FCC RF TEST REPORT

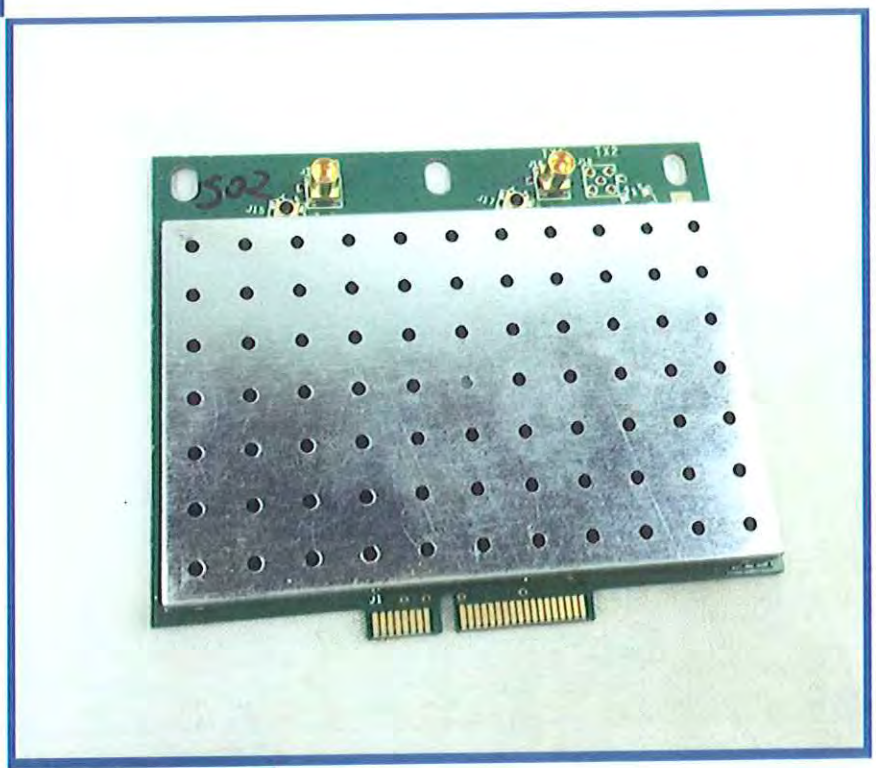
ISSUED BY
Shenzhen BALUN Technology Co., Ltd.

FOR

Broadband Digital Transmission System

ISSUED TO
LigoWave LLC

138 Mountain Brook Dr Canton, GA 30115 United States



Report No.:	BL-SZ1560065-601
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 90 Subpart Y
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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Date 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
Brand Name	LigoWave
The Under Test 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

2.4 Technical Information

Modulation technology	OFDM
Modulation Type	BPSK, QPSK, 16QAM, 64QAM
Operating Frequency	4950 MHz to 4980 MHz
Device Type	Fixed point-to-point
Channel Bandwidth	20 MHz
Test Chanel	Low (4950 MHz), MID (4965 MHz), High (4980MHz)
Number of Channels	7
Transfer Rate (Mbps)	54/ 48/ 36 / 24 / 18 / 9/ 6 Mbps
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

4950 - 4980 MHz			
Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	**4950**	5	4970
2	4955	6	4975
3	4960	**7**	**4980**
4	**4965**		

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

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	Modulation Technology	Modulation Type	Data Rate (Mbps)	Channel	
Output Power	OFDM	BPSK	6	1/4/7	Low/Mid/High
Occupied Bandwidth & Emissions Mask	OFDM	BPSK	6	1/4/7	Low/Mid/High
Peak Excursion	OFDM	BPSK	6	1/4/7	Low/Mid/High
Power Spectral Density	OFDM	BPSK	6	1/4/7	Low/Mid/High
Radiated Spurious Emission	OFDM	BPSK	6	1/4/7	Low/Mid/High
Conducted Spurious Emissions at the Antenna Terminals	OFDM	BPSK	6	1/4/7	Low/Mid/High
Radiated Spurious Emissions	OFDM	BPSK	6	1/4/7	Low/Mid/High
Frequency Stability	OFDM	BPSK	6	1/4/7	Low/Mid/High

Note: The above EUT information in section 2.3 and 2.4 was declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

Special test descriptions: See power table information below:

4950 - 4980 MHz				
Channel	Frequency (MHz)	Power setting		
		3 dBi Antenna	18 dBi Antenna	23 dBi Antenna
Low	4950	28	27	26
Mid	4965	28	27	26
High	4980	28	27	26

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 90, Subpart Y	Regulations Governing Licensing and Use of Frequencies in the 4940-4990 MHz Band
2	KDB Publication 789033 D02v01	MEASUREMENT GUIDANCE FOR CERTIFICATION OF LICENSED DIGITAL TRANSMITTERS
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	Peak Output Power	FCC §2.1046 FCC §90.1215(a)	ANNEX A.1	Pass
3	Occupied Bandwidth & Emissions Mask	FCC §2.1049 FCC §90.210	ANNEX A.2	Pass
4	Peak Excursion	FCC §90.1215	ANNEX A.3	Pass
5	Power Spectral Density	FCC §2.1046 FCC §90.1215(a)	ANNEX A.4	Pass
6	Conducted Spurious Emissions at the Antenna Terminals	FCC §2.1051 FCC §90.210	ANNEX A.5	Pass
7	Radiated Spurious Emissions	FCC §2.1053 FCC §90.210	ANNEX A.6	Pass
8	Frequency Stability	FCC §2.1055 FCC §90.213	ANNEX A.7	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

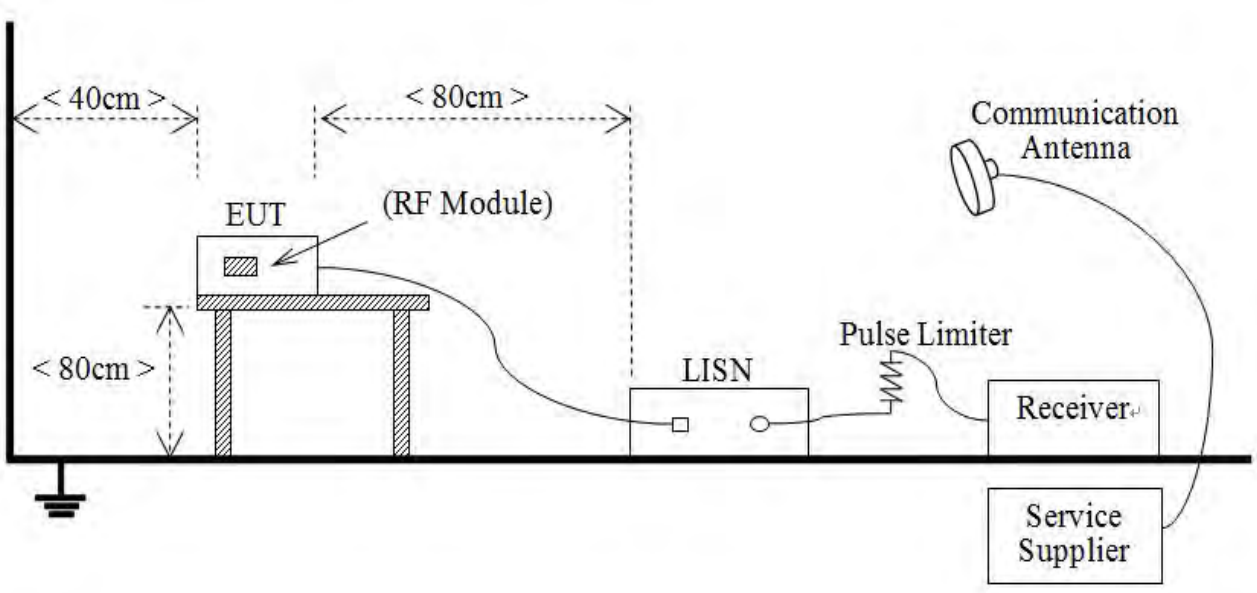
Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-30	103118	2015.07.16	2016.07.15
Vector Signal Generator	ROHDE&SCHWARZ	SMBV100A	177746	2015.07.16	2016.07.15
Signal Generator	ROHDE&SCHWARZ	SMB100A	260592	2015.07.16	2016.07.15
Switch Unit with OSP-B157	ROHDE&SCHWARZ	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

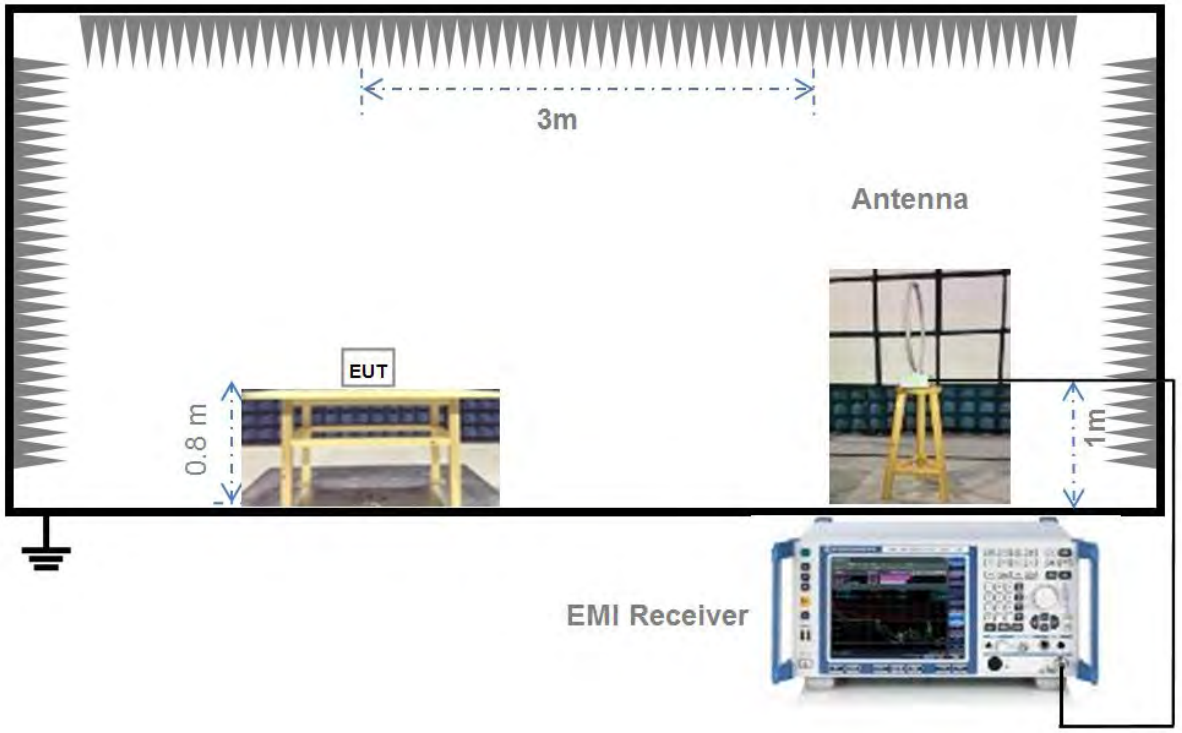
(Diagram 1)

4. 3. 2 For AC Power Supply Port Test



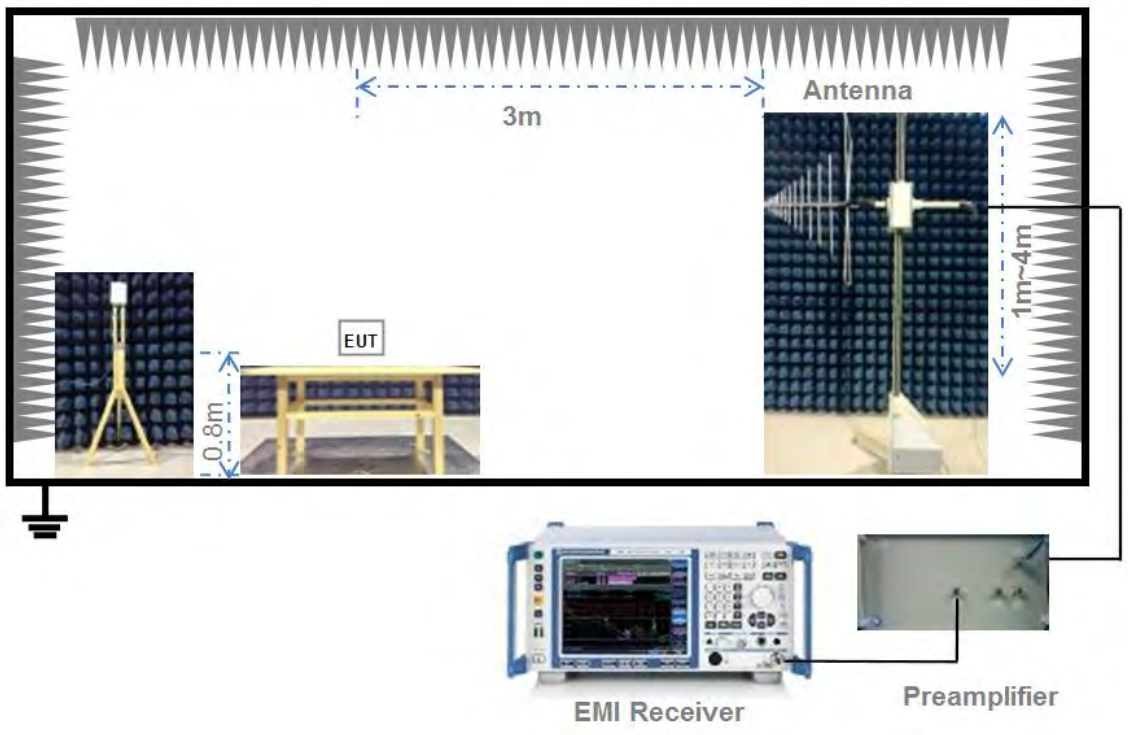
(Diagram 2)

4.3.3 For Radiated Test (Below 30 MHz)



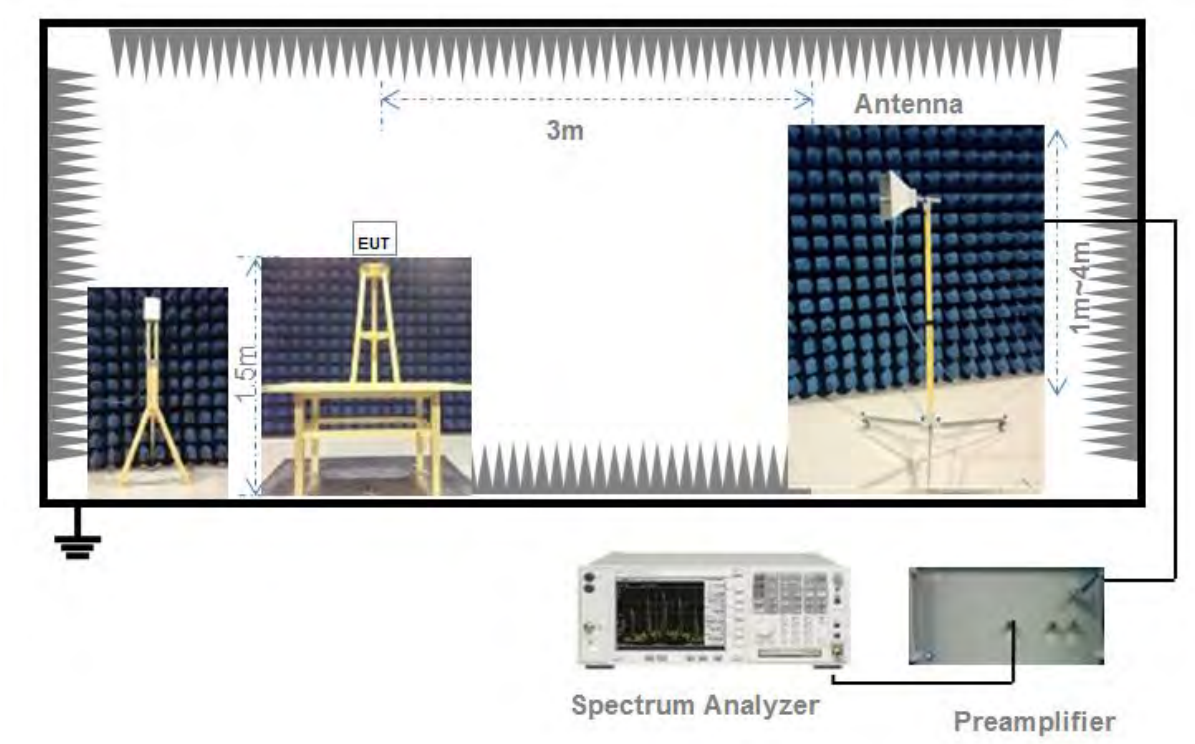
(Diagram 3)

4.3.4 For Radiated Test (30 MHz-1 GHz)



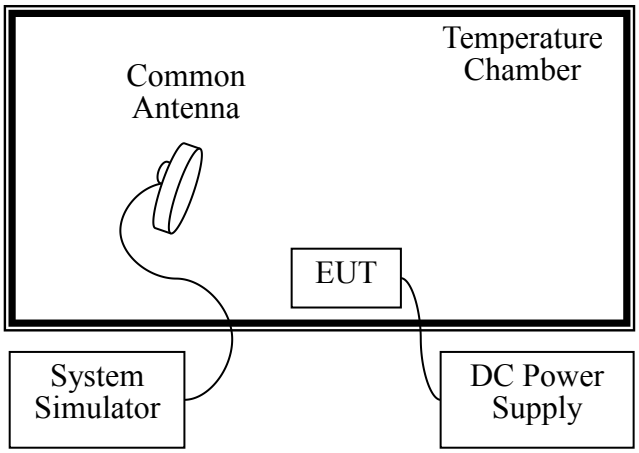
(Diagram 4)

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

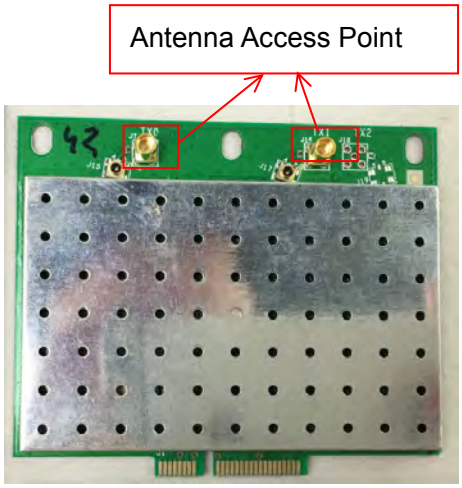
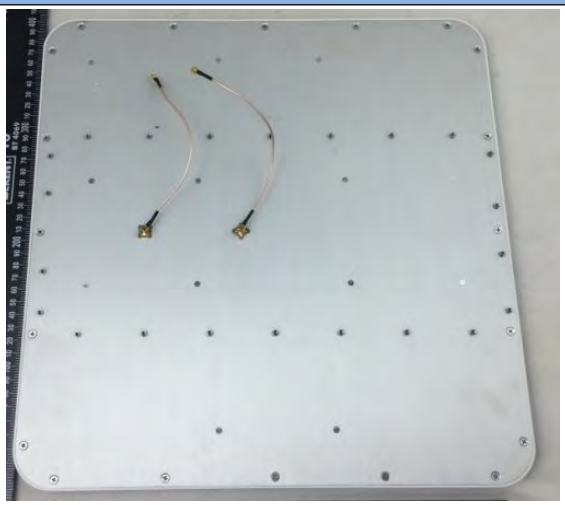
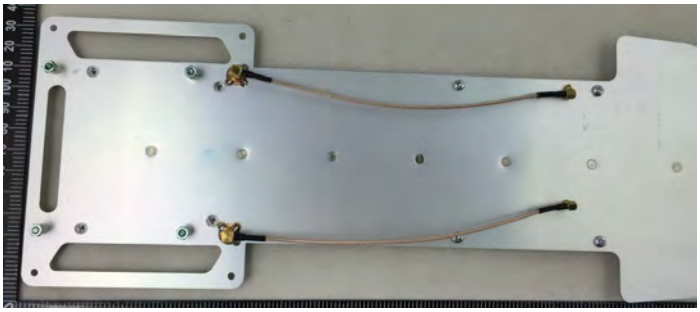
FCC §15.203 & 15.247(b)

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 Peak Output Power

5.2.1 Test Limit

FCC §90.1215

The transmitting power of stations operating in the 4940-4990 MHz band must not exceed the maximum limits in this section.

The maximum conducted output power should not exceed:

Channel bandwidth (MHz)	Low power maximum conducted output power (dBm)	High power maximum conducted output power (dBm)
1	7	20
5	14	27
10	17	30
15	18.8	31.8
20	20	33

5.2.2 Test Procedure

Maximum peak conducted output power

The maximum peak conducted output power may be measured using a broadband peak 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 Occupied Bandwidth & Emissions Mask

5.3.1 Limit

FCC §2.1049 & 90.210

For Low power transmitters (20 dBm or less) and high power transmitters (greater that 20 dBm) operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

Frequency Offset f_d	Low power maximum conducted output power (dBm)	High power maximum conducted output power (dBm)
$0 < f_d \leq 45$	0	0
$45 < f_d \leq 50$	219 log(f_d/45)	568 log(f_d/45)
$50 < f_d \leq 55$	10 + 242 log(f_d/50)	26 +145 log(f_d/50)
$55 < f_d \leq 100$	20 + 31 log(f_d/55)	32 + 31 log(f_d/55)
$100 < f_d \leq 150$	28 + 68 log(f_d/100)	40 + 57 log(f_d/100)
$f_d > 150$	40	50 dB or 55 + 242 log(P), Whichever is the lesser attenuation
fd is the percentage of the equipment's channel bandwidth		

5.3.2 Test Procedure

The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz.

5.4 Peak Excursion

5.4.1 Limit

FCC §90.1215

The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

5.4.2 Test Procedure

The EUT was set to transmit continuously.
The following setting were set on the spectrum analyzer:

Trace 1:

a) RBW = 1 MHz

b) VBW = 3 x RBW

c) Span = 50 MHz

d) Detector = Peak

e) Trace mode = max hold

Trace 2:

a) RBW = 1 MHz

b) VBW = 3 x RBW

c) Span = 50 MHz

d) Detector = Average (RMS)

e) Trace mode = max hold

5.5 Power Spectral density (PSD)

5.5.1 Limit

FCC §2.1046 & 90.1215

High power devices are also limited to a peak power spectral density of 21 dBm per one MHz. High power devices using channel bandwidths other than those listed above are permitted; however, they are limited to peak power spectral density of 21 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the maximum conducted output power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi. However, high power point-to-point and point-to-multipoint operations (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the maximum conducted output power or spectral density. Corresponding reduction in the maximum conducted output power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi.

Low power devices are also limited to a peak power spectral density of 8 dBm per one MHz. Low power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 8 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the maximum conducted output power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi.

5.5.2 Test Procedure

The following procedure can be used with a spectrum/signal analyzer or EMC receiver to determine the peak PSD.

a) Set the analyzer center frequency to the OBW center frequency.

b) Set the span to 1.5 times the OBW bandwidth.

c) Set the RBW to the specified reference bandwidth (often 1 MHz).

d) Set the VBW ≥ 3 * RBW.

e) Set the number of points in sweep ≥ span / RBW.

NOTE: This requirement is applicable only to final measurement. It can be violated for preliminary (pre-scan) measurements when necessary for wide span measurements.

f) Detector = peak.

g) Sweep time = auto couple.

h) Trace mode = max hold.

i) Allow trace to fully stabilize.

j) Use the peak marker function to determine the maximum amplitude level within the specified reference bandwidth (PSD).

5.6 Conducted Spurious Emission

5.6.1 Limit

FCC §90.210 (L) & §90.210 (M)

For Low power transmitters (20 dBm or less) and high power transmitters (greater that 20 dBm) operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

Frequency Offset f_d	Low power maximum conducted output power (dBm)	High power maximum conducted output power (dBm)
$0 < f_d \leq 45$	0	0
$45 < f_d \leq 50$	$219 \log(f_d/45)$	$568 \log(f_d/45)$
$50 < f_d \leq 55$	$10 + 242 \log(f_d/50)$	$26 + 145 \log(f_d/50)$
$55 < f_d \leq 100$	$20 + 31 \log(f_d/55)$	$32 + 31 \log(f_d/55)$
$100 < f_d \leq 150$	$28 + 68 \log(f_d/100)$	$40 + 57 \log(f_d/100)$
$f_d > 150$	40	50 dB or $55 + 242 \log(P)$, Whichever is the lesser attenuation
fd is the percentage of the equipment's channel bandwidth		

5.6.2 Test Procedure

The EUT was set to transmit in a modulated transmit mode.
The RF output of the EUT was connected to a spectrum analyzer using appropriate attenuation.
Conducted spurious emissions were measured up to 40 GHz.
Sufficient scans were taken to shown any out of band emissions.

5.7 Radiated Spurious Emission

5.7.1 Limit

FCC §15.209

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

FCC §90.210 (L) & §90.210 (M)

For Low power transmitters (20 dBm or less) and high power transmitters (greater that 20 dBm) operating in the 4940-4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

Frequency Offset f_d	Low power maximum conducted output power (dBm)	High power maximum conducted output power (dBm)
$0 < f_d \leq 45$	0	0
$45 < f_d \leq 50$	219 log(f_d/45)	568 log(f_d/45)
$50 < f_d \leq 55$	10 + 242 log(f_d/50)	26 +145 log(f_d/50)
$55 < f_d \leq 100$	20 + 31 log(f_d/55)	32 + 31 log(f_d/55)
$100 < f_d \leq 150$	28 + 68 log(f_d/100)	40 + 57 log(f_d/100)
$f_d > 150$	40	50 dB or 55 + 242 log(P), Whichever is the lesser attenuation
fd is the percentage of the equipment's channel bandwidth		

5.7.2 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:

$E = EIRP – 20\log D + 104.8$

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

5.8 Frequency Stability

5.8.1 Limit

FCC §2.1055 &90.213

The test shall be performed at normal and extreme test conditions, From -30 to +50 and vary the primary supply voltage from 85% to 115% of the nominal value.

5.8.2 Test Procedure

The EUT was switched on and allowed to warm up to its normal operation condition.
The EUT output was connected to a spectrum analyser and the frequency stability was measured.
Measurements were taken after a thermal balance was obtained.
Normal and extreme test conditions were measured.

ANNEX A TEST RESULT

A.1 Peak Output Power

Test Data

High Power Setting - Maximum Peak Output Power measurement results (3 dBi Antenna Gain)

Channel	Frequency (MHz)	Conducted Power (dBm)			Output Power Limit (dBm)	Verdict
		Chain 1	Chain 2	Total Power		
Low	4950	25.63	26.25	28.96	33	Pass
Mid	4965	25.41	26.13	28.80	33	Pass
High	4980	25.36	26.08	28.75	33	Pass

High Power Setting - Maximum Peak Output Power measurement results (18 dBi Antenna Gain)

Channel	Frequency (MHz)	Conducted Power (dBm)			Output Power Limit (dBm)	Verdict
		Chain 1	Chain 2	Total Power		
Low	4950	25.01	25.64	28.35	33	Pass
Mid	4965	24.62	25.26	27.96	33	Pass
High	4980	25.06	25.33	28.21	33	Pass
Note: high power point-to-point and point-to-multipoint operations (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the maximum conducted output power.						

High Power Setting - Maximum Peak Output Power measurement results (23 dBi Antenna Gain)

Channel	Frequency (MHz)	Conducted Power (dBm)			Output Power Limit (dBm)	Verdict
		Chain 1	Chain 2	Total Power		
Low	4950	24.68	25.06	27.88	33	Pass
Mid	4965	24.16	24.97	27.59	33	Pass
High	4980	24.21	24.85	27.55	33	Pass
Note: high power point-to-point and point-to-multipoint operations (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the maximum conducted output power.						

