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**ENGINEERING TEST REPORT # TR 315108 A**  
**LSR Job #: C-2289**

Compliance Testing of:  
5-200-0081 Radio Module

Test Date(s):  
August 15 and November 18, 19, 23, 24 2015

Prepared For:  
Midmark Corporation  
Attn: Maria Mareno  
690 Knox Street, Suite 100  
Torrance, CA 90502

**This Test Report issued:**  
Adam Alger, EMC Engineer

Signature: \_\_\_\_\_ Date: 1-21-16  
*Adam O Alger*

**Quality Assurance by:**  
Michael Hintzke, EMC Engineer

Signature: \_\_\_\_\_ Date: 1-21-16  
*M Hintzke*

**Report by:**  
Adam Alger, EMC Engineer

Signature: \_\_\_\_\_ Date: 1-7-16  
*Adam O Alger*

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|                                   |                               |
|-----------------------------------|-------------------------------|
| Prepared For: Midmark Corporation | Name: 5-200-0081 Radio Module |
| Report: TR 315108                 | Model: 5-200-0081             |
| LSR: C-2289                       | Serial: Eng. Sample           |

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## LS Research, LLC in Review

As an EMC Testing Laboratory, our Accreditation and Assessments are recognized through the following:

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A2LA – American Association for Laboratory Accreditation

Accreditation based on ISO/IEC 17025: 2005 with Electrical (EMC) Scope of Accreditation  
A2LA Certificate Number: 1255.01

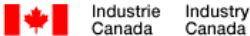
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Federal Communications Commission (FCC) – USA

Listing of 3 Meter Semi-Anechoic Chamber based on Title 47 CFR – Part 2.948  
FCC Registration Number: 90756

---



**Canada**

Industry Canada

On file, 3 Meter Semi-Anechoic Chamber based on RSS-212 – Issue 1  
File Number: IC 3088-A  
On file, 3 and 10 Meter OATS based on RSS-212 – Issue 1  
File Number: IC 3088

---



U. S. Conformity Assessment Body (CAB) Validation

Validated by the European Commission as a U. S. Competent Body operating under the U. S./EU, Mutual Recognition Agreement (MRA) operating under the European Union Electromagnetic Compatibility –Council Directive 2004/108/EC (formerly 89/336/EEC, Article 10.2).  
Date of Validation: January 16, 2001

Validated by the European Commission as a U.S. Notified Body operating under the U.S. /EU, Mutual Recognition Agreement (MRA) operating under the European Union Telecommunication Equipment – Council Directive 99/5/EC, Annex V.  
Date of Validation: November 20, 2002  
Notified Body Identification Number: 1243

|                                   |                               |
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## 1.0 Summary of Test Report

In 2015 the EUT, 5-200-0081 Radio Module, as provided by Midmark Corporation was tested and MEETS the following requirements:

| FCC Requirement                  | IC Requirement                  | Test Requirements                                                   | Measurement Procedure                              | Compliance (Yes/No) |
|----------------------------------|---------------------------------|---------------------------------------------------------------------|----------------------------------------------------|---------------------|
| 15.247 (a)(2)                    | RSS-247<br>Section 5.2 (1)      | 6 dB Bandwidth of a Digital Modulation System                       | ANSI C63.10-2013<br>Section 11.8                   | Yes                 |
| 15.247(b) &<br>1.1310            | RSS-247<br>Section 5.4 (4)      | Maximum Output Power                                                | ANSI C63.10-2013<br>Section 11.9                   | Yes                 |
| 15.247 (e)                       | RSS-247<br>Section 5.2 (2)      | Power Spectral Density of a Digital Modulation System               | ANSI C63.10-2013<br>Section 11.10                  | Yes                 |
| 15.247(d)                        | RSS-247<br>Section 5.5          | RF Conducted Spurious Emissions at the Transmitter Antenna Terminal | ANSI C63.10-2013<br>Section 11.11                  | Yes                 |
| 15.247(c),<br>15.209 &<br>15.205 | RSS-GEN<br>Section 8.9,<br>8.10 | Transmitter Radiated Emissions in Restricted Bands                  | ANSI C63.10-2013<br>Section 11.12<br>(6.3,6.5,6.6) | Yes                 |
| 2.1055 (d)                       | RSS-GEN<br>Section 6.11         | Frequency Stability                                                 | ANSI C63.10-2013<br>Section 6.8                    | Yes                 |
| 15.207                           | RSS-GEN<br>Section 8.8          | Power Line Conducted Emissions Measurements                         | ANSI C63.10-2013<br>Section 6.2                    | Yes                 |

## 2.0 Test Facilities

All testing was performed at:

LS Research, LLC  
W66 N220 Commerce Court  
Cedarburg, Wisconsin, 53012 USA

LS Research, LLC is accredited by A2LA (American Association for Laboratory Accreditation) to the requirements of ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted.

|                                   |                               |
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### 3.0 Client Information

|                           |                                               |
|---------------------------|-----------------------------------------------|
| <b>Manufacturer Name:</b> | Midmark Corporation                           |
| <b>Address:</b>           | 690 Knox Street, Suite 100 Torrance, CA 90502 |
| <b>Contact Person:</b>    | Maria Moreno                                  |

### 3.1 Equipment Under Test (EUT) Information

*The following information has been supplied by the applicant.*

|                       |                         |
|-----------------------|-------------------------|
| <b>Product Name:</b>  | 5-200-0081 Radio Module |
| <b>Model Number:</b>  | 5-200-0081              |
| <b>Serial Number:</b> | Eng. Sample             |
| <b>FCC ID:</b>        | 2AF4M-5-200-0081        |
| <b>IC:</b>            | 20691-52000081          |

### 3.2 Product Information

Bluetooth Low Energy module utilizing PCB trace antenna

### 3.3 Modifications Incorporated In the EUT for Compliance Purposes

None noted at time of test

### 3.4 Deviations & Exclusions from Test Specifications

None noted at time of test

### 3.5 Additional Information

EUT programmed for continuous transmit via FTDI to USB cable connected to laptop computer running TI Smart RF Studio 7 V2.0.0. Test channels; Low Channel (2402 MHz), Mid Channel (2440 MHz), and High Channel (2480 MHz).

|                                   |                               |
|-----------------------------------|-------------------------------|
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#### 4.0 Conditions of Test

Environmental:

Temperature: 20-25° C  
Relative Humidity: 30-60%  
Atmospheric Pressure: 86-106 kPa

Mains Voltage: 120VAC 60Hz

#### 5.0 Test Equipment

All test equipment is calibrated by a calibration laboratory accredited by A2LA to the requirements of ISO 17025. For a complete list of test equipment and calibration dates, see Appendix A. Unless otherwise noted, resolution bandwidth of measuring instrument used during testing for given frequency range, see below.

| Frequency Range   | Resolution Bandwidth |
|-------------------|----------------------|
| 9 kHz – 150 kHz   | 200 Hz               |
| 150 kHz – 30 MHz  | 9 kHz                |
| 30 MHz – 1000 MHz | 120 kHz              |
| Above 1000 MHz    | 1 MHz                |

## 6.0 Conformance Summary

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, 15.207, Industry Canada RSS-247, Issue 1 (2015), Annex 8, RSS-GEN Issue 4 (2014).

If some emissions are seen to be within 3 dB of their respective limits:

As these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

|                                   |                               |
|-----------------------------------|-------------------------------|
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## Appendix A – Test Equipment



Date : 18-Nov-2015      Type Test : All      Job # : C-2289  
 Prepared By: Shane Dock / Adam Alger      Customer : Midmark      Quote # : 315108

| No. | Asset #   | Description                  | Manufacturer      | Model #            | Serial #   | Cal Date  | Cal Due Date | Equipment Status   |
|-----|-----------|------------------------------|-------------------|--------------------|------------|-----------|--------------|--------------------|
| 1   | EE 960085 | N9038A MXE 26.5GHz Receiver  | Agilent           | N9038A             | MY51210148 | 5/6/2015  | 5/6/2016     | Active Calibration |
| 2   | AA 960150 | Biconical Antenna            | ETS               | 3110B              | 0003-3346  | 1/22/2015 | 1/22/2016    | Active Calibration |
| 3   | AA 960163 | Log Periodic Antenna         | A.H. Systems, Inc | SAS-512-2          | 500        | 3/16/2015 | 3/16/2016    | Active Calibration |
| 4   | AA 960158 | Double Ridge Horn Antenna    | ETS Lindgren      | 3117               | 109300     | 7/9/2015  | 7/9/2016     | Active Calibration |
| 5   | AA 960153 | 2.4GHz High Pass Filter      | KVM               | HPF-L-14186        | 7272-04    | 4/15/2015 | 4/15/2016    | Active Calibration |
| 6   | EE 960159 | 0.8 - 21GHz LNA              | Mini-Circuits     | ZVA-213K-S+        | 740411007  | 7/9/2015  | 7/9/2016     | Active Calibration |
| 7   | EE 960146 | Std. Gain Horn Ant. w/preamp | Adv. Micro / EMC  | WLA622-4 / 3160-09 | 123001     | 8/19/2015 | 8/19/2016    | Active Calibration |
| 8   | EE 960162 | LISN - 15A                   | COM-POWER         | LI-215A            | 191969     | 7/24/2015 | 7/24/2016    | Active Calibration |

Project Engineer: Shane Dock

Quality Assurance: Peter Finken

Prepared For: Midmark Corporation

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Model: 5-200-0081

Serial: Eng. Sample

## Appendix B – Test Data

### B.1 – RF Conducted Emissions

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Manufacturer                       | Midmark Corporation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Test Location                      | LS Research, LLC                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Rule Part                          | FCC 15.247<br>IC RSS-247                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| General Measurement Procedure      | ANSI C63.10 Section 6.7                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| General Description of Measurement | A direct measurement of the transmitted signal was performed at the antenna port of the EUT via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. |

|                                   |                               |
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### B.1.1 – RF Conducted – Fundamental Bandwidth

|                                       |                                                      |
|---------------------------------------|------------------------------------------------------|
| Manufacturer                          | Midmark Corporation                                  |
| Date                                  | 9-15, 11-23 2015                                     |
| Operator                              | Adam A                                               |
| Temp. / R.H.                          | 20 - 25° C / 30-60% R.H.                             |
| Rule Part                             | FCC 15.247 (a)(2)<br>IC RSS-247 Section 5.2(1)       |
| Specific Measurement Procedure        | ANSI C63.10-2013 Section 11.8                        |
| Additional Description of Measurement | Peak detector used                                   |
| Additional Notes                      | 1. Continuous transmit modulated used for this test. |

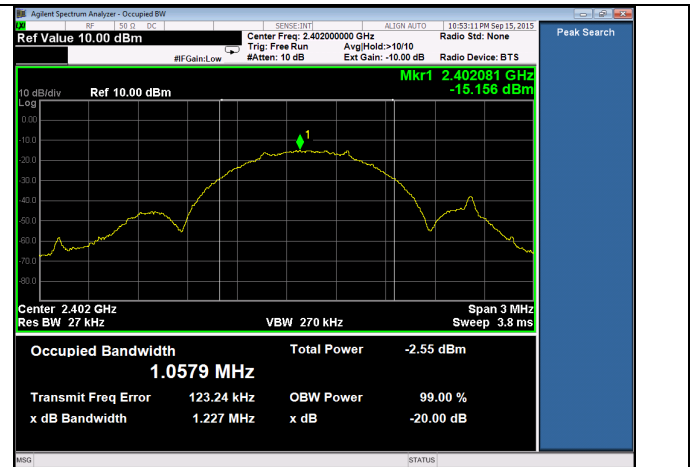
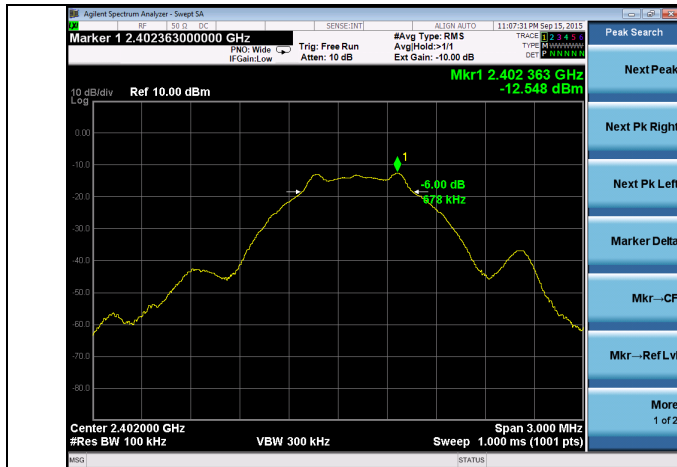
**Table**  
**Maximum Power**

| Frequency (MHz) | 99% BW (MHz) | 20 dB BW (MHz) | 6 dB DTS BW (MHz) |
|-----------------|--------------|----------------|-------------------|
| 2402            | 1.058        | 1.227          | 0.678             |
| 2440            | 1.061        | 1.218          | 0.686             |
| 2480            | 1.059        | 1.221          | 0.681             |

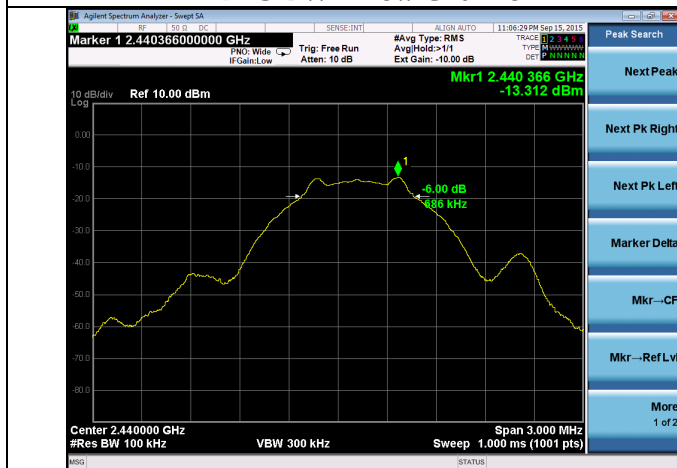
**Minimum Power**

| Frequency (MHz) | 99% BW (MHz) | 20 dB BW (MHz) | 6 dB DTS BW (MHz) |
|-----------------|--------------|----------------|-------------------|
| 2402            | 1.072        | 1.213          | 0.688             |
| 2440            | 1.070        | 1.211          | 0.674             |
| 2480            | 1.075        | 1.225          | 0.696             |

