Novatel

REVISED TEST REPORT FOR

PwrPak7
Model: 01019717

Tested To The Following Standards:

FCC Part 15 Subpart C Section(s)

15.247
(DTS 2400-2483.5 MHz)

Report No.: 100173-6A

Date of issue: September 26, 2017

ACCREDITED
Testing Certificates:
803.01, 803.02, 803.05, 803.06

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of EMC testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

Testing the Future
CKC LABORATORIES, INC.

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Test Report Information

REPORT PREPARED FOR:

Novatel
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Calgary AB T2E 8S5
Canada

REPRESENTATIVE: Jim Turner
Customer Reference Number: RPO0005724

REPORT PREPARED BY:

Terri Rayle
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

Project Number: 100173

DATE OF EQUIPMENT RECEIPT: August 7, 2017
DATE(S) OF TESTING: August 7-10, 2017 and September 12, 2017

Revision History

Original: Testing of the PwrPak7, Model: 01019717 to FCC Part 15 Subpart C Section(s), 15.247 (DTS 2400-2483.5 MHz).
Revision A: To replace data, plots and correct the limit values in section 15.247(d) Conducted Emissions and Band Edge.

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the sample equipment tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.

Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information

Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
22116 23rd Drive S.E., Suite A
Canyon Park, Bothell, WA 98021

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.02

Site Registration & Accreditation Information

Location	NIST CB #	TAIWAN	CANADA	FCC	JAPAN
Canyon Park, Bothell, WA	US0081	SL2-IN-E-1145R	3082C-1	US1022	A-0148

SUMMARY OF RESULTS

Standard / Specification: FCC Part 15 Subpart C - 15.247 (DTS)

Test Procedure	Description	Modifications	Results
15.247(a)(2)	6dB Bandwidth	NA	Pass
15.247(b)(3)	Output Power	NA	Pass
15.247(e)	Power Spectral Density	NA	Pass
15.247(d)	RF Conducted Emissions & Band Edge	NA	Pass
15.247(d)	Radiated Emissions & Band Edge	NA	Pass
15.207	AC Conducted Emissions	NA	NP

NA = Not Applicable
NP = CKC Laboratories was not contracted to perform test.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions
No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions
All data rates investigated, only worst case data reported.

EQUIPMENT UNDER TEST (EUT)

During testing, numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
PwrPak7	Novatel	01019717	NMNE17190018S

Support Equipment:

Device	Manufacturer	Model #	S/N
GNSS Active Antenna	Novatel	GPS-703-GGG	NA
Laptop	Panasonic	Toughbook CF-31	NA
AC Adaptor (for Laptop)	Panasonic	CF-AA5713A	NA
Bias Tee Coupler	Mini-Circuits	ZFBT-4R2G-FT	NA
Amplifier	Mini-Circuits	ZHL-1217HLN-SMA	NA
Attenuator	Alan	Model 50TX82.5 BNC	NA
CAN Interface	Vector	VN1610	NA
USB to 4 Port RS-232 Serial HUB	Moxa	UPort 1450	NA

Configuration 2

Equipment Tested:

Device	Manufacturer	Model #	S/N
PwrPak7	Novatel	01019717	NMNE17190014K

Support Equipment:

Device	Manufacturer	Model #	S/N
GNSS Active Antenna	Novatel	GPS-703-GGG	NA
Laptop	Panasonic	Toughbook CF-31	NA
AC Adaptor (for Laptop)	Panasonic	CF-AA5713A	NA
Bias Tee Coupler	Mini-Circuits	ZFBT-4R2G-FT	NA
Amplifier	Mini-Circuits	ZHL-1217HLN-SMA	NA
Attenuator	Alan	Model 50TX82.5 BNC	NA
CAN Interface	Vector	VN1610	NA
USB to 4 Port RS-232 Serial HUB	Moxa	UPort 1450	NA

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Stand-Alone Equipment
Type of Wideband System:	802.11 b/g/n20
Operating Frequency Range:	2412-2462MHz
Modulation Type(s):	CCK, DQPSK, PBCC, BPSK, QPSK OFDM, 16-QAM, 64-QAM
Maximum Duty Cycle:	Tested 100%
Number of TX Chains:	1
Antenna Type(s) and Gain:	Integral Trace, 2.6dBi
Beamforming Type:	NA
Antenna Connection Type:	Integral (External connector provided to facilitate testing)
Nominal Input Voltage:	13.2VDC (9V-36VDC range)
Firmware / Software used for Test:	OM7CR0301SN0007 / WifiConfigSequencer.exe

FCC Part 15 Subpart C

15.247(a)(2) 6dB Bandwidth

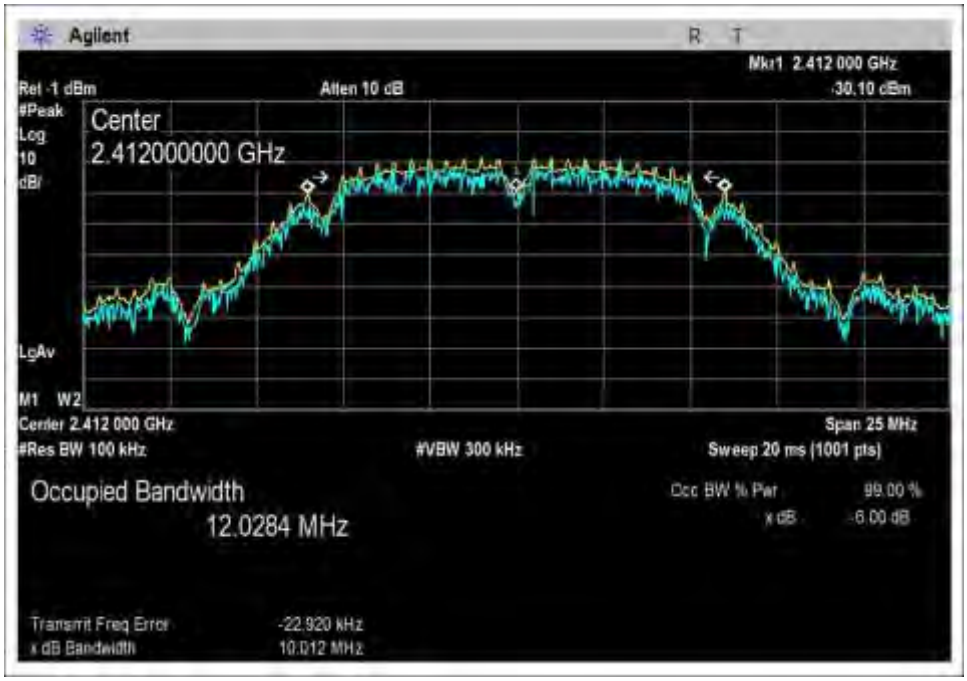
Test Setup/Conditions			
Test Location:	Bothell Lab Bench	Test Engineer:	M. Atkinson
Test Method:	ANSI C63.10 (2013), KDB 558074 v04 (April 5, 2017)	Test Date(s):	8/10/2017
Configuration:	2		
Test Setup:	The EUT is DC powered through a battery with a nominal voltage of 13.2VDC. The EUT is connected to an external GNSS active antenna which is located remotely with an open view of the sky. The active antenna is powered by a Bias Tee coupler and the signal strength is tuned with an amplifier and output DC power supply. The Bias Tee coupler is powered by a dual output power supply. The EUT is connected to a support laptop via Ethernet and the 2 x USB ports. The 26Pin IO contained 1 x CAN Interface and 3 x RS-232 ports. The CAN Interface is connected to the laptop via a CAN USB Adapter with a Terminator Resistor on the adapter side. The RS-232 ports which were connected to a serial to USB 4 port hub which is then connected to the laptop. The EUT is continuously transmitting. Low, Mid, and High channels as well as all data rates investigated, worst case data reported. The EUT is fully exercised with communication and data transfer between the EUT and support laptop. The EUT was fitted with a temporary antenna port for direct conducted measurements.		

Environmental Conditions			
Temperature (ºC)	22.4	Relative Humidity (%):	41

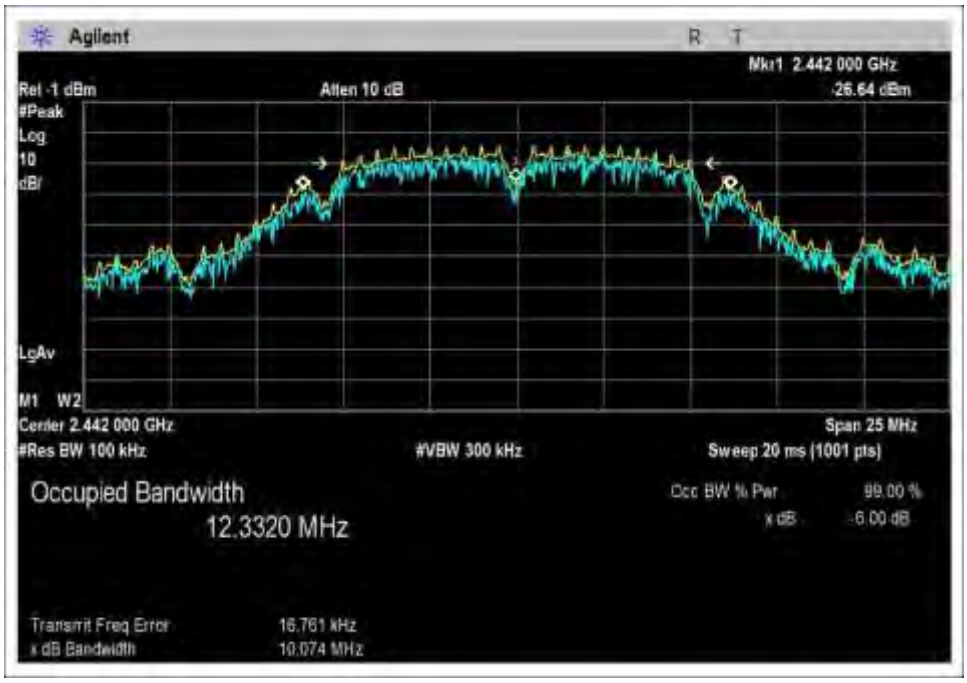
Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02871	Spectrum Analyzer	Agilent	E4440A	2/24/2017	2/24/2019
P05748	Attenuator	Pasternack	PE7004-20	4/11/2016	4/11/2018
P06518	Cable	Andrews	Heliax	1/21/2016	1/21/2018

Test Data Summary					
Frequency (MHz)	Antenna Port	Modulation	Measured (kHz)	Limit (kHz)	Results
2412	1	1M Data Rate (CCK/DQPSK)	10012	≥500	Pass
2442	1	1M Data Rate (CCK/DQPSK)	10074	≥500	Pass
2462	1	1M Data Rate (CCK/DQPSK)	9600	≥500	Pass
2412	1	11M Data Rate (PBCC/QPSK)	9244	≥500	Pass
2442	1	11M Data Rate (PBCC/QPSK)	8887	≥500	Pass
2462	1	11M Data Rate (PBCC/QPSK)	9108	≥500	Pass
2412	1	24M Data Rate (OFDM/16-QAM)	16509	≥500	Pass
2442	1	24M Data Rate (OFDM/16-QAM)	16535	≥500	Pass
2462	1	24M Data Rate (OFDM/16-QAM)	16522	≥500	Pass
2412	1	MCS7 Data Rate (64-QAM)	17746	≥500	Pass
2442	1	MCS7 Data Rate (64-QAM)	17757	≥500	Pass
2462	1	MCS7 Data Rate (64-QAM)	17734	≥500	Pass

