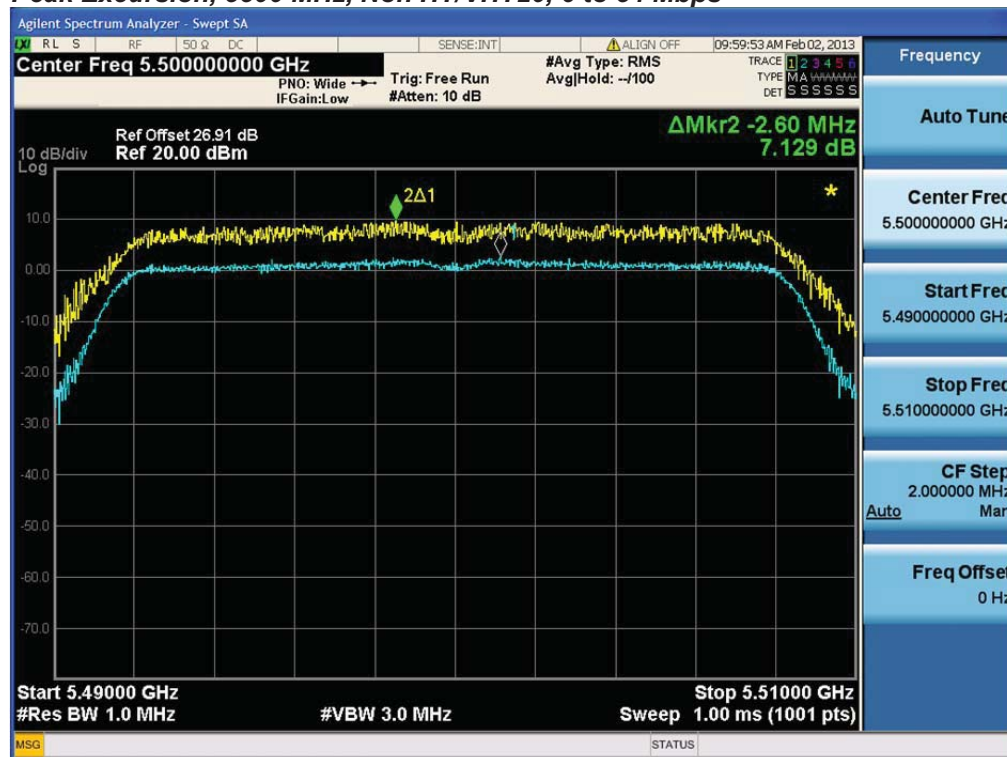
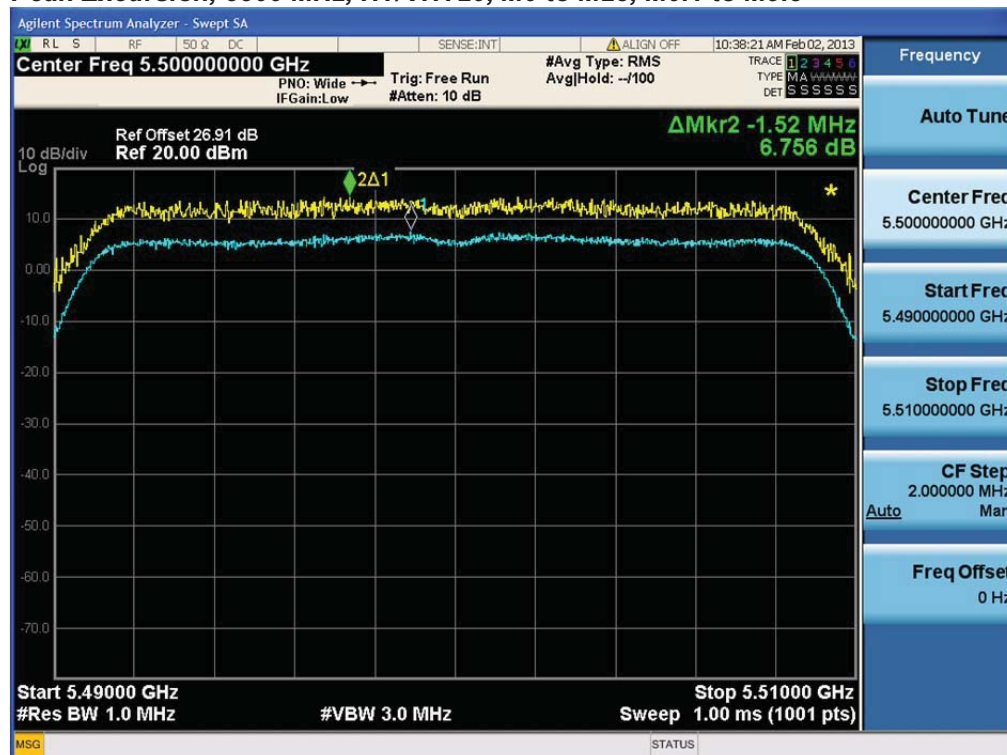
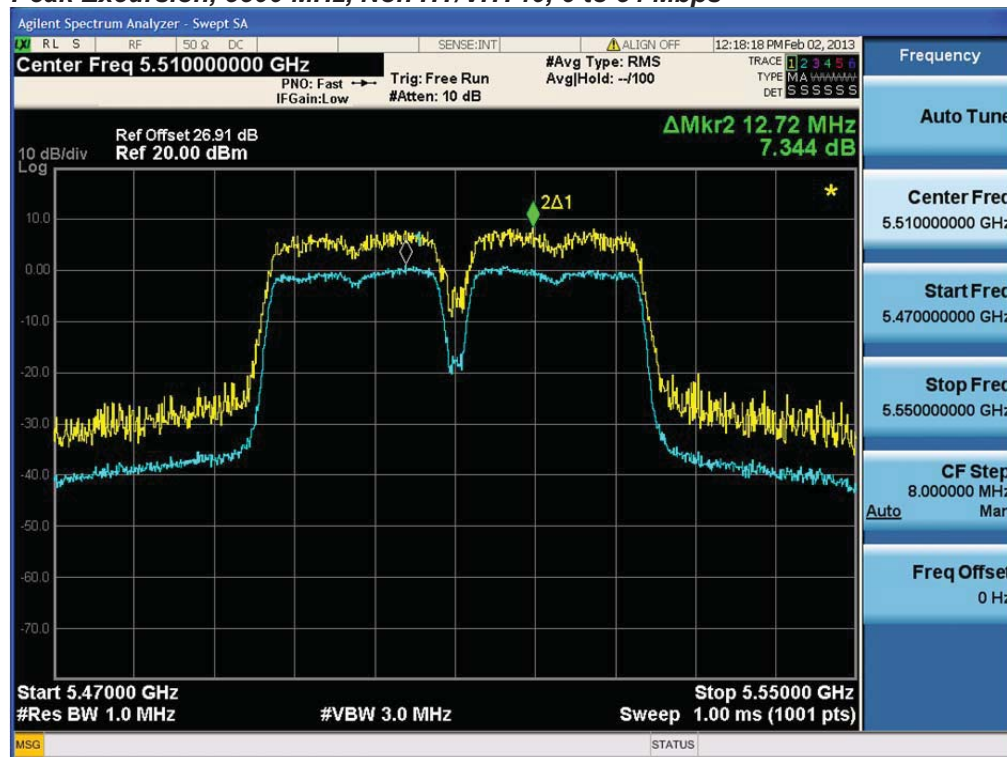
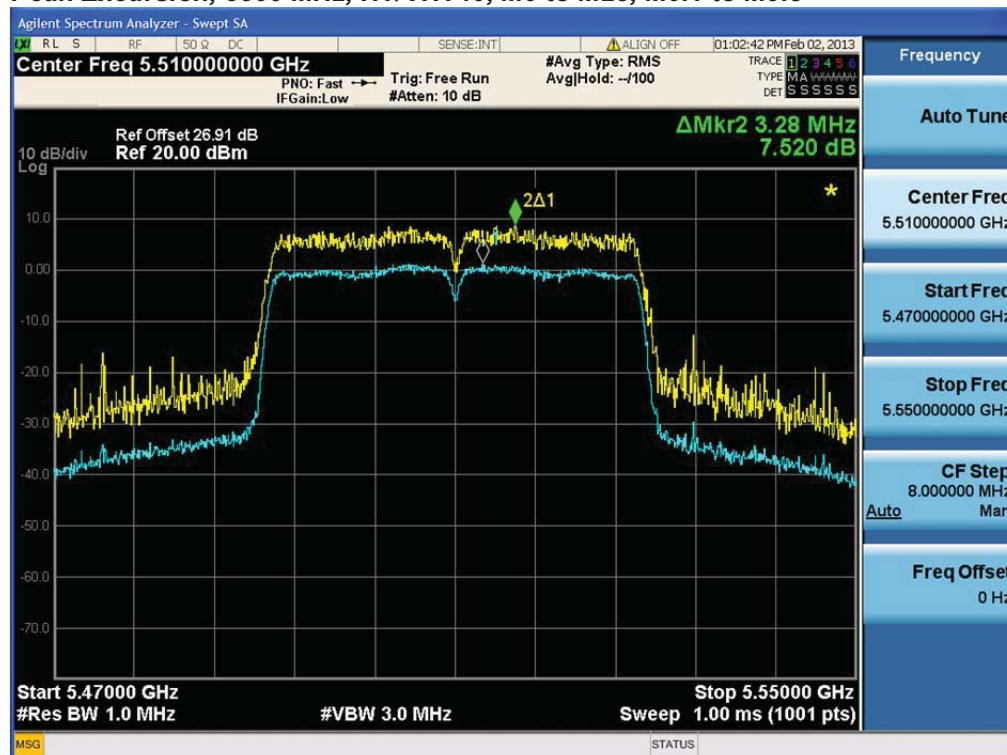
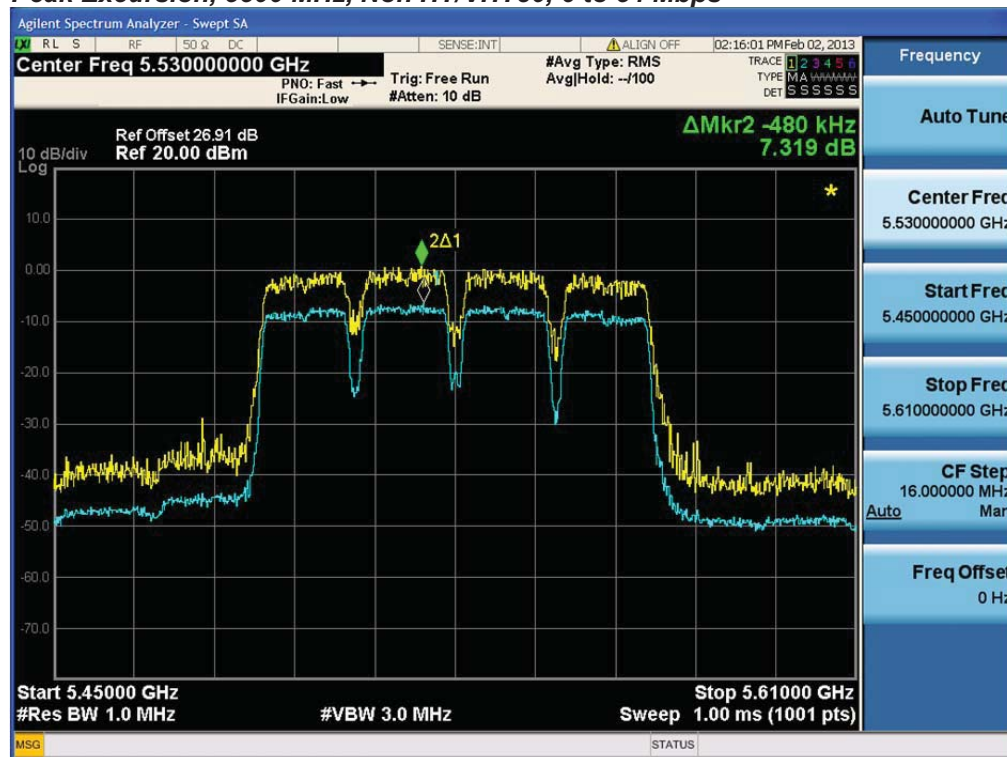
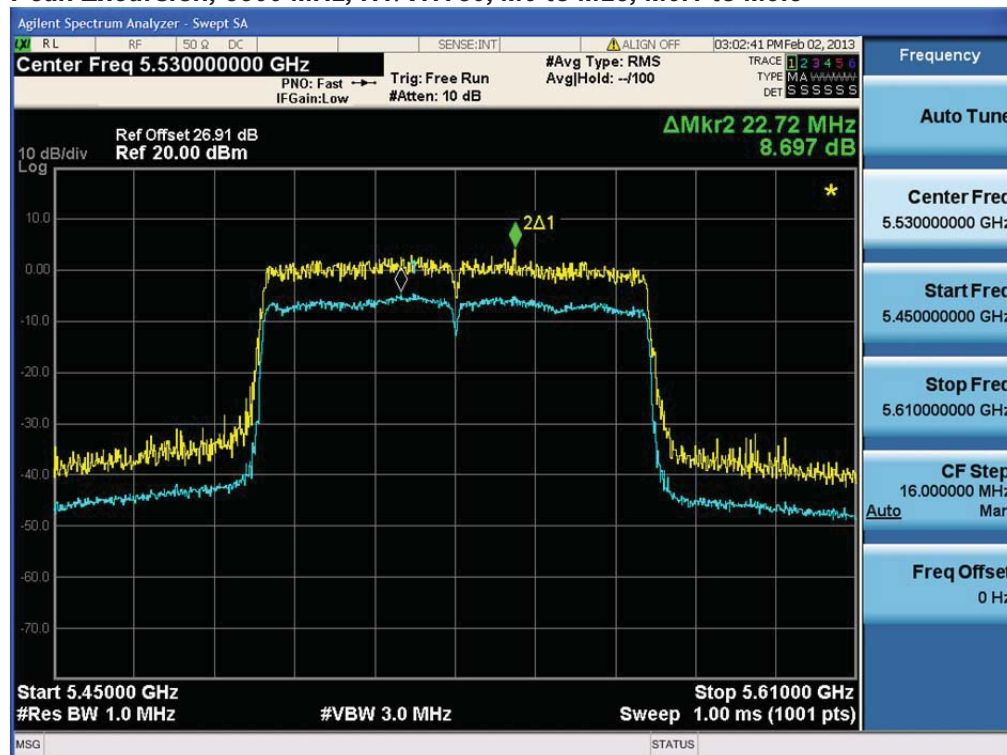
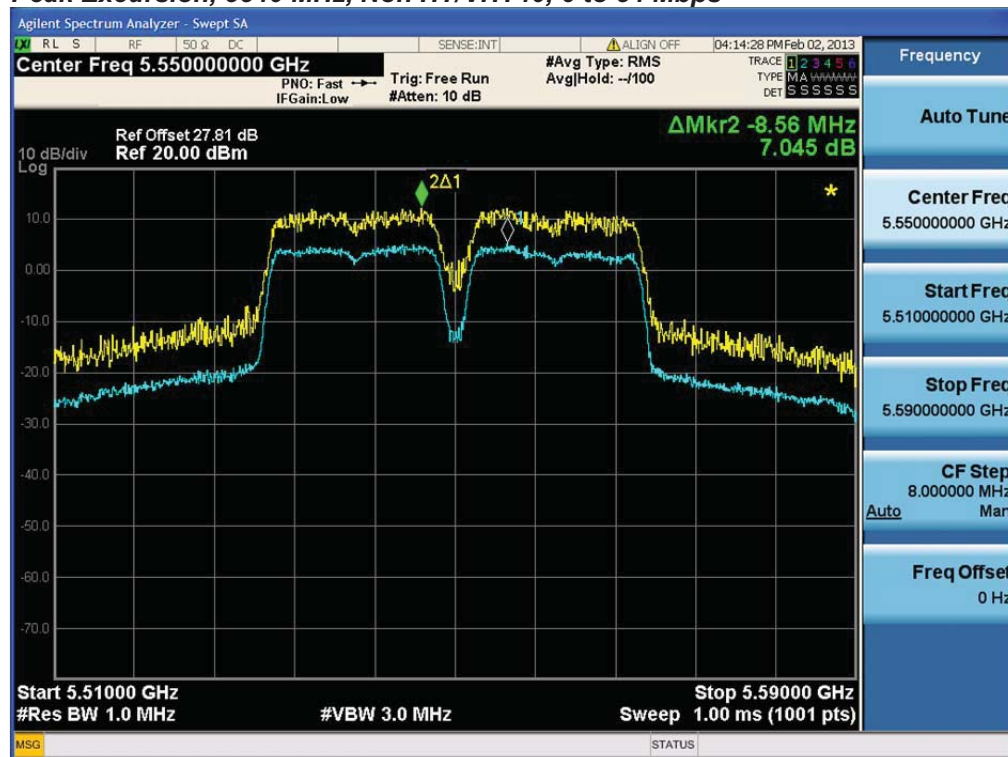
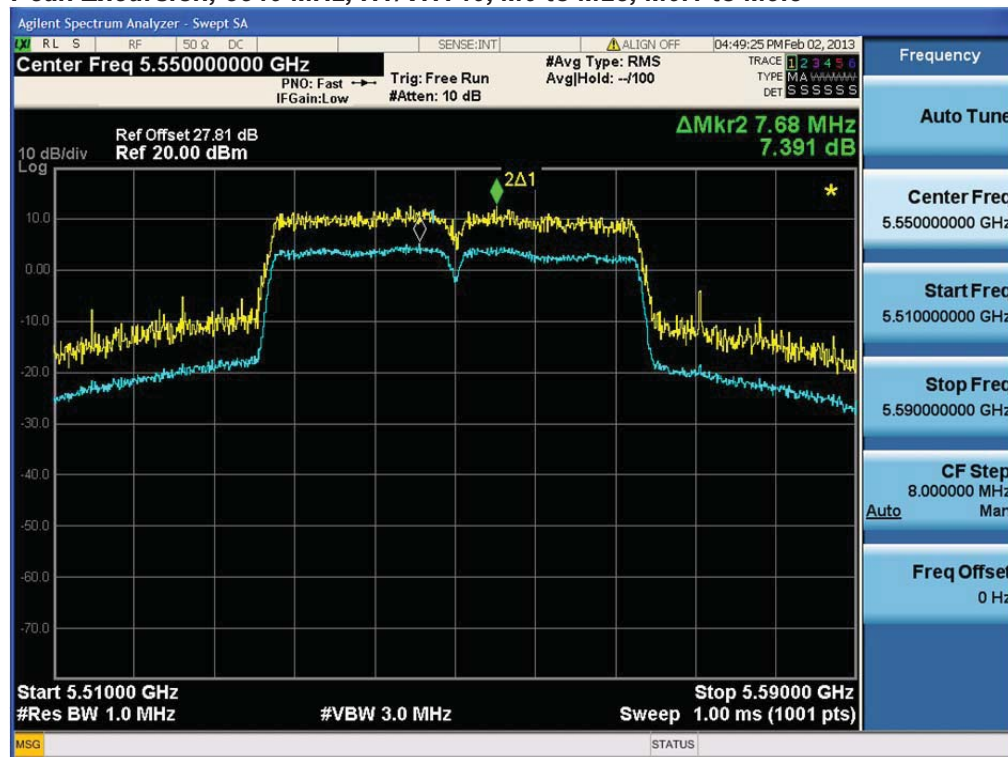
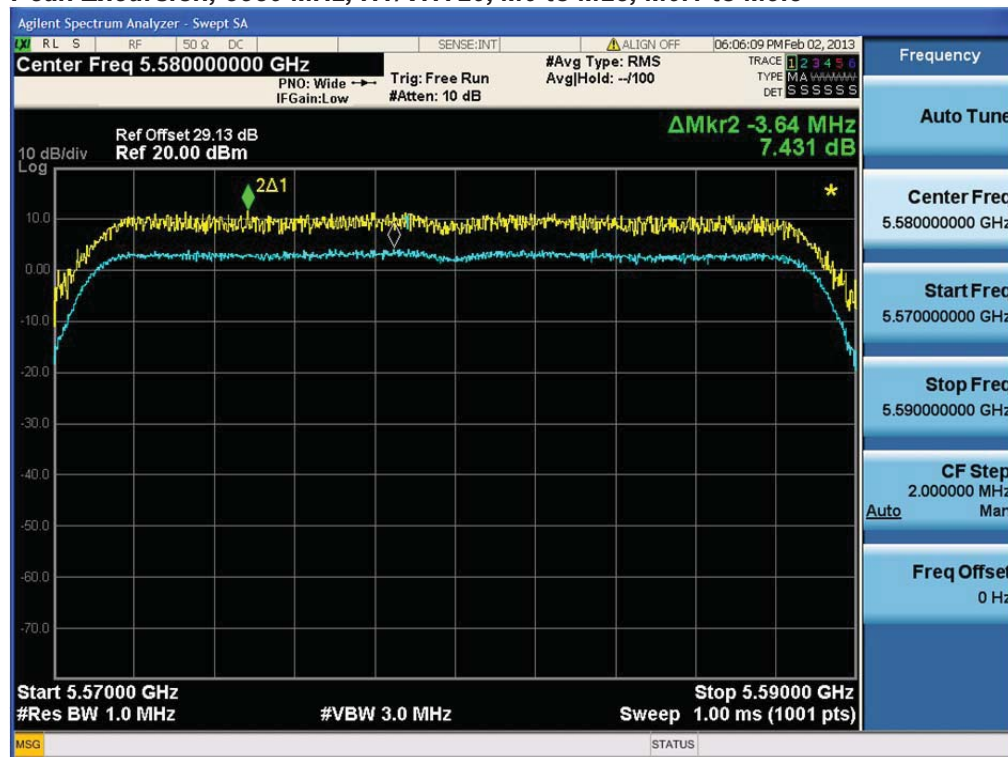