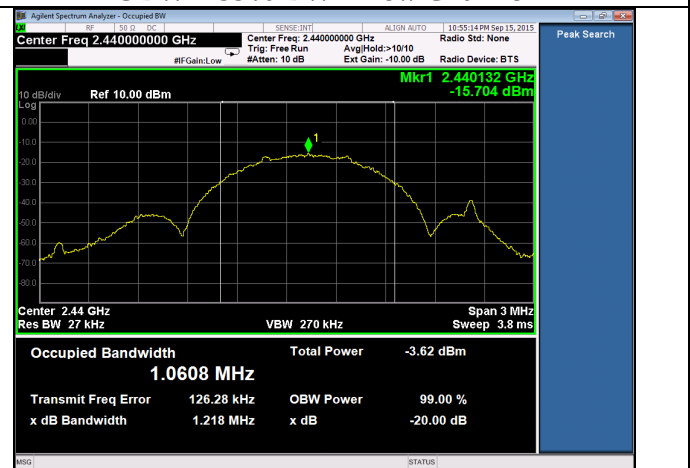
## Plots – Max Power



## DTS BW – Low Channel



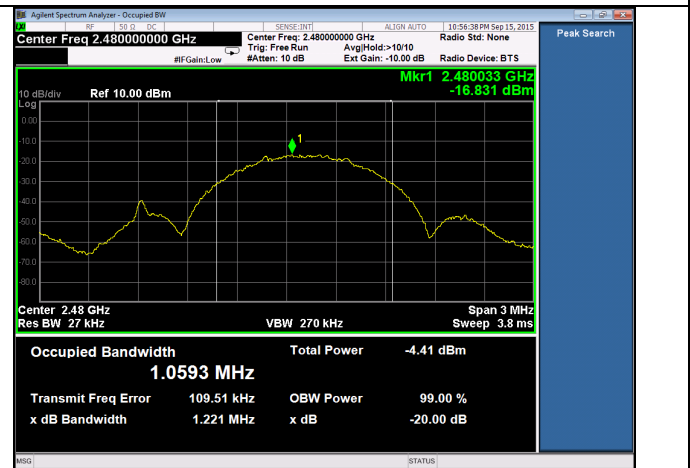
## OBW + 99% BW – Low Channel



## DTS BW – Mid Channel



## OBW + 99% BW – Mid Channel



## DTS BW – High Channel

## OBW + 99% BW – High Channel

Prepared For: Midmark Corporation

Report: TR 315108

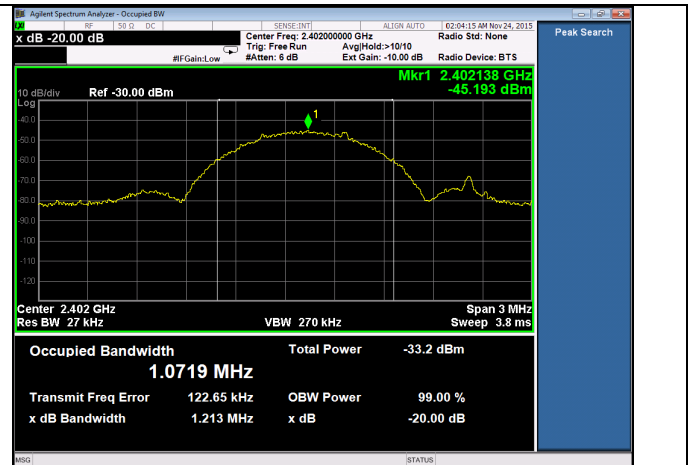
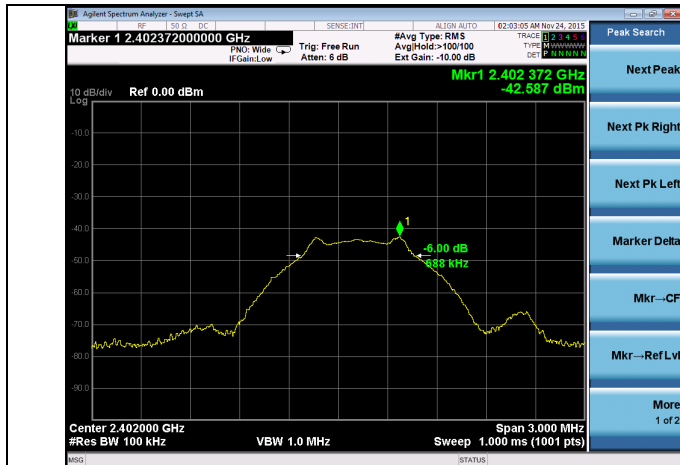
LSR: C-2289

Name: 5-200-0081 Radio Module

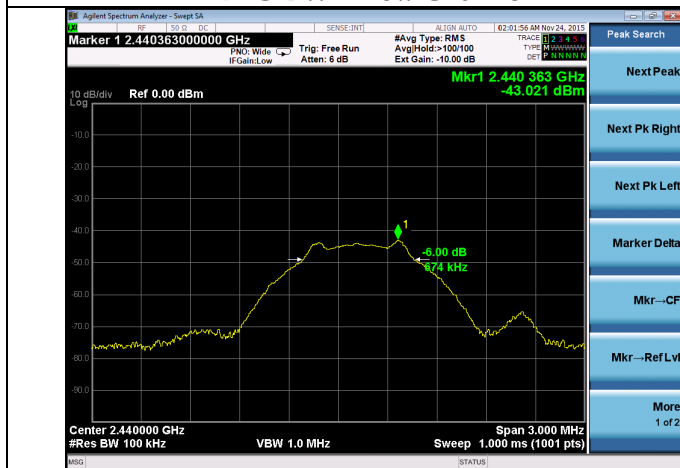
Model: 5-200-0081

Serial: Eng. Sample

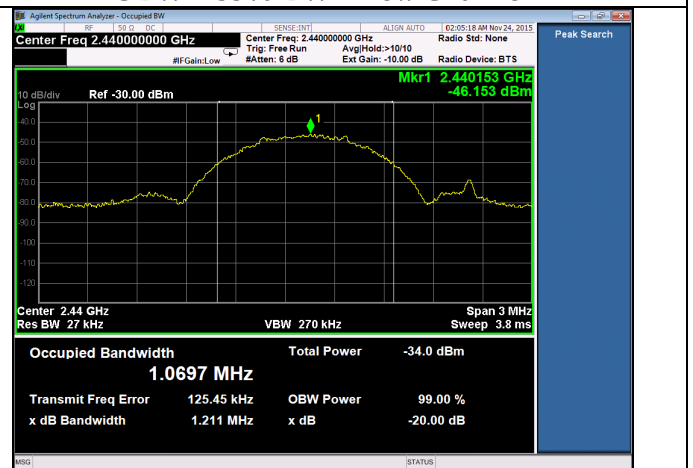
## Plots – Min Power



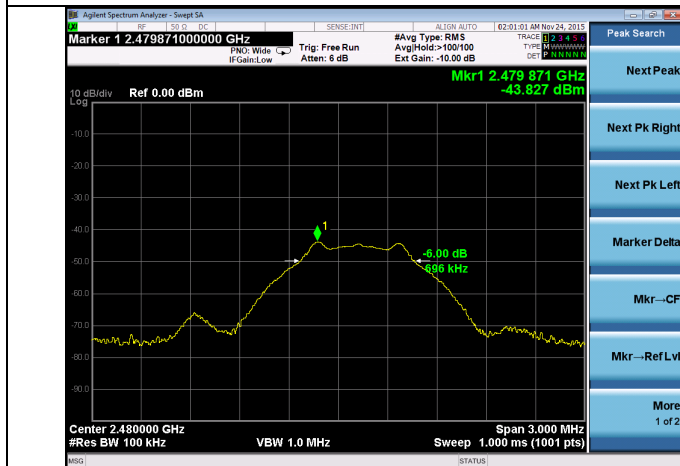
### DTS BW – Low Channel



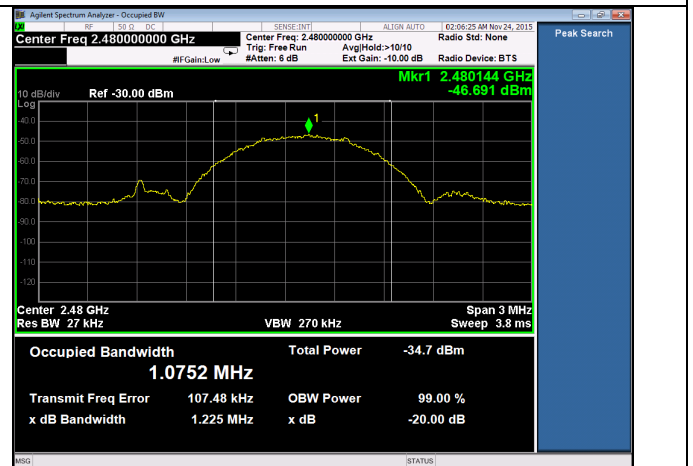
### OBW + 99% BW – Low Channel



### DTS BW – Mid Channel



### OBW + 99% BW – Mid Channel



### DTS BW – High Channel

### OBW + 99% BW – High Channel

Prepared For: Midmark Corporation

Report: TR 315108

LSR: C-2289

Name: 5-200-0081 Radio Module

Model: 5-200-0081

Serial: Eng. Sample

### B.1.2 – RF Conducted – Fundamental Power and Spectral Density

|                                       |                                                                                                                                                  |
|---------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| Manufacturer                          | Midmark Corporation                                                                                                                              |
| Date                                  | 9-15, 11-23 2015                                                                                                                                 |
| Operator                              | Adam A                                                                                                                                           |
| Temp. / R.H.                          | 20 - 25° C / 30-60% R.H.                                                                                                                         |
| Rule Part                             | FCC 15.247 (b) & (e)<br>IC RSS-247 Section 5.4 (4) & 5.2 (2)                                                                                     |
| Specific Measurement Procedure        | ANSI C63.10-2013 Section 11.9 and 11.10                                                                                                          |
| Additional Description of Measurement | Peak Output Power and Peak PSD methods utilized for measurement<br>100 kHz resolution bandwidth used for Peak Power Spectral Density measurement |
| Additional Notes                      | 1. Continuous transmit modulated used for this test.<br>Sample Calculation:<br>Margin (dB) = Limit – Measured Level                              |

**Table**  
**Maximum Power**

| Frequency (MHz) | 99% BW (MHz) | 20 dB BW (MHz) | 6 dB DTS BW (MHz) | PSD (dBm/100 kHz) | Power  |
|-----------------|--------------|----------------|-------------------|-------------------|--------|
| 2402            | 1.058        | 1.227          | 0.678             | -12.55            | -12.23 |
| 2440            | 1.061        | 1.218          | 0.686             | -13.31            | -12.90 |
| 2480            | 1.059        | 1.221          | 0.681             | -14.08            | -13.62 |

**Minimum Power**

| Frequency (MHz) | 99% BW (MHz) | 20 dB BW (MHz) | 6 dB DTS BW (MHz) | PSD (dBm/100 kHz) | Power  |
|-----------------|--------------|----------------|-------------------|-------------------|--------|
| 2402            | 1.072        | 1.213          | 0.688             | -42.59            | -41.15 |
| 2440            | 1.070        | 1.211          | 0.674             | -43.02            | -41.91 |
| 2480            | 1.075        | 1.225          | 0.696             | -43.83            | -42.49 |

PSD limit = 8 dBm / 3 kHz

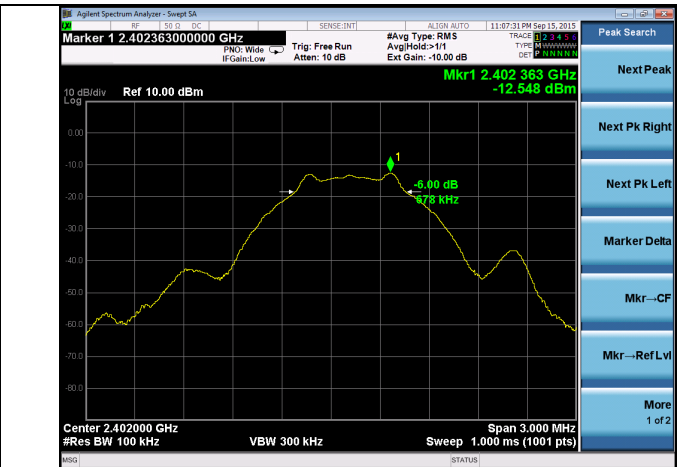
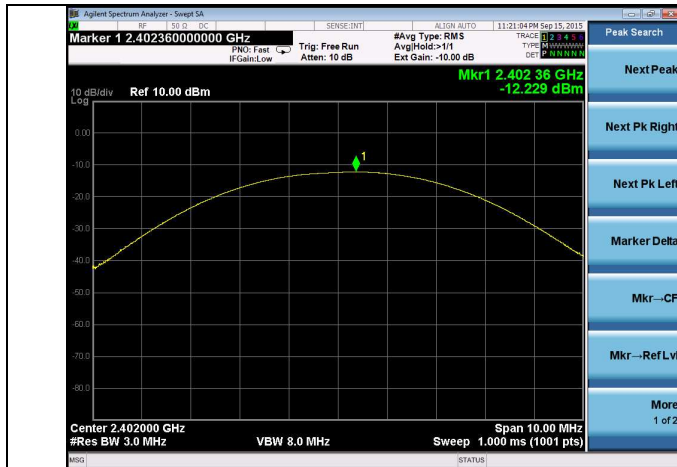
Power limit = 30 dBm

