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EMC Test Report

Application for Grant of Equipment Authorization

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

Model: B3000n Communication Badge

IC CERTIFICATION #:	4362A-B3000N
FCC ID:	QGZB3000N
APPLICANT:	Vocera Communications, Inc. 525 Race Street San Jose, CA 95126
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-7
REPORT DATE:	September 10, 2014
FINAL TEST DATES:	March 26, April 4, 29, 30, May 1, and 2, 2014
TOTAL NUMBER OF PAGES:	53

PROGRAM MGR /
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A2LA ACCREDITED
Testing Cert #0214.26

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	September 10, 2014	First release	

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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 C

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

ANSI C63.10-2009
FHSS test procedure DA 00-0705A1

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:

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

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

The test results recorded herein are based on a single type test of 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

FREQUENCY HOPPING SPREAD SPECTRUM (2400 – 2483.5 MHz, 75 channels or more)

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.247 (a) (1)	RSS 210 A8.1 (1)	20dB Bandwidth	Basic Rate: 1121kHz EDR: 1333kHz	Channel spacing > 2/3rds 20dB BW	Complies
		Channel Separation	1000kHz		Complies
15.247 (a) (1) (iii)	RSS 210 A8.1 (4)	Channel Dwell Time (*average time of occupancy)*	0.4 seconds per 31.6 seconds for 79 channels	<0.4 second within a period of 0.4 x number of channels	Complies
15.247 (a) (1) (iii)	RSS 210 A8.1 (4)	Number of Channels	Max: 79 Min: 20	75 or more	Complies
15.247 (a) (1)	RSS 210 A8.1 (1)	Channel Utilization	The system uses the BlueTooth algorithm and, therefore, meets all requirements for channel utilization.	All channels shall, on average, be used equally	Complies
15.247 (b) (3)	RSS 210 A8.4 (2)	Output Power (multipoint systems)	Basic Rate: 8dBm (0.006W) EDR: 5.8dBm (0.004W) EIRP = 0.012W Note 1	0.125 Watts	Complies
15.247(c)	RSS 210 A8.5	Spurious Emissions – 30MHz – 25GHz	All spurious emissions < -20dBc	< -20dBc	Complies
15.247(c) / 15.209	RSS 210 A8.5 Table 2, 3	Radiated Spurious Emissions 30MHz – 25GHz	47.7 dBµV/m @ 7439.7 MHz (-6.3 dB)	15.207 in restricted bands, all others < -20dBc	Complies
15.247 (a) (1)	RSS 210 A8.1(2)	Receiver bandwidth	Refer to operational description	Shall match the channel bandwidth	Complies
Note 1: EIRP calculated using antenna gain of 3 dBi					

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 Manual	Statement required regarding non-interference	Complies

MEASUREMENT UNCERTAINTIES

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

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

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Vocera Communications, Inc. model B3000n Communication Badge is a 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, April 4, 29, 30, May 1, and 2, 2014. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Vocera Communications	B3000n (Northstar)	Communication Badge	3C	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	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
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 and the maximum output power. Where noted in the test data, testing was performed with the EUT configured to hop across all available channels.

TEST SITE

GENERAL INFORMATION

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

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

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

RADIATED EMISSIONS CONSIDERATIONS

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

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

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

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

INSTRUMENT CONTROL COMPUTER

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

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

FILTERS/ATTENUATORS

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

ANTENNAS

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

ANTENNA MAST AND EQUIPMENT TURNTABLE

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

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

INSTRUMENT CALIBRATION

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

TEST PROCEDURES

EUT AND CABLE PLACEMENT

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

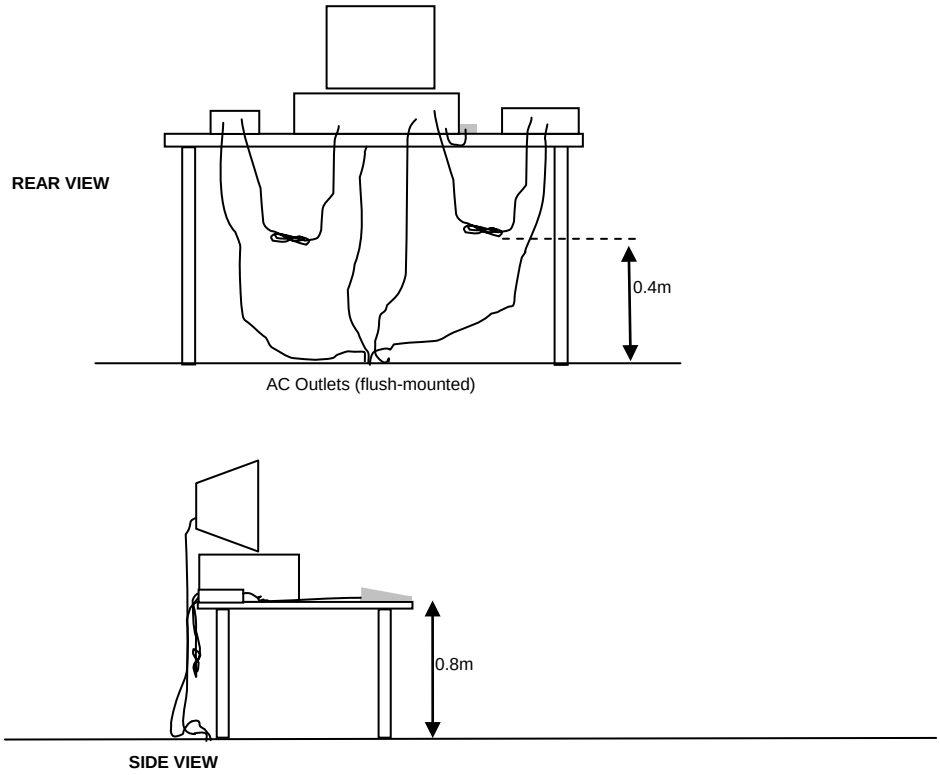
RADIATED EMISSIONS

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

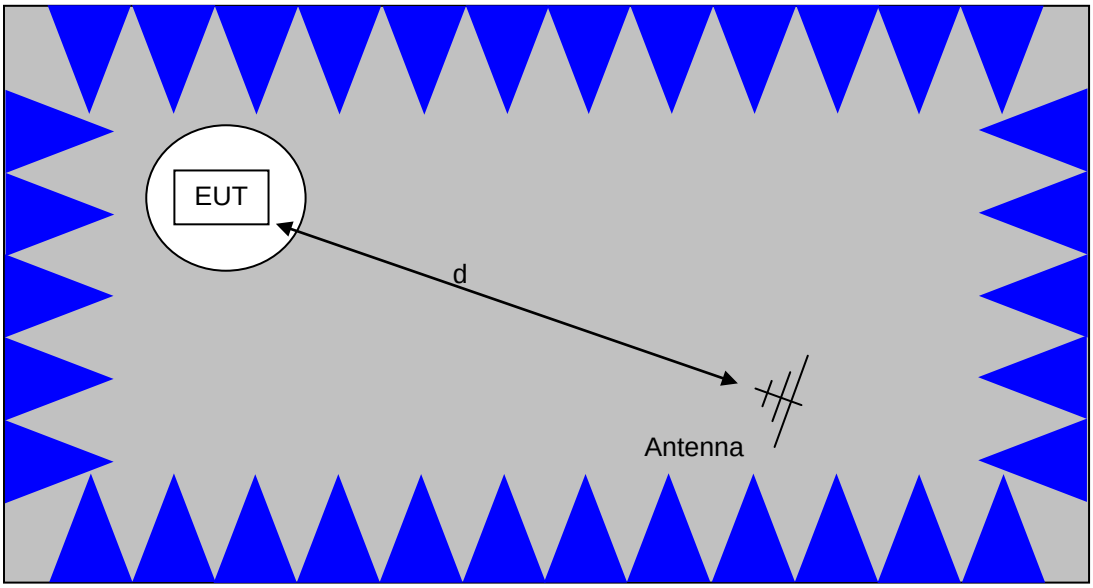
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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

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

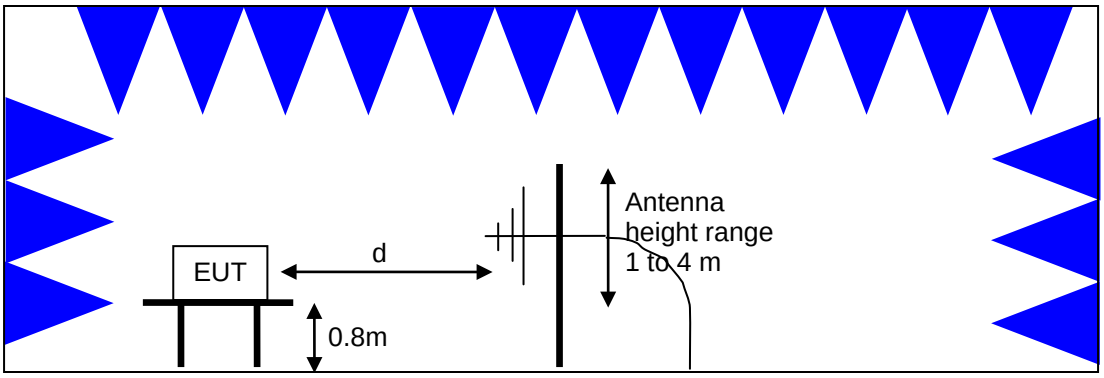


Typical Test Configuration for Radiated Field Strength Measurements



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

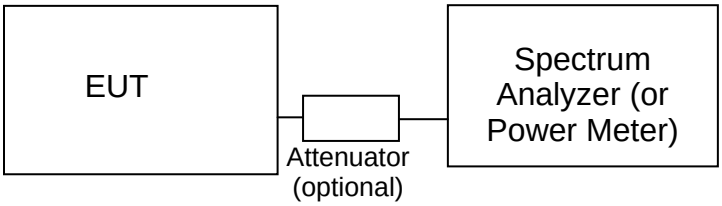
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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

CONDUCTED EMISSIONS FROM ANTENNA PORT

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



Test Configuration for Antenna Port Measurements

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

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

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

BANDWIDTH MEASUREMENTS

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

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

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

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

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

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

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

OUTPUT POWER LIMITS – FHSS SYSTEMS

The table below shows the limits for output power based on the number of channels available for the hopping system.

Operating Frequency (MHz)	Number of Channels	Output Power
902 – 928	≥ 50	1 Watt (30 dBm)
902 – 928	25 to 49	0.25 Watts (24 dBm)
2400 – 2483.5	≥ 75	1 Watt (30 dBm)
2400 – 2483.5	< 75	0.125 Watts (21 dBm)
5725 – 5850	75	1 Watt (30 dBm)

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

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

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

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

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:

R_r = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_C = R_r + F_d$$

and

$$M = R_C - L_S$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_C = Corrected Reading in dBuV/m

L_S = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp), or where a field strength measurement of output power is made in lieu of a direct measurement, the following formula is used to convert between eirp and field strength at a distance of d (meters) from the equipment under test:

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

where P is the eirp (Watts)

For a measurement at 3m the conversion from a logarithmic value for field strength (dBuV/m) to an eirp power (dBm) is -95.3dB.

Appendix A Test Equipment Calibration Data

Manufacturer	Description	Model	Asset #	Cal Due
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), 04-Apr-14				
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	2/6/2015
Radiated Emissions, 1,000 - 12,000 MHz, 29-Apr-14				
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	10/31/2014
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	8/23/2014
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/14/2014
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1538	12/14/2014
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1683	8/2/2014
Radiated Emissions, 1000 - 18,000 MHz, 30-Apr-14				
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	10/31/2014
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	8/23/2014
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/14/2014
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2238	9/18/2014
Radiated Emissions, 1,000 - 18,000 MHz, 01-May-14				
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	10/31/2014
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	8/23/2014
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/14/2014
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	2238	9/18/2014
Radiated Emissions, 18,000 - 26,000 MHz, 02-May-14				
Hewlett Packard	Head (Inc flex cable, 1143, 2198) Red	84125C	1145	6/26/2014
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	9/14/2014
A. H. Systems	Spare System Horn, 18-40GHz	SAS-574, p/n: 2581	2162	7/24/2014

Appendix B Test Data

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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/RSS-210	Class:	-
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Vocera Communications

Product

Northstar (1x1 802.11abgn + BT)

Date of Last Test: 5/2/2014

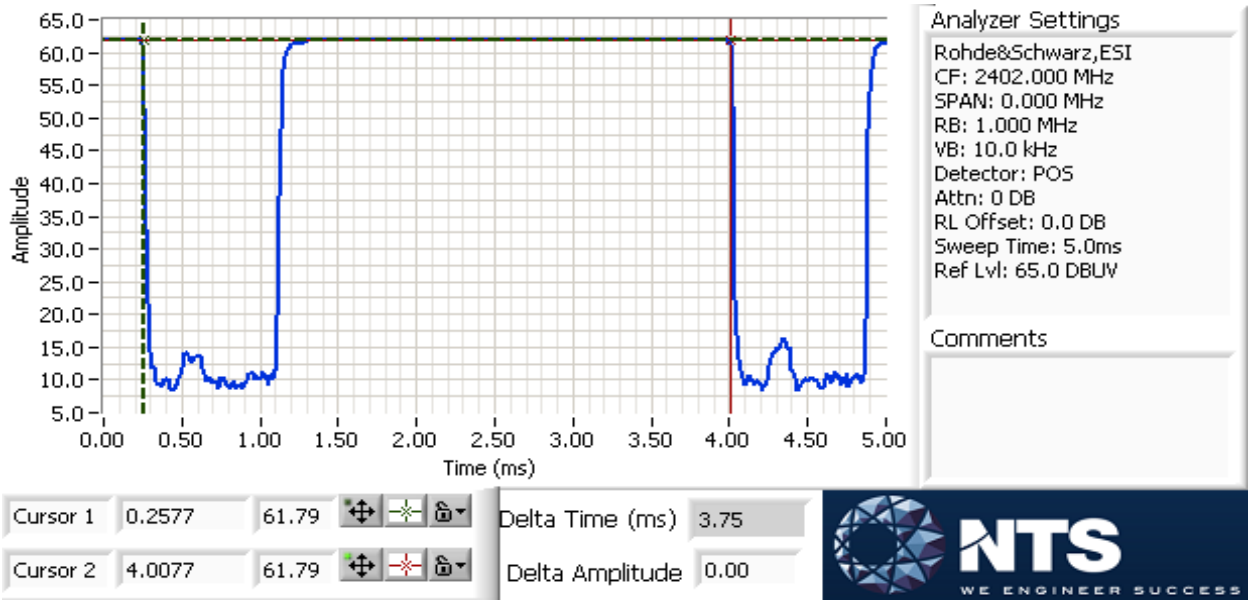
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

