NTS Silicon Valley
www.nts.com
41039 Boyce Road
Fremont, CA 94538
510-578-3500 Phone
510-440-9525 Fax

EMC Test Report

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

FCC Part 15, Subpart E

Model: XR-630

FCC ID:	SK6-XR630
APPLICANT:	Xirrus, Inc. 2101 Corporate Center Drive Thousand Oaks, CA 91320
TEST SITE(S):	National Technical Systems - Silicon Valley 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-4
REPORT DATE:	March 23, 2016
REISSUE DATE:	May 6, 2016
FINAL TEST DATES:	March 7 and 9, 2016
TOTAL NUMBER OF PAGES:	41

PROGRAM MGR /
TECHNICAL REVIEWER:

Mark E Hill
Staff Engineer

QUALITY ASSURANCE DELEGATE /
FINAL REPORT PREPARER:

David Guidotti
Senior Technical Writer

A2LA ACCREDITED
Testing Cert #0214.26

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	March 23, 2016	First release	
1.0	May 6, 2016	Added Part 2 references to results summary	MEH

TABLE OF CONTENTS

SCOPE

An electromagnetic emissions test has been performed on the Xirrus, Inc. model XR-630, pursuant to the following rules:

FCC Part 15, Subpart E requirements for UNII Devices

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

FCC General UNII Test Procedures KDB789033

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of Xirrus, Inc. model XR-630 complied with the requirements of the following regulations:

FCC Part 15, Subpart E requirements for UNII Devices

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

The test results recorded herein are based on a single type test of Xirrus, Inc. model XR-630 and therefore apply only to the tested sample. The sample was selected and prepared by Paul Zahra of Xirrus, 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

Testing limited to CH122 (5610MHz) in ac80 mode. Compliance with the DFS requirements are addressed in a separate report.

OPERATION IN THE 5.47 – 5.725 GHZ BAND

Radio 1

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.407(a) (2) / 2.1049		26dB Bandwidth	> 20MHz for all modes	N/A – limits output power if < 20MHz	N/A
	RSS-247 6.2.3 (1)	99% Bandwidth	ac80: 76.2 MHz	N/A – limits EIRP if < 20MHz	N/A
15.407(a) (2) / 2.1046	RSS-210 A9.2(2)	Output Power	ac80: 46.8 mW (Max eirp: 21.9 dBm 153.5 mW)	24 dBm (250 mW) EIRP <= 1W	Complies
15.407(a) (2) / 2.1046	RSS-247 6.2.3 (1)	Power Spectral Density	ac80: 0.7 mW/MHz	11 dBm/MHz	Complies
15.407(b) (3) / 15.209 / 2.1053	RSS-247 6.2.3 (2)	Spurious Emissions	49.2 dBµV/m @ 5350.2 MHz (-4.8 dB)	Refer to the limits section (p19) for restricted bands, all others -27 dBm/MHz EIRP	Complies

Radio 2

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.407(a) (2) / 2.1049		26dB Bandwidth	> 20MHz for all modes	N/A – limits output power if < 20MHz	N/A
	RSS-247 6.2.3 (1)	99% Bandwidth	ac80: 76.1 MHz	N/A – limits EIRP if < 20MHz	N/A
15.407(a) (2) / 2.1046	RSS-210 A9.2(2)	Output Power	ac80: 43.8 mW (Max eirp: 21.6 dBm 143.7 mW)	24 dBm (250 mW) EIRP <= 1W	Complies
15.407(a) (2) / 2.1046	RSS-247 6.2.3 (1)	Power Spectral Density	ac80: 0.6 mW/MHz	11 dBm/MHz	Complies
15.407(b) (3) / 15.209 / 2.1053	RSS-247 6.2.3 (2)	Spurious Emissions	49.2 dBµV/m @ 5350.2 MHz (-4.8 dB)	Refer to the limits section (p19) for restricted bands, all others -27 dBm/MHz EIRP	Complies

REQUIREMENTS FOR ALL U-NII/LELAN BANDS

FCC Rule Part	RSS Rule Part	Description	Measured Value / Comments	Limit / Requirement	Result
15.407 / 2.1047	RSS-247 6.1	Modulation	Unchanged from original filing		
15.31 (m)	RSS-247 6.4 (1) RSS-Gen 6.8	Channel Selection	Emissions tested at outermost and middle channels in each band	Device was tested on the top, bottom and center channels in each band	N/A
15.407 (c)	RSS-247 6.4 (2)	Operation in the absence of information to transmit	Unchanged from original filing		
15.407 (g) / 2.1055		Frequency Stability			
15.407 (h1)	RSS-247 6.2.2 (1) 6.2.3 (1)	Transmit Power Control			
15.407 (h2)	RSS-247 6.3	Dynamic frequency Selection (device with radar detection)	Refer to separate test report	Threshold -62dBm (-64dBm if eirp > 200mW) Channel Availability Check > 60s Channel closing transmission time < 260ms Channel move time < 10s Non occupancy period > 30minutes	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	Unchanged from original filing		
15.407 (b) (6)	RSS-Gen Table 3	AC Conducted Emissions			
15.247 (i) 15.407 (f) / 2.1091	RSS 102	RF Exposure Requirements	Original MPE exhibit represent the worse case condition for single and multiple transmission conditions	Refer to OET 65, FCC Part 1 and RSS 102	Complies

MEASUREMENT UNCERTAINTIES

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

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

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Xirrus, Inc. model XR-630 is a dual IEEE 802.11abgn/ac 3x3 radio access point. The XR-630 is power via POE.

The sample was received on March 7, 2016 and tested on March 7 and 9, 2016. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Xirrus	XR-630	dual 3x3 radio AP	X307532049ADC	SK6-XR630

OTHER EUT DETAILS

Dual radio, each radio can operate in either 2.4GHz or 5GHz bands. Radios will not operate in the same band at the same time.
Each radio is 3x3, only supports 3Tx modes

ANTENNA SYSTEM

Antennas are fixed to the motherboard of the system.

ENCLOSURE

The EUT enclosure measures approximately 20cm in diameter by 5cm high. It is primarily constructed of uncoated coated plastic.

MODIFICATIONS

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

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
HP	Compaq 6910p	Laptop Computer	CND816363N	-
Xirrus	XP1-MSI-75	POE Injector	P21401034C1	-

EUT INTERFACE PORTS

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

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Gigabit1/POE	POE Injector	CAT5	Unshielded	5
Gigabit2	not connected*	-	-	-

* - Preliminary testing showed that the addition of the 2nd Ethernet cable does not affect the radio emissions.

EUT OPERATION

During testing, the EUT configured for continuous transmission on the noted channel. The data rate with the highest output power was used. When testing radio 1, radio 2 was disabled, and vice-versa.

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 4	US0027	2845B-4	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

Software is used to view and convert receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers. The software used for radiated and conducted emissions measurements is NTS EMI Test Software (rev 2.10)

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.

