FCC RF TEST REPORT

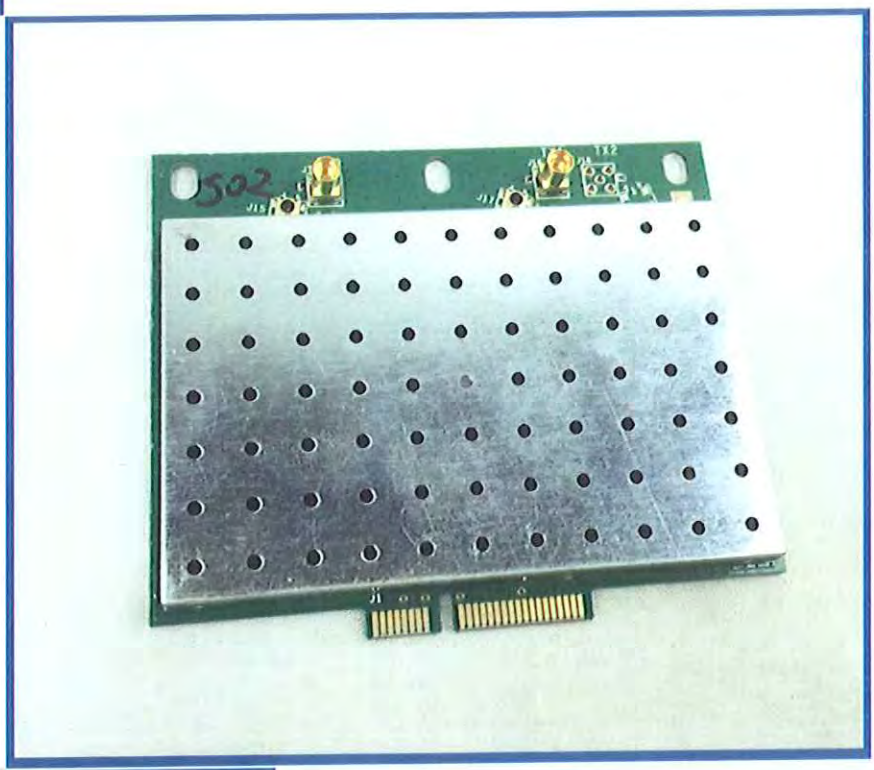
ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

Broadband Digital Transmission System

ISSUED TO
LigoWave LLC

138 Mountain Brook Dr Canton, GA 30115 United States



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Zhang Yanqing
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Date Oct. 27, 2015

Approved by:
Liao Jianming
(Technical Director)
Date Oct. 27. 2015

Report No.:	BL-SZ1560065-602
EUT Type:	Broadband Digital Transmission System
Model Name:	FWBD-2701, LigoPTP 5-N RapidFire, LigoPTP 5-23 RapidFire
Brand Name:	LigoWave
Test Standard:	47 CFR Part 15 Subpart E
FCC ID:	V2V-FWBD2701
Test conclusion:	Pass
Test Date:	Jul. 9, 2015 ~ Oct. 25, 2015
Date of Issue:	Oct. 27, 2015

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Revision History

Version	Issue Date	Revisions
Rev. 01	Sep. 18, 2015	Initial Issue
Rev. 02	Oct. 27, 2015	The Second Issue

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1 ADMINISTRATIVE DATA (GENERAL INFORMATION)

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6683 3402
Fax Number	+86 755 6182 4271

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1. The laboratory has been listed by US Federal Communications Commission to perform electromagnetic emission measurements. The recognition numbers of test site are 832625. The laboratory has met the requirements of the IAS Accreditation Criteria for Testing Laboratories (AC89), has demonstrated compliance with ISO/IEC Standard 17025:2005. The accreditation certificate number is TL-588. The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Announce

(1) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.

(2) The test report is invalid if there is any evidence and/or falsification.

(3) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.

(4) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.

(5) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

2 PRODUCT INFORMATION

2.1 Applicant

Applicant	LigoWave LLC
Address	138 Mountain Brook Dr Canton, GA 30115 United States

2.2 Manufacturer

Manufacturer	LigoWave LLC
Address	138 Mountain Brook Dr Canton, GA 30115 United States

2.3 General Description for Equipment under Test (EUT)

EUT Type	Broadband Digital Transmission System
Model Name	FWBD-2701
Series Model Name	FWBD-2701, LigoPTP 5-N RapidFire, LigoPTP 5-23 RapidFire
Description of Model name differentiation	The equipment model FWBD-2701, LigoPTP 5-N RapidFire and LigoPTP 5-23 RapidFire are Broadband Digital Transmission System, the electrical parameters and internal structure of circuit are same, only the model name is different.
Hardware Version	N/A
Software Version	N/A
Network and Wireless connectivity	802.11a/n(HT20/40)/ac(HT20/40/80): 5150 MHz to 5250 MHz 802.11a/n(HT20/40)/ac(HT20/40/80): 5725 MHz to 5850 MHz

2.4 Technical Information

Frequency Range	802.11a/ n/ac: 5.15 GHz – 5.25 GHz, 5.725 GHz – 5.850 GHz
Modulation technology	OFDM
Modulation Type	256QAM, 64QAM, 16QAM, BPSK, QPSK
Transfer Rate (Mbps)	802.11a: 54/ 48/ 36 / 24 / 18 / 9/ 6 Mbps 802.11n: up to 135 Mbps 802.11ac: up to V9
Operating Frequency	Band I: 5150 MHz to 5250 MHz, Band IV: 5725 MHz to 5850 MHz
Channel Bandwidth	802.11a: 20 MHz 802.11n: 20 MHz, 40 MHz 802.11ac: 20 MHz, 40 MHz, 80 MHz
Device Type	Fixed point-to-point
Maximum Output Power	Band I: 27.71 dBm, Band IV: 29.70 dBm
Antenna Type&Gain	3 dBi: External antenna (Onmi antenna) 18 dBi: External antenna (Sector antenna) 23 dBi: External antenna (Panel antenna)

2.5 Channel List

Band I (5150 - 5250 MHz)		Band IV (5725 - 5850 MHz)	
Channel	Frequency (MHz)	Channel	Frequency (MHz)
36	5180	149	5745
38	5190	151	5755
40	5200	153	5765
42	5210	155	5775
44	5220	157	5785
46	5230	159	5795
48	5240	161	5805
		165	5725

The Lowest frequency, the middle frequency and the highest frequency of channel were selected to perform the test, and the selected channel see below:

For 802.11a/n(HT20)/ac(HT20)

Band I (5150 - 5250 MHz)		Band IV (5725 - 5850 MHz)	
Channel	Frequency (MHz)	Channel	Frequency (MHz)
36	5180	149	5745
30	5200	157	5785
48	5240	165	5825

For 802.11n(HT40)/ac(HT40)

Band I (5150 - 5250 MHz)		Band IV (5725 - 5850 MHz)	
Channel	Frequency (MHz)	Channel	Frequency (MHz)
38	5190	151	5755
46	5230	159	5795

For 802.11ac(HT80)

Band I (5150 - 5250 MHz)		Band IV (5725 - 5850 MHz)	
Channel	Frequency (MHz)	Channel	Frequency (MHz)
42	5210	155	5775

Note: Preliminary tests were performed in different data rate in above table to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate	Modulation Technology	Modulation Type	Band I Channel	Band IV Channel
RF Output Power	11a	6	OFDM	BPSK	48/40/36	165/157/149
	11n(20 MHz)	6.5	OFDM	BPSK	48/40/36	165/157/149
	11n(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(20 MHz)	6.5	OFDM	BPSK	48/36	165/149
	11ac(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(80 MHz)	V0	OFDM	BPSK	42	155
Emission Bandwidth & 99% Occupied Bandwidth	11a	6	OFDM	BPSK	48/40/36	165/157/149
	11n(20 MHz)	6.5	OFDM	BPSK	48/40/36	165/157/149
	11n(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(20 MHz)	6.5	OFDM	BPSK	48/36	165/149
	11ac(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(80 MHz)	V0	OFDM	BPSK	42	155
6 dB bandwidth	11a	6	OFDM	BPSK	N/A	165/157/149
	11n(20 MHz)	6.5	OFDM	BPSK	N/A	165/157/149
	11n(40 MHz)	13.5	OFDM	BPSK	N/A	159/151
	11ac(20 MHz)	6.5	OFDM	BPSK	N/A	165/157/149
	11ac(40 MHz)	13.5	OFDM	BPSK	N/A	159/151
	11ac(80 MHz)	V0	OFDM	BPSK	N/A	155
Power Spectral Density	11a	6	OFDM	BPSK	48/40/36	165/157/149
	11n(20 MHz)	6.5	OFDM	BPSK	48/40/36	165/157/149
	11n(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(20 MHz)	6.5	OFDM	BPSK	48/36	165/149
	11ac(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(80 MHz)	V0	OFDM	BPSK	42	155
Band edge	11a	6	OFDM	BPSK	48/40/36	165/157/149
	11n(20 MHz)	6.5	OFDM	BPSK	48/40/36	165/157/149
	11n(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(20 MHz)	6.5	OFDM	BPSK	48/36	165/149
	11ac(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(80 MHz)	V0	OFDM	BPSK	42	155
Conducted Spurious Emissions	11a	6	OFDM	BPSK	48/40/36	165/157/149
	11n(20 MHz)	6.5	OFDM	BPSK	48/40/36	165/157/149
	11n(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(20 MHz)	6.5	OFDM	BPSK	48/36	165/149
	11ac(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(80 MHz)	V0	OFDM	BPSK	42	155

Radiated Spurious Emissions	11a	6	OFDM	BPSK	48/40/36	165/157/149
	11n(20 MHz)	6.5	OFDM	BPSK	48/40/36	165/157/149
	11n(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(20 MHz)	6.5	OFDM	BPSK	48/36	165/149
	11ac(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(80 MHz)	V0	OFDM	BPSK	42	155
Frequency Stability	11a	6	OFDM	BPSK	48/40/36	165/157/149
	11n(20 MHz)	6.5	OFDM	BPSK	48/40/36	165/157/149
	11n(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(20 MHz)	6.5	OFDM	BPSK	48/36	165/149
	11ac(40 MHz)	13.5	OFDM	BPSK	46/38	159/151
	11ac(80 MHz)	V0	OFDM	BPSK	42	155

2.6 Additional comments

Special test descriptions: See power table information below:

Band I (5150 - 5250 MHz)			Band IV (5725 - 5850 MHz)		
Mode	Frequency (MHz)	Power setting	Mode	Frequency (MHz)	Power setting
11a	5180	26	11a	5745	28
	5200	26		5785	30
	5240	26		5825	30
11n(HT20)	5180	26	11n(HT20)	5745	28
	5200	26		5785	30
	5240	26		5825	30
11n(HT40)	5190	27	11n(HT40)	5755	27
	5230	27		5795	27
11ac(HT20)	5180	26	11ac(HT20)	5745	28
	5200	26		5785	30
	5240	26		5825	30
11ac(HT40)	5190	27	11ac(HT40)	5755	27
	5230	27		5795	27
11ac(HT80)	5210	26	11ac(HT80)	5775	26

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15 Subpart E	Unlicensed National Information Infrastructure Devices
2	KDB Publication 789033 D02v01	Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
3	KDB Publication 662911 D01v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band (e.g., MIMO, Smart Antenna, etc)
4	ANSI C63.4-2014	American National Standard for Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
5	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices

3.2 Verdict

No.	Description	FCC Part No.	Test Result	Verdict
1	Antenna Requirement	15.203	--	Pass Note 1
2	RF Output Power	15.407(a)	ANNEX A.1	Pass
3	Emission Bandwidth & 99% Occupied Bandwidth	15.407(a)	ANNEX A.2	Pass
4	6 dB bandwidth	15.407(e)	ANNEX A.3	Pass
5	Power Spectral Density	15.407(a)	ANNEX A.4	Pass
6	Band edge	15.407(b)	ANNEX A.5	Pass
7	Conducted Spurious Emissions	15.407(b) 15.209	ANNEX A.6	Pass
8	Radiated Spurious Emissions	15.407(b)	ANNEX A.7	Pass
9	Frequency Stability	FCC §2.1055 FCC §90.213	ANNEX A.8	Pass
Note 1: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.				

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity	45% - 55%	
Atmospheric Pressure	100 kPa - 102 kPa	
Temperature	NT (Normal Temperature)	+22℃ to +25℃
Working Voltage of the EUT	NV (Normal Voltage)	DC 48 V from PoE
	LV (Low Voltage)	DC 40.8 V
	HV (High Voltage)	DC 55.2 V

4.2 Test Equipment List

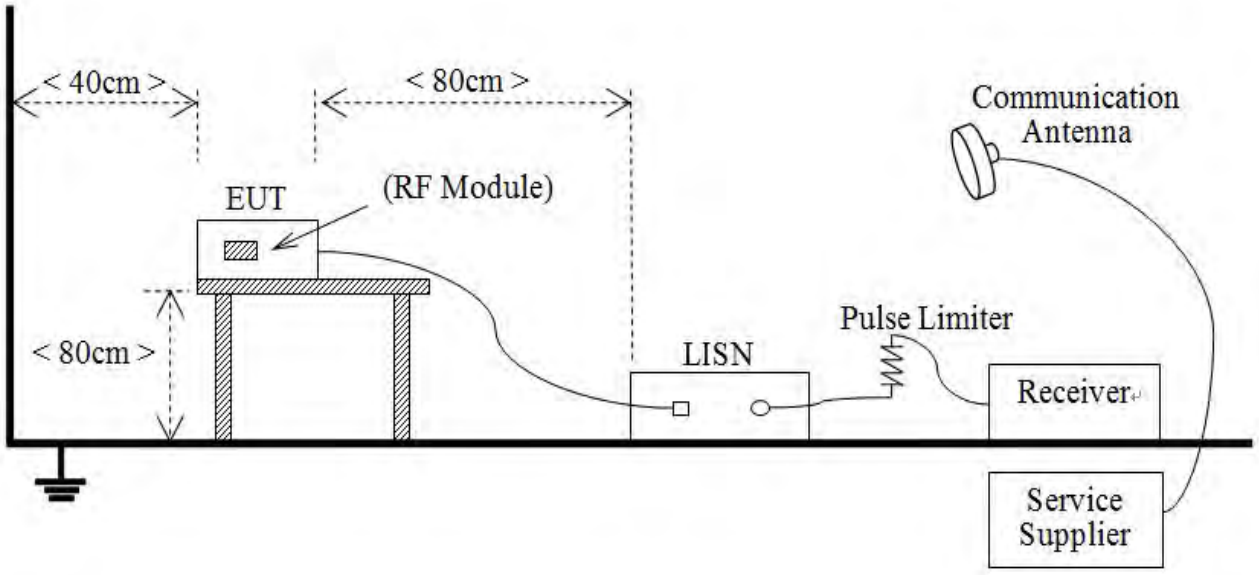
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-30	103118	2015.07.16	2016.07.15
Vector Signal Generator	ROHDE&SCHWARZ	SMBV100A	177746	2015.07.16	2016.07.15
Signal Generator	ROHDE&SCHWARZ	SMB100A	260592	2015.07.16	2016.07.15
Switch Unit with OSP-B157	ROHDE&SCHWARZ	OSP120	101270	2015.07.16	2016.07.15
Spectrum Analyzer	AGILENT	E4440A	MY45304434	2014.10.18	2015.10.17
Spectrum Analyzer	AGILENT	N9038A	MY53290041	2014.10.18	2015.10.17
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2015.07.14	2016.07.13
LISN	SCHWARZBECK	NSLK 8127	8127-687	2015.07.01	2016.06.30
Bluetooth Tester	ROHDE&SCHWARZ	CBT	101005	2015.07.16	2016.07.15
Power Splitter	KMW	DCPD-LDC	1305003215	2015.07.01	2016.06.30
Power Sensor	ROHDE&SCHWARZ	NRP-Z21	103971	2015.07.21	2016.07.20
Attenuator (20 dB)	KMW	ZA-S1-201	110617091	--	--
Attenuator (6 dB)	KMW	ZA-S1-61	1305003189	--	--
DC Power Supply	ROHDE&SCHWARZ	HMP2020	018141664	2015.07.17	2016.07.16
Temperature Chamber	ANGELANTIONI SCIENCE	NTH64-40A	1310	2014/11/20	2015/11/19
Test Antenna-Loop(9 kHz-30 MHz)	SCHWARZBECK	FMZB 1519	1519-037	2015.07.22	2017.07.21
Test Antenna-Bi-Log(30 MHz-3 GHz)	SCHWARZBECK	VULB 9163	9163-624	2015.07.22	2017.07.21
Test Antenna-Horn(1-18 GHz)	SCHWARZBECK	BBHA 9120D	9120D-1148	2015.07.22	2017.07.21
Test Antenna-Horn(18-40 GHz)	SCHWARZBECK	BBHA 9170	9170-1025	2015.07.22	2017.07.21
Anechoic Chamber	RAINFORD	9m*6m*6m	N/A	2015.02.28	2016.02.27
Shielded Enclosure	ChangNing	CN-130701	130703	--	--

4. 3 Description of Test Setup

4. 3. 1 For Antenna Port Test

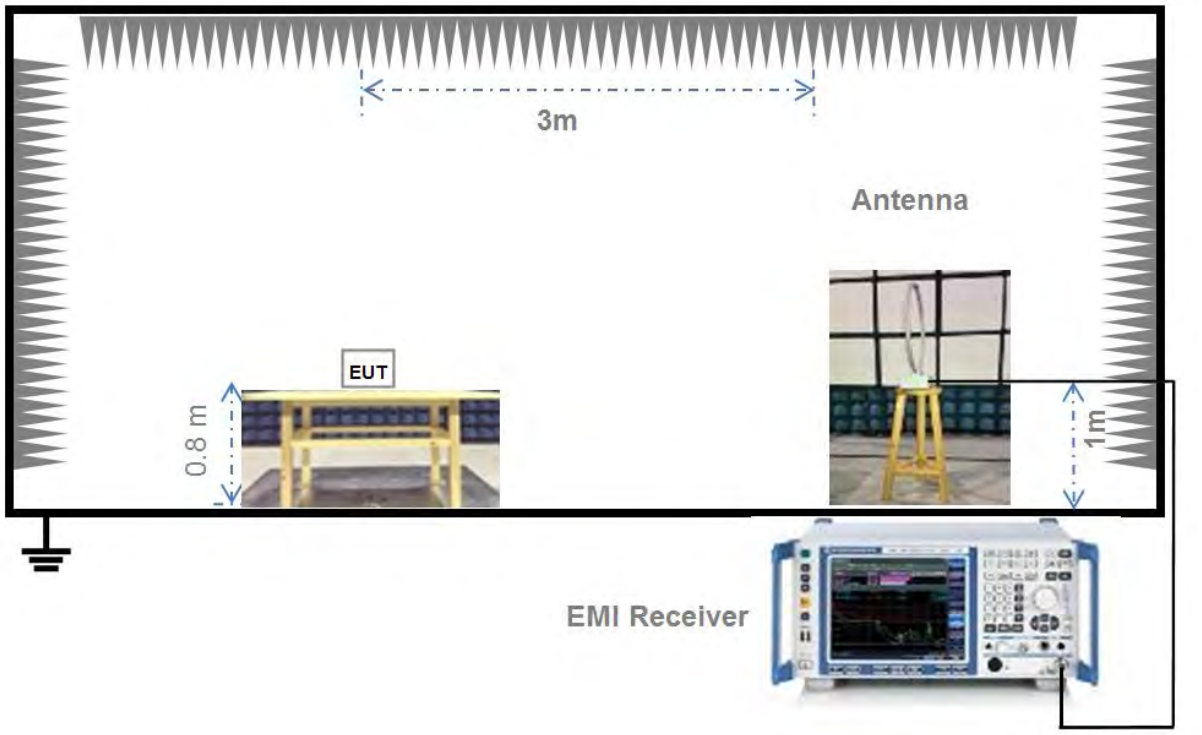
(Diagram 1)

4. 3. 2 For AC Power Supply Port Test



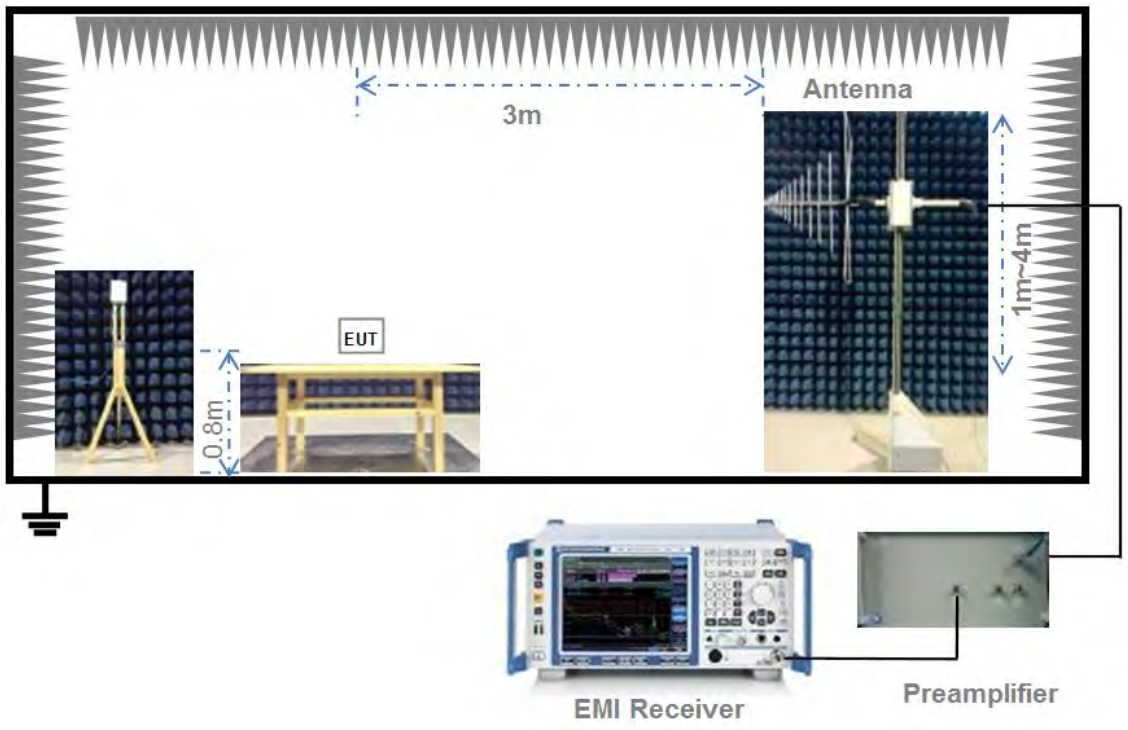
(Diagram 2)

4.3.3 For Radiated Test (Below 30 MHz)



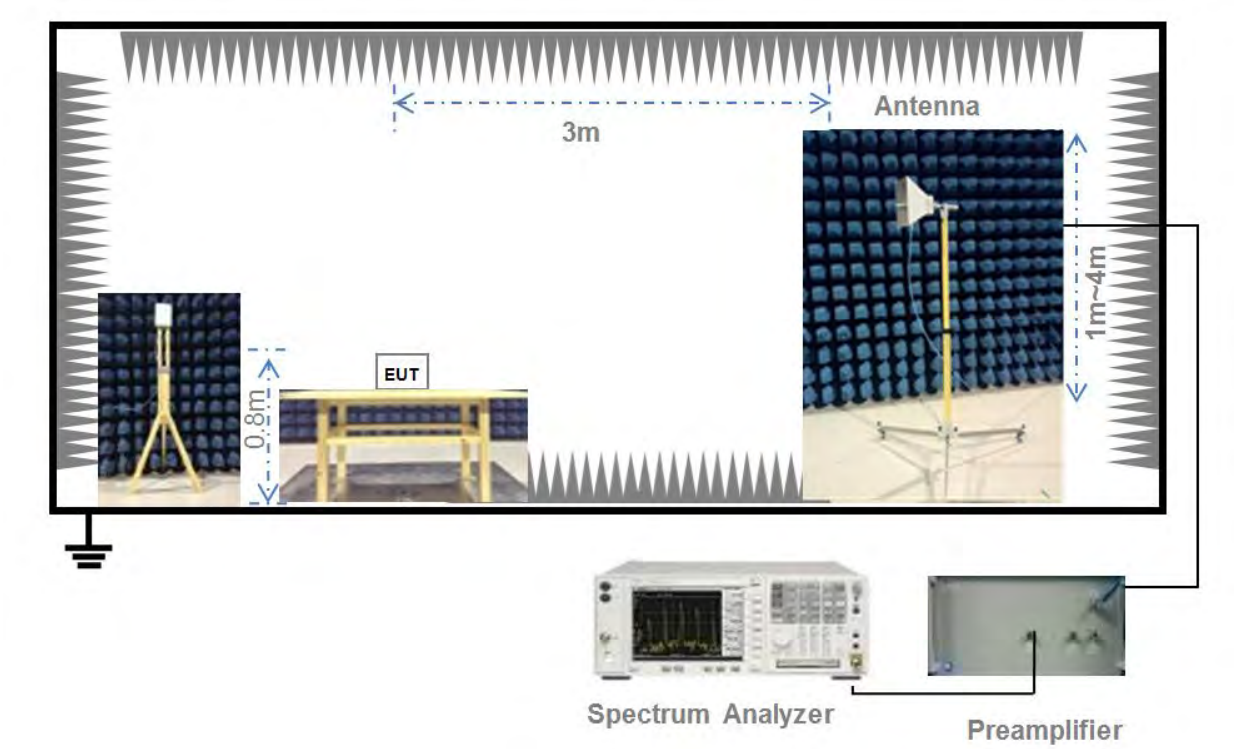
(Diagram 3)

4.3.4 For Radiated Test (30 MHz-1 GHz)



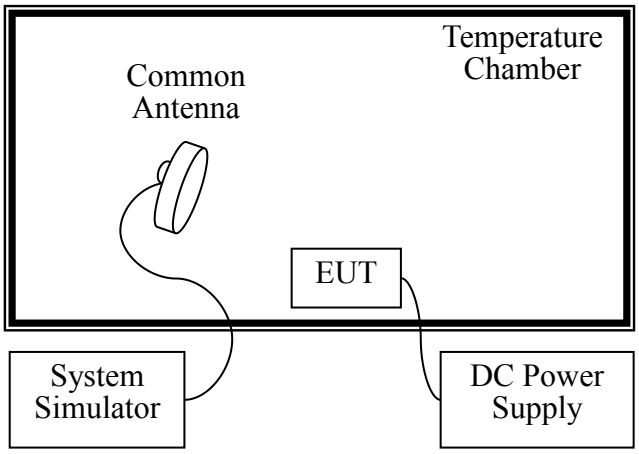
(Diagram 4)

4. 3. 5 For Radiated Test (Above 1 GHz)



(Diagram 5)

4. 3. 6 For Frequency Stability Test



(Diagram 6)

5 TEST ITEMS

5.1 Antenna Requirements

5.1.1 Standard Applicable

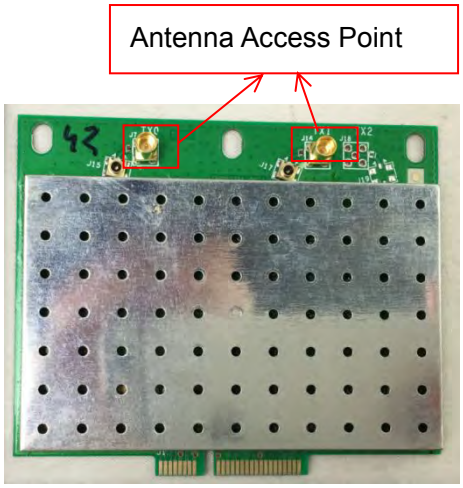
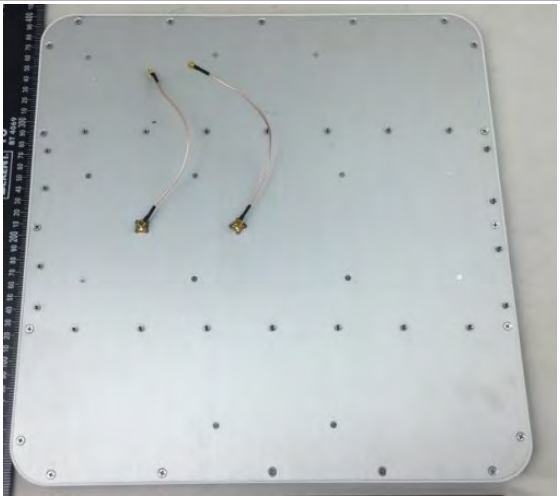
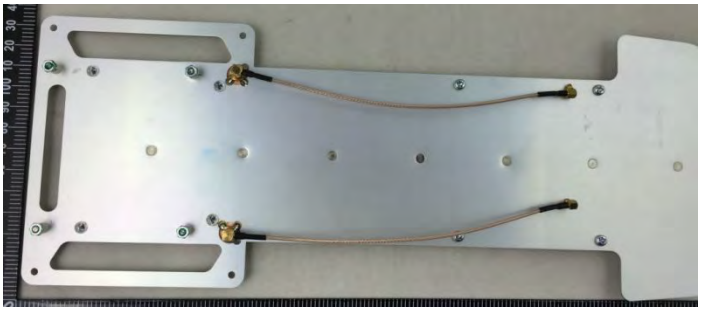
FCC §15.203 & 15.247(b)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna using a special access.	The antenna using a special joint which cannot replace by end-user.

Reference Documents	Item
Photo	 Module  23 dBi  18 dBi  3 dBi

5.2 RF Output Power

5.2.1 Test Limit

FCC §15.407(a)

The maximum conducted output power should not exceed:

Frequency band 5150-5250 MHz (Band I)		
Operating Mode		Limit
☐	Outdoor access point	Conducted Power: 1 W The maximum e.i.r.p. At any elevation angle above 30 degrees as measured form the horizon must not exceed 125 mW (21 dBm)
☐	Indoor access point	Conducted Power: 1 W
☒	Fixed point-to-point access point	Conducted Power: 1 W
☐	Mobile and portable client devices	Conducted Power: 250 mW

Frequency Band (MHz)		Limit
☐	5250-5350	250 mW or 11 dBm + 10log B
☐	5470-5725	250 mW or 11 dBm + 10log B
☒	5725-5850	1 W
Note: “B” is the 26 dB emission bandwidth in MHz.		

Note 1: For fixed point-to-point access points operating in the band 5.15-5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band. Fixed point-to-point U-NII devices may employ antennas with directional gain up to 23 dBi without any corresponding reduction in the maximum conducted output power or maximum power spectral density. For fixed point-to-point transmitters that employ a directional antenna gain greater than 23 dBi, a 1 dB reduction in maximum conducted output power and maximum power spectral density is required for each 1 dB of antenna gain in excess of 23 dBi.

Note 2: For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W. In addition, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power.

5.2.2 Test Procedure

Maximum peak conducted output power

The maximum peak conducted output power may be measured using a broadband Average RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the emission bandwidth and utilize a fast-responding diode detector.

5.3 Emission Bandwidth & Occupied Bandwidth & 6 dB Bandwidth

5.3.1 Limit

FCC §15.407(a)

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

5.3.2 Test Procedure

1. Set RBW = 100 kHz, VBW = 300 kHz.

2. Detector = Peak.Trace mode = Max hold.

3. Allow the trace to stabilize.

4. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.4 Power Spectral density (PSD)

5.4.1 Limit

FCC §15.407(a)

Frequency band 5150-5250 MHz		
Operating Mode		Limit
☐	Outdoor access point	17 dBm/MHz
☐	Indoor access point	17 dBm/MHz
☒	Fixed point-to-point access point	17 dBm/MHz
☐	Mobile and portable client devices	11 dBm/MHz

Frequency Band (MHz)		Limit
☐	5250-5350	11 dBm/MHz
☐	5470-5725	11 dBm/MHz
☒	5725-5850	30 dBm/500kHz
Note: “B” is the 26 dB emission bandwidth in MHz.		

5.4.2 Test Procedure

Set the spectrum analyzer or EMI receiver span to view the entire emission bandwidth.

1. Set RBW = 510 kHz/1 MHz, VBW ≥ 3*RBW, Sweep time = Auto, Detector = RMS.
2. Allow the sweeps to continue until the trace stabilizes.
3. Use the peak marker function to determine the maximum amplitude level.

5.5 Transmitter Radiated and Band Edge Emissions

5.5.1 Limit

FCC §15.209 & 15.407(b)

Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3
Note 1: Quasi-Peak value is measured for frequency below 1 GHz except for 9-90 kHz frequency band, Peak and average value are measured for frequency above 1 GHz. The limit on average radio frequency emission is as above table. The limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit. Note 2: Measurement may be performed at a distance other than what is specified provided, When performing measurement at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor as below, frequency at or above 30 MHz: 20 dB/decade frequency below 30 MHz: 40 dB/decade.		

Un-restricted band emissions	
Out Operating Band (MHz)	Limit
5150 - 5250	e.i.r.p. -27 dBm (68.2 dBuV/m@3m)
5250 - 5350	e.i.r.p. -27 dBm (68.2 dBuV/m@3m)
5470 - 5725	e.i.r.p. -27 dBm (68.2 dBuV/m@3m)
5725 - 5850	5715 -5725 MHz: e.i.r.p. -17 dBm (78.2 dBuV/m@3m) 5850 -5860 MHz: e.i.r.p. -17 dBm (78.2 dBuV/m@3m) Other un-restricted band: e.i.r.p. -27 dBm(68.2 dBuV/m@3m)

5.5.2 Test Procedure

Since the emission limits are specified in terms of radiated field strength levels, measurements performed to demonstrate compliance have traditionally relied on a radiated test configuration. Radiated measurements remain the principal method for demonstrating compliance to the specified limits; however antenna-port conducted measurements are also now acceptable to demonstrate compliance (see below for details). When radiated measurements are utilized, test site requirements and procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 shall be followed.

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

General Procedure for conducted measurements in restricted bands

a) Measure the conducted output power (in dBm) using the detector specified (see guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).

b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see guidance on determining the applicable antenna gain)

c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).

d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).

e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:

E = EIRP – 20log D + 104.8

where:

E = electric field strength in dBμV/m,

EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

f) Compare the resultant electric field strength level to the applicable limit.

g) Perform radiated spurious emission test.

Quasi-Peak measurement procedure

The specifications for measurements using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Frequency Interference (CISPR) of the International Electrotechnical Commission.

As an alternative to CISPR quasi-peak measurement, compliance can be demonstrated to the applicable emission limits using a peak detector.

Peak power measurement procedure

Peak emission levels are measured by setting the instrument as follows:

a) RBW = as specified in Table 1.

b) VBW ≥ 3 x RBW.

c) Detector = Peak.

d) Sweep time = auto.

e) Trace mode = max hold.

f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be longer for low duty cycle applications).

Table 1—RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement.

Trace averaging across on and off times of the EUT transmissions followed by duty cycle correction

If continuous transmission of the EUT (i.e., duty cycle ≥ 98 percent) cannot be achieved and the duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent), then the following procedure shall be used:

a) The EUT shall be configured to operate at the maximum achievable duty cycle.

b) Measure the duty cycle, x, of the transmitter output signal as described in section 6.0.

c) RBW = 1 MHz (unless otherwise specified).

d) VBW ≥ 3 x RBW.

e) Detector = RMS, if span/(# of points in sweep) ≤ (RBW/2). Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.

f) Averaging type = power (i.e., RMS).

1) As an alternative, the detector and averaging type may be set for linear voltage averaging.

2) Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.

g) Sweep time = auto.

h) Perform a trace average of at least 100 traces.

i) A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:

1) If power averaging (RMS) mode was used in step f), then the applicable correction factor is 10 log(1/x), where x is the duty cycle.

2) If linear voltage averaging mode was used in step f), then the applicable correction factor is 20 log(1/x), where x is the duty cycle.

3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

NOTE: Reduction of the measured emission amplitude levels to account for operational duty factor is not permitted. Compliance is based on emission levels occurring during transmission - not on an average across on and off times of the transmitter.

Determining the applicable transmit antenna gain

A conducted power measurement will determine the maximum output power associated with a restricted band emission; however, in order to determine the associated EIRP level, the gain of the transmitting antenna (in dBi) must be added to the measured output power (in dBm).

Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.

See KDB 662911 for guidance on calculating the additional array gain term when determining the effective antenna gain for a EUT with multiple outputs occupying the same or overlapping frequency ranges in the same band.

Radiated spurious emission test

An additional consideration when performing conducted measurements of restricted band emissions is that unwanted emissions radiating from the EUT cabinet, control circuits, power leads, or intermediate circuit elements will likely go undetected in a conducted measurement configuration. To address this concern, a radiated test shall be performed to ensure that emissions emanating from the EUT cabinet (rather than the antenna port) also comply with the applicable limits.

For these cabinet radiated spurious emission measurements the EUT transmit antenna may be replaced with a termination matching the nominal impedance of the antenna. Procedures for performing radiated measurements are specified in ANSI C63.10. All detected emissions shall comply with the applicable limits.

The measurement frequency range is from 30 MHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

5.6 Frequency Stability

5.6.1 Limit

FCC §15.407(g)

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

5.6.2 Test Procedure

The EUT is installed in an environment test chamber with external power source.
Set the chamber to operate at 50 centigrade and external power source to output at nominal voltage of EUT.
A sufficient stabilization period at each temperatures is used prior to each frequency measurement.
When temperature is stabled, measure the frequency stability.
The test shall be performed under -30 to 50 centigrade and 85 to 115 percent of the nominal voltage.
Change setting of chamber and external power source to complete all conditions.

ANNEX A TEST RESULT

A.1 RF Output Power

Test Data

Band I (3 dBi Antenna & 18 dBi Antenna & 23 dBi Antenna)							
Mode	Channel	Frequency (MHz)	Conducted Power (dBm)			Output Power Limit (dBm)	Verdict
			Chain 1	Chain 2	Total Power		
11a	CH36	5180	24.02	24.48	27.27	30	Pass
11a	CH40	5200	24.15	24.32	27.25	30	Pass
11a	CH48	5240	24.05	24.47	27.28	30	Pass
11n (HT20)	CH36	5180	24.11	24.32	27.23	30	Pass
11n (HT20)	CH40	5200	24.36	24.55	27.47	30	Pass
11n (HT20)	CH48	5240	24.41	24.51	27.47	30	Pass
11n (HT40)	CH38	5190	24.32	24.48	27.41	30	Pass
11n (HT40)	CH46	5230	24.61	24.78	27.71	30	Pass
11ac (HT20)	CH36	5180	23.98	24.06	27.03	30	Pass
11ac (HT20)	CH40	5200	24.03	24.30	27.18	30	Pass
11ac (HT20)	CH48	5240	24.21	24.51	27.37	30	Pass
11ac (HT40)	CH38	5190	24.03	24.07	27.06	30	Pass
11ac (HT40)	CH46	5230	24.26	24.53	27.41	30	Pass
11ac (HT80)	CH42	5210	24.13	24.32	27.24	30	Pass

Band IV (3 dBi Antenna & 18 dBi Antenna & 23 dBi Antenna)							
Mode	Channel	Frequency (MHz)	Conducted Power (dBm)			Output Power Limit (dBm)	Verdict
			Chain 1	Chain 2	Total Power		
11a	CH149	5745	25.19	25.45	28.33	30	Pass
11a	CH157	5785	26.39	26.57	29.49	30	Pass
11a	CH165	5825	26.12	26.37	29.26	30	Pass
11n (HT20)	CH149	5745	25.13	25.44	28.30	30	Pass
11n (HT20)	CH157	5785	26.36	26.55	29.47	30	Pass
11n (HT20)	CH165	5825	26.08	26.34	29.22	30	Pass
11n (HT40)	CH151	5755	26.02	26.11	29.08	30	Pass
11n (HT40)	CH159	5795	25.63	25.75	28.70	30	Pass
11ac (HT20)	CH149	5745	25.16	25.43	28.31	30	Pass
11ac (HT20)	CH157	5785	26.36	26.54	29.46	30	Pass
11ac (HT20)	CH165	5825	26.09	26.34	29.23	30	Pass
11ac (HT40)	CH151	5755	26.11	26.07	29.10	30	Pass
11ac (HT40)	CH159	5795	25.63	25.75	28.70	30	Pass
11ac (HT80)	CH155	5775	25.50	25.59	28.56	30	Pass

A.2 Emission Bandwidth & 99% Bandwidth

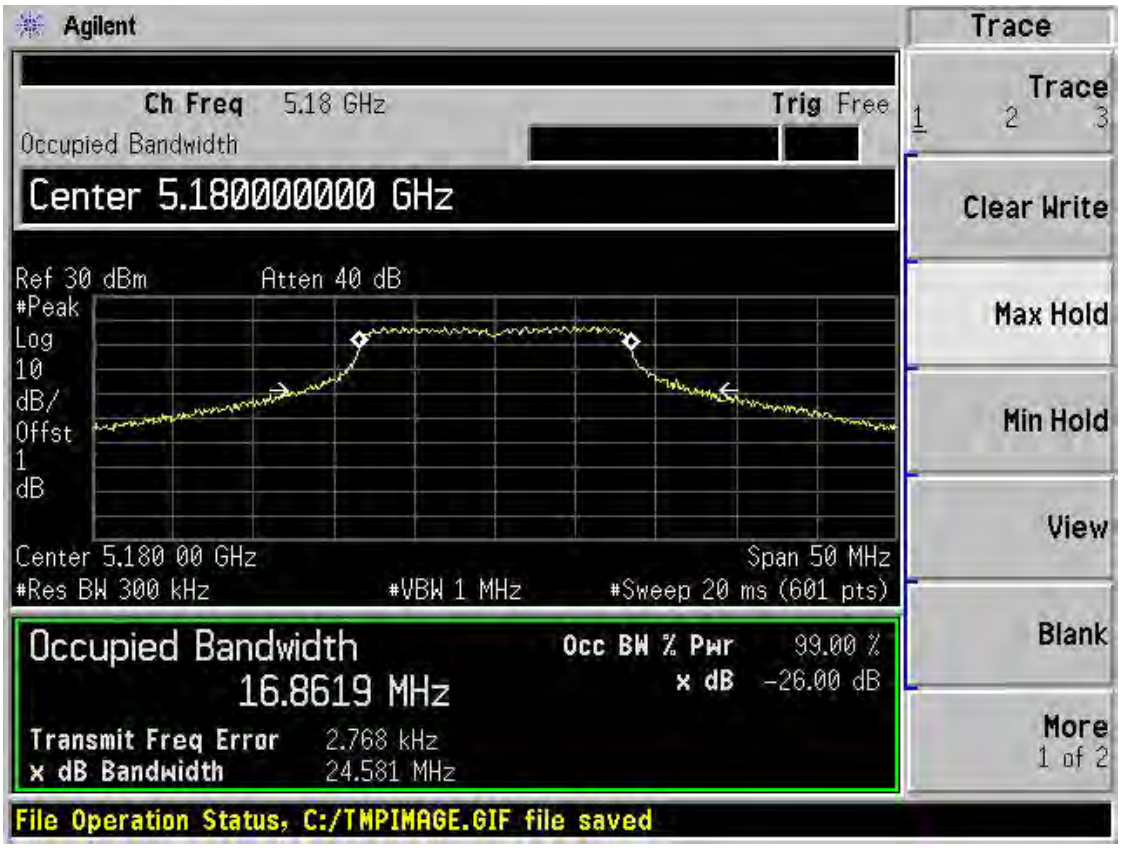
Test Data

Band I (3 dBi Antenna & 18 dBi Antenna & 23 dBi Antenna)						
Mode	Channel	Frequency (MHz)	26 dB Bandwidth (MHz)		99% Bandwidth (MHz)	
			Chain 1	Chain 2	Chain 1	Chain 2
11a	CH36	5180	24.581	25.285	16.8619	16.8654
11a	CH40	5200	25.941	25.257	16.8572	16.8112
11a	CH48	5240	24.542	25.924	16.8221	16.9124
11n (HT20)	CH36	5180	24.578	25.179	18.0023	18.0089
11n (HT20)	CH40	5200	25.384	25.439	18.0343	18.0143
11n (HT20)	CH48	5240	25.689	25.470	18.0423	18.0409
11n (HT40)	CH38	5190	78.360	78.221	38.6329	39.0032
11n (HT40)	CH46	5230	78.730	77.524	38.2096	38.5900
11ac (HT20)	CH36	5180	25.146	25.201	18.0071	18.0451
11ac (HT20)	CH40	5200	25.998	27.134	17.9666	18.0872
11ac (HT20)	CH48	5240	26.007	25.922	18.0036	18.0744
11ac (HT40)	CH38	5190	77.029	77.576	39.2473	39.5244
11ac (HT40)	CH46	5230	77.013	79.375	38.5347	38.6188
11ac (HT80)	CH42	5210	154.134	156.205	79.0172	80.205

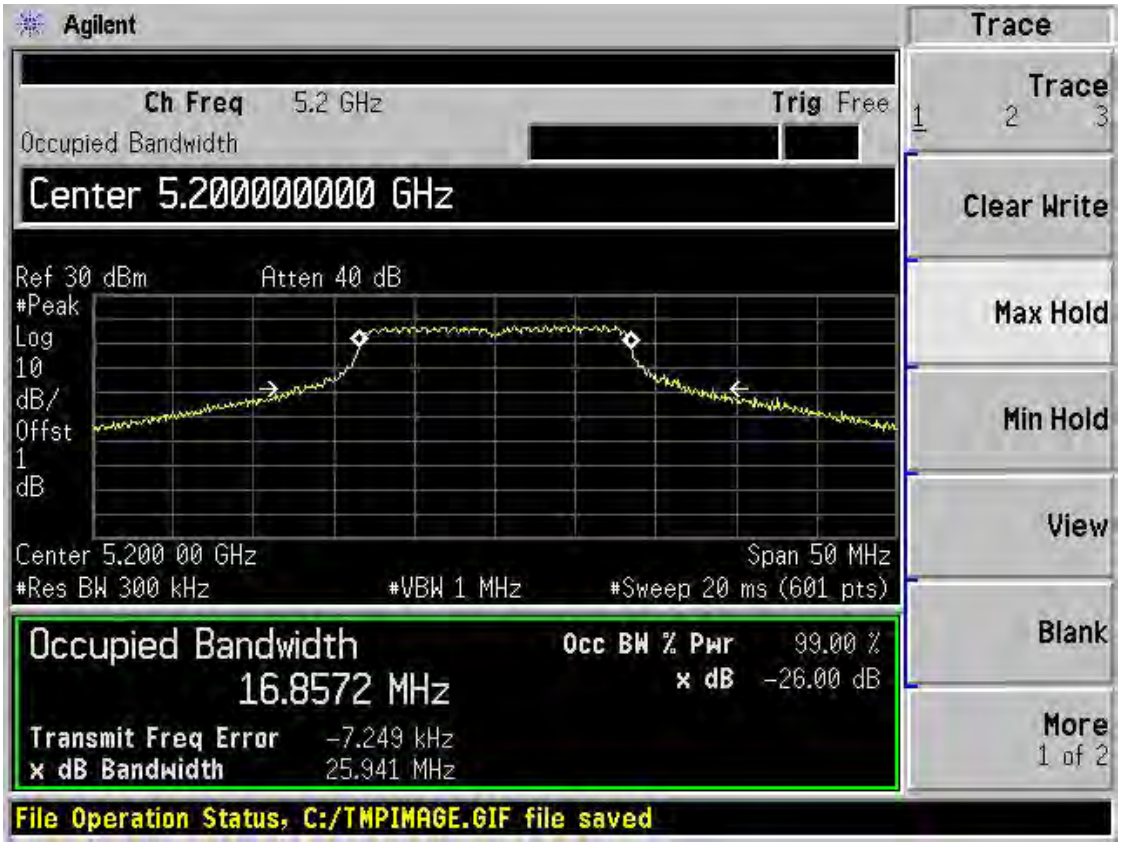
Band IV (3 dBi Antenna & 18 dBi Antenna & 23 dBi Antenna)						
Mode	Channel	Frequency (MHz)	26 dB Bandwidth (MHz)		99% Bandwidth (MHz)	
			Chain 1	Chain 2	Chain 1	Chain 2
11a	CH149	5745	32.389	35.664	17.6703	19.2849
11a	CH157	5785	44.068	43.027	28.3936	26.9739
11a	CH165	5825	43.911	44.449	27.9135	28.5607
11n (HT20)	CH149	5745	34.570	37.290	18.5771	19.4472
11n (HT20)	CH157	5785	46.365	46.118	49.4303	28.5770
11n (HT20)	CH165	5825	46.670	48.263	29.8464	30.7682
11n (HT40)	CH151	5755	58.872	58.762	36.9347	36.9593
11n (HT40)	CH159	5795	64.341	64.716	37.0842	36.9700
11ac (HT20)	CH149	5745	35.318	37.984	18.7720	19.4722
11ac (HT20)	CH157	5785	46.111	45.473	29.3679	28.4069
11ac (HT20)	CH165	5825	46.108	46.735	29.3190	29.5117
11ac (HT40)	CH151	5755	63.684	58.932	36.9708	37.0329
11ac (HT40)	CH159	5795	61.111	62.566	37.1065	37.1524
11ac (HT80)	CH155	5775	85.994	83.859	76.1166	76.0814

Test Plots

Band I 11a CH36 Chain 1



Band I 11a CH40 Chain 1



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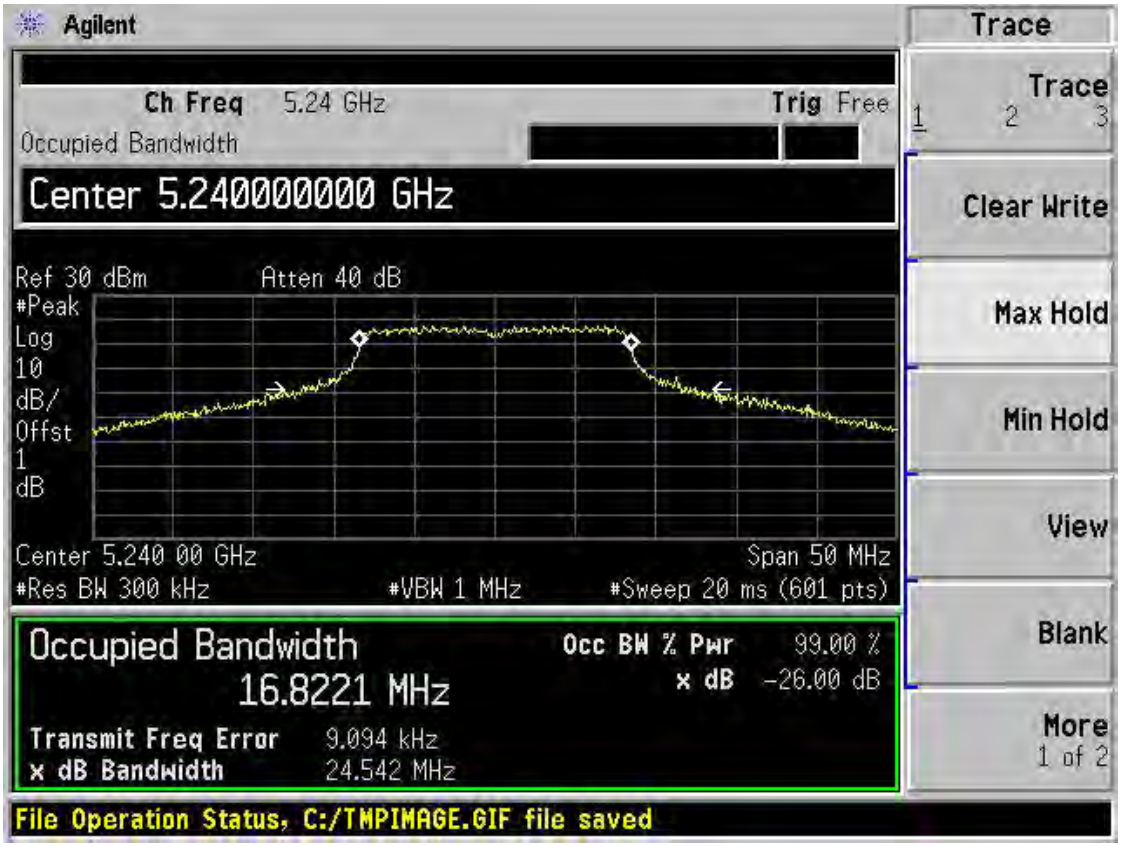
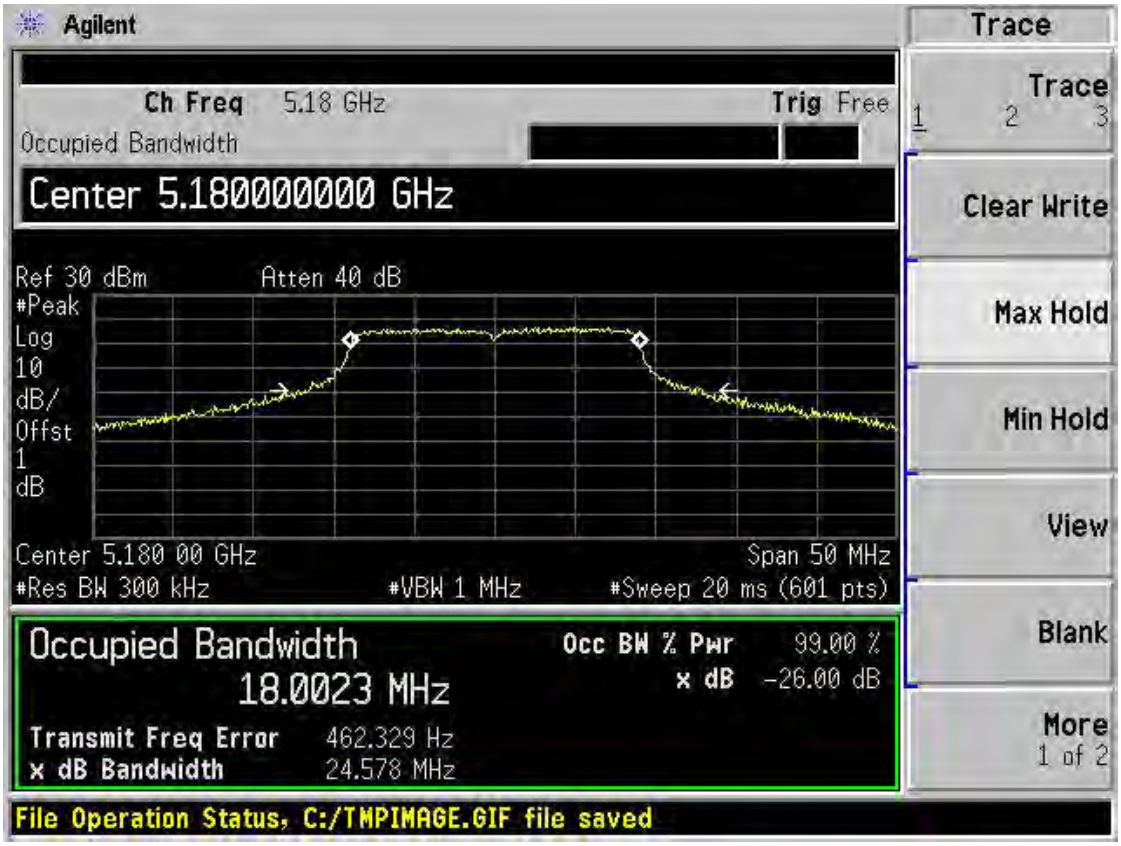


Band I 11n(HT20) CH36 Chain 1



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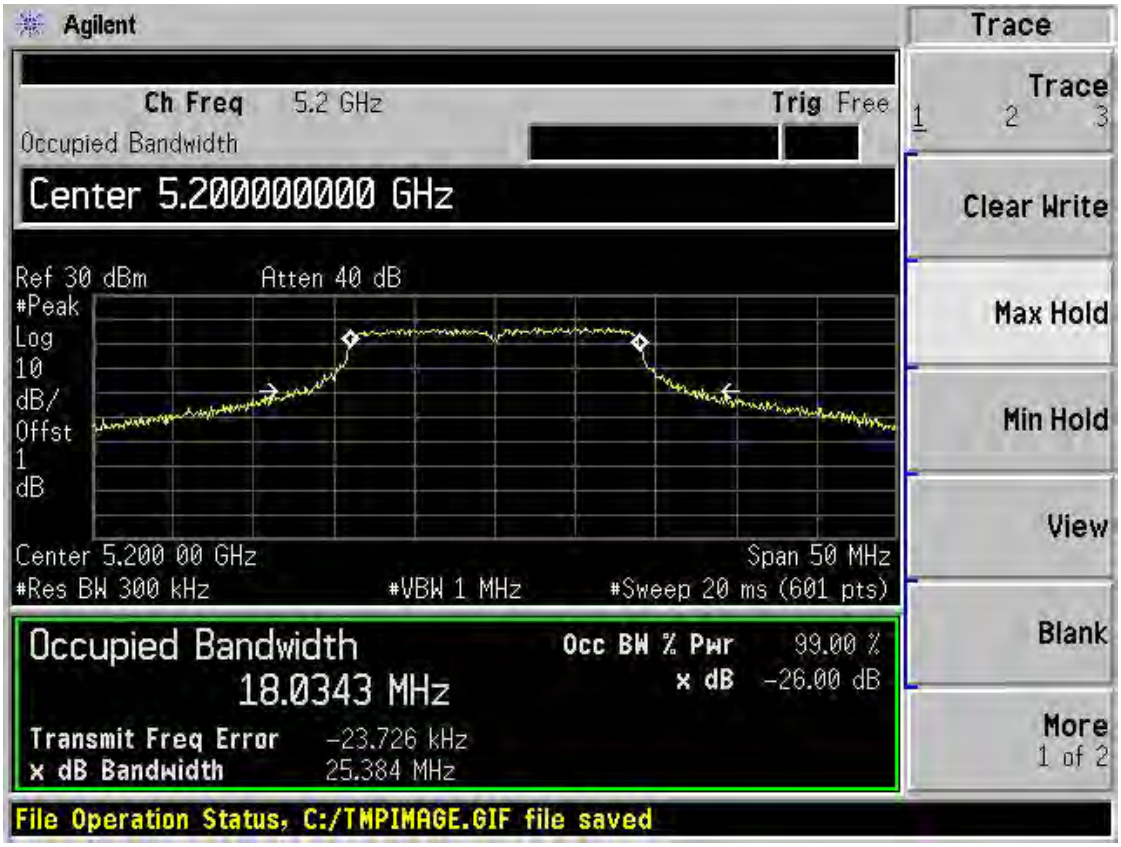

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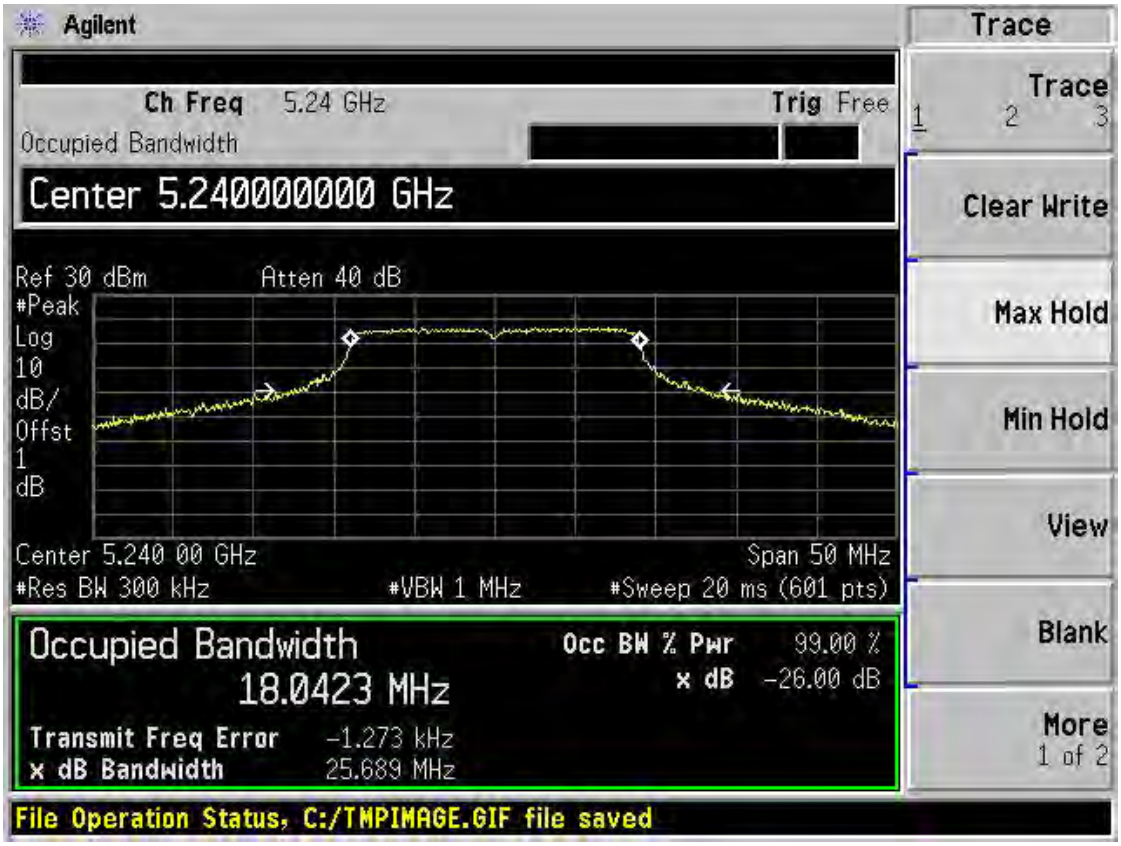
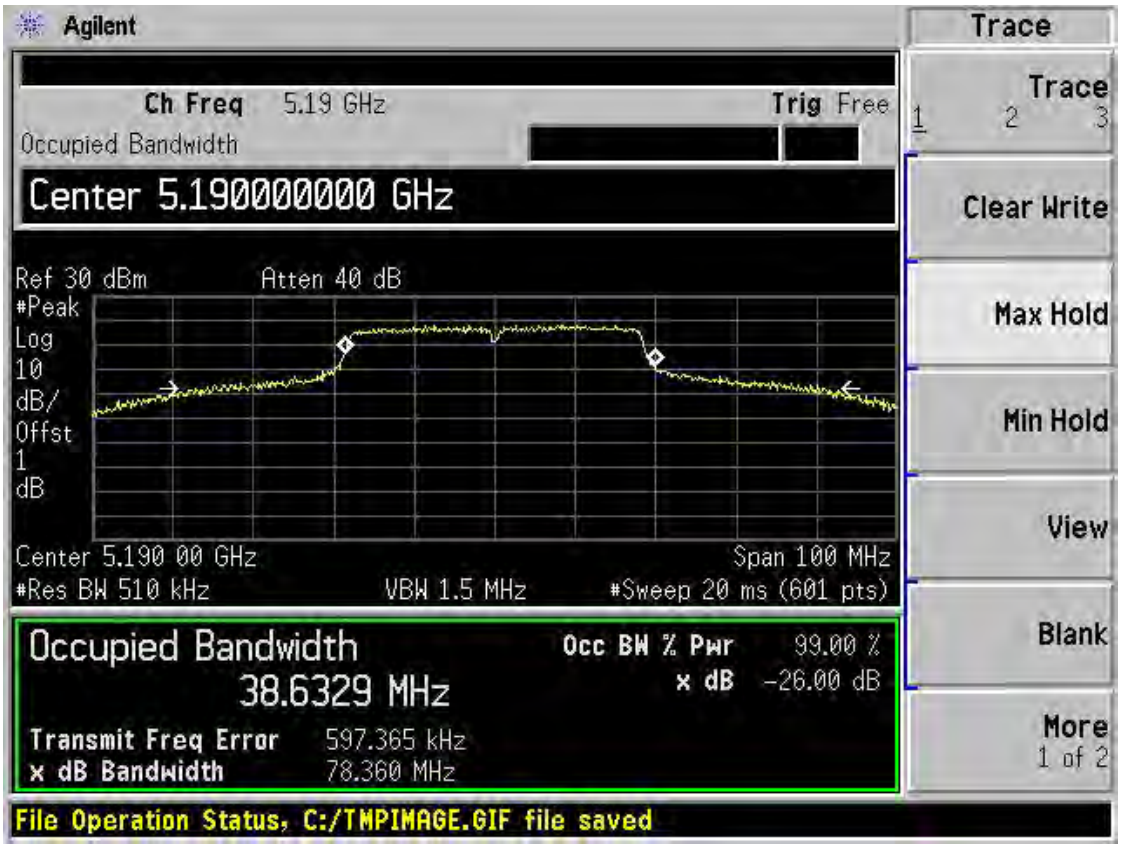


Band I 11n(HT40) CH38 Chain 1



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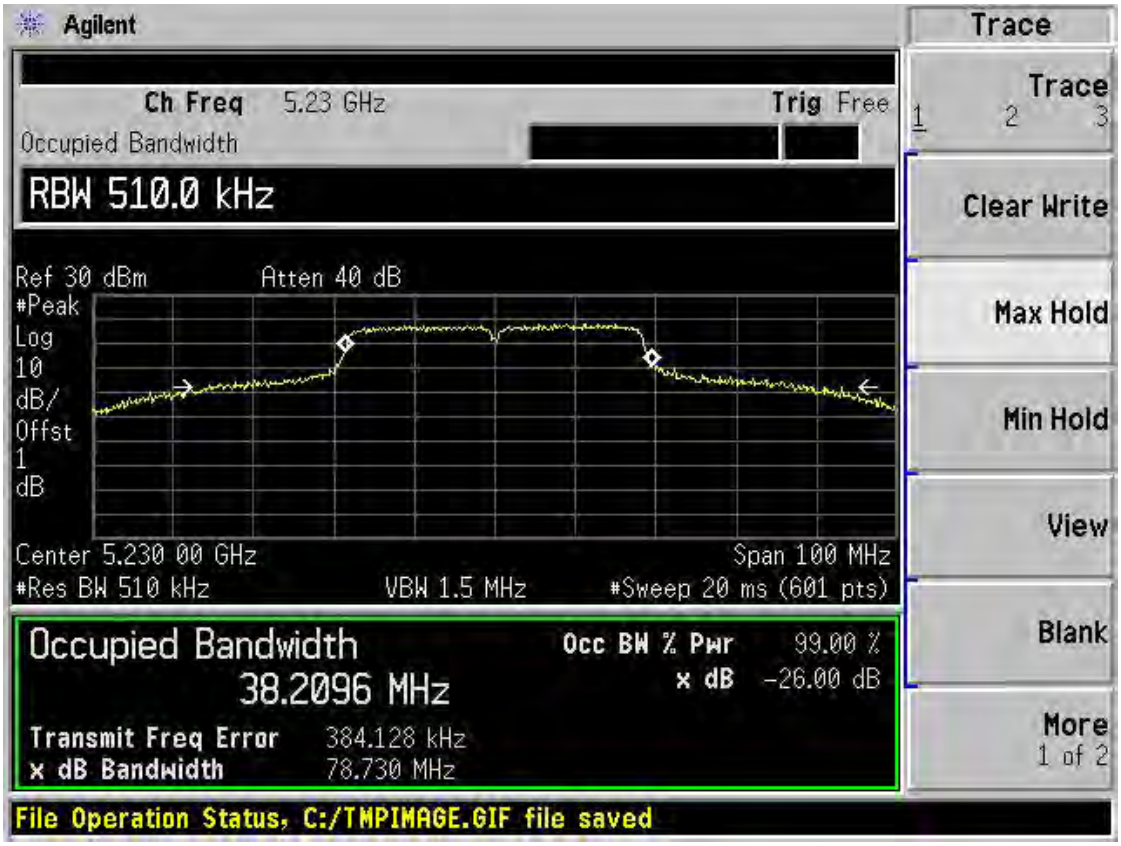

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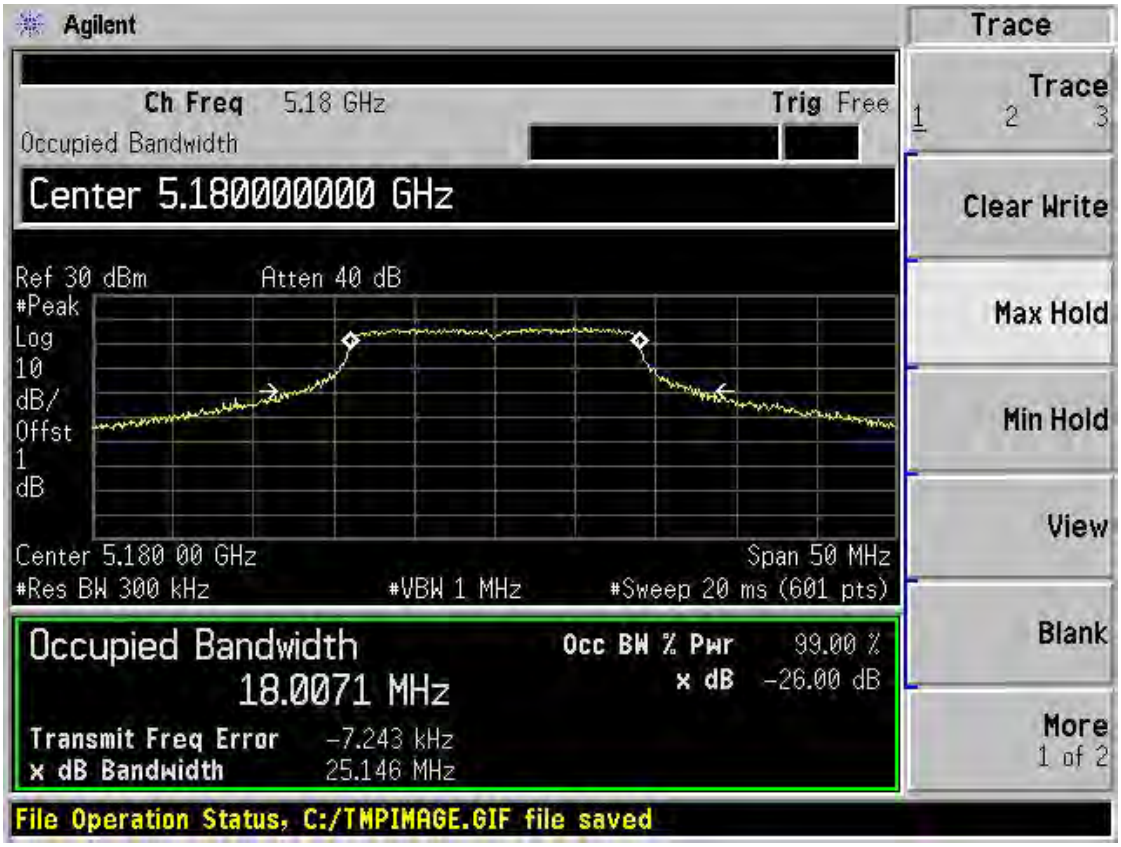

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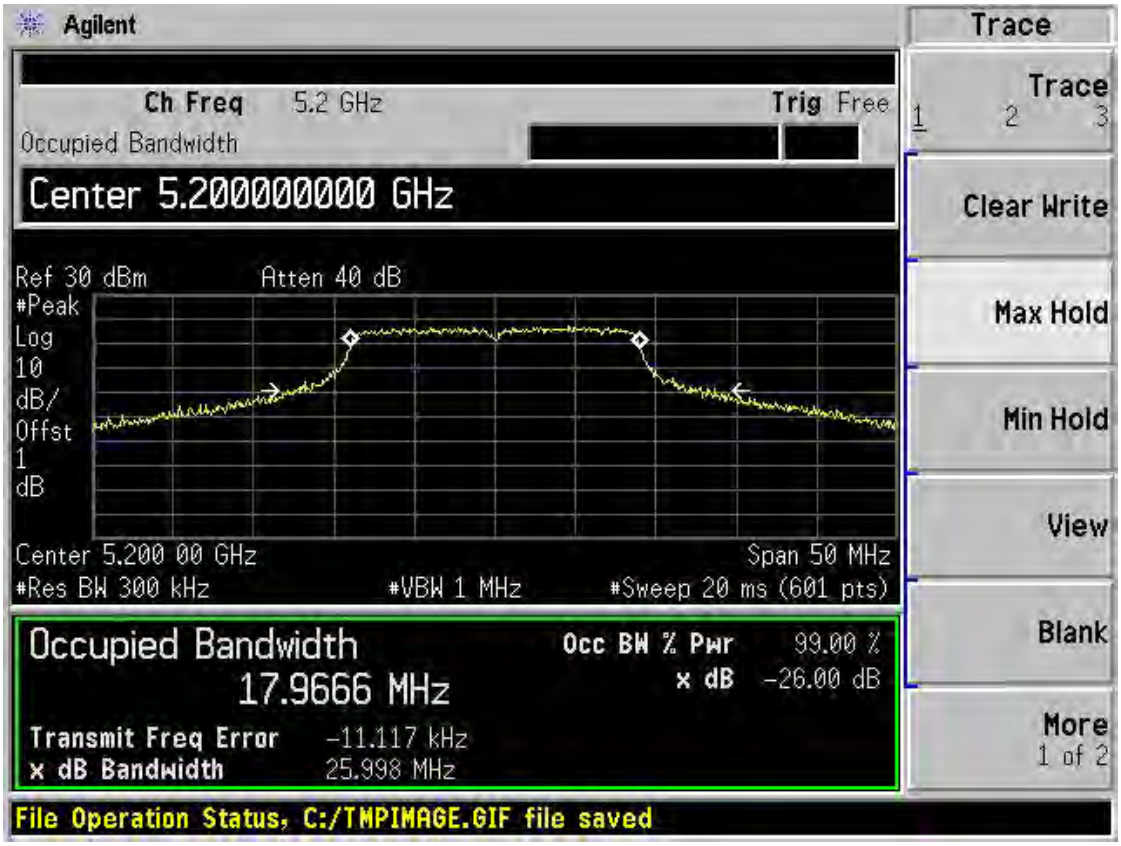

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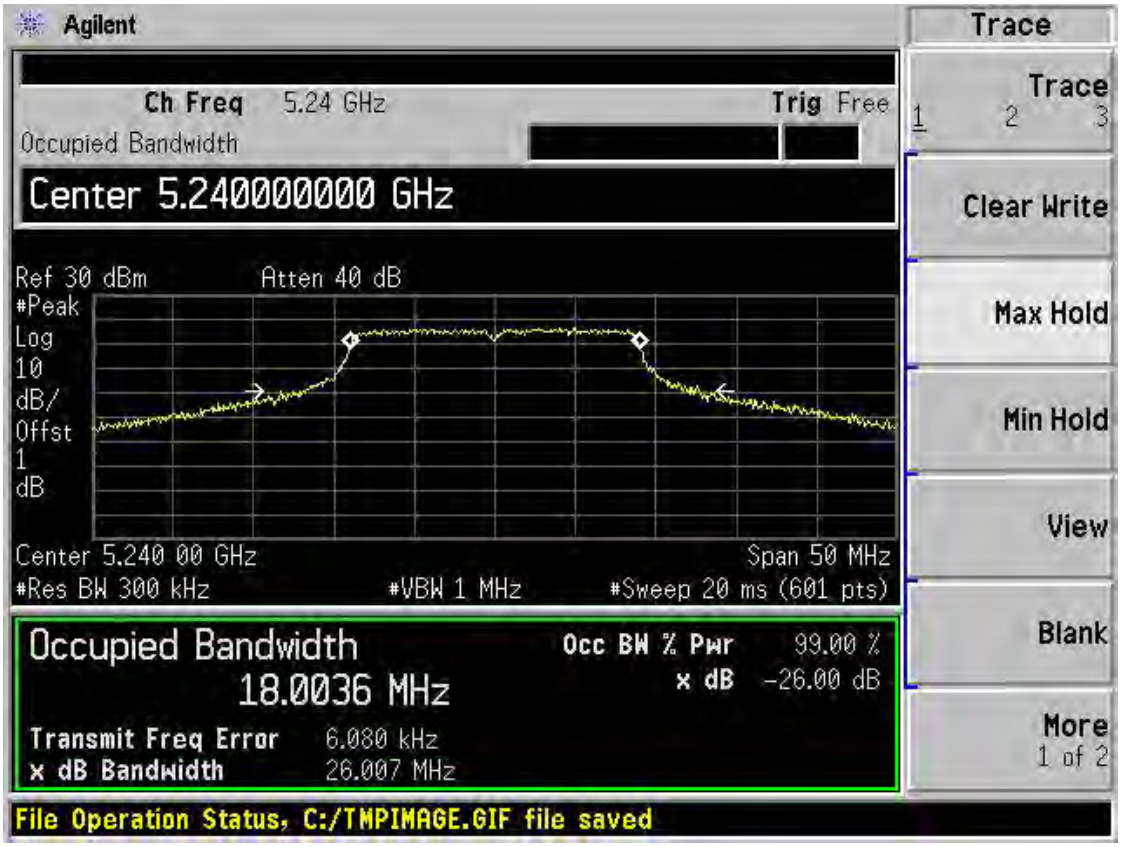