Worst Case PSD / 100 kHz = -12.55 < 8 dBm = PASS

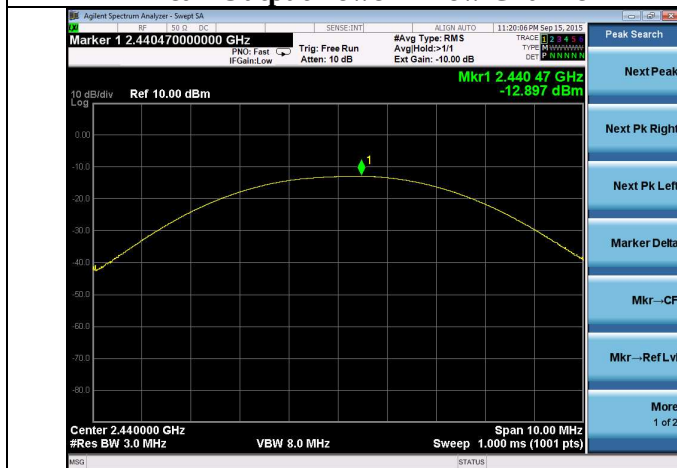
Worst Case Power = -12.23 < 30 dBm = PASS

|                                   |                               |
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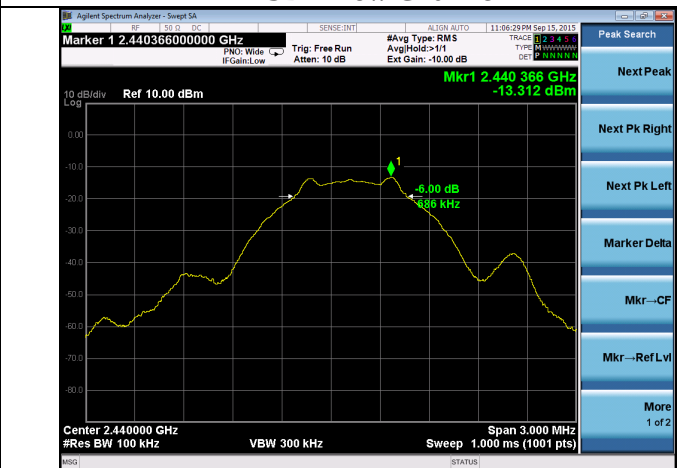
## Plots – Max Power



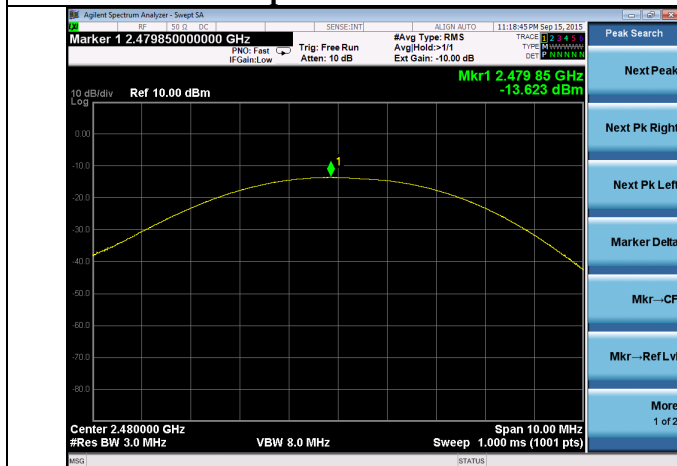
## Peak Output Power – Low Channel



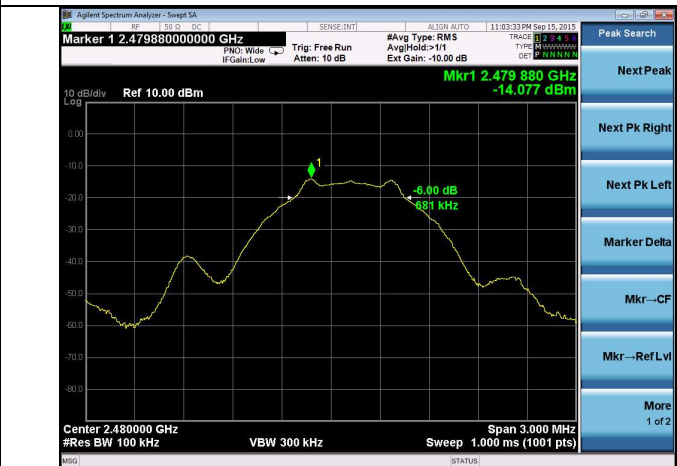
## PPSD – Low Channel



## Peak Output Power – Mid Channel



## PPSD – Md Channel



## Peak Output Power – High Channel

## PPSD – High Channel

Prepared For: Midmark Corporation

Report: TR 315108

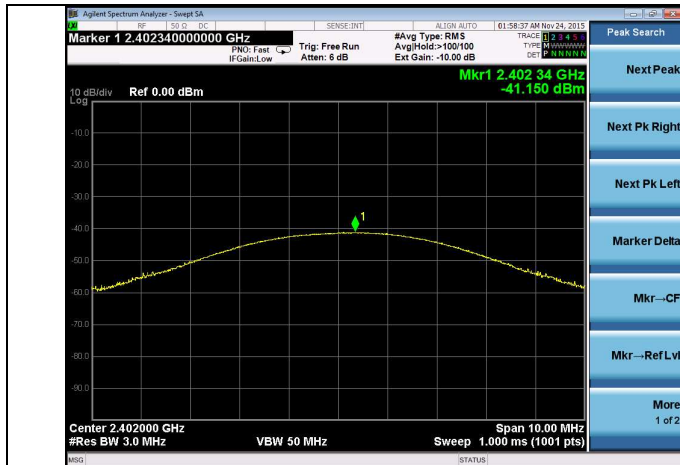
LSR: C-2289

Name: 5-200-0081 Radio Module

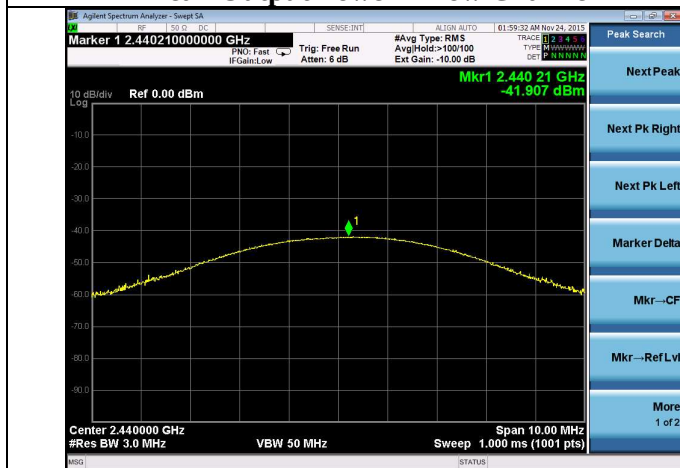
Model: 5-200-0081

Serial: Eng. Sample

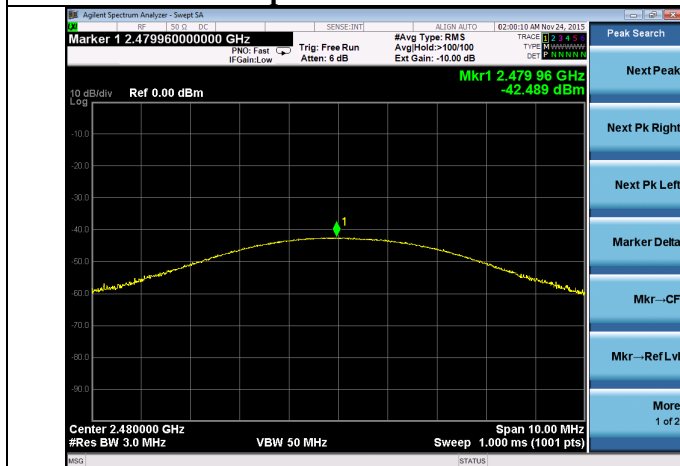
## Plots – Min Power



## Peak Output Power – Low Channel



## Peak Output Power – Mid Channel



## Peak Output Power – High Channel

## PPSD – High Channel

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Name: 5-200-0081 Radio Module

Model: 5-200-0081

Serial: Eng. Sample

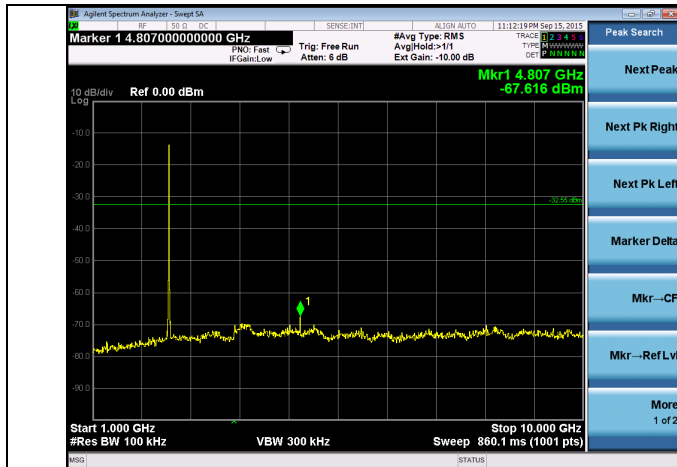
### B.1.3 – RF Conducted – Spurious Emissions

|                                       |                                                                                                                                                           |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Manufacturer                          | Midmark Corporation                                                                                                                                       |
| Date                                  | 9-15, 11-23 2015                                                                                                                                          |
| Operator                              | Adam A                                                                                                                                                    |
| Temp. / R.H.                          | 20 - 25° C / 30-60% R.H.                                                                                                                                  |
| Rule Part                             | FCC 15.247 (d)<br>IC RSS-247 Section 5.5                                                                                                                  |
| Specific Measurement Procedure        | ANSI C63.10-2013 Section 11.11                                                                                                                            |
| Additional Description of Measurement | Peak output power measurements therefore spurious emissions attenuated 20 dBc.                                                                            |
| Additional Notes                      | 1. Continuous transmit modulated used for this test.<br>2. See DTS BW plots for 100 kHz reference<br>3. No spurious emissions found within 20 dB of limit |

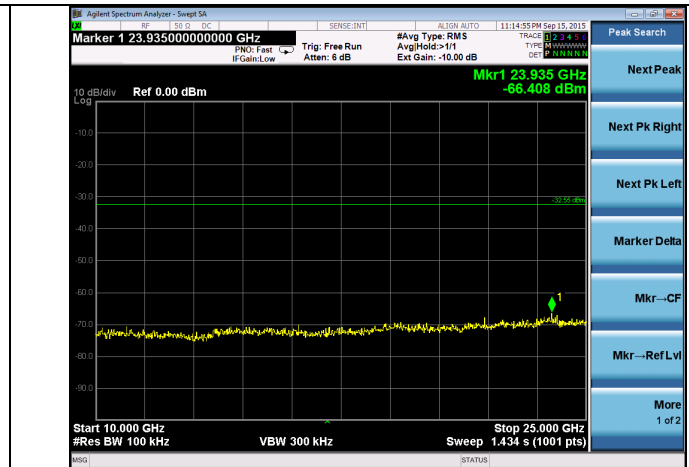
No emissions found within 20 dB of limit

|                                   |                               |
|-----------------------------------|-------------------------------|
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| LSR: C-2289                       | Serial: Eng. Sample           |