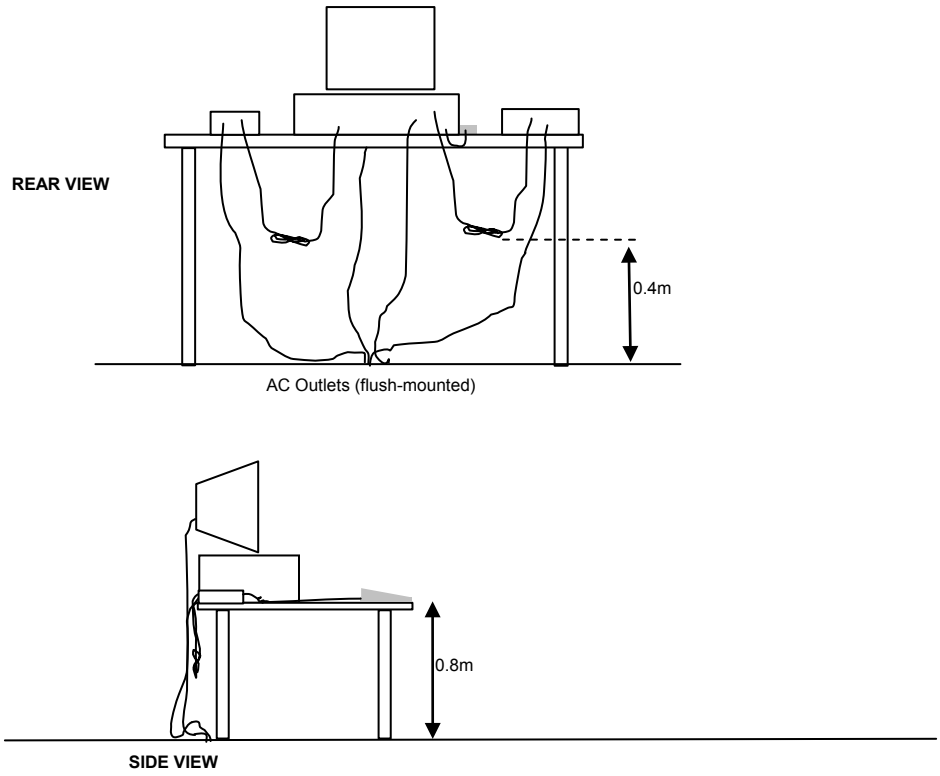
RADIATED EMISSIONS

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.

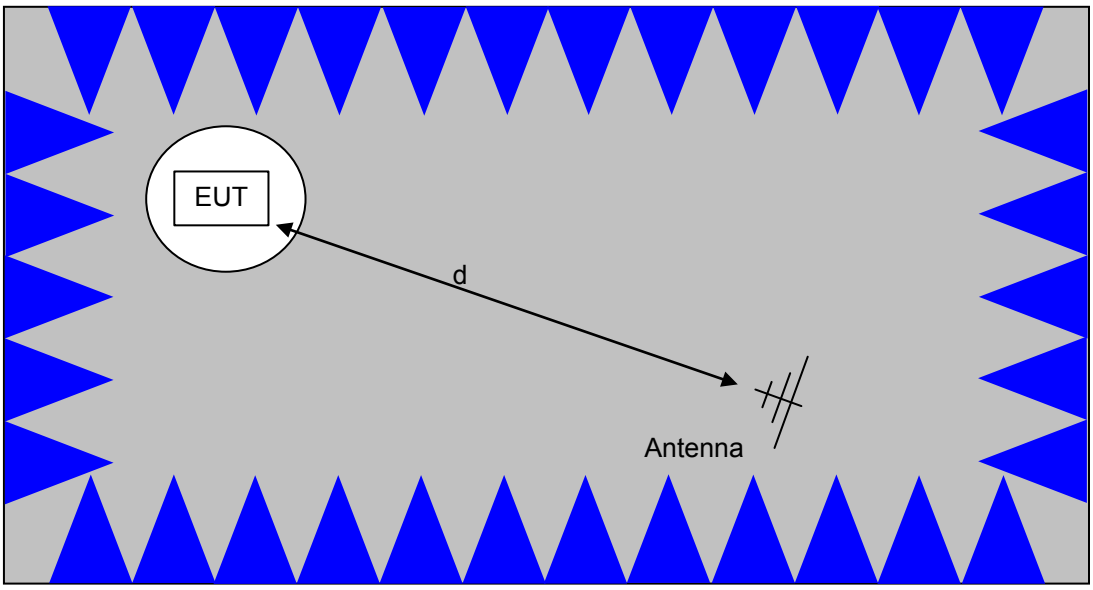
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

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.

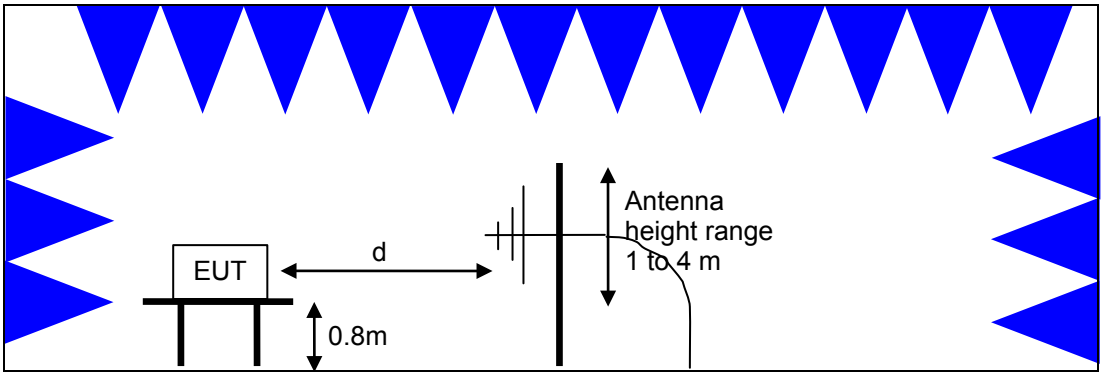


Typical Test Configuration for Radiated Field Strength Measurements



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.

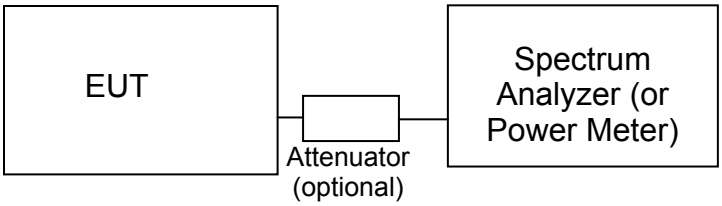
Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



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:

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

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

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

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands[1].

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

[1] The restricted bands are detailed in FCC 15.205 and RSS-Gen Table 6

FCC 15.407 (a) OUTPUT POWER LIMITS

The table below shows the limits for output power and output power density. For the 5250-5350 and 5470-5725 MHz bands, 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	1Watt (30 dBm)	17 dBm/MHz
5250 – 5350 and 5470-5725	250 mW (24 dBm)	11 dBm/MHz
5725 – 5825	1 Watt (30 dBm)	30 dBm/500kHz

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

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 field strength of 68.3dBuV/m/MHz at a distance of 3m. For devices operating in the 5725-5850 MHz 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:

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

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

Radiated Emissions, 1 - 40 GHz, 07-Mar-16

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
NTS	NTS EMI Software (rev 2.10)	N/A	0		N/A
NTS	NTS Capture Analyzer Software (rev 3.8)	N/A	0		N/A
EMCO	Antenna, Horn, 1-18 GHz	3115	487	7/29/2014	7/29/2016
Hewlett Packard	High Pass filter, 8.2 GHz	P/N 84300-80039	1156	6/2/2015	6/2/2016
Micro-Tronics	Band Reject Filter, 5470-5725 MHz	BRC50704-02	1681	7/13/2015	7/13/2016
A. H. Systems	Spare System Horn, 18-40GHz	SAS-574, p/n: 2581	2162	7/29/2015	7/29/2017
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	2199	10/9/2015	10/9/2016
Hewlett Packard	Spectrum Analyzer (SA40) Purple 9 kHz - 40 GHz,	8564E (84125C)	2415	3/7/2015	3/19/2016

Radio Antenna Port (Power and Spurious Emissions), 09-Mar-16

Manufacturer	Description	Model	Asset #	Calibrated	Cal Due
Agilent Technologies	3Hz -44GHz PSA Spectrum Analyzer	E4446A	2796	3/31/2015	3/31/2016

Appendix B Test Data

T101147 Pages 25 – 40

Client:	Xirrus Inc	Job Number:	JD100975
Product	XR-630	T-Log Number:	T101147
System Configuration:	-	Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Emissions Standard(s):	FCC 15.407	Class:	B
Immunity Standard(s):	-	Environment:	-

EMC Test Data

For The

Xirrus Inc

Product

XR-630

Date of Last Test: 3/9/2016

Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A

RSS-247 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 was 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: 20-22 °C
Rel. Humidity: 30-35 %