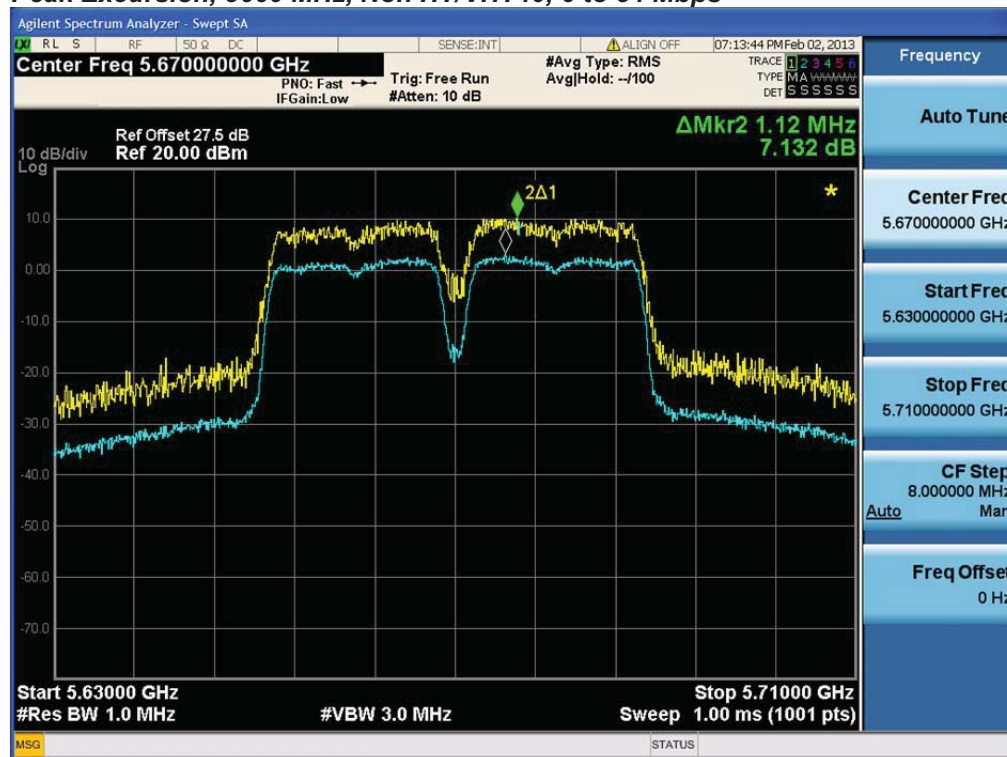
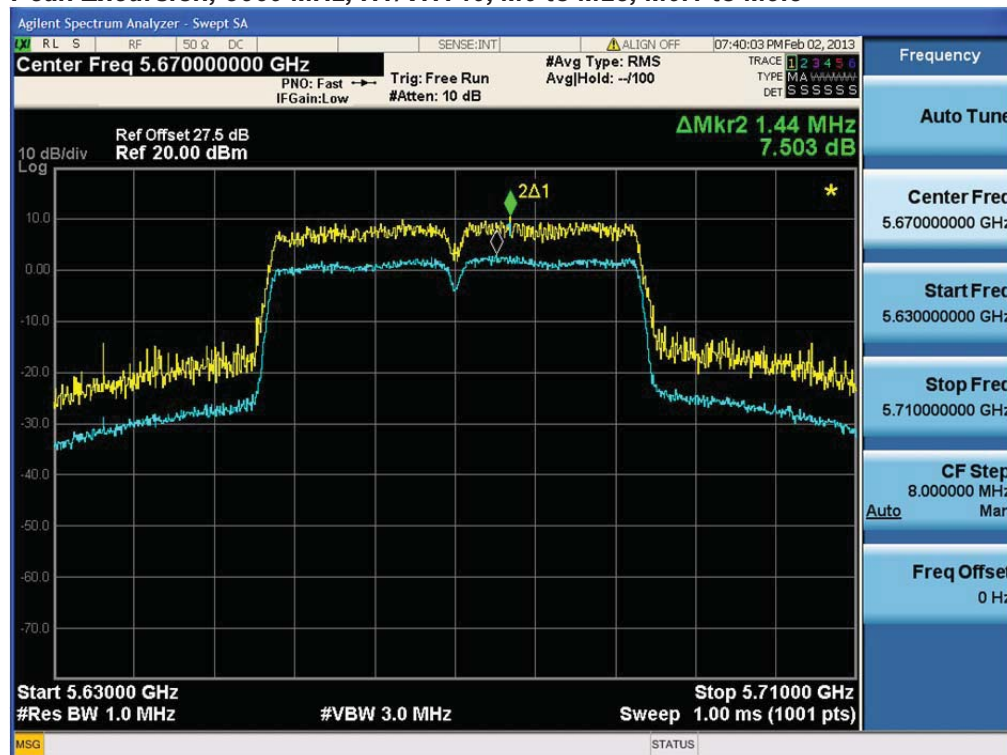
Peak Excursion, 5500 MHz, Non HT/VHT20, 6 to 54 Mbps**Peak Excursion, 5500 MHz, HT/VHT20, M0 to M23, M0.1 to M9.3**

