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EMC Test Report

Application for Grant of Equipment Authorization

Industry Canada RSS-Gen Issue 4 / RSS 247 Issue 1
FCC Part 15 Subpart C

Model: H1B

IC CERTIFICATION #:	20282-1H1B
FCC ID:	2AEP5H1B
APPLICANT:	Olio Devices 2101 Pacific Ave #303 San Francisco, CA 94115
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-5
REPORT DATE:	July 29, 2015
FINAL TEST DATES:	May 27, 28 and July 10, 2015
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Testing Cert #0214.26

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	July 29, 2015	First release	

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SCOPE

An electromagnetic emissions test has been performed on the Olio Devices model H1B, pursuant to the following rules:

Industry Canada RSS-Gen Issue 4
RSS 247 Issue 1 "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 - Silicon Valley test procedures:

ANSI C63.10-20013
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.

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 sample of Olio Devices model H1B complied with the requirements of the following regulations:

Industry Canada RSS-Gen Issue 4
RSS 247 Issue 1 "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 Olio Devices model H1B and therefore apply only to the tested sample. The sample was selected and prepared by AJ Cooper of Olio Devices.

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)	5.2	Digital Modulation	Systems uses DSSS techniques	System must utilize a digital transmission technology	Complies
15.247 (a) (2)	5.2 (1)	6dB Bandwidth	681kHz	>500kHz	Complies
15.247 (b) (3)	5.4 (4)	Output Power (multipoint systems)	2.8 dBm (0.0019 Watts) EIRP = 0.5 mW Note 1	1Watt, EIRP limited to 4 Watts.	Complies
15.247(d)	5.2 (2)	Power Spectral Density	-3.9 dBm / 100kHz	8dBm/3kHz	Complies
15.247(c)	5.5	Antenna Port Spurious Emissions 30MHz – 25 GHz	All emissions >30dB below the limit	< -30dBc Note 2	Complies
15.247(c) / 15.209	5.5 RSS GEN Table 3	Radiated Spurious Emissions 30MHz – 25 GHz	47.6 dBµV/m @ 4804.4 MHz (-6.4 dB)	15.207 in restricted bands, all others <-30dBc Note 2	Complies

Note 1: EIRP calculated using antenna gain of -6.0 dBi for the highest EIRP system.
Note 2: Limit of -30dBc used because the power was measured using the UNII test procedure (maximum power averaged over a transmission burst).

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Antenna is integral to the device	Unique or integral antenna required	Complies
15.207	RSS GEN Table 3	AC Conducted Emissions	N/A – the EUT is battery powered. It is recharged via a wireless power function		
15.247 (b) (5) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to SAR Exclusion calculations in separate exhibit	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
Conducted emission of receiver	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 26500 MHz	± 2.5 dB
Radiated emission (field strength)	dBµV/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB
Conducted Emissions (AC Power)	dBµV	0.15 to 30 MHz	± 2.4 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Olio Devices model H1B is a wrist watch that is designed to be worn by a consumer. It utilizes an Bluetooth 4.0 radio. The EUT was treated as tabletop equipment during testing for purpose of testing. The electrical rating of the EUT is battery power via a magnetic coil.

The sample was received on May 27, 2015 and tested on May 27, 28 and July 10, 2015. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Olio	Model One	Watch	H1B	2AEP5H1B

ANTENNA SYSTEM

The antenna consist of a slot radiator formed by the sheet metal and steel housing. The antenna gain is -6.0dBi @ 2.4GHz.

ENCLOSURE

The EUT enclosure is primarily constructed of steel. It measures approximately 25 x 4.5 x 1.5cm.

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
Camelion	AD3127	USB Power Adapter	NA	-

The following equipment was used as remote support equipment for emissions testing:

Company	Model	Description	Serial Number	FCC ID
Dell	Inspiron 14	laptop	1ZL5832	DoC

EUT INTERFACE PORTS

The EUT has no interface ports.

EUT OPERATION

Unless otherwise noted, the EUT configured for continuous transmission at the maximum output power. The modulation used is noted for each test.

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 4	US0027	2845B-4	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. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.10. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

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

The receivers utilize either a Rohde & Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the 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 Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

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. 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.