Summary of Results

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
80MHz channel added in TDWR band							
1	ac80	122 - 5610MHz	15	15	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	49.2 dBµV/m @ 5350.2 MHz (-4.8 dB)
2	ac80	122 - 5610MHz	15	15	Radiated Emissions, 1 - 40 GHz	FCC 15.209 / 15 E	47.1 dBµV/m @ 5350.5 MHz (-6.9 dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

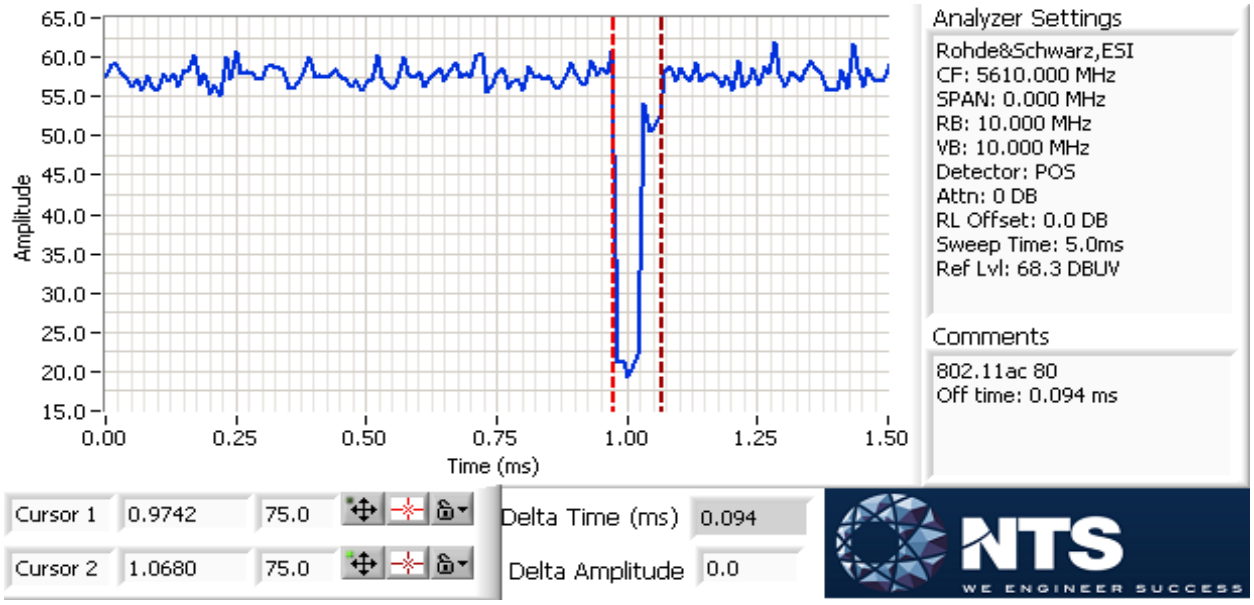
No deviations were made from the requirements of the standard.

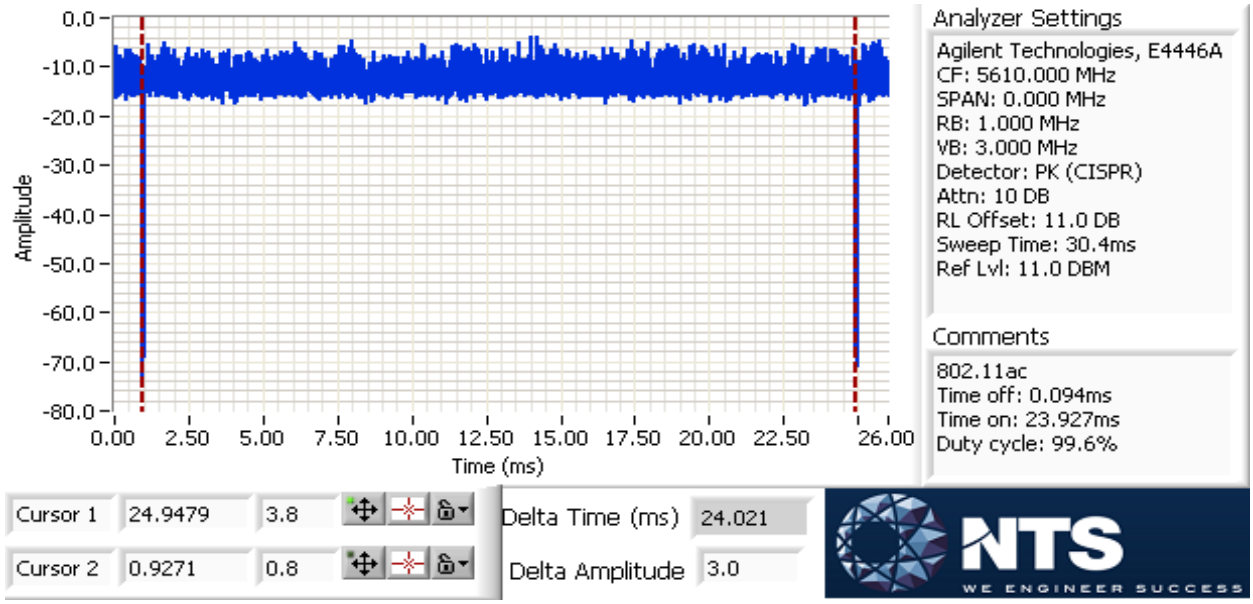
Procedure Comments:

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 ≥ 98% and was measured using RBW=1MHz, VBW=10Hz, peak detector, linear average mode, auto sweep time, max hold 50 traces. (method VB of KDB 789033)

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
ac80	MCS0	99.6%	Y	23.984	0	0	10

Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A





Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A

Sample Notes

Sample S/N: X307532049ADC
Driver: XR.7.4.2
Antenna: Integral (3x3)

Notes:

Notes:	Worse case data rate taken from original testing/certification.
	Original testing showed no radio related emissions below 1GHz.
	Original testing showed no intermodulation products when both radios were operating. This testing was performed with only one radio operating at a time.

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.

Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A

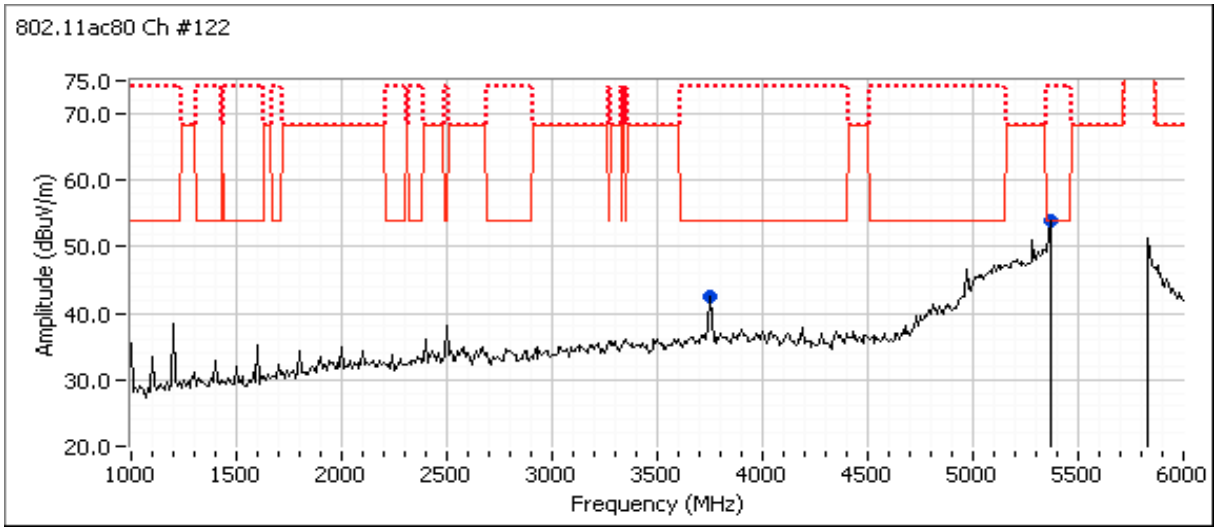
Run #1, Radiated Spurious Emissions, 1,000 - 40,000 MHz. Operation in the 5470-5725 MHz Band

