# REGULATORY COMPLIANCE TEST REPORT

## FCC CFR47 Part 27: MISCELLANEOUS WIRELESS COMMUNICATION SERVICES

**Report No.: PULO01-U2 Rev A**

**Company:** Puloli Inc.

**Model Name:** RU700A 1.0

# REGULATORY COMPLIANCE TEST REPORT

**Company:** Puloli Inc.

**Model Name:** RU700A 1.0

**To:** FCC CFR47 Part 27 Miscellaneous Wireless Communication Services

Test Report Serial No.: PULO01-U2 Rev A

This report supersedes: NONE

Applicant: Puloli Inc
649 Mission Street Ste 416
San Francisco, California 94105
USA

Issue Date: 23rd May 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
Fax: +1 (925) 462-0306
www.micomlabs.com

ACCREDITED
TESTING CERT #2381.01

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

# Table of Contents

# 1. ACCREDITATION, LISTINGS & RECOGNITION

## 1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2005. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

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 | 15th May 2019 | Initial Draft |
| Draft #2 | 22nd May 2019 | |
| Rev A | 23rd May 2019 | Initial Release |
| . | | |
| . | | |
| . | | |
| . | | |
| . | | |

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

# 3. TEST RESULT CERTIFICATE

| | | | |
|---|---|---|---|
| **Manufacturer:** | Puloli, Inc.<br>649 Mission Street Ste 416<br>San Francisco, CA 94105<br>USA | **Tested By:** | MiCOM Labs, Inc.<br>575 Boulder Court<br>Pleasanton California 94566<br>USA |
| **Model:** | RU700A 1.0 | **Telephone:** | +1 925 462 0304 |
| **Type Of Equipment:** | 3GPP NB-IoT | **Fax:** | +1 925 462 0306 |
| **S/N's:** | 1749002312 | | |
| **Test Date(s):** | 10th – 16th May 2019 | **Website:** | www.micomlabs.com |

| STANDARD(S) | TEST RESULTS |
|---|---|
| FCC 47 CFR Part 27 | EQUIPMENT COMPLIES |

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

**Notes:**

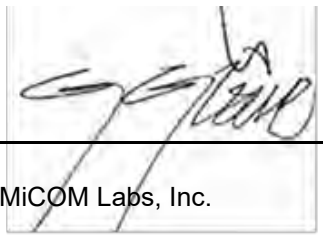
1. This document reports conditions under which testing was conducted and the results of testing performed.

2. Details of test methods used have been recorded and kept on file by the laboratory.

3. Test results apply only to the item(s) tested.

A2LA ACCREDITED
TESTING CERT #2381.01

**Approved & Released for MiCOM Labs, Inc. by**:



Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

# 4. REFERENCES AND MEASUREMENT UNCERTAINTY

## 4.1. Normative References

| REF. | PUBLICATION | YEAR | TITLE |
|---|---|---|---|
| I | FCC 47 CFR Part 27 | 2019 | Miscellaneous Wireless Communications Services |
| 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 | ETSI TR 100 028 | 2001 | Parts 1 and 2<br>Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics |
| VI | M 3003 | Edition 3 Nov.2012 | Expression of Uncertainty and Confidence in Measurements |
| VII | FCC 47 CFR Part 2.1033 | 2016 | FCC requirements and rules regarding photographs and test setup diagrams. |
| VIII | KDB 971168 D01 V02r01 | 27th October, 2017 | Measurement Guidance for Certification of Licensed Digital Transmitters |
| VIV | KDB 971168 D01 V03r01 | 9th April 2018 | Measurement Guidance for Certification of Licensed Digital Transmitters |

## 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 Puloli Inc. RU700A 1.0 to FCC CFR 47 Part 27. Miscellaneous Wireless Communications Services |
| Applicant: | Puloli, Inc.<br>649 Mission Street Ste 416<br>San Francisco, CA 94105 USA |
| Manufacturer: | Puloli Inc. |
| Laboratory performing the tests: | MiCOM Labs, Inc.<br>575 Boulder Court<br>Pleasanton California 94566 USA |
| Test report reference number: | PULO02-U2 |
| Date EUT received: | 10th May 2019 |
| Standard(s) applied: | FCC CFR 47 Part 27 |
| Dates of test (from - to): | 10th – 16th May 2019 |
| No of Units Tested: | 1 |
| Product Family Name: | RU700A |
| Model(s): | RU700A 1.0 |
| Location for use: | Indoors |
| Declared Frequency Range(s): | 787-788 MHz; |
| Type of Modulation: | BPSK, QPSK |
| EUT Modes of Operation: | NB IoT |
| Declared Nominal Output Power (dBm): | +23 dBm |
| Transmit/Receive Operation: | Transceiver Half Duplex |
| Rated Input Voltage and Current: | 5Vdc 2A |
| Operating Temperature Range: | 0ºC - 40ºC |
| ITU Emission Designator: | 200KG2D |
| Equipment Dimensions: | 65mm x 77 mm x 28.5 mm |
| Weight: | 100g |
| Hardware Rev: | 1.0 |
| Software Rev: | 1.18.1.r1 |

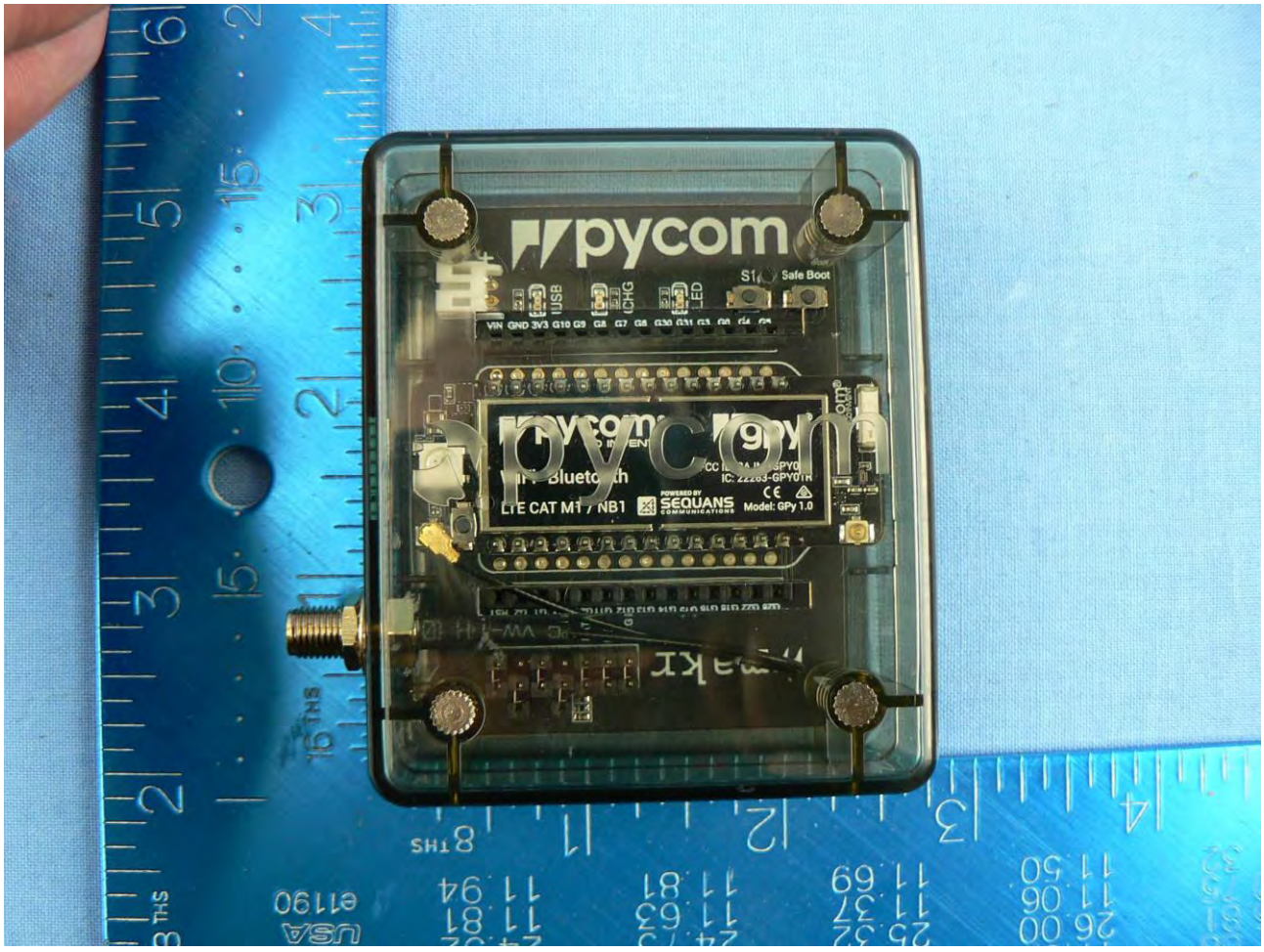
## 5.2. Scope Of Test Program

**Puloli Inc.RU700A 1.0**

The scope of the test program was to test the Puloli Inc RU700A 1.0 configurations in the frequency ranges 787-788 MHz; for compliance against the following specification:

**FCC CFR 47 Part 27**
Miscellaneous Wireless Communications Services

**Puloli Inc. RU700A 1.0**



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

| Type (EUT/ Support) | Equipment Description | Mfr | Model No. | Serial No. |
|---|---|---|---|---|
| EUT | IoT end point | Puloli Inc. | RU700A 1.0 | 1749002312 |
| EUT | Power Supply | ICV | AC Adapter | -- |
| Support | Base Station | Nutaq | PicoSDR2x2E | -- |
| Support | HDMI Monitor | ASUS | VS228 | -- |
| Support | Keyboard | Dell | | -- |

## 5.4. External A.C/D.C. Power Adaptor

| AC/DC Adaptor |
|---|
| Manufacturer: ICV<br>Model: ICV-U0510E-1<br>I: 100 – 240 $V_{AC}$, 0.3 A 50/60 Hz<br>0: +5 $V_{DC}$ 2.0 A |

## 5.5. Antenna Details

| Type | Manufacturer | Model | Family | Gain (dBi) | BF Gain | Dir BW | X-Pol | Frequency Band (MHz) |
|---|---|---|---|---|---|---|---|---|
| External | Linx Technologies | ANT-LTE-WS | Dipole | -1.78 (avg) | N/A | N/A | N/A | 698-960 |
| External | Proxicast | ANT-128-001 | Yagi | 11dBi (pk)-6dB pad = 5dBi | N/A | 60º Vert 90º Hor | N/A | 700-2700 |

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

## 5.6. Cabling and I/O Ports

| Port Type | Max Cable Length | # of Ports | Screened | Conn Type | Data Type | Bit Rate | Environment |
|---|---|---|---|---|---|---|---|
| dc | 1m | 1 | Yes | USB Micro | dc Power | N/A | Power |
| RF | Up to 25m (Yagi only) | 1 | Yes | SMA | N/A | N/A | End-User |
| GPIO | < 3m | 2 | No | GPIO | | | End-User |

## 5.7. Test Configurations

Results for the following configurations are provided in this report:

| Operational Mode(s) (NB IoT) | Bandwidth (kHz) | Channel Frequency (MHz) | | |
|---|---|---|---|---|
| | | Low | Mid | High |
| **787 - 788 MHz** | | | | |
| BPSK | 3.75 | 787.2 | 787.5 | 787.8 |
| BPSK | 15 | 787.2 | 787.5 | 787.8 |
| QPSK | 3.75 | 787.2 | 787.5 | 787.8 |
| QPSK | 15 | 787.2 | 787.5 | 787.8 |
| QPSK | 180 | 787.2 | 787.5 | 787.8 |

A comparison between QPSK and BPSK modulation types was performed for power and bandwidth, no difference was found and QPSK was selected as the conducted test mode. Radiated testing was performed on BPSK and QPSK operational modes.

## 5.8. Equipment Modifications

The following modifications were required to bring the equipment into compliance:
1. Issue with 2nd harmonic falling within the GPS frequency band

As a result, the following modifications were required to bring the equipment into compliance:
Output power was tested on the RU700A device and it was found that a power reduction was required due to a non-compliant 2nd harmonic falling within the GPS band (1559 – 1610 MHz). This influenced both the following antennas:

1).. Dipole -1.78 dBi
2).. Yagi 11.0 dBi

In order to bring the RU700A into compliance the following fix was implemented:
i).. Dipole antenna output power was reduced 6 dB from +23 dBm to +17dBm

ii).. Yagi antenna gain was also reduced 6 dB by adding a 6 dB attenuator to the antenna. Output power was reduced 3 dB from +23 dBm to +20 dBm.

The output power results reported in Section 9.4 ‘Conducted Output Power’ reflect the above situation

## 5.9. Deviations from the Test Standard

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

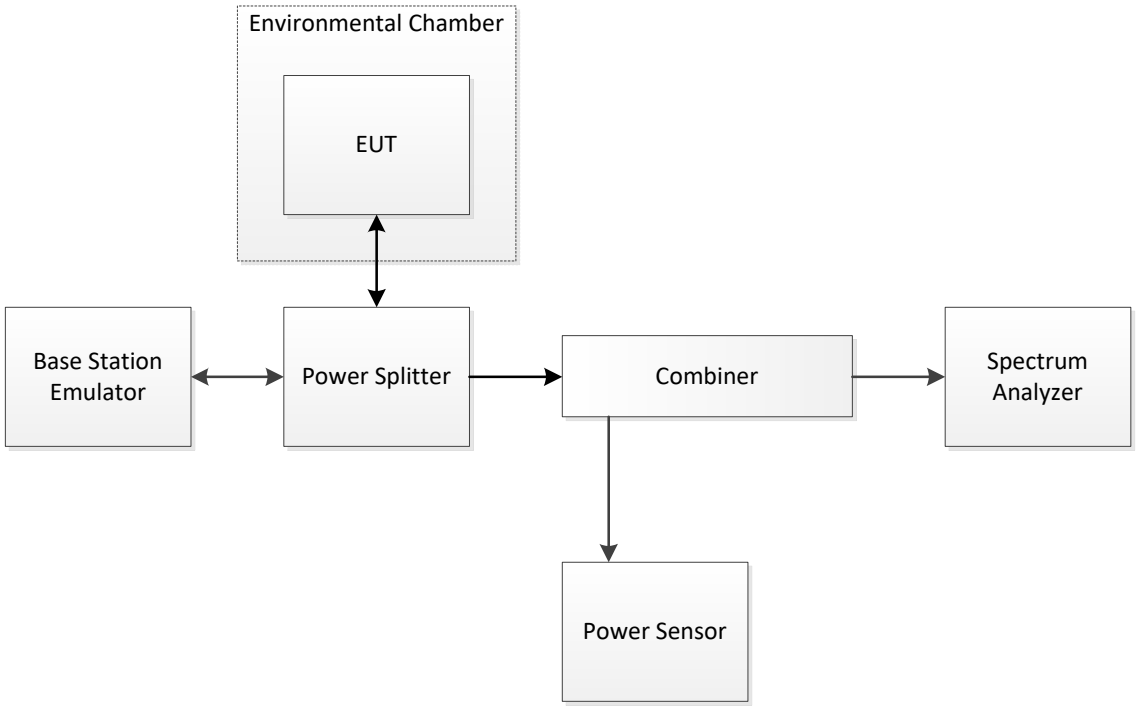
# 6. TEST SUMMARY

List of Measurements

| Section(s) | Test Items | Description | Result | Test Report Section |
|---|---|---|---|---|
| **2.1033(c)** | Type of Modulation | Modulation type | Complies | View Data |
| **2.1033(c)** | Channel Bandwidth | 26dB & 99% Emission Bandwidth | Complies | View Data |
| **2.1055, 27.54** | Transmitter Frequency Stability | Frequency contained within band of interest | Complies | View Data |
| **2.1046, 27.50 (10)** | Transmitter Output Power | Power Measurement | Complies | View Data |
| **Emissions** | | | | |
| **2.1051, 27.53(c)** | Transmitter Unwanted Emissions | Conducted Spurious Emissions | Complies | View Data |
| **27.53(c)** | Transmitter Unwanted Emissions | Radiated Transmitter Spurious Emissions | Complies | View Data |
| **15.109** | Digital Emissions | Digital Emissions < 1GHz | Complies - Class A | View Data |
| **15.107** | AC Wireline | Powerline Emissions | Complies - Class A | View Data |

# 7. TEST EQUIPMENT CONFIGURATION(S)

## 7.1. Conducted Test Setup




**Conducted Test Setup**

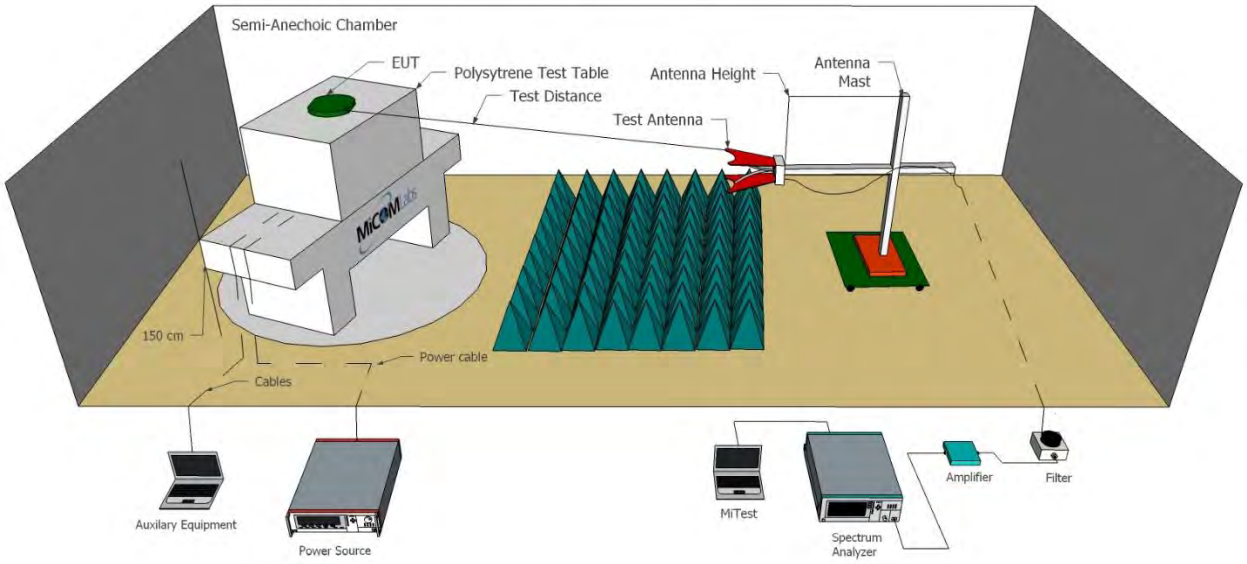
A full system calibration was performed on the test station and any resulting system losses (or gains) were considered in the production of all final measurement data.

| Asset# | Description | Manufacturer | Model# | Serial# | Calibration Due Date |
|---|---|---|---|---|---|
| 249 | Resistance Thermometer | Thermotronics | GR2105-02 | 9340 #2 | 30 Oct 2019 |
| 378 | Rohde & Schwarz 40 GHz Receiver with Generator | Rhode & Schwarz | ESIB40 | 100107/040 | 12 Oct 2019 |
| 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 |
| 461 | Spectrum Analyzer | Agilent | E4440A | MY46185537 | 20 Sep 2019 |
| 510 | Barometer/Thermometer | Control Company | 68000-49 | 170871375 | 11 Dec 2019 |
| 75 | Environmental Chamber | Thermatron | SE-300-2-2 | 27946 | 24 Feb 2020 |

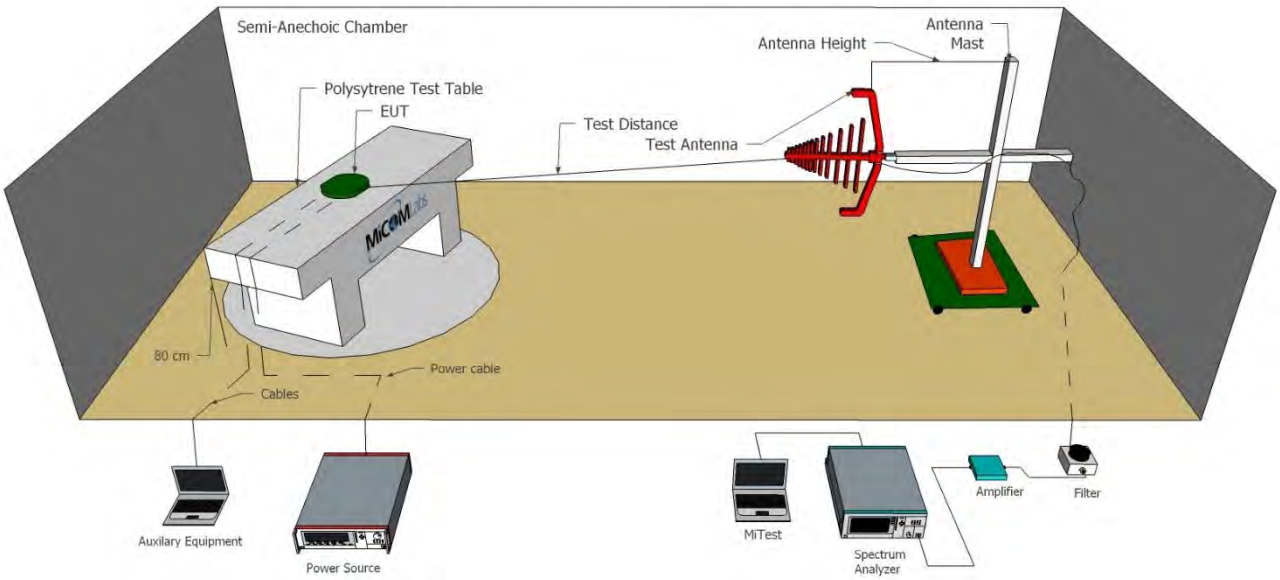
## 7.2. Radiated Emissions - 3m Chamber

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

Radiated Emissions Above 1GHz Test Setup




Radiated Emissions Below 1GHz Test Setup

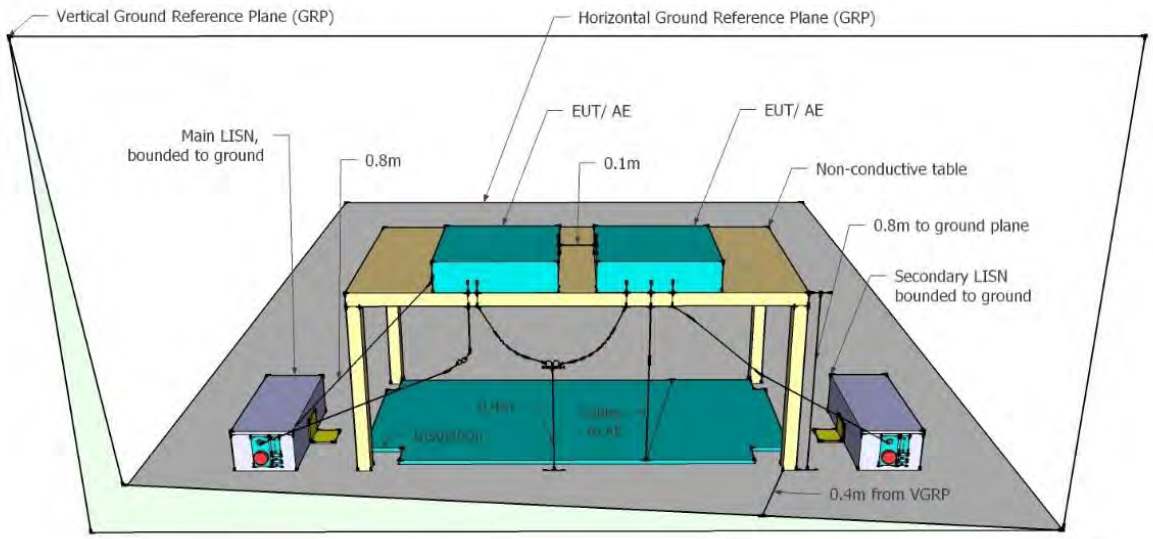


A full system calibration was performed on the test station and any resulting system losses (or gains) were considered in the production of all final measurement data.

| Asset# | Description | Manufacturer | Model# | Serial# | Calibration Due Date |
|---|---|---|---|---|---|
| 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 2020 |
| 338 | Sunol 30 to 3000 MHz Antenna | Sunol | JB3 | A052907 | 4 Apr 2020 |
| 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 Apr 2020 |
| 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 Apr 2020 |
| 410 | Desktop Computer | Dell | Inspiron 620 | WS38 | Not Required |
| 411 | Mast/Turntable Controller | Sunol Sciences | SC98V | 060199-1D | Not Required |
| 412 | USB to GPIB Interface | National Instruments | GPIB-USB HS | 11B8DC2 | Not Required |
| 413 | Mast Controller | Sunol Science | TWR95-4 | 030801-3 | Not Required |
| 415 | Turntable Controller | Sunol Sciences | Turntable Controller | None | Not Required |
| 416 | Gigabit ethernet filter | ETS-Lingren | Gigafoil 260366 | None | Not Required |
| 447 | MiTest Rad Emissions Test Software | MiCOM | Rad Emissions Test Software Version 1.0 | 447 | Not Required |
| 462 | Schwarzbeck cable from Antenna to Amplifier. | Schwarzbeck | AK 9513 | 462 | 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 |

## 7.3. ac Wireline Emissions

**Test Setup – Power Input / Output Port**




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 |
|---|---|---|---|---|---|
| 184 | Pulse Limiter | Rhode & Schwarz | ESH3Z2 | 357.8810.52 | 6 Oct 2019 |
| 190 | LISN (two-line V-network) | Rhode & Schwarz | ESH3Z5 | 836679/006 | 18 Oct 2019 |
| 287 | Rohde & Schwarz 40 GHz Receiver | Rhode & Schwarz | ESIB40 | 100201 | 2 Jul 2019 |
| 295 | Conducted Emissions Chamber Maintenance Check | MiCOM | Conducted Emissions Chamber | 295 | 19 Jun 2019 |
| 307 | BNC-CABLE | Megaphase | 1689 1GVT4 | 15F50B002 | 11 Jun 2019 |
| 316 | Dell desktop computer workstation | Dell | Desktop | WS04 | Not Required |
| 372 | AC Variable PS | California Instruments | 1251P | L06951 | Cal when used |
| 388 | LISN (3 Phase) 9kHz - 30MHz | Rohde & Schwarz | ESH2-Z5 | 892107/022 | 20 Oct 2019 |
| 496 | MiTest Conducted Emissions test software. | MiCOM | Conducted Emissions Test Software Version 1.0 | 496 | Not Required |
| 510 | Barometer/Thermometer | Control Company | 68000-49 | 170871375 | 11 Dec 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 Patented MiCOM Labs "MiTest" Automated Test System"

# 9. TEST RESULTS

## 9.1. Type of Modulation

| Conducted Test Conditions for Type of Modulation | | | |
|---|---|---|---|
| **Standard:** | FCC CFR 47:Part 27 | **Ambient Temp. (ºC):** | 24.0 - 27.5 |
| **Test Heading:** | Type of Modulation | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | 2.1033(c) | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | | | |

**Test Procedure for Type of Modulation**

The type of a digital modulation employed for the Puloli RU700A 1.0 is QPSK, BPSK.

**Requirement**

Equipment certified under the standard shall employ digital modulation

## 9.2. 26dB & 99% Bandwidth

| Conducted Test Conditions 26dB & 99% Bandwidth | | | |
|---|---|---|---|
| **Standard:** | FCC CFR 47:Part 27 | **Ambient Temp. (ºC):** | 24.0 - 27.5 |
| **Test Heading:** | 99 % Occupied Bandwidth | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | 2.1033(c) | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

**Test Procedure for Channel Bandwidth Measurement**

The 26dB & 99 % channel bandwidth is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency. The Resolution Bandwidth was set to approximately 1% or greater of the emission bandwidth.

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

**Limits**

The channel bandwidth shall be equal to or greater than 1 MHz and shall be reported by the certification applicant. Based on the channel bandwidth, the channel edge shall be used as reference point in the measurement of the transmitter unwanted emission power.

| Equipment Configuration for 26 dB & 99% Bandwidth | | | |
|---|---|---|---|
| **Variant:** | NB IoT | **Duty Cycle (%):** | 85 |
| **Data Rate:** | 3.75 KHz | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | QPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | GMH |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Measured 26 dB Bandwidth (KHz) | | | |
|---|---|---|---|---|
| | Port(s) | | | |
| MHz | a | b | c | d |
| 787.11188 | 44.008 | -- | -- | -- |
| 787.41188 | 41.303 | -- | -- | -- |
| 787.88813 | 44.008 | -- | -- | -- |

| Test Frequency | Measured 99% Bandwidth (KHz) | | | |
|---|---|---|---|---|
| | Port(s) | | | |
| MHz | a | b | c | d |
| 787.11188 | 42.926 | -- | -- | -- |
| 787.41188 | 42.926 | -- | -- | -- |
| 787.88813 | 42.745 | -- | -- | -- |

| 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).





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

| Equipment Configuration for 26 dB & 99% Bandwidth | | | |
|---|---|---|---|
| **Variant:** | NB IoT | **Duty Cycle (%):** | 85 |
| **Data Rate:** | 15 KHz | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | QPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | GMH |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Measured 26 dB Bandwidth (KHz) | | | |
|---|---|---|---|---|
| | Port(s) | | | |
| MHz | a | b | c | d |
| 787.1175 | 169.749 | -- | -- | -- |
| 787.4175 | 167.735 | -- | -- | -- |
| 787.8825 | 155.11 | -- | -- | -- |

| Test Frequency | Measured 99% Bandwidth (KHz) | | | |
|---|---|---|---|---|
| | Port(s) | | | |
| MHz | a | b | c | d |
| 787.1175 | 127.455 | -- | -- | -- |
| 787.4175 | 127.455 | -- | -- | -- |
| 787.8825 | 128.056 | -- | -- | -- |

| 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).





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

| Equipment Configuration for 26 dB & 99% Bandwidth | | | |
|---|---|---|---|
| **Variant:** | NB IoT | **Duty Cycle (%):** | 85 |
| **Data Rate:** | 180 KHz | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | QPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | GMH |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Measured 26 dB Bandwidth (KHz) | | | | |
|---|---|---|---|---|---|
| | Port(s) | | | | |
| MHz | a | b | c | d | |
| 787.11188 | 267.535 | -- | -- | -- | |
| 787.41188 | 265.130 | -- | -- | -- | |
| 787.88813 | 260.922 | -- | -- | -- | |

| Test Frequency | Measured 99% Bandwidth (KHz) | | | | |
|---|---|---|---|---|---|
| | Port(s) | | | | |
| MHz | a | b | c | d | |
| 787.11188 | 186.373 | -- | -- | -- | |
| 787.41188 | 187.575 | -- | -- | -- | |
| 787.88813 | 186.373 | -- | -- | -- | |

| 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).



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

## 9.3. Transmitter Frequency Stability

| Conducted Test Conditions for Transmitter Frequency Stability | | | |
|---|---|---|---|
| **Standard:** | FCC CFR 47 Part 27 | **Ambient Temp. (ºC):** | 24.0 - 27.5 |
| **Test Heading:** | Transmitter Frequency Stability | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | FCC 2.1055, 27.54 | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | | | |

**Test Procedure for Transmitter Frequency Stability**
Transmitter Frequency Stability testing was performed over nominal voltage and ambient temperature except at room temperature where the voltage was varied ±10% and results reported for a single antenna port.

**Definition**
The center frequency is the center of the channel declared by the manufacturer as part of the declared channel plan(s).

**Limits**
The applicant shall ensure frequency stability by showing that fundamental emissions are maintained within the frequency band of operation when tested at the temperature and supply voltage variations specified in the relevant standard FCC Part 2.1055 and 27.54.

**Measurement Results for Transmitter Frequency Stability**
**Operating Mode: 3.75 KHz QPSK**

| Test Frequency: | 787.411875 MHz | Measured Frequency | Frequency Error | |
|---|---|---|---|---|
| **Temperature** | **Voltage** | **MHz** | **KHz** | **PPM** |
| 0°C | 5 Vdc | 787.41187580 | 0.750 | 0.095 |
| +10°C | 5 Vdc | 787.41187275 | -2.250 | -0.286 |
| 20°C | 5 Vdc | 787.41187375 | -1.250 | -0.159 |
| 20°C | 4.5 Vdc | 787.41187375 | -1.250 | -0.159 |
| 20°C | 5.5 Vdc | 787.41187025 | -4.750 | -0.603 |
| +30°C | 5 Vdc | 787.41187125 | -3.750 | -0.476 |
| +40°C | 5 Vdc | 787.41187375 | -1.250 | -0.159 |

## 9.4. Conducted Output Power

| Conducted Test Conditions for Fundamental Emission Output Power | | | |
|---|---|---|---|
| **Standard:** | FCC CFR 47 Part 27 | **Ambient Temp. (ºC):** | 24.0 - 27.5 |
| **Test Heading:** | Output Power | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | FCC 27.50 (10) | **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.

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

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

A = Total Power [10*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**
(10) Portable stations (hand-held devices) transmitting in the 746-757 MHz, 776-788 MHz, and 805-806 MHz bands are limited to 3 watts ERP.

ERP in dBm = 10 * LOG (P/1mW) = 10*LOG(3000) = 34.77 dBm

The following modifications were required to bring the equipment into compliance:
1. Issue with 2nd harmonic falling within the GPS frequency band

As a result, the following modifications were required to bring the equipment into compliance:
Output power was tested on the RU700A device and it was found that a power reduction was required due to a non-compliant 2nd harmonic falling within the GPS band (1559 – 1610 MHz). This influenced both the following antennas:

1).. Dipole -1.78 dBi
2).. Yagi 11.0 dBi

In order to bring the RU700A into compliance the following fix was implemented:
i).. Dipole antenna output power was reduced 6 dB from +23 dBm to +17dBm

ii).. Yagi antenna gain was also reduced 6 dB by adding a 6 dB attenuator to the antenna. Output power was reduced 3 dB from +23 dBm to +20 dBm.

The output power results reported in Section 9.4 ‘Conducted Output Power’ reflect the above situation

| Equipment Configuration for Peak Output Power | | | |
|---|---|---|---|
| **Variant:** | NB IoT | **Duty Cycle (%):** | 85.0 |
| **Data Rate:** | 3.75 KHz | **Antenna Gain (dBi):** | -1.78 (Dipole) |
| **Modulation:** | QPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | GMH |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Measured Output Power (dBm) Port(s) | | | | Calculated Total Power Σ Port(s) | ERP | ERP Limit | Margin | EUT Power Setting |
|---|---|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dBm | dB | |
| 787.111875 | 17.86 | -- | -- | -- | 17.86 | 18.22 | 34.77 | -16.55 | 17 |
| 787.411875 | 17.99 | -- | -- | -- | 17.99 | 18.35 | 34.77 | -16.42 | 17 |
| 787.888125 | 17.44 | -- | -- | -- | 17.44 | 17.80 | 34.77 | -16.97 | 17 |

| Equipment Configuration for Peak Output Power | | | |
|---|---|---|---|
| **Variant:** | NB IoT | **Duty Cycle (%):** | 85.0 |
| **Data Rate:** | 3.75 KHz | **Antenna Gain (dBi):** | 5 (Yagi) |
| **Modulation:** | QPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | GMH |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Measured Output Power (dBm) Port(s) | | | | Calculated Total Power Σ Port(s) | ERP | ERP Limit | Margin | EUT Power Setting |
|---|---|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dBm | dB | |
| 787.111875 | 20.86 | -- | -- | -- | 20.86 | 28.00 | 34.77 | -6.77 | 20 |
| 787.411875 | 20.99 | -- | -- | -- | 20.99 | 28.13 | 34.77 | -6.64 | 20 |
| 787.888125 | 20.44 | -- | -- | -- | 20.44 | 27.58 | 34.77 | -7.19 | 20 |

| Traceability to Industry Recognized Test Methodologies | |
|---|---|
| Work Instruction: | WI-01 MEASURING RF OUTPUT POWER |
| Measurement Uncertainty: | ±1.33 dB |

The above measurements include a Duty Cycling correction factor of 0.7 dB.

