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EMC Test Report

Application for FCC Grant of Equipment Authorization
Canada Certification

Innovation, Science and Economic Development Canada
RSS-Gen Issue 4 / RSS 247 Issue 2
FCC Part 15 Subpart C

Model: H0A

IC CERTIFICATION #:	10395A-H0A
FCC ID:	A4RH0A
APPLICANT:	Google Inc. 1600 Amphitheatre Pky Mountain View, CA 94043
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-7
REPORT DATE:	August 14, 2017
REVISION DATE:	August 25, 2017
FINAL TEST DATES:	June 28 and 30 and July 3, 17, 18, and 21, 2017
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ACCREDITED
Testing Cert #0214.26

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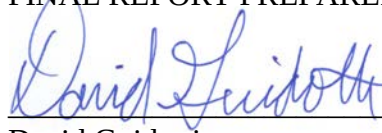

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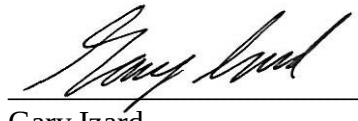


Gary Izard
Technical Writer

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	August 14, 2017	First release	
1.0	August 25, 2017	Removed detailed product information for confidentiality	MEH

TABLE OF CONTENTS

SCOPE

An electromagnetic emissions test has been performed on the Google Inc. model H0A, pursuant to the following rules:

RSS-Gen Issue 4 " General Requirements for Compliance of Radio Apparatus"
RSS 247 Issue 2 "Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices"
FCC Part 15 Subpart C

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in National Technical Systems - 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 Google Inc. model H0A complied with the requirements of the following regulations:

RSS-Gen Issue 4 " General Requirements for Compliance of Radio Apparatus"
RSS 247 Issue 2 "Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSS) and Licence-Exempt Local Area Network (LE-LAN) Devices"
FCC Part 15 Subpart C

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of Google Inc. model H0A and therefore apply only to the tested sample. The sample was selected and prepared by Dominik Mente of Google 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) – Bluetooth Low Energy

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247(a)	RSS 247 5.2	Digital Modulation	Systems uses DSSS techniques	System must utilize a digital transmission technology	Complies
15.247 (a) (2)	RSS 247 5.2 (a)	6dB Bandwidth	690 kHz	>500kHz	Complies
15.247 (b) (3)	RSS 247 5.4 (d)	Output Power (multipoint systems)	BLE: 5.8 dBm (3.8mW)	1Watt, EIRP limited to 4 Watts.	Complies
15.247(e)	RSS 247 5.2 (b)	Power Spectral Density	BLE: -4.0 dBm/10kHz	8dBm/3kHz	Complies
15.247(d)	RSS 247 5.5	Antenna Port Spurious Emissions 30MHz – 25 GHz	> 20dB margin	< -20dBc	Complies
15.247(d) / 15.209	RSS 247 5.5	Radiated Spurious Emissions 30MHz – 25 GH	40.7 dBµV/m @ 2487.8 MHz (-13.3 dB)	Refer to the limits section (p21) for restricted bands, all others < -20dBc	Complies

DIGITAL TRANSMISSION SYSTEMS (2400 – 2483.5MHz) – IEEE 802.11bgn

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247(a)	RSS 247 5.2	Digital Modulation	Systems uses OFDM / DSSS techniques	System must utilize a digital transmission technology	Complies
15.247 (a) (2)	RSS 247 5.2 (a)	6dB Bandwidth	11b: 10.1 MHz 11g: 16.3 MHz n20: 17.5 MHz	>500kHz	Complies
15.247 (b) (3)	RSS 247 5.4 (d)	Output Power (multipoint systems)	11b: 18.5 dBm (71mW) 11g: 18.7dBm (74mW) n20: 18.8dBm (76mW))	1Watt, EIRP limited to 4 Watts.	Complies
15.247(e)	RSS 247 5.2 (b)	Power Spectral Density	11b: 0.4 dBm/10kHz 11g: -1.4dBm/10kHz n20: -1.1dBm/10kHz	8dBm/3kHz	Complies
15.247(d)	RSS 247 5.5	Antenna Port Spurious Emissions 30MHz – 25 GHz	> 30dB margin	< -30dBc Note 2	Complies
15.247(d) / 15.209	RSS 247 5.5	Radiated Spurious Emissions 30MHz – 25 GHz	52.4 dBµV/m @ 2483.6 MHz (-1.6 dB)	Refer to the limits section (p21) for restricted bands, all others <-30dBc Note 2	Complies

Note 2: Limit of -30dBc used because the power was measured using the UNII test procedure (maximum power averaged over a transmission burst).

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Antennas are internal	Unique or integral antenna required	Complies
15.407 (b) (6)	RSS-Gen Table 3	AC Conducted Emissions	27.7 dBµV @ 0.823 MHz (-18.3 dB)	Refer to page 20	Complies
15.247 (i) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to MPE calculations in separate exhibit, RSS 102 declaration and User Manual statements.	Refer to OET 65, FCC Part 1 and RSS 102	Complies
-	RSP-100 RSS-Gen 6.6	Occupied Bandwidth	BLE: 1.038 MHz WIFI: 11b: 13.3 MHz 11g: 17.1 MHz n20: 18.1 MHz	Information only	N/A

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted (power meter)	dBm	25 to 7000 MHz	± 0.52 dB
RF power, conducted (Spectrum analyzer)	dBm	25 to 7000 MHz	± 0.7 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
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 Google Inc. model H0A is an interactive media streaming device. Since the EUT would be placed on a tabletop during operation, the EUT was treated as tabletop equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 100-240 Volts, 50-60Hz Hz, 0.4 Amps.

The sample was received on June 28, 2017 and tested on June 28 and 30 and July 3, 17, 18, and 21, 2017. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Google	H0A	Streaming Media Device (RF Radiated and AC Conducted)	Prototype Sample #2	A4RH0A
Google	H0A	Streaming Media Device (RF Conducted)	Prototype Sample #1	A4RH0A
Chicony	W17-009N1X	AC-DC Adapter	N/A	N/A

ANTENNA SYSTEM

Two internal antennas: 4.0dBi and 3.4dBi @ 2.4GHz, 3.7dBi and 3.5dBi @ 5GHz Tx/Rx diversity

ENCLOSURE

The EUT enclosure is primarily constructed of uncoated plastic.

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
Dell	Latitude	Laptop	-	-
-	-	Laptop Power Supply	-	-

Note: The laptop was used to configure the radio operation and then was removed from the setup.

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
EUT DC Power	External Power Supply	Multiwire	Shielded	2
AC In (external supply)	AC Mains	Direct plug in	-	-
USB	USB splitter	Multiwire	Shielded	0.3

EUT OPERATION

The EUT was configured to transmit continuously at the maximum output power setting. Specifics for the channel and mode are described in the test data.

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
Chamber 4	US0027	2845B-4	

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 80 centimeters for measurements below 1GHz and 1.5m for measurements above 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.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.

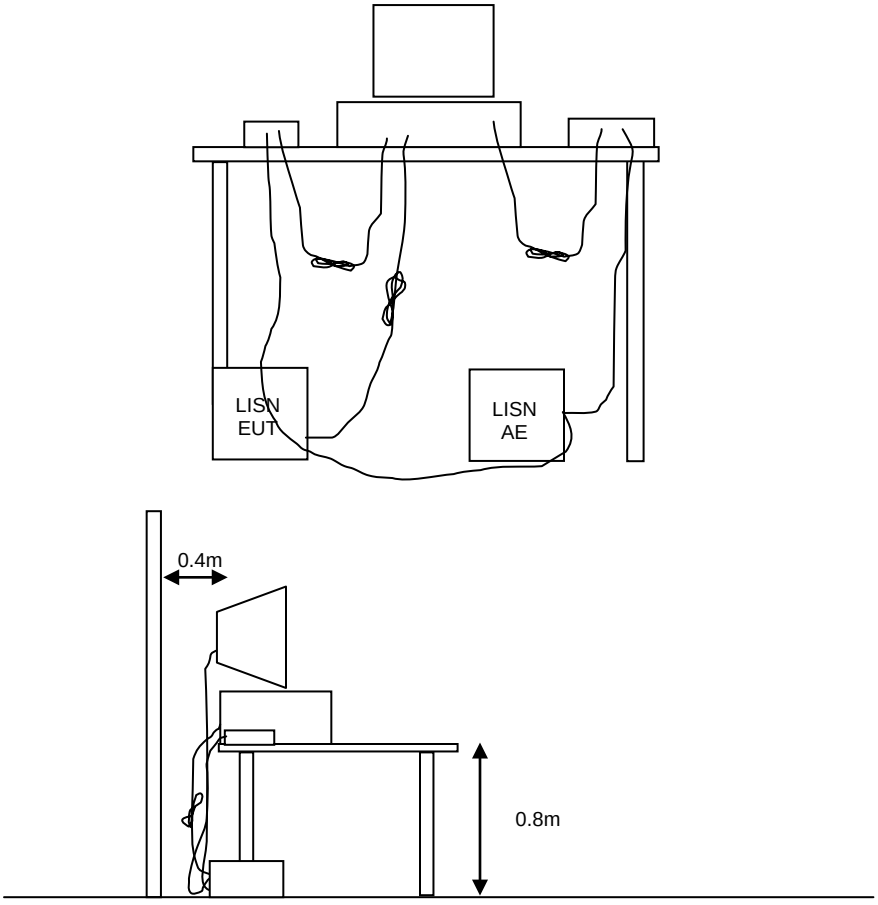


Figure 1 Typical Conducted Emissions Test Configuration

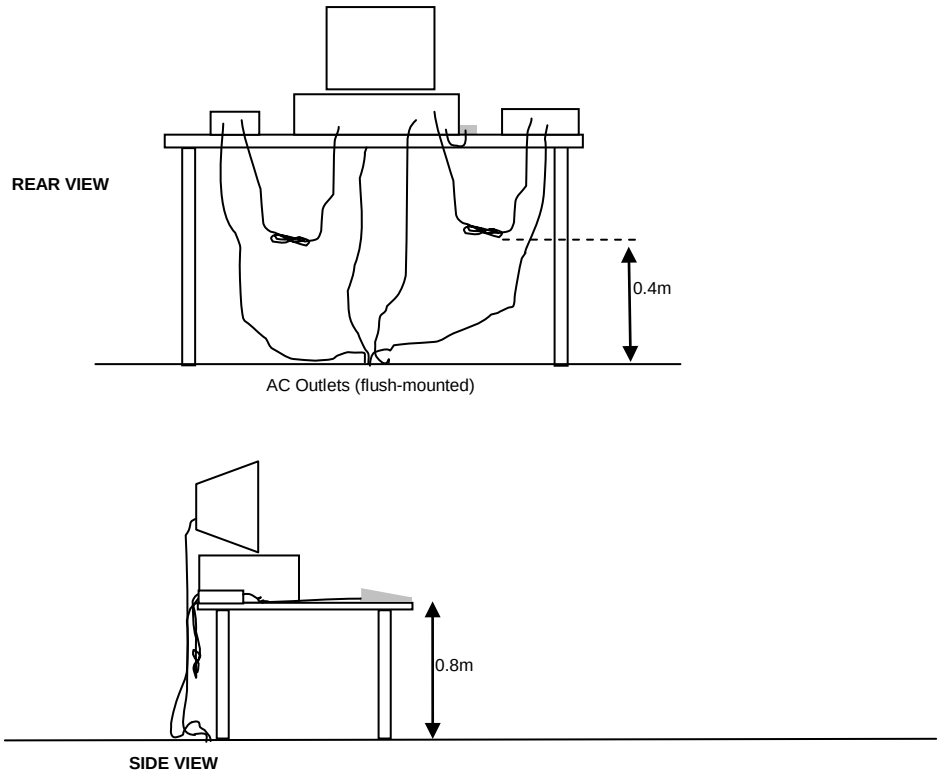
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

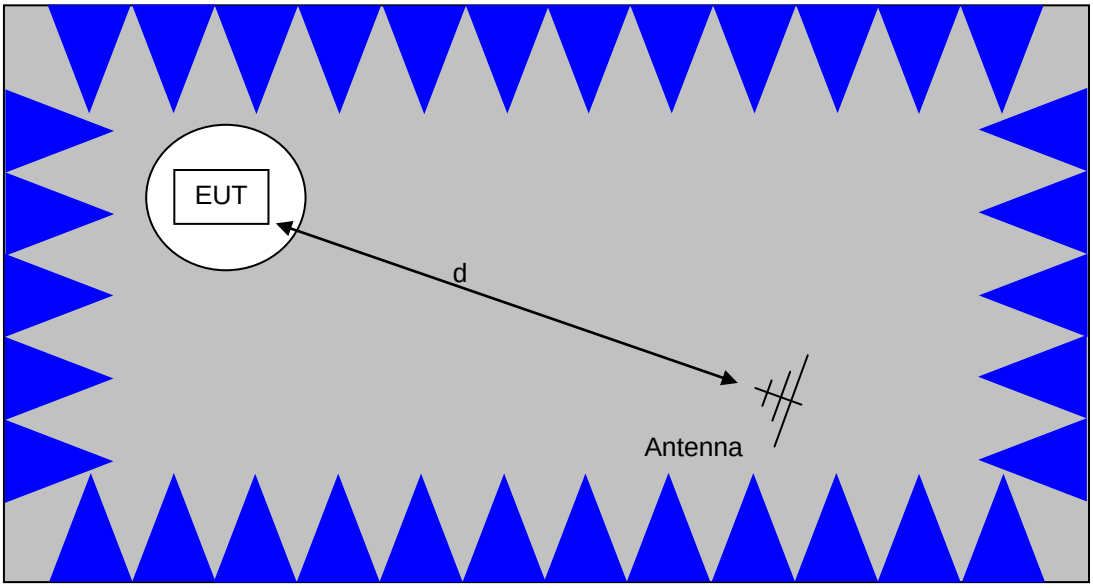
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

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

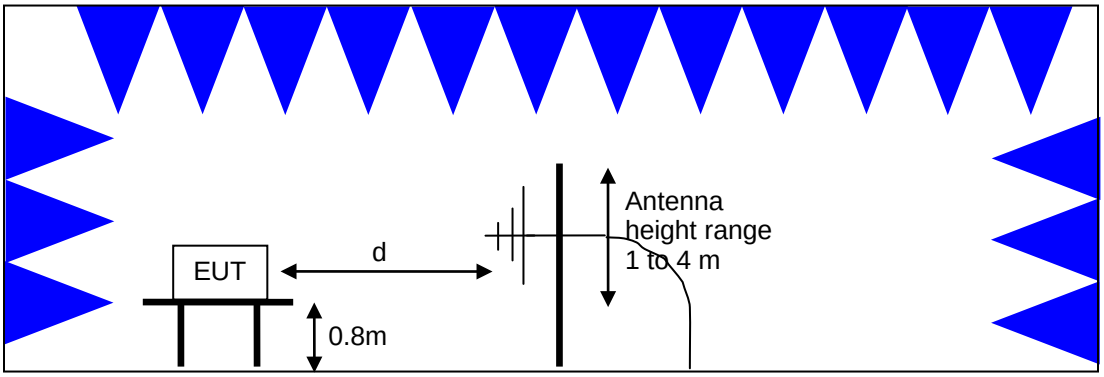


Typical Test Configuration for Radiated Field Strength Measurements



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

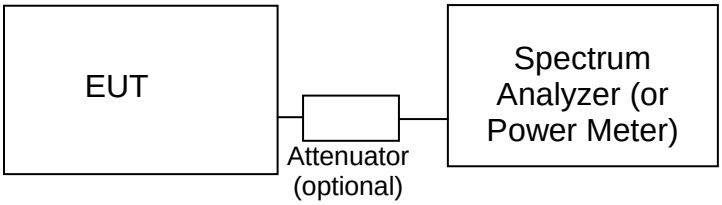
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

CONDUCTED EMISSIONS FROM ANTENNA PORT

Direct measurements of power, bandwidth and power spectral density are performed, where possible, with the antenna port of the EUT connected to either the power meter or spectrum analyzer via a suitable attenuator and/or filter. These are used to ensure that the front end of the measurement instrument is not overloaded by the fundamental transmission.



Test Configuration for Antenna Port Measurements

Measurement bandwidths (video and resolution) are set in accordance with the relevant standards and NTS Silicon Valley's test procedures for the type of radio being tested. When power measurements are made using a resolution bandwidth less than the signal bandwidth the power is calculated by summing the power across the signal bandwidth using either the analyzer channel power function or by capturing the trace data and calculating the power using software. In both cases the summed power is corrected to account for the equivalent noise bandwidth (ENBW) of the resolution bandwidth used.

If power averaging is used (typically for certain digital modulation techniques), the EUT is configured to transmit continuously. Power averaging is performed using either the built-in function of the analyzer or, if the analyzer does not feature power averaging, using external software. In both cases the average power is calculated over a number of sweeps (typically 100). When the EUT cannot be configured to continuously transmit then either the analyzer is configured to perform a gated sweep to ensure that the power is averaged over periods that the device is transmitting or power averaging is disabled and a max-hold feature is used.

If a power meter is used to make output power measurements the sensor head type (peak or average) is stated in the test data table.

BANDWIDTH MEASUREMENTS

The 6dB, 20dB, 26dB and/or 99% signal bandwidth are measured using the bandwidths recommended by ANSI C63.10 and RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

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].

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 Spurious Emissions, Bandedges, 1 - 6.5 GHz, 28-Jun-17					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	1538	2/11/2017	2/11/2018
Radiated Spurious Emissions, Bandedges, 1 - 6.5 GHz, 29-Jun-17					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	1538	2/11/2017	2/11/2018
Radiated Emissions, 1000 - 25,000 MHz, 30-Jun-17					
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Hewlett Packard	High Pass filter, 8.2 GHz	P/N 84300-80039	1156	5/10/2017	5/10/2018
HP / Miteq	SA40 P Head HF preAmplifier, 18-40 GHz (w/2415)	TTA1840-45-5P-HG-S	1772	9/12/2016	N/A
A. H. Systems	Spare System Horn, 18-40GHz	SAS-574, p/n: 2581	2162	7/29/2015	7/29/2017
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	9/30/2016	9/30/2017
Micro-Tronics	Band Reject Filter, 2400-2500 MHz 18GHz	BRM50702-02	2238	5/17/2017	5/17/2018
Hewlett Packard	Spectrum Analyzer (SA40) Purple 9 kHz - 40 GHz,	8564E (84125C)	2415	3/1/2017	3/1/2018
Radiated Emissions, 1000 - 12,000 MHz, 3-Jul-17					
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	9/30/2016	9/30/2017
Micro-Tronics	Band Reject Filter, 2400-2500 MHz 18GHz	BRM50702-02	2238	5/17/2017	5/17/2018
Hewlett Packard	Spectrum Analyzer (SA40) Purple 9 kHz - 40 GHz,	8564E (84125C)	2415	3/1/2017	3/1/2018
Radiated Spurious Emissions, 1000 - 6,500 MHz, 12-Jul-17					
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	1756	6/29/2016	7/29/2017
EMCO	Antenna, Horn, 1-18 GHz	3115	2870	8/31/2015	8/31/2017
Radiated Emissions, 1000 - 12,000 MHz, 13-Jul-17					
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	9/29/2016	9/29/2018
Hewlett Packard	Spectrum Analyzer (SA40) Red 30 Hz -40 GHz	8564E (84125C)	1148	10/31/2016	11/1/2017
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	9/30/2016	9/30/2017
Micro-Tronics	Band Reject Filter, 2400-2500 MHz 18GHz	BRM50702-02	2238	5/17/2017	5/17/2018
Radio Antenna Port (Power and Spurious Emissions), 17-Jul-17					

Manufacturer	Description	Model	Asset#	Calibrated	Cal Due
National Technical Systems	NTS EMI Software (rev 2.10)	N/A	0		N/A
National Technical Systems	NTS Capture Analyzer Software (rev 3.8)	N/A	0		N/A
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/22/2017	5/22/2018
Radio Antenna Port (Power and Spurious Emissions), 18-Jul-17					
Rohde & Schwarz	Signal Analyzer 20 Hz - 26.5 GHz	FSQ26	2327	6/24/2017	6/24/2018
Radiated Emissions, 30 - 1,000 MHz, 18-Jul-17					
Sunol Sciences	Biconilog, 30-3000 MHz	JB3	1548	10/12/2016	10/12/2018
Com-Power	Preamplifier, 30-1000 MHz	PA-103	1632	3/8/2017	3/8/2018
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	1756	7/8/2017	7/8/2018
Micro-Tronics	Band Reject Filter, 2400-2500 MHz 18GHz	BRM50702-02	2238	5/17/2017	5/17/2018
Micro-Tronics	Band Reject Filter, 5150-5350 MHz	BRC50703-02	2251	9/19/2016	9/19/2017
Radiated Emissions, 1000 - 12,000 MHz, 18-Jul-17					
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	9/30/2016	9/30/2017
Micro-Tronics	Band Reject Filter, 2400-2500 MHz 18GHz	BRM50702-02	2238	5/17/2017	5/17/2018
Hewlett Packard	Spectrum Analyzer (SA40) Purple 9 kHz - 40 GHz,	8564E (84125C)	2415	3/1/2017	3/1/2018
Radio Antenna Port (Power and Spurious Emissions), 19-Jul-17					
Rohde & Schwarz	Signal Analyzer 20 Hz - 26.5 GHz	FSQ26	2327	6/24/2017	6/24/2018
Radiated Emissions, 1000 - 25,000 MHz, 19-Jul-17					
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Hewlett Packard	High Pass filter, 8.2 GHz	P/N 84300-80039	1156	5/10/2017	5/10/2018
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	1756	7/8/2017	7/8/2018
HP / Miteq	SA40 P Head HF preAmplifier, 18-40 GHz (w/2415)	TTA1840-45-5P-HG-S	1772	9/12/2016	N/A
A. H. Systems	Spare System Horn, 18-40GHz	SAS-574, p/n: 2581	2162	7/29/2015	8/29/2017
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	9/30/2016	9/30/2017
Micro-Tronics	Band Reject Filter, 2400-2500 MHz 18GHz	BRM50702-02	2238	5/17/2017	5/17/2018
Hewlett Packard	Spectrum Analyzer (SA40) Purple 9 kHz - 40 GHz,	8564E (84125C)	2415	3/1/2017	3/1/2018
Radio Antenna Port (Power and Spurious Emissions), 21-Jul-17					
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	5/22/2017	5/22/2018
Radiated Emissions, 1000 - 40,000 MHz, 21-Jul-17					
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/21/2015	12/21/2017
Hewlett Packard	High Pass filter, 8.2 GHz	P/N 84300-80039	1156	5/10/2017	5/10/2018

Manufacturer	Description	Model	Asset#	Calibrated	Cal Due
HP / Miteq	SA40 P Head HF preAmplifier, 18-40 GHz (w/2415)	TTA1840-45-5P-HG-S	1772	9/12/2016	N/A
A. H. Systems	Spare System Horn, 18-40GHz	SAS-574, p/n: 2581	2162	7/29/2015	8/29/2017
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	9/30/2016	9/30/2017
Hewlett Packard	Spectrum Analyzer (SA40) Purple 9 kHz - 40 GHz,	8564E (84125C)	2415	3/1/2017	3/1/2018
Micro-Tronics	Band Reject Filter, 5725-5875 MHz	BRC50705-01	2738	10/7/2016	10/7/2017
Conducted Emissions - AC Power Ports, 21-Jul-17					
EMCO	LISN, 10 kHz-100 MHz	3825/2	1292	8/1/2016	8/1/2017
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1401	2/3/2017	2/3/2018
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB 7	1756	7/8/2017	7/8/2018

Appendix B Test Data

T104956 Pages 28 – 104

Client:	Google Inc.	Job Number:	JD104891
Product	Model H0A	T-Log Number:	T104956
System Configuration:	-	Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Emissions Standard(s):	FCC 15.247 / 15.407 / RSS-247	Class:	B
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Google Inc.

Product

Model H0A

Date of Last Test: 7/24/2017

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

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

Test Specific Details

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

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.
For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 25 °C
Rel. Humidity: 38 %

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	6	6	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	36.6 dBµV/m @ 2378.0 MHz (-17.4 dB)
	BLE	2480MHz	6	6	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	40.7 dBµV/m @ 2487.8 MHz (-13.3 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: Engineering Radiated Sample #2
Driver: -
Antenna: Internal

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / 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 a duty cycle ≥ 98% and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BLE	1Mb/s	0.62	Yes	0.387	2.1	4.1	2584

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 6:	Emission has non constant duty cycle < 98%, average measurement performed: RBW=1MHz, VBW> 1/T, peak detector, linear average mode, sweep time auto, max hold. Max hold for 50*(1/DC) traces
Note 8:	Plots of the average and peak bandedge do not account for any duty cycle correction. Refer to the tabular results for final measurements.

