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EMC Test Report

Application for Grant of Equipment Authorization

Industry Canada RSS-Gen Issue 3 / RSS 210 Issue 8
FCC Part 15 Subpart C

Model: IPW8000 Wireless STB

IC CERTIFICATION #:	3439B-IPW8X4N
FCC ID:	PGRIPW8X4N
APPLICANT:	Pace Americas, Inc. 310 Providence Mine Road, Suite 200 Nevada City, CA 95959
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-3; 2845B-4, 2845B-5, 2845B-7
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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	09-23-2013	First release	
1.0	10-03-2013	Updated radiated spurious results.	MEH
2.0	10-18-2013	Clarified channel selection for spurious emissions	MEH

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SCOPE

An electromagnetic emissions test has been performed on the Pace Americas, Inc. model IPW8000 Wireless STB, pursuant to the following rules:

Industry Canada RSS-Gen Issue 3
RSS 210 Issue 8 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in National Technical Systems - Silicon Valley test procedures:

ANSI C63.10-2009
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 Pace Americas, Inc. model IPW8000 Wireless STB complied with the requirements of the following regulations:

Industry Canada RSS-Gen Issue 3
RSS 210 Issue 8 "Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment"
FCC Part 15 Subpart C

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

The test results recorded herein are based on a single type test of Pace Americas, Inc. model IPW8000 Wireless STB and therefore apply only to the tested sample. The sample was selected and prepared by Mark Rieger of Pace Americas, 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 (5725 –5850 MHz)

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247(a)	RSS 210 A8.2	Digital Modulation	Systems uses OFDM / DSSS techniques	System must utilize a digital transmission technology	Complies
15.247 (a) (2)	RSS 210 A8.2 (1)	6dB Bandwidth	a: 16.3 MHz n20: 17.6 MHz n40: 36.3 MHz	>500kHz	Complies
15.247 (b)	RSS 210 A8.2 (4)	Output Power (multipoint systems)	a: 25.6dBm (364mW) n20:25.6dBm (360mW) n40:26.1dBm (407mW) EIRP = 2.51 W Note 1	1Watt, EIRP limited to 4 Watts.	Complies
15.247(d)	RSS 210 A8.2 (2)	Power Spectral Density	a: 5.1dBm/10kHz n20: 5.8dBm/10kHz n40: 2.8dBm/10kHz	Maximum permitted is 8dBm/3kHz	Complies
15.247(c)	RSS 210 A8.5	Antenna Port Spurious Emissions – 30MHz – 40 GHz	All spurious emissions < -20dBc	< -30dBc Note 2	Complies
15.247(c) / 15.209	RSS 210 A8.5 Table 2, 3	Radiated Spurious Emissions 30MHz – 40 GHz	53.2 dBµV/m @ 3856.8 MHz (-0.8 dB)	15.207 in restricted bands, all others <-30dBc Note 2	Complies

Note 1: EIRP calculated using antenna gain of 7.9dBi (directional) for the highest EIRP system multi-point system.
Note 2: Limit of -30dBc used because the power was measured using the UNII test procedure (maximum power averaged over a transmission burst).

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Antennas are internal to the EUT enclosure.	Unique or integral antenna required	Complies
15.207	RSS GEN Table 2	AC Conducted Emissions	48.9 dBµV @ 16.228 MHz (-1.1 dB)	Refer to page 18	Complies
15.109	RSS GEN 7.2.3 Table 1	Receiver spurious emissions	N/A – RX tunes above 960MHz		
15.247 (b) (5) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to MPE calculations in Exhibit 11, RSS 102 declaration and User Manual statements.	Refer to OET 65, FCC Part 1 and RSS 102	Complies
-	RSP 100 RSS GEN 7.1.5	User Manual	Refer to manual	Statement required regarding non-interference	Complies
-	RSP 100 RSS GEN 7.1.5	User Manual	Refer to manual	Statement for products with detachable antenna	Complies
-	RSP 100 RSS GEN 4.4.1	99% Bandwidth	a: 19.0 MHz n20: 19.7 MHz n40: 36.7 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 Pace Americas, Inc. model IPW8000 Wireless STB is a wireless set top box that is designed to wirelessly play video. 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 120 Volts, 60 Hz.

The sample was received on August 1, 2013 and tested on August 1, 5, 6, 7, 8, 14 and 15, 2013. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Pace Americas	IPW8000	Wireless Set top box	prototype	PGRIPW8X4N
PI	T018WA1225	AC to DC adapter	810611239000001000	-

OTHER EUT DETAILS

The EUT supports 802.11a, n20, and n40 data rates. For all modes, all four Tx chains transmit. It supports operation in the 5GHz bands only.

ANTENNA SYSTEM

The EUT uses internal antennas, soldered directly to the PCB.

ENCLOSURE

The EUT enclosure measures approximately 15cm wide by 14cm deep by 4.5cm high. It is primarily constructed of uncoated coated plastic.

MODIFICATIONS

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

SUPPORT EQUIPMENT

No local support equipment was used during testing.

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

Company	Model	Description	Serial Number	FCC ID
Dell	Latitude 131L	Laptop	-	-

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Ethernet	Remote Laptop	RJ-45	Unshielded	5
Power	AC/DC Adapter	2Wire	Unshielded	1.5
AC/DC Adapter	AC Mains	2Wire	Unshielded	-
RCA (x6)	Unterminated	RCA	Shielded	1.5
HDMI	Unterminated	HDMI	Shielded	1.5

EUT OPERATION

During testing, the EUT was configured to transmit continuously on the noted channel. The lowest data rate was used for each transmit mode.

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	Registration Numbers		Location
	FCC	Canada	
Chamber 3	769238	2845B-3	41039 Boyce Road Fremont, CA 94538-2435
Chamber 4	211948	2845B-4	
Chamber 5	211948	2845B-5	
Chamber 7	A2LA accreditation	2845B-7	

ANSI C63.4 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4.

CONDUCTED EMISSIONS CONSIDERATIONS

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

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde & Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

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

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.10 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor as specified in ANSI C63.4. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.10, and the worst-case orientation is used for final measurements.

CONDUCTED EMISSIONS

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

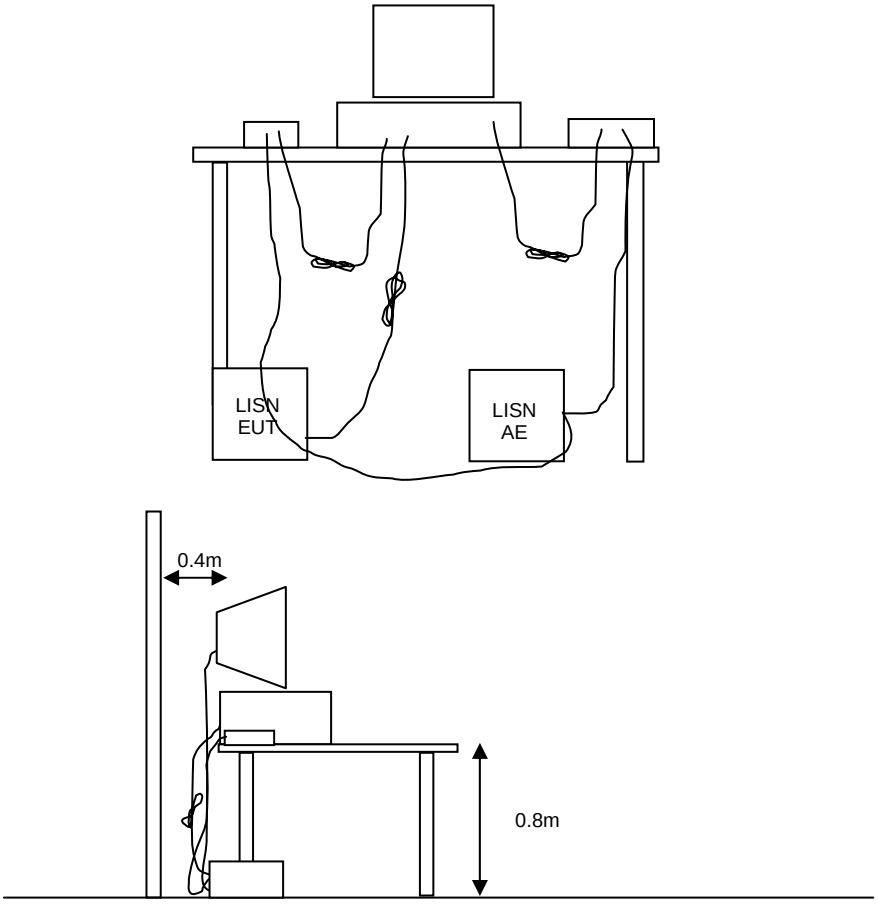


Figure 1 Typical Conducted Emissions Test Configuration

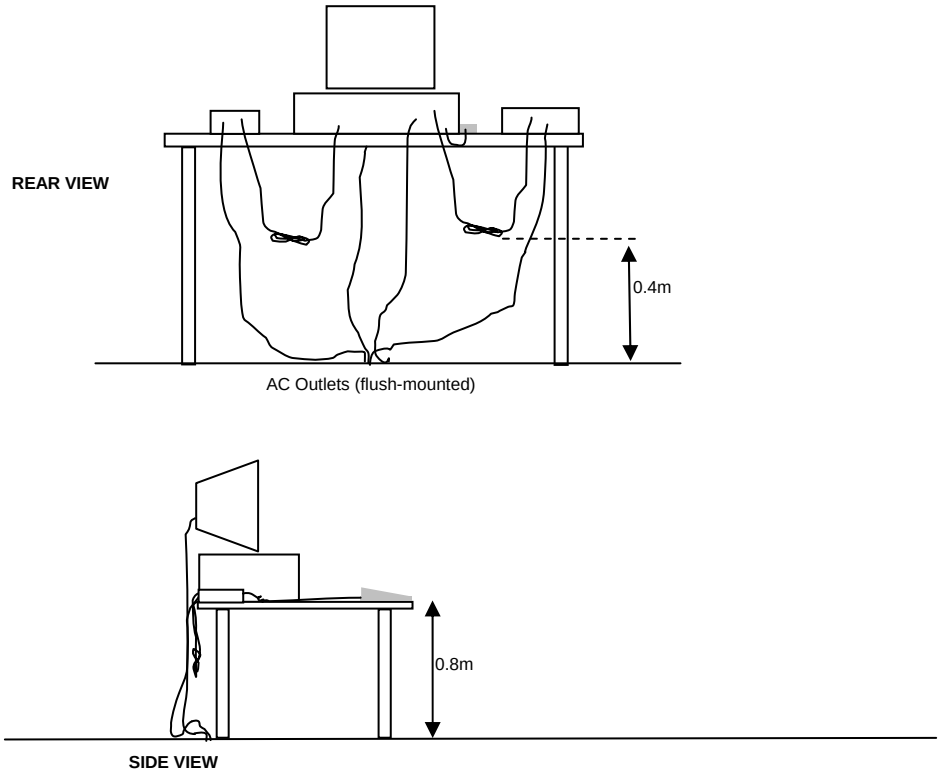
RADIATED EMISSIONS

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

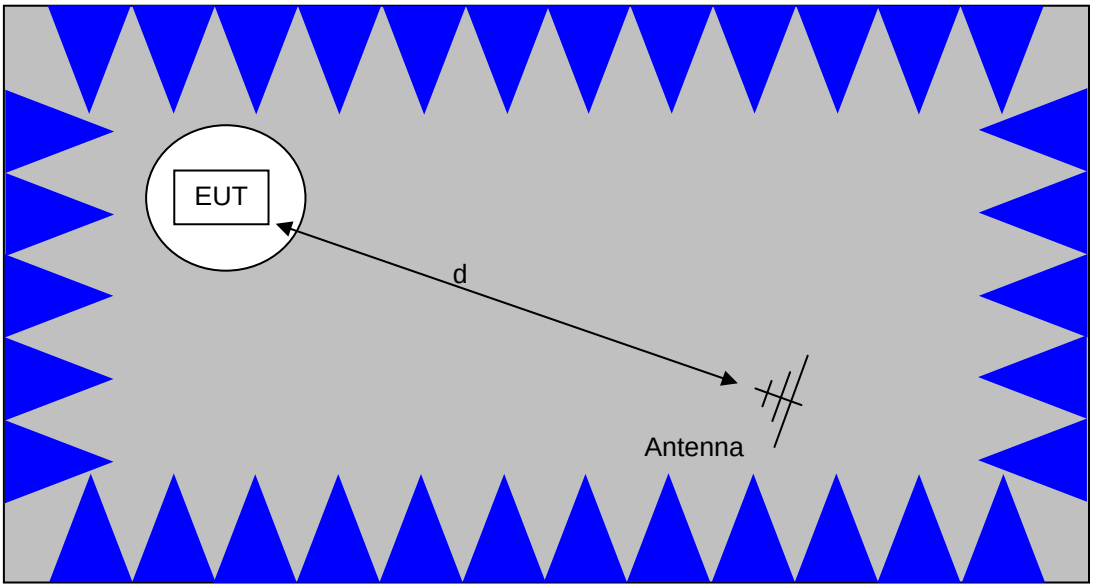
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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

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

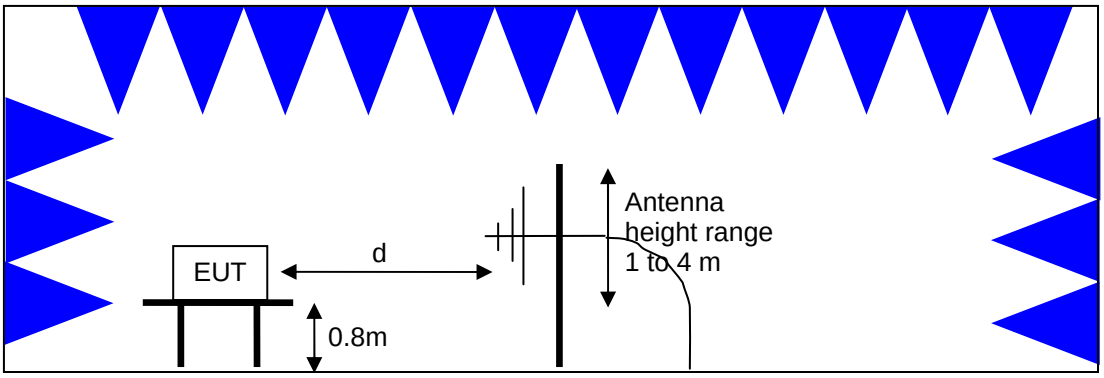


Typical Test Configuration for Radiated Field Strength Measurements



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

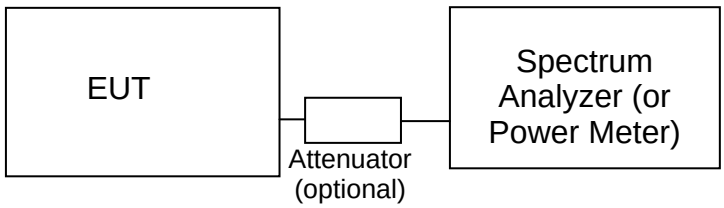
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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

CONDUCTED EMISSIONS FROM ANTENNA PORT

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



Test Configuration for Antenna Port Measurements

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

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

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

BANDWIDTH MEASUREMENTS

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

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

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

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

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

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

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

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands[1] (with the exception of transmitters operating under FCC Part 15 Subpart D and RSS 210 Annex 9), the limits for all emissions from a low power device operating under the general rules of RSS 310 (tables 3 and 4), RSS 210 (table 2) and FCC Part 15 Subpart C section 15.209.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

RECEIVER RADIATED SPURIOUS EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from receivers as detailed in FCC Part 15.109, RSS 210 Table 2, RSS GEN Table 1 and RSS 310 Table 3. Note that receivers operating outside of the frequency range 30 MHz – 960 MHz are exempt from the requirements of 15.109.

Frequency Range (MHz)	Limit (uV/m @ 3m)	Limit (dBuV/m @ 3m)
30 to 88	100	40
88 to 216	150	43.5
216 to 960	200	46.0
Above 960	500	54.0

[1] The restricted bands are detailed in FCC 15.203, RSS 210 Table 1 and RSS 310 Table 2

OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Output Power	Power Spectral Density
902 – 928	1 Watt (30 dBm)	8 dBm/3kHz
2400 – 2483.5	1 Watt (30 dBm)	8 dBm/3kHz
5725 – 5850	1 Watt (30 dBm)	8 dBm/3kHz

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

The limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands are those specified in the general limits sections of FCC Part 15 and RSS 210. All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level (30dB if the power is measured using the sample detector/power averaging method).

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 #	Cal Due
Radiated Emissions, 1000 - 6,500 MHz, 01-Aug-13				
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	7/12/2014
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	6/8/2014
Radiated Emissions, 1000 - 40,000 MHz, 05-Aug-13				
EMCO	Antenna, Horn, 1-18 GHz	3115	487	7/19/2014
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	11/9/2013
Hewlett Packard	Head (Inc flex cable, 1143, 2198) Red	84125C	1145	6/26/2014
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/14/2013
A. H. Systems	Spare System Horn, 18-40GHz	SAS-574, p/n: 2581	2162	7/24/2014
Micro-Tronics	Band Reject Filter, 5725-5875 MHz	BRC50705-02	2241	10/4/2013
Hewlett Packard	High Pass filter, 8.2 GHz (Purple System)	P/N 84300-80039	1767	12/5/2013
Radiated Emissions, 1000 - 40,000 MHz, 06-Aug-13				
EMCO	Antenna, Horn, 1-18 GHz	3115	487	7/19/2014
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	11/9/2013
Hewlett Packard	Head (Inc flex cable, 1143, 2198) Red	84125C	1145	6/26/2014
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/14/2013
A. H. Systems	Spare System Horn, 18-40GHz	SAS-574, p/n: 2581	2162	7/24/2014
Micro-Tronics	Band Reject Filter, 5150-5350 MHz	BRC50703-02	2239	10/4/2013
Hewlett Packard	High Pass filter, 8.2 GHz (Purple System)	P/N 84300-80039	1767	12/5/2013
Micro-Tronics	Band Reject Filter, 5470-5725 MHz	BRC50704-02	2240	10/4/2013
Radiated Emissions, 1000 - 40,000 MHz, 07-Aug-13				
EMCO	Antenna, Horn, 1-18 GHz	3115	487	7/19/2014
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	11/9/2013
Hewlett Packard	Head (Inc flex cable, 1143, 2198) Red	84125C	1145	6/26/2014
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/14/2013
A. H. Systems	Spare System Horn, 18-40GHz	SAS-574, p/n: 2581	2162	7/24/2014
Micro-Tronics	Band Reject Filter, 5150-5350 MHz	BRC50703-02	2239	10/4/2013
Hewlett Packard	High Pass filter, 8.2 GHz (Purple System)	P/N 84300-80039	1767	12/5/2013
Micro-Tronics	Band Reject Filter, 5470-5725 MHz	BRC50704-02	2240	10/4/2013
Radiated Emissions, 1000 - 6,000 MHz, 08-Aug-13				
EMCO	Antenna, Horn, 1-18 GHz	3115	487	7/19/2014
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	6/8/2014

Manufacturer	Description	Model	Asset #	Cal Due
Radio Antenna Port (Power and Spurious Emissions), 14-Aug-13				
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	1/28/2014
Conducted Emissions - AC Power Ports, 15-Aug-13				
EMCO	LISN, 10 kHz-100 MHz, 25A	3825/2	1292	2/14/2014
Rohde & Schwarz	Pulse Limiter	ESH3 Z2	1401	5/15/2014
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESIB40 (1088.7490.40)	2493	1/18/2014
Radiated Emissions, 1000 - 6,000 MHz, 15-Aug-13				
EMCO	Antenna, Horn, 1-18 GHz	3115	487	7/19/2014
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1756	6/8/2014
DFS, 20-Aug-13				
Hewlett Packard	EMC Spectrum Analyzer, 9 kHz - 6.5 GHz	8595EM	780	3/7/2014
EMCO	Antenna, Horn, 1-18 GHz	3117	1662	5/25/2014
Agilent Technologies	PSG Vector Signal Generator (250kHz - 20GHz)	E8267C	1877	6/5/2014
Tektronix	500MHz, 2CH, 5GS/s Scope	TDS5052B	2118	10/22/2013

Appendix B Test Data

T93085 Pages 26 - 81

Client:	Pace Americas	Job Number:	J93000
Product	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Emissions Standard(s):	FCC, IC	Class:	B
Immunity Standard(s):	-	Environment:	Radio

EMC Test Data

For The

Pace Americas

Product

IPW8000 Wireless STB

Date of Last Test: 10/18/2013

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	B

Conducted Emissions

(Elliott Laboratories 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: 8/15/2013
Test Engineer: Rafael Varelas
Test Location: Fremont Chamber #5
Config. Used: 2
Config Change: Added RCA and HDMI cables
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. Remote support equipment was located outside of the semi-anechoic chamber. Any cables running to remote support equipment where routed through metal conduit and when possible passed through a ferrite clamp upon exiting the chamber.

