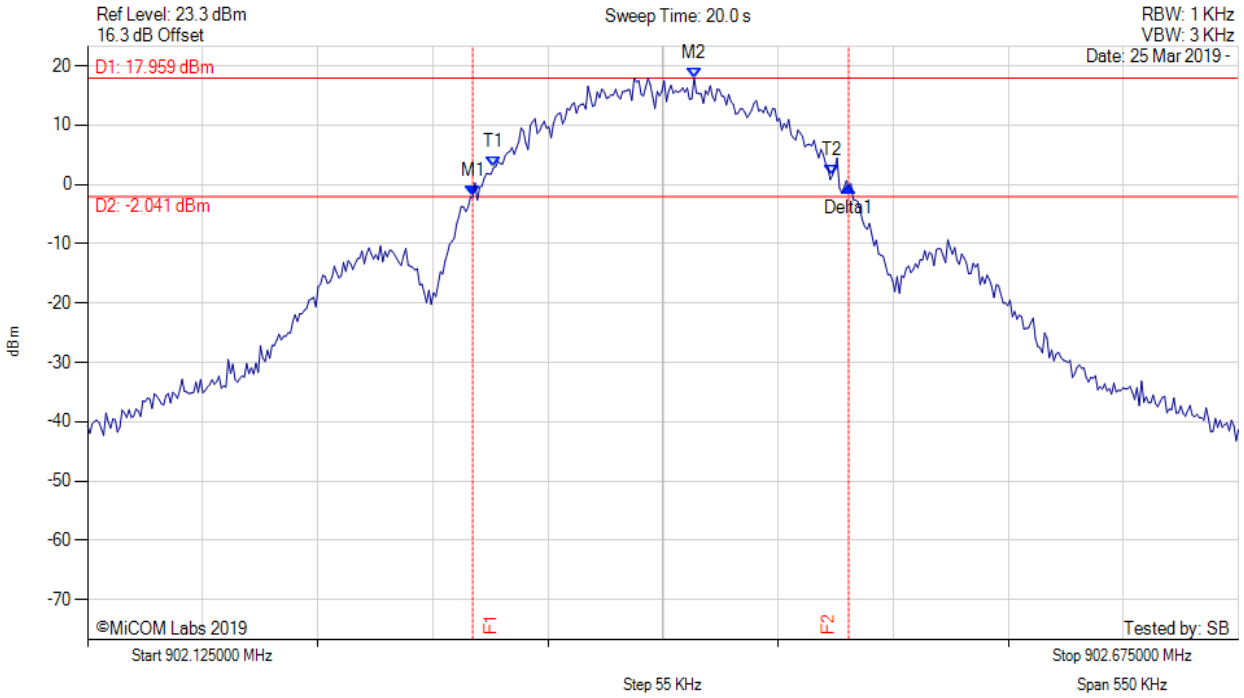



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = MAX HOLD | M1 : 926.835 MHz : -3.021 dBm<br>M2 : 926.910 MHz : 17.311 dBm<br>Delta1 : 127 KHz : 1.171 dB<br>T1 : 926.842 MHz : 0.681 dBm<br>T2 : 926.957 MHz : 1.602 dBm<br>OBW : 115 KHz | Measured 20 dB  Bandwidth: 0.127 MHz<br>Limit: 0.5 kHz<br>Margin: 0.37 MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: FSK, Channel: 902.40 MHz, Chain a, Temp: 20, Voltage: Vdc

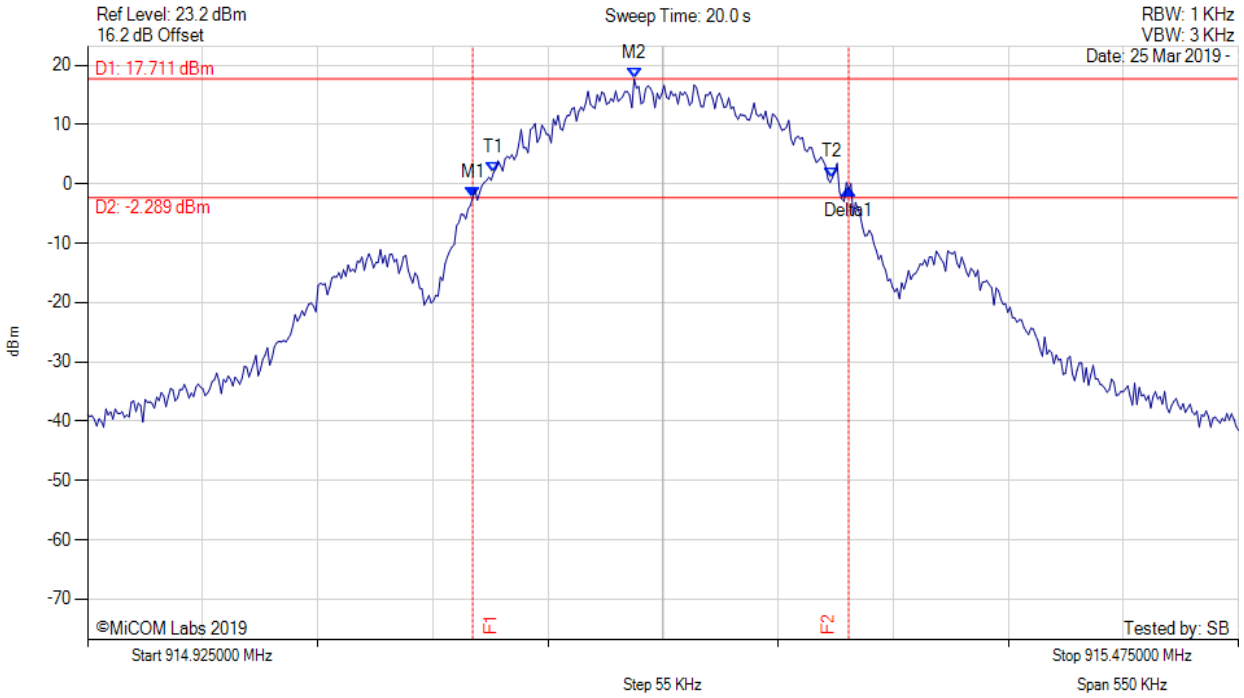



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = MAX HOLD | M1 : 902.309 MHz : -2.045 dBm<br>M2 : 902.415 MHz : 17.959 dBm<br>Delta1 : 180 KHz : 1.725 dB<br>T1 : 902.319 MHz : 2.849 dBm<br>T2 : 902.481 MHz : 1.596 dBm<br>OBW : 162 KHz | Measured 20 dB Bandwidth: 0.180 MHz<br>Limit: 0.5 kHz<br>Margin: 0.32 MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage: Vdc

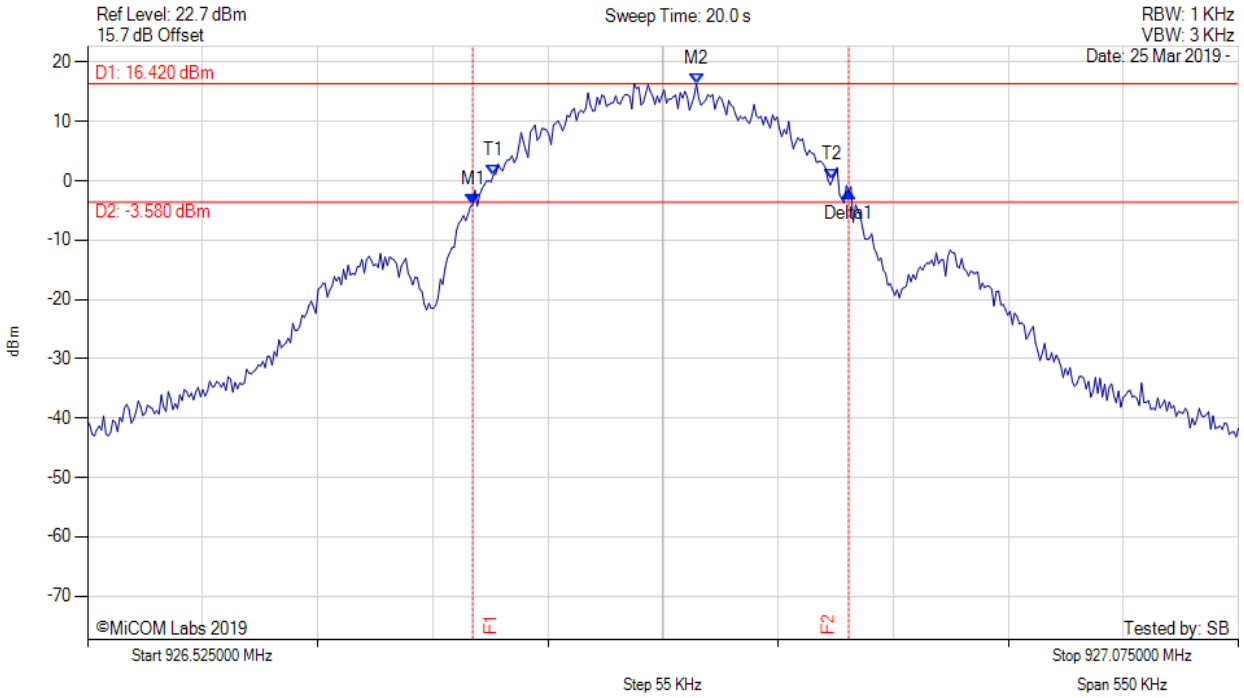



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = MAX HOLD | M1 : 915.109 MHz : -2.303 dBm<br>M2 : 915.186 MHz : 17.711 dBm<br>Delta1 : 180 KHz : 1.373 dB<br>T1 : 915.119 MHz : 1.850 dBm<br>T2 : 915.281 MHz : 1.081 dBm<br>OBW : 162 KHz | Measured 20 dB Bandwidth: 0.180 MHz<br>Limit: 0.5 kHz<br>Margin: 0.32 MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: FSK, Channel: 926.80 MHz, Chain a, Temp: 20, Voltage: Vdc

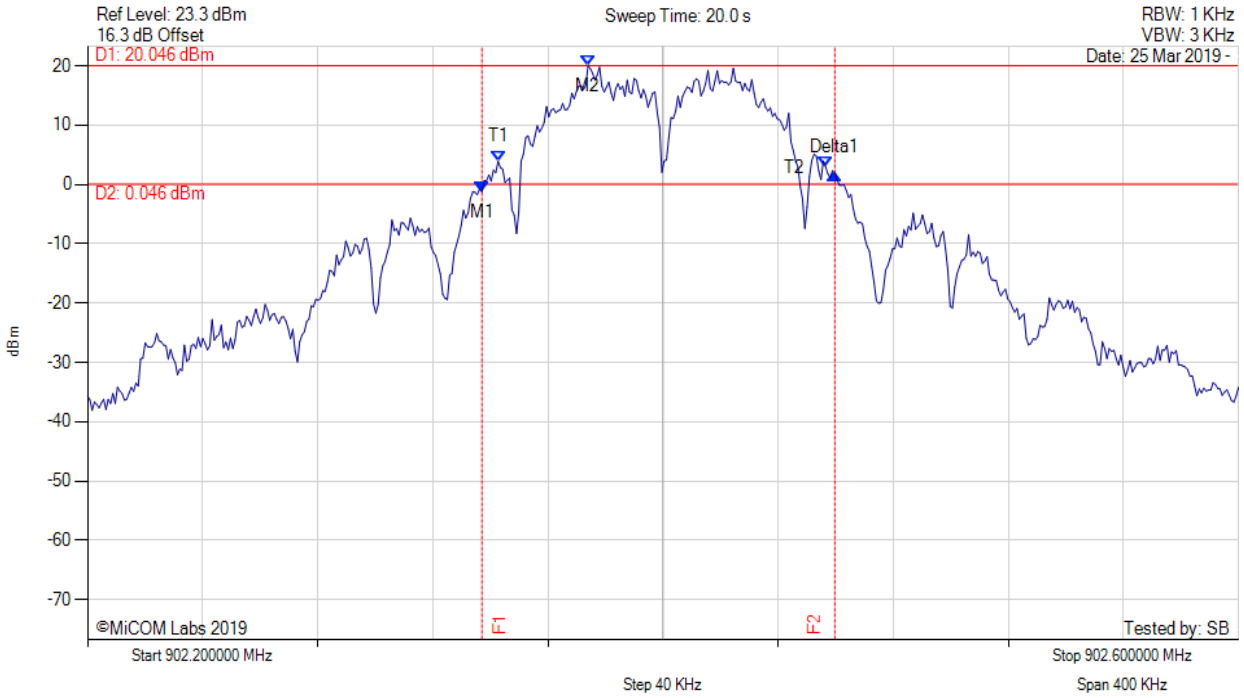



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = MAX HOLD | M1 : 926.709 MHz : -3.989 dBm<br>M2 : 926.816 MHz : 16.420 dBm<br>Delta1 : 180 KHz : 2.125 dB<br>T1 : 926.719 MHz : 1.024 dBm<br>T2 : 926.881 MHz : 0.201 dBm<br>OBW : 162 KHz | Measured 20 dB Bandwidth: 0.180 MHz<br>Limit: 0.5 kHz<br>Margin: 0.32 MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: OQPSK, Channel: 902.40 MHz, Chain a, Temp: 20, Voltage: Vdc

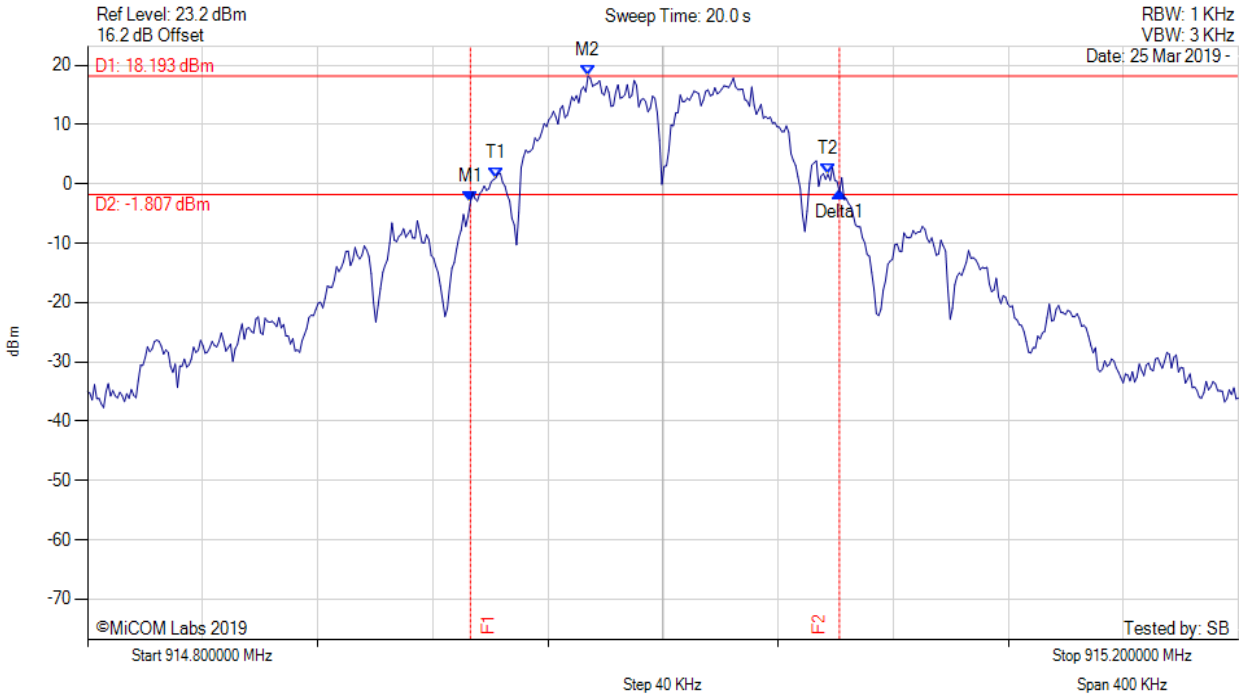



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = MAX HOLD | M1 : 902.337 MHz : -1.229 dBm<br>M2 : 902.374 MHz : 20.046 dBm<br>Delta1 : 123 KHz : 3.122 dB<br>T1 : 902.343 MHz : 3.906 dBm<br>T2 : 902.457 MHz : 2.971 dBm<br>OBW : 114 KHz | Measured 20 dB Bandwidth: 0.123 MHz<br>Limit: 0.5 kHz<br>Margin: 0.38 MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: OQPSK, Channel: 915.00 MHz, Chain a, Temp: 20, Voltage:  Vdc

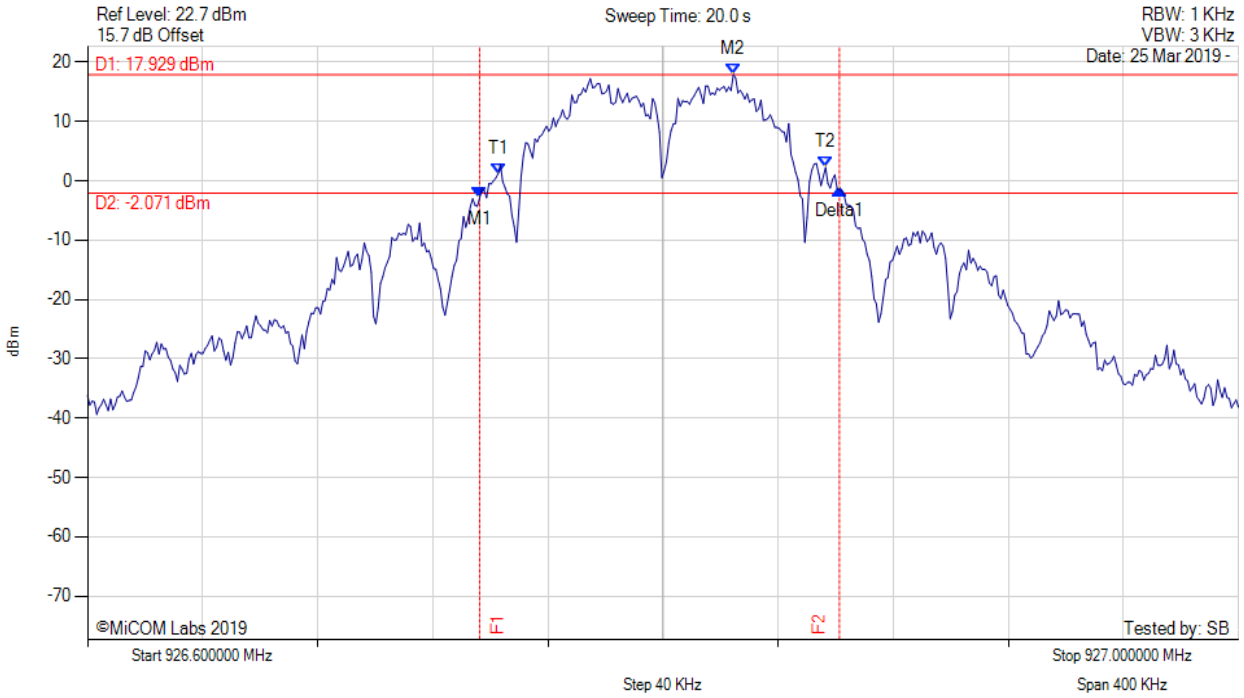



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = MAX HOLD | M1 : 914.933 MHz : -3.096 dBm<br>M2 : 914.974 MHz : 18.193 dBm<br>Delta1 : 128 KHz : 1.780 dB<br>T1 : 914.942 MHz : 0.989 dBm<br>T2 : 915.057 MHz : 1.632 dBm<br>OBW : 115 KHz | Measured 20 dB  Bandwidth: 0.128 MHz<br>Limit: 0.5 kHz<br>Margin: 0.37 MHz |

back to matrix

20 dB 99% BANDWIDTH

Variant: OQPSK, Channel: 926.80 MHz, Chain a, Temp: 20, Voltage: Vdc

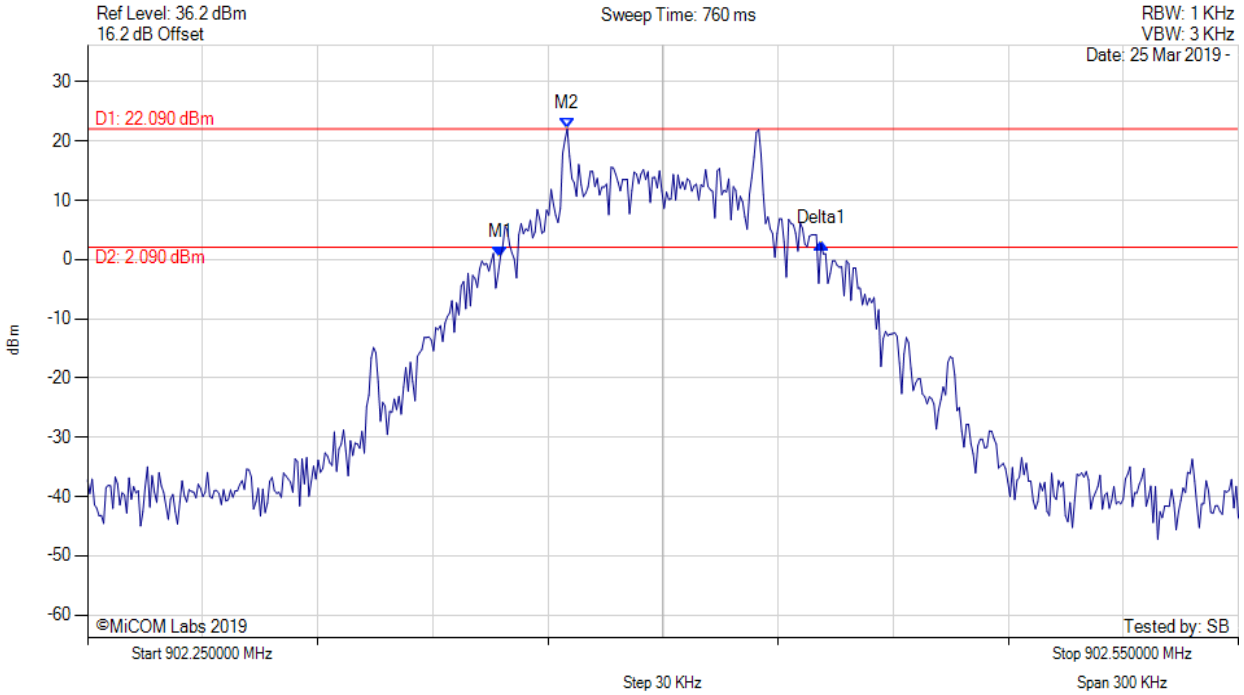



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 20<br>Trace Mode = MAX HOLD | M1 : 926.736 MHz : -2.866 dBm<br>M2 : 926.824 MHz : 17.929 dBm<br>Delta1 : 125 KHz : 1.430 dB<br>T1 : 926.743 MHz : 1.207 dBm<br>T2 : 926.857 MHz : 2.287 dBm<br>OBW : 114 KHz | Measured 20 dB Bandwidth: 0.125 MHz<br>Limit: 0.5 kHz<br>Margin: 0.38 MHz |

back to matrix

20 dB BANDWIDTH

Variant: 2FSK, Channel: 902.40 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

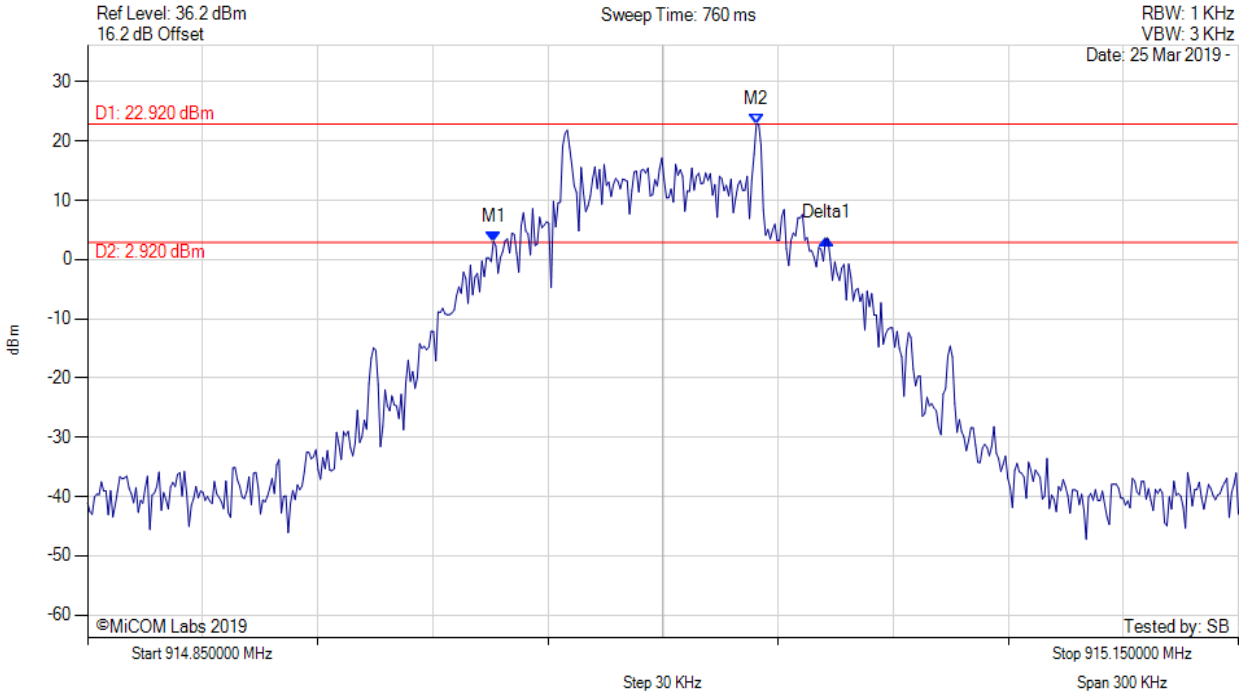



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 902.358 MHz : 0.477 dBm<br>M2 : 902.375 MHz : 22.090 dBm<br>Delta1 : 84 KHz : 2.184 dB | Channel Frequency: 902.40 MHz |

back to matrix

20 dB BANDWIDTH

Variant: 2FSK, Channel: 915.00 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