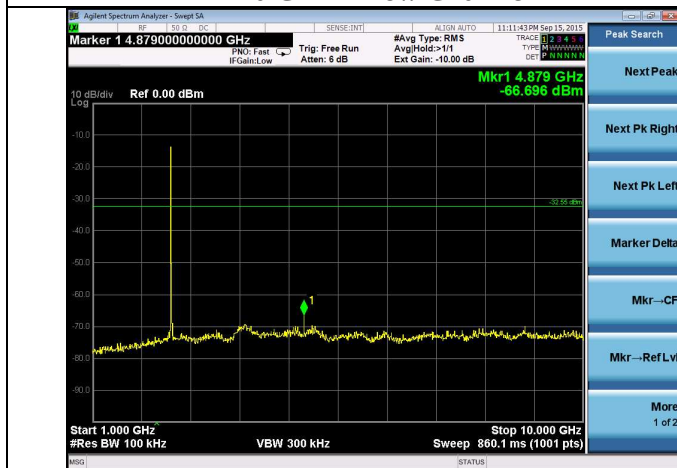
## Plots – Max Power



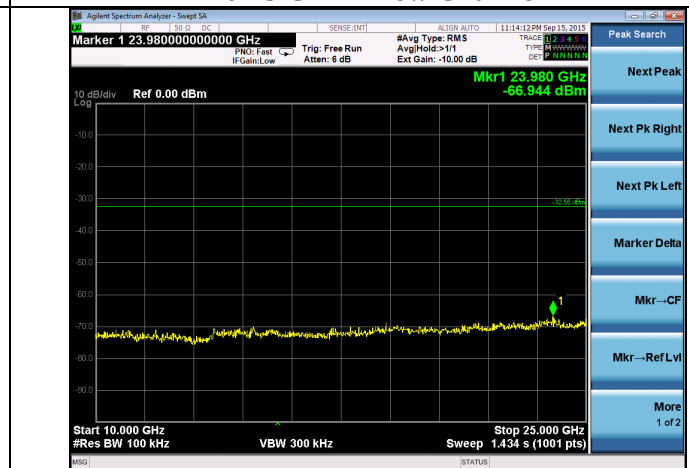
1-10 GHz – Low Channel



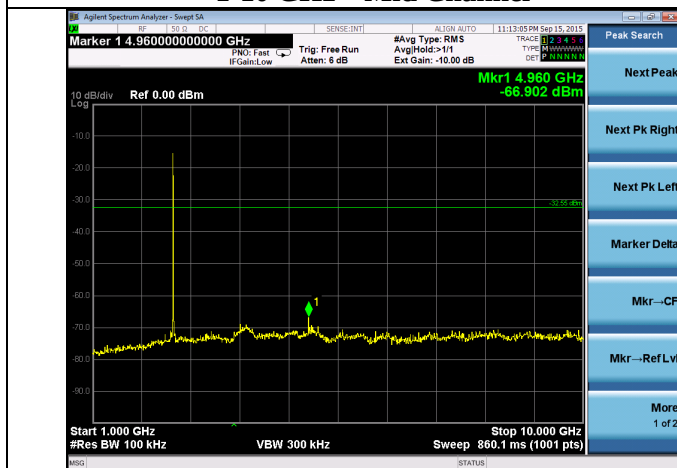
10-25 GHz – Low Channel



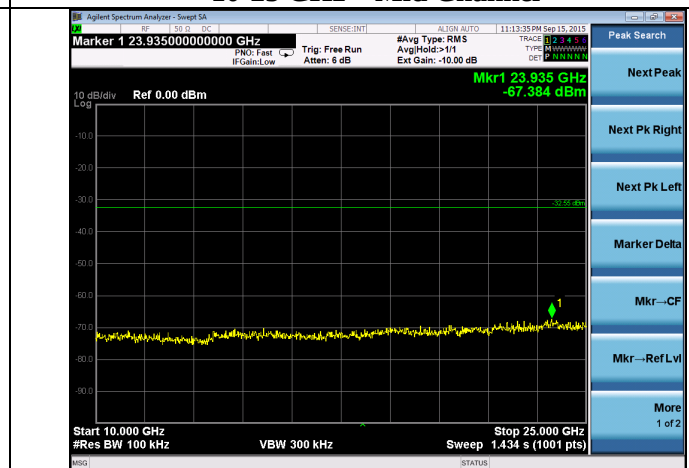
1-10 GHz – Mid Channel



10-25 GHz – Mid Channel



1-10 GHz – High Channel



10-25 GHz – High Channel

Prepared For: Midmark Corporation

Report: TR 315108

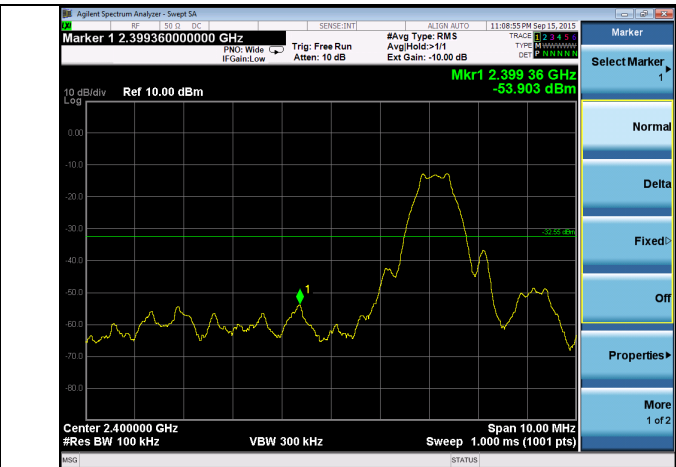
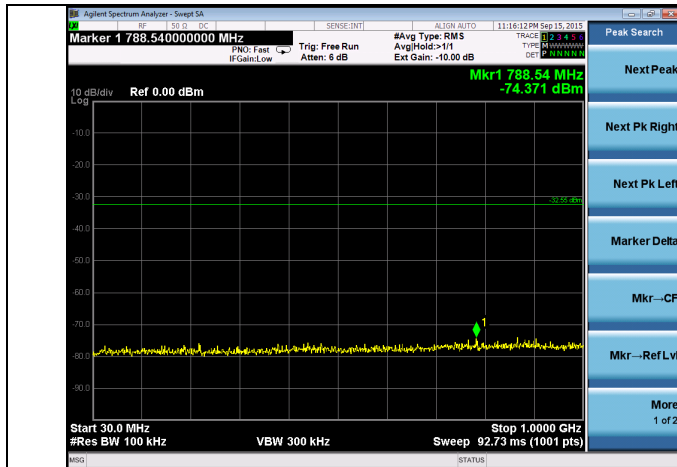
LSR: C-2289

Name: 5-200-0081 Radio Module

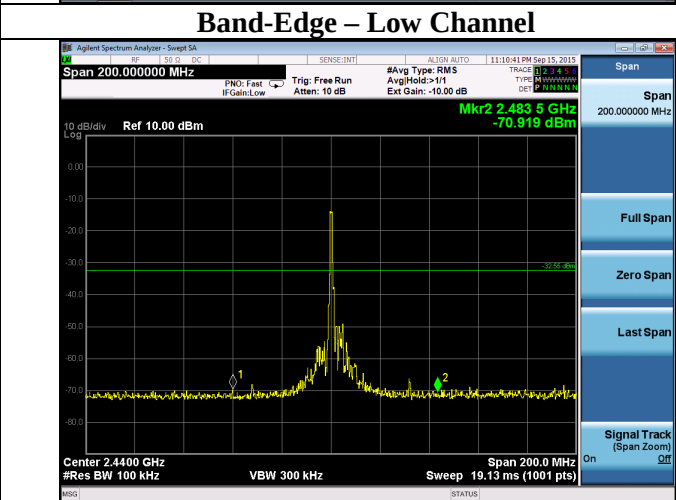
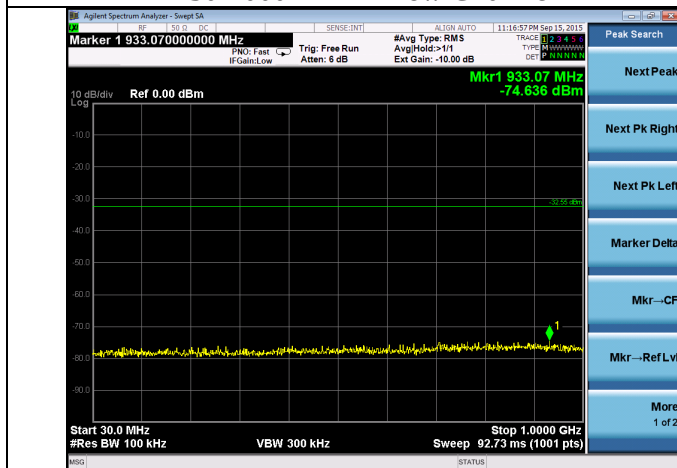
Model: 5-200-0081

Serial: Eng. Sample

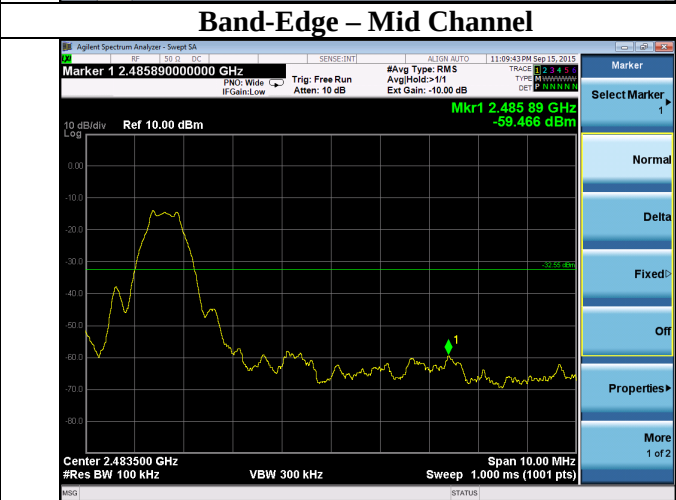
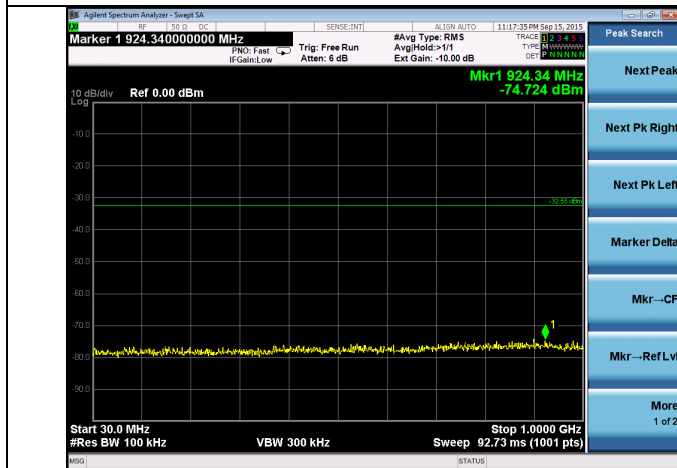
## Plots – Max Power