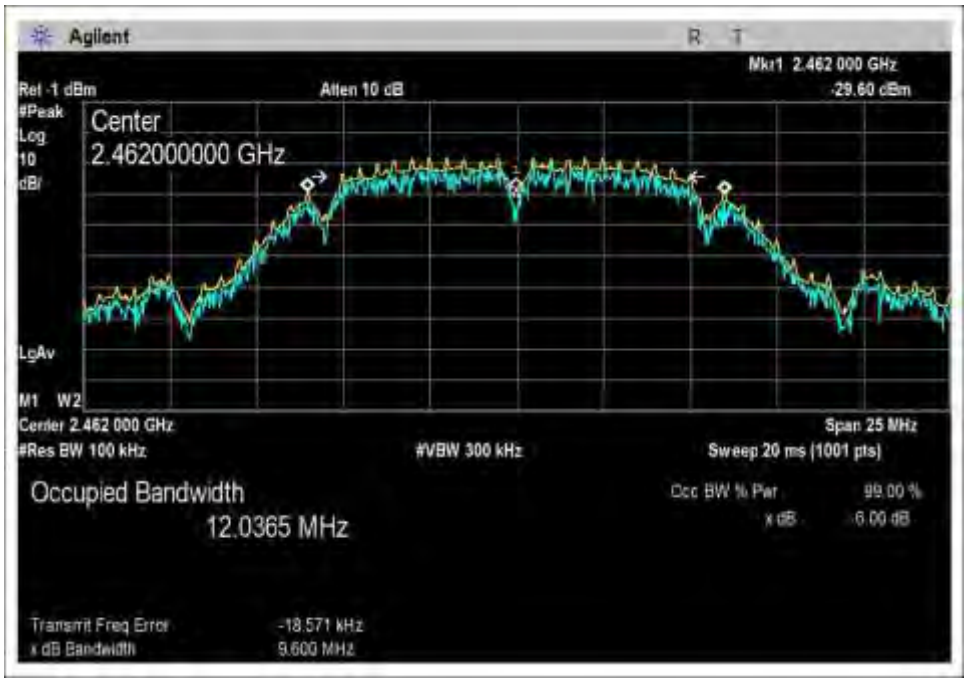
Plots



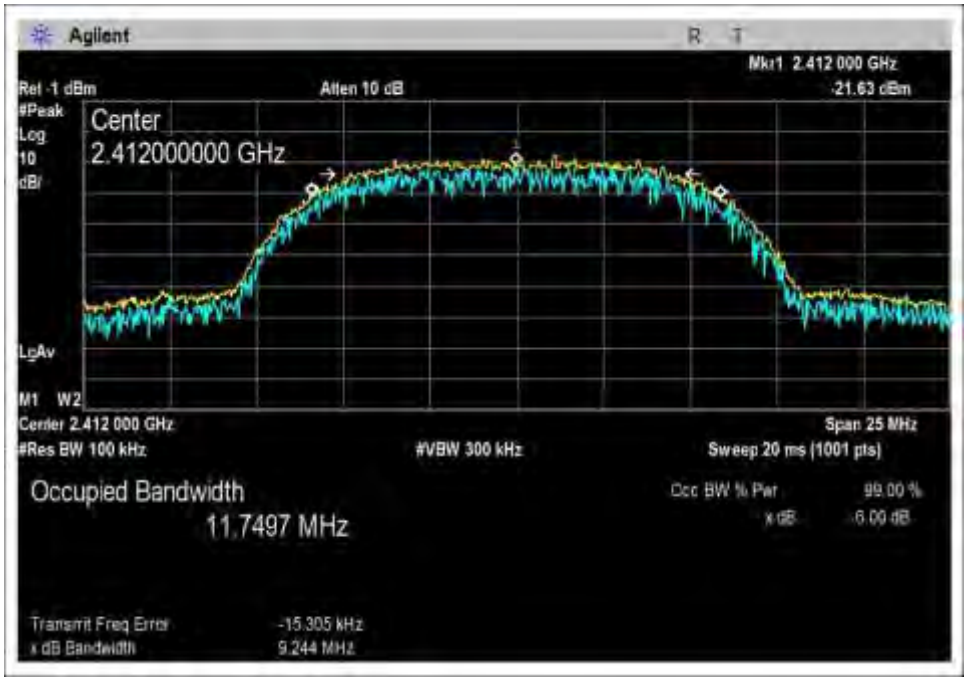
Data Rate 1Mbps, Low Channel



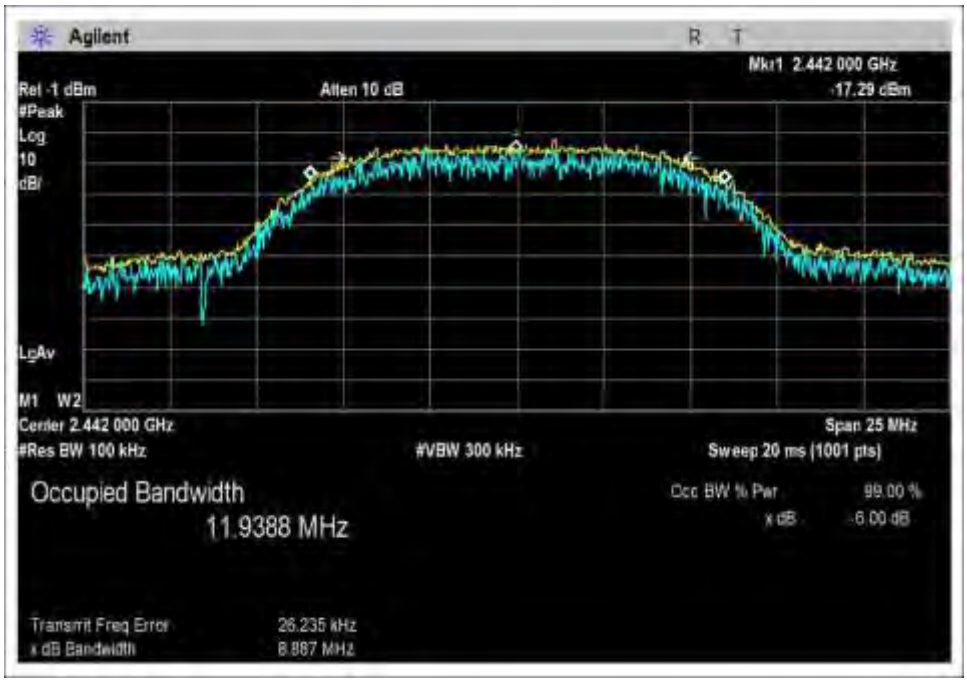
Data Rate 1Mbps, Middle Channel



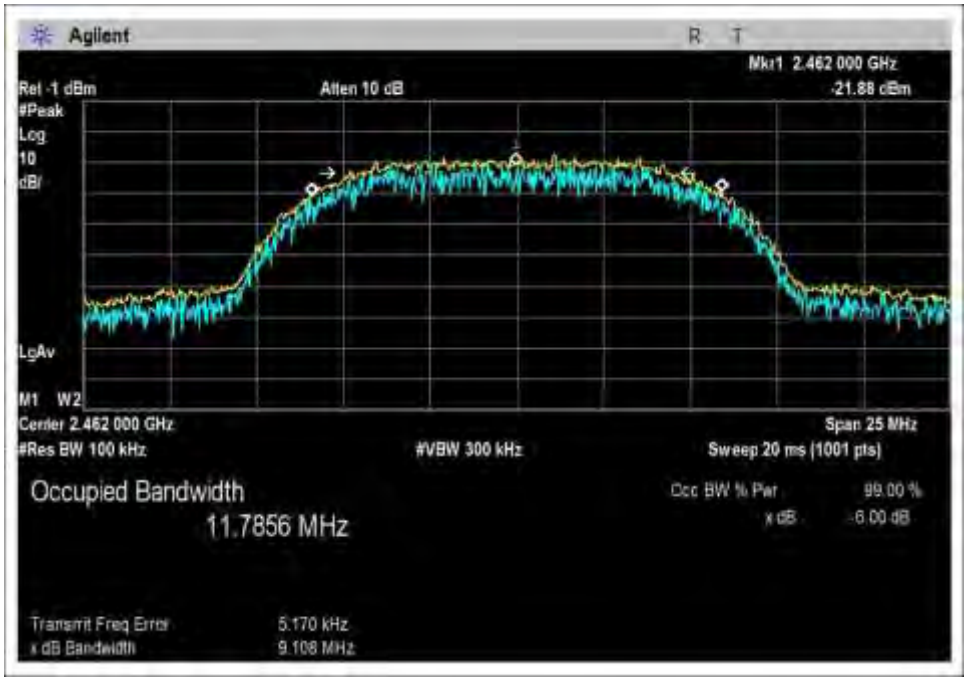
Data Rate 1Mbps, High Channel



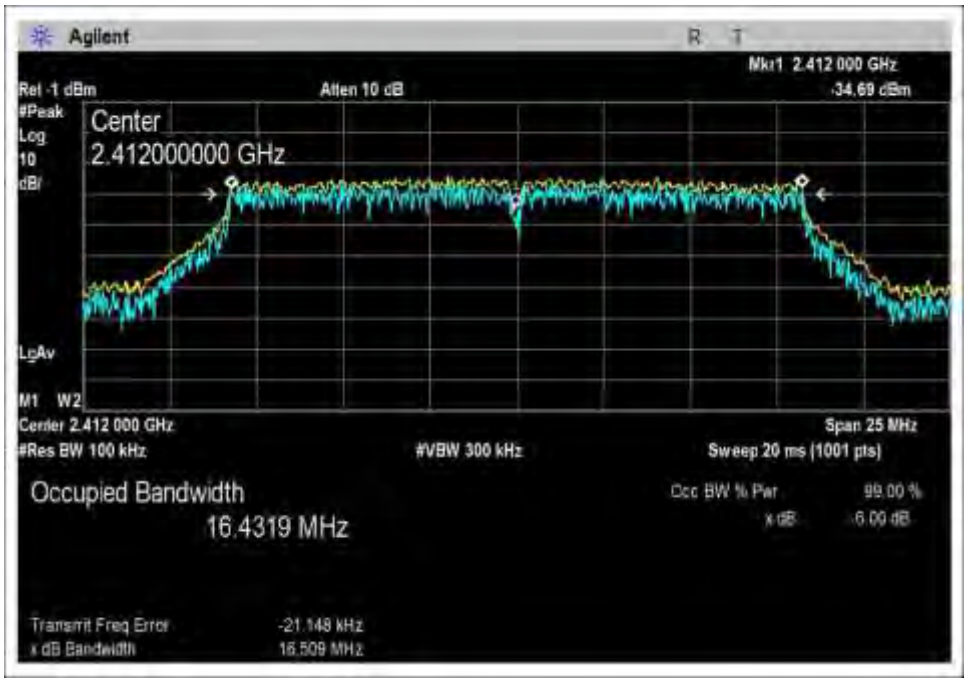
Data Rate 11Mbps, Low Channel



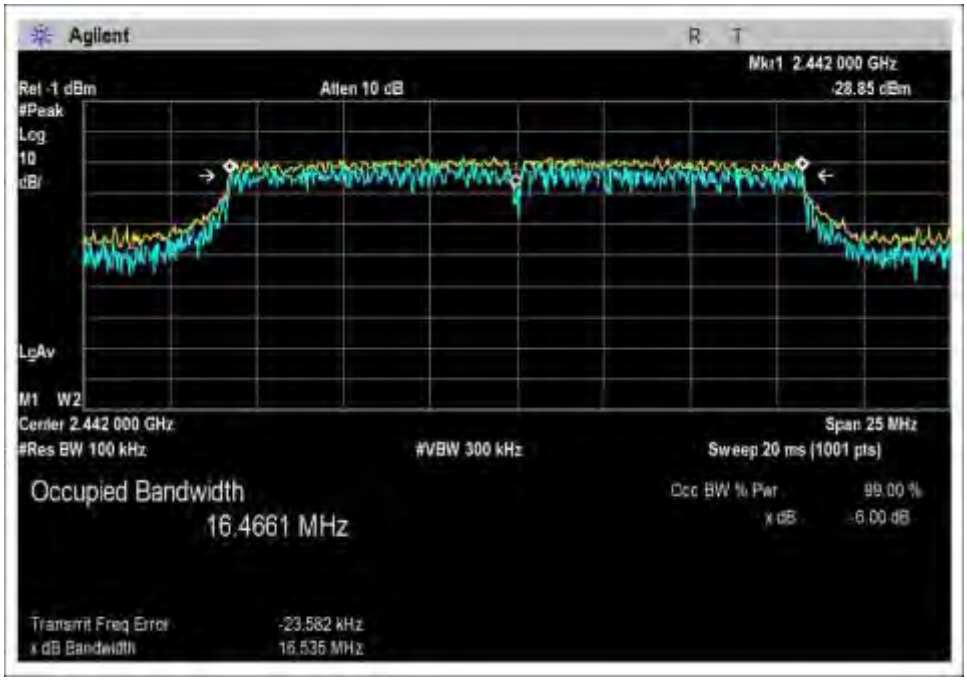
Data Rate 11Mbps, Middle Channel



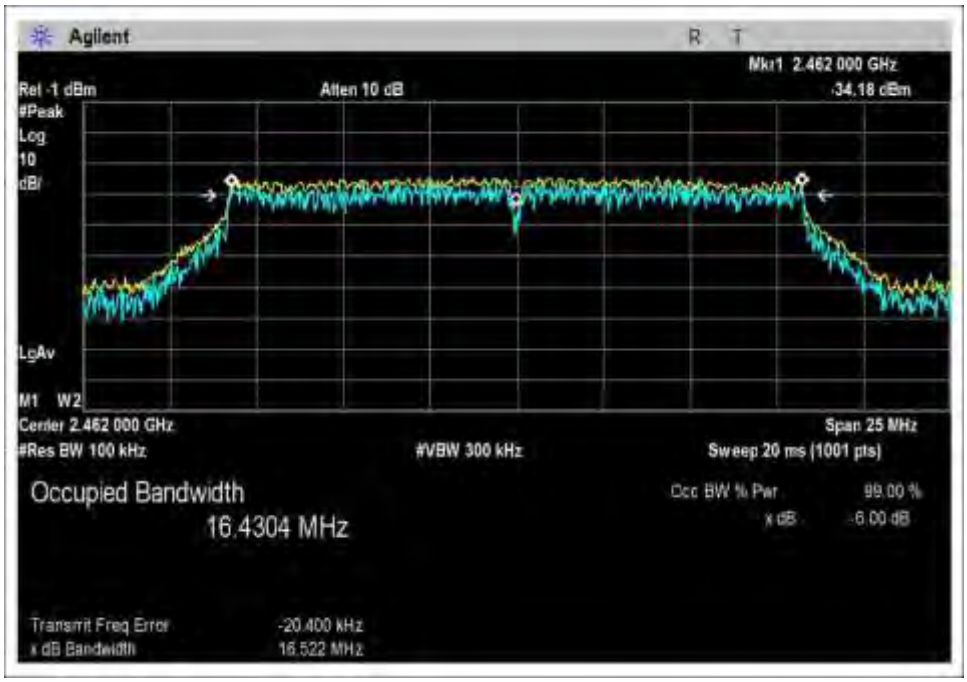
Data Rate 11Mbps, High Channel



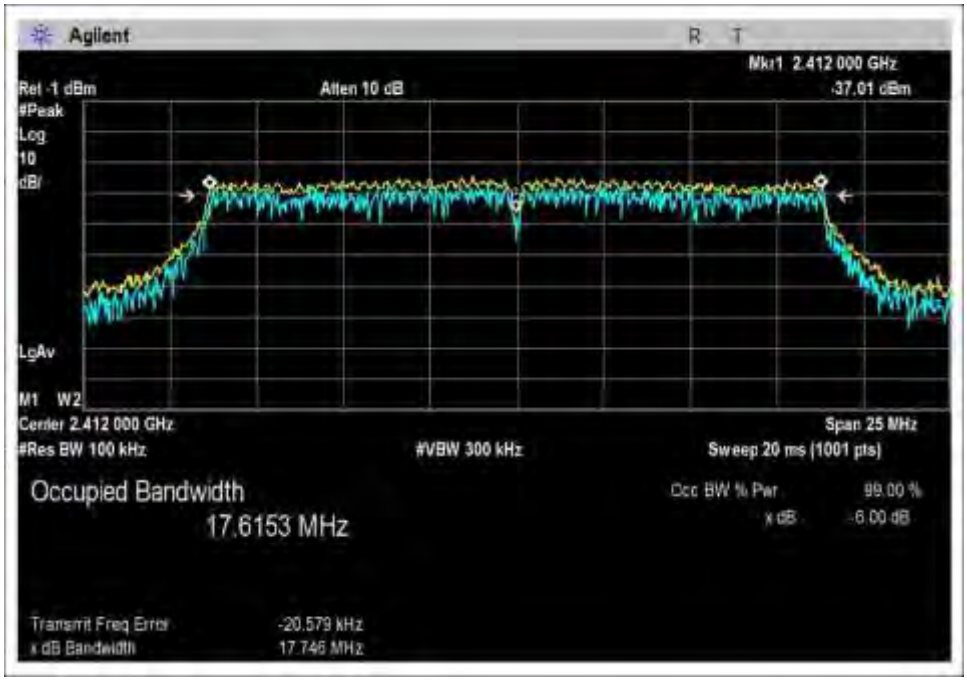
Data Rate 24Mbps, Low Channel



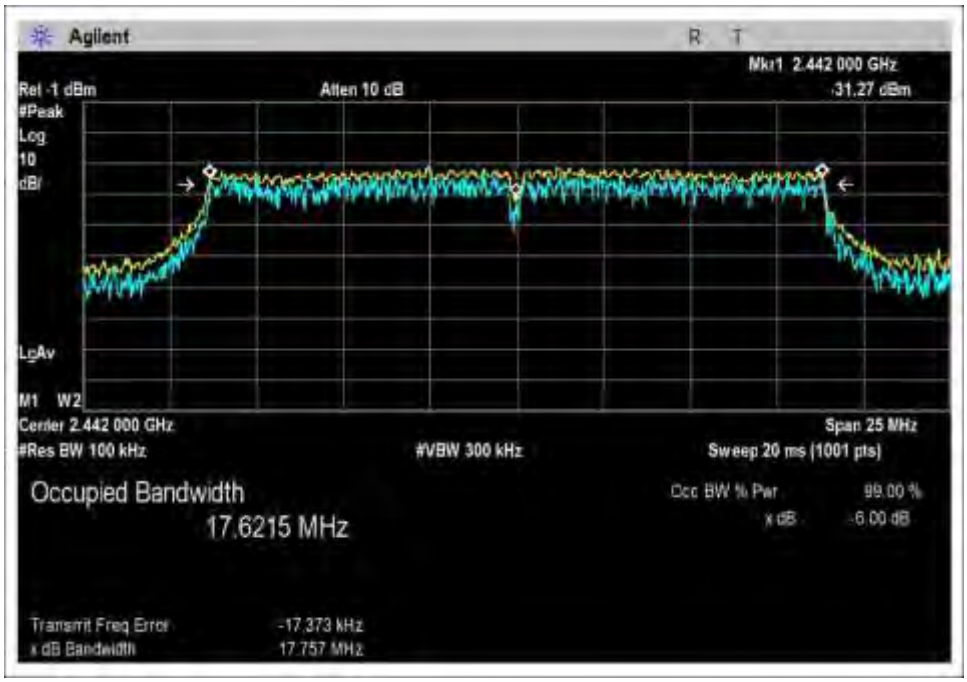
Data Rate 24Mbps, Middle Channel



Data Rate 24Mbps, High Channel



Data Rate MCS7, Low Channel



Data Rate MCS7, Middle Channel

Data Rate MCS7, High Channel

Test Setup Photo

15.247(b)(3) Output Power

Test Data Summary - Voltage Variations					
Frequency (MHz)	**Modulation**	**$V_{Minimum}$ (dBm)**	**$V_{Nominal}$ (dBm)**	**$V_{Maximum}$ (dBm)**	**Max Deviation from $V_{Nominal}$ (dB)**
2412	11M Data Rate (PBCC/QPSK) (Worst Case)	11.1	11.1	11.1	0.0
2442	11M Data Rate (PBCC/QPSK) (Worst Case)	16.2	16.2	16.2	0.0
2462	11M Data Rate (PBCC/QPSK) (Worst Case)	11.3	11.3	11.3	0.0

Test performed using operational mode with the highest output power, representing worst case.

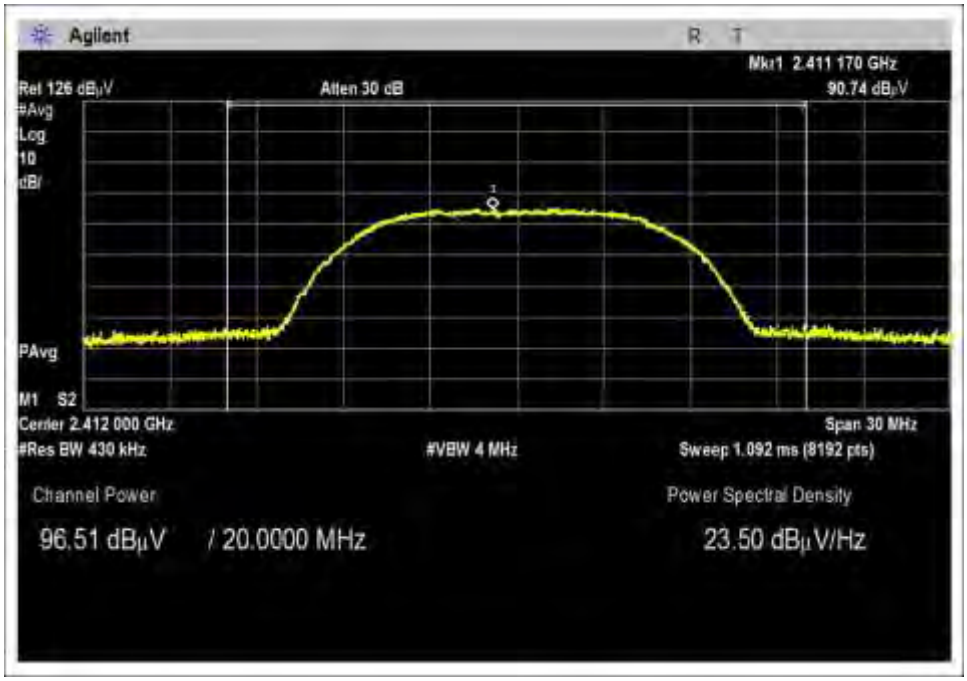
Parameter Definitions:

Measurements performed at input voltage according to manufacturer specification.

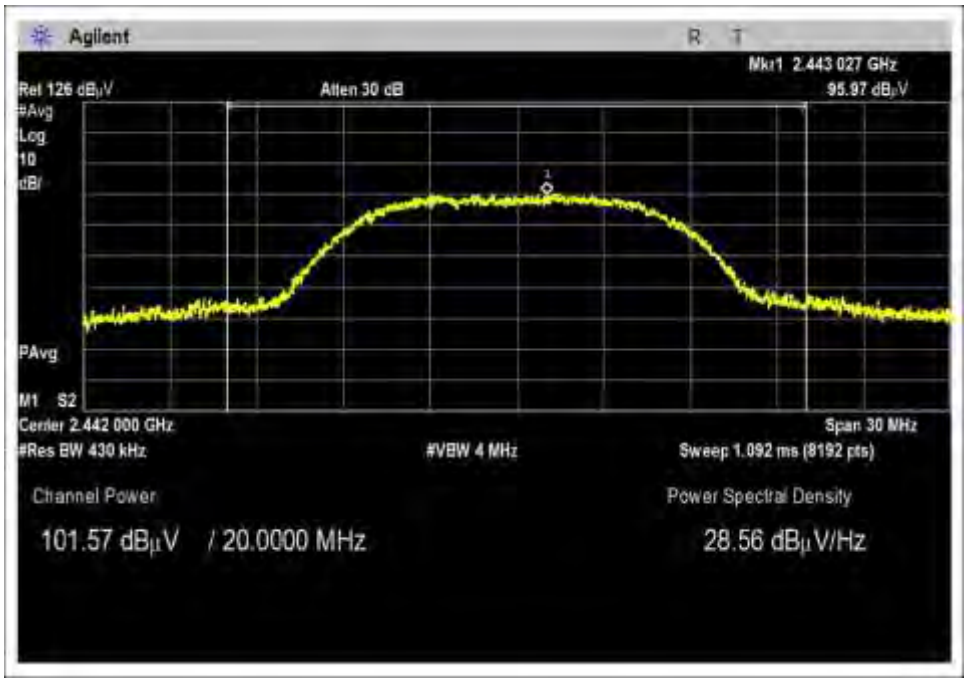
Parameter	Value
$V_{Nominal}$:	13.2VDC
$V_{Minimum}$:	9VDC
$V_{Maximum}$:	36VDC

Test Data Summary - RF Conducted Measurement					
Measurement Option: AVGSA-1					
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Measured (dBm)**	**Limit (dBm)**	**Results**
2412	11M Data Rate (PBCC/QPSK) (Worst Case)	Integral Trace / 2.6dBi	11.1	≤30	Pass
2442	11M Data Rate (PBCC/QPSK) (Worst Case)	Integral Trace / 2.6dBi	16.2	≤30	Pass
2462	11M Data Rate (PBCC/QPSK) (Worst Case)	Integral Trace / 2.6dBi	11.3	≤30	Pass

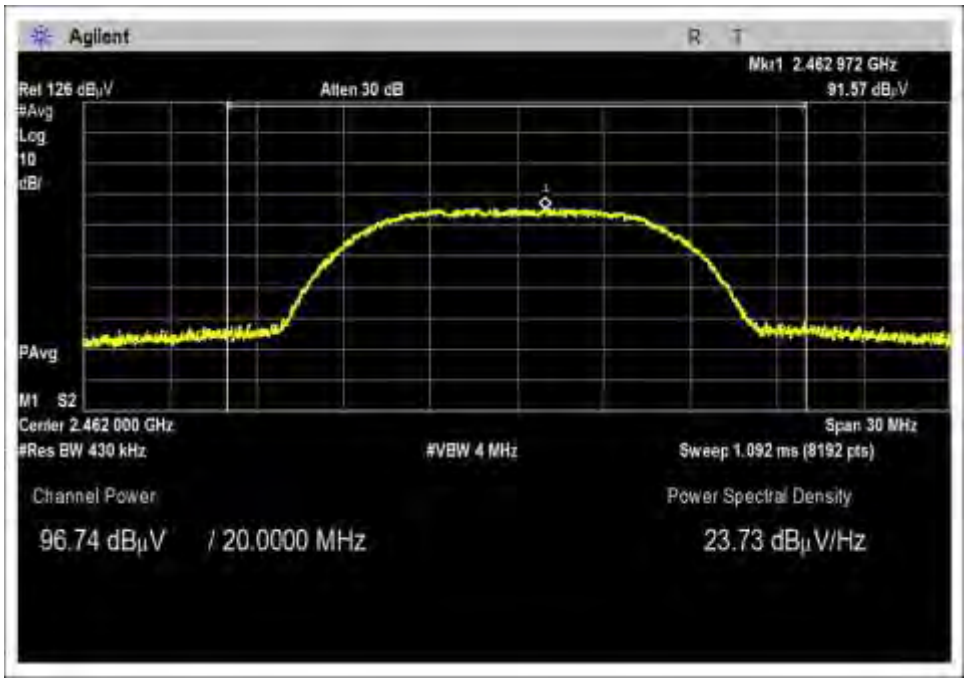
Plots



Low Channel



Middle Channel



High Channel

Test Setup / Conditions / Data

Test Location:	CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)		
Customer:	**Novatel**		
Specification:	**15.247(b) Power Output (2400-2483.5 MHz DTS)**		
Work Order #:	**100173**	Date:	9/12/2017
Test Type:	**Conducted Emissions**	Time:	15:41:52
Tested By:	Michael Atkinson	Sequence#:	12
Software:	EMITest 5.03.02		13.2VDC

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

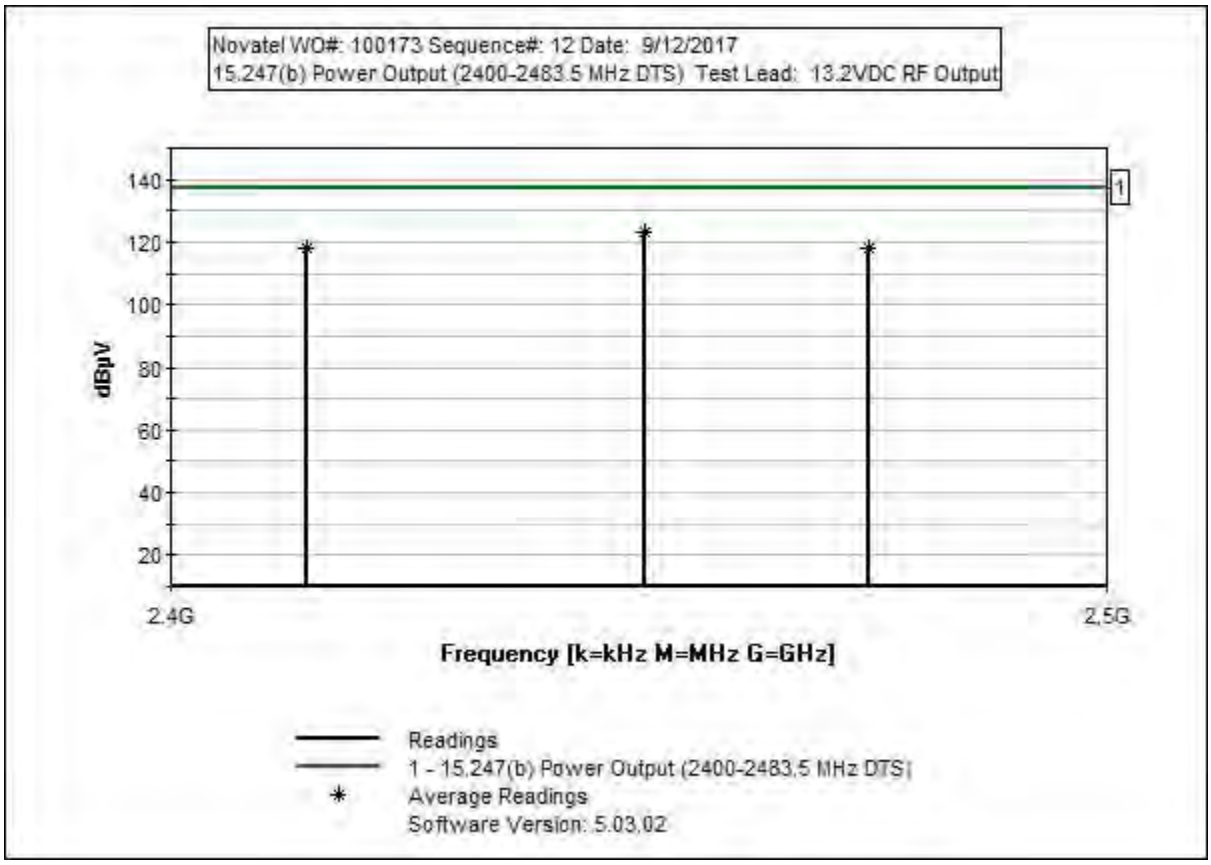
Frequency Range: Fundamental
Frequency tested: 2412, 2442, 2462MHz
Firmware power setting: Max
EUT Firmware: OM7CR0301SN0007
Modulation/Data Rate: **All data rates investigated, 11M data rate worst case.**

Antenna type: Integral Trace
Antenna Gain : 2.6dBi

Duty Cycle: 100%
Bothell Lab Bench
Test Method: ANSI C63.10 (2013), KDB 558074 v04 (April 5, 2017)
Temperature (ºC):19-20
Relative Humidity (%): 35-45

Setup:
The EUT is DC powered through a power supply to vary the voltage. The EUT is connected to an external GNSS active antenna which is located remotely with an open view of the sky. The active antenna is powered by a Bias Tee coupler and the signal strength is tuned with an amplifier and output DC power supply. The Bias Tee coupler is powered by a dual output power supply. The EUT is connected to a support laptop via Ethernet and the 2 x USB ports. The 26Pin IO contained 1 x CAN Interface and 3 x RS-232 ports. The CAN Interface is connected to the laptop via a CAN USB Adapter with a Terminator Resistor on the adapter side. The RS-232 ports which were connected to a serial to USB 4 port hub which is then connected to the laptop.