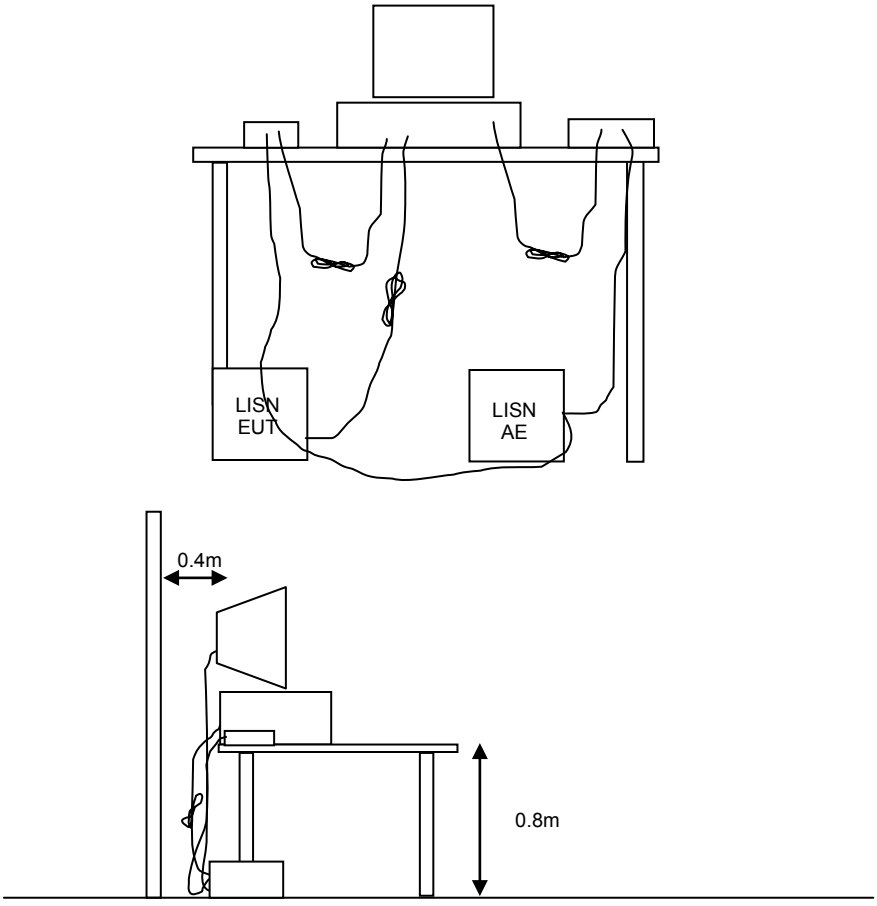


Figure 1 Typical Conducted Emissions Test Configuration

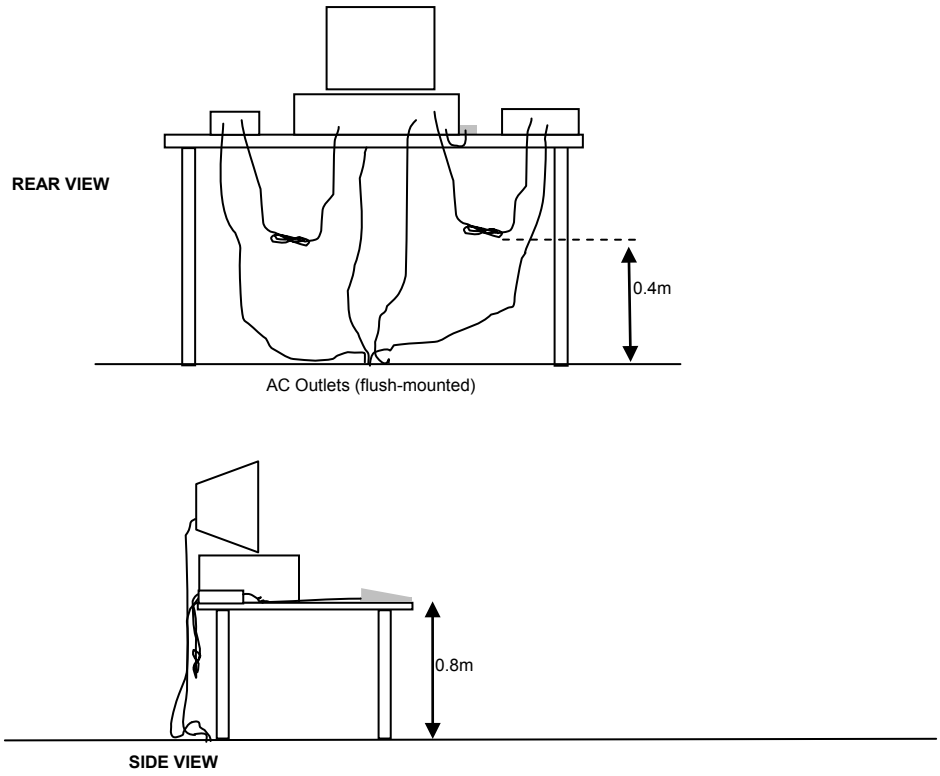
RADIATED EMISSIONS

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

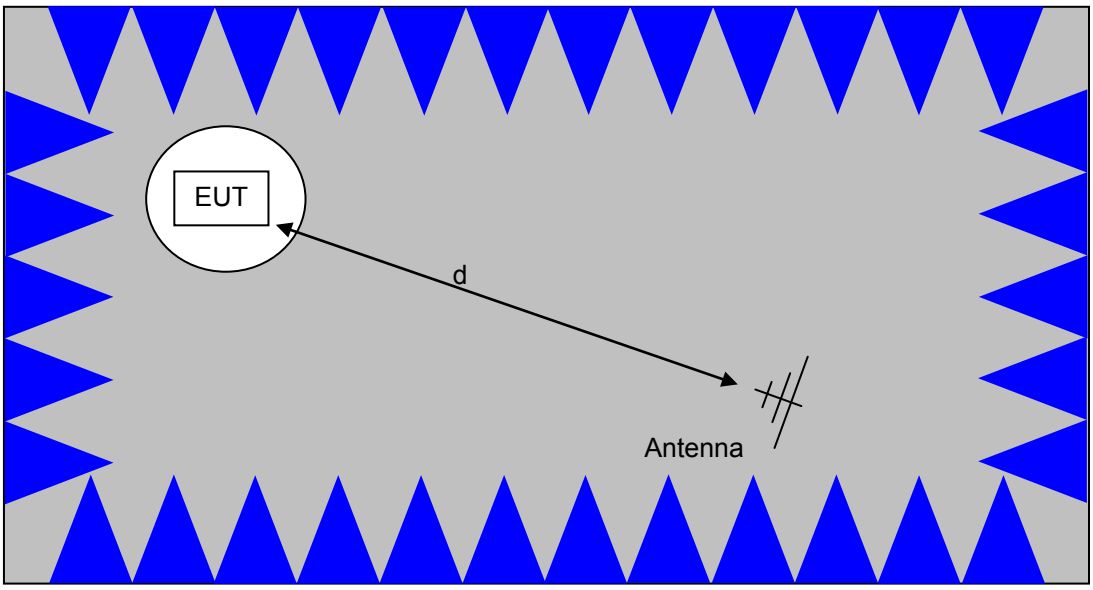
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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.

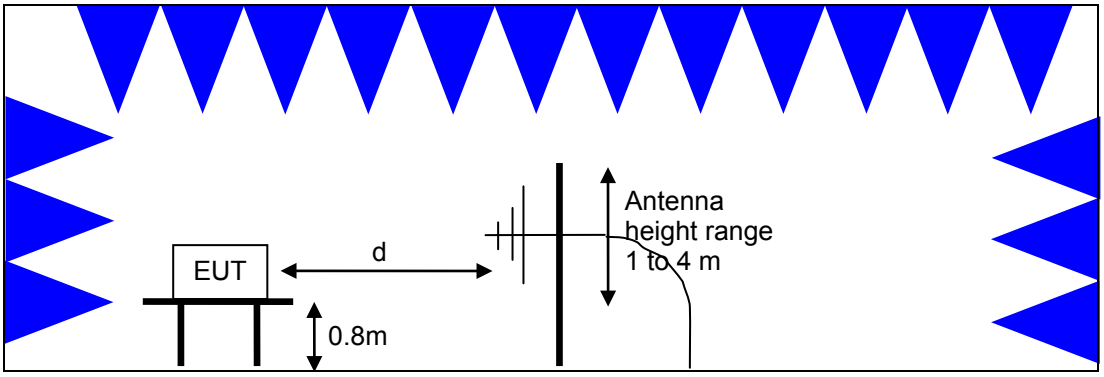


Typical Test Configuration for Radiated Field Strength Measurements



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.

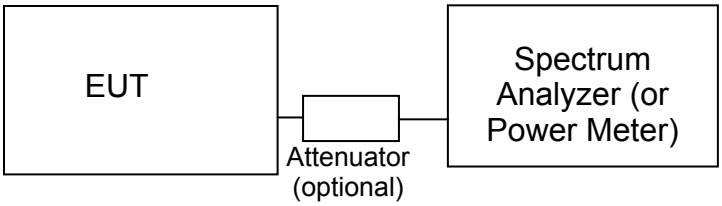
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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] (with the exception of transmitters operating under FCC Part 15 Subpart D and RSS 210 Annex 9), the limits for all emissions from a low power device operating under the general rules of RSS 310 (tables 3 and 4), RSS GEN (table 5) and FCC Part 15 Subpart C section 15.209.

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
2400 – 2483.5	1 Watt (30 dBm)	8 dBm/3kHz

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi.

