Conducted Spurs Average, 5825 MHz, Non HT-20, 6 to 54 Mbps

Antenna A

Conducted Spurs Average, 5825 MHz, Non HT-20, 6 to 54 Mbps

Antenna A

Antenna B

Conducted Spurs Average, 5825 MHz, HT-20, M0 to M7

Antenna A

Conducted Spurs Average, 5825 MHz, HT-20, M0 to M7

Antenna A

Antenna B

Conducted Spurs Average, 5825 MHz, HT-20, M8 to M15

Antenna A

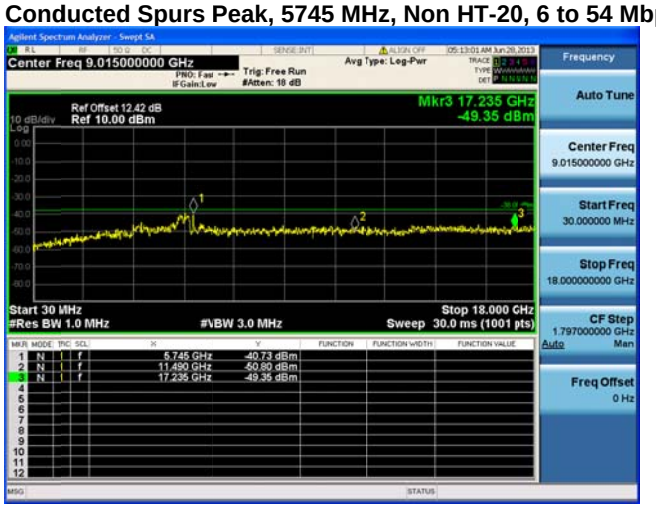
Antenna B

Conducted Spurs Average, 5825 MHz, HT-20 STBC, M0 to M7

Antenna A

Antenna B

Conducted Spurs Peak, 5745 MHz, Non HT-20, 6 to 54 Mbps



Antenna A

Conducted Spurs Peak, 5745 MHz, Non HT-20, 6 to 54 Mbps

Antenna A

Antenna B

Conducted Spurs Peak, 5745 MHz, HT-20, M0 to M7

Antenna A

Conducted Spurs Peak, 5745 MHz, HT-20, M0 to M7

Antenna A

Antenna B

Conducted Spurs Peak, 5745 MHz, HT-20, M8 to M15

Antenna A

Antenna B

Conducted Spurs Peak, 5745 MHz, HT-20 STBC, M0 to M7

Antenna A

Antenna B

Conducted Spurs Peak, 5755 MHz, Non HT-40, 6 to 54 Mbps

Antenna A

Conducted Spurs Peak, 5755 MHz, Non HT-40, 6 to 54 Mbps

Antenna A

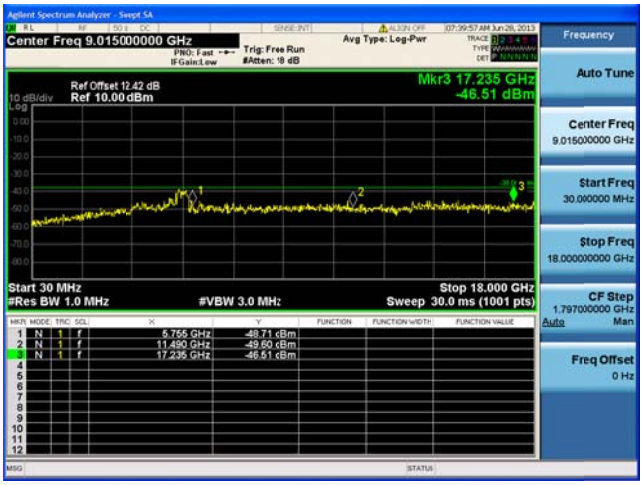
Antenna B

Conducted Spurs Peak, 5755 MHz, HT-40, M0 to M7

Antenna A

Conducted Spurs Peak, 5755 MHz, HT-40, M0 to M7

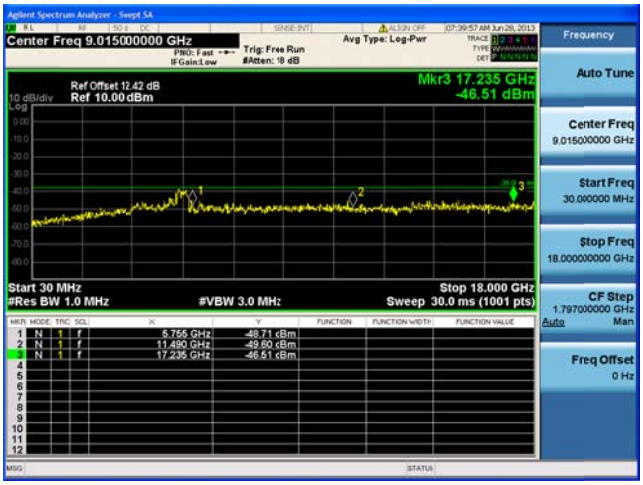
Antenna A



Antenna B

Conducted Spurs Peak, 5755 MHz, HT-40, M8 to M15

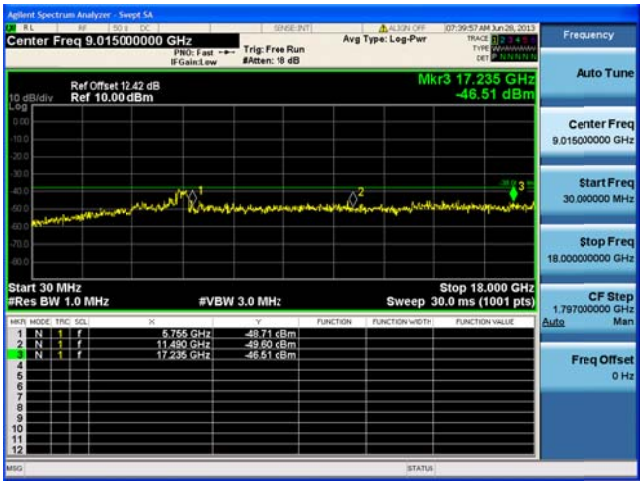
Antenna A



Antenna B

Conducted Spurs Peak, 5755 MHz, HT-40 STBC, M0 to M7

Antenna A



Antenna B

Conducted Spurs Peak, 5785 MHz, Non HT-20, 6 to 54 Mbps

Antenna A

Conducted Spurs Peak, 5785 MHz, Non HT-20, 6 to 54 Mbps

Antenna A

Antenna B

Conducted Spurs Peak, 5785 MHz, HT-20, M0 to M7

Antenna A

Conducted Spurs Peak, 5785 MHz, HT-20, M0 to M7

