Test Report

AIR-CAP1602y-A-K9
AIR-SAP1602y-A-K9
AIR-CLD1602y-A-K9

Cisco Aironet 802.11n Dual Band Access Points

FCC ID: LDK102084
IC: 2461B-102084

Also covers:

AIR-CAP1602y-N-K9, AIR-SAP1602y-N-K9, AIR-CLD1602y-N-K9
AIR-CAP1602y-T-K9, AIR-SAP1602y-T-K9, AIR-CLD1602y-T-K9
AIR-CAP1602y-Z-K9, AIR-SAP1602y-Z-K9, AIR-CLD1602y-Z-K9

y = E (External Antenna) or I (Internal Antenna)

5725-5850 MHz

Against the following Specifications:

CFR47 Part 15.247

RSS210

Cisco Systems
170 West Tasman Drive
San Jose, CA 95134

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Section 1: Overview

1.1 Test Summary

The samples were assessed against the tests detailed in section 3 under the requirements of the following specifications:

Emission	Immunity
CFR47 Part 15.247 RSS210	N/A

The specifications listed above represent actual tests performed to demonstrate compliance against the specifications and basic standards listed on the front cover of this report. This list is not a one to one match to the front cover for one or more of the following reasons.

1. Basic standards call up many different test phenomena specifications such as the 61000-4-X series. The basic standards define which elements and levels shall be applied from these specifications and as such it is not appropriate to list the individual specifications on the front cover.
2. A Standard listed on the front cover may be required in a particular country but is not appropriate for the particular technologies included in the equipment under test. E.g. You cannot test a DC product to the mains Harmonics requirements in EN61000-3-2. See section 3.2.
3. Test results against a particular standard or specification may be included in a different test report. See section 3.2 for an EDCS reference of this data.
4. Where appropriate, Cisco may have substituted a later revision of a basic standard to those referenced in the specification on the front sheet of this test report. This decision was based upon improved test methodology and repeatability and/or where the newer revision represented a more stringent test.
5. Where relevant, testing has been carried out to the requirements of both EN and IEC Specifications. This was possible because of the similarities of the test methods involved and the Cisco EMC test procedures.
6. Testing may have been performed to an equivalent test that satisfies the requirements of the standards and specifications listed on the front cover of the report. See section 3.2.
7. Where radiated emissions testing has been performed to EN55022/CISPR22 the additional requirements of VCCI: V- 3/2006.04, EN55022: 1994 +A1/2 and CAN/CSA- CISPR 22-02 have also been evaluated unless otherwise stated.
8. Testing to the requirements of CFR47 Part 15 was performed against the CISPR22 limits. The results are therefore deemed satisfactory evidence of compliance with Industry Canada Interference Causing Equipment Standard ICES-003.
9. Where assessment has been performed to CISPR24, all the applicable test requirements may have not been covered. Refer to the results section for the tests performed.

Notes:

1) Where a specification listed on the front cover of this report has deviations from the basic standards listed above, the additional technical requirements of the specification were also assessed.
2) Where appropriate, Cisco may have substituted a later revision of a basic standard to those referenced in the specification on the front sheet of this test report. This decision was based upon improved test methodology and repeatability and/or where the newer revision represented a more stringent test.
3) Where relevant, testing has been carried out to the requirements of both EN and IEC Specifications. This was possible because of the similarities of the test methods involved and the Cisco EMC test procedures.

Section 2: Assessment Information

2.1 General

This report contains an assessment of an apparatus against Electromagnetic Compatibility Standards based upon tests carried out on the samples submitted. The testing was performed by and for the use of Cisco systems Inc:

With regard to this assessment, the following points should be noted:

a) The results contained in this report relate only to the items tested and were obtained in the period between the date of the initial assessment and the date of issue of the report. Manufactured products will not necessarily give identical results due to production and measurement tolerances.

b) The apparatus was set up and exercised using the configuration and modes of operation defined in this report only.

c) Where relevant, the apparatus was only assessed using the susceptibility criteria defined in this report and the Test Assessment Plan (TAP).

d) All testing was performed under the following environmental conditions:

Temperature	15°C to 35°C (54°F to 95°F)
Atmospheric Pressure	860mbar to 1060mbar (25.4" to 31.3")
Humidity	10% to 75*%

*[Where applicable] For ESD testing the humidity limits used were 30% to 60% and for EFT/B tests the humidity limits used were 25% to 75%.

e) All AC testing was performed at one or more of the following supply voltages:
110V 60 Hz (+/-20%)
220V 50 Hz (+/-20%)

2.2 Date of testing

02-July-2012 – 22-July-2012

2.3 Report Issue Date

Cisco uses an electronic system to issue, store and control the revision of test reports. This system is called the Engineering Document Control System (EDCS). The actual report issue date is embedded into the original file on EDCS. Any copies of this report, either electronic or paper, that are not on EDCS must be considered uncontrolled

2.4 Testing facilities

This assessment was performed by:

Testing Laboratory

Cisco Systems, Inc.,	Cisco Systems, Inc.
4125 Highlander Parkway	170 West Tasman Drive
Richfield, OH 44286	San Jose, CA 95134
USA	USA

Test Engineers

James Nicholson

2.5 Equipment Assessed (EUT)

AIR-CAP1602E-A-K9 Cisco Aironet 802.11n Dual Band Access Point

2.6 EUT Description

The 1600 Series Cisco Aironet 802.11n Dual Band Access Points support the following modes of operation. The modes are further defined in the radio Theory of Operation. The modes included in this report represent the worst case data for all modes.

Non HT-20, One Antenna, 6 to 54 Mbps
Non HT-20, Two Antennas, 6 to 54 Mbps
Non HT-20, Three Antennas, 6 to 54 Mbps

Non HT-20 Beam Forming, Two Antennas, 6 to 54 Mbps
Non HT-20 Beam Forming, Three Antennas, 6 to 54 Mbps

HT-20, One Antenna, M0 to M7
HT-20, Two Antennas, M0 to M15
HT-20, Three Antennas, M0 to M15

HT-20 STBC, Two Antennas, M0 to M7
HT-20 STBC, Three Antennas, M0 to M7

HT-20 Beam Forming, Two Antennas, M0 to M15
HT-20 Beam Forming, Three Antennas, M0 to M15

Non HT-40 Duplicate, One Antenna, 6-54 Mbps
Non HT-40 Duplicate, Two Antennas, 6-54 Mbps
Non HT-40 Duplicate, Three Antennas, 6-54 Mbps

HT-40, One Antenna, M0 to M7
HT-40, Two Antennas, M0 to M15
HT-40, Three Antennas, M0 to M15

HT-40 STBC, Two Antennas, M0 to M7
HT-40 STBC, Three Antennas, M0 to M7

HT-40 Beam Forming, Two Antennas, M0 to M15
HT-40 Beam Forming, Three Antennas, M0 to M15

The following antennas are supported by this product series.

The data included in this report represent the worst case data for all antennas.

Frequency	Part Number	Antenna Type	Antenna Gain (dBi)
2.4/5 GHz	AIR-ANT2524DB-R	Dual-resonant black dipole	2 / 4
	AIR-ANT2524DW-R	Dual-resonant white dipole	2 / 4
	AIR-ANT2524DG-R	Dual-resonant gray dipole	2 / 4
	AIR-ANT2524V4C-R	Dual-resonant ceiling mount omni (4-pack)	2 / 4
	Internal	Omni-Directional	4 / 4
	AIR-ANT2544V4M-R	Dual-resonant omni (4-pack)	4 / 4
	AIR-ANT2566P4W-R	Dual-resonant "directional" antenna (4-pack)	6 / 6

Section 4: Sample Details

Note: Each sample was evaluated to ensure that its condition was suitable to be used as a test sample prior to the commencement of testing. Please also refer to the "Justification for worst Case test Configuration" section of this report for further details on the selection of EUT samples.

4.1 Sample Details (Photographs of the test samples, where appropriate can be found in appendix H)

Sample No.	Equipment Details	Part Number	Manufacturer	Hardware Rev.	Firmware Rev.	Software Rev.	Serial Number
S01	AIR-CAP1602E-A-K9		Cisco Systems	NA	NA	NA	
S02	AIR-PWR-B	341-0306-01	Cisco Systems	NA	NA	NA	

4.2 System Details

System #	Description	Samples
1	EUT	S01, S02

4.3 Mode of Operation Details

Mode#	Description	Comments
1	Continuous Transmitting	Continuous Transmitting

Appendix A: Emission Test Results
Testing Laboratory: Cisco Systems, Inc., 4125 Highlander Parkway, Richfield, OH, USA

Target Maximum Channel Power

The following table details the maximum supported Total Channel Power for all operating modes.

	Maximum Channel Power (dBm)		
	Frequency (MHz)		
Operating Mode	5745	5785	5825
Non HT-20, 6 to 54 Mbps	22	22	22
Non HT-20 Beam Forming, 6 to 54 Mbps	22	22	22
HT-20, M0 to M15	22	22	22
HT-20 STBC, M0 to M7	22	22	22
HT-20 Beam Forming, M0 to M15	22	22	22
	5745/5765		5785/5805
Non HT-40 Duplicate, 6-54 Mbps	19		22
HT-40, M0 to M15	22		22
HT-40 STBC, M0 to M7	22		22
HT-40 Beam Forming, M0 to M15	22		22

6dB Bandwidth

15.247: Systems using digital modulation techniques may operate in the 5725-5850 MHz band. The minimum 6 dB bandwidth shall be at least 500 kHz.

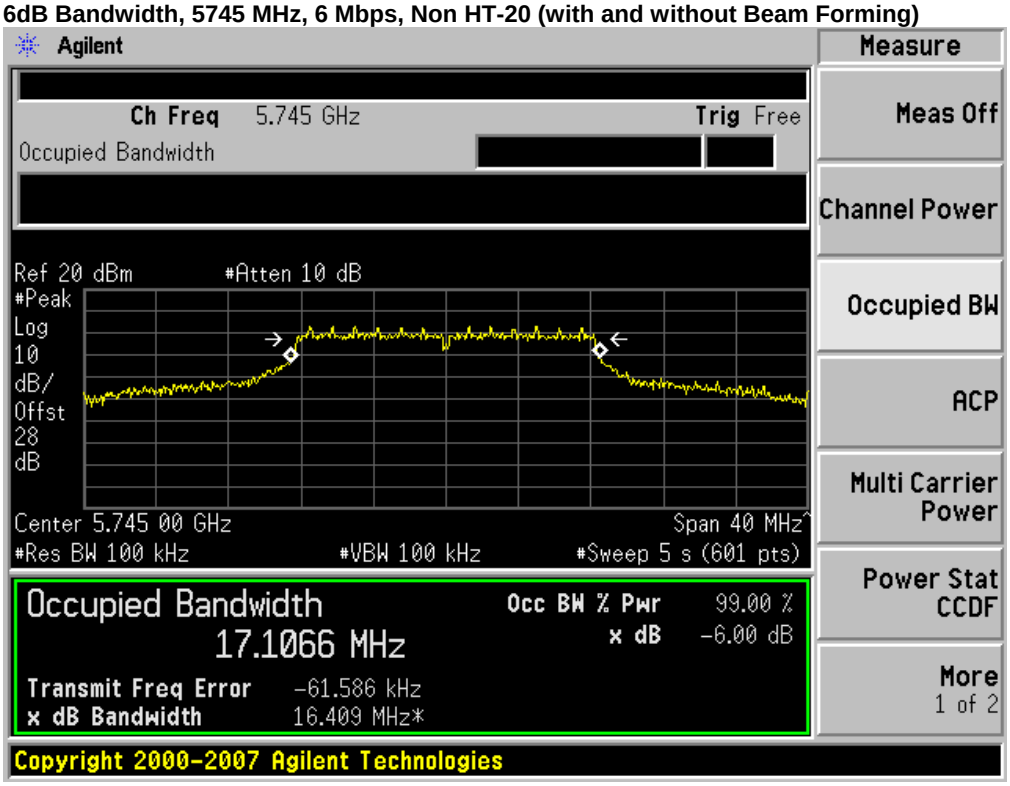
Connect the antenna port(s) to the spectrum analyzer input. Using the spectrum analyzer Channel Bandwidth mode, configure the spectrum analyzer as shown below (enter all losses between the transmitter output and the spectrum analyzer).

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:	100 kHz
Video Bandwidth:	100 kHz
X dB Bandwidth:	6 dB
Detector:	Peak
Trace:	Single

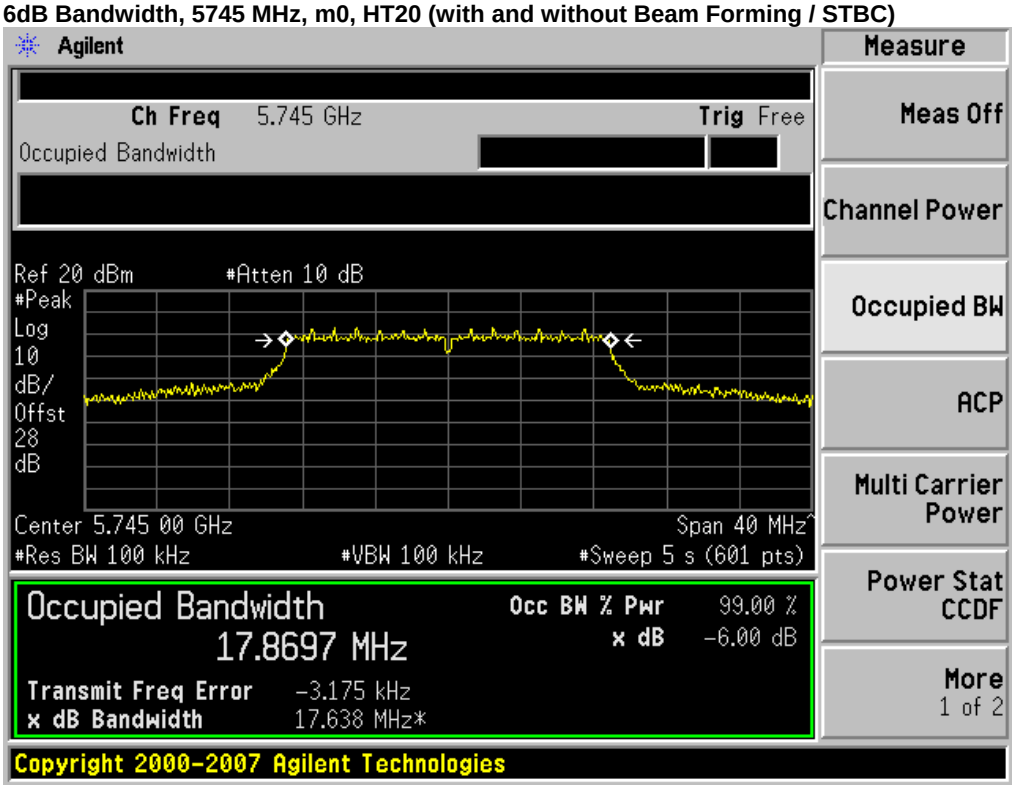
Place the radio in continuous transmit mode. View the transmitter waveform on the spectrum analyzer, and record the pertinent measurements:

Frequency (MHz)	Mode	Data Rate (Mbps)	6dB BW (MHz)	Limit (kHz)	Margin (MHz)
5745	Non HT-20, 6 to 54 Mbps	6	**16.4**	>500	15.9
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	**16.4**	>500	15.9
	HT-20, M0 to M15	m0	**17.6**	>500	17.1
	HT-20 STBC, M0 to M7	m0	**17.6**	>500	17.1
	HT-20 Beam Forming, M0 to M15	m0	**17.6**	>500	17.1
5785	Non HT-20, 6 to 54 Mbps	6	**16.4**	>500	15.9
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	**16.4**	>500	15.9
	HT-20, M0 to M15	m0	**17.7**	>500	17.2
	HT-20 STBC, M0 to M7	m0	**17.7**	>500	17.2
	HT-20 Beam Forming, M0 to M15	m0	**17.7**	>500	17.2
5825	Non HT-20, 6 to 54 Mbps	6	**16.4**	>500	15.9
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	**16.4**	>500	15.9
	HT-20, M0 to M15	m0	**17.7**	>500	17.2
	HT-20 STBC, M0 to M7	m0	**17.7**	>500	17.2
	HT-20 Beam Forming, M0 to M15	m0	**17.7**	>500	17.2
5745/5765	Non HT-40 Duplicate, 6-54 Mbps	6	**36.4**	>500	35.9
	HT-40, M0 to M15	m0	**36.5**	>500	36.0
	HT-40 STBC, M0 to M7	m0	**36.5**	>500	36.0
	HT-40 Beam Forming, M0 to M15	m0	**36.5**	>500	36.0
5785/5805	Non HT-40 Duplicate, 6-54 Mbps	6	**36.4**	>500	35.9
	HT-40, M0 to M15	m0	**36.4**	>500	35.9
	HT-40 STBC, M0 to M7	m0	**36.4**	>500	35.9
	HT-40 Beam Forming, M0 to M15	m0	**36.5**	>500	36.0

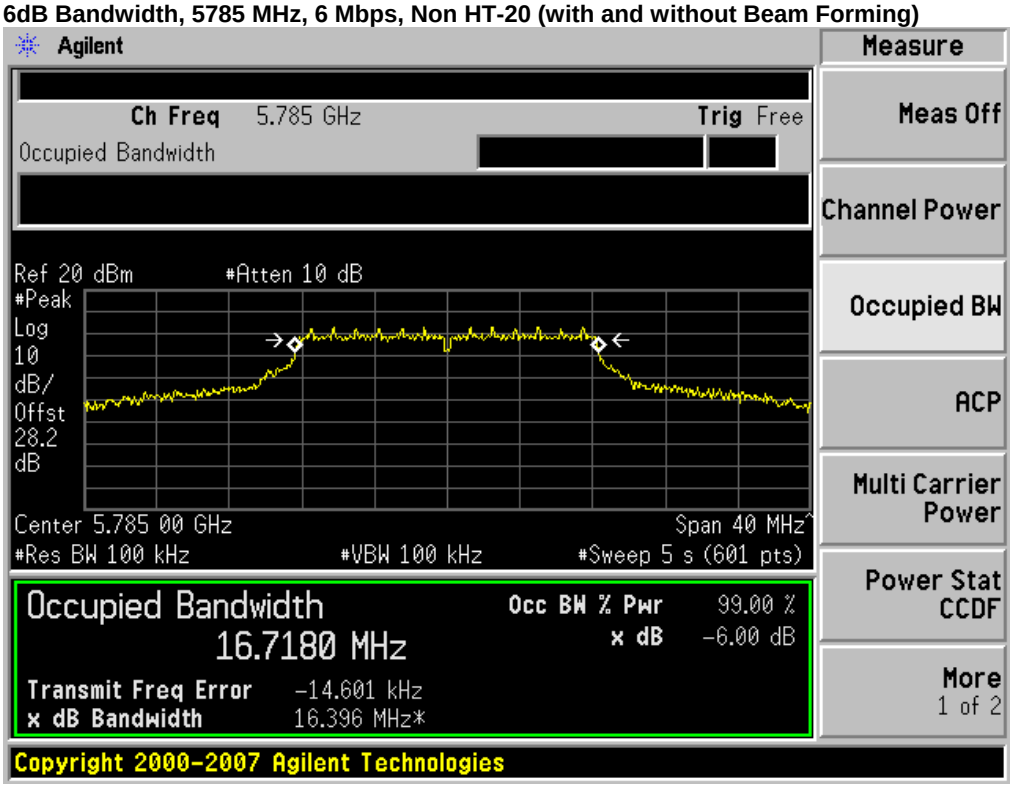
6dB Bandwidth, 5745 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



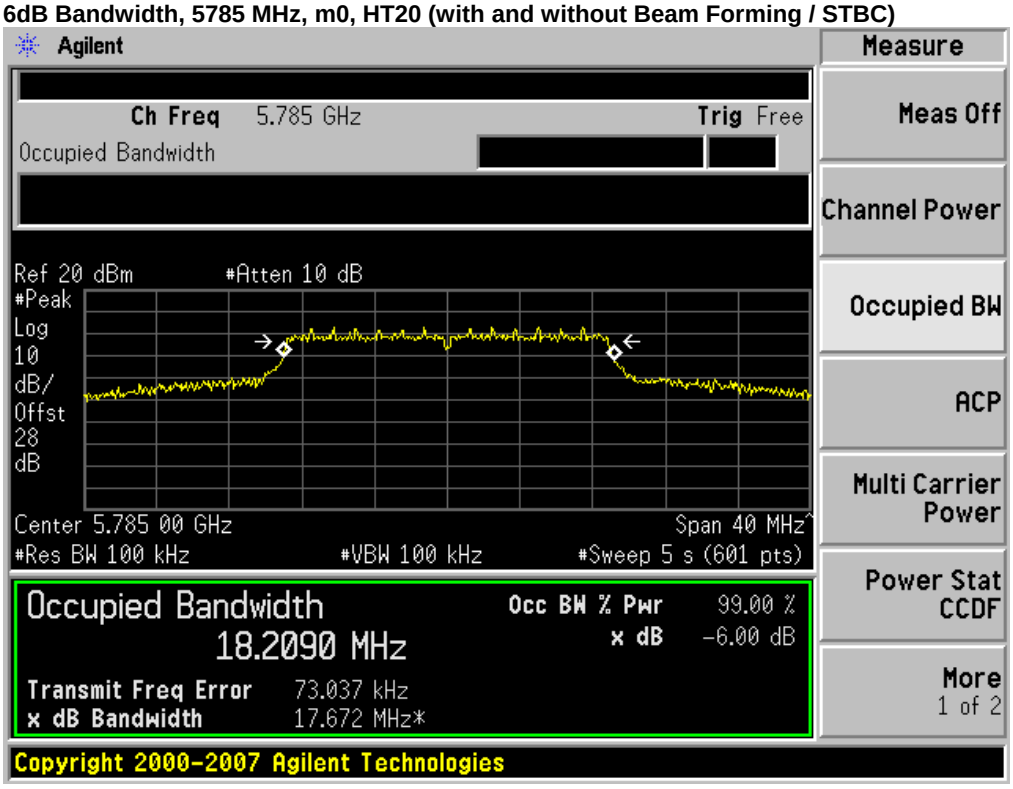
6dB Bandwidth, 5745 MHz, m0, HT20 (with and without Beam Forming / STBC)



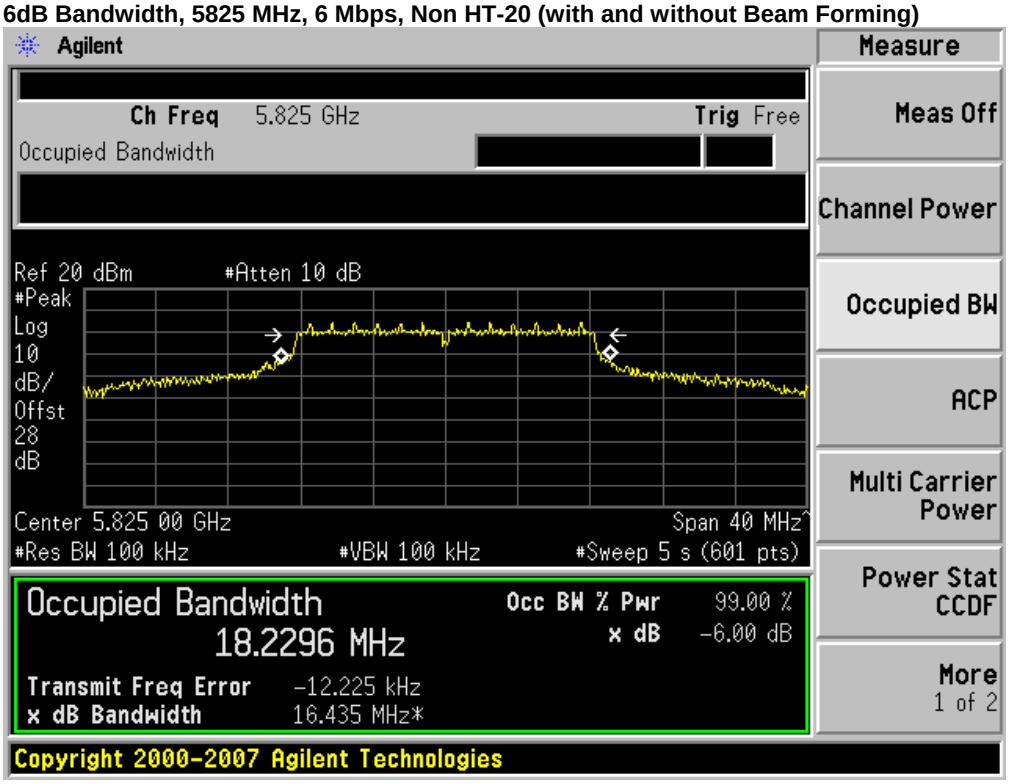
6dB Bandwidth, 5785 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



