

MEASUREMENT REPORT

FCC PART 247 / ISED RSS 247 Bluetooth (Low Energy)

Applicant Name:
Eko Devices, Inc.
2600 10th St. Ste 260
Berkeley, CA 94710 USA

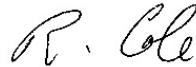
Date of Issue:
11/15/2017
Test Site/Location:
EMCE Engineering, San Jose, California, USA
Report No.: 4328-1
EMCE FRN: 007198120

FCC ID :	2ANB3-E5
IC :	23063-E5

Application Type : Certification
Model E5
Additional Model(s): N/A
EUT Type: EKG and digital stethoscope device
Max. RF Output Power: -2.15 dBm / 0.609 mW Peak Conducted
Frequency Range: 2402 MHz - 2480 MHz
Modulation type : GFSK
FCC Classification: Digital Transmission System(DTS)
FCC Rule Part(s): Part 15.247
ISED Rule Part(s): RSS-247 Issue 2(Feb. 2017) / RSS-GEN Issue 4 (Nov. 2014)
Test Procedure(s): ANSI C63.10-2013

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the applicable limits. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all personnel taking them.

EMCE Engineering Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998, 21 U.S. C.853(a)

Report prepared by:
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Administrative Assistant,
EMCE Engineering

Approved by:
Bob Cole
President,
EMCE Engineering

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FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EKG and digital stethoscope device	IC : 23063-E5

Version

TEST REPORT NO.	DATE	DESCRIPTION
4328-1	11/15/2017	- First Approval Report

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

Table of Contents

1. GENERAL INFORMATION	4
2. EUT DESCRIPTION	4
3. TEST METHODOLOGY	5
3.1 EUT CONFIGURATION	5
3.2 EUT EXERCISE	5
3.3 GENERAL TEST PROCEDURES	5
3.4 DESCRIPTION OF TEST MODES	6
4. INSTRUMENT CALIBRATION	6
5. FACILITIES AND ACCREDITATIONS	6
5.1 FACILITIES	6
5.2 EQUIPMENT	6
6. ANTENNA REQUIREMENTS	7
7. SUMMARY TEST OF RESULTS	8
8. TEST RESULT	9
8.1 6dB BANDWIDTH / 99% BANDWIDTH	9
8.2 MAXIMUM PEAK CONDUCTED OUTPUT POWER	12
8.3 POWER SPECTRAL DENSITY	15
8.4 OUT OF BAND EMISSIONS AT THE BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS ...	17
8.5.1 RADIATED SPURIOUS EMISSIONS	22
8.5.2 RADIATED RESTRICTED BAND EDGES	26
8.6 POWERLINE CONDUCTED EMISSIONS	27
9. LIST OF TEST EQUIPMENT	28

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

1. GENERAL INFORMATION

Applicant: EKO Devices, Inc.
Applicant Address: 2600 10th St. Ste 260 Berkeley, CA 94710 USA
FCC ID: 2ANB3-E5
IC: 23063-E5
EUT Type: EKG and digital stethoscope device
Model name: E5
Additional Model name(s): N/A
Test Device Serial No.: N/A Production Pre-Production Engineering
Date(s) of Tests: 10/16/2017 - 10/23/2017
Place of Tests: EMCE Engineering
 1726 Ringwood Ave. San Jose, CA 95131 USA
 (IC Recognition No. : 3324A)

2. EUT DESCRIPTION

EUT Type	EKG and digital stethoscope device	
Model Name	E5	
Additional Model name(s):	N/A	
Power Supply	Battery	
Battery type	550 mAh Lithium-ion Battery (Standard)	
Frequency Range	TX	2402 – 2480 MHz
	RX	2402 – 2480 MHz
Max. RF Output Power	Peak	-2.15 dBm / 0.609 mW
99% Bandwidth	1.091MHz	
Modulation Type	GFSK	
Antenna Specification	Antenna type: PCB trace Peak Gain : -13dBi(0.05 (numeric))	

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

3. TEST METHODOLOGY

The measurement procedure described in the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices (ANSI C63.10-2013) was used in the measurement of the test device.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10 – 2013. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane for the range of .009 – 1000 MHz, 1.5 Meters above the ground plane for measurements >1000 MHz. According to the requirements in Section 6.3.1 of ANSI C63.10 – 2013. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in ANSI C63.10. - 2013

Conducted Antenna Terminal

See Section from 11.12.2 in ANSI C63.10 - 2013

FCC PT.15.247 TEST REPORT		FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device		IC : 23063-E5

3.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed. Channel low, mid and high with highest data rate (worst case) is chosen for full testing.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

The SAC (Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 1726 Ringwood Ave. San Jose, CA 95131 USA. The site is constructed in conformance with the requirements of ANSI C63.4 - 2014) and CISPR Publication 22. Detailed description of test facility was submitted to the NVLAP, designated US0125.

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

FCC PT.15.247 TEST REPORT		FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device		IC : 23063-E5

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

* The antenna of this E.U.T. is a trace antenna.

*The E.U.T Complies with the requirement of §15.203

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

7. SUMMARY TEST OF RESULTS

Test Description	FCC / ISED Part Section(s)	Test Limit	Test Condition	Test Result
6 dB Bandwidth	§15.247(a)(2)	> 500 kHz	CONDUCTED	PASS
99% Bandwidth	RSS 247 5.2(1)	For Info Purpose Only		PASS
Conducted Maximum Peak Output Power	§15.247(b)(3) RSS 247 5.4(4)	< 1 Watt		PASS
Power Spectral Density	§15.247(e) RSS 247 5.2(2)	< 8 dBm / 3 kHz Band		PASS
Band Edge (Out of Band Emissions)	§15.247(d) RSS 247 5.5	Conducted < 20 dBc		PASS
AC Power line Conducted Emissions	§15.207	cf. Section 6.2		N/A
Radiated Spurious Emissions	§15.205, 15.209 RSS 247 5.5	cf. Section 6.6.4	RADIATED	PASS
Radiated Restricted Band Edge	§15.247(d), 15.205, 15.209 RSS 247 5.5	cf. Section 6.10.5		PASS

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

8. TEST RESULT

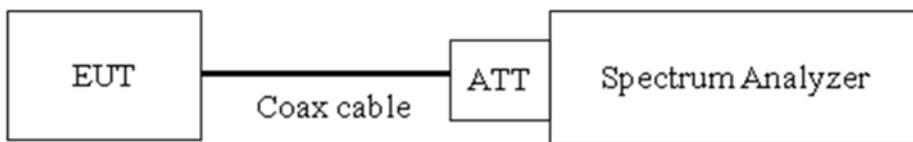
8.1 6dB BANDWIDTH / 99% BANDWIDTH

■ Test Requirements and Limit, §15.247(a)(2)

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the transmitter antenna terminal of the EUT while the EUT is operating at maximum power and at the appropriate frequencies. All modes of operation were investigated and the worst case configuration results are reported in this section.

