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EMC Test Report

Application for FCC Grant of Equipment Authorization

FCC Part 15 Subpart C
Innovation, Science and Economic Development Canada
RSS-Gen Issue 5 / RSS-247 Issue 2

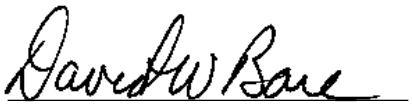
Model: Zio MCT ECG Monitor

FCC ID:	2AFBP-MCT22P
APPLICANT:	iRhythm Technologies Inc. 699 8th Street #600 San Francisco, CA 94103
TEST SITE(S):	NTS Labs LLC 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-7
PROJECT NUMBER:	PR163245
REPORT DATE:	September 29, 2022
RE-ISSUED DATE:	February 2, 2023
FINAL TEST DATES:	September 22 and 23, 2022
TOTAL NUMBER OF PAGES:	54

ACCREDITED
Testing Cert #0214.26

VALIDATING SIGNATORIES

PROGRAM MGR



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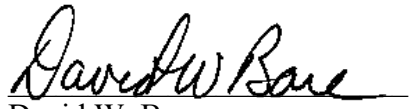

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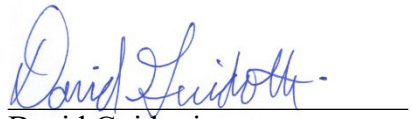

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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	September 29, 2022	First release	
1	February 2, 2023	The test description on Page 15 was revised to add a note about testing in the additional 2 orthogonal axis. The statement about factors on page 21 was revised. The missing antenna and amplifier on page 23 were added.	dwb

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SCOPE

An electromagnetic emissions test has been performed on the iRhythm Technologies Inc. model Zio MCT ECG Monitor, pursuant to the following rules:

RSS-GEN Issue 5 " General Requirements for Compliance of Radio Apparatus"
RSS 247 Issue 2 "Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices"
FCC Part 15 Subpart C

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in NTS Labs LLC test procedures:

ANSI C63.10-2013
FCC DTS Measurement Guidance KDB558074

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

NTS Labs LLC is accredited by the A2LA, certificate number 0214.26, to perform the test(s) listed in this report, except where noted otherwise.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Prior to marketing in Canada, Class I transmitters, receivers and transceivers require certification. Class II devices are required to meet the appropriate technical requirements but are exempt from certification requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested samples of iRhythm Technologies Inc. model Zio MCT ECG Monitor complied with the requirements of the following regulations:

RSS-GEN Issue 5 " General Requirements for Compliance of Radio Apparatus"
RSS 247 Issue 2 "Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices"
FCC Part 15 Subpart C

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of iRhythm Technologies Inc. model Zio MCT ECG Monitor and therefore apply only to the tested samples. The samples were selected and prepared by Jason Van Vliet of iRhythm Technologies Inc.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY

DIGITAL TRANSMISSION SYSTEMS (2400 – 2483.5MHz)

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247(a)	RSS 247 5.2	Digital Modulation	Systems uses GFSK modulation techniques	System must utilize a digital transmission technology	Complies
15.247 (a) (2)	RSS 247 5.2 (1)	6dB Bandwidth	652 kHz	>500kHz	Complies
15.247 (b) (3)	RSS 247 5.4 (4)	Output Power (multipoint systems)	-7.9 dBm (0.000162 Watts) EIRP = 0.0 W Note 1	1Watt, EIRP limited to 4 Watts.	Complies
15.247(e)	RSS 247 5.2 (2)	Power Spectral Density	< -7.9 dBm	8dBm/3kHz	Complies
15.247(d)	RSS 247 5.5	Antenna Port Spurious Emissions 30MHz – 25 GHz	-24.7 dBc (Margin: -4.7 dB)	< -20dBc	Complies
15.247(d) / 15.209	RSS 247 5.5	Radiated Spurious Emissions 30MHz – 25 GHz	50.2 dBµV/m @ 4880.0 MHz (Margin: -3.8 dB)	Refer to the limits section (p19) for restricted bands, all others < -20dBc	Complies

Note 1 EIRP calculated using antenna gains of 0.9 dBi for the highest EIRP system.
Note 2 Pass/Fail criteria defined by standards listed above.

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Integral antenna	Unique or integral antenna required	Complies
15.247 (i) 15.407 (f)	RSS 102	RF Exposure Requirements	Power less than 1 mW (Exempt)	Refer to OET 65, FCC Part 1 and RSS 102	Complies

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted (power meter)	dBm	25 to 7000 MHz	± 0.52 dB
RF power, conducted (Spectrum analyzer)	dBm	25 to 7000 MHz	± 0.7 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission (field strength)	dBµV/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The iRhythm Technologies Inc. model Zio MCT ECG Monitor is the patch unit of a system comprised of a single-use ECG patch monitor and a patient data transmission gateway that is designed to capture, analyze and report symptomatic and asymptomatic cardiac events and continuous electrocardiogram (ECG) information for long-term monitoring. Since the patch would be placed on a patient and the gateway could be placed in any position during operation, the EUT was treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the patch is 3 VDC, supplied from an internal non-rechargeable battery.

The samples were received on September 15, 2022 and tested on September 22 and 23, 2022. The following samples of the EUT were used during testing:

Company	Model	Description	Serial Number	FCC ID
iRhythm Technologies Inc.	DSB0002	ECG Monitor	CAA21TTAGT CH2422141023005	2AFBP-MCT22P

OTHER EUT DETAILS

The following EUT details should be noted: The patch communicates with the gateway via BLE.

ANTENNA SYSTEM

The antenna system consists of an integral antenna.

ENCLOSURE

The patch enclosure is primarily constructed of plastic. It measures approximately 14.2 cm wide by 1.0 cm deep by 5.6 cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at NTS Labs LLC.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
Dell	Precision 7540	Laptop	6ZVFW33	-
iRhythm	Shasta Patch BOB (DMB0004.B)	Break Out Board	48	-
Keysight	E36312A	Power Supply	MY59004715	-

No remote support equipment was used during testing.

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

EUT

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Temporary antenna	Measurement Instrument	TEC 2032440-1 COAX	Shielded	0.15

Additional on Support Equipment

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Test	Laptop USB	Multiwire P/N TTL-232RG	Shielded	1.7
BOB Power	Power Supply	Two wire	Unshielded	0.3
BOB USB	Laptop USB	Multiwire	Shielded	1.7

EUT OPERATION

During emissions testing the EUT was set using DTM to operate on the selected channel at the default power setting.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 6.2 of RSS-GEN, NTS Labs LLC has been recognized as an accredited test laboratory by the Commission and Innovation, Science and Economic Development Canada. A description of the facilities employed for testing is maintained by NTS Labs LLC.

Site	Company / Registration Numbers		Location
	FCC	Canada	
Chamber 7	US1031	2845B (Wireless Test Lab #US0027)	41039 Boyce Road Fremont, CA 94538-2435

ANSI C63.4 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Results from testing performed in this chamber have been correlated with results from an open area test site. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

Software is used to view and convert receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers. The software used for radiated and conducted emissions measurements is NTS Labs LLC EMI Test Software (rev 2.10)

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.10 specifies that the test height above ground for table mounted devices shall be 80 centimeters for testing below 1 GHz and 1.5m for testing above 1 GHz. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor as specified in ANSI C63.4. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.10, and the worst-case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