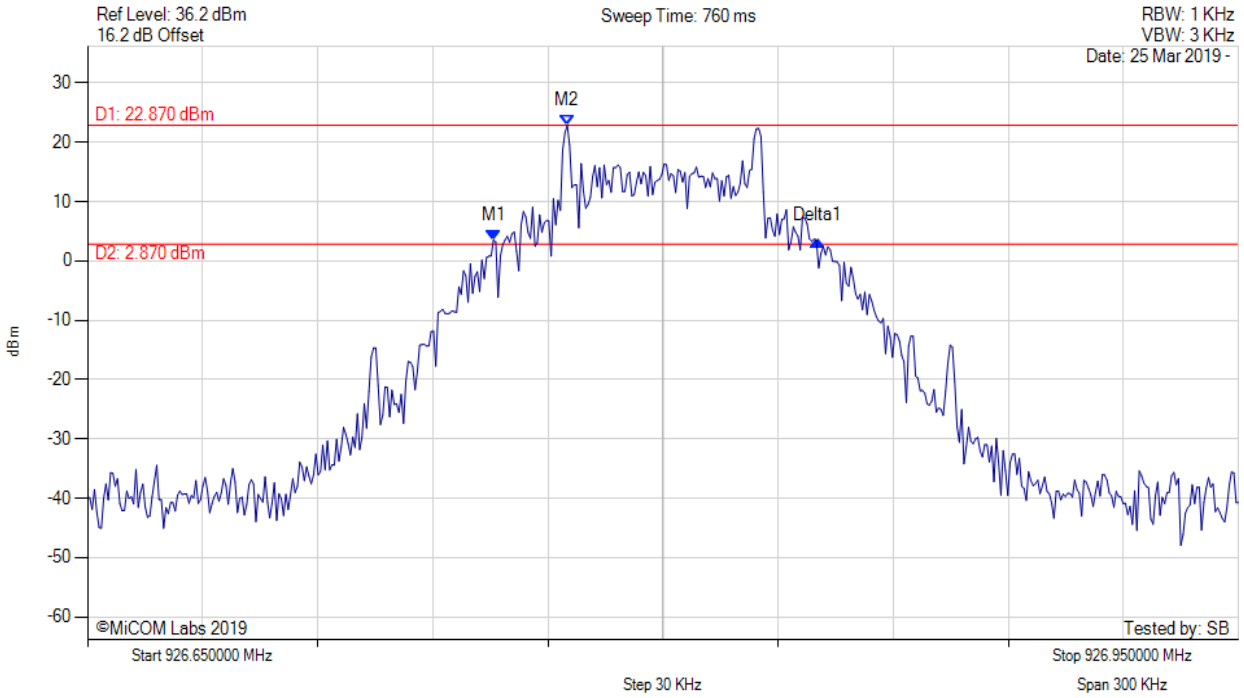



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 914.956 MHz : 3.076 dBm<br>M2 : 915.024 MHz : 22.916 dBm<br>Delta1 : 87 KHz : 0.480 dB | Channel Frequency: 915.00 MHz |

back to matrix

20 dB BANDWIDTH

Variant: 2FSK, Channel: 926.80 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

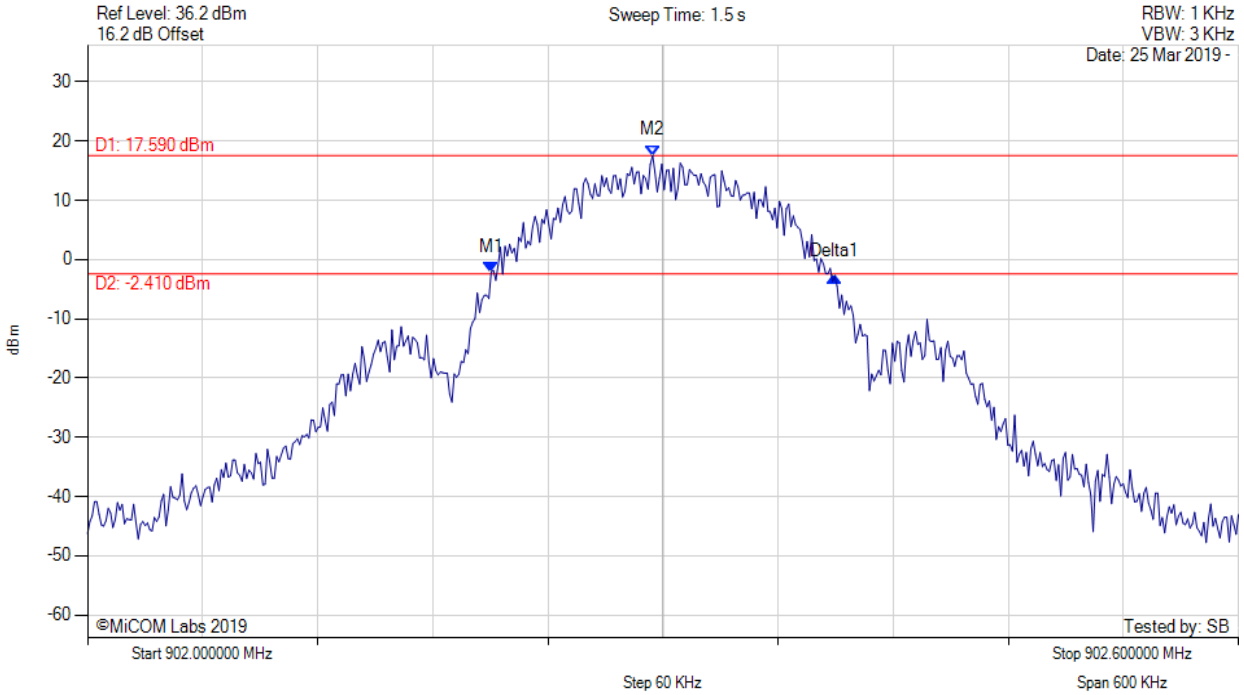



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 926.756 MHz : 3.536 dBm<br>M2 : 926.775 MHz : 22.875 dBm<br>Delta1 : 84 KHz : -0.102 dB | Channel Frequency: 926.80 MHz |

back to matrix

20 dB BANDWIDTH

Variant: GFSK, Channel: 902.30 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

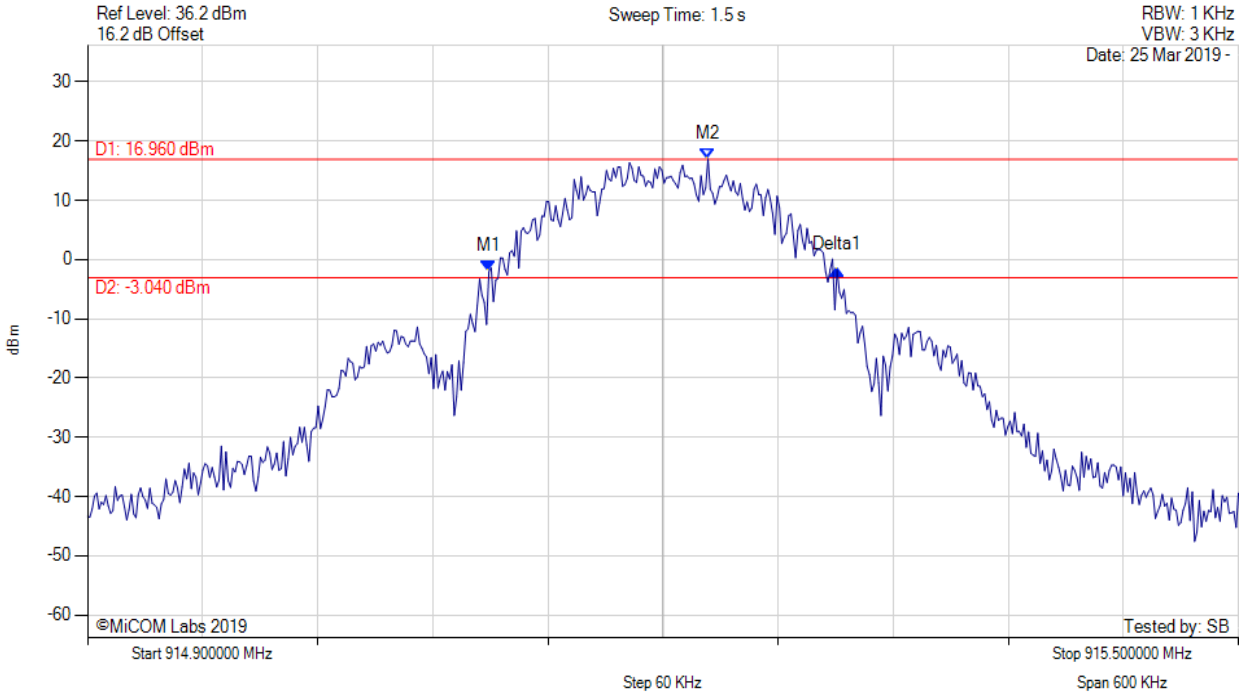



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 902.210 MHz : -2.108 dBm<br>M2 : 902.295 MHz : 17.591 dBm<br>Delta1 : 179 KHz : -0.750 dB | Channel Frequency: 902.30 MHz |

back to matrix

20 dB BANDWIDTH

Variant: GFSK, Channel: 915.20 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

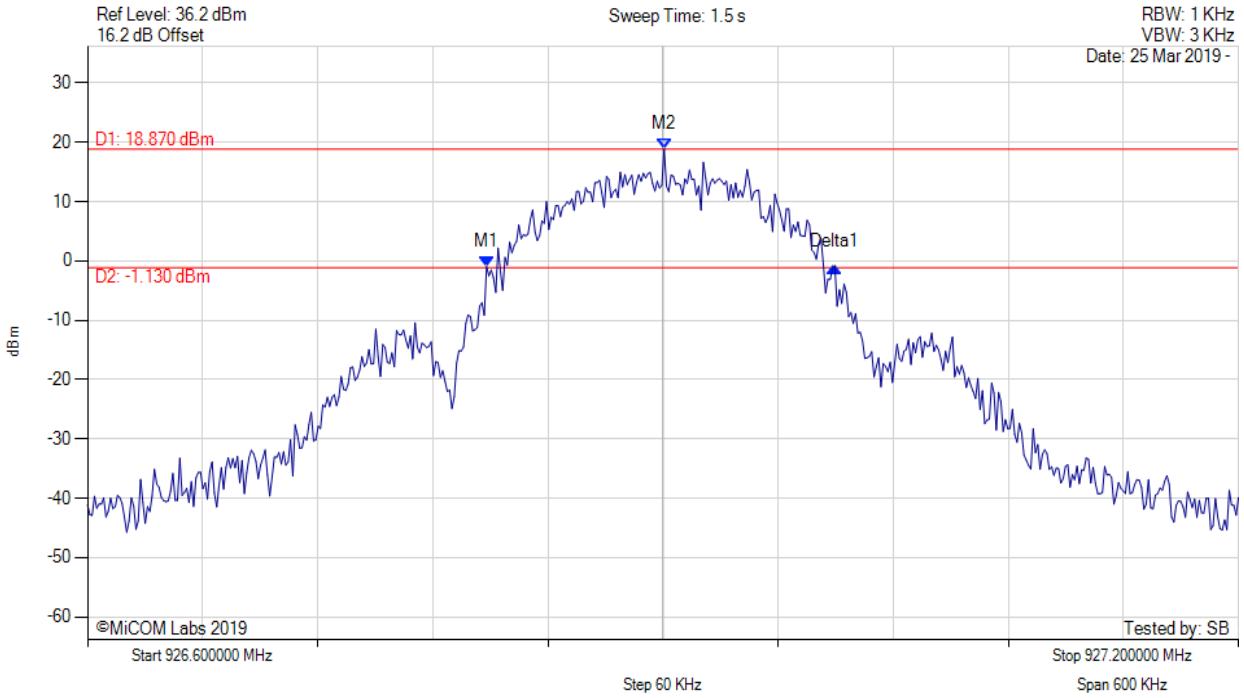



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 915.109 MHz : -2.006 dBm<br>M2 : 915.223 MHz : 16.961 dBm<br>Delta1 : 182 KHz : 0.234 dB | Channel Frequency: 915.20 MHz |

back to matrix

20 dB BANDWIDTH

Variant: GFSK, Channel: 926.90 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

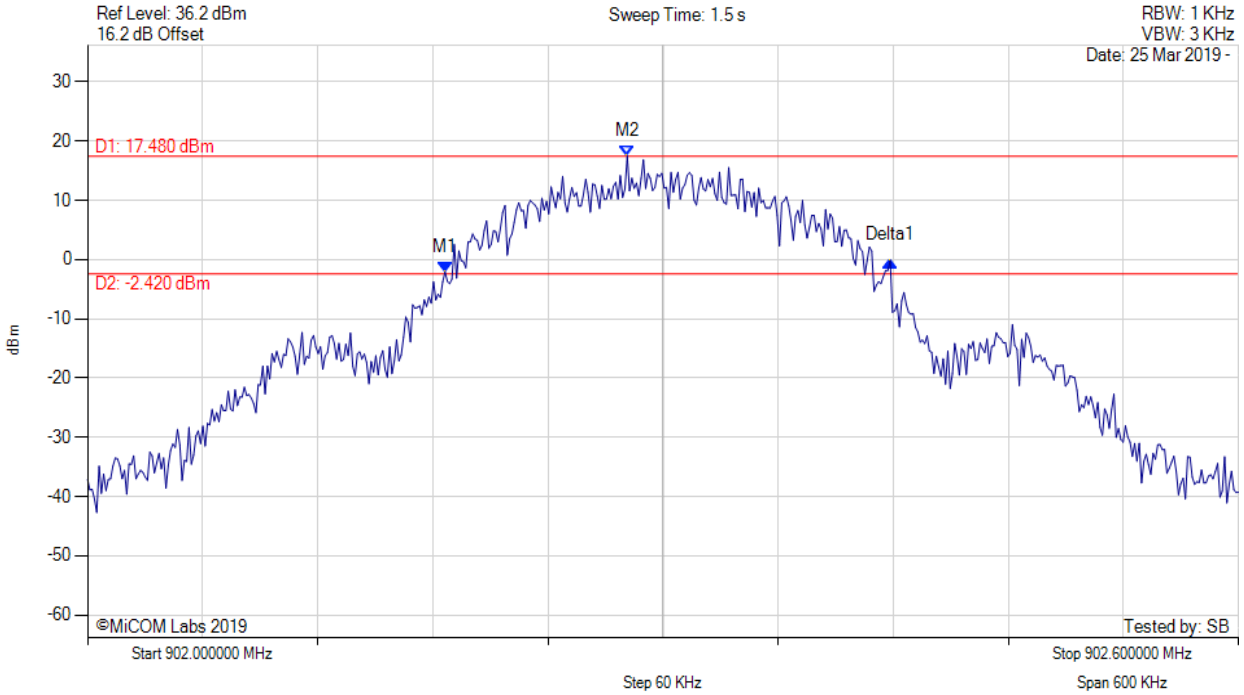



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 926.808 MHz : -0.940 dBm<br>M2 : 926.901 MHz : 18.875 dBm<br>Delta1 : 181 KHz : 0.035 dB | Channel Frequency: 926.90 MHz |

back to matrix

20 dB BANDWIDTH

Variant: GFSK, Channel: 902.30 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

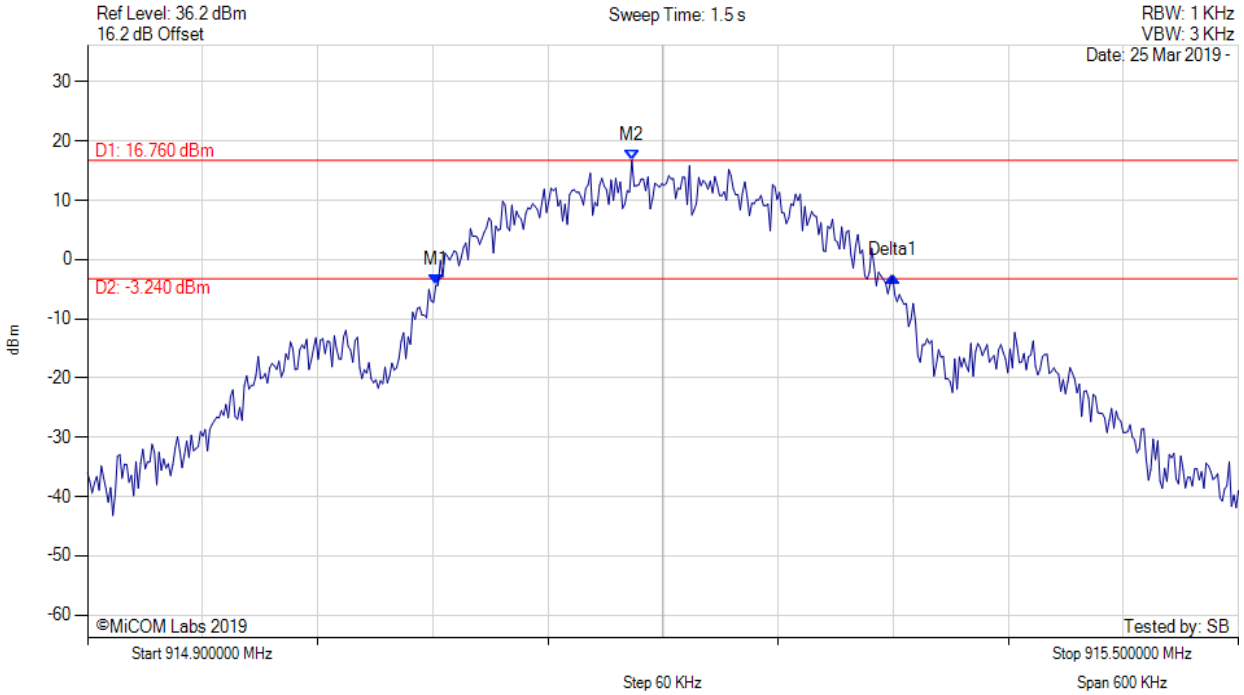



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 902.186 MHz : -2.061 dBm<br>M2 : 902.281 MHz : 17.481 dBm<br>Delta1 : 232 KHz : 1.897 dB | Channel Frequency: 902.30 MHz |

back to matrix

20 dB BANDWIDTH

Variant: GFSK, Channel: 915.20 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

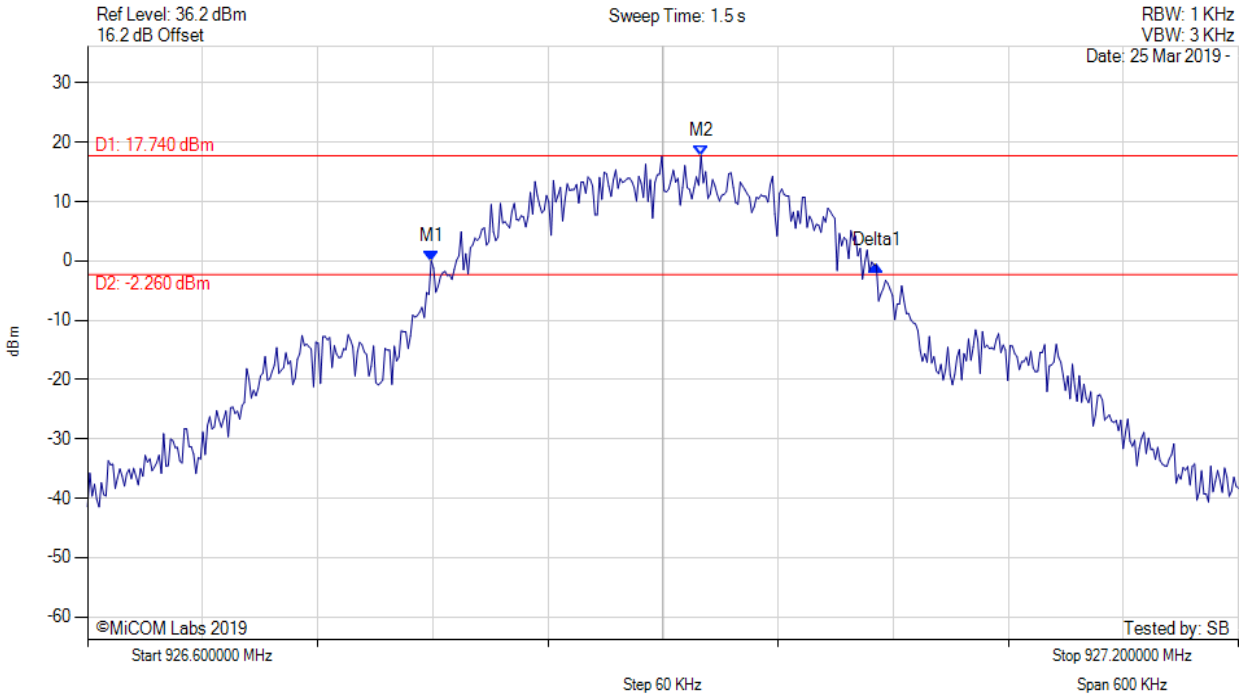



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 915.082 MHz : -4.314 dBm<br>M2 : 915.184 MHz : 16.759 dBm<br>Delta1 : 238 KHz : 1.576 dB | Channel Frequency: 915.20 MHz |

back to matrix

20 dB BANDWIDTH

Variant: GFSK, Channel: 926.90 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

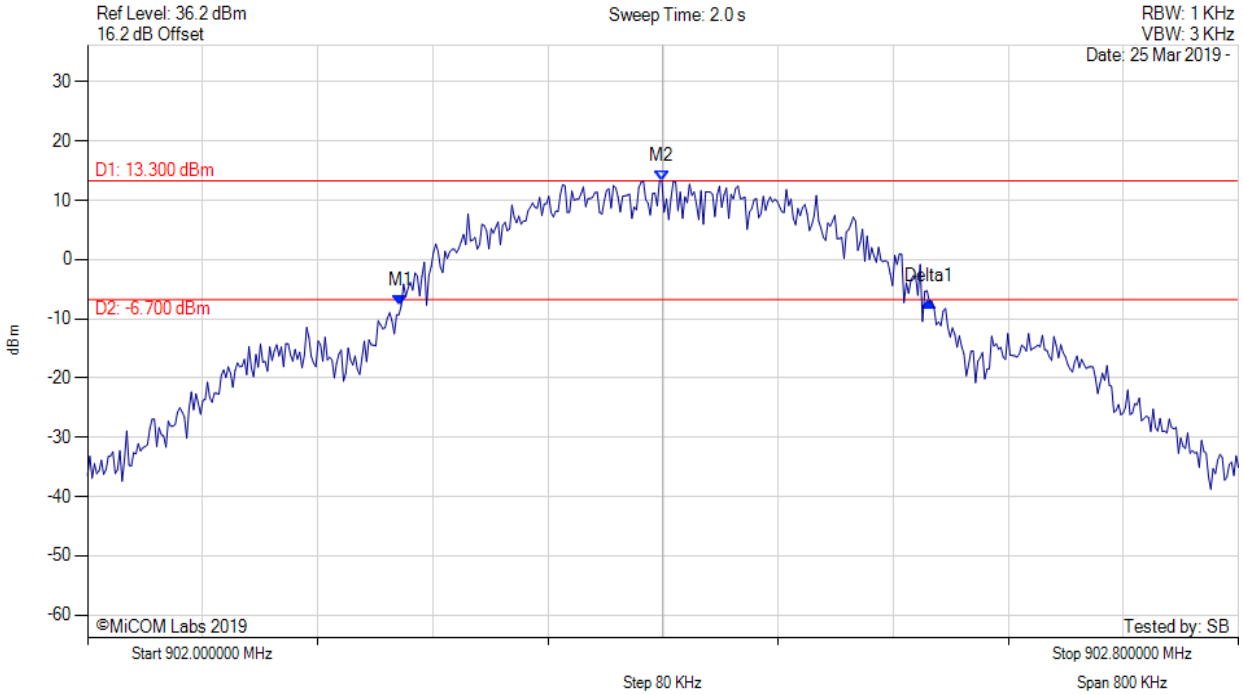



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 926.779 MHz : 0.036 dBm<br>M2 : 926.920 MHz : 17.740 dBm<br>Delta1 : 232 KHz : -0.700 dB | Channel Frequency: 926.90 MHz |

back to matrix

20 dB BANDWIDTH

Variant: GFSK, Channel: 902.40 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

