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ENGINEERING TEST REPORT # TR 315108 B

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

Test Report issued:

Adam Alger, Quality Manger – Test Services

Signature:

Date: 1-20-16

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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:



TESTING CERT #1255.01

A2LA – American Association for Laboratory Accreditation

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

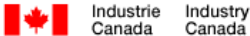
A2LA Certificate Number: 1255.01



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 Client Information

Manufacturer Name:	Midmark Corporation
Address:	690 Knox Street, Suite 100 Torrance, CA 90502
Contact Person:	Maria Moreno

1.1 Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

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

1.2 Product Information

Bluetooth Low Energy module utilizing PCB trace antenna

1.3 Modifications Incorporated In the EUT for Compliance Purposes

None noted at time of test

1.4 Deviations & Exclusions from Test Specifications

None noted at time of test

1.5 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).

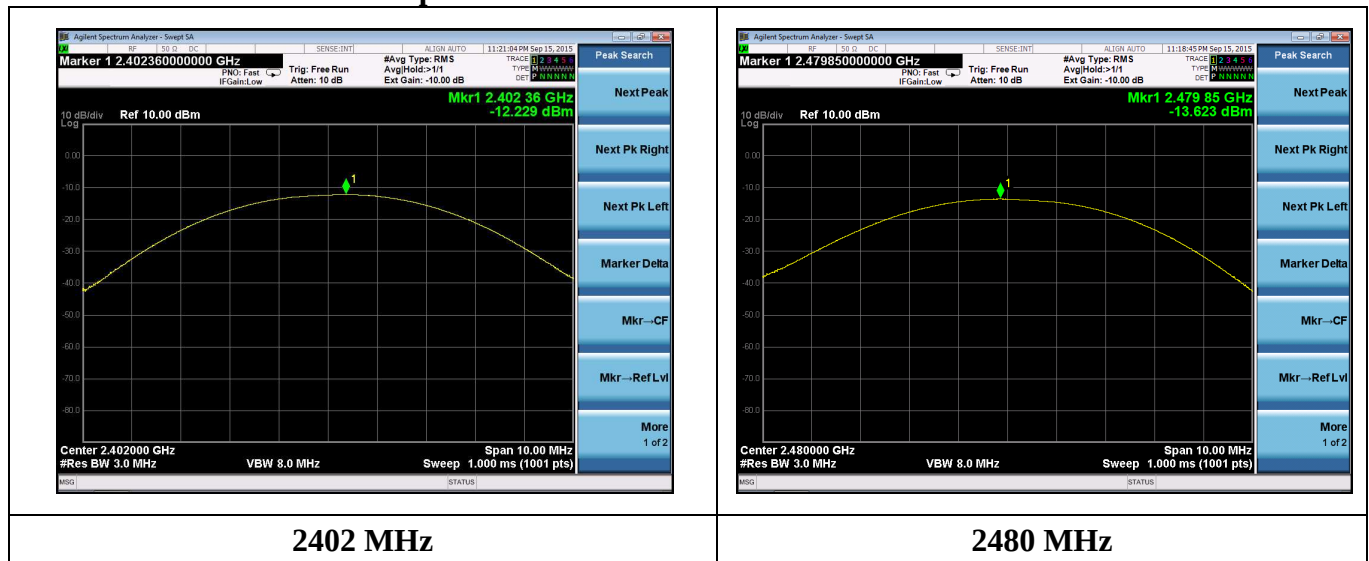
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2.0 RF Conducted Measurement Data

Table

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

Plots – Maximum Peak Output Power



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	KWM	HPF-L-14186	7272-04	4/15/2015	4/15/2016	Active Calibration
6	EE 960159	0.8 - 21GHz LNA	Mini-Circuits	ZVA-213X-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 Alger*

Quality Assurance: *Peter Fisher*

Prepared For: Midmark Corporation

Report: TR 315108

LSR: C-2289

Name: 5-200-0081 Radio Module

Model: 5-200-0081

Serial: Eng. Sample

3.0 FCC SAR Test Exclusion Threshold

SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm

1-g SAR test exclusion threshold equation:

$$\left[\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} \right] * [\sqrt{f(\text{GHz})}] \leq 3.0$$

10-g SAR test exclusion threshold equation:

$$\left[\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} \right] * [\sqrt{f(\text{GHz})}] \leq 7.5$$

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3.1 FCC SAR Test Exclusion Calculation