Duty Cycle

Date of Test: 4/28/2014
Test Engineer: Mark Hill
Test Location: FT Lab # 4B

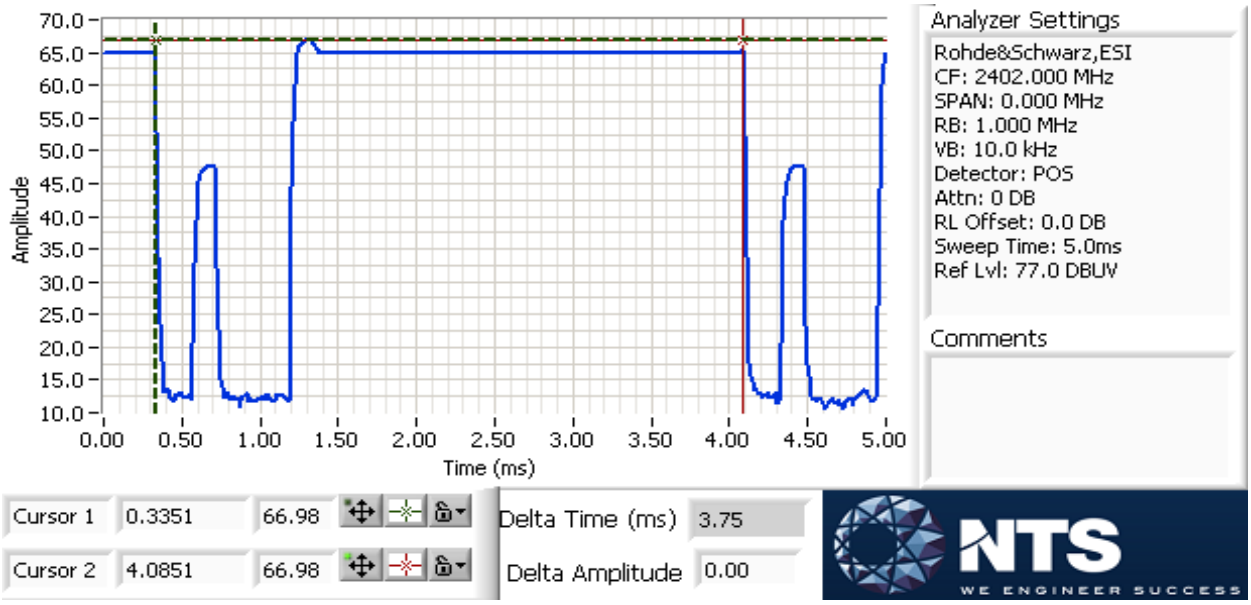
Duty cycle measurements performed on the worse case data rate for power.
Notes: Measurements taken with maximum RBW/VBW settings allowed.

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BT	Basic	0.76	Yes	2.86	1.2	2.4	350
BT	EDR	0.76	Yes	2.86	1.2	2.4	350



Basic Rate

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/RSS-210	Class:	N/A



EDR Mode

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/RSS-210	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

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

General Test Configuration

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

Ambient Conditions:

Temperature: 24 °C
Rel. Humidity: 38 %

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

Run #	Mode	Channel	Target Power	Power Setting	Test Performed	Limit	Result / Margin
1a	Basic	low	8	default	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	36.5 dBµV/m @ 2317.7 MHz (-17.5 dB)
			8	default	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	46.4 dBµV/m @ 7206.1 MHz (-7.6 dB)
1b	Basic	center	8	default	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	46.5 dBµV/m @ 12205.1 MHz (-7.5 dB)
1c	Basic	high	8	default	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	45.0 dBµV/m @ 2487.5 MHz (-9.0 dB)
			8	default	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	47.7 dBµV/m @ 7439.7 MHz (-6.3 dB)
2a	EDR	low	5	default	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	35.0 dBµV/m @ 2311.6 MHz (-19.0 dB)
			5	default	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	40.6 dBµV/m @ 7205.2 MHz (-13.4 dB)
2b	EDR	center	5	default	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	42.1 dBµV/m @ 7322.3 MHz (-11.9 dB)
2c	EDR	high	5	default	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	67.3 dBµV/m @ 2486.7 MHz (-6.7 dB)
			5	default	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	44.4 dBµV/m @ 7439.3 MHz (-9.6 dB)

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/RSS-210	Class:	N/A

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Procedure Comments:

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

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
BT	Basic	0.76	Yes	2.86	1.2	2.4	350
BT	EDR	0.76	Yes	2.86	1.2	2.4	350

Sample Notes

Sample S/N: 3C (NTS 2014-3722)
Driver: 88

Measurement Specific Notes:

Note 1:	Emission in non-restricted band, but limit of 15.209 used.
Note 2:	Emission in non-restricted band, the limit was set 30dB below the level of the fundamental and measured in 100kHz.
Note 2:	Emission has duty cycle ≥ 98%, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces
Note 3:	Emission has duty cycle < 98%, but constant, average measurement performed: RBW=1MHz, VBW=10Hz, peak detector, linear averaging, auto sweep, trace average 100 traces, measurement corrected by Linear Voltage correction factor
Note 4:	Emission has duty cycle < 98% and is NOT constant, average measurement performed: RBW=1MHz, VBW> 1/T, peak detector, linear average mode, sweep time auto, max hold. Max hold for 50*(1/DC) traces
Note 5:	Emission has duty cycle < 98%, but constant, average measurement performed: RBW=1MHz, VBW=3MHz, RMS, Power averaging, auto sweep, trace average 100 traces, measurement corrected by Pwr correction factor
Note 6:	Plots of the average and peak bandedge do not account for any duty cycle correction. Refer to the tabluar results for final measurements.
Note 7:	Average reading calculated from peak measurement with the Bluetooth hopping duty cycle applied (see below)

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/RSS-210	Class:	N/A

Notes (Bluetooth hopping duty cycle)

Device is handheld. Worse case orientation based on results from the Wifi testing was on side.

Bluetooth uses a frequency hopping algorithm that means that the device, during normal operation, is only on a specific channel for a short period of time. The average correction factor is calculated as follows:

A maximum length packet has a duration of 5 time slots.

The hopping rate is 1600 hops/second so the maximum dwell time is 5/1600 seconds, or 3.125ms.

With a minimum of 20 hopping channels a channel will not be used more than 4 times in any 100ms period.

The maximum dwell time in a 100ms period is 4 x 3.125ms = 12.5ms.

The average correction factor is, therefore, 20log(12.5/100) =-18dB

As this is a hopping radio this correction factor can be applied to the average value of the signal provided the average value was measured with the device continuously transmitting. DA 00-0705 permits the use of the average correction on the measured average value for frequency hopping radios.

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/RSS-210	Class:	N/A

Run #1: Radiated Spurious Emissions, 30 - 25000 MHz. Operating Mode: Basic

Date of Test: 4/29/14, 4/30/14, 5/1/14. 5/2/14 — Config. Used: 1

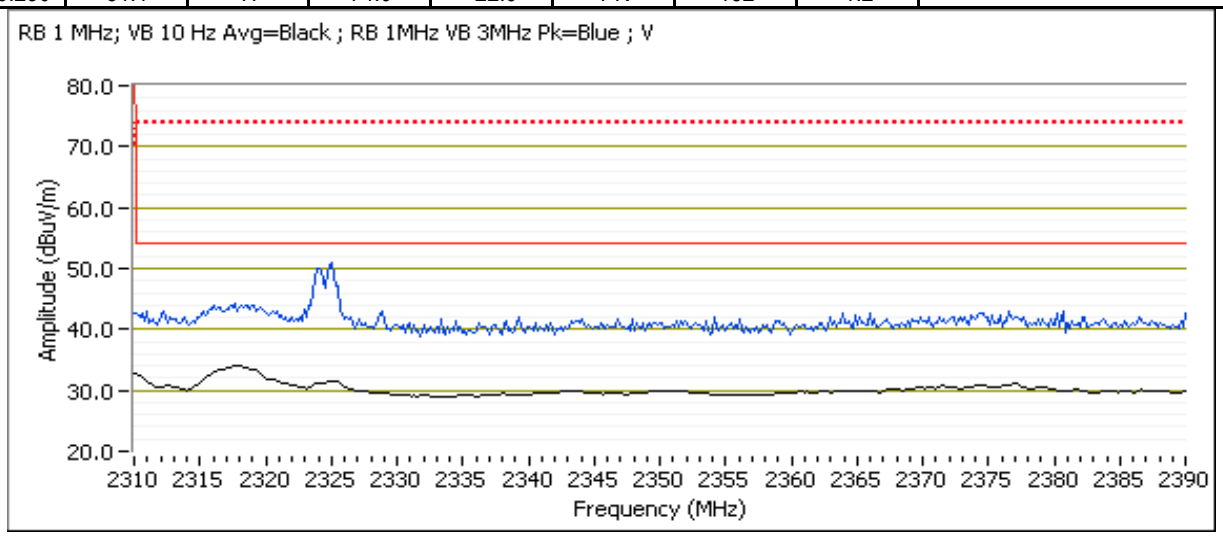
Test Engineer: Jack Liu / Rafael Varelas — Config Change: None

Test Location: Fremont CH# 7 — EUT Voltage: Battery

Run #1a: Low Channel @ 2402 MHz

Band Edge Signal Field Strength - Direct measurement of field strength

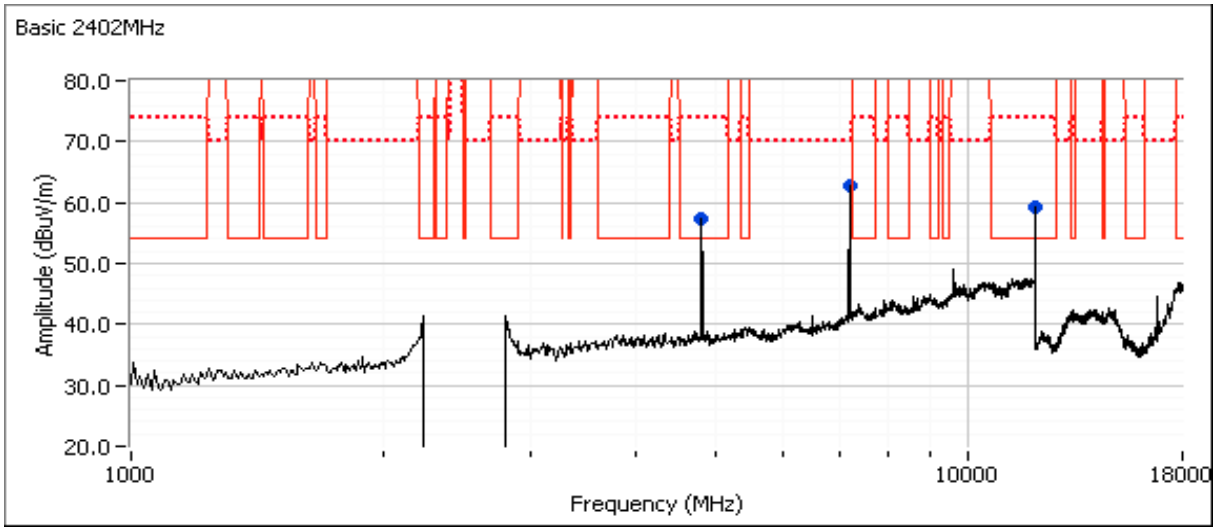
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2317.700	36.5	V	54.0	-17.5	AVG	177	1.0	Note 3
2324.110	51.1	V	74.0	-22.9	PK	177	1.0	
2317.700	36.3	H	54.0	-17.7	AVG	152	1.2	Note 3
2316.250	51.1	H	74.0	-22.9	PK	152	1.2	

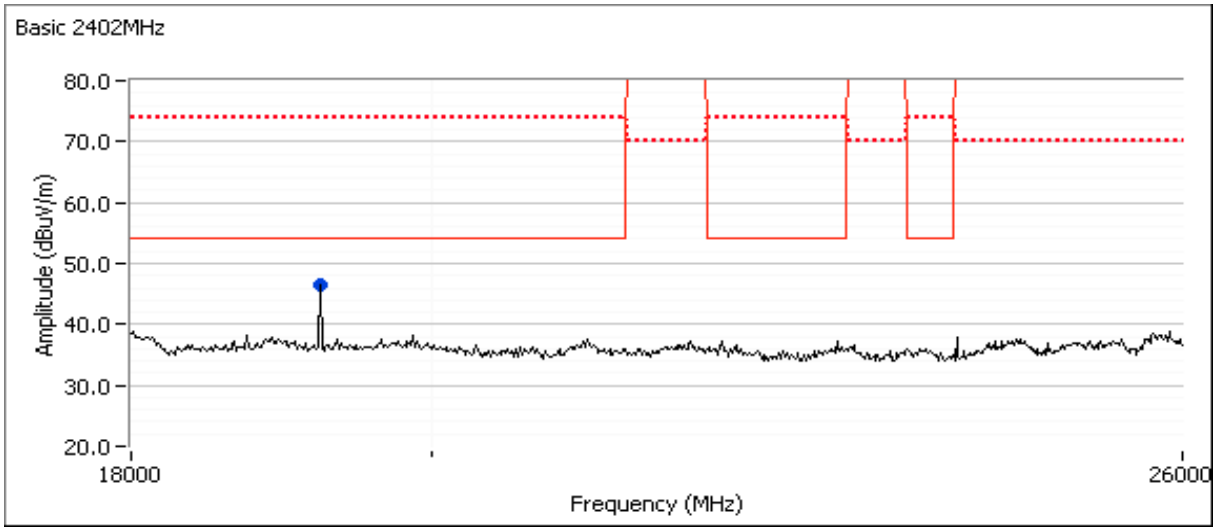


Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7206.070	46.4	H	54.0	-7.6	AVG	236	1.2	Note 1 , 7
7205.660	64.4	H	74.0	-9.6	PK	236	1.2	Note 1
4804.080	40.6	V	54.0	-13.4	AVG	230	1.2	Note 7
4804.180	58.6	V	74.0	-15.4	PK	230	1.2	
12009.820	43.5	V	54.0	-10.5	PK	192	2.0	Note 7
12009.820	61.5	V	74.0	-12.5	PK	192	2.0	
19216.050	33.0	V	54.0	-21.0	AVG	82	1.0	Note 7
19216.620	51.0	V	74.0	-23.0	PK	82	1.0	