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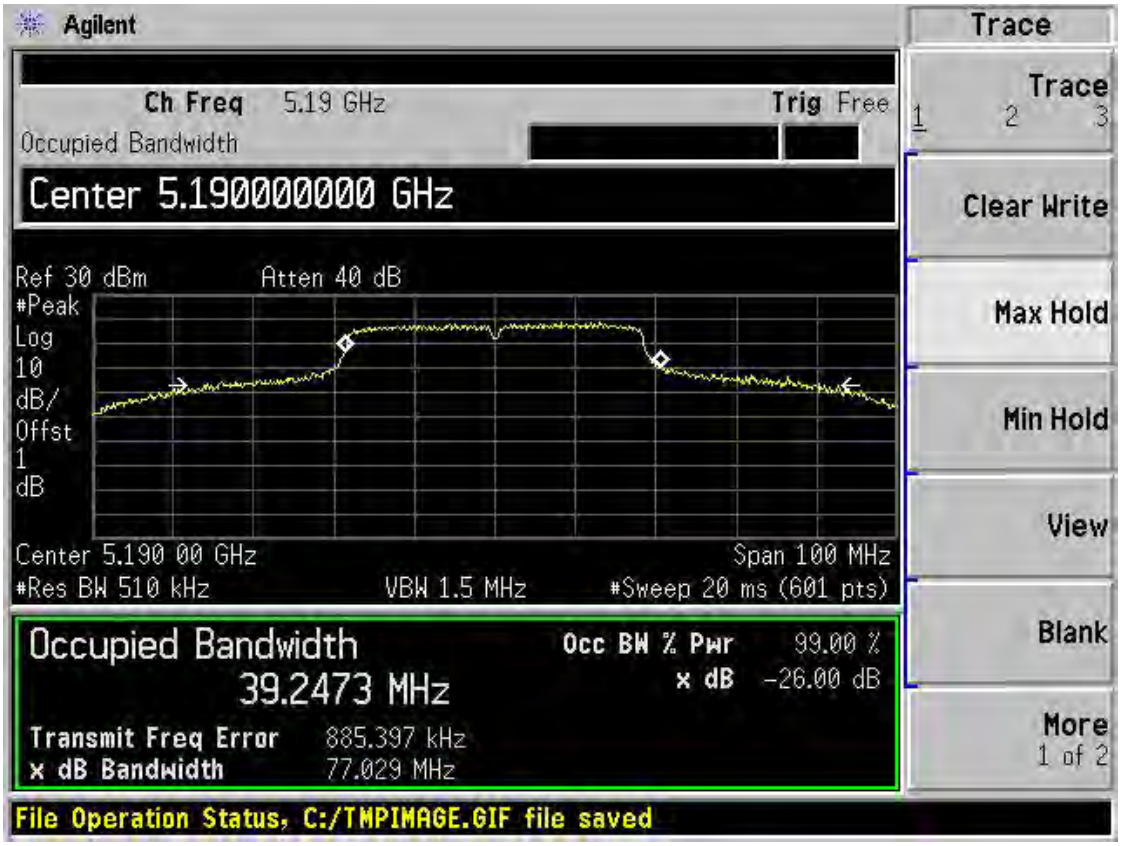

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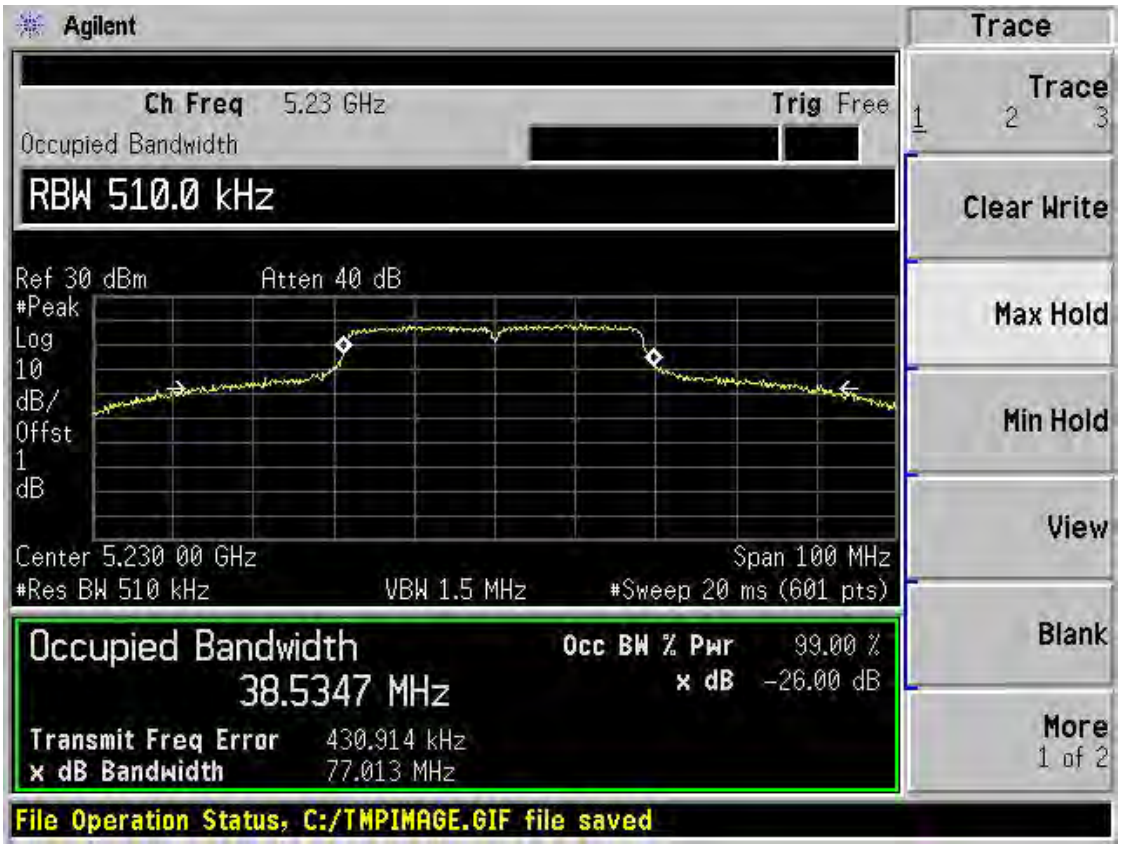

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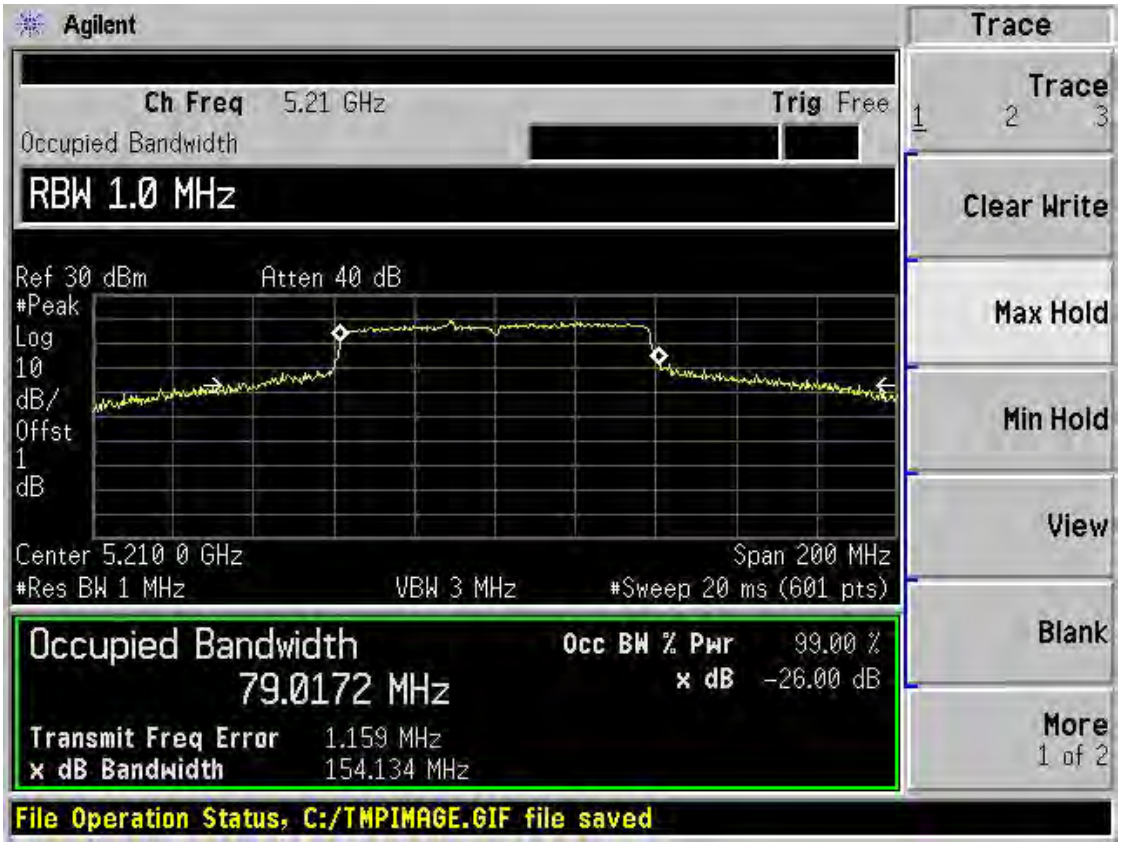
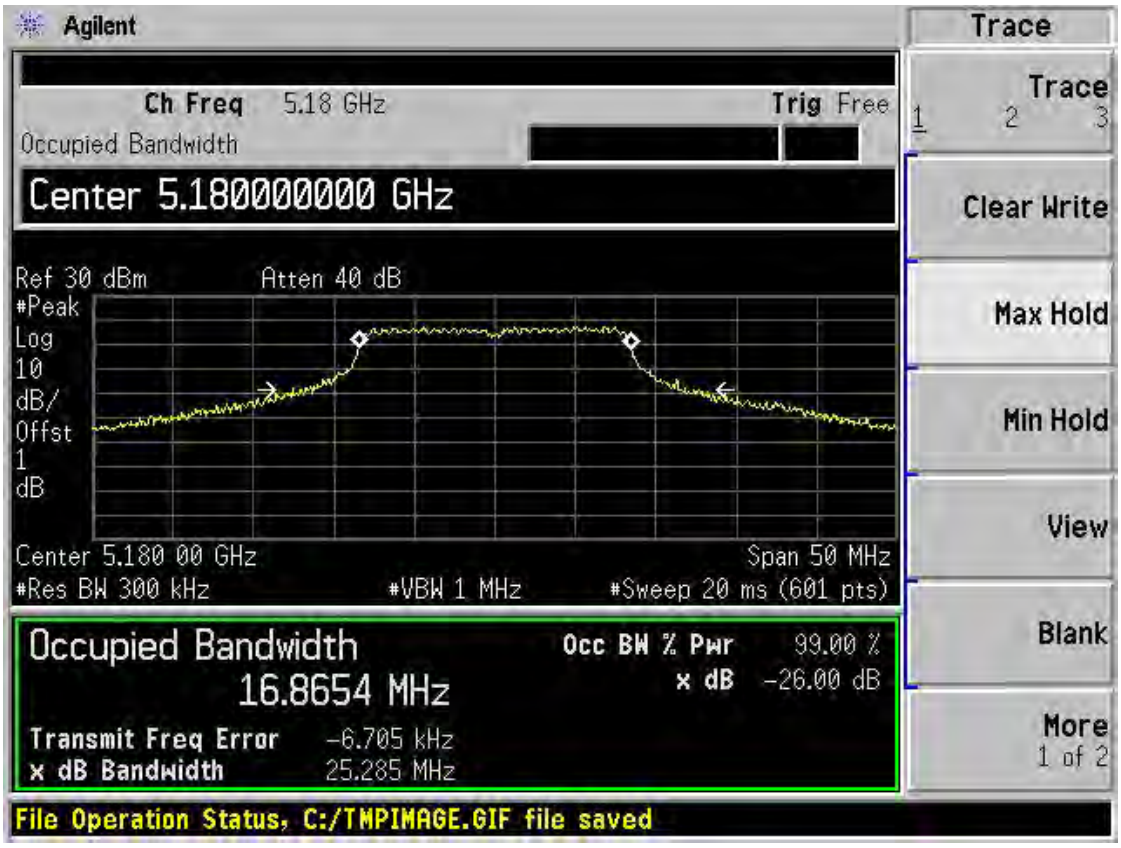


Band I 11a CH36 Chain 2



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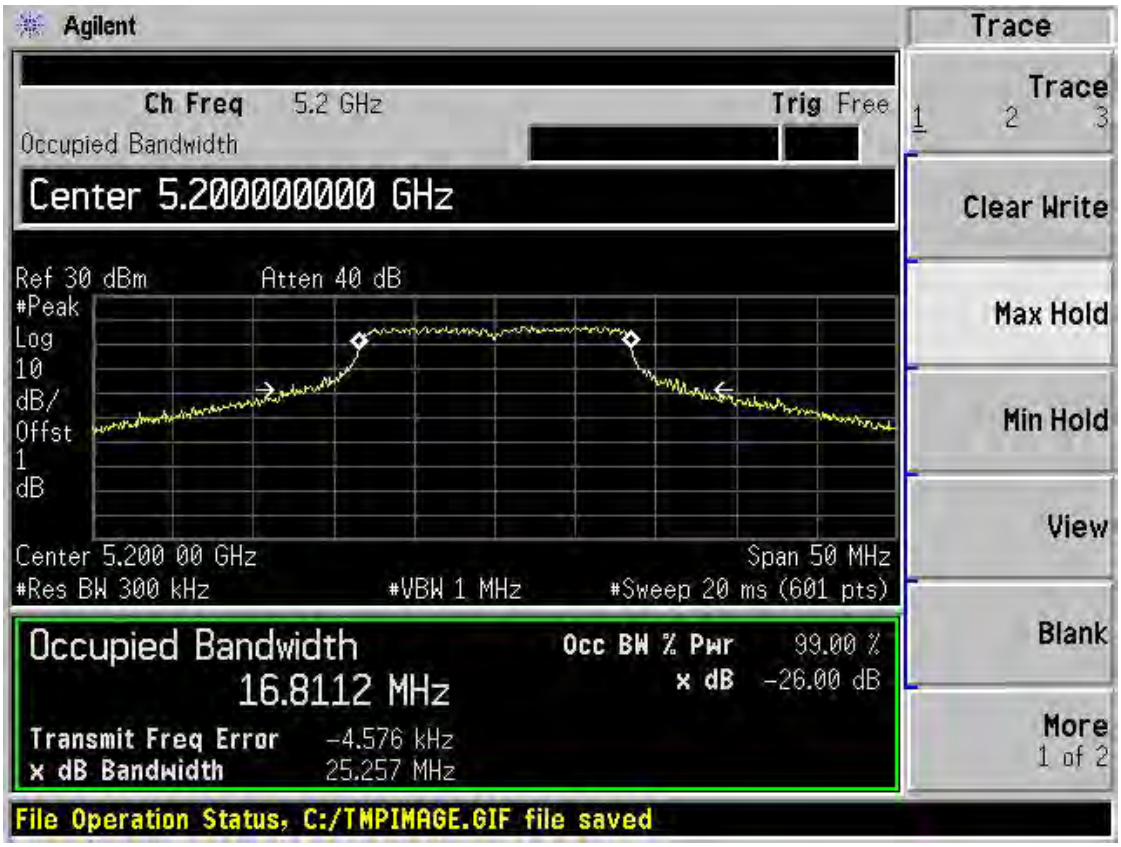

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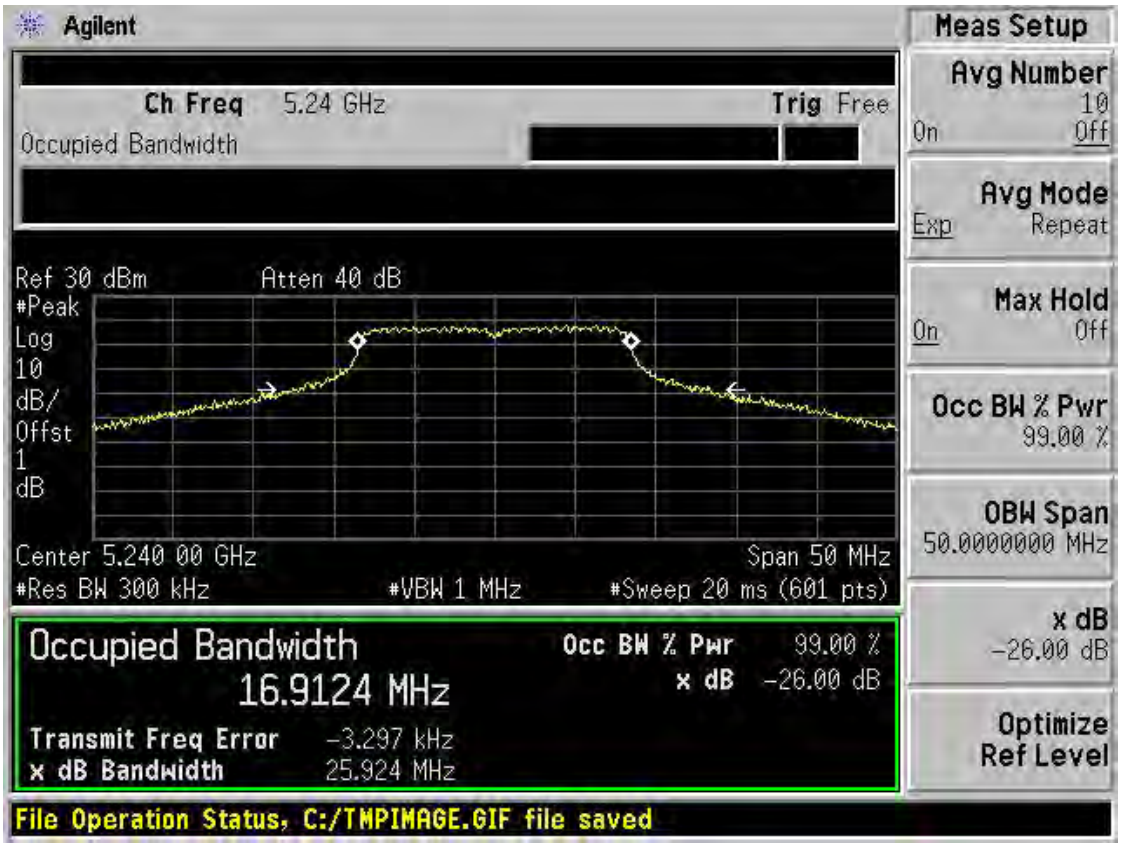

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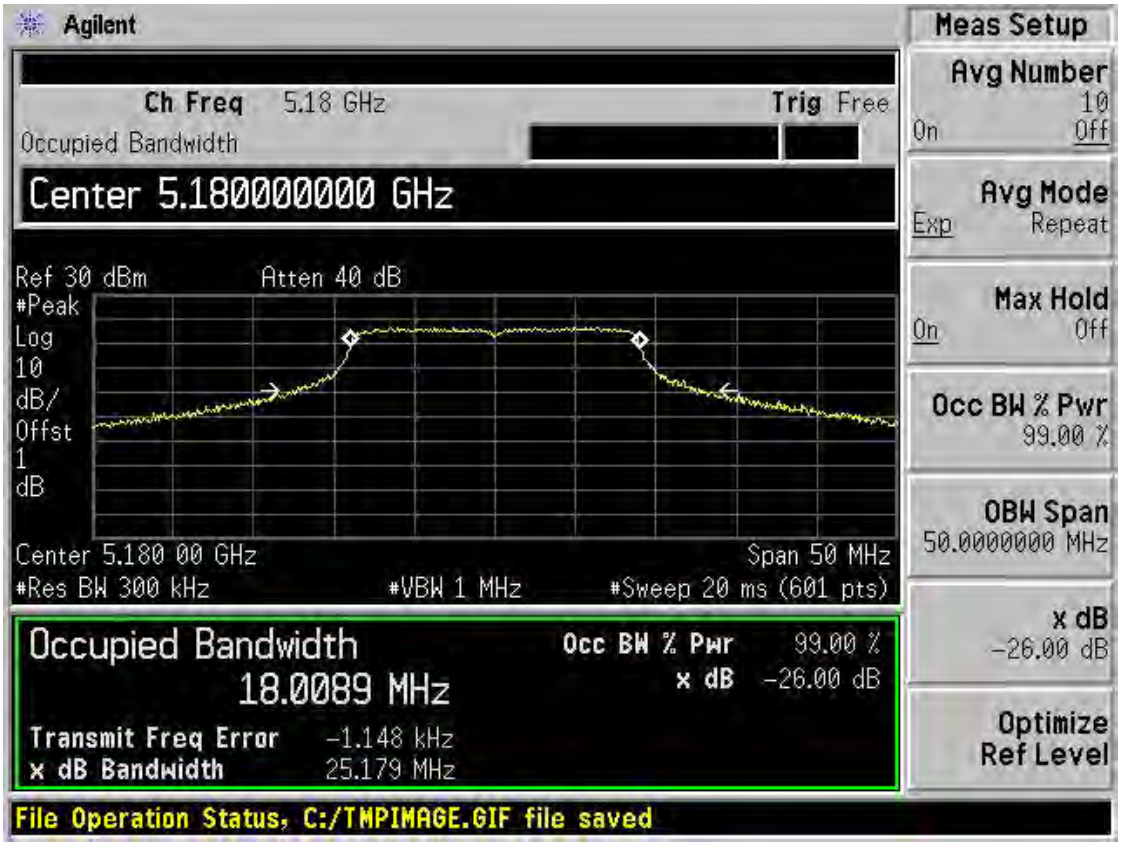

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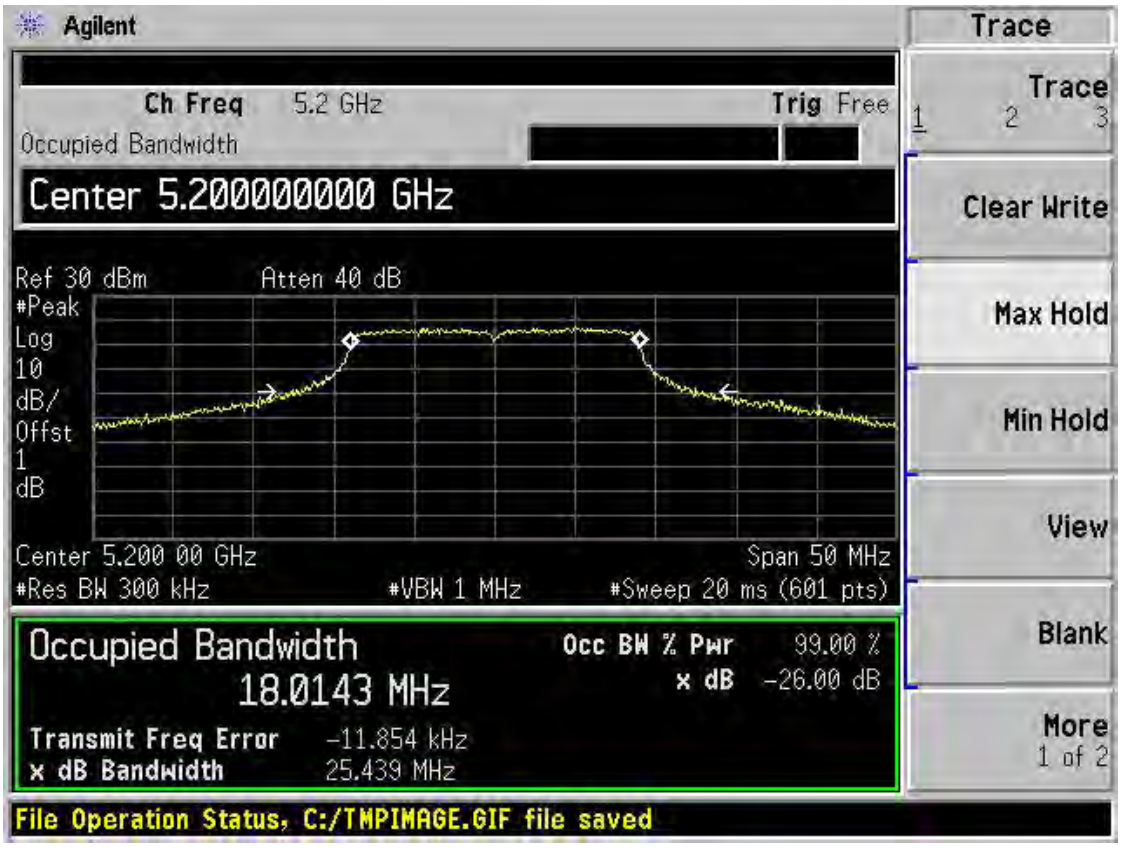

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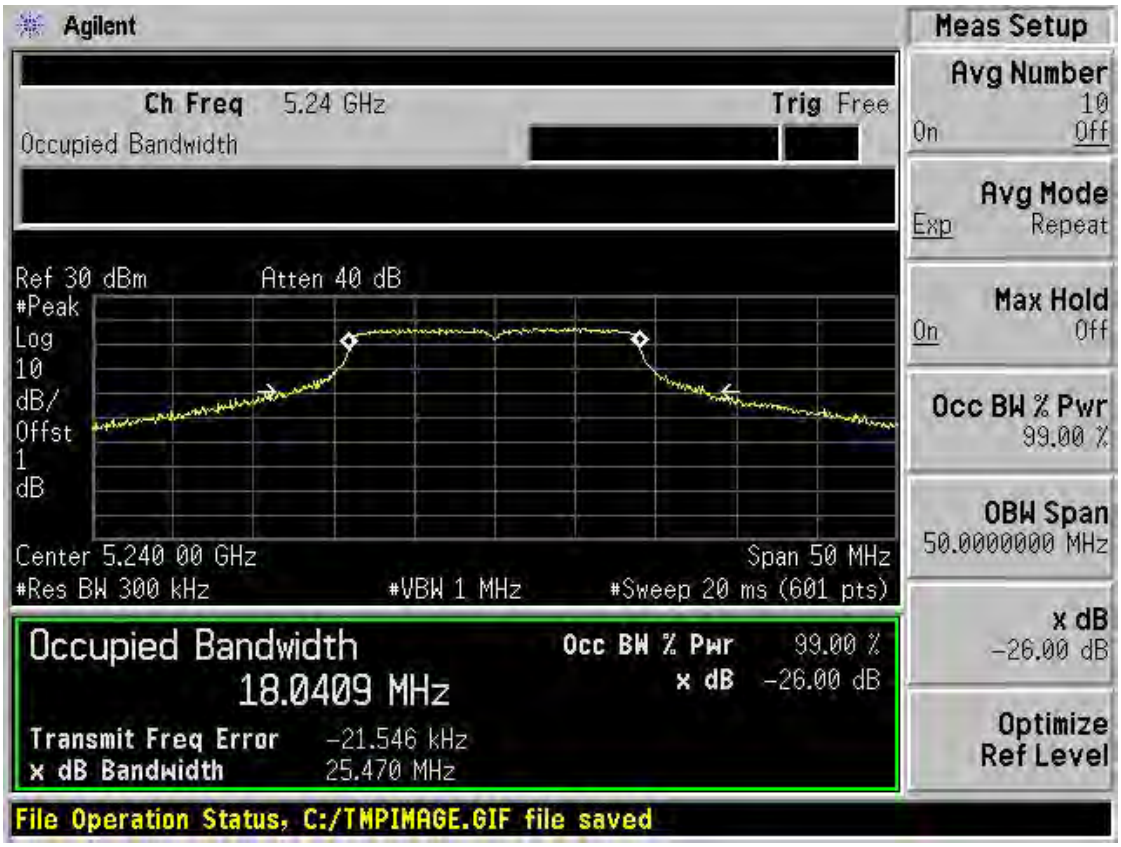
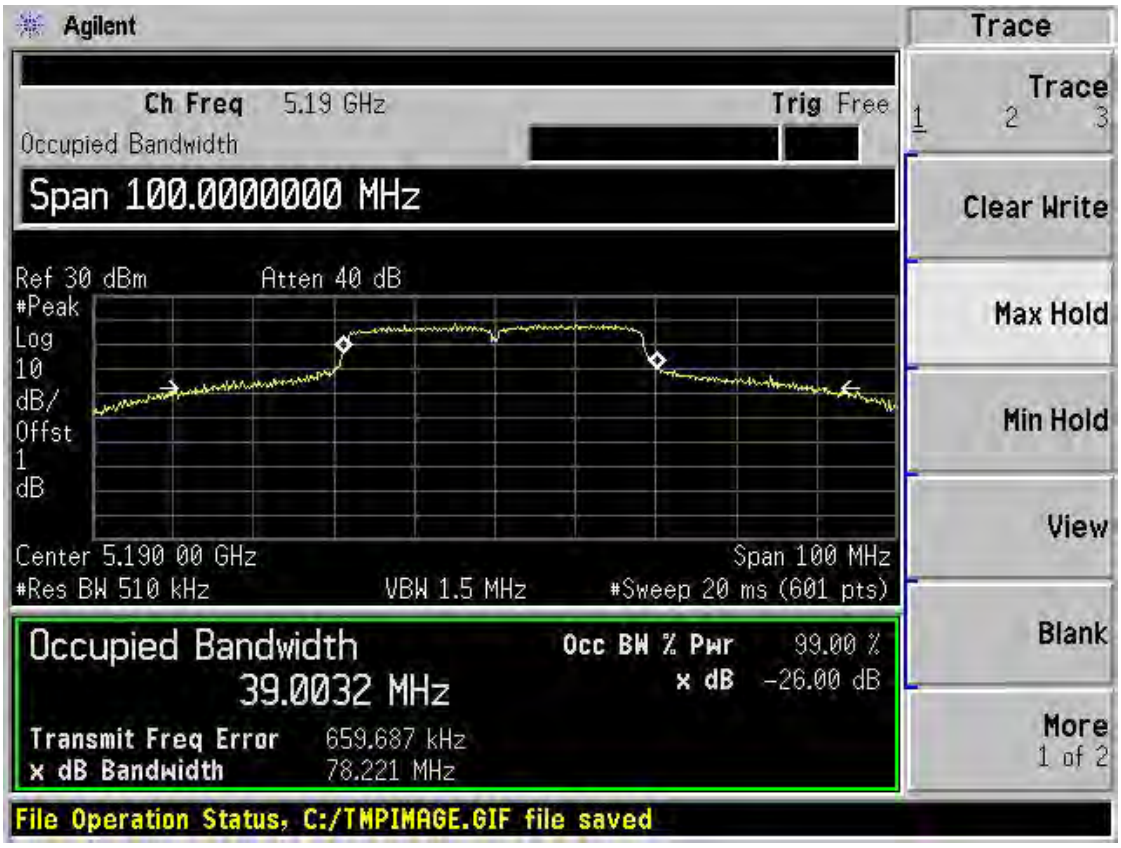
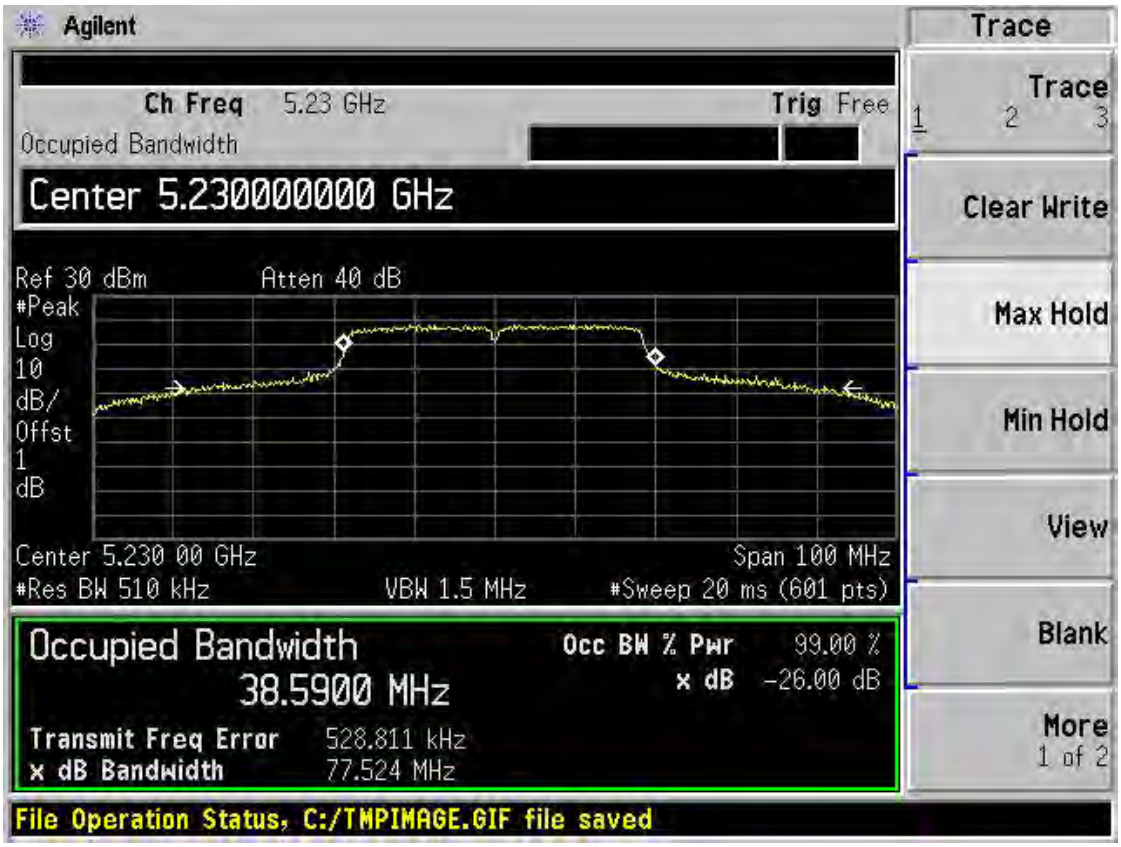


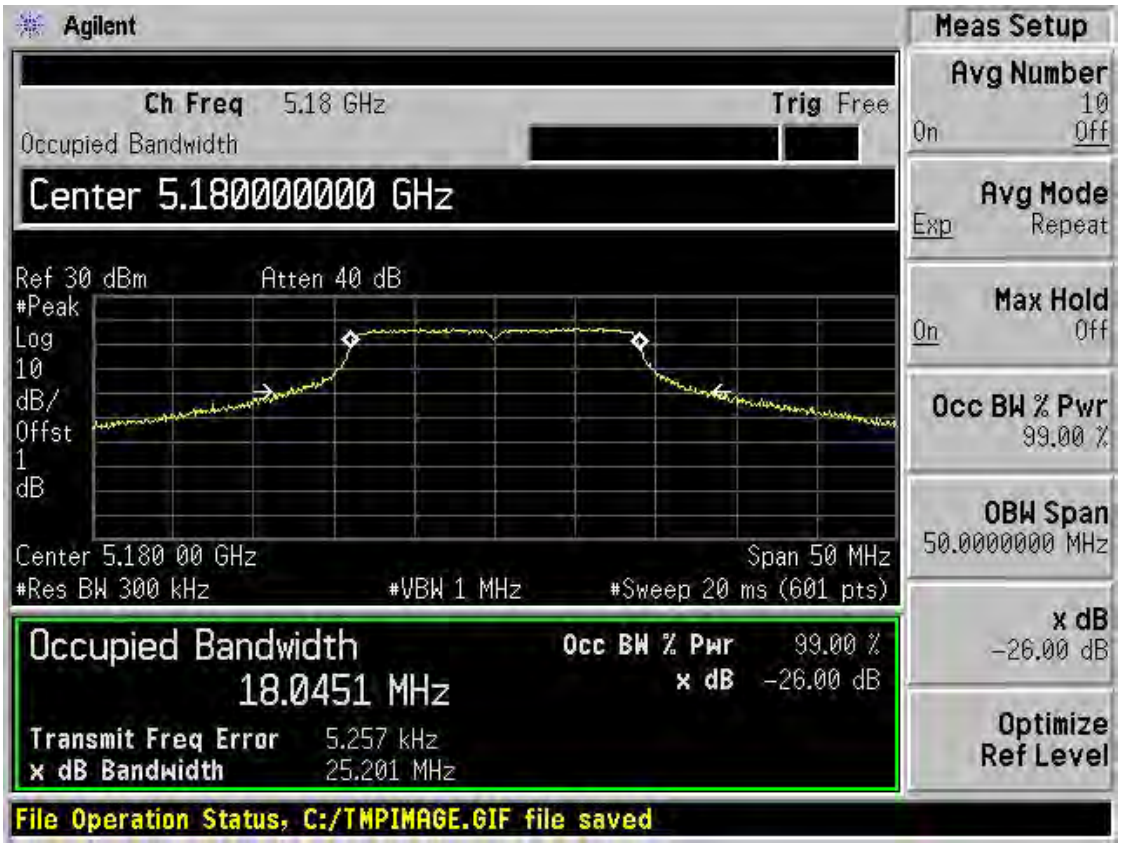
Band I 11n(HT40) CH38 Chain 2



Band I 11n(HT40) CH46 Chain 2



Band I 11ac(HT20) CH36 Chain 2



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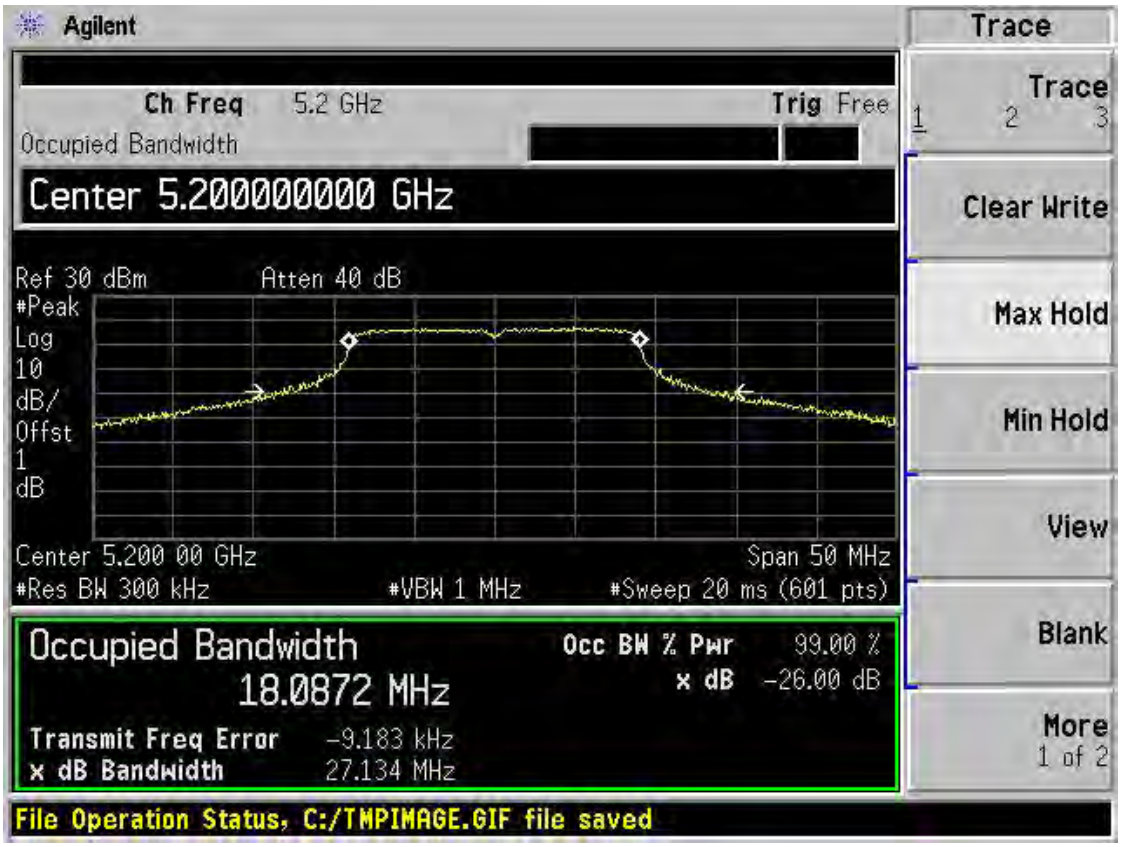

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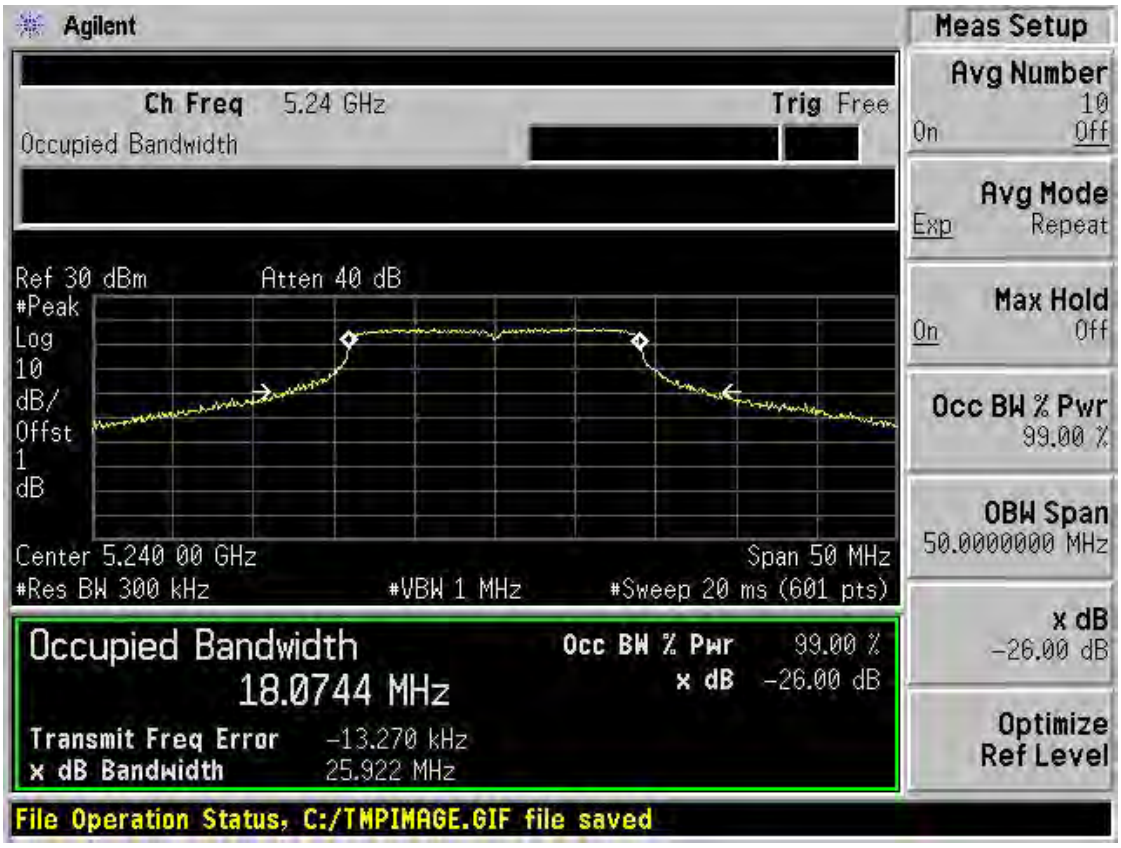

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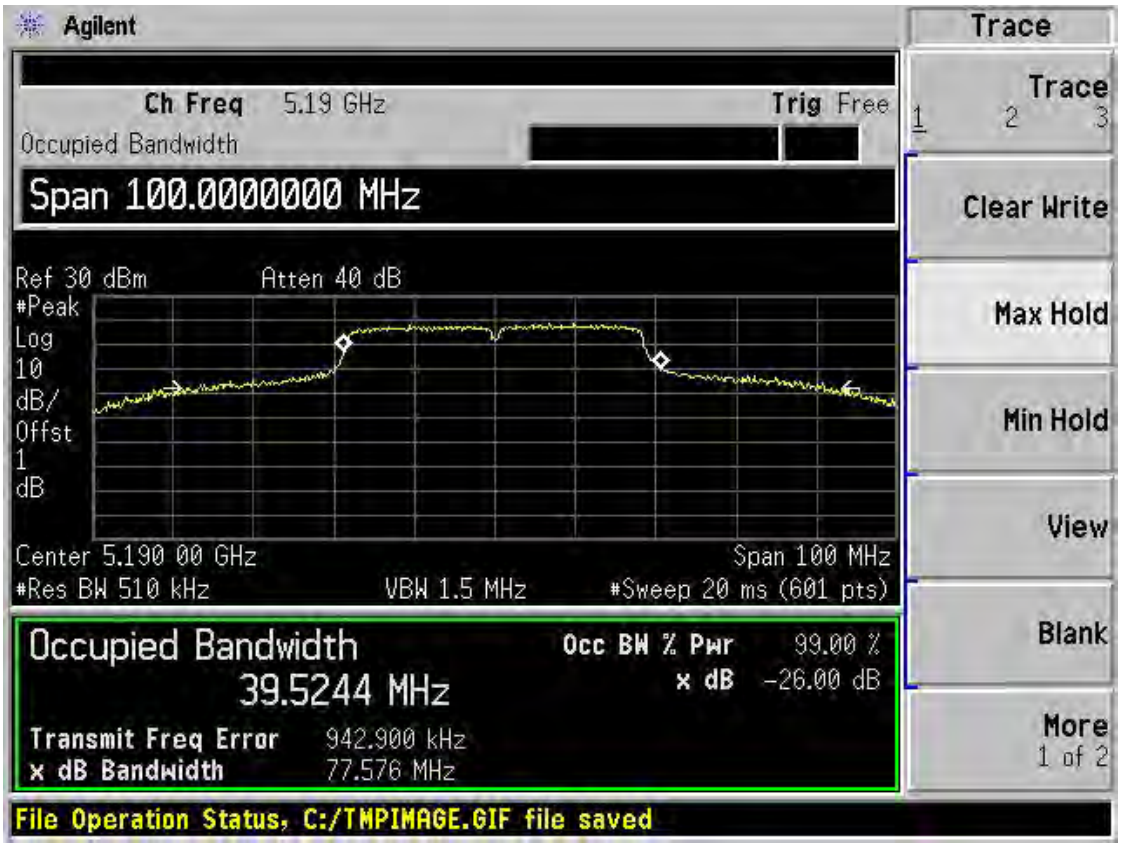

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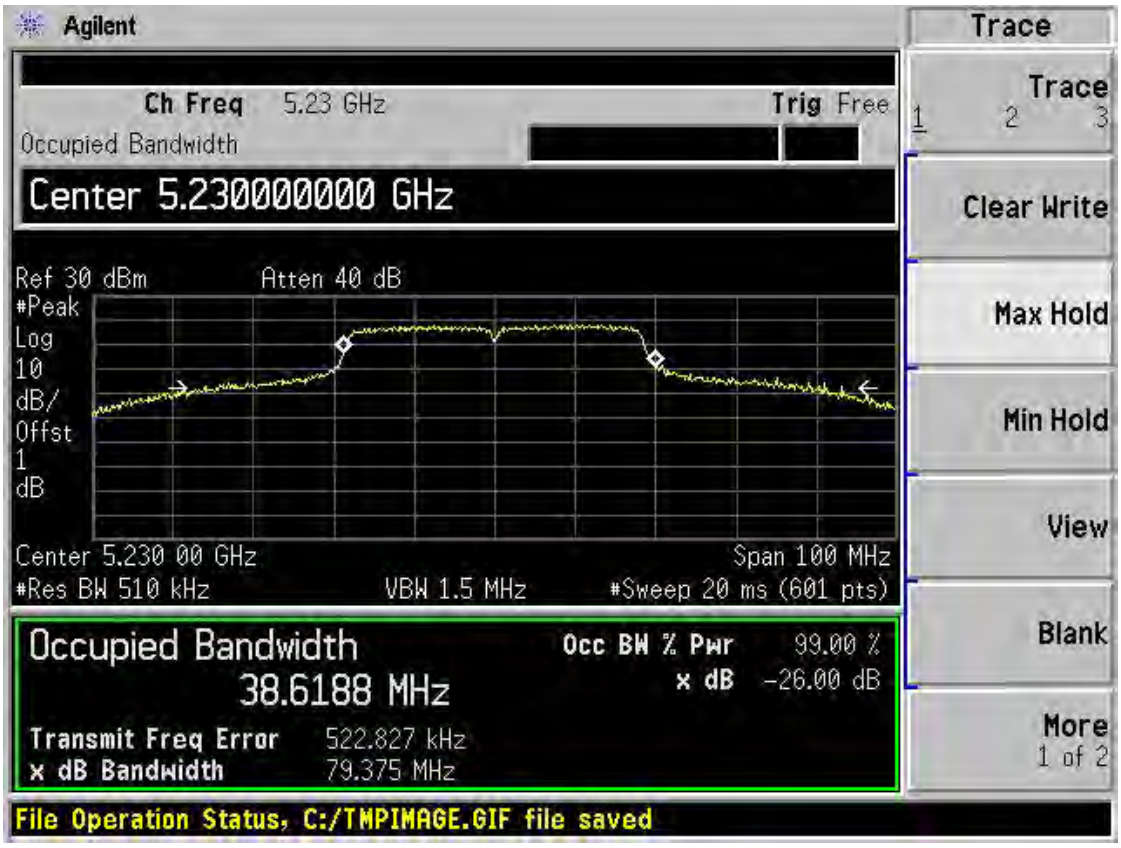
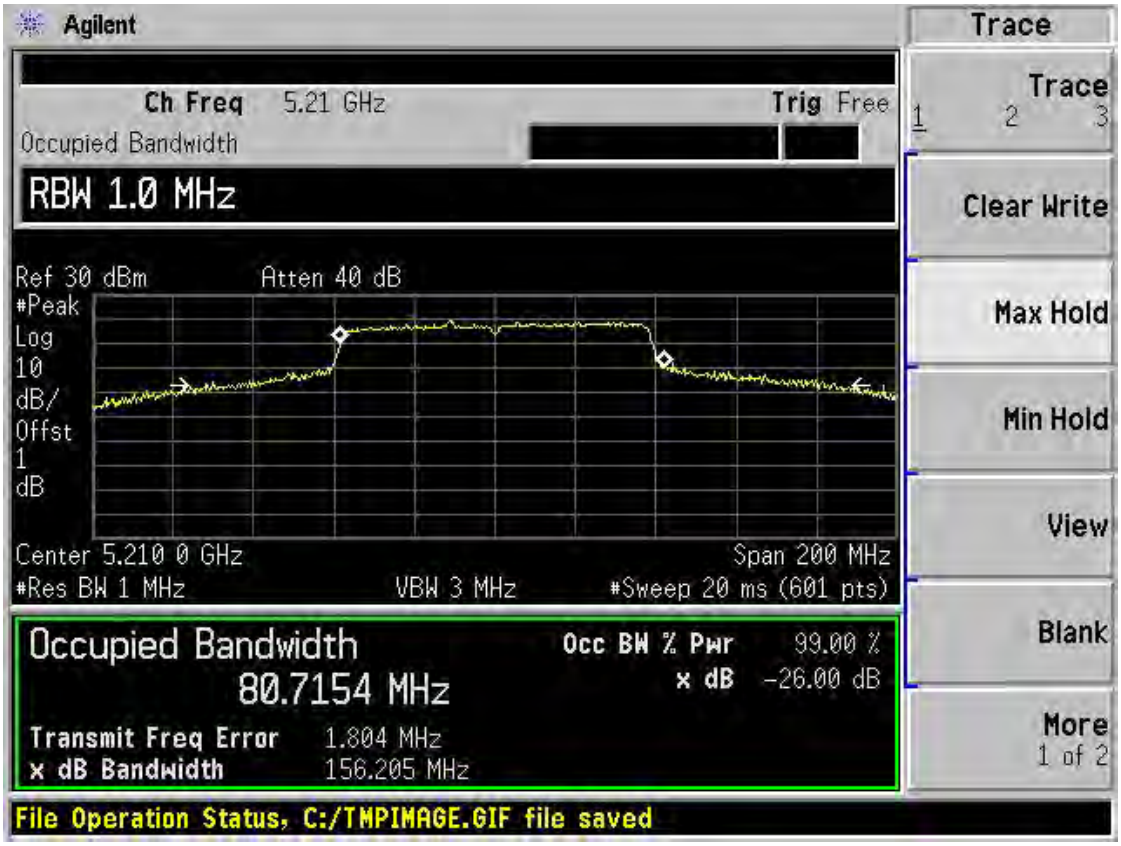
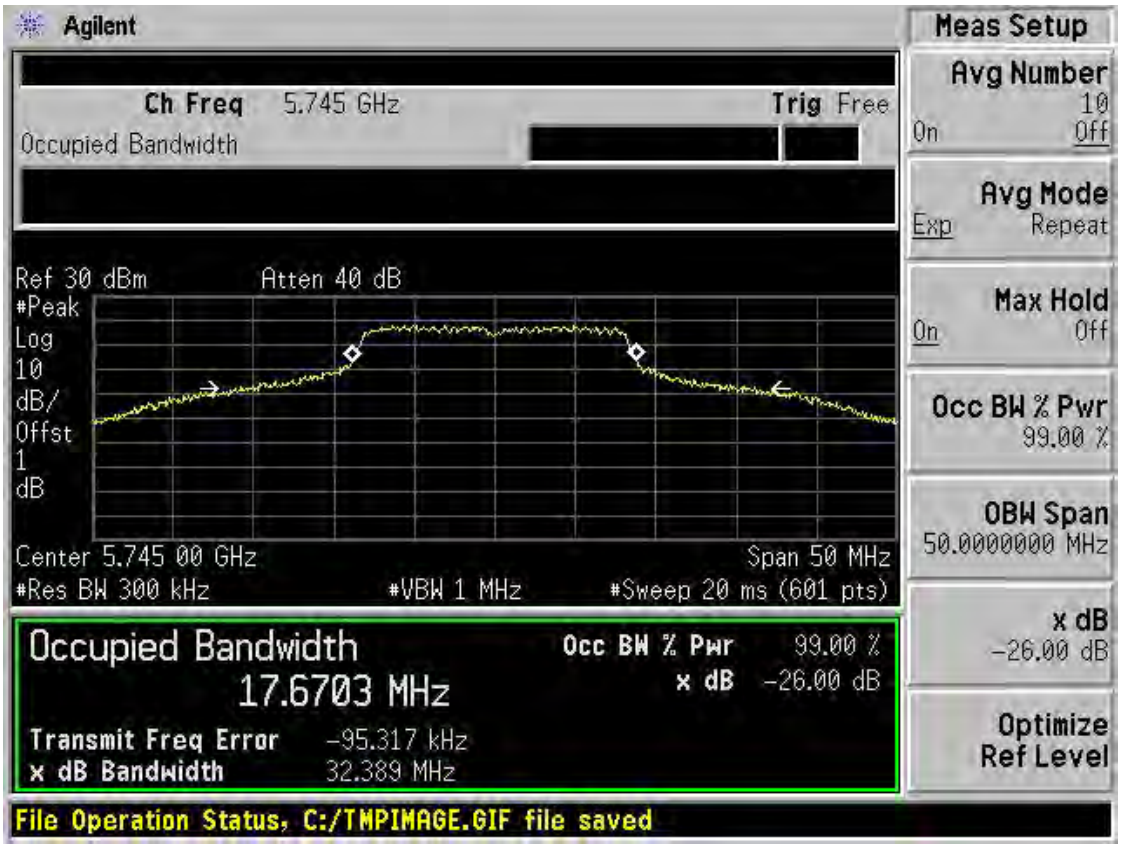


