

EMC Test Report

Application for Grant of Equipment Authorization

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

Model: B3000n Communication Badge

IC CERTIFICATION #: 4362A-B3000N
 FCC ID: QGZB3000N

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TEST SITE(S): National Technical Systems - Silicon Valley
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IC SITE REGISTRATION #: 2845B-3; 2845B-4, 2845B-5

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Testing Cert #0214.26

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REVISION HISTORY

Rev#	Date	Comments	Modified By
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SCOPE

An electromagnetic emissions test has been performed on the Vocera Communications, Inc. model B3000n Communication Badge, 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 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.

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 Vocera Communications, Inc. model B3000n Communication Badge complied with the requirements of the following regulations:

RSS 210 Issue 8 “Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment”
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 Vocera Communications, Inc. model B3000n Communication Badge and therefore apply only to the tested sample. The sample was selected and prepared by Rob Holt of Vocera Communications, 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(e)	A9.2(1)	Indoor operation only	Refer to user's manual	N/A	Complies
15.407(a) (2)	-	26dB Bandwidth	a: 19.9MHz n20: 20.3MHz n40: 40.1MHz	N/A – limits output power if < 20MHz	N/A
15.407 (a) (1)	A9.2(1)	Output Power	a: 14.4dBm (27.8mW) n20: 14.4dBm (27.7mW) n40: 14.3dBm (27.0mW) (Max eirp: 0.056W)	17dBm	Complies
15.407 (a) (1)	-	Power Spectral Density	a: 1.6dBm/MHz n20: 1.2dBm/MHz n40: -1.9dBm/MHz	4 dBm/MHz	Complies
-	A9.5 (2)			7 dBm/MHz	Complies

Operation in the 5.25 – 5.35 GHz Band

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.407(a) (2)	-	26dB Bandwidth	a: 19.9MHz n20: 20.2MHz n40: 40.3MHz	N/A – limits output power if < 20MHz	N/A
15.407(a) (2)	A9.2(2)	Output Power	a: 14.3dBm (27.0mW) n20: 14.8dBm (30.0mW) n40: 14.6dBm (29.0mW) (Max eirp: 0.060W)	24 dBm / 250mW (eirp < 30dBm)	Complies
15.407(a) (2)	-	Power Spectral Density	a: 1.4dBm/MHz n20: 1.8dBm/MHz n40: -1.5dBm/MHz	11 dBm/MHz	Complies
-	A9.2(2) / A9.5 (2)	Power Spectral Density		11 dBm / MHz ¹	Complies

Operation in the 5.47 – 5.725 GHz Band

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.407(a) (2)	-	26dB Bandwidth	a: 19.9MHz n20: 20.2MHz n40: 40.3MHz	N/A – limits output power if < 20MHz	N/A
15.407(a) (2)	A9.2(2)	Output Power	a: 14.1dBm (25.6mW) n20: 14.2dBm (26.1mW) n40: 14.4dBm (27.7mW) (Max eirp: 0.055W)	24 dBm / 250mW (eirp < 30dBm)	Complies
15.407(a) (2)	-	Power Spectral Density	a: 1.2dBm/MHz n20: 1.0dBm/MHz n40: -1.9dBm/MHz	11 dBm/MHz	Complies
-	A9.2(2) / A9.5 (2)	Power Spectral Density		11 dBm / MHz ²	Complies
KDB 443999	A9	Non-operation in 5600 – 5650 MHz sub band	Device cannot operate in the 5600 – 5650 MHz band –refer to Operational Description		Complies

¹ Reduced from 11dBm because highest value exceeded the average value by more than 3dB² Reduced from 11dBm because highest value exceeded the average value by more than 3dB

Requirements for all U-NII/LELAN bands

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.407	A9.5a	Modulation	OFDM Modulation is used	Digital modulation is required	Complies
15.407(b) (5) / 15.209	A9.3	Spurious Emissions	53.9 dB μ V/m @ 5150.0 MHz (-0.1 dB)	Refer to page 20	Complies
15.407(b) (5) / 15.209					
15.407(a)(6)	-	Peak Excursion Ratio	9dB	< 13dB	Complies
-	A9.5 (3)	Channel Selection	Spurious emissions tested at outermost channels in each band	Device was tested on the top, bottom and center channels in each band	N/A
15	-		Measurements on three channels in each band		Complies
15.407 (c)	A9.5(4)	Operation in the absence of information to transmit	Operation is discontinued in the absence of information	Device shall automatically discontinue operation in the absence of information to transmit	Complies
15.407 (g)	A9.5 (5)	Frequency Stability	Frequency stability is better than 10ppm	Signal shall remain within the allocated band	Complies
15.407 (h1)	A9.4	Transmit Power Control	TPC is not required as the device operates at below 500mW eirp	The U-NII device shall have the capability to operate with a mean EIRP value lower than 24dBm (250mW)	Complies
15.407 (h2)	A9.4	Dynamic frequency Selection (device without radar detection)	Refer to separate test report, reference R95844	Channel move time < 10s Channel closing transmission time < 260ms	Complies
-	A9.9g	User Manual information	Refer to Exhibit 6 for details	Warning regarding interference from Satellite Systems	Complies

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part	RSS Rule part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203	-	RF Connector	Antenna is integral to EUT	Unique or integral antenna required	Complies
15.207	RSS GEN Table 4	AC Conducted Emissions	N/A – EUT is battery powered.		
15.247 (b) (5) 15.407 (f)	RSS 102	RF Exposure Requirements	Refer to SAR report and RSS 102 declaration	Refer to OET 65, FCC Part 1 and RSS 102	Complies
-	RSP 100 RSS GEN 7.1.3	User Manual	Refer to Users Manual	Statement required regarding non-interference	Complies
-	RSP 100 RSS GEN 4.6.1	99% Bandwidth	a: 16.8MHz n20: 18.0MHz n40: 36.5MHz	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)	dB μ V/m	25 to 1000 MHz 1000 to 40000 MHz	± 3.6 dB ± 6.0 dB
Conducted Emissions (AC Power)	dB μ V	0.15 to 30 MHz	± 2.4 dB

EQUIPMENT UNDER TEST (EUT) DETAILS**GENERAL**

The Vocera Communications, Inc. model B3000n Communication Badge is an 802.11abgn + BT 3.0 pendent that is designed to provide communication to mobile users. 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 EUT is battery powered and is unable to transmit while charging.

The sample was received on March 25, 2014 and tested on March 26-27, April 1, June 6, 11-13, and 16, 2014. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Vocera Communications	B3000n (Northstar)	Communication Badge	3E, 3C, 4E	QGZB3000N

OTHER EUT DETAILS

802.11abgn, 1x1, no diversity
Bluetooth 3.0 (no LE)
No simultaneous transmission of BT/WiFi
Handheld
2.4GHz – 20MHz operation only
5GHz – 20/40MHz operation
DFS Client (see below)
Testing was performed with the Varta Standard Battery installed

ANTENNA SYSTEM

Internal antenna, 3dBi @ 2.4GHz and 5GHz

ENCLOSURE

The EUT enclosure is primarily constructed of Plastic. It measures approximately 9.8 cm wide by 3.6 cm deep by 1.8 cm high.

MODIFICATIONS

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

SUPPORT EQUIPMENT

No support equipment was used during testing.

EUT INTERFACE PORTS

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

Port	Connected To	Description	Cable(s)		Length(m)
			Shielded or Unshielded		
Headphones	Not connected	-	-	-	-

Preliminary testing showed no affect on radio related emissions with a headphone cable connected.

EUT OPERATION

The EUT was configured for continuous transmission on the channel noted, worse case data rate, and the maximum output power.

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 FCC	Designation / Registration Numbers Canada	Location
Chamber 4	US0027	2845B-4	41039 Boyce Road Fremont, CA 94538-2435
Chamber 5	US0027	2845B-5	

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.

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.

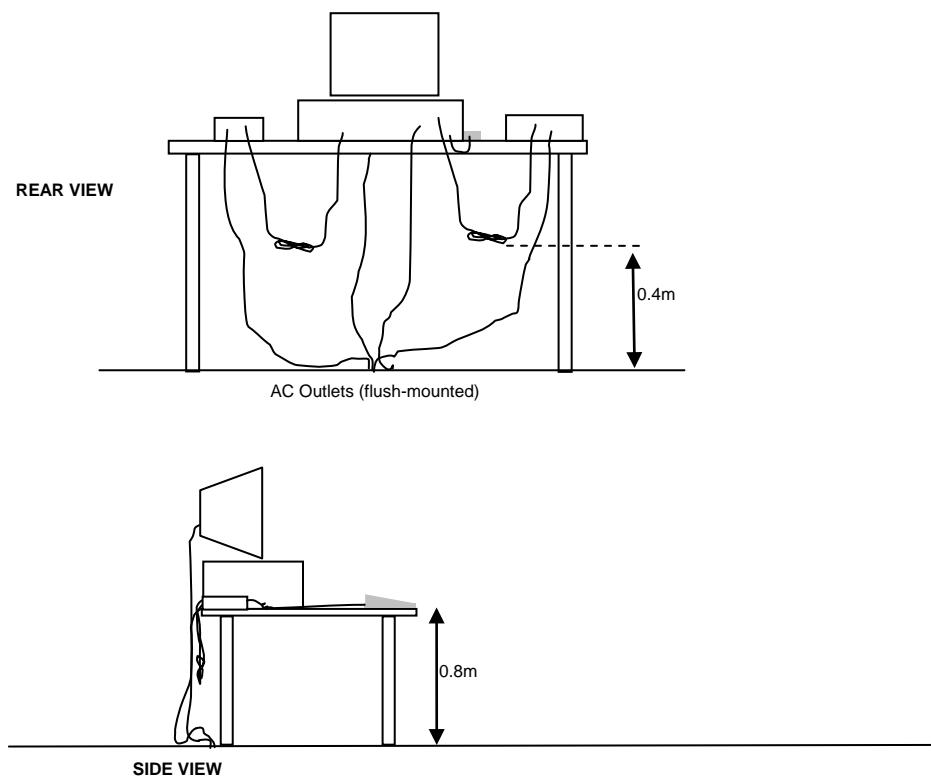
RADIATED EMISSIONS

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.

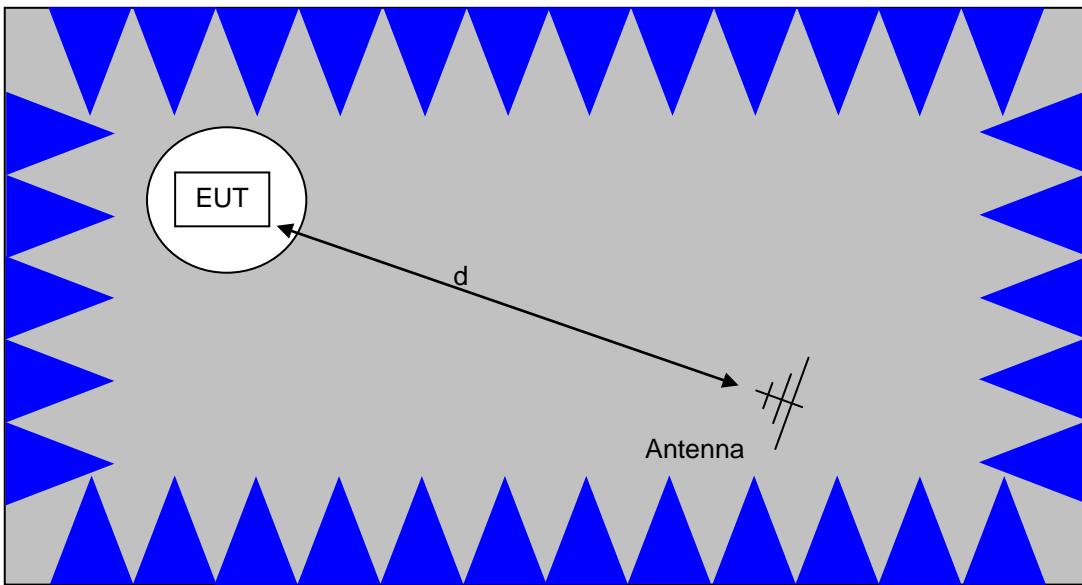
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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.

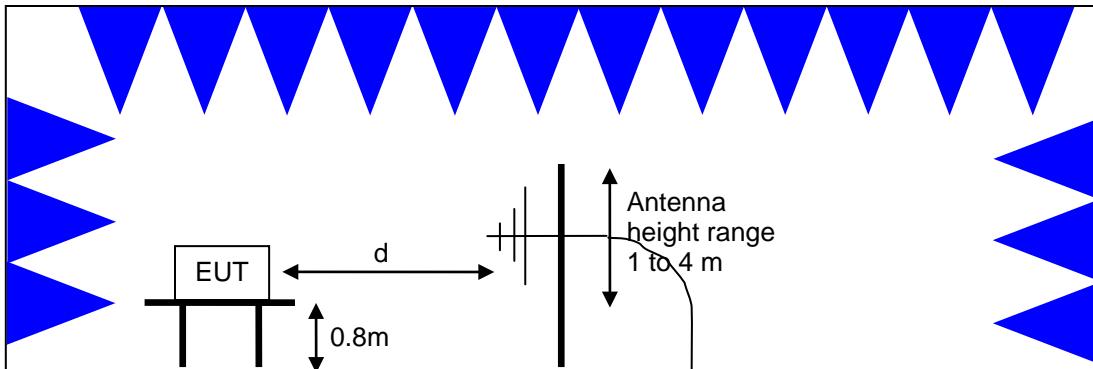


Typical Test Configuration for Radiated Field Strength Measurements



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.

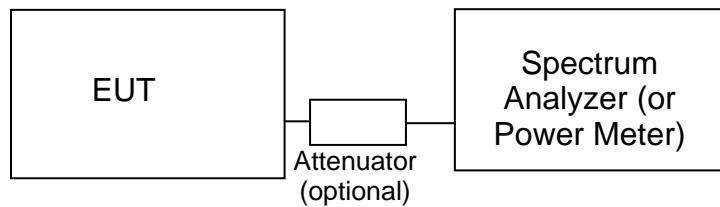
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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 bands³ (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	$2400/F_{\text{KHz}} @ 300\text{m}$	$67.6 - 20 \cdot \log_{10}(F_{\text{KHz}}) @ 300\text{m}$
0.490-1.705	$24000/F_{\text{KHz}} @ 30\text{m}$	$87.6 - 20 \cdot \log_{10}(F_{\text{KHz}}) @ 30\text{m}$
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

³ The restricted bands are detailed in FCC 15.203, RSS 210 Table 1 and RSS 310 Table 2

FCC 15.407 (a) OUTPUT POWER LIMITS

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
5150 – 5250	50mW (17 dBm)	4 dBm/MHz
5250 – 5350	250 mW (24 dBm)	11 dBm/MHz
5725 – 5825	1 Watts (30 dBm)	17 dBm/MHz

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. Fixed point-to-point applications using the 5725 – 5825 MHz band may use antennas with gains of up to 23dBi without this limitation. If the gain exceeds 23dBi then the output power limit of 1 Watt is reduced by 1dB for every dB the gain exceeds 23dBi.

The peak excursion envelope is limited to 13dB.

OUTPUT POWER LIMITS –LELAN DEVICES

The table below shows the limits for output power and output power density defined by RSS 210. 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
5150 – 5250	200mW (23 dBm) eirp	10 dBm/MHz eirp
5250 – 5350	250 mW (24 dBm) ⁴ 1W (30dBm) eirp	11 dBm/MHz
5470 – 5725	250 mW (24 dBm) ⁵ 1W (30dBm) eirp	11 dBm/MHz
5725 – 5825	1 Watts (30 dBm) 4W eirp	17 dBm/MHz

In addition, the power spectral density limit shall be reduced by 1dB for every dB the highest power spectral density exceeds the “average” power spectral density) by more than 3dB. The “average” power spectral density is determined by dividing the output power by $10\log(\text{EBW})$ where EBW is the 99% power bandwidth.

Fixed point-to-point applications using the 5725 – 5825 MHz band may use antennas with gains of up to 23dBi without this limitation. If the gain exceeds 23dBi then the output power limit of 1 Watt is reduced by 1dB for every dB the gain exceeds 23dBi.

⁴ If EIRP exceeds 500mW the device must employ TPC

⁵ If EIRP exceeds 500mW the device must employ TPC

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 under the LELAN/UNII rules, 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:

$$F_d = 20 * \text{LOG10} (D_m/D_s)$$

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:

$$F_d = 40 * \text{LOG10} (D_m/D_s)$$

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:

$$R_C = R_f + F_d$$

and

$$M = R_C - L_S$$

where:

R_f = 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:

$$E = \frac{1000000 \sqrt{30 P}}{d} \text{ microvolts per meter}$$

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

<u>Manufacturer</u>	<u>Description</u>	<u>Model</u>	<u>Asset #</u>	<u>Cal Due</u>
Radio Antenna Port (Power and Spurious Emissions), 26-Mar-14				
Agilent Technologies	PSA, Spectrum Analyzer, (installed options, 111, 115, 123, 1DS, B7J, HYX,	E4446A	2139	3/27/2014
Agilent Technologies	USB Average Power Sensor	U2001A	2442	12/19/2014
Radio Antenna Port (Power and Spurious Emissions), 27-Mar-14				
Agilent Technologies	USB Average Power Sensor	U2001A	2442	12/19/2014
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	2/6/2015
Radio Antenna Port (Power and Spurious Emissions), 01-Apr-14				
Rohde & Schwarz	Power Meter, Single Channel	NRVS	1422	1/24/2015
Rohde & Schwarz	Power Sensor 100 uW - 2 Watts use with 20dB attenuator sn:1031.6959.00 only	NRV-Z32	1423	9/17/2014
Agilent Technologies	USB Average Power Sensor	U2001A	2442	12/19/2014
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	2/6/2015
Radiated Emissions, 1,000 - 40,000 MHz, 06-Jun-14				
EMCO	Antenna, Horn, 1-18GHz	3115	868	6/19/2014
Hewlett Packard	High Pass filter, 8.2 GHz (Purple System)	P/N 84300-80039	1767	11/26/2014
Hewlett Packard	Head (Inc W1-W4, 1946 , 1947) Purple	84125C	1772	4/25/2015
A. H. Systems	Blue System Horn, 18-40GHz	SAS-574, p/n: 2581	2159	8/8/2014
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	2/20/2015
Micro-Tronics	Band Reject Filter, 5150-5350 MHz	BRC50703-02	2239	9/18/2014
Micro-Tronics	Band Reject Filter, 5470-5725 MHz	BRC50704-02	2240	9/18/2014
Micro-Tronics	Band Reject Filter, 5725-5875 MHz	BRC50705-02	2241	9/18/2014
Hewlett Packard	SpecAn 9 kHz - 40 GHz, (SA40) Purple	8564E (84125C)	2415	2/27/2015
Radiated Emissions, 1,000- 18,000 MHz, 12-Jun-14				
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/20/2015
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	2/20/2015
Hewlett Packard	SpecAn 9 kHz - 40 GHz, (SA40) Purple	8564E (84125C)	2415	2/27/2015
Radiated Emissions, Band edge, 13-Jun-14				
EMCO	Antenna, Horn, 1-18 GHz	3115	786	12/20/2015
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1630	6/22/2014
Radiated Emissions, Band Edge, 16-Jun-14				
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	8/23/2014
Rohde & Schwarz	EMI Test Receiver, 20 Hz-40 GHz	ESIB40 (1088.7490.40)	2493	1/11/2015

Appendix B Test Data

T94632 Pages 24 - 77



EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Product	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Emissions Standard(s):	FCC 15.247/15.E/RSS-210	Class:	-
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Vocera Communications

Product

Northstar (1x1 802.11abgn + BT)

Date of Last Test: 7/23/2014



EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/15.E/RSS-210	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: 20-24 °C
Rel. Humidity: 30-45 %

Summary of Results

Run #	Mode	Channel	Power Setting	Final Power Setting	Test Performed	Limit	Result / Margin
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Scans on "center" channel in all four OFDM modes to determine the worst case mode.