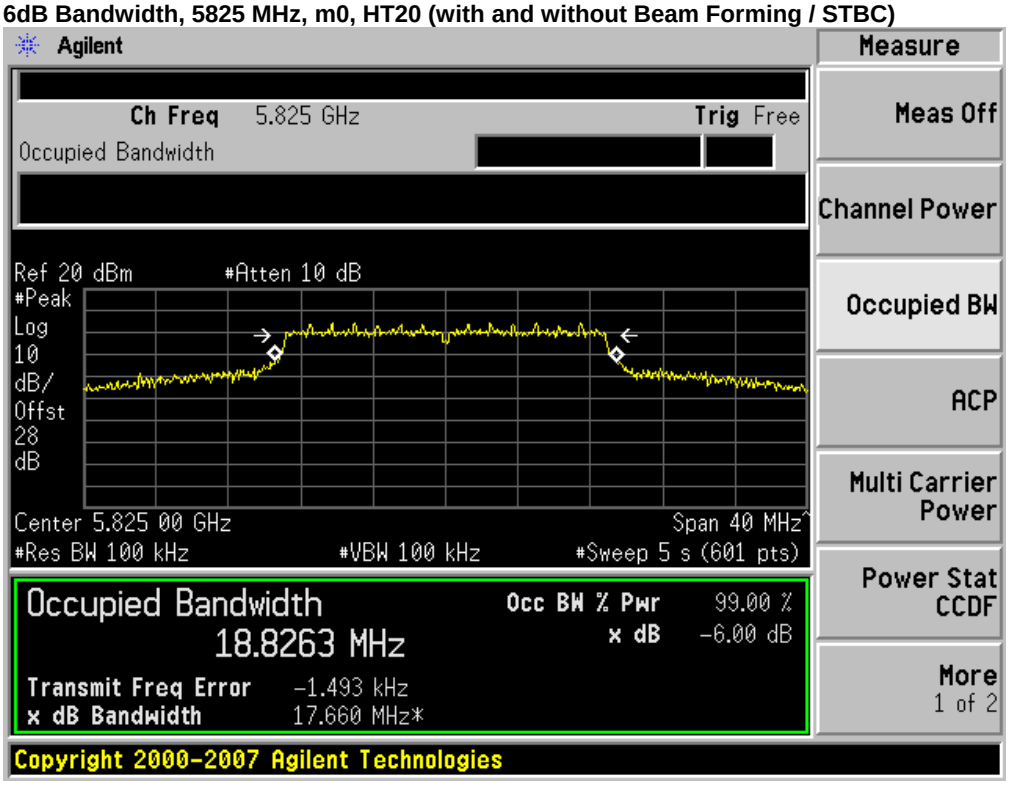
6dB Bandwidth, 5785 MHz, m0, HT20 (with and without Beam Forming / STBC)



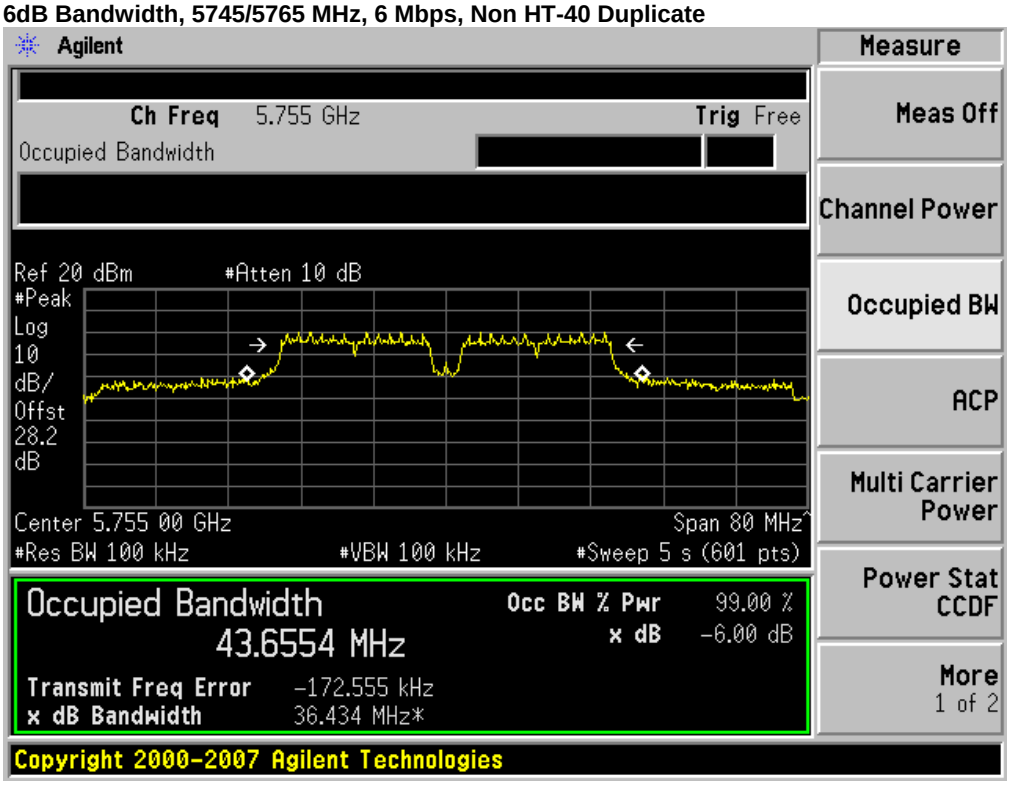
6dB Bandwidth, 5825 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



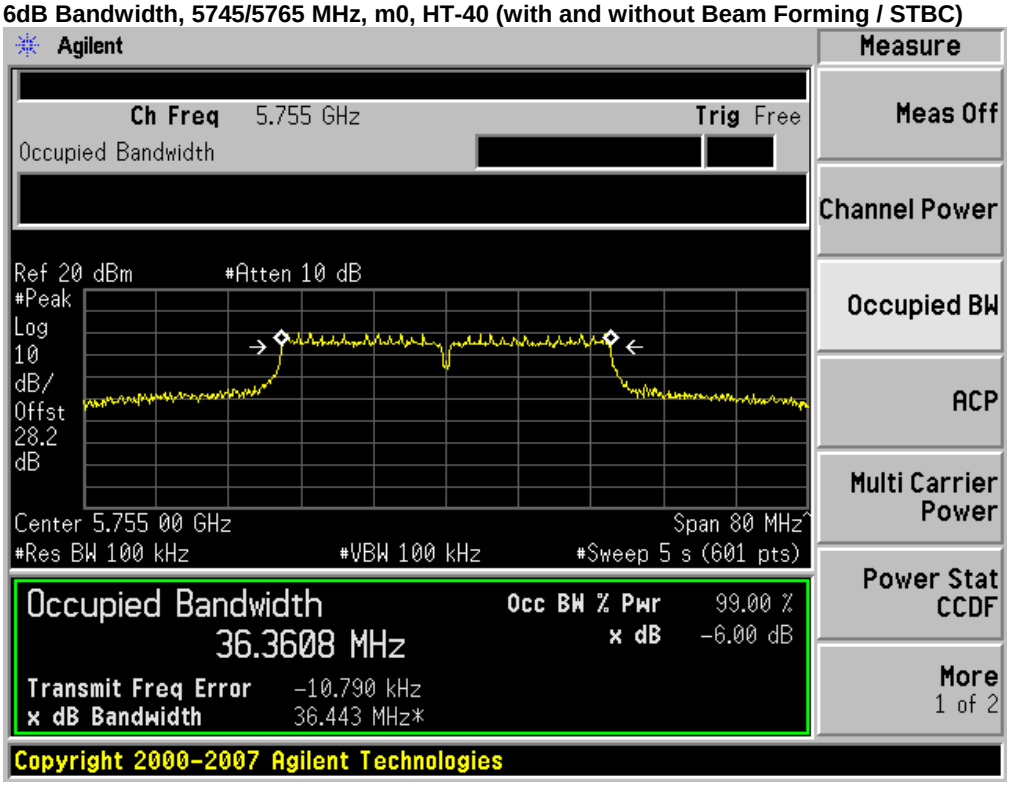
6dB Bandwidth, 5825 MHz, m0, HT20 (with and without Beam Forming / STBC)



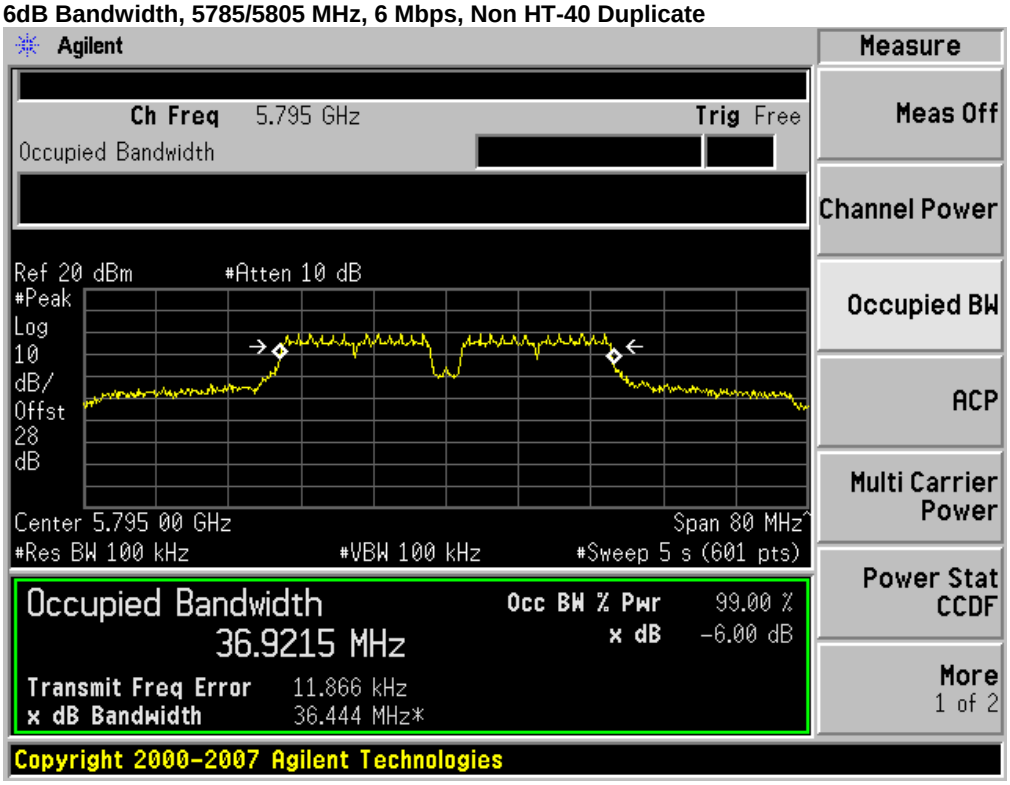
6dB Bandwidth, 5745/5765 MHz, 6 Mbps, Non HT-40 Duplicate



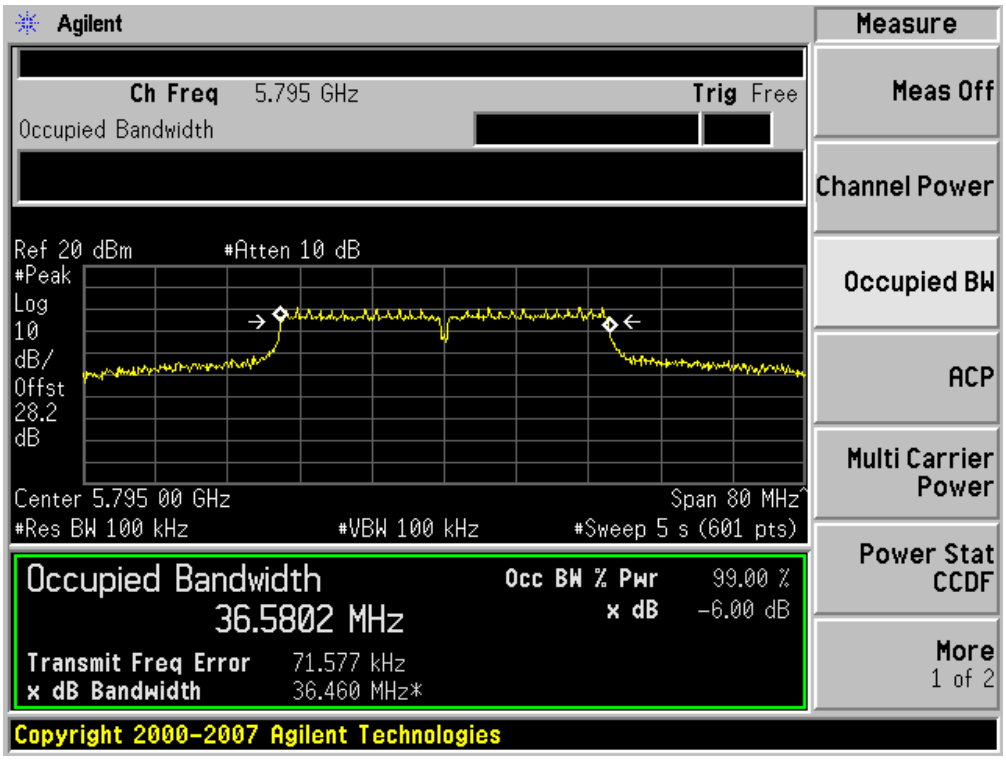
6dB Bandwidth, 5745/5765 MHz, m0, HT-40 (with and without Beam Forming / STBC)



6dB Bandwidth, 5785/5805 MHz, 6 Mbps, Non HT-40 Duplicate



6dB Bandwidth, 5785/5805 MHz, m0, HT-40 (with and without Beam Forming / STBC)



99% and 26dB Bandwidth

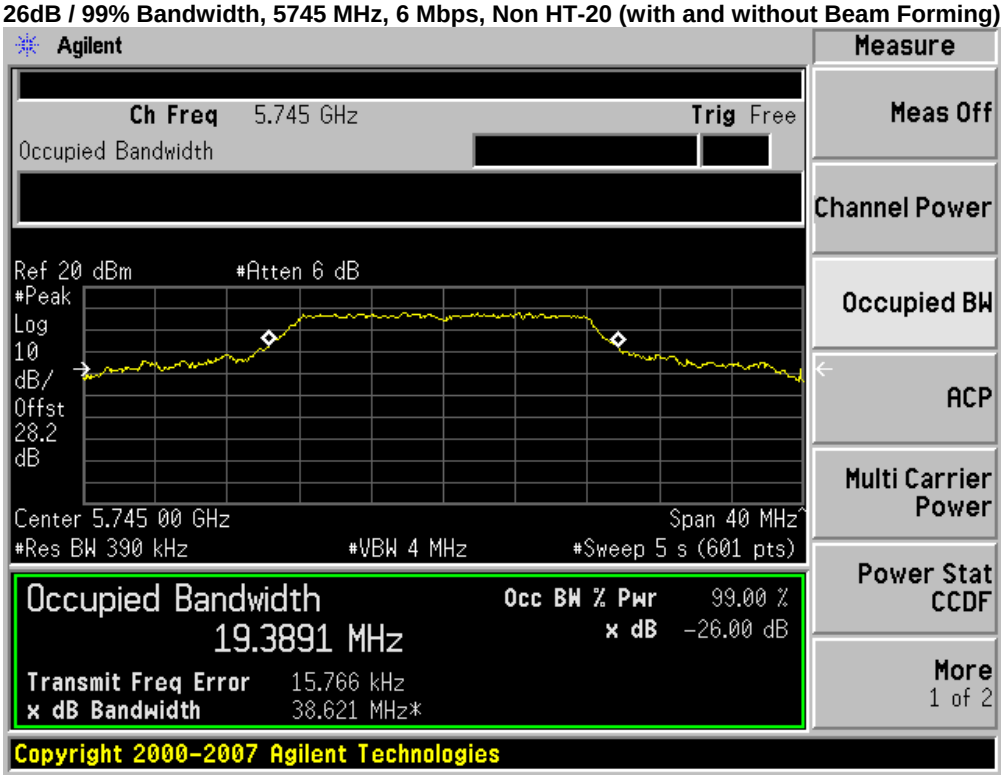
Connect the antenna port(s) to the spectrum analyzer input. Using the spectrum analyzer Channel Bandwidth mode, configure the spectrum analyzer as shown below (enter all losses between the transmitter output and the spectrum analyzer).

Center Frequency:	Frequency from table be.low
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 26 dB Bandwidth
Video Bandwidth:	≥Resolution Bandwidth
X dB Bandwidth:	26 dB
Detector:	Peak
Trace:	Single

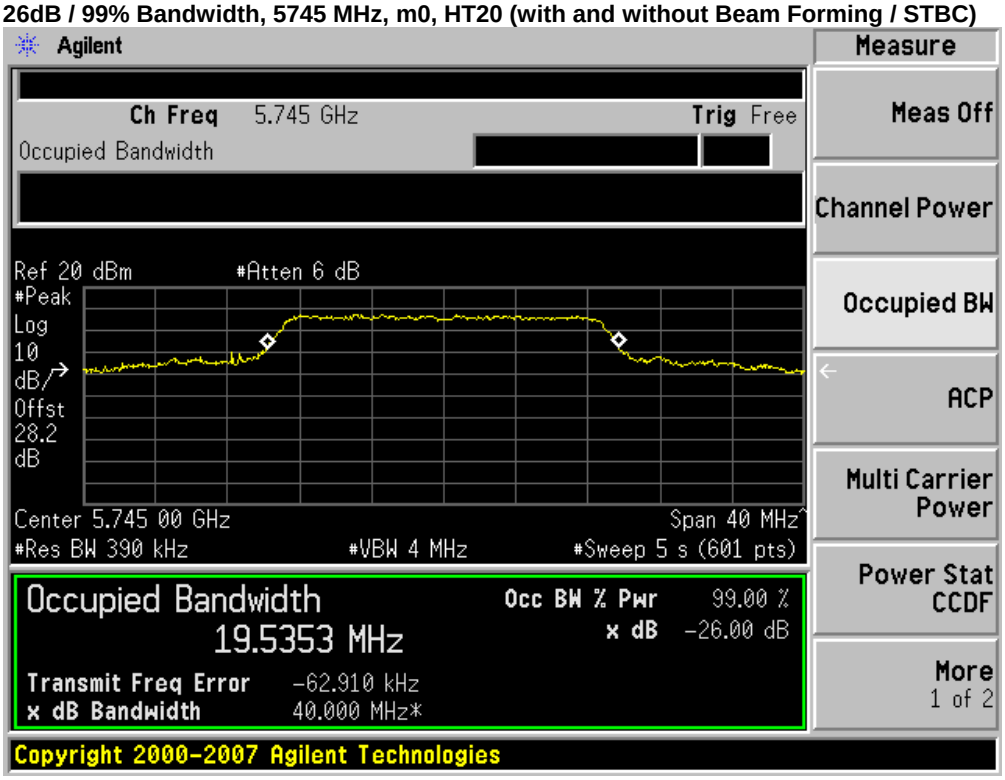
Place the radio in continuous transmit mode. View the transmitter waveform on the spectrum analyzer, and record the pertinent measurements:

Frequency (MHz)	Mode	Data Rate (Mbps)	26dB BW (MHz)	99% BW (MHz)
5745	Non HT-20, 6 to 54 Mbps	6	**38.6**	19.4
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	**38.6**	19.4
	HT-20, M0 to M15	m0	**40.0**	19.5
	HT-20 STBC, M0 to M7	m0	**40.0**	19.5
	HT-20 Beam Forming, M0 to M15	m0	**40.0**	19.5
5785	Non HT-20, 6 to 54 Mbps	6	**37.9**	21.1
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	**37.9**	21.1
	HT-20, M0 to M15	m0	**40.0**	22.0
	HT-20 STBC, M0 to M7	m0	**40.0**	22.0
	HT-20 Beam Forming, M0 to M15	m0	**40.0**	22.0
5825	Non HT-20, 6 to 54 Mbps	6	**37.9**	21.7
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	**37.9**	21.7
	HT-20, M0 to M15	m0	**40.0**	23.9
	HT-20 STBC, M0 to M7	m0	**40.0**	23.9
	HT-20 Beam Forming, M0 to M15	m0	**40.0**	23.9
5745/5765	Non HT-40 Duplicate, 6-54 Mbps	6	**78.9**	54.9
	HT-40, M0 to M15	m0	**80.0**	40.0
	HT-40 STBC, M0 to M7	m0	**80.0**	40.0
	HT-40 Beam Forming, M0 to M15	m0	**80.0**	40.0
5785/5805	Non HT-40 Duplicate, 6-54 Mbps	6	**79.7**	57.5
	HT-40, M0 to M15	m0	**80.0**	42.8
	HT-40 STBC, M0 to M7	m0	**80.0**	42.8
	HT-40 Beam Forming, M0 to M15	m0	**80.0**	42.8

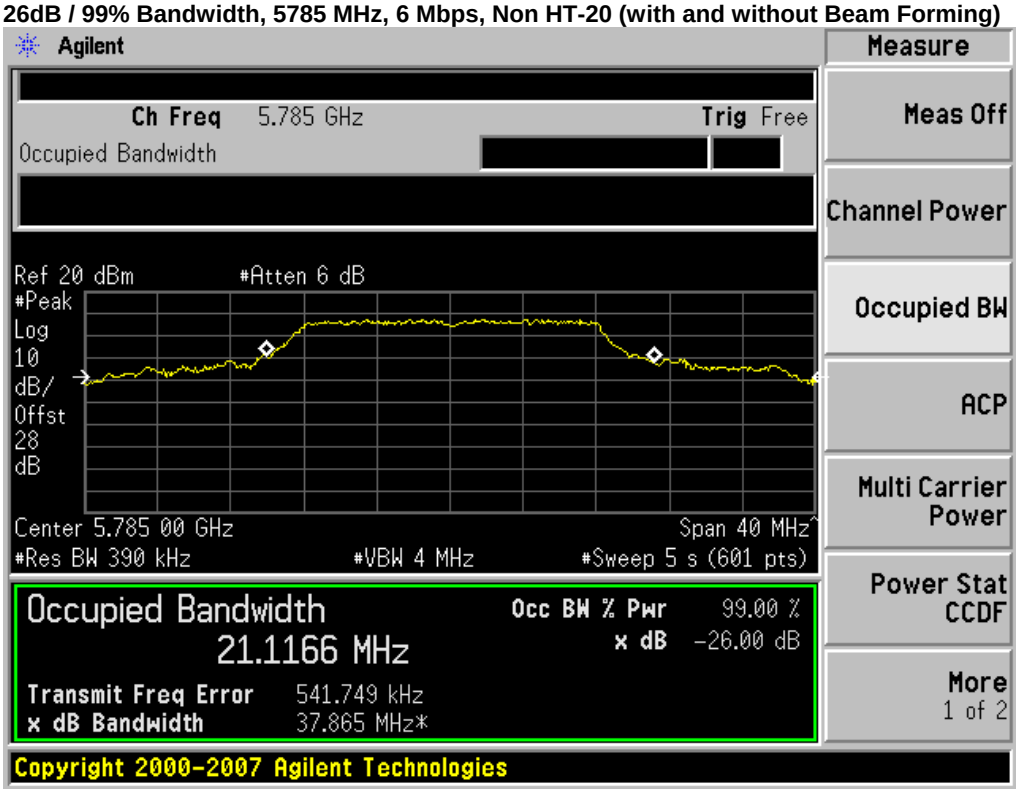
26dB / 99% Bandwidth, 5745 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



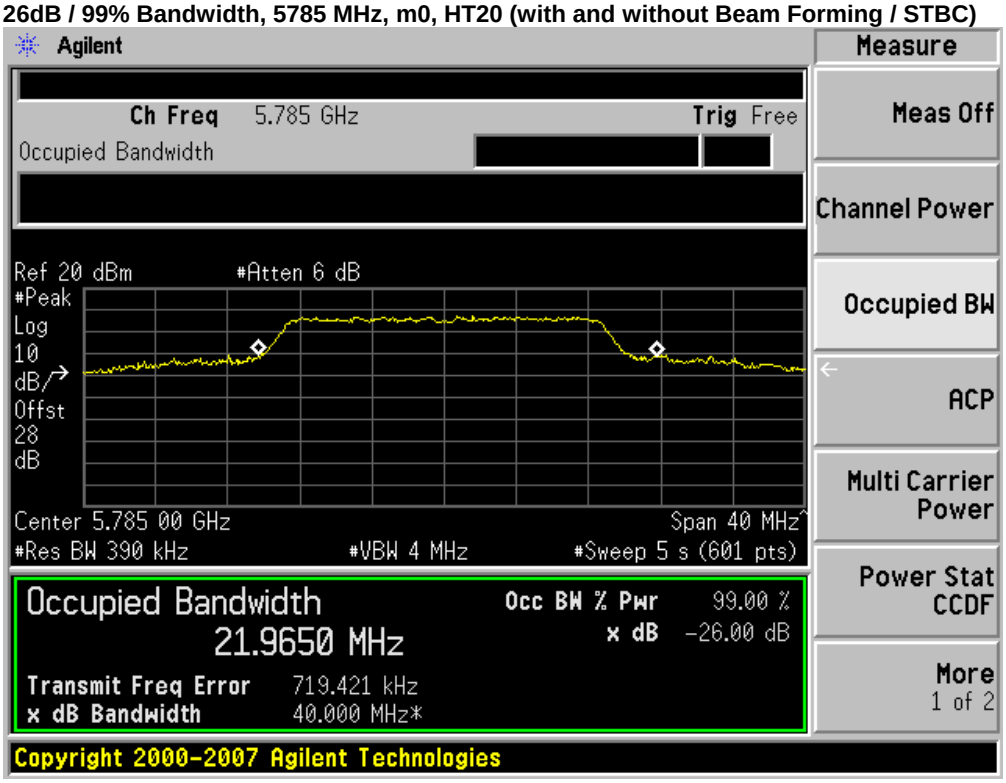
26dB / 99% Bandwidth, 5745 MHz, m0, HT20 (with and without Beam Forming / STBC)