Antenna A

Antenna B

Conducted Spurs Peak, 5785 MHz, HT-20, M8 to M15

Antenna A

Antenna B

Conducted Spurs Peak, 5785 MHz, HT-20 STBC, M0 to M7

Antenna A

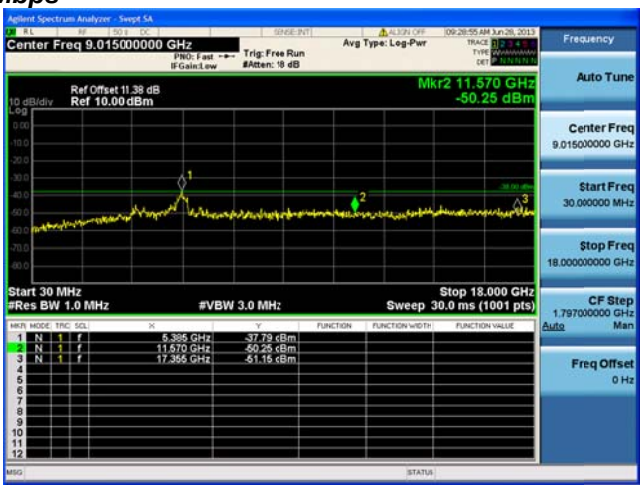
Antenna B

Conducted Spurs Peak, 5795 MHz, Non HT-40, 6 to 54 Mbps

Antenna A

Conducted Spurs Peak, 5795 MHz, Non HT-40, 6 to 54 Mbps

Antenna A



Antenna B

Conducted Spurs Peak, 5795 MHz, HT-40, M0 to M7

Antenna A

Conducted Spurs Peak, 5795 MHz, HT-40, M0 to M7

Antenna A

Antenna B

Conducted Spurs Peak, 5795 MHz, HT-40, M8 to M15

Antenna A

Antenna B

Conducted Spurs Peak, 5795 MHz, HT-40 STBC, M0 to M7

Antenna A

Antenna B

Conducted Spurs Peak, 5825 MHz, Non HT-20, 6 to 54 Mbps

Antenna A

Conducted Spurs Peak, 5825 MHz, Non HT-20, 6 to 54 Mbps

Antenna A

Antenna B

Conducted Spurs Peak, 5825 MHz, HT-20, M0 to M7

Antenna A

Conducted Spurs Peak, 5825 MHz, HT-20, M0 to M7

Antenna A

Antenna B

Conducted Spurs Peak, 5825 MHz, HT-20, M8 to M15

Antenna A

Antenna B

Conducted Spurs Peak, 5825 MHz, HT-20 STBC, M0 to M7

Antenna A

Antenna B

Conducted Bandedge

15.247: In any 100 kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

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).

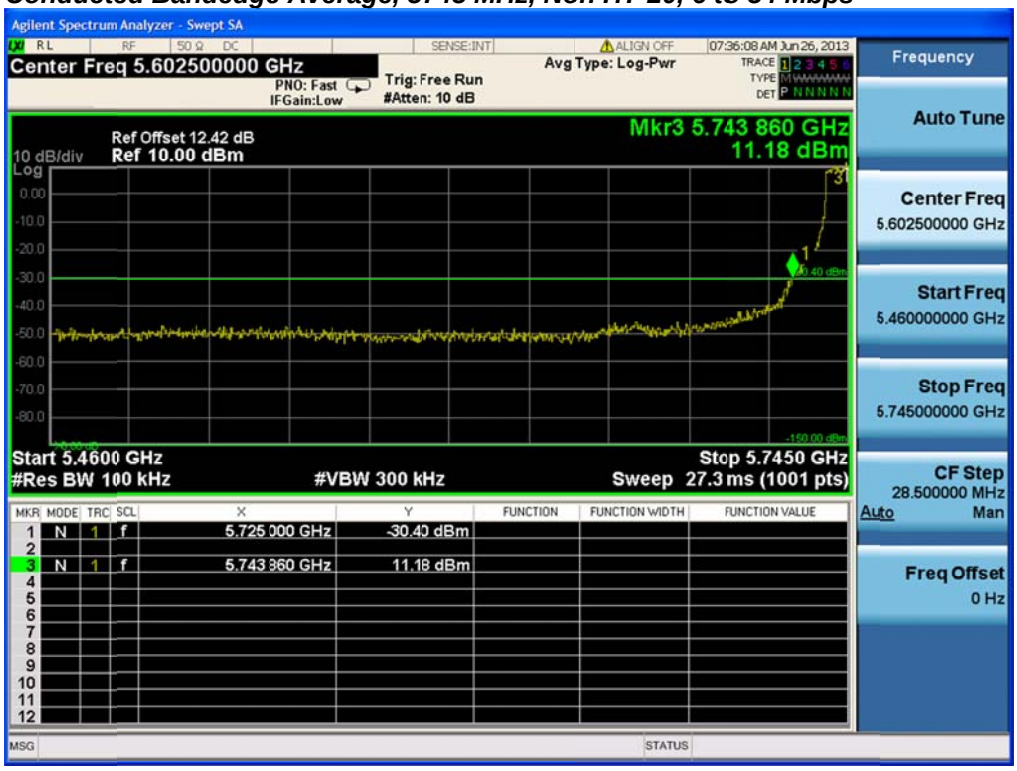
Span:	30 MHz-26 GHz
Reference Level:	20 dBm
Attenuation:	10 dB
Sweep Time:	5s
Resolution Bandwidth:	100 kHz
Video Bandwidth:	300 kHz
Detector:	Peak
Trace:	Single
Marker:	Peak

Record the marker waveform peak to spur difference

Out-of-band and spurious emissions tests are performed on each output individually without summing or adding 10 log(N) since the measurements are made relative to the in-band emissions on the individual outputs. The worst case output is recorded.