Ambient Conditions:

Temperature: 21.5 °C
Rel. Humidity: 38 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
1	CE, AC Power,120V/60Hz	Class B	Pass	48.9 dBµV @ 16.228 MHz(-1.1 dB)

Modifications Made During Testing

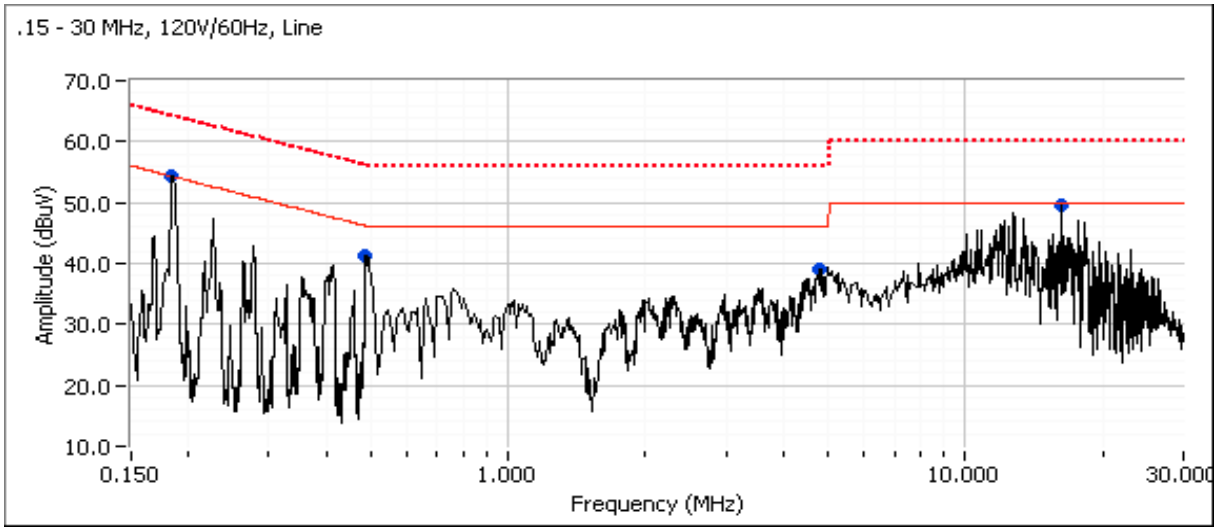
No modifications were made to the EUT during testing

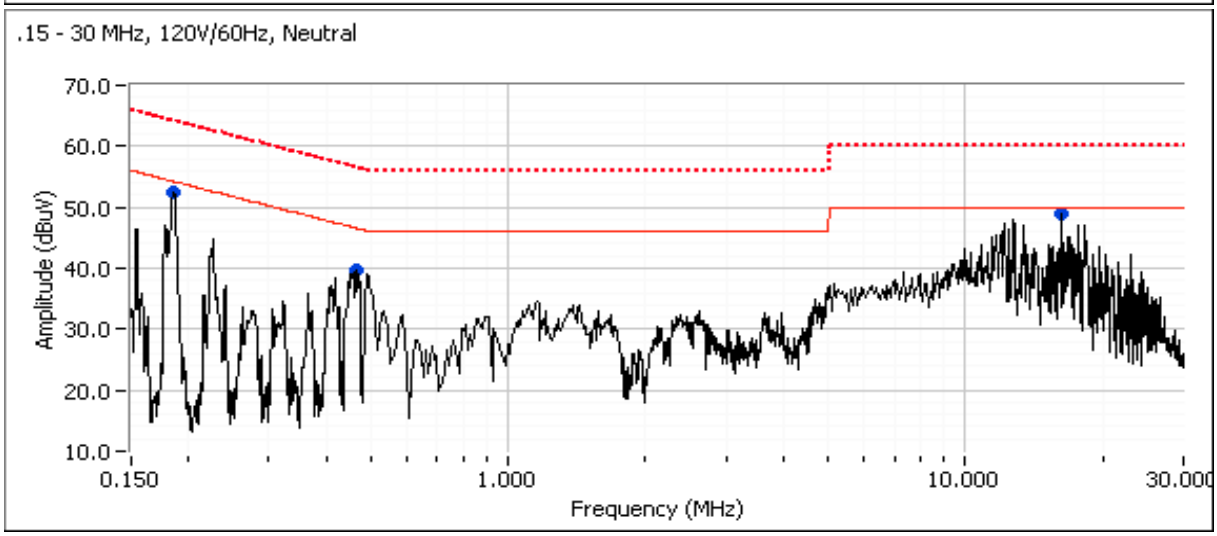
Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	B

Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz
EUT transmitting at 5300 MHz, power setting 18





Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	B

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

Frequency	Level	AC	Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
0.185	54.4	Line 1	54.3	0.1	Peak	
0.488	41.2	Line 1	46.2	-5.0	Peak	
4.791	38.9	Line 1	46.0	-7.1	Peak	
16.228	49.6	Line 1	50.0	-0.4	Peak	
0.185	52.3	Neutral	54.2	-1.9	Peak	
0.467	39.7	Neutral	46.6	-6.9	Peak	
16.228	48.8	Neutral	50.0	-1.2	Peak	

Final quasi-peak and average readings

Frequency	Level	AC	Class B		Detector	Comments
MHz	dBµV	Line	Limit	Margin	QP/Ave	
16.228	48.9	Line 1	50.0	-1.1	AVG	AVG (0.10s)
16.228	48.5	Neutral	50.0	-1.5	AVG	AVG (0.10s)
16.228	49.6	Line 1	60.0	-10.4	QP	QP (1.00s)
16.228	49.2	Neutral	60.0	-10.8	QP	QP (1.00s)
0.185	52.3	Neutral	64.3	-12.0	QP	QP (1.00s)
0.488	33.3	Line 1	46.2	-12.9	AVG	AVG (0.10s)
0.185	51.2	Line 1	64.3	-13.1	QP	QP (1.00s)
0.488	42.0	Line 1	56.2	-14.2	QP	QP (1.00s)
4.791	28.3	Line 1	46.0	-17.7	AVG	AVG (0.10s)
0.185	36.5	Neutral	54.3	-17.8	AVG	AVG (0.10s)
0.467	28.8	Neutral	46.6	-17.8	AVG	AVG (0.10s)
0.467	38.5	Neutral	56.6	-18.1	QP	QP (1.00s)
4.791	37.0	Line 1	56.0	-19.0	QP	QP (1.00s)
0.185	34.5	Line 1	54.3	-19.8	AVG	AVG (0.10s)

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

RSS 210 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: 21.2 °C
Rel. Humidity: 37 %

Summary of Results - Device Operating in the 5725-5850 MHz Band

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
Scans on center channel in all three OFDM modes to determine the worst case mode.							
1	n20	157 - 5785MHz	19		Radiated Emissions, 1 - 40 GHz	FCC Part 15.209 / 15.247(c)	53.2 dBµV/m @ 3856.8 MHz (-0.8 dB)
	n40	159 - 5795MHz	18		Radiated Emissions, 1 - 40 GHz	FCC Part 15.209 / 15.247(c)	51.0 dBµV/m @ 3863.4 MHz (-3.0 dB)
40MHz mode complied at the lower power setting. Testing performed on only remaining 40MHz channel in band.							
2	n40	151 - 5755MHz	20		Radiated Emissions, 1 - 40 GHz	FCC Part 15.209 / 15.247(c)	52.0 dBµV/m @ 11510.2 MHz (-2.0 dB)

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	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.

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074 v03r01, dated April 9, 2013
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.
5.8GHz 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)
n20	MCS0	0.99	Yes	4.96	0.04	0.09	201.6
n40	MCS0	0.98	Yes	4.76	0.08	0.16	210.1

Sample Notes

Module S/N: TDVAAGC325620001
Driver: ?
Antenna: Internal

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

Notes

Device operates in 4x4 mode only.
Testing performed at the highest power setting
n20 tested as representative of 11a
No spurious emissions below 1GHz were observed in preliminary testing

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 2:	Emission has duty cycle ≥ 98%, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces
Note 3:	Emission has duty cycle < 98%, but constant, average measurement performed: RBW=1MHz, VBW=10Hz, peak detector, linear averaging, auto sweep, trace average 100 traces, measurement corrected by Linear Voltage correction factor
Note 4:	Emission has duty cycle < 98% and is NOT constant, 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 5:	Emission has duty cycle < 98%, but constant, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces, measurement corrected by Pwr correction factor
Note 6:	Plots of the average and peak bandedge do not account for any duty cycle correction. Refer to the tabluar results for final measurements.

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

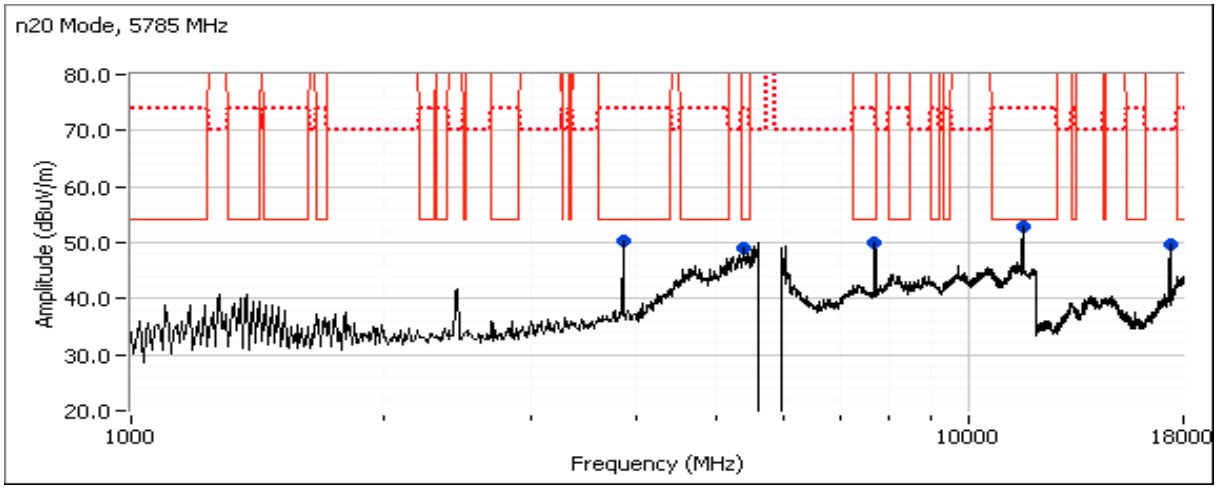
Run #1: Radiated Spurious Emissions, 30 - 40000 MHz. Operating Mode: Determination of worse case OFDM mode
Date of Test: 8/5/2013
Test Engineer: Rafael Varelas
Test Location: FT Chamber #7

Run #1b: Center Channel

Channel: 157
Tx Chain: 4x4 mode
Mode: n20
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	
3856.750	53.2	H	54.0	-0.8	AVG	186	1.0	
3856.620	55.6	H	74.0	-18.4	PK	186	1.0	
5386.400	59.0	H	74.0	-15.0	PK	169	1.0	
5386.400	47.8	H	54.0	-6.2	AVG	169	1.0	
11572.070	48.7	V	54.0	-5.3	AVG	284	1.0	
11572.330	60.6	V	74.0	-13.4	PK	284	1.0	
7713.400	48.1	V	54.0	-5.9	AVG	322	1.0	
7713.460	53.9	V	74.0	-20.1	PK	322	1.0	
17342.340	47.9	H	54.0	-6.1	PK	324	1.0	Note 1

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 signifcant emissions in this frequency range



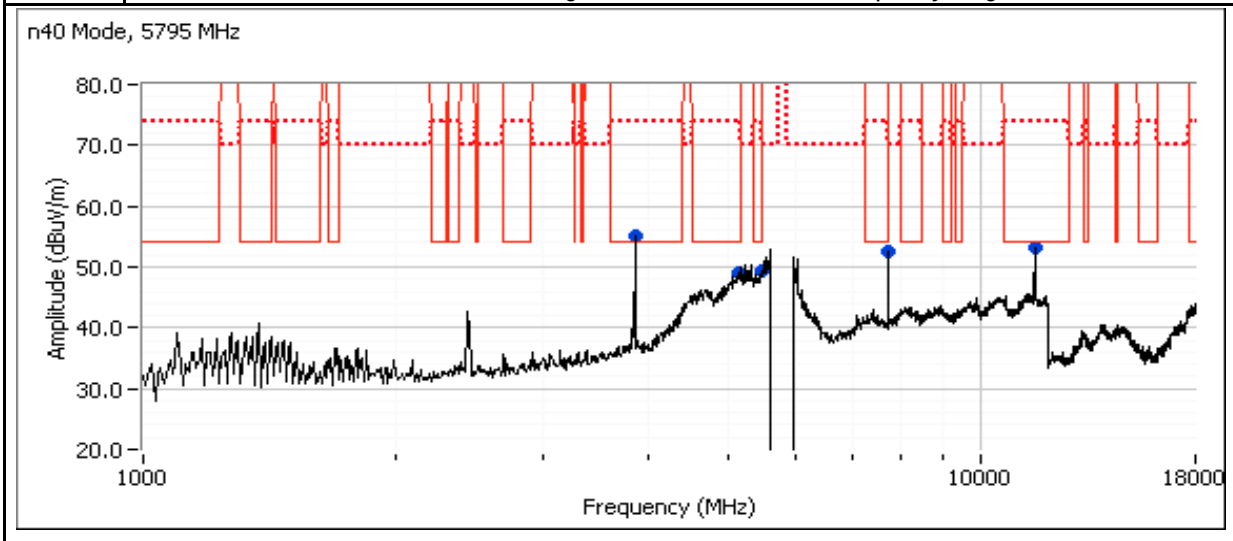
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

Run #1c: Center Channel

Channel: 159
Tx Chain: 4x4 mode
Mode: n40
Data Rate: MCSO

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
3863.420	51.0	H	54.0	-3.0	AVG	182	1.0	
3863.360	54.1	H	74.0	-19.9	PK	182	1.0	
7726.840	47.2	V	54.0	-6.8	AVG	264	1.0	
7726.910	55.3	V	74.0	-18.7	PK	264	1.0	
5132.510	46.3	H	54.0	-7.7	AVG	170	1.0	
5133.640	57.8	H	74.0	-16.2	PK	170	1.0	
5455.710	44.5	V	54.0	-9.5	AVG	102	1.4	
5455.660	56.2	V	74.0	-17.8	PK	102	1.4	
11590.360	53.0	V	54.0	-1.0	AVG	54	1.5	
11590.500	58.6	V	74.0	-15.4	PK	54	1.5	

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 signifcant emissions in this frequency range*



Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

Run #2: Radiated Spurious Emissions, 30 - 25000 MHz. Operating Mode: Worse Case OFDM

Date of Test: 8/5/2013
Test Engineer: Rafael Varelas
Test Location: FT Chamber #7

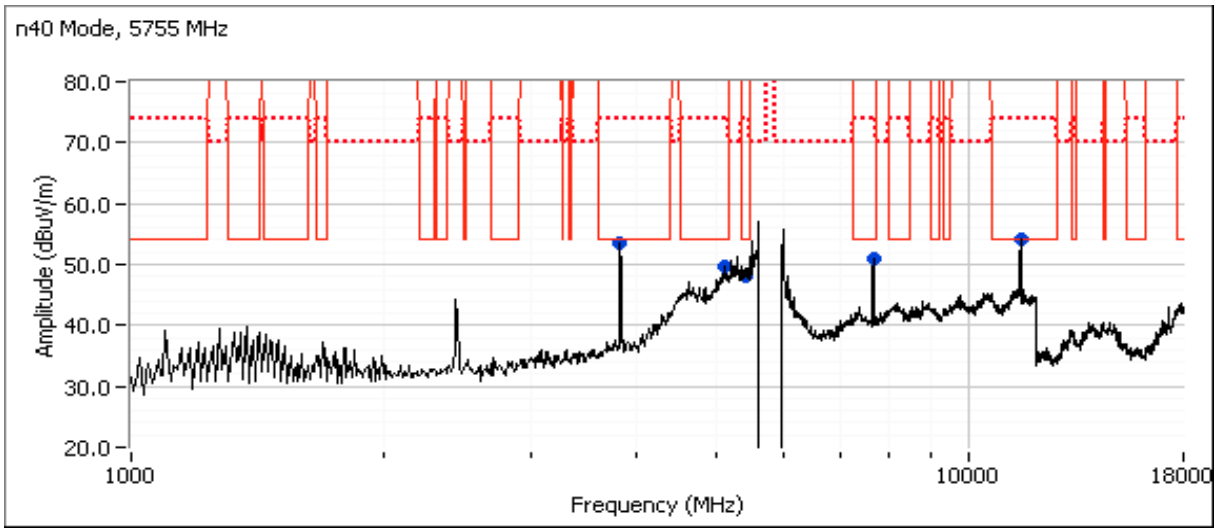
Run #2a: Low Channel

Channel: 151
Tx Chain: 4x4 mode
Mode: n40
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	
11510.230	52.0	V	54.0	-2.0	AVG	338	1.4	
11510.410	58.1	V	74.0	-15.9	PK	338	1.4	
7673.520	46.6	V	54.0	-7.4	AVG	268	1.0	
7673.460	54.3	V	74.0	-19.7	PK	268	1.0	
3836.780	53.2	H	54.0	-0.8	AVG	186	1.0	
3836.890	55.3	H	74.0	-18.7	PK	186	1.0	
5412.450	47.9	H	54.0	-6.1	AVG	167	1.4	
5412.520	59.2	H	74.0	-14.8	PK	167	1.4	
5121.310	44.6	H	54.0	-9.4	AVG	120	1.0	
5121.410	56.3	H	74.0	-17.7	PK	120	1.0	

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 signifcant emissions in this frequency range

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A



Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Antenna Port Measurements
MIMO and Smart Antenna Systems
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.

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: 20.6 °C
Rel. Humidity: 37 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1	20	-	Output Power	15.247(b)	Pass	a: 25.6dBm (364mW) n20:25.6dBm (360mW) n40:26.1dBm (407mW)
2	21	-	Power spectral Density (PSD)	15.247(d)	Pass	a: 5.1dBm/10kHz n20: 5.8dBm/10kHz n40: 2.8dBm/10kHz
3	21	-	Minimum 6dB Bandwidth	15.247(a)	Pass	a: 16.3 MHz n20: 17.6 MHz n40: 36.3 MHz
3	21	-	99% Bandwidth	RSS GEN	Pass	a: 19.0 MHz n20: 19.7 MHz n40: 36.7 MHz
4	21	-	Spurious emissions	15.247(b)	Pass	All emissions below -30dBc limit

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	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.

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 558074 v03r01, dated April 9, 2013

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11a	6	0.98	Yes	5.35	0.09	0.18	186.9
n20	MCS0	0.99	Yes	4.96	0.04	0.09	201.6
n40	MCS0	0.98	Yes	4.76	0.08	0.16	210.1

Sample Notes

Sample S/N:
Driver:

Antenna Gain Information

Freq	Antenna Gain (dBi) / Chain				BF	MultiChain Legacy	CDD	Sectorized / Xpol	Dir G (PWR)	Dir G (PSD)
	1	2	3	4						
5725-5850	1.84	1.91	1.89	1.88	Yes	Yes	Yes	No	7.90	7.90

For devices that support CDD modes

Min # of spatial streams: 1
Max # of spatial streams: 4

Notes:	BF = beamforming mode supported, Multichain Legacy = 802.11 legacy data rates supported for multichain transmissions, CDD = Cyclic Delay Diversity (or Cyclic Shift Diversity) modes supported, Sectorized / Xpol = antennas are sectorized or cross polarized
Notes:	Dir G (PWR) = total gain (Gant + Array Gain) for power calculations; Dir G (PSD) = total gain for PSD calculations based on FCC KDB 662911. Depending on the modes supported, the Array Gain value for power could be different from the PSD value.
Notes:	Array gain for power/psd calculated per KDB 662911 D01

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

Run #1: Output Power
Date of Test: 8/12/2013
Test Engineer: John Caizzi
Test Location: Lab 4A

Operating Mode: 11a
Directional Gain (dBi): Yes

Frequency (MHz)	Chain	Software Setting	Power[1] dBm	Total Power mW	Total Power dBm	Limit dBm	Max Power (W)	Result		Power (dBm)[3]
5745	1	19	18.9	334.8	25.2	28.1	0.364	Pass		
	2		18.9							
	3		19.6							
	4		19.4							
5785	1	19	19.0	331.1	25.2	28.1		Pass		
	2		19.0							
	3		19.6							
	4		19.2							
5825	1	19	19.4	364.0	25.6	28.1		Pass		
	2		19.3							
	3		20.0							
	4		19.7							

Note 1:	Duty Cycle ≥ 98%. Output power measured using a spectrum analyzer (see plots below) with RBW= 1-5% of OBW, VB≥3* RBW, RMS detector, power averaging on, and power integration over the OBW, trace average 100 traces (option AVGSA-1, in KDB 558074). Spurious limit becomes -30dBc.
Note 2:	Power setting - if a single number the same power setting was used for each chain. If multiple numbers the power setting for each chain is separated by a comma (e.g. x,y would indicate power setting x for chain 1, power setting y for chain 2.
Note 3:	Power measured using average power meter (non-gated) and is included for reference only.

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

Operating Mode: n20
Directional Gain (dBi): Yes

Frequency (MHz)	Chain	Software Setting	Power[1] dBm	Total Power mW	Total Power dBm	Limit dBm	Max Power (W)	Result		Power (dBm)[3]
5745	1	19	19.0	344.5	25.4	28.1	0.360	Pass		
	2		19.1							
	3		19.7							
	4		19.5							
5785	1	19	18.7	330.5	25.2	28.1		Pass		
	2		18.9							
	3		19.7							
	4		19.3							
5825	1	19	19.3	359.9	25.6	28.1		Pass		
	2		19.3							
	3		20.0							
	4		19.6							

Note 1:	Duty Cycle ≥ 98%. Output power measured using a spectrum analyzer (see plots below) with RBW= 1-5% of OBW, VB≥3* RBW, RMS detector, power averaging on, and power integration over the OBW, trace average 100 traces (option AVGSA-1, in KDB 558074). Spurious limit becomes -30dBc.
Note 2:	Power setting - if a single number the same power setting was used for each chain. If multiple numbers the power setting for each chain is separated by a comma (e.g. x,y would indicate power setting x for chain 1, power setting y for chain 2.
Note 3:	Power measured using average power meter (non-gated) and is included for reference only.

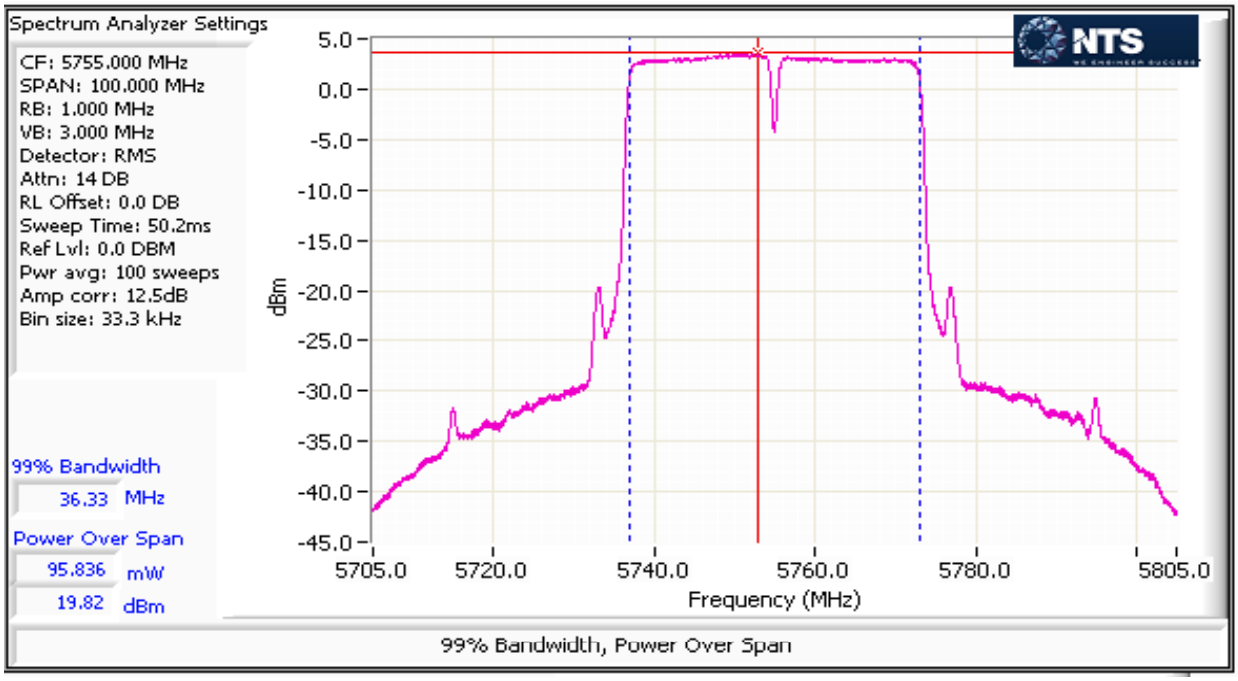
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