1	a	40 - 5200MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	63.9 dB μ V/m @ 6933.3 MHz (-4.4 dB)
	n20	40 - 5200MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	63.5 dB μ V/m @ 6933.4 MHz (-4.8 dB)
	n40	38 - 5190MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	65.0 dB μ V/m @ 6919.9 MHz (-3.3 dB)

n40 has worse case emission

2		46 - 5230MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	66.1 dB μ V/m @ 6973.4 MHz (-2.2 dB)
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Scans on "center" channel in all four OFDM modes to determine the worst case mode.

3	a	60 - 5300MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	47.6 dB μ V/m @ 10600.0 MHz (-6.4 dB)
	n20	60 - 5300MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	46.8 dB μ V/m @ 10600.1 MHz (-7.2 dB)
	n40	54 - 5270MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	62.1 dB μ V/m @ 7026.7 MHz (-6.2 dB)

n40 has worse case emission

4	n40	62 - 5310MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	46.7 dB μ V/m @ 10616.7 MHz (-7.3 dB)
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EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
			Class: N/A

Run #	Mode	Channel	Power Setting	Final Power Setting	Test Performed	Limit	Result / Margin
Scans on "center" channel in all four OFDM modes to determine the worst case mode.							
5	a	116 - 5580MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	48.6 dB μ V/m @ 7440.0 MHz (-5.4 dB)
	n20	116 - 5580MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	48.7 dB μ V/m @ 7440.0 MHz (-5.3 dB)
	n40	110 - 5550MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	47.9 dB μ V/m @ 7400.0 MHz (-6.1 dB)
Measurements on low and high channels in worst-case OFDM mode.							
6	n20	100 - 5500MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	48.3 dB μ V/m @ 7333.4 MHz (-5.7 dB)
	n20	140- 5700MHz	16	16	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	47.8 dB μ V/m @ 7600.0 MHz (-6.2 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.

Preliminary testing below 1GHz showed no radio related emissions



EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
			Class: N/A

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
11a	6	100.00	-	-	0	0	-
11n20	MCS0	100.00	-	-	0	0	-
11n40	MCS0	100.00	-	-	0	0	-

Sample Notes

Sample S/N: 3E

Notes

Device is handheld. Evaluation of the fundamental field strength at CH40, 60, 116, 11a mode was performed thru three orientation to determine worse case orientation for that particular band.

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 tabular results for final measurements.



EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #1, Radiated Spurious Emissions, 1,000 - 40,000 MHz. Operation in the 5150-5250 MHz Band

Date of Test: 6/6/2014 0:00

Config. Used: 1

Test Engineer: Deniz Demirci

Config Change: none

Test Location: FT Ch#4

EUT Voltage: Battery Operated

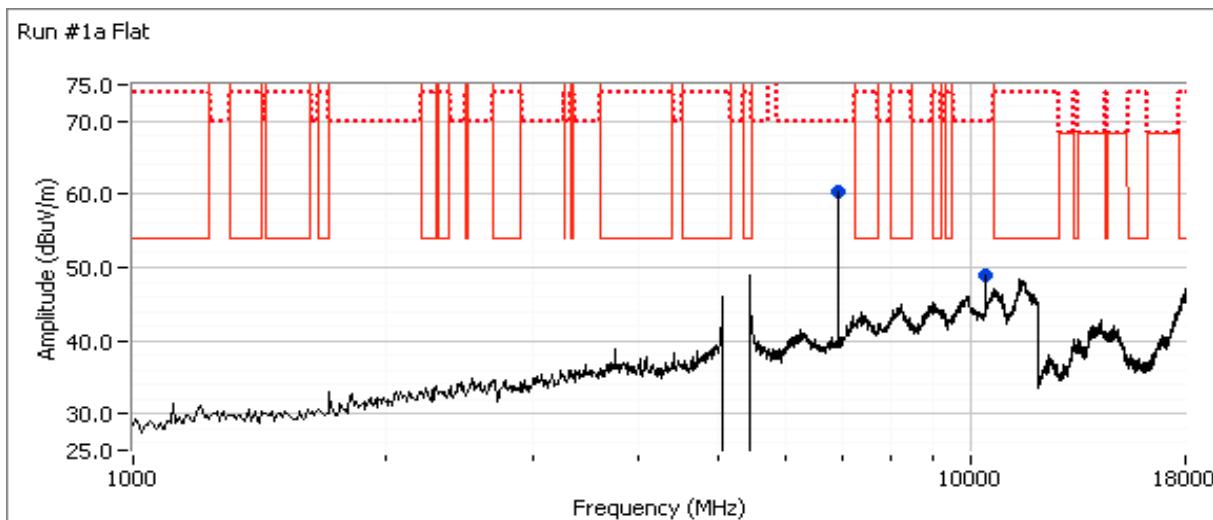
Run #1a: Center Channel

Channel: 40 Mode: a Orientation: Flat
Tx Chain: Main Data Rate: 6

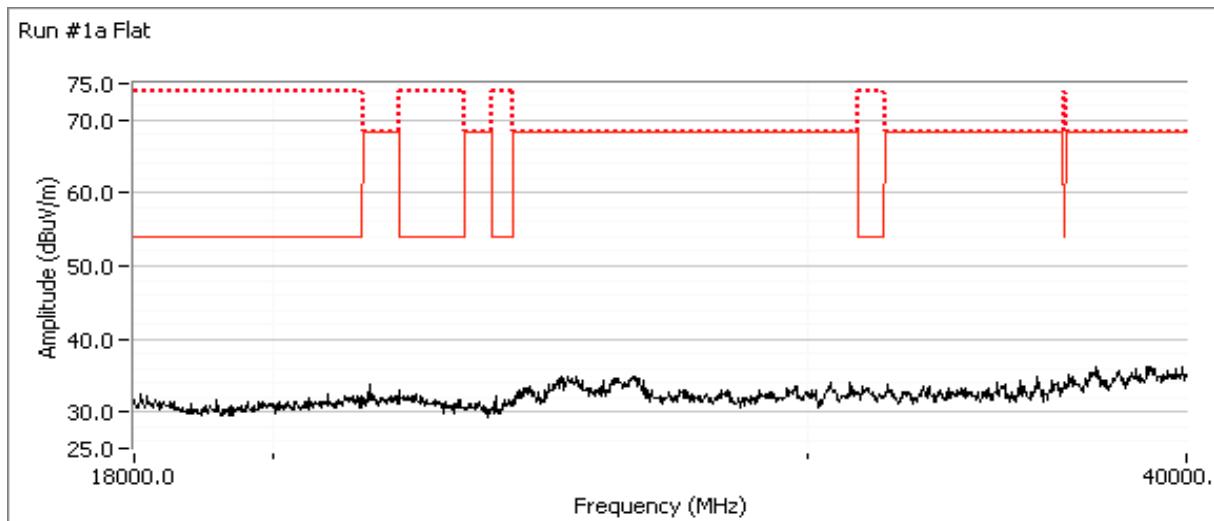
Frequency	Level	Pol	15.209 / 15E	Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters
6933.350	61.8	H	68.3	-6.5	PK	315	1.0
6933.300	59.7	V	68.3	-8.6	PK	291	1.6
10401.930	58.0	V	68.3	-10.3	PK	74	1.0
10403.530	54.0	H	68.3	-14.3	PK	81	1.7

Note 1: For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.

Note 2: For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dB μ V/m). The measurement method required is a peak measurement (RB=1MHz, VB \geq 3MHz, peak detector).



Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A





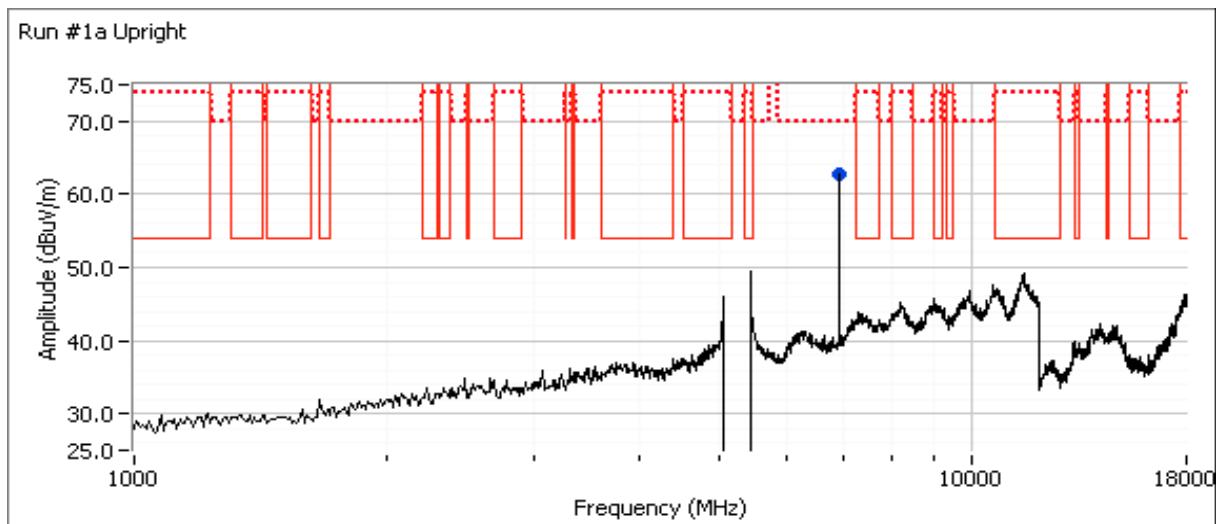
EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Channel: 40 Mode: a Orientation: Upright
Tx Chain: Main Data Rate: 6

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
6933.330	63.9	V	68.3	-4.4	PK	333	1.6	RB 1 MHz;VB 3 MHz;Peak
6933.390	61.8	H	68.3	-6.5	PK	131	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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	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).





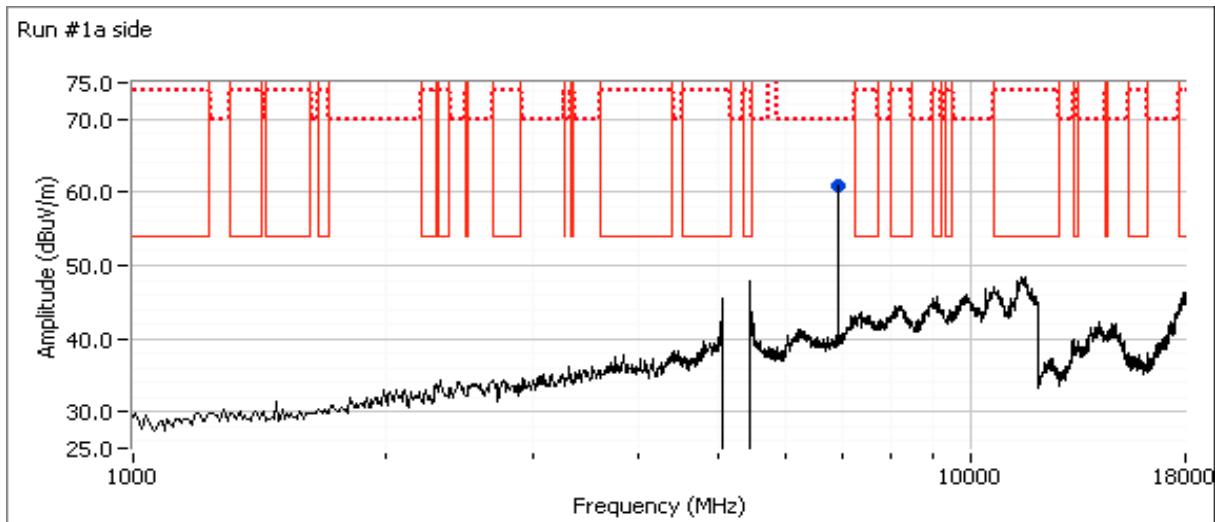
EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Channel: 40 Mode: a Orientation: Side
Tx Chain: Main Data Rate: 6

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
6933.390	62.2	V	68.3	-6.1	PK	69	1.7	RB 1 MHz;VB 3 MHz;Peak
6933.230	53.6	H	68.3	-14.7	PK	68	2.5	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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	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).



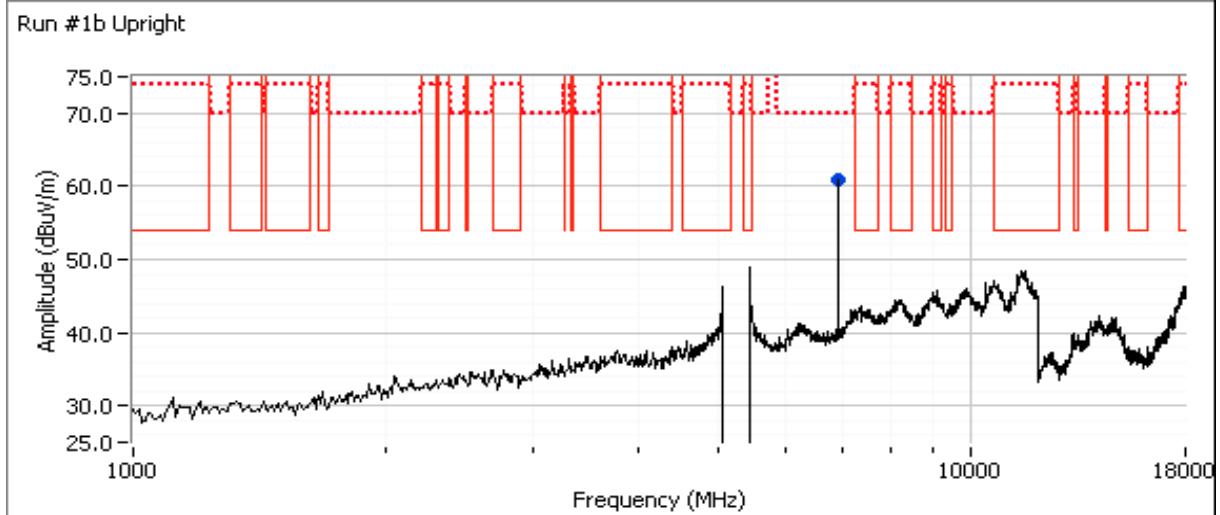
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #1b: Center Channel

Channel: 40 Mode: 11n20 Orientation: Upright
 Tx Chain: Main Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
6933.350	63.5	V	68.3	-4.8	PK	342	1.5	RB 1 MHz;VB 3 MHz;Peak
6933.240	61.8	H	68.3	-6.5	PK	125	1.0	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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dB μ V/m). The measurement method required is a peak measurement (RB=1MHz, VB≥3MHz, peak detector).



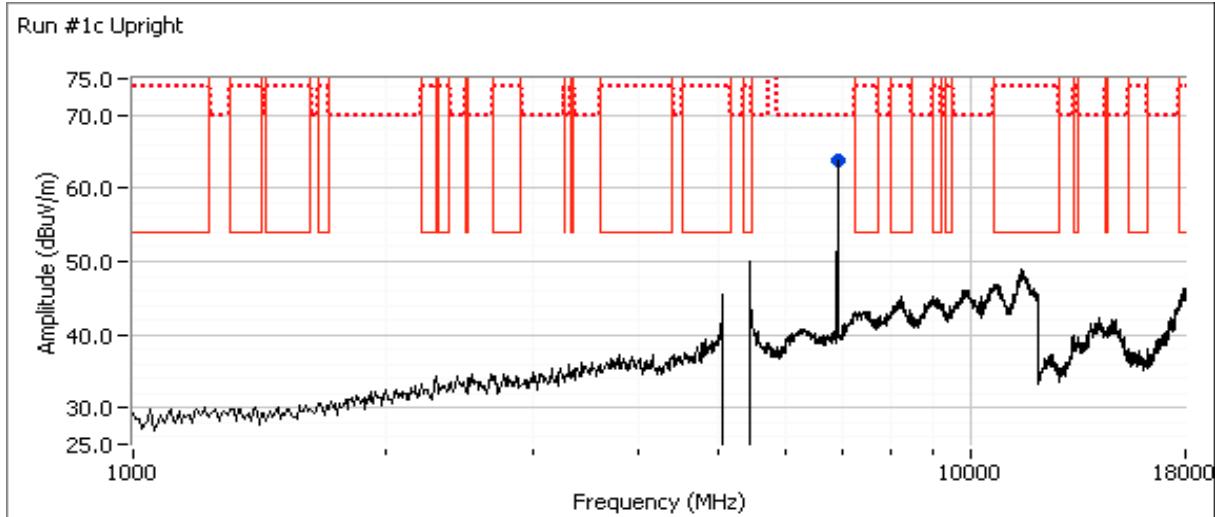
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #1c: Center Channel

Channel: 38 Mode: 11n40 Orientation: Upright
 Tx Chain: Main Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
6919.940	65.0	V	68.3	-3.3	PK	318	1.6	RB 1 MHz;VB 3 MHz;Peak
6920.000	61.1	H	68.3	-7.2	PK	115	1.3	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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dB μ V/m). The measurement method required is a peak measurement (RB=1MHz, VB \geq 3MHz, peak detector).



Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #2: Radiated Spurious Emissions, 1,000 - 40000 MHz. Operating Mode: Worse case from Run #1

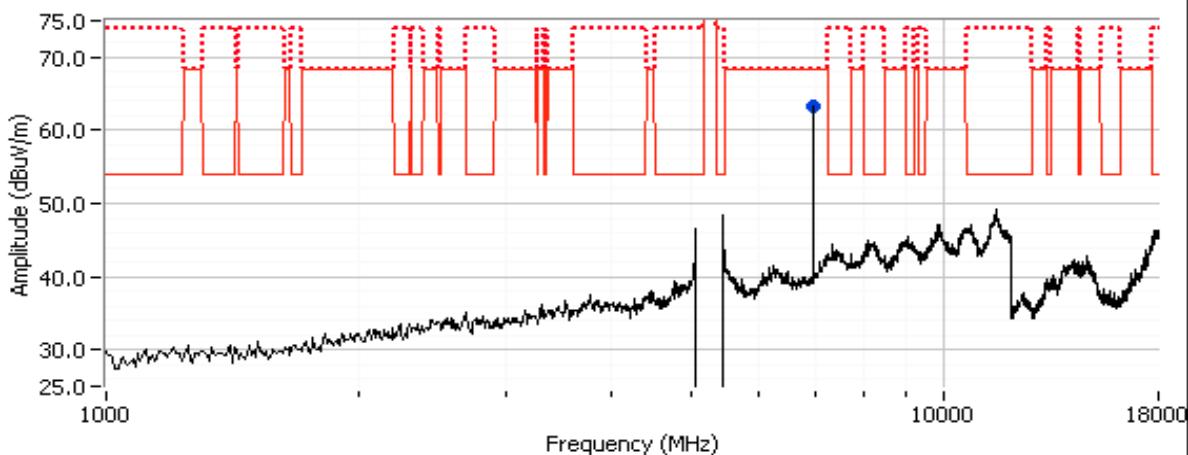
Run #2a: High Channel

Channel: 46 Mode: 11n40 Orientation: Upright
 Tx Chain: Main Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
6973.380	66.1	V	68.3	-2.2	PK	332	1.6	RB 1 MHz;VB 3 MHz;Peak
6973.370	60.7	H	68.3	-7.6	PK	118	1.0	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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dB μ V/m). The measurement method required is a peak measurement (RB=1MHz, VB \geq 3MHz, peak detector).