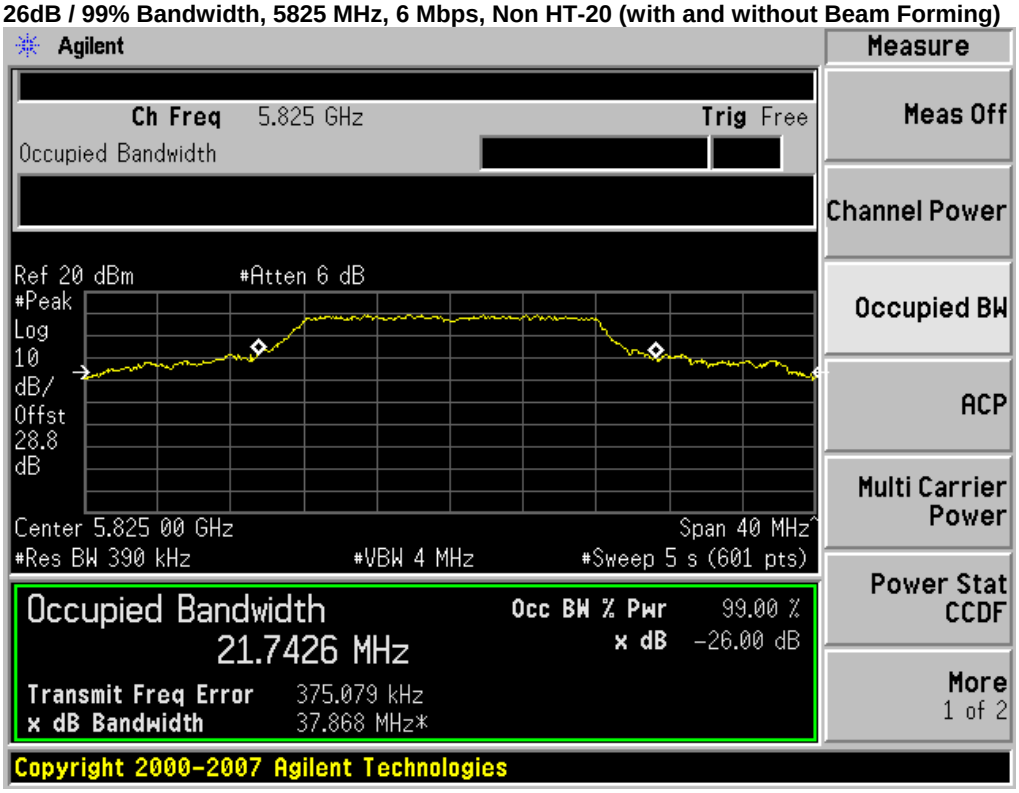
26dB / 99% Bandwidth, 5785 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



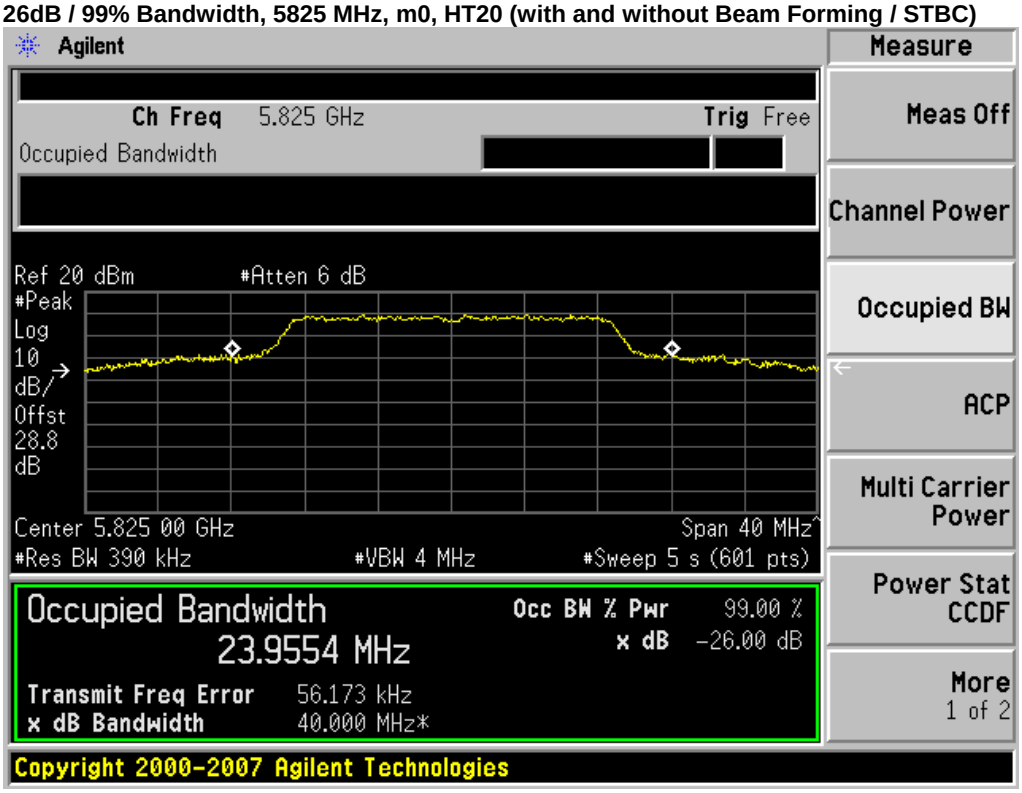
26dB / 99% Bandwidth, 5785 MHz, m0, HT20 (with and without Beam Forming / STBC)



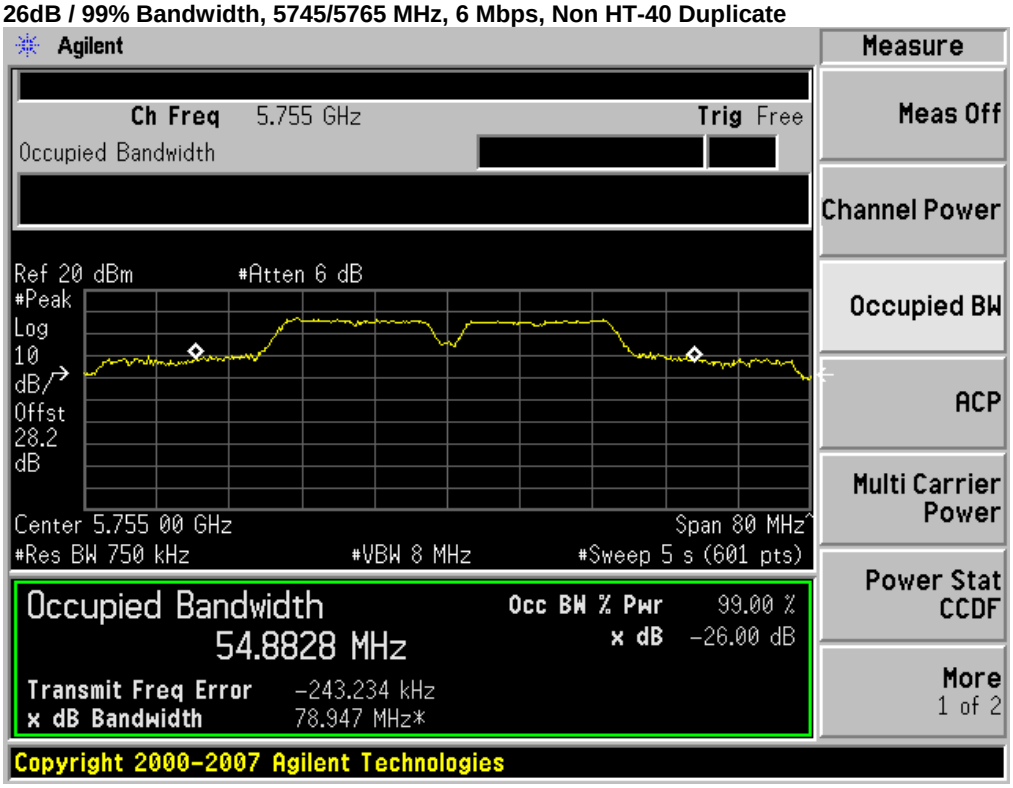
26dB / 99% Bandwidth, 5825 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



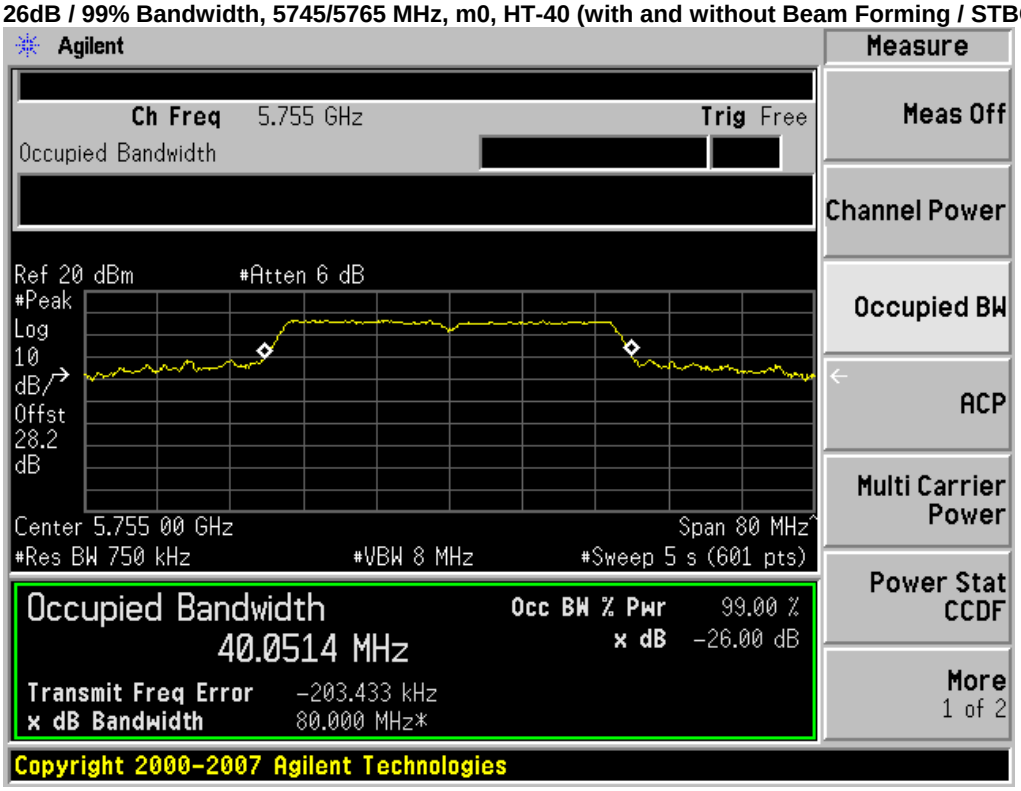
26dB / 99% Bandwidth, 5825 MHz, m0, HT20 (with and without Beam Forming / STBC)



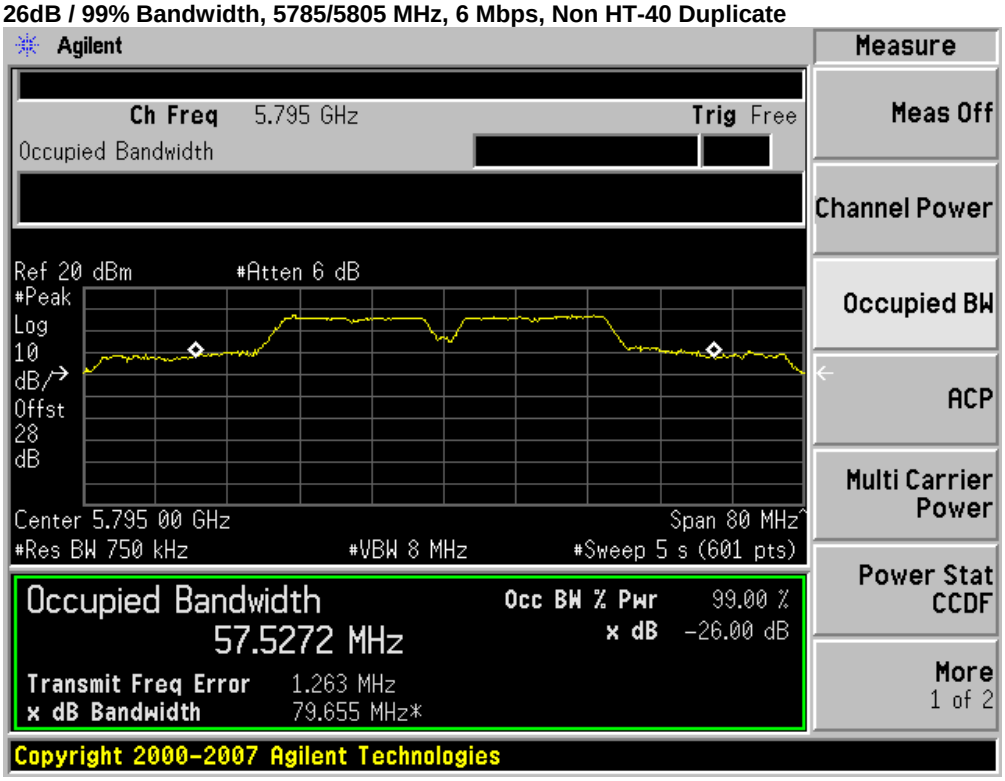
26dB / 99% Bandwidth, 5745/5765 MHz, 6 Mbps, Non HT-40 Duplicate



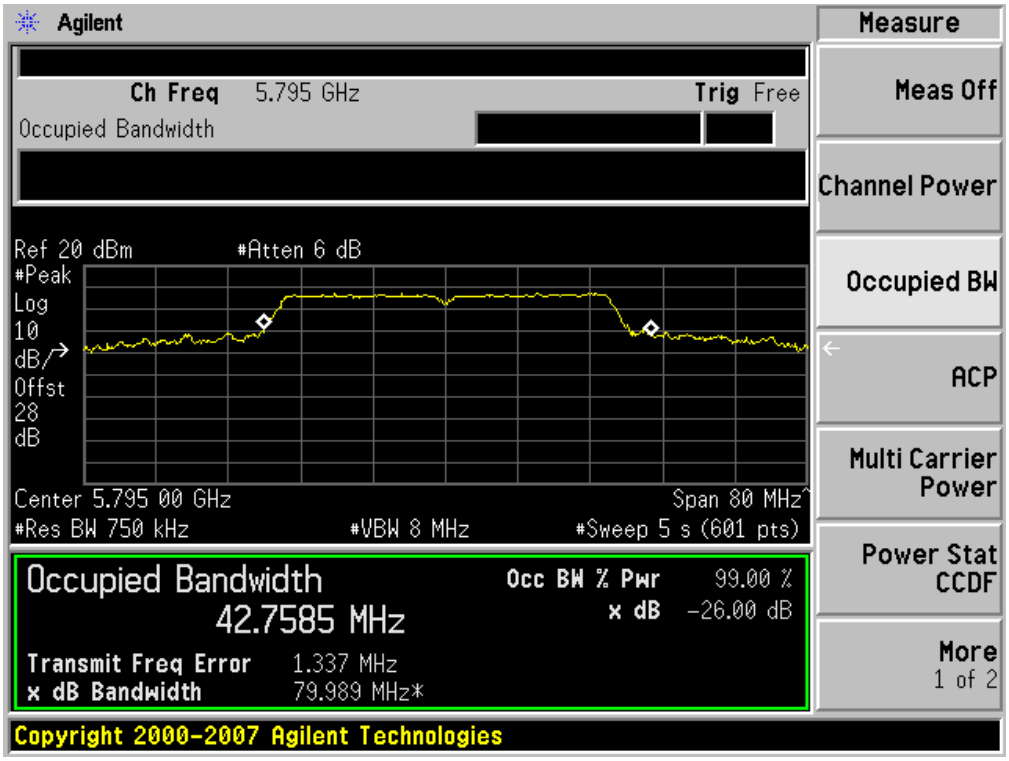
26dB / 99% Bandwidth, 5745/5765 MHz, m0, HT-40 (with and without Beam Forming / STBC)



26dB / 99% Bandwidth, 5785/5805 MHz, 6 Mbps, Non HT-40 Duplicate



26dB / 99% Bandwidth, 5785/5805 MHz, m0, HT-40 (with and without Beam Forming / STBC)



Peak Output Power

15.247: The maximum conducted output power of the intentional radiator for systems using digital modulation in the 5725-5850 MHz band shall not exceed 1 Watt (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum supported antenna gain is 6dBi. The peak correlated gain for each mode is listed in the table below. See the Theory of Operation for details on the correlated gain for each mode.

Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below.

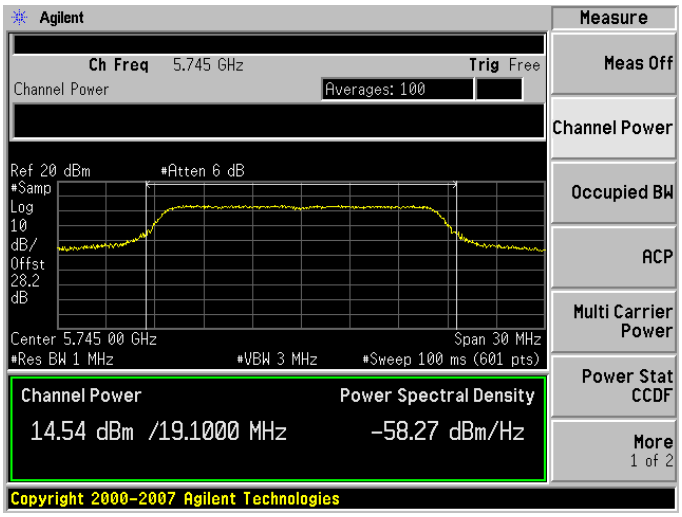
Enable "Channel Power" function of analyzer	
Center Frequency:	Frequency from table below
Span:	20 MHz (must be greater than 26dB bandwidth, adjust as necessary)
Ref Level Offset:	Correct for attenuator and cable loss.
Reference Level:	20 dBm
Attenuation:	20 dB
Sweep Time:	100ms, Single sweep
Resolution Bandwidth:	1 MHz
Video Bandwidth:	3 MHz
Detector:	Sample
Trace:	Trace Average 100 traces in Power Averaging Mode
Integration BW:	=26 dB BW from 26 dB Bandwidth Data

After averaging 100 traces of the transmitter waveform on the spectrum analyzer, record the spectrum analyzer Channel Power.

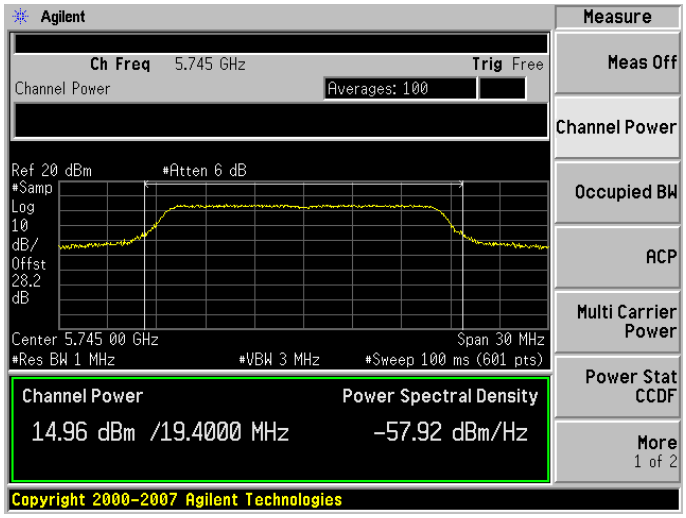
The “measure-and-sum technique” is used for measuring in-band transmit power of a device. In the measure-and-sum approach, the conducted emission level is measured at each antenna port. The measured results at the various antenna ports are then summed mathematically to determine the total emission level from the device. Summing is performed in linear power units.

Frequency (MHz)	Operating Mode	Tx Paths	Correlated Antenna Gain (dBi)	Tx 1 Peak Power (dBm)	Tx 2 Peak Power (dBm)	Tx 3 Peak Power (dBm)	Total Tx Channel Power (dBm)	Limit (dBm)	Margin (dB)
5745	Non HT-20, 6 to 54 Mbps	3	6	14.5	15.0	14.2	19.3	30	10.7
	Non HT-20 Beam Forming, 6 to 54 Mbps	3	11	14.5	15.0	14.2	19.3	25	5.7
	HT-20, M0 to M15	3	6	14.5	15.0	14.5	19.4	30	10.6
	HT-20 STBC, M0 to M7	3	6	14.5	15.0	14.5	19.4	30	10.6
	HT-20 Beam Forming, M0 to M7	3	11	14.5	15.0	14.5	19.4	25	5.6
	HT-20 Beam Forming, M8 to M15	3	9	14.5	15.0	14.5	19.4	27	7.6
5785	Non HT-20, 6 to 54 Mbps	4	6	14.2	15.0	14.6	19.4	30	10.6
	Non HT-20 Beam Forming, 6 to 54 Mbps	4	11	14.2	15.0	14.6	19.4	25	5.6
	HT-20, M0 to M15	4	6	14.5	15.0	14.6	19.5	30	10.5
	HT-20 STBC, M0 to M7	4	6	14.5	15.0	14.6	19.5	30	10.5
	HT-20 Beam Forming, M0 to M7	4	11	14.5	15.0	14.6	19.5	25	5.5
	HT-20 Beam Forming, M8 to M15	4	9	14.5	15.0	14.6	19.5	27	7.5
5825	Non HT-20, 6 to 54 Mbps	4	6	15.8	16.5	15.6	20.7	30	9.3
	Non HT-20 Beam Forming, 6 to 54 Mbps	4	12	15.8	16.5	15.6	20.7	24	3.2
	HT-20, M0 to M15	4	6	16.1	16.4	15.6	20.8	30	9.2
	HT-20 STBC, M0 to M7	4	6	16.1	16.4	15.6	20.8	30	9.2
	HT-20 Beam Forming, M0 to M7	4	12	16.1	16.4	15.6	20.8	24	3.2
	HT-20 Beam Forming, M8 to M15	4	9	16.1	16.4	15.6	20.8	27	6.2
5745/5765	Non HT-40 Duplicate, 6-54 Mbps	4	6	14.1	14.1	13.7	18.7	30	11.3
	HT-40, M0 to M15	4	6	14.1	14.7	13.9	19.0	30	11.0
	HT-40 STBC, M0 to M7	4	6	14.1	14.7	13.9	19.0	30	11.0
	HT-40 Beam Forming, M0 to M7	4	11	14.1	14.7	13.9	19.0	25	6.0
	HT-40 Beam Forming, M8 to M15	4	8	14.1	14.7	13.9	19.0	28	9.0
5785/5805	Non HT-40 Duplicate, 6-54 Mbps	4	6	13.8	14.4	13.9	18.8	30	11.2
	HT-40, M0 to M15	4	6	14.4	15.1	14.3	19.4	30	10.6
	HT-40 STBC, M0 to M7	4	6	14.4	15.1	14.3	19.4	30	10.6
	HT-40 Beam Forming, M0 to M7	4	11	14.4	15.1	14.3	19.4	25	5.6
	HT-40 Beam Forming, M8 to M15	4	8	14.4	15.1	14.3	19.4	28	8.6

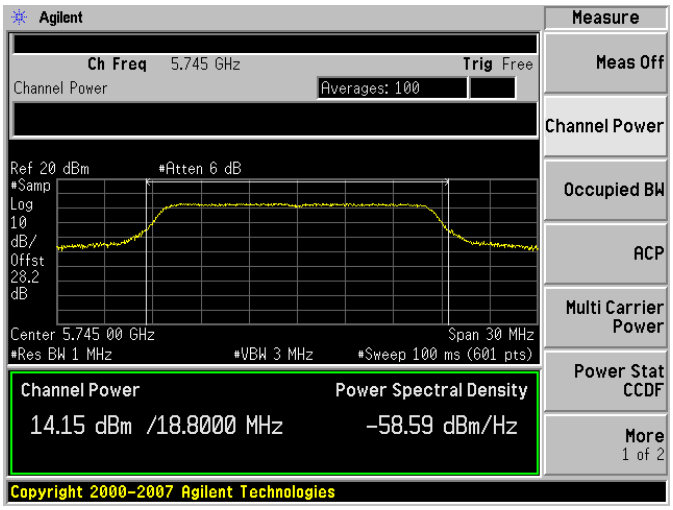
Peak Output Power, 5745 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



