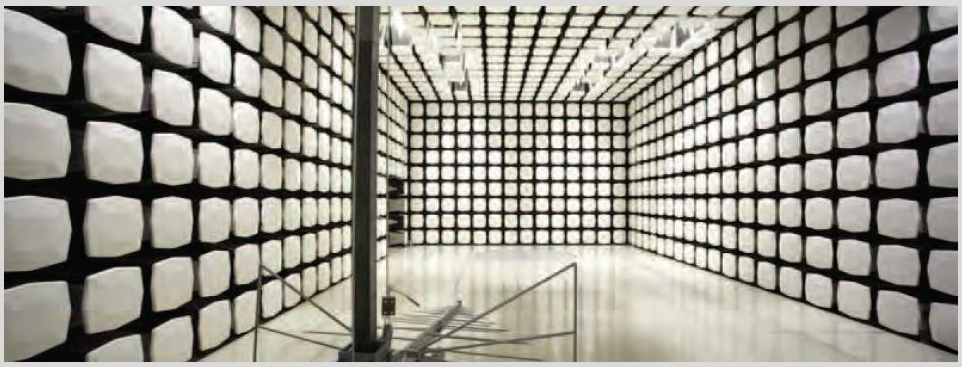
Medtronic, Inc.

PAL™ Controller for HeartWare™ HVAD™ Pump
Model Number: MCS3101CO

FCC 15.247:2019
Bluetooth Low Energy

Report # MDTR0798 Rev. 1



NVLAP LAB CODE: 200881-0

CERTIFICATE OF TEST

Last Date of Test: June 20, 2019
Medtronic, Inc.
PAL™ Controller for HeartWare™ HVAD™ Pump
Model: MCS3101CO

Radio Equipment Testing

Standards

Specification	Method
FCC 15.207:2019	ANSI C63.10:2013
FCC 15.247:2019	KDB 558074

Results

Method Clause	Test Description	Applied	Results	Comments
6.2	Powerline Conducted Emissions	Yes	Pass	
11.6	Duty Cycle	Yes	Pass	
11.8.2	Occupied Bandwidth	Yes	Pass	
11.9.1.1	Output Power	Yes	Pass	
11.9.1.1	Equivalent Isotropic Radiated Power	Yes	Pass	
11.10.2	Power Spectral Density	Yes	Pass	
11.11	Band Edge Compliance	Yes	Pass	
11.11	Spurious Conducted Emissions	Yes	Pass	
11.12.1, 11.13.2, 6.5, 6.6	Spurious Radiated Emissions	Yes	Pass	

Deviations From Test Standards

None

Approved By:

Eric Brandon, Department Manager

Product compliance is the responsibility of the client; therefore, the tests and equipment modes of operation represented in this report were agreed upon by the client, prior to testing. The results of this test pertain only to the sample(s) tested. The specific description is noted in each of the individual sections of the test report supporting this certificate of test. This report reflects only those tests from the referenced standards shown in the certificate of test. It does not include inspection or verification of labels, identification, marking or user information. As indicated in the Statement of Work sent with the quotation, Element's standard process is to always use the latest published version of the test methods even when earlier versions are cited in the test specification. Issuance of a purchase order was de facto acceptance of this approach. Otherwise, the client would have advised Element in writing of the specific version of the test methods they wanted applied to the subject testing.

REVISION HISTORY

Revision Number	Description	Date (yyyy-mm-dd)	Page Number
00	None		
01	Updated the testing objective	2020-01-28	8

ACCREDITATIONS AND AUTHORIZATIONS

United States

FCC - Designated by the FCC as a Telecommunications Certification Body (TCB). Certification chambers, Open Area Test Sites, and conducted measurement facilities are listed with the FCC.

A2LA - Accredited by A2LA to ISO / IEC 17065 as a product certifier. This allows Element to certify transmitters to FCC and IC specifications.

NVLAP - Each laboratory is accredited by NVLAP to ISO 17025

Canada

ISED - Recognized by Innovation, Science and Economic Development Canada as a Certification Body (CB) and as a CAB for the acceptance of test data.

European Union

European Commission – Within Element, we have a EU Notified Body validated for the EMCD and RED Directives.

Australia/New Zealand

ACMA - Recognized by ACMA as a CAB for the acceptance of test data.

Korea

MSIT / RRA - Recognized by KCC's RRA as a CAB for the acceptance of test data.

Japan

VCCI - Associate Member of the VCCI. Conducted and radiated measurement facilities are registered.

Taiwan

BSMI – Recognized by BSMI as a CAB for the acceptance of test data.

NCC - Recognized by NCC as a CAB for the acceptance of test data.

Singapore

IDA – Recognized by IDA as a CAB for the acceptance of test data.

Israel

MOC – Recognized by MOC as a CAB for the acceptance of test data.

Hong Kong

OFCA – Recognized by OFCA as a CAB for the acceptance of test data.

Vietnam

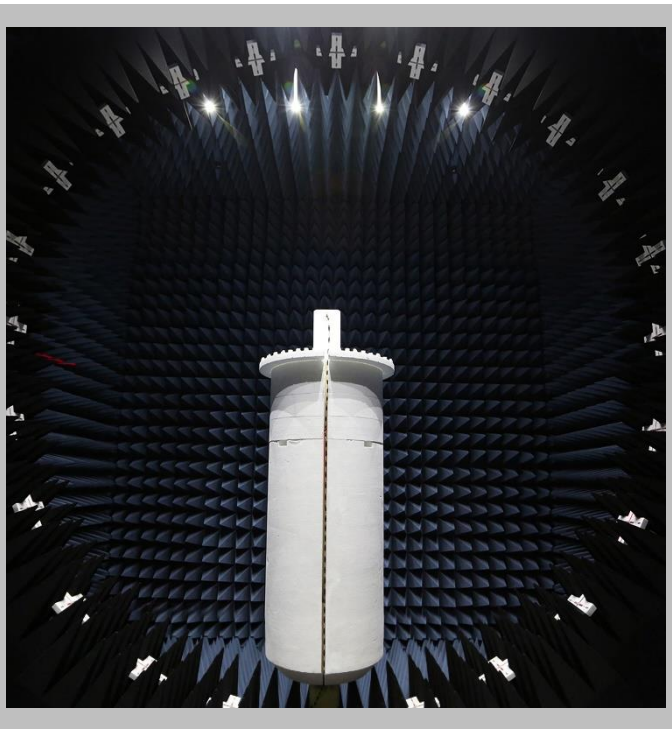
MIC – Recognized by MIC as a CAB for the acceptance of test data.

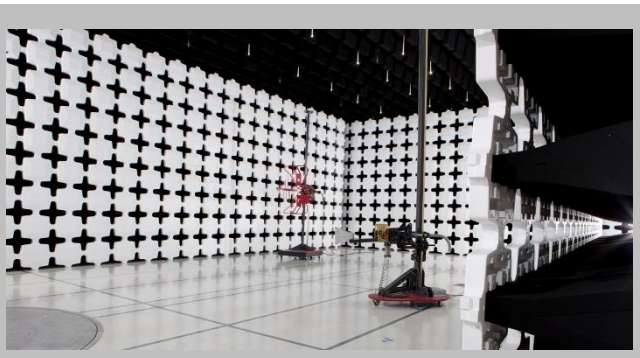
SCOPE

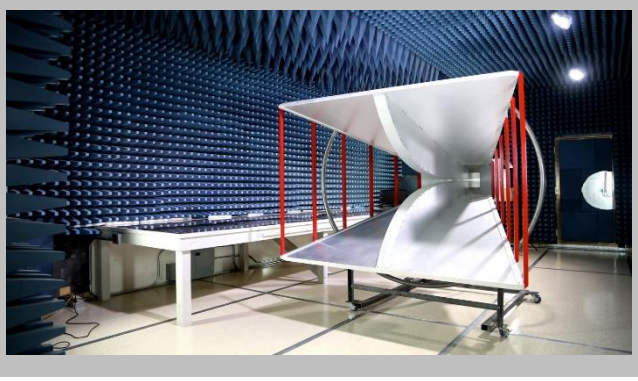
For details on the Scopes of our Accreditations, please visit:
https://www.nwemc.com/emc-testing-accreditations

FACILITIES

California	Minnesota	Oregon	Texas	Washington
Labs OC01-17 41 Tesla Irvine, CA 92618 (949) 861-8918	Labs MN01-10 9349 W Broadway Ave. Brooklyn Park, MN 55445 (612)-638-5136	Labs EV01-12 6775 NE Evergreen Pkwy #400 Hillsboro, OR 97124 (503) 844-4066	Labs TX01-09 3801 E Plano Pkwy Plano, TX 75074 (469) 304-5255	Labs NC01-05 19201 120th Ave NE Bothell, WA 98011 (425)984-6600
NVLAP				
NVLAP Lab Code: 200676-0	NVLAP Lab Code: 200881-0	NVLAP Lab Code: 200630-0	NVLAP Lab Code:201049-0	NVLAP Lab Code: 200629-0
Innovation, Science and Economic Development Canada				
2834B-1, 2834B-3	2834E-1, 2834E-3	2834D-1	2834G-1	2834F-1
BSMI				
SL2-IN-E-1154R	SL2-IN-E-1152R	SL2-IN-E-1017	SL2-IN-E-1158R	SL2-IN-E-1153R
VCCI				
A-0029	A-0109	A-0108	A-0201	A-0110
Recognized Phase I CAB for ISED, ACMA, BSMI, IDA, KCC/RRA, MIC, MOC, NCC, OFCA				
US0158	US0175	US0017	US0191	US0157







MEASUREMENT UNCERTAINTY

WTD.2016.12.19

Measurement Uncertainty

When a measurement is made, the result will be different from the true or theoretically correct value. The difference is the result of tolerances in the measurement system that cannot be completely eliminated. To the extent that technology allows us, it has been our aim to minimize this error. Measurement uncertainty is a statistical expression of measurement error qualified by a probability distribution.

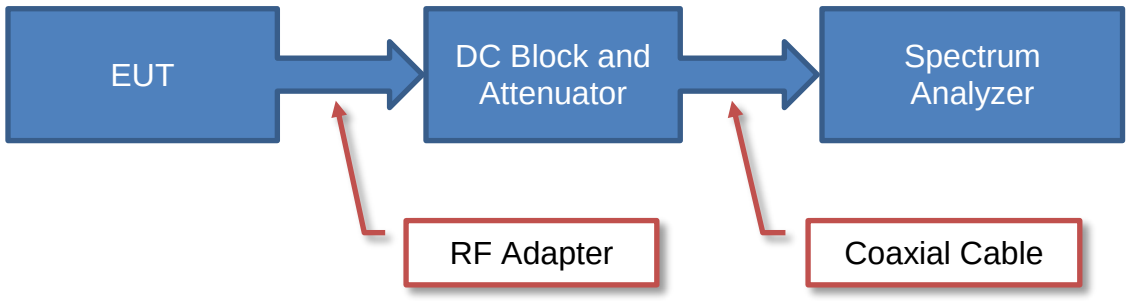
A measurement uncertainty estimation has been performed for each test per our internal quality document WP 342. The estimation is used to compare the measured result with its "true" or theoretically correct value. The expanded measurement uncertainty (K=2) for each test is on each data sheet. Our measurement data meets or exceeds the measurement uncertainty requirements of the applicable specification; therefore, the test data can be compared directly to the specification limit to determine compliance. The calculations for estimating measurement uncertainty are based upon ETSI TR 100 028 (or CISPR 16-4-2 as applicable), and are available upon request.

The following table represents the Measurement Uncertainty (MU) budgets for each of the tests that may be contained in this report.

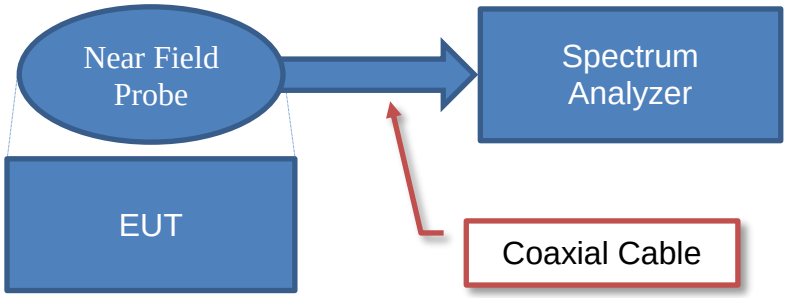
Test	+ MU	- MU
Frequency Accuracy (Hz)	0.0007%	-0.0007%
Amplitude Accuracy (dB)	1.2 dB	-1.2 dB
Conducted Power (dB)	0.3 dB	-0.3 dB
Radiated Power via Substitution (dB)	0.7 dB	-0.7 dB
Temperature (degrees C)	0.7°C	-0.7°C
Humidity (% RH)	2.5% RH	-2.5% RH
Voltage (AC)	1.0%	-1.0%
Voltage (DC)	0.7%	-0.7%
Field Strength (dB)	5.2 dB	-5.2 dB
AC Powerline Conducted Emissions (dB)	2.4 dB	-2.4 dB

