

EMC Test Report

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

Industry Canada RSS-Gen Issue 4 / RSS 210 Issue 8 FCC Part 15, Subpart E

Model: HR44-700

FCC ID: PGRHR44

APPLICANT: Pace Americas Inc.
310 Providence Mine Road
Nevada City, CA 95959

TEST SITE(S): National Technical Systems - Silicon Valley
41039 Boyce Road.
Fremont, CA. 94538-2435

IC SITE REGISTRATION #: 2845B-7

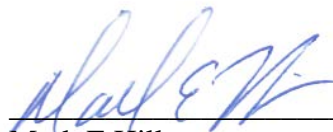
REPORT DATE: February 24, 2015

REISSUE DATE: March 5, 2015

FINAL TEST DATES: February 11 and 12, 2015

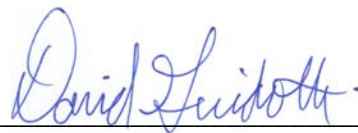
TOTAL NUMBER OF PAGES: 77

PROGRAM MGR /
TECHNICAL REVIEWER:



Mark E Hill
Staff Engineer

QUALITY ASSURANCE DELEGATE /
FINAL REPORT PREPARER:



David Guidotti
Senior Technical Writer



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REVISION HISTORY

Rev#	Date	Comments	Modified By
-	February 24, 2015	First release	
1	March 5, 2015	Updated note on page 46 to provide clarification regarding emissions below 1GHz	David Guidotti

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SCOPE

An electromagnetic emissions test has been performed on the Pace Americas Inc. model HR44-700, pursuant to the following rules:

FCC Part 15, Subpart E requirements for UNII Devices

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 General UNII Test Procedures KDB789033

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.

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 HR44-700 complied with the requirements of the following regulations:

FCC Part 15, Subpart E requirements for UNII Devices

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 HR44-700 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

UNII / LELAN DEVICES

Operation in the 5.15 – 5.25 GHz Band

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.407 (a) (1) (iv)	-	Output Power	a: 22.1dBm (0.162mW) n20: 22.5dBm (0.178mW) n40: 23.4dBm (0.219mW) (Max eirp: 0.564W)	24dBm	Complies
15.407 (a) (1) (iv)	-	Power Spectral Density	a: 10.2 dBm/MHz n20: 9.8 dBm/MHz n40: 8.1 dBm/MHz	11 dBm/MHz	Complies

Operation in the 5.725-5.850 GHz Band

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.407(e)		6dB Bandwidth	a: 16.4 MHz n20: 17.6 MHz n40: 35.1 MHz	>500kHz	N/A
15.407(a) (3)	-	Output Power	a: 22.2dBm (0.168mW) n20: 24.8dBm (0.300mW) n40: 24.6dBm (0.288mW) (Max eirp: 0.741W)	30 dBm)	Complies
15.407(a) (3)	-	Power Spectral Density	a: 9.6 dBm/MHz n20: 11.8 dBm/MHz n40: 9.4 dBm/MHz	30 dBm/500kHz	Complies

Requirements for all U-NII/LELAN bands

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.407	-	Modulation	No changes from original filing		
15.407(b) (1) and (5) / 15.209	-	Spurious Emissions	53.8 dBμV/m @ 5410.2 MHz (-0.2 dB)	Refer to page 18	Complies
15.407 (c)	-	Operation in the absence of information to transmit	No changes from original filing		
15.407 (g)	-	Frequency Stability	No changes from original filing		

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	No changes from original filing		
15.207	-	AC Conducted Emissions	No changes from original filing		
15.247 (b) (5) / 15.407 (f)	=	RF Exposure Requirements	Refer to MPE calculations in separate exhibit	Refer to OET 65, FCC Part 1 and RSS 102	Complies

MEASUREMENT UNCERTAINTIES

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

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted (power meter)	dBm	25 to 7000 MHz	± 0.52 dB
RF power, conducted (Spectrum analyzer)	dBm	25 to 7000 MHz	± 0.7 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 26500 MHz	± 2.5 dB
Radiated emission (field strength)	dBμV/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB
Conducted Emissions (AC Power)	dBμV	0.15 to 30 MHz	± 2.4 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Pace Americas Inc. model HR44-700 is a set-top-box that incorporates 802.11abgn 2x2 and 2.4GHz 802.15.4 radios. Since the EUT would be placed on a table top during operation, the EUT was treated as table-top equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 120 Volts, 60Hz, 1.3 Amps.

The sample was received on February 10, 2015 and tested on February 11 and 12, 2015. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Pace	HR44	Set-top Box	G33DT4PA003103	PGRHR44
DirecTV	EPS44R3-16	AC/DC adapter	DD44B1425A0039	N/A

ANTENNA SYSTEM

The wifi and 802.15.4 radios use separate antennas.

The peak gain for the WiFi antennas: 3.3 dBi (2.4GHz), 4.1 dBi (5GHz)

The peak gain for the 802.15.4 antennas: 4.9 dBi (2.4GHz)

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 34 cm wide by 25 cm deep by 4.5 cm high.

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	35271456913	-

EUT INTERFACE PORTS

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

Port	Connected To	Description	Cable(s)	
			Shielded or Unshielded	Length(m)
Serial	Laptop	Multiwire	Shielded	5
DC power	External power supply	2 wire	Unshielded	2
AC power (ext supply)	AC Mains	3 wire	Unshielded	2

EUT OPERATION

During emissions testing the EUT was transmitting in the mode, on the channel, & at the power called out in the individual tests. For 802.11b mode tests, 1Mb/s was used; 6Mb/s for 802.11g; MCS0 for n20 and n40. These represented the worse case modes.

Note – during testing for the original filing testing was performed with both the wifi and zigbee radios operating at the same time. There was no measureable difference with only one radio operating. All final testing was performed with only one radio operating, unless otherwise noted.

Original testing also confirmed that the addition of the interface cables to the EUT did not affect the radio related emissions.

TEST SITE**GENERAL INFORMATION**

Final test measurements were taken at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Designation / Registration Numbers		Location
	FCC	Canada	
Chamber 7	US0027	2845B-7	41039 Boyce Road Fremont, CA 94538-2435

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

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.

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.

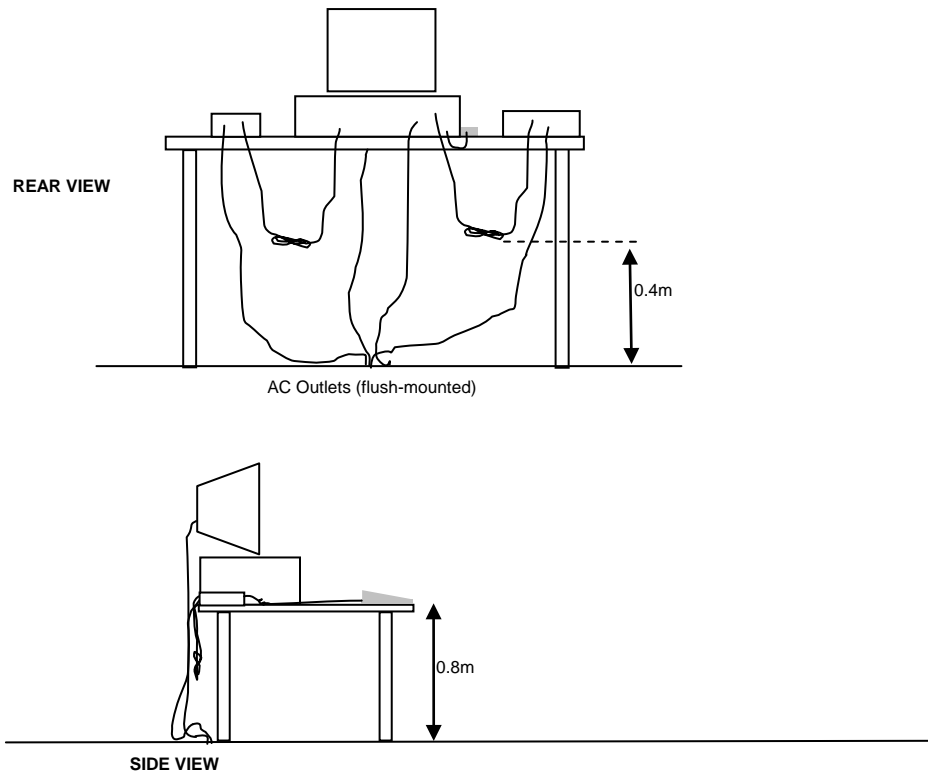
RADIATED EMISSIONS

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

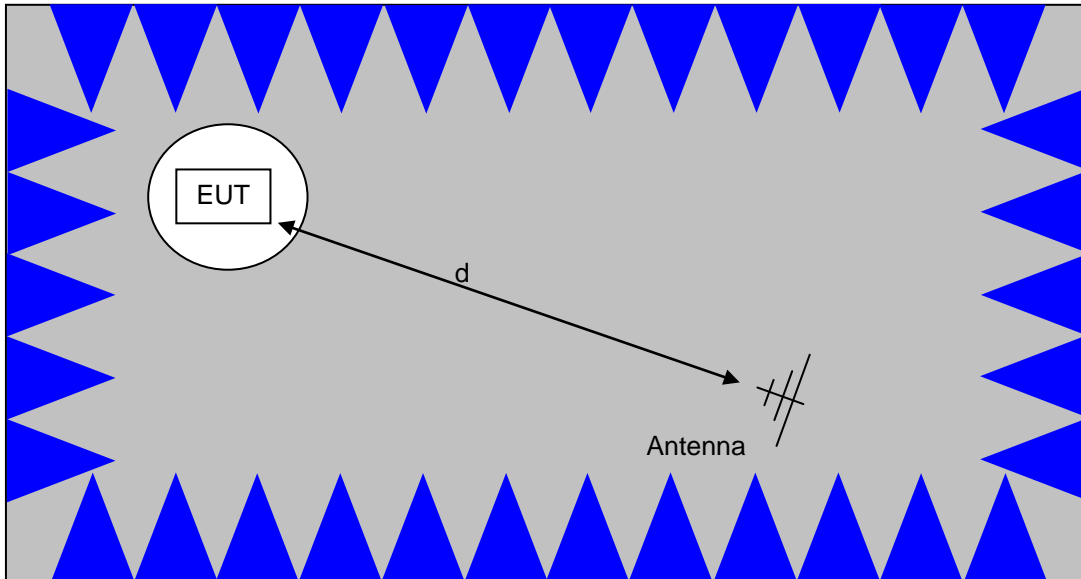
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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

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

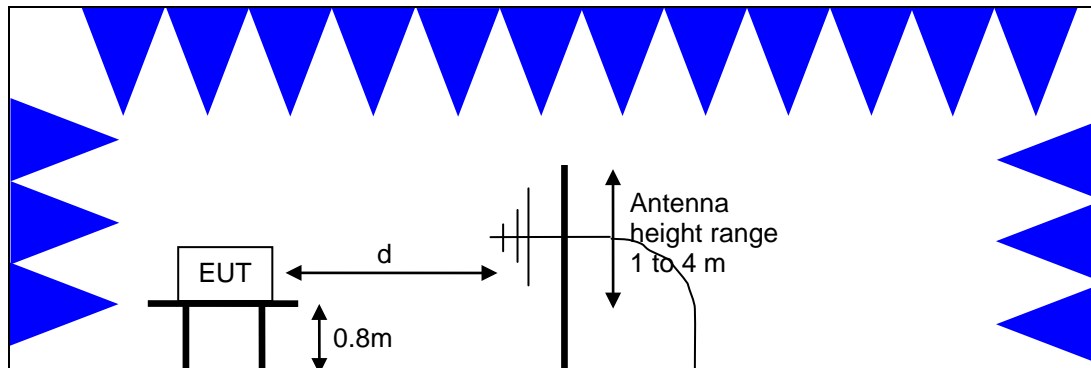


Typical Test Configuration for Radiated Field Strength Measurements



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

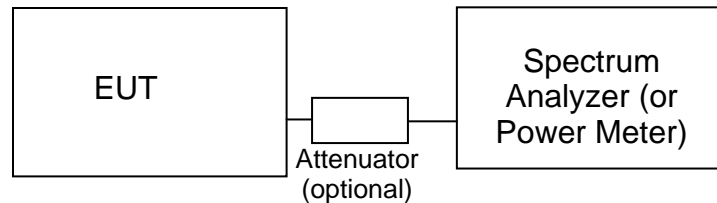
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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

CONDUCTED EMISSIONS FROM ANTENNA PORT

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

Test Configuration for Antenna Port Measurements

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

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

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

BANDWIDTH MEASUREMENTS

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

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

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

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

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands¹ (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

FCC 15.407 (a) OUTPUT POWER LIMITS

The table below shows the limits for output power and output power density.

Operating Frequency (MHz)	Output Power	Power Spectral Density
5150 – 5250	250mW (24 dBm)	11 dBm/MHz
5725 – 5855	1 Watts (30 dBm)	30 dBm/500kHz

For system using antennas with gains exceeding 6dBi, the output power and power spectral density limits are reduced by 1dB for every dB the antenna gain exceeds 6dBi.

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

SPURIOUS EMISSIONS LIMITS –UNII and LELAN DEVICES

The spurious emissions limits for signals below 1GHz are the FCC/RSS-GEN general limits. For emissions above 1GHz, signals in restricted bands are subject to the FCC/RSS GEN general limits. All other signals have a limit of -27dBm/MHz , which is a field strength of 68.3dBuV/m/MHz at a distance of 3m. For devices operating in the 5725-5850Mhz bands, the limit within 10MHz of the allocated band is increased to -17dBm/MHz .

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:

$$F_d = 20 * \text{LOG}_{10} (D_m/D_s)$$

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:

$$F_d = 40 * \text{LOG}_{10} (D_m/D_s)$$

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

Radio Antenna Port (Power and Duty cycle), 11-Feb-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Rohde & Schwarz	Power Sensor, 1 uW-100 mW, DC-18 GHz, 50ohms	NRV-Z51	1070	6/6/2014	6/6/2015
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1422	1/22/2015	1/22/2016
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/20/2014	12/20/2015

Radiated Emissions, 1,000 - 6,000 MHz, 11-Feb-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/20/2014	12/20/2015
EMCO	Antenna, Horn, 1-18 GHz	3115	2870	8/20/2013	8/20/2015

Radiated Emissions, 1000 - 40,000 MHz, 11-Feb-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/20/2014	12/20/2015
Hewlett Packard	High Pass filter, 8.2 GHz (Purple System)	P/N 84300-80039	1767	11/14/2014	11/14/2015
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	2/20/2014	2/20/2015
Micro-Tronics	Band Reject Filter, 5150-5350 MHz	BRC50703-02	2239	9/16/2014	9/16/2015
Micro-Tronics	Band Reject Filter, 5725-5875 MHz	BRC50705-02	2241	9/16/2014	9/16/2015
Hewlett Packard	SpecAn 9 kHz - 40 GHz, (SA40) Purple	8564E (84125C)	2415	2/27/2014	2/27/2015
EMCO	Antenna, Horn, 1-18 GHz	3115	2870	8/20/2013	8/20/2015

Radio Antenna Port (Power and Spurious Emissions), 12-Feb-15

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Calibrated</u>	<u>Cal Due</u>
Agilent Technologies	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HXX,	E4446A	2139	4/8/2014	4/8/2015

Appendix B Test Data

T97548 Pages 22 – 76



EMC Test Data

Client:	Pace Americas, Inc	Job Number:	J97522
Product:	HR44-700	T-Log Number:	T97548
Contact:	Mark Rieger	Project Manager:	Irene Rademacher
Emissions Standard(s):	FCC 15.407 (New Rules)	Class:	B
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Pace Americas, Inc

Product

HR44-700

Date of Last Test: 2/12/2015



EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

Power vs. Data Rate

In normal operating modes the card uses power settings stored on EEPROM to set the output power. For a given nominal output power the actual transmit power normally is reduced as the data rate increases, therefore testing was performed at the data rate in the mode with highest power to determine compliance with the requirements.