The EUT is continuously transmitting. Low, Mid, and High channels as well as all data rates investigated, worst case data reported. The EUT is fully exercised with communication and data transfer between the EUT and support laptop. The EUT was fitted with a temporary antenna port for direct conducted measurements.



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP05748	Attenuator	PE7004-20	4/11/2016	4/11/2018
T2	ANP06518	Cable	Heliax	1/21/2016	1/21/2018
	AN02871	Spectrum Analyzer	E4440A	2/24/2017	2/24/2019

Measurement Data: Reading listed by margin. Test Lead: RF Output

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	2442.000M Ave	101.6	+20.1	+1.5			+0.0	123.2	137.0	-13.8	RF Ou
2	2462.000M Ave	96.7	+20.1	+1.5			+0.0	118.3	137.0	-18.7	RF Ou
3	2412.000M Ave	96.5	+20.1	+1.5			+0.0	118.1	137.0	-18.9	RF Ou

Test Setup Photo

15.247(e) Power Spectral Density

Test Data Summary - Radiated Measurement						
Measurement Method: PKPSD						
Frequency (MHz)	**Modulation**	**Ant. Type / Gain (dBi)**	**Field Strength (dBuV/m @3m)**	**Calculated (dBm/3kHz)**	**Limit (dBm/3kHz)**	**Results**
2412	11M Data Rate (PBCC/QPSK) (Worst Case)	Integral Trace / 2.6dBi	95.0	-2.83	≤8	Pass
2442	11M Data Rate (PBCC/QPSK) (Worst Case)	Integral Trace / 2.6dBi	97.6	-0.23	≤8	Pass
2462	11M Data Rate (PBCC/QPSK) (Worst Case)	Integral Trace / 2.6dBi	93.7	-4.13	≤8	Pass

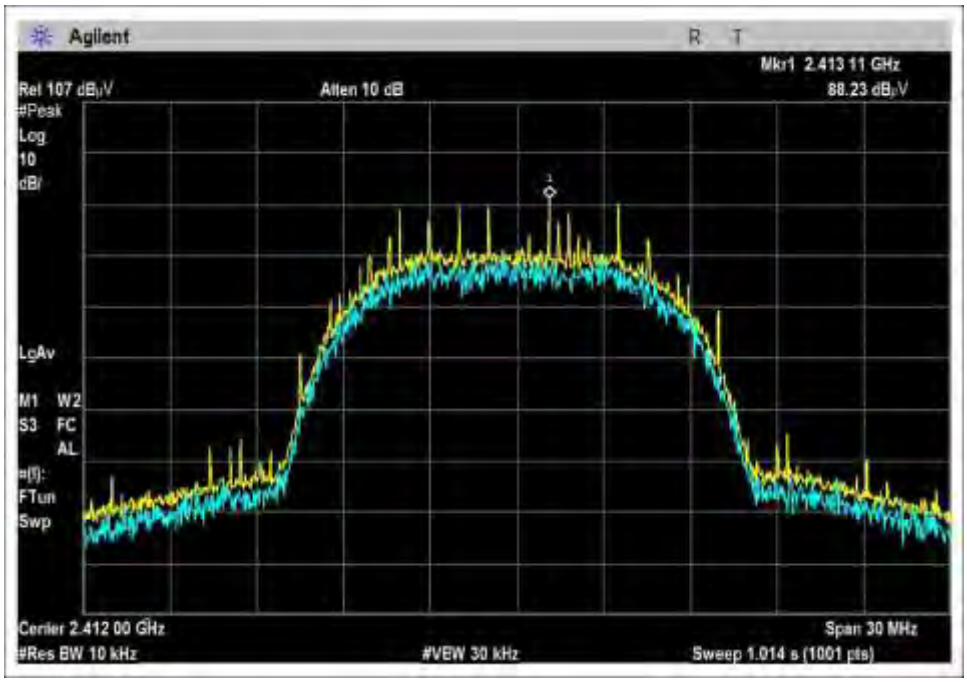
Conducted RF output power calculated in accordance with ANSI C63.10.

$$P(W) = \frac{(E \cdot d)^2}{30\ G}$$

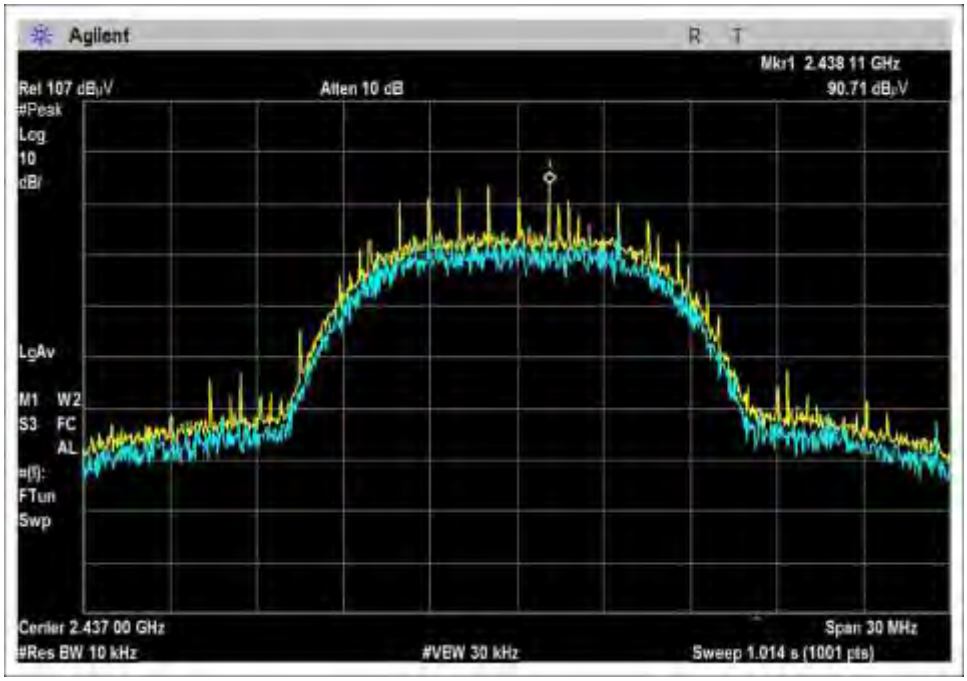
Or equivalently, in logarithmic form:

$$P(dBm) = E(dBuV/m) + 20LOG(d) - G\ - 104.77$$

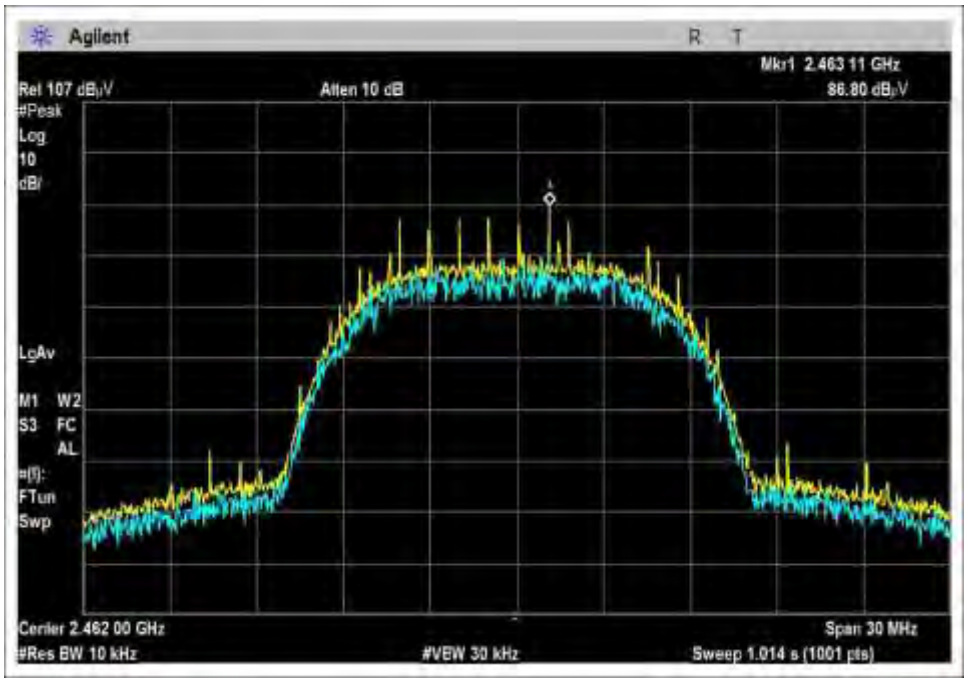
Plots



Low Channel



Middle Channel



High Channel

Test Setup / Conditions / Data

Test Location:	CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)		
Customer:	**Novatel**		
Specification:	**15.247(e) Peak Power Spectral Density (2400-2483.5 MHz DTS)**		
Work Order #:	**100173**	Date:	8/9/2017
Test Type:	**Maximized Emissions**	Time:	13:55:24
Tested By:	Michael Atkinson	Sequence#:	10
Software:	EMITest 5.03.02		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Frequency Range: Fundamental
Frequency tested: 2412, 2442, 2462MHz
Firmware power setting: Max
EUT Firmware: OM7CR0301SN0007
Modulation/Data Rate: **All data rates investigated, only worst case data reported**

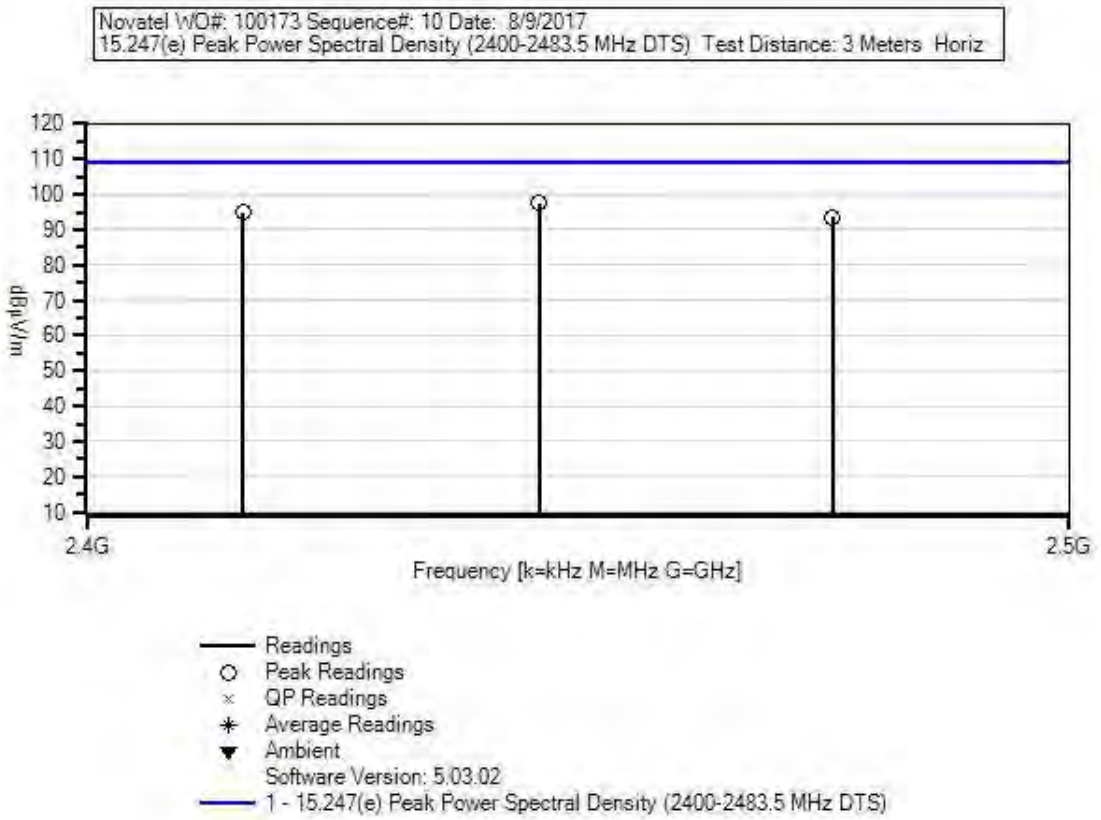
Antenna type: Integral Trace
Antenna Gain: 2.6dBi

Duty Cycle: 100%

Setup:
The EUT is DC powered through a power supply to vary the voltage. The EUT is connected to an external GNSS active antenna which is located remotely with an open view of the sky. The active antenna is powered by a Bias Tee coupler and the signal strength is tuned with an amplifier and output DC power supply. The Bias Tee coupler is powered by a dual output power supply. The EUT is connected to a support laptop via Ethernet and the 2 x USB ports. The 26Pin IO contained 1 x CAN Interface and 3 x RS-232 ports. The CAN Interface is connected to the laptop via a CAN USB Adapter with a Terminator Resistor on the adapter side. The RS-232 ports which were connected to a serial to USB 4 port hub which is then connected to the laptop.

The EUT is continuously transmitting. Low, Mid, and High channels as well as all data rates investigated, worst case data reported. Horizontal and Vertical antenna polarities investigated, only worst case reported. The EUT is fully exercised with communication and data transfer between the EUT and support laptop. The EUT is on the test table 150cm high connected to the internal trace antenna.

Test Method: ANSI C63.10 (2013), KDB 558074 v04 (April 5, 2017)
Temperature (ºC): 26
Relative Humidity (%): 38
Bothell Lab C3



Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02872	Spectrum Analyzer	E4440A	11/18/2015	11/18/2017
T1	ANP06540	Cable	Heliax	10/29/2015	10/29/2017
T2	ANP05305	Cable	ETSI-50T	2/15/2016	2/15/2018
T3	AN03540	Preamp	83017A	5/2/2017	5/2/2019
T4	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	8/12/2015	8/12/2017
T5	ANP06935	Cable	32026-29801-29801-18	3/11/2016	3/11/2018
T6	ANP06219	Attenuator	768-10	4/12/2016	4/12/2018

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	2438.110M	90.7	+0.6 +0.4	+2.9 +9.3	-34.0	+27.7	+0.0	97.6	109.2 11M	-11.6	Horiz
2	2413.110M	88.2	+0.6 +0.4	+2.8 +9.3	-34.0	+27.7	+0.0	95.0	109.2 11M	-14.2	Horiz
3	2463.110M	86.8	+0.6 +0.4	+2.9 +9.3	-34.0	+27.7	+0.0	93.7	109.2 11M	-15.5	Horiz

Test Setup Photo

15.247(d) RF Conducted Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)		
Customer:	**Novatel**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**100173**	Date:	8/10/2017
Test Type:	**Conducted Emissions**	Time:	16:27:05
Tested By:	Michael Atkinson	Sequence#:	13
Software:	EMITest 5.03.02		13.2VDC

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

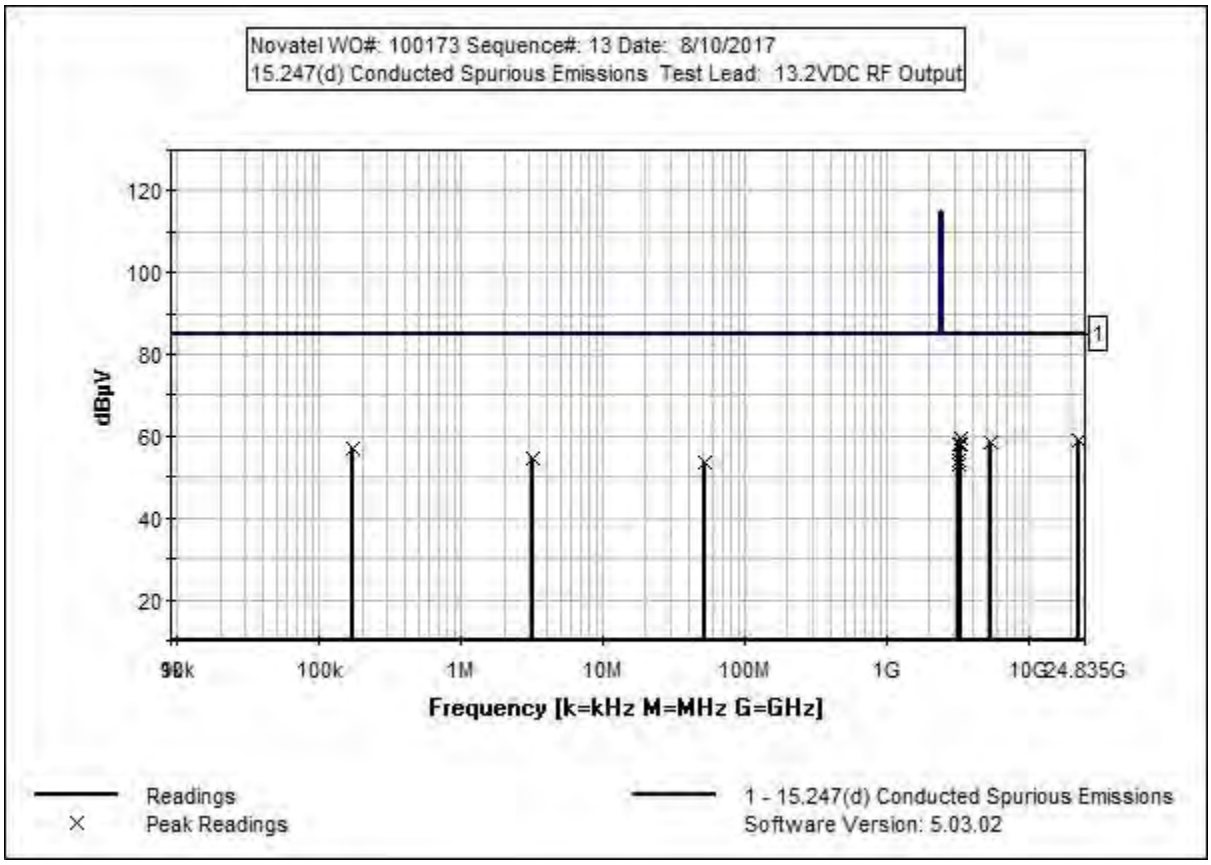
Frequency Range: 9kHz to 24.835GHz
Frequency tested: 2412, 2442, 2462MHz
Firmware power setting: Max
EUT Firmware: OM7CR0301SN0007
Modulation/Data Rate: **All data rates investigated, only worst case data reported.**

Antenna type: Integral Trace
Antenna Gain: 2.6dBi

Duty Cycle: 100%
Test Method: ANSI C63.10 (2013), KDB 558074 v04 (April 5, 2017)
Temperature (ºC): 19
Relative Humidity (%): 45
Bothell Lab Bench

Setup:
The EUT is DC powered through a power supply to vary the voltage. The EUT is connected to an external GNSS active antenna which is located remotely with an open view of the sky. The active antenna is powered by a Bias Tee coupler and the signal strength is tuned with an amplifier and output DC power supply. The Bias Tee coupler is powered by a dual output power supply. The EUT is connected to a support laptop via Ethernet and the 2 x USB ports. The 26Pin IO contained 1 x CAN Interface and 3 x RS-232 ports. The CAN Interface is connected to the laptop via a CAN USB Adapter with a Terminator Resistor on the adapter side. The RS-232 ports which were connected to a serial to USB 4 port hub which is then connected to the laptop.