Date of Test: 3/7/2016 Config. Used: 1 (Radio 1)
Test Engineer: Mehran Birgani Config Change: None
Test Location: FT Ch #4 EUT Voltage: POE

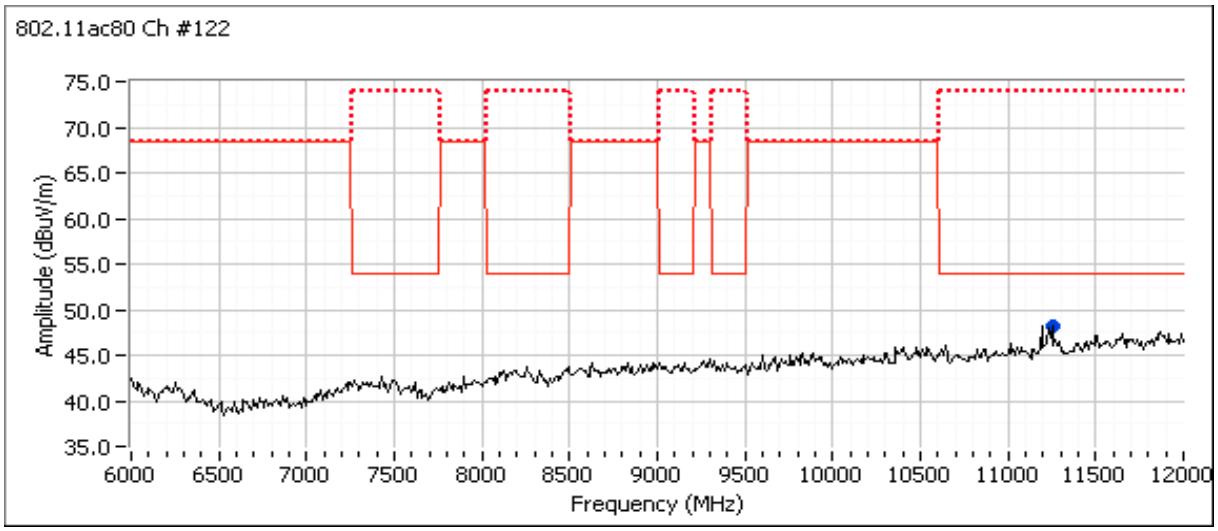
Channel: 122 Mode: ac80
Tx Chain: 3Tx (Radio #1) Data Rate: MCS0

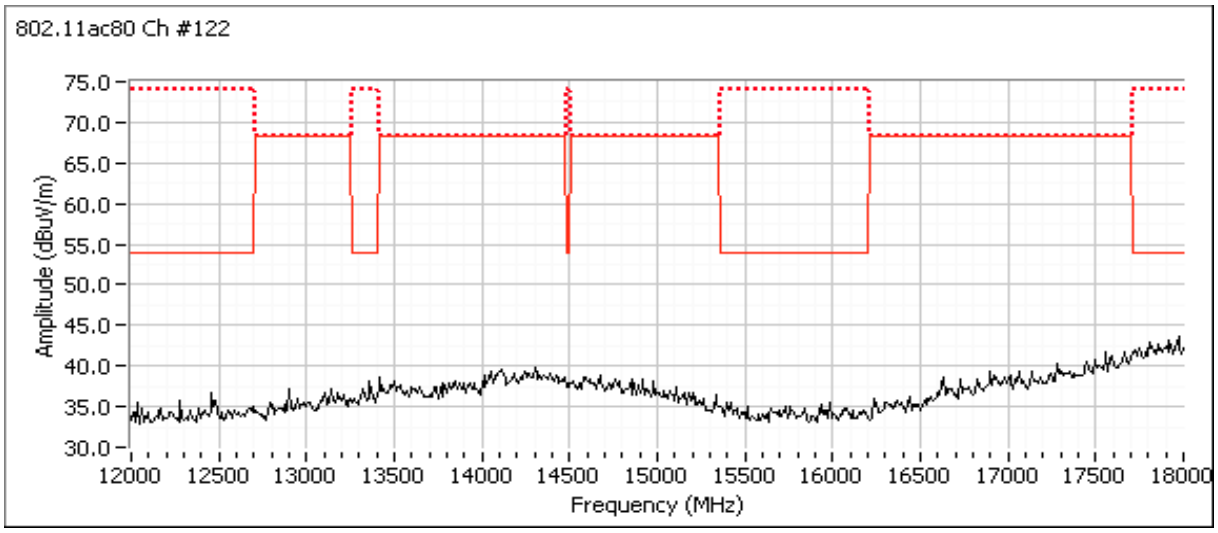
Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5350.180	**49.2**	V	54.0	**-4.8**	AVG	360	2.3	RB 1 MHz;VB 10 Hz;Peak
11220.530	42.0	H	54.0	-12.0	AVG	90	2.0	RB 1 MHz;VB 10 Hz;Peak
5358.250	61.6	V	74.0	-12.4	PK	360	2.3	RB 1 MHz;VB 3 MHz;Peak
3750.100	37.5	V	54.0	-16.5	AVG	182	1.7	RB 1 MHz;VB 10 Hz;Peak
11242.800	54.0	H	74.0	-20.0	PK	90	2.0	RB 1 MHz;VB 3 MHz;Peak
3750.000	47.0	V	74.0	-27.0	PK	182	1.7	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≥3MHz, peak detector).