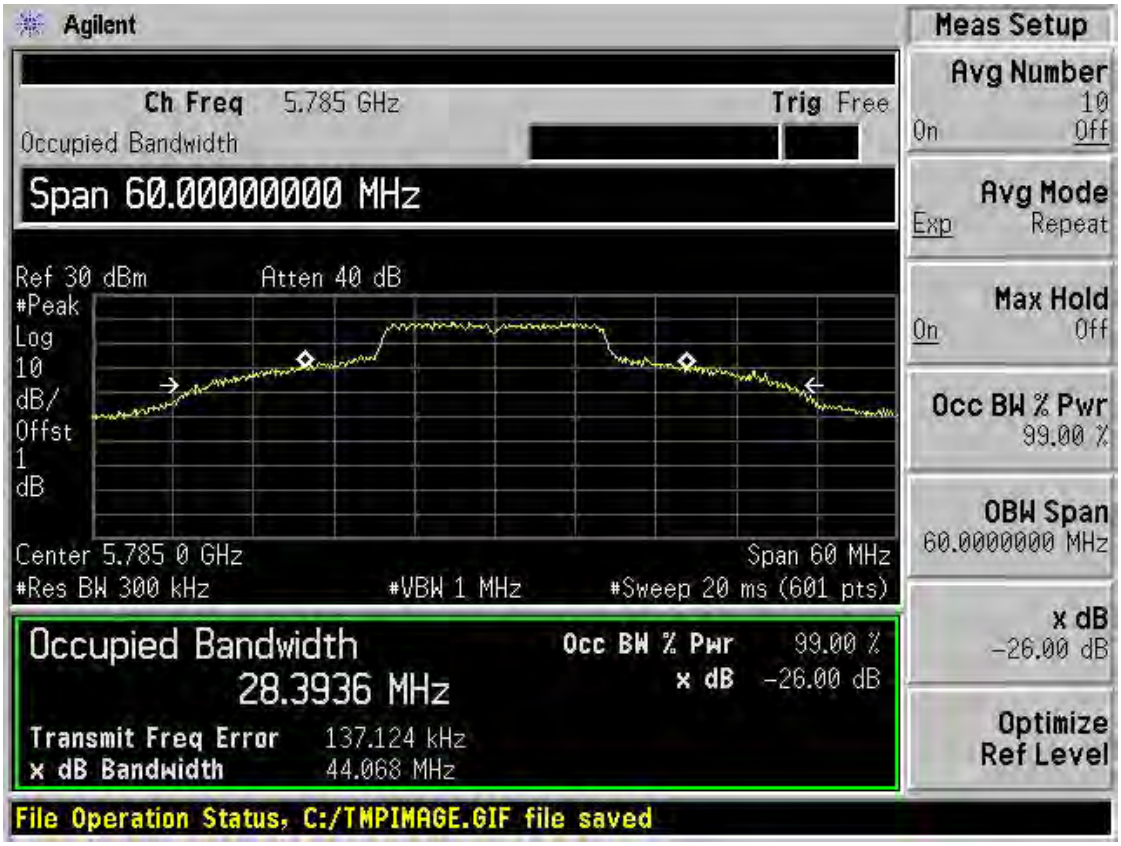
Band I 11ac(HT80) CH42 Chain 2



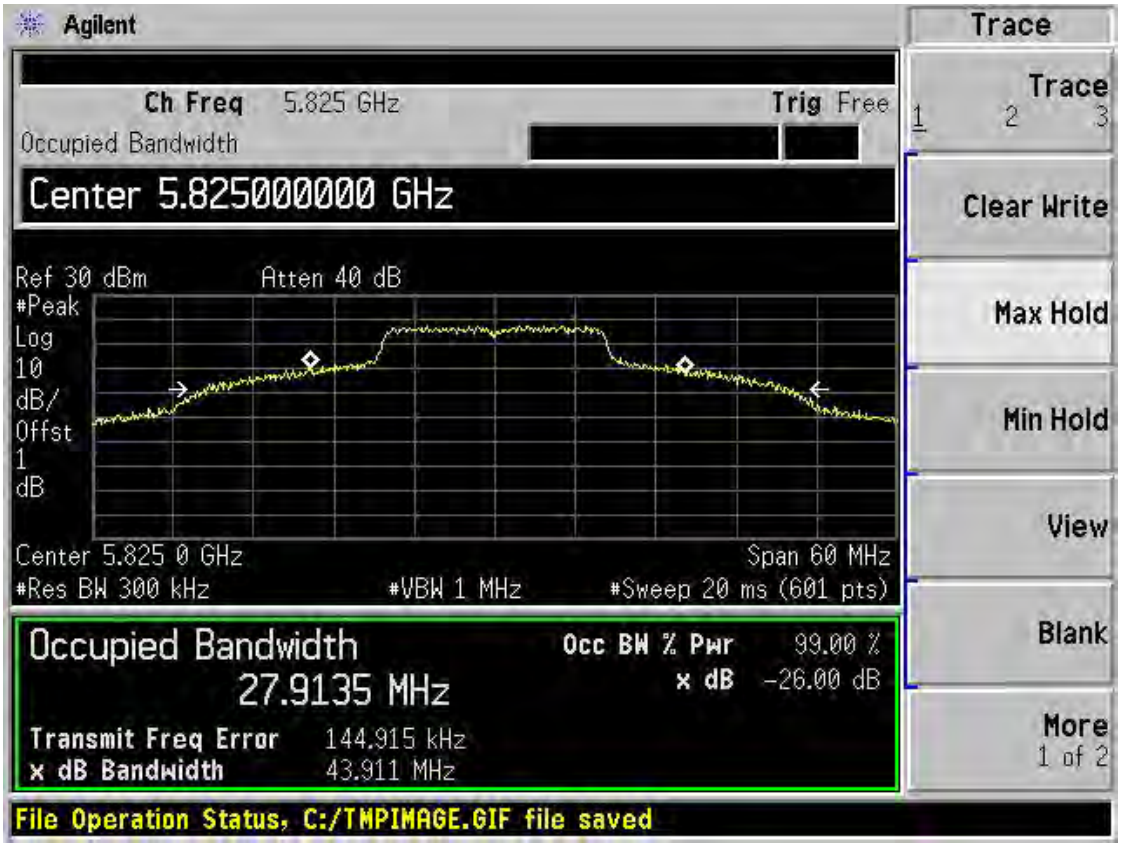
Band IV 11a CH149 Chain 1



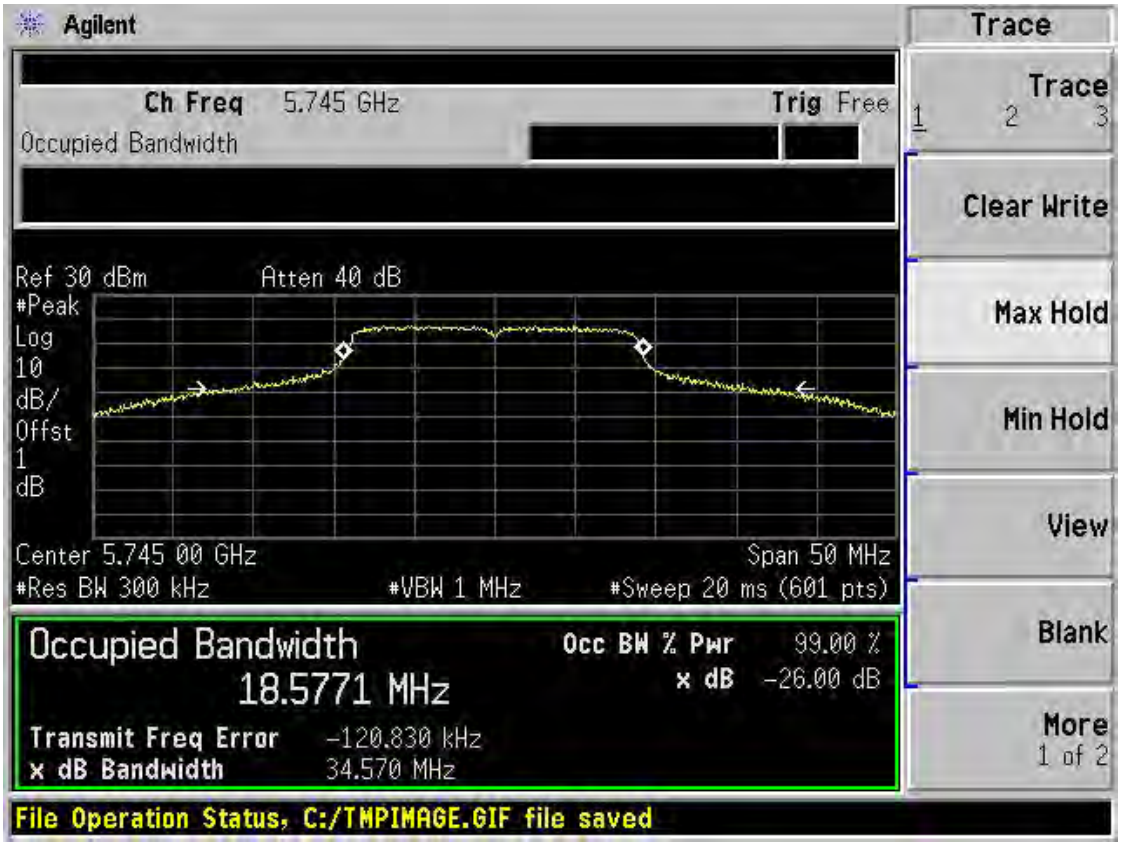
Band IV 11a CH157 Chain 1



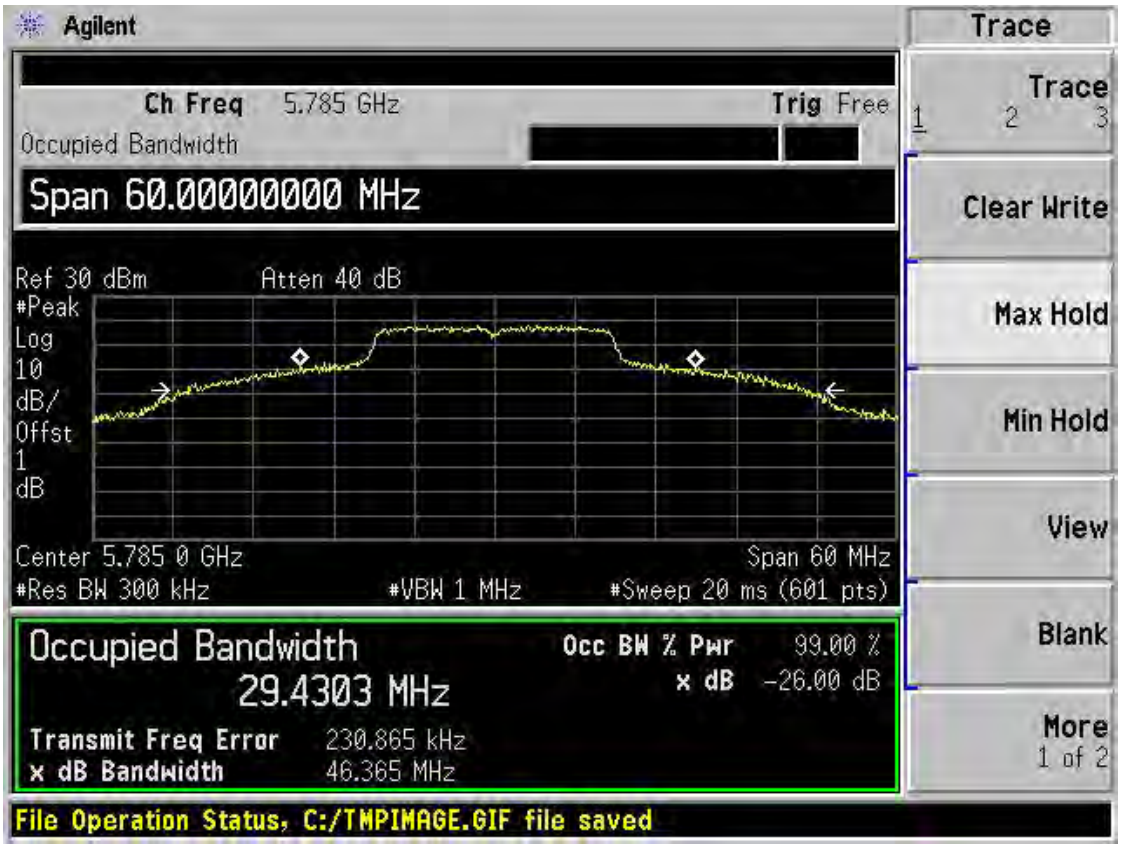
Band IV 11a CH165 Chain 1



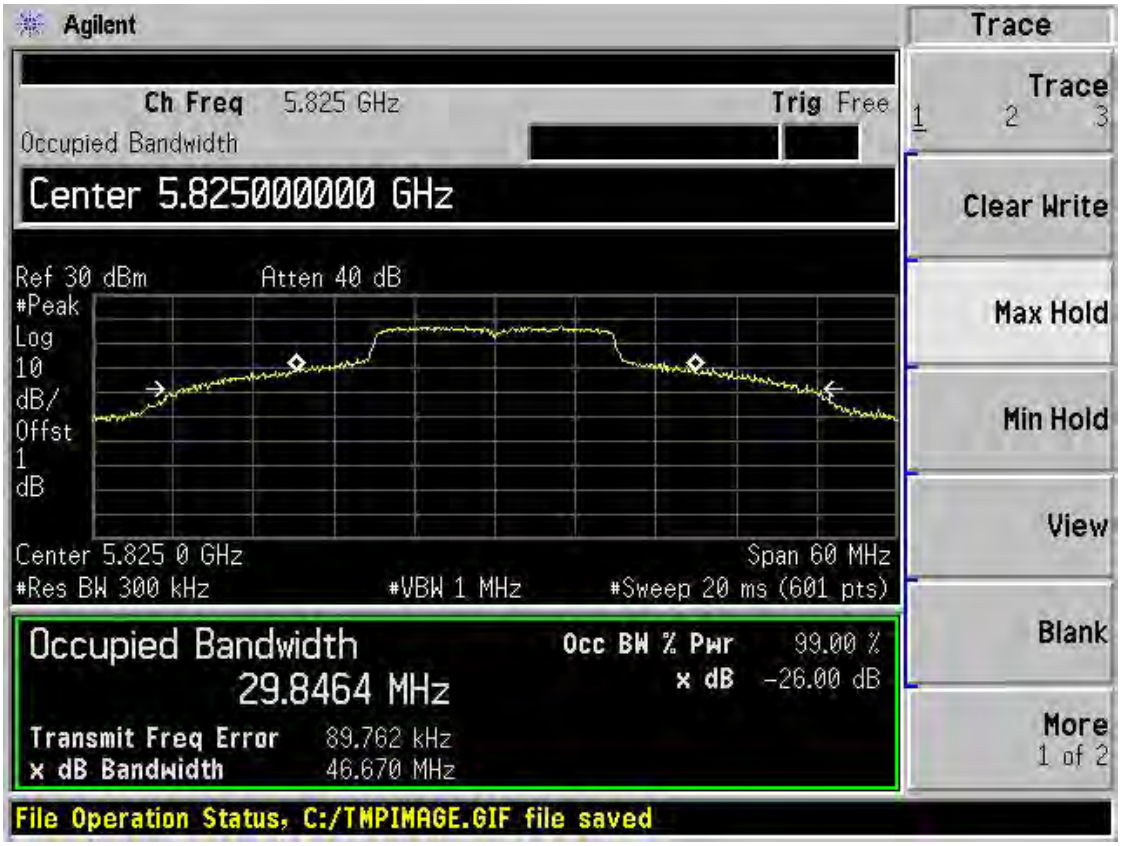
Band IV 11n(HT20) CH149 Chain 1



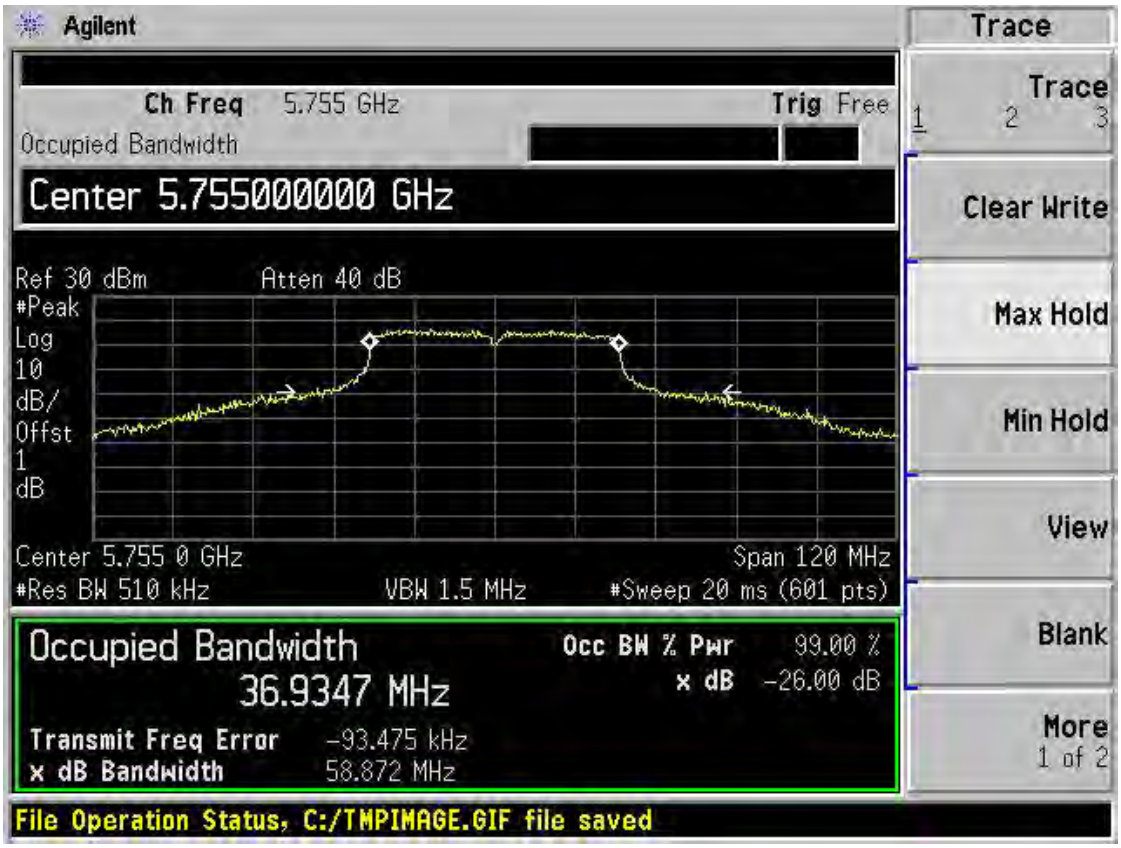
Band IV 11n(HT20) CH157 Chain 1



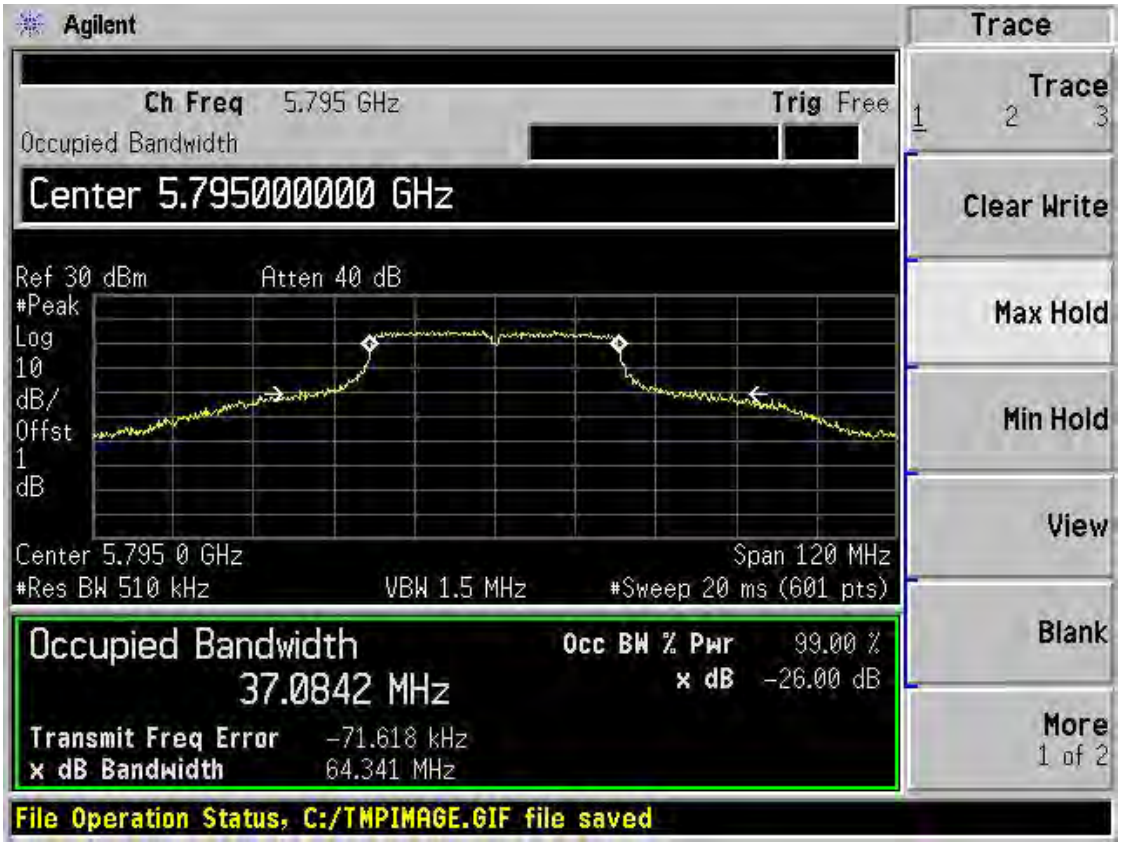
Band IV 11n(HT20) CH165 Chain 1



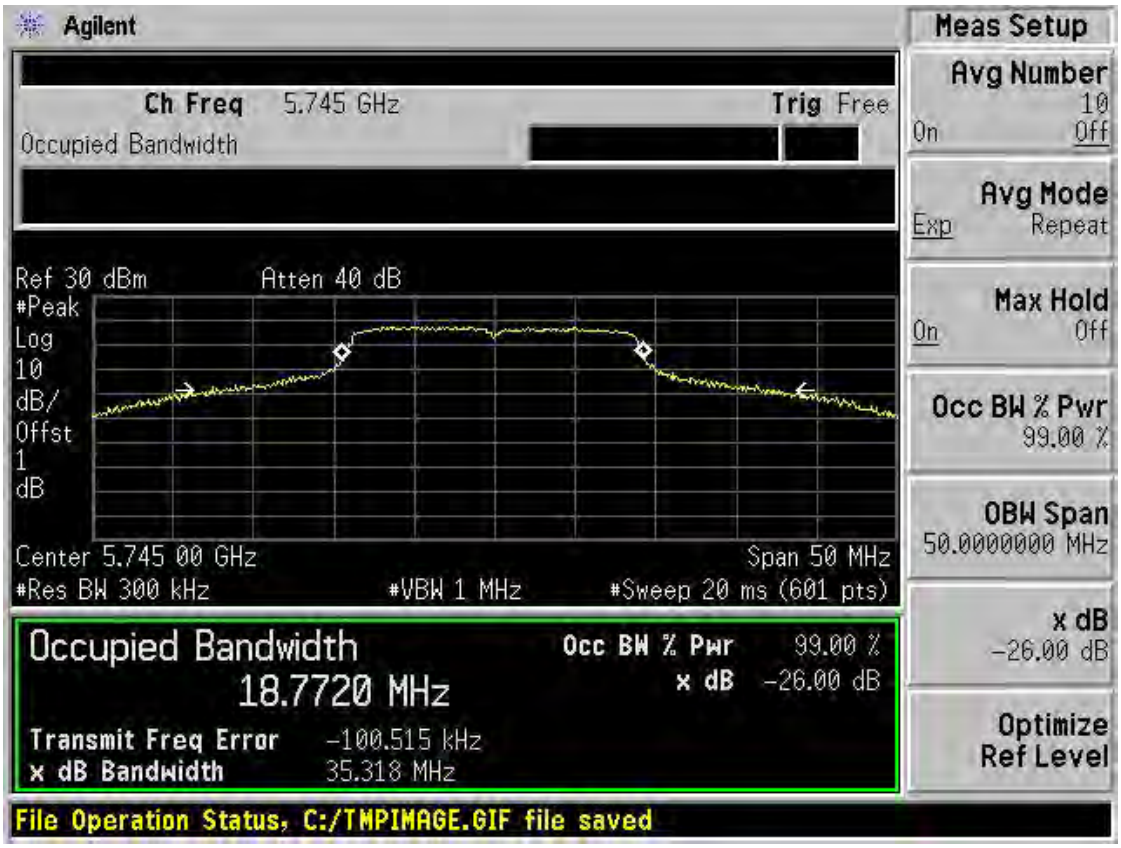
Band IV 11n(HT40) CH151 Chain 1



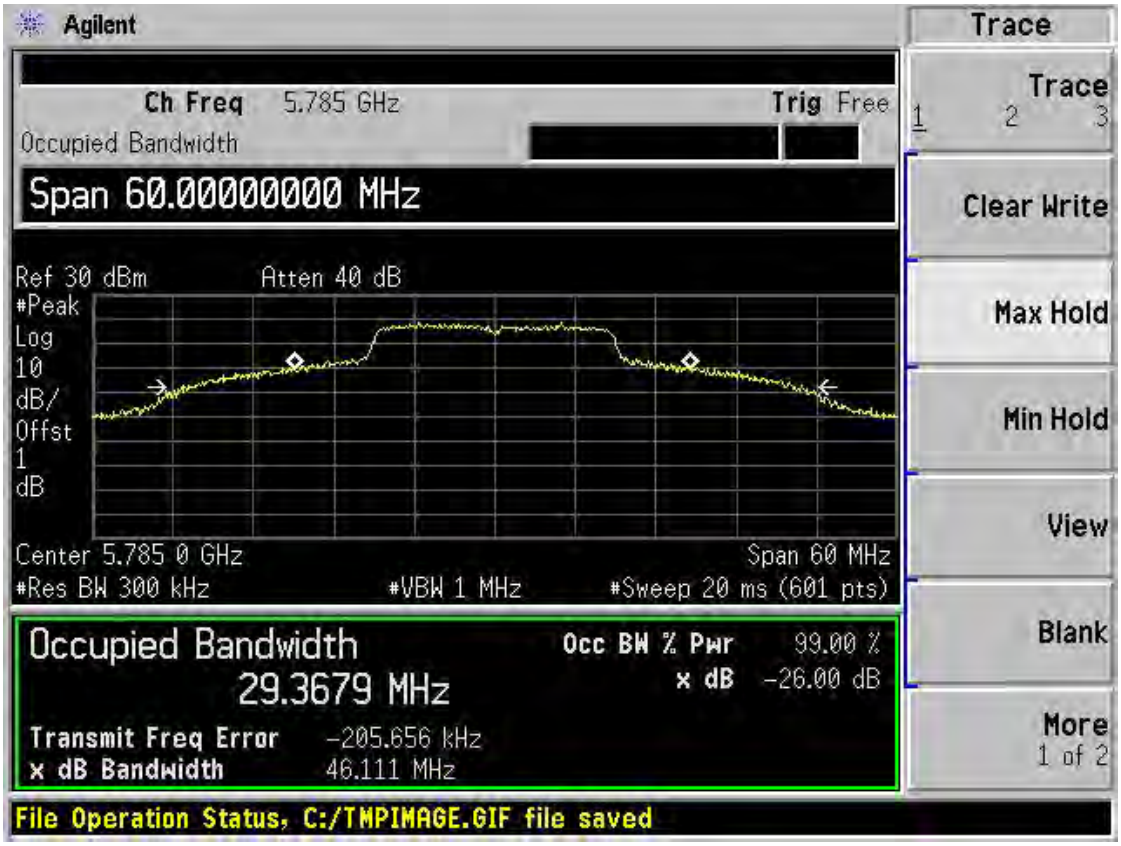
Band IV 11n(HT40) CH159 Chain 1



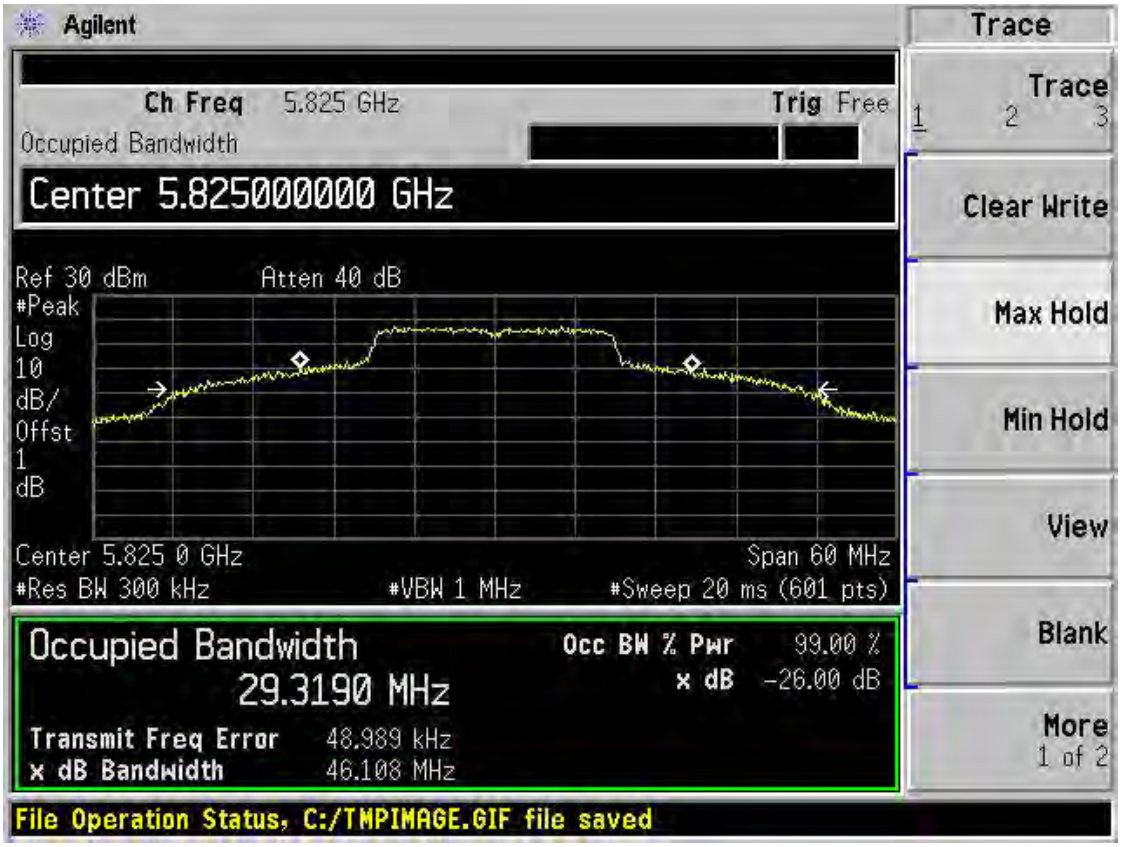
Band IV 11ac(HT20) CH149 Chain 1



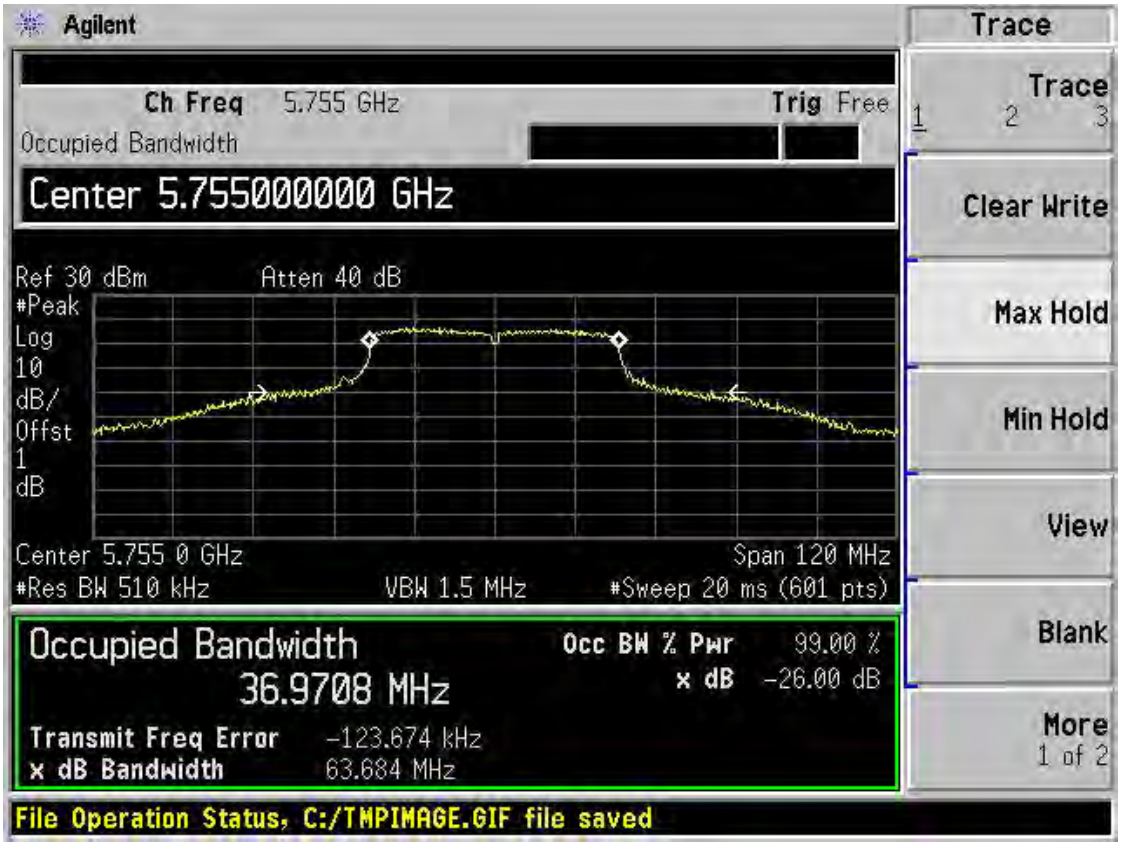
Band IV 11ac(HT20) CH157 Chain 1



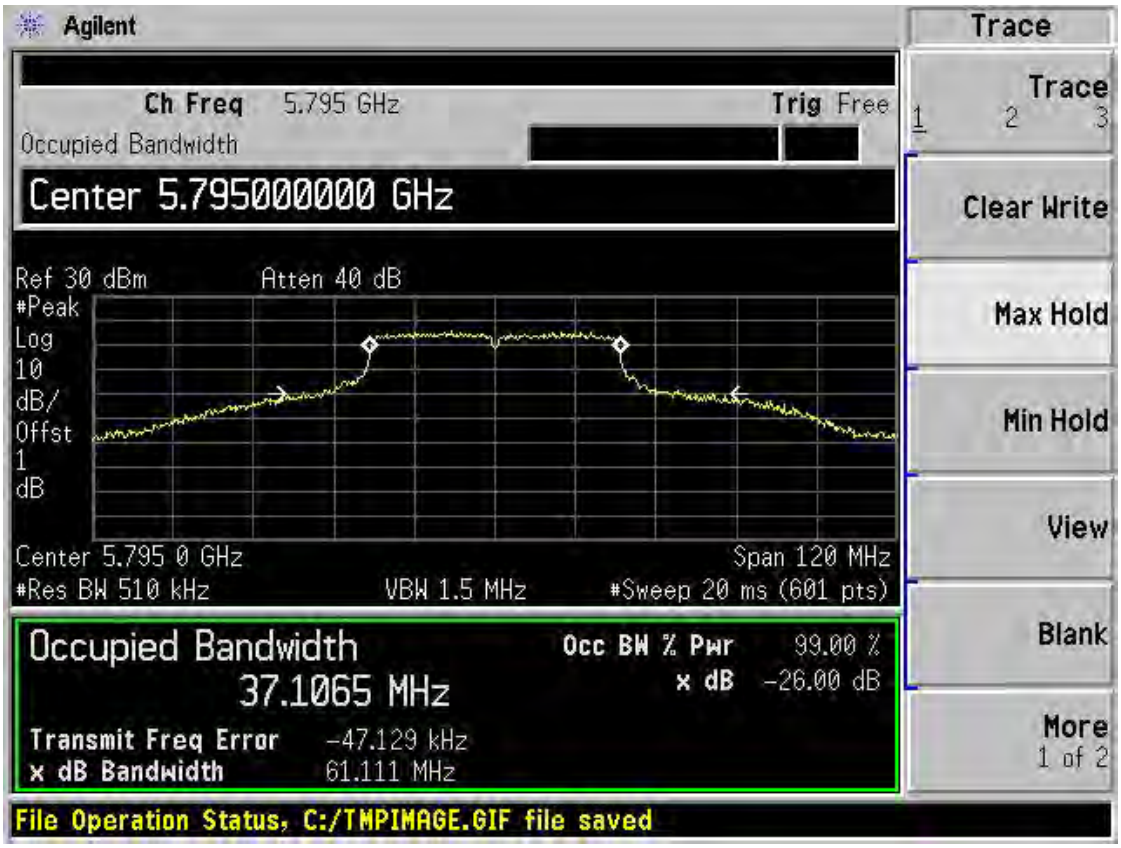
Band IV 11ac(HT20) CH165 Chain 1



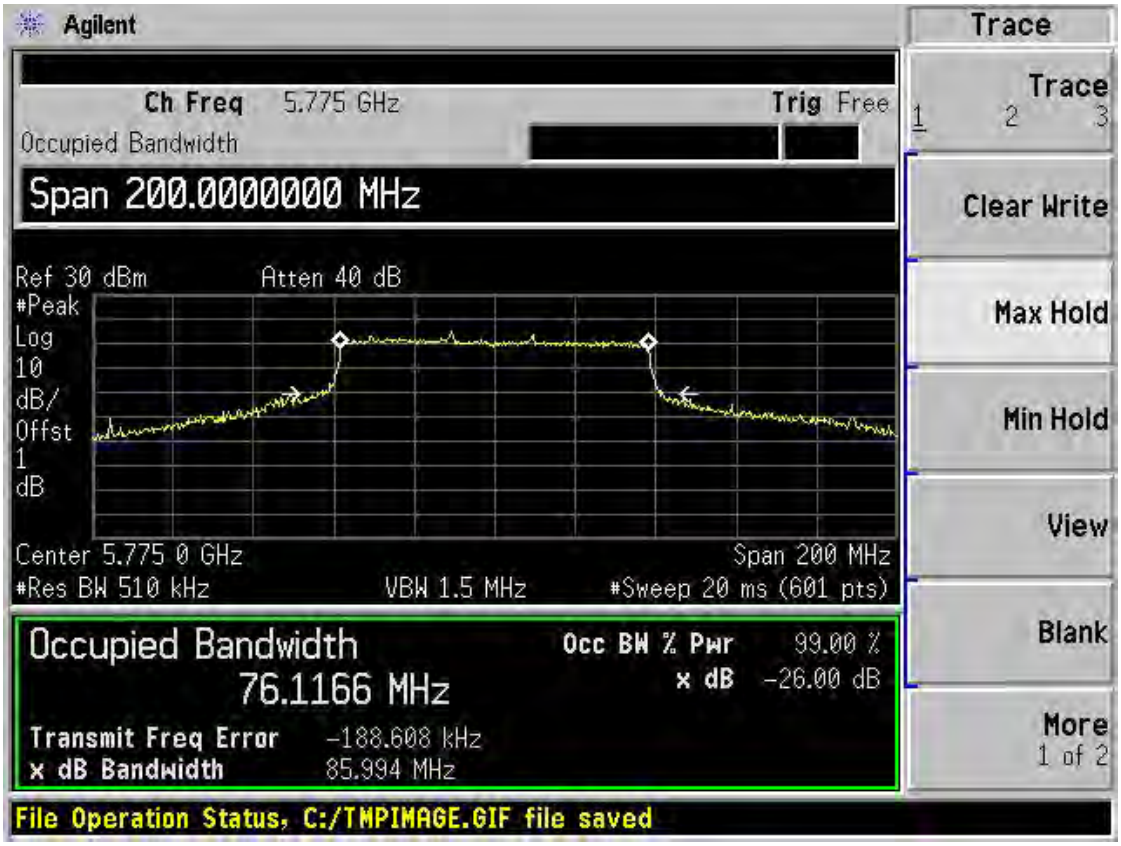
Band IV 11ac(HT40) CH151 Chain 1



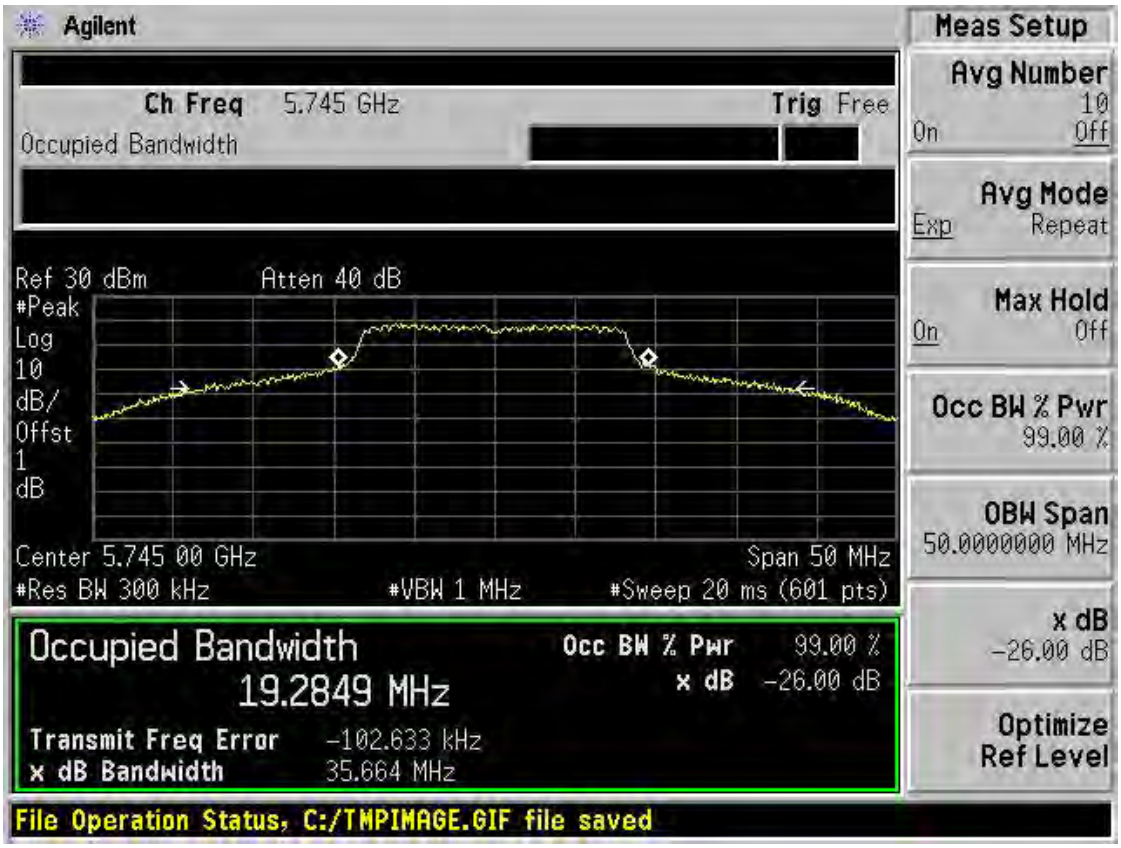
Band IV 11ac(HT40) CH159 Chain 1



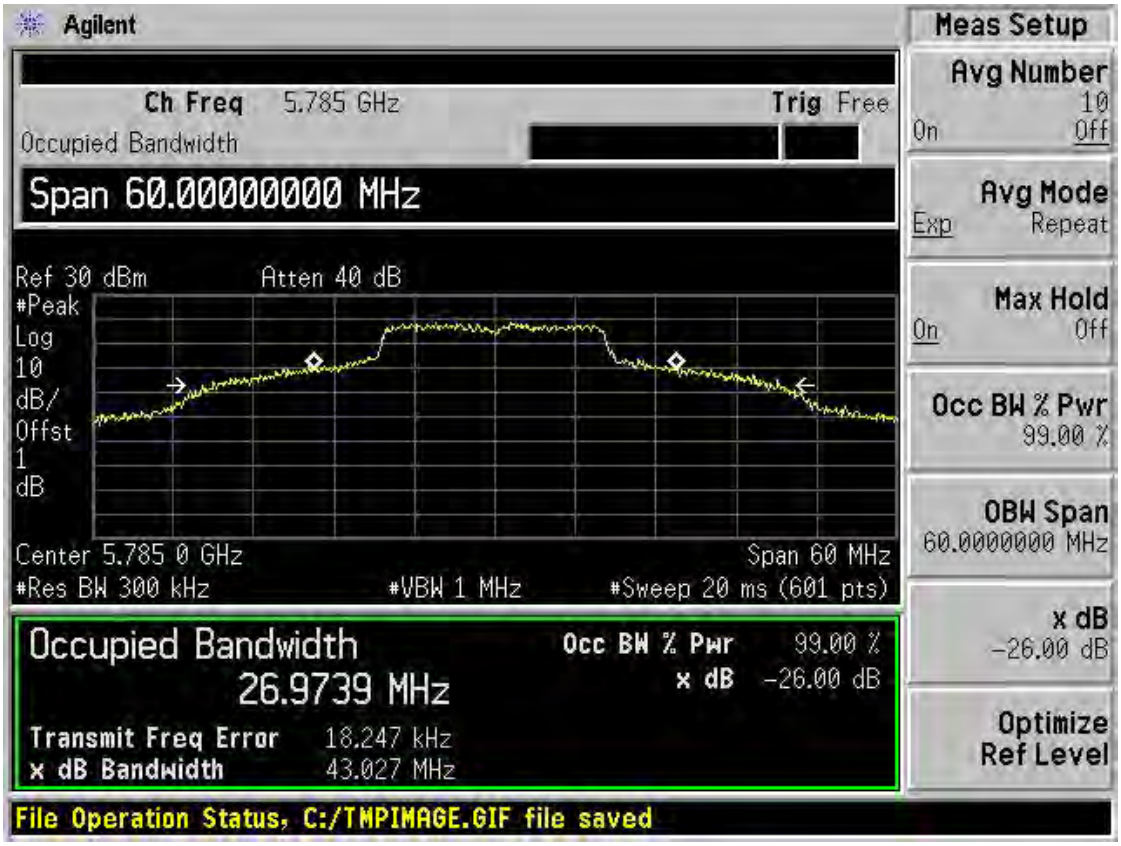
Band IV 11ac(HT80) CH155 Chain 1



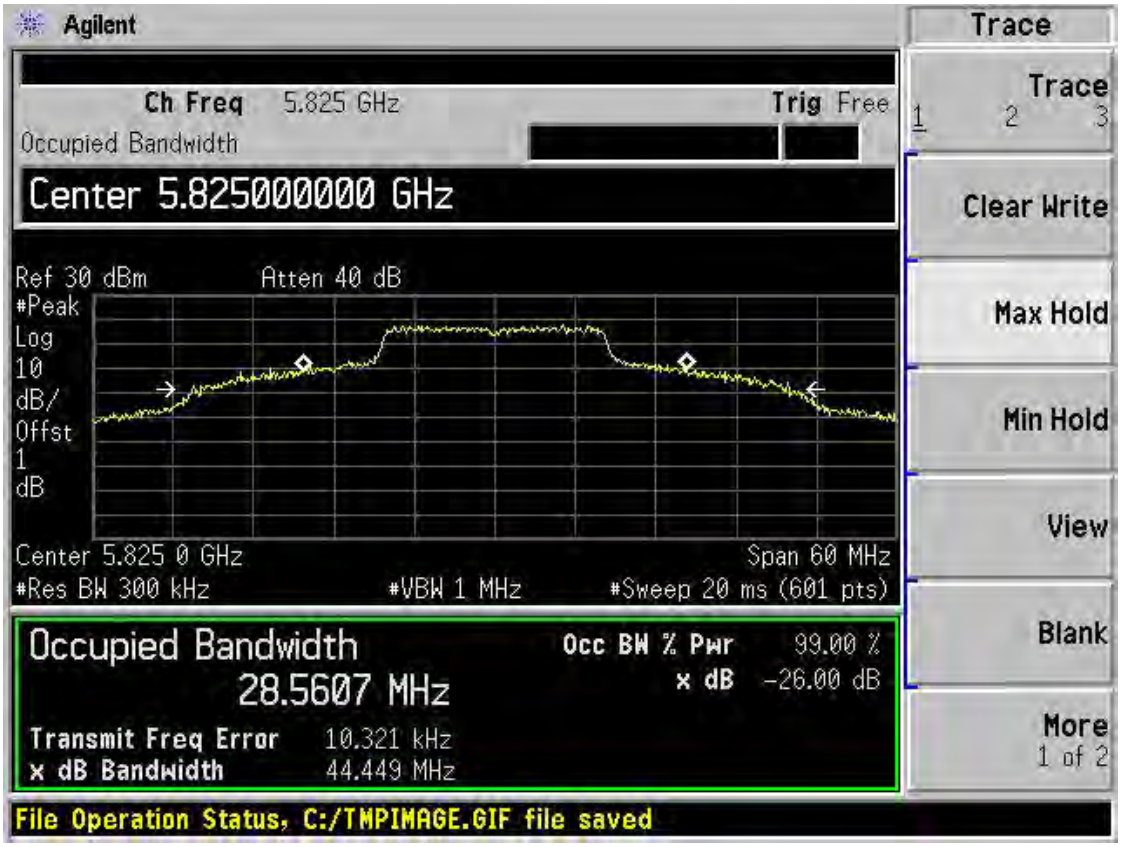
Band IV 11a CH149 Chain 2



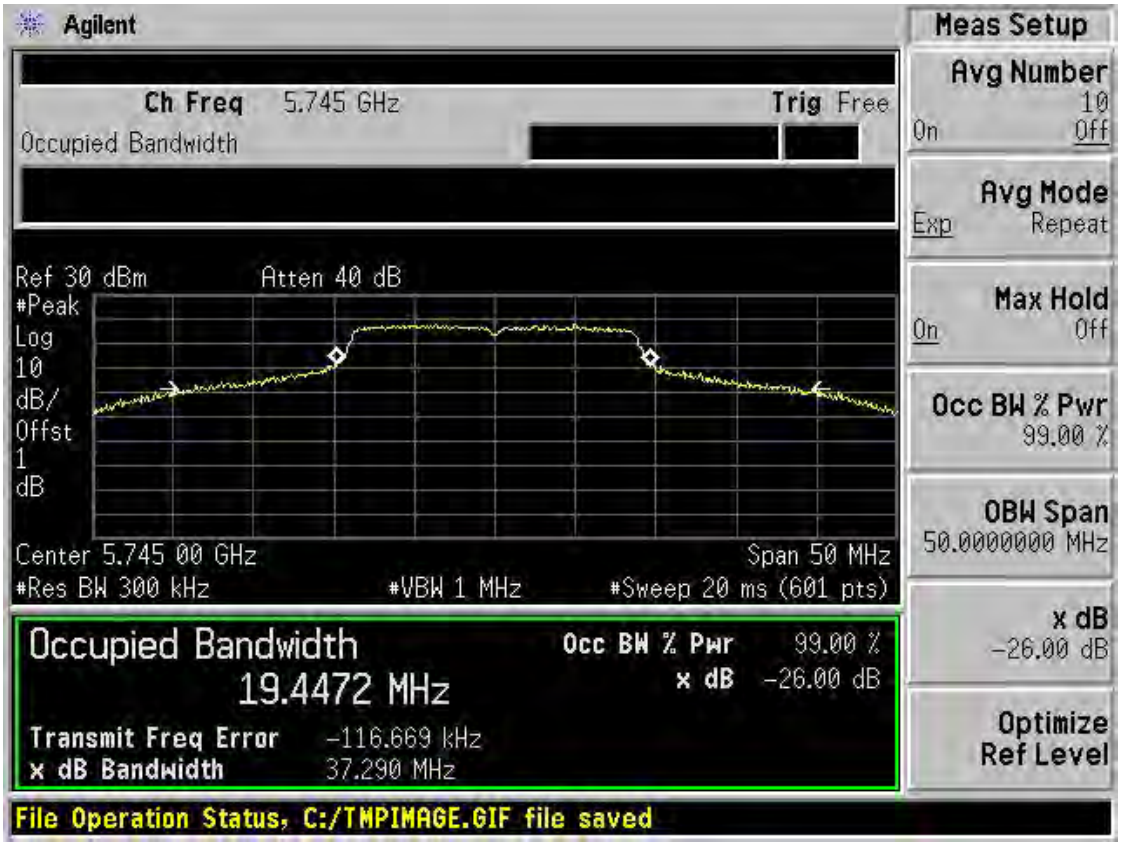
Band IV 11a CH157 Chain 2



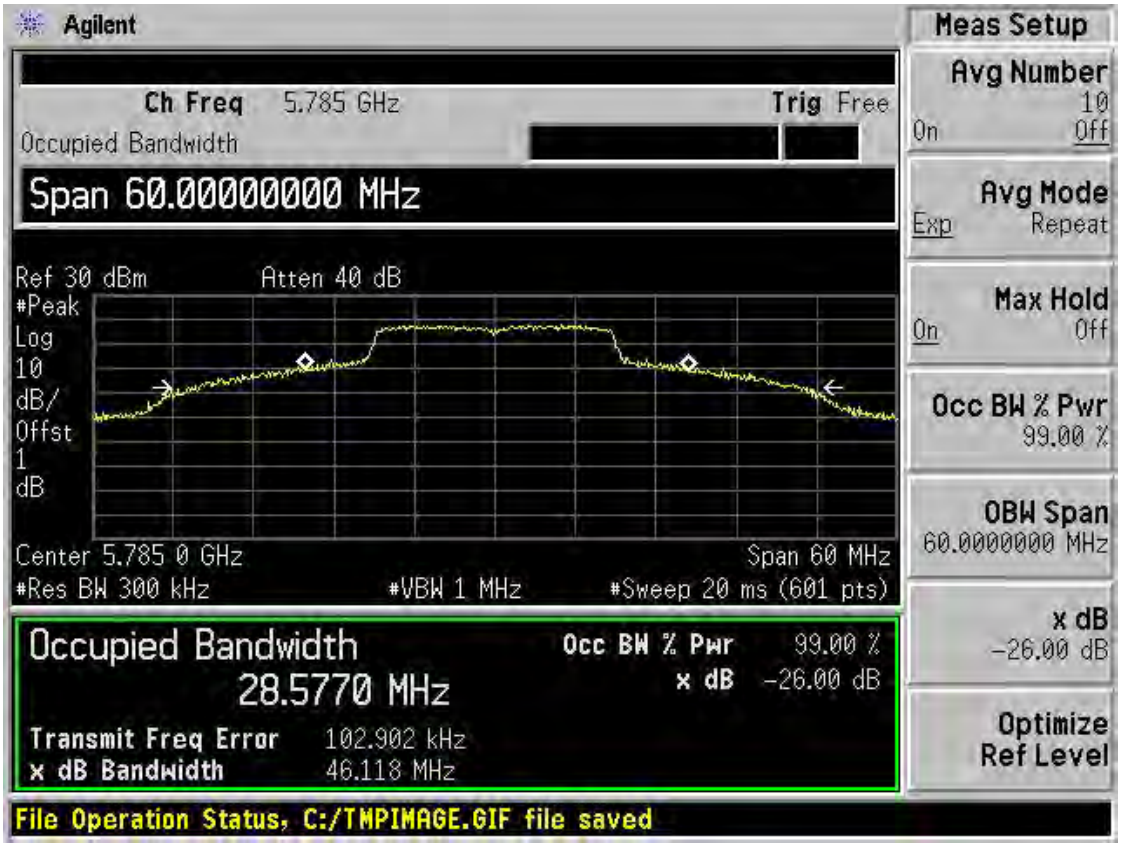
Band IV 11a CH165 Chain 2



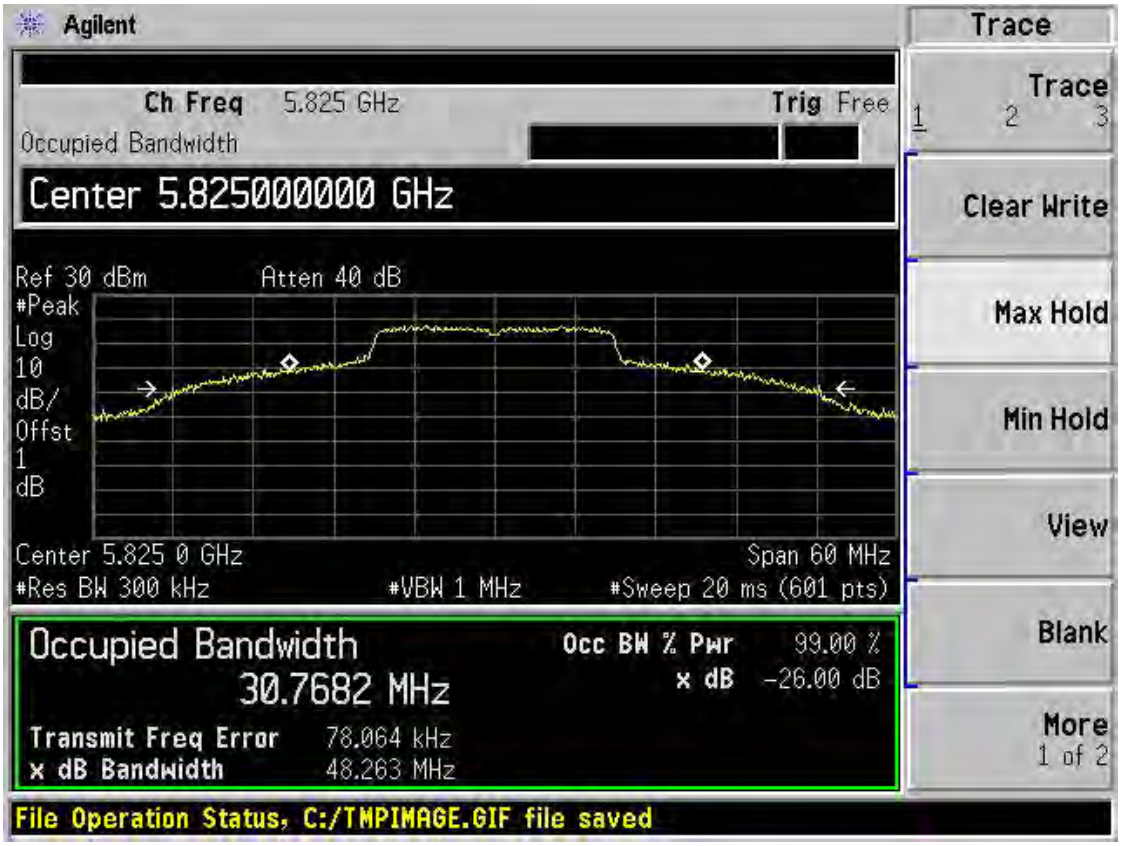
Band IV 11n(HT20) CH149 Chain 2



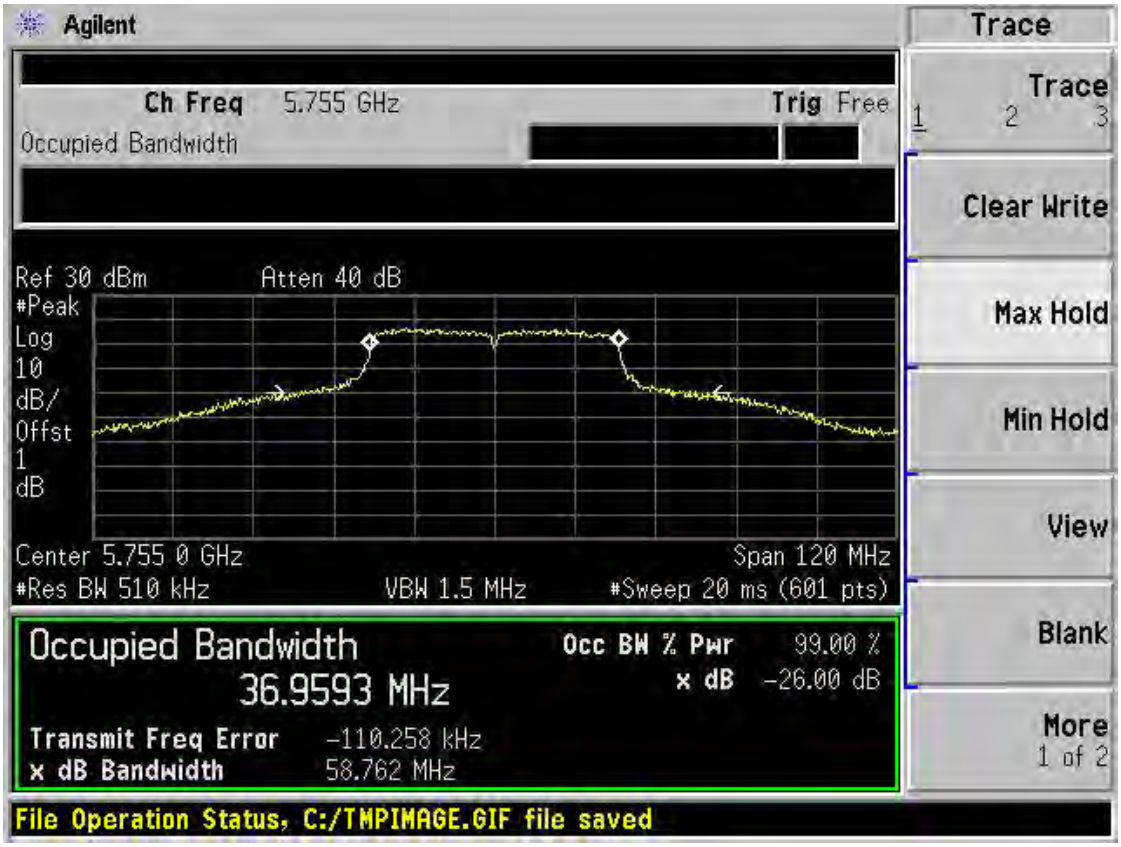
Band IV 11n(HT20) CH157 Chain 2



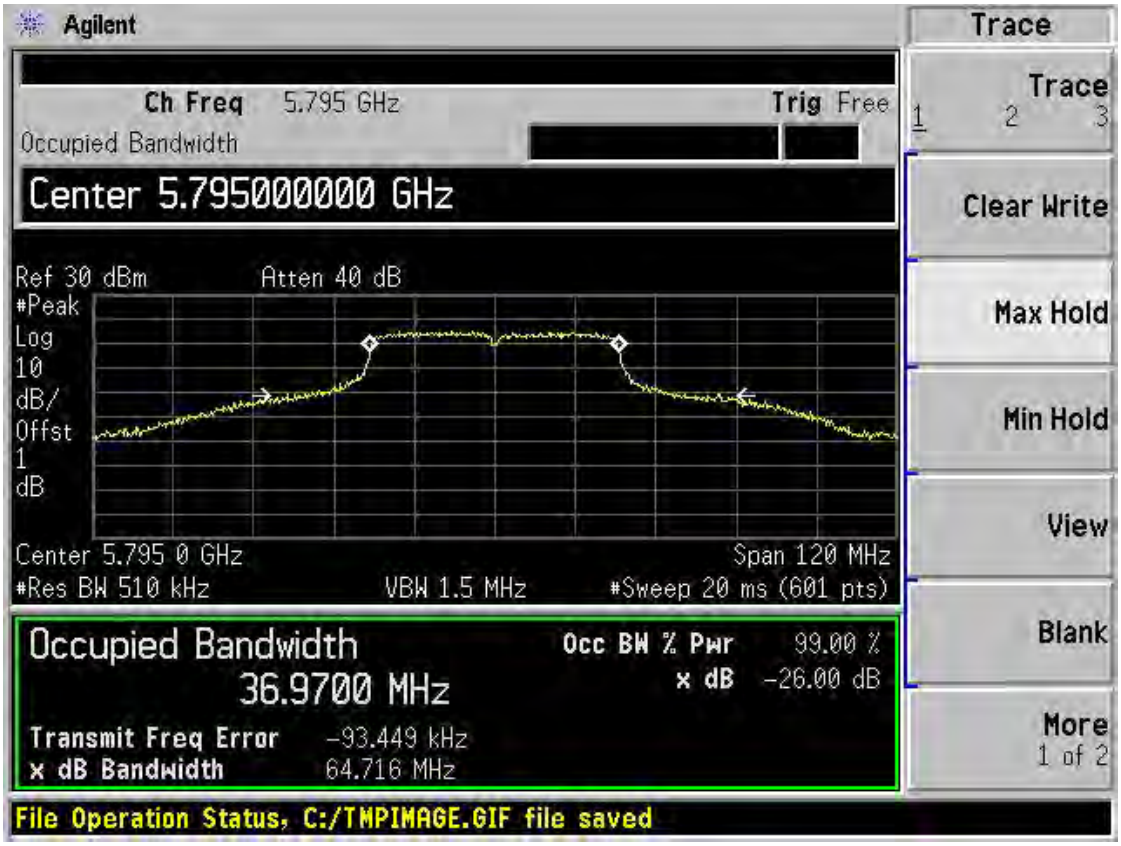
Band IV 11n(HT20) CH165 Chain 2



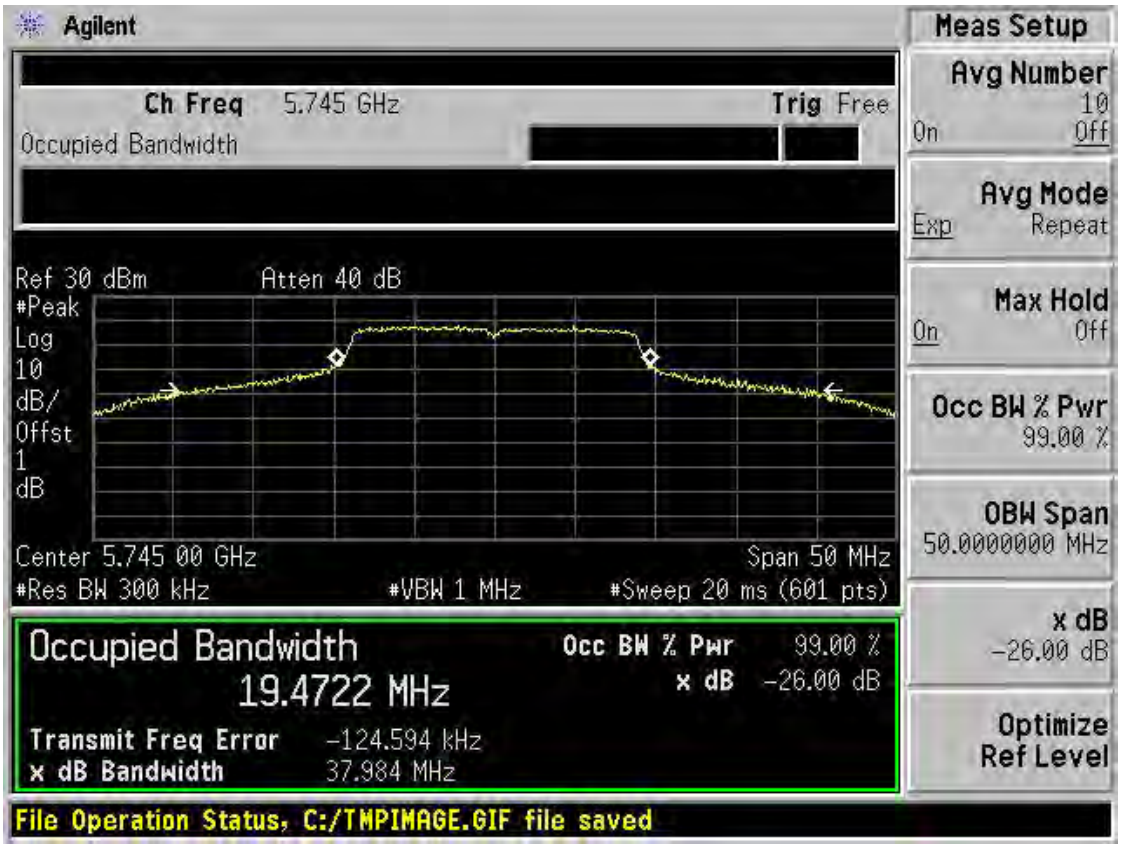
Band IV 11n(HT40) CH151 Chain 2



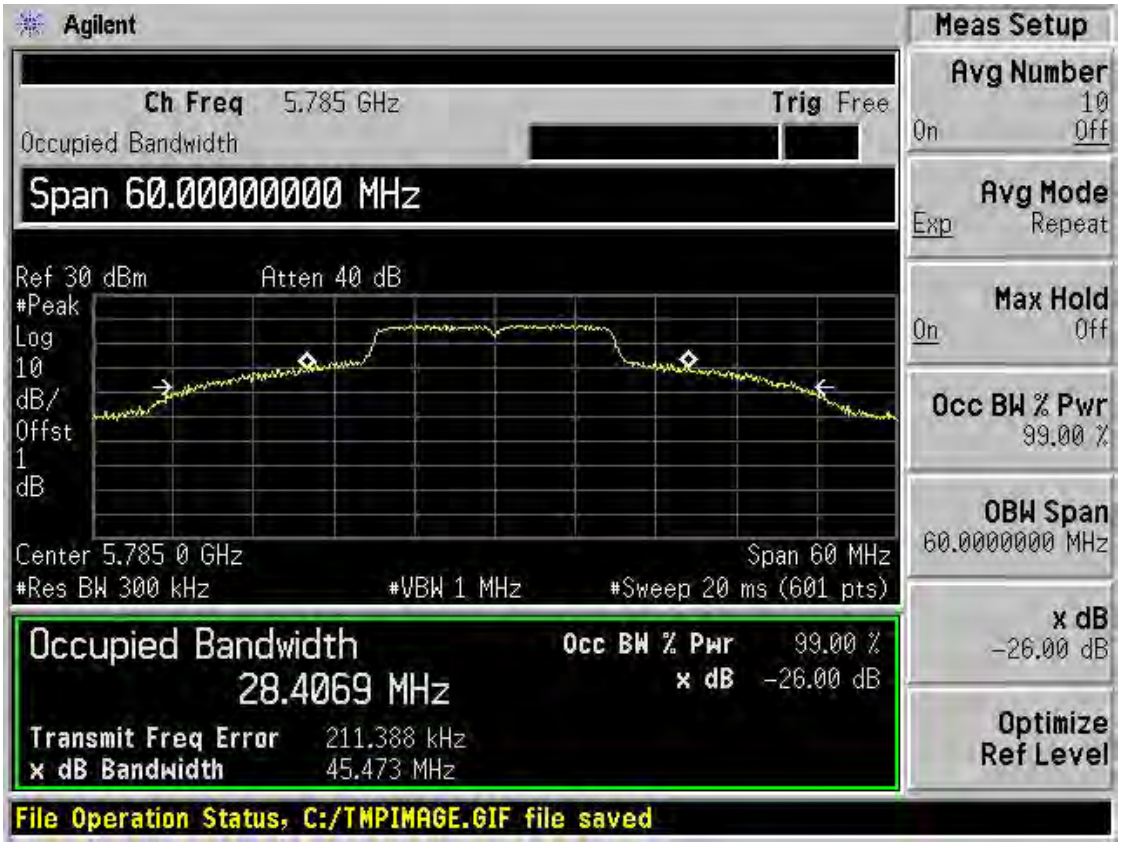
Band IV 11n(HT40) CH159 Chain 2



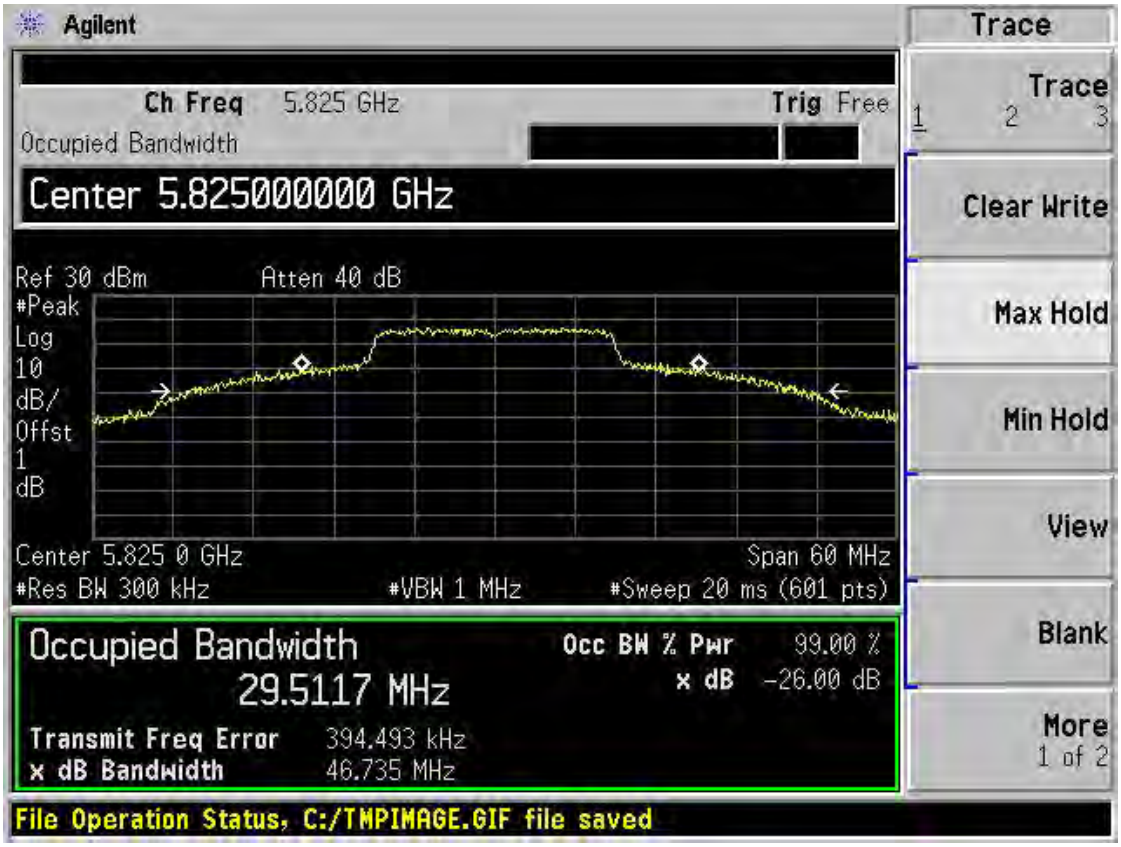
Band IV 11ac(HT20) CH149 Chain 2



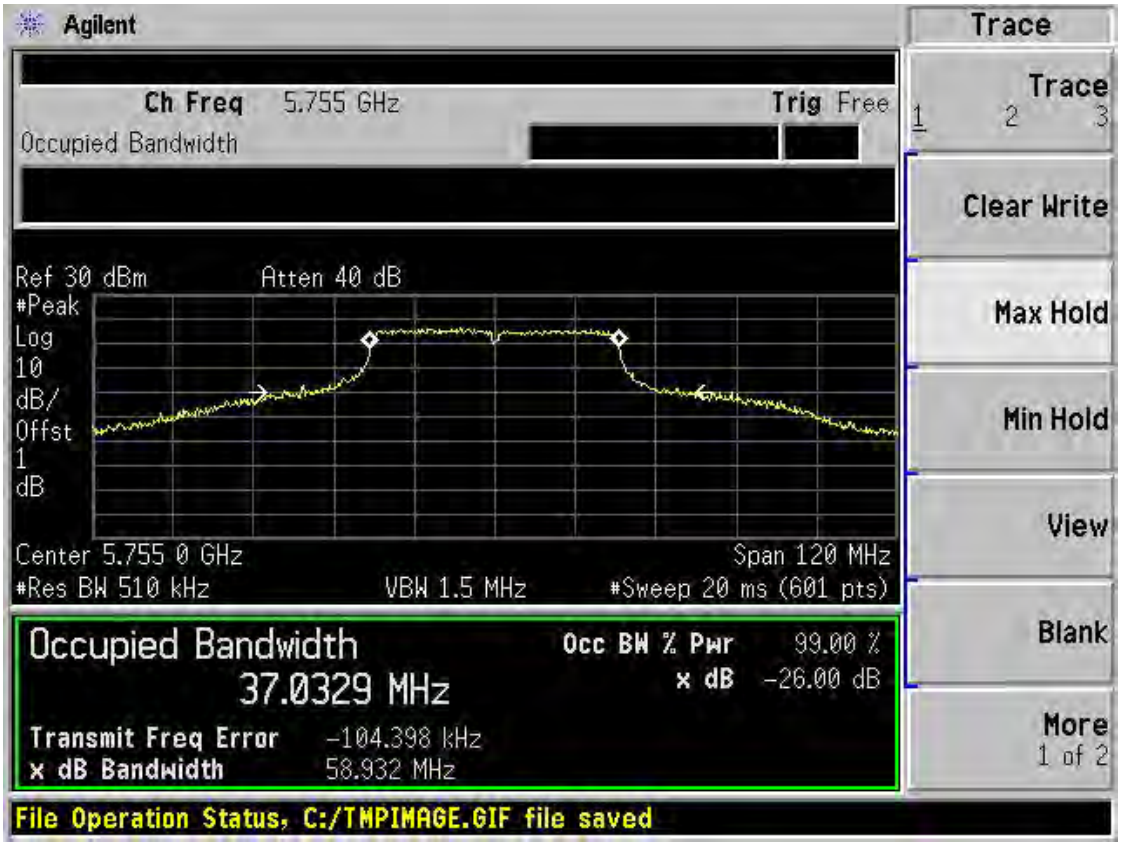
Band IV 11ac(HT20) CH157 Chain 2



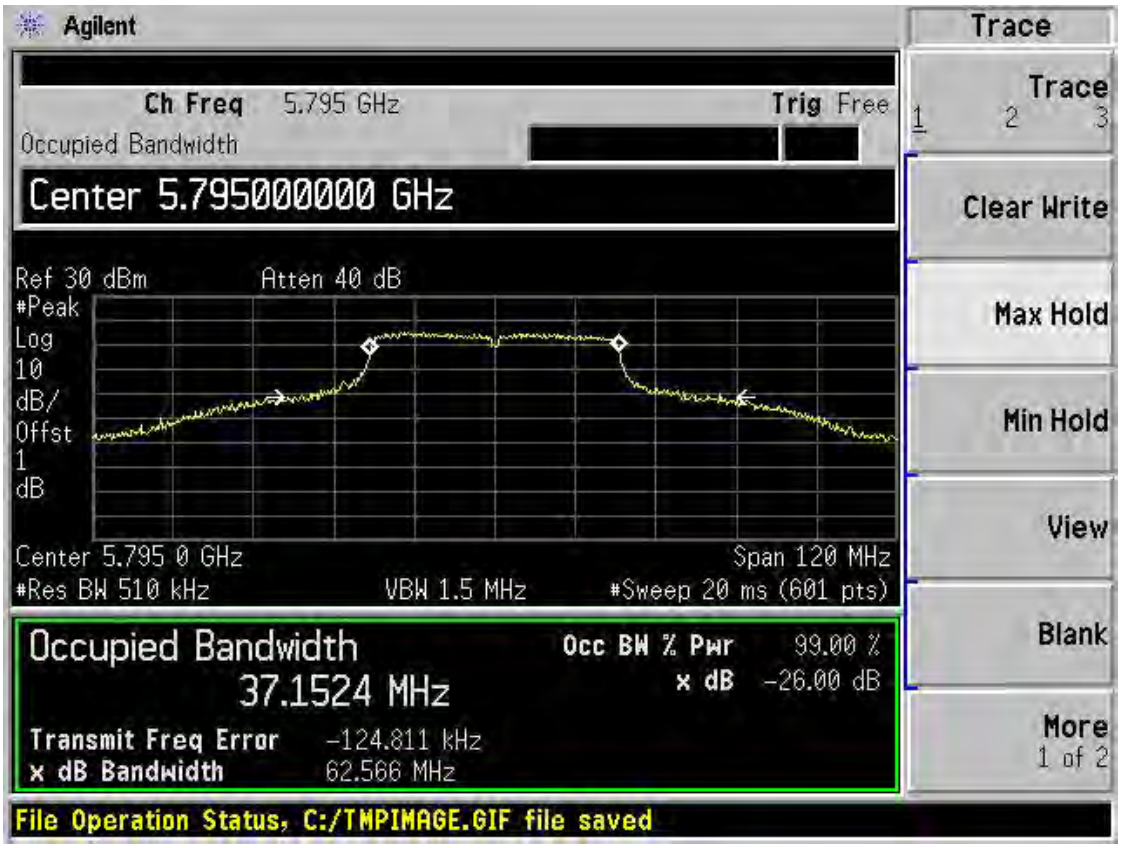
Band IV 11ac(HT20) CH165 Chain 2



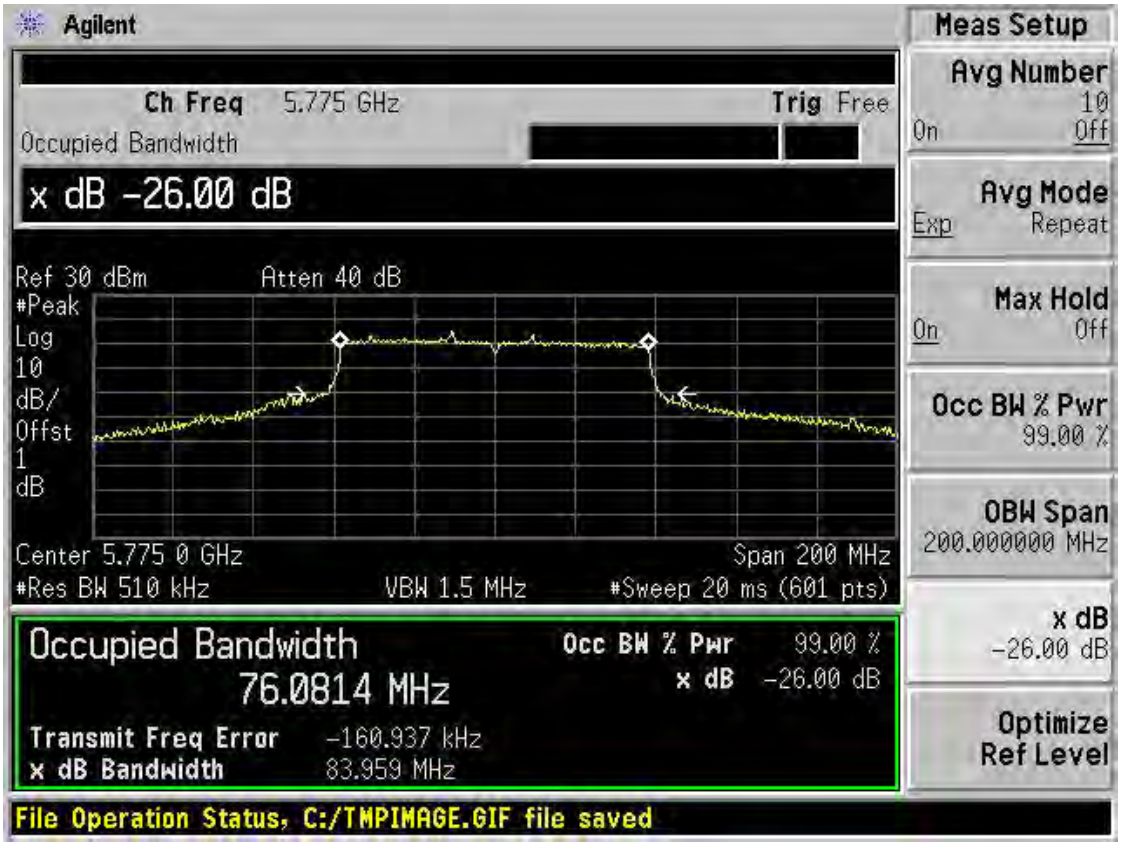
Band IV 11ac(HT40) CH151 Chain 2



Band IV 11ac(HT40) CH159 Chain 2



Band IV 11ac(HT80) CH155 Chain 2



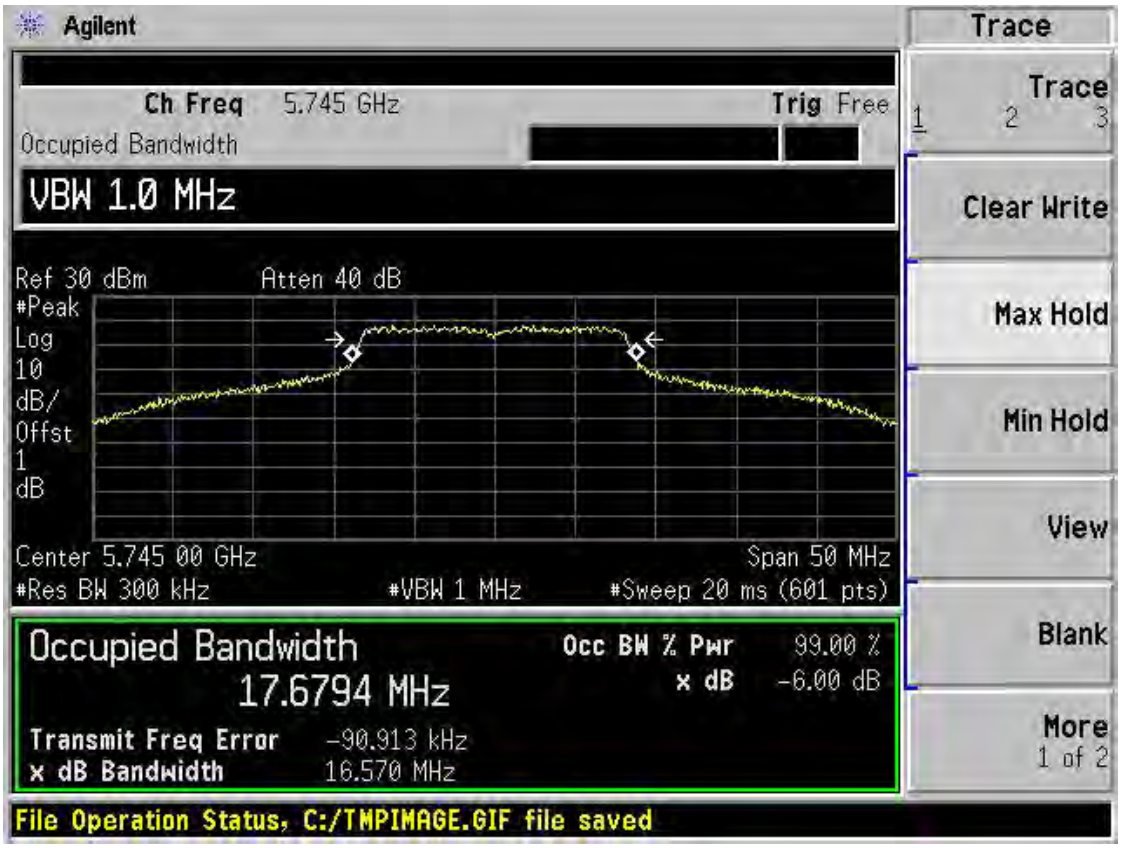
A.3 6 dB Bandwidth

Test Data

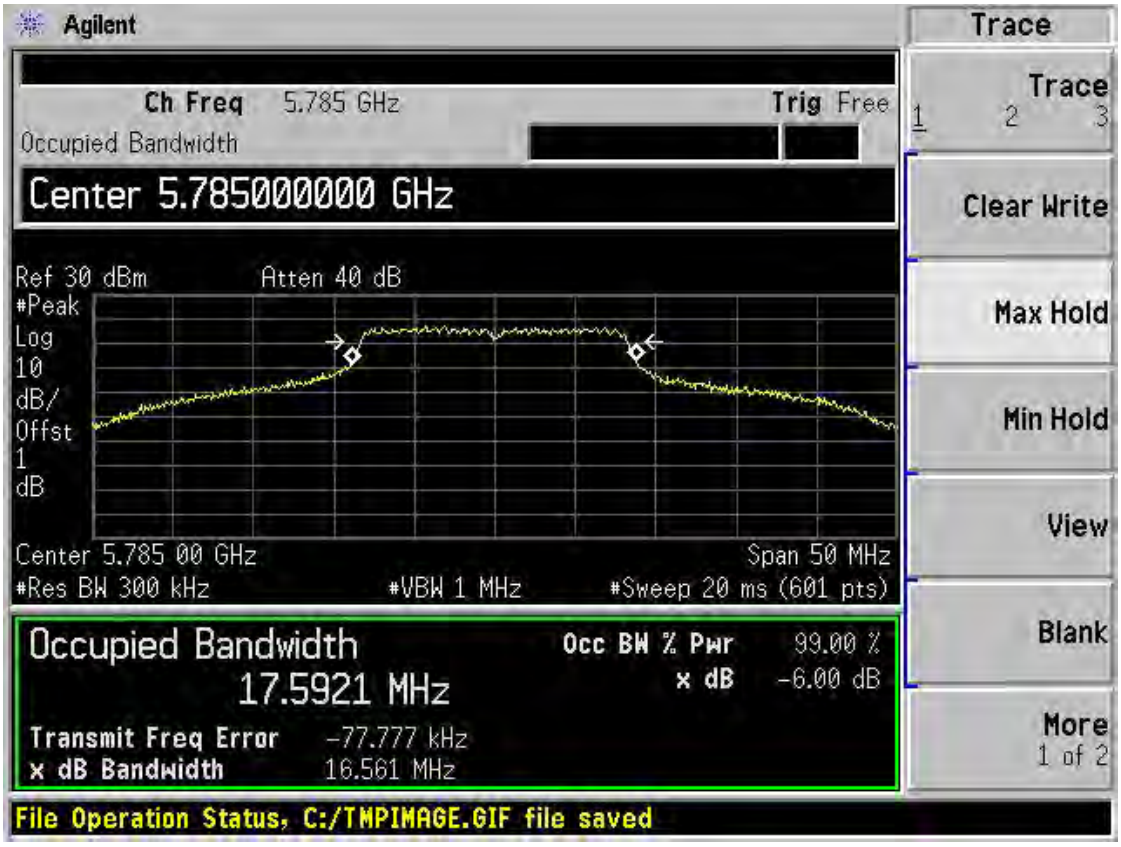
Band IV (3 dBi Antenna & 18 dBi Antenna & 23 dBi Antenna)						
Mode	Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Limit (MHz)	Verdict
			Chain 1	Chain 2		
11a	CH149	5745	16.570	16.579	0.5	Pass
11a	CH157	5785	16.561	16.568	0.5	Pass
11a	CH165	5825	18.538	16.510	0.5	Pass
11n (HT20)	CH149	5745	17.754	17.768	0.5	Pass
11n (HT20)	CH157	5785	17.738	17.687	0.5	Pass
11n (HT20)	CH165	5825	17.779	17.727	0.5	Pass
11n (HT40)	CH151	5755	36.646	36.518	0.5	Pass
11n (HT40)	CH159	5795	36.510	36.609	0.5	Pass
11ac (HT20)	CH149	5745	17.769	17.783	0.5	Pass
11ac (HT20)	CH157	5785	17.728	17.668	0.5	Pass
11ac (HT20)	CH165	5825	17.800	17.772	0.5	Pass
11ac (HT40)	CH151	5755	36.549	36.594	0.5	Pass
11ac (HT40)	CH159	5795	36.655	36.482	0.5	Pass
11ac (HT80)	CH155	5775	75.297	73.163	0.5	Pass