Frequency (MHz)	Mode	Tx Paths	Conducted Bandedge Delta (dB)	Limit (dB c)	Margin (dB)
5745	Non HT-20, 6 to 54 Mbps	6	41.6	>30	11.6
	HT-20, M0 to M23	m0	40.1	>30	10.1
5755	Non HT-40, 6 to 54 Mbps	6	33.5	>30	3.5
	HT-40, M0 to M23	m0	34.7	>30	4.7
5795	Non HT-40, 6 to 54 Mbps	6	46.6	>30	16.6
	HT-40, M0 to M23	m0	51.9	>30	21.9
5825	Non HT-20, 6 to 54 Mbps	6	46.9	>30	16.9
	HT-20, M0 to M23	m0	49.4	>30	19.4

Conducted Bandedge Average, 5745 MHz, Non HT-20, 6 to 54 Mbps



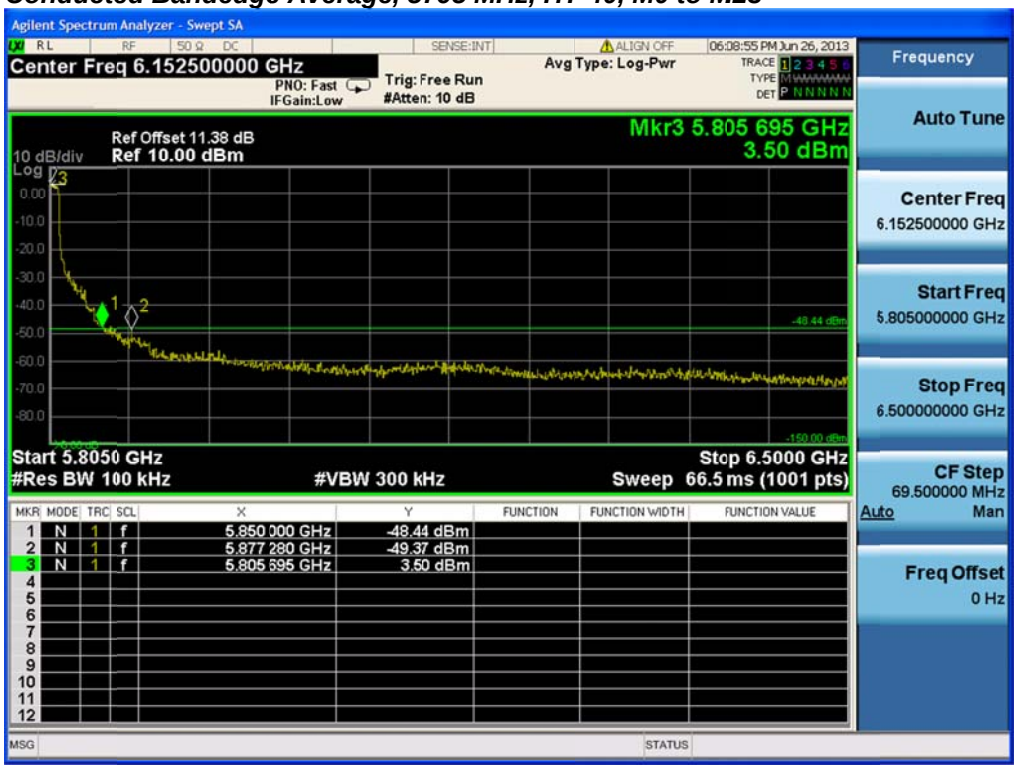
Conducted Bandedge Average, 5745 MHz, HT-20, M0 to M23

Conducted Bandedge Average, 5755 MHz, Non HT-40, 6 to 54 Mbps

Conducted Bandedge Average, 5755 MHz, HT-40, M0 to M23

Conducted Bandedge Average, 5795 MHz, Non HT-40, 6 to 54 Mbps

Conducted Bandedge Average, 5795 MHz, HT-40, M0 to M23



Conducted Bandedge Average, 5825 MHz, Non HT-20, 6 to 54 Mbps

Conducted Bandedge Average, 5825 MHz, HT-20, M0 to M23

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)

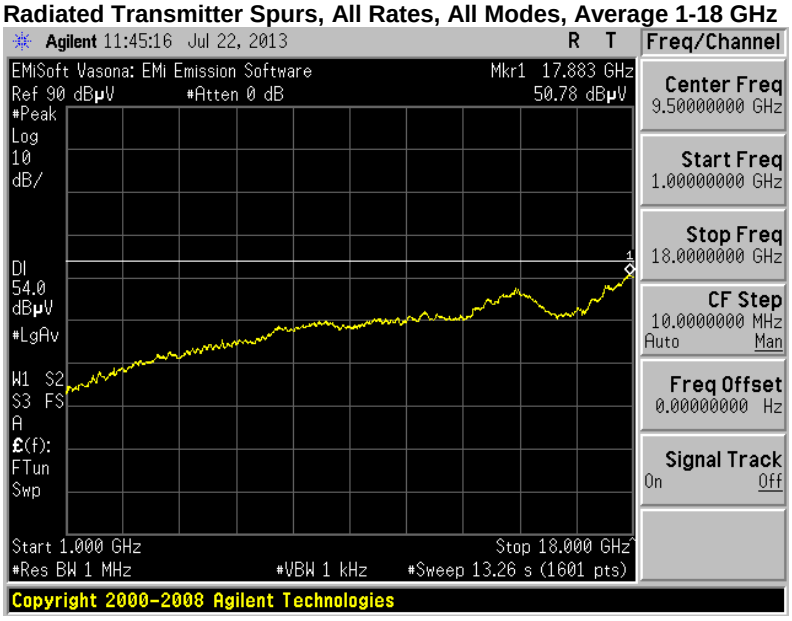
Save 2 plots: 1) Average Plot (Vertical and Horizontal), Limit= 54dBuV @3m
2) Peak plot (Vertical and Horizontal), Limit = 74dBuV @3m

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.