### 30-1000 MHz – Low Channel



### 30-1000 MHz – Mid Channel



### 30-1000 MHz – High Channel

### Band-Edge – High Channel

Prepared For: Midmark Corporation

Report: TR 315108

LSR: C-2289

Name: 5-200-0081 Radio Module

Model: 5-200-0081

Serial: Eng. Sample

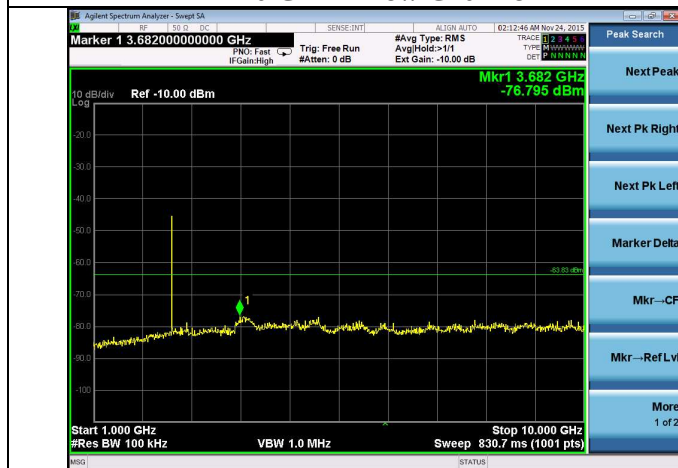
## Plots – Min Power



1-10 GHz – Low Channel



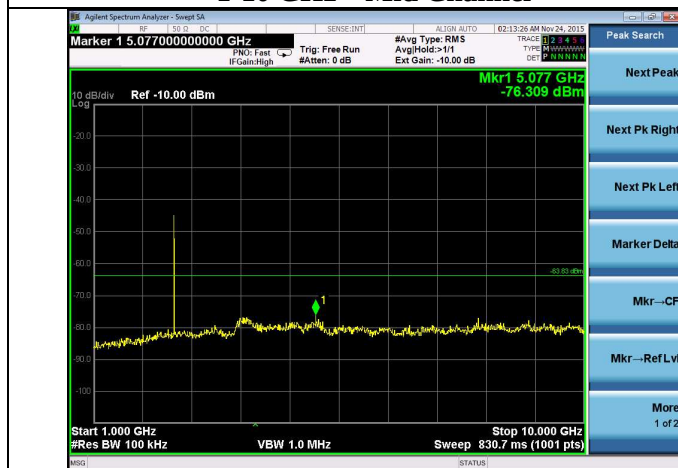
10-25 GHz – Low Channel



1-10 GHz – Mid Channel



10-25 GHz – Mid Channel



1-10 GHz – High Channel



10-25 GHz – High Channel

Prepared For: Midmark Corporation

Report: TR 315108

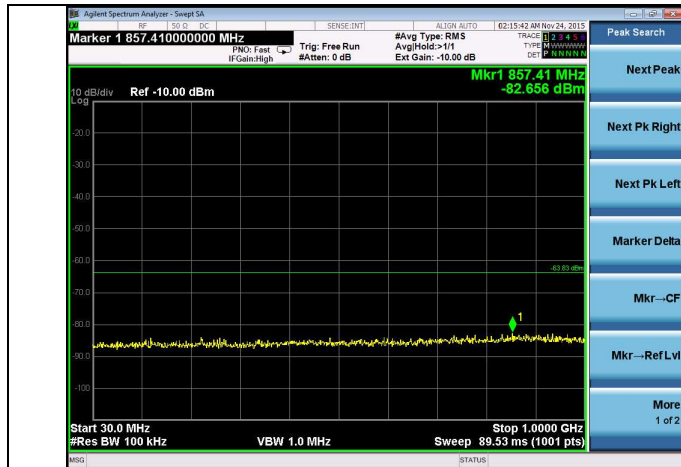
LSR: C-2289

Name: 5-200-0081 Radio Module

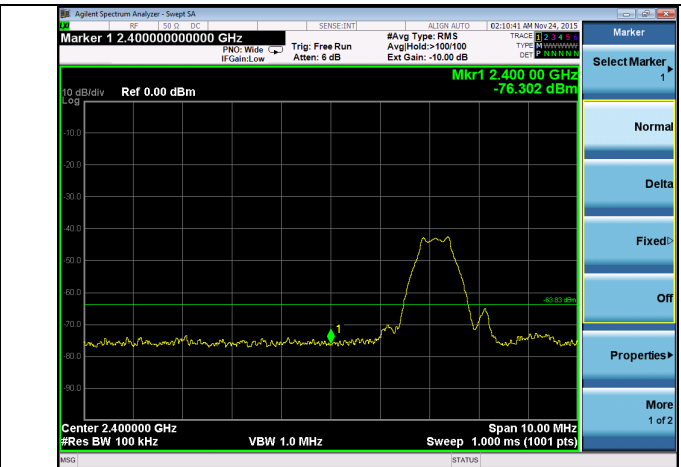
Model: 5-200-0081

Serial: Eng. Sample

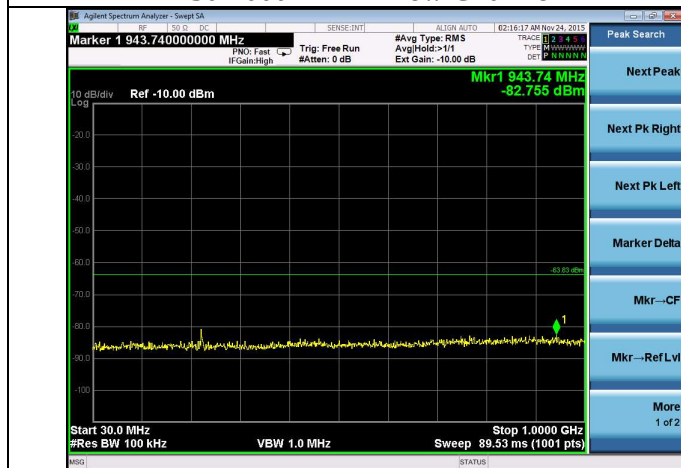
## Plots – Min Power



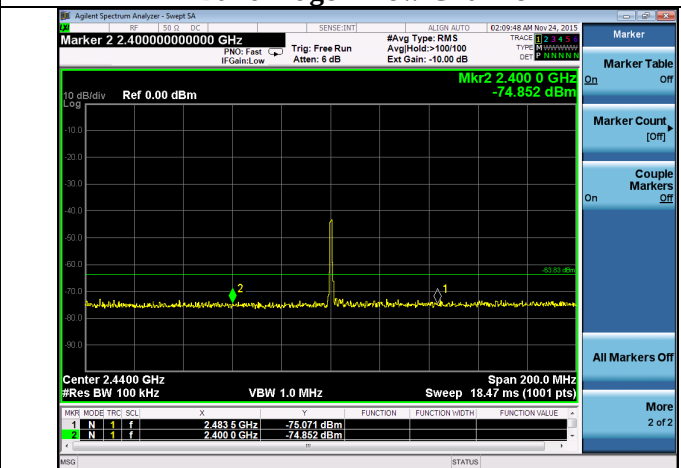
30-1000 MHz – Low Channel



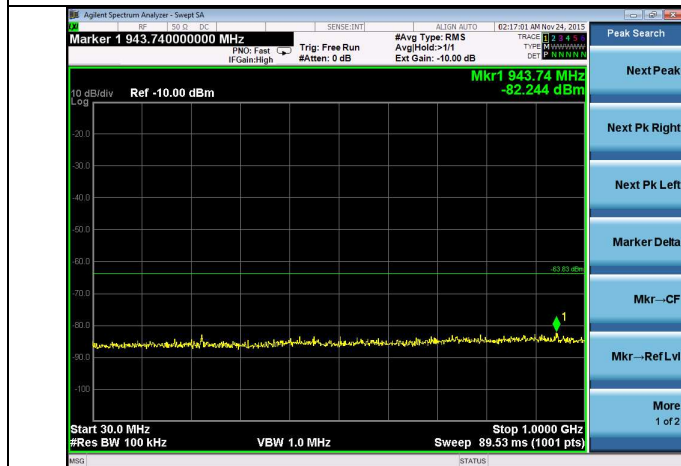
Band-Edge – Low Channel



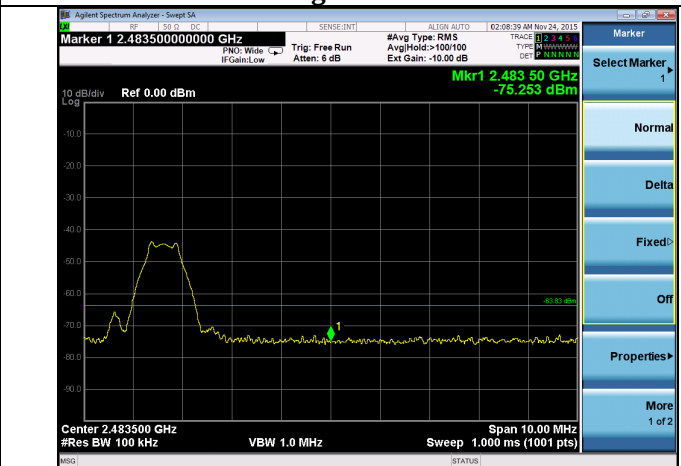
30-1000 MHz – Mid Channel



Band-Edge – Mid Channel



30-1000 MHz – High Channel



Band-Edge – High Channel

Prepared For: Midmark Corporation

Report: TR 315108

LSR: C-2289

Name: 5-200-0081 Radio Module

Model: 5-200-0081

Serial: Eng. Sample

#### B.1.4 – RF Conducted – Frequency Stability

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Manufacturer                          | Midmark Corporation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Date                                  | 9-15-15                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Operator                              | Adam A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Temp. / R.H.                          | 20 - 25° C / 30-60% R.H.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Rule Part                             | FCC 2.1055<br>RSS-GEN Section 6.11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Specific Measurement Procedure        | ANSI C63.10-2013 Section 6.8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Additional Description of Measurement | RF Conducted Measurement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Additional Notes                      | <p>The power and frequency stability of the device was examined as a function of the input voltage available to the EUT. A Spectrum Analyzer was used to measure the RF output power and frequency at the appropriate frequency markers. Power was supplied by an external bench-type DC power supply and was varied from the nominal.</p> <p>The power was then cycled On/Off to observe system response. No unusual response was observed, the emission characteristics were well behaved, and the system returned to the same state of operation as before the power cycle.</p> <p>Below is data showing stability of the fundamental frequency.</p> <p>Continuous transmit un-modulated used for this test.<br/>EUT operates at 5.0 VDC nominal</p> |

**Table**

|              | 4.25 VDC    |                | 5.0 VDC     |                | 5.75 VDC    |                | FREQ DRIFT (Hz) |
|--------------|-------------|----------------|-------------|----------------|-------------|----------------|-----------------|
|              | POWER (dBm) | FREQUENCY (Hz) | POWER (dBm) | FREQUENCY (Hz) | POWER (dBm) | FREQUENCY (Hz) |                 |
| LOW CHANNEL  | -12.521     | 2402113684     | -12.518     | 2402113718     | -12.530     | 2402113678     | 40              |
| MID CHANNEL  | -13.243     | 2440115493     | -13.210     | 2440115503     | -13.216     | 2440115557     | 64              |
| HIGH CHANNEL | -14.006     | 2480117466     | -13.997     | 2480117416     | -13.985     | 2480117410     | 56              |

|                                   |                               |
|-----------------------------------|-------------------------------|
| Prepared For: Midmark Corporation | Name: 5-200-0081 Radio Module |
| Report: TR 315108                 | Model: 5-200-0081             |
| LSR: C-2289                       | Serial: Eng. Sample           |

## B.2 – Transmitter Radiated Emissions in Restricted Bands

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                            |                                                                          |                                 |
|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------------------------------------------|---------------------------------|
| Rule Part(s)                   | FCC: 15.247 / 15.205 / 15.209<br>IC: RSS-GEN Section 8.9,8.10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                            |                                                                          |                                 |
| Measurement Procedure          | ANSI C63.10 – 2013 Section 11.12 (6.3,6.5,6.6)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                            |                                                                          |                                 |
| Test Location                  | LS Research, LLC - FCC Listed 3 meter Semi-Anechoic Chamber                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                            |                                                                          |                                 |
| Test Distance                  | See data section                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                            |                                                                          |                                 |
| EUT Placement                  | Above 1 GHz: 150 cm height non-conductive table above reference ground plane covered with absorbers<br>Below 1 GHz: 80 cm height non-conductive table above reference ground plane                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                            |                                                                          |                                 |
| Frequency Range of Measurement | Biconical:<br>30-300 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Log Periodic Dipole Array:<br>300-1000 MHz | Double-Ridged Waveguide Horn:<br>1-18 GHz                                | Standard Gain Horn:<br>18-26GHz |
| Measurement Detectors          | 30-1000MHz<br>RBW: 120 kHz<br>VBW: At least 300 kHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                            | 1 - 40 GHz:<br>RBW : 1MHz<br>VBW: At least 3 (MHz) Peak<br>10 Hz Average |                                 |
| Description of Measurement     | 1) The antenna, cable, pre-amp, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are preformed. The data is gathered and reported as the corrected values.<br><br>2) The EUT is placed on a non-conductive pedestal <u>made of expanded polyethylene foam</u> centered on a turn-table in the test location with the antenna at the test distance from the EUT<br><br>3) Maximum radiated RF emissions are determined by rotation of azimuth and scanning the sense antenna between 1 and 4 meters in height using both horizontal and vertical antenna polarities. Maximized levels are manually noted at degree values of azimuth and at sense antenna height. |                                            |                                                                          |                                 |
| Example Calculations           | Reported Measurement data = Raw receiver measurement + Antenna Correction Factor + Cable factor (dB) - amplification factor (when applicable) + Additional factor (when applicable)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                            |                                                                          |                                 |

### Limits:

| Frequency (MHz) | 3 m Limit (µV/m) | 3 m Limit (dBµV/m) | Type             |
|-----------------|------------------|--------------------|------------------|
| 30-88           | 100              | 40.0               | Quasi-Peak       |
| 88-216          | 150              | 43.5               | Quasi-Peak       |
| 216-960         | 200              | 46.0               | Quasi-Peak       |
| Above 960       | 500              | 54.0               | Average (>1 GHz) |

|                                   |                               |
|-----------------------------------|-------------------------------|
| Prepared For: Midmark Corporation | Name: 5-200-0081 Radio Module |
| Report: TR 315108                 | Model: 5-200-0081             |
| LSR: C-2289                       | Serial: Eng. Sample           |

### B.2.1 – Transmitter Band-Edge Restricted Band

|                       |                                                                                             |
|-----------------------|---------------------------------------------------------------------------------------------|
| Manufacturer          | Midmark Corporation                                                                         |
| Date                  | 11-18, 11-23 2015                                                                           |
| Operator              | Adam A                                                                                      |
| Temp. / R.H.          | 20 - 25° C / 30-60% R.H.                                                                    |
| Rule Part             | FCC 15.247/ 15.205 / 15.209<br>IC RSS-247 / RSS-GEN                                         |
| Measurement Procedure | ANSI C63.10-2013 Section 11.12                                                              |
| Test Distance         | 3 meter                                                                                     |
| EUT Placement         | 150 cm height non-conductive table centered on turn-table , absorbers covering ground plane |
| Detectors             | Final Measurements: Peak / Max Hold, RBW 1 MHz, Average VBW 10Hz, Peak VBW 3 MHz            |
| Additional Notes      | 1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported. |

#### Example Calculation:

Limit (dBμV/m) – Reading (dBμV/m) = Margin (dB)

#### Max Power

##### Average Table

| EUT Channel | Frequency (MHz) | Average Reading (dBμV/m) | Average Limit (dBμV/m) | Average Margin (dB) |
|-------------|-----------------|--------------------------|------------------------|---------------------|
| Low         | 2389.5          | 45.0                     | 54.0                   | 9.0                 |
| High        | 2485.4          | 43.2                     | 54.0                   | 10.8                |

##### Peak Table

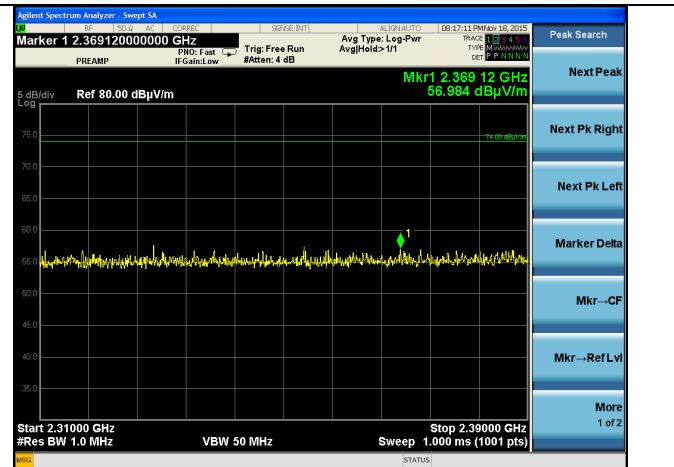
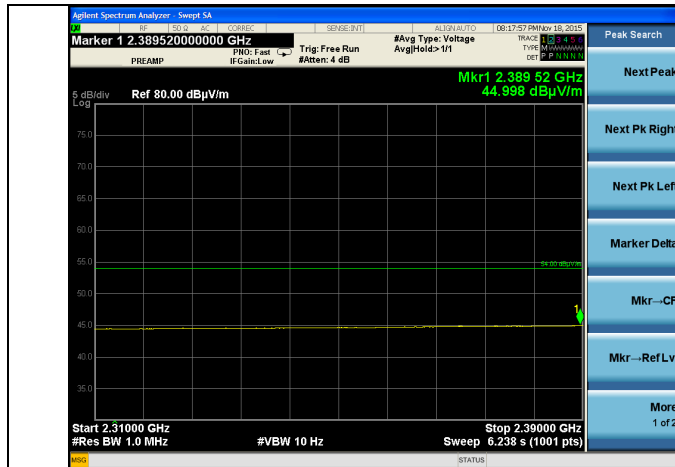
| EUT Channel | Frequency (MHz) | Peak Reading (dBμV/m) | Peak Limit (dBμV/m) | Peak Margin (dB) |
|-------------|-----------------|-----------------------|---------------------|------------------|
| Low         | 2369.1          | 57.0                  | 74.0                | 17.0             |
| High        | 2488.2          | 58.7                  | 74.0                | 15.3             |