Test Setup Block Diagrams

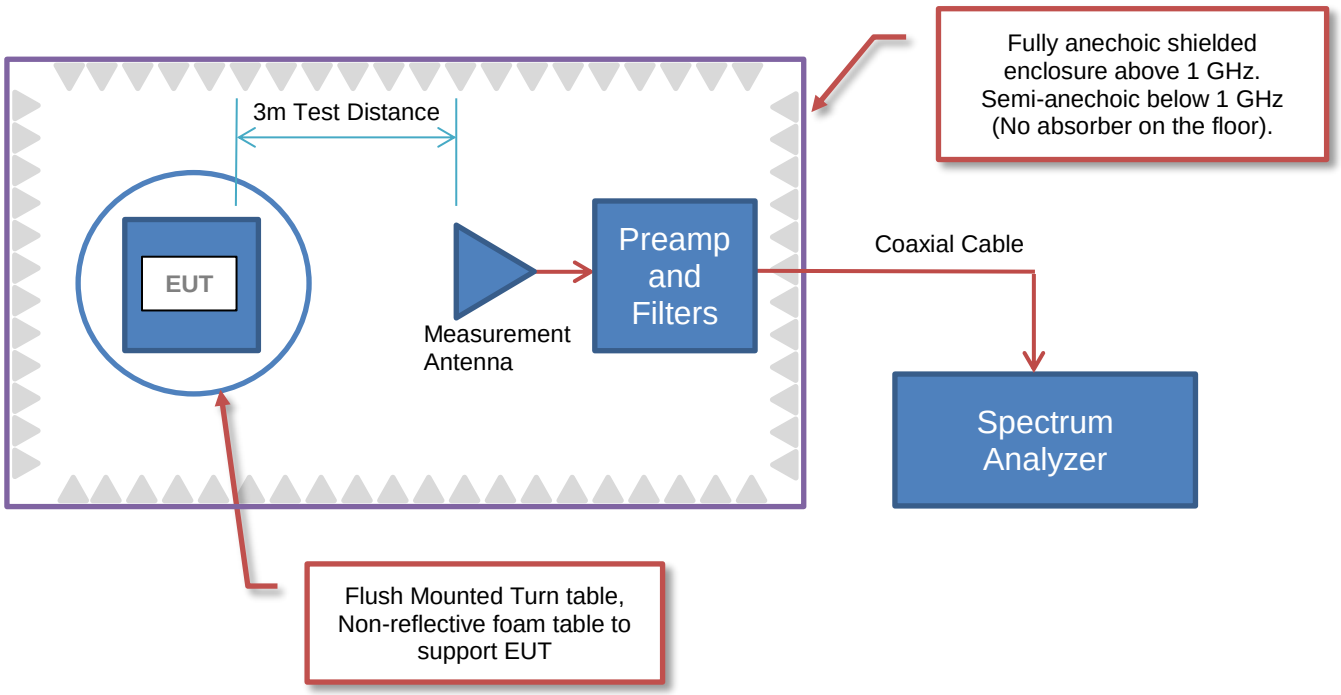
Antenna Port Conducted Measurements



Near Field Test Fixture Measurements



Spurious Radiated Emissions



PRODUCT DESCRIPTION

Client and Equipment Under Test (EUT) Information

Company Name:	Medtronic, Inc.
Address:	710 Medtronic Parkway NE
City, State, Zip:	Minneapolis, MN 55432
Test Requested By:	Jeffrey Brown
Model:	PAL™ Controller for HeartWare™ HVAD™ Pump, Model MCS3101CO
First Date of Test:	June 14, 2019
Last Date of Test:	June 20, 2019
Receipt Date of Samples:	June 14, 2019
Equipment Design Stage:	Production Equivalent
Equipment Condition:	No Damage
Purchase Authorization:	Verified

Information Provided by the Party Requesting the Test

Functional Description of the EUT:

Controller:
The controller transmits and receives data from the companion device via Bluetooth Low Energy. The BLE module is located within the controller.

System:
The PAL Commercial Heart Ventricular Assist Device (HVAD) is composed of several components, including: the Controller, the Monitor that is used by the Clinician to program the controller; and power sources in the form of an external dual battery and an AC adapters. System components can be connected in various configurations, depending on use of the system.

The implantable HVAD pump does not contain radio equipment and is not included in the equipment under test. All radio equipment is external to the patient.

Testing Objective:

To demonstrate compliance of the Bluetooth Low Energy radio to FCC 15.247 requirements.

CONFIGURATIONS

Configuration MDTR0798- 1

Software/Firmware Running during test	
Description	**Version**
Protocol Tool	1.82.28.29661
PAL System Functional Test Firmware	90

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
HVAD PAL Commercial Controller	Medtronic, Inc.	MCS3101CO	PAL000404A
AC Adapter (HVAD PAL)	Medtronic, Inc.	CMP02974	PAC000093A
Ext. Battery	Medtronic, Inc.	CMP02432	PDB001167A

Remote Equipment Outside of Test Setup Boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Spectrum Analyzer	Keysight	N99144	ES058324

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
AC Cable (HVAD PAL)	No	2.5 m	No	AC Adapter	AC Mains
DC Cable (HVAD PAL)	No	2.8 m	Yes	HVAD PAL	AC Adapter
Driveline Cable	No	1 m	Yes	HVAD PAL	Unterminated

CONFIGURATIONS

Configuration MDTR0798- 2

Software/Firmware Running during test	
Description	**Version**
Protocol Tool	1.82.28.29661
PAL System Functional Test Firmware	90

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
HVAD PAL Commercial Controller	Medtronic, Inc.	MCS3101CO	PAL000404A
AC Adapter (HVAD PAL)	Medtronic, Inc.	MP02974	PAC000093A
Ext. Battery	Medtronic, Inc.	CMP02432	PDB001167A

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
Laptop	Dell	Latitude E6410	7KGKYN1
Power Supply (Laptop)	Dell	LA90PM111	CN-0Y4M8K-72438-38R-C8D9-A01
Mouse	Amazon Basics	MSU0939	7G184C1409B

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
AC Cable (HVAD PAL)	No	2.5 m	No	AC Adapter	AC Mains
DC Cable (HVAD PAL)	No	2.8 m	Yes	HVAD PAL	AC Adapter
Driveline Cable	No	1 m	Yes	HVAD PAL	Unterminated
USB Cable	Yes	2.8m	Yes	HVAD PAL	Laptop
AC Cable (Laptop)	No	1.0m	No	AC Mains	Power Supply (Laptop)
DC Cable (Laptop)	No	1.8m	Yes	Power Supply (Laptop)	Laptop
USB Cable (Mouse)	No	1.8m	No	Mouse	Laptop

CONFIGURATIONS

Configuration MDTR0798- 5

Software/Firmware Running during test	
Description	**Version**
Monitor Firmware	0.67
PAL System Functional Test Firmware	90

EUT			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
HVAD PAL Commercial Controller	Medtronic, Inc.	MCS3101CO	PAL000405A
Ext. Battery	Medtronic, Inc.	CMP02432	PDB001167A

Peripherals in test setup boundary			
Description	**Manufacturer**	**Model/Part Number**	**Serial Number**
AC Adapter (HVAD PAL)	Medtronic, Inc.	CMP02974	PAC000093A
PAL Monitor	Medtronic, Inc.	1521	PMN000053
AC Adapter (Monitor)	Medtronic, Inc.	1555	MAC093294

Cables					
Cable Type	**Shield**	**Length (m)**	**Ferrite**	**Connection 1**	**Connection 2**
AC Cable (HVAD PAL)	No	2.5 m	No	AC Adapter	AC Mains
DC Cable (HVAD PAL)	No	2.8 m	Yes	HVAD PAL	AC Adapter
Driveline Cable	No	1 m	Yes	HVAD PAL	Driveline Ext. Cable
USB Cable	Yes	2.8m	Yes	HVAD PAL	Monitor
AC Cable (Monitor)	No	2.3m	No	AC Mains	AC Adapter (Monitor)
DC Cable (Monitor)	No	1.8m	Yes	AC Adapter (Monitor)	Monitor
Driveline Ext. Cable	No	3.2 m	Yes	Driveline Cable	Unterminated

MODIFICATIONS

Equipment Modifications

Item	Date	Test	Modification	Note	Disposition of EUT
1	2019-06-14	Powerline Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
2	2019-06-17	Occupied Bandwidth	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
3	2019-06-17	Output Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
4	2019-06-17	Equivalent Isotropic Radiated Power	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
5	2019-06-17	Power Spectral Density	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
6	2019-06-17	Band Edge Compliance	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
7	2019-06-17	Spurious Conducted Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	EUT remained at Element following the test.
8	2019-06-20	Spurious Radiated Emissions	Tested as delivered to Test Station.	No EMI suppression devices were added or modified during this test.	Scheduled testing was completed.

POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.1.24

TEST DESCRIPTION

Using the mode of operation and configuration noted within this report, conducted emissions tests were performed. The frequency range investigated (scanned), is also noted in this report. Conducted power line measurements are made, unless otherwise specified, over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from the EUT power-input terminals that are directly (or indirectly via separate transformer or power supplies) connected to a public power network. Per the standard, an insulating material was also added to ground plane between the EUT's power and remote I/O cables. Equipment is tested with power cords that are normally used or that have electrical or shielding characteristics that are the same as those cords normally used. Typically those measurements are made using a LISN (Line Impedance Stabilization Network), the 50ohm measuring port is terminated by a 50ohm EMI meter or a 50ohm resistive load. All 50ohm measuring ports of the LISN are terminated by 50ohm. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
LISN	Solar Electronics	9252-50-R-24-BNC	LIY	2019-03-15	2020-03-15
Receiver	Rohde & Schwarz	ESR7	ARI	2018-06-26	2019-06-26
Cable - Conducted Cable Assembly	Northwest EMC	MNC, HGN, TYK	MNCA	2019-03-13	2020-03-13

MEASUREMENT UNCERTAINTY

Description		
Expanded k=2	2.4 dB	-2.4 dB

CONFIGURATIONS INVESTIGATED

MDTR0798-1

MODES INVESTIGATED

BLE Mid Ch. 2442 MHz modulated

POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.1.24

EUT:	PAL™ Controller for HeartWare™ HVAD™ Pump	Work Order:	MDTR0798
Serial Number:	PAL000404A	Date:	2019-06-14
Customer:	Medtronic, Inc.	Temperature:	21.7°C
Attendees:	Jeffrey Brown	Relative Humidity:	45.6%
Customer Project:	None	Bar. Pressure:	1009 mb
Tested By:	Chris Patterson	Job Site:	MN03
Power:	110VAC/60Hz	Configuration:	MDTR0798-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	4	Line:	Neutral	Add. Ext. Attenuation (dB):	0

COMMENTS

Monitoring BLE signal via client Spec. Analyzer (Ref # ES058324)

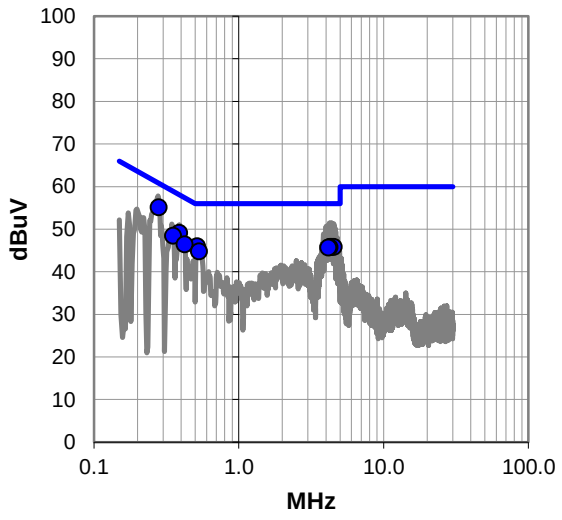
EUT OPERATING MODES

BLE Mid Ch. 2442 MHz modulated

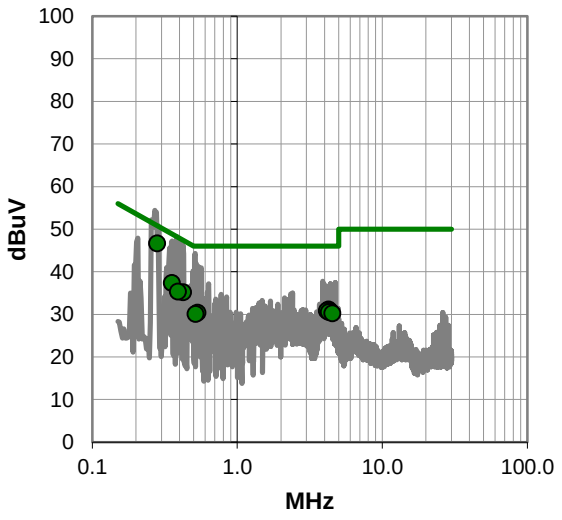
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.1.24

RESULTS - Run #4

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.279	34.5	20.7	55.2	60.8	-5.6
0.388	28.6	20.6	49.2	58.1	-8.9
0.515	25.4	20.6	46.0	56.0	-10.0
4.282	25.2	20.7	45.9	56.0	-10.1
4.385	25.2	20.7	45.9	56.0	-10.1
4.528	25.2	20.7	45.9	56.0	-10.1
4.245	25.1	20.7	45.8	56.0	-10.2
4.146	24.9	20.8	45.7	56.0	-10.3
0.353	27.9	20.6	48.5	58.9	-10.4
0.423	25.9	20.6	46.5	57.4	-10.9
0.531	24.2	20.6	44.8	56.0	-11.2

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.279	26.0	20.7	46.7	50.8	-4.1
0.353	16.8	20.6	37.4	48.9	-11.5
0.423	14.6	20.6	35.2	47.4	-12.2
0.388	14.8	20.6	35.4	48.1	-12.7
4.245	10.5	20.7	31.2	46.0	-14.8
4.146	10.1	20.8	30.9	46.0	-15.1
4.385	10.0	20.7	30.7	46.0	-15.3
4.282	9.9	20.7	30.6	46.0	-15.4
0.531	9.8	20.6	30.4	46.0	-15.6
4.528	9.6	20.7	30.3	46.0	-15.7
0.515	9.5	20.6	30.1	46.0	-15.9

CONCLUSION

Pass

Tested By

POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.1.24

EUT:	PAL™ Controller for HeartWare™ HVAD™ Pump	Work Order:	MDTR0798
Serial Number:	PAL000404A	Date:	2019-06-14
Customer:	Medtronic, Inc.	Temperature:	21.7°C
Attendees:	Jeffrey Brown	Relative Humidity:	45.6%
Customer Project:	None	Bar. Pressure:	1009 mb
Tested By:	Chris Patterson	Job Site:	MN03
Power:	110VAC/60Hz	Configuration:	MDTR0798-1

TEST SPECIFICATIONS

Specification:	Method:
FCC 15.207:2019	ANSI C63.10:2013

TEST PARAMETERS

Run #:	5	Line:	High Line	Add. Ext. Attenuation (dB):	0

COMMENTS

Monitoring BLE signal via client Spec. Analyzer (Ref # ES058324)

