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EMC Test Report

Application for FCC Grant of Equipment Authorization
Canada Certification

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

Model: ANGi 1.0

IC:	3672A-ANGI001
FCC ID:	OXXANGI001
APPLICANT:	Specialized Bicycle Components, Inc. 15130 Concord Circle Morgan Hill, CA 95037
TEST SITE(S):	National Technical Systems 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-5
PROJECT NUMBER:	PR079926
REPORT DATE:	July 13, 2018
REISSUE DATE:	August 3, 2018
FINAL TEST DATES:	June 14, 19 and July 10, 2018
TOTAL NUMBER OF PAGES:	56

ACCREDITED
Testing Cert #0214.26

VALIDATING SIGNATORIES

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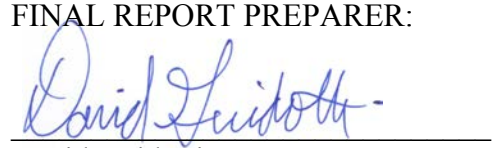

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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	July 13, 2018	First release	
1	July 27, 2018	Reissued report to correct Manufacturer and model number	David Guidotti
2	August 3, 2018	Reissued report to correct Manufacturer	David Guidotti

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SCOPE

An electromagnetic emissions test has been performed on the Specialized Bicycle Components, Inc. model ANGi 1.0, 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 National Technical Systems 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.

National Technical Systems 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 Specialized Bicycle Components, Inc. model ANGi 1.0 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 Specialized Bicycle Components, Inc. model ANGi 1.0 and therefore apply only to the tested samples. The samples were selected and prepared by Gunaprakash Venugopal on behalf of Specialized Bicycle Components, 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	System must utilize a digital transmission technology	Complies
15.247 (a) (2)	RSS 247 5.2 (1)	6dB Bandwidth	816 kHz	>500kHz	Complies
15.247 (b) (3)	RSS 247 5.4 (4)	Output Power	0.2 dBm (0.001 Watts) EIRP = 0.0007 W Note 1	1Watt, EIRP limited to 4 Watts.	Complies
15.247(e)	RSS 247 5.2 (2)	Power Spectral Density	-12.5 dBm/3kHz	8dBm/3kHz	Complies
15.247(d)	RSS 247 5.5	Antenna Port Spurious Emissions 30MHz – 25 GHz	All emissions below -20dBc limit	< -20dBc	Complies
15.247(d) / 15.209	RSS 247 5.5	Radiated Spurious Emissions 30 kHz – 25 GHz	53.3 dBµV/m @ 7439.8 MHz (-0.7 dB)	Refer to the limits section (p19) for restricted bands, all others < -20dBc	Complies
Note 1: EIRP calculated using antenna gains of -2.0 dBi for the highest EIRP system.					

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector		Unique or integral antenna required	Complies
15.407 (b) (6)	RSS-Gen Table 4	AC Conducted Emissions	Testing was not performed as the EUT does not have any AC power ports.		
15.247 (i) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to SAR Exclusion calculations in separate exhibit, RSS 102 declaration and User Manual statements.	Refer to OET 65, FCC Part 1 and RSS 102	Complies
-	RSS-Gen 6.8	User Manual	Integral Antenna	Statement for products with detachable antenna	N/A
-	RSS-Gen 8.4	User Manual	See user manual	Statement for all products	Complies
-	RSP-100 RSS-Gen 6.7	Occupied Bandwidth	1.88 MHz	Information only	N/A

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 Specialized Bicycle Components, Inc. model ANGi 1.0 is a wireless crash sensor mounted in a bicycle helmet. It contains accelerometers & gyroscopes, as well as a Bluetooth Low Energy radio, designed to communicate with a cell phone and, by means of a special app, make a 911 call. The EUT was treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 3 VDC provided by a non-rechargeable battery.

The samples were received on June 12, 2018 and tested on June 14, 19 and July 10, 2018. The following samples of the EUT were used for testing:

Company	Model	Description	Serial Number	FCC ID
Specialized Bicycle Components, Inc.	ANGi 1.0	ANGi Helmet Sensor	44002265	OXXANGI001
			44002255	

ANTENNA SYSTEM

The antenna system consists of an integral 2.0 dBi chip antenna

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 2.5 cm wide by 3.9 cm deep by 1.0 cm high.

MODIFICATIONS

No modifications were made to the EUT during the time the product was at NTS Silicon Valley.

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
Hewlett Packard	EliteBook	Laptop	U27045	-

Note: The laptop was used for configuration only and was disconnected during testing

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
EUT/5Pin connector	Laptop/USB	USB	Shielded	1m

Note: The test unit was modified with a 5pin connector for testing purposes only. For antenna conducted tests, a temporary antenna connector was added to the sample.

EUT OPERATION

During testing the EUT was configured to transmit on the selected channel at max power.

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 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Designation / Registration Numbers		Location
	FCC	Canada	
Chamber 5	US0027	2845B-5	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 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.

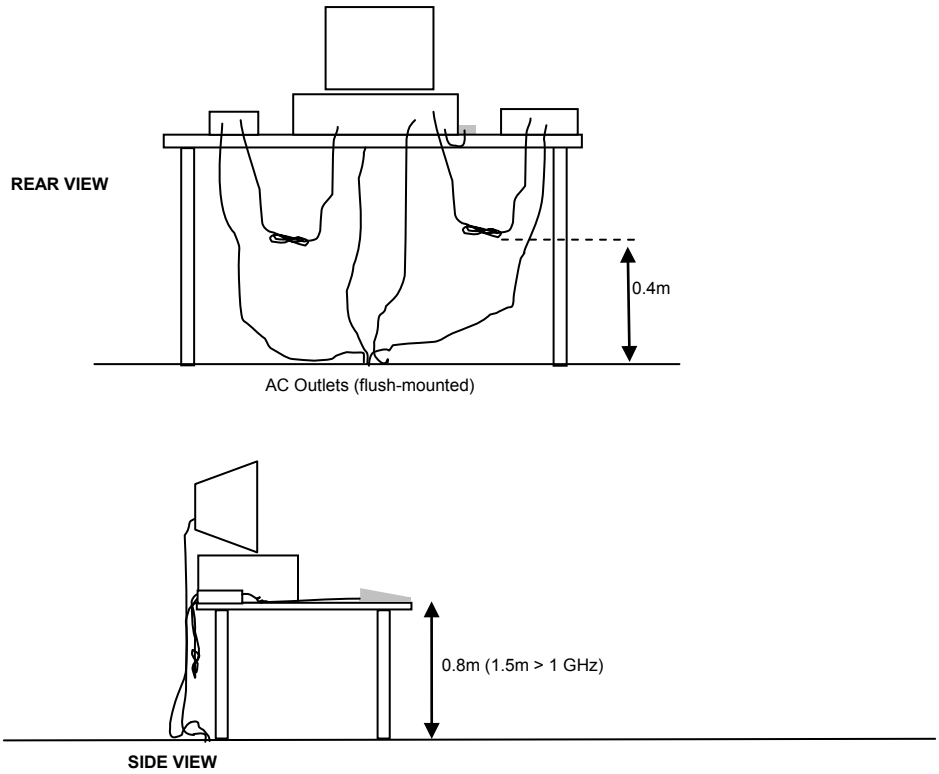
RADIATED EMISSIONS

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. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

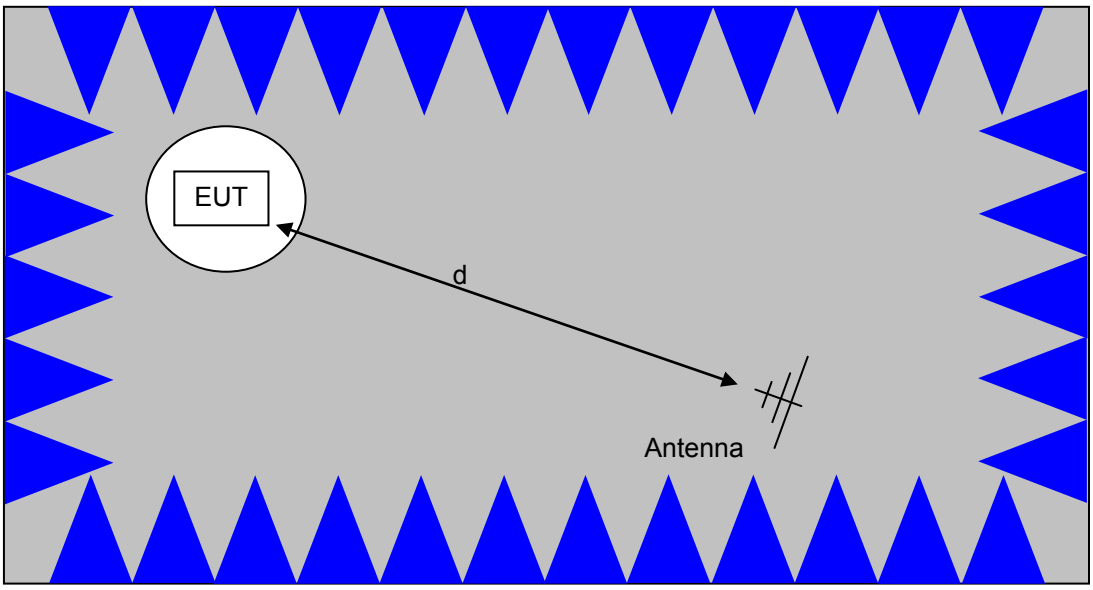
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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.