A. 2402 MHz

Description	Line #	Data	Unit	Additional Description
Transmit Packet on time:	1	100	(ms)	Worst case
Packet repetition time:	2	100	(ms)	Worst case
Duty factor:	3	1		Transmit Packet on time / Packet repetition time (Line # 1/2)
Maximum peak output power at antenna input terminal:	4	-12.23	(dBm)	Measured worst case
Maximum peak power:	5	0.060	(mW)	dBm to mW conversion
Prediction distance:	6	5	(mm)	Minimum test separation distance
Prediction frequency:	7	2.402	(GHz)	Measured frequency
Square root of frequency (GHz):	8	1.549839		Calculation
Duty factor applied to maximum peak radiated power (mW):	9	0.059841	(mW)	duty factor * maximum peak power (Line # 11*3)
Source based power (mW) / min test separation distance (mm):	10	0.011968		Calculation (Line # 5/6)
SAR exclusion calculation:	11	0.02		Calculation (Line # 10*8)
Threshold:	12	3		
Margin:	13	2.98		Calculation (Line # 12-11)

B. 2480 MHz

Description	Line #	Data	Unit	Additional Description
Transmit Packet on time:	1	100	(ms)	Worst case
Packet repetition time:	2	100	(ms)	Worst case
Duty factor:	3	1		Transmit Packet on time / Packet repetition time (Line # 1/2)
Maximum peak output power at antenna input terminal:	4	-13.62	(dBm)	Measured worst case
Maximum peak power:	5	0.043	(mW)	dBm to mW conversion
Prediction distance:	6	5	(mm)	Minimum test separation distance
Prediction frequency:	7	2.48	(GHz)	Measured frequency
Square root of frequency (GHz):	8	1.574802		Calculation
Duty factor applied to maximum peak radiated power (mW):	9	0.043451	(mW)	duty factor * maximum peak power (Line # 11*3)
Source based power (mW) / min test separation distance (mm):	10	0.00869		Calculation (Line # 5/6)
SAR exclusion calculation:	11	0.01		Calculation (Line # 10*8)
Threshold:	12	3		
Margin:	13	2.99		Calculation (Line # 12-11)

Note: 100% duty factor

3.2 FCC Conformance Summary

The EUT was found to MEET the 5mm minimum test separation distance threshold for SAR test exclusion per FCC §2.1091(mobile) and §2.1093(portable) using methods of FCC KDB 447498 D01 General RF Exposure Guidance v05r02 as a standalone device.

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4.0 Industry Canada Low Power Exemption

RSS 102 Issue 5 Section 2.5 states that all transmitters that meet the exemption limits as stated in section 2.5.1 are exempt from routine SAR and RF exposure evaluation.

Output Power Evaluation.

Device Operation separation distance: 5mm

Evaluation Frequency = 2402 MHz

Maximum Effective Isotropic Radiated Power (dBm) = -12.23 dBm + 0 dBi = -12.23

Maximum Effective Isotropic Radiated Power (mW) = $\log^{-1}(\text{EIRP (dBm)}/10)$ = **0.0598 mW**

Interpolate to obtain limit of frequency 2402 MHz at separation of $\leq 5\text{mm}$: **4.3 mW**

Evaluation Frequency = 2480 MHz

Maximum Effective Isotropic Radiated Power (dBm) = -13.62 dBm + 0 dBi = -13.62 dBm

Maximum Effective Isotropic Radiated Power (mW) = $\log^{-1}(\text{EIRP (dBm)}/10)$ = **0.0434 mW**

Interpolate to obtain limit of frequency 2480 MHz at separation of $\leq 5\text{mm}$: **3.8 mW**

Section 2.5.1 Table 1 general public use limit at for devices operating less than 20cm:

Frequency (MHz)	Exemption Limits (mW)				
	At separation distance of $\leq 5\text{ mm}$	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
≤ 300	71 mW	101 mW	132 mW	162 mW	193 mW
450	52 mW	70 mW	88 mW	106 mW	123 mW
835	17 mW	30 mW	42 mW	55 mW	67 mW
1900	7 mW	10 mW	18 mW	34 mW	60 mW
2450	4 mW	7 mW	15 mW	30 mW	52 mW
3500	2 mW	6 mW	16 mW	32 mW	55 mW
5800	1 mW	6 mW	15 mW	27 mW	41 mW

4.1 IC Conformance Summary

The EUT was found to MEET the 5mm minimum test separation distance threshold for SAR test exclusion per IC RSS-102 Issue 5.

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END OF REPORT

Date	Version	Comments	Person
1-20-16	V1	Final	Adam A

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