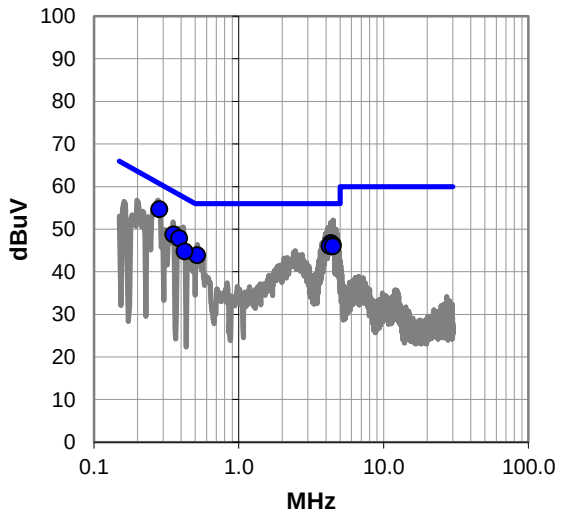
EUT OPERATING MODES

BLE Mid Ch. 2442 MHz modulated

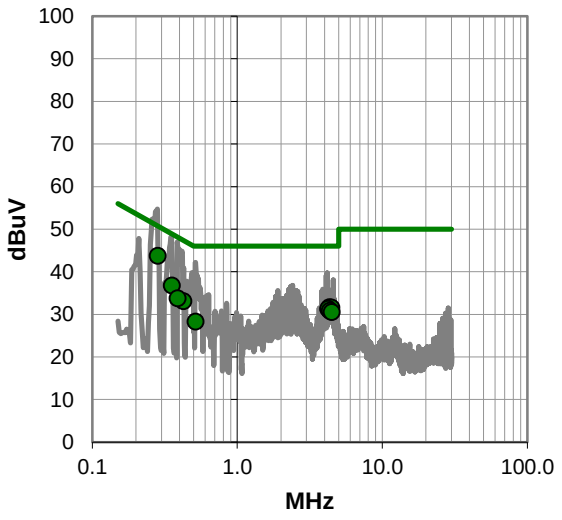
DEVIATIONS FROM TEST STANDARD

None

Quasi Peak Data - vs - Quasi Peak Limit



Average Data - vs - Average Limit



POWERLINE CONDUCTED EMISSIONS

element
WTD.2019.1.24

RESULTS - Run #5

Quasi Peak Data - vs - Quasi Peak Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.283	34.1	20.6	54.7	60.7	-6.0
4.317	26.1	20.7	46.8	56.0	-9.2
4.458	25.7	20.7	46.4	56.0	-9.6
4.348	25.4	20.7	46.1	56.0	-9.9
4.238	25.4	20.7	46.1	56.0	-9.9
4.469	25.3	20.7	46.0	56.0	-10.0
0.353	28.2	20.6	48.8	58.9	-10.1
0.387	27.3	20.6	47.9	58.1	-10.2
0.514	23.3	20.6	43.9	56.0	-12.1
0.424	24.2	20.6	44.8	57.4	-12.6

Average Data - vs - Average Limit

Freq (MHz)	Amp. (dBuV)	Factor (dB)	Adjusted (dBuV)	Spec. Limit (dBuV)	Margin (dB)
0.283	23.2	20.6	43.8	50.7	-6.9
0.353	16.2	20.6	36.8	48.9	-12.1
0.424	12.5	20.6	33.1	47.4	-14.3
4.317	11.0	20.7	31.7	46.0	-14.3
0.387	13.2	20.6	33.8	48.1	-14.3
4.458	10.9	20.7	31.6	46.0	-14.4
4.238	10.6	20.7	31.3	46.0	-14.7
4.348	10.2	20.7	30.9	46.0	-15.1
4.469	9.9	20.7	30.6	46.0	-15.4
0.514	7.7	20.6	28.3	46.0	-17.7

CONCLUSION

Pass

Tested By

DUTY CYCLE

TEST DESCRIPTION

The Duty Cycle (x) were measured for each of the EUT operating modes. The measurements were made using a zero span on the spectrum analyzer to see the pulses in the time domain. The transmit power was set to its default maximum. A direct connection was made between the RF output of the EUT and a spectrum analyzer. Attenuation and a DC block were used

The duty cycle was calculated by dividing the transmission pulse duration (T) by the total period of a single on and total off time.

The EUT operates at 100% Duty Cycle.

OCCUPIED BANDWIDTH

XMit 2019.05.15

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	E4422B	TGQ	15-Mar-18	15-Mar-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	11-Apr-19	11-Apr-20
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-19	13-Feb-20
Block - DC	Fairview Microwave	SD3379	AMI	7-Sep-18	7-Sep-19
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	13-Dec-18	13-Dec-19

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The EUT was set to the channels and modes listed in the datasheet.

The 6dB occupied bandwidth was measured using 100 kHz resolution bandwidth and 300 kHz video bandwidth. The 99.0% occupied bandwidth was also measured at the same time which can be needed during Output Power depending on the applicable method.

OCCUPIED BANDWIDTH

TbtTx 2018.09.13 XMit 2019.05.15

EUT:	PAL™ Controller for HeartWare™ HVAD™ Pump			**Work Order:**	MDTR0798
Serial Number:	PAL000404A			**Date:**	17-Jun-19
Customer:	Medtronic, Inc.			**Temperature:**	21.3 °C
Attendees:	Jeffrey Brown			**Humidity:**	58.2% RH
Project:	None			**Barometric Pres.:**	1017 mbar
Tested by:	Dustin Sparks	**Power:**	110VAC/60Hz	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

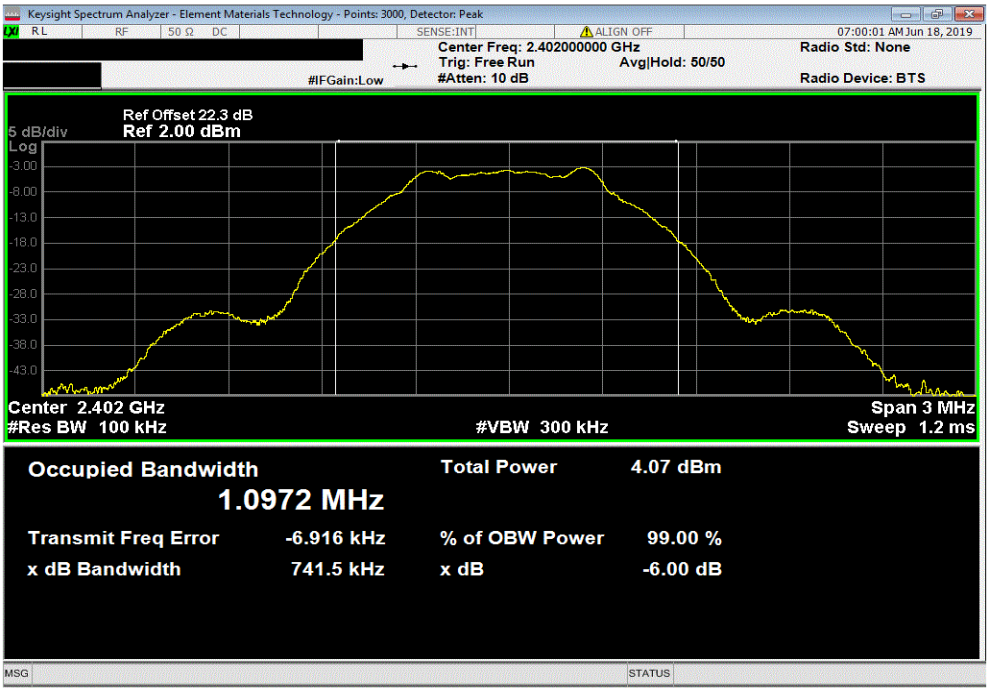
None

Configuration #	2	Signature Dustin Sparks

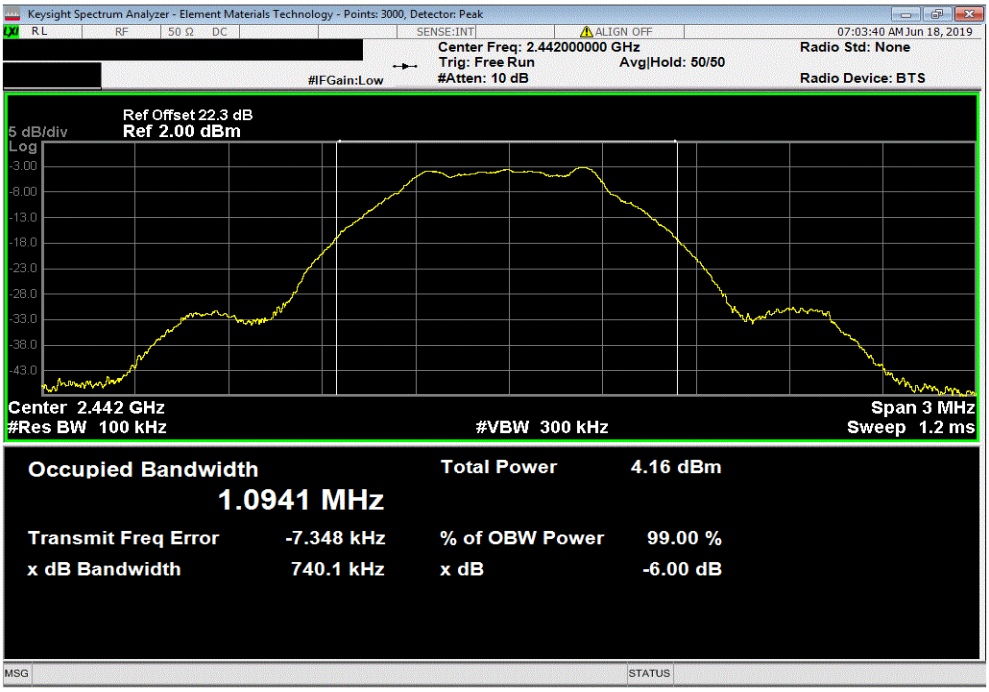
	Value	Limit (≥)	Result
BLE/GFSK Low Channel, 2402 MHz	741.534 kHz	500 kHz	Pass
BLE/GFSK Mid Channel, 2442 MHz	740.129 kHz	500 kHz	Pass
BLE/GFSK High Channel, 2480 MHz	740.911 kHz	500 kHz	Pass

OCCUPIED BANDWIDTH

BLE/GFSK Low Channel, 2402 MHz						
				Value	Limit (≥)	Result
				741.534 kHz	500 kHz	Pass

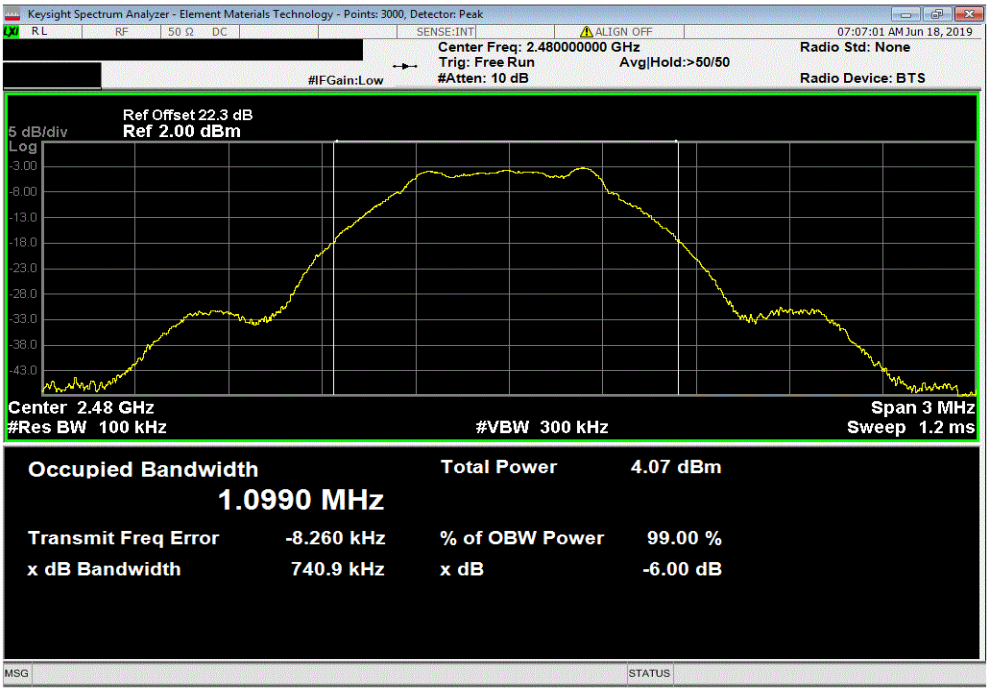


BLE/GFSK Mid Channel, 2442 MHz						
				Value	Limit (≥)	Result
				740.129 kHz	500 kHz	Pass



OCCUPIED BANDWIDTH

BLE/GFSK High Channel, 2480 MHz							
					Value	Limit (≥)	Result
					740.911 kHz	500 kHz	Pass



OUTPUT POWER

XMit 2019.05.15

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	E4422B	TGQ	15-Mar-18	15-Mar-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	11-Apr-19	11-Apr-20
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-19	13-Feb-20
Block - DC	Fairview Microwave	SD3379	AMI	7-Sep-18	7-Sep-19
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	13-Dec-18	13-Dec-19

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum.

Prior to measuring peak transmit power the DTS bandwidth (B) was measured.

The method found in ANSI C63.10:2013 Section 11.9.1.1 was used because the RBW on the analyzer was greater than the DTS Bandwidth of the radio.