Test Plots

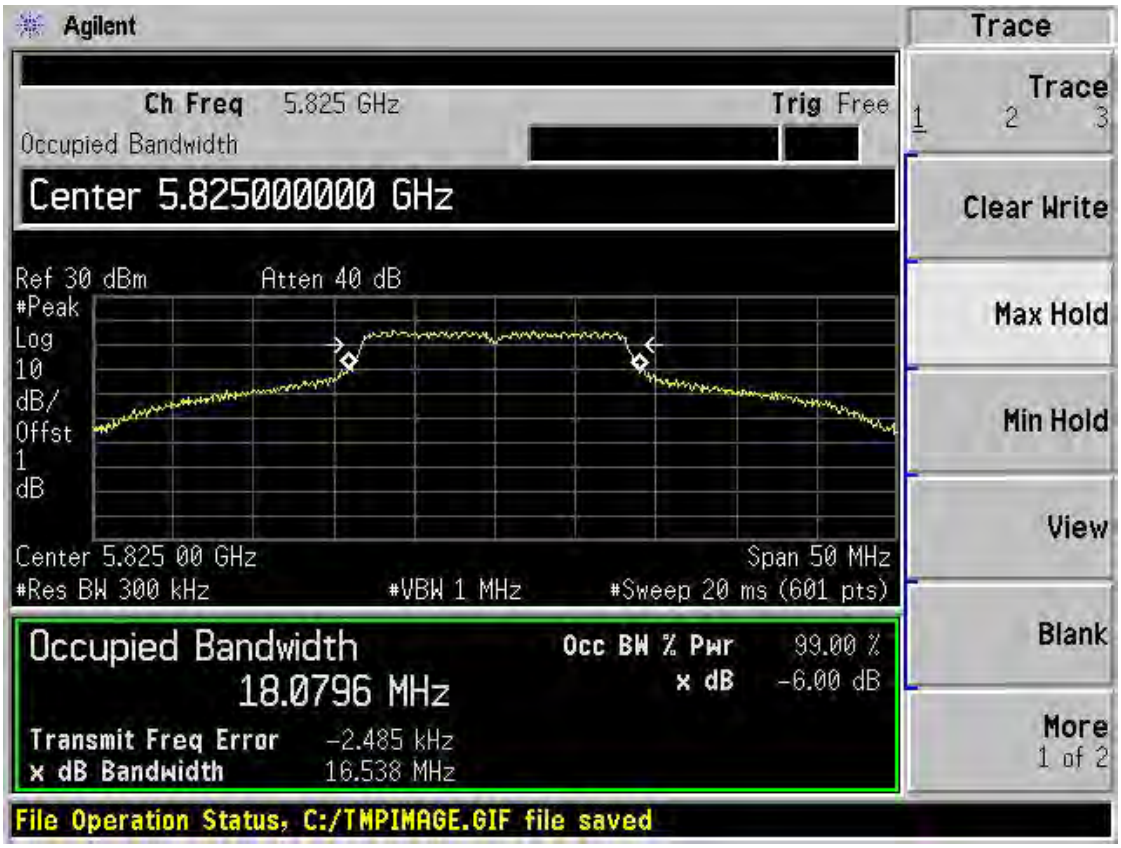
Band IV 11a CH149 Chain 1



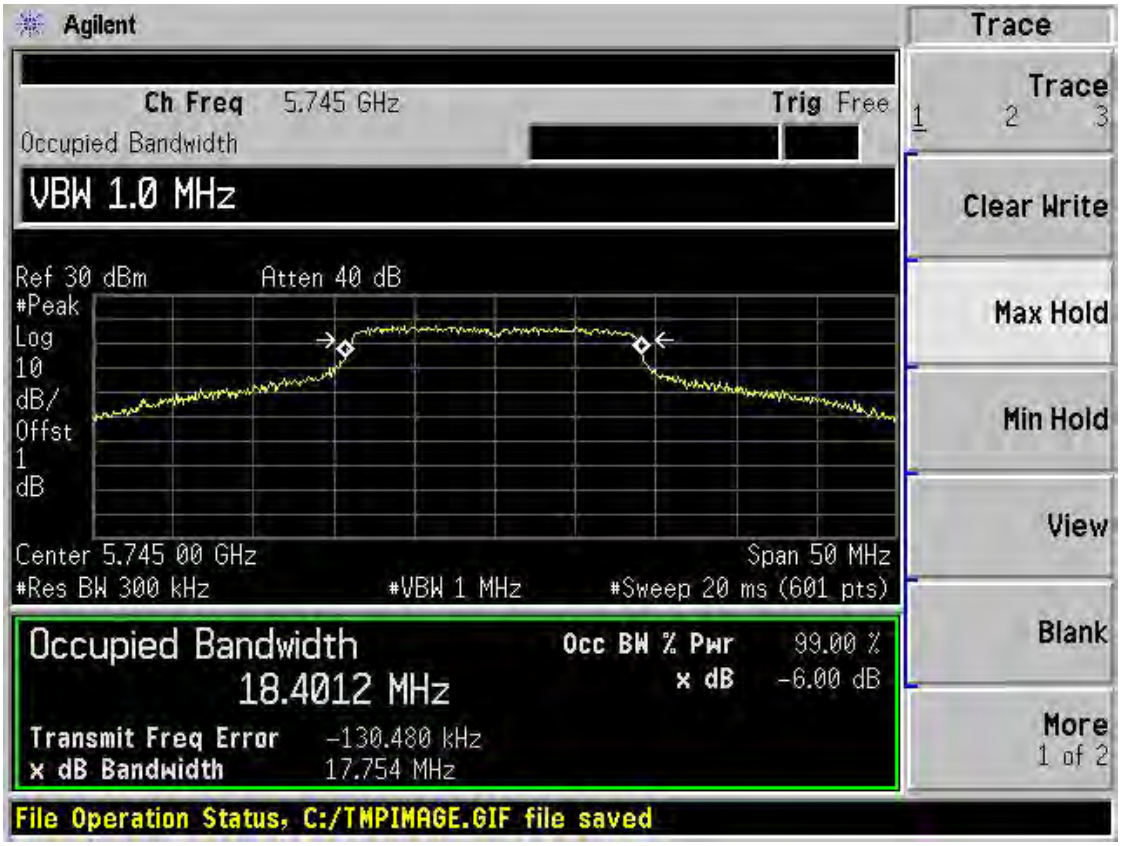
Band IV 11a CH157 Chain 1



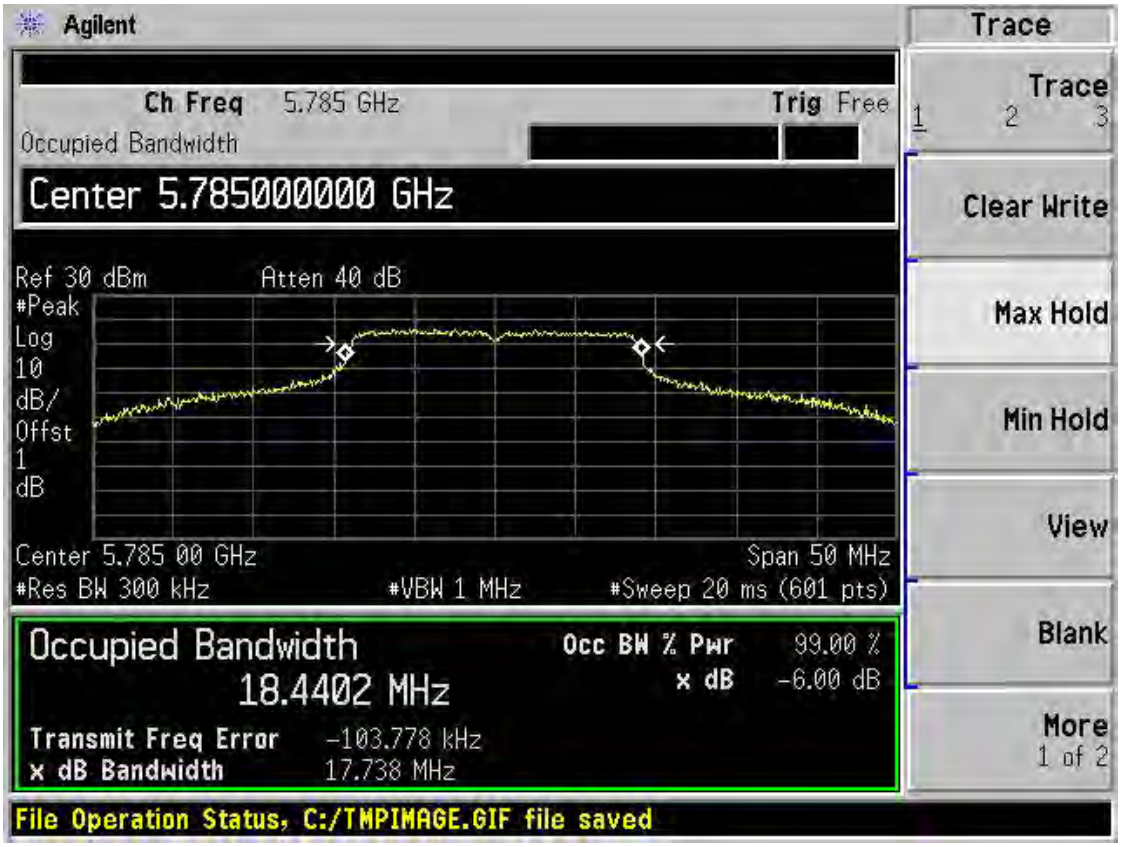
Band IV 11a CH165 Chain 1



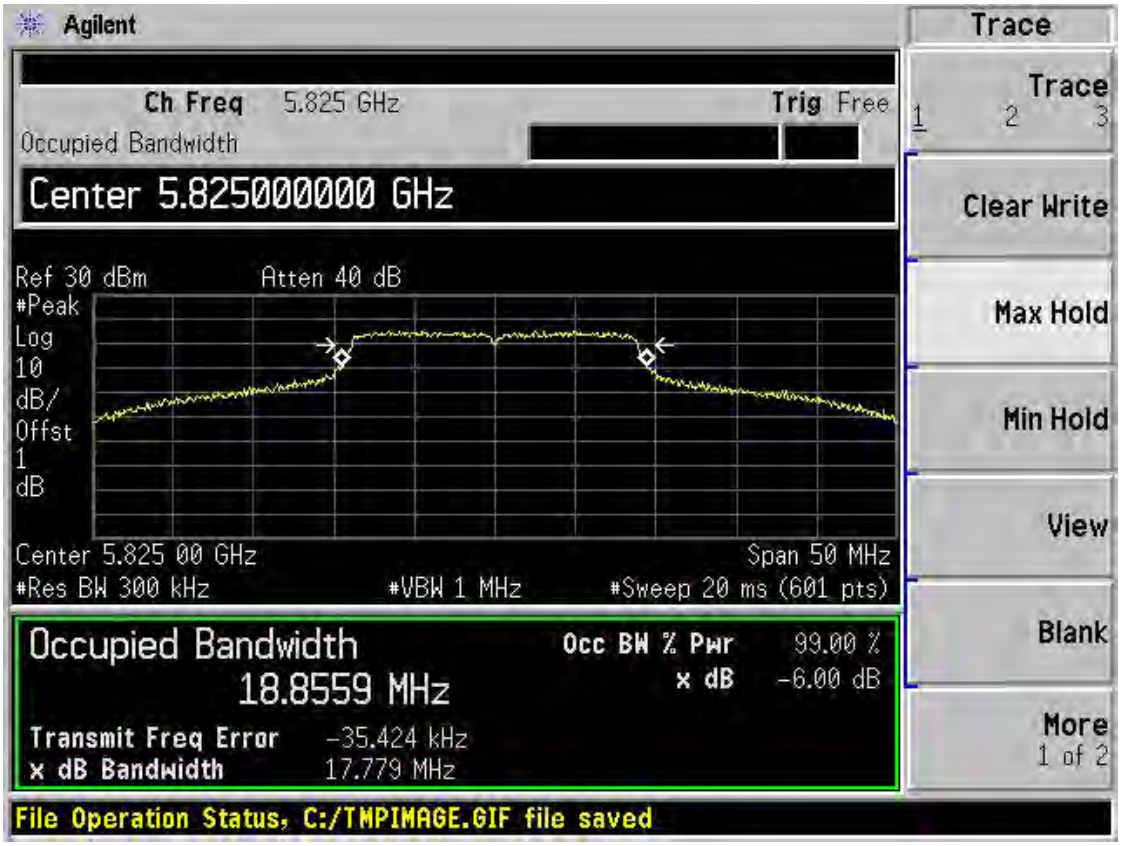
Band IV 11n(HT20) CH149 Chain 1



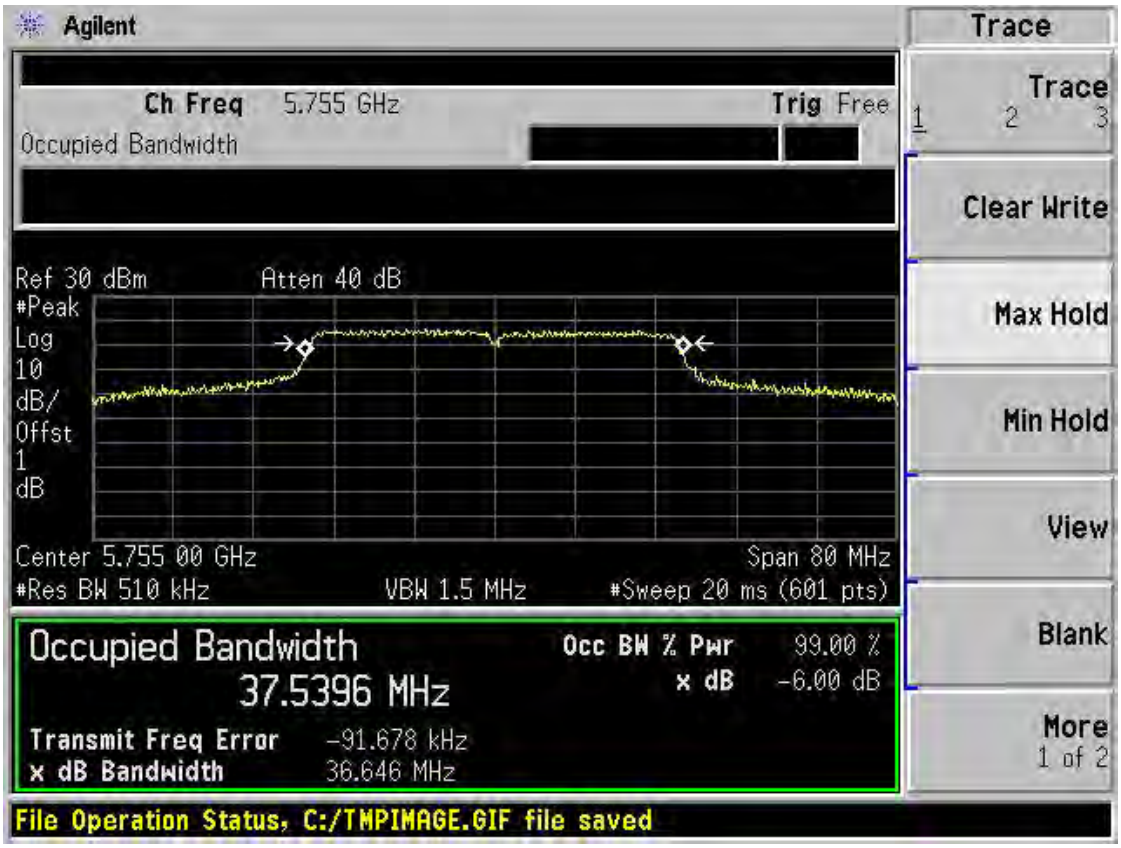
Band IV 11n(HT20) CH157 Chain 1



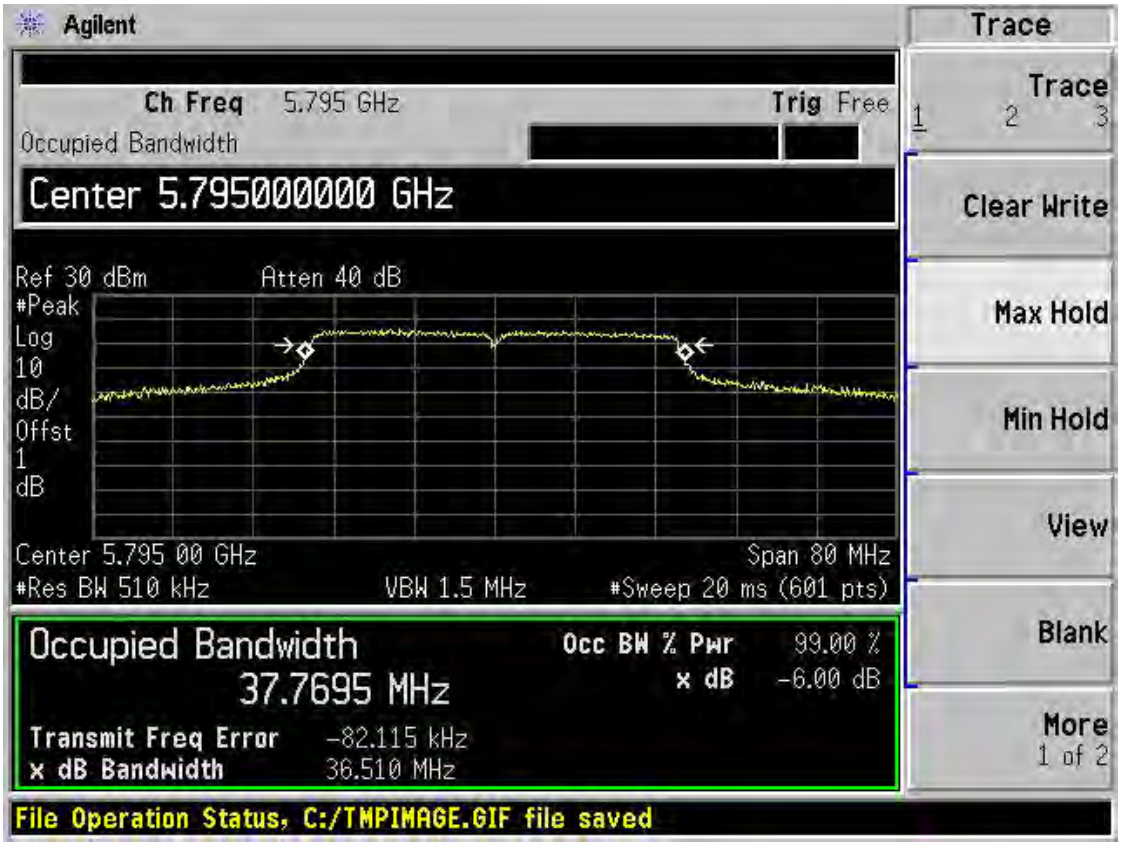
Band IV 11n(HT20) CH165 Chain 1



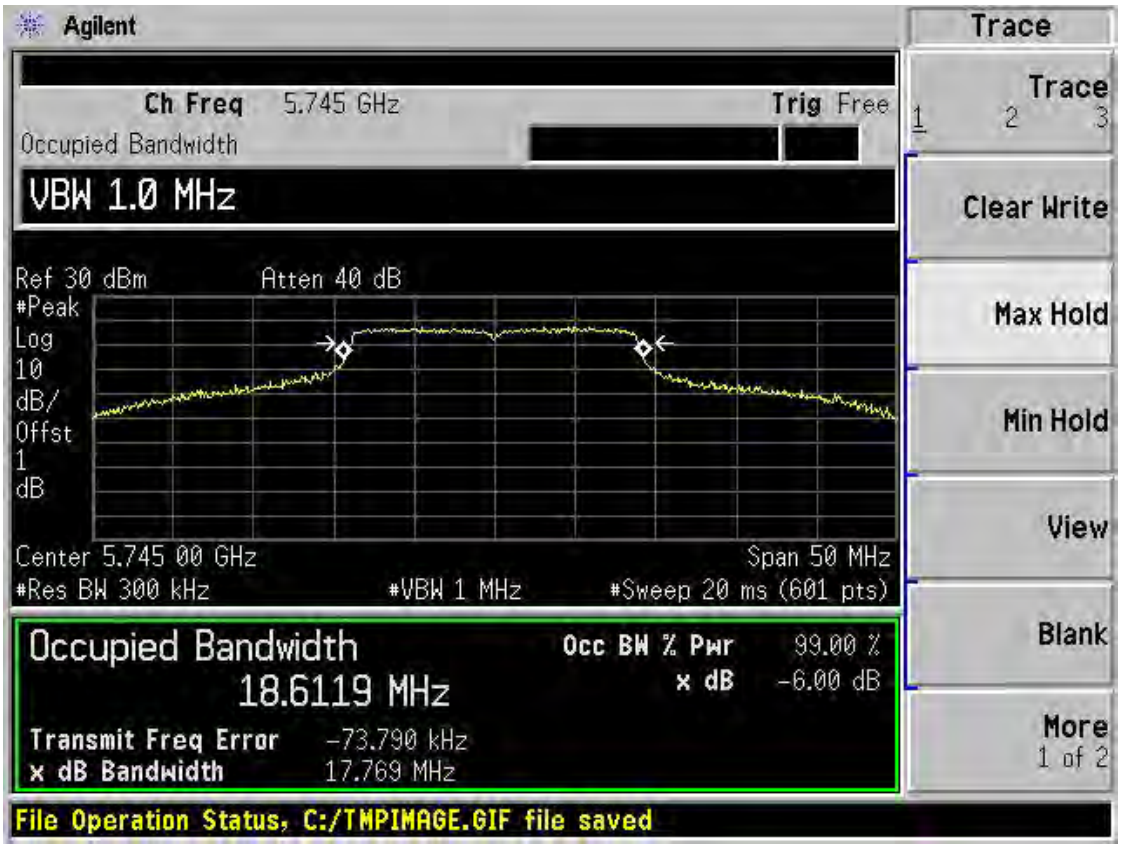
Band IV 11n(HT40) CH151 Chain 1



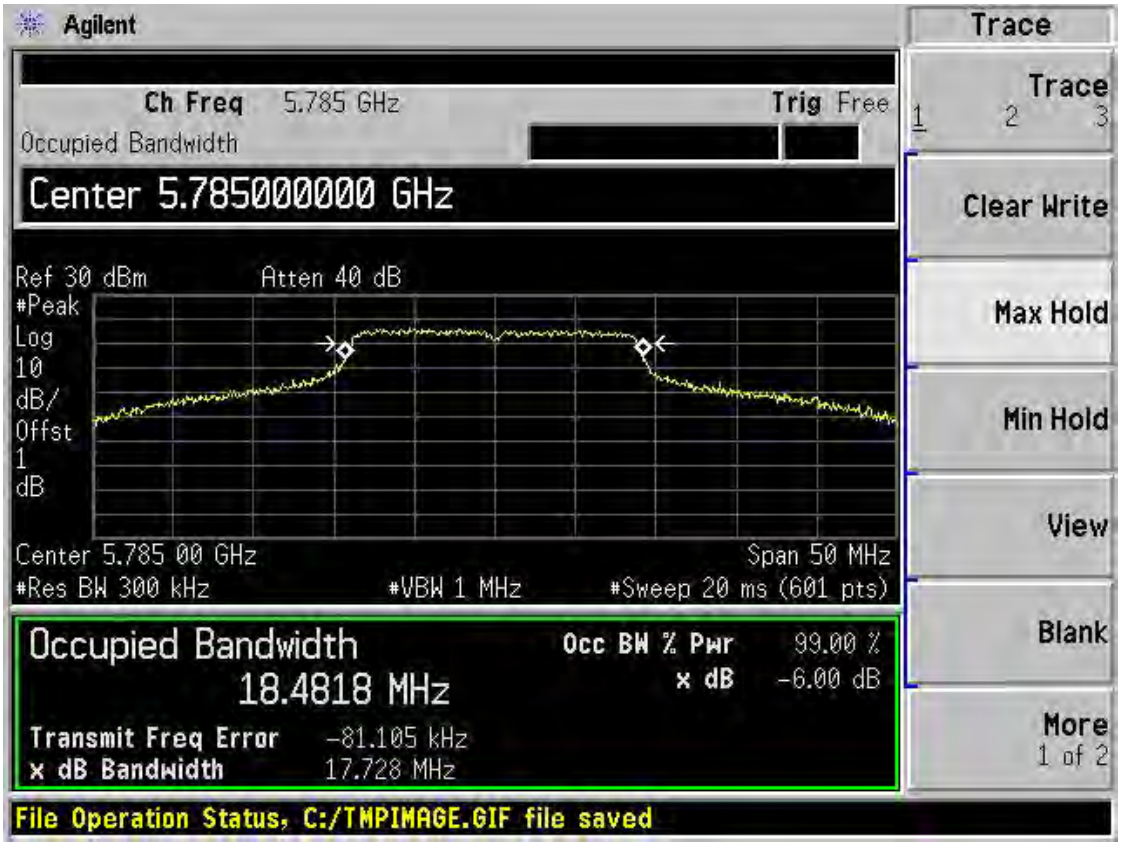
Band IV 11n(HT40) CH159 Chain 1



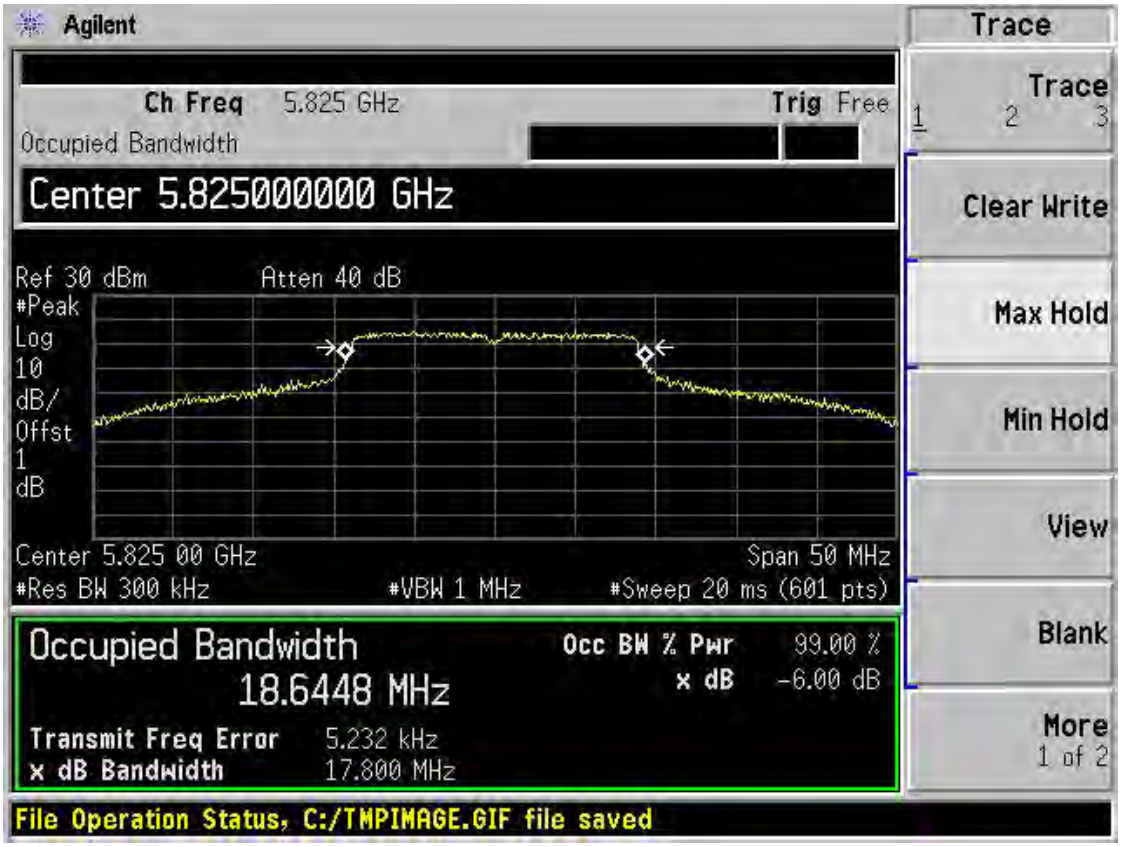
Band IV 11ac(HT20) CH149 Chain 1



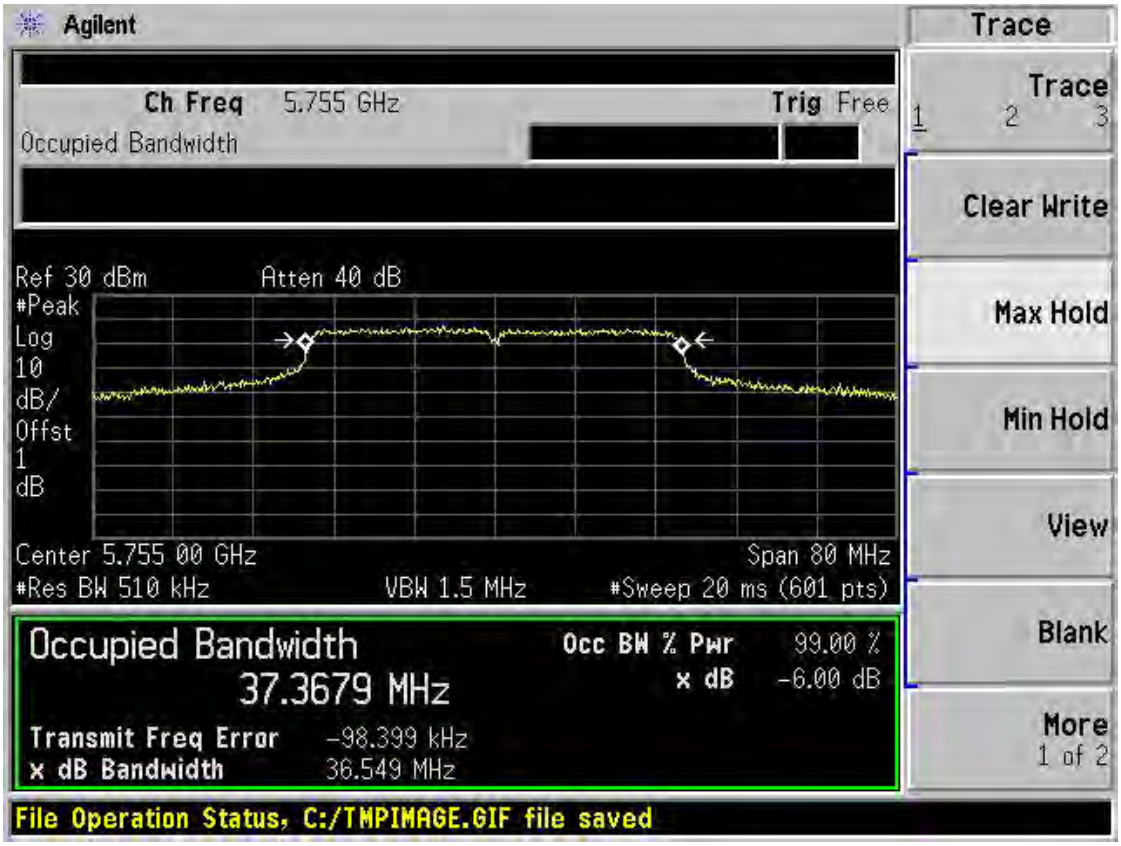
Band IV 11ac(HT20) CH157 Chain 1



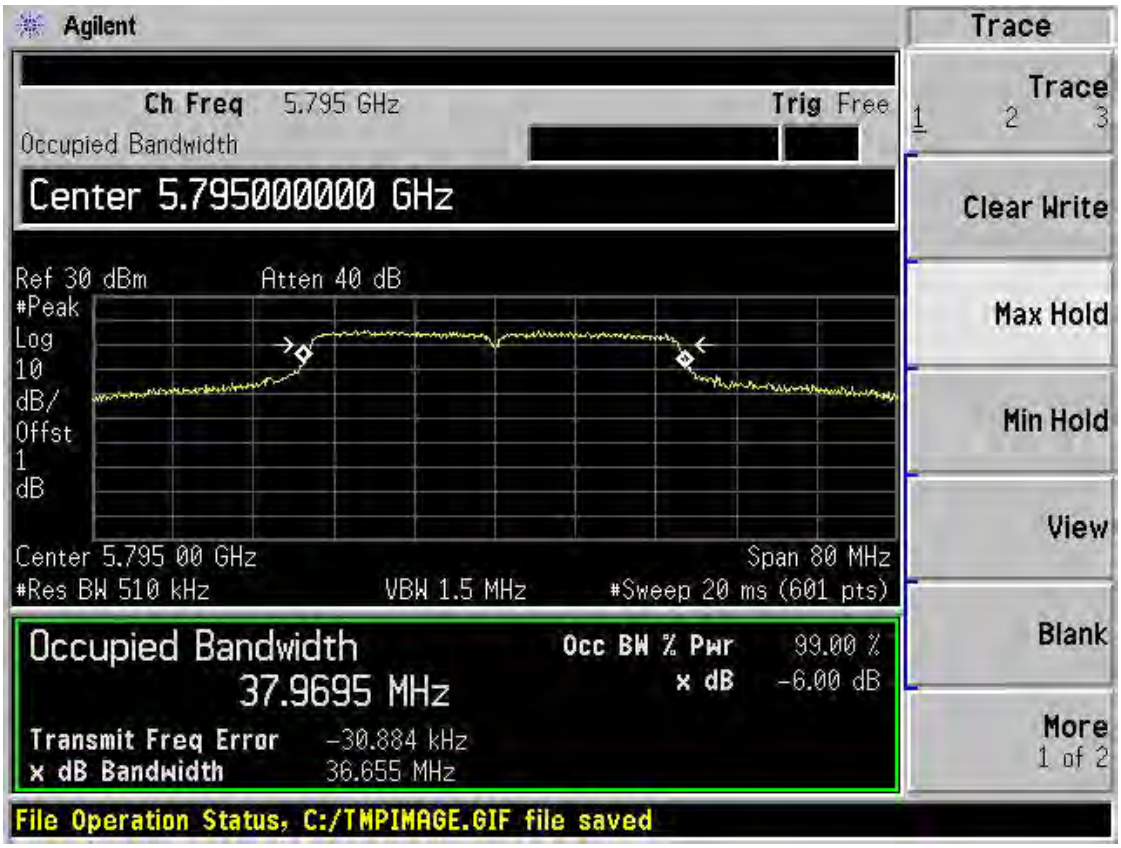
Band IV 11ac(HT20) CH165 Chain 1



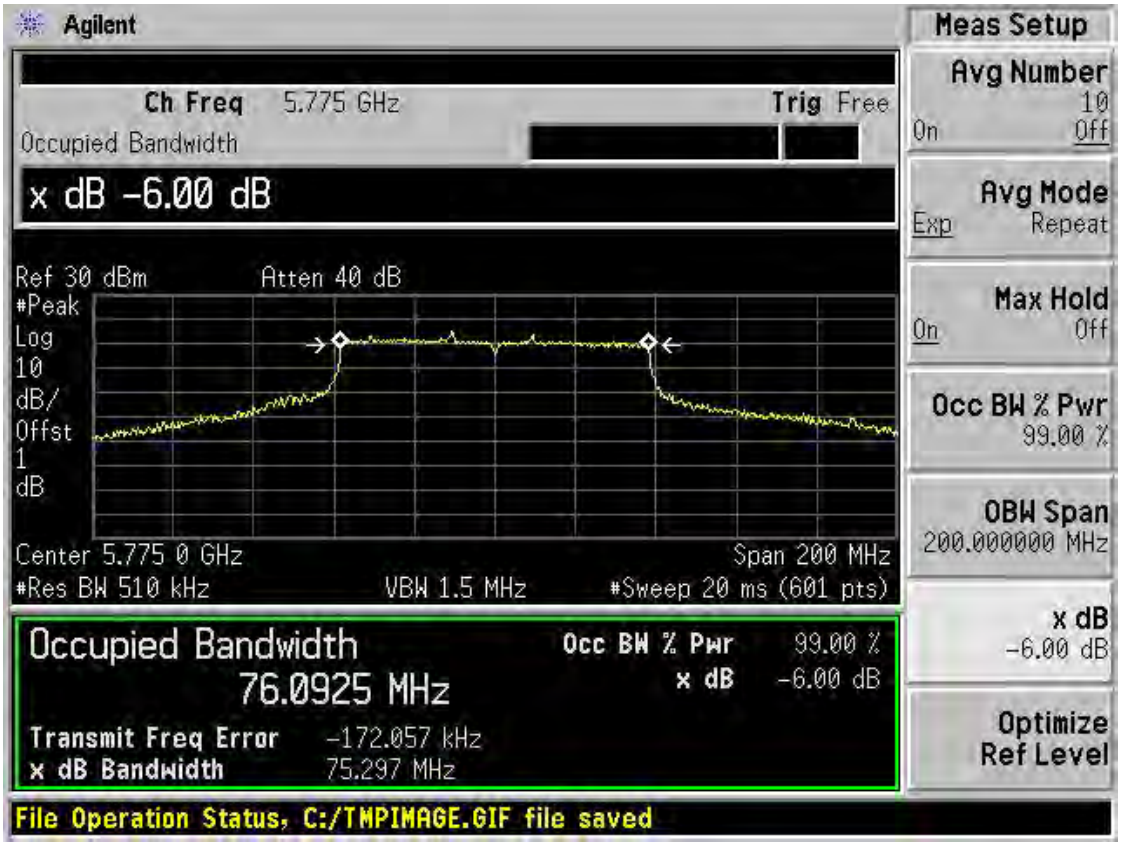
Band IV 11ac(HT40) CH151 Chain 1



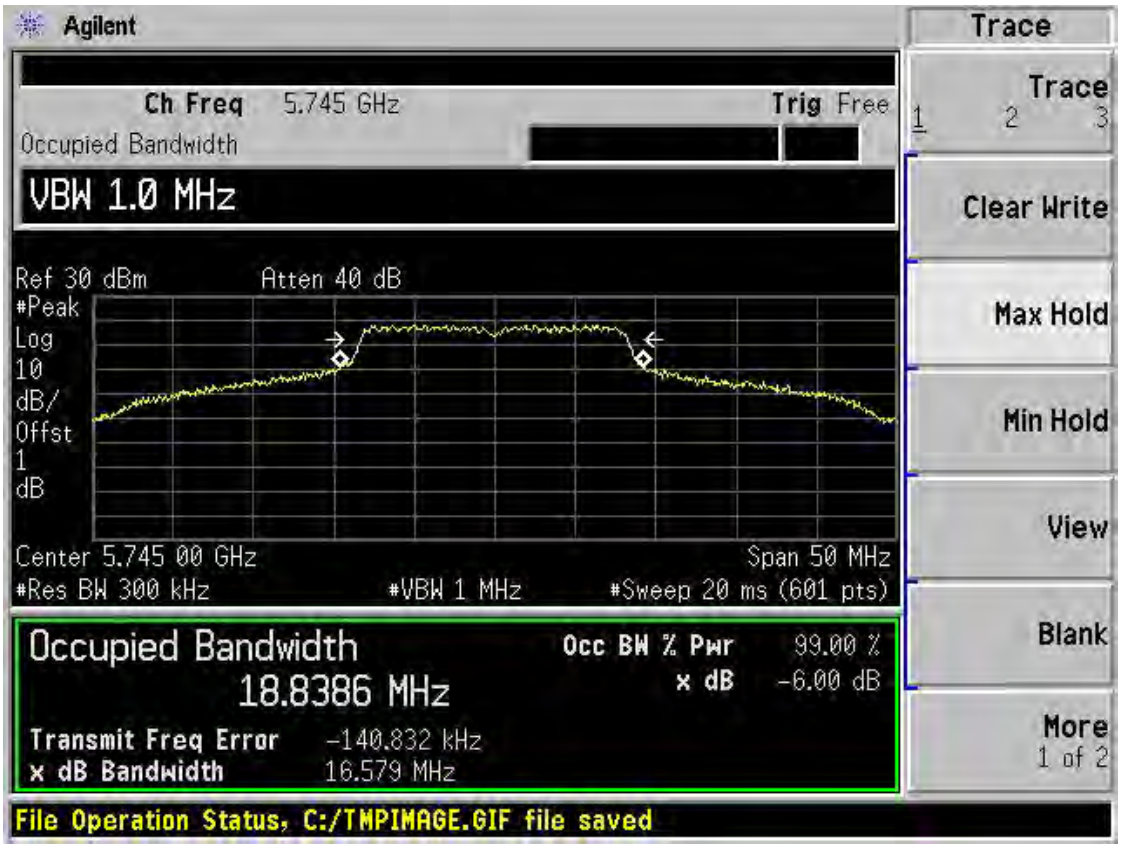
Band IV 11ac(HT40) CH159 Chain 1



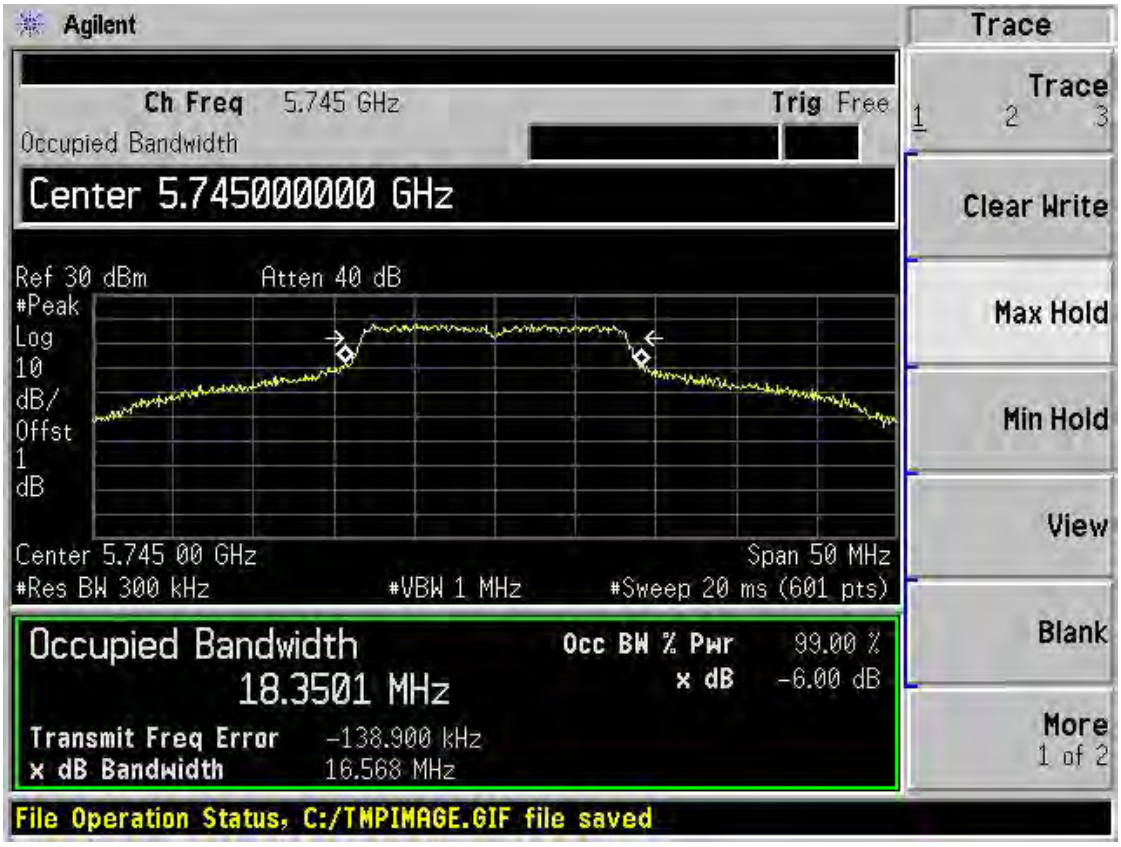
Band IV 11ac(HT80) CH155 Chain 1



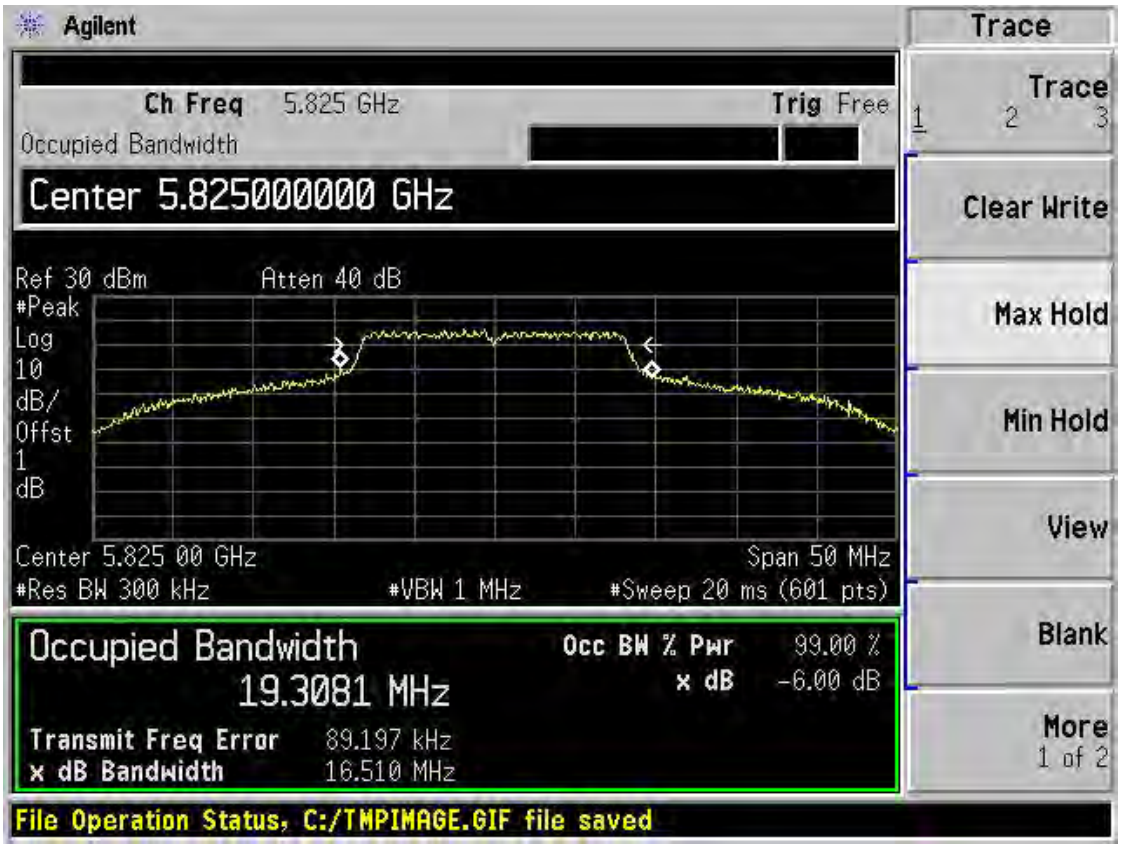
Band IV 11a CH149 Chain 2



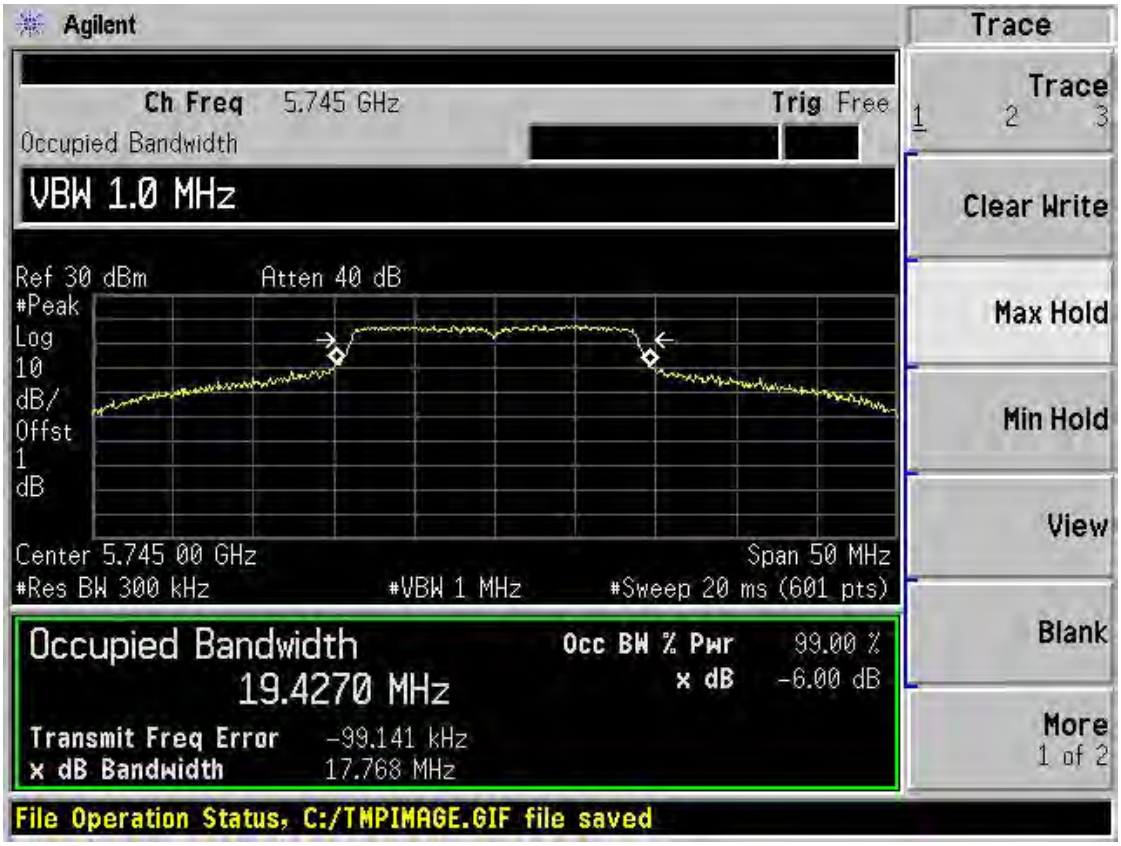
Band IV 11a CH157 Chain 2



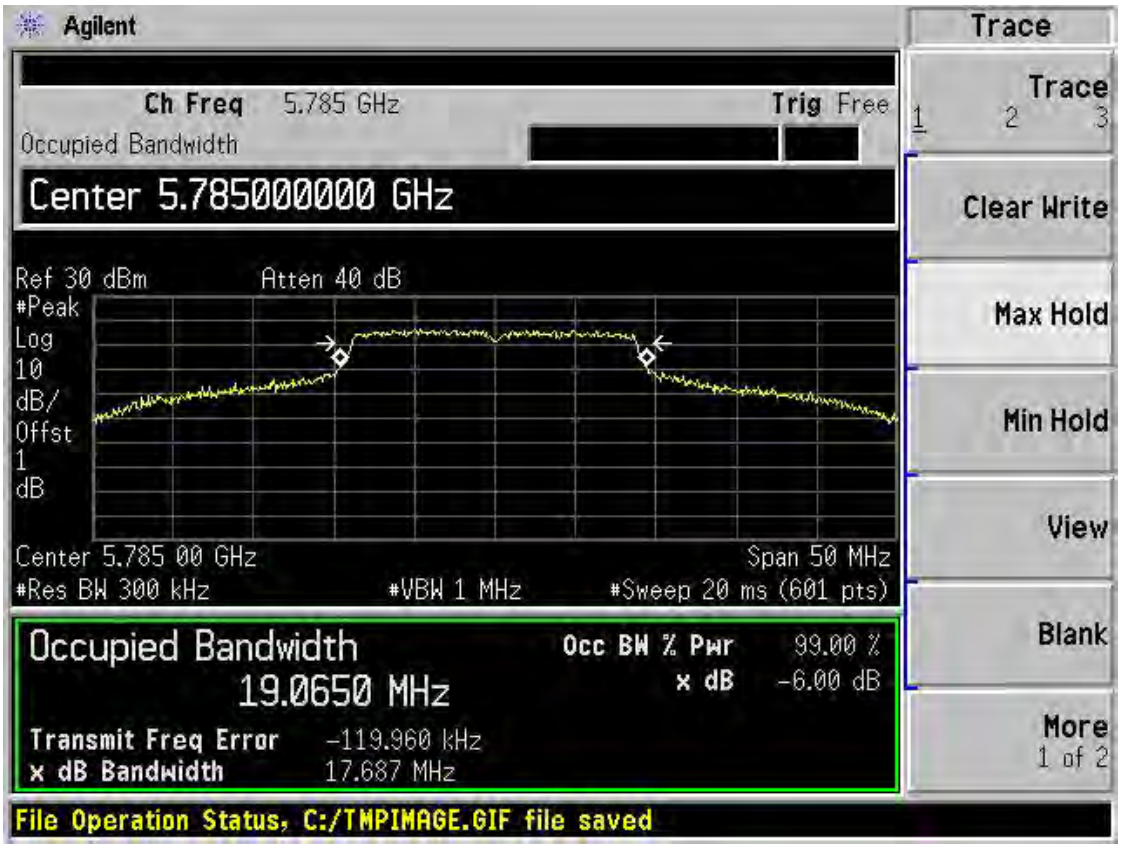
Band IV 11a CH165 Chain 2



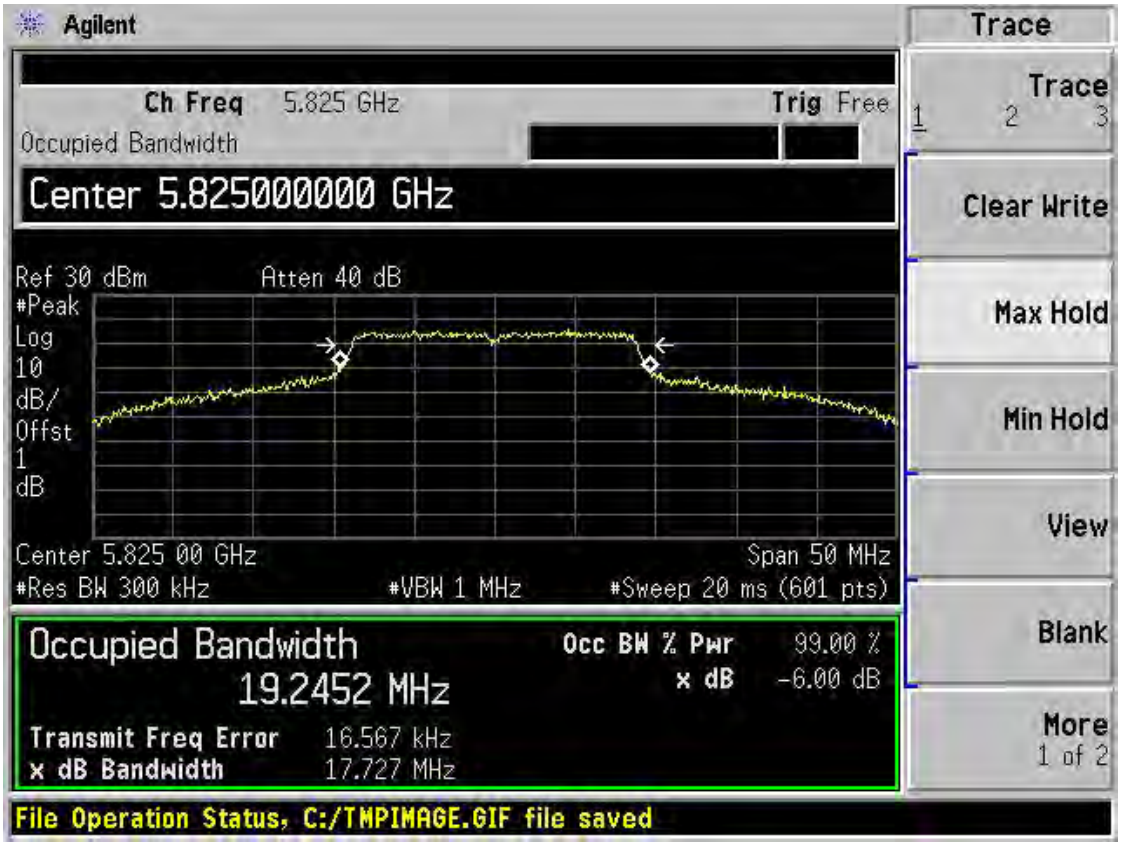
Band IV 11n(HT20) CH149 Chain 2



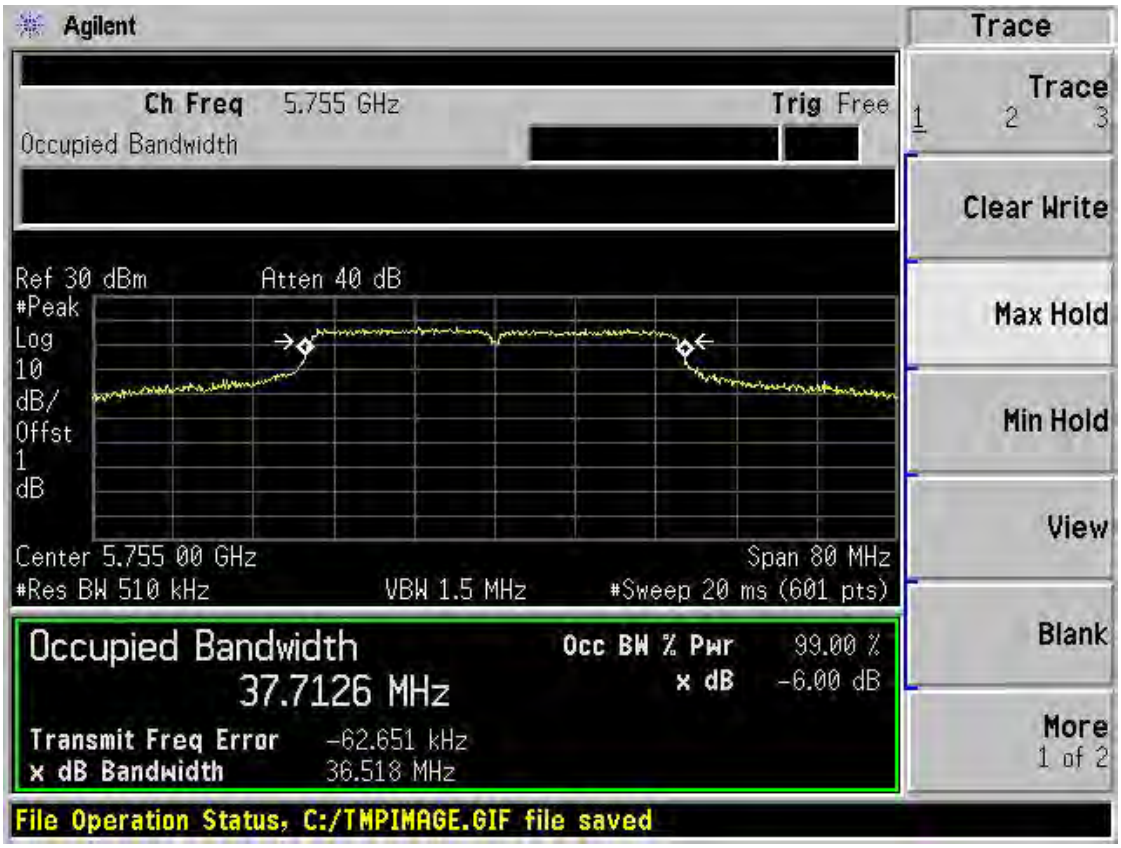
Band IV 11n(HT20) CH157 Chain 2



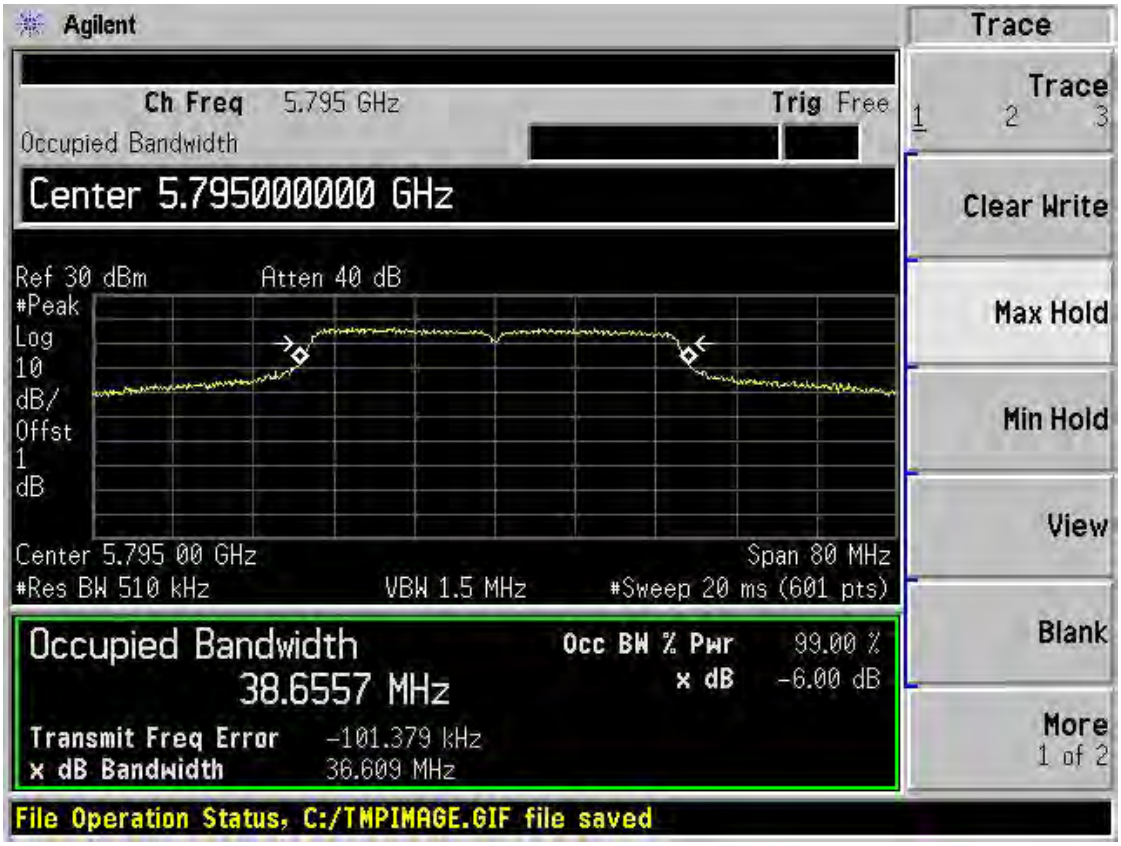
Band IV 11n(HT20) CH165 Chain 2



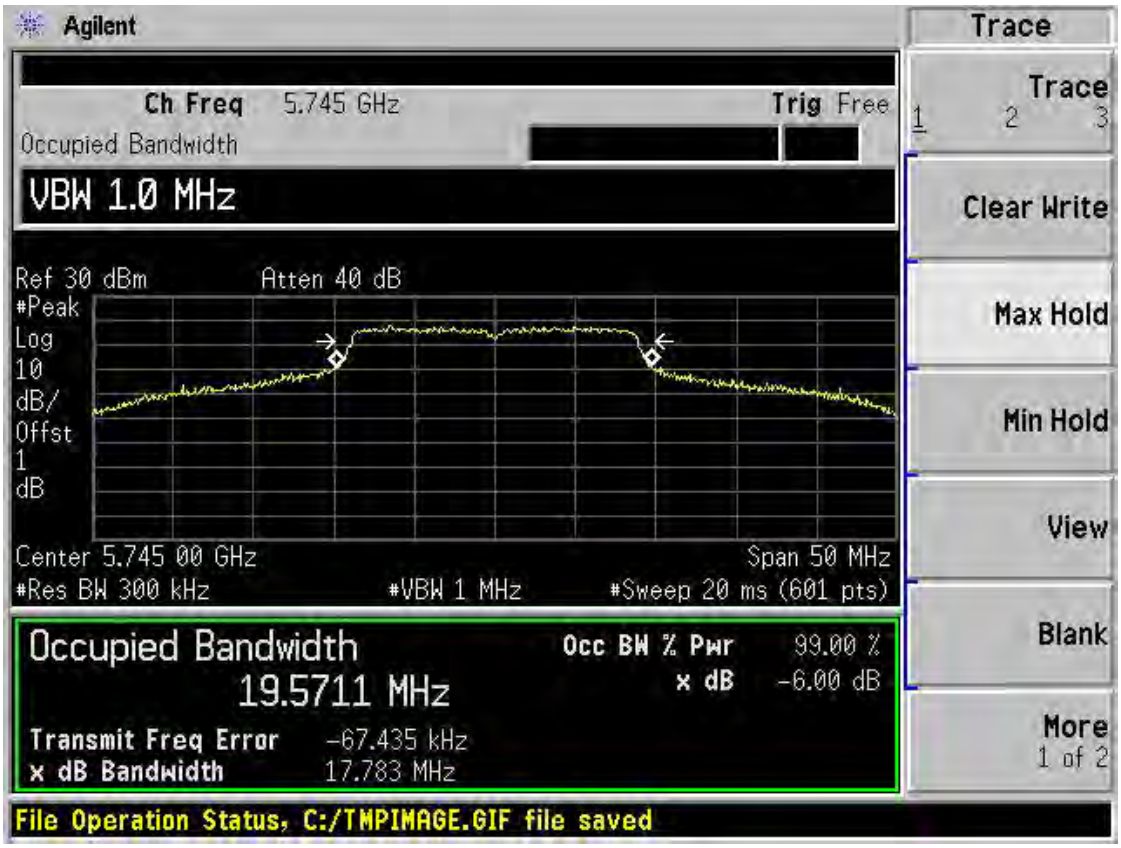
Band IV 11n(HT40) CH151 Chain 2



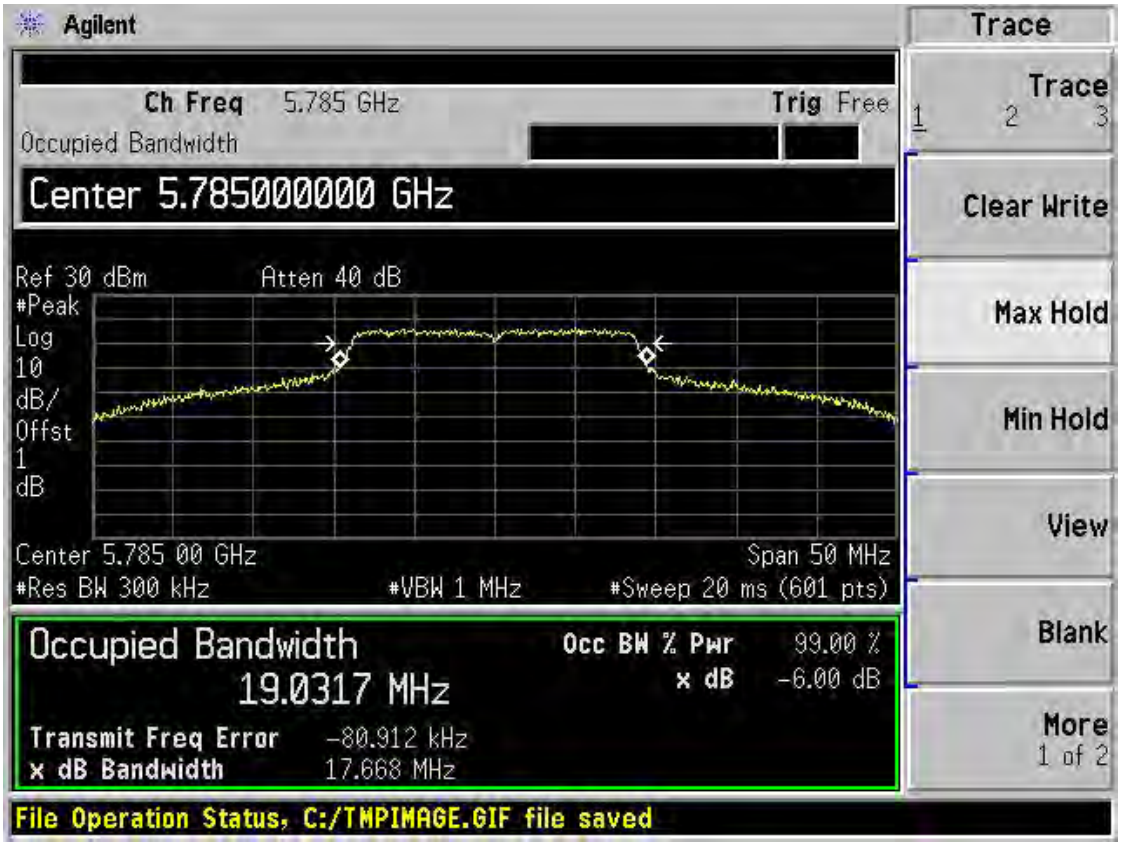
Band IV 11n(HT40) CH159 Chain 2



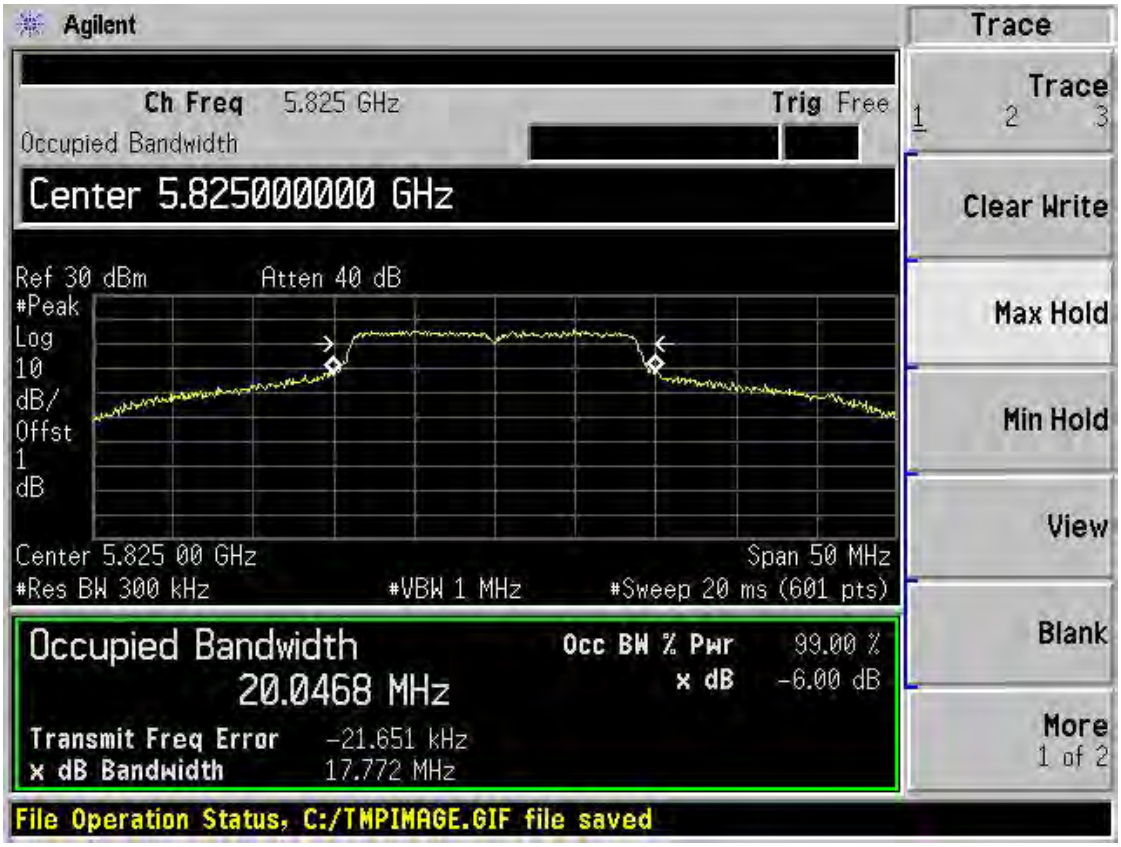
Band IV 11ac(HT20) CH149 Chain 2



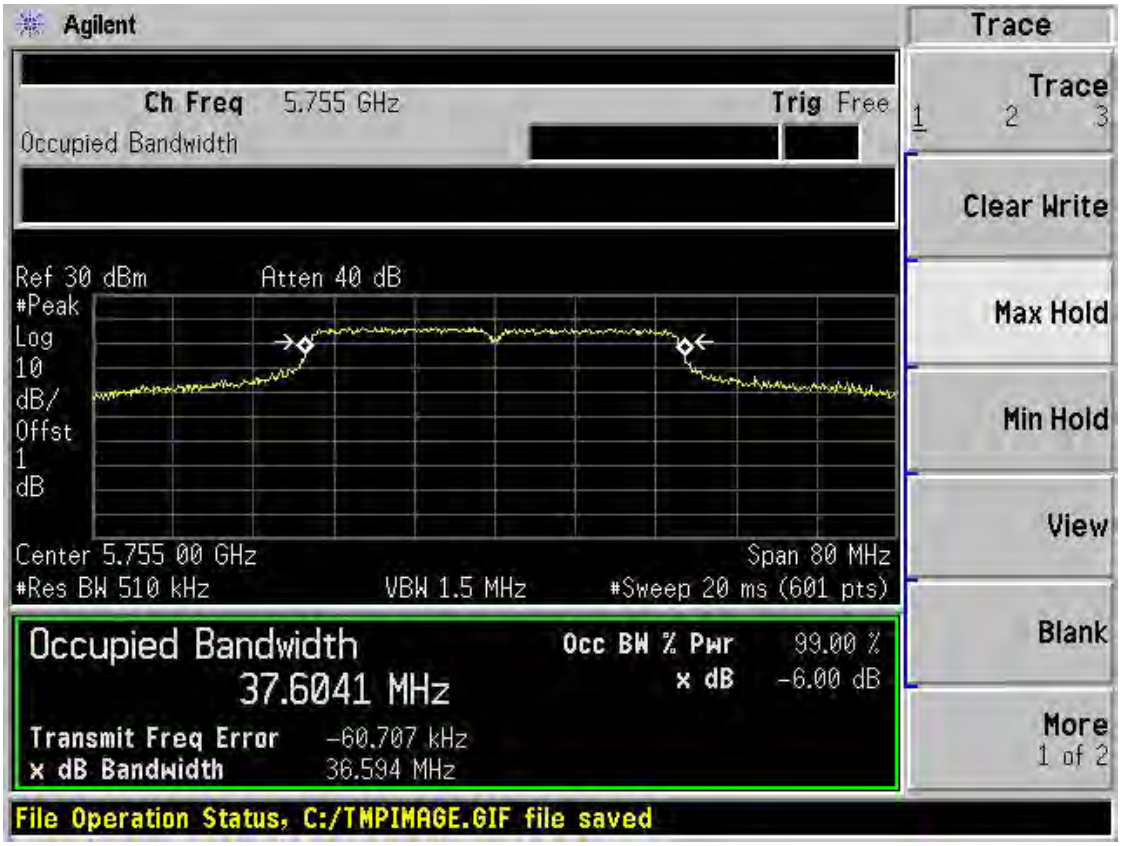
Band IV 11ac(HT20) CH157 Chain 2



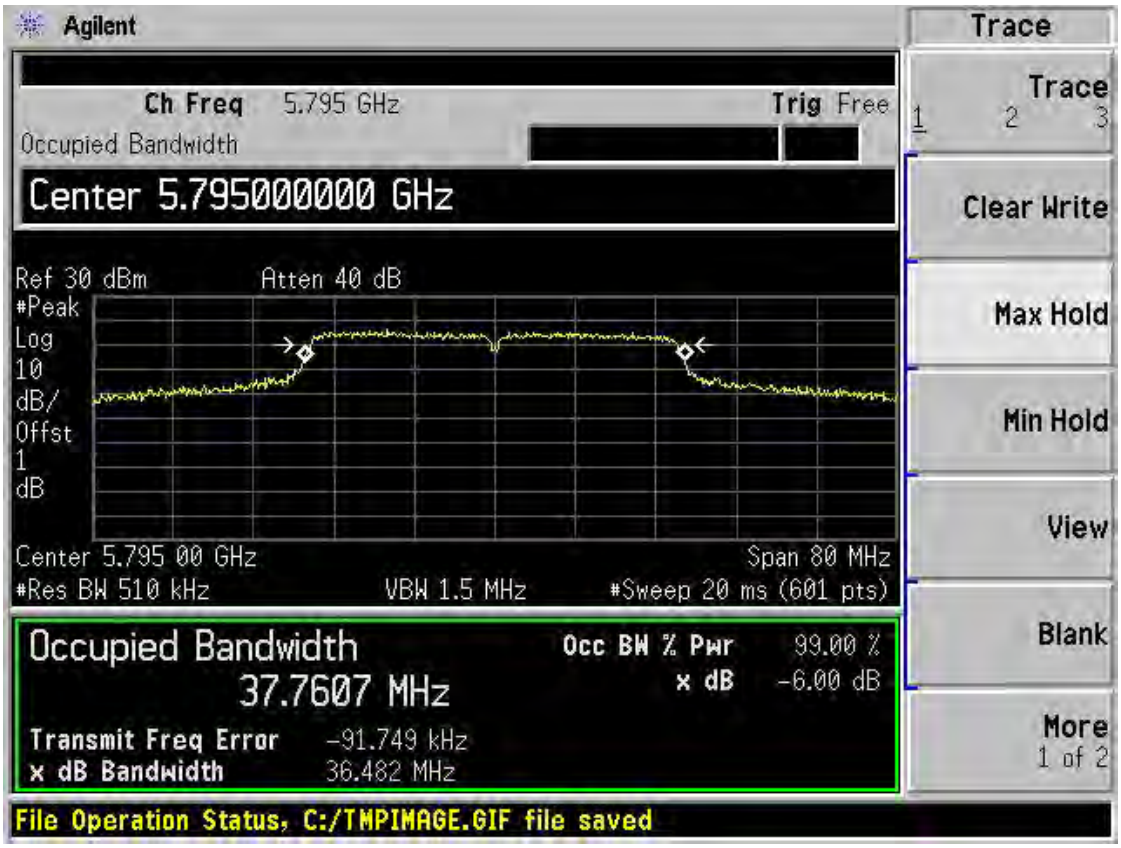
Band IV 11ac(HT20) CH165 Chain 2



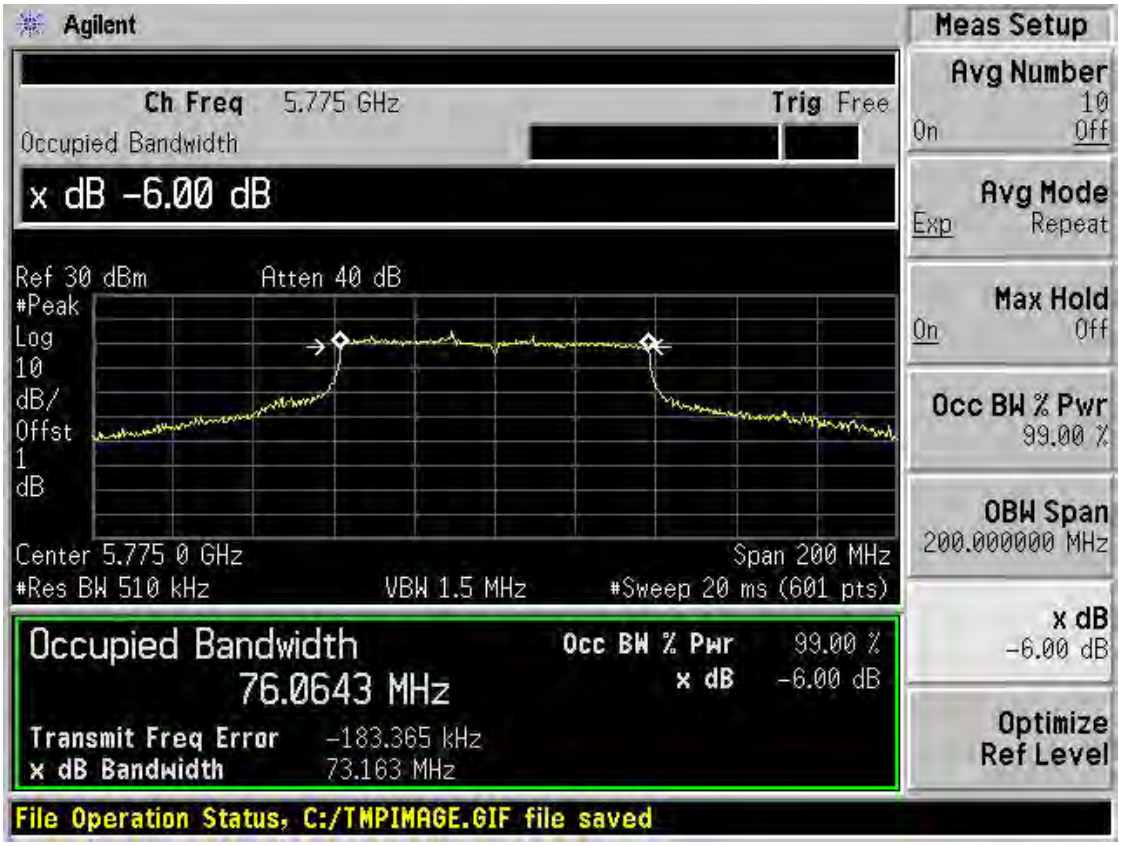
Band IV 11ac(HT40) CH151 Chain 2



Band IV 11ac(HT40) CH159 Chain 2



Band IV 11ac(HT80) CH155 Chain 2



A.4 Power Spectral Density

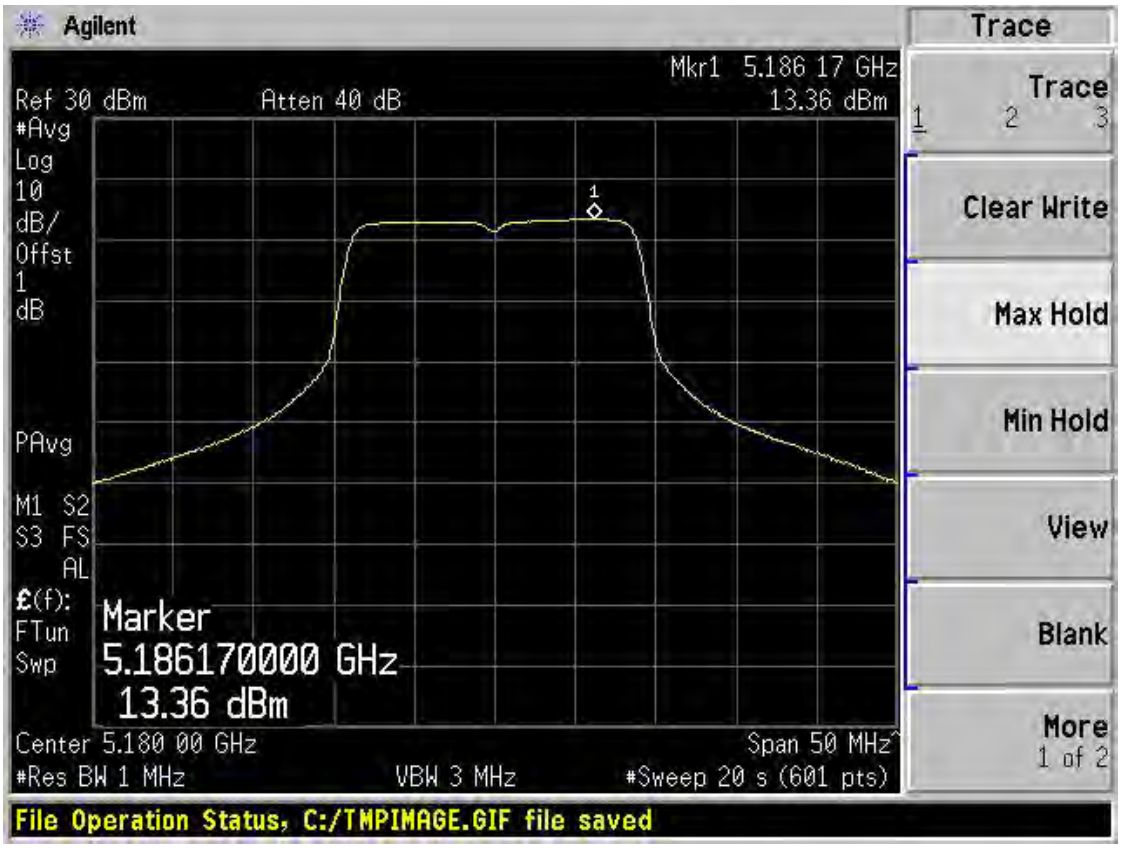
Test Data

Band I (3 dBi Antenna & 18 dBi Antenna & 23 dBi Antenna)							
Mode	Channel	Frequency (MHz)	Power Spectral Density (dBm/MHz)			PSD Limit (dBm)	Verdict
			Chain 1	Chain 2	Total PSD		
11a	CH36	5180	13.36	13.97	16.69	17	Pass
11a	CH40	5200	13.65	14.21	16.95	17	Pass
11a	CH48	5240	13.55	14.11	16.85	17	Pass
11n (HT20)	CH36	5180	13.72	13.62	16.68	17	Pass
11n (HT20)	CH40	5200	13.98	13.94	16.97	17	Pass
11n (HT20)	CH48	5240	13.87	13.78	16.84	17	Pass
11n (HT40)	CH38	5190	12.05	12.31	15.19	17	Pass
11n (HT40)	CH46	5230	11.77	12.18	14.99	17	Pass
11ac (HT20)	CH36	5180	13.36	13.63	16.51	17	Pass
11ac (HT20)	CH40	5200	13.61	13.91	16.77	17	Pass
11ac (HT20)	CH48	5240	13.49	13.73	16.62	17	Pass
11ac (HT40)	CH38	5190	12.01	12.36	15.20	17	Pass
11ac (HT40)	CH46	5230	11.75	12.18	14.98	17	Pass
11ac (HT80)	CH42	5210	8.60	8.98	11.80	17	Pass