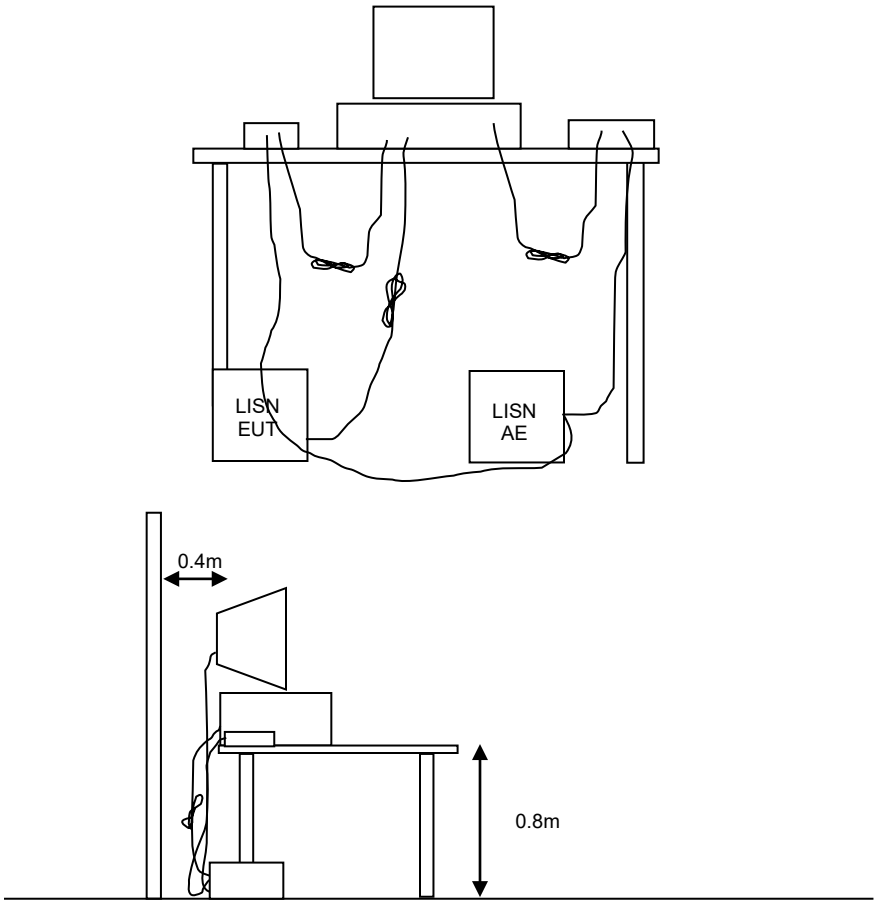


Figure 1 Typical Conducted Emissions Test Configuration

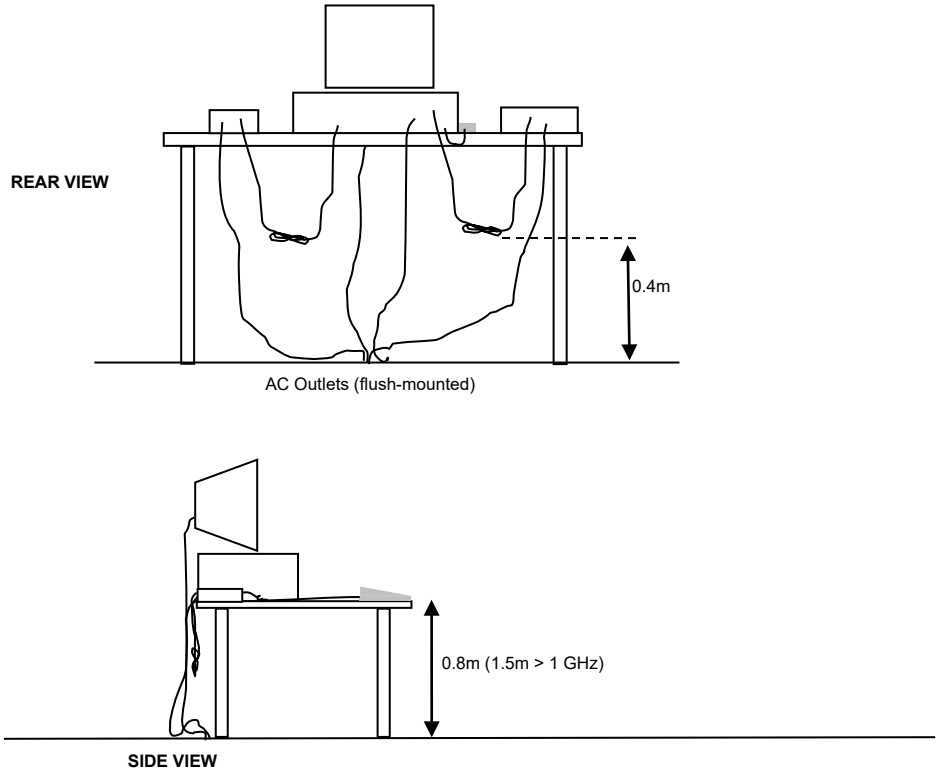
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. This was repeated with the EUT oriented in the 2 other orthogonal orientations. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

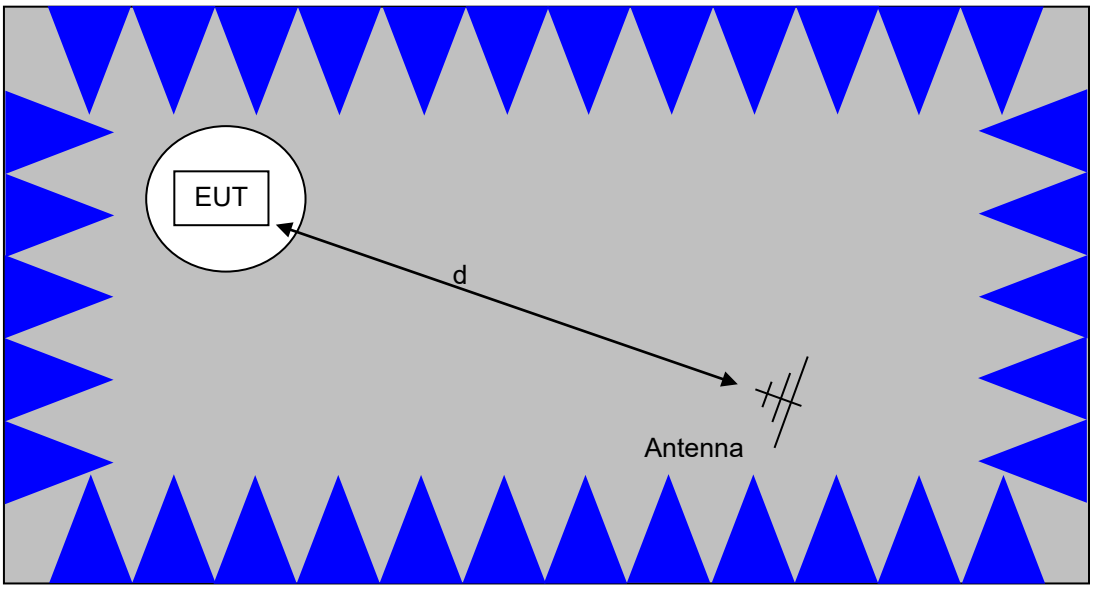
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.

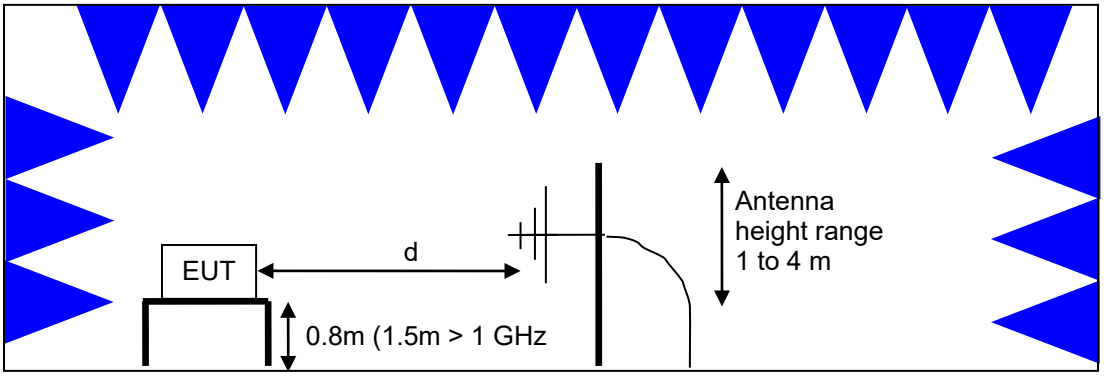


Typical Test Configuration for Radiated Field Strength Measurements



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

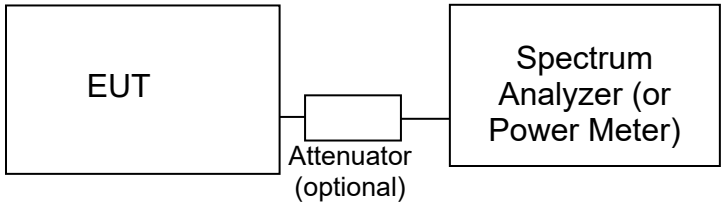
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements of power, bandwidth and power spectral density are performed, where possible, with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.



Test Configuration for Antenna Port Measurements

Measurement bandwidths (video and resolution) are set in accordance with the relevant standards and NTS Labs LLC's test procedures for the type of radio being tested. When power measurements are made using a resolution bandwidth less than the signal bandwidth the power is calculated by summing the power across the signal bandwidth using either the analyzer channel power function or by capturing the trace data and calculating the power using software. In both cases the summed power is corrected to account for the equivalent noise bandwidth (ENBW) of the resolution bandwidth used.

If power averaging is used (typically for certain digital modulation techniques), the EUT is configured to transmit continuously. Power averaging is performed using either the built-in function of the analyzer or, if the analyzer does not feature power averaging, using external software. In both cases the average power is calculated over a number of sweeps (typically 100). When the EUT cannot be configured to continuously transmit then either the analyzer is configured to perform a gated sweep to ensure that the power is averaged over periods that the device is transmitting or power averaging is disabled and a max-hold feature is used.

If a power meter is used to make output power measurements the sensor head type (peak or average) is stated in the test data table.

BANDWIDTH MEASUREMENTS

The 6dB, 20dB, 26dB and/or 99% signal bandwidth are measured using the bandwidths recommended by ANSI C63.10 and RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands[1].

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

[1] The restricted bands are detailed in FCC 15.205 and RSS-Gen Table 7

OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Output Power	Power Spectral Density
902 – 928	1 Watt (30 dBm)	8 dBm/3kHz
2400 – 2483.5	1 Watt (30 dBm)	8 dBm/3kHz
5725 – 5850	1 Watt (30 dBm)	8 dBm/3kHz

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. For FCC, fixed point to point applications using the 2400-2483.5 MHz band may use antennas with more than 6 dBi gain but output power is reduced by 1 dB for every 3dB that the antenna gain exceeds 6 dBi. For Canada, fixed point-to-point applications using the 2400-2483.5 MHz band are not subject to this restriction. Fixed point-to-point applications using the 5725 – 5850 MHz band are also not subject to this restriction. Certification of DTS systems operating in the 5725-5850 MHz band is no longer allowed under FCC Rules per §15.37(h).

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

The limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands are those specified in the general limits sections of FCC Part 15 and RSS GEN. All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level (30dB if the power is measured using the sample detector/power averaging method).

SAMPLE CALCULATIONS - RADIATED EMISSIONS

A computer program reads the receiver levels and corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements. The corrected receiver readings are compared directly to the specification limit (decibel form).

A distance factor, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB
D_m = Measurement Distance in meters
D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m
F_d = Distance Factor in dB
R_c = Corrected Reading in dBuV/m
L_s = Specification Limit in dBuV/m
M = Margin in dB Relative to Spec

SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp), or where a field strength measurement of output power is made in lieu of a direct measurement, the following formula is used to convert between eirp and field strength at a distance of d (meters) from the equipment under test:

$$E = \frac{1000000 \sqrt{30 P}}{d} \quad \text{microvolts per meter}$$

where P is the eirp (Watts)

For a measurement at 3m the conversion from a logarithmic value for field strength (dBuV/m) to an eirp power (dBm) is -95.3dB.

Appendix A Test Equipment Calibration Data

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Radiated Emissions, 30 - 26,500 MHz, 22-Sep-22					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
National Technical Systems	NTS Capture Analyzer Software (rev 4.0)	N/A	WC022706	N/A	
Agilent Technologies	PSA Spectrum Analyzer	E4446A	WC055650	8/30/2022	8/31/2023
Hewlett Packard	High Pass filter, 3.7 GHz	P/N 84300-80038	WC064434	2/9/2022	2/9/2023
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	WC064573	2/27/2022	8/1/2024
EMCO	Antenna, Horn, 1-18 GHz	3115	WC064707	12/22/2020	12/22/2022
Com-Power	Preamplifier, 1-1000 MHz	PAM-103	WC064733	6/2/2022	6/2/2023
Rohde & Schwarz	EMI Test Receiver, 20Hz-40GHz	ESI	WC068000	7/21/2022	7/21/2023
MITEQ	Preamplifier, 1-18 GHz	AFS44	WC071561	4/22/2022	4/22/2023
Hewlett Packard	Microwave Preamplifier Head, 18-40 GHz (Purple)	84125C Head	WC055610	10/29/2021	10/29/2022
A. H. Systems	Antenna, Horn, 18-40GHz	SAS-574	WC064555	8/16/2021	8/16/2023
Radiated Emissions, 30 kHz - 30 MHz, 23-Sep-22					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
Rhode & Schwarz	Loop Antenna	HFH2-Z2	WC062457	2/17/2022	2/17/2024
Rohde & Schwarz	EMI Test Receiver, 20Hz-40GHz	ESI	WC068000	7/21/2022	7/21/2023
Radio Antenna Port (Power and Spurious Emissions), 23-Sep-22					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	WC022452	N/A	
National Technical Systems	NTS Capture Analyzer Software (rev 4.0)	N/A	WC022706	N/A	
Rohde & Schwarz	Spectrum Analyzer	FSQ26	WC055662	10/15/2021	10/25/2022
Rohde & Schwarz	Power Meter, Single	NRVS	WC062570	2/11/2022	2/11/2023
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts use with 20dB attenuator sn:1031.6959.00 only	NRV-Z32	WC064862	11/18/2021	11/18/2022
Rohde & Schwarz	Signal Analyzer OTA	FSV13	WC064873	5/12/2022	5/12/2023