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

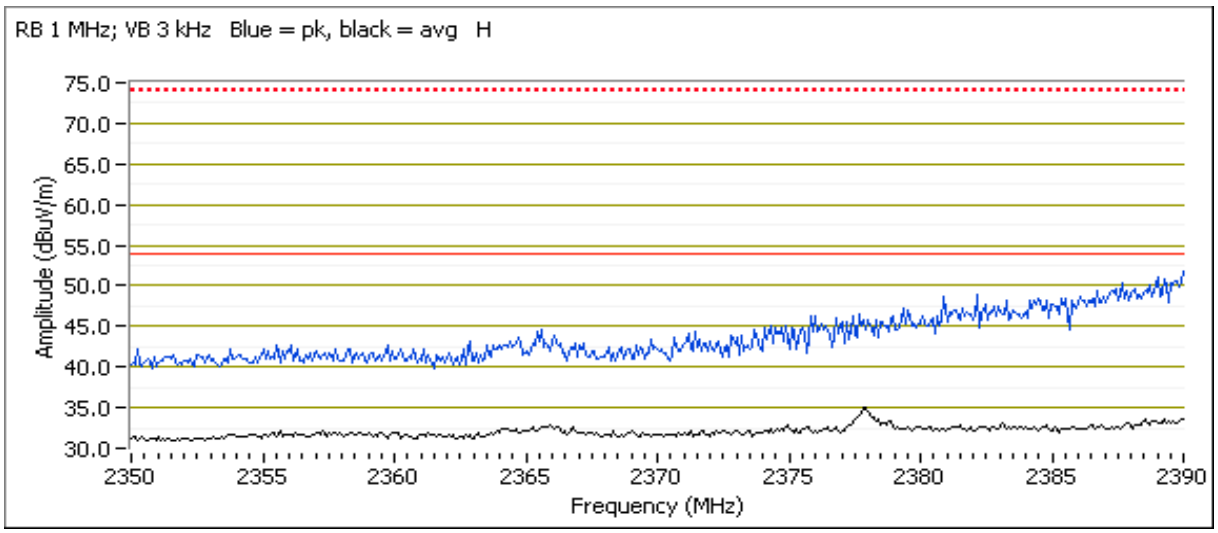
Run #1: Radiated Bandedge Measurements

Date of Test: 6/28/2017 0:00 Config. Used: 1
Test Engineer: Rafael Varelas Config Change: None
Test Location: FT Chamber #7 EUT Voltage: USB

Channel: 2402MHz Mode: BLE
Tx Chain: Antenna 2 Data Rate: 1Mb/s

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
Antenna 1								
2370.810	36.0	H	54.0	-18.0	Avg	30	1.8	RB 1 MHz; VB: 3 kHz, note 4
2389.050	49.9	H	74.0	-24.1	PK	30	1.8	POS; RB 1 MHz; VB: 3 MHz
Antenna 2								
2377.950	36.6	H	54.0	-17.4	Avg	336	2.0	RB 1 MHz; VB: 3 kHz, note 4
2389.610	51.3	H	74.0	-22.7	PK	336	2.0	POS; RB 1 MHz; VB: 3 MHz
2377.860	36.3	V	54.0	-17.7	Avg	45	1.5	RB 1 MHz; VB: 3 kHz, note 4
2389.160	51.5	V	74.0	-22.5	PK	45	1.5	POS; RB 1 MHz; VB: 3 MHz

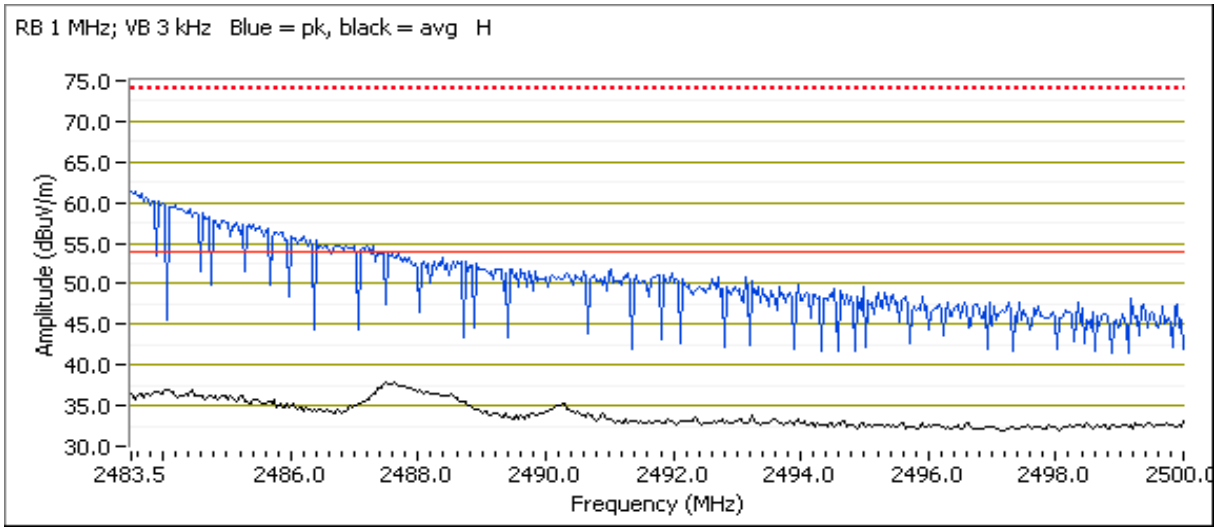


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Channel: 2480MHz Mode: BLE
Tx Chain: Antenna 1 Data Rate: 1Mb/s

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
Antenna 1								
2487.840	40.7	H	54.0	-13.3	Avg	353	1.1	RB 1 MHz; VB: 3 kHz, note 4
2483.720	61.7	H	74.0	-12.3	PK	353	1.1	POS; RB 1 MHz; VB: 3 MHz
2487.840	38.2	V	54.0	-15.8	Avg	301	2.0	RB 1 MHz; VB: 3 kHz, note 4
2483.520	57.6	V	74.0	-16.4	PK	301	2.0	POS; RB 1 MHz; VB: 3 MHz
Antenna 2								
2488.200	39.3	H	54.0	-14.7	Avg	343	1.7	RB 1 MHz; VB: 3 kHz, note 4
2484.100	61.4	H	74.0	-12.6	PK	343	1.7	POS; RB 1 MHz; VB: 3 MHz
2487.840	38.4	V	54.0	-15.6	Avg	58	1.6	RB 1 MHz; VB: 3 kHz, note 4
2483.670	59.0	V	74.0	-15.0	PK	58	1.6	POS; RB 1 MHz; VB: 3 MHz



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

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

Test Specific Details

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

General Test Configuration

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

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 23.4 °C
Rel. Humidity: 41 %

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	6	6	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	37.3 dBµV/m @ 4803.3 MHz (-16.7 dB)
	BLE	2440MHz		6	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	38.2 dBµV/m @ 4879.9 MHz (-15.8 dB)
	BLE	2480MHz		6	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	37.6 dBµV/m @ 4979.0 MHz (-16.4 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: Engineering Radiated Sample #2
Driver: -
Antenna: Internal

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / 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	1Mb/s	0.62	Yes	0.387	2.1	4.1	2584

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

Note: All testing performed on the Antenna 2 port (wifi set to 10 1 1, which forces BT to Antenna 2), as this was worse case from preliminary measurements.

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

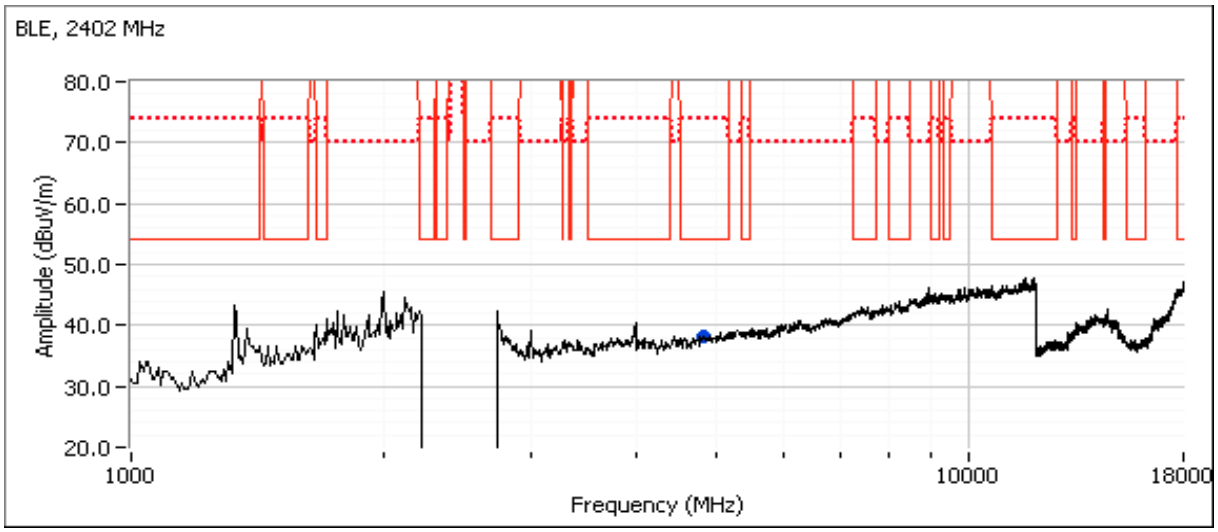
Run #1: Radiated Spurious Emissions, 1,000 - 25000 MHz. Operating Mode: 802.11b

Date of Test: 7/3/2017 0:00 Config. Used: 1
Test Engineer: Rafael Varelas Config Change: None
Test Location: FT Chamber #7 EUT Voltage: USB

Run #1a: Low Channel

Channel: 2402MHz Mode: BLE
Tx Chain: Antenna 2 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	
4803.340	37.3	V	54.0	-16.7	Avg	322	1.0	RB 1 MHz; VB: 3 kHz, note 4
4802.930	44.8	V	74.0	-29.2	PK	322	1.0	RB 1 MHz;VB 3 MHz;Peak



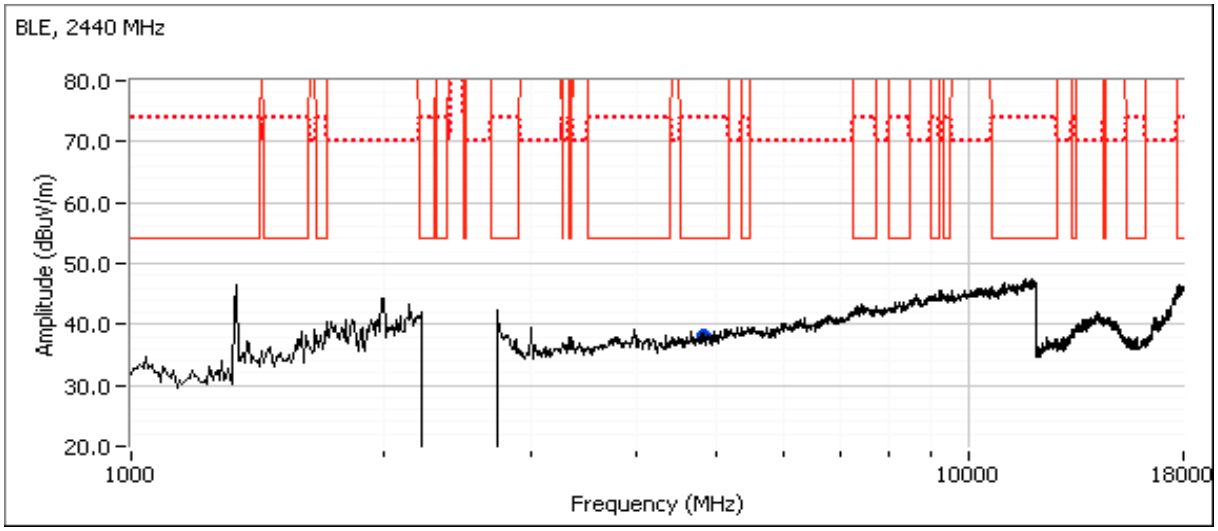
Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #1b: Center Channel

Channel: 2440MHz Mode: BLE
Tx Chain: Antenna 2 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	
4879.930	38.2	H	54.0	-15.8	Avg	319	1.0	RB 1 MHz; VB: 3 kHz, note 4
4879.860	45.7	H	74.0	-28.3	PK	319	1.0	RB 1 MHz;VB 3 MHz;Peak

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

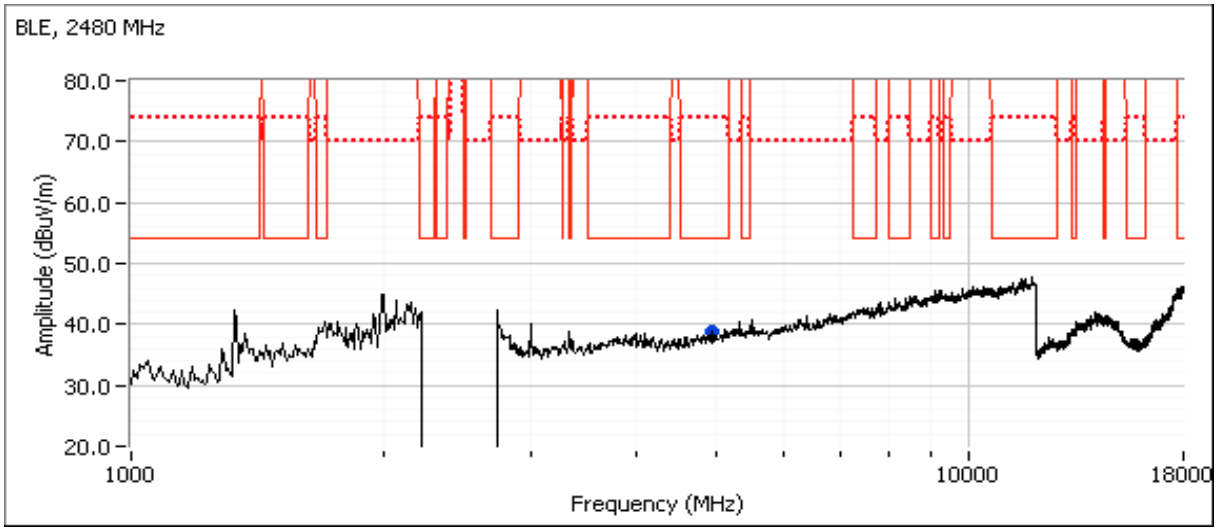


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #1c: High Channel

Channel: 2480MHz Mode: BLE
Tx Chain: Antenna 2 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	
4978.980	37.6	V	54.0	-16.4	Avg	330	1.0	RB 1 MHz; VB: 3 kHz, note 4
4979.960	45.4	V	74.0	-28.6	PK	330	1.0	RB 1 MHz;VB 3 MHz;Peak



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

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

Power, PSD, Bandwidth and Spurious Emissions

Test Specific Details

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

Date of Test: 7/21/2017
Test Engineer: John Caizzi
Test Location: Lab 4B

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: 24 °C
Rel. Humidity: 45 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1	6		Output Power	15.247(b)	Pass	5.8 dBm (3.8mW)
2			Power spectral Density (PSD)	15.247(d)	Pass	-4.0 dBm/10kHz
3			Minimum 6dB Bandwidth	15.247(a)	Pass	690 kHz
3			99% Bandwidth	RSS GEN	-	1.038 MHz
4			Spurious emissions	15.247(b)	Pass	All spurious < -20 dBc

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.

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

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	0.387	2.1	4.1	2584

Sample Notes

Sample S/N: Prototype Sample #1
Driver: -

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #1: Output Power

Mode: BLE

Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W	Output Power (dBm)[3]	Output Power mW
6	2402	5.8	3.8	4.0	Pass	9.8	0.010		
6	2440	5.7	3.7	4.0	Pass	9.7	0.009		
6	2480	5.5	3.5	4.0	Pass	9.5	0.009		

Note 1:	Output power measured using a peak power meter, spurious limit is -20dBc.
Note 2:	Power setting - the software power setting used during testing, included for reference only.
Note 3:	Power measured using average power meter (non-gated) and is included for reference only.
Note 4:	Power was measured on both antenna ports and it was the same. All subsequent readings done on port 2.

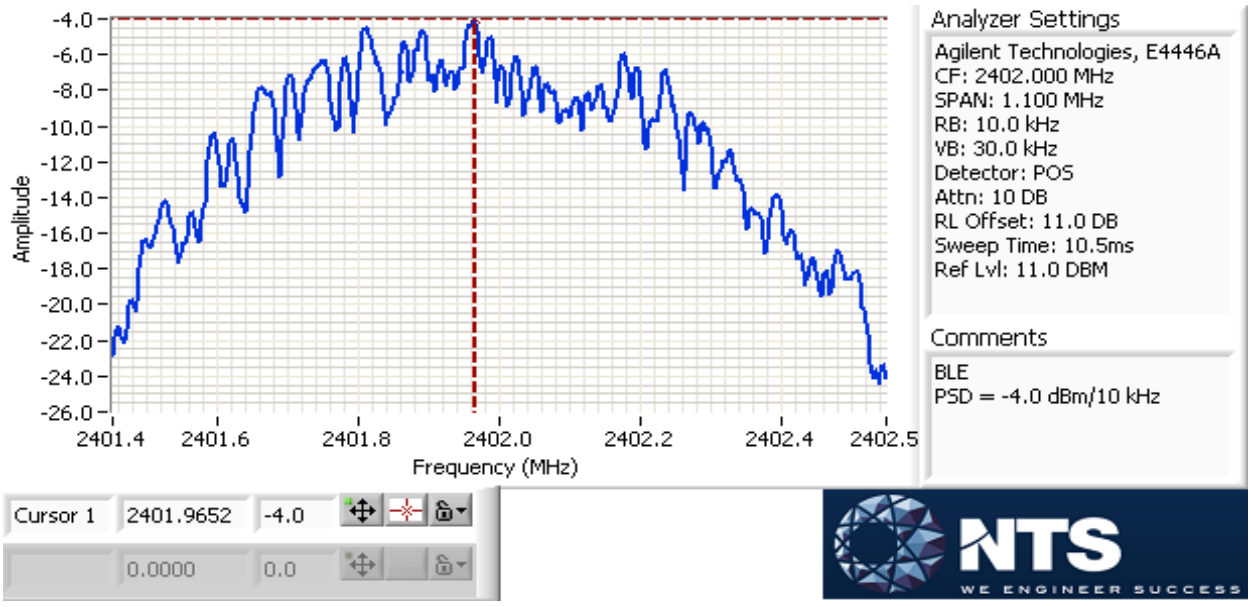
Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #2: Power spectral Density

Mode: BLE

Power Setting	Frequency (MHz)	PSD (dBm/10kHz) Note 1	Limit dBm/3kHz	Result
6	2402	-4.0	8.0	Pass
	2440	-4.2	8.0	Pass
	2480	-4.2	8.0	Pass

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



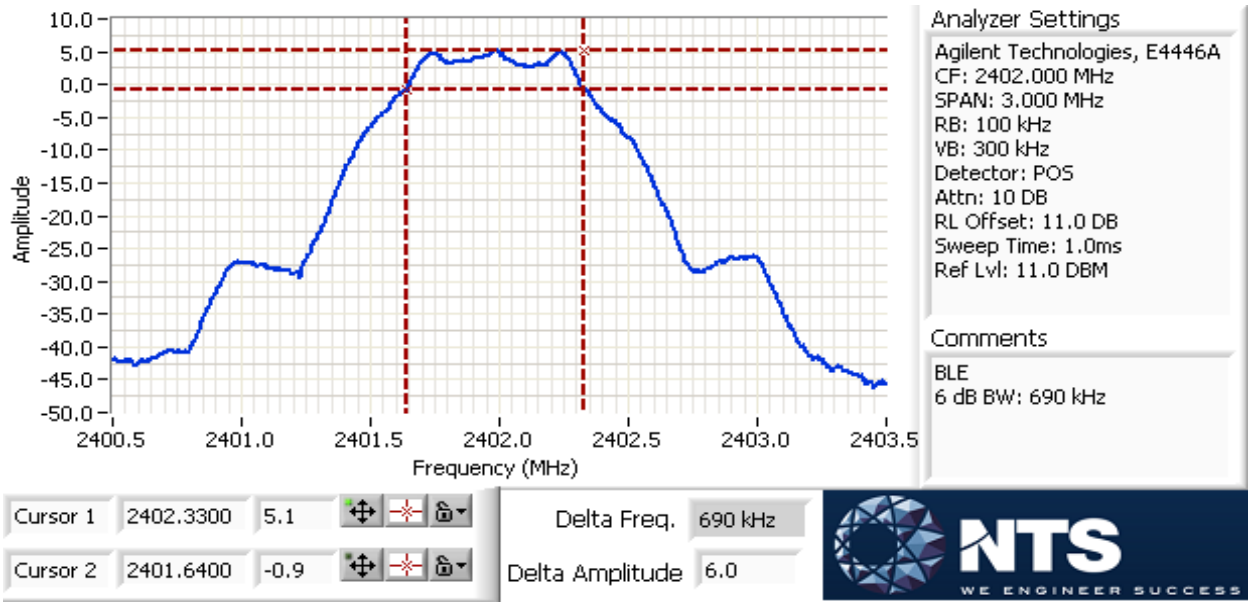
Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #3: Signal Bandwidth

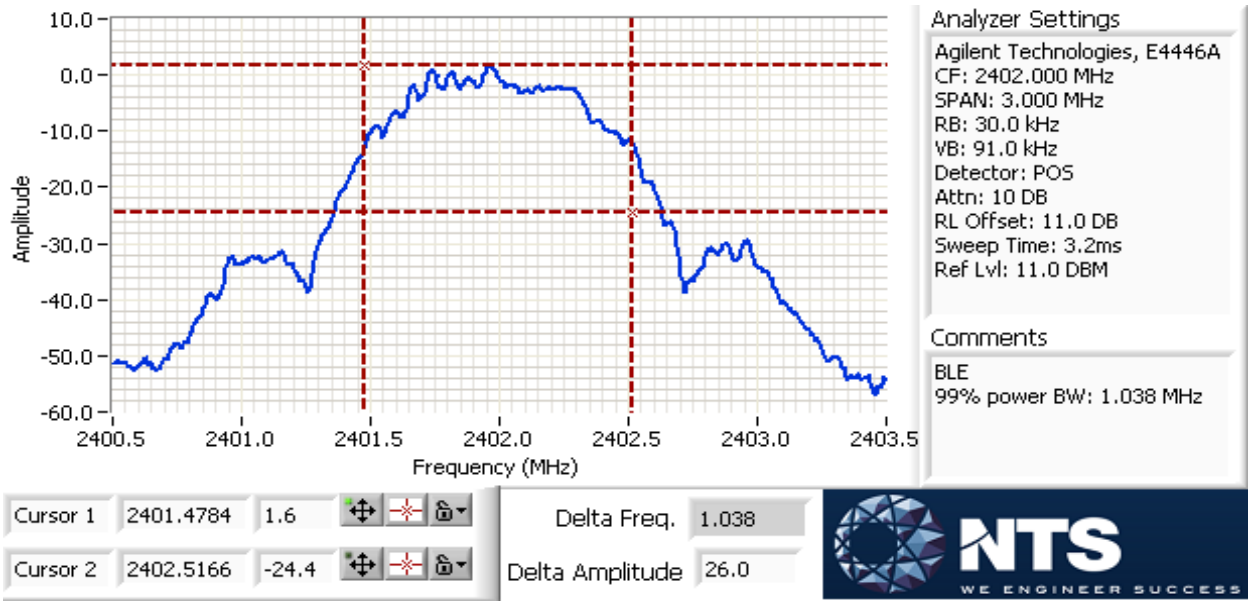
Mode: BLE

Power Setting	Frequency (MHz)	Bandwidth (kHz)		RBW Setting (kHz)	
		6dB	99%	6dB	99%
6	2402	100	30	690	1038
	2440			690	1038
	2480			700	1038

Note 1:	DTS BW: RBW=100kHz, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time, Span 2-5 times measured BW. 99% BW: RBW=1-5% of 99%BW, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time. Span 1.5-5 times OBW.



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A



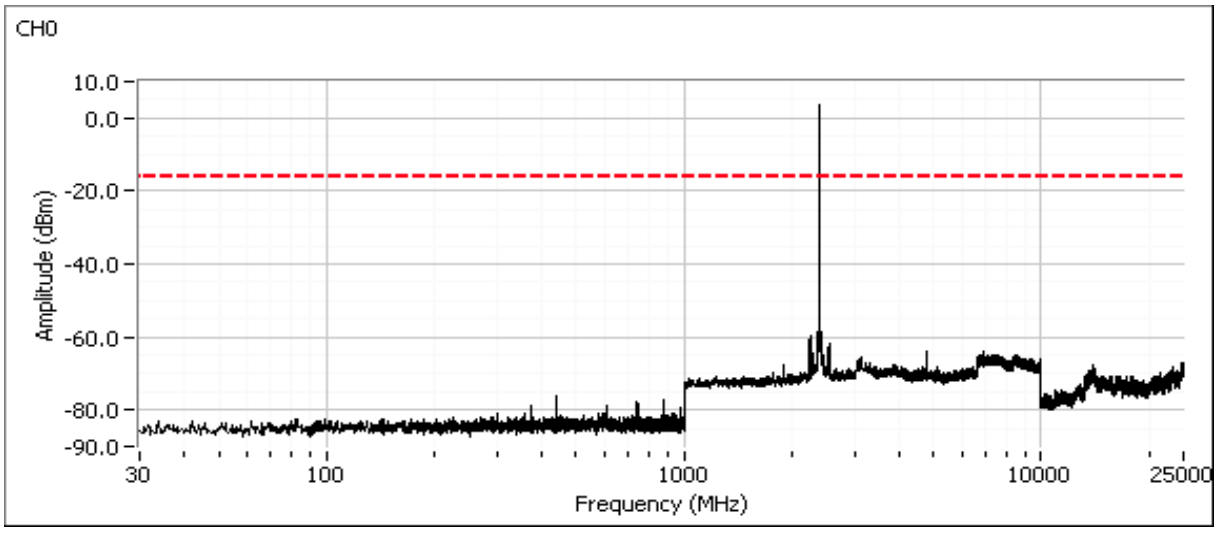
Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #4a: Out of Band Spurious Emissions

Frequency (MHz)	Power Setting	Mode	Limit	Result
2402	6	BLE	-20dBc	Pass
2440				Pass
2480				Pass

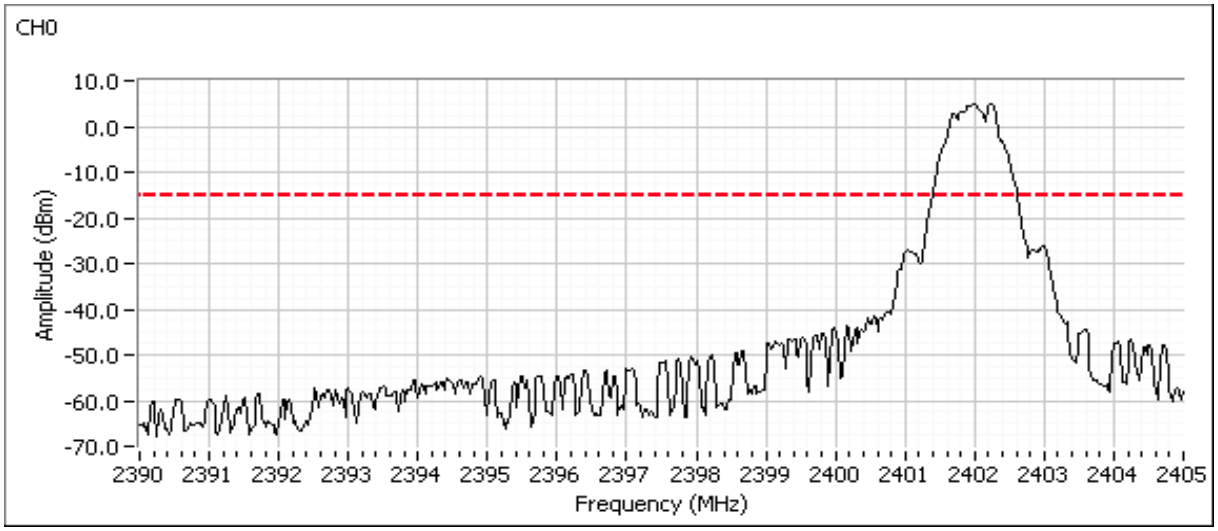
RBW = 100 kHz and VBW = 300 kHz for all plots.