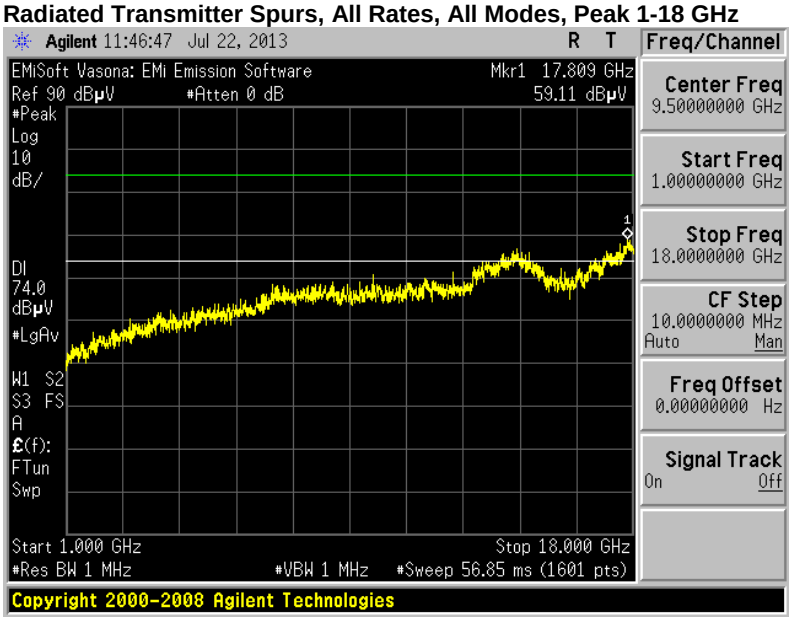
This report represents the worst case data for all supported operating modes and antennas. There are no measurable emissions above 18 GHz.

