41039 Boyce Road
Fremont, CA. 94538

510-578-3500 Phone
510-440-9525 Fax

EMC Test Report

Application for Grant of Equipment Authorization

Industry Canada RSS-Gen Issue 5 / RSS-210 Issue 9 (B.6)
FCC Part 15 Subpart C (15.225)

Model: FB410

IC CERTIFICATION #:	8542A-FB410
FCC ID:	XRAFB410
APPLICANT:	Fitbit, Inc. 199 Fremont Street, 14th Floor San Francisco, CA 94105
TEST SITE(S):	National Technical Systems 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-7
PROJECT NUMBER:	PR069580
REPORT DATE:	May 30, 2018
RE-ISSUED DATE:	July 24, 2018
FINAL TEST DATES:	April 12, 17 and 24, 2018
TOTAL NUMBER OF PAGES:	42

ACCREDITED
Testing Cert #0214.26

VALIDATING SIGNATORIES

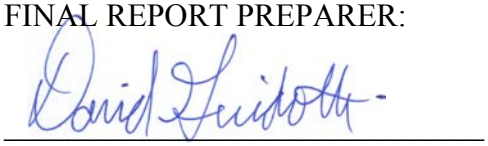
PROGRAM MGR

David W. Bare
Chief Engineer

TECHNICAL REVIEWER:

David W. Bare
Chief Engineer

FINAL REPORT PREPARER:



David Guidotti
Senior Technical Writer

QUALITY ASSURANCE DELEGATE

Gary Izard
Technical Writer

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	May 30, 2018	First release	
1	July 24, 2018	Added information about correlation with an open area test site	dwb

TABLE OF CONTENTS

SCOPE

An electromagnetic emissions test has been performed on the Fitbit, Inc. model FB410, pursuant to the following rules:

Industry Canada RSS-Gen Issue 5
RSS-210 Issue 9 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
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

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 sample of Fitbit, Inc. model FB410 complied with the requirements of the following regulations:

Industry Canada RSS-Gen Issue 5
RSS-210 Issue 9 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
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 FB410 and therefore apply only to the tested samples. The samples were selected and prepared by Ricky Wang 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

OPERATION WITHIN THE BAND 13.110 ~ 14.010 MHZ

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.225(a)	RSS-210 B.6(a)	Fundamental Emission	21.4 dBµV/m @ 3 m	84.0 dBµV/m @ 30m	Complies
15.225(b)	RSS-210 B.6(b)	Emissions in 13.410-13.553 and 13.567-13.710 MHz bands		50.5 dBµV/m @ 30m	Complies
15.225(c)	RSS-210 B.6(c)	Emissions in 13.110-13.410 and 13.710-14.010 MHz bands		50.5 dBµV/m @ 30m	Complies
15.225(d)	RSS-210 B.6(d)	Radiated Spurious Emissions –9 kHz – 150 MHz	9.6 dBµV/m @ 17.983 MHz (-19.9 dB)	General Field Strength Limits See page 20	Complies
15.255(e)	RSS-210 B.6	Frequency Tolerance	0.00077%	Less than 0.01% (100 ppm)	Complies
-	RSS-GEN	Occupied Bandwidth	2.66 kHz	-	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	Integral antenna	Unique or integral antenna required	Complies
15.207	RSS-GEN Table 4	AC Conducted Emissions	35.5 dBµV @ 0.48 MHz(-20.7 dB)	Refer to page 19	Complies
-	RSS-GEN 6.8	User Manual	Non detachable antenna	Statement for products with detachable antenna	Complies
-	RSS-GEN 8.4	User Manual	In user manual, product to small	Statement of Compliance	Complies
-	RSP 100 RSS-GEN 6.7	Occupied Bandwidth	2.66 kHz	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
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 FB410 is a wrist-worn activity tracker, which sends data about activity to the user via a Bluetooth Low Energy (BLE) link. It also has an NFC transceiver. 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 3.85 VDC.

The samples were received on April 9, 2018 and tested on April 12, 17 and 24, 2018. The following samples of the EUT were tested:

Company	Model	Description	Serial Number	FCC ID
Fitbit, Inc.	FB410	Wireless Activity Tracker	B2-SAT2-279A-C43	XRAFB410
Fitbit, Inc.	FB410	Wireless Activity Tracker	B2-D-102	XRAFB410

ANTENNA SYSTEM

The antenna system consists of an integral antenna.

ENCLOSURE

The EUT enclosure is primarily constructed of metal and plastic. It measures approximately 24 cm wide by 2.5 cm deep by 1.3 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 local support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
Choetech	Qualcomm Quickcharge 30	USB charger	NA	-
Fitbit	-	Charging cable	NA	-

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Charge contacts	Charger	3 pin custom	Shielded	0.4

ADDITIONAL INTERFACE PORTS ON SUPPORT EQUIPMENT

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
AC in (charger)	AC mains	Direct connect	NA	NA

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. The display was configured to display a cross pattern.

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. 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.

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 software used for radiated and conducted emissions measurements is NTS EMI Test Software (rev 2.10)

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.