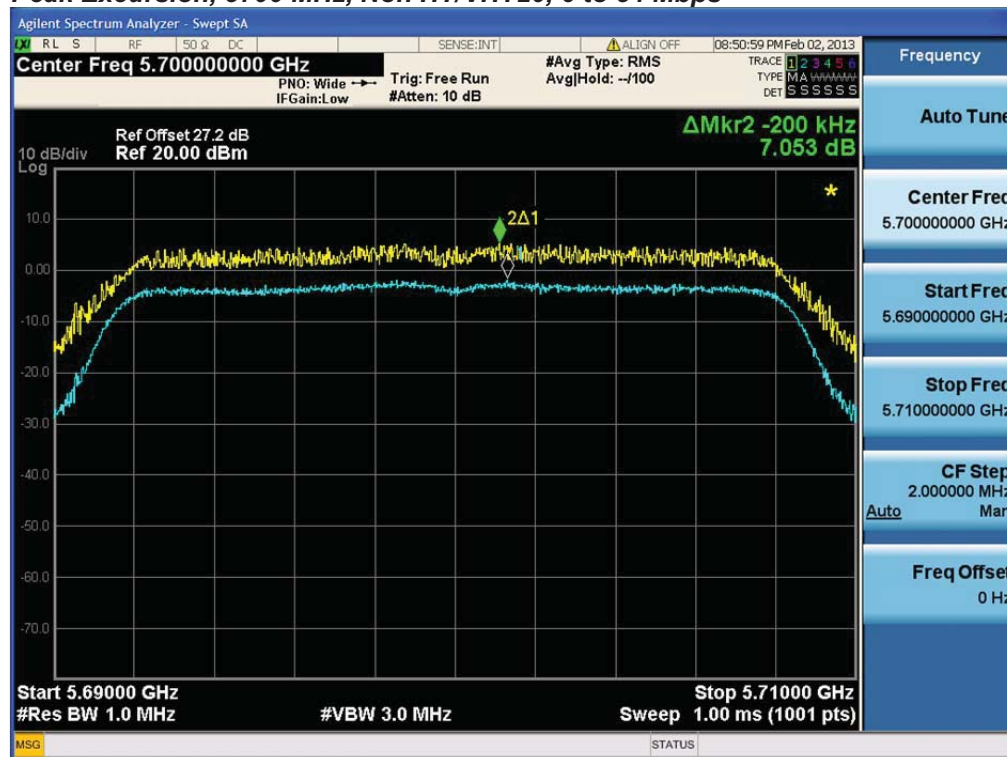
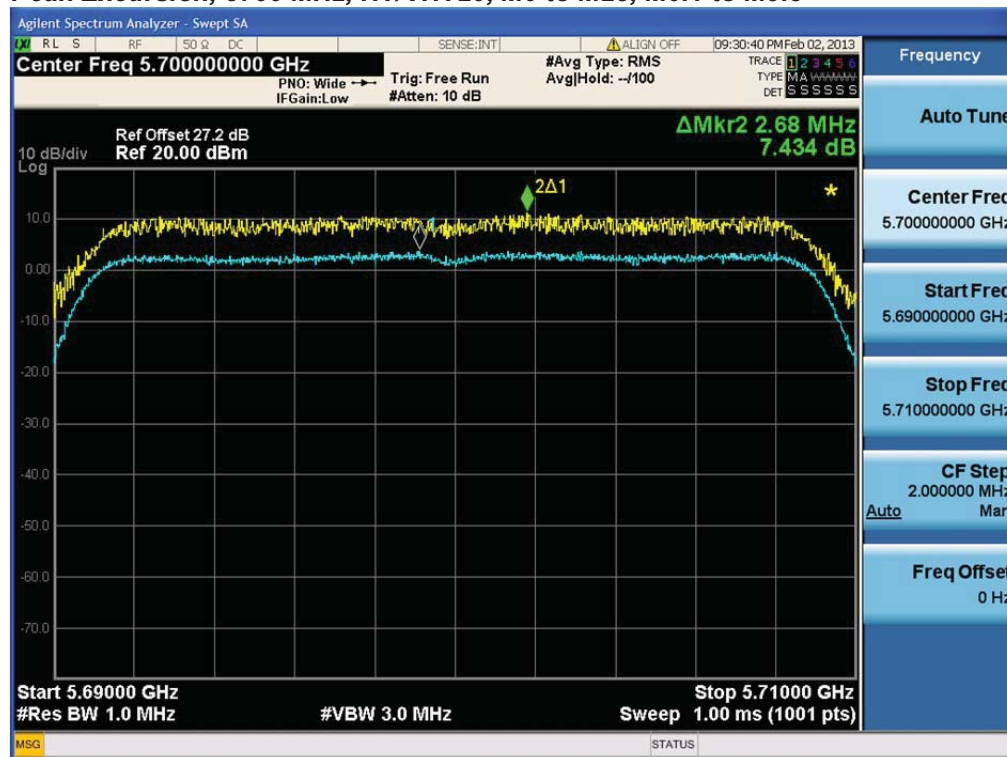
Peak Excursion, 5500 MHz, Non HT/VHT40, 6 to 54 Mbps**Peak Excursion, 5500 MHz, HT/VHT40, M0 to M23, M0.1 to M9.3**

Peak Excursion, 5500 MHz, Non HT/VHT80, 6 to 54 Mbps**Peak Excursion, 5500 MHz, HT/VHT80, M0 to M23, M0.1 to M9.3**

Peak Excursion, 5540 MHz, Non HT/VHT40, 6 to 54 Mbps**Peak Excursion, 5540 MHz, HT/VHT40, M0 to M23, M0.1 to M9.3**



Peak Excursion, 5660 MHz, Non HT/VHT40, 6 to 54 Mbps**Peak Excursion, 5660 MHz, HT/VHT40, M0 to M23, M0.1 to M9.3**

Peak Excursion, 5700 MHz, Non HT/VHT20, 6 to 54 Mbps**Peak Excursion, 5700 MHz, HT/VHT20, M0 to M23, M0.1 to M9.3**



Conducted Spurious Emissions

15.407: For transmitters operating in the 5.25-5.35 and 5.47-5.725 GHz band: all emissions outside of the 5.25-5.35 and 5.47-5.725 GHz bands shall not exceed an EIRP of -27dBm/MHz.

Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer).

Span:	30 MHz-40 GHz
Reference Level:	20 dBm
Attenuation:	10 dB
Sweep Time:	10 s
Resolution Bandwidth:	1 MHz
Video Bandwidth:	3 MHz
Detector:	Peak
Trace:	Single
Marker:	Peak