OUTPUT POWER

element

TbtTx 2018.09.13 XMit 2019.05.15

EUT:	**PAL™ Controller for HeartWare™ HVAD™ Pump**			**Work Order:**	**MDTR0798**
Serial Number:	**PAL000404A**			**Date:**	**17-Jun-19**
Customer:	**Medtronic, Inc.**			**Temperature:**	**21.4 °C**
Attendees:	**Jeffrey Brown**			**Humidity:**	**57.5% RH**
Project:	**None**			**Barometric Pres.:**	**1017 mbar**
Tested by:	**Dustin Sparks**	**Power:**	**110VAC/60Hz**	**Job Site:**	**MN08**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2019	**ANSI C63.10:2013**

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

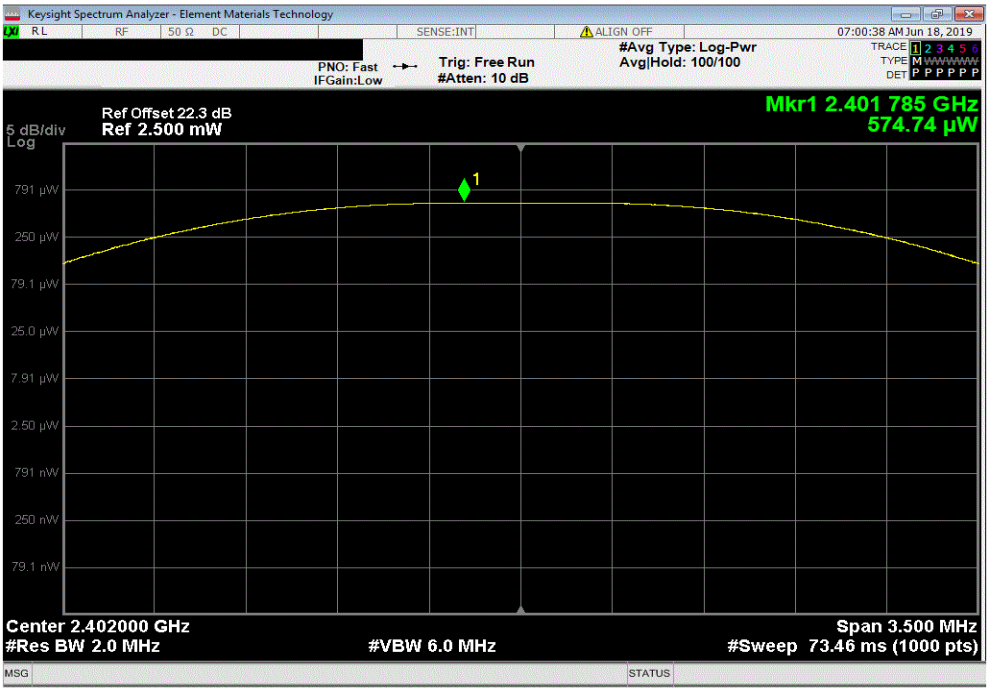
None

Configuration #	**2**	*Signature* Dustin Sparks

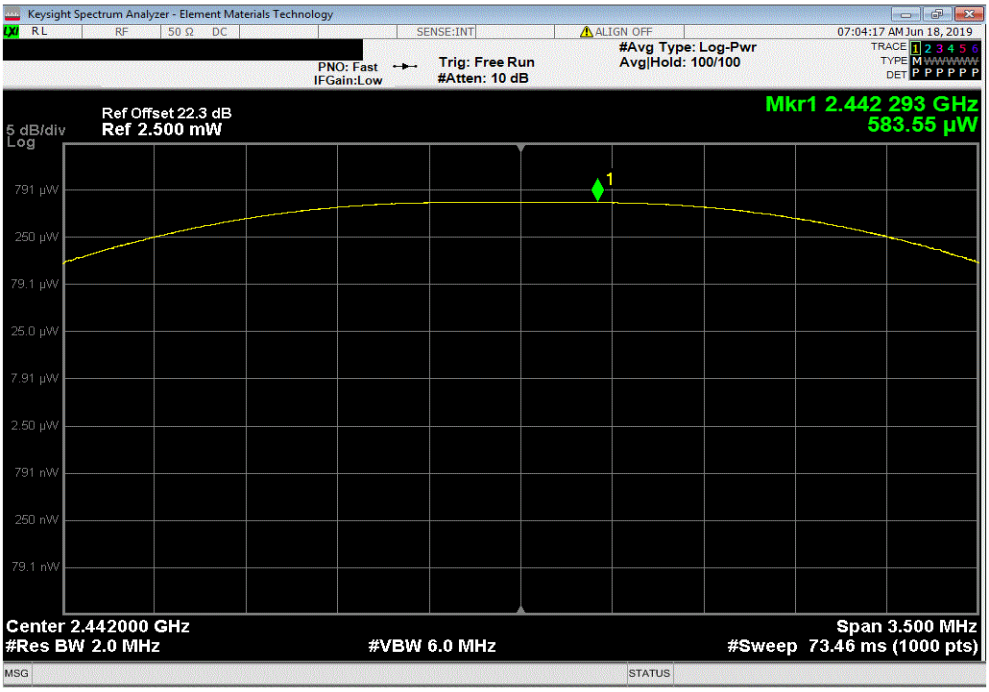
	Value	**Limit (<)**	**Result**
BLE/GFSK Low Channel, 2402 MHz	574.74 uW	1 W	Pass
BLE/GFSK Mid Channel, 2442 MHz	583.55 uW	1 W	Pass
BLE/GFSK High Channel, 2480 MHz	568.16 uW	1 W	Pass

OUTPUT POWER

BLE/GFSK Low Channel, 2402 MHz						
				Value	Limit (<)	Result
				574.74 uW	1 W	Pass

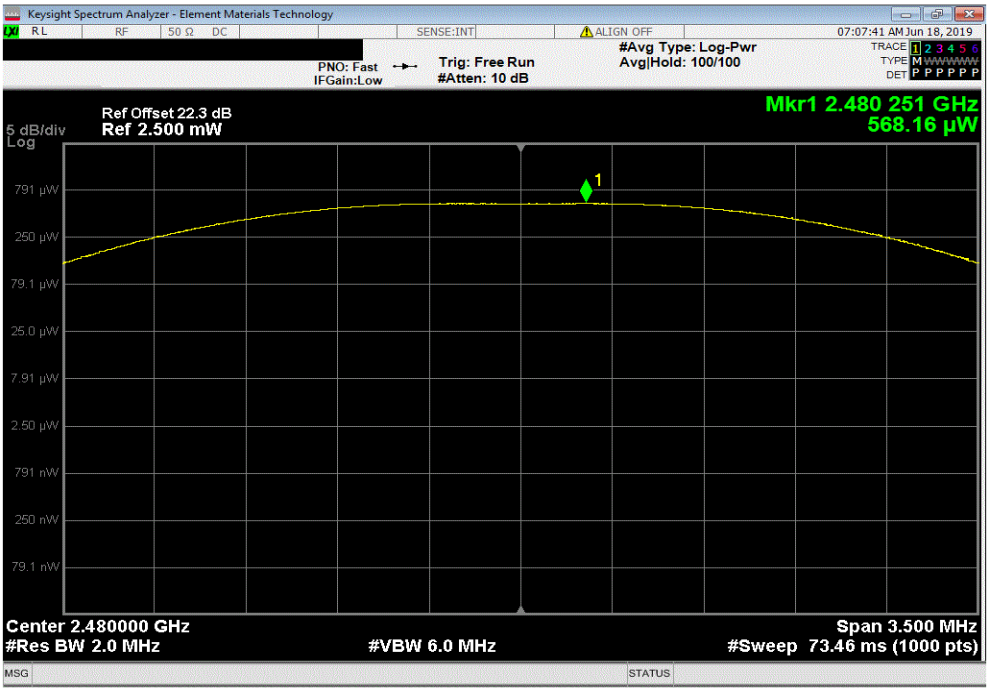


BLE/GFSK Mid Channel, 2442 MHz						
				Value	Limit (<)	Result
				583.55 uW	1 W	Pass



OUTPUT POWER

BLE/GFSK High Channel, 2480 MHz						
				Value	Limit (<)	Result
				568.16 uW	1 W	Pass



EQUIVALENT ISOTROPIC RADIATED POWER

XMit 2019.05.15

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	E4422B	TGQ	15-Mar-18	15-Mar-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	11-Apr-19	11-Apr-20
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-19	13-Feb-20
Block - DC	Fairview Microwave	SD3379	AMI	7-Sep-18	7-Sep-19
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	13-Dec-18	13-Dec-19

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The transmit frequency was set to the required channels in each band. The transmit power was set to its default maximum.

Prior to measuring peak transmit power the DTS bandwidth (B) was measured.

The method found in ANSI C63.10:2013 Section 11.9.1.1 was used because the RBW on the analyzer was greater than the DTS Bandwidth of the radio. The actual antenna gain of the EUT was added to the conducted output power to derive the EIRP values.

EQUIVALENT ISOTROPIC RADIATED POWER

TbtTx 2018.09.13 XMit 2019.05.15

EUT:	**PAL™ Controller for HeartWare™ HVAD™ Pump**			**Work Order:**	**MDTR0798**
Serial Number:	**PAL000404A**			**Date:**	**17-Jun-19**
Customer:	**Medtronic, Inc.**			**Temperature:**	**21.4 °C**
Attendees:	**Jeffrey Brown**			**Humidity:**	**57.5% RH**
Project:	**None**			**Barometric Pres.:**	**1017 mbar**
Tested by:	**Dustin Sparks**	**Power:**	**110VAC/60Hz**	**Job Site:**	**MN08**

TEST SPECIFICATIONS	**Test Method**
FCC 15.247:2019	**ANSI C63.10:2013**

COMMENTS

None

DEVIATIONS FROM TEST STANDARD

None

Configuration #	**2**	*Signature* Dustin Sparks

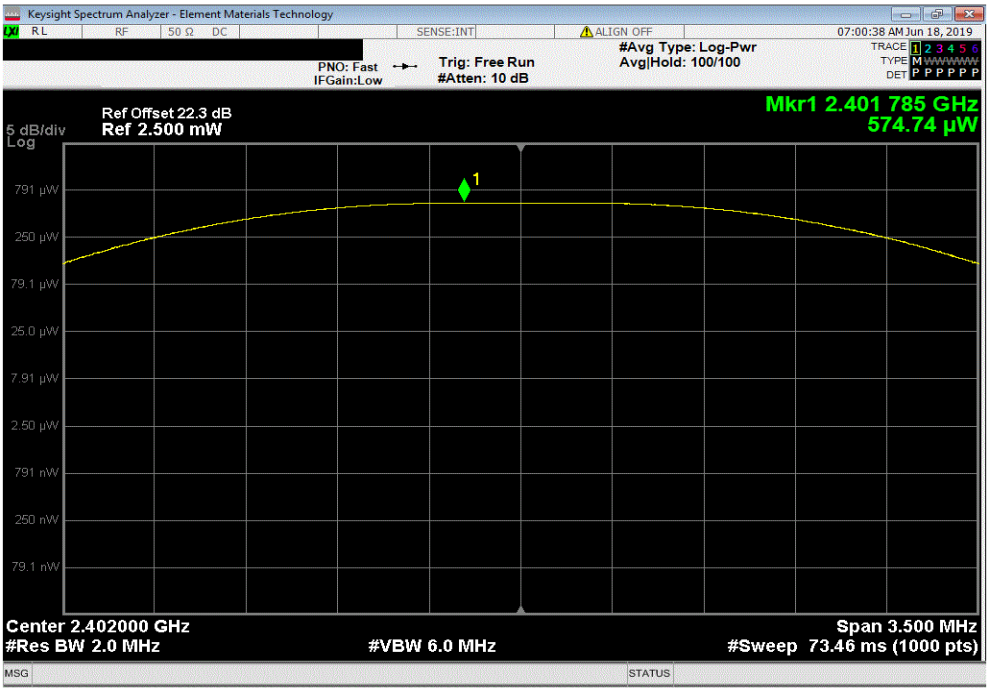
	Value	Value (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (< dBm)	Result
BLE/GFSK Low Channel, 2402 MHz	574.74 uW	-2.41	-0.6	-3.01	36	Pass
BLE/GFSK Mid Channel, 2442 MHz	583.55 uW	-2.34	-0.6	-2.94	36	Pass
BLE/GFSK High Channel, 2480 MHz	568.16 uW	-2.46	-0.6	-3.06	36	Pass

EQUIVALENT ISOTROPIC RADIATED POWER

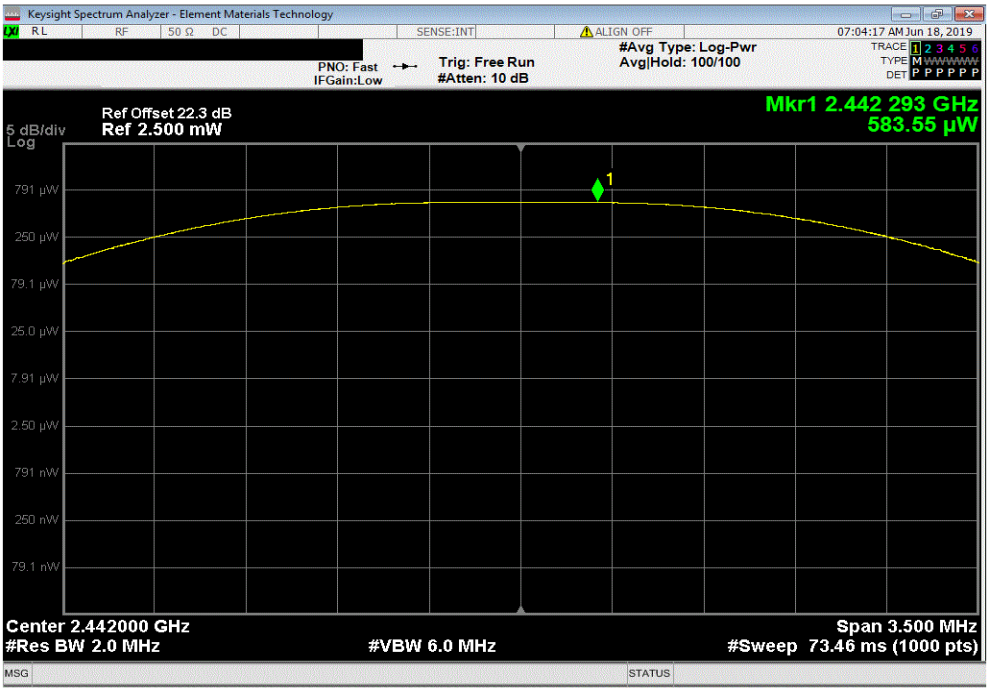
element

TbtTx 2018.09.13 XMit 2019.05.15

BLE/GFSK Low Channel, 2402 MHz						
	Value	Value (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (< dBm)	Result
	574.74 uW	-2.41	-0.6	-3.01	36	Pass

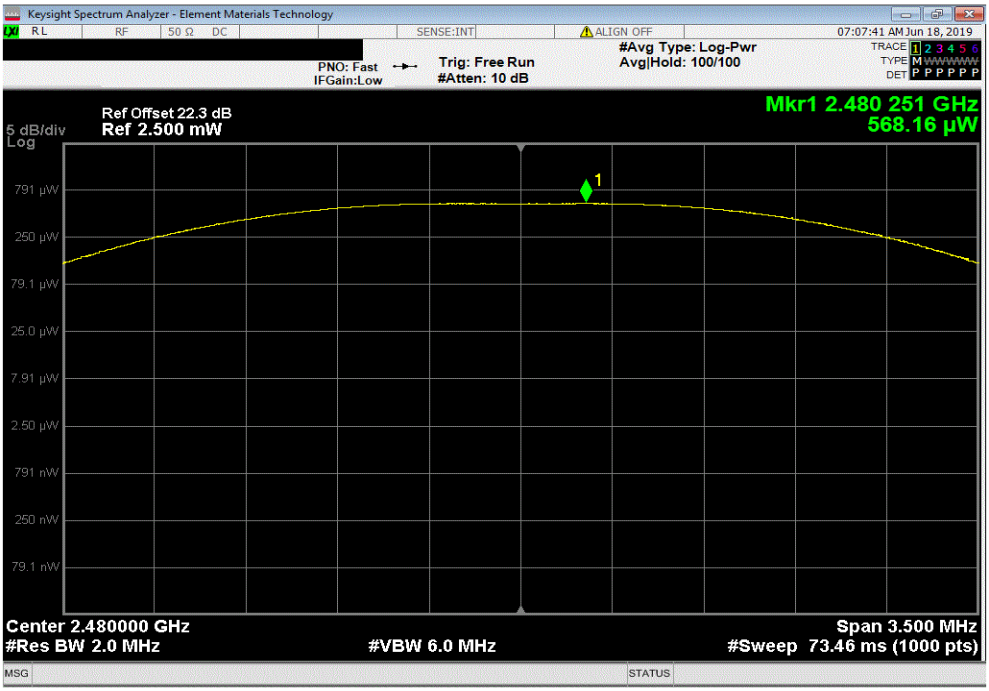


BLE/GFSK Mid Channel, 2442 MHz						
	Value	Value (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (< dBm)	Result
	583.55 uW	-2.34	-0.6	-2.94	36	Pass



EQUIVALENT ISOTROPIC RADIATED POWER

BLE/GFSK High Channel, 2480 MHz						
	Value	Value (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (< dBm)	Result
	568.16 uW	-2.46	-0.6	-3.06	36	Pass



POWER SPECTRAL DENSITY

XMit 2019.05.15

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	E4422B	TGQ	15-Mar-18	15-Mar-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	11-Apr-19	11-Apr-20
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-19	13-Feb-20
Block - DC	Fairview Microwave	SD3379	AMI	7-Sep-18	7-Sep-19
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	13-Dec-18	13-Dec-19

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The maximum power spectral density measurements was measured using the channels and modes as called out on the following data sheets.