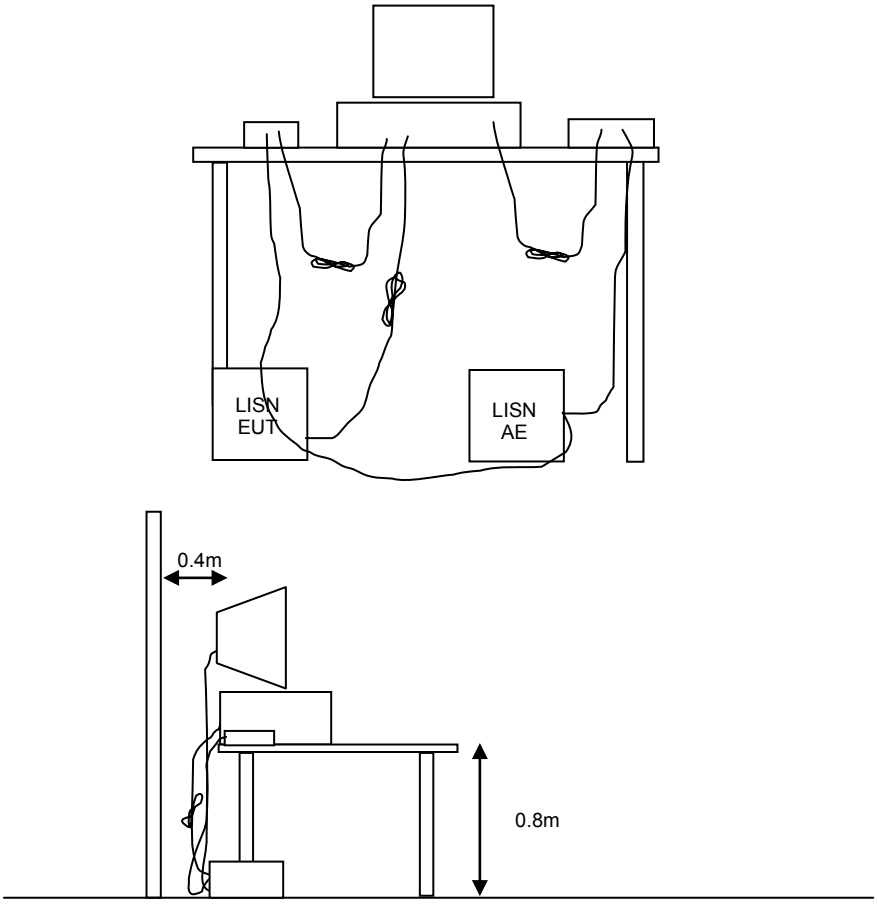


Figure 1 Typical Conducted Emissions Test Configuration

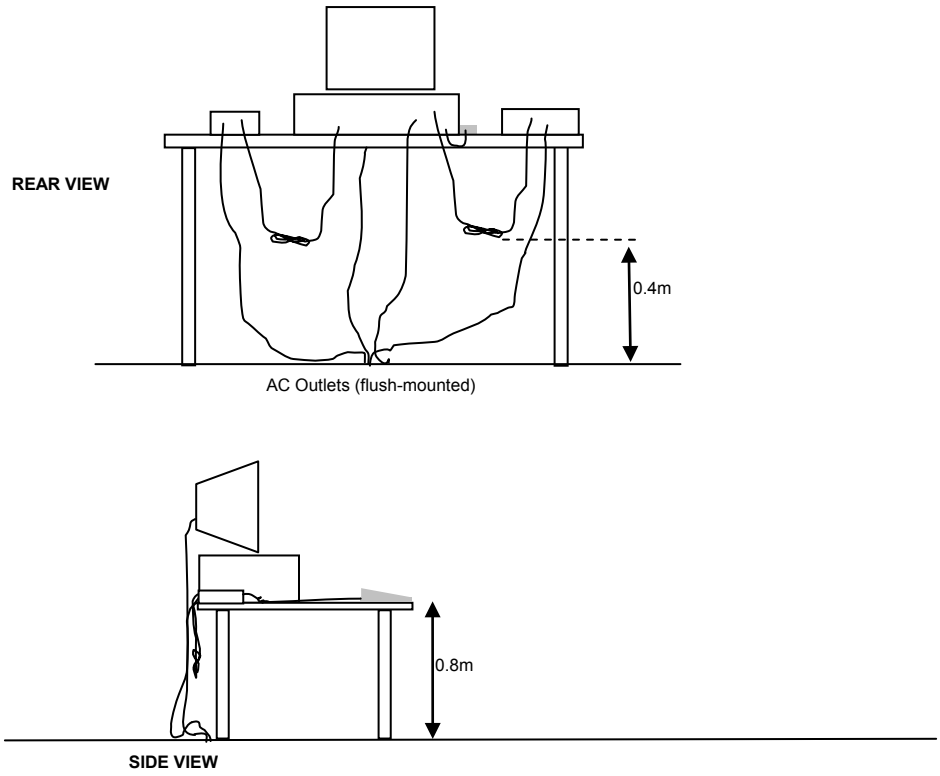
RADIATED EMISSIONS

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.

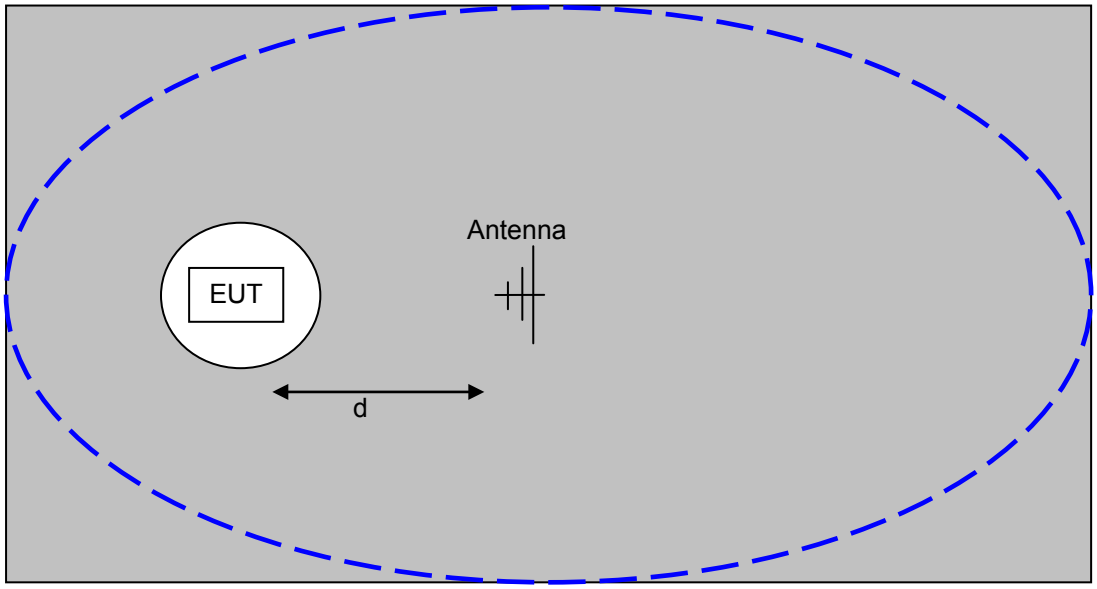
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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.

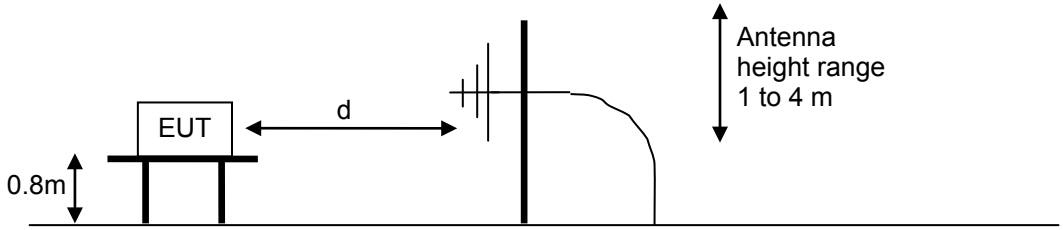
When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.



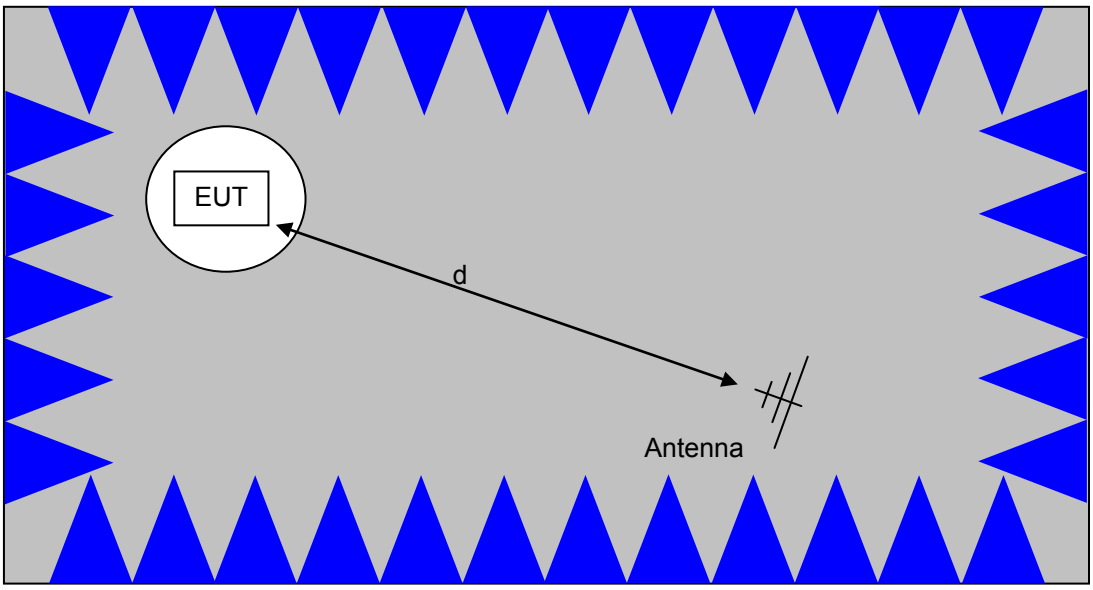
Typical Test Configuration for Radiated Field Strength Measurements



The ground plane extends beyond the ellipse defined in CISPR 16 / CISPR 22 / ANSI C63.4 and is large enough to accommodate test distances (d) of 3m and 10m. Refer to the test data tables for the actual measurement distance.