Investigated EUT is continuously transmitting. Low, Mid, and High channels as well as all data rates investigated, worst case data reported. The EUT is fully exercised with communication and data transfer between the EUT and support laptop. The EUT was fitted with a temporary antenna port for direct conducted measurements. Also investigated EUT in receive only mode.


Novatel WO#: 100173 Sequence#: 13 Date: 8/10/2017
15.247(d) Conducted Spurious Emissions Test Lead: 13.2VDC RF Output
120
100
80
60
40
20
dBµV
1
90k
100k
1M
10M
100M
1G
10G24.835G
Frequency [k=kHz M=MHz G=GHz]
Readings
Peak Readings
1 - 15.247(d) Conducted Spurious Emissions
Software Version: 5.03.02

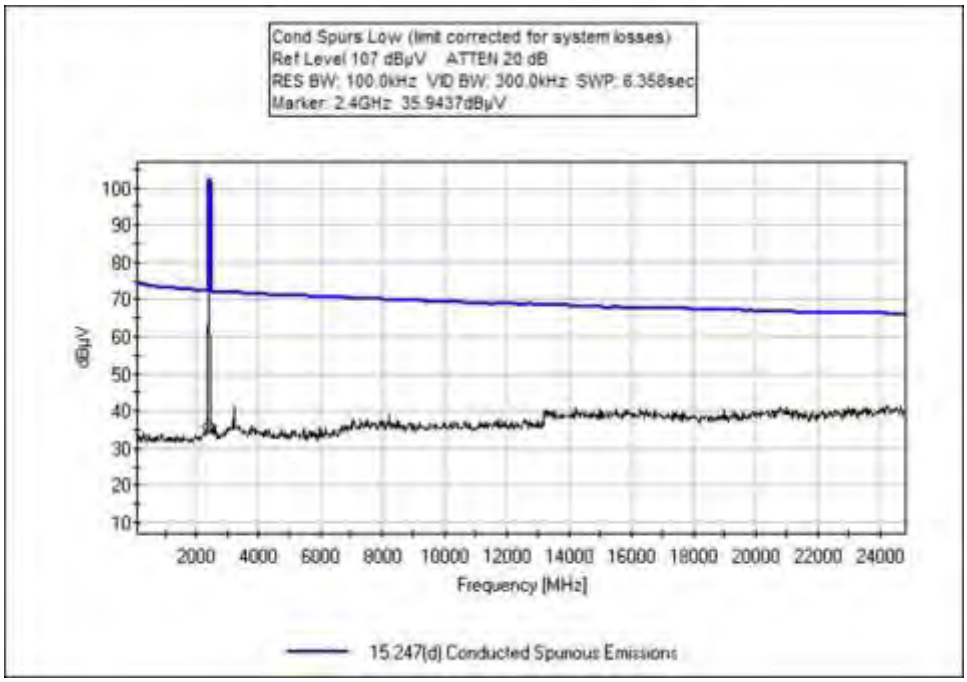
Test Equipment:

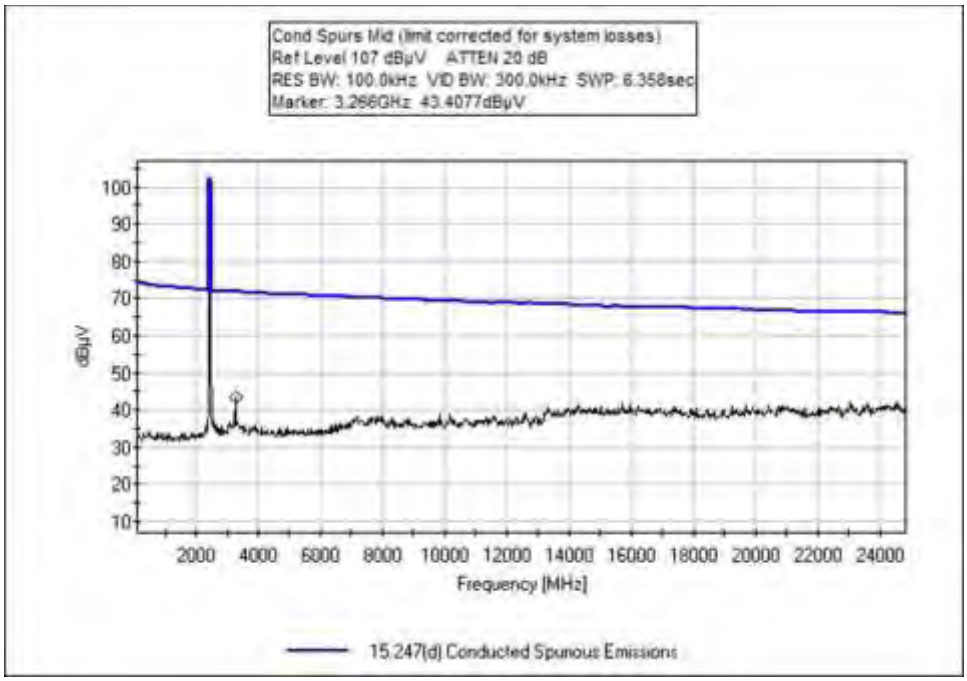
ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02871	Spectrum Analyzer	E4440A	2/24/2017	2/24/2019
T1	ANP06678	Cable	32026-29801-29801-144	9/19/2016	9/19/2018
T2	ANP06241	Attenuator	54A-10	3/28/2016	3/28/2018
T3	ANP05748	Attenuator	PE7004-20	4/11/2016	4/11/2018
T4	ANP06518	Cable	Heliax	1/21/2016	1/21/2018

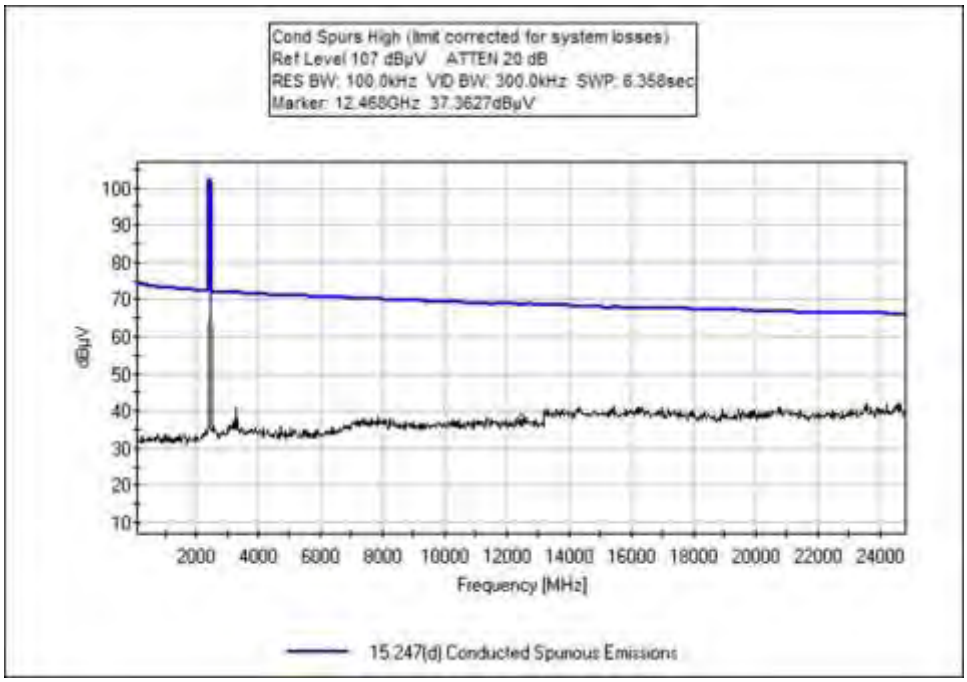
Measurement Data: Reading listed by margin. Test Lead: RF Output

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	3317.000M	37.4	+0.0	+0.0	+20.2	+1.7	+0.0	59.3	84.7	-25.4	RF Ou
2	22878.555 M	40.7	+8.4	+10.0	+0.0	+0.0	+0.0	59.1	84.7	-25.6	RF Ou
3	5379.000M	36.0	+0.0	+0.0	+20.3	+2.4	+0.0	58.7	84.7	-26.0	RF Ou
4	3353.000M	36.2	+0.0	+0.0	+20.2	+1.7	+0.0	58.1	84.7	-26.6	RF Ou
5	3260.000M	45.3	+3.1	+9.7	+0.0	+0.0	+0.0	58.1	84.7	-26.6	RF Ou
6	170.559k	36.9	+0.0	+0.0	+20.1	+0.1	+0.0	57.1	84.7	-27.6	RF Ou
7	3.210M	34.6	+0.0	+0.0	+20.1	+0.1	+0.0	54.8	84.7	-29.9	RF Ou
8	3217.000M	41.2	+3.1	+9.7	+0.0	+0.0	+0.0	54.0	84.7	-30.7	RF Ou
9	52.400M	33.1	+0.0	+0.0	+20.0	+0.3	+0.0	53.4	84.7	-31.3	RF Ou
10	3208.000M	40.3	+3.1	+9.7	+0.0	+0.0	+0.0	53.1	84.7	-31.6	RF Ou

Plots


Cond Spurs Low (limit corrected for system losses)
Ref Level 107 dBµV ATTEN 20 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 6.358sec
Marker: 2.4GHz 35.9437dBµV
dBµV
Frequency [MHz]
15.247(d) Conducted Spurious Emissions

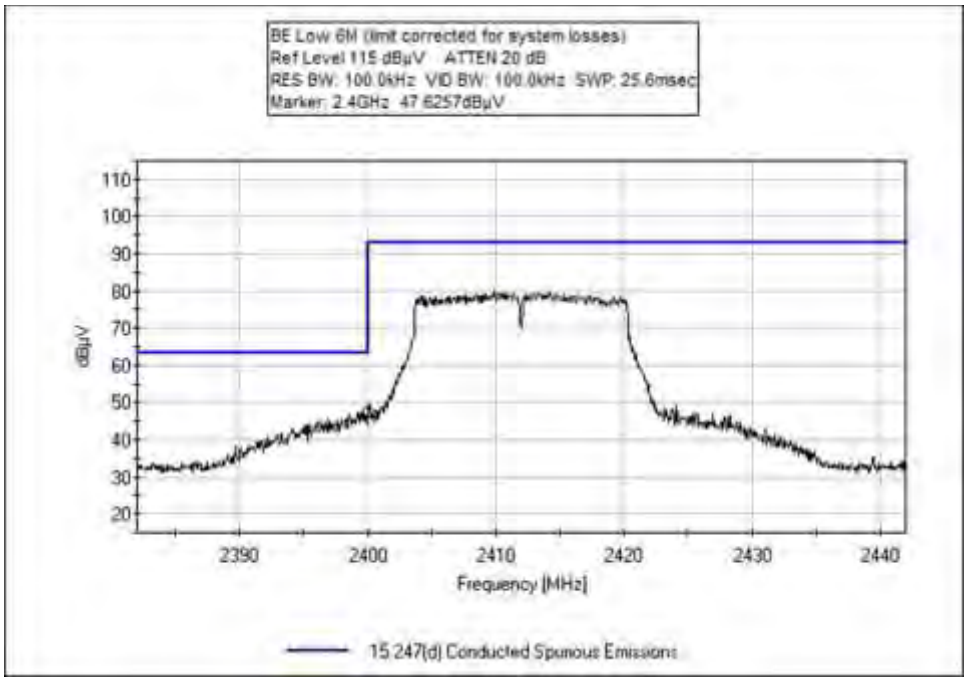

Cond Spurs Mid (limit corrected for system losses)
Ref Level 107 dBµV ATTEN 20 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 6.358sec
Marker: 3.266GHz 43.4077dBµV
dBµV
Frequency [MHz]
15.247(d) Conducted Spurious Emissions

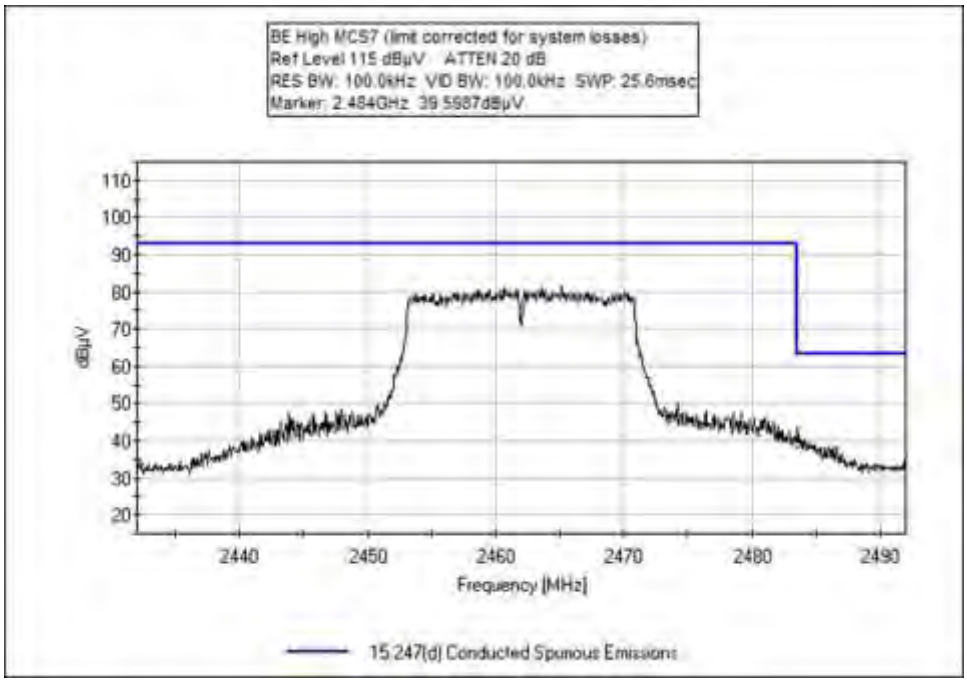

Cond Spurs High (limit corrected for system losses)
Ref Level 107 dBµV ATTEN 20 dB
RES BW: 100.0kHz VID BW: 300.0kHz SWP: 6.358sec
Marker: 12.468GHz 37.3627dBµV
dBµV
100
90
80
70
60
50
40
30
20
10
2000 4000 6000 8000 10000 12000 14000 16000 18000 20000 22000 24000
Frequency [MHz]
15.247(d) Conducted Spurious Emissions

Band Edge

Band Edge Summary				
Limit applied: Max Power/100kHz - 30dB (When average power limit is applied).				
Frequency (MHz)	**Modulation**	**Measured (dBm)**	**Limit (dBm)**	**Results**
2400.0	6M Data Rate (OFDM/BPSK) (Worst Case)	-37.8	<-22.3	Pass
2483.5	MCS7 Data Rate (64-QAM) (Worst Case)	-45.7	<-22.3	Pass

Band Edge Plots





Test Setup / Conditions / Data

Test Location:	CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)		
Customer:	**Novatel**		
Specification:	**15.247(d) Conducted Spurious Emissions**		
Work Order #:	**100173**	Date:	8/10/2017
Test Type:	**Conducted Emissions**	Time:	15:30:01
Tested By:	Michael Atkinson	Sequence#:	12
Software:	EMITest 5.03.02		13.2VDC

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 2			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 2			

Test Conditions / Notes:

Frequency Range: Band Edge
Frequency tested: 2412, 2442, 2462MHz
Firmware power setting: Max
EUT Firmware: OM7CR0301SN0007
Modulation/Data Rate: **All data rates investigated, only worst case data reported.**

Antenna type: Integral Trace
Antenna Gain : 2.6dBi

Duty Cycle: 100%
Bothell Lab Bench
Test Method: ANSI C63.10 (2013)
Temperature (ºC): 19
Relative Humidity (%): 45

Setup:
The EUT is DC powered through a power supply to vary the voltage. The EUT is connected to an external GNSS active antenna which is located remotely with an open view of the sky. The active antenna is powered by a Bias Tee coupler and the signal strength is tuned with an amplifier and output DC power supply. The Bias Tee coupler is powered by a dual output power supply. The EUT is connected to a support laptop via Ethernet and the 2 x USB ports. The 26Pin IO contained 1 x CAN Interface and 3 x RS-232 ports. The CAN Interface is connected to the laptop via a CAN USB Adapter with a Terminator Resistor on the adapter side. The RS-232 ports which were connected to a serial to USB 4 port hub which is then connected to the laptop.

The EUT is continuously transmitting. Low, Mid, and High channels as well as all data rates investigated, worst case data reported. The EUT is fully exercised with communication and data transfer between the EUT and support laptop. The EUT was fitted with a temporary antenna port for direct conducted measurements.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	ANP05748	Attenuator	PE7004-20	4/11/2016	4/11/2018
T2	ANP06518	Cable	Heliax	1/21/2016	1/21/2018
T3	AN02871	Spectrum Analyzer	E4440A	2/24/2017	2/24/2019

Measurement Data: Reading listed by margin. Test Lead: RF Output

#	Freq MHz	Rdng dBµV	T1 dB	T2 dB	T3 dB	dB	Dist Table	Corr dBµV	Spec dBµV	Margin dB	Polar Ant
1	2400.000M	47.6	+20.1	+1.5	+0.0		+0.0	69.2	84.7	-15.5	RF Ou
									6M		
2	2483.500M	39.6	+20.1	+1.5	+0.0		+0.0	61.2	84.7	-23.5	RF Ou
									MCS7		

Test Setup Photo

15.247(d) Radiated Emissions & Band Edge

Test Setup / Conditions / Data

Test Location:	CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)		
Customer:	**Novatel**		
Specification:	**15.209 Radiated Emissions**		
Work Order #:	**100174**	Date:	8/7/2017
Test Type:	**Maximized Emissions**	Time:	16:11:36
Tested By:	Michael Atkinson	Sequence#:	5
Software:	EMITest 5.03.02		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Frequency Range: 9kHz-24.835GHz
Frequency tested: 2412, 2442, 2462MHz
Firmware power setting: Max
EUT Firmware: OM7CR0301SN0007
Modulation/Data Rate: **All data rates investigated, only worst case data reported**

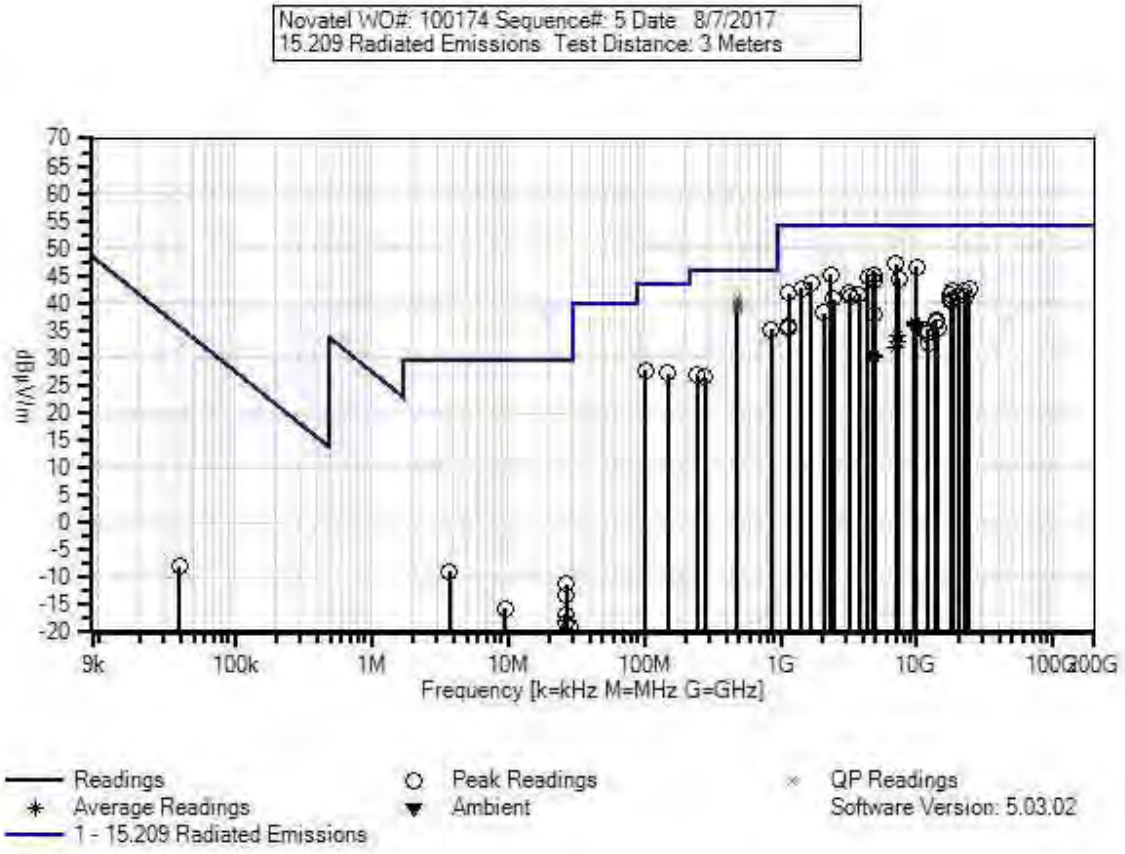
Antenna type: Integral Trace
Antenna Gain: 2.6dBi

Duty Cycle: 100%

Setup:
The EUT is DC powered through a battery. The EUT is connected to an external GNSS active antenna which is located remotely with an open view of the sky. The active antenna is powered by a Bias Tee coupler and the signal strength is tuned with an amplifier and output DC power supply. The Bias Tee coupler is powered by a dual output power supply. The EUT is connected to a support laptop via Ethernet and the 2 x USB ports. The 26Pin IO contained 1 x CAN Interface and 3 x RS-232 ports. The CAN Interface is connected to the laptop via a CAN USB Adapter with a Terminator Resistor on the adapter side. The RS-232 ports which were connected to a serial to USB 4 port hub which is then connected to the laptop.