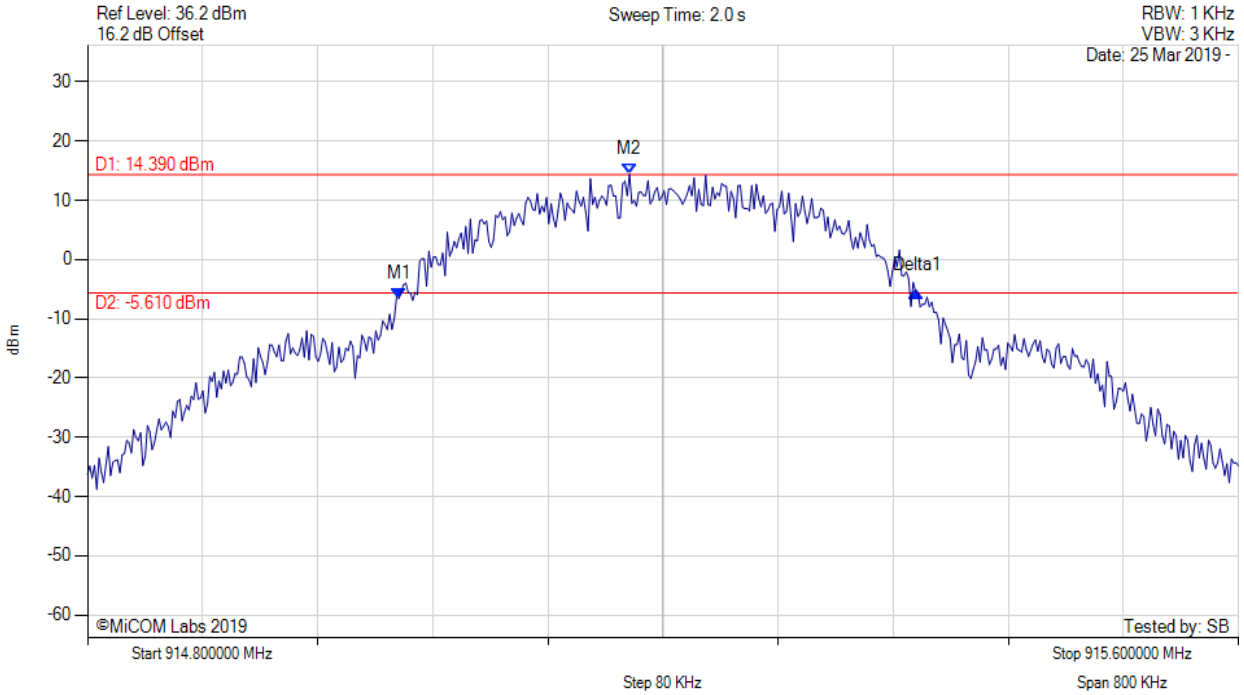



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 902.217 MHz : -7.806 dBm<br>M2 : 902.399 MHz : 13.300 dBm<br>Delta1 : 367 KHz : 0.661 dB | Channel Frequency: 902.40 MHz |

back to matrix

20 dB BANDWIDTH

Variant: GFSK, Channel: 915.20 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

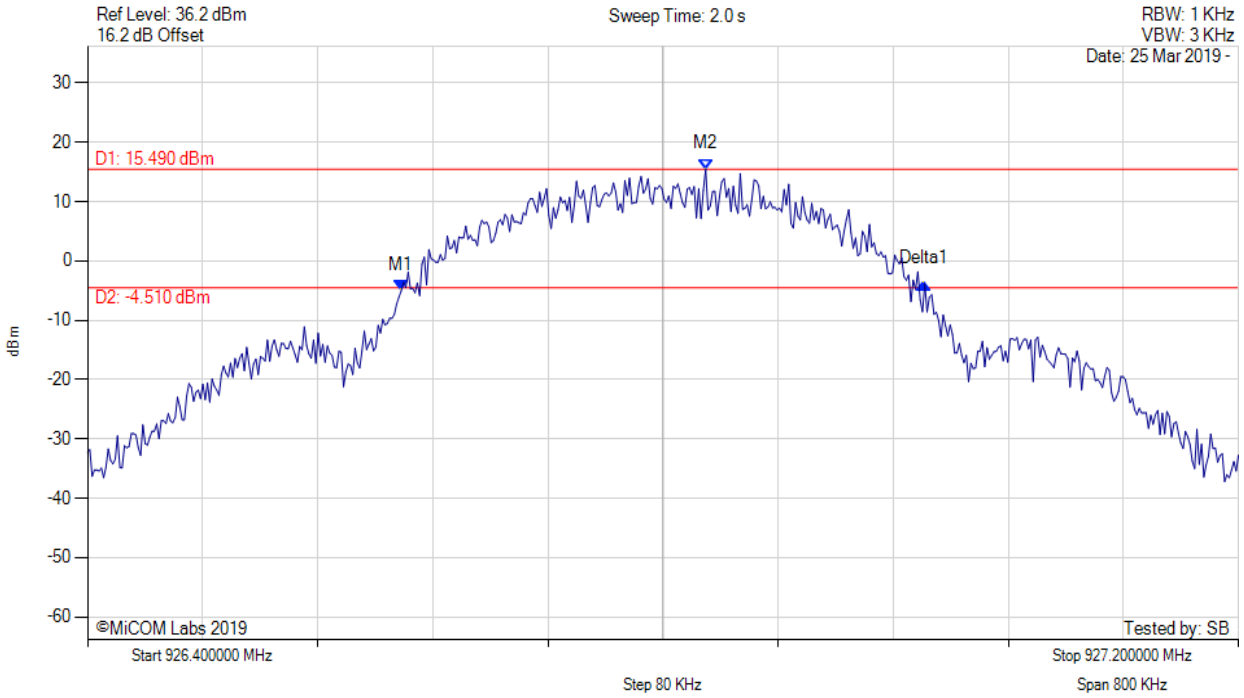



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 915.016 MHz : -6.523 dBm<br>M2 : 915.177 MHz : 14.388 dBm<br>Delta1 : 360 KHz : 1.208 dB | Channel Frequency: 915.20 MHz |

back to matrix

20 dB BANDWIDTH

Variant: GFSK, Channel: 926.80 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

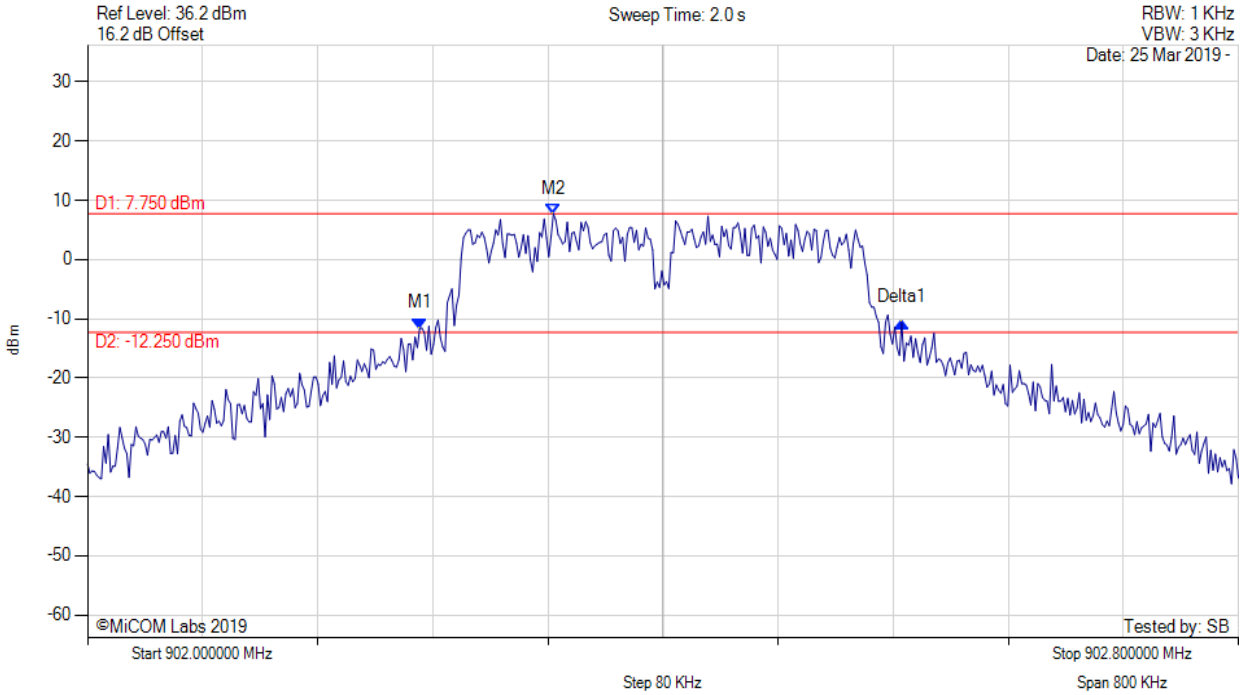



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 926.618 MHz : -5.032 dBm<br>M2 : 926.830 MHz : 15.494 dBm<br>Delta1 : 363 KHz : 1.192 dB | Channel Frequency: 926.80 MHz |

back to matrix

20 dB BANDWIDTH

Variant: OFDM3, Channel: 902.40 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

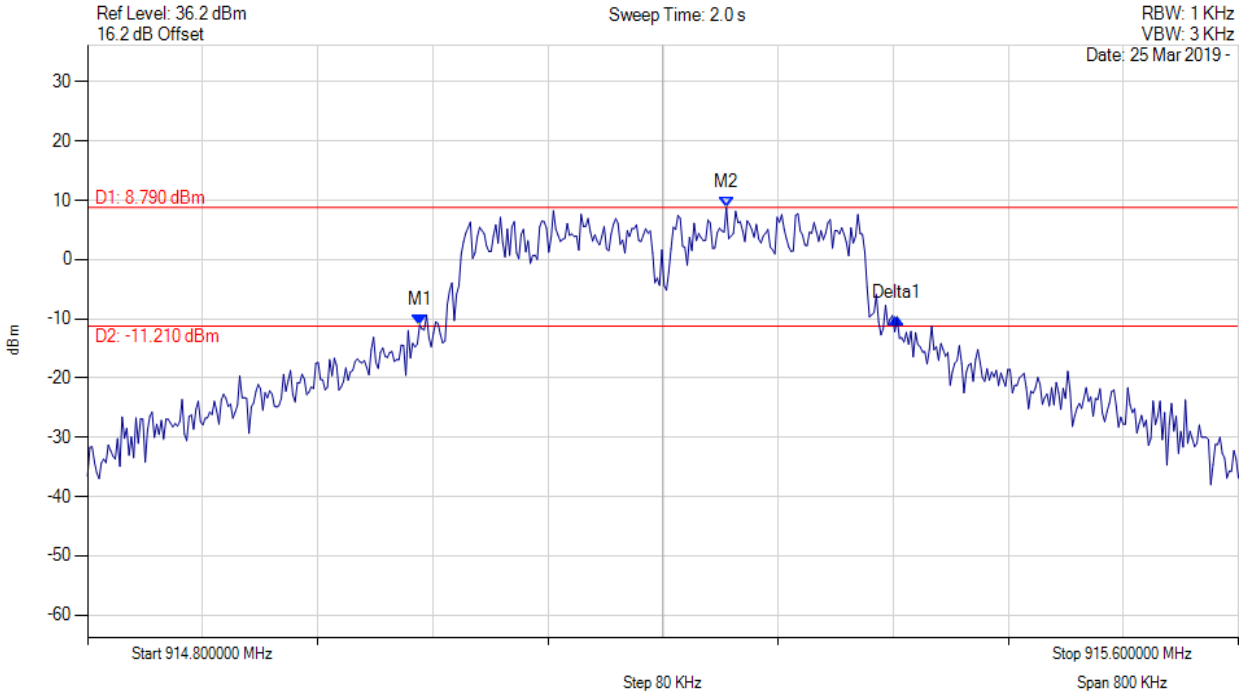



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 902.231 MHz : -11.609 dBm<br>M2 : 902.324 MHz : 7.754 dBm<br>Delta1 : 335 KHz : 0.986 dB | Channel Frequency: 902.40 MHz |

back to matrix

20 dB BANDWIDTH

Variant: OFDM3, Channel: 915.20 MHz, Chain a, Temp: 25, Voltage: 24 Vdc

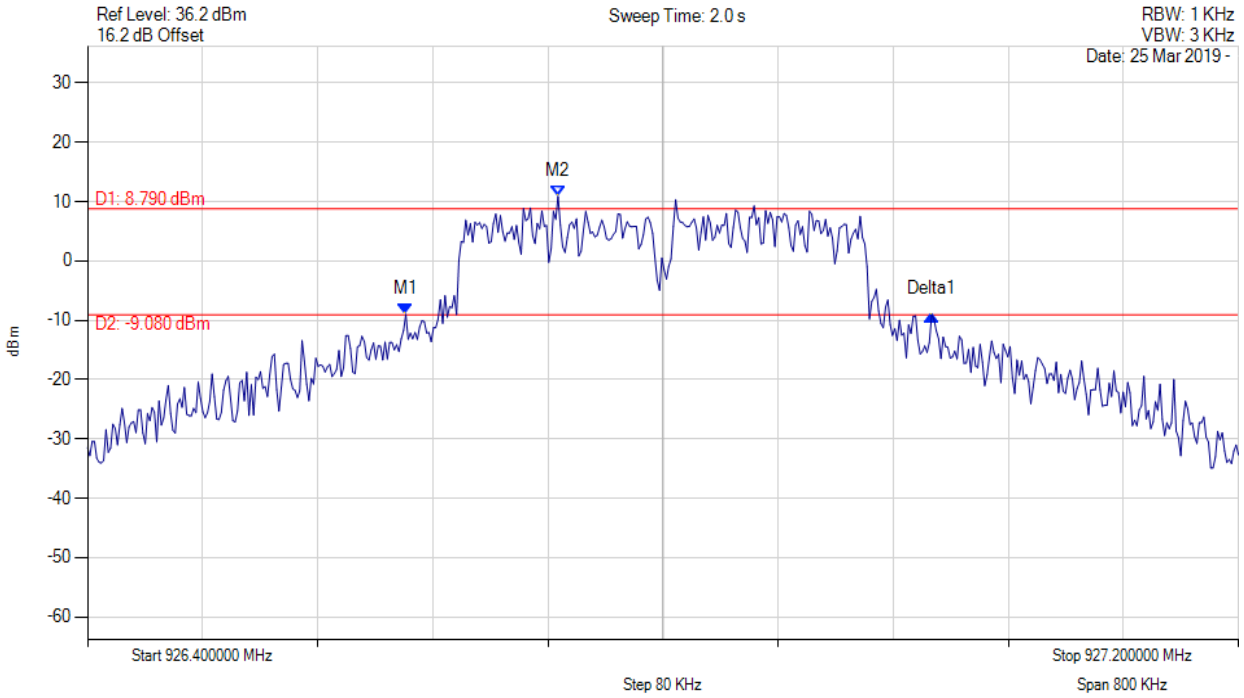



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 915.031 MHz : -11.032 dBm<br>M2 : 915.244 MHz : 8.789 dBm<br>Delta1 : 332 KHz : 1.121 dB | Channel Frequency: 915.20 MHz |

back to matrix

20 dB BANDWIDTH

Variant: OFDM3, Channel: 926.80 MHz, Chain a, Temp: 25, Voltage: 24 Vdc




| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = CLR/WRITE | M1 : 926.621 MHz : -8.982 dBm<br>M2 : 926.727 MHz : 10.925 dBm<br>Delta1 : 366 KHz : -0.059 dB | Channel Frequency: 926.80 MHz |

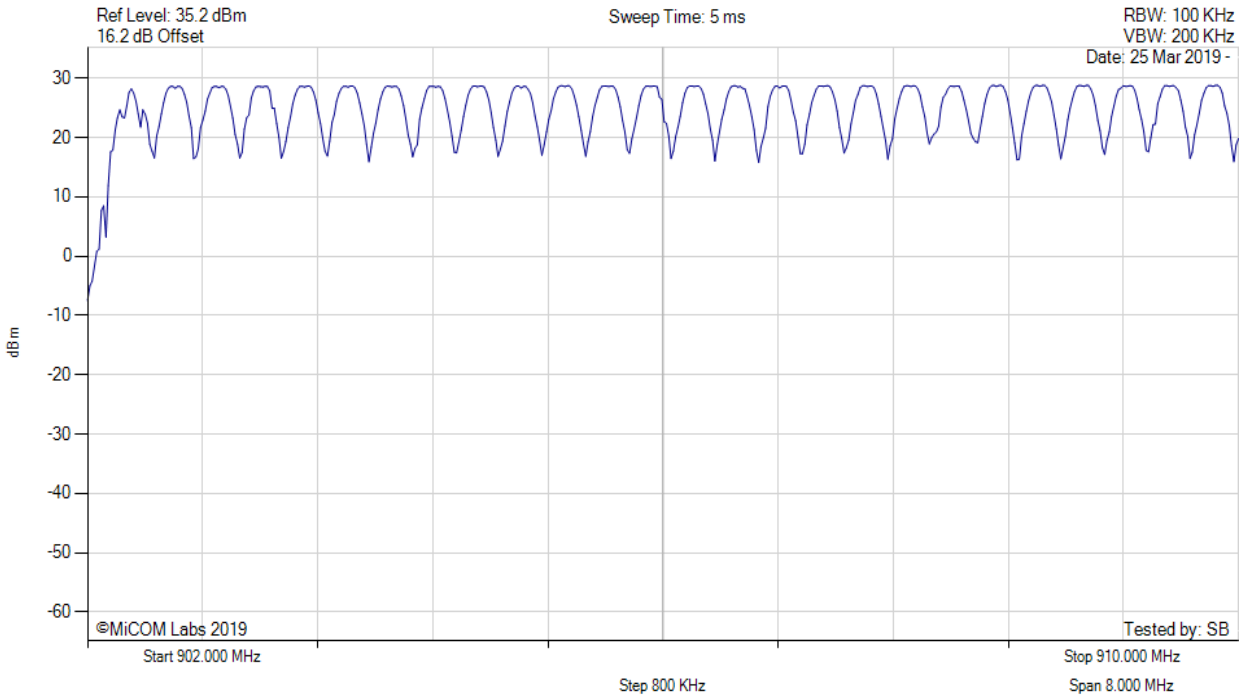
back to matrix

# A.2. Frequency Hopping Tests

## A.2.1. Number of Hopping Channels

NUMBER OF HOPPING CHANNELS

Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage: Vdc

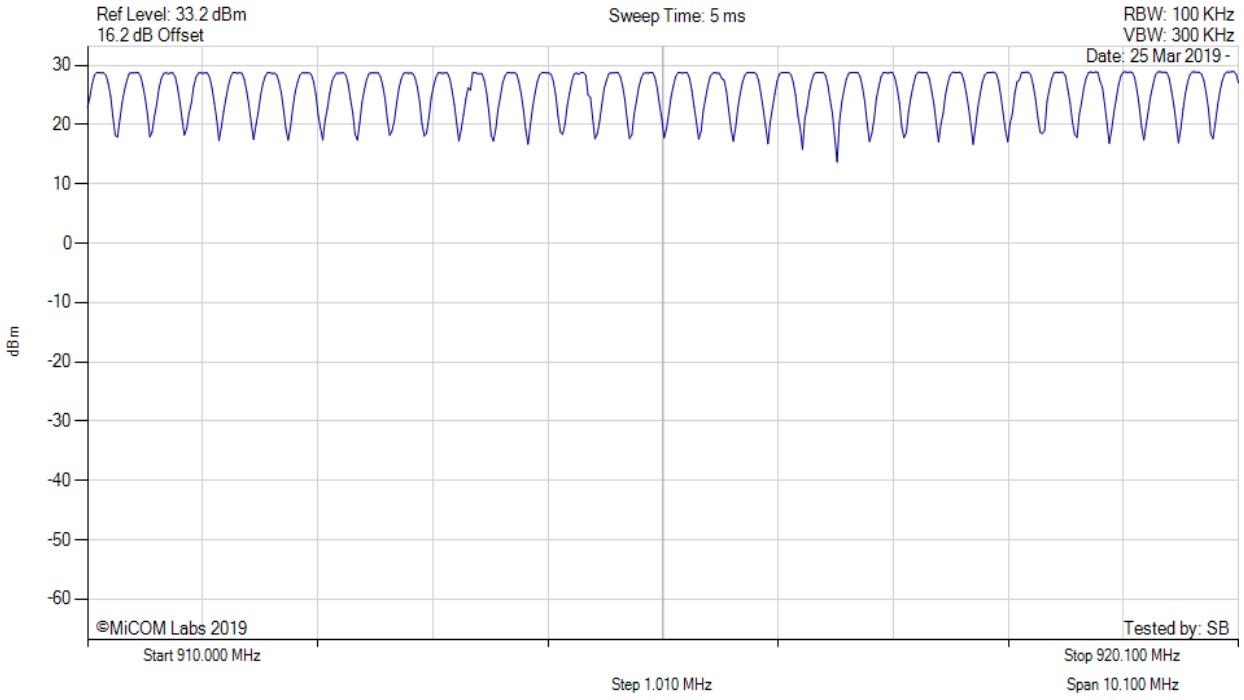



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | | Channel Frequency: 915.20 MHz |

back to matrix

NUMBER OF HOPPING CHANNELS

Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage: Vdc

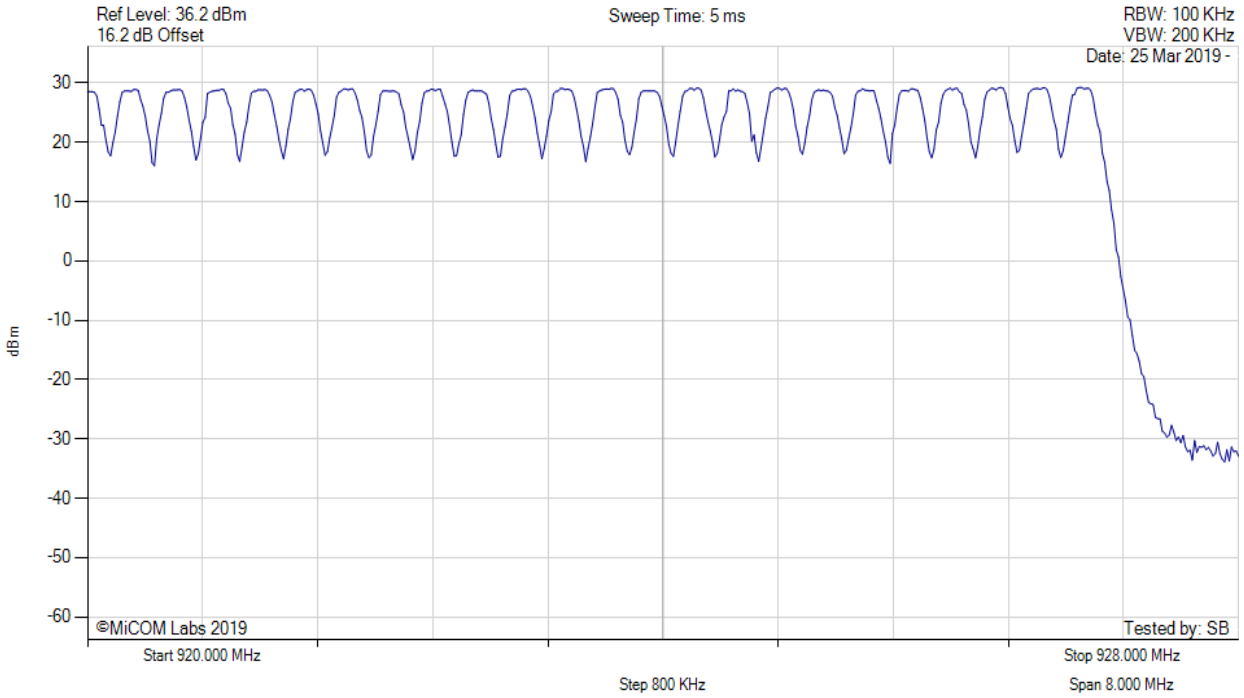



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | | Channel Frequency: 915.20 MHz |

back to matrix

NUMBER OF HOPPING CHANNELS

Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage: Vdc

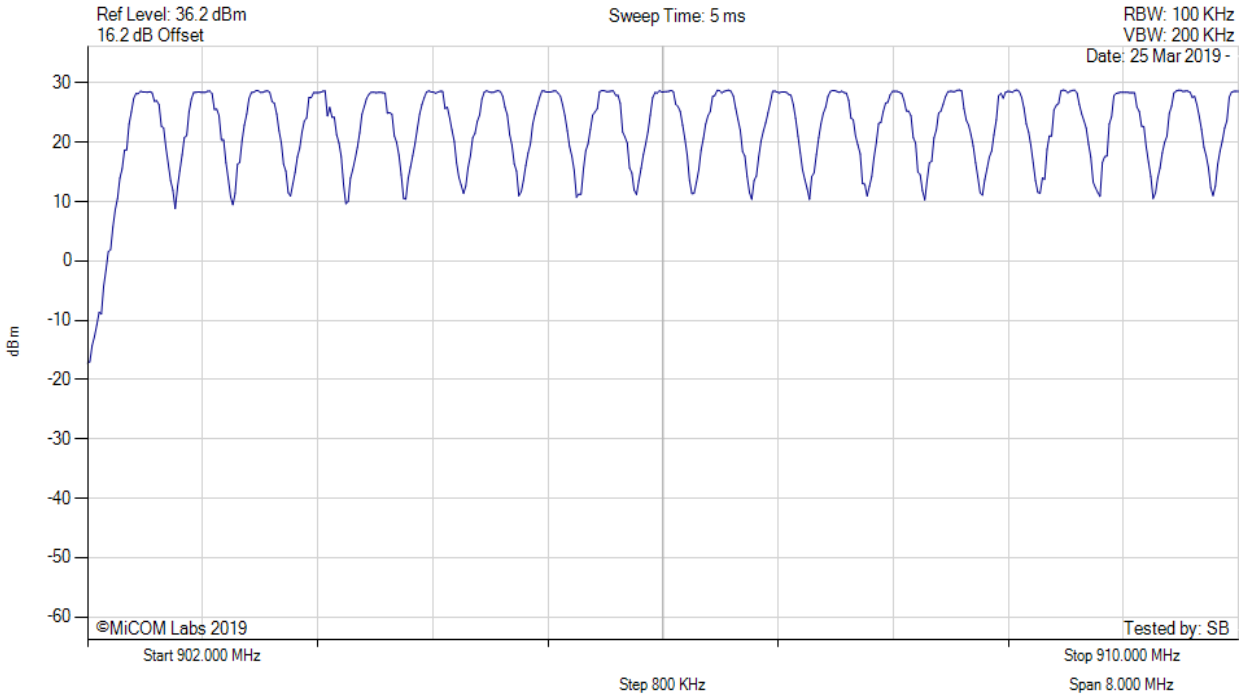



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | | Channel Frequency: 915.20 MHz |