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 247. 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 15.203, RSS 210 Table 1 and RSS 310 Table 2

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, 27-May-15

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
EMCO	Antenna, Horn, 1-18 GHz	3115	487	7/29/2014	7/29/2016
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	10/31/2014	10/31/2015
Hewlett Packard	SpecAn 9 kHz - 40 GHz, FT (SA40) Blue	8564E (84125C)	1393	5/2/2015	5/2/2016
Hewlett Packard	Head (Inc flex cable, (1742,1743) Blue)	84125C	1620	5/6/2014	6/6/2015
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1683	8/4/2014	8/4/2015
A. H. Systems	Spare System Horn, 18-40GHz	SAS-574, p/n: 2581	2162	7/24/2014	7/24/2015
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESIB40 (1088.7490.40)	2493	1/23/2015	1/23/2016
Hewlett Packard	High Pass filter, 8.2 GHz (Purple System)	P/N 84300-80039	1767	11/14/2014	11/14/2015

Radiated Emissions, 1,000 - 25,000 MHz, 28-May-15

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/20/2013	12/20/2015
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	2/20/2015	2/20/2016
Hewlett Packard	Head (Inc flex cable, 1143, 2198) Red	84125C	1145	6/17/2014	6/17/2015
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/20/2014	9/20/2015
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1683	8/4/2014	8/4/2015
A. H. Systems	Red System Horn, 18-40GHz	SAS-574, p/n: 2581	2161	7/9/2014	7/9/2015

Radio Antenna Port (Power and Spurious Emissions), 28-May-15

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/20/2013	12/20/2015
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESIB40 (1088.7490.40)	2493	1/23/2015	1/23/2016

Radiated Emissions, 30 - 1,000 MHz, 01-Jun-15

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1548	9/17/2014	9/17/2016
Com-Power	Preamplifier, 30-1000 MHz	PA-103A	2359	12/22/2014	12/22/2015
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESIB40 (1088.7490.40)	2493	1/23/2015	1/23/2016

Radiated Emissions, 100 - 26,000 MHz, 10-Jul-15

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/20/2013	12/20/2015
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1630	7/6/2015	7/6/2016
Hewlett Packard	Head (Inc 3136 Miteq + cable) Purple		1772	6/19/2015	6/19/2016
A. H. Systems	Purple System Horn, 18-40GHz	SAS-574, p/n: 2581	2160	8/11/2014	8/11/2015
Hewlett Packard	Microwave Preamplifier, 1-	8449B	2199	2/20/2015	2/20/2016

	26.5GHz				
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2238	9/16/2014	9/16/2015
Hewlett Packard	SpecAn 9 kHz - 40 GHz, (SA40) Purple	8564E (84125C)	2415	3/7/2015	3/7/2016

Appendix B Test Data

T98220 Pages 24 - 40

Client:	Olio	Job Number:	J98176
Product	Wireless Watch (H1B) & charger	T-Log Number:	T98220
		Project Manager:	Irene Rademacher
Contact:	AJ Cooper	Project Coordinator:	
Emissions Standard(s):	FCC 15.247 / 15.B / RSS-247	Class:	B
Immunity Standard(s):	-	Environment:	

EMC Test Data

For The

Olio

Product

Wireless Watch (H1B) & charger

Date of Last Test: 7/13/2015

Client:	Olio	Job Number:	J98176
Model:	Wireless Watch (H1B) & charger	T-Log Number:	T98220
		Project Manager:	Irene Rademacher
Contact:	AJ Cooper	Project Coordinator:	-
Standard:	FCC 15.247 / 15.B / 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: 20.8 °C
Rel. Humidity: 36 %

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

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1a	BLE	2402	default	-	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	43.6 dBµV/m @ 2380.1 MHz (-10.4 dB)
			default	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	47.6 dBµV/m @ 4804.4 MHz (-6.4 dB)
1b	BLE	2440	default	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	44.9 dBµV/m @ 4879.2 MHz (-9.1 dB)
1c	BLE	2480	default	-	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	42.8 dBµV/m @ 2487.5MHz (-11.2 dB)
			default	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	46.3 dBµV/m @ 4959.3 MHz (-7.7 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.

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Contact:	AJ Cooper	Project Coordinator:	-
Standard:	FCC 15.247 / 15.B / RSS-247	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.
Testing performed at 1.5m, per C63.10
EUT rotated thru three orientations to determine worse case position. Only worse case results are presented.
No emissions below 1GHz were observed in preliminary testing.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BLE	1 Mb/s	0.50	Yes	0.32	3.0103	6.0205999	3125

Sample Notes

Sample S/N: Bluetooth#1
Driver: -
Antenna: Internal

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:	Peak measurement complied with average limit
Note 6:	Plots of the average and peak bandedge do not account for any duty cycle correction. Refer to the tabular results for final measurements.

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Contact:	AJ Cooper	Project Coordinator:	-
Standard:	FCC 15.247 / 15.B / RSS-247	Class:	N/A

Run #1: Radiated Spurious Emissions, 1000 - 26,000 MHz. Operating Mode: BLE

Date of Test: 7/10/2015 0:00 Config. Used: 1

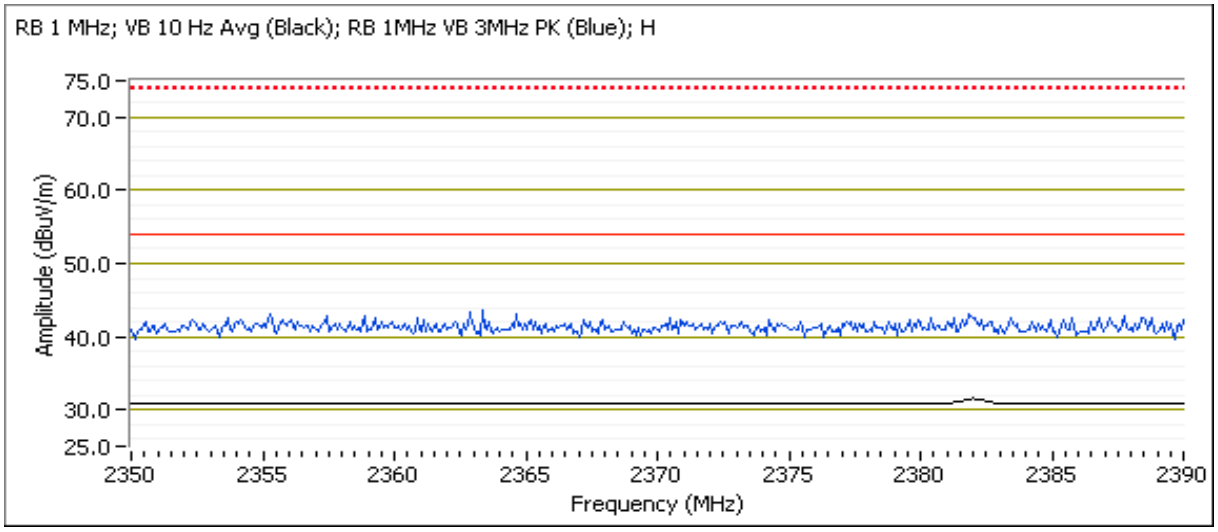
Test Engineer: Rafael Varelas Config Change: None

Test Location: FT Chamber #4 EUT Voltage: Battery

Run #1a: Low Channel @ 2402 MHz

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	
2382.710	42.2	H	54.0	-11.8	PK	296	1.0	POS; RB 1 MHz; VB: 3 MHz, note 3
2380.140	43.6	V	54.0	-10.4	PK	108	1.0	POS; RB 1 MHz; VB: 3 MHz, note 3