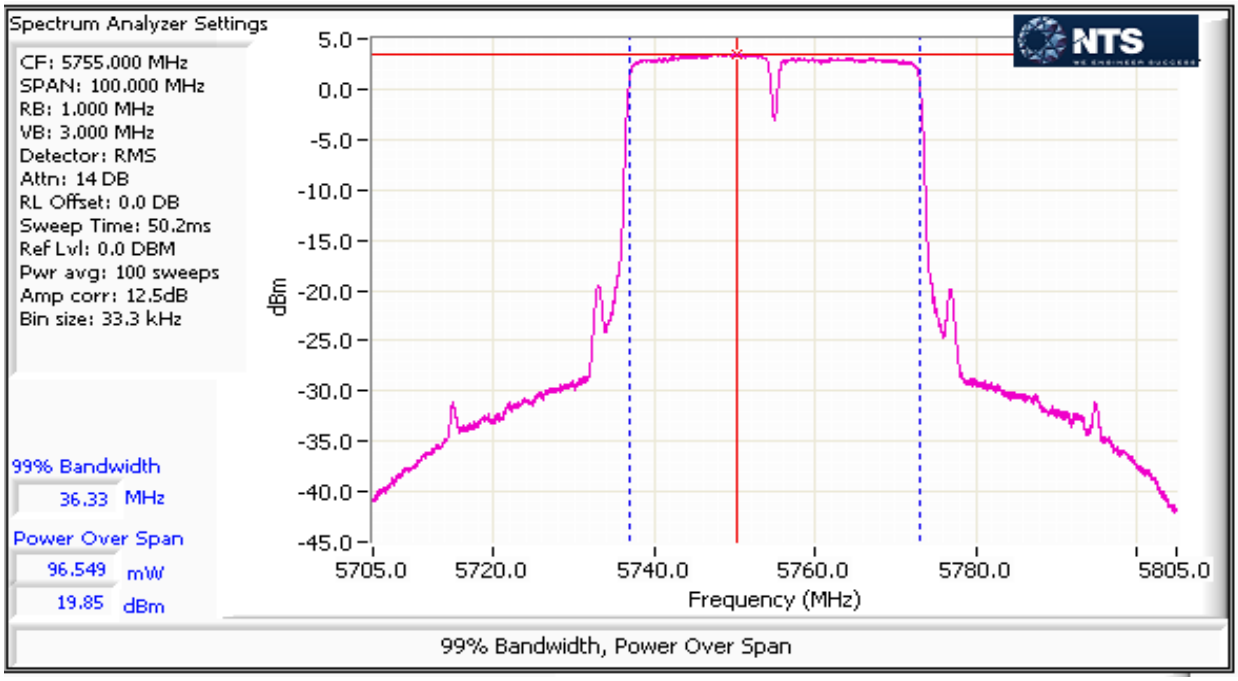
Operating Mode: n40
Directional Gain (dBi): Yes

Frequency (MHz)	Chain	Software Setting	Power[1] dBm	Total Power mW	Total Power dBm	Limit dBm	Max Power (W)	Result	Power eirp (mW)	Power (dBm)[3]
5755	1	20	19.8	406.9	26.1	28.1	0.407	Pass	2509.2	
	2		19.9							
	3		20.4							
	4		20.2							
5795	1	18	17.8	260.8	24.2	28.1		Pass		
	2		17.5							
	3		18.7							
	4		18.4							

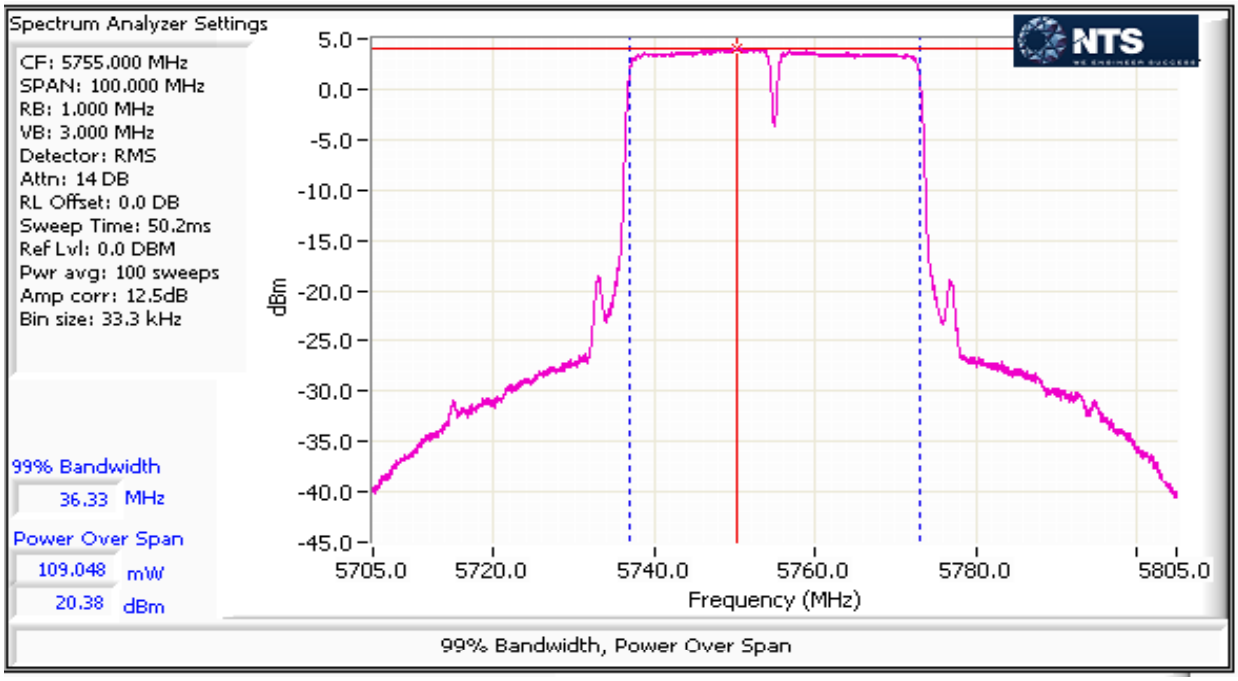
Note 1:	Duty Cycle ≥ 98%. Output power measured using a spectrum analyzer (see plots below) with RBW= 1-5% of OBW, VB≥3* RBW, RMS detector, power averaging on, and power integration over the OBW, trace average 100 traces (option AVGSA-1, in KDB 558074). Spurious limit becomes -30dBc.
Note 2:	Power setting - if a single number the same power setting was used for each chain. If multiple numbers the power setting for each chain is separated by a comma (e.g. x,y would indicate power setting x for chain 1, power setting y for chain 2.
Note 3:	Power measured using average power meter (non-gated) and is included for reference only.

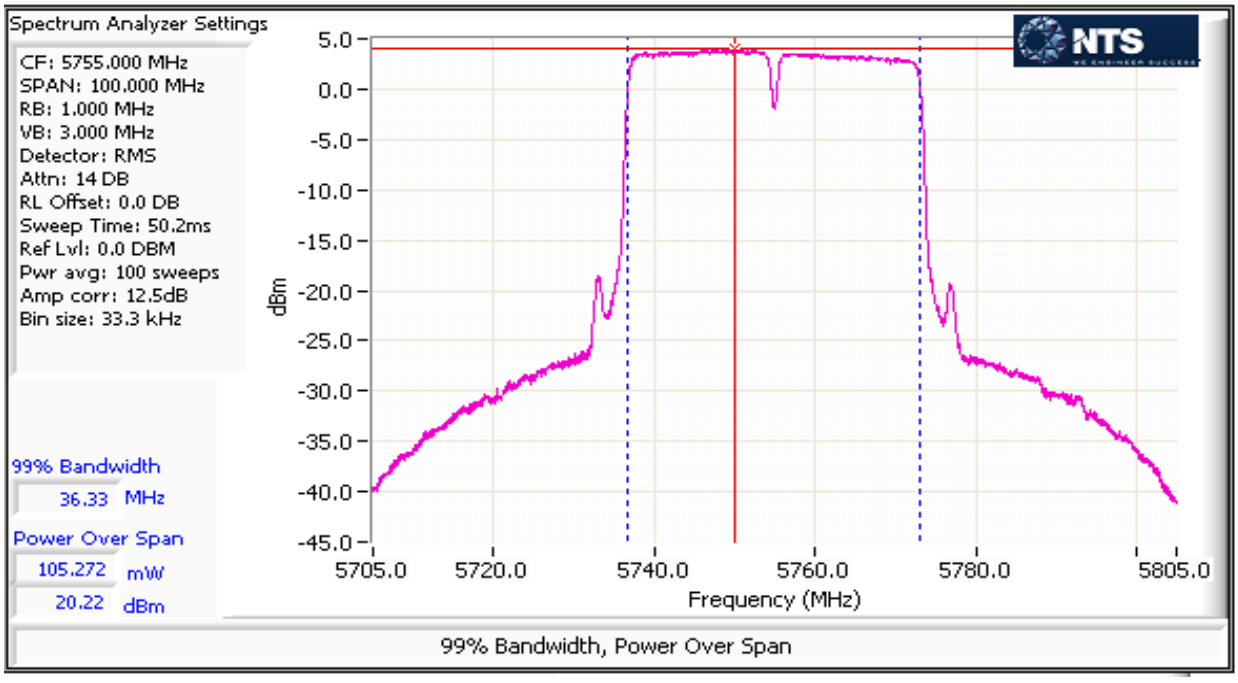
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A





Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A





Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

Run #2: Power spectral Density
Date of Test: 8/9/2013
Test Engineer: Rafael Varelas
Test Location: FT Lab 4A

11a

Power Setting	Frequency (MHz)	PSD (dBm/10kHz) Note 1					Limit dBm/3kHz	Result
		Chain 1	Chain 2	Chain 3	Chain 4	Total		
21	5745	-1.6	-1.4	-1.3	-1.3	4.6	8.0	Pass
21	5785	-1.9	-1.5	-1.4	-1.1	4.6	8.0	Pass
21	5825	-0.6	-1.1	-0.9	-1.0	5.1	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.

n20

Power Setting	Frequency (MHz)	PSD (dBm/10kHz) Note 1					Limit dBm/3kHz	Result
		Chain 1	Chain 2	Chain 3	Chain 4	Total		
21	5745	-1.2	-0.7	0.0	0.1	5.6	8.0	Pass
21	5785	-1.2	-0.9	-0.7	-0.5	5.2	8.0	Pass
21	5825	-0.7	-0.2	0.4	-0.3	5.8	8.0	Pass

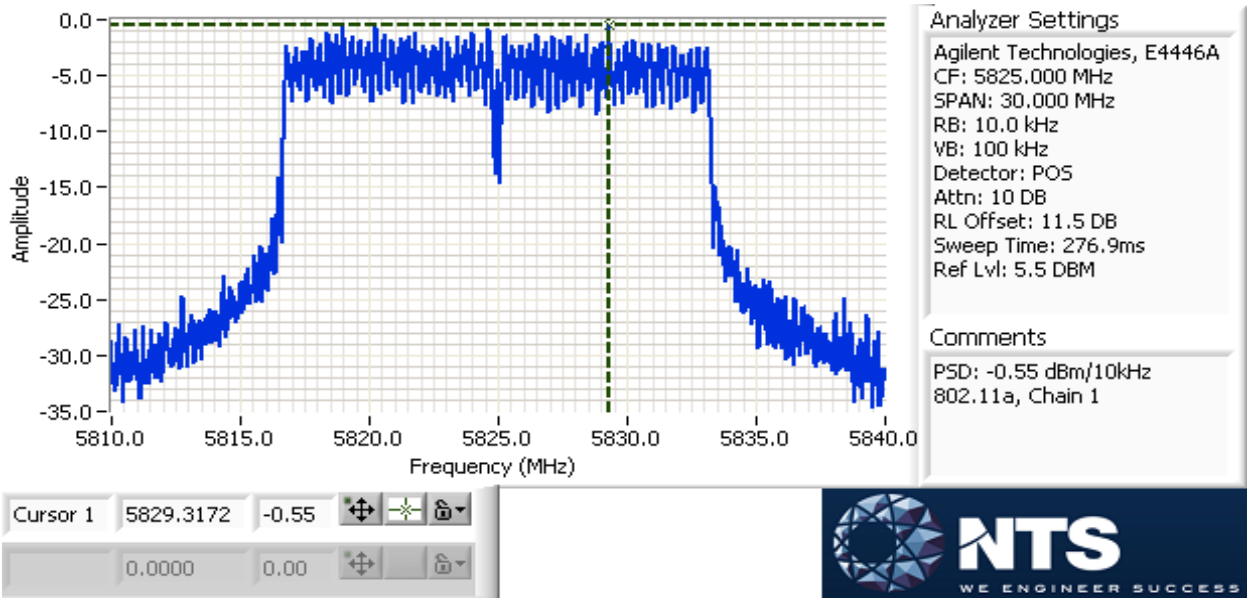
Note 1:	Test performed per method PKSPD, in KDB 558074. Power spectral density measured using: 3kHz ≤ RBW ≤ 100kHz, VBW=3*RBW, peak detector, span = 1.5*DTS BW, auto sweep time, max hold.

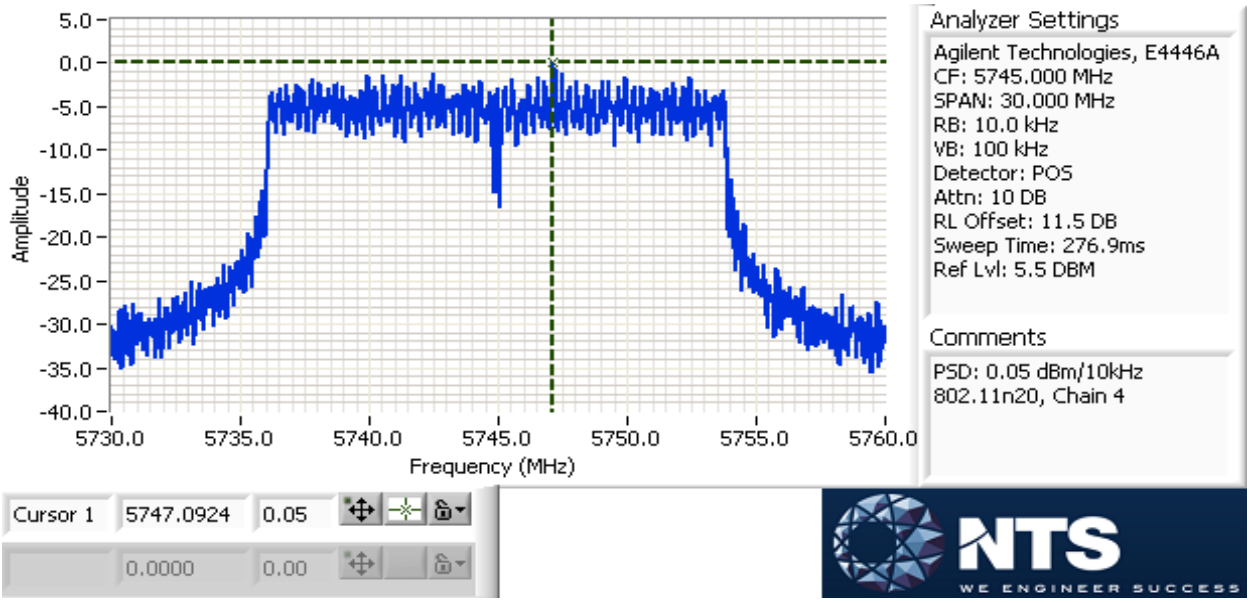
n40

Power Setting	Frequency (MHz)	PSD (dBm/10kHz) Note 1					Limit dBm/3kHz	Result
		Chain 1	Chain 2	Chain 3	Chain 4	Total		
21	5755	-3.8	-3.1	-3.7	-3.1	2.6	8.0	Pass
21	5795	-3.0	-3.2	-3.4	-3.4	2.8	8.0	Pass

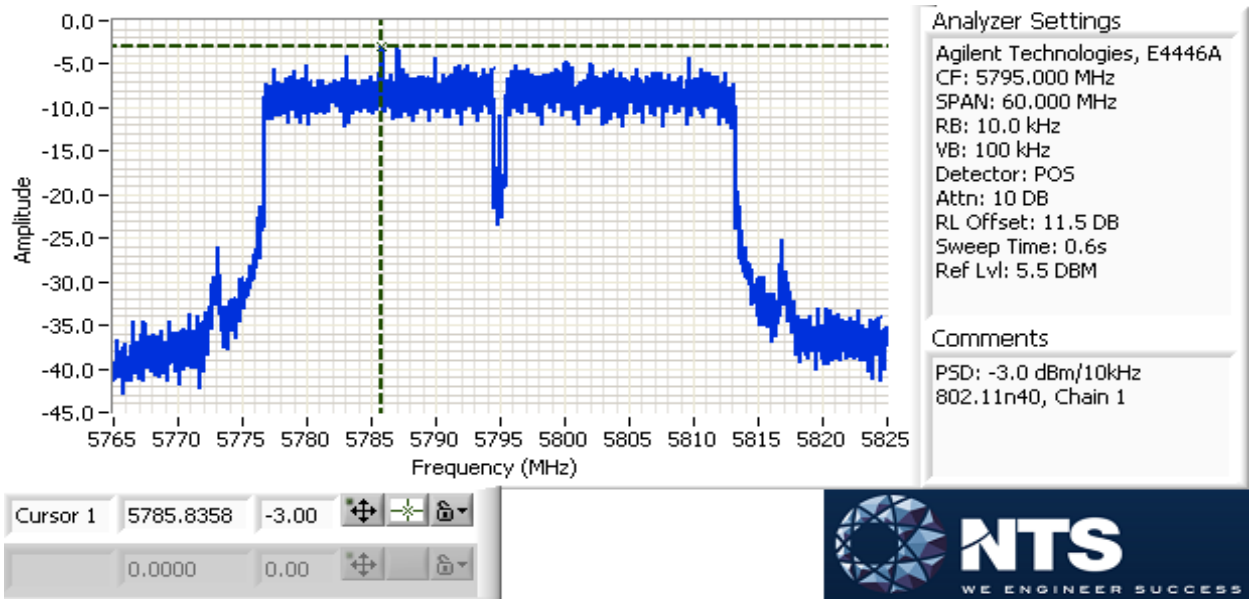
Note 1:	Test performed per method PKSPD, in KDB 558074. Power spectral density measured using: 3kHz ≤ RBW ≤ 100kHz, VBW=3*RBW, peak detector, span = 1.5*DTS BW, auto sweep time, max hold.

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A





Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A



Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

Run #3: Signal Bandwidth
Date of Test: 8/9/2013
Test Engineer: Rafael Varelas
Test Location: FT Lab 4A

11a

Power Setting	Frequency (MHz)	Bandwidth (kHz) 6dB		RBW Setting (MHz) 99%	
21	5745	100kHz	16.3	1MHz	19.0
21	5785	100kHz	16.4	1MHz	18.8
21	5825	100kHz	16.3	1MHz	18.9

Note 1:	DTS BW: RBW=100kHz, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time. 99% BW: RBW=1-5% of of 99%BW, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time.
Note 2:	Measurements performed on chain 1

n20

Power Setting	Frequency (MHz)	Bandwidth (kHz) 6dB		RBW Setting (MHz) 99%	
21	5745	100kHz	17.6	1MHz	19.5
21	5785	100kHz	17.6	1MHz	19.7
21	5825	100kHz	17.6	1MHz	19.6

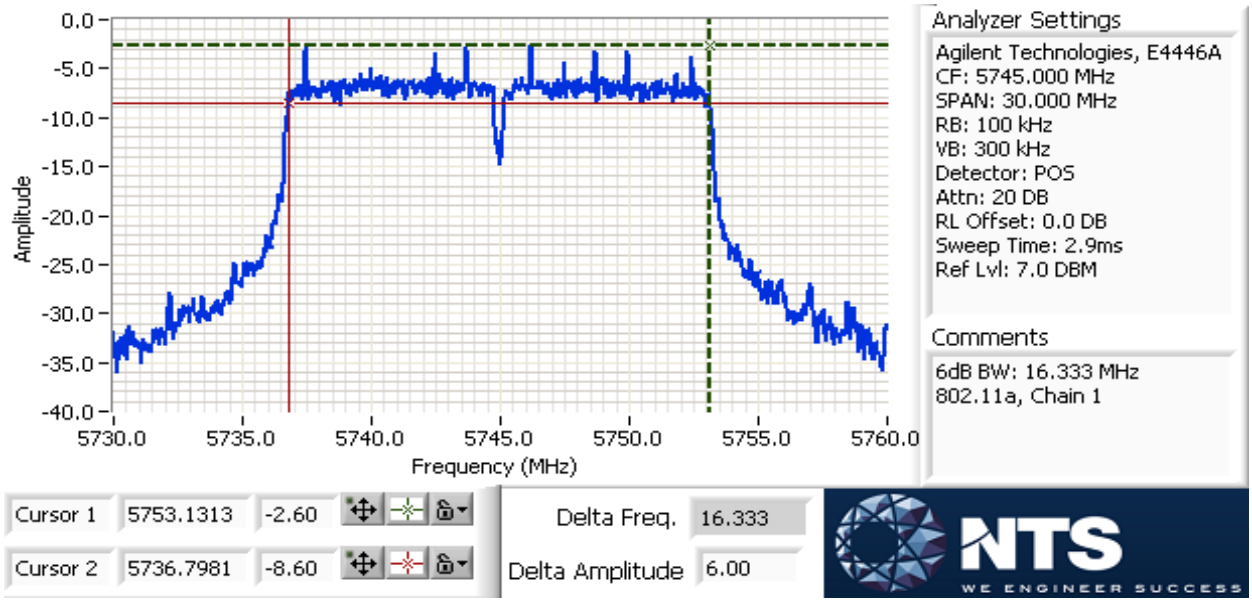
Note 1:	DTS BW: RBW=100kHz, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time. 99% BW: RBW=1-5% of of 99%BW, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time.
Note 2:	Measurements performed on chain 1

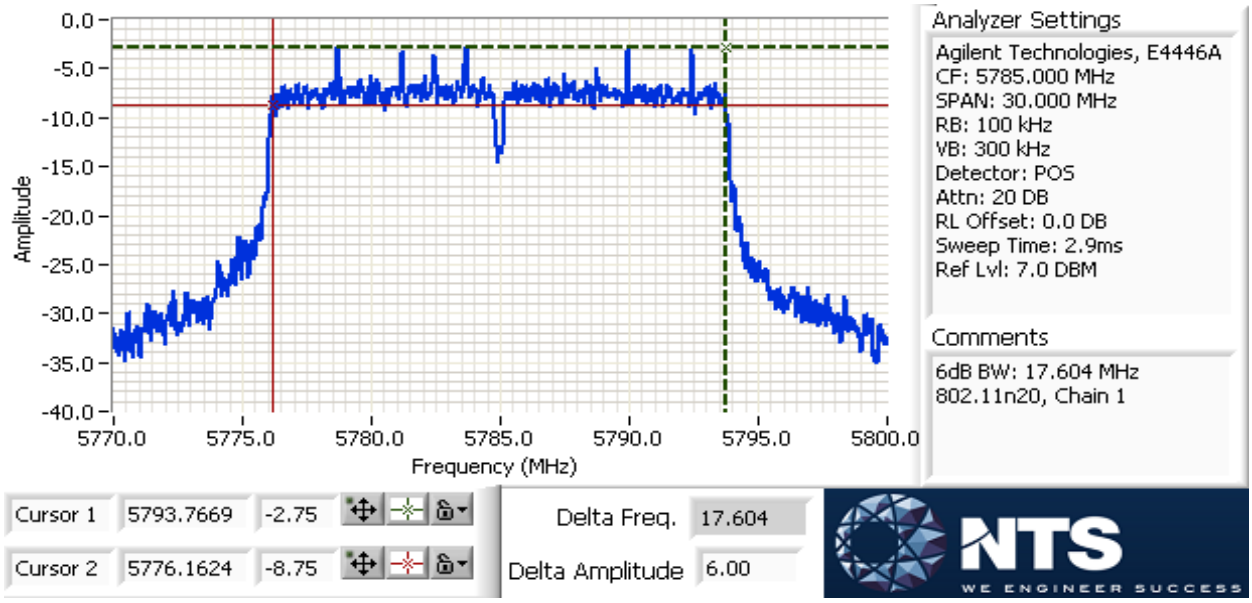
n40

Power Setting	Frequency (MHz)	Bandwidth (kHz) 6dB		RBW Setting (MHz) 99%	
21	5755	100kHz	36.3	1MHz	36.7
21	5795	100kHz	36.3	1MHz	36.7