The following power measurements were made using a GATED average power meter and with the device configured in a continuous transmit mode on Ant 1 at the various data rates in each mode to verify the highest power mode:

Sample Notes

Sample S/N: G33DT4PA003103

Wifi MAC: BC307D5B7E36

Driver: 5.99 RC 188.10

Date of Test: 2/11/2015

Test Engineer: Jack Liu

Test Location: FT Chamber# 7

Mode	Data Rate	Power (dBm)	Power setting
802.11a Ant 0	6	19.0	19.0
802.11a Ant 1	6	19.1	
802.11a Ant 1	9	18.9	
	12	18.9	
	18	18.9	
	24	18.8	
	36	18.8	
	48	18.8	
	54	18.8	



EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

Mode	Data Rate	Power (dBm)	Power setting
802.11n 20MHz Ant 1	6.5	18.8	19.0
	13	18.8	
	19.5	18.7	
	26	18.7	
	39	18.6	
	52	18.6	
	58.5	18.7	
	65	18.7	
802.11n/ac 40MHz	13.5	18.0	19.0
	27	18.0	
	40.5	18.0	
	54	17.9	
	81	17.9	
	108	17.9	
	121.5	17.9	
	135	17.9	

Note : Power setting - the software power setting used during testing, included for reference only.

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

Duty Cycle

Date of Test: 2/11/2015
 Test Engineer: Jack Liu
 Test Location: FT Chamber# 7

Duty cycle measurements performed on the worse case data rate for power.

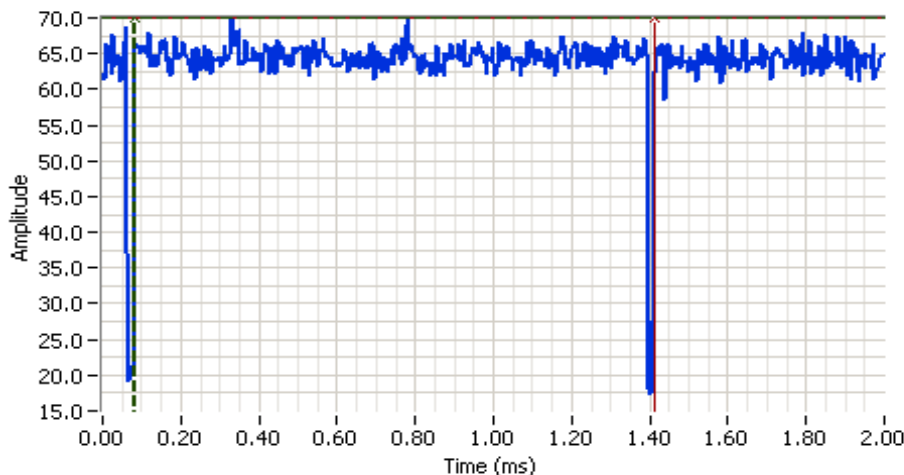
Notes: Measurements taken with maximum RBW/VBW settings allowed.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11a	6Mbps	0.99	Yes	1.33	0	0	752
n20	MCS0	0.99	Yes	1.33	0	0	752
n40	MCS0	0.95	Yes	0.362	0.2341445	0.468289	2762

* Correction factor when using RMS/Power averaging - $10 \cdot \log(1/x)$

** Correction factor when using linear voltage average - $20 \cdot \log(1/x)$

T = Minimum transmission duration



Analyzer Settings

Rohde&Schwarz,ESI
 CF: 5180.000 MHz
 SPAN: 0.000 MHz
 RB: 10.000 MHz
 VB: 10.000 MHz
 Detector: POS
 Attn: 0 DB
 RL Offset: 0.0 DB
 Sweep Time: 2.0ms
 Ref Lvl: 72.0 DBUV

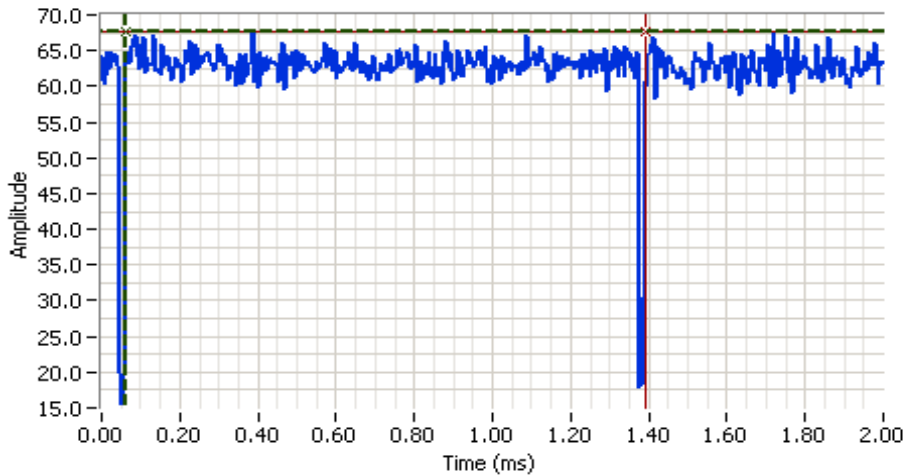
Comments

a
 Cycle Time = 1.330ms
 Off time = 0.018ms
 Duty Cycle = 99%

Cursor 1	0.0825	69.88	
Cursor 2	1.4124	69.88	

Delta Time (ms)	1.330
Delta Amplitude	0.00

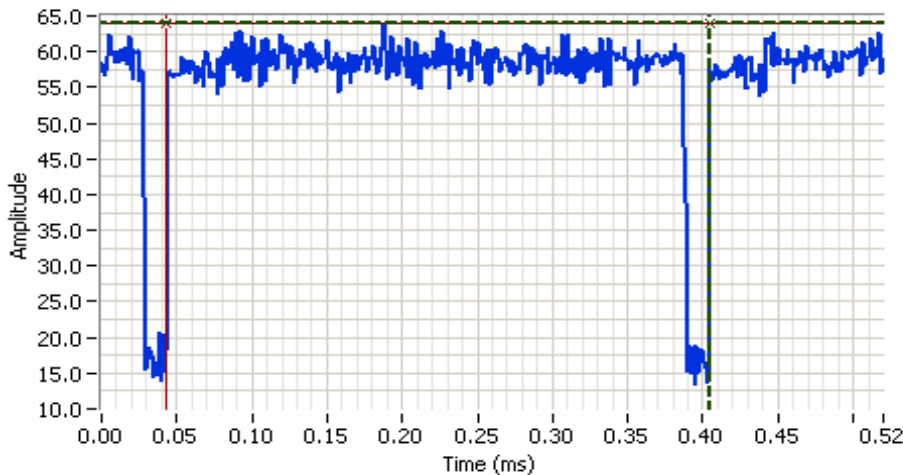
Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A



Analyzer Settings
 Rohde&Schwarz,ESI
 CF: 5180.000 MHz
 SPAN: 0.000 MHz
 RB: 10.000 MHz
 VB: 10.000 MHz
 Detector: POS
 Attn: 0 DB
 RL Offset: 0.0 DB
 Sweep Time: 2.0ms
 Ref Lvl: 72.0 DBUV

Comments
 n20
 Cycle Time = 1.330ms
 Off time = 0.018ms
 Duty Cycle = 99%

Cursor 1	0.0619	67.59	⊕ ⊖ 🔒	Delta Time (ms)	1.330
Cursor 2	1.3918	67.59	⊕ ⊖ 🔒	Delta Amplitude	0.00



Analyzer Settings
 Rohde&Schwarz,ESI
 CF: 5190.000 MHz
 SPAN: 0.000 MHz
 RB: 10.000 MHz
 VB: 10.000 MHz
 Detector: POS
 Attn: 0 DB
 RL Offset: 0.0 DB
 Sweep Time: 0.5ms
 Ref Lvl: 72.0 DBUV

Comments
 n40
 Cycle Time = 0.362ms
 Off time = 0.019ms
 Duty Cycle = 95%

Cursor 1	0.4047	63.90	⊕ ⊖ 🔒	Delta Time (ms)	0.362
Cursor 2	0.0429	63.90	⊕ ⊖ 🔒	Delta Amplitude	0.00





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

RSS 210 and FCC 15.407 (UNII) Radiated Spurious Emissions

Test Specific Details

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

General Test Configuration

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

Ambient Conditions:

Temperature: 20-25 °C
Rel. Humidity: 38-40 %

Summary of Results

Run #	Mode	Channel	Target Power Setting	Passing Power Setting	Test Performed	Limit	Result / Margin
20MHz Bandwith Modes							
1	a Ant 1	36 - 5180MHz	20	20	Restricted Band Edge at 5150 MHz	15.209	52.2 dBµV/m @ 5150.0 MHz (-1.8 dB)
2	a Ant 1	149 - 5745MHz	20	16	Band Edge at 5715 MHz	15.209	64.8 dBµV/m @ 5713.1 MHz (-3.5 dB)
		149 - 5745MHz	20	16	Band Edge at 5725 MHz	15E	74.7 dBµV/m @ 5724.1 MHz (-3.6 dB)
		165 - 5825MHz	20	19	Band Edge 5850MHz	15E	76.5 dBµV/m @ 5855.2 MHz (-1.8 dB)
		165 - 5825MHz	20	19	Band Edge 5860MHz	15E	63.8 dBµV/m @ 5862.2 MHz (-4.5 dB)
3	n20	36 - 5180MHz	20	19	Restricted Band Edge at 5150 MHz	15.209	52.8 dBµV/m @ 5149.1 MHz (-1.2 dB)
4	n20	149 - 5745MHz	20	16	Band Edge at 5715 MHz	15.209	64.8 dBµV/m @ 5714.4 MHz (-3.5 dB)
		149 - 5745MHz	20	16	Band Edge at 5725 MHz	15E	77.7 dBµV/m @ 5724.9 MHz (-0.6 dB)
		165 - 5825MHz	20	19	Band Edge 5850MHz	15E	76.9 dBµV/m @ 5850.1 MHz (-1.4 dB)
		165 - 5825MHz	20	19	Band Edge 5860MHz	15E	65.6 dBµV/m @ 5862.3 MHz (-2.7 dB)



EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Run #	Mode	Channel	Target Power Setting	Passing Power Setting	Test Performed	Limit	Result / Margin
40MHz Bandwith Modes							
5	n40	38 - 5190MHz	20	14	Restricted Band Edge at 5150 MHz	15.209	52.3 dBµV/m @ 5149.5 MHz (-1.7 dB)
6	n40	151 - 5755MHz	20	15	Band Edge at 5715 MHz	15.209	67.4 dBµV/m @ 5714.8 MHz (-0.9 dB)
		151 - 5755MHz	20	15	Band Edge at 5725 MHz	15E	74.6 dBµV/m @ 5724.5 MHz (-3.7 dB)
		159 - 5795MHz	20	20	Band Edge 5850MHz	15E	71.6 dBµV/m @ 5854.8 MHz (-6.7 dB)
		159 - 5795MHz	20	20	Band Edge 5860MHz	15E	66.1 dBµV/m @ 5861.3 MHz (-2.2 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.

Procedure Comments:

Measurements performed in accordance with FCC KDB 789033

Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ 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)
11a	6Mbps	0.99	Yes	1.33	0	0	752
n20	MCS0	0.99	Yes	1.33	0	0	752
n40	MCS0	0.95	Yes	0.362	0.23	0.47	2762

Sample Notes

Sample S/N: G33DT4PA003103

Wifi MAC: BC307D5B7E36

Driver: 5.99 RC 188.10



EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

Notes:

Based on original approval, Chain 2 was worse case for 11a (Ant 1)

Measurement Specific Notes:

Note 1:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dBuV/m). The measurement method required is a peak measurement (RB=1MHz, VB≥3MHz, peak detector). Per KDB 789033 2) c) (i), compliance can be demonstrated by meeting the average and peak limits of 15.209, as an alternative.
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 * 1/DC 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 * 1/DC 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.



EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Run #1: Radiated Bandedge Measurements, 5150-5250MHz

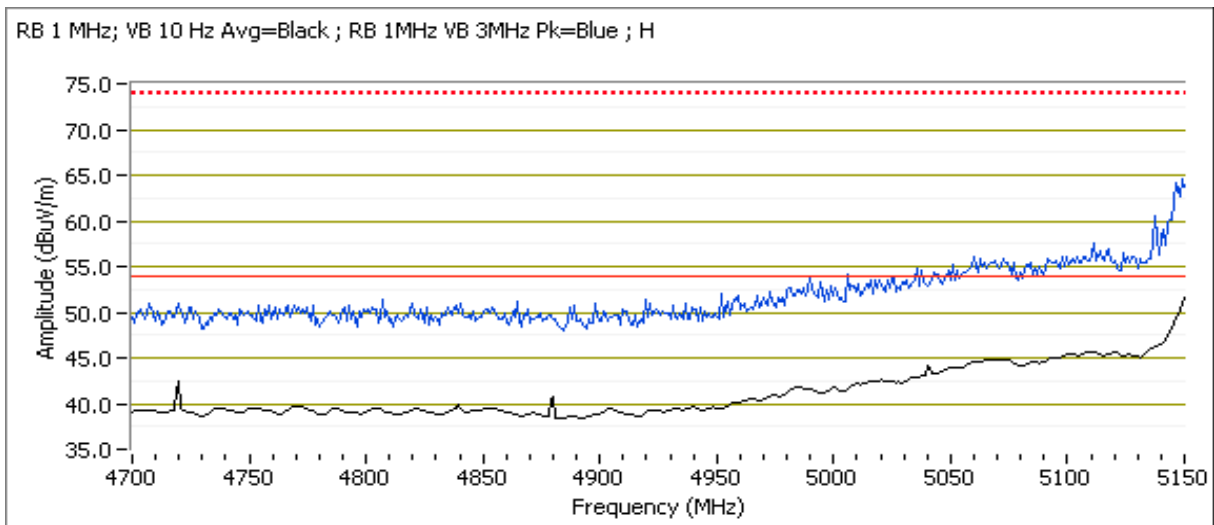
Date of Test: 2/11/2015 0:00
 Test Engineer: Jack Liu
 Test Location: FT Chamber #7

Config. Used: 1
 Config Change: -
 EUT Voltage: 120V/60Hz

Channel: 36 - 5180 MHz Pwr setting 20
 Tx Chain: 2
 Mode: a
 Data Rate: 6Mbps

5150 MHz Band Edge Signal Radiated Field Strength

Frequency MHz	Level dB μ V/m	Pol v/h	FCC 15.209		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
5150.000	52.2	H	54.0	-1.8	AVG	283	1.3	POS; RB 1 MHz; VB: 10 Hz
5150.000	68.3	H	74.0	-5.7	PK	283	1.3	POS; RB 1 MHz; VB: 3 MHz
5150.000	47.2	V	54.0	-6.8	AVG	39	1.4	POS; RB 1 MHz; VB: 10 Hz
5146.870	64.0	V	74.0	-10.0	PK	39	1.4	POS; RB 1 MHz; VB: 3 MHz





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Run #2: Radiated Bandedge Measurements, 5725-5850MHz

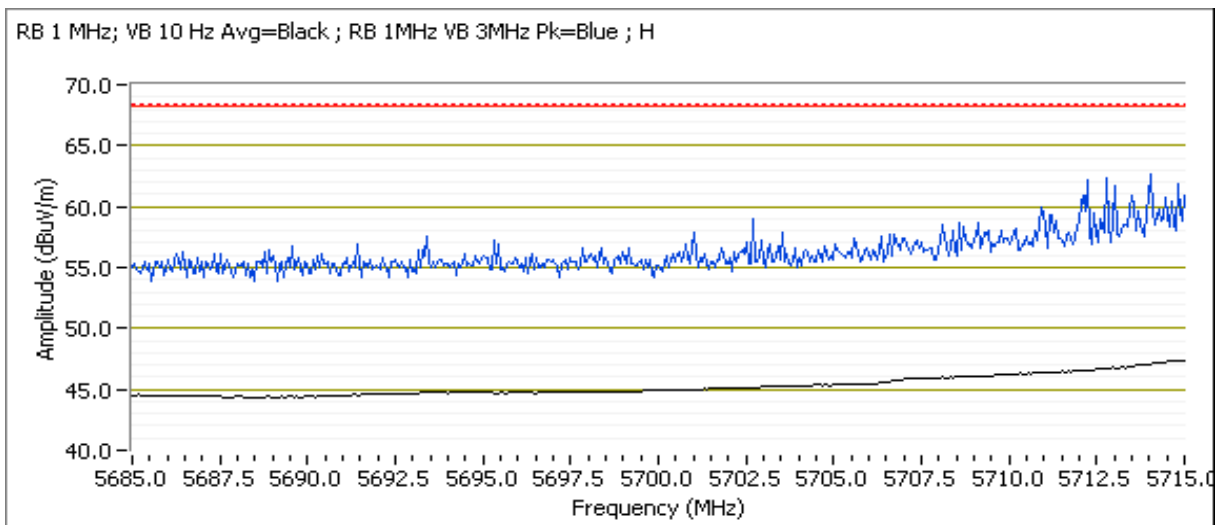
Date of Test: 2/11/2015 0:00
 Test Engineer: Jack Liu / R. Varelas
 Test Location: FT Chamber #7