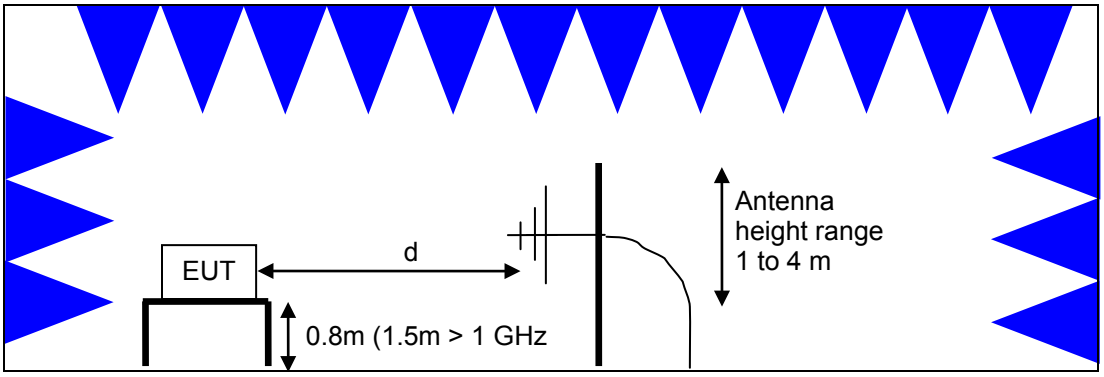


Typical Test Configuration for Radiated Field Strength Measurements



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.

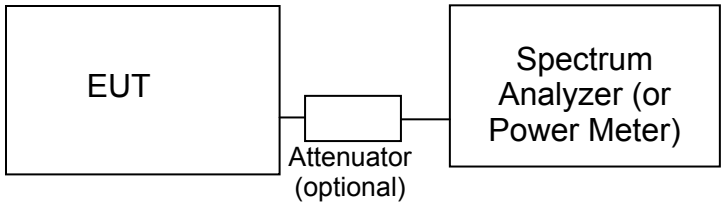
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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 Silicon Valley'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

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. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

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 210. 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).

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

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:
R_r = Receiver Reading in dBuV
S = Specification Limit in dBuV
M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally 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.

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

Radiated Emissions, 1000 - 25,000 MHz, 14-Jun-18

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	9/29/2016	9/29/2018
HP / Miteq	SA40 R Head HF preAmplifier, 18-40 GHz (w/1148)	TTA1840-45-5P-HG-S	1145	9/8/2017	9/8/2018
Hewlett Packard	Spectrum Analyzer (SA40) Red 30 Hz -40 GHz	8564E (84125C)	1148	10/14/2017	10/14/2018
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	1780	8/31/2017	8/31/2018
A. H. Systems	Spare System Horn, 18-40GHz	SAS-574, p/n: 2581	2162	8/4/2017	8/4/2019
Micro-Tronics	Band Reject Filter, 2400-2500 MHz 18GHz	BRM50702-02	2238	5/1/2018	5/1/2019

Radiated Emissions, 30 - 1,000 MHz, 14-Jun-18

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1549	5/30/2017	5/30/2019
Com-Power	Preamplifier, 1-1000 MHz	PAM-103	2885	8/30/2017	8/30/2018
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	9482	10/28/2016	10/28/2018

Radio Antenna Port (Power and Spurious Emissions), 19-Jun-18

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1422	2/6/2018	2/6/2019
Fluke	Fluke Mulitmeter, True RMS	175	1447	8/7/2017	8/7/2018
Agilent Technologies	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	7/31/2017	7/31/2018
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts use with 20dB attenuator sn:1031.6959.00 only	NRV-Z32	3225	11/5/2017	11/5/2018

Conducted and Radiated Emissions, 0.03 - 30 MHz, 10-Jul-18

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Compower	Magnetic Loop Antenna, 9 kHz-30 MHz	AL-130	3003	09-Aug-16	09-Aug-18
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	9482	28-Oct-16	28-Oct-18

Appendix B Test Data

TL079926-RA-FCC Pages 24 – 55

Client:	Specialized Bicycle Components, Inc.	PR Number:	PR079926
Product	ANGi 1.0	T-Log Number:	TL079926-RA
System Configuration:	-	Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Engineer:	David Bare
Emissions Standard(s):	FCC Part 15, LP0002	Class:	B
Immunity Standard(s):		Environment:	Radio

EMC Test Data

For The

Specialized Bicycle Components, Inc.

Product

ANGi 1.0

Date of Last Test: 6/20/2018

Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

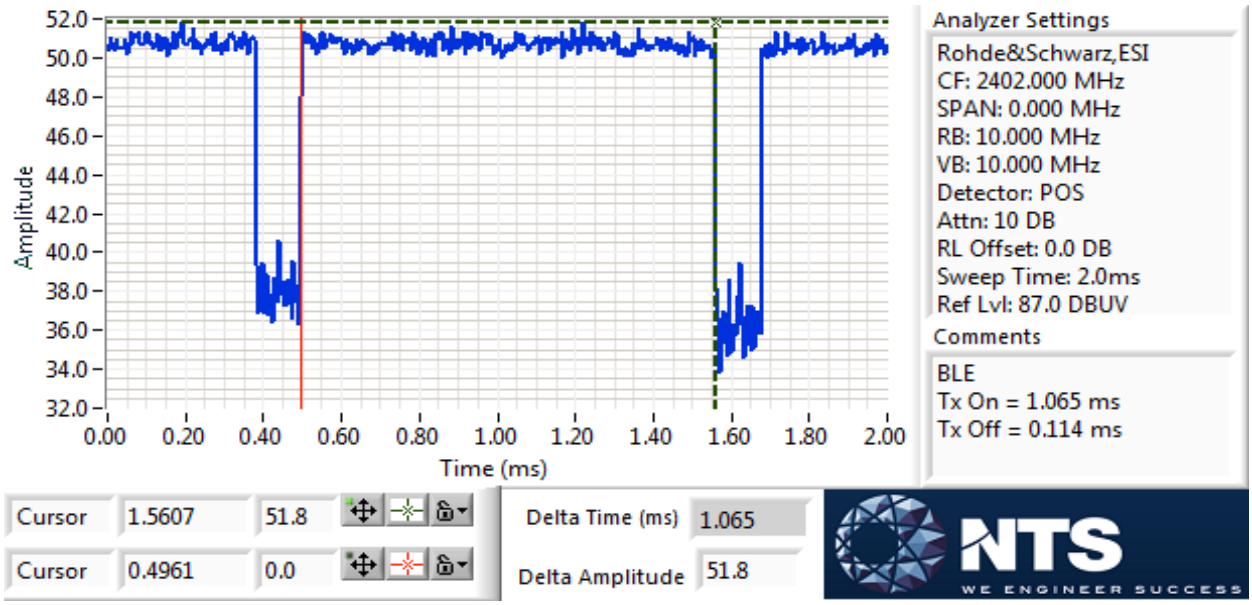
Duty Cycle

Date of Test: 6/1418
Test Engineer: Rafael Varelas
Test Location: FT Chamber #5

Notes: Measurements taken with maximum RBW/VBW settings allowed.

Mode		Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BLE	1Mbps	0.90	Yes	1.065	0.4	0.9	939

* Correction factor when using RMS/Power averaging - 10*log(1/x)
** Correction factor when using linear voltage average - 20*log(1/x)
T = Minimum transmission duration



Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

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

Power, PSD, 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: 6/19/2018
Test Engineer: Rafael Varelas
Test Location: Fremont Lab #4A

Config. Used: 2
Config Change: None
EUT Voltage: 3V internal Lithium battery

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: 22.8 °C
Rel. Humidity: 37 %

Summary of Results

Run #	Pwr setting		Test Performed	Limit	Pass / Fail	Result / Margin
1	0		Output Power	15.247(b)	Pass	0.2 dBm
2	0		Power spectral Density (PSD)	15.247(d)	Pass	-12.5 dBm/3kHz
3	0		Minimum 6dB Bandwidth	15.247(a)	Pass	816 kHz
3	0		99% Bandwidth	RSS GEN	-	1.875 MHz
4	0		Spurious emissions	15.247(b)	Pass	All emissions below -20dBc limit

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.

Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Mode		Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BLE	1Mbps	0.90	Yes	1.065	0.4	0.9	939

Sample Notes

Sample S/N: 44002265

Run #1: Output Power

Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W	Output Power (dBm)[3]	Output Power mW
0	2402	0.2	1.0	-2.0	Pass	-1.8	0.0007		
0	2440	-3.0	0.5	-2.0	Pass	-5.0	0.0003		
0	2480	-1.0	0.8	-2.0	Pass	-3.0	0.0005		

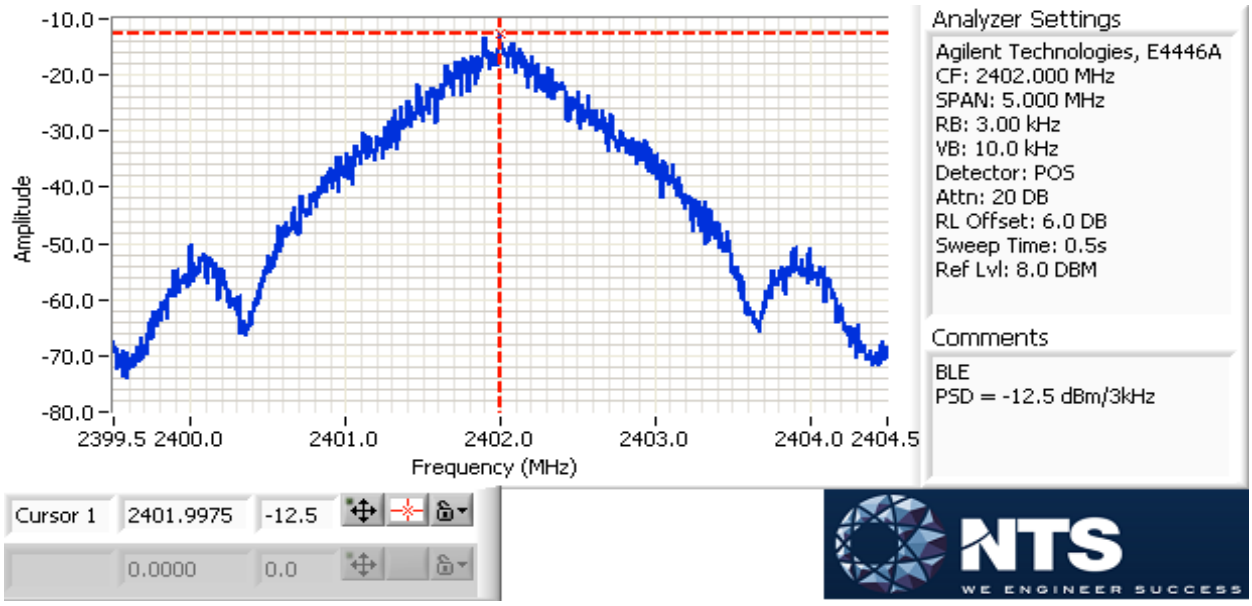
Note 1:	Output power measured using a peak power meter, spurious limit is -20dBc.
Note 2:	Power setting - the software power setting used during testing, included for reference only.
Note 3:	Power measured using average power meter (non-gated) and is included for reference only.

Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Run #2: Power spectral Density

Power Setting	Frequency (MHz)	PSD (dBm/3kHz) Note 1	Limit dBm/3kHz	Result
0	2402	-12.5	8.0	Pass
0	2440	-13.9	8.0	Pass
0	2480	-14.5	8.0	Pass

Note 1:	Test performed per method PKSPD, in KDB 558074. Power spectral density measured using: 3kHz ≤ RBW ≤ 100kHz, VBW=3*RBW, peak detector, span = 1.5*DTS BW, auto sweep time, max hold.

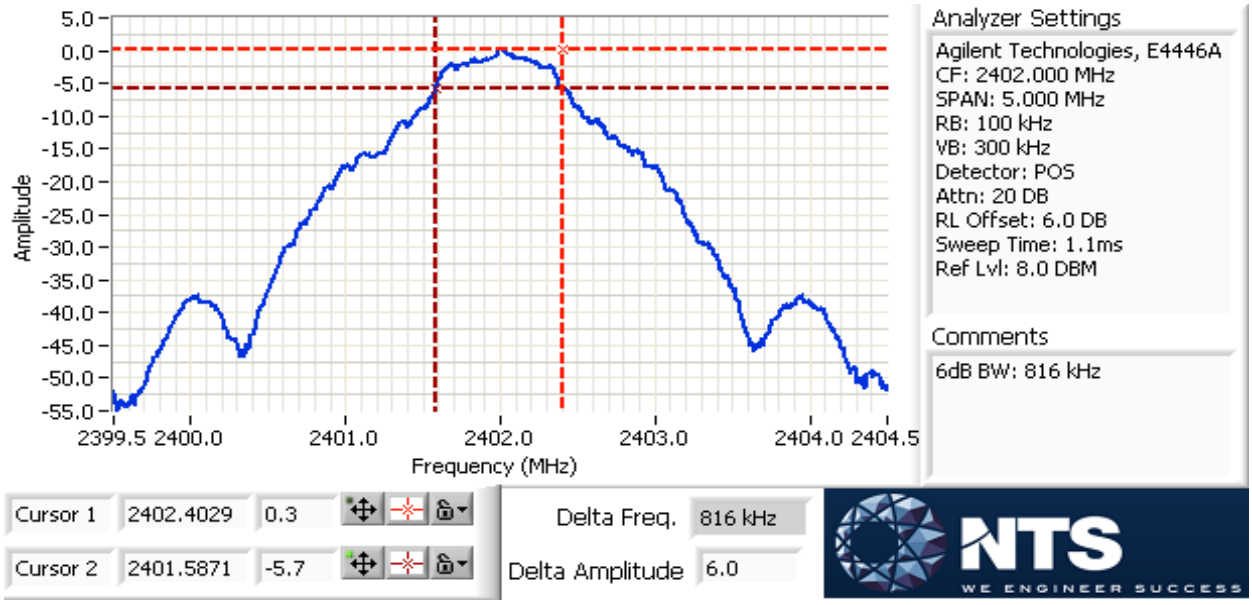


Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

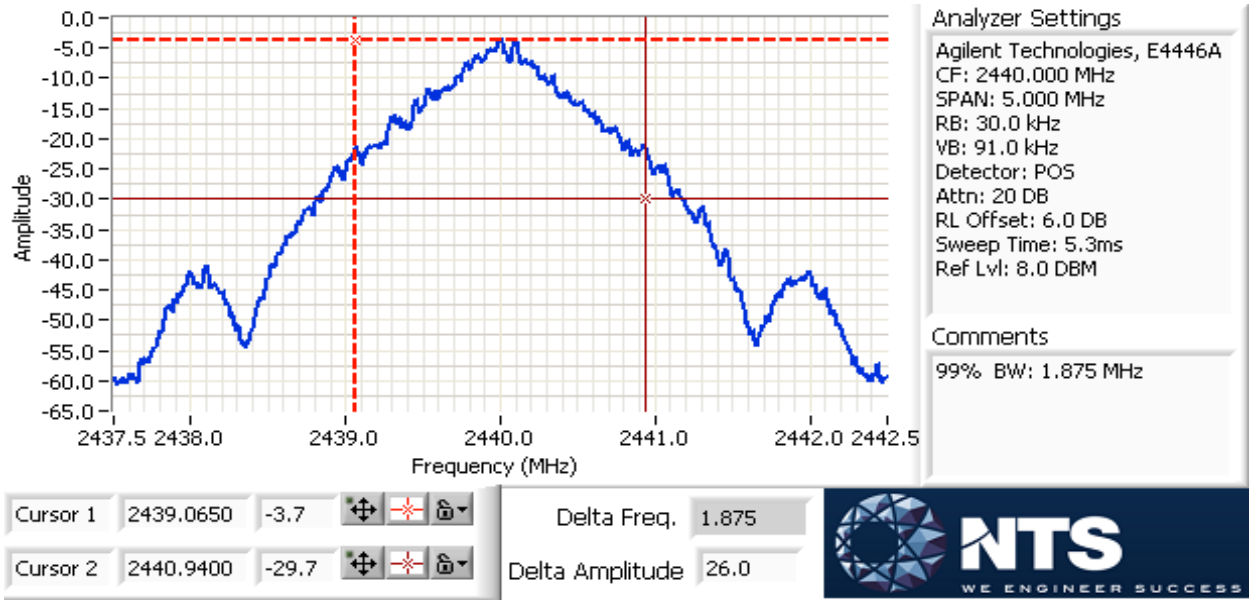
Run #3: Signal Bandwidth

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (kHz)	
		6dB	99%	6dB	99%
0	2402	0.816	1.84	100	30
0	2440	0.871	1.88	100	30
0	2480	0.841	1.84	100	30

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:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A



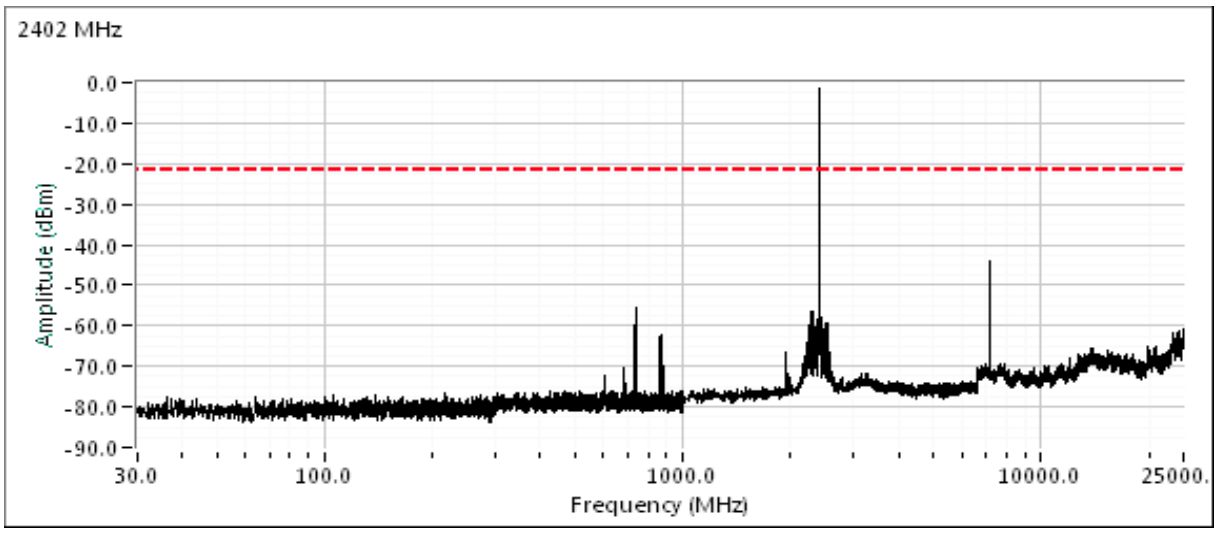
Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Run #4a: Out of Band Spurious Emissions

Frequency (MHz)	Power Setting	Mode	Limit	Result
2402	0	BLE	-20dBc	Pass
2440	0	BLE	-20dBc	Pass
2480	0	BLE	-20dBc	Pass

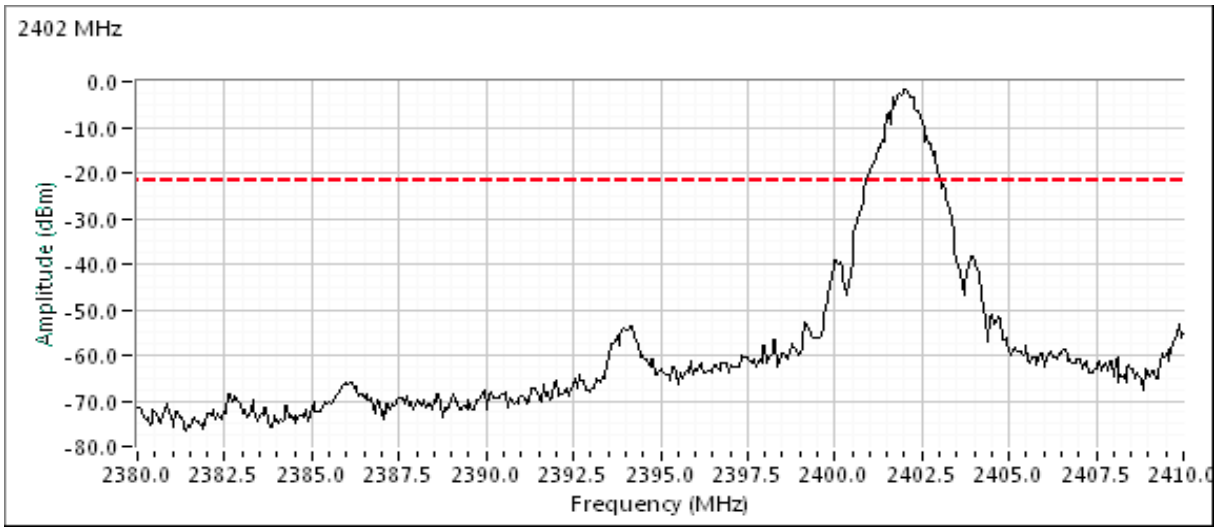
RBW = 100 kHz and VBW = 300 kHz for all plots.