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/RSS-210	Class:	N/A

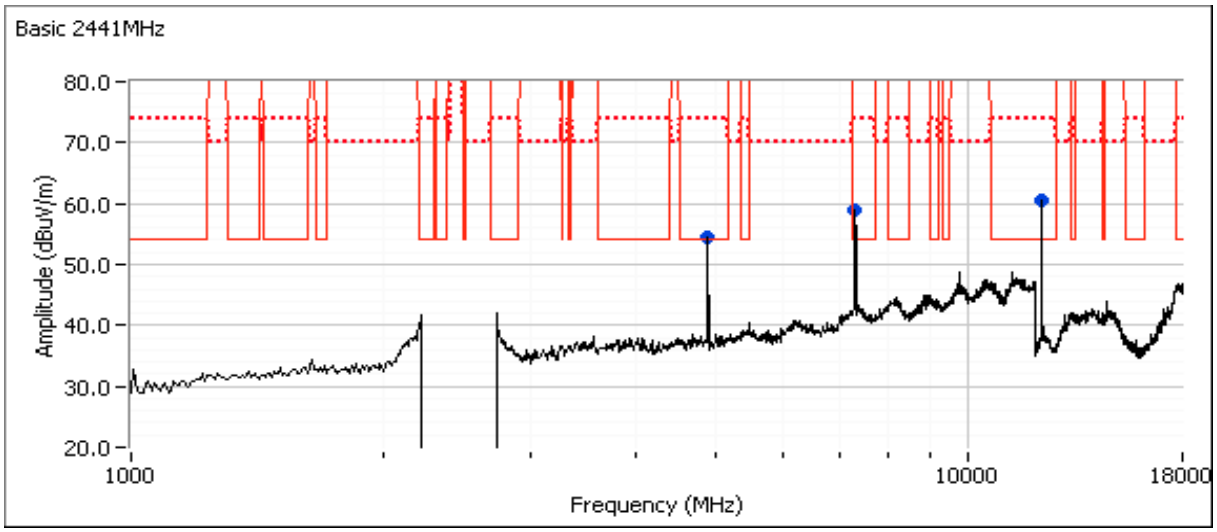




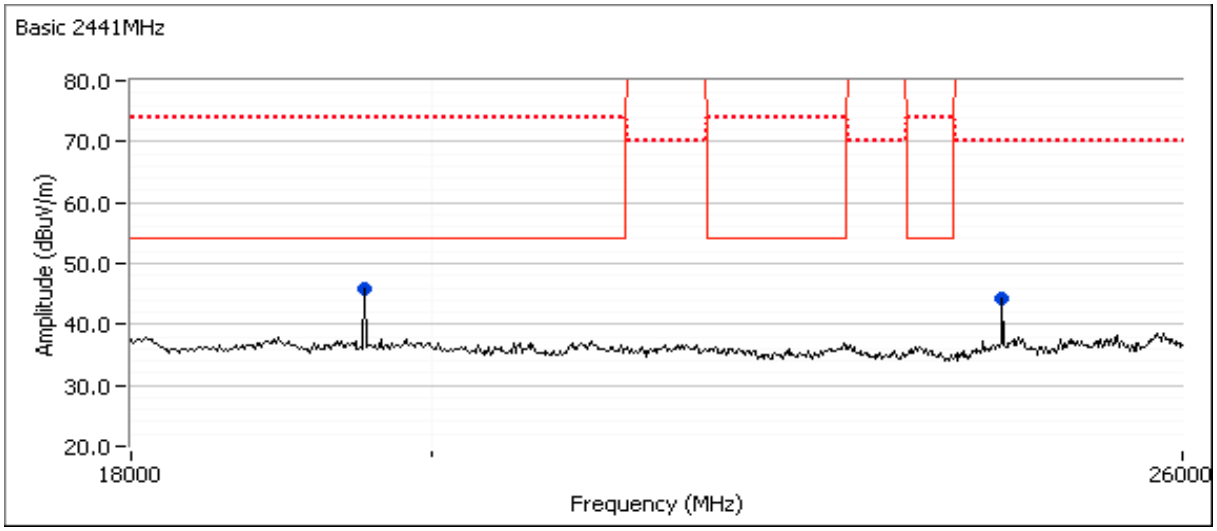
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

Run #1b: Center Channel @ 2441 MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
12205.080	46.5	H	54.0	-7.5	AVG	311	1.0	Note 7
12205.420	64.5	H	74.0	-9.5	PK	311	1.0	
7323.070	46.0	H	54.0	-8.0	AVG	50	1.2	Note 7
7323.280	64.0	H	74.0	-10.0	PK	50	1.2	
4882.050	39.8	V	54.0	-14.2	AVG	138	1.3	Note 7
4882.080	57.8	V	74.0	-16.2	PK	138	1.3	
24411.030	31.6	H	54.0	-22.4	AVG	211	1.0	Note 1, 7
24411.480	49.6	H	74.0	-24.4	PK	211	1.0	Note 1
19527.430	31.2	V	54.0	-22.8	AVG	79	1.0	Note 7
19526.800	49.2	V	74.0	-24.8	PK	79	1.0	



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/RSS-210	Class:	N/A

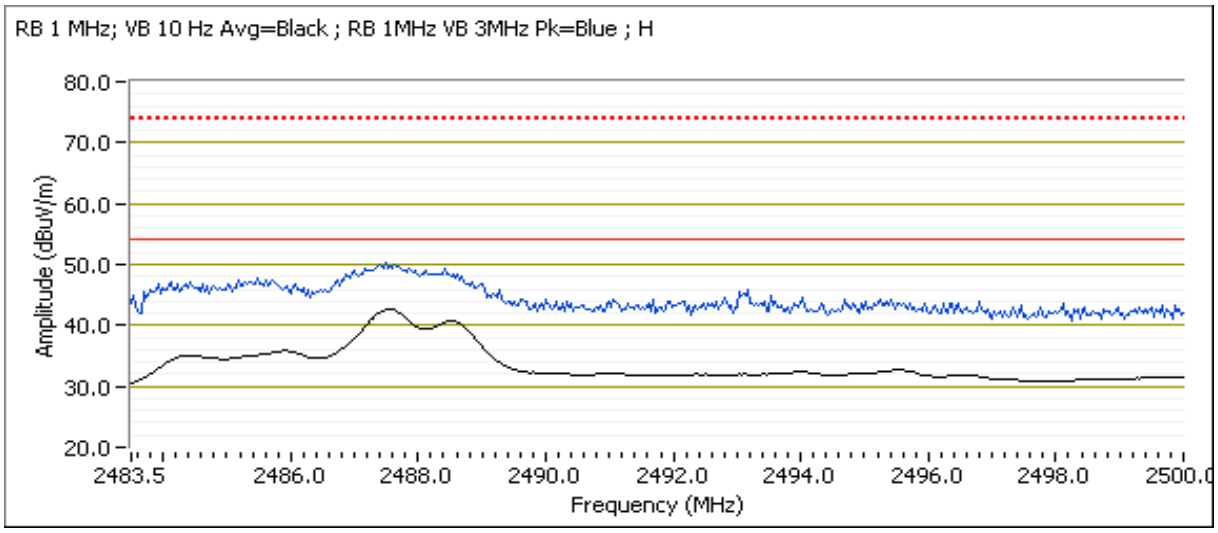


Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

Run #1c: High Channel @ 2480 MHz

Band Edge Signal Field Strength - Direct measurement of field strength

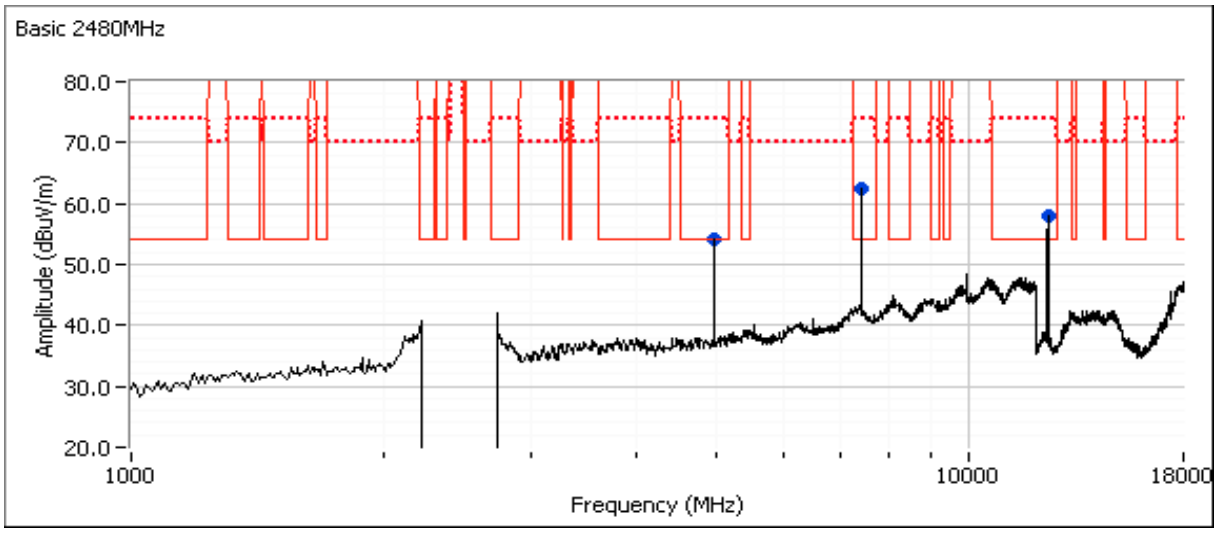
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2487.530	45.0	H	54.0	-9.0	AVG	165	1.1	Note 3
2488.290	50.1	H	74.0	-23.9	PK	165	1.1	
2487.530	39.3	V	54.0	-14.7	AVG	189	1.2	Note 3
2487.200	45.5	V	74.0	-28.5	PK	189	1.2	

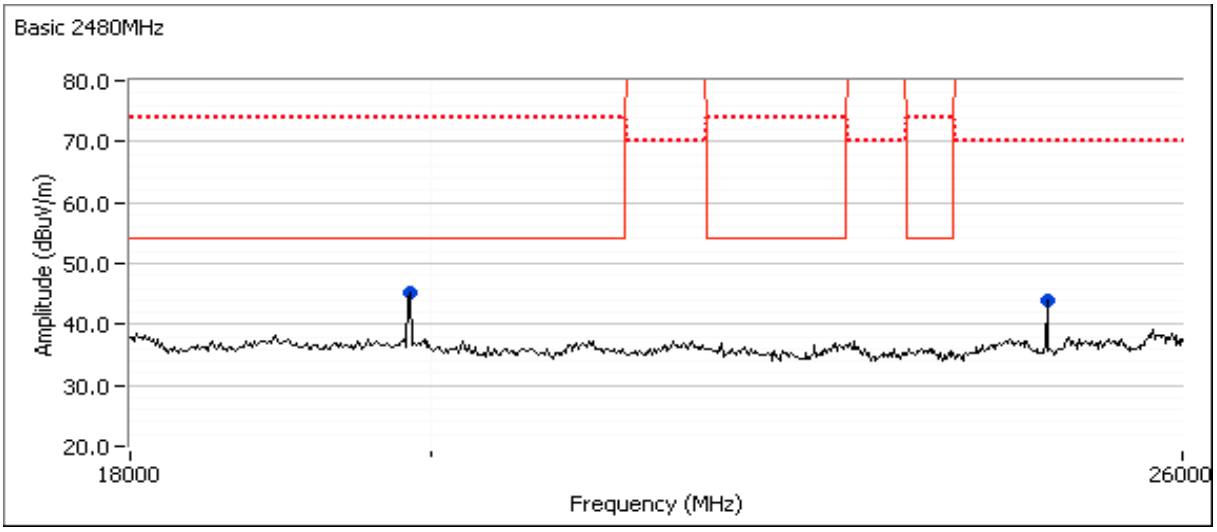


Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7439.700	47.7	H	54.0	-6.3	Avg	221	1.3	Note 7
7439.700	65.7	H	74.0	-8.3	PK	221	1.3	
4963.510	38.7	V	54.0	-15.3	Avg	310	1.0	Note 7
4963.510	56.7	V	74.0	-17.3	PK	310	1.0	
12400.100	43.2	H	54.0	-10.8	AVG	304	1.0	Note 7
12399.480	61.2	H	74.0	-12.8	PK	304	1.0	
19840.650	34.2	V	54.0	-19.8	AVG	138	1.0	
19838.930	52.2	V	74.0	-21.8	PK	138	1.0	Note 7
24799.100	32.7	H	54.0	-21.3	AVG	206	1.0	Note 1, 7
24801.700	50.7	H	74.0	-23.3	PK	206	1.0	Noite1