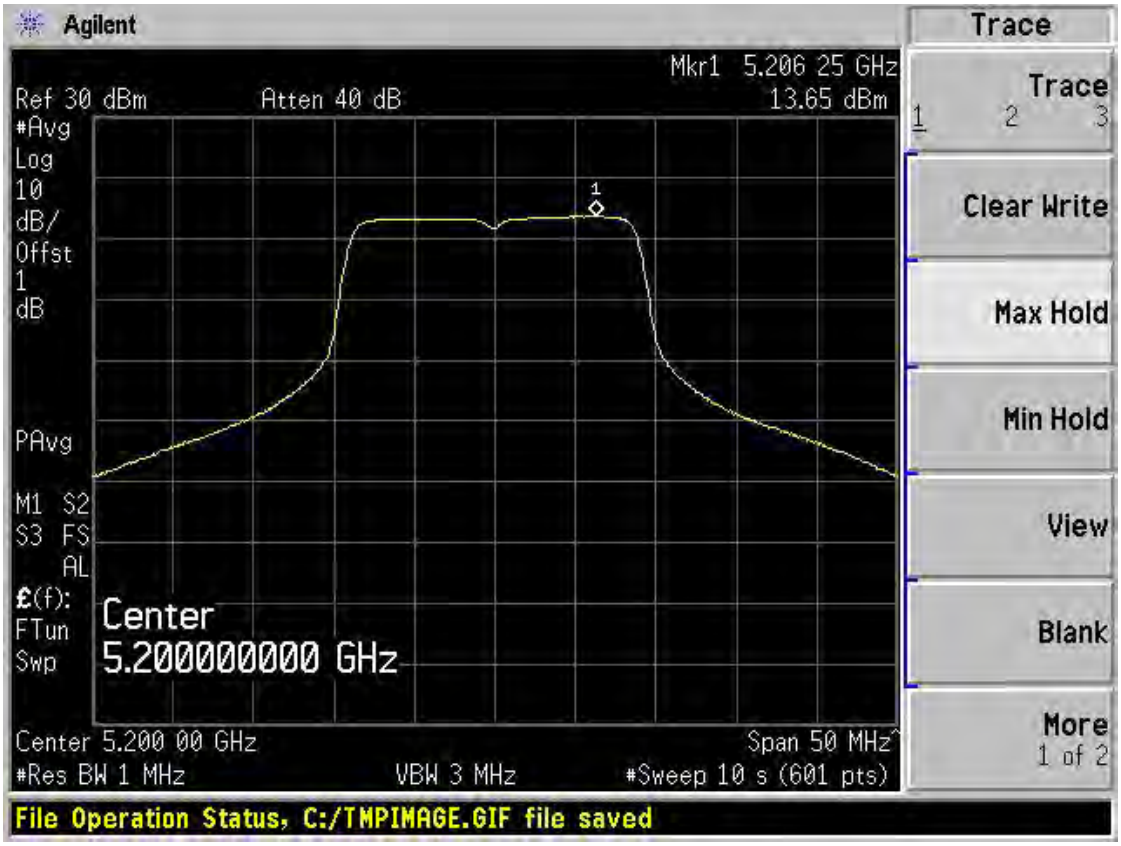
Band IV (3 dBi Antenna & 18 dBi Antenna & 23 dBi Antenna)							
Mode	Channel	Frequency (MHz)	Power Spectral Density (dBm/500kHz)			PSD Limit (dBm)	Verdict
			Chain 1	Chain 2	Total PSD		
11a	CH149	5745	11.58	11.64	14.62	30	Pass
11a	CH157	5785	12.09	12.33	15.22	30	Pass
11a	CH165	5825	10.61	10.88	13.76	30	Pass
11n (HT20)	CH149	5745	11.14	11.39	14.28	30	Pass
11n (HT20)	CH157	5785	11.62	11.74	14.69	30	Pass
11n (HT20)	CH165	5825	10.13	10.41	13.28	30	Pass
11n (HT40)	CH151	5755	7.21	7.87	10.56	30	Pass
11n (HT40)	CH159	5795	6.06	6.65	9.38	30	Pass
11ac (HT20)	CH149	5745	11.17	11.22	14.21	30	Pass
11ac (HT20)	CH157	5785	11.61	12.05	14.85	30	Pass
11ac (HT20)	CH165	5825	10.35	10.39	13.38	30	Pass
11ac (HT40)	CH151	5755	7.17	7.90	10.56	30	Pass
11ac (HT40)	CH159	5795	6.22	6.63	9.44	30	Pass
11ac (HT80)	CH155	5775	3.42	3.73	6.59	30	Pass