Run #2a Upright





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/15.E/RSS-210	Class:	N/A

Run #3, Radiated Spurious Emissions, 1,000 - 40,000 MHz. Operation in the 5250-5350 MHz Band

Date of Test: 6/11/2014

Config. Used: 1

Test Engineer: Deniz Demirci

Config Change: None

Test Location: FT CH#3

EUT Voltage: Battery Operated

Run #3a: Center Channel

Channel: 60

Mode: a

Orientation: Flat

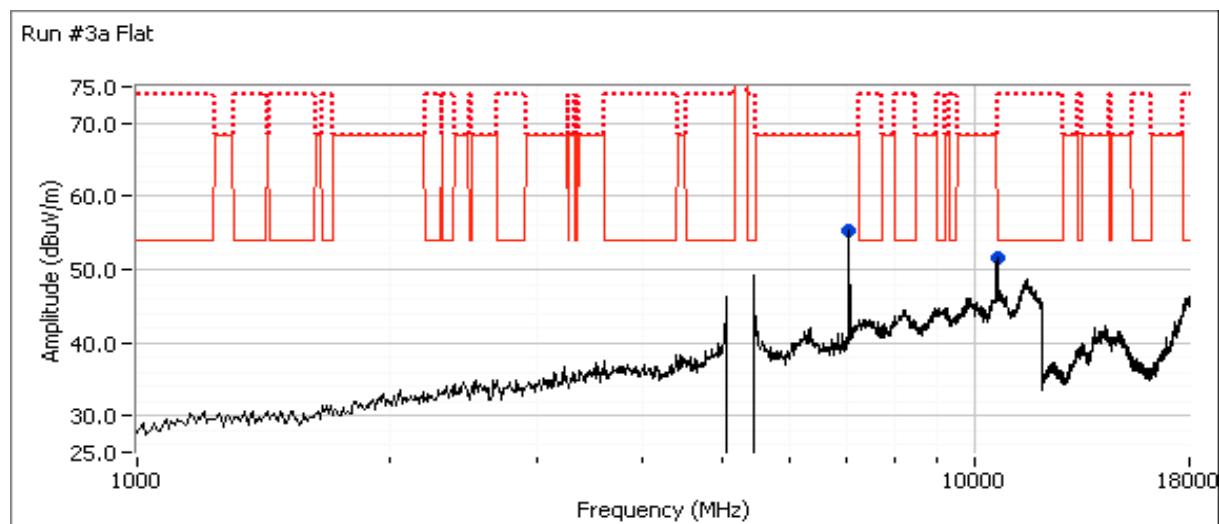
Tx Chain: Main

Data Rate: 6

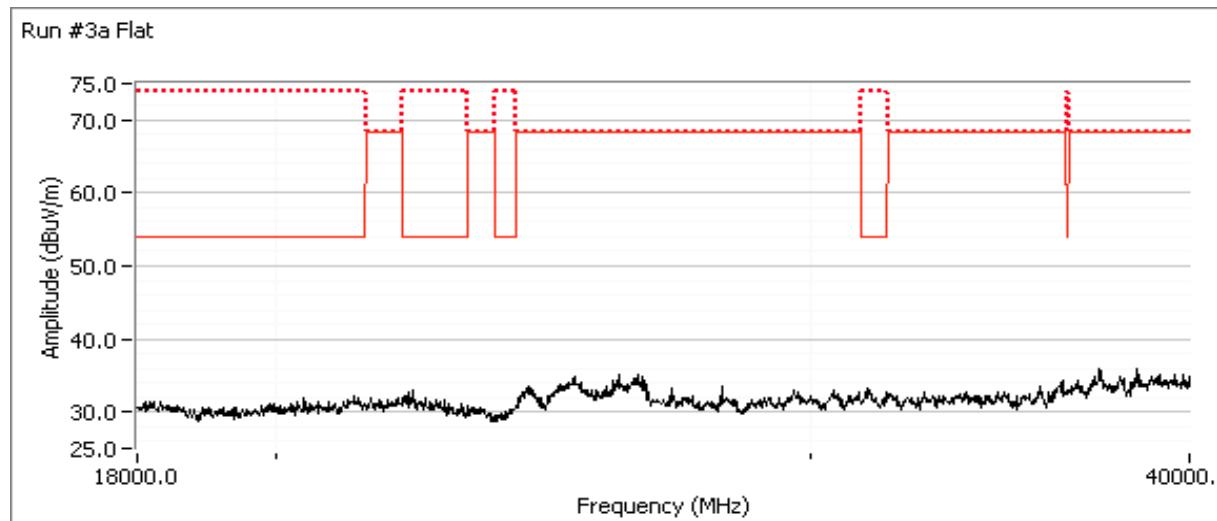
Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
10600.020	47.6	V	54.0	-6.4	AVG	83	1.1	RB 1 MHz;VB 10 Hz;Peak
10600.330	45.2	H	54.0	-8.8	AVG	342	1.0	RB 1 MHz;VB 10 Hz;Peak
7066.670	57.7	H	68.3	-10.6	PK	35	1.0	RB 1 MHz;VB 3 MHz;Peak
7066.690	56.2	V	68.3	-12.1	PK	219	1.8	RB 1 MHz;VB 3 MHz;Peak
10600.660	59.9	V	74.0	-14.1	PK	83	1.1	RB 1 MHz;VB 3 MHz;Peak
10600.860	56.7	H	74.0	-17.3	PK	342	1.0	RB 1 MHz;VB 3 MHz;Peak

Note 1: For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.

Note 2: 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:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A





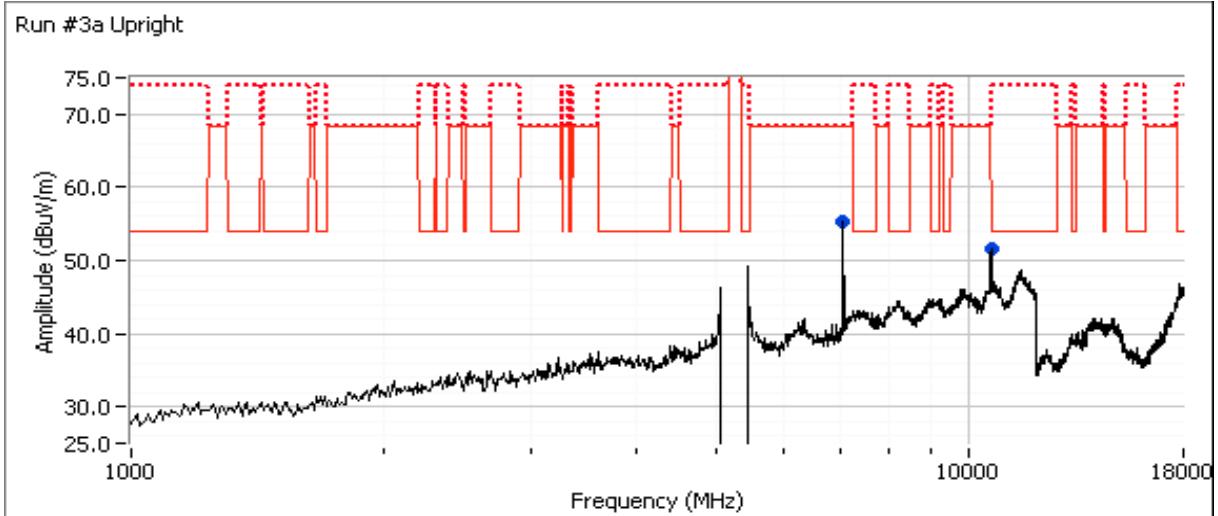
EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Channel: 60 Mode: a Orientation: Upright
Tx Chain: Main Data Rate: 6

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
10600.160	46.3	V	54.0	-7.7	AVG	198	1.0	RB 1 MHz;VB 10 Hz;Peak
10600.000	58.7	V	74.0	-15.3	PK	198	1.0	RB 1 MHz;VB 3 MHz;Peak
10600.040	45.4	H	54.0	-8.6	AVG	57	1.3	RB 1 MHz;VB 10 Hz;Peak
10600.230	57.7	H	74.0	-16.3	PK	57	1.3	RB 1 MHz;VB 3 MHz;Peak
7066.630	58.4	V	68.3	-9.9	PK	225	1.5	RB 1 MHz;VB 3 MHz;Peak
7066.660	57.7	H	68.3	-10.6	PK	324	1.3	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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dB μ V/m). The measurement method required is a peak measurement (RB=1MHz, VB \geq 3MHz, peak detector).





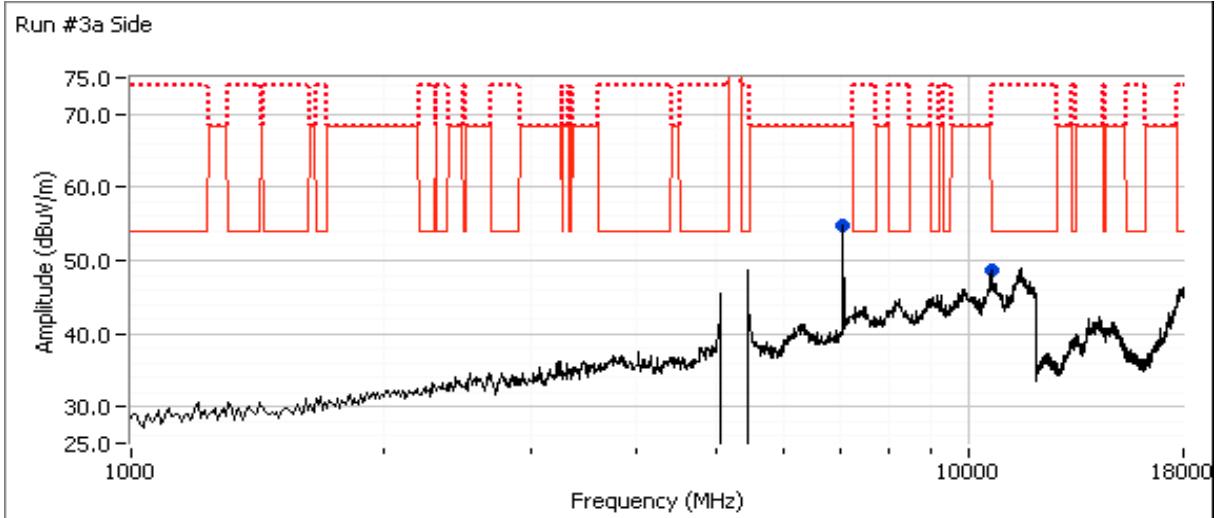
EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Channel: 60 Mode: a Orientation: Side
Tx Chain: Main Data Rate: 6

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dBuV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7066.730	59.0	V	68.3	-9.3	PK	313	1.6	RB 1 MHz;VB 3 MHz;Peak
7066.610	56.2	H	68.3	-12.1	PK	108	1.0	RB 1 MHz;VB 3 MHz;Peak
10600.090	46.3	V	54.0	-7.7	AVG	288	1.5	RB 1 MHz;VB 10 Hz;Peak
10600.180	58.8	V	74.0	-15.2	PK	288	1.5	RB 1 MHz;VB 3 MHz;Peak
10600.110	45.6	H	54.0	-8.4	AVG	286	1.5	RB 1 MHz;VB 10 Hz;Peak
10600.170	57.7	H	74.0	-16.3	PK	286	1.5	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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	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).





EMC Test Data

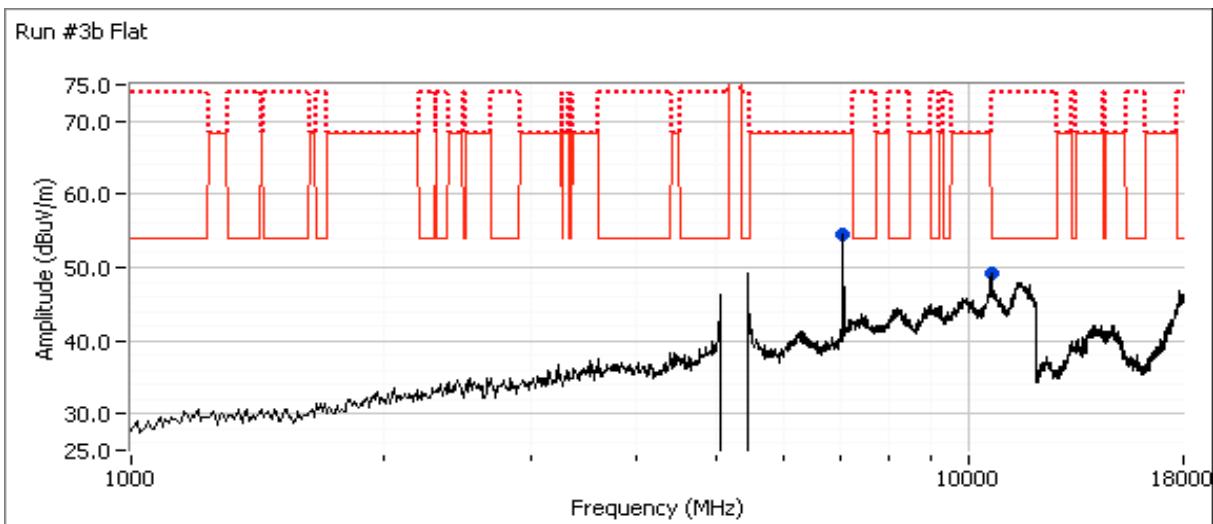
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #3b: Center Channel

Channel: 60 Mode: 11n20 Orientation: Flat
Tx Chain: Main Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
10600.050	46.8	V	54.0	-7.2	AVG	274	1.6	RB 1 MHz;VB 10 Hz;Peak
10600.030	59.1	V	74.0	-14.9	PK	274	1.6	RB 1 MHz;VB 3 MHz;Peak
10600.230	44.7	H	54.0	-9.3	AVG	0	1.6	RB 1 MHz;VB 10 Hz;Peak
10600.140	57.1	H	74.0	-16.9	PK	0	1.6	RB 1 MHz;VB 3 MHz;Peak
7066.680	57.6	H	68.3	-10.7	PK	36	1.5	RB 1 MHz;VB 3 MHz;Peak
7066.480	55.3	V	68.3	-13.0	PK	145	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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dB μ V/m). The measurement method required is a peak measurement (RB=1MHz, VB≥3MHz, peak detector).



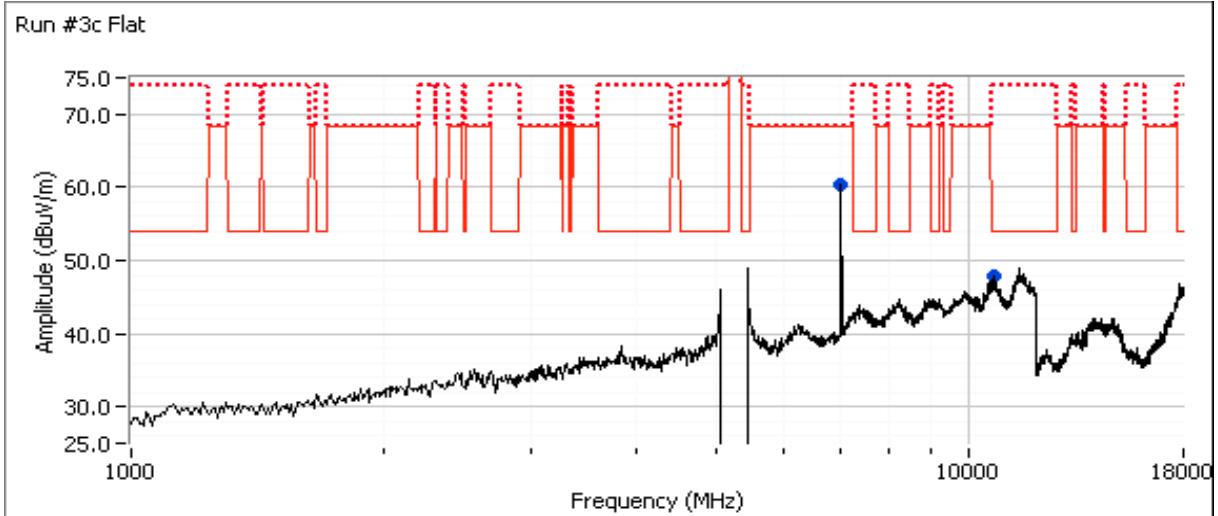
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #3c: Center Channel

Channel: 54 Mode: 11n40 Orientation: flat
 Tx Chain: Main Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7026.650	62.1	H	68.3	-6.2	PK	39	1.0	RB 1 MHz;VB 3 MHz;Peak
7026.580	56.7	V	68.3	-11.6	PK	290	1.2	RB 1 MHz;VB 3 MHz;Peak
10539.590	55.8	H	68.3	-12.5	PK	253	1.0	RB 1 MHz;VB 3 MHz;Peak
10539.700	42.9	H	68.3	-25.4	AVG	253	1.0	RB 1 MHz;VB 10 Hz;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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dB μ V/m). The measurement method required is a peak measurement (RB=1MHz, VB \geq 3MHz, peak detector).





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

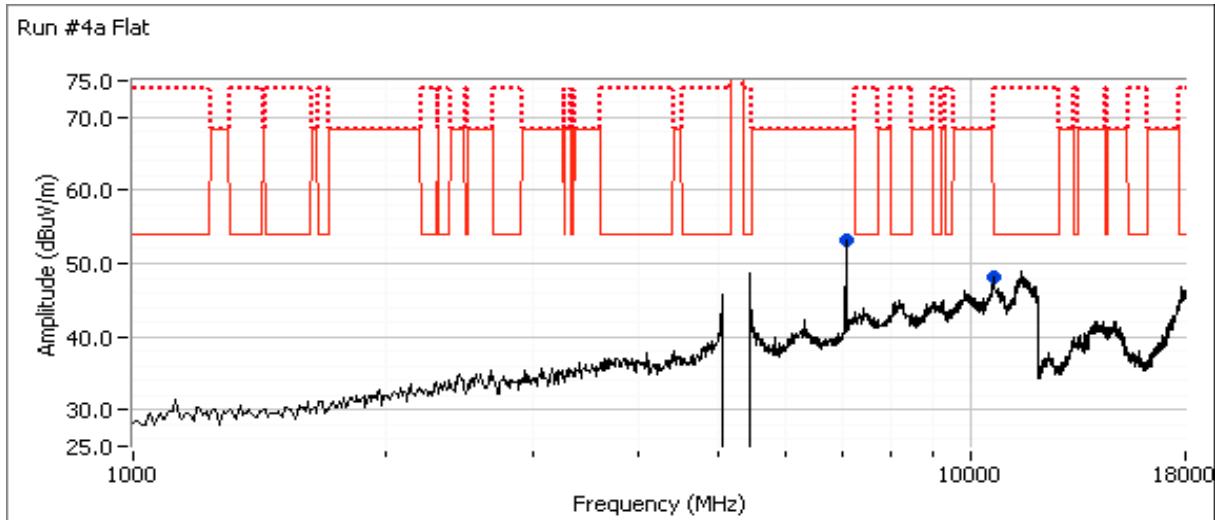
Run #4: Radiated Spurious Emissions, 1,000 - 40000 MHz. Operating Mode: Worse case from Run #3

Run #4a: High Channel

Channel: 62 Mode: n40 Orientation: Flat
Tx Chain: Main Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
10616.730	46.7	V	54.0	-7.3	AVG	148	1.5	RB 1 MHz;VB 10 Hz;Peak
10615.130	44.9	H	54.0	-9.1	AVG	347	1.3	RB 1 MHz;VB 10 Hz;Peak
7079.980	56.8	H	68.3	-11.5	PK	31	1.1	RB 1 MHz;VB 3 MHz;Peak
7080.150	54.6	V	68.3	-13.7	PK	150	1.9	RB 1 MHz;VB 3 MHz;Peak
10623.320	58.9	V	74.0	-15.1	PK	148	1.5	RB 1 MHz;VB 3 MHz;Peak
10617.150	56.8	H	74.0	-17.2	PK	347	1.3	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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dB μ V/m). The measurement method required is a peak measurement (RB=1MHz, VB \geq 3MHz, peak detector).