Plots for low channel

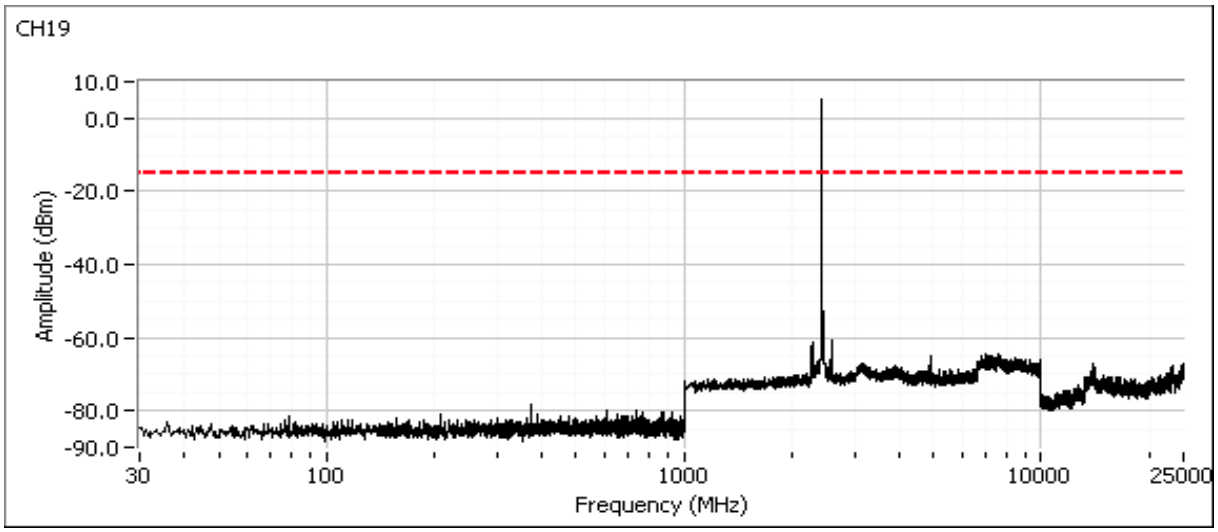


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

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

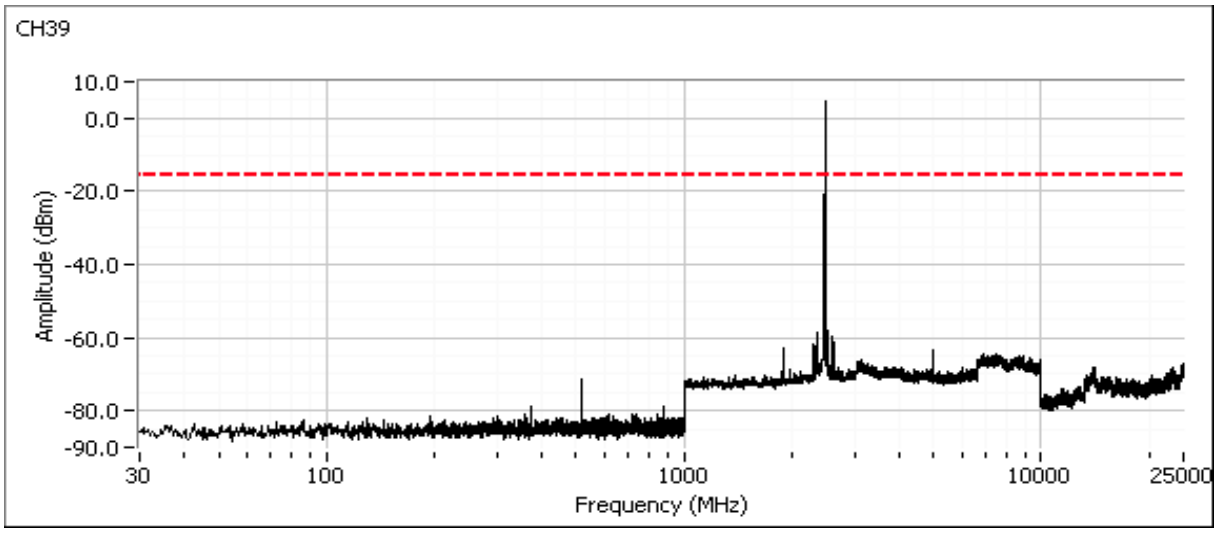


Plot for center channel



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Plot for high channel



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

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

Test Specific Details

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

Date of Test: 6/28 & 7/19/17
Test Engineer: John Caizzi/R. Varelas
Test Location: Chamber 7

Config. Used: 1
Config Change: none
EUT Voltage: USB

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:

	6/28/2017	7/19/2017
Temperature:	25 °C	23.6 °C
Rel. Humidity:	38 %	41 %

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

Run #	Mode	Channel	Target Power (dBm)	Passing Power Setting	Test Performed	Limit	Result / Margin
1	b	1 2412 MHz	-	18	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	49.1 dBµV/m @ 2386.3 MHz (-4.9 dB)
		11 2462 MHz		19	Restricted Band Edge (2483.5 MHz)		48.6 dBµV/m @ 2483.5 MHz (-5.4 dB)
2	g	1 2412 MHz		14	Restricted Band Edge (2390 MHz)		51.2 dBµV/m @ 2390.0 MHz (-2.8 dB)
		2 2417 MHz		18	Restricted Band Edge (2390 MHz)		51.8 dBµV/m @ 2390.0 MHz (-2.2 dB)
		3 2422 MHz		19	Restricted Band Edge (2390 MHz)		52.1 dBµV/m @ 2390.0 MHz (-1.9 dB)
		11 2462 MHz		16	Restricted Band Edge (2483.5 MHz)		52.1 dBµV/m @ 2483.5 MHz (-1.9 dB)
		10 2457 MHz		18	Restricted Band Edge (2483.5 MHz)		52.0 dBµV/m @ 2483.5 MHz (-2.0 dB)
		9 2452 MHz		19	Restricted Band Edge (2483.5 MHz)		52.4 dBµV/m @ 2483.6 MHz (-1.6 dB)

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #	Mode	Channel	Target Power (dBm)	Passing Power Setting	Test Performed	Limit	Result / Margin
3	n20	1 2412 MHz	-	13	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	51.7 dBµV/m @ 2390.0 MHz (-2.3 dB)
		2 2417 MHz		18	Restricted Band Edge (2390 MHz)		52.1 dBµV/m @ 2390.0 MHz (-1.9 dB)
		3 2422 MHz		18	Restricted Band Edge (2390 MHz)		49.6 dBµV/m @ 2389.9 MHz (-4.4 dB)
		11 2462 MHz		15	Restricted Band Edge (2483.5 MHz)		51.8 dBµV/m @ 2483.5 MHz (-2.2 dB)
		10 2457 MHz		17	Restricted Band Edge (2483.5 MHz)		70.7 dBµV/m @ 2483.8 MHz (-3.3 dB)
		9 2452 MHz		18	Restricted Band Edge (2483.5 MHz)		70.5 dBµV/m @ 2484.0 MHz (-3.5 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: Engineering Radiated Sample #2
Driver: -
Antenna: internal

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074
Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time
Unless otherwise stated/noted, emission has a duty cycle ≥ 98% and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold.

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11b	1 Mb/s	> .99	Yes	-	0	0	10
11g	6 Mb/s	99.3%	Yes	3.12	0	0	10
n20	MCS0	99.3%	Yes	2.928	0	0	10

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Date of Test: 7/12/2017 0:00
Test Engineer: John Caizzi
Test Location: Chamber 7

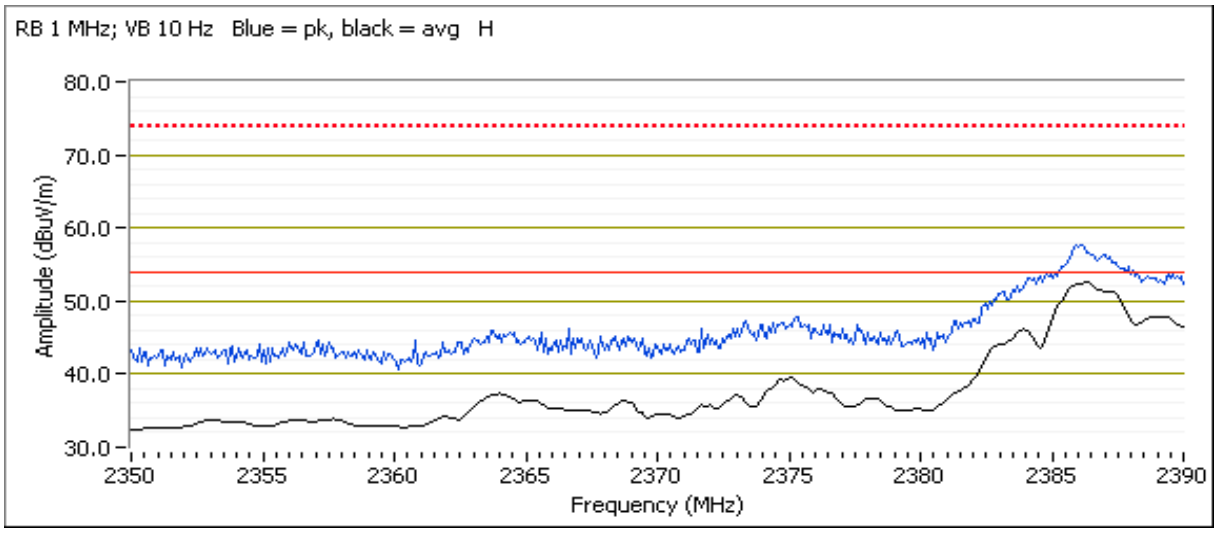
Config. Used: 1
Config Change: none
EUT Voltage: USB

Channel: 1
Antenna 2

Mode: b
Data Rate: 1 Mb/s

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2386.260	49.1	H	54.0	-4.9	AVG	16	1.79	
2386.080	55.5	H	74.0	-18.5	PK	16	1.79	



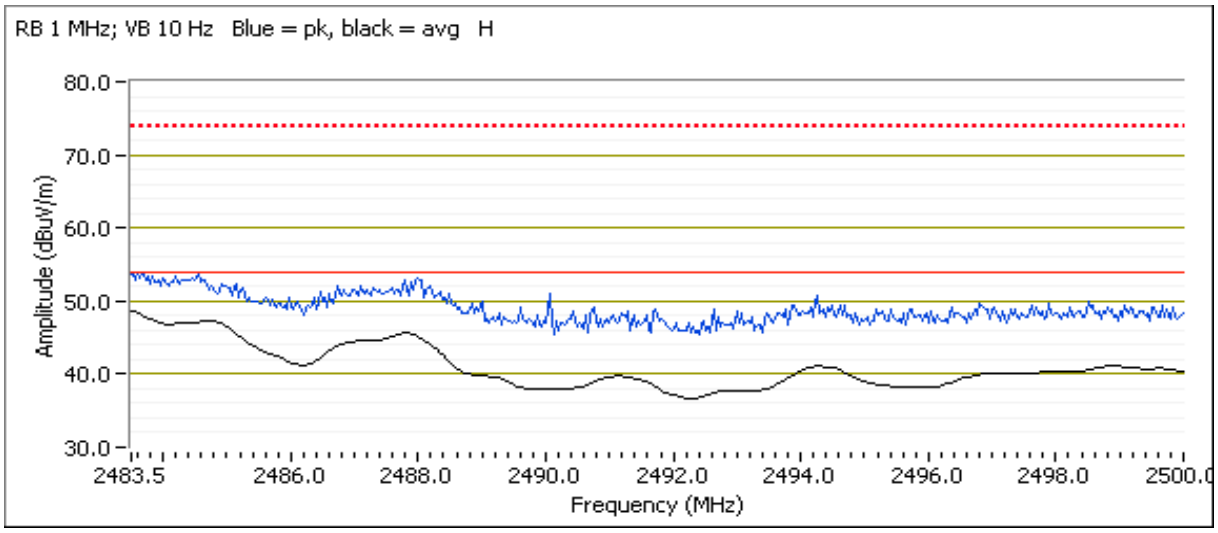
Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Date of Test: 7/12/2017 0:00 Config. Used: 1
Test Engineer: John Caizzi Config Change: none
Test Location: Chamber 7 EUT Voltage: USB

Channel: 11 Mode: b
Antenna 1 Data Rate: 1 Mb/s

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.500	48.6	H	54.0	-5.4	AVG	352	1.89	
2483.540	55.1	H	74.0	-18.9	PK	352	1.89	



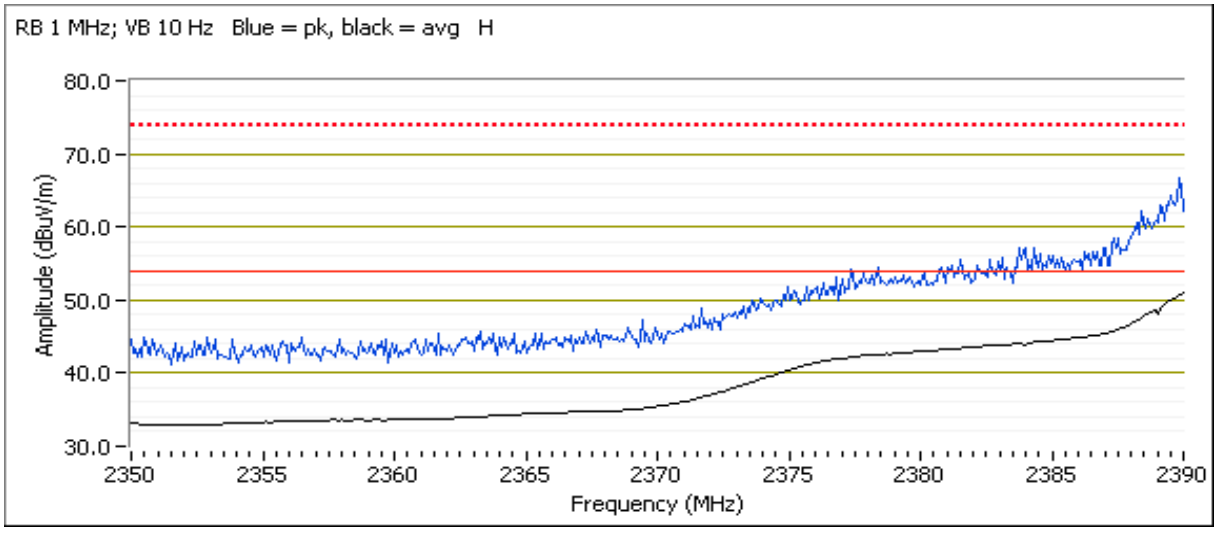
Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #2: Radiated Bandedge Measurements

Channel: 1 Mode: g
Antenna 1 Data Rate: 6 Mb/s

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2390.000	51.1	H	54.0	-2.9	AVG	1	2.01	
2389.900	69.6	H	74.0	-4.4	PK	1	2.01	

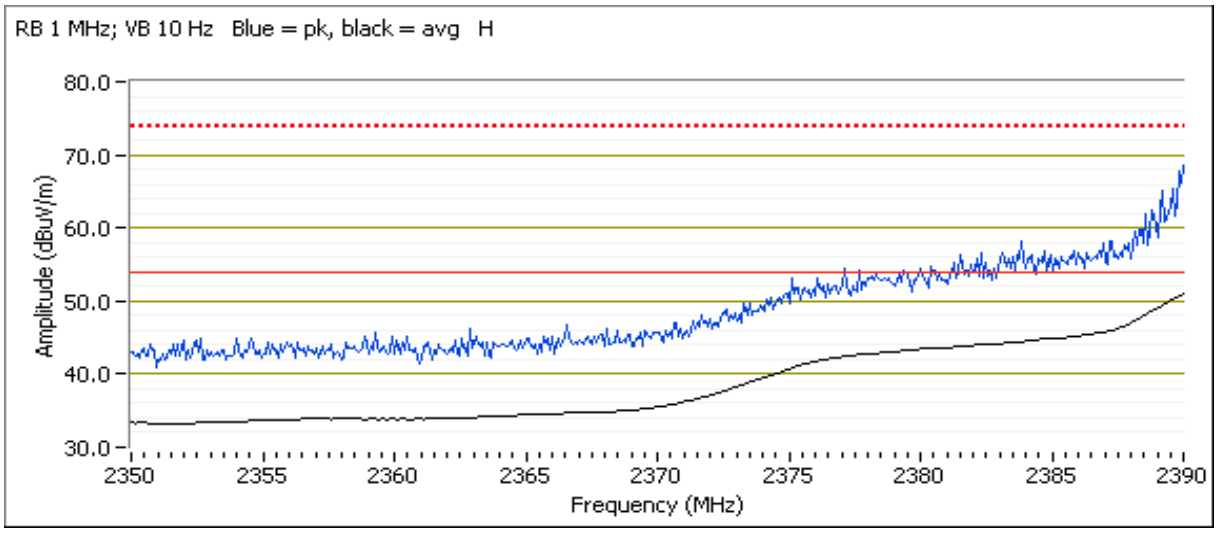


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Channel: 1 Mode: g
Antenna 2 Data Rate: 6 Mb/s

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2390.000	51.2	H	54.0	-2.8	AVG	360	1.79	
2389.920	69.2	H	74.0	-4.8	PK	360	1.79	



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Date of Test: 7/19/2017 0:00
Test Engineer: Rafael Varelas
Test Location: Chamber #4

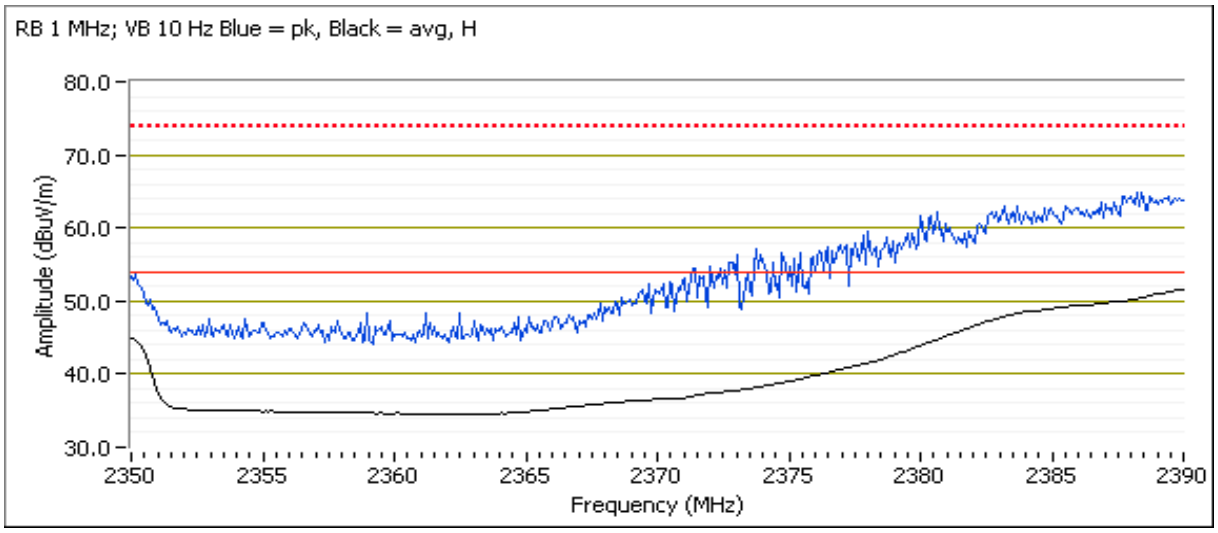
Config. Used: 1
Config Change: none
EUT Voltage: USB

Channel: 2
Antenna 2

Mode: g
Data Rate: 6 Mb/s

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2390.000	51.8	H	54.0	-2.2	AVG	353	2.0	
2387.820	65.4	H	74.0	-8.6	PK	353	2.0	



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Date of Test: 7/19/2017 0:00
Test Engineer: Rafael Varelas
Test Location: Chamber #4

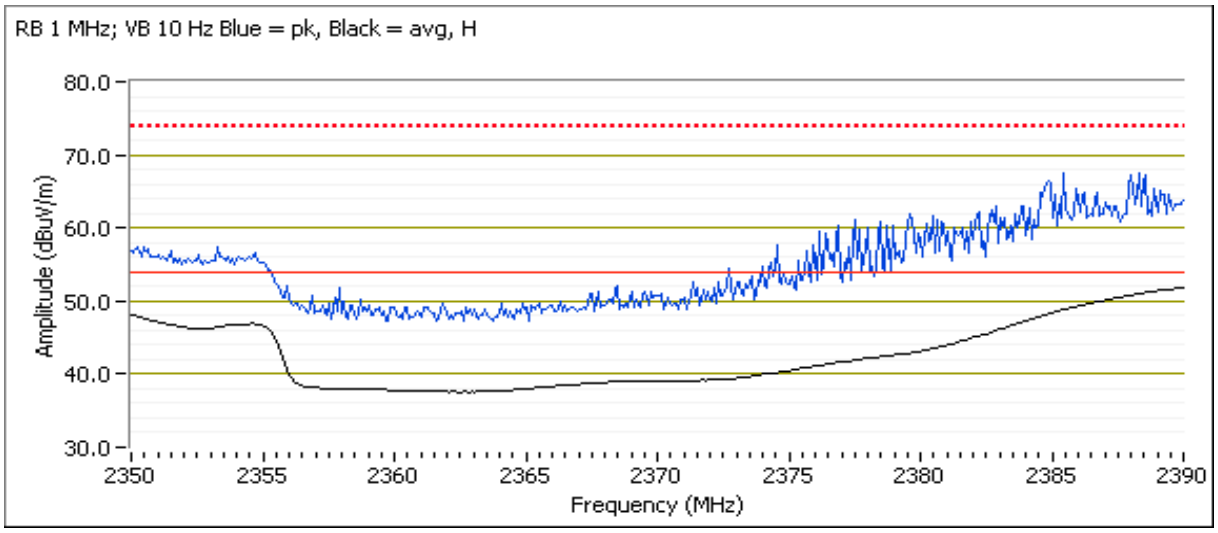
Config. Used: 1
Config Change: none
EUT Voltage: USB

Channel: 3
Antenna 2

Mode: g
Data Rate: 6 Mb/s

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2389.990	52.1	H	54.0	-1.9	AVG	360	2.0	
2385.270	67.8	H	74.0	-6.2	PK	360	2.0	



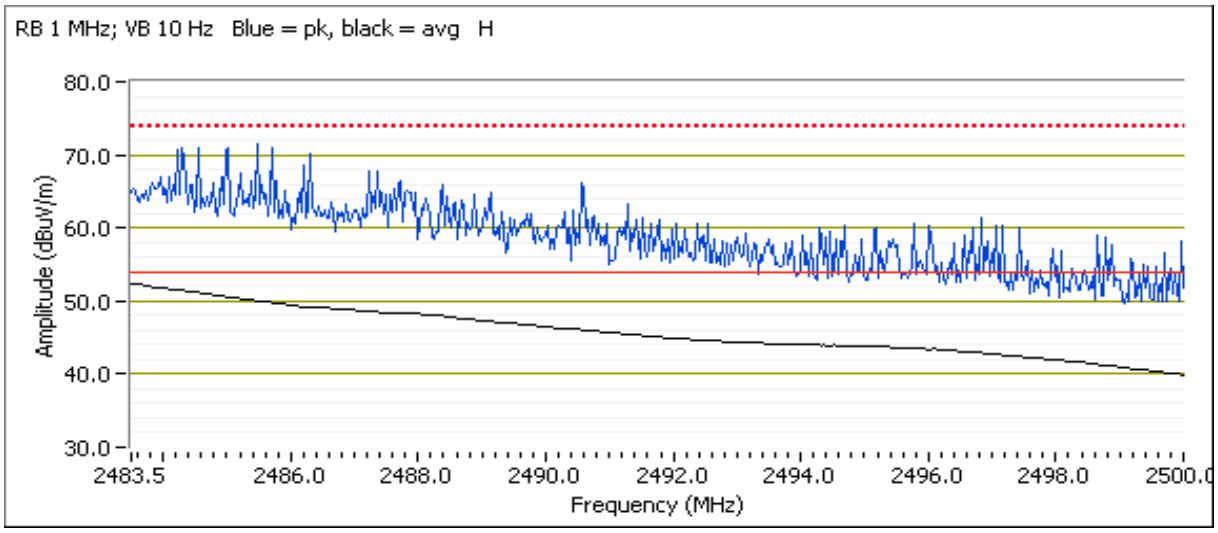
Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Date of Test: 7/12/2017 0:00 Config. Used: 1
Test Engineer: John Caizzi Config Change: none
Test Location: Chamber 7 EUT Voltage: USB

