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EMC Test Report

Application for FCC Grant of Equipment Authorization
Canada Certification
Class II Permissive Change/Reassessment

Innovation, Science and Economic Development Canada
RSS-Gen Issue 4 / RSS 247 Issue 1
FCC Part 15 Subpart C

Model: FB406

IC CERTIFICATION #:	8542A-FB406
FCC ID:	XRAFB406
APPLICANT:	Fitbit, Inc. 405 Howard Street San Francisco, CA 94105
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-7
REPORT DATE:	October 10, 2016
REISSUE DATE:	October 21, 2016
FINAL TEST DATES:	August 29, 30, 31 and September 21, 2016
TOTAL NUMBER OF PAGES:	40

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ACCREDITED
Testing Cert #0214.26

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	October 10, 2016	First release	
1.0	October 21, 2016	Clarified spurious emissions frequency range investigated. Updated power measurements with peak power measurements.	MEH

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SCOPE

An electromagnetic emissions test has been performed on the Fitbit, Inc. model FB406, pursuant to the following rules:

RSS-Gen Issue 4 " General Requirements for Compliance of Radio Apparatus"
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 C63.10-2013
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.

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 Fitbit, Inc. model FB406 complied with the requirements of the following regulations:

RSS-Gen Issue 4 " General Requirements for Compliance of Radio Apparatus"
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 Fitbit, Inc. model FB406 and therefore apply only to the tested sample. The sample was selected and prepared by Sachin Sawalapurkar of Fitbit, 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	Unchanged from original filing		
15.247 (a) (2)	RSS 247 5.2 (1)	6dB Bandwidth			
15.247 (b) (3)	RSS 247 5.4 (4)	Output Power (multipoint systems)	Unchanged from original filing		
15.247(e)	RSS 247 5.2 (2)	Power Spectral Density	Unchanged from original filing		
15.247(d)	RSS 247 5.5	Antenna Port Spurious Emissions 30MHz – 25 GHz			
15.247(d) / 15.209	RSS 247 5.5	Radiated Spurious Emissions 30MHz – 25 GHz	46.4 dBµV/m @ 4959.8 MHz (-7.6 dB)	Refer to the limits section (p17) for restricted bands, all others < -20dBc	Complies

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Unchanged from original filing		
15.407 (b) (6)	RSS-Gen Table 3	AC Conducted Emissions			
15.247 (i) 15.407 (f)	RSS 102	RF Exposure Requirements			

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 Fitbit, Inc. model FB406 is a wireless fitness tracker, which communicates with the user by a Bluetooth Low Energy link. It is powered by an internal, rechargeable battery. The EUT was treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 5 VDC.

The sample was received on August 29, 2016 and tested on August 29, 30, 31 and September 21, 2016. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Fitbit, Inc.	FB406	Wireless Activity Tracker	Refer to test data	XRAFB406

ANTENNA SYSTEM

Internal Antenna, -7.4dBi

ENCLOSURE

The EUT enclosure is primarily constructed of metal. It measures approximately 3.5 cm wide by 1.5 cm deep by 1 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
Nikon	EH-69P	USB charger	-	N/A

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
USB	Charger out	2 wire	Unshielded	0.3

Additional on Support Equipment

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Charger in	AC mains	2 wire	Unshielded	1

EUT OPERATION

During emissions testing the EUT was continuously transmitting at maximum power on the channel called out in the individual test. The modulation used was 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 7	US0027	2845B-7	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

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)

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 1.5m for measurements above 1GHz, and 0.8m for measurements below 1GHz. 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.

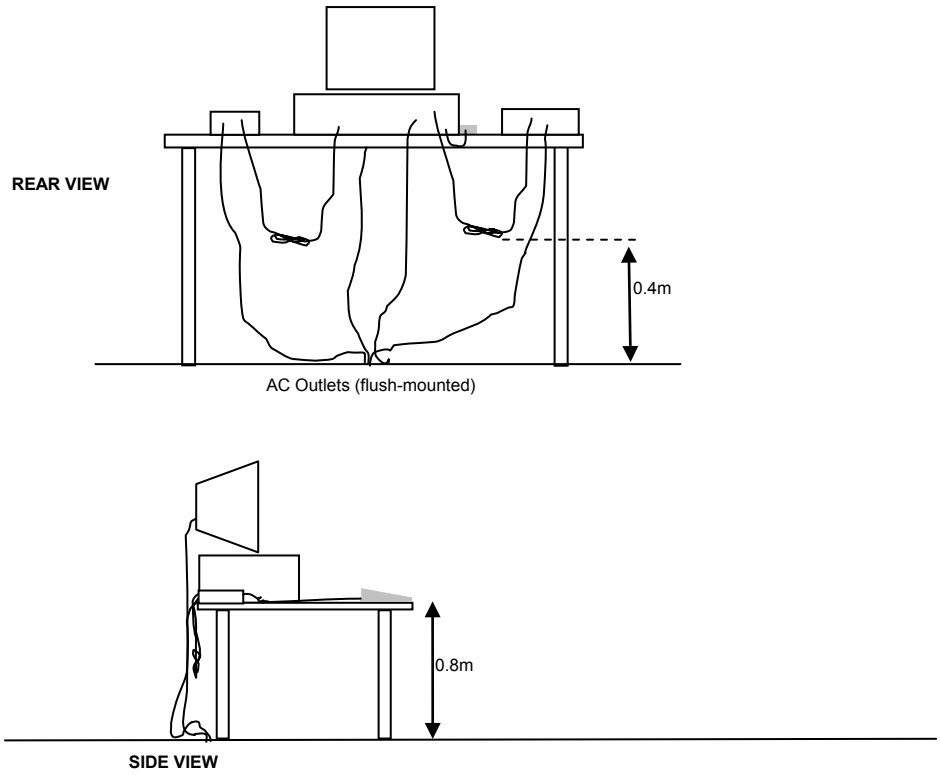
RADIATED EMISSIONS

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.