The minimum permissible 6dB bandwidth is 500 kHz.

■ Test Setup



■ Test Procedure

1. The signal analyzers' automatic bandwidth measurement capability of the spectrum analyzer was used to perform the 6dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 6. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 100kHz
3. VBW \geq 3 x RBW
4. Detector = Peak
5. Trace mode = max hold
6. Sweep = auto couple
7. The trace was allowed to stabilize

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

Test Results

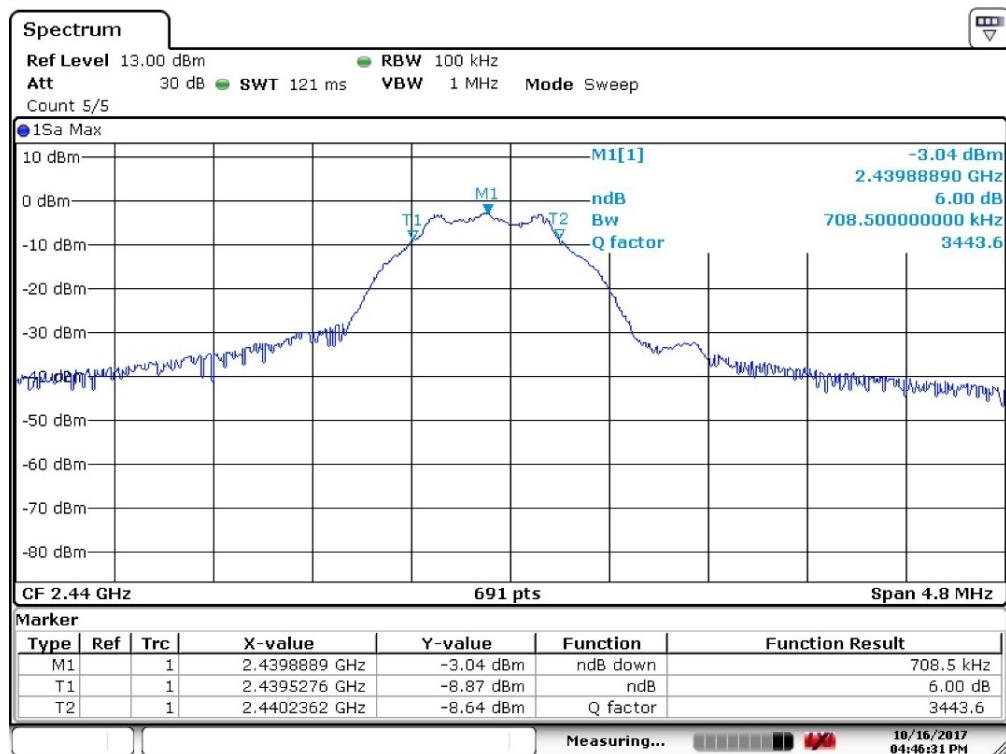
Note : In order to simplify the report, worst case plots for each mode are shown.

Conducted 6dB Bandwidth Measurements

GSFK	Measured Bandwidth [kHz]	Minimum Bandwidth [kHz]	Pass / Fail
Frequency [MHz]			
2402	708.5	500	Pass
2440	708.5	500	Pass
2480	707.5	500	Pass

Center Frequency Plot is shown as representative in order to simplify this report.

2440 MHz



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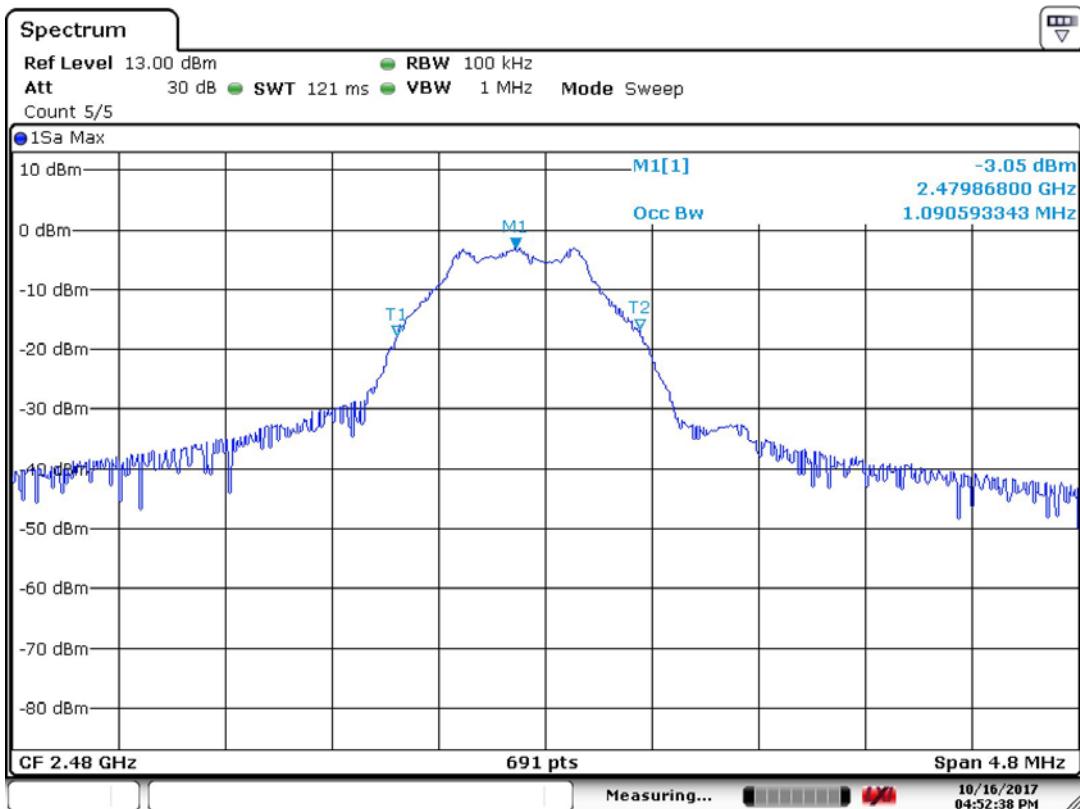
FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT			FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device		IC : 23063-E5

Conducted 99% Bandwidth Measurements – For Information Purpose Only

GFSK	Measured Bandwidth [MHz]	Minimum Bandwidth [kHz]	Pass / Fail
Frequency [MHz]			
2402	1.090	N/A	N/A
2440	1.091	N/A	N/A
2480	1.091	N/A	N/A

Center Frequency Plot is shown as representative in order to simplify this report.