*Power reduced to meet TX Spurious Limit in GPS band

| Equipment Configuration for Peak Output Power | | | |
|---|---|---|---|
| **Variant:** | NB IoT | **Duty Cycle (%):** | 85.0 |
| **Data Rate:** | 15 KHz | **Antenna Gain (dBi):** | -1.78 (Dipole) |
| **Modulation:** | QPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | GMH |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Measured Output Power (dBm) Port(s) | | | | Calculated Total Power Σ Port(s) | ERP | ERP Limit | Margin | EUT Power Setting |
|---|---|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dBm | dB | |
| 787.1175 | 17.67 | -- | -- | -- | 17.67 | 18.03 | 34.77 | -16.74 | 17 |
| 787.4175 | 17.70 | -- | -- | -- | 17.70 | 18.06 | 34.77 | -16.71 | 17 |
| 787.8825 | 17.26 | -- | -- | -- | 17.26 | 17.62 | 34.77 | -17.15 | 17 |

| Equipment Configuration for Peak Output Power | | | |
|---|---|---|---|
| **Variant:** | NB IoT | **Duty Cycle (%):** | 85.0 |
| **Data Rate:** | 15 KHz | **Antenna Gain (dBi):** | 5 (Yagi) |
| **Modulation:** | QPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | GMH |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Measured Output Power (dBm) Port(s) | | | | Calculated Total Power Σ Port(s) | ERP | ERP Limit | Margin | EUT Power Setting |
|---|---|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dBm | dB | |
| 787.1175 | 20.67 | -- | -- | -- | 20.67 | 27.81 | 34.77 | -6.96 | 20 |
| 787.4175 | 20.70 | -- | -- | -- | 20.70 | 27.84 | 34.77 | -6.93 | 20 |
| 787.8825 | 20.26 | -- | -- | -- | 20.26 | 27.40 | 34.77 | -7.37 | 20 |

| Traceability to Industry Recognized Test Methodologies | |
|---|---|
| Work Instruction: | WI-01 MEASURING RF OUTPUT POWER |
| Measurement Uncertainty: | ±1.33 dB |

The above measurements include a Duty Cycling correction factor of 0.7 dB.

*Power reduced to meet TX Spurious Limit in GPS band

| Equipment Configuration for Peak Output Power | | | |
|---|---|---|---|
| **Variant:** | NB IoT | **Duty Cycle (%):** | 85.0 |
| **Data Rate:** | 180 KHz | **Antenna Gain (dBi):** | -1.78 (Dipole) |
| **Modulation:** | QPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | GMH |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Measured Output Power (dBm) Port(s) | | | | Calculated Total Power Σ Port(s) | ERP | ERP Limit | Margin | EUT Power Setting |
|---|---|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dBm | dB | |
| 787.2 | 17.21 | -- | -- | -- | 17.21 | 17.57 | 34.77 | -17.2 | 17 |
| 787.5 | 17.17 | -- | -- | -- | 17.17 | 17.53 | 34.77 | -17.24 | 17 |
| 787.8 | 17.17 | -- | -- | -- | 17.17 | 17.53 | 34.77 | -17.24 | 17 |

| Equipment Configuration for Peak Output Power | | | |
|---|---|---|---|
| **Variant:** | NB IoT | **Duty Cycle (%):** | 85.0 |
| **Data Rate:** | 180 KHz | **Antenna Gain (dBi):** | 5 (Yagi) |
| **Modulation:** | QPSK | **Beam Forming Gain (Y)(dB):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | GMH |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Measured Output Power (dBm) Port(s) | | | | Calculated Total Power Σ Port(s) | ERP | ERP Limit | Margin | EUT Power Setting |
|---|---|---|---|---|---|---|---|---|---|
| MHz | a | b | c | d | dBm | dBm | dBm | dB | |
| 787.2 | 20.21 | -- | -- | -- | 20.21 | 27.35 | 34.77 | -7.42 | 20 |
| 787.5 | 20.17 | -- | -- | -- | 20.17 | 27.31 | 34.77 | -7.46 | 20 |
| 787.8 | 20.17 | -- | -- | -- | 20.17 | 27.31 | 34.77 | -7.46 | 20 |

| Traceability to Industry Recognized Test Methodologies | |
|---|---|
| Work Instruction: | WI-01 MEASURING RF OUTPUT POWER |
| Measurement Uncertainty: | ±1.33 dB |

The above measurements include a Duty Cycling correction factor of 0.7 dB.

*Power reduced to meet TX Spurious Limit in GPS band

# 9.5. Emissions

## 9.5.1. Conducted Emissions

### 9.5.1.1. Conducted Spurious Emissions

| Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions | | | |
|---|---|---|---|
| **Standard:** | FCC CFR 47: Part 27 | **Ambient Temp. (ºC):** | 24.0 - 27.5 |
| **Test Heading:** | Transmitter Unwanted Emissions | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | FCC 2.1051, 27.53(C), | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

**Test Procedure for Transmitter Conducted Spurious and Band-Edge Emissions Measurement**
The Transmitter Unwanted Emissions were measurement conductively. Testing was performed on individual antenna ports and limits applied to each plot respectively.
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, however output power was (in all cases) set for +23 dBm.

**Limits Transmitter Conducted Spurious and Band-Edge Emissions**
(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:
(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;
(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;
(3) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations;
(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;
(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;
(6) Compliance with the provisions of paragraphs (c)(3) and (c)(4) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

Only worst-case modes were examined for band-edge and spurious emissions. 3.75 kHz single tone and 15 kHz ‘all tones’ (180 kHz bandwidth).

| Equipment Configuration for Conducted Spurious Emissions - Peak | | | |
|---|---|---|---|
| **Variant:** | NB IoT | **Duty Cycle (%):** | 85 |
| **Data Rate:** | 3.75 KHz | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | QPSK | **Beam Forming Gain (Y):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | GMH |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Operating Tones | Frequency Range | Conducted Spurious Emissions - Peak (dBm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Port a | | Port b | | Port c | | Port d | |
| MHz | | MHz | SE | Limit | SE | Limit | SE | Limit | SE | Limit |
| 787.111875 | First | 30.0 - 763 | -56.3 | -13.0 | -- | -- | -- | -- | -- | -- |
| | First | 763 - 775 | -65.84 | -35.0 | -- | -- | -- | -- | -- | -- |
| | First* | 775 - 786.9* | -26.59 | -13.0 | -- | -- | -- | -- | -- | -- |
| | First | 786.9 - 787 | -20.62 | -13.0 | -- | -- | -- | -- | -- | -- |
| 787.888125 | Last | 788 – 788.1 | -24.82 | -13.0 | -- | -- | -- | -- | -- | -- |
| | Last* | 788.1 – 793* | -25.76 | -13.0 | -- | -- | -- | -- | -- | -- |
| | Last | 793 5 - 805 | -62.32 | -35.0 | -- | -- | -- | -- | -- | -- |
| | Last | 805 – 10,000 | -48.94 | -13.0 | -- | -- | -- | -- | -- | -- |

| 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 |

*RBW reduced to 50 kHz, additional 3dB added to integrate over 100 kHz RBW

**Note All measurements in this table include a 0.7dB duty cycle correction factor.

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

| Equipment Configuration for Conducted Spurious Emissions - Peak | | | |
|---|---|---|---|
| **Variant:** | NB IoT | **Duty Cycle (%):** | 85 |
| **Data Rate:** | 180 KHz | **Antenna Gain (dBi):** | Not Applicable |
| **Modulation:** | QPSK | **Beam Forming Gain (Y):** | Not Applicable |
| **TPC:** | Not Applicable | **Tested By:** | GMH |
| **Engineering Test Notes:** | | | |

**Test Measurement Results**

| Test Frequency | Operating Tones | Frequency Range | Conducted Spurious Emissions - Peak (dBm) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Port a | | Port b | | Port c | | Port d | |
| MHz | | MHz | SE | Limit | SE | Limit | SE | Limit | SE | Limit |
| 787.2 | All | 30.0 - 763 | -56.30 | -13.0 | -- | -- | -- | -- | -- | -- |
| | All | 763 - 775 | -71.87 | -35.0 | -- | -- | -- | -- | -- | -- |
| | All | 775 - 786.9 | -16.58 | -13.0 | -- | -- | -- | -- | -- | -- |
| | All | 786.9 - 787 | -18.86 | -13.0 | -- | -- | -- | -- | -- | -- |
| 787.8 | All | 788 – 788.1 | -18.92 | -13.0 | -- | -- | -- | -- | -- | -- |
| | All | 788.1 – 793 | -14.59 | -13.0 | -- | -- | -- | -- | -- | -- |
| | All | 793 5 - 805 | -66.70 | -35.0 | -- | -- | -- | -- | -- | -- |
| | All | 805 – 10,000 | -48.94 | -13.0 | -- | -- | -- | -- | -- | -- |

| 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 All measurements in this table include a 0.7dB duty cycle correction factor.

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

## 9.5.2. Radiated Emissions

| Radiated Test Conditions for Radiated Spurious and GPS Emissions | | | |
|---|---|---|---|
| **Standard:** | FCC CFR 47: Part 27 | **Ambient Temp. (ºC):** | 20.0 - 24.5 |
| **Test Heading:** | Radiated Spurious | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | FCC 2.1051, 27.53(c),27.53(f) | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

**Test Procedure for Radiated Spurious Emissions**
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
(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:
(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;
(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;

(f) For operations in the 746-758 MHz, 775-788 MHz, and 805-806 MHz bands, emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation:

EUT needs Antenna connected to receive base station signals to transmit.

## 9.5.2.2. TX Spurious

### Dipole Antenna 30-1000 MHz

**Equipment Configuration for Radiated Spurious Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.80 | **Data Rate:** | 3.75 KHz |
| **Power Setting:** | 23 | **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 | 787.95 | 113.32 | 6.33 | -6.00 | 113.65 | Fundamental | Vertical | 100 | 0 | -- | -- | -- |
| #2 | 788.00 | 67.37 | 6.33 | -6.00 | 67.70 | MaxQP | Vertical | 135 | 179 | 82.2 | -14.5 | Pass |
| #3 | 788.10 | 69.56 | 6.33 | -6.10 | 69.79 | MaxQP | Vertical | 104 | 305 | 82.2 | -12.4 | Pass |
| #4 | 788.16 | 66.45 | 6.33 | -6.10 | 66.68 | MaxQP | Vertical | 224 | 3 | 82.2 | -15.6 | Pass |
| #5 | 788.22 | 64.77 | 6.33 | -6.10 | 65.00 | MaxQP | Vertical | 152 | 311 | 82.2 | -17.2 | Pass |
| #6 | 788.27 | 59.57 | 6.33 | -6.10 | 59.80 | MaxQP | Vertical | 156 | 204 | 82.2 | -22.4 | Pass |

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor.

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

## Equipment Configuration for Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | BPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.80 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 23 | **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 | 787.95 | 113.25 | 6.33 | -6.00 | 113.58 | Fundamental | Vertical | 100 | 0 | -- | -- | -- |
| #2 | 788.07 | 72.37 | 6.33 | -6.10 | 72.60 | MaxAvg | Vertical | 122 | 191 | 82.2 | -9.6 | Pass |
| #3 | 788.11 | 69.69 | 6.33 | -6.10 | 69.92 | MaxAvg | Vertical | 194 | 203 | 82.2 | -12.3 | Pass |
| #4 | 788.17 | 66.00 | 6.33 | -6.10 | 66.23 | MaxAvg | Vertical | 157 | 305 | 82.2 | -16.0 | Pass |
| #5 | 788.25 | 64.32 | 6.33 | -6.10 | 64.55 | MaxAvg | Vertical | 127 | 301 | 82.2 | -17.7 | Pass |
| #6 | 788.32 | 61.71 | 6.33 | -6.10 | 61.94 | MaxAvg | Vertical | 138 | 326 | 82.2 | -20.3 | Pass |

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor.

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

## Equipment Configuration for Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.80 | **Data Rate:** | 3.75 KHz |
| **Power Setting:** | 23 | **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 | 787.95 | 113.17 | 6.33 | -6.00 | 113.50 | Fundamental | Vertical | 100 | 0 | -- | -- | |
| #2 | 788.00 | 67.63 | 6.33 | -6.00 | 67.96 | MaxAvg | Vertical | 131 | 100 | 82.2 | -14.3 | Pass |
| #3 | 788.10 | 70.56 | 6.33 | -6.10 | 70.79 | MaxAvg | Vertical | 125 | 179 | 82.2 | -11.4 | Pass |
| #4 | 788.25 | 65.43 | 6.33 | -6.10 | 65.66 | MaxAvg | Vertical | 138 | 288 | 82.2 | -16.6 | Pass |
| #5 | 788.34 | 59.66 | 6.33 | -6.10 | 59.89 | MaxAvg | Vertical | 123 | 311 | 82.2 | -22.3 | Pass |
| #6 | 788.44 | 56.85 | 6.33 | -6.10 | 57.08 | MaxAvg | Vertical | 167 | 311 | 82.2 | -25.2 | Pass |
| Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. 788 MHz measured with 30 KHz RBW | | | | | | | | | | | | |

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

## Equipment Configuration for Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.80 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 23 | **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 | 787.95 | 112.83 | 6.33 | -6.00 | 113.16 | Fundamental | Vertical | 100 | 0 | -- | -- | -- |
| #2 | 788.00 | 71.03 | 6.33 | -6.00 | 71.36 | MaxAvg | Vertical | 120 | 180 | 82.2 | -10.9 | Pass |
| #3 | 788.13 | 69.66 | 6.33 | -6.10 | 69.89 | MaxAvg | Vertical | 125 | 179 | 82.2 | -12.3 | Pass |
| #4 | 788.16 | 66.66 | 6.33 | -6.10 | 66.89 | MaxAvg | Vertical | 148 | 296 | 82.2 | -15.3 | Pass |
| #5 | 788.33 | 63.72 | 6.33 | -6.10 | 63.95 | MaxAvg | Vertical | 126 | 209 | 82.2 | -18.3 | Pass |
| #6 | 788.44 | 61.96 | 6.33 | -6.10 | 62.19 | MaxAvg | Vertical | 133 | 315 | 82.2 | -20.0 | Pass |

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. 788 MHz measured with 30 KHz RBW

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

## Equipment Configuration for Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.80 | **Data Rate:** | 180 KHz |
| **Power Setting:** | 23 | **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 | 787.84 | 113.72 | 6.33 | -6.00 | 114.05 | Fundamental | Vertical | 100 | 0 | -- | -- | -- |
| #2 | 788.00 | 74.77 | 6.33 | -6.00 | 75.10 | MaxAvg | Vertical | 111 | 188 | 82.2 | -7.1 | Pass |
| #3 | 788.11 | 66.88 | 6.33 | -6.10 | 67.11 | MaxAvg | Vertical | 148 | 291 | 82.2 | -15.1 | Pass |
| #4 | 788.15 | 65.77 | 6.33 | -6.10 | 66.00 | MaxAvg | Vertical | 159 | 305 | 82.2 | -16.2 | Pass |
| #5 | 788.25 | 64.40 | 6.33 | -6.10 | 64.63 | MaxAvg | Vertical | 133 | 275 | 82.2 | -17.6 | Pass |
| #6 | 788.30 | 63.37 | 6.33 | -6.10 | 63.60 | MaxAvg | Vertical | 144 | 181 | 82.2 | -18.6 | Pass |

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor.

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

## Dipole Antenna 1-10 GHz

**Equipment Configuration for Transmitter Spurious Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | BPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 3.75 KHz |
| **Power Setting:** | 23 | **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 | 1574.95 | 90.78 | -1.43 | -16.56 | 68.79 | Peak (Scan) | Horizontal | 100 | 132 | 82.2 | * | Pass |
| Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately. | | | | | | | | | | | | |

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





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

**Equipment Configuration for Restricted Band Spurious Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | BPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 23 | **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 | 1574.89 | 87.09 | -1.43 | -16.56 | 69.10 | Peak (Scan) | Horizontal | 100 | 40 | 82.2 | * | Pass |
| Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately. | | | | | | | | | | | | |

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

**Equipment Configuration for Transmitter Spurious Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 3.75 KHz |
| **Power Setting:** | 23 | **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 | 1574.91 | 82.33 | -1.43 | -16.56 | 64.34 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |
| Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately. | | | | | | | | | | | | |

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

## Equipment Configuration for Transmitter Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 23 | **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 | 1574.91 | 82.33 | -1.43 | -16.56 | 64.34 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |
| Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately. | | | | | | | | | | | | |

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

## Equipment Configuration for Transmitter Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 180 KHz |
| **Power Setting:** | 23 | **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 | 1574.89 | 92.65 | -1.43 | -16.56 | 74.66 | Peak (Scan) | Horizontal | 100 | 36 | 82.2 | * | Pass |
| Test Notes: EUT powered up linked to Base station via antenna. Multicarrier. | | | | | | | | | | | | |

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

*1559-1610 MHz is in GPS band with limit measured separately.

## Yagi Antenna 30-1000 MHz

**Equipment Configuration for Radiated Spurious Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | BPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.80 | **Data Rate:** | 3.75 KHz |
| **Power Setting:** | 23 | **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 | 757.82 | 69.78 | 6.26 | -6.50 | 69.54 | MaxQP | Vertical | 100 | 277 | 82.2 | -12.7 | Pass |
| #2 | 787.84 | 114.01 | 6.33 | -6.00 | 114.34 | Fundamental | Horizontal | 100 | 0 | -- | -- | -- |
| #3 | 788.00 | 72.99 | 6.33 | -6.00 | 73.32 | MaxQP | Horizontal | 100 | 356 | 82.2 | -8.9 | Pass |
| #4 | 788.22 | 65.19 | 6.33 | -6.10 | 65.42 | MaxQP | Horizontal | 100 | 37 | 82.2 | -16.8 | Pass |
| #5 | 788.88 | 56.35 | 6.33 | -6.10 | 56.58 | MaxQP | Horizontal | 100 | 0 | 82.2 | -25.7 | Pass |
| #6 | 789.54 | 48.17 | 6.33 | -6.00 | 48.50 | MaxQP | Horizontal | 101 | 5 | 82.2 | -33.7 | Pass |

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. 788 MHz measured with 30 KHz RBW

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





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

## Equipment Configuration for Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | BPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.80 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 23 | **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 | 757.78 | 62.09 | 6.26 | -6.50 | 61.85 | MaxAvg | Horizontal | 101 | 5 | 82.2 | -20.4 | Pass |
| #2 | 787.84 | 121.98 | 6.33 | -6.00 | 122.31 | Fundamental | Horizontal | 100 | 0 | -- | -- | -- |
| #3 | 788.00 | 77.07 | 6.33 | -6.00 | 77.40 | MaxAvg | Horizontal | 100 | 356 | 82.2 | -4.8 | Pass |
| #4 | 788.10 | 74.37 | 6.33 | -6.10 | 74.60 | MaxAvg | Horizontal | 100 | 356 | 82.2 | -7.6 | Pass |
| #5 | 788.24 | 68.94 | 6.33 | -6.10 | 69.17 | MaxAvg | Horizontal | 100 | 37 | 82.2 | -13.1 | Pass |
| #6 | 788.42 | 61.69 | 6.33 | -6.10 | 61.92 | MaxAvg | Horizontal | 100 | 0 | 82.2 | -20.3 | Pass |
| Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. 788 MHz measured with 30 KHz RBW | | | | | | | | | | | | |

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

## Equipment Configuration for Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.80 | **Data Rate:** | 3.75 KHz |
| **Power Setting:** | 23 | **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 | 757.85 | 66.11 | 6.26 | -6.50 | 65.87 | MaxAvg | Vertical | 101 | 341 | 82.2 | -16.4 | Pass |
| #2 | 787.80 | 121.98 | 6.33 | -6.00 | 122.31 | Fundamental | Horizontal | 100 | 0 | -- | -- | -- |
| #3 | 788.00 | 76.47 | 6.33 | -6.00 | 76.80 | MaxAvg | Horizontal | 202 | 4 | 82.2 | -5.4 | Pass |
| #4 | 788.10 | 74.67 | 6.33 | -6.10 | 74.90 | MaxAvg | Horizontal | 100 | 356 | 82.2 | -7.3 | Pass |
| #5 | 788.25 | 68.89 | 6.33 | -6.10 | 69.12 | MaxAvg | Horizontal | 212 | 0 | 82.2 | -13.1 | Pass |
| #6 | 788.77 | 64.46 | 6.33 | -6.10 | 64.69 | MaxAvg | Horizontal | 101 | 357 | 82.2 | -17.5 | Pass |
| Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. 788 MHz measured with 30 KHz RBW | | | | | | | | | | | | |

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

## Equipment Configuration for Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.80 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 23 | **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 | 757.75 | 66.84 | 6.26 | -6.50 | 66.60 | MaxAvg | Vertical | 109 | 231 | 82.2 | -15.6 | Pass |
| #2 | 787.84 | 121.92 | 6.33 | -6.00 | 122.25 | Fundamental | Horizontal | 100 | 0 | -- | -- | -- |
| #3 | 788.06 | 76.27 | 6.33 | -6.10 | 76.50 | MaxAvg | Horizontal | 106 | 357 | 82.2 | -5.7 | Pass |
| #4 | 788.13 | 74.67 | 6.33 | -6.10 | 74.90 | MaxAvg | Horizontal | 104 | 18 | 82.2 | -7.3 | Pass |
| #5 | 788.24 | 72.27 | 6.33 | -6.10 | 72.50 | MaxAvg | Horizontal | 104 | 10 | 82.2 | -9.7 | Pass |
| #6 | 788.46 | 64.47 | 6.33 | -6.10 | 64.70 | MaxAvg | Horizontal | 184 | 2 | 82.2 | -17.5 | Pass |

Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. 788 MHz measured with 30 KHz RBW

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

## Equipment Configuration for Radiated Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.80 | **Data Rate:** | 180 KHz |
| **Power Setting:** | 23 | **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 | 757.77 | 67.33 | 6.26 | -6.50 | 67.09 | MaxAvg | Vertical | 106 | 338 | 82.2 | -15.1 | Pass |
| #2 | 787.84 | 122.14 | 6.33 | -6.00 | 122.47 | Fundamental | Horizontal | 100 | 0 | -- | -- | -- |
| #3 | 788.00 | 79.17 | 6.33 | -6.00 | 79.50 | MaxAvg | Horizontal | 113 | 3 | 82.2 | -2.7 | Pass |
| #4 | 788.13 | 76.57 | 6.33 | -6.10 | 76.80 | MaxAvg | Horizontal | 101 | 2 | 82.2 | -5.4 | Pass |
| #5 | 788.23 | 73.74 | 6.33 | -6.10 | 73.97 | MaxAvg | Horizontal | 117 | 350 | 82.2 | -8.3 | Pass |
| #6 | 788.30 | 73.73 | 6.33 | -6.10 | 73.96 | MaxAvg | Horizontal | 110 | 0 | 82.2 | -8.3 | Pass |
| #7 | 788.39 | 69.13 | 6.33 | -6.10 | 69.36 | MaxAvg | Horizontal | 114 | 10 | 82.2 | -12.9 | Pass |
| Test Notes: EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 Duty Cycle Correction Factor. | | | | | | | | | | | | |

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

## Yagi Antenna 1-10 GHz

**Equipment Configuration for Transmitter Spurious Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | BPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 3.75 KHz |
| **Power Setting:** | 23 | **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 | 1574.87 | 74.42 | -1.43 | -16.56 | 56.43 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |
| Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately. | | | | | | | | | | | | |

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

## Equipment Configuration for Transmitter Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | BPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 23 | **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 | 1574.96 | 73.50 | -1.43 | -16.56 | 55.51 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |
| Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately. | | | | | | | | | | | | |

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

## Equipment Configuration for Transmitter Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 3.75 KHz |
| **Power Setting:** | 23 | **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 | 1574.84 | 73.34 | -1.43 | -16.56 | 55.35 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |
| Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately. | | | | | | | | | | | | |

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

**Equipment Configuration for Transmitter Spurious Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 23 | **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 | 1575.00 | 73.14 | -1.43 | -16.57 | 55.14 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |
| Test Notes: EUT powered up linked to Base station via antenna*1559-1610 MHz is in GPS band with separate limit measured separately. | | | | | | | | | | | | |

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

**Equipment Configuration for Transmitter Spurious Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 23 | **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 | 1575.00 | 73.14 | -1.43 | -16.57 | 55.14 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |
| Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately. | | | | | | | | | | | | |

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

## Equipment Configuration for Transmitter Spurious Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 180 KHz |
| **Power Setting:** | 23 | **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 | 1574.87 | 80.66 | -1.43 | -16.56 | 62.67 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |
| Test Notes: EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately. | | | | | | | | | | | | |

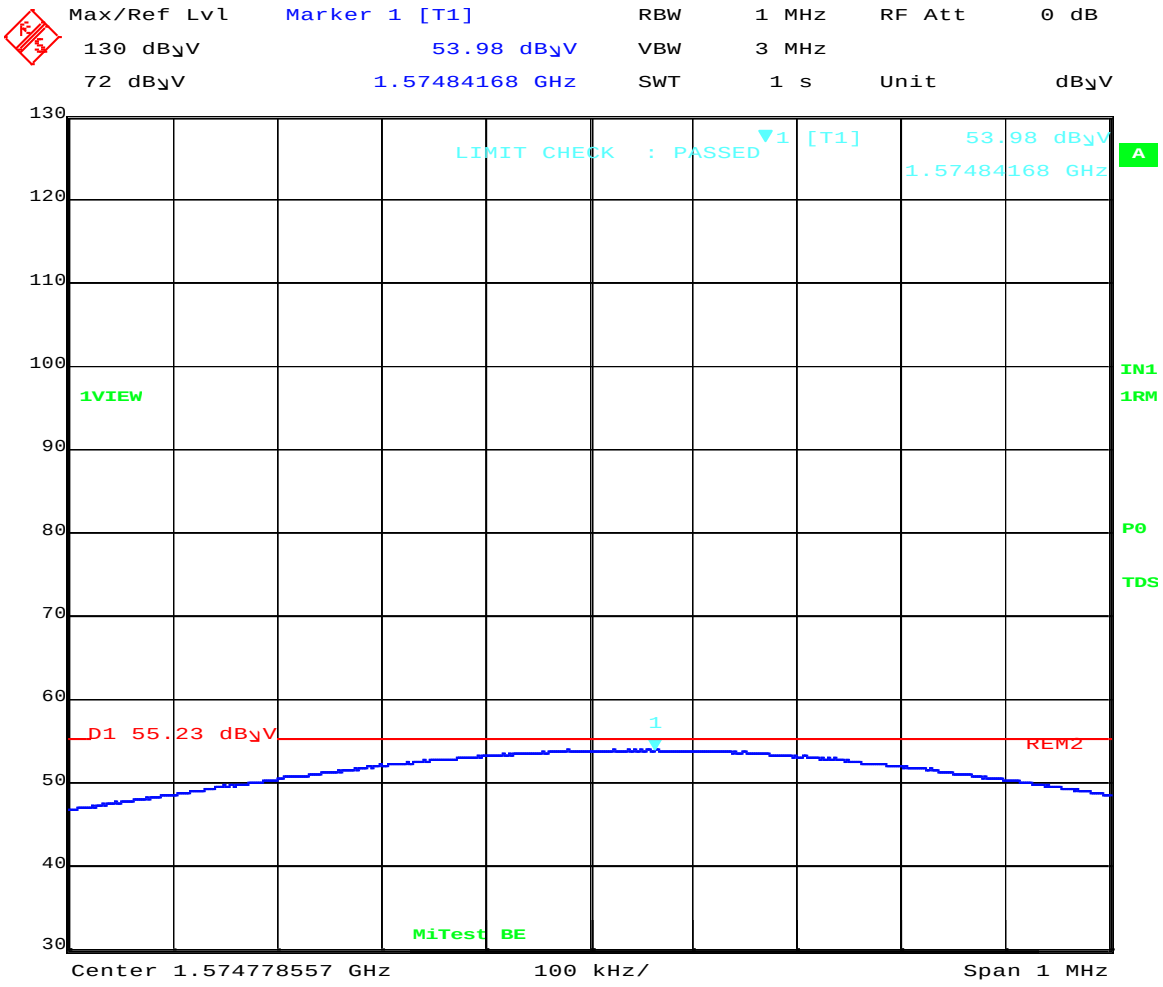
Note: click the links in the above matrix to view the graphical image (plot).

## 9.5.2.3. GPS Emissions

### Dipole Antenna

| Equipment Configuration for GPS Band Emissions | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | BPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 3.75 KHz |
| **Power Setting:** | 17 | **Tested By:** | JMH |

**Test Measurement Results**

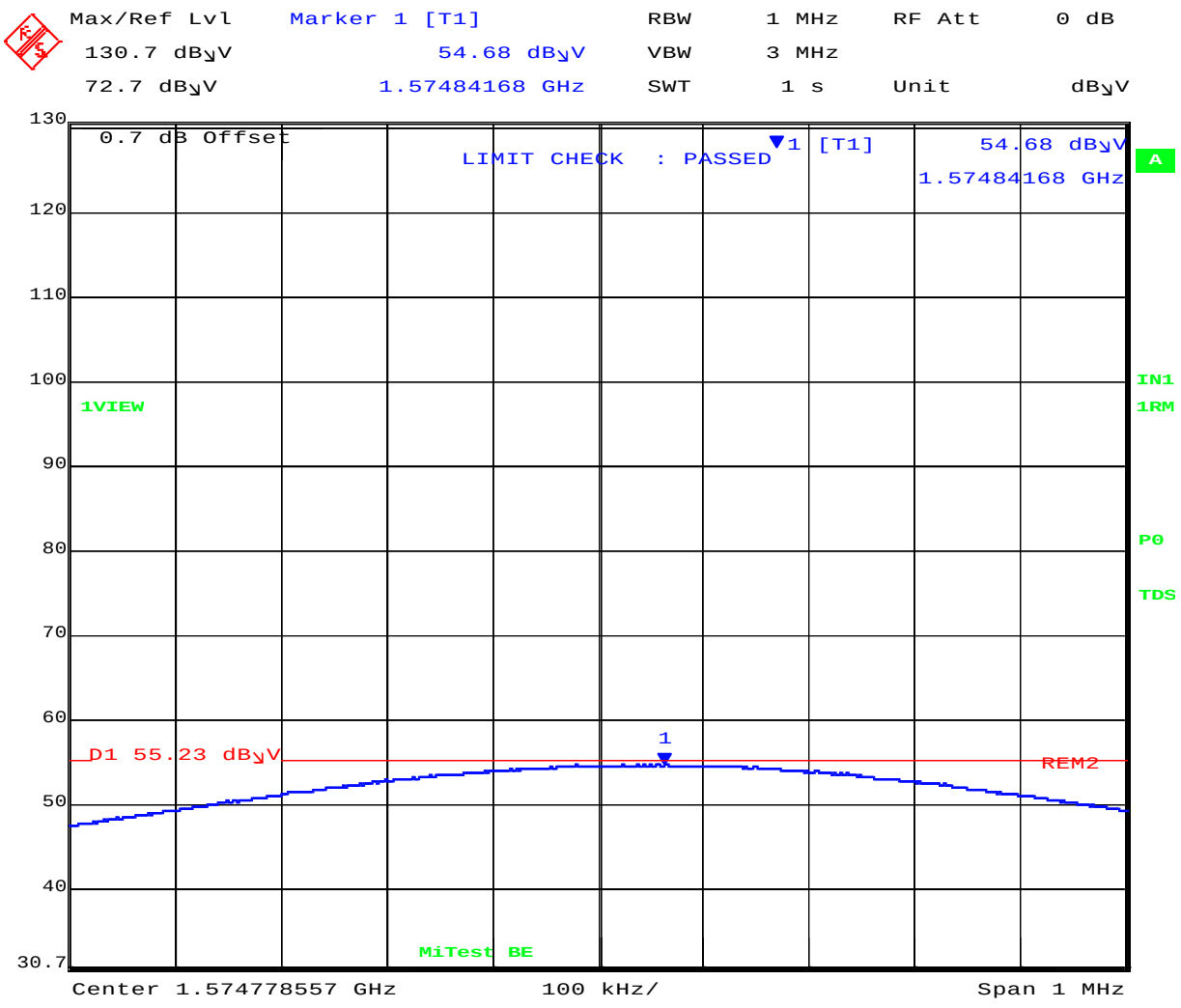



53.98 dBuV/m + 0.7 (Duty Cycle) = 54.68 dBuV/m Corrected Value

## Equipment Configuration for GPS Band Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | BPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 17 | **Tested By:** | JMH |

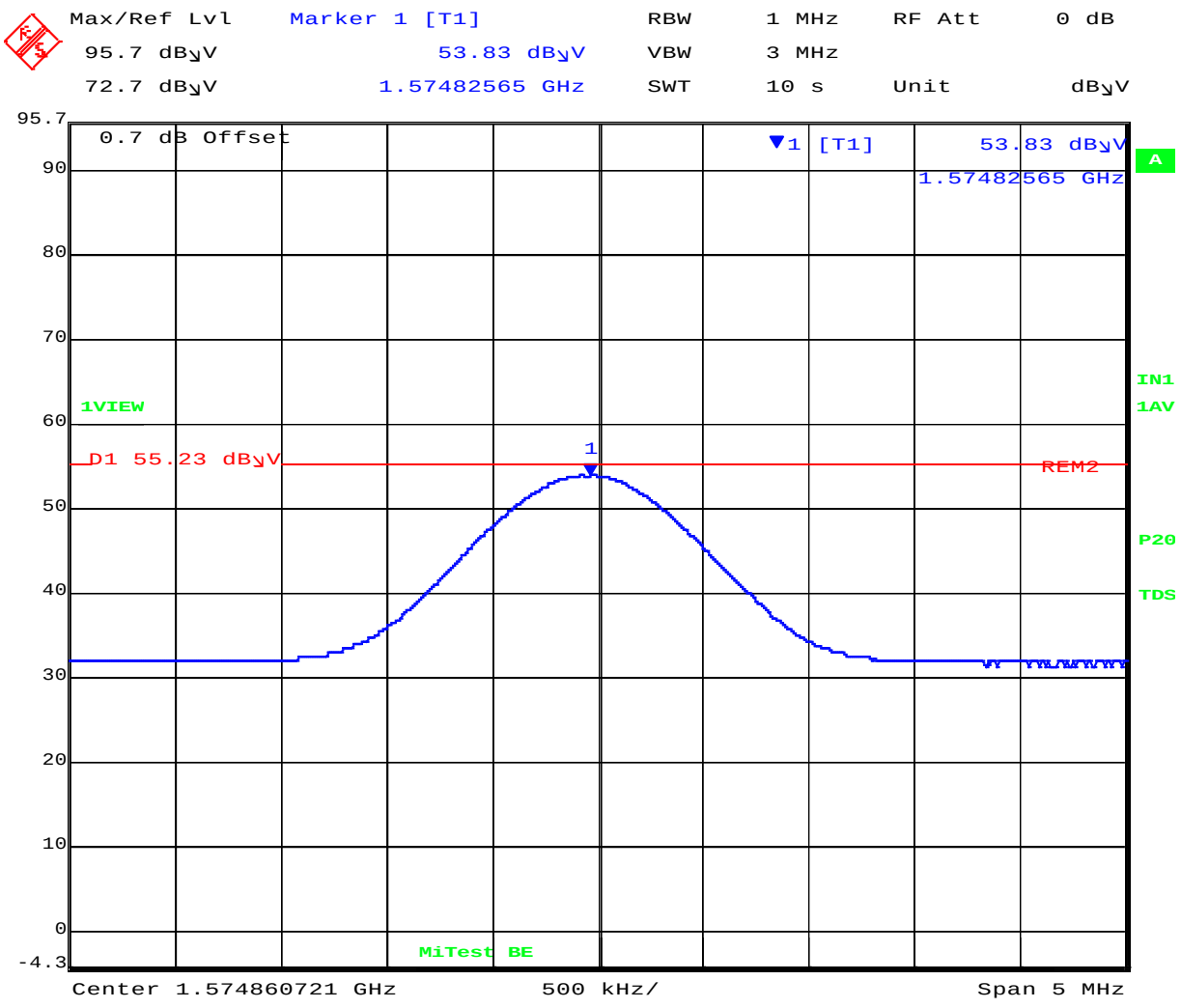
## Test Measurement Results




*Measurement includes +0.7dB offset for Duty Cycle Correction

| Equipment Configuration for GPS Band Emissions | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 3.75 KHz |
| **Power Setting:** | 17 | **Tested By:** | JMH |