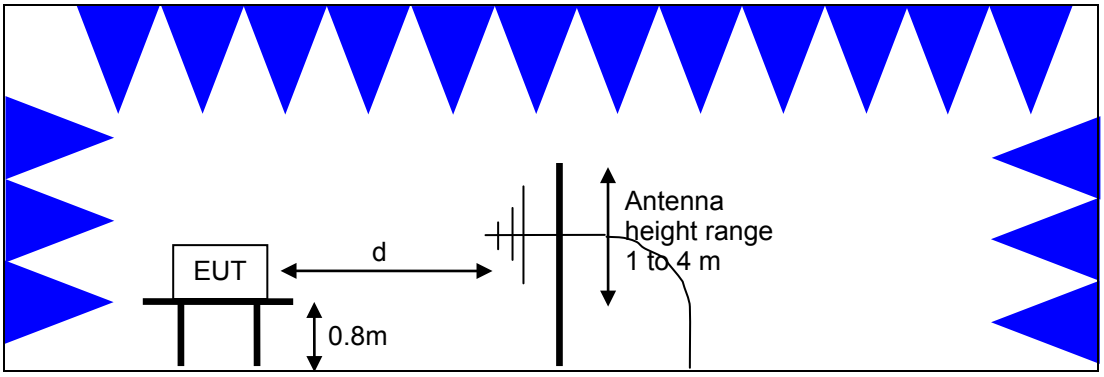


Test Configuration for Radiated Field Strength Measurements
OATS- Plan and Side Views



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.

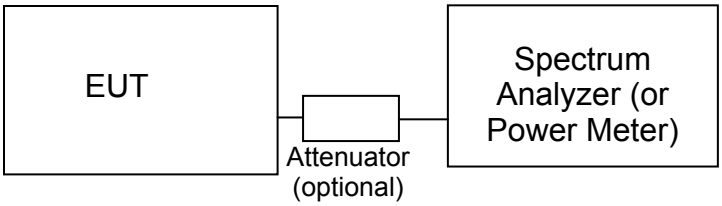
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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:

CONDUCTED EMISSIONS SPECIFICATION LIMITS: FCC 15.207; FCC 15.107(a), RSS-GEN

The table below shows the limits for the emissions on the AC power line from an intentional radiator and a receiver.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

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), the limits for all emissions from a low power device operating under the general rules of RSS-GEN (Tables 5 and 6) and FCC Part 15 Subpart C §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

RADIATEDFUNDAMENTAL & SPURIOUS EMISSIONS SPECIFICATION LIMITS – 15.225 and RSS-210 B.6

Frequency Range (MHz)	Limit for Fundamental @ 3m	Limit for all signals outside of the occupied bandwidth @ 3m
13.553 – 13.567	15,848 uV/m 84 dBuV/m	General limits apply
13.410 – 15.553 13.567 – 13.710	334 uV/m 50.5 dBuV/m	
13.110 – 13.410 13.710 – 14.010	106 uV/m 40.5 dBuV/m	

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

[1] The restricted bands are detailed in FCC 15.205, RSS-GEN Table7

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

Conducted Emissions - AC Power Ports, 12-Apr-18

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
EMCO	LISN, 10 kHz-100 MHz	3825/2	1292	8/8/2017	8/8/2018
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1401	1/8/2018	1/8/2019
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESI 40	2493	3/22/2018	3/22/2019

Radiated Emissions, 9kHz - 30 MHz, 17-Apr-18

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESI 40	2493	3/22/2018	3/22/2019
Compower	Magnetic Loop Antenna, 9 kHz-30 MHz	AL-130	3003	8/9/2016	8/9/2018

Radiated Emissions, 30 - 150 MHz, 17-Apr-18

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1657	7/27/2016	7/27/2018
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESI 40	2493	3/22/2018	3/22/2019
Hewlett Packard	9KHz-1300MHz pre-amp	8447F	2777	12/27/2017	12/27/2018

Frequency Stability, 24-Apr-18

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Agilent Technologies	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	7/31/2017	7/31/2018
Watlow	Temp Chamber (w/ F4 watlow Controller)	96A0	2171	7/7/2017	7/7/2018

Appendix B Test Data

T106007 Pages 25 – 41

Client:	Fitbit, Inc.	Job Number:	JD105947
Product	FB410	T-Log Number:	T106007
System Configuration:	-	Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Coordinator:	-
Emissions Standard(s):	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	-
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Fitbit, Inc.

Product

FB410

Date of Last Test: 4/17/2018

Client:	Fitbit, Inc.	PR Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Engineer:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	-

Conducted Emissions

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

Test Specific Details

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

Date of Test: 4/12/2018
Test Engineer: Rafael Varelas
Test Location: FT Chamber #7
Config. Used: 1
Config Change: None
EUT Voltage: See Individual Runs

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: 38 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power,110V/60Hz	Class B	Pass	33.1 dBµV @ 0.40 MHz(-24.6 dB)
2	CE, AC Power,220V/60Hz	Class B	Pass	35.5 dBµV @ 0.48 MHz(-20.7 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

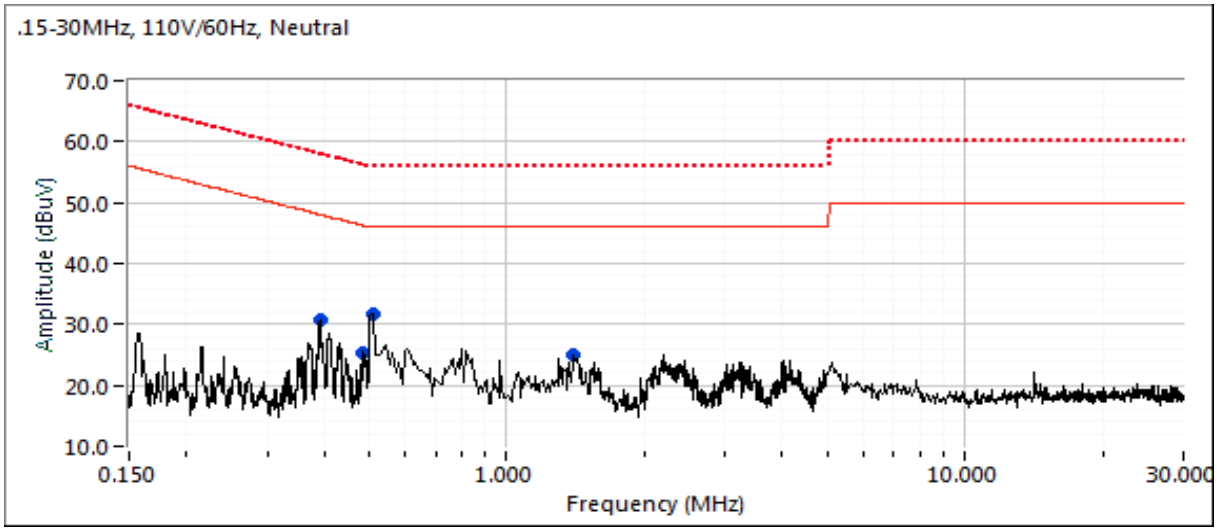
Sample S/N: B2-SAT2-279A-C43
Driver: 1.5.9615
Antenna: internal

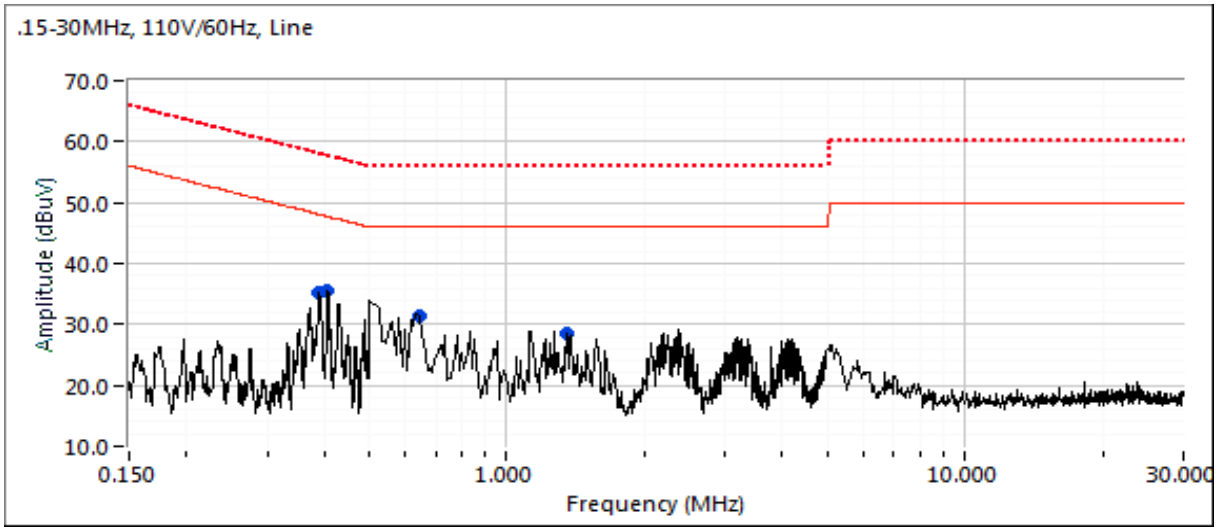
Notes:

EUT configured to transmit on channel 19 at power setting Max

Client:	Fitbit, Inc.	PR Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Engineer:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	-

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 110V/60Hz





Client:	Fitbit, Inc.	PR Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Engineer:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	-

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

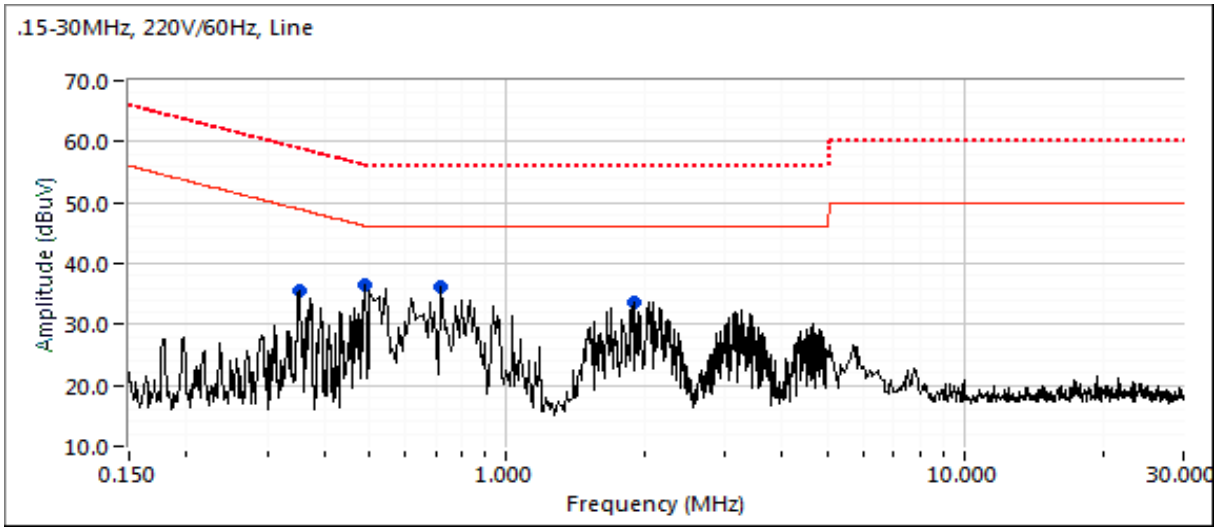
Frequency	Level	AC	Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.388	30.8	Neutral	48.0	-17.2	Peak	
0.487	25.4	Neutral	46.2	-20.8	Peak	
0.522	31.6	Neutral	46.0	-14.4	Peak	
1.416	24.9	Neutral	46.0	-21.1	Peak	
0.389	35.3	Line 1	48.1	-12.8	Peak	
0.406	35.6	Line 1	47.7	-12.1	Peak	
0.602	31.5	Line 1	46.0	-14.5	Peak	
1.305	28.5	Line 1	46.0	-17.5	Peak	

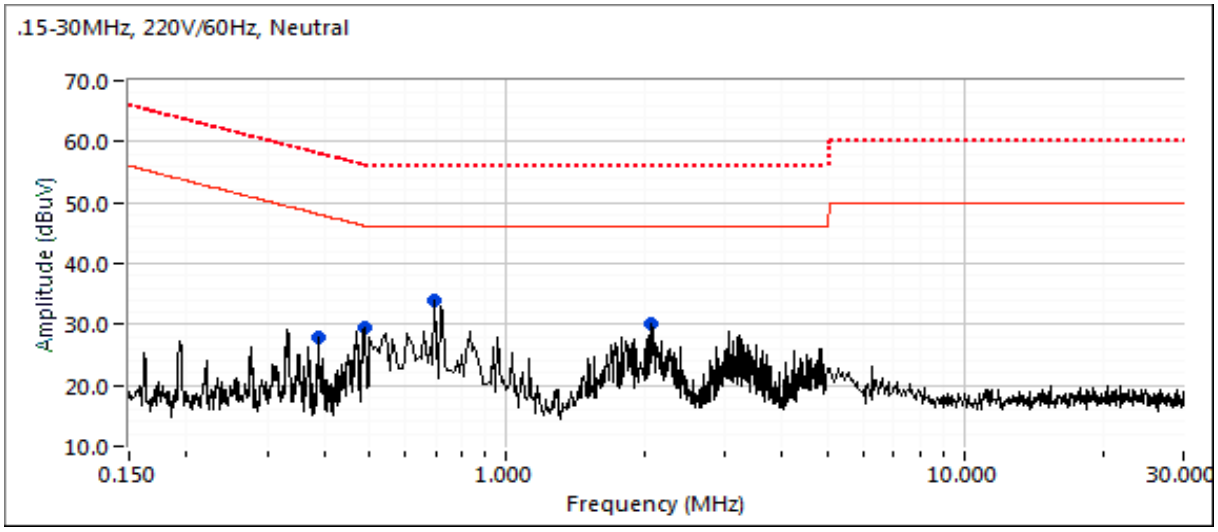
Final quasi-peak and average readings

Frequency	Level	AC	Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.406	33.1	Line 1	57.7	-24.6	QP	QP (1.00s)
0.406	21.6	Line 1	47.7	-26.1	AVG	AVG (0.10s)
0.389	21.9	Line 1	48.1	-26.2	AVG	AVG (0.10s)
0.389	31.8	Line 1	58.1	-26.3	QP	QP (1.00s)
0.602	28.3	Line 1	56.0	-27.7	QP	QP (1.00s)
0.388	19.8	Neutral	48.1	-28.3	AVG	AVG (0.10s)
0.602	17.7	Line 1	46.0	-28.3	AVG	AVG (0.10s)
0.522	16.6	Neutral	46.0	-29.4	AVG	AVG (0.10s)
0.522	25.7	Neutral	56.0	-30.3	QP	QP (1.00s)
0.487	15.6	Neutral	46.2	-30.6	AVG	AVG (0.10s)
0.388	26.5	Neutral	58.1	-31.6	QP	QP (1.00s)
0.487	24.2	Neutral	56.2	-32.0	QP	QP (1.00s)
1.305	21.6	Line 1	56.0	-34.4	QP	QP (1.00s)
1.416	10.5	Neutral	46.0	-35.5	AVG	AVG (0.10s)
1.416	19.2	Neutral	56.0	-36.8	QP	QP (1.00s)
1.305	8.9	Line 1	46.0	-37.1	AVG	AVG (0.10s)

Client:	Fitbit, Inc.	PR Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Engineer:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	-

Run #2: AC Power Port Conducted Emissions, 0.15 - 30MHz, 220V/60Hz





Client:	Fitbit, Inc.	PR Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Engineer:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	-

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	
0.352	35.6	Line 1	48.9	-13.3	Peak	
0.486	36.5	Line 1	46.2	-9.7	Peak	
0.698	36.1	Line 1	46.0	-9.9	Peak	
1.885	33.5	Line 1	46.0	-12.5	Peak	
0.392	27.9	Neutral	48.1	-20.2	Peak	
0.487	29.4	Neutral	46.2	-16.8	Peak	
0.700	34.0	Neutral	46.0	-12.0	Peak	
2.043	30.2	Neutral	46.0	-15.8	Peak	