Record the marker waveform peak to spur difference

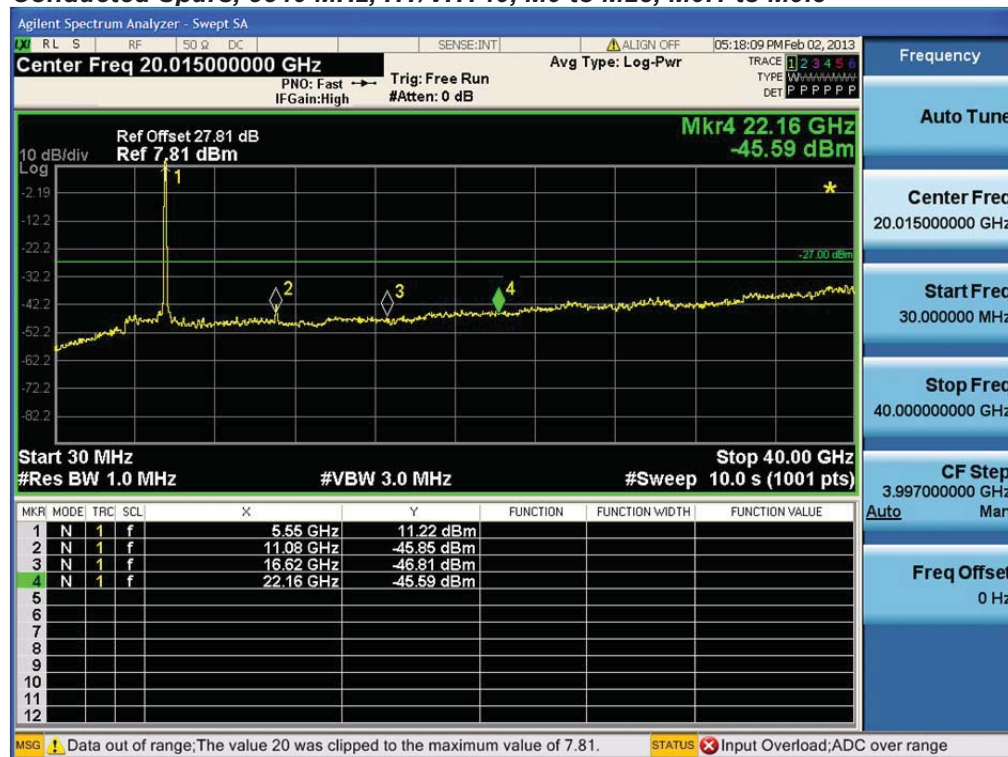


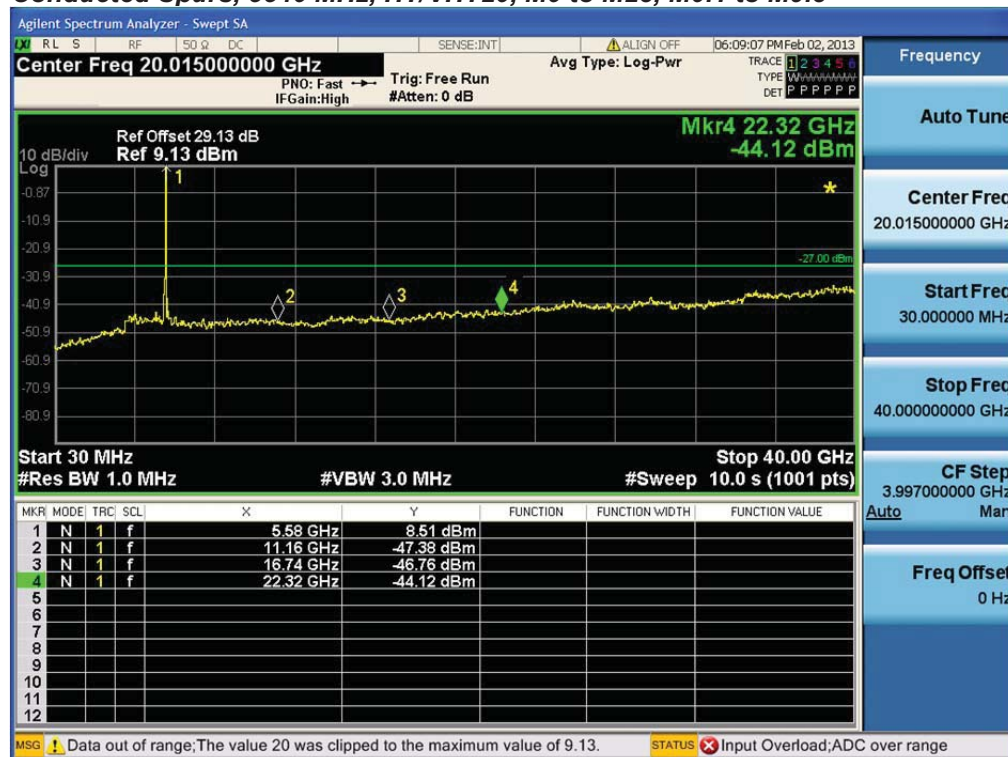
Frequency (MHz)	Mode	Tx Paths	Correlated Antenna Gain (dBi)	Conducted Spur (dBm/MHz)	Total Conducted Spur (dBm/MHz)	Limit (dBm)	Margin (dB)
5500	Non HT/VHT20, 6 to 54 Mbps	2	10	-46.9	-34.09	-27	7.09
	HT/VHT20, M0 to M23, M0.1 to M9.3	3	5	-47.4	-37.63	-27	10.63
	Non HT/VHT40, 6 to 54 Mbps	1	5	-47.5	-42.50	-27	15.50
	HT/VHT40, M0 to M23, M0.1 to M9.3	3	5	-47	-37.23	-27	10.23
	Non HT/VHT80, 6 to 54 Mbps	2	5	-46.9	-38.89	-27	11.89
	HT/VHT80, M0 to M23, M0.1 to M9.3	3	5	-46.7	-36.93	-27	9.93
5540	Non HT/VHT40, 6 to 54 Mbps	2	5	-45.2	-37.19	-27	10.19
	HT/VHT40, M0 to M23, M0.1 to M9.3	2	8	-45.2	-34.19	-27	7.19
5580	Non HT/VHT20, 6 to 54 Mbps	2	10	-44.5	-31.69	-27	4.69
	HT/VHT20, M0 to M23, M0.1 to M9.3	3	5	-44.1	-34.33	-27	7.33
5660	Non HT/VHT40, 6 to 54 Mbps	2	5	-45.7	-37.69	-27	10.69
	HT/VHT40, M0 to M23, M0.1 to M9.3	2	8	-45.7	-34.69	-27	7.69
5700	Non HT/VHT20, 6 to 54 Mbps	2	10	-45.8	-32.99	-27	5.99
	HT/VHT20, M0 to M23, M0.1 to M9.3	2	8	-46.2	-35.19	-27	8.19

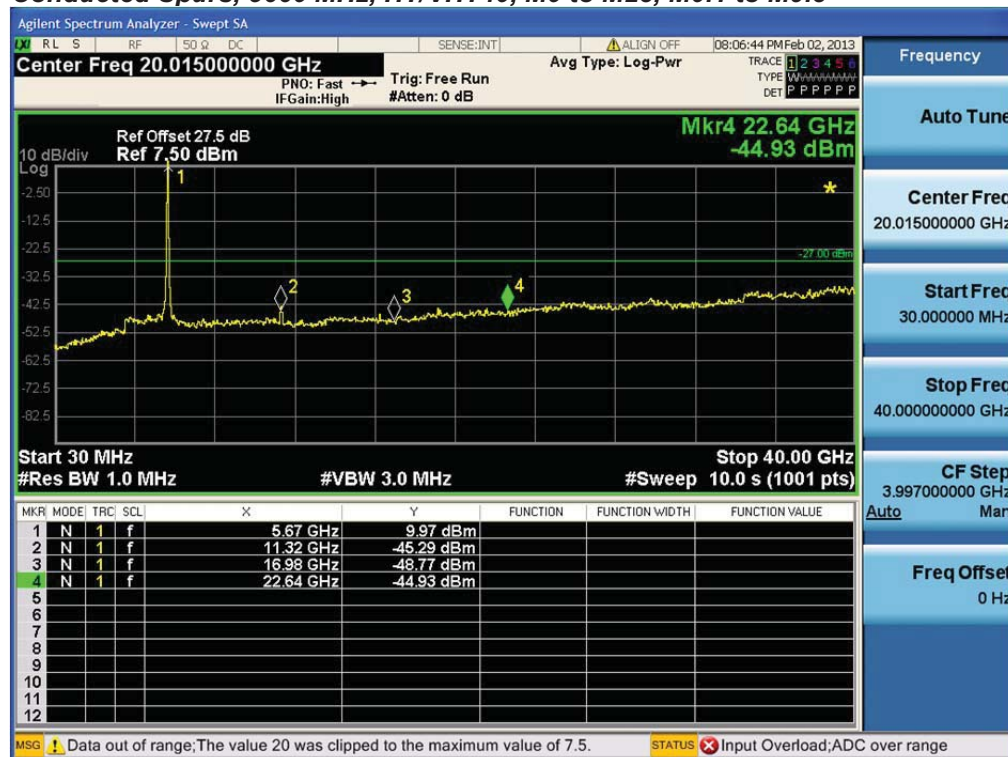
**Conducted Spurs, 5500 MHz, Non HT/VHT20, 6 to 54 Mbps****Conducted Spurs, 5500 MHz, HT/VHT20, M0 to M23, M0.1 to M9.3**

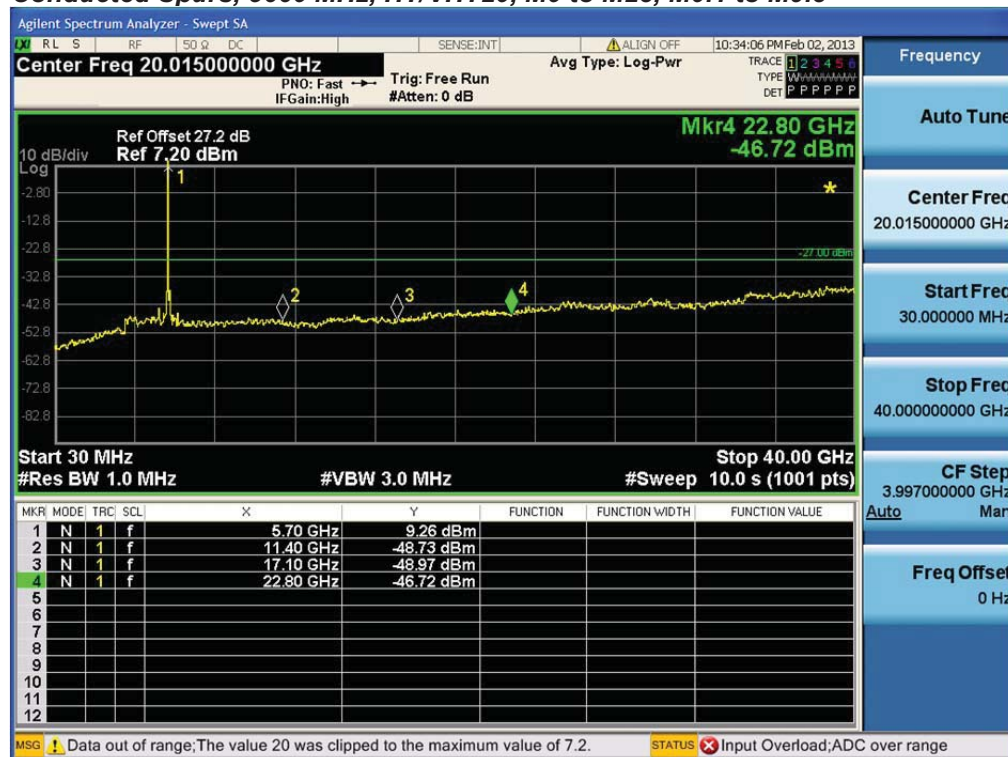
**Conducted Spurs, 5500 MHz, Non HT/VHT40, 6 to 54 Mbps****Conducted Spurs, 5500 MHz, HT/VHT40, M0 to M23, M0.1 to M9.3**

**Conducted Spurs, 5500 MHz, Non HT/VHT80, 6 to 54 Mbps****Conducted Spurs, 5500 MHz, HT/VHT80, M0 to M23, M0.1 to M9.3**

**Conducted Spurs, 5540 MHz, Non HT/VHT40, 6 to 54 Mbps****Conducted Spurs, 5540 MHz, HT/VHT40, M0 to M23, M0.1 to M9.3**

Conducted Spurs, 5540 MHz, Non HT/VHT20, 6 to 54 Mbps**Conducted Spurs, 5540 MHz, HT/VHT20, M0 to M23, M0.1 to M9.3**

**Conducted Spurs, 5660 MHz, Non HT/VHT40, 6 to 54 Mbps****Conducted Spurs, 5660 MHz, HT/VHT40, M0 to M23, M0.1 to M9.3**

**Conducted Spurs, 5660 MHz, Non HT/VHT20, 6 to 54 Mbps****Conducted Spurs, 5660 MHz, HT/VHT20, M0 to M23, M0.1 to M9.3**



Conducted Bandedge

15.407: For transmitters operating in the 5.25-5.35 and 5.47-5.725 GHz band: all emissions outside of the 5.25-5.35 and 5.47-5.725 GHz bands shall not exceed an EIRP of -27dBm/MHz.

Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer).

Span:	30 MHz-40 GHz
Reference Level:	20 dBm
Attenuation:	10 dB
Sweep Time:	10 s
Resolution Bandwidth:	1 MHz
Video Bandwidth:	3 MHz
Detector:	Peak
Trace:	Single
Marker:	Peak

Record the marker waveform peak to spur difference



Frequency (MHz)	Mode	Data Rate (Mbps)	Correlated Antenna Gain (dBi)	Conducted Bandedge Level (dBm/MHz)	Total Bandedge Level (dBm/MHz)	Limit (dBm/MHz)	Margin (dB)
5500	Non HT/VHT20, 6 to 54 Mbps	3	5	-39.91	-30.14	-27	3.14
	HT/VHT20, M0 to M23, M0.1 to M9.3	3	5	-40.37	-30.60	-27	3.60
	Non HT/VHT40, 6 to 54 Mbps	3	5	-38.1	-28.33	-27	1.33
	HT/VHT40, M0 to M23, M0.1 to M9.3	1	5	-32.54	-27.54	-27	0.54
	Non HT/VHT80, 6 to 54 Mbps	3	5	-38.07	-28.30	-27	1.30
	HT/VHT80, M0 to M23, M0.1 to M9.3	2	5	-35.02	-27.01	-27	0.01
5700	Non HT/VHT20, 6 to 54 Mbps	2	8	-38.95	-27.94	-27	0.94
	HT/VHT20, M0 to M23, M0.1 to M9.3	1	5	-32.15	-27.15	-27	0.15

Agilent Spectrum Analyzer - Swept SA

Conducted Bandwidth Average, 5000 MHz, Res BW 10 MHz, 0 to 0.1 Hz

☒ R L S RF 50 Ω DC SENSE:INT ☒ ALIGN OFF 10:03:32 AM Feb 02, 2013

Center Freq 5.42500000 GHz PNO: Fast → Trig: Free Run #Avg Type: RMS TRACE 1 2 3 4 5 6
 IF Gain: Low #Atten: 4 dB Avg Hold: --/100 TYPE M M M M M M M M
 DET P P P P P P