Channel: 11 Mode: g
Antenna 1 Data Rate: 6 Mb/s

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.520	52.1	H	54.0	-1.9	AVG	328	1.09	
2483.930	70.0	H	74.0	-4.0	PK	328	1.09	

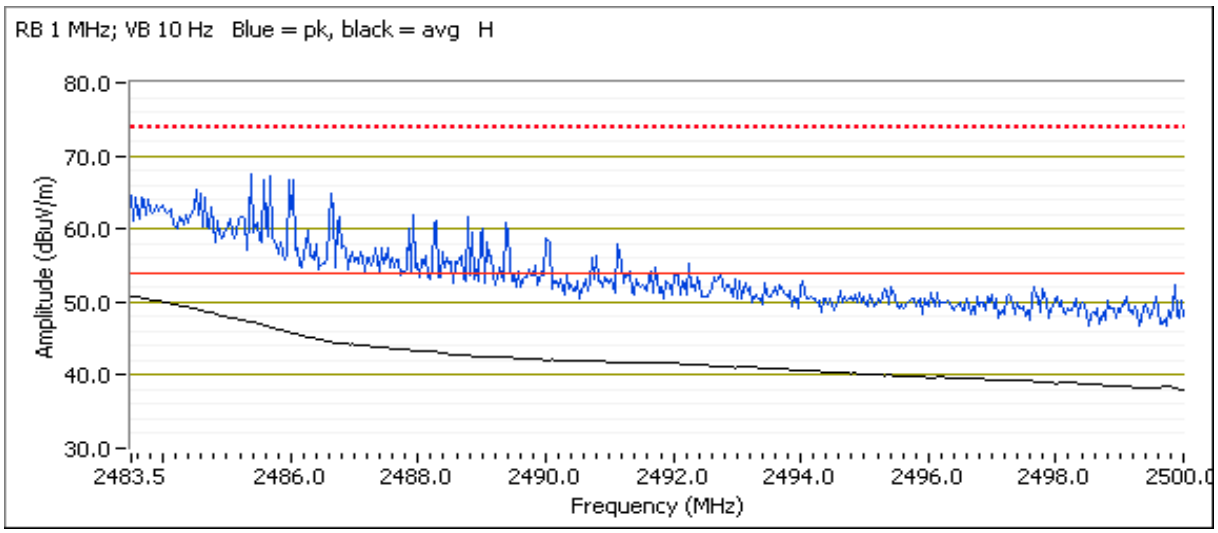


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Channel: 11 Mode: g
Antenna 2 Data Rate: 6 Mb/s

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.500	50.9	H	54.0	-3.1	AVG	28	1.72	
2483.930	69.2	H	74.0	-4.8	PK	28	1.72	



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Date of Test: 7/19/2017 0:00
Test Engineer: Rafael Varelas
Test Location: Chamber #4

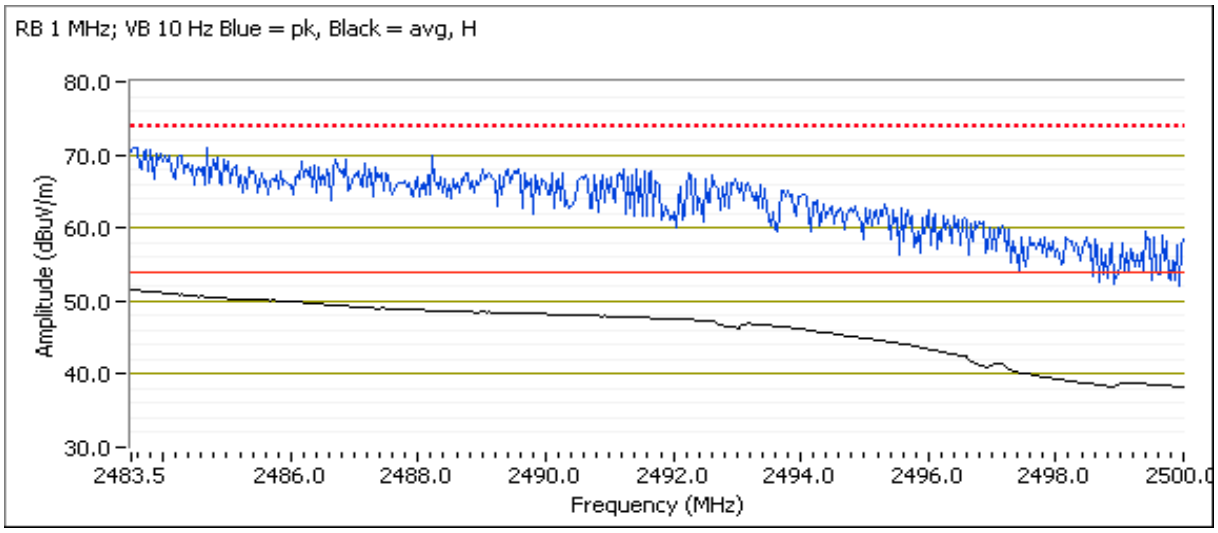
Config. Used: 1
Config Change: none
EUT Voltage: USB

Channel: 10
Antenna 1

Mode: g
Data Rate: 6 Mb/s

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.510	52.0	H	54.0	-2.0	AVG	339	1.0	
2484.840	70.5	H	74.0	-3.5	PK	339	1.0	



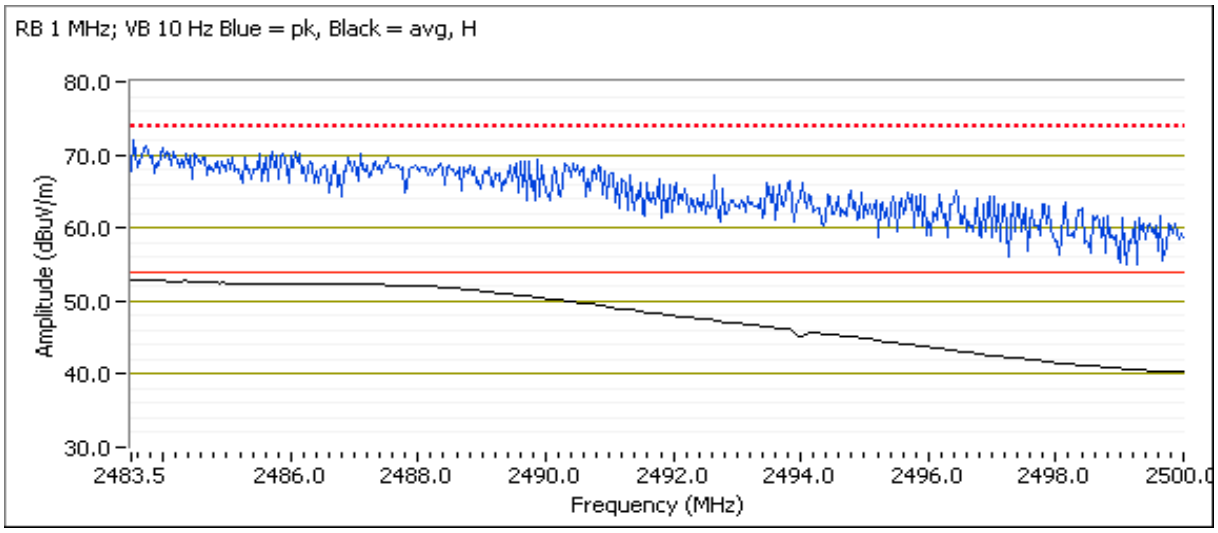
Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Date of Test: 7/19/2017 0:00 Config. Used: 1
Test Engineer: Rafael Varelas Config Change: none
Test Location: Chamber #4 EUT Voltage: USB

Channel: 9 Mode: g
Antenna 1 Data Rate: 6 Mb/s

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.570	52.4	H	54.0	-1.6	AVG	337	1.9	
2483.890	72.0	H	74.0	-2.0	PK	337	1.9	



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #3: Radiated Bandedge Measurements

Date of Test: 7/12/2017 0:00
Test Engineer: John Caizzi
Test Location: Chamber 7

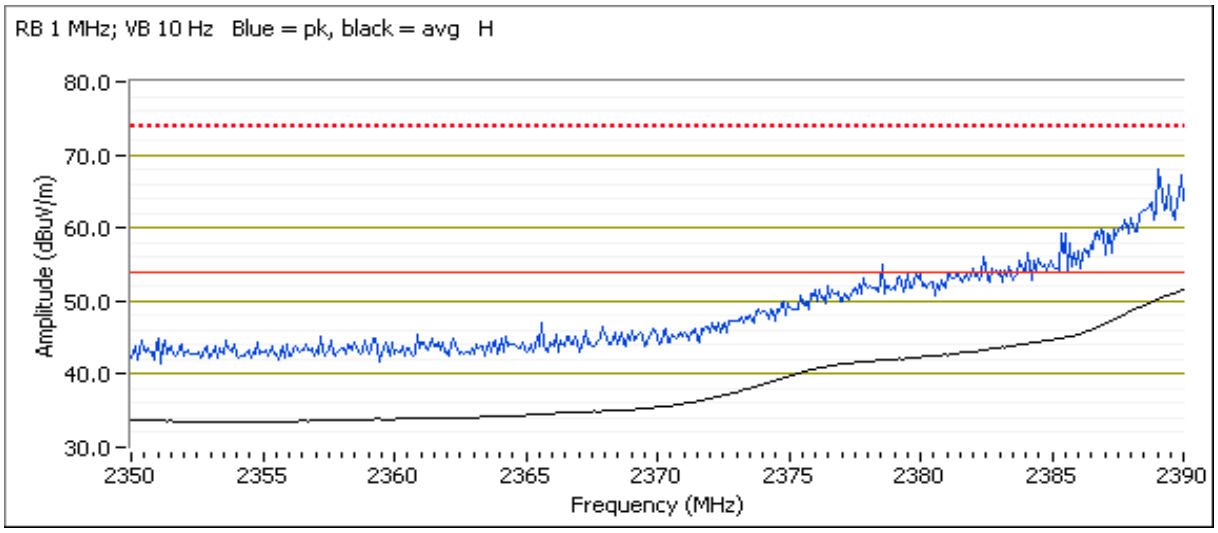
Config. Used: 1
Config Change: none
EUT Voltage: USB

Channel: 1
Antenna 2

Mode: n20
Data Rate: MCS0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2389.970	51.7	H	54.0	-2.3	AVG	6	1.98	
2389.700	68.3	H	74.0	-5.7	PK	6	1.98	



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Date of Test: 7/19/2017 0:00
Test Engineer: Rafael Varelas
Test Location: Chamber #4

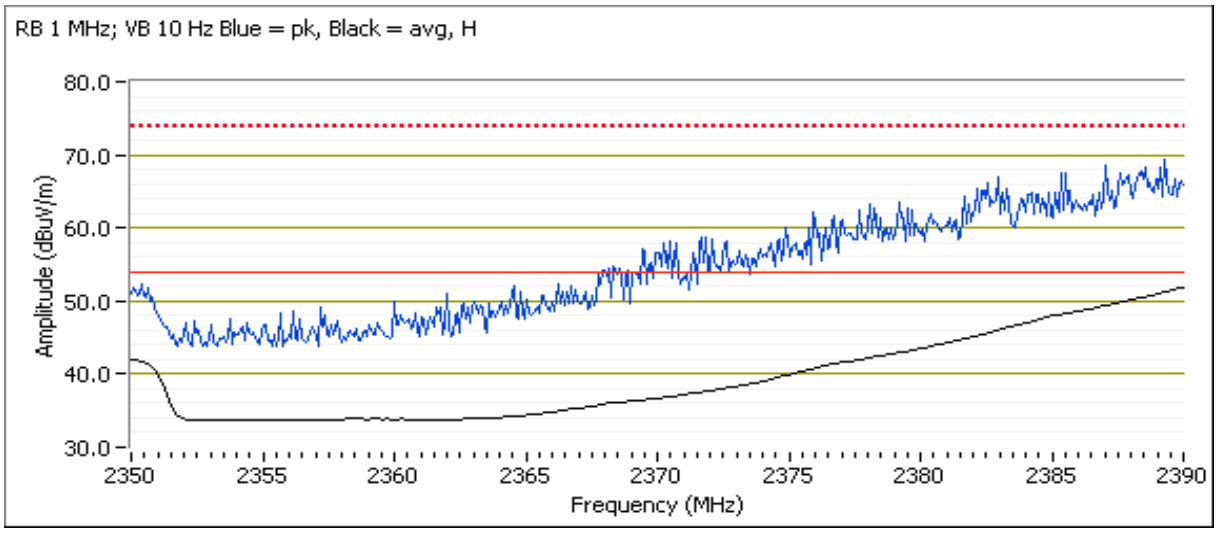
Config. Used: 1
Config Change: none
EUT Voltage: USB

Channel: 2
Antenna 2

Mode: n20
Data Rate: MCS0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2389.980	52.1	H	54.0	-1.9	AVG	23	1.8	
2389.400	68.4	H	74.0	-5.6	PK	23	1.8	



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Date of Test: 7/19/2017 0:00
Test Engineer: Rafael Varelas
Test Location: Chamber #4

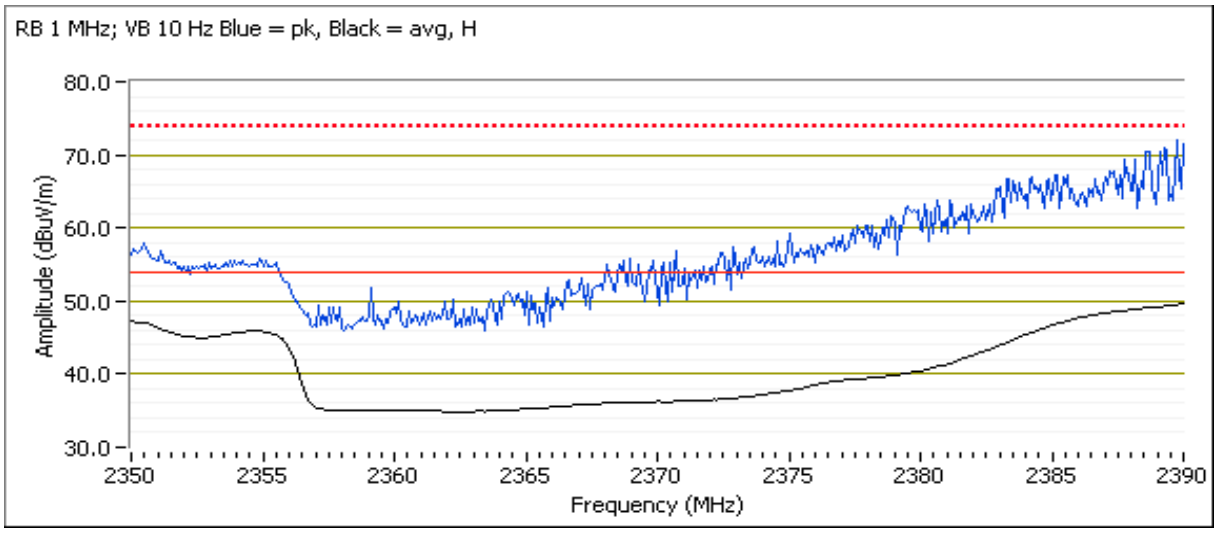
Config. Used: 1
Config Change: none
EUT Voltage: USB

Channel: 3
Antenna 2

Mode: n20
Data Rate: MCS0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2389.920	49.6	H	54.0	-4.4	AVG	330	1.6	
2389.800	70.9	H	74.0	-3.1	PK	330	1.6	



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Date of Test: 7/12/2017 0:00
Test Engineer: John Caizzi
Test Location: Chamber 7

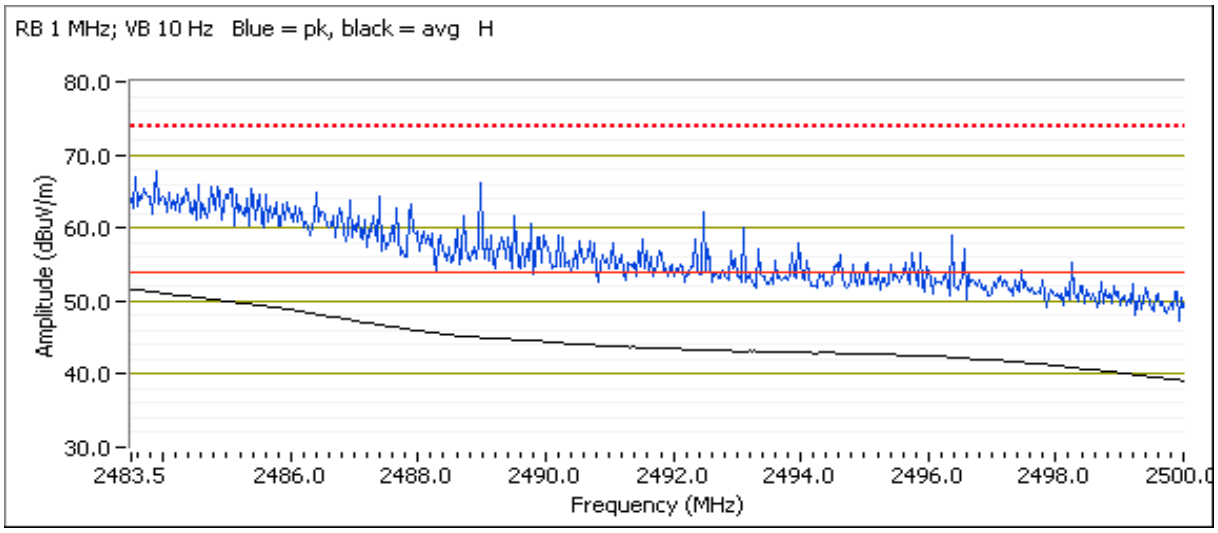
Config. Used: 1
Config Change: none
EUT Voltage: USB

Channel: 11
Antenna 1

Mode: n20
Data Rate: MCS0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.5100	51.8	H	54.0	-2.2	AVG	333	1.11	
2484.110	68.9	H	74.0	-5.1	PK	333	1.11	



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Date of Test: 7/19/2017 0:00
Test Engineer: Rafael Varelas
Test Location: Chamber #4

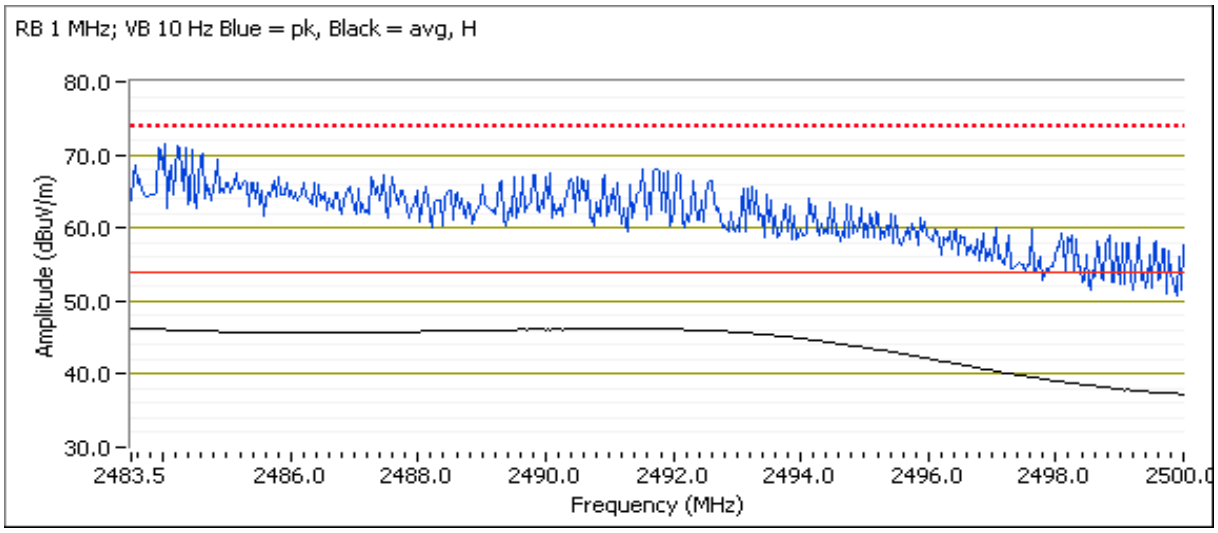
Config. Used: 1
Config Change: none
EUT Voltage: USB

Channel: 10
Antenna 1

Mode: n20
Data Rate: MCS0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.810	70.7	H	74.0	-3.3	PK	360	1.9	
2483.500	46.5	H	54.0	-7.5	AVG	360	1.9	



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Date of Test: 7/19/2017 0:00
Test Engineer: Rafael Varelas
Test Location: Chamber #4

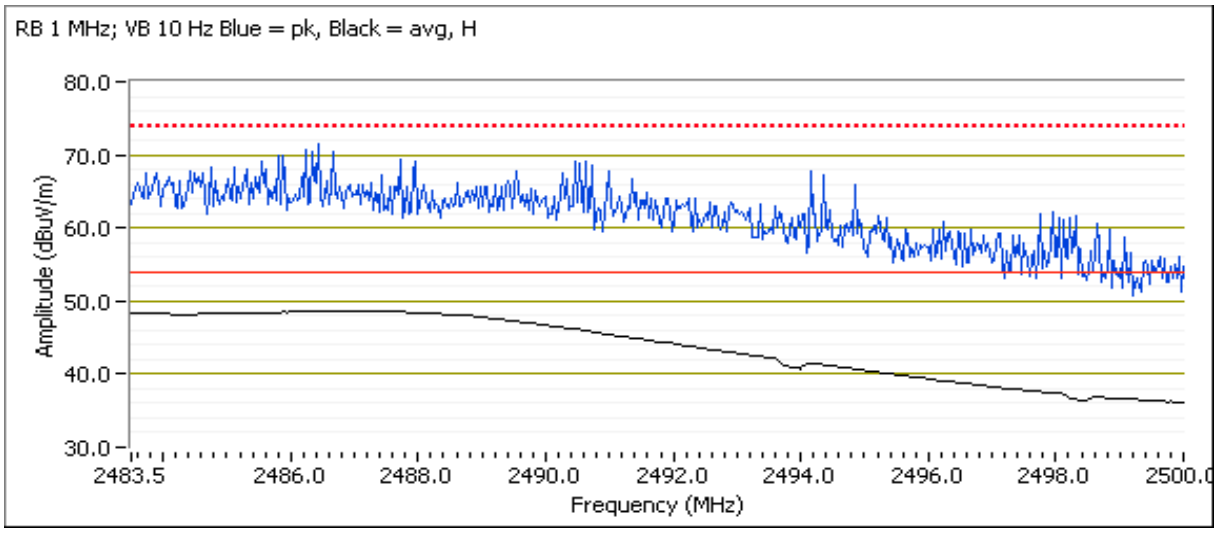
Config. Used: 1
Config Change: none
EUT Voltage: USB

Channel: 9
Antenna 1

Mode: n20
Data Rate: MCS0

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2483.960	70.5	H	74.0	-3.5	PK	340	1.7	POS; RB 1 MHz; VB: 3 MHz
2483.630	48.6	H	54.0	-5.4	AVG	340	1.7	POS; RB 1 MHz; VB: 10 Hz



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

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

Test Specific Details

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

General Test Configuration

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

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

Temperature: 22.9 °C
Rel. Humidity: 40 %

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

Run #	Mode	Channel	Target Power (dBm)	Passing Power Setting	Test Performed	Limit	Result / Margin
1	b	1 - 2412MHz	-	19	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	46.5 dBµV/m @ 7235.3 MHz (-7.5 dB)
	b	6 - 2437MHz		19	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	45.9 dBµV/m @ 7311.9 MHz (-8.1 dB)
	b	11 - 2462MHz		19	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	47.0 dBµV/m @ 4924.0 MHz (-7.0 dB)
Scans on center channel in all OFDM modes to determine the worst case mode.							
2	g	6 - 2437MHz		19	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	45.0 dBµV/m @ 7314.1 MHz (-9.0 dB)
	n20	6 - 2437MHz		19	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	44.3 dBµV/m @ 7313.4 MHz (-9.7 dB)
Measurements on low and high channels in worst-case OFDM mode.							
3	g	1 - 2412MHz	-	16	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	34.6 dBµV/m @ 4823.3 MHz (-19.4 dB)
	g	11 - 2462MHz		16	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247(c)	35.2 dBµV/m @ 4924.0 MHz (-18.8 dB)

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	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: Engineering Radiated Sample #2
Driver: -
Antenna: internal

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / 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)
11b	1 Mb/s	> .99	Yes		0	0	
11g	6 Mb/s	99.3%	Yes	3.12	0	0	10
n20	MCS0	99.3%	Yes	2.928	0	0	10

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

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

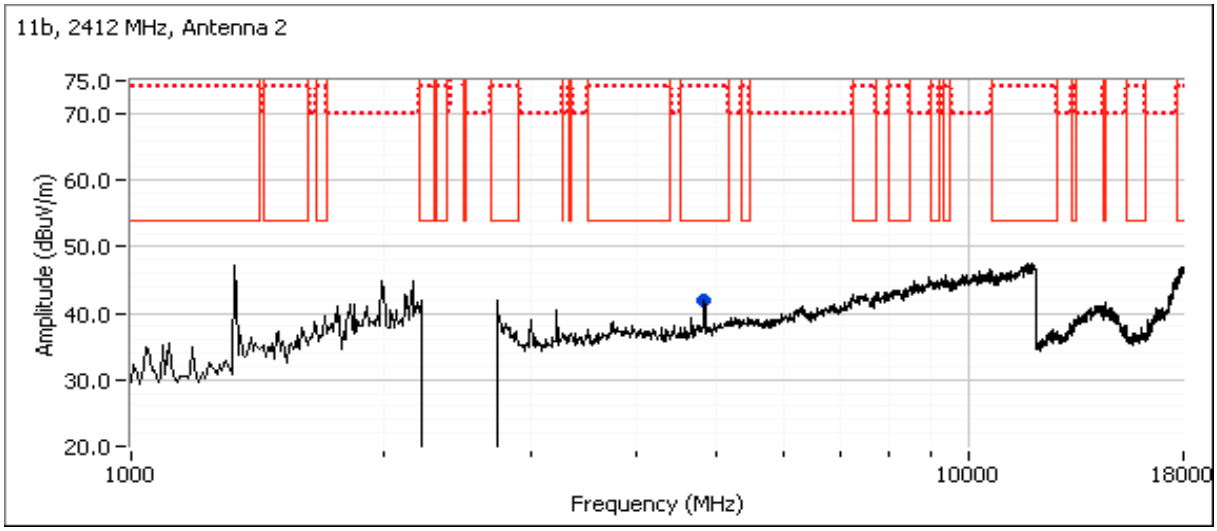
Run #1: Radiated Spurious Emissions, 1,000 - 25000 MHz. Operating Mode: 802.11b