Final quasi-peak and average readings

Frequency	Level	AC	Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.486	35.5	Line 1	56.2	-20.7	QP	QP (1.00s)
0.697	30.4	Line 1	56.0	-25.6	QP	QP (1.00s)
0.487	29.6	Neutral	56.2	-26.6	QP	QP (1.00s)
1.885	28.9	Line 1	56.0	-27.1	QP	QP (1.00s)
0.486	18.2	Line 1	46.2	-28.0	AVG	AVG (0.10s)
0.352	30.8	Line 1	58.9	-28.1	QP	QP (1.00s)
0.700	26.8	Neutral	56.0	-29.2	QP	QP (1.00s)
0.487	15.1	Neutral	46.2	-31.1	AVG	AVG (0.10s)
0.697	14.0	Line 1	46.0	-32.0	AVG	AVG (0.10s)
2.043	23.4	Neutral	56.0	-32.6	QP	QP (1.00s)
0.700	13.3	Neutral	46.0	-32.7	AVG	AVG (0.10s)
1.885	12.9	Line 1	46.0	-33.1	AVG	AVG (0.10s)
0.352	15.0	Line 1	48.9	-33.9	AVG	AVG (0.10s)
0.392	13.1	Neutral	48.0	-34.9	AVG	AVG (0.10s)
2.043	11.0	Neutral	46.0	-35.0	AVG	AVG (0.10s)
0.392	22.4	Neutral	58.0	-35.6	QP	QP (1.00s)

Client:	Fitbit, Inc.	Job Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Coordinator:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	N/A

Radiated Emissions

Test Specific Details

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

General Test Configuration

The EUT was located on the turntable for radiated emissions testing. The EUT was tested in all three orthogonal orientations.

The test distance and extrapolation factor (if applicable) 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:	22.4 °C
Rel. Humidity:	41 %

Summary of Results - 15.209/RSS-GEN

Run #	Test Performed	Limit	Result	Value / Margin
1	Fundamental Signal Field Strength	FCC 15.209 RSS-GEN	Pass	21.4 dBµV/m @ 13.560 MHz (-8.1 dB)
2	Transmitter Radiated Spurious Emissions, 9kHz-30 MHz	FCC 15.209 RSS GEN	Pass	9.60 dBµV/m @ 17.983 MHz (-19.9 dB)
3	Transmitter Radiated Spurious Emissions, 30-150MHz	FCC 15.209 RSS GEN	Pass	17.6 dBµV/m @ 32.17 MHz (-22.4 dB)
4	99% Bandwidth	RSS-GEN	N/A	2.66 kHz
5	Frequency Stability	FCC 15.225 RSS-210 Annex B.6	Pass	0.00077%

Client:	Fitbit, Inc.	Job Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Coordinator:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	N/A

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: B2-D-102
Driver: 1.5.9615
Antenna: internal

Note: It was determined that the EUT Side and Type B were worst case when preliminary testing was performed for Type A and Type B modes. All testing was performed on the EUT Side and Type B mode NFC212.

Run #1: Fundamental Field Strength

Date of Test: 4/17/18
Test Engineer: Rafael Varelas
Test Location: Chamber #7

Config. Used: 1
Config Change: -
EUT Voltage: Battery

Fundamental Field Strength

Frequency	Level	Pol	RSS GEN/FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
13.560	21.4	Open	29.5	-8.1	QP	302	1.3	EUT Side
13.560	21.3	Open	29.5	-8.2	QP	282	1.3	EUT Upright
13.560	16.5	Open	29.5	-13.0	QP	110	1.3	EUT Flat
13.560	13.4	Closed	29.5	-16.1	QP	23	1.3	EUT Side

Client:	Fitbit, Inc.	Job Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Coordinator:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	N/A

Run #2: Maximized Radiated Emissions, 9kHz-30MHz, Transmitter Spurious Emissions

Date of Test: 4/17/18
Test Engineer: Rafael Varelas
Test Location: Chamber #7

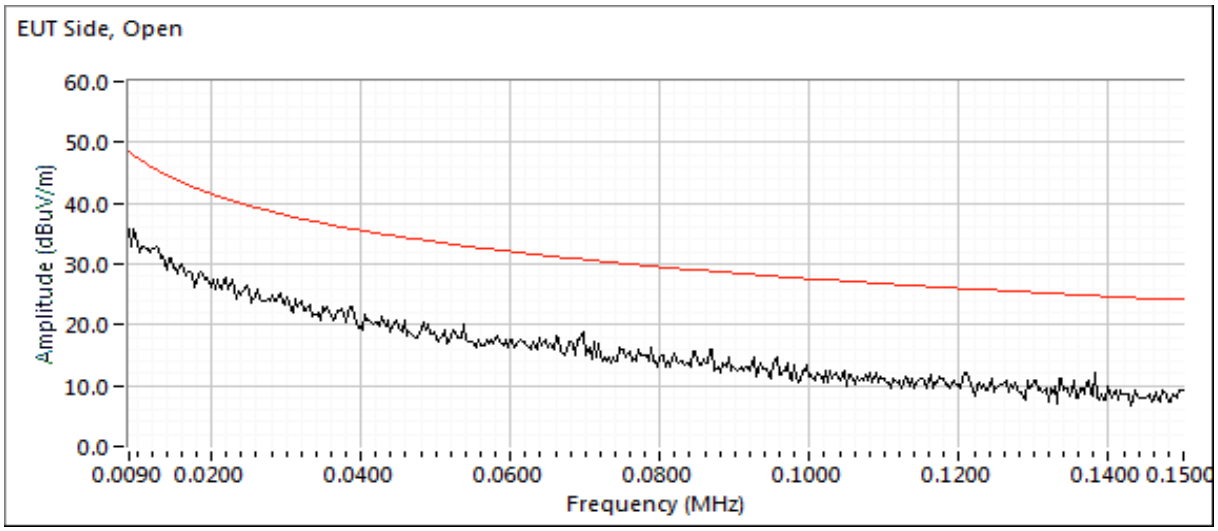
Config. Used: 1
Config Change: -
EUT Voltage: Battery

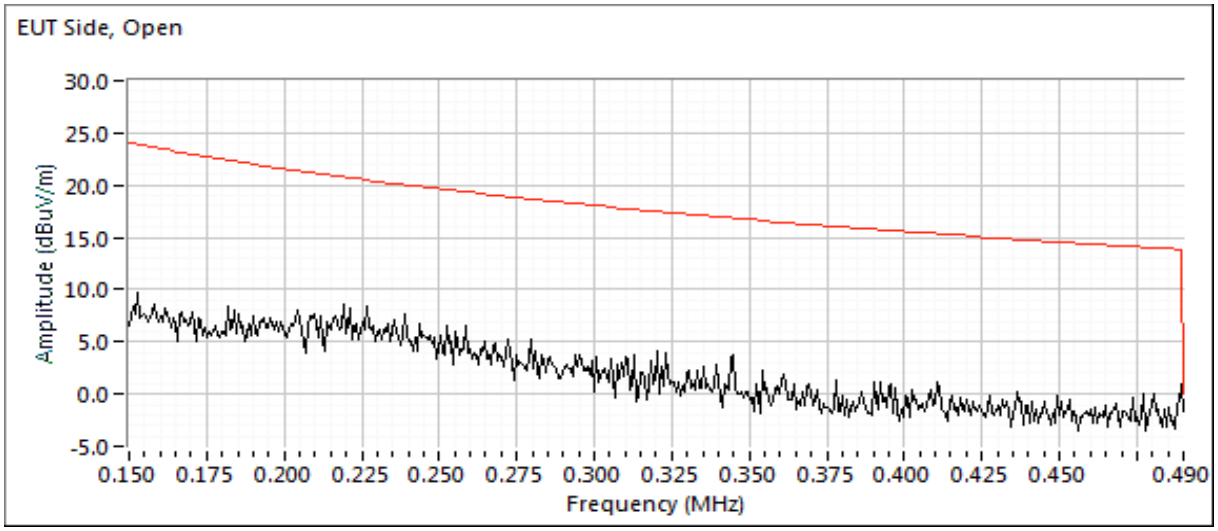
Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
9kHz-490kHz	3	300	-40.0
490kHz-30MHz	3	30	-20.0

Note: The field strength of any spurious emissions may not exceed the field strength of the fundamental signal.