Appendix B Test Data

TL163245-RANA Pages 25 – 53

Client:	iRhythm	PR Number:	PR163245
Product	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
System Configuration:	Patch only	Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Emissions Standard(s):	FCC Part 15.247, RSS-247	Class:	N/A
Immunity Standard(s):	-	Environment:	Home Health Care

EMC Test Data

For The

iRhythm

Product

Zio MCT ECG Monitor

Date of Last Test: 9/23/2022

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Radiated Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 9/23/2022
Test Engineer: M. Birgani
Test Location: Fremont Chamber #7
Config. Used: 1
Config Change: None
EUT Voltage: Battery

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing.
The test distance and extrapolation factor (if used) are detailed under each run description.
Note, preliminary testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. Maximized testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

Ambient Conditions:

Temperature: 23-24 °C
Rel. Humidity: 48-50 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	30 kHz - 30 MHz	FCC 15.209	Pass	12.6 dBµV/m @ 30.00 MHz (Margin: -16.9 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

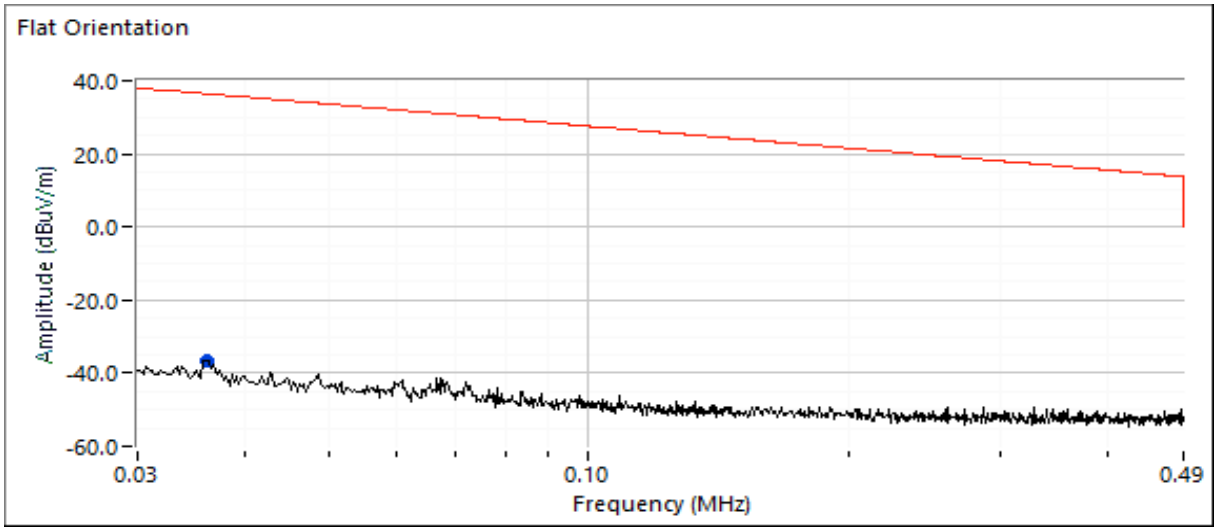
No deviations were made from the requirements of the standard.

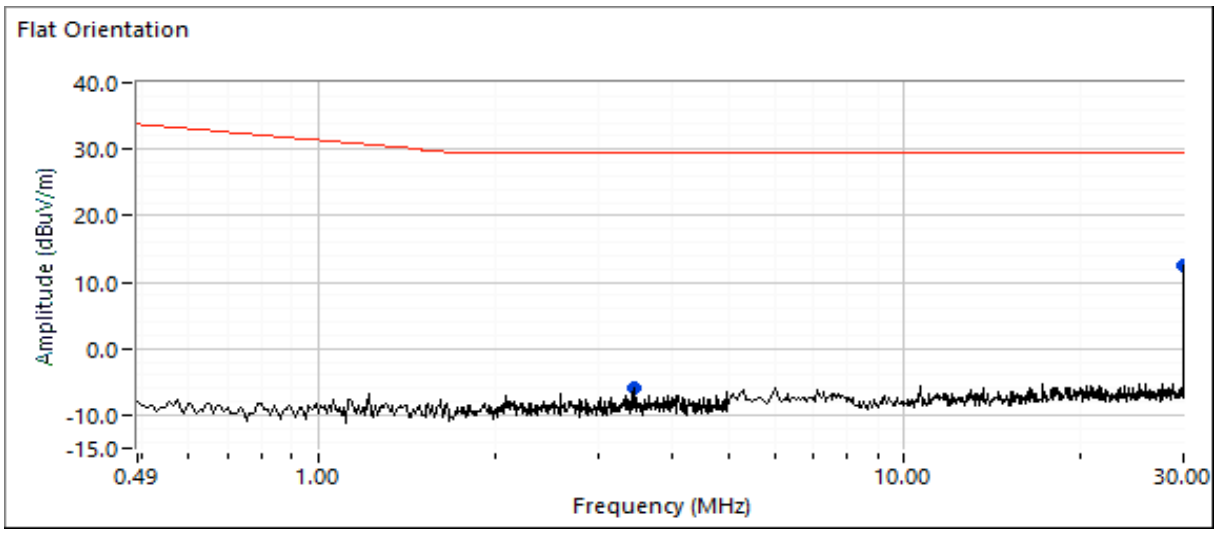
Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
0.030 - 0.490 MHz	3	300	Per ANSI C63.10
0.490 - 1.705 MHz	3	30	Per ANSI C63.10
1.705 - 30.0 MHz	3	30	Per ANSI C63.10

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Run #1: Radiated Emissions, 30 kHz - 30 MHz, FCC 15.209

Note - the extrapolation factor is based on calculations per section 6.4.4 of ANSI C63.10





Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Run #1: Radiated Emissions, 30 kHz - 30 MHz, FCC 15.209

Note - the extrapolation factor is based on calculations per section 6.4.4 of ANSI C63.10

Preliminary readings

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
30.000	**12.6**	Open	29.5	**-16.9**	Peak	207	1.0	Peak reading with QP limit, Note 3
3.445	-6.0	Open	29.5	-35.5	Peak	34	1.0	Peak reading with QP limit, Note 3
2.569	-6.1	Open	29.5	-35.6	Peak	109	1.0	Peak reading with QP limit, Note 3
0.036	-36.5	Open	36.5	-73.0	Peak	65	1.0	Peak reading with QP limit, Note 2

Note 1:	The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, with a peak limit 20dB above the average limit.
Note 2:	Value calculated from measured value at 3m extrapolated to 300m using formulas form ANSI C63.10.
Note 3:	Value calculated from measured value at 3m extrapolated to 30m using formulas from ANSI C63.10.

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Radiated Emissions

(NTS Silicon Valley, Fremont Facility, Semi-Anechoic Chamber)

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 9/23/2022
Test Engineer: M. birgani
Test Location: Fremont Chamber #7

Config. Used: 1
Config Change: None
EUT Voltage: Battery

General Test Configuration

The EUT and any local support equipment were located on the turntable for radiated emissions testing.
The test distance and extrapolation factor (if applicable) are detailed under each run description.
Note, preliminary testing indicates that the emissions were measured using a peak detector and were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables. Maximized readings were obtained based on the worst case w.r.t. the limits from the preliminary testing and used the detector specified in the FCC rules.

Ambient Conditions:

Temperature: 23-24 °C
Rel. Humidity: 48-50 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	Radiated Emissions 30 - 1000 MHz, Preliminary	FCC 15.209		Refer to individual runs
2	Radiated Emissions 30 - 1000 MHz, Maximized	FCC 15.209	Pass	18.6 dBµV/m @ 30.54 MHz (Margin: -21.4 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

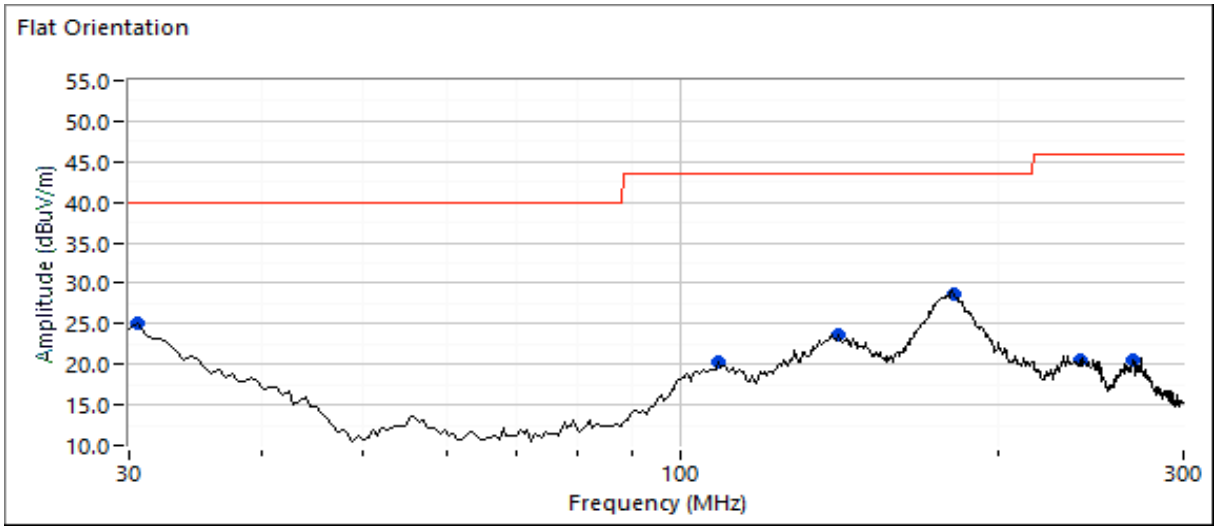
Deviations From The Standard

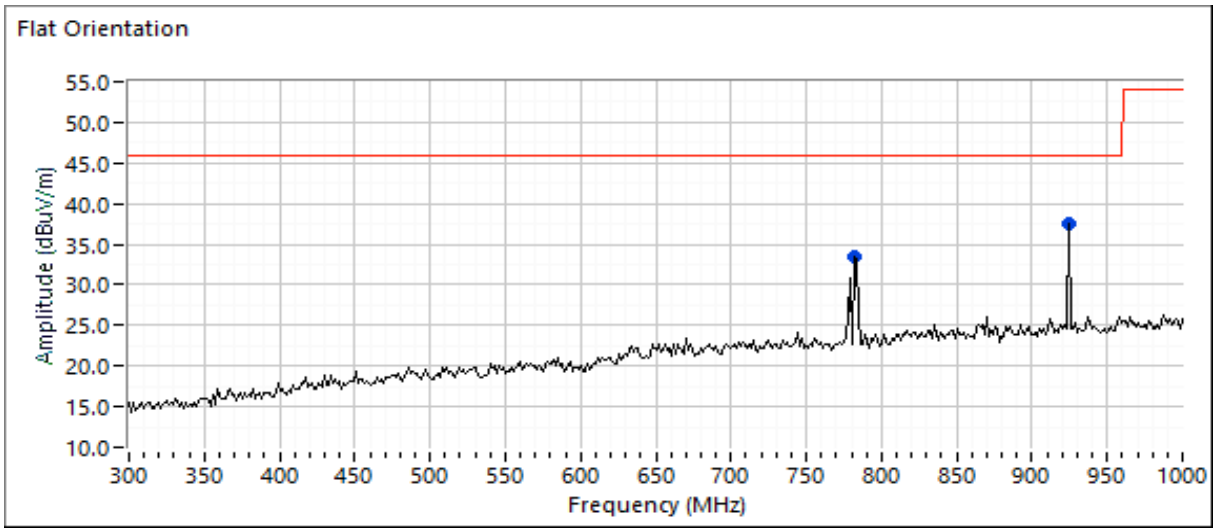
No deviations were made from the requirements of the standard.