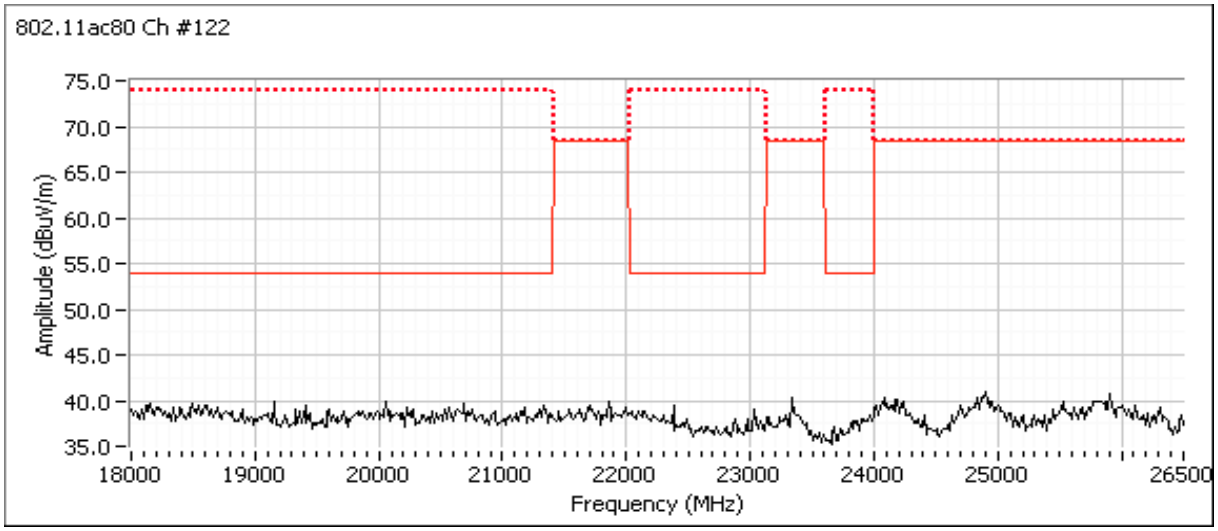


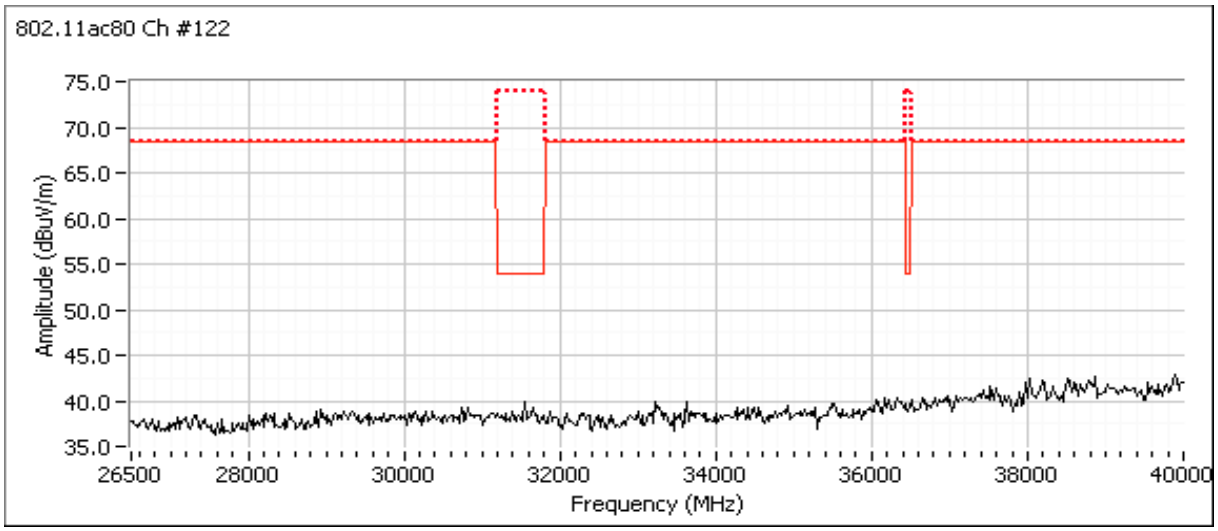
Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A





Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A





Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A

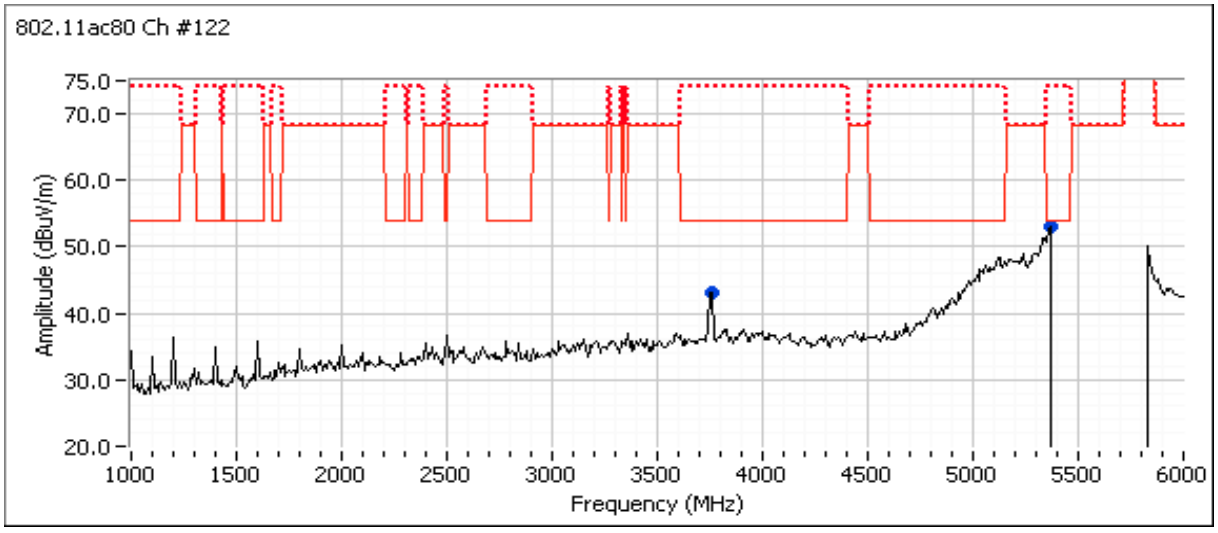
Run #2, Radiated Spurious Emissions, 1,000 - 40,000 MHz. Operation in the 5470-5725 MHz Band

Date of Test: 3/7/2016 Config. Used: 1 (Radio 2)
Test Engineer: Mehran Birgani Config Change: None
Test Location: FT Ch #4 EUT Voltage: POE

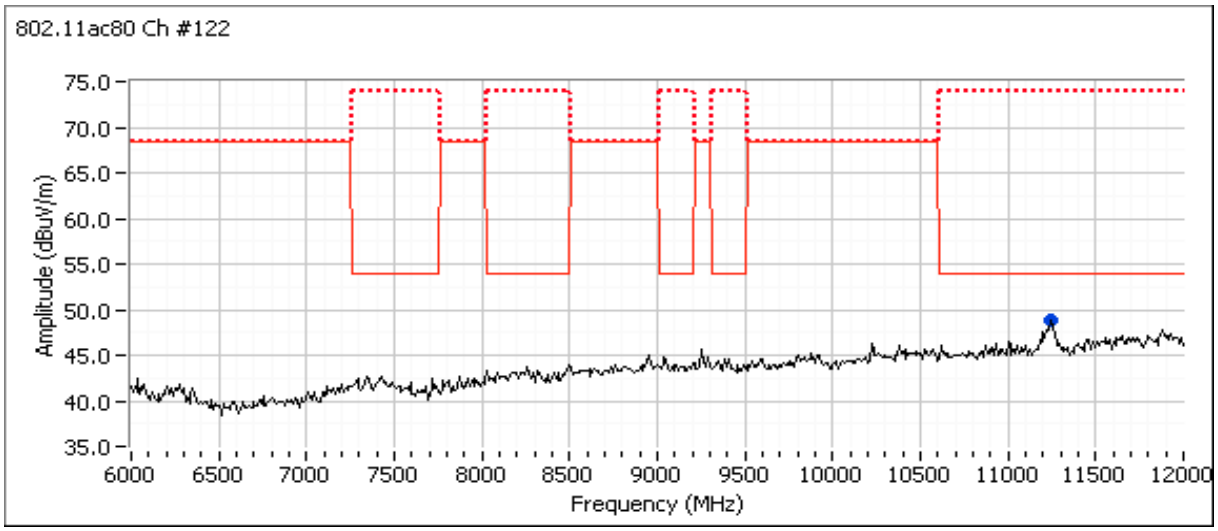
Channel: 122 Mode: ac80
Tx Chain: 3Tx (Radio #2) Data Rate: MCS0