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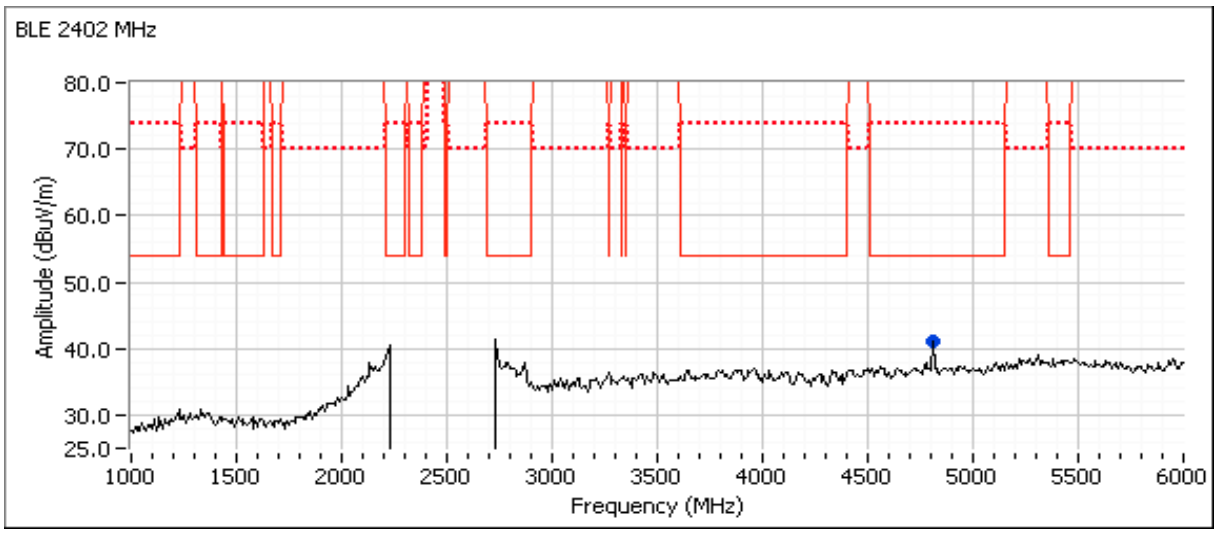
Contact:	AJ Cooper	Project Coordinator:	-
Standard:	FCC 15.247 / 15.B / RSS-247	Class:	N/A

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4804.440	47.6	H	54.0	-6.4	PK	143	1.3	RB 1 MHz;VB 3 MHz;Peak, note 3

Note:	Scans made between 6 - 26 GHz with the measurement antenna moved around the card and its antennas 20-50cm from the device indicated there were no significant emissions in this frequency range



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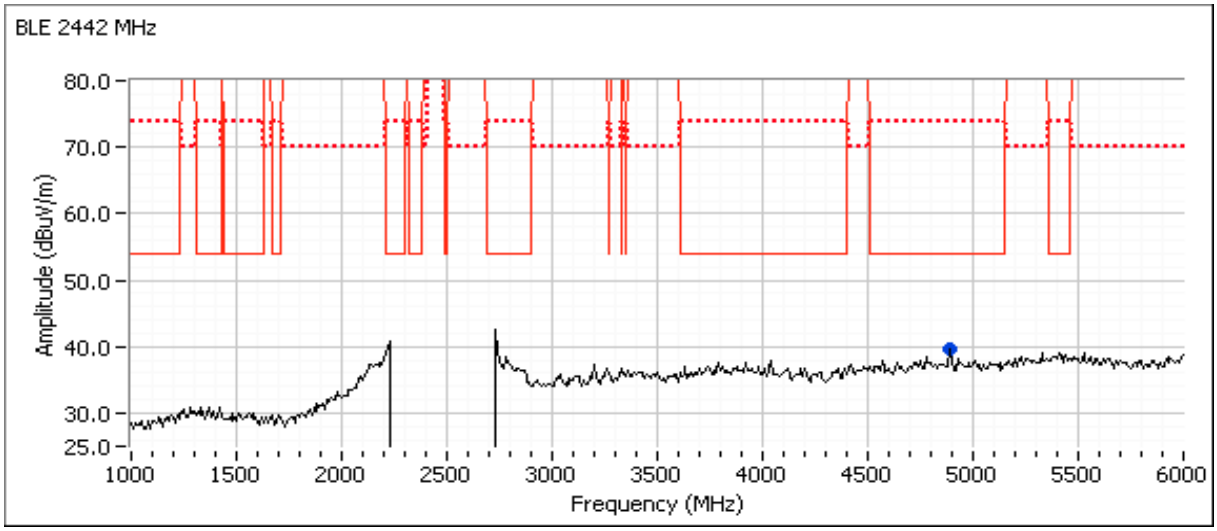
Contact:	AJ Cooper	Project Coordinator:	-
Standard:	FCC 15.247 / 15.B / RSS-247	Class:	N/A

Run #1b: Center Channel @ 2442 MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4879.150	44.9	H	54.0	-9.1	PK	136	1.7	RB 1 MHz;VB 3 MHz;Peak, note 3

Note:	Scans made between 6 - 26 GHz with the measurement antenna moved around the card and its antennas 20-50cm from the device indicated there were no significant emissions in this frequency range



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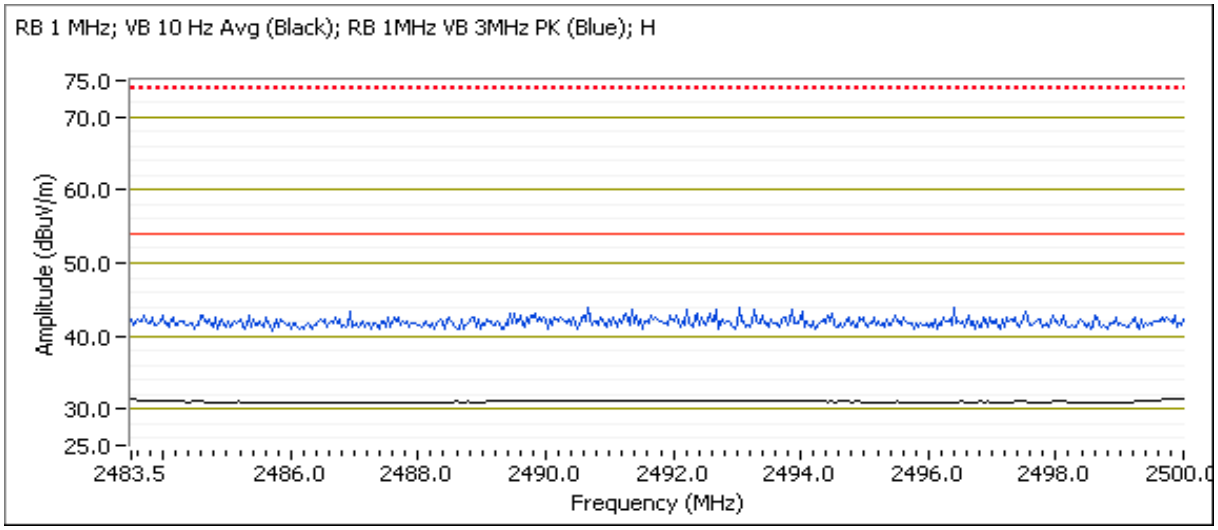
Contact:	AJ Cooper	Project Coordinator:	-
Standard:	FCC 15.247 / 15.B / RSS-247	Class:	N/A

Run #1c: High Channel @ 2480 MHz
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	
2488.860	42.5	H	54.0	-11.5	PK	268	1.4	RB 1 MHz;VB 3 MHz;Peak, note 3
2487.500	42.8	V	54.0	-11.2	PK	75	2.5	RB 1 MHz;VB 3 MHz;Peak, note 3