2440



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FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

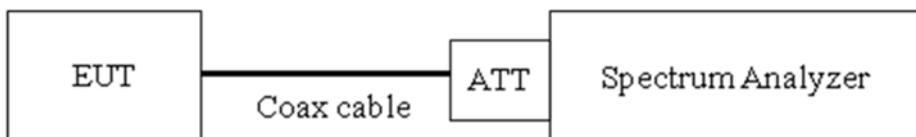
8.2 MAXIMUM PEAK CONDUCTED OUTPUT POWER

■ Test Requirements and limit, §15.247(b)(3)

The transmitter antenna terminal of the EUT is connected to the input of a spectrum analyzer. Measurements are made while the EUT is operating at maximum power and at the appropriate frequencies.

The maximum permissible conducted output power is 1 Watt.

■ Test Setup



■ Test Procedure

1. Set the RBW \geq DTS bandwidth.
2. Set the VBW $\geq [3 \times \text{RBW}]$.
3. Set span $\geq [3 \times \text{RBW}]$.
4. Sweep time = auto couple.
5. Detector = Peak.
6. Trace mode = max hold.
7. Sweep = auto couple.
8. Allow trace to fully stabilize.
9. Use peak marker function to determine the peak amplitude level.

■ Sample Calculation

$$\begin{aligned}
 \text{Power} &= \text{Reading Value} + \text{ATT loss} + \text{Cable loss(1 ea)} \\
 &= -5 \text{ dBm} + 10 \text{ dB} + 0.8 \text{ dB} = 5.8 \text{ dBm}
 \end{aligned}$$

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

□ Test Results

Mode	Channel	Power (dBm)	Power (mW)
GSFK	2402	-2.15	0.610
GSFK	2440	-3.20	0.478
GSFK	2480	-2.30	0.588

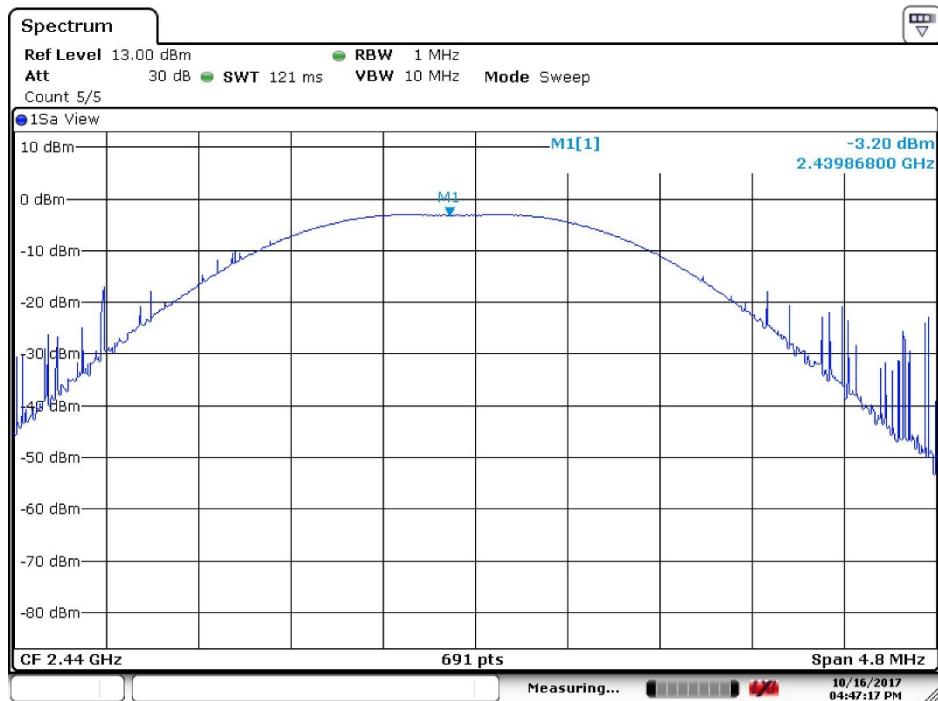
2402



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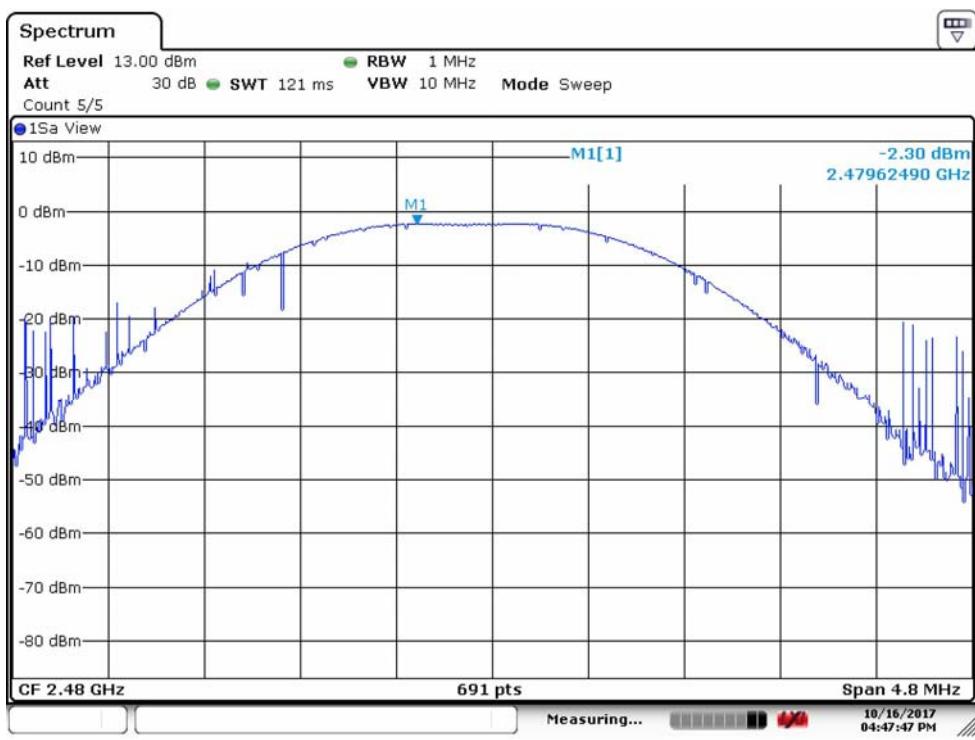
FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