Config. Used: 1
 Config Change: -
 EUT Voltage: 120V/60Hz

Channel: 149 - 5745MHz Pwr setting 16
 Tx Chain: 2
 Mode: a
 Data Rate: 6Mbps

5715 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
Pwr setting 16								
5713.080	64.8	H	68.3	-3.5	PK	278	1.2	POS; RB 1 MHz; VB: 3 MHz
5714.460	57.3	V	68.3	-11.0	PK	264	1.0	POS; RB 1 MHz; VB: 3 MHz



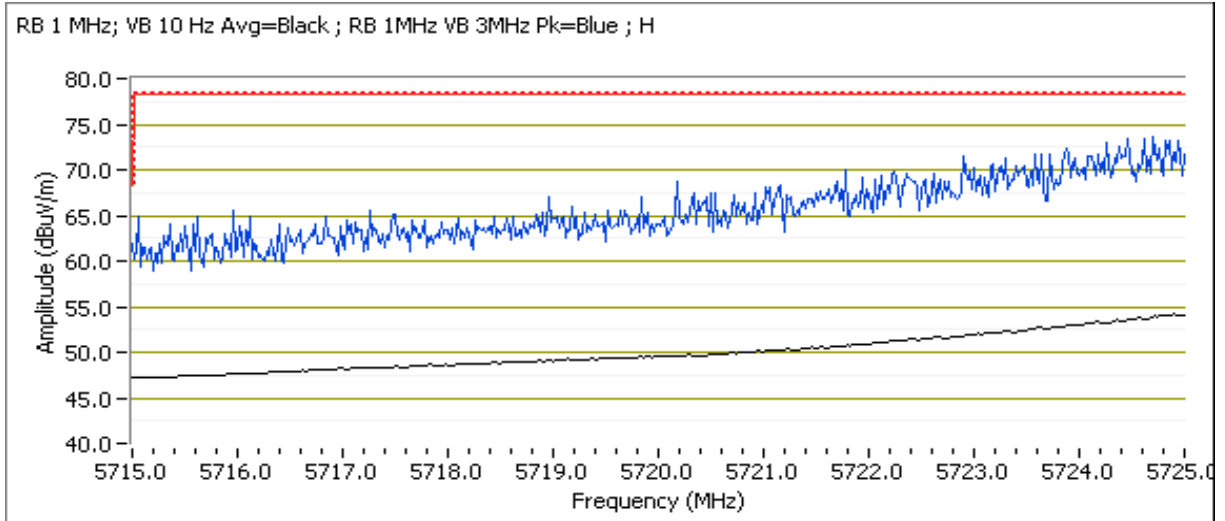


EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

5725 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	15.E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
Pwr setting 16								
5724.120	74.7	H	78.3	-3.6	PK	286	1.1	POS; RB 1 MHz; VB: 3 MHz
5724.720	68.4	V	78.3	-9.9	PK	264	1.0	POS; RB 1 MHz; VB: 3 MHz





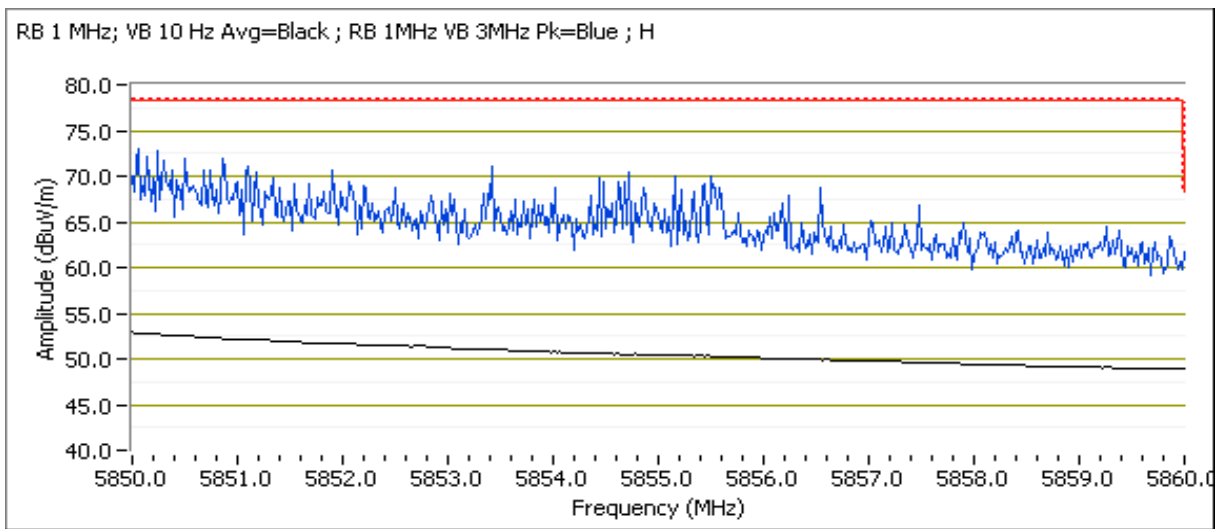
EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Channel: 165 - 5825MHz Pwr setting 19
 Tx Chain: 2
 Mode: a
 Data Rate:

5850 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	15.E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
Pwr setting 19								
5855.190	76.5	H	78.3	-1.8	PK	289	1.0	POS; RB 1 MHz; VB: 3 MHz
5851.140	66.2	V	78.3	-12.1	PK	45	1.7	POS; RB 1 MHz; VB: 3 MHz



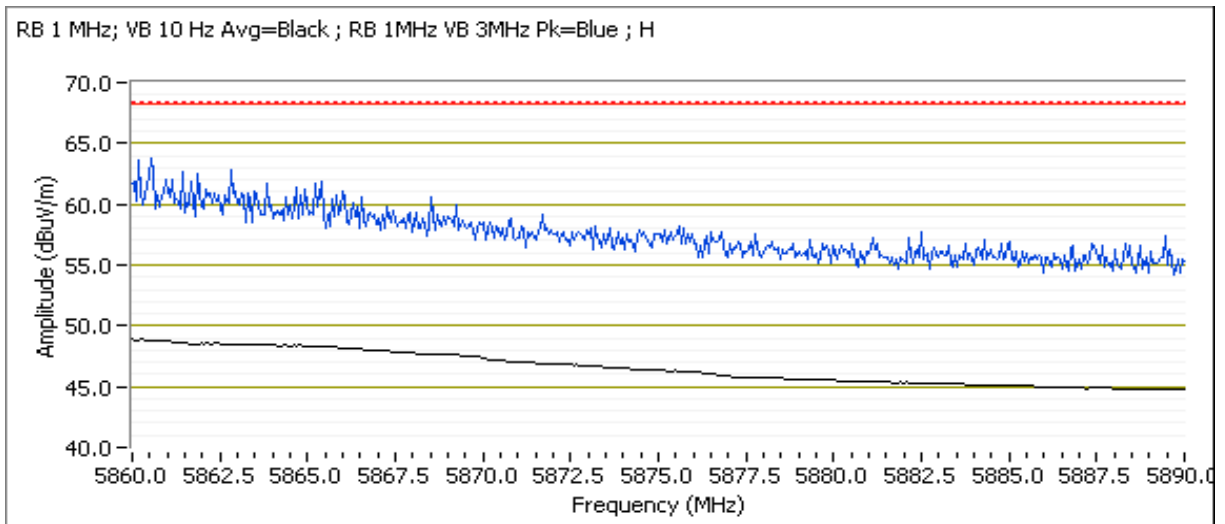


EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

5860 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	15.E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
Pwr setting 19								
5862.160	63.8	H	68.3	-4.5	PK	289	1.0	POS; RB 1 MHz; VB: 3 MHz
5861.980	56.5	V	68.3	-11.8	PK	45	1.7	POS; RB 1 MHz; VB: 3 MHz





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Run #3: Radiated Bandedge Measurements, 5150-5250MHz

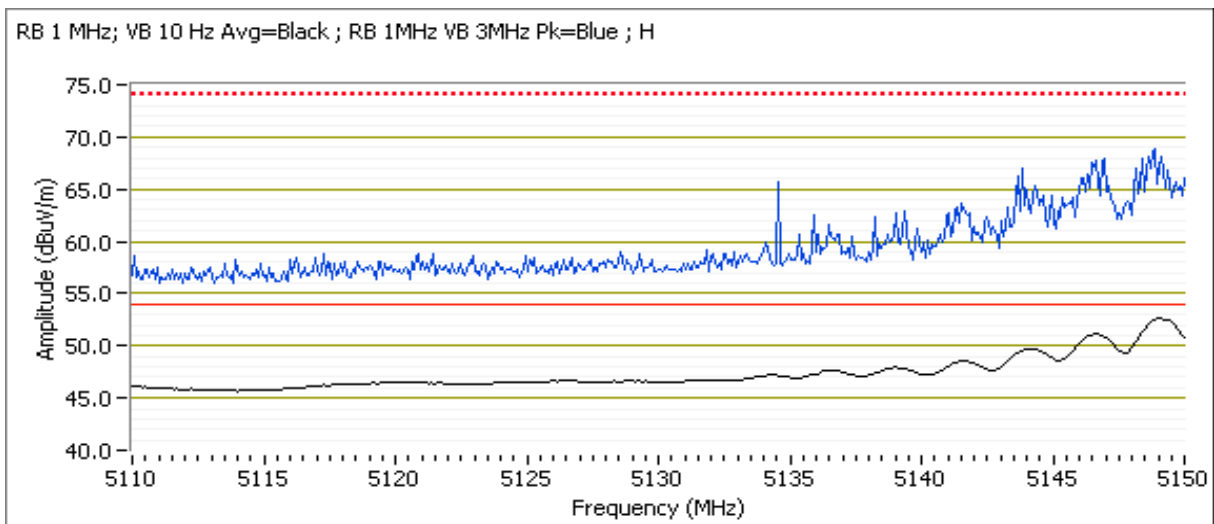
Date of Test: 2/11/2015 0:00
 Test Engineer: Rafael Varelas
 Test Location: FT Chamber #7

Config. Used: 1
 Config Change: -
 EUT Voltage: 120V/60Hz

Channel: 36 - 5180 MHz Pwr setting 19
 Tx Chain: 2x2
 Mode: n20
 Data Rate: MCS0

5150 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
Pwr setting 19								
5149.120	52.8	H	54.0	-1.2	AVG	283	1.1	POS; RB 1 MHz; VB: 10 Hz
5146.790	68.4	H	74.0	-5.6	PK	283	1.1	POS; RB 1 MHz; VB: 3 MHz
5150.000	51.6	V	54.0	-2.4	AVG	37	1.0	POS; RB 1 MHz; VB: 10 Hz
5149.920	65.6	V	74.0	-8.4	PK	37	1.0	POS; RB 1 MHz; VB: 3 MHz





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Run #4: Radiated Bandedge Measurements, 5725-5850MHz

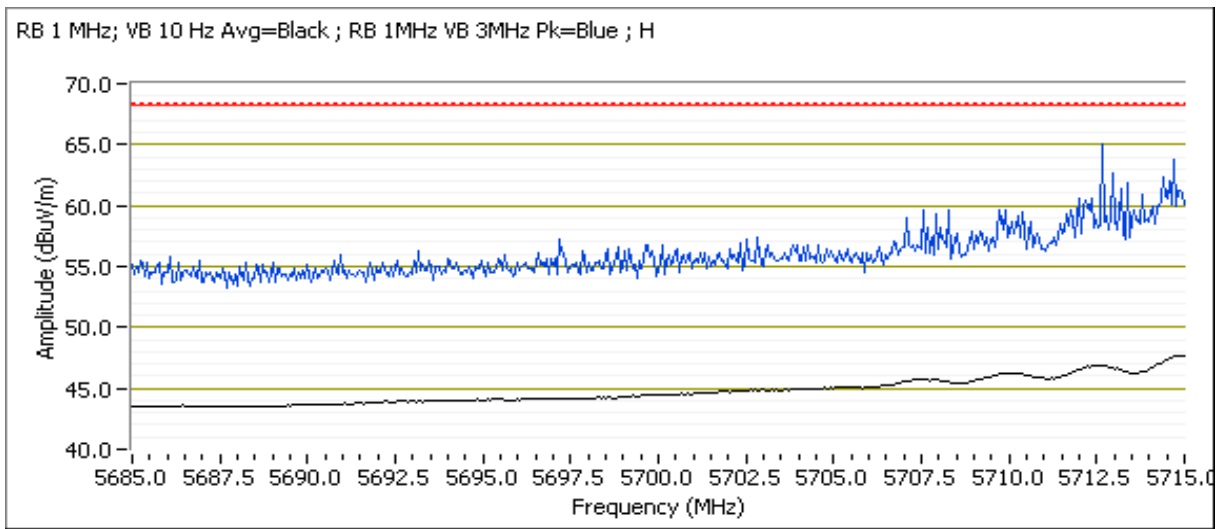
Date of Test: 2/11/2015 0:00
 Test Engineer: Rafael Varelas
 Test Location: FT Chamber #7

Config. Used: 1
 Config Change: -
 EUT Voltage: 120V/60Hz

Channel: 149 - 5745MHz Pwr setting 16
 Tx Chain: 2x2
 Mode: n20
 Data Rate: MCS0

5715 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
Pwr setting 16								
5714.400	64.8	H	68.3	-3.5	PK	287	1.1	POS; RB 1 MHz; VB: 3 MHz
5712.960	62.3	V	68.3	-6.0	PK	24	1.0	POS; RB 1 MHz; VB: 3 MHz



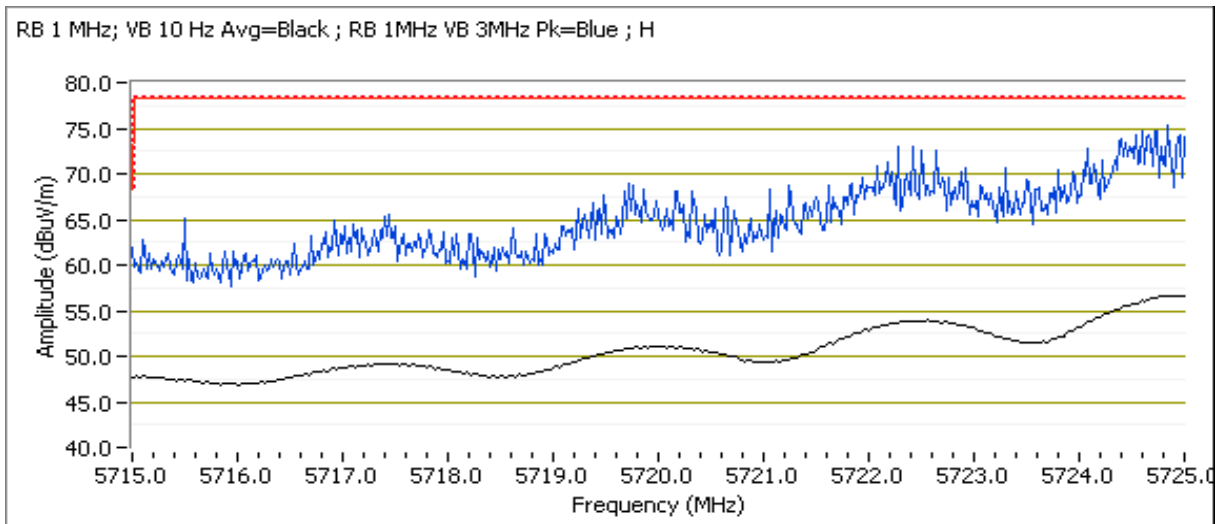


EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

5725 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	15.E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
Pwr setting 16								
5724.920	77.7	H	78.3	-0.6	PK	287	1.1	POS; RB 1 MHz; VB: 3 MHz
5724.740	74.1	V	78.3	-4.2	PK	24	1.0	POS; RB 1 MHz; VB: 3 MHz