A.2 Occupied Bandwidth & Emissions Mask

Test Data

Occupied Bandwidth measurement results (3 dBi Antenna Gain)

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)		99% Bandwidth (MHz)	
		Chain 1	Chain 2	Chain 1	Chain 2
Low	4950	22.415	21.769	16.7603	16.7540
Mid	4965	22.195	22.021	16.7749	16.7768
High	4980	21.587	21.572	16.7846	16.7372

Occupied Bandwidth measurement results (18 dBi Antenna Gain)

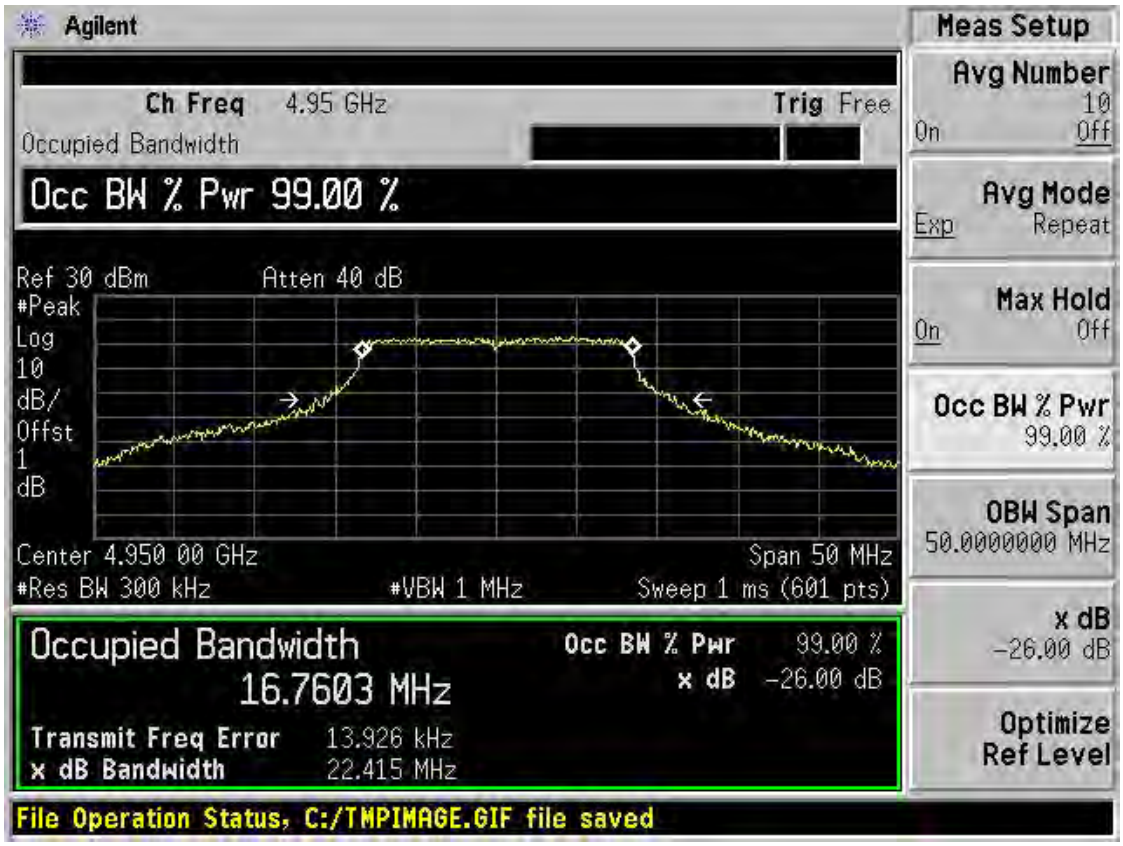
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)		99% Bandwidth (MHz)	
		Chain 1	Chain 2	Chain 1	Chain 2
Low	4950	22.980	23.418	16.8346	16.8566
Mid	4965	23.090	23.226	16.8480	16.7501
High	4980	23.300	21.584	16.7943	16.7813

Occupied Bandwidth measurement results (23 dBi Antenna Gain)

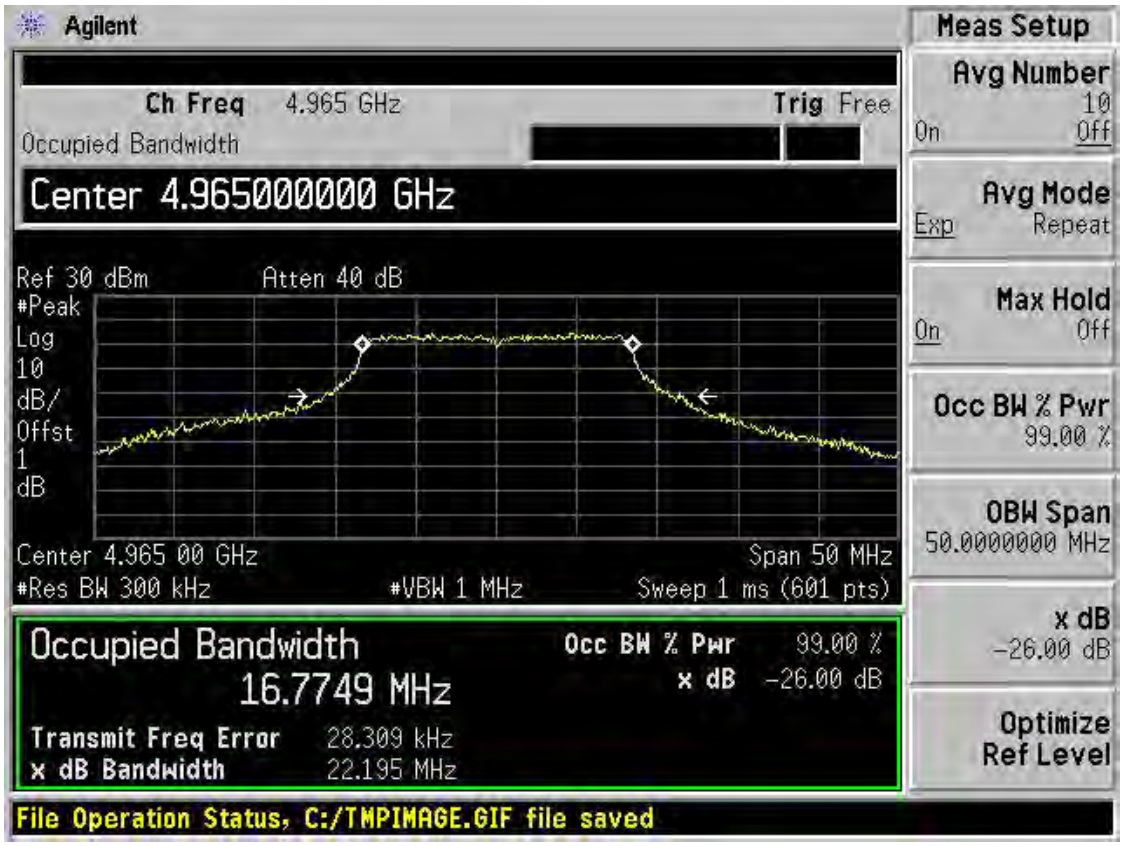
Channel	Frequency (MHz)	26 dB Bandwidth (MHz)		99% Bandwidth (MHz)	
		Chain 1	Chain 2	Chain 1	Chain 2
Low	4950	22.730	22.690	16.8639	16.8598
Mid	4965	23.359	22.477	16.8128	16.7687
High	4980	22.191	22.876	16.7464	16.8327

26dB & 99% Bandwidth Test Plots

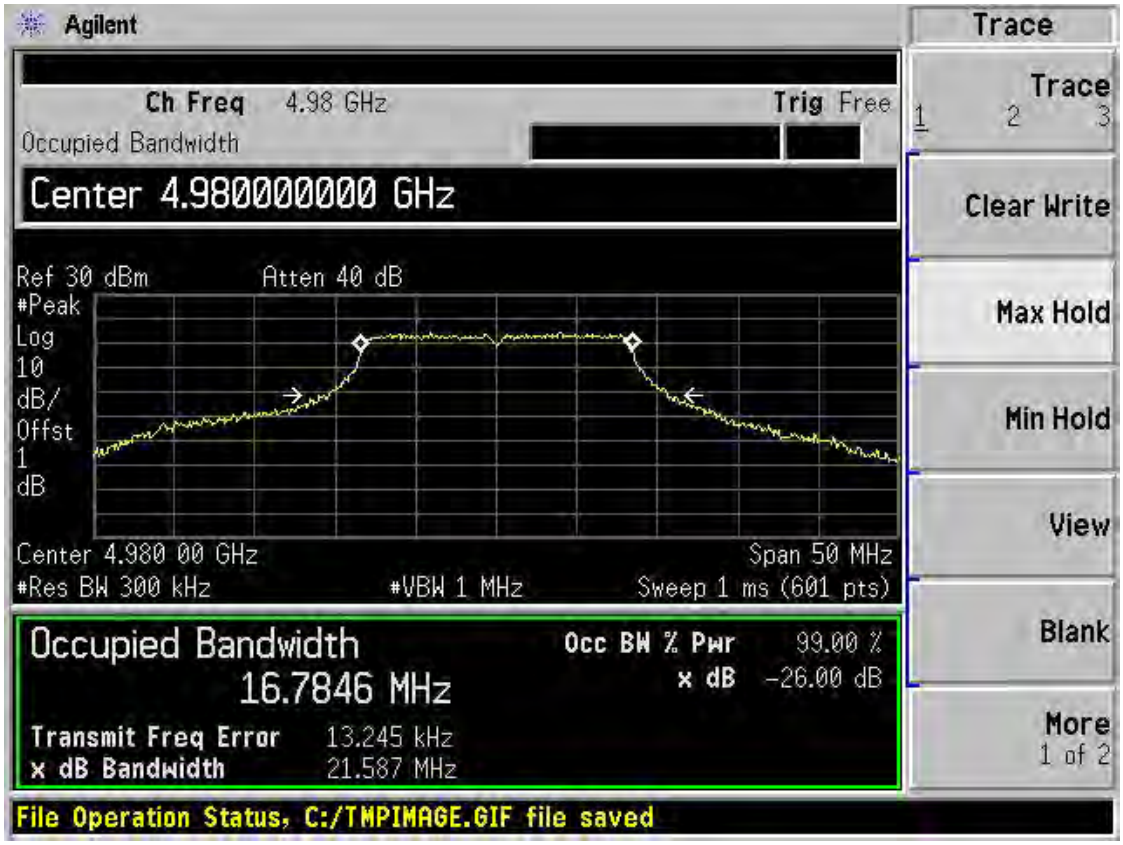
Chain 1 26dB & 99% Bandwidth (3 dBi Antenna)-Low Channel



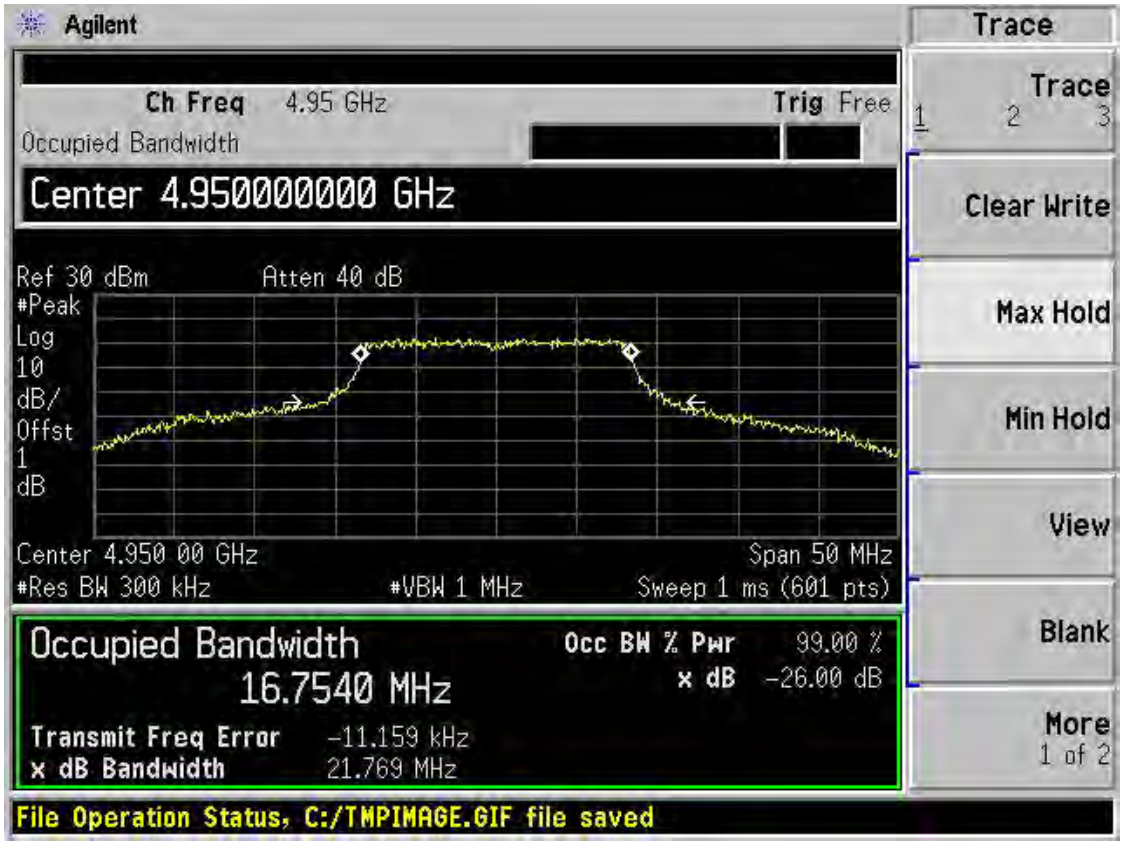
Chain 1 26dB & 99% Bandwidth (3 dBi Antenna)-Mid Channel



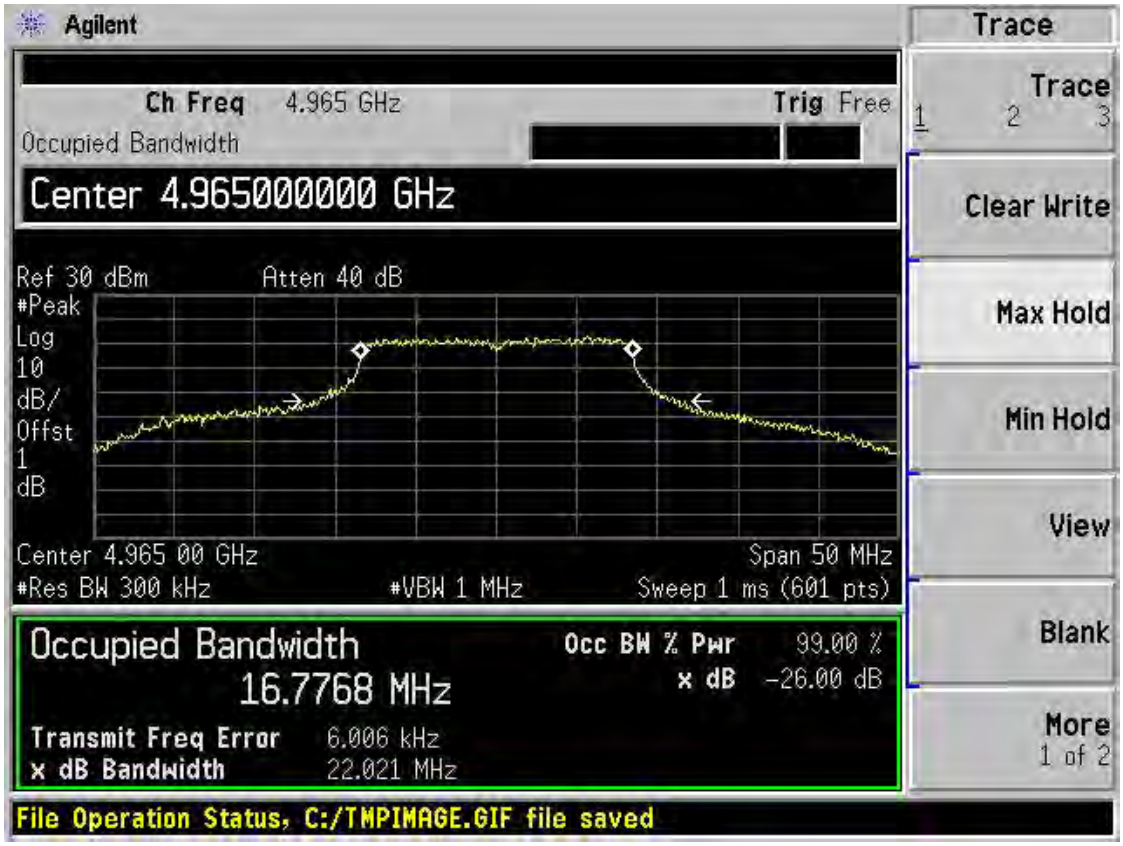
Chain 1 26dB & 99% Bandwidth (3 dBi Antenna)-High Channel



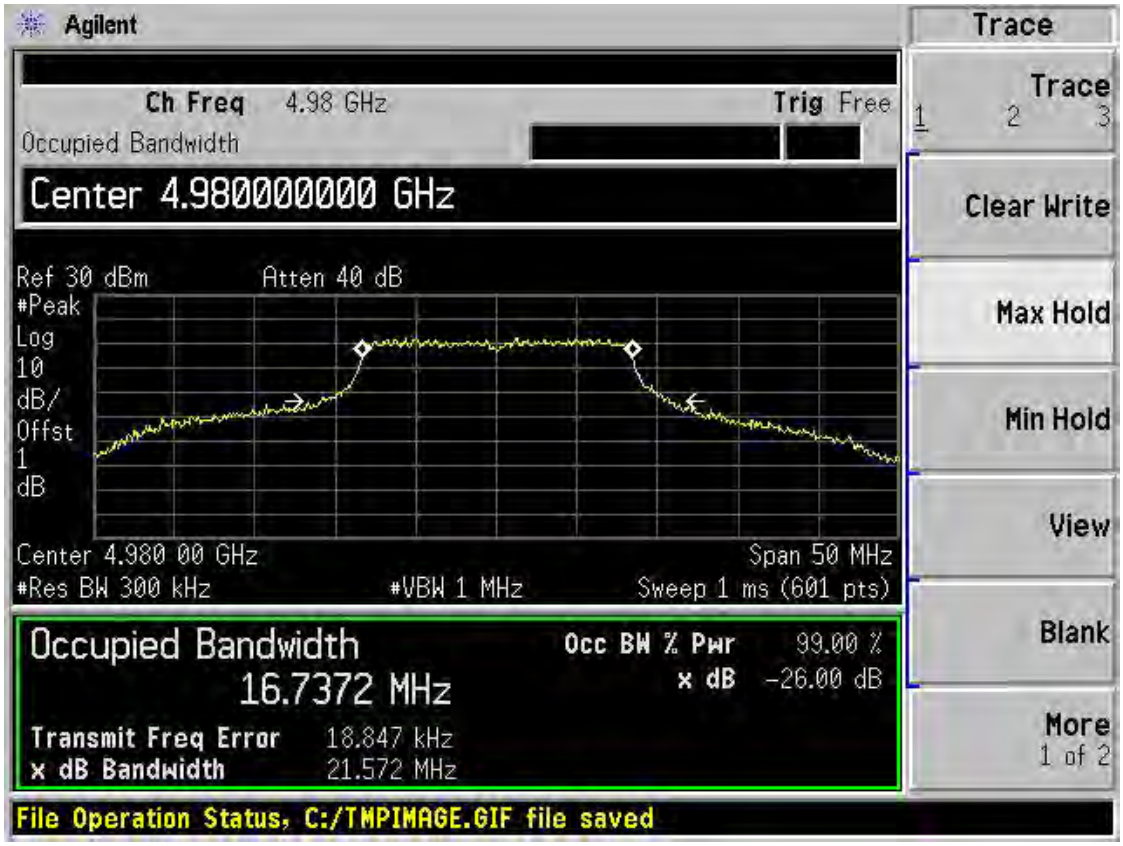
Chain 2 26dB & 99% Bandwidth (3 dBi Antenna)-Low Channel



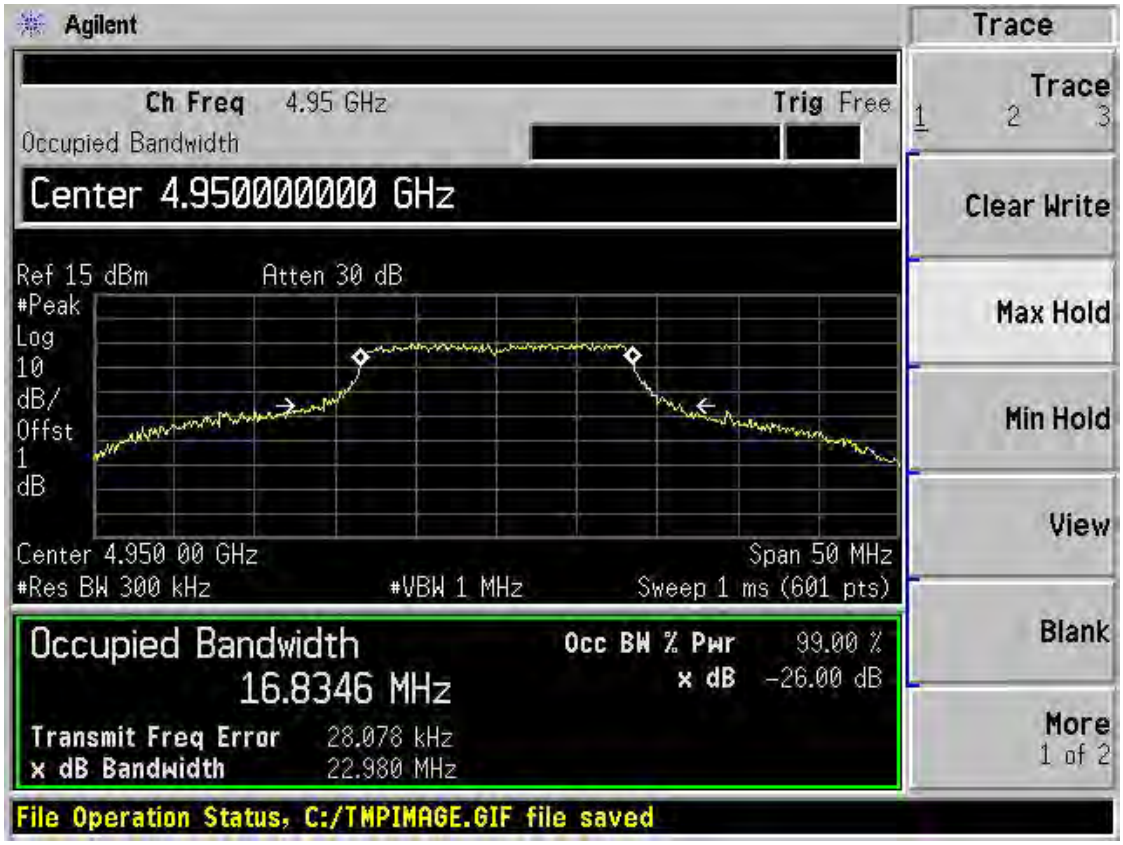
Chain 2 26dB & 99% Bandwidth (3 dBi Antenna)-Mid Channel



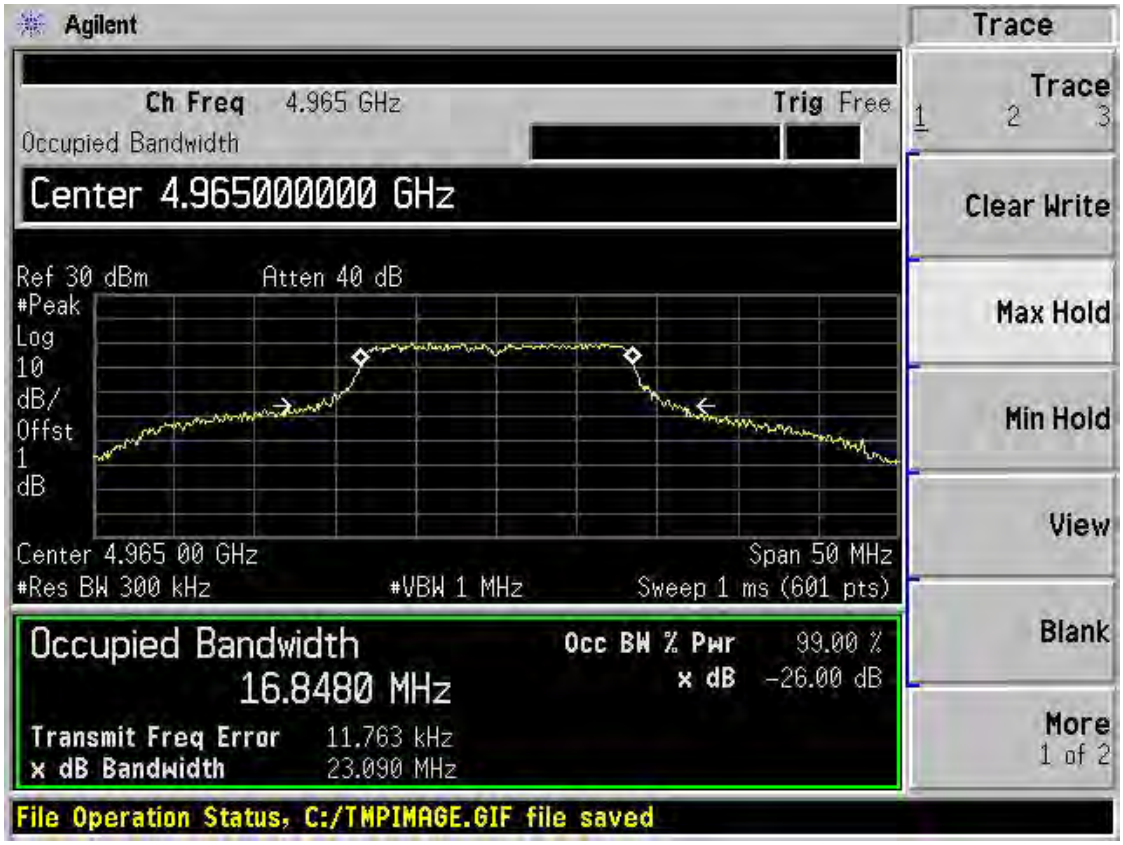
Chain 2 26dB & 99% Bandwidth (3 dBi Antenna)-High Channel