2440



Date: 16.OCT.2017 16:47:17

2480



Date: 16.OCT.2017 16:47:48

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

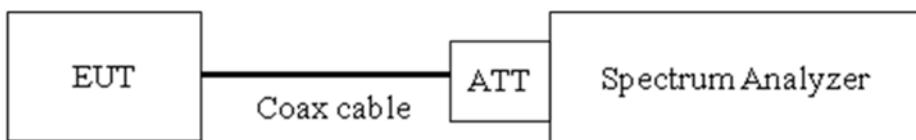
8.3 POWER SPECTRAL DENSITY

■ Test Requirements and limit, §15.247(e)

The peak power spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

The maximum permissible power spectral density is 8 dBm in any 3 kHz band.

■ Test Setup



■ Test Procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the Span = 1.5 times the DTS channel bandwidth.
3. Set the RBW to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
4. Set the VBW $\geq [3 \times \text{RBW}]$.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak mark function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

■ Sample Calculation

$$\begin{aligned}
 \text{PSD} &= \text{Reading Value} + \text{ATT loss} + \text{Cable loss(1 ea)} \\
 &= -5 \text{ dBm} + 10 \text{ dB} + 0.8 \text{ dB} = 5.8 \text{ dBm}
 \end{aligned}$$

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

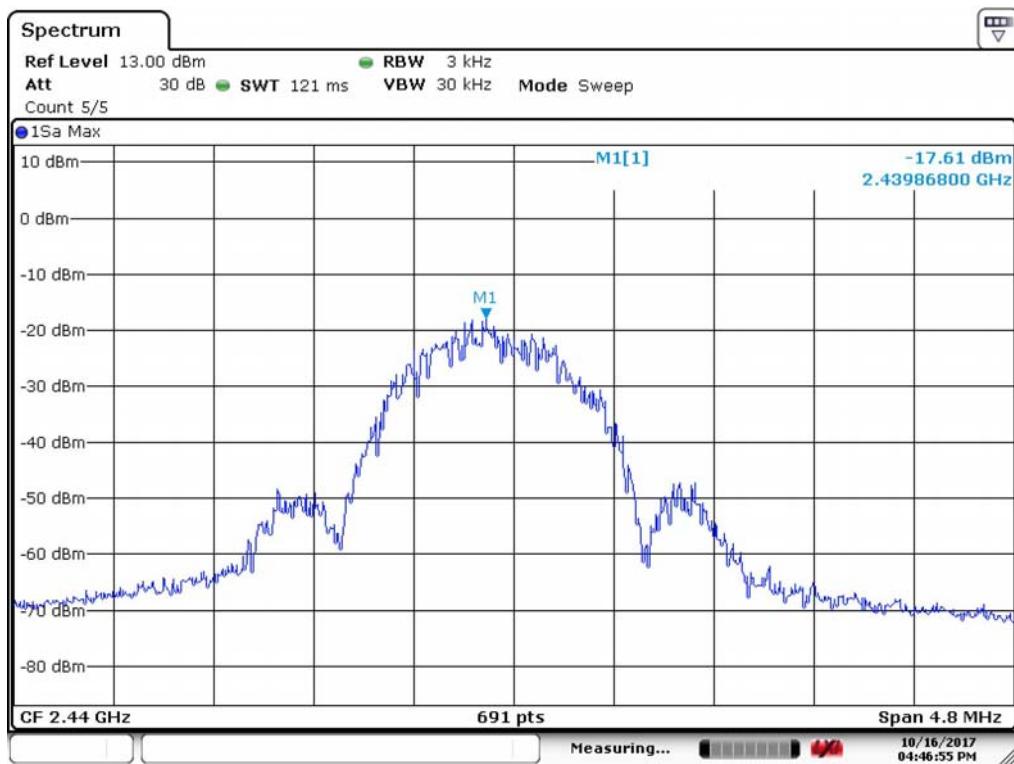
■ Test Results

Note : In order to simplify the report, the attached plots are only the highest PSD channels.

Mode	Channel	Power (dBm)
GSFK	2402	-17.31
GSFK	2440	-17.61
GSFK	2480	-17.55

Center Frequency Plot is shown as representative in order to simplify this report.

2440



Date: 16.OCT.2017 16:46:55

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

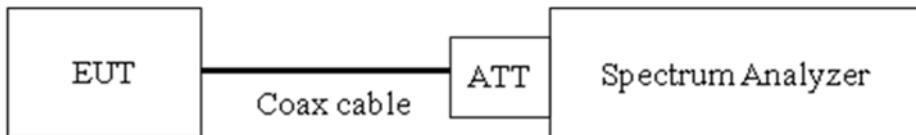
8.4 OUT OF BAND EMISSIONS AT THE BAND EDGE/ CONDUCTED SPURIOUS EMISSIONS

■ Test Requirements and limit, §15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

The limit for out-of-band spurious emissions at the band edge is 20 dB below the fundamental emission level, as determined from the in-band power measurement of the DTS channel performed in a 100 kHz bandwidth.

■ Test Setup



■ Test Procedure

1. Start and stop frequency were set such that the band edge would be placed in the center of the plot.
2. Span was set large enough so as to capture all out of band emissions near the band edge.
3. RBW = 100 kHz.
4. VBW = 300 kHz.
5. Detector = peak.
6. Number of sweep points $\geq 2 \times$ Span/RBW.
7. Sweep time = auto couple.
8. Trace mode = max hold.

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

9. Allow trace to fully stabilize.
10. Use the peak mark function to determine the maximum amplitude level within the RBW.
11. If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.