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

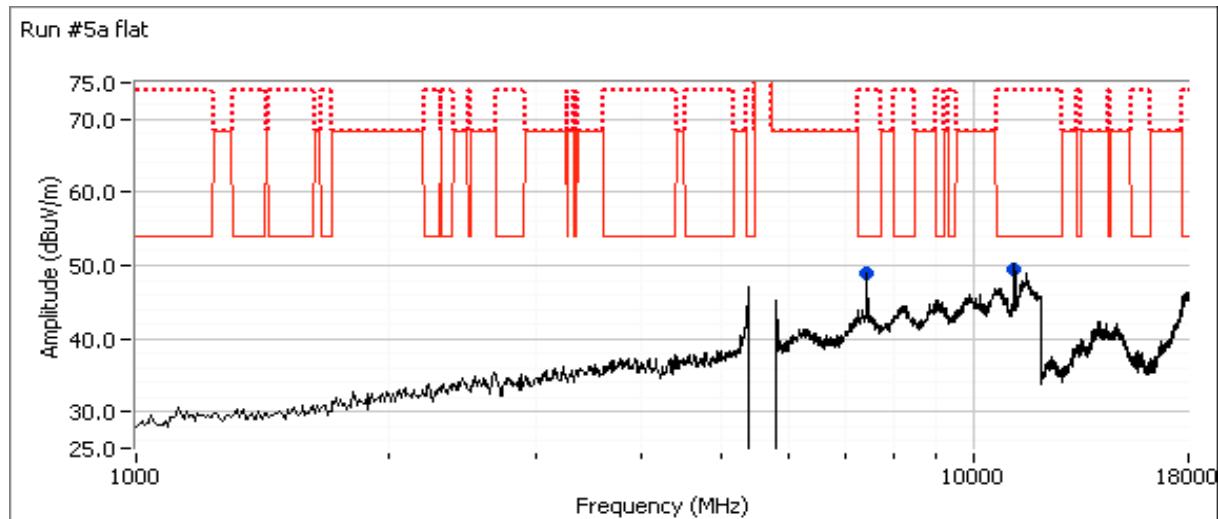
Run #5, Radiated Spurious Emissions, 1,000 - 40,000 MHz. Operation in the 5470-5725 MHz Band

Run #5a: Center Channel

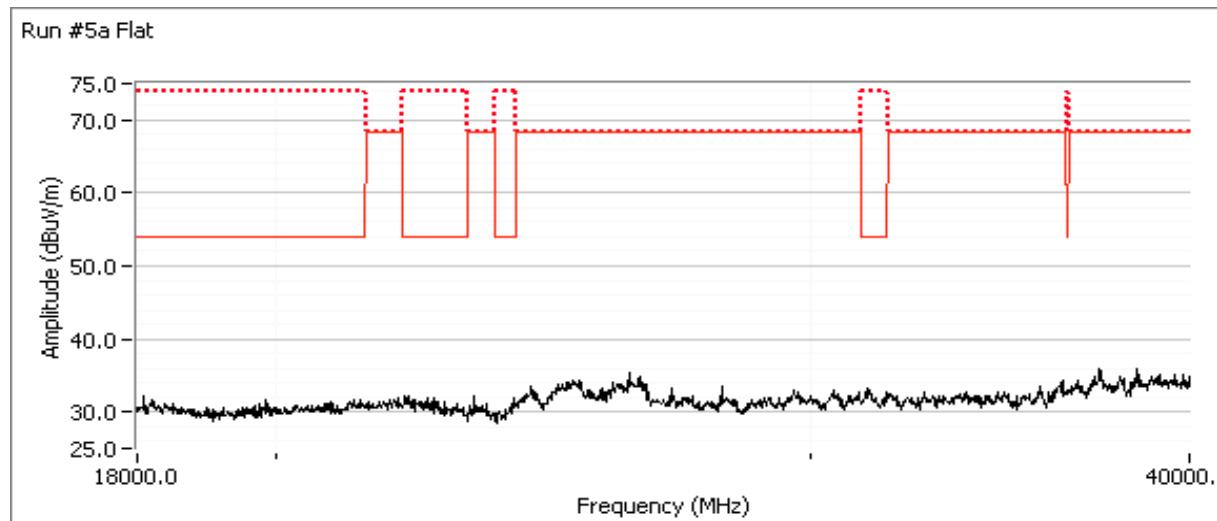
Channel: 116 Mode: a Orientation: Flat
Tx Chain: Main Data Rate: 6

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7440.050	46.8	V	54.0	-7.2	AVG	73	1.7	RB 1 MHz;VB 10 Hz;Peak
7440.090	55.7	V	74.0	-18.3	PK	73	1.7	RB 1 MHz;VB 3 MHz;Peak
7440.000	47.3	H	54.0	-6.7	AVG	34	1.0	RB 1 MHz;VB 10 Hz;Peak
7440.000	55.1	H	74.0	-18.9	PK	34	1.0	RB 1 MHz;VB 3 MHz;Peak
11160.200	45.7	V	54.0	-8.3	AVG	33	1.3	RB 1 MHz;VB 10 Hz;Peak
11160.330	57.5	V	74.0	-16.5	PK	33	1.3	RB 1 MHz;VB 3 MHz;Peak
11160.130	42.1	H	54.0	-11.9	AVG	240	1.4	RB 1 MHz;VB 10 Hz;Peak
11157.600	53.7	H	74.0	-20.3	PK	240	1.4	RB 1 MHz;VB 3 MHz;Peak

Note 1: For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.



Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A





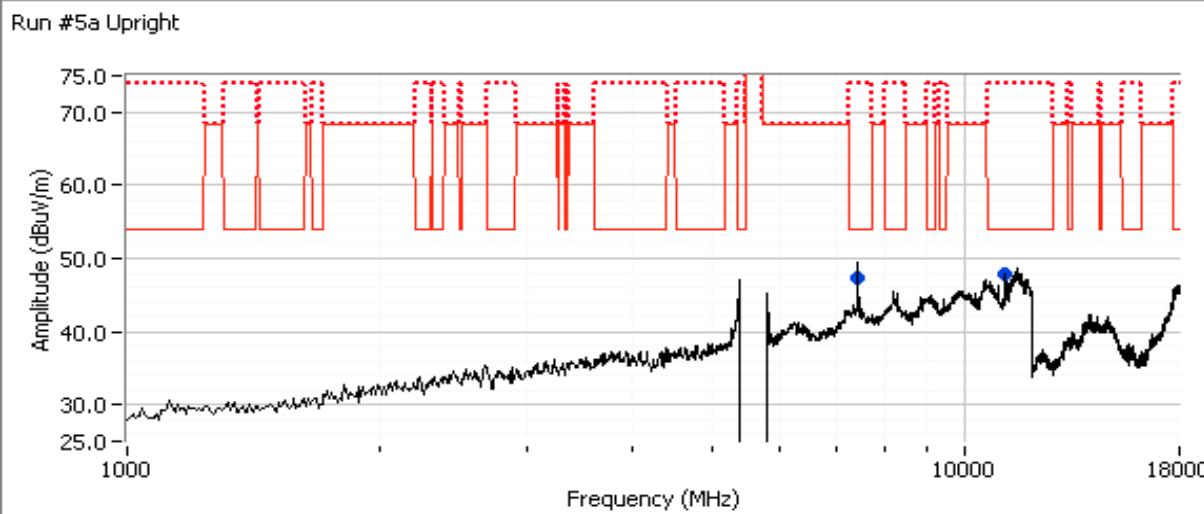
EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Channel: 116 Mode: a Orientation: Upright
Tx Chain: Main Data Rate: 6

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7440.000	48.6	V	54.0	-5.4	AVG	127	1.6	RB 1 MHz;VB 10 Hz;Peak
7440.020	55.9	V	74.0	-18.1	PK	127	1.6	RB 1 MHz;VB 3 MHz;Peak
7440.000	45.5	H	54.0	-8.5	AVG	219	1.4	RB 1 MHz;VB 10 Hz;Peak
7440.130	54.3	H	74.0	-19.7	PK	219	1.4	RB 1 MHz;VB 3 MHz;Peak
11160.130	44.2	H	54.0	-9.8	AVG	246	1.0	RB 1 MHz;VB 10 Hz;Peak
11156.800	56.4	H	74.0	-17.6	PK	246	1.0	RB 1 MHz;VB 3 MHz;Peak
11160.260	44.7	V	54.0	-9.3	AVG	179	1.6	RB 1 MHz;VB 10 Hz;Peak
11160.620	57.5	V	74.0	-16.5	PK	179	1.6	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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Channel: 116 Mode: a Orientation: Side
Tx Chain: Main Data Rate: 6

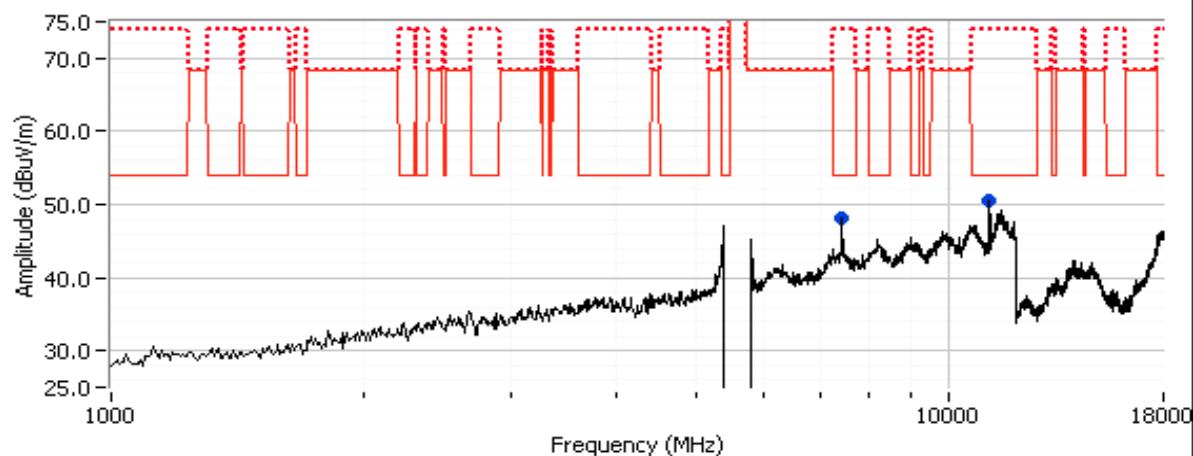
Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7439.990	48.0	H	54.0	-6.0	AVG	321	1.0	RB 1 MHz;VB 10 Hz;Peak
7440.150	55.5	H	74.0	-18.5	PK	321	1.0	RB 1 MHz;VB 3 MHz;Peak
7440.010	48.1	V	54.0	-5.9	AVG	69	1.7	RB 1 MHz;VB 10 Hz;Peak
7440.400	55.0	V	74.0	-19.0	PK	69	1.7	RB 1 MHz;VB 3 MHz;Peak
11161.960	46.0	H	54.0	-8.0	AVG	219	1.5	RB 1 MHz;VB 10 Hz;Peak
11160.540	58.6	H	74.0	-15.4	PK	219	1.5	RB 1 MHz;VB 3 MHz;Peak
11160.210	44.4	V	54.0	-9.6	AVG	228	1.0	RB 1 MHz;VB 10 Hz;Peak
11160.200	56.7	V	74.0	-17.3	PK	228	1.0	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 1: For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.

Note 2: For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dB μ V/m). The measurement method required is a peak measurement (RB=1MHz, VB \geq 3MHz, peak detector).

Run #5a Side



Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #5b: Center Channel

Date of Test: 6/11/2014

Config. Used: 1

Test Engineer: Joseph Cadigal

Config Change: None

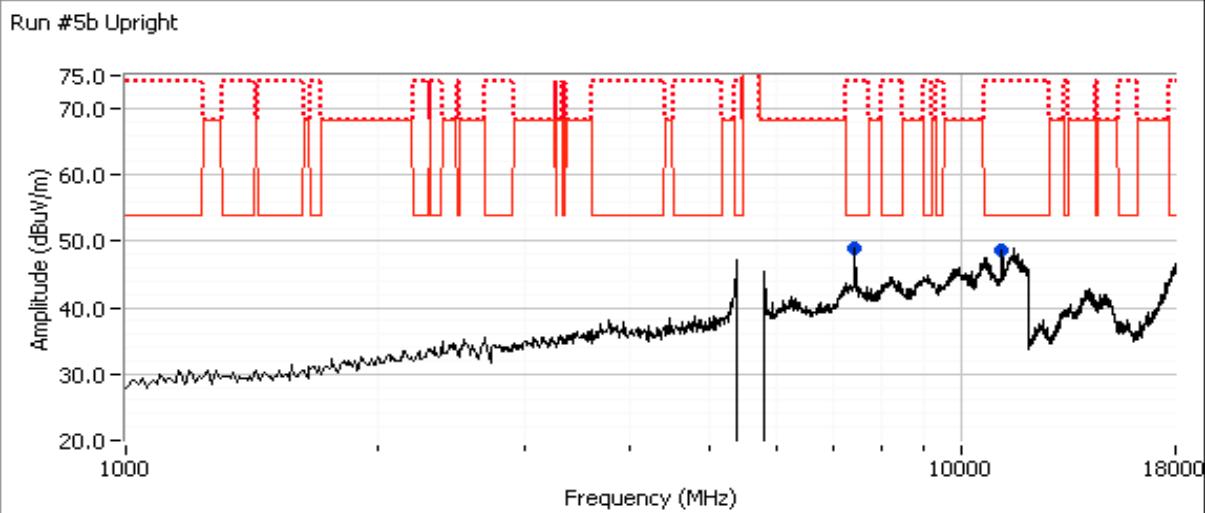
Test Location: FT CH#3

EUT Voltage: Battery Operated

 Channel: 116 Mode: 11n20 Orientation: Upright
 Tx Chain: Main Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7440.030	48.7	V	54.0	-5.3	AVG	141	1.7	RB 1 MHz;VB 10 Hz;Peak
7440.120	55.7	V	74.0	-18.3	PK	141	1.7	RB 1 MHz;VB 3 MHz;Peak
7440.020	45.8	H	54.0	-8.2	AVG	142	1.4	RB 1 MHz;VB 10 Hz;Peak
7440.370	54.5	H	74.0	-19.5	PK	142	1.4	RB 1 MHz;VB 3 MHz;Peak
11165.980	43.7	H	54.0	-10.3	AVG	251	1.6	RB 1 MHz;VB 10 Hz;Peak
11165.330	56.1	H	74.0	-17.9	PK	251	1.6	RB 1 MHz;VB 3 MHz;Peak
11165.020	43.5	V	54.0	-10.5	AVG	190	1.5	RB 1 MHz;VB 10 Hz;Peak
11164.890	56.4	V	74.0	-17.6	PK	190	1.5	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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dB μ V/m). The measurement method required is a peak measurement (RB=1MHz, VB≥3MHz, peak detector).



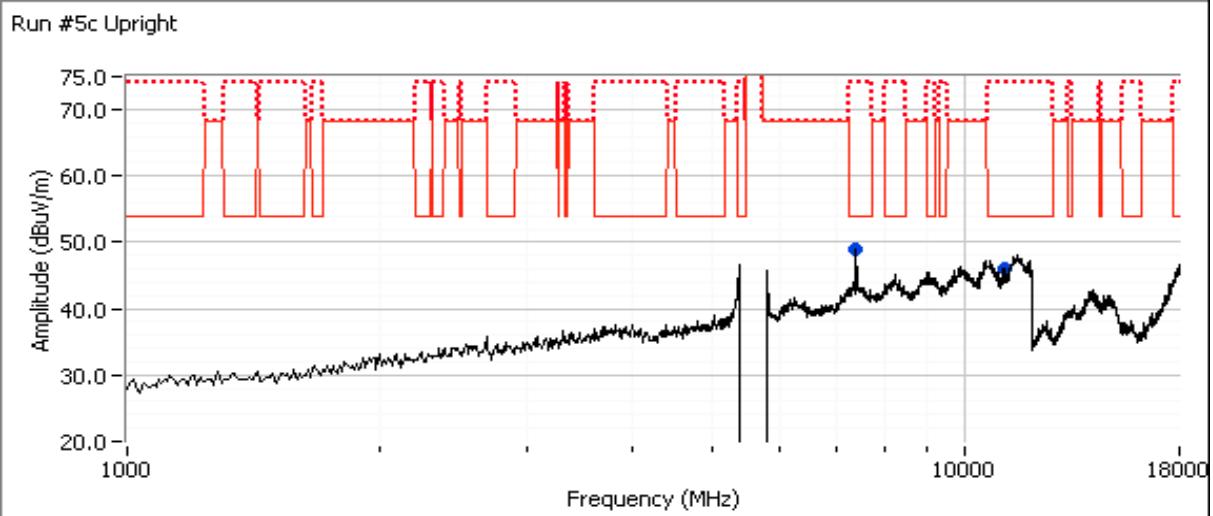
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #5c: Center Channel

Channel: 110 Mode: 11n40 Orientation: Upright
 Tx Chain: Main Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7399.990	47.9	V	54.0	-6.1	AVG	31	1.5	RB 1 MHz;VB 10 Hz;Peak
7400.250	56.4	V	74.0	-17.6	PK	31	1.5	RB 1 MHz;VB 3 MHz;Peak
7399.990	46.9	H	54.0	-7.1	AVG	219	1.5	RB 1 MHz;VB 10 Hz;Peak
7400.240	55.3	H	74.0	-18.7	PK	219	1.5	RB 1 MHz;VB 3 MHz;Peak
11113.410	43.0	V	54.0	-11.0	AVG	185	1.5	RB 1 MHz;VB 10 Hz;Peak
11110.840	55.2	V	74.0	-18.8	PK	185	1.5	RB 1 MHz;VB 3 MHz;Peak
11113.510	42.4	H	54.0	-11.6	AVG	246	1.5	RB 1 MHz;VB 10 Hz;Peak
11113.090	54.8	H	74.0	-19.2	PK	246	1.5	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 1:	For emissions in restricted bands, the limit of 15.209 was used which requires average and peak measurements.
Note 2:	For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dB μ V/m). The measurement method required is a peak measurement (RB=1MHz, VB≥3MHz, peak detector).