Plots for low channel

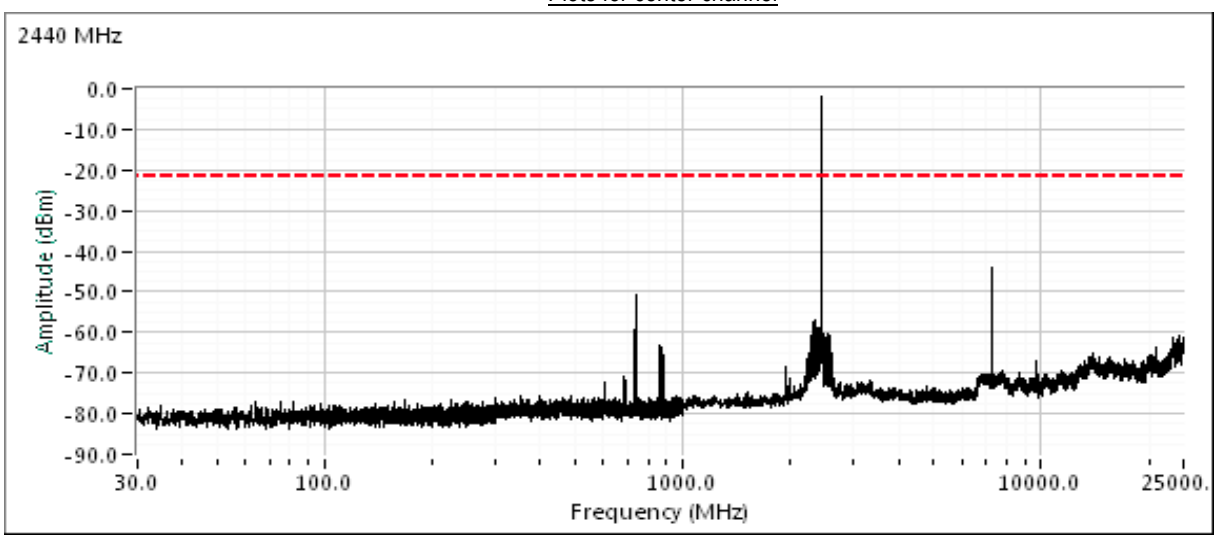


Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Additional plot showing compliance with -30dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.

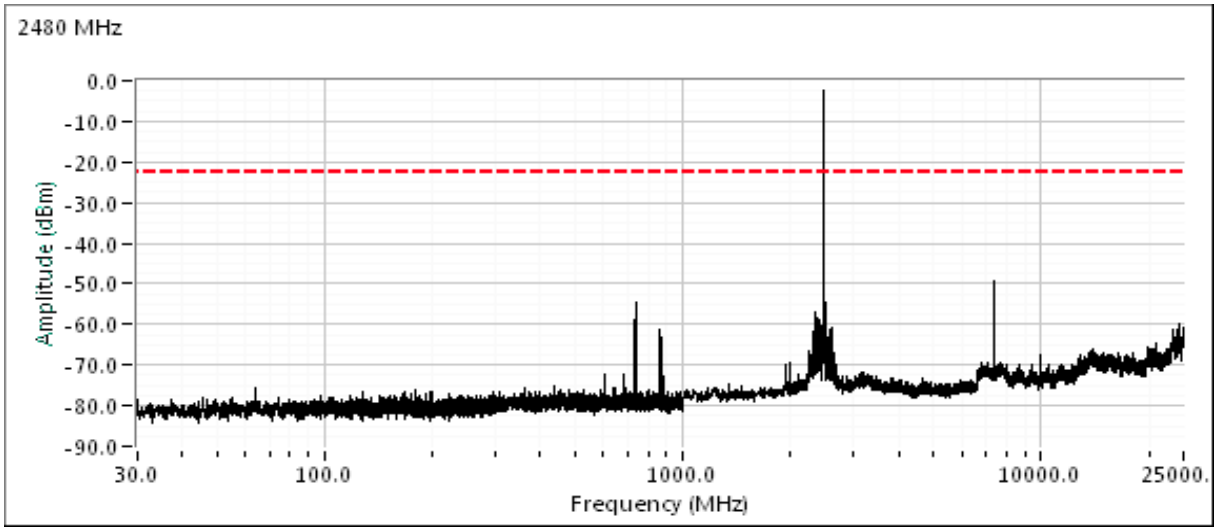


Plots for center channel



Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Plots for high channel



Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

RSS-247 and FCC 15.247 (DTS) Antenna Port Measurements
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: 7/10/2018
Test Engineer: Rafael Varelas
Test Location: Fremont Lab #4A
Config. Used: 2
Config Change: None
EUT Voltage: 3V internal Lithium battery

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: 22.8 °C
Rel. Humidity: 37 %

Summary of Results

Run #	Pwr setting		Test Performed	Limit	Pass / Fail	Result / Margin
1	0		Spurious emissions, 30 kHz - 30 MHz	15.247(b)	Pass	All emissions below -20dBc limit

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.

Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Mode		Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BLE	1Mbps	0.90	Yes	1.065	0.4	0.9	939

Sample Notes

Sample S/N: 44002265

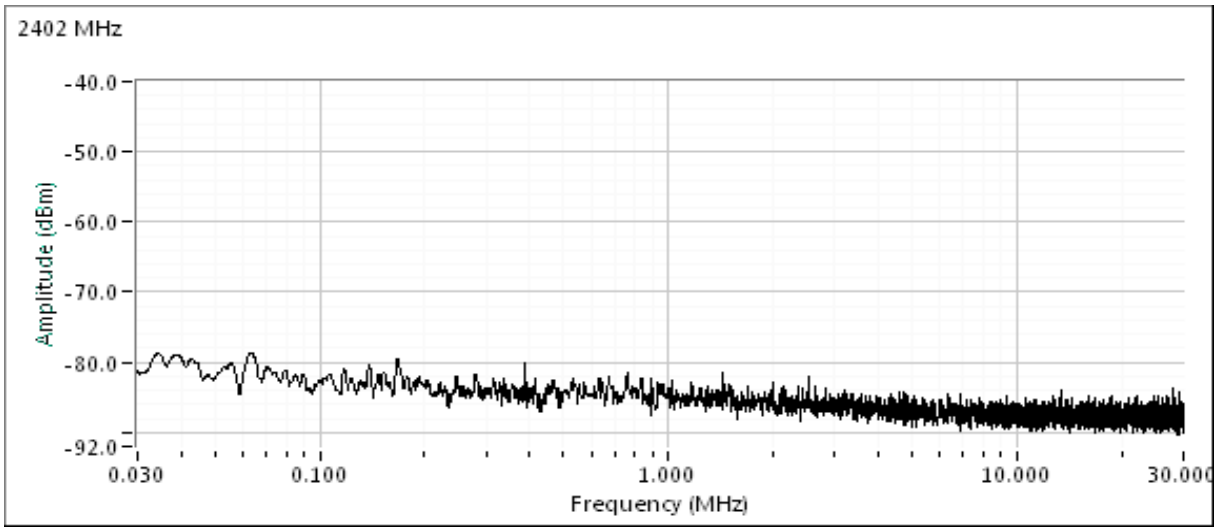
Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Run #1: Out of Band Spurious Emissions

Frequency (MHz)	Power Setting	Mode	Limit	Result
2402	0	BLE	-20dBc	Pass
2440	0	BLE	-20dBc	Pass
2480	0	BLE	-20dBc	Pass

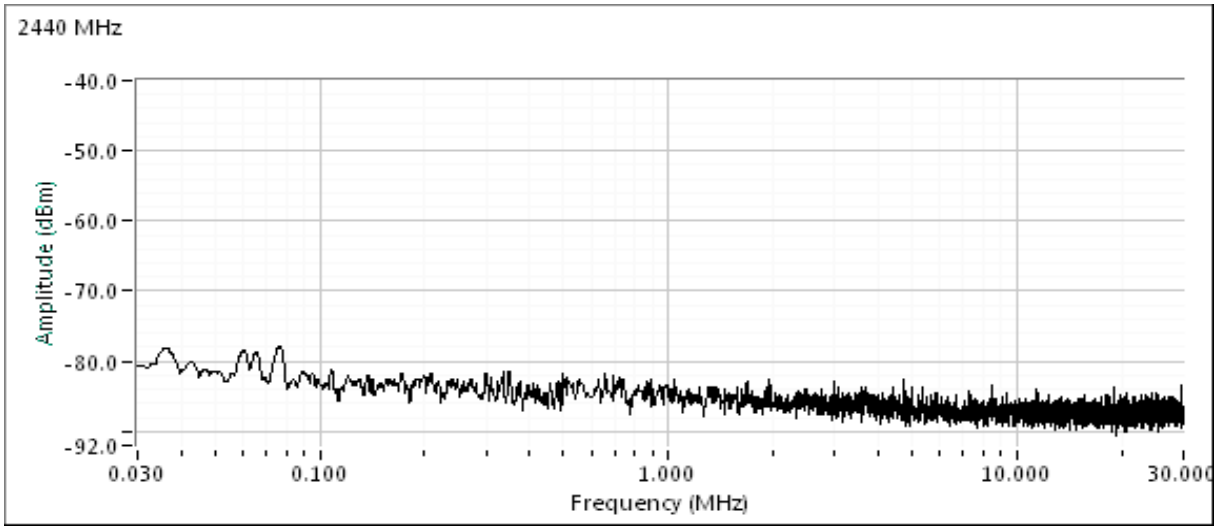
RBW = 9 kHz and VBW = 30 kHz for all plots.