Date of Test: 6/30/2017 0:00 Config. Used: 1
Test Engineer: Rafael Varelas Config Change: None
Test Location: FT Chamber #7 EUT Voltage: USB

Run #1a: Low Channel

Channel: 1 Mode: b
Tx Chain: Antenna 2 Data Rate: 1 Mb/s

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7235.270	46.5	H	54.0	-7.5	AVG	127	1.2	
7237.270	54.2	H	74.0	-19.8	PK	127	1.2	
4823.980	45.5	H	54.0	-8.5	AVG	56	1.2	
4824.170	50.1	H	74.0	-23.9	PK	56	1.2	



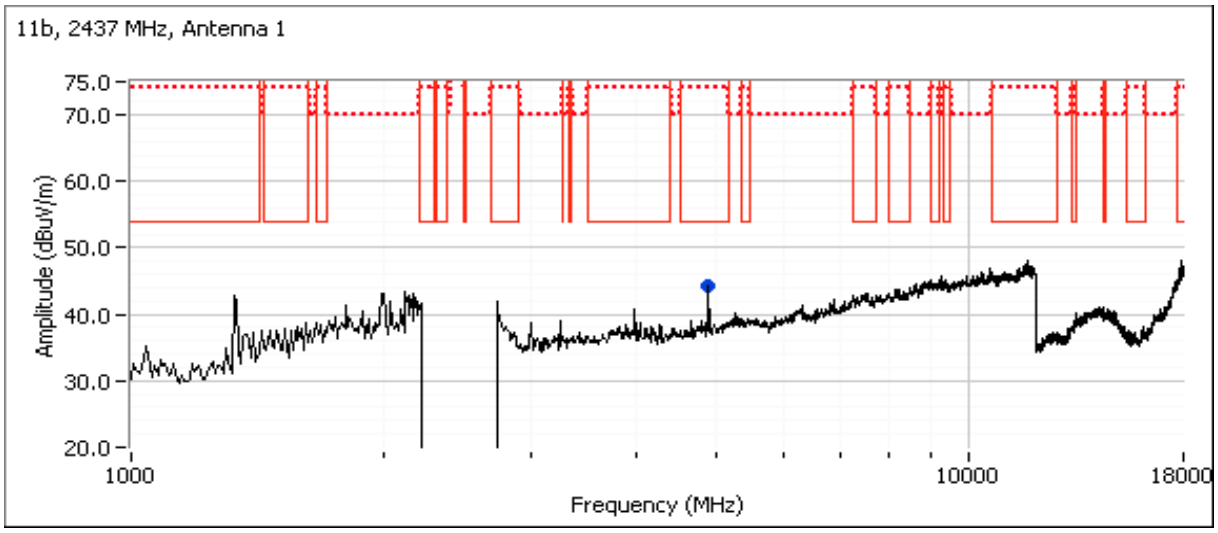
Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #1b: Center Channel

Channel: 6 Mode: b
Tx Chain: Antenna 1 Data Rate: 1 Mb/s

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4874.020	42.8	H	54.0	-11.2	AVG	321	1.5	
4873.920	49.2	H	74.0	-24.8	PK	321	1.5	

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

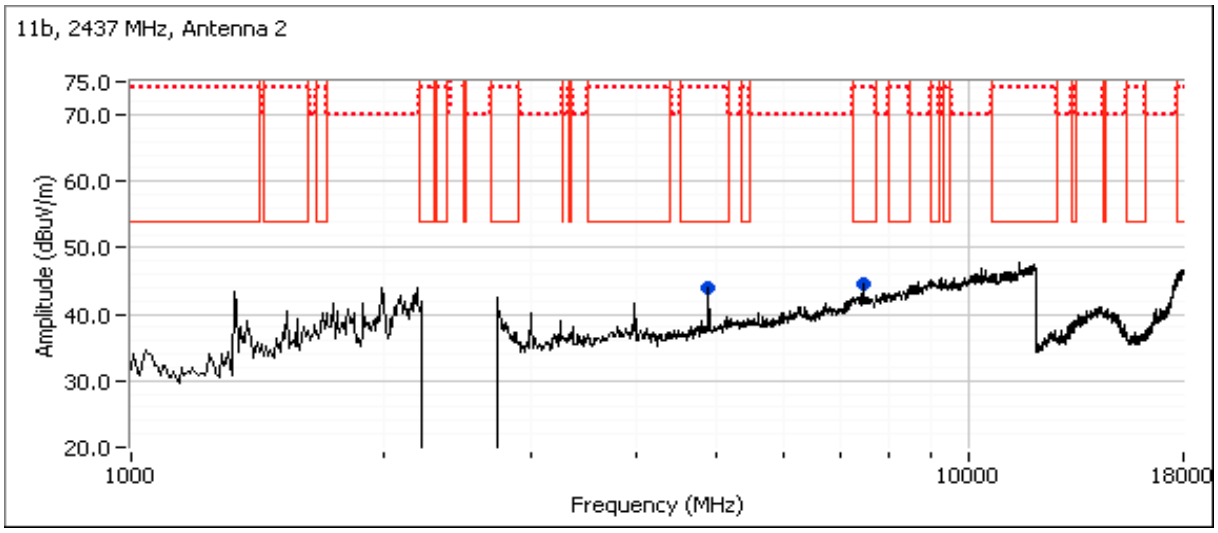


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Channel: 6 Mode: b
Tx Chain: Antenna 2 Data Rate: 1 Mb/s

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7311.880	45.9	H	54.0	-8.1	AVG	44	2.1	
7311.810	53.7	H	74.0	-20.3	PK	44	2.1	
4874.190	44.0	H	54.0	-10.0	AVG	61	1.0	
4873.970	49.6	H	74.0	-24.4	PK	61	1.0	

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

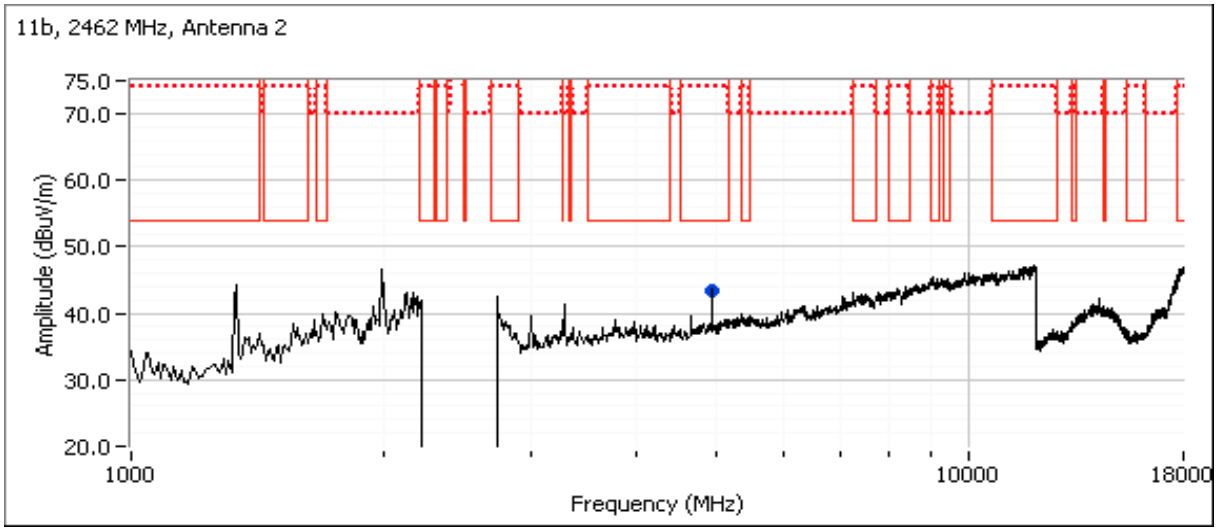


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #1c: High Channel

Channel: 11 Mode: b
Tx Chain: Antenna 2 Data Rate: 1 Mb/s

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4924.020	47.0	H	54.0	-7.0	AVG	19	1.5	
4924.040	51.1	H	74.0	-22.9	PK	19	1.5	
7385.270	46.5	H	54.0	-7.5	AVG	137	1.0	
7384.800	53.9	H	74.0	-20.1	PK	137	1.0	



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #2: Radiated Spurious Emissions, 1,000 - 25000 MHz. Operating Mode: OFDM

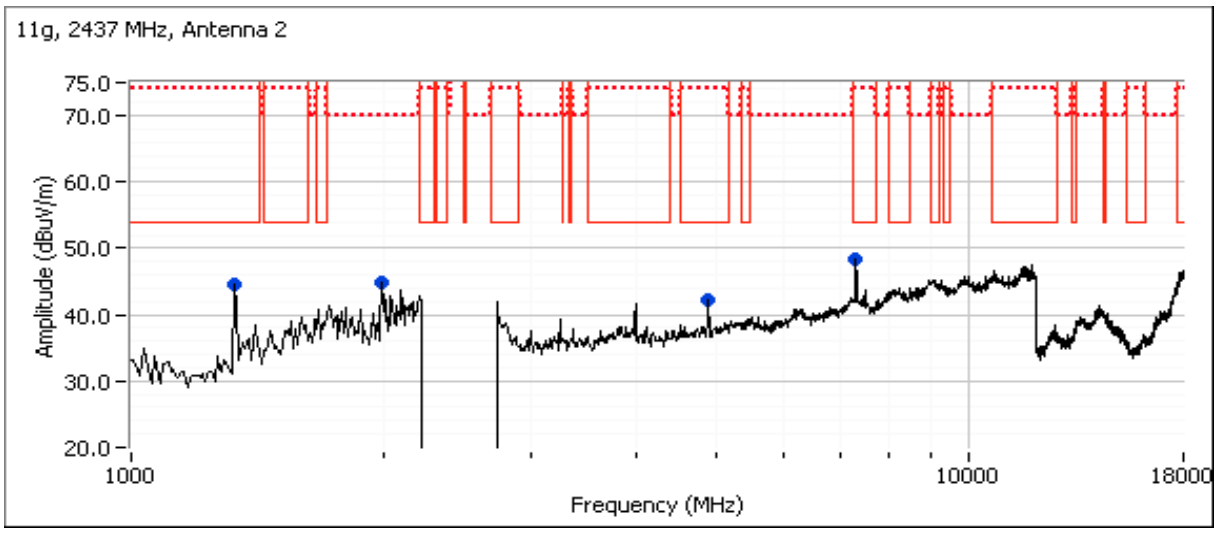
Date of Test: 6/30/2017 0:00 Config. Used: 1
Test Engineer: Rafael Varelas Config Change: None
Test Location: FT Chamber #7 EUT Voltage: USB

Run #2a: Center Channel

Channel: 6 Mode: g Pwr setting = 19
Tx Chain: Antenna 2 Data Rate: 6 Mb/s

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7314.100	45.0	H	54.0	-9.0	AVG	224	1.0	
7316.700	57.7	H	74.0	-16.3	PK	224	1.0	
4874.140	36.0	H	54.0	-18.0	AVG	338	1.5	
4880.740	48.4	H	74.0	-25.6	PK	338	1.5	
1325.000	44.6	V	54.0	-9.4	Peak	210	1.6	Not radio ralated
1991.670	44.8	V	70.0	-25.2	Peak	125	1.0	Not radio ralated

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

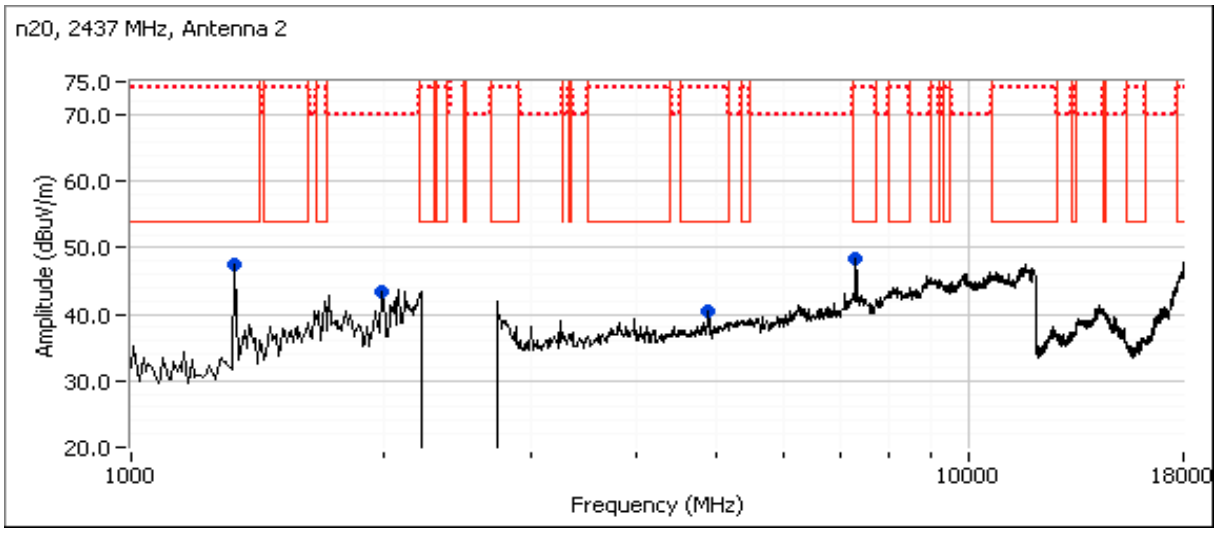


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Channel: 6 Mode: n20
Tx Chain: Antenna 2 Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7313.400	44.3	H	54.0	-9.7	AVG	218	1.0	
7313.530	57.2	H	74.0	-16.8	PK	218	1.0	
4874.480	35.3	H	54.0	-18.7	AVG	5	1.4	
4866.880	47.1	H	74.0	-26.9	PK	5	1.4	
1325.000	47.6	V	54.0	-6.4	Peak	157	1.2	Not radio ralated
1991.670	43.3	V	70.0	-26.7	Peak	129	1.2	Not radio ralated

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:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

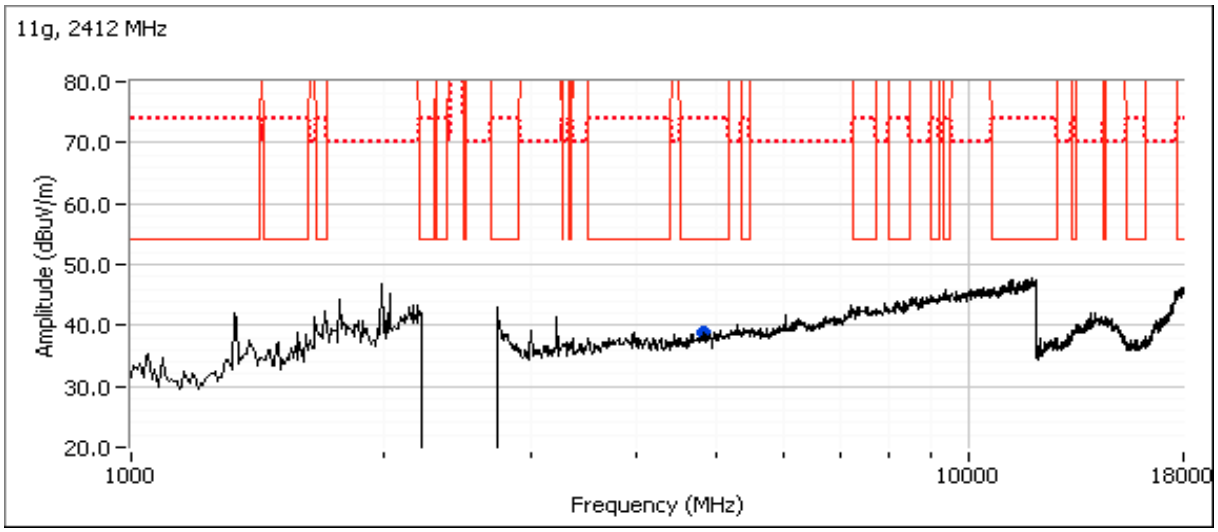
Run #3: Radiated Spurious Emissions, 1,000 - 25000 MHz. Operating Mode: Worse case from Run #2

Date of Test: 7/3/2017 0:00 Config. Used: 1
Test Engineer: Rafael Varelas Config Change: None
Test Location: FT Chamber #7 EUT Voltage: USB

Run #3a: Low Channel

Channel: 1 Mode: g
Tx Chain: Antenna 2 Data Rate: 6 Mb/s

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4823.330	34.6	H	54.0	-19.4	AVG	317	1.5	
4821.310	47.1	H	74.0	-26.9	PK	317	1.5	

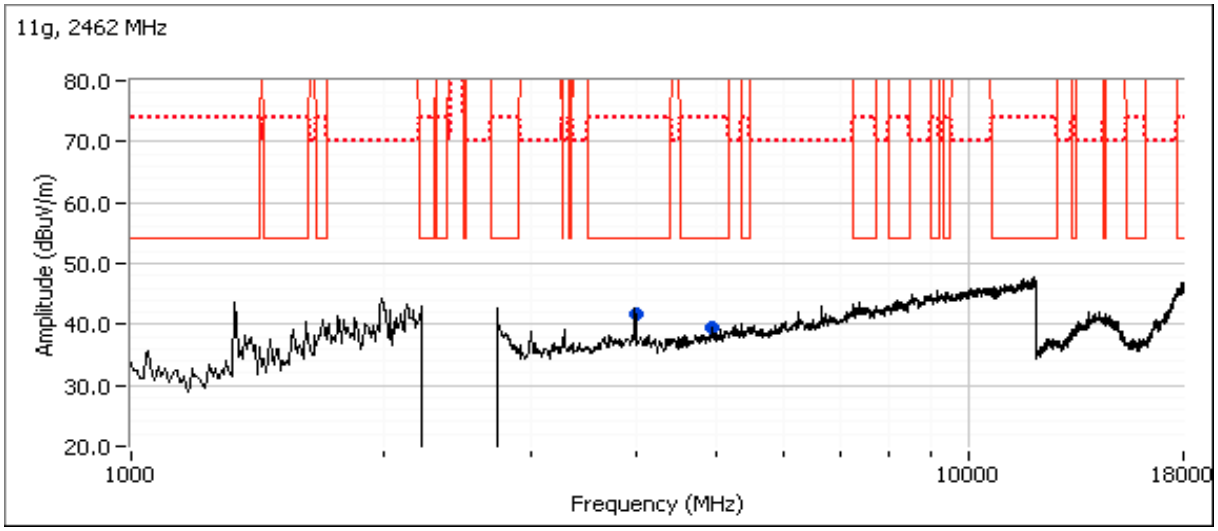


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #3b: High Channel

Channel: 11 Mode: g
Tx Chain: Antenna 2 Data Rate: 6 Mb/s

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4923.990	35.2	H	54.0	-18.8	AVG	325	1.5	
4923.690	47.3	H	74.0	-26.7	PK	325	1.5	
4001.750	41.7	V	54.0	-12.3	Peak	98	1.3	Not related to Radio



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

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

Power, PSD, Bandwidth and Spurious Emissions

Test Specific Details

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

Date of Test: 7/17/2017; 7/18/2017
Test Engineer: J. Caizzi; M. Birgani
Test Location: Lab 4

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: 23-25 °C
Rel. Humidity: 38-40 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1			Output Power	15.247(b)	Pass	11b: 18.5 dBm (71mW) 11g: 18.7dBm (74mW) n20: 18.8dBm (76mW)
2			Power spectral Density (PSD)	15.247(d)	Pass	11b: 0.4 dBm/10kHz 11g: -1.4dBm/10kHz n20: -1.1dBm/10kHz
3			Minimum 6dB Bandwidth	15.247(a)	Pass	11b: 10.1 MHz 11g: 16.3 MHz n20: 17.5 MHz
3			99% Bandwidth	RSS GEN	Pass	11b: 13.3 MHz 11g: 17.1 MHz n20: 18.1 MHz
4			Spurious emissions	15.247(b)	Pass	All signls below limit

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / 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)
11b	1 Mb/s	100%	Yes	-	-	0	10
11g	6 Mb/s	99.3%	Yes	3.12	0	0	10
n20	MCS0	99.3%	Yes	2.928	0	0	10

Sample Notes

Sample S/N: Eng conducted sample #1
Driver: -

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #1: Output Power

Mode: 11b

Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W		
18	2412	17.4	55.0	4.0	Pass	21.4	0.138		
19	2437	18.2	66.1	4.0	Pass	22.2	0.166		
19	2462	18.5	70.8	4.0	Pass	22.5	0.178		

Mode: 11g

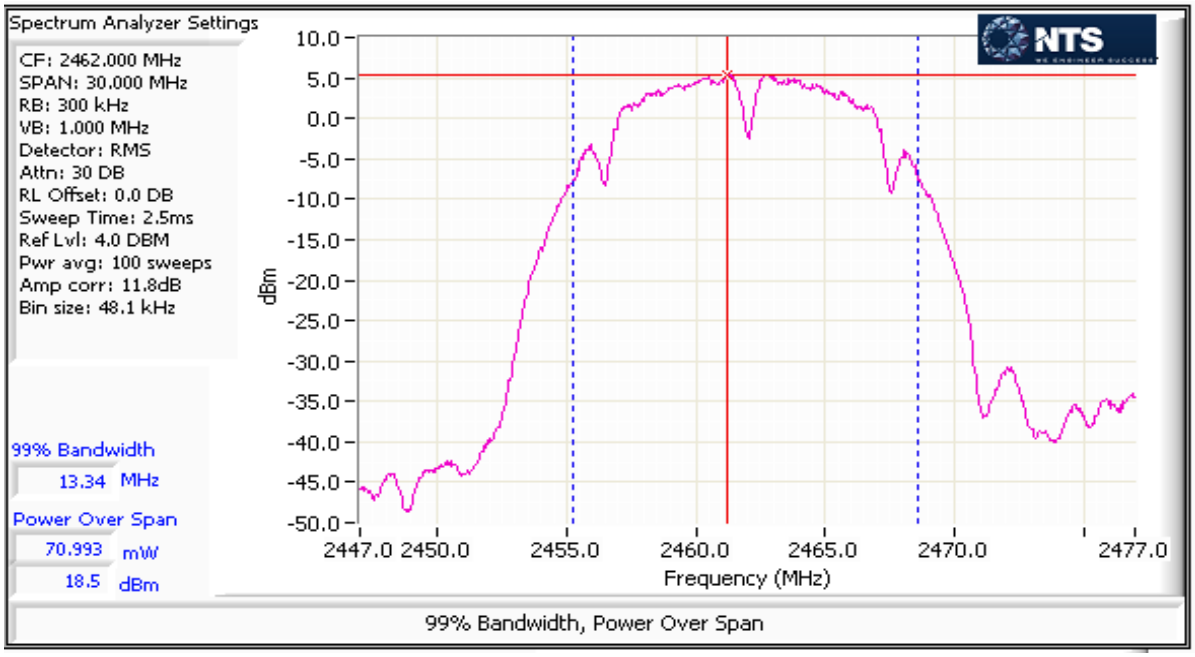
Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W		
14	2412	13.8	24.0	4.0	Pass	17.8	0.060		
19	2437	18.7	74.1	4.0	Pass	22.7	0.186		
16	2462	15.4	34.7	4.0	Pass	19.4	0.087		

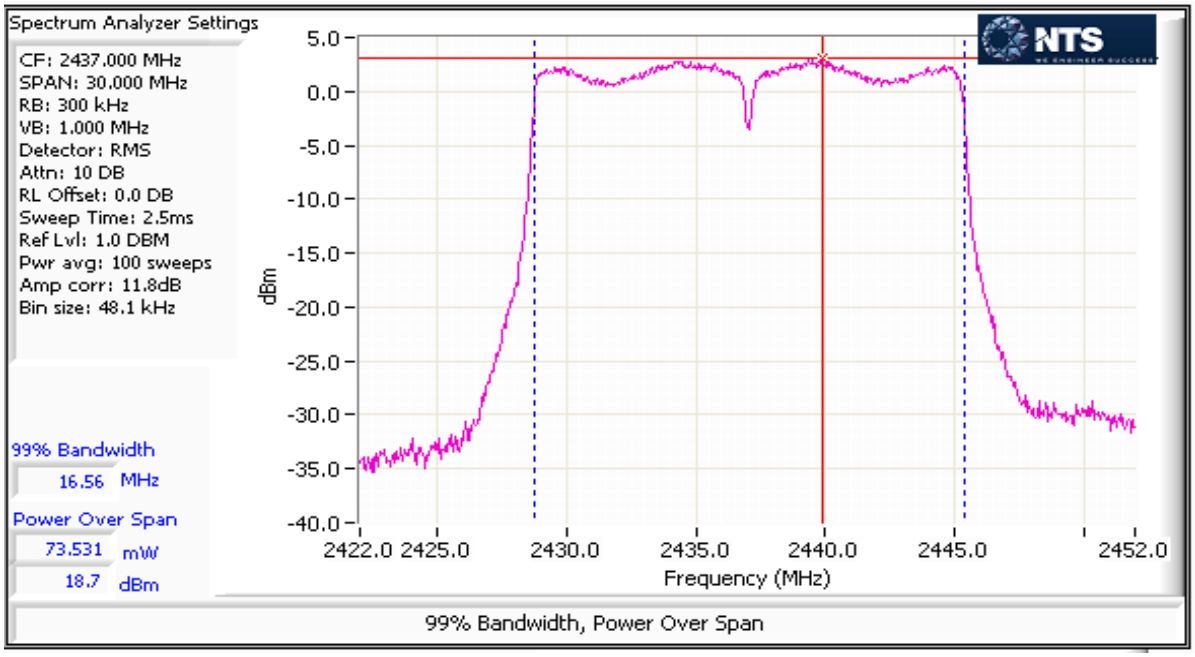
Mode: n20

Power Setting[2]	Frequency (MHz)	Output Power (dBm)[1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP dBm	EIRP W		
13	2412	13.3	21.4	4.0	Pass	17.3	0.054		
19	2437	18.8	75.9	4.0	Pass	22.8	0.191		
15	2462	14.6	28.8	4.0	Pass	18.6	0.072		