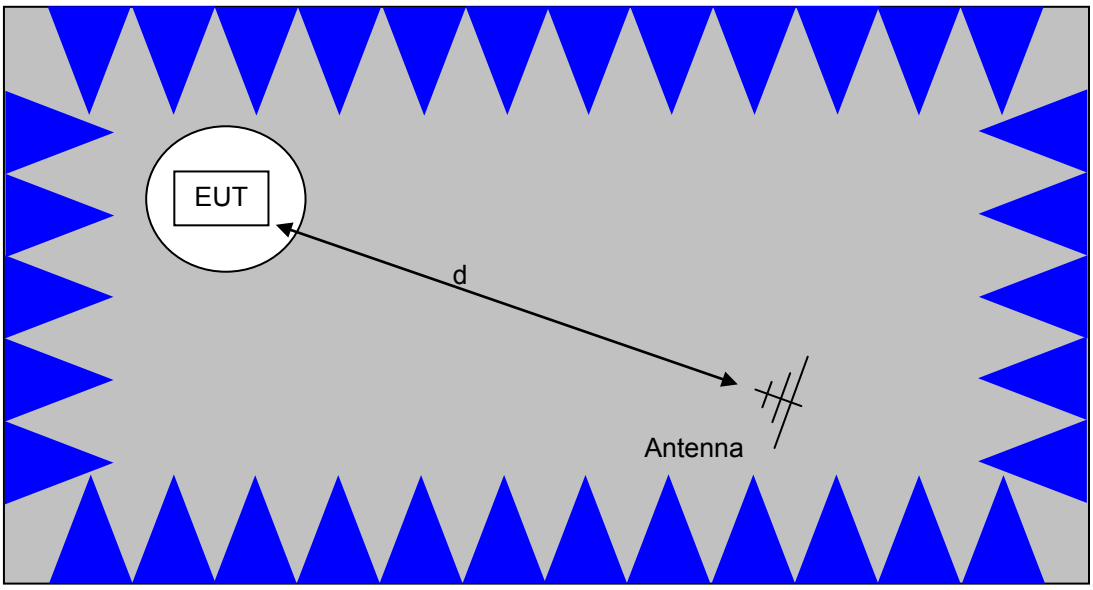
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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.

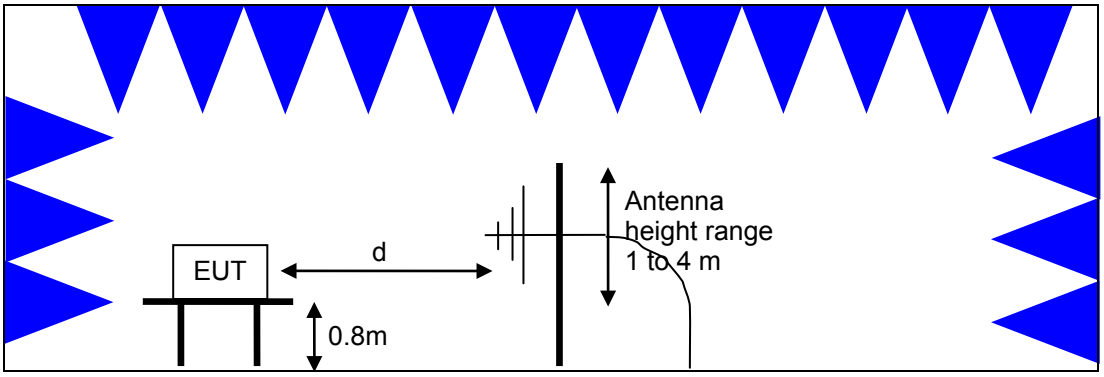


Typical Test Configuration for Radiated Field Strength Measurements



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.

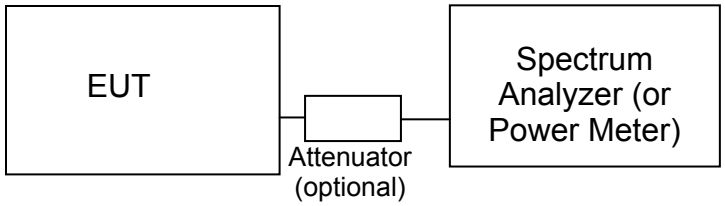
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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. .

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 15.205 and RSS-Gen Table 6

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

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Radiated Emissions, 1000 - 25,000 MHz, 29-Aug-16					
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	7/8/2016	7/8/2018
HP / Miteq	SA40 Head (Purple)	TTA1840-45-5P-HG-S	1772	12/21/2015	N/A
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	1780	10/9/2015	10/9/2016
A. H. Systems	Spare System Horn, 18-40GHz	SAS-574, p/n: 2581	2162	7/29/2015	7/29/2017
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2238	9/16/2015	9/16/2016
Hewlett Packard	Spectrum Analyzer (SA40) Purple 9 kHz - 40 GHz,	8564E (84125C)	2415	3/19/2016	3/19/2017
Radiated Emissions, 1000 - 12,000 MHz, 30-Aug-16					
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	7/8/2016	7/8/2018
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	1780	10/9/2015	10/9/2016
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2238	9/16/2015	9/16/2016
Hewlett Packard	Spectrum Analyzer (SA40) Purple 9 kHz - 40 GHz,	8564E (84125C)	2415	3/19/2016	3/19/2017
Conducted Emissions - AC Power Ports, 30-Aug-16					
EMCO	LISN, 10 kHz-100 MHz	3825/2	1292	8/1/2016	8/1/2017
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/19/2015	12/19/2016
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1594	5/5/2016	5/5/2017
Radiated Emissions, 30 - 1,000 MHz, 31-Aug-16					
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/19/2015	12/19/2016
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1549	6/2/2015	6/2/2017
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2249	9/16/2015	9/16/2016
Hewlett Packard	9KHz-1300MHz pre-amp	8447F	2777	1/26/2016	1/26/2017
Radio Antenna Port (Power), 21-Sep-16					
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1422	22-Jan-16	22-Jan-17
Rohde & Schwarz	Peak Power Sensor 100 uW - 2 Watts (w/ 20 dB pad, SN BJ5155)	NRV-Z32	1536	10-Mar-16	10-Mar-17

Appendix B Test Data

T102804 Pages 22 - 39

Client:	Fitbit	Job Number:	JD102309
Product	FB406 (IMP-01)	T-Log Number:	T102804
System Configuration:		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	
Emissions Standard(s):	FCC 15.247 / RSS-247	Class:	B
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Fitbit

Product

FB406 (IMP-01)

Date of Last Test: 9/21/2016

Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / 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 engineering evaluation testing of the EUT with respect to the specification listed above.