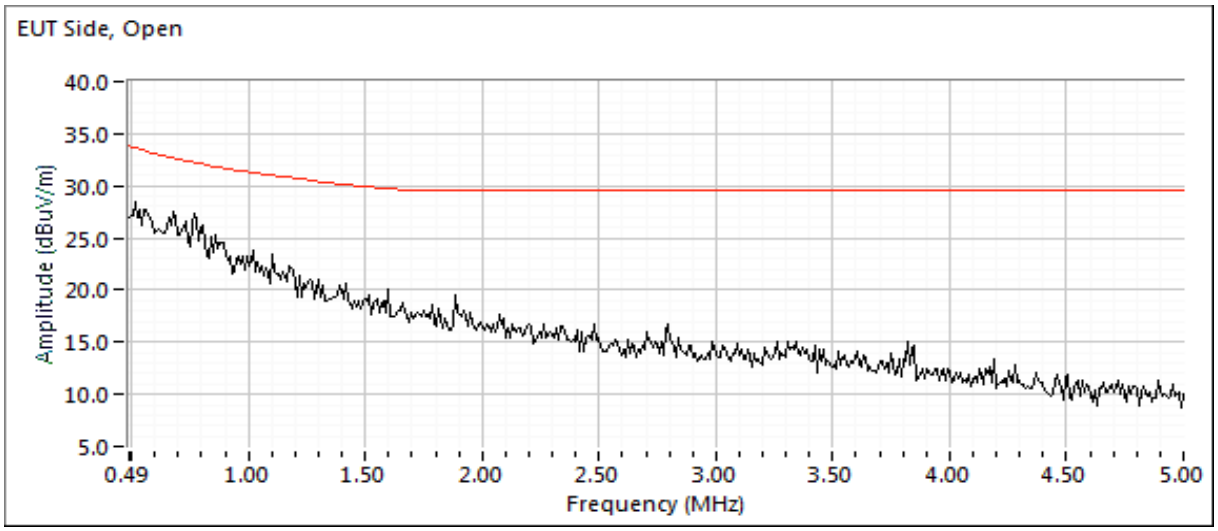
Frequency	Level	Pol	RSS 210 / FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
17.983	9.6	Closed	29.5	-19.9	QP	110	1.3	
13.560	21.4	Open	-	-	QP	302	1.3	Fundamental
20.230	-0.5	Open	29.5	-30.0	QP	208	1.3	
13.560	13.4	Closed	-	-	QP	23	1.3	Fundamental

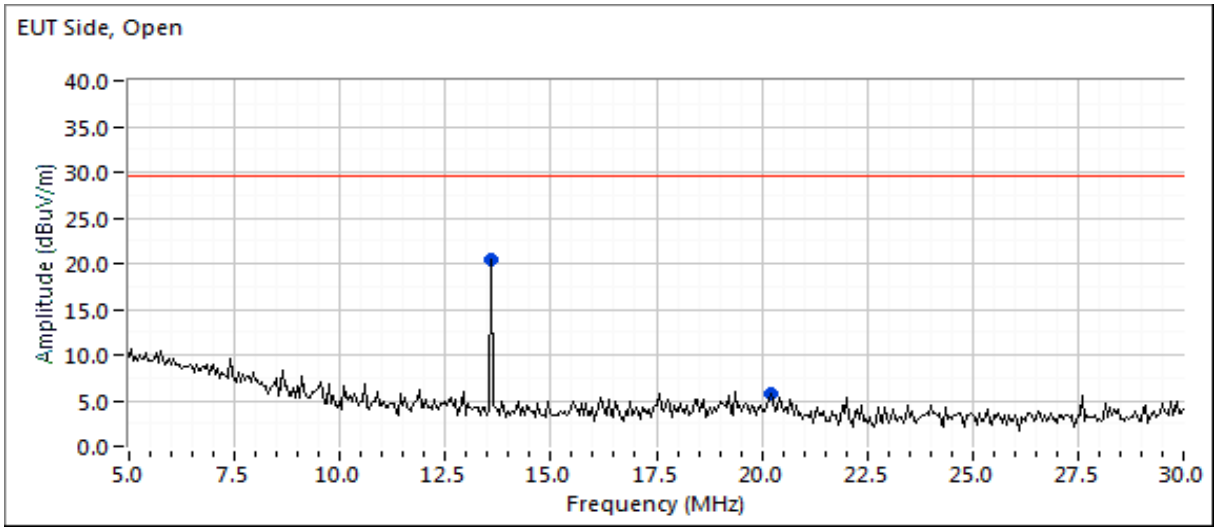
Client:	Fitbit, Inc.	Job Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Coordinator:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	N/A



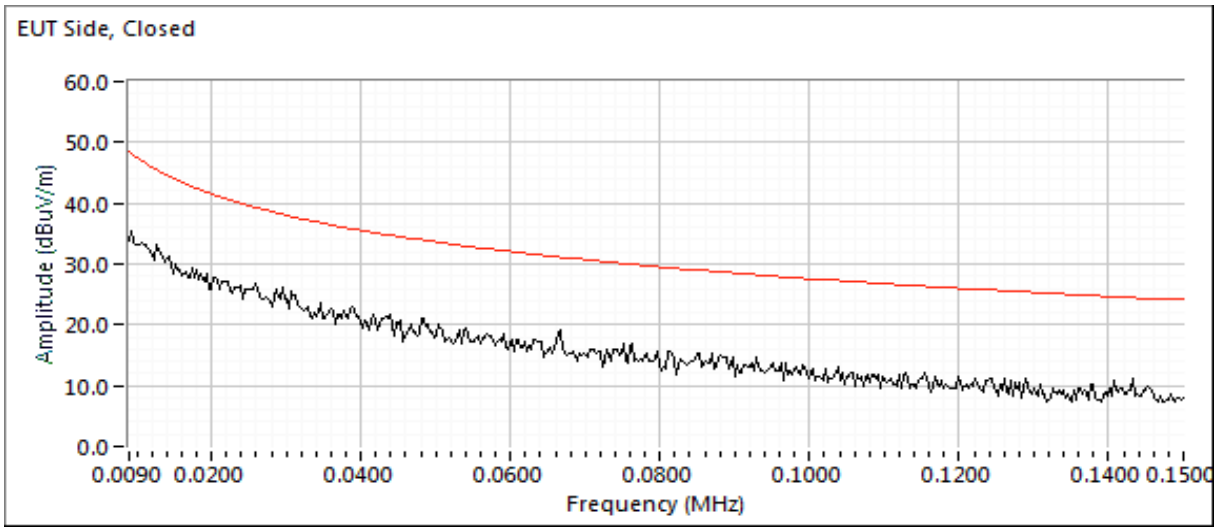


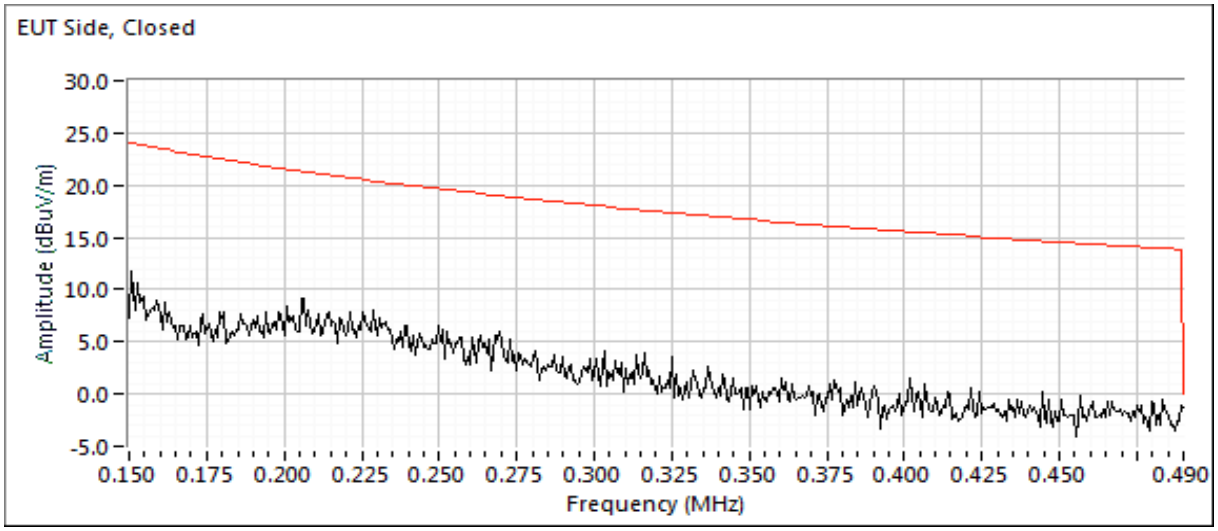
Client:	Fitbit, Inc.	Job Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Coordinator:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	N/A