Antenna A

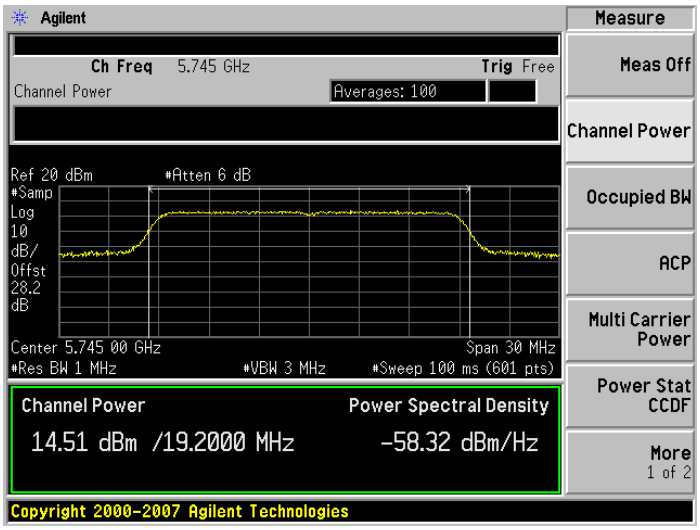


Antenna B

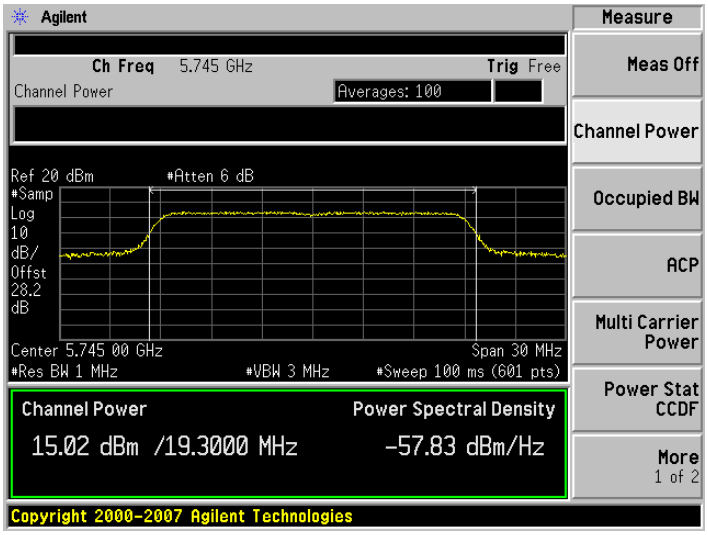


Antenna C

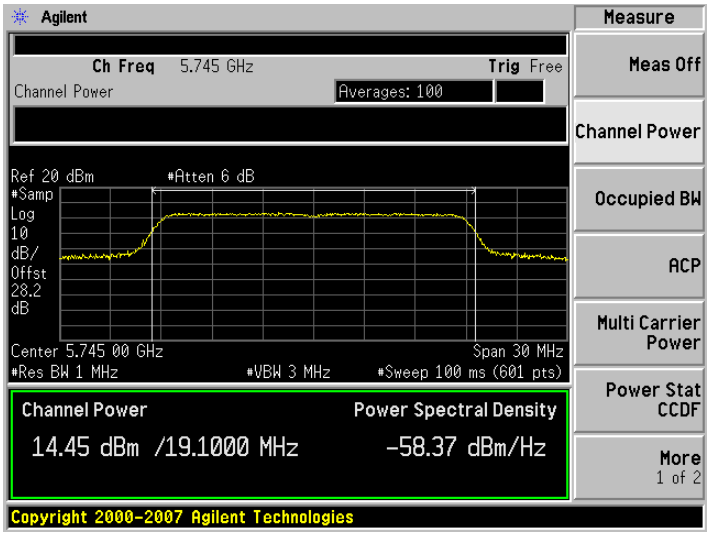
Peak Output Power, 5745 MHz, m0-m15, HT20 (with and without Beam Forming / STBC)



Antenna A

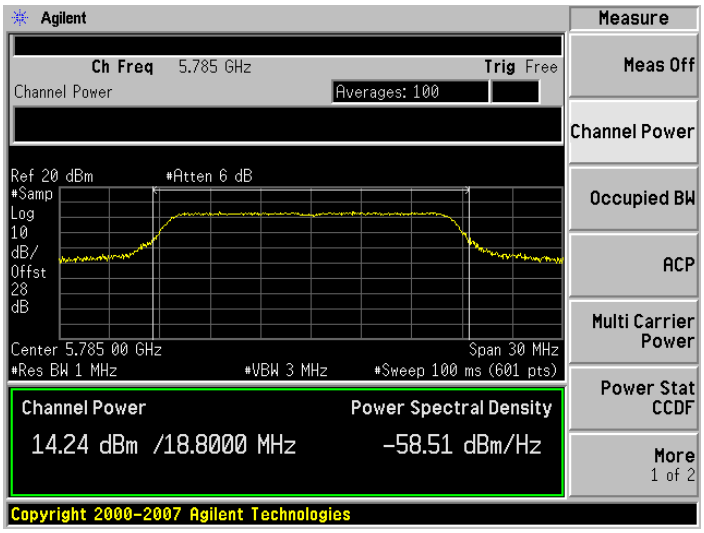


Antenna B

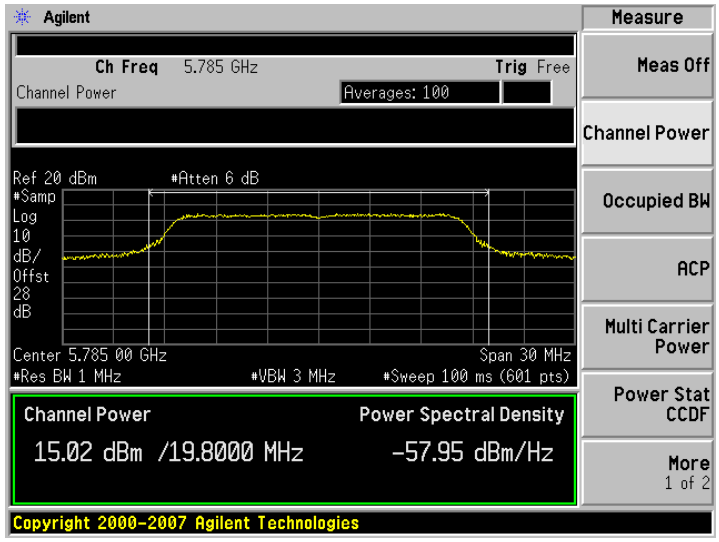


Antenna C

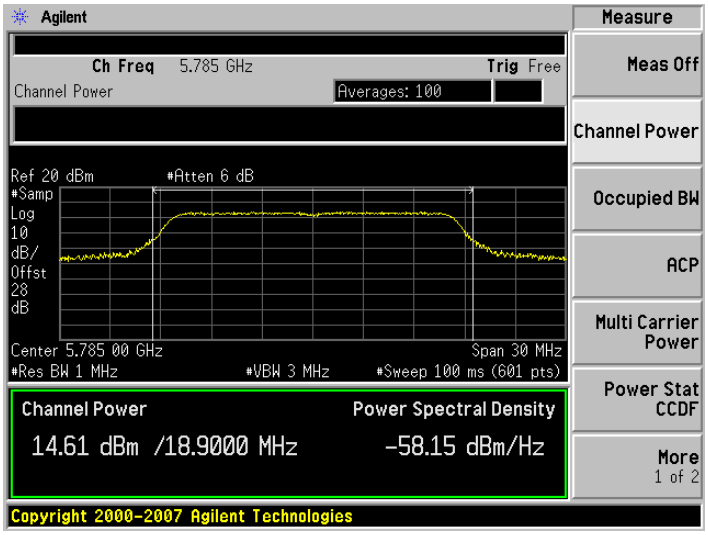
Peak Output Power, 5785 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



Antenna A

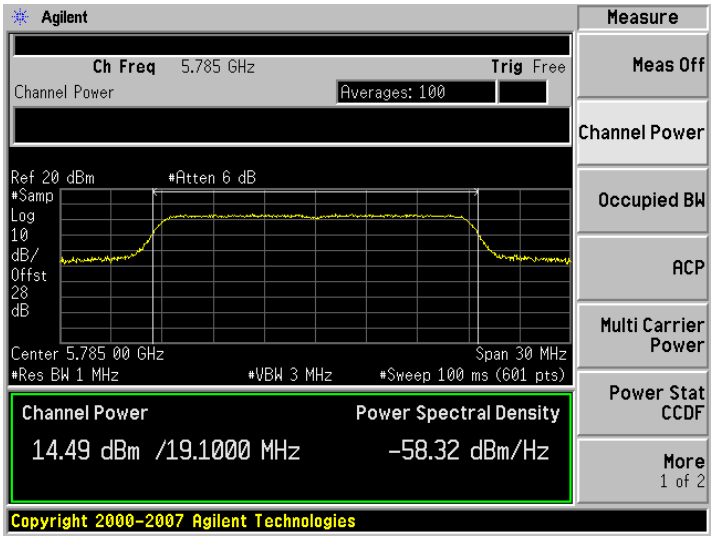


Antenna B

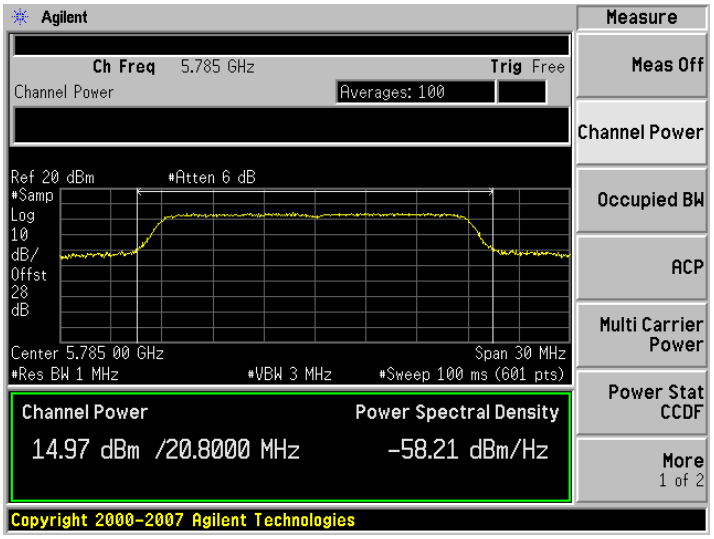


Antenna C

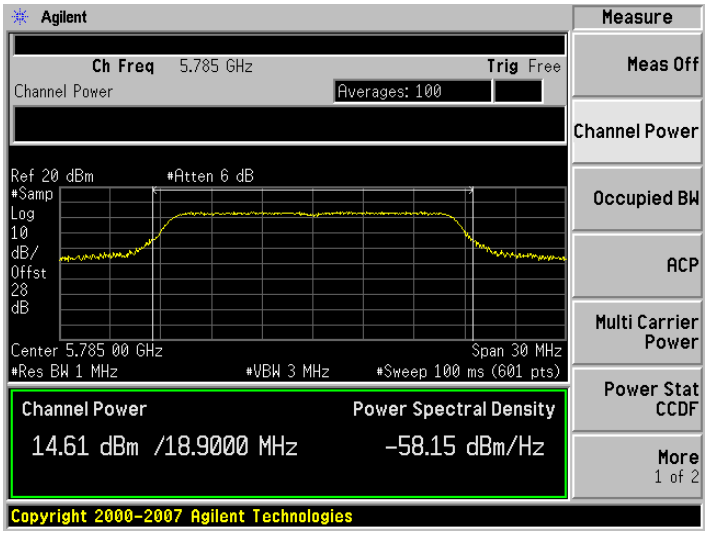
Peak Output Power, 5785 MHz, m0-m15, HT20 (with and without Beam Forming / STBC)



Antenna A

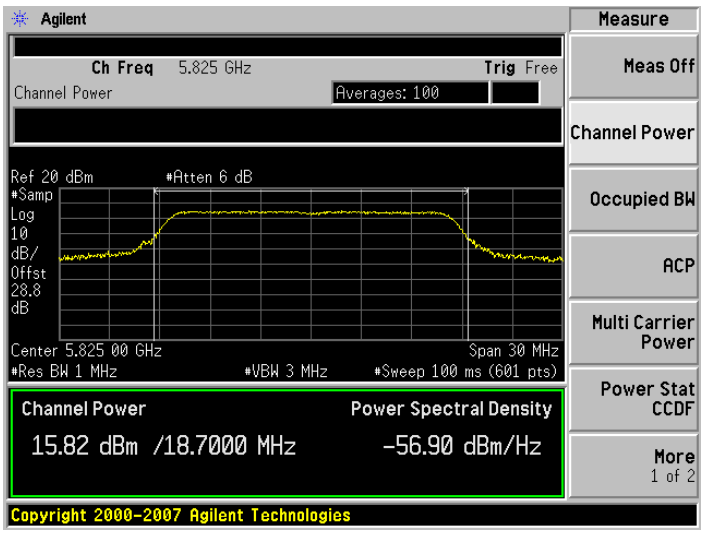


Antenna B

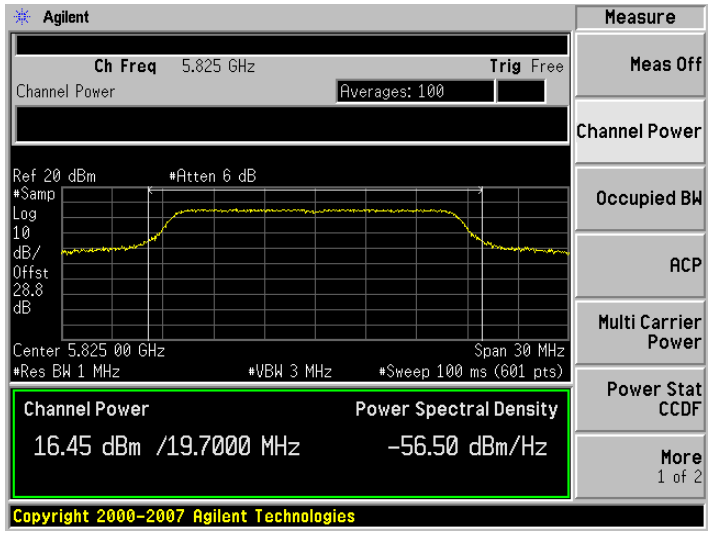


Antenna C

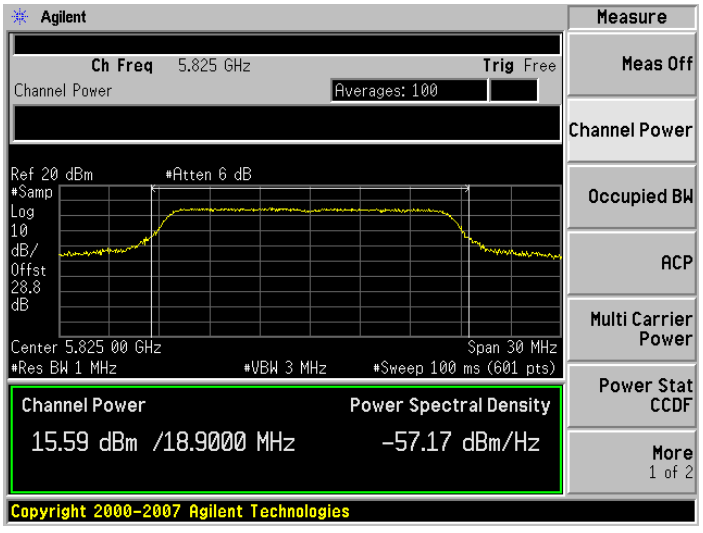
Peak Output Power, 5825 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



Antenna A

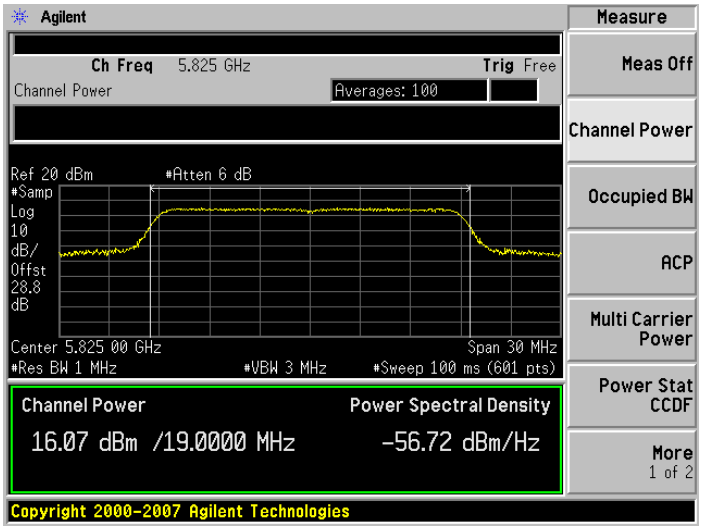


Antenna B

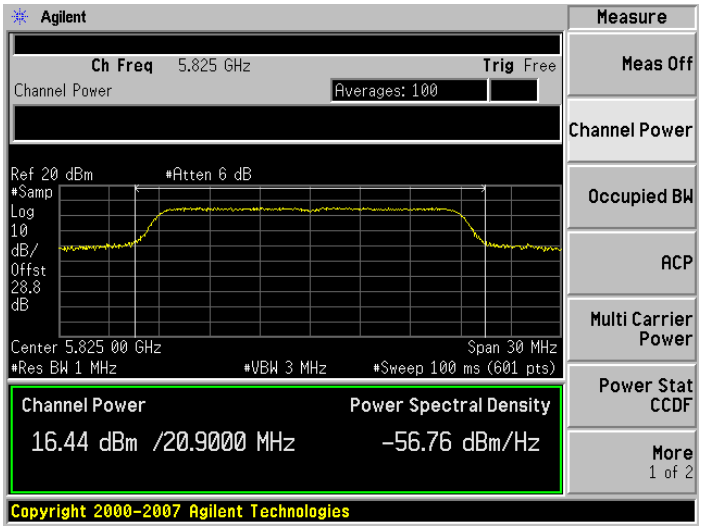


Antenna C

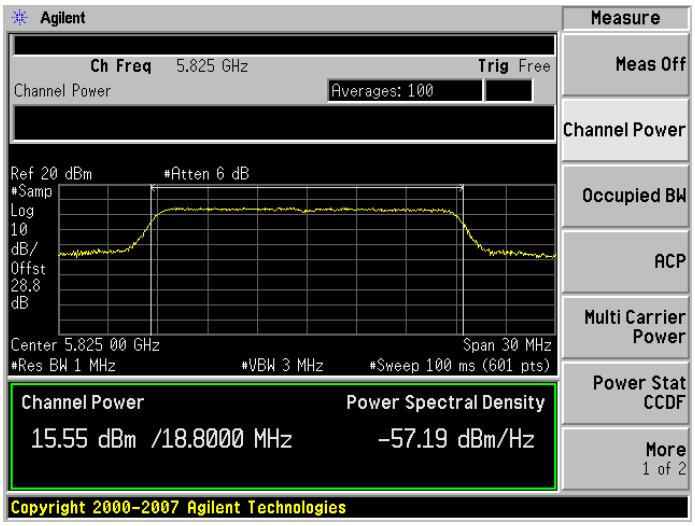
Peak Output Power, 5825 MHz, m0-m15, HT20 (with and without Beam Forming / STBC)



Antenna A

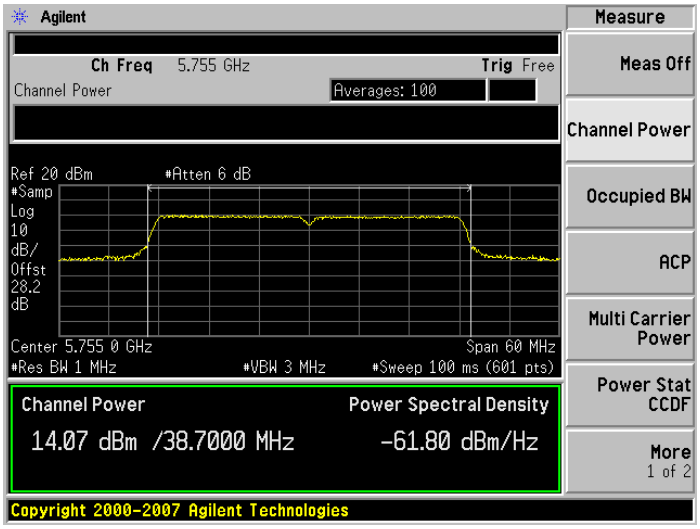


Antenna B

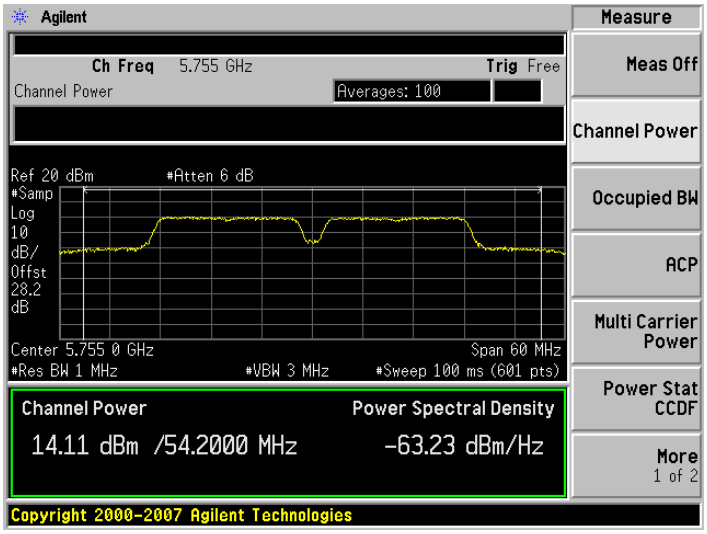


Antenna C

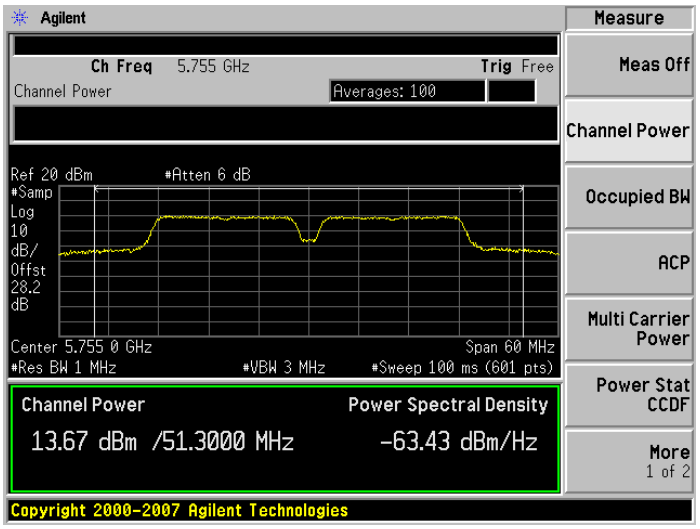
Peak Output Power, 5745/5765 MHz, 6 Mbps, Non-HT40



Antenna A

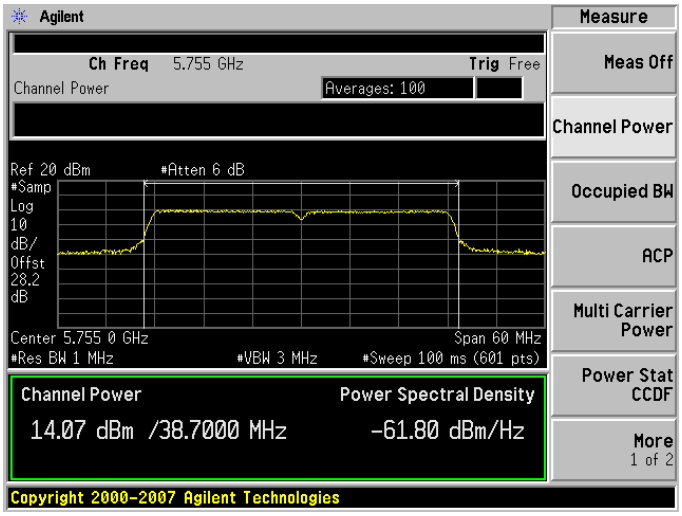


Antenna B

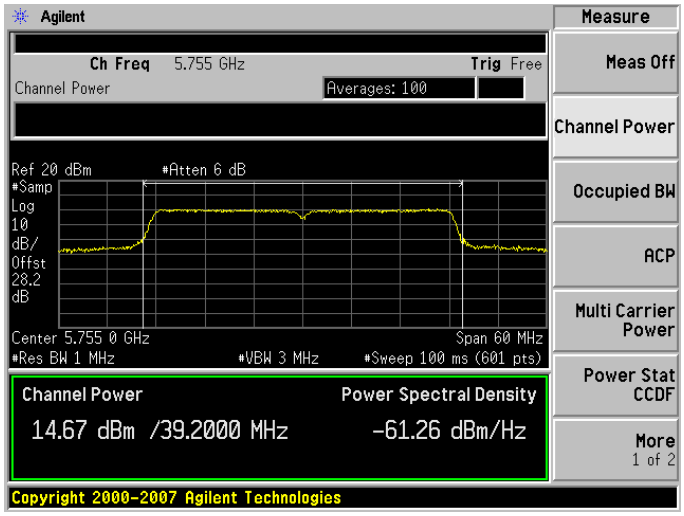


Antenna C

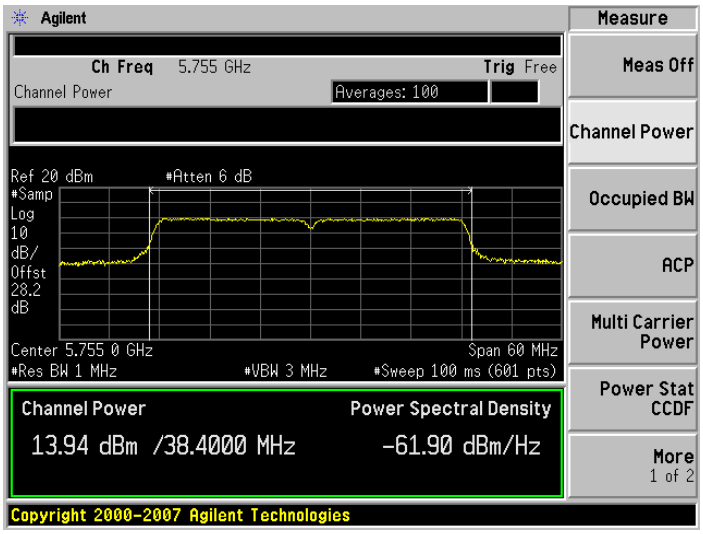
Peak Output Power, 5745/5765 MHz, m0-m15, HT40 (with and without Beam Forming / STBC)