**Test Measurement Results**



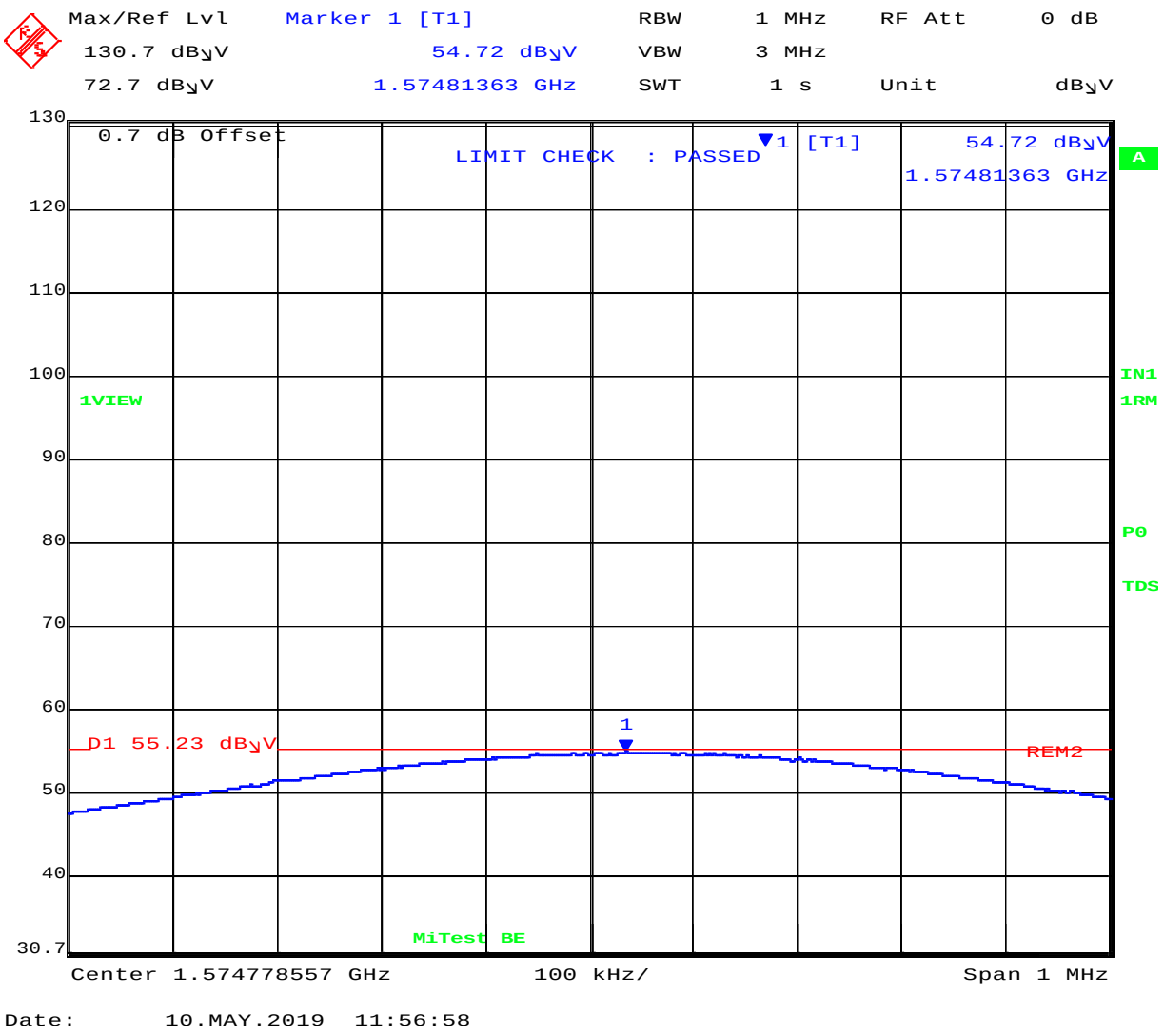

Date: 10.MAY.2019 15:42:43

*Measurement includes +0.7dB offset for Duty Cycle Correction

## Equipment Configuration for GPS Band Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 17 | **Tested By:** | JMH |

## Test Measurement Results

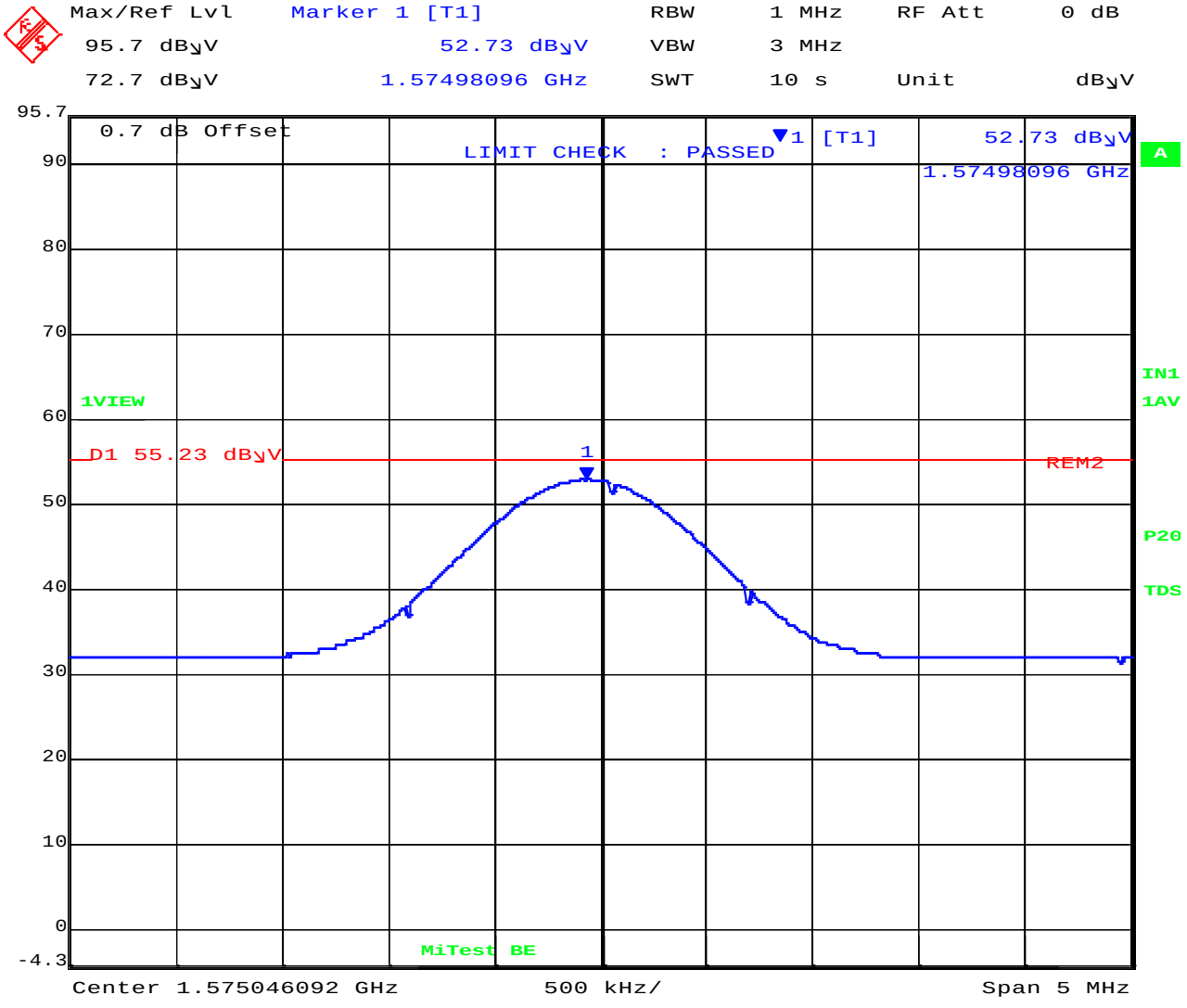



Date: 10.MAY.2019 11:56:58

*Measurement includes +0.7dB offset for Duty Cycle Correction

| Equipment Configuration for GPS Band Emissions | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 180 KHz |
| **Power Setting:** | 17 | **Tested By:** | JMH |

**Test Measurement Results**




Date: 10.MAY.2019 15:23:47

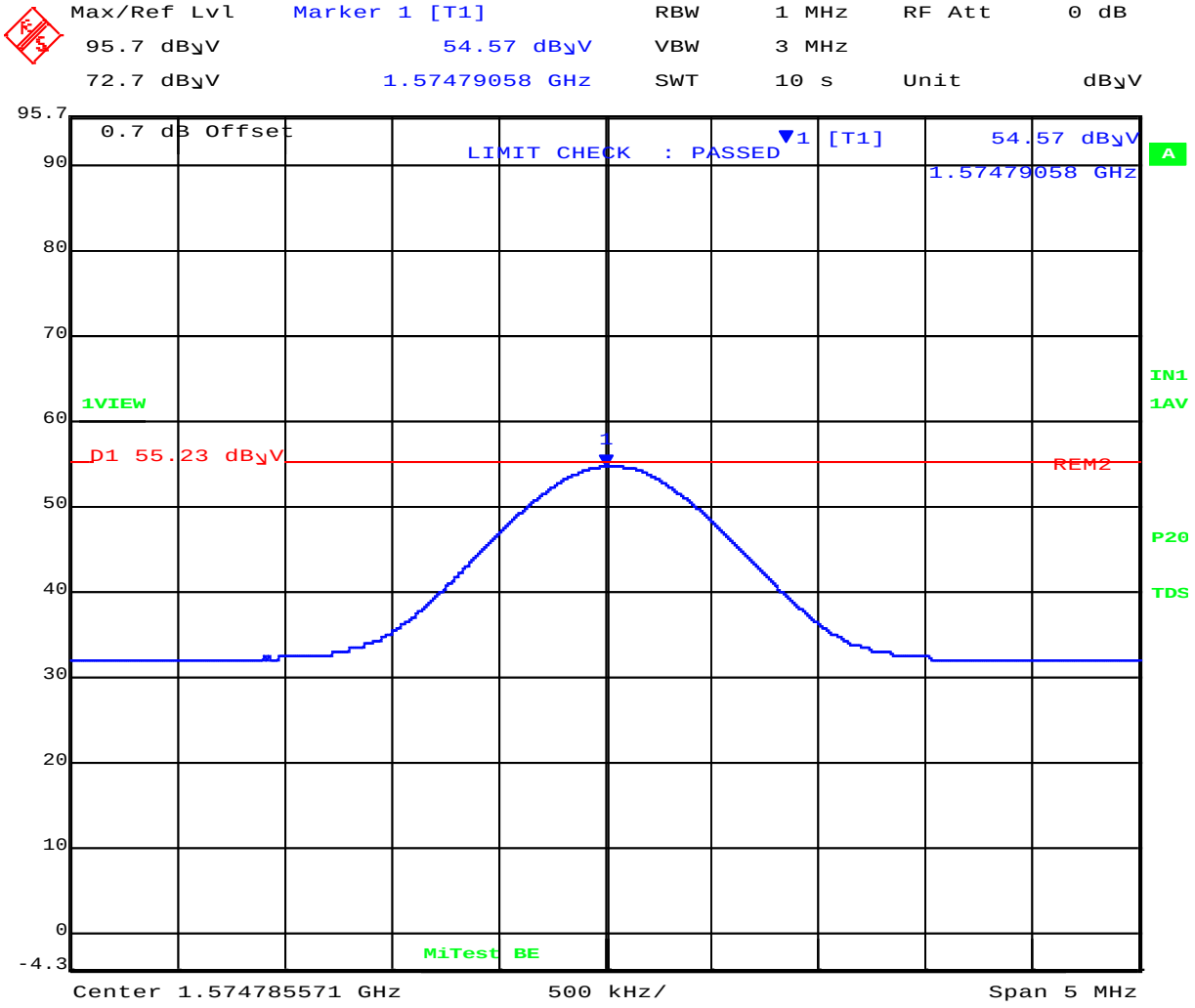
*Measurement includes +0.7dB offset for Duty Cycle Correction

## Yagi Antenna

**Equipment Configuration for GPS Band Emissions**

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi + 6dB Pad | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | BPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 3.75 KHz |
| **Power Setting:** | 20 | **Tested By:** | JMH |

**Test Measurement Results**



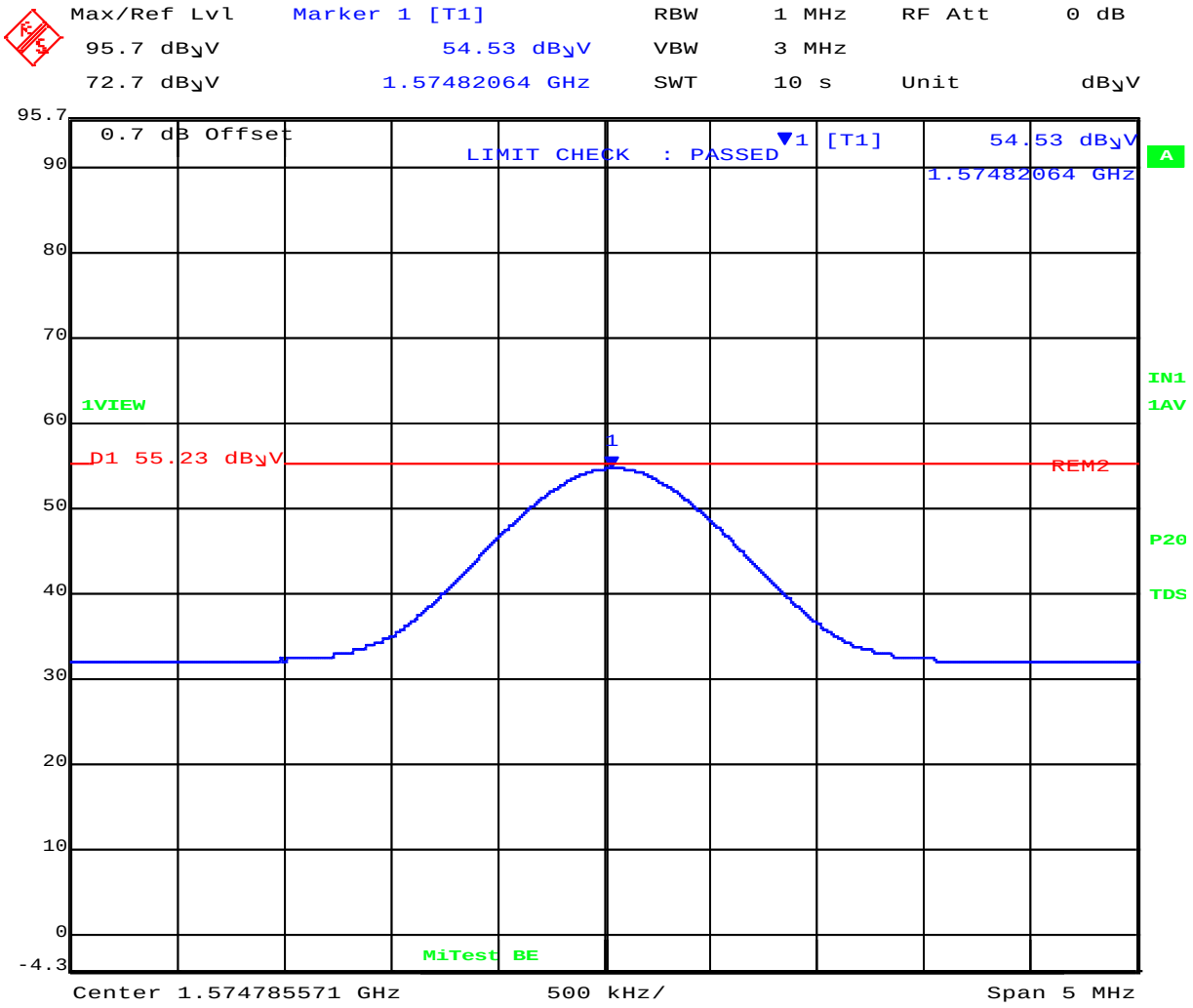

Date: 13.MAY.2019 10:12:46

*Measurement includes +0.7dB offset for Duty Cycle Correction

## Equipment Configuration for GPS Band Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi + 6dB Pad | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | BPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 20 | **Tested By:** | JMH |

## Test Measurement Results

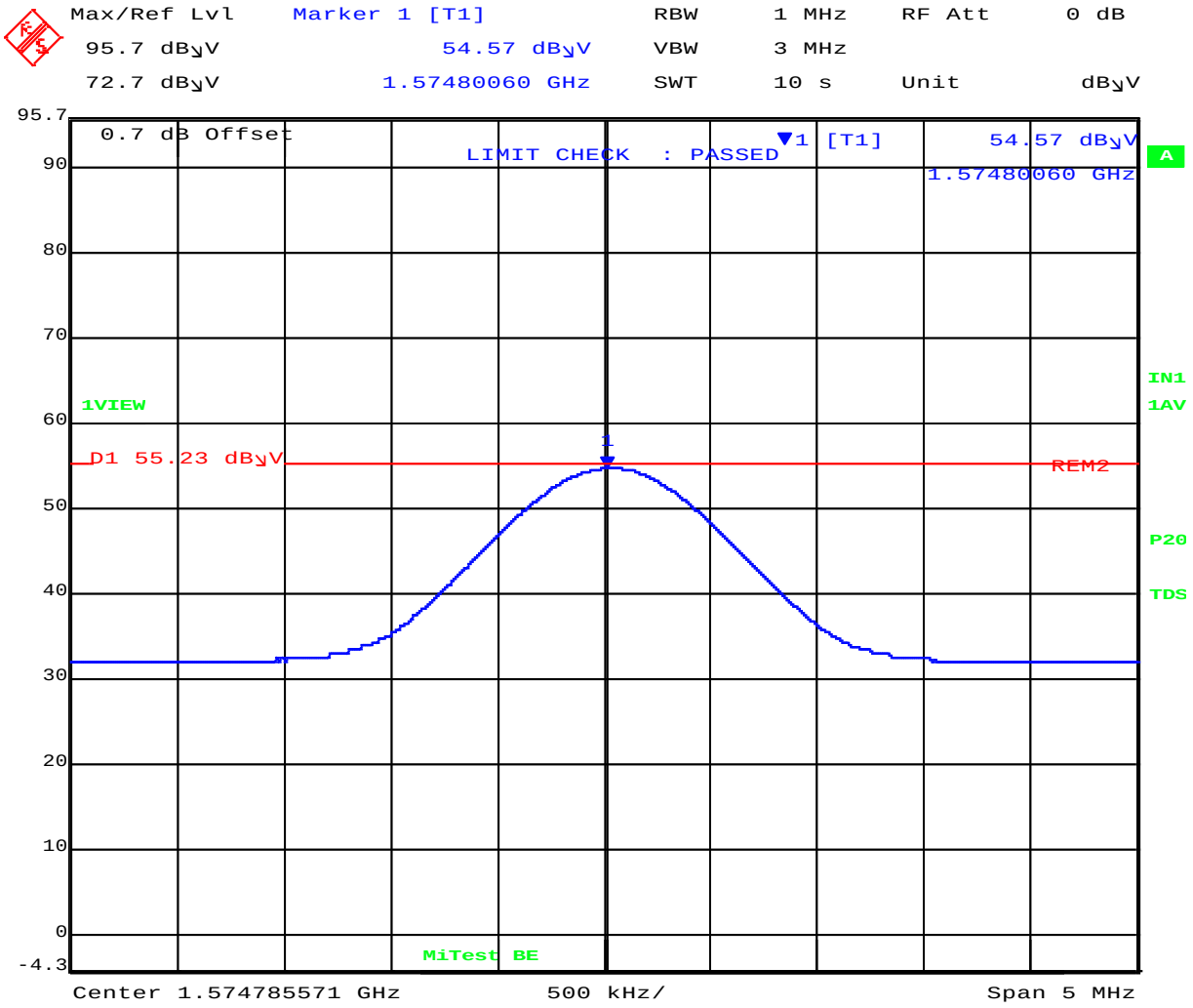



*Measurement includes +0.7dB offset for Duty Cycle Correction

## Equipment Configuration for GPS Band Emissions

| | | | |
|---|---|---|---|
| **Antenna:** | Yagi + 6dB Pad | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 3.75 KHz |
| **Power Setting:** | 20 | **Tested By:** | JMH |

## Test Measurement Results

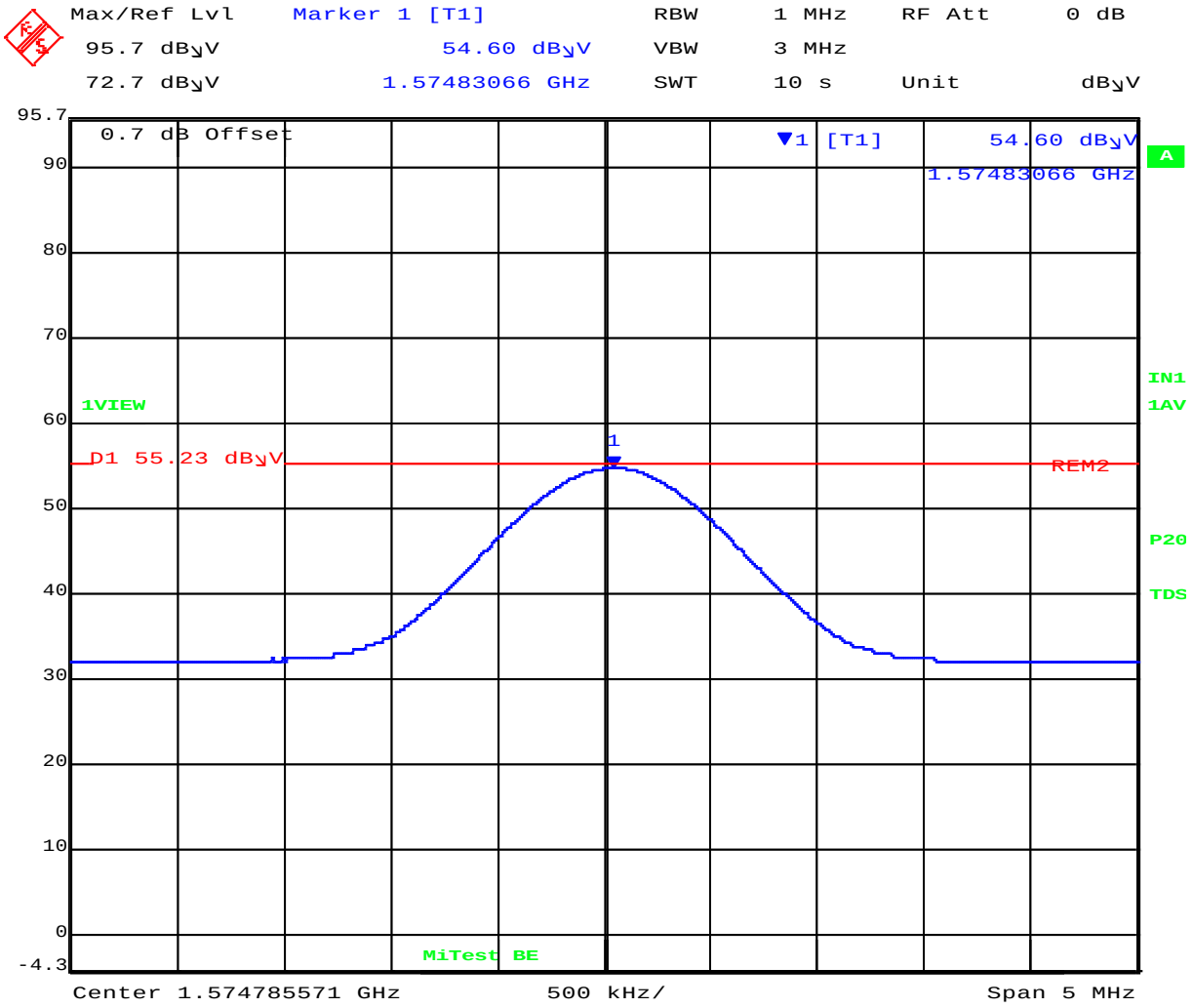



Date: 13.MAY.2019 09:34:17

*Measurement includes +0.7dB offset for Duty Cycle Correction

| Equipment Configuration for GPS Band Emissions | | | |
|---|---|---|---|
| **Antenna:** | Yagi + 6dB Pad | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 15 KHz |
| **Power Setting:** | 20 | **Tested By:** | JMH |

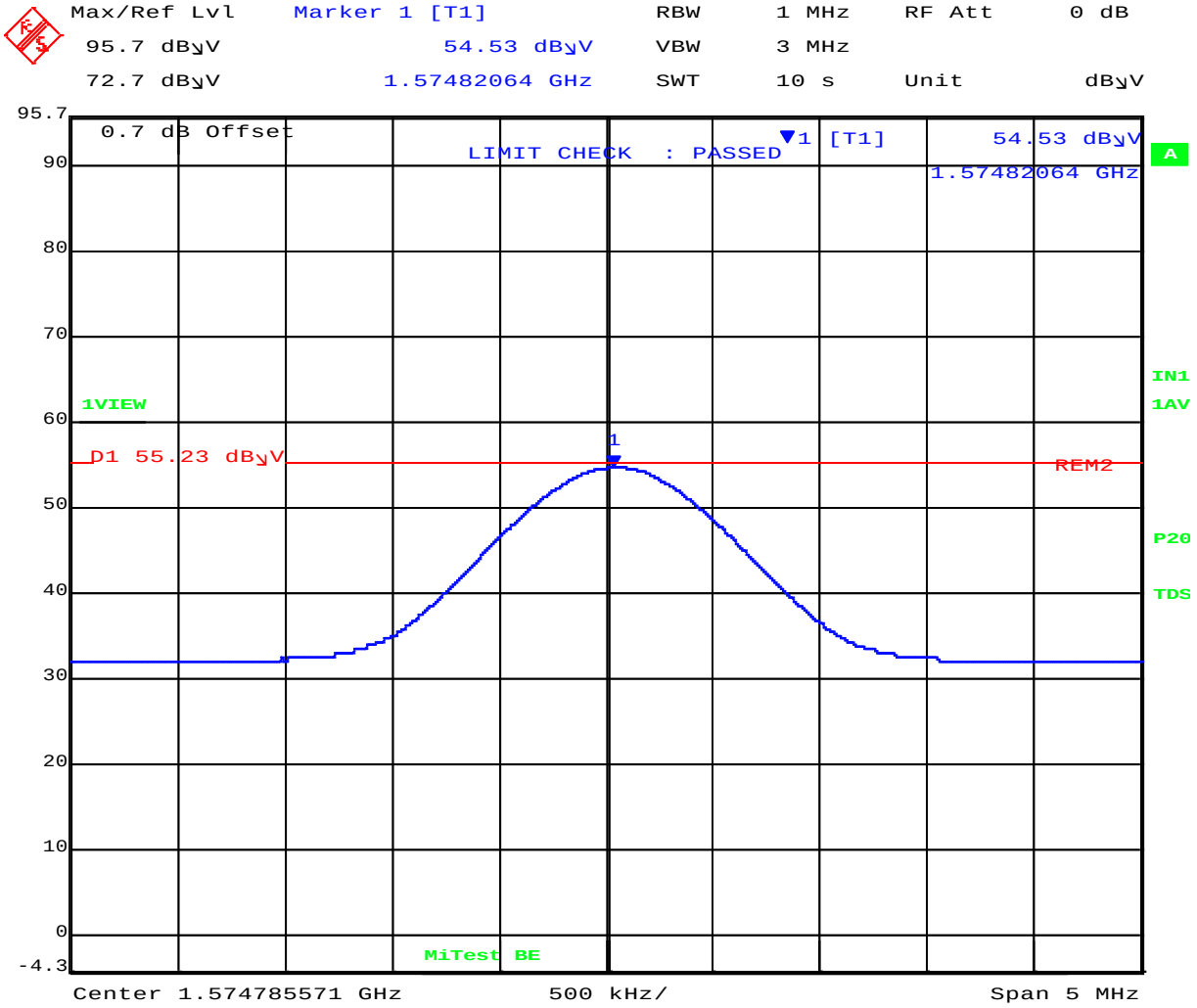
**Test Measurement Results**




*Measurement includes +0.7dB offset for Duty Cycle Correction

| Equipment Configuration for GPS Band Emissions | | | |
|---|---|---|---|
| **Antenna:** | Yagi + 6dB Pad | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | QPSK |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | 85 |
| **Channel Frequency (MHz):** | 787.50 | **Data Rate:** | 180 KHz |
| **Power Setting:** | 20 | **Tested By:** | JMH |

**Test Measurement Results**




Date: 13.MAY.2019 10:03:13

*Measurement includes +0.7dB offset for Duty Cycle Correction

## 9.5.3. Digital Emissions

| Test Conditions for Digital Emissions | | | |
|---|---|---|---|
| **Standard:** | FCC CFR 47:15.109 | **Ambient Temp. (ºC):** | 24.0 - 27.5 |
| **Test Heading:** | Radiated Emissions Limits | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | 15.109 (a) | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

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

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

**15.109 Radiated limits.**
((a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:

| Frequency (MHz) | Quasi-peak Limit (dBµV/m) | Measurement Distance (meters) |
|---|---|---|
| 30 to 88 | 40 | 3 |
| 88-216 | 43.5 | 3 |
| 216-960 | 46 | 3 |
| 960-1000 | 54 | 3 |

**(b) The field strength of radiated emissions from a Class A digital device, as determined at a distance of 10 meters, shall not exceed the following:**

| Frequency(MHz) | Quasi-peak Limit (dBµV/m) | Measurement Distance (meters) |
|---|---|---|
| 30 to 88 | 49.5 | 3 |
| 88-216 | 54 | 3 |
| 216-960 | 56.5 | 3 |
| 960-1000 | 60 | 3 |

**Traceability**

| Laboratory Measurement Uncertainty | |
|---|---|
| Measurement uncertainty | +5.6/ -4.5 dB |

## Digital Emissions 30-1000 MHz Class A

**Equipment Configuration for Radiated Digital Emissions (Class A)**

| | | | |
|---|---|---|---|
| **Antenna:** | Dipole | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | NA |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | NA |
| **Channel Frequency (MHz):** | 0.00 | **Data Rate:** | NA |
| **Power Setting:** | NA | **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 | 32.55 | 32.76 | 3.54 | -9.40 | 26.90 | MaxQP | Vertical | 98 | 268 | 49.5 | -22.6 | Pass |
| #2 | 193.02 | 48.11 | 4.43 | -16.50 | 36.04 | MaxQP | Vertical | 98 | 356 | 54.0 | -18.0 | Pass |
| #3 | 207.94 | 46.81 | 4.49 | -17.20 | 34.10 | MaxQP | Vertical | 113 | 4 | 54.0 | -19.9 | Pass |
| #4 | 320.02 | 49.29 | 4.91 | -13.90 | 40.30 | MaxQP | Vertical | 99 | 51 | 57.0 | -16.7 | Pass |
| Test Notes: EUT powered by AC/DC PS. | | | | | | | | | | | | |

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





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

## Digital Emissions 1-10 GHz Class A

| Equipment Configuration for Digital Emissions 1-10 GHx | | | |
|---|---|---|---|
| **Antenna:** | Not Applicable | **Variant:** | NB IOT |
| **Antenna Gain (dBi):** | Not Applicable | **Modulation:** | Not Applicable |
| **Beam Forming Gain (Y):** | Not Applicable | **Duty Cycle (%):** | Not Applicable |
| **Channel Frequency (MHz):** | 0.00 | **Data Rate:** | Not Applicable |
| **Power Setting:** | Not Applicable | **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 | 6064.07 | 68.53 | -2.84 | -10.00 | 55.69 | Max Peak | Vertical | 178 | 32 | 80.0 | -24.3 | Pass |
| #2 | 6064.07 | 68.33 | -2.84 | -10.00 | 55.49 | Max Avg | Vertical | 178 | 32 | 60.0 | -4.5 | Pass |
| #3 | 6068.87 | 71.37 | -2.85 | -9.84 | 57.68 | Max Peak | Horizontal | 101 | 295 | 80.0 | -22.3 | Pass |
| #4 | 6068.87 | 69.94 | -2.85 | -9.84 | 57.25 | Max Avg | Horizontal | 101 | 295 | 60.0 | -2.8 | Pass |
| #5 | 6068.92 | 71.29 | -2.85 | -9.84 | 58.60 | Max Peak | Vertical | 123 | 194 | 80.0 | -21.4 | Pass |
| #6 | 6068.92 | 68.30 | -2.85 | -9.84 | 55.61 | Max Avg | Vertical | 123 | 194 | 60.0 | -4.4 | Pass |
| Test Notes: EUT powered up | | | | | | | | | | | | |

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

## 9.5.4. AC Wireline Emissions

| Test Conditions for AC Mains Conducted Emissions | | | |
|---|---|---|---|
| **Standard:** | FCC CFR 47:15.107 | **Ambient Temp. (ºC):** | 24.0 - 27.5 |
| **Test Heading:** | AC Mains Conducted Limits | **Rel. Humidity (%):** | 32 - 45 |
| **Standard Section(s):** | 15.107 (a) | **Pressure (mBars):** | 999 - 1001 |
| **Reference Document(s):** | See Normative References | | |

**Test Method**

The test method shall be in accordance with ANSI C63.4 and the Artificial Mains Networks (AMNs) shall be connected to the AC mains power source. The measurement frequency range extends from 150 kHz to 30 MHz. When the EUT is a transmitter operating at frequencies below 30 MHz, then the exclusion band for transmitters applies for measurements in the transmit mode of operation.

**Test Procedure for AC Mains Conducted Emissions Measurement**
The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

**15.107 Conducted limits.**
(a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the band edges.

| Frequency of emission (MHz) | Conducted limit (dBµV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

*Decreases with the logarithm of the frequency.