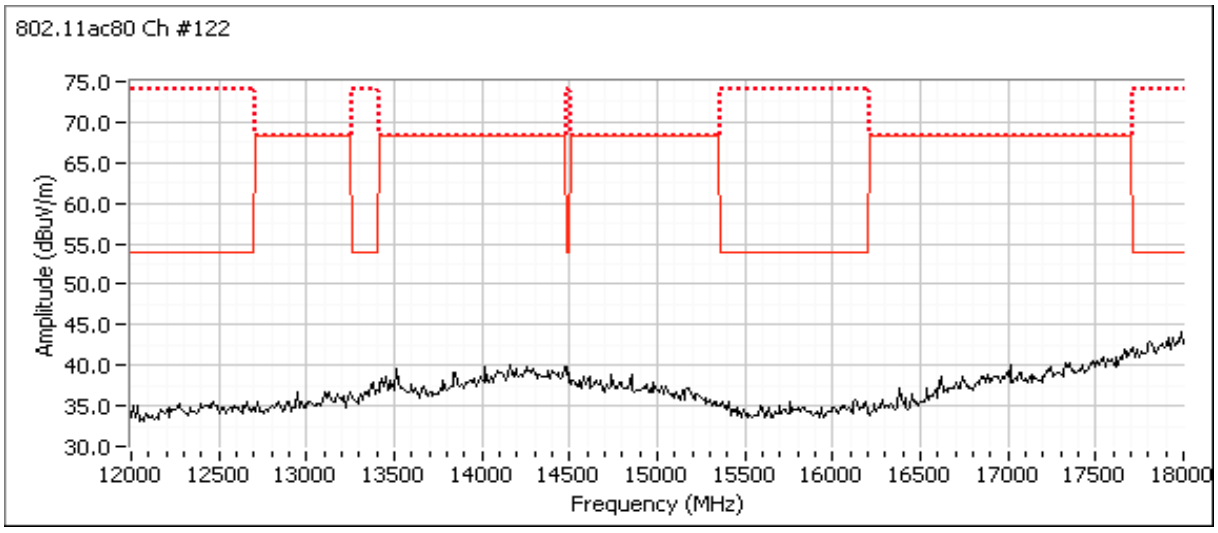
Frequency	Level	Pol	15.209 / 15E		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
5350.520	**47.1**	V	54.0	**-6.9**	AVG	28	1.5	RB 1 MHz;VB 10 Hz;Peak
11234.130	44.7	V	54.0	-9.3	AVG	28	1.0	RB 1 MHz;VB 10 Hz;Peak
5355.120	59.9	V	74.0	-14.1	PK	28	1.5	RB 1 MHz;VB 3 MHz;Peak
3750.080	39.8	V	54.0	-14.2	AVG	178	2.0	RB 1 MHz;VB 10 Hz;Peak
11239.670	57.2	V	74.0	-16.8	PK	28	1.0	RB 1 MHz;VB 3 MHz;Peak
3750.310	46.8	V	74.0	-27.2	PK	178	2.0	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≥3MHz, peak detector).

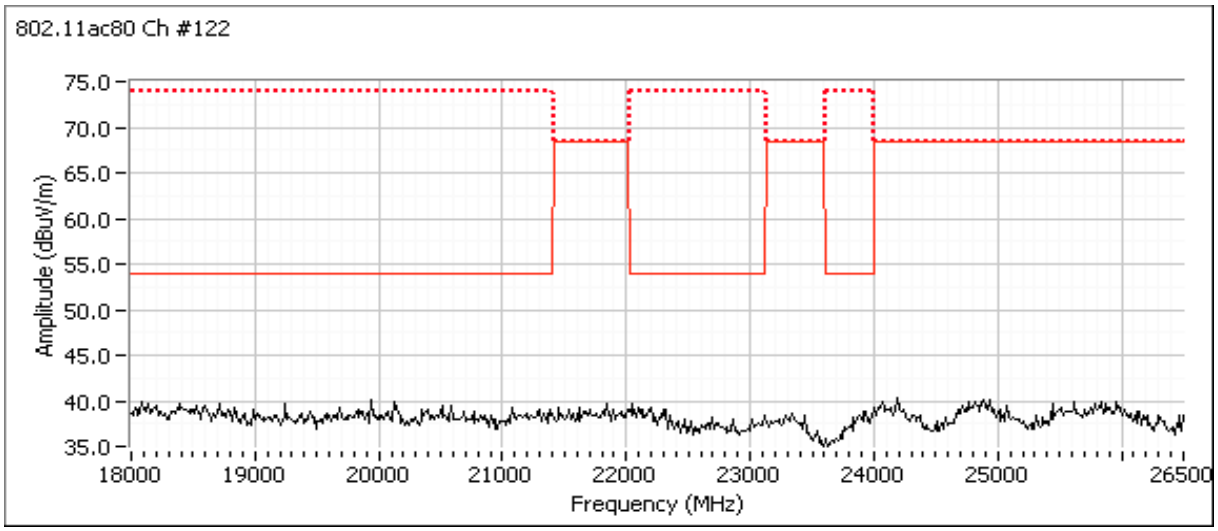


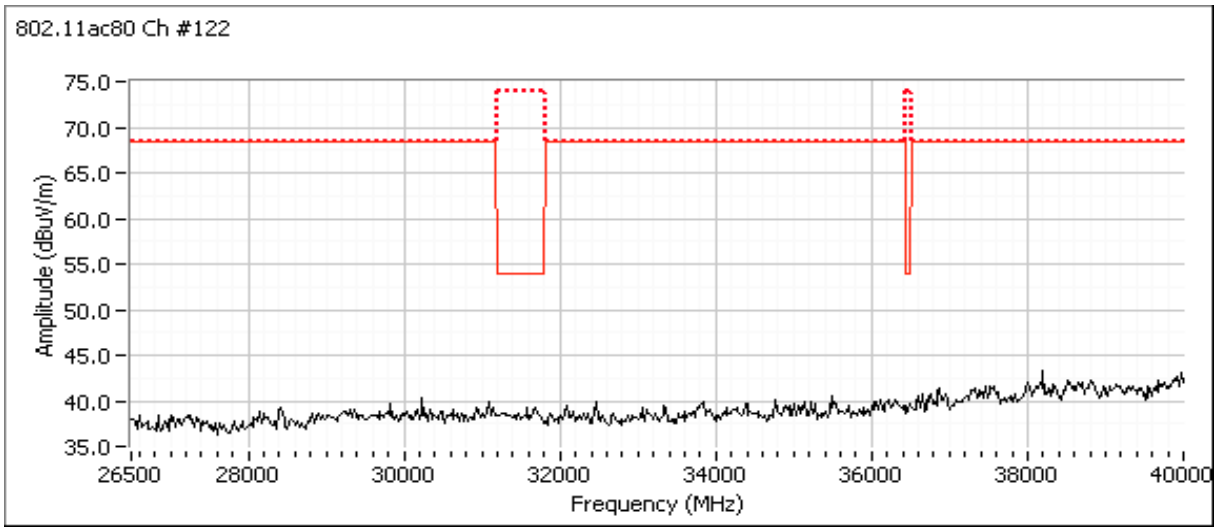
Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A





Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A





Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A

RSS-247 (LELAN) and FCC 15.407(UNII)
Antenna Port Measurements
Power, PSD, Bandwidth and Spurious Emissions

Test Specific Details

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

Summary of Results

Run #	Test Performed	Limit	Pass / Fail	Result / Margin
1 (Radio 1)	Power, 5470 - 5725MHz	15.407(a) (1), (2), (3) RSS-247 6.2	Pass	ac80: 46.8 mW (16.7dBm)
1 (Radio 1)	PSD, 5470 - 5725MHz	15.407(a) (1), (2), (3) RSS-247 6.2	Pass	ac80: 0.7 mW/MHz
1 (Radio 1)	Max EIRP 5470 - 5725MHz	TPC required if EIRP≥ 500mW (27dBm). EIRP ≥ 200mW (23dBm) DFS threshold = -64dBm.	Pass	EIRP = 21.9 dBm (153.5 mW)
1 (Radio 1)	26dB Bandwidth	15.407 (Information only)	-	> 20MHz for all modes
1 (Radio 1)	99% Bandwidth	RSS-247 (Information only)	N/A	ac80: 76.2 MHz
2 (Radio 2)	Power, 5470 - 5725MHz	15.407(a) (1), (2), (3) RSS-247 6.2	Pass	ac80: 43.8 mW (16.4dBm)
2 (Radio 2)	PSD, 5470 - 5725MHz	15.407(a) (1), (2), (3) RSS-247 6.2	Pass	ac80: 0.6 mW/MHz
2 (Radio 2)	Max EIRP 5470 - 5725MHz	TPC required if EIRP≥ 500mW (27dBm). EIRP ≥ 200mW (23dBm) DFS threshold = -64dBm.	Pass	EIRP = 21.6 dBm (143.7 mW)
2 (Radio 2)	26dB Bandwidth	15.407 (Information only)	-	> 20MHz for all modes
2 (Radio 2)	99% Bandwidth	RSS-247 (Information only)	N/A	ac80: 76.1 MHz

General Test Configuration

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

Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A

Ambient Conditions:

Temperature: 18-19 °C
Rel. Humidity: 35-40 %

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

Mode	Data Rate	Duty Cycle (x)	Constant DC?	T (ms)	Pwr Cor Factor*	Lin Volt Cor Factor**	Min VBW for FS (Hz)
ac80	MCS0	99.6%	Y	23.984	0	0	10