Antenna A

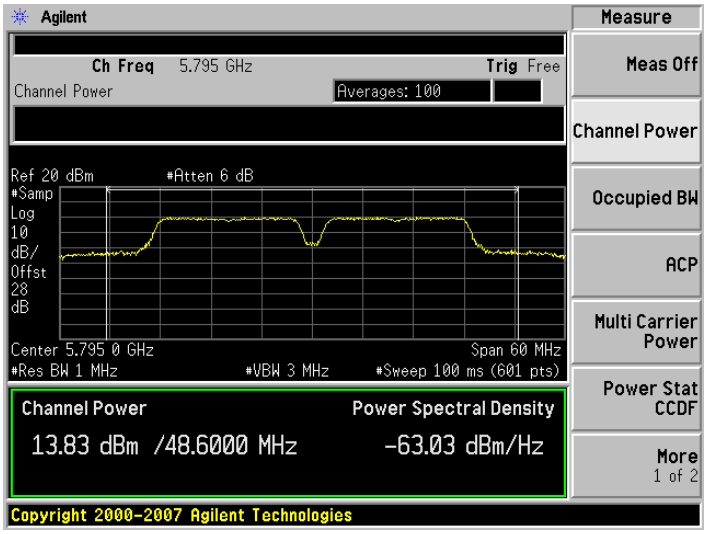


Antenna B

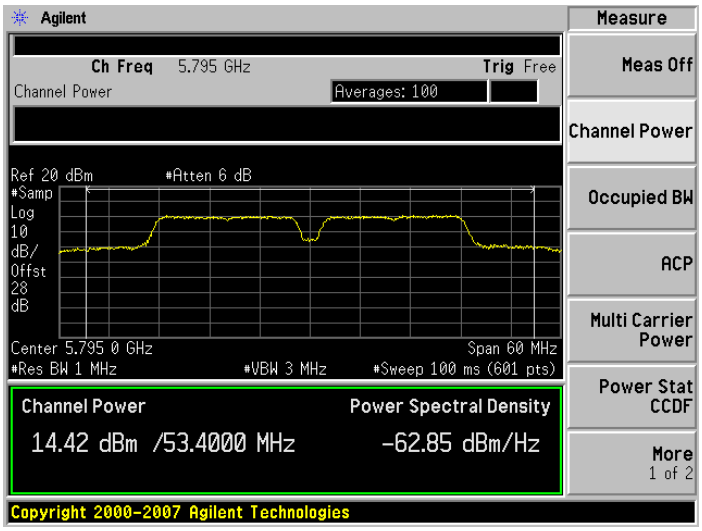


Antenna C

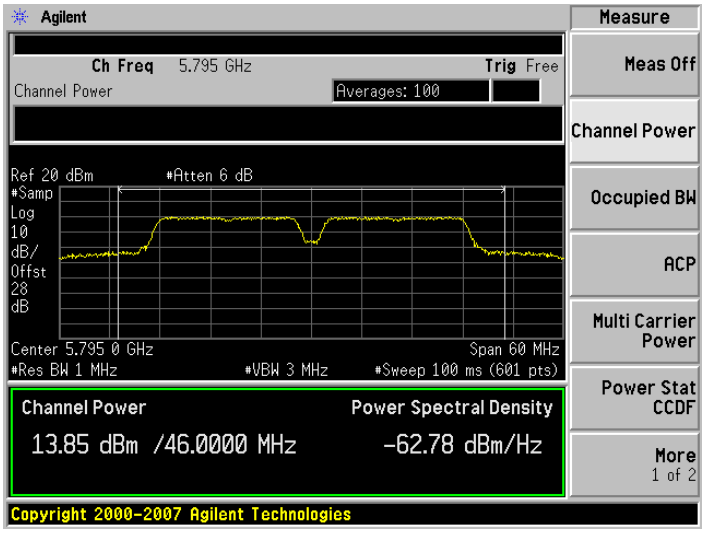
Peak Output Power, 5785/5805 MHz, 6 Mbps, Non-HT40



Antenna A

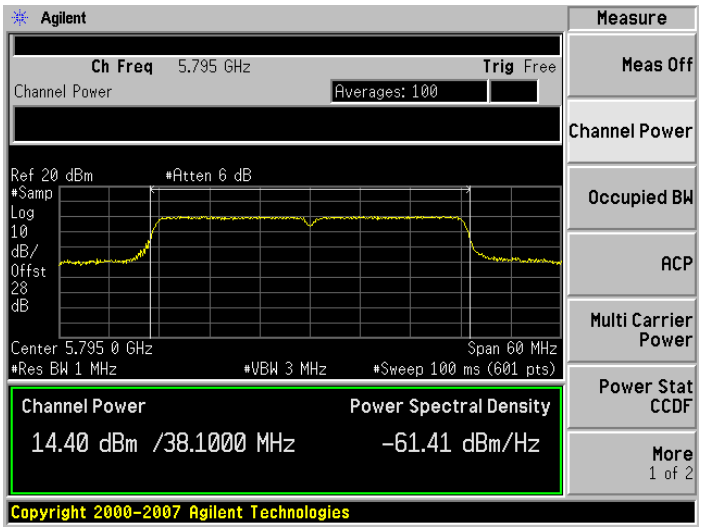


Antenna B

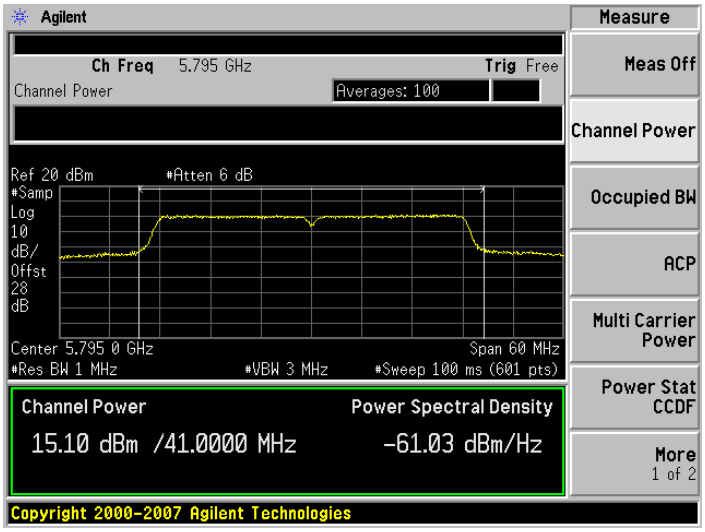


Antenna C

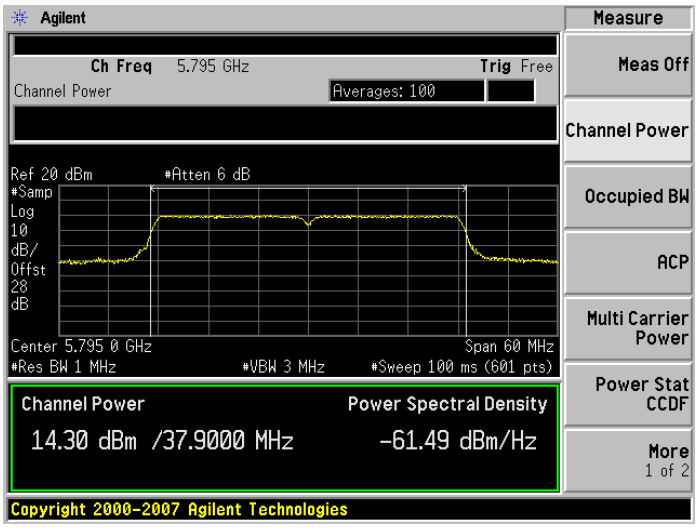
Peak Output Power, 5785/5805 MHz, m0-m15, HT40 (with and without Beam Forming / STBC)



Antenna A



Antenna B



Antenna C

Power Spectral Density

15.247: For digitally modulated systems, the peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Connect the antenna port(s) to the spectrum analyzer input. Place the radio in continuous transmit mode. Configure the spectrum analyzer as shown below.

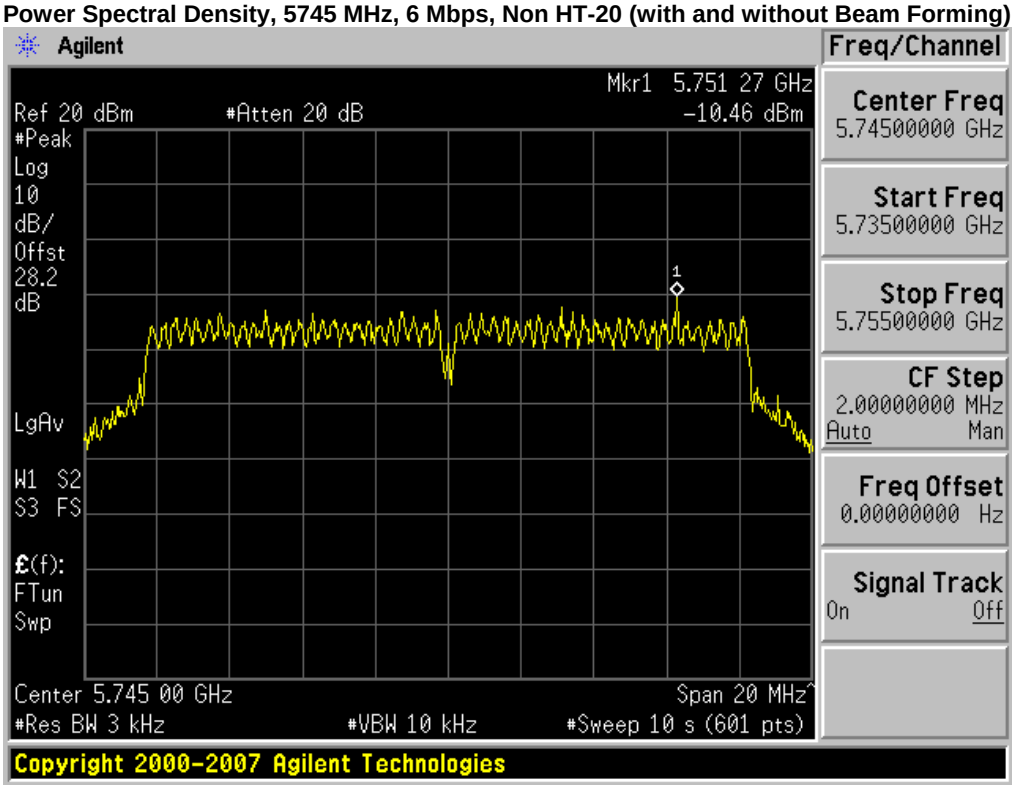
Center Frequency:	Frequency from table below
Span:	20 MHz
Ref Level Offset:	Correct for attenuator and cable loss.
Reference Level:	20 dBm
Attenuation:	20 dB
Sweep Time:	10s
Resolution Bandwidth:	3 kHz
Video Bandwidth:	10 kHz
Detector:	Peak
Trace:	Single
Marker:	Peak Search

Record the Marker value.

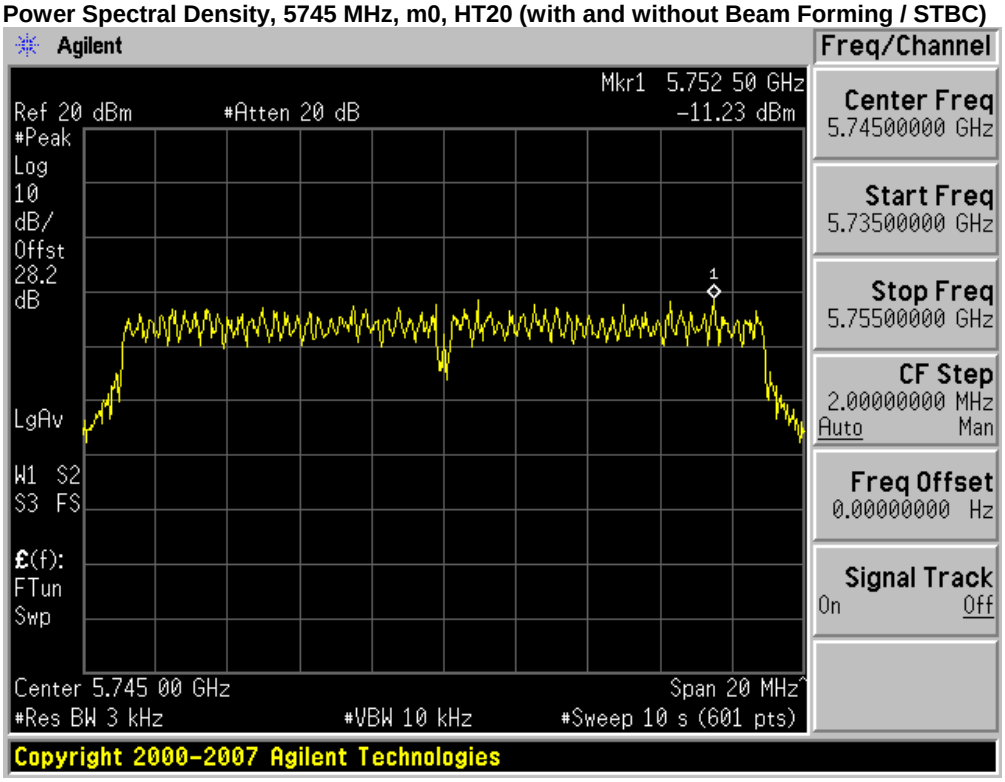
The “Measure and add 10 log(N) dB technique”, where N is the number of outputs, is used for measuring in-band Power Spectral Density. With this technique, spectrum measurements are performed at each output of the device, and the quantity 10 log(4) (or 6dB) is added to the worst case spectrum value before comparing to the emission limit.

Frequency (MHz)	Mode	Data Rate (Mbps)	PSD / Antenna (dBm/3kHz)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Margin (dB)
5745	Non HT-20, 6 to 54 Mbps	6	**-10.5**	**-4.4**	8	12.4
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	**-10.5**	**-4.4**	8	12.4
	HT-20, M0 to M15	m0	**-11.2**	**-5.2**	8	13.2
	HT-20 STBC, M0 to M7	m0	**-11.2**	**-5.2**	8	13.2
	HT-20 Beam Forming, M0 to M15	m0	**-11.2**	**-5.2**	8	13.2
5785	Non HT-20, 6 to 54 Mbps	6	**-11.5**	**-5.5**	8	13.5
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	**-11.5**	**-5.5**	8	13.5
	HT-20, M0 to M15	m0	**-11.7**	**-5.7**	8	13.7
	HT-20 STBC, M0 to M7	m0	**-11.7**	**-5.7**	8	13.7
	HT-20 Beam Forming, M0 to M15	m0	**-11.7**	**-5.7**	8	13.7
5825	Non HT-20, 6 to 54 Mbps	6	**-9.5**	**-3.5**	8	11.5
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	**-9.5**	**-3.5**	8	11.5
	HT-20, M0 to M15	m0	**-9.4**	**-3.3**	8	11.3
	HT-20 STBC, M0 to M7	m0	**-9.4**	**-3.3**	8	11.3
	HT-20 Beam Forming, M0 to M15	m0	**-9.4**	**-3.3**	8	11.3
5745/5765	Non HT-40 Duplicate, 6-54 Mbps	6	**-14.1**	**-8.0**	8	16.0
	HT-40, M0 to M15	m0	**-12.6**	**-6.6**	8	14.6
	HT-40 STBC, M0 to M7	m0	**-12.6**	**-6.6**	8	14.6
	HT-40 Beam Forming, M0 to M15	m0	**-12.6**	**-6.6**	8	14.6
5785/5805	Non HT-40 Duplicate, 6-54 Mbps	6	**-12.9**	**-6.9**	8	14.9
	HT-40, M0 to M23	m0	**-13.7**	**-7.7**	8	15.7
	HT-40 STBC, M0 to M7	m0	**-13.7**	**-7.7**	8	15.7
	HT-40 Beam Forming, M0 to M23	m0	**-13.7**	**-7.7**	8	15.7

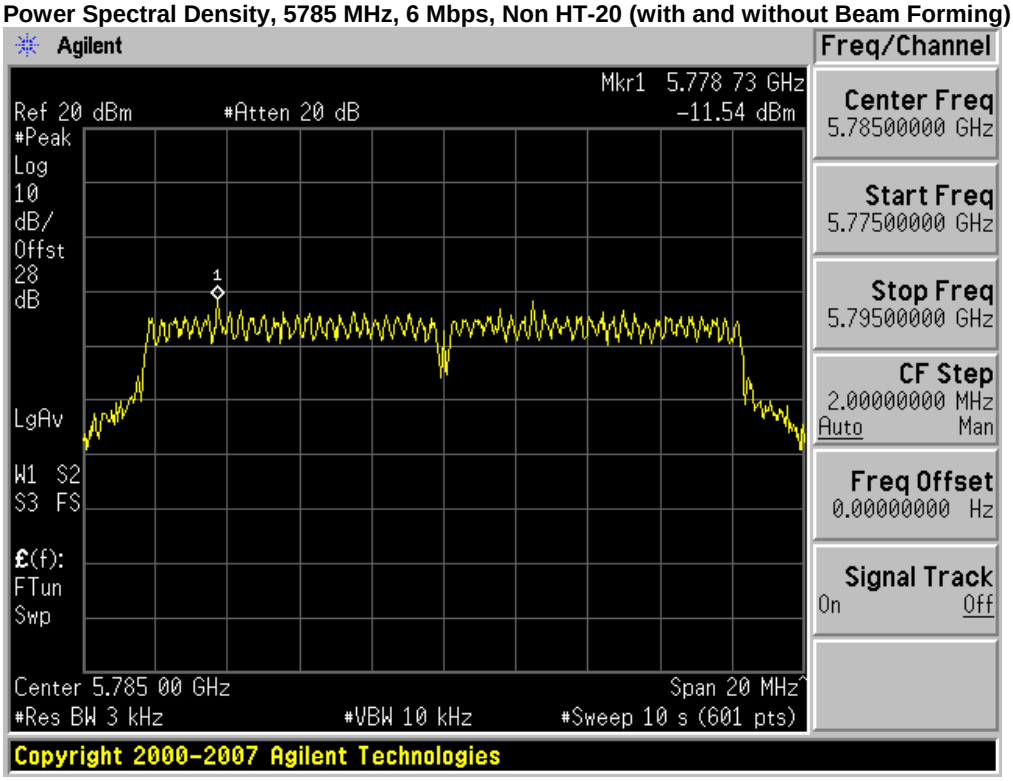
Power Spectral Density, 5745 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



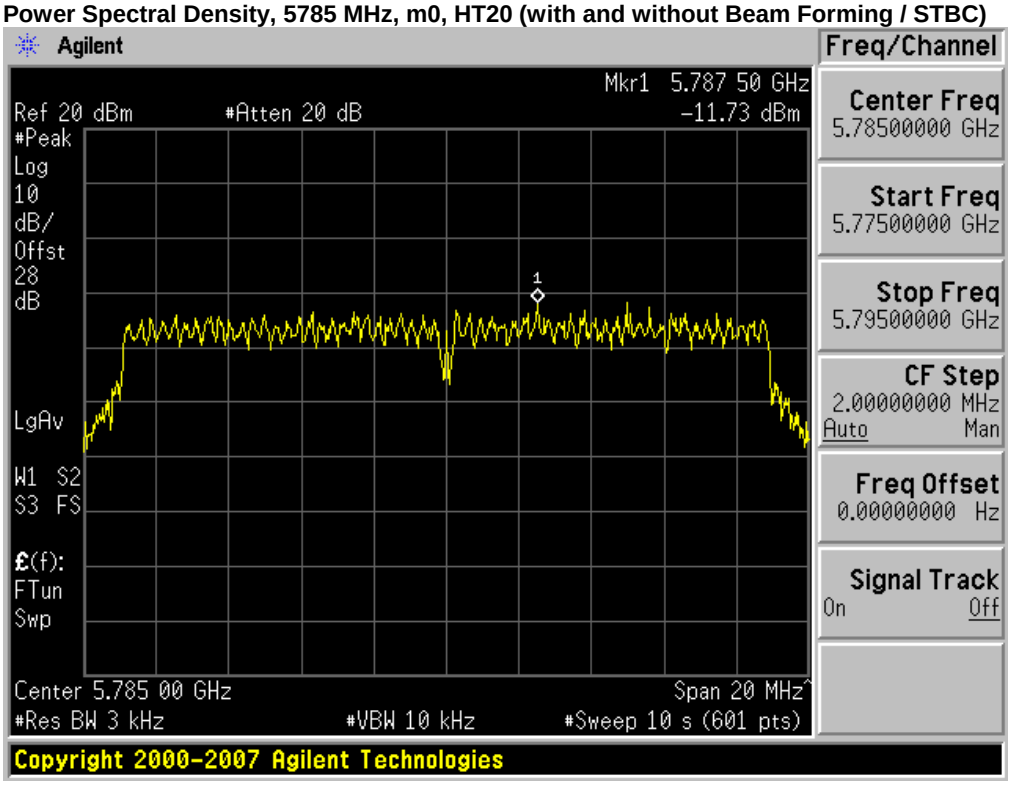
Power Spectral Density, 5745 MHz, m0, HT20 (with and without Beam Forming / STBC)



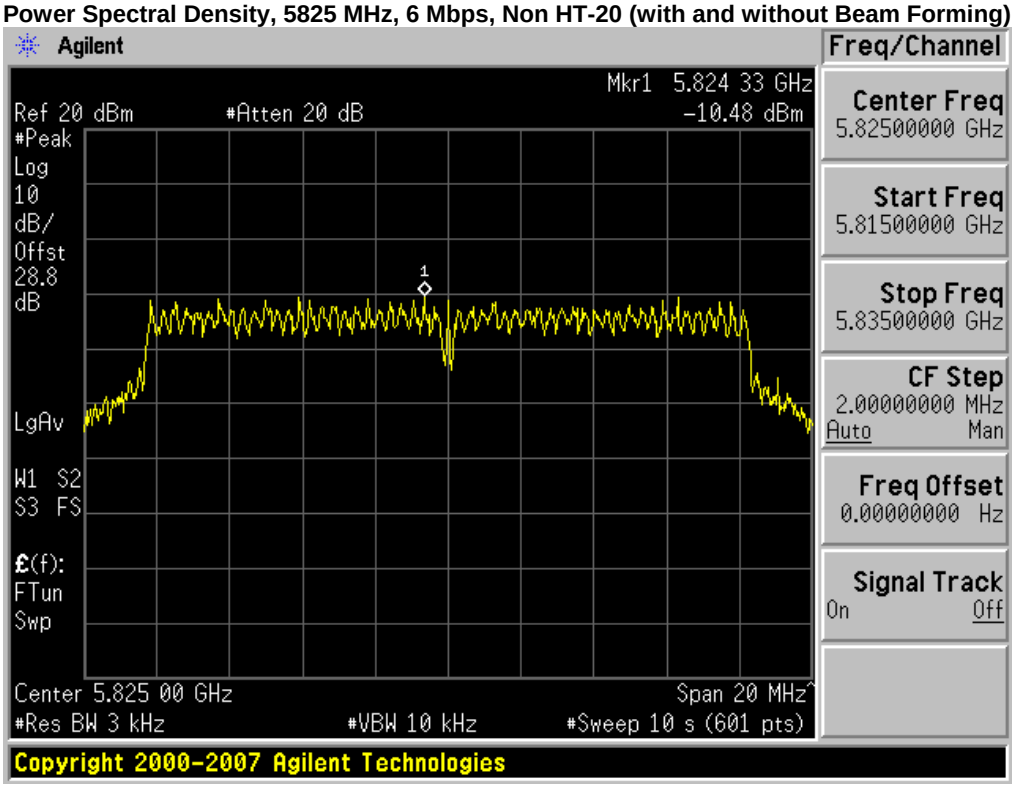
Power Spectral Density, 5785 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



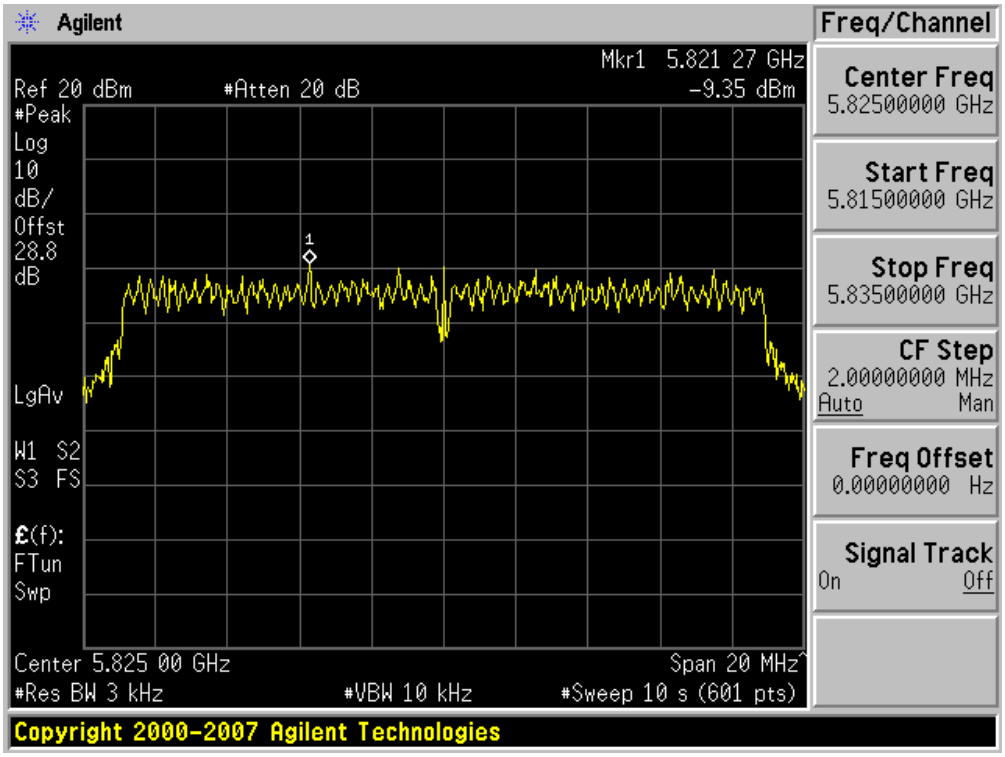
Power Spectral Density, 5785 MHz, m0, HT20 (with and without Beam Forming / STBC)