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/15.E/RSS-210	Class:	N/A

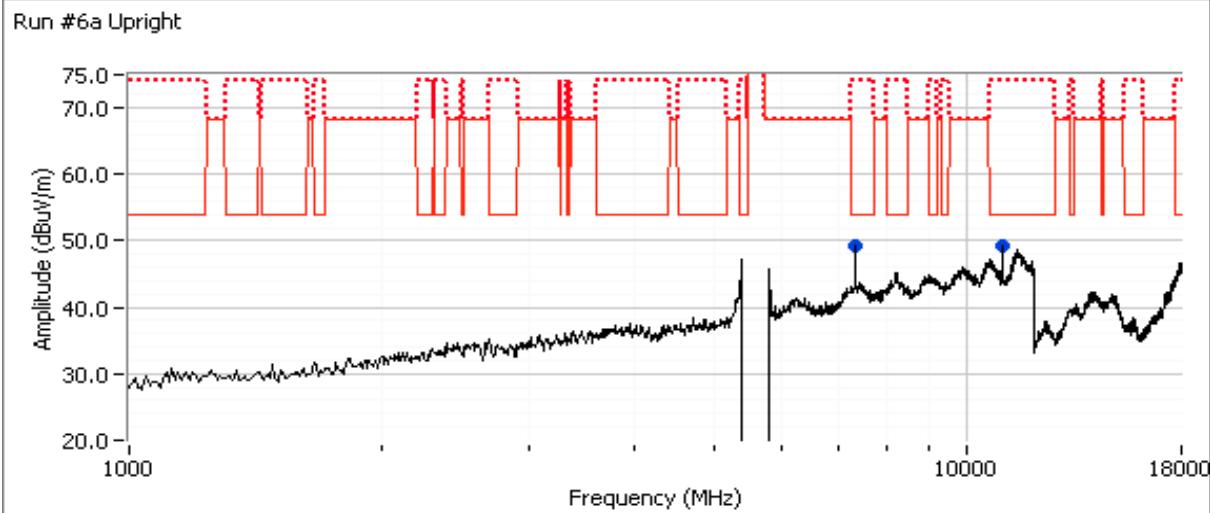
Run #6: Radiated Spurious Emissions, 1,000 - 40000 MHz. Operating Mode: Worse case from Run #5

Run #6a: Low Channel

Channel: 100 Mode: 11n20 Orientation: Upright
Tx Chain: Main Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7333.400	48.3	V	54.0	-5.7	AVG	65	1.6	RB 1 MHz;VB 10 Hz;Peak
7333.200	55.9	V	74.0	-18.1	PK	65	1.6	RB 1 MHz;VB 3 MHz;Peak
7333.320	44.6	H	54.0	-9.4	AVG	161	1.3	RB 1 MHz;VB 10 Hz;Peak
7333.550	53.1	H	74.0	-20.9	PK	161	1.3	RB 1 MHz;VB 3 MHz;Peak
11003.210	44.9	H	54.0	-9.1	AVG	221	1.6	RB 1 MHz;VB 10 Hz;Peak
11003.430	57.0	H	74.0	-17.0	PK	221	1.6	RB 1 MHz;VB 3 MHz;Peak
11004.270	42.5	V	54.0	-11.5	AVG	19	1.1	RB 1 MHz;VB 10 Hz;Peak
11004.920	55.5	V	74.0	-18.5	PK	19	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



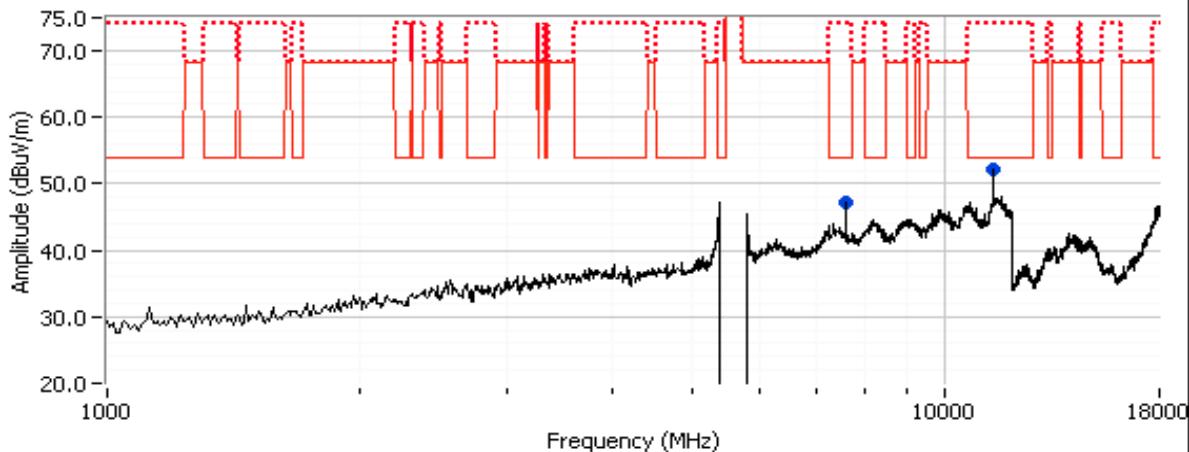
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #6b: High Channel

Channel: 140 Mode: 11n20 Orientation: Upright
 Tx Chain: Main Data Rate: MCS0

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7599.970	47.8	V	54.0	-6.2	AVG	67	1.5	RB 1 MHz;VB 10 Hz;Peak
7600.110	54.4	V	74.0	-19.6	PK	67	1.5	RB 1 MHz;VB 3 MHz;Peak
7600.020	44.5	H	54.0	-9.5	AVG	214	1.5	RB 1 MHz;VB 10 Hz;Peak
7599.970	53.5	H	74.0	-20.5	PK	214	1.5	RB 1 MHz;VB 3 MHz;Peak
11399.960	45.8	V	54.0	-8.2	AVG	212	1.4	RB 1 MHz;VB 10 Hz;Peak
11401.030	57.7	V	74.0	-16.3	PK	212	1.4	RB 1 MHz;VB 3 MHz;Peak
11400.410	46.3	H	54.0	-7.7	AVG	212	1.0	RB 1 MHz;VB 10 Hz;Peak
11400.840	57.8	H	74.0	-16.2	PK	212	1.0	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

Run #6b Upright




EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		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: 21-25 °C

Rel. Humidity: 30-45 %

Summary of Results

Run #	Mode	Channel	Target Power	Final Power Setting	Test Performed	Limit	Result / Margin
20MHz Bandwidth Modes							
1	a	36 - 5180MHz	16	16	Restricted Band Edge at 5150 MHz	15.209	41.3 dB μ V/m @ 5150.0 MHz (-12.7 dB)
2	a	64 - 5320MHz	16	16	Restricted Band Edge at 5350 MHz	15.209	42.2 dB μ V/m @ 5350.1 MHz (-11.8 dB)
3	a	100 - 5500MHz	16	16	Restricted Band Edge at 5460 MHz	15.209	41.7 dB μ V/m @ 5441.6 MHz (-12.3 dB)
	a	100 - 5500MHz	16	16	Band Edge 5460 - 5470 MHz	15E	55.4 dB μ V/m @ 5484.0 MHz (-12.9 dB)
	a	140 - 5700MHz	16	16	Band Edge 5725MHz	15E	65.4 dB μ V/m @ 5725.0 MHz (-2.9 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:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		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	6	100.00	-	-	0	0	-
11n20	MCS0	100.00	-	-	0	0	-
11n40	MCS0	100.00	-	-	0	0	-

Sample Notes

Sample S/N: 3E

Notes

Device is handheld. Evaluation of the fundamental field strength at CH40, 60, 116, 11a mode was performed thru three orientation to determine worse case orientation for that particular band.

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) 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 $\geq 98\%$, 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 tabular results for final measurements.



EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

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

Date of Test: 6/12/2014 0:00

Config. Used: 1

Test Engineer: Joseph Cadigal

Config Change: None

Test Location: FT Chamber#4

EUT Voltage: Battery Operated

Channel: 36 - 5180 MHz

Orientation: Side

Tx Chain: Main

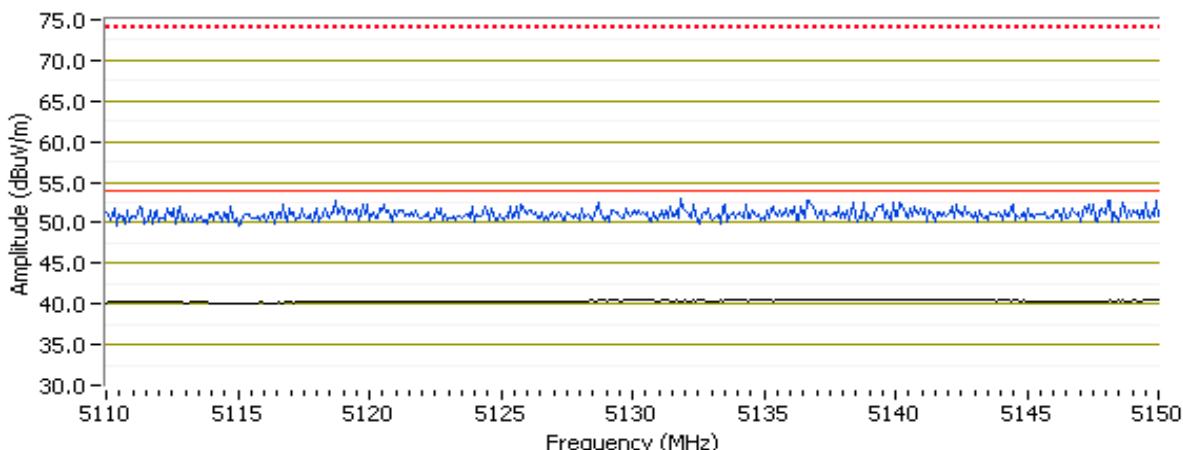
Mode: a

Data Rate: 6Mbs

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	
5150.000	41.3	H	54.0	-12.7	AVG	50	1.1	Side
5124.590	52.7	H	74.0	-21.3	PK	50	1.1	Side
5139.820	40.7	V	54.0	-13.3	AVG	178	1.0	Side
5123.790	52.0	V	74.0	-22.0	PK	178	1.0	Side
5150.000	40.8	V	54.0	-13.2	AVG	83	2.0	Flat
5144.630	52.4	V	74.0	-21.6	PK	83	2.0	Flat
5149.920	41.1	H	54.0	-12.9	AVG	233	1.3	Flat
5145.750	52.8	H	74.0	-21.2	PK	233	1.3	Flat
5140.220	40.5	V	54.0	-13.5	AVG	360	4.0	Upright
5138.140	52.2	V	74.0	-21.8	PK	360	4.0	Upright
5140.220	40.6	H	54.0	-13.4	AVG	0	2.1	Upright
5130.920	53.3	H	74.0	-20.7	PK	0	2.1	Upright

RB 1 MHz; VB 10 Hz = Avg, 1MHz 3MHz = Pk, H





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

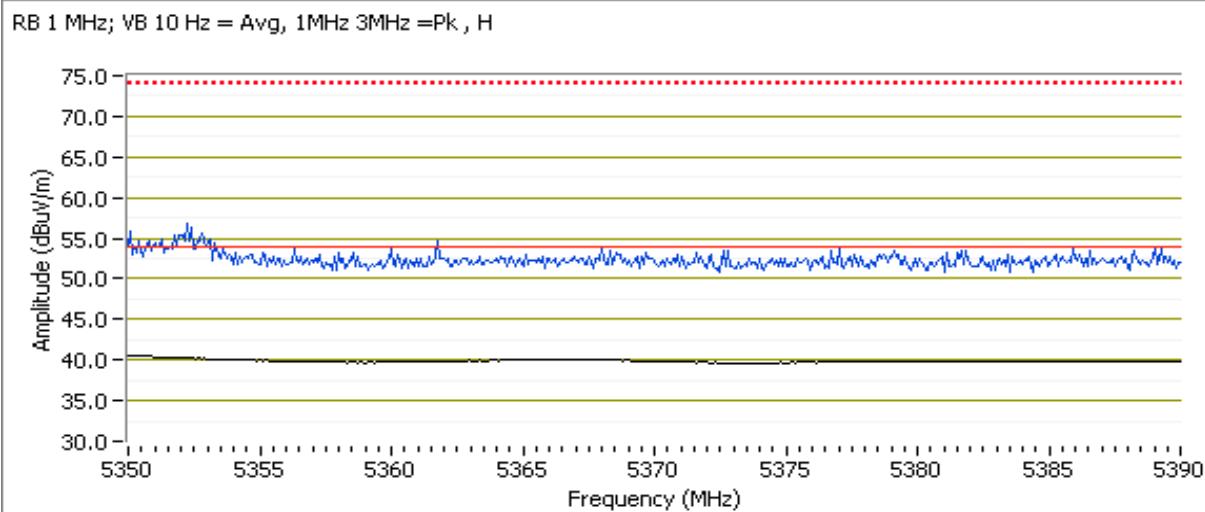
Run #2: Radiated Bandedge Measurements, 5250-5350MHz

Date of Test: 6/12/2014 0:00
Test Engineer: Joseph Cadigal
Test Location: FT Chamber#4
Channel: 64 - 5320MHz
Tx Chain: Main
Mode: a
Data Rate: 6Mbs

Config. Used: 1
Config Change: None
EUT Voltage: Battery Operated
Orientation: Side

5350 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	
5350.080	42.2	H	54.0	-11.8	AVG	301	0.9	POS; RB 1 MHz; VB: 10 Hz
5351.680	53.9	H	74.0	-20.1	PK	301	0.9	POS; RB 1 MHz; VB: 3 MHz
5350.000	42.2	V	54.0	-11.8	AVG	297	1.0	POS; RB 1 MHz; VB: 10 Hz
5350.400	53.8	V	74.0	-20.2	PK	297	1.0	POS; RB 1 MHz; VB: 3 MHz





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #3: Radiated Bandedge Measurements, 5470-5725MHz

Date of Test: 6/12/2014 0:00

Config. Used: 1

Test Engineer: Joseph Cadigal

Config Change: None

Test Location: FT Chamber#4

EUT Voltage: Battery Operated

Channel: 100 - 5500MHz

Orientation: Side

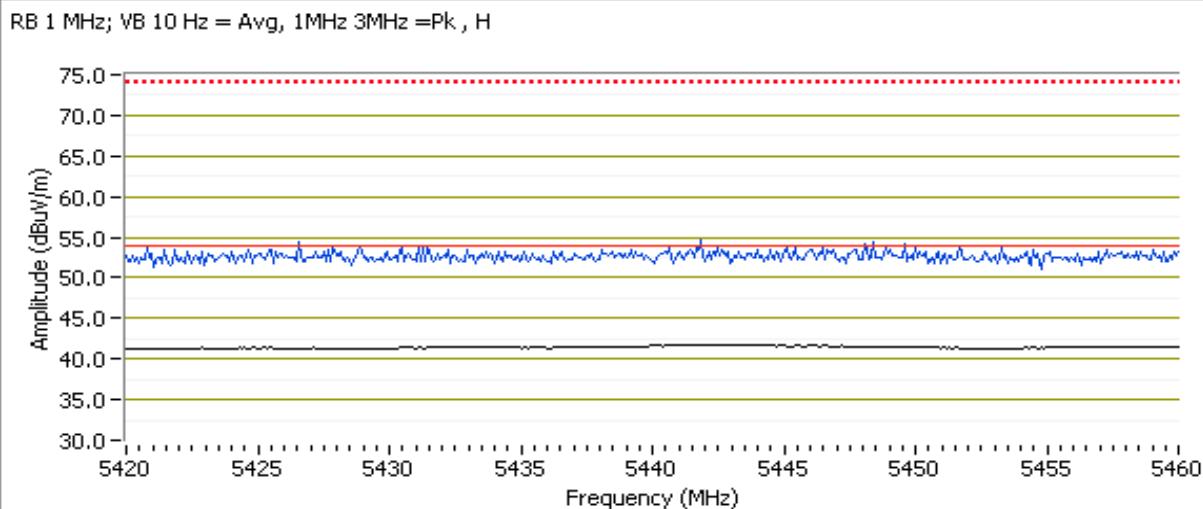
Tx Chain: Main

Mode: a

Data Rate: 6Mbs

5460 MHz Band Edge Signal Radiated Field Strength

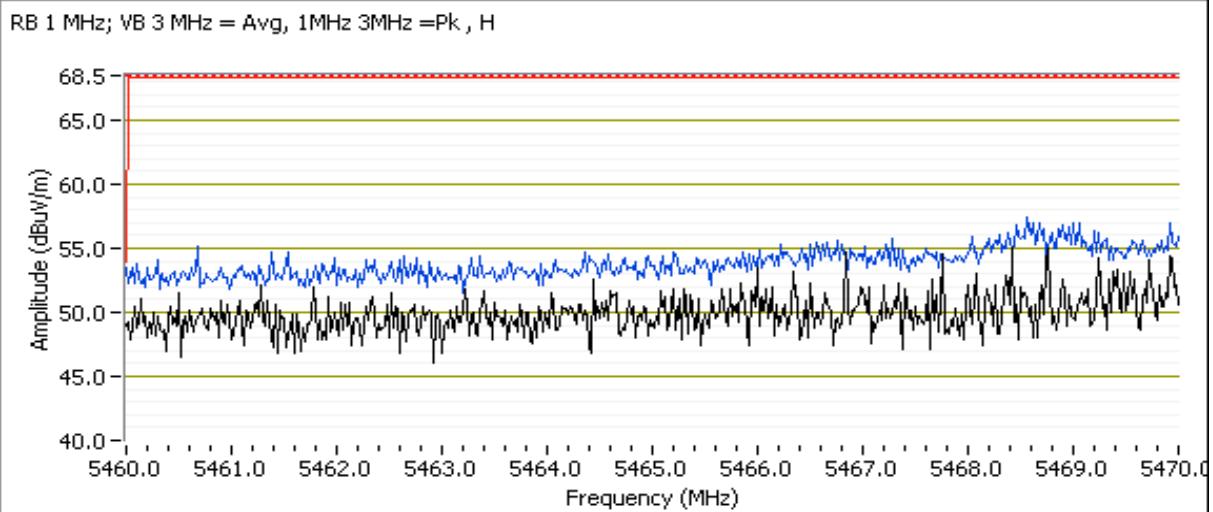
Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5441.560	41.7	H	54.0	-12.3	AVG	360	1.0	POS; RB 1 MHz; VB: 10 Hz
5450.620	53.1	H	74.0	-20.9	PK	360	1.0	POS; RB 1 MHz; VB: 3 MHz
5440.920	41.6	V	54.0	-12.4	AVG	54	1.0	POS; RB 1 MHz; VB: 10 Hz
5431.060	53.0	V	74.0	-21.0	PK	54	1.0	POS; RB 1 MHz; VB: 3 MHz



Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

5470 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	
5484.000	55.4	H	68.3	-12.9	PK	360	1.0	POS; RB 1 MHz; VB: 3 MHz
5468.940	54.9	V	68.3	-13.4	PK	55	1.0	POS; RB 1 MHz; VB: 3 MHz





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Channel: 140 - 5700MHz Orientation: Side

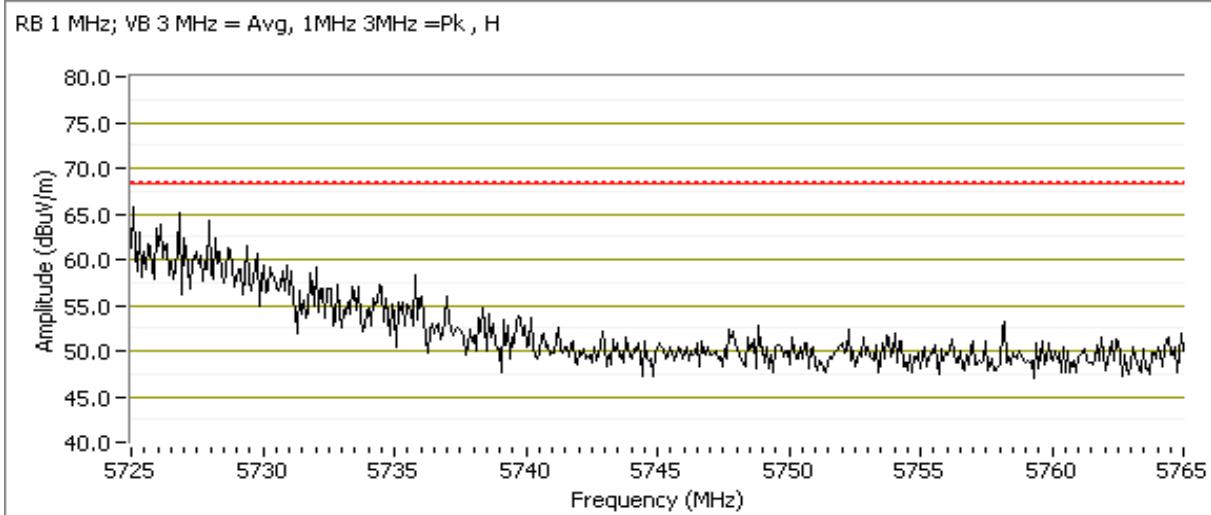
Tx Chain: Main

Mode: a

Data Rate: 6Mbs

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	
5725.000	65.4	H	68.3	-2.9	PK	131	1.0	POS; RB 1 MHz; VB: 3 MHz
5725.240	62.4	V	68.3	-5.9	PK	249	1.2	POS; RB 1 MHz; VB: 3 MHz





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/15.E/RSS-210	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: 21-25 °C
Rel. Humidity: 30-45 %

Summary of Results

Run #	Mode	Channel	Target Power	Final Power Setting	Test Performed	Limit	Result / Margin
20MHz Bandwidth Modes							
4	n20	36 - 5180MHz	16	16	Restricted Band Edge at 5150 MHz	15.209	43.2 dB μ V/m @ 5150.0 MHz (-10.8 dB)
5	n20	64 - 5320MHz	16	16	Restricted Band Edge at 5350 MHz	15.209	43.2 dB μ V/m @ 5350.2 MHz (-10.8 dB)
6	n20	100 - 5500MHz	16	16	Restricted Band Edge at 5460 MHz	15.209	41.9 dB μ V/m @ 5459.7 MHz (-12.1 dB)
	n20	100 - 5500MHz	16	16	Band Edge 5460 - 5470 MHz	15E	62.8 dB μ V/m @ 5469.9 MHz (-5.5 dB)
	n20	140 - 5700MHz	16	16	Band Edge 5725MHz	15E	53.1 dB μ V/m @ 5725.0 MHz (-0.9 dB)
40MHz Bandwidth Modes							
7	n40	38 - 5190MHz	16	16	Restricted Band Edge at 5150 MHz	15.209	53.9 dB μ V/m @ 5150.0 MHz (-0.1 dB)
8	n40	62 - 5310MHz	16	16	Restricted Band Edge at 5350 MHz	15.209	52.2 dB μ V/m @ 5350.0 MHz (-1.8 dB)
9	n40	102 - 5510MHz	16	16	Restricted Band Edge at 5460 MHz	15.209	48.2 dB μ V/m @ 5460.0 MHz (-5.8 dB)
	n40	102 - 5510MHz	16	16	Band Edge 5460 - 5470 MHz	15E	67.9 dB μ V/m @ 5464.8 MHz (-0.4 dB)
	n40	134 - 5670MHz	16	16	Band Edge 5725MHz	15E	61.4 dB μ V/m @ 5736.9 MHz (-6.9 dB)



EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		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 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	6	100.00	-	-	0	0	-
11n20	MCS0	100.00	-	-	0	0	-
11n40	MCS0	100.00	-	-	0	0	-

Sample Notes

Sample S/N: 3E

Notes

Device is handheld. Evaluation of the fundamental field strength at CH40, 60, 116, 11a mode was performed thru three orientation to determine worse case orientation for that particular band.