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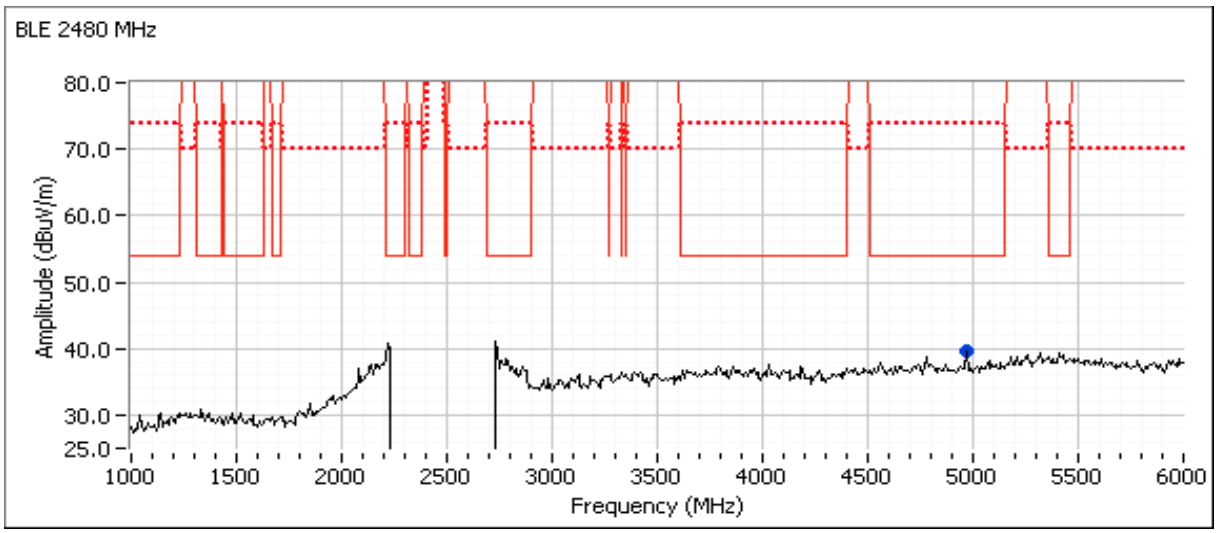
		Project Manager:	Irene Rademacher
Contact:	AJ Cooper	Project Coordinator:	-
Standard:	FCC 15.247 / 15.B / RSS-247	Class:	N/A

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4959.270	46.3	H	54.0	-7.7	PK	152	1.3	RB 1 MHz;VB 3 MHz;Peak, note 3

Note:	Scans made between 6 - 26 GHz with the measurement antenna moved around the card and its antennas 20-50cm from the device indicated there were no significant emissions in this frequency range



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Contact:	AJ Cooper	Project Coordinator:	-
Standard:	FCC 15.247 / 15.B / RSS-247	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: 7/10/2015
Test Engineer: Rafael Varelas
Test Location: FT Chamber #4

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

General Test Configuration

The EUT and all local support equipment were located on the turntable for testing.

Ambient Conditions:

Temperature: 20.8 °C
Rel. Humidity: 36 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1	-	-	Output Power	15.247(b)	Pass	2.8 dBm (0.0019 W)
2	-	-	Power spectral Density (PSD)	15.247(d)	Pass	-3.9 dBm/100kHz
3	-	-	Minimum 6dB Bandwidth	15.247(a)	Pass	681 kHz
3	-	-	99% Bandwidth	RSS GEN	-	1060 kHz
4	-	-	Spurious emissions	15.247(b)	Pass	All emissions >30dB below the 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.

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Contact:	AJ Cooper	Project Coordinator:	-
Standard:	FCC 15.247 / 15.B / RSS-247	Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BLE	1Mb/s	0.50	Yes	0.32	3.0103	6.0205999	3125

Sample Notes

Sample S/N: Bluetooth#1
Driver: -
Antenna: Internal

Run #1: Output Power

Mode: BLE

Power Setting[2]	Frequency (MHz)	Output Power (EIRP) (dBm)[1]	mW	Antenna Gain (dBi)	Result	Power dBm	W	Output Power (dBm)	mW
Vertical									
default	2402	-4.2	0.4	-6.0	Pass	1.8	0.0015		
default	2442	-4.1	0.4	-6.0	Pass	1.9	0.0015		
default	2480	-4.3	0.4	-6.0	Pass	1.7	0.0015		
Horizontal									
default	2402	-3.7	0.4	-6.0	Pass	2.3	0.0017		
default	2442	-3.2	0.5	-6.0	Pass	2.8	0.0019		
default	2480	-3.8	0.4	-6.0	Pass	2.2	0.0017		

Note 1:	Duty Cycle < 98%, constant duty cycle. Output power measured using a spectrum analyzer (see plots below) with RBW= 1-5% of OBW, VB≥3* RBW, RMS detector, power averaging on, and power integration over the OBW, trace average 100 traces (option AVGSA-1, in KDB 558074). Measurement corrected by Pwr Cor Factor. Spurious limit becomes -30dBc. Plots do not include the duty cycle corretion of 3dB.
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.