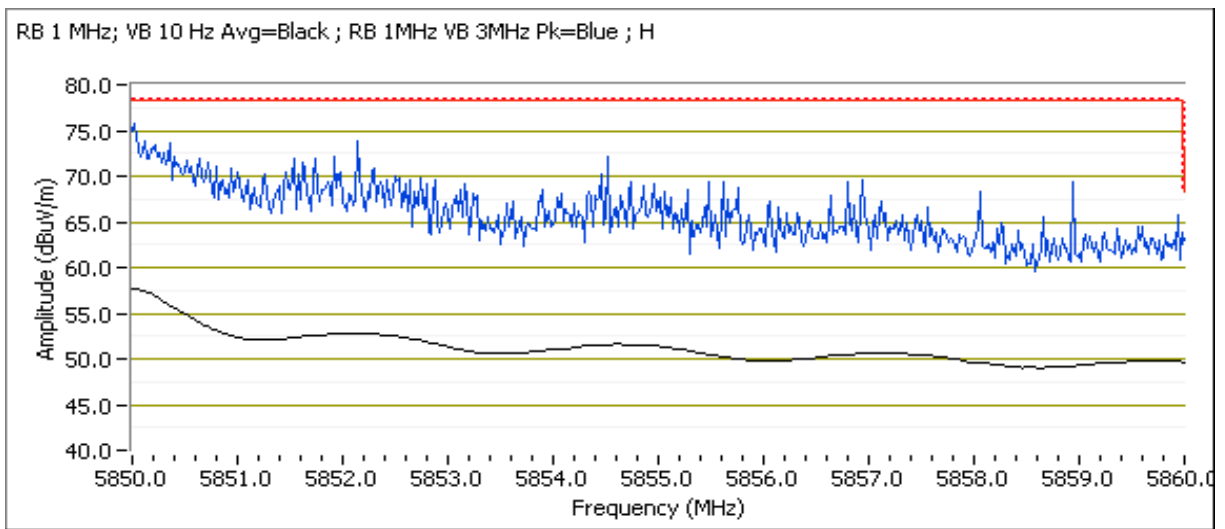
EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Channel: 165 - 5825MHz
 Tx Chain: 2x2
 Mode: n20
 Data Rate:

5850 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	15.E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
Pwr setting 19								
5850.060	76.9	H	78.3	-1.4	PK	290	1.0	POS; RB 1 MHz; VB: 3 MHz
5850.120	71.3	V	78.3	-7.0	PK	23	1.3	POS; RB 1 MHz; VB: 3 MHz



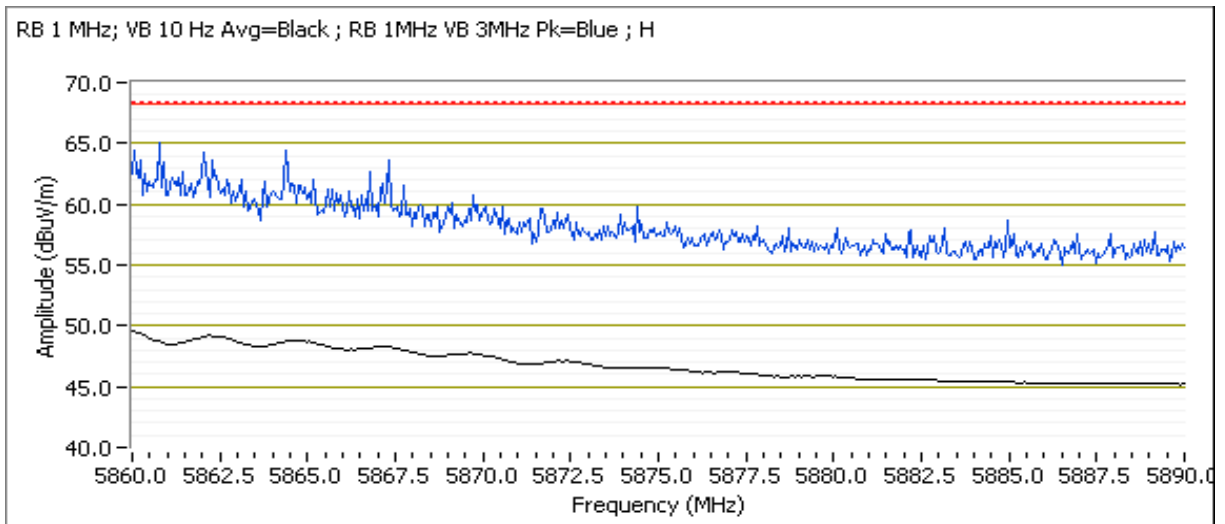


EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

5860 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	15.E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
Pwr setting 19								
5862.340	65.6	H	68.3	-2.7	PK	290	1.0	POS; RB 1 MHz; VB: 3 MHz
5865.050	62.4	V	68.3	-5.9	PK	23	1.3	POS; RB 1 MHz; VB: 3 MHz





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Run #5: Radiated Bandedge Measurements, 5150-5250MHz

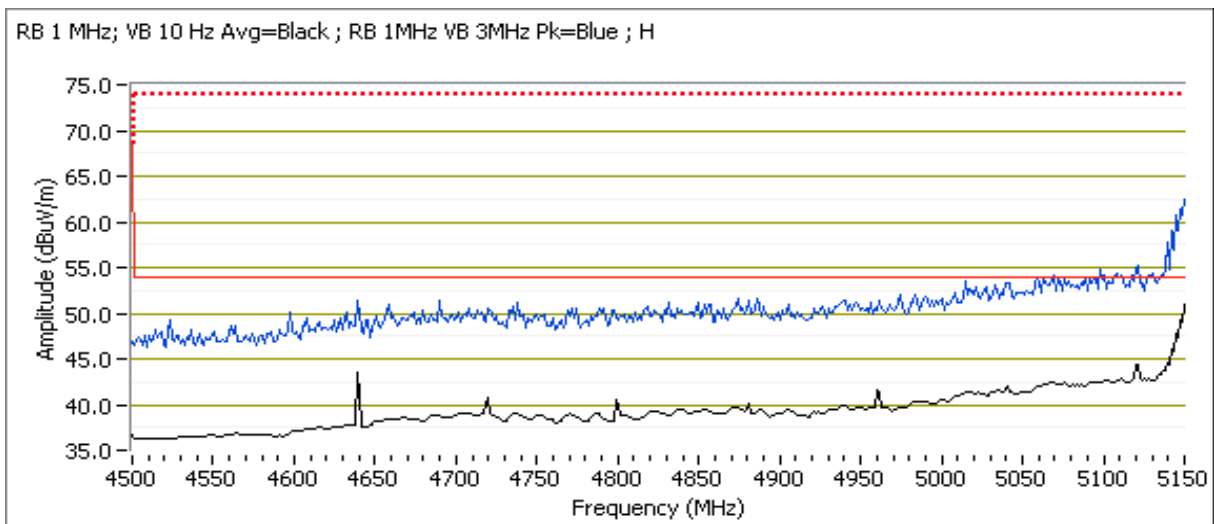
Date of Test: 2/11/2015 0:00
 Test Engineer: Rafael Varelas
 Test Location: FT Chamber #7

Config. Used: 1
 Config Change: -
 EUT Voltage: 120V/60Hz

Channel: 38 - 5190 MHz Pwr setting 14
 Tx Chain: 2x2
 Mode: n40
 Data Rate: MCS0

5150 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
Pwr setting 14								
5149.520	52.3	H	54.0	-1.7	AVG	288	1.1	POS; RB 1 MHz; VB: 10 Hz
5146.390	66.7	H	74.0	-7.3	PK	288	1.1	POS; RB 1 MHz; VB: 3 MHz
5150.000	50.4	V	54.0	-3.6	AVG	38	1.0	POS; RB 1 MHz; VB: 10 Hz
5149.520	60.8	V	74.0	-13.2	PK	38	1.0	POS; RB 1 MHz; VB: 3 MHz





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Run #6: Radiated Bandedge Measurements, 5725-5850MHz

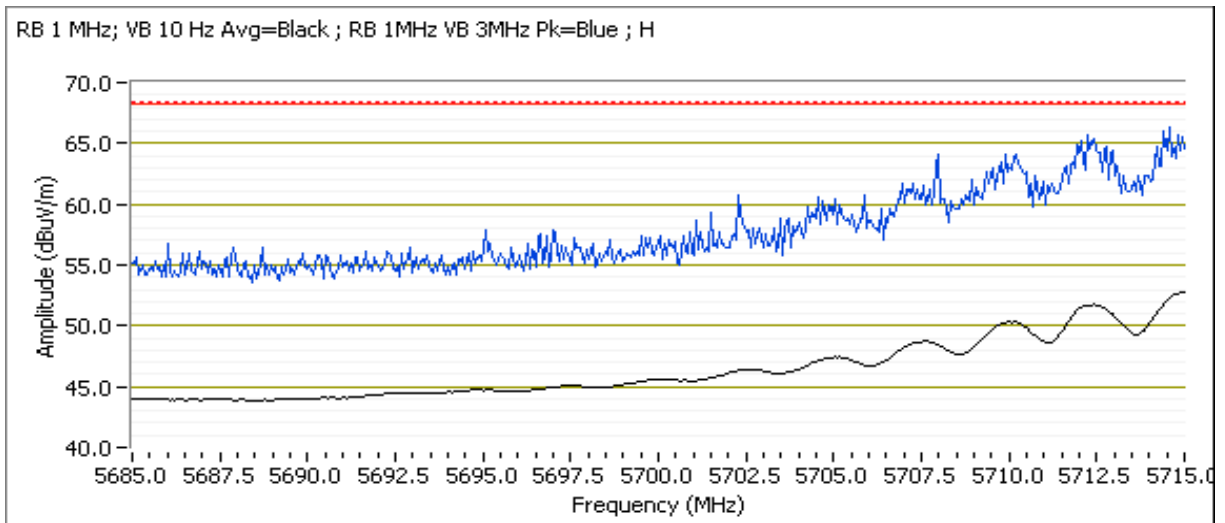
Date of Test: 2/11/2015 0:00
 Test Engineer: Rafael Varelas
 Test Location: FT Chamber #7

Config. Used: 1
 Config Change: -
 EUT Voltage: 120V/60Hz

Channel: 151 - 5755MHz Pwr setting 15
 Tx Chain: 2x2
 Mode: n40
 Data Rate:

5715 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
Pwr setting 15								
5714.820	67.4	H	68.3	-0.9	PK	287	1.1	POS; RB 1 MHz; VB: 3 MHz
5714.940	63.5	V	68.3	-4.8	PK	25	1.2	POS; RB 1 MHz; VB: 3 MHz



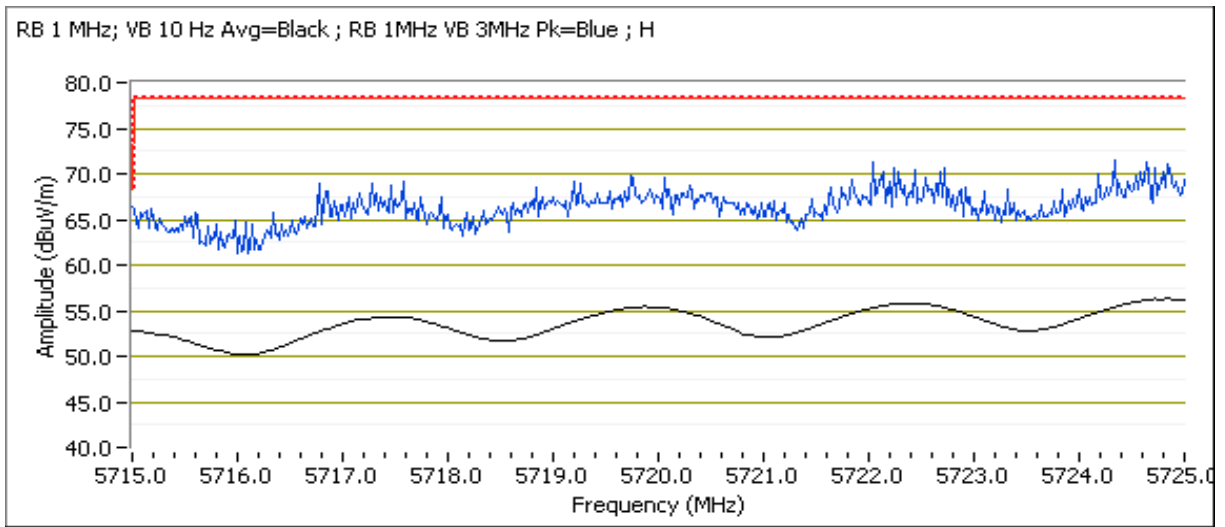


EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

5725 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	15.E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	PK/QP/Avg	degrees	meters	
Pwr setting 15								
5724.520	74.6	H	78.3	-3.7	PK	287	1.1	POS; RB 1 MHz; VB: 3 MHz
5722.460	71.6	V	78.3	-6.7	PK	25	1.2	POS; RB 1 MHz; VB: 3 MHz





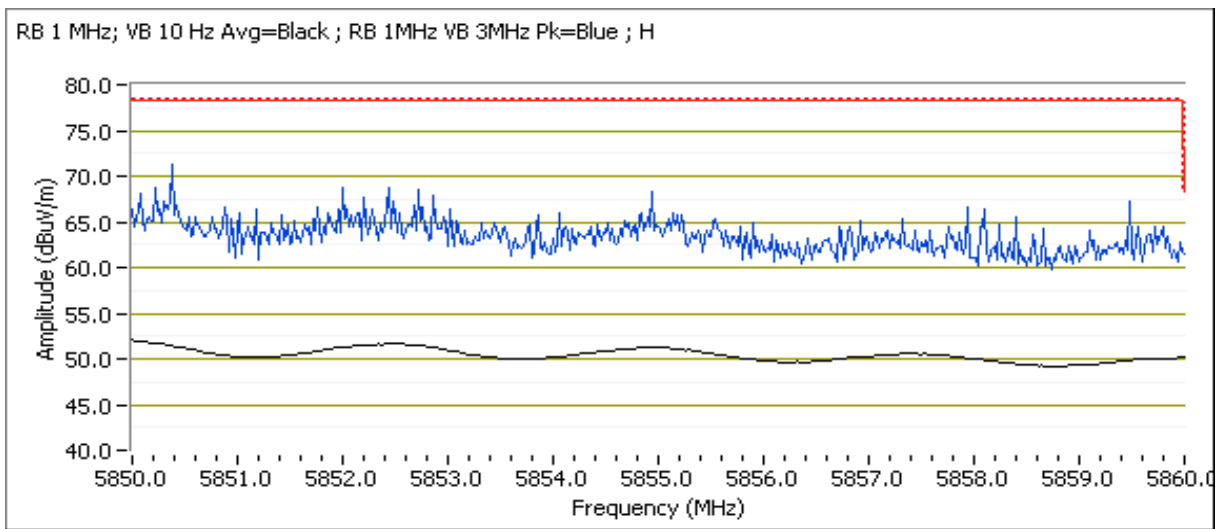
EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Channel: 159 - 5795MHz
 Tx Chain: 2x2
 Mode: n40
 Data Rate:

5850 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	15.E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5854.750	71.6	H	78.3	-6.7	PK	289	1.0	POS; RB 1 MHz; VB: 3 MHz
5850.340	65.8	V	78.3	-12.5	PK	24	1.4	POS; RB 1 MHz; VB: 3 MHz