Ref Offset 26.91 dB
 Ref 10.00 dBm

Mkr2 5.424 25 GHz
-39.905 dBm

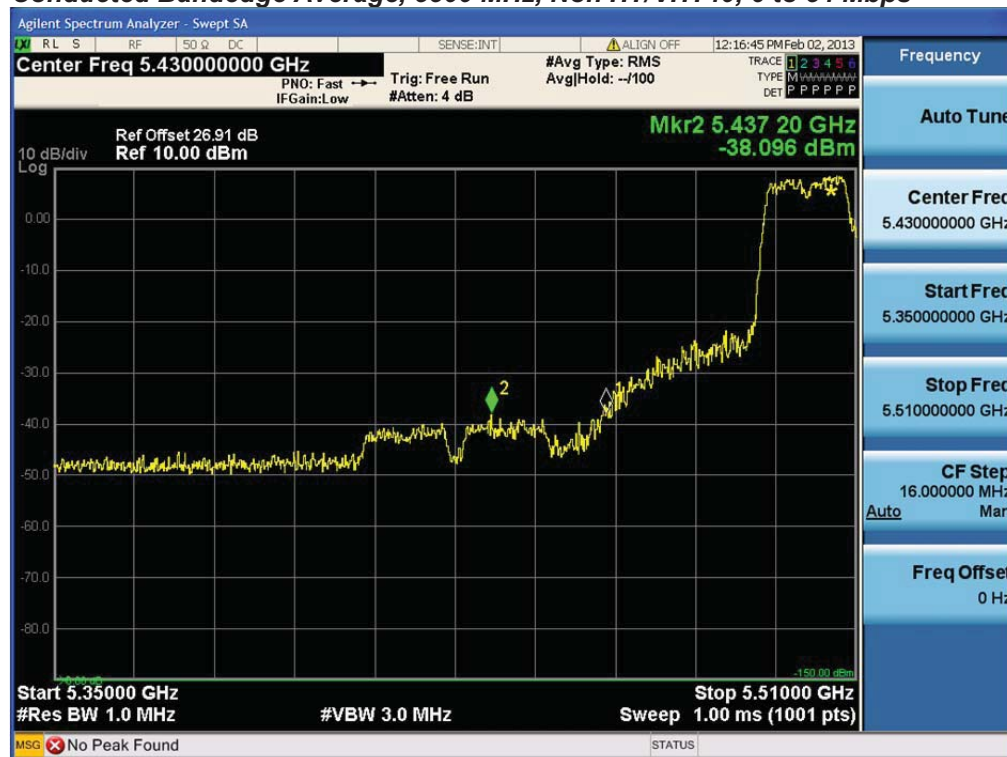
10 dB/div
 Log

Start 5.35000 GHz Stop 5.50000 GHz
 #Res BW 1.0 MHz #VBW 3.0 MHz #Sweep 1.00 ms (1001 pts)

MSG ☒ No Peak Found STATUS

Frequency
 Auto Tune
 Center Freq 5.42500000 GHz
 Start Freq 5.35000000 GHz
 Stop Freq 5.50000000 GHz
 CF Step 15.000000 MHz
 Auto Man
 Freq Offset 0 Hz

[illegible]

Conducted Bandedge Average, 5500 MHz, Non HT/VHT40, 6 to 54 Mbps**Conducted Bandedge Average, 5500 MHz, HT/VHT40, M0 to M23, M0.1 to M9.3**

Conducted Bandedge Average, 5500 MHz, Non HT/VHT80, 6 to 54 Mbps**Conducted Bandedge Average, 5500 MHz, HT/VHT80, M0 to M23, M0.1 to M9.3**

Conducted Bandedge Average, 5500 MHz, Non HT/VHT20, 6 to 54 Mbps**Conducted Bandedge Average, 5500 MHz, HT/VHT20, M0 to M23, M0.1 to M9.3**



20dB Bandwidth

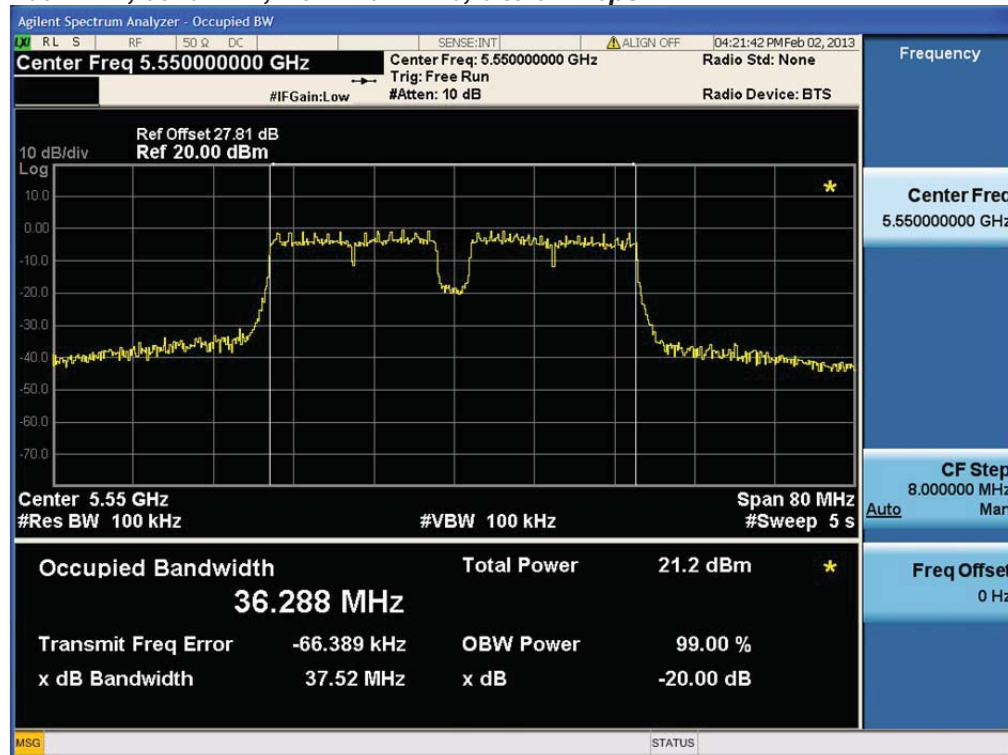
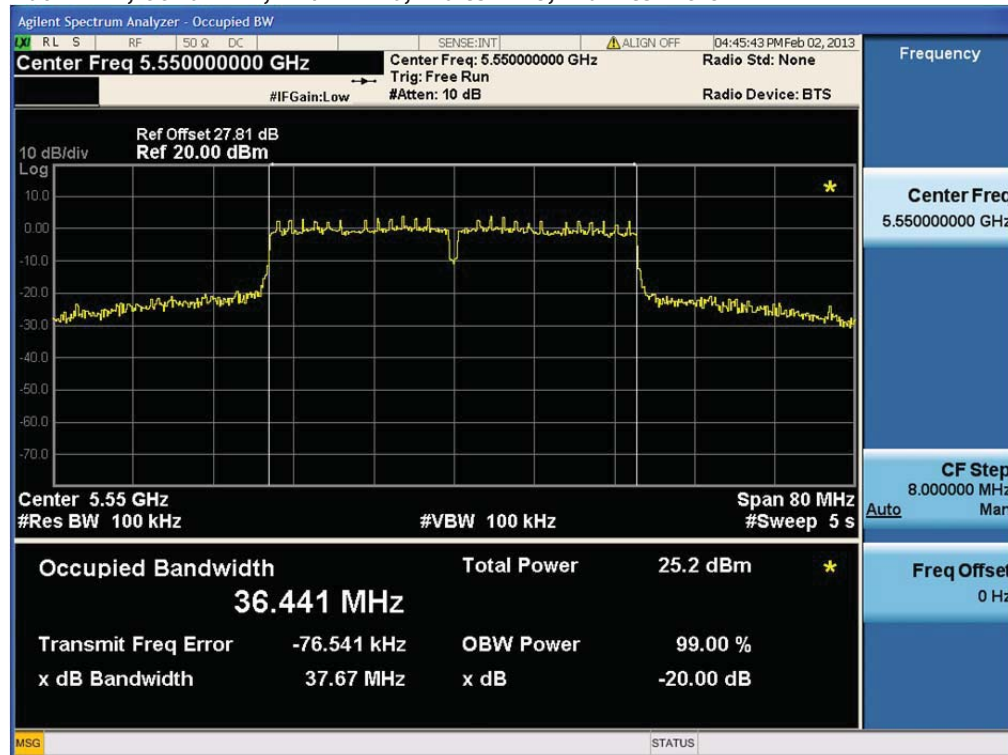
Connect the antenna port(s) to the spectrum analyzer input. Using the spectrum analyzer Channel Bandwidth mode, configure the spectrum analyzer as shown below (enter all losses between the transmitter output and the spectrum analyzer).

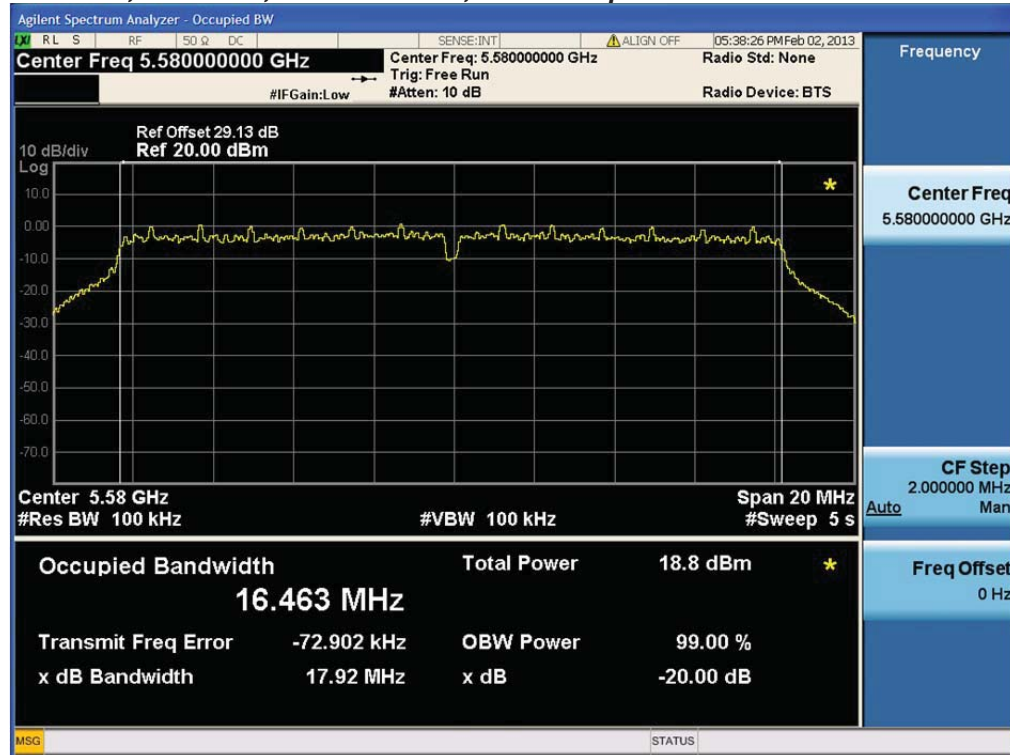
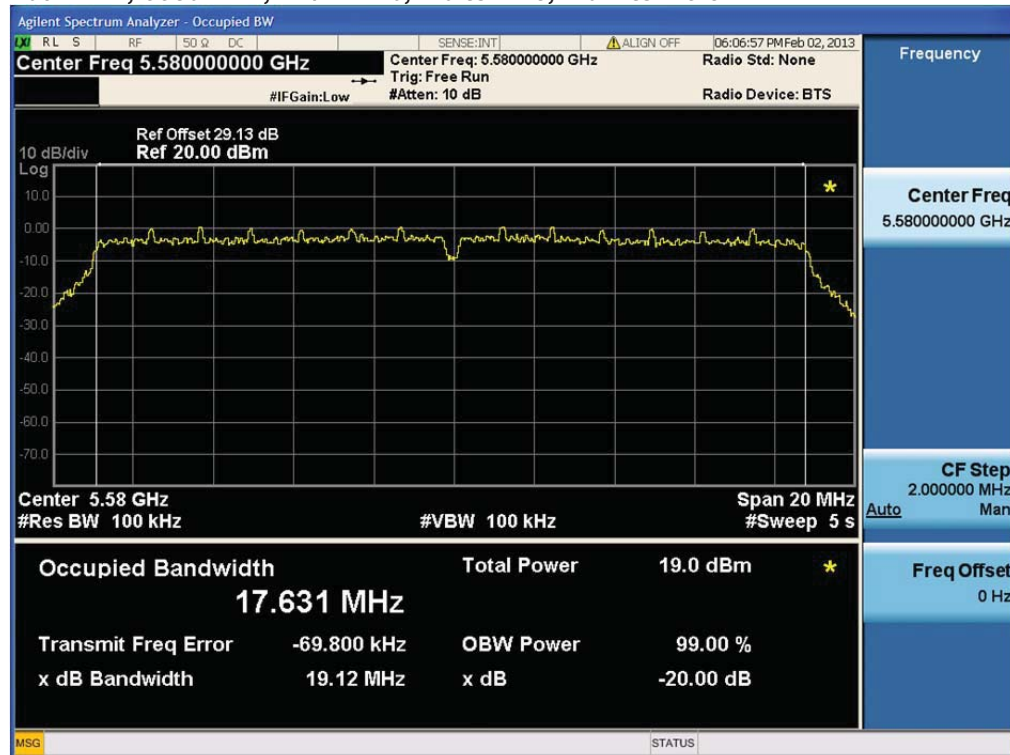
Center Frequency:	Frequency from table below
Span:	2 x Nominal Bandwidth (e.g. 40MHz for a 20MHz channel)
Reference Level:	20 dBm
Attenuation:	10 dB
Sweep Time:	5 s
Resolution Bandwidth:	1%-3% of 20 dB Bandwidth
Video Bandwidth:	≥Resolution Bandwidth
X dB Bandwidth:	20 dB
Detector:	Peak
Trace:	Single