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

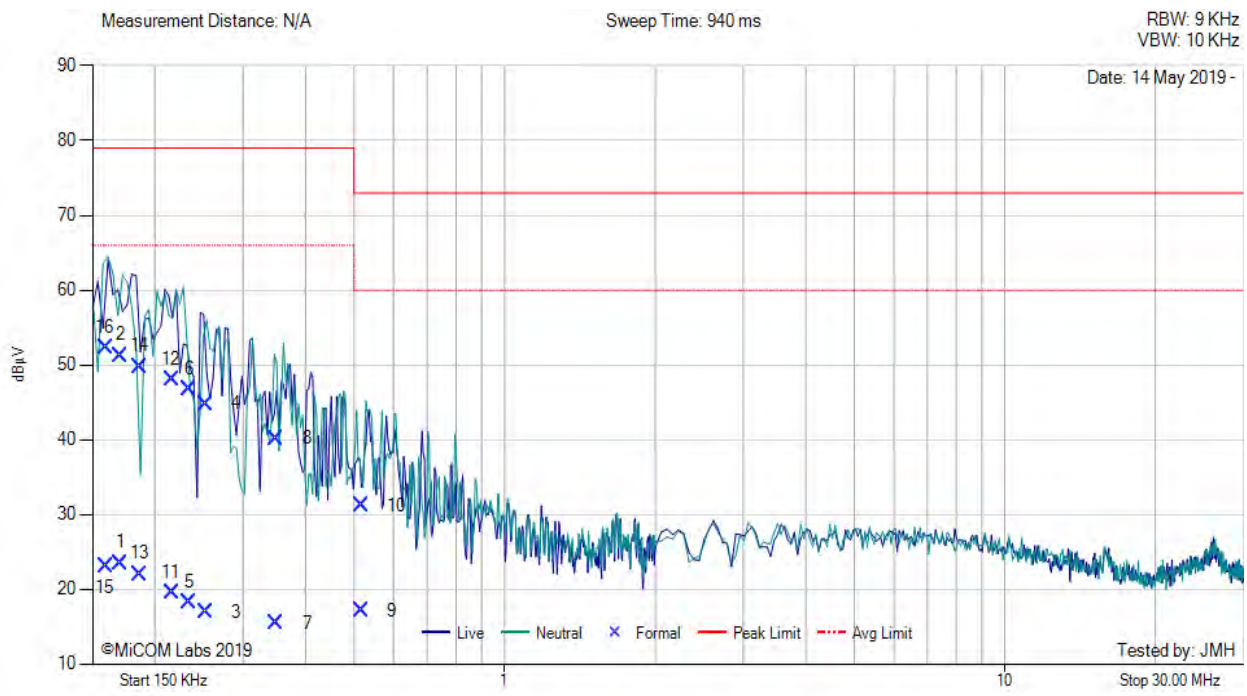
| Frequency of emission (MHz) | Conducted limit (dBµV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 79 | 66 |
| 0.5-30 | 73 | 60 |

**Traceability**
All conducted emission measurements are traceable to national standards. The uncertainty of measurement at a confidence level of not less than 95 %, with a coverage factor of k=2, in the range 9 kHz – 30 MHz (Average & Quasi-peak) is ±2.64 dB.

| Laboratory Measurement Uncertainty | |
|---|---|
| Measurement uncertainty | ±2.64 dB |

| | | | |
|---|---|---|---|
| Model: | RU700A 1.0 | Configuration tested: | AC/DC PS |
| Input power: | 120$V_{AC}$/60Hz | Standard: | FCC Class A |

Variant: , Test Freq: 0.00 MHz

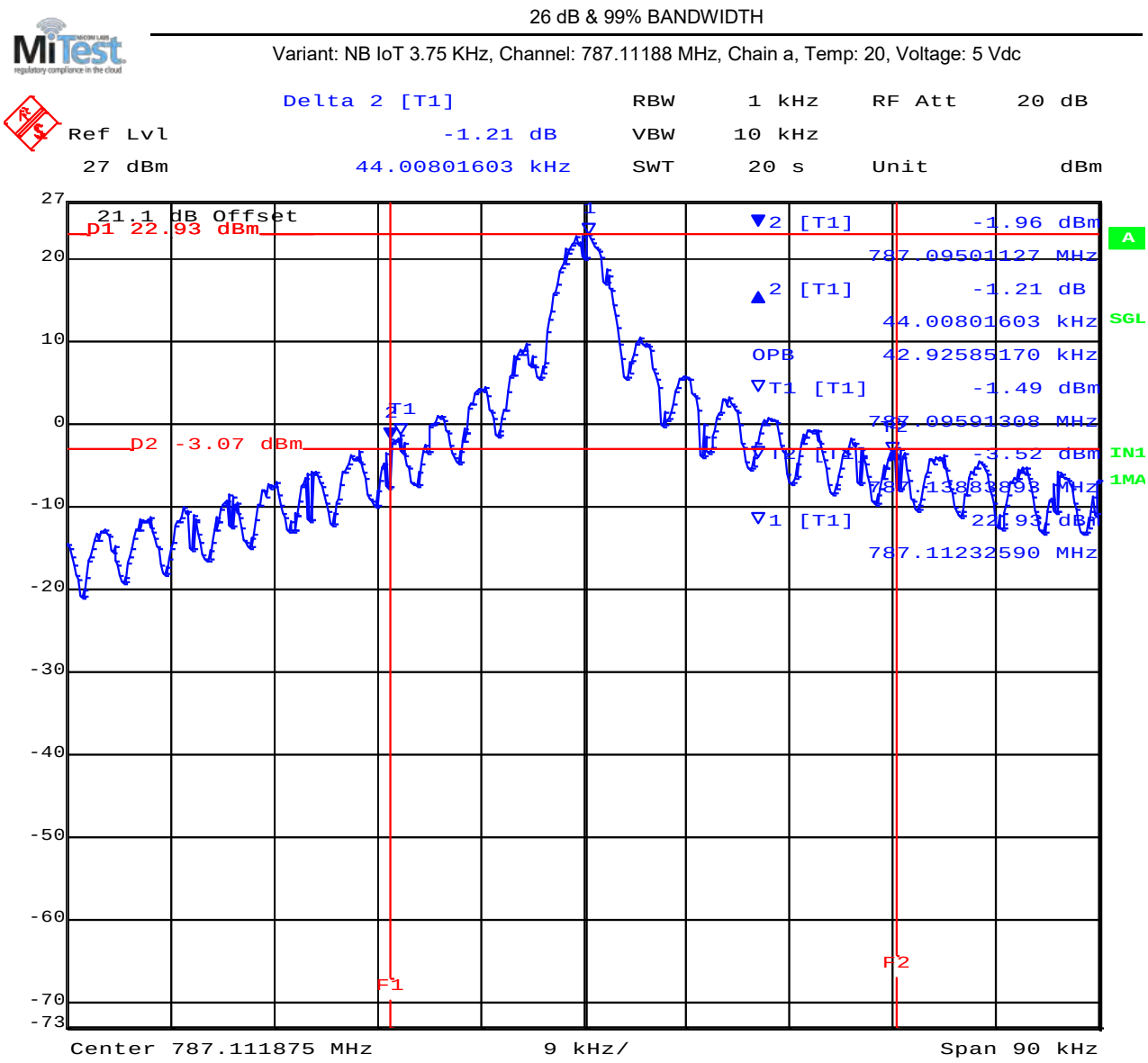



| Num | Frequency MHz | Raw dBµV | Cable Loss dB | Factor dB | Total Correction dBµV | Corrected Value dBµV | Measurement Type | Line | Limit dBµV/m | Margin dB | Pass /Fail |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.170 | 13.55 | 0.05 | 9.92 | 9.97 | 23.52 | Max Avg | Neutral | 66.0 | -42.5 | Pass |
| 2 | 0.170 | 41.31 | 0.05 | 9.92 | 9.97 | 51.28 | Max Qp | Neutral | 79.0 | -27.7 | Pass |
| 3 | 0.253 | 6.98 | 0.07 | 9.92 | 9.99 | 16.97 | Max Avg | Live | 66.0 | -49.0 | Pass |
| 4 | 0.253 | 34.80 | 0.07 | 9.92 | 9.99 | 44.79 | Max Qp | Live | 79.0 | -34.2 | Pass |
| 5 | 0.234 | 8.30 | 0.07 | 9.92 | 9.99 | 18.29 | Max Avg | Neutral | 66.0 | -47.7 | Pass |
| 6 | 0.234 | 36.72 | 0.07 | 9.92 | 9.99 | 46.71 | Max Qp | Neutral | 79.0 | -32.3 | Pass |
| 7 | 0.350 | 5.57 | 0.04 | 9.92 | 9.96 | 15.53 | Max Avg | Neutral | 66.0 | -50.5 | Pass |
| 8 | 0.350 | 30.21 | 0.04 | 9.92 | 9.96 | 40.17 | Max Qp | Neutral | 79.0 | -38.8 | Pass |
| 9 | 0.516 | 7.08 | 0.09 | 9.92 | 10.01 | 17.09 | Max Avg | Neutral | 60.0 | -42.9 | Pass |
| 10 | 0.516 | 21.16 | 0.09 | 9.92 | 10.01 | 31.17 | Max Qp | Neutral | 73.0 | -41.8 | Pass |
| 11 | 0.216 | 9.56 | 0.06 | 9.92 | 9.98 | 19.54 | Max Avg | Neutral | 66.0 | -46.5 | Pass |
| 12 | 0.216 | 38.09 | 0.06 | 9.92 | 9.98 | 48.07 | Max Qp | Neutral | 79.0 | -30.9 | Pass |
| 13 | 0.186 | 12.09 | 0.06 | 9.92 | 9.98 | 22.07 | Max Avg | Neutral | 66.0 | -43.9 | Pass |
| 14 | 0.186 | 39.80 | 0.06 | 9.92 | 9.98 | 49.78 | Max Qp | Neutral | 79.0 | -29.2 | Pass |
| 15 | 0.159 | 13.11 | 0.05 | 9.92 | 9.97 | 23.08 | Max Avg | Neutral | 66.0 | -42.9 | Pass |
| 16 | 0.159 | 42.36 | 0.05 | 9.92 | 9.97 | 52.33 | Max Qp | Neutral | 79.0 | -26.7 | Pass |

**Test Notes:** Powered by AC DC PS

# A. APPENDIX - GRAPHICAL IMAGES

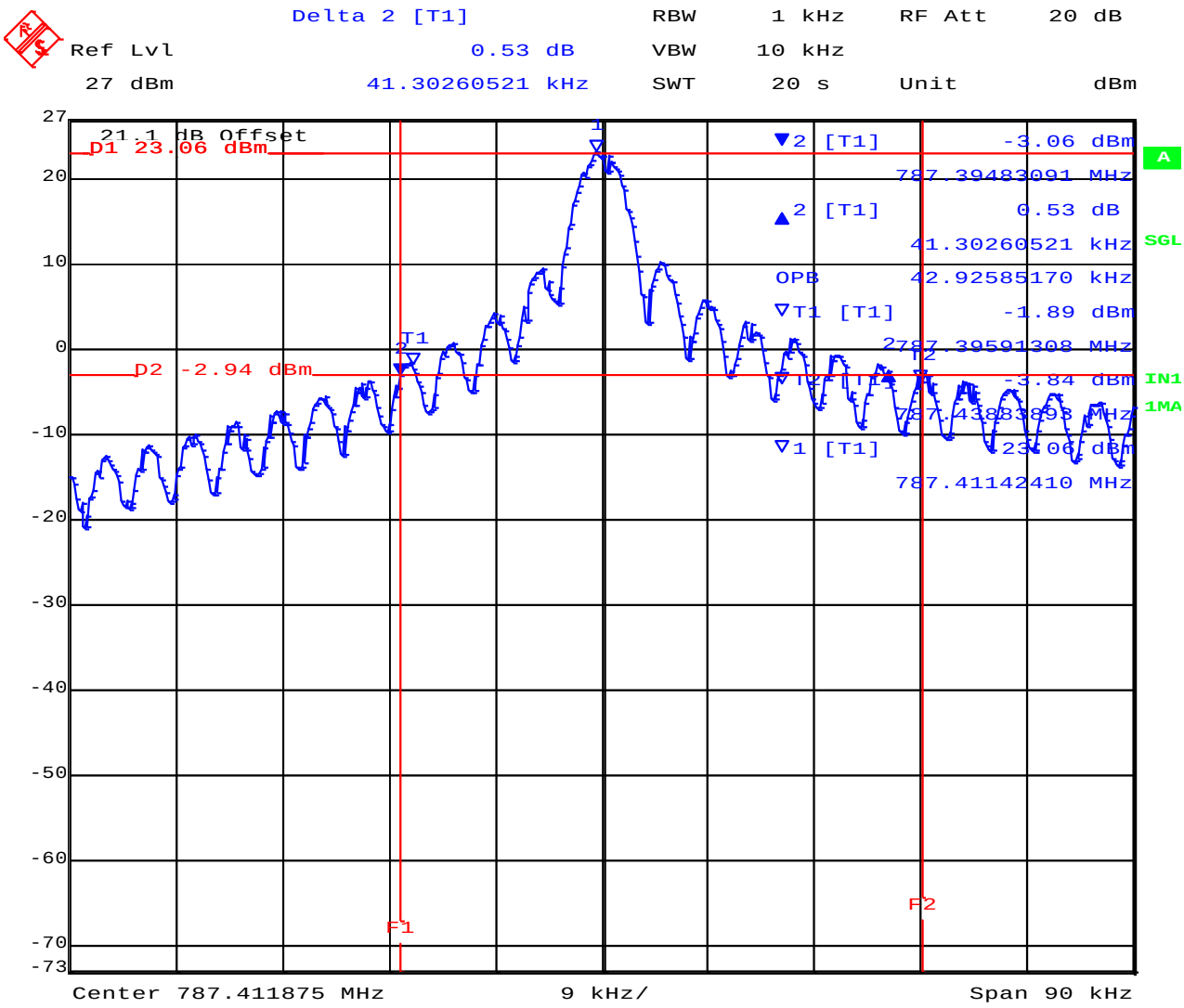
## A.1. 26 dB & 99% Bandwidth




back to matrix

26 dB & 99% BANDWIDTH

Variant: NB IoT 3.75 KHz, Channel: 787.41188 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

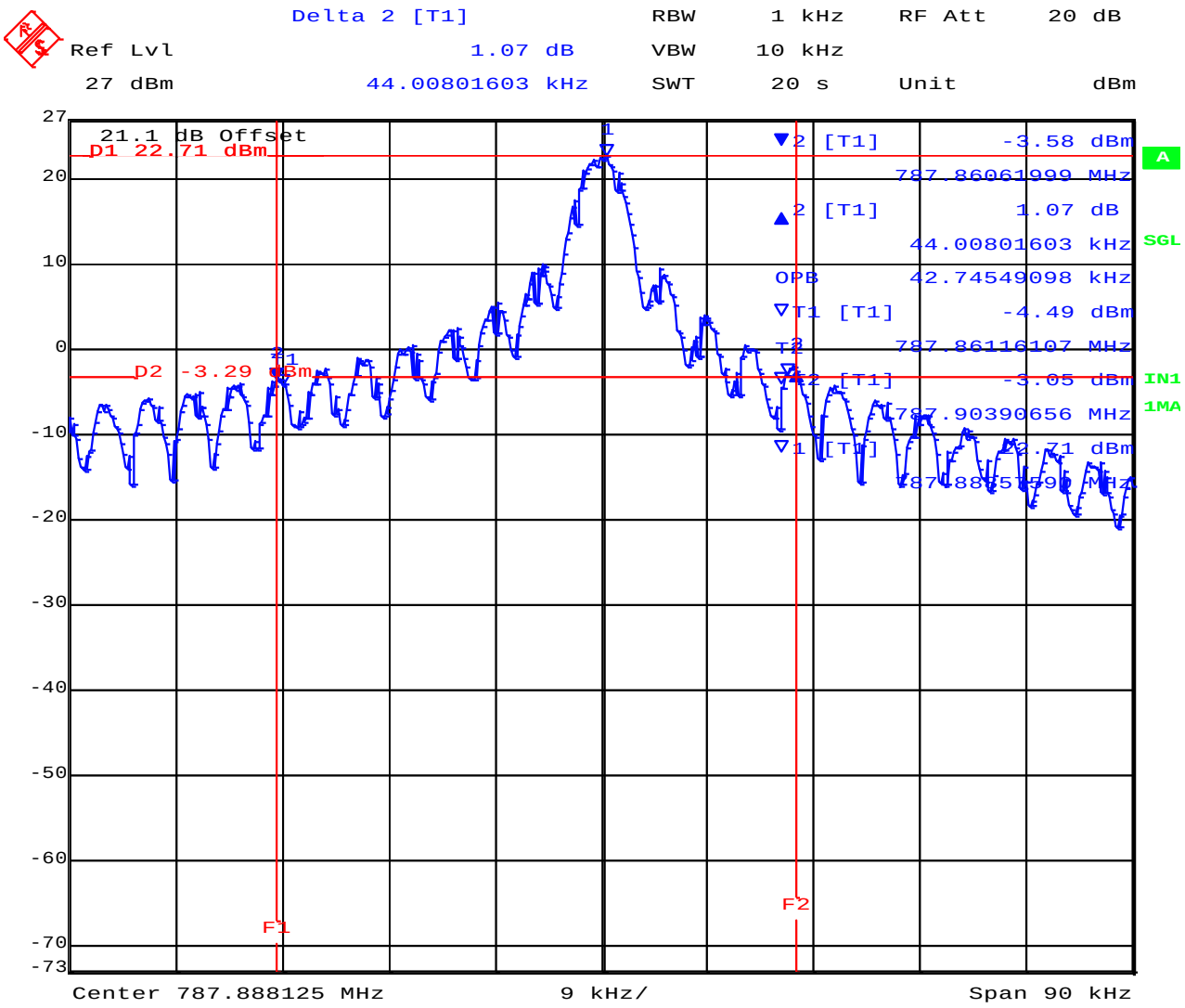



Date: 15.MAY.2019 16:42:43

back to matrix

## 26 dB & 99% BANDWIDTH

Variant NB IoT 3.75 KHz, Channel: 787.88813 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



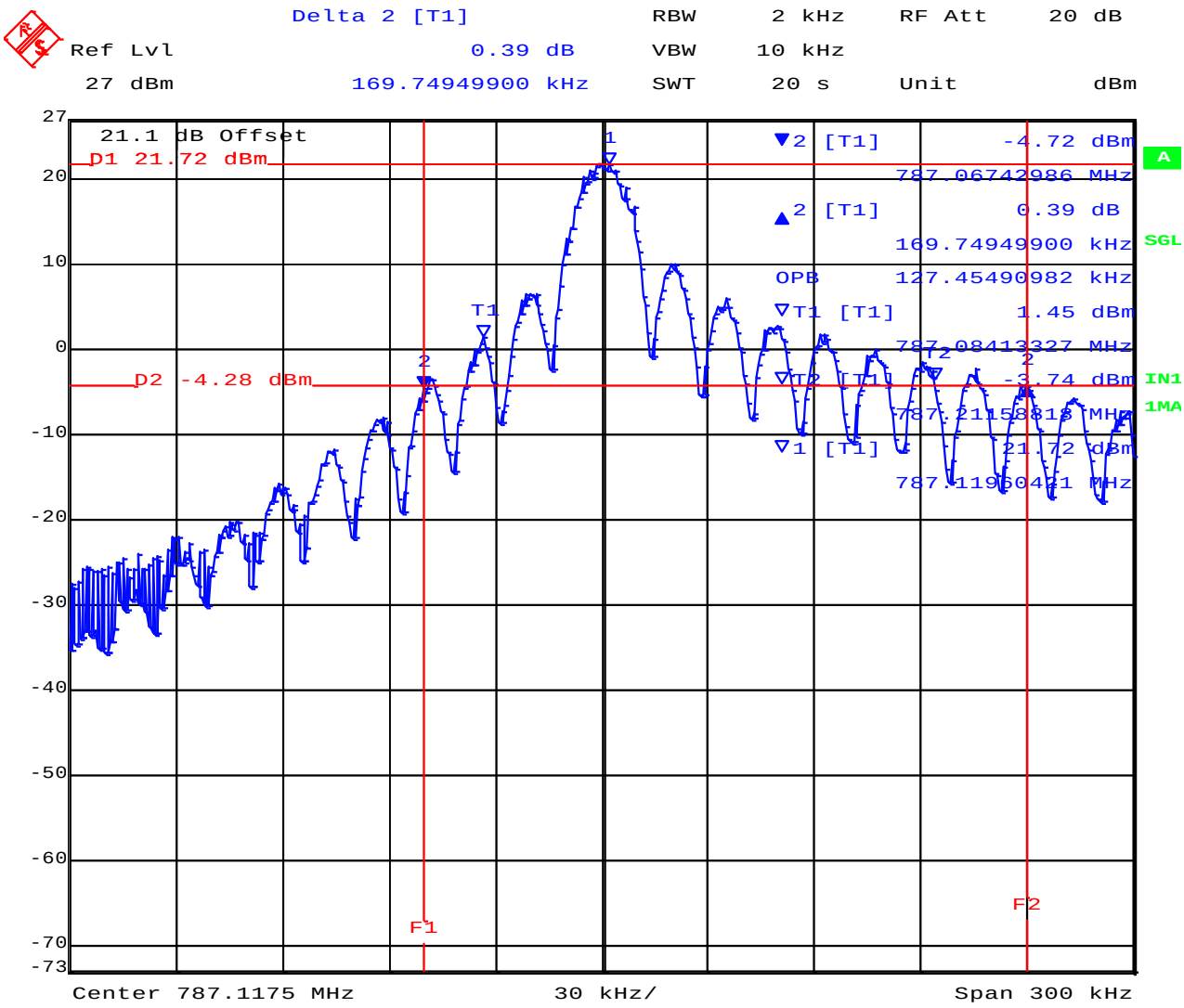

Date: 15.MAY.2019 17:01:11

| 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 : 2425.619 MHz : -11.605 dBm<br>M2 : 2425.988 MHz : -5.416 dBm<br>Delta1 : 689 KHz : 0.927 dB<br>T1 : 2425.379 MHz : -24.326 dBm<br>T2 : 2426.573 MHz : -21.875 dBm<br>OBW : 1.194 MHz | Channel Frequency: 2426.00 MHz |

back to matrix

26 dB & 99% BANDWIDTH

Variant: NB IOT 15 KHz, Channel: 787.1175 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

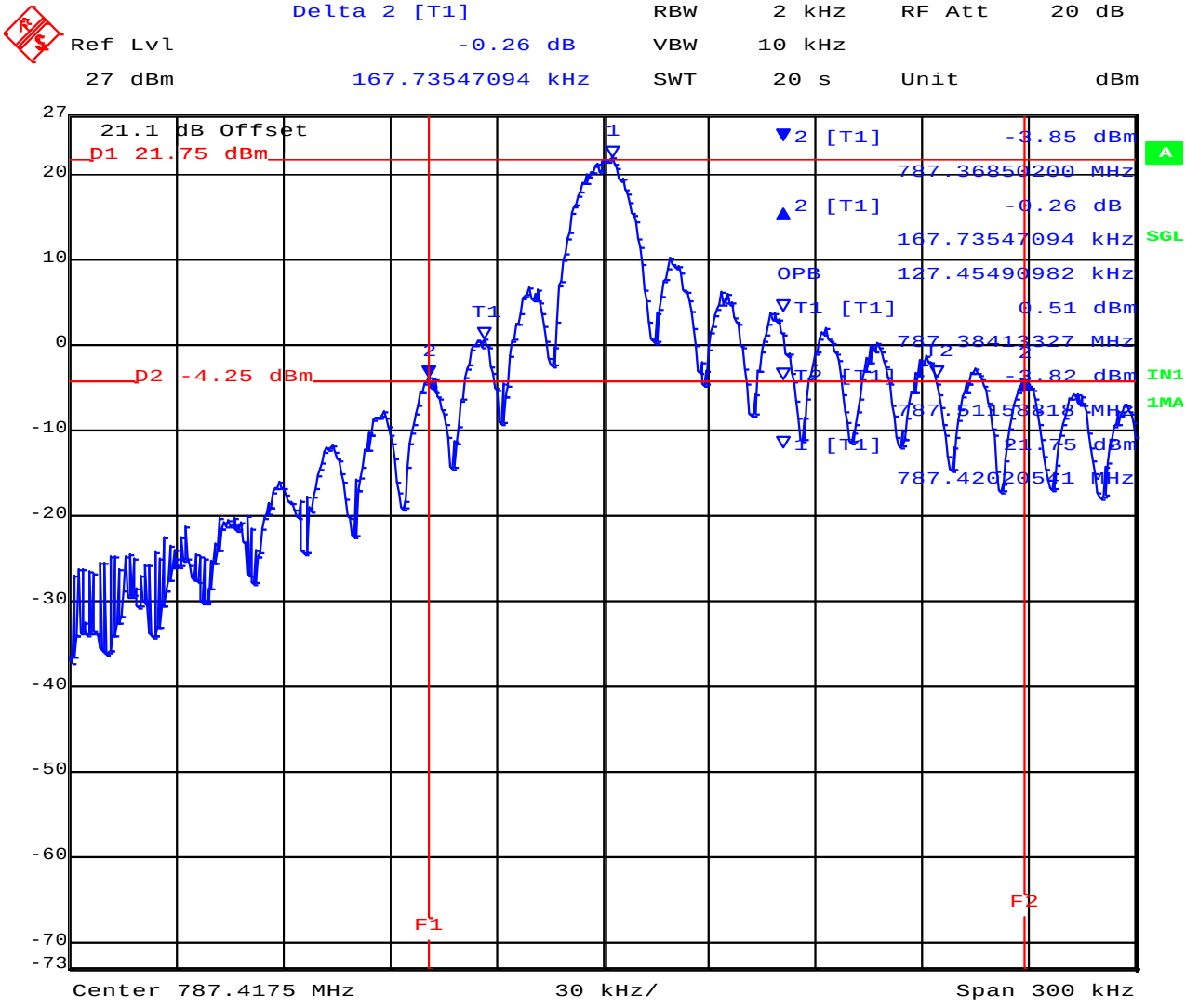



Date: 15.MAY.2019 17:18:25

back to matrix

26 dB & 99% BANDWIDTH

Variant NB IOT 15 KHz, Channel: 787.4175 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

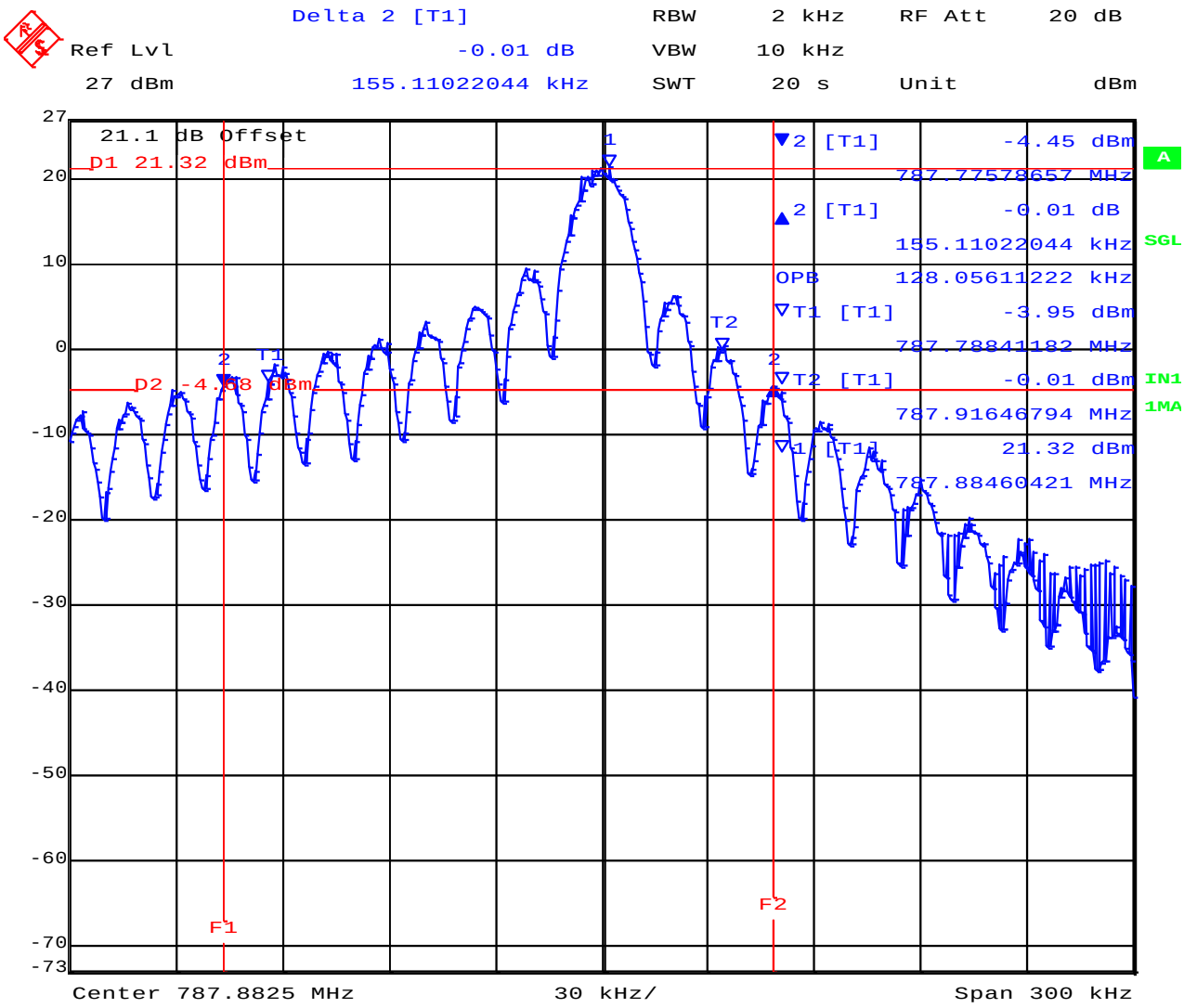



Date: 15.MAY.2019 17:25:34

back to matrix

26 dB & 99% BANDWIDTH

Variant NB IOT 15 KHz, Channel: 787.8825 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

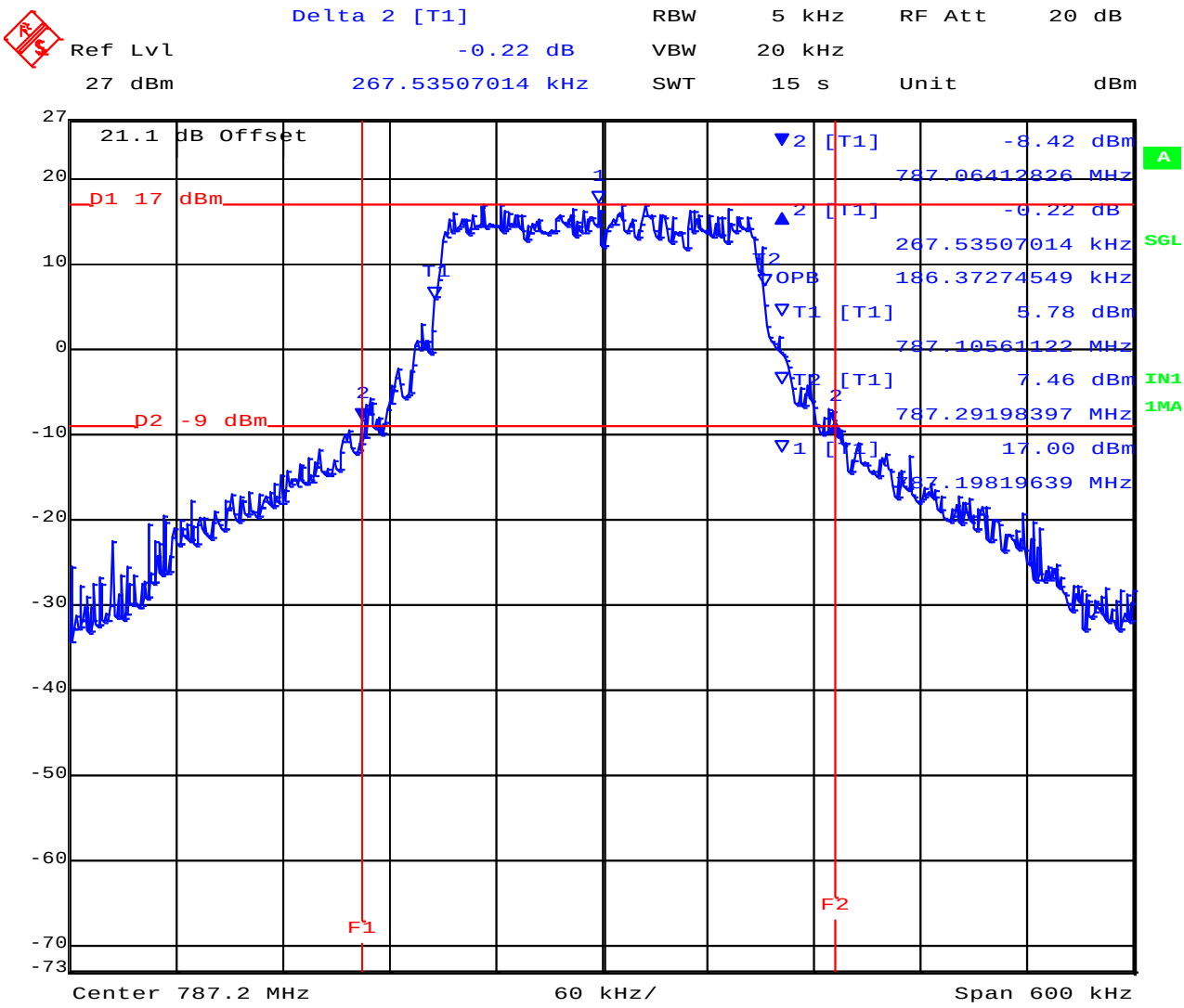



Date: 15.MAY.2019 17:31:08

back to matrix

## 26 dB & 99% BANDWIDTH

Variant: NB IOT 180 KHz, Channel: 787.2 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

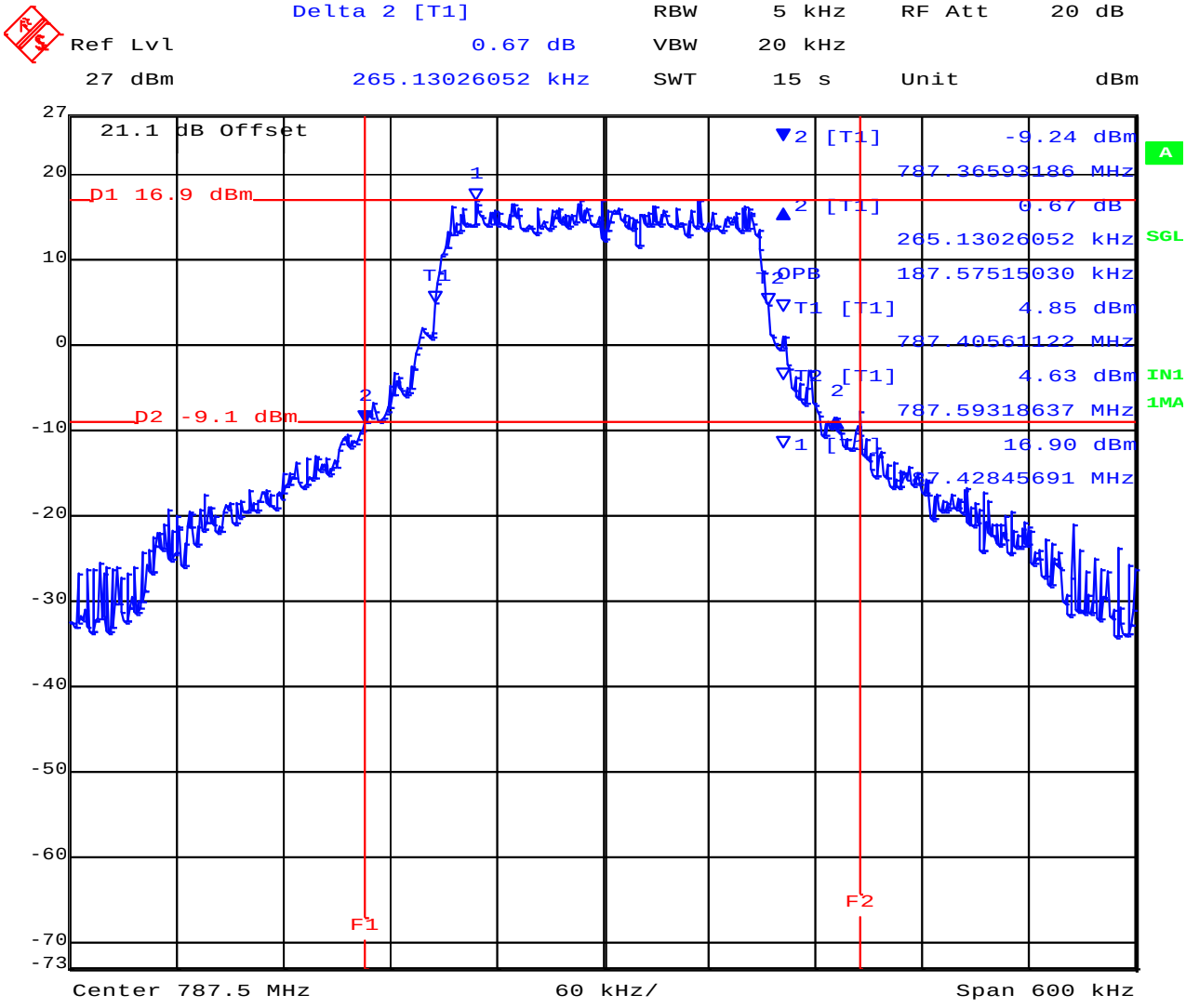



Date: 15.MAY.2019 16:16:58

back to matrix

26 dB & 99% BANDWIDTH

Variant NB IOT 180 KHz, Channel: 787.5 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