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/RSS-210	Class:	N/A





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/RSS-210	Class:	N/A

Run #2: Radiated Spurious Emissions, 30 - 25000 MHz. Operating Mode: EDR

Date of Test: 4/29/14, 4/30/14, 5/1/14, 5/2/14 Config. Used: 1

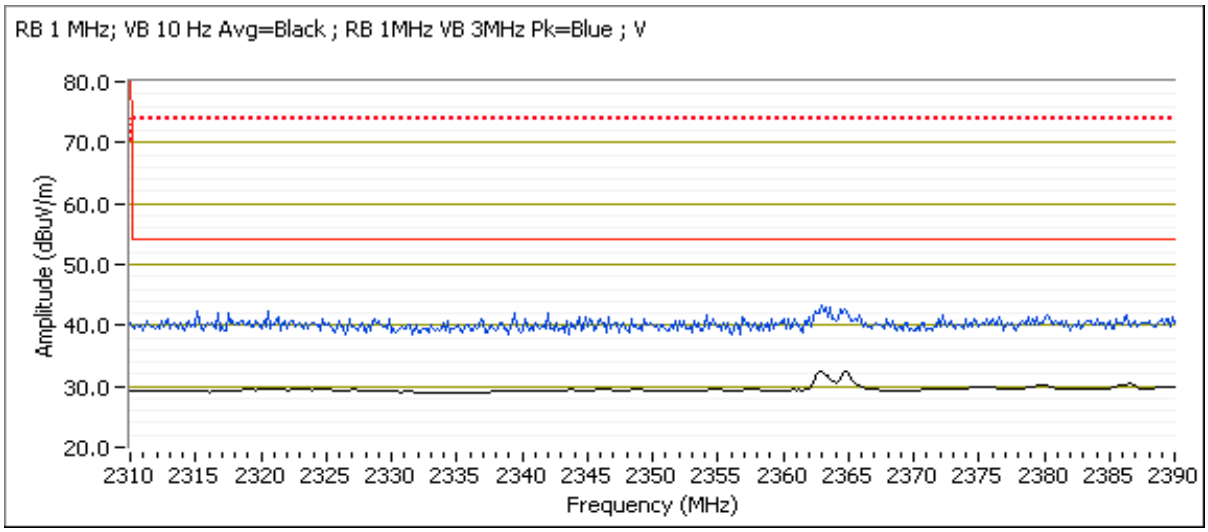
Test Engineer: Jack Liu / Rafael Varelas Config Change: None

Test Location: Fremont CH# 7 EUT Voltage: Battery

Run #2a: Low Channel @ 2402 MHz

Band Edge Signal Field Strength - Direct measurement of field strength

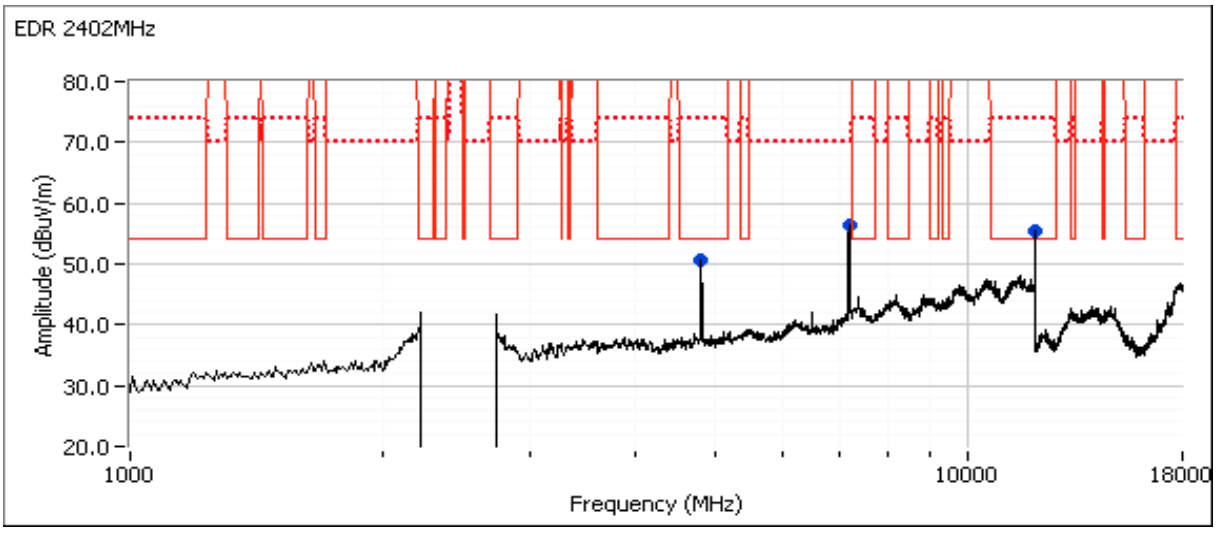
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2311.600	35.0	V	54.0	-19.0	AVG	167	1.0	Note 3
2350.880	41.5	V	74.0	-32.5	PK	167	1.0	
2374.770	31.4	H	54.0	-22.6	AVG	257	2.3	Note 3
2344.790	41.8	H	74.0	-32.2	PK	257	2.3	

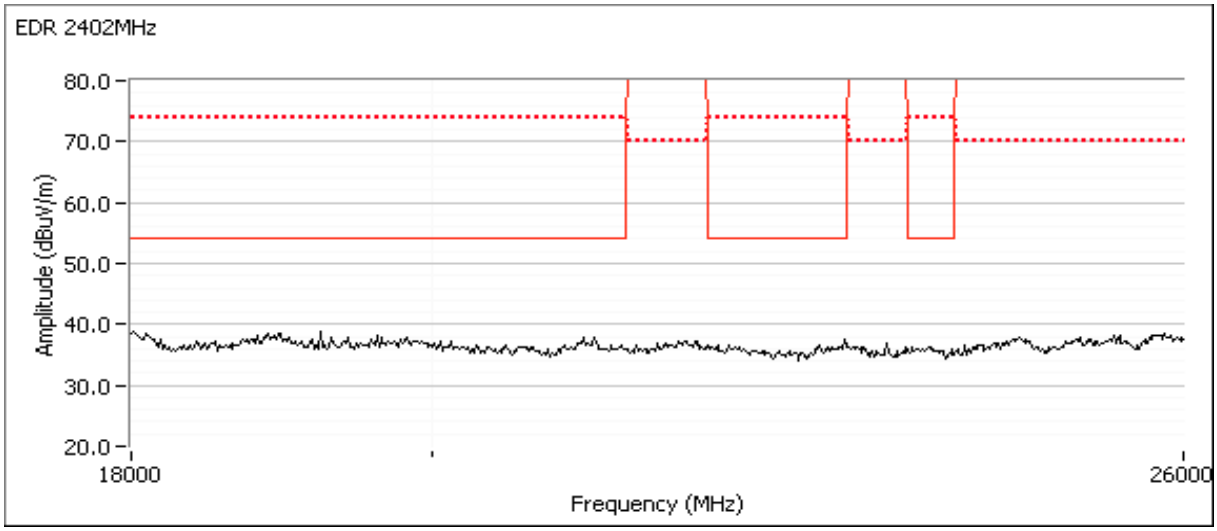


Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7205.240	40.6	V	54.0	-13.4	AVG	308	1.9	Note 1 , 7
7206.370	58.6	V	74.0	-15.4	PK	308	1.9	Note 1
4803.670	35.8	V	54.0	-18.2	AVG	42	1.1	Note 7
4803.650	53.8	V	74.0	-20.2	PK	42	1.1	
11996.240	37.4	H	54.0	-16.6	AVG	334	1.0	Note 7
12000.000	55.4	H	74.0	-18.6	PK	334	1.0	

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/RSS-210	Class:	N/A

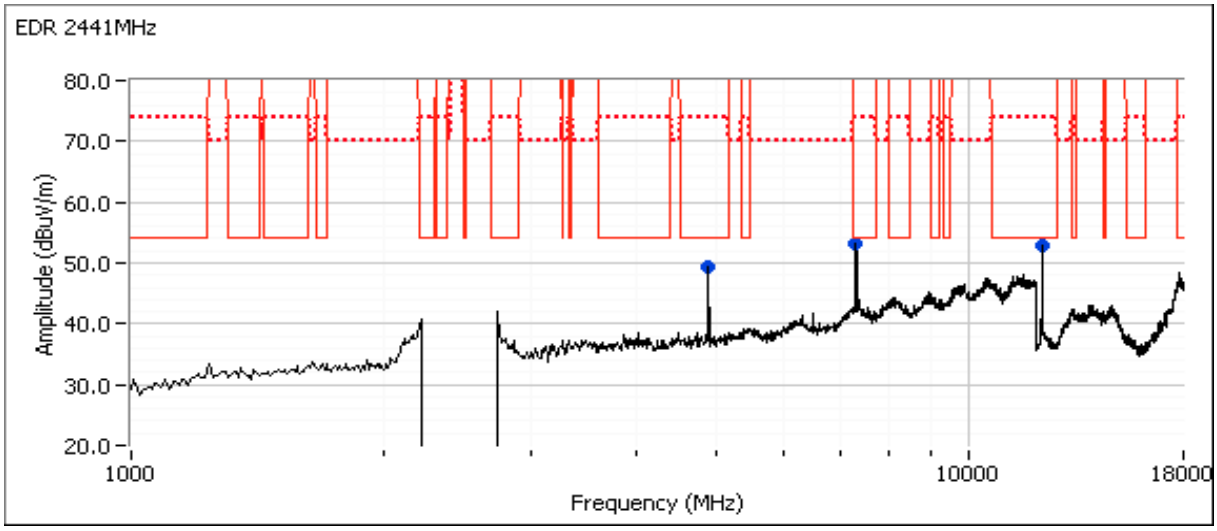




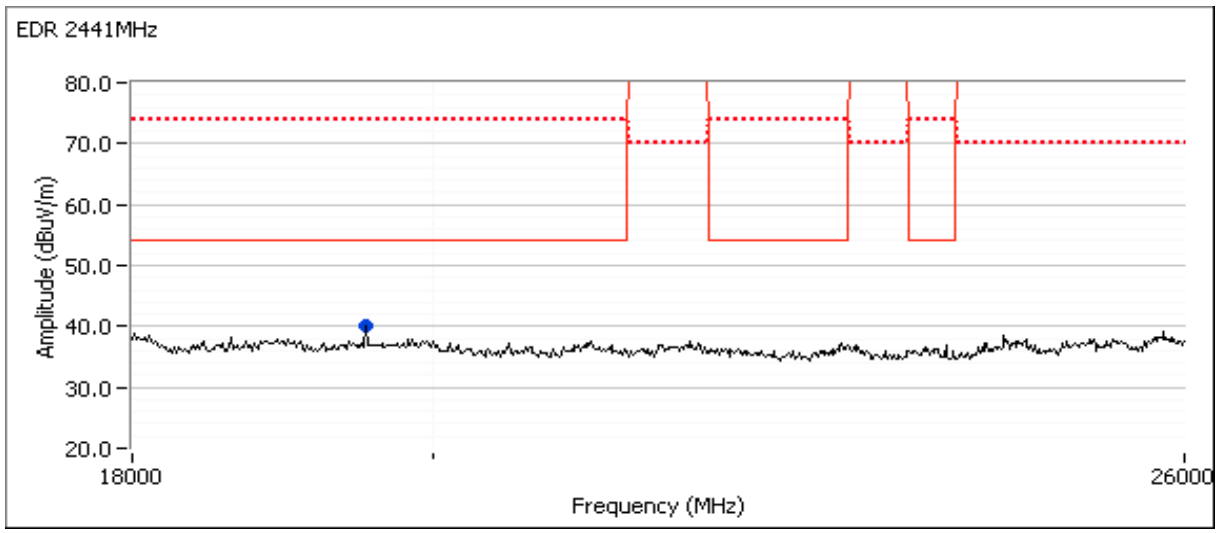
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

Run #2b: Center Channel @ 2441 MHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7322.270	42.1	H	54.0	-11.9	AVG	62	1.6	Note 7
7322.580	60.1	H	74.0	-13.9	PK	62	1.6	
4881.660	35.8	V	54.0	-18.2	AVG	118	1.3	Note 7
4881.850	53.8	V	74.0	-20.2	PK	118	1.3	
12204.950	40.0	V	54.0	-14.0	AVG	280	1.0	Note 7
12204.970	58.0	V	74.0	-16.0	PK	280	1.0	
19527.050	28.4	H	54.0	-25.6	AVG	339	1.0	Note 7
19529.210	46.4	H	74.0	-27.6	PK	339	1.0	