EUT is continuously transmitting. Low, Mid, and High channels as well as all data rates investigated, worst case data reported. Horizontal and Vertical antenna polarities investigated, only worst case reported. The EUT is fully exercised with communication and data transfer between the EUT and support laptop. Below 1GHz: the EUT is on the test table 80cm high. Above 1GHz: The EUT is on the test table 150cm high. EUT connected to the internal trace antenna. Also investigated the EUT in receive only mode.

Test Method: ANSI C63.10 (2013), KDB 558074 v04 (April 5, 2017)
Temperature (ºC): 23-26
Relative Humidity (%): 35-41
Bothell Lab C3


Novatel WO#: 100174 Sequence#: 5 Date: 8/7/2017
15.209 Radiated Emissions Test Distance: 3 Meters
dBµV/m
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
-20
9k
100k
1M
10M
100M
1G
10G
100G
Frequency [k=kHz M=MHz G=GHz]
Readings
Average Readings
1 - 15.209 Radiated Emissions
Peak Readings
Ambient
QP Readings
Software Version: 5.03.02

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02872	Spectrum Analyzer	E4440A	11/18/2015	11/18/2017
T2	ANP06540	Cable	Heliax	10/29/2015	10/29/2017
T3	ANP05963	Cable	RG-214	2/15/2016	2/15/2018
T4	ANP05360	Cable	RG214	11/30/2016	11/30/2018
T5	AN02307	Preamp	8447D	2/15/2016	2/15/2018
T6	ANP06123	Attenuator	18N-6	5/5/2017	5/5/2019
T7	AN03628	Biconilog Antenna	3142E	6/7/2017	6/7/2019
T8	ANP05305	Cable	ETSI-50T	2/15/2016	2/15/2018
T9	AN00052	Loop Antenna	6502	4/8/2016	4/8/2018
T10	AN03540	Preamp	83017A	5/2/2017	5/2/2019
T11	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	8/12/2015	8/12/2017
T12	ANP06935	Cable	32026-29801-29801-18	3/11/2016	3/11/2018
T13	ANP06124	Attenuator	18N-6	5/5/2017	5/5/2019
T14	AN03116	High Pass Filter	11SH10-00313	1/16/2017	1/16/2019
T15	AN02741	Active Horn Antenna	AMFW-5F-12001800-20-10P	3/30/2017	3/30/2019
T16	AN02742	Active Horn Antenna	AMFW-5F-18002650-20-10P	10/7/2016	10/7/2018
T17	ANP06678	Cable	32026-29801-29801-144	9/19/2016	9/19/2018
T18	AN03122	Cable	32026-2-29801-36	4/28/2016	4/28/2018
T19	AN02763-69	Waveguide	Multiple	7/14/2017	7/14/2019

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5 T9 T13 T17	T2 T6 T10 T14 T18	T3 T7 T11 T15 T19	T4 T8 T12 T16	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	480.004M	40.9	+0.0	+0.3	+1.9	+1.4	+0.0	40.7	46.0	-5.3	Horiz
	QP		-28.0	+5.9	+18.3	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
2	479.997M	40.1	+0.0	+0.3	+1.9	+1.4	+0.0	39.9	46.0	-6.1	Horiz
	QP		-28.0	+5.9	+18.3	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
3	480.010M	39.6	+0.0	+0.3	+1.9	+1.4	+0.0	39.4	46.0	-6.6	Vert
	QP		-28.0	+5.9	+18.3	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
^	480.100M	39.6	+0.0	+0.3	+1.9	+1.4	+0.0	39.4	46.0	-6.6	Vert
			-28.0	+5.9	+18.3	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
5	480.002M	39.4	+0.0	+0.3	+1.9	+1.4	+0.0	39.2	46.0	-6.8	Horiz
	QP		-28.0	+5.9	+18.3	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
^	479.976M	42.5	+0.0	+0.3	+1.9	+1.4	+0.0	42.3	46.0	-3.7	Horiz
			-28.0	+5.9	+18.3	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
^	479.988M	41.4	+0.0	+0.3	+1.9	+1.4	+0.0	41.2	46.0	-4.8	Horiz
			-28.0	+5.9	+18.3	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
^	480.100M	40.5	+0.0	+0.3	+1.9	+1.4	+0.0	40.3	46.0	-5.7	Horiz
			-28.0	+5.9	+18.3	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
^	480.100M	40.2	+0.0	+0.3	+1.9	+1.4	+0.0	40.0	46.0	-6.0	Horiz
			-28.0	+5.9	+18.3	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						

10	6994.000M	39.8	+0.0	+1.2	+0.0	+0.0	+0.0	47.1	54.0	-6.9	Vert
			+0.0	+0.0	+0.0	+4.3			Receive Mode		
			+0.0	-33.8	+34.9	+0.7					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
11	9848.650M	34.1	+0.0	+1.4	+0.0	+0.0	+0.0	46.6	54.0	-7.4	Horiz
			+0.0	+0.0	+0.0	+6.1			High		
			+0.0	-33.6	+37.3	+0.7					
			+0.0	+0.6	+0.0	+0.0					
			+0.0	+0.0	+0.0						
12	2322.000M	41.9	+0.0	+0.6	+0.0	+0.0	+0.0	45.2	54.0	-8.8	Horiz
			+0.0	+0.0	+0.0	+2.8					
			+0.0	-34.1	+27.7	+0.4					
			+5.9	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
13	4824.160M	39.0	+0.0	+0.9	+0.0	+0.0	+0.0	45.2	54.0	-8.8	Horiz
			+0.0	+0.0	+0.0	+4.3			Low		
			+0.0	-33.2	+32.7	+0.5					
			+0.0	+1.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
14	4393.000M	40.0	+0.0	+0.9	+0.0	+0.0	+0.0	44.6	54.0	-9.4	Vert
			+0.0	+0.0	+0.0	+4.1			Receive Mode		
			+0.0	-33.1	+32.2	+0.5					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
15	7386.650M	34.8	+0.0	+1.3	+0.0	+0.0	+0.0	44.5	54.0	-9.5	Horiz
			+0.0	+0.0	+0.0	+4.8			High		
			+0.0	-34.3	+36.4	+0.6					
			+0.0	+0.9	+0.0	+0.0					
			+0.0	+0.0	+0.0						
16	4924.650M	37.7	+0.0	+0.9	+0.0	+0.0	+0.0	44.1	54.0	-9.9	Horiz
			+0.0	+0.0	+0.0	+4.4			High		
			+0.0	-33.2	+32.8	+0.5					
			+0.0	+1.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
17	1692.000M	43.0	+0.0	+0.5	+0.0	+0.0	+0.0	43.7	54.0	-10.3	Horiz
			+0.0	+0.0	+0.0	+2.4					
			+0.0	-34.7	+26.3	+0.3					
			+5.9	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
18	858.400M	29.3	+0.0	+0.3	+2.3	+2.0	+0.0	35.2	46.0	-10.8	Vert
			-27.6	+5.9	+23.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
19	1432.000M	43.9	+0.0	+0.5	+0.0	+0.0	+0.0	42.7	54.0	-11.3	Horiz
			+0.0	+0.0	+0.0	+2.2					
			+0.0	-35.1	+25.0	+0.3					
			+5.9	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						

20	24043.000 M	43.1	+0.0 +0.0 +0.0 +0.0 +8.5	+0.0 +0.0 +0.0 +0.0 +2.4	+0.0 +0.0 +0.0 +0.0 +1.0	+0.0 +0.0 +0.0 -12.5	+0.0	42.5	54.0	-11.5	Vert
21	22142.000 M	44.5	+0.0 +0.0 +0.0 +0.0 +8.3	+0.0 +0.0 +0.0 +0.0 +2.3	+0.0 +0.0 +0.0 +0.0 +1.5	+0.0 +0.0 +0.0 -14.4	+0.0	42.2	54.0	-11.8	Vert
22	17824.000 M	40.2	+0.0 +0.0 +0.0 +0.0 +0.0	+2.1 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 -9.2 +0.0	+0.0 +9.0 +0.0 +0.0	+0.0	42.1	54.0	-11.9	Vert
23	3178.000M	41.4	+0.0 +0.0 +0.0 +0.0 +0.0	+0.7 +0.0 -33.6 +0.0 +0.0	+0.0 +0.0 +29.7 +0.0 +0.0	+0.0 +3.3 +0.4 +0.0	+0.0	41.9	54.0	-12.1	Horiz
24	1154.000M	45.1	+0.0 +0.0 +0.0 +5.9 +0.0	+0.4 +0.0 -36.1 +0.0 +0.0	+0.0 +0.0 +24.2 +0.0 +0.0	+0.0 +2.0 +0.3 +0.0	+0.0	41.8	54.0	-12.2	Horiz
25	3781.000M	39.7	+0.0 +0.0 +0.0 +0.0 +0.0	+0.7 +0.0 -33.4 +0.0 +0.0	+0.0 +0.0 +30.3 +0.0 +0.0	+0.0 +3.8 +0.5 +0.0	+0.0	41.6	54.0	-12.4	Horiz
26	17760.000 M	39.6	+0.0 +0.0 +0.0 +0.0 +0.0	+2.1 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 -9.4 +0.0	+0.0 +9.1 +0.0 +0.0	+0.0	41.4	54.0	-12.6	Vert
27	3252.000M	39.5	+0.0 +0.0 +0.0 +0.0 +0.0	+0.7 +0.0 -33.5 +1.1 +0.0	+0.0 +0.0 +29.6 +0.0 +0.0	+0.0 +3.4 +0.4 +0.0	+0.0	41.2	54.0	-12.8	Horiz
28	22503.000 M	43.7	+0.0 +0.0 +0.0 +0.0 +8.4	+0.0 +0.0 +0.0 +0.0 +2.3	+0.0 +0.0 +0.0 +0.0 +1.4	+0.0 +0.0 +0.0 -14.6	+0.0	41.2	54.0	-12.8	Horiz
29	20007.000 M	41.9	+0.0 +0.0 +0.0 +0.0 +7.9	+0.0 +0.0 +0.0 +0.0 +2.1	+0.0 +0.0 +0.0 +0.0 +1.6	+0.0 +0.0 +0.0 -12.5	+0.0	41.0	54.0	-13.0	Vert

30	2431.000M	43.3	+0.0 +0.0 +0.0 +0.0 +0.0	+0.6 +0.0 -34.0 +0.0 +0.0	+0.0 +0.0 +27.7 +0.0 +0.0	+0.0 +2.8 +0.4 +0.0	+0.0	40.8	54.0 Receive Mode	-13.2	Vert
31	17520.000 M	39.9	+0.0 +0.0 +0.0 +0.0 +0.0	+2.1 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 -10.3 +0.0	+0.0 +8.9 +0.0 +0.0	+0.0	40.6	54.0	-13.4	Horiz
32	18268.000 M	41.7	+0.0 +0.0 +0.0 +0.0 +7.5	+0.0 +0.0 +0.0 +0.0 +2.0	+0.0 +0.0 +0.0 +0.0 +2.0	+0.0 +0.0 +0.0 -12.9	+0.0	40.3	54.0	-13.7	Vert
33	2080.000M	41.2	+0.0 +0.0 +0.0 +0.0 +0.0	+0.6 +0.0 -34.2 +0.0 +0.0	+0.0 +0.0 +27.7 +0.0 +0.0	+0.0 +2.6 +0.3 +0.0	+0.0	38.2	54.0	-15.8	Horiz
34	101.800M	39.5	+0.0 -27.7 +0.0 +0.0 +0.0	+0.1 +5.9 +0.0 +0.0 +0.0	+1.2 +8.1 +0.0 +0.0 +0.0	+0.6 +0.0 +0.0 +0.0	+0.0	27.7	43.5	-15.8	Vert
35	4871.700M	31.9	+0.0 +0.0 +0.0 +0.0 +0.0	+0.9 +0.0 -33.2 +1.0 +0.0	+0.0 +0.0 +32.7 +0.0 +0.0	+0.0 +4.3 +0.5 +0.0	+0.0	38.1	54.0 Mid	-15.9	Horiz
36	148.300M	37.7	+0.0 -27.5 +0.0 +0.0 +0.0	+0.2 +5.9 +0.0 +0.0 +0.0	+1.3 +8.9 +0.0 +0.0 +0.0	+0.7 +0.0 +0.0 +0.0	+0.0	27.2	43.5	-16.3	Vert
37	13760.000 M	42.3	+0.0 +0.0 +0.0 +0.0 +0.0	+1.8 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 -14.4 +0.0	+0.0 +7.3 +0.0 +0.0	+0.0	37.0	54.0	-17.0	Horiz
38	9648.350M Ave	23.7	+0.0 +0.0 +0.0 +0.0 +0.0	+1.5 +0.0 -33.6 +0.9 +0.0	+0.0 +0.0 +37.3 +0.0 +0.0	+0.0 +6.1 +0.7 +0.0	+0.0	36.6	54.0 Low	-17.4	Horiz
^	9648.350M	34.6	+0.0 +0.0 +0.0 +0.0 +0.0	+1.5 +0.0 -33.6 +0.9 +0.0	+0.0 +0.0 +37.3 +0.0 +0.0	+0.0 +6.1 +0.7 +0.0	+0.0	47.5	54.0 Low	-6.5	Horiz

40	13704.000 M	41.8	+0.0 +0.0 +0.0 +0.0 +0.0	+1.8 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 -14.4 +0.0	+0.0 +7.3 +0.0 +0.0	+0.0	36.5	54.0	-17.5	Vert
41	9748.900M Ave	23.7	+0.0 +0.0 +0.0 +0.0 +0.0	+1.4 +0.0 -33.6 +0.6 +0.0	+0.0 +0.0 +37.3 +0.0 +0.0	+0.0 +6.1 +0.7 +0.0	+0.0	36.2	54.0 Mid	-17.8	Horiz
^	9748.900M	32.2	+0.0 +0.0 +0.0 +0.0 +0.0	+1.4 +0.0 -33.6 +0.6 +0.0	+0.0 +0.0 +37.3 +0.0 +0.0	+0.0 +6.1 +0.7 +0.0	+0.0	44.7	54.0 Mid	-9.3	Horiz
43	9613.000M Ave	23.7	+0.0 +0.0 +0.0 +0.0 +0.0	+1.5 +0.0 -33.5 +0.0 +0.0	+0.0 +0.0 +37.4 +0.0 +0.0	+0.0 +6.1 +0.8 +0.0	+0.0	36.0	54.0 Receive Mode	-18.0	Horiz
^	9613.000M	36.9	+0.0 +0.0 +0.0 +0.0 +0.0	+1.5 +0.0 -33.5 +0.0 +0.0	+0.0 +0.0 +37.4 +0.0 +0.0	+0.0 +6.1 +0.8 +0.0	+0.0	49.2	54.0 Receive Mode	-4.8	Horiz
45	1144.000M	45.1	+0.0 +0.0 +0.0 +0.0 +0.0	+0.4 +0.0 -36.1 +0.0 +0.0	+0.0 +0.0 +24.2 +0.0 +0.0	+0.0 +2.0 +0.3 +0.0	+0.0	35.9	54.0	-18.1	Vert
46	1153.000M	44.9	+0.0 +0.0 +0.0 +0.0 +0.0	+0.4 +0.0 -36.1 +0.0 +0.0	+0.0 +0.0 +24.2 +0.0 +0.0	+0.0 +2.0 +0.3 +0.0	+0.0	35.7	54.0	-18.3	Horiz
47	14216.000 M	40.7	+0.0 +0.0 +0.0 +0.0 +0.0	+1.9 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 -14.7 +0.0	+0.0 +7.7 +0.0 +0.0	+0.0	35.6	54.0	-18.4	Vert
48	11920.000 M	40.4	+0.0 +0.0 +0.0 +0.0 +0.0	+1.5 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 -13.2 +0.0	+0.0 +6.5 +0.0 +0.0	+0.0	35.2	54.0	-18.8	Vert
49	244.400M	33.1	+0.0 -27.1 +0.0 +0.0 +0.0	+0.2 +5.9 +0.0 +0.0 +0.0	+1.5 +12.3 +0.0 +0.0 +0.0	+0.9 +0.0 +0.0 +0.0	+0.0	26.8	46.0	-19.2	Horiz

50	12186.650 M	39.9	+0.0 +0.0 +0.0 +0.0 +0.0	+1.5 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 -13.1 +0.0	+0.0 +6.5 +0.0 +0.0	+0.0	34.8	54.0	-19.2	Vert
51	11920.000 M	39.8	+0.0 +0.0 +0.0 +0.0 +0.0	+1.5 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 -13.2 +0.0	+0.0 +6.5 +0.0 +0.0	+0.0	34.6	54.0	-19.4	Horiz
52	281.200M	32.5	+0.0 -27.0 +0.0 +0.0 +0.0	+0.2 +5.9 +0.0 +0.0 +0.0	+1.6 +12.4 +0.0 +0.0 +0.0	+1.0 +0.0 +0.0 +0.0	+0.0	26.6	46.0	-19.4	Horiz
53	11984.000 M	39.9	+0.0 +0.0 +0.0 +0.0 +0.0	+1.5 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 -13.3 +0.0	+0.0 +6.4 +0.0 +0.0	+0.0	34.5	54.0	-19.5	Vert
54	7312.850M Ave	24.7	+0.0 +0.0 +0.0 +0.0 +0.0	+1.2 +0.0 -34.1 +1.0 +0.0	+0.0 +0.0 +36.1 +0.0 +0.0	+0.0 +4.7 +0.6 +0.0	+0.0	34.2	54.0 Mid	-19.8	Horiz
^	7312.850M	32.7	+0.0 +0.0 +0.0 +0.0 +0.0	+1.2 +0.0 -34.1 +1.0 +0.0	+0.0 +0.0 +36.1 +0.0 +0.0	+0.0 +4.7 +0.6 +0.0	+0.0	42.2	54.0 Mid	-11.8	Horiz
56	7240.050M Ave	24.7	+0.0 +0.0 +0.0 +0.0 +0.0	+1.2 +0.0 -33.9 +1.0 +0.0	+0.0 +0.0 +35.8 +0.0 +0.0	+0.0 +4.6 +0.6 +0.0	+0.0	34.0	54.0 Low	-20.0	Horiz
^	7240.050M	38.3	+0.0 +0.0 +0.0 +0.0 +0.0	+1.2 +0.0 -33.9 +1.0 +0.0	+0.0 +0.0 +35.8 +0.0 +0.0	+0.0 +4.6 +0.6 +0.0	+0.0	47.6	54.0 Low	-6.4	Horiz
58	7282.000M Ave	24.7	+0.0 +0.0 +0.0 +0.0 +0.0	+1.2 +0.0 -34.0 +0.0 +0.0	+0.0 +0.0 +36.0 +0.0 +0.0	+0.0 +4.6 +0.6 +0.0	+0.0	33.1	54.0	-20.9	Horiz
^	7282.000M	38.5	+0.0 +0.0 +0.0 +0.0 +0.0	+1.2 +0.0 -34.0 +0.0 +0.0	+0.0 +0.0 +36.0 +0.0 +0.0	+0.0 +4.6 +0.6 +0.0	+0.0	46.9	54.0	-7.1	Horiz