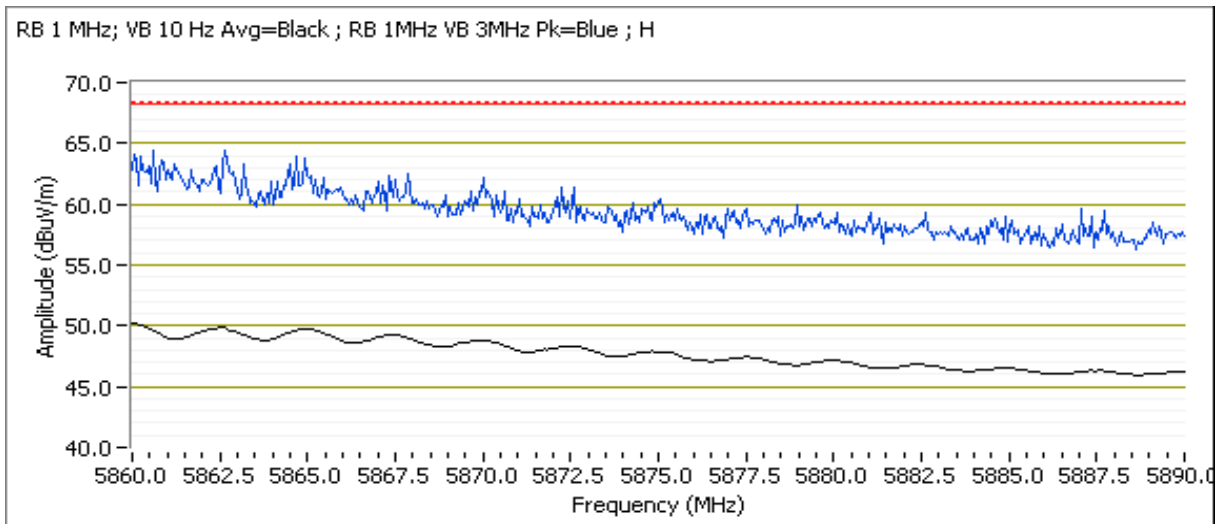


EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

5860 MHz Band Edge Signal Radiated Field Strength

Frequency MHz	Level dB μ V/m	Pol v/h	15.E		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
5861.320	66.1	H	68.3	-2.2	PK	289	1.0	POS; RB 1 MHz; VB: 3 MHz
5860.540	62.5	V	68.3	-5.8	PK	24	1.4	POS; RB 1 MHz; VB: 3 MHz



Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

RSS 210 and FCC 15.407 (UNII) 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: 21.4 °C
Rel. Humidity: 39 %

Summary of Results

Run #	Mode	Channel	Target Power Setting	Passing Power Setting	Test Performed	Limit	Result / Margin
Measurements on the worse case mode for UNII1 band from original testing/certification							
1	n20	36 - 5180MHz	20	20	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	53.1 dBµV/m @ 9000.5 MHz (-0.9 dB)
	n20	40 - 5200MHz	20	20	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	52.2 dBµV/m @ 9000.5 MHz (-1.8 dB)
	n20	48 - 5240MHz	20	20	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	52.7 dBµV/m @ 9000.5 MHz (-1.3 dB)
Measurements on the worse case mode for UNII3 (old DTS) band from original testing/certification							
2	n20	149 - 5745MHz	20	20	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	52.3 dBµV/m @ 5425.7 MHz (-1.7 dB)
	n20	157 - 5785MHz	20	20	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	53.8 dBµV/m @ 5410.2 MHz (-0.2 dB)
	n20	165 - 5820MHz	20	20	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	53.5 dBµV/m @ 5423.1 MHz (-0.5 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.



EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 789033

Peak measurements performed with: RBW=1MHz, VBW=3MHz, peak detector, max hold, auto sweep time

Unless otherwise stated/noted, emission has duty cycle $\geq 98\%$ 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)
11a	6Mbps	0.99	Yes	1.33	0	0	752
n20	MCS0	0.99	Yes	1.33	0	0	752
n40	MCS0	0.95	Yes	0.362	0.23	0.47	2762

Sample Notes

Sample S/N: G33DT4PA003103

Wifi MAC: BC307D5B7E36

Driver: 5.99 RC 188.10

Notes:

Based on original approval, Chain 2 was worse case for 11a

No emissions were observed below 1GHz in original testing, an evaluation showed that the increase in output power did not affect the original results

Testing performed on worse case mode (for each band) from original testing/certification

Measurement Specific Notes:

Note 1:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dBuV/m). The measurement method required is a peak measurement (RB=1MHz, VB \geq 3MHz, peak detector). Per KDB 789033 2) (i), compliance can be demonstrated by meeting the average and peak limits of 15.209, as an alternative.
Note 2:	Emission has duty cycle $\geq 98\%$, 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 * 1/DC 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 * 1/DC 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.



EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

Run #1, Radiated Spurious Emissions, 1,000 - 40,000 MHz. Operation in the 5150-5250 MHz Band
 Date of Test: 2/11/2015 0:00 Config. Used: 1
 Test Engineer: Rafael Varelas Config Change: -
 Test Location: FT Chamber #7 EUT Voltage: 120V/60Hz

Run #1a: Low Channel

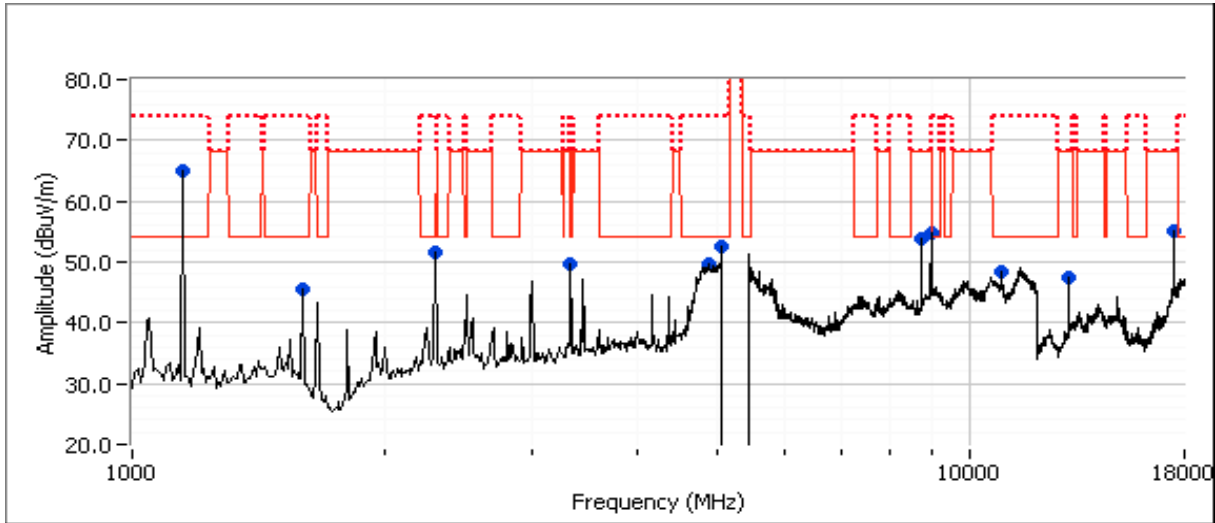
Channel: 36 Mode: n20
 Tx Chain: 2x2 Data Rate: MCS0

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15E		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
9000.460	53.1	V	54.0	-0.9	AVG	0	1.2	RB 1 MHz;VB 10 Hz;Peak
9000.520	59.1	V	74.0	-14.9	PK	0	1.2	RB 1 MHz;VB 3 MHz;Peak
1150.010	42.2	H	54.0	-11.8	AVG	344	2.0	Intermittent signal
1149.020	58.8	H	74.0	-15.2	PK	344	2.0	Intermittent signal
2299.010	34.5	H	54.0	-19.5	AVG	344	1.0	RB 1 MHz;VB 10 Hz;Peak
2295.560	43.5	H	74.0	-30.5	PK	344	1.0	RB 1 MHz;VB 3 MHz;Peak
3332.040	49.7	V	54.0	-4.3	AVG	320	1.0	RB 1 MHz;VB 10 Hz;Peak
3331.990	53.4	V	68.3	-14.9	PK	320	1.0	RB 1 MHz;VB 3 MHz;Peak
10899.970	47.3	V	54.0	-6.7	AVG	294	2.0	RB 1 MHz;VB 10 Hz;Peak
10900.120	55.8	V	74.0	-18.2	PK	294	2.0	RB 1 MHz;VB 3 MHz;Peak
5052.920	49.1	H	54.0	-4.9	AVG	280	1.1	RB 1 MHz;VB 10 Hz;Peak
5052.600	60.0	H	74.0	-14.0	PK	280	1.1	RB 1 MHz;VB 3 MHz;Peak
1599.990	40.5	V	54.0	-13.5	AVG	258	1.6	RB 1 MHz;VB 10 Hz;Peak
1600.020	41.1	V	74.0	-32.9	PK	258	1.6	RB 1 MHz;VB 3 MHz;Peak
4879.830	45.8	H	54.0	-8.2	AVG	82	1.0	RB 1 MHz;VB 10 Hz;Peak
4881.030	57.2	H	74.0	-16.8	PK	82	1.0	RB 1 MHz;VB 3 MHz;Peak
8719.950	55.4	V	68.3	-12.9	PK	47	1.0	RB 1 MHz;VB 3 MHz;Peak
17440.770	63.2	V	68.3	-5.1	PK	224	1.0	RB 1 MHz;VB 3 MHz;Peak
13080.210	59.8	V	68.3	-8.5	PK	83	1.1	RB 1 MHz;VB 3 MHz;Peak

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

Note: For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dBuV/m). The measurement method required is a peak measurement (RB=1MHz, VB≥3MHz, peak detector).

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

Run #1b: Center Channel

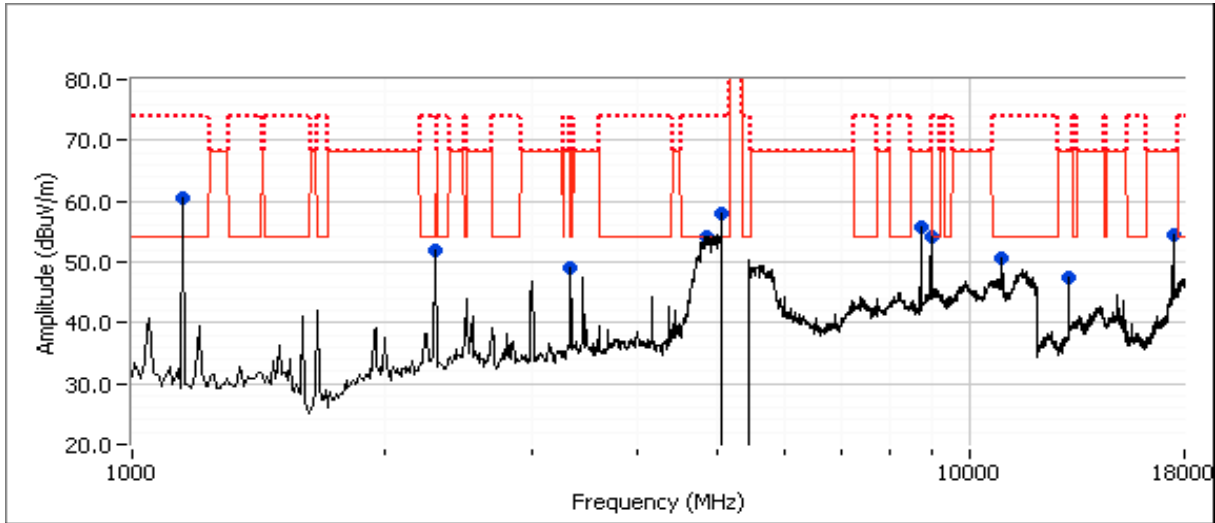
Channel: 40 Mode: n20
 Tx Chain: 2x2 Data Rate: MCS0

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15E		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
9000.470	52.2	V	54.0	-1.8	AVG	9	1.0	RB 1 MHz;VB 10 Hz;Peak
9000.480	58.2	V	74.0	-15.8	PK	9	1.0	RB 1 MHz;VB 3 MHz;Peak
2299.280	33.3	H	54.0	-20.7	AVG	13	1.0	RB 1 MHz;VB 10 Hz;Peak
2299.970	42.7	H	74.0	-31.3	PK	13	1.0	RB 1 MHz;VB 3 MHz;Peak
5047.500	51.7	H	54.0	-2.3	AVG	282	1.1	RB 1 MHz;VB 10 Hz;Peak
5047.200	63.3	H	74.0	-10.7	PK	282	1.1	RB 1 MHz;VB 3 MHz;Peak
4861.480	49.9	H	54.0	-4.1	AVG	292	1.0	RB 1 MHz;VB 10 Hz;Peak
4861.800	61.6	H	74.0	-12.4	PK	292	1.0	RB 1 MHz;VB 3 MHz;Peak
3331.940	53.7	V	68.3	-14.6	PK	321	1.0	RB 1 MHz;VB 3 MHz;Peak
10904.270	42.8	V	54.0	-11.2	AVG	340	1.0	RB 1 MHz;VB 10 Hz;Peak
10904.470	54.2	V	74.0	-19.8	PK	340	1.0	RB 1 MHz;VB 3 MHz;Peak
1150.610	48.6	H	54.0	-5.4	AVG	346	1.0	Intermittent signal
1150.050	56.2	H	74.0	-17.8	PK	346	1.0	Intermittent signal
8719.980	59.2	V	68.3	-9.1	PK	357	1.3	RB 1 MHz;VB 3 MHz;Peak
13080.050	59.8	V	68.3	-8.5	PK	83	1.2	RB 1 MHz;VB 3 MHz;Peak
17440.250	63.8	V	68.3	-4.5	PK	276	1.8	RB 1 MHz;VB 3 MHz;Peak

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

Note: For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dBuV/m). The measurement method required is a peak measurement (RB=1MHz, VB \geq 3MHz, peak detector).