Sample Notes

Sample S/N: X307532049ADC
Driver: XR.7.4.2
Antenna: Integral (3x3)

Antenna:	**IPA0 (Radio 1)**	chain 1	P400	**IPA1 (Radio 2)**	chain 1	P400
		chain 2	P401		chain 2	P401
		chain 3	P402		chain 3	P402

Note 1:	Output power measured using gated average power meter. (method PM-G in ANSI C63.10).
Note 1:	Duty Cycle ≥ 98%. Output power measured using a spectrum analyzer (see plots below). RBW=1MHz, VB=3 MHz, Span > OBW, # of points in sweep ≥ 2*span/RBW, auto sweep, **RMS** detector, power averaging on (transmitted signal was continuous, duty cycle ≥ 98%) and power integration over the OBW (method SA-1 of ANSI C63.10).
Note 2:	Measured using the same analyzer settings used for output power.
Note 3:	99% Bandwidth measured in accordance with C63.10 - RB between 1-5 % of OBW and VB ≥ 3*RB, Span between 1.5 and 5 times OBW.
Note 4:	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 on the 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.

Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A

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

Date of Test: 03/09/16 Config. Used: Conducted

Test Engineer: Mehran Birgani Config Change: -

Test Location: Lab 4 EUT Voltage: PoE

Antenna Gain Information

Freq	Antenna Gain (dBi) / Chain				BF	MultiChain Legacy	CDD	Sectorized / Xpol	Dir G (PWR)	Dir G (PSD)
	1	2	3	4						
5150-5250	5.16	5.16			No	Yes	Yes	No	5.16	8.2
5250-5350	5.16	5.16			No	Yes	Yes	No	5.16	8.2
5470-5725	5.16	5.16			No	Yes	Yes	No	5.16	8.2
5725-5825	5.16	5.16			No	Yes	Yes	No	5.16	8.2

For devices that support CDD modes

Min # of spatial streams: 1

Max # of spatial streams: 2

Notes:	BF = beamforming mode supported, Multichain Legacy = 802.11 legacy data rates supported for multichain transmissions, CDD = Cyclic Delay Diversity (or Cyclic Shift Diversity) modes supported, Sectorized / Xpol = antennas are sectorized or cross polarized.
Notes:	Dir G (PWR) = total gain (Gant + Array Gain) for power calculations; GA (PSD) = total gain for PSD calculations based on FCC KDB 662911. Depending on the modes supported, the Array Gain value for power could be different from the PSD value.
Notes:	Array gain for power/psd calculated per KDB 662911 D01.
Notes:	For systems with Beamforming and CDD, choose one the following options: Option 1: Delays are optimized for beamforming, rather than being selected from cyclic delay table of 802.11; Array gains calculated based on beamforming criteria. Option 2: Antennas are paired for beamforming, and the pairs are configured to use the cyclic delay diversity of 802.11; the array gain associated with beamforming with 2 antennas (3dB), and the array gain associated with CDD with two antennas (3dB for PSD and 0 dB for power)

Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A

Radio 1 (IAP0)

MIMO Device - 5470-5725 MHz Band - FCC

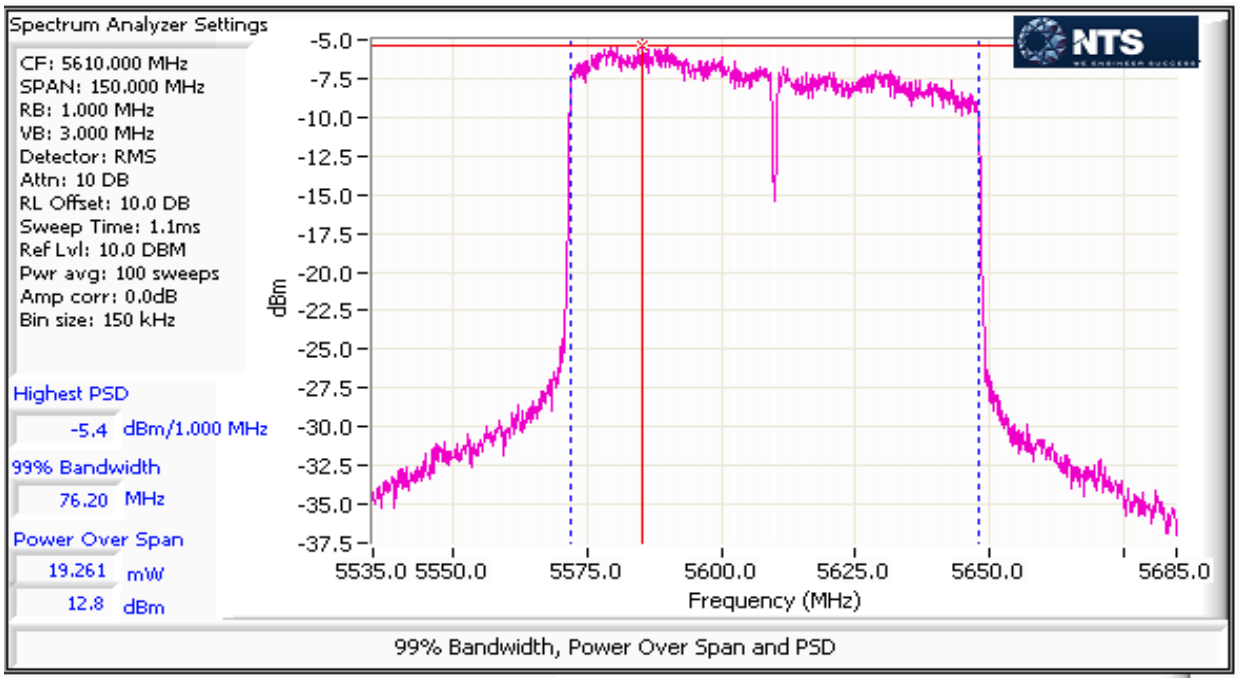
Mode: ac80 Max EIRP (mW): 153.5

Frequency (MHz)	Chain	Software Setting	26dB BW (MHz)	Duty Cycle %	Power[1] dBm	Total Power mW	Total Power dBm	FCC Limit dBm	Max Power (W)	Result
5610	1	15	126.3	99.6	12.8	46.8	16.7	24.0	0.047	Pass
	3				12.1					
	4									
	2				10.6					