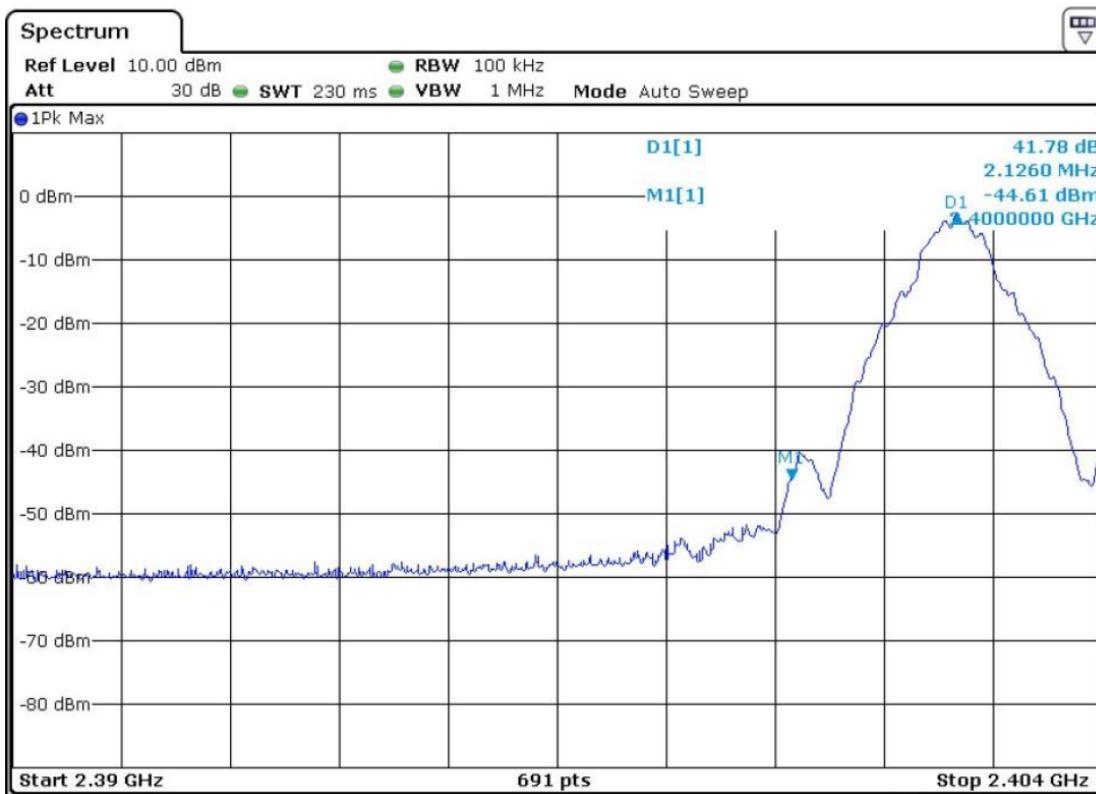
Measurements are made over the 30 MHz to 10th harmonic range with the transmitter set to the lowest, middle, and highest channels.

Test Results

CONDUCTED BAND EDGE DATA

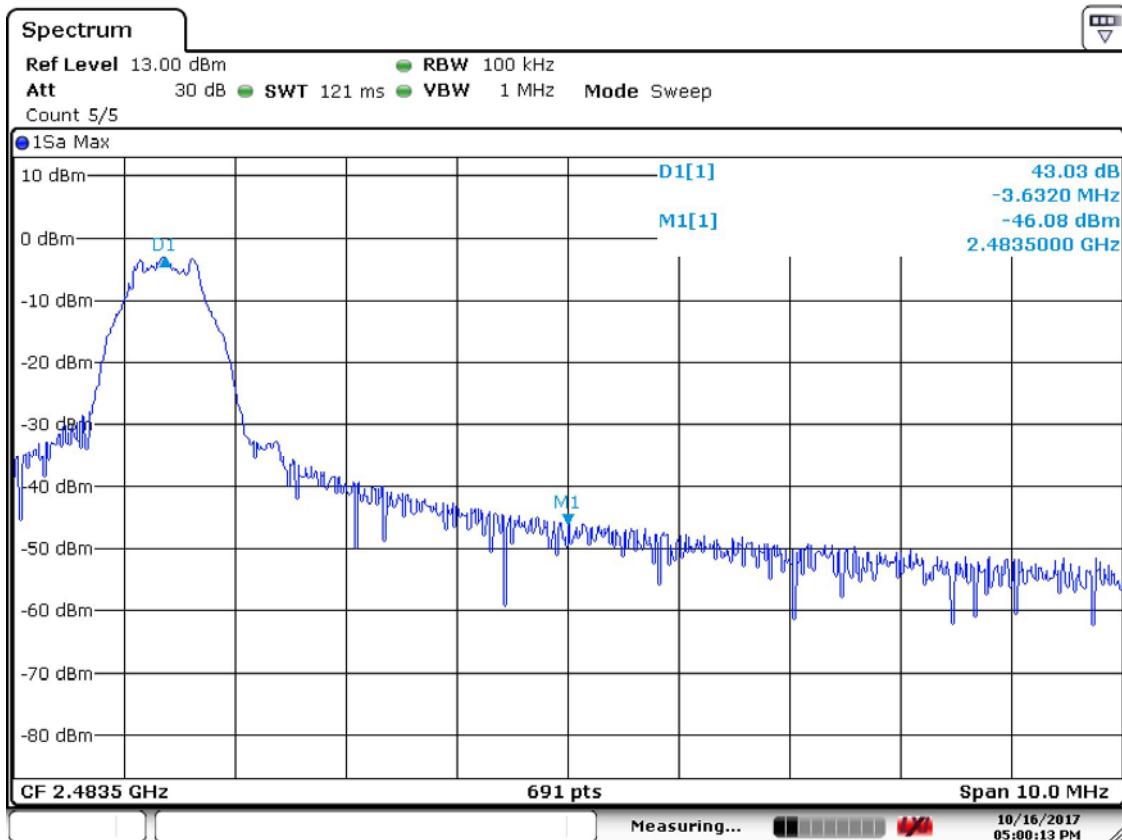
Mode	Frequency	Delta Measured	Delta Limit (dB)
GSFK	2400	41.78	>20
	2483.5	43.03	>20