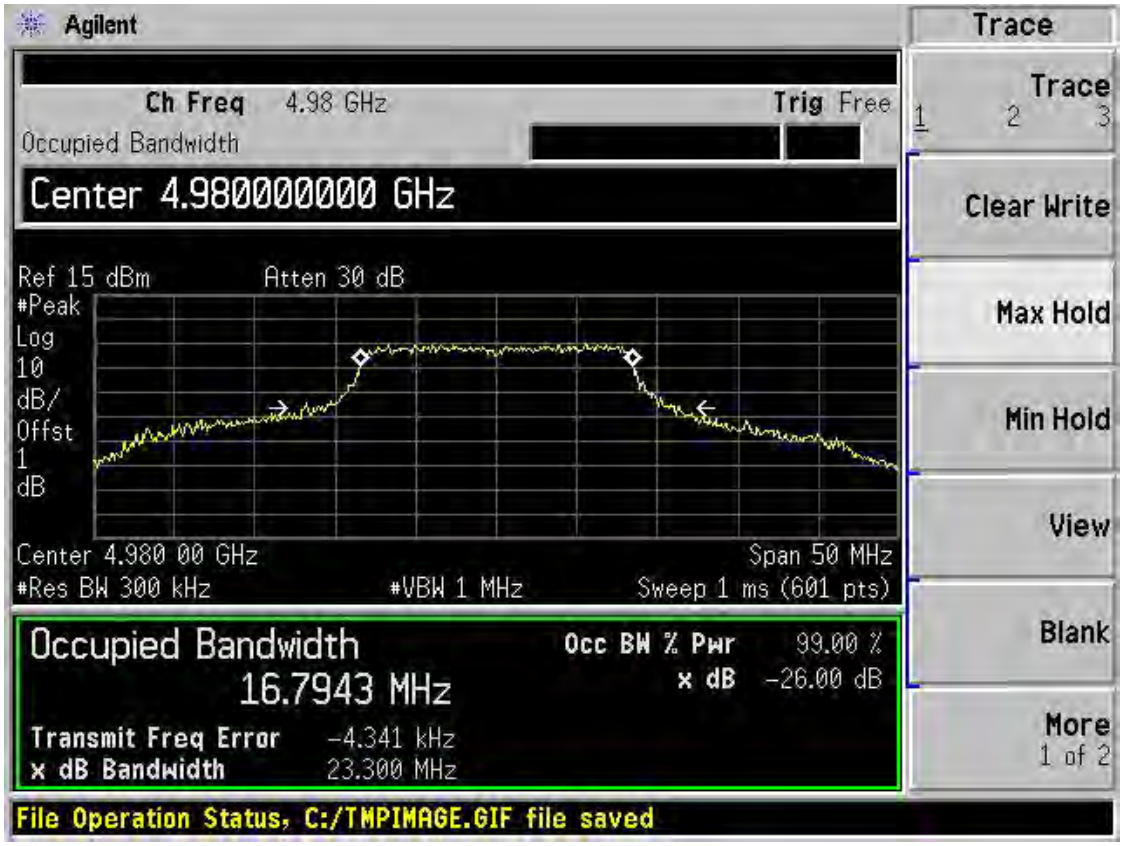
Chain 1 26dB & 99% Bandwidth (18 dBi Antenna)-Low Channel



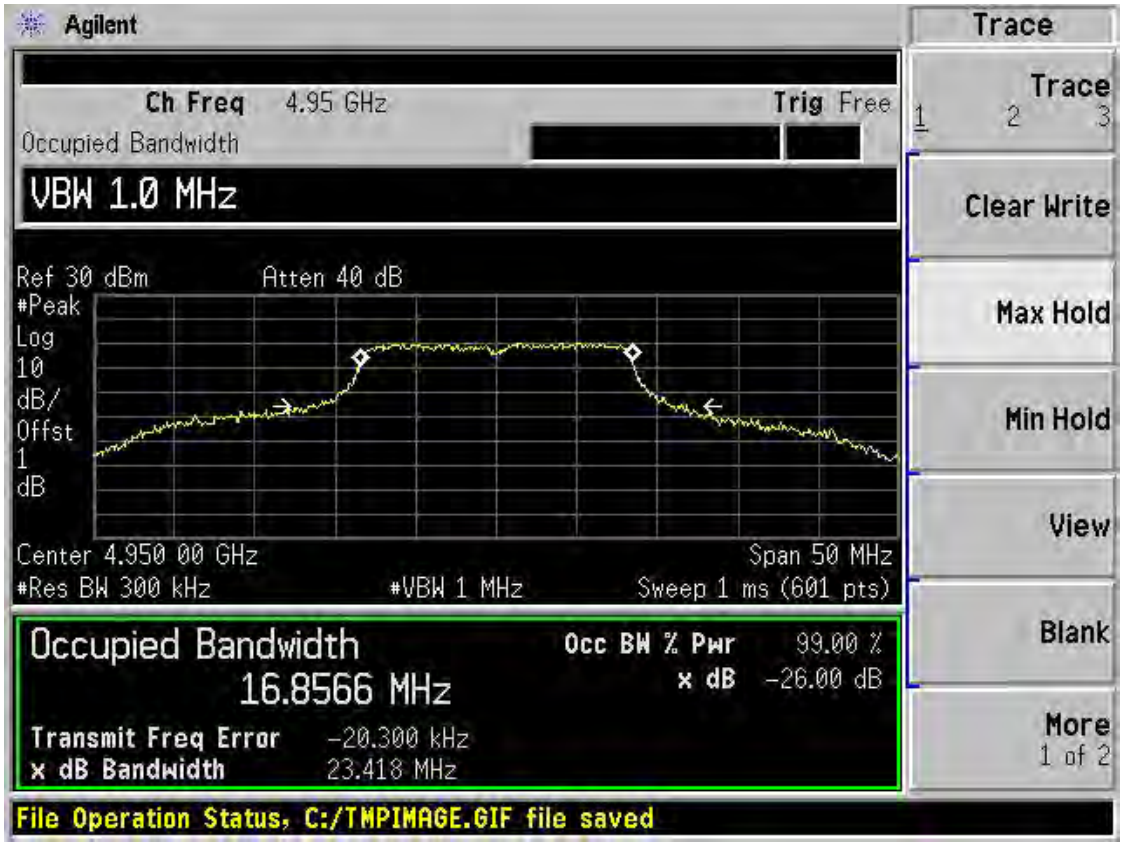
Chain 1 26dB & 99% Bandwidth (18 dBi Antenna)-Mid Channel



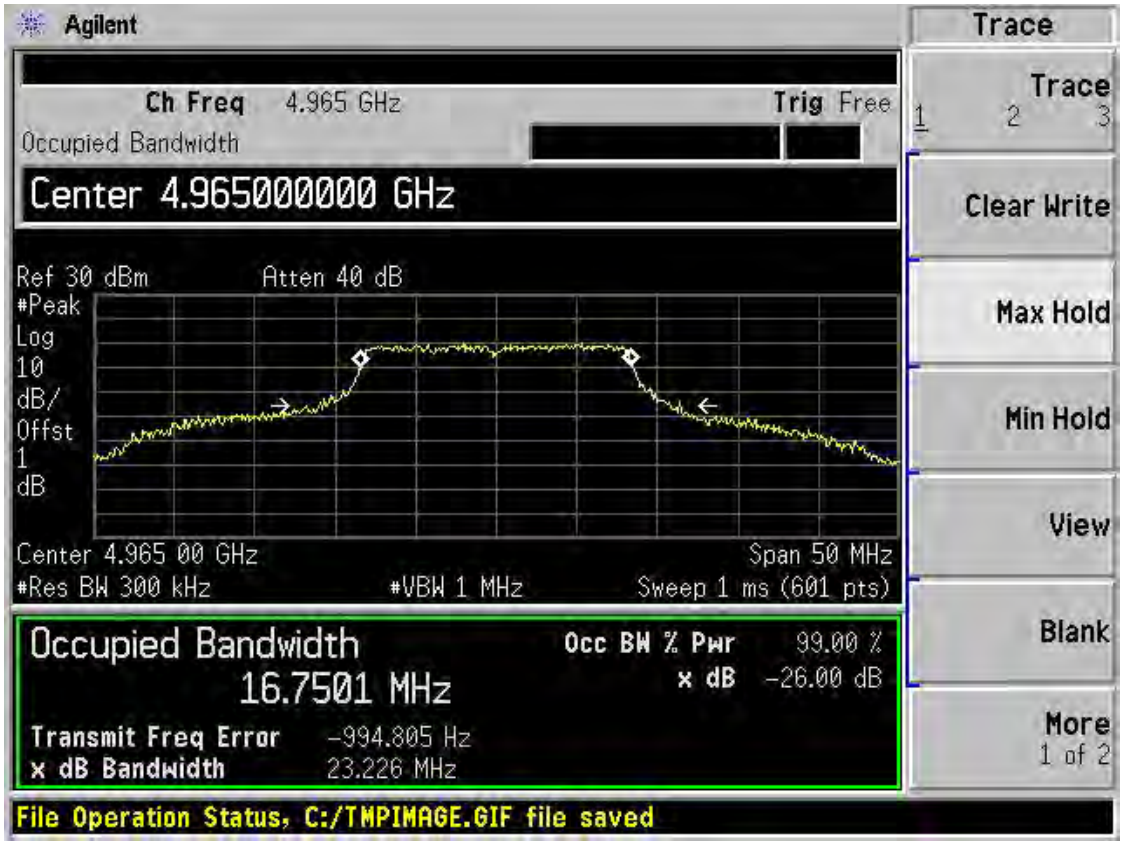
Chain 1 26dB & 99% Bandwidth (18 dBi Antenna)-High Channel



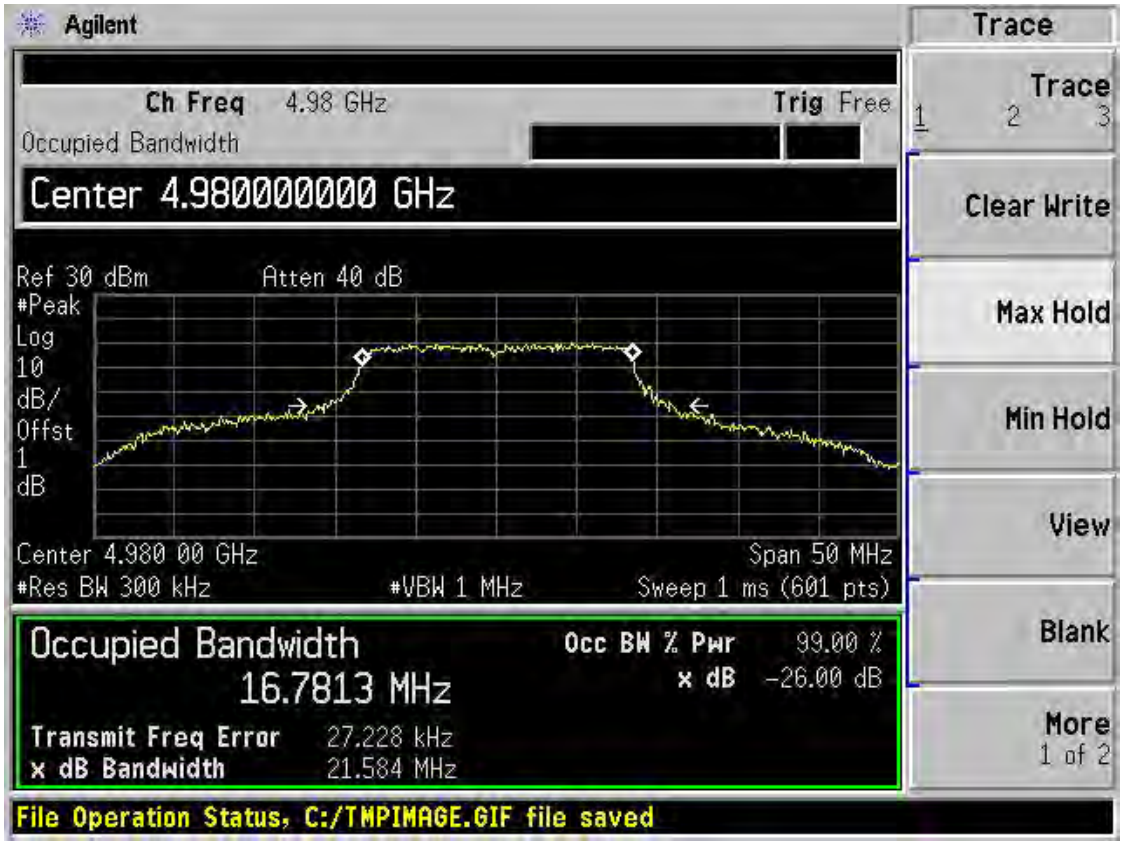
Chain 2 26dB & 99% Bandwidth (18 dBi Antenna)-Low Channel



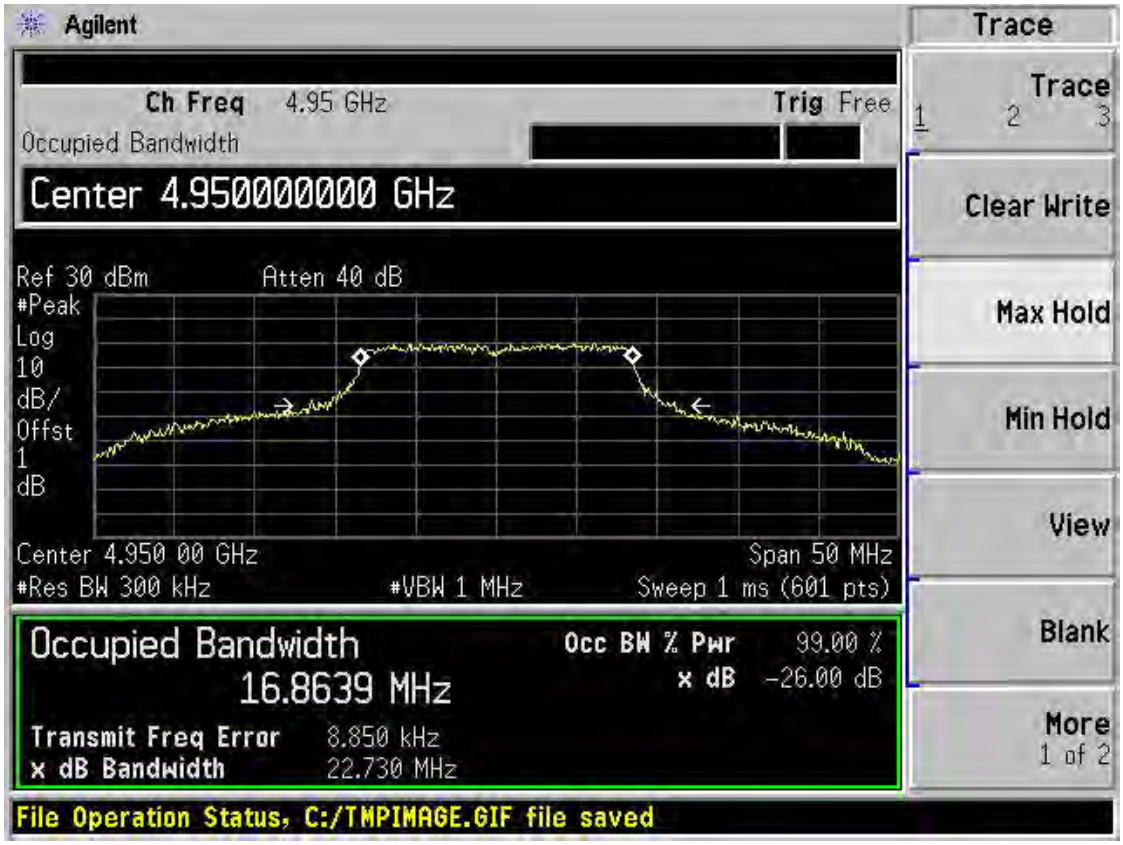
Chain 2 26dB & 99% Bandwidth (18 dBi Antenna)-Mid Channel



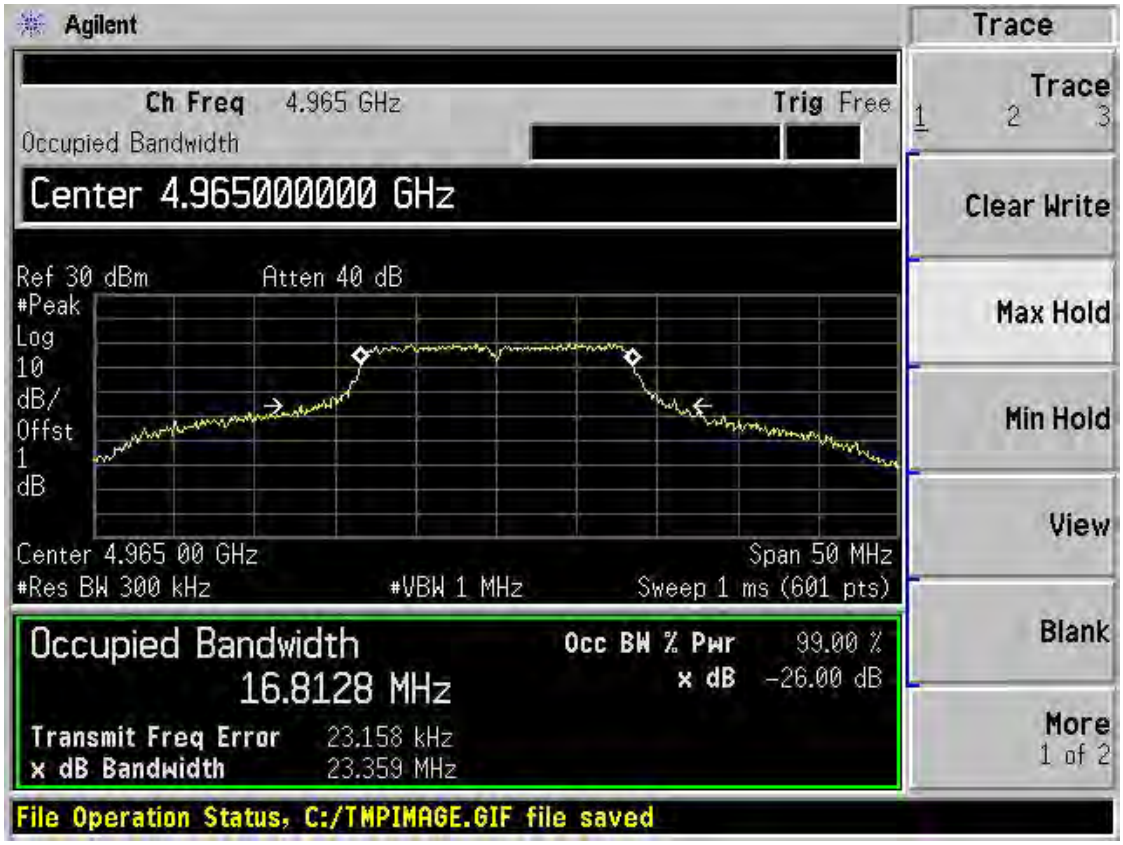
Chain 2 26dB & 99% Bandwidth (18 dBi Antenna)-High Channel



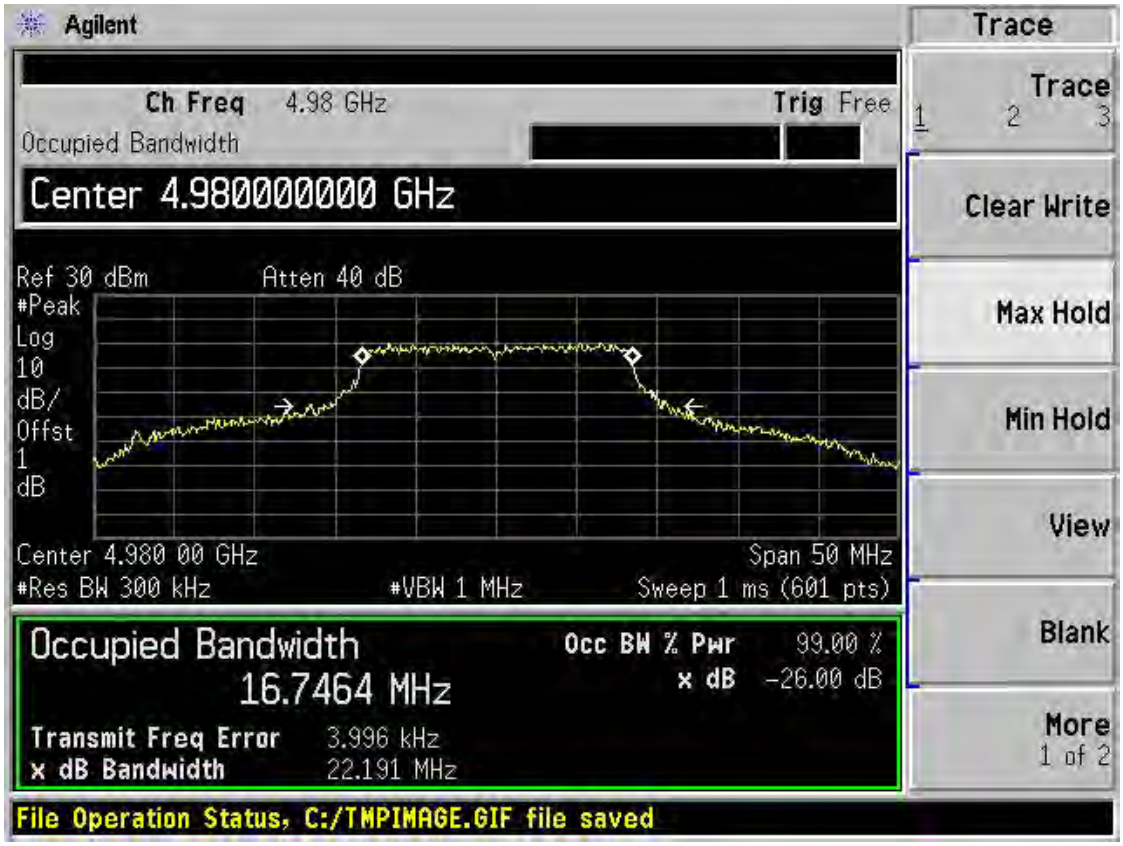
Chain 1 26dB & 99% Bandwidth (23 dBi Antenna)-Low Channel



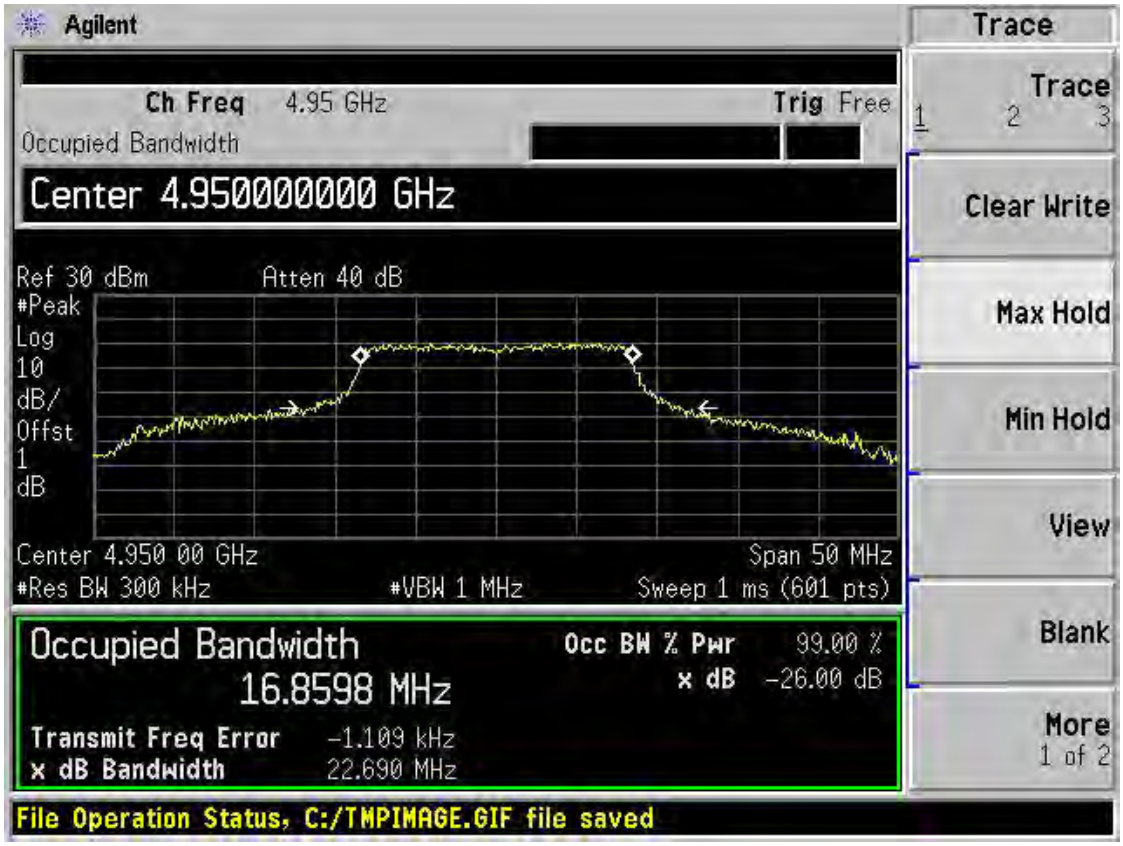
Chain 1 26dB & 99% Bandwidth (23 dBi Antenna)-Mid Channel



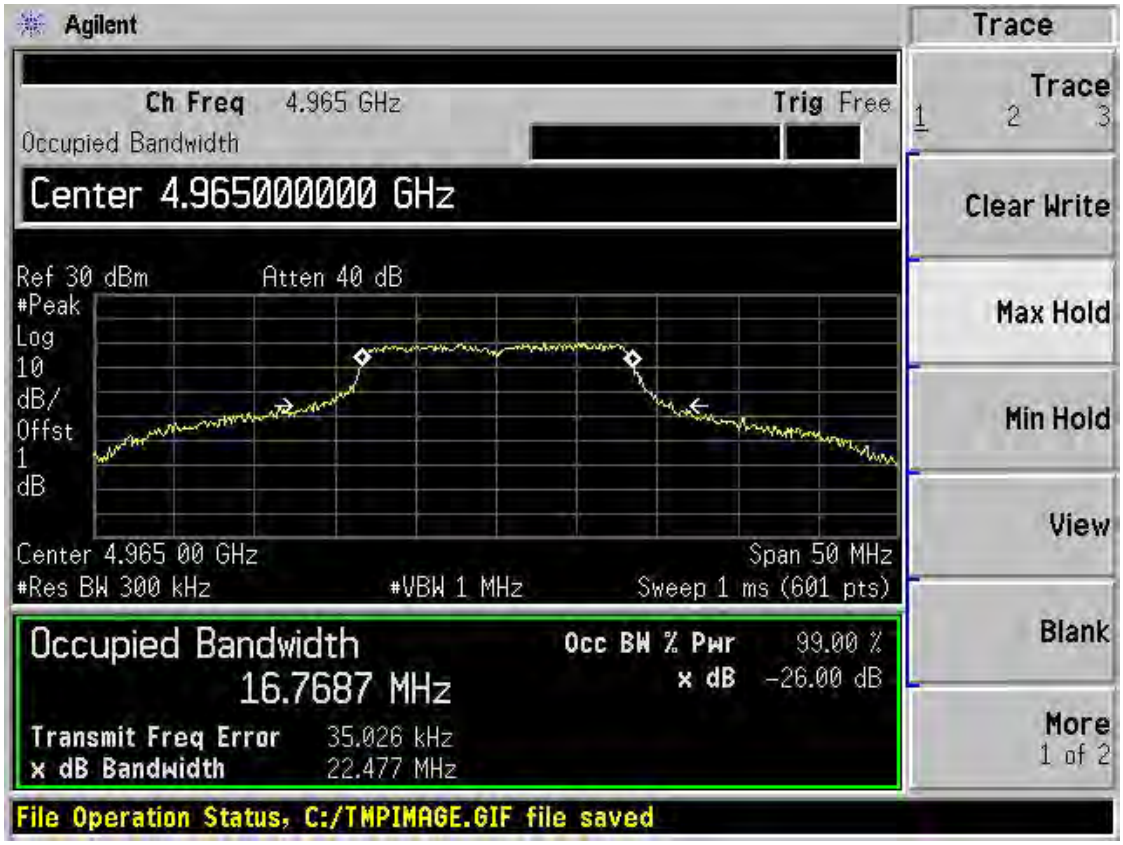
Chain 1 26dB & 99% Bandwidth (23 dBi Antenna)-High Channel