back to matrix

NUMBER OF HOPPING CHANNELS

Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage: Vdc

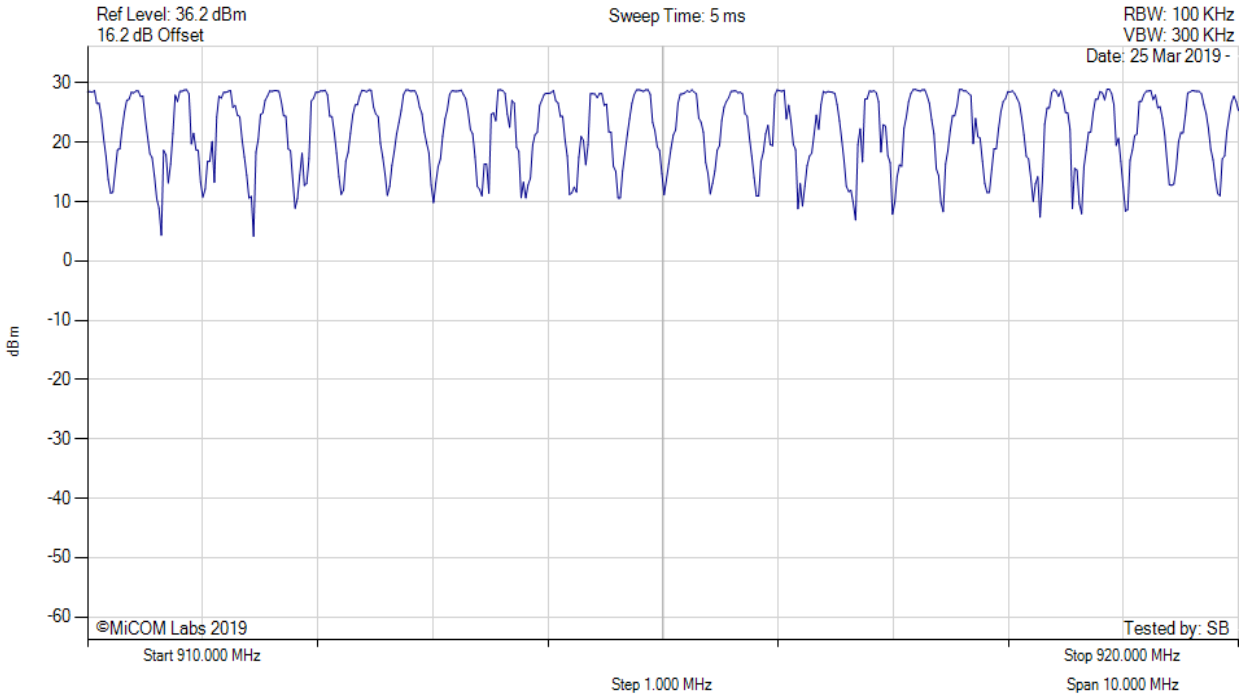



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | | Channel Frequency: 915.20 MHz |

back to matrix

NUMBER OF HOPPING CHANNELS

Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage: Vdc

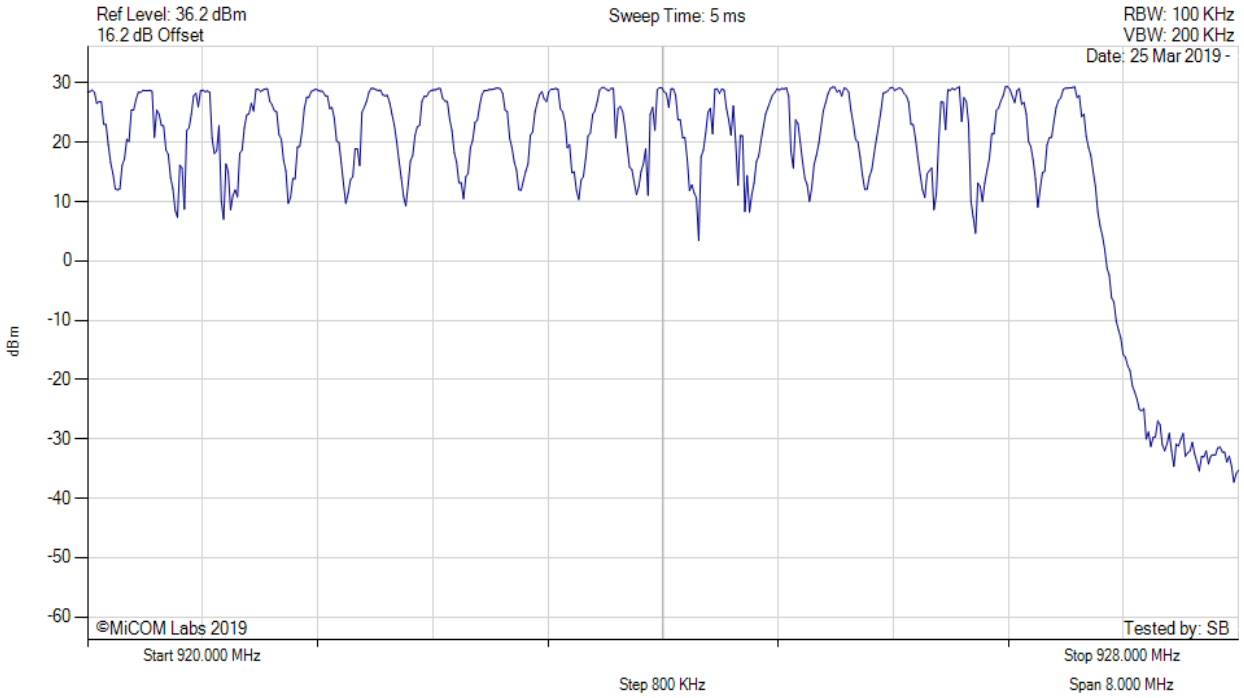



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | | Channel Frequency: 915.20 MHz |

back to matrix

NUMBER OF HOPPING CHANNELS

Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage: Vdc

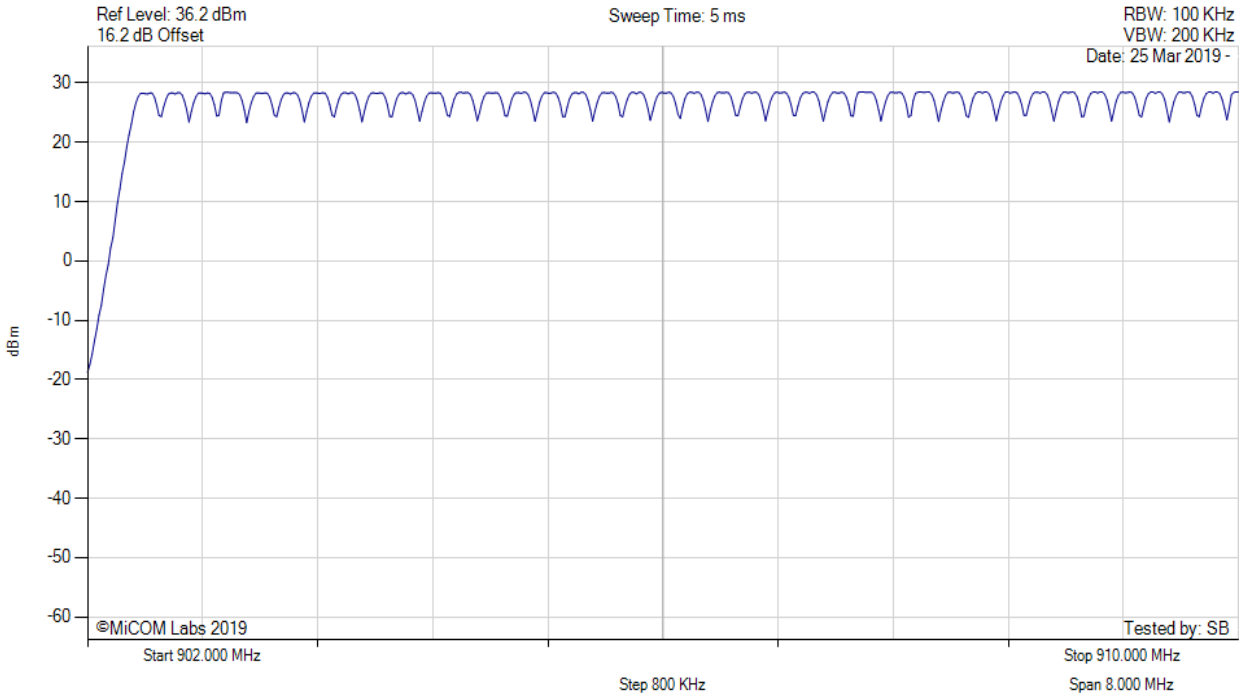



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | | Channel Frequency: 915.20 MHz |

back to matrix

NUMBER OF HOPPING CHANNELS

Variant: OQPSK, Channel: 915.00 MHz, Chain a, Temp: 20, Voltage:  Vdc

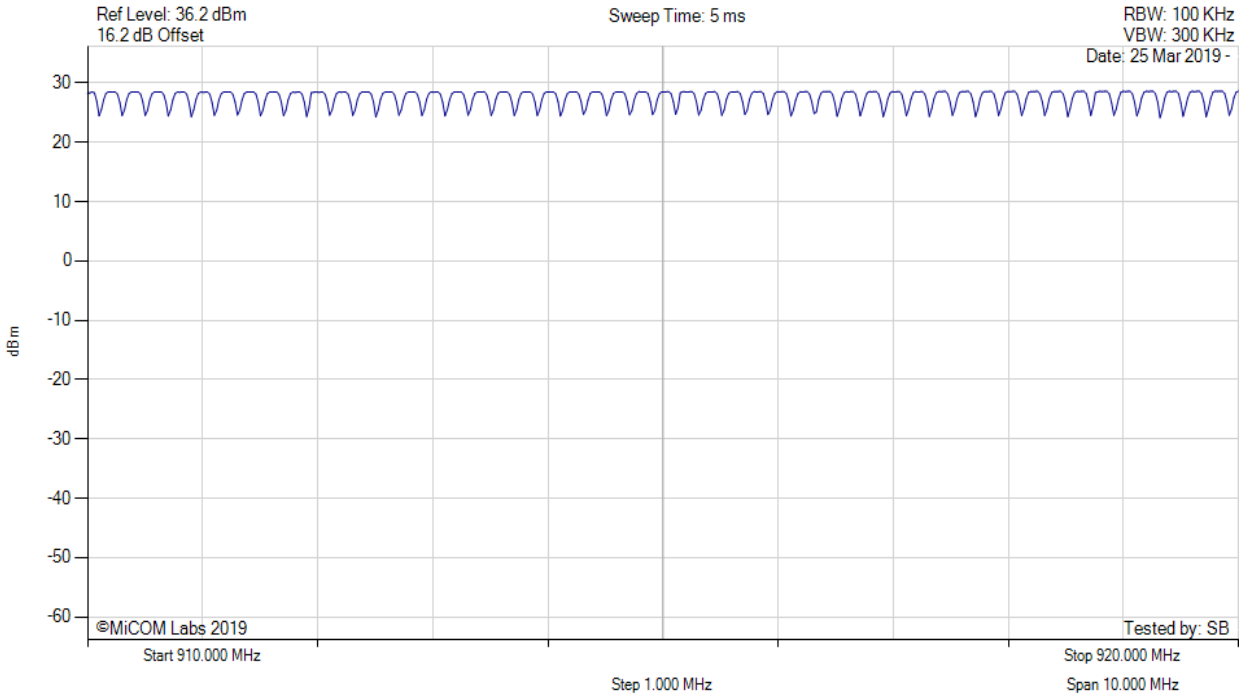



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | | Channel Frequency: 915.00 MHz |

back to matrix

NUMBER OF HOPPING CHANNELS

Variant: OQPSK, Channel: 915.00 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: 915.00 MHz |

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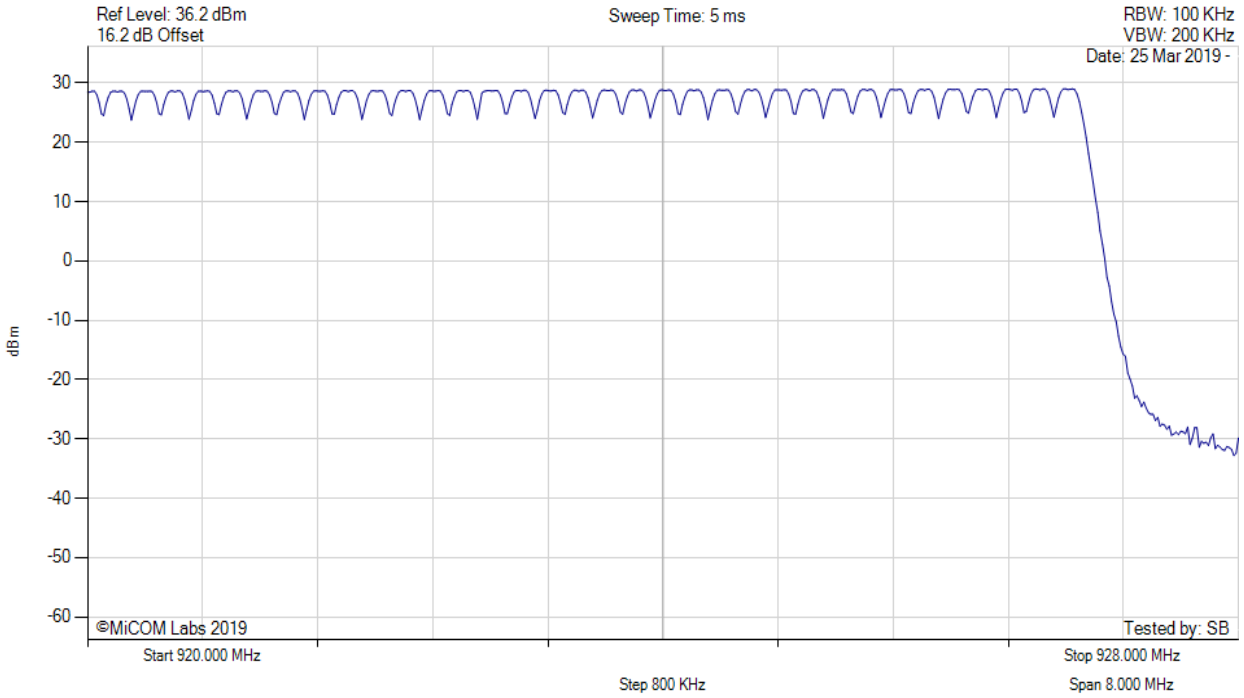
NUMBER OF HOPPING CHANNELS

Variant: OQPSK, Channel: 915.00 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: 915.00 MHz |

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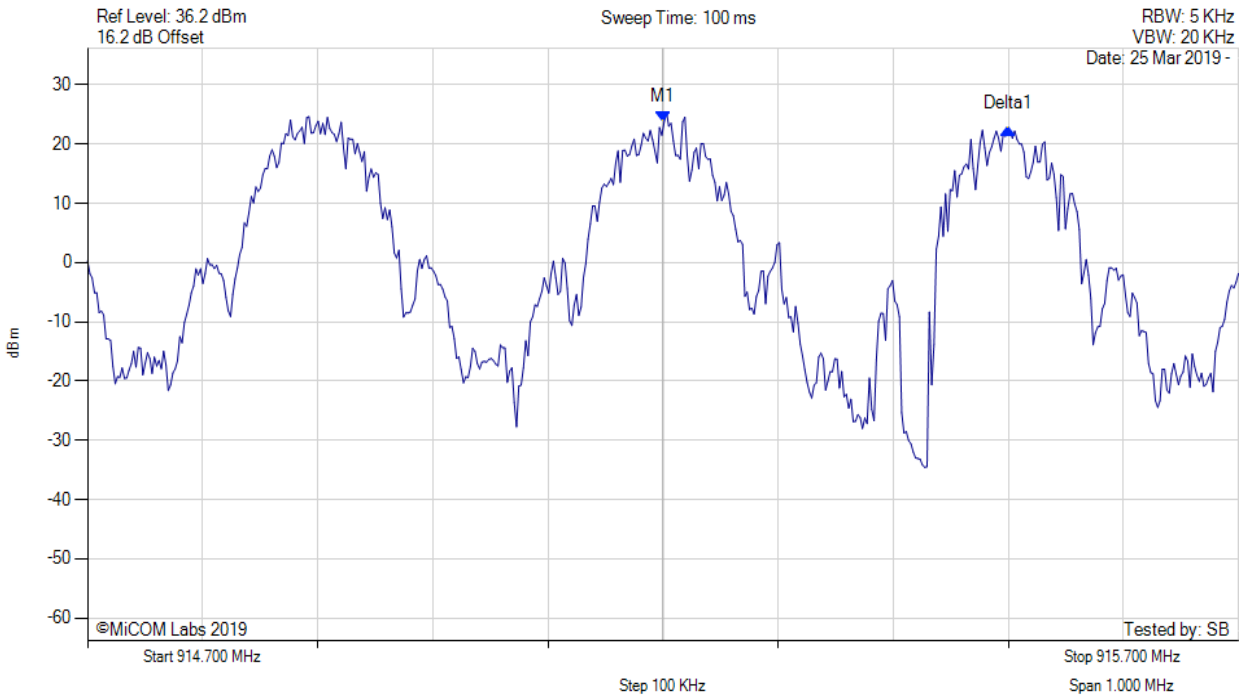
## A.2.2. Channel Separation

CHANNEL SEPARATION

Variant: FSK, Channel: 915.20 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 : 915.200 MHz : 23.737 dBm<br>Delta1 : 300 KHz : -1.176 dB | Channel Frequency: 915.20 MHz |

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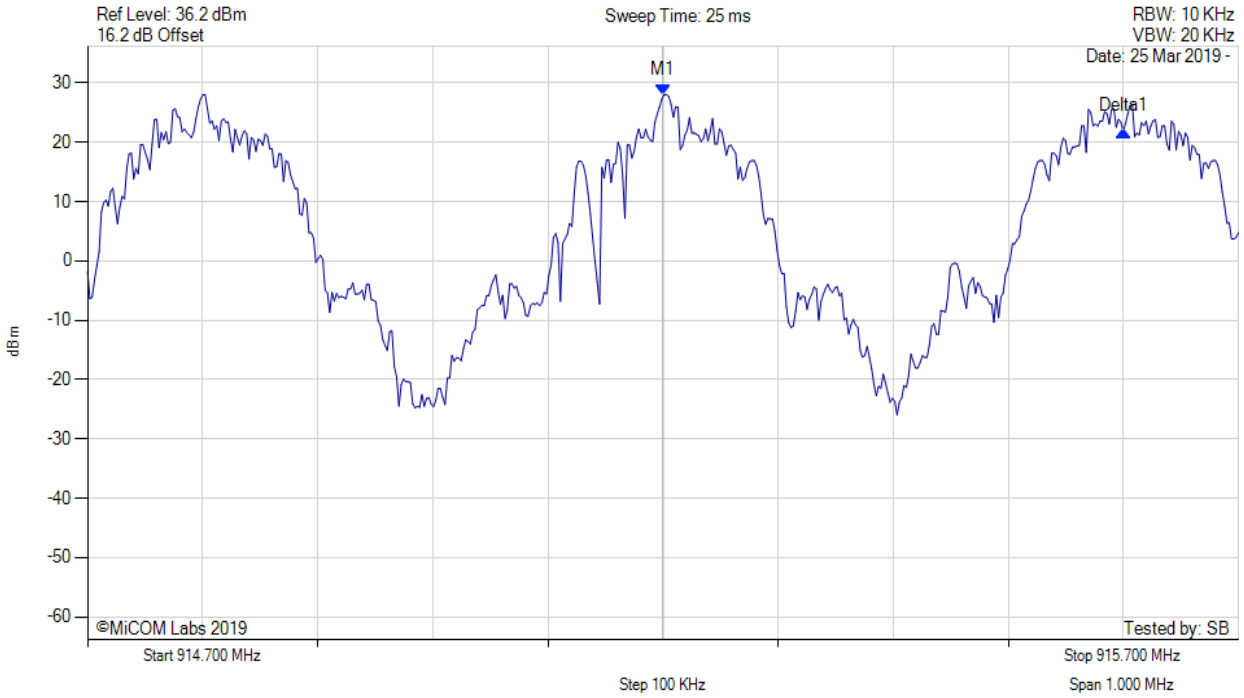
CHANNEL SEPARATION

Variant: FSK, Channel: 915.20 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 : 915.200 MHz : 28.037 dBm<br>Delta1 : 400 KHz : -6.052 dB | Channel Frequency: 915.20 MHz |

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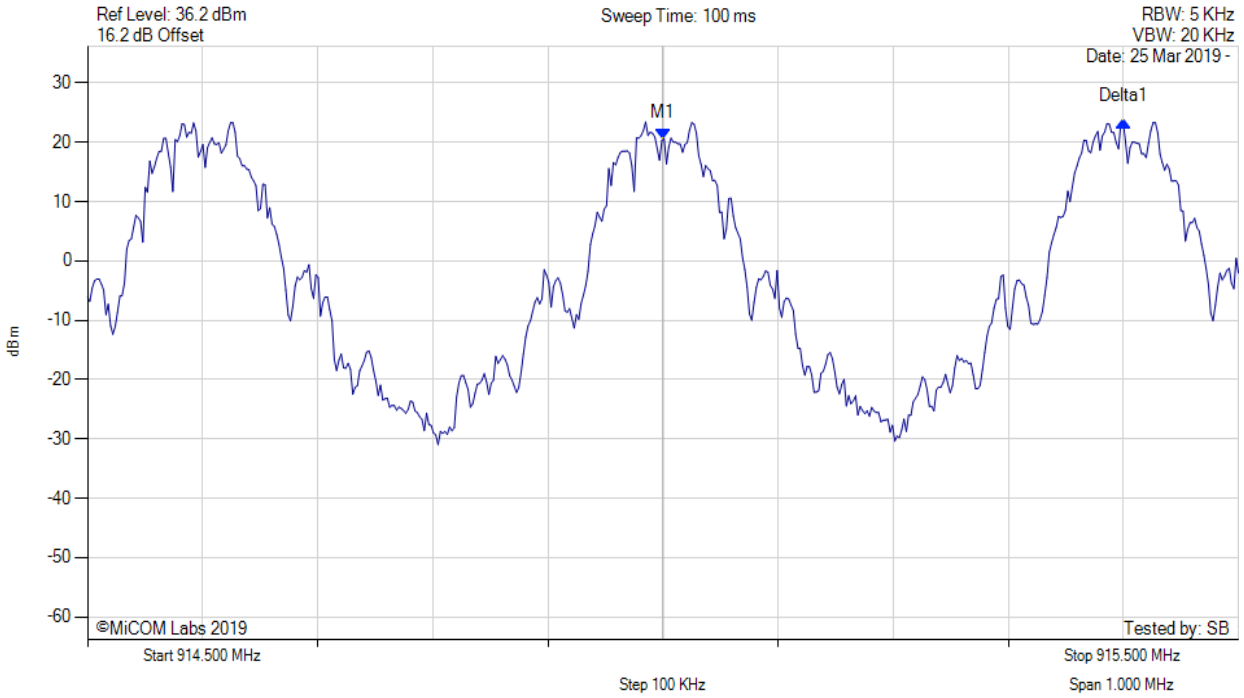
CHANNEL SEPARATION

Variant: OQPSK, Channel: 915.00 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 : 915.000 MHz : 20.617 dBm<br>Delta1 : 400 KHz : 2.851 dB | Channel Frequency: 915.00 MHz |