Transmitter Radiated Spurious Emissions

Radiated Transmitter Spurs, All Rates, All Modes, Average 1-18 GHz

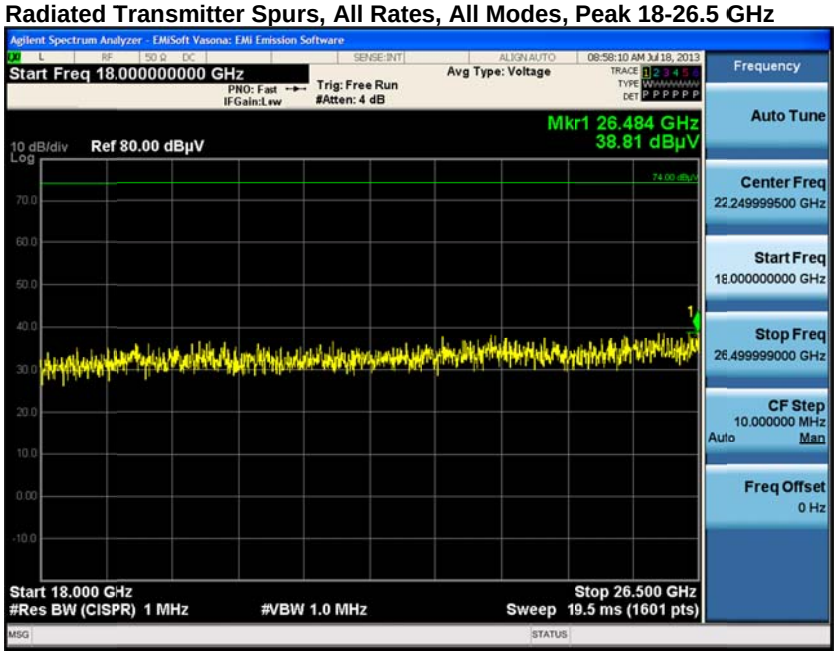


Radiated Transmitter Spurs, All Rates, All Modes, Peak 1-18 GHz

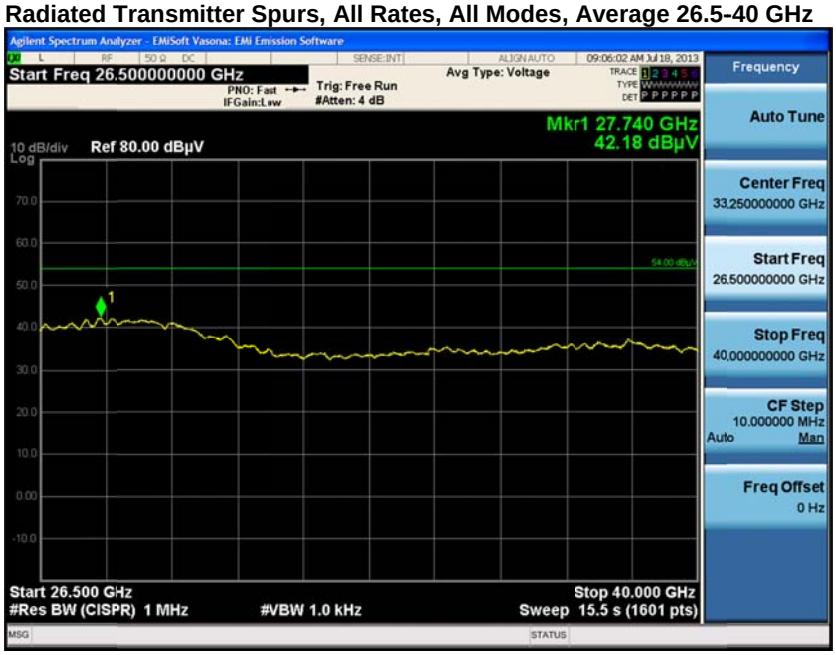


Radiated Transmitter Spurs, All Rates, All Modes, Average 18-26.5 GHz

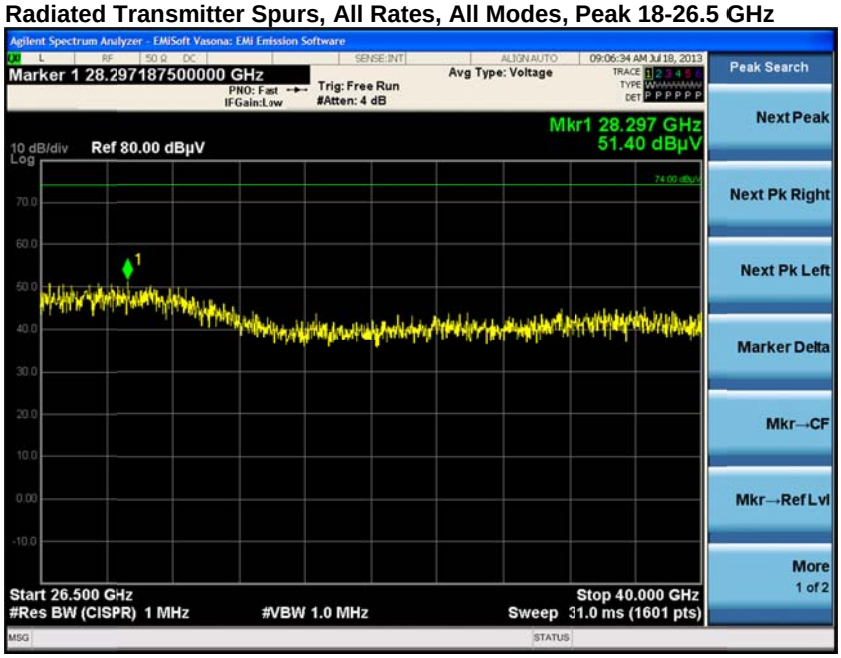
Radiated Transmitter Spurs, All Rates, All Modes, Peak 18-26.5 GHz