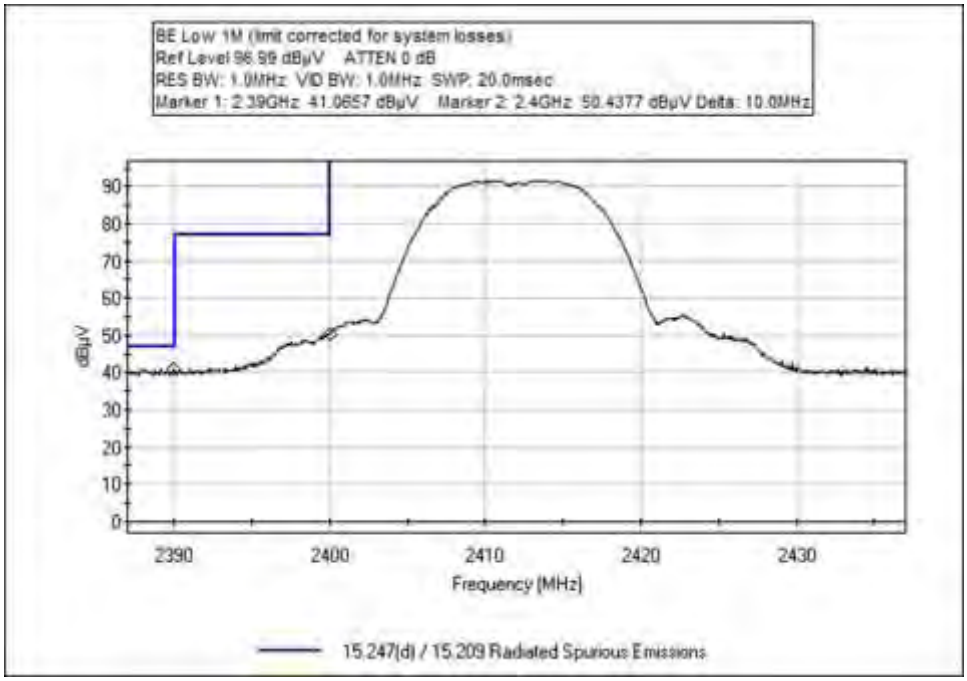
60	12059.400 M	38.2	+0.0 +0.0 +0.0 +0.0 +0.0	+1.5 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 -13.3 +0.0	+0.0 +6.4 +0.0 +0.0	+0.0	32.8	54.0	-21.2	Vert
61	6994.000M Ave	24.5	+0.0 +0.0 +0.0 +0.0 +0.0	+1.2 +0.0 -33.8 +0.0 +0.0	+0.0 +0.0 +34.9 +0.0 +0.0	+0.0 +4.3 +0.7 +0.0	+0.0	31.8	54.0 Receive Mode	-22.2	Horiz
62	4823.800M Ave	24.4	+0.0 +0.0 +0.0 +0.0 +0.0	+0.9 +0.0 -33.2 +1.0 +0.0	+0.0 +0.0 +32.7 +0.0 +0.0	+0.0 +4.3 +0.5 +0.0	+0.0	30.6	54.0 Low	-23.4	Horiz
63	4876.450M Ave	23.7	+0.0 +0.0 +0.0 +0.0 +0.0	+0.9 +0.0 -33.2 +1.0 +0.0	+0.0 +0.0 +32.7 +0.0 +0.0	+0.0 +4.4 +0.5 +0.0	+0.0	30.0	54.0 Mid	-24.0	Horiz
^	4876.450M	34.5	+0.0 +0.0 +0.0 +0.0 +0.0	+0.9 +0.0 -33.2 +1.0 +0.0	+0.0 +0.0 +32.7 +0.0 +0.0	+0.0 +4.4 +0.5 +0.0	+0.0	40.8	54.0 Mid	-13.2	Horiz
65	3.728M	21.4	+0.0 +0.0 +9.5 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.1 +0.0 +0.0	-40.0	-9.0	29.5	-38.5	Perp
66	27.160M	22.2	+0.0 +0.0 +6.4 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.3 +0.0 +0.0	-40.0	-11.1	29.5	-40.6	Groun
67	27.151M	20.1	+0.0 +0.0 +6.4 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.3 +0.0 +0.0	-40.0	-13.2	29.5	-42.7	Groun
68	39.000k	60.6	+0.0 +0.0 +11.4 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	-80.0	-8.0	35.8	-43.8	Perp
69	9.546M	15.0	+0.0 +0.0 +9.2 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0 +0.0	+0.0 +0.2 +0.0 +0.0	-40.0	-15.6	29.5	-45.1	Para

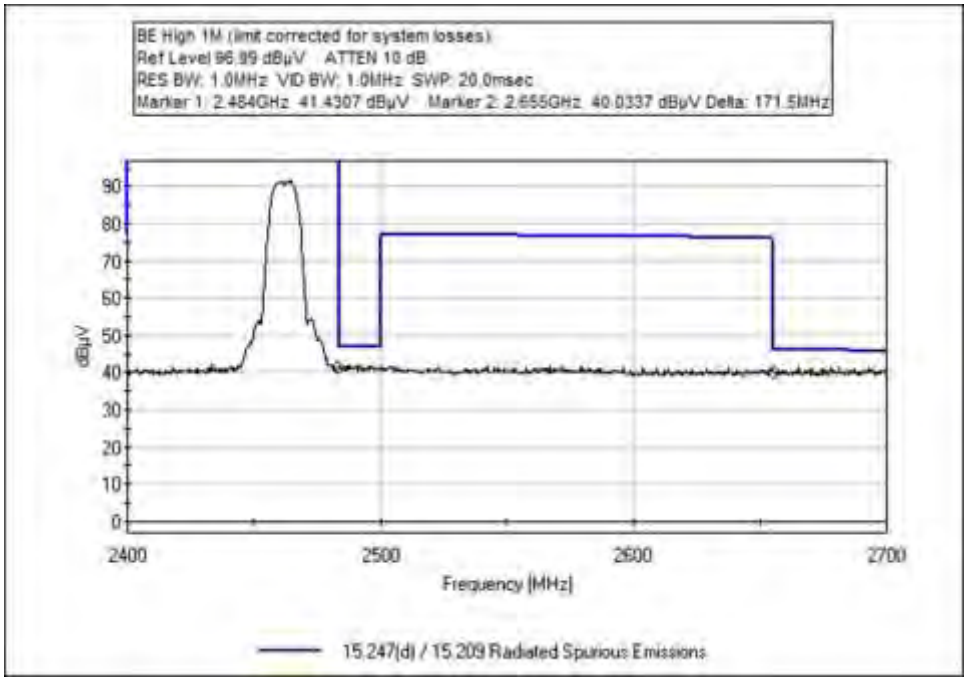
70	26.611M	16.5	+0.0	+0.0	+0.0	+0.0	-40.0	-16.7	29.5	-46.2	Groun
			+0.0	+0.0	+0.0	+0.3					
			+6.5	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
71	26.611M	15.0	+0.0	+0.0	+0.0	+0.0	-40.0	-18.2	29.5	-47.7	Para
			+0.0	+0.0	+0.0	+0.3					
			+6.5	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
72	28.350M	14.5	+0.0	+0.0	+0.0	+0.0	-40.0	-19.1	29.5	-48.6	Perp
			+0.0	+0.0	+0.0	+0.3					
			+6.1	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						
73	20.000k	42.6	+0.0	+0.0	+0.0	+0.0	-80.0	-23.6	41.6	-65.2	Para
			+0.0	+0.0	+0.0	+0.0					
			+13.8	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0						

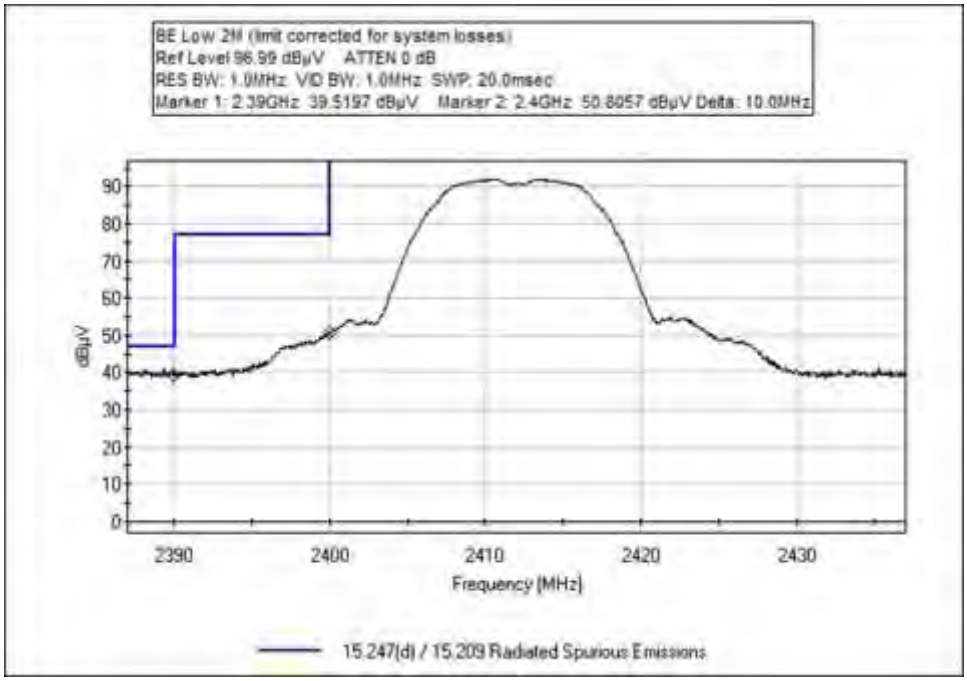
Band Edge

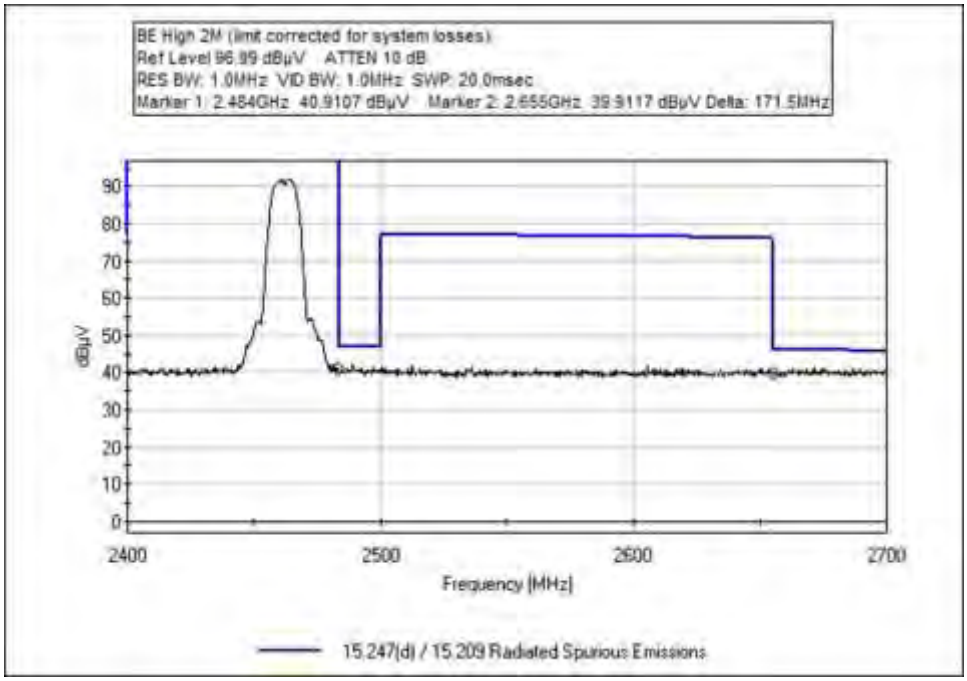
Band Edge Summary					
Frequency (MHz)	**Modulation**	**Ant. Type**	**Field Strength (dBuV/m @3m)**	**Limit (dBuV/m @3m)**	**Results**
2390.0 (PEAK)	MCS7 Data Rate - 64-QAM (Worst Case)	Integral Trace	61.1	<74	Pass
2390.0 (AVG)	MCS7 Data Rate - 64-QAM (Worst Case)	Integral Trace	40.7	<54	Pass
2400.0 (PEAK)	MCS7 Data Rate - 64-QAM (Worst Case)	Integral Trace	69.7	<104	Pass
2400.0 (AVG)	MCS7 Data Rate - 64-QAM (Worst Case)	Integral Trace	51.1	<84	Pass
2483.5 (PEAK)	6M Data Rate (OFDM)	Integral Trace	61.5	<74	Pass
2483.5 (AVG)	MCS7 Data Rate - 64-QAM (Worst Case)	Integral Trace	41.1	<54	Pass

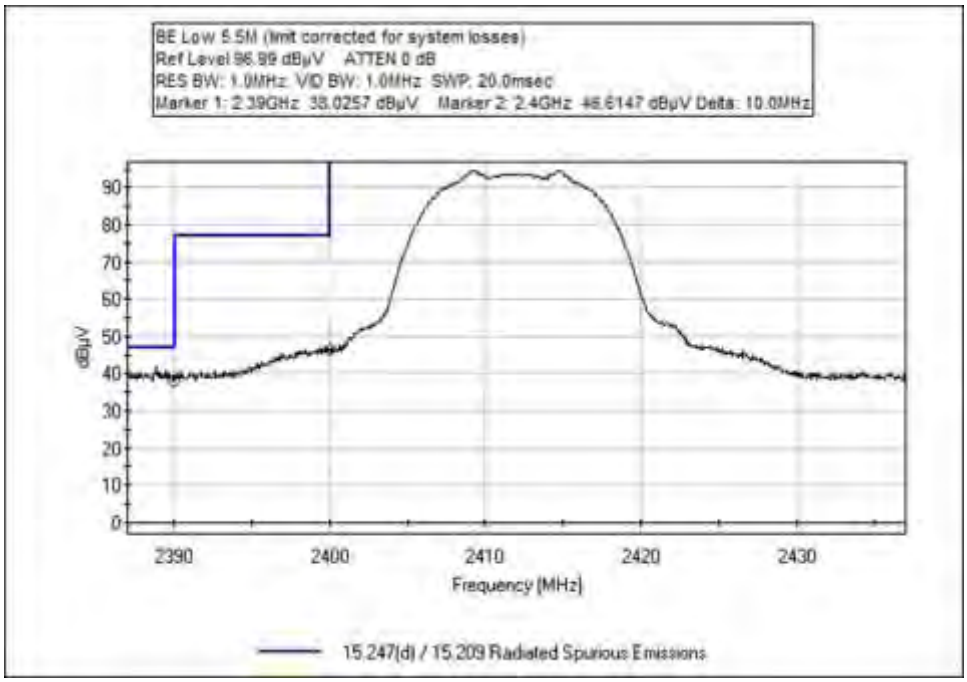
Band Edge Plots

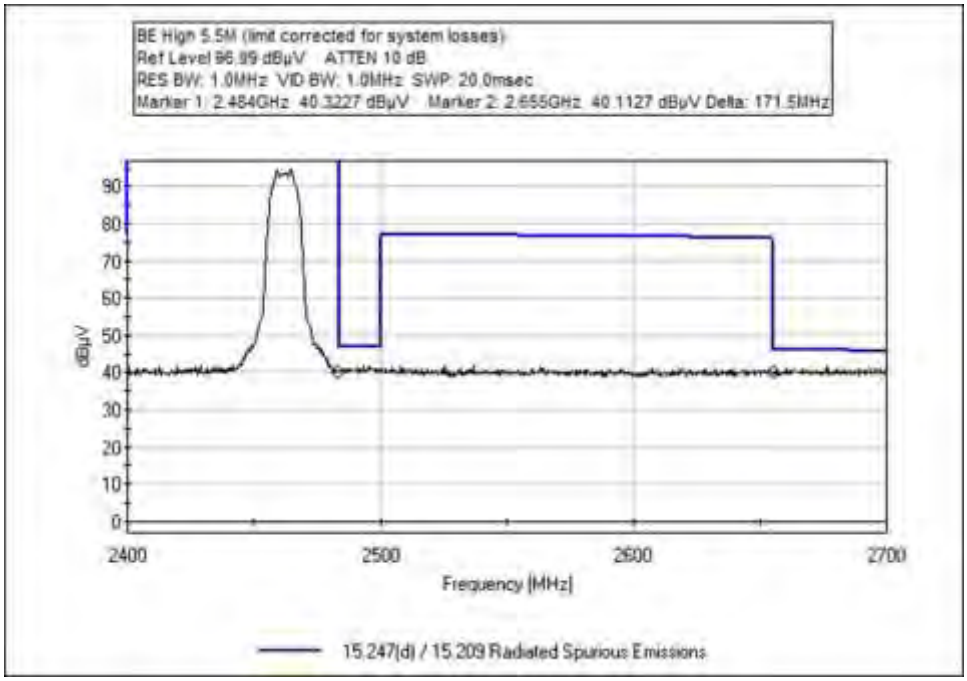


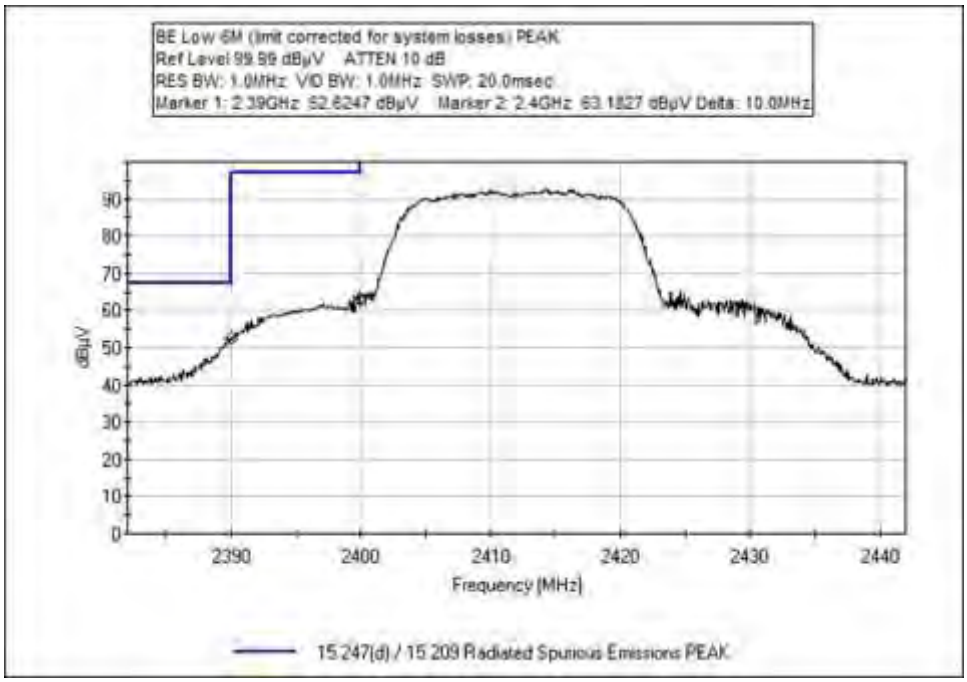


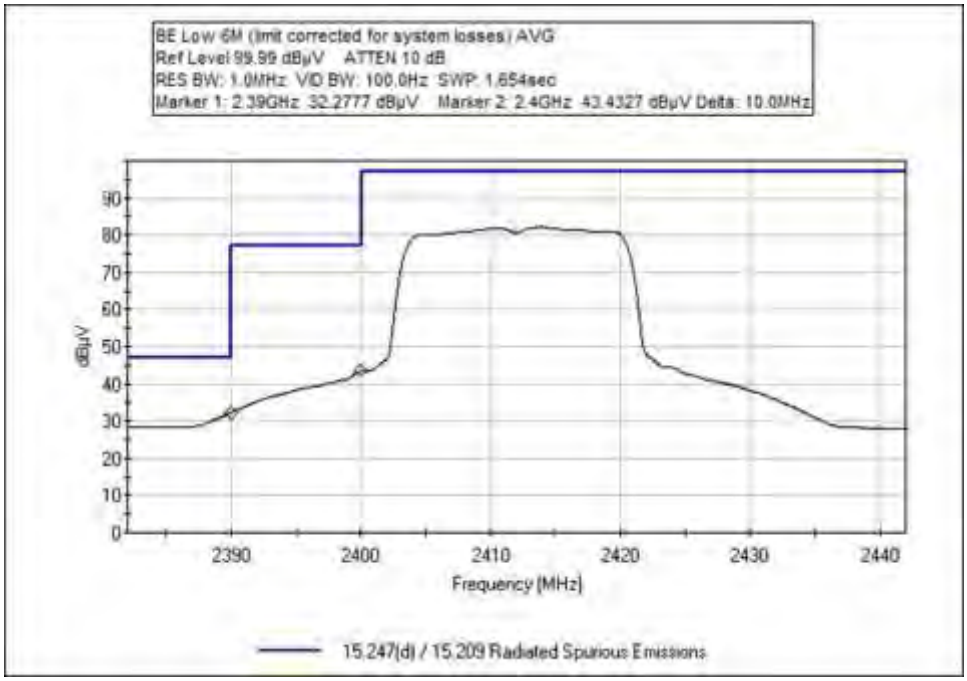

BE Low 2M (limit corrected for system losses)
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 20.0msec
Marker 1: 2.39GHz 39.5197 dBµV Marker 2: 2.4GHz 50.8057 dBµV Delta: 10.0MHz
dBµV
90
80
70
60
50
40
30
20
10
0
2390
2400
2410
2420
2430
Frequency (MHz)
15.247(d) / 15.209 Radiated Spurious Emissions