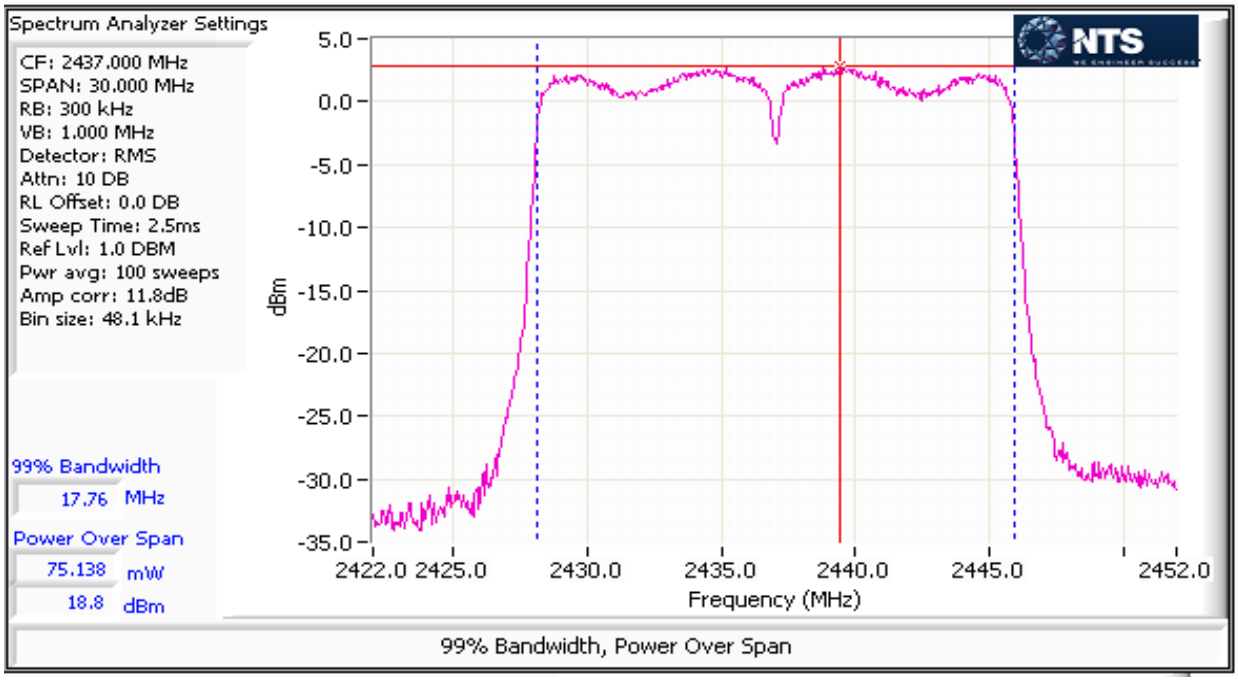
Note 1:	Duty Cycle ≥ 98%. Output power measured using a spectrum analyzer (see plots below) with RBW= 1-5% of OBW and ≤ 1 MHz, VB≥3* RBW, Span ≥ 1.5 of OBW, auto sweep time, RMS detector, power averaging on, and power integration over the OBW, trace average 100 traces (option AVGSA-1 in ANSI C63.10). Spurious limit becomes -30dBc.
Note 2:	Power setting - the software power setting used during testing, included for reference only.
Note 3:	Power measured using average power meter (non-gated) and is included for reference only.
Note 4:	Port 1 used for final measurments. Preliminary measurements indicated Port 1 was the worse case.

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A





Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #2: Power spectral Density

Mode: 11b

Power Setting	Frequency (MHz)	PSD (dBm/10kHz) Note 1	Limit dBm/3kHz	Result
18	2412	-0.5	8.0	Pass
19	2437	0.1	8.0	Pass
19	2462	0.4	8.0	Pass

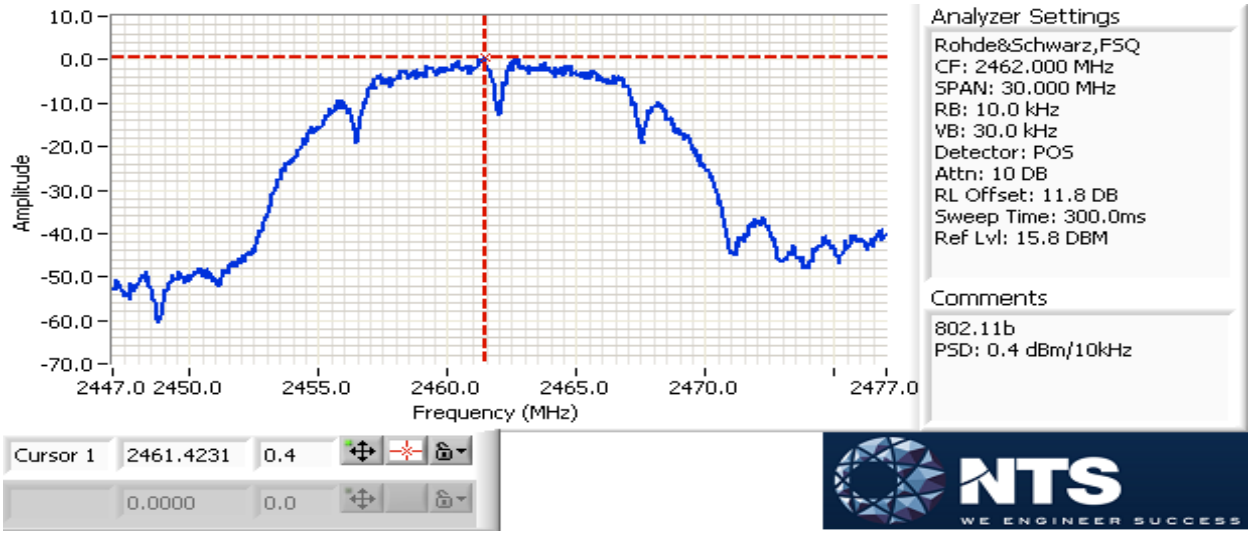
Mode: 11g

Power Setting	Frequency (MHz)	PSD (dBm/10kHz) Note 1	Limit dBm/3kHz	Result
14	2412	-5.6	8.0	Pass
19	2437	-1.4	8.0	Pass
16	2462	-4.5	8.0	Pass

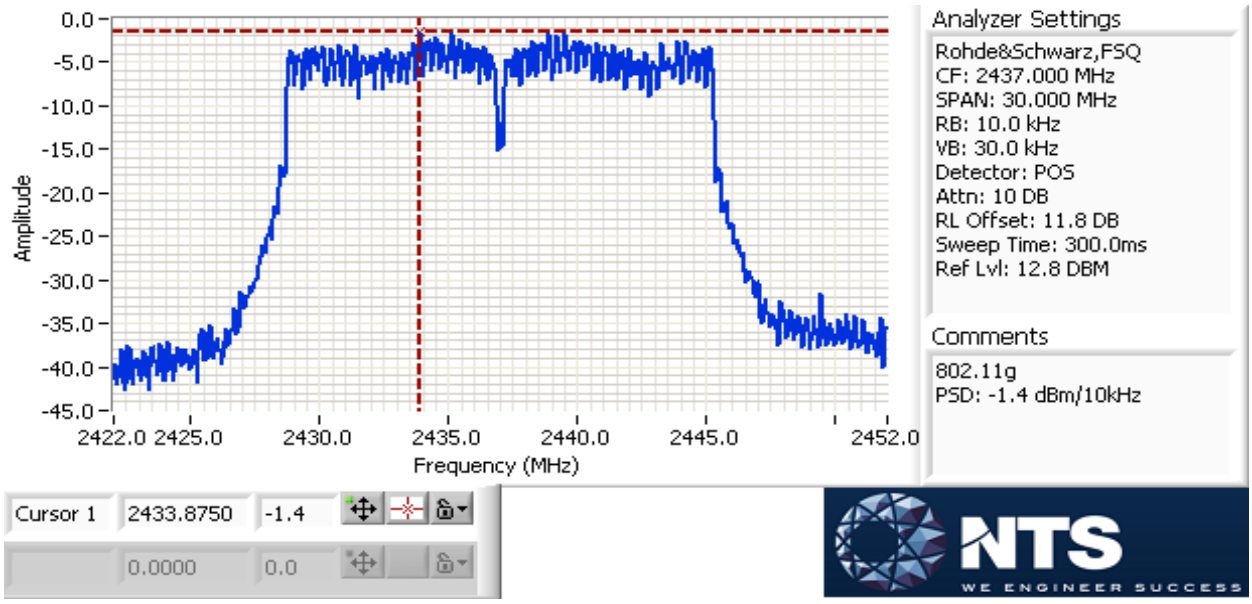
Mode: n20

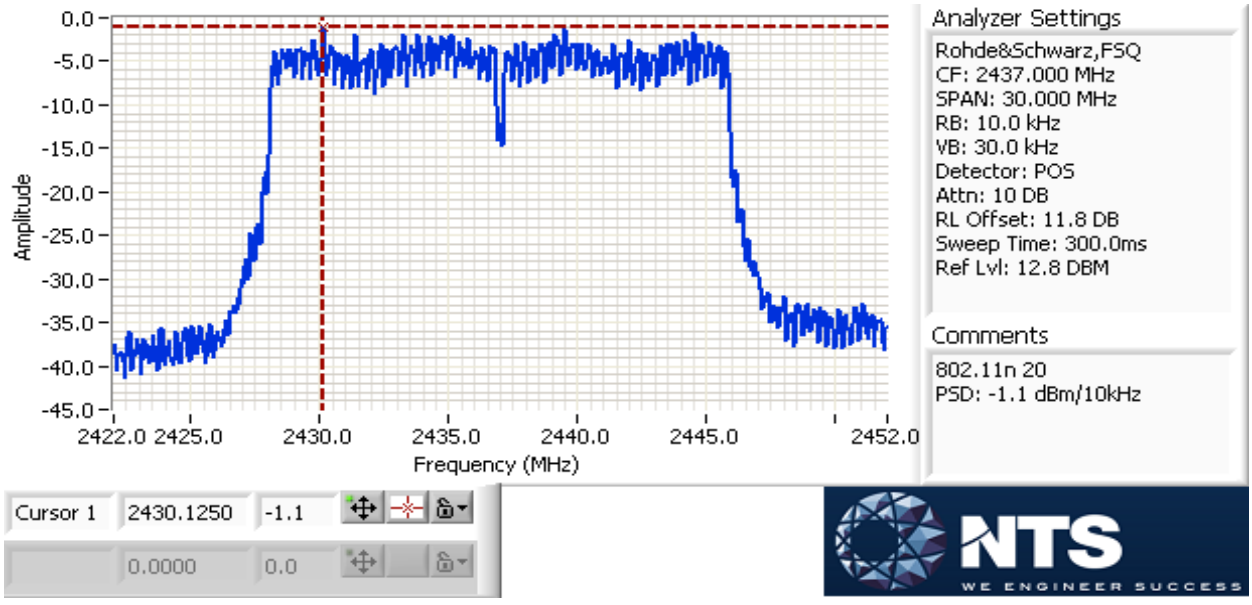
Power Setting	Frequency (MHz)	PSD (dBm/10kHz) Note 1	Limit dBm/3kHz	Result
13	2412	-6.5	8.0	Pass
19	2437	-1.1	8.0	Pass
15	2462	-5.3	8.0	Pass

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



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A





Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #3: Signal Bandwidth

Mode: 11b

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (kHz)	
		6dB	99%	6dB	99%
19	2412	10.3	13.3	100	300
19	2437	10.1	13.3		
19	2462	10.1	13.3		

Mode: 11g

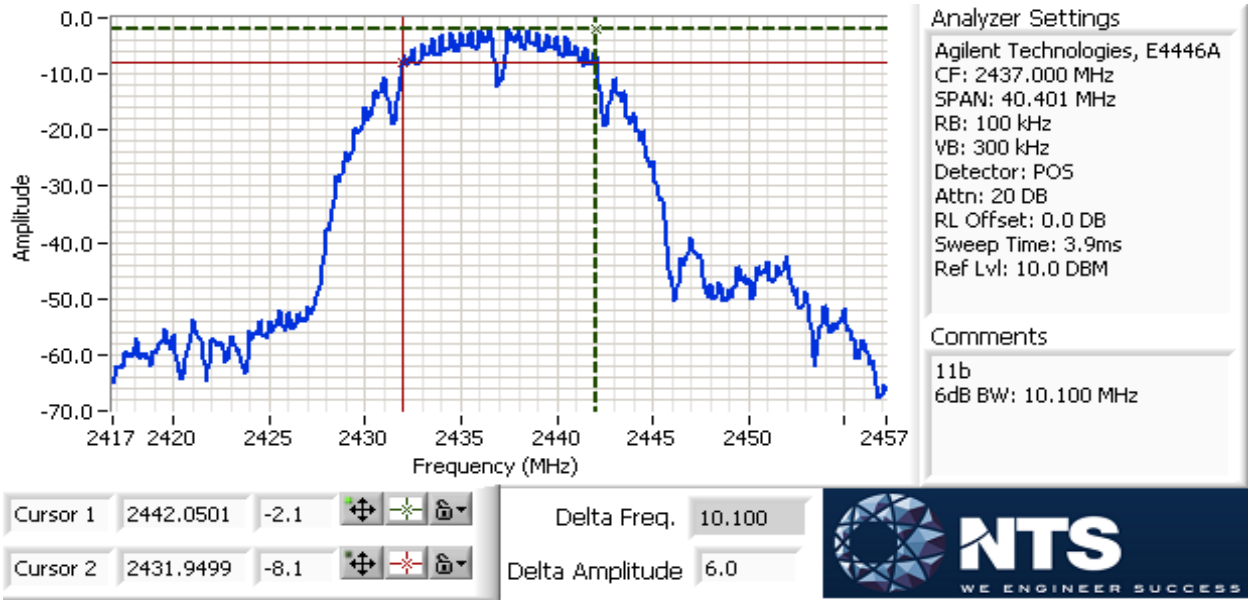
Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (MHz)	
		6dB	99%	6dB	99%
16	2412	16.3	16.8	100	300
19	2437	16.3	17.1		
16	2462	16.3	16.8		

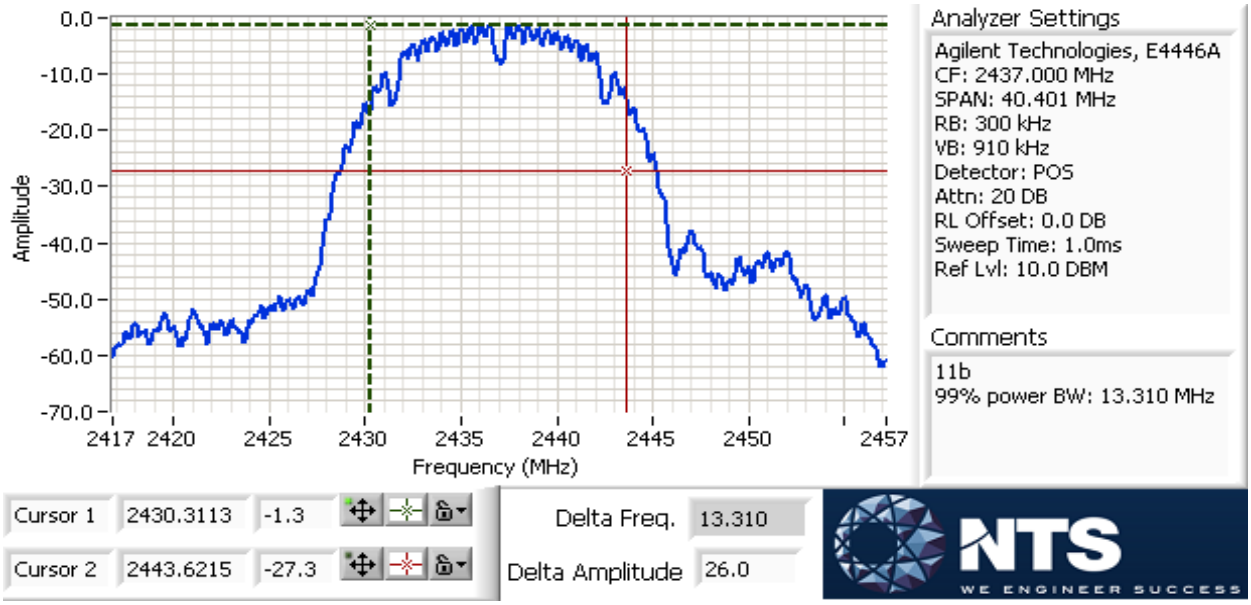
Mode: n20

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (MHz)	
		6dB	99%	6dB	99%
16	2412	17.5	17.7	100	300
19	2437	17.6	18.1		
16	2462	17.5	17.7		

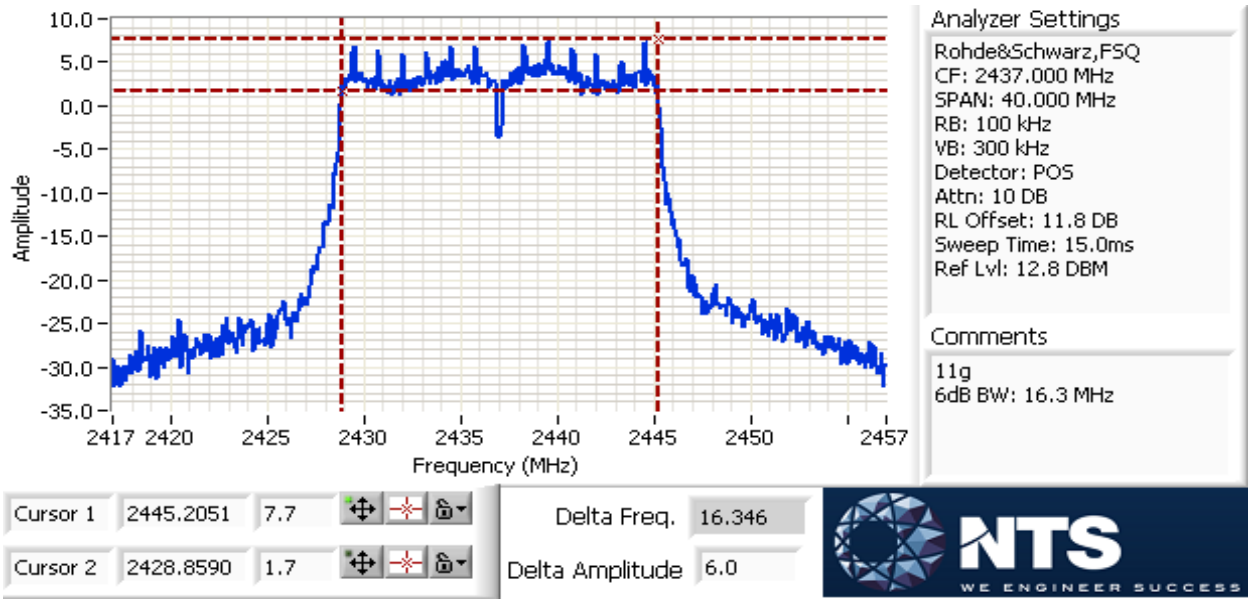
Note 1:	DTS BW: RBW=100kHz, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time, Span 2-5 times measured BW. 99% BW: RBW=1-5% of 99%BW, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time. Span 1.5-5 times OBW.
Note 2	All measurements made on antenna port #2.

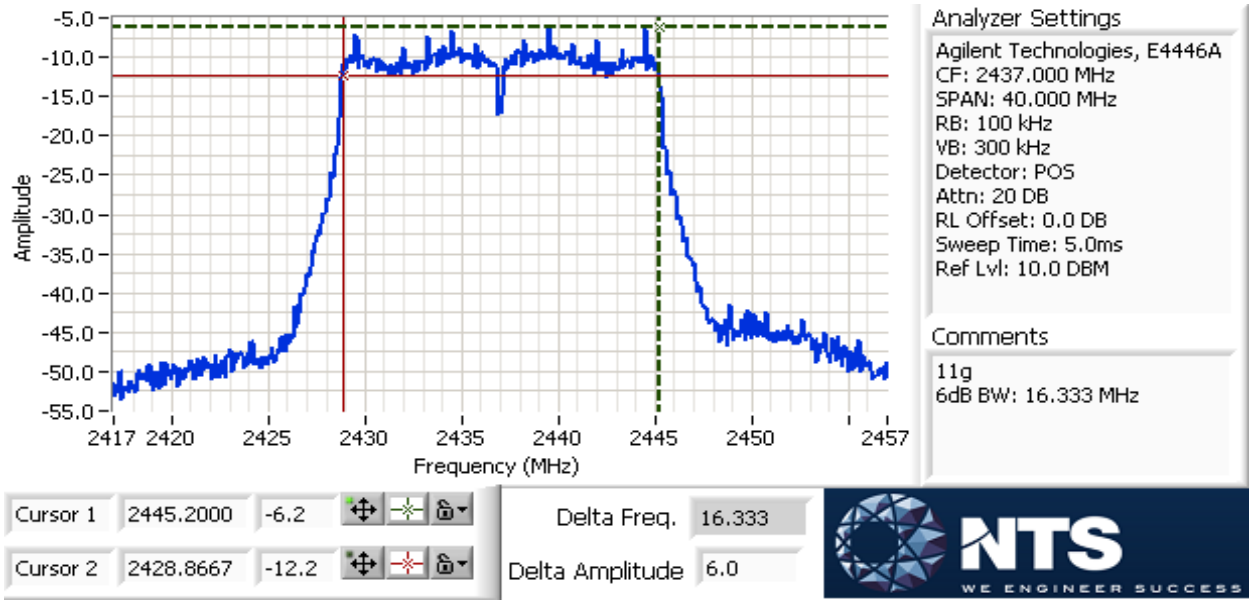
Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A



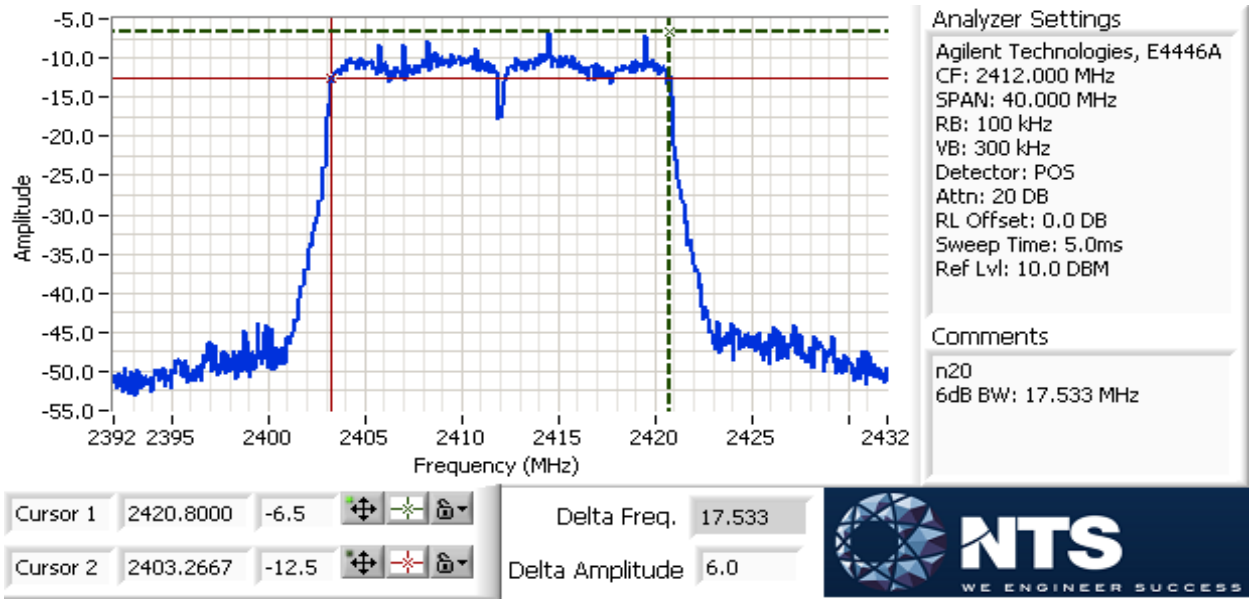


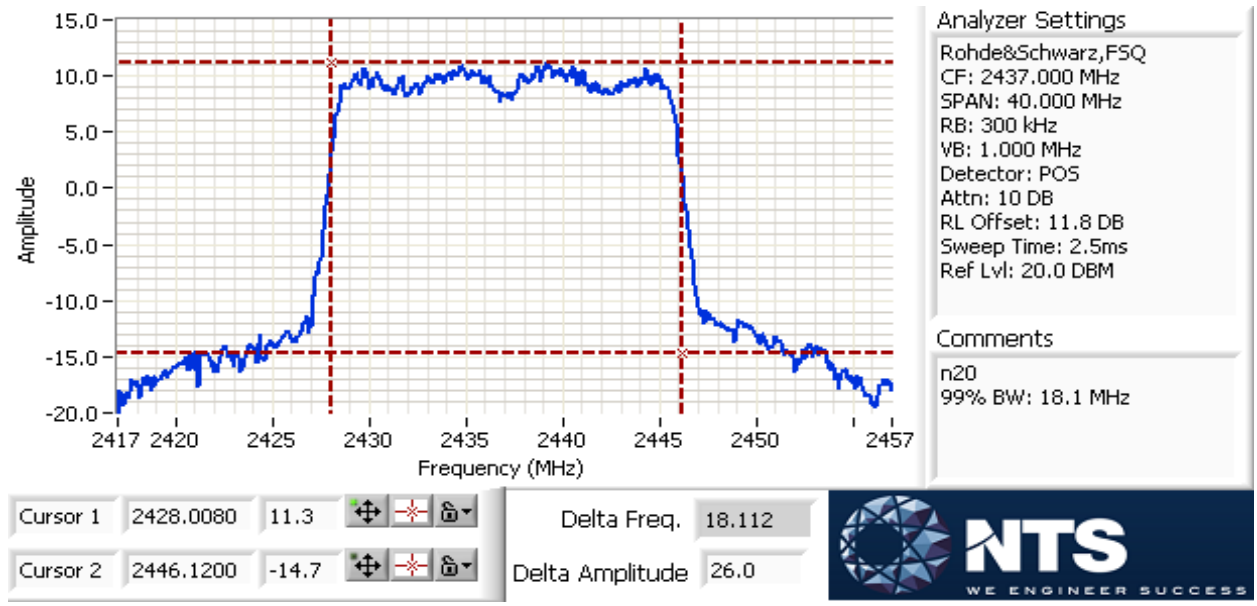
Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A





Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A





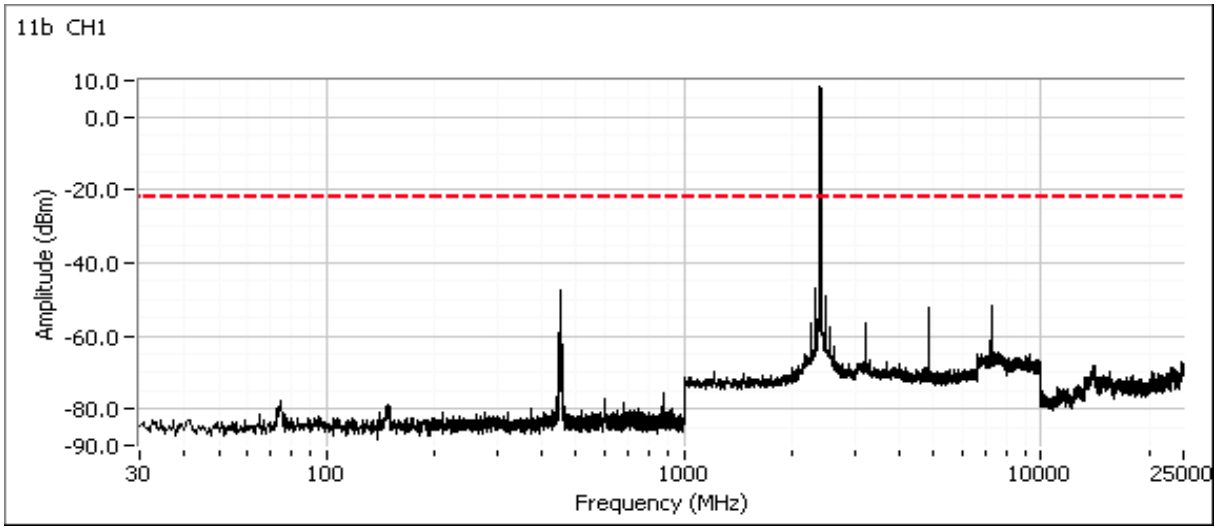
Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #4a: Out of Band Spurious Emissions

Frequency (MHz)	Power Setting	Mode	Limit	Result
2412	19	11b	-30dBc	Pass
2437	19		-30dBc	Pass
2462	19		-30dBc	Pass
2412	17	11g	-30dBc	Pass
2437	19		-30dBc	Pass
2462	17		-30dBc	Pass
2412	17	11n 20	-30dBc	Pass
2437	19		-30dBc	Pass
2462	17		-30dBc	Pass

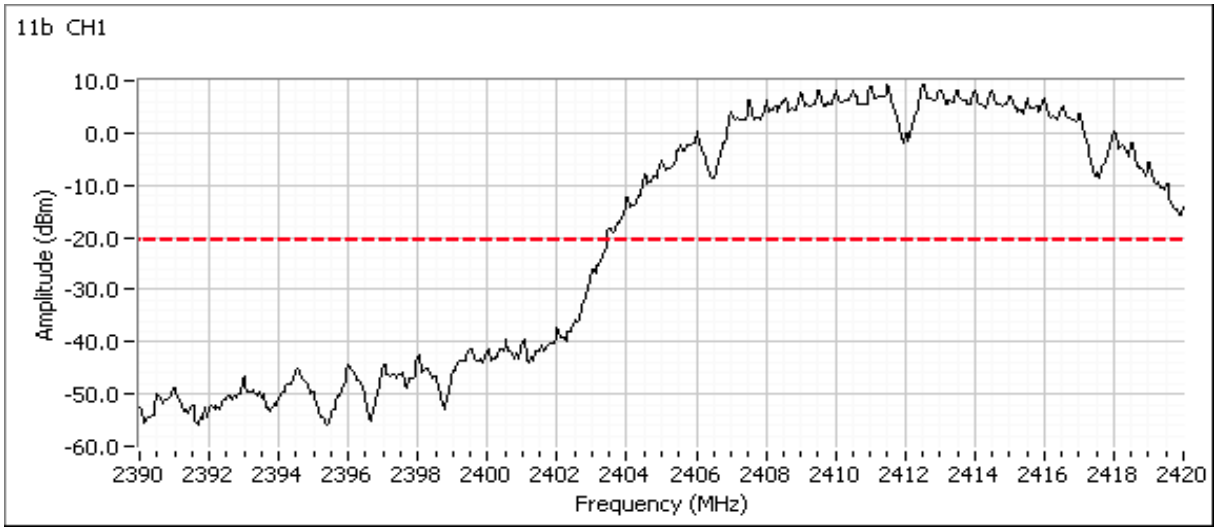
RBW = 100 kHz and VBW = 300 kHz for all plots.

Plots for low channel

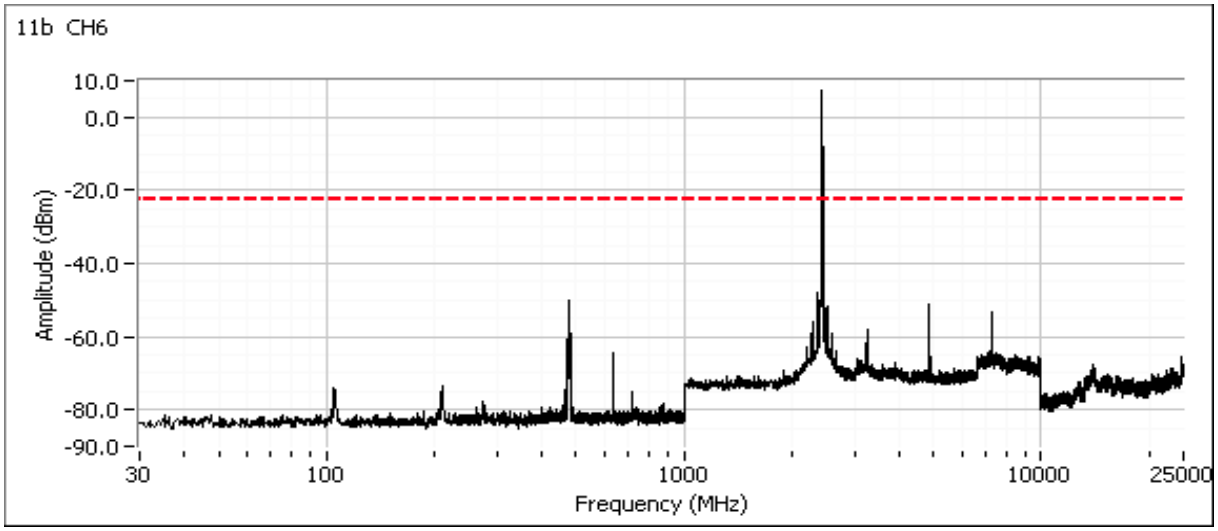


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

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

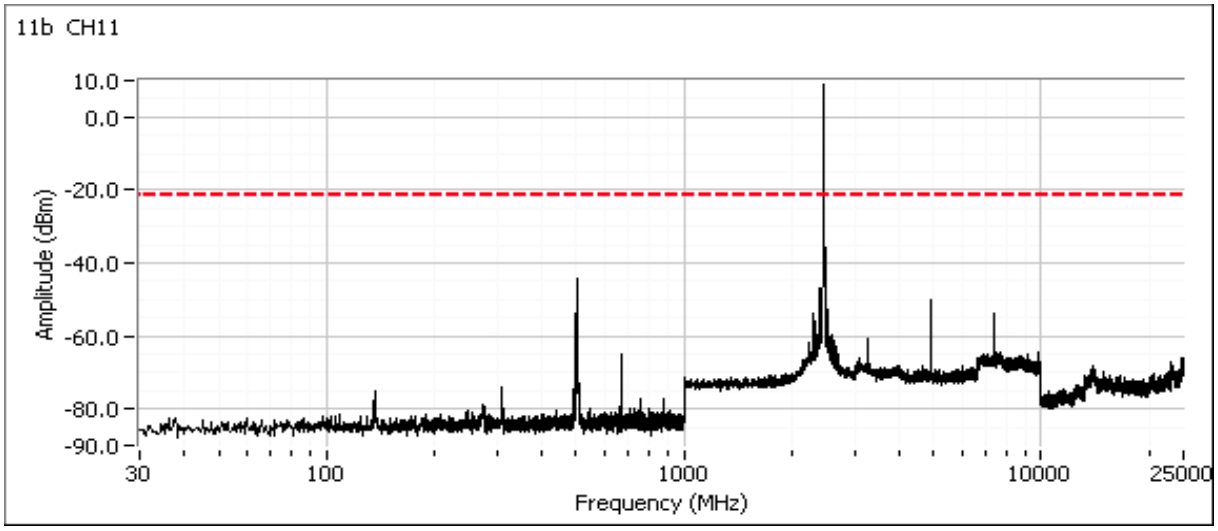


Plots for center channel

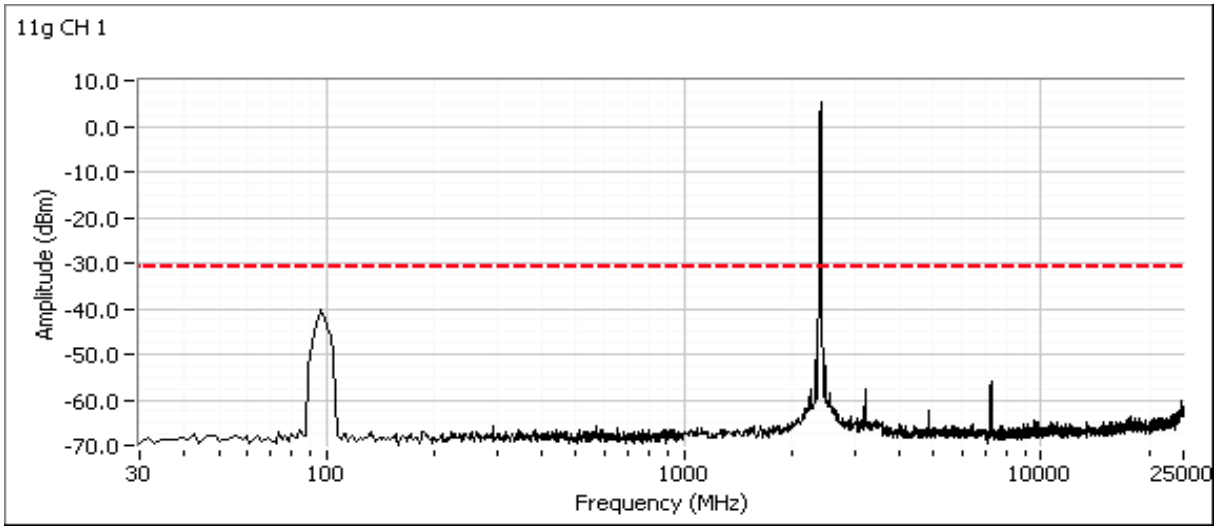


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Plots for high channel

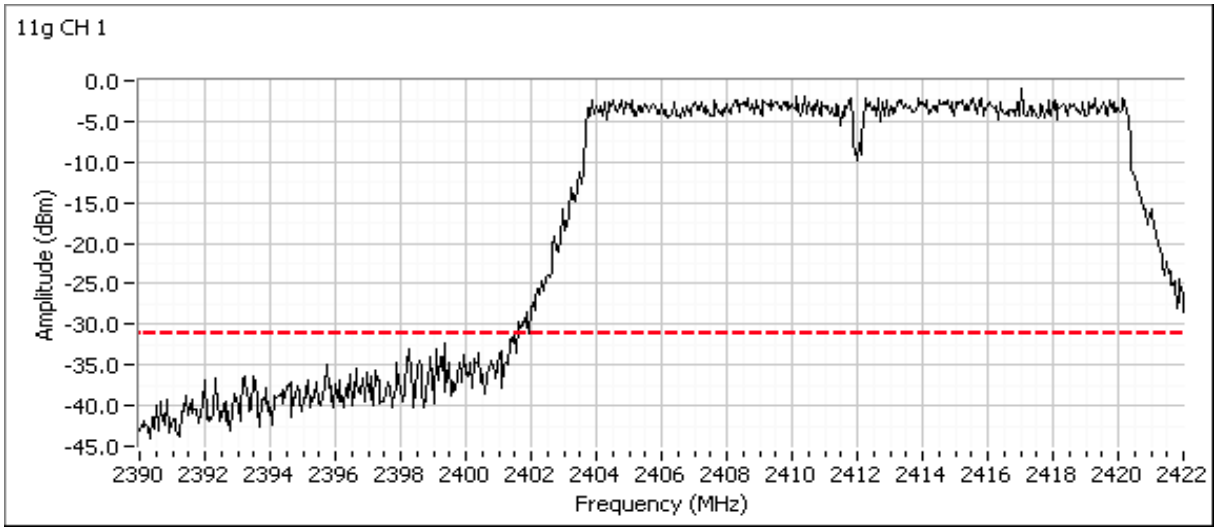


Plots for low channel

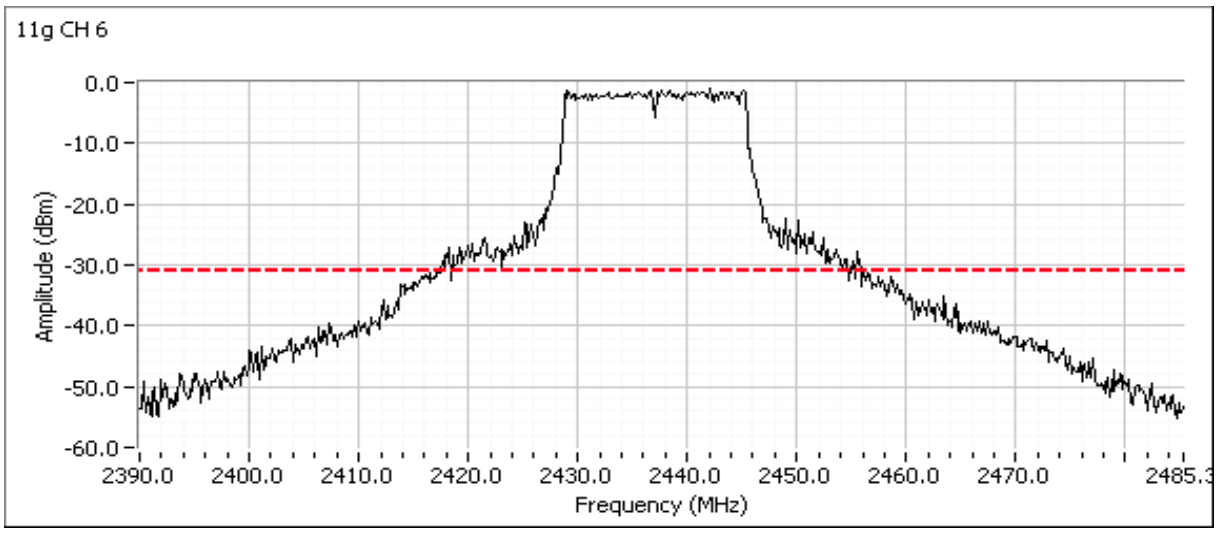


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

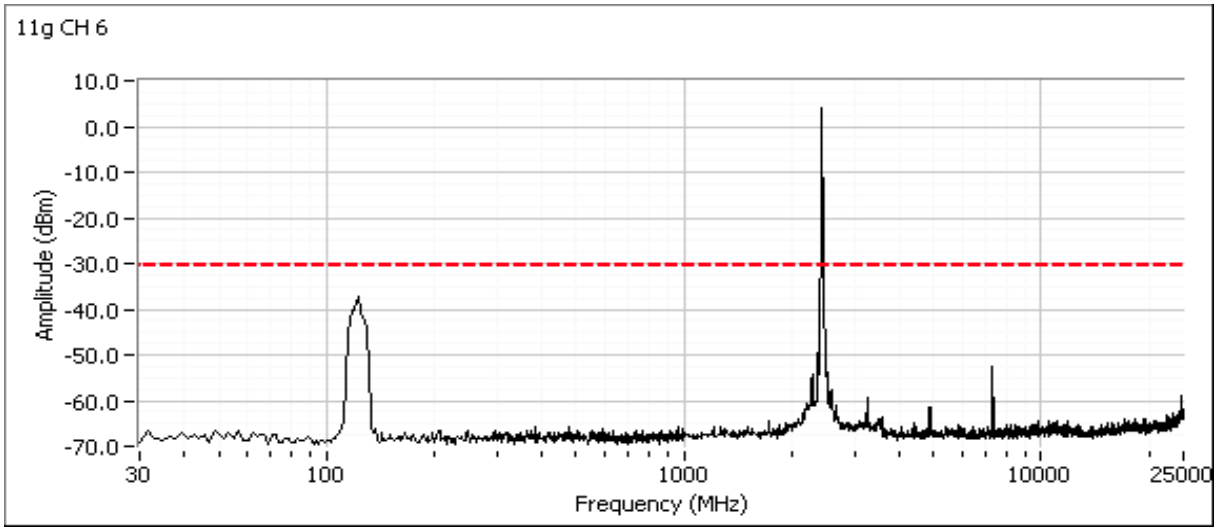
Additional plot showing compliance with -30dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.



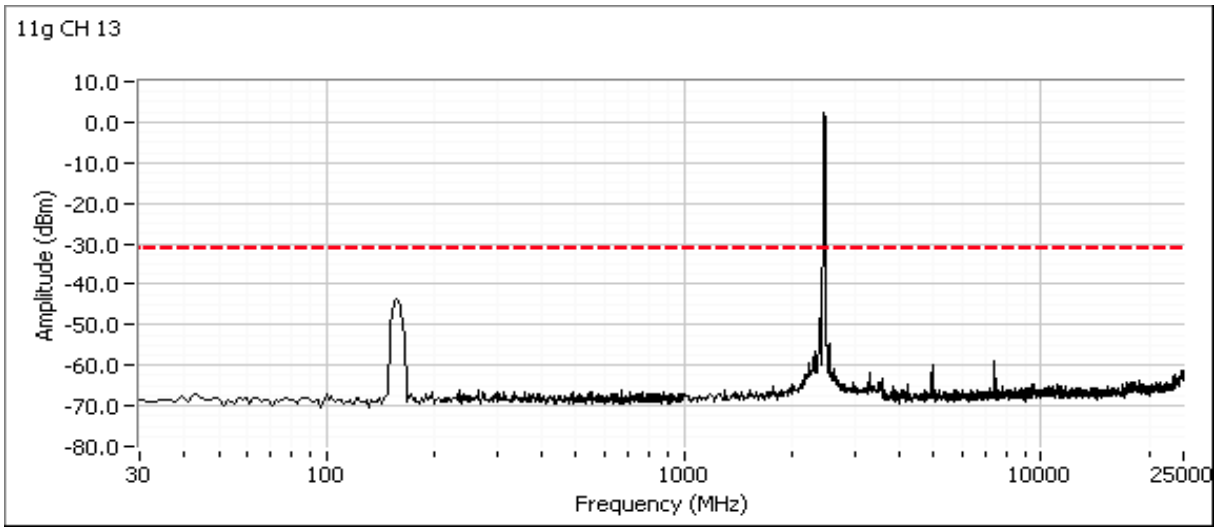
Plots for center channel



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

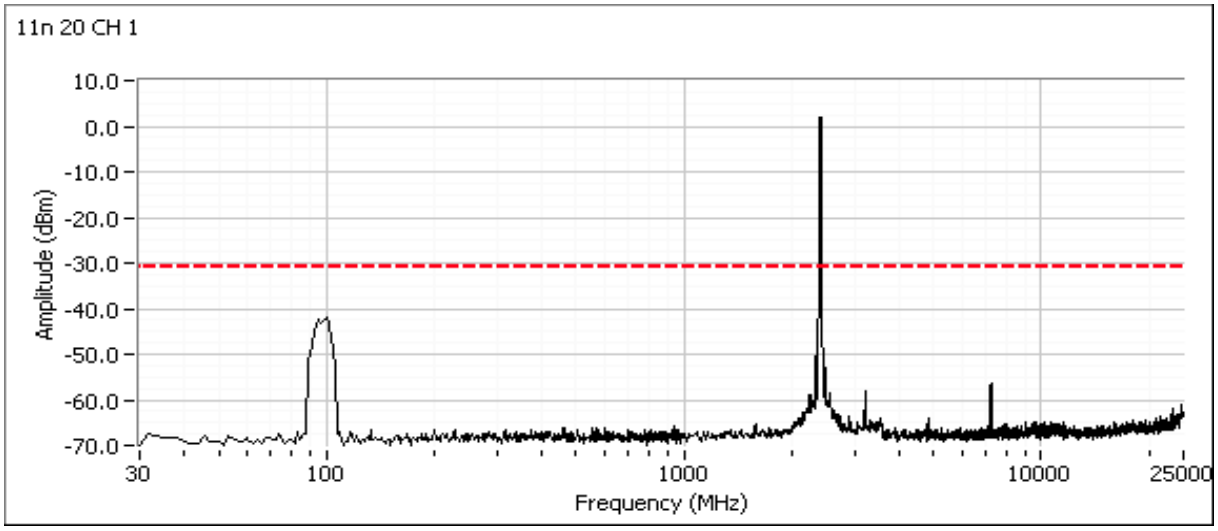


Plots for high channel

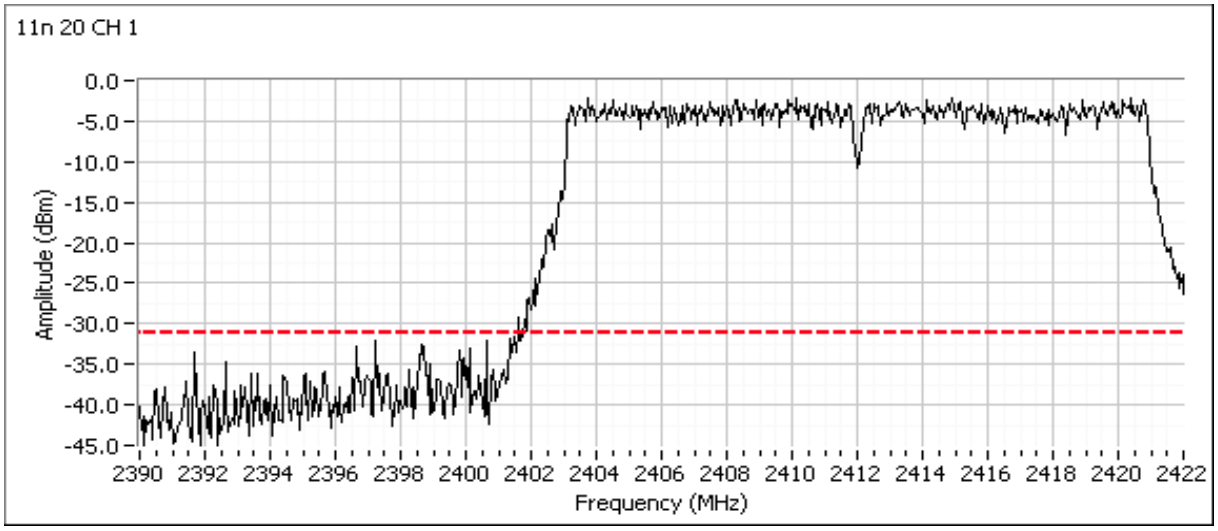


Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Plots for low channel

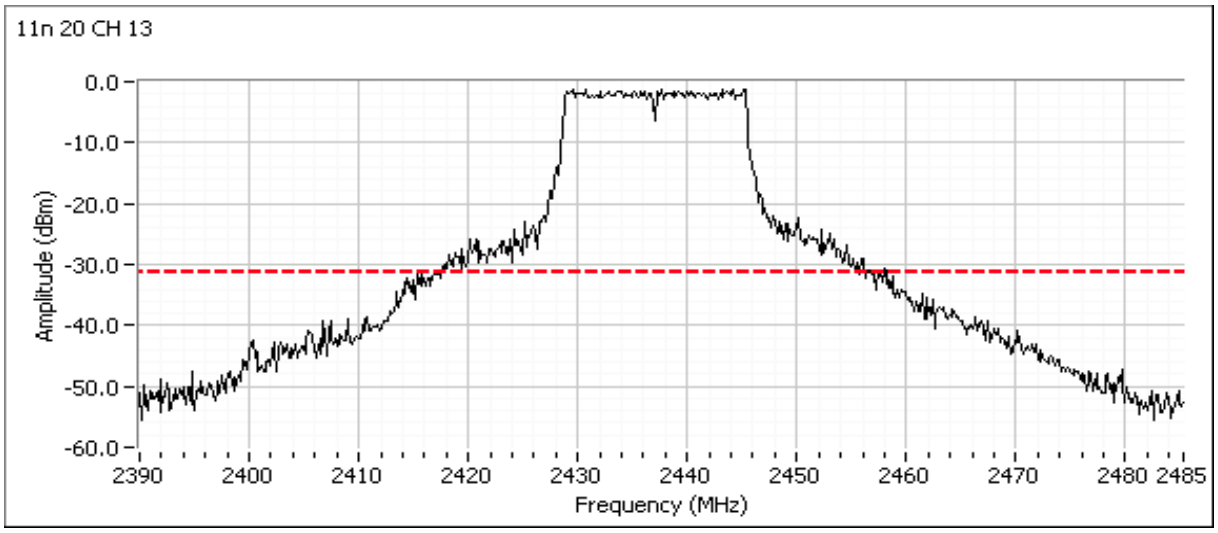


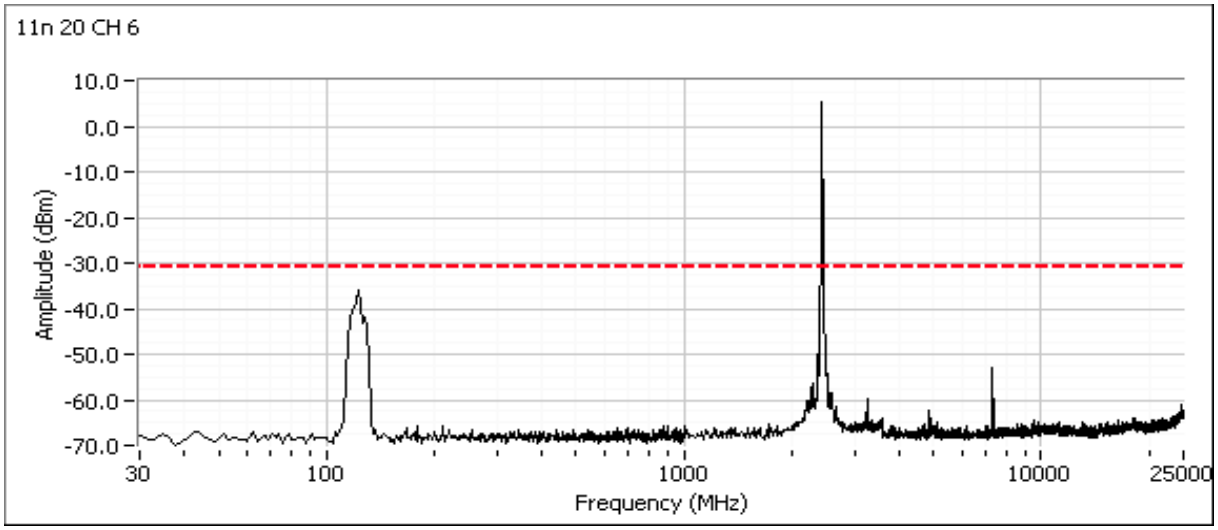
Additional plot showing compliance with -30dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