Per the procedure outlined in ANSI C63.10 the peak power spectral density was measured in a 3 kHz RBW.

POWER SPECTRAL DENSITY

TbtTx 2018.09.13 XMit 2019.05.15

EUT:	PAL™ Controller for HeartWare™ HVAD™ Pump			**Work Order:**	MDTR0798
Serial Number:	PAL000404A			**Date:**	17-Jun-19
Customer:	Medtronic, Inc.			**Temperature:**	21.3 °C
Attendees:	Jeffrey Brown			**Humidity:**	56.9% RH
Project:	None			**Barometric Pres.:**	1017 mbar
Tested by:	Dustin Sparks	**Power:**	110VAC/60Hz	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

None

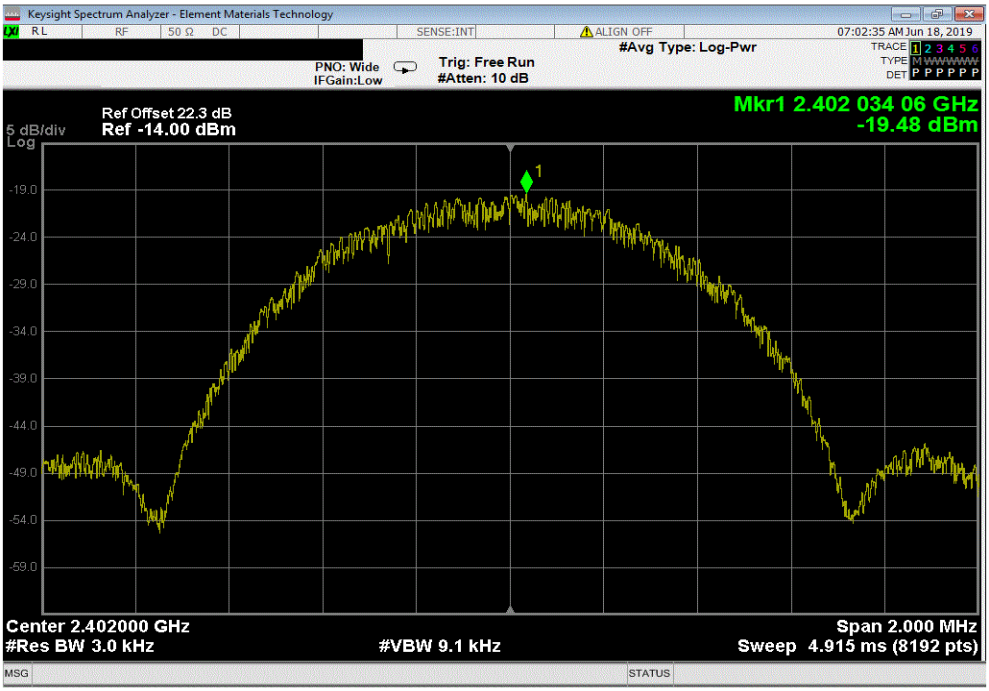
DEVIATIONS FROM TEST STANDARD

None

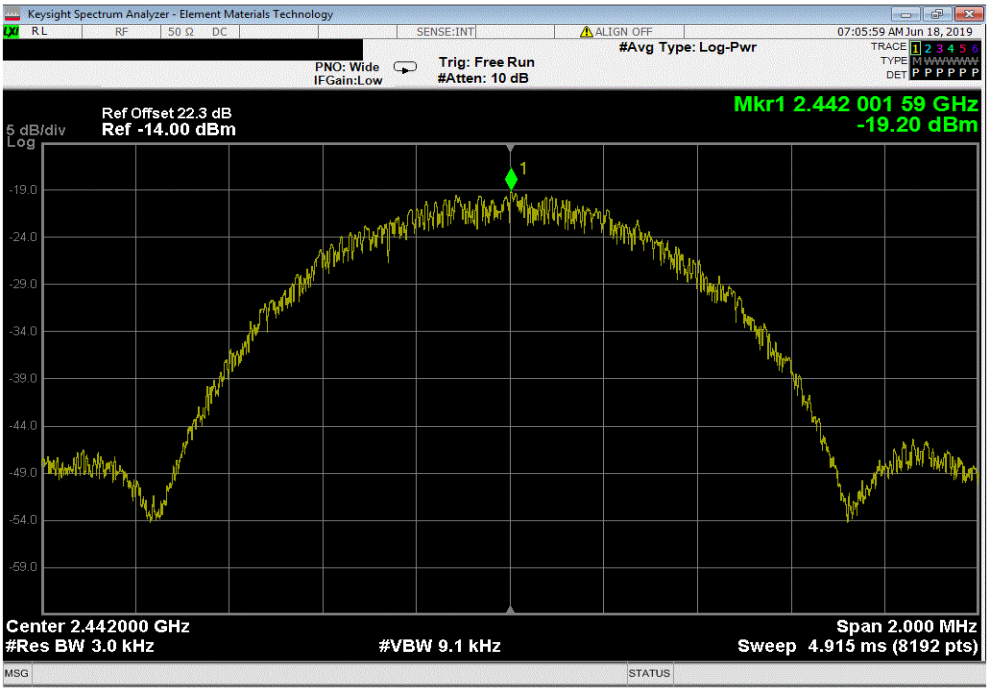
Configuration #	2	Signature

	Value dBm/3kHz	Limit < dBm/3kHz	Results
BLE/GFSK Low Channel, 2402 MHz	-19.482	8	Pass
BLE/GFSK Mid Channel, 2442 MHz	-19.201	8	Pass
BLE/GFSK High Channel, 2480 MHz	-19.309	8	Pass

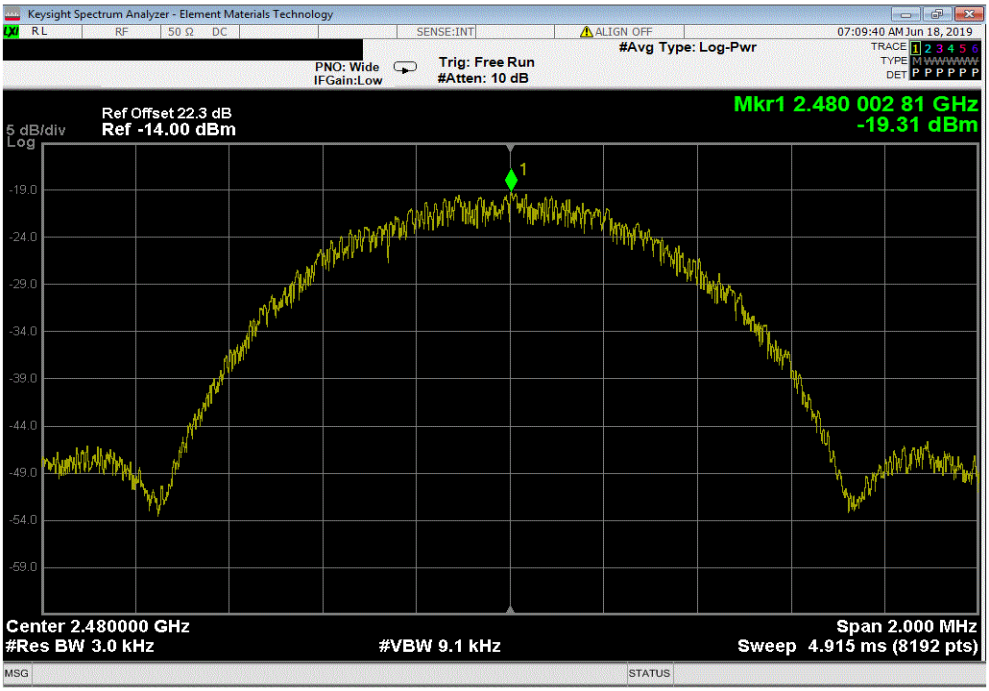
BLE/GFSK Low Channel, 2402 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-19.482	8	Pass



BLE/GFSK Mid Channel, 2442 MHz						
				Value dBm/3kHz	Limit < dBm/3kHz	Results
				-19.201	8	Pass



BLE/GFSK High Channel, 2480 MHz							
					Value dBm/3kHz	Limit < dBm/3kHz	Results
					-19.309	8	Pass



BAND EDGE COMPLIANCE

XMit 2019.05.15

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	E4422B	TGQ	15-Mar-18	15-Mar-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	11-Apr-19	11-Apr-20
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-19	13-Feb-20
Block - DC	Fairview Microwave	SD3379	AMI	7-Sep-18	7-Sep-19
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	13-Dec-18	13-Dec-19

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The spurious RF conducted emissions at the edges of the authorized bands were measured with the EUT set to low and high transmit frequencies in each available band. The channels closest to the band edges were selected. The EUT was transmitting at the data rate(s) listed in the datasheet.

The spectrum was scanned below the lower band edge and above the higher band edge.

BAND EDGE COMPLIANCE

TbtTx 2018.09.13 XMit 2019.05.15

EUT:	PAL™ Controller for HeartWare™ HVAD™ Pump			**Work Order:**	MDTR0798
Serial Number:	PAL000404A			**Date:**	17-Jun-19
Customer:	Medtronic, Inc.			**Temperature:**	21.3 °C
Attendees:	Jeffrey Brown			**Humidity:**	59% RH
Project:	None			**Barometric Pres.:**	1018 mbar
Tested by:	Dustin Sparks	**Power:**	110VAC/60Hz	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

None

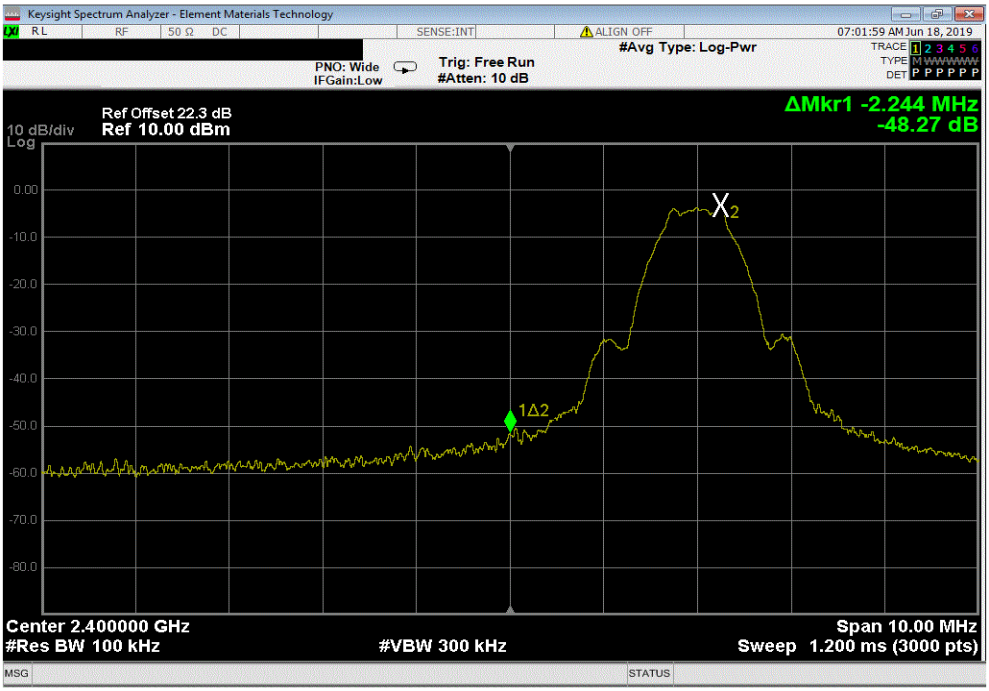
DEVIATIONS FROM TEST STANDARD

None

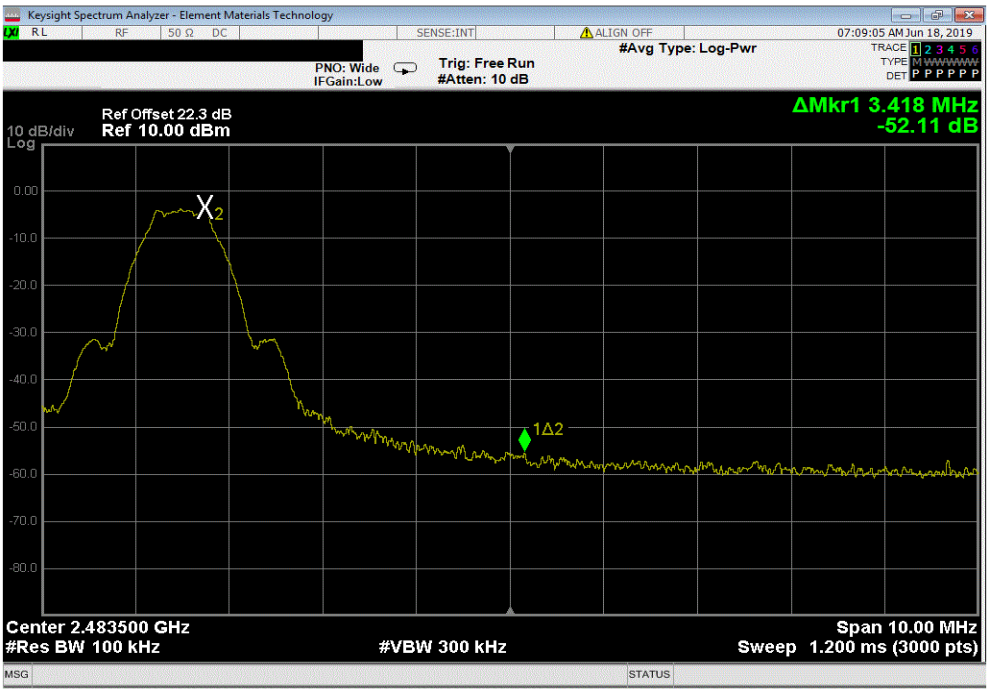
Configuration #	2	Signature

	Value (dBc)	Limit ≤ (dBc)	Result
BLE/GFSK Low Channel, 2402 MHz	-48.27	-20	Pass
BLE/GFSK High Channel, 2480 MHz	-52.11	-20	Pass

BLE/GFSK Low Channel, 2402 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-48.27	-20	Pass



BLE/GFSK High Channel, 2480 MHz						
				Value (dBc)	Limit ≤ (dBc)	Result
				-52.11	-20	Pass



SPURIOUS CONDUCTED EMISSIONS

XMit 2019.05.15

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data.