Date of Test: 9/21/2016
Test Engineer: Rafael Varelas
Test Location: Fremont EMC Lab #4A

Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

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

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

Ambient Conditions:

Temperature: 23 °C
Rel. Humidity: 44.6 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1	13	-	Output Power	15.247(b)	Pass	3.6 dBm (2.3mW)

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:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / 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	1 Mb/s	0.64	Yes	0.406	1.9424769	3.8849538	2463

Run #1: Output Power

Sample Notes

Sample S/N: 0x151a132970aa
Driver: 21.24 Build#0x00000013, Compiled 1-6-2016

Mode: BLE

Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W	Original Filing (dBm)[3]	Original Filing mW
13	2402	3.7	2.3	-7.4	Pass	-3.7	0.0004	3.6	2.3
	2440	3.7	2.3	-7.4	Pass	-3.7	0.0004	3.5	2.2
	2480	3.7	2.3	-7.4	Pass	-3.7	0.0004	3.3	2.1

Note 1:	Output power measured using peak power meter.
Note 2:	Power setting - the software power setting used during testing, included for reference only.
Note 3:	Power from original certification, granted on 2/3/16

Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	N/A

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

Test Specific Details

Objective: The objective of this test session is to perform engineering evaluation 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: 35 %

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

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
1	BLE	2402 MHz	13	13	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	45.9 dBµV/m @ 12011.2 MHz (-8.1 dB)
		2442 MHz					46.2 dBµV/m @ 4883.8 MHz (-7.8 dB)
		2480 MHz					46.4 dBµV/m @ 4959.8 MHz (-7.6 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: See runs below
Driver: See runs below
Antenna: Internal

Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / 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.
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	1 Mb/s	0.62	Yes	0.391	2.1	4.2	2558

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission in non-restricted band, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 4:	Emission has constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW>1/T but not less than 10Hz, peak detector, linear averaging, auto sweep, trace average 100 traces, measurement corrected by Linear voltage correction factor
Note:	Scans made between 18 - 25 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

Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	N/A

Radiated Spurious Emissions, 1,000 - 25000 MHz.

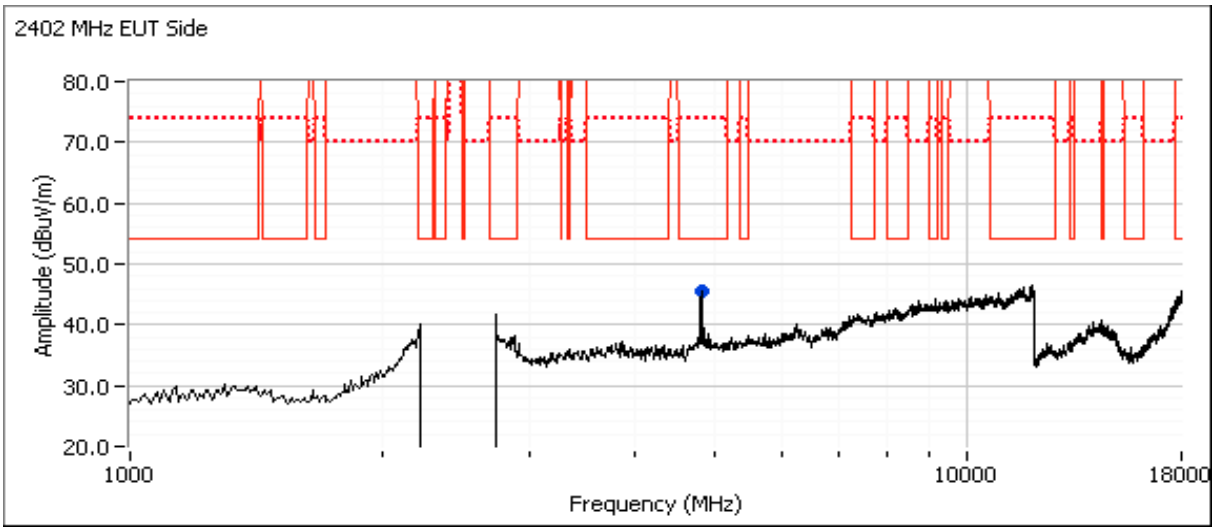
Date of Test: 8/29/2016 0:00 Config. Used: 1
Test Engineer: Rafael Varelas Config Change: none
Test Location: FT Chamber #7 EUT Voltage: 120V/60Hz

Run #1:
Sample S/N: 0x1518ef2970aa
Driver: 21.24.19, compiled 1/6/16
Antenna: Internal

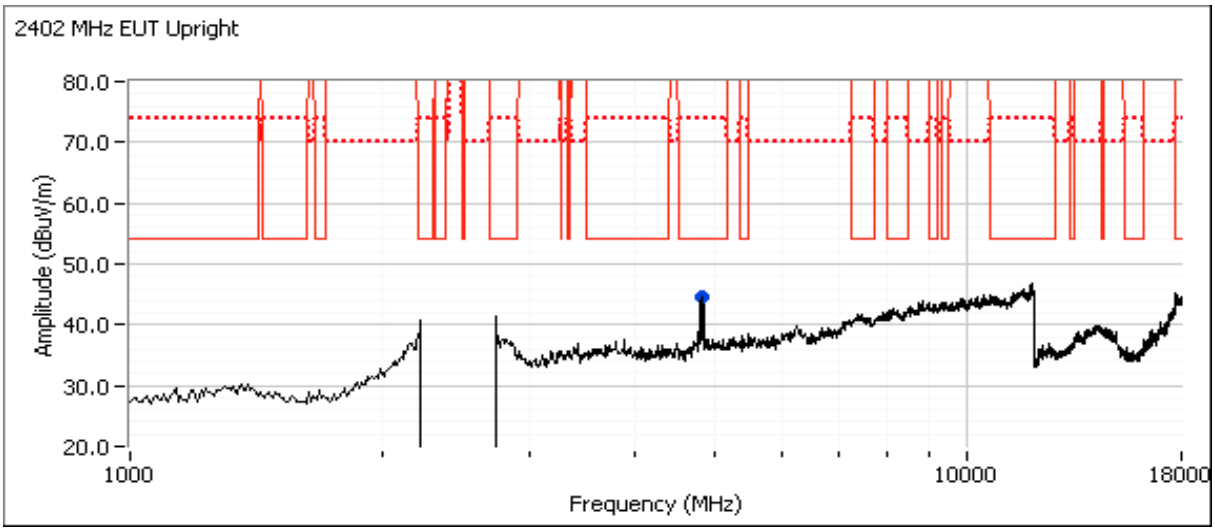
Channel: 2402MHz Mode: BLE EUT Orientation: All orientations evaluated
Tx Chain: N/A Data Rate: 1Mb/s