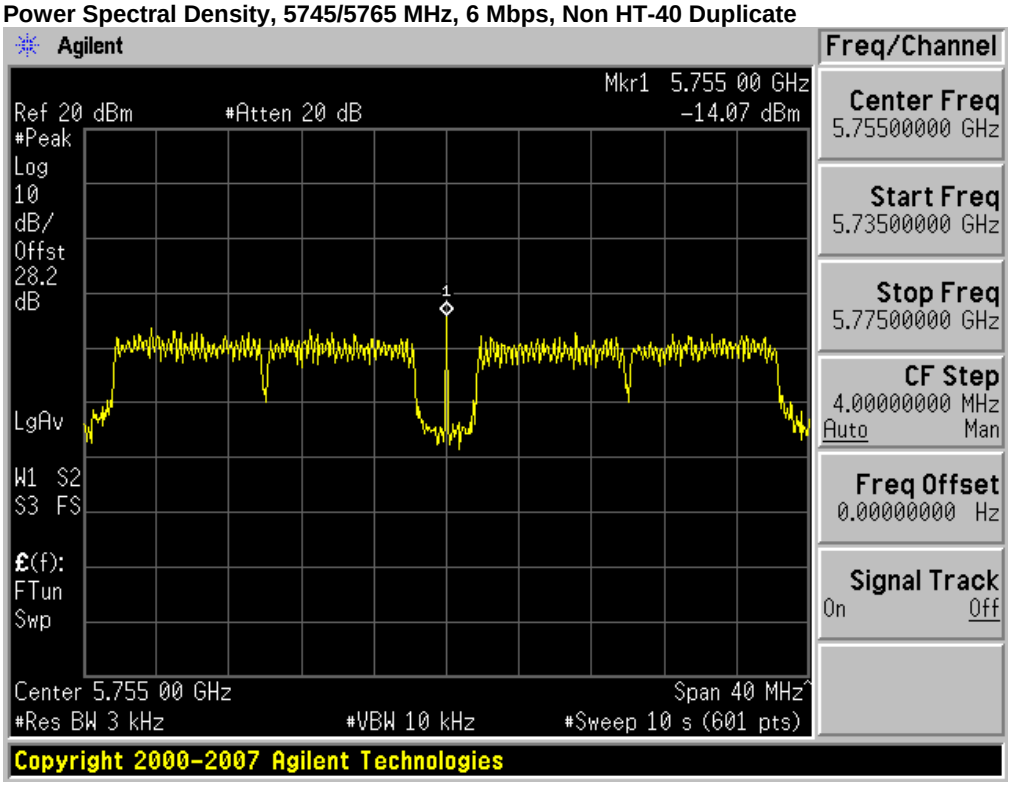
Power Spectral Density, 5825 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



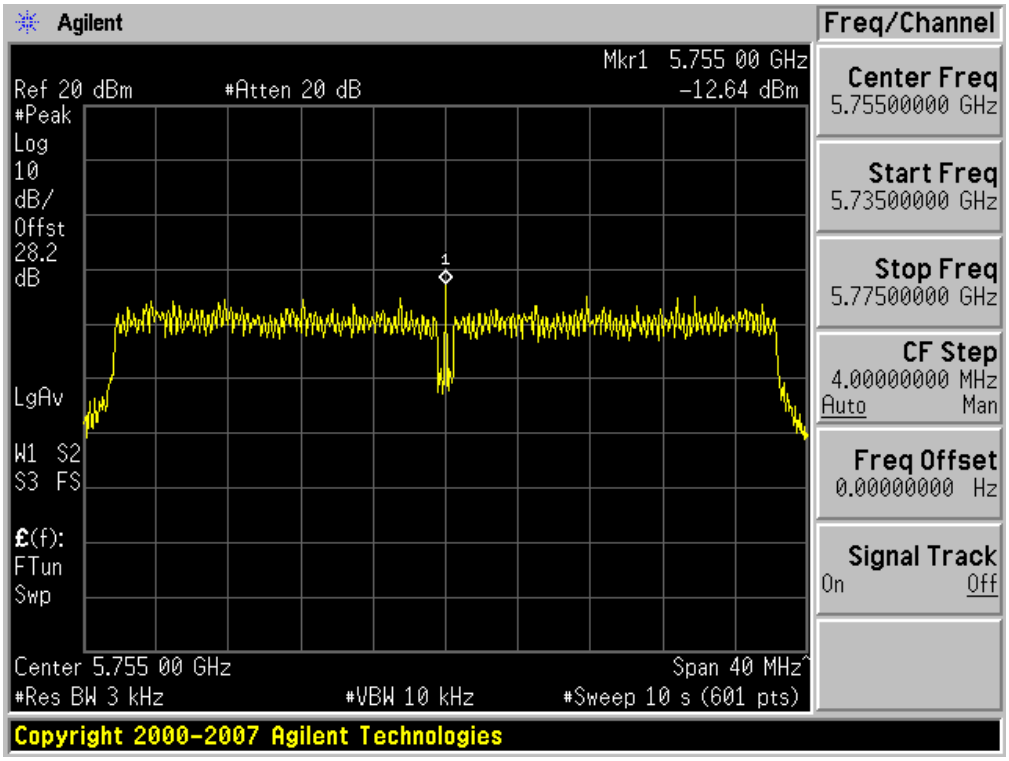
Power Spectral Density, 5825 MHz, m0, HT20 (with and without Beam Forming / STBC)



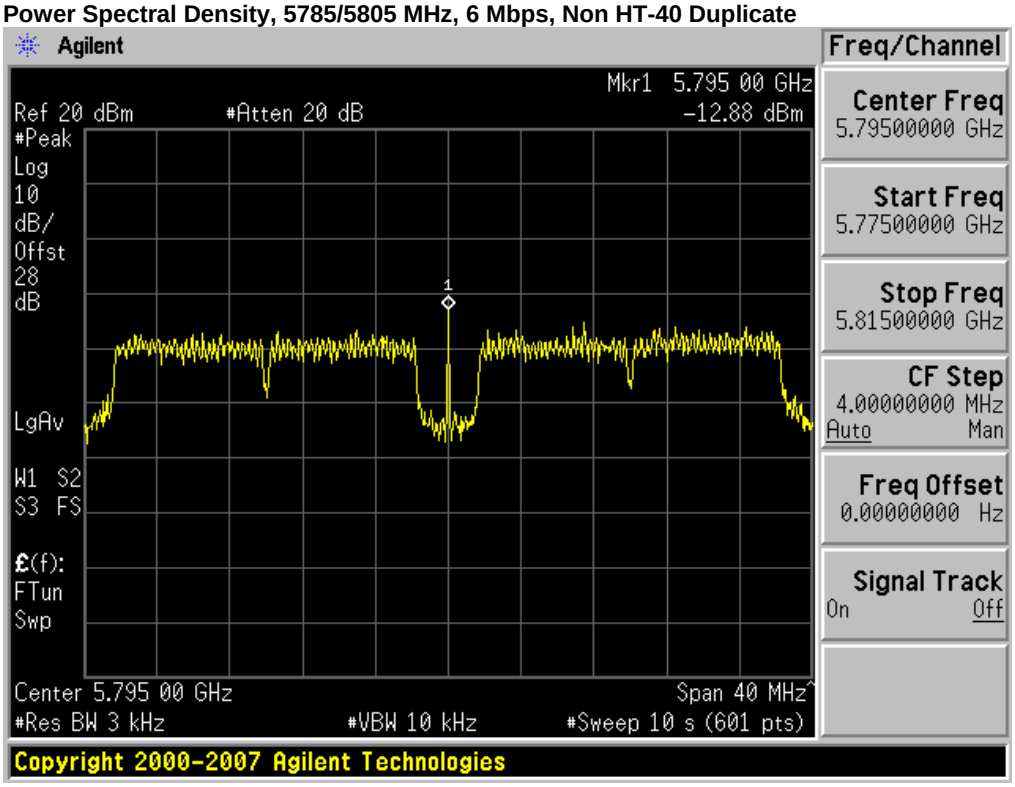
Power Spectral Density, 5745/5765 MHz, 6 Mbps, Non HT-40 Duplicate



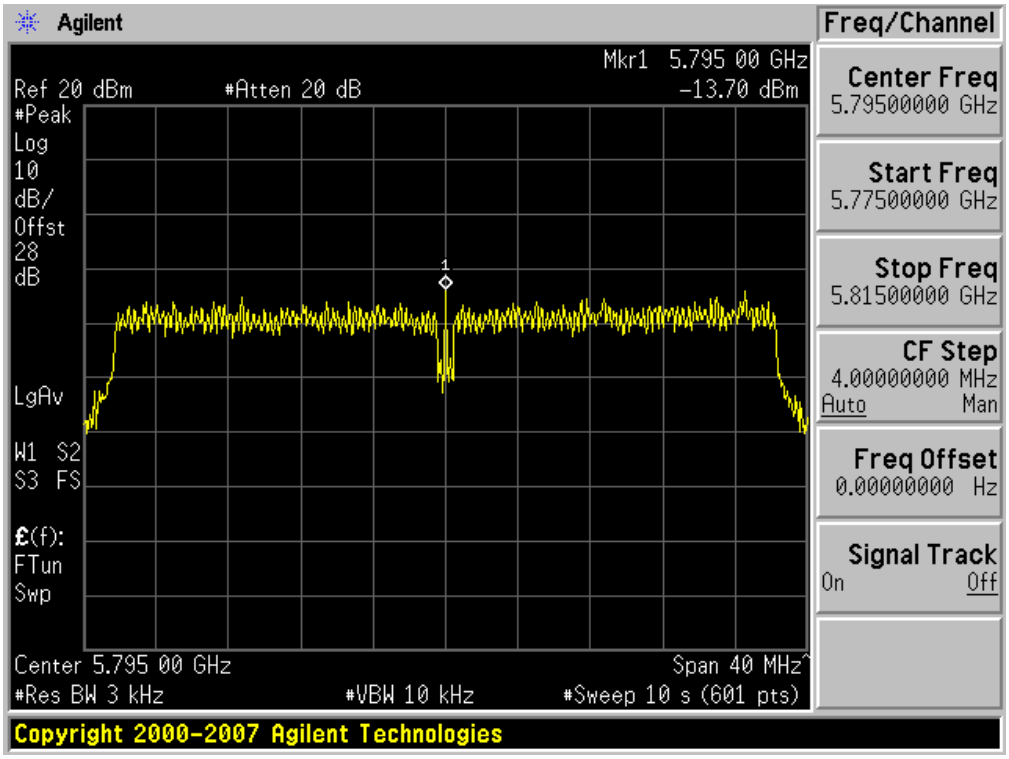
Power Spectral Density, 5745/5765 MHz, m0, HT-40 (with and without Beam Forming / STBC)



Power Spectral Density, 5785/5805 MHz, 6 Mbps, Non HT-40 Duplicate



Power Spectral Density, 5785/5805 MHz, m0, HT-40 (with and without Beam Forming / STBC)



Conducted Spurious Emissions

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).

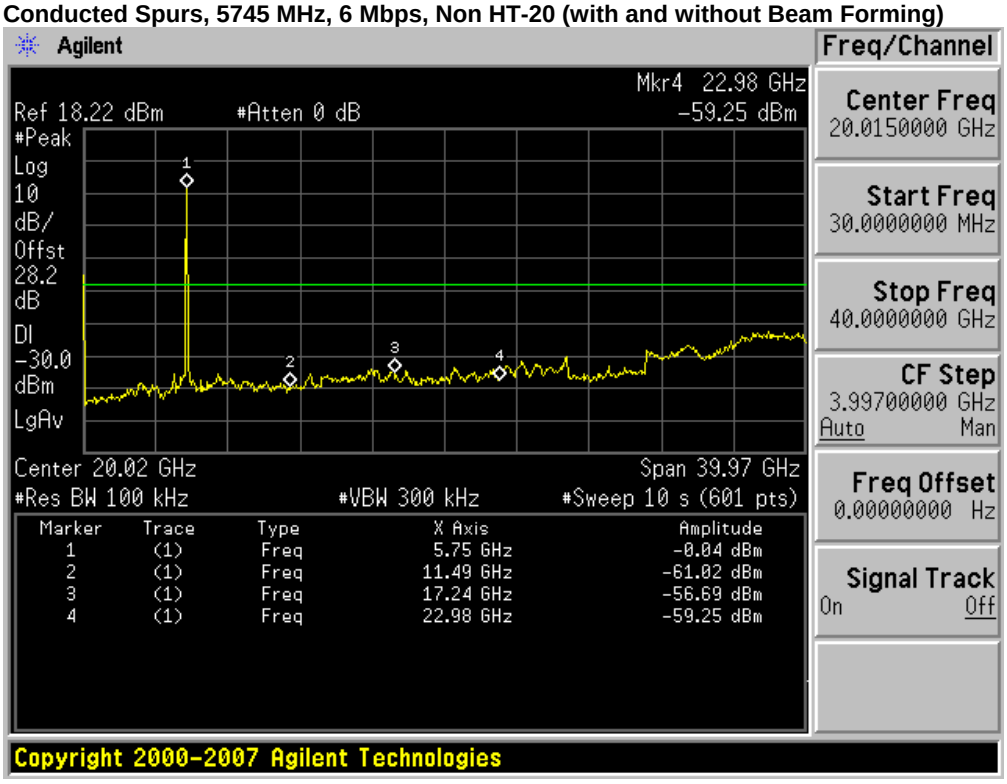
Span:	30 MHz-26 GHz
Reference Level:	20 dBm
Attenuation:	10 dB
Sweep Time:	5s
Resolution Bandwidth:	100 kHz
Video Bandwidth:	300 kHz
Detector:	Peak
Trace:	Single
Marker:	Peak

Record the marker waveform peak to spur difference

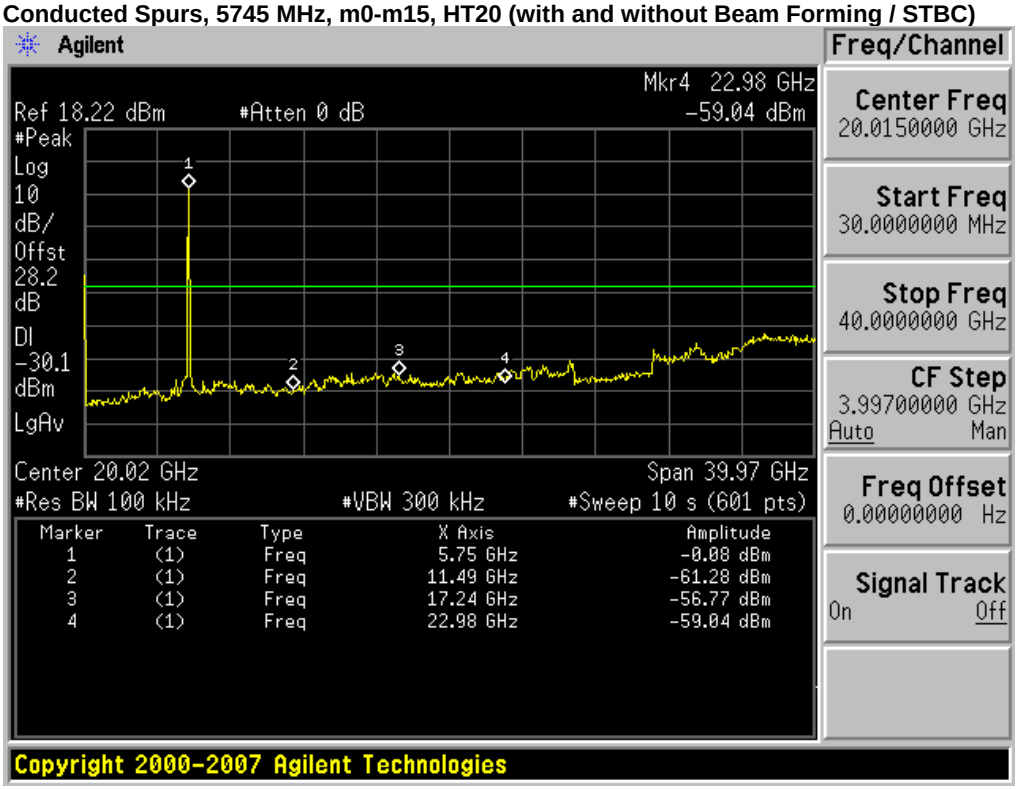
Out-of-band and spurious emissions tests are performed on each output individually without summing or adding 10 log(N) since the measurements are made relative to the in-band emissions on the individual outputs. The worst case output is recorded.

Frequency (MHz)	Mode	Data Rate (Mbps)	Conducted Spur Delta (dB)	Limit (dBc)	Margin (dB)
5745	Non HT-20, 6 to 54 Mbps	6	**56.7**	30.0	26.7
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	**56.7**	30.0	26.7
	HT-20, M0 to M15	m0	**56.7**	30.0	26.7
	HT-20 STBC, M0 to M7	m0	**56.7**	30.0	26.7
	HT-20 Beam Forming, M0 to M15	m0	**56.7**	30.0	26.7
5785	Non HT-20, 6 to 54 Mbps	6	**58.4**	30.0	28.4
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	**58.4**	30.0	28.4
	HT-20, M0 to M15	m0	**58.7**	30.0	28.7
	HT-20 STBC, M0 to M7	m0	**58.7**	30.0	28.7
	HT-20 Beam Forming, M0 to M15	m0	**58.7**	30.0	28.7
5805	Non HT-20, 6 to 54 Mbps	6	**58.0**	30.0	28.0
	Non HT-20 Beam Forming, 6 to 54 Mbps	6	**58.0**	30.0	28.0
	HT-20, M0 to M15	m0	**57.1**	30.0	27.1
	HT-20 STBC, M0 to M7	m0	**57.1**	30.0	27.1
	HT-20 Beam Forming, M0 to M15	m0	**57.1**	30.0	27.1
5745/5765	Non HT-40 Duplicate, 6-54 Mbps	6	**53.5**	30.0	23.5
	HT-40, M0 to M15	m0	**56.7**	30.0	26.7
	HT-40 STBC, M0 to M7	m0	**56.7**	30.0	26.7
	HT-40 Beam Forming, M0 to M15	m0	**56.7**	30.0	26.7
5785/5805	Non HT-40 Duplicate, 6-54 Mbps	6	**54.4**	30.0	24.4
	HT-40, M0 to M15	m0	**55.9**	30.0	25.9
	HT-40 STBC, M0 to M7	m0	**55.9**	30.0	25.9
	HT-40 Beam Forming, M0 to M15	m0	**55.9**	30.0	25.9

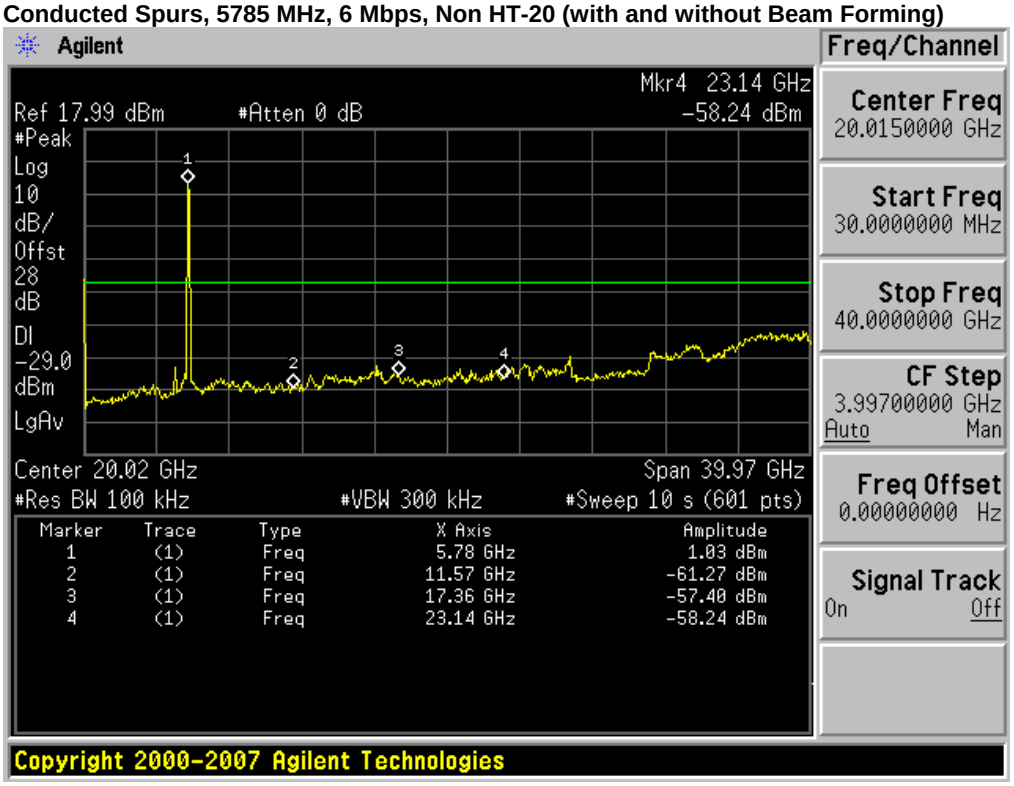
Conducted Spurs, 5745 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



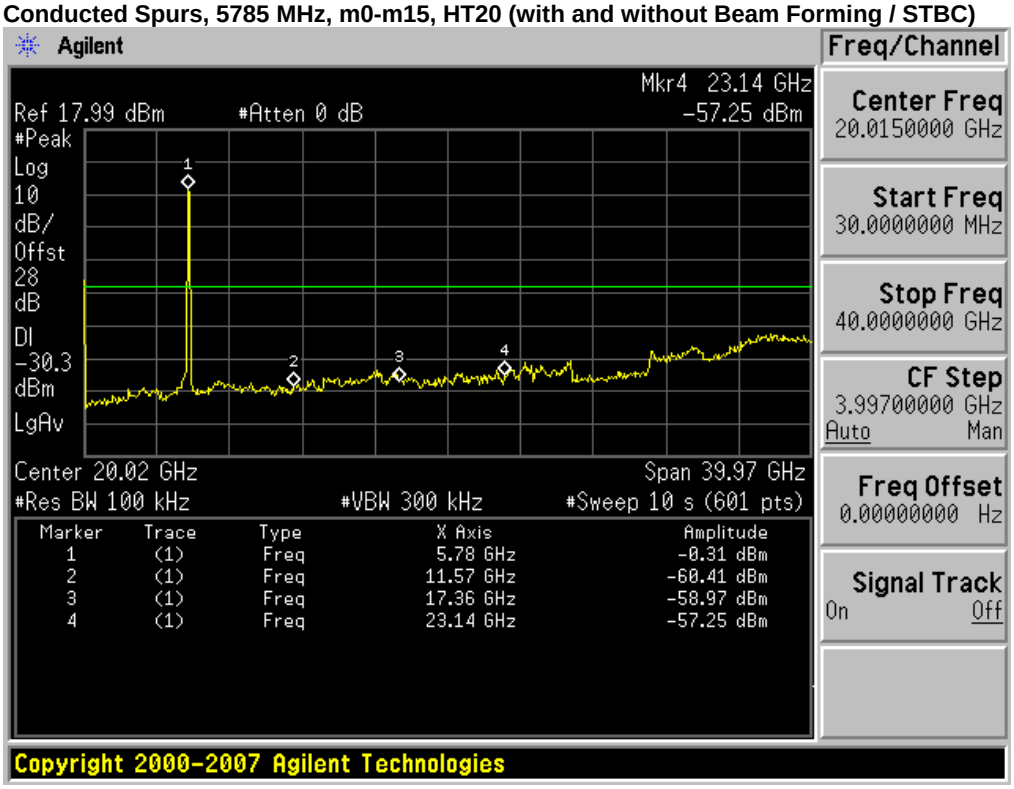
Conducted Spurs, 5745 MHz, m0-m15, HT20 (with and without Beam Forming / STBC)



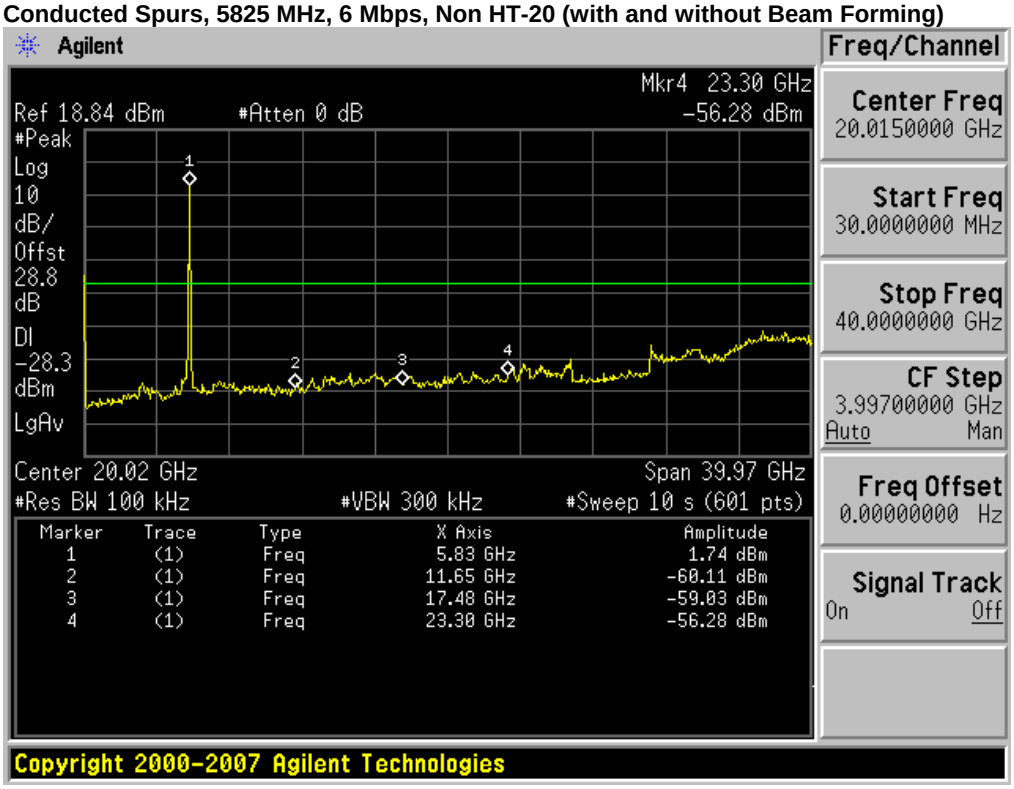
Conducted Spurs, 5785 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