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Cal. Due
Generator - Signal	Agilent	E4422B	TGQ	15-Mar-18	15-Mar-21
Cable	ESM Cable Corp.	TTBJ141 KMKM-72	MNU	11-Apr-19	11-Apr-20
Attenuator	S.M. Electronics	SA26B-20	RFW	13-Feb-19	13-Feb-20
Block - DC	Fairview Microwave	SD3379	AMI	7-Sep-18	7-Sep-19
Analyzer - Spectrum Analyzer	Keysight	N9010A (EXA)	AFQ	13-Dec-18	13-Dec-19

TEST DESCRIPTION

The measurement was made using a direct connection between the RF output of the EUT and a spectrum analyzer. The spurious RF conducted emissions were measured with the EUT set to low, medium and high transmit frequencies. The EUT was transmitting at the data rate(s) listed in the datasheet. For each transmit frequency, the spectrum was scanned throughout the specified frequency range.

SPURIOUS CONDUCTED EMISSIONS

TbtTx 2018.09.13 XMit 2019.05.15

EUT:	PAL™ Controller for HeartWare™ HVAD™ Pump			**Work Order:**	MDTR0798
Serial Number:	PAL000404A			**Date:**	17-Jun-19
Customer:	Medtronic, Inc.			**Temperature:**	21.3 °C
Attendees:	Jeffrey Brown			**Humidity:**	56.5% RH
Project:	None			**Barometric Pres.:**	1018 mbar
Tested by:	Dustin Sparks	**Power:**	110VAC/60Hz	**Job Site:**	MN08

TEST SPECIFICATIONS	Test Method
FCC 15.247:2019	ANSI C63.10:2013

COMMENTS

None

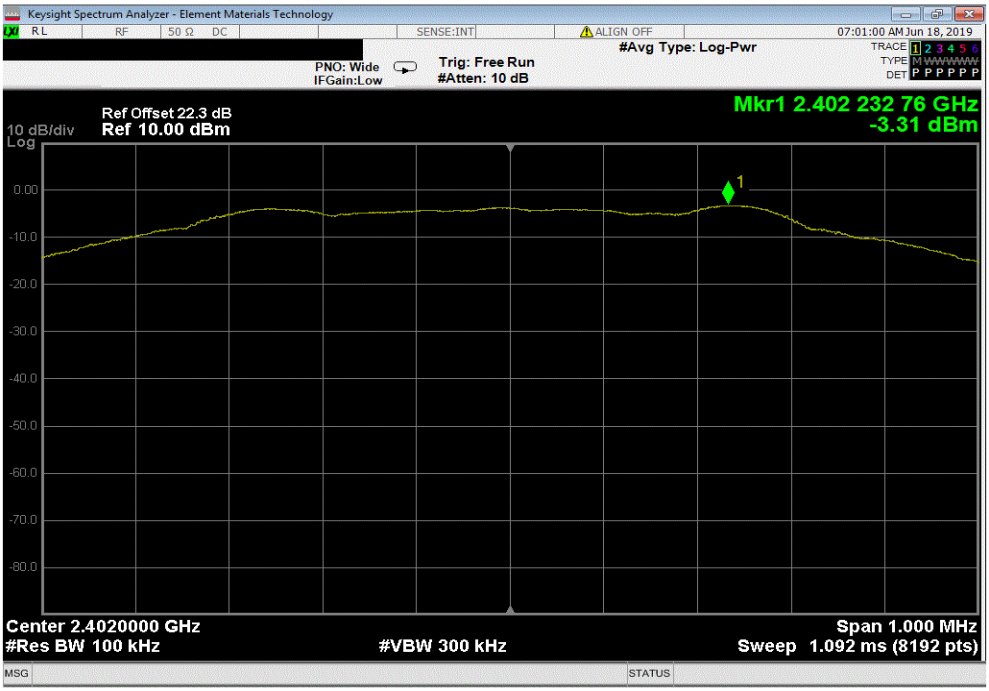
DEVIATIONS FROM TEST STANDARD

None

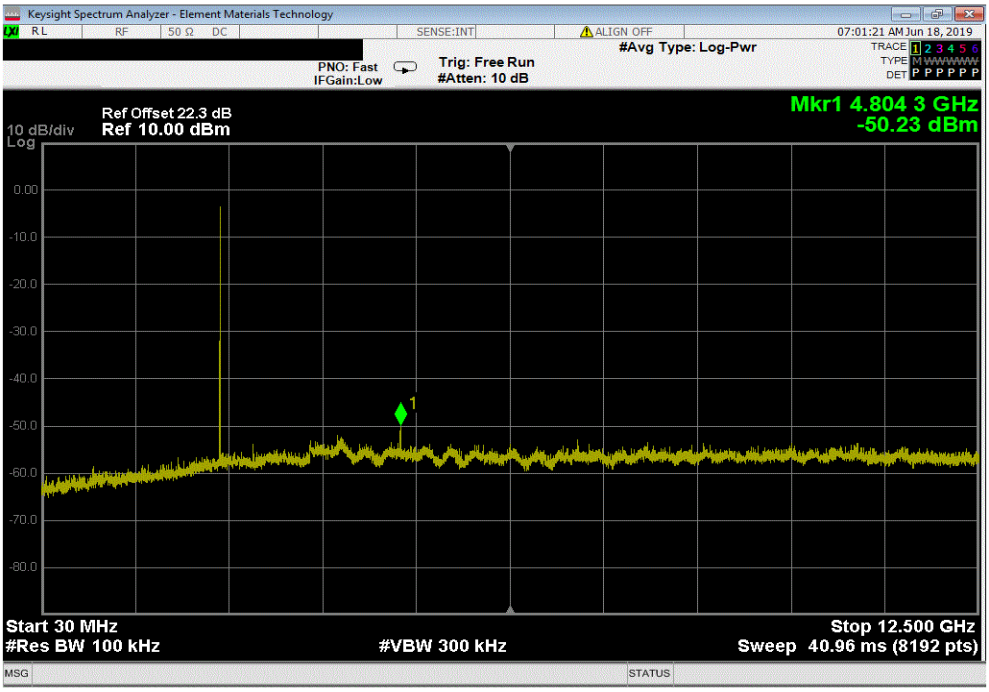
Configuration #	2	Signature

	Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
BLE/GFSK Low Channel, 2402 MHz	Fundamental	2402.23	N/A	N/A	N/A
BLE/GFSK Low Channel, 2402 MHz	30 MHz - 12.5 GHz	4804.25	-46.92	-20	Pass
BLE/GFSK Low Channel, 2402 MHz	12.5 GHz - 25 GHz	24069.1	-46.59	-20	Pass
BLE/GFSK Mid Channel, 2442 MHz	Fundamental	2442.23	N/A	N/A	N/A
BLE/GFSK Mid Channel, 2442 MHz	30 MHz - 12.5 GHz	4883.42	-47.93	-20	Pass
BLE/GFSK Mid Channel, 2442 MHz	12.5 GHz - 25 GHz	23934.81	-45.95	-20	Pass
BLE/GFSK High Channel, 2480 MHz	Fundamental	2480.23	N/A	N/A	N/A
BLE/GFSK High Channel, 2480 MHz	30 MHz - 12.5 GHz	4959.54	-46.3	-20	Pass
BLE/GFSK High Channel, 2480 MHz	12.5 GHz - 25 GHz	24935.91	-46.14	-20	Pass

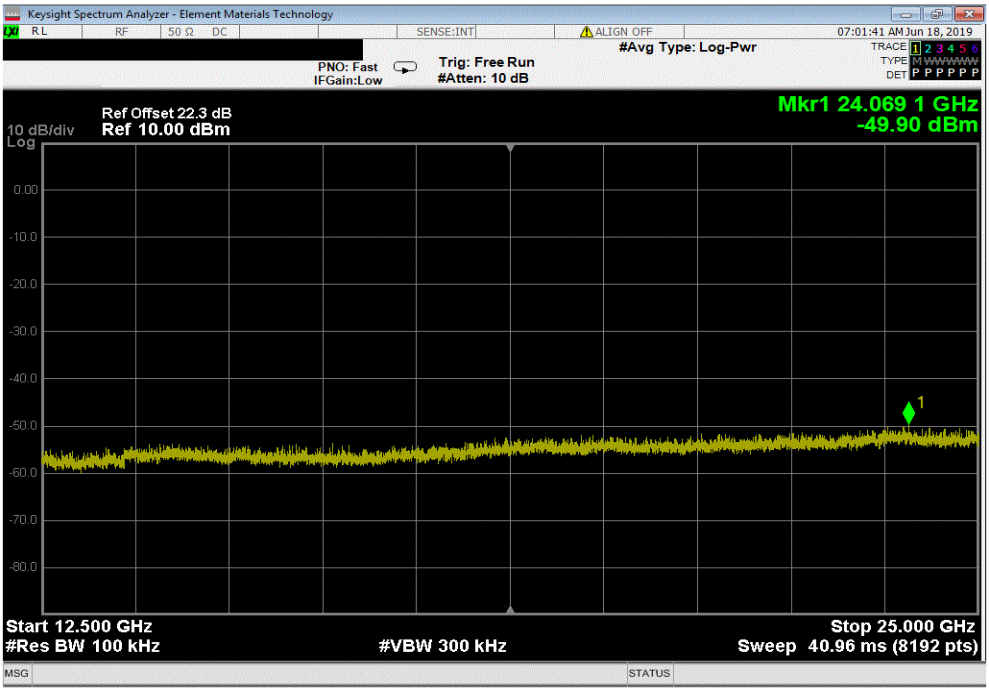
BLE/GFSK Low Channel, 2402 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2402.23	N/A	N/A	N/A



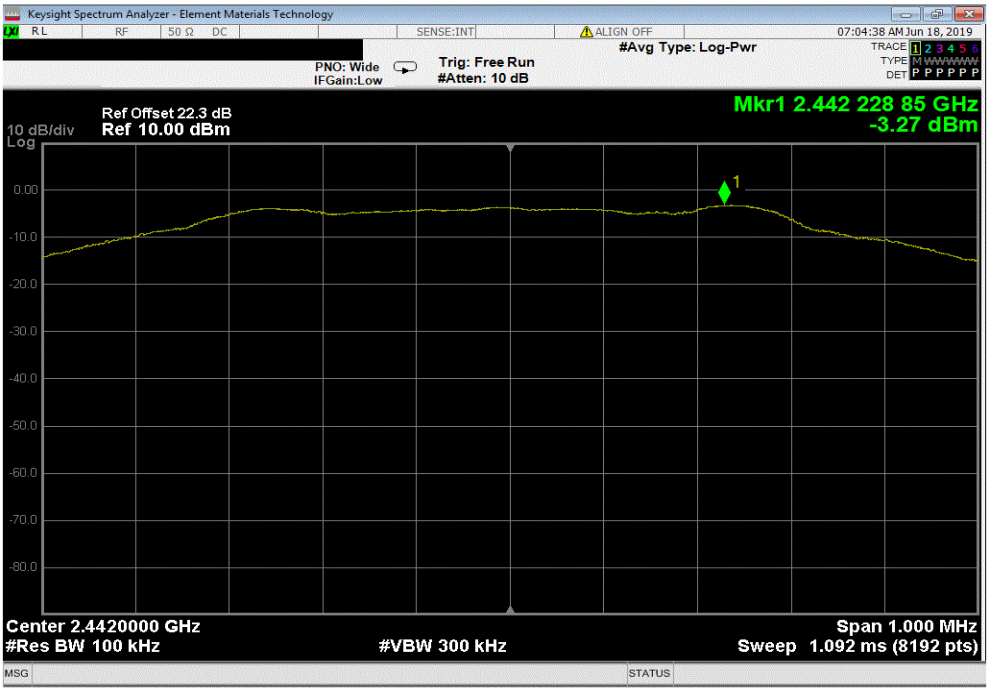
BLE/GFSK Low Channel, 2402 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	4804.25	-46.92	-20	Pass



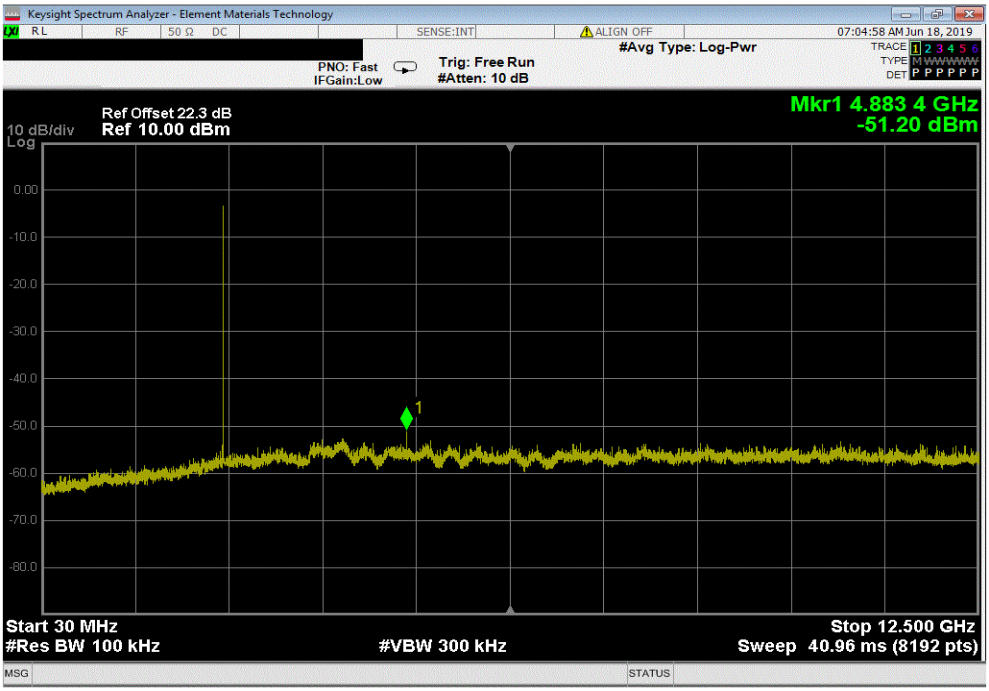
BLE/GFSK Low Channel, 2402 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	24069.1	-46.59	-20	Pass