Test Plots

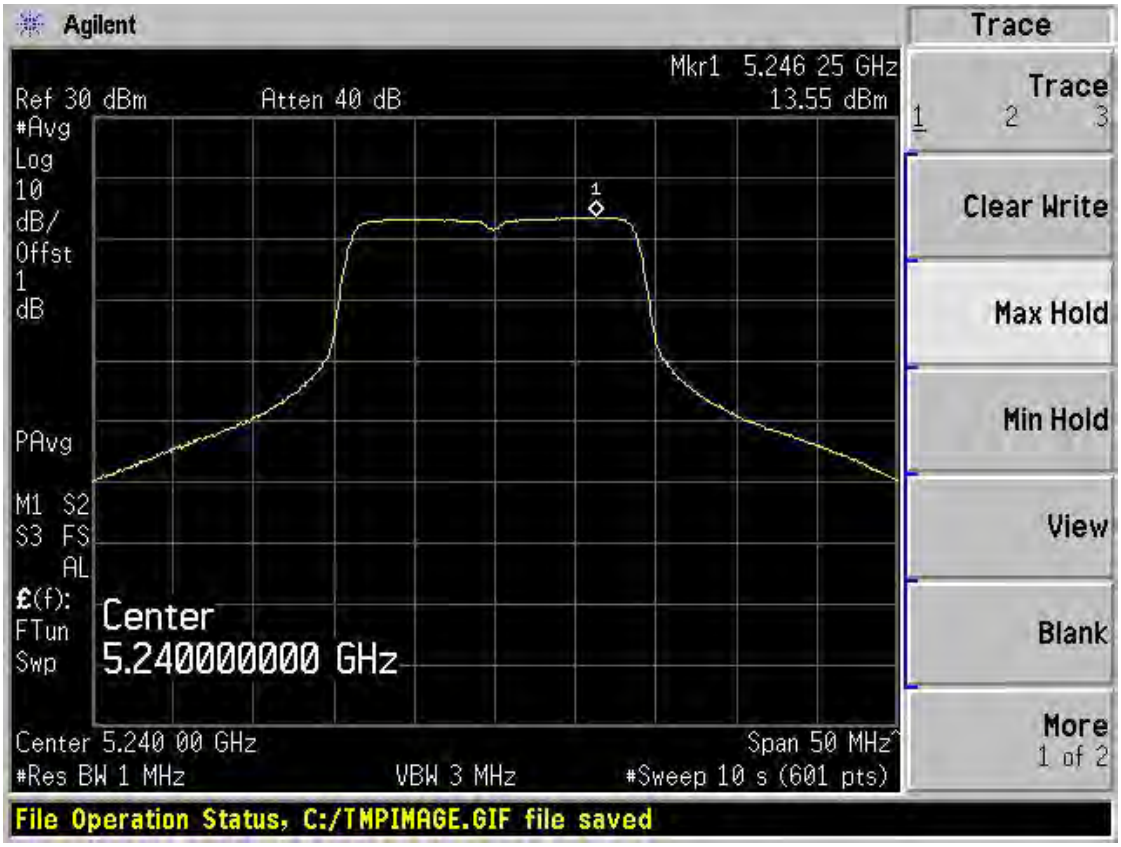
Band I 11a CH36 Chain 1



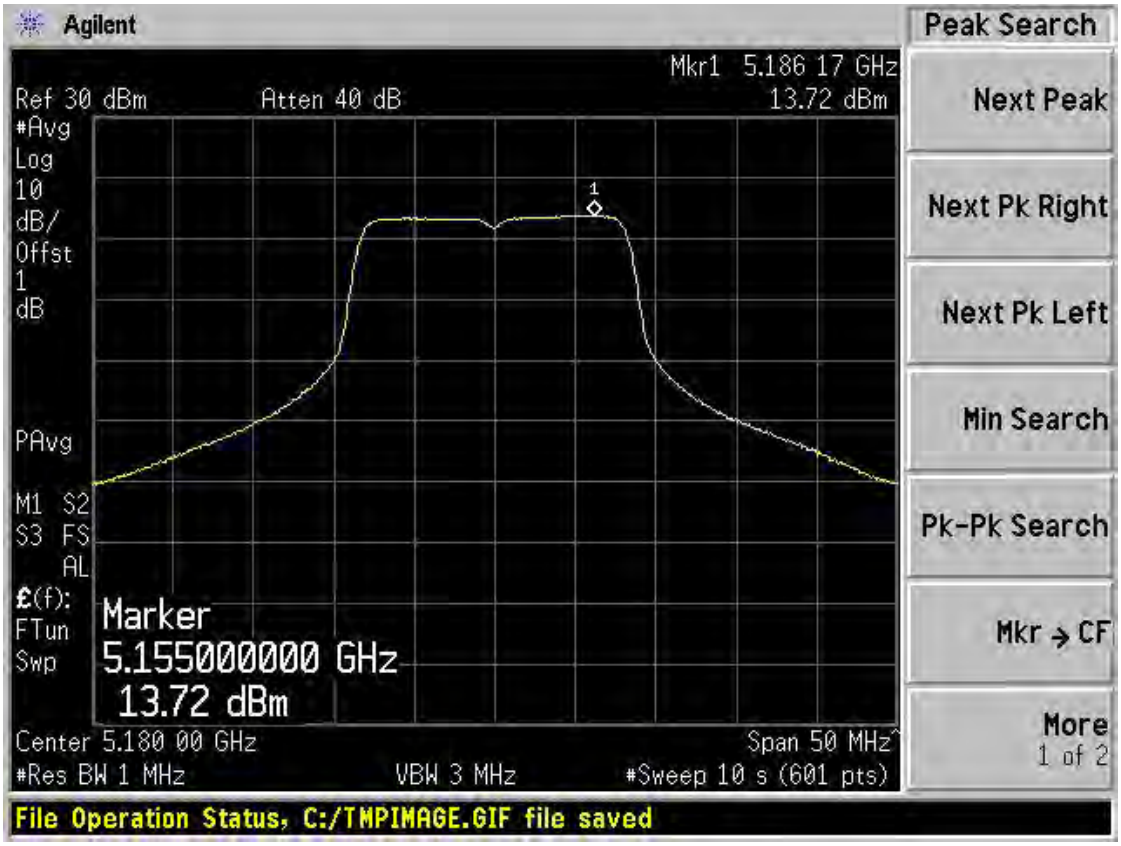
Band I 11a CH40 Chain 1



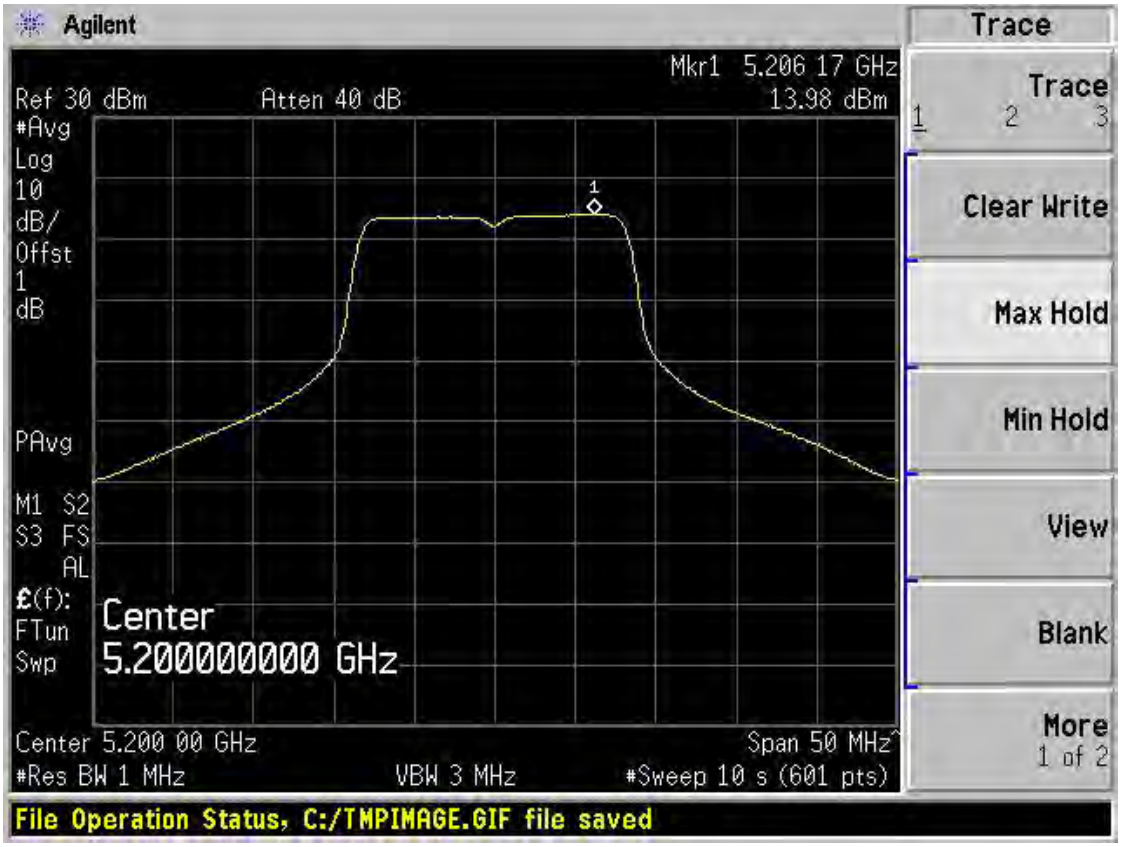
Band I 11a CH48 Chain 1



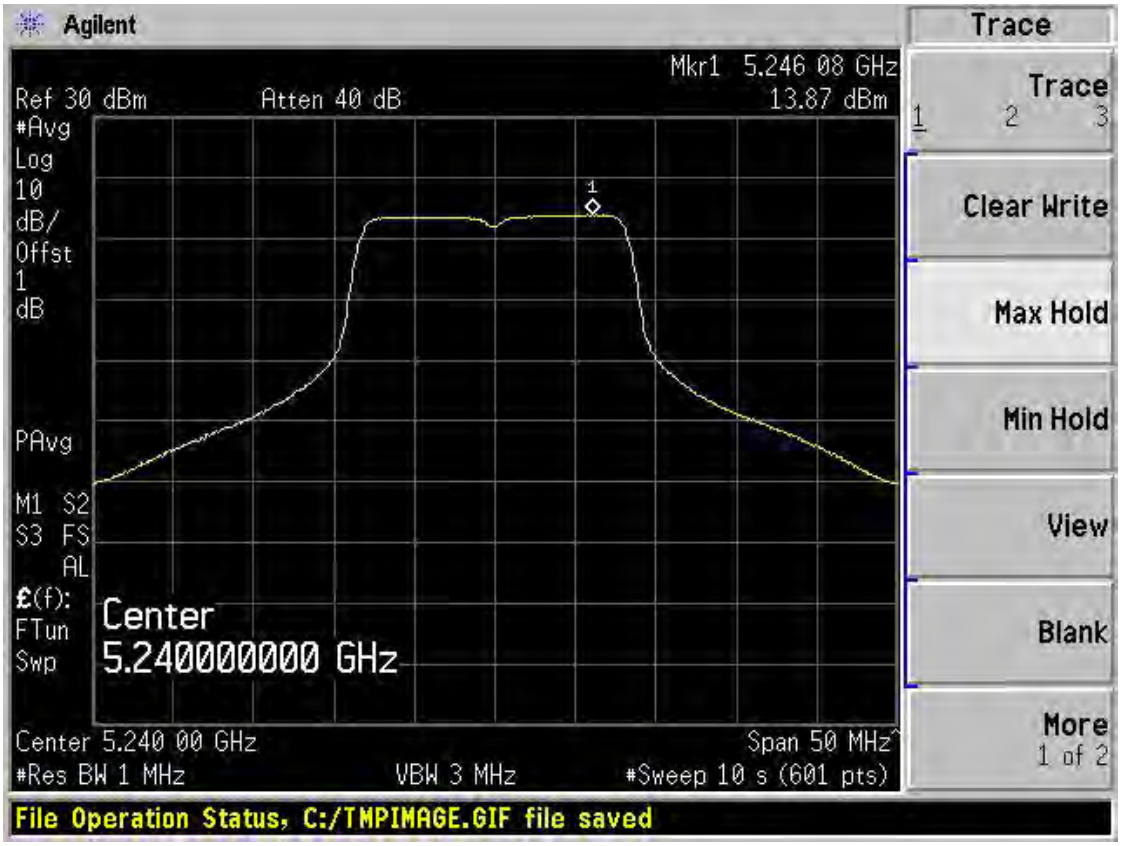
Band I 11n(HT20) CH36 Chain 1



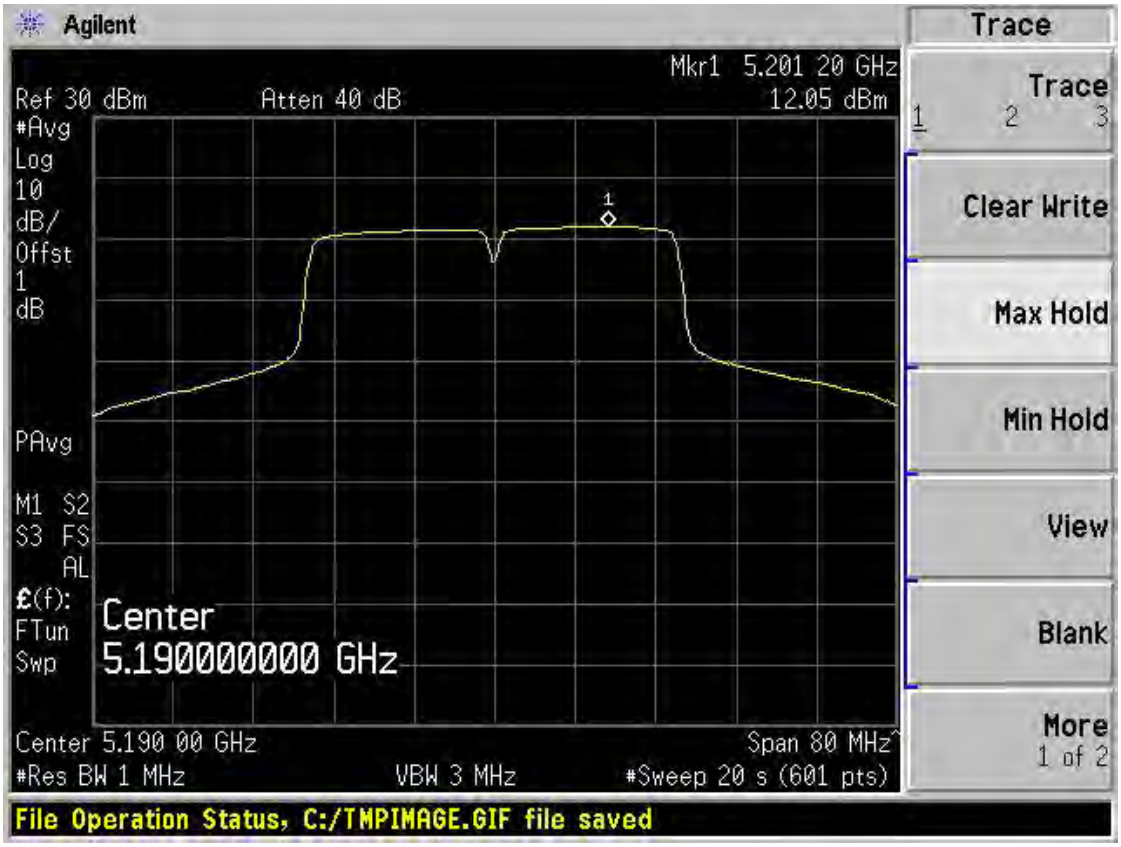
Band I 11n(HT20) CH40 Chain 1



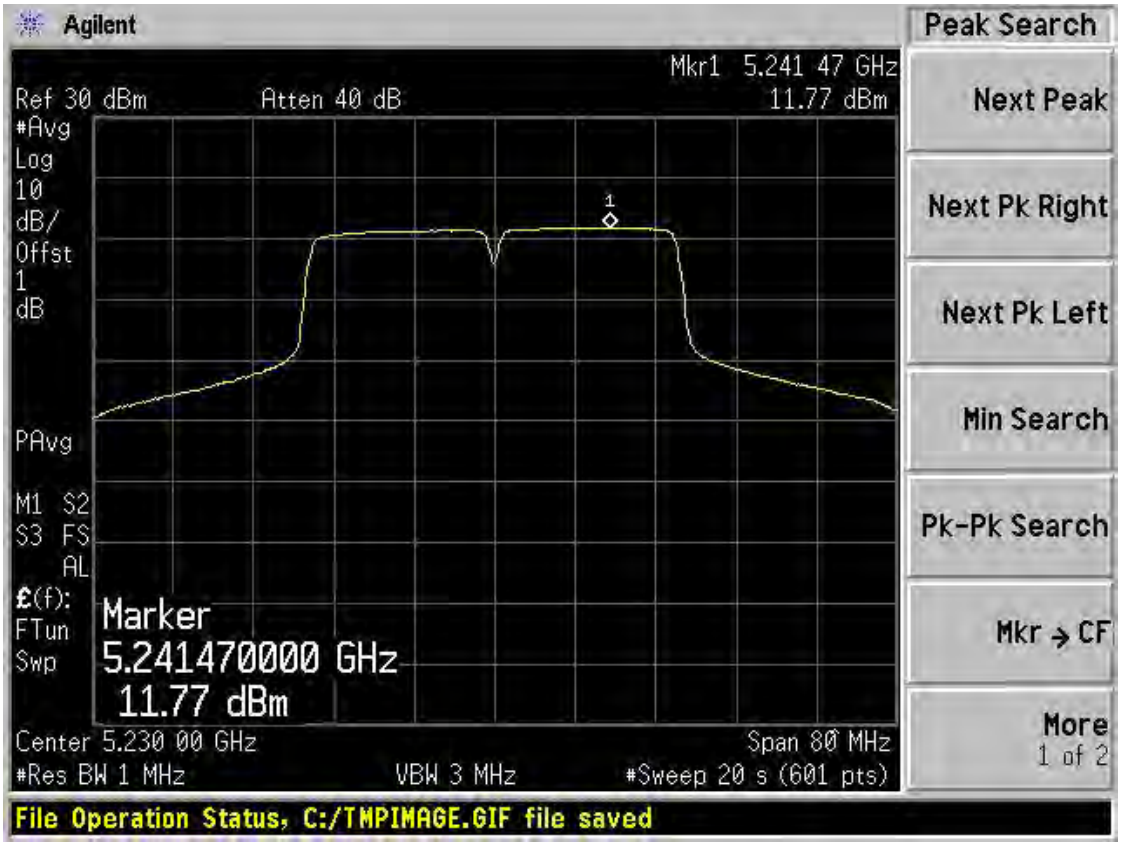
Band I 11n(HT20) CH48 Chain 1



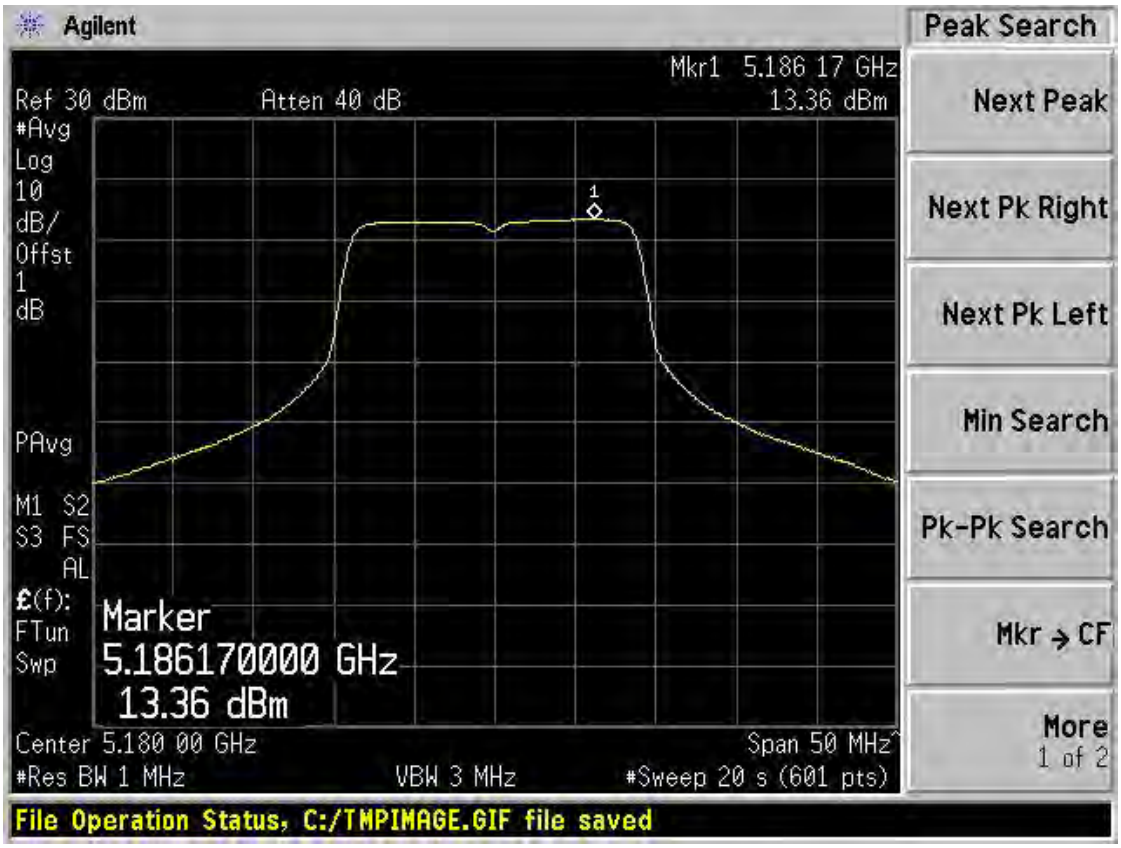
Band I 11n(HT40) CH38 Chain 1



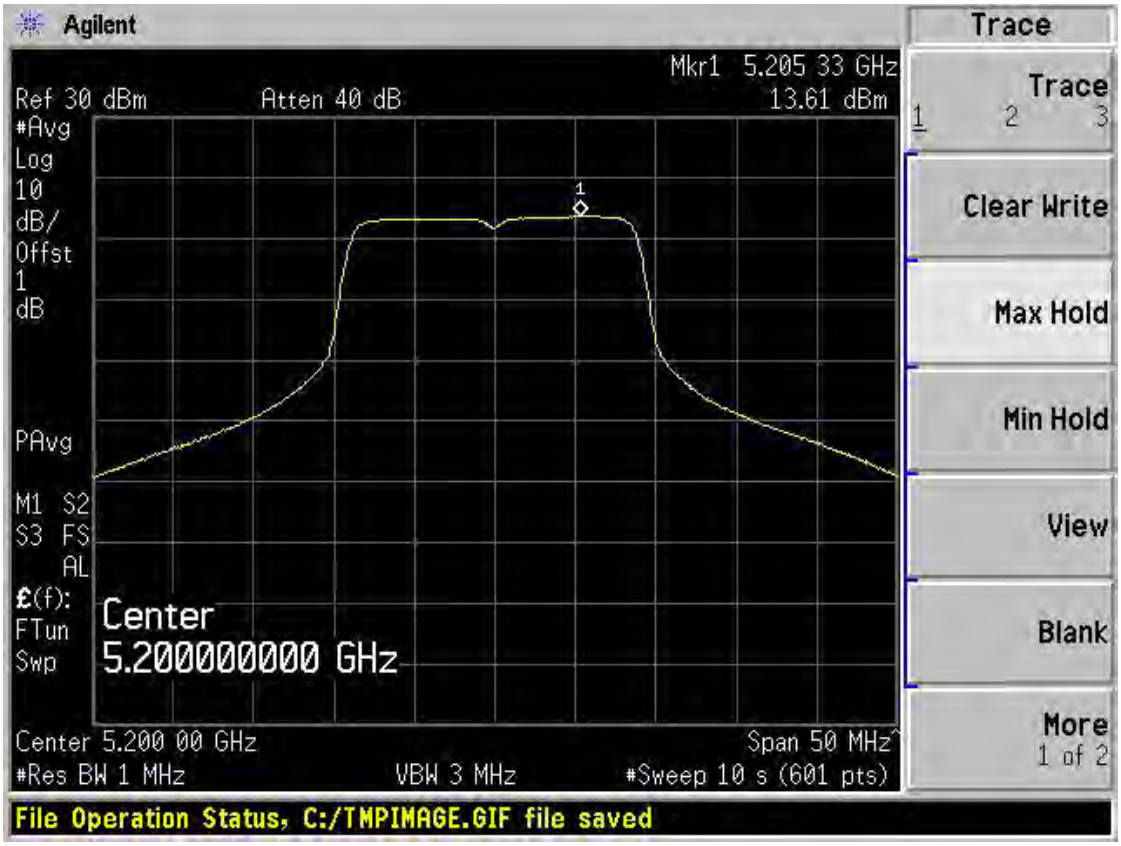
Band I 11n(HT40) CH46 Chain 1



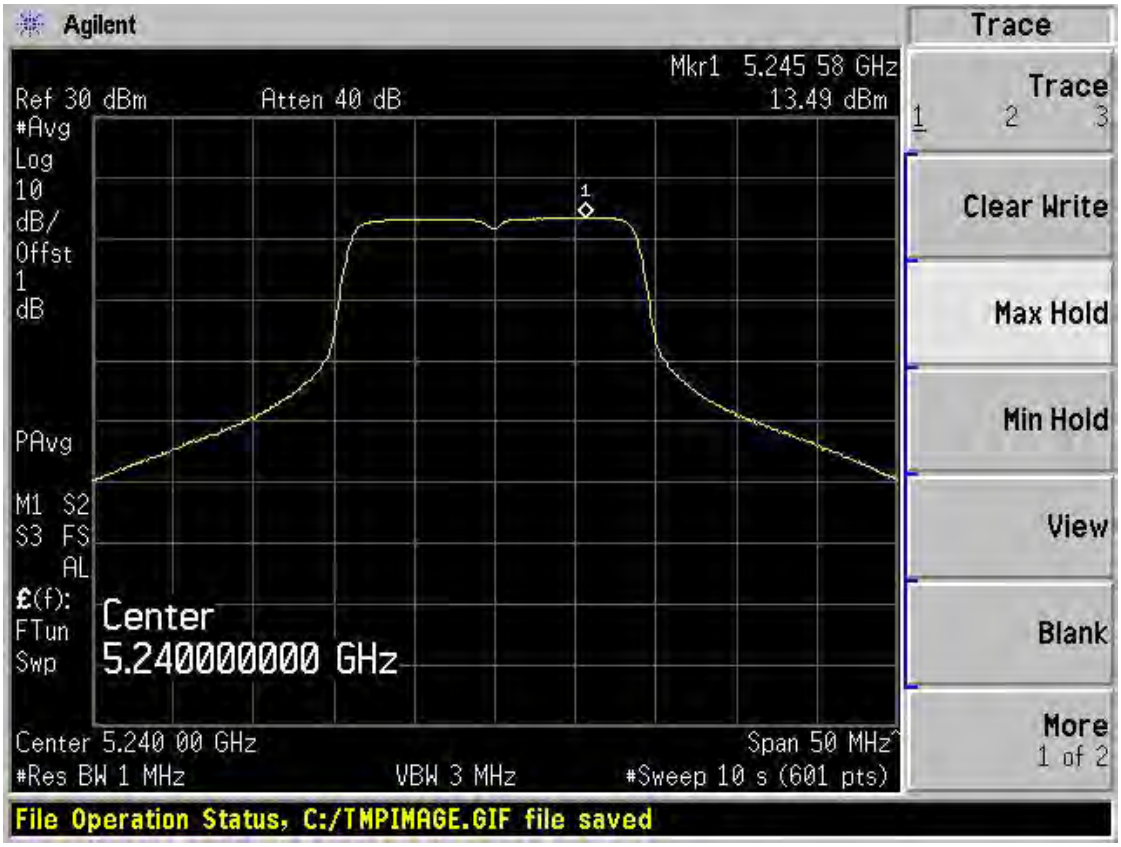
Band I 11ac(HT20) CH36 Chain 1



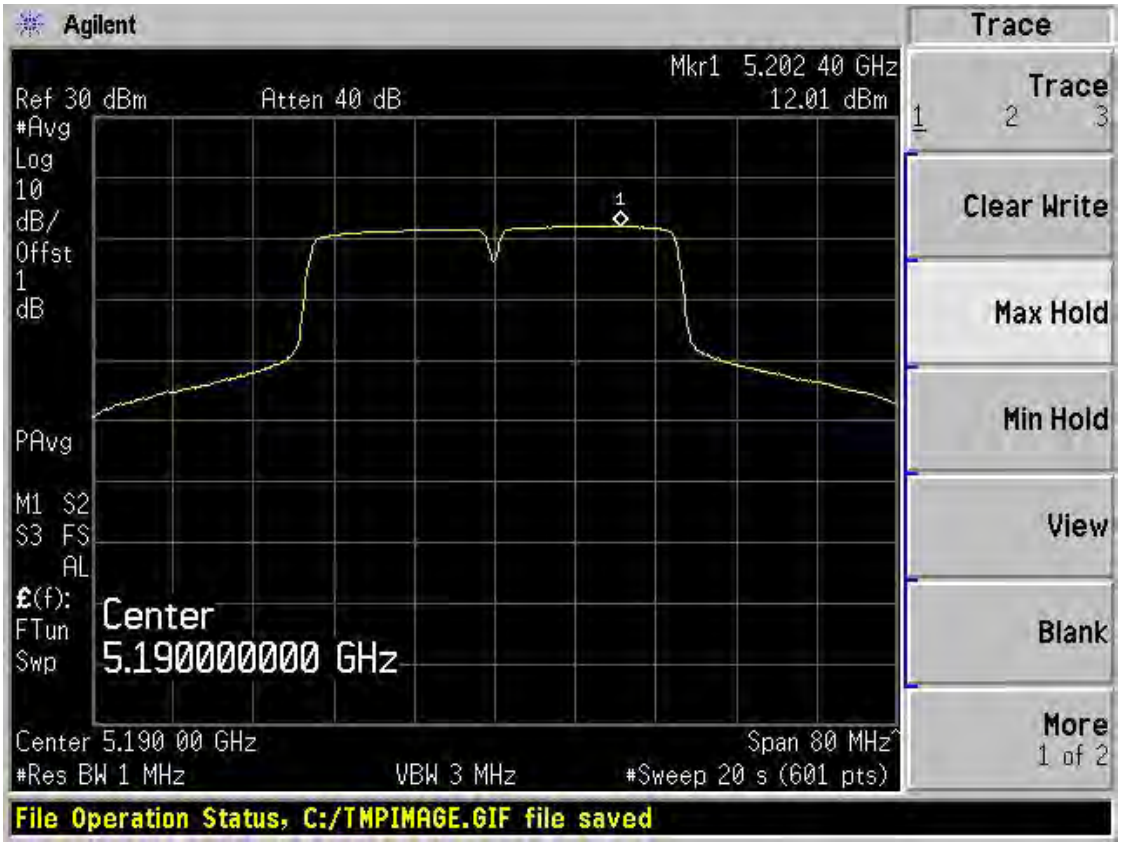
Band I 11ac(HT20) CH40 Chain 1



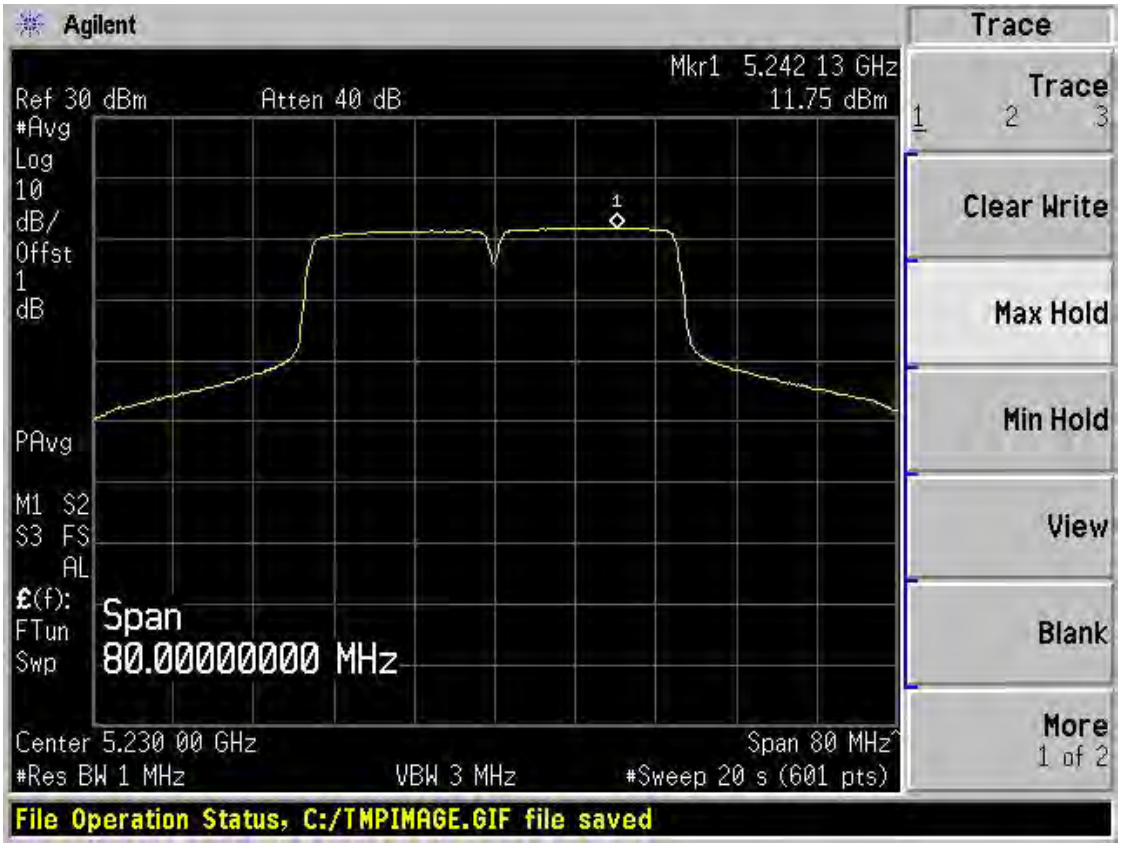
Band I 11ac(HT20) CH48 Chain 1



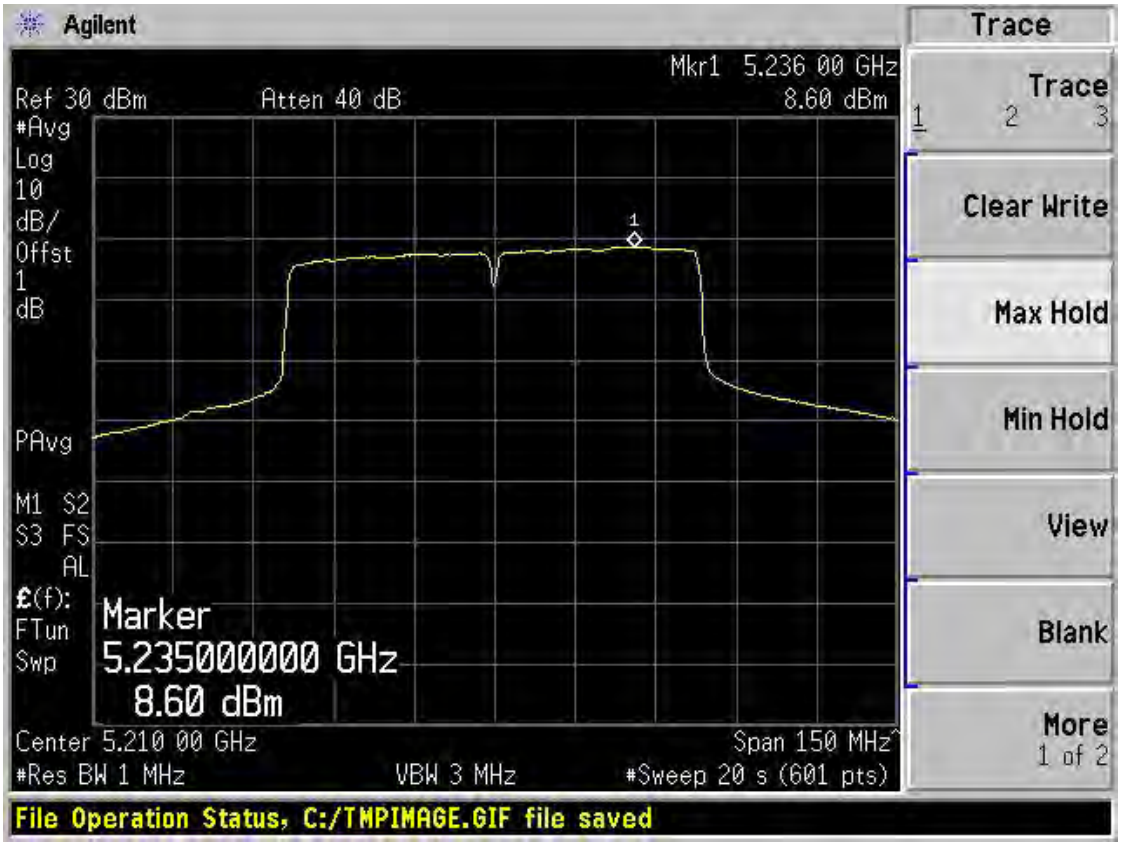
Band I 11ac(HT40) CH38 Chain 1



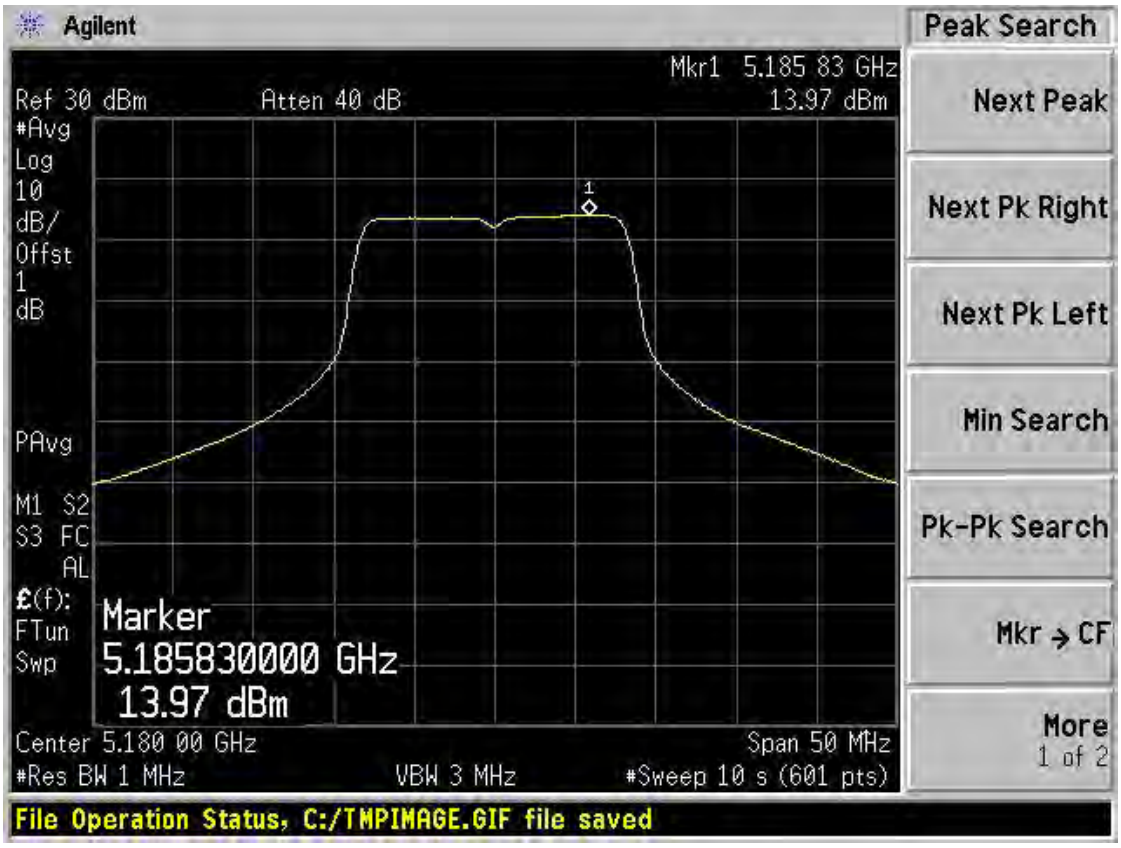
Band I 11ac(HT40) CH46 Chain 1



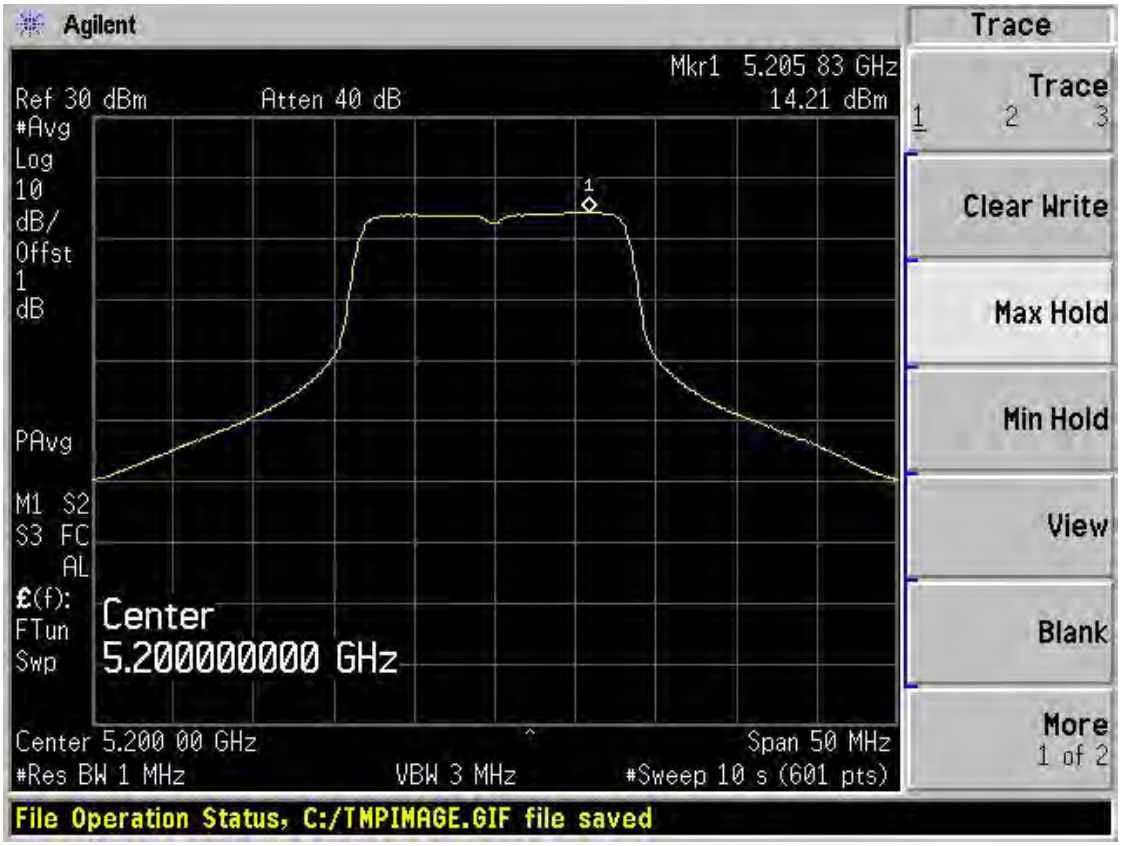
Band I 11ac(HT80) CH42 Chain 1



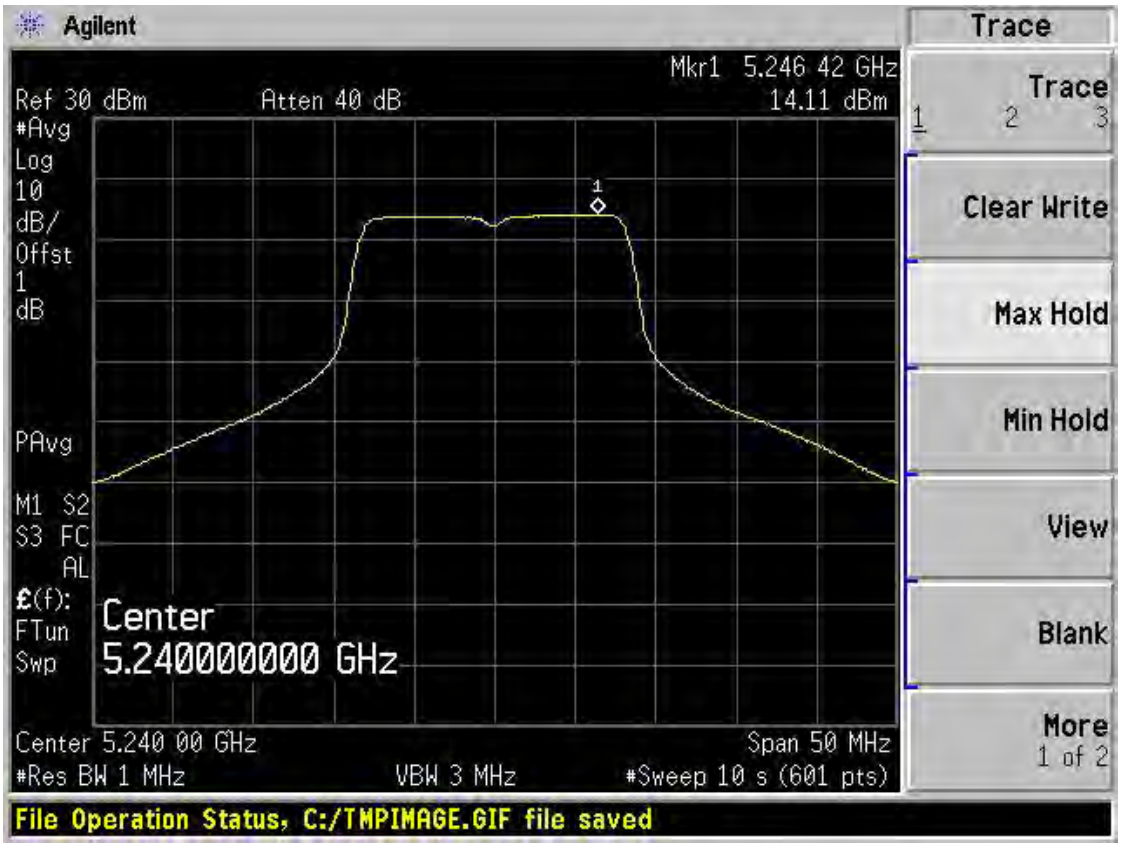
Band I 11a CH36 Chain 2



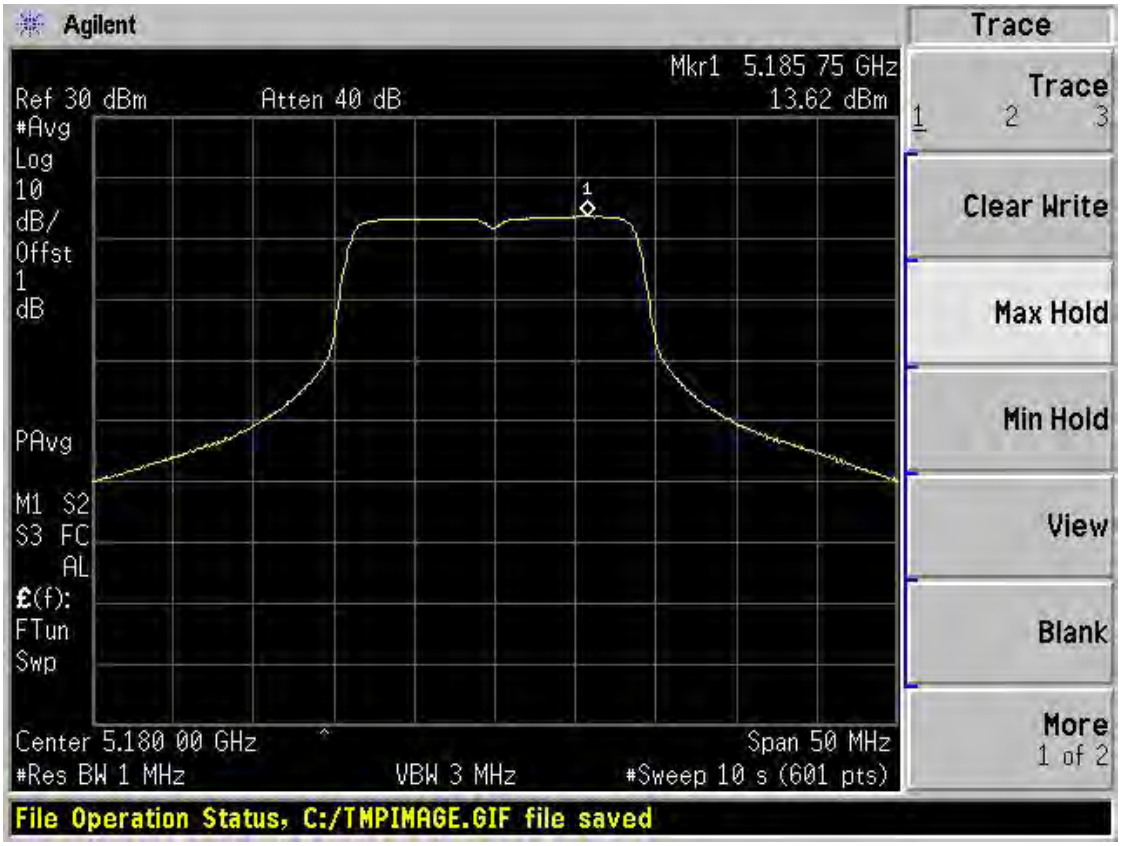
Band I 11a CH40 Chain 2



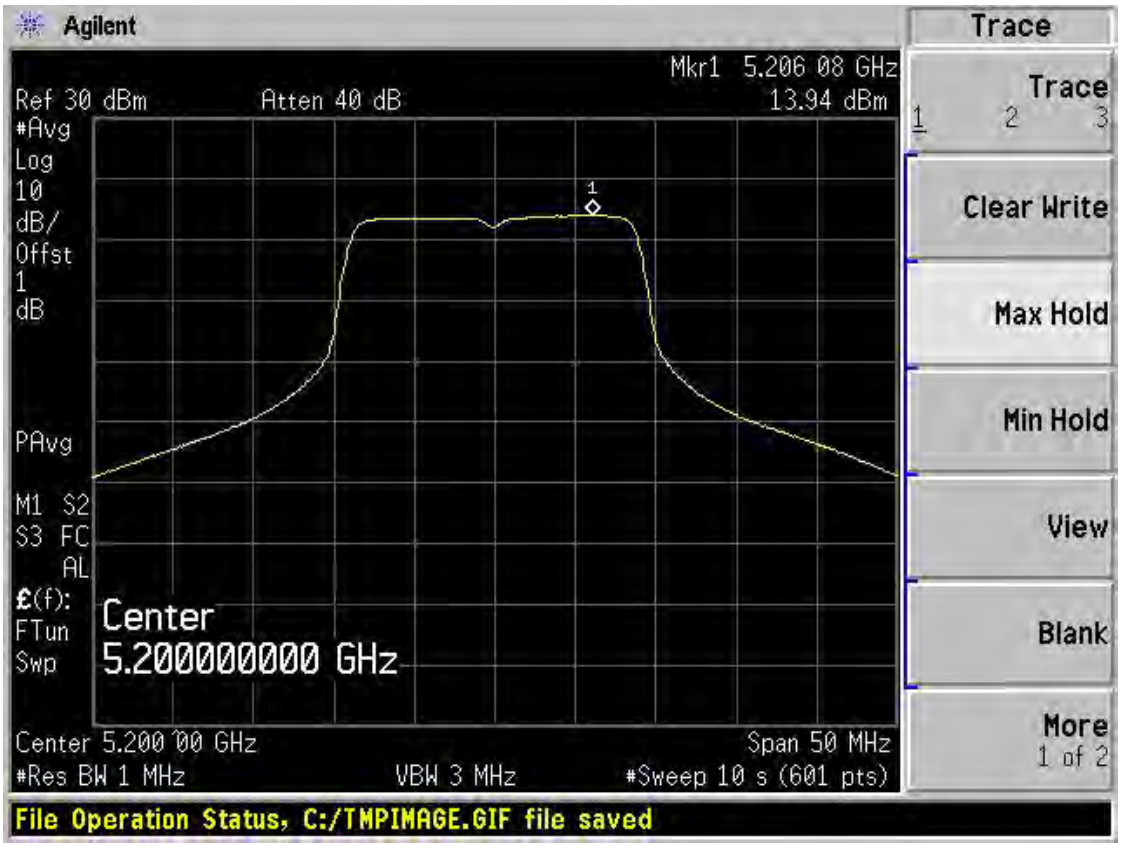
Band I 11a CH48 Chain 2



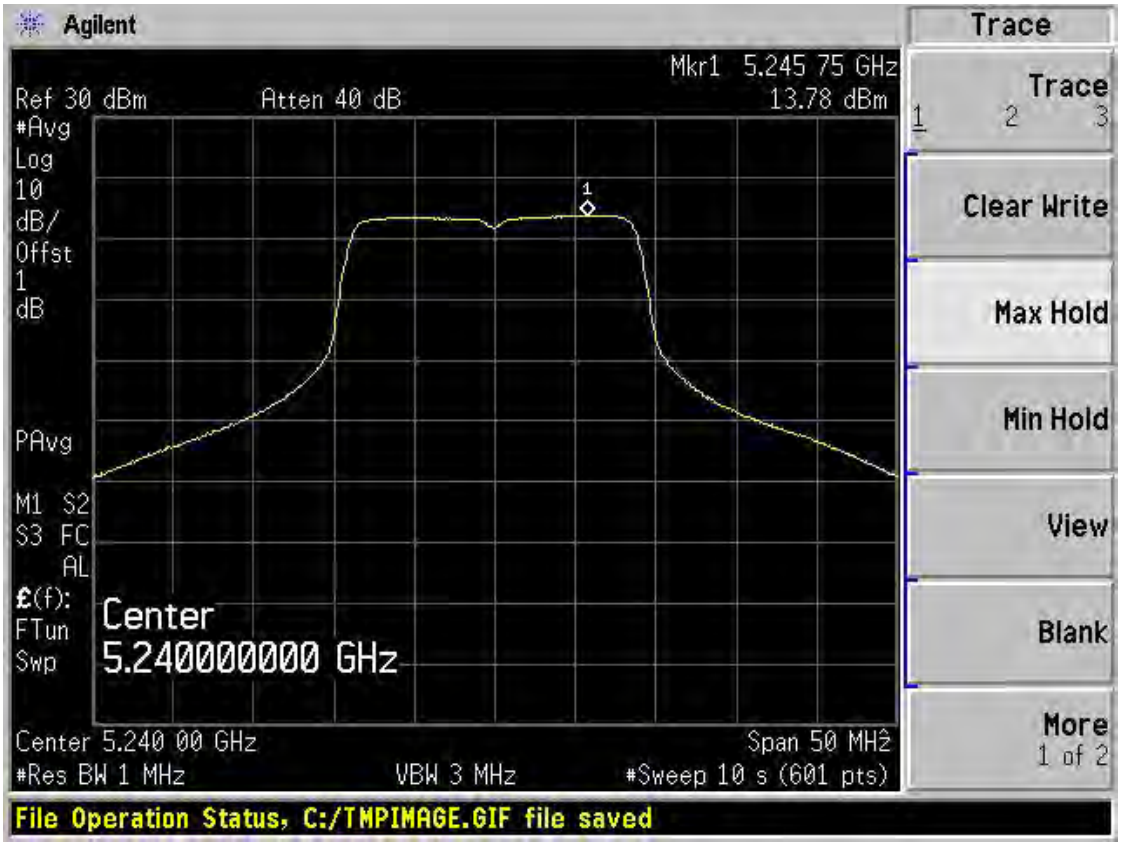
Band I 11n(HT20) CH36 Chain 2



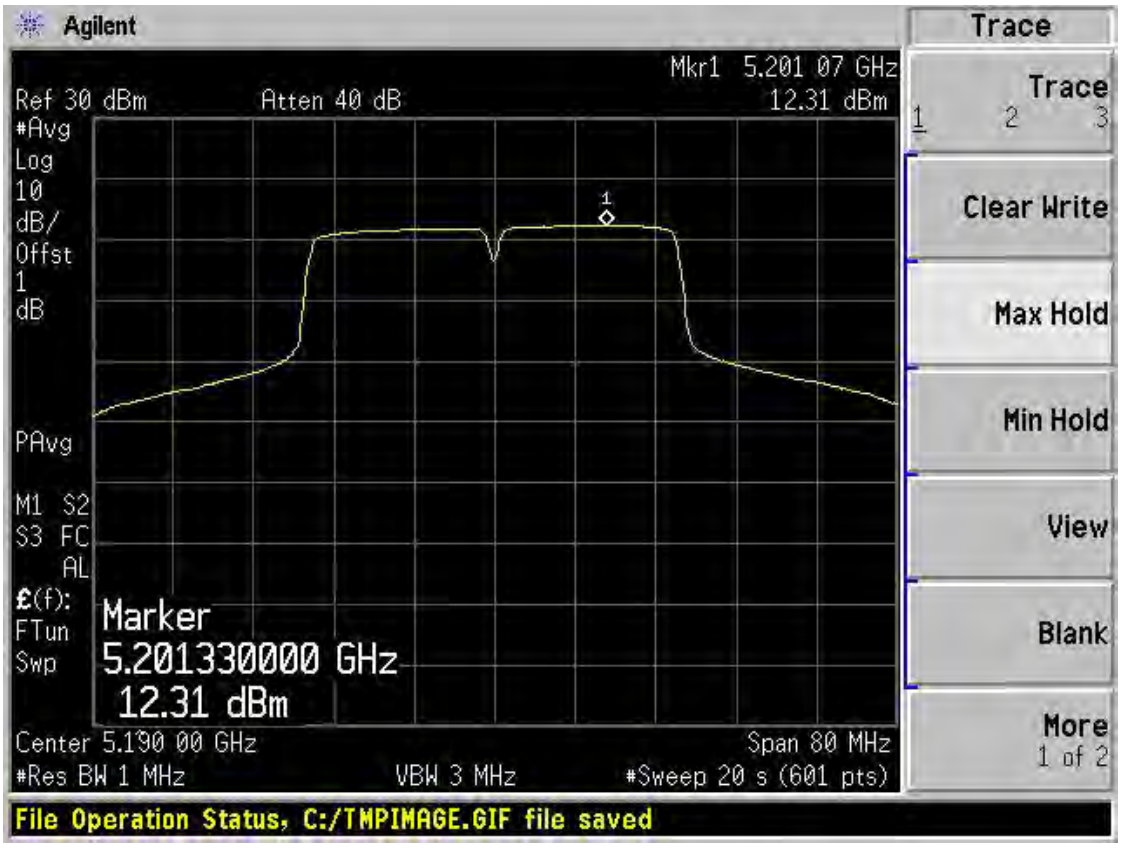
Band I 11n(HT20) CH40 Chain 2



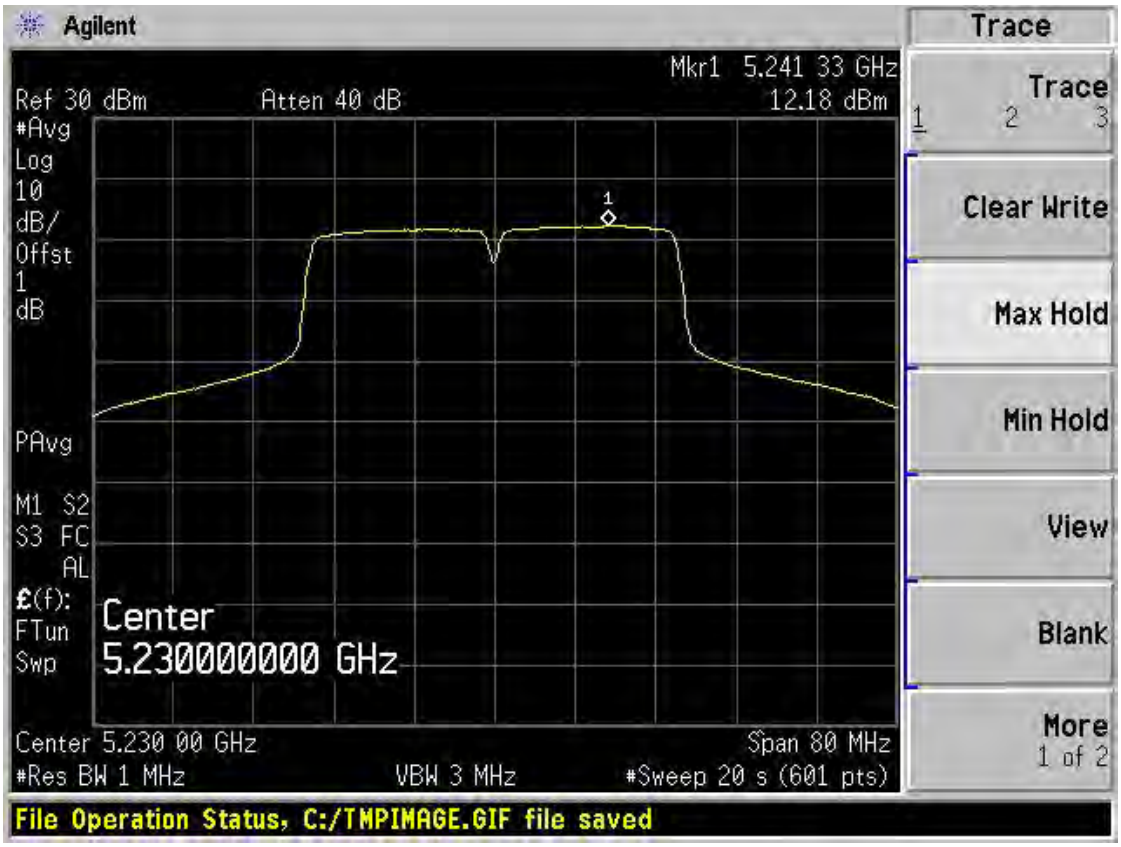
Band I 11n(HT20) CH48 Chain 2



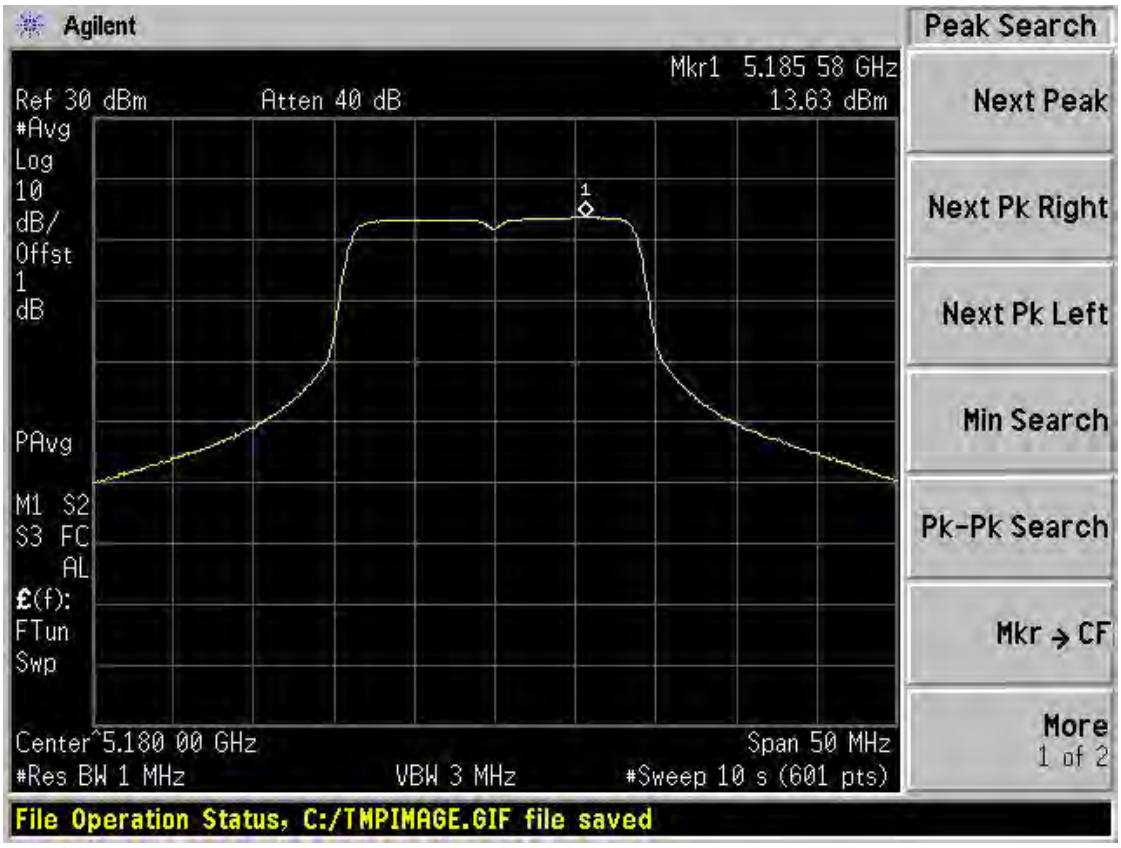
Band I 11n(HT40) CH38 Chain 2



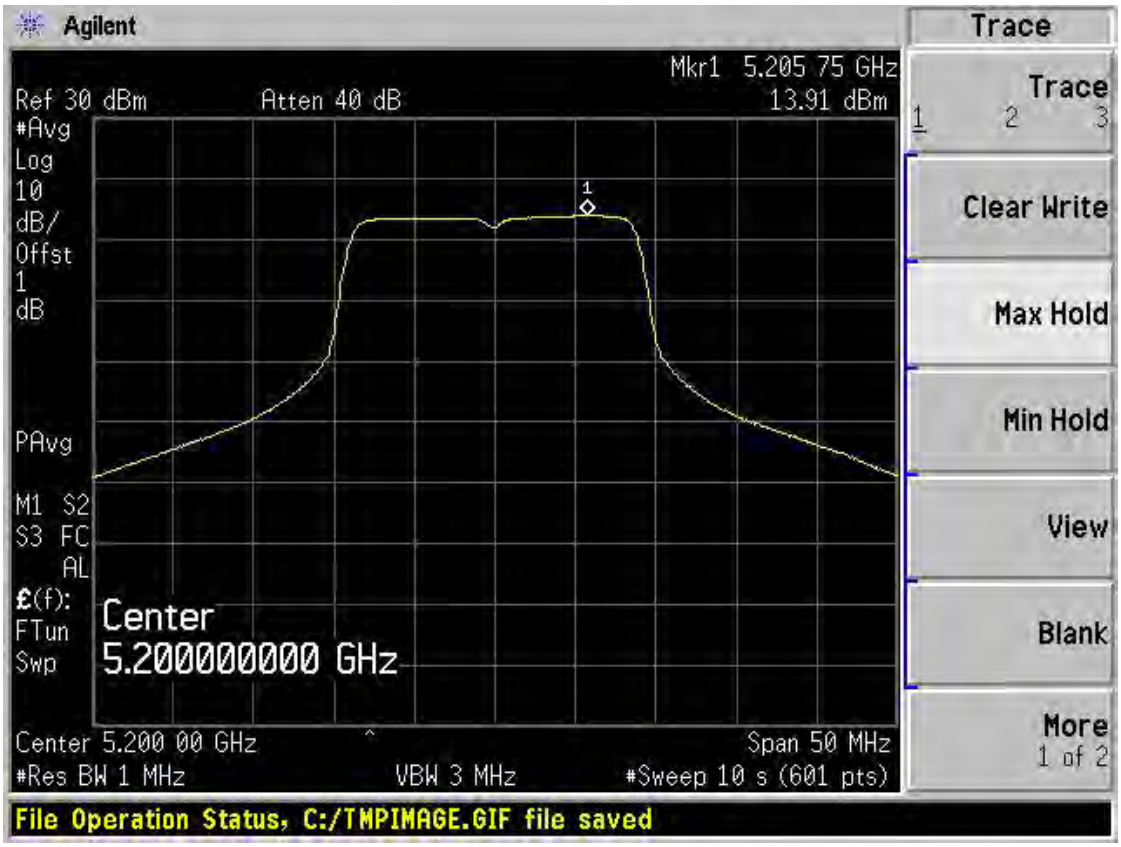
Band I 11n(HT40) CH46 Chain 2



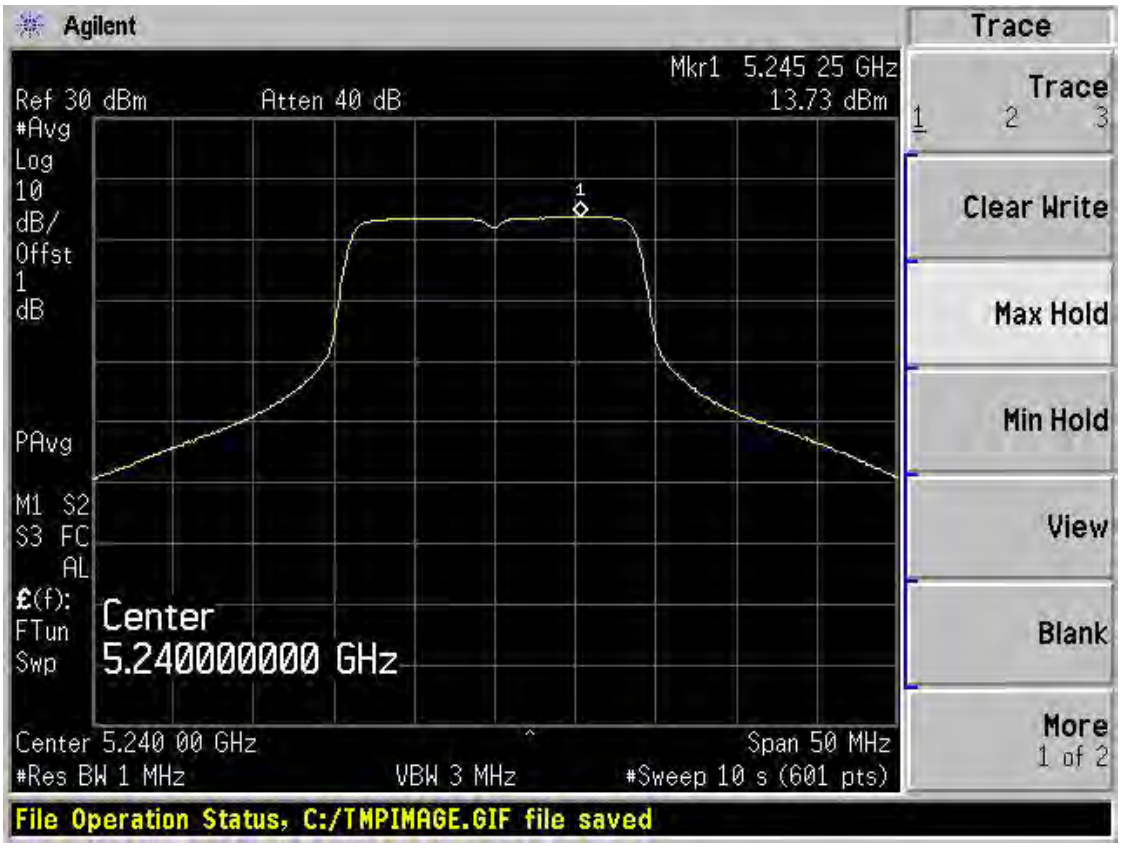
Band I 11ac(HT20) CH36 Chain 2



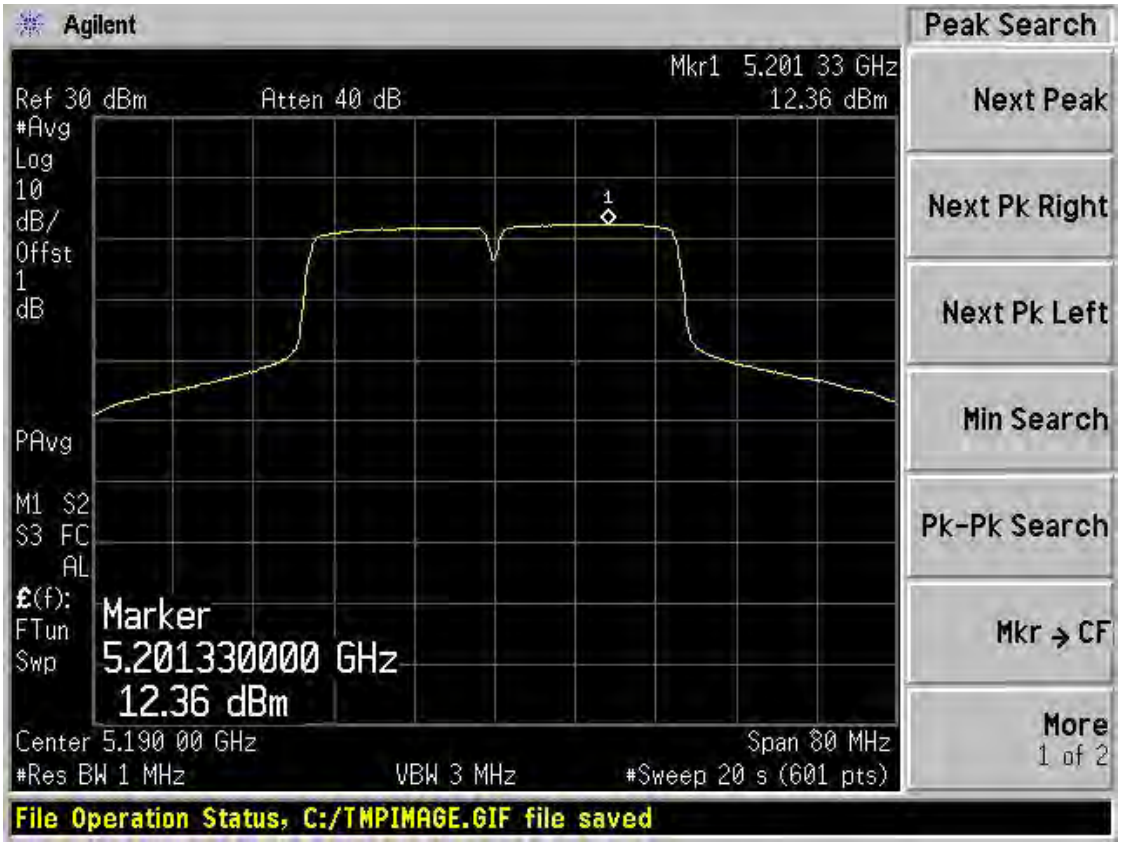
Band I 11ac(HT20) CH40 Chain 2



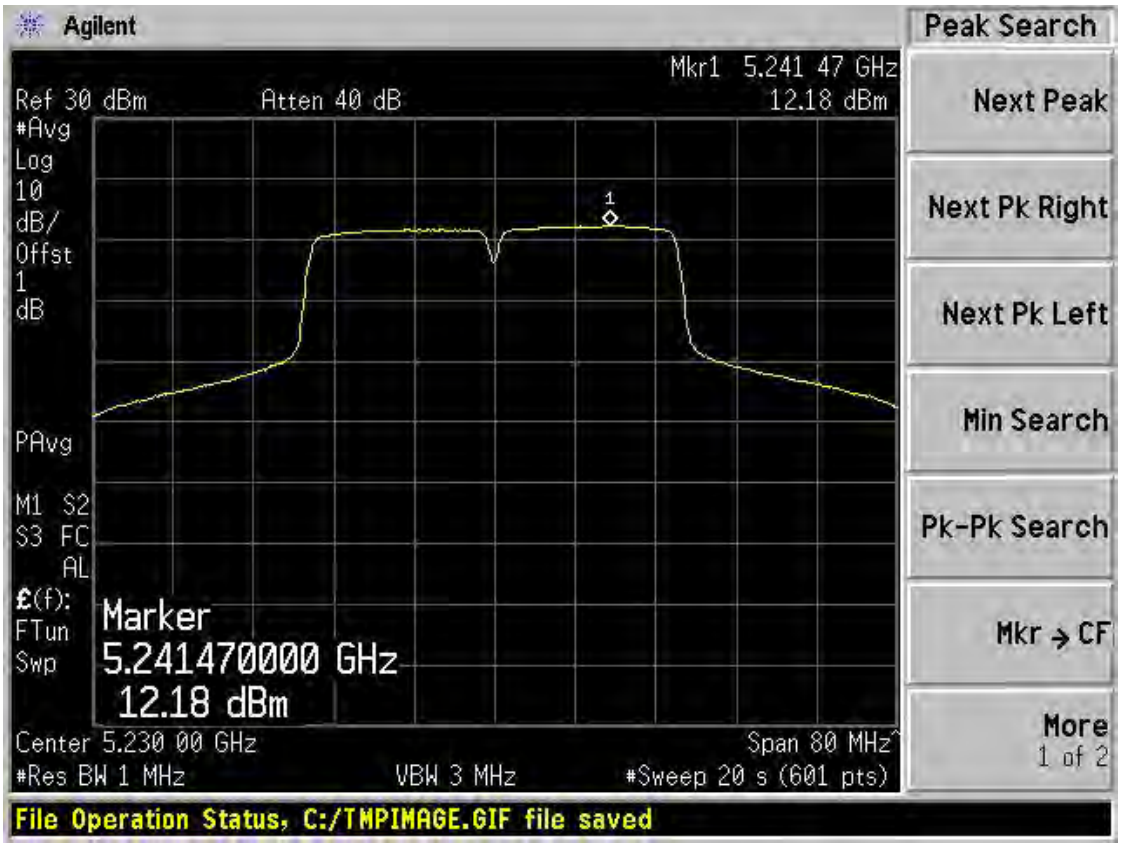
Band I 11ac(HT20) CH48 Chain 2



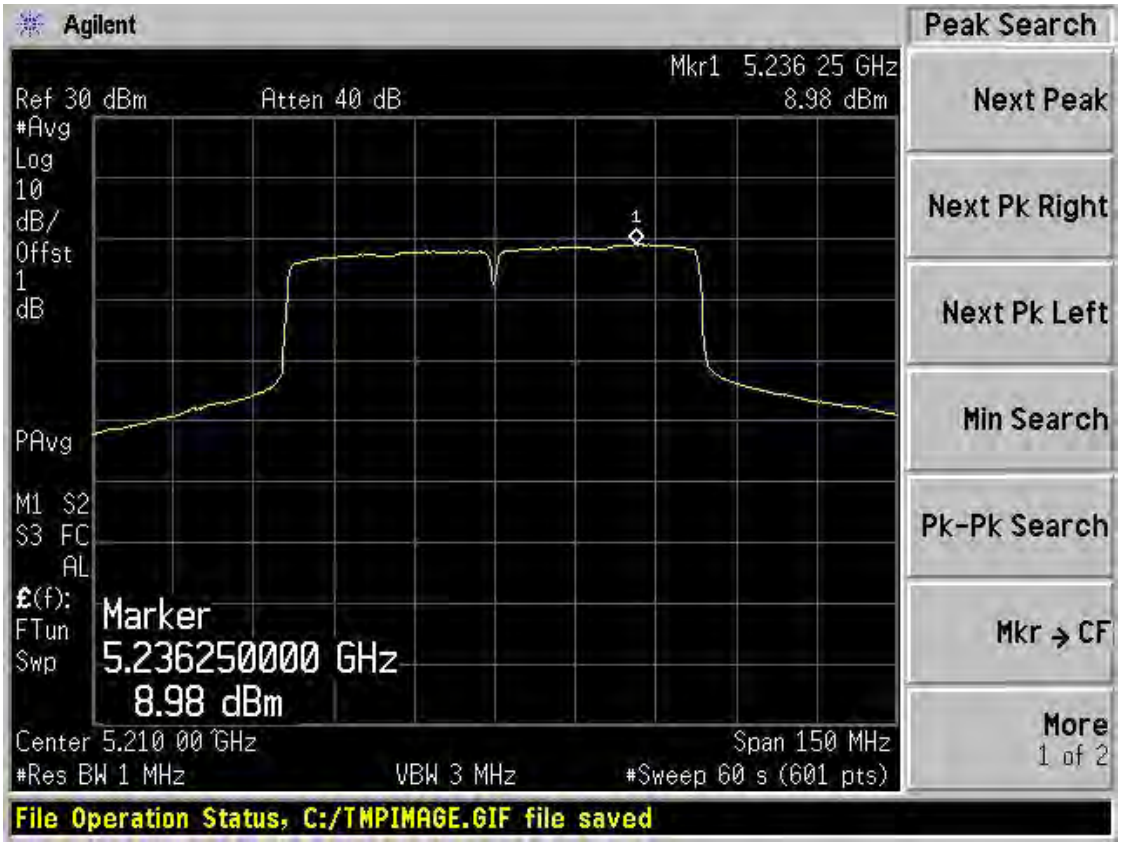
Band I 11ac(HT40) CH38 Chain 2



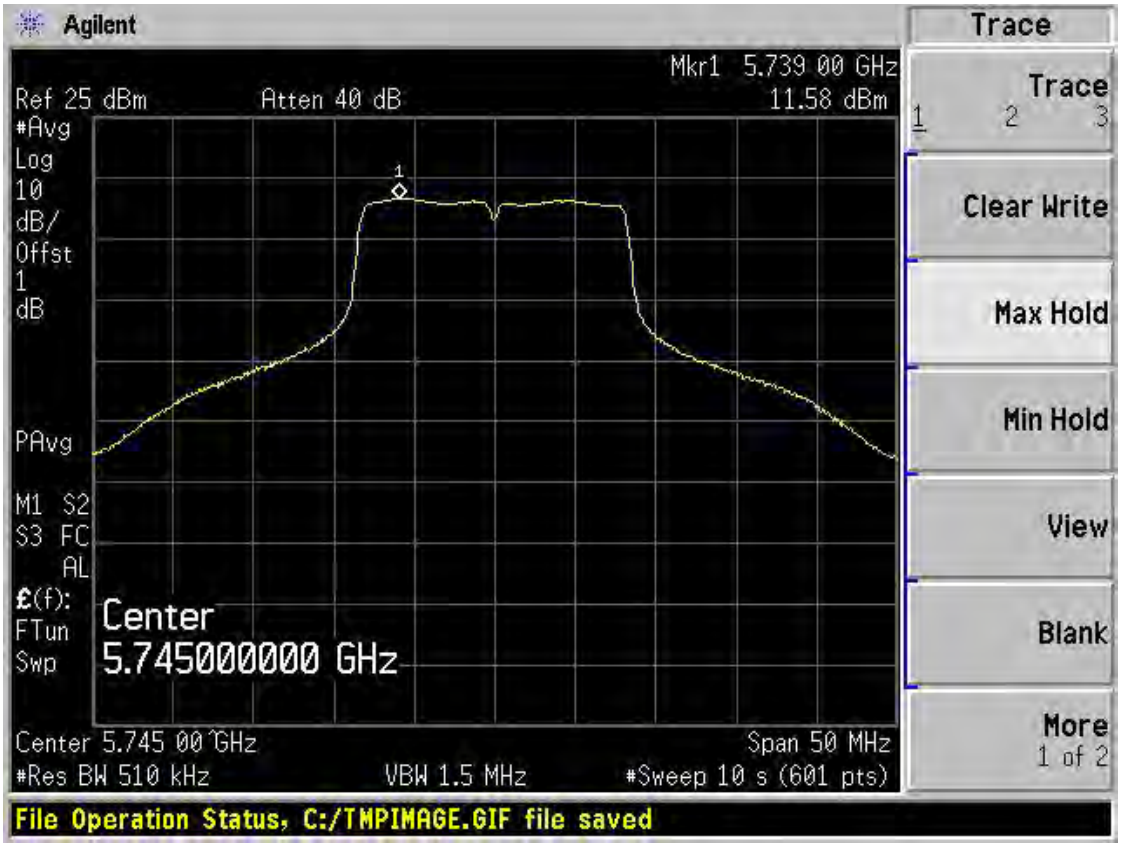
Band I 11ac(HT40) CH46 Chain 2



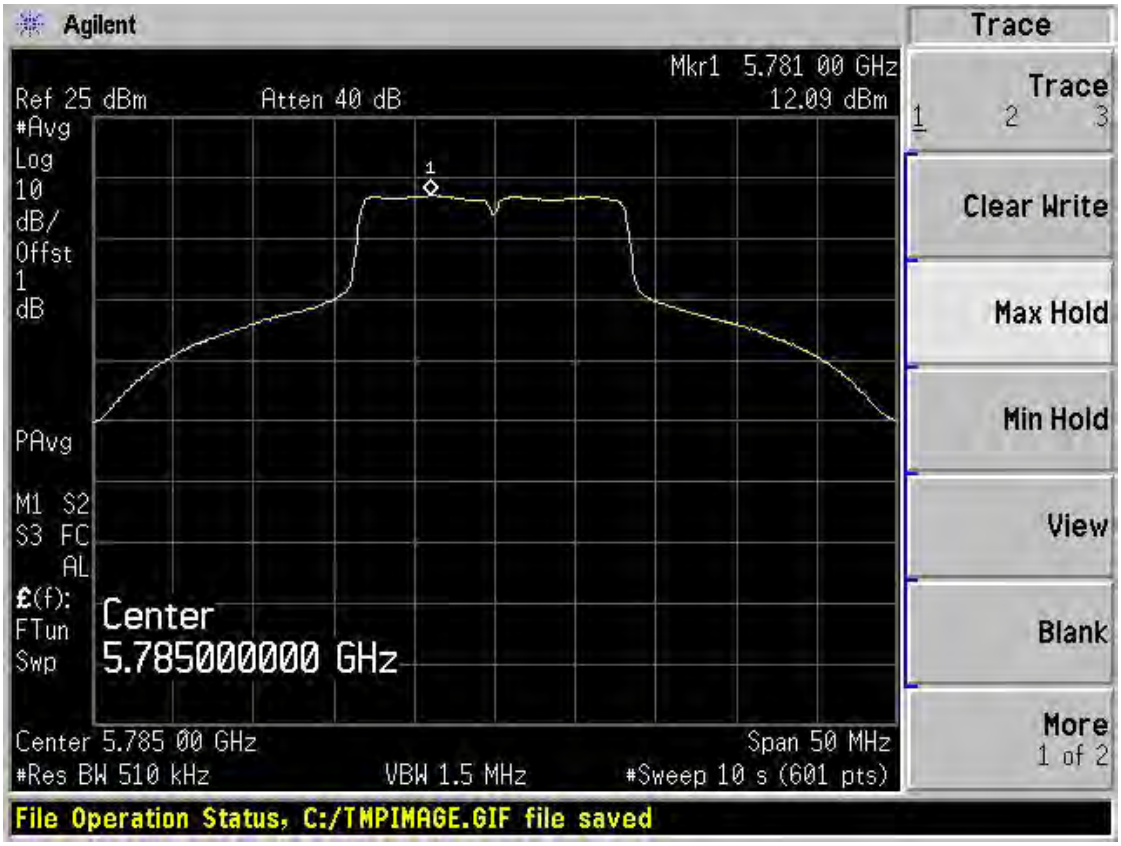
Band I 11ac(HT80) CH42 Chain 2



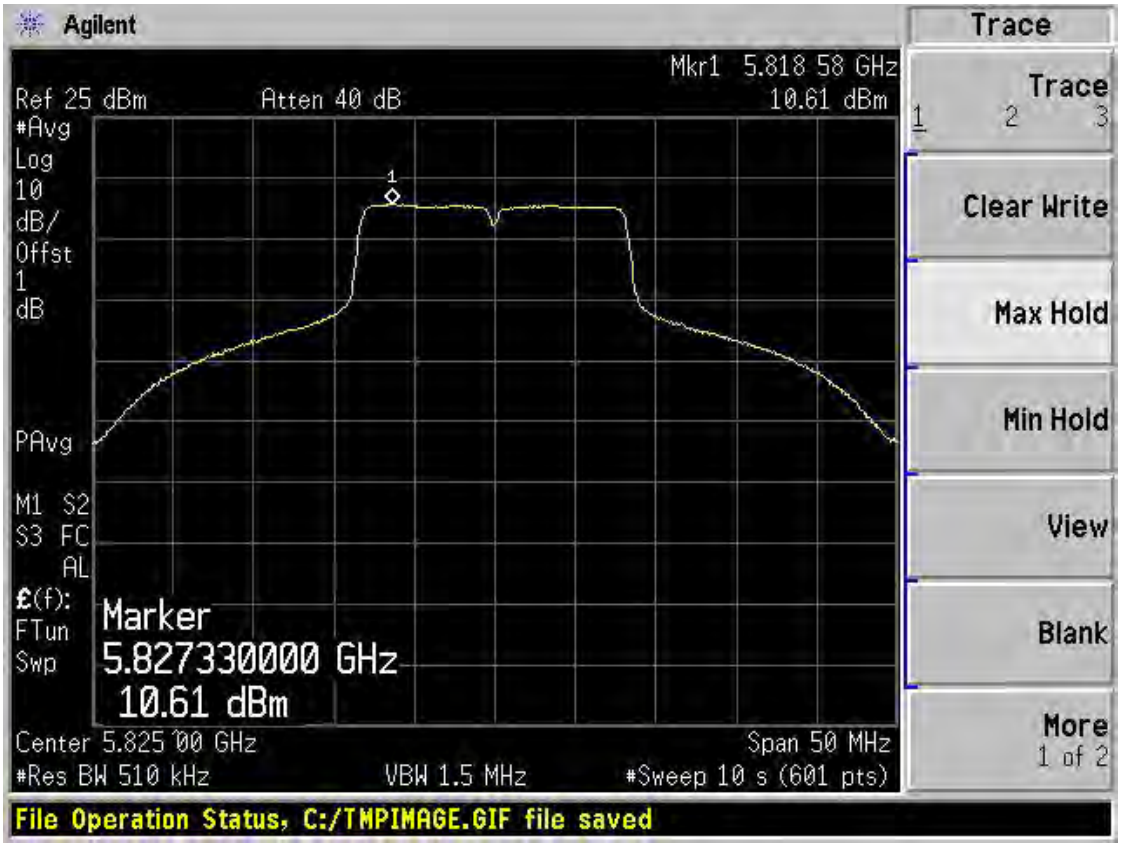
Band IV 11a CH149 Chain 1



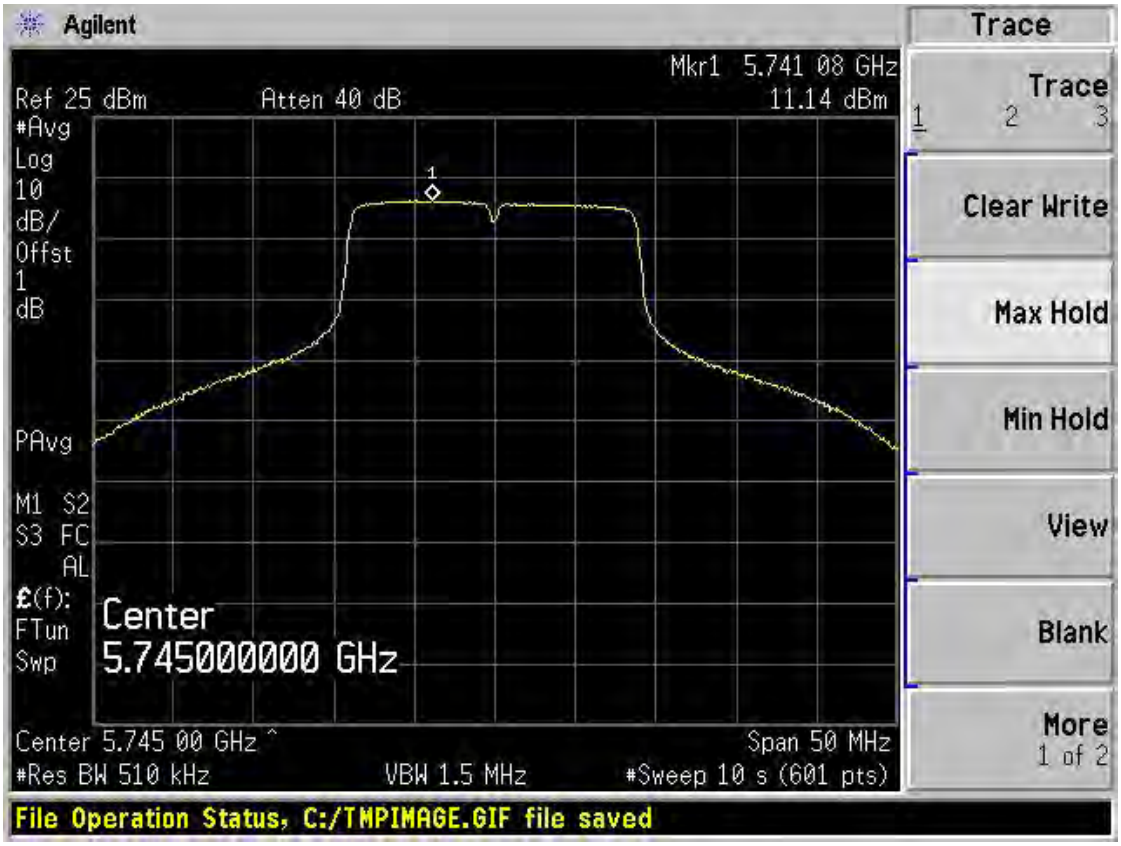
Band IV 11a CH157 Chain 1



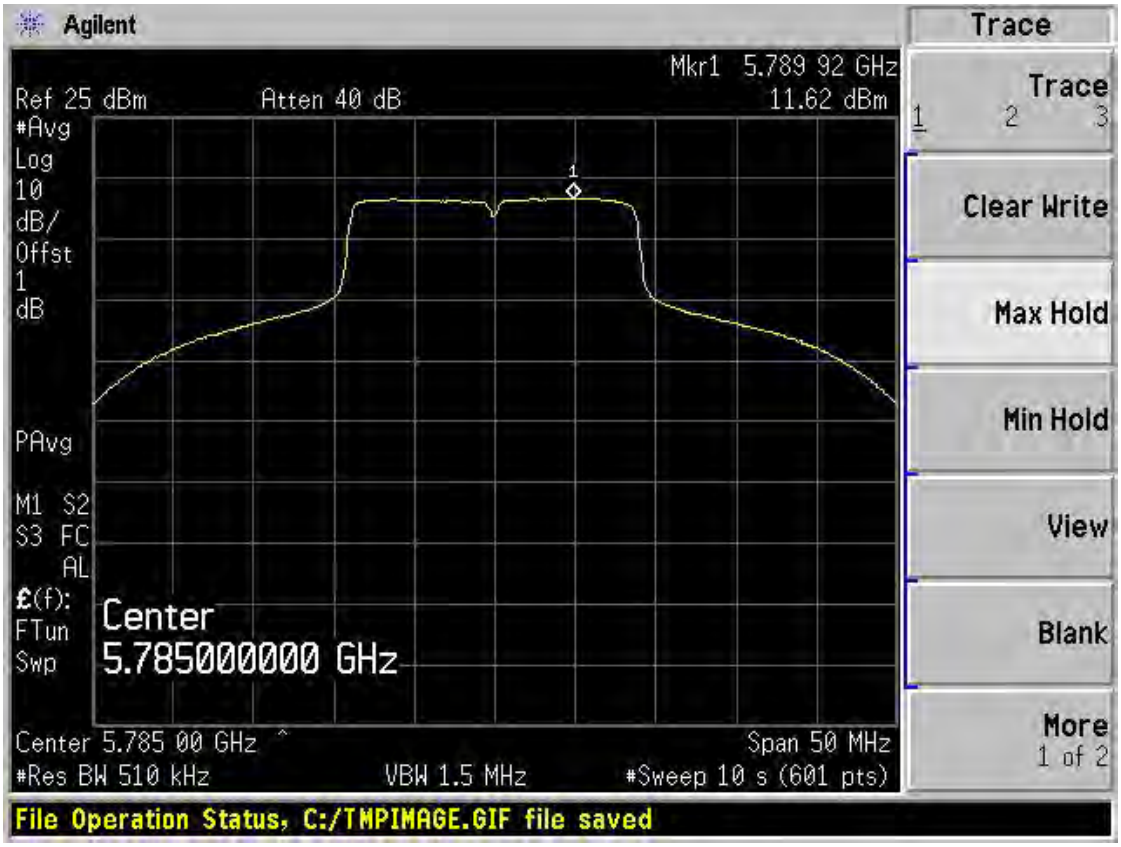
Band IV 11a CH165 Chain 1



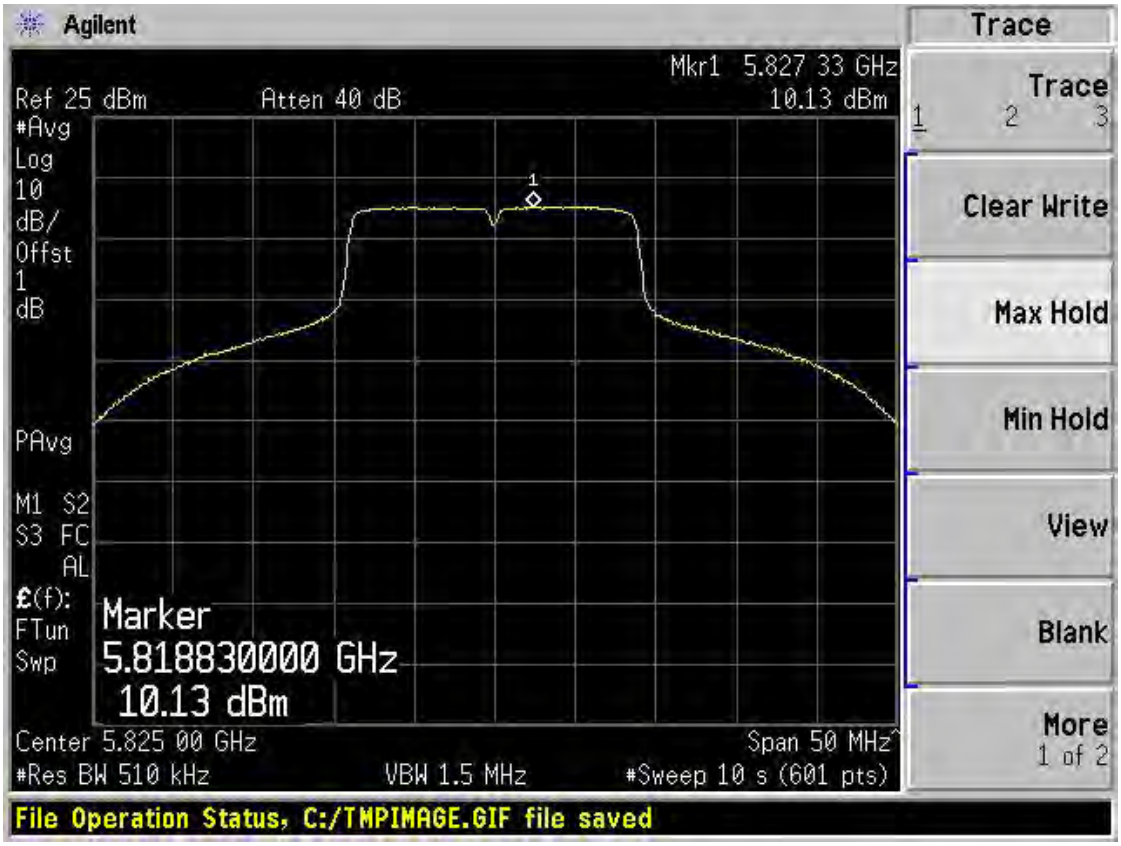
Band IV 11n(HT20) CH149 Chain 1



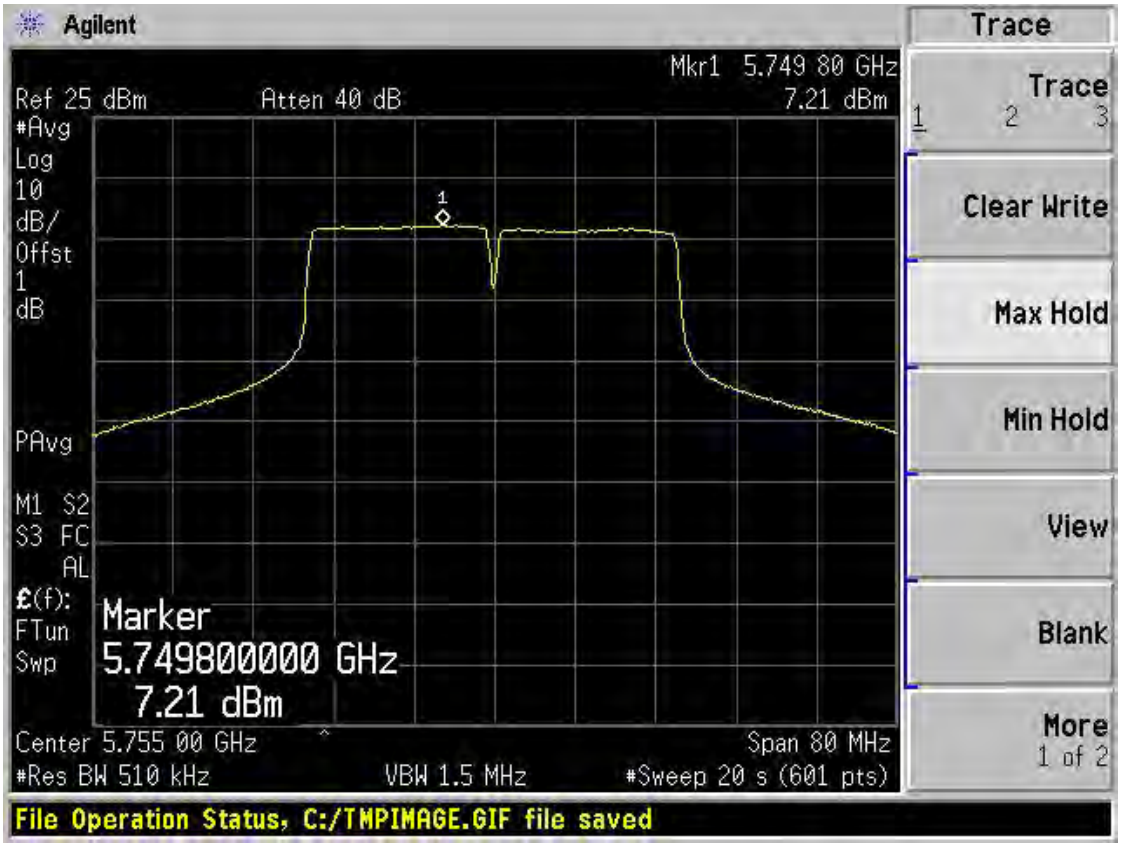
Band IV 11n(HT20) CH157 Chain 1



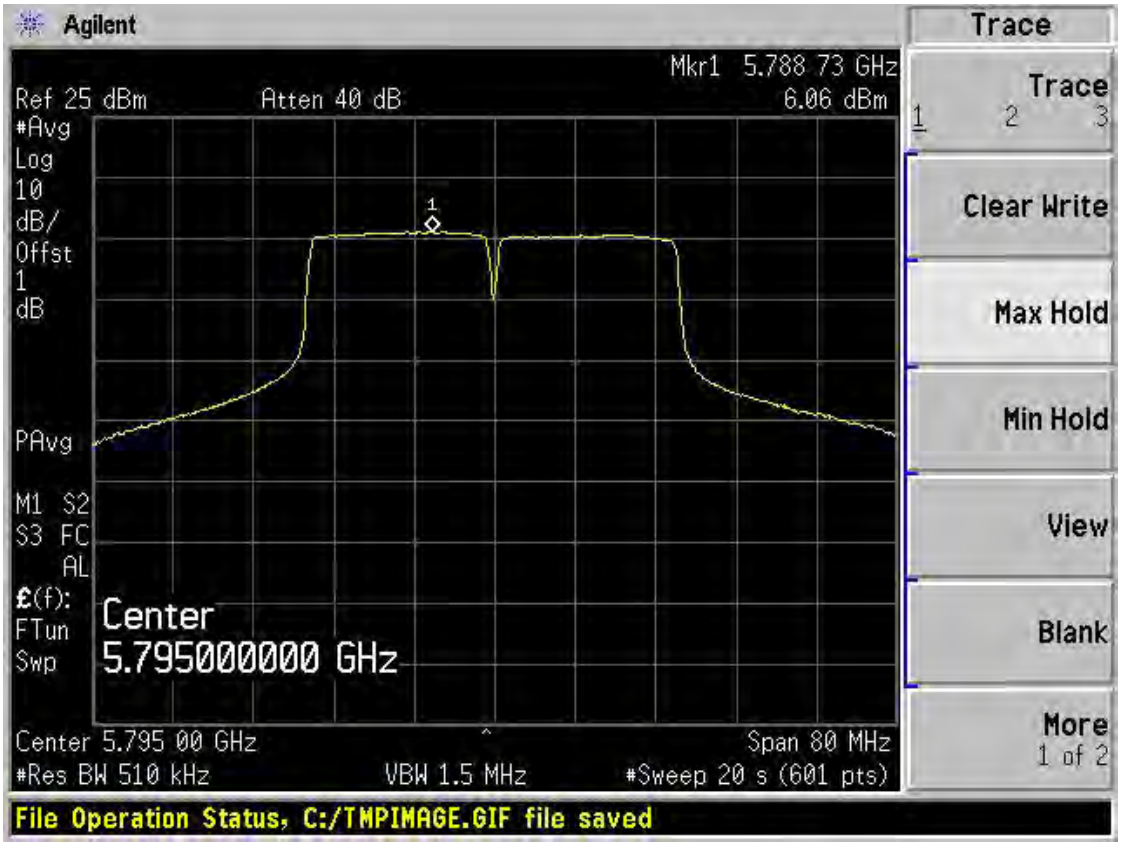
Band IV 11n(HT20) CH165 Chain 1



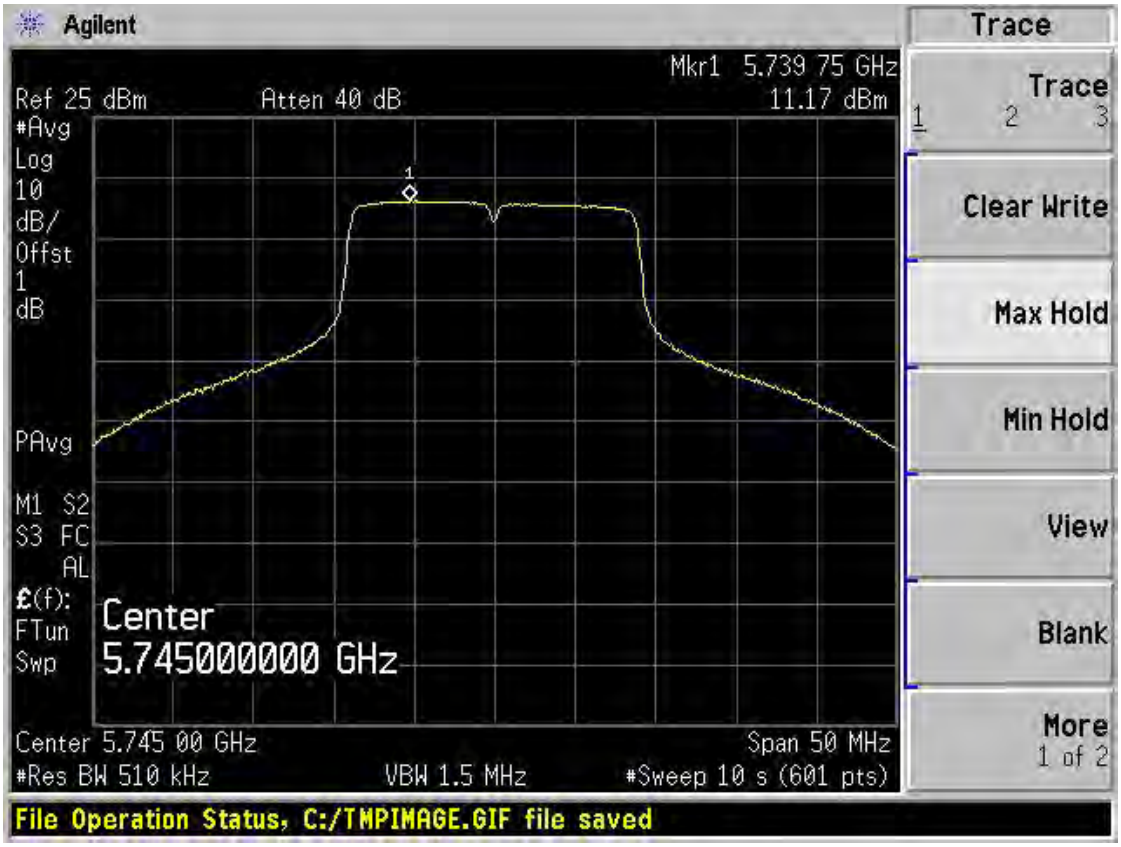
Band IV 11n(HT40) CH151 Chain 1



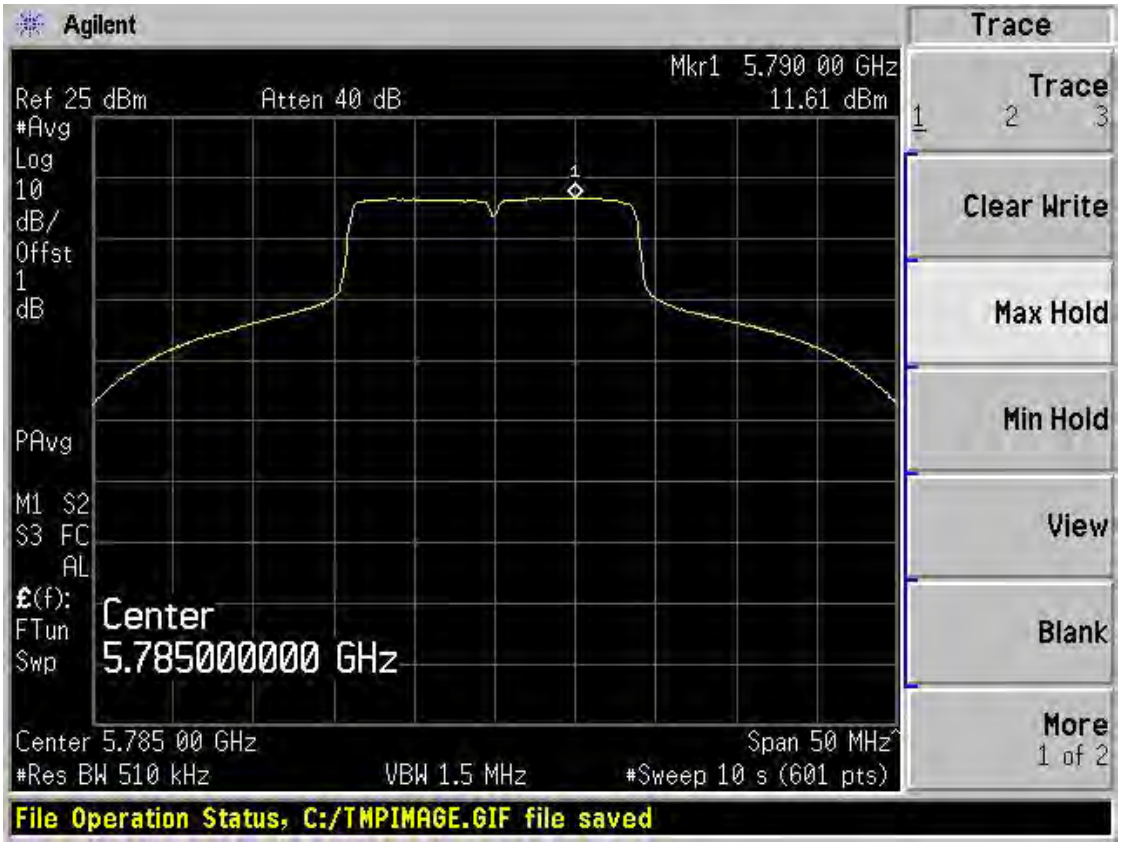
Band IV 11n(HT40) CH159 Chain 1



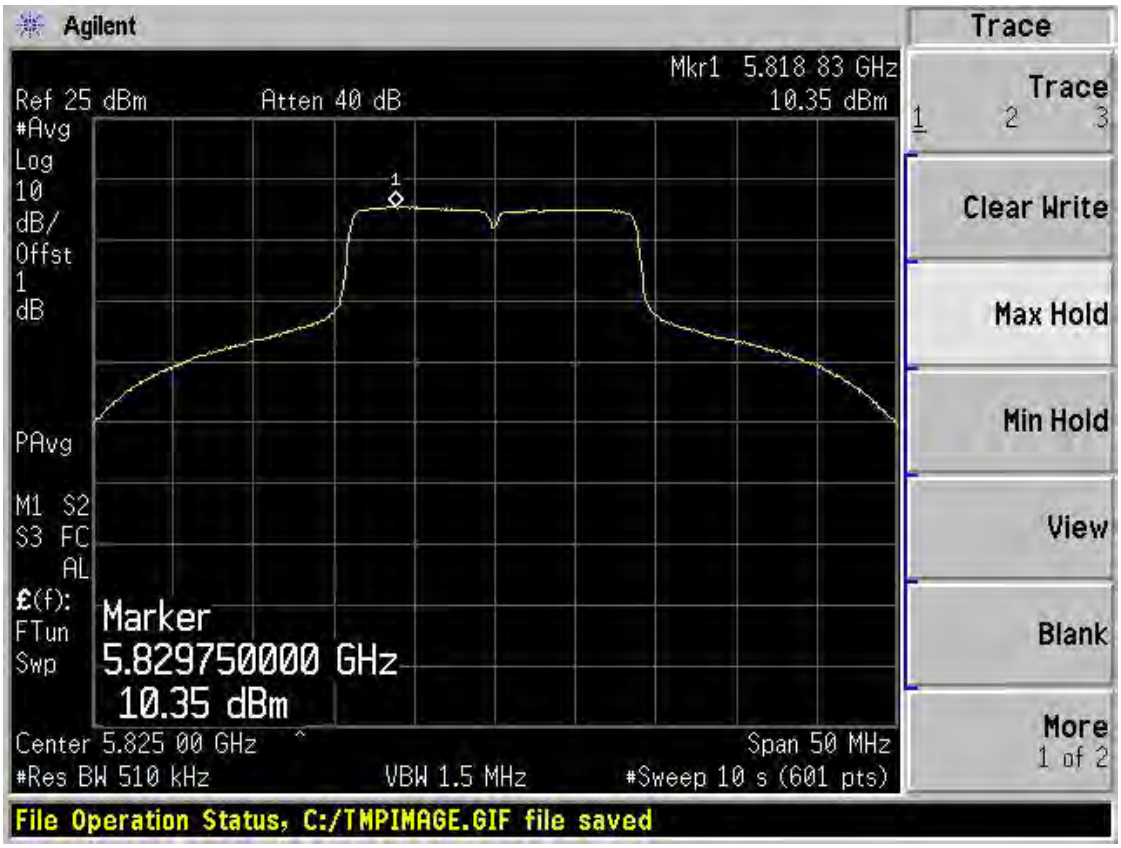
Band IV 11ac(HT20) CH149 Chain 1



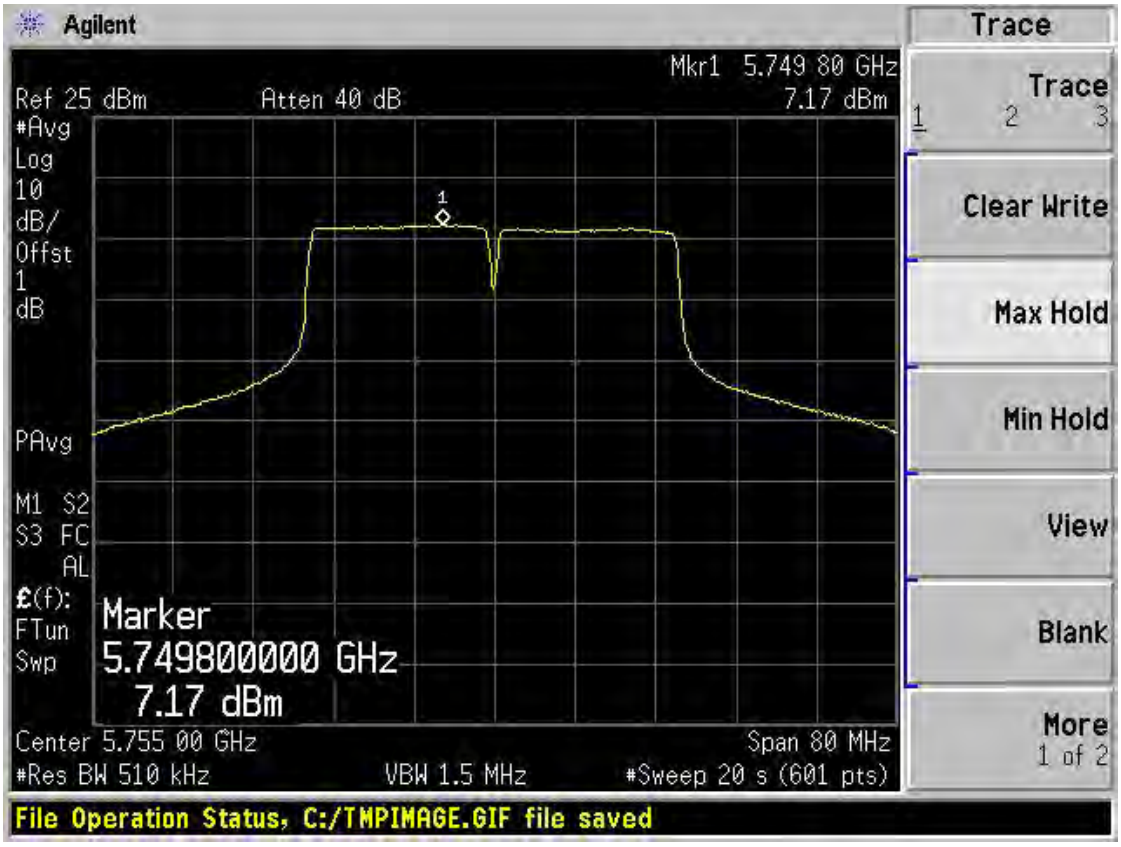
Band IV 11ac(HT20) CH157 Chain 1



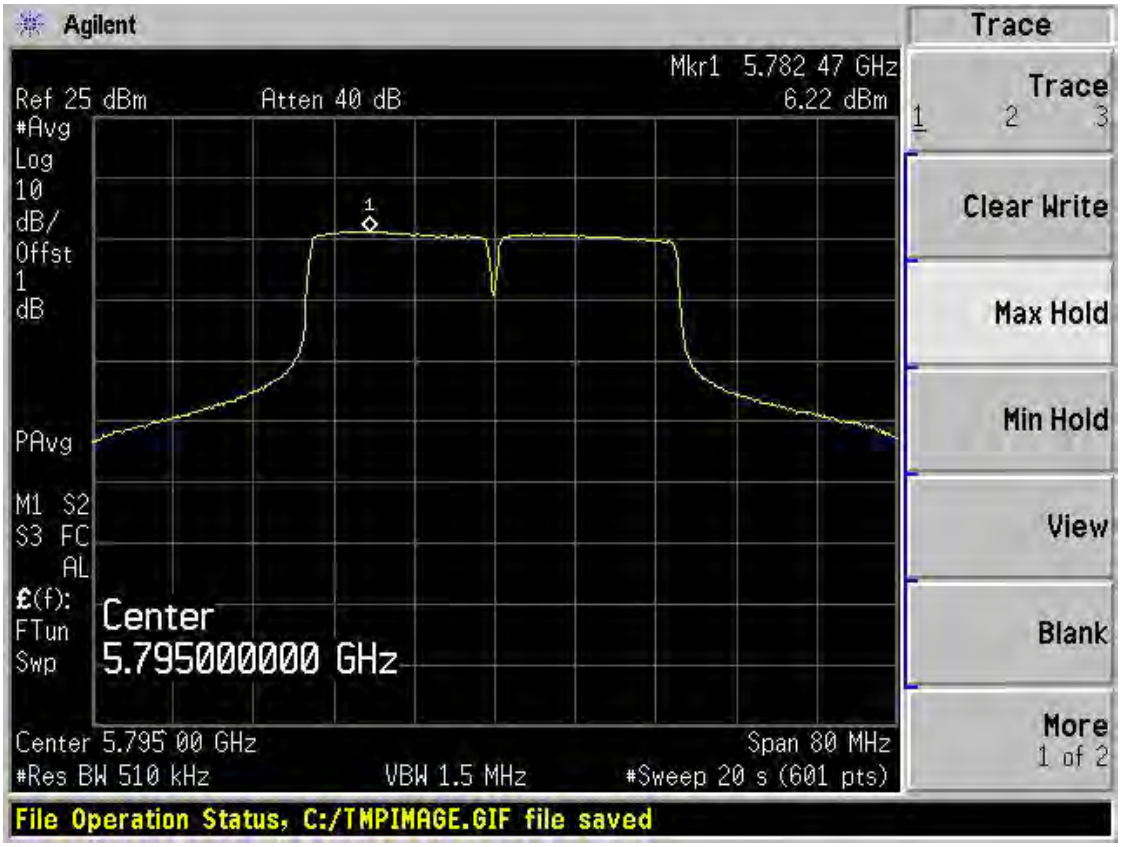
Band IV 11ac(HT20) CH165 Chain 1



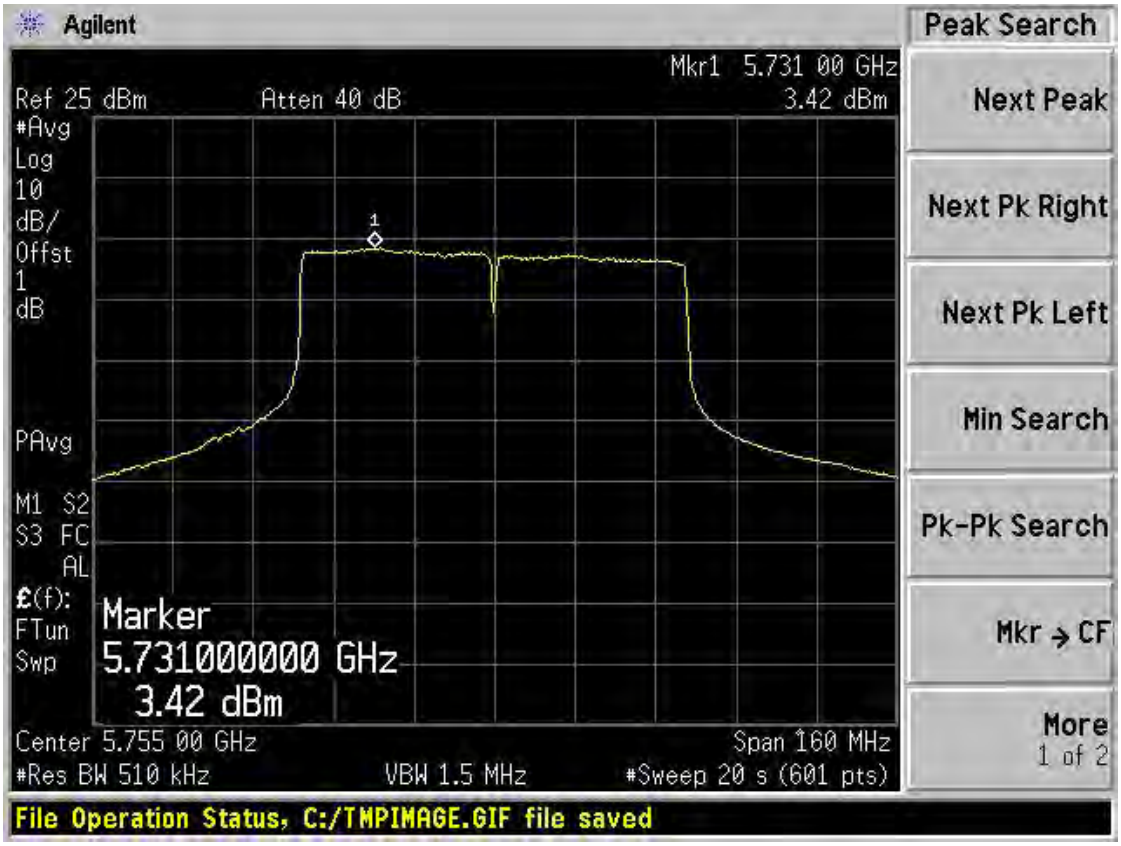