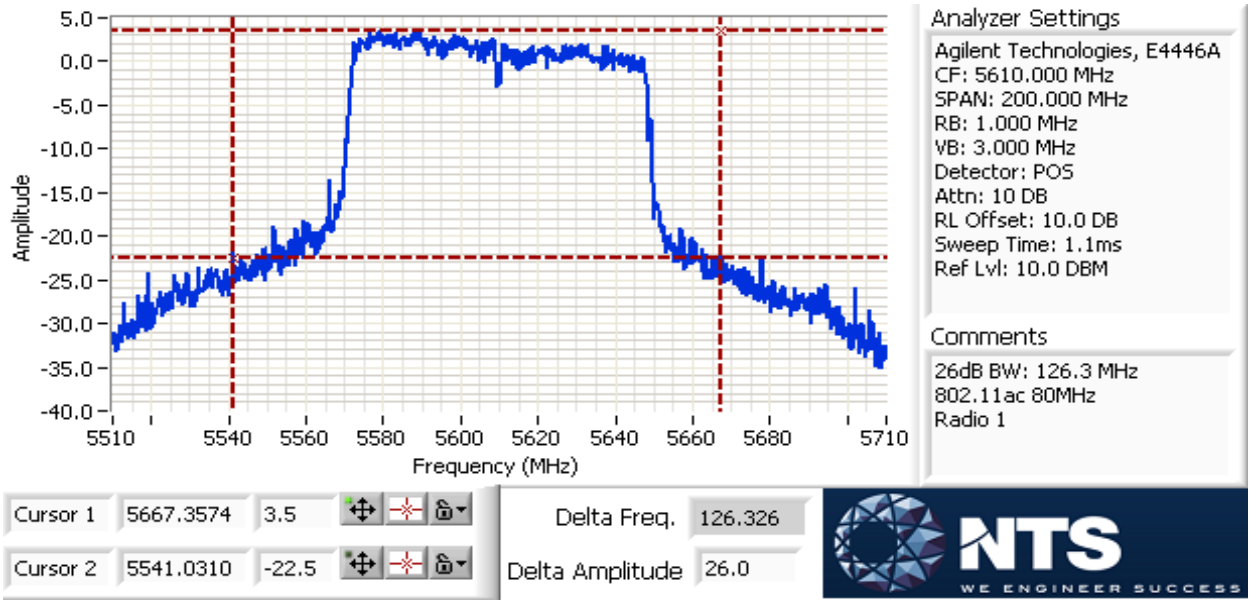
5470-5725 PSD - FCC/IC

Mode: ac80

Frequency (MHz)	Chain	Software Setting	99% BW (MHz)	Duty Cycle %	PSD dBm/MHz	Total PSD[1] mW/MHz	Total PSD[1] dBm/MHz	FCC Limit dBm/MHz	IC limit dBm/MHz	Result
5610	1	15		99.6	-5.4	0.7	-1.5	8.8	11.0	Pass
	3				-6.2					
	4									
	2				-7.8					



Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A



Radio 2 (IAP1)

MIMO Device - 5470-5725 MHz Band - FCC

Mode: **ac80** Max EIRP (mW): 143.7

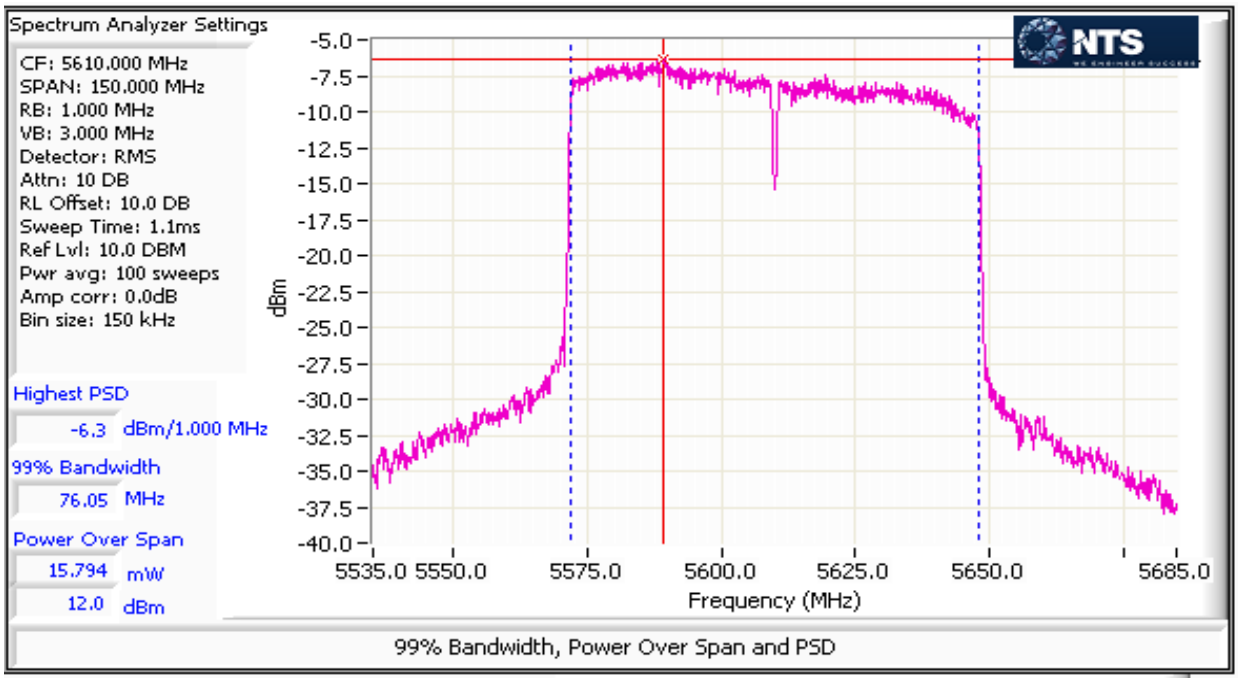
Frequency (MHz)	Chain	Software Setting	26dB BW (MHz)	Duty Cycle %	Power[1] dBm	Total Power mW	Total Power dBm	FCC Limit dBm	Max Power (W)	Result
5610	1	15	129.6	99.6	12.0	43.8	16.4	24.0	0.044	Pass
	3				11.6					
	4									
	2				11.3					

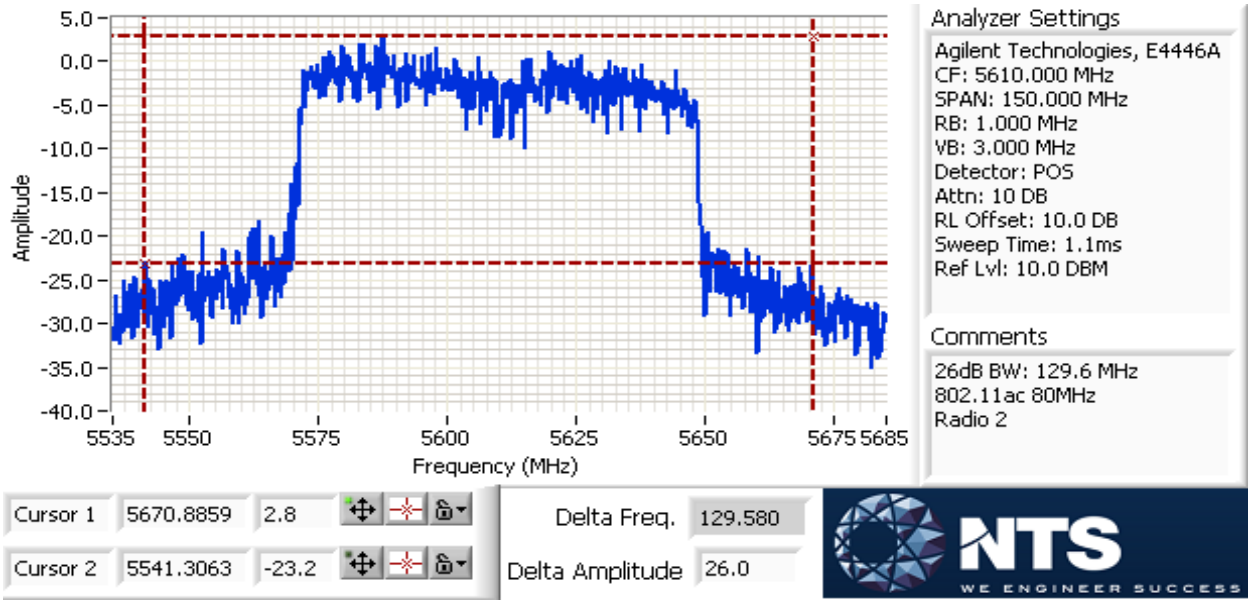
5470-5725 PSD - FCC/IC

Mode: **ac80**

Frequency (MHz)	Chain	Software Setting	99% BW (MHz)	Duty Cycle %	PSD dBm/MHz	Total PSD[1] mW/MHz	Total PSD[1] dBm/MHz	FCC Limit dBm/MHz	IC limit dBm/MHz	Result
5610	1	15		99.6	-6.3	0.6	-2.2	8.8	11.0	Pass
	3				-6.6					
	4									
	2				-7.6					

Client:	Xirrus Inc	Job Number:	JD100975
Model:	XR-630	T-Log Number:	T101147
		Project Manager:	Christine Krebill
Contact:	Paul Zahara	Project Coordinator:	-
Standard:	FCC 15.407	Class:	N/A





End of Report

This page is intentionally blank and
marks the last page of this test report.