2400 MHz Band Edge



FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

2483.5 MHz Band Edge



Date: 16.OCT.2017 17:00:13

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

Conducted Spurious Emissions

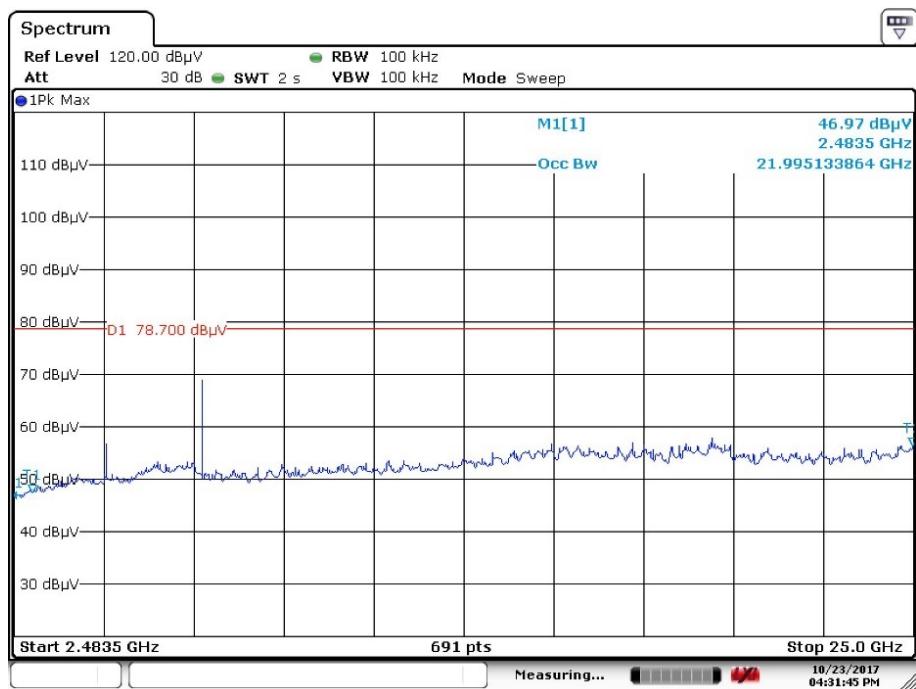
9 kHz – 30MHz

Frequency	Reading	Cable loss	Total	Limit	Margin
MHz	dBm	dBm	dBm	dBm	dB
No Critical Peaks Detected					

30 MHz – 2.4 GHz

Frequency	Reading	Cable loss	Total	Limit	Margin
MHz	dBm	dBm	dBm	dBm	dB
No Critical Peaks Detected					

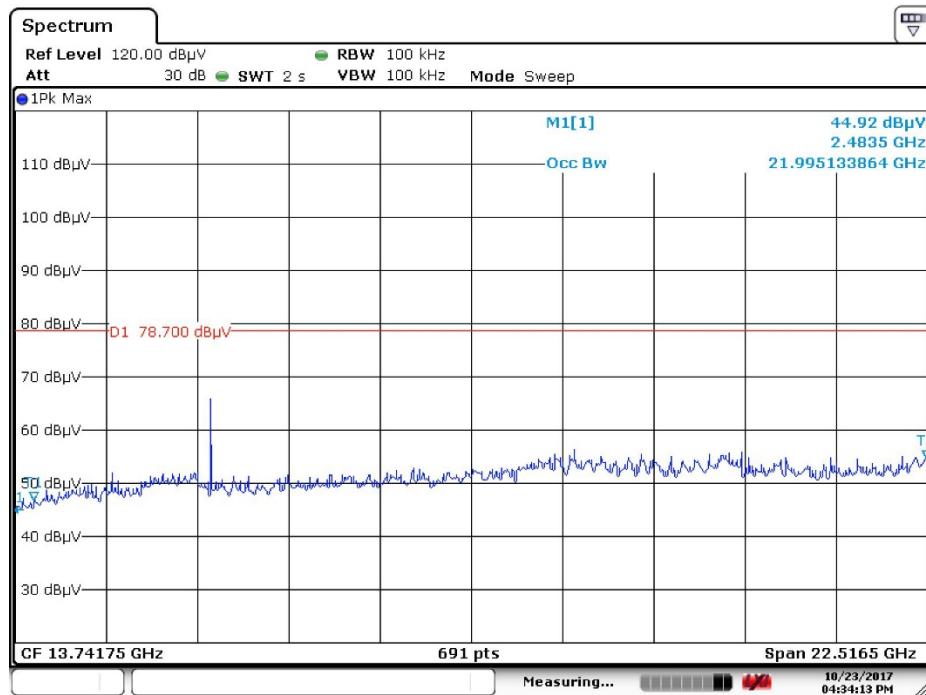
2.4835 – 25 GHz 2402 Tx



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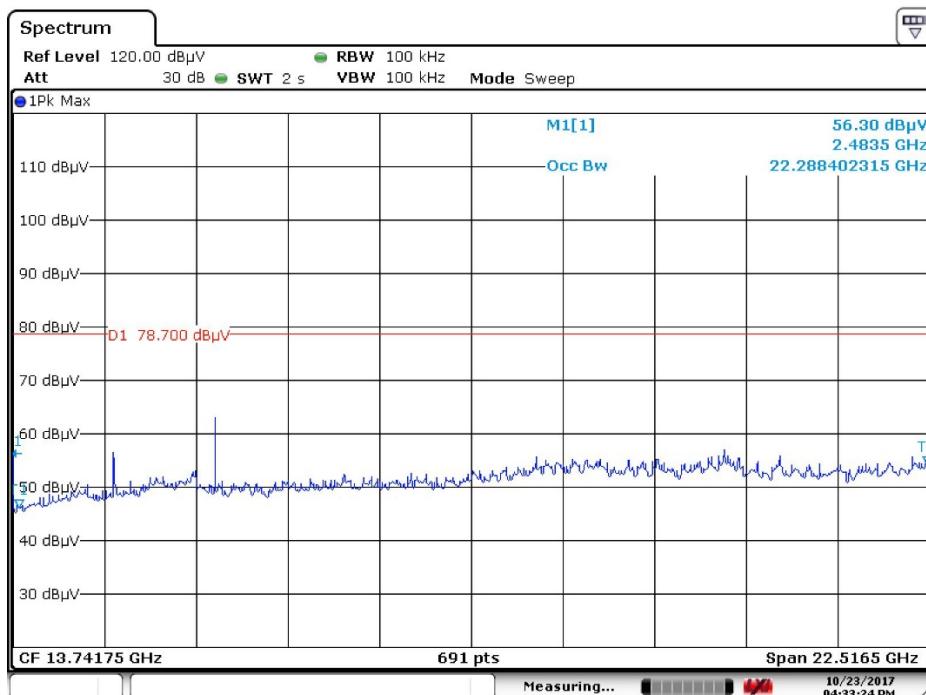
FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