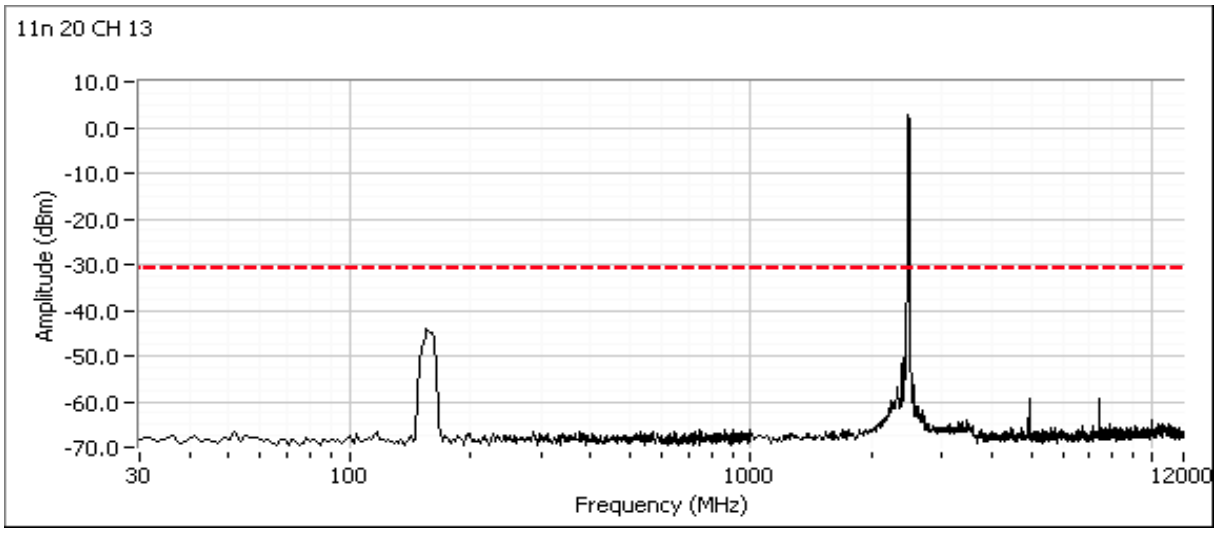
Plots for center channel





Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Plots for high channel



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

RSS-247, FCC 15.247, 15.407 Radiated Spurious Emissions

Test Specific Details

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

General Test Configuration

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

For radiated emissions testing the measurement antenna was located 3 meters from the EUT, unless otherwise noted.

Ambient Conditions:

	7/7/2017	7/18/2017
Temperature:	23.4 °C	22.8 °C
Rel. Humidity:	41 %	40 %

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

Run #	Mode	Channel	Target Power (dBm)	Passing Power Setting	Test Performed	Limit	Result / Margin
1	BLE + 11b	2402MHz 2462MHz	6 16	6 19	Radiated Emissions, 30-1000MHz	FCC Part 15.209 / 15.247 / 15.407	27.6 dBµV/m @ 125.06 MHz (-15.9 dB)
	BLE + 11b	2402MHz 2462MHz	6 16	6 19	Radiated Emissions, 1 - 25 GHz	FCC Part 15.209 / 15.247 / 15.407	46.1 dBµV/m @ 4924.0 MHz (-7.9 dB)
2	BLE + 11a	2480MHz 5180MHz	6 16	6 16	Radiated Emissions, 30-1000MHz	FCC Part 15.209 / 15.247 / 15.407	38.7 dBµV/m @ 960.04 MHz (-15.3 dB)
	BLE + 11a	2480MHz 5180MHz	6 16	6 16	Radiated Emissions, 1 - 40 GHz	FCC Part 15.209 / 15.247 / 15.407	42.8 dBµV/m @ 4952.9 MHz (-11.2 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.

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Sample Notes

Sample S/N: Engineering Radiated Sample #2
Driver: -
Antenna: Internal

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)
11b	1 Mb/s	> .99	Yes	-	0	0	10
11a	6MB/s	0.99	Yes	2.157	0	0	10
BLE	1Mb/s	0.62	Yes	0.387	2.1	4.1	2584

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

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #1: Radiated Spurious Emissions, 30MHz - 25GHz.

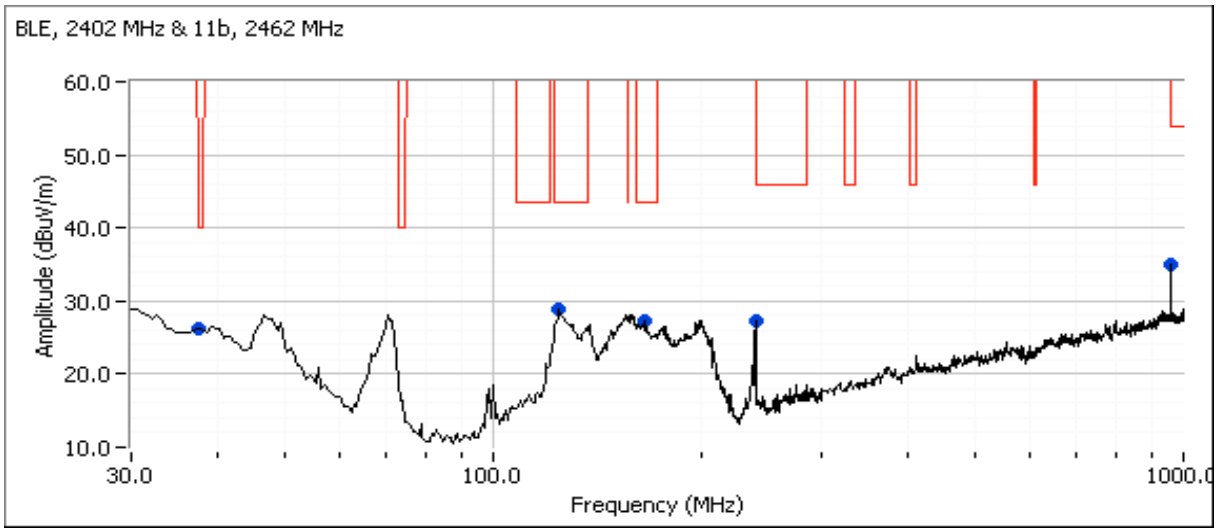
Date of Test: 7/18/2017 0:00 Config. Used: 1
Test Engineer: Rafael Varelas Config Change: None
Test Location: FT Chamber #4 EUT Voltage: 120V/60Hz

Channel: 2462 MHz Mode: b
Antenna 2 Data Rate: 1 Mb/s

Channel: 2402 MHz Mode: BLE
Antenna 2 Data Rate: 1 Mb/s

Run #1a: 30-1000MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
125.057	27.6	H	43.5	-15.9	QP	84	2.0	QP (1.00s)
37.813	24.1	V	40.0	-15.9	QP	306	1.0	QP (1.00s)
240.018	27.8	H	46.0	-18.2	QP	282	1.3	QP (1.00s)
167.180	24.8	V	43.5	-18.7	QP	238	1.0	QP (1.00s)
960.036	34.9	H	54.0	-19.1	QP	70	1.4	QP (1.00s)



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

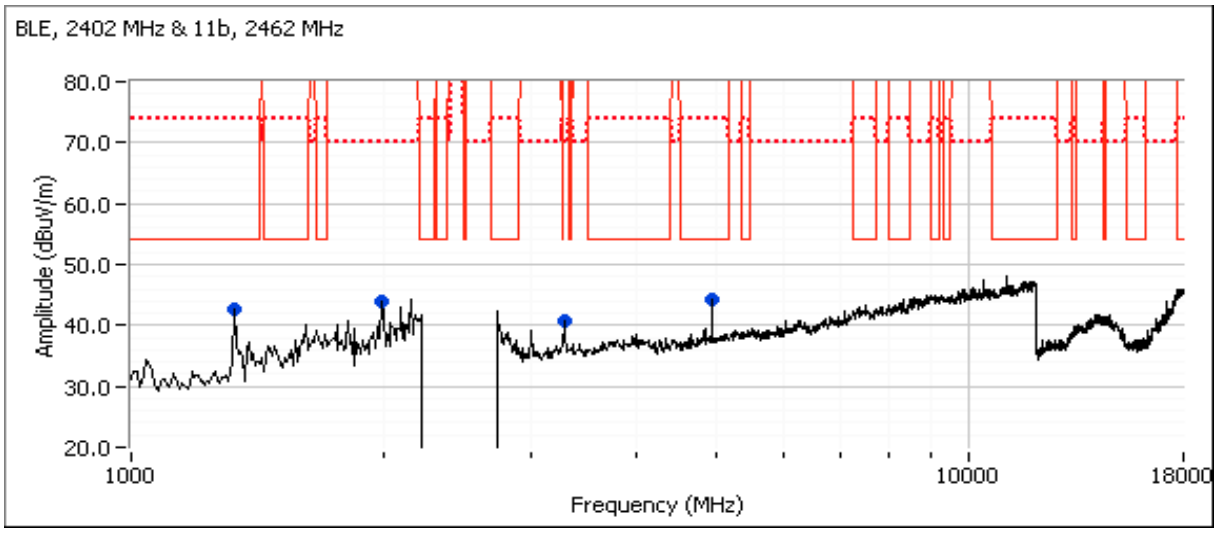
Run #1b: 1000-25000MHz

Date of Test: 7/7/2017 0:00
Test Engineer: Rafael Varelas
Test Location: FT Chamber #7

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

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4923.980	46.1	H	54.0	-7.9	AVG	18	1.0	RB 1 MHz;VB 10 Hz;Peak
4923.950	51.4	H	74.0	-22.6	PK	18	1.0	RB 1 MHz;VB 3 MHz;Peak
3282.680	38.8	H	54.0	-15.2	AVG	352	1.5	RB 1 MHz;VB 10 Hz;Peak
3282.760	46.0	H	74.0	-28.0	PK	352	1.5	RB 1 MHz;VB 3 MHz;Peak
1325.000	42.6	V	54.0	-11.4	Peak	81	1.0	Not a radio signal.
1991.670	44.0	H	70.0	-26.0	Peak	127	2.5	Not a radio signal.

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:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

Run #2: Radiated Spurious Emissions, 30MHz - 40GHz.

Date of Test: 7/18/2017 0:00
Test Engineer: Rafael Varelas
Test Location: FT Chamber #4

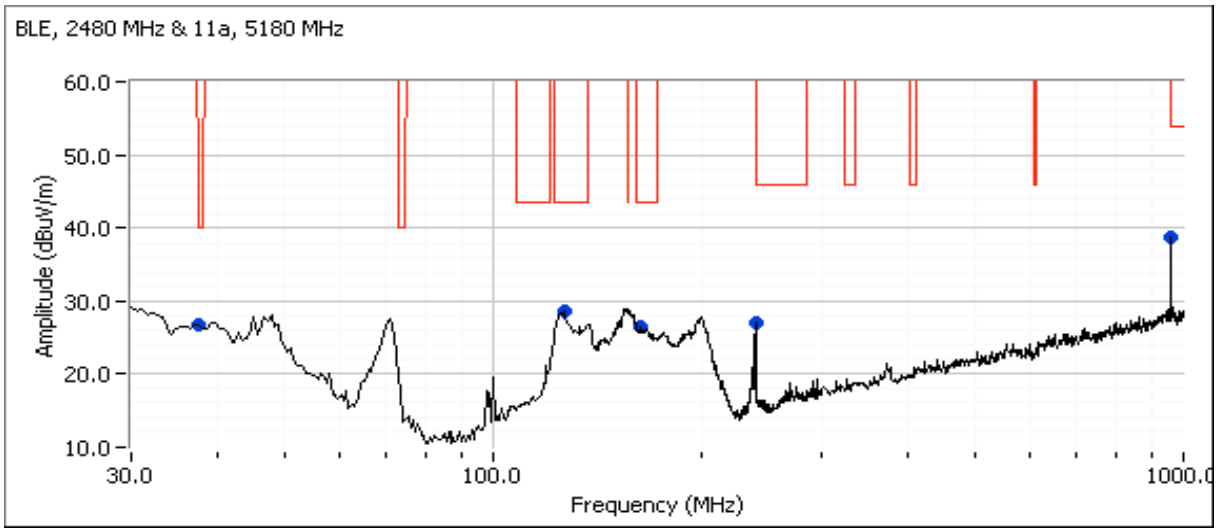
Config. Used: 1
Config Change: None
EUT Voltage: 120V/60Hz

Channel: 5180 MHz
Antenna 2
Mode: a
Data Rate: 6MB/s

Channel: 2480 MHz
Antenna 2
Mode: BLE
Data Rate: 1 Mb/s

Run #2a: 30-1000MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
960.036	38.7	H	54.0	-15.3	QP	122	1.5	QP (1.00s)
37.778	23.9	V	40.0	-16.1	QP	266	1.0	QP (1.00s)
126.832	27.2	H	43.5	-16.3	QP	97	1.9	QP (1.00s)
164.920	25.4	V	43.5	-18.1	QP	210	1.0	QP (1.00s)
240.018	26.6	H	46.0	-19.4	QP	266	1.0	QP (1.00s)



Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	N/A

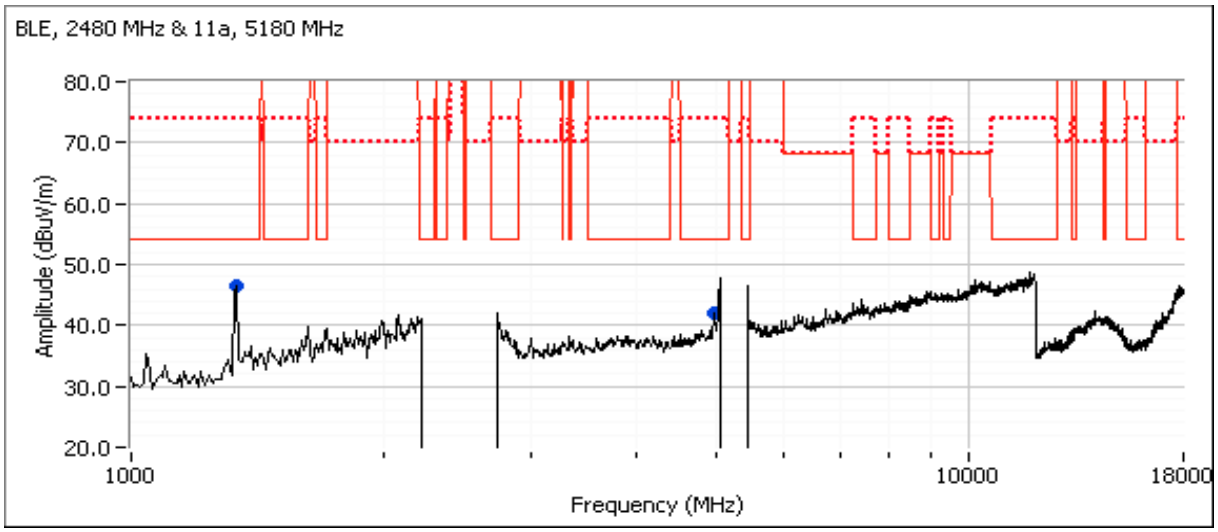
Run #2b: 1000-40000MHz

Date of Test: 7/7/2017 0:00
Test Engineer: Rafael Varelas
Test Location: FT Chamber #7

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

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4952.930	42.8	H	54.0	-11.2	Avg	11	1.3	RB 1 MHz;VB 3 kHz note 4
4952.680	50.9	H	74.0	-23.1	PK	11	1.3	RB 1 MHz;VB 3 MHz;Peak
1333.330	46.4	V	54.0	-7.6	Peak	124	1.0	Not a radio signal.

Note: Scans made between 18 - 40 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:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / 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 final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 7/21/2017
Test Engineer: Rafael Varelas
Test Location: FT Chamber #4

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: 23.4 °C
Rel. Humidity: 41 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power,120V/60Hz	15.207	Pass	27.7 dBµV @ 0.823 MHz (-18.3 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

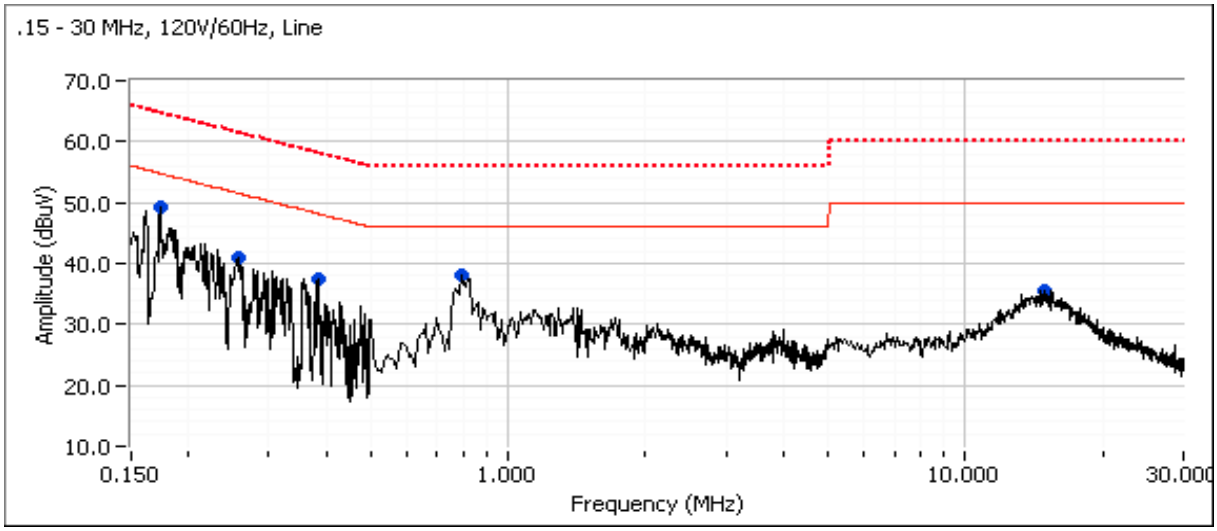
No deviations were made from the requirements of the standard.

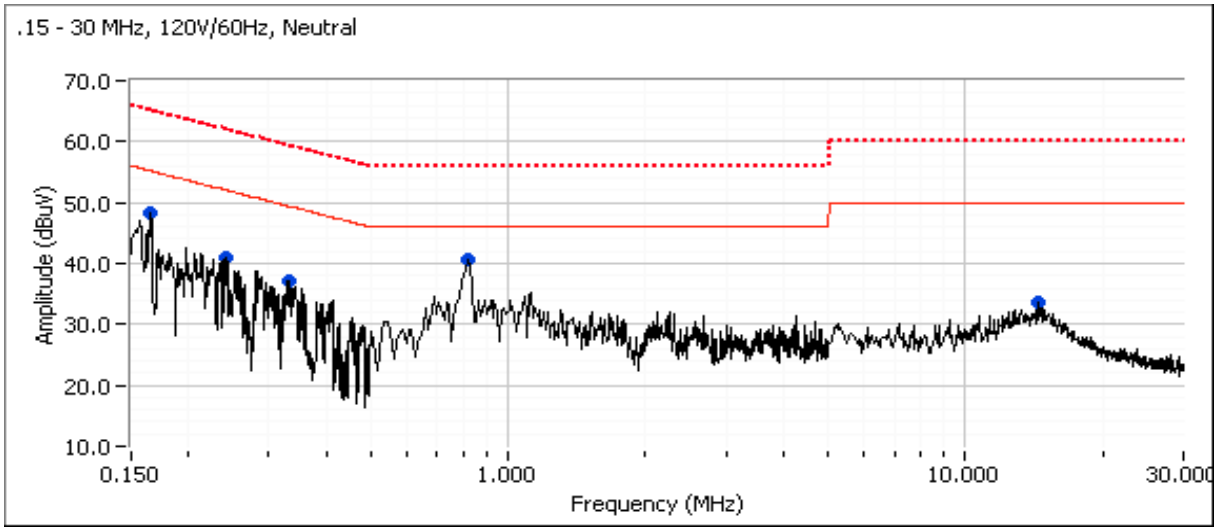
Channel: 5180 MHz
Antenna 2
Mode: a
Data Rate: 6MB/s

Channel: 2480 MHz
Antenna 2
Mode: BLE
Data Rate: 1MB/s

Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	B

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





Client:	Google Inc.	Job Number:	JD104891
Model:	Model H0A	T-Log Number:	T104956
		Project Manager:	Deepa Shetty
Contact:	Dominik Mente	Project Coordinator:	-
Standard:	FCC 15.247 / 15.407 / RSS-247	Class:	B

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

Frequency	Level	AC	15.207		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.172	49.2	Line 1	54.8	-5.6	Peak	
0.257	40.9	Line 1	51.5	-10.6	Peak	
0.383	37.4	Line 1	48.2	-10.8	Peak	
0.800	38.2	Line 1	46.0	-7.8	Peak	
14.888	35.6	Line 1	50.0	-14.4	Peak	
0.165	48.3	Neutral	55.2	-6.9	Peak	
0.240	41.0	Neutral	52.1	-11.1	Peak	
0.330	37.1	Neutral	49.4	-12.3	Peak	
0.823	40.6	Neutral	46.0	-5.4	Peak	
14.437	33.5	Neutral	50.0	-16.5	Peak	

Final quasi-peak and average readings

Frequency	Level	AC	15.207		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.823	27.7	Neutral	46.0	-18.3	AVG	AVG (0.10s)
0.823	37.3	Neutral	56.0	-18.7	QP	QP (1.00s)
0.800	24.6	Line 1	46.0	-21.4	AVG	AVG (0.10s)
0.800	34.2	Line 1	56.0	-21.8	QP	QP (1.00s)
0.172	42.0	Line 1	64.9	-22.9	QP	QP (1.00s)
0.165	41.5	Neutral	65.2	-23.7	QP	QP (1.00s)
0.257	36.5	Line 1	61.5	-25.0	QP	QP (1.00s)
0.330	34.3	Neutral	59.5	-25.2	QP	QP (1.00s)
14.888	23.5	Line 1	50.0	-26.5	AVG	AVG (0.10s)
0.383	31.3	Line 1	58.2	-26.9	QP	QP (1.00s)
14.437	22.7	Neutral	50.0	-27.3	AVG	AVG (0.10s)
0.240	34.2	Neutral	62.1	-27.9	QP	QP (1.00s)
14.888	30.9	Line 1	60.0	-29.1	QP	QP (1.00s)
0.330	18.7	Neutral	49.5	-30.8	AVG	AVG (0.10s)
0.257	20.6	Line 1	51.5	-30.9	AVG	AVG (0.10s)
0.383	16.9	Line 1	48.2	-31.3	AVG	AVG (0.10s)
14.437	27.9	Neutral	60.0	-32.1	QP	QP (1.00s)
0.172	22.4	Line 1	54.9	-32.5	AVG	AVG (0.10s)
0.240	18.5	Neutral	52.1	-33.6	AVG	AVG (0.10s)
0.165	20.1	Neutral	55.2	-35.1	AVG	AVG (0.10s)

End of Report

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