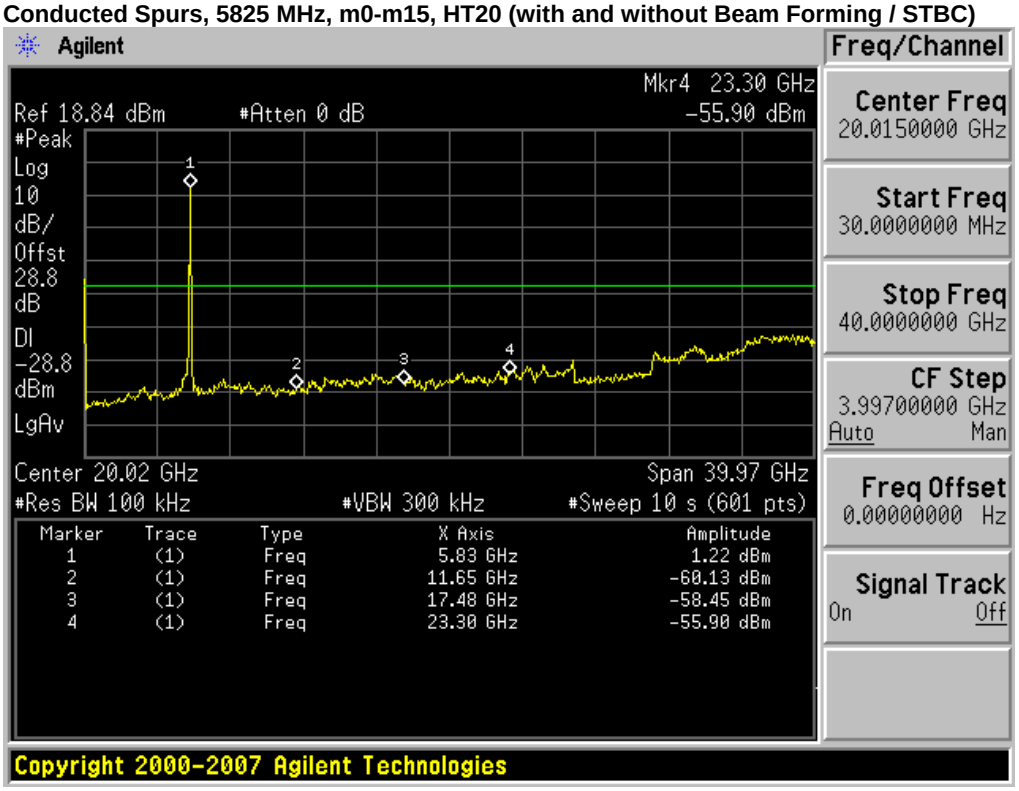
Conducted Spurs, 5785 MHz, m0-m15, HT20 (with and without Beam Forming / STBC)



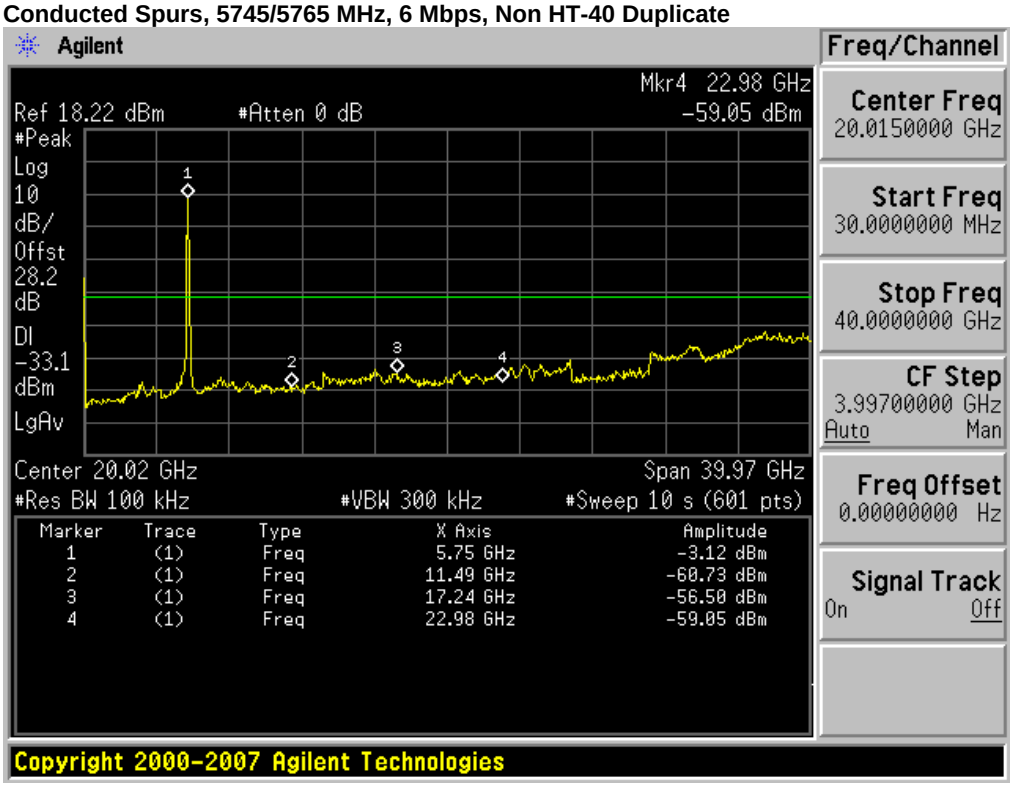
Conducted Spurs, 5825 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



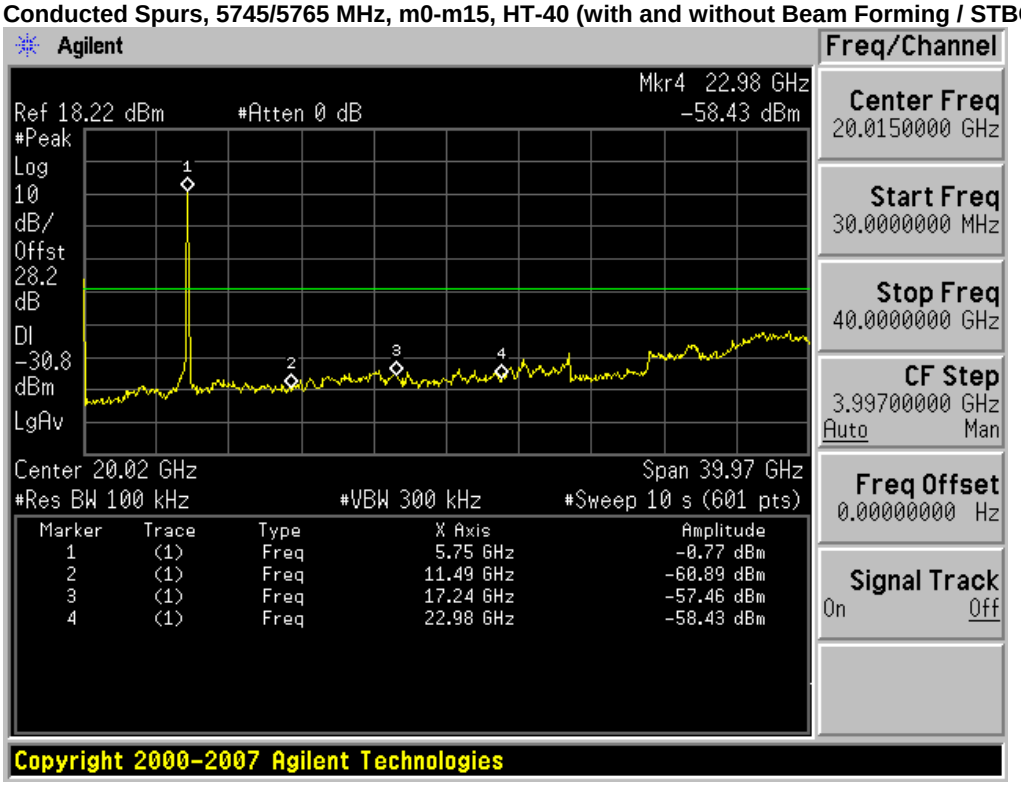
Conducted Spurs, 5825 MHz, m0-m15, HT20 (with and without Beam Forming / STBC)



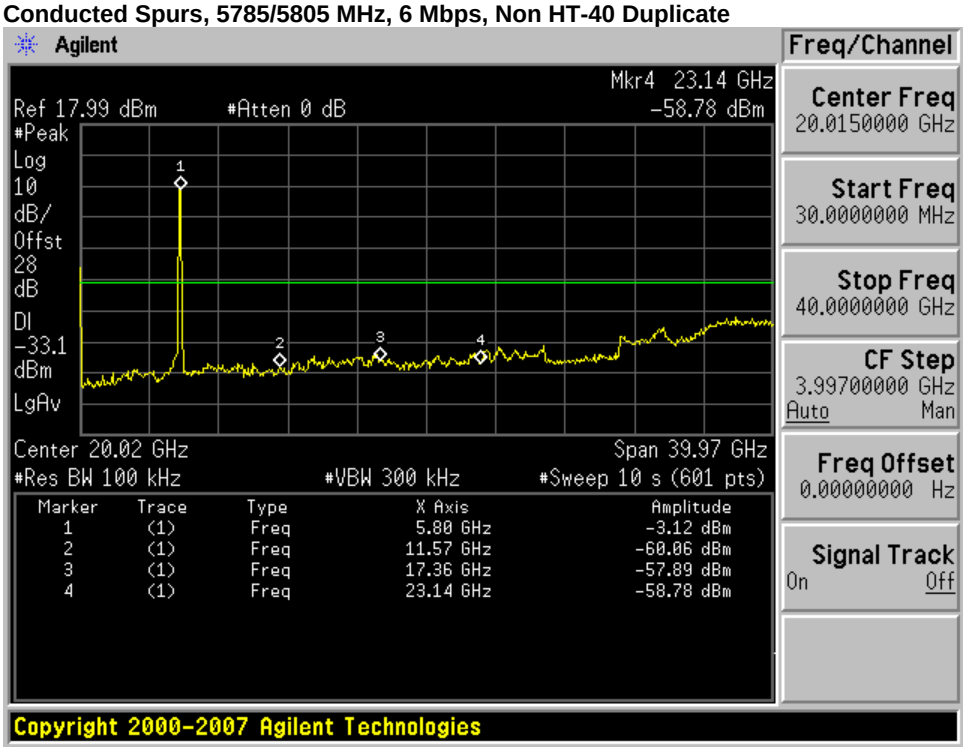
Conducted Spurs, 5745/5765 MHz, 6 Mbps, Non HT-40 Duplicate



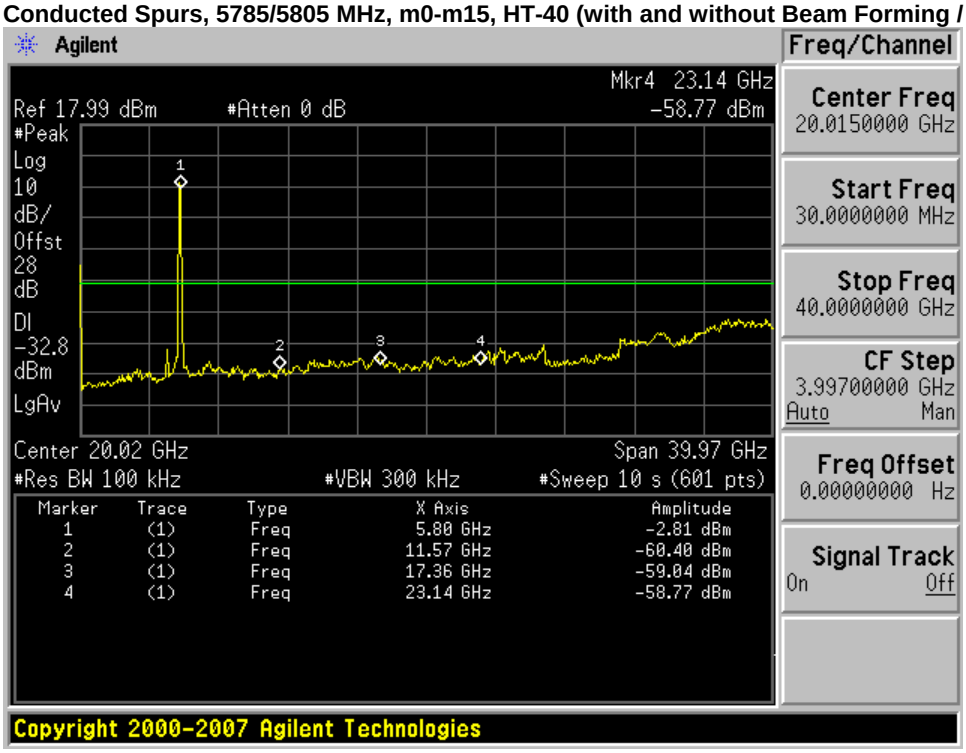
Conducted Spurs, 5745/5765 MHz, m0-m15, HT-40 (with and without Beam Forming / STBC)



Conducted Spurs, 5785/5805 MHz, 6 Mbps, Non HT-40 Duplicate



Conducted Spurs, 5785/5805 MHz, m0-m15, HT-40 (with and without Beam Forming / STBC)



APPENDIX 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).

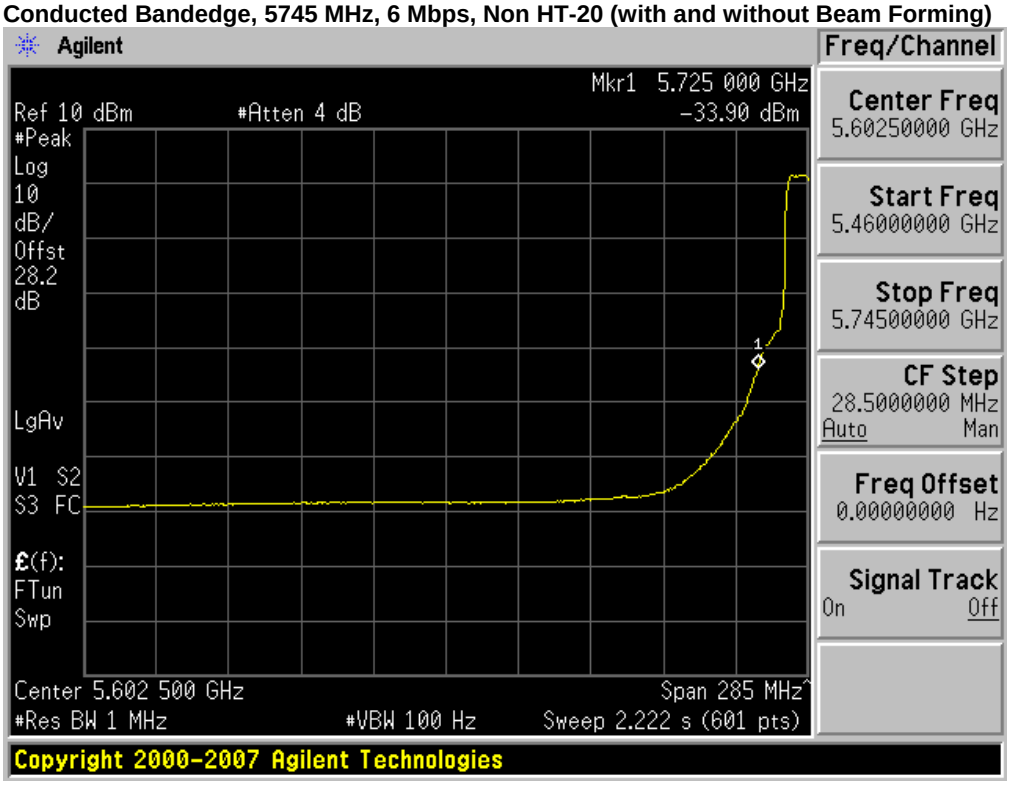
Span:	30 MHz-26 GHz
Reference Level:	20 dBm
Attenuation:	10 dB
Sweep Time:	5s
Resolution Bandwidth:	100 kHz
Video Bandwidth:	300 kHz
Detector:	Peak
Trace:	Single
Marker:	Peak

Record the marker waveform peak to spur difference

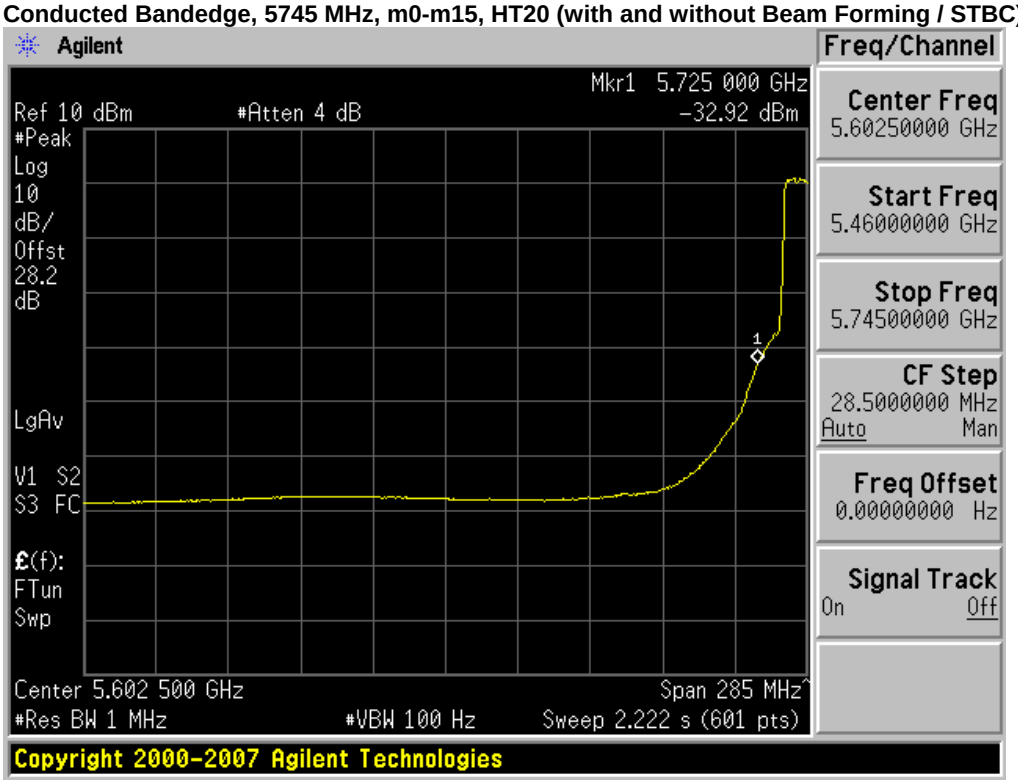
Out-of-band and spurious emissions tests are performed on each output individually without summing or adding 10 log(N) since the measurements are made relative to the in-band emissions on the individual outputs. The worst case output is recorded.

Frequency (MHz)	Operating Mode	Tx Paths	Conducted Bandedge Delta (dB)	Limit (dBc)	Margin (dB)
5745	Non HT-20, 6 to 54 Mbps	3	**33.9**	>30	3.9
	Non HT-20 Beam Forming, 6 to 54 Mbps	3	**33.9**	>30	3.9
	HT-20, M0 to M15	3	**32.9**	>30	2.9
	HT-20 STBC, M0 to M7	3	**32.9**	>30	2.9
	HT-20 Beam Forming, M0 to M7	3	**32.9**	>30	2.9
	HT-20 Beam Forming, M8 to M15	3	**32.9**	>30	2.9
5825	Non HT-20, 6 to 54 Mbps	3	**38.4**	>30	8.4
	Non HT-20 Beam Forming, 6 to 54 Mbps	3	**38.4**	>30	8.4
	HT-20, M0 to M15	3	**35.4**	>30	5.4
	HT-20 STBC, M0 to M7	3	**35.4**	>30	5.4
	HT-20 Beam Forming, M0 to M7	3	**35.4**	>30	5.4
	HT-20 Beam Forming, M8 to M15	3	**35.4**	>30	5.4
5745/5765	Non HT-40 Duplicate, 6-54 Mbps	3	**31.6**	>30	1.6
	HT-40, M0 to M15	3	**31.6**	>30	1.6
	HT-40 STBC, M0 to M7	3	**31.6**	>30	1.6
	HT-40 Beam Forming, M0 to M7	3	**31.6**	>30	1.6
	HT-40 Beam Forming, M8 to M15	3	**31.6**	>30	1.6
5785/5805	Non HT-40 Duplicate, 6-54 Mbps	3	**44.2**	>30	14.2
	HT-40, M0 to M15	3	**44.2**	>30	14.2
	HT-40 STBC, M0 to M7	3	**44.2**	>30	14.2
	HT-40 Beam Forming, M0 to M7	3	**44.2**	>30	14.2
	HT-40 Beam Forming, M8 to M15	3	**44.2**	>30	14.2

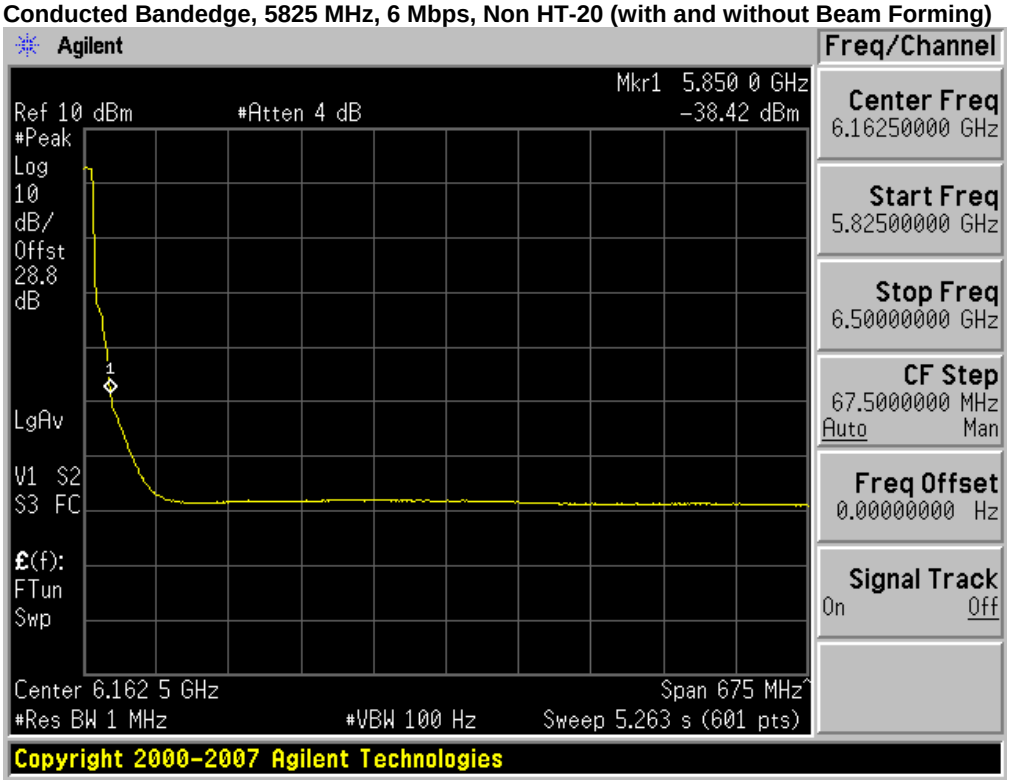
Conducted Bandedge, 5745 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