2.4835 – 25 GHz 2440 Tx



Date: 23.OCT.2017 16:34:13

2.4835 – 25 GHz 2480 Tx



Date: 23.OCT.2017 16:33:24

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

8.5 RADIATED MEASUREMENT

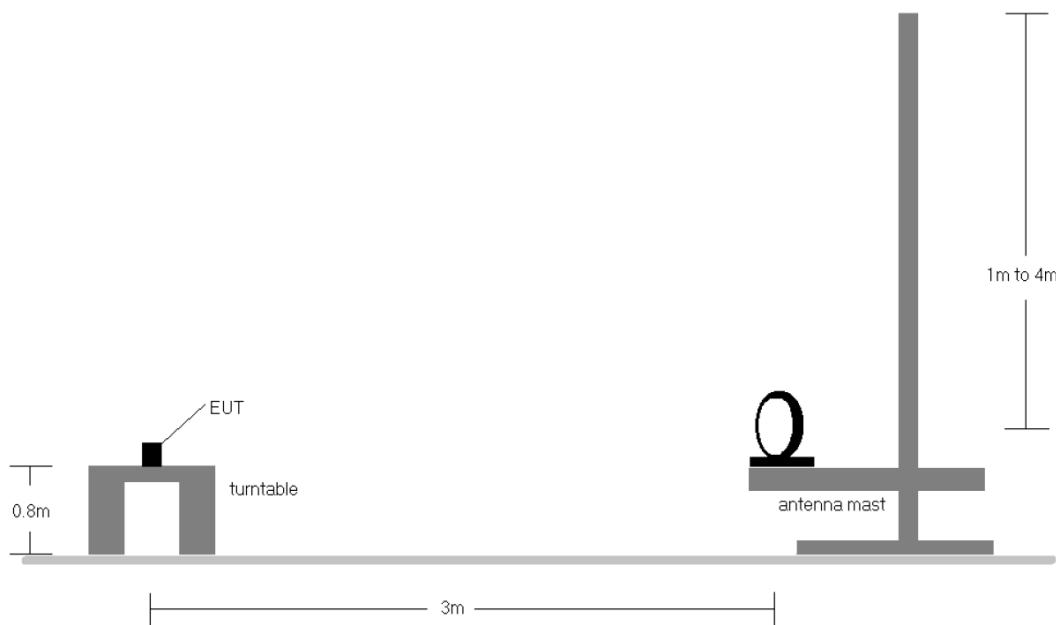
8.5.1 RADIATED SPURIOUS EMISSIONS.