Band IV 11ac(HT40) CH151 Chain 1



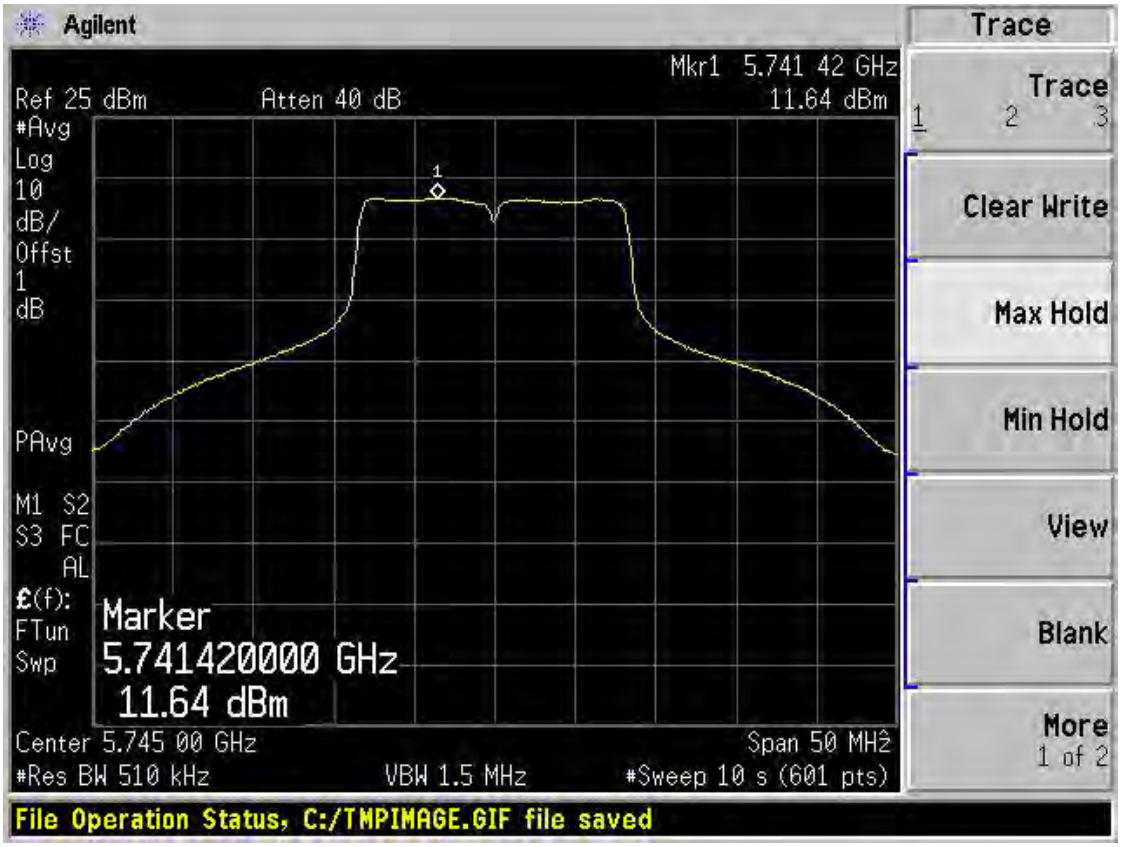
Band IV 11ac(HT40) CH159 Chain 1



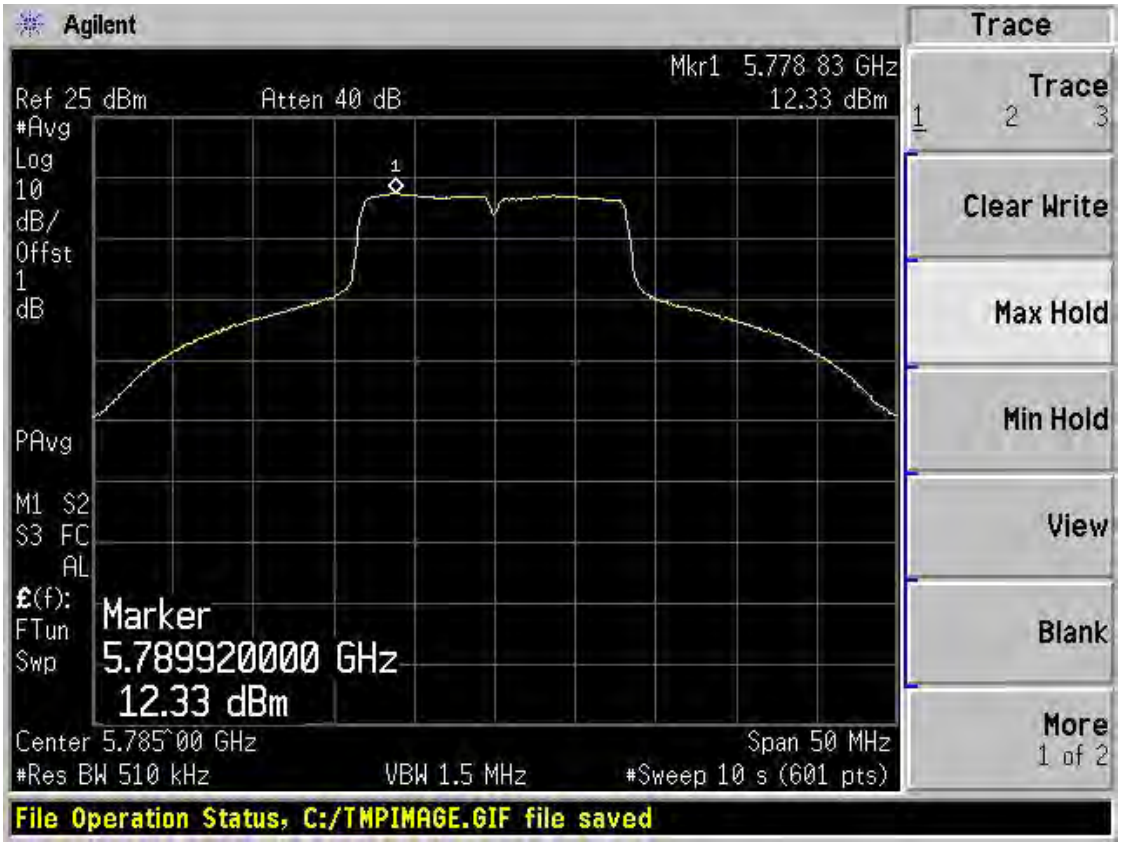
Band IV 11ac(HT80) CH155 Chain 1



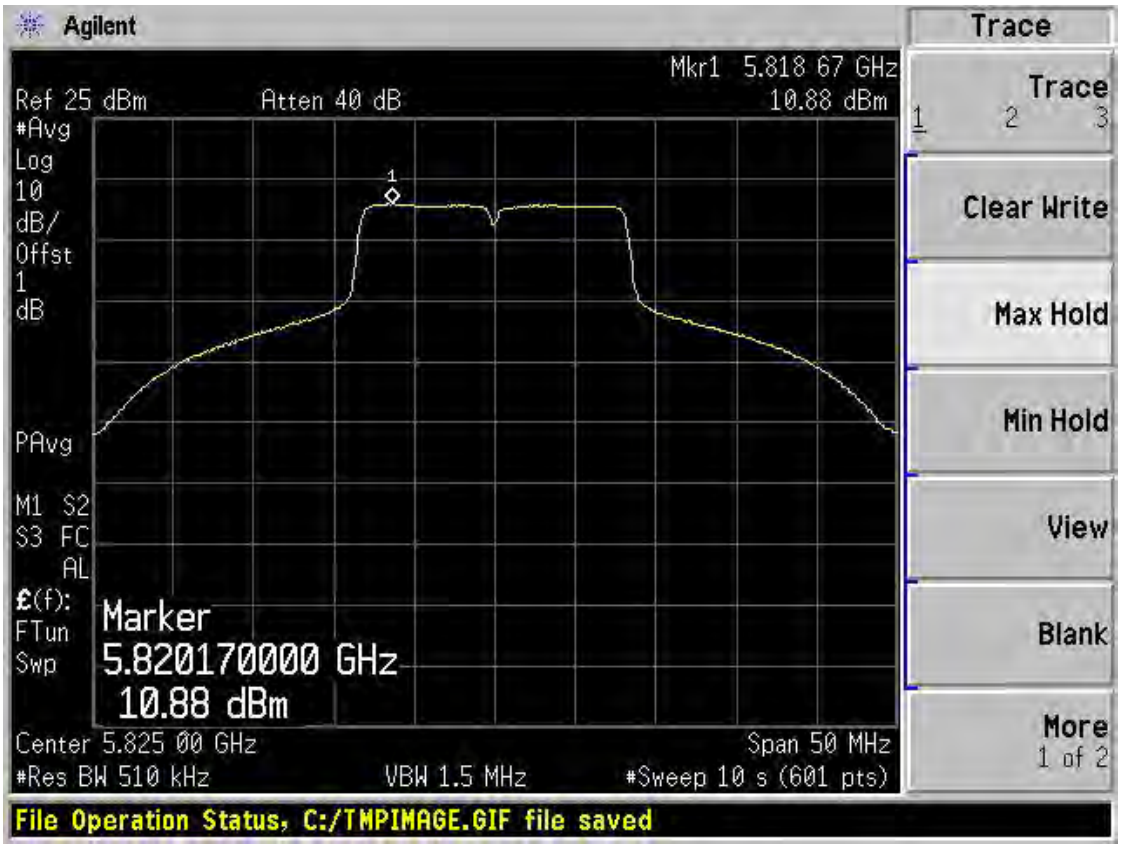
Band IV 11a CH149 Chain 2



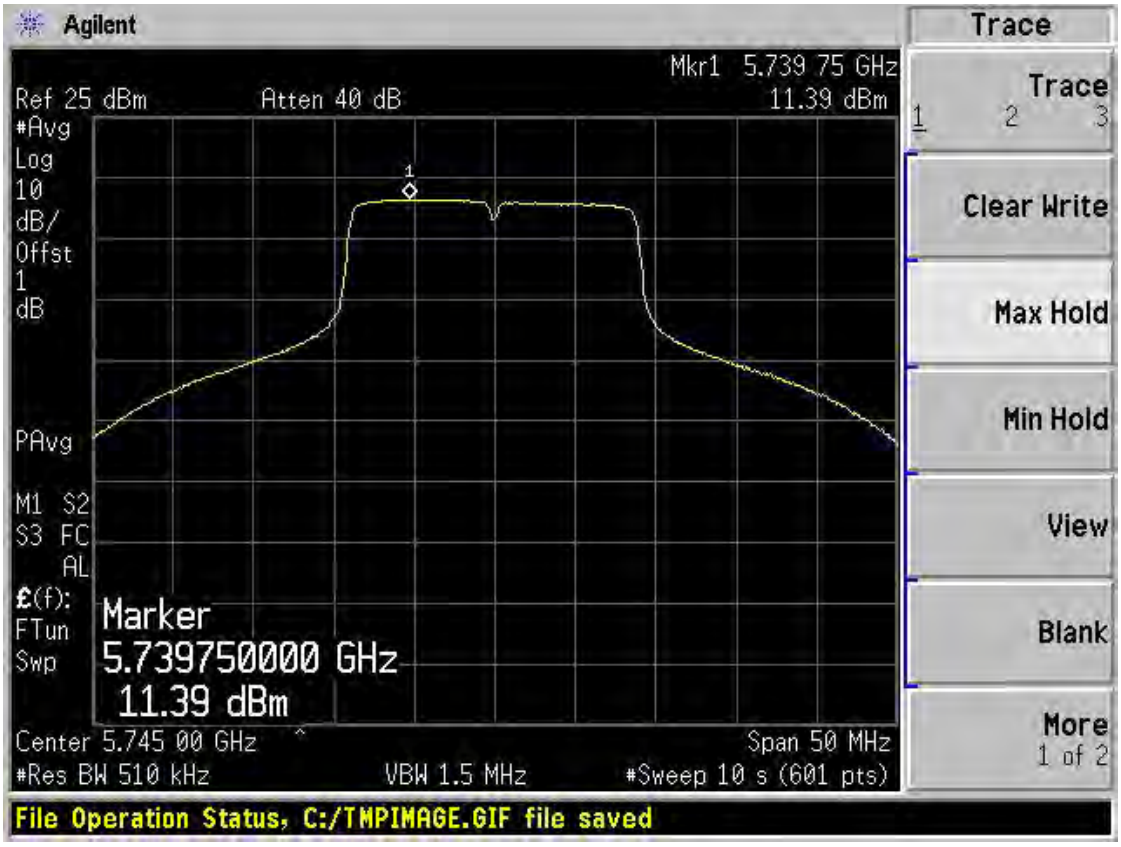
Band IV 11a CH157 Chain 2



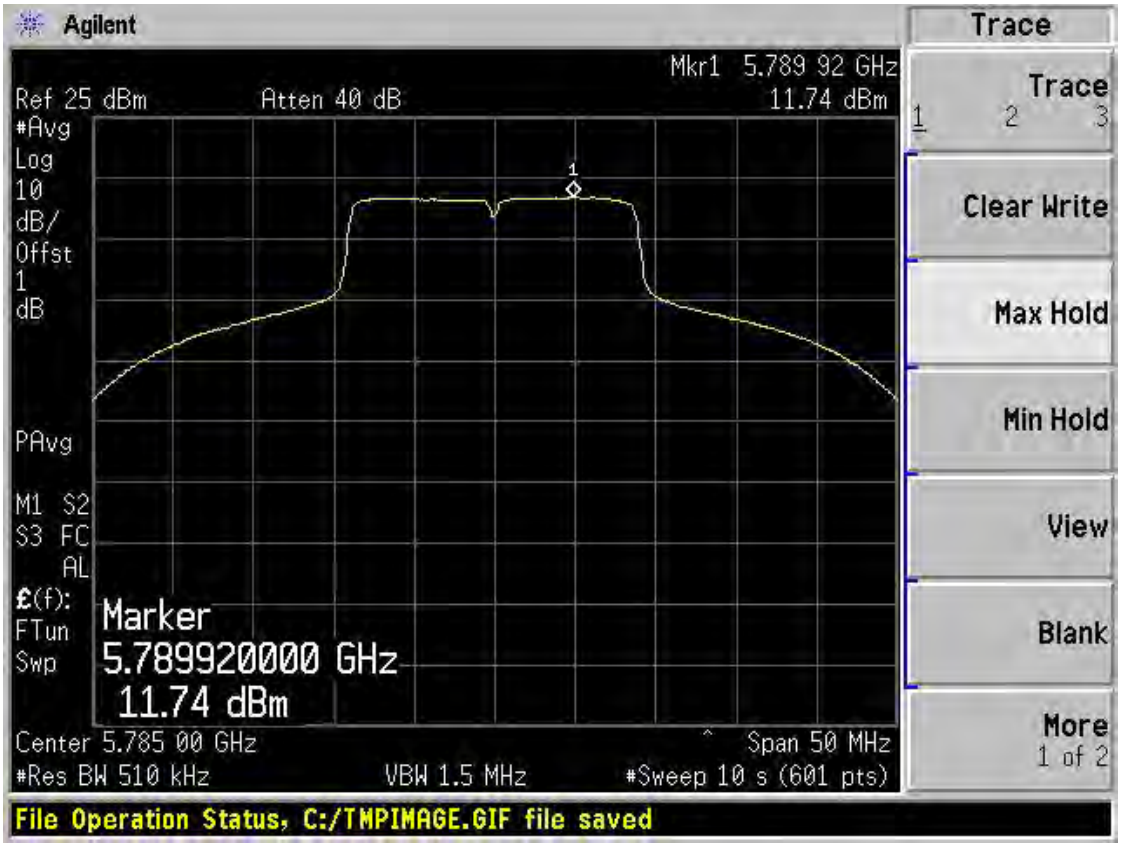
Band IV 11a CH165 Chain 2



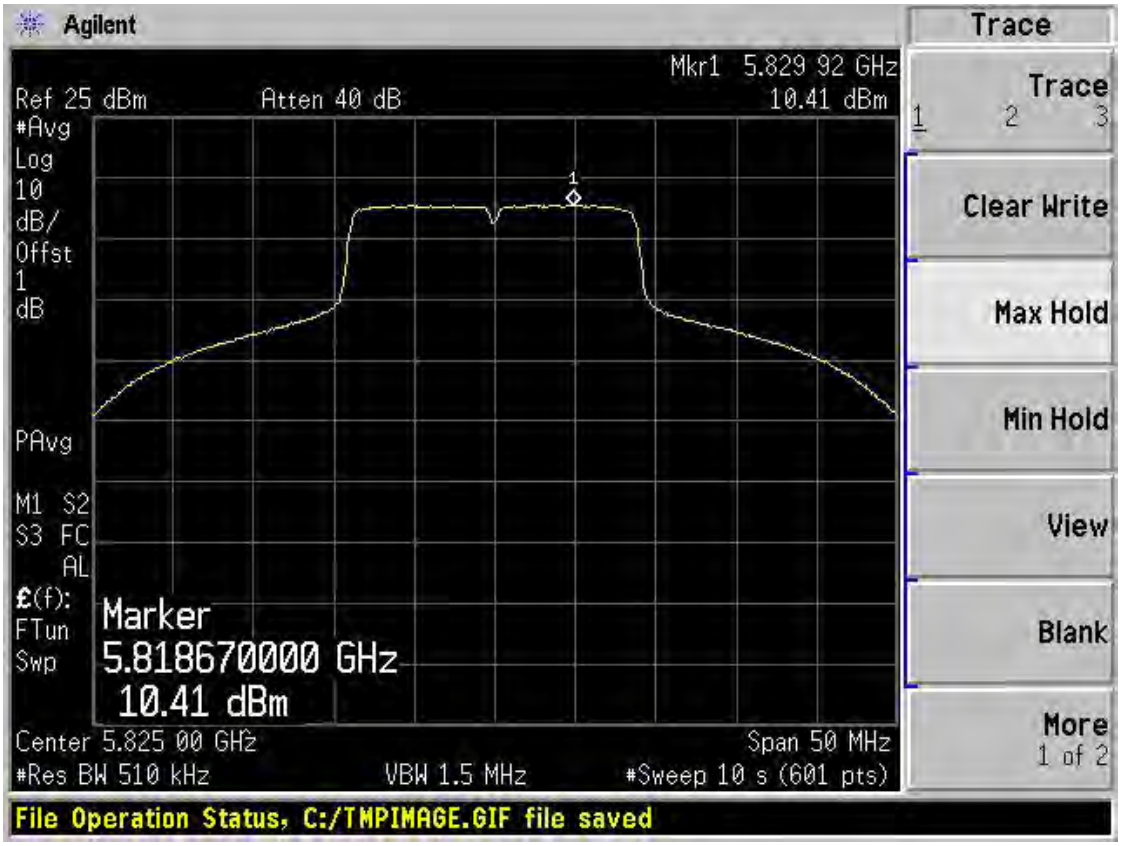
Band IV 11n(HT20) CH149 Chain 2



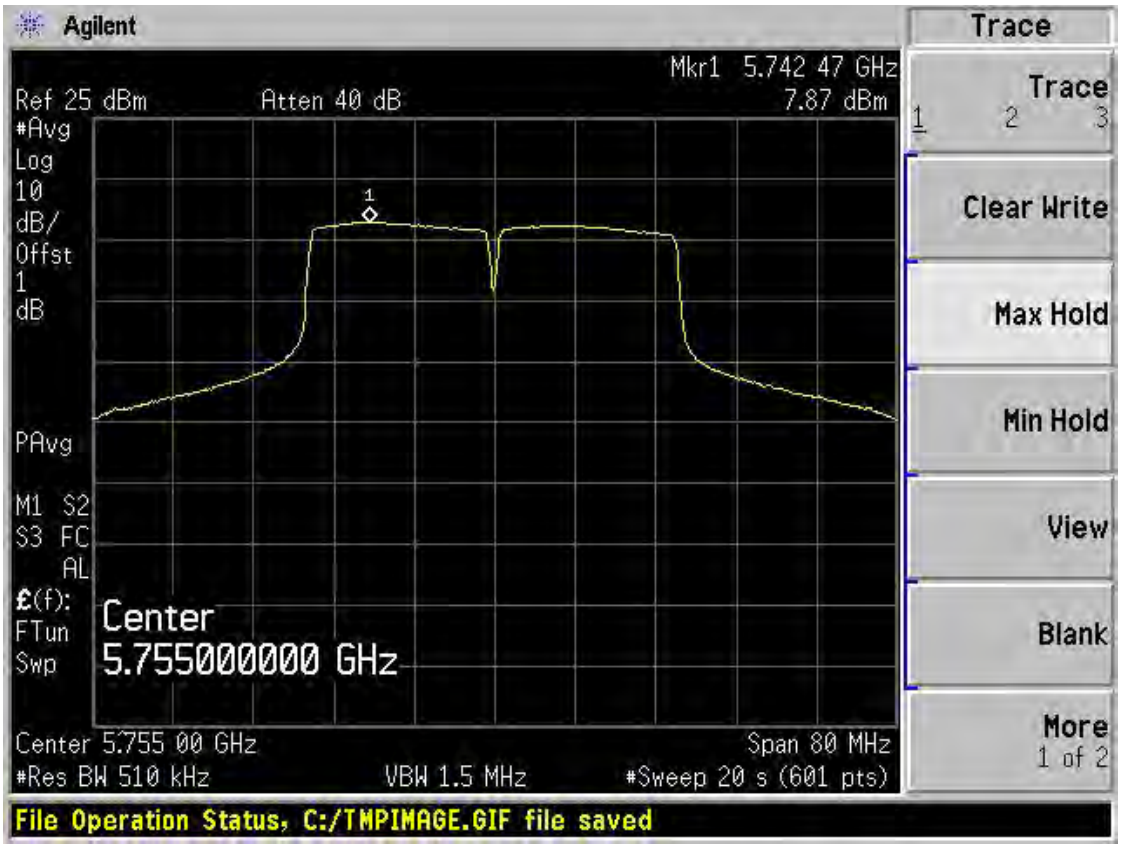
Band IV 11n(HT20) CH157 Chain 2



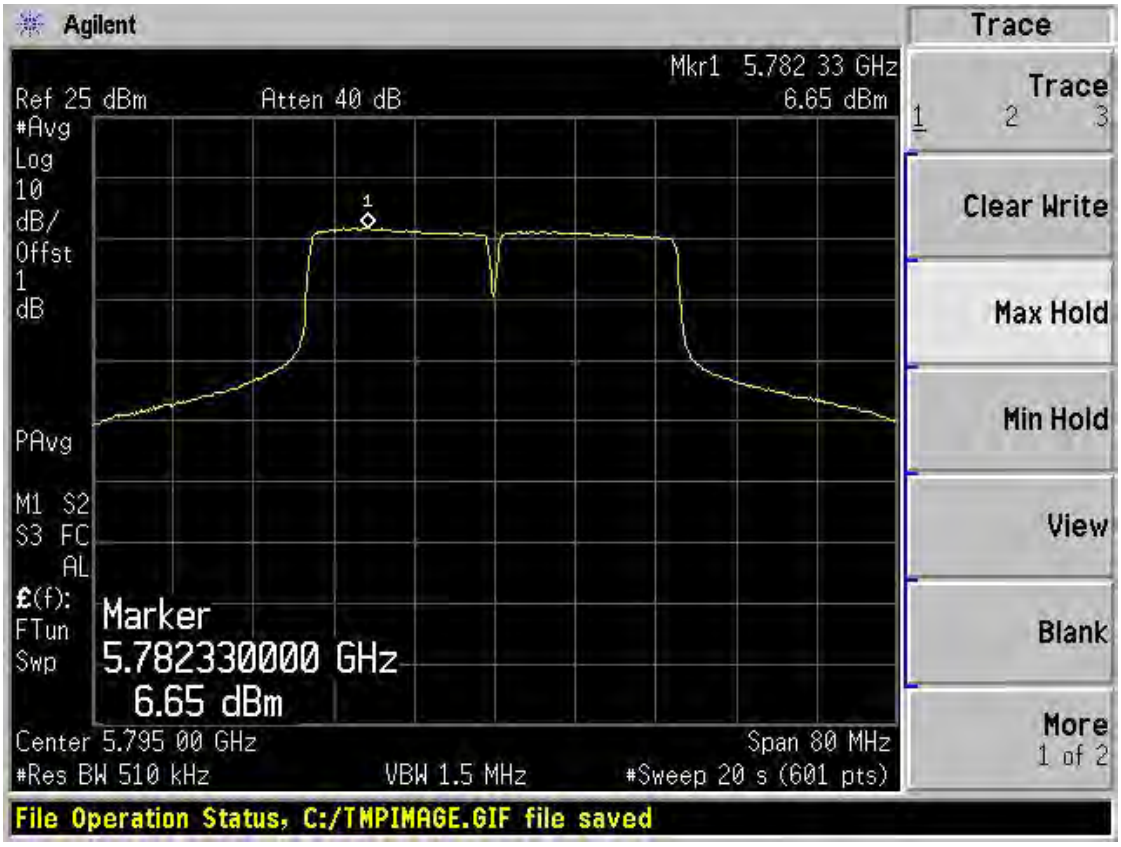
Band IV 11n(HT20) CH165 Chain 2



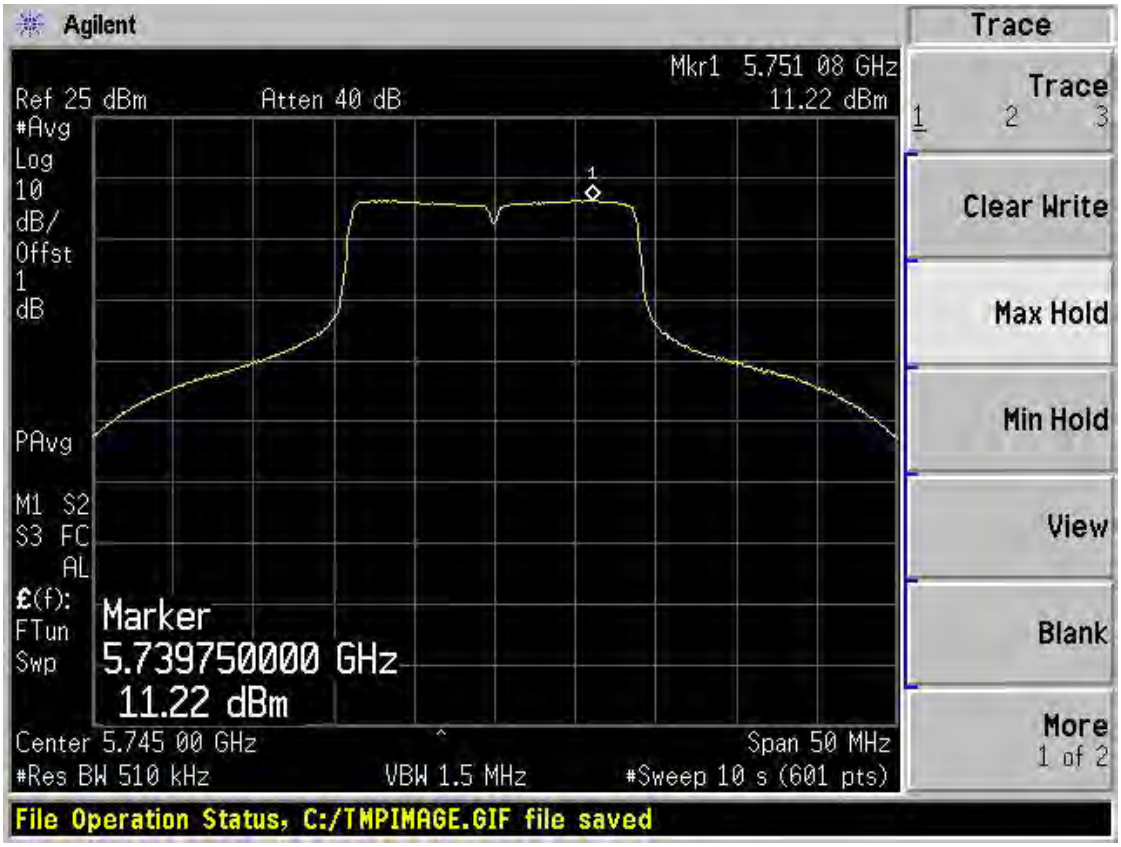
Band IV 11n(HT40) CH151 Chain 2



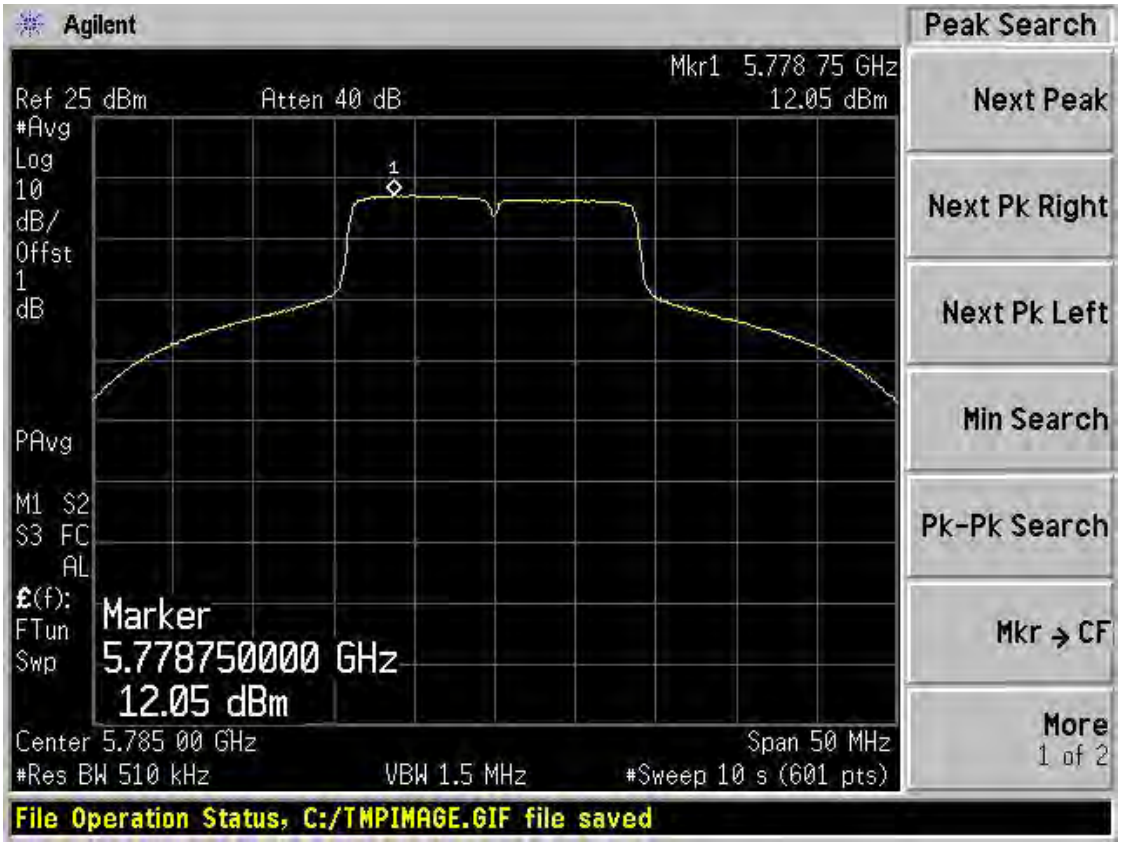
Band IV 11n(HT40) CH159 Chain 2



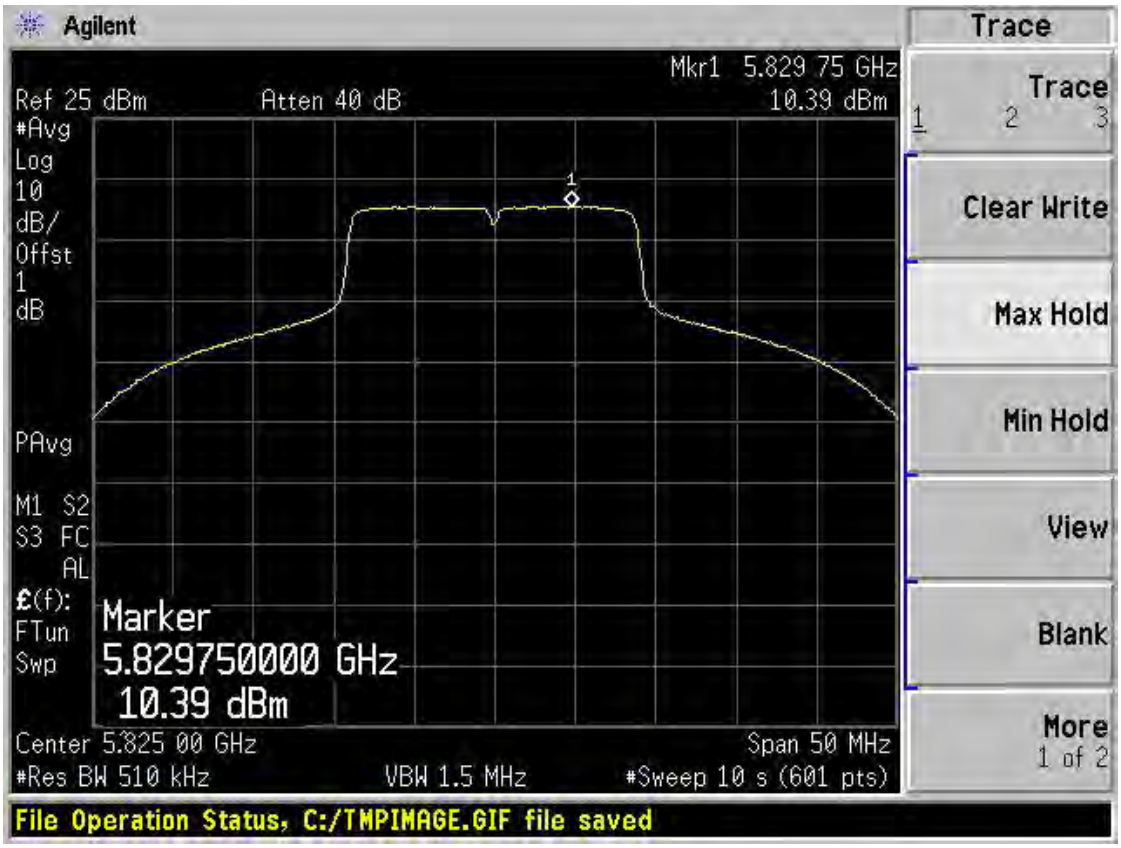
Band IV 11ac(HT20) CH149 Chain 2



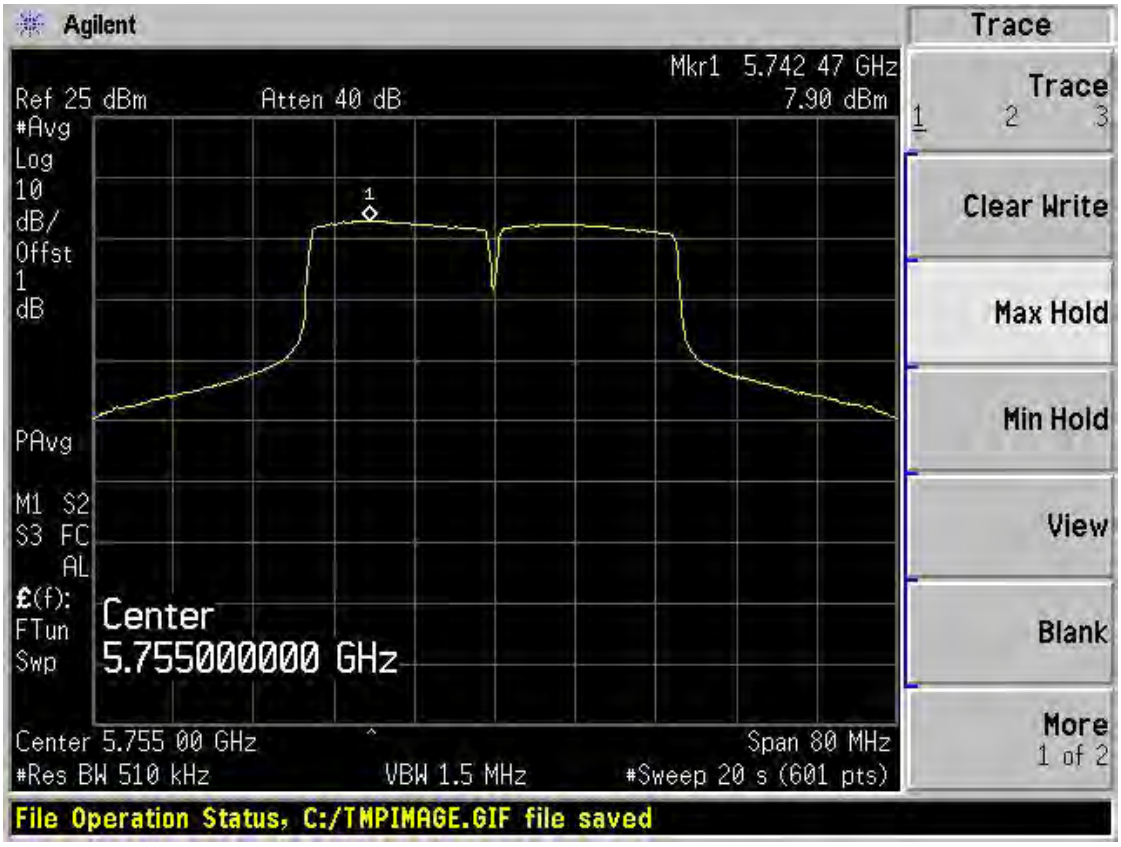
Band IV 11ac(HT20) CH157 Chain 2



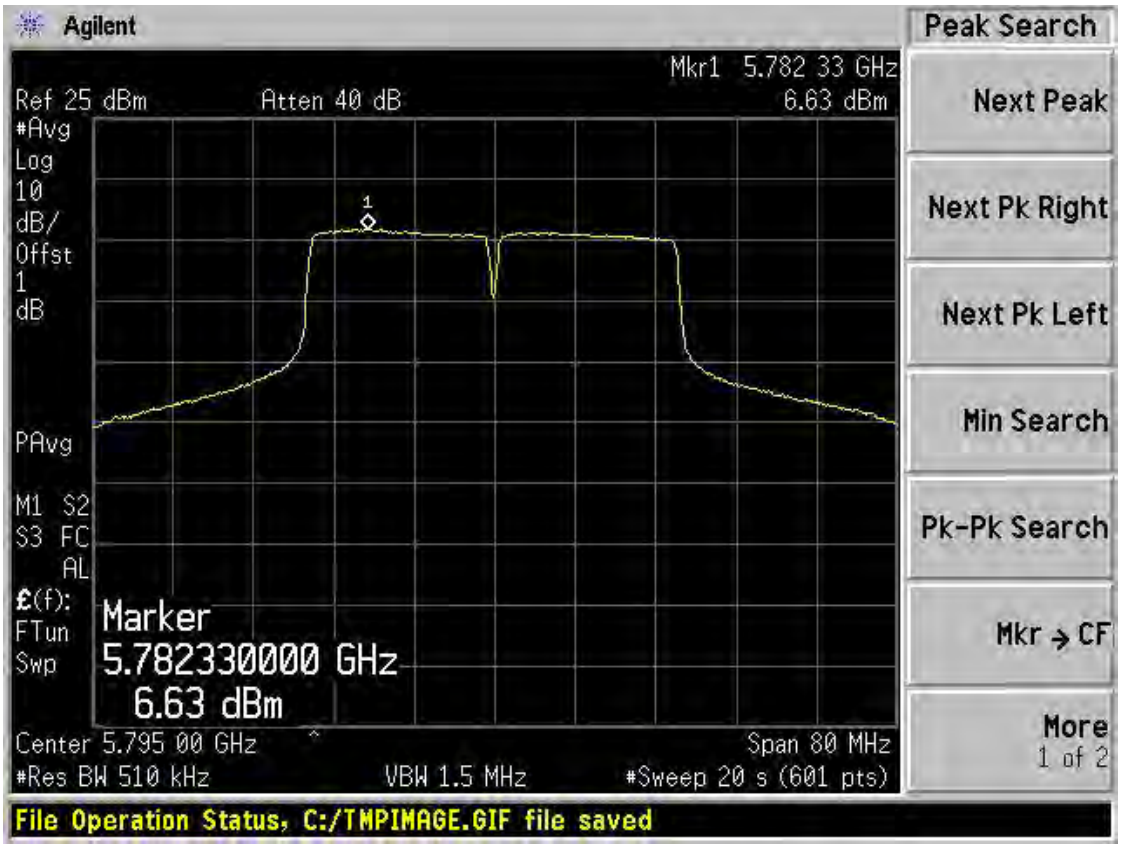
Band IV 11ac(HT20) CH165 Chain 2



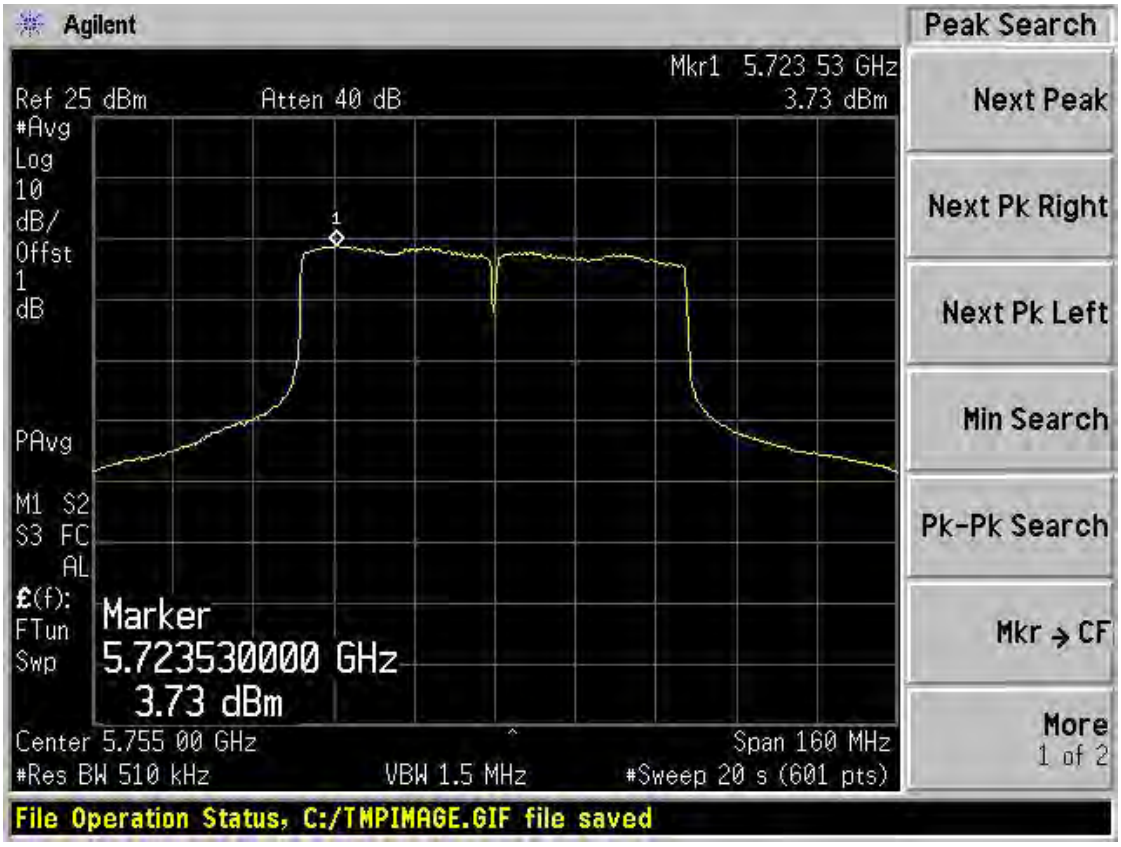
Band IV 11ac(HT40) CH151 Chain 2



Band IV 11ac(HT40) CH159 Chain 2



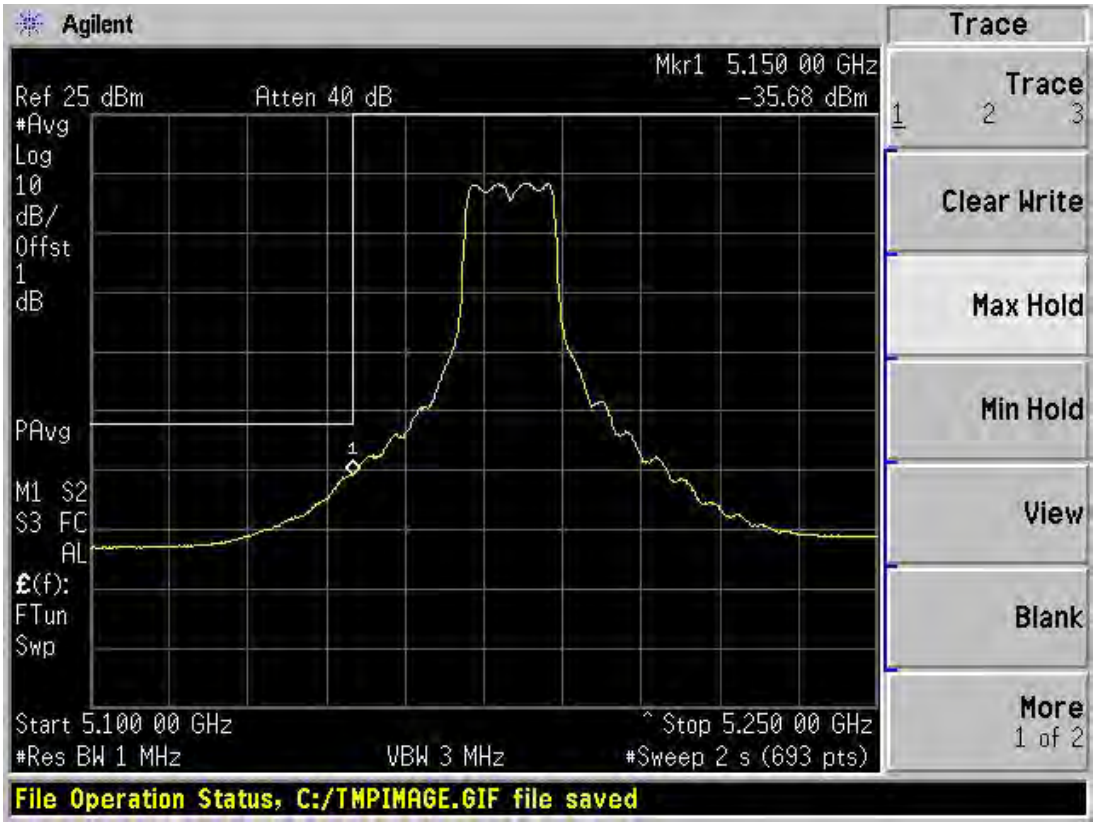
Band IV 11ac(HT80) CH155 Chain 2



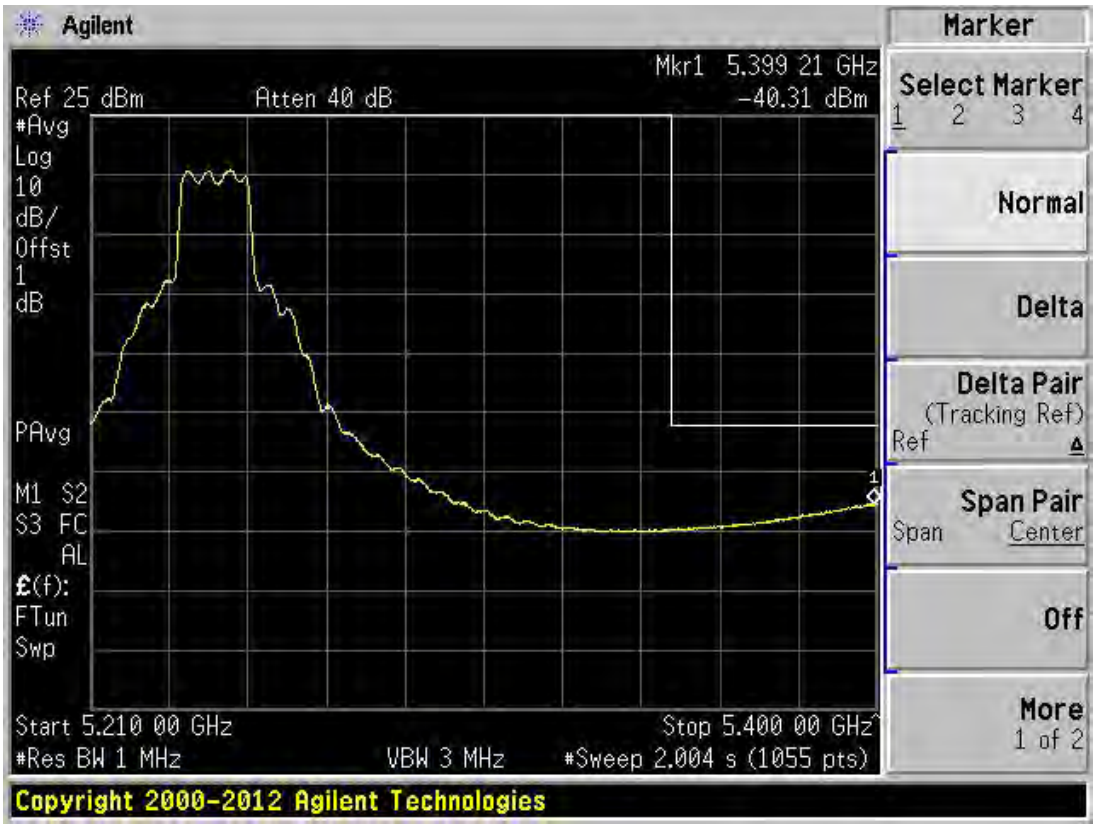
A.5 Band Edge

Test Data and Test Plots

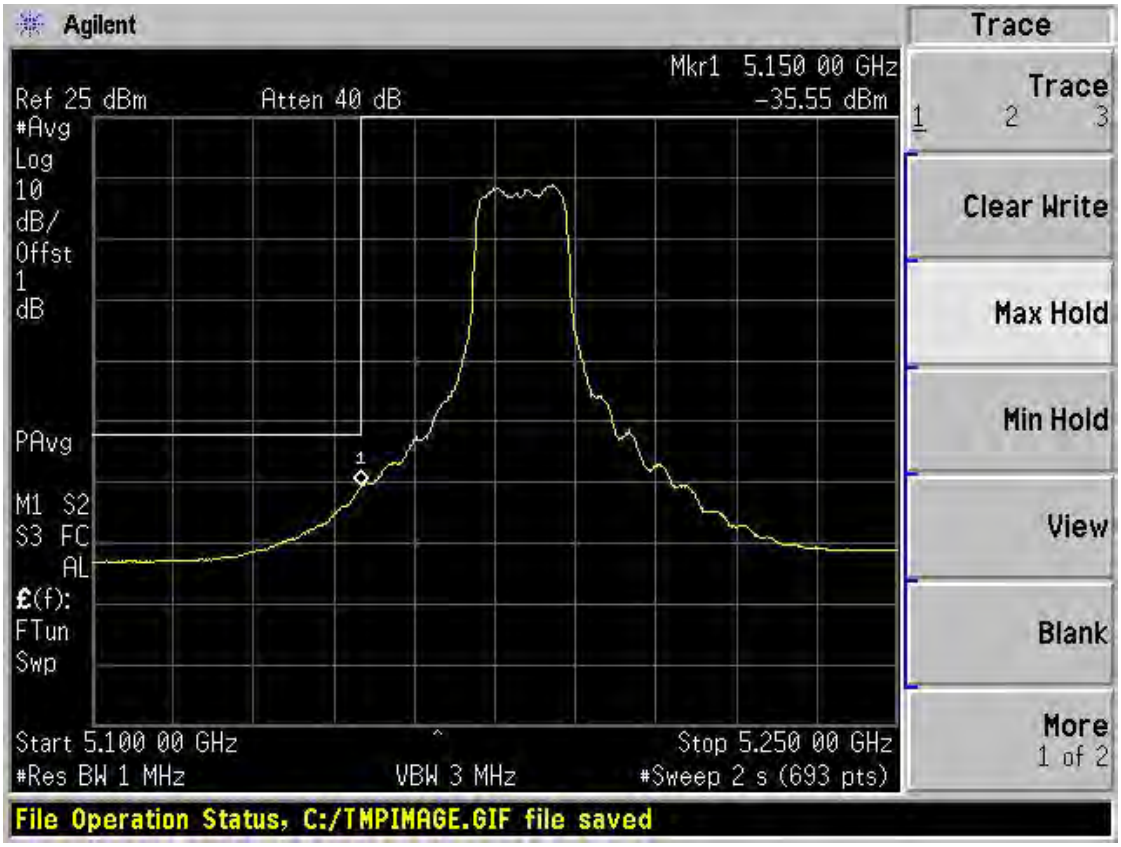
Band I 11a CH36 Chain 1



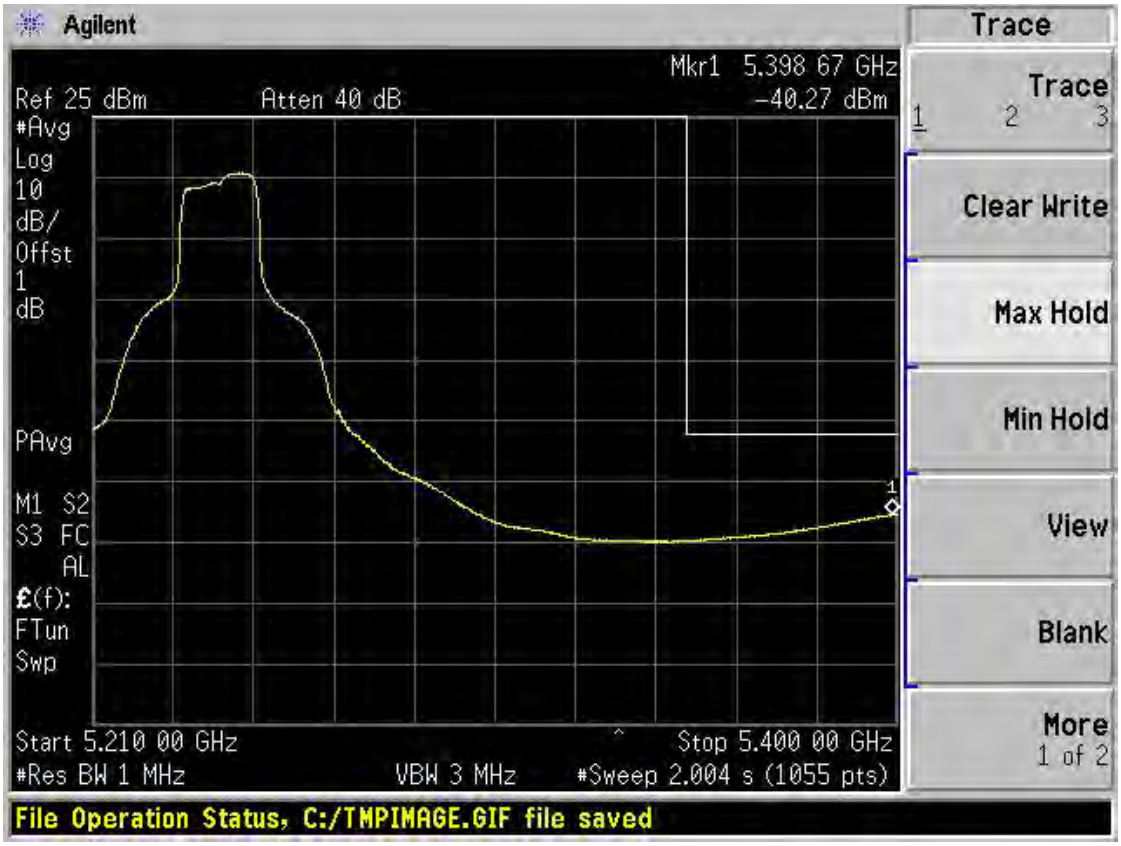
Band I 11a CH48 Chain 1



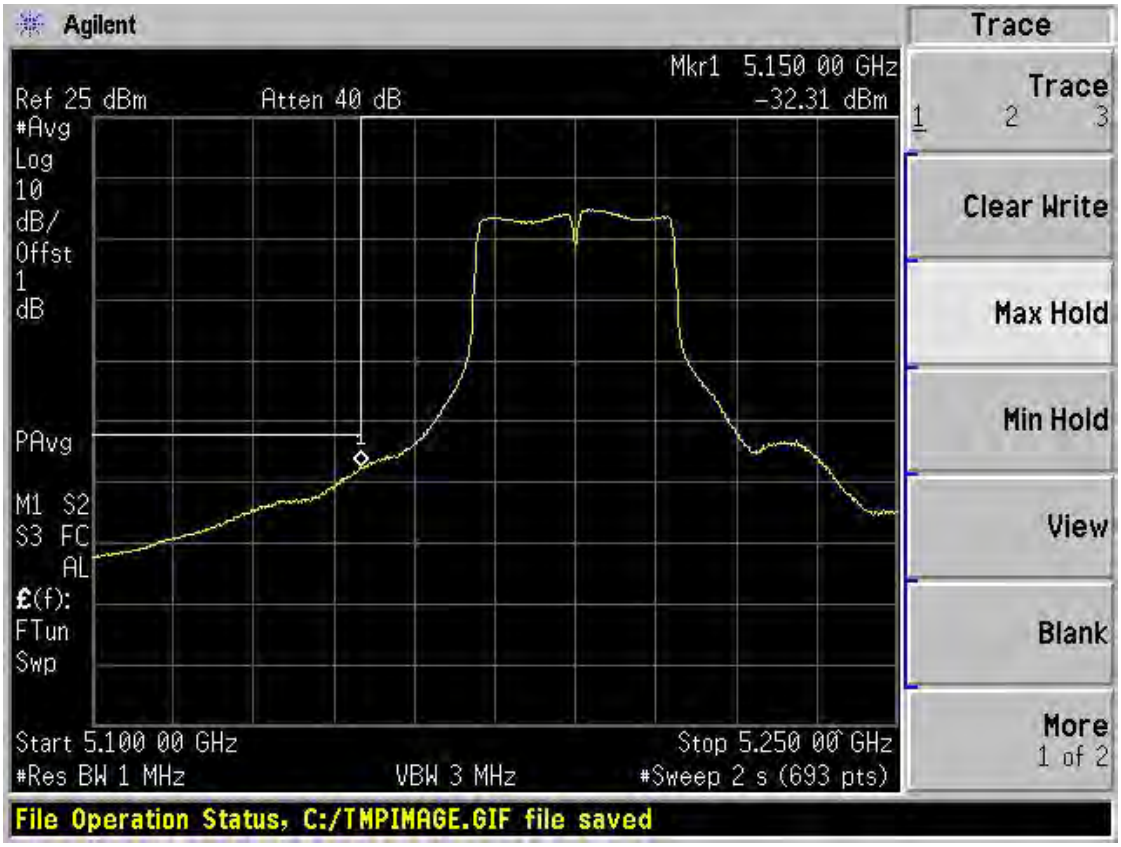
Band I 11n(HT20) CH36 Chain 1



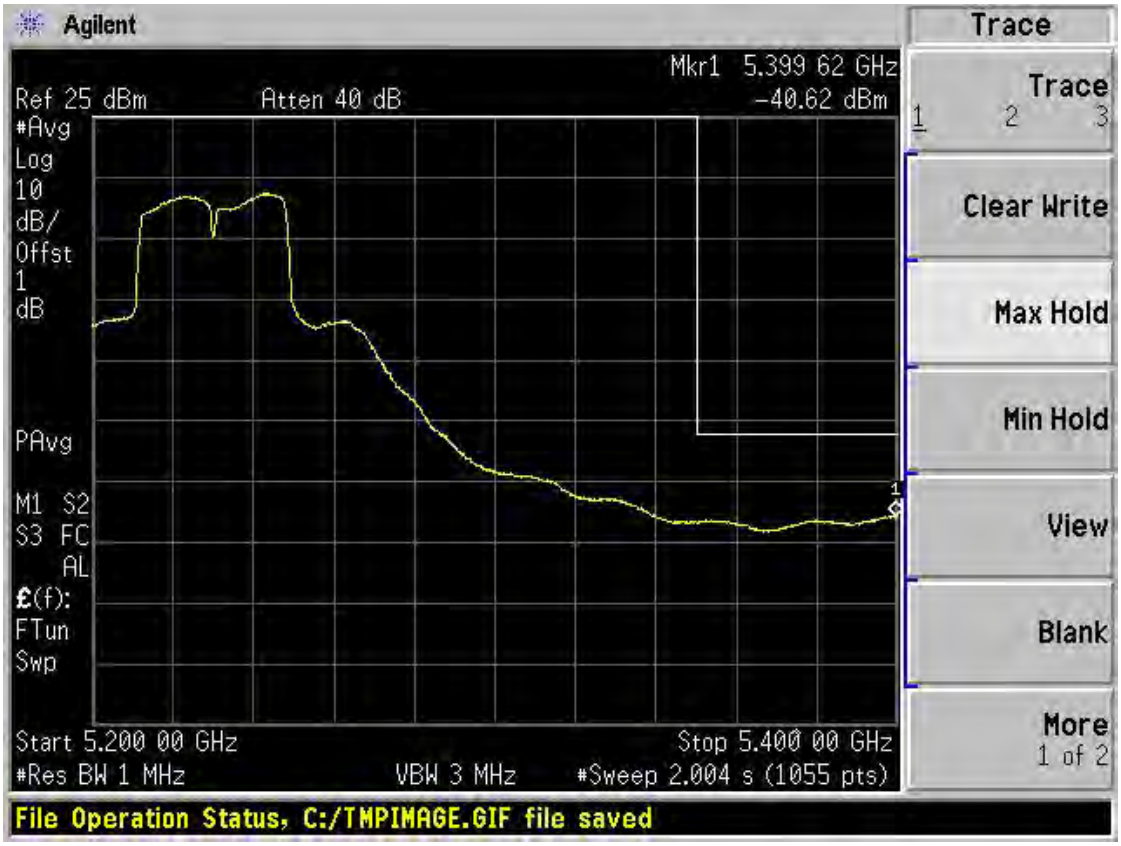
Band I 11n(HT20) CH48 Chain 1



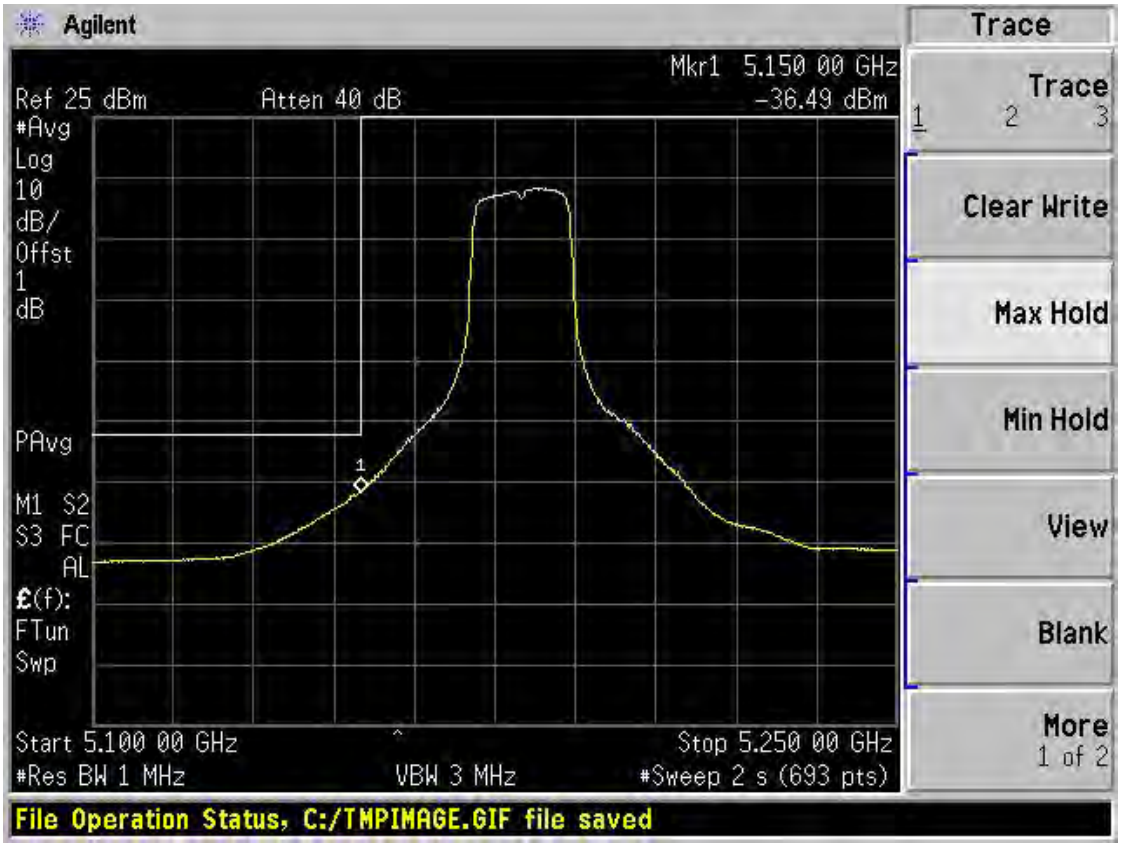
Band I 11n(HT40) CH38 Chain 1



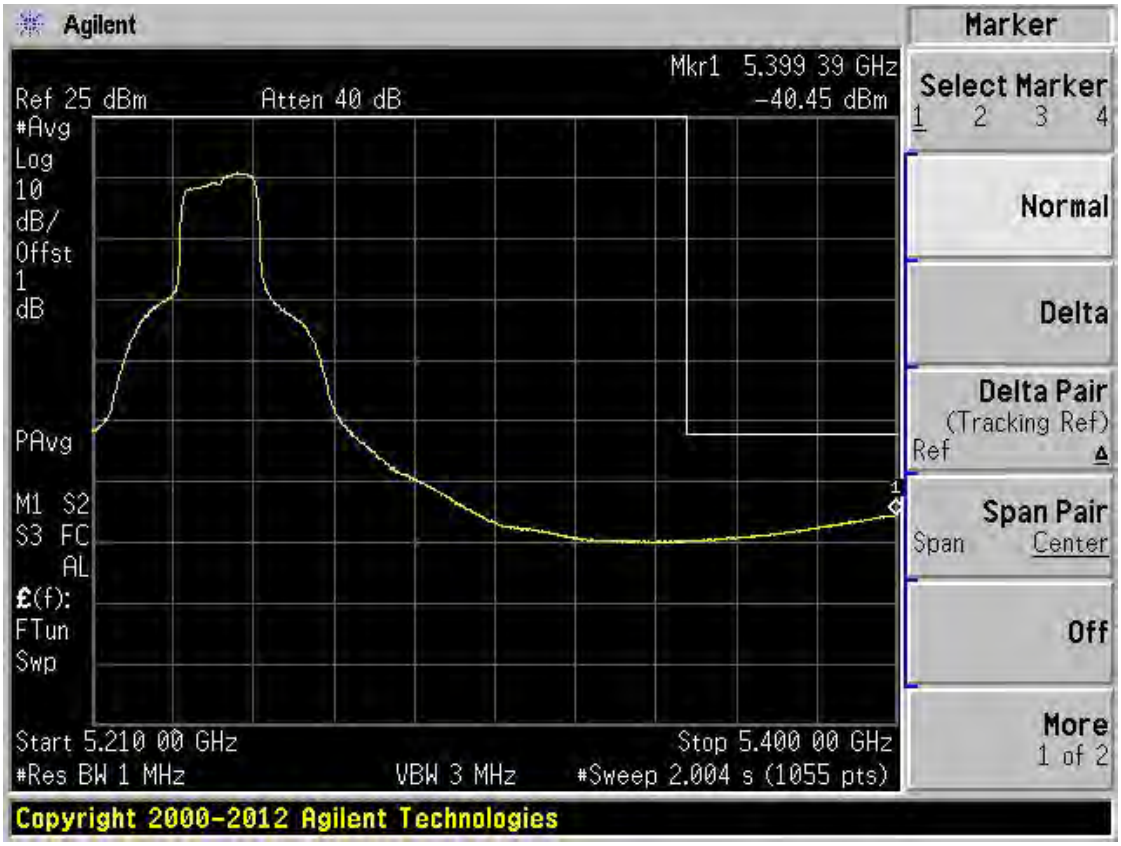
Band I 11n(HT40) CH46 Chain 1



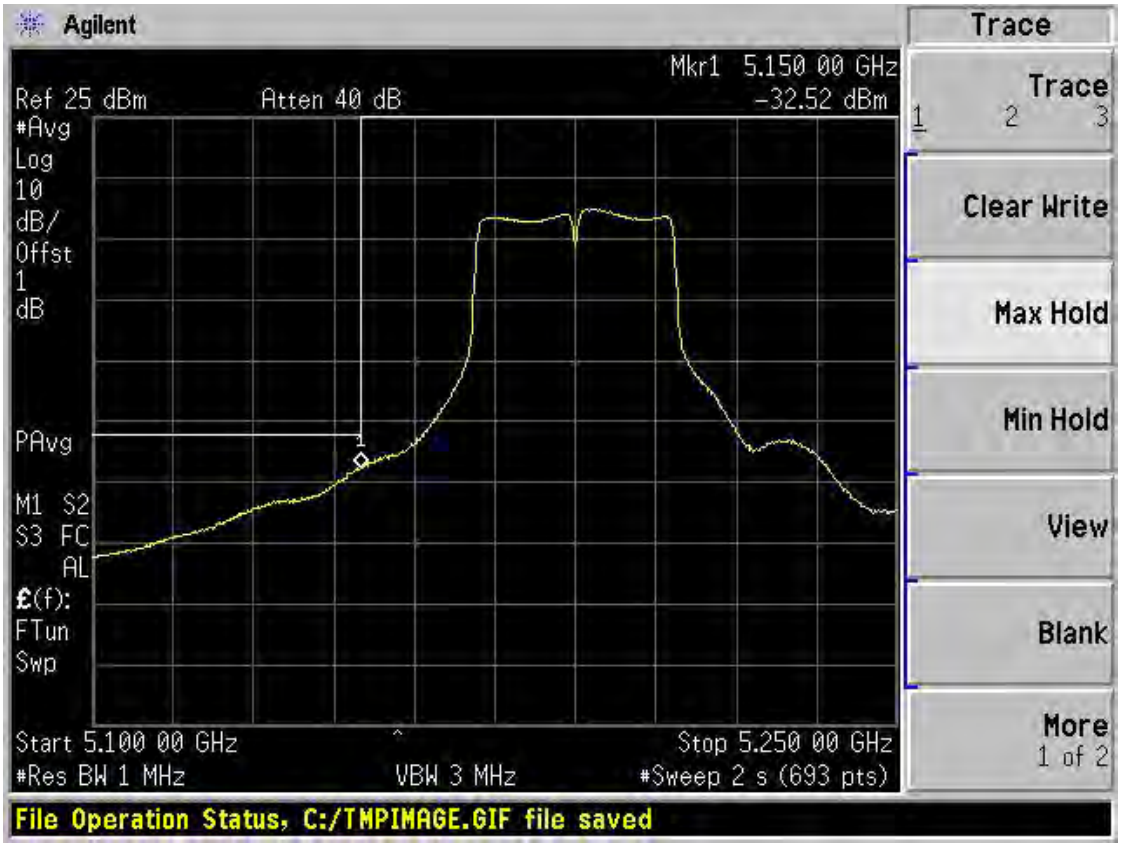
Band I 11ac(HT20) CH36 Chain 1



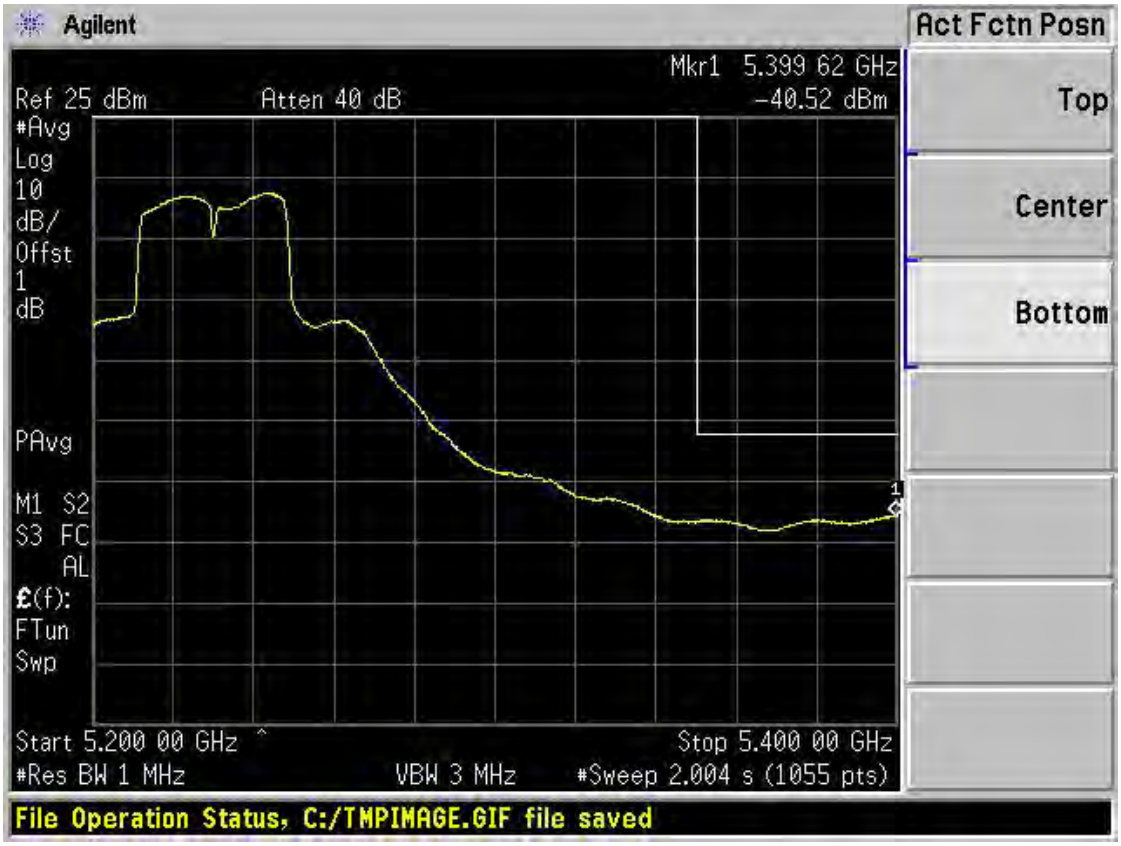
Band I 11ac(HT20) CH48 Chain 1



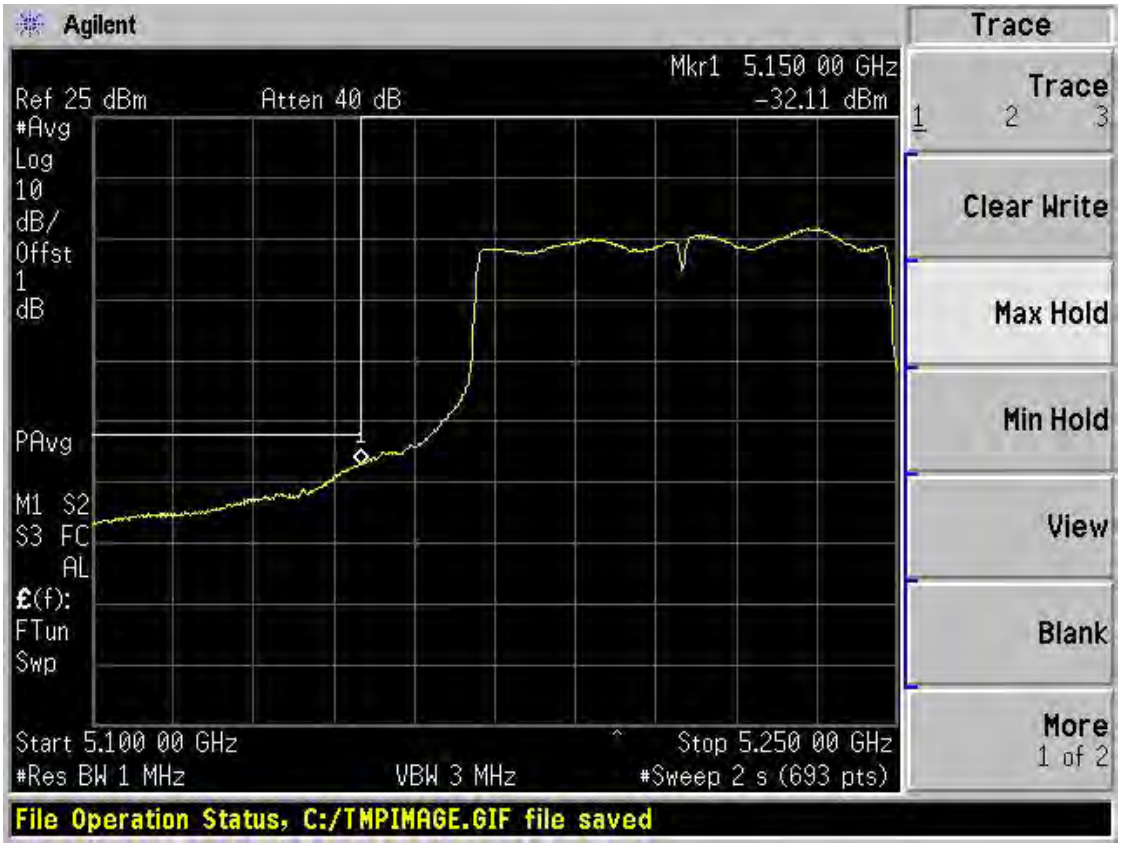
Band I 11ac(HT40) CH38 Chain 1



Band I 11ac(HT40) CH46 Chain 1

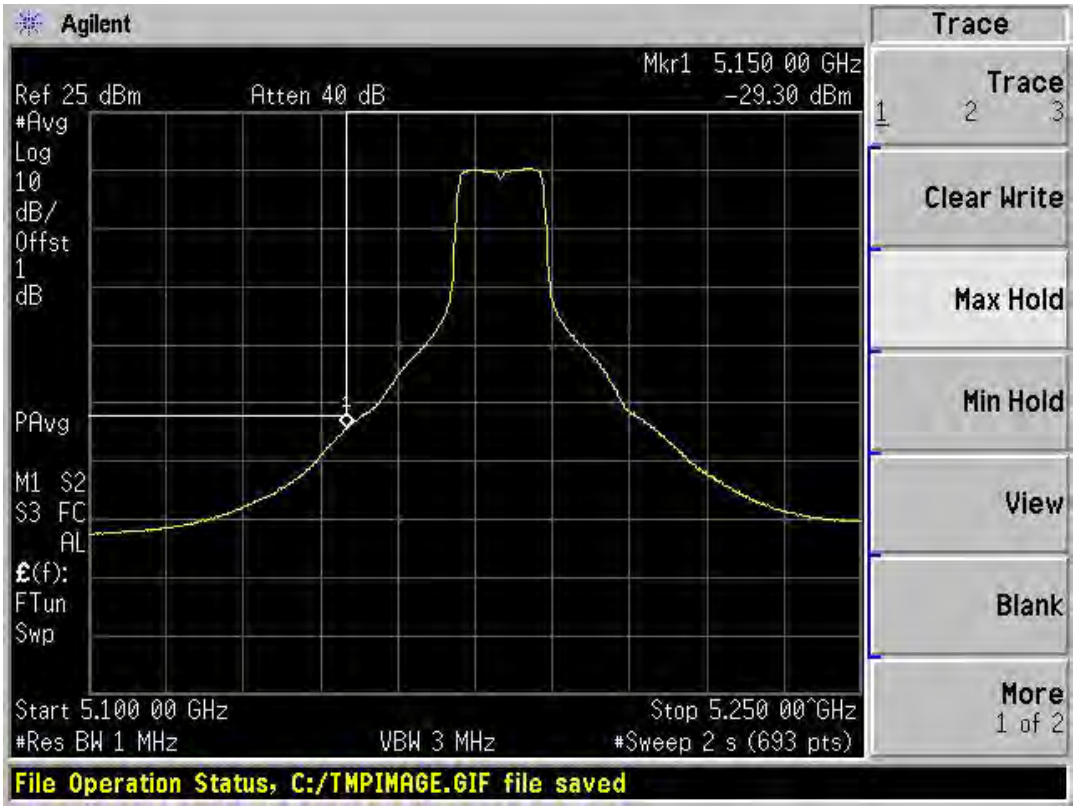


Band I 11ac(HT80) CH42 Chain 1

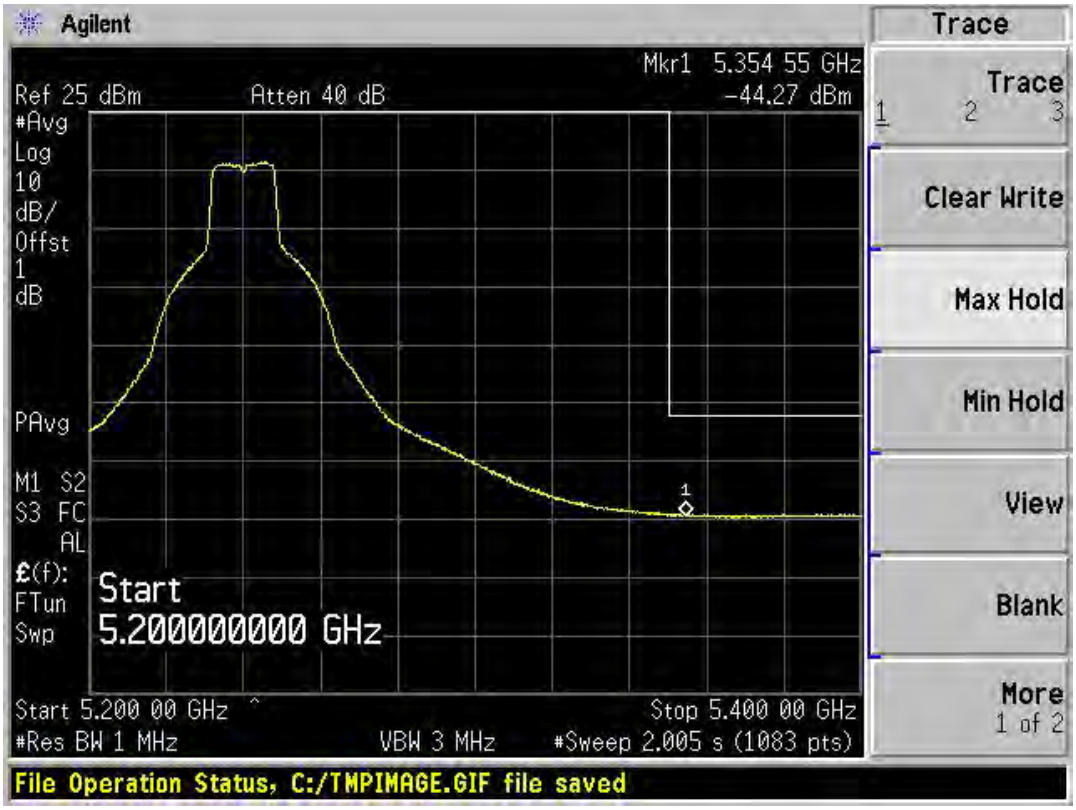


Band I 11ac(HT80) CH42 Chain 1

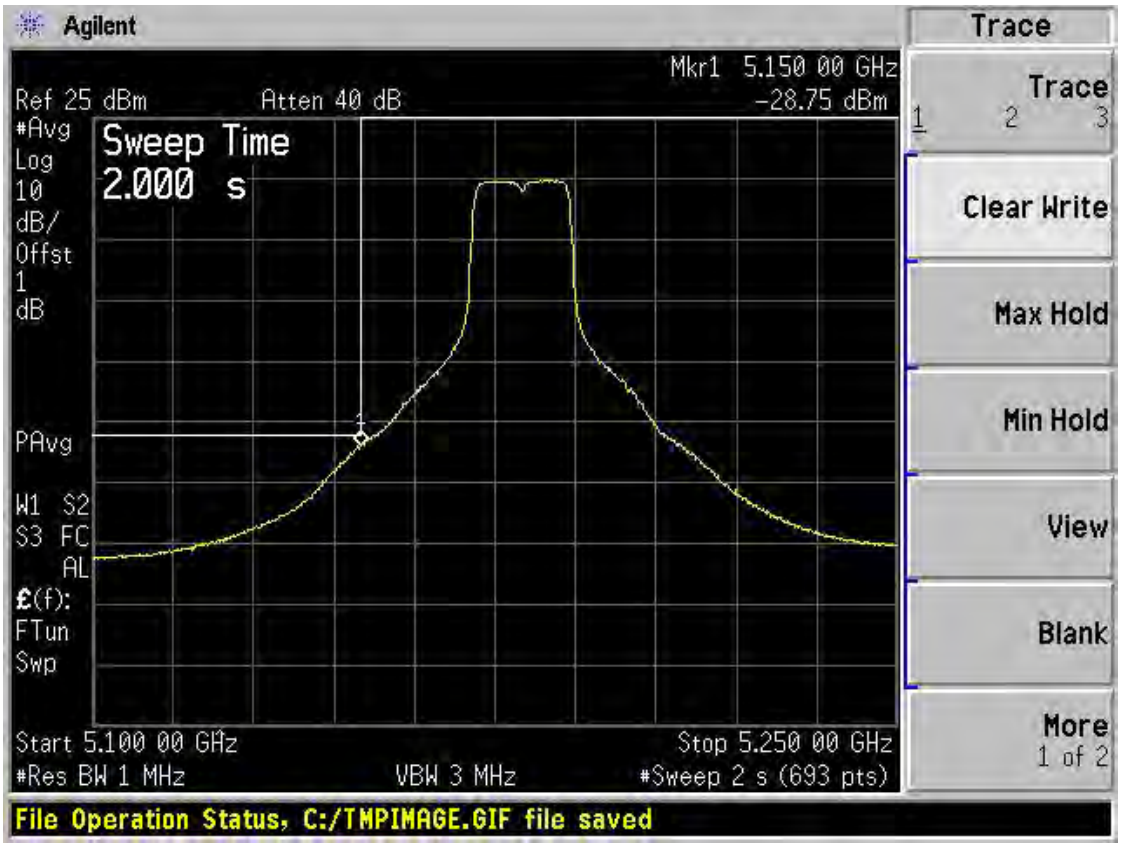
Band I 11a CH36 Chain 2



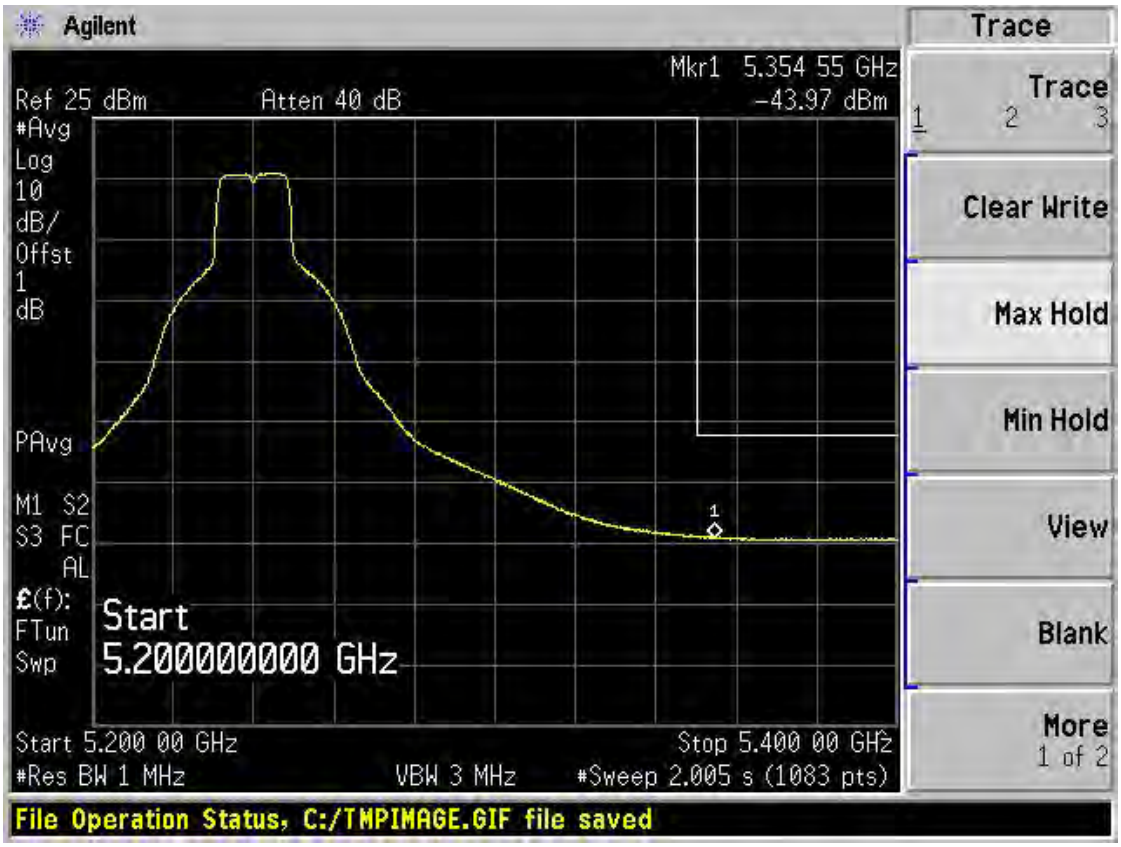
Band I 11a CH48 Chain 2



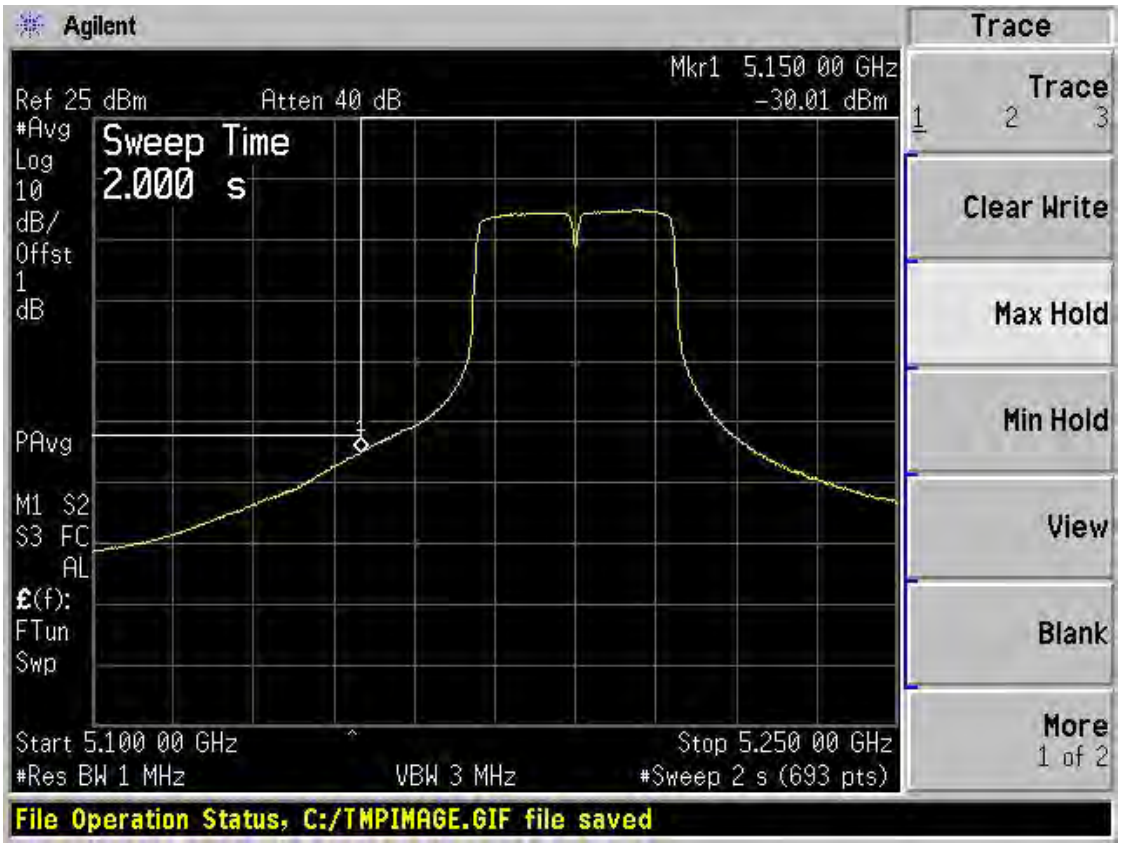
Band I 11n(HT20) CH36 Chain 2



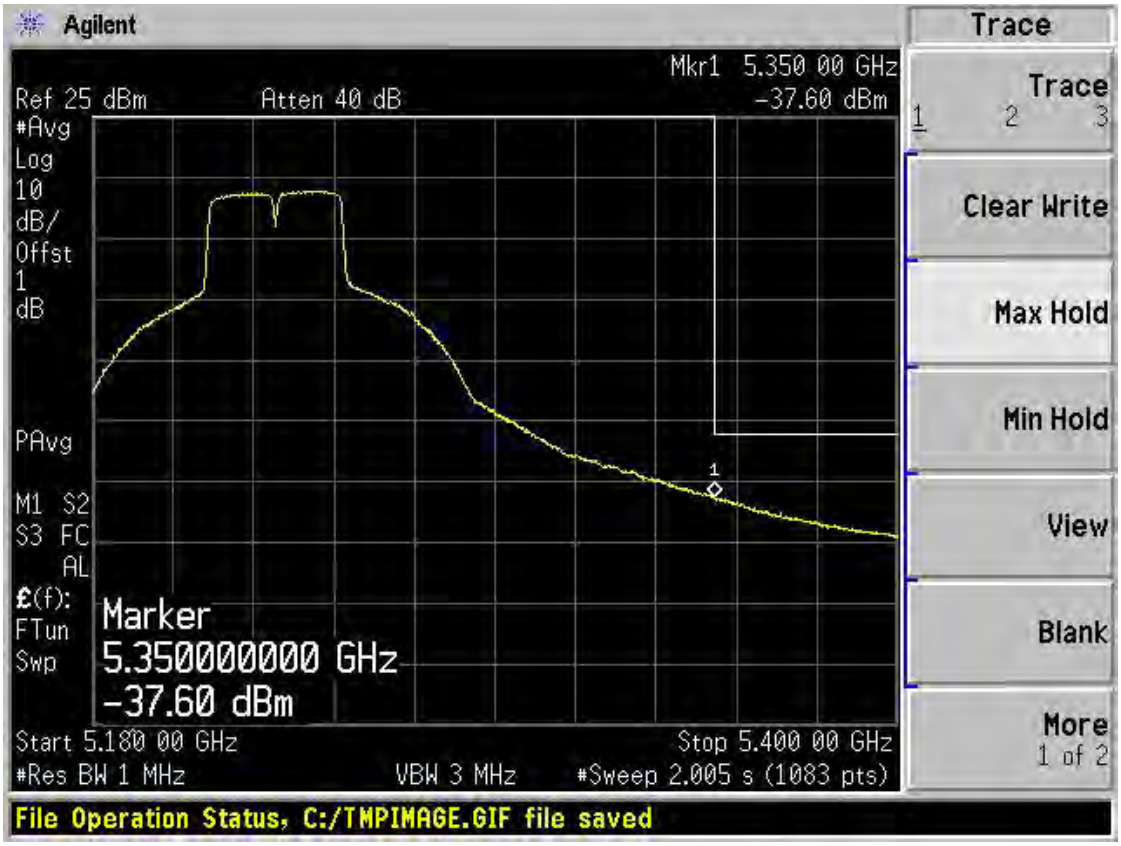
Band I 11n(HT20) CH48 Chain 2



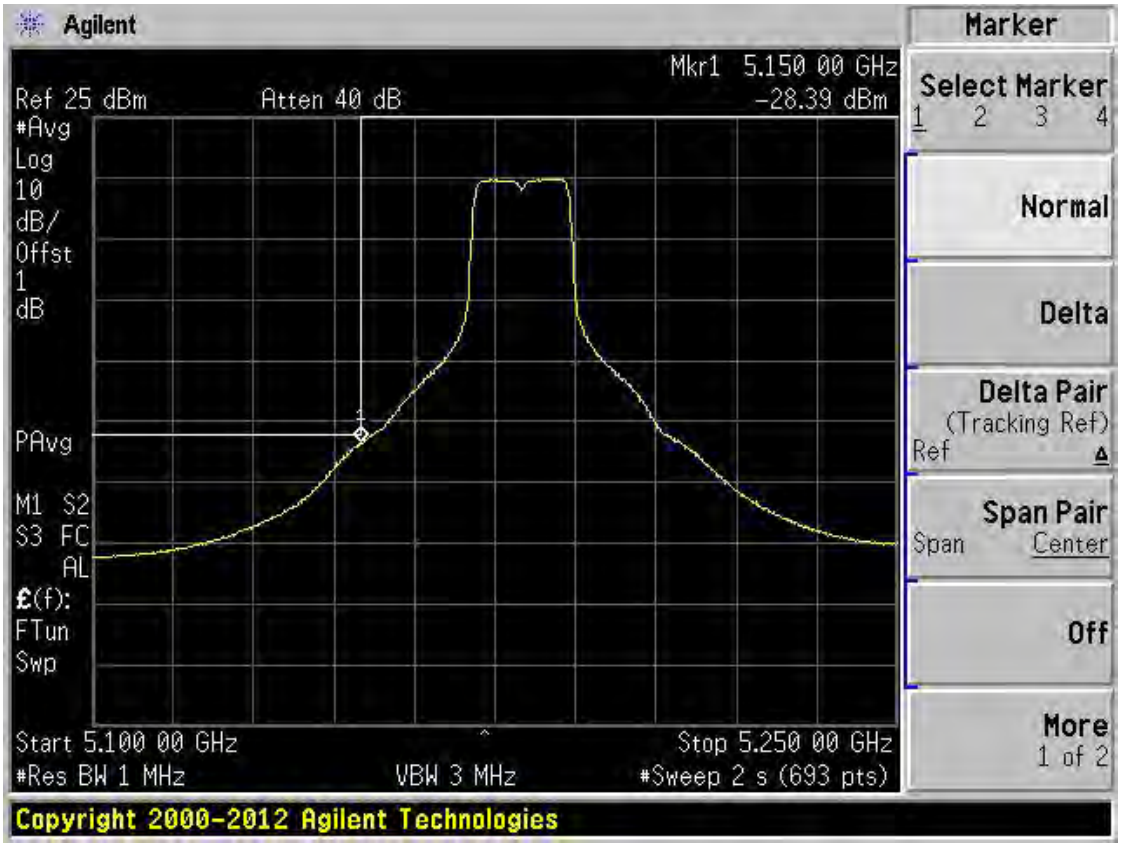
Band I 11n(HT40) CH38 Chain 2



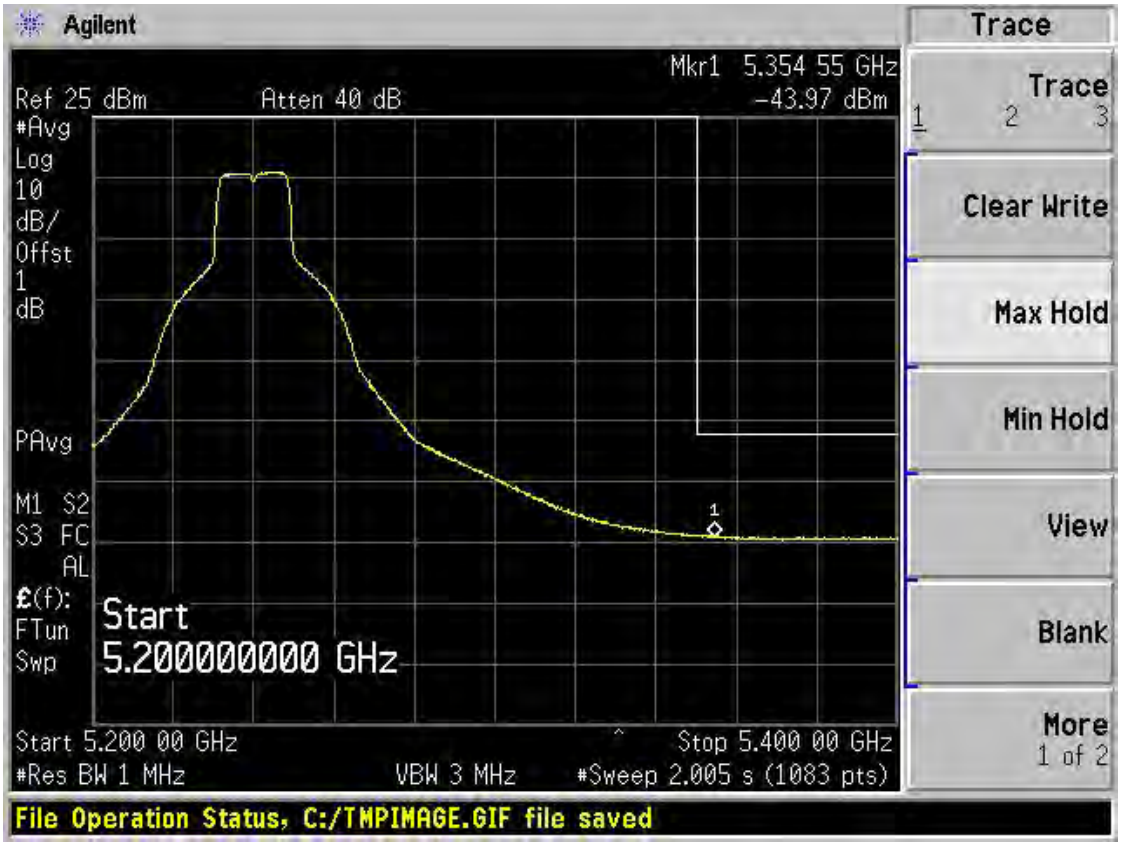
Band I 11n(HT40) CH46 Chain 2



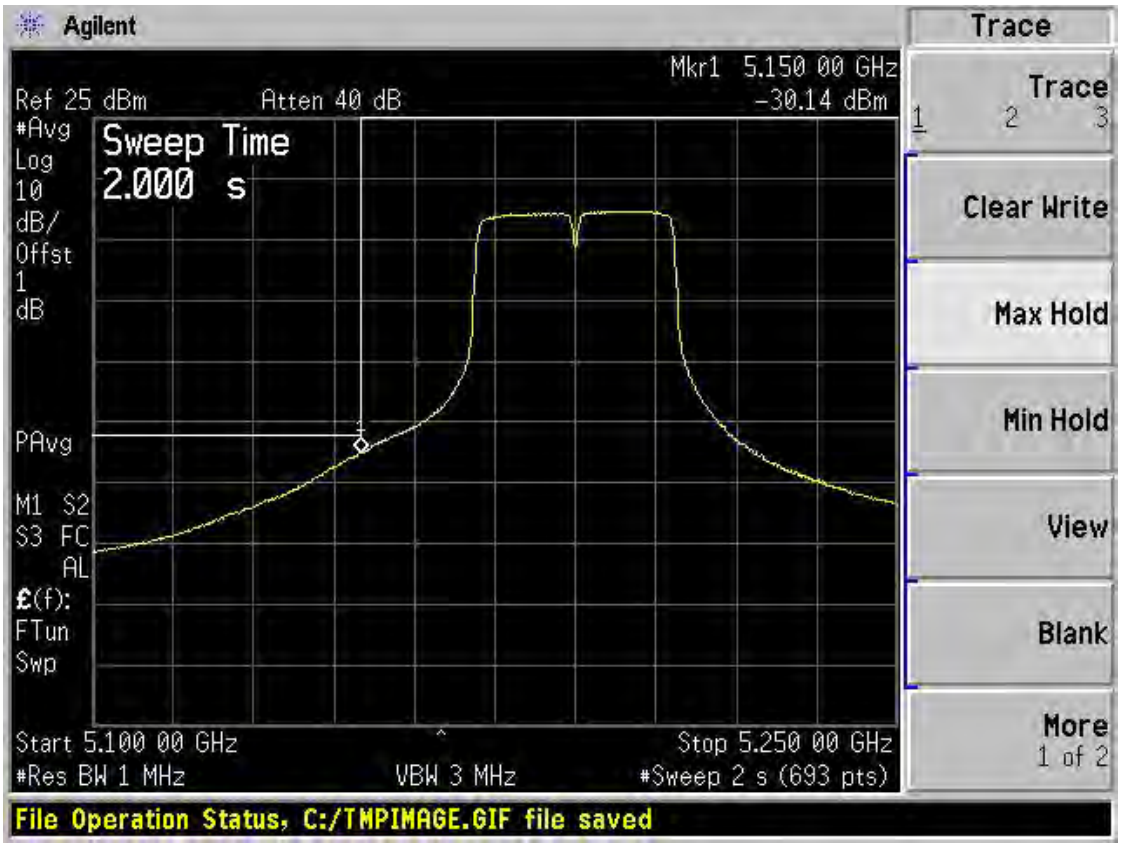
Band I 11ac(HT20) CH36 Chain 2



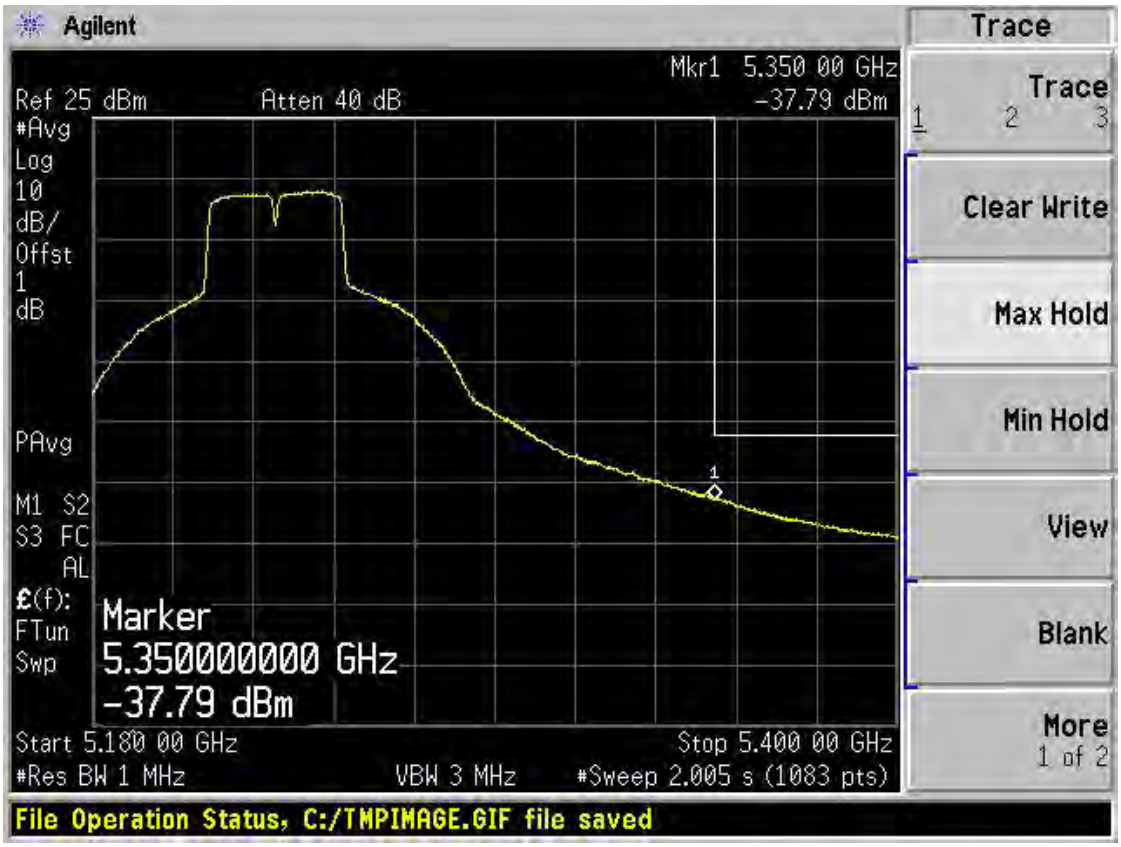
Band I 11ac(HT20) CH48 Chain 2



Band I 11ac(HT40) CH38 Chain 2

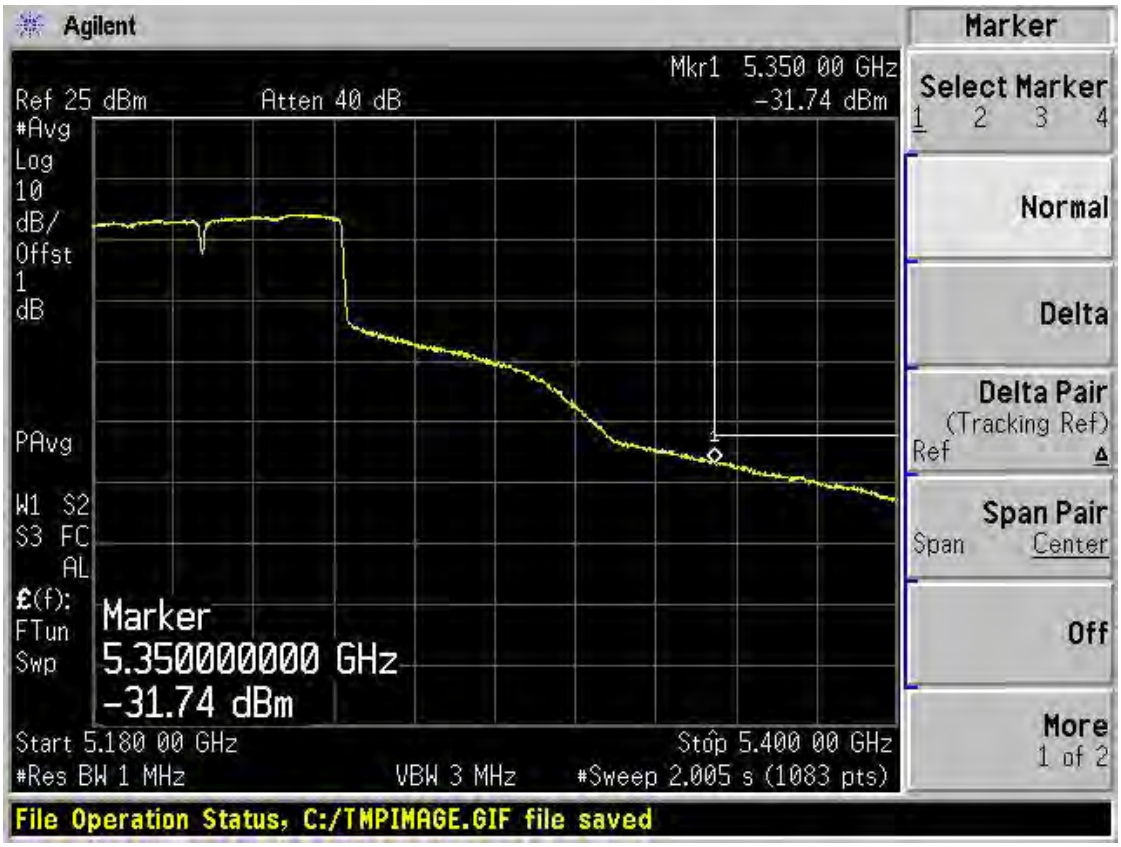


Band I 11ac(HT40) CH46 Chain 2

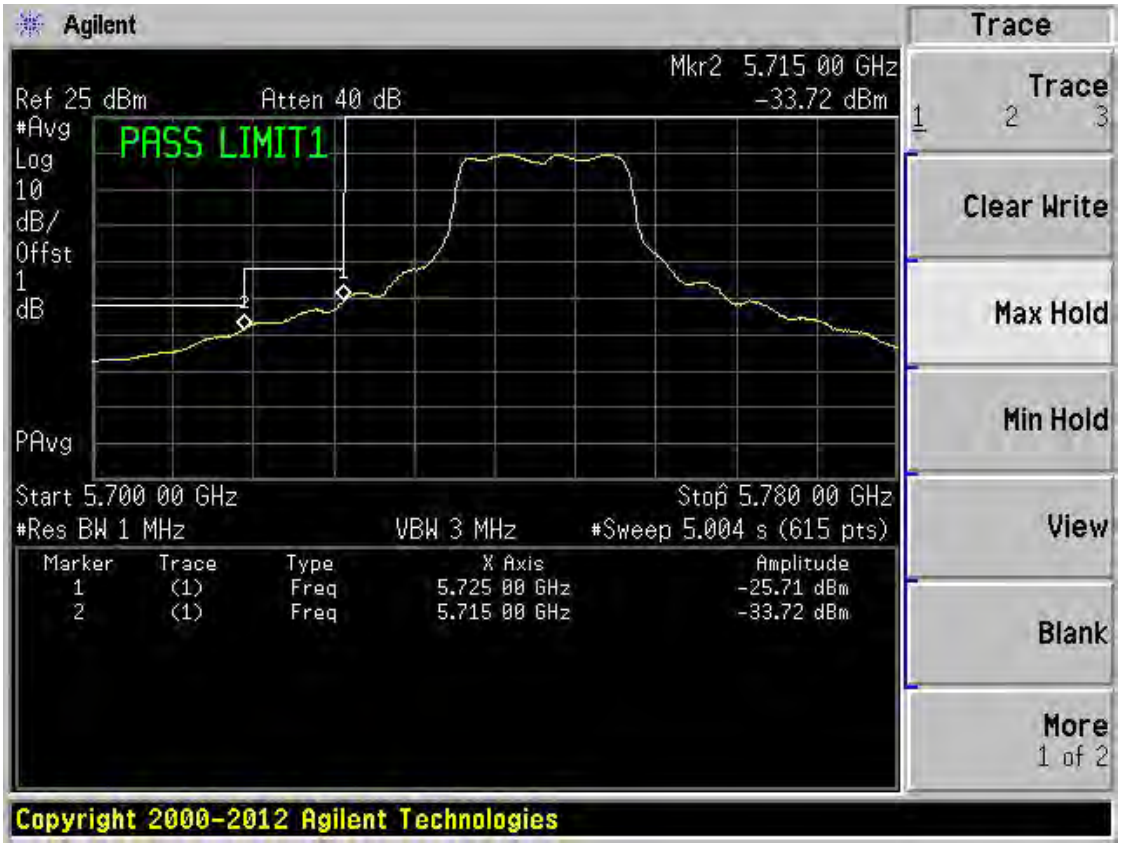


Band I 11ac(HT80) CH42 Chain 2 (Low Frequency Band)