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## A.2.3. Dwell Time

DWELL TIME

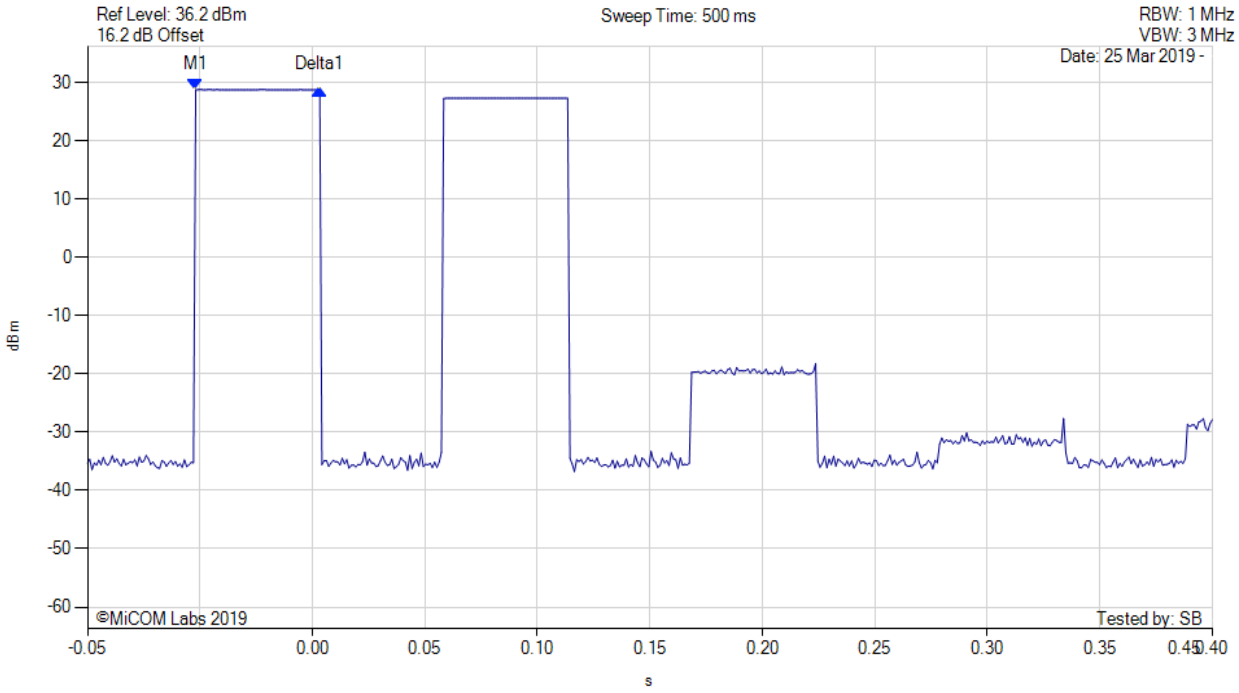
Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage: Vdc


| Analyzer Setup | Marker:Time:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1(915.20 MHz) : -0.003 s : 28.604 dBm<br>Delta1(915.20 MHz) : 0.101 s : 0.085 dB | Channel Frequency: 915.20 MHz |

back to matrix

DWELL TIME

Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage: Vdc

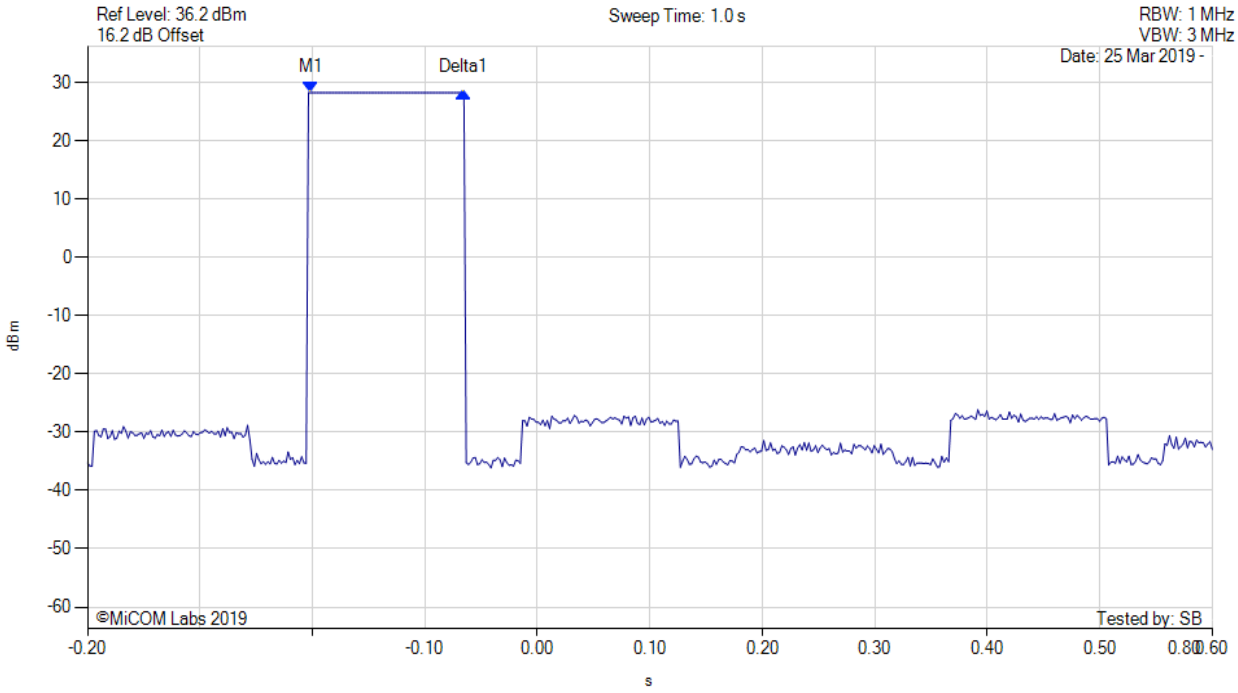



| Analyzer Setup | Marker:Time:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1(915.20 MHz) : -0.002 s : 28.742 dBm<br>Delta1(915.20 MHz) : 0.055 s : 0.000 dB | Channel Frequency: 915.20 MHz |

back to matrix

DWELL TIME

Variant: OQPSK, Channel: 915.00 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(915.00 MHz) : -0.002 s : 28.260 dBm<br>Delta1(915.00 MHz) : 0.136 s : 0.000 dB | Channel Frequency: 915.00 MHz |

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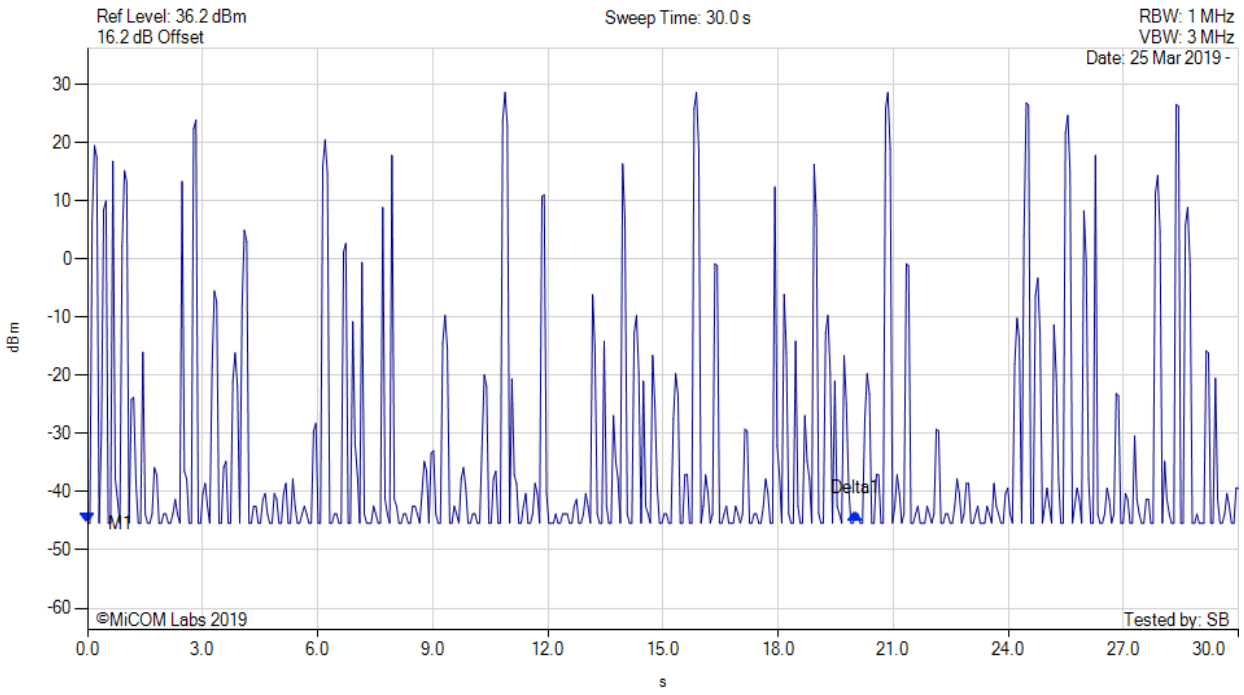
## A.2.4. Channel Occupancy

CHANNEL OCCUPANCY

Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage:  Vdc




| Analyzer Setup | Marker:Time:Amplitude | Test Results |
|---|---|---|
| Detector = RMS<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1(915.20 MHz) : 0.000 s : -45.386 dBm<br>Delta1(915.20 MHz) : 20.000 s : 1.584 dB | Channel Frequency: 915.20 MHz |

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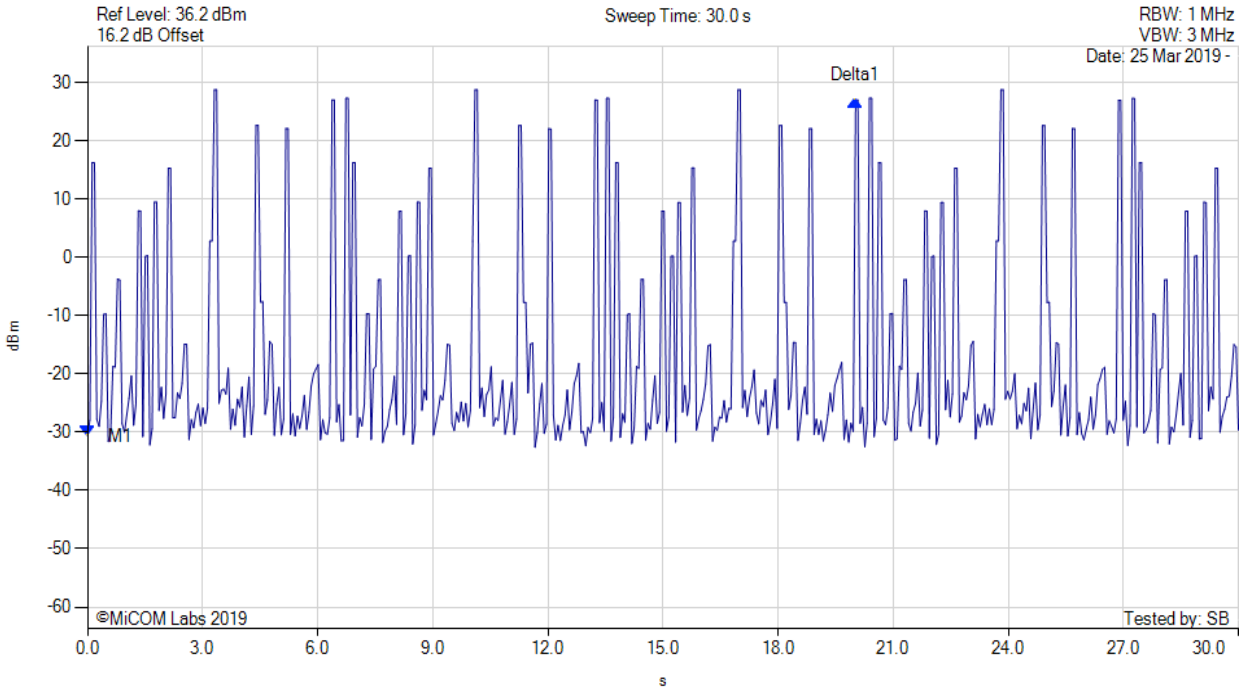
CHANNEL OCCUPANCY

Variant: FSK, Channel: 915.20 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(915.20 MHz) : 0.000 s : -30.651 dBm<br>Delta1(915.20 MHz) : 20.000 s : 57.608 dB | Channel Frequency: 915.20 MHz |

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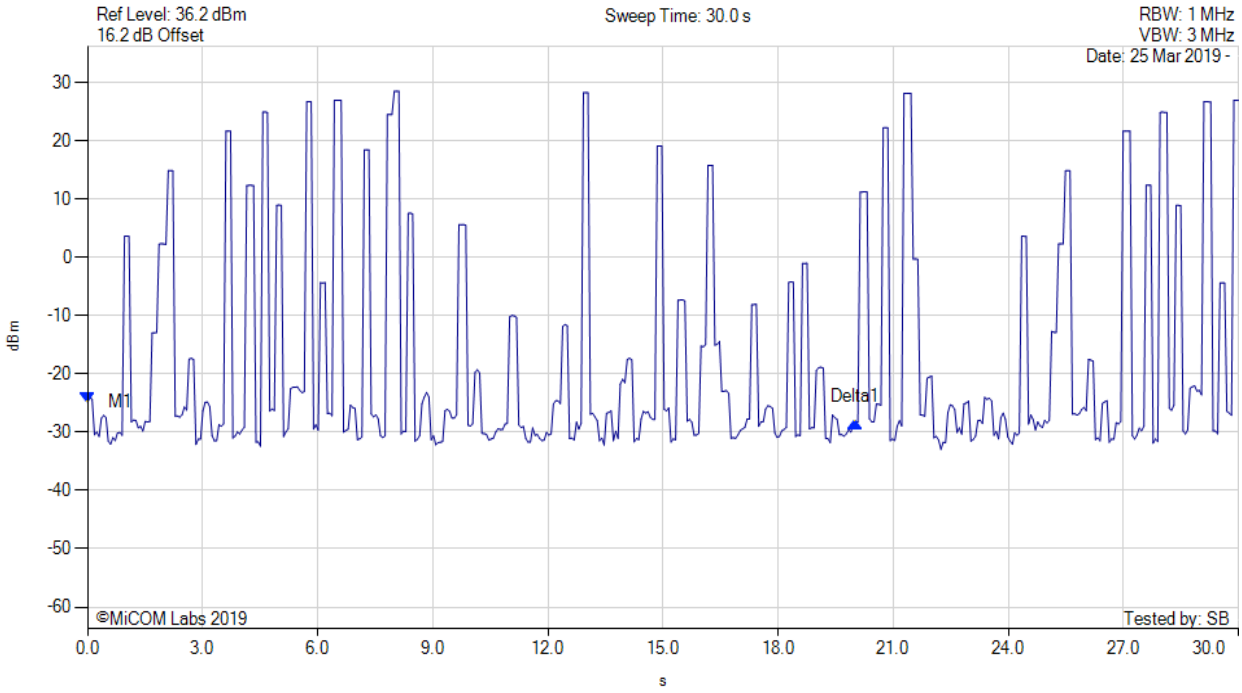
CHANNEL OCCUPANCY

Variant: OQPSK, Channel: 915.00 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(915.00 MHz) : 0.000 s : -24.814 dBm<br>Delta1(915.00 MHz) : 20.000 s : -3.386 dB | Channel Frequency: 915.00 MHz |

back to matrix

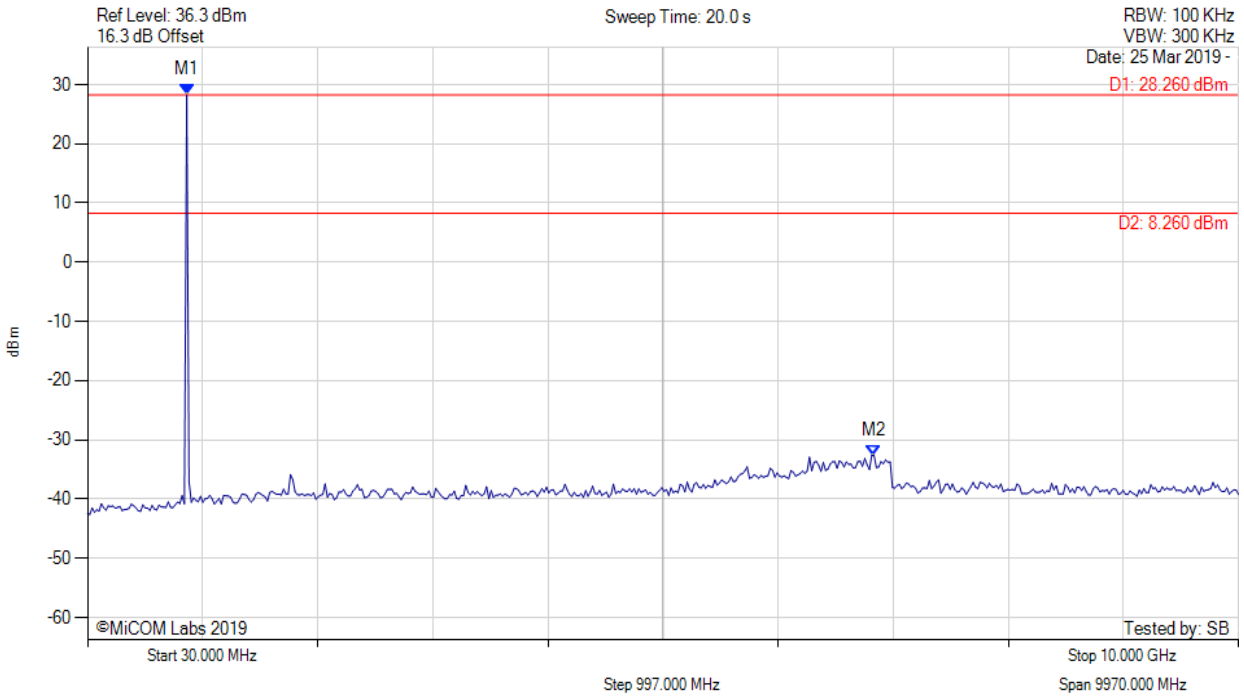
# A.3. Emissions

## A.3.1. Conducted Emissions

### A.3.1.1. Conducted Unwanted Spurious Emissions

UNWANTED EMISSIONS PEAK

Variant: FSK, Channel: 902.30 MHz, Chain a, Temp: 20, Voltage: Vdc

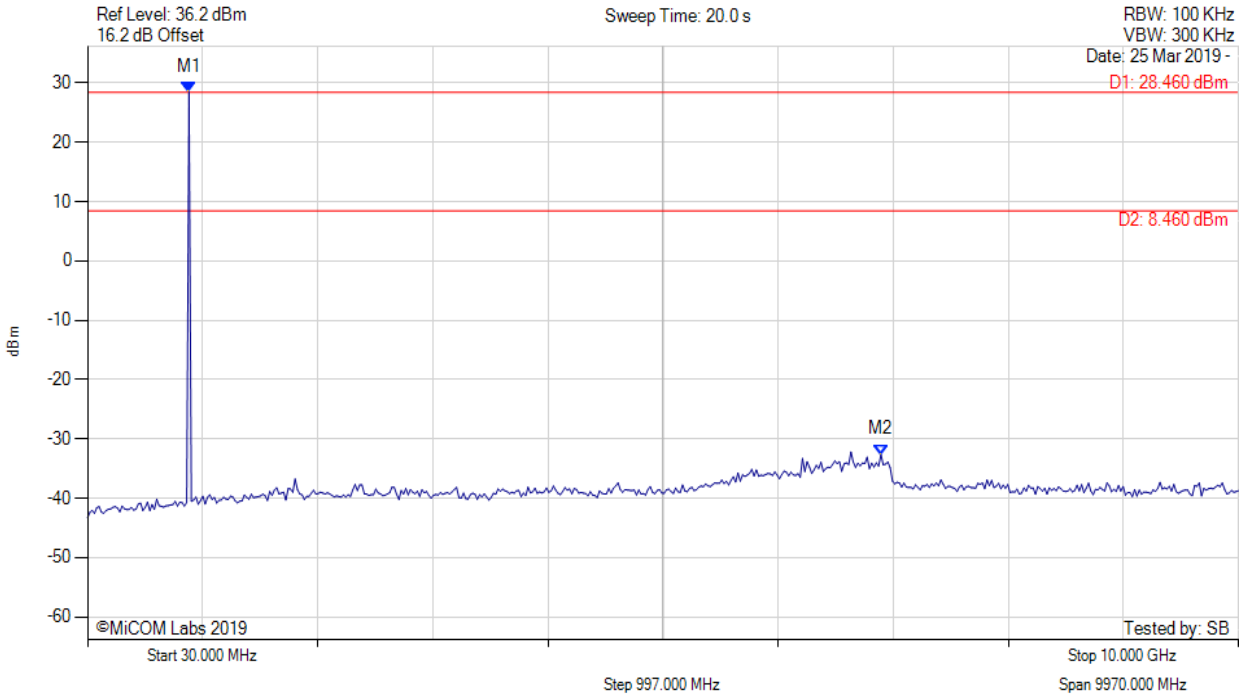



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 889.138 MHz : 28.263 dBm<br>M2 : 6843.166 MHz : -32.622 dBm | Limit: 8.26 dBm<br>Margin: -40.88 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage:  Vdc

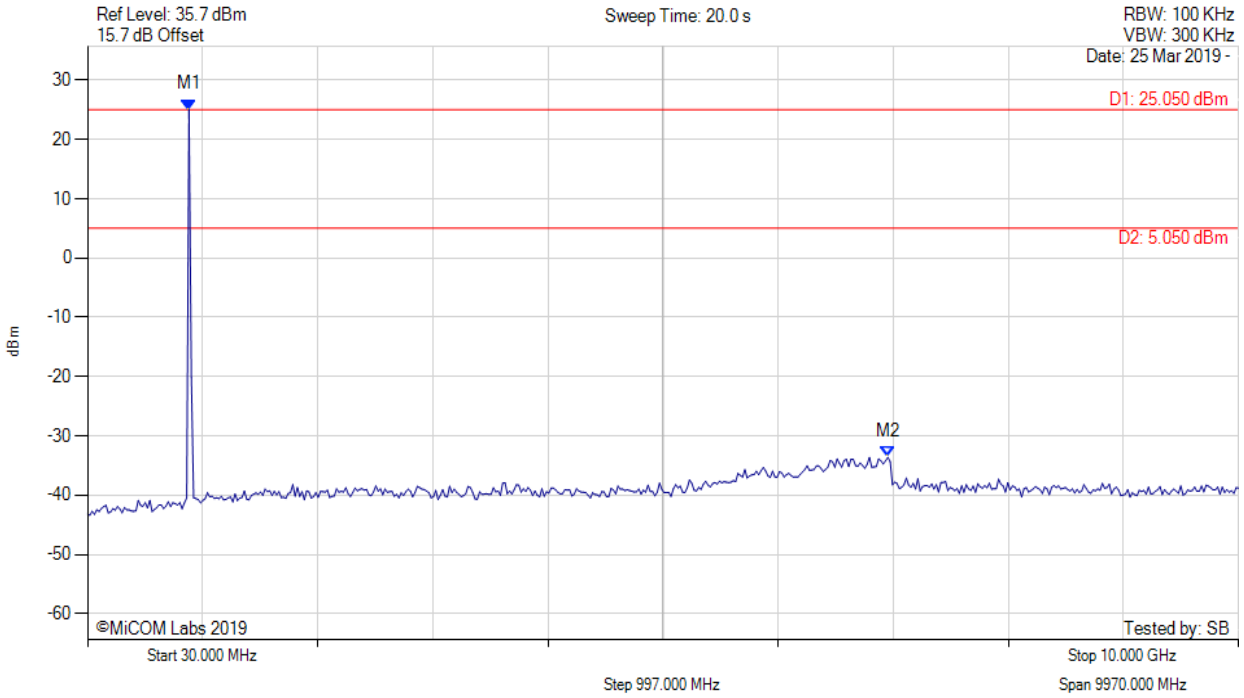



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 909.118 MHz : 28.464 dBm<br>M2 : 6903.106 MHz : -32.661 dBm | Limit: 8.46 dBm<br>Margin: -41.12 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: FSK, Channel: 926.90 MHz, Chain a, Temp: 20, Voltage:  Vdc

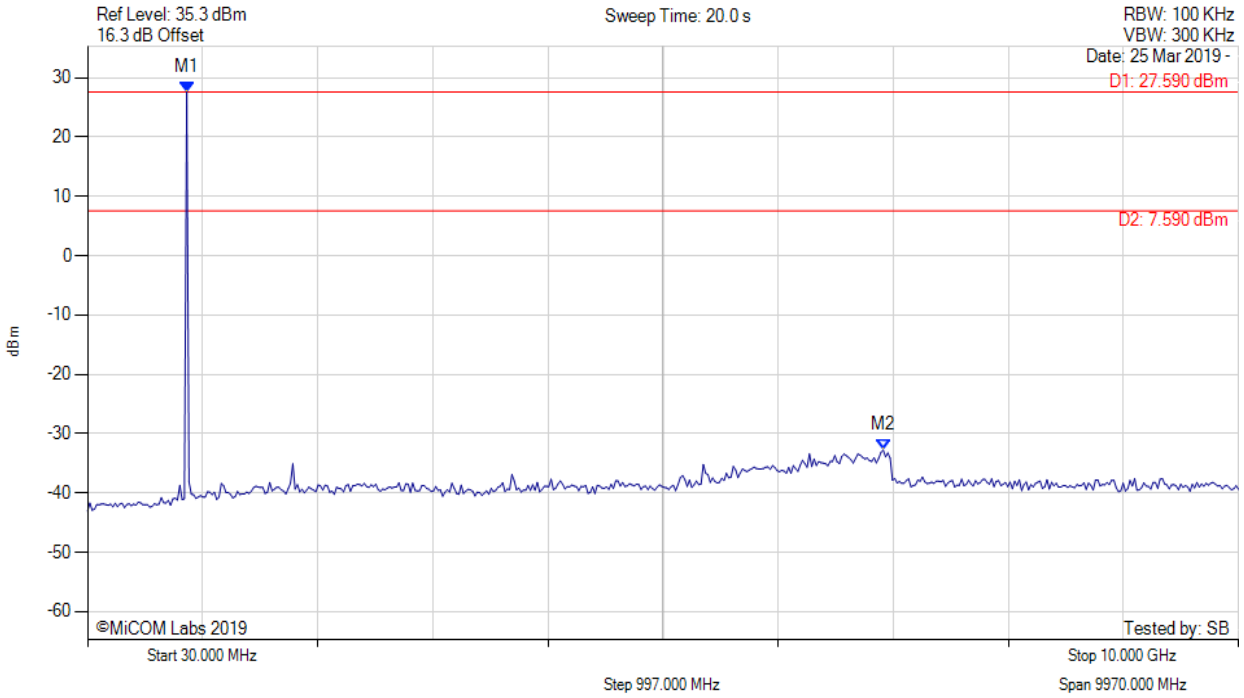



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 909.118 MHz : 25.045 dBm<br>M2 : 6963.046 MHz : -33.600 dBm | Limit: 5.05 dBm<br>Margin: -38.65 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: FSK, Channel: 902.40 MHz, Chain a, Temp: 20, Voltage:  Vdc