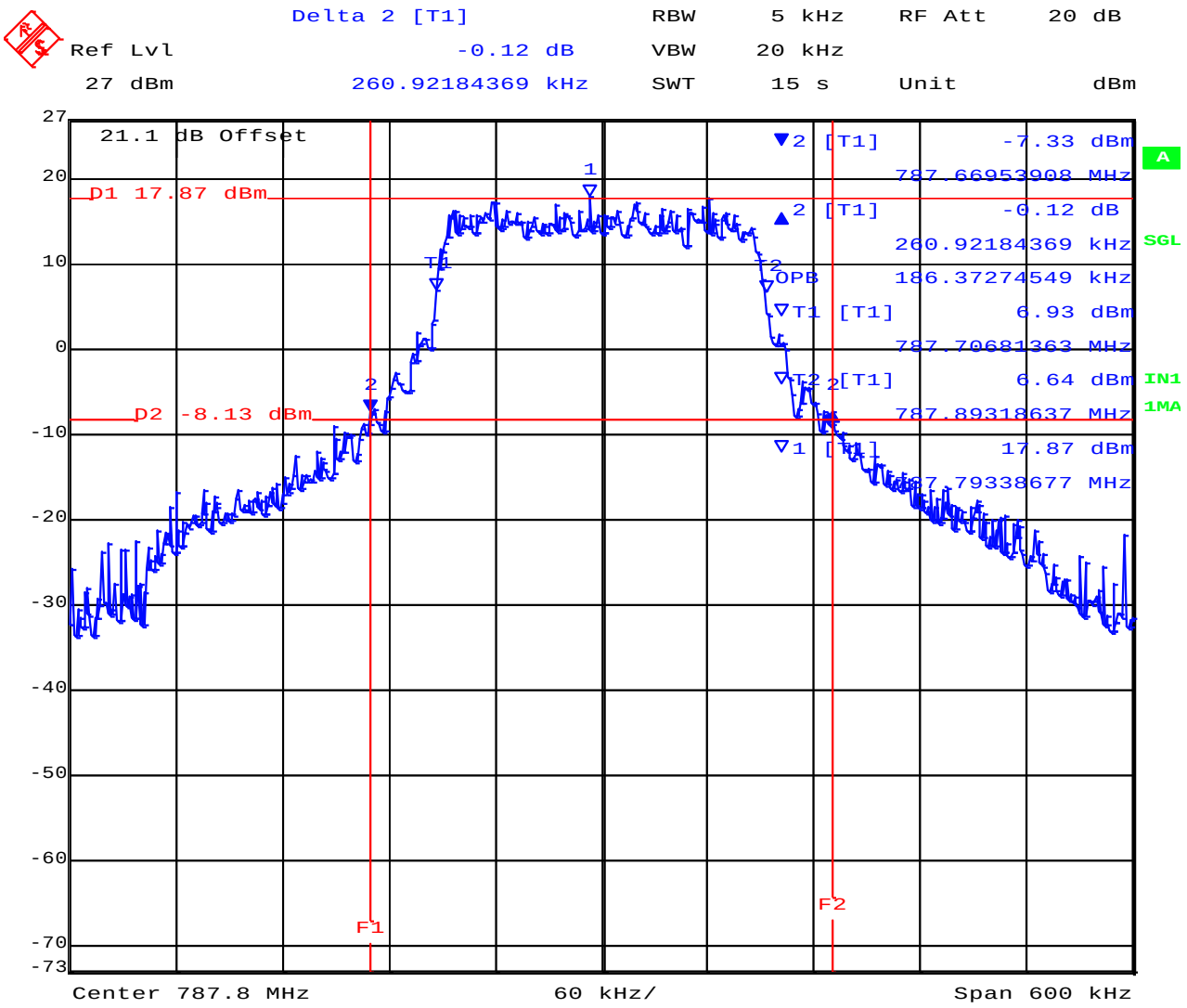



Date: 15.MAY.2019 16:12:39

back to matrix

26 dB & 99% BANDWIDTH

Variant NB IOT 180 KHz, Channel: 787.8 MHz, Chain a, Temp: 20, Voltage: 5 Vdc




Date: 15.MAY.2019 16:22:23

back to matrix

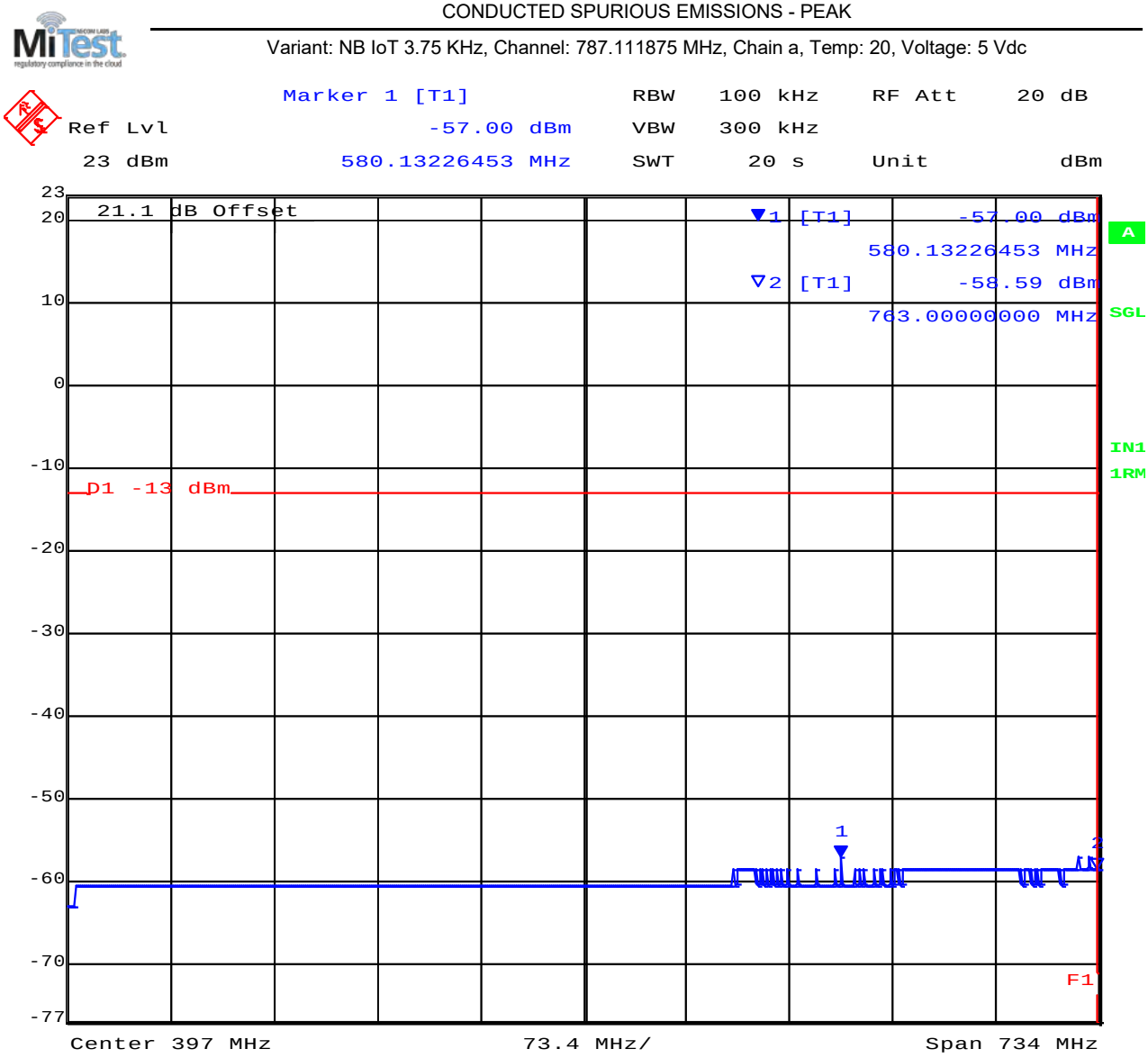
# A.2. Emissions

## A.2.1. Conducted Emissions

### A.2.1.1. Conducted Spurious Emissions

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.111875 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

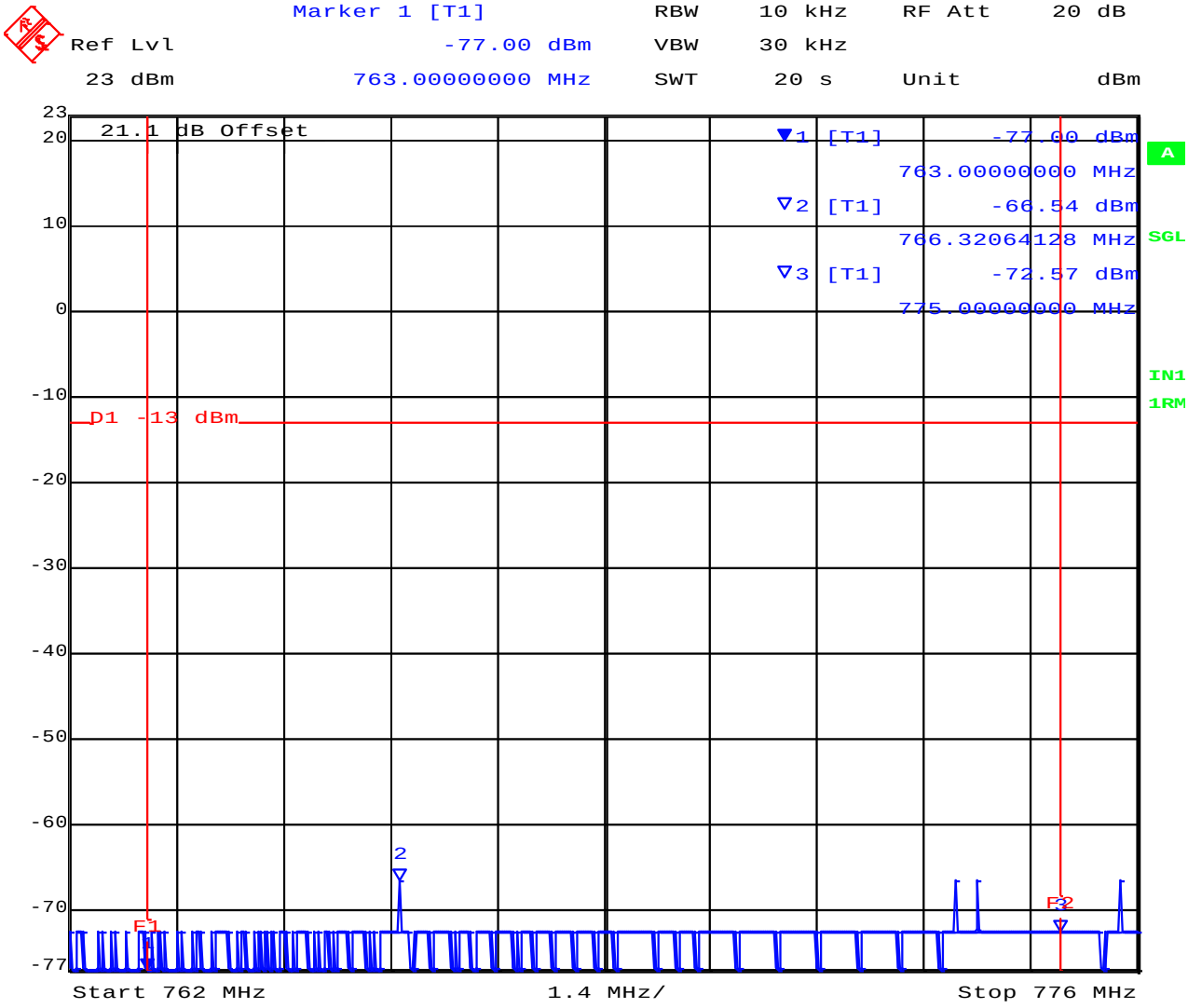



Date: 16.MAY.2019 11:22:42

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.111875 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

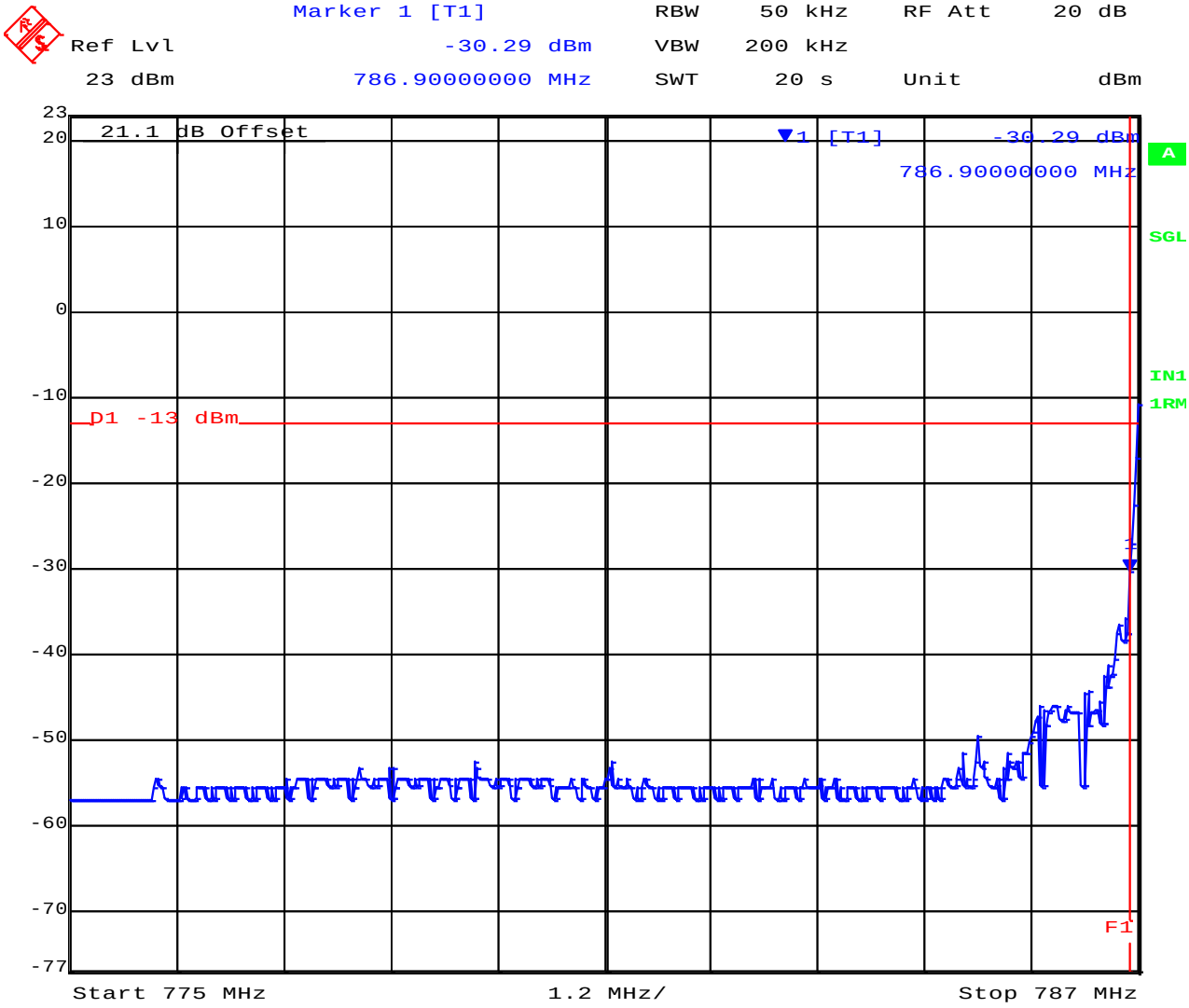



Date: 16.MAY.2019 11:13:42

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.111875 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

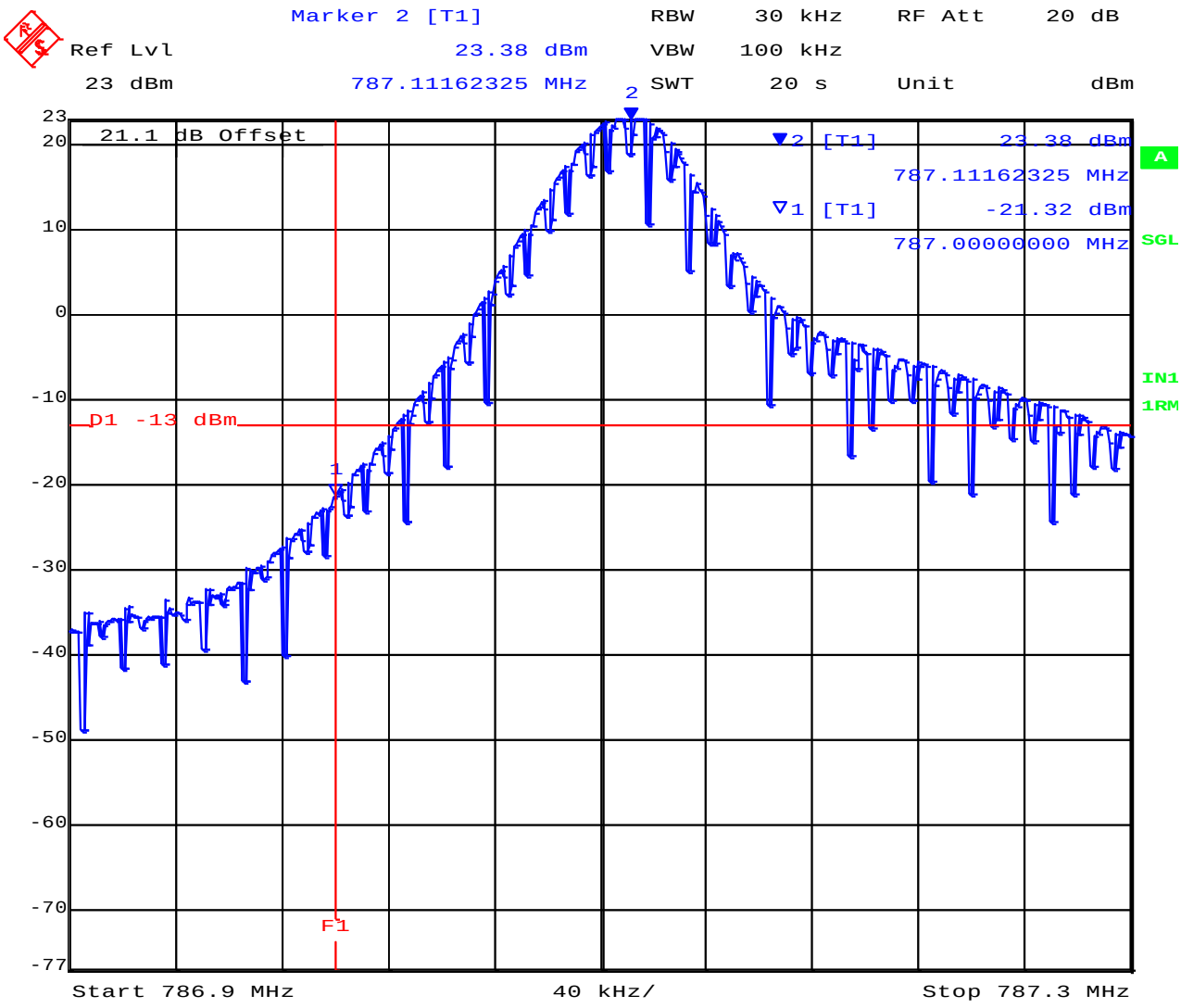



Date: 16.MAY.2019 13:16:52

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.111875 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

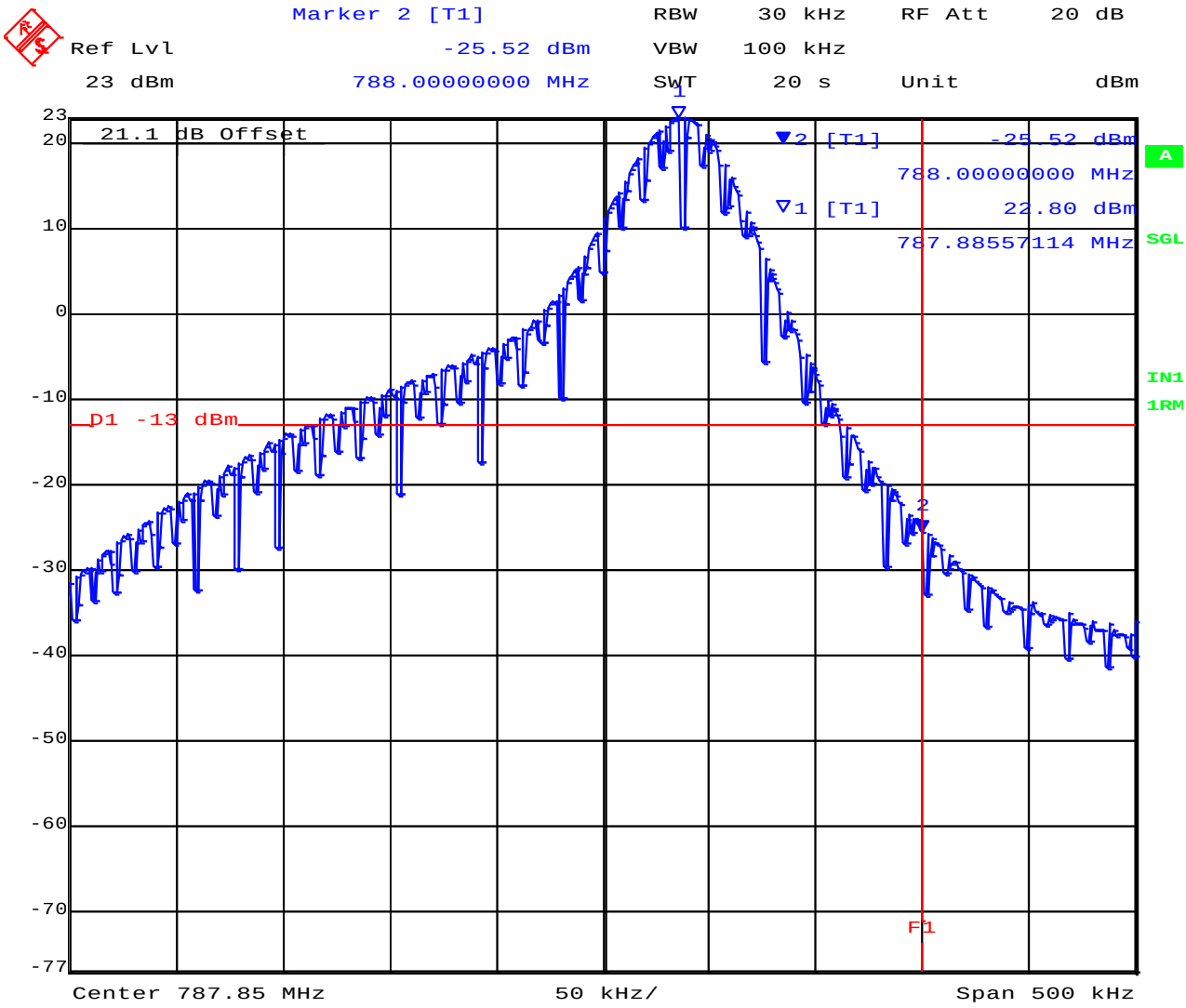



Date: 16.MAY.2019 10:00:18

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.888125 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

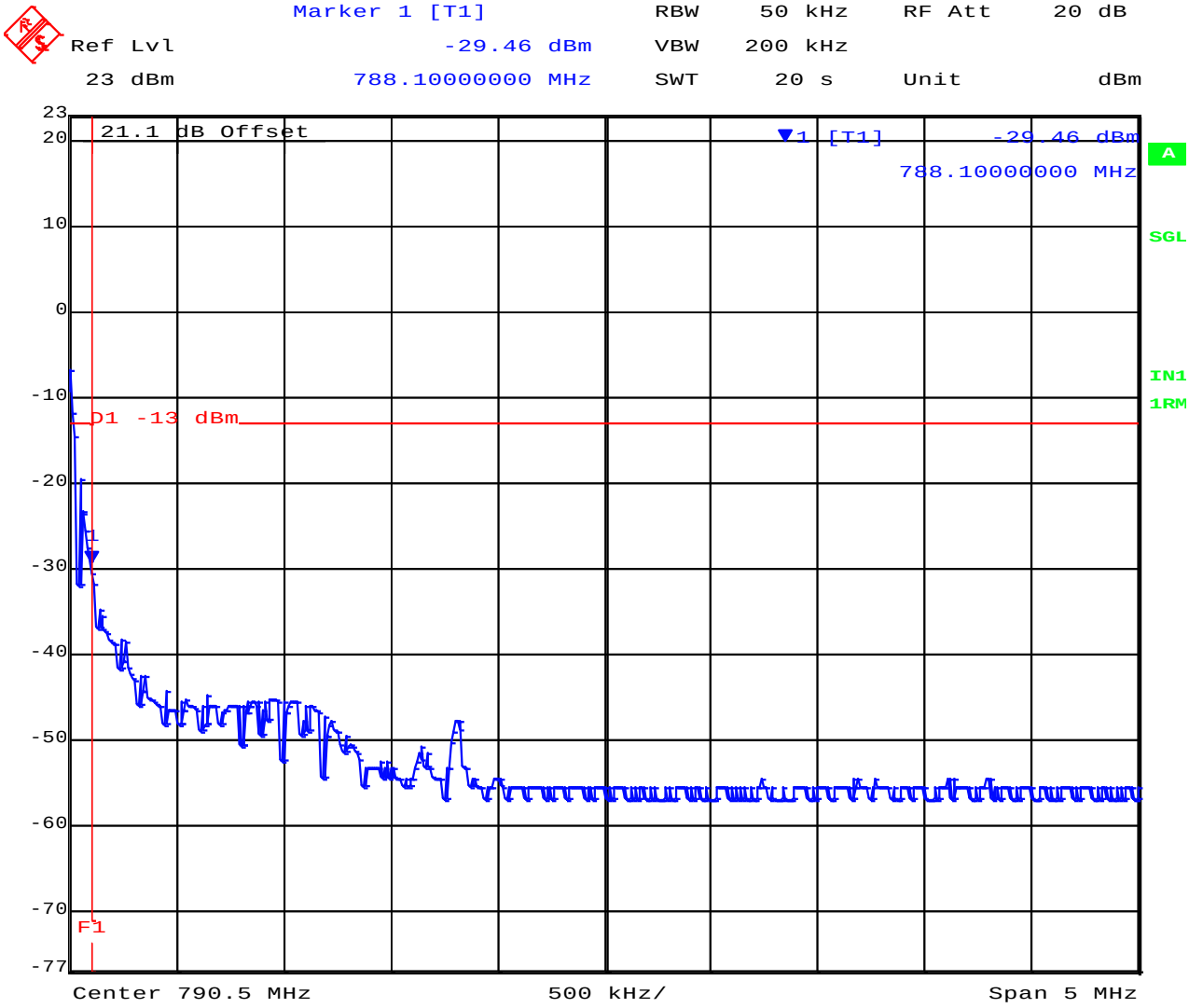



Date: 16.MAY.2019 10:16:18

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.888125 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

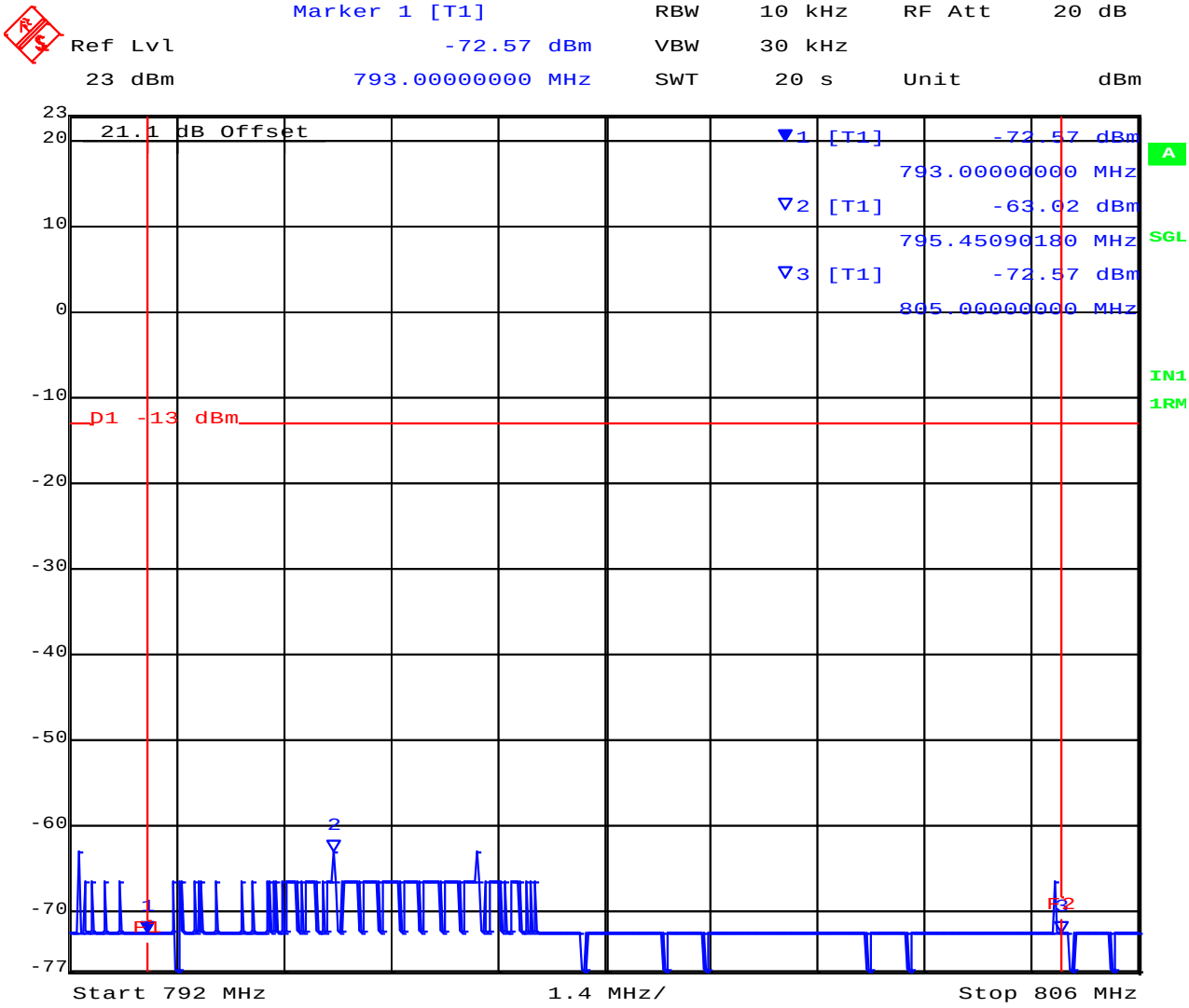



Date: 16.MAY.2019 13:12:30

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.888125 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

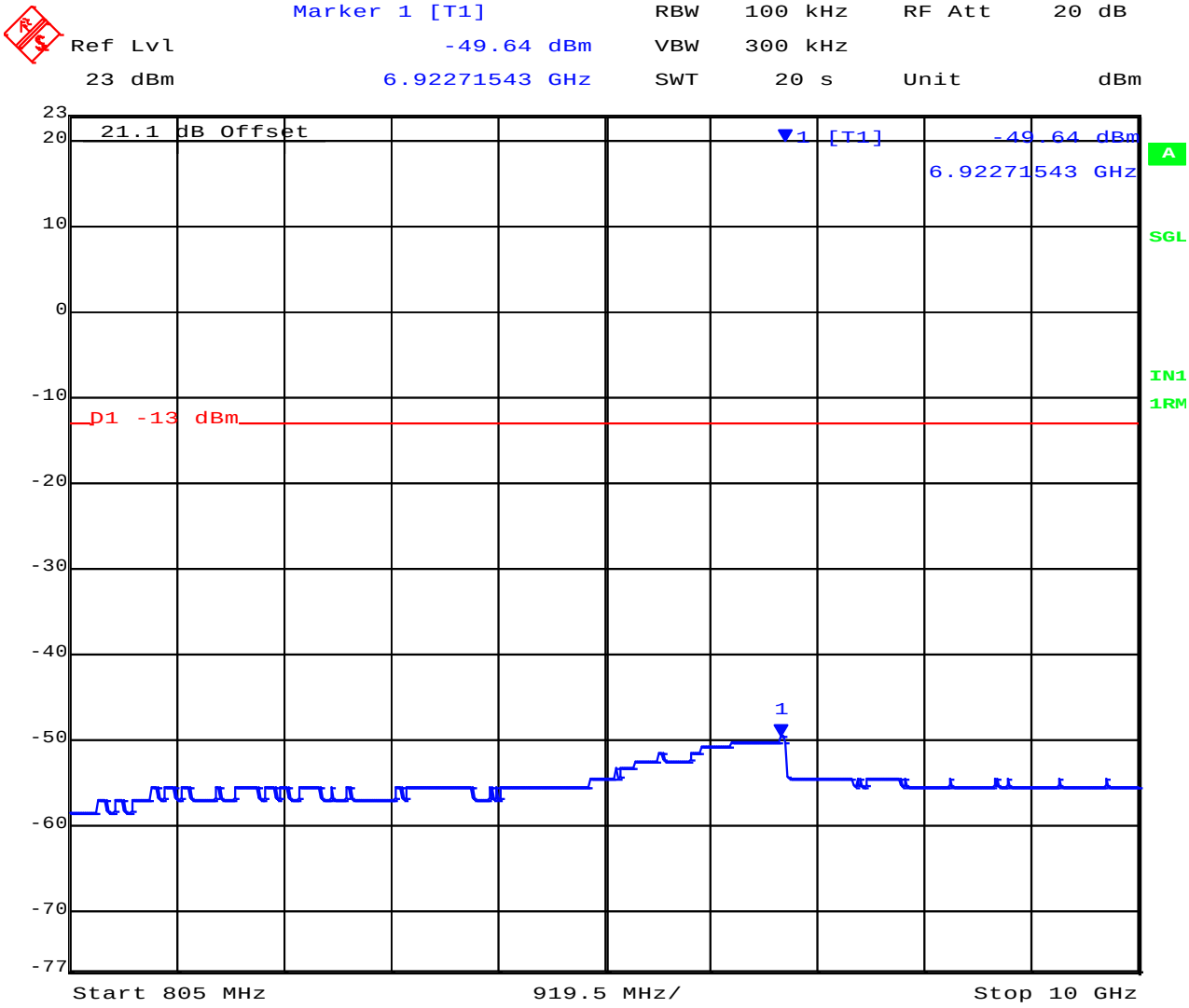



Date: 16.MAY.2019 11:06:41

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 3.75 KHz, Channel: 787.888125 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