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

Run #1c: High Channel

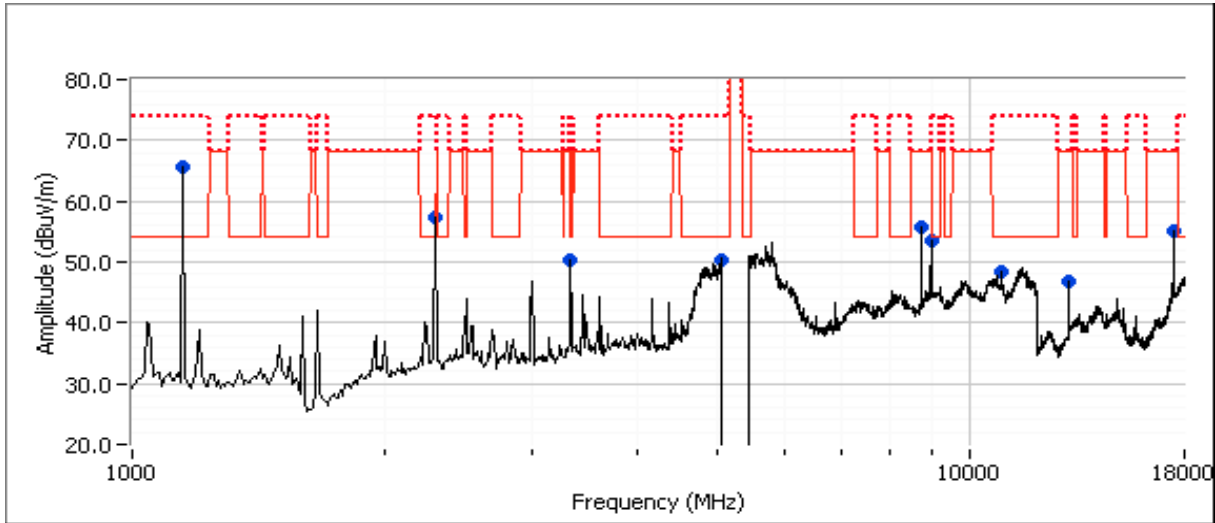
Channel: 48 Mode: n20
Tx Chain: 2x2 Data Rate: MCS0

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15E		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
9000.450	52.7	V	54.0	-1.3	AVG	14	1.0	RB 1 MHz;VB 10 Hz;Peak
9000.400	57.9	V	74.0	-16.1	PK	14	1.0	RB 1 MHz;VB 3 MHz;Peak
8720.090	58.0	V	68.3	-10.3	PK	351	1.1	RB 1 MHz;VB 3 MHz;Peak
3332.010	50.3	V	54.0	-3.7	AVG	322	1.7	RB 1 MHz;VB 10 Hz;Peak
3332.390	54.7	V	74.0	-19.3	PK	322	1.7	RB 1 MHz;VB 3 MHz;Peak
5052.000	47.8	H	54.0	-6.2	AVG	280	1.1	RB 1 MHz;VB 10 Hz;Peak
5052.190	59.6	H	74.0	-14.4	PK	280	1.1	RB 1 MHz;VB 3 MHz;Peak
10914.950	42.8	V	54.0	-11.2	AVG	274	1.0	RB 1 MHz;VB 10 Hz;Peak
10913.790	54.3	V	74.0	-19.7	PK	274	1.0	RB 1 MHz;VB 3 MHz;Peak
1150.190	41.0	H	54.0	-13.0	AVG	51	1.0	Intermittent signal
1150.020	42.8	H	74.0	-31.2	PK	51	1.0	Intermittent signal
2299.830	38.1	H	54.0	-15.9	AVG	7	1.0	RB 1 MHz;VB 10 Hz;Peak
2298.790	43.3	H	74.0	-30.7	PK	7	1.0	RB 1 MHz;VB 3 MHz;Peak
17445.970	63.6	V	68.3	-4.7	PK	225	1.1	RB 1 MHz;VB 3 MHz;Peak
13079.790	59.8	V	68.3	-8.5	PK	81	1.1	RB 1 MHz;VB 3 MHz;Peak

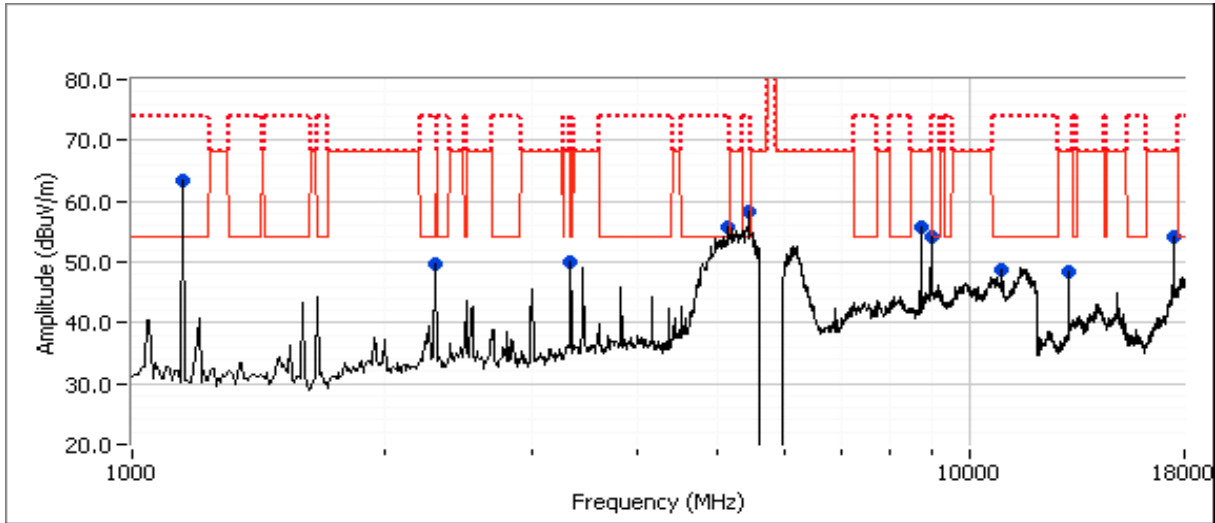
Note: Scans made between 18 - 40 GHz with the measurement antenna moved around the card and its antennas 20-50cm from the device indicated there were no significant emissions in this frequency range

Note: For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dBuV/m). The measurement method required is a peak measurement (RB=1MHz, VB≥3MHz, peak detector).

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A



Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Run #2b: Center Channel

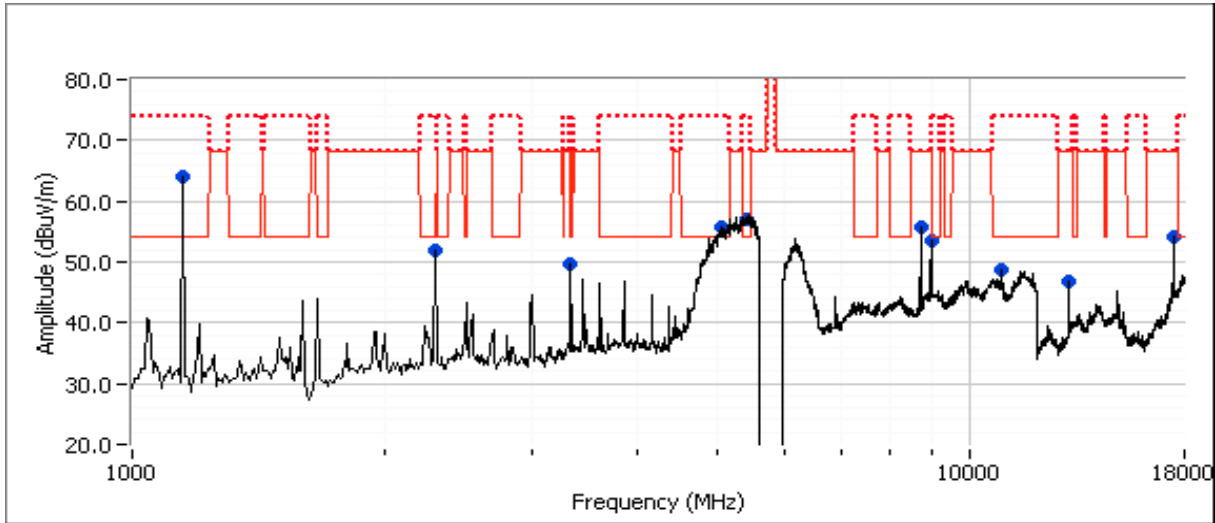
Channel: 157 Mode: n20
 Tx Chain: 2x2 Data Rate: MCS0

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15E		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
5410.170	53.8	H	54.0	-0.2	AVG	71	1.4	RB 1 MHz;VB 10 Hz;Peak
5409.850	65.9	H	74.0	-8.1	PK	71	1.4	RB 1 MHz;VB 3 MHz;Peak
8719.860	57.7	V	68.3	-10.6	PK	351	1.0	RB 1 MHz;VB 3 MHz;Peak
3332.070	50.0	V	54.0	-4.0	AVG	321	1.5	RB 1 MHz;VB 10 Hz;Peak
3332.440	53.7	V	74.0	-20.3	PK	321	1.5	RB 1 MHz;VB 3 MHz;Peak
10900.010	47.2	V	54.0	-6.8	AVG	290	2.0	RB 1 MHz;VB 10 Hz;Peak
10900.010	55.6	V	74.0	-18.4	PK	290	2.0	RB 1 MHz;VB 3 MHz;Peak
1150.920	41.8	V	54.0	-12.2	AVG	222	1.0	Intermittent signal
1149.890	58.3	V	74.0	-15.7	PK	222	1.0	Intermittent signal
2300.040	50.3	V	54.0	-3.7	AVG	152	1.0	RB 1 MHz;VB 10 Hz;Peak
2299.060	51.6	V	74.0	-22.4	PK	152	1.0	RB 1 MHz;VB 3 MHz;Peak
5065.650	51.3	H	54.0	-2.7	AVG	95	1.1	RB 1 MHz;VB 10 Hz;Peak
5066.740	63.0	H	74.0	-11.0	PK	95	1.1	RB 1 MHz;VB 3 MHz;Peak
9000.420	51.1	V	54.0	-2.9	AVG	5	1.0	RB 1 MHz;VB 10 Hz;Peak
9000.290	56.8	V	74.0	-17.2	PK	5	1.0	RB 1 MHz;VB 3 MHz;Peak
17436.980	63.1	V	68.3	-5.2	PK	223	1.1	RB 1 MHz;VB 3 MHz;Peak
13079.970	58.6	V	68.3	-9.7	PK	285	1.7	RB 1 MHz;VB 3 MHz;Peak

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

Note: For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dBuV/m). The measurement method required is a peak measurement (RB=1MHz, VB \geq 3MHz, peak detector).

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

Run #2c: High Channel

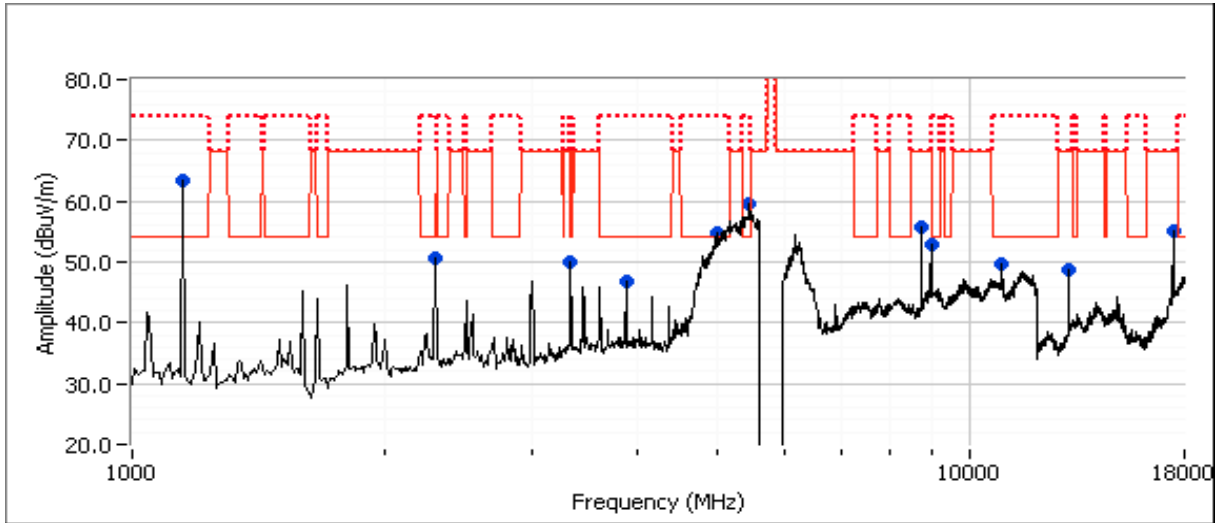
Channel: 165 Mode: n20
Tx Chain: 2x2 Data Rate: MCS0

Frequency MHz	Level dB μ V/m	Pol v/h	15.209 / 15E		Detector Pk/QP/Avg	Azimuth degrees	Height meters	Comments
			Limit	Margin				
5423.110	53.5	H	54.0	-0.5	AVG	68	1.0	RB 1 MHz;VB 10 Hz;Peak
5420.940	66.1	H	74.0	-7.9	PK	68	1.0	RB 1 MHz;VB 3 MHz;Peak
9000.360	52.8	V	54.0	-1.2	AVG	13	1.0	RB 1 MHz;VB 10 Hz;Peak
9000.460	57.9	V	74.0	-16.1	PK	13	1.0	RB 1 MHz;VB 3 MHz;Peak
2300.680	42.9	H	68.3	-25.4	PK	23	1.0	RB 1 MHz;VB 3 MHz;Peak
4986.600	49.5	H	54.0	-4.5	AVG	78	1.0	RB 1 MHz;VB 10 Hz;Peak
4987.100	60.8	H	74.0	-13.2	PK	78	1.0	RB 1 MHz;VB 3 MHz;Peak
3883.390	47.1	H	54.0	-6.9	AVG	81	1.9	RB 1 MHz;VB 10 Hz;Peak
3883.330	50.3	H	74.0	-23.7	PK	81	1.9	RB 1 MHz;VB 3 MHz;Peak
1150.020	39.0	H	54.0	-15.0	AVG	156	1.0	Intermittent signal
1150.100	44.7	H	74.0	-29.3	PK	156	1.0	Intermittent signal
10912.420	42.7	V	54.0	-11.3	AVG	310	1.0	RB 1 MHz;VB 10 Hz;Peak
10912.080	54.3	V	74.0	-19.7	PK	310	1.0	RB 1 MHz;VB 3 MHz;Peak
3331.960	51.0	V	68.3	-17.3	AVG	318	1.5	RB 1 MHz;VB 10 Hz;Peak
3332.060	54.5	V	74.0	-19.5	PK	318	1.5	RB 1 MHz;VB 3 MHz;Peak
8719.970	59.1	V	68.3	-9.2	PK	357	1.3	RB 1 MHz;VB 3 MHz;Peak
13080.110	59.0	V	68.3	-9.3	PK	285	1.8	RB 1 MHz;VB 3 MHz;Peak
17439.520	64.0	V	68.3	-4.3	PK	276	1.8	RB 1 MHz;VB 3 MHz;Peak

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

Note: For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dBuV/m). The measurement method required is a peak measurement (RB=1MHz, VB \geq 3MHz, peak detector).

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

RSS-210 (LELAN) and FCC 15.407(UNII) Antenna Port Measurements Power, PSD, Peak Excursion, 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.

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1	Power, 5150 - 5250MHz	15.407(a) (1) (iv)	Pass	a: 22.1dBm (0.162mW) n20: 22.5dBm (0.178mW) n40: 23.4dBm (0.219mW)
1	PSD, 5150 - 5250MHz	15.407(a) (1) (iv)	Pass	a: 10.2 dBm/MHz n20: 9.8 dBm/MHz n40: 8.1 dBm/MHz
1	Power, 5725 - 5850MHz	15.407(a) (3)	Pass	a: 22.2dBm (0.168mW) n20: 24.8dBm (0.300mW) n40: 24.6dBm (0.288mW)
1	PSD, 5725 - 5850MHz	15.407(a) (3)	Pass	a: 9.6 dBm/MHz n20: 11.8 dBm/MHz n40: 9.4 dBm/MHz
3	6dB BW (UNII3)	15.407(e)	Pass	a: 16.4 MHz n20: 17.6 MHz n40: 35.1 MHz

General Test Configuration

When measuring the conducted emissions from the EUT's antenna port, the antenna port of the EUT was connected to the spectrum analyzer or power meter via a suitable attenuator to prevent overloading the measurement system. All measurements are corrected to allow for the external attenuators and cables used.

Ambient Conditions: Temperature: 18-20 °C
 Rel. Humidity: 30-35 %

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, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

Procedure Comments:

Measurements performed in accordance with FCC KDB 789033 D01 v01r03, dated April 8, 2013

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11a	6Mbps	98.6%	Yes	1.33	0	0	752
n20	MCS0	98.6%	Yes	1.33	0	0	752
n40	MCS0	94.8%	Yes	0.362	0.23	0.47	2762

Sample Notes

Sample S/N: G33DT4PA003103
 Wifi MAC: BC307D5B7E36
 Driver: 5.99 RC 188.10

Date of Test: 02/12/15
 Test Engineer: Mehran Birgani
 Test Location: Lab 4

Config. Used: 1
 Config Change: -
 EUT Voltage: 120V/ 60Hz

Run #1: Bandwidth, Output Power and Power Spectral Density - MIMO Systems

Note 1:	Output power measured using a spectrum analyzer (see plots below). RBW=1MHz, VB=3 MHz, # of points in sweep $\geq 2 \times \text{span/RBW}$, RMS detector, power averaging on (transmitted signal was continuous) and power integration over 50 MHz for 802.11a and n20 modes and over 75 MHz for 802.11n 40MHz (method SA-1 of KDB 789033).
Note 2:	Measured using the same analyzer settings used for output power.
Note 3:	For RSS-210 the limit for the 5150 - 5250 MHz band accounts for the antenna gain as the maximum eirp allowed is 10dBm/MHz. The limits are also corrected for instances where the highest measured value of the PSD exceeds the average PSD (calculated from the measured power divided by the measured 99% bandwidth) by more than 3dB by the amount that the measured value exceeds the average by more than 3dB.
Note 4:	99% Bandwidth measured in accordance with RSS GEN - RB > 1% of span and VB $\geq 3 \times \text{RB}$
Note 5:	For MIMO systems the total output power and total PSD are calculated from the sum of the powers of the individual chains (in linear terms). The antenna gain used to determine the EIRP and limits for PSD/Output power depends on the operating mode of the MIMO device. If the signals are non-coherent between the transmit chains then the gain used to determine the limits is the highest gain of the individual chains and the EIRP is the sum of the products of gain and power on each chain. If the signals are coherent then the effective antenna gain is the sum (in linear terms) of the gains for each chain and the EIRP is the product of the effective gain and total power.



EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

Antenna Gain Information

Freq	Antenna Gain (dBi) / Chain				BF	MultiChain Legacy	CDD	Sectorized / Xpol	Dir G (PWR)	Dir G (PSD)
	1	2	3	4						
5150-5250	4.1	4.1			No	No	Yes	No	4.1	7.1
5250-5350	4.1	4.1			No	No	Yes	No	4.1	7.1
5470-5725	4.1	4.1			No	No	Yes	No	4.1	7.1
5725-5825	4.1	4.1			No	No	Yes	No	4.1	7.1

For devices that support CDD modes

Min # of spatial streams: 1
 Max # of spatial streams: 2

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; GA (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 DKB 662911 D01, v01r02. Spatial Multiplexing with Nant=4, Nss=2, for worse case condition. Array gain = $10 \cdot \log(4/2) = 3\text{dB}$.
Notes:	For systems with Beamforming and CDD, choose one the following options: Option 1: Delays are optimized for beamforming, rather than being selected from cyclic delay table of 802.11; Array gains calculated based on beamforming criteria. Option 2: Antennas are paired for beamforming, and the pairs are configured to use the cyclic delay diversity of 802.11; the array gain associated with beamforming with 2 antennas (3dB), and the array gain associated with CDD with two antennas (3dB for PSD and 0 dB for power)



EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

MIMO Device - 5150-5250 MHz Band - FCC

Mode: 11a

Max EIRP (mW): 416.9

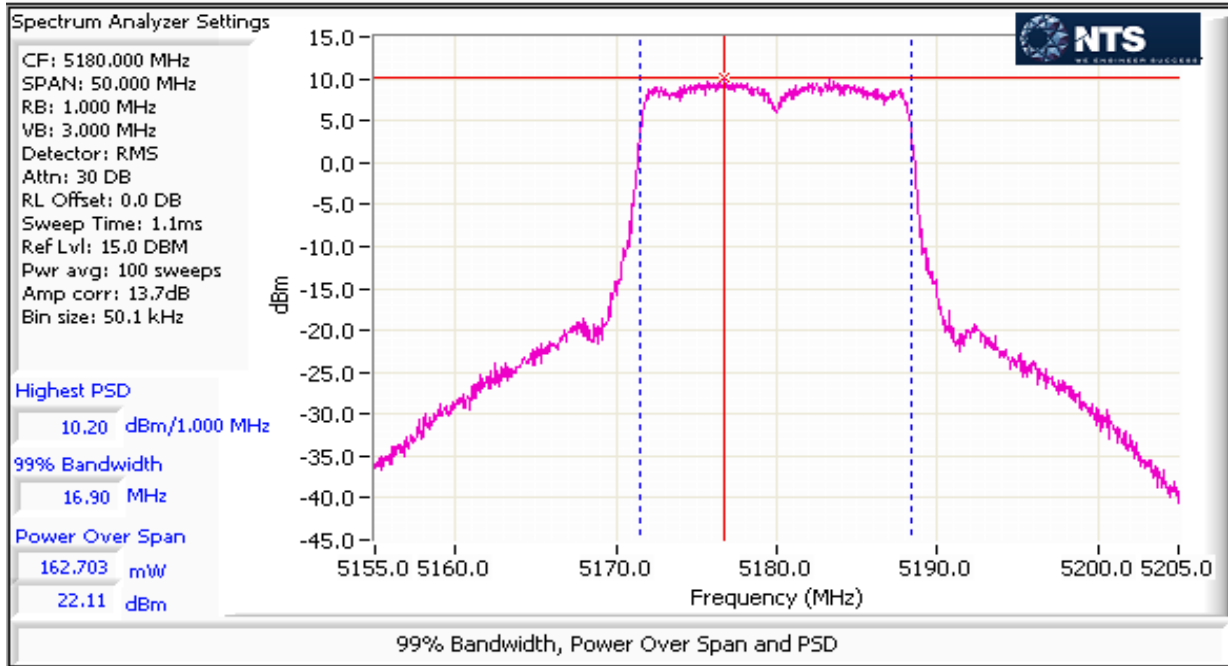
Frequency (MHz)	Chain	Software Setting	26dB BW (MHz)	Duty Cycle %	Power ¹ dBm	Total Power mW	dBm	FCC Limit dBm	Max Power (W)	Result
5180	1	20		100		162.2	22.1	24.0	0.162	Pass
	3									
	4									
	2				22.1					
5200	1	19		100		124.7	21.0	24.0		Pass
	3									
	4									
	2				21.0					
5240	1	19		100		128.2	21.1	24.0		Pass
	3									
	4									
	2				21.1					

5150-5250 PSD - FCC

Mode: 11a

Frequency (MHz)	Chain	Software Setting	99% BW (MHz)	Duty Cycle %	PSD dBm/MHz	Total PSD ¹ mW/MHz	dBm/MHz	FCC Limit dBm/MHz	IC Limit dBm/MHz	Result
5180	1	20	16.9	100		10.5	10.2	11.0	-	Pass
	3									
	4									
	2				10.2					
5200	1	19	16.9	100		7.5	8.7	11.0	-	Pass
	3									
	4									
	2				8.7					
5240	1	19	16.9	100		7.0	8.5	11.0	-	Pass
	3									
	4									
	2				8.5					

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

MIMO Device - 5150-5250 MHz Band - FCC

Mode: n20

Max EIRP (mW): 457.7

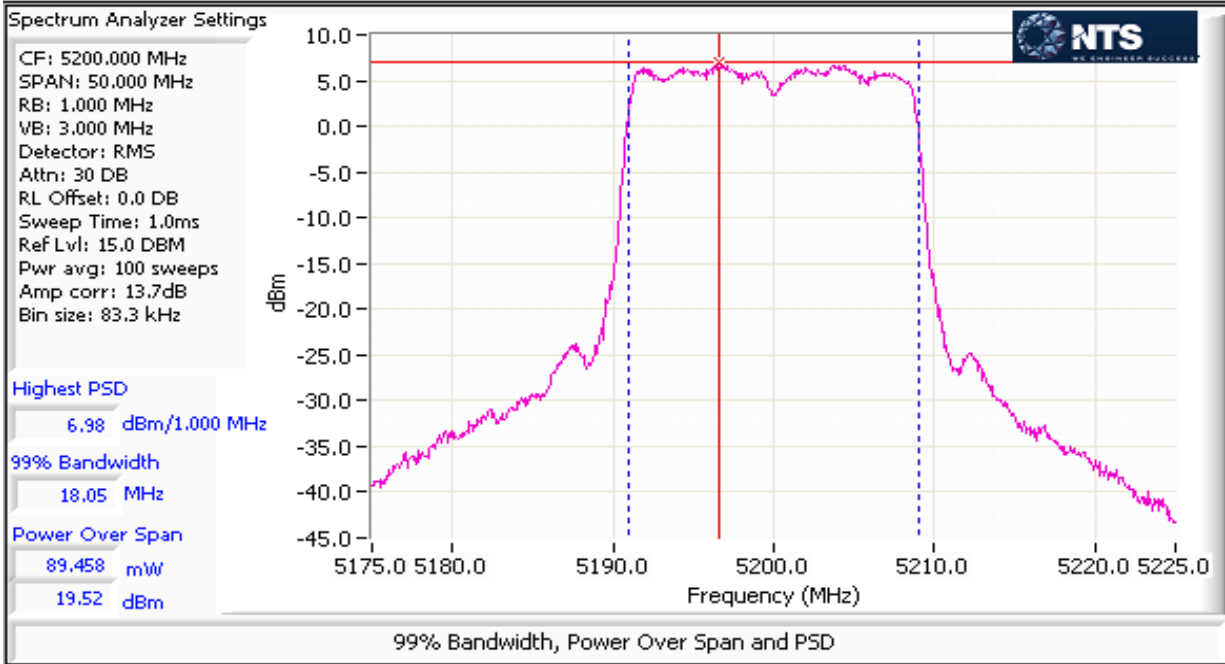
Frequency (MHz)	Chain	Software Setting	26dB BW (MHz)	Duty Cycle %	Power ¹ dBm	Total Power mW	dBm	FCC Limit dBm	Max Power (W)	Result
5180	1	17		100	18.8	151.4	21.8	24.0	0.178	Pass
	3									
	4									
	2									
5200	1	18		100	19.5	178.0	22.5	24.0		Pass
	3									
	4									
	2									
5240	1	18		100	19.5	176.2	22.5	24.0		Pass
	3									
	4									
	2									

5150-5250 PSD - FCC

Mode: n20

Frequency (MHz)	Chain	Software Setting	99% BW (MHz)	Duty Cycle %	PSD dBm/MHz	Total PSD ¹ mW/MHz	dBm/MHz	FCC Limit dBm/MHz	IC Limit dBm/MHz	Result
5180	1	17	18.1	100	6.0	8.0	9.1	9.9	-	Pass
	3									
	4									
	2									
5200	1	18	18.1	100	6.6	9.5	9.8	9.9	-	Pass
	3									
	4									
	2									
5240	1	18	18.1	100	6.6	9.0	9.5	9.9	-	Pass
	3									
	4									
	2									

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

MIMO Device - 5150-5250 MHz Band - FCC

Mode: n40

Max EIRP (mW): 564.0

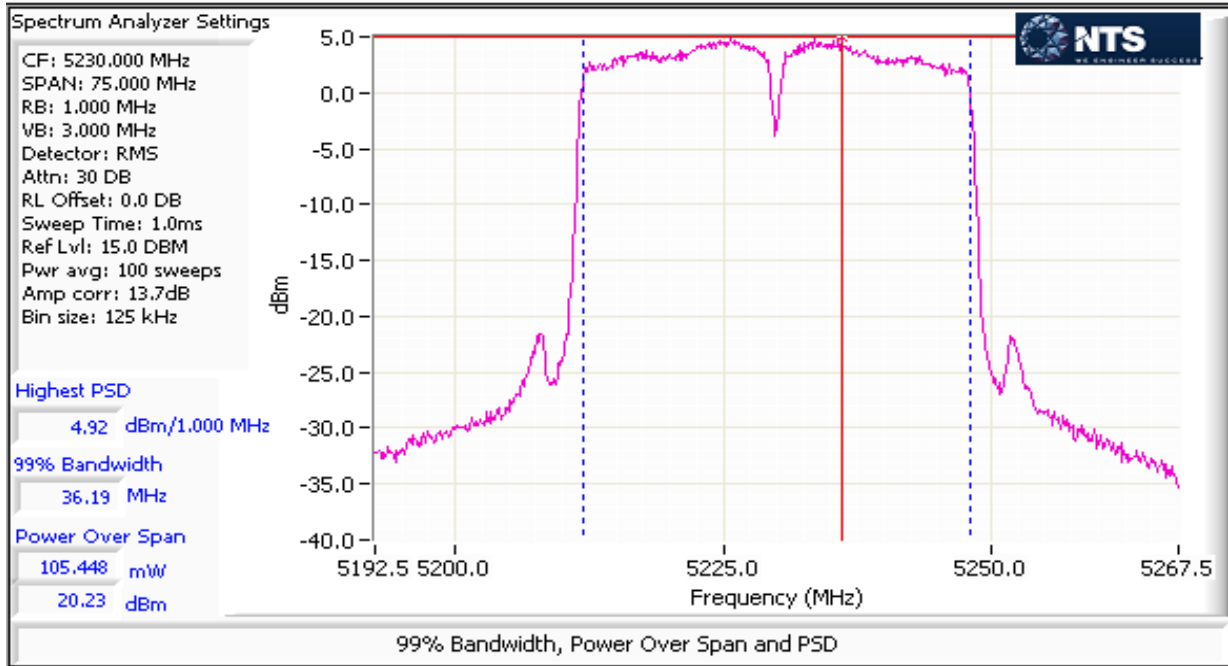
Frequency (MHz)	Chain	Software Setting	26dB BW (MHz)	Duty Cycle %	Power dBm	Total Power ¹ mW	dBm	FCC Limit dBm	Max Power (W)	Result
5190	1	14		94.8	15.4	69.7	18.4	24.0	0.219	Pass
	3									
	4									
	2									
5230	1	19		94.8	20.2	219.4	23.4	24.0		
	3									
	4									
	2									

5150-5250 PSD - FCC/IC

Mode: n40

Frequency (MHz)	Chain	Software Setting	99% BW (MHz)	Duty Cycle %	PSD dBm/MHz	Total PSD ¹ mW/MHz	dBm/MHz	FCC Limit dBm/MHz	IC Limit dBm/MHz	Result
5190	1	14	36.2	94.8	-0.2	2.0	3.0	9.9	-	Pass
	3									
	4									
	2									
5230	1	19	36.3	94.8	4.9	6.5	8.1	9.9	-	Pass
	3									
	4									
	2									

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

MIMO Device - 5725-5850 MHz Band - FCC

Mode: 11a

Max EIRP (mW): 430.5

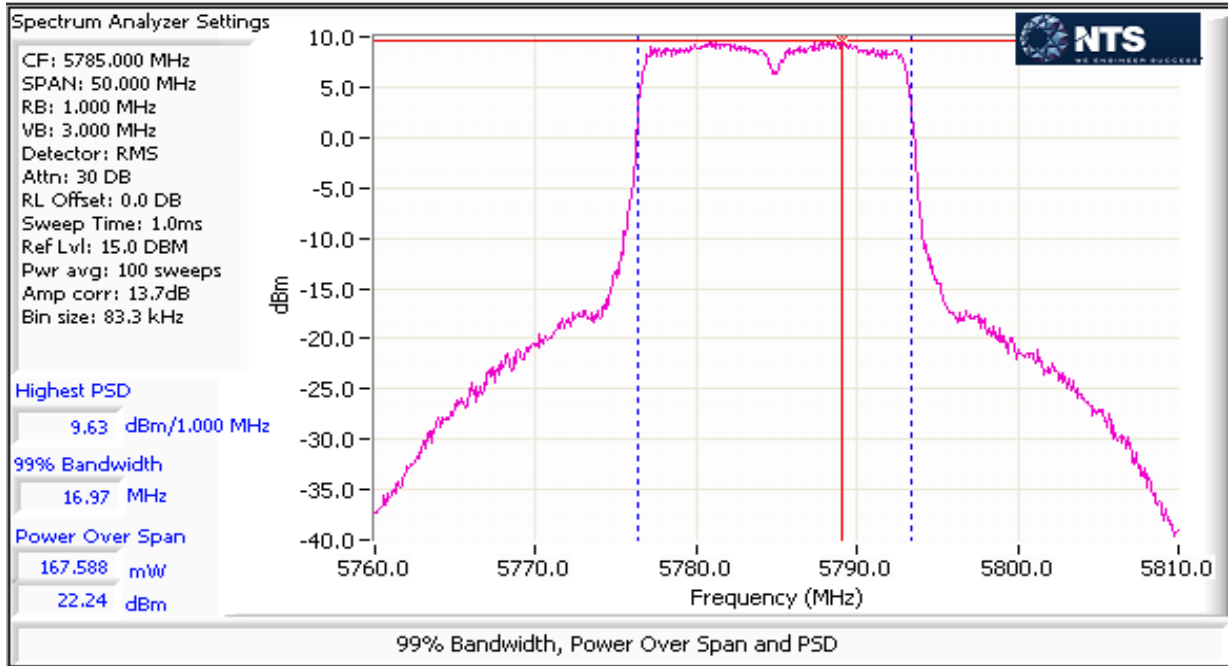
Frequency (MHz)	Chain	Software Setting	26dB BW (MHz)	Duty Cycle %	Power ¹ dBm	Total Power mW	dBm	FCC Limit dBm	Max Power (W)	Result
5745	1	16		100		66.2	18.2	30.0	0.168	Pass
	3									
	4									
	2				18.2					
5785	1	20		100		167.5	22.2	30.0		Pass
	3									
	4									
	2				22.2					
5825	1	19		100		135.8	21.3	30.0		Pass
	3									
	4									
	2				21.3					