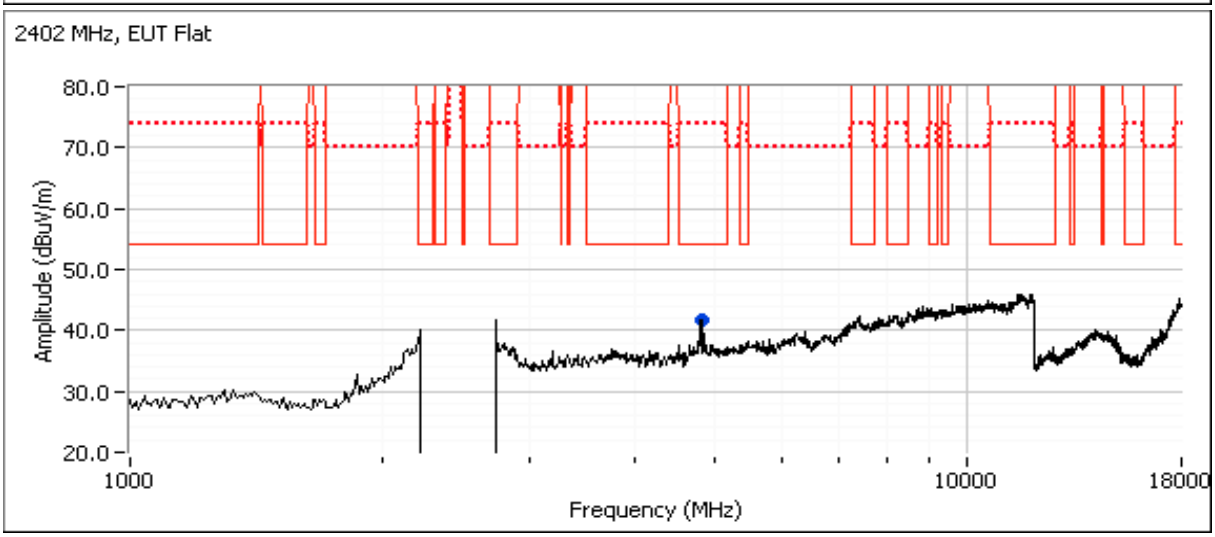
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
EUT Side								
4803.760	45.7	V	54.0	-8.3	Avg	0	1.5	Note 4;VB 3 kHz;Peak VAVG 50
4803.640	49.9	V	74.0	-24.1	PK	0	1.5	RB 1 MHz;VB 3 MHz;Peak
4803.640	44.3	H	54.0	-9.7	Avg	156	1.0	Note 4;VB 3 kHz;Peak VAVG 50
4803.720	48.6	H	74.0	-25.4	PK	156	1.0	RB 1 MHz;VB 3 MHz;Peak
12011.320	45.9	V	54.0	-8.1	Avg	40	1.3	Note 4;VB 3 kHz;Peak VAVG 50
12009.260	53.2	V	74.0	-20.8	PK	40	1.3	RB 1 MHz;VB 3 MHz;Peak
12011.200	45.9	H	54.0	-8.1	Avg	97	1.0	Note 4;VB 3 kHz;Peak VAVG 50
12009.500	53.1	H	74.0	-20.9	PK	97	1.0	RB 1 MHz;VB 3 MHz;Peak
EUT Upright								
4803.670	42.1	V	54.0	-11.9	Avg	23	1.7	Note 4;VB 3 kHz;Peak VAVG 50
4803.510	47.7	V	74.0	-26.3	PK	23	1.7	RB 1 MHz;VB 3 MHz;Peak
4803.680	44.0	H	54.0	-10.0	Avg	37	1.0	Note 4;VB 3 kHz;Peak VAVG 50
4803.680	49.4	H	74.0	-24.6	PK	37	1.0	RB 1 MHz;VB 3 MHz;Peak
12010.670	45.9	V	54.0	-8.1	Avg	1	2.3	Note 4;VB 3 kHz;Peak VAVG 50
12010.230	53.6	V	74.0	-20.4	PK	1	2.3	RB 1 MHz;VB 3 MHz;Peak
12011.470	45.9	H	54.0	-8.1	Avg	112	1.0	Note 4;VB 3 kHz;Peak VAVG 50
12011.200	53.4	H	74.0	-20.6	PK	112	1.0	RB 1 MHz;VB 3 MHz;Peak
EUT Flat								
4803.850	42.8	V	54.0	-11.2	Avg	152	1.0	Note 4;VB 3 kHz;Peak VAVG 50
4804.080	48.4	V	74.0	-25.6	PK	152	1.0	RB 1 MHz;VB 3 MHz;Peak
4803.760	41.3	H	54.0	-12.7	Avg	157	1.0	Note 4;VB 3 kHz;Peak VAVG 50
4804.630	48.5	H	74.0	-25.5	PK	157	1.0	RB 1 MHz;VB 3 MHz;Peak
12010.430	45.9	V	54.0	-8.1	Avg	264	2.1	Note 4;VB 3 kHz;Peak VAVG 50
12011.500	53.7	V	74.0	-20.3	PK	264	2.1	RB 1 MHz;VB 3 MHz;Peak
12011.440	45.9	H	54.0	-8.1	Avg	130	1.0	Note 4;VB 3 kHz;Peak VAVG 50
12010.460	53.5	H	74.0	-20.5	PK	130	1.0	RB 1 MHz;VB 3 MHz;Peak

Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	N/A



Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	N/A

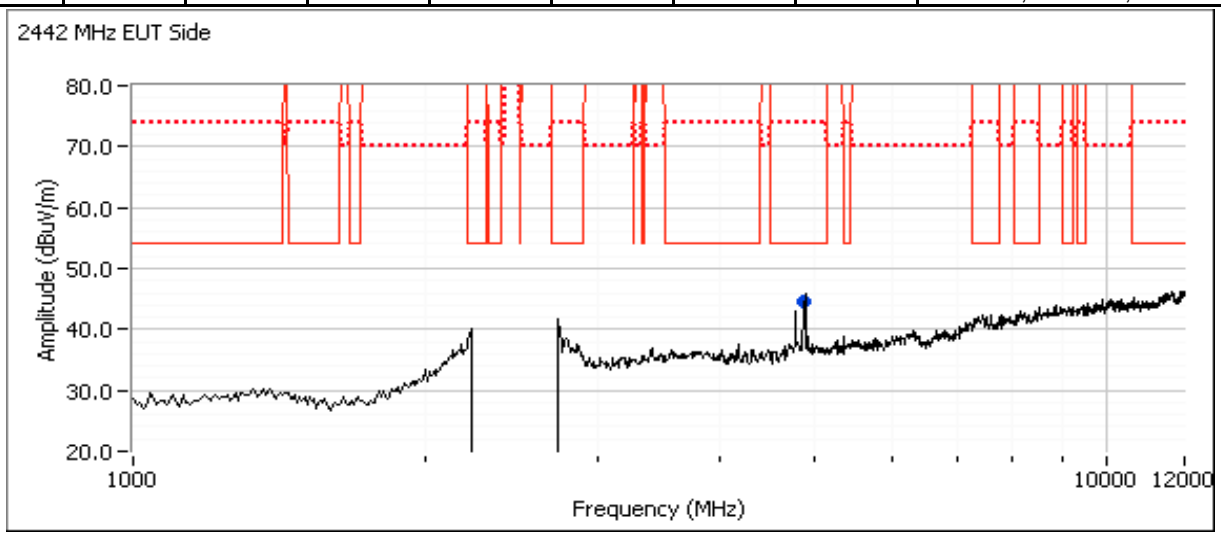


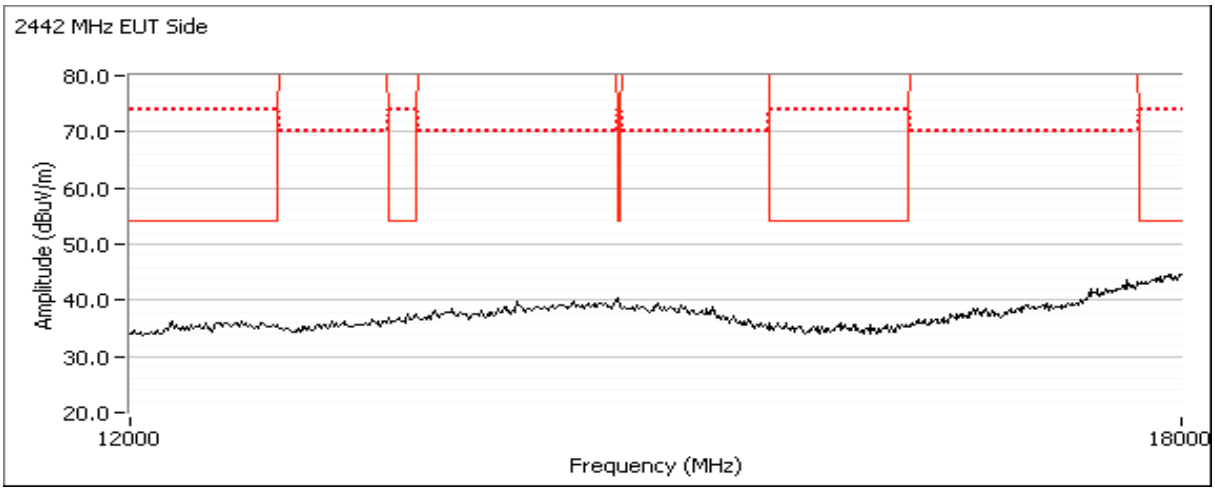


Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	N/A

Channel: 2442MHz Mode: BLE EUT Orientation: Side
Tx Chain: N/A Data Rate: 1Mb/s

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4883.780	46.2	V	54.0	-7.8	Avg	337	1.6	Note 4;VB 3 kHz;Peak VAVG 50
4883.630	49.9	V	74.0	-24.1	PK	337	1.6	RB 1 MHz;VB 3 MHz;Peak
4883.690	45.2	H	54.0	-8.8	Avg	152	1.2	Note 4;VB 3 kHz;Peak VAVG 50
4883.570	49.1	H	74.0	-24.9	PK	152	1.2	RB 1 MHz;VB 3 MHz;Peak