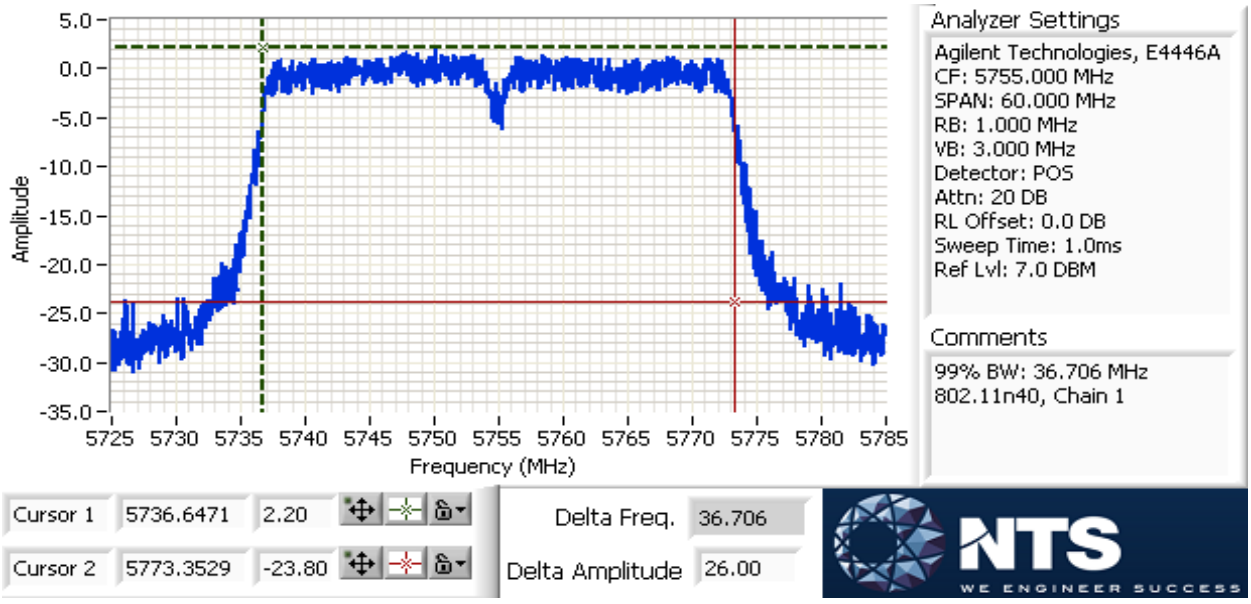
Note 1:	DTS BW: RBW=100kHz, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time. 99% BW: RBW=1-5% of of 99%BW, VBW ≥ 3*RBW, peak detector, max hold, auto sweep time.
Note 2:	Measurements performed on chain 1

Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A





Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A



Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

Run #4: Out of Band Spurious Emissions

Date of Test: 8/9/2013

Test Engineer: Rafael Varelas

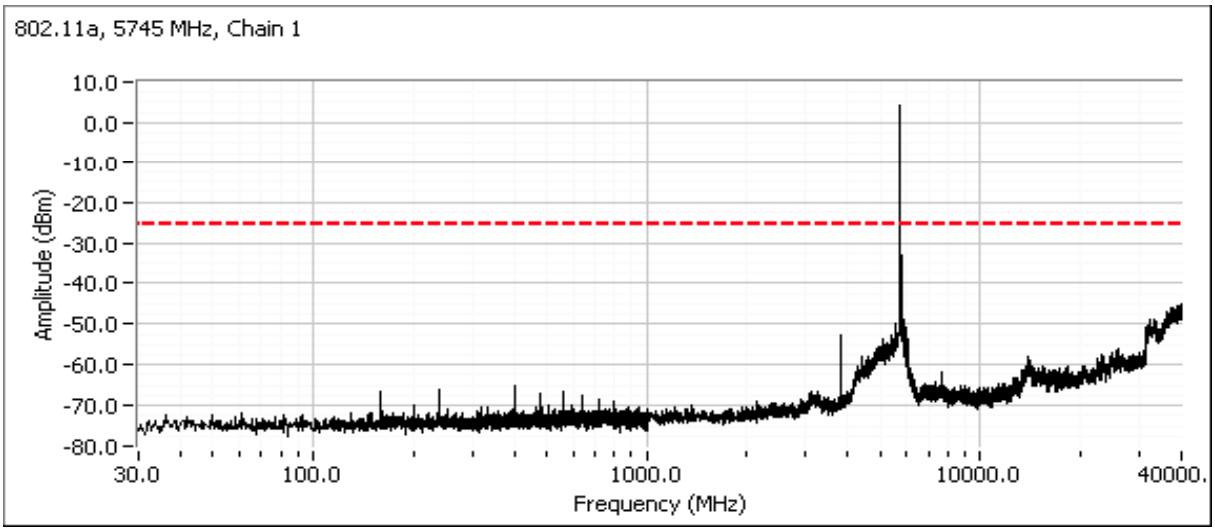
Test Location: FT Lab 4A

11a

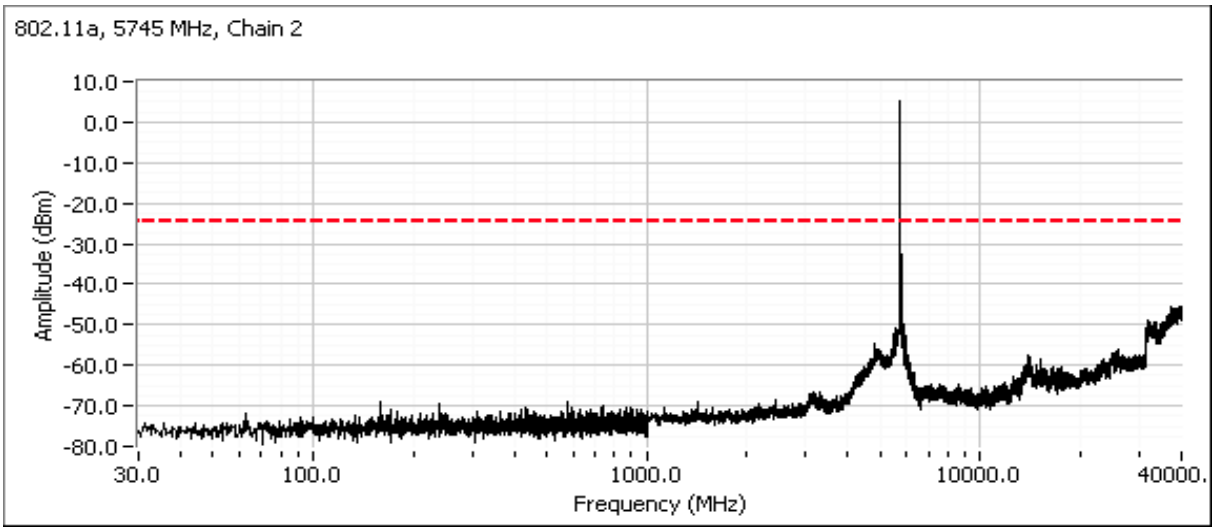
Power Setting Per Chain				Frequency (MHz)	Limit	Result
#1	#2	#3	#4			
21	21	21	21	5745	-30dBc	Pass
21	21	21	21	5785	-30dBc	Pass
21	21	21	21	5825	-30dBc	Pass

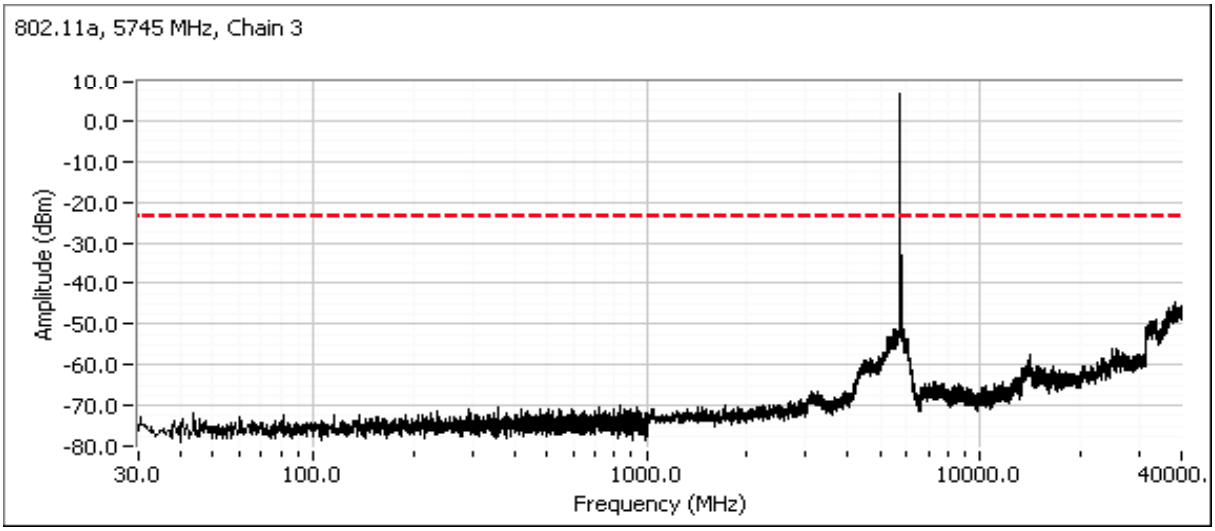
Note 1:	Measured on each chain individually

Plots for low channel

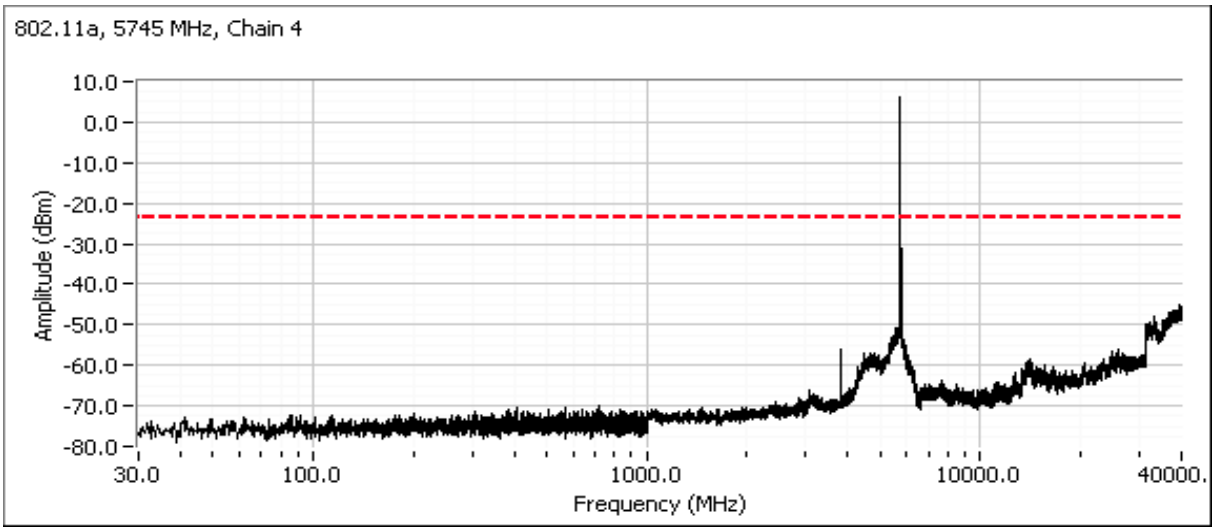


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

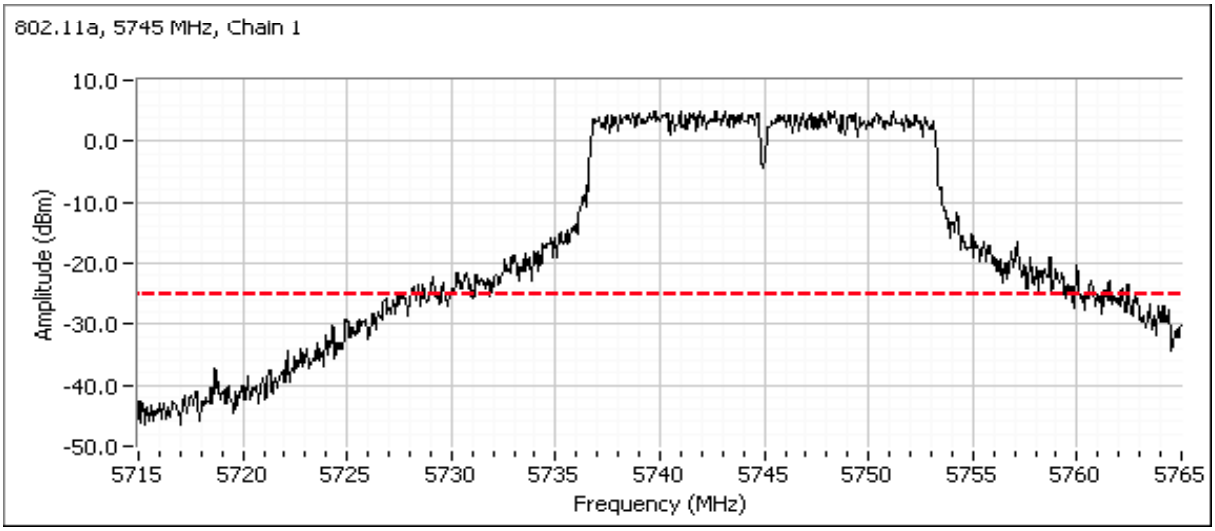




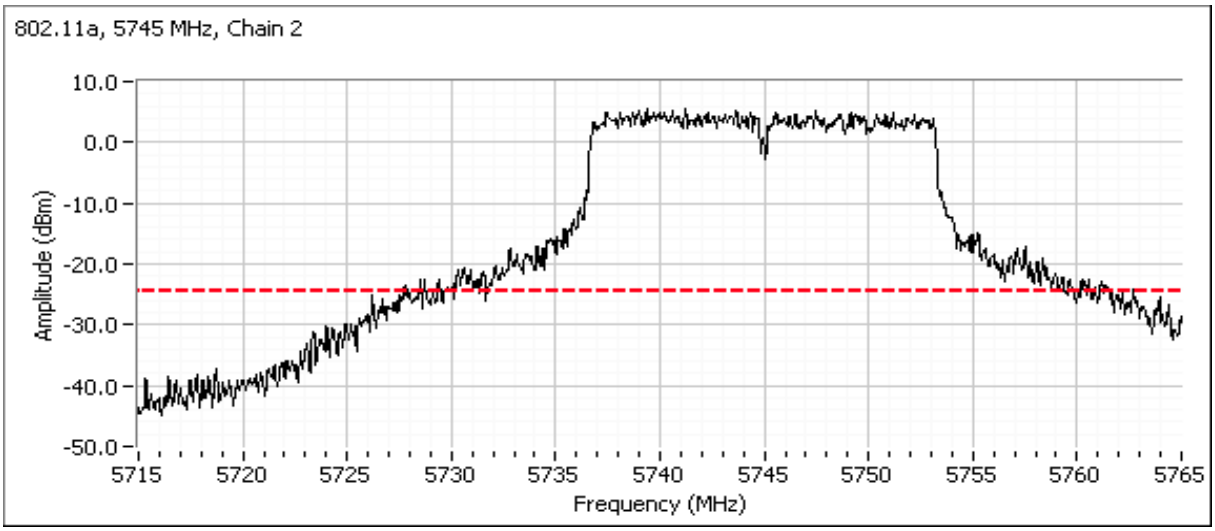
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

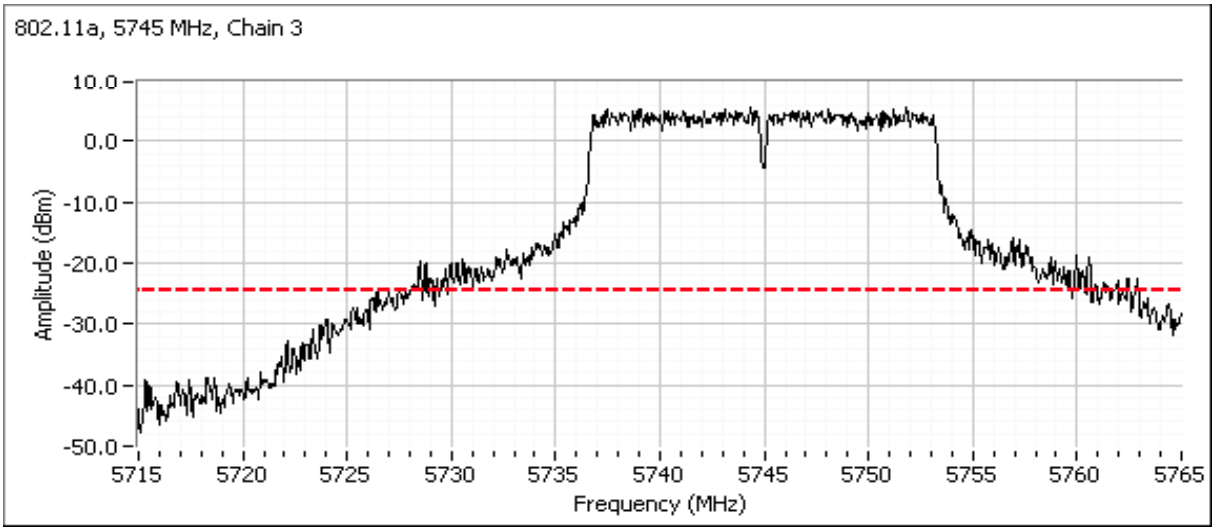


Additional plot from 5715 - 5765 MHz showing compliance with -30dBc at the band edge.

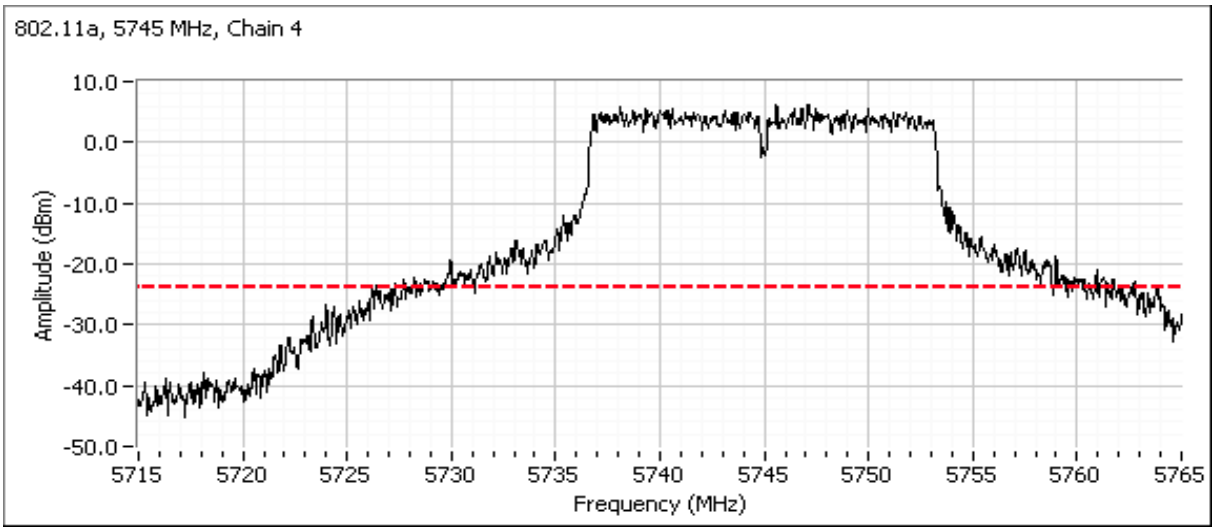


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

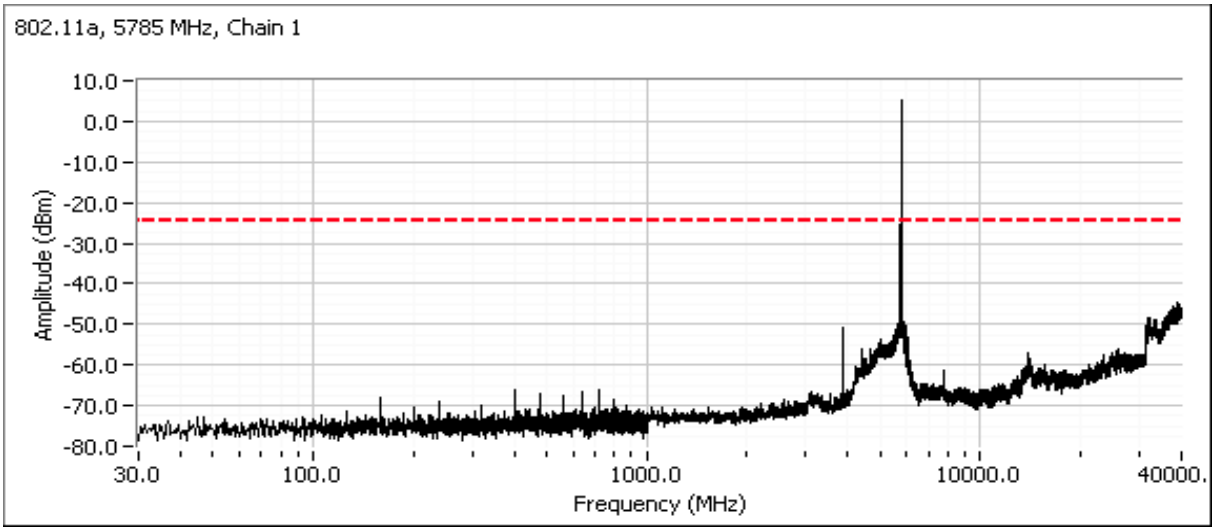




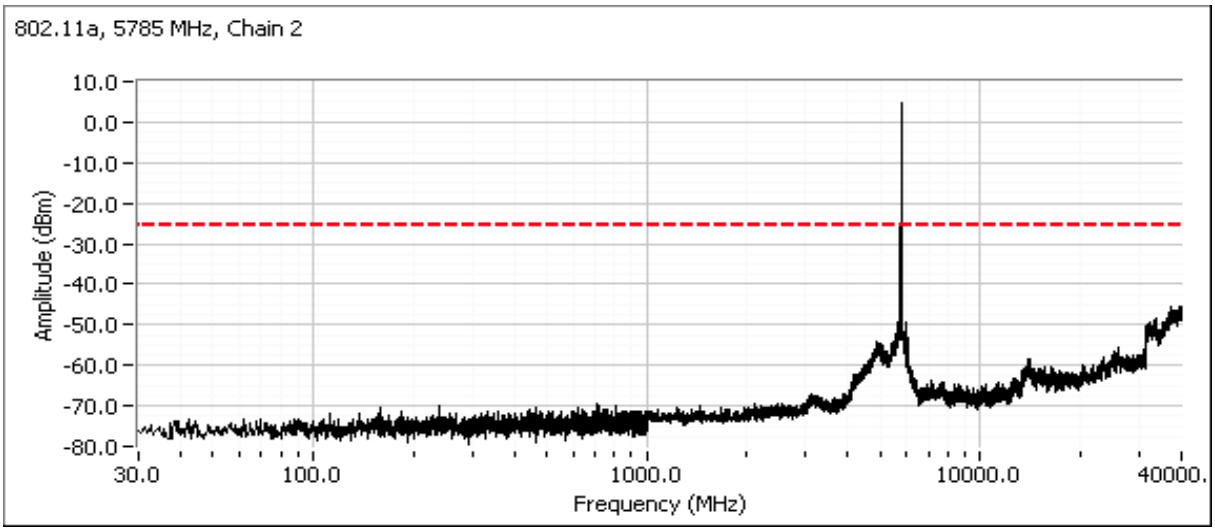
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