Test Parameters for Preliminary Scan(s)			
Frequency Range (MHz)	Prescan Distance (meters)	Limit Distance (meters)	Extrapolation Factor (dB, applied to data)
30 - 1000	3	3	0.0

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz





Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Run #1: Preliminary Radiated Emissions, 30 - 1000 MHz
Preliminary peak readings captured during pre-scan

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
30.541	25.0	V	40.0	-15.0	Peak	99	2.5	
108.457	20.3	H	43.5	-23.2	Peak	44	1.5	Peak with QP limit
140.922	23.7	H	43.5	-19.8	Peak	316	1.0	Peak with QP limit
181.503	28.7	H	43.5	-14.8	Peak	289	2.0	
239.399	20.5	H	46.0	-25.5	Peak	54	3.5	Peak with QP limit
269.158	20.5	H	46.0	-25.5	Peak	234	4.0	Peak with QP limit
782.565	33.4	H	46.0	-12.6	Peak	157	2.0	
924.248	37.5	V	46.0	-8.5	Peak	265	2.0	

Run #2: Maximized Readings From Run #1
Maximized quasi-peak readings (includes manipulation of EUT interface cables)

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
30.541	**18.6**	V	40.0	**-21.4**	QP	99	2.5	QP (1.00s)
924.248	20.0	V	46.0	-26.0	QP	265	2.0	QP (1.00s)
782.565	18.4	H	46.0	-27.6	QP	157	2.0	QP (1.00s)
181.503	7.6	H	43.5	-35.9	QP	289	2.0	QP (1.00s)

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

RSS-247 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.
For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 22 °C
Rel. Humidity: 47 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel			Test Performed	Limit	Result / Margin
1	BLE	37 - 2402MHz			Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	28.5 dBµV/m @ 2388.6 MHz (-25.5 dB)
	BLE	39 - 2480MHz			Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	29.0 dBµV/m @ 2483.8 MHz (-25.0 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: CAA21TTAGT
Driver: DTM

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Procedure Comments:

Measurements performed in accordance with ANSI C63.10
Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time
Unless otherwise stated/noted, emission has a duty cycle ≥ 98% and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear voltage average, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BLE	1 Mbps	0.71	Yes	0.441	1.51	3.03	2268

Measurement Specific Notes:

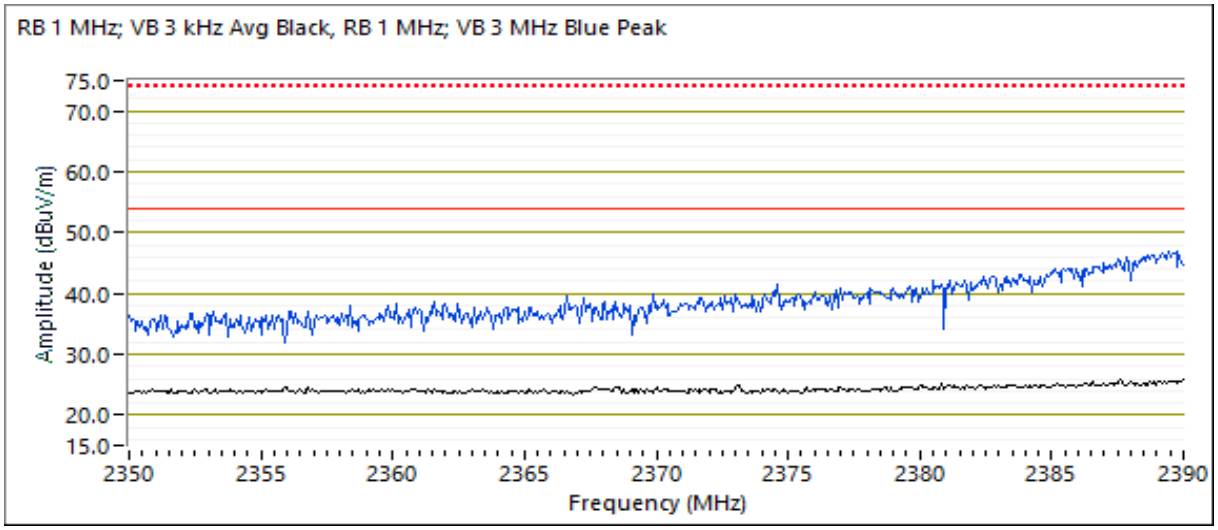
Note 3:	Emission has a duty cycle ≥ 98%, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces
Note 4:	Emission has constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW>1/T but not less than 10Hz, peak detector, linear averaging, auto sweep, trace average 100 traces, measurement corrected by Linear voltage correction factor
Note 8:	Plots of the average and peak bandedge do not account for any duty cycle correction. Refer to the tabular results for final measurements.

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Run #1: Radiated Bandedge Measurements

Date of Test: 9/23/2022 Config. Used: 1
Test Engineer: David Bare Config Change: None
Test Location: Fremont Chamber #7 EUT Voltage: Battery

Flat orientation

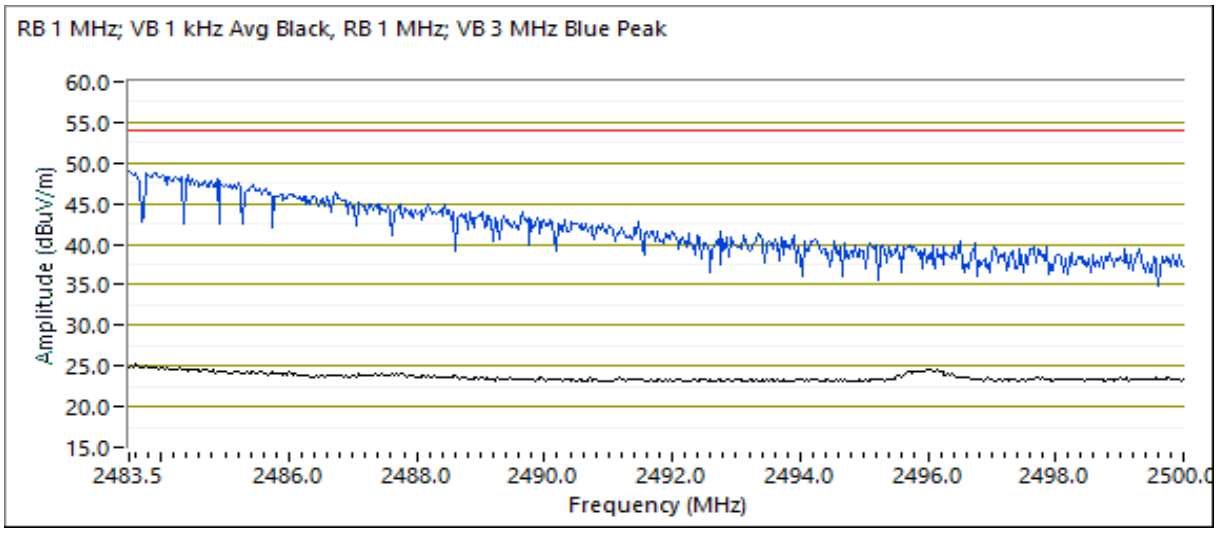


Channel: 37 Mode: BLE Pwr Setting: Default

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2388.560	28.5	H	54.0	-25.5	Avg	305	1.5	RB 1 MHz; VB: 3 kHz Note 4
2389.070	46.9	H	74.0	-27.1	PK	305	1.5	RB 1 MHz; VB: 3 MHz

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A



Channel: 39 Mode: BLE Pwr Setting: Default

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.820	29.0	H	54.0	-25.0	Avg	286	1.6	RB 1 MHz; VB: 3 kHz Note 4
2484.950	48.9	H	74.0	-25.1	PK	286	1.6	RB 1 MHz; VB: 3 MHz

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

RSS-247 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.
For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 21-23 °C
Rel. Humidity: 43-48 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel			Test Performed	Limit	Result / Margin
Scans on center channel in all three orientations to determine the worst case orientation.							
1	BLE	17 - 2440MHz			Radiated Emissions, 1 - 10 GHz	FCC Part 15.209 / 15.247(c)	49.7 dBµV/m @ 4880.0 MHz (-4.3 dB)
2	BLE	37 - 2402MHz			Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	49.9 dBµV/m @ 4804.0 MHz (-4.1 dB)
	BLE	17 - 2440MHz			Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	50.2 dBµV/m @ 4880.0 MHz (-3.8 dB)
	BLE	39 - 2480MHz			Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	49.4 dBµV/m @ 4960.1 MHz (-4.6 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: CAA21TTAGT
Driver: DTM

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Procedure Comments:

Measurements performed in accordance with ANSI C63.10
Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time
Unless otherwise stated/noted, emission has duty cycle ≥ 98% and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear voltage average, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BLE	1 Mbps	70.6%	Yes	0.441	1.51	3.03	2268

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission in non-restricted band, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 4:	Emission has constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW>1/T but not less than 10Hz, peak detector, linear averaging, auto sweep, trace average 100 traces, measurement corrected by Linear voltage correction factor
Note 5:	Emission has constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces, measurement corrected by Pwr correction factor