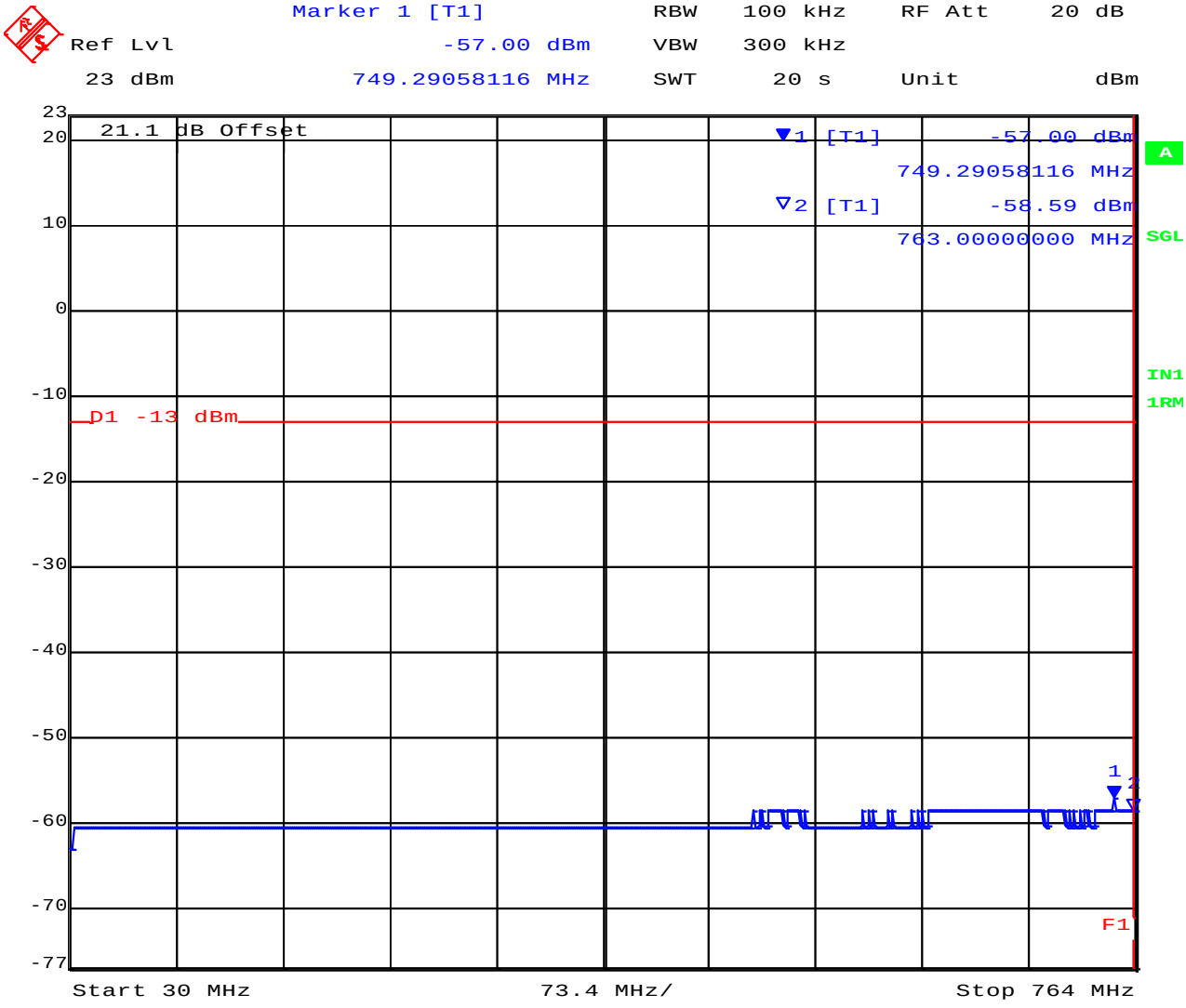



Date: 16.MAY.2019 11:27:19

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.2 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

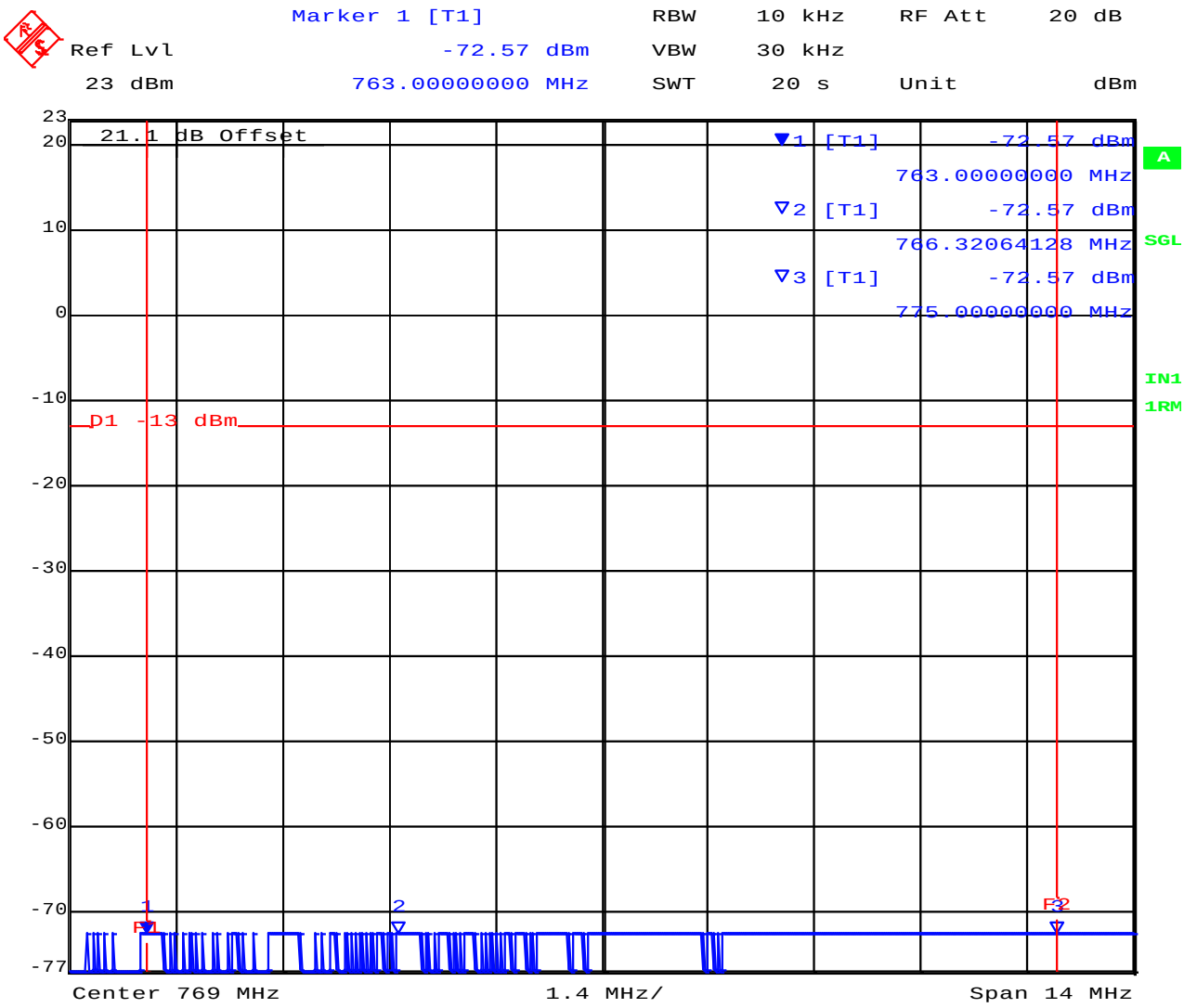



Date: 16.MAY.2019 11:20:25

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.2 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

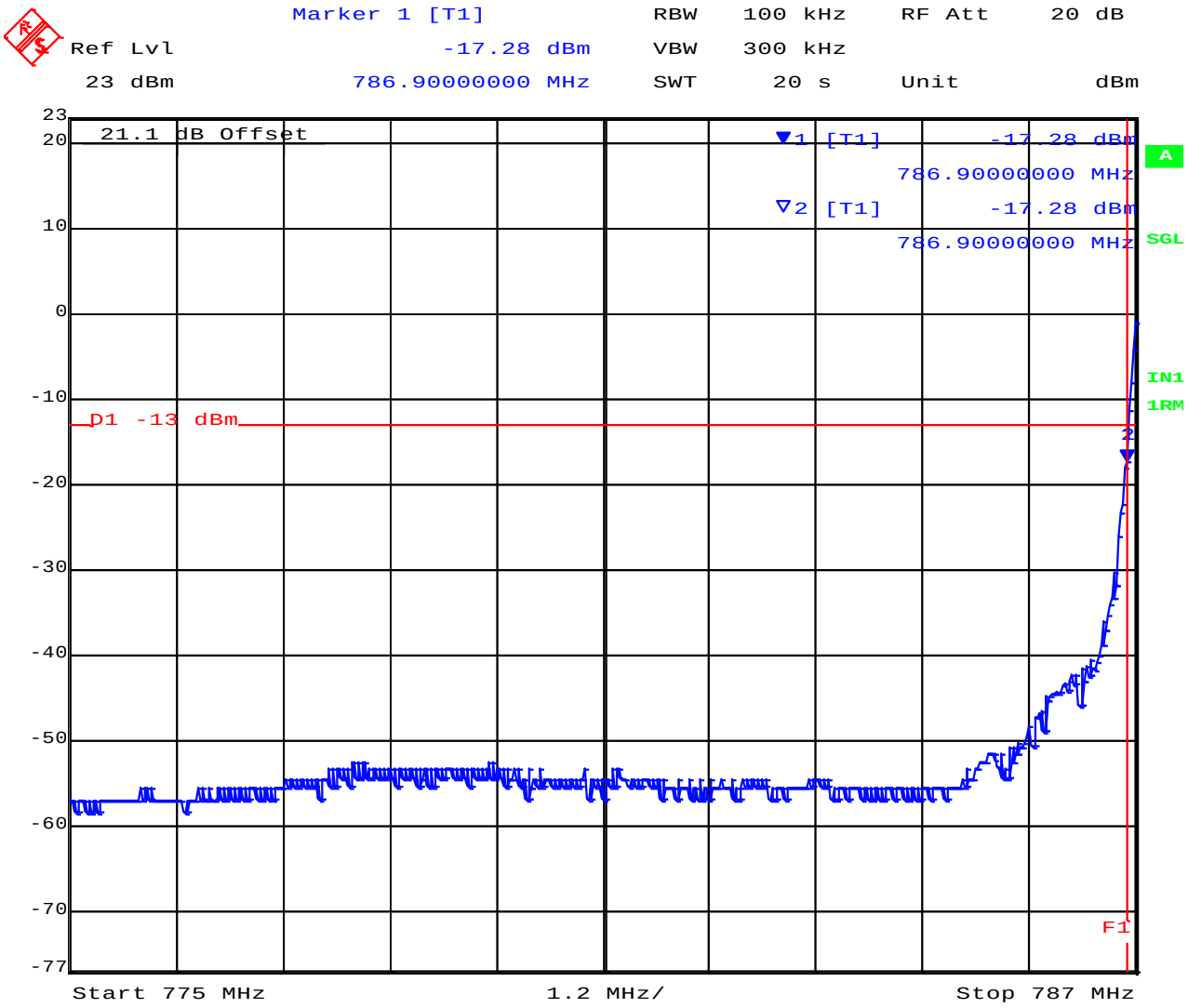



Date: 16.MAY.2019 11:16:57

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.2 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

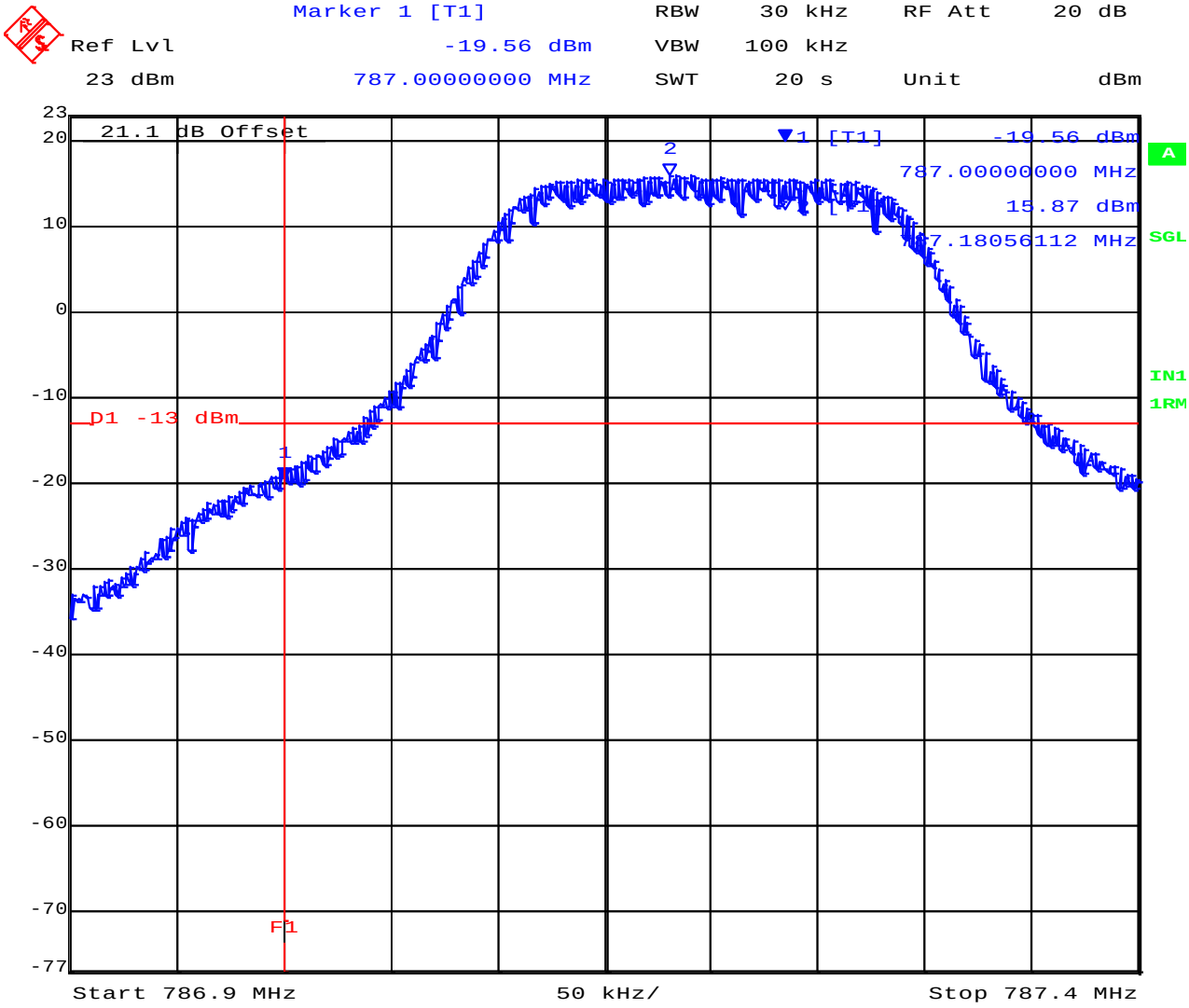



Date: 16.MAY.2019 10:33:48

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.2 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

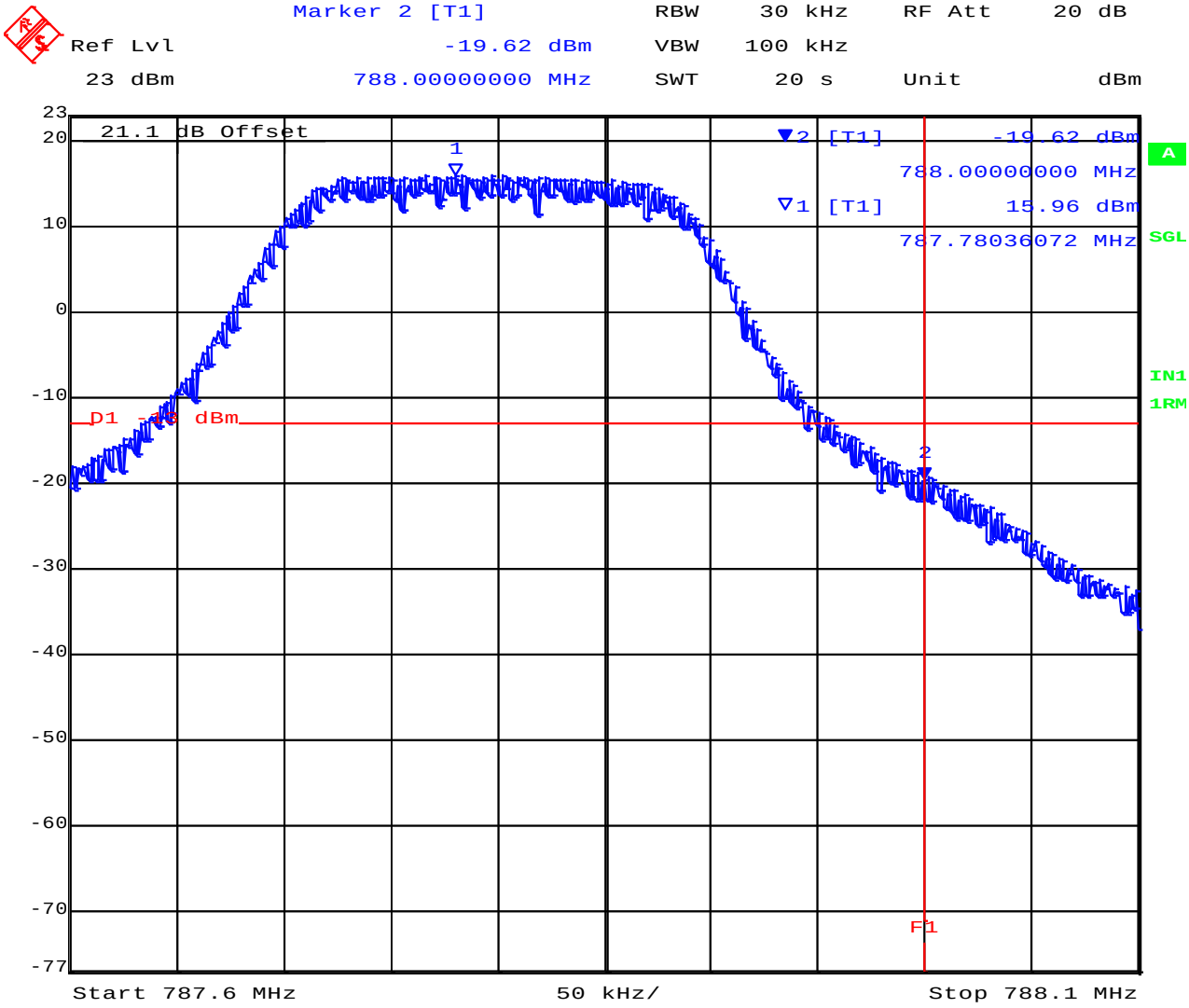



Date: 16.MAY.2019 10:22:12

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.8 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

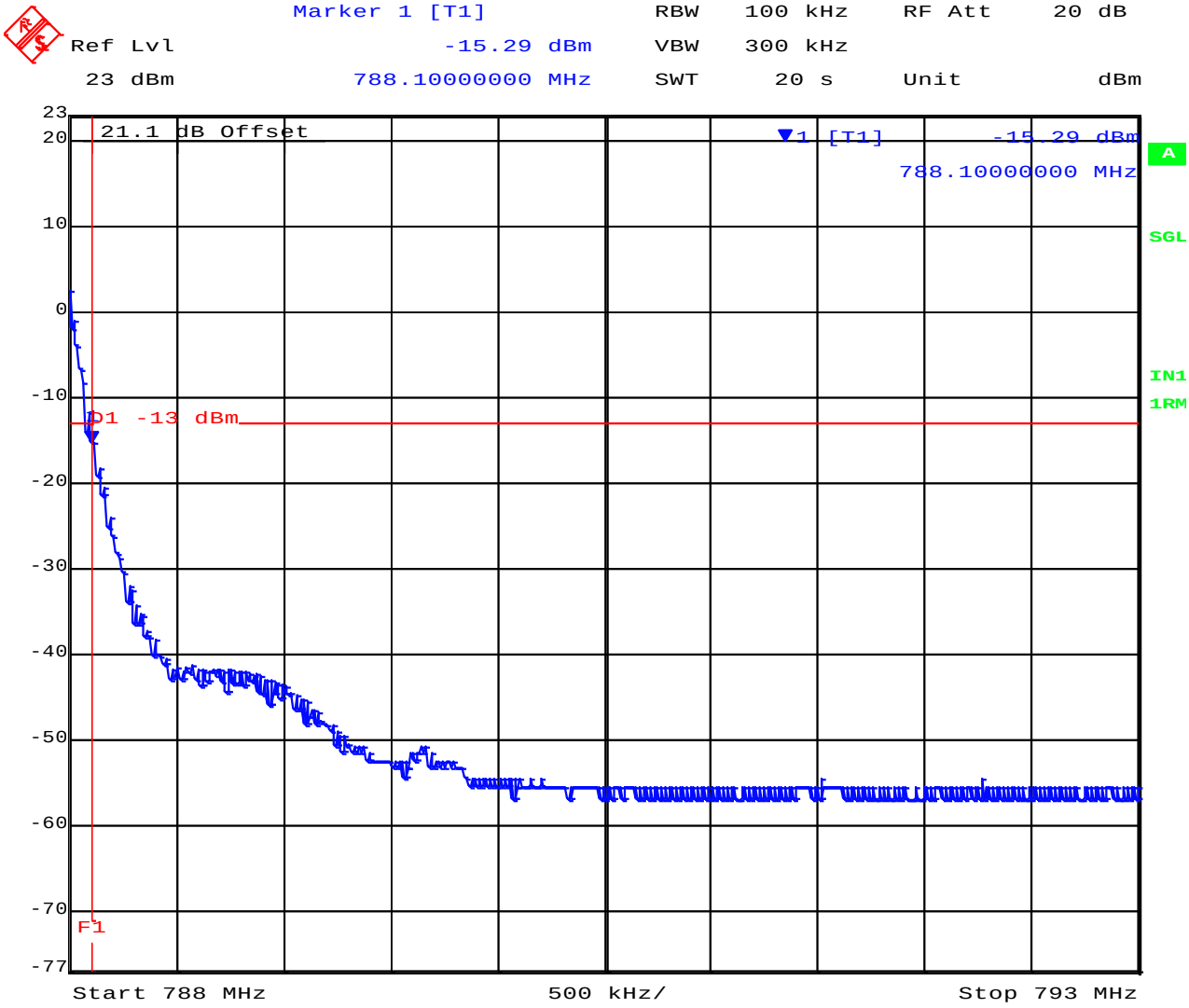



Date: 16.MAY.2019 10:11:17

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.8 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

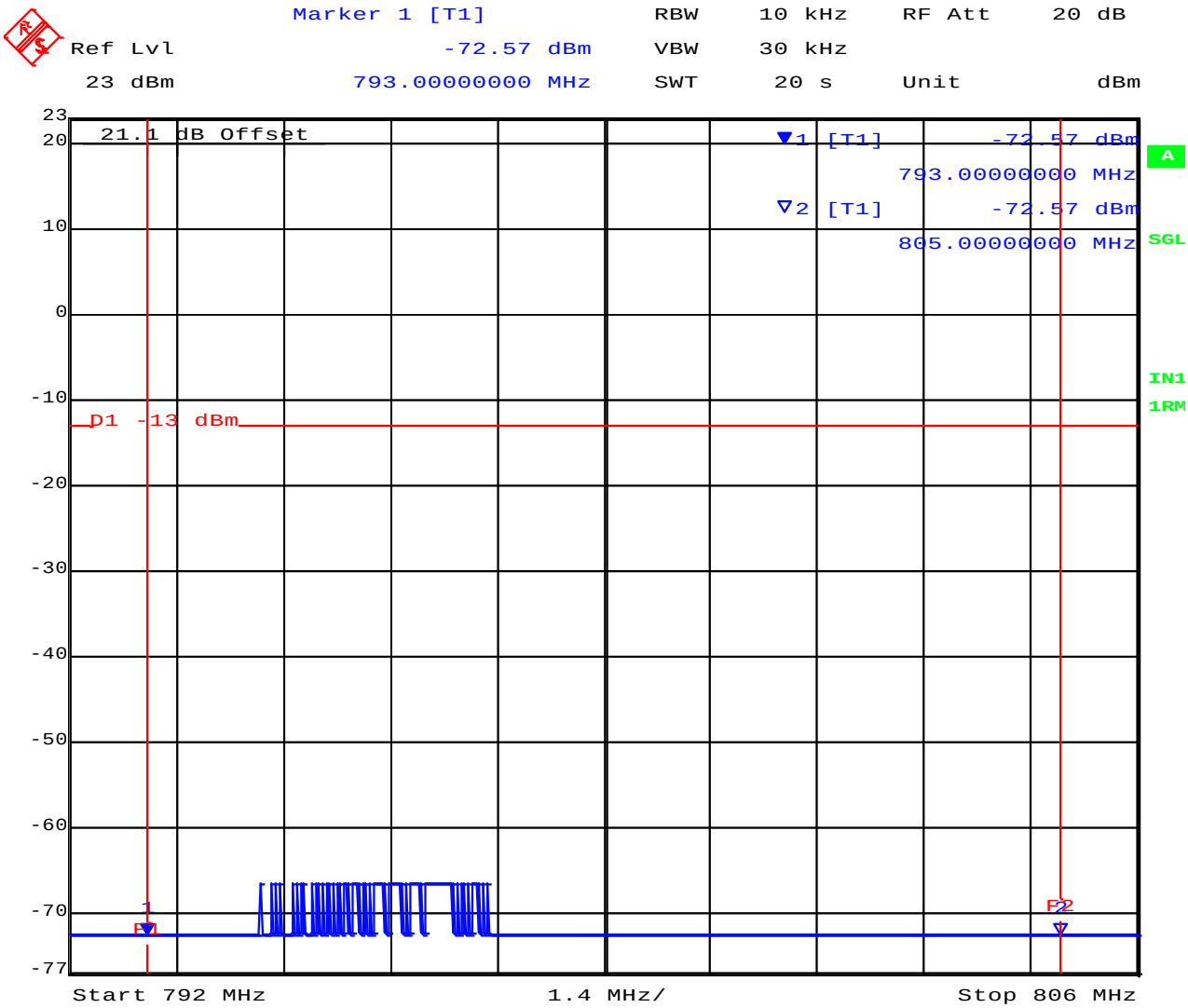



Date: 16.MAY.2019 10:58:44

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.8 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

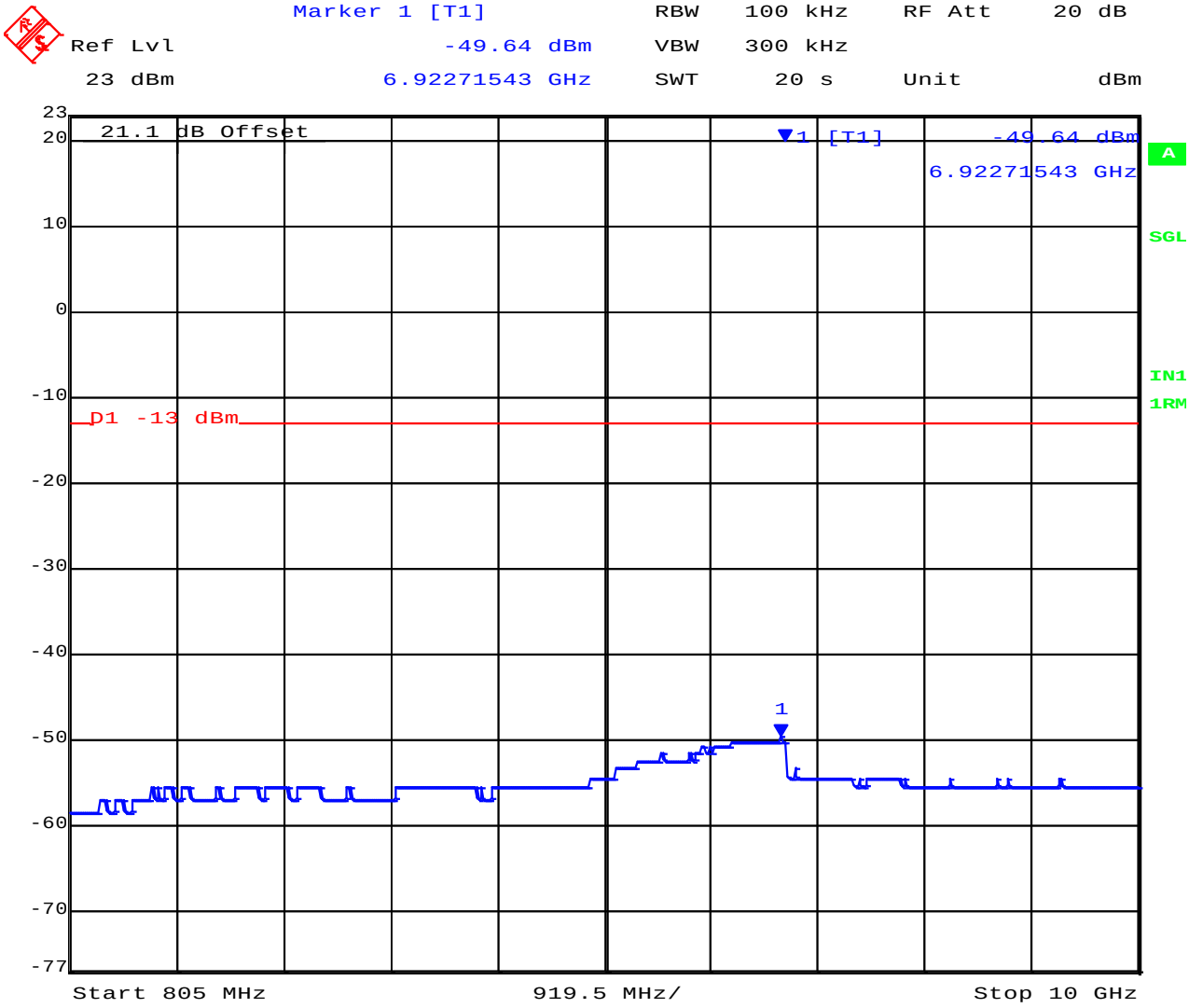



Date: 16.MAY.2019 11:02:47

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: NB IoT 180 KHz, Channel: 787.8 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



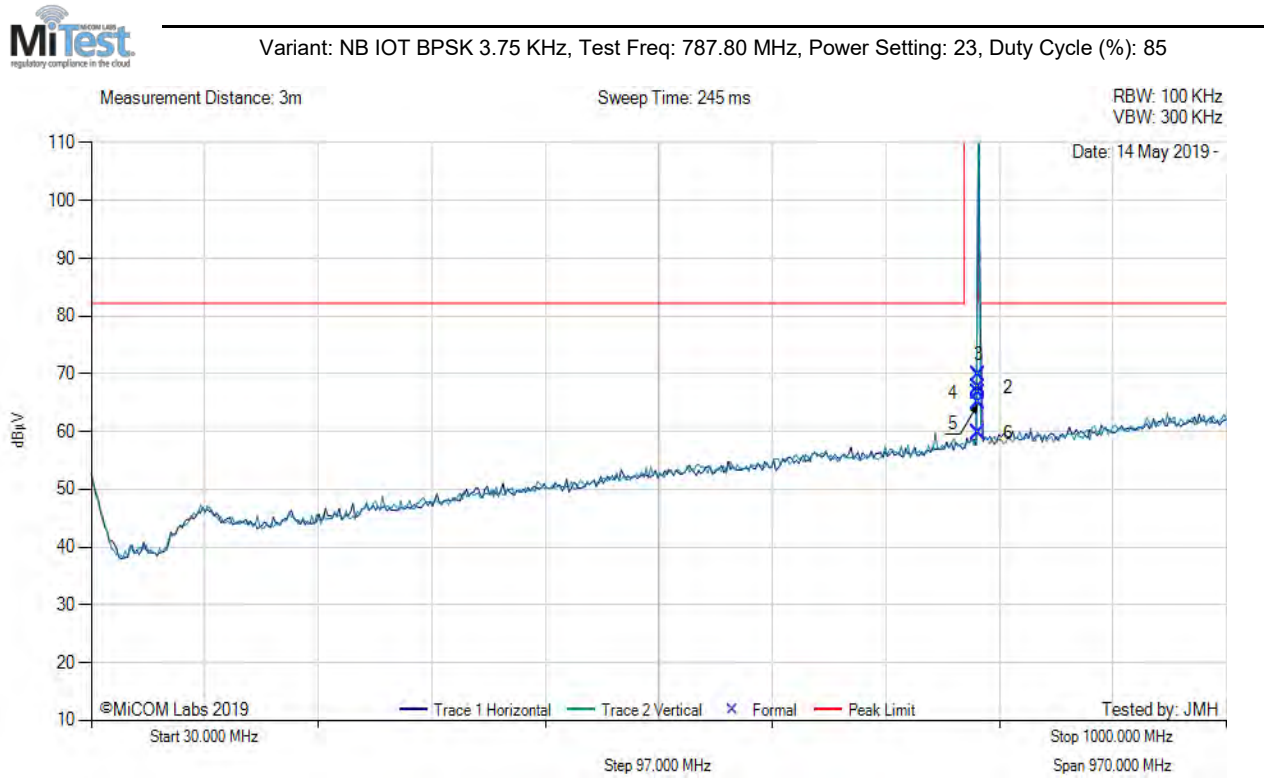

Date: 16.MAY.2019 11:30:06

back to matrix

## A.2.2. Radiated Emissions

### A.2.2.2. TX Spurious Emissions

### Dipole Antenna 30-1000 MHz

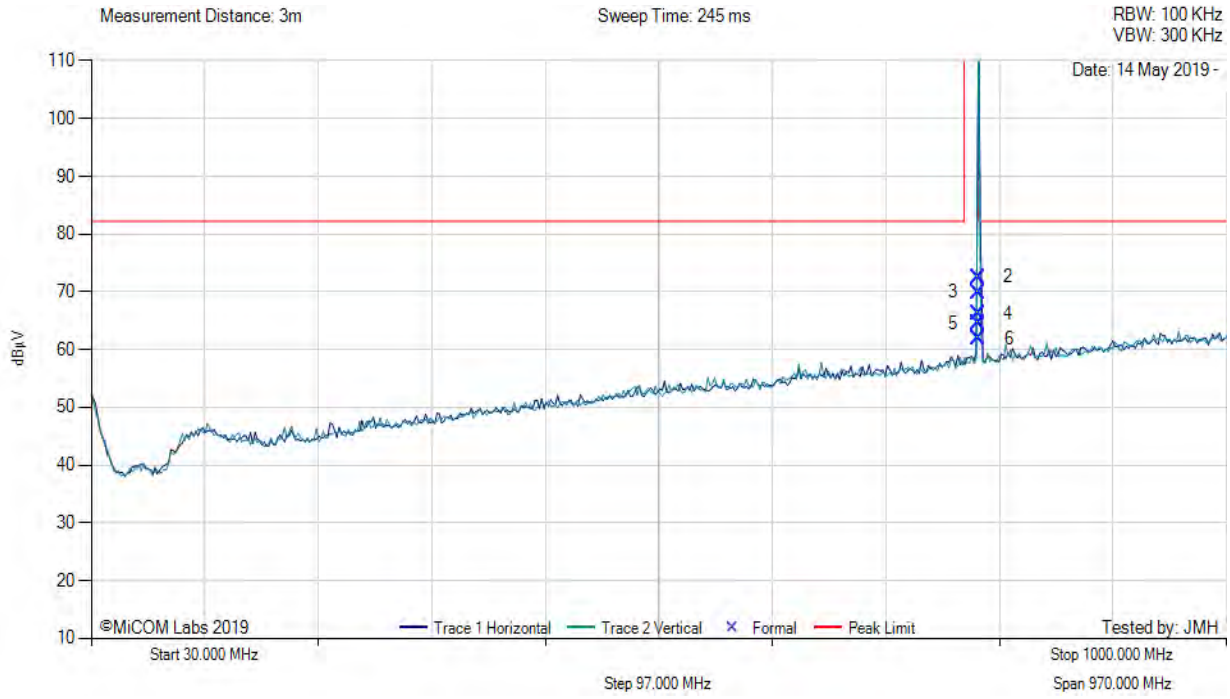



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 787.95 | 113.32 | 6.33 | -6.00 | 113.65 | Fundamental | Vertical | 100 | 0 | -- | -- | |
| 2 | 788.00 | 67.37 | 6.33 | -6.00 | 67.70 | MaxQP | Vertical | 135 | 179 | 82.2 | -14.5 | Pass |
| 3 | 788.10 | 69.56 | 6.33 | -6.10 | 69.79 | MaxQP | Vertical | 104 | 305 | 82.2 | -12.4 | Pass |
| 4 | 788.16 | 66.45 | 6.33 | -6.10 | 66.68 | MaxQP | Vertical | 224 | 3 | 82.2 | -15.6 | Pass |
| 5 | 788.22 | 64.77 | 6.33 | -6.10 | 65.00 | MaxQP | Vertical | 152 | 311 | 82.2 | -17.2 | Pass |
| 6 | 788.27 | 59.57 | 6.33 | -6.10 | 59.80 | MaxQP | Vertical | 156 | 204 | 82.2 | -22.4 | Pass |