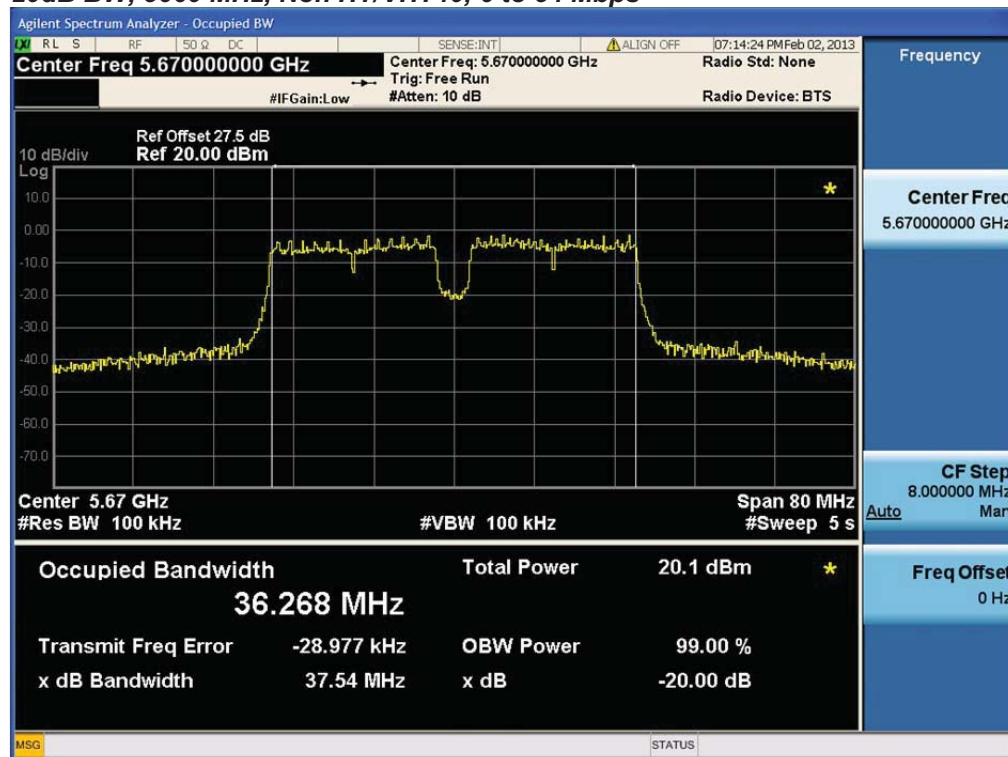
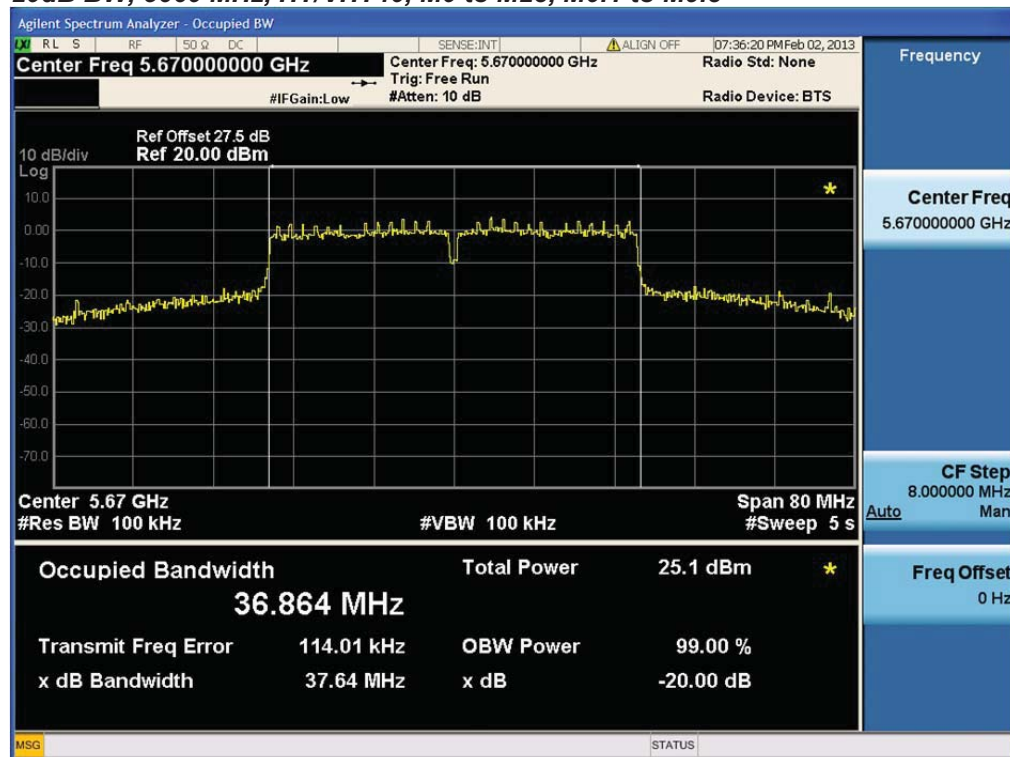
Place the radio in continuous transmit mode. View the transmitter waveform on the spectrum analyzer, and record the pertinent measurements:

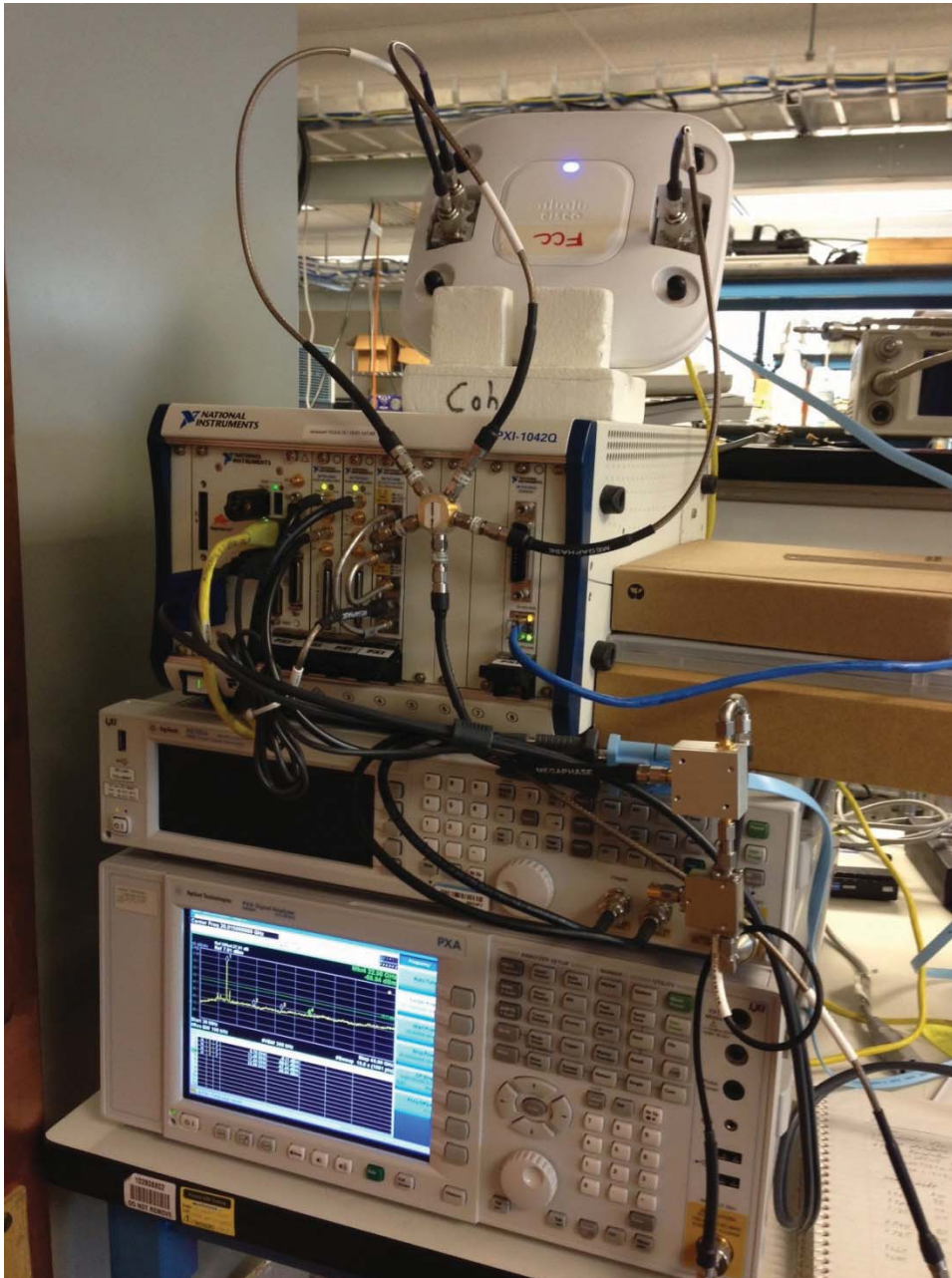


Frequency (MHz)	Mode	Data Rate (Mbps)	20dB BW (MHz)	Limit (kHz)	Margin (MHz)
5540	Non HT/VHT40, 6 to 54 Mbps	6	37.5	40	2.5
	HT/VHT40, M0 to M23, M0.1 to M9.3	M0.	37.6	40	2.4
5580	Non HT/VHT20, 6 to 54 Mbps	6	17.9	20	2.1
	HT/VHT20, M0 to M23, M0.1 to M9.3	M0.	19.1	20	0.9
5660	Non HT/VHT40, 6 to 54 Mbps	6	37.5	40	2.5
	HT/VHT40, M0 to M23, M0.1 to M9.3	M0.	37.7	40	2.3

20dB BW, 5540 MHz, Non HT/VHT40, 6 to 54 Mbps**20dB BW, 5540 MHz, HT/VHT40, M0 to M23, M0.1 to M9.3**

**20dB BW, 5580 MHz, Non HT/VHT20, 6 to 54 Mbps****20dB BW, 5580 MHz, HT/VHT20, M0 to M23, M0.1 to M9.3**

20dB BW, 5660 MHz, Non HT/VHT40, 6 to 54 Mbps**20dB BW, 5660 MHz, HT/VHT40, M0 to M23, M0.1 to M9.3**



Title: Conducted Test Setup

**Appendix B: Emission Test Results**

Testing Laboratory: Cisco Systems, Inc., 170 West Tasman Drive, San Jose, CA 95134, USA

Radiated Spurious Emissions

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

Using Vasona, configure the spectrum analyzer as shown below (be sure to enter all losses between the transmitter output and the spectrum analyzer). Place the radio in continuous transmit mode.