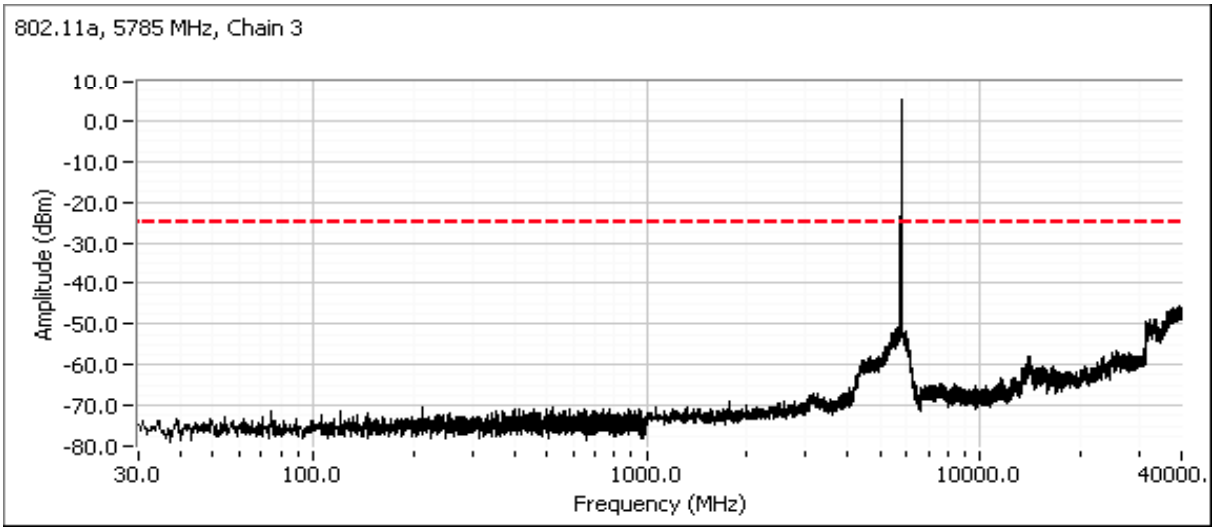


Plots for center channel

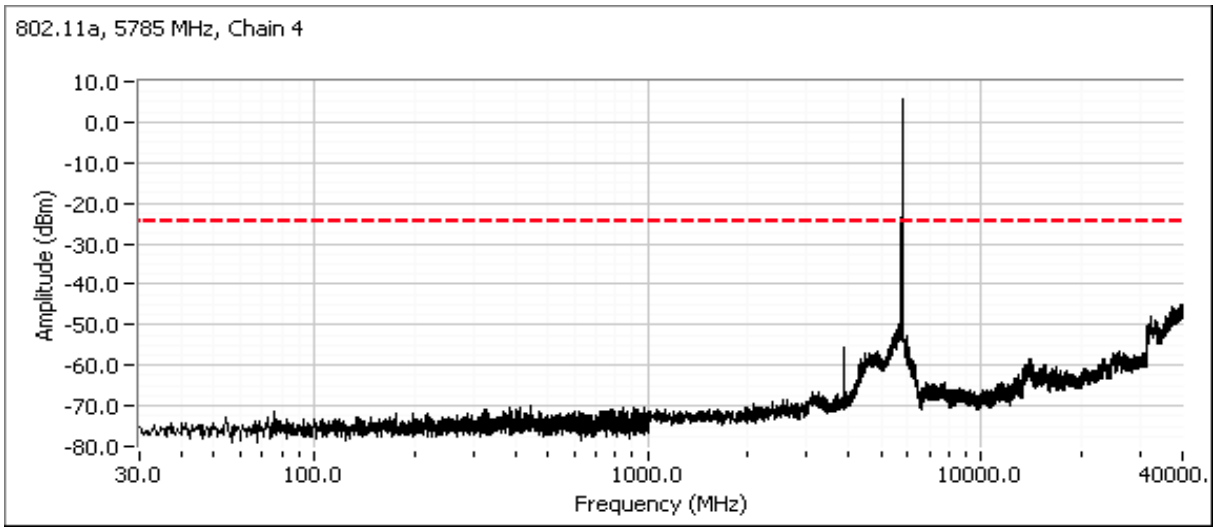


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

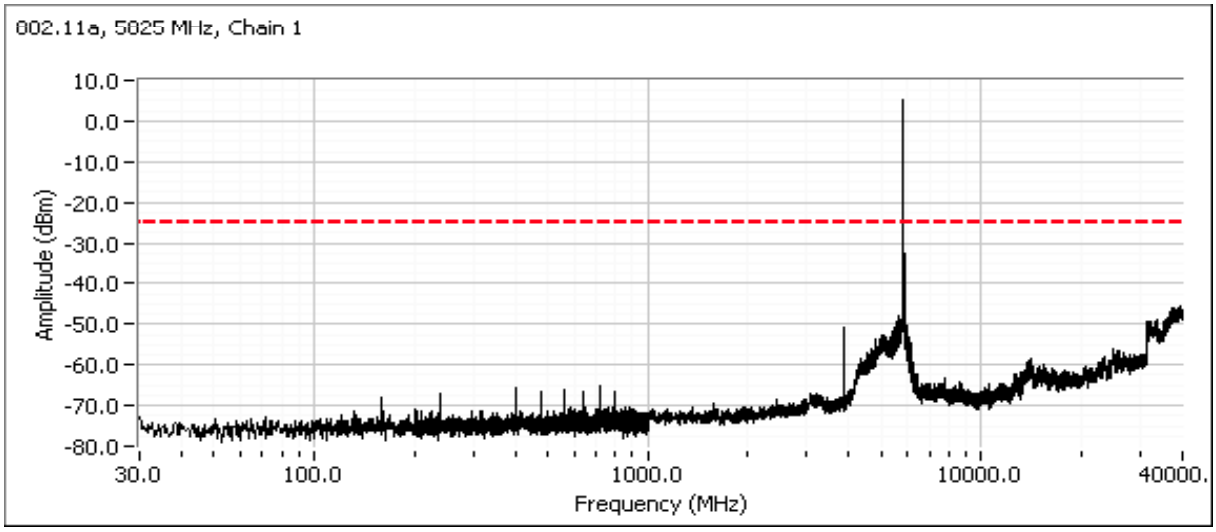




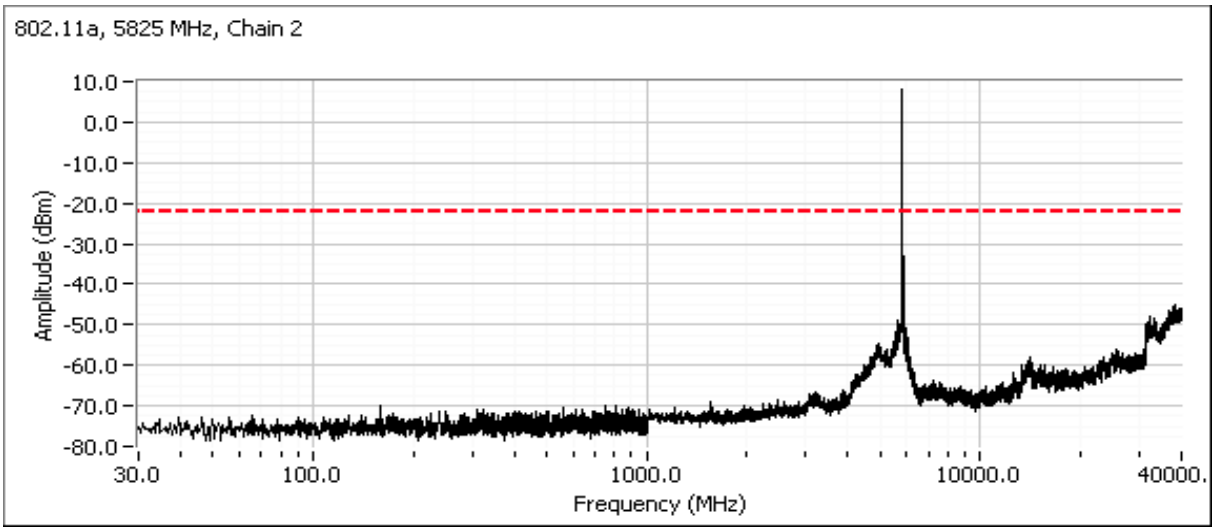
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

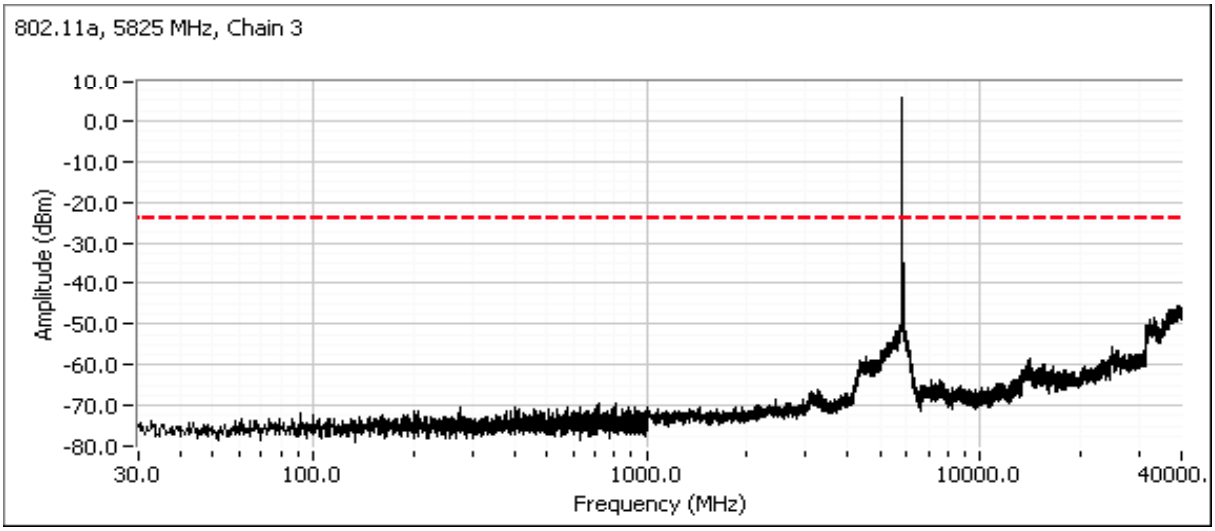


Plots for high channel

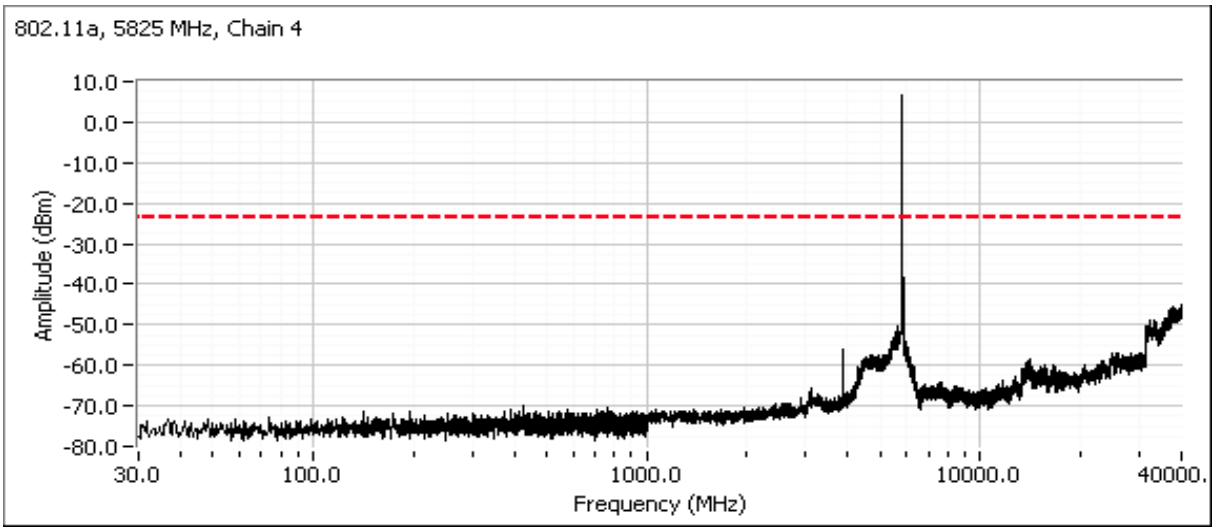


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

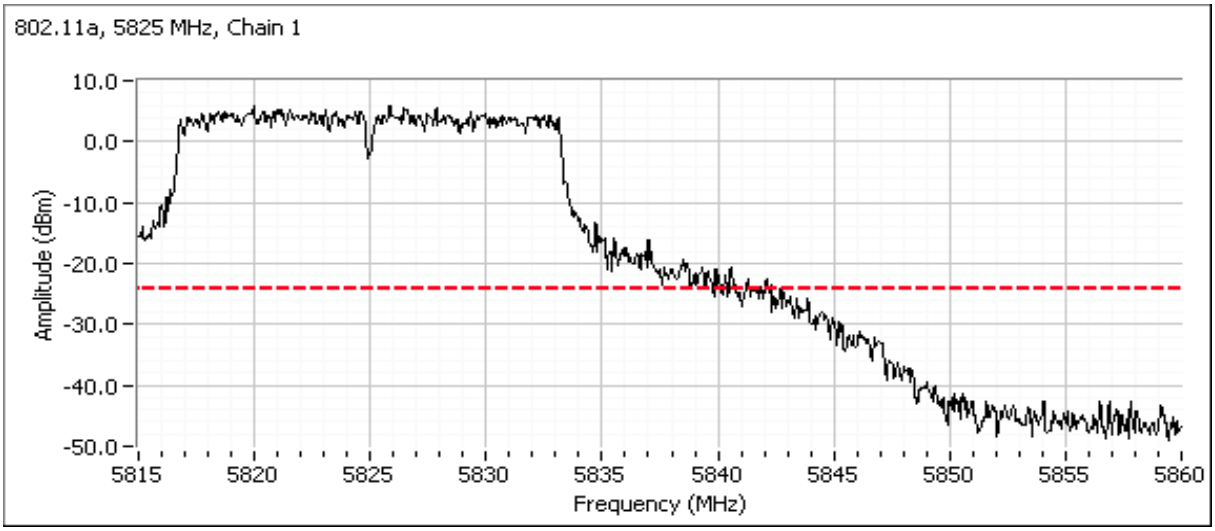




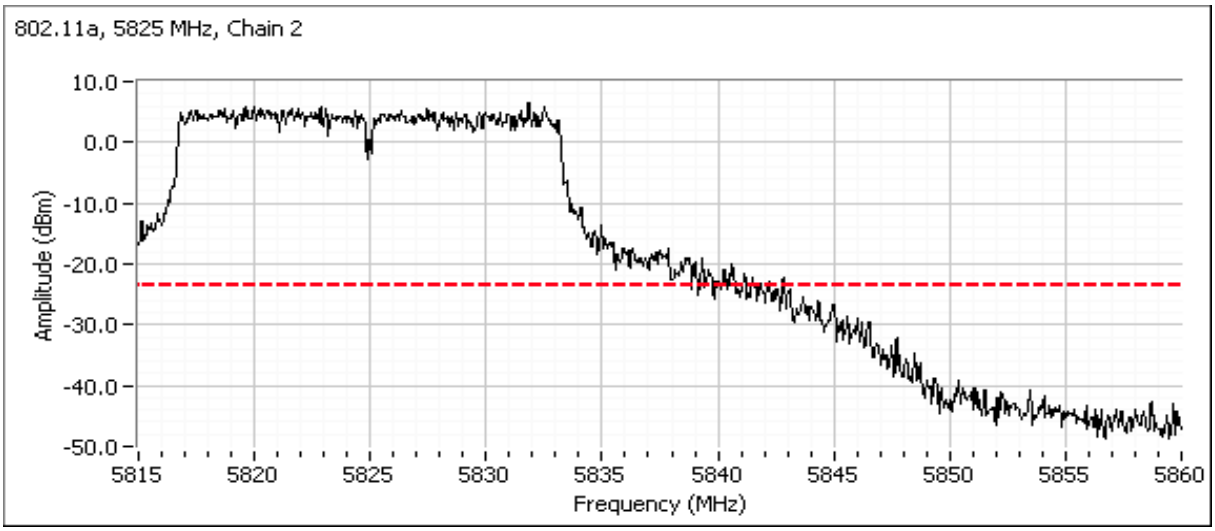
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

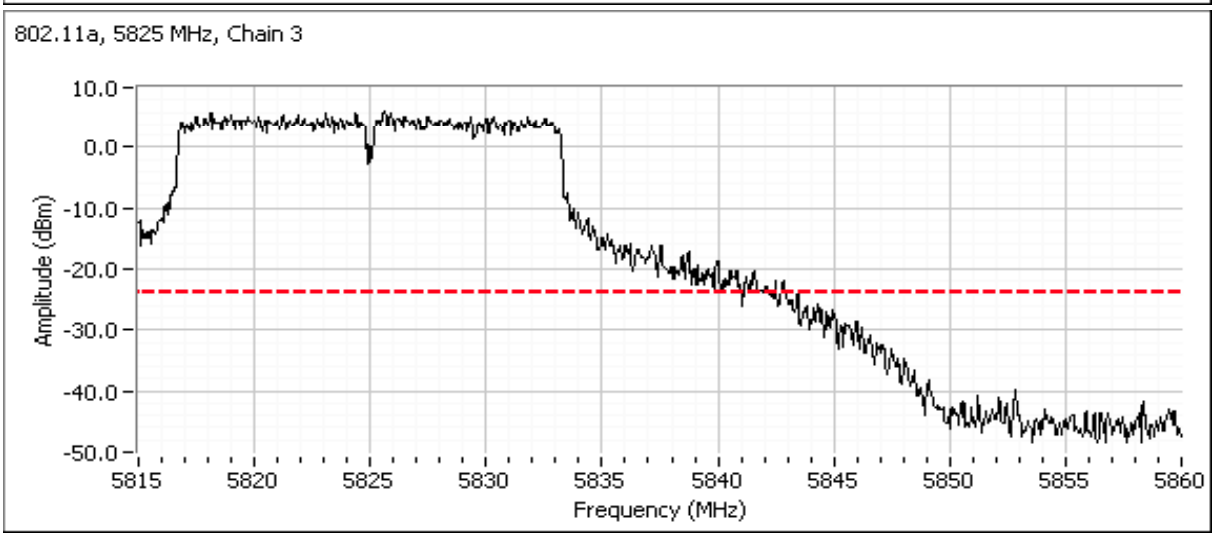


Additional plot from 5815 - 5860 MHz showing compliance with -30dBc at the band edge.

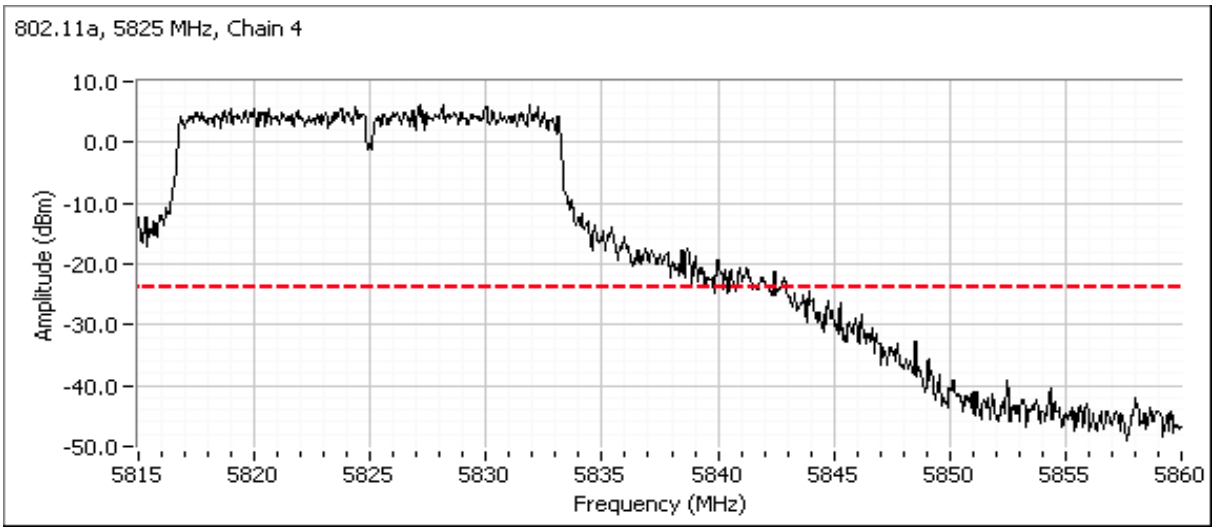


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A





Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A



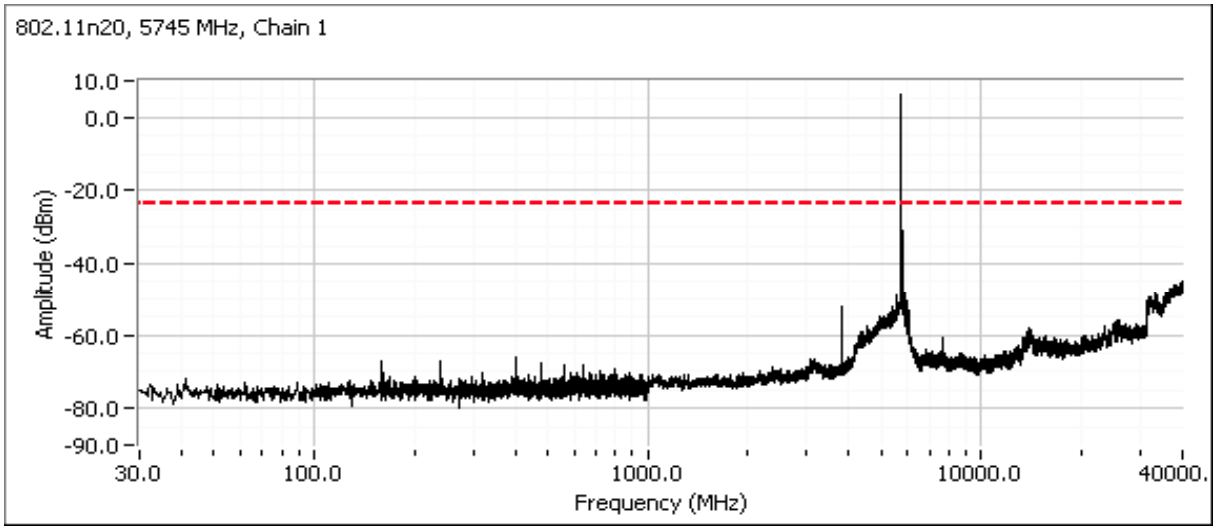
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

n20

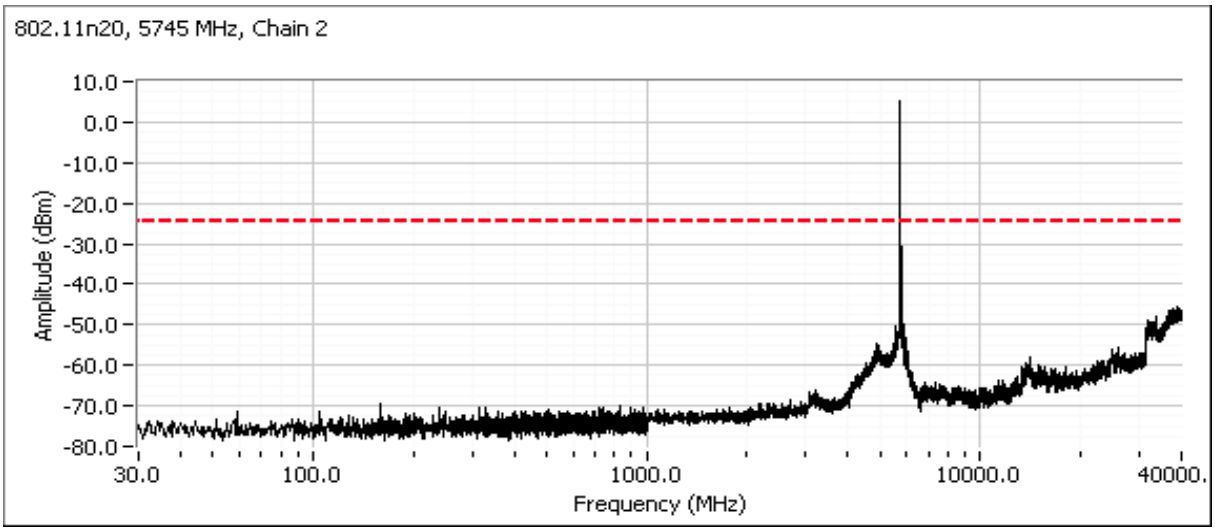
Power Setting Per Chain				Frequency (MHz)	Limit	Result
#1	#2	#3	#4			
21	21	21	21	5745	-30dBc	Pass
21	21	21	21	5785	-30dBc	Pass
21	21	21	21	5825	-30dBc	Pass