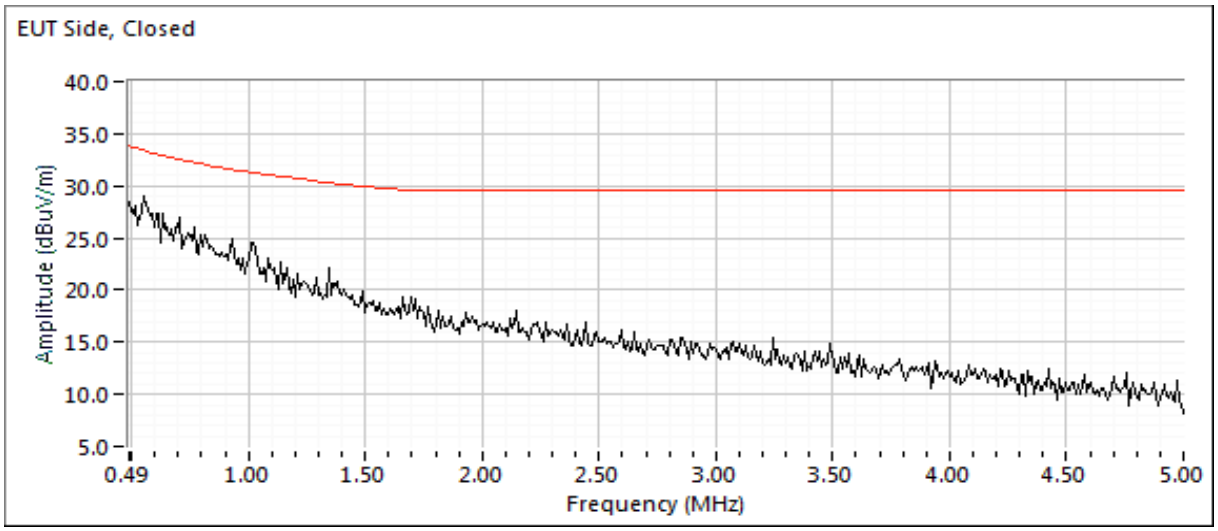


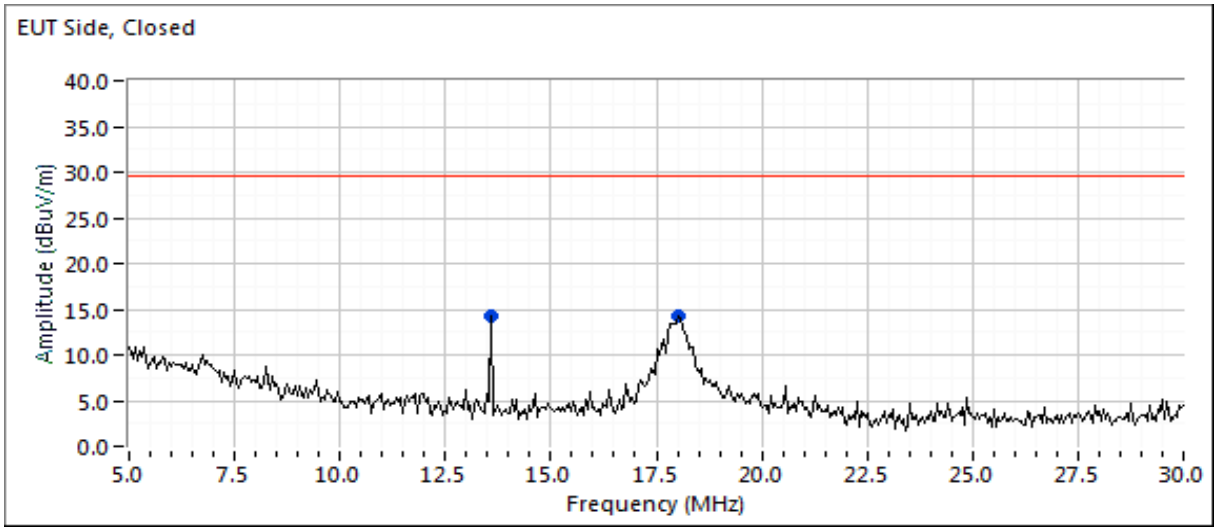
Client:	Fitbit, Inc.	Job Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Coordinator:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	N/A





Client:	Fitbit, Inc.	Job Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Coordinator:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	N/A





Client:	Fitbit, Inc.	Job Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Coordinator:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	N/A

Run #3: Maximized Radiated Emissions, 30MHz-150MHz, Transmitter Spurious Emissions

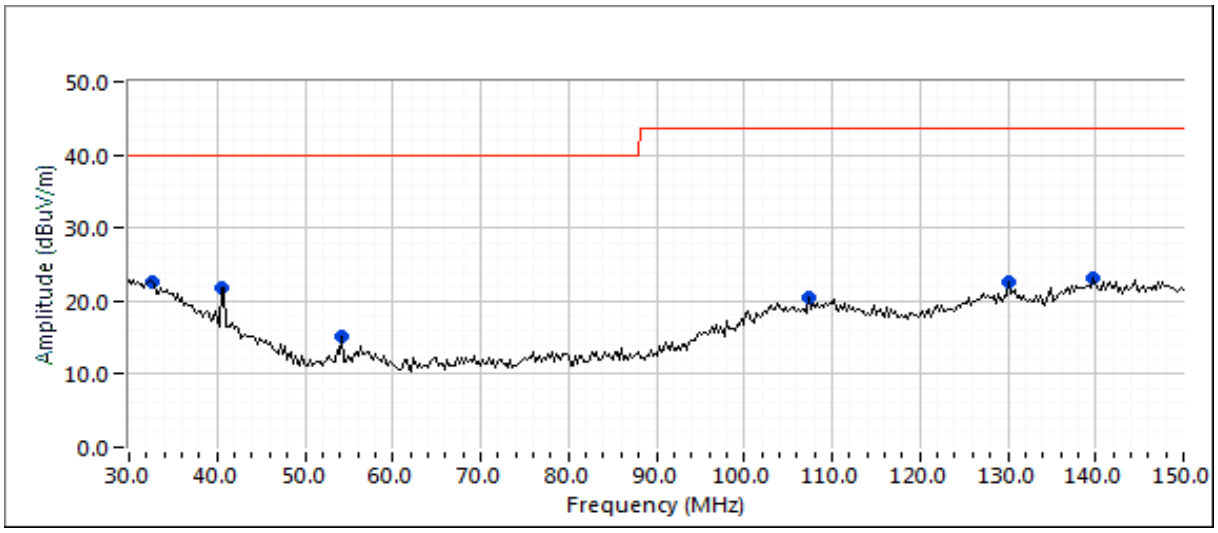
Date of Test: 4/17/18
Test Engineer: Rafael Varelas
Test Location: Chamber #7

Config. Used: 1
Config Change: -
EUT Voltage: Battery

Frequency Range	Test Distance	Limit Distance	Extrapolation Factor
30-150MHz	3	3	0.0

Note: The field strength of any spurious emissions may not exceed the field strength of the fundamental signal.