#### Min Power

##### Peak meets Average Limit

| EUT Channel | Frequency (MHz) | Peak Reading (dBμV/m) | Average Limit (dBμV/m) | Margin (dB) |
|-------------|-----------------|-----------------------|------------------------|-------------|
| Low         | 2366.2          | 42.1                  | 54.0                   | 11.9        |
| High        | 2495.1          | 42.9                  | 54.0                   | 11.1        |

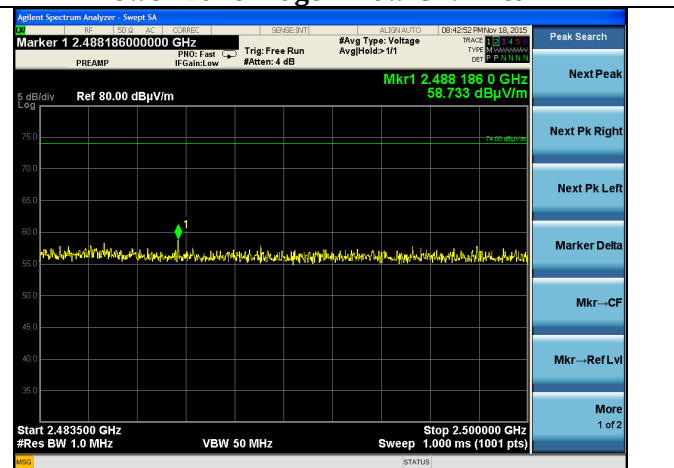
## Plots – Max Power



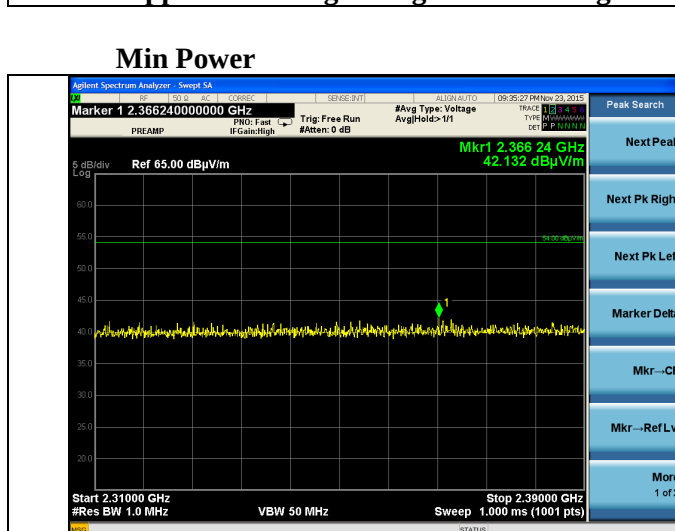
## Lower Band-Edge – Low Ch. - Average



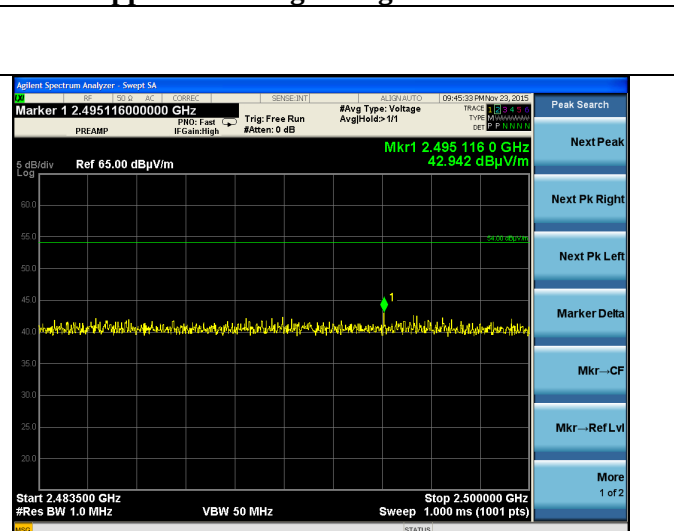
## Lower Band-Edge – Low Ch. - Peak



## Upper Band-Edge – High Ch. - Average



## Upper Band-Edge – High Ch. - Peak



## Lower Band-Edge – Low Ch. - Peak

## Upper Band-Edge – High Ch. - Peak

Prepared For: Midmark Corporation

Report: TR 315108

LSR: C-2289

Name: 5-200-0081 Radio Module

Model: 5-200-0081

Serial: Eng. Sample

## B.2.2 – Transmitter Radiated Spurious Emissions in Restricted Bands

|                       |                                                                                                                                                                                      |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Manufacturer          | Midmark Corporation                                                                                                                                                                  |
| Date                  | 11-18, 11-23 2015                                                                                                                                                                    |
| Operator              | Adam A                                                                                                                                                                               |
| Temp. / R.H.          | 20 - 25° C / 30-60% R.H.                                                                                                                                                             |
| Rule Part             | FCC 15.247/ 15.205 / 15.209<br>IC RSS-247 / RSS-GEN                                                                                                                                  |
| Measurement Procedure | ANSI C63.10-2013 Section 11.12                                                                                                                                                       |
| Test Distance         | 3 meter                                                                                                                                                                              |
| EUT Placement         | Above 1 GHz: 150 cm height non-conductive table centered on turn-table with absorbers covering ground plane<br>Below 1 GHz: 80 cm height non-conductive table centered on turn-table |
| Detectors             | Final Measurements: Peak / Max Hold, RBW 1 MHz, Average VBW 30Hz, Peak VBW 3 MHz                                                                                                     |
| Additional Notes      | 1) EUT maximized in orientation, azimuth, and antenna height with maximum results reported.                                                                                          |

### Example Calculation:

Limit (dBμV/m) – Reading (dBμV/m) = Margin (dB)

**Table**  
**30-1000 MHz**

| Frequency (MHz) | Antenna Polarity | Azimuth (degree) | Height (cm) | Quasi-Peak Reading (dBμV/m) | Quasi-Peak Limit (dBμV/m) | Margin (dB) |
|-----------------|------------------|------------------|-------------|-----------------------------|---------------------------|-------------|
| 70.68           | Vertical         | 0                | 100         | 27.35                       | 40.0                      | 12.7        |
| 130.27          | Vertical         | 0                | 100         | 27.91                       | 43.5                      | 15.6        |
| 167.77          | Vertical         | 231              | 100         | 28.50                       | 43.5                      | 15.0        |
| 45.72           | Vertical         | 0                | 100         | 24.02                       | 40.0                      | 16.0        |
| 100.26          | Vertical         | 204              | 100         | 23.22                       | 43.5                      | 20.3        |
| 167.7           | Horizontal       | 238              | 200         | 21.84                       | 43.5                      | 21.7        |

### 1-25 GHz

| Frequency (MHz) | Height (cm) | Azimuth (degree) | Peak Reading (dBμV/m) | Peak Limit (dBμV/m) | Average Reading (dBμV/m) | Average Limit (dBμV/m) | Average Margin (dB) | Peak Margin (dB) | Antenna Polarity | EUT orientation |
|-----------------|-------------|------------------|-----------------------|---------------------|--------------------------|------------------------|---------------------|------------------|------------------|-----------------|
| 4882.3          | 246.76      | 238              | 43.63                 | 74                  | 34.43                    | 54                     | 19.6                | 30.4             | H                | F               |
| 4882.0          | 142.42      | 256.25           | 43.93                 | 74                  | 35.55                    | 54                     | 18.5                | 30.1             | V                | F               |
| 4882.3          | 233.95      | 87.75            | 44.35                 | 74                  | 36.82                    | 54                     | 17.2                | 29.7             | H                | H               |
| 4882.1          | 234.90      | 82.5             | 44.01                 | 74                  | 35.25                    | 54                     | 18.8                | 30.0             | V                | H               |
| 4882.0          | 149.85      | 227              | 42.58                 | 74                  | 31.8                     | 54                     | 22.2                | 31.4             | V                | V               |
| 4882.1          | 150.04      | 231              | 43.26                 | 74                  | 33.96                    | 54                     | 20.0                | 30.7             | H                | V               |