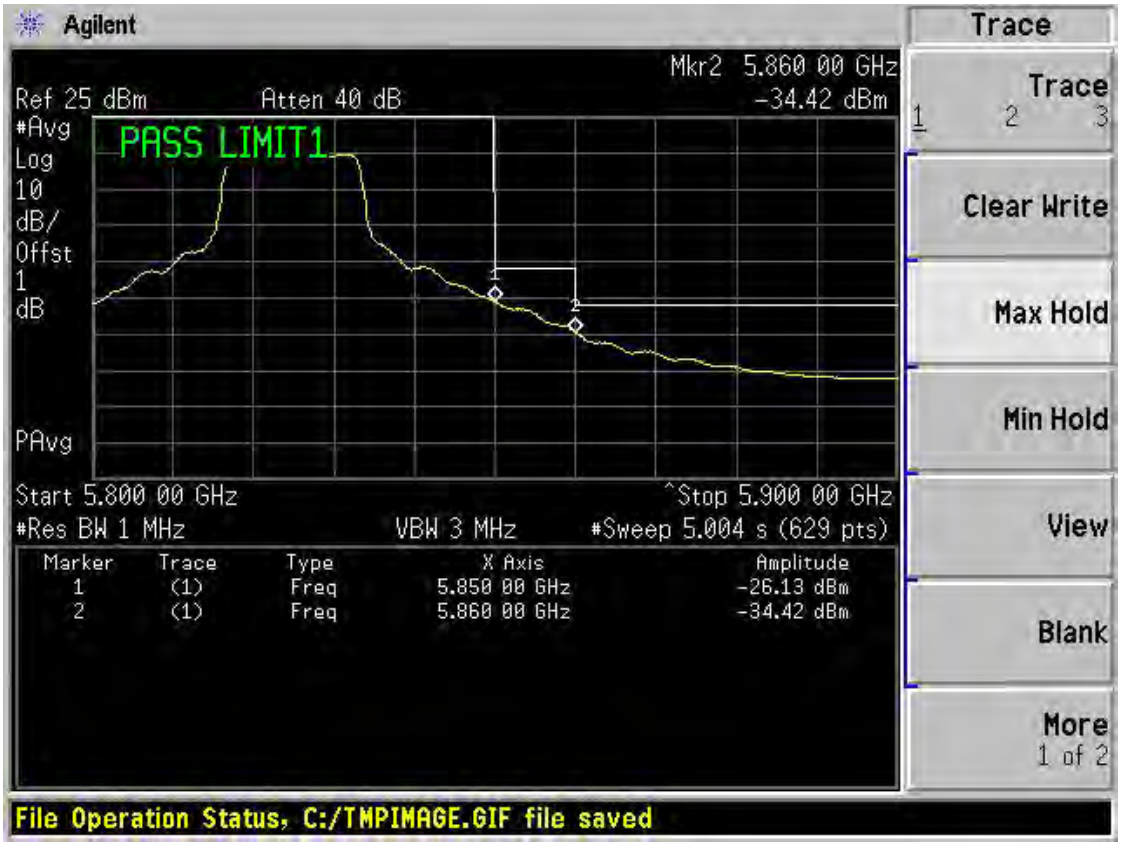
Band I 11ac(HT80) CH42 Chain 2 (High Frequency Band)



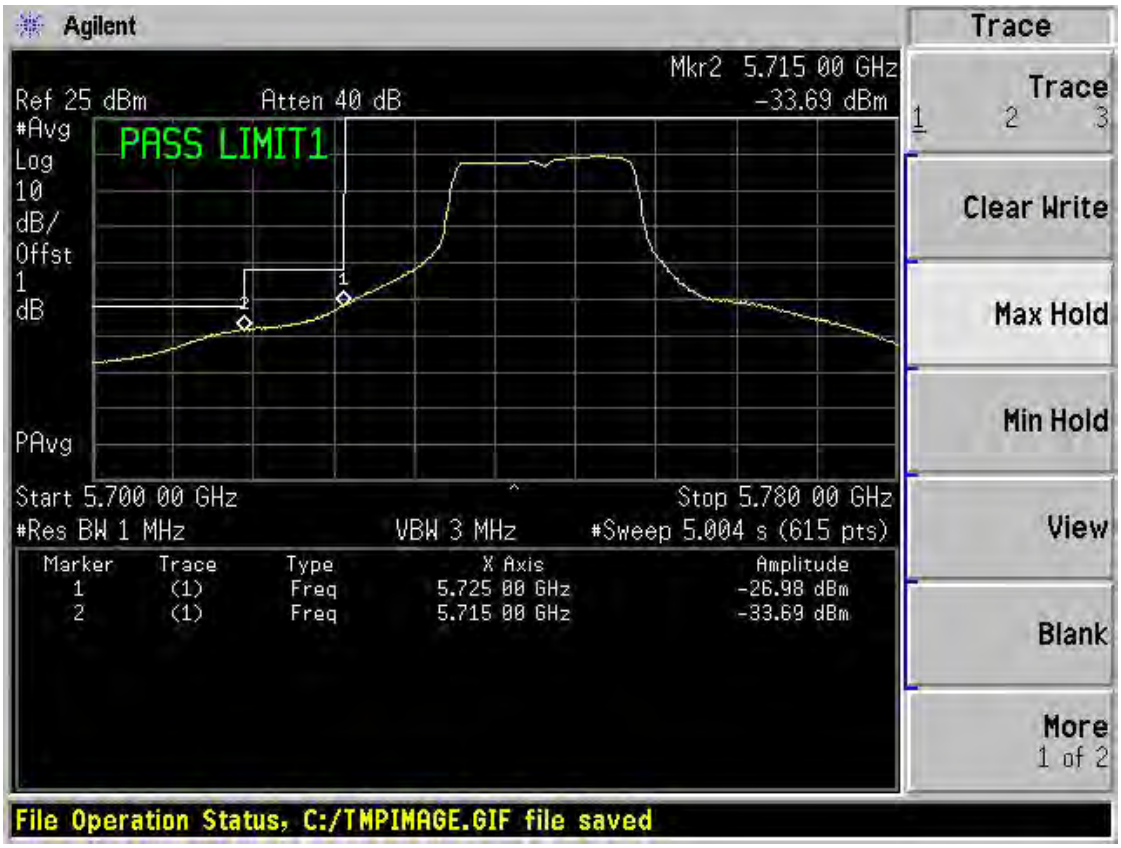
Band IV 11a CH149 Chain 1



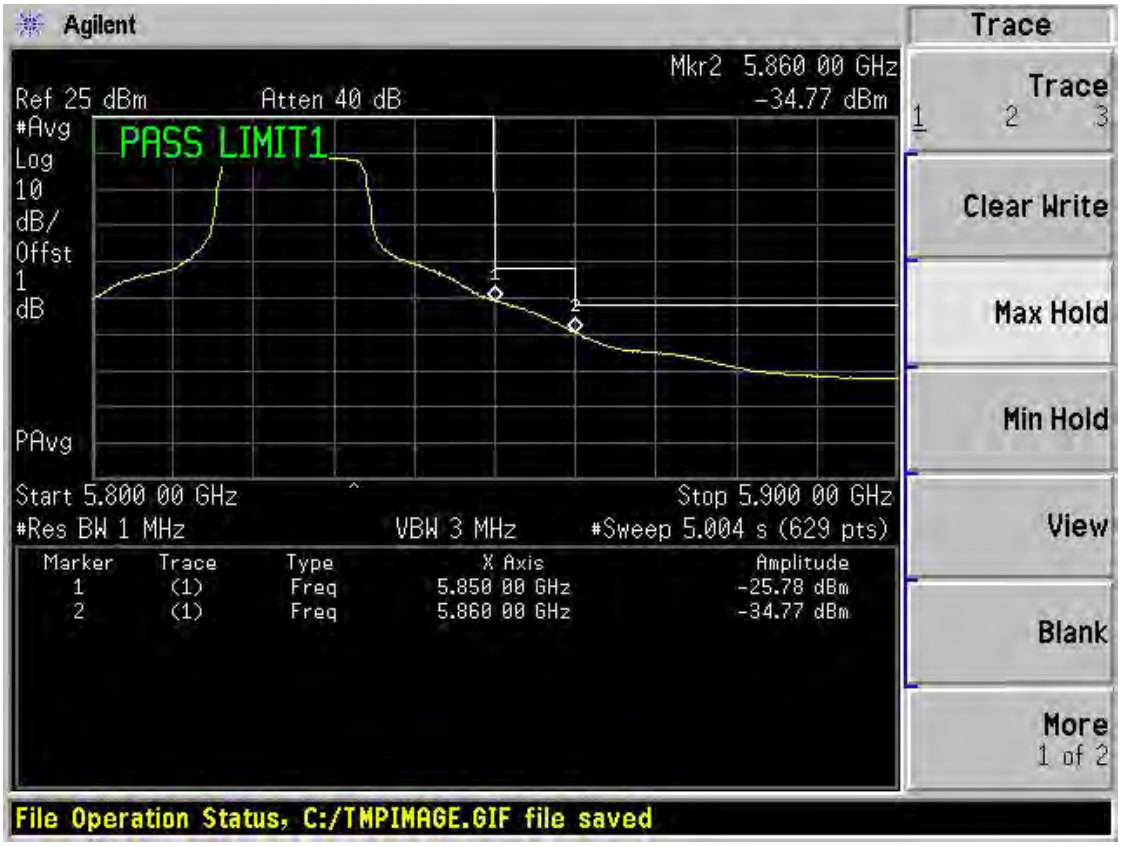
Band IV 11a CH165 Chain 1



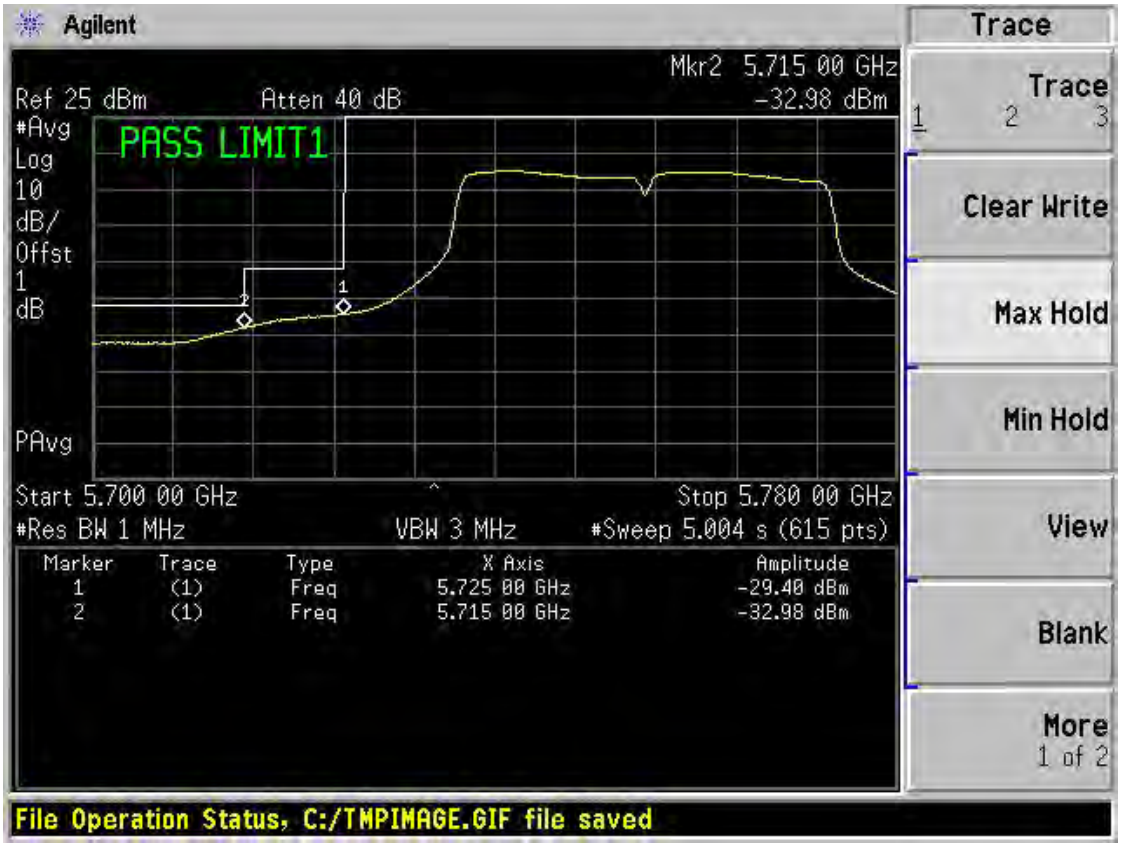
Band IV 11n(HT20) CH149 Chain 1



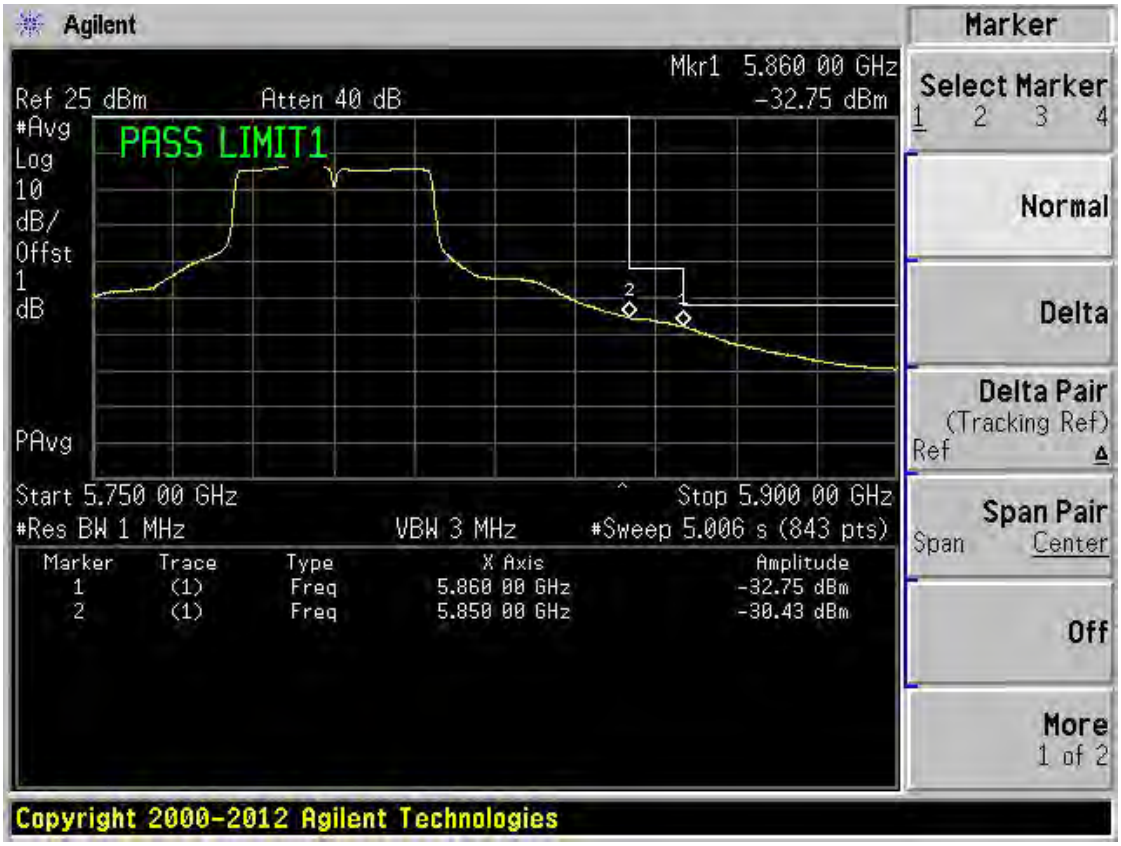
Band IV 11n(HT20) CH165 Chain 1



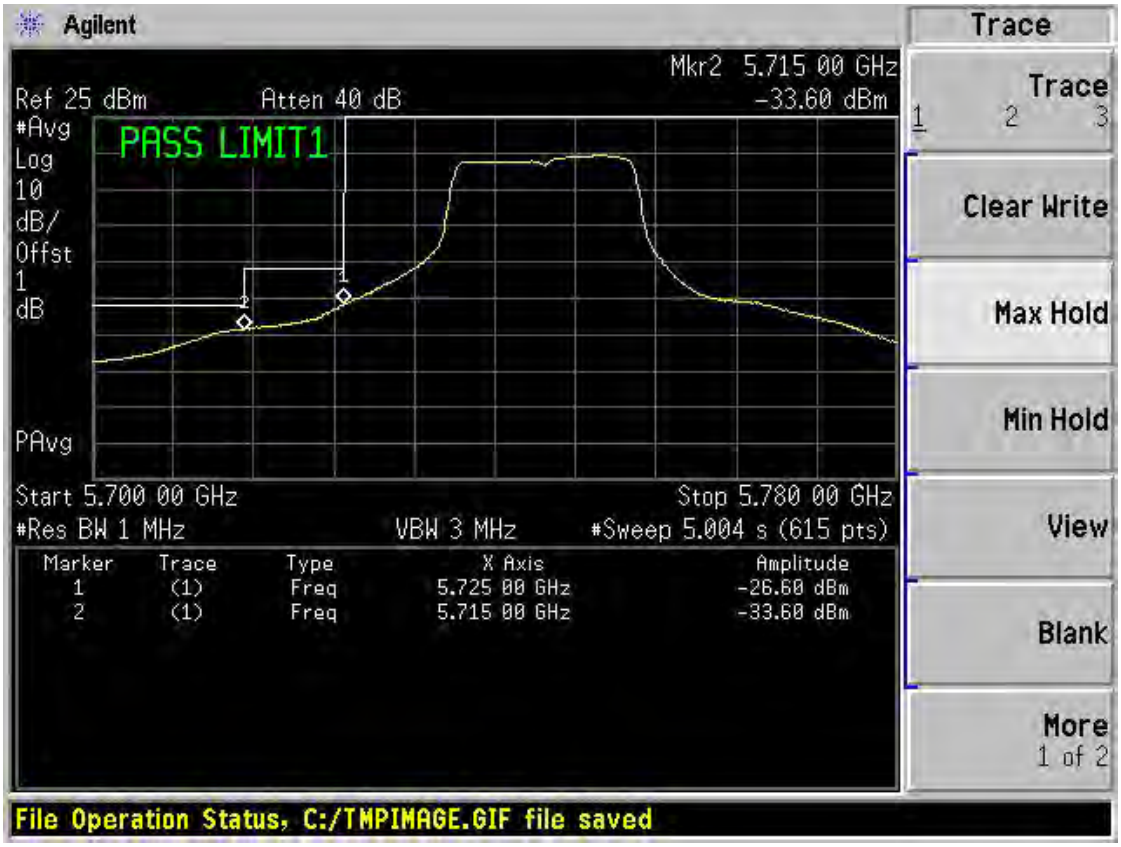
Band IV 11n(HT40) CH151 Chain 1



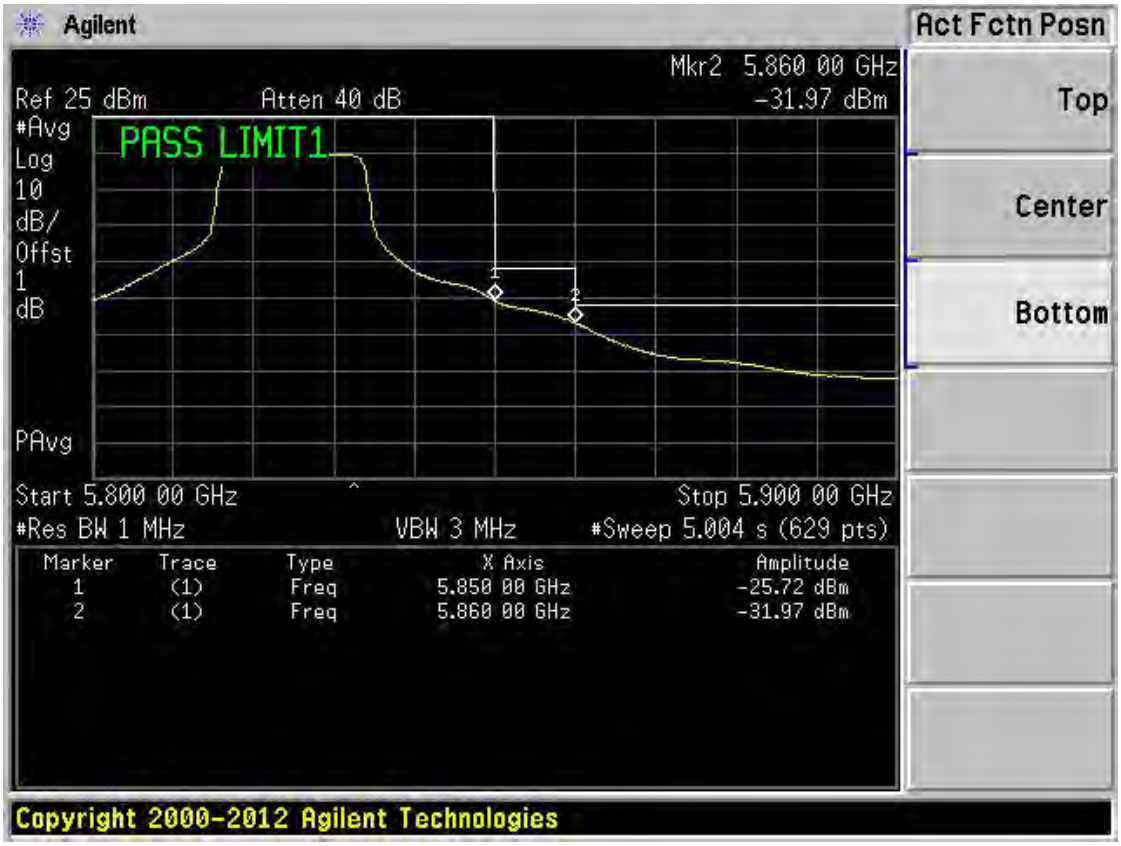
Band IV 11n(HT40) CH159 Chain 1



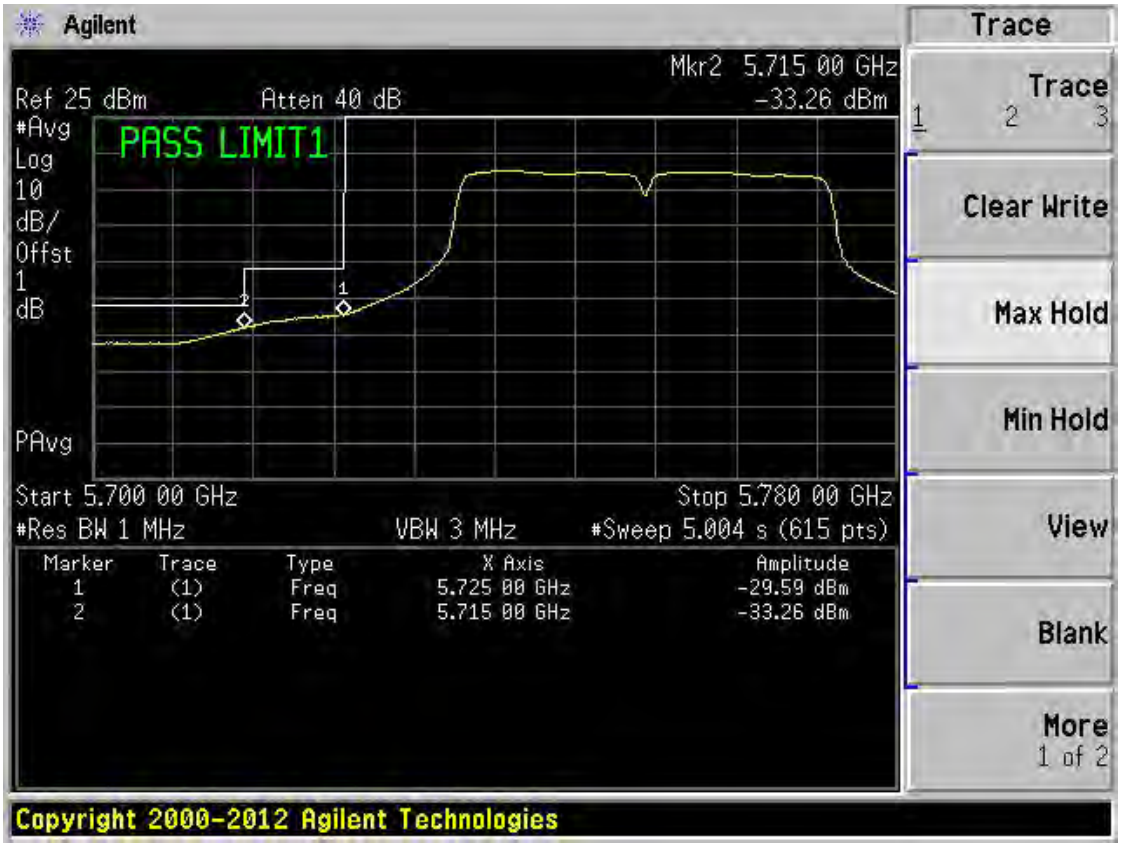
Band IV 11ac(HT20) CH149 Chain 1



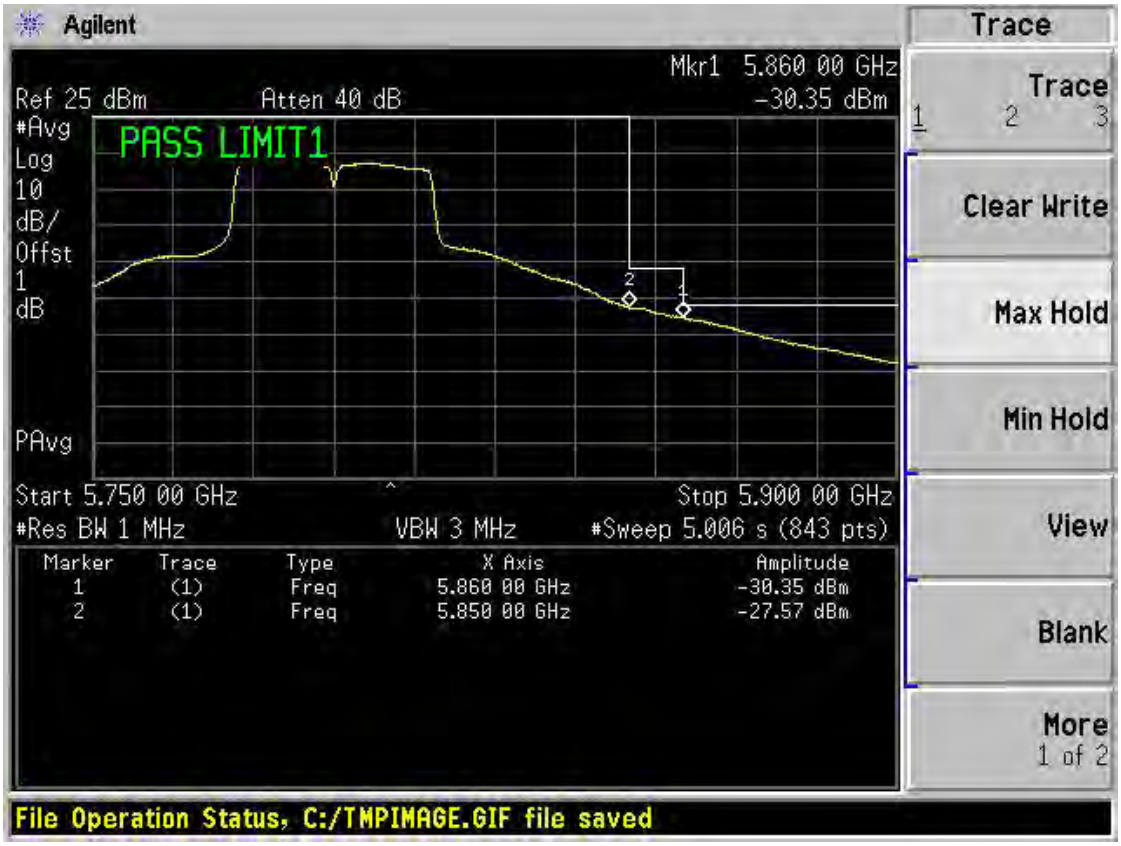
Band IV 11ac(HT20) CH165 Chain 1



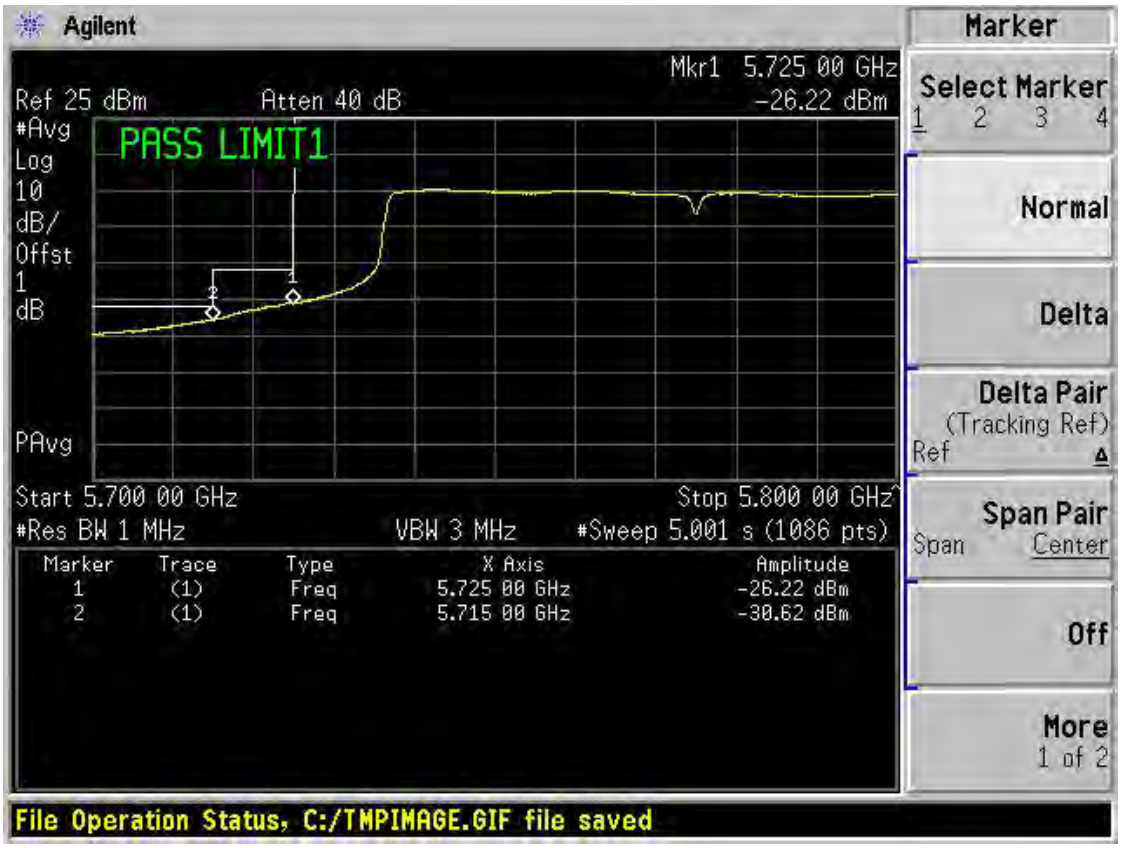
Band IV 11ac(HT40) CH151 Chain 1



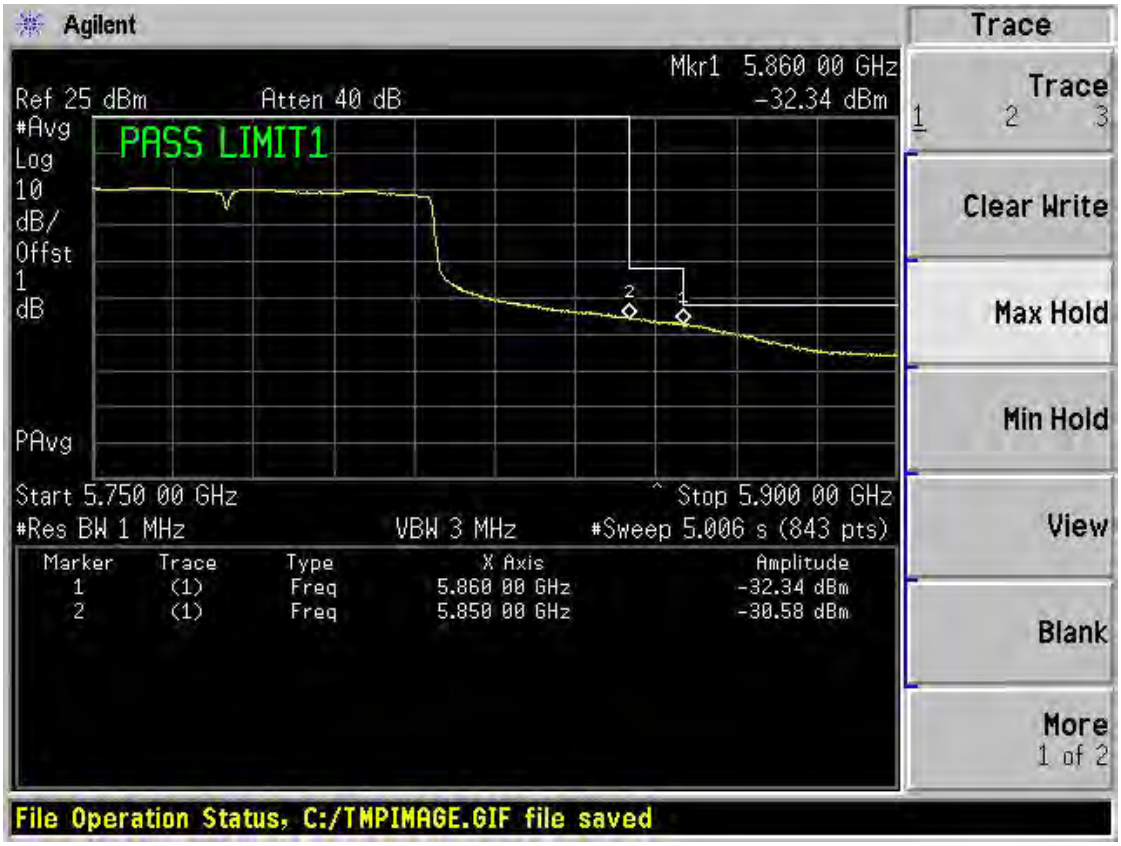
Band IV 11ac(HT40) CH159 Chain 1



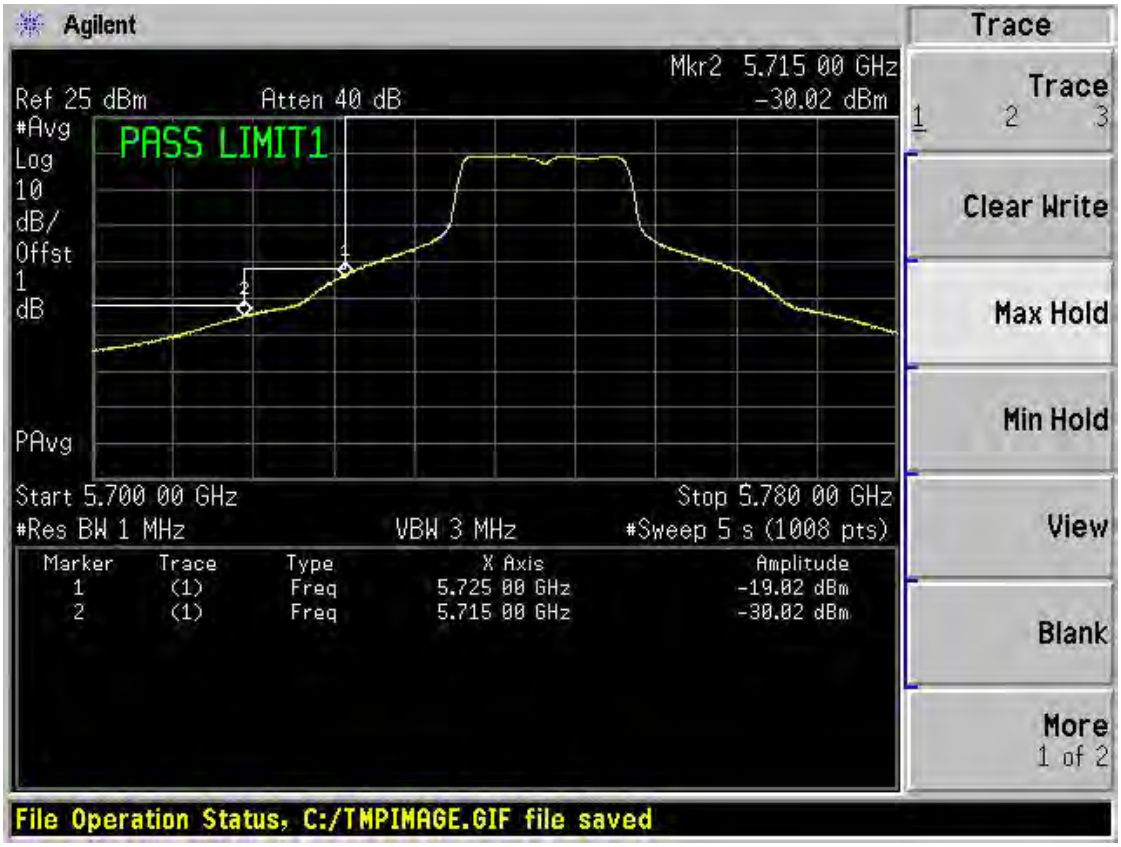
Band IV 11ac(HT80) CH155 Chain 1



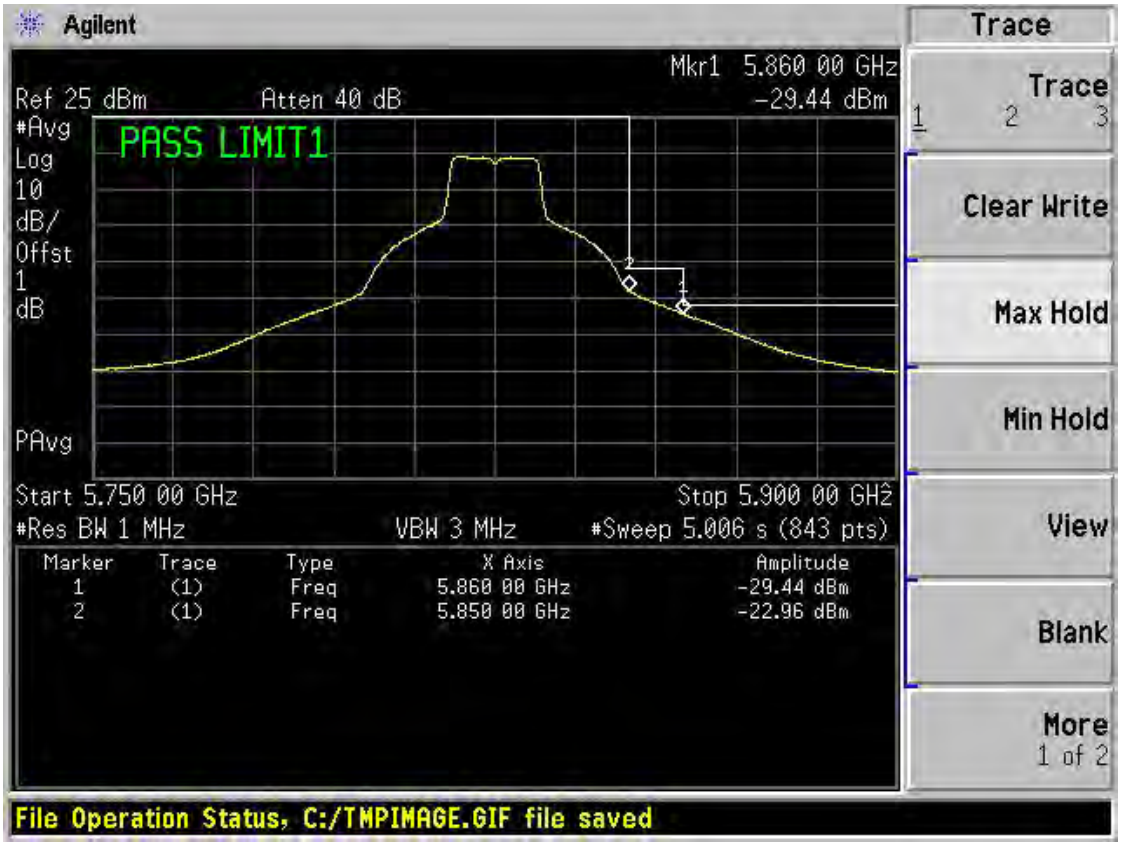
Band IV 11ac(HT80) CH155 Chain 1



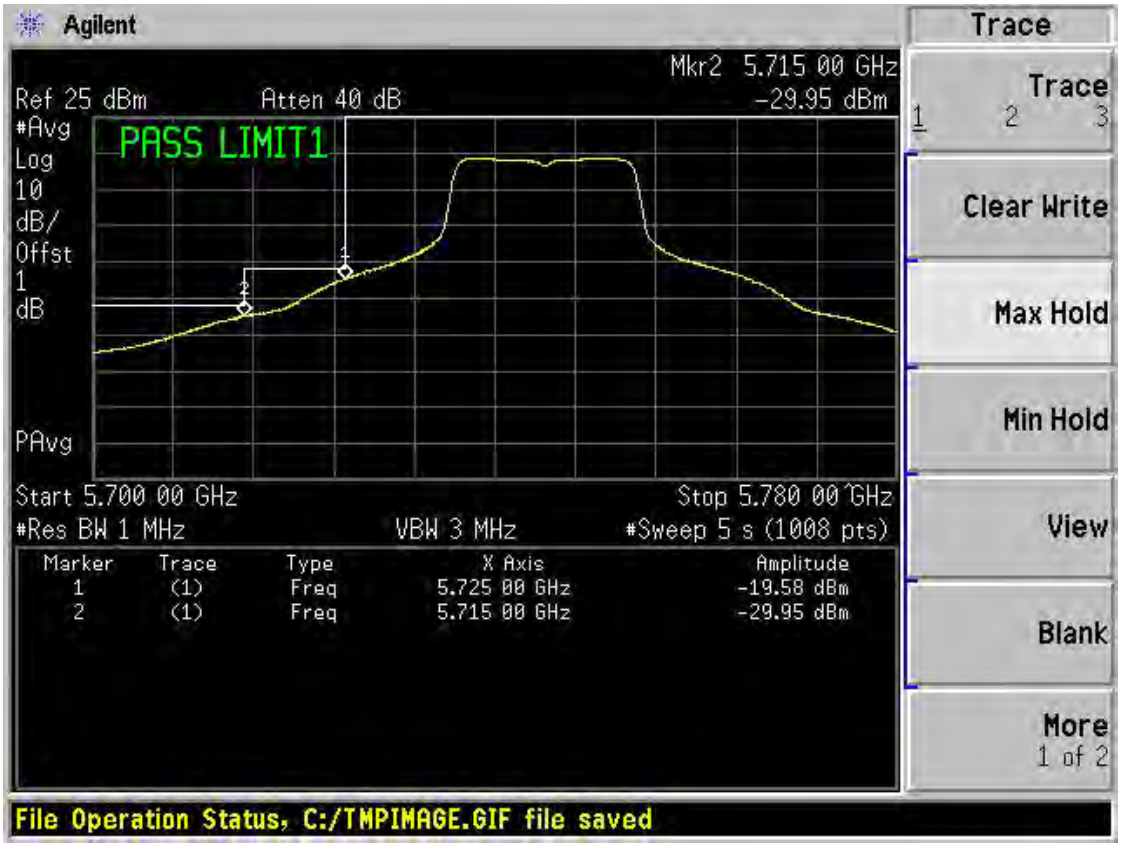
Band IV 11a CH149 Chain 2



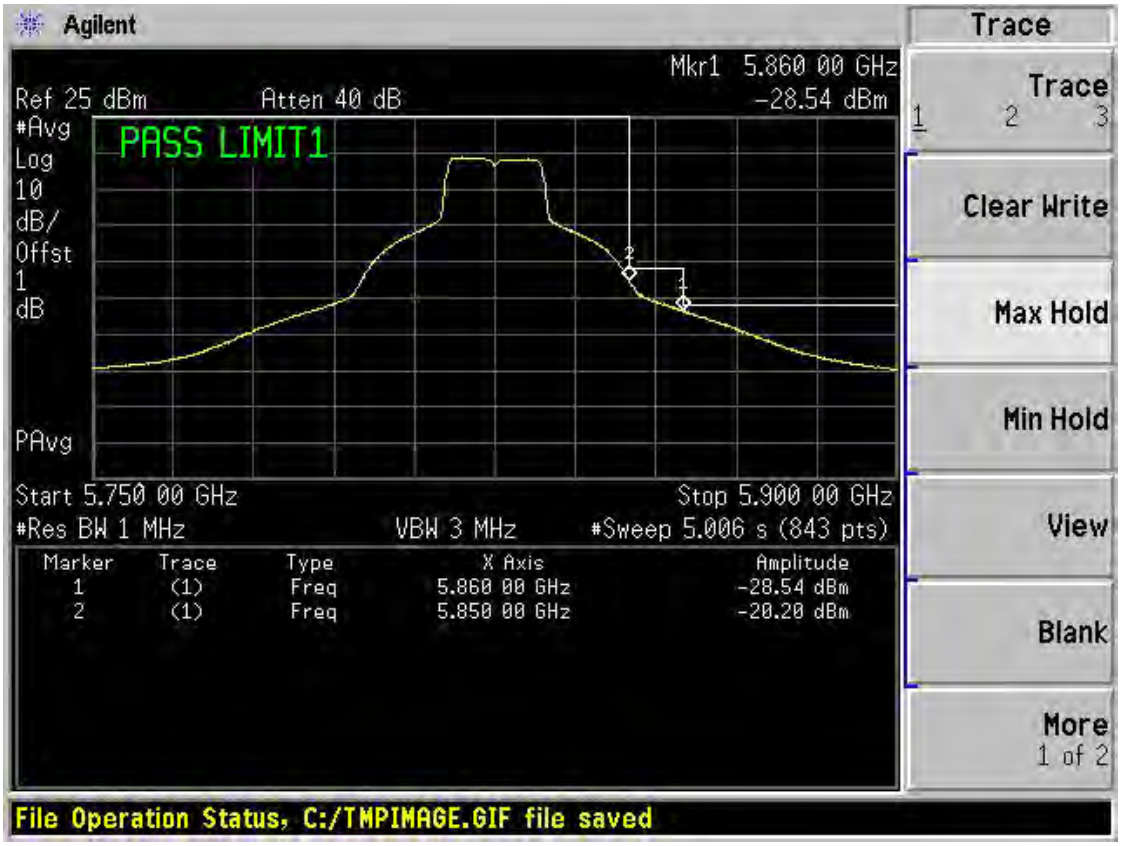
Band IV 11a CH165 Chain 2



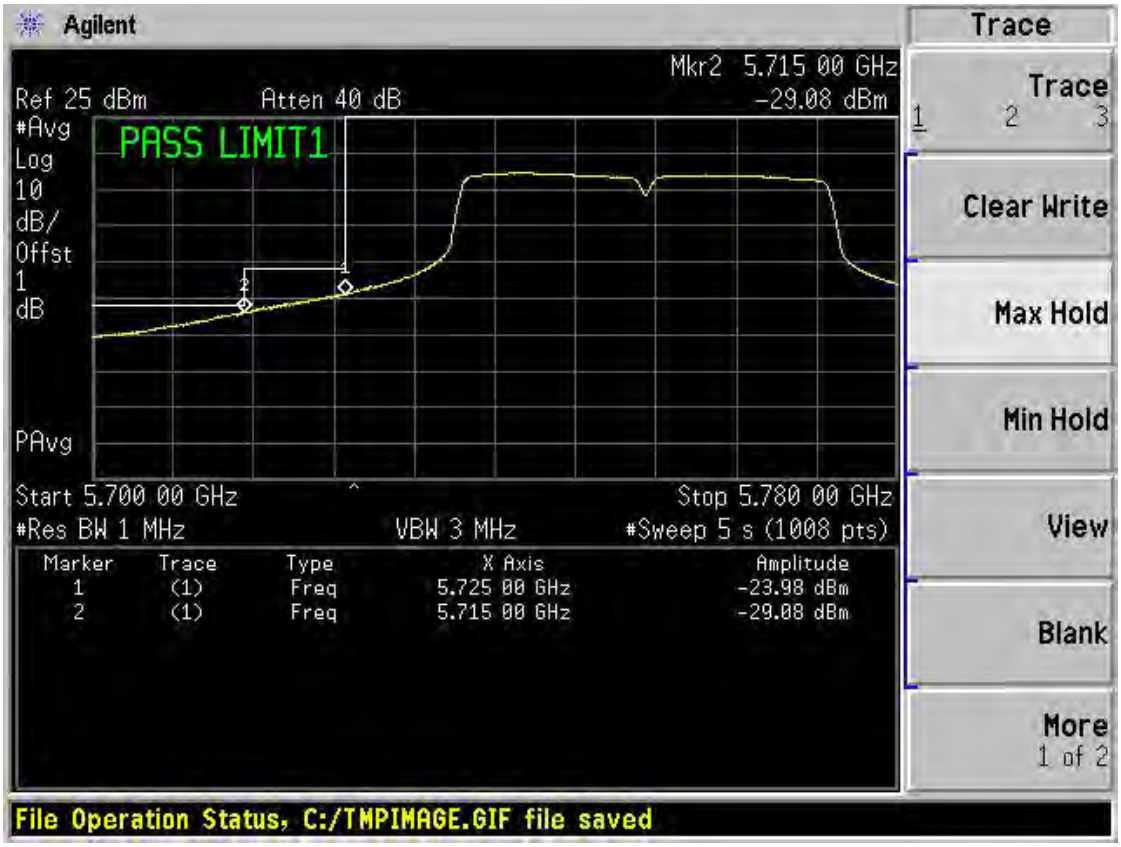
Band IV 11n(HT20) CH149 Chain 2



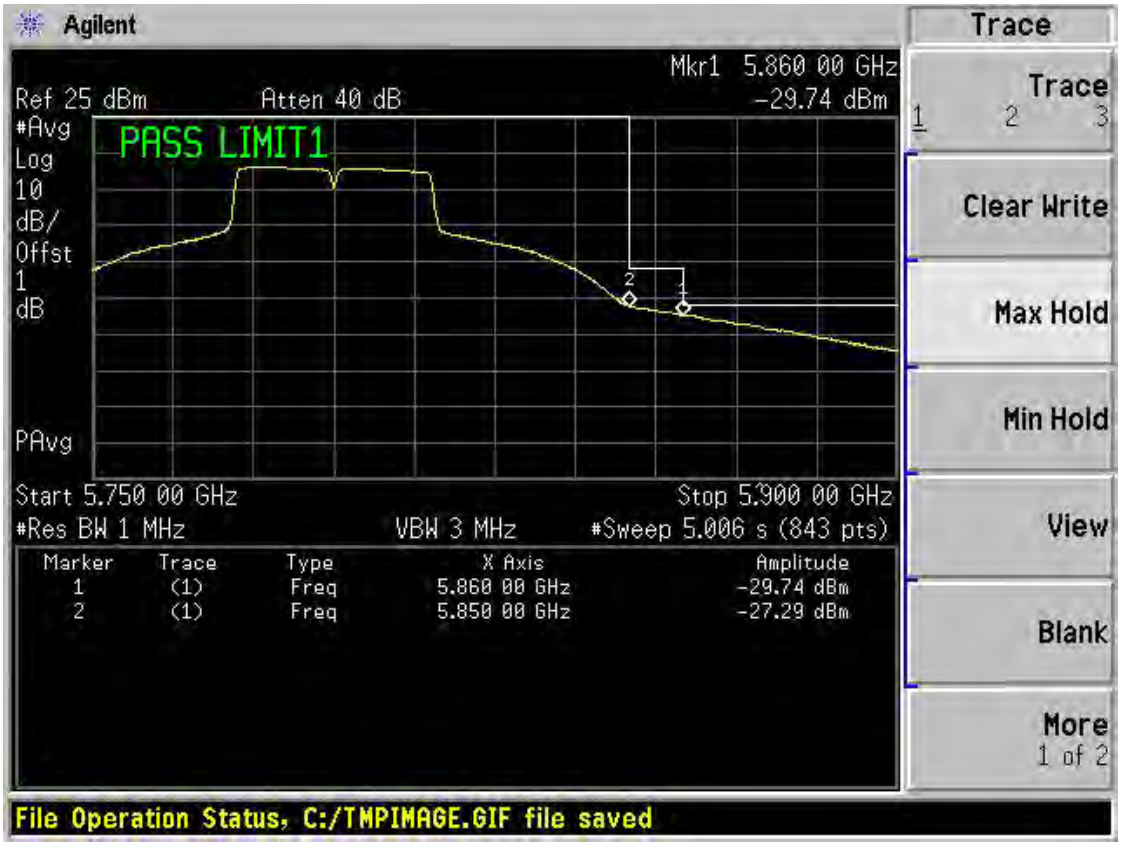
Band IV 11n(HT20) CH165 Chain 2



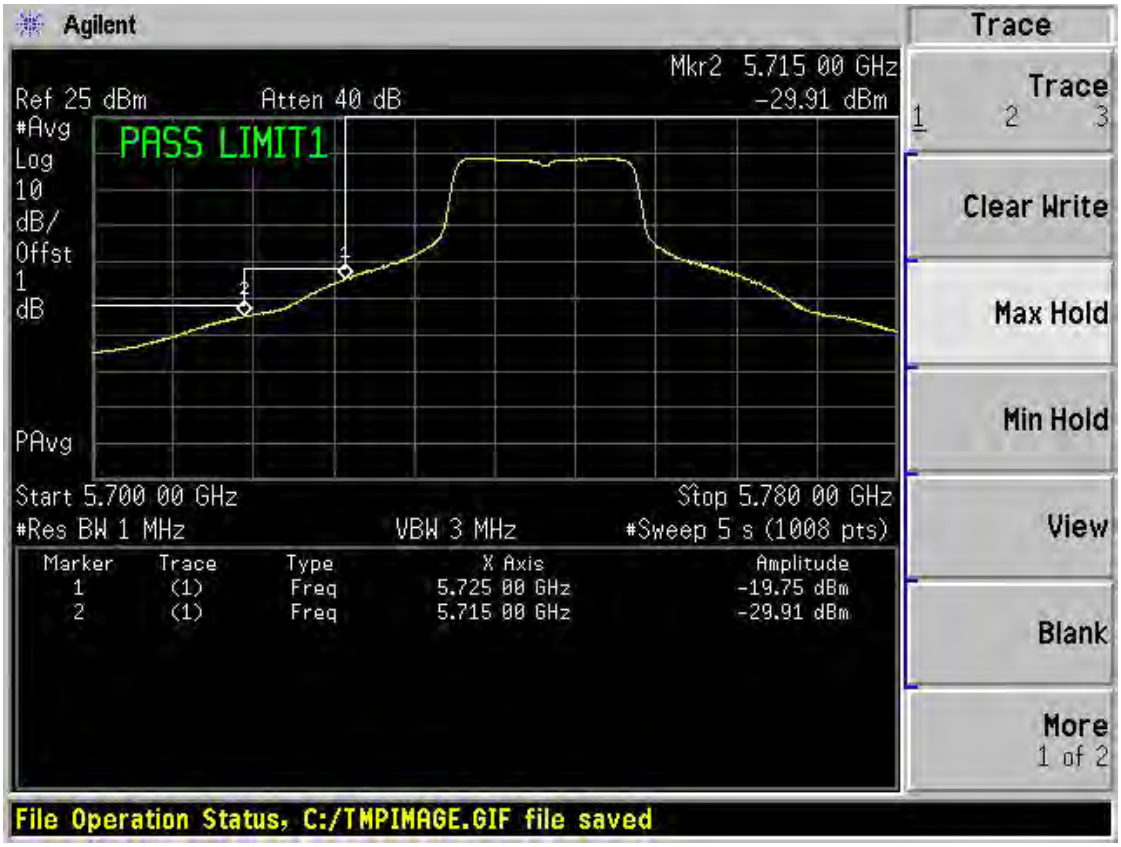
Band IV 11n(HT40) CH151 Chain 2



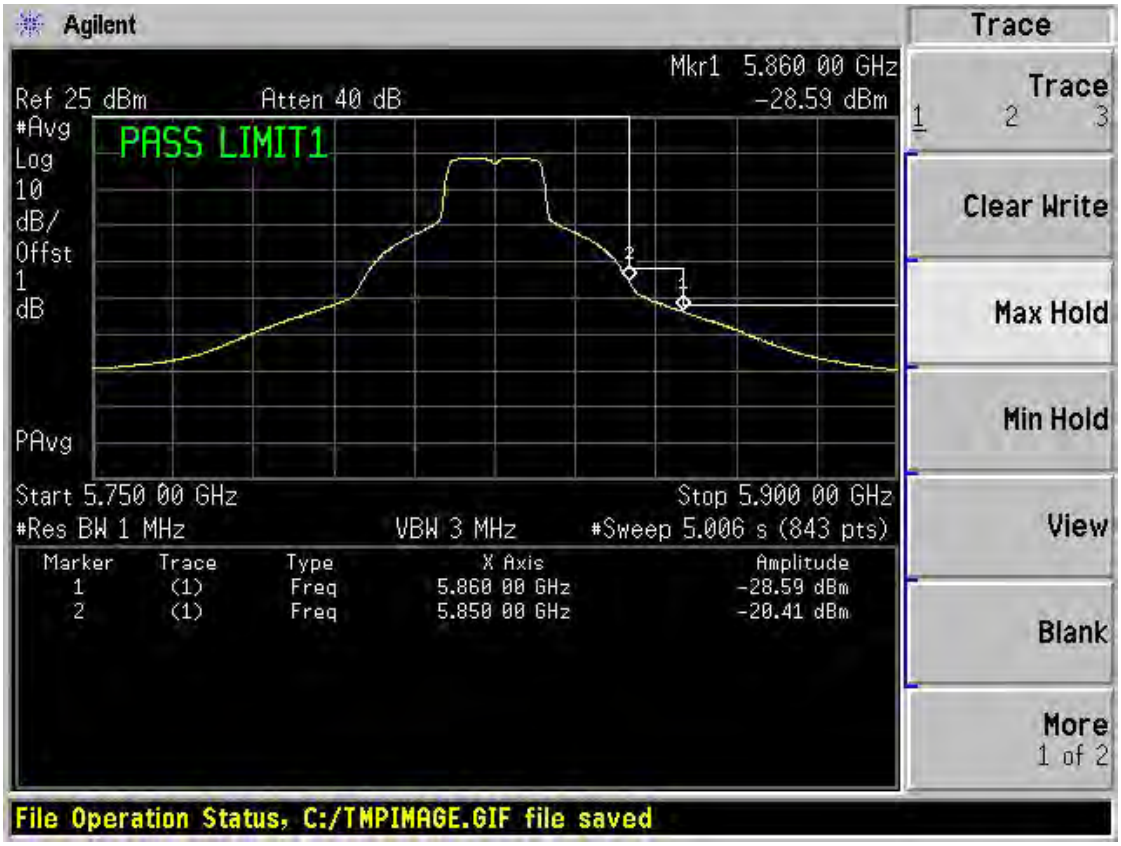
Band IV 11n(HT40) CH159 Chain 2



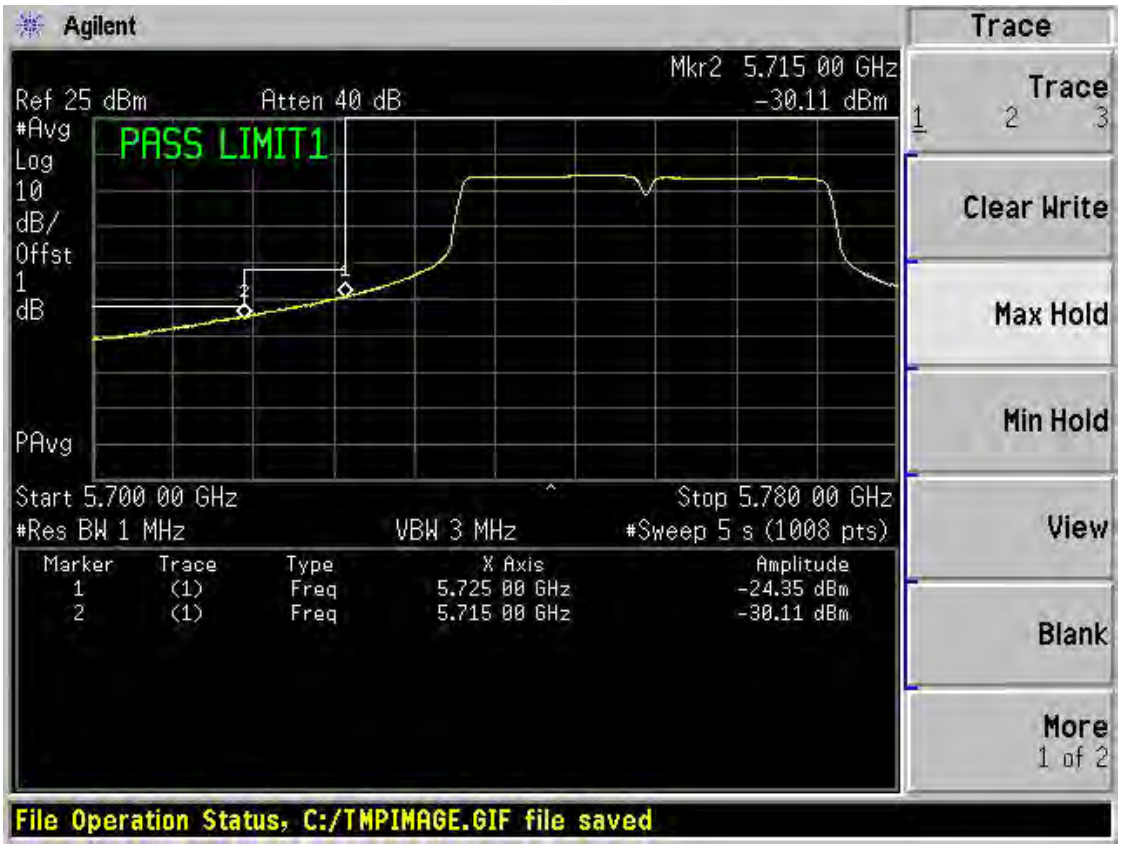
Band IV 11ac(HT20) CH149 Chain 2



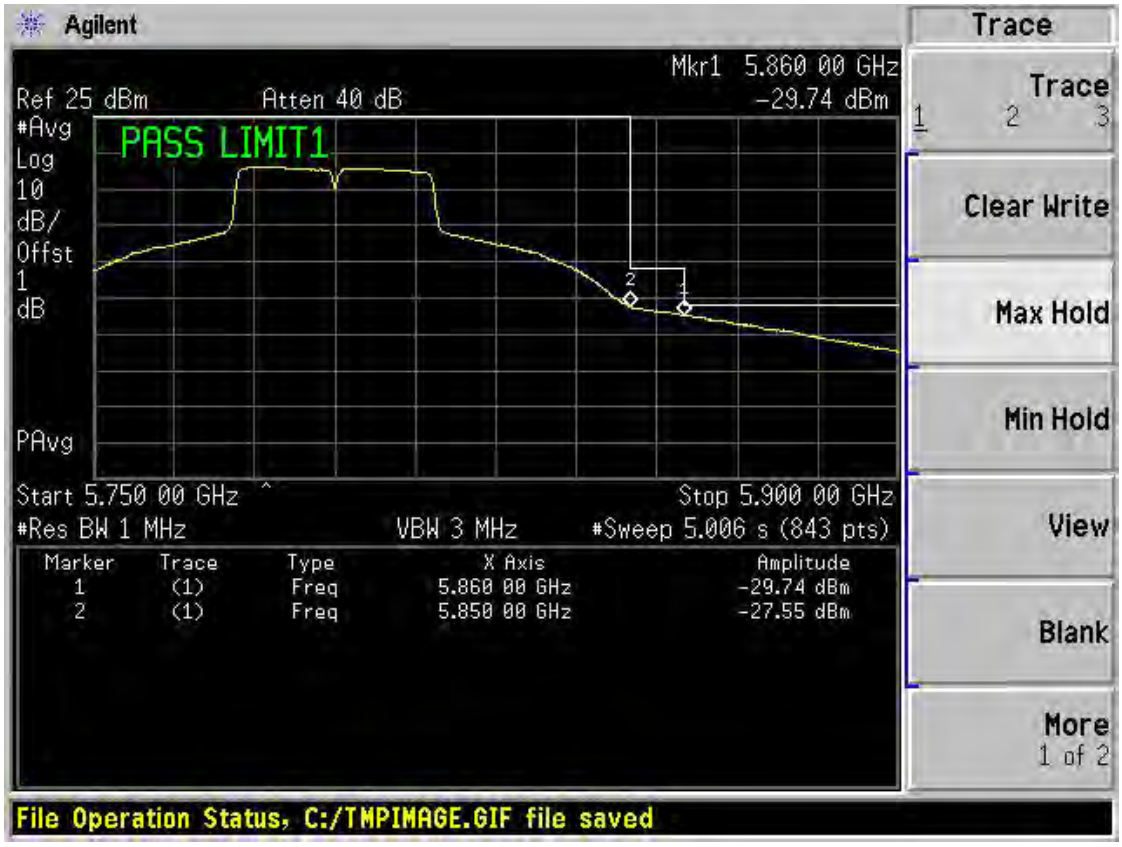
Band IV 11ac(HT20) CH165 Chain 2



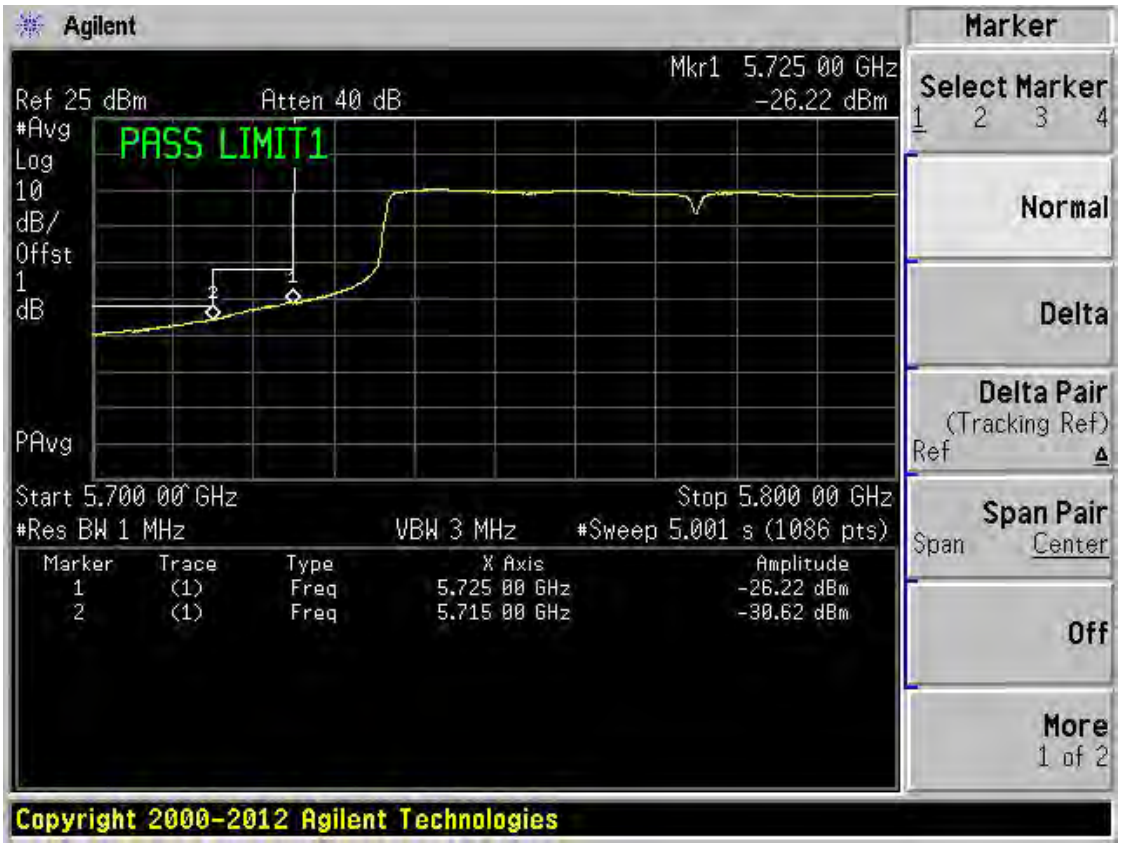
Band IV 11ac(HT40) CH151 Chain 2



Band IV 11ac(HT40) CH159 Chain 2



Band IV 11ac(HT80) CH155 Chain 2 (Low Frequency Band)



Band IV 11ac(HT80) CH155 Chain 2 (High Frequency Band)