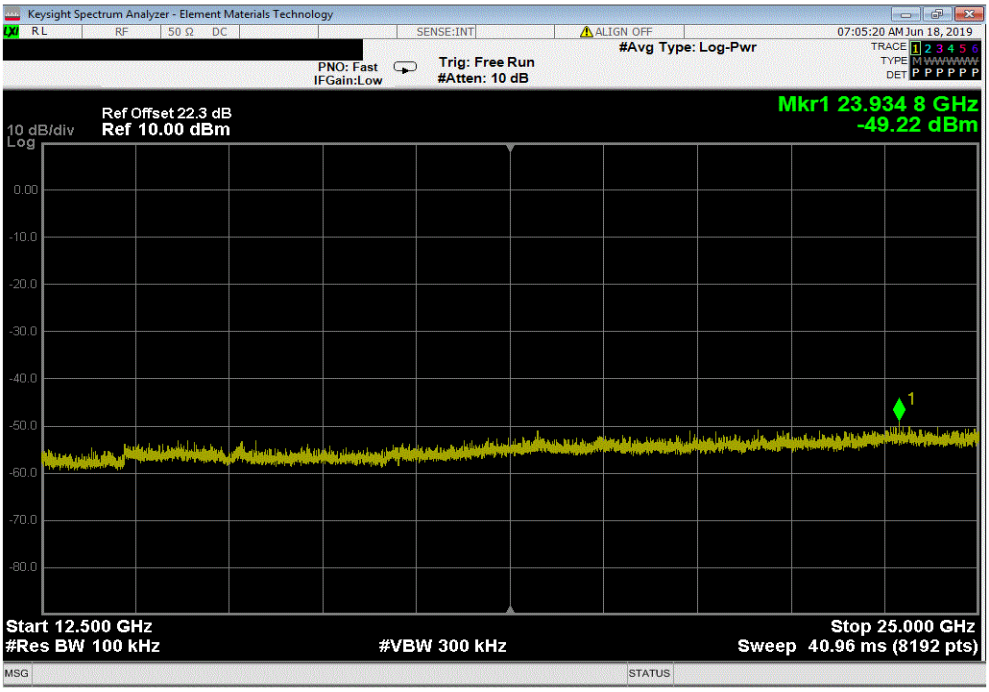
BLE/GFSK Mid Channel, 2442 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
Fundamental	2442.23	N/A	N/A	N/A



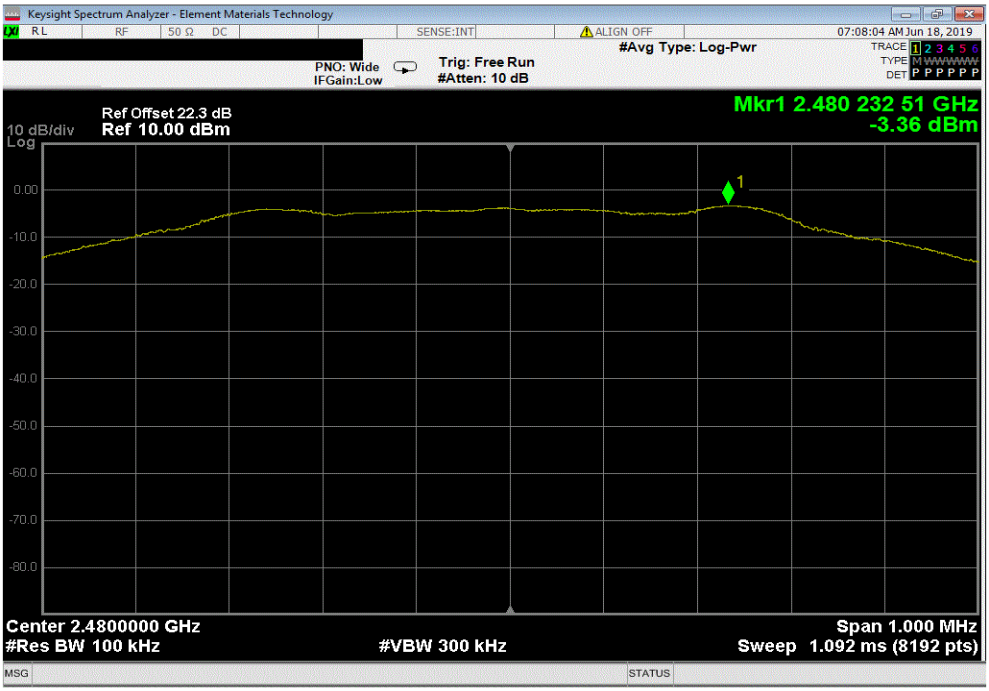
BLE/GFSK Mid Channel, 2442 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	4883.42	-47.93	-20	Pass



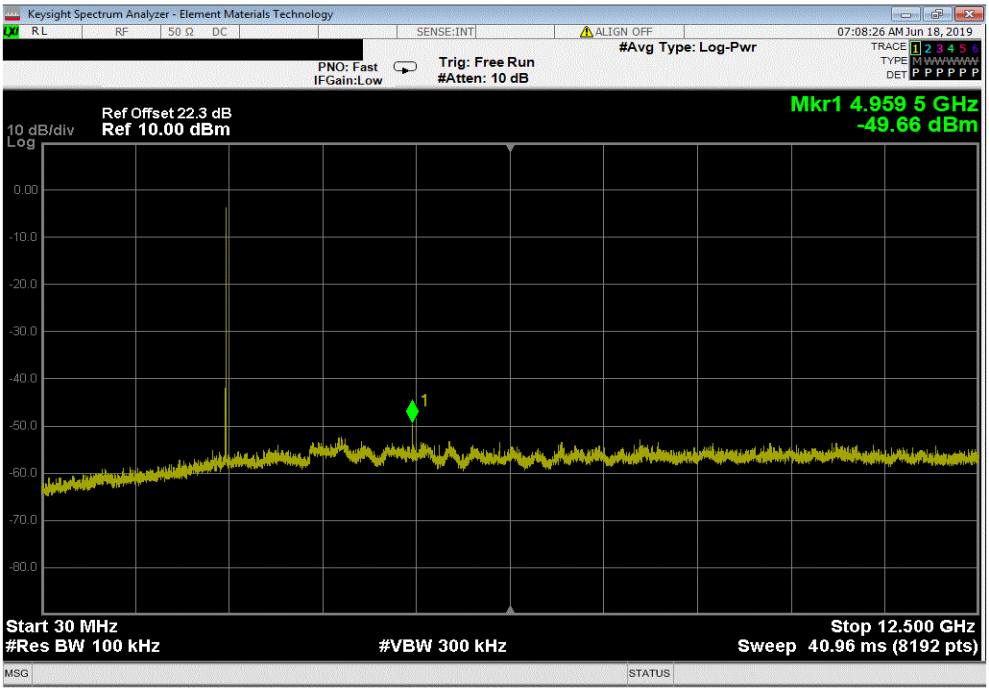
BLE/GFSK Mid Channel, 2442 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	23934.81	-45.95	-20	Pass



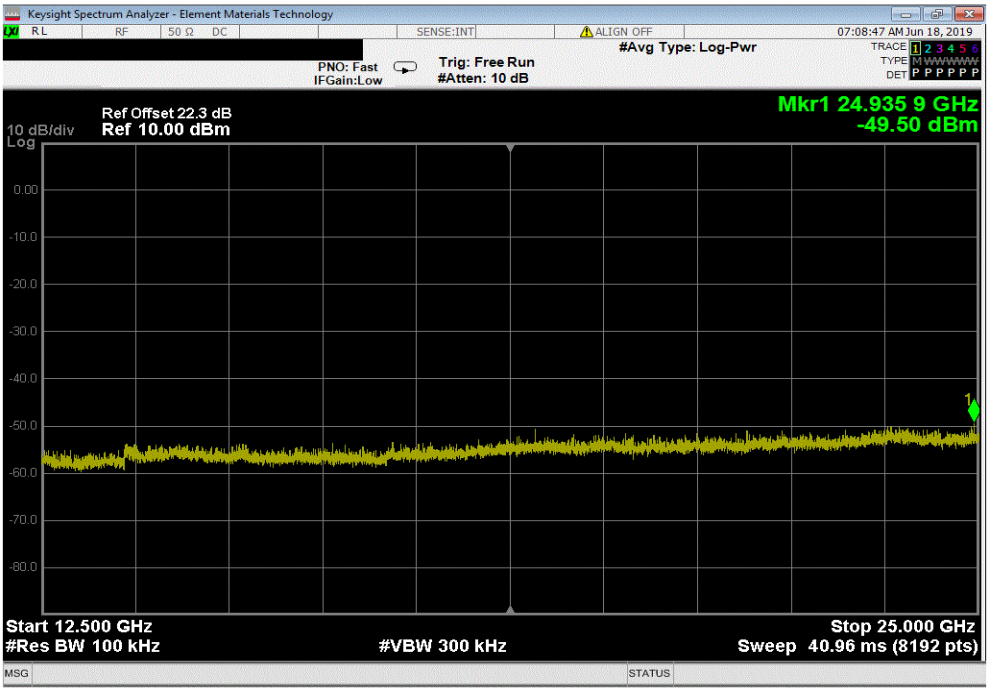
BLE/GFSK High Channel, 2480 MHz					
Frequency Range		Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
	Fundamental	2480.23	N/A	N/A	N/A



BLE/GFSK High Channel, 2480 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
30 MHz - 12.5 GHz	4959.54	-46.3	-20	Pass



BLE/GFSK High Channel, 2480 MHz				
Frequency Range	Measured Freq (MHz)	Max Value (dBc)	Limit ≤ (dBc)	Result
12.5 GHz - 25 GHz	24935.91	-46.14	-20	Pass



SPURIOUS RADIATED EMISSIONS

PSA-ESCI 2019.05.10

Testing was performed using the mode(s) of operation and configuration(s) noted within the report. The individuals and/or the organization requesting the test provided the modes, configurations and settings used to complete the evaluation. The actual test parameters are specified in the test data, this includes items such as investigated frequency range (scanned) and test levels. The testing methods and performance specifications, as well as the test site used for the evaluation are indicated in the test data. The test data represents the configuration / operating mode/ model that produced the highest emission levels as compared to the specification limit.

MODES OF OPERATION

Transmitting BLE - low channel (2402 MHz), mid channel (2442 MHz), and high channel (2480 MHz)

POWER SETTINGS INVESTIGATED

110VAC/60Hz

CONFIGURATIONS INVESTIGATED

MDTR0798 - 5

FREQUENCY RANGE INVESTIGATED

Start Frequency	30 MHz	Stop Frequency	26500 MHz

SAMPLE CALCULATIONS

Radiated Emissions: Field Strength = Measured Level + Antenna Factor + Cable Factor - Amplifier Gain + Distance Adjustment Factor + External Attenuation

TEST EQUIPMENT

Description	Manufacturer	Model	ID	Last Cal.	Interval
Amplifier - Pre-Amplifier	Miteq	JSD4-18002600-26-8P	APU	13-Sep-2018	12 mo
Cable	ESM Cable Corp	TTBJ141 KMKM-72	MNP	12-Sep-2018	12 mo
Antenna - Standard Gain	ETS Lindgren	3160-09	AHG	NCR	0 mo
Amplifier - Pre-Amplifier	L-3 Narda-MITEQ	AMF-6F-12001800-30-10P	PAP	23-Feb-2019	12 mo
Cable	Element	Biconilog Cable	MNX	23-Feb-2019	12 mo
Cable	Element	Standard Gain Cable	MNW	23-Feb-2019	12 mo
Cable	Element	Double Ridge Guide Horn Cables	MNV	23-Feb-2019	12 mo
Filter - Low Pass	Micro-Tronics	LPM50004	HGG	26-Sep-2018	12 mo
Filter - High Pass	Micro-Tronics	HPM50111	HFM	26-Sep-2018	12 mo
Attenuator	Coaxicom	3910-20	AXY	26-Sep-2018	12 mo
Antenna - Biconilog	ETS Lindgren	3142D	AXO	15-Dec-2017	24 mo
Amplifier - Pre-Amplifier	Miteq	AMF-3D-00100800-32-13P	AVX	23-Feb-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AMF-6F-08001200-30-10P	AVC	23-Feb-2019	12 mo
Amplifier - Pre-Amplifier	Miteq	AM-1064-9079 and SA18E-10	AOO	23-Feb-2019	12 mo
Antenna	ETS-Lindgren	3160-08	AJP	NCR	0 mo
Antenna	ETS-Lindgren	3160-07	AJJ	NCR	0 mo
Antenna - Double Ridge	ETS Lindgren	3115	AIB	27-Aug-2018	24 mo
Analyzer - Spectrum Analyzer	Agilent	E4440A	AFG	5-Jul-2018	12 mo

MEASUREMENT BANDWIDTHS

Frequency Range (MHz)	Peak Data (kHz)	Quasi-Peak Data (kHz)	Average Data (kHz)
0.01 - 0.15	1.0	0.2	0.2
0.15 - 30.0	10.0	9.0	9.0
30.0 - 1000	100.0	120.0	120.0
Above 1000	1000.0	N/A	1000.0

SPURIOUS RADIATED EMISSIONS

PSA-ESCI 2019.05.10

TEST DESCRIPTION

The highest gain antenna of each type to be used with the EUT was tested. The EUT was configured for the required transmit frequencies and the modes as showed in the data sheets.

For each configuration, the spectrum was scanned throughout the specified range as part of the exploratory investigation of the emissions. These “pre-scans” are not included in the report. Final measurements on individual emissions were then made and included in this test report.

The individual emissions from the EUT were maximized by rotating the EUT on a turntable, adjusting the position of the EUT and EUT antenna in three orthogonal axis if required, and adjusting the measurement antenna height and polarization (per ANSI C63.10). A preamp and high pass filter (and notch filter) were used for this test in order to provide sufficient measurement sensitivity.