Radiated Transmitter Spurs, All Rates, All Modes, Average 26.5-40 GHz

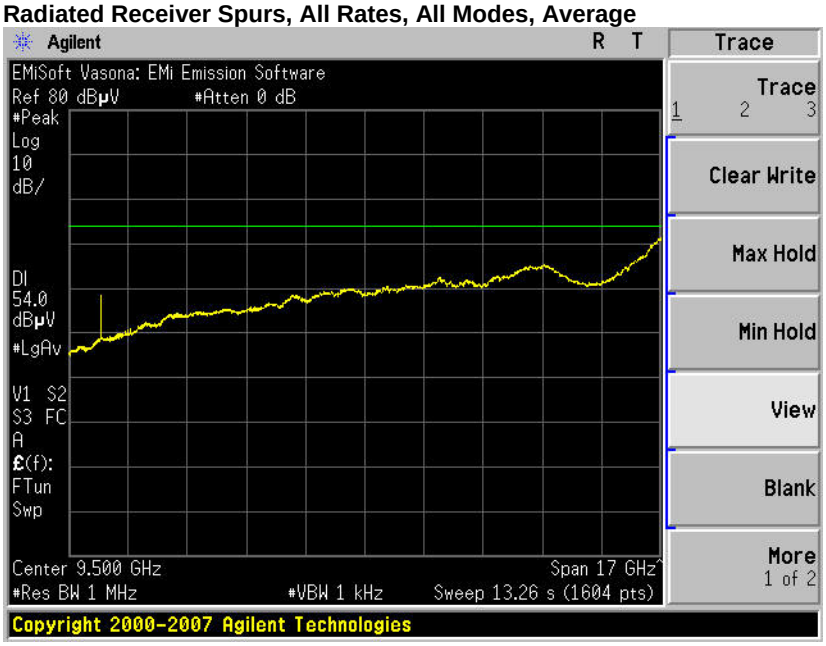


Radiated Transmitter Spurs, All Rates, All Modes, Peak 18-26.5 GHz

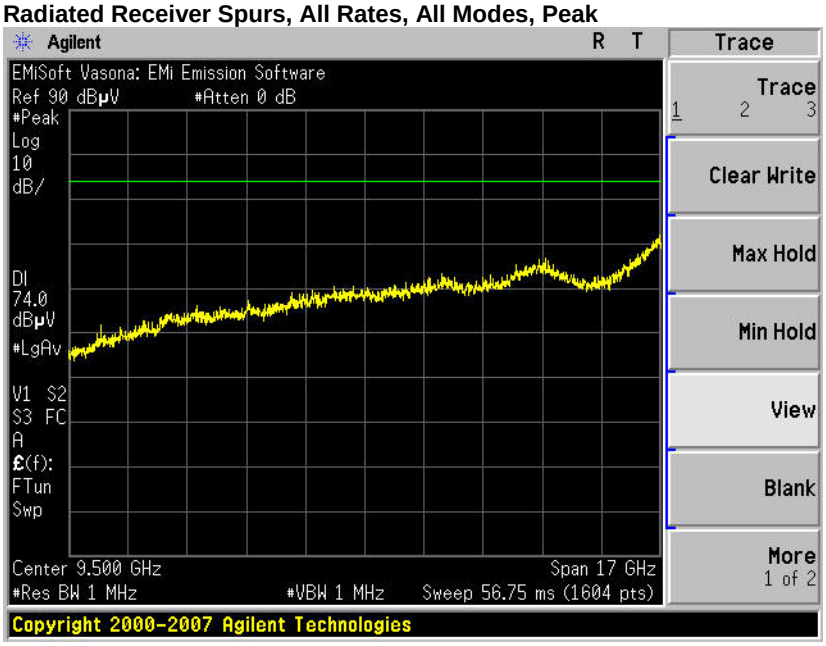


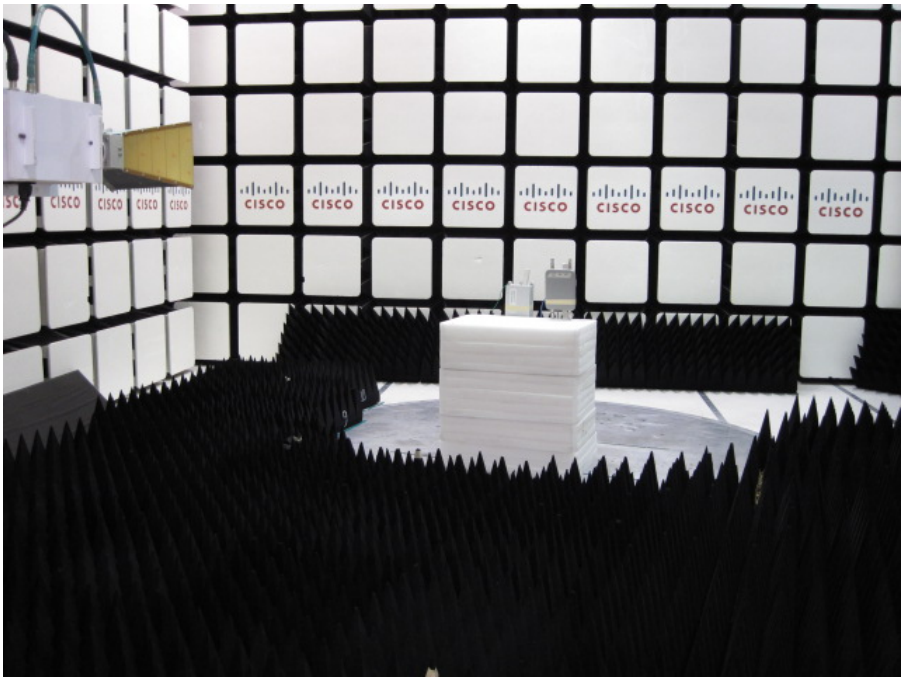
Receiver Radiated Spurious Emissions

Radiated Receiver Spurs, All Rates, All Modes, Average

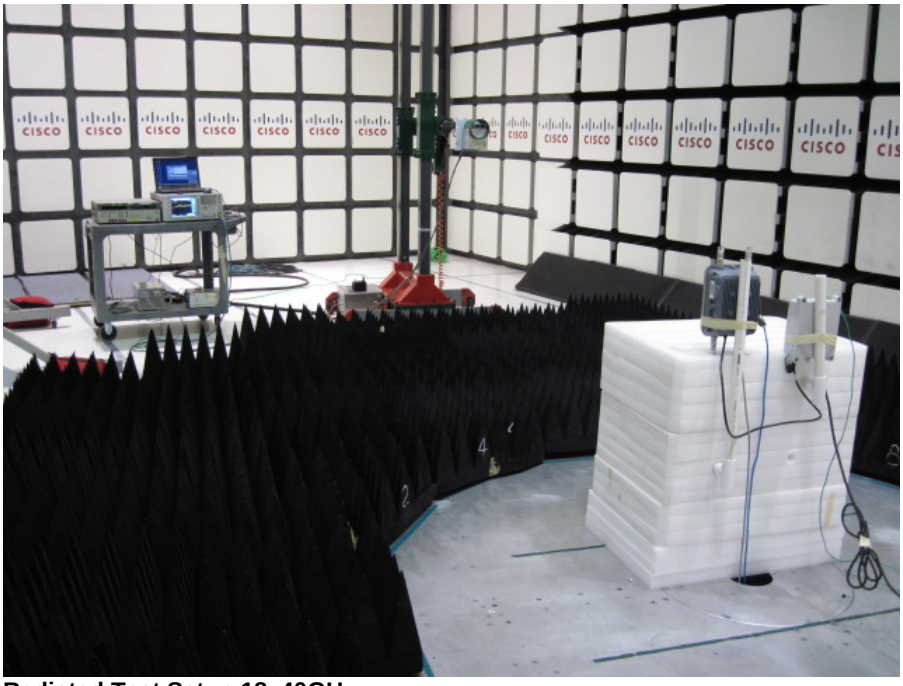


Radiated Receiver Spurs, All Rates, All Modes, Peak



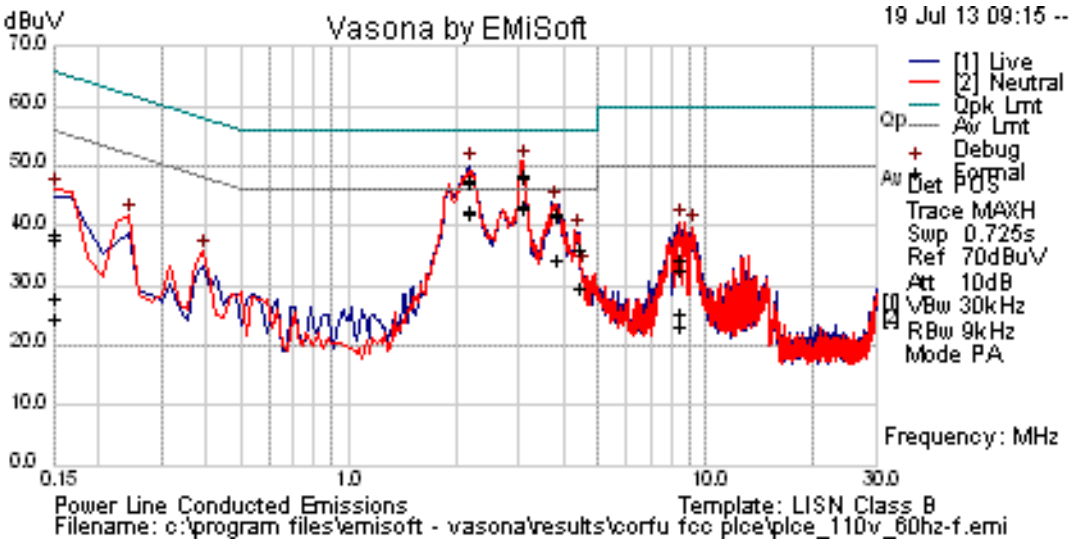


Radiated Test Setup 1–18GHz



Radiated Test Setup 18–40GHz

Conducted Emissions

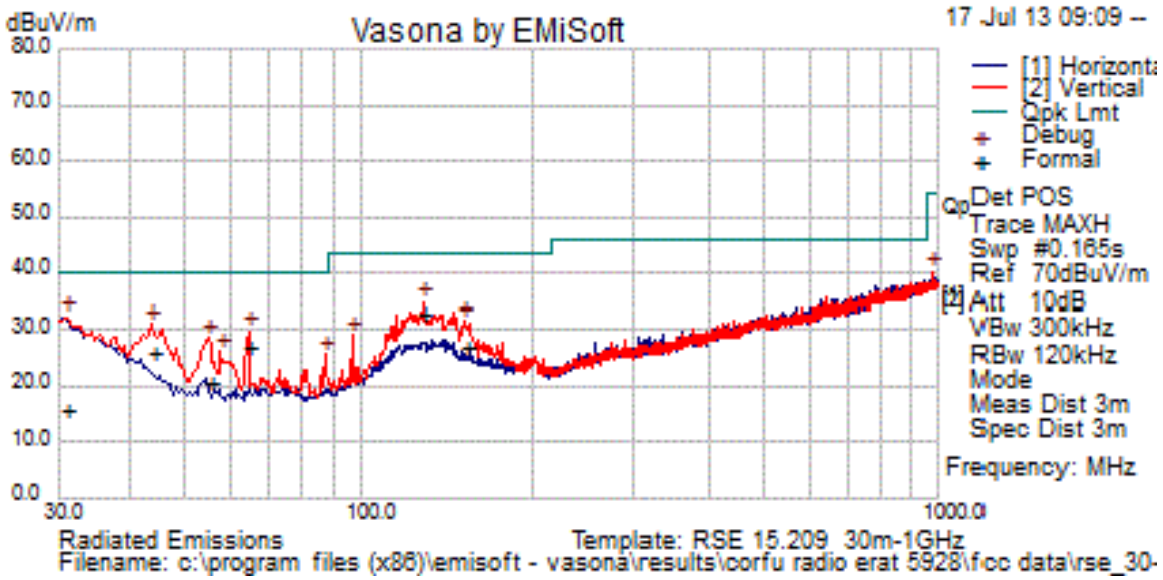


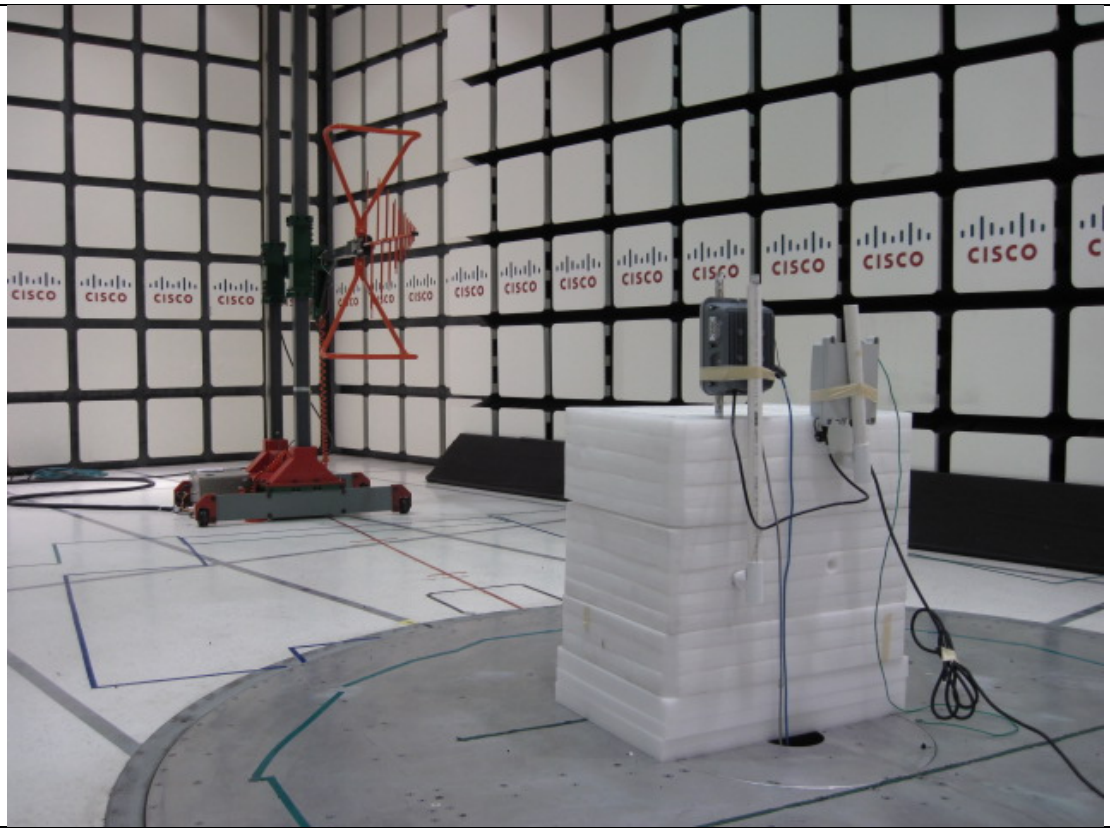
No	Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass / Fail
1	3.079	23.2	20.0	.0	43.2	Average	Neutral	46.0	-2.8	Pass
2	3.079	23.1	20.0	.0	43.1	Average	Live	46.0	-2.9	Pass
3	2.183	22.3	20.0	.0	42.3	Average	Neutral	46.0	-3.7	Pass
4	2.184	22.2	20.0	.0	42.2	Average	Live	46.0	-3.8	Pass