Span:	1GHz – 18 GHz
Reference Level:	80 dBuV
Attenuation:	10 dB
Sweep Time:	Coupled
Resolution Bandwidth:	1MHz
Video Bandwidth:	1 MHz for peak, 10 Hz for average
Detector:	Peak

Maximize Turntable (find worst case table angle), Maximize Antenna (find worst case height)

Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= 54dBuV @3m
 2) Peak plot (Vertical and Horizontal), Limit = 74dBuV @3m

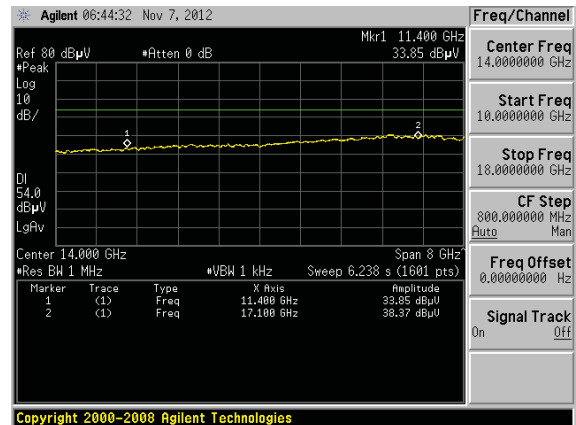
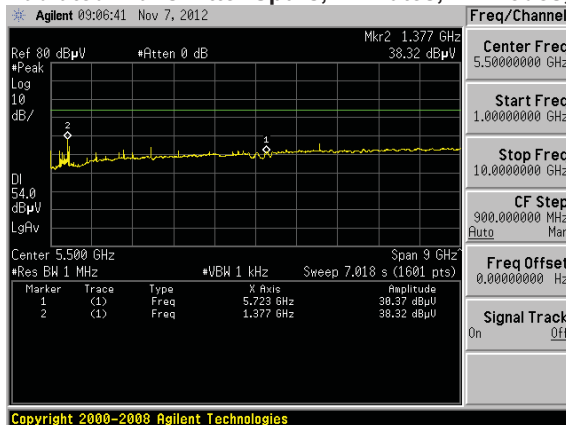
Place a marker at the end of the restricted band closest to the transmit frequency to show compliance.
Also measure any emissions in the restricted bands.

This report represents the worst case data for all supported operating modes and antennas.
There are no measurable emissions above 18 GHz.

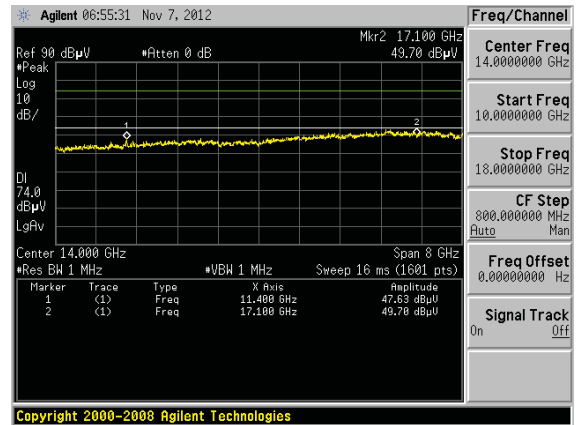
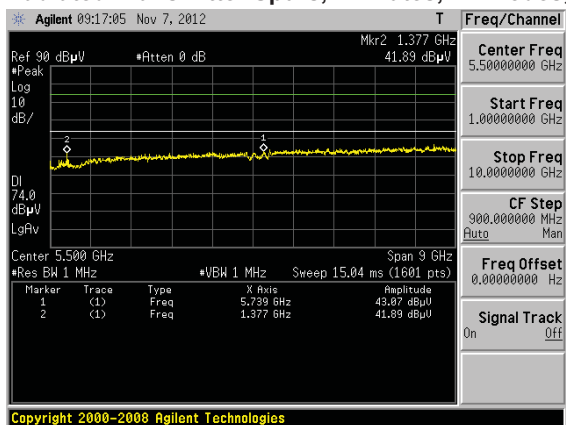