5725-5850 PSD - FCC

Mode: 11a

Frequency (MHz)	Chain	Software Setting	99% BW (MHz)	Duty Cycle %	PSD dBm/MHz	Total PSD ¹ mW/MHz	dBm/MHz	FCC Limit dBm/500kHz	IC Limit	Result
5745	1	16	17.0	100		3.6	5.6	30.0	-	Pass
	3									
	4									
	2				5.6					
5785	1	20	17.0	100		9.2	9.6	30.0	-	Pass
	3									
	4									
	2				9.6					
5825	1	19	17.0	100		7.7	8.9	30.0	-	Pass
	3									
	4									
	2				8.9					

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

MIMO Device - 5725-5850 MHz Band - FCC

Mode: n20

Max EIRP (mW): 299.6

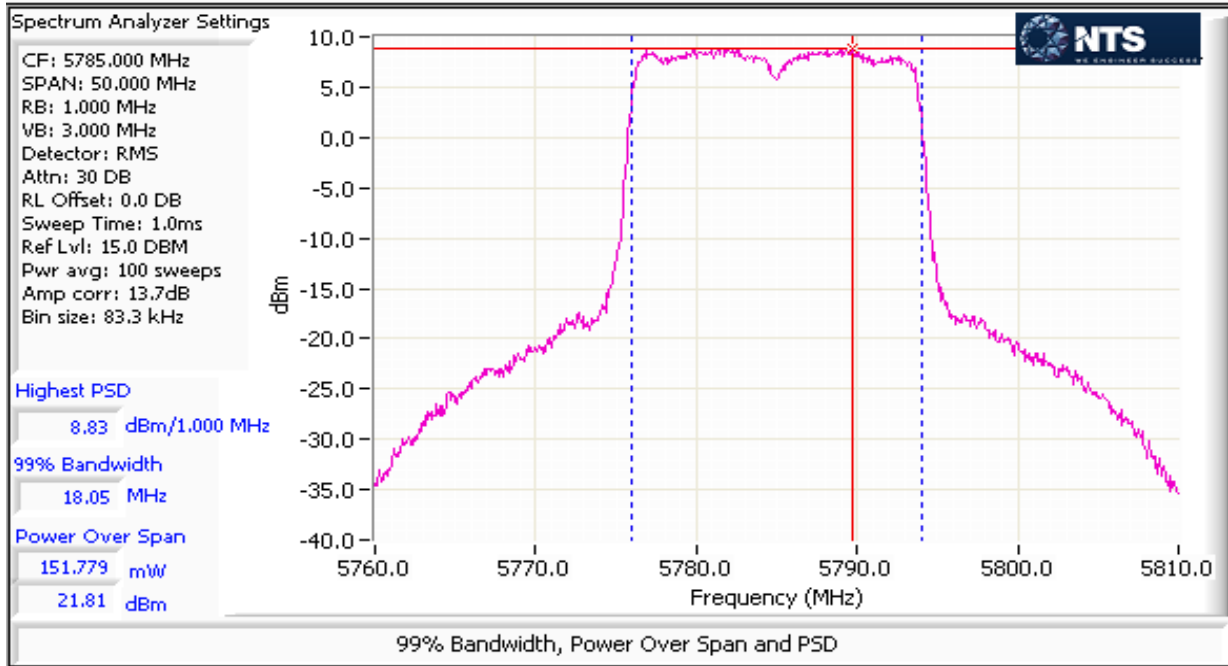
Frequency (MHz)	Chain	Software Setting	26dB BW (MHz)	Duty Cycle %	Power ¹ dBm	Total Power mW	dBm	FCC Limit dBm	Max Power (W)	Result
5745	1	16		100	18.7	135.6	21.3	30.0	0.300	Pass
	3									
	4									
	2				17.9					
5785	1	20		100	21.8	299.6	24.8	30.0		Pass
	3									
	4									
	2				21.7					
5825	1	19		100	21.0	255.6	24.1	30.0		Pass
	3									
	4									
	2				21.2					

5725-5850 PSD - FCC

Mode: n20

Frequency (MHz)	Chain	Software Setting	99% BW (MHz)	Duty Cycle %	PSD dBm/MHz	Total PSD ¹ mW/MHz	dBm/MHz	FCC Limit dBm/500kHz	IC Limit	Result
5745	1	16	18.0	100	5.8	7.3	8.6	28.9	-	Pass
	3									
	4									
	2				5.4					
5785	1	20	18.1	100	8.8	15.2	11.8	28.9	-	Pass
	3									
	4									
	2				8.8					
5825	1	19	18.1	100	8.2	13.1	11.2	28.9	-	Pass
	3									
	4									
	2				8.2					

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A





EMC Test Data

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
	Project Manager: Irene Rademacher
Contact: Mark Rieger	Project Coordinator: -
Standard: FCC 15.407 (New Rules)	Class: N/A

MIMO Device - 5725-5850 MHz Band - FCC

Mode: n40

Max EIRP (mW): 740.8

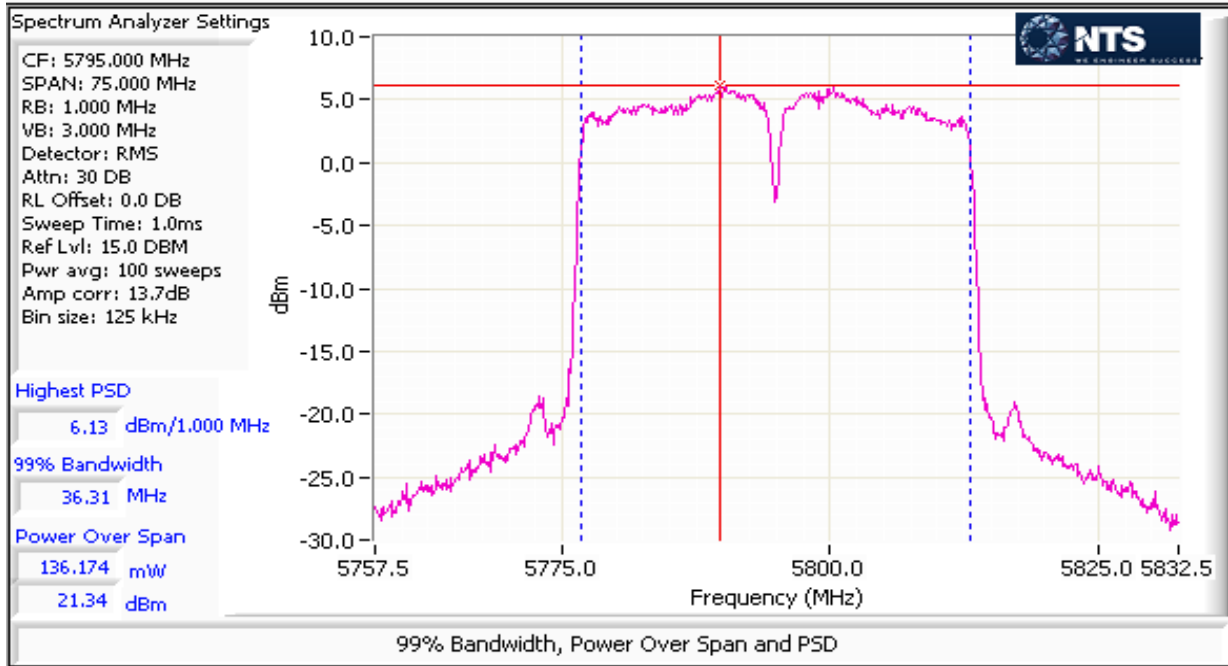
Frequency (MHz)	Chain	Software Setting	26dB BW (MHz)	Duty Cycle %	Power dBm	Total Power ¹ mW	dBm	FCC Limit dBm	Max Power (W)	Result
5755	1	15		94.8	16.8	95.7	19.8	30.0	0.288	Pass
	3									
	4									
	2									
5795	1	20		94.8	21.3	288.2	24.6	30.0		
	3									
	4									
	2									

5725-5850 PSD - FCC/IC

Mode: n40

Frequency (MHz)	Chain	Software Setting	99% BW (MHz)	Duty Cycle %	PSD dBm/MHz	Total PSD ¹ mW/MHz	dBm/MHz	FCC Limit dBm/500kHz	IC Limit	Result
5755	1	15	36.3	94.8	1.5	2.9	4.7	28.9	-	Pass
	3									
	4									
	2									
5795	1	20	36.3	94.8	6.1	8.8	9.4	28.9	-	Pass
	3									
	4									
	2									

Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A



Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

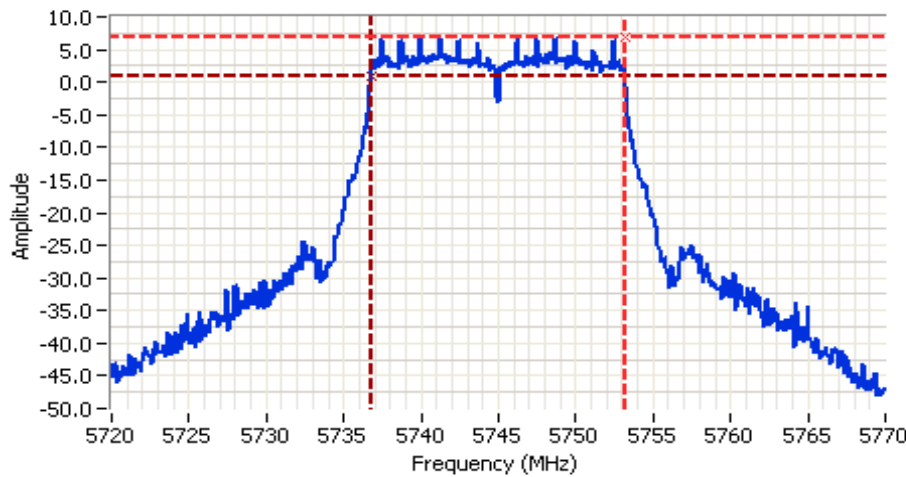
Run #2: Bandwidth Measurements

Mode: 11a
 5725-5850MHz band (UNII3)

Testing performed on port: 2

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (kHz)	
		6dB	99%	6dB	99%
16	5745	16.4	17.0	100	1000
20	5785	16.4	17.0	100	1000
19	5825	16.4	17.0	100	1000

Note 1: 6dB 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.



Analyzer Settings
 Agilent Technologies, E4446A
 CF: 5745.000 MHz
 SPAN: 50.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 10 DB
 RL Offset: 13.7 DB
 Sweep Time: 4.8ms
 Ref Lvl: 13.7 DBM

Comments
 6dB BW: 16.4 MHz

Cursor 1	5753.1667	6.97	Delta Freq.	16.417
Cursor 2	5736.7500	0.97	Delta Amplitude	6.00

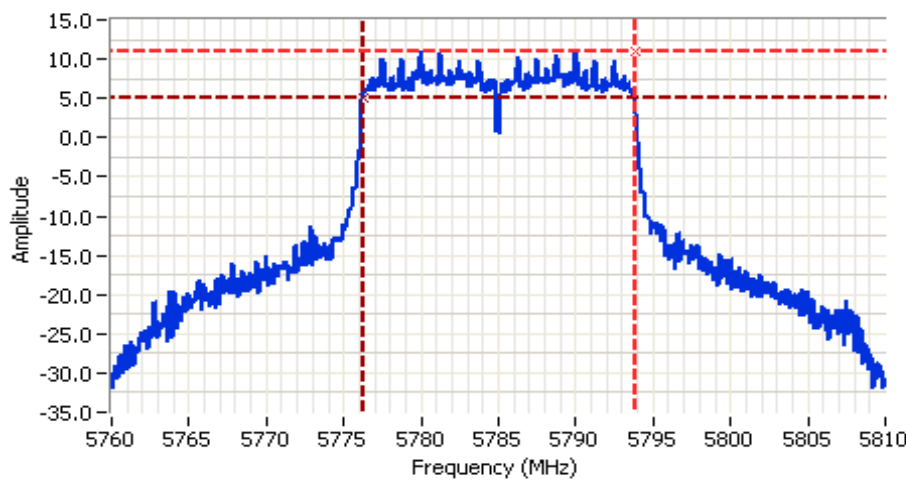
Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Mode: n20
 5725-5850MHz band (UNII3)

Testing performed on port: **2**

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (kHz)	
		6dB	99%	6dB	99%
16	5745	17.6	18.0	100	1000
20	5785	17.6	18.1	100	1000
19	5825	17.6	18.1	100	1000

Note 1: 6dB 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.



Analyzer Settings

Agilent Technologies, E4446A
 CF: 5785.000 MHz
 SPAN: 50.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 10 DB
 RL Offset: 13.7 DB
 Sweep Time: 4.8ms
 Ref Lvl: 13.7 DBM

Comments

6dB BW: 17.6 MHz

Cursor 1	5793.8333	11.08		Delta Freq.	17.583
Cursor 2	5776.2500	5.08		Delta Amplitude	6.00



EMC Test Data

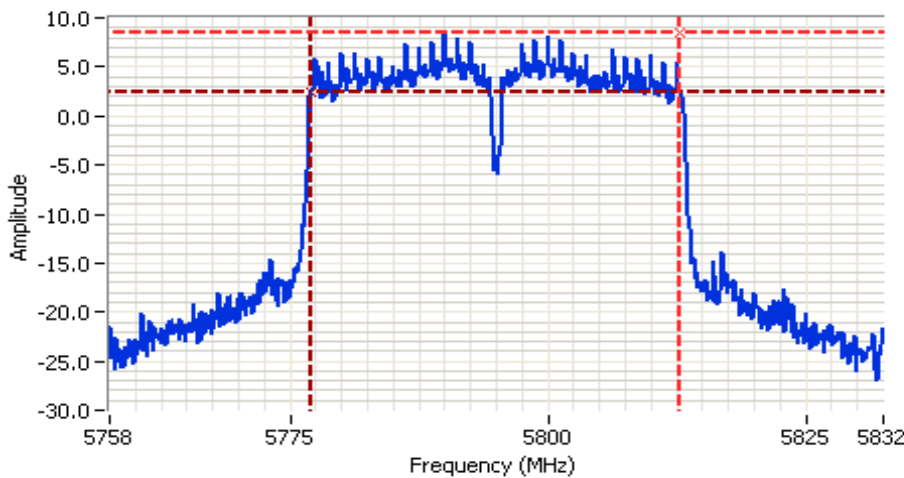
Client: Pace Americas, Inc	Job Number: J97522
Model: HR44-700	T-Log Number: T97548
Contact: Mark Rieger	Project Manager: Irene Rademacher
Standard: FCC 15.407 (New Rules)	Project Coordinator: -
	Class: N/A

Mode: n40
5725-5850MHz band (UNII3)

Testing performed on port: 2

Power Setting	Frequency (MHz)	Bandwidth (MHz)		RBW Setting (MHz)	
		6dB	99%	6dB	99%
15	5755	35.1	36.3	100	1000
20	5795	35.6	36.3	100	1000

Note 1: 6dB 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.



Analyzer Settings
 Agilent Technologies, E4446A
 CF: 5795.000 MHz
 SPAN: 75.000 MHz
 RB: 100 kHz
 VB: 300 kHz
 Detector: POS
 Attn: 10 DB
 RL Offset: 13.7 DB
 Sweep Time: 7.2ms
 Ref Lvl: 13.7 DBM

Comments
 6dB BW: 35.6 MHz

Cursor 1: 5812.7500 8.50 Delta Freq. 35.625
 Cursor 2: 5777.1250 2.50 Delta Amplitude 6.00



End of Report

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