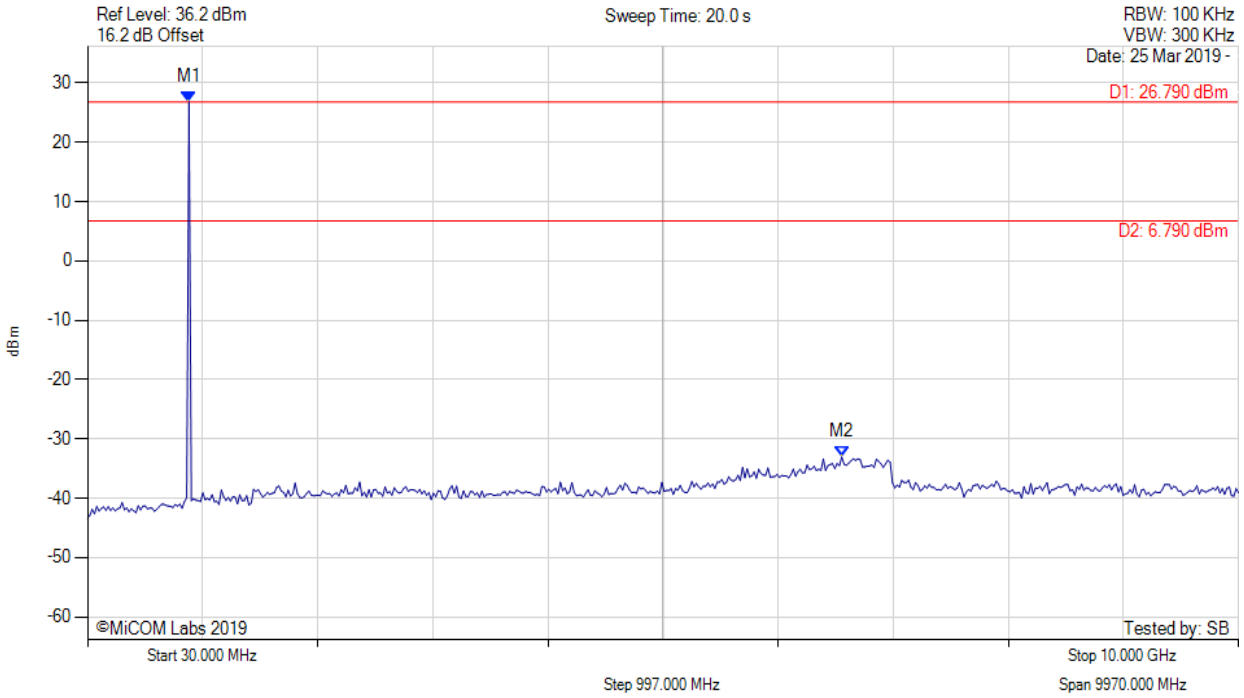



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 889.138 MHz : 27.592 dBm<br>M2 : 6923.086 MHz : -32.769 dBm | Limit: 7.59 dBm<br>Margin: -40.36 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: FSK, Channel: 915.20 MHz, Chain a, Temp: 20, Voltage:  Vdc

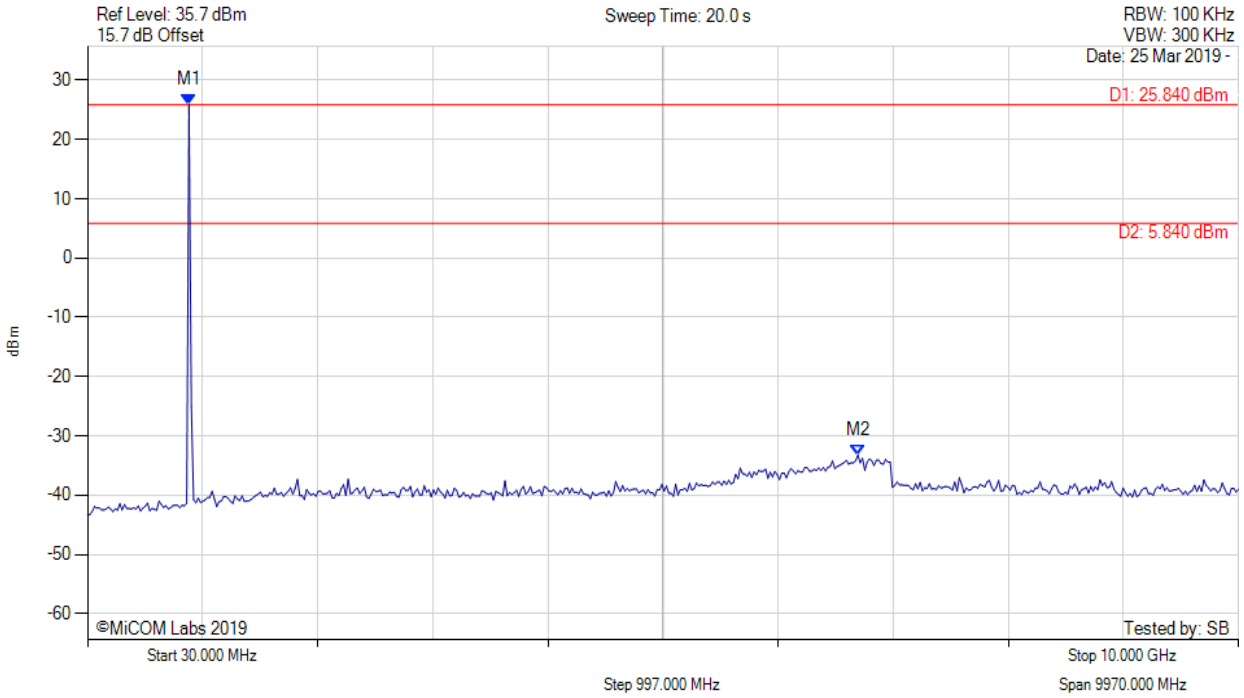



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 909.118 MHz : 26.790 dBm<br>M2 : 6563.447 MHz : -33.029 dBm | Limit: 6.79 dBm<br>Margin: -39.82 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: FSK, Channel: 926.80 MHz, Chain a, Temp: 20, Voltage:  Vdc

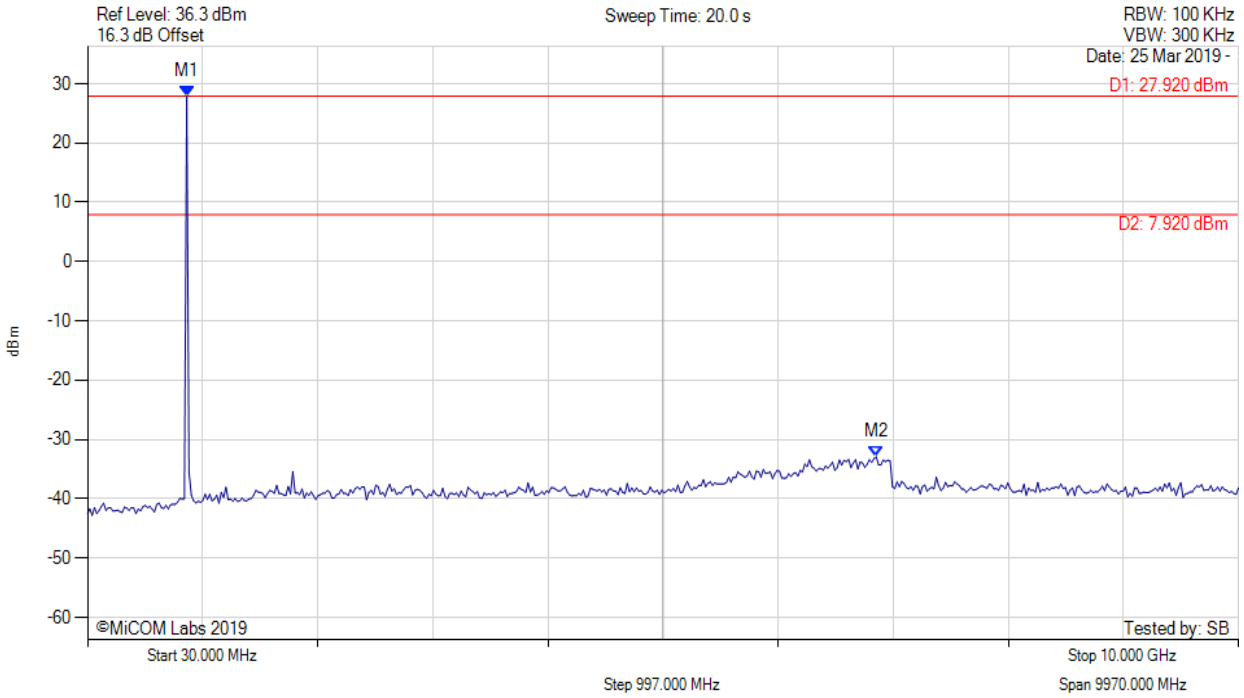



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 909.118 MHz : 25.836 dBm<br>M2 : 6703.307 MHz : -33.213 dBm | Limit: 5.84 dBm<br>Margin: -39.05 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: OQPSK, Channel: 902.40 MHz, Chain a, Temp: 20, Voltage:  Vdc

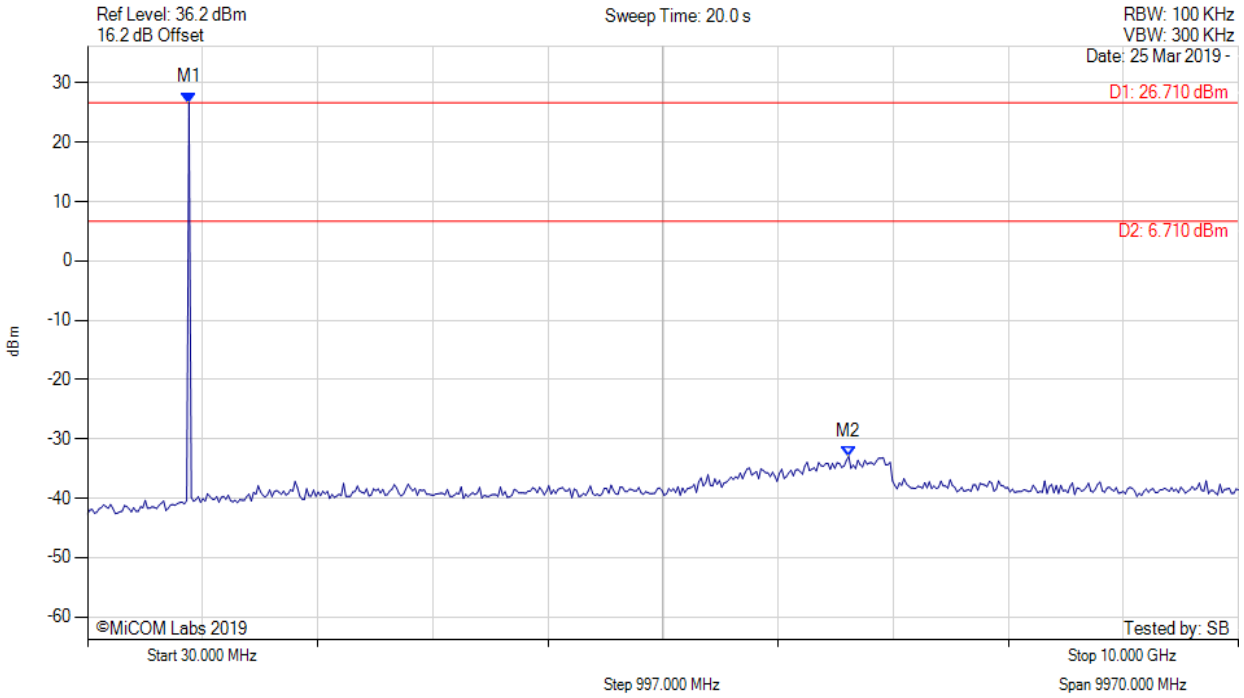



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 889.138 MHz : 27.921 dBm<br>M2 : 6863.146 MHz : -32.927 dBm | Limit: 7.92 dBm<br>Margin: -40.85 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: OQPSK, Channel: 915.00 MHz, Chain a, Temp: 20, Voltage:  Vdc

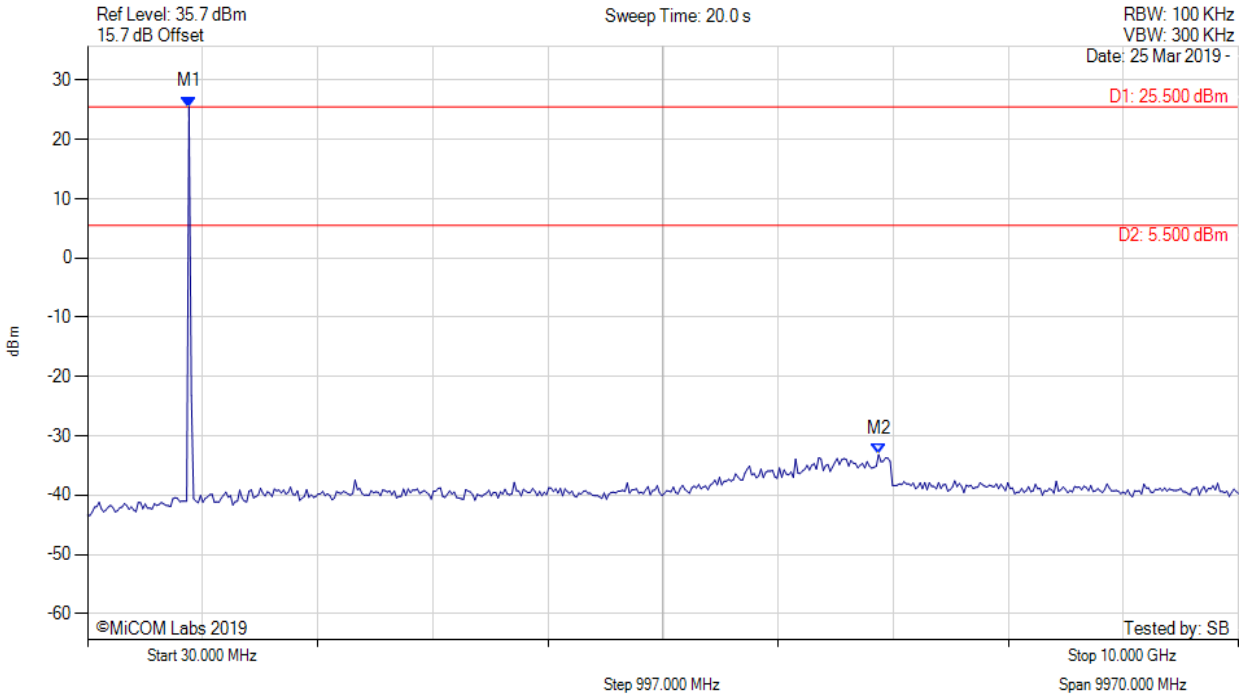



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 909.118 MHz : 26.709 dBm<br>M2 : 6623.387 MHz : -32.960 dBm | Limit: 6.71 dBm<br>Margin: -39.67 dB |

back to matrix

UNWANTED EMISSIONS PEAK

Variant: OQPSK, Channel: 926.80 MHz, Chain a, Temp: 20, Voltage:  Vdc



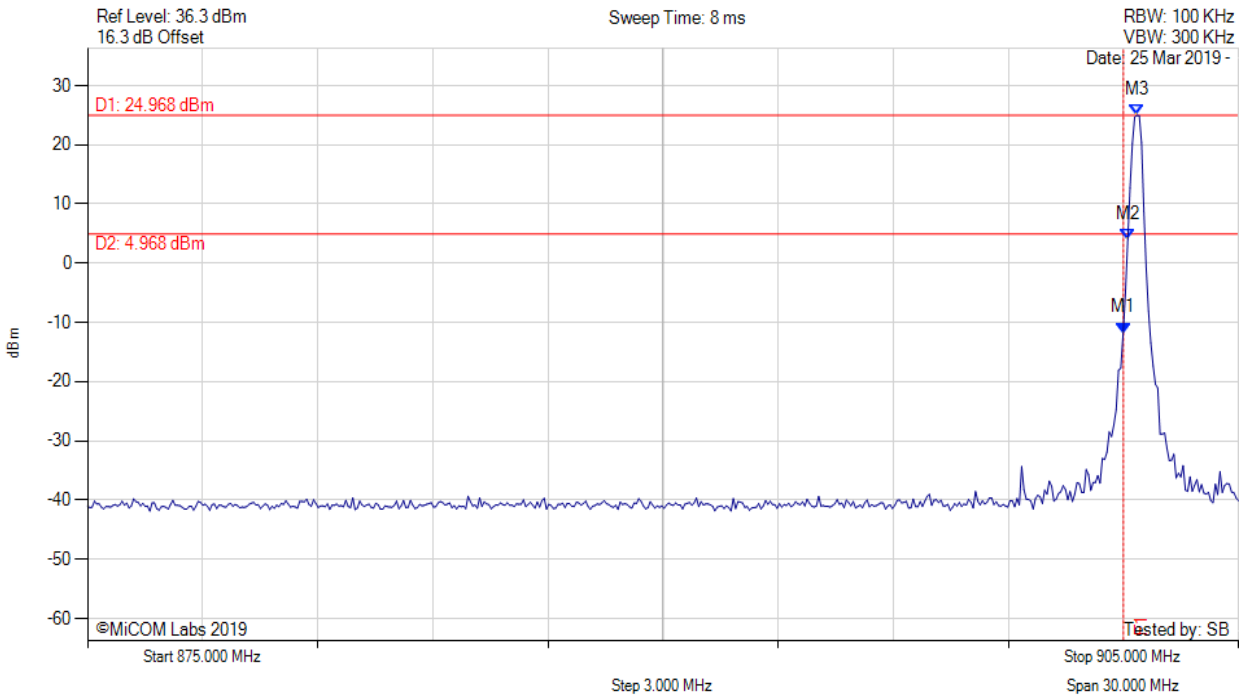

| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 909.118 MHz : 25.497 dBm<br>M2 : 6883.126 MHz : -33.132 dBm | Limit: 5.50 dBm<br>Margin: -38.63 dB |

back to matrix

## A.3.1.2. Conducted Band-Edge Emissions

CONDUCTED LOW BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: FSK, Channel: 902.30 MHz, Chain a, Temp: 20, Voltage: Vdc

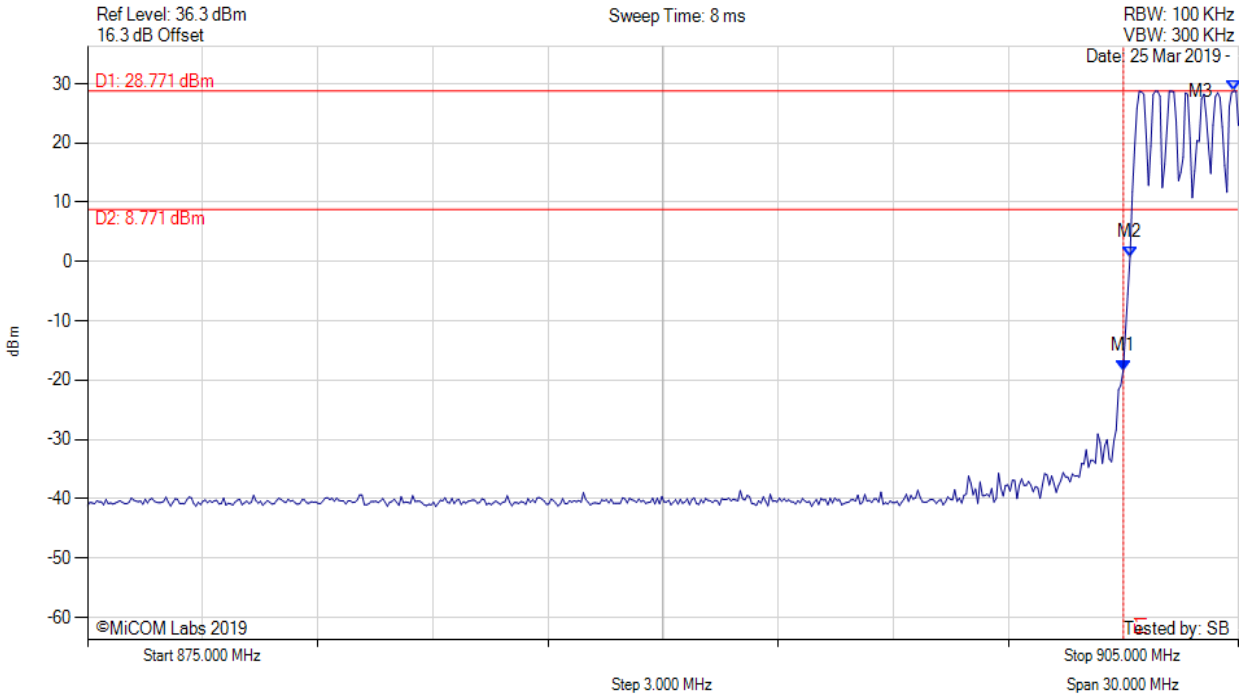



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1 : 902.000 MHz : -11.753 dBm<br>M2 : 902.114 MHz : 4.045 dBm<br>M3 : 902.355 MHz : 24.968 dBm | Channel Frequency: 902.30 MHz |

back to matrix

CONDUCTED LOW BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: FSK, Channel: 902.40 MHz, Chain a, Temp: 20, Voltage: Vdc

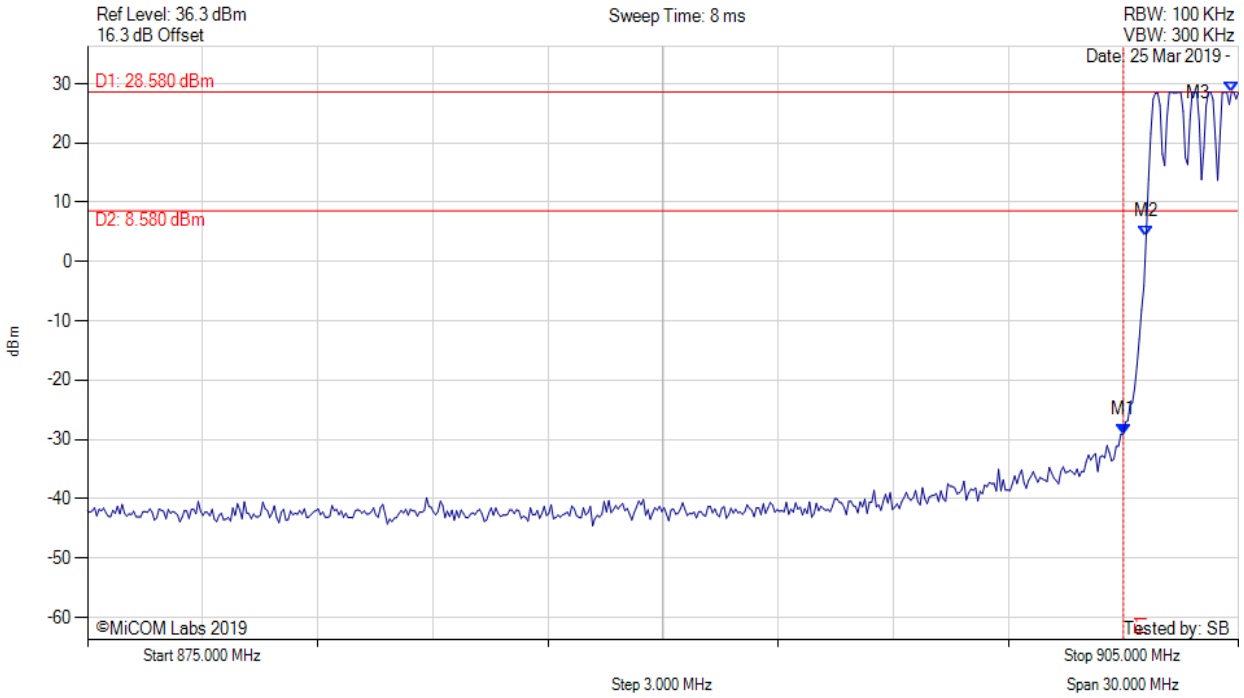



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1 : 902.000 MHz : -18.379 dBm<br>M2 : 902.174 MHz : 0.795 dBm<br>M3 : 904.880 MHz : 28.771 dBm | Channel Frequency: 902.40 MHz |

back to matrix

CONDUCTED LOW BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: OQPSK, Channel: 902.40 MHz, Chain a, Temp: 20, Voltage:  Vdc