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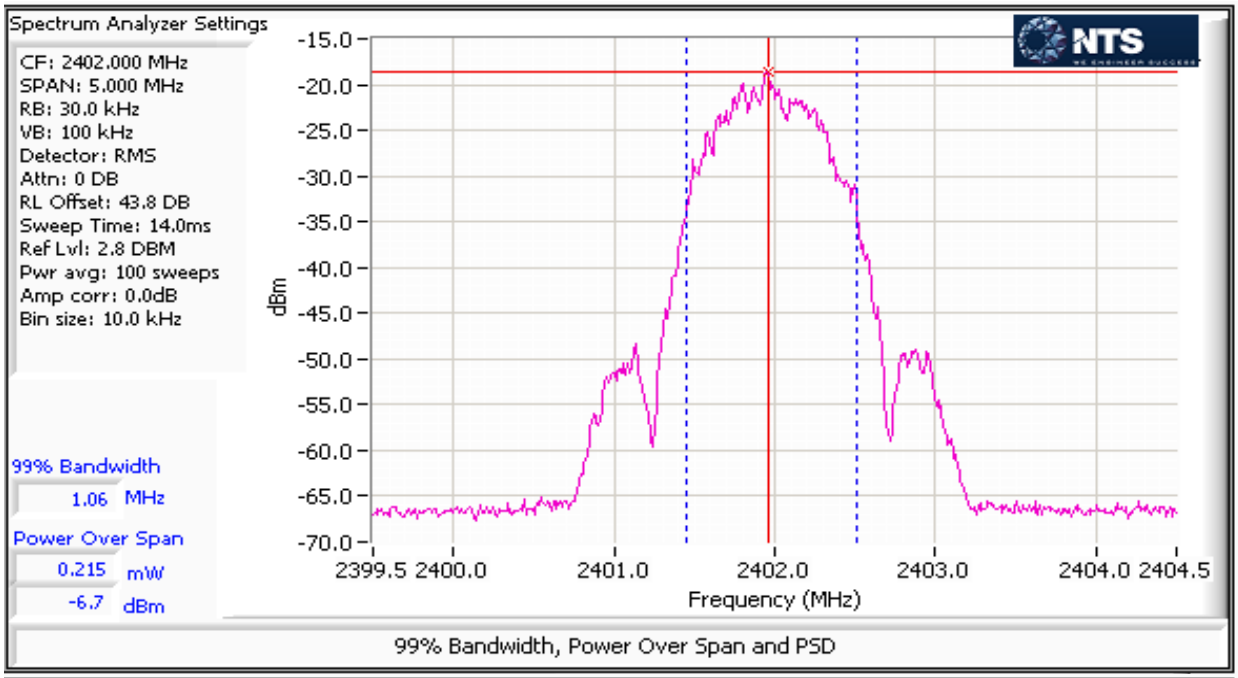
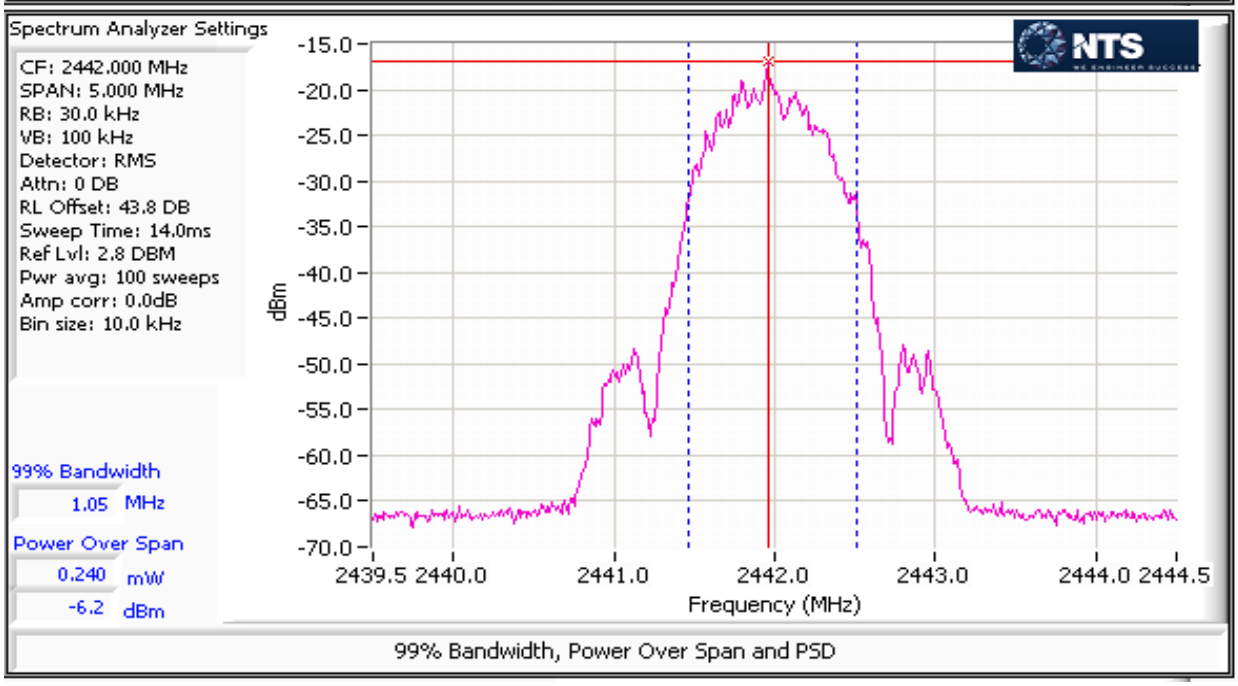
Standard:	FCC 15.247 / 15.B / RSS-247	Class:	N/A



99% Bandwidth, Power Over Span and PSD



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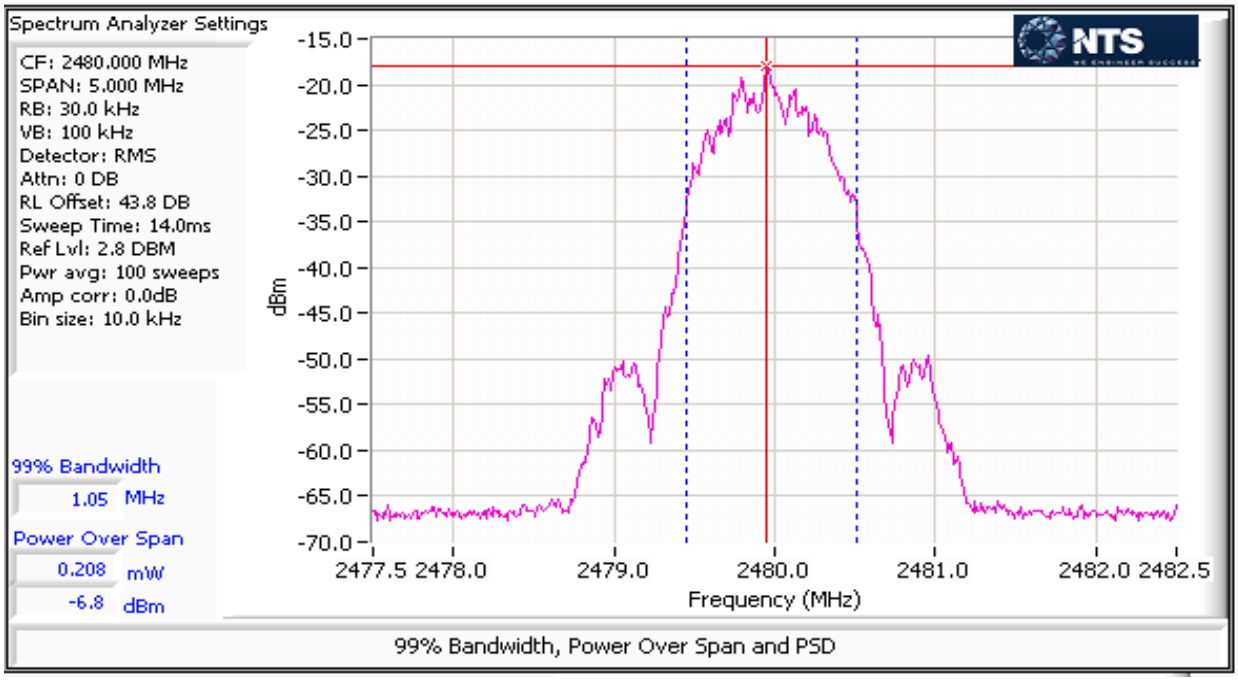

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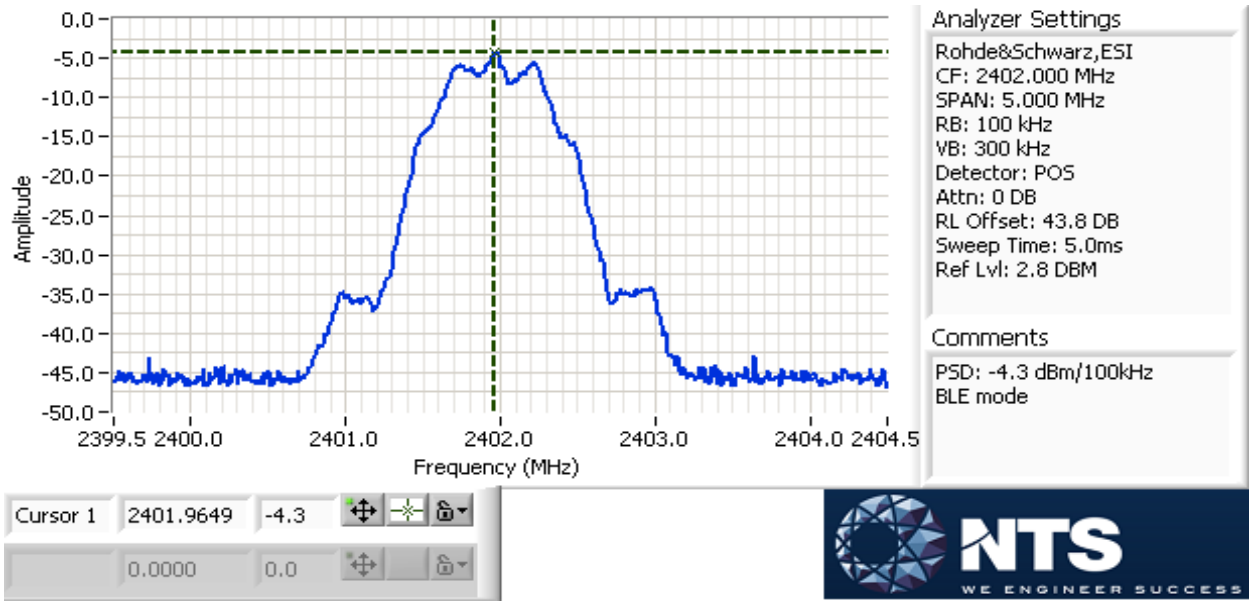
Contact:	AJ Cooper	Project Coordinator:	-
Standard:	FCC 15.247 / 15.B / RSS-247	Class:	N/A