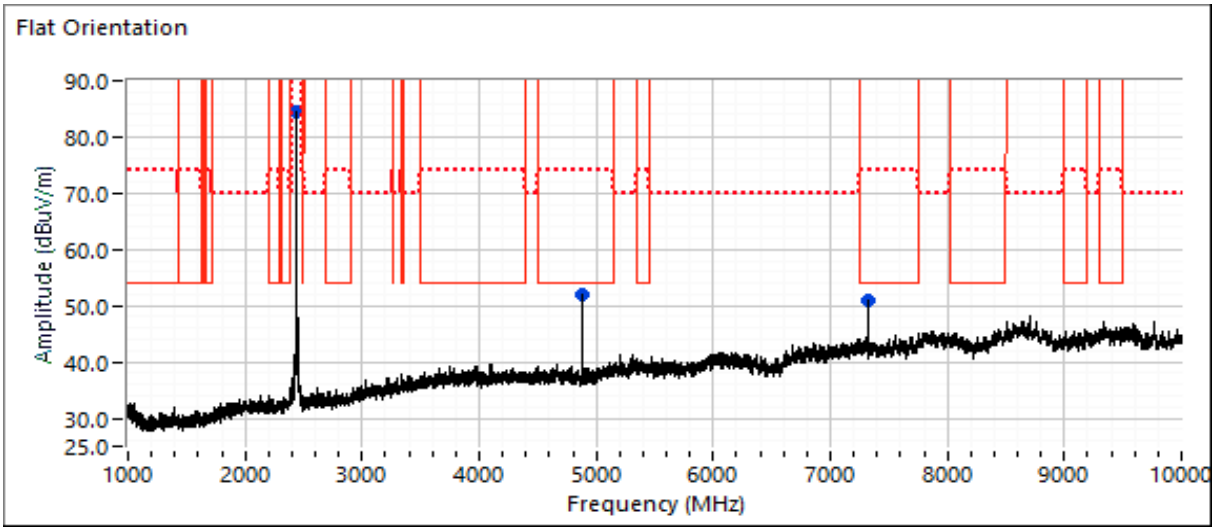
Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

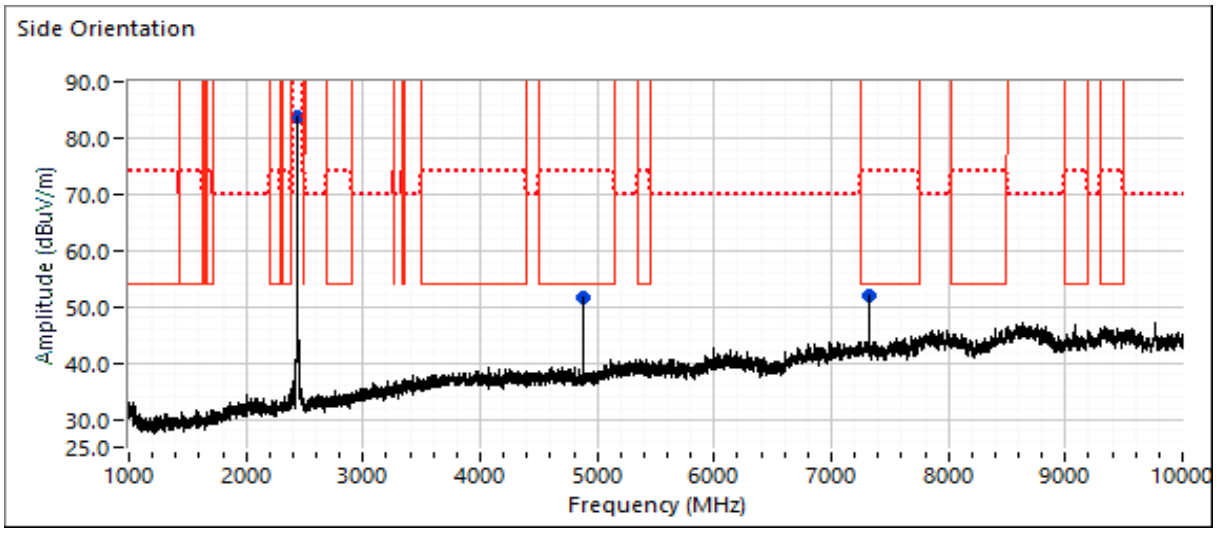
Run #1: Radiated Spurious Emissions, 1,000 - 10,000 MHz (Orientation Evaluation for Maximum Emission)

Date of Test: 09/22/22 Config. Used: 1

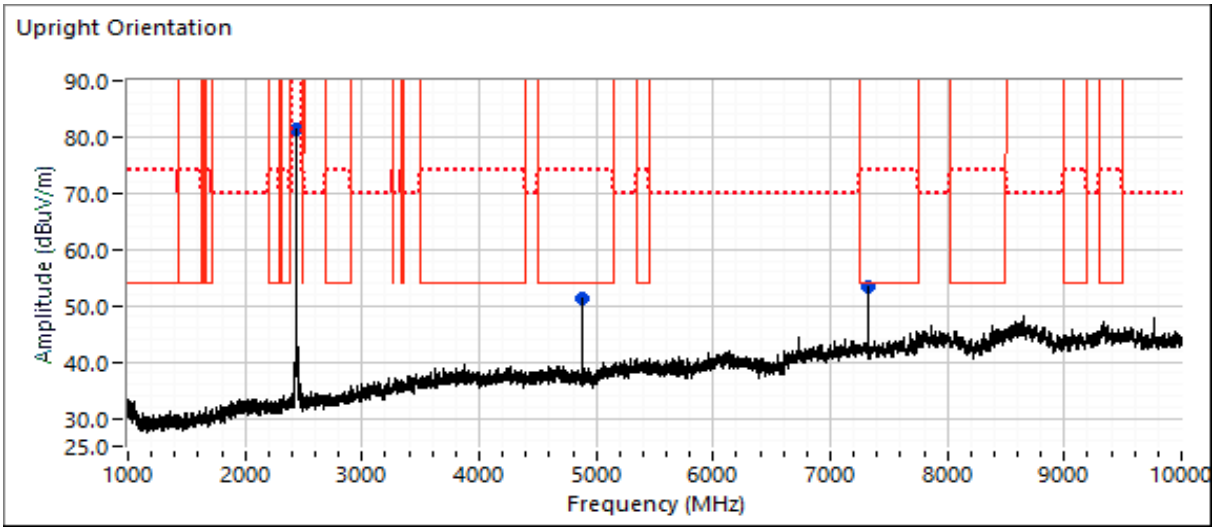
Test Engineer: M. Birgani Config Change: -

Test Location: Chamber #7 EUT Voltage: Internal Battery





Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A



Channel: 17 Mode: BLE Pwr Setting: Default

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2440.170	84.3	H	-	-	PK	315	1.3	Flat Orientation
4879.960	49.7	H	54.0	-4.3	AVG	310	1.3	Flat Orientation
4879.520	53.8	H	74.0	-20.2	PK	310	1.3	Flat Orientation
7319.540	44.1	H	54.0	-9.9	AVG	344	2.0	Flat Orientation
7320.100	51.3	H	74.0	-22.7	PK	344	2.0	Flat Orientation
2440.270	83.7	H	-	-	PK	28	1.3	Side Orientation
4880.000	48.9	H	54.0	-5.1	AVG	298	1.3	Side Orientation
4880.060	53.0	H	74.0	-21.0	PK	298	1.3	Side Orientation
7319.560	47.6	H	54.0	-6.4	AVG	360	2.2	Side Orientation
7319.200	54.8	H	74.0	-19.2	PK	360	2.2	Side Orientation
2439.750	81.7	H	-	-	PK	156	1.6	Upright Orientation
4879.960	47.9	H	54.0	-6.1	AVG	130	1.6	Upright Orientation
4880.390	52.1	H	74.0	-21.9	PK	130	1.6	Upright Orientation
7319.560	47.4	V	54.0	-6.6	AVG	6	1.0	Upright Orientation
7320.690	54.4	V	74.0	-19.6	PK	6	1.0	Upright Orientation

Note: Based on preliminary testing, no emissions from the BLE radio were observed below 1 GHz.

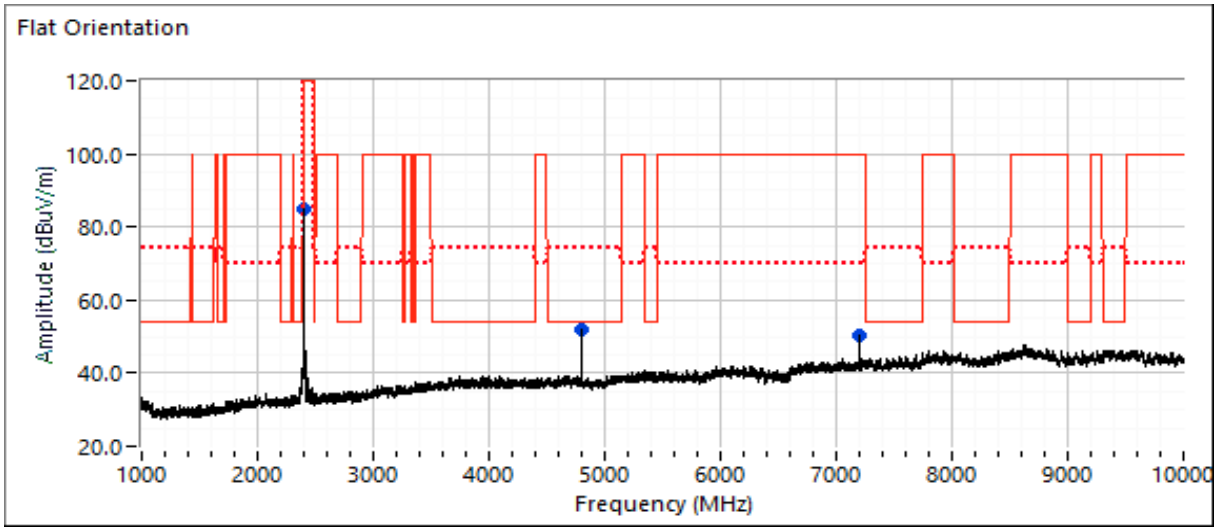
Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