Plot for low channel

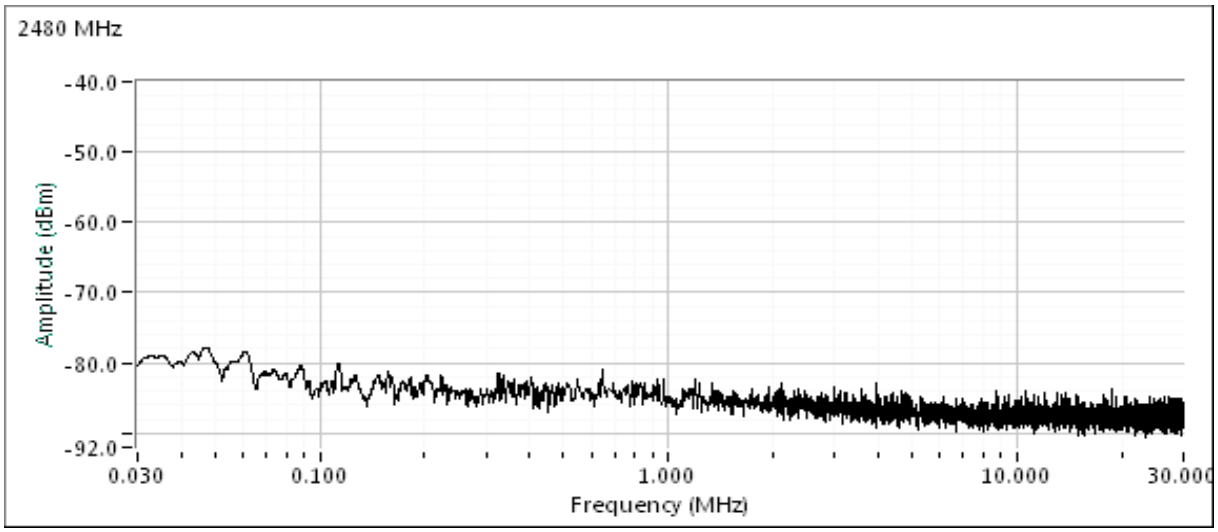


Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Plot for center channel



Plot for high channel



Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	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: 22.4 °C
Rel. Humidity: 39 %

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

Run #	Mode	Channel		Power Setting	Test Performed	Limit	Result / Margin
1	BLE	17 - 2402MHz		0	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	32.2 dBµV/m @ 2370.1 MHz (-21.8 dB)
	BLE	39 - 2480MHz		0	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	33.5 dBµV/m @ 2488.0 MHz (-20.5 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: 44002255
Antenna: Internal

Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074
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 average mode, 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	1Mbps	0.90	Yes	1.065	0.4	0.9	939

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 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 5:	Emission has constatnt 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
Note 6:	Emission has non constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW> 1/T, peak detector, linear average mode, sweep time auto, max hold. Max hold for 50*(1/DC) traces
Note 7:	Emission has non constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW> 1/T, RMS detector, sweep time auto, max hold. Max hold for 50*(1/DC) traces
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:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Run #1: Radiated Bandedge Measurements

Date of Test: 6/1418 Config. Used: 1

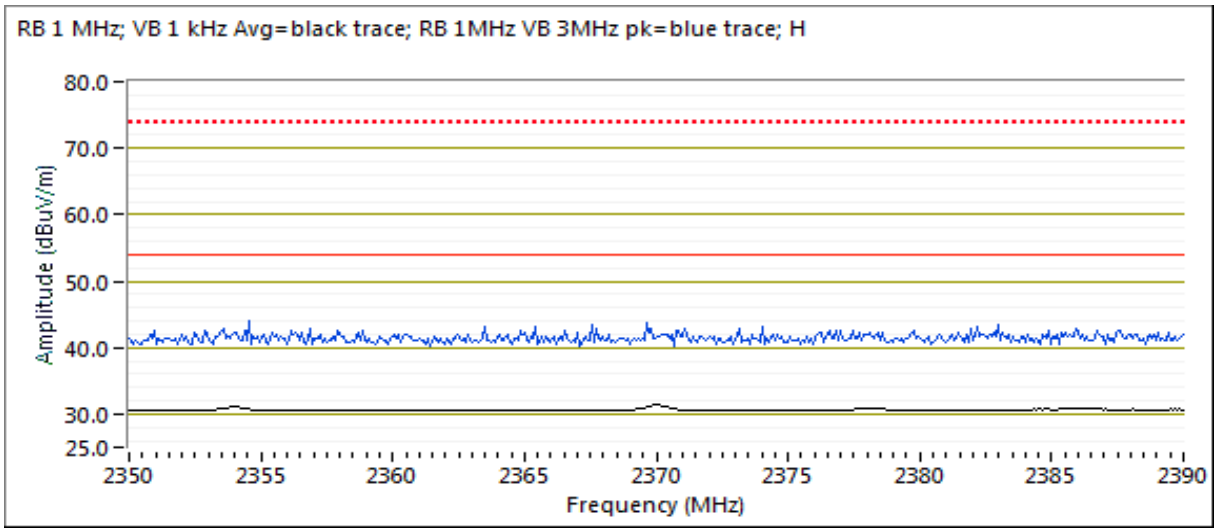
Test Engineer: Rafael Varelas Config Change: None

Test Location: FT Chamber #5 EUT Voltage: 3V internal Lithium battery

Channel: 17 EUT Orientation : Flat

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	
2370.110	32.2	H	54.0	-21.8	Avg	232	1.7	Note 4,POS Vavg:100; RB 1 MHz; VB
2368.330	43.5	H	74.0	-30.5	PK	232	1.7	POS; RB 1 MHz; VB: 3 MHz
2389.120	31.7	V	54.0	-22.3	Avg	339	1.0	Note 4,POS Vavg:100; RB 1 MHz; VB
2386.630	43.7	V	74.0	-30.3	PK	339	1.0	POS; RB 1 MHz; VB: 3 MHz

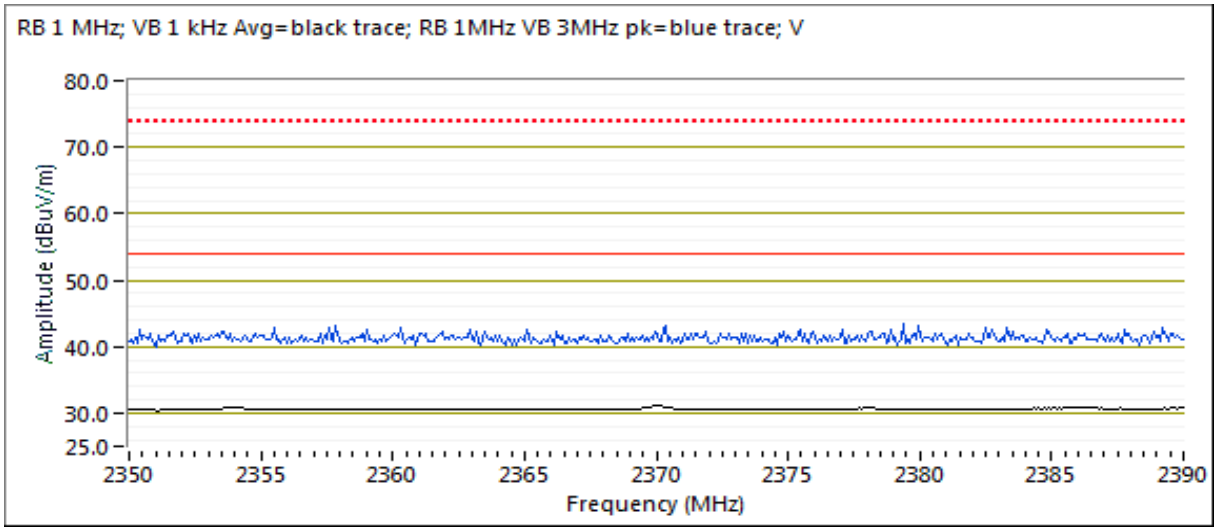


Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Channel: 17 EUT Orientation : Side

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	
2369.960	32.0	V	54.0	-22.0	Avg	118	1.0	Note 4,POS Vavg:100; RB 1 MHz; VB
2371.800	43.2	V	74.0	-30.8	PK	118	1.0	POS; RB 1 MHz; VB: 3 MHz
2385.830	31.7	H	54.0	-22.3	Avg	164	1.8	Note 4,POS Vavg:100; RB 1 MHz; VB
2374.610	43.0	H	74.0	-31.0	PK	164	1.8	POS; RB 1 MHz; VB: 3 MHz

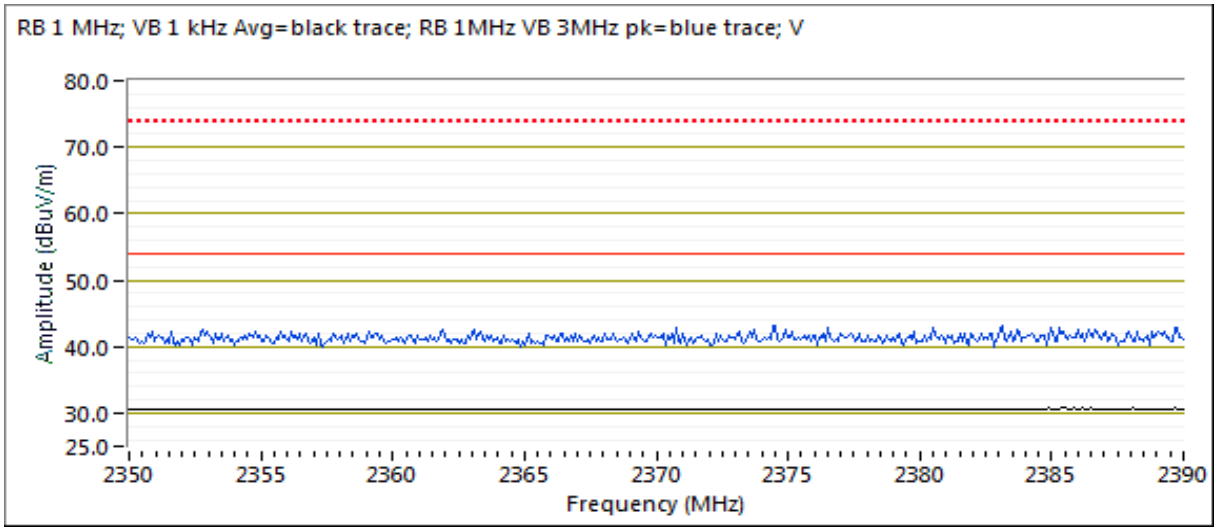


Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Channel: 17 EUT Orientation : Upright