**Test Notes:** EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction.

back to matrix

Variant: NB IOT BPSK 15 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85

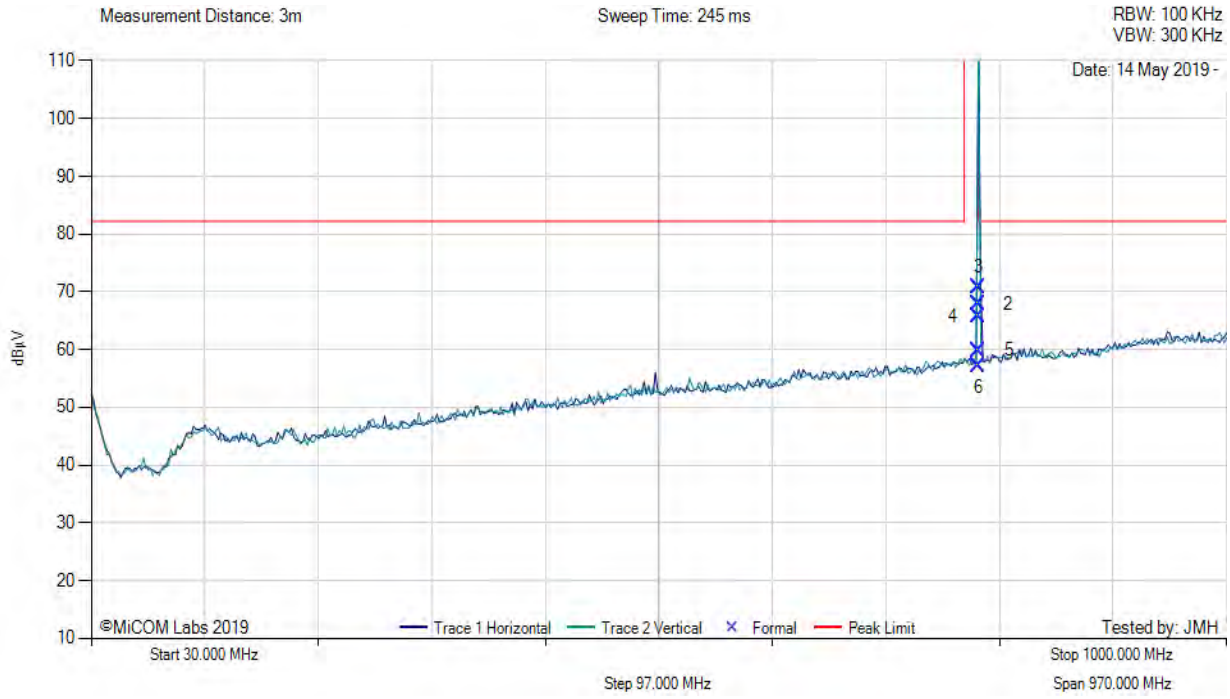



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 787.95 | 113.25 | 6.33 | -6.00 | 113.58 | Fundamental | Vertical | 100 | 0 | -- | -- | |
| 2 | 788.07 | 72.37 | 6.33 | -6.10 | 72.60 | MaxAvg | Vertical | 122 | 191 | 82.2 | -9.6 | Pass |
| 3 | 788.11 | 69.69 | 6.33 | -6.10 | 69.92 | MaxAvg | Vertical | 194 | 203 | 82.2 | -12.3 | Pass |
| 4 | 788.17 | 66.00 | 6.33 | -6.10 | 66.23 | MaxAvg | Vertical | 157 | 305 | 82.2 | -16.0 | Pass |
| 5 | 788.25 | 64.32 | 6.33 | -6.10 | 64.55 | MaxAvg | Vertical | 127 | 301 | 82.2 | -17.7 | Pass |
| 6 | 788.32 | 61.71 | 6.33 | -6.10 | 61.94 | MaxAvg | Vertical | 138 | 326 | 82.2 | -20.3 | Pass |

**Test Notes:** EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction.

back to matrix

Variant: NB IOT QPSK 3.75 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85

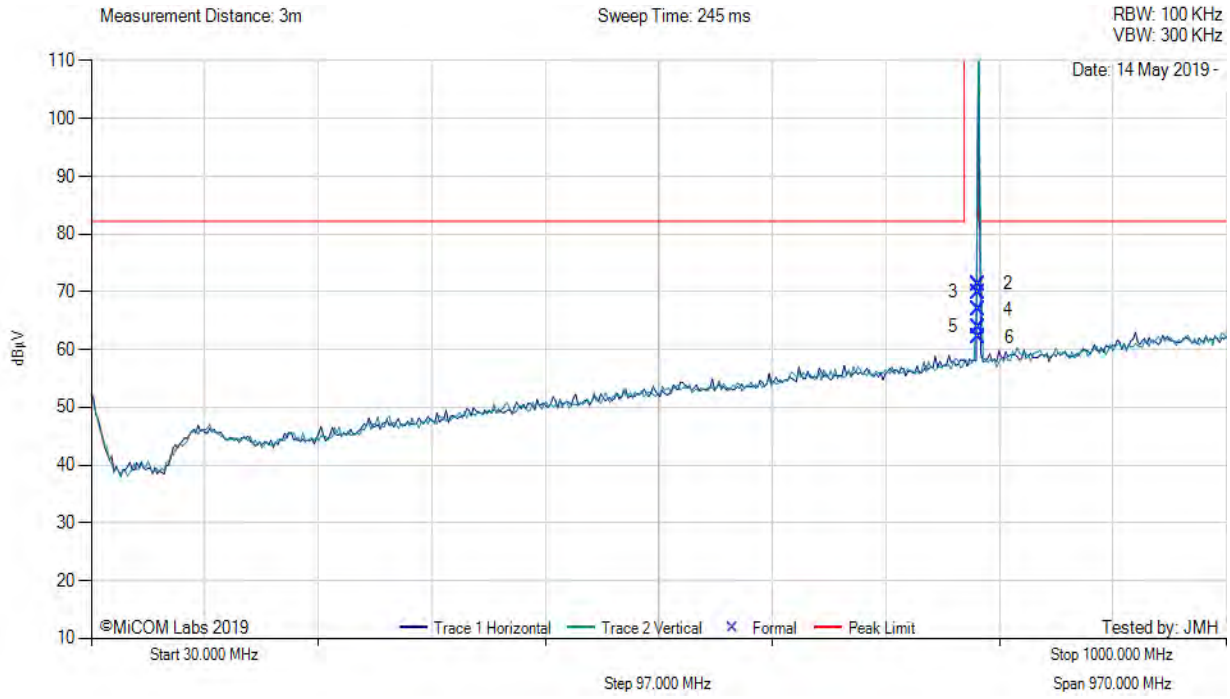



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 787.95 | 113.17 | 6.33 | -6.00 | 113.50 | Fundamental | Vertical | 100 | 0 | -- | -- | |
| 2 | 788.00 | 67.63 | 6.33 | -6.00 | 67.96 | MaxAvg | Vertical | 131 | 100 | 82.2 | -14.3 | Pass |
| 3 | 788.10 | 70.56 | 6.33 | -6.10 | 70.79 | MaxAvg | Vertical | 125 | 179 | 82.2 | -11.4 | Pass |
| 4 | 788.25 | 65.43 | 6.33 | -6.10 | 65.66 | MaxAvg | Vertical | 138 | 288 | 82.2 | -16.6 | Pass |
| 5 | 788.34 | 59.66 | 6.33 | -6.10 | 59.89 | MaxAvg | Vertical | 123 | 311 | 82.2 | -22.3 | Pass |
| 6 | 788.44 | 56.85 | 6.33 | -6.10 | 57.08 | MaxAvg | Vertical | 167 | 311 | 82.2 | -25.2 | Pass |

**Test Notes:** EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction. 788 MHz measured with 30 KHz RBW

back to matrix

Variant: NB IOT QPSK 15 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85

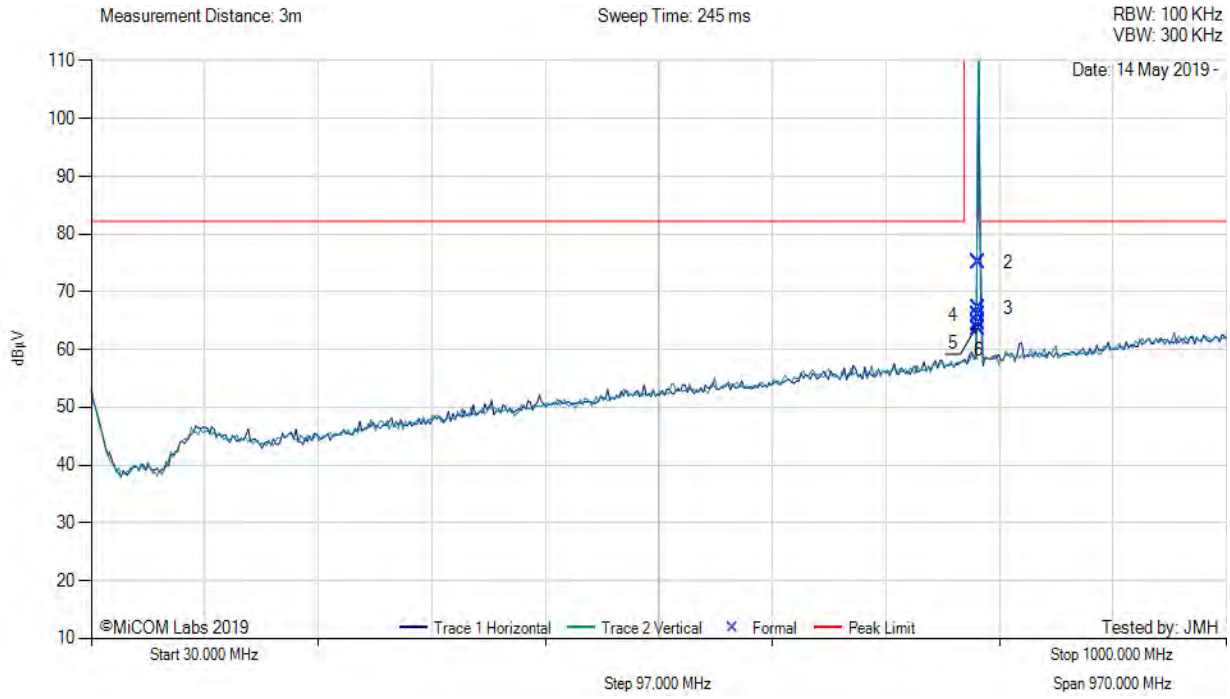



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 787.95 | 112.83 | 6.33 | -6.00 | 113.16 | Fundamental | Vertical | 100 | 0 | -- | -- | |
| 2 | 788.00 | 71.03 | 6.33 | -6.00 | 71.36 | MaxAvg | Vertical | 120 | 180 | 82.2 | -10.9 | Pass |
| 3 | 788.10 | 69.66 | 6.33 | -6.10 | 69.89 | MaxAvg | Vertical | 125 | 179 | 82.2 | -12.3 | Pass |
| 4 | 788.16 | 66.66 | 6.33 | -6.10 | 66.89 | MaxAvg | Vertical | 148 | 296 | 82.2 | -15.3 | Pass |
| 5 | 788.33 | 63.72 | 6.33 | -6.10 | 63.95 | MaxAvg | Vertical | 126 | 209 | 82.2 | -18.3 | Pass |
| 6 | 788.44 | 61.96 | 6.33 | -6.10 | 62.19 | MaxAvg | Vertical | 133 | 315 | 82.2 | -20.0 | Pass |

**Test Notes:** EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction. 788 MHz measured with 30 KHz RBW

back to matrix

Variant: NB IOT QPSK 180 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85



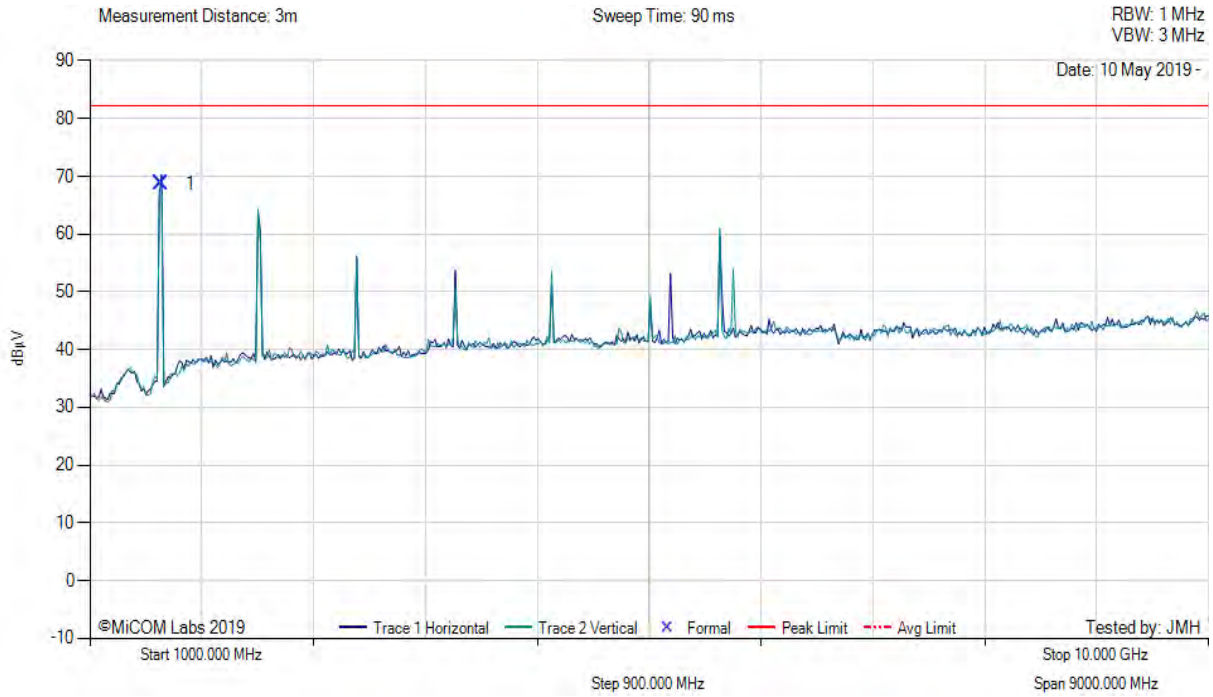

| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 787.84 | 113.72 | 6.33 | -6.00 | 114.05 | Fundamental | Vertical | 100 | 0 | -- | -- | |
| 2 | 788.00 | 74.77 | 6.33 | -6.00 | 75.10 | MaxAvg | Vertical | 111 | 188 | 82.2 | -7.1 | Pass |
| 3 | 788.11 | 66.88 | 6.33 | -6.10 | 67.11 | MaxAvg | Vertical | 148 | 291 | 82.2 | -15.1 | Pass |
| 4 | 788.15 | 65.77 | 6.33 | -6.10 | 66.00 | MaxAvg | Vertical | 159 | 305 | 82.2 | -16.2 | Pass |
| 5 | 788.25 | 64.40 | 6.33 | -6.10 | 64.63 | MaxAvg | Vertical | 133 | 275 | 82.2 | -17.6 | Pass |
| 6 | 788.30 | 63.37 | 6.33 | -6.10 | 63.60 | MaxAvg | Vertical | 144 | 181 | 82.2 | -18.6 | Pass |

**Test Notes:** EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction.

back to matrix

## Dipole Antenna 1-10 GHz

Variant: NB IOT BPSK 3.75 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85



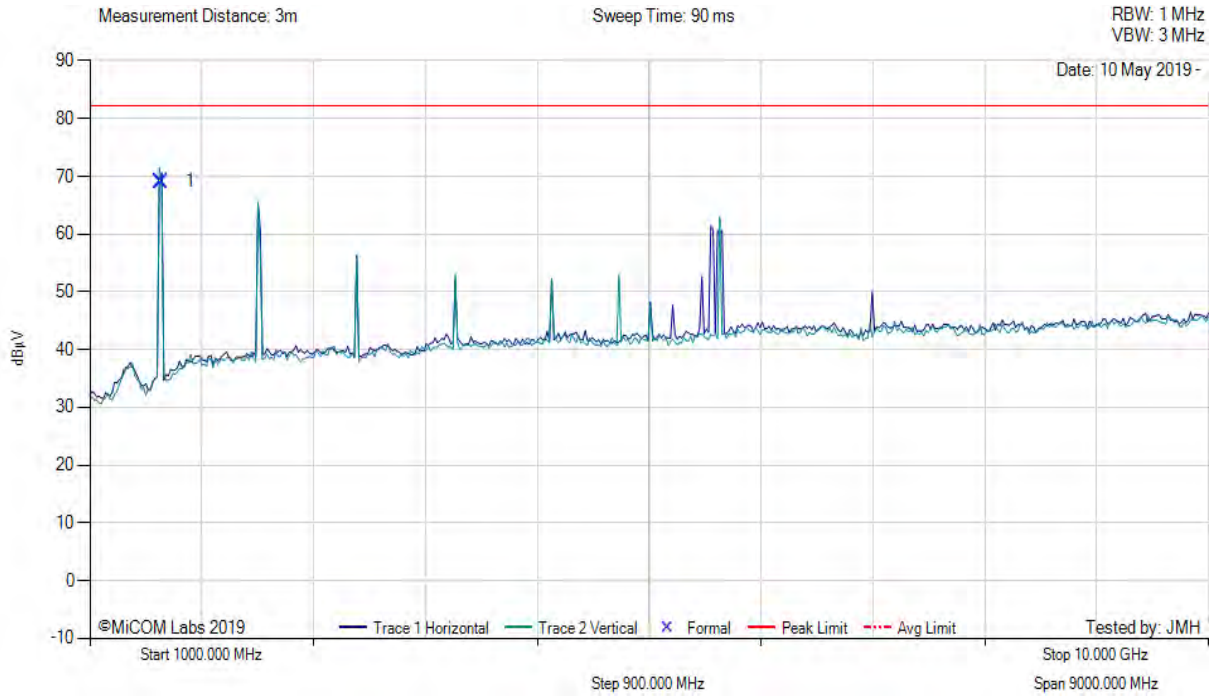

| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 1574.95 | 90.78 | -1.43 | -16.56 | 68.79 | Peak (Scan) | Horizontal | 100 | 132 | 82.2 | * | Pass |

**Test Notes:** EUT powered up linked to Base station via antenna. 1577 MHz has separate limit and is tested separately

*1559-1610 MHz has separate limits, See GPS Band Emissions in Section 9.5.2.3

back to matrix

Variant: NB IOT BPSK 15 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85

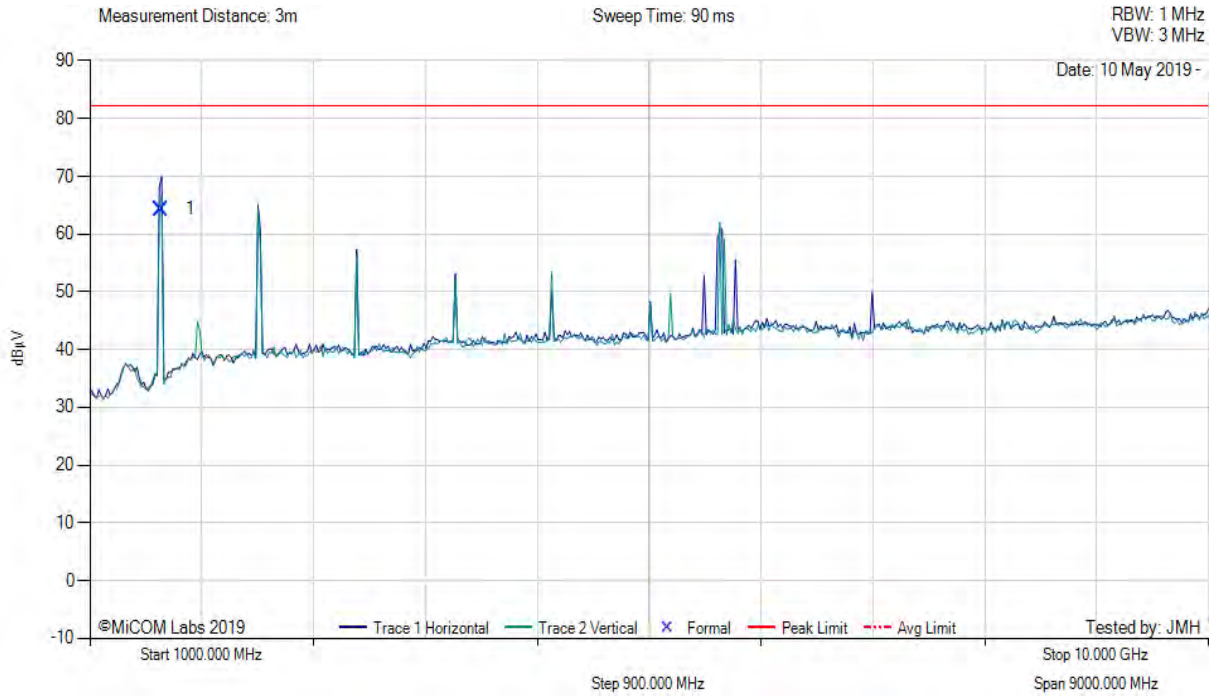



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 1574.89 | 87.09 | -1.43 | -16.56 | 69.10 | Peak (Scan) | Horizontal | 100 | 40 | 82.2 | * | Pass |

**Test Notes:** EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

back to matrix

Variant: NB IOT QPSK 3.75 KHz, Test Freq: 787.50 MHz, Antenna: dipole, Power Setting: 23, Duty Cycle (%): 85

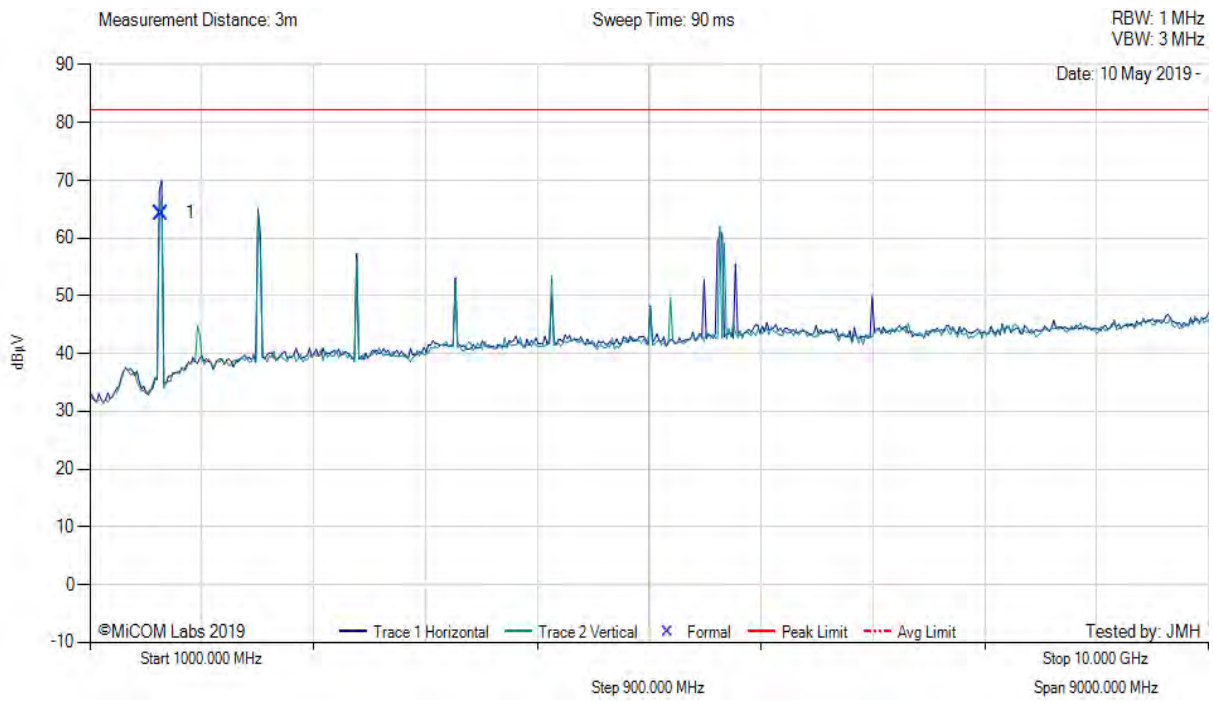



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 1574.91 | 82.33 | -1.43 | -16.56 | 64.34 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |

**Test Notes:** EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

back to matrix

Variant: NB IOT QPSK 15 KHz, Test Freq: 787.50 MHz, Antenna: dipole, Power Setting: 23, Duty Cycle (%): 85

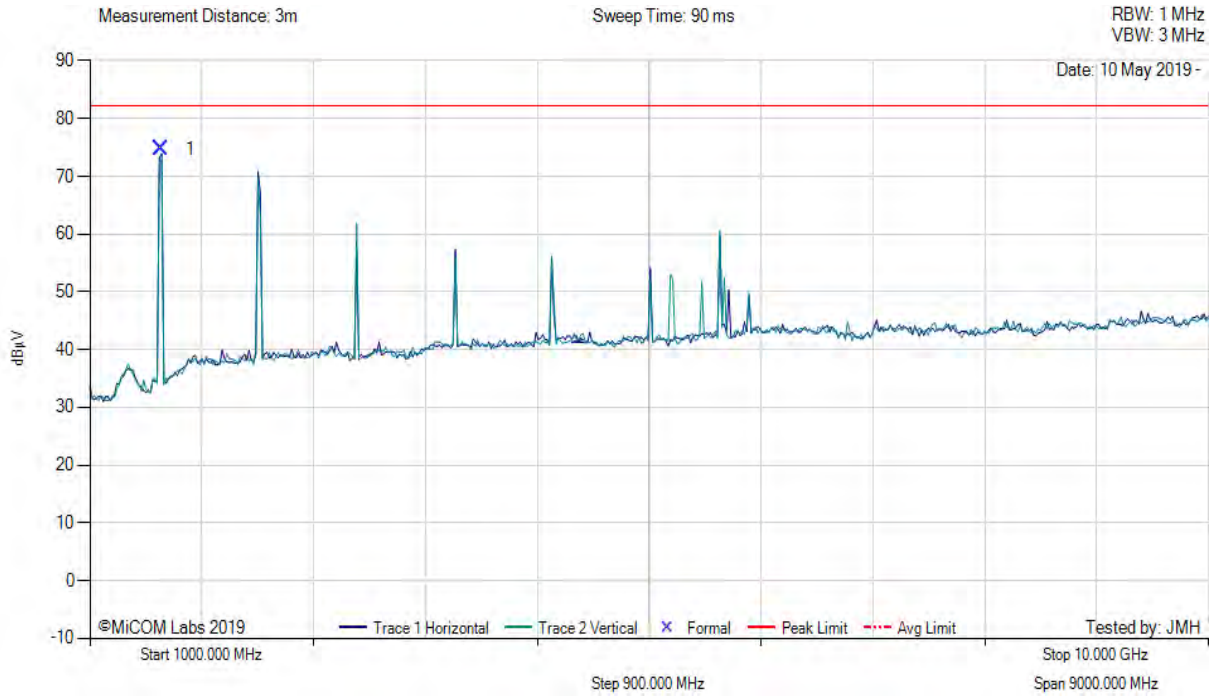



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 1574.91 | 82.33 | -1.43 | -16.56 | 64.34 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |

**Test Notes:** EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

back to matrix

Variant: NB IOT QPSK 180 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85



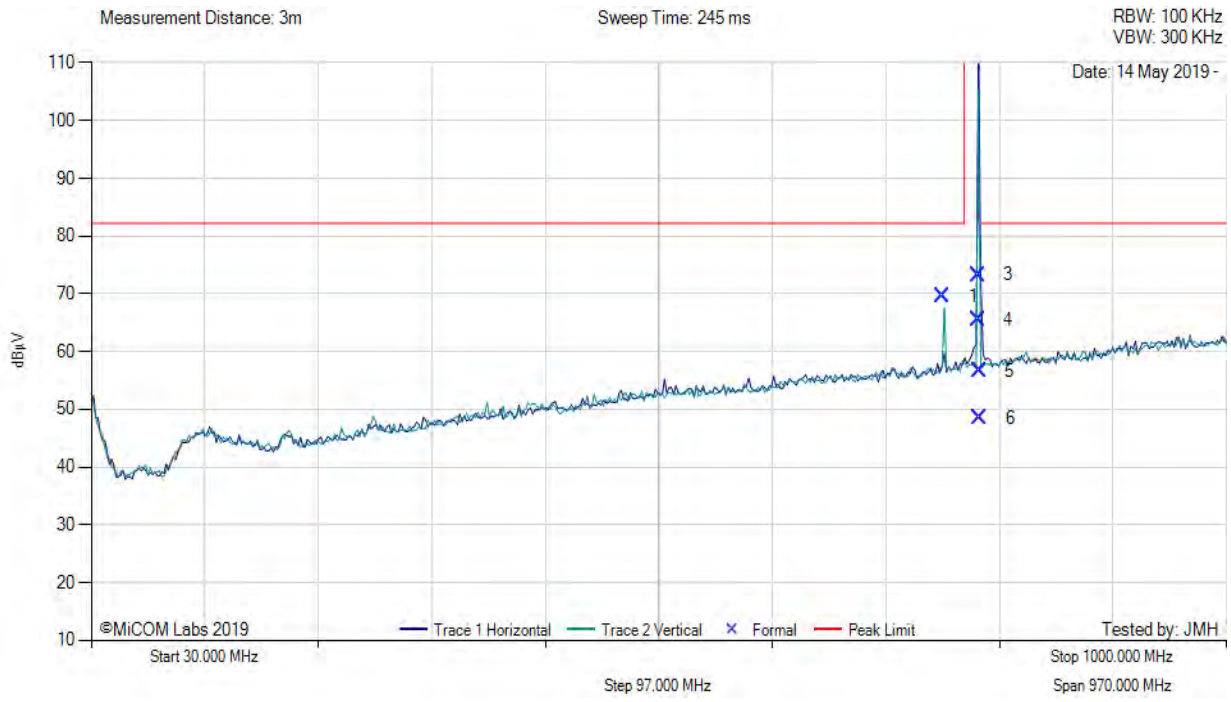

| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 1574.89 | 92.65 | -1.43 | -16.56 | 74.66 | Peak (Scan) | Horizontal | 100 | 36 | 82.2 | * | Pass |

**Test Notes:** EUT powered up linked to Base station via antenna. Multicarrier. *1559-1610 MHz is in GPS band with separate limit measured separately.

back to matrix

## Yagi Antenna 30-1000 MHz

Variant: NB IOT BPSK 3.75 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85

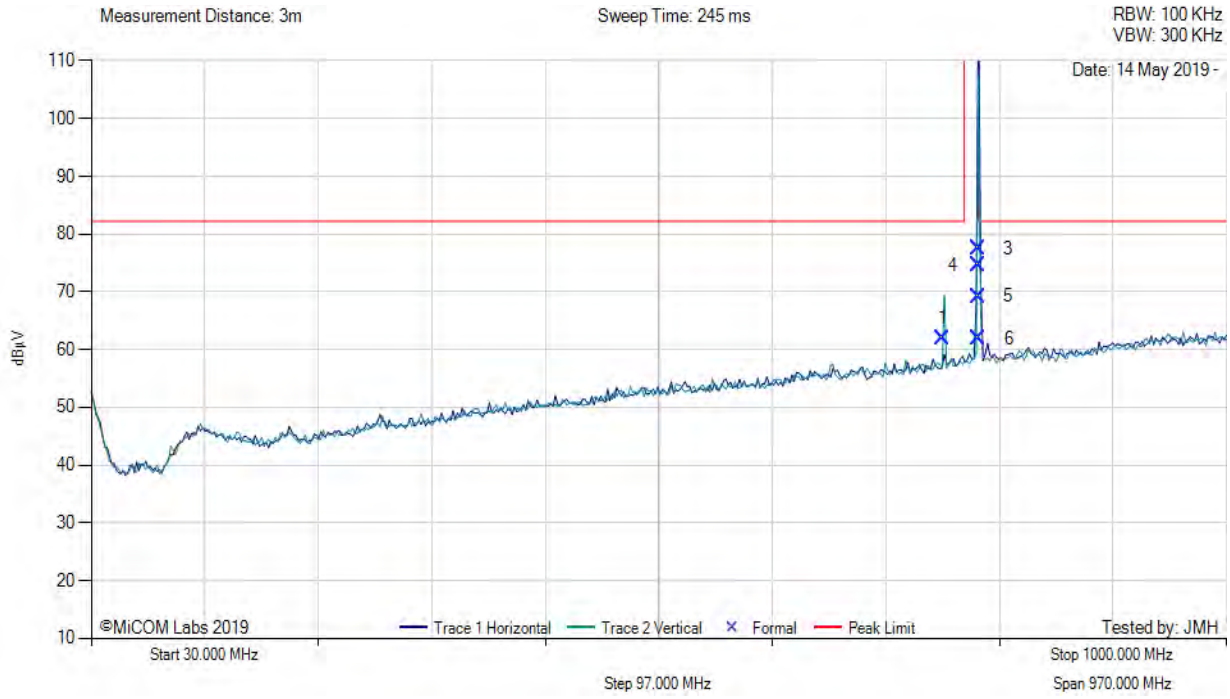



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 757.82 | 69.78 | 6.26 | -6.50 | 69.54 | MaxQP | Vertical | 100 | 277 | 82.2 | -12.7 | Pass |
| 2 | 787.84 | 114.01 | 6.33 | -6.00 | 114.34 | Fundamental | Horizontal | 100 | 0 | -- | -- | |
| 3 | 788.00 | 72.99 | 6.33 | -6.00 | 73.32 | MaxQP | Horizontal | 100 | 356 | 82.2 | -8.9 | Pass |
| 4 | 788.22 | 65.19 | 6.33 | -6.10 | 65.42 | MaxQP | Horizontal | 100 | 37 | 82.2 | -16.8 | Pass |
| 5 | 788.88 | 56.35 | 6.33 | -6.10 | 56.58 | MaxQP | Horizontal | 100 | 0 | 82.2 | -25.7 | Pass |
| 6 | 789.54 | 48.17 | 6.33 | -6.00 | 48.50 | MaxQP | Horizontal | 101 | 5 | 82.2 | -33.7 | Pass |