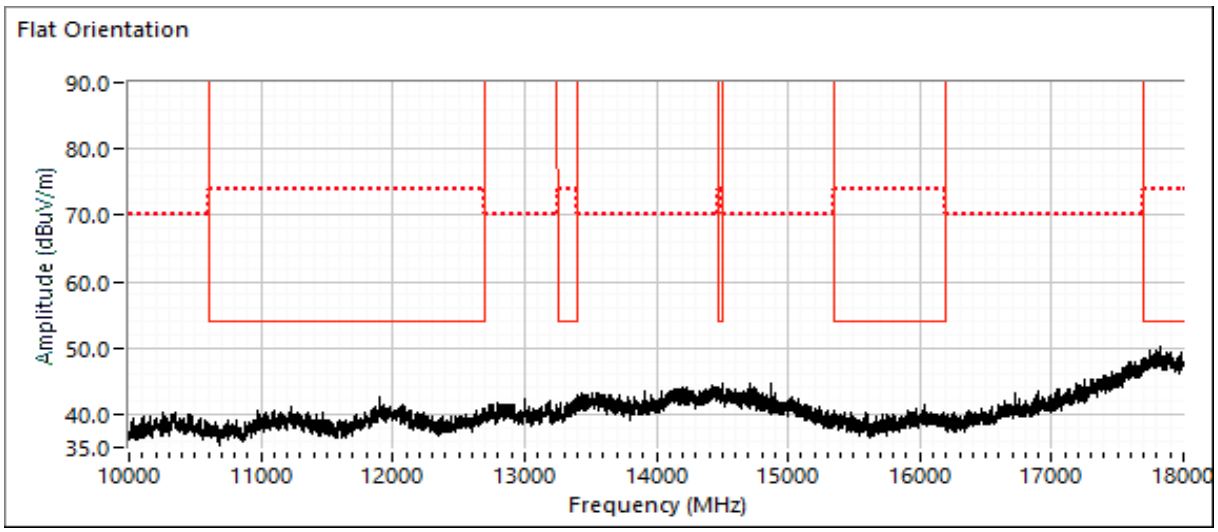
Run #2: Radiated Spurious Emissions, 1,000 - 25,000 MHz

Date of Test: 9/22 & 9/23/2022 Config. Used: 1
Test Engineer: M. Birgani & D. Bare Config Change: -
Test Location: Chamber #7 EUT Voltage: Internal Battery

Run #2a: Low Channel

Channel: 37 Mode: BLE Pwr Setting: Default





Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Run #2a: Low Channel

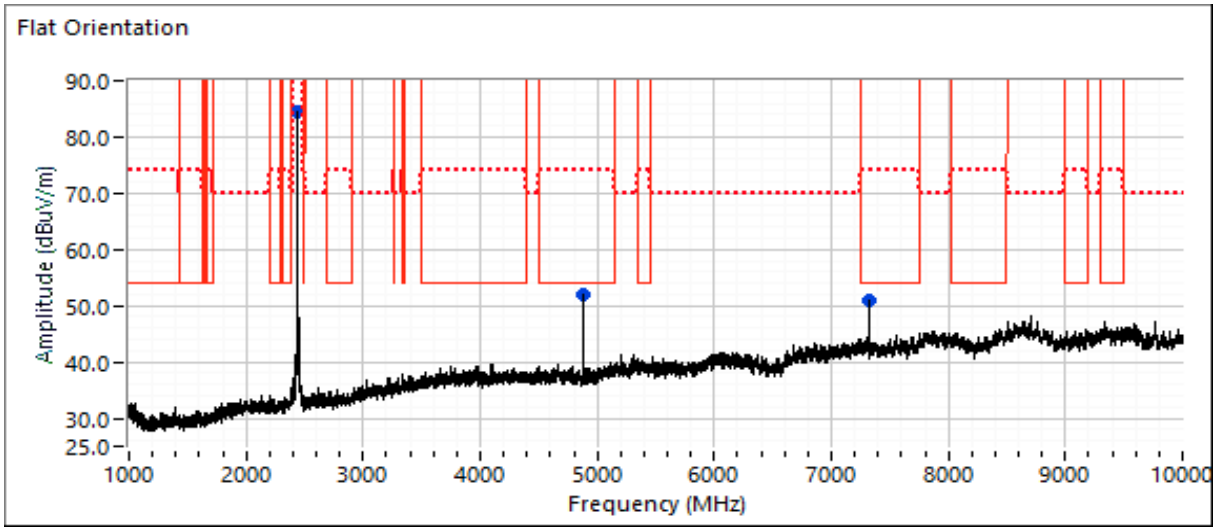
Channel: 37 Mode: BLE Pwr Setting: Default

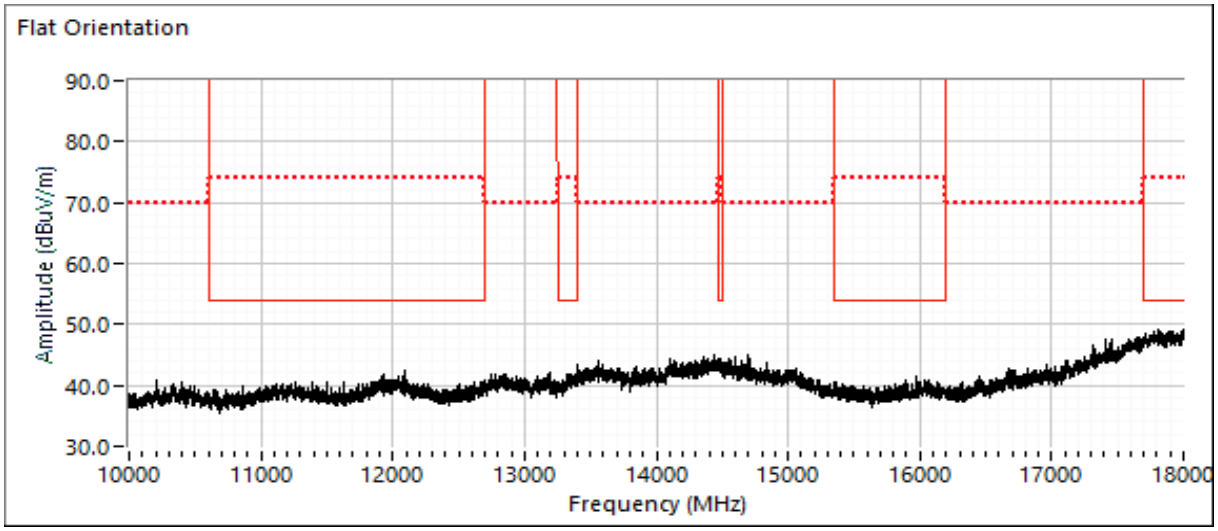
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
2401.710	84.6	H	-	-	PK	120	1.2	RB 100 kHz; VB: 100 kHz
2402.090	84.7	H	-	-	PK	120	1.2	RB 1 MHz; VB: 3 MHz
4803.970	49.9	H	54.0	-4.1	VAVG	122	1.4	RB 1 MHz; VB: 3 kHz Note 4
4803.560	54.1	H	74.0	-19.9	PK	122	1.4	RB 1 MHz; VB: 3 MHz
7205.520	44.6	H	54.0	-9.4	VAVG	161	1.4	RB 1 MHz; VB: 3 kHz Note 1,4
7205.270	51.3	H	74.0	-22.7	PK	161	1.4	RB 1 MHz; VB: 3 MHz Note 1

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Run #2b: Center Channel

Channel: 17 Mode: BLE Pwr Setting: Default





Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Run #2b: Center Channel

Channel: 17 Mode: BLE Pwr Setting: Default

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments	
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters		
2440.170	84.3	H	-	-	PK	315	1.3	Fundamental	
4879.960	50.2	H	54.0	-3.8	VAVG	138	1.7	RB 1 MHz; VB: 3 kHz	Note 4
4880.040	54.4	H	74.0	-19.6	PK	138	1.7	RB 1 MHz; VB: 3 MHz	
7319.540	44.1	H	54.0	-9.9	AVG	344	2.0	RB 1 MHz; VB: 3 kHz	Note 4
7320.100	51.3	H	74.0	-22.7	PK	344	2.0	RB 1 MHz; VB: 3 MHz	

Note:	Scans made between 18 - 25 GHz with the measurement antenna moved around the EUT 30cm from the device indicated there were no significant emissions in this frequency range.
Note:	During spurious emission scan, no filter was used, during final measurment of the harmonics, a 3.5 GHz high pass filter was used.

Client:	iRhythm	PR Number:	PR163245
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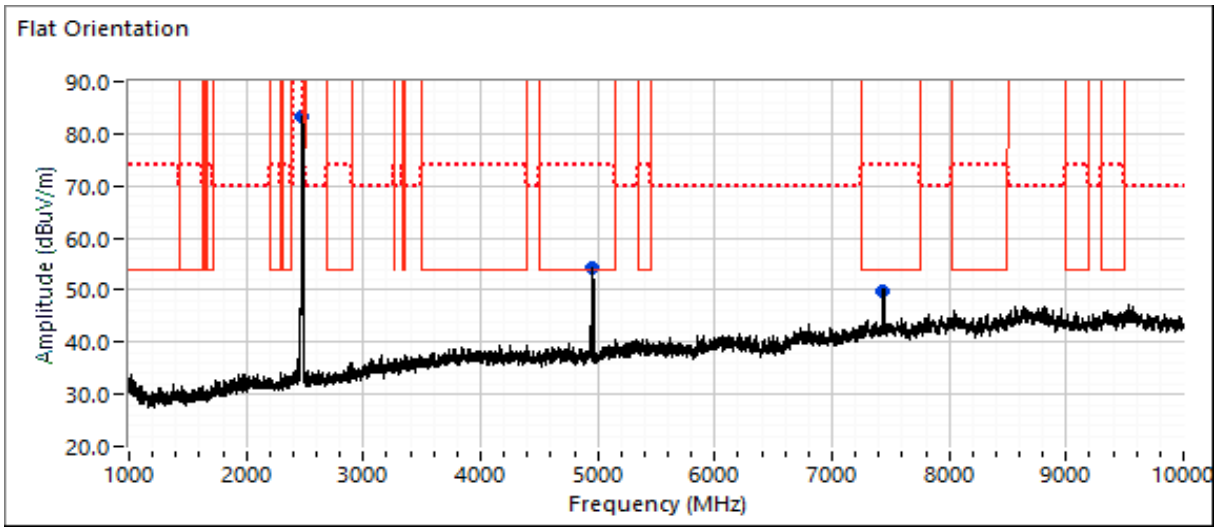
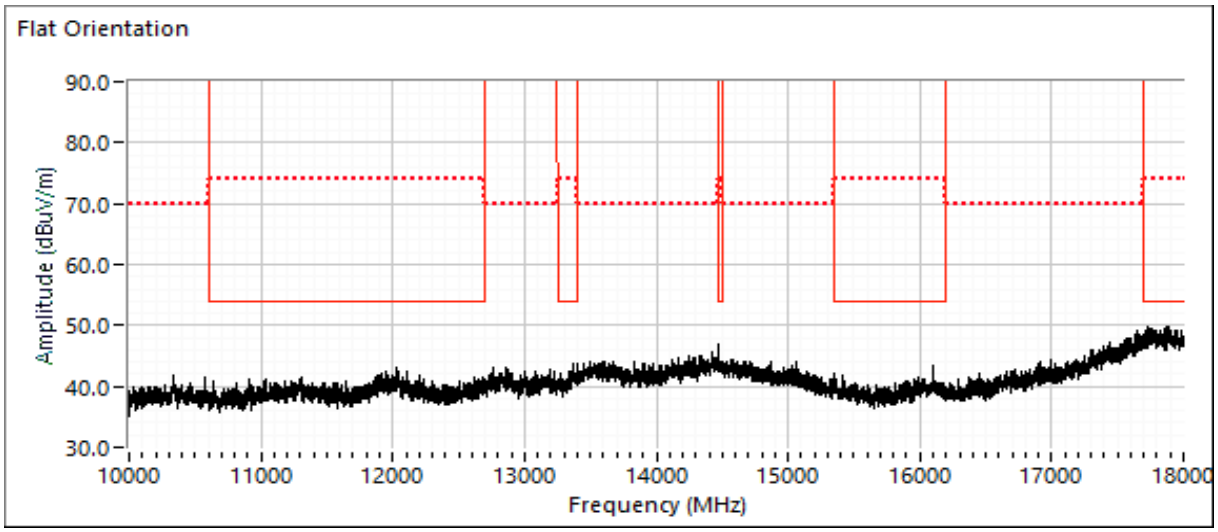
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Run #2c: High Channel