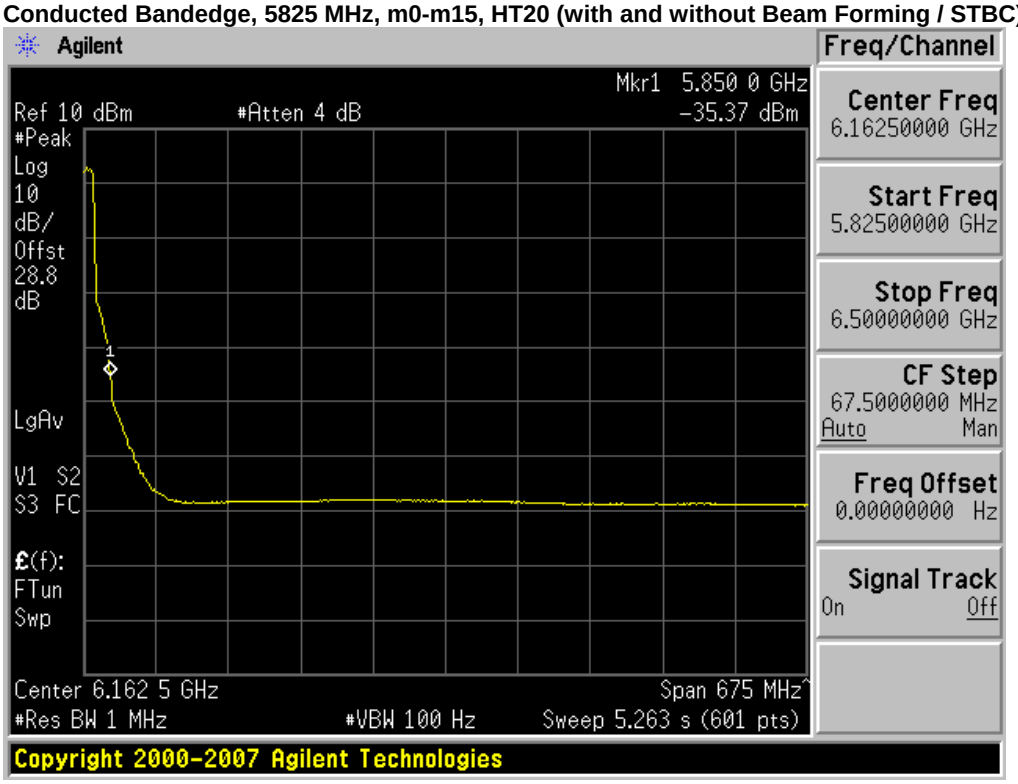
Conducted Bandedge, 5745 MHz, m0-m15, HT20 (with and without Beam Forming / STBC)



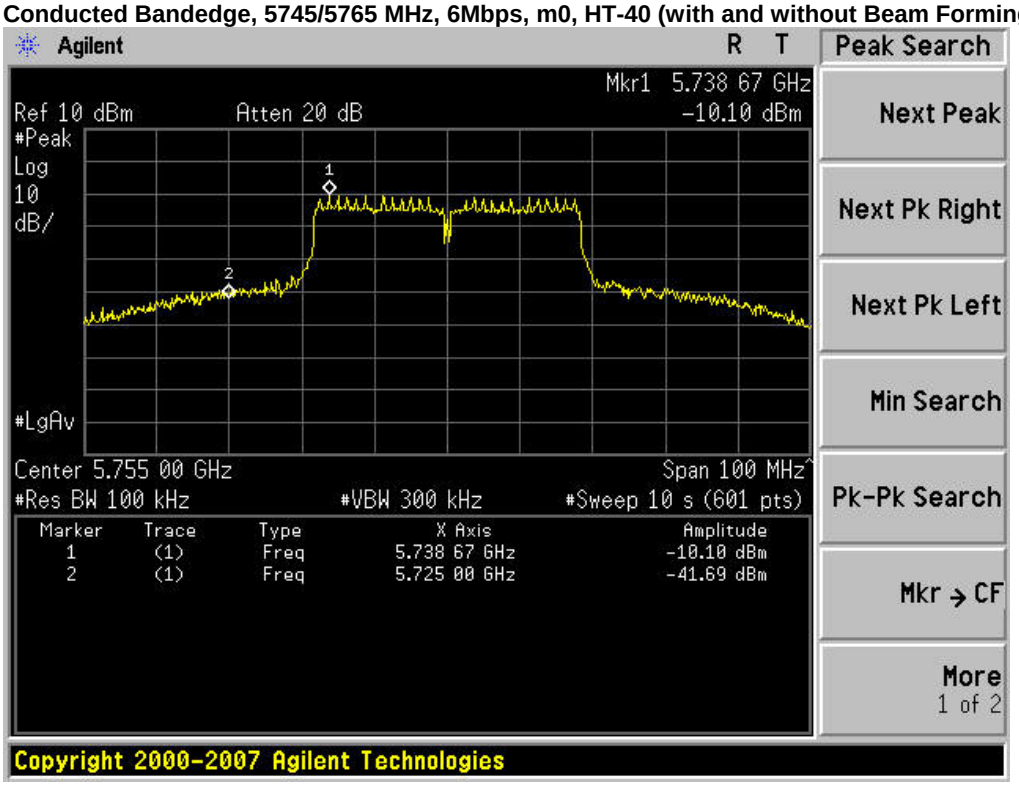
Conducted Bandedge, 5825 MHz, 6 Mbps, Non HT-20 (with and without Beam Forming)



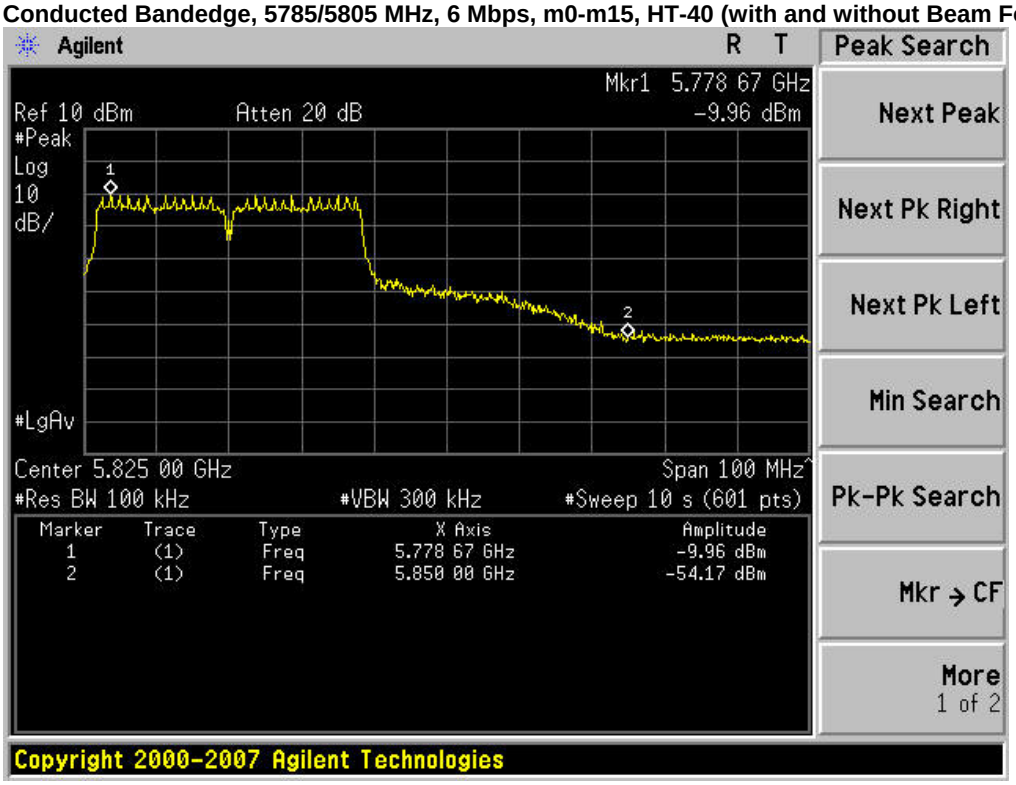
Conducted Bandedge, 5825 MHz, m0-m15, HT20 (with and without Beam Forming / STBC)

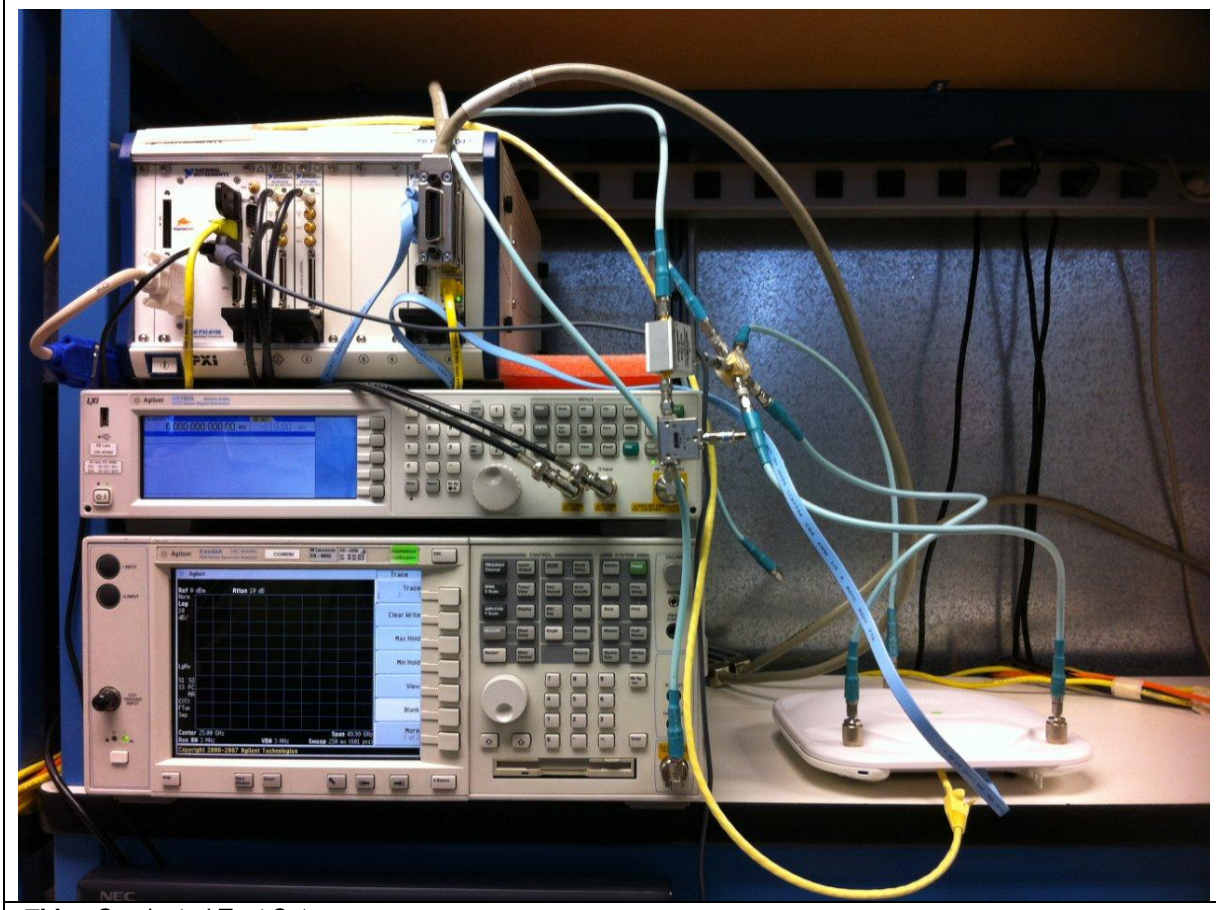


Conducted Bandedge, 5745/5765 MHz, 6Mbps, m0, HT-40 (with and without Beam Forming / STBC)



Conducted Bandedge, 5785/5805 MHz, 6 Mbps, m0-m15, HT-40 (with and without Beam Forming / STBC)

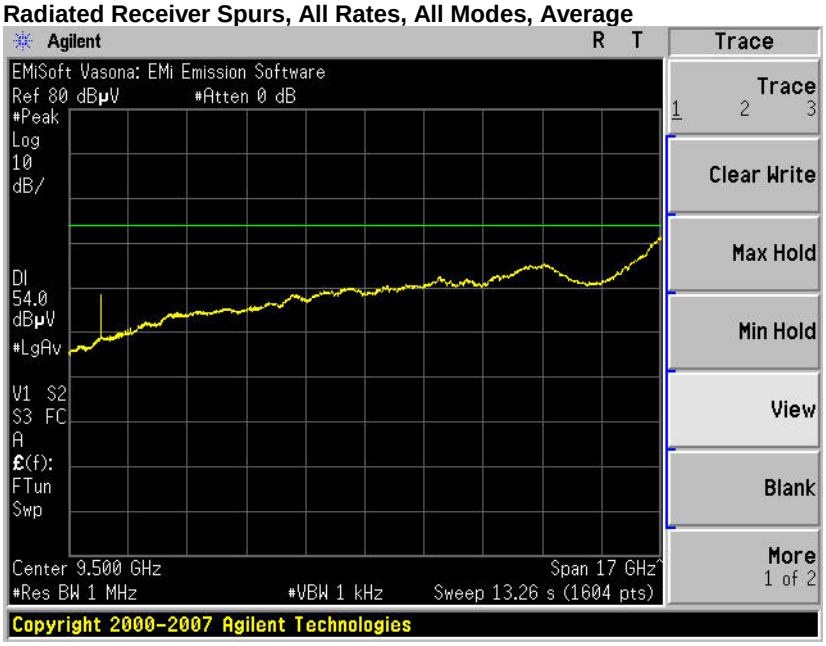




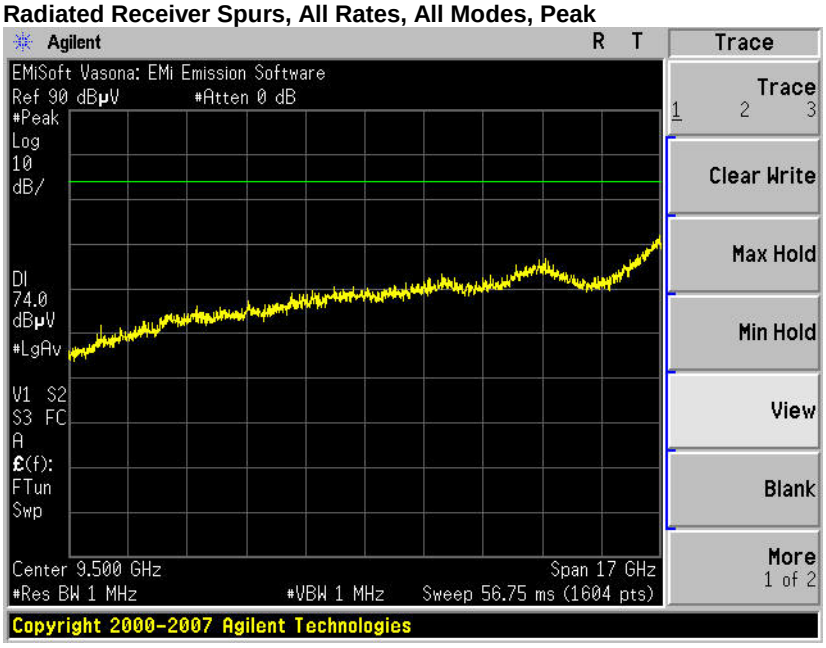
Title: Conducted Test Setup

Receiver Radiated Emissions

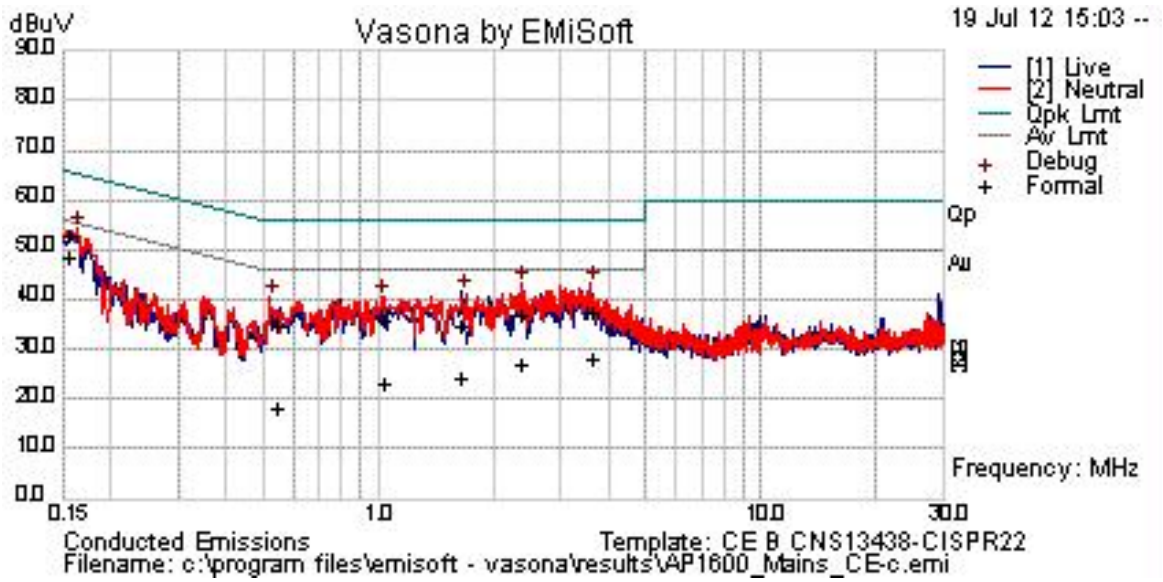
Radiated Receiver Spurs, All Rates, All Modes, Average



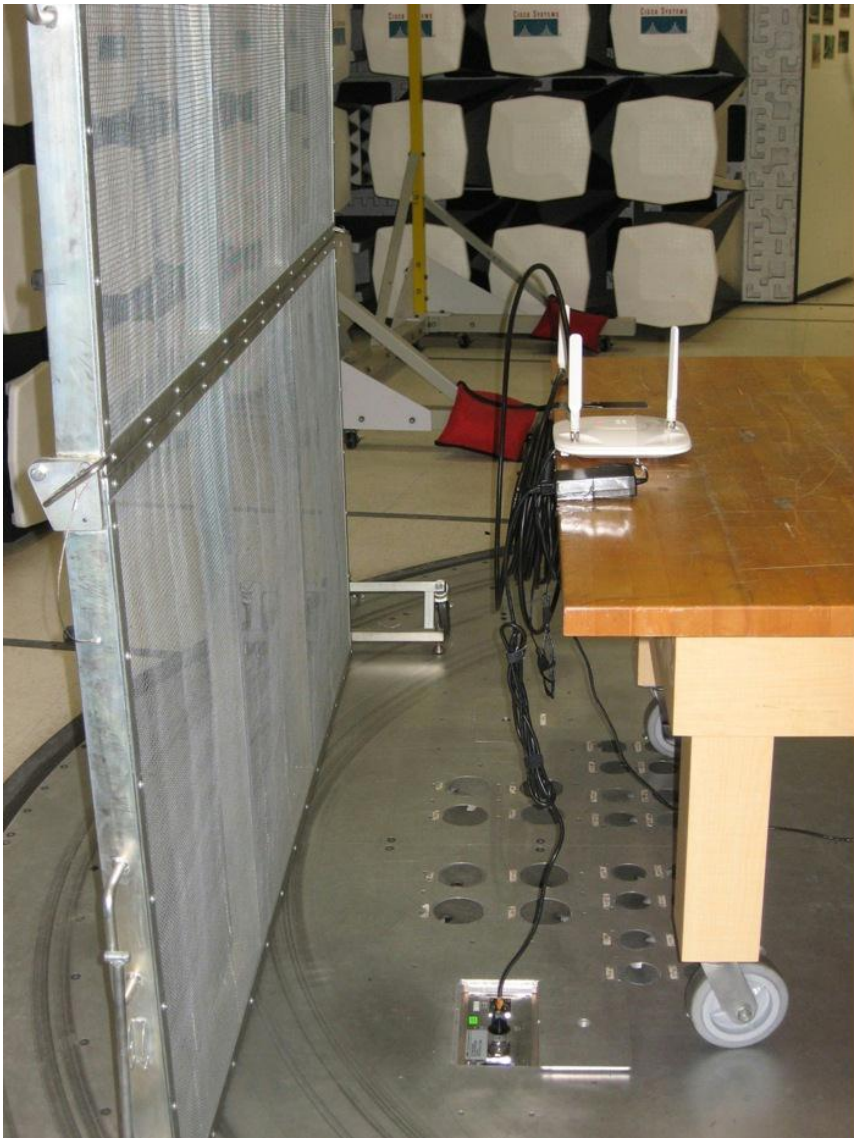
Radiated Receiver Spurs, All Rates, All Modes, Peak



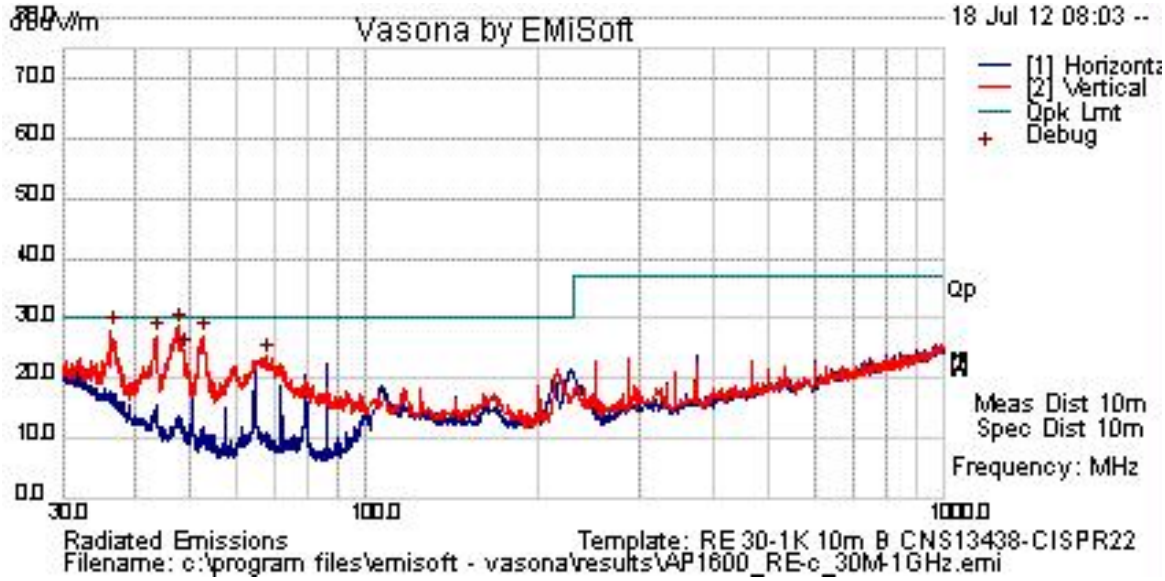
Conducted Emissions



Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.155687	25.7	21.4	1.6	48.7	Av	N	55.7	-7	Pass	
0.155687	29.8	21.4	1.6	52.8	Qp	N	65.7	-12.9	Pass	
0.538798	14	20.1	0.6	34.6	Qp	N	56	-21.4	Pass	
0.538798	-2.7	20.1	0.6	18	Av	N	46	-28	Pass	
1.027	15.3	20	0.5	35.9	Qp	N	56	-20.1	Pass	
1.027	2.4	20	0.5	23	Av	N	46	-23	Pass	
1.645	14.1	20.2	0.5	34.7	Qp	L	56	-21.3	Pass	
1.645	3.7	20.2	0.5	24.3	Av	L	46	-21.7	Pass	
2.359	6.5	20.3	0.5	27.3	Av	N	46	-18.7	Pass	
2.359	16	20.3	0.5	36.7	Qp	N	56	-19.3	Pass	
3.617	7.3	20.4	0.5	28.3	Av	N	46	-17.7	Pass	
3.617	16.8	20.4	0.5	37.7	Qp	N	56	-18.3	Pass	



Radiated Emissions



Test Results Table

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
36.355	34.7	0.6	-10.1	25.2	Qp	V	208	102	30	-4.8	Pass	
43.321	37.9	0.6	-15.1	23.4	Qp	V	350	138	30	-6.6	Pass	
47.511	42.6	0.7	-17.6	25.6	Qp	V	261	78	30	-4.4	Pass	
52.426	40.3	0.7	-19.1	22	Qp	V	221	121	30	-8	Pass	
250.015	34.1	1.5	-14.1	21.5	Qp	V	111	195	37	-15.5	Pass	
375.005	30.6	1.8	-11.1	21.3	Qp	V	101	186	37	-15.7	Pass	
1000	24.8	3	-3.1	24.7	Qp	V	283	60	37	-12.3	Pass	

Title: Radiated Emissions 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=√(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=√((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*√((30*(P/1000)*G)/(3770*S))
d=0.282*√(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)/√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 6 dBi (11dBi with beam forming). 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)
5745	54	1	22.0	11	**12.60**	20	7.40
5785	54	1	22.0	11	**12.60**	20	7.40
5825	54	1	22.0	11	**12.60**	20	7.40

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)
5745	54	20	22.0	11	**0.40**	1	0.60
5785	54	20	22.0	11	**0.40**	1	0.60
5825	54	20	22.0	11	**0.40**	1	0.60

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

Equip #	Manufacturer	Model	Description	Next Due
CIS004882	EMC Test Systems	3115	Double Ridged Guide Horn Antenna	4-June-13
CIS005691	Miteq	NSP1800-25-S1	Broadband Preamplifier	31-Jan-13
COM001051	TTE	H785-150K-50-21378	Hi Pass Filter - 150KHz cutoff	14-May-13
COM000213	Fischer	FCC-LISN-50-50-2M	Turntable LISN (150KHz-30MHz)	28-Feb-13
CIS021117	Micro-Coax	UFB311A-0-2484-520520	RF Coaxial Cable, to 18GHz, 248.4 in	24-Aug-12
CIS030564	Micro-Coax	UFB311A-1-0950-504504	RF Coaxial Cable, to 18GHz, 95 in	24-Aug-12
COM000233	Sunol Sciences	JB1	Combination Antenna, 30MHz-2GHz	28-Sep-12
COM000239	Rohde & Schwarz	ESI40	EMI Test Receiver	12-Jun-13
CIS034972	Midwest Microwave	ATT-0640-20-29M-02	Attenuator, 20dB	16-May-12
CIS043116	Huber + Suhner	Sucoflex 104PE	N & SMA RF cable	14-Dec-12
CIS040603	Agilent	E4440A	Spectrum Analyzer	6-Aug-13
CIS040053	Agilent	E4448A	Spectrum Analyzer	6-Apr-13