Run #2: Power spectral Density

Mode: BLE

Power Setting	Frequency (MHz)	PSD (eirp) (dBm/100kHz) Note 1	Ant Gain (dBi)	PSD (dBm/100kHz) Note 1	Limit dBm/3kHz	Result
default	2402	-4.3	-6	1.7	8.0	Pass
default	2442	-3.9	-6	2.1	8.0	Pass
default	2480	-4.7	-6	1.3	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.



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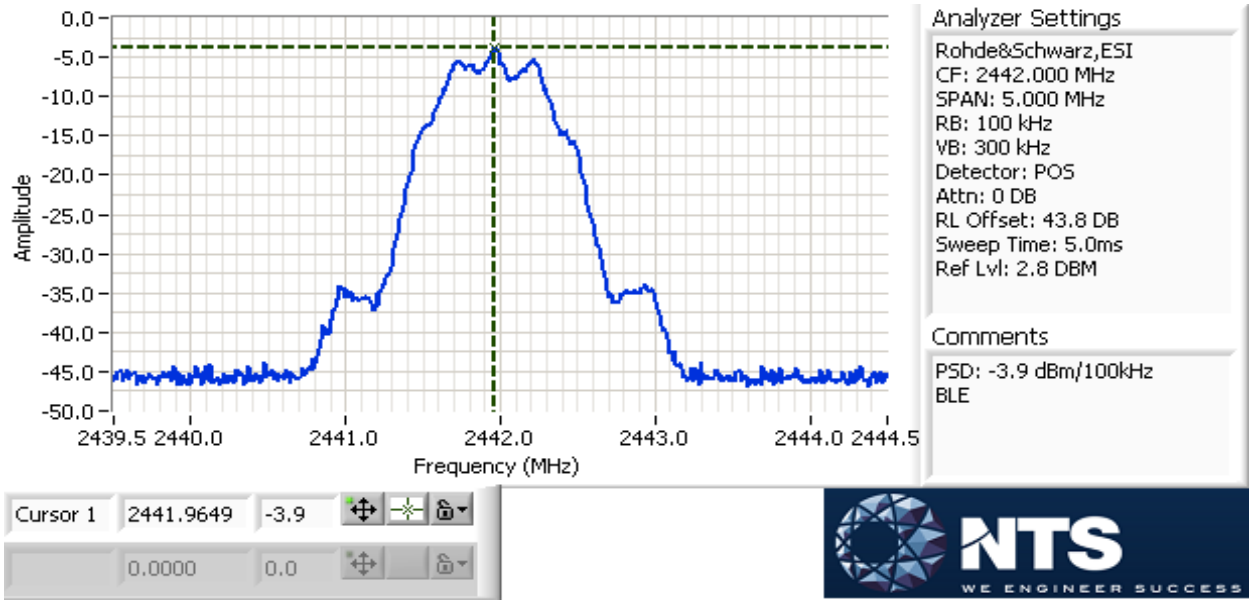
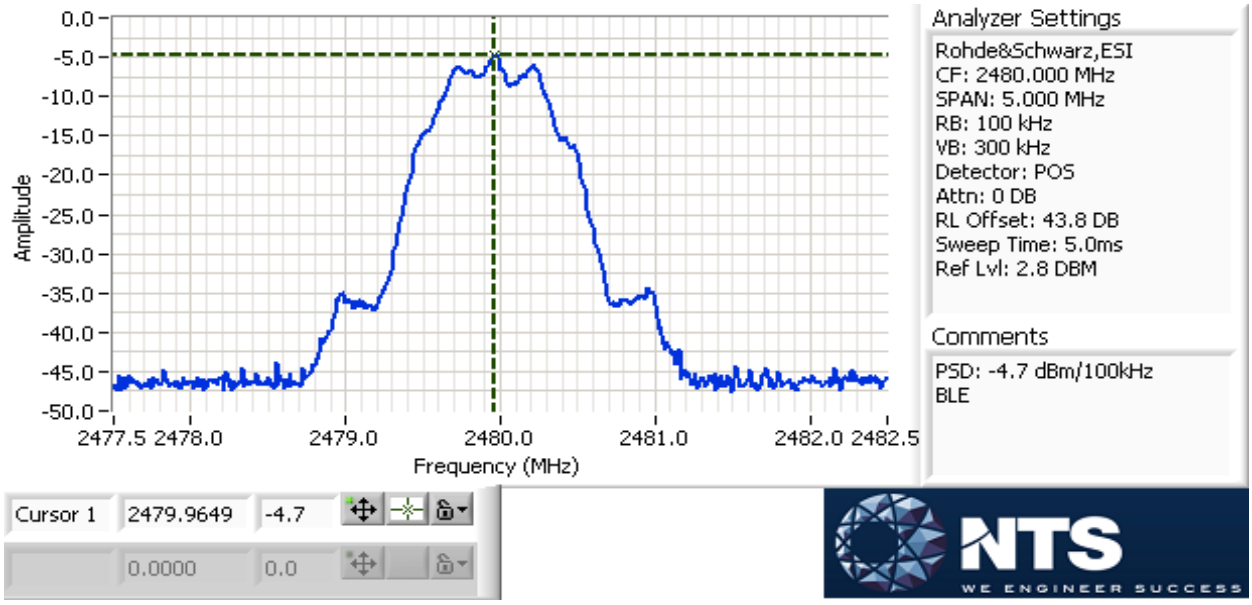
Standard:	FCC 15.247 / 15.B / RSS-247	Class:	N/A