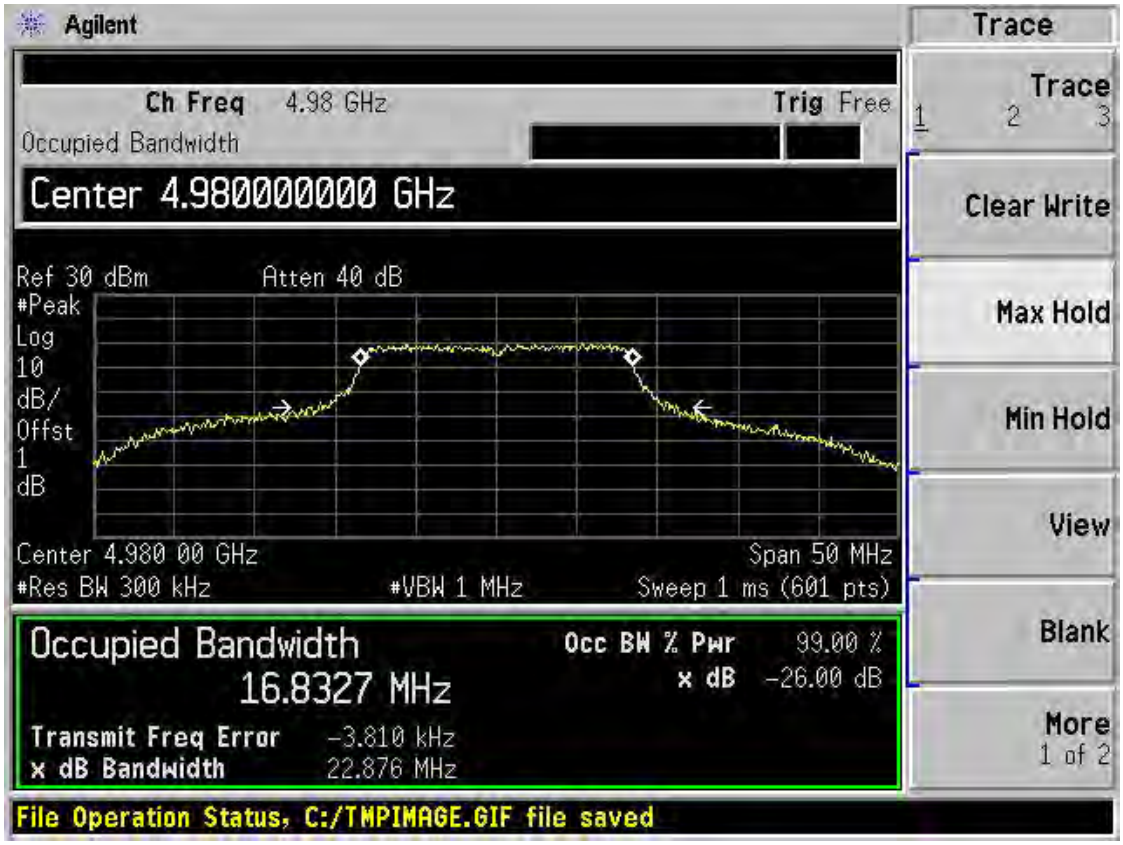
Chain 2 26dB & 99% Bandwidth (23 dBi Antenna)-Low Channel



Chain 2 26dB & 99% Bandwidth (23 dBi Antenna)-Mid Channel

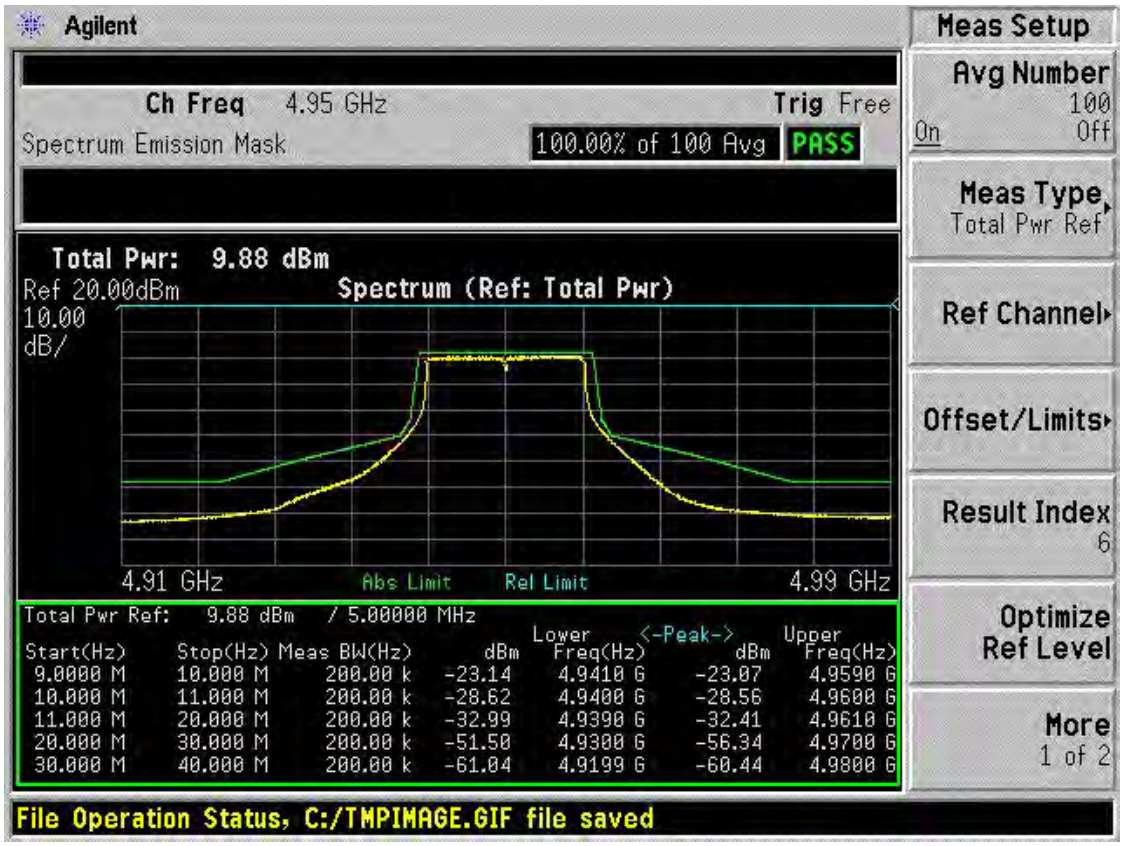


Chain 2 26dB & 99% Bandwidth (23 dBi Antenna)-High Channel

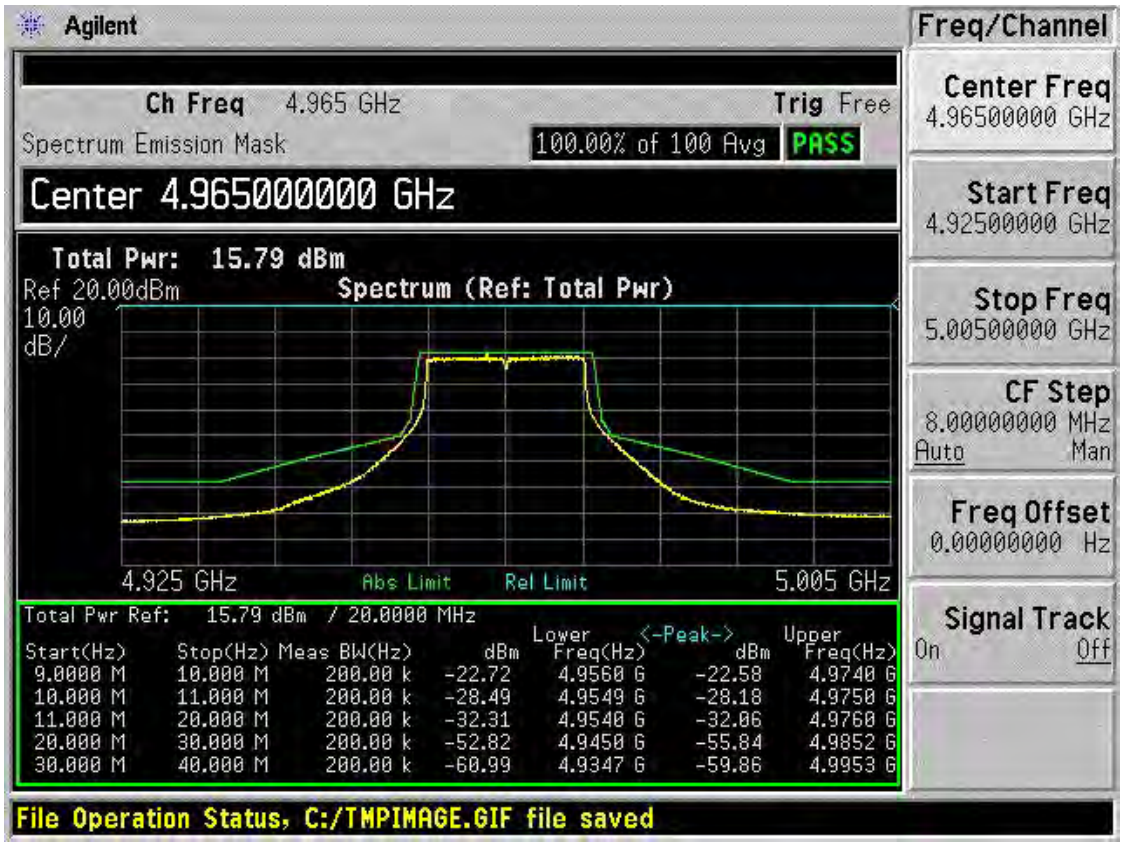


Emission Mask Test Plots

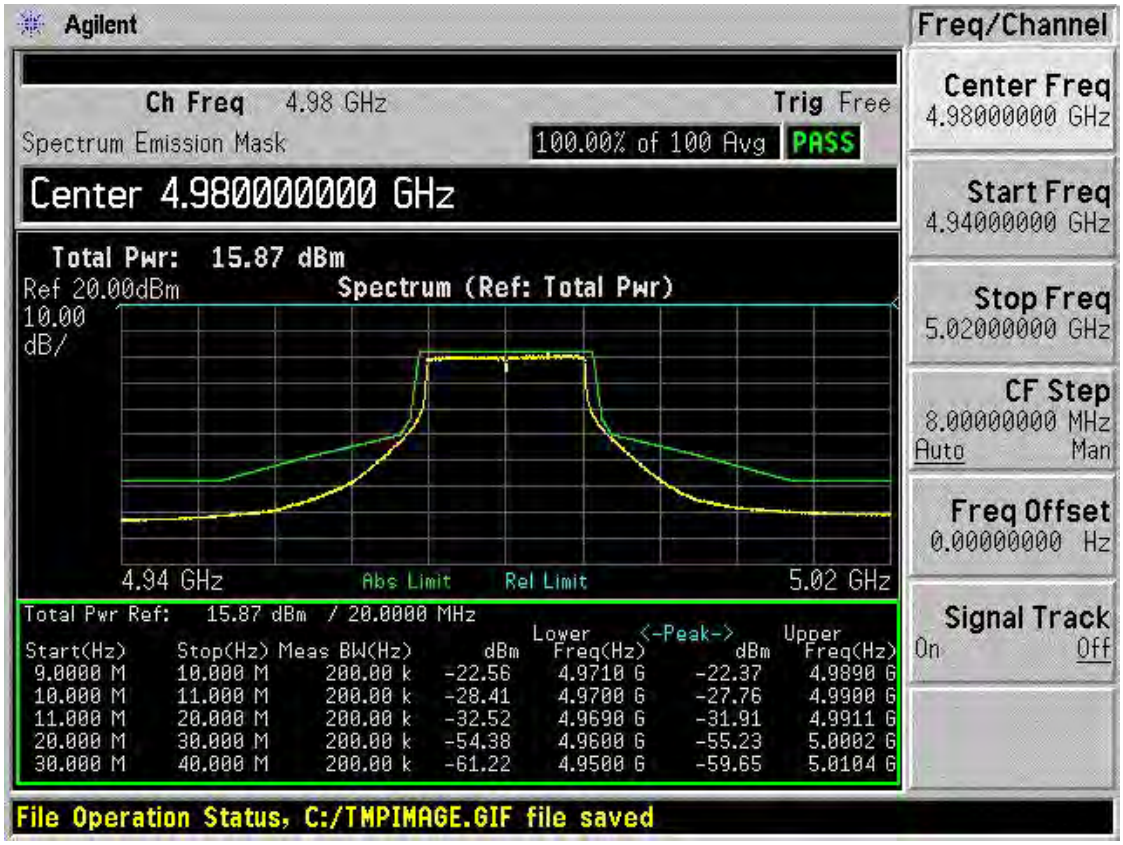
Chain 1 Mask (3 dBi Antenna)-Low Channel



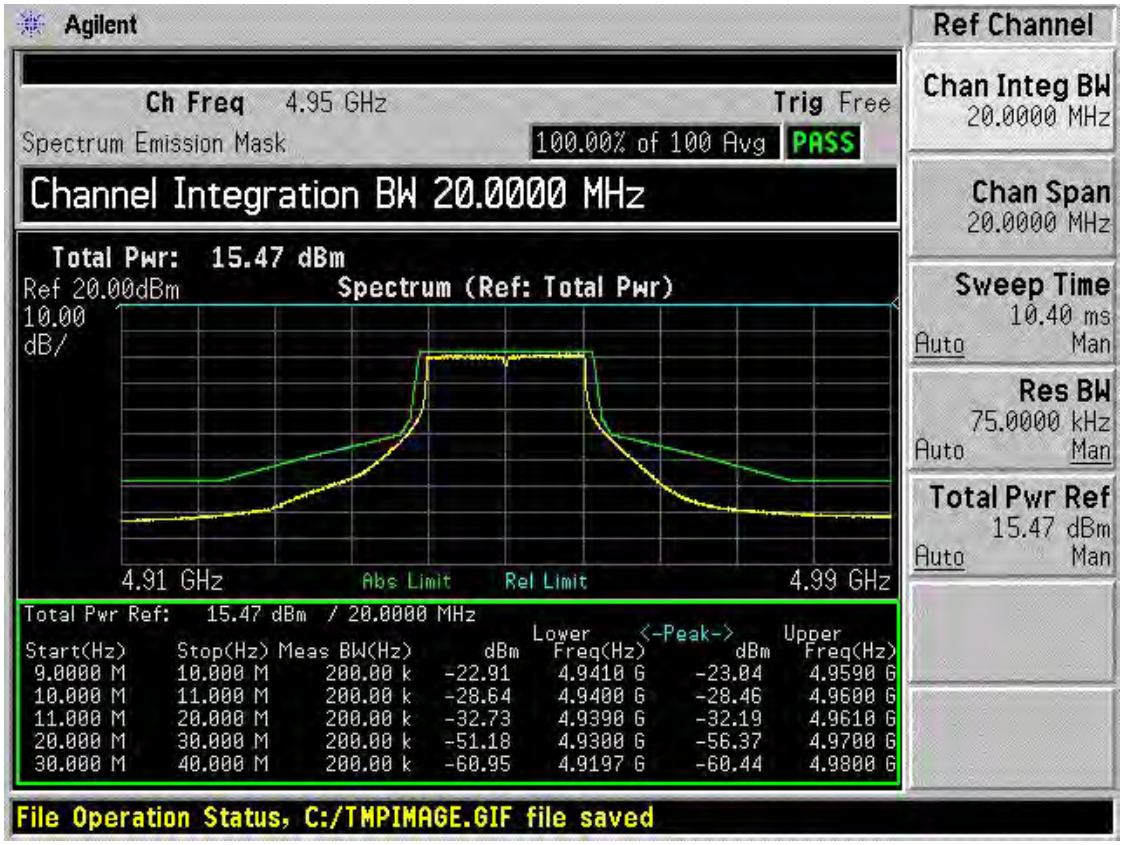
Chain 1 Mask (3 dBi Antenna)-Mid Channel



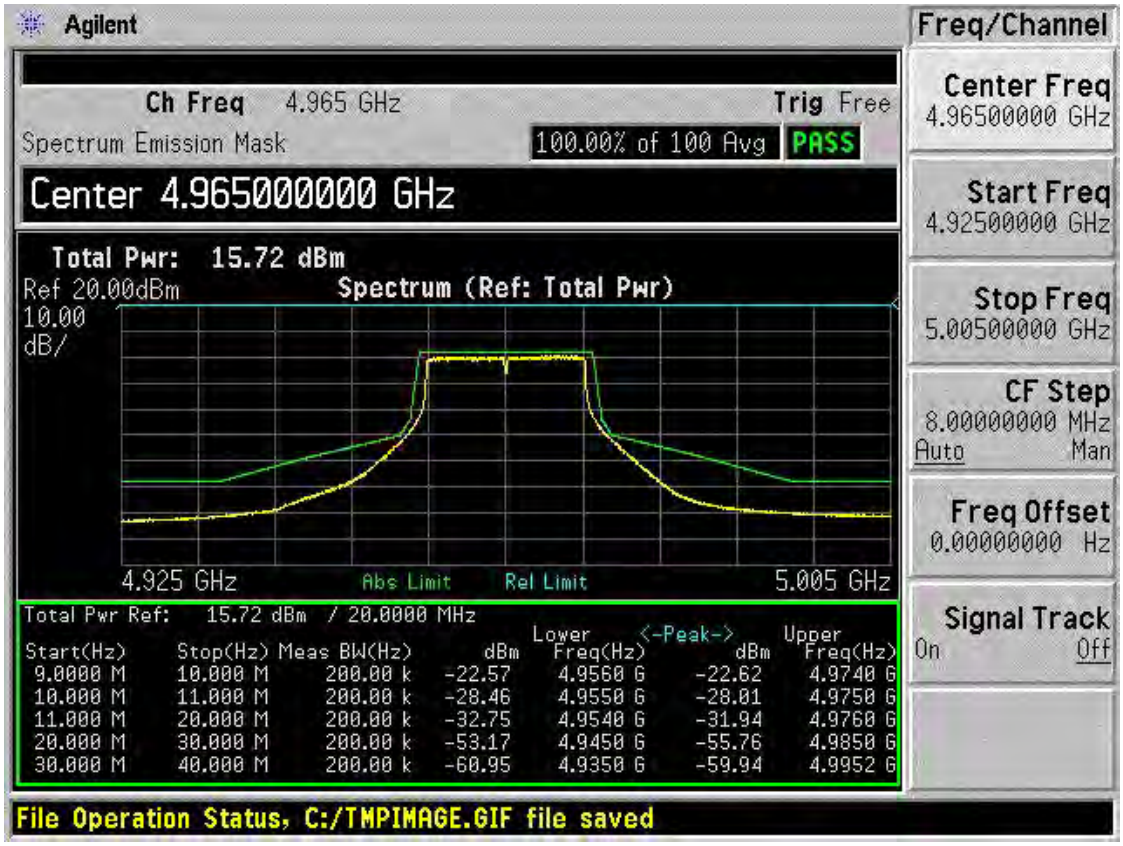
Chain 1 Mask (3 dBi Antenna)-High Channel



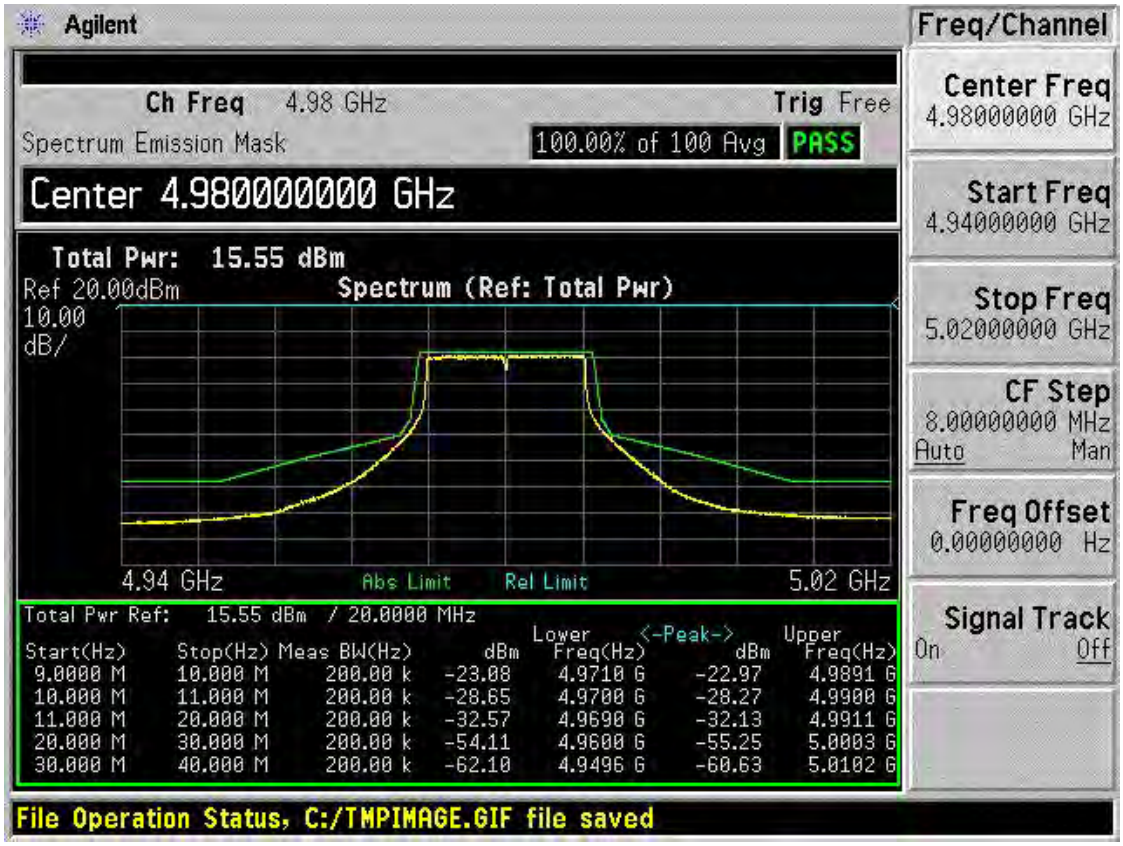
Chain 2 Mask (3 dBi Antenna)-Low Channel



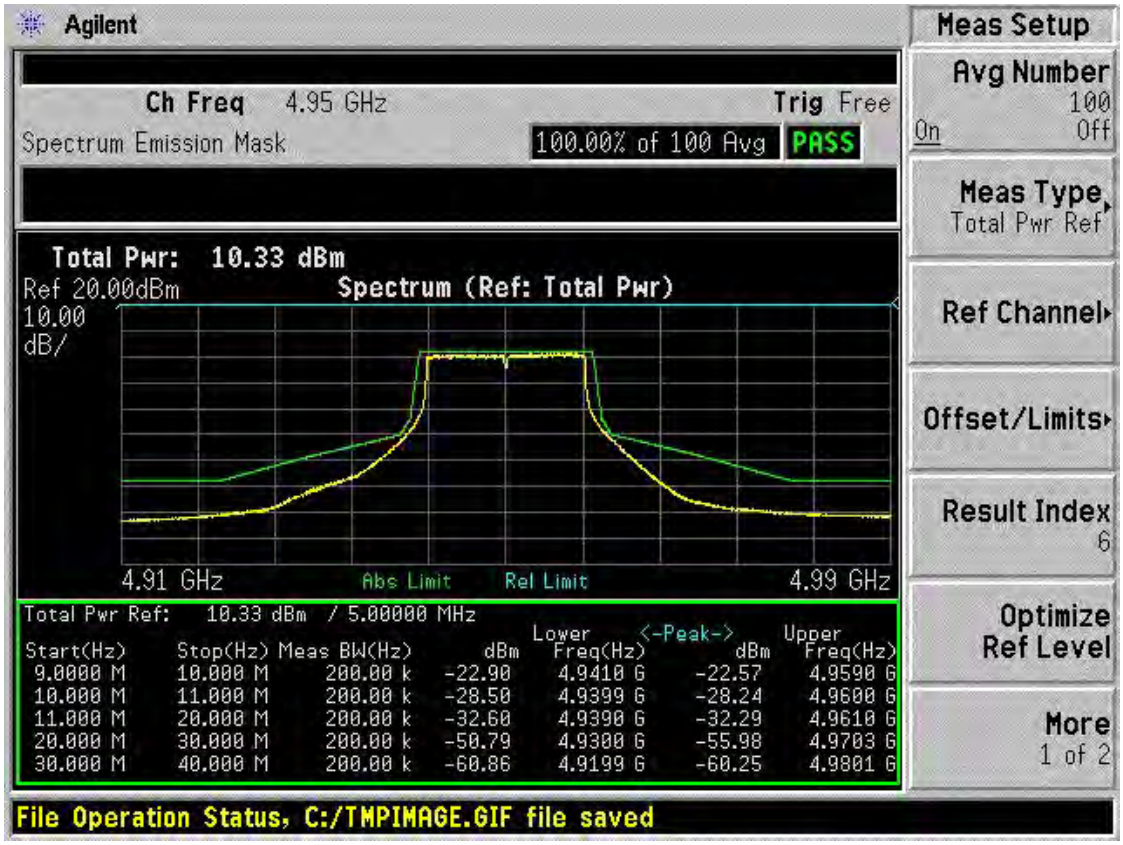
Chain 2 Mask (3 dBi Antenna)-Mid Channel



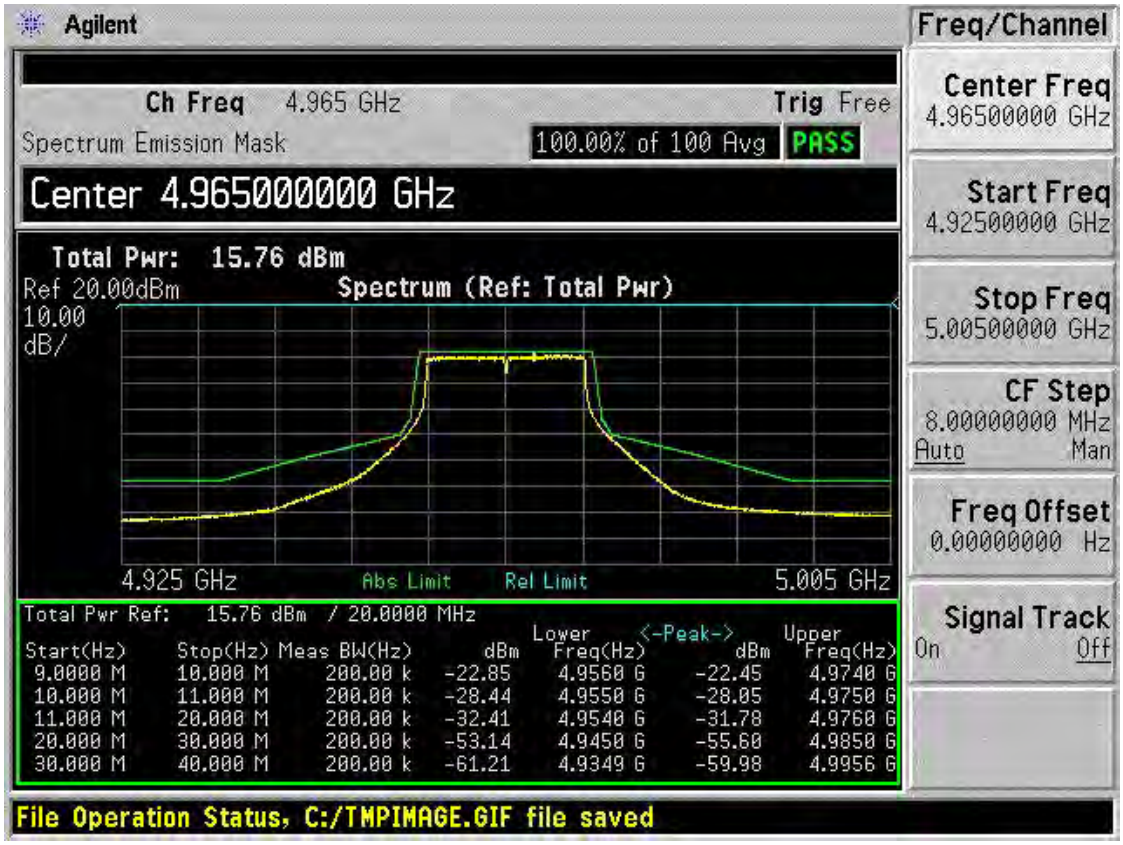
Chain 2 Mask (3 dBi Antenna)-High Channel