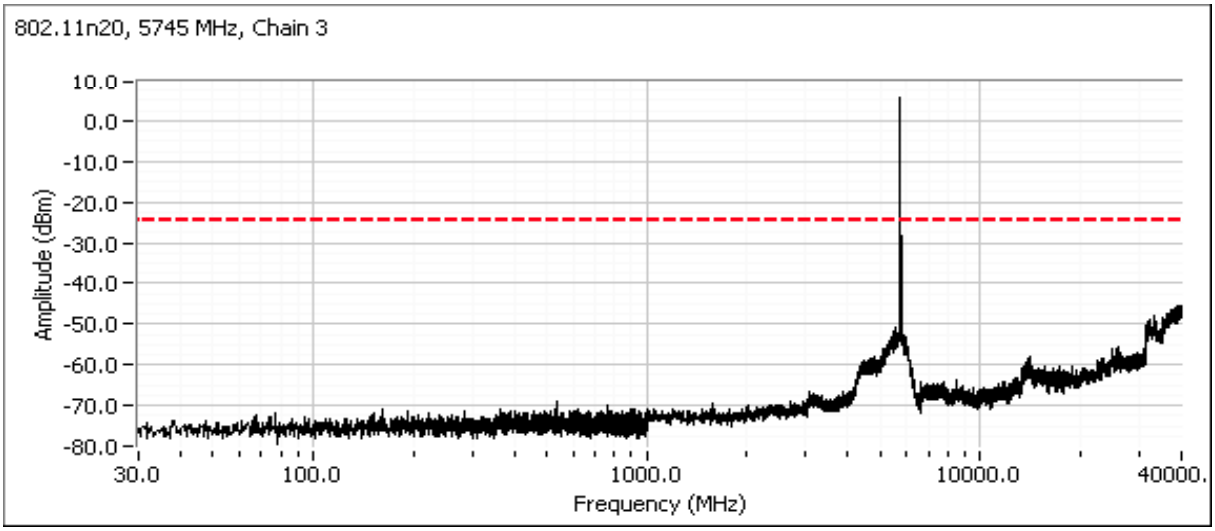
Note 1:	Measured on each chain individually

Plots for low channel

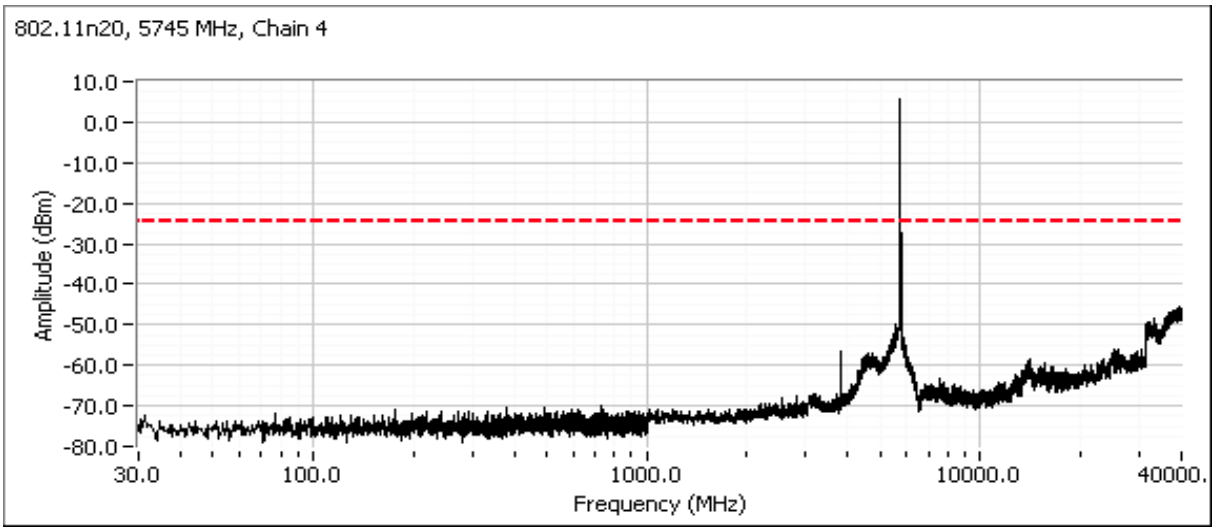


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

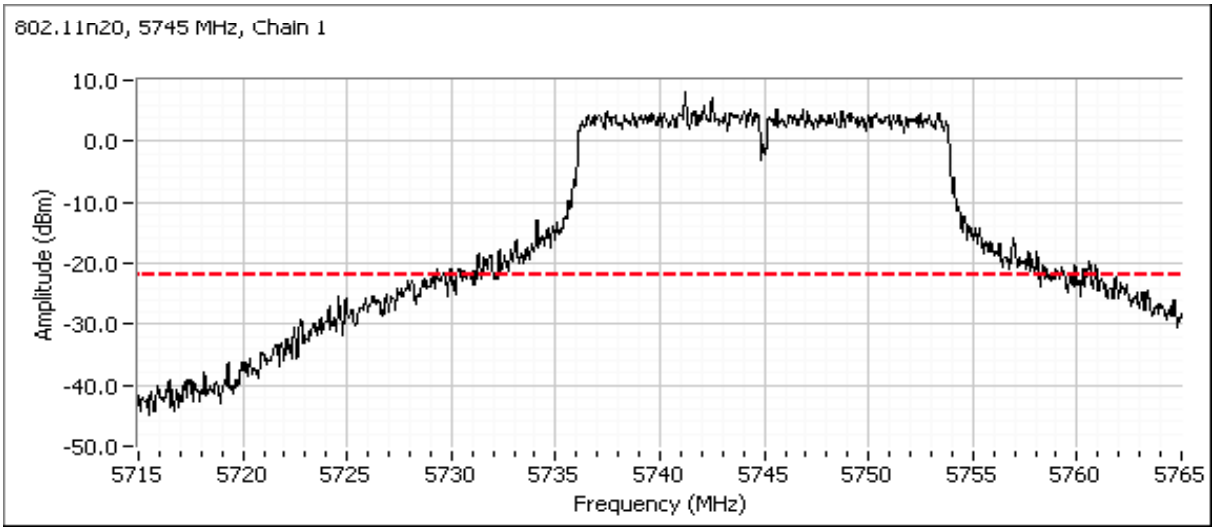




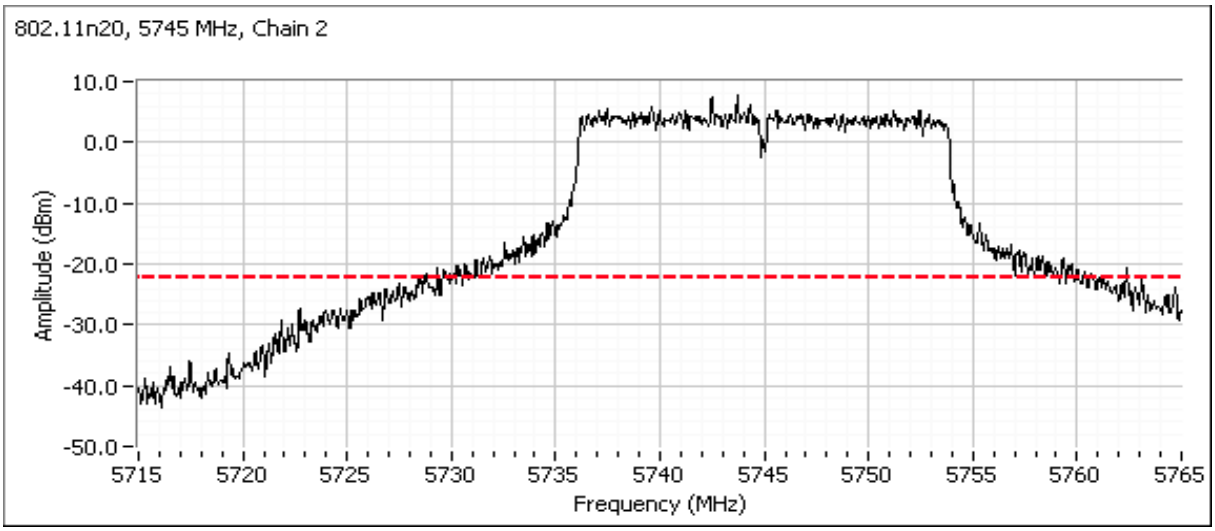
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

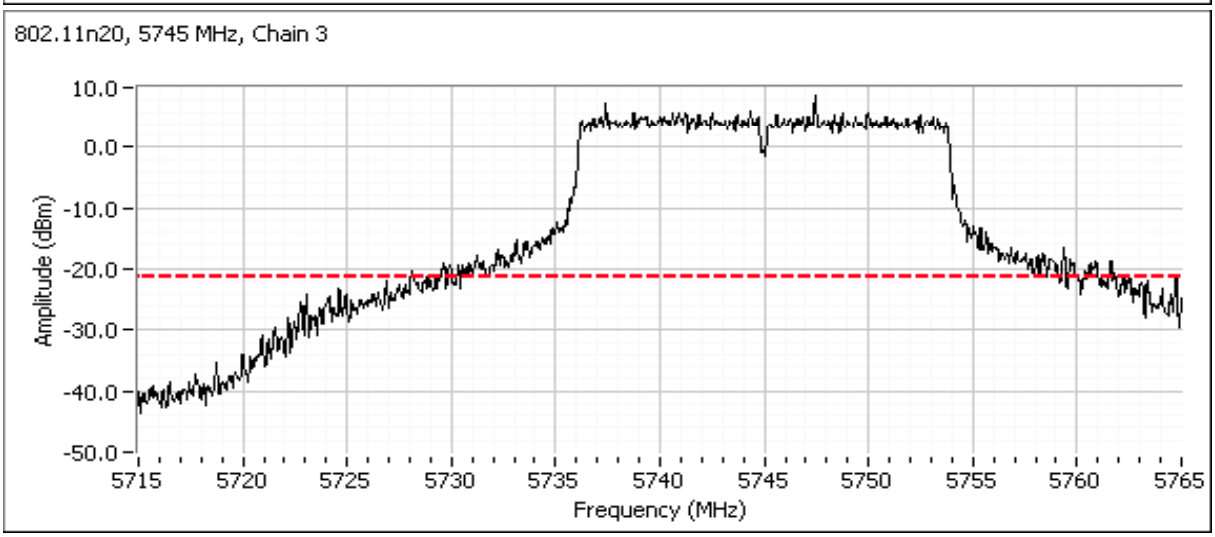


Additional plot from 5715 - 5765 MHz showing compliance with -30dBc at the band edge.

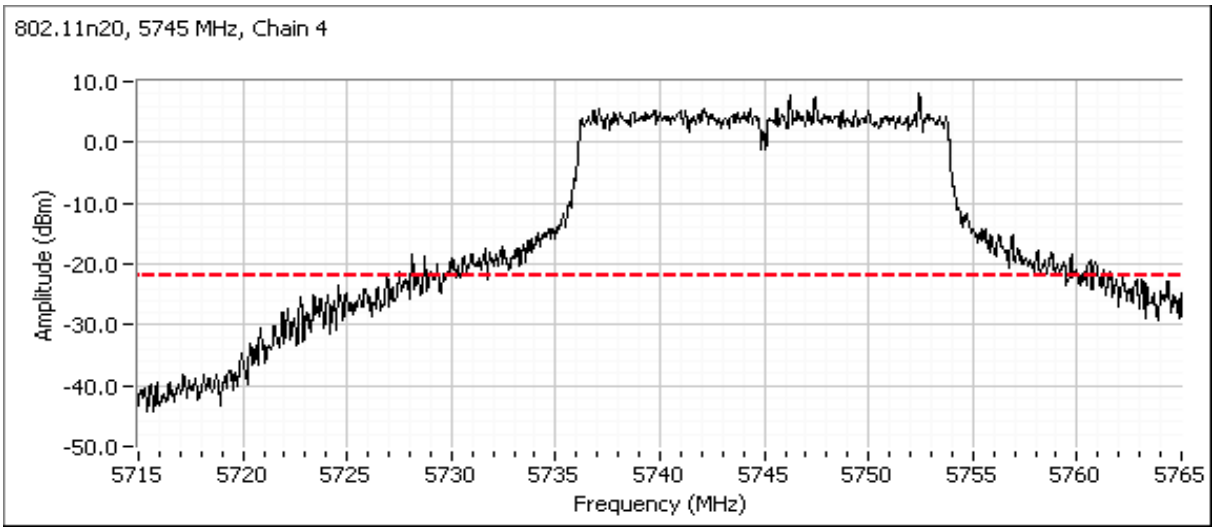


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

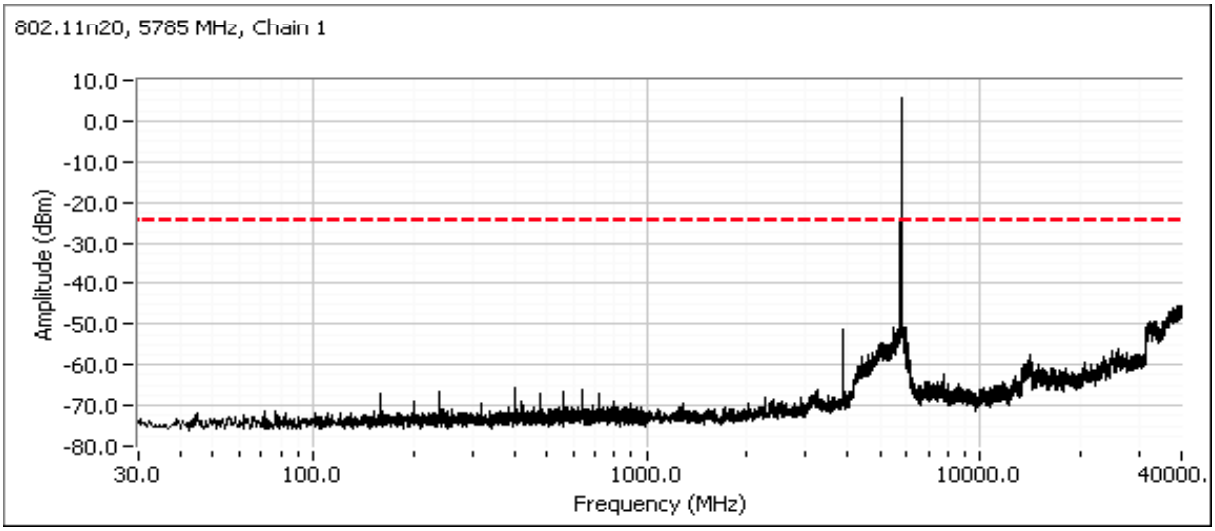




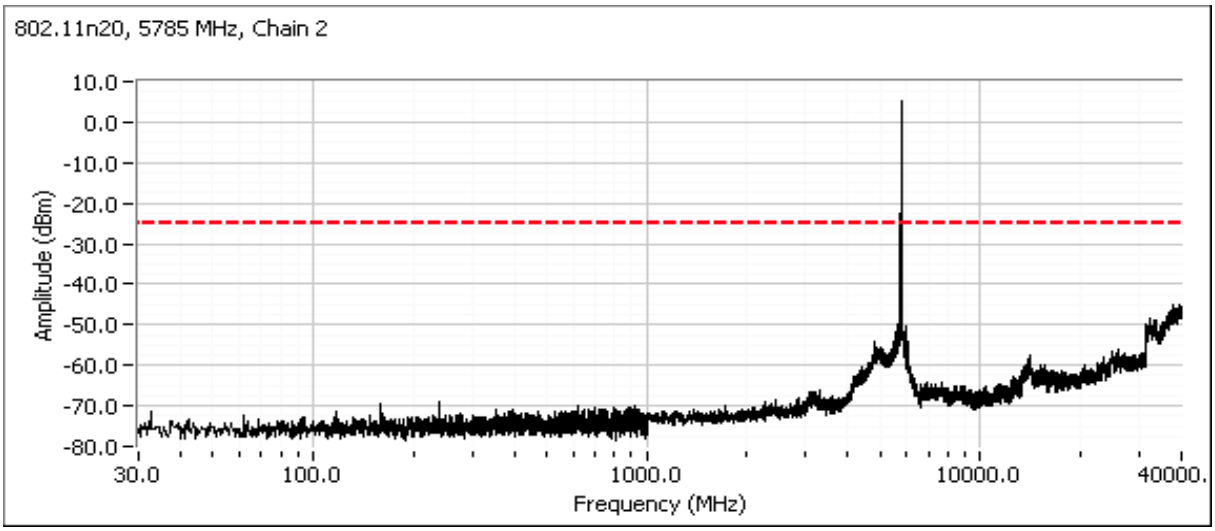
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

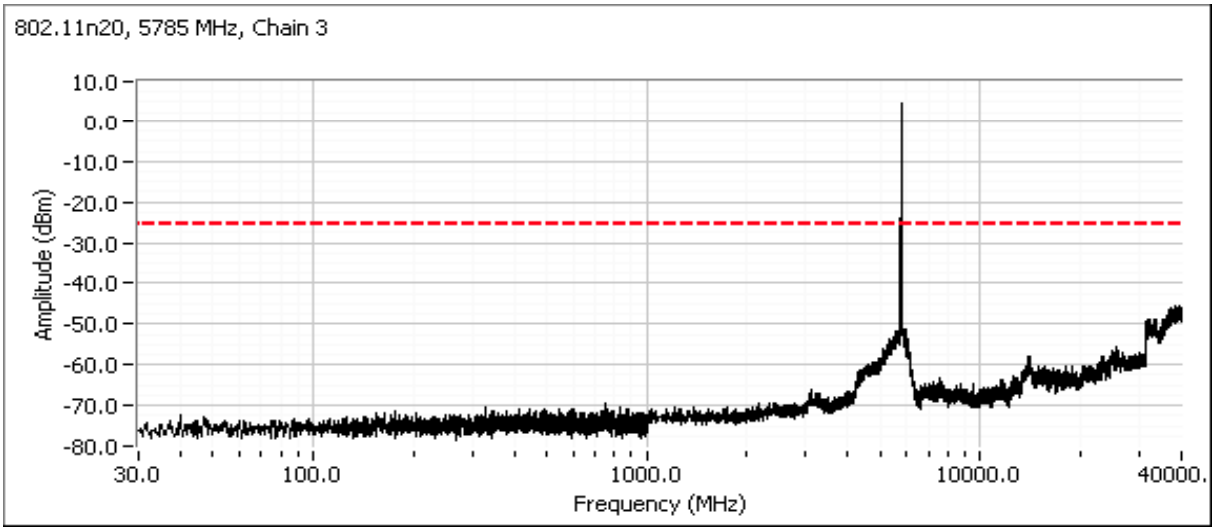


Plots for center channel

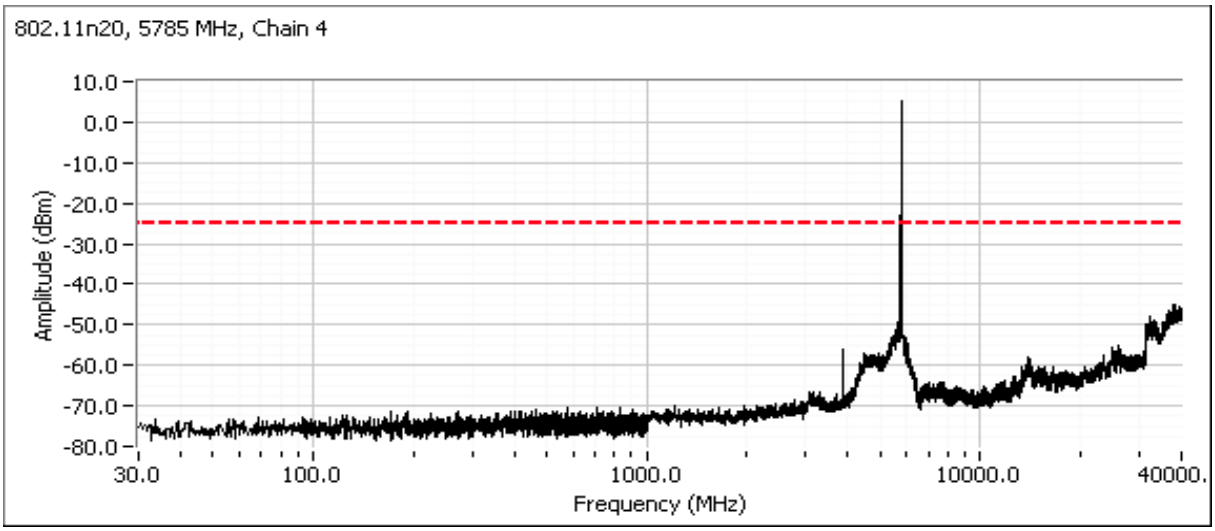


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

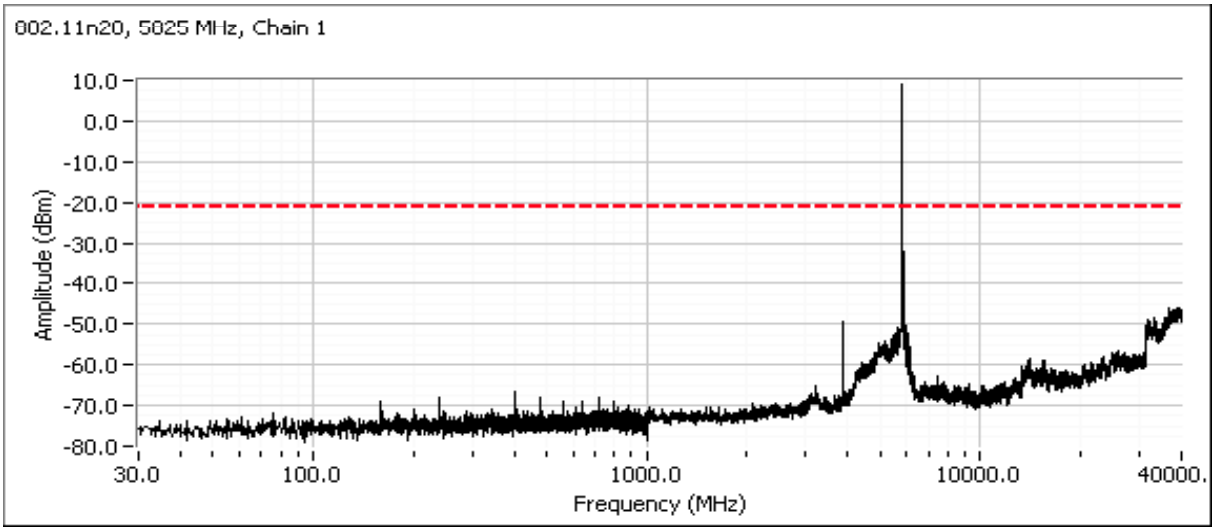




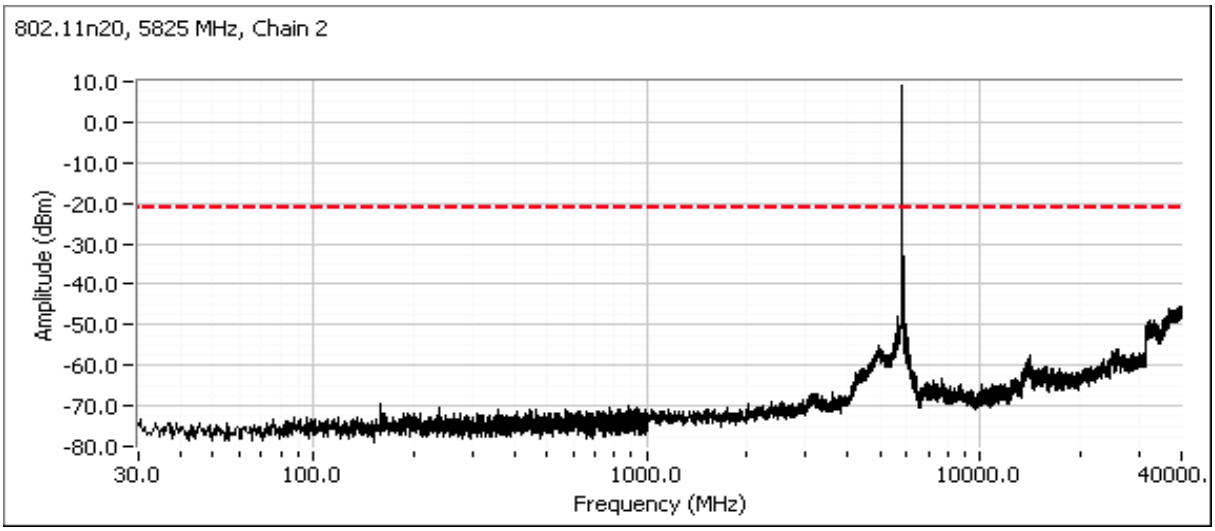
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