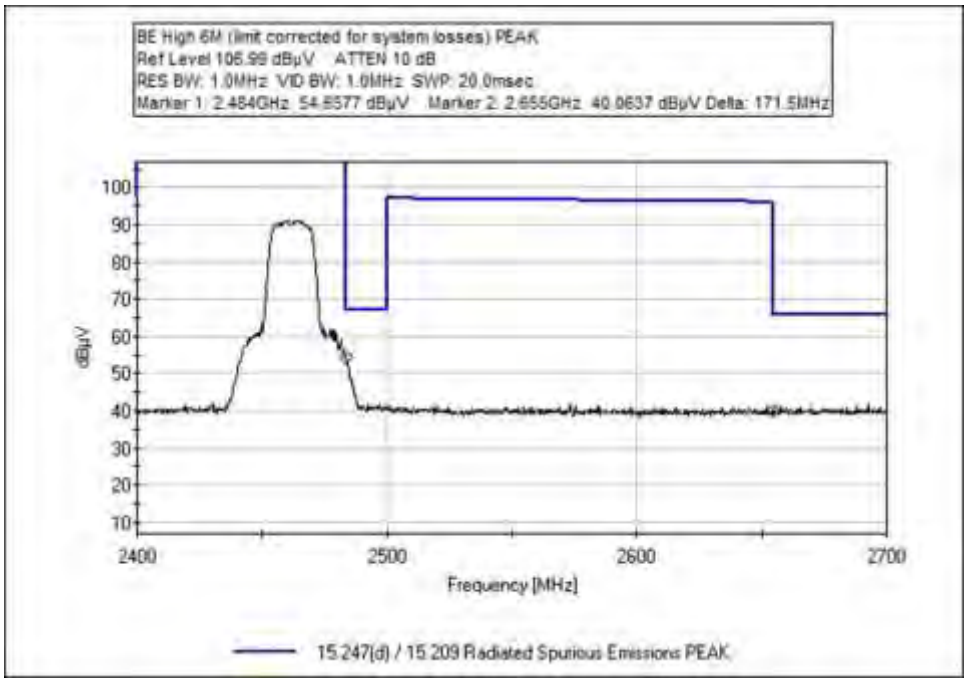

BE High 2M (limit corrected for system losses)
Ref Level 96.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 20.0msec
Marker 1: 2.484GHz 40.9107 dBµV Marker 2: 2.655GHz 39.9117 dBµV Delta: 171.5MHz
dBµV
90
80
70
60
50
40
30
20
10
0
2400
2500
2600
2700
Frequency (MHz)
15.247(d) / 15.209 Radiated Spurious Emissions

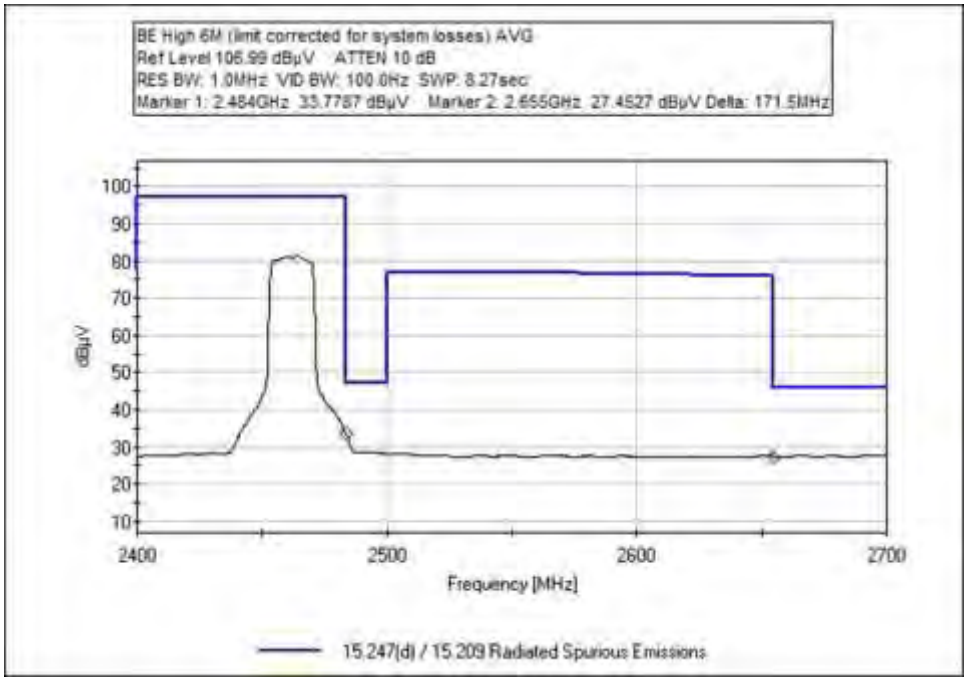

BE Low 5.5M (limit corrected for system losses)
Ref Level 96.99 dBµV ATTEN 0 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 20.0msec
Marker 1: 2.39GHz 38.0257 dBµV Marker 2: 2.4GHz 46.6147 dBµV Delta: 10.0MHz
dBµV
90
80
70
60
50
40
30
20
10
0
2390
2400
2410
2420
2430
Frequency (MHz)
15.247(d) / 15.209 Radiated Spurious Emissions

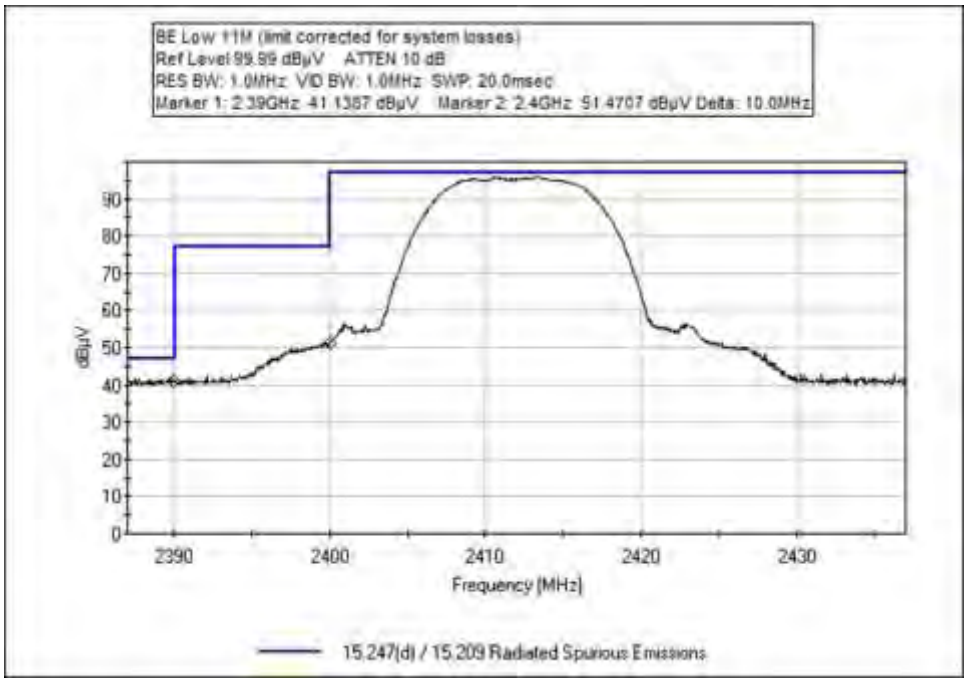

BE High 5.5M (limit corrected for system losses)
Ref Level 96.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 20.0msec
Marker 1: 2.484GHz 40.3227 dBµV Marker 2: 2.655GHz 40.1127 dBµV Delta: 171.5MHz
dBµV
90
80
70
60
50
40
30
20
10
0
2400
2500
2600
2700
Frequency (MHz)
15.247(d) / 15.209 Radiated Spurious Emissions

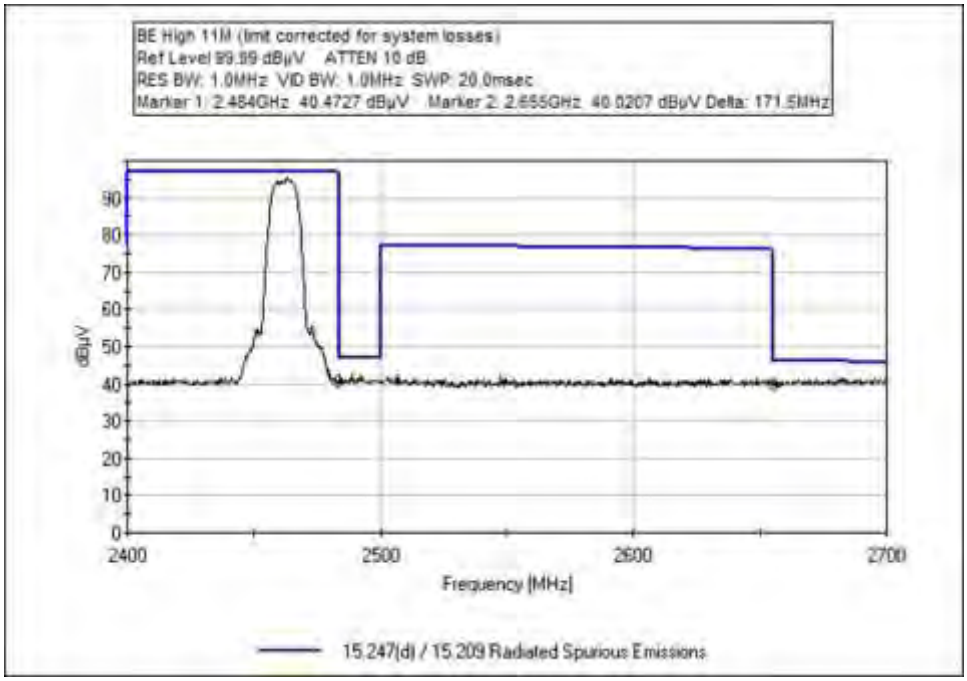

BE Low 6M (limit corrected for system losses) PEAK
Ref Level 99.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 20.0msec
Marker 1: 2.39GHz 52.6247 dBµV Marker 2: 2.4GHz 63.1827 dBµV Delta: 10.0MHz
dBµV
Frequency (MHz)
15.247(d) / 15.209 Radiated Spurious Emissions PEAK

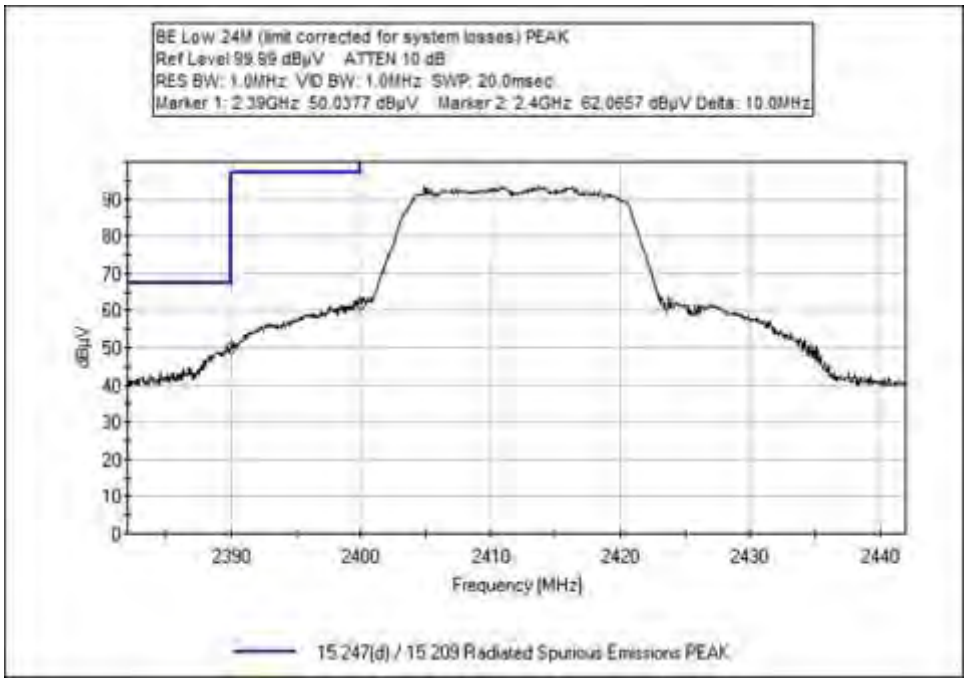

BE Low 6M (limit corrected for system losses) AVG
Ref Level 99.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 100.0Hz SWP: 1.654sec
Marker 1: 2.39GHz 32.2777 dBµV Marker 2: 2.4GHz 43.4327 dBµV Delta: 10.0MHz
dBµV
Frequency (MHz)
15.247(d) / 15.209 Radiated Spurious Emissions

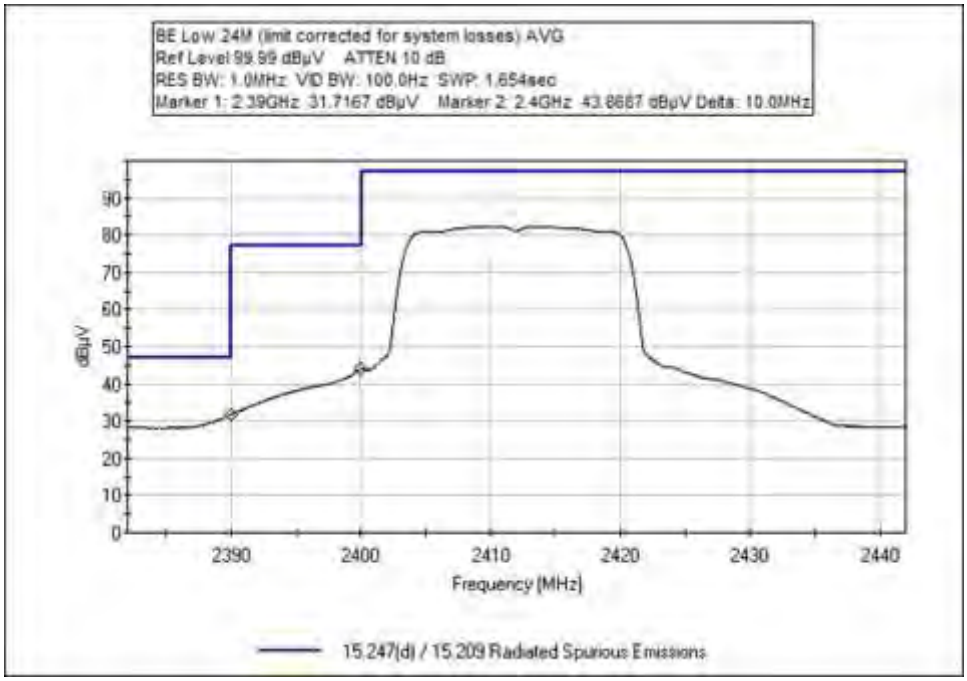

BE High 6M (limit corrected for system losses) PEAK
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 20.0msec
Marker 1: 2.484GHz 54.6577 dBµV Marker 2: 2.655GHz 40.0637 dBµV Delta: 171.5MHz
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions PEAK

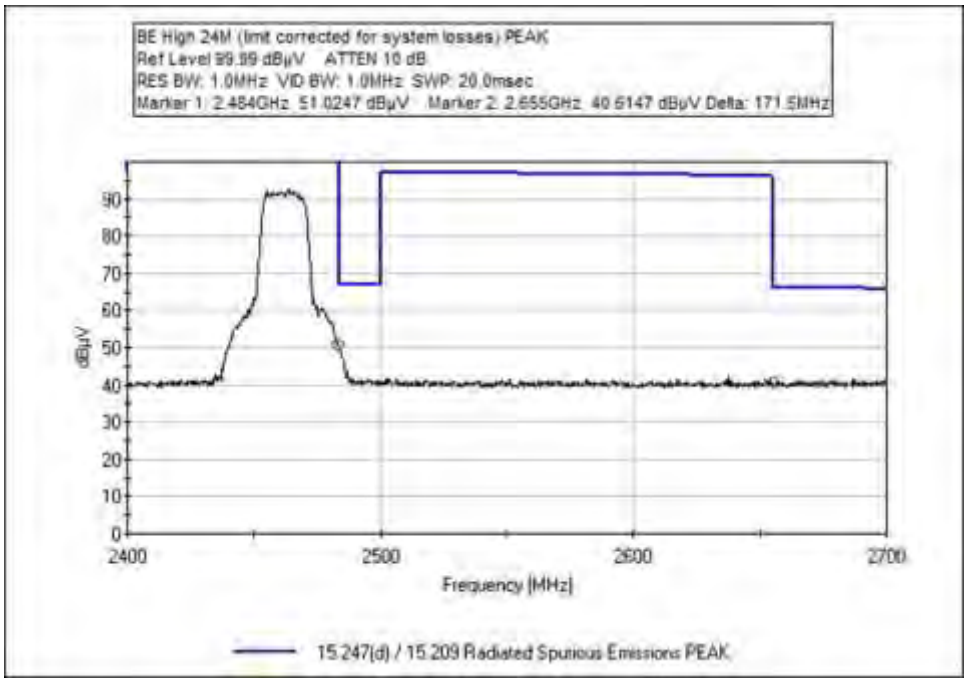

BE High 6M (limit corrected for system losses) AVG
Ref Level 106.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 100.0Hz SWP: 8.27sec
Marker 1: 2.484GHz 33.7787 dBµV Marker 2: 2.655GHz 27.4527 dBµV Delta: 171.5MHz
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

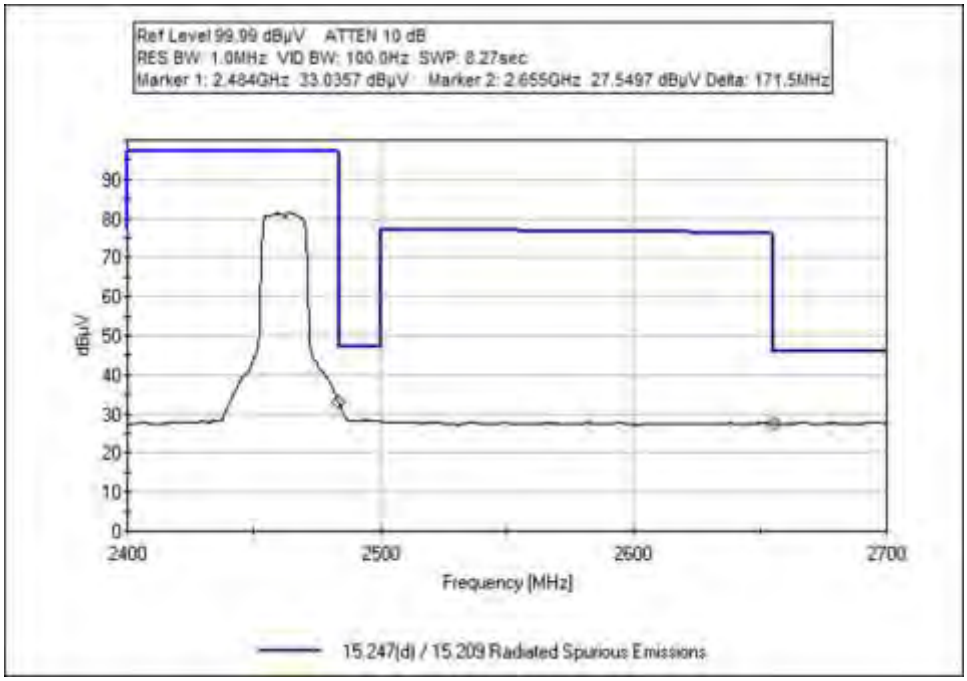

BE Low 11M (limit corrected for system losses)
Ref Level 99.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 20.0msec
Marker 1: 2.39GHz 41.1367 dBµV Marker 2: 2.4GHz 51.4707 dBµV Delta: 10.0MHz
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

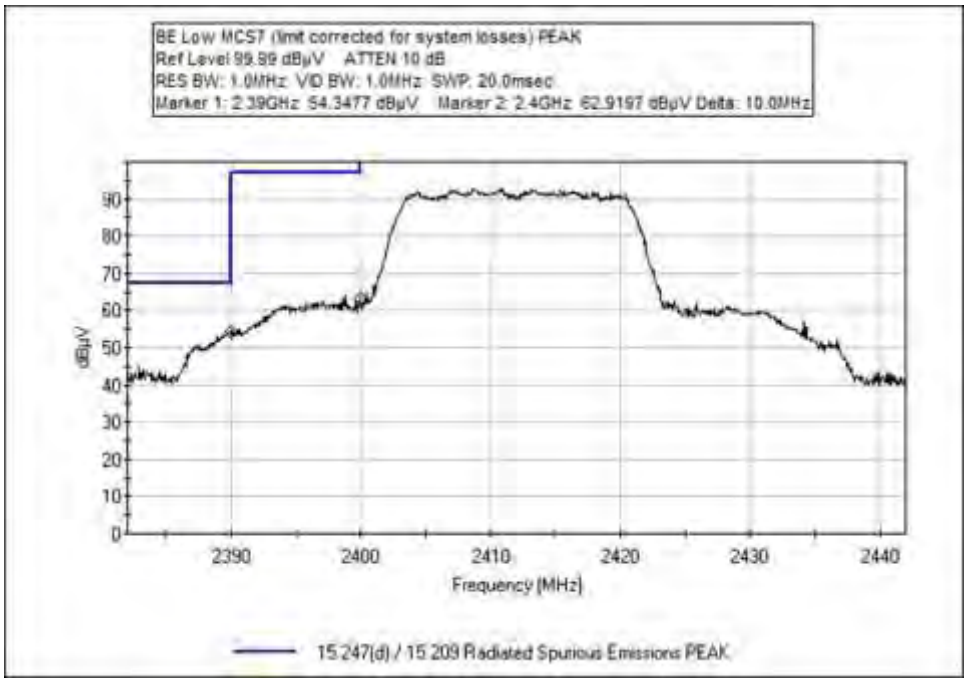

BE High 11M (limit corrected for system losses)
Ref Level 99.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 20.0msec
Marker 1: 2.484GHz 40.4727 dBµV Marker 2: 2.655GHz 40.0207 dBµV Delta: 171.5MHz
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