5	3.079	28.3	20.0	.0	48.3	Quasi Peak	Neutral	56.0	-7.7	Pass
6	3.079	28.2	20.0	.0	48.2	Quasi Peak	Live	56.0	-7.8	Pass
7	2.183	27.4	20.0	.0	47.5	Quasi Peak	Neutral	56.0	-8.6	Pass
8	2.184	27.3	20.0	.0	47.3	Quasi Peak	Live	56.0	-8.7	Pass
9	3.819	14.3	20.0	.1	34.3	Average	Neutral	46.0	-11.7	Pass
10	3.819	14.3	20.0	.1	34.3	Average	Live	46.0	-11.7	Pass
11	3.819	22.0	20.0	.1	42.0	Quasi Peak	Neutral	56.0	-14.0	Pass
12	3.819	21.6	20.0	.1	41.6	Quasi Peak	Live	56.0	-14.4	Pass
13	4.420	9.5	20.0	.1	29.5	Average	Neutral	46.0	-16.5	Pass
14	4.420	9.4	20.0	.1	29.5	Average	Live	46.0	-16.5	Pass
15	4.420	16.1	20.0	.1	36.2	Quasi Peak	Live	56.0	-19.8	Pass
16	4.420	16.0	20.0	.1	36.1	Quasi Peak	Neutral	56.0	-19.9	Pass
17	8.469	5.0	20.1	.1	25.2	Average	Neutral	50.0	-24.8	Pass
18	8.469	14.3	20.1	.1	34.5	Quasi Peak	Neutral	60.0	-25.5	Pass
19	8.469	2.8	20.1	.1	23.0	Average	Live	50.0	-27.0	Pass
20	.150	17.3	21.4	.1	38.8	Quasi Peak	Neutral	66.0	-27.2	Pass
21	8.469	12.6	20.1	.1	32.8	Quasi Peak	Live	60.0	-27.2	Pass