Transmitter Radiated Spurious Emissions

Radiated Transmitter Spurs, All Rates, All Modes, Average

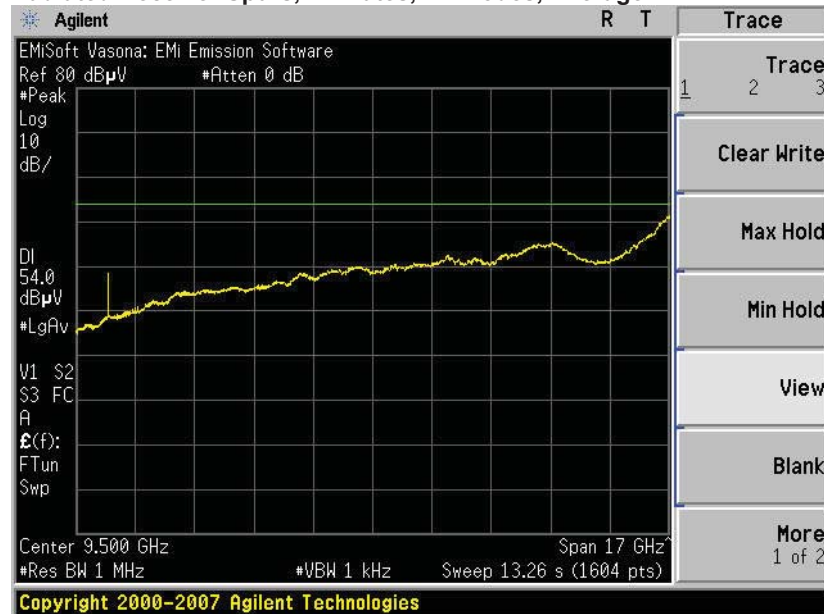


Radiated Transmitter Spurs, All Rates, All Modes, Peak

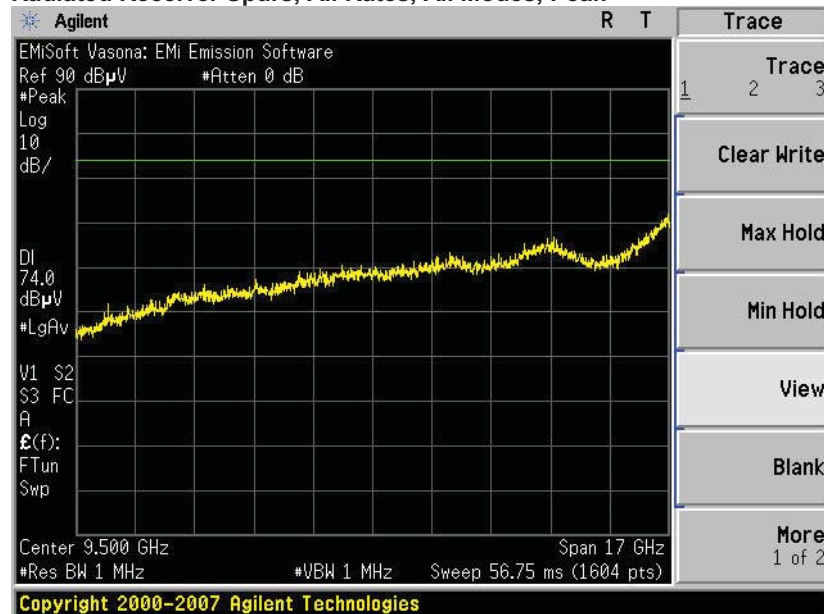


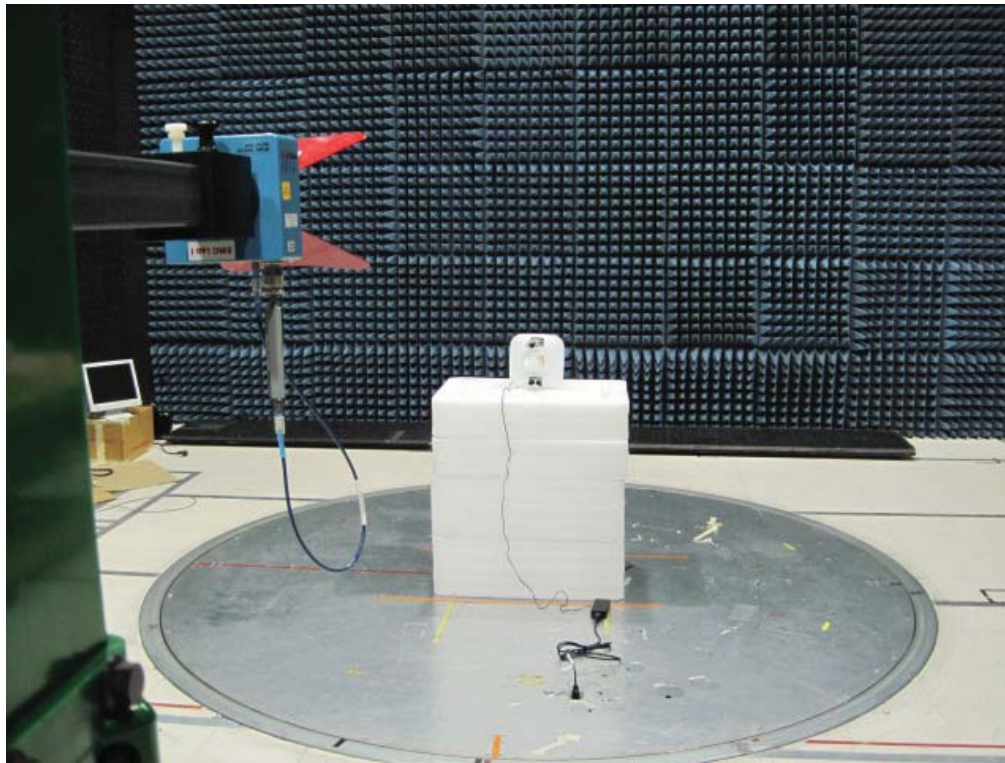
Receiver Radiated Spurious Emissions

Radiated Receiver Spurs, All Rates, All Modes, Average



Radiated Receiver Spurs, All Rates, All Modes, Peak

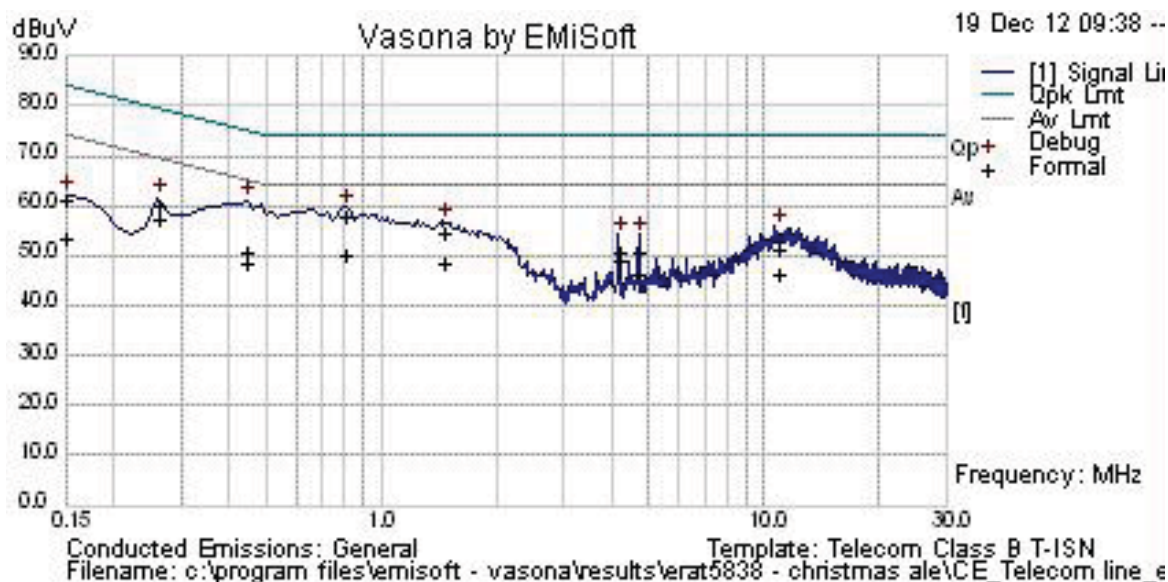




Radiated Test Setup



Conducted Emissions

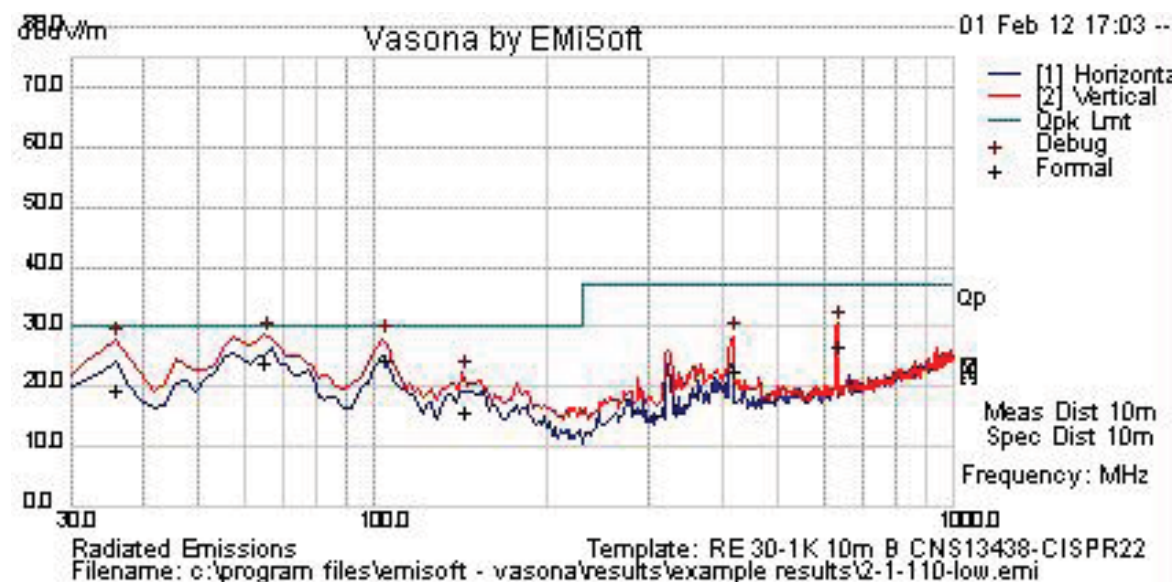


Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.444	38.7	0.2	9.7	48.6	Qp	SL	75	-26.4	Pass	
0.808	48.2	0.2	9.7	58	Qp	SL	74	-16	Pass	
1.46	44.8	0.2	9.7	54.7	Qp	SL	74	-19.3	Pass	
0.261	50.4	0.1	9.8	60.2	Qp	SL	79.4	-19.2	Pass	
10.86	40.7	0.4	10	51.1	Qp	SL	74	-22.9	Pass	
4.703	40.5	0.3	9.8	50.5	Qp	SL	74	-23.5	Pass	
4.181	40.8	0.3	9.8	50.8	Qp	SL	74	-23.2	Pass	
0.15	51.6	0.1	9.8	61.5	Qp	SL	84	-22.5	Pass	
0.444	41	0.2	9.7	50.9	Av	SL	65	-14.1	Pass	
0.808	40.3	0.2	9.7	50.1	Av	SL	64	-13.9	Pass	
1.46	38.6	0.2	9.7	48.4	Av	SL	64	-15.6	Pass	
0.261	47.4	0.1	9.8	57.3	Av	SL	69.4	-12.1	Pass	
10.86	36.1	0.4	10	46.5	Av	SL	64	-17.5	Pass	
4.703	36.5	0.3	9.8	46.5	Av	SL	64	-17.5	Pass	
4.181	39.2	0.3	9.8	49.2	Av	SL	64	-14.8	Pass	
0.15	43.6	0.1	9.8	53.5	Av	SL	74	-20.5	Pass	



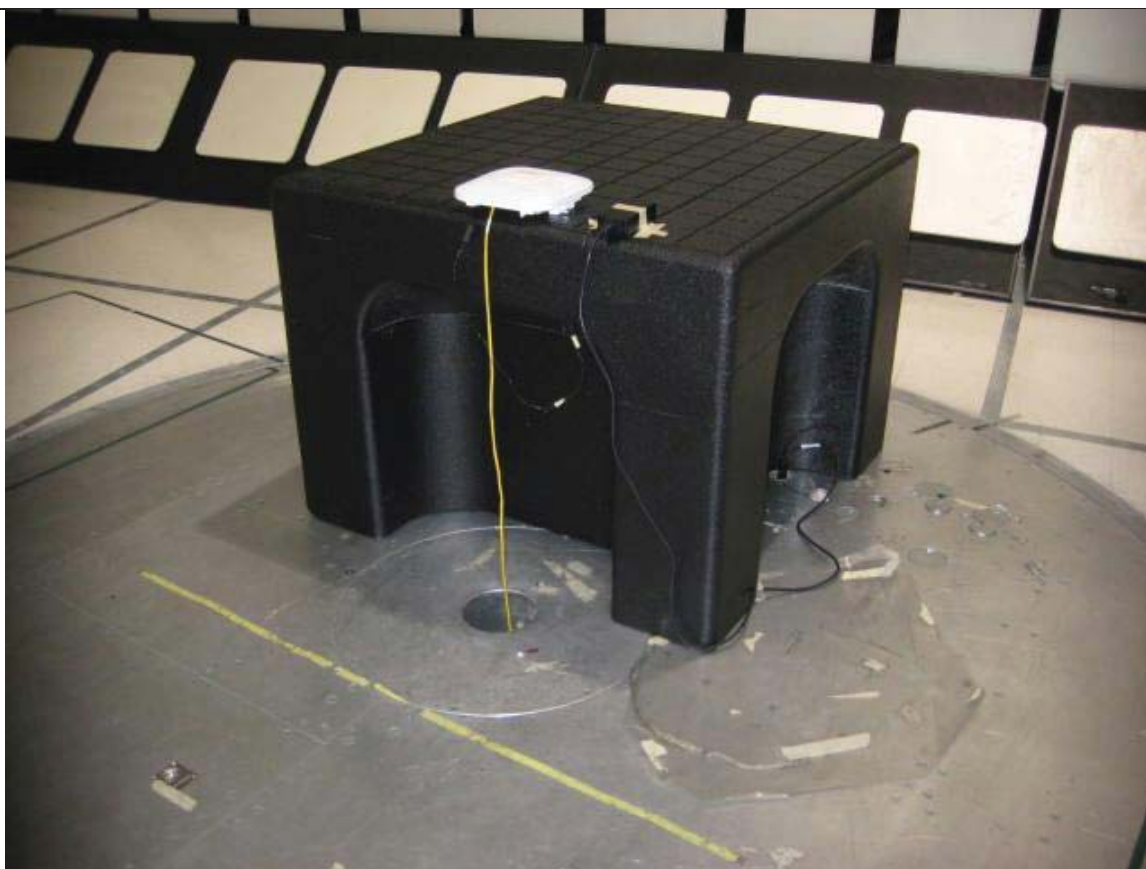


Radiated emissions



Test Results Table

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measureme nt Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
103.916	44.1	1.2	-20.8	24.5	Qp	V	137	204	30	-5.5	Pass	
64.728	47.2	1	-24.3	24	Qp	V	170	134	30	-6	Pass	
632.581	37.4	2.4	-13.4	26.5	Qp	V	126	0	37	-10.5	Pass	
35.673	34.1	0.9	-15.5	19.4	Qp	V	317	253	30	-10.6	Pass	
143.086	33.8	1.3	-19.6	15.6	Qp	V	282	44	30	-14.4	Pass	
416.829	36.6	2	-16.2	22.5	Qp	V	148	26	37	-14.5	Pass	



Title: Radiated Emissions Configuration Photograph

Maximum Permissible Exposure (MPE) Calculations

15.407: U-NII devices are subject to the radio frequency radiation exposure requirements specified in Sec. 1.1307(b), Sec. 2.1091 and Sec. 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a "general population/uncontrolled" environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.

Given

$$E = \sqrt{(30 \cdot P \cdot G)/d} \text{ and } S = E^2/3770$$

where

E=Field Strength in Volts/meter

P=Power in Watts

G=Numeric Antenna Gain

d=Distance in meters

S=Power Density in mW/cm²

Combine equations and rearrange the terms to express the distance as a function of the remaining variables:

$$d = \sqrt{((30 \cdot P \cdot G)/(3770 \cdot S))}$$

Changing to units of power in mW and distance in cm, using:

$$P(\text{mW}) = P(\text{W})/1000 \quad d(\text{cm}) = 100 \cdot d(\text{m})$$

yields

$$d = 100 \cdot \sqrt{((30 \cdot (P/1000) \cdot G)/(3770 \cdot S))}$$

$$d = 0.282 \cdot \sqrt{(P \cdot G/S)}$$

where

d=Distance in cm

P=Power in mW

G=Numerica Antenna Gain

S=Power Density in mW/cm²

Substituting the logarithmic form of power and gain using:

$$P(\text{mW}) = 10^{(P(\text{dBm})/10)} \quad G(\text{numeric}) = 10^{(G(\text{dBi})/10)}$$

yields

$$d = 0.282 \cdot 10^{((P+G)/20)} / \sqrt{S} \quad \text{Equation (1)}$$

and

$$s = ((0.282 \cdot 10^{((P+G)/20)})/d)^2 \quad \text{Equation (2)}$$

where

d=MPE distance in cm

P=Power in dBm

G=Antenna Gain in dBi

S=Power Density in mW/cm²



Equation (1) and the measured peak power are used to calculate the MPE distance. Note that for mobile or fixed location transmitters such as an access point, the minimum separation distance is 20 cm even if the calculations indicate that the MPE distance may be less.

$S=1\text{mW/cm}^2$ maximum. The highest supported antenna gain is 6 dBi (9dBi with beamforming). Using the peak power levels recorded in the test report along with Equation 1 above, the MPE distances are calculated as follows.

Frequency (MHz)	Bit Rate (Mbps)	Power Density (mW/cm ²)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)	Limit (cm)	Margin (cm)
5500	54	1	20	10	8.92	20	11.08
5700	54	1	20	10	8.92	20	11.08

MPE Calculations

To maintain compliance, installations will assure a separation distance of at least 20cm.

Using Equation 2, the MPE levels (s) at 20 cm are calculated as follows:

Frequency (MHz)	Bit Rate (Mbps)	MPE Distance (cm)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm ²)	Limit (mW/cm ²)	Margin (mW/cm ²)
5500	54	20	20	10	0.20	1	0.80
5700	54	20	20	10	0.20	1	0.80

**Appendix C: Test Equipment/Software Used to perform the test**

Equip #	Manufacturer	Model	Description	Last Cal	Next Due
CIS004882	EMC Test Systems	3115	Double Ridged Guide Horn Antenna	26-May-12	26-May-13
CIS005691	Miteq	NSP1800-25-S1	Broadband Preamplifier	31-Jan-12	31-Jan-13
COM000210	TTE	H785-150K-50-21378	Hi Pass Filter - 150KHz cutoff	17-Aug-12	17-Aug-13
COM000213	Fischer	FCC-LISN-50-50-2M	Turntable LISN (150KHz-30MHz)	5-Mar-12	5-Mar-13
CIS021117	Micro-Coax	UFB311A-0-2484-520520	RF Coaxial Cable, to 18GHz, 248.4 in	24-Aug-12	24-Aug-13
CIS030564	Micro-Coax	UFB311A-1-0950-504504	RF Coaxial Cable, to 18GHz, 95 in	24-Aug-12	24-Aug-13
COM000233	Sunol Sciences	JB1	Combination Antenna, 30MHz-2GHz	13-Jul-12	13-Jul-13
COM000239	Rohde & Schwarz	ESI40	EMI Test Receiver	21-Jun-12	21-Jun-13
COM000443	Sonoma Instrument	310N	Amplifier 9kHz-1GHz	8-Apr-12	8-Apr-13
CIS034972	Midwest Microwave	ATT-0640-20-29M-02	Attenuator, 20dB	17-May-12	16-May-13
CIS043116	Huber + Suhner	Sucoflex 104PE	N & SMA RF cable	14-Dec-12	14-Dec-13
CIS040603	Agilent	E4440A	Spectrum Analyzer	5-Aug-12	5-Aug-13
CIS040053	Agilent	E4448A	Spectrum Analyzer	29-Apr-12	28-Apr-13