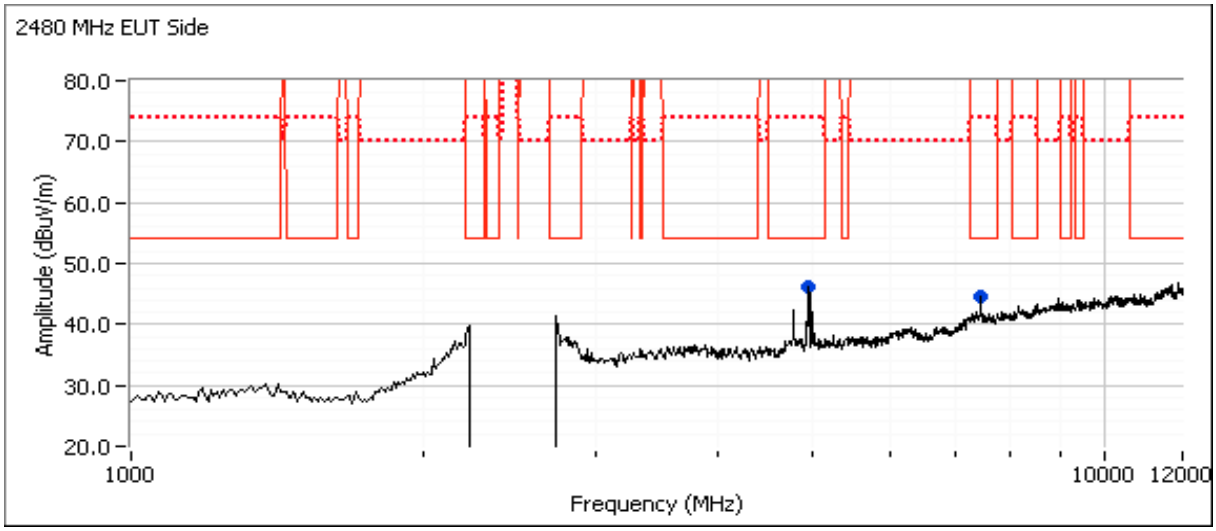




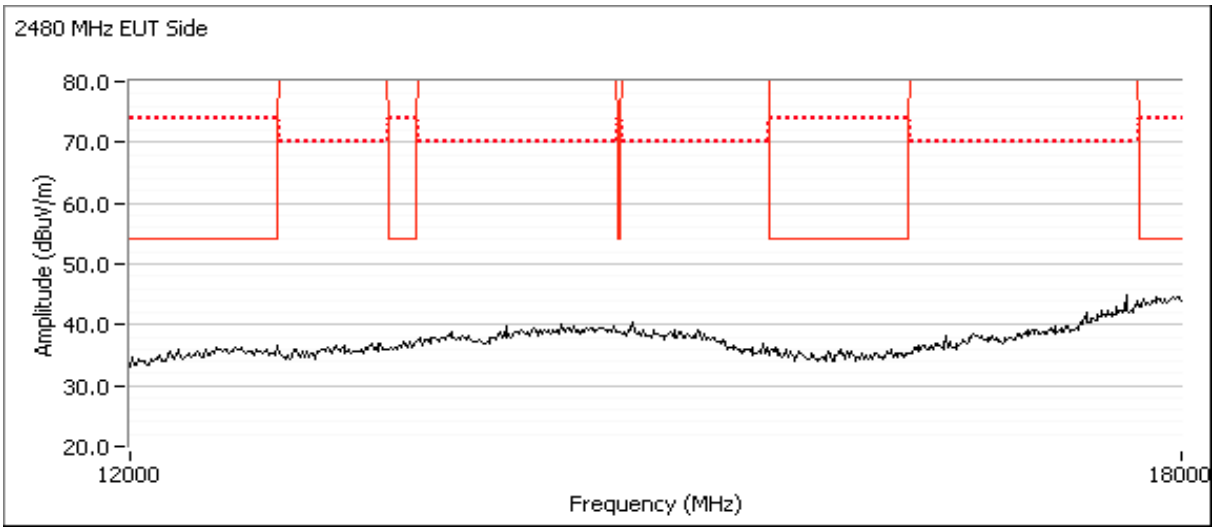
Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	N/A

Channel: 2480MHz Mode: BLE EUT Orientation: Side
Tx Chain: N/A Data Rate: 1Mb/s

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4959.840	46.4	V	54.0	-7.6	Avg	6	1.4	Note 4;VB 3 kHz;Peak VAVG 50
4960.260	50.1	V	74.0	-23.9	PK	6	1.4	RB 1 MHz;VB 3 MHz;Peak
4959.730	44.0	H	54.0	-10.0	Avg	156	1.4	Note 4;VB 3 kHz;Peak VAVG 50
4960.550	47.8	H	74.0	-26.2	PK	156	1.4	RB 1 MHz;VB 3 MHz;Peak
7439.360	45.5	V	54.0	-8.5	Avg	342	1.3	Note 4;VB 3 kHz;Peak VAVG 50
7439.270	52.1	V	74.0	-21.9	PK	342	1.3	RB 1 MHz;VB 3 MHz;Peak
7443.680	42.8	H	54.0	-11.2	Avg	166	1.0	Note 4;VB 3 kHz;Peak VAVG 50
7437.380	50.2	H	74.0	-23.8	PK	166	1.0	RB 1 MHz;VB 3 MHz;Peak



Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	N/A



Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	N/A

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

Test Specific Details

Objective: The objective of this test session is to perform engineering evaluation 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: 24-25 °C
Rel. Humidity: 50-52 %

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

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
1	BLE	2402MHz	-	13	Radiated Emissions, 30 - 1000 MHz	FCC Part 15.209 / 15.247(d)	25.1 dBµV/m @ 175.75 MHz (-18.4 dB)
		2480MHz	-				25.1 dBµV/m @ 175.59 MHz (-18.4 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: 0x1518ef2970aa Driver: 21.24.19, compiled 1/6/16
Antenna: internal

Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / 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.
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	1 Mbps	63%	yes	0.39	2.0	4.1	2597.4

Measurement Specific Notes:

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

Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	N/A

Run #1: Radiated Spurious Emissions, 30 - 1000 MHz. Operating Mode: BLE

Date of Test: 08/31/16 Config. Used: 1

Test Engineer: Mehran Birgani Config Change: none

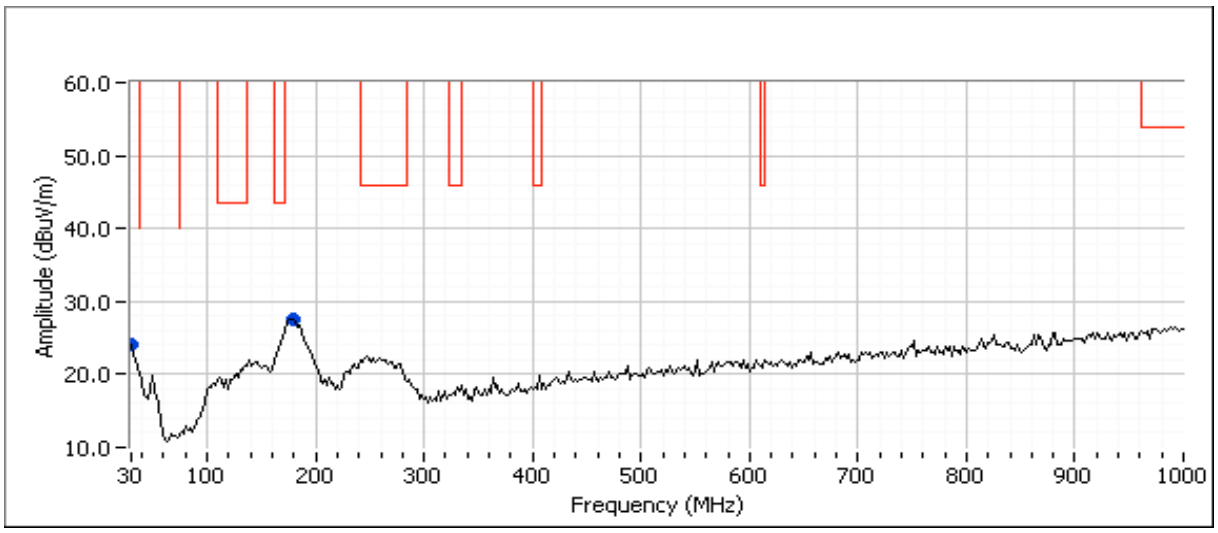
Test Location: Chamber #7 EUT Voltage: 120V / 60Hz

Run #1a: Low Channel (EUT Side)

Channel: 2402MHz Mode: BLE

Tx Chain: N/A Data Rate: 1 Mbps

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
175.748	25.1	H	43.5	-18.4	QP	218	3.5	Note 1
30.140	19.6	V	40.0	-20.4	QP	158	1.0	Note 1



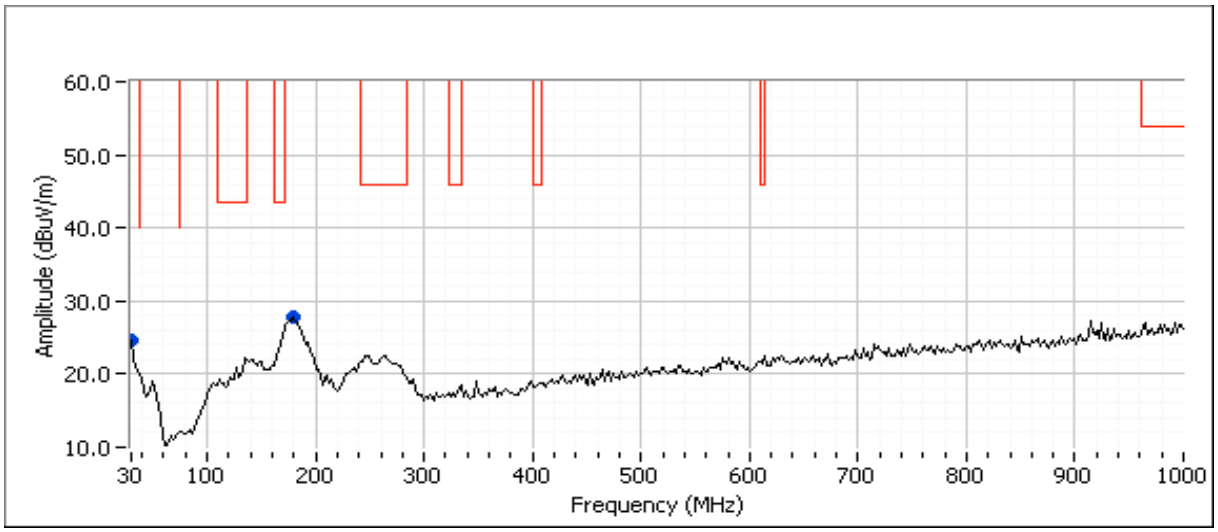
Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	N/A

Run #1b: High Channel (EUT Upright)

Channel: 2480 Mode: BLE

Tx Chain: N/A Data Rate: 1 Mbps

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
175.585	25.1	H	43.5	-18.4	QP	71	2.0	Note 1
30.350	19.3	H	40.0	-20.7	QP	238	1.0	Note 1



Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	B

Conducted Emissions

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

Test Specific Details

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

Date of Test: 8/30/2016
Test Engineer: Rafael Varelas
Test Location: Fremont Chamber #7
Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

General Test Configuration

For tabletop equipment, the EUT was located on a wooden table inside the semi-anechoic chamber, 40 cm from a vertical coupling plane and 80cm from the LISN.

Ambient Conditions:

Temperature: 22.4 °C
Rel. Humidity: 37 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power,120V/60Hz	Class B	Pass	40.3 dBµV @ 0.612 MHz (-5.7 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