Channel: 39 Mode: BLE Pwr Setting: Default





Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Run #2c: High Channel

Channel: 39 Mode: BLE Pwr Setting: Default

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments	
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters		
2480.000	83.2	H	-	-	Peak	286	1.6	Fundamental	
4960.080	49.4	H	54.0	-4.6	VAVG	302	1.5	RB 1 MHz; VB: 3 kHz	Note 4
4960.420	54.9	H	74.0	-19.1	PK	302	1.5	RB 1 MHz; VB: 3 MHz	
7439.770	45.3	H	54.0	-8.7	VAVG	331	2.1	RB 1 MHz; VB: 3 kHz	Note 4
7439.400	53.0	H	74.0	-21.0	PK	331	2.1	RB 1 MHz; VB: 3 MHz	

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
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Standard:	FCC Part 15.247, RSS-247	Class:	N/A

RSS-247 and FCC 15.247 (DTS) Antenna Port Measurements

Power, Bandwidth and Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 9/23/2022
Test Engineer: David Bare
Test Location: Fremont OTA Chamber

Config. Used: 2
Config Change: None
EUT Voltage: 3V

General Test Configuration

The EUT was connected to the spectrum analyzer or power meter via a suitable attenuator. All measurements were made on a single chain.

All measurements have been corrected to allow for the external attenuators used.

Ambient Conditions:

Temperature: 23 °C
Rel. Humidity: 47 %

Summary of Results

Run #	Pwr setting		Test Performed	Limit	Pass / Fail	Result / Margin
1	Default		Output Power	15.247(b)	Pass	-7.9 dBm
2	Default		Power spectral Density (PSD)	15.247(d)	Pass	< -7.9 dBm
3	Default		Minimum 6dB Bandwidth	15.247(a)	Pass	0.652 MHz
3	Default		99% Bandwidth	RSS GEN	-	2.692 MHz
4	Default		Spurious emissions	15.247(b)	Pass	-4.7 dB

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Procedure Comments:

Measurements performed in accordance with ANSI C63.10 and FCC KDB 558074

Client:	iRhythm	PR Number:	PR163245
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
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Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Sample Notes

Sample S/N: CH2422141023005
Driver: DTM
Test cable loss: 0.4 dB

Run #1: Output Power

Power Setting[2]	Frequency (MHz)	Output Power (dBm) [1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W
Default	2402	-8.1	0.155	0.7	Pass	-7.4	0.000
Default	2440	-8.0	0.158	0.9	Pass	-7.1	0.000
Default	2480	-7.9	0.162	-0.4	Pass	-8.3	0.000

Note 1:	Output power measured using a peak power meter, spurious limit is **-20dBc**.
Note 2:	Power setting - the software power setting used during testing, included for reference only.

Run #2: Power spectral Density

As the power is less than 8 dBm, no PSD test is required

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Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Run #3: Signal Bandwidth

Mode: BLE

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (MHz)	
		6dB	99%	6dB	99%
Default	2402	0.667	1.483	0.1	0.03
Default	2440	0.652	1.823	0.1	0.03
Default	2480	1.645	2.692	0.1	0.03

Note 1:	DTS BW: RBW=100kHz, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time, Span 2-5 times measured BW. 99% BW: RBW=1-5% of 99%BW, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time. Span 1.5-5 times OBW.

Client:	iRhythm	PR Number:	PR163245
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Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Run #4a: Out of Band Spurious Emissions

Frequency (MHz)	Power Setting	Mode	Limit	Result
2402	Default	BLE	-20dBc	Pass
2440	Default	BLE	-20dBc	Pass
2480	Default	BLE	-20dBc	Pass

RBW = 100 kHz and VBW = 300 kHz for all plots.

Frequency MHz	Level dBµV	Port	Limit	Margin	Detector QP/Ave	Comments
2402.000	-8.4	RF Port	-	-	Peak	Ch 37
2400.000	-40.1	RF Port	-28.4	-11.7	Peak	Ch 37
4804.000	-34.6	RF Port	-28.4	-6.2	Peak	Ch 37
7206.000	-41.0	RF Port	-28.4	-12.6	Peak	Ch 37
9608.000	-49.4	RF Port	-28.4	-21.0	Peak	Ch 37
12010.000	-62.2	RF Port	-28.4	-33.8	Peak	Ch 37
14412.000	-66.5	RF Port	-28.4	-38.1	Peak	Ch 37
2440.000	-8.7	RF Port	-	-	Peak	Ch 17
4880.000	-33.4	RF Port	-28.7	-4.7	Peak	Ch 17
7320.000	-41.2	RF Port	-28.7	-12.5	Peak	Ch 17
9760.000	-52.3	RF Port	-28.7	-23.6	Peak	Ch 17
12200.000	-62.8	RF Port	-28.7	-34.1	Peak	Ch 17
14640.000	-69.8	RF Port	-28.7	-41.1	Peak	Ch 17
2480.000	-8.6	RF Port	-	-	Peak	Ch 39
4960.000	-35.0	RF Port	-28.6	-6.4	Peak	Ch 39
7440.000	-40.6	RF Port	-28.6	-12.0	Peak	Ch 39
9920.000	-51.0	RF Port	-28.6	-22.4	Peak	Ch 39
12400.000	-63.4	RF Port	-28.6	-34.8	Peak	Ch 39
14880.000	-71.9	RF Port	-28.6	-43.3	Peak	Ch 39

Client:	iRhythm	PR Number:	PR163245
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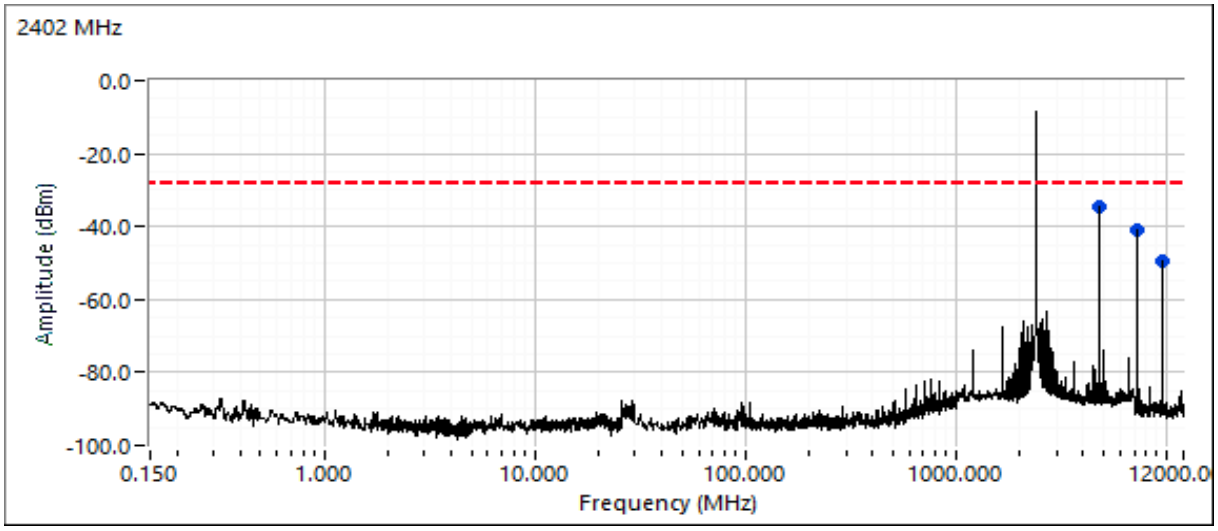
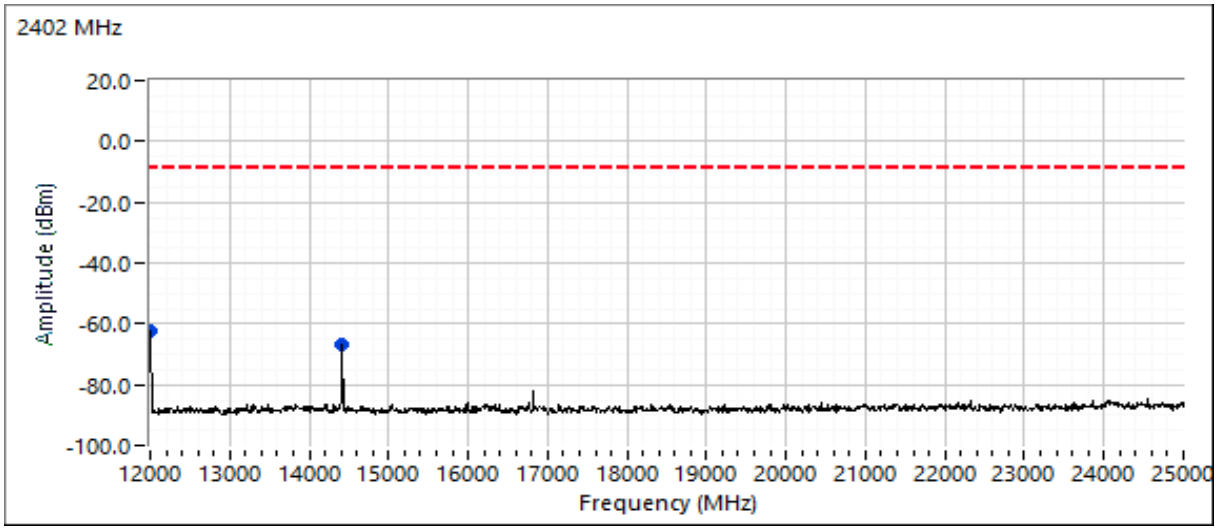
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Plots for low channel