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/RSS-210	Class:	N/A

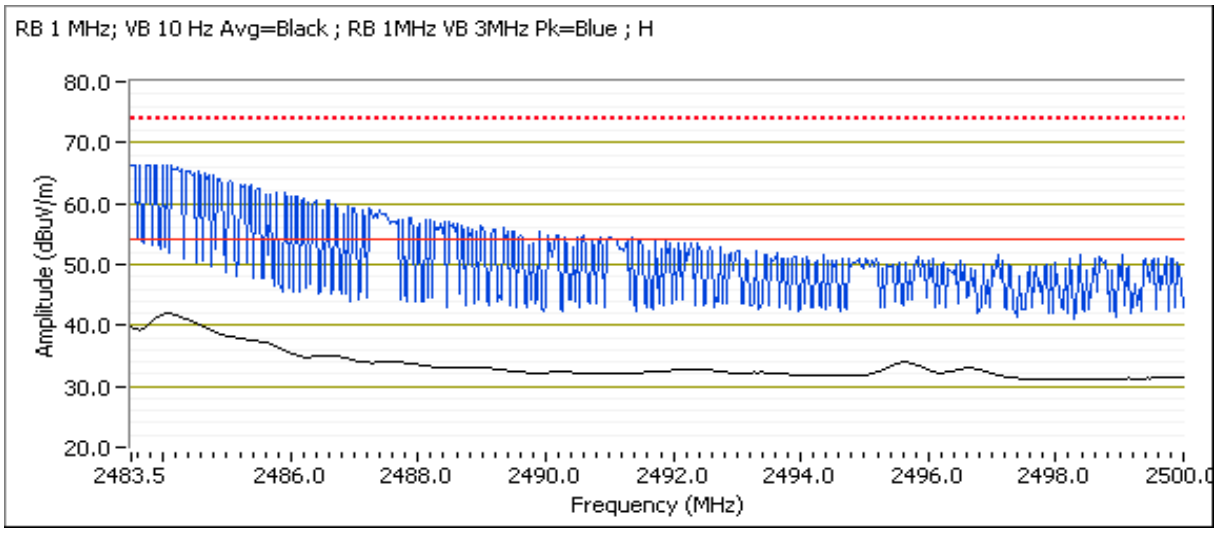


Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

Run #2c: High Channel @ 2480 MHz

Band Edge Signal Field Strength - Direct measurement of field strength

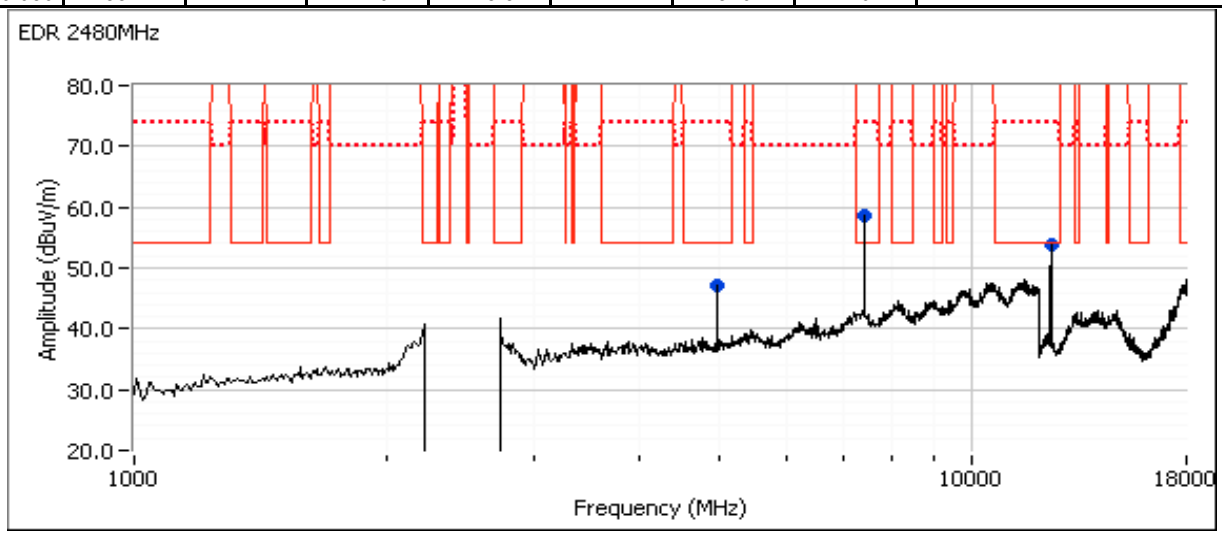
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
2484.100	46.6	H	54.0	-7.4	AVG	172	1.1	Note 3
2486.710	67.3	H	74.0	-6.7	PK	172	1.1	
2483.500	40.3	V	54.0	-13.7	AVG	180	1.3	Note 3
2484.760	49.4	V	74.0	-24.6	PK	180	1.3	

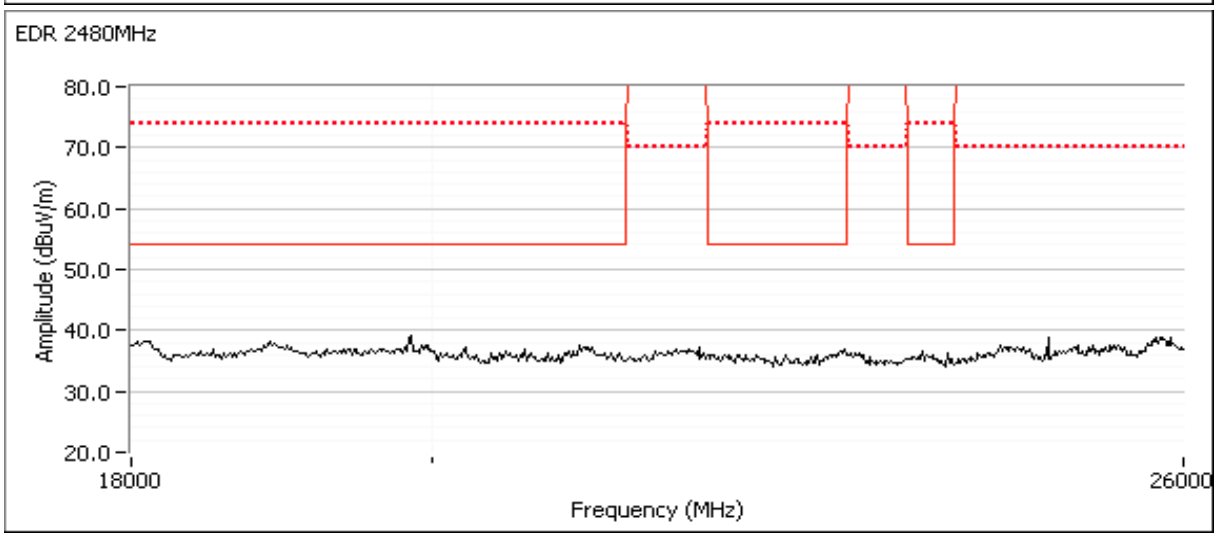


Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
7439.270	44.4	H	54.0	-9.6	AVG	36	1.1	Note 7
7440.270	62.4	H	74.0	-11.6	PK	36	1.1	
4959.650	34.1	V	54.0	-19.9	AVG	135	1.1	Note 7
4959.630	52.1	V	74.0	-21.9	PK	135	1.1	
12399.870	37.7	H	54.0	-16.3	AVG	320	1.0	Note 7
12400.030	55.7	H	74.0	-18.3	PK	320	1.0	





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/RSS-210	Class:	N/A

FCC 15.247 FHSS - Power, Bandwidth and Spurious Emissions

Test Specific Details

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

Date of Test: 4/4/2014 Config. Used: 1

Test Engineer: Jack Liu Config Change: None

Test Location: FT Lab # 4A EUT Voltage: 4.2VDC

General Test Configuration

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

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 used.

Unless stated otherwise the EUT was operating such that it constantly hopped on either the low, center or high channels.

Ambient Conditions:

Temperature: 24 °C

Rel. Humidity: 40 %

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
3	30 - 25000 MHz - Transmitter Conducted Spurious Emissions	FCC Part 15.247(c)	Pass	All emissions below -20dBc
4	Output Power	15.247(b)	Pass	Basic Rate: 8 dBm (0.006 W) EDR: 5.8 dBm (0.004 W)
5	20dB Bandwidth	15.247(a)	Pass	Basic Rate: 1121kHz EDR: 1333kHz
5	99% bandwidth	15.247(a)		
5	Channel Occupancy	15.247(a)	Pass	Complies with Bluetooth protocol
5	Number of Channels	15.247(a)	Pass	79 channels

Modifications Made During Testing:

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Sample Notes

Sample S/N: 3C (NTS 2014-3722)

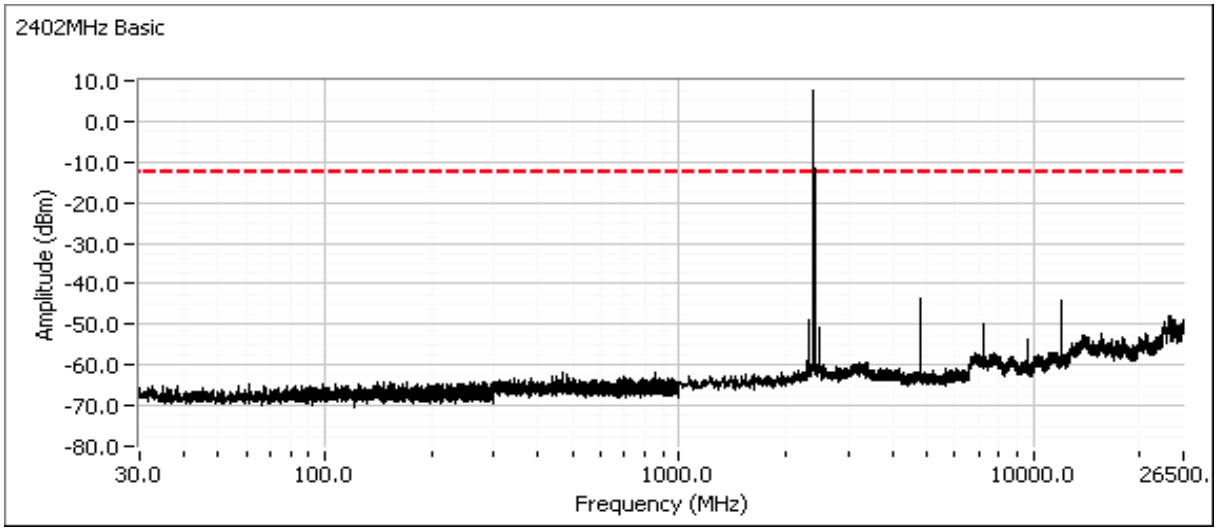
Driver: 88

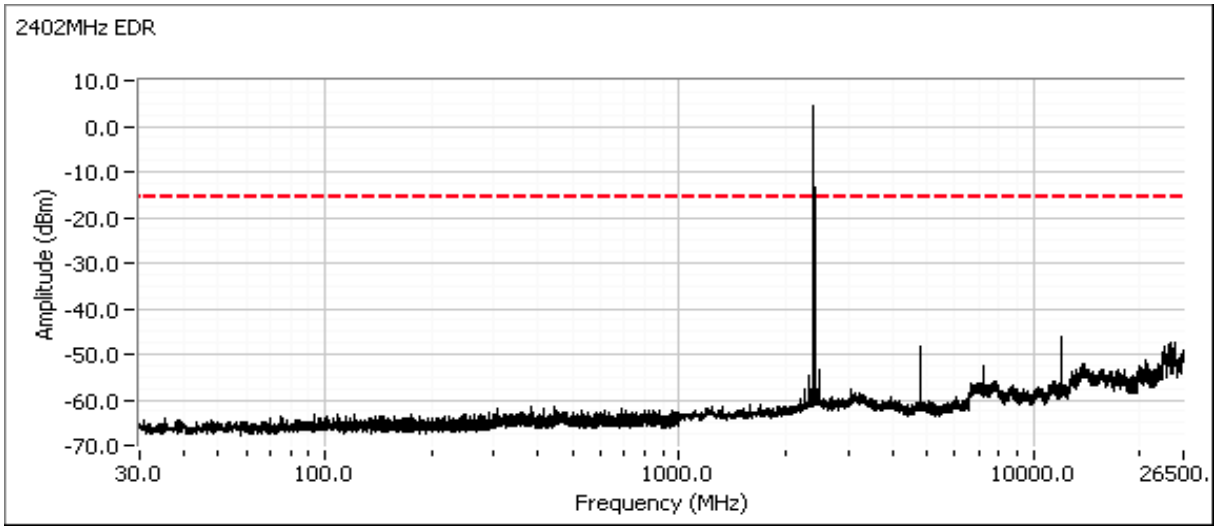
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

Run #3: Antenna Conducted Spurious Emissions, 30 - 25000 MHz.
Date of Test: 4/25/2014
Test Engineer: Jack Liu
Test Location: FT Lab #4A

Refer to plots below. Scans made using RBW=100kHz VB=300KHz with the limit line set at 20dB below the highest in-band signal level with the hopping feature disabled.