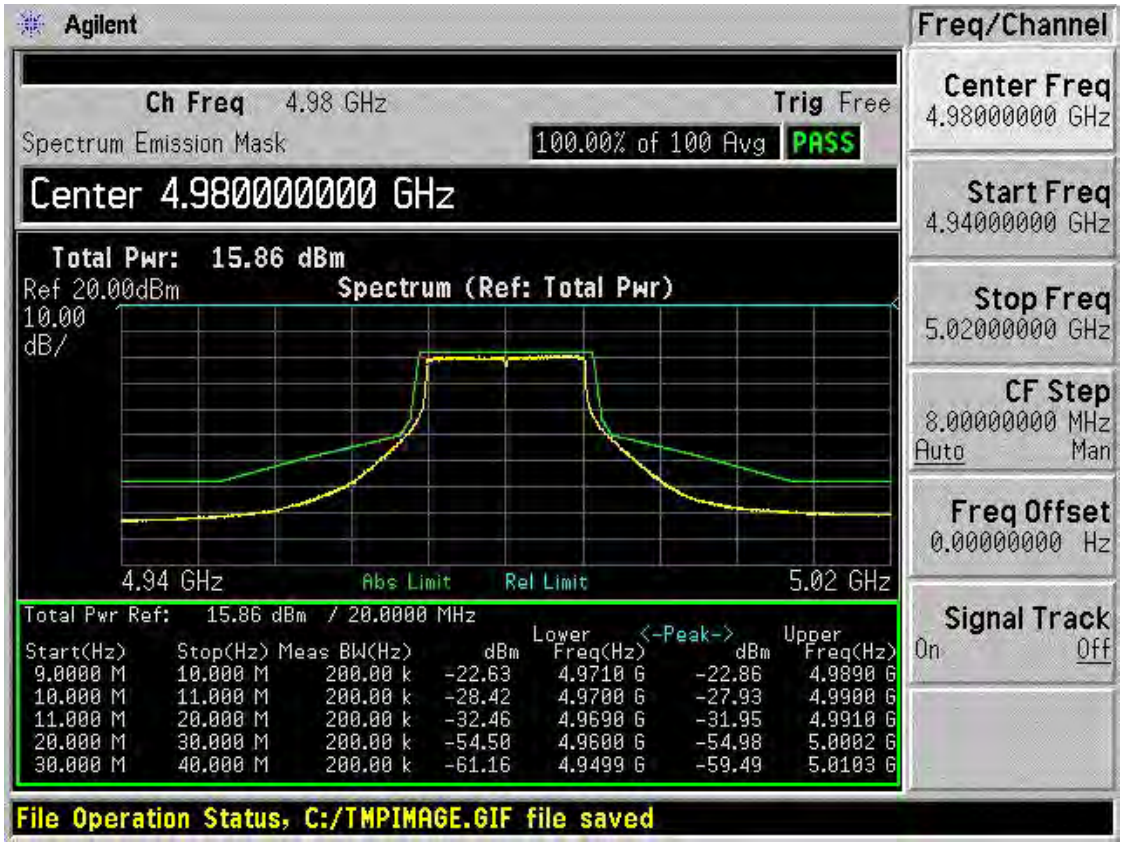
Chain 1 Mask (18 dBi Antenna)-Low Channel



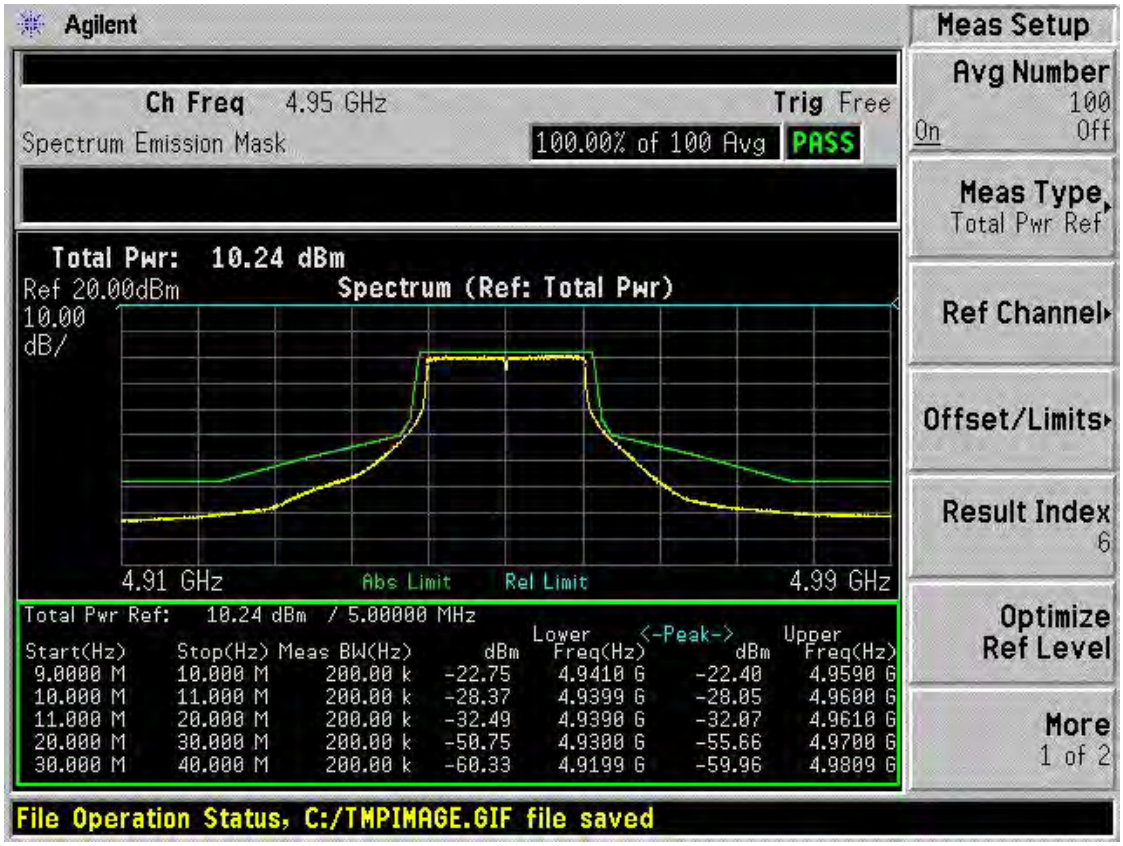
Chain 1 Mask (18 dBi Antenna)-Mid Channel



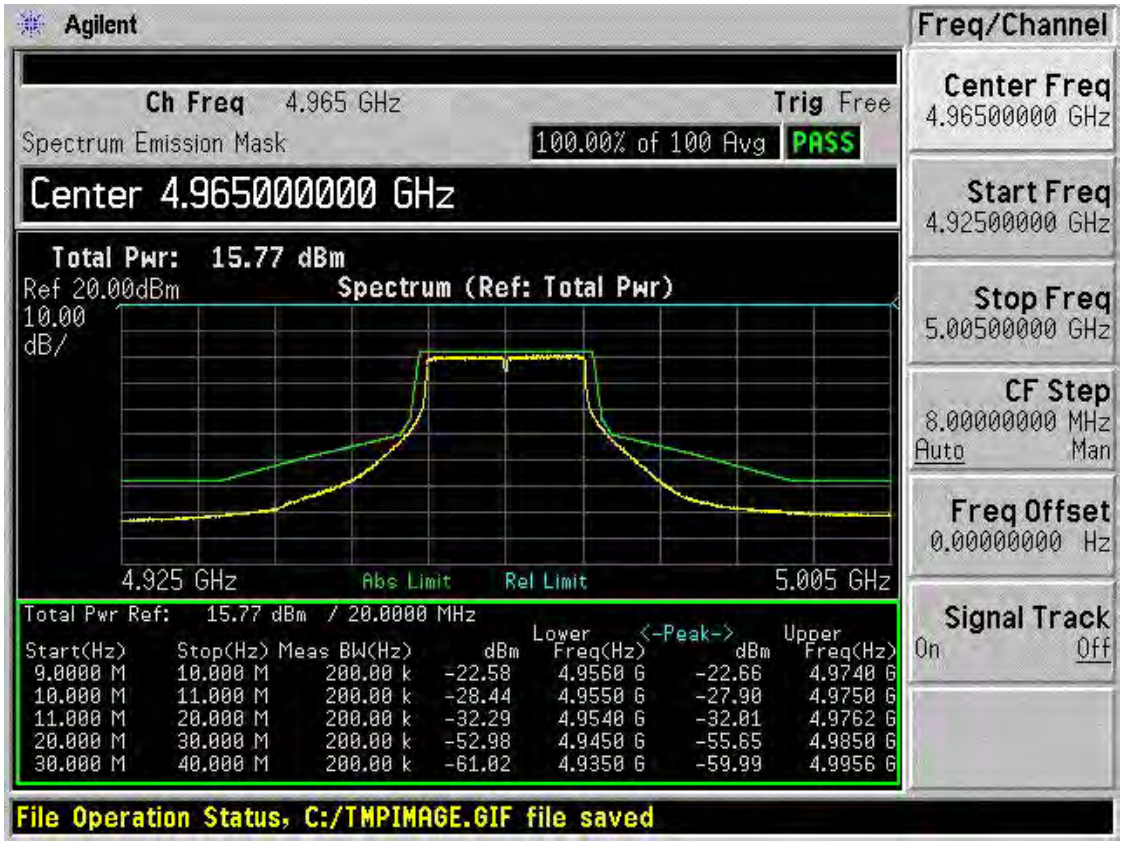
Chain 1 Mask (18 dBi Antenna)-High Channel



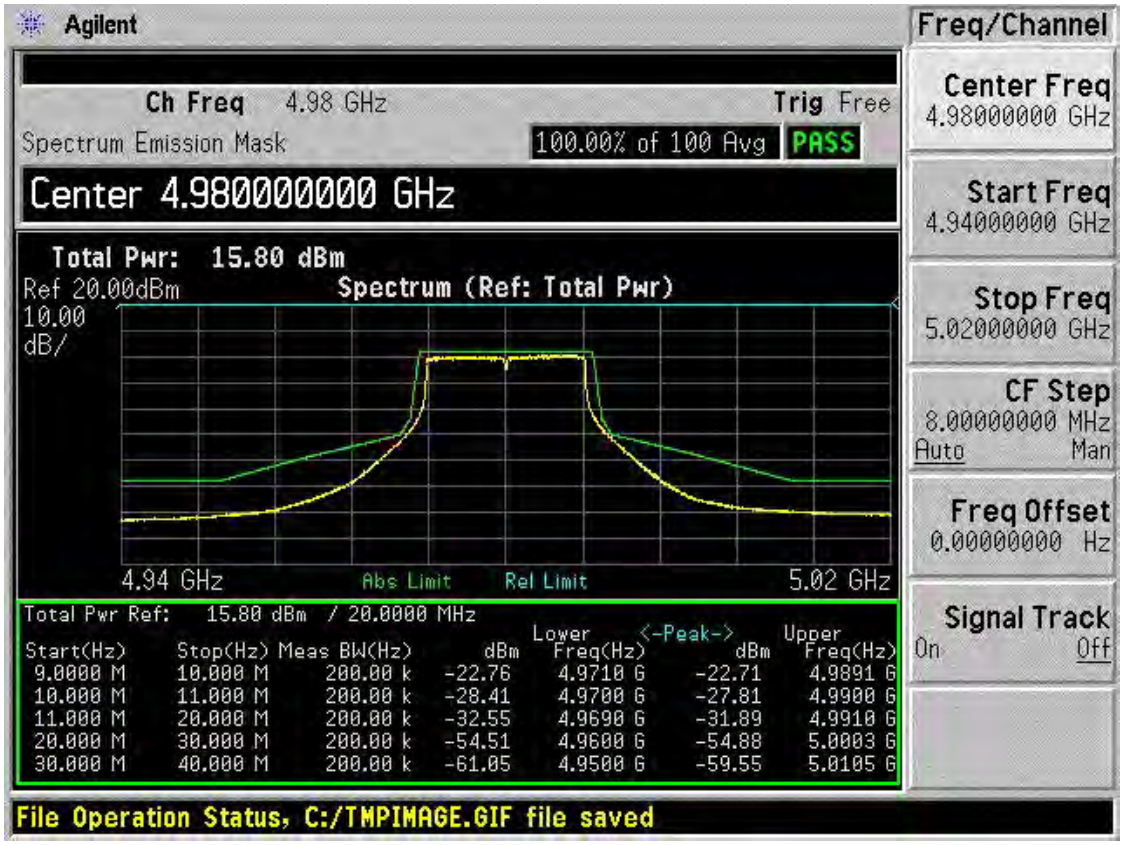
Chain 2 Mask (18 dBi Antenna)-Low Channel



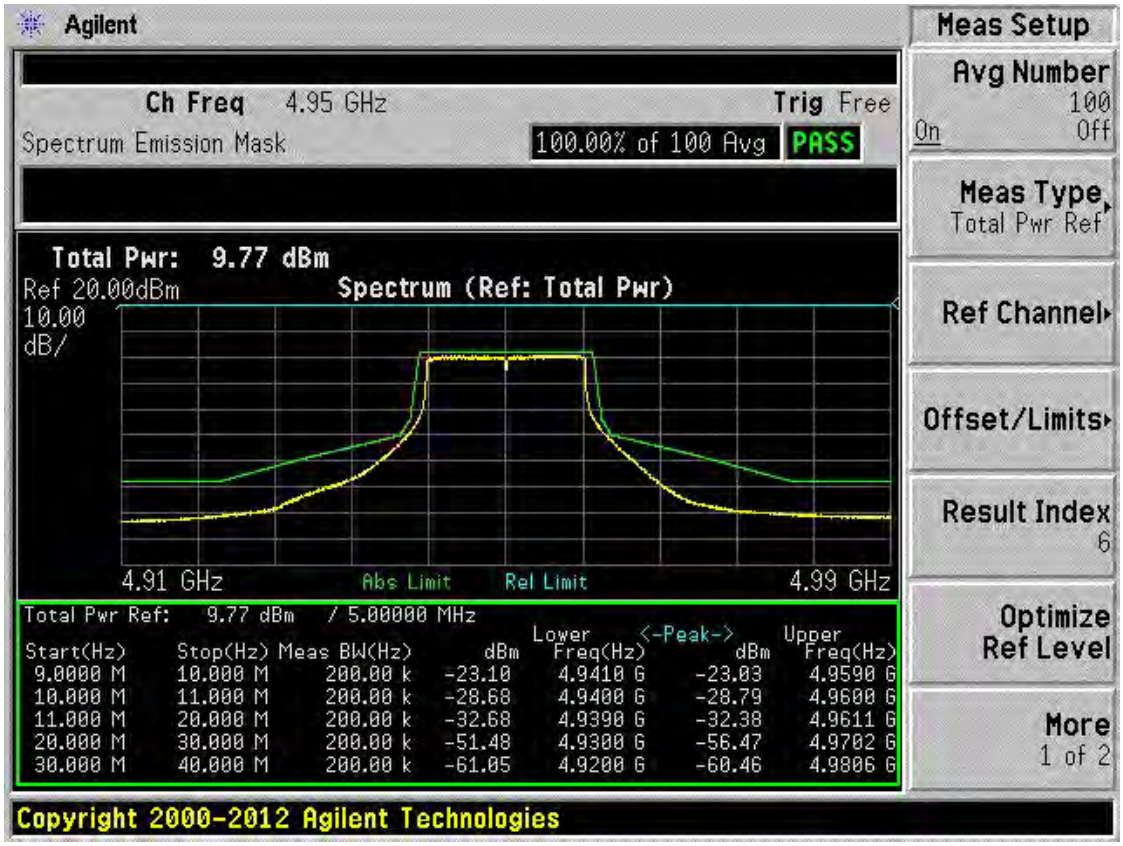
Chain 2 Mask (18 dBi Antenna)-Mid Channel



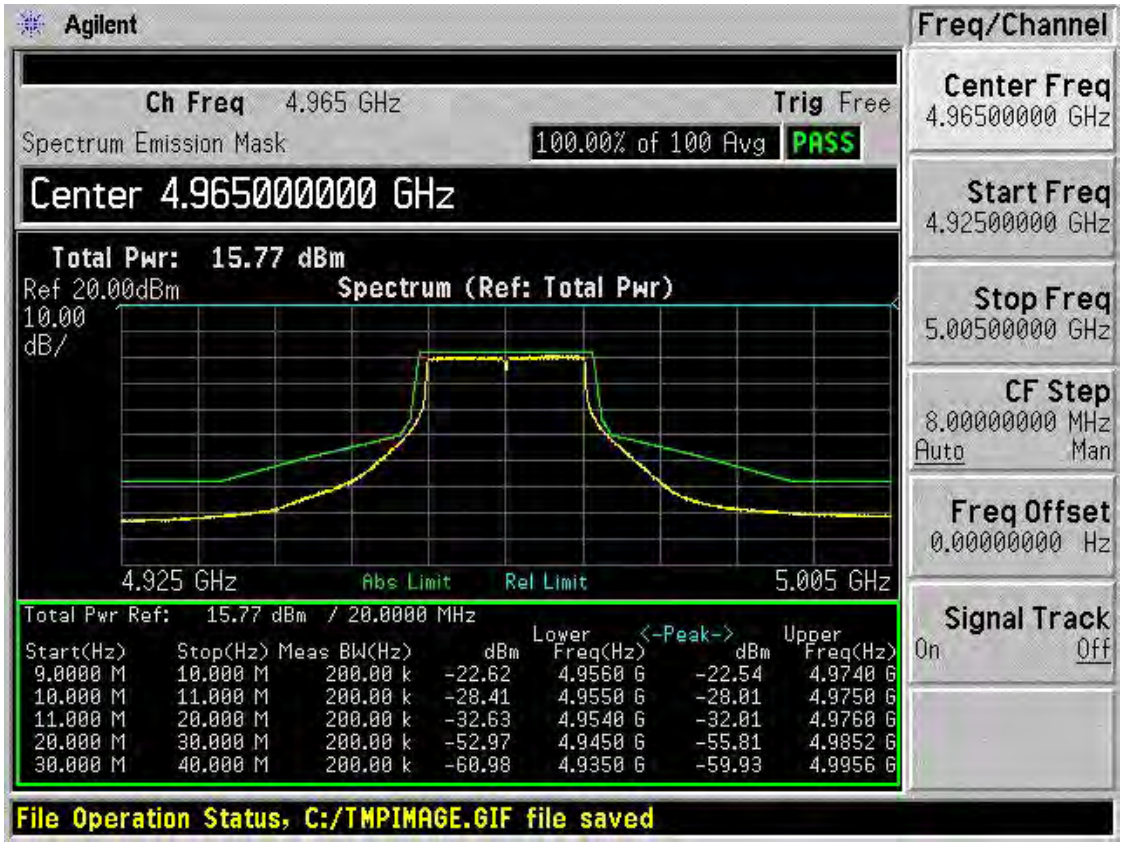
Chain 2 Mask (18 dBi Antenna)-High Channel



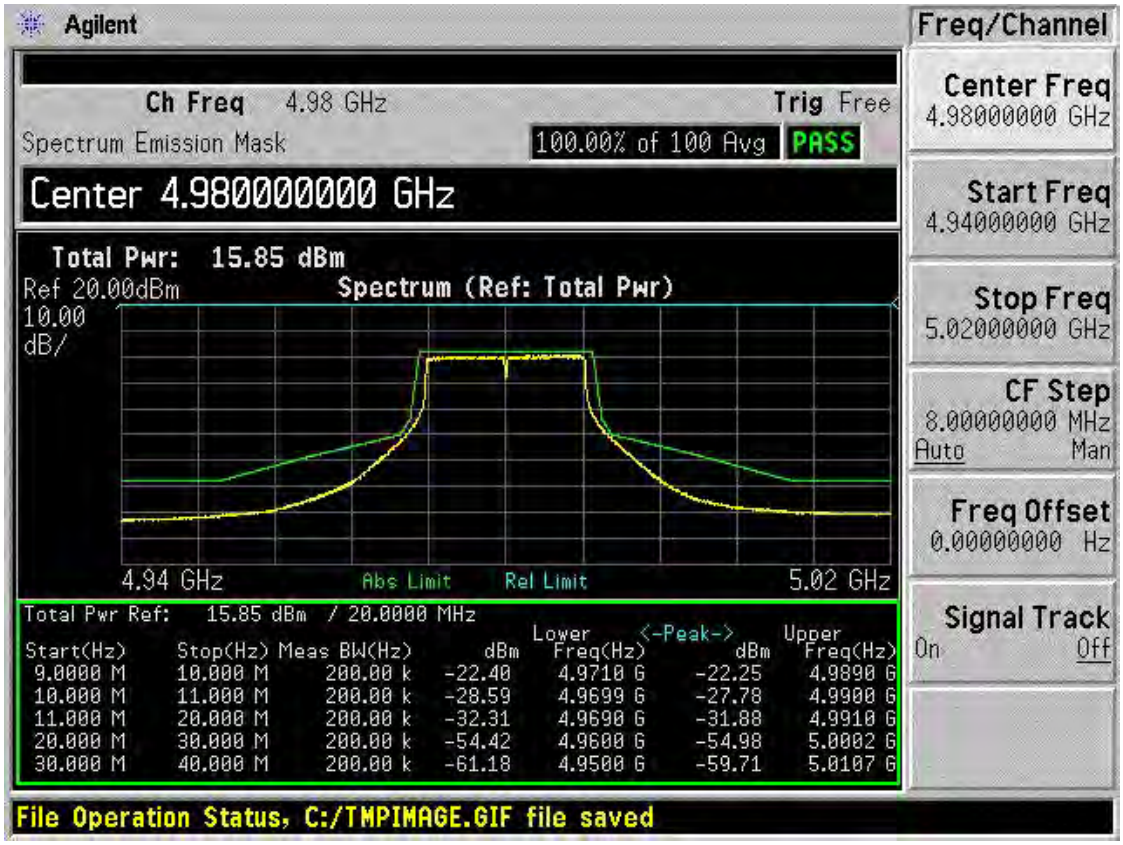
Chain 1 Mask (23 dBi Antenna)-Low Channel



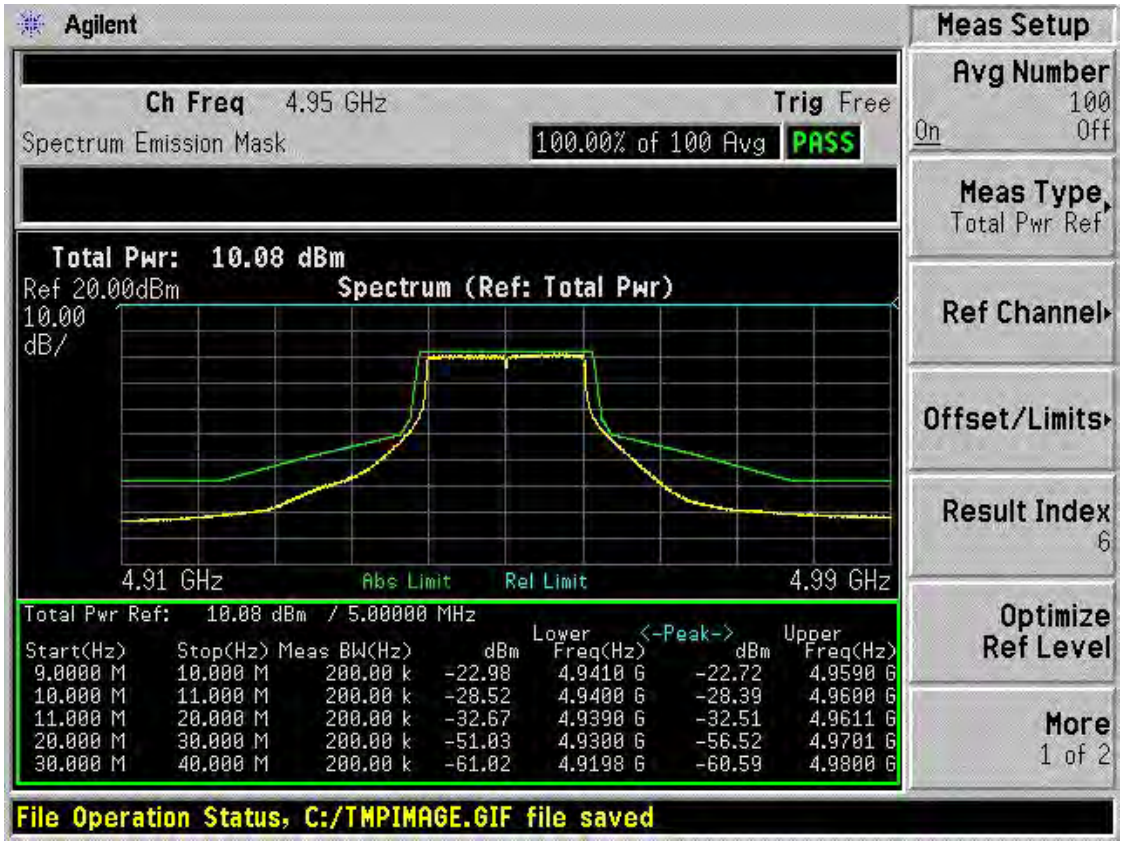
Chain 1 Mask (23 dBi Antenna)-Mid Channel



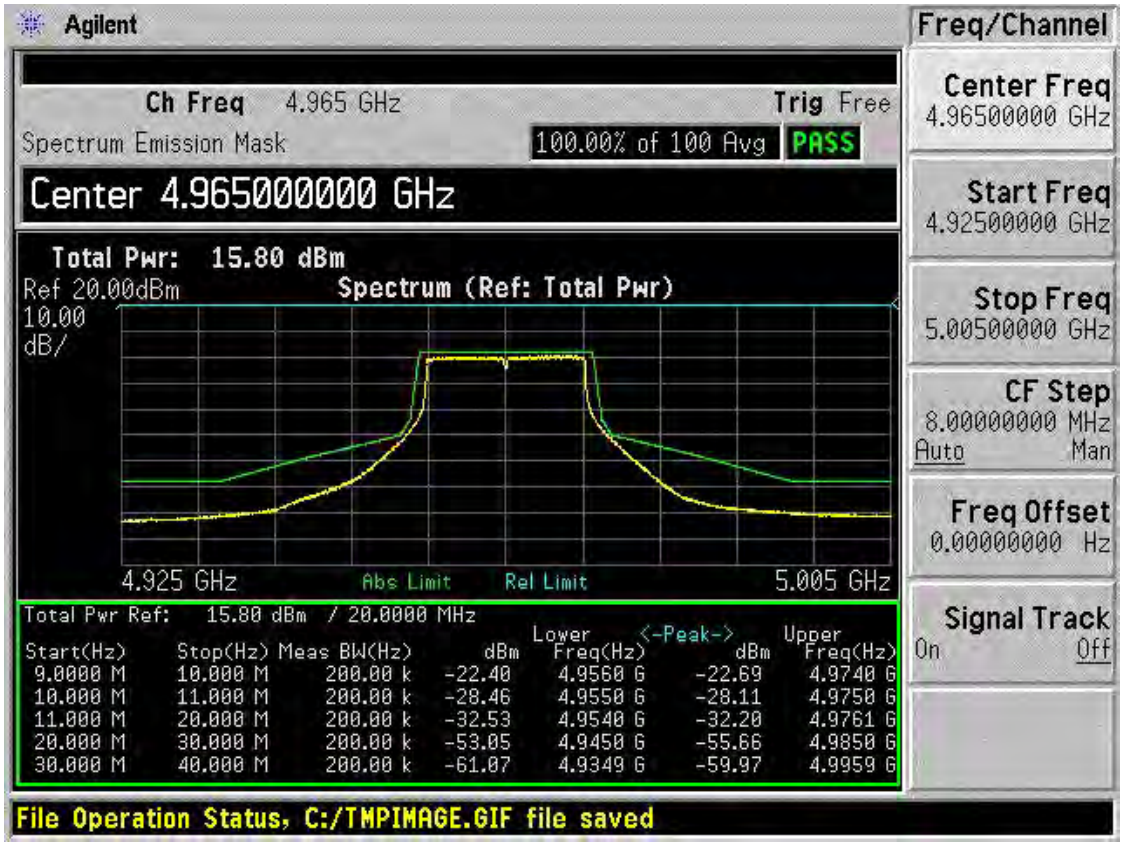
Chain 1 Mask (23 dBi Antenna)-High Channel