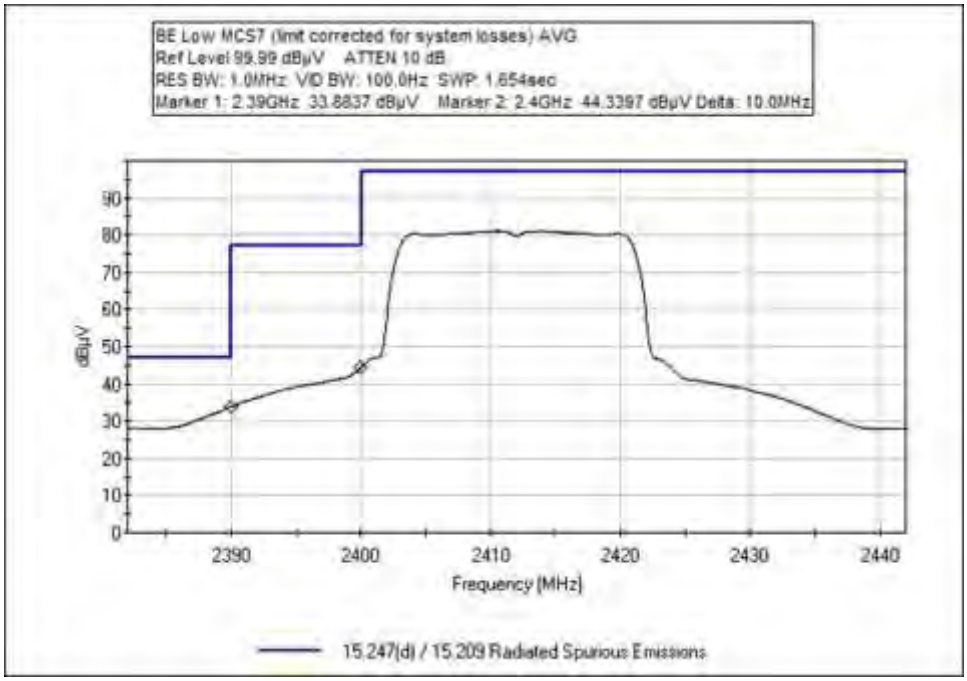

BE Low 24M (limit corrected for system losses) PEAK
Ref Level 99.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 20.0msec
Marker 1: 2.39GHz 50.0377 dBµV Marker 2: 2.4GHz 62.0657 dBµV Delta: 10.0MHz
dBµV
Frequency (MHz)
15.247(d) / 15.209 Radiated Spurious Emissions PEAK

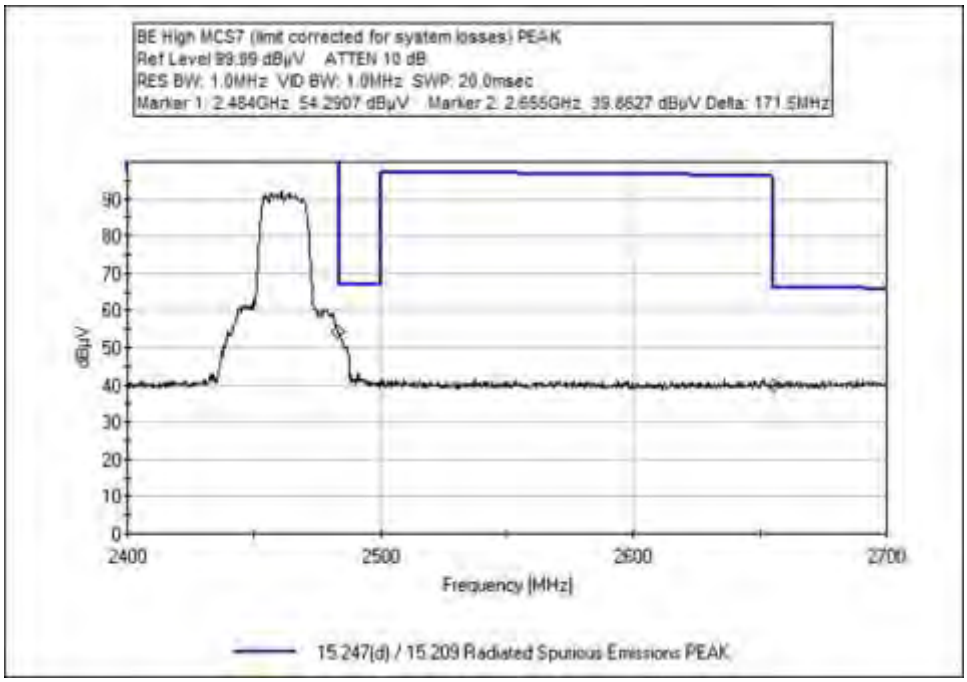

BE Low 24M (limit corrected for system losses) AVG
Ref Level 99.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 100.0Hz SWP: 1.654sec
Marker 1: 2.39GHz 31.7167 dBµV Marker 2: 2.4GHz 43.8667 dBµV Delta: 10.0MHz
dBµV
Frequency (MHz)
15.247(d) / 15.209 Radiated Spurious Emissions

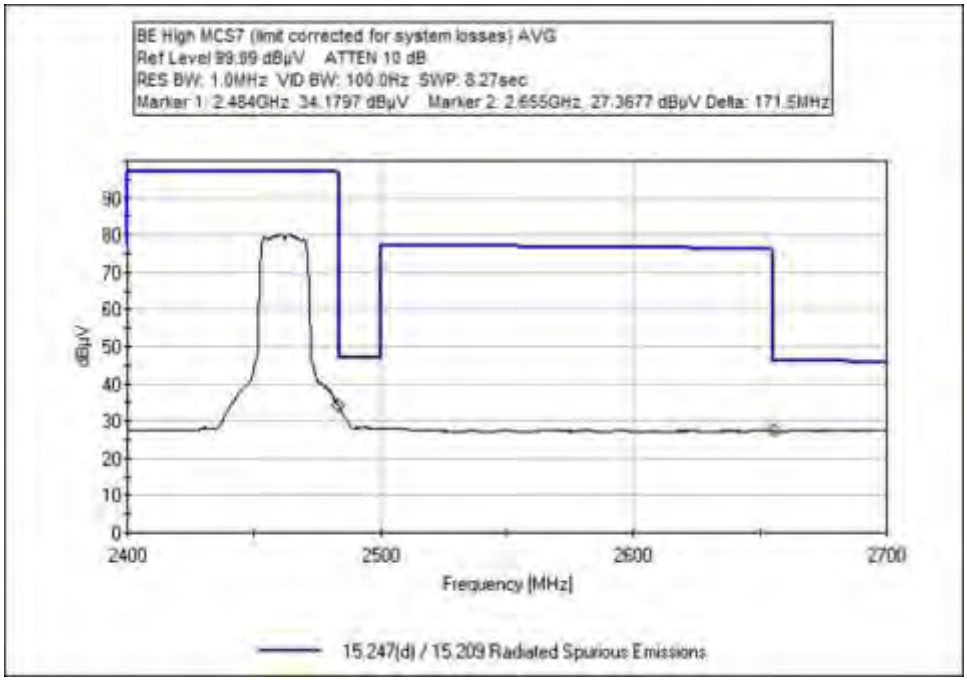

BE High 24M (limit corrected for system losses) PEAK
Ref Level 99.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 20.0msec
Marker 1: 2.484GHz 51.0247 dBµV Marker 2: 2.655GHz 40.6147 dBµV Delta: 171.5MHz
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions PEAK


Ref Level 99.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 100.0Hz SWP: 8.27sec
Marker 1: 2.484GHz 33.0357 dBµV Marker 2: 2.655GHz 27.5497 dBµV Delta: 171.5MHz
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions


BE Low MCS7 (limit corrected for system losses) PEAK
Ref Level 99.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 20.0msec
Marker 1: 2.39GHz 54.3477 dBµV Marker 2: 2.4GHz 62.9197 dBµV Delta: 10.0MHz
dBµV
Frequency (MHz)
15.247(d) / 15.209 Radiated Spurious Emissions PEAK


BE Low MCS7 (limit corrected for system losses) AVG
Ref Level 99.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 100.0Hz SWP: 1.654sec
Marker 1: 2.39GHz 33.8837 dBµV Marker 2: 2.4GHz 44.3397 dBµV Delta: 10.0MHz
dBµV
Frequency (MHz)
15.247(d) / 15.209 Radiated Spurious Emissions


BE High MCS7 (limit corrected for system losses) PEAK
Ref Level 99.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 1.0MHz SWP: 20.0msec
Marker 1: 2.484GHz 54.2907 dBµV Marker 2: 2.655GHz 39.8627 dBµV Delta: 171.5MHz
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions PEAK


BE High MCS7 (limit corrected for system losses) AVG
Ref Level 99.99 dBµV ATTEN 10 dB
RES BW: 1.0MHz VID BW: 100.0Hz SWP: 8.27sec
Marker 1: 2.484GHz 34.1797 dBµV Marker 2: 2.655GHz 27.3677 dBµV Delta: 171.5MHz
dBµV
Frequency [MHz]
15.247(d) / 15.209 Radiated Spurious Emissions

Test Setup / Conditions / Data

Test Location:	CKC Laboratories • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • 1-800-500-4EMC (4362)		
Customer:	**Novatel**		
Specification:	**15.247(d) / 15.209 Radiated Spurious Emissions**		
Work Order #:	**100174**	Date:	8/8/2017
Test Type:	**Maximized Emissions**	Time:	18:06:49
Tested By:	Michael Atkinson	Sequence#:	7
Software:	EMITest 5.03.02		

Equipment Tested:

Device	Manufacturer	Model #	S/N
Configuration 1			

Support Equipment:

Device	Manufacturer	Model #	S/N
Configuration 1			

Test Conditions / Notes:

Frequency Range: Band Edge
Frequency tested: 2412, 2442, 2462MHz
Firmware power setting: Max
EUT Firmware: OM7CR0301SN0007
Modulation/Data Rate: **All data rates investigated, only worst case data reported**

Antenna type: Integral Trace
Antenna Gain : 2.6dBi

Duty Cycle: 100%

Setup:
The EUT is DC powered through a battery. The EUT is connected to an external GNSS active antenna which is located remotely with an open view of the sky. The active antenna is powered by a Bias Tee coupler and the signal strength is tuned with an amplifier and output DC power supply. The Bias Tee coupler is powered by a dual output power supply. The EUT is connected to a support laptop via Ethernet and the 2 x USB ports. The 26Pin IO contained 1 x CAN Interface and 3 x RS-232 ports. The CAN Interface is connected to the laptop via a CAN USB Adapter with a Terminator Resistor on the adapter side. The RS-232 ports which were connected to a serial to USB 4 port hub which is then connected to the laptop.

Investigated EUT is continuously transmitting. Low, Mid, and High channels as well as all data rates investigated, worst case data reported. Horizontal and Vertical antenna polarities, only worst case reported. The EUT is fully exercised with communication and data transfer between the EUT and support laptop. The EUT is on the test table 150cm high connected to the internal trace antenna.

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02872	Spectrum Analyzer	E4440A	11/18/2015	11/18/2017
T2	ANP06540	Cable	Heliax	10/29/2015	10/29/2017
T3	ANP05305	Cable	ETSI-50T	2/15/2016	2/15/2018
T4	AN03540	Preamp	83017A	5/2/2017	5/2/2019
T5	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	8/12/2015	8/12/2017
T6	ANP06935	Cable	32026-29801-29801-18	3/11/2016	3/11/2018
T7	ANP06219	Attenuator	768-10	4/12/2016	4/12/2018

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq	Rdng	T1 T5	T2 T6	T3 T7	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBµV	dB	dB	dB	dB	Table	dBµV/m	dBµV/m	dB	Ant
1	2483.500M	34.2	+0.0	+0.6	+2.9	-34.0	+0.0	41.1	54.0	-12.9	Horiz
	Ave		+27.7	+0.4	+9.3				BE High MCS7		
2	2390.000M	33.9	+0.0	+0.6	+2.8	-34.0	+0.0	40.7	54.0	-13.3	Horiz
	Ave		+27.7	+0.4	+9.3				BE Low MCS7		
3	2483.500M	33.8	+0.0	+0.6	+2.9	-34.0	+0.0	40.7	54.0	-13.3	Horiz
	Ave		+27.7	+0.4	+9.3				BE High 6M		
4	2483.500M	33.0	+0.0	+0.6	+2.9	-34.0	+0.0	39.9	54.0	-14.1	Horiz
	Ave		+27.7	+0.4	+9.3				BE High 24M		
^	2483.500M	54.6	+0.0	+0.6	+2.9	-34.0	+0.0	61.5	74.0	-12.5	Horiz
			+27.7	+0.4	+9.3				BE High 6M		
^	2483.500M	54.3	+0.0	+0.6	+2.9	-34.0	+0.0	61.2	74.0	-12.8	Horiz
			+27.7	+0.4	+9.3				BE High MCS7		
^	2483.500M	51.0	+0.0	+0.6	+2.9	-34.0	+0.0	57.9	74.0	-16.1	Horiz
			+27.7	+0.4	+9.3				BE High 24M		
^	2483.500M	41.4	+0.0	+0.6	+2.9	-34.0	+0.0	48.3	74.0	-25.7	Horiz
			+27.7	+0.4	+9.3				BE High 1M		
^	2483.500M	40.9	+0.0	+0.6	+2.9	-34.0	+0.0	47.8	74.0	-26.2	Horiz
			+27.7	+0.4	+9.3				BE High 2M		
^	2483.500M	40.5	+0.0	+0.6	+2.9	-34.0	+0.0	47.4	74.0	-26.6	Horiz
			+27.7	+0.4	+9.3				BE High 11M		
^	2483.500M	40.3	+0.0	+0.6	+2.9	-34.0	+0.0	47.2	74.0	-26.8	Horiz
			+27.7	+0.4	+9.3				BE High 5.5M		
12	2390.000M	32.3	+0.0	+0.6	+2.8	-34.0	+0.0	39.1	54.0	-14.9	Horiz
	Ave		+27.7	+0.4	+9.3				BE Low 6M		

13	2390.000M	31.7	+0.0	+0.6	+2.8	-34.0	+0.0	38.5	54.0	-15.5	Horiz
	Ave		+27.7	+0.4	+9.3				BE Low 24M		
^	2390.000M	54.3	+0.0	+0.6	+2.8	-34.0	+0.0	61.1	74.0	-12.9	Horiz
			+27.7	+0.4	+9.3				BE Low MCS7		
^	2390.000M	52.6	+0.0	+0.6	+2.8	-34.0	+0.0	59.4	74.0	-14.6	Horiz
			+27.7	+0.4	+9.3				BE Low 6M		
^	2390.000M	50.0	+0.0	+0.6	+2.8	-34.0	+0.0	56.8	74.0	-17.2	Horiz
			+27.7	+0.4	+9.3				BE Low 24M		
^	2390.000M	41.1	+0.0	+0.6	+2.8	-34.0	+0.0	47.9	74.0	-26.1	Horiz
			+27.7	+0.4	+9.3				BE Low 11M		
^	2390.000M	41.1	+0.0	+0.6	+2.8	-34.0	+0.0	47.9	74.0	-26.1	Horiz
			+27.7	+0.4	+9.3				BE Low 1M		
^	2390.000M	39.5	+0.0	+0.6	+2.8	-34.0	+0.0	46.3	74.0	-27.7	Horiz
			+27.7	+0.4	+9.3				BE Low 2M		
^	2390.000M	39.1	+0.0	+0.6	+2.8	-34.0	+0.0	45.9	74.0	-28.1	Horiz
			+27.7	+0.4	+9.3				BE Low 5.5M		
21	2655.000M	27.5	+0.0	+0.7	+3.0	-33.9	+0.0	35.4	54.0	-18.6	Horiz
	Ave		+28.4	+0.4	+9.3				BE High 24M		
22	2655.000M	27.5	+0.0	+0.7	+3.0	-33.9	+0.0	35.4	54.0	-18.6	Horiz
	Ave		+28.4	+0.4	+9.3				BE High 6M		
23	2655.000M	27.4	+0.0	+0.7	+3.0	-33.9	+0.0	35.3	54.0	-18.7	Horiz
	Ave		+28.4	+0.4	+9.3				BE High MCS7		
^	2655.000M	40.6	+0.0	+0.7	+3.0	-33.9	+0.0	48.5	74.0	-25.5	Horiz
			+28.4	+0.4	+9.3				BE High 24M		
^	2655.000M	40.1	+0.0	+0.7	+3.0	-33.9	+0.0	48.0	74.0	-26.0	Horiz
			+28.4	+0.4	+9.3				BE High 5.5M		
^	2655.000M	40.1	+0.0	+0.7	+3.0	-33.9	+0.0	48.0	74.0	-26.0	Horiz
			+28.4	+0.4	+9.3				BE High 6M		
^	2655.000M	40.0	+0.0	+0.7	+3.0	-33.9	+0.0	47.9	74.0	-26.1	Horiz
			+28.4	+0.4	+9.3				BE High 1M		
^	2655.000M	40.0	+0.0	+0.7	+3.0	-33.9	+0.0	47.9	74.0	-26.1	Horiz
			+28.4	+0.4	+9.3				BE High 11M		
^	2655.000M	39.9	+0.0	+0.7	+3.0	-33.9	+0.0	47.8	74.0	-26.2	Horiz
			+28.4	+0.4	+9.3				BE High 2M		
^	2655.000M	39.9	+0.0	+0.7	+3.0	-33.9	+0.0	47.8	74.0	-26.2	Horiz
			+28.4	+0.4	+9.3				BE High MCS7		
31	2400.000M	44.3	+0.0	+0.6	+2.8	-34.0	+0.0	51.1	84.0	-32.9	Horiz
	Ave		+27.7	+0.4	+9.3				BE Low MCS7		

32	2400.000M	43.9	+0.0	+0.6	+2.8	-34.0	+0.0	50.7	84.0	-33.3	Horiz
	Ave		+27.7	+0.4	+9.3				BE Low 24M		
33	2400.000M	43.4	+0.0	+0.6	+2.8	-34.0	+0.0	50.2	84.0	-33.8	Horiz
	Ave		+27.7	+0.4	+9.3				BE Low 6M		
^	2400.000M	63.2	+0.0	+0.6	+2.8	-34.0	+0.0	70.0	104.0	-34.0	Horiz
			+27.7	+0.4	+9.3				BE Low 6M		
^	2400.000M	62.9	+0.0	+0.6	+2.8	-34.0	+0.0	69.7	104.0	-34.3	Horiz
			+27.7	+0.4	+9.3				BE Low MCS7		
^	2400.000M	62.1	+0.0	+0.6	+2.8	-34.0	+0.0	68.9	104.0	-35.1	Horiz
			+27.7	+0.4	+9.3				BE Low 24M		
^	2400.000M	51.5	+0.0	+0.6	+2.8	-34.0	+0.0	58.3	104.0	-45.7	Horiz
			+27.7	+0.4	+9.3				BE Low 11M		
^	2400.000M	50.8	+0.0	+0.6	+2.8	-34.0	+0.0	57.6	104.0	-46.4	Horiz
			+27.7	+0.4	+9.3				BE Low 2M		
^	2400.000M	50.4	+0.0	+0.6	+2.8	-34.0	+0.0	57.2	104.0	-46.8	Horiz
			+27.7	+0.4	+9.3				BE Low 1M		
^	2400.000M	46.6	+0.0	+0.6	+2.8	-34.0	+0.0	53.4	104.0	-50.6	Horiz
			+27.7	+0.4	+9.3				BE Low 5.5M		

Test Setup Photos

Below 1GHz, 80cm table height

Above 1 GHz, 150cm table height

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

Uncertainties reported are worst case for all CKC Laboratories' sites and represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

Unless otherwise indicated, the following configuration parameters are used for equipment setup: The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in dBµV/m, the spectrum analyzer reading in dBµV was corrected by using the following formula. This reading was then compared to the applicable specification limit. Individual measurements were compared with the displayed limit value in the margin column. The margin was calculated based on subtracting the limit value from the corrected measurement value; a positive margin represents a measurement exceeding the limit, while a negative margin represents a measurement less than the limit.

SAMPLE CALCULATIONS		
	Meter reading	(dBµV)
+	Antenna Factor	(dB/m)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBµV/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. Unless otherwise specified, the following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	9 kHz	150 kHz	200 Hz
RADIATED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or caret ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point, the measuring device is set into the linear mode and the scan time is reduced.