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Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
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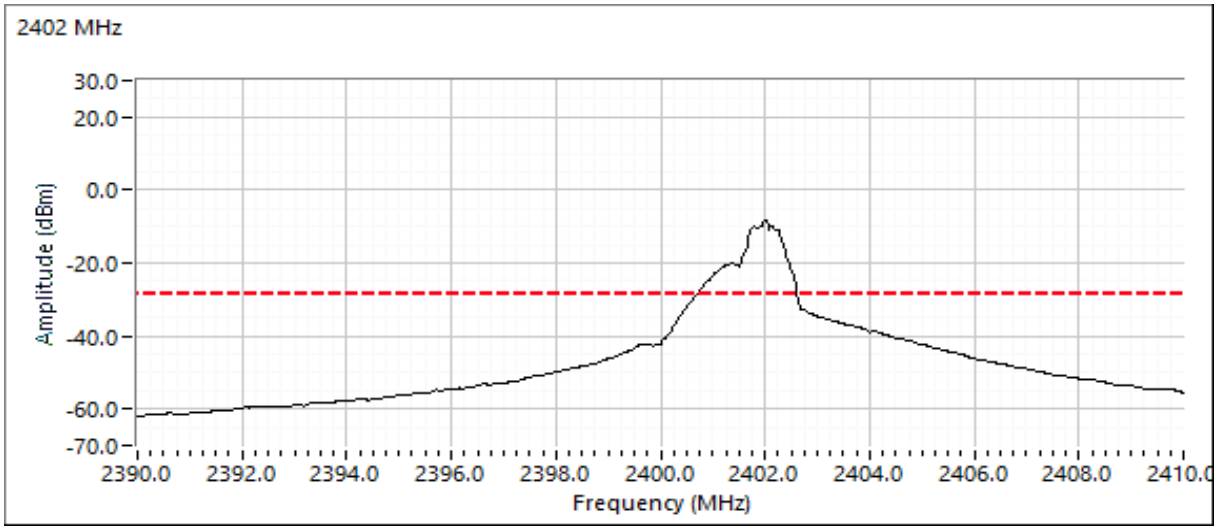
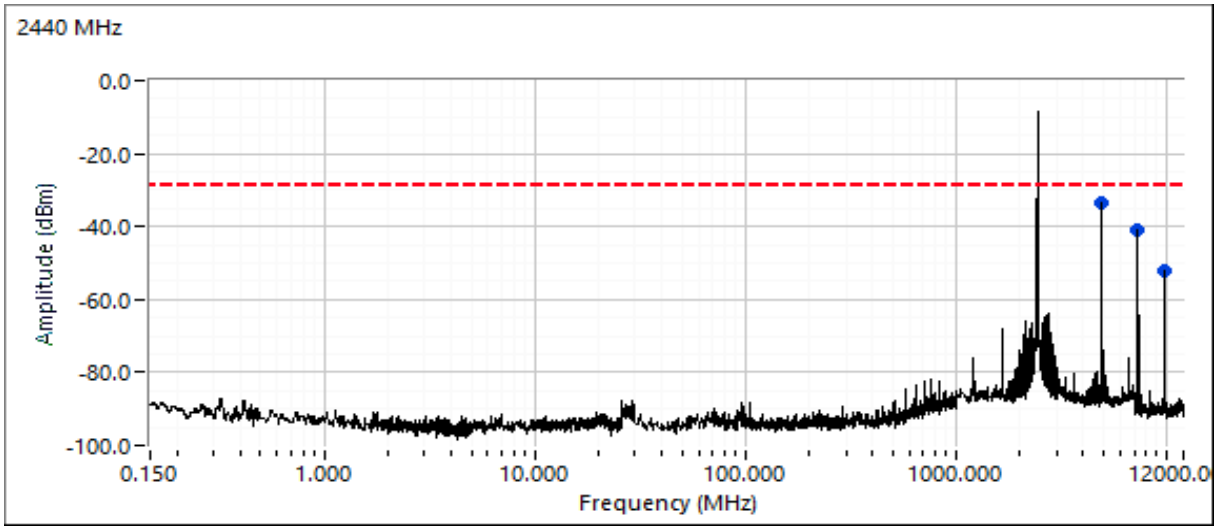
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A

Additional plot showing compliance with -20dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.



Plots for center channel



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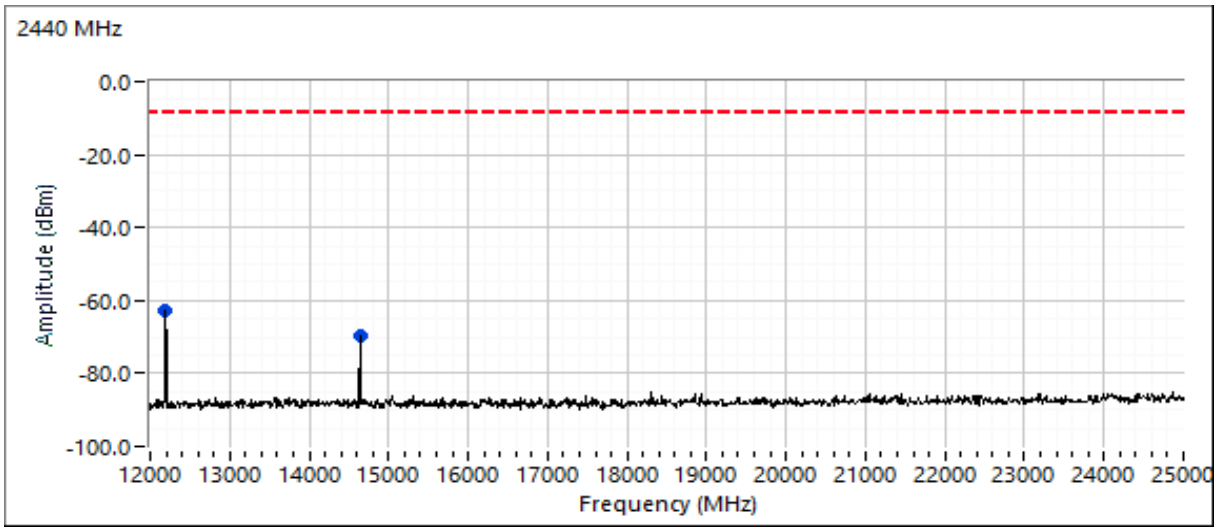
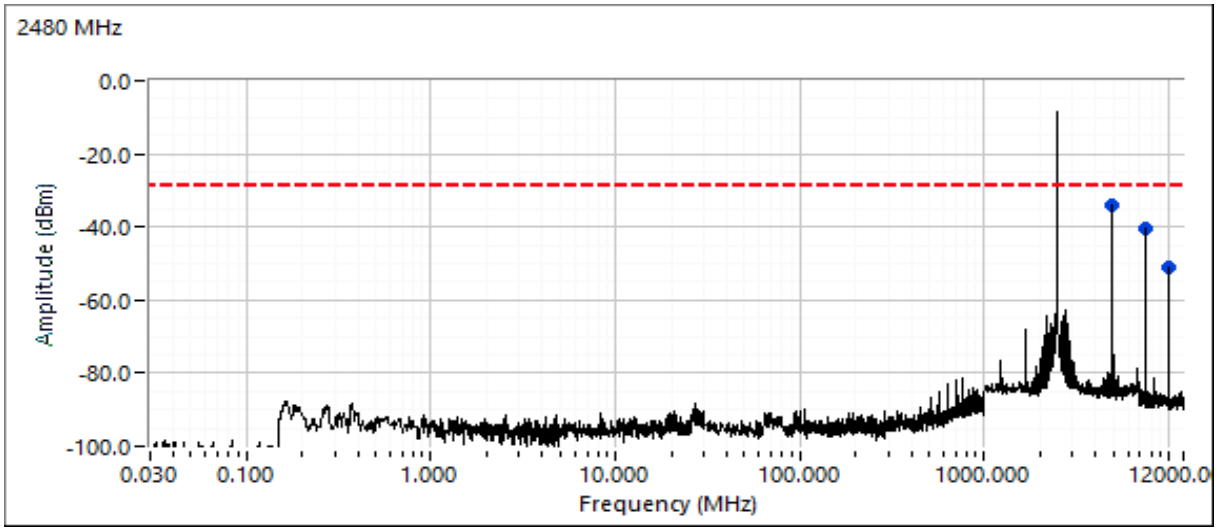
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A



Plots for high channel



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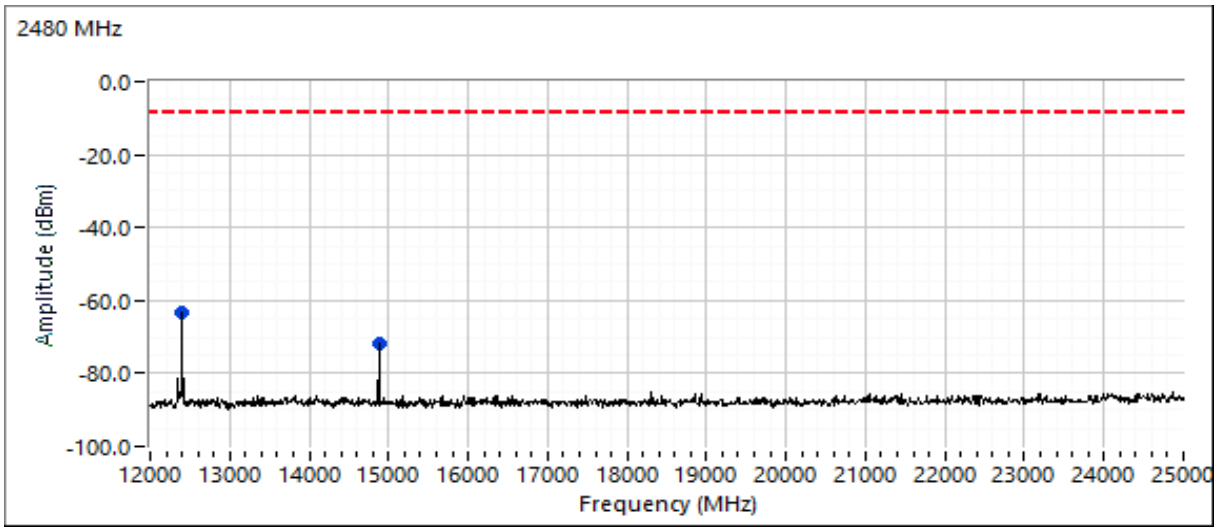
Model:	Zio MCT ECG Monitor	T-Log Number:	TL163245-RANA-Patch
		Project Manager:	Deepa Shetty
Contact:	Jason Van Vliet	Project Engineer:	David Bare
Standard:	FCC Part 15.247, RSS-247	Class:	N/A



End of Report

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