Measurements were made with the required detectors and annotated on the data for each individual point using the following annotation:

QP = Quasi-Peak Detector
PK = Peak Detector
AV = RMS Detector

Measurements were made to satisfy the specific requirements of the test specification for out of band emissions as well as the restricted band requirements.

If there are no detectable emissions above the noise floor, the data included may show noise floor measurements for reference only.

Measurements at the edges of the allowable band may be presented in an alternative method as provided for in the ANSI C63.10 Marker-Delta method. This method involves performing an in-band fundamental measurement followed by a screen capture of the fundamental and out-of-band emission using reduced measurement instrumentation bandwidths. The amplitude delta measured on this screen capture is applied to the fundamental emission value to show the out-of-band emission level as applied to the limit.

Where the radio test software does not provide for a duty cycle at continuous transmit conditions (> 98%) and the RMS (power average) measurements were made across the on and off times of the EUT transmissions, a duty cycle correction is added to the measurements using the formula of 10*LOG(dc).

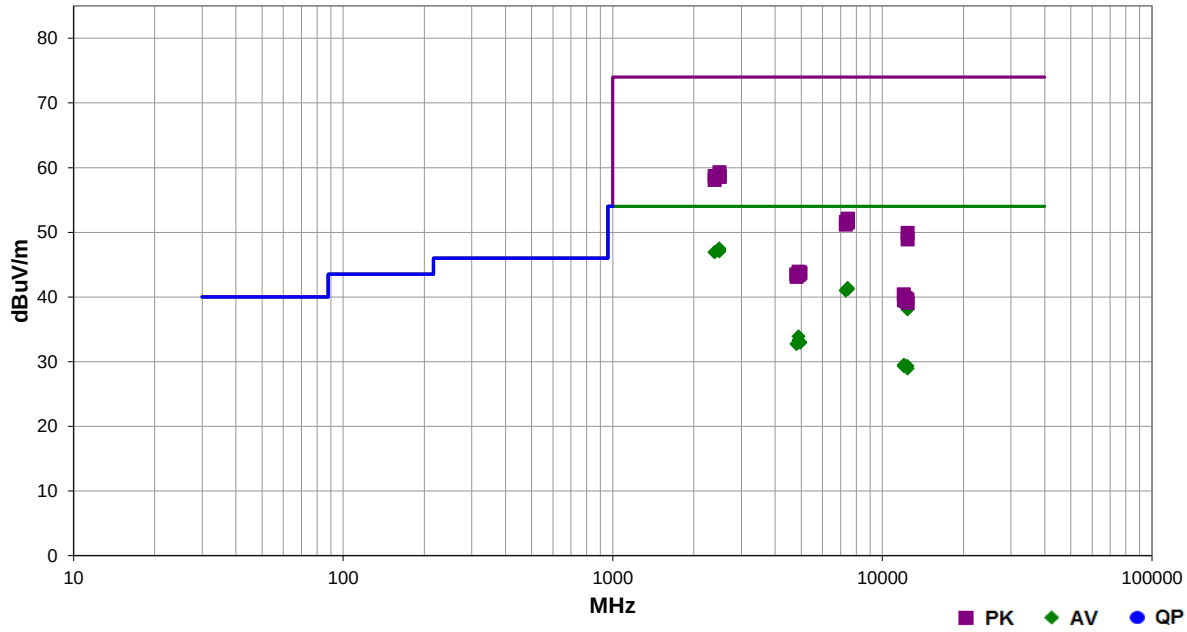
SPURIOUS RADIATED EMISSIONS

EmiR5 2019.05.20 PSA-ESCI 2019.05.10

Work Order:	MDTR0798	**Date:**	20-Jun-2019		
Project:	None	**Temperature:**	21.9 °C		
Job Site:	MN09	**Humidity:**	52.8% RH		
Serial Number:	PAL000405A	**Barometric Pres.:**	1012 mbar	**Tested by:**	Dustin Sparks
EUT:	PAL™ Controller for HeartWare™ HVAD™ Pump				
Configuration:	5				
Customer:	Medtronic, Inc.				
Attendees:	Jeffrey Brown, Aaron Ledebuhr				
EUT Power:	110VAC/60Hz				
Operating Mode:	Transmitting BLE - low channel (2402 MHz), mid channel (2442 MHz), and high channel (2480 MHz)				
Deviations:	None				
Comments:	None				

Test Specifications	**Test Method**
FCC 15.247:2019	ANSI C63.10:2013

Run #	12	**Test Distance (m)**	3	**Antenna Height(s)**	1 to 4(m)	**Results**	Pass



Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2483.867	31.6	-4.1	1.5	332.0	3.0	20.0	Horz	AV	0.0	47.5	54.0	-6.5	High ch, EUT horizontal
2484.342	31.4	-4.1	1.5	328.0	3.0	20.0	Vert	AV	0.0	47.3	54.0	-6.7	High ch, EUT horizontal
2483.625	31.3	-4.1	1.5	191.0	3.0	20.0	Horz	AV	0.0	47.2	54.0	-6.8	High ch, EUT on side
2483.925	31.2	-4.1	2.1	249.0	3.0	20.0	Vert	AV	0.0	47.1	54.0	-6.9	High ch, EUT on side
2487.042	31.2	-4.1	2.6	319.0	3.0	20.0	Horz	AV	0.0	47.1	54.0	-6.9	High ch, EUT vertical
2485.108	31.2	-4.1	1.5	28.0	3.0	20.0	Vert	AV	0.0	47.1	54.0	-6.9	High ch, EUT vertical
2385.742	31.1	-4.2	1.5	70.0	3.0	20.0	Horz	AV	0.0	46.9	54.0	-7.1	Low ch, EUT horizontal
2387.817	31.1	-4.2	1.5	303.0	3.0	20.0	Vert	AV	0.0	46.9	54.0	-7.1	Low ch, EUT horizontal
7439.500	28.6	12.8	1.5	239.0	3.0	0.0	Horz	AV	0.0	41.4	54.0	-12.6	High ch, EUT horizontal
7437.958	28.5	12.8	3.5	77.0	3.0	0.0	Vert	AV	0.0	41.3	54.0	-12.7	High ch, EUT horizontal
7429.542	28.4	12.8	1.5	10.0	3.0	0.0	Horz	AV	0.0	41.2	54.0	-12.8	High ch, EUT on side
7428.208	28.4	12.8	3.2	105.0	3.0	0.0	Vert	AV	0.0	41.2	54.0	-12.8	High ch, EUT on side
7435.542	28.4	12.8	1.7	199.0	3.0	0.0	Horz	AV	0.0	41.2	54.0	-12.8	High ch, EUT vertical
7436.208	28.4	12.8	1.5	96.0	3.0	0.0	Vert	AV	0.0	41.2	54.0	-12.8	High ch, EUT vertical
7313.500	28.3	12.7	1.5	138.0	3.0	0.0	Horz	AV	0.0	41.0	54.0	-13.0	Mid ch, EUT horizontal
7326.292	28.3	12.7	3.0	333.0	3.0	0.0	Vert	AV	0.0	41.0	54.0	-13.0	Mid ch, EUT horizontal
2486.333	43.4	-4.1	1.5	332.0	3.0	20.0	Horz	PK	0.0	59.3	74.0	-14.7	High ch, EUT horizontal
2486.017	42.8	-4.1	1.5	328.0	3.0	20.0	Vert	PK	0.0	58.7	74.0	-15.3	High ch, EUT horizontal

Freq (MHz)	Amplitude (dBuV)	Factor (dB)	Antenna Height (meters)	Azimuth (degrees)	Test Distance (meters)	External Attenuation (dB)	Polarity/ Transducer Type	Detector	Distance Adjustment (dB)	Adjusted (dBuV/m)	Spec. Limit (dBuV/m)	Compared to Spec. (dB)	Comments
2485.325	42.8	-4.1	2.1	249.0	3.0	20.0	Vert	PK	0.0	58.7	74.0	-15.3	High ch, EUT on side
2386.158	42.9	-4.2	1.5	303.0	3.0	20.0	Vert	PK	0.0	58.7	74.0	-15.3	Low ch, EUT horizontal
2487.308	42.7	-4.1	1.5	191.0	3.0	20.0	Horz	PK	0.0	58.6	74.0	-15.4	High ch, EUT on side
2487.033	42.7	-4.1	2.6	319.0	3.0	20.0	Horz	PK	0.0	58.6	74.0	-15.4	High ch, EUT vertical
2487.833	42.7	-4.1	1.5	28.0	3.0	20.0	Vert	PK	0.0	58.6	74.0	-15.4	High ch, EUT vertical
12403.600	25.6	12.5	3.0	360.0	3.0	0.0	Horz	AV	0.0	38.1	54.0	-15.9	High ch, EUT horizontal
12403.400	25.6	12.5	3.4	54.0	3.0	0.0	Vert	AV	0.0	38.1	54.0	-15.9	High ch, EUT horizontal
2385.858	42.3	-4.2	1.5	70.0	3.0	20.0	Horz	PK	0.0	58.1	74.0	-15.9	Low ch, EUT horizontal
4883.917	30.4	3.5	3.4	232.0	3.0	0.0	Vert	AV	0.0	33.9	54.0	-20.1	Mid ch, EUT horizontal
4884.667	29.8	3.5	1.5	15.0	3.0	0.0	Horz	AV	0.0	33.3	54.0	-20.7	Mid ch, EUT horizontal
4960.250	29.2	3.8	1.9	51.0	3.0	0.0	Vert	AV	0.0	33.0	54.0	-21.0	High ch, EUT horizontal
4957.042	29.2	3.7	1.5	51.0	3.0	0.0	Horz	AV	0.0	32.9	54.0	-21.1	High ch, EUT horizontal
4803.625	29.2	3.5	1.5	207.0	3.0	0.0	Horz	AV	0.0	32.7	54.0	-21.3	Low ch, EUT horizontal
4804.750	29.2	3.5	1.5	44.0	3.0	0.0	Vert	AV	0.0	32.7	54.0	-21.3	Low ch, EUT horizontal
7449.667	39.3	12.8	1.5	239.0	3.0	0.0	Horz	PK	0.0	52.1	74.0	-21.9	High ch, EUT horizontal
7433.292	39.2	12.8	1.5	96.0	3.0	0.0	Vert	PK	0.0	52.0	74.0	-22.0	High ch, EUT vertical
7446.375	38.9	12.8	1.5	10.0	3.0	0.0	Horz	PK	0.0	51.7	74.0	-22.3	High ch, EUT on side
7432.333	38.9	12.8	1.7	199.0	3.0	0.0	Horz	PK	0.0	51.7	74.0	-22.3	High ch, EUT vertical
7442.167	38.9	12.7	3.2	105.0	3.0	0.0	Vert	PK	0.0	51.6	74.0	-22.4	High ch, EUT on side
7325.708	38.9	12.7	1.5	138.0	3.0	0.0	Horz	PK	0.0	51.6	74.0	-22.4	Mid ch, EUT horizontal
7435.875	38.7	12.8	3.5	77.0	3.0	0.0	Vert	PK	0.0	51.5	74.0	-22.5	High ch, EUT horizontal
7313.500	38.5	12.7	3.0	333.0	3.0	0.0	Vert	PK	0.0	51.2	74.0	-22.8	Mid ch, EUT horizontal
12407.650	37.3	12.6	3.4	54.0	3.0	0.0	Vert	PK	0.0	49.9	74.0	-24.1	High ch, EUT horizontal
12017.290	30.7	-1.2	1.5	313.0	3.0	0.0	Horz	AV	0.0	29.5	54.0	-24.5	Low ch, EUT horizontal
12009.040	30.5	-1.2	1.5	159.0	3.0	0.0	Vert	AV	0.0	29.3	54.0	-24.7	Low ch, EUT horizontal
12205.500	29.7	-0.4	1.5	122.0	3.0	0.0	Horz	AV	0.0	29.3	54.0	-24.7	Mid ch, EUT horizontal
12208.290	29.7	-0.4	2.9	338.0	3.0	0.0	Vert	AV	0.0	29.3	54.0	-24.7	Mid ch, EUT horizontal
12397.460	29.5	-0.2	4.0	338.0	3.0	0.0	Horz	AV	0.0	29.3	54.0	-24.7	High ch, EUT horizontal
12392.750	29.2	-0.3	1.5	241.0	3.0	0.0	Vert	AV	0.0	28.9	54.0	-25.1	High ch, EUT horizontal
12408.710	36.3	12.6	3.0	360.0	3.0	0.0	Horz	PK	0.0	48.9	74.0	-25.1	High ch, EUT horizontal
4888.667	40.4	3.5	3.4	232.0	3.0	0.0	Vert	PK	0.0	43.9	74.0	-30.1	Mid ch, EUT horizontal
4955.958	40.1	3.7	1.5	51.0	3.0	0.0	Horz	PK	0.0	43.8	74.0	-30.2	High ch, EUT horizontal
4959.917	39.8	3.8	1.9	51.0	3.0	0.0	Vert	PK	0.0	43.6	74.0	-30.4	High ch, EUT horizontal
4793.167	40.0	3.5	1.5	207.0	3.0	0.0	Horz	PK	0.0	43.5	74.0	-30.5	Low ch, EUT horizontal
4883.125	39.9	3.5	1.5	15.0	3.0	0.0	Horz	PK	0.0	43.4	74.0	-30.6	Mid ch, EUT horizontal
4807.708	39.6	3.5	1.5	44.0	3.0	0.0	Vert	PK	0.0	43.1	74.0	-30.9	Low ch, EUT horizontal
12006.080	41.6	-1.2	1.5	313.0	3.0	0.0	Horz	PK	0.0	40.4	74.0	-33.6	Low ch, EUT horizontal
12205.830	40.2	-0.4	2.9	338.0	3.0	0.0	Vert	PK	0.0	39.8	74.0	-34.2	Mid ch, EUT horizontal
12389.480	39.9	-0.3	4.0	338.0	3.0	0.0	Horz	PK	0.0	39.6	74.0	-34.4	High ch, EUT horizontal
12021.790	40.7	-1.2	1.5	159.0	3.0	0.0	Vert	PK	0.0	39.5	74.0	-34.5	Low ch, EUT horizontal
12204.130	39.8	-0.4	1.5	122.0	3.0	0.0	Horz	PK	0.0	39.4	74.0	-34.6	Mid ch, EUT horizontal
12397.330	39.3	-0.2	1.5	241.0	3.0	0.0	Vert	PK	0.0	39.1	74.0	-34.9	High ch, EUT horizontal