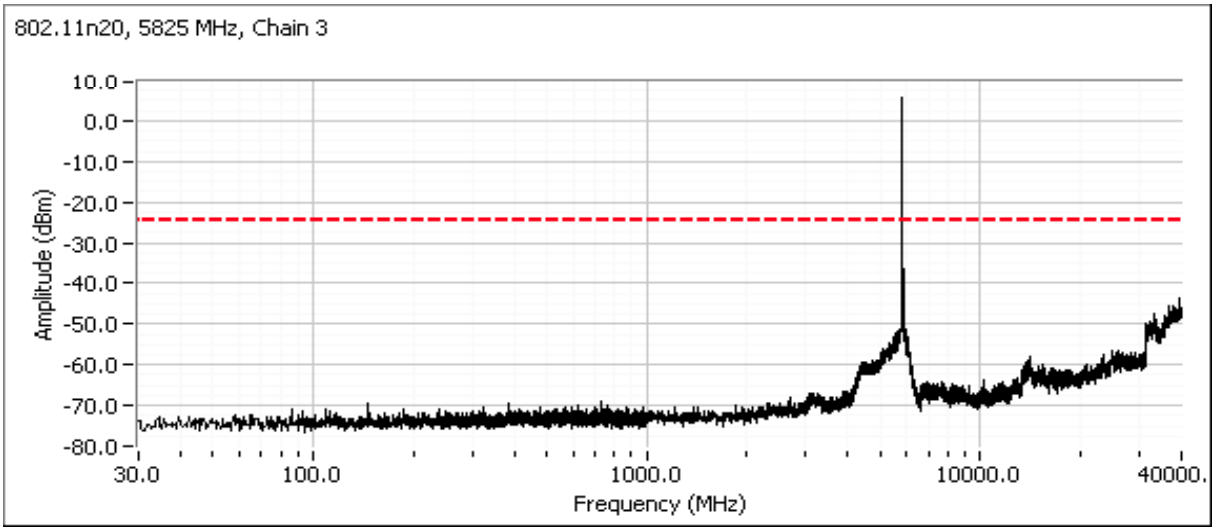


Plots for high channel

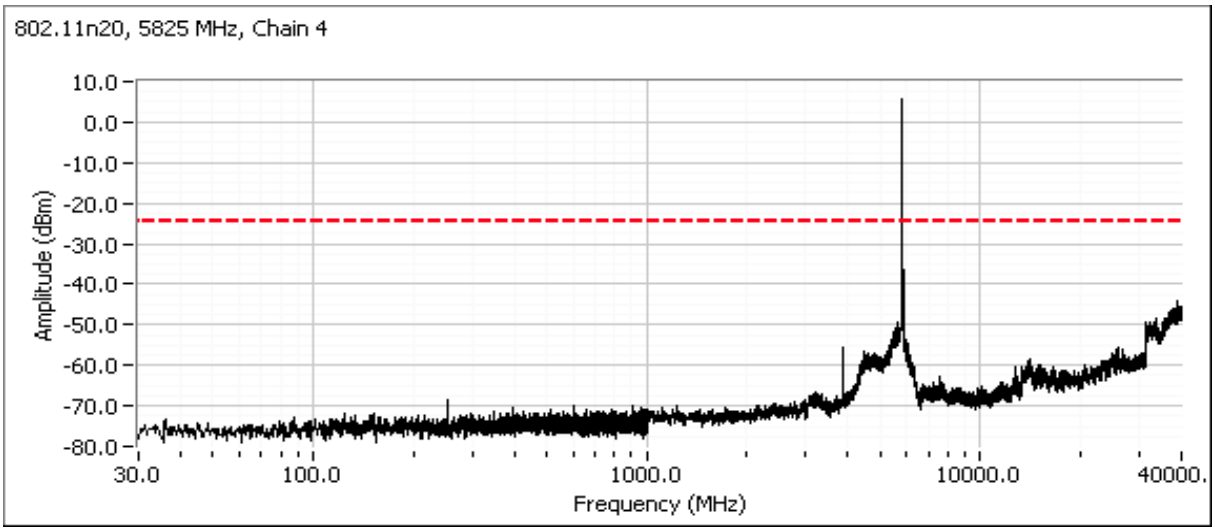


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

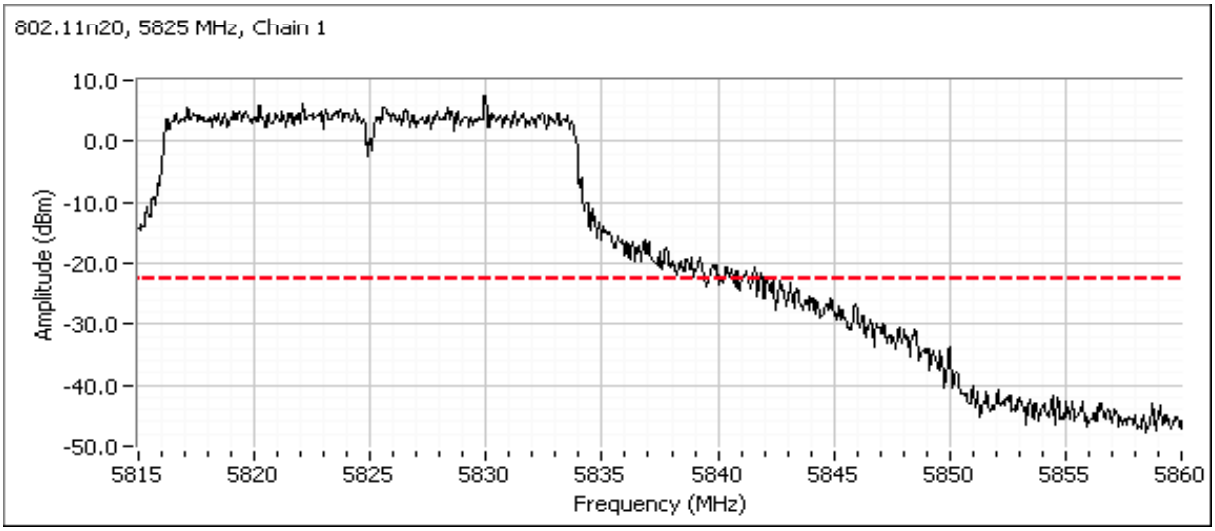




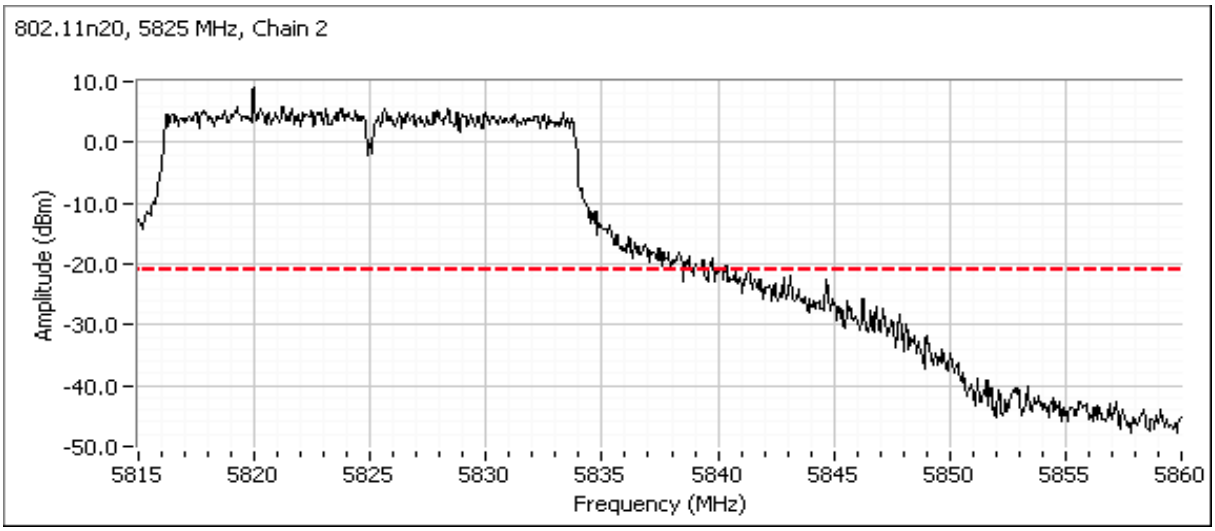
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

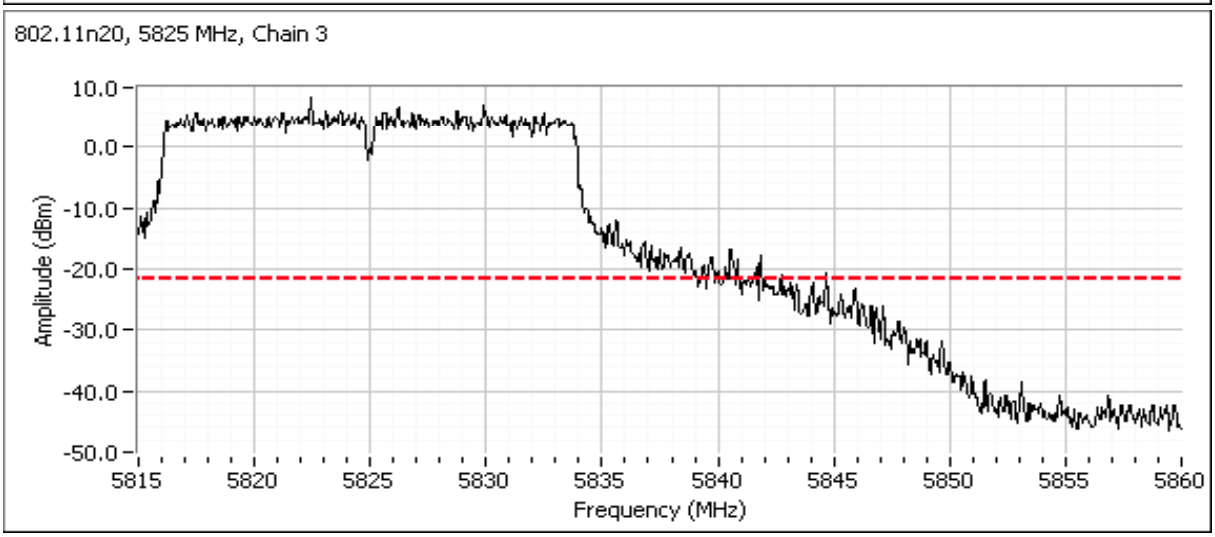


Additional plot from 5815 - 5860 MHz showing compliance with -30dBc at the band edge.

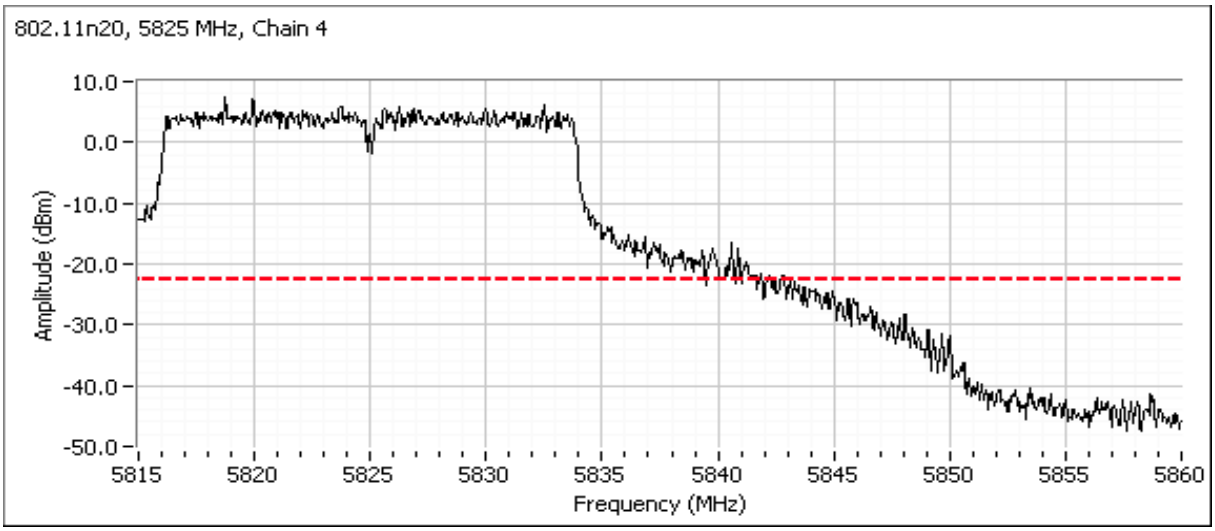


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A





Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A



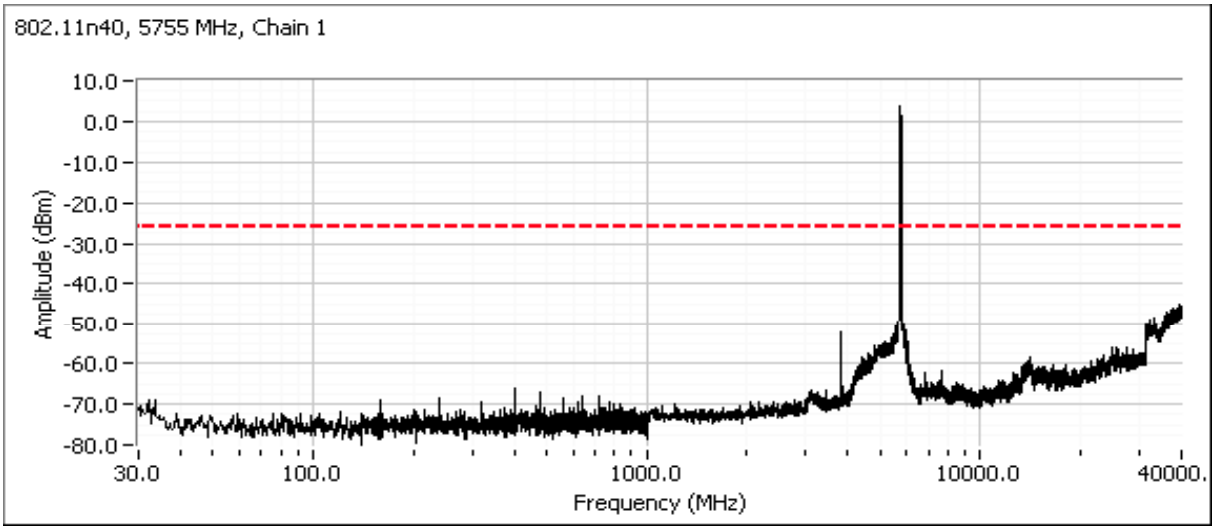
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

n40

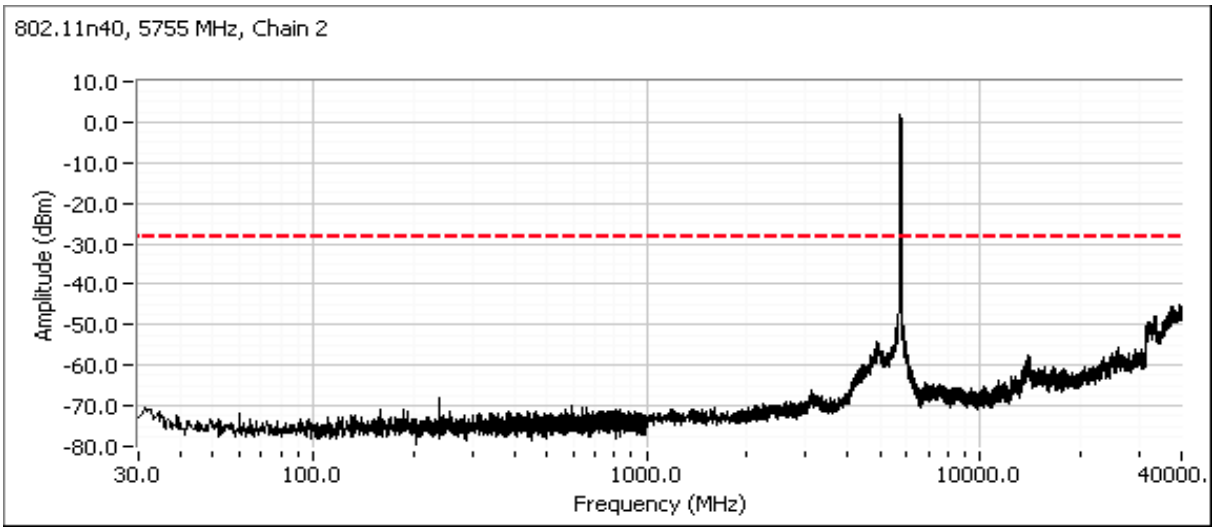
Power Setting Per Chain				Frequency (MHz)	Limit	Result
#1	#2	#3	#4			
21	21	21	21	5755	-30dBc	Pass
21	21	21	21	5795	-30dBc	Pass

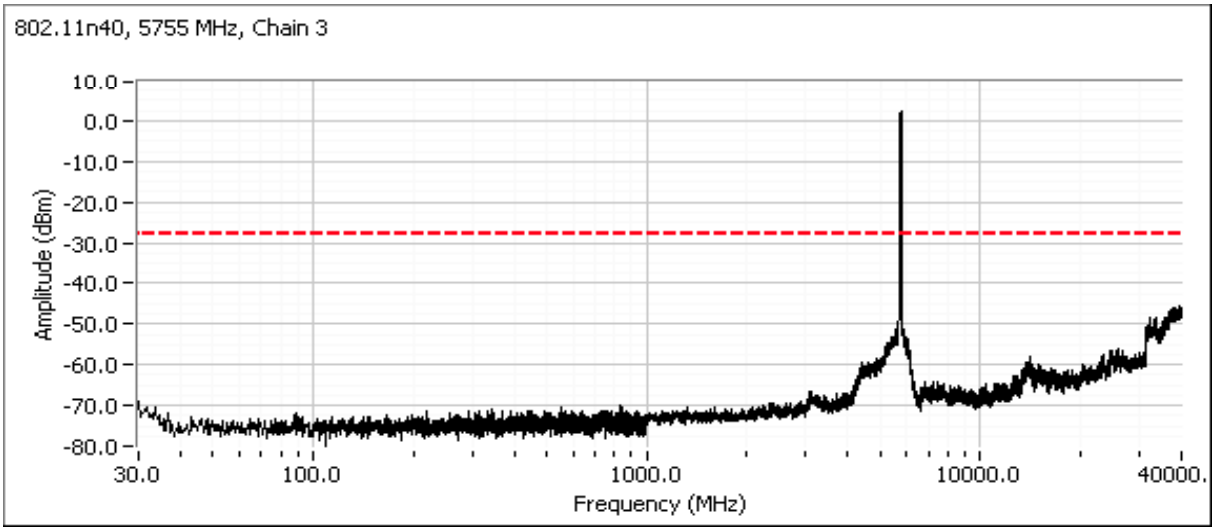
Note 1:	Measured on each chain individually

Plots for low channel

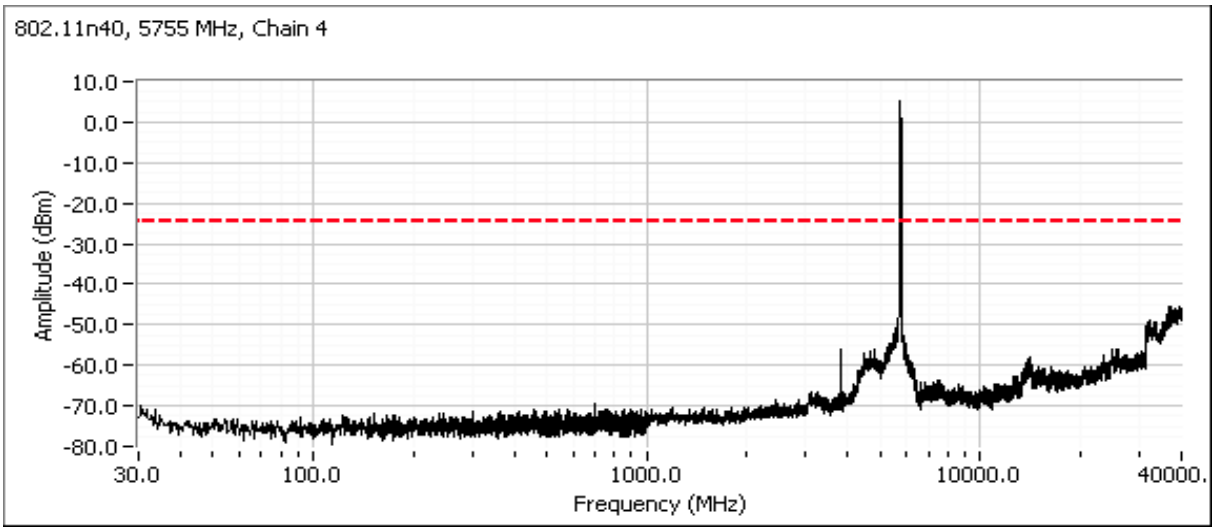


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

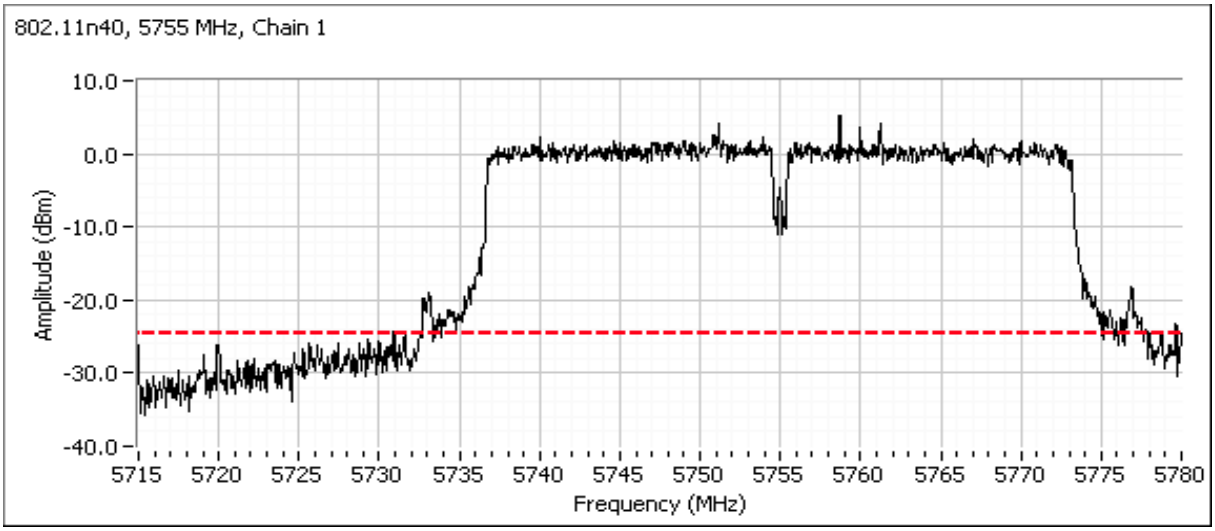




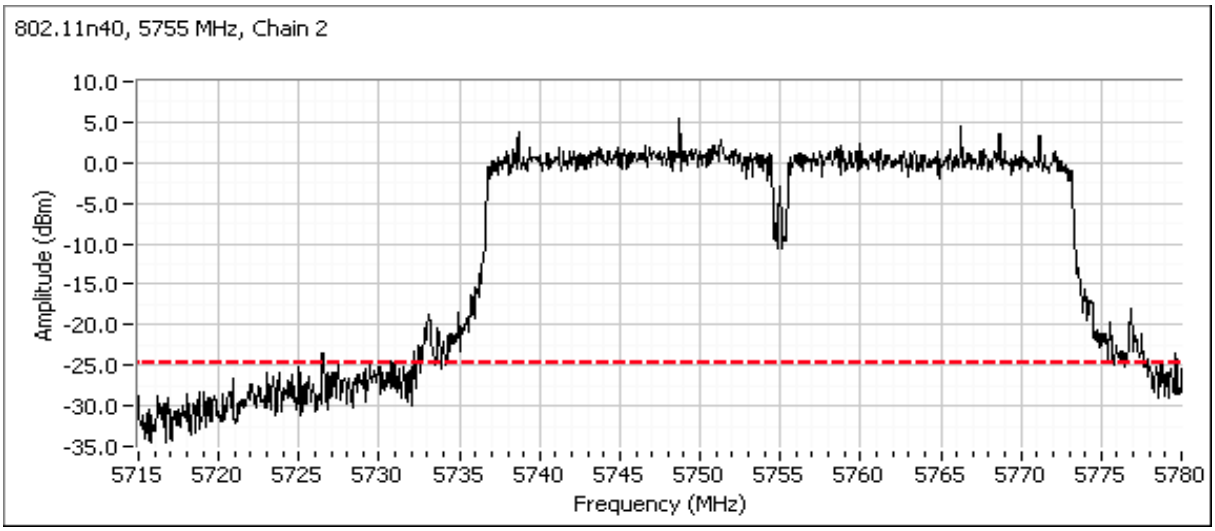
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