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) c) (i), compliance can be demonstrated by meeing 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:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #4: Radiated Bandedge Measurements, 5150-5250MHz

Date of Test: 6/13/2014
Test Engineer: Deniz Demirci
Test Location: FT Chamber#4

Config. Used: 1
Config Change: None
EUT Voltage: Battery Operated

Channel: 36 - 5180 MHz

Orientation: Side

Tx Chain: Main

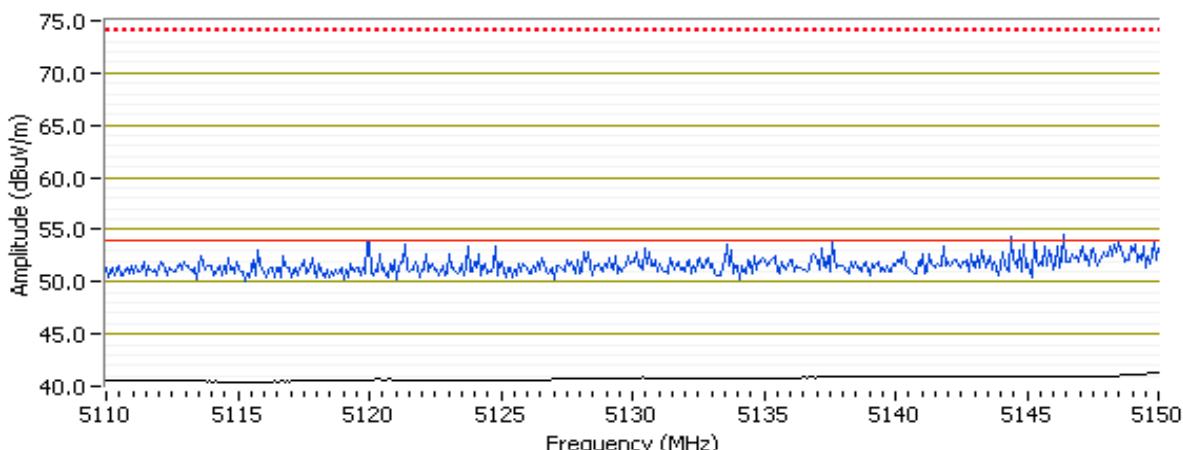
Mode: n20

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	
5150.000	43.2	H	54.0	-10.8	AVG	204	1.0	Side
5146.630	54.3	H	74.0	-19.7	PK	204	1.0	Side
5140.060	40.7	V	54.0	-13.3	AVG	186	1.0	Side
5137.330	53.1	V	74.0	-20.9	PK	186	1.0	Side
5150.000	41.2	H	54.0	-12.8	AVG	59	1.4	Flat
5145.510	54.5	H	74.0	-19.5	PK	59	1.4	Flat

RB 1 MHz; VB 10 Hz Average, RB 1 MHz; VB 3 MHz Peak (Blue) H-pol



Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #5: Radiated Bandedge Measurements, 5250-5350MHz

Channel: 64 - 5320MHz

Orientation: Side

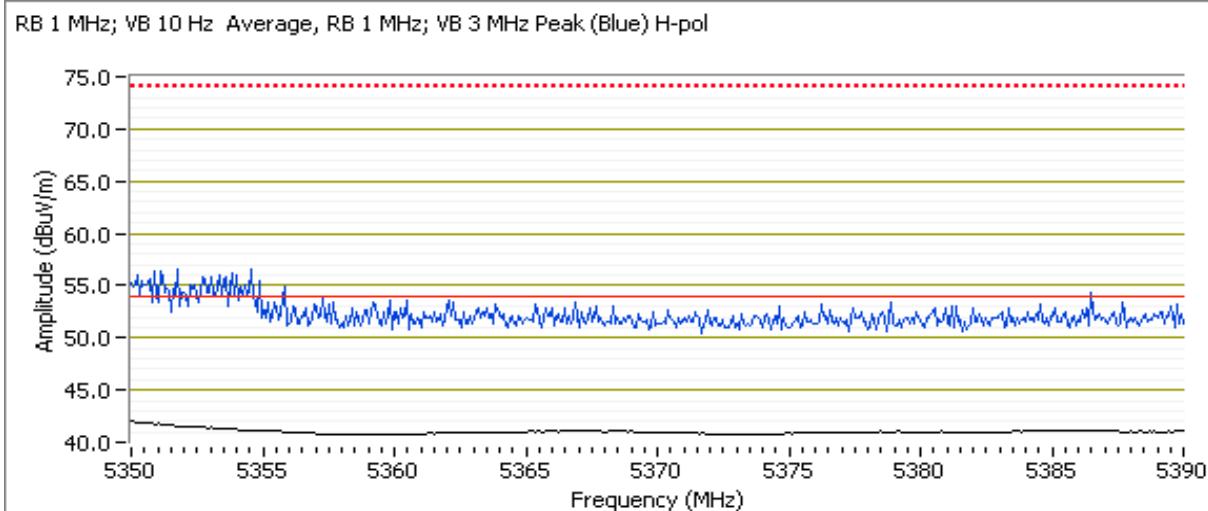
Tx Chain: Main

Mode: n20

Data Rate: MCS0

5350 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
5350.160	43.2	H	54.0	-10.8	AVG	309	0.9
5353.930	57.1	H	74.0	-16.9	PK	309	0.9
5350.000	41.4	V	54.0	-12.6	AVG	87	1.5
5350.400	57.4	V	74.0	-16.6	PK	87	1.5





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #6: Radiated Bandedge Measurements, 5470-5725MHz

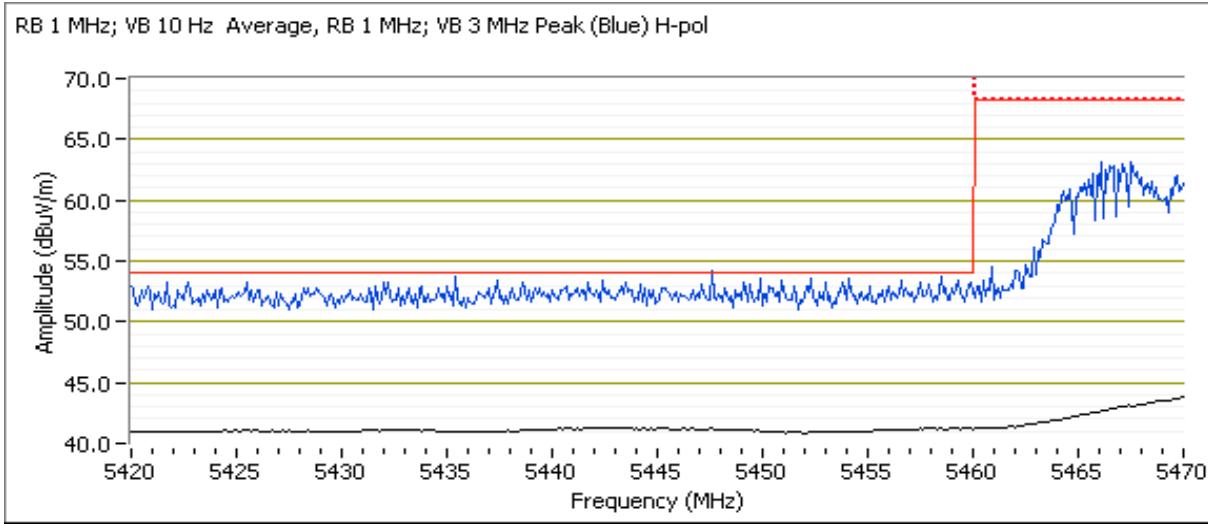
Channel: 100 - 5500MHz Orientation: Side
Tx Chain: Main
Mode: n20
Data Rate: MCS0

5460 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	
5459.720	41.9	H	54.0	-12.1	AVG	295	1.2	Side
5455.090	54.2	H	74.0	-19.8	PK	295	1.2	Side
5458.280	41.2	V	54.0	-12.8	AVG	94	1.4	Side
5458.460	53.6	V	74.0	-20.4	PK	94	1.4	Side
5459.900	41.1	H	54.0	-12.9	AVG	0	1.0	Flat
5452.890	53.9	H	74.0	-20.1	PK	0	1.0	Flat

5470 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	
5469.900	62.8	H	68.3	-5.5	PK	295	1.2	Side
5466.890	61.8	V	68.3	-6.5	PK	94	1.4	Side
5466.910	62.2	H	68.3	-6.1	PK	0	1.0	Flat



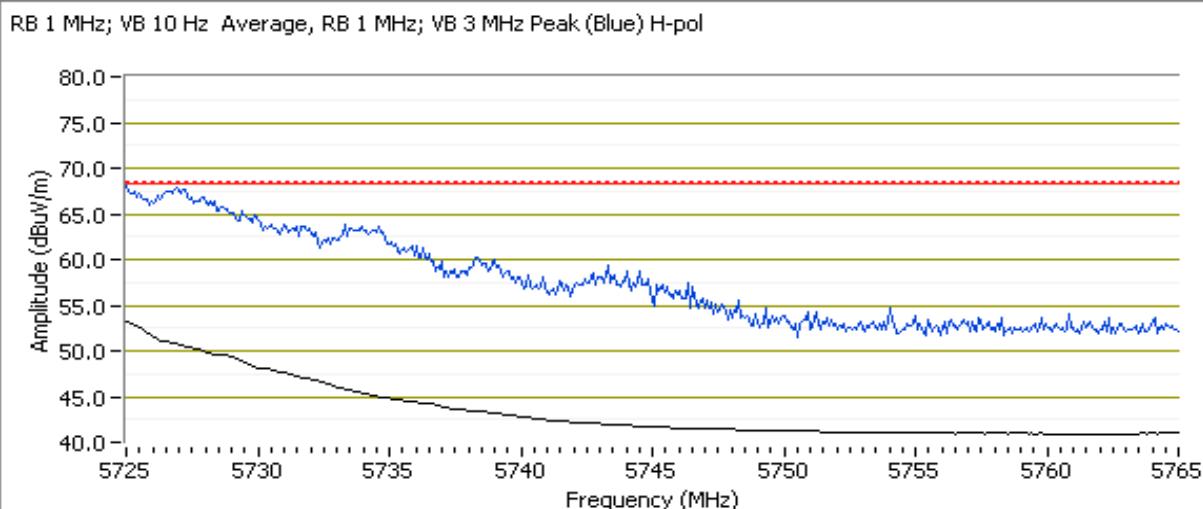
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Channel: 140 - 5700MHz Orientation Side
 Tx Chain: Main
 Mode: n20
 Data Rate: MCS0

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	
5725.000	53.1	H	54.0	-0.9	AVG	323	1.5	Side
5725.240	70.1	H	74.0	-3.9	PK	323	1.5	Side
5725.000	50.5	V	54.0	-3.5	AVG	41	1.0	Side
5726.920	67.8	V	74.0	-6.2	PK	41	1.0	Side
5725.000	49.6	H	54.0	-4.4	AVG	258	1.1	Flat
5725.320	64.8	H	74.0	-9.2	PK	258	1.1	Flat

Note 1: For emissions outside of the restricted bands the limit is -27dBm/MHz eirp (68.3dB μ V/m). The measurement method required is a peak measurement (RB=1MHz, VB \geq 3MHz, peak detector). Per KDB 789033 2) c) (i). As an alternative, the compliance was demonstrated by meeing the average and peak limits of 15.209.





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

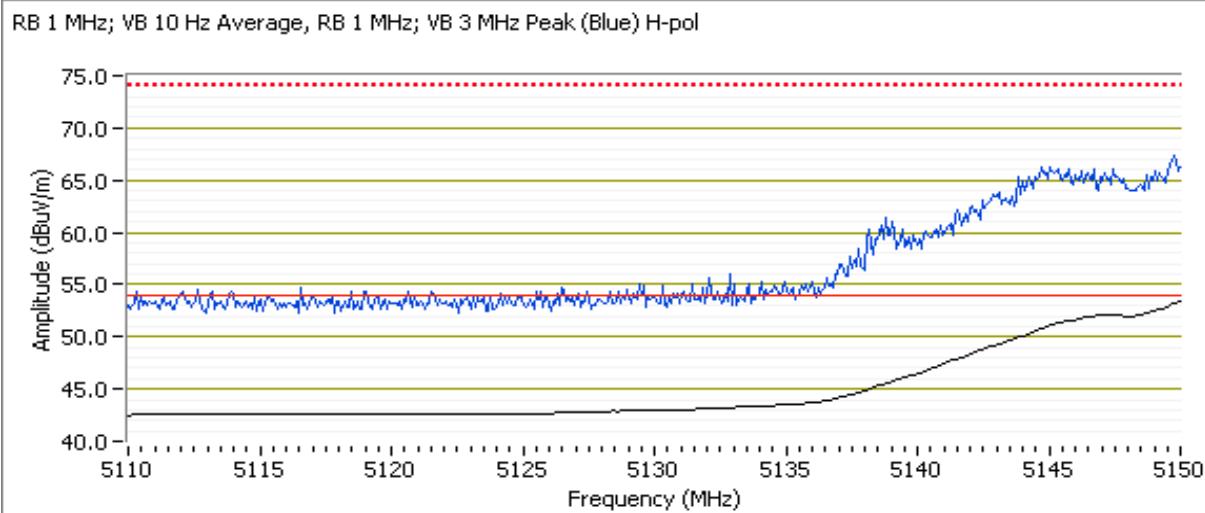
Run #7: Radiated Bandedge Measurements, 5150-5250MHz

Date of Test: 6/16/2014
Test Engineer: Deniz Demirci
Test Location: FT Chamber#5
Channel: 38 - 5190 MHz
Tx Chain: Main
Mode: n40
Data Rate: MCS0

Config. Used: 1
Config Change: None
EUT Voltage: Battery Operated
Orientation: Side

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	
5150.000	53.9	H	54.0	-0.1	AVG	340	1.3	Flat
5145.110	67.5	H	74.0	-6.5	PK	340	1.3	Flat
5150.000	51.0	V	54.0	-3.0	AVG	93	1.8	Flat
5145.750	64.5	V	74.0	-9.5	PK	93	1.8	Flat
5150.000	53.9	H	54.0	-0.1	AVG	199	1.1	Side
5144.950	65.9	H	74.0	-8.1	PK	199	1.1	Side
5150.000	49.5	V	54.0	-4.5	AVG	183	1.4	Side
5148.720	62.3	V	74.0	-11.7	PK	183	1.4	Side
5150.000	46.9	H	54.0	-7.1	AVG	195	1.0	Upright
5146.230	60.3	H	74.0	-13.7	PK	195	1.0	Upright
5150.000	52.7	V	54.0	-1.3	AVG	349	1.0	Upright
5150.000	66.2	V	74.0	-7.8	PK	349	1.0	Upright





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #8: Radiated Bandedge Measurements, 5250-5350MHz

Channel: 62 - 5310MHz

Orientation: Side

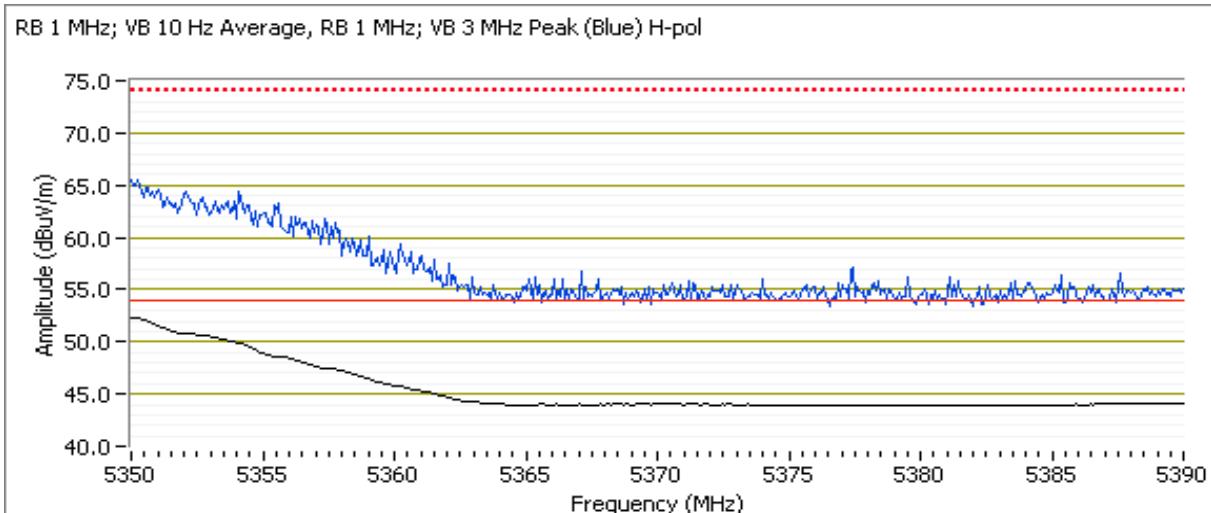
Tx Chain: Main

Mode: n40

Data Rate: MCS0

5350 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	
5350.080	51.7	H	54.0	-2.3	AVG	337	1.1	Flat
5350.160	64.8	H	74.0	-9.2	PK	337	1.1	Flat
5350.000	50.7	V	54.0	-3.3	AVG	79	2.0	Flat
5352.000	65.4	V	74.0	-8.6	PK	79	2.0	Flat
5350.000	52.2	H	54.0	-1.8	AVG	304	1.0	Side
5351.120	65.3	H	74.0	-8.7	PK	304	1.0	Side
5350.080	48.6	V	54.0	-5.4	AVG	41	1.4	Side
5351.920	61.5	V	74.0	-12.5	PK	41	1.4	Side



Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Run #9: Radiated Bandedge Measurements, 5470-5725MHz

Channel: 102 - 5510MHz

Orientation: Side

Tx Chain: Main

Mode: n40

Data Rate: MCS0

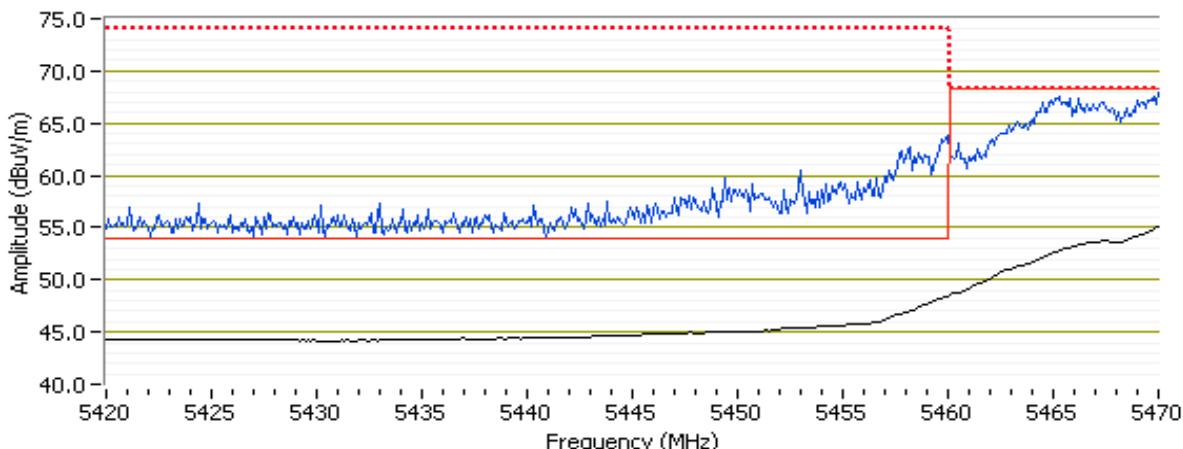
5460 MHz Band Edge Signal Radiated Field Strength

Frequency	Level	Pol	FCC 15.209		Detector	Azimuth	Height	Comments
MHz	dB μ V/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5460.000	47.2	H	54.0	-6.8	AVG	304	1.2	Side
5459.360	62.0	H	74.0	-12.0	PK	304	1.2	Side
5460.000	48.2	V	54.0	-5.8	AVG	73	1.3	Side
5459.760	63.2	V	74.0	-10.8	PK	73	1.3	Side
5460.000	47.5	H	54.0	-6.5	AVG	104	1.2	Flat
5459.440	62.8	H	74.0	-11.2	PK	104	1.2	Flat
5460.000	47.8	V	54.0	-6.2	AVG	76	2.0	Flat
5459.760	62.4	V	74.0	-11.6	PK	76	2.0	Flat

5470 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	
5464.790	67.4	H	68.3	-0.9	PK	304	1.2	Side
5467.800	67.9	V	68.3	-0.4	PK	73	1.3	Side
5467.190	67.6	H	68.3	-0.7	PK	104	1.2	Flat
5469.700	67.2	V	68.3	-1.1	PK	76	2.0	Flat

RB 1 MHz; VB 10 Hz Average, RB 1 MHz; VB 3 MHz Peak (Blue) V-pol



Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

Channel: 134 - 5670MHz Orientation: Side

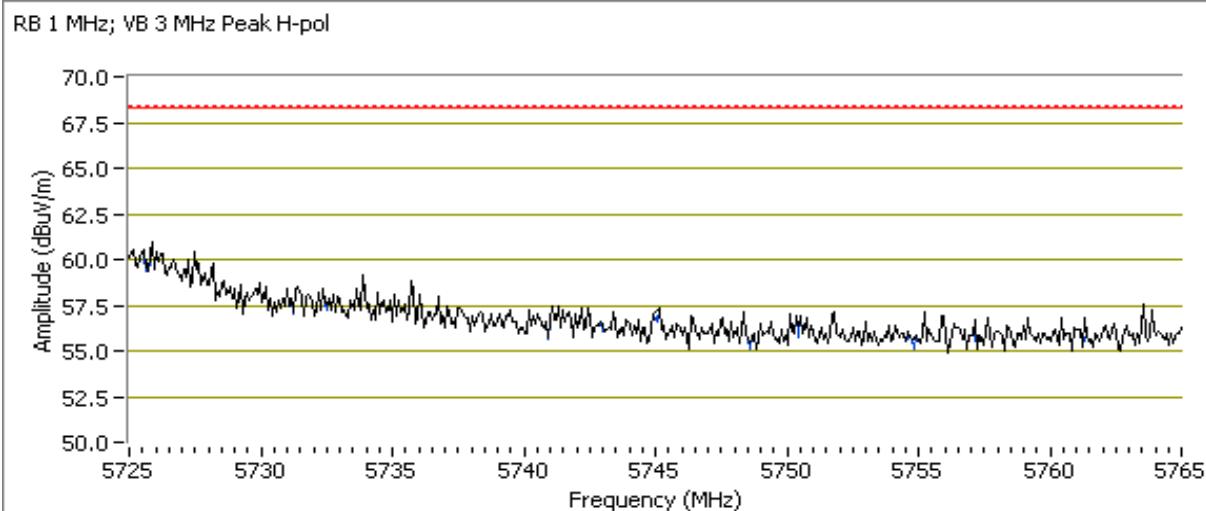
Tx Chain: Main

Mode: n40

Data Rate: MCS0

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	
5736.860	61.4	H	68.3	-6.9	PK	312	1.1	Side
5730.210	58.8	V	68.3	-9.5	PK	262	1.1	Side
5753.140	58.2	H	68.3	-10.1	PK	351	1.0	Flat
5726.760	57.3	V	68.3	-11.0	PK	49	1.7	Flat





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/15.E/RSS-210	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), (2)	Pass	a: 14.4dBm (27.8mW) n20: 14.4dBm (27.7mW) n40: 14.3dBm (27.0mW)
1	PSD, 5150 - 5250MHz	15.407(a) (1), (2)	Pass	a: 1.6dBm/MHz n20: 1.2dBm/MHz n40: -1.9dBm/MHz
1	Power, 5250 - 5350MHz	15.407(a) (1), (2)	Pass	a: 14.3dBm (27.0mW) n20: 14.8dBm (30.0mW) n40: 14.6dBm (29.0mW)
1	PSD, 5250 - 5350MHz	15.407(a) (1), (2)	Pass	a: 1.4dBm/MHz n20: 1.8dBm/MHz n40: -1.5dBm/MHz
1	Max EIRP 5250 - 5350MHz	TPC required if EIRP \geq 500mW (27dBm). EIRP \geq 200mW (23dBm) DFS threshold = -64dBm.	Pass	EIRP = 17.8dBm (59.7mW)
1	Power, 5470 - 5725MHz	15.407(a) (1), (2)	Pass	a: 14.1dBm (25.6mW) n20: 14.2dBm (26.1mW) n40: 14.4dBm (27.7mW)
1	PSD, 5470 - 5725MHz	15.407(a) (1), (2)	Pass	a: 1.2dBm/MHz n20: 1.0dBm/MHz n40: -1.9dBm/MHz
1	Max EIRP 5470 - 5725MHz	TPC required if EIRP \geq 500mW (27dBm). EIRP \geq 200mW (23dBm) DFS threshold = -64dBm.	Pass	EIRP = 17.4dBm (55.2mW)



EMC Test Data

Client:	Vocera Communications			Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)			T-Log Number:	T94631
Contact:	Rob Holt			Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210			Project Coordinator:	Irene Rademacher
					Class: N/A
Run #	Test Performed	Limit	Pass / Fail	Result / Margin	
1	26dB Bandwidth	15.407 (Information only)	-	a: 19.9MHz n20: 20.2MHz n40: 40.1MHz	
1	99% Bandwidth	RSS 210 (Information only)	N/A	a: 16.8MHz n20: 18.0MHz n40: 36.5MHz	
2	Peak Excursion Envelope	15.407(a) (6) 13dB	Pass	9dB	
3	Antenna Conducted - Out of Band Spurious	15.407(b) -27dBm/MHz	N/A	Refer to radiated measurements	

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: 21.4 °C
Rel. Humidity: 42 %

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 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	6Mb/s	100.00	-	-	0	0	-
n20	MCS0	100.00	-	-	0	0	-
n40	MCS0	100.00	-	-	0	0	-

Sample Notes

Sample S/N: 3C (NTS 2014-3721)

Driver: M3X14447 (a and n20)

Driver: M3X144473 FW:14.66.35.P46 (n40)



EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A

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

Date of Test: 3/27/14, 4/1/14

Config. Used: 1

Test Engineer: Rafael Varelas / Jack Liu

Config Change: None

Test Location: FT Lab 4B / 6

EUT Voltage: 4.2Vdc

Note 1:	Output power measured using a spectrum analyzer (see plots below). RBW=1MHz, VB=3 MHz, # of points in sweep \geq 2*span/RBW, sample RMS detector, power averaging on (transmitted signal was continuous) and power integration over 40 and 80 MHz (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 3xRB
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.

SISO Device - 5150-5250 MHz Band - FCC

Antenna Gain (dBi): 3 Max EIRP: 55.5 mW 17.4 dBm

Frequency (MHz)	Software Setting	26dB BW (MHz)	Duty Cycle %	Output Power ¹ dBm			PSD ² dBm/MHz			Result
				Measured	Calculated	Limit	Measured	Calculated	Limit	
802.11a										
5180	16.0	19.9	100.0	14.0	14.0	17.0	0.9	0.9	4.0	Pass
5200	16.0	19.9	100.0	14.1	14.1	17.0	1.3	1.3	4.0	Pass
5240	16.0	19.9	100.0	14.4	14.4	17.0	1.6	1.6	4.0	Pass
802.11n 20MHz										
5180	16.0	20.3	100.0	13.9	13.9	17.0	0.5	0.5	4.0	Pass
5200	16.0	20.4	100.0	14.4	14.4	17.0	1.2	1.2	4.0	Pass
5240	16.0	20.4	100.0	14.2	14.2	17.0	1.0	1.0	4.0	Pass
802.11n 40MHz										
5190	16.0	40.1	100.0	14.3	14.3	17.0	-1.9	-1.9	4.0	Pass
5230	16.0	40.8	100.0	14.2	14.2	17.0	-2.0	-2.0	4.0	Pass



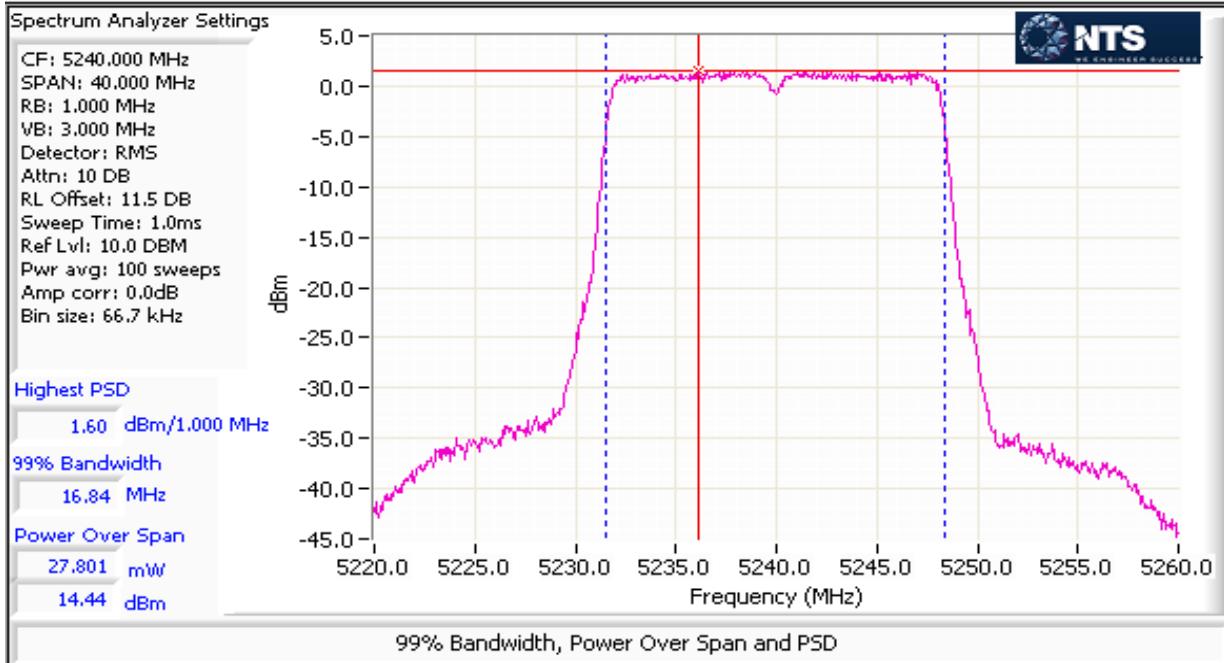
EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/15.E/RSS-210	Class:	N/A

SISO Device - 5150-5250 MHz Band - Industry Canada

Antenna Gain (dBi): 3 Max EIRP: 55.5 mW 17.4 dBm

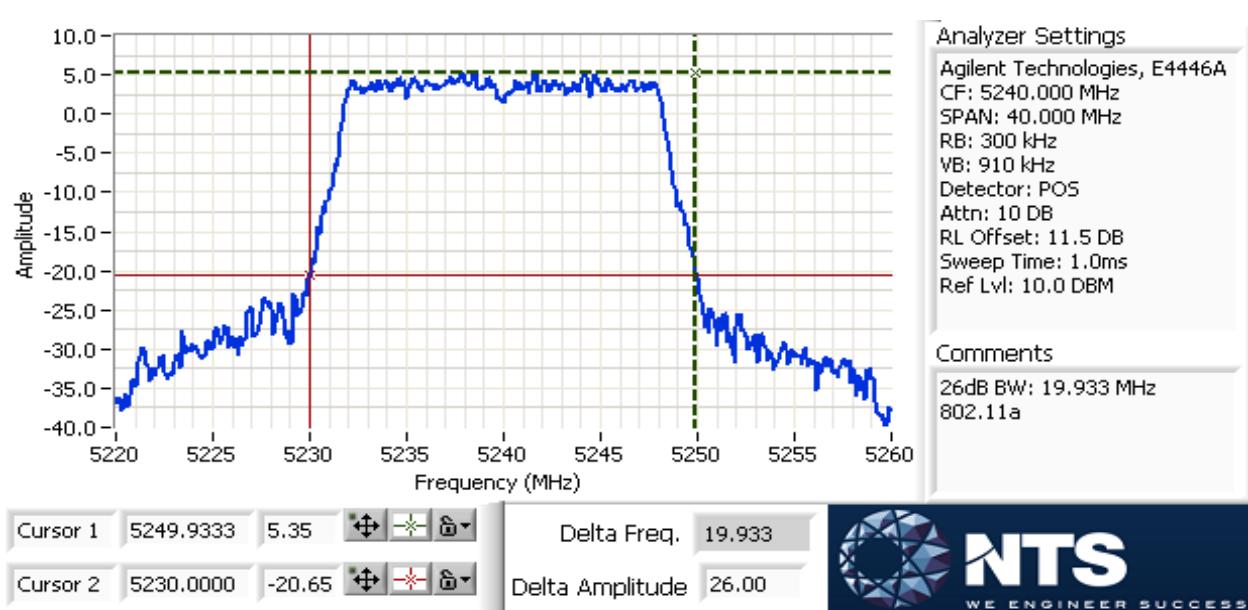
Frequency (MHz)	Software Setting	99% BW (MHz)	Duty Cycle %	Output Power ¹ dBm			PSD ² dBm/MHz			Result
				Measured	Calculated	Limit	Measured	Calculated	Limit ³	
802.11a										
5180	16.0	16.8	100.0	14.0	14.0	16.3	0.9	0.9	7.0	Pass
5200	16.0	16.8	100.0	14.1	14.1	16.3	1.3	1.3	7.0	Pass
5240	16.0	16.8	100.0	14.4	14.4	16.3	1.6	1.6	7.0	Pass
802.11n 20MHz										
5180	16.0	18.0	100.0	13.9	13.9	16.6	0.5	0.5	7.0	Pass
5200	16.0	18.0	100.0	14.4	14.4	16.6	1.2	1.2	7.0	Pass
5240	16.0	18.0	100.0	14.2	14.2	16.6	1.0	1.0	7.0	Pass
802.11n 40MHz										
5190	16.0	36.5	100.0	14.3	14.3	17.0	-1.8	-1.8	7.0	Pass
5230	16.0	36.5	100.0	14.2	14.2	17.0	-2.0	-2.0	7.0	Pass





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/15.E/RSS-210	Class:	N/A





EMC Test Data

Client:	Vocera Communications				Job Number:	J94614		
Model:	Northstar (1x1 802.11abgn + BT)				T-Log Number:	T94631		
Contact:	Rob Holt				Project Manager:	Christine Krebill		
Standard:	FCC 15.247/15.E/RSS-210				Project Coordinator:	Irene Rademacher		

SISO Device - 5250-5350 MHz Band - FCC

Antenna Gain (dBi): 3 Max EIRP: 59.7 mW 17.8 dBm

Frequency (MHz)	Software Setting	26dB BW (MHz)	Duty Cycle %	Output Power ¹ dBm			PSD ² dBm/MHz			Result
				Measured	Calculated	Limit	Measured	Calculated	Limit	
802.11a										
5260	16.0	20.0	100.0	14.1	14.1	24.0	1.3	1.3	11.0	Pass
5300	16.0	19.9	100.0	14.3	14.3	24.0	1.3	1.3	11.0	Pass
5320	16.0	20.0	100.0	14.3	14.3	24.0	1.4	1.4	11.0	Pass
802.11n 20MHz										
5260	16.0	20.2	100.0	14.1	14.1	24.0	1.0	1.0	11.0	Pass
5300	16.0	20.5	100.0	14.4	14.4	24.0	1.2	1.2	11.0	Pass
5320	16.0	20.4	100.0	14.8	14.8	24.0	1.8	1.8	11.0	Pass
802.11n 40MHz										
5270	16.0	40.3	100.0	14.3	14.3	24.0	-1.8	-1.8	11.0	Pass
5310	16.0	40.7	100.0	14.6	14.6	24.0	-1.5	-1.5	11.0	Pass