Prepared For: Midmark Corporation

Report: TR 315108

LSR: C-2289

Name: 5-200-0081 Radio Module

Model: 5-200-0081

Serial: Eng. Sample

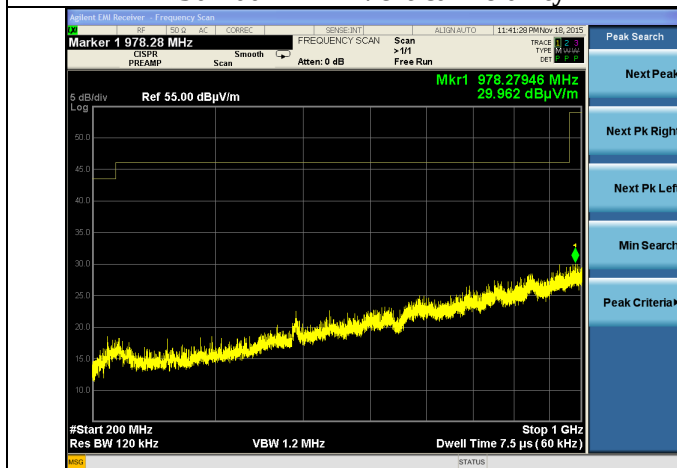
## Plots – Max Power



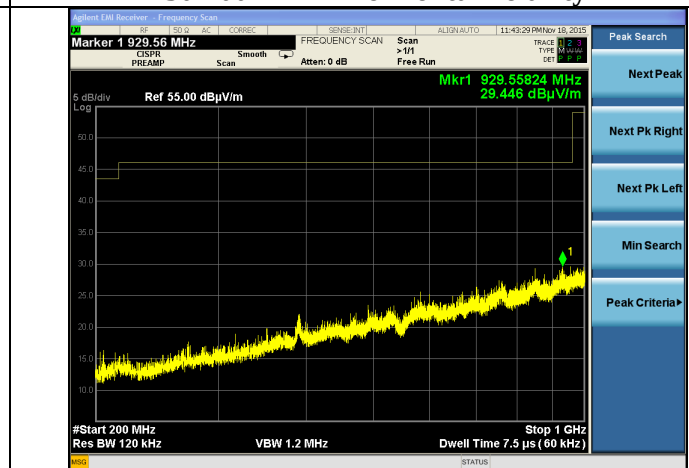
30-200 MHz - Vertical Polarity



30-200 MHz - Horizontal Polarity



200-1000 MHz - Vertical Polarity



200-1000 MHz - Horizontal Polarity

**Note:** Emissions seen likely not from transmitter but power supply.

Prepared For: Midmark Corporation

Report: TR 315108

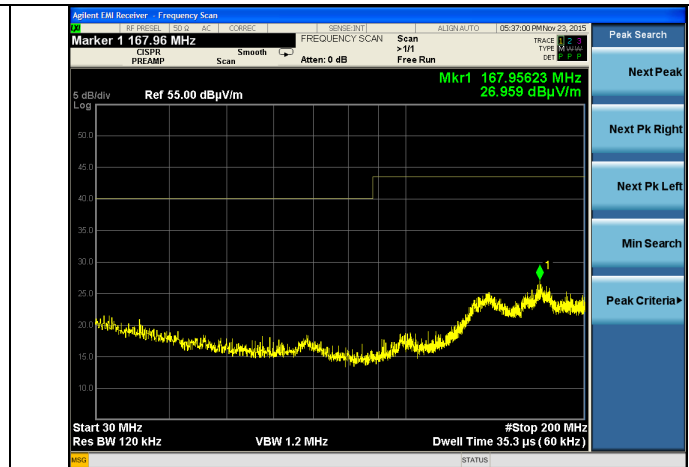
LSR: C-2289

Name: 5-200-0081 Radio Module

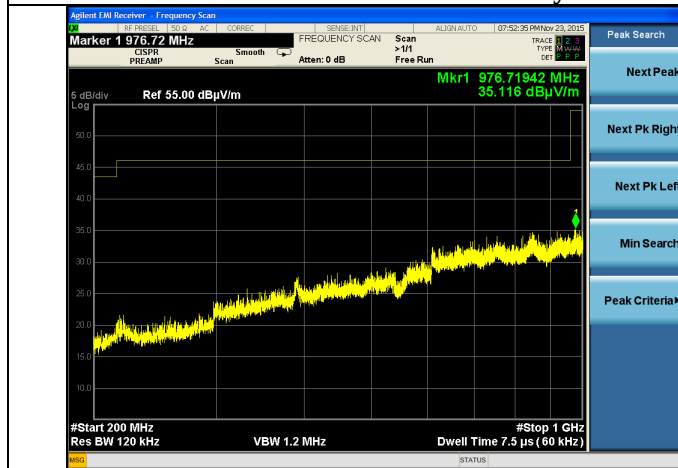
Model: 5-200-0081

Serial: Eng. Sample

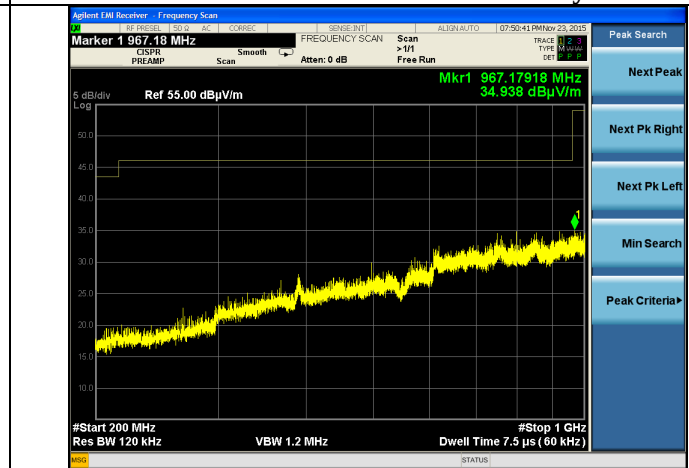
## Plots – Min Power



### 30-200 MHz - Vertical Polarity



### 30-200 MHz - Horizontal Polarity



### 200-1000 MHz - Vertical Polarity

### 200-1000 MHz - Horizontal Polarity

**Note:** Emissions seen likely not from transmitter but power supply.

Prepared For: Midmark Corporation

Report: TR 315108

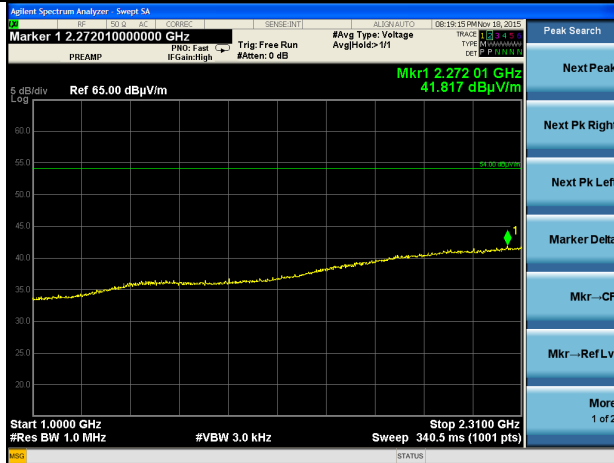
LSR: C-2289

Name: 5-200-0081 Radio Module

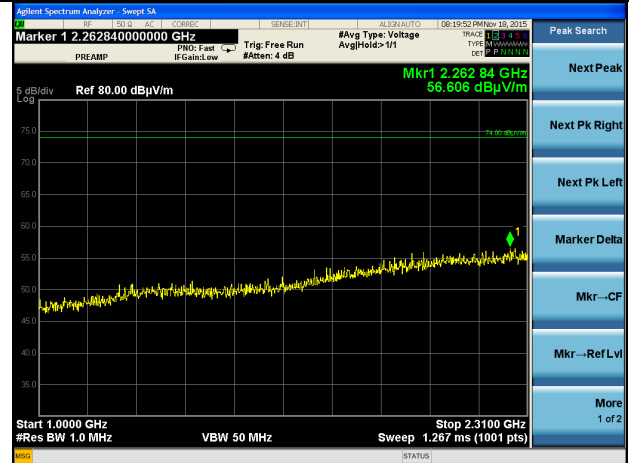
Model: 5-200-0081

Serial: Eng. Sample

## Plots – Max Power



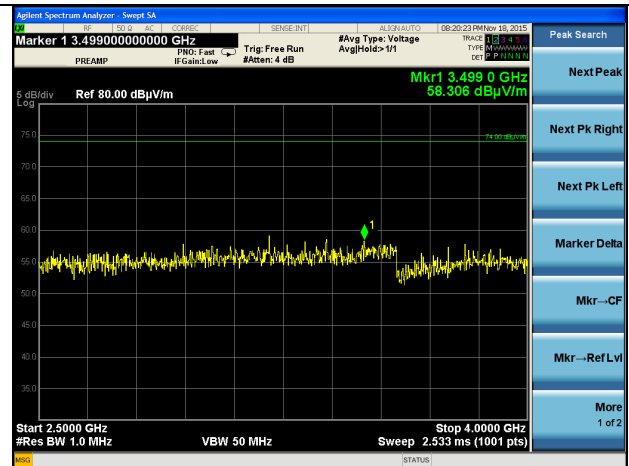
1-2.31 GHz – Average



1-2.31 GHz - Peak

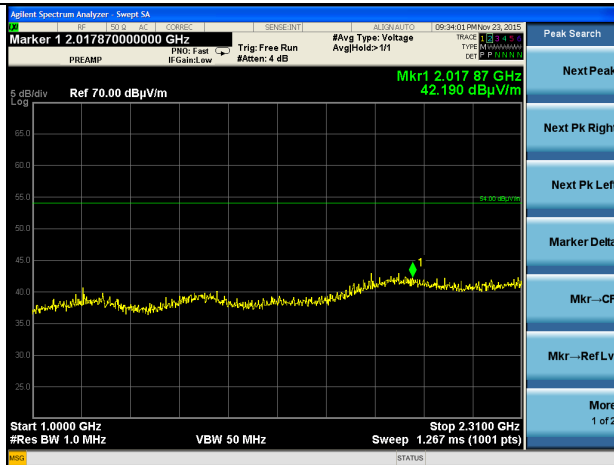


2.5-4 GHz – Average

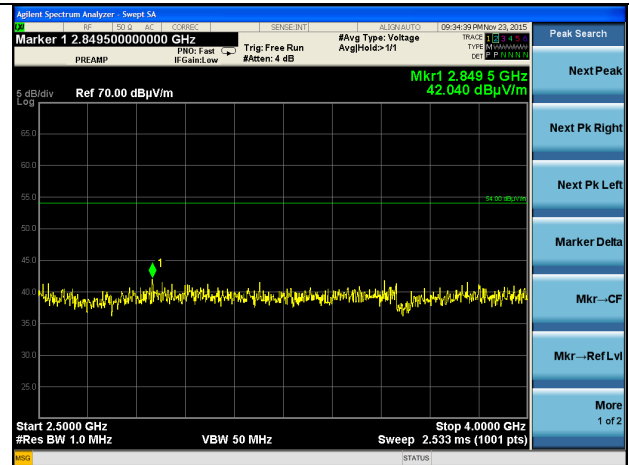


2.5-4 GHz - Peak

## Plots – Min Power



1-2.31 GHz – Peak



2.5-4 GHz - Peak

Prepared For: Midmark Corporation

Report: TR 315108

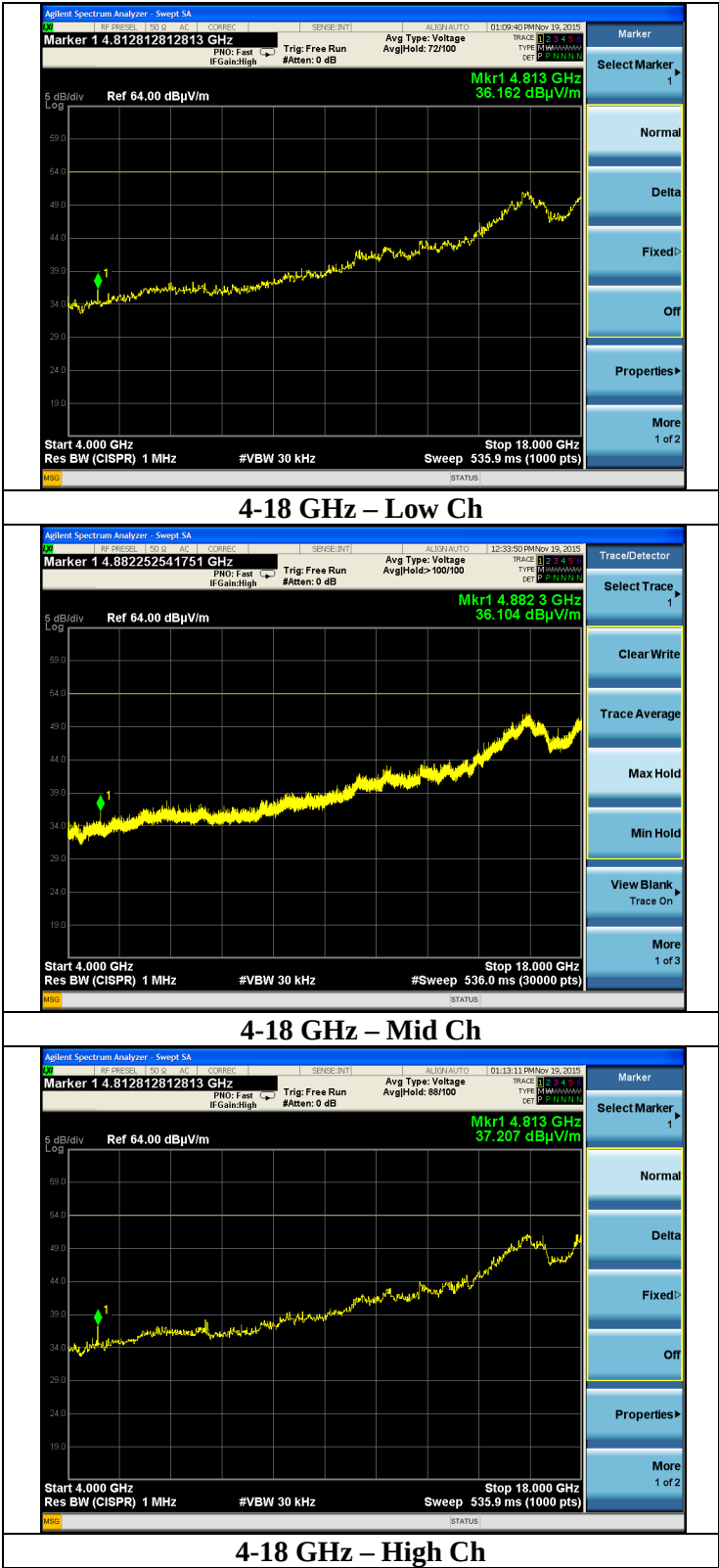
LSR: C-2289

Name: 5-200-0081 Radio Module

Model: 5-200-0081

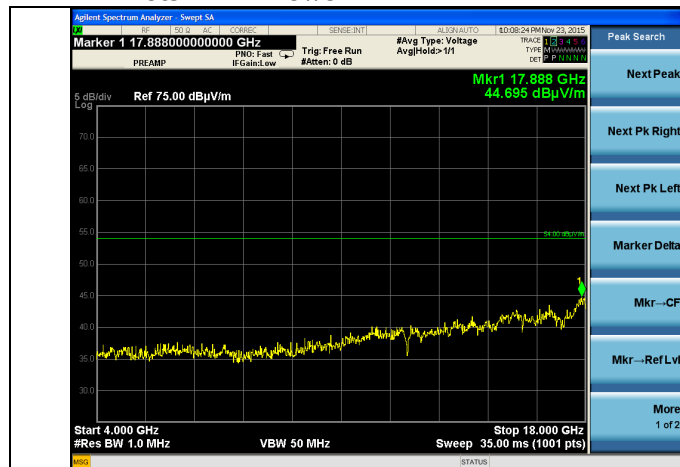
Serial: Eng. Sample

Plots – Max Power

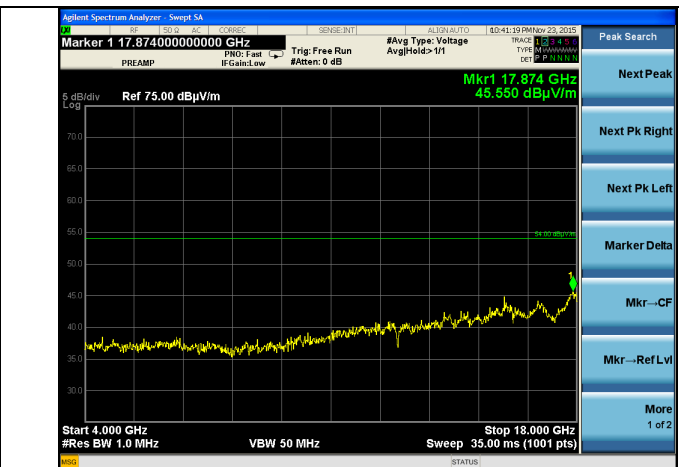


|                                   |                               |
|-----------------------------------|-------------------------------|
| Prepared For: Midmark Corporation | Name: 5-200-0081 Radio Module |
| Report: TR 315108                 | Model: 5-200-0081             |
| LSR: C-2289                       | Serial: Eng. Sample           |

## Plots – Min Power

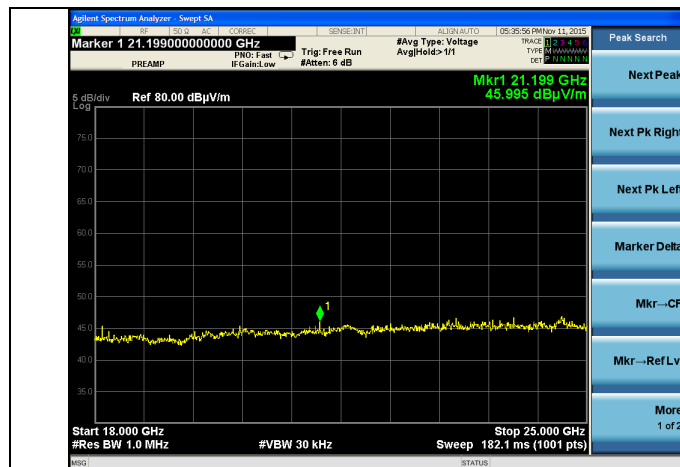


4-18 GHz – Peak

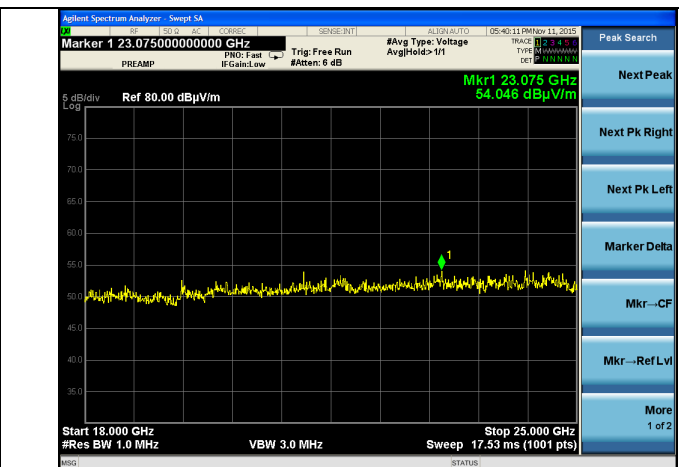


4-18 GHz – Peak

Note: All channels no emissions found



18-25 GHz – Average



18-25 GHz - Peak

Prepared For: Midmark Corporation

Report: TR 315108

LSR: C-2289

Name: 5-200-0081 Radio Module

Model: 5-200-0081

Serial: Eng. Sample

### B.3 – AC Mains Conducted Emissions

|                                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rule Part(s)                   | FCC: 15.207<br>IC: RSS-247 / RSS-GEN                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Measurement Procedure          | ANSI C63.4 - 2014<br>ANSI C63.10 – 2013                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Test Location                  | LS Research, LLC – Conducted Emissions Area                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Test Voltage                   | 120 VAC 60 Hz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| EUT Placement                  | 80 cm height non-conductive table above reference ground plane                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Frequency Range of Measurement | 150 kHz – 30 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Measurement Detectors          | Peak, Quasi-Peak, Average<br>RBW: 9 kHz<br>VBW: At least 27 kHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| Description of Measurement     | 1) The LISN, cable, limiter, and other necessary measurement system correction factors are loaded onto the EMI receiver / spectrum analyzer when the measurements are performed. The data is gathered and reported as the corrected values.<br><br>2) The EUT is placed on a non-conductive pedestal at appropriate distance from ground planes and plugged into LISN. The LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).<br><br>3) Maximum emissions are determined with peak detector and measurements at select points are made with quasi-peak and average detectors. Results are recorded and compared to limit. |
| Example Calculations           | Reported Measurement data = Raw receiver measurement + LISN Factor + Cable factor (dB) + Additional factor (when applicable)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