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	
2384.870	31.7	V	54.0	-22.3	Avg	278	1.1	Note 4,POS Vavg:100; RB 1 MHz; VB
2376.050	43.3	V	74.0	-30.7	PK	278	1.1	POS; RB 1 MHz; VB: 3 MHz
2386.470	31.7	H	54.0	-22.3	Avg	294	2.5	Note 4,POS Vavg:100; RB 1 MHz; VB
2366.910	43.4	H	74.0	-30.6	PK	294	2.5	POS; RB 1 MHz; VB: 3 MHz

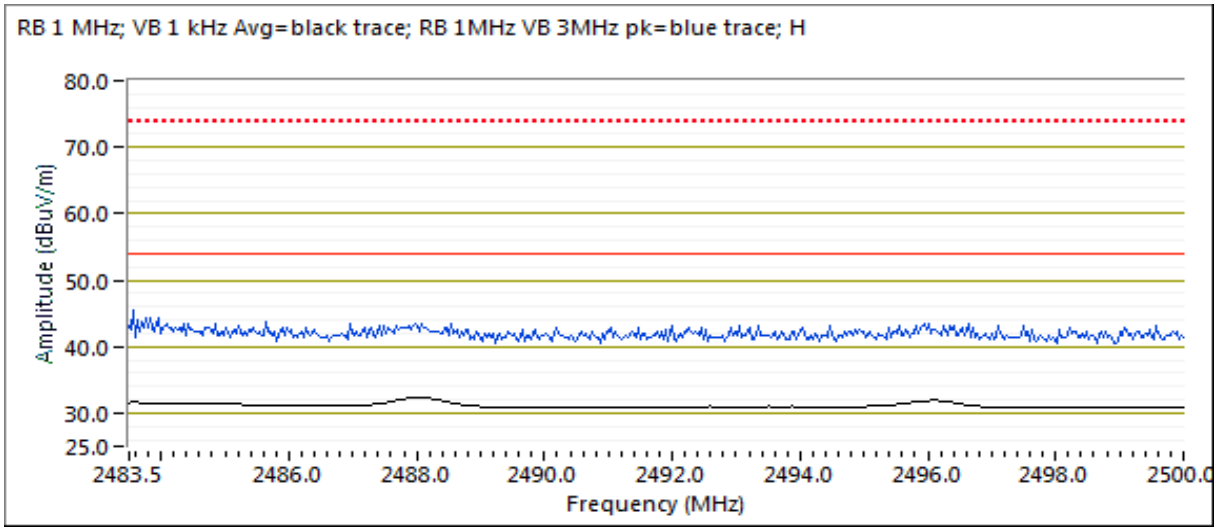


Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Channel: 39 EUT Orientation : Flat

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	
2488.020	33.5	H	54.0	-20.5	Avg	24	1.3	Note 4,POS Vavg:100; RB 1 MHz; VB
2488.060	44.3	H	74.0	-29.7	PK	24	1.3	POS; RB 1 MHz; VB: 3 MHz
2495.070	31.9	V	54.0	-22.1	Avg	18	1.0	Note 4,POS Vavg:100; RB 1 MHz; VB
2492.760	43.4	V	74.0	-30.6	PK	18	1.0	POS; RB 1 MHz; VB: 3 MHz



Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	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.
Radiated emissions tests above 1 GHz were performed with floor absorbers in place in accordance with the test methods of ANSI C63.4 and CISPR 16-1-4.

Ambient Conditions:

Temperature: 22.4 °C
Rel. Humidity: 39 %

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

Run #	Mode	Channel		Power Setting	Test Performed	Limit	Result / Margin
1	BLE	17 - 2402MHz		0	Radiated Emissions, 30 MHz - 25 GHz	FCC Part 15.209 / 15.247(c)	47.3 dBµV/m @ 7205.9 MHz (-6.7 dB)
	BLE	37 - 2440MHz		0	Radiated Emissions, 30 MHz - 25 GHz	FCC Part 15.209 / 15.247(c)	49.1 dBµV/m @ 7319.6 MHz (-4.9 dB)
	BLE	39 - 2480MHz		0	Radiated Emissions, 30 MHz - 25 GHz	FCC Part 15.209 / 15.247(c)	53.3 dBµV/m @ 7439.8 MHz (-0.7 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.

Sample Notes

Sample S/N: 44002255
Antenna: Internal

Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074
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 average mode, auto sweep time, max hold.
2.4GHz band reject filter used

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BLE	1Mbps	0.90	Yes	1.065	0.4	0.9	939

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 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 5:	Emission has constatnt 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
Note 6:	Emission has non constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW> 1/T, peak detector, linear average mode, sweep time auto, max hold. Max hold for 50*(1/DC) traces
Note 7:	Emission has non constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW> 1/T, RMS detector, sweep time auto, max hold. Max hold for 50*(1/DC) traces

Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

Run #1: Radiated Spurious Emissions, 1,000 - 25000 MHz. Operating Mode: BLE

Date of Test: 6/1418 Config. Used: 1

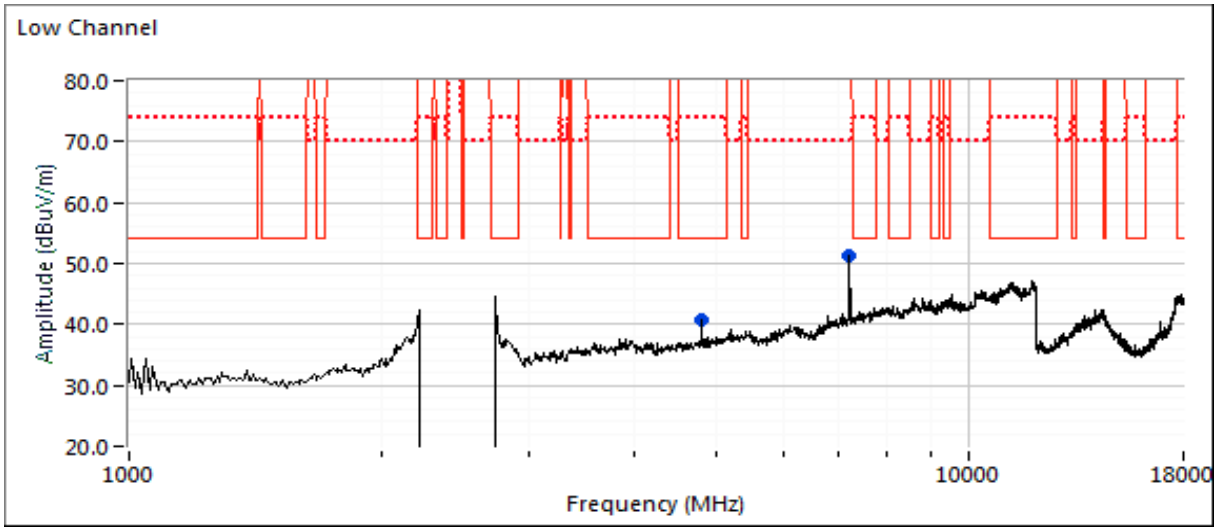
Test Engineer: Rafael Varelas Config Change: None

Test Location: FT Chamber #5 EUT Voltage: 3V internal Lithium battery

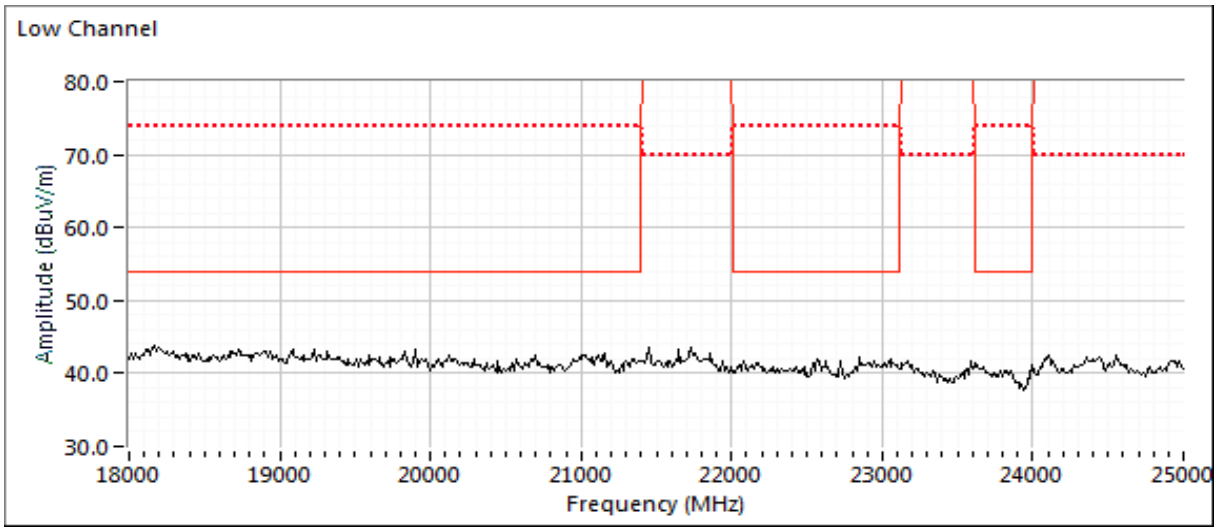
Run #1a: Low Channel

Channel: 17 EUT Orientation : Flat

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7205.870	47.3	H	54.0	-6.7	Avg	310	1.3	Note 1,4,RB 1 MHz;VB 1 kHz;Peak V
7205.100	56.1	H	74.0	-17.9	PK	310	1.3	RB 1 MHz;VB 3 MHz;Peak
4804.090	39.2	H	54.0	-14.8	Avg	306	1.4	Note 4,RB 1 MHz;VB 1 kHz;Peak VA
4805.100	48.4	H	74.0	-25.6	PK	306	1.4	RB 1 MHz;VB 3 MHz;Peak



Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

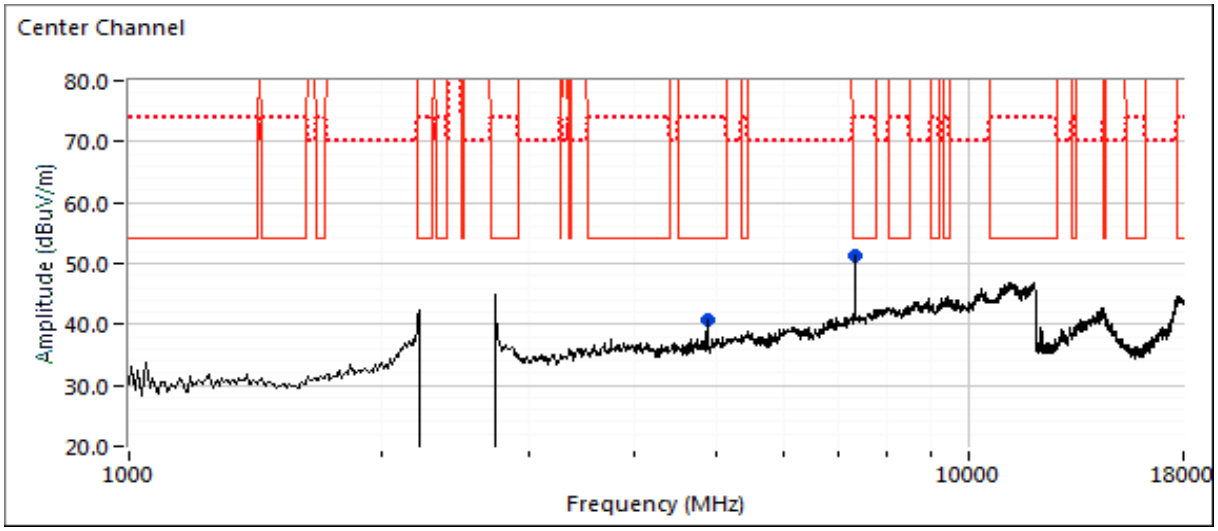


Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

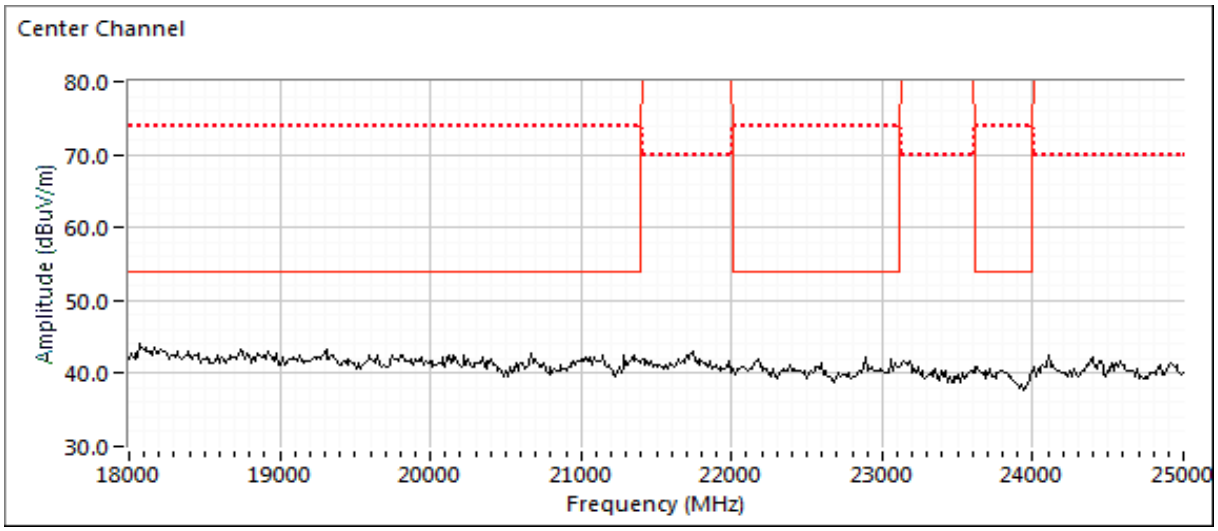
Run #1b: Center Channel

Channel: 37 EUT Orientation : Flat

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7319.590	49.1	H	54.0	-4.9	Avg	269	1.5	Note 4,RB 1 MHz;VB 1 kHz;Peak VA
7319.080	57.2	H	74.0	-16.8	PK	269	1.5	RB 1 MHz;VB 3 MHz;Peak
4879.930	40.5	H	54.0	-13.5	Avg	34	1.4	Note 4,RB 1 MHz;VB 1 kHz;Peak VA
4880.750	48.7	H	74.0	-25.3	PK	34	1.4	RB 1 MHz;VB 3 MHz;Peak



Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A



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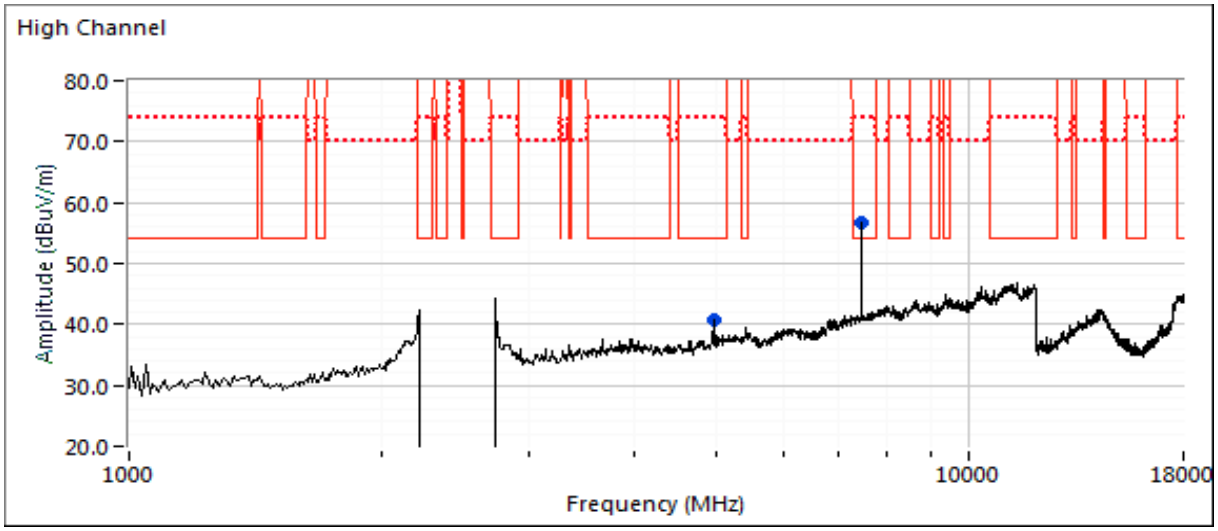
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A

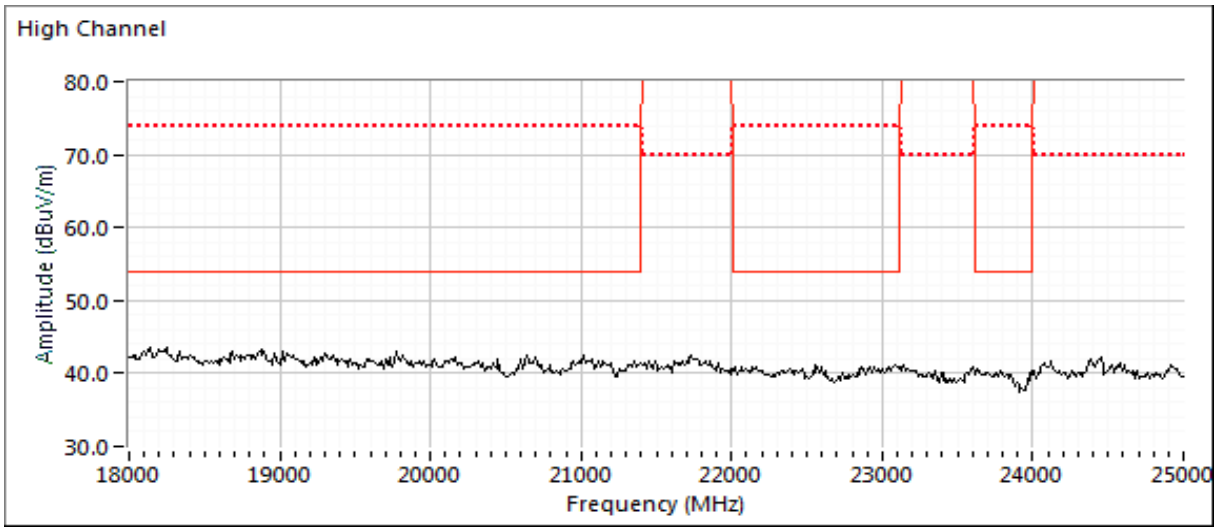
Run #1c: High Channel

Channel: 39 EUT Orientation : Flat

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7439.770	53.3	H	54.0	-0.7	AVG	274	1.0	RB 1 MHz;VB 10 Hz;Peak
7439.100	60.8	H	74.0	-13.2	PK	274	1.0	RB 1 MHz;VB 3 MHz;Peak
4959.960	36.7	H	54.0	-17.3	AVG	243	1.0	RB 1 MHz;VB 10 Hz;Peak
4960.420	47.7	H	74.0	-26.3	PK	243	1.0	RB 1 MHz;VB 3 MHz;Peak



Client:	Specialized Bicycle Components, Inc.	Job Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Coordinator:	David Bare
Standard:	FCC Part 15, LP0002	Class:	N/A



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Model:	ANGi 1.0	T-Log Number:	TL079926-RA
		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Engineer:	David Bare
Standard:	FCC Part 15, LP0002	Class:	B

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: 7/10/2018
Test Engineer: Rafael Varelas
Test Location: Fremont Chamber #5
Config. Used: 1
Config Change: none
EUT Voltage: 3V from 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: 23.4 °C
Rel. Humidity: 39 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	30 kHz - 30 MHz	FCC 15.209	Pass	Refer to individual runs

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: 44002255
Antenna: Internal

EUT configured for Center channel 2440 MHz, No emissions were found from the BLE radio below 30 MHz.