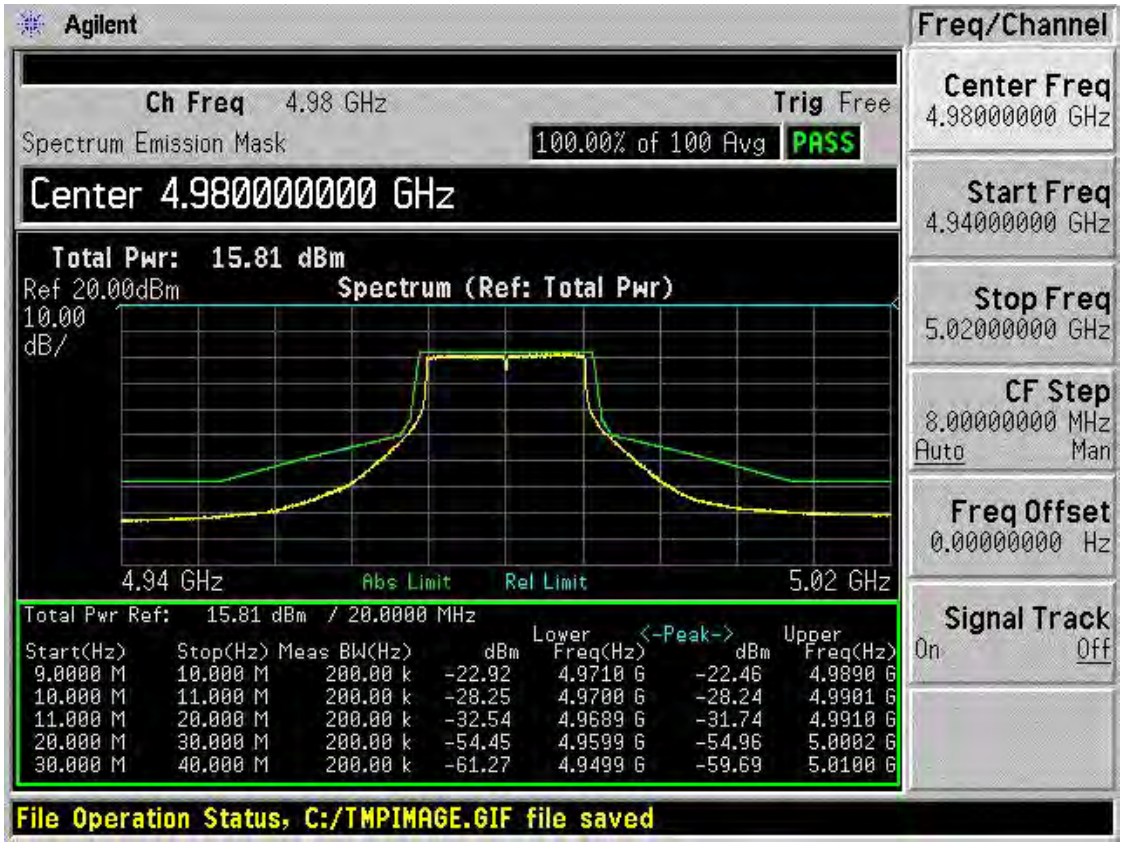
Chain 2 Mask (23 dBi Antenna)-Low Channel



Chain 2 Mask (23 dBi Antenna)-Mid Channel



Chain 2 Mask (23 dBi Antenna)-High Channel



A.3 Peak Excursion

Test Data

Peak excursion measurement results (3 dBi Antenna Gain)

Channel	Frequency (MHz)	Peak Excursion (dBm)		Limit (dBm)	Verdict
		Chain 1	Chain 2		
Low	4950	7.304	8.527	13.0	Pass
Mid	4965	7.737	8.476	13.0	Pass
High	4980	7.114	8.859	13.0	Pass

Peak excursion measurement results (18 dBi Antenna Gain)

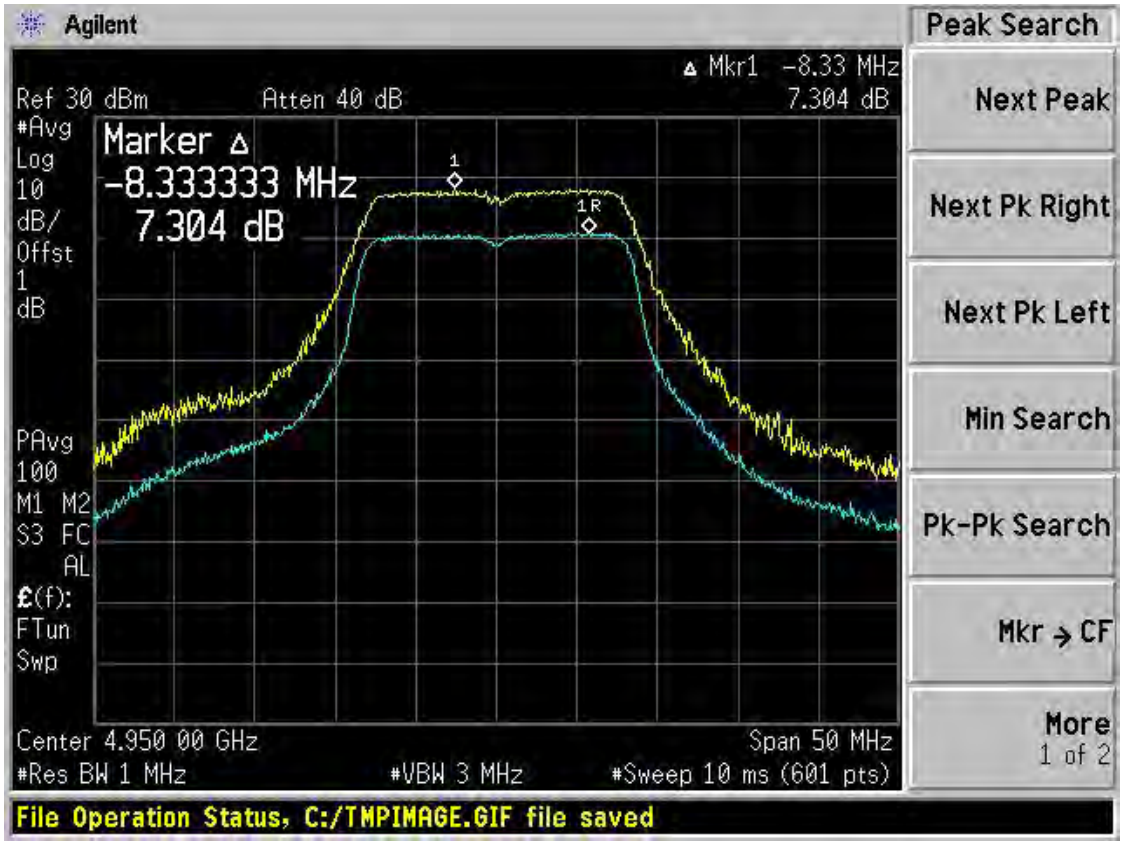
Channel	Frequency (MHz)	Peak Excursion (dBm)		Limit (dBm)	Verdict
		Chain 1	Chain 2		
Low	4950	7.445	7.308	13.0	Pass
Mid	4965	7.348	8.444	13.0	Pass
High	4980	7.543	8.233	13.0	Pass

Peak excursion measurement results (23 dBi Antenna Gain)

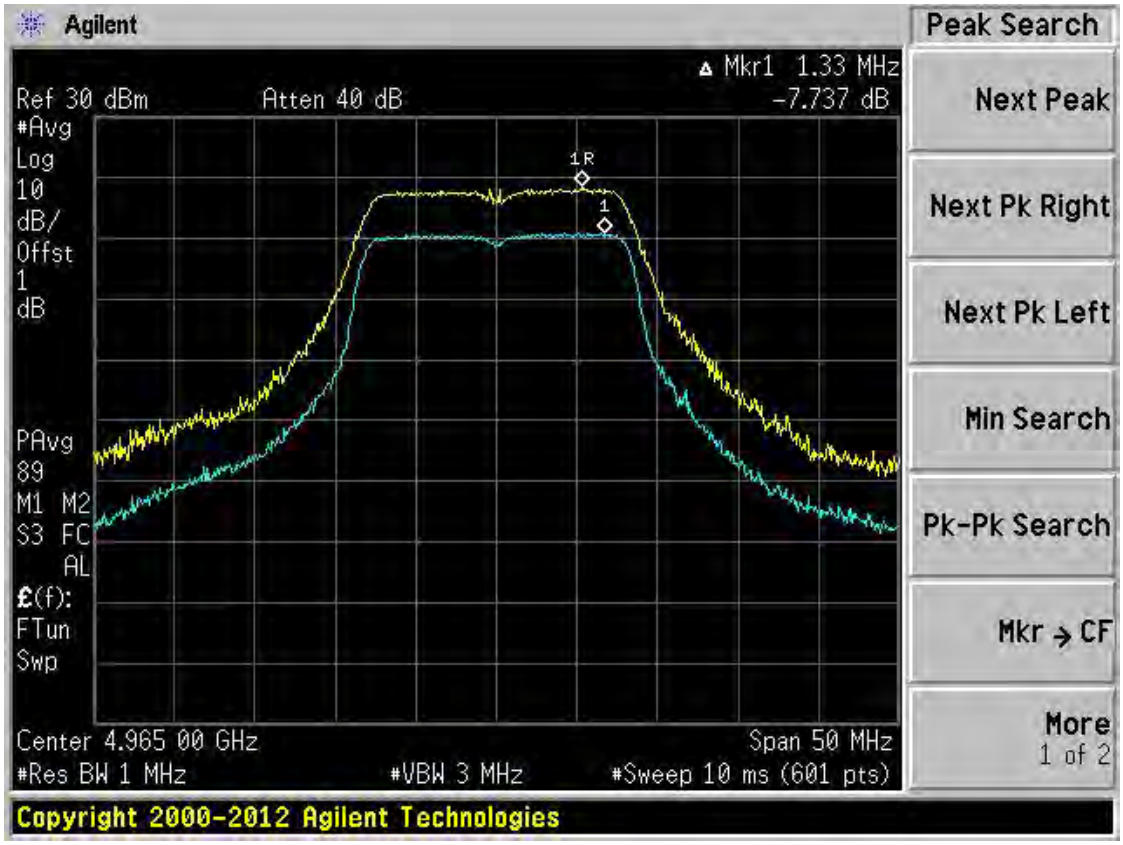
Channel	Frequency (MHz)	Peak Excursion (dBm)		Limit (dBm)	Verdict
		Chain 1	Chain 2		
Low	4950	7.926	8.034	13.0	Pass
Mid	4965	8.015	8.219	13.0	Pass
High	4980	7.562	8.657	13.0	Pass

Test Plots

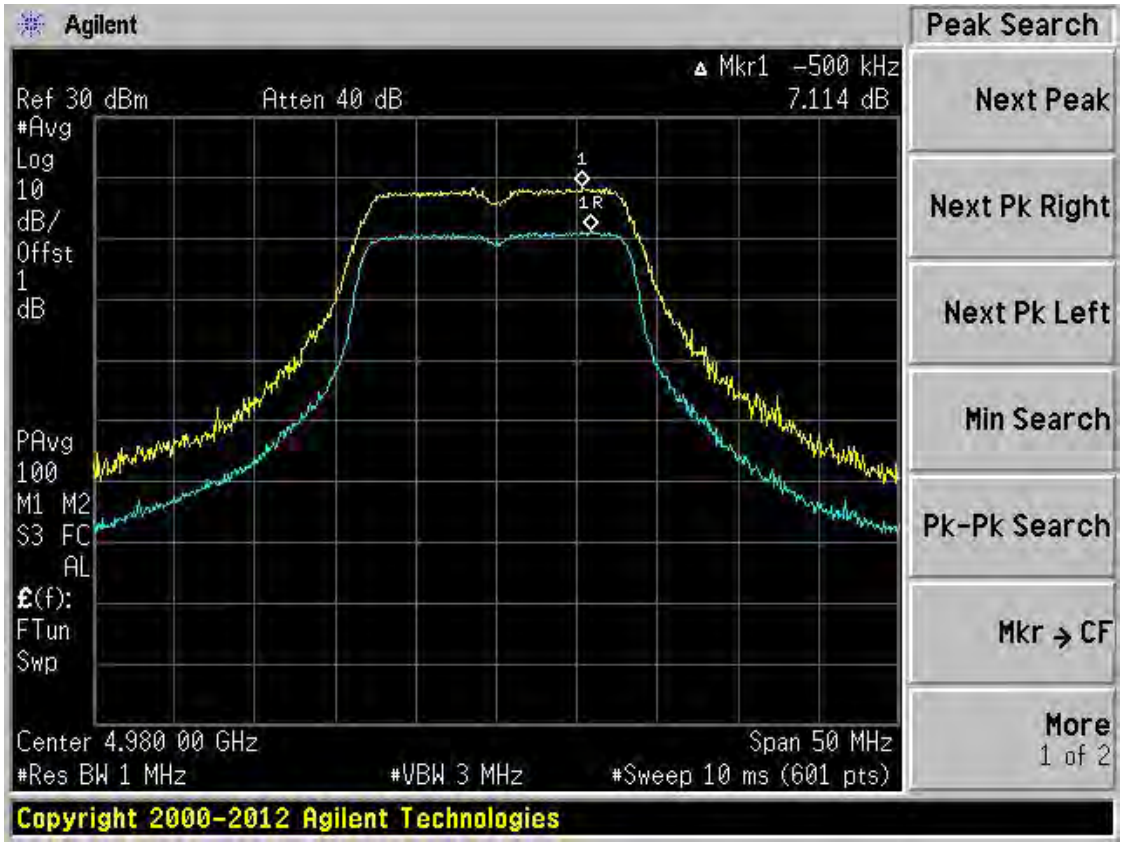
Chain 1 Peak excursion (3 dBi Antenna)-Low Channel



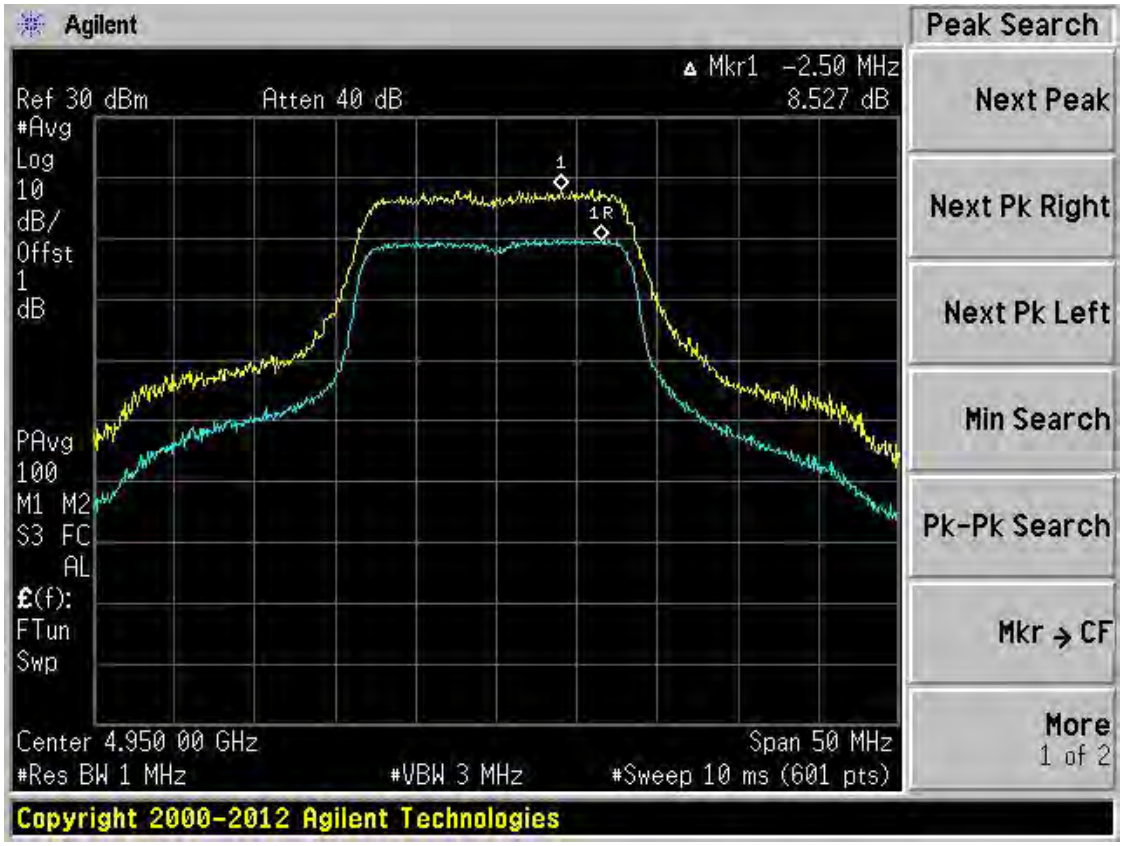
Chain 1 Peak excursion (3 dBi Antenna)-Mid Channel



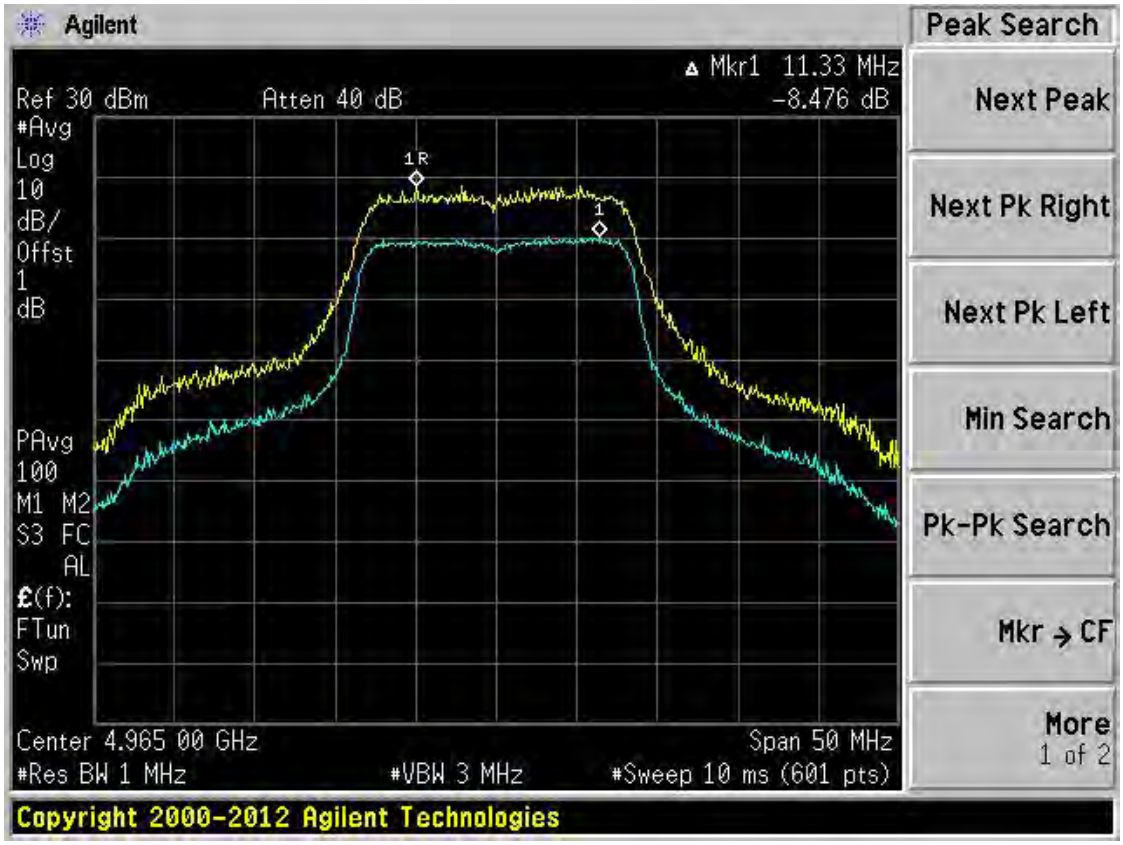
Chain 1 Peak excursion (3 dBi Antenna)-High Channel



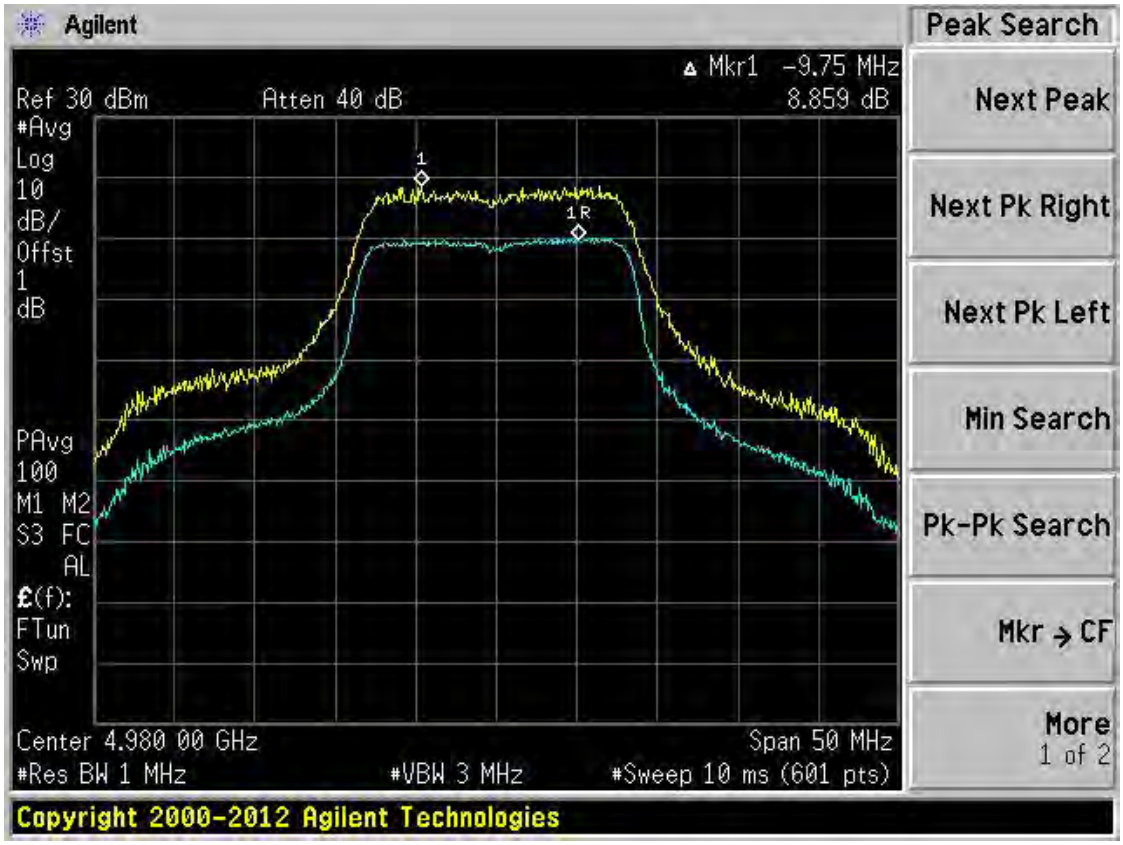
Chain 2 Peak excursion (3 dBi Antenna)-Low Channel



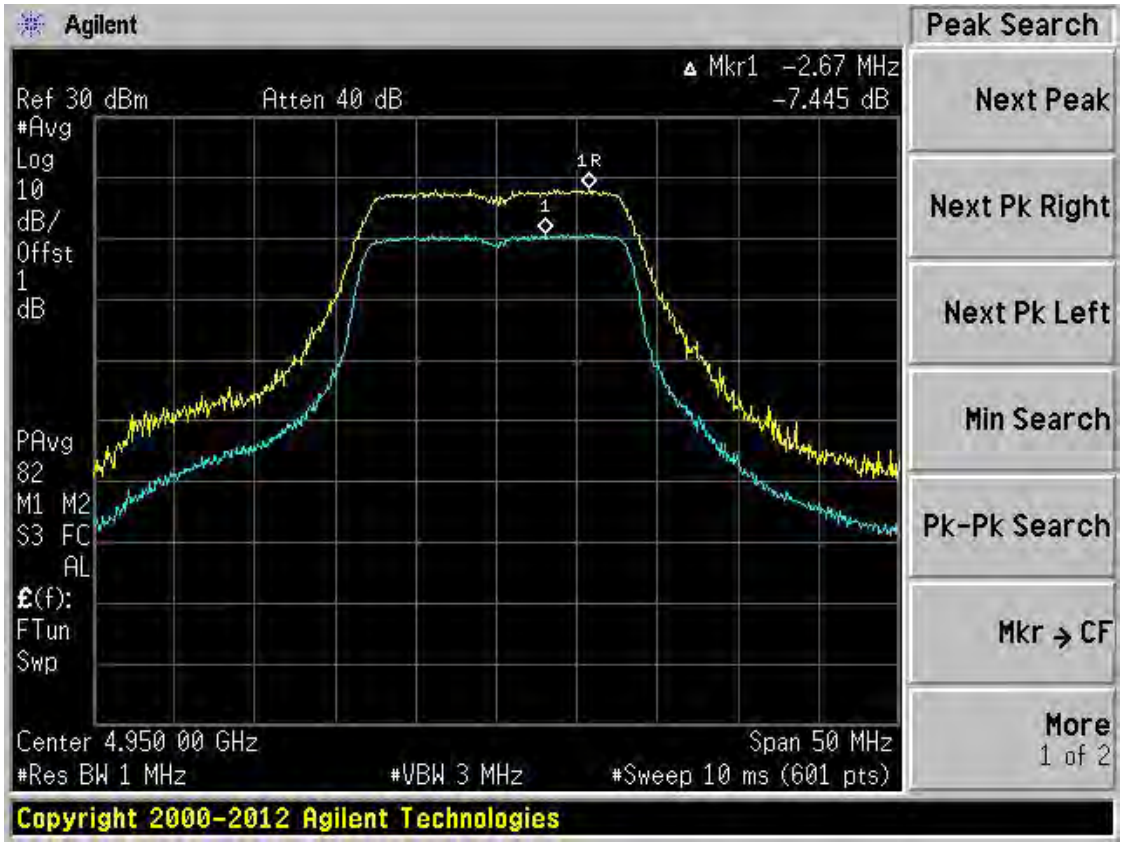
Chain 2 Peak excursion (3 dBi Antenna)-Mid Channel