#### Limits of Conducted Emissions at the AC Mains Ports:

| Frequency Range (MHz)                                                             | Class B Limits (dBμV) |         |
|-----------------------------------------------------------------------------------|-----------------------|---------|
|                                                                                   | Quasi-Peak            | Average |
| 0.150 -0.50 *                                                                     | 66-56                 | 56-46   |
| 0.5 – 5.0                                                                         | 56                    | 46      |
| 5.0 – 30                                                                          | 60                    | 50      |
| * The limit decreases linearly with the logarithm of the frequency in this range. |                       |         |

|                                   |                               |
|-----------------------------------|-------------------------------|
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#### B.4.1 – AC Mains Conducted Emissions

|                       |                                                                                             |
|-----------------------|---------------------------------------------------------------------------------------------|
| Manufacturer          | Midmark Corporation                                                                         |
| Date                  | 11-19, 11-23 2015                                                                           |
| Operator              | Adam A                                                                                      |
| Temp. / R.H.          | 20 - 25° C / 30-60% R.H.                                                                    |
| Rule Part             | 15.207 / RSS-GEN                                                                            |
| Measurement Procedure | ANSI C63.4 - 2014<br>ANSI C63.10 - 2013 Section 6.2                                         |
| Test Voltage          | 120 VAC 60 Hz                                                                               |
| EUT Placement         | 80 cm height non-conductive table, 40 cm from vertical ground plane                         |
| Detectors             | Peak; RBW 9 kHz<br>Quasi-Peak and Average                                                   |
| Additional Notes      | 1) Tested in continuous transmit with no significant difference between operating channels. |

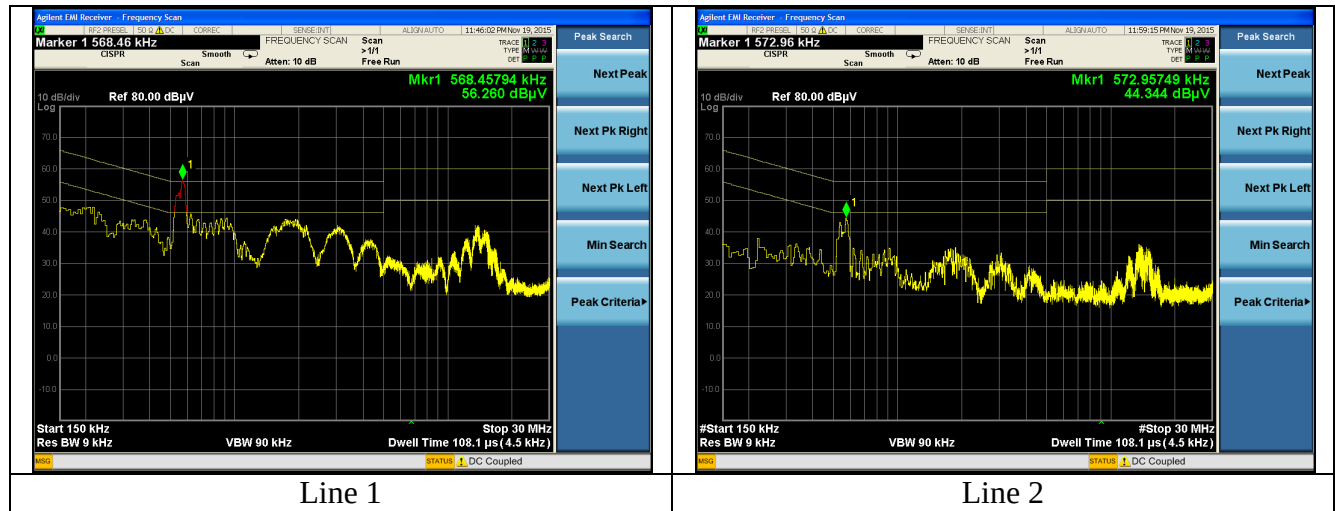
#### Example Calculation:

$$\text{Margin (dB)} = \text{Limit (dB}\mu\text{V)} - \text{Reading (dB}\mu\text{V)}$$

**Table – Max Power**

| Frequency (MHz) | Line | Peak Reading (dB $\mu$ V) | Quasi-Peak Reading (dB $\mu$ V) | Average Reading (dB $\mu$ V) | Q-Peak Limit (dB $\mu$ V) | Quasi-Peak Margin (dB) | Average Limit (dB $\mu$ V) | Average Margin (dB) |
|-----------------|------|---------------------------|---------------------------------|------------------------------|---------------------------|------------------------|----------------------------|---------------------|
| 0.574           | 1    | 55.6                      | 54.1                            | 44.8                         | 56.0                      | 1.9                    | 46.0                       | 1.2                 |
| 0.565           | 1    | 55.8                      | 51.6                            | 37.6                         | 56.0                      | 4.4                    | 46.0                       | 8.4                 |
| 0.577           | 1    | 54.9                      | 52.9                            | 43.1                         | 56.0                      | 3.1                    | 46.0                       | 2.9                 |
| 0.555           | 1    | 52.1                      | 47.9                            | 33.7                         | 56.0                      | 8.1                    | 46.0                       | 12.3                |
| 0.523           | 1    | 47.3                      | 45.7                            | 36.6                         | 56.0                      | 10.3                   | 46.0                       | 9.4                 |
| 1.909           | 1    | 42.4                      | 40.1                            | 29.4                         | 56.0                      | 15.9                   | 46.0                       | 16.6                |
| 0.573           | 2    | 46.3                      | 43.2                            | 32.9                         | 56.0                      | 12.8                   | 46.0                       | 13.1                |
| 0.577           | 2    | 45.4                      | 43.1                            | 32.9                         | 56.0                      | 12.9                   | 46.0                       | 13.1                |
| 0.537           | 2    | 44.2                      | 37.4                            | 24.7                         | 56.0                      | 18.6                   | 46.0                       | 21.3                |

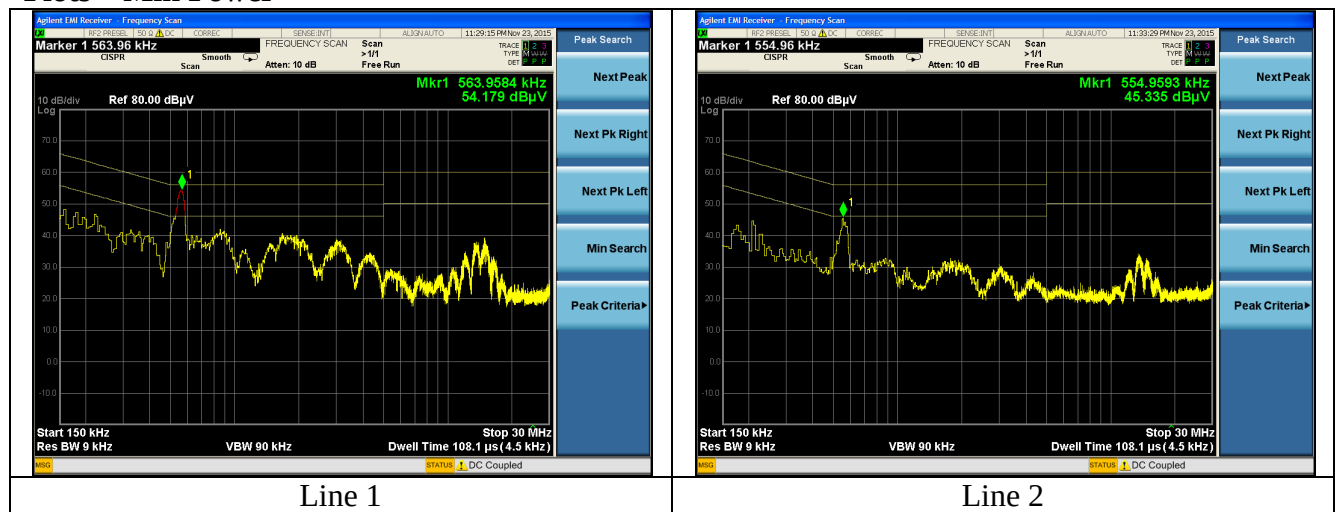
## Plots – Max Power



## Table – Min Power

| Frequency (MHz) | Line | Peak Reading (dBμV) | Quasi-Peak Reading (dBμV) | Average Reading (dBμV) | Q-Peak Limit (dBμV) | Quasi-Peak Margin (dB) | Average Limit (dBμV) | Average Margin (dB) |
|-----------------|------|---------------------|---------------------------|------------------------|---------------------|------------------------|----------------------|---------------------|
| 0.574           | 1    | 55.6                | 54.1                      | 44.8                   | 56.0                | 1.9                    | 46.0                 | 1.2                 |
| 0.565           | 1    | 55.8                | 51.6                      | 37.6                   | 56.0                | 4.4                    | 46.0                 | 8.4                 |
| 0.577           | 1    | 54.9                | 52.9                      | 43.1                   | 56.0                | 3.1                    | 46.0                 | 2.9                 |
| 0.555           | 1    | 52.1                | 47.9                      | 33.7                   | 56.0                | 8.1                    | 46.0                 | 12.3                |
| 0.523           | 1    | 47.3                | 45.7                      | 36.6                   | 56.0                | 10.3                   | 46.0                 | 9.4                 |
| 1.909           | 1    | 42.4                | 40.1                      | 29.4                   | 56.0                | 15.9                   | 46.0                 | 16.6                |
| 0.573           | 2    | 46.3                | 43.2                      | 32.9                   | 56.0                | 12.8                   | 46.0                 | 13.1                |
| 0.577           | 2    | 45.4                | 43.1                      | 32.9                   | 56.0                | 12.9                   | 46.0                 | 13.1                |
| 0.537           | 2    | 44.2                | 37.4                      | 24.7                   | 56.0                | 18.6                   | 46.0                 | 21.3                |

## Plots – Min Power



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## Appendix C - Uncertainty Summary

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of  $k=2$ .

*Table of Expanded Uncertainty Values, (K=2) for Specified Measurements*

| Measurement Type             | Particular Configuration              | Uncertainty Values |
|------------------------------|---------------------------------------|--------------------|
| Radiated Emissions           | 3 – Meter chamber, Biconical Antenna  | 4.82 dB            |
| Radiated Emissions           | 3-Meter Chamber, Log Periodic Antenna | 4.88 dB            |
| Radiated Emissions           | 3-Meter Chamber, Horn Antenna         | 4.85 dB            |
| Absolute Conducted Emissions | Agilent PSA/ESA Series                | 1.38 dB            |
| AC Line Conducted Emissions  | Shielded Room/EMCO LISN               | 3.20 dB            |
| Radiated Immunity            | 3 Volts/Meter in 3-Meter Chamber      | 2.05 Volts/Meter   |
| Conducted Immunity           | 3 Volts level                         | 2.33 V             |
| EFT Burst, Surge, VDI        | 230 VAC                               | 54.4 V             |
| ESD Immunity                 | Discharge at 15kV                     | 3200 V             |
| Temperature/Humidity         | Thermo-hygrometer                     | 0.64° / 2.88 %RH   |

## Appendix D - References

| Publication        | Year | Title                                                                                                                         |
|--------------------|------|-------------------------------------------------------------------------------------------------------------------------------|
| FCC CFR Parts 0-15 | 2015 | Code of Federal Regulations – Telecommunications                                                                              |
| RSS-247 Issue 1    | 2015 | Digital Transmissions Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices |
| RSS-GEN Issue 4    | 2014 | General Requirements and Information for the Certification of Radio Apparatus                                                 |
| ANSI C63.10        | 2013 | American National Standard of Procedures for Compliance Testing Unlicensed Wireless Devices                                   |

Prepared For: Midmark Corporation

Report: TR 315108

LSR: C-2289

Name: 5-200-0081 Radio Module

Model: 5-200-0081

Serial: Eng. Sample

## END OF REPORT

| Date    | Version | Comments              | Person |
|---------|---------|-----------------------|--------|
| 1-7-16  | V0      | Initial Draft Release | Adam A |
| 1-21-16 | V1      | Final Version         | Adam A |
|         |         |                       |        |
|         |         |                       |        |
|         |         |                       |        |
|         |         |                       |        |

|                                   |                               |
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