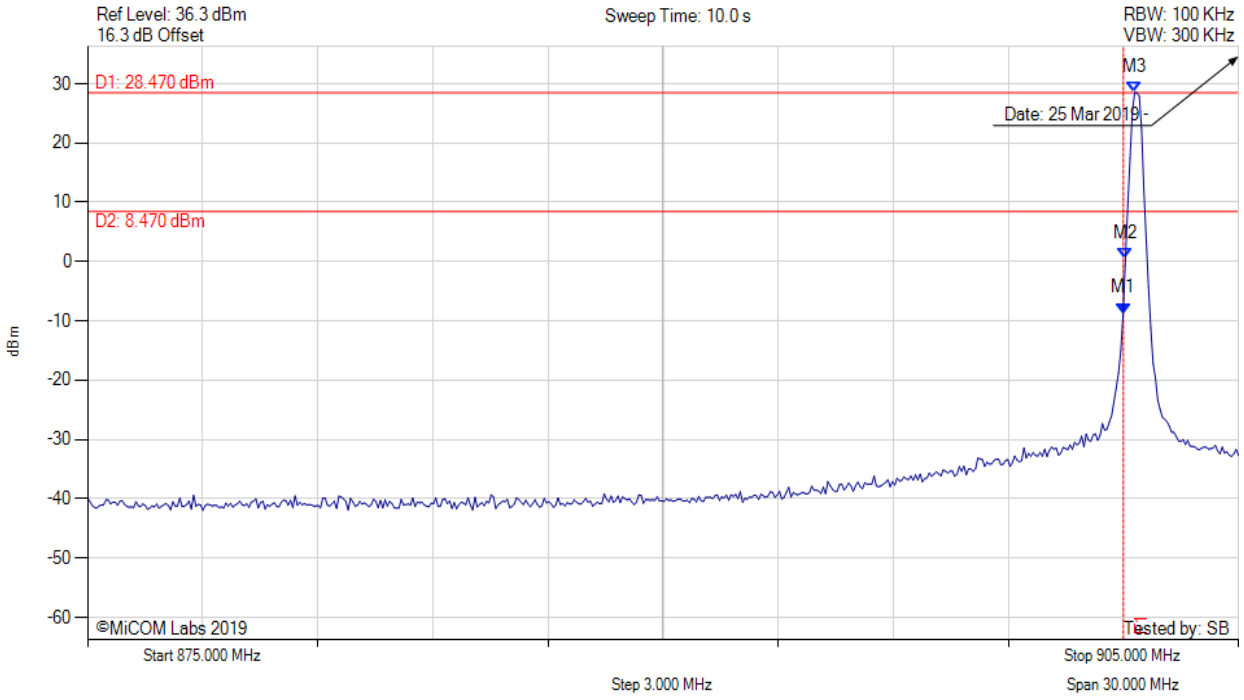



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1 : 902.000 MHz : -29.166 dBm<br>M2 : 902.595 MHz : 4.244 dBm<br>M3 : 904.820 MHz : 28.580 dBm | Channel Frequency: 902.40 MHz |

back to matrix

CONDUCTED LOW BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: FSK, Channel: 902.30 MHz, Chain a, Temp: 20, Voltage: Vdc

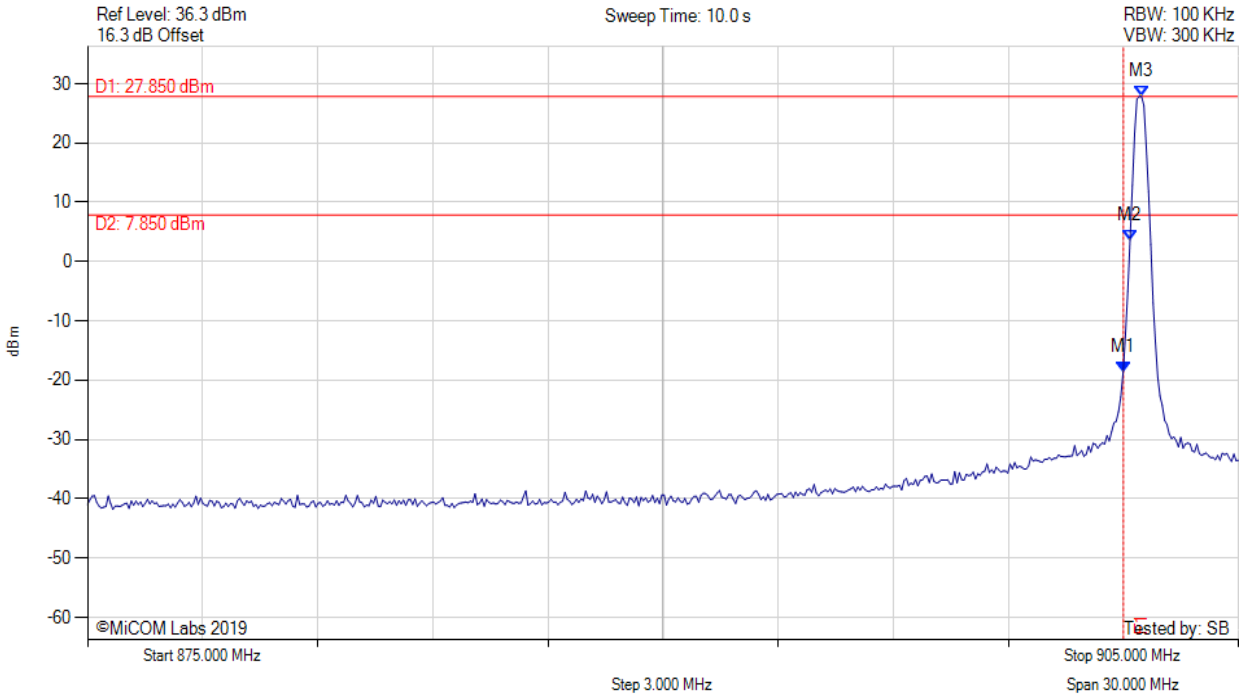



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 902.000 MHz : -8.723 dBm<br>M2 : 902.054 MHz : 0.514 dBm<br>M3 : 902.295 MHz : 28.470 dBm | Channel Frequency: 902.30 MHz |

back to matrix

CONDUCTED LOW BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: FSK, Channel: 902.40 MHz, Chain a, Temp: 20, Voltage:  Vdc

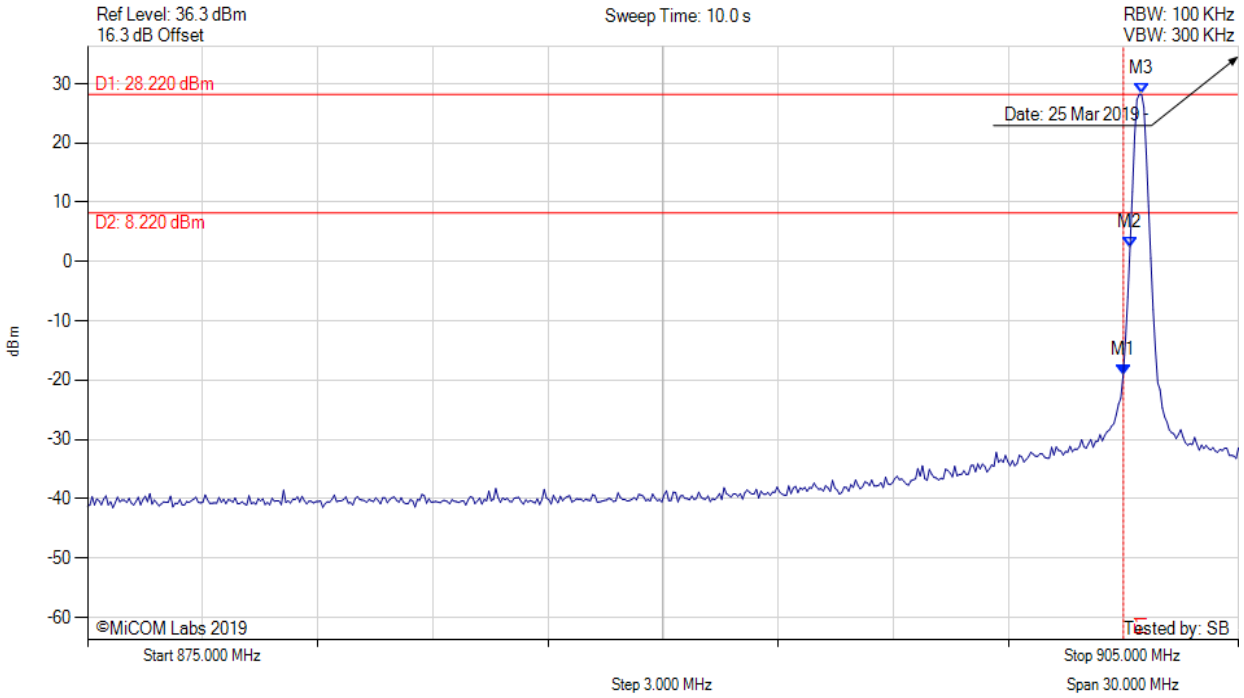



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 902.000 MHz : -18.591 dBm<br>M2 : 902.174 MHz : 3.648 dBm<br>M3 : 902.475 MHz : 27.850 dBm | Channel Frequency: 902.40 MHz |

back to matrix

CONDUCTED LOW BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: OQPSK, Channel: 902.40 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 : 902.000 MHz : -19.111 dBm<br>M2 : 902.174 MHz : 2.444 dBm<br>M3 : 902.475 MHz : 28.222 dBm | Channel Frequency: 902.40 MHz |

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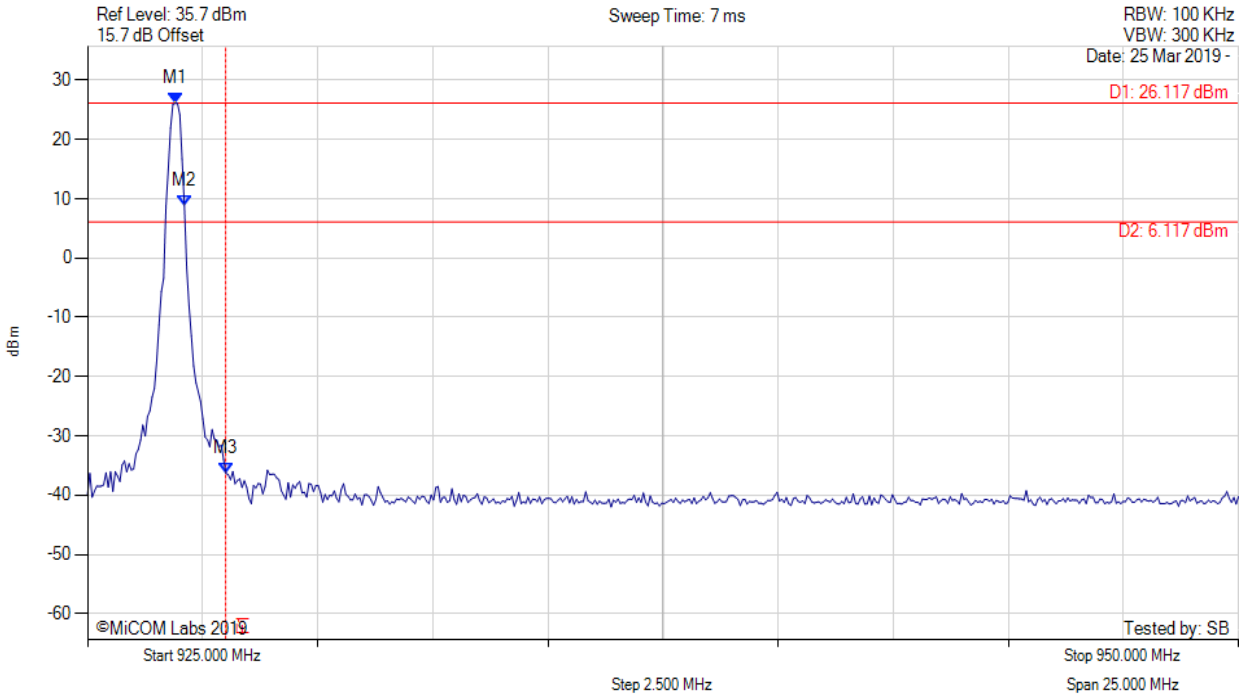
CONDUCTED UPPER BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: FSK, Channel: 926.90 MHz, Chain a, Temp: 20, Voltage:  Vdc

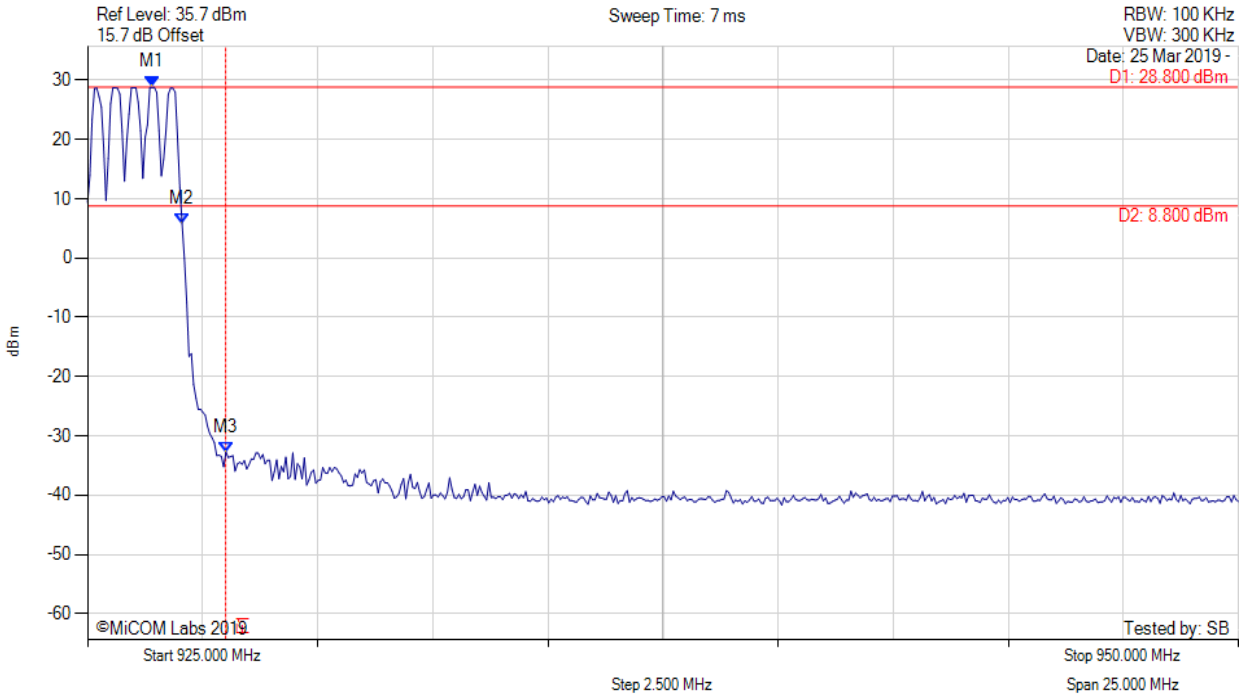



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1 : 926.904 MHz : 26.117 dBm<br>M2 : 927.104 MHz : 8.783 dBm<br>M3 : 928.000 MHz : -36.297 dBm | Channel Frequency: 926.90 MHz |

back to matrix

CONDUCTED UPPER BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: FSK, Channel: 926.80 MHz, Chain a, Temp: 20, Voltage: Vdc

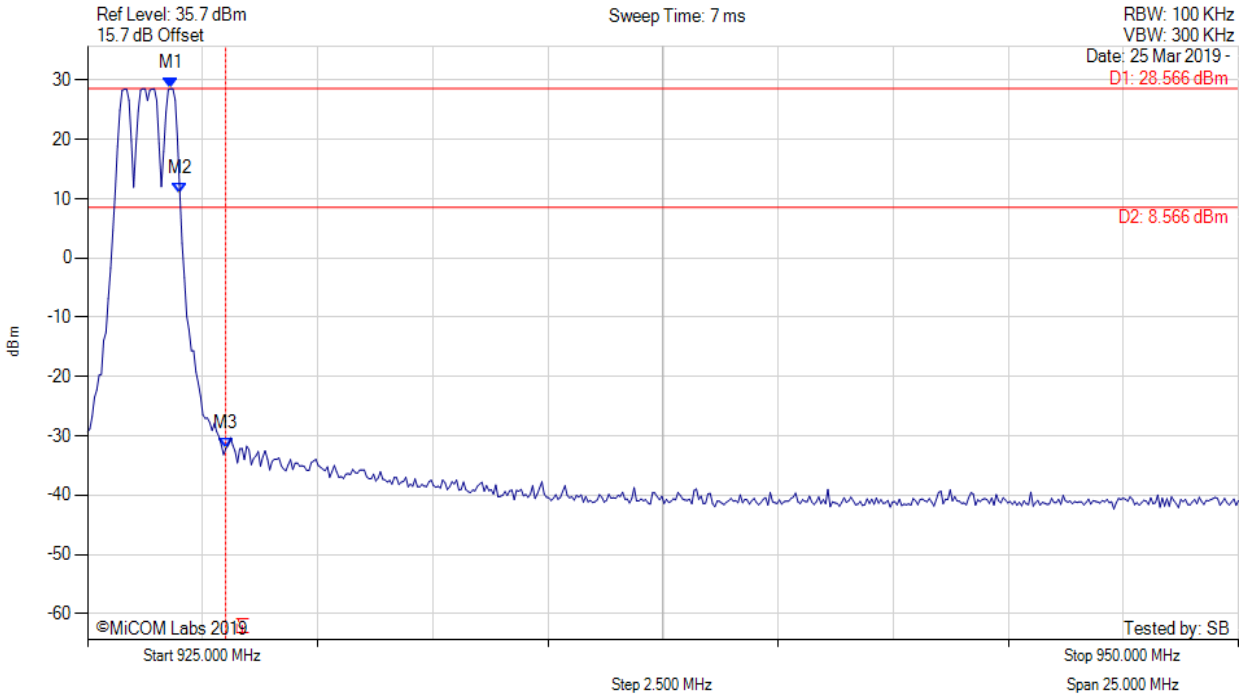



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 926.403 MHz : 28.800 dBm<br>M2 : 927.054 MHz : 5.753 dBm<br>M3 : 928.000 MHz : -32.723 dBm | Channel Frequency: 926.80 MHz |

back to matrix

CONDUCTED UPPER BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: OQPSK, Channel: 926.80 MHz, Chain a, Temp: 20, Voltage:  Vdc

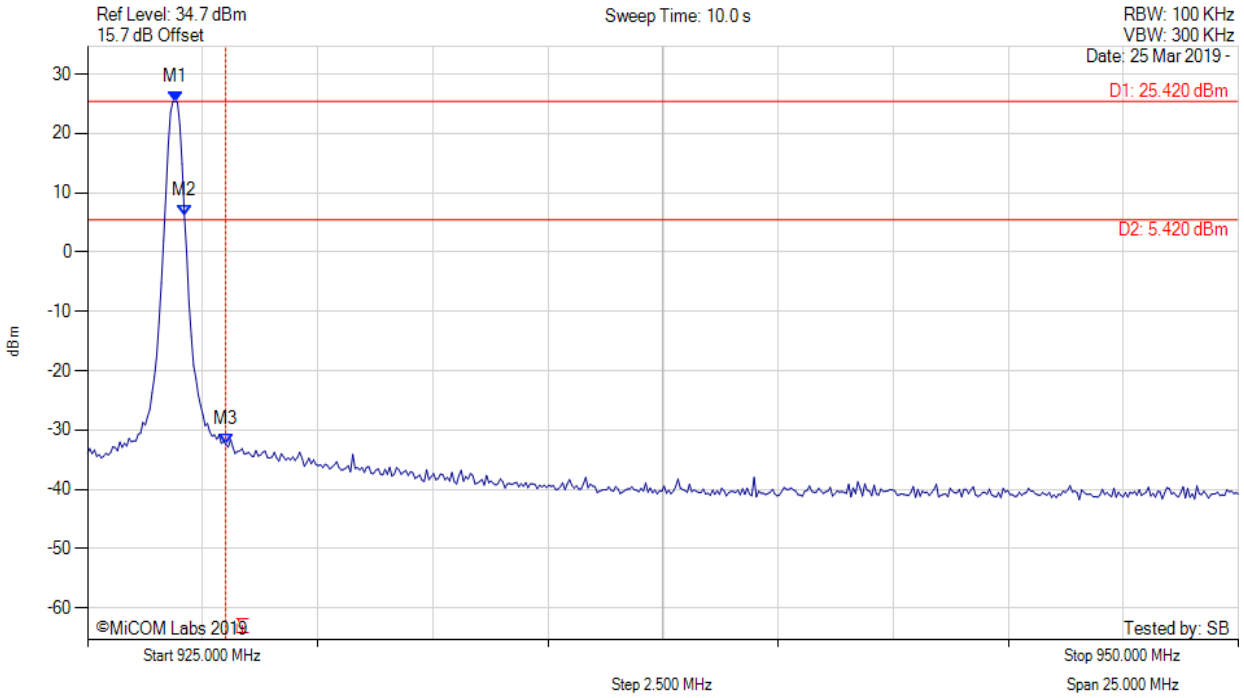



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = VIEW | M1 : 926.804 MHz : 28.566 dBm<br>M2 : 927.004 MHz : 10.872 dBm<br>M3 : 928.000 MHz : -32.040 dBm | Channel Frequency: 926.80 MHz |

back to matrix

CONDUCTED UPPER BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: FSK, Channel: 926.90 MHz, Chain a, Temp: 20, Voltage:  Vdc

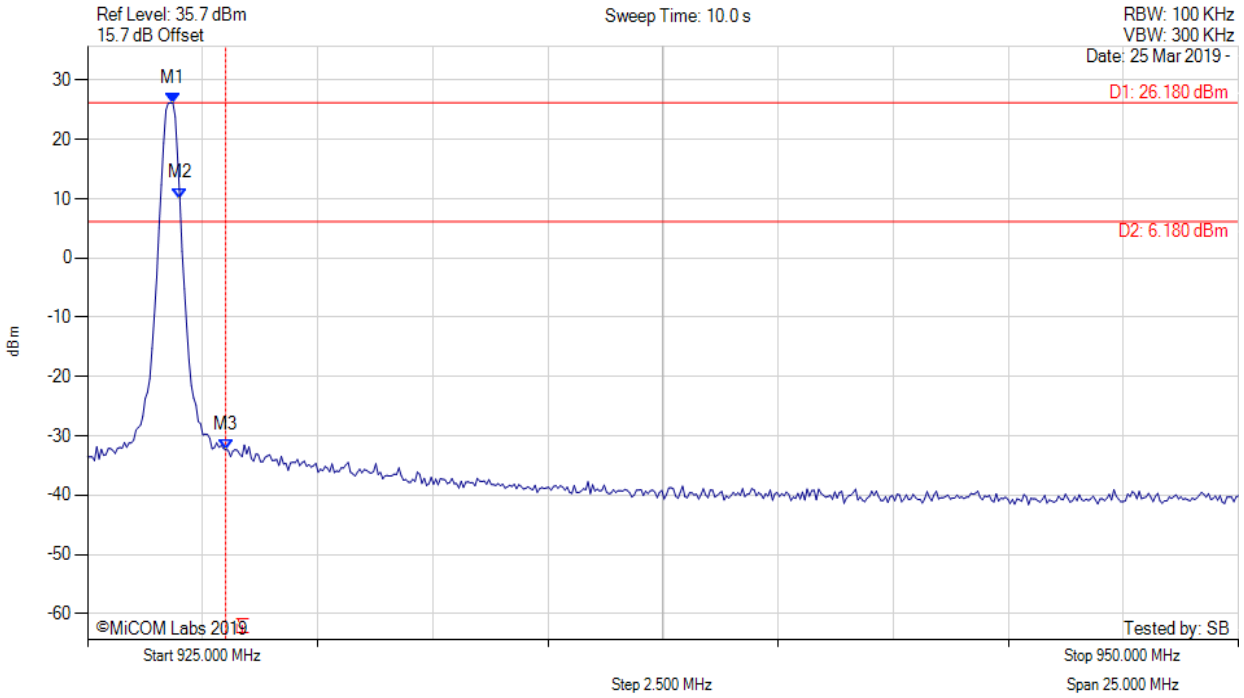



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 926.904 MHz : 25.416 dBm<br>M2 : 927.104 MHz : 6.211 dBm<br>M3 : 928.000 MHz : -32.420 dBm | Channel Frequency: 926.90 MHz |

back to matrix

CONDUCTED UPPER BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: FSK, Channel: 926.80 MHz, Chain a, Temp: 20, Voltage:  Vdc