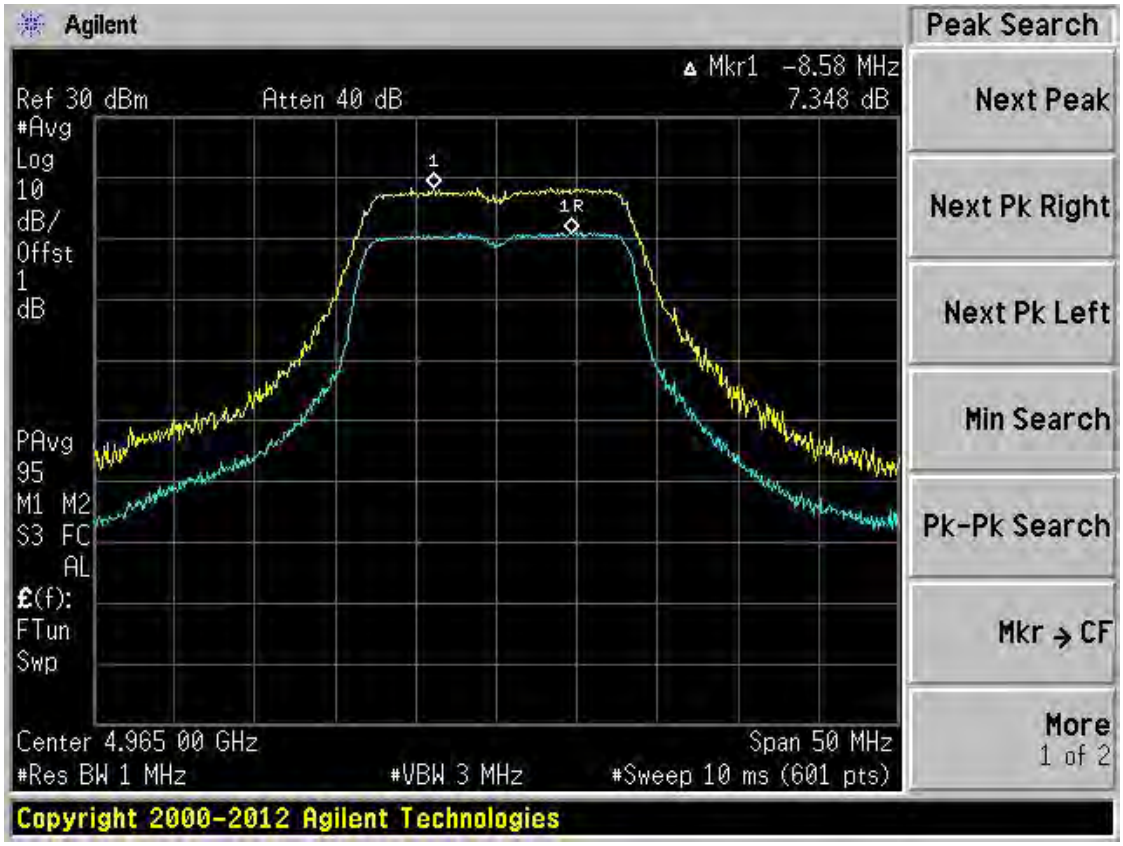
Chain 2 Peak excursion (3 dBi Antenna)-High Channel



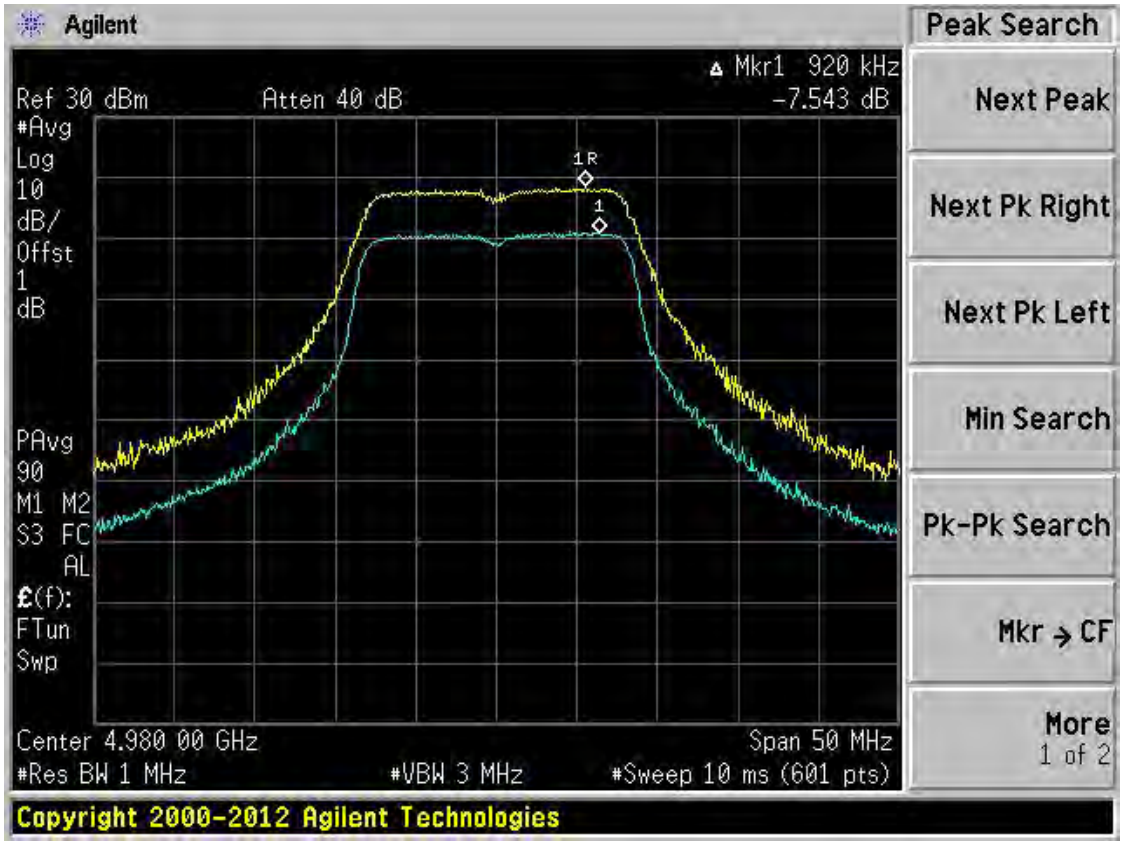
Chain 1 Peak excursion (18 dBi Antenna)-Low Channel



Chain 1 Peak excursion (18 dBi Antenna)-Mid Channel

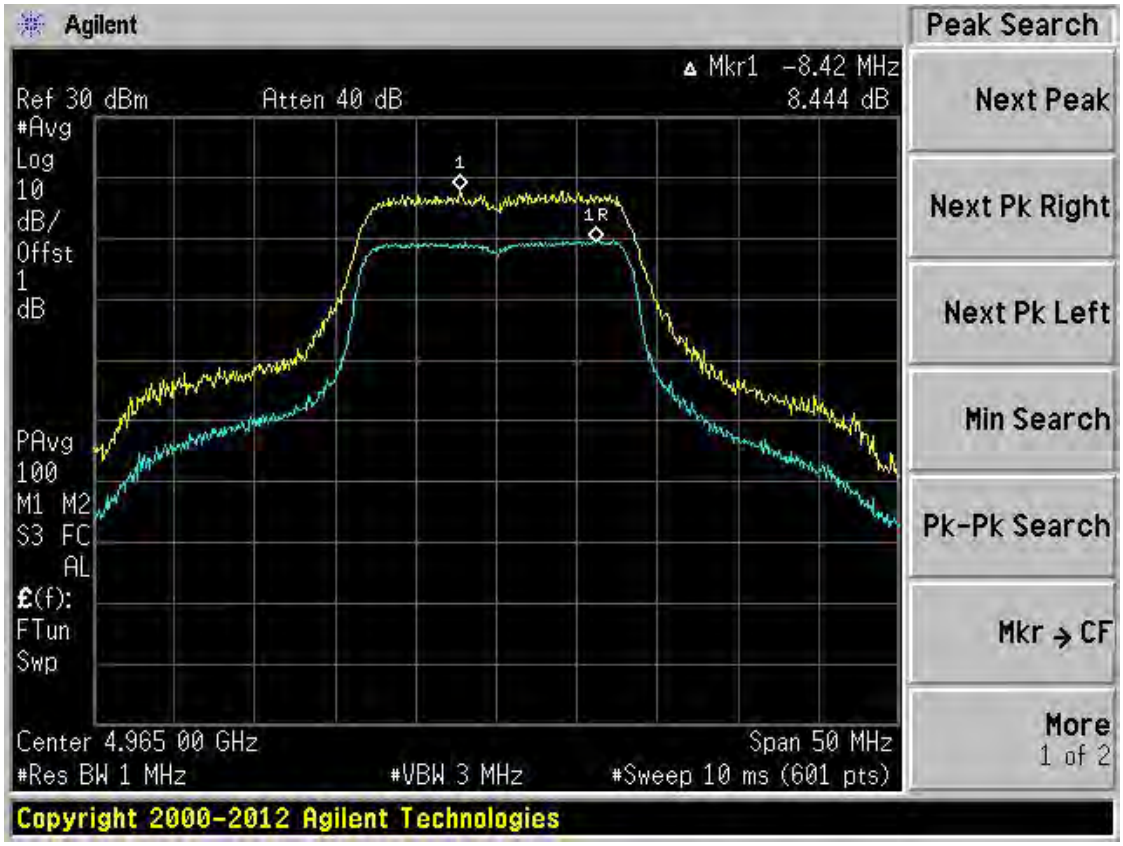


Chain 1 Peak excursion (18 dBi Antenna)-High Channel

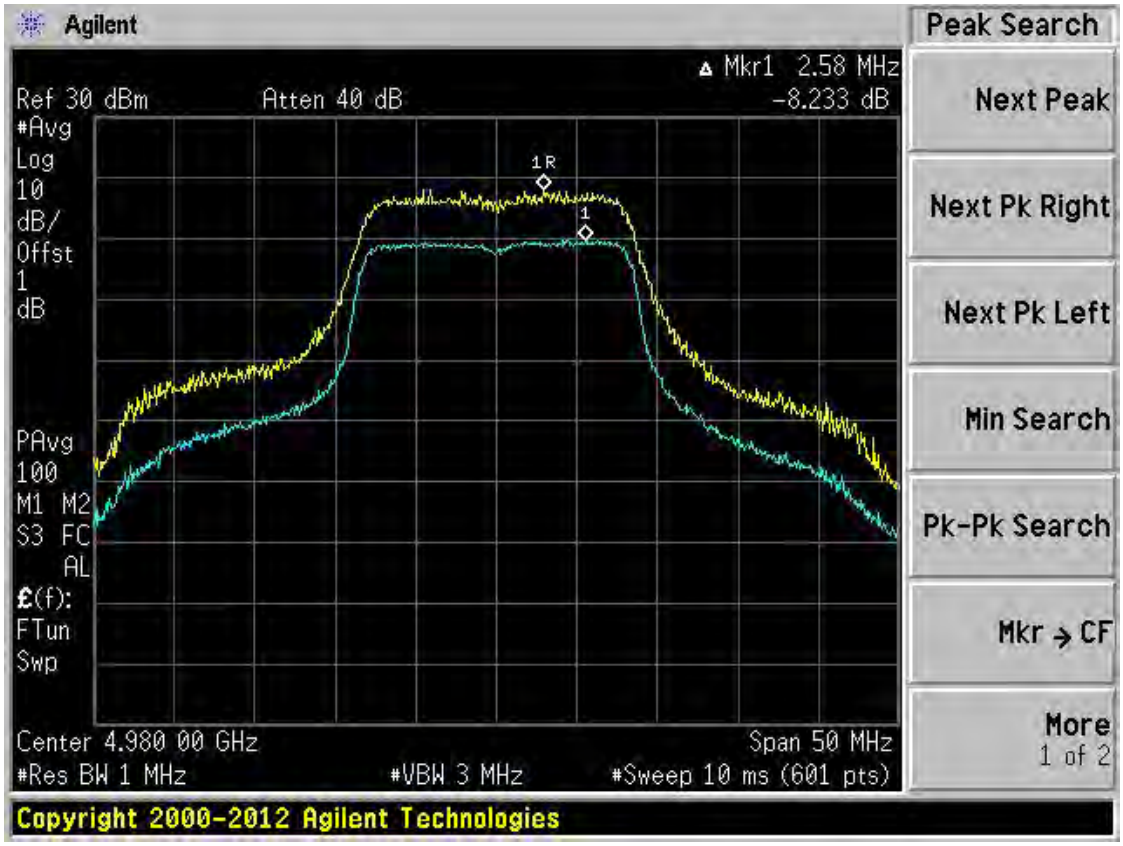


Chain 2 Peak excursion (18 dBi Antenna)-Low Channel

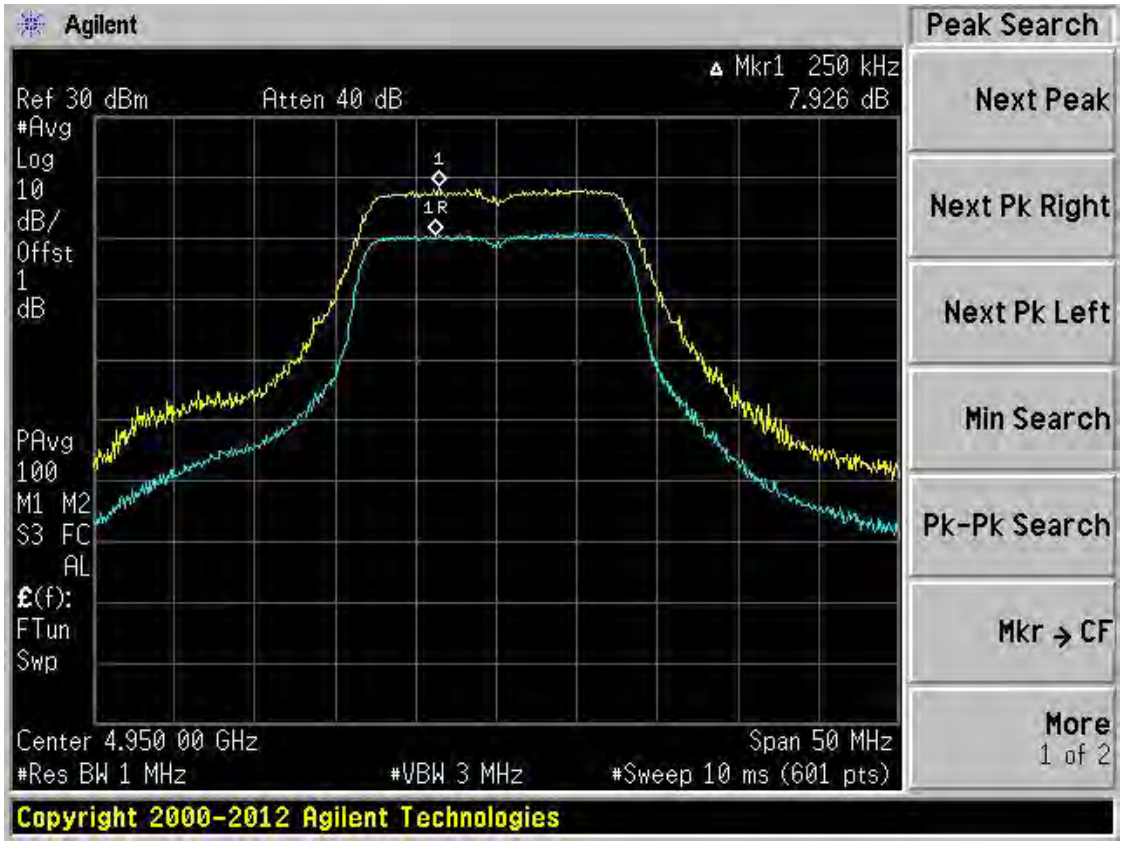
Chain 2 Peak excursion (18 dBi Antenna)-Mid Channel



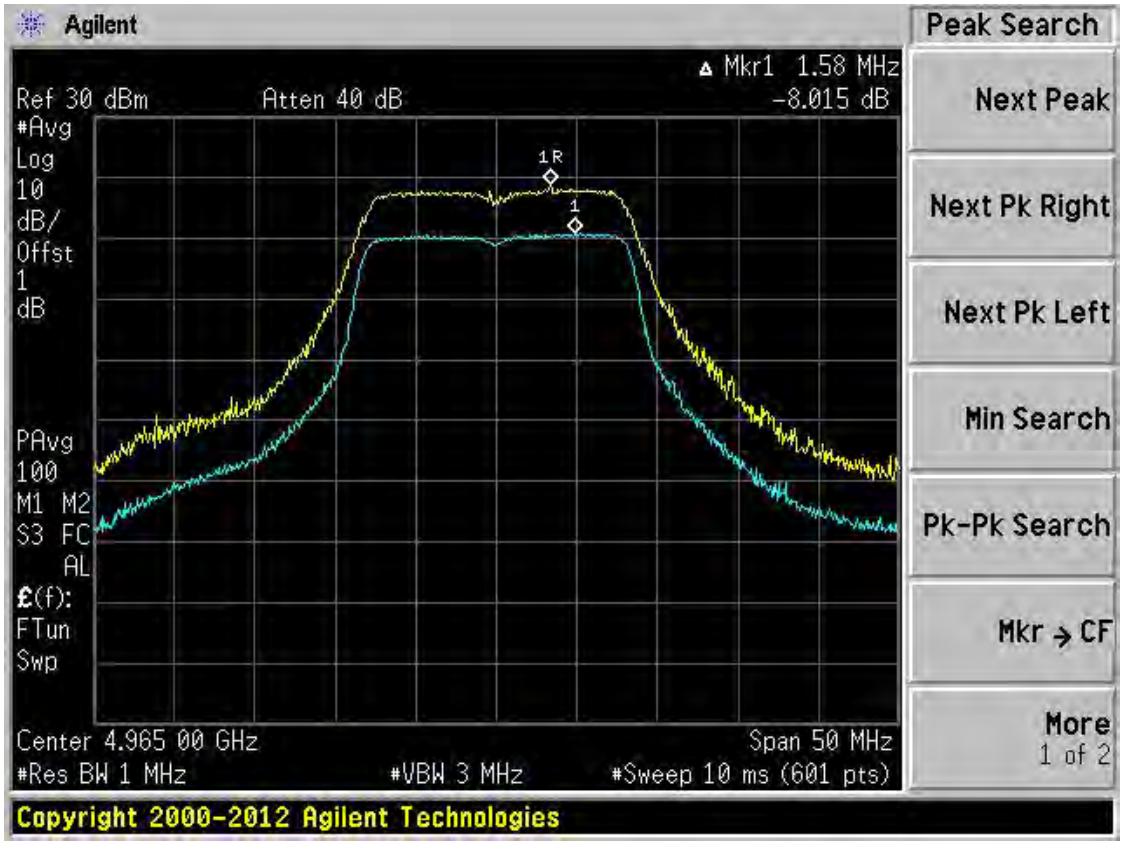
Chain 2 Peak excursion (18 dBi Antenna)-High Channel



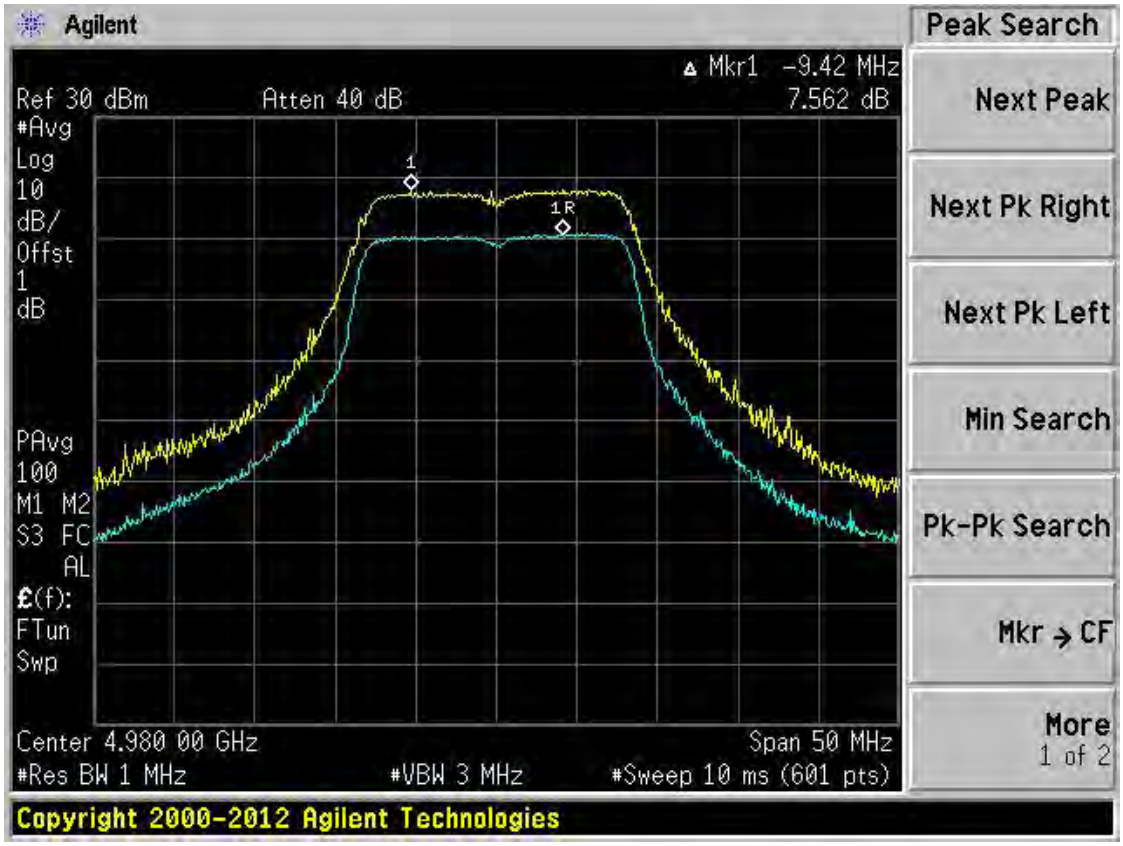
Chain 1 Peak excursion (23 dBi Antenna)-Low Channel



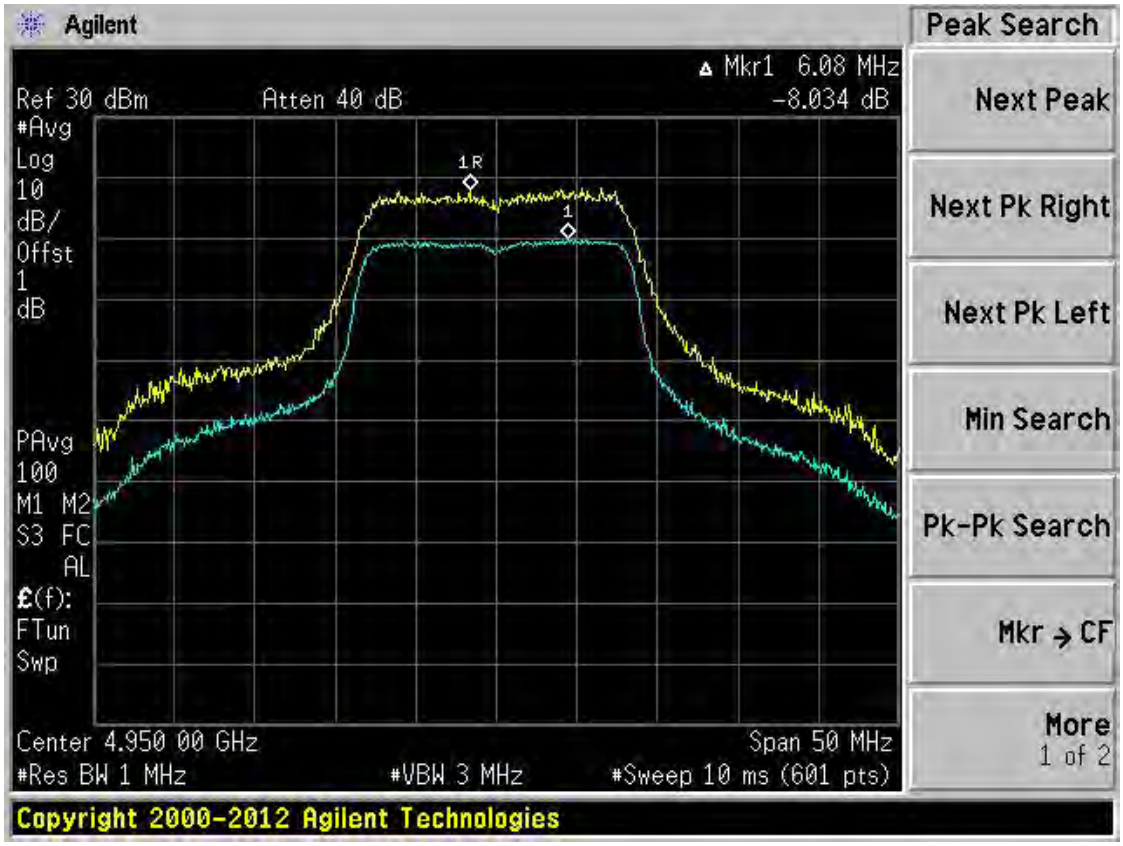
Chain 1 Peak excursion (23 dBi Antenna)-Mid Channel



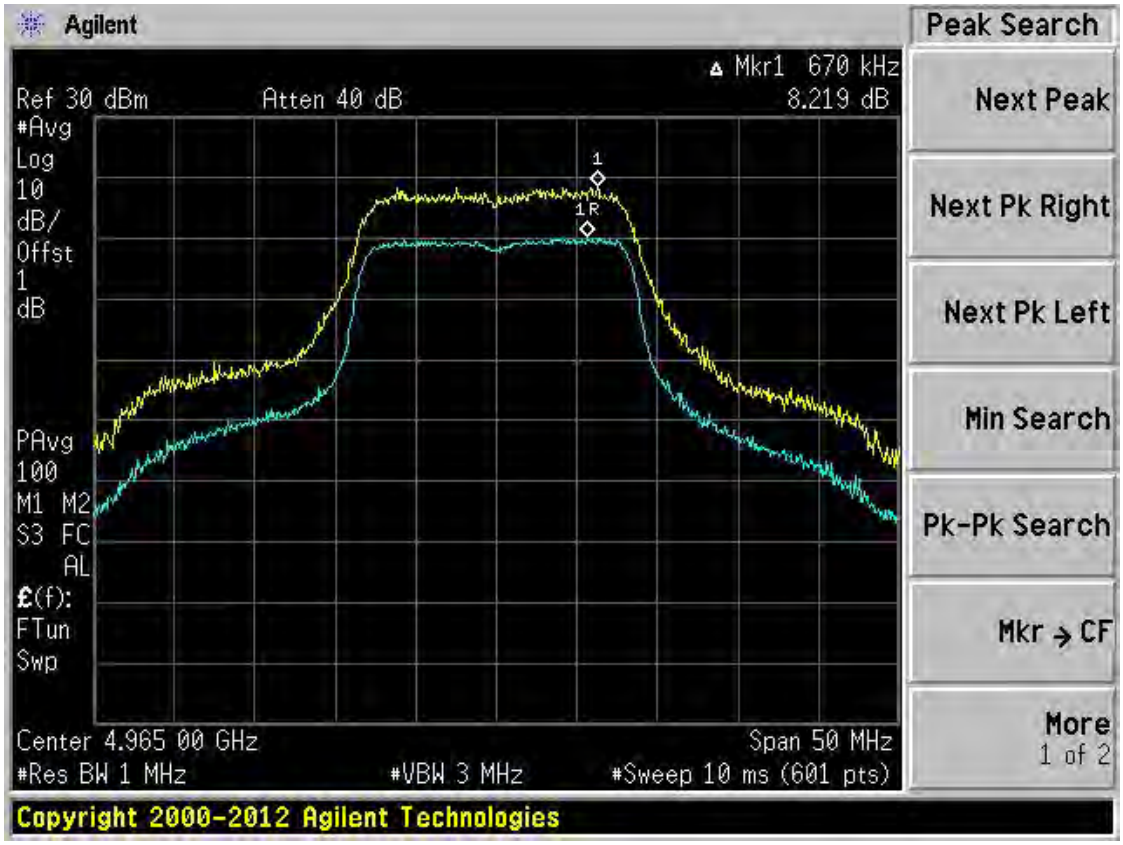
Chain 1 Peak excursion (23 dBi Antenna)-High Channel