Frequency	Level	Pol	RSS 210 / FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
32.172	17.6	H	40.0	-22.4	QP	358	2.5	QP (1.00s)
139.375	19.6	H	43.5	-23.9	QP	148	2.5	QP (1.00s)
129.668	17.8	H	43.5	-25.7	QP	48	1.0	QP (1.00s)
108.130	17.3	H	43.5	-26.2	QP	55	1.2	QP (1.00s)
40.367	13.2	V	40.0	-26.8	QP	2	1.1	QP (1.00s)
54.786	7.7	V	40.0	-32.3	QP	66	1.0	QP (1.00s)



Client:	Fitbit, Inc.	Job Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Coordinator:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	N/A

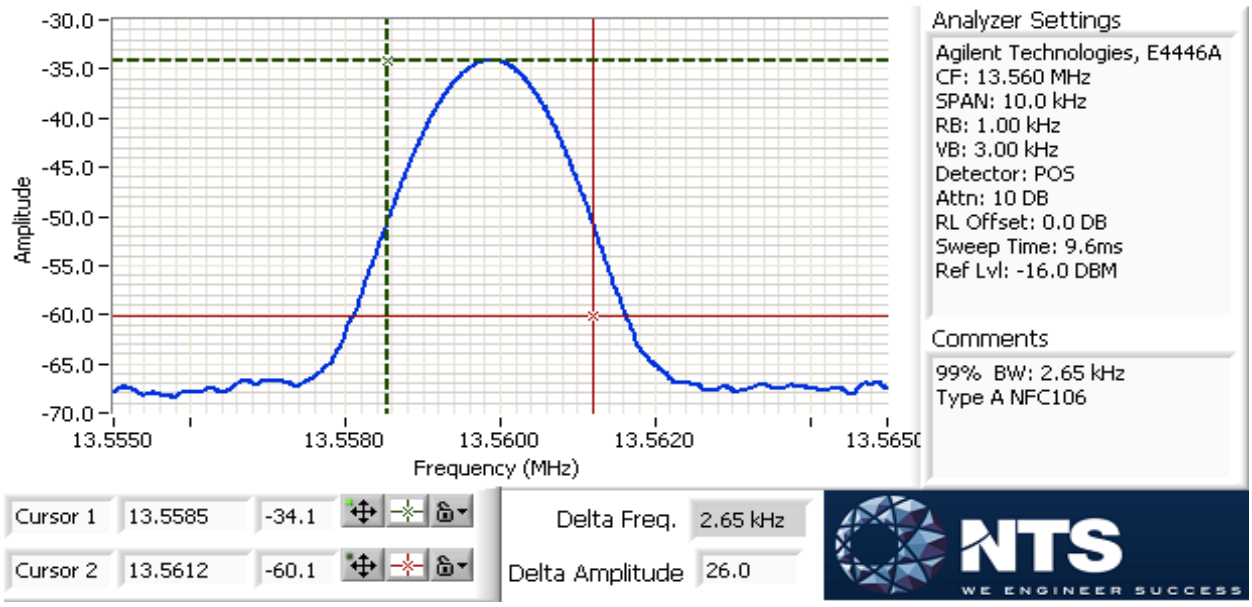
Run #4: Bandwidth Measurement(s)

Date of Test: 4/24/2018
Test Engineer: Rafael Varelas
Test Location: FT Lab 4B

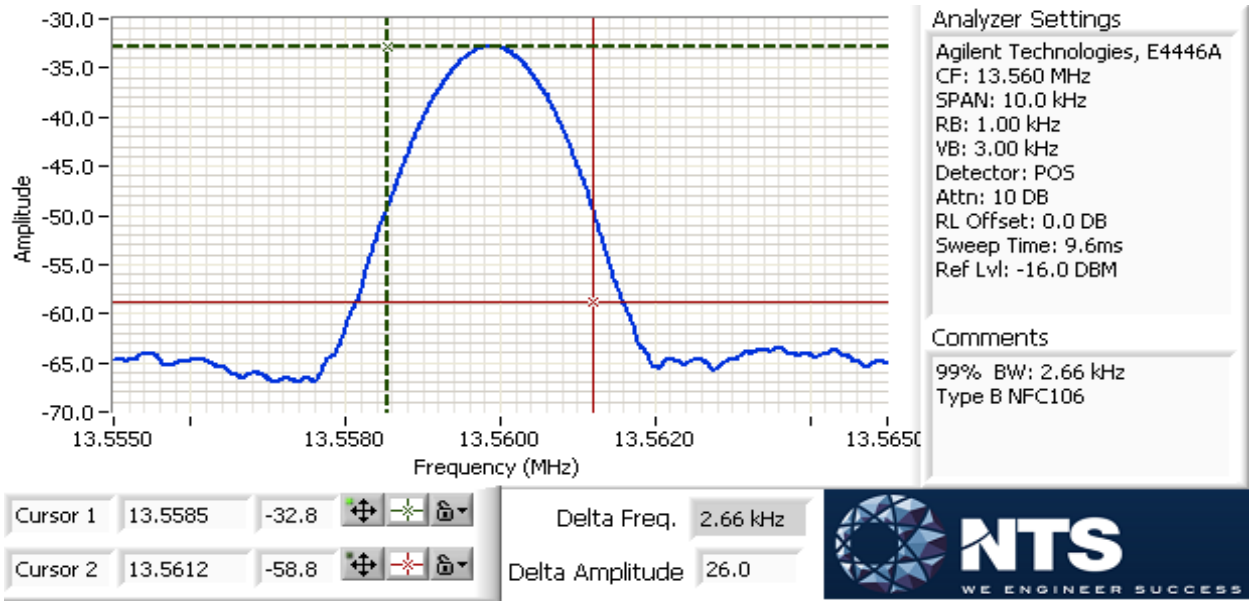
Config. Used: 2
Config Change: None
EUT Voltage: 4.4Vdc

Power Setting	Frequency (MHz)	Resolution Bandwidth	Video Bandwidth	Bandwidth (kHz) 99%	
4	13.56	1kHz	3kHz	2.65	Type A NFC106 mode
4	13.56	1kHz	3kHz	2.53	Type A NFC212 mode
4	13.56	1kHz	3kHz	2.48	Type A NFC424 mode
4	13.56	1kHz	3kHz	2.45	Type A NFC848 mode
4	13.56	1kHz	3kHz	2.66	Type B NFC106 mode
4	13.56	1kHz	3kHz	2.55	Type B NFC212 mode
4	13.56	1kHz	3kHz	2.48	Type B NFC424 mode
4	13.56	1kHz	3kHz	2.45	Type B NFC848 mode

Note 1:	99% bandwidth measured in accordance with ANSI C63.10, with RB between 1% and 5% of the measured bandwidth and VB ≥ 3*RB and Span ≥ 1.5% and ≤ 5% of measured bandwidth.



Client:	Fitbit, Inc.	Job Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Coordinator:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	N/A



Client:	Fitbit, Inc.	Job Number:	JD105947
Model:	FB410	T-Log Number:	T106007
		Project Manager:	Deepa Shetty
Contact:	Ricky Wang	Project Coordinator:	-
Standard:	FCC 15.247, 15.209 / RSS-247, RSS-210 / LP0002	Class:	N/A

Run #5: Frequency Stability

Date of Test: 4/24/2018
Test Engineer: Rafael Varelas
Test Location: FT Lab 4B

Config. Used: 2
Config Change: None
EUT Voltage: 4.4 V

Nominal Frequency: 13.559883 MHz

Frequency Stability Over Temperature

The EUT was soaked at each temperature for a minimum of 30 minutes prior to starting the transmitter and making the measurements to ensure the EUT and chamber had stabilized at that temperature.

Limit: ±0.01% of operating frequency (100 ppm)
1355.9883 Hz

Temperature	Frequency Measured	Drift	
(Celsius)	(MHz)	(Hz)	%
-20	13.559988	105	0.00077
-10	13.559976	93	0.00069
0	13.559950	67	0.00049
10	13.559922	39	0.00029
20	13.559883	0	0.00000
30	13.559884	1	0.00001
40	13.559898	15	0.00011
50	13.559935	52	0.00038
	Worst case:	105	0.00077

7.7 ppm

Frequency Stability Over Input Voltage

Nominal Voltage is 3.8Vdc

Voltage	Frequency Measured	Drift		
(DC)	(MHz)	(Hz)	%	
4.4V	13.559883	0	0.00	Upper Extreme Voltage
3.8V	13.559883	0	0.00	Lower Extreme Voltage
	Worst case:	0	0.0	

Result: As the device is battery powered the frequency stability under low voltage conditions was verified. The transmitter switched off (at 3.2Vdc) when the voltage dropped below the lower extreme with no variation in the frequency.

End of Report

This page is intentionally blank and
marks the last page of this test report.