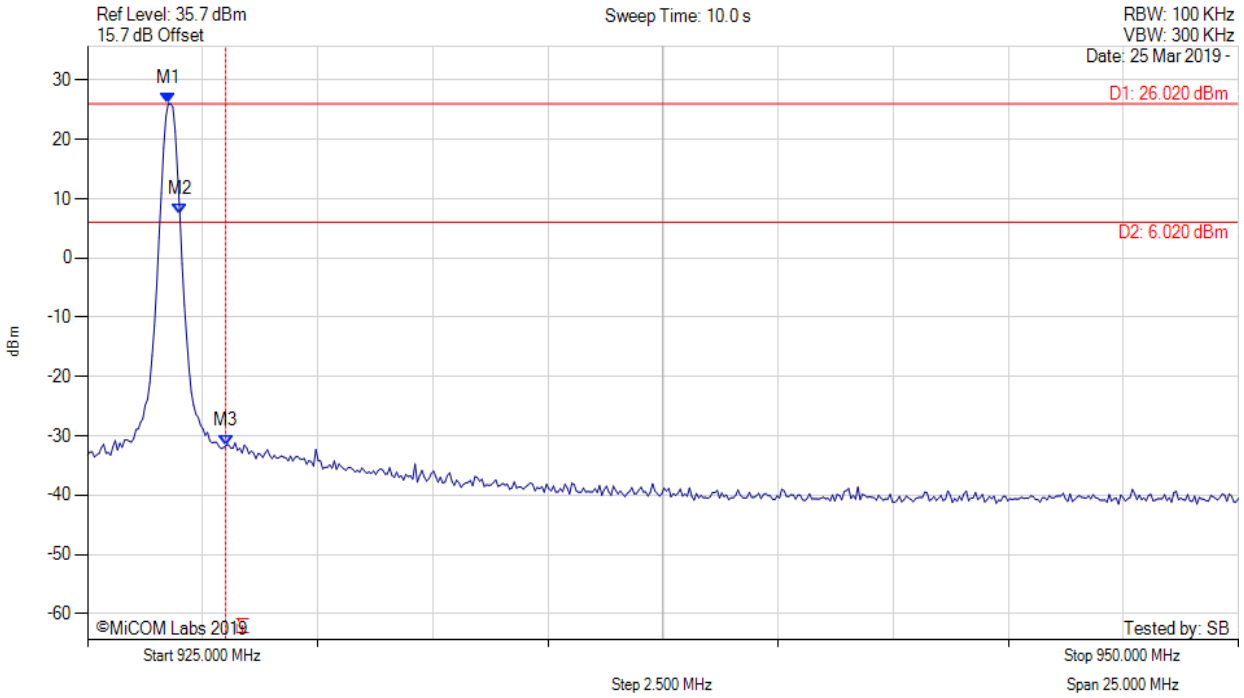



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 926.854 MHz : 26.176 dBm<br>M2 : 927.004 MHz : 10.075 dBm<br>M3 : 928.000 MHz : -32.329 dBm | Channel Frequency: 926.80 MHz |

back to matrix

CONDUCTED UPPER BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: OQPSK, Channel: 926.80 MHz, Chain a, Temp: 20, Voltage:  Vdc

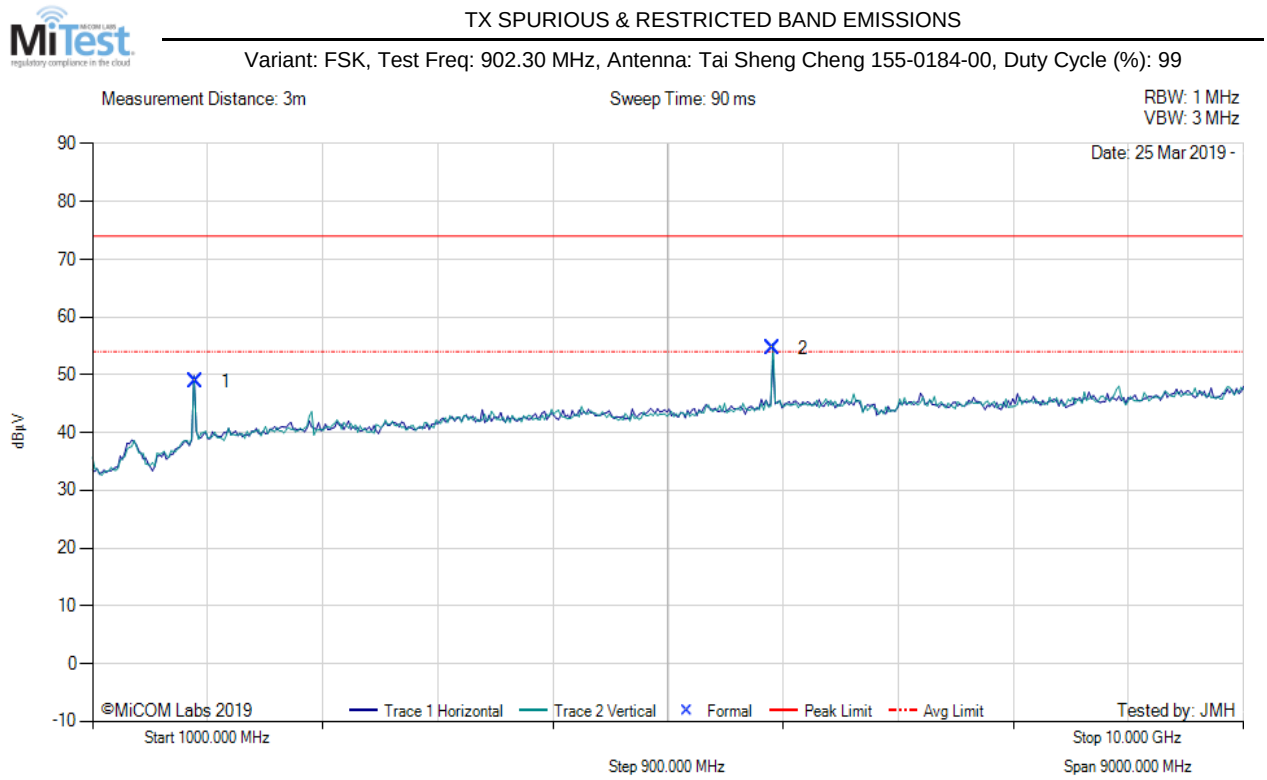



| Analyzer Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK<br>Sweep Count = 0<br>RF Atten (dB) = 30<br>Trace Mode = MAX HOLD | M1 : 926.754 MHz : 26.019 dBm<br>M2 : 927.004 MHz : 7.439 dBm<br>M3 : 928.000 MHz : -31.637 dBm | Channel Frequency: 926.80 MHz |

back to matrix

## A.3.2. Radiated Emissions

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



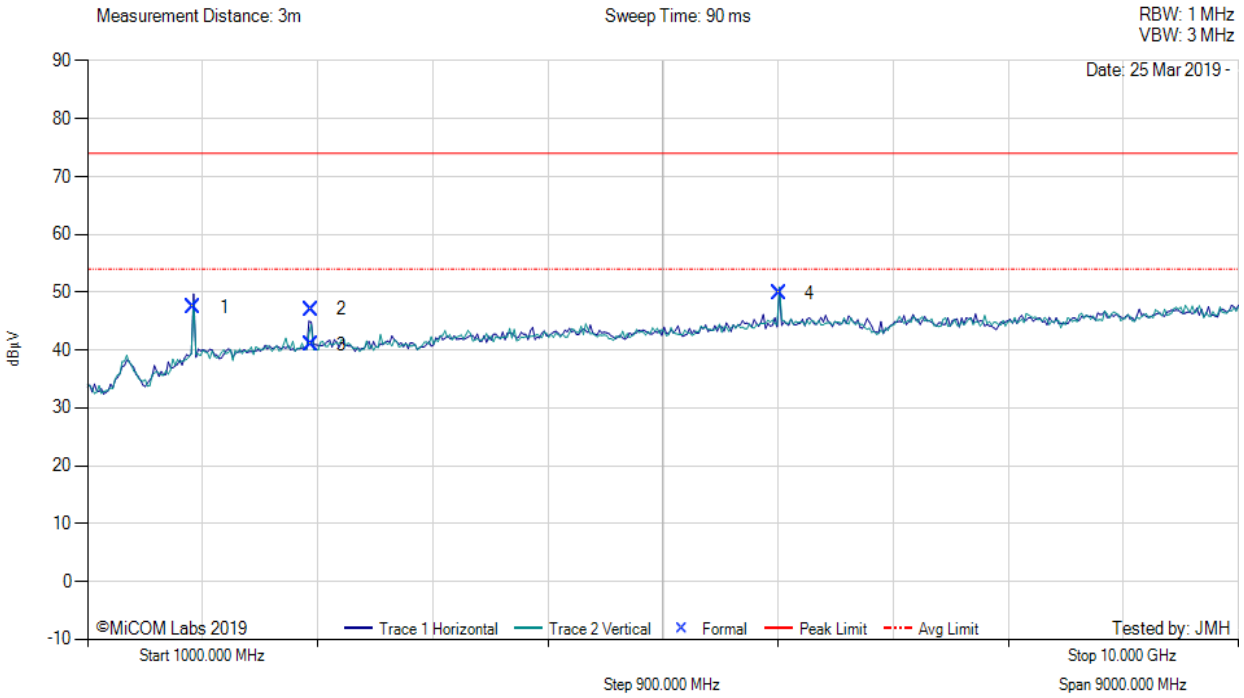

| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 1804.71 | 64.79 | -1.55 | -14.44 | 48.80 | Peak (NRB) | Horizontal | 200 | 77 | -- | -- | Pass |
| 2 | 6316.09 | 66.56 | -2.91 | -9.12 | 54.53 | Peak (NRB) | Vertical | 200 | 212 | -- | -- | Pass |

**Test Notes:** EUT powered by DC 24 V

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: FSK, Test Freq: 915.20 MHz, Antenna: Tai Sheng Cheng 155-0184-00, Duty Cycle (%): 99



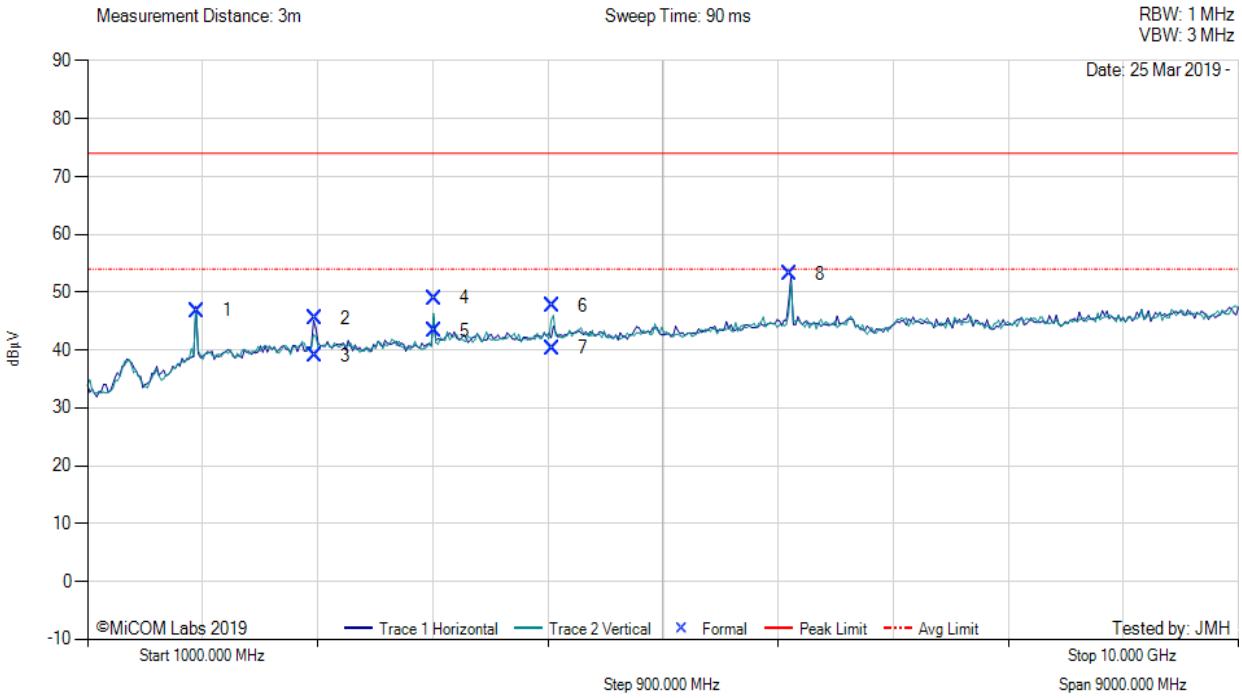

| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 1830.41 | 62.98 | -1.52 | -14.03 | 47.43 | Peak (NRB) | Horizontal | 200 | 81 | -- | -- | Pass |
| 2 | 2745.73 | 60.93 | -1.91 | -11.96 | 47.06 | Max Peak | Horizontal | 98 | 224 | 74.0 | -26.9 | Pass |
| 3 | 2745.73 | 54.87 | -1.91 | -11.96 | 41.00 | Max Avg | Horizontal | 98 | 224 | 54.0 | -13.0 | Pass |
| 4 | 6406.56 | 62.02 | -2.96 | -9.21 | 49.85 | Peak (NRB) | Vertical | 200 | 81 | -- | -- | Pass |

**Test Notes:** EUT powered by DC 24 V

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: FSK, Test Freq: 926.90 MHz, Antenna: Tai Sheng Cheng 155-0184-00, Duty Cycle (%): 99




| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 1854.36 | 62.21 | -1.56 | -13.81 | 46.84 | Peak (NRB) | Horizontal | 200 | 19 | -- | -- | Pass |
| 2 | 2781.81 | 59.36 | -1.89 | -11.91 | 45.56 | Max Peak | Horizontal | 177 | 162 | 74.0 | -28.4 | Pass |
| 3 | 2781.81 | 52.77 | -1.89 | -11.91 | 38.97 | Max Avg | Horizontal | 177 | 162 | 54.0 | -15.0 | Pass |
| 4 | 3708.96 | 62.82 | -2.20 | -11.63 | 48.99 | Max Peak | Vertical | 134 | 98 | 74.0 | -25.0 | Pass |
| 5 | 3708.96 | 57.17 | -2.20 | -11.63 | 43.34 | Max Avg | Vertical | 134 | 98 | 54.0 | -10.7 | Pass |
| 6 | 4635.98 | 62.32 | -2.49 | -12.24 | 47.59 | Max Peak | Vertical | 179 | 155 | 74.0 | -26.4 | Pass |
| 7 | 4635.98 | 55.10 | -2.49 | -12.24 | 40.37 | Max Avg | Vertical | 179 | 155 | 54.0 | -13.6 | Pass |
| 8 | 6490.26 | 65.12 | -2.95 | -8.94 | 53.23 | Peak (NRB) | Horizontal | 200 | 282 | -- | -- | Pass |

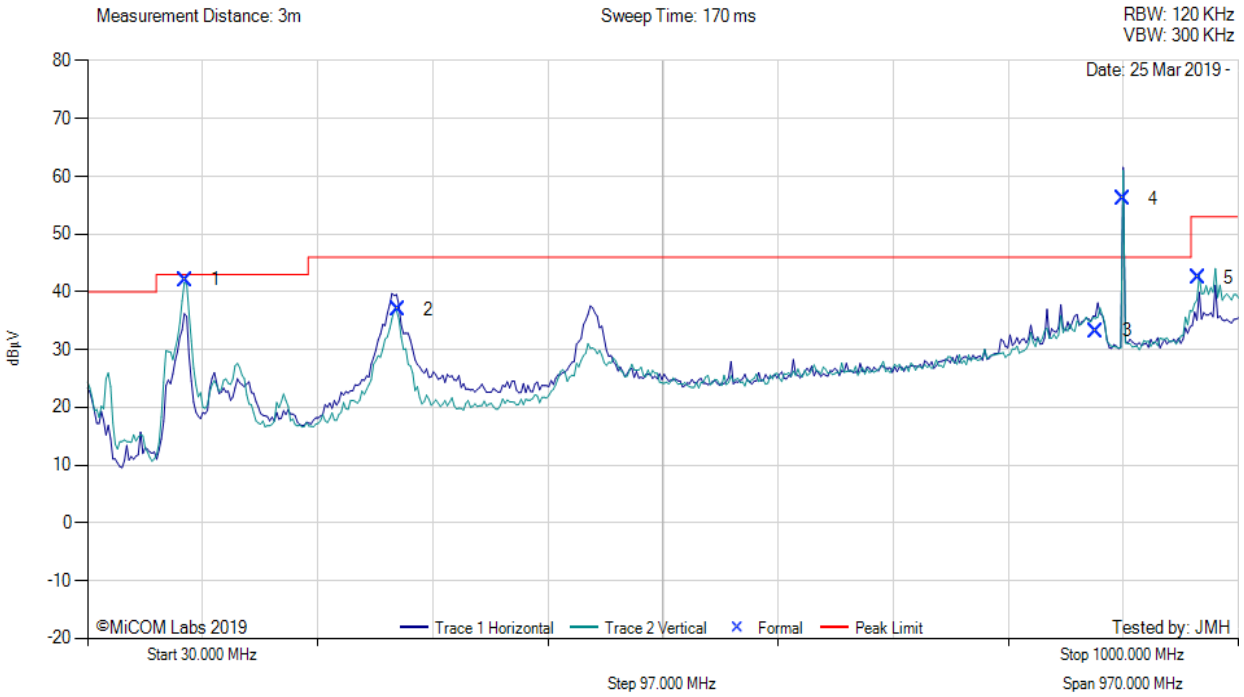
**Test Notes:** EUT powered by DC 24 V

back to matrix

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

RADIATED DIGITAL EMISSIONS

Variant: FSK, Test Freq: 902.30 MHz, Antenna: Tai Sheng Cheng 155-0184-00, Duty Cycle (%): 99



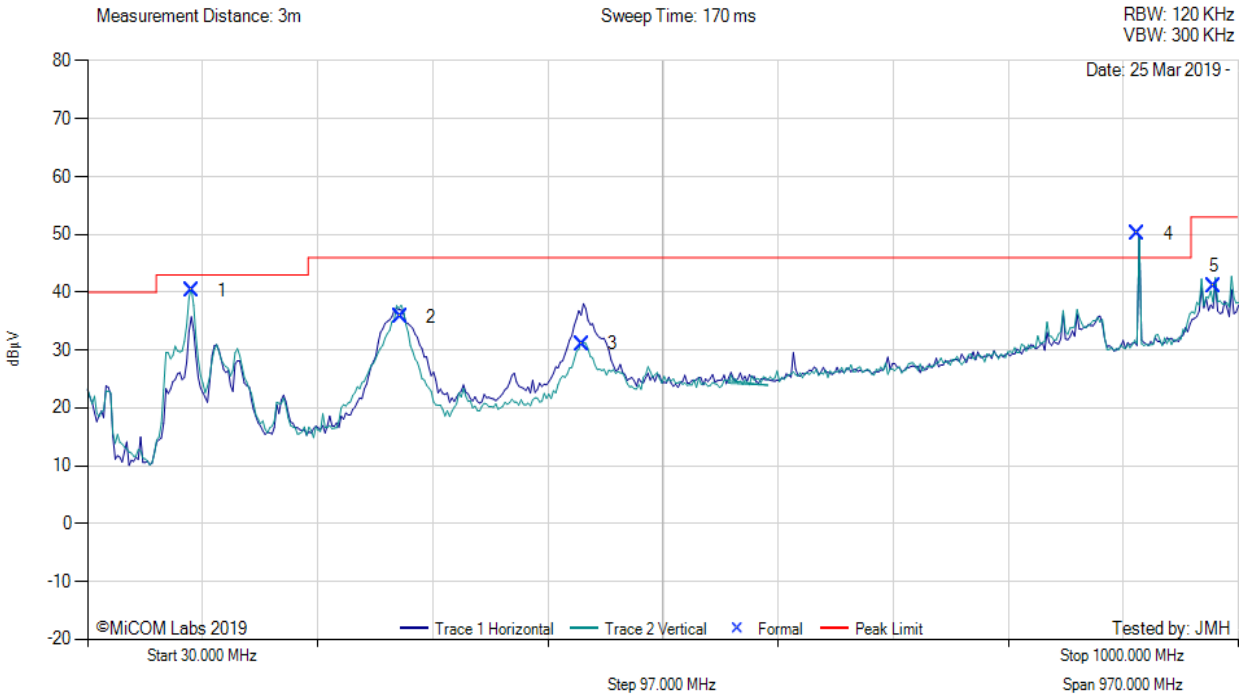

| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 112.75 | 53.43 | 4.06 | -15.40 | 42.09 | MaxQP | Vertical | 99 | 138 | 43.0 | -0.9 | Pass |
| 2 | 291.54 | 46.84 | 4.80 | -14.70 | 36.94 | MaxQP | Horizontal | 98 | 212 | 46.0 | -9.1 | Pass |
| 3 | 880.25 | 31.79 | 6.59 | -5.20 | 33.18 | MaxQP | Horizontal | 98 | 209 | 46.0 | -12.8 | Pass |
| 4 | 902.29 | 54.55 | 6.65 | -5.10 | 56.10 | Fundamental | Horizontal | 100 | 0 | -- | -- | |
| 5 | 966.30 | 39.65 | 6.84 | -4.00 | 42.49 | MaxQP | Vertical | 107 | 343 | 53.0 | -10.5 | Pass |

**Test Notes:** EUT powered by DC 24 V. 900 MHz notch in front of amp to prevent overload

back to matrix

RADIATED DIGITAL EMISSIONS

Variant: FSK, Test Freq: 915.20 MHz, Antenna: Tai Sheng Cheng 155-0184-00, Duty Cycle (%): 99



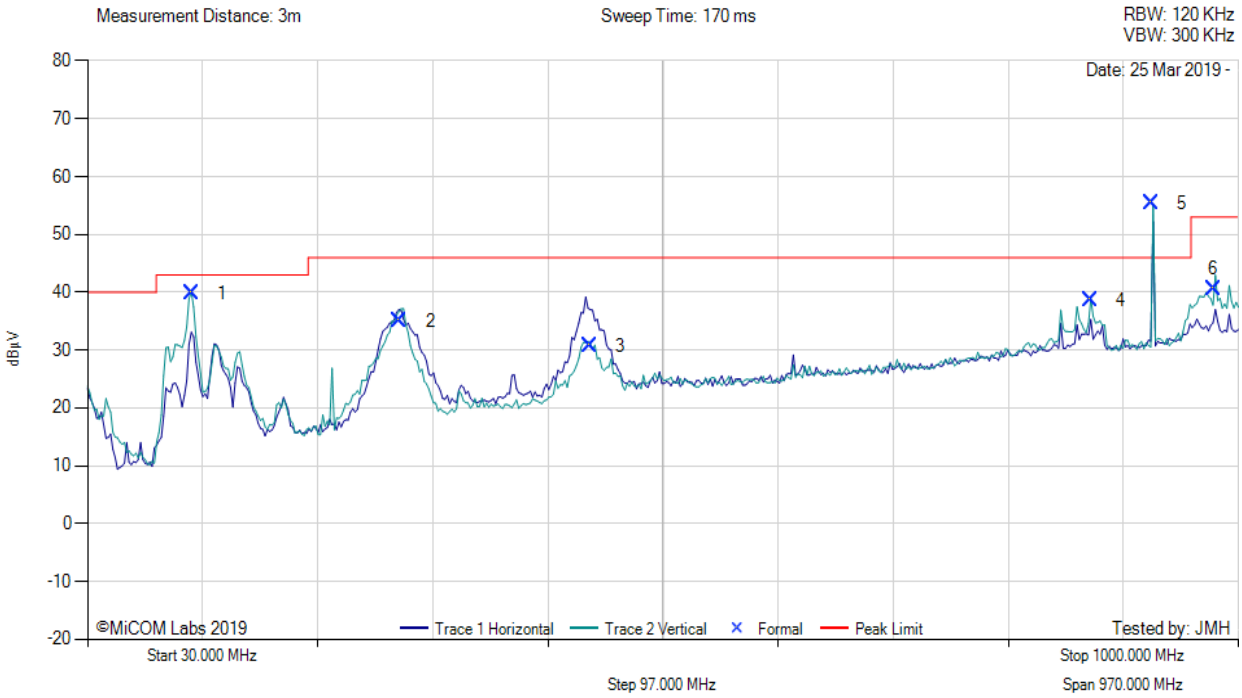

| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 118.18 | 51.04 | 4.09 | -14.80 | 40.33 | MaxQP | Vertical | 98 | 144 | 43.0 | -2.7 | Pass |
| 2 | 293.50 | 45.57 | 4.81 | -14.60 | 35.78 | MaxQP | Vertical | 132 | 173 | 46.0 | -10.2 | Pass |
| 3 | 446.59 | 36.90 | 5.34 | -11.20 | 31.04 | MaxQP | Horizontal | 101 | 176 | 46.0 | -15.0 | Pass |
| 4 | 915.18 | 48.13 | 6.67 | -4.70 | 50.10 | Fundamental | Vertical | 100 | 0 | -- | -- | |
| 5 | 979.17 | 38.00 | 6.88 | -3.80 | 41.08 | MaxQP | Vertical | 105 | 281 | 53.0 | -11.9 | Pass |

**Test Notes:** EUT powered by DC 24 V. 900 MHz notch in front of amp to prevent overload

back to matrix

RADIATED DIGITAL EMISSIONS

Variant: FSK, Test Freq: 926.90 MHz, Antenna: Tai Sheng Cheng 155-0184-00, Duty Cycle (%): 99




| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 118.20 | 50.59 | 4.09 | -14.80 | 39.88 | MaxQP | Vertical | 99 | 148 | 43.0 | -3.1 | Pass |
| 2 | 293.17 | 44.82 | 4.81 | -14.60 | 35.03 | MaxQP | Vertical | 98 | 151 | 46.0 | -11.0 | Pass |
| 3 | 453.19 | 36.31 | 5.36 | -11.00 | 30.67 | MaxQP | Horizontal | 194 | 171 | 46.0 | -15.3 | Pass |
| 4 | 874.91 | 37.30 | 6.58 | -5.20 | 38.68 | MaxQP | Vertical | 124 | 13 | 46.0 | -7.3 | Pass |
| 5 | 926.93 | 53.30 | 6.72 | -4.60 | 55.42 | Fundamental | Vertical | 100 | 0 | -- | -- | |
| 6 | 978.86 | 37.63 | 6.87 | -3.90 | 40.60 | MaxQP | Vertical | 103 | 310 | 53.0 | -12.4 | Pass |

**Test Notes:** EUT powered by DC 24 V. 900 MHz notch in front of amp to prevent overload

back to matrix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