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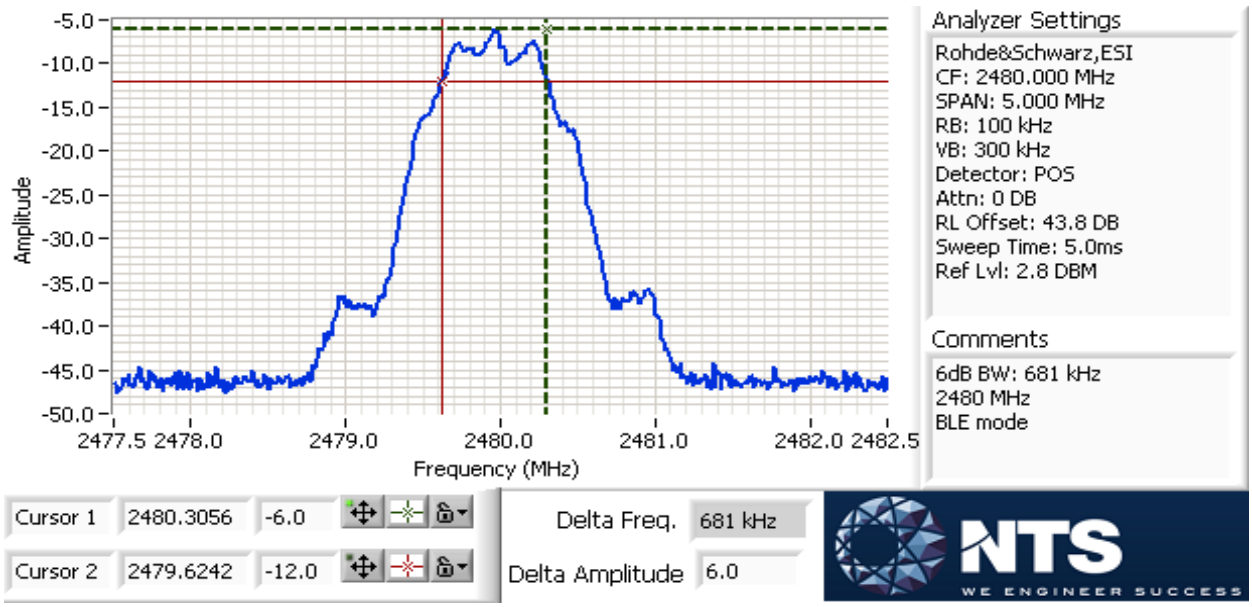
Contact:	AJ Cooper	Project Coordinator:	-
Standard:	FCC 15.247 / 15.B / RSS-247	Class:	N/A

Run #3: Signal Bandwidth

Mode: BLE

Power Setting	Frequency (MHz)	Bandwidth (kHz)		RBW Setting (MHz)	
		6dB	99%	6dB	99%
default	2402	681	1060	100kHz	30kHz
default	2442	681	1060	100kHz	30kHz
default	2480	681	1060	100kHz	30kHz

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



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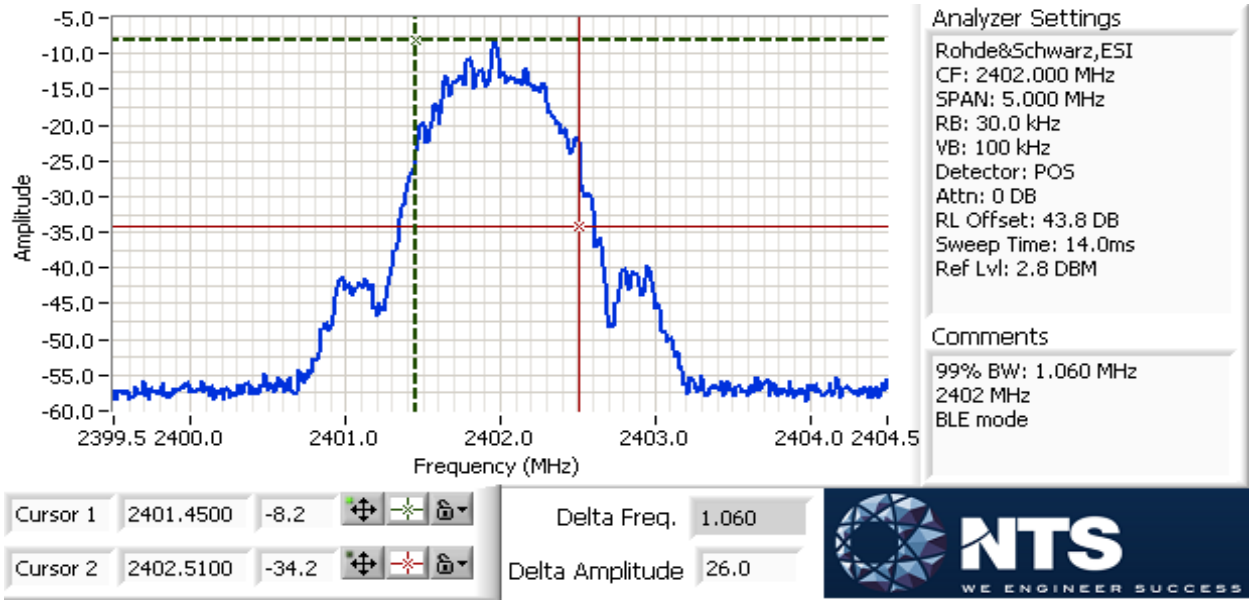
Contact:	AJ Cooper	Project Coordinator:	-
Standard:	FCC 15.247 / 15.B / RSS-247	Class:	N/A



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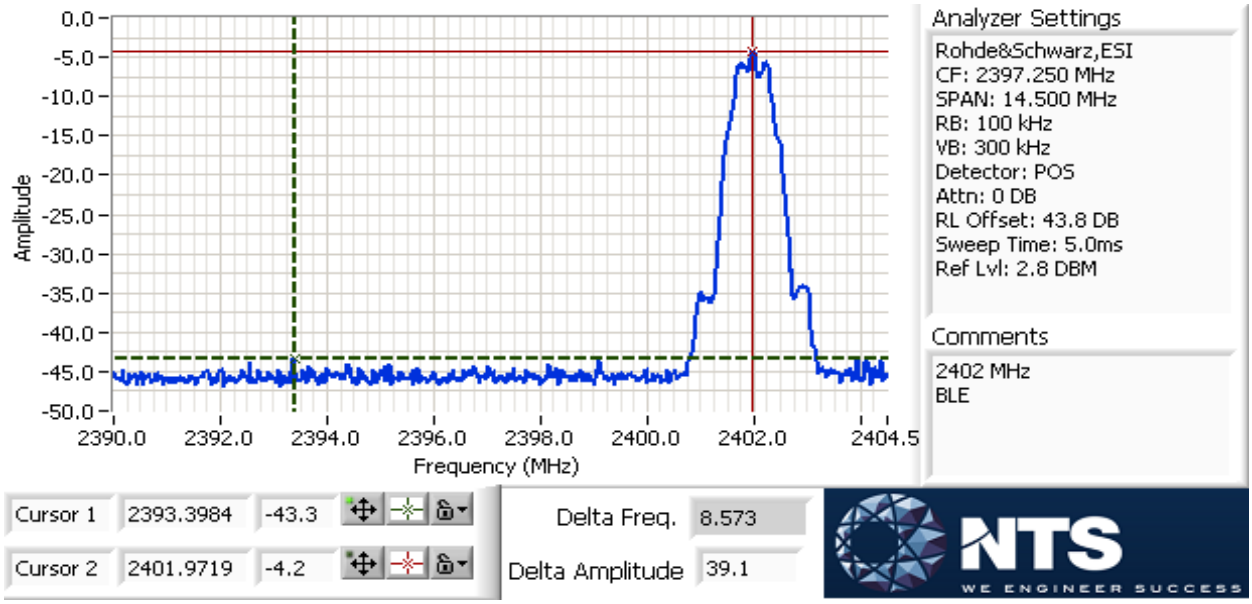
Standard:	FCC 15.247 / 15.B / RSS-247	Class:	N/A

Run #4a: Out of Band Spurious Emissions

Frequency (MHz)	Power Setting	Mode	Limit	Result
2402 MHz	default	BLE	-30dBc	Pass

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.

Measurement performed using RBW=100kHz, VBW=300kHz, peak detector, max hold



End of Report

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