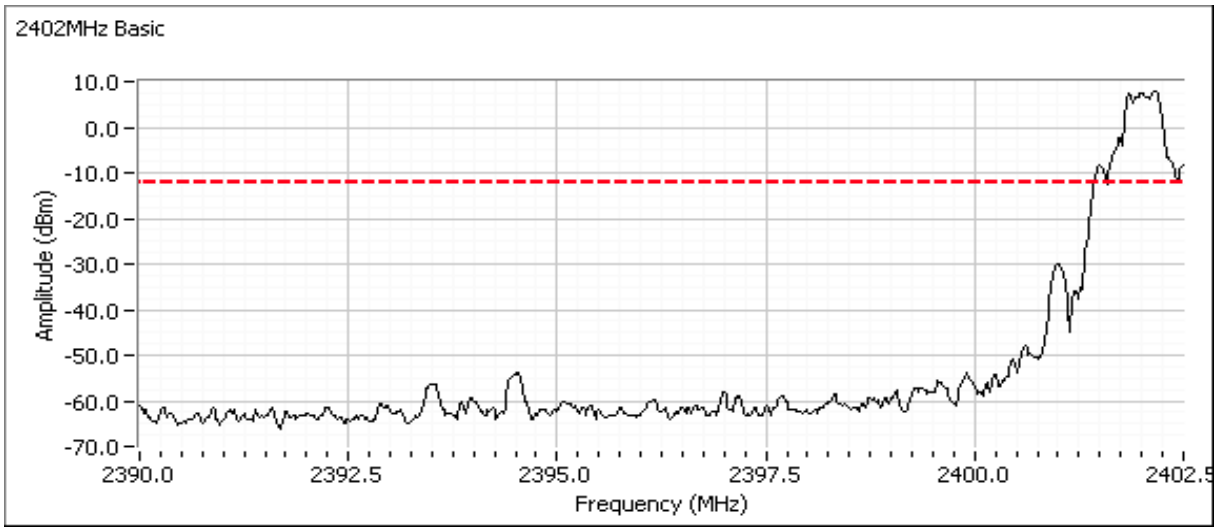
Low channel
Broadband plot

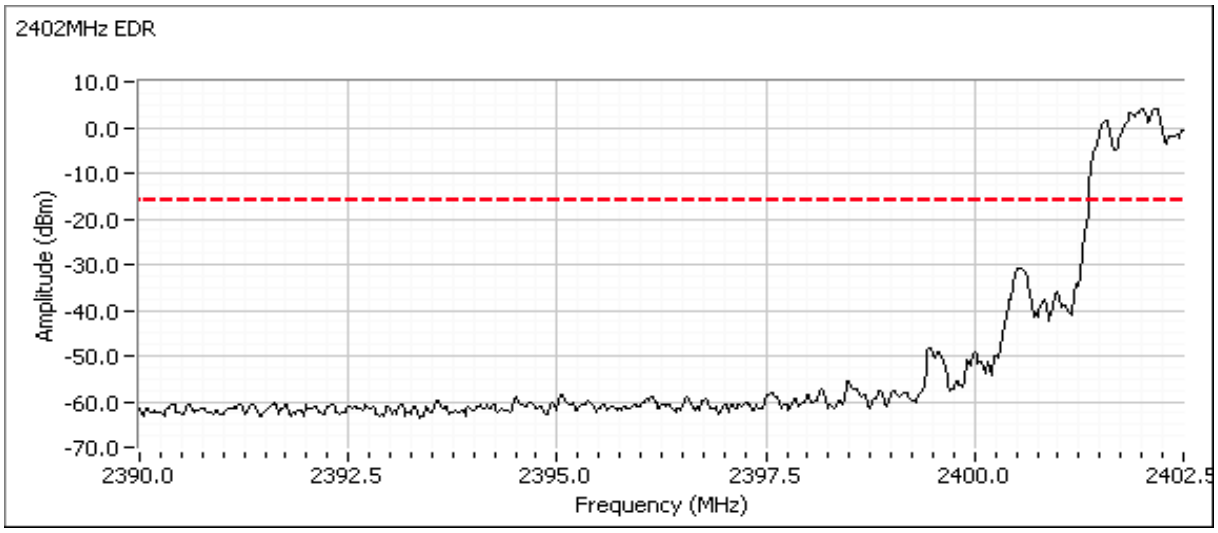




Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

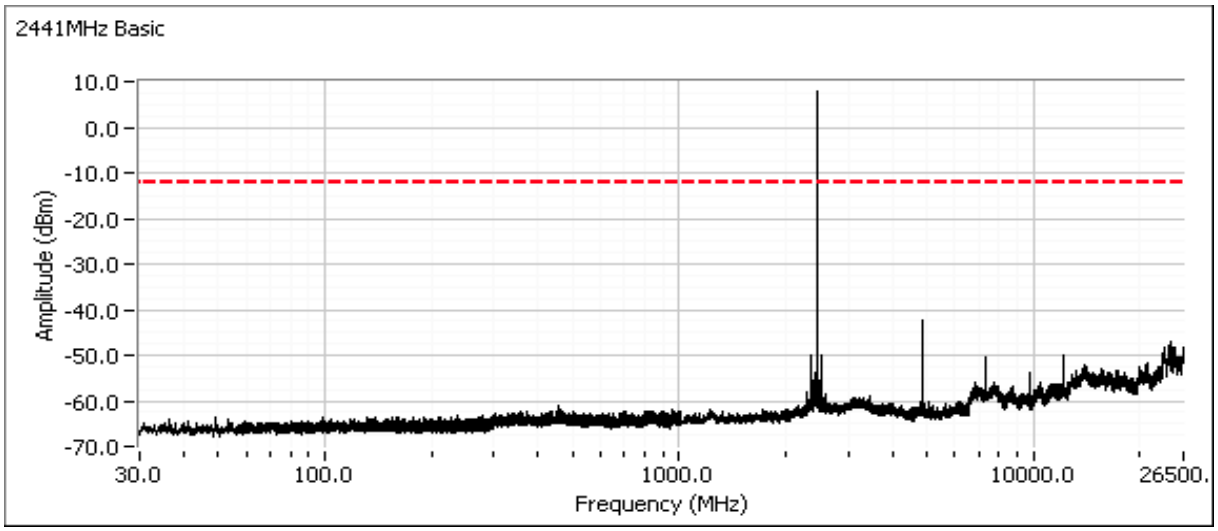
Plot showing -20dBc at the lower band edge