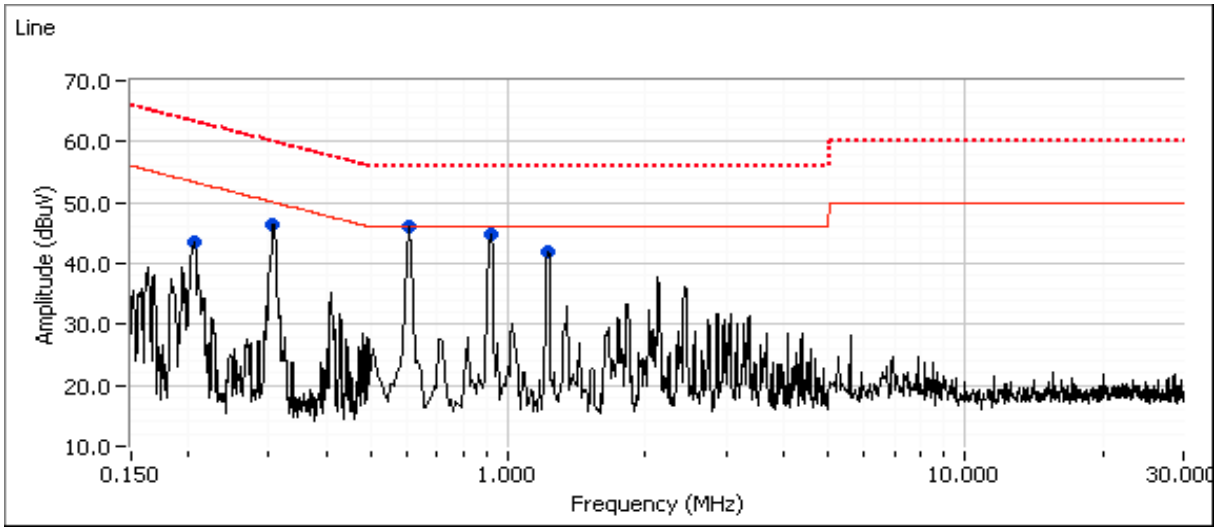
Deviations From The Standard

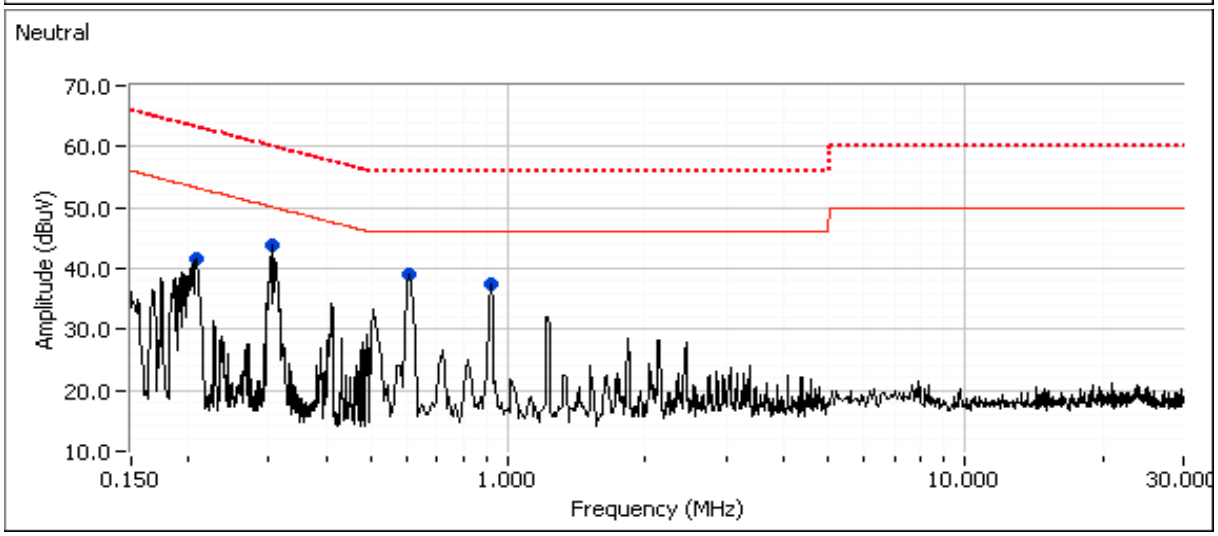
No deviations were made from the requirements of the standard.

Sample S/N: 0x1518ef2970aa
Driver: 21.24.19, compiled 1/6/16
Antenna: Internal

Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz





Client:	Fitbit	Job Number:	JD102309
Model:	FB406 (IMP-01)	T-Log Number:	T102804
		Project Manager:	Deepa Shetty
Contact:	Sachin Sawalapurkar	Project Coordinator:	-
Standard:	FCC 15.247 / RSS-247	Class:	B

Preliminary peak readings captured during pre-scan (peak readings vs. average limit)

Frequency	Level	AC	Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.205	43.4	Line 1	53.3	-9.9	Peak	
0.304	46.4	Line 1	50.1	-3.7	Peak	
0.612	46.0	Line 1	46.0	0.0	Peak	
0.914	44.8	Line 1	46.0	-1.2	Peak	
1.218	41.8	Line 1	46.0	-4.2	Peak	
0.206	41.7	Neutral	53.3	-11.6	Peak	
0.305	43.8	Neutral	50.1	-6.3	Peak	
0.611	38.9	Neutral	46.0	-7.1	Peak	
0.918	37.6	Neutral	46.0	-8.4	Peak	

Final quasi-peak and average readings

Frequency	Level	AC	Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.612	40.3	Line 1	46.0	-5.7	AVG	AVG (0.10s)
0.914	37.8	Line 1	46.0	-8.2	AVG	AVG (0.10s)
0.304	39.6	Line 1	50.1	-10.5	AVG	AVG (0.10s)
0.612	44.9	Line 1	56.0	-11.1	QP	QP (1.00s)
0.914	43.4	Line 1	56.0	-12.6	QP	QP (1.00s)
0.611	32.7	Neutral	46.0	-13.3	AVG	AVG (0.10s)
1.218	31.6	Line 1	46.0	-14.4	AVG	AVG (0.10s)
0.304	44.5	Line 1	60.1	-15.6	QP	QP (1.00s)
0.918	29.8	Neutral	46.0	-16.2	AVG	AVG (0.10s)
0.305	33.3	Neutral	50.1	-16.8	AVG	AVG (0.10s)
1.218	38.7	Line 1	56.0	-17.3	QP	QP (1.00s)
0.305	42.4	Neutral	60.1	-17.7	QP	QP (1.00s)
0.611	37.5	Neutral	56.0	-18.5	QP	QP (1.00s)
0.918	34.5	Neutral	56.0	-21.5	QP	QP (1.00s)
0.205	40.4	Line 1	63.4	-23.0	QP	QP (1.00s)
0.206	39.7	Neutral	63.4	-23.7	QP	QP (1.00s)
0.205	18.9	Line 1	53.4	-34.5	AVG	AVG (0.10s)
0.206	17.3	Neutral	53.4	-36.1	AVG	AVG (0.10s)

End of Report

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