22	.150	6.3	21.4	.1	27.8	Average	Neutral	56.0	-28.2	Pass
23	.150	16.2	21.4	.1	37.7	Quasi Peak	Live	66.0	-28.3	Pass
24	.150	2.9	21.4	.1	24.4	Average	Live	56.0	-31.6	Pass

Conducted Emission Test Setup

Radiated emissions





Title: Radiated Emissions 30-1000MHz Configuration Photograph

Maximum Permissible Exposure (MPE) Calculations

15.247: 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

$E=\sqrt{(30*P*G)/d}$ 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/cm^2

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

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

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

P(mW)=P(W)/1000 d(cm)=100*d(m)

yields

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

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

where

d=Distance in cm
P=Power in mW
G=Numeric Antenna Gain
S=Power Density in mW/cm^2

Substituting the logarithmic form of power and gain using:

P(mW)=10^(P(dBm)/10) G(numeric)=10^(G(dBi)/10)

yields

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

and

$s=((0.282*10^{((P+G)/20)})/d)^2$ Equation (2)

where

d=MPE distance in cm
P=Power in dBm
G=Antenna Gain in dBi
S=Power Density in mW/cm^2

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=1mW/cm^2 maximum. The highest supported antenna gain is 5 dBi. Using the peak power levels recorded in the test report along with Equation 1 above, the MPE distances are calculated as follows.

Frequency (MHz)	Power Density (mW/cm^2)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	MPE Distance (cm)	Limit (cm)	Margin (cm)
5745	1	26.6	5	**10.72**	20	9.28
5785	1	25.9	5	**9.89**	20	10.11
5825	1	26.0	5	**10.01**	20	9.99

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)	MPE Distance (cm)	Peak Transmit Power (dBm)	Antenna Gain (dBi)	Power Density (mW/cm^2)	Limit (mW/cm^2)	Margin (mW/cm^2)
5745	20	26.7	5	**0.29**	1	0.71
5785	20	26.0	5	**0.25**	1	0.75
5825	20	26.3	5	**0.27**	1	0.73

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

Equip #	Manufacturer	Model	Description	Last Cal	Next Due
44940	Rohde & Schwarz	ESU	Spectrum Analyzer	15May13	15May14
40514	Agilent	E4440A	Spectrum Analyzer	12-NOV-12	12-NOV-13
47299	Agilent	PXA	Signal Analyzer	04Sept12	04Sept13
3003	HP	8373B	Signal Generator	26Mar13	26Mar14
30654	Sunol Sciences	JB1	Combination Antenna	16Oct12	16Oct13
4882	EMCO	3115	Horn Antenna	28Jun13	28Jun14
41935	Newport	iBTHP-5-DB9	Temperature Probe	25MAR13	25MAR14
5691	Miteq	NSP1800-25-S1	1GHz to 18GHz Pre-Amplifier	01Feb13	01Feb14
41979	Cisco	1840	18-40GHz EMI Test Head	09Jul13	09Jul14
25658	Micro-Coax	UFB311A-1-0840-504504	RF Cable	13Feb13	13Feb14
21117	Micro-Coax	UFB311A-0-2484-520520	RF Cable	24Aug12	24Aug13
48720	Huber Suhner	Sucoflex 106PA	RF Cable	20Aug12	20Aug13
47300	Agilent	MXE	EMI Receiver	13Nov12	13Nov13
8195	TTE	H613-150K-50-21378	Filter	04Jan13	04Jan14
8496	Fischer Custom	FCC-450B-2.4-N	Pulse limiter	20May13	20May14
39110	Coleman	RG-223	RF Cable, 25 ft., N	29Nov12	29Nov13
29957	Fischer	FCC-LISN-50/250-50-2-01	LISN	02Aug12	02Aug13
29959	Fischer	FCC-LISN-PA-NENA-5-15	LISN Adapter	02Aug12	02Aug13
44023	Fischer	M2	CDN	16Nov12	16Nov13
31919	Midwest Microwave	TRM-2048-MC-BNC-10	50Ohm Terminator	30Aug12	30Aug13
39162	Coleman	RG-223	RF Cable, 2 ft. BNC	09Oct12	09Oct13
25001	Micro-Coax	UFB197C-1-0240-504504	RF Cable, 2 ft.	24Mar13	24Mar14