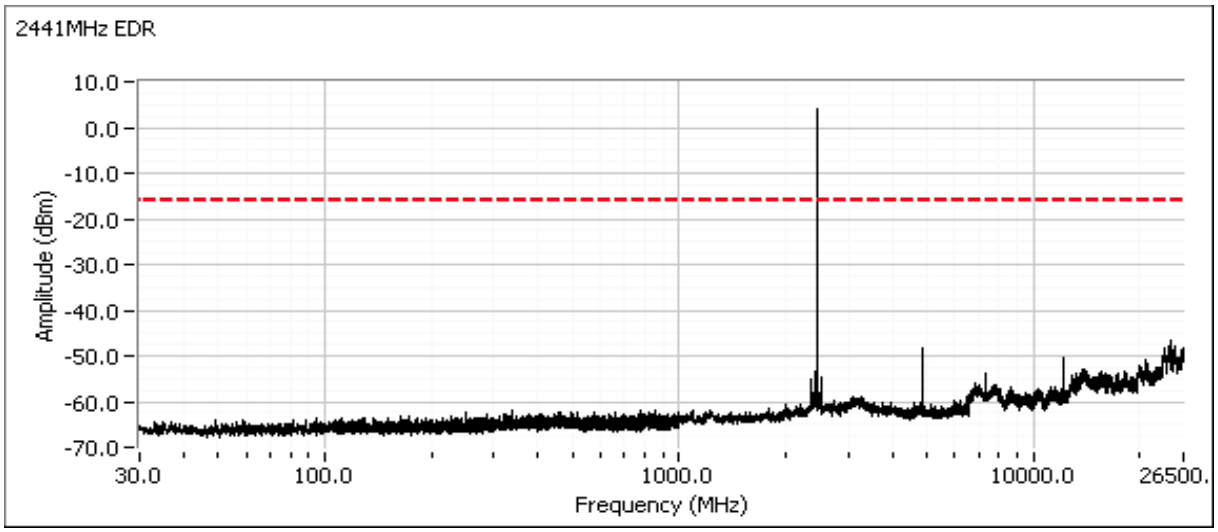




Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

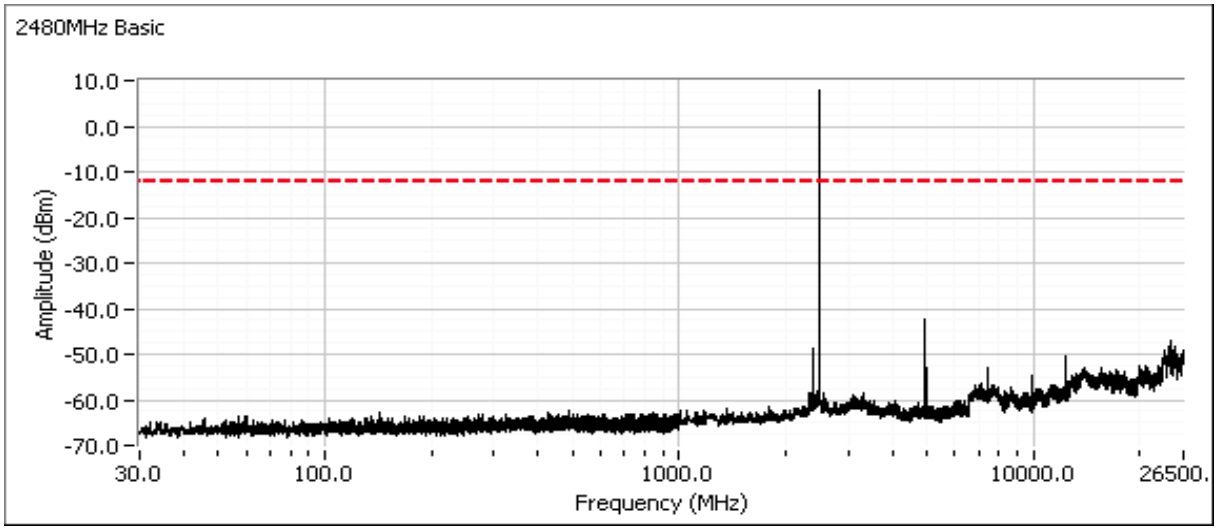
Center channel
Broadband plot

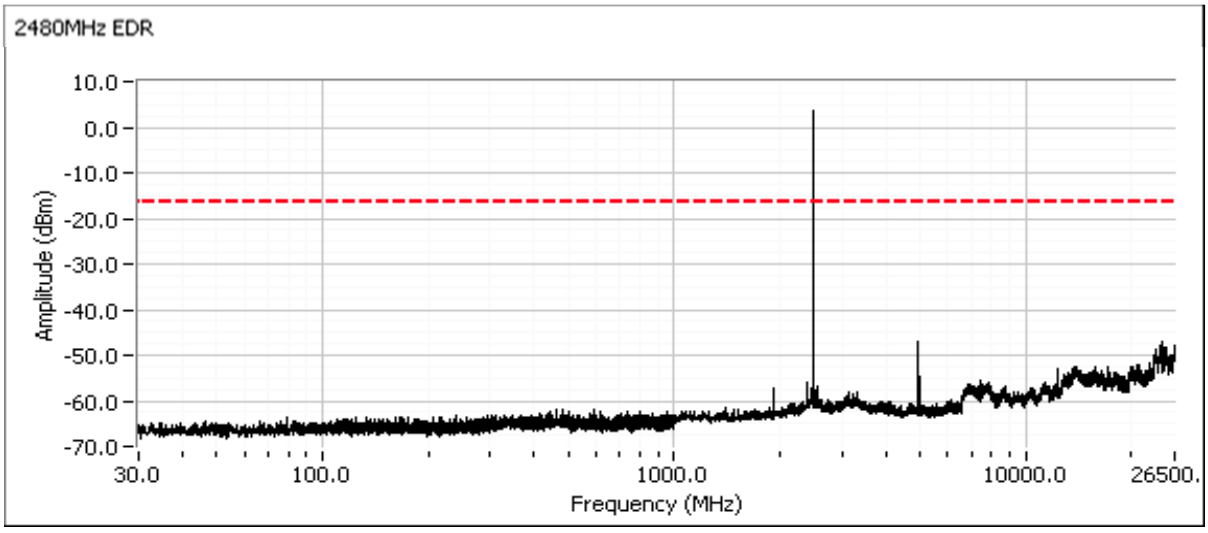




Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

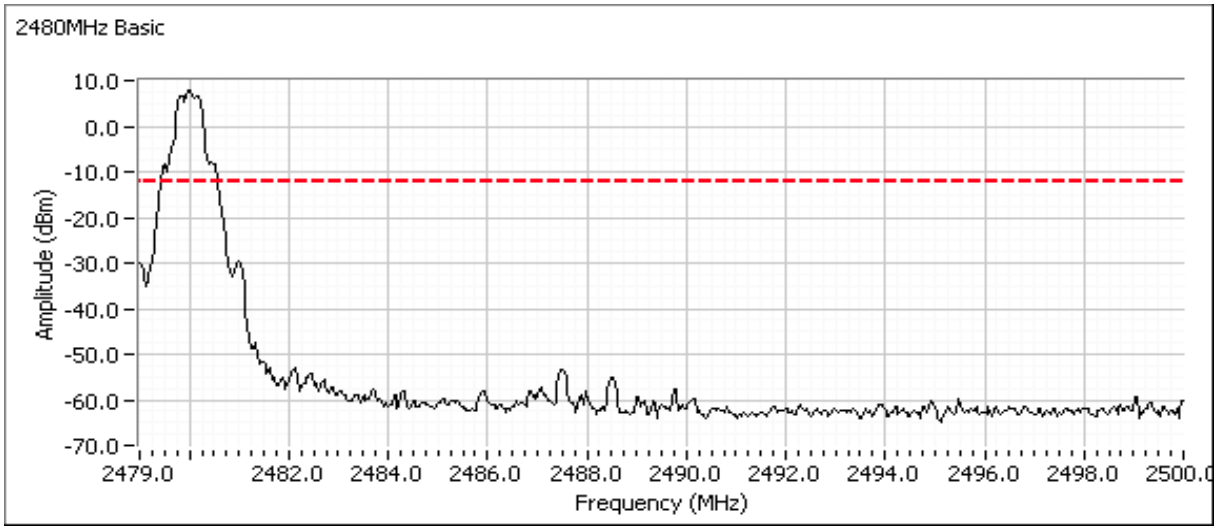
High channel
Broadband plot

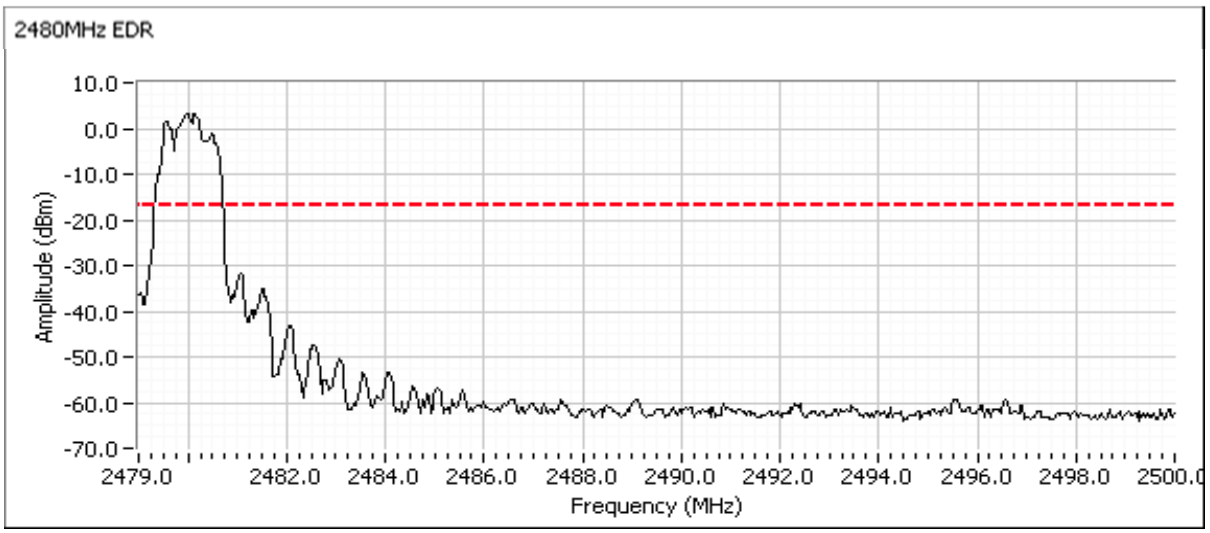




Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

Plot showing -20dBc at the upper band edge



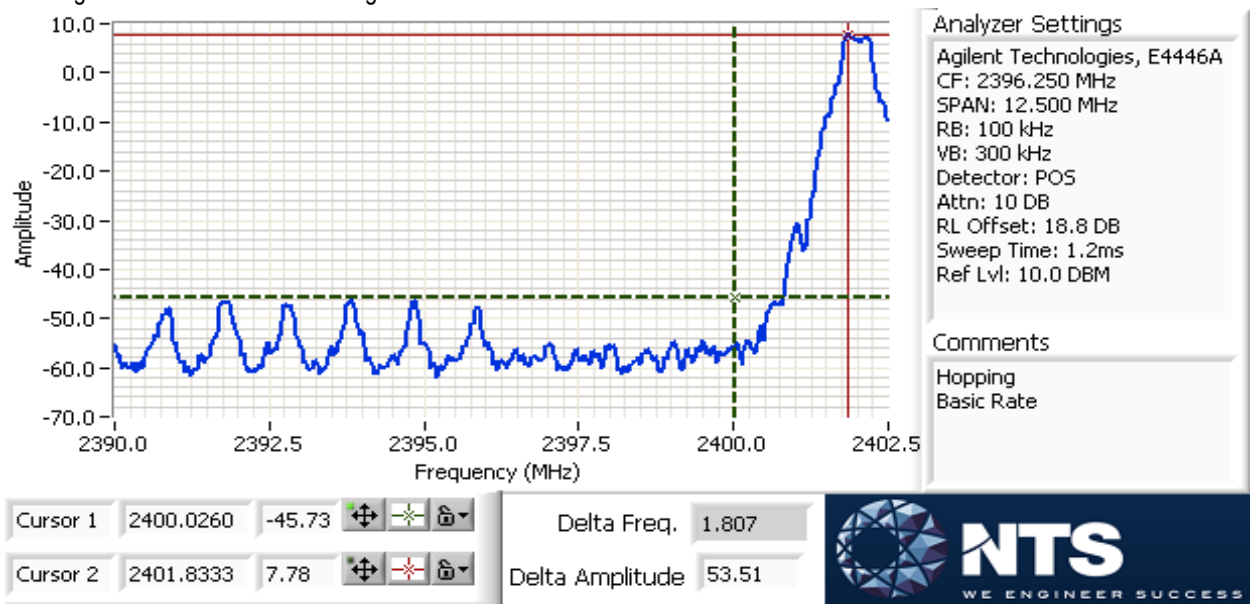


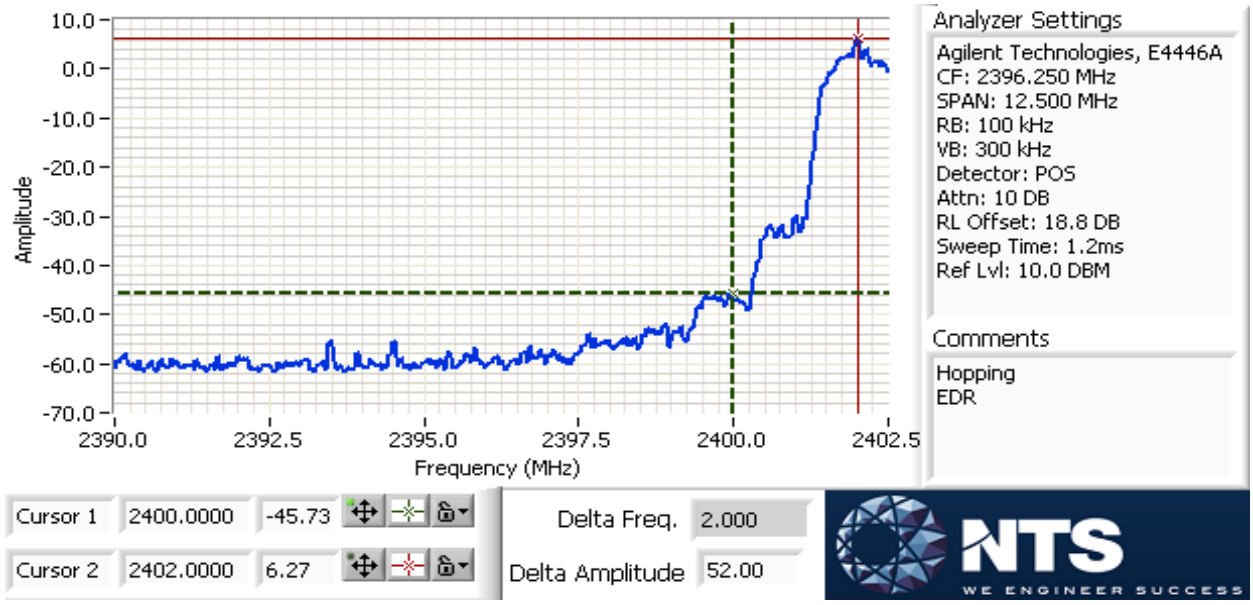
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

Refer to plots below. Scans made using RBW=100kHz VB=300KHz with the limit line set at 20dB below the highest in-band signal level with the hopping feature enabled to show compliance with the -20dBc requirement at the allocated band edge. The spectrum analyzer is left in max hold mode until the trace stabilizes.

Low channel, hopping enabled

Plot showing -20dBc at the lower band edge

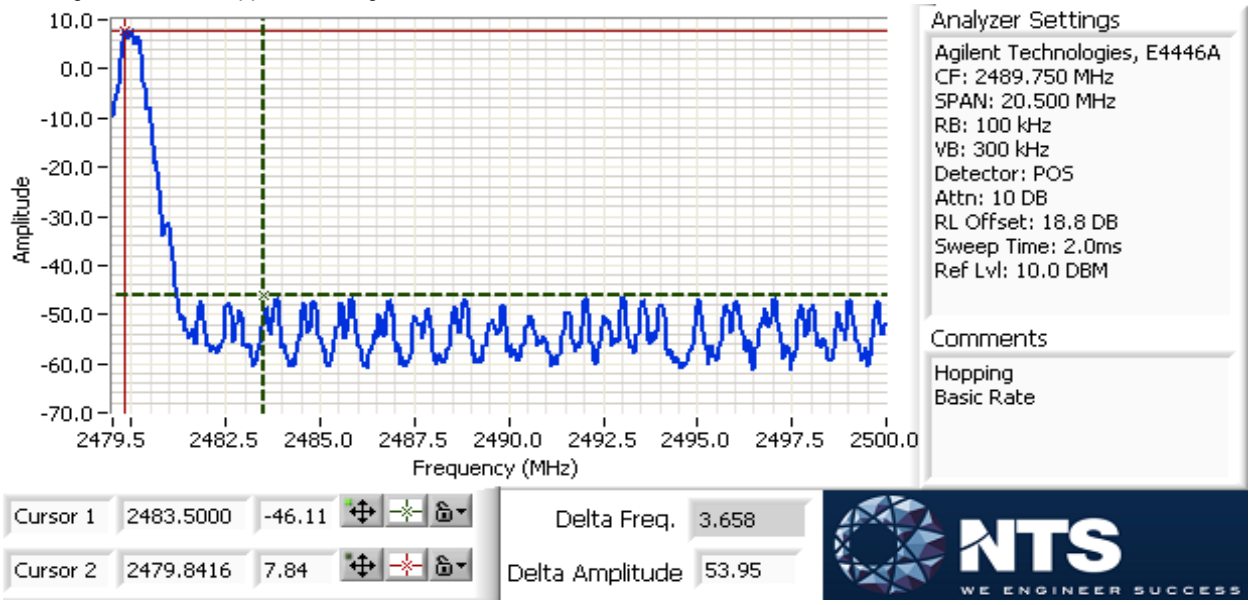


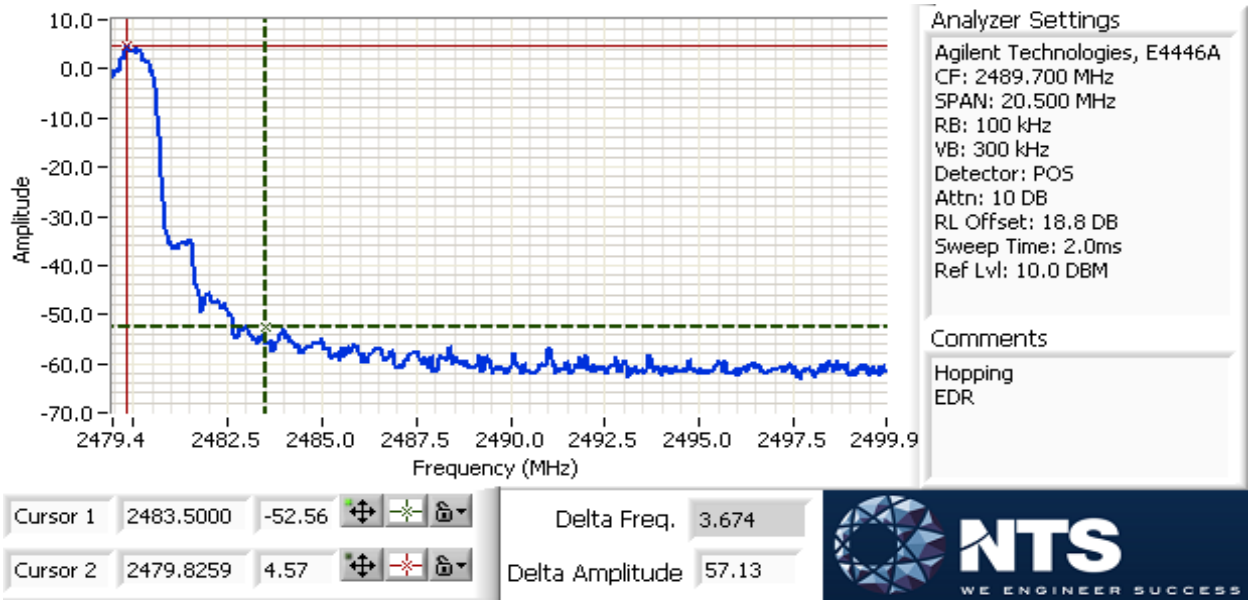


Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

High channel, hopping enabled

Plot showing -20dBc at the upper band edge





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/RSS-210	Class:	N/A

Run #4: Output Power

Date of Test: 4/25/2014

Test Engineer: Jack Liu

Test Location: FT Lab #4A

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt.

For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

Power set using Bluetooth Tester

Maximum antenna gain: 3 dBi

Channel	Frequency (MHz)	Res BW	Output Power (dBm)	Output Power (W)	EIRP (W)
Basic					
Low	2402		7.7	0.0059	0.0117
Mid	2441		8.0	0.0063	0.0126
High	2480		7.9	0.0062	0.0123
EDR					
Low	2402		5.5	0.0035	0.0071
Mid	2441		5.8	0.0038	0.0076
High	2480		5.6	0.0036	0.0072

Note 1:	Output power measured using a peak power meter, spurious limit is -20dBc.

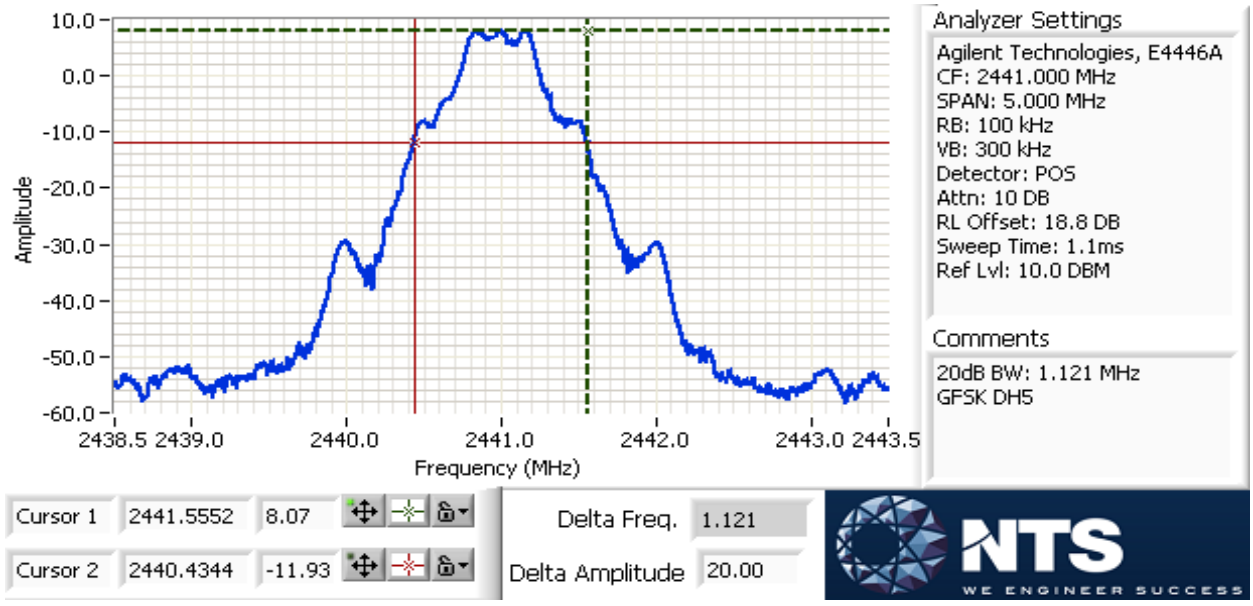
Client:	Vocera Communications	Job Number:	J94614
Model:	Northstar (1x1 802.11abgn + BT)	T-Log Number:	T94631
		Project Manager:	Christine Krebill
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A