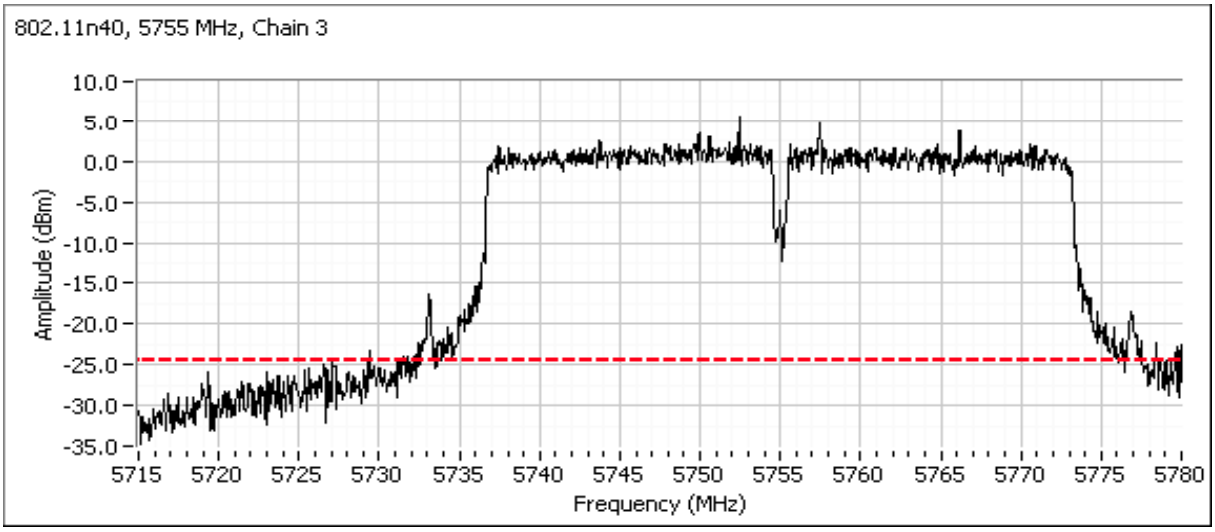


Additional plot from 5715 - 5780 MHz showing compliance with -30dBc at the band edge.

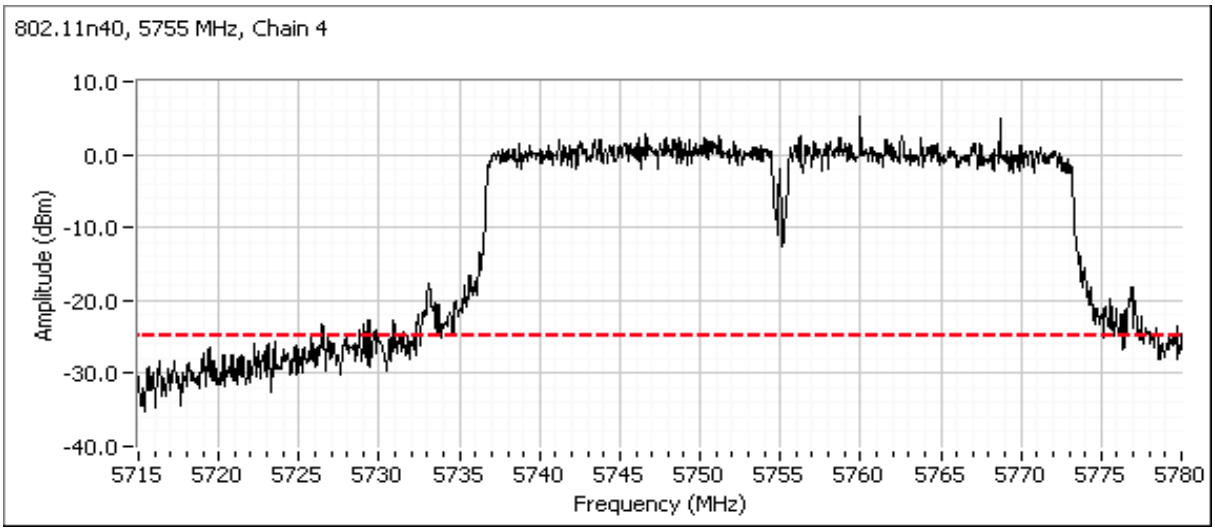


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

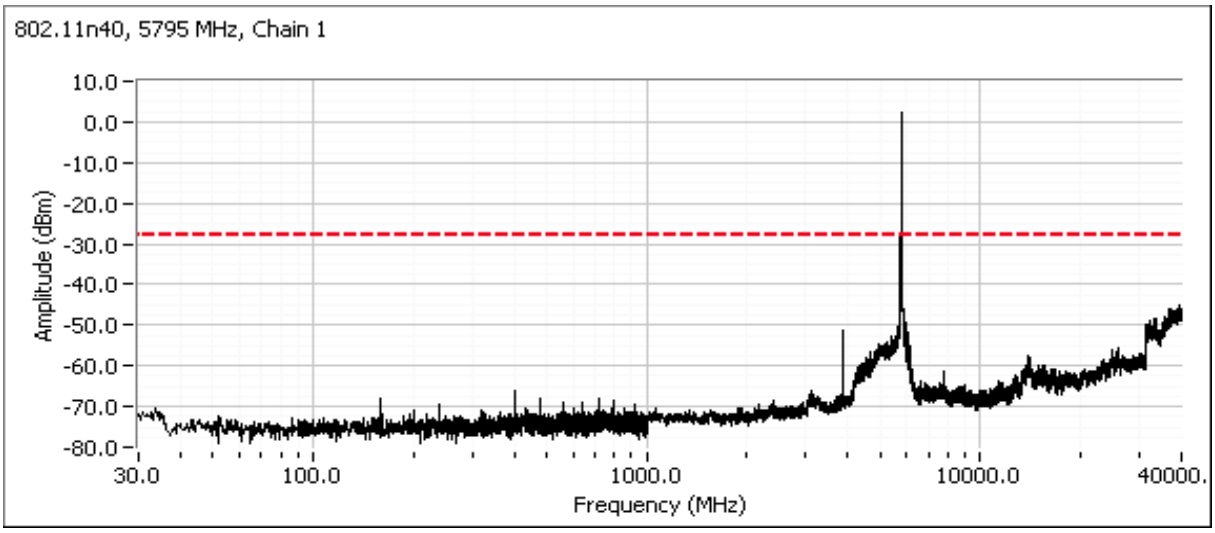




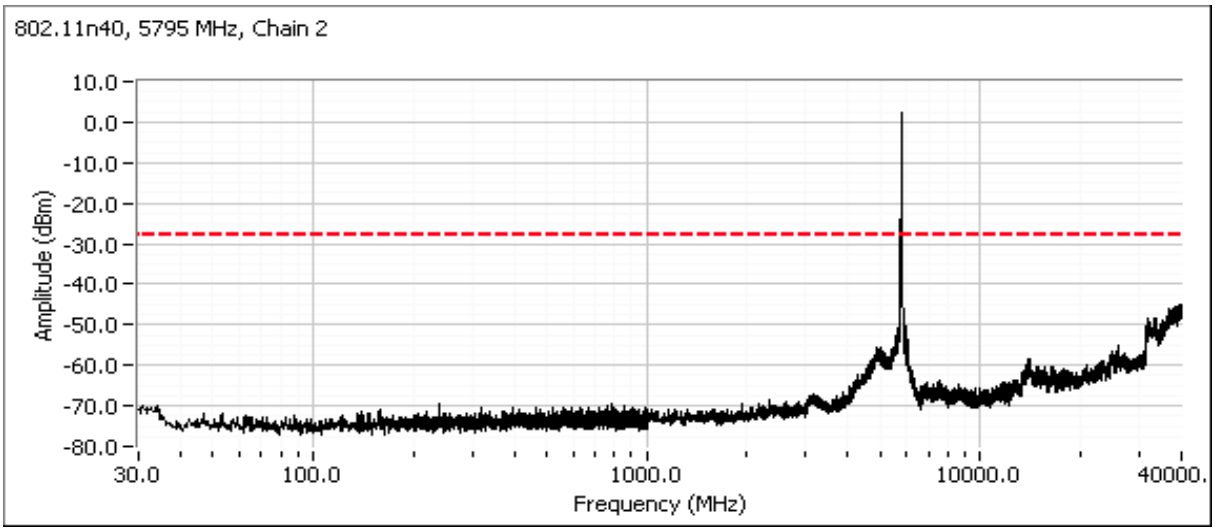
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

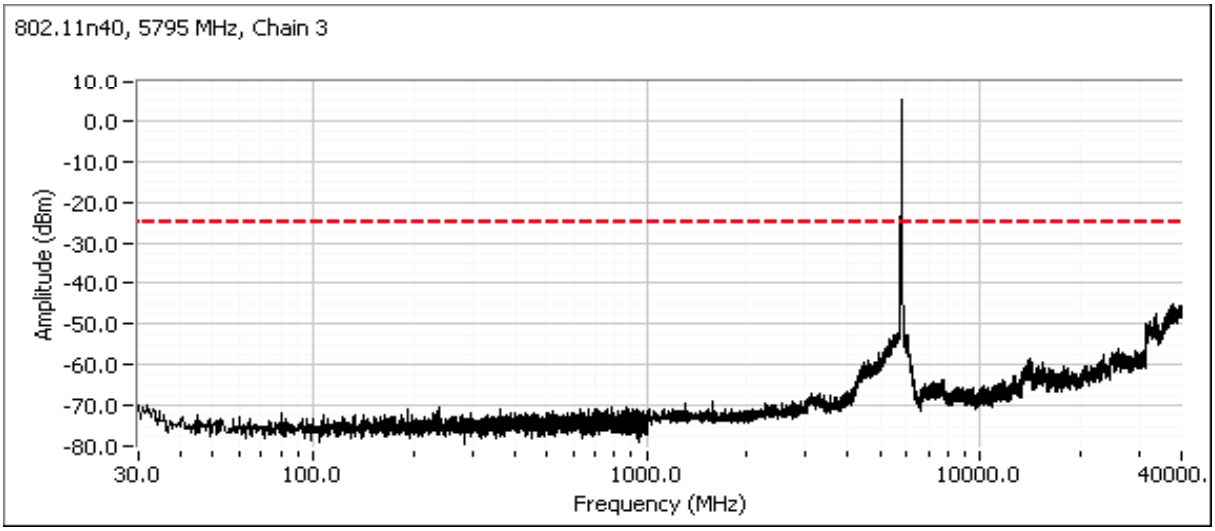


Plots for high channel

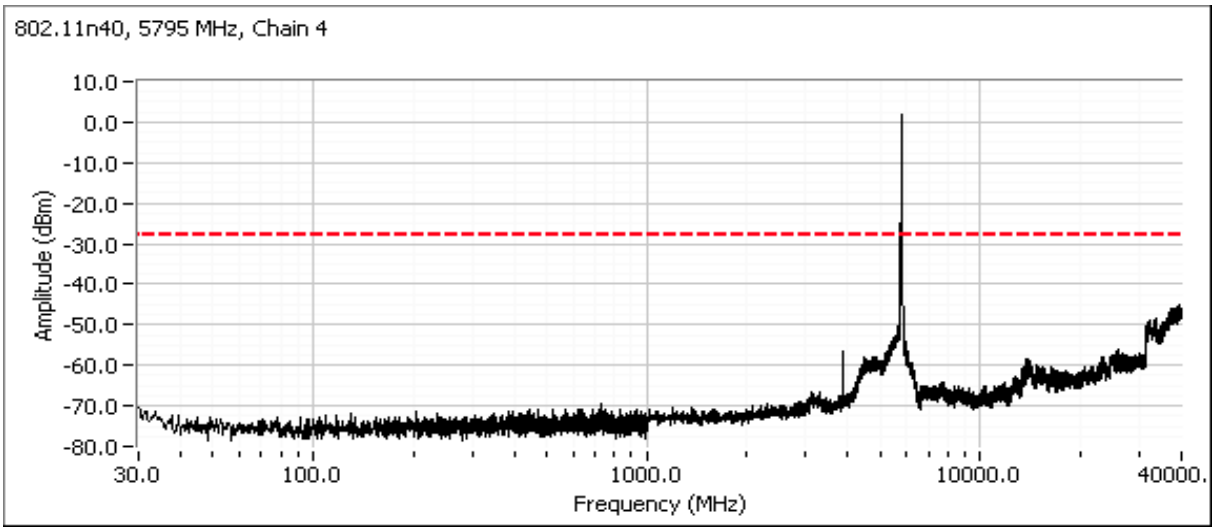


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

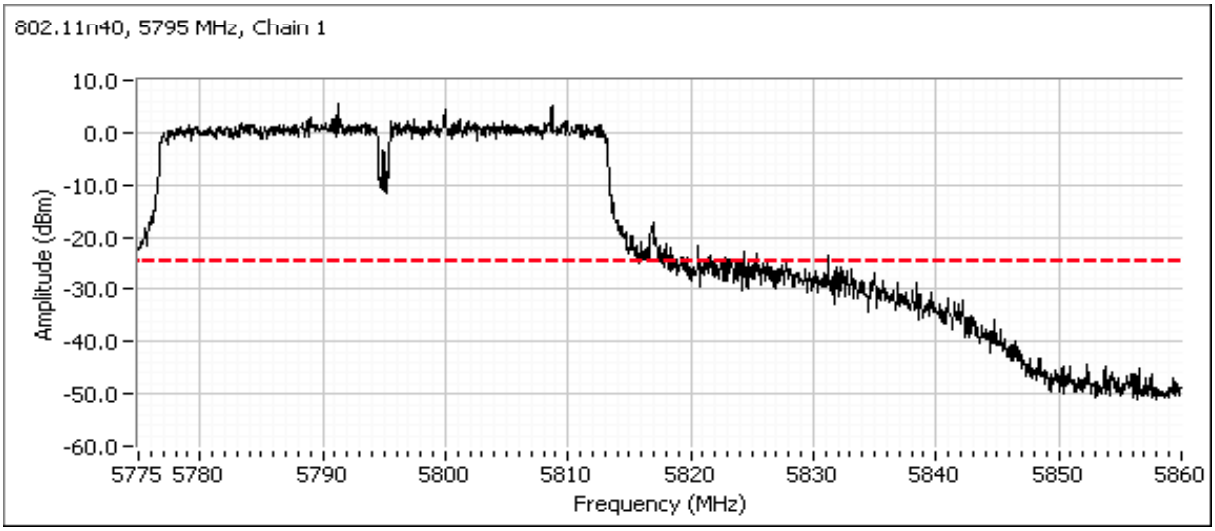




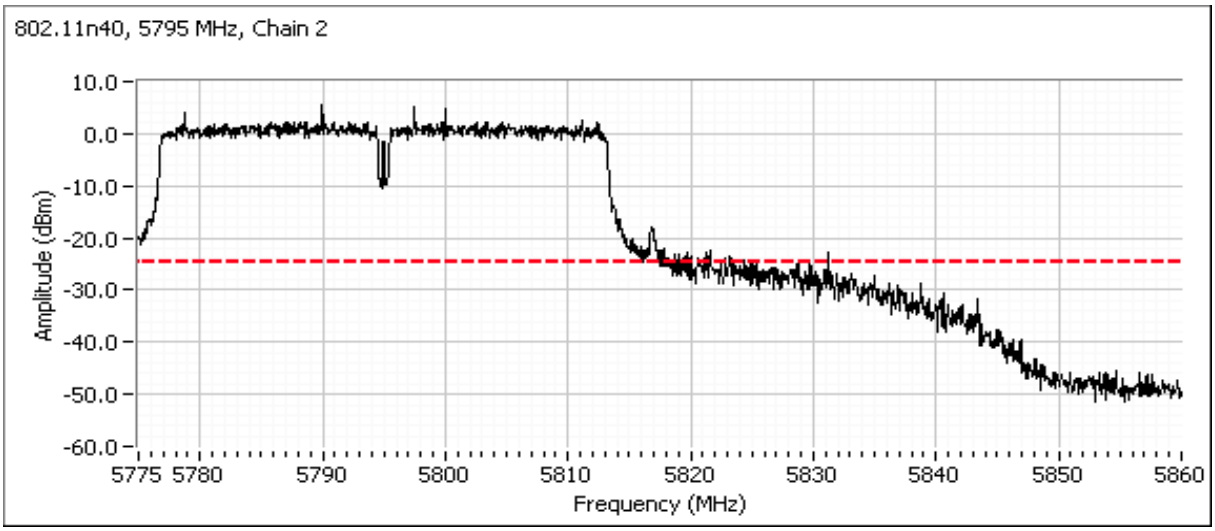
Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A

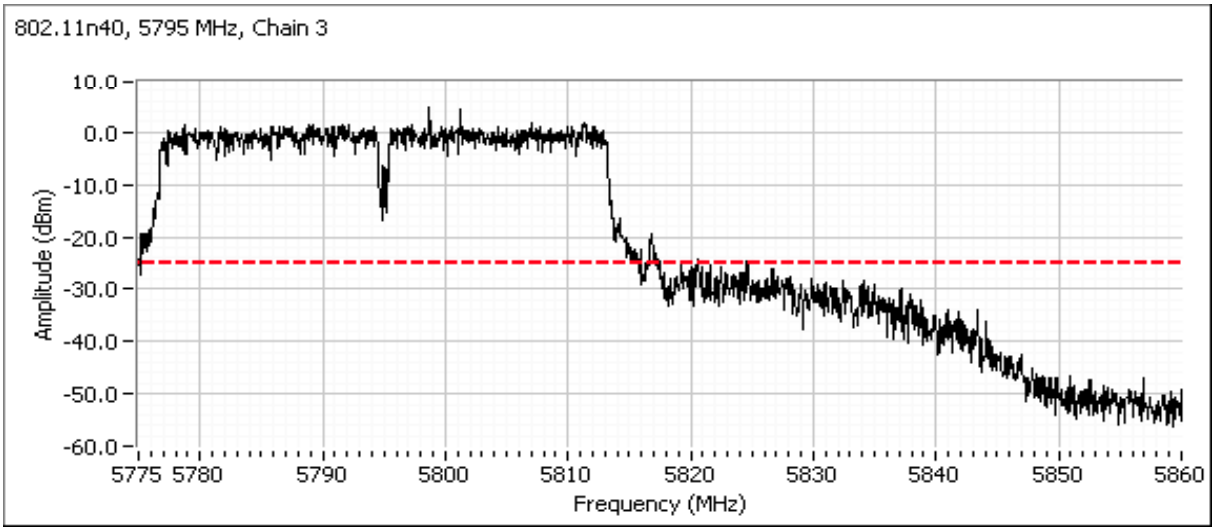


Additional plot from 5775 - 5860 MHz showing compliance with -30dBc at the band edge.

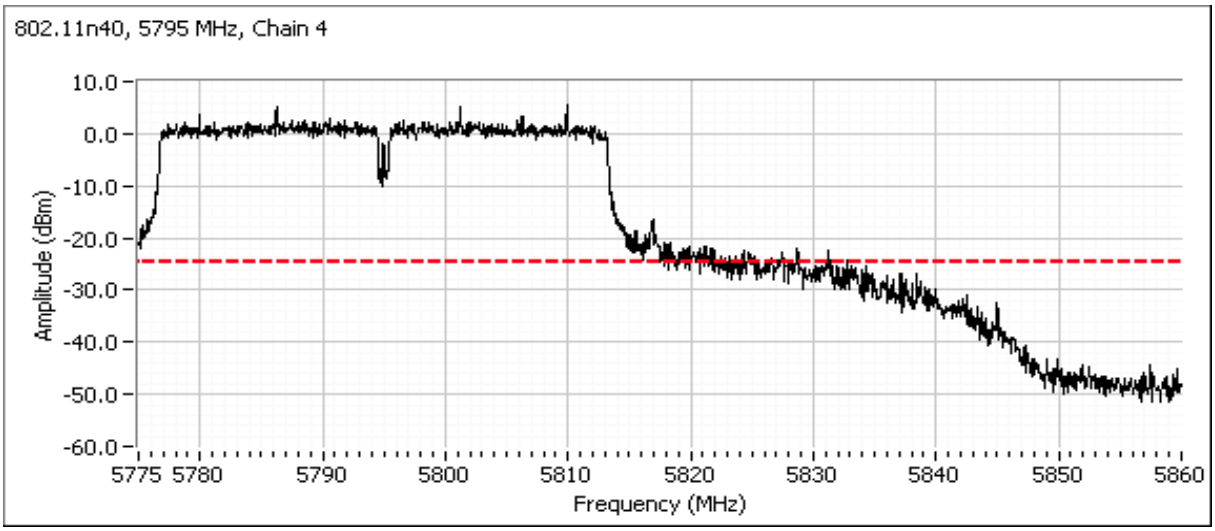


Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A





Client:	Pace Americas	Job Number:	J93000
Model:	IPW8000 Wireless STB	T-Log Number:	T93085
		Project Manager:	Susan Hill
Contact:	Mark Rieger	Project Coordinator:	Irene Rademacher
Standard:	FCC, IC	Class:	N/A



End of Report

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