**Test Notes:** EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction. 788 MHz measured with 30 KHz RBW

back to matrix

Variant: NB IOT BPSK 15 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85

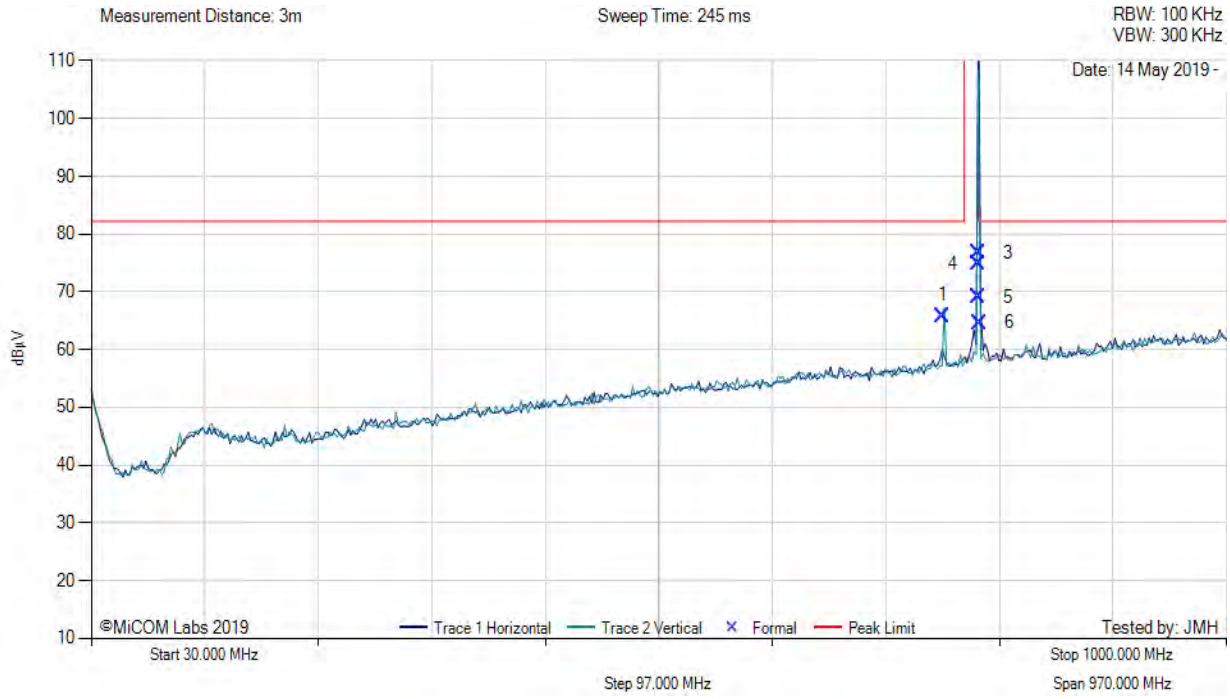



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 757.78 | 62.09 | 6.26 | -6.50 | 61.85 | MaxAvg | Horizontal | 101 | 5 | 82.2 | -20.4 | Pass |
| 2 | 787.84 | 121.98 | 6.33 | -6.00 | 122.31 | Fundamental | Horizontal | 100 | 0 | -- | -- | |
| 3 | 788.00 | 77.07 | 6.33 | -6.00 | 77.40 | MaxAvg | Horizontal | 100 | 356 | 82.2 | -4.8 | Pass |
| 4 | 788.10 | 74.37 | 6.33 | -6.10 | 74.60 | MaxAvg | Horizontal | 100 | 356 | 82.2 | -7.6 | Pass |
| 5 | 788.24 | 68.94 | 6.33 | -6.10 | 69.17 | MaxAvg | Horizontal | 100 | 37 | 82.2 | -13.1 | Pass |
| 6 | 788.42 | 61.69 | 6.33 | -6.10 | 61.92 | MaxAvg | Horizontal | 100 | 0 | 82.2 | -20.3 | Pass |

**Test Notes:** EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction. 788 MHz measured with 30 KHz RBW

back to matrix

Variant: NB IOT QPSK 3.75 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85

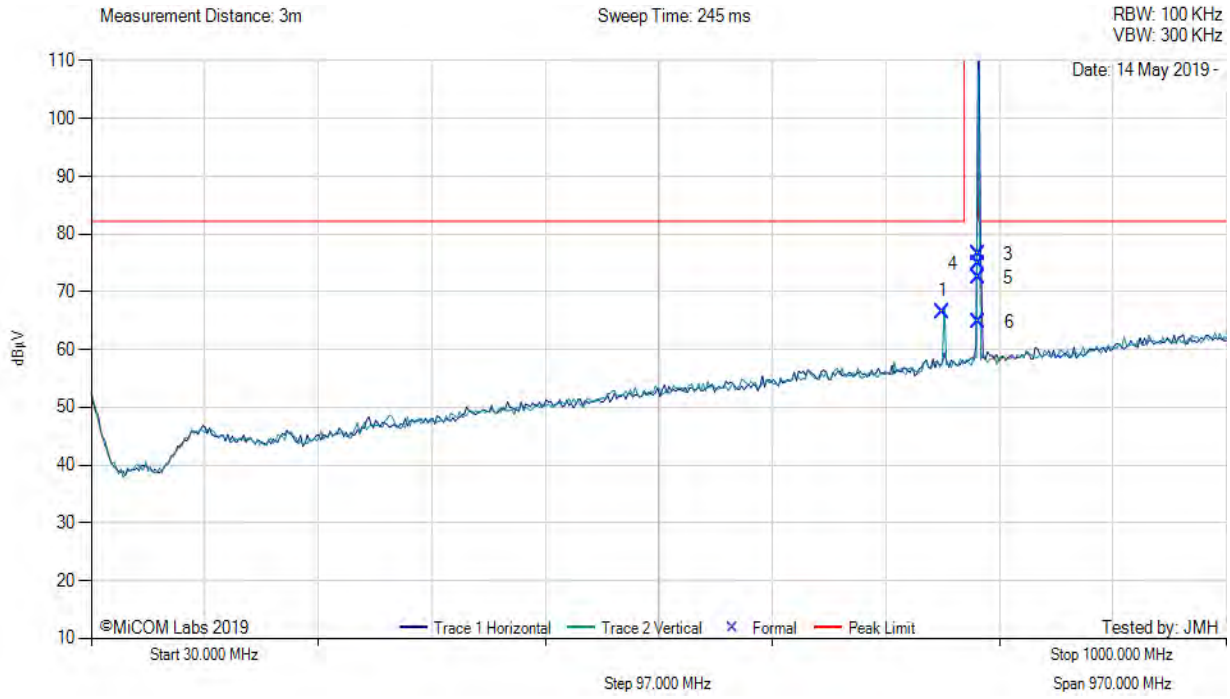



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 757.85 | 66.11 | 6.26 | -6.50 | 65.87 | MaxAvg | Vertical | 101 | 341 | 82.2 | -16.4 | Pass |
| 2 | 787.80 | 121.98 | 6.33 | -6.00 | 122.31 | Fundamental | Horizontal | 100 | 0 | -- | -- | |
| 3 | 788.00 | 76.47 | 6.33 | -6.00 | 76.80 | MaxAvg | Horizontal | 202 | 4 | 82.2 | -5.4 | Pass |
| 4 | 788.10 | 74.67 | 6.33 | -6.10 | 74.90 | MaxAvg | Horizontal | 100 | 356 | 82.2 | -7.3 | Pass |
| 5 | 788.25 | 68.89 | 6.33 | -6.10 | 69.12 | MaxAvg | Horizontal | 212 | 0 | 82.2 | -13.1 | Pass |
| 6 | 788.77 | 64.46 | 6.33 | -6.10 | 64.69 | MaxAvg | Horizontal | 101 | 357 | 82.2 | -17.5 | Pass |

**Test Notes:** EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction. 788 MHz measured with 30 KHz RBW

back to matrix

Variant: NB IOT QPSK 15 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85

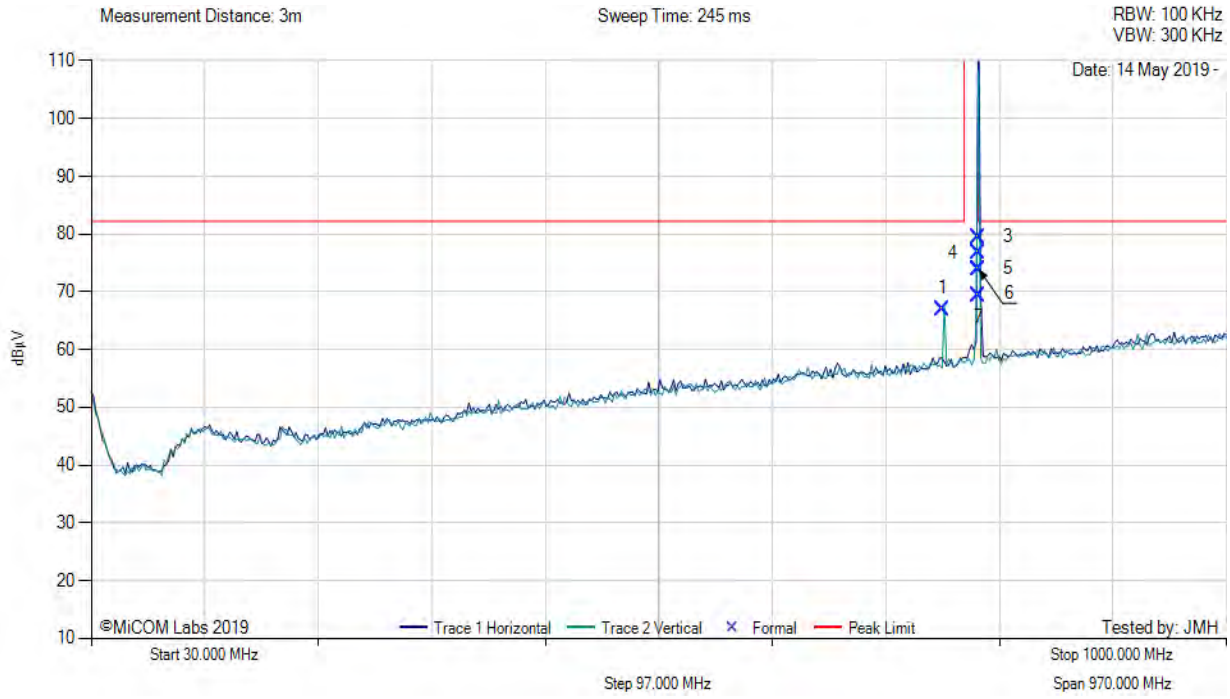



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 757.75 | 66.84 | 6.26 | -6.50 | 66.60 | MaxAvg | Vertical | 109 | 231 | 82.2 | -15.6 | Pass |
| 2 | 787.84 | 121.92 | 6.33 | -6.00 | 122.25 | Fundamental | Horizontal | 100 | 0 | -- | -- | |
| 3 | 788.06 | 76.27 | 6.33 | -6.10 | 76.50 | MaxAvg | Horizontal | 106 | 357 | 82.2 | -5.7 | Pass |
| 4 | 788.13 | 74.67 | 6.33 | -6.10 | 74.90 | MaxAvg | Horizontal | 104 | 18 | 82.2 | -7.3 | Pass |
| 5 | 788.24 | 72.27 | 6.33 | -6.10 | 72.50 | MaxAvg | Horizontal | 104 | 10 | 82.2 | -9.7 | Pass |
| 6 | 788.46 | 64.47 | 6.33 | -6.10 | 64.70 | MaxAvg | Horizontal | 184 | 2 | 82.2 | -17.5 | Pass |

**Test Notes:** EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction. 788 MHz measured with 30 KHz RBW

back to matrix

Variant: NB IOT QPSK 180 KHz, Test Freq: 787.80 MHz, Power Setting: 23, Duty Cycle (%): 85



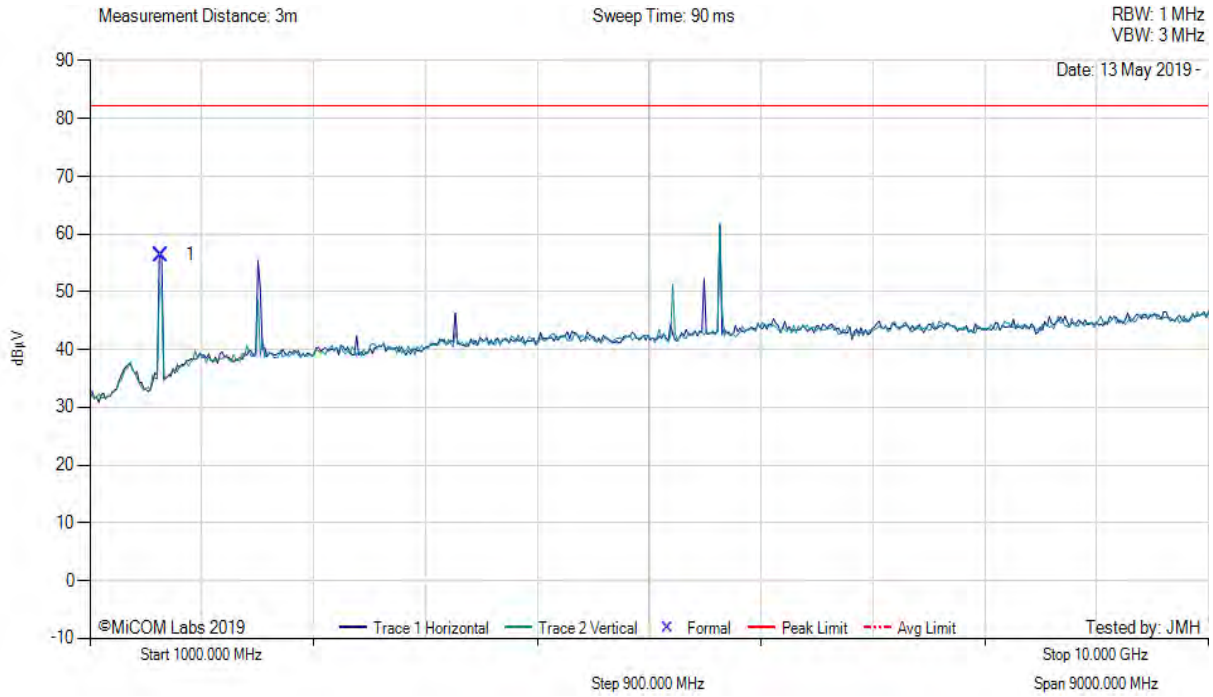

| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 757.77 | 67.33 | 6.26 | -6.50 | 67.09 | MaxAvg | Vertical | 106 | 338 | 82.2 | -15.1 | Pass |
| 2 | 787.84 | 122.14 | 6.33 | -6.00 | 122.47 | Fundamental | Horizontal | 100 | 0 | -- | -- | |
| 3 | 788.00 | 79.17 | 6.33 | -6.00 | 79.50 | MaxAvg | Horizontal | 113 | 3 | 82.2 | -2.7 | Pass |
| 4 | 788.13 | 76.57 | 6.33 | -6.10 | 76.80 | MaxAvg | Horizontal | 101 | 2 | 82.2 | -5.4 | Pass |
| 5 | 788.23 | 73.74 | 6.33 | -6.10 | 73.97 | MaxAvg | Horizontal | 117 | 350 | 82.2 | -8.3 | Pass |
| 6 | 788.30 | 73.73 | 6.33 | -6.10 | 73.96 | MaxAvg | Horizontal | 110 | 0 | 82.2 | -8.3 | Pass |
| 7 | 788.39 | 69.13 | 6.33 | -6.10 | 69.36 | MaxAvg | Horizontal | 114 | 10 | 82.2 | -12.9 | Pass |

**Test Notes:** EUT powered by AC/DC PS. Connected via Antenna to Base station outside chamber. 30 dB pad in front of amp to prevent overload. Measurements include 0.7 DC Correction

back to matrix

**Yagi Antenna 1-10 GHz**

Variant: NB IOT BPSK 3.75 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85

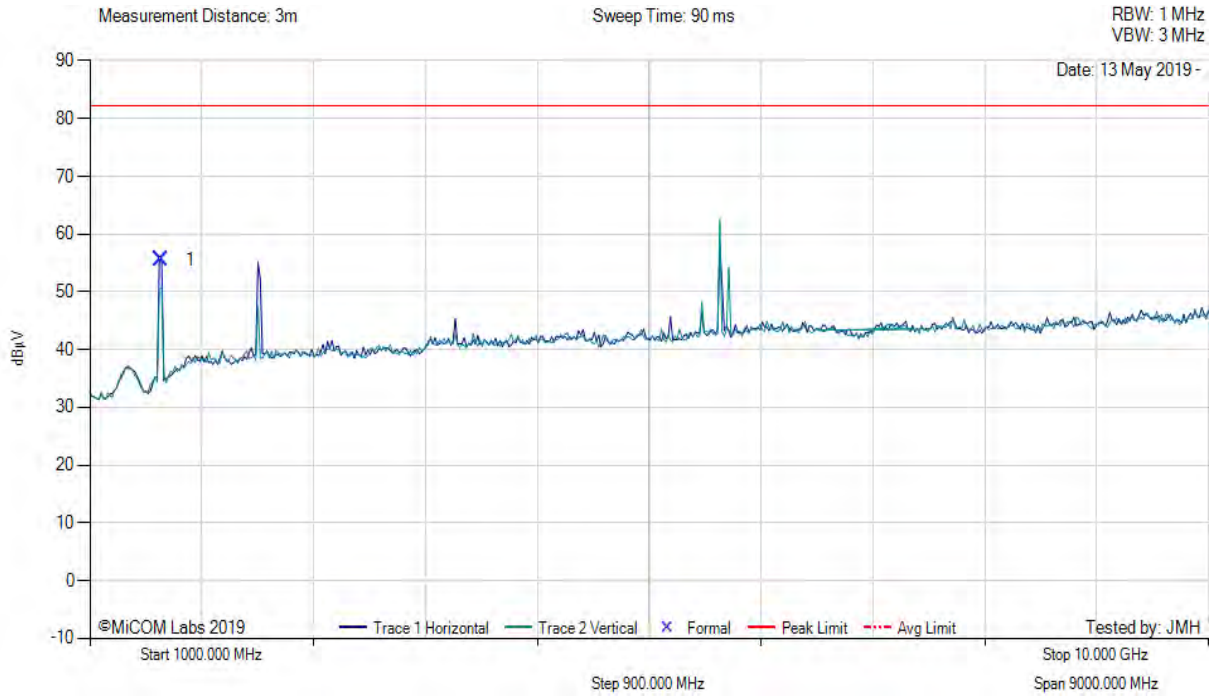



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 1574.87 | 74.42 | -1.43 | -16.56 | 56.43 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |

**Test Notes:** EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

back to matrix

Variant: NB IOT BPSK 15 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85

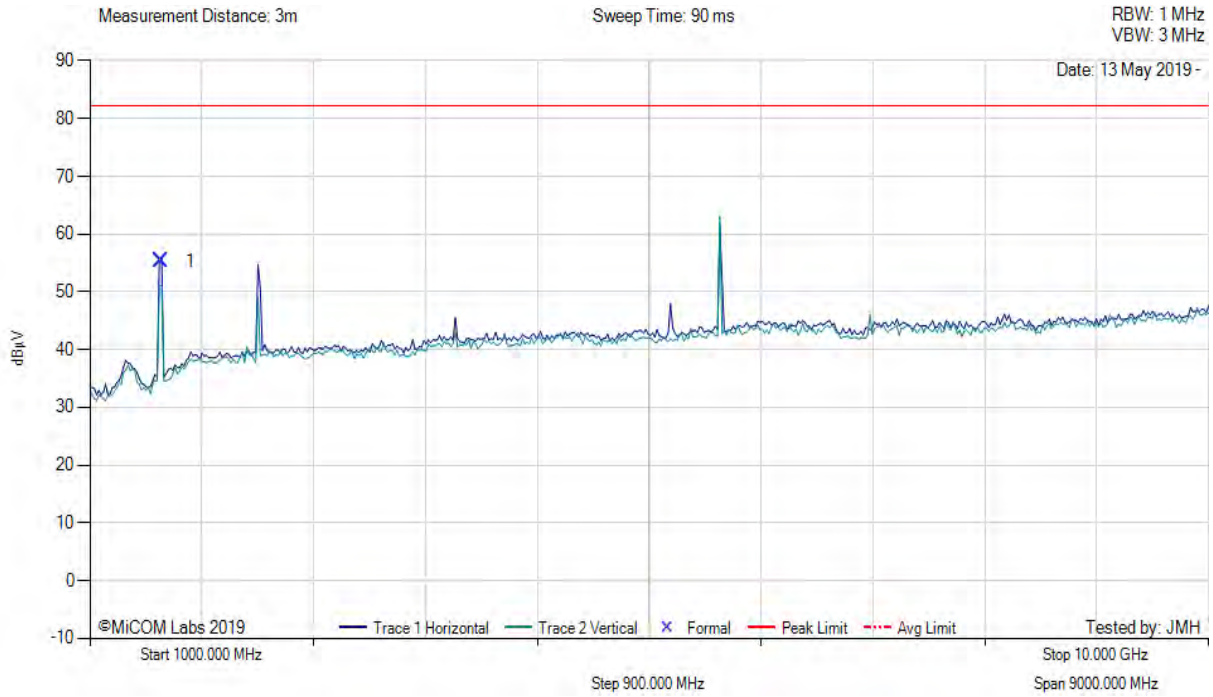



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 1574.96 | 73.50 | -1.43 | -16.56 | 55.51 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |

**Test Notes:** EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

back to matrix

Variant: NB IOT QPSK 3.75 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85

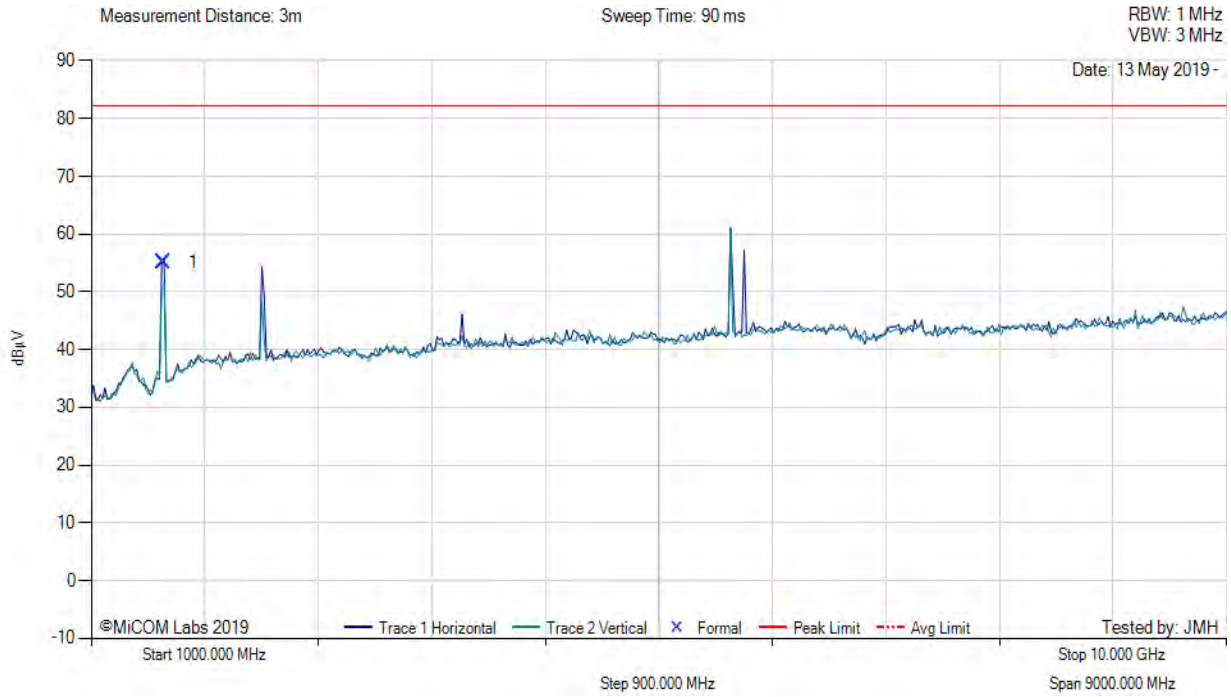



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Num** | **Frequency MHz** | **Raw dBµV** | **Cable Loss dB** | **AF dB/m** | **Level dBµV/m** | **Measurement Type** | **Pol** | **Hgt cm** | **Azt Deg** | **Limit dBµV/m** | **Margin dB** | **Pass /Fail** |
| 1 | 1574.84 | 73.34 | -1.43 | -16.56 | 55.35 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |

**Test Notes:** EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

back to matrix

Variant: NB IOT QPSK 15 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85

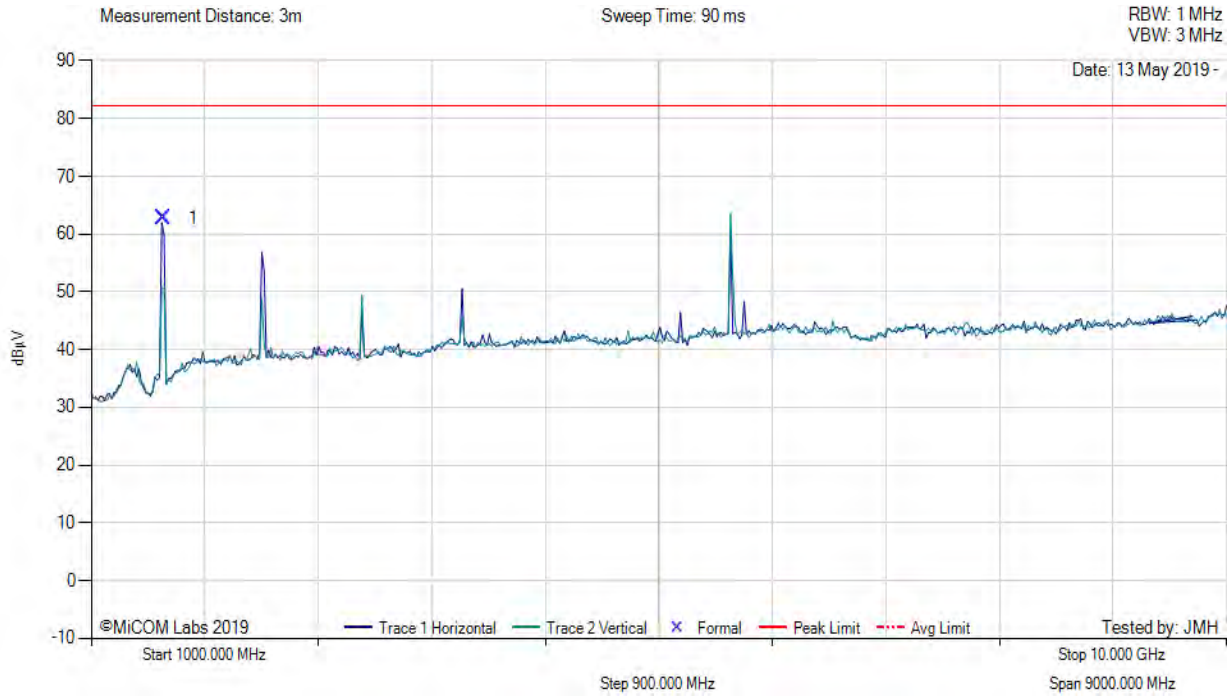



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 1575.00 | 73.14 | -1.43 | -16.57 | 55.14 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |

**Test Notes:** EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

back to matrix

Variant: NB IOT QPSK 180 KHz, Test Freq: 787.50 MHz, Power Setting: 23, Duty Cycle (%): 85



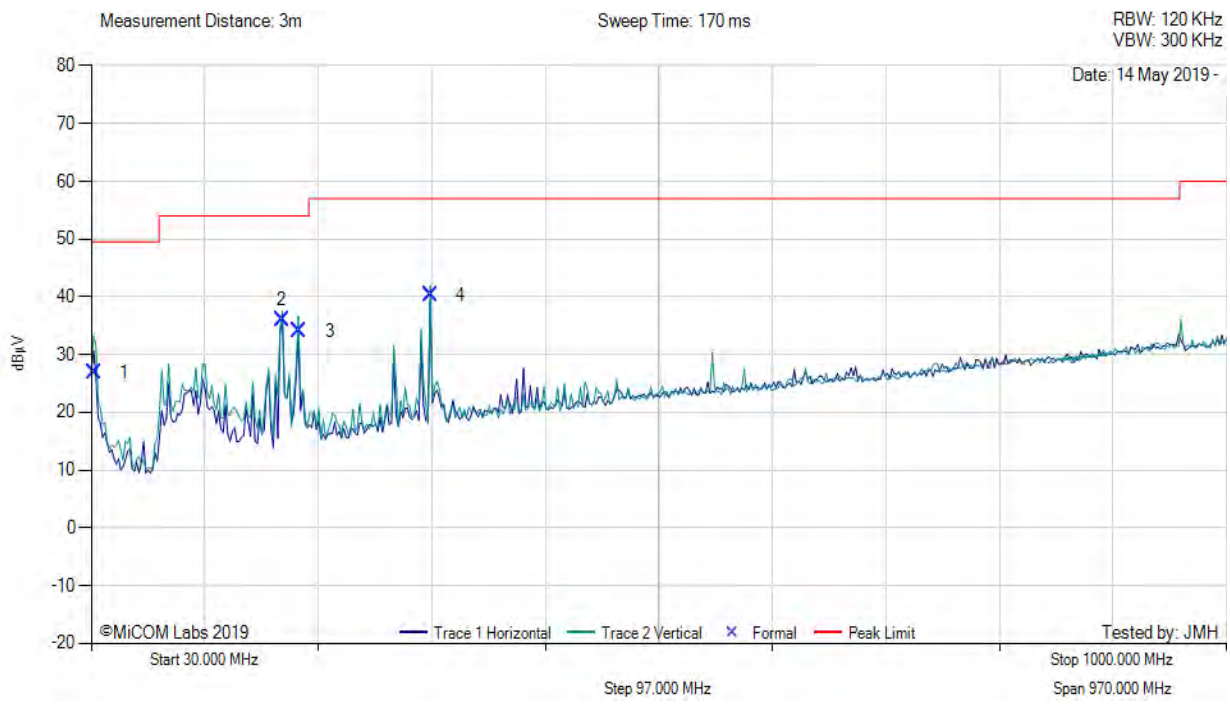

| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 1574.87 | 80.66 | -1.43 | -16.56 | 62.67 | Peak (Scan) | Horizontal | 100 | 0 | 82.2 | * | Pass |

**Test Notes:** EUT powered up linked to Base station via antenna. *1559-1610 MHz is in GPS band with separate limit measured separately.

back to matrix

## A.2.3. Digital Emissions

Variant: NB IOT, Test Freq: 0.00 MHz, Power Setting: NA, Duty Cycle (%): NA

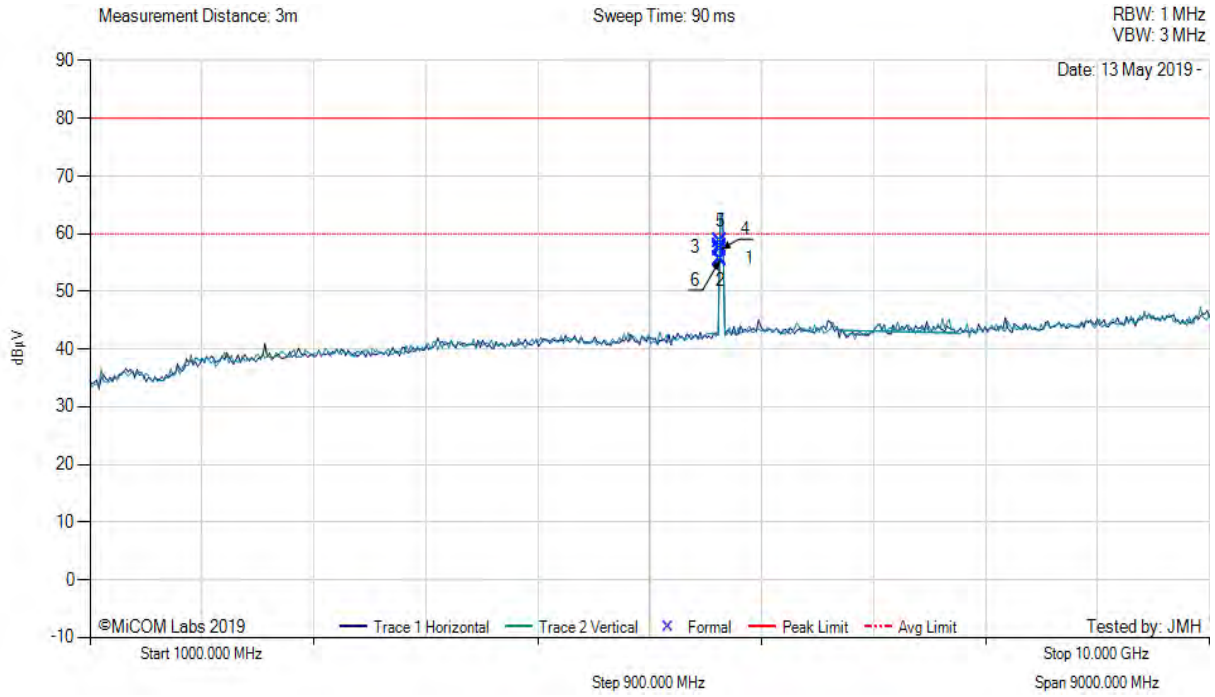



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 32.55 | 32.76 | 3.54 | -9.40 | 26.90 | MaxQP | Vertical | 98 | 268 | 49.5 | -22.6 | Pass |
| 2 | 193.02 | 48.11 | 4.43 | -16.50 | 36.04 | MaxQP | Vertical | 98 | 356 | 54.0 | -18.0 | Pass |
| 3 | 207.94 | 46.81 | 4.49 | -17.20 | 34.10 | MaxQP | Vertical | 113 | 4 | 54.0 | -19.9 | Pass |
| 4 | 320.02 | 49.29 | 4.91 | -13.90 | 40.30 | MaxQP | Vertical | 99 | 51 | 57.0 | -16.7 | Pass |

**Test Notes:** EUT powered by AC/DC PS.

back to matrix

Variant: NB IOT, Test Freq: 0.00 MHz, Power Setting: Not Applicable, Duty Cycle (%): 80




| 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 | 6064.07 | 68.53 | -2.84 | -10.00 | 55.69 | Max Peak | Vertical | 178 | 32 | 80.0 | -24.3 | Pass |
| 2 | 6064.07 | 68.33 | -2.84 | -10.00 | 55.49 | Max Avg | Vertical | 178 | 32 | 60.0 | -4.5 | Pass |
| 3 | 6068.87 | 71.37 | -2.85 | -9.84 | 57.68 | Max Peak | Horizontal | 101 | 295 | 80.0 | -22.3 | Pass |
| 4 | 6068.87 | 69.94 | -2.85 | -9.84 | 57.25 | Max Avg | Horizontal | 101 | 295 | 60.0 | -2.8 | Pass |
| 5 | 6068.92 | 71.29 | -2.85 | -9.84 | 58.60 | Max Peak | Vertical | 123 | 194 | 80.0 | -21.4 | Pass |
| 6 | 6068.92 | 68.30 | -2.85 | -9.84 | 55.61 | Max Avg | Vertical | 123 | 194 | 60.0 | -4.4 | Pass |

**Test Notes:** EUT powered up

back to matrix

MiCOMLabs
opening wireless markets

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