Run #5: Bandwidth, Channel Occupancy, Spacing and Number of Channels

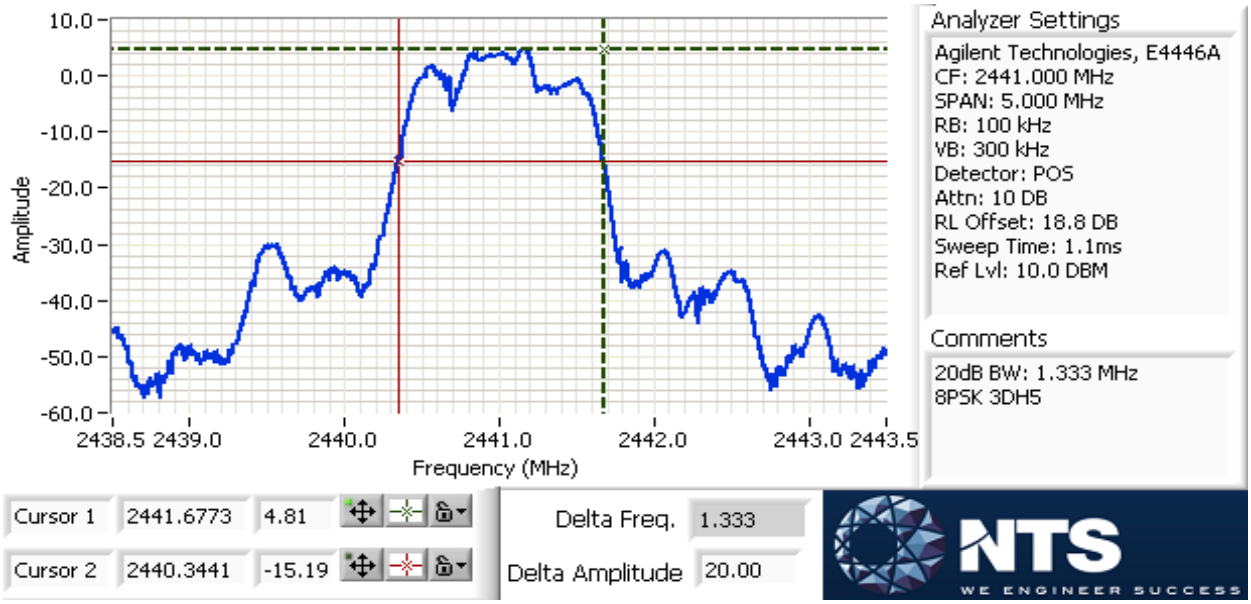
Date of Test: 4/25/2014
Test Engineer: Jack Liu
Test Location: FT Lab #4A

Channel	Frequency (MHz)	Resolution Bandwidth	20dB Bandwidth (kHz)
GFSK (Basic)			
Low	2402	100k	1120
Mid	2441	100k	1121
High	2480	100k	1121
8PSK (EDR)			
Low	2402	100k	1331
Mid	2441	100k	1333
High	2480	100k	1330

Note 1:	20dB bandwidth measured using RB = 100k, VB = 300k (VB > RB)



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/RSS-210	Class:	N/A



Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.
The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. (Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.)

The channel dwell time is calculated from the transmit time on a channel multiplied by the number of times a channel could be used in a period of 0.4 times the number of channels, N (i.e. 0.4N divided by the time between successive hops, rounded up to the closest integer), unless the time between successive hops exceeds 0.4N, in which case the channel dwell time is the transmit time on a channel.

Maximum 20dB bandwidth:	1333	kHz
Channel spacing:	1000	kHz
Transmission time per hop:	0.397	ms
Number of channels (N):	79	

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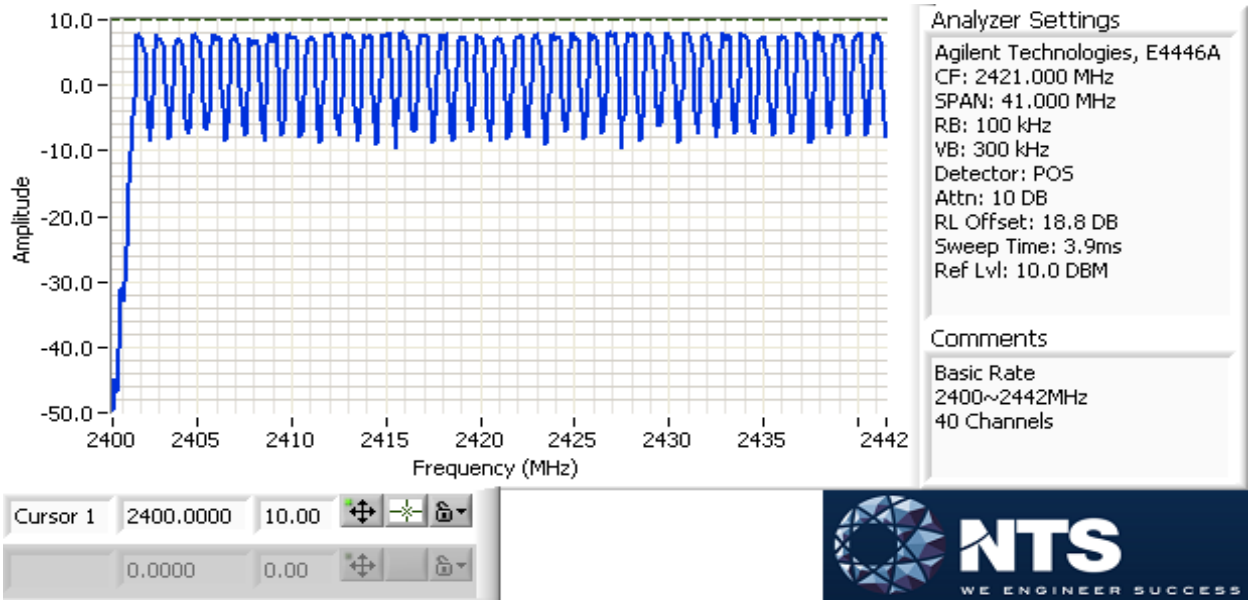
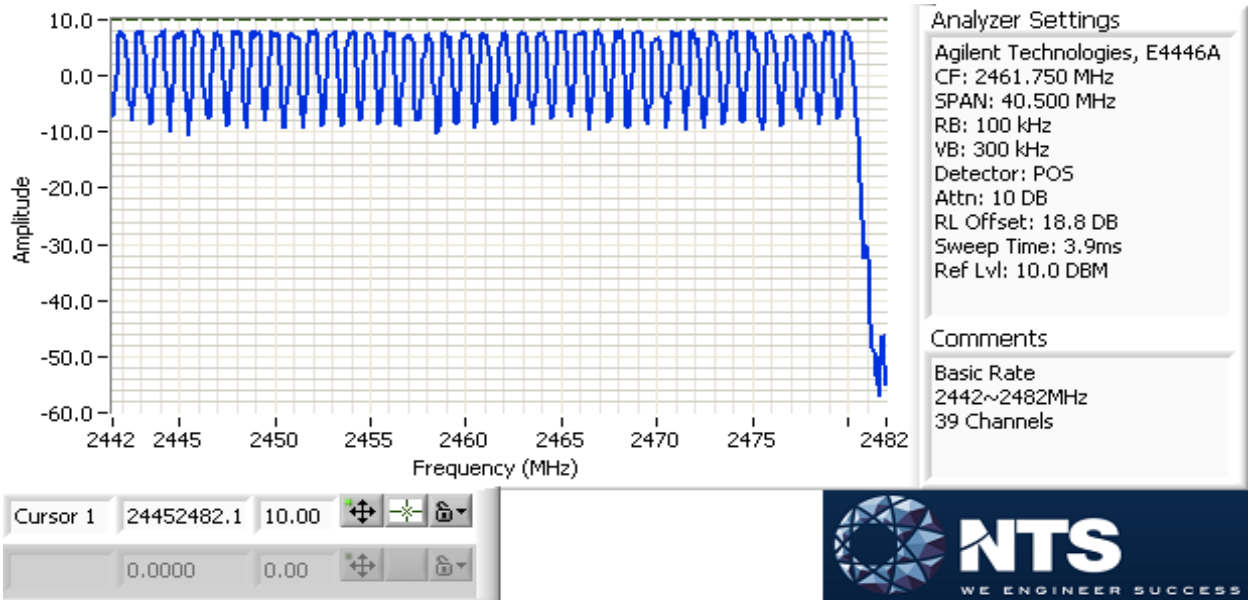
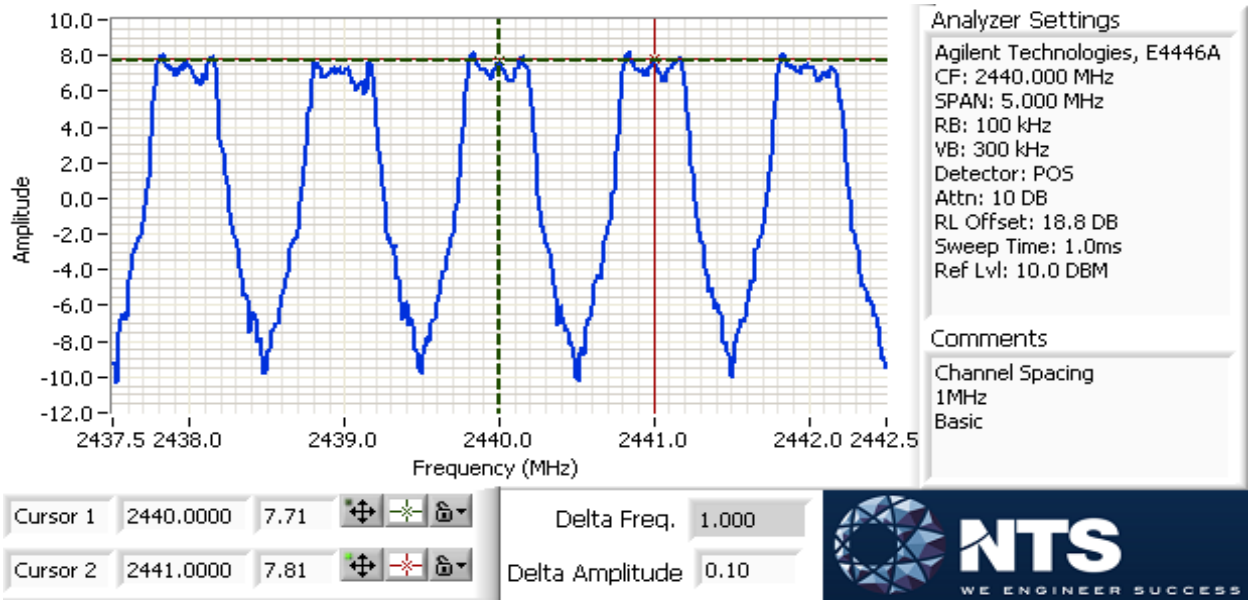
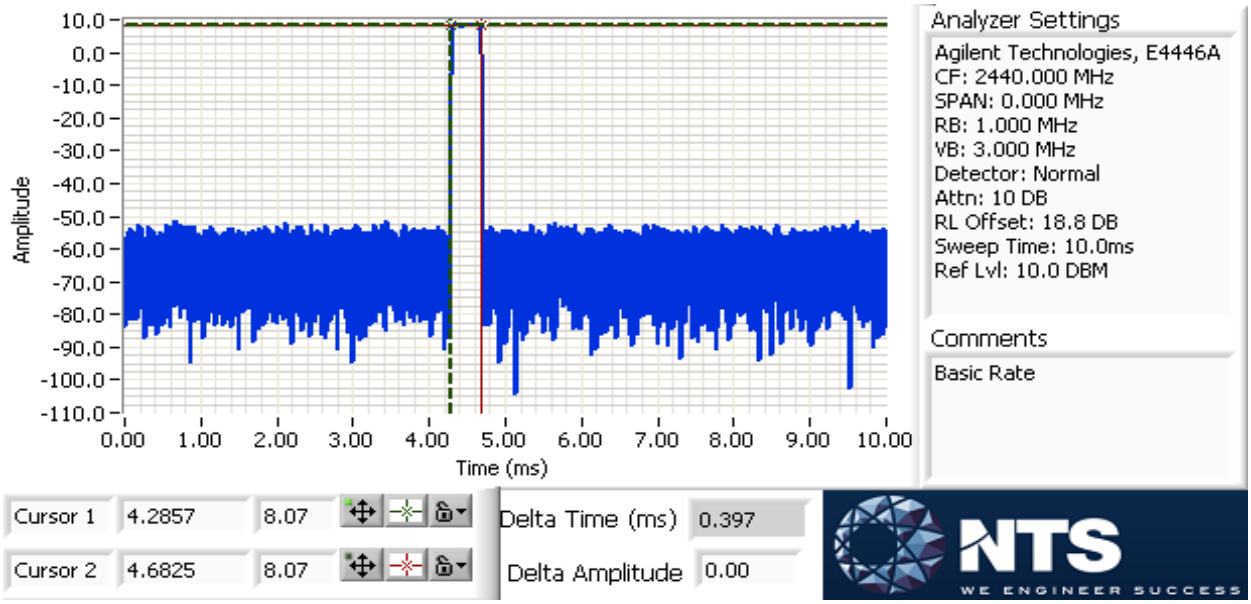
Contact:	Rob Holt	Project Coordinator:	Irene Rademacher
Standard:	FCC 15.247/RSS-210	Class:	N/A





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/RSS-210	Class:	N/A





End of Report

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