Test Requirements and limit, §15.205, §15.209

Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

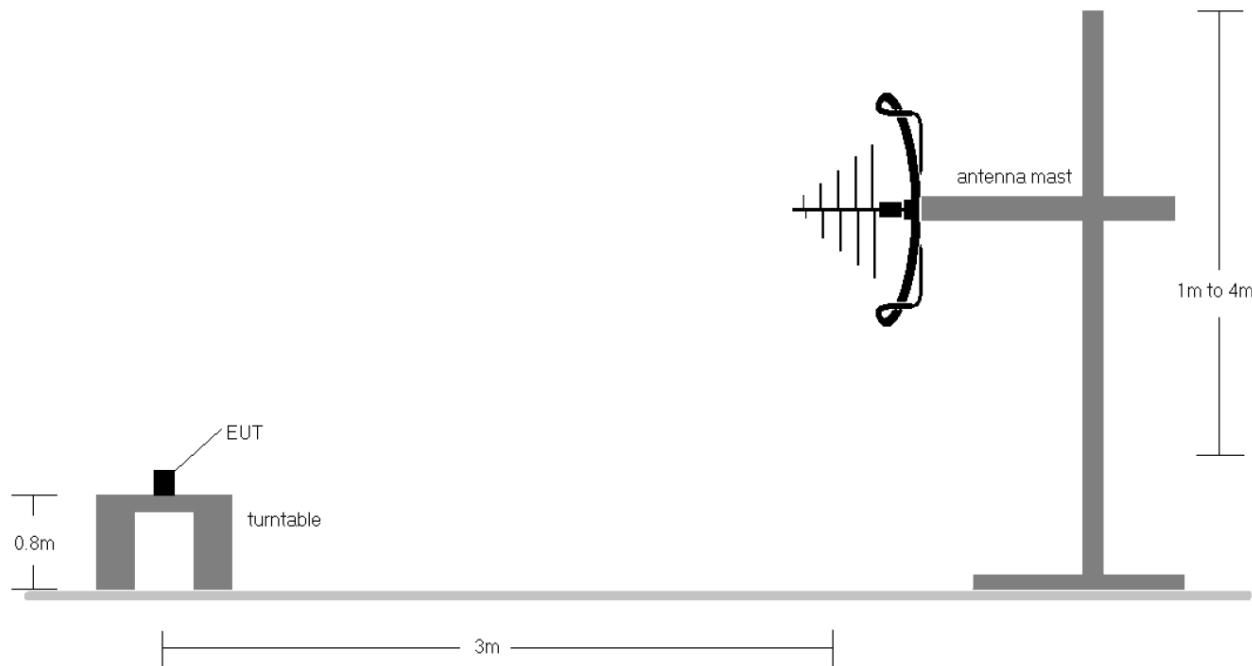
Test Setup

Below 30 MHz

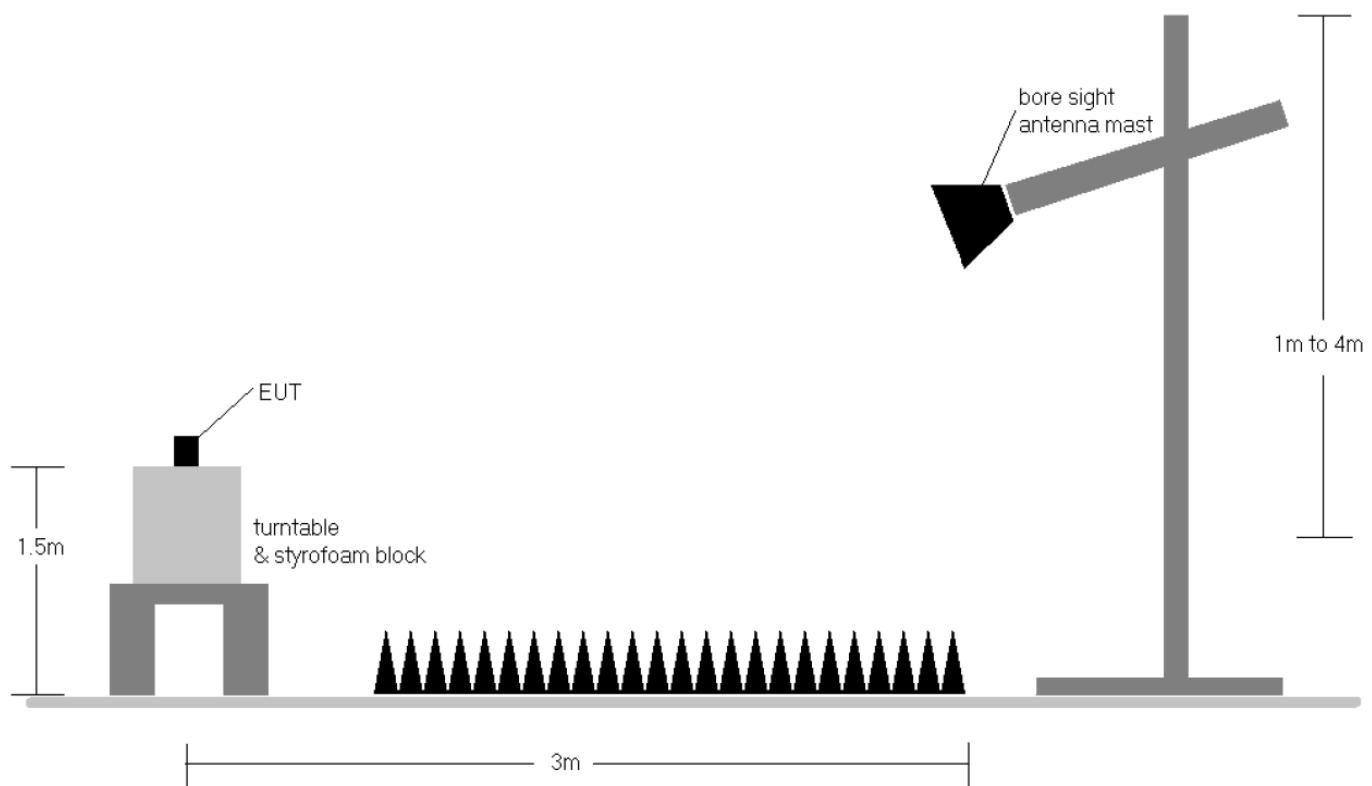


FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

30 MHz - 1 GHz



Above 1 GHz



FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

■Test Procedure

1. The EUT is placed on a turntable, which is 1.5 m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.
7. Spectrum Setting
 - a. Peak Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 MHz.
 - b. AV Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 kHz $\geq 1/\tau$ Hz, where τ = pulse width in seconds.

Table 1 —RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

■Test Results

9 kHz – 30MHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dB μ V/m	dBm /m	dBm	(H/V)	dB μ V/m	dB μ V/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB)
4. Limit line = specific Limits (dB μ V) + Distance extrapolation factor
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

30 MHz - 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
MHz	dB μ N/m	dBm /m	dBm	(H/V)	dB μ N/m	dB μ N/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

1 GHz - 25 GHz

Frequency (MHz)	Meter dB μ V/m	Corr. Factor	Corr. Reading	Spec	Margin	Detector Type	Polarity	Test Distance(m)
7206.0	39.77	20.14	59.91	74	-14.09	PK	V	3
7206.0	27.01	20.14	47.15	54	-6.85	AVE	H	3
4480.0	37.75	16.59	54.34	74	-19.66	PK	V	3
4480.0	27.41	16.59	44.00	54	-10.00	AVE	H	3
7440.0	37.16	20.35	57.51	74	-16.49	PK	V	3
7440.0	26.11	20.35	46.46	54	-7.54	AVE	H	3
2483.5	39.77	10.50	50.27	74	-23.73	PK	V	3
2483.5	32.51	10.50	43.01	54	-10.99	AVE	H	3

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain.
5. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT			FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device		IC : 23063-E5

8.5.2 RADIATED RESTRICTED BAND EDGES

■Test Requirements and limit, §15.247(d) §15.205, §15.209

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a) (See section 15.205(c)).

■Test Results

Frequency (MHz)	Meter dB μ V/m	Corr. Factor	Corr. Reading	Spec	Margin	Detector Type	Polarity	Test Distance(m)
2402 Tx								
2390.0	39.92	10.37	50.29	74	-23.71	PK	V	3
2390.0	30.12	10.37	40.49	54	-13.51	AVE	V	3
2390.0	41.48	10.37	51.85	74	-22.15	PK	H	3
2390.0	29.35	10.37	39.72	54	-14.28	AVE	H	3
2480 Tx								
2483.5	39.87	10.50	50.37	74	-23.63	PK	V	3
2483.5	32.09	10.50	42.59	54	-11.41	AVE	V	3
2483.5	42.18	10.50	52.68	74	-21.32	PK	H	3
2483.5	30.28	10.50	40.78	54	-13.22	AVE	H	3

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT			FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device		IC : 23063-E5

8.6 POWERLINE CONDUCTED EMISSIONS

■ Test Requirements and limit, §15.207

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

■ Test Setup

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

■ Test Procedure

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.
5. We are performed the AC Power Line Conducted Emission test for 13 Mbps, Ch.6 and 802.11n_20 MHz BW. Because 802.11n_20 MHz BW mode is worst case.

■ Test Results:

Not Applicable – Battery Powered

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5

9. LIST OF TEST EQUIPMENT

Equipment	Serial Number	Last Calibration Date	Calibration Due
Omega-IBTHXBP Temp / Humidity Meter	14490199	7/8/2016	7/8/2018
ETS – EmPower Power Sensor	141000-48SNO051	6/9/2017	6/9/2019
Fluke-87 DMM	64920001	6/28/2016	6/28/2018
EMCO-3816-2 LISN	9809-1089	6/12/2017	6/12/2019
Rohde & Schwarz- FSV40 Spectrum Analyzer	101424	6/20/2016	6/20/2018
Sunol Sciences-JB6 BiConilog Antenna	A042610	6/8/2017	6/8/2019
A.H. Systems-SAS- 571 Horn Antenna	236	6/13/2017	6/13/2019

END OF REPORT

FCC PT.15.247 TEST REPORT	FCC CERTIFICATION REPORT		FCC ID : 2ANB3-E5
Test Report No. 4328-1	Date of Issue: 11/15/2017	EUT Type: EKG and digital stethoscope device	IC : 23063-E5