SISO Device - 5250-5350 MHz Band - Industry Canada

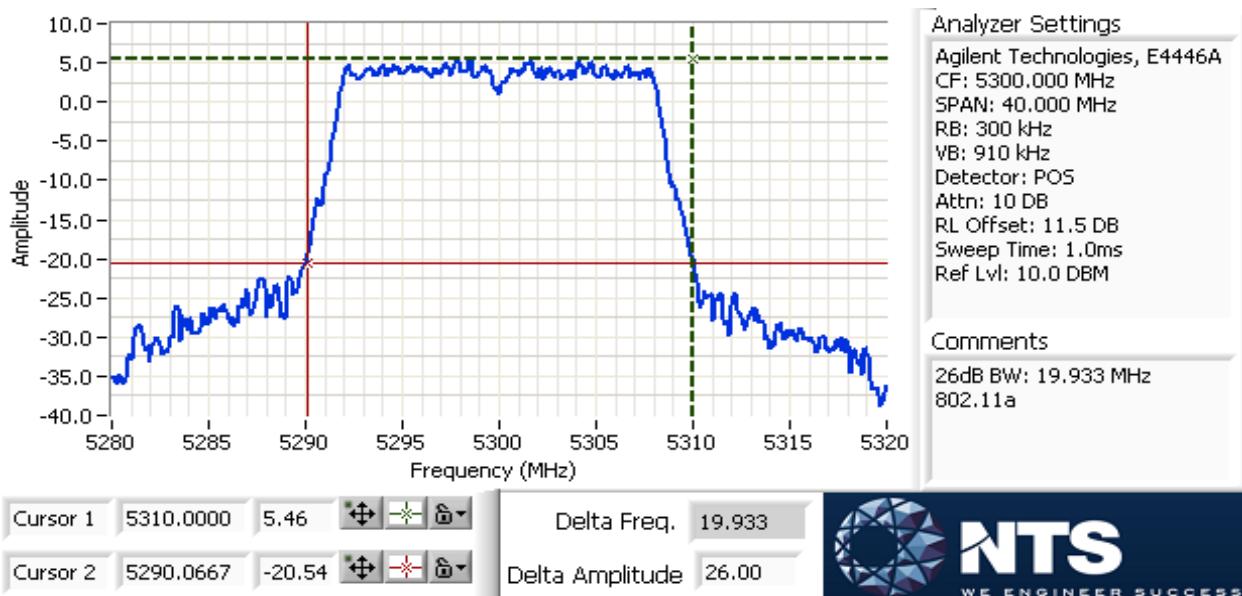
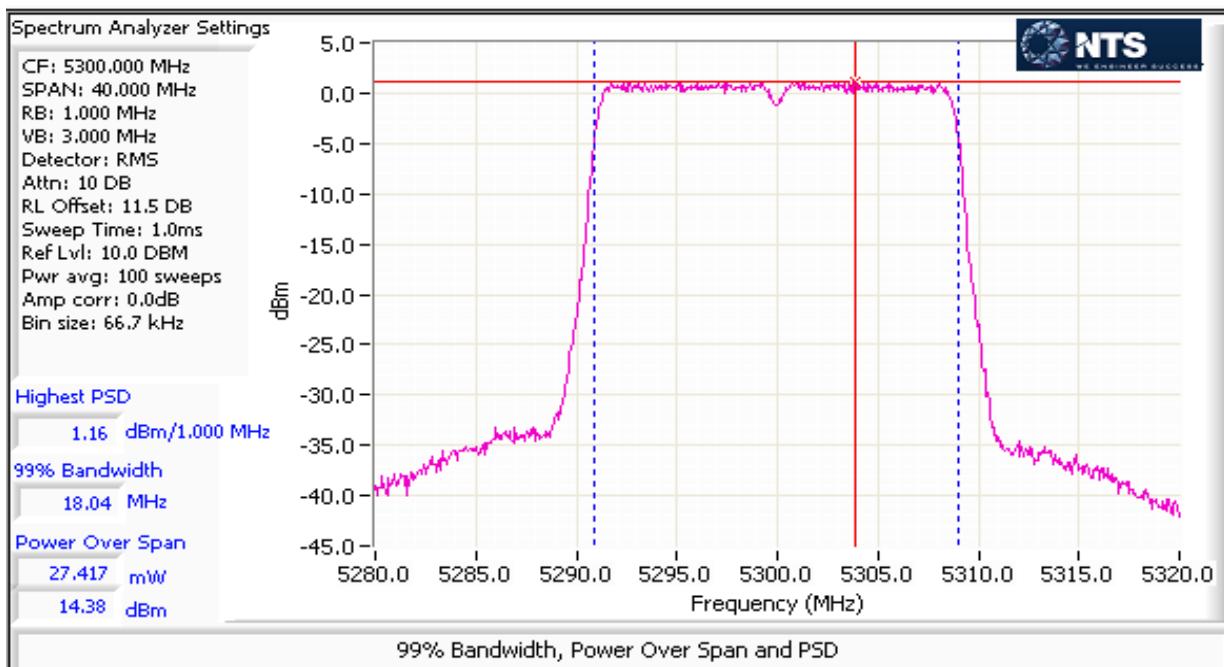
Antenna Gain (dBi): 3 Max EIRP: 59.7 mW 17.8 dBm

Frequency (MHz)	Software Setting	99% BW (MHz)	Duty Cycle %	Output Power ¹ dBm			PSD ² dBm/MHz			Result
				Measured	Calculated	Limit	Measured	Calculated	Limit ³	
802.11a										
5260	16.0	16.8	100.0	14.1	14.1	23.3	1.3	1.3	11.0	Pass
5300	16.0	16.8	100.0	14.3	14.3	23.3	1.3	1.3	11.0	Pass
5320	16.0	16.8	100.0	14.3	14.3	23.3	1.4	1.4	11.0	Pass
802.11n 20MHz										
5260	16.0	18.0	100.0	14.1	14.1	23.6	1.0	1.0	11.0	Pass
5300	16.0	18.0	100.0	14.4	14.4	23.6	1.2	1.2	11.0	Pass
5320	16.0	18.0	100.0	14.8	14.8	23.6	1.8	1.8	11.0	Pass
802.11n 40MHz										
5270	16.0	36.5	100.0	14.3	14.3	24.0	-1.8	-1.8	11.0	Pass
5310	16.0	36.5	100.0	14.6	14.6	24.0	-1.5	-1.5	11.0	Pass



EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
Contact:	Rob Holt	Project Manager:	Christine Krebill
Standard:	FCC 15.247/15.E/RSS-210	Project Coordinator:	Irene Rademacher
		Class:	N/A





EMC Test Data

Client:	Vocera Communications				Job Number:	J94614		
Model:	Northstar (1x1 802.11abgn + BT)				T-Log Number:	T94631		
Contact:	Rob Holt				Project Manager:	Christine Krebill		
Standard:	FCC 15.247/15.E/RSS-210				Project Coordinator:	Irene Rademacher		

SISO Device - 5470-5725 MHz Band - FCC

Antenna Gain (dBi): 3 Max EIRP: 55.2 mW 17.4 dBm

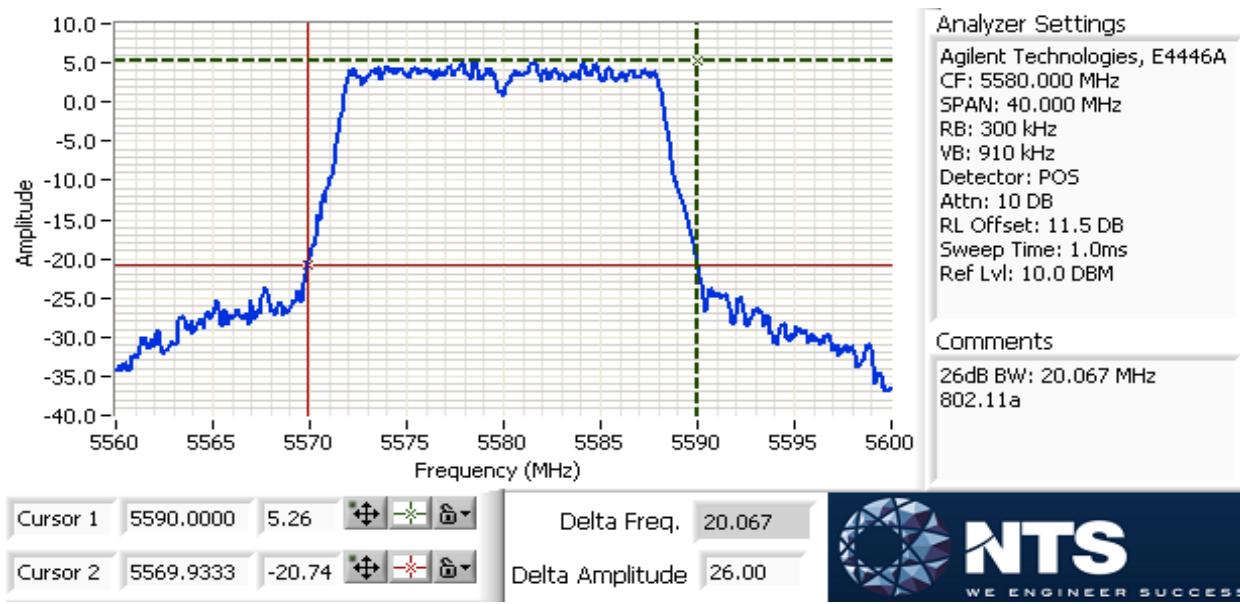
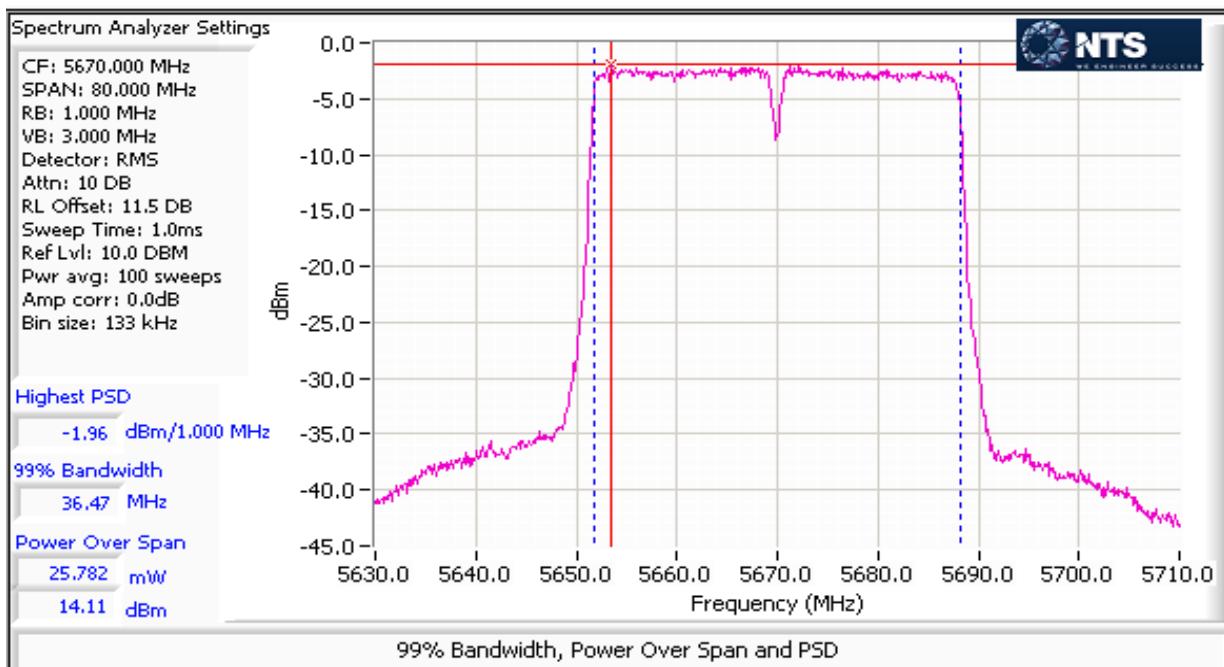
Frequency (MHz)	Software Setting	26dB BW (MHz)	Duty Cycle %	Output Power ¹ dBm			PSD ² dBm/MHz			Result
				Measured	Calculated	Limit	Measured	Calculated	Limit	
802.11a										
5500	16.0	20.1	100.0	14.1	14.1	24.0	1.2	1.2	11.0	Pass
5580	16.0	20.1	100.0	14.0	14.0	24.0	1.1	1.1	11.0	Pass
5700	16.0	20.0	100.0	13.6	13.6	24.0	0.7	0.7	11.0	Pass
802.11n 20MHz										
5500	16.0	20.3	100.0	14.2	14.2	24.0	1.0	1.0	11.0	Pass
5580	16.0	20.4	100.0	14.1	14.1	24.0	1.0	1.0	11.0	Pass
5700	16.0	20.3	100.0	13.7	13.7	24.0	0.5	0.5	11.0	Pass
802.11n 40MHz										
5510	16.0	40.3	100.0	14.2	14.2	24.0	-2.0	-2.0	11.0	Pass
5550	16.0	40.8	100.0	14.4	14.4	24.0	-1.9	-1.9	11.0	Pass
5670	16.0	40.7	100.0	14.1	14.1	24.0	-2.0	-2.0	11.0	Pass

SISO Device - 5470-5725 MHz Band - Industry Canada

Antenna Gain (dBi): 3 Max EIRP: 55.2 mW 17.4 dBm

Frequency (MHz)	Software Setting	99% BW (MHz)	Duty Cycle %	Output Power ¹ dBm			PSD ² dBm/MHz			Result
				Measured	Calculated	Limit	Measured	Calculated	Limit ³	
802.11a										
5500	16.0	16.8	100.0	14.1	14.1	23.3	1.2	1.2	11.0	Pass
5580	16.0	16.8	100.0	14.0	14.0	23.3	1.1	1.1	11.0	Pass
5700	16.0	16.8	100.0	13.6	13.6	23.3	0.7	0.7	11.0	Pass
802.11n 20MHz										
5500	16.0	18.0	100.0	14.2	14.2	23.6	1.0	1.0	11.0	Pass
5580	16.0	18.0	100.0	14.1	14.1	23.6	1.0	1.0	11.0	Pass
5700	16.0	18.0	100.0	13.7	13.7	23.6	0.5	0.5	11.0	Pass
802.11n 40MHz										
5510	16.0	36.5	100.0	14.2	14.2	24.0	-2.0	-2.0	11.0	Pass
5550	16.0	36.5	100.0	14.4	14.4	24.0	-1.9	-1.9	11.0	Pass
5670	16.0	36.5	100.0	14.1	14.1	24.0	-2.0	-2.0	11.0	Pass

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/15.E/RSS-210	Class:	N/A





EMC Test Data

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/15.E/RSS-210	Class:	N/A

Run #2: Peak Excursion Measurement

Date of Test: 3/27/14, 4/1/14

Config. Used: 1

Test Engineer: Rafael Varelas / Jack Liu

Config Change: None

Test Location: FT Lab 4B / 6

EUT Voltage: 4.2Vdc

802.11a

20MHz: Device meets the requirement for the peak excursion

Freq	Peak Excursion(dB)	Freq	Peak Excursion(dB)	Freq	Peak Excursion(dB)
(MHz)	Value	Limit	(MHz)	Value	Limit
5180	6.7	13.0	5260	6.2	13.0
5200	6.4	13.0	5300	6.5	13.0
5240	6.2	13.0	5320	6.4	13.0

802.11n20

20MHz: Device meets the requirement for the peak excursion

Freq	Peak Excursion(dB)	Freq	Peak Excursion(dB)	Freq	Peak Excursion(dB)
(MHz)	Value	Limit	(MHz)	Value	Limit
5180	7.1	13.0	5260	6.6	13.0
5200	6.9	13.0	5300	7.0	13.0
5240	6.6	13.0	5320	6.1	13.0

802.11n40

40MHz: Device meets the requirement for the peak excursion

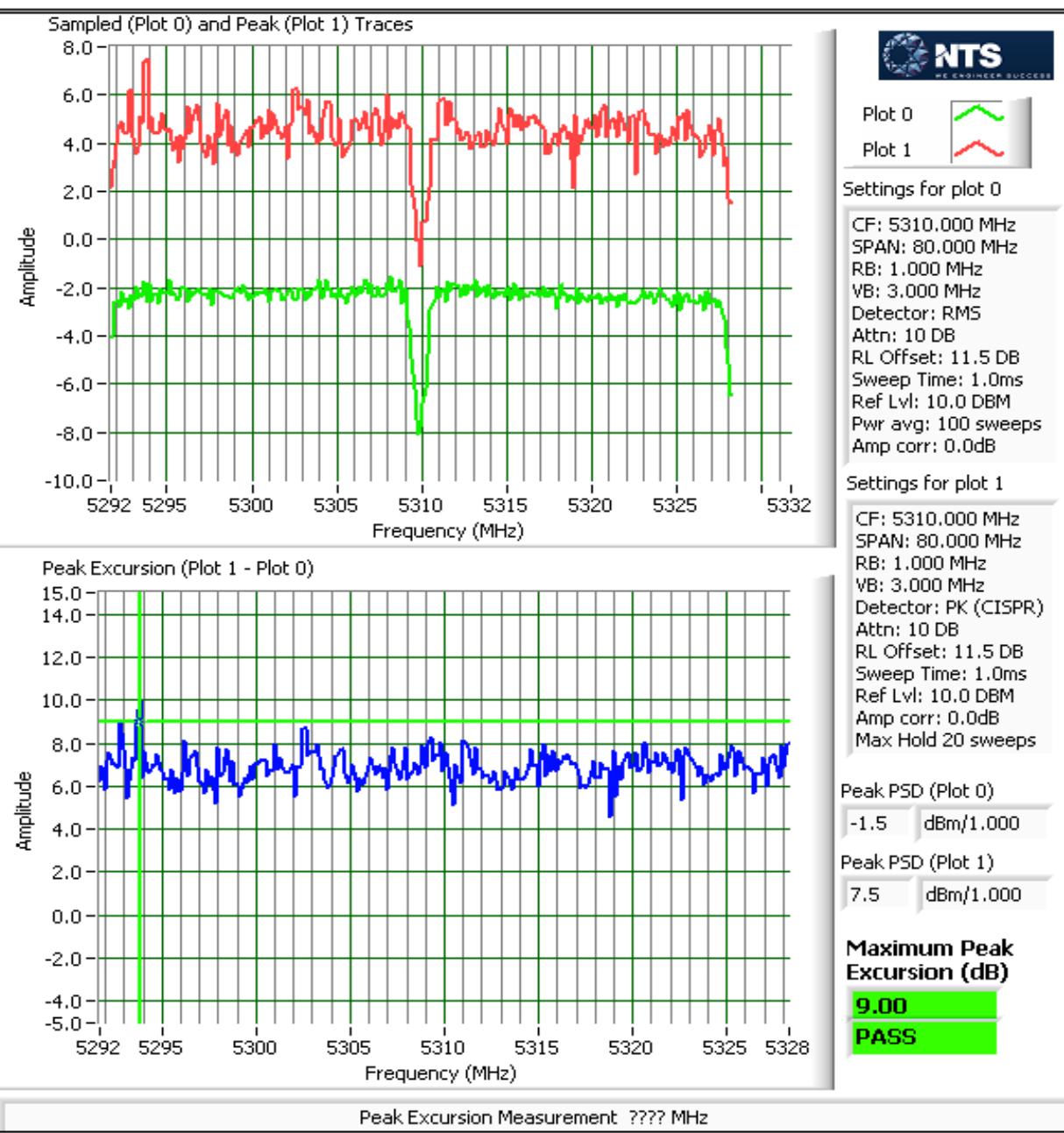
Freq	Peak Excursion(dB)	Freq	Peak Excursion(dB)	Freq	Peak Excursion(dB)
(MHz)	Value	Limit	(MHz)	Value	Limit
5190	7.6	13.0	5270	8.3	13.0
5230	7.9	13.0	5310	9.0	13.0
				5670	7.2
					13.0

Plots Showing Peak Excursion

Trace A: RBW = 1MHz, VBW = 3MHz, Peak hold

Trace B: Same settings as used for power/PSD measurements (RBW = 1 MHz, VBW = 3MHz, Integrated average power)

Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/15.E/RSS-210	Class:	N/A



End of Report

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