Client:	Specialized Bicycle Components, Inc.	PR Number:	PR079926
Model:	ANGi 1.0	T-Log Number:	TL079926-RA
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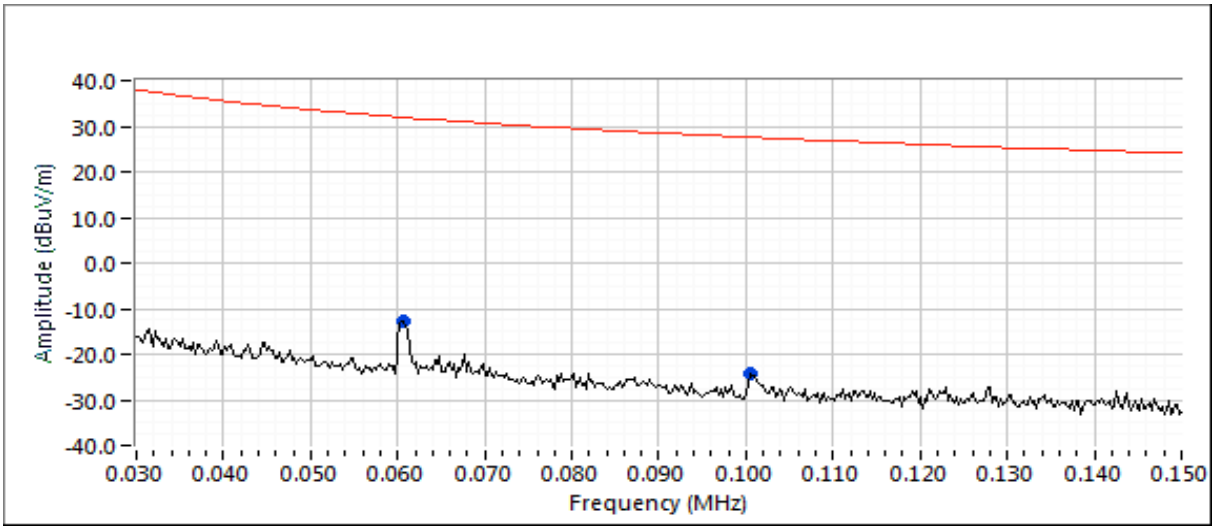
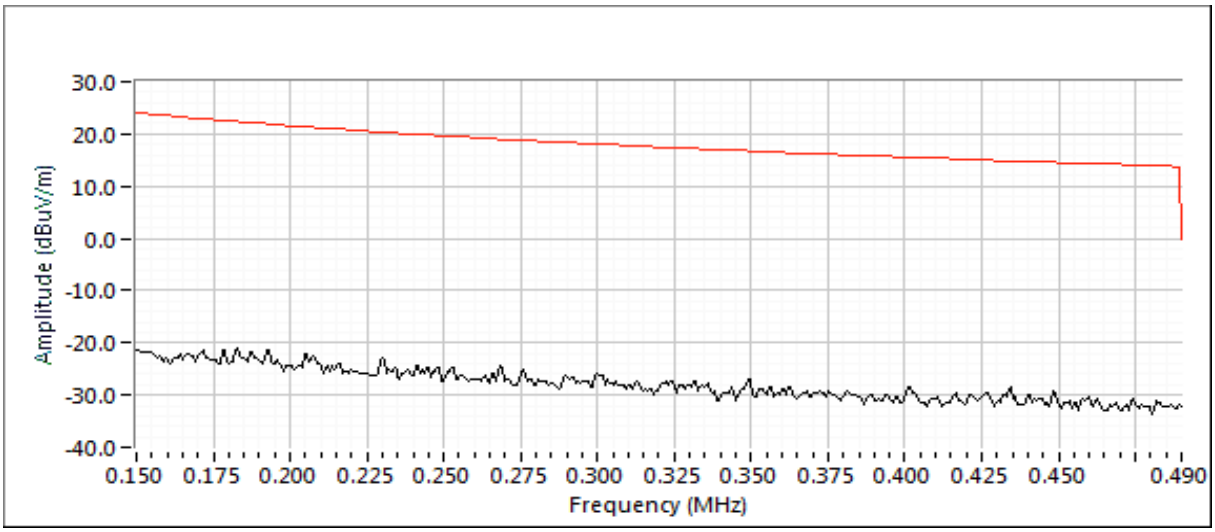
Contact:	Orlando Cordero	Project Engineer:	David Bare
Standard:	FCC Part 15, LP0002	Class:	B

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

Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
0.009 - 0.490 MHz	3	300	-80.0
0.490 - 1.705 MHz	3	30	-40.0
1.705 - 30.0 MHz	3	30	-40.0

Note - the extrapolation factor is based on 40log(test distance/limit distance) as permitted by FCC 15.31





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Model:	ANGi 1.0	T-Log Number:	TL079926-RA
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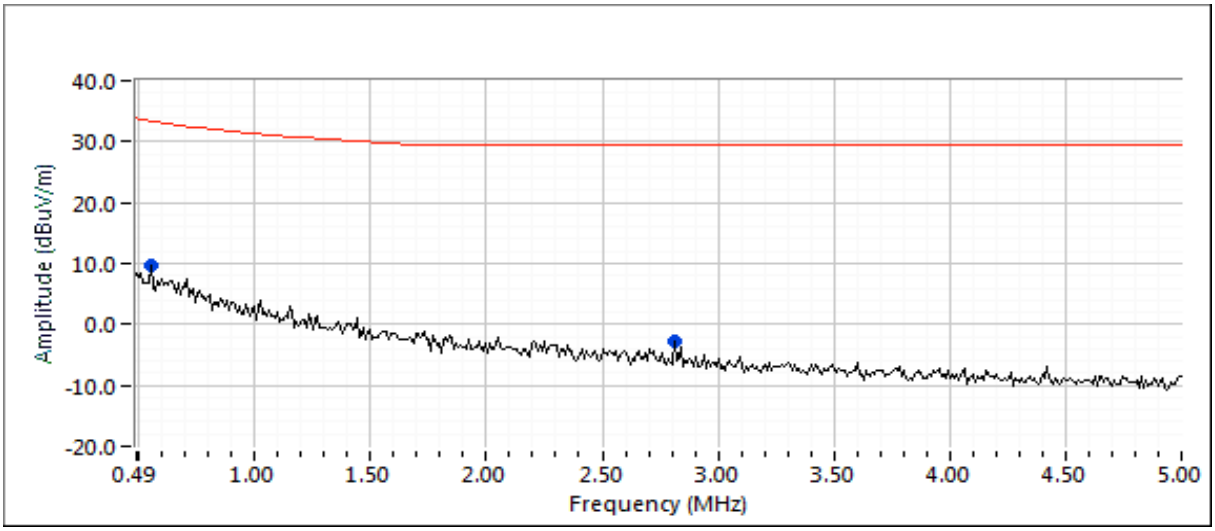
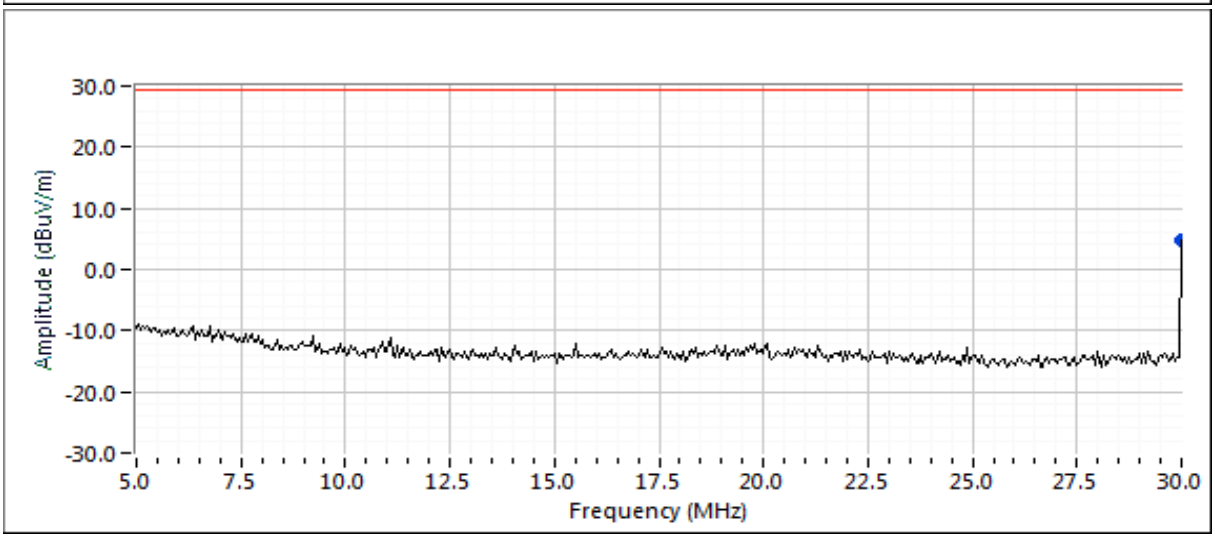
Standard:	FCC Part 15, LP0002	Class:	B





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		Project Manager:	Deepa Shetty
Contact:	Orlando Cordero	Project Engineer:	David Bare
Standard:	FCC Part 15, LP0002	Class:	B

Preliminary readings

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
0.061	-12.7	H	31.9	-44.6	Peak	294	1.2	
0.101	-24.2	H	27.6	-51.8	Peak	197	1.2	
0.553	9.6	H	33.4	-23.8	Peak	353	1.2	
2.813	-2.8	H	29.5	-32.3	Peak	349	1.2	
30.000	4.9	H	29.5	-24.6	Peak	28	1.2	

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.

Maximized 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	
30.000	4.9	H	29.5	-24.6	Peak	28	1.2	
0.553	9.6	H	33.4	-23.8	Peak	353	1.2	

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.

End of Report

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