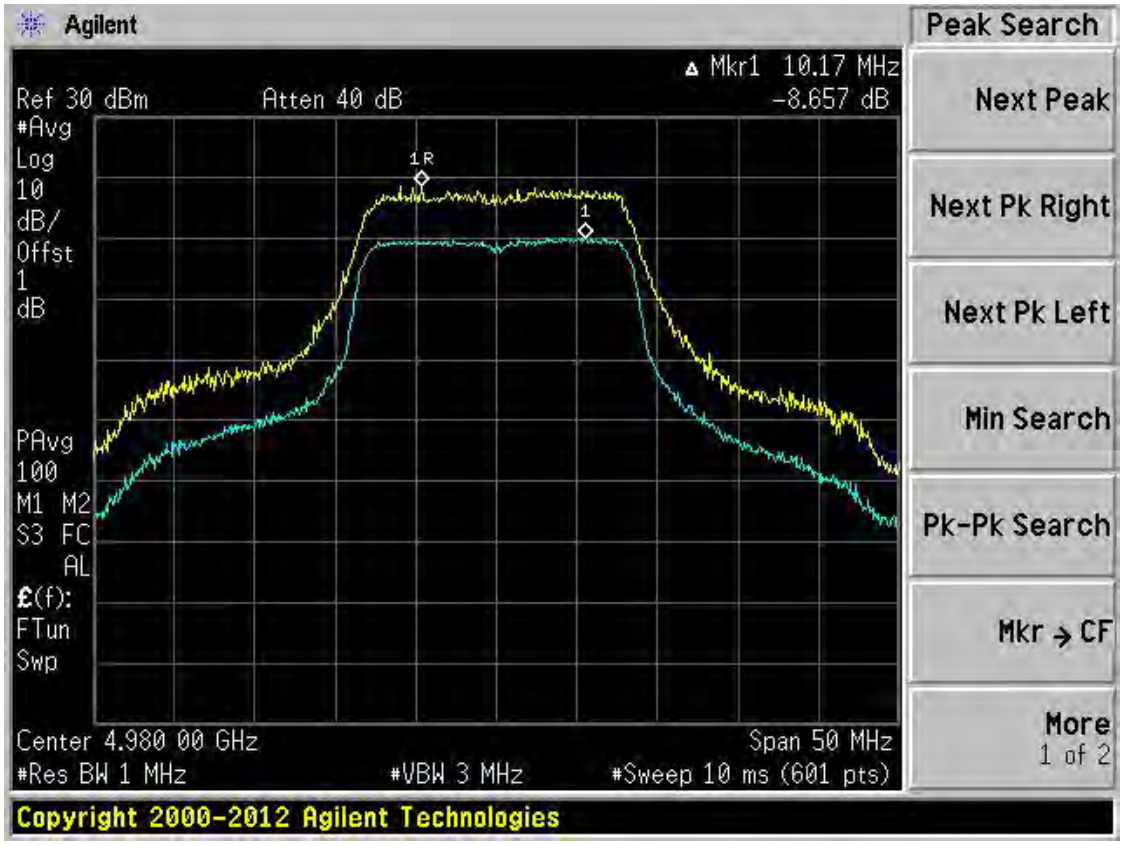
Chain 2 Peak excursion (23 dBi Antenna)-Low Channel



Chain 2 Peak excursion (23 dBi Antenna)-Mid Channel



Chain 2 Peak excursion (2 dBi Antenna)-High Channel



A.4 Power Spectral Density

Test Data

High Power Setting - Power Spectral Density measurement results (3 dBi Antenna Gain)

Channel	Frequency (MHz)	Conducted Power (dBm)			PSD Limit (dBm)	Verdict
		Chain 1	Chain 2	Total Power		
Low	4950	11.371	11.863	14.63	21	Pass
Mid	4965	11.354	12.001	14.70	21	Pass
High	4980	11.531	12.027	14.80	21	Pass
Note: high power point-to-point and point-to-multipoint operations (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the spectral density.						

High Power Setting - Power Spectral Density measurement results (18 dBi Antenna Gain)

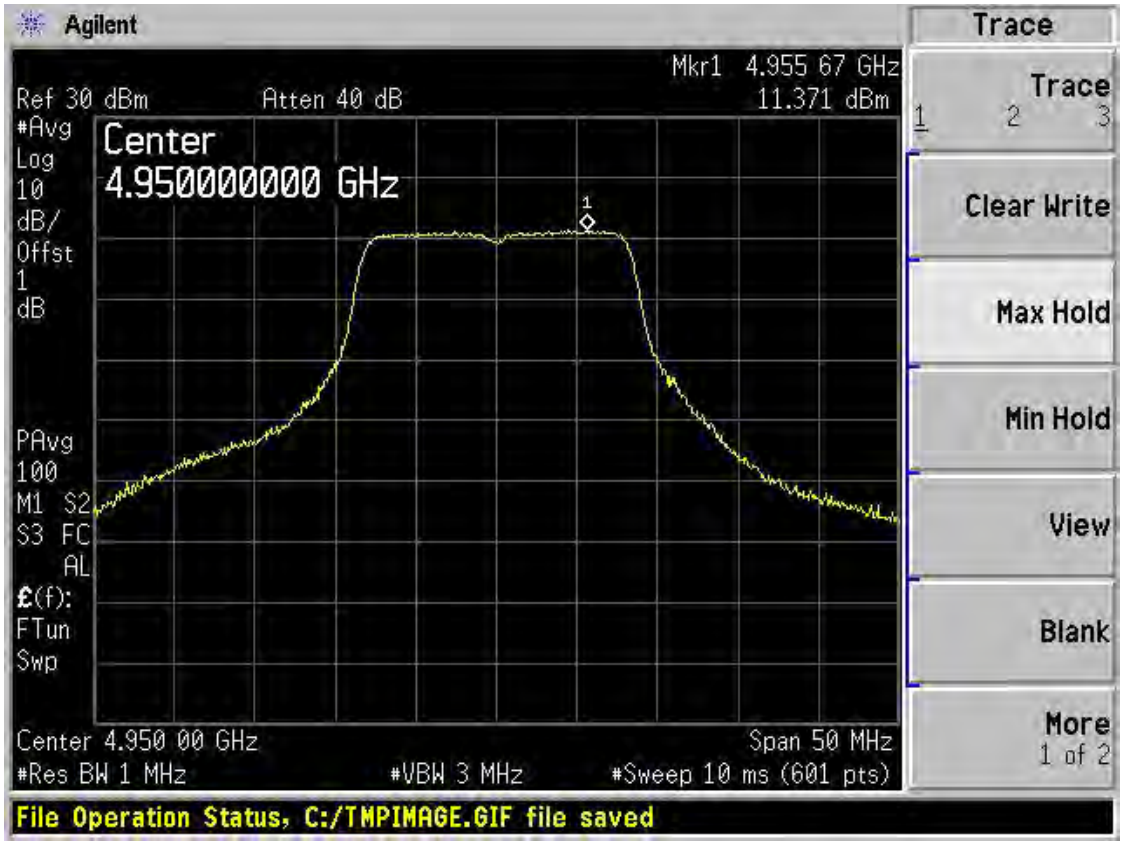
Channel	Frequency (MHz)	Conducted Power (dBm)			PSD Limit (dBm)	Verdict
		Chain 1	Chain 2	Total Power		
Low	4950	11.205	11.851	14.55	21	Pass
Mid	4965	11.338	11.981	14.68	21	Pass
High	4980	11.413	11.902	14.67	21	Pass
Note: high power point-to-point and point-to-multipoint operations (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the spectral density.						

High Power Setting - Power Spectral Density measurement results (23 dBi Antenna Gain)

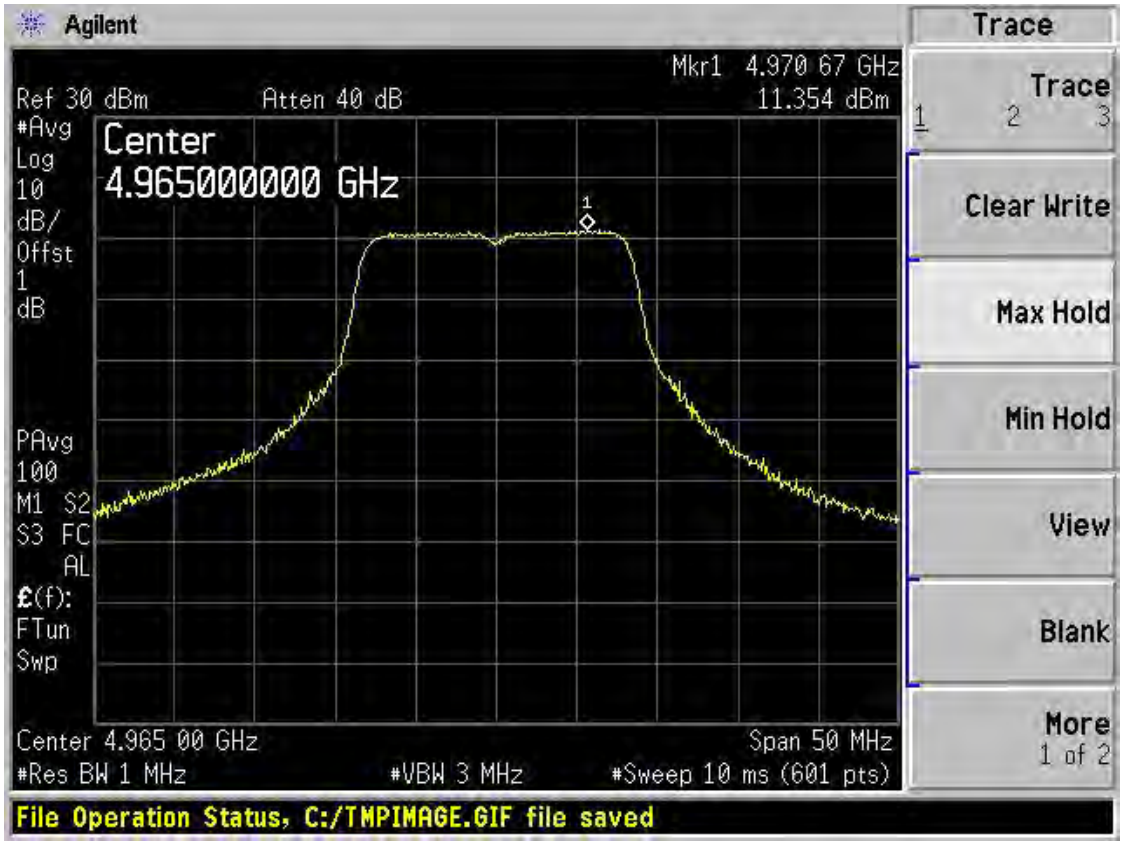
Channel	Frequency (MHz)	Conducted Power (dBm)			PSD Limit (dBm)	Verdict
		Chain 1	Chain 2	Total Power		
Low	4950	11.142	11.571	14.37	21	Pass
Mid	4965	11.174	11.422	14.31	21	Pass
High	4980	11.462	11.334	14.41	21	Pass
Note: high power point-to-point and point-to-multipoint operations (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the spectral density.						

Test Plots

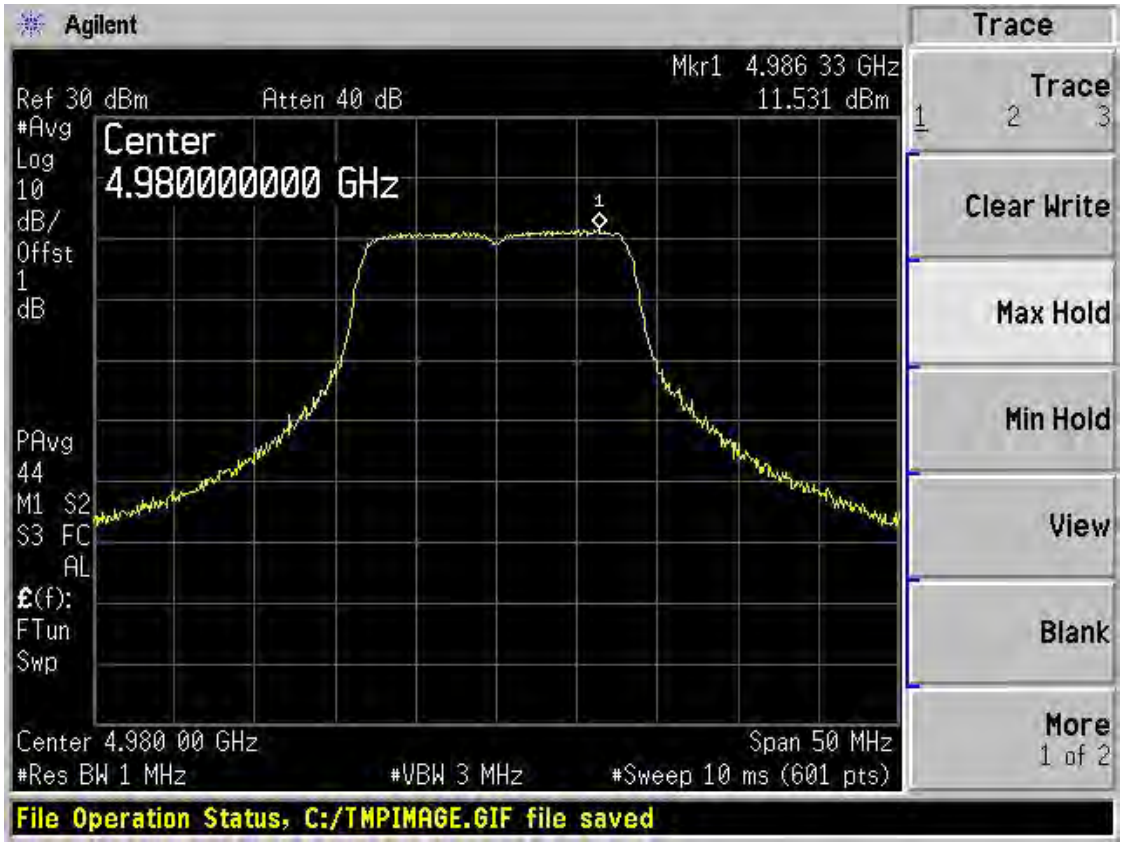
Chain 1 PSD (3 dBi Antenna)-Low Channel



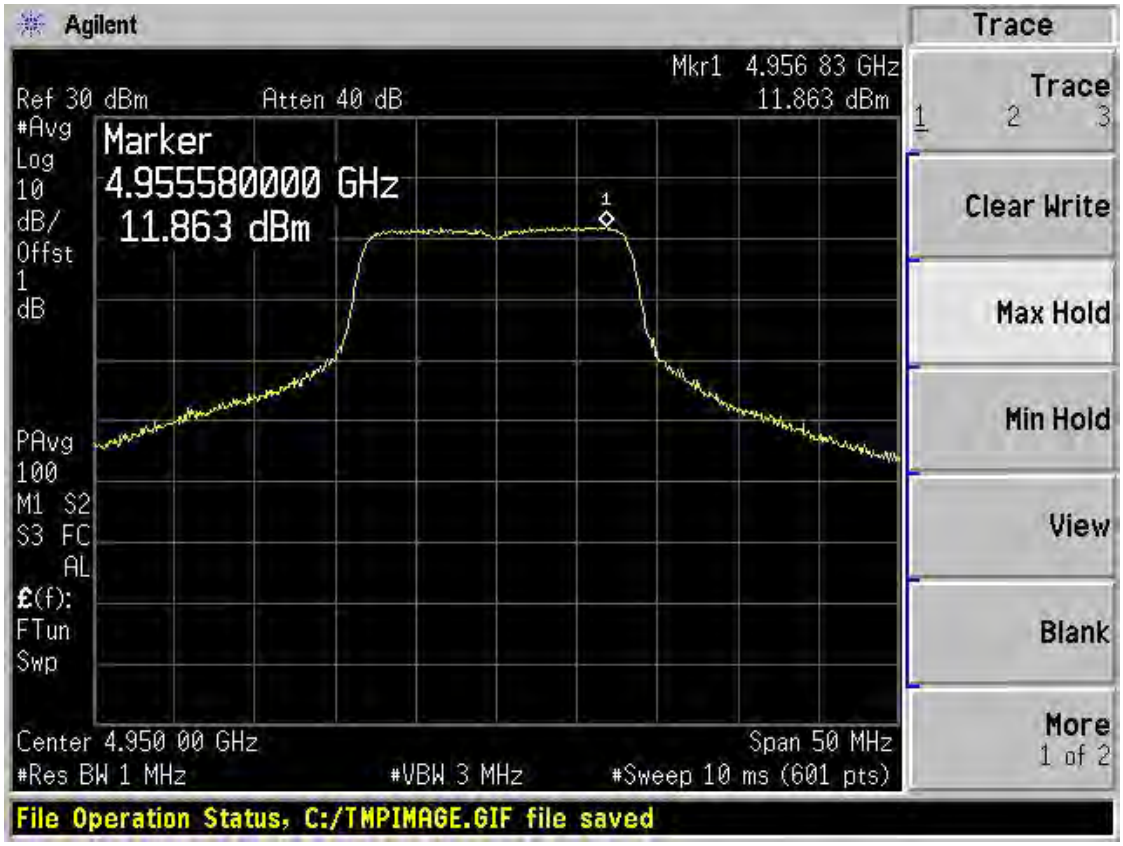
Chain 1 PSD (3 dBi Antenna)-Mid Channel



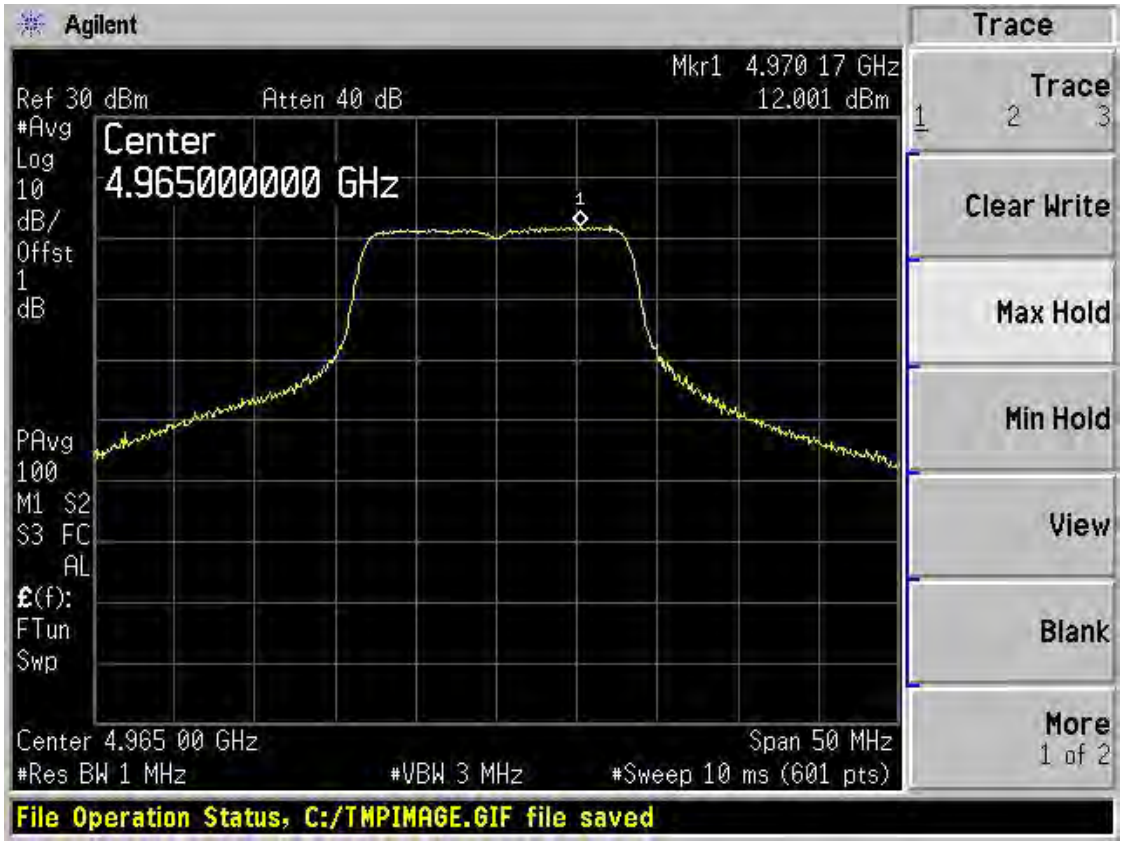
Chain 1 PSD (3 dBi Antenna)-High Channel



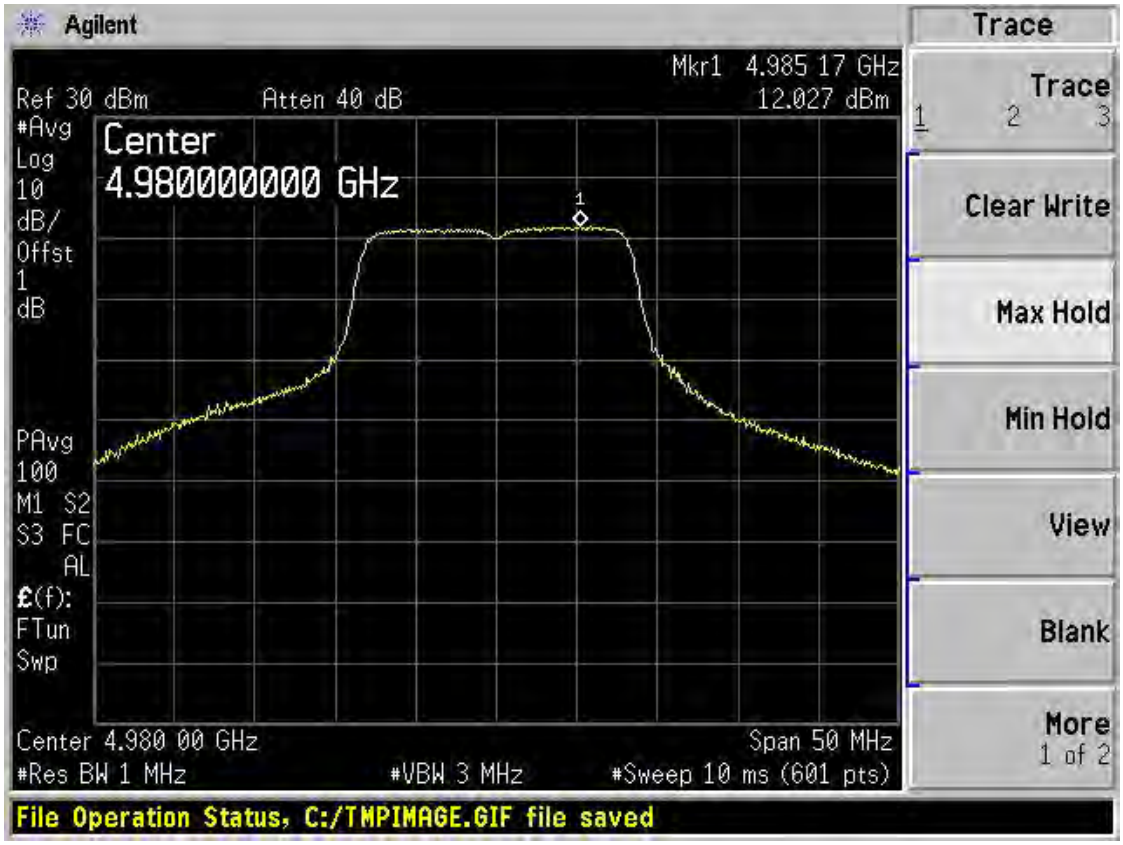
Chain 2 PSD (3 dBi Antenna)-Low Channel



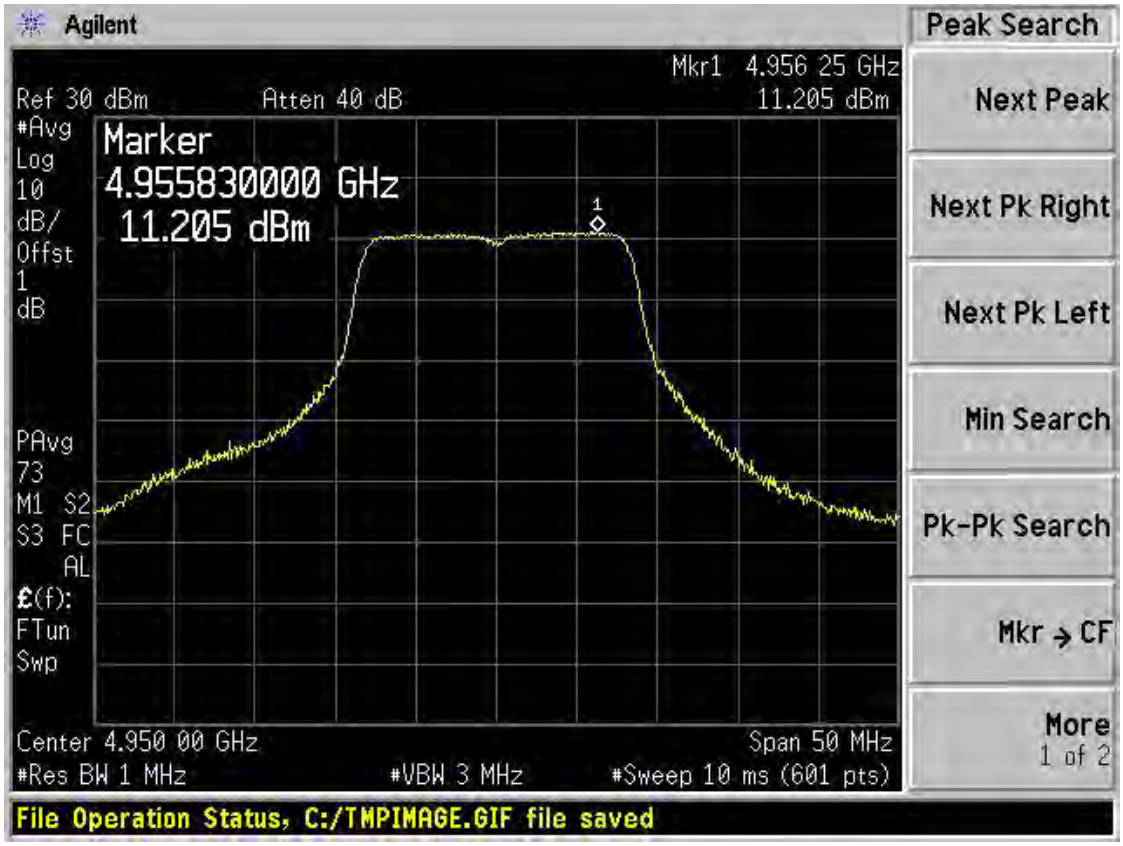
Chain 2 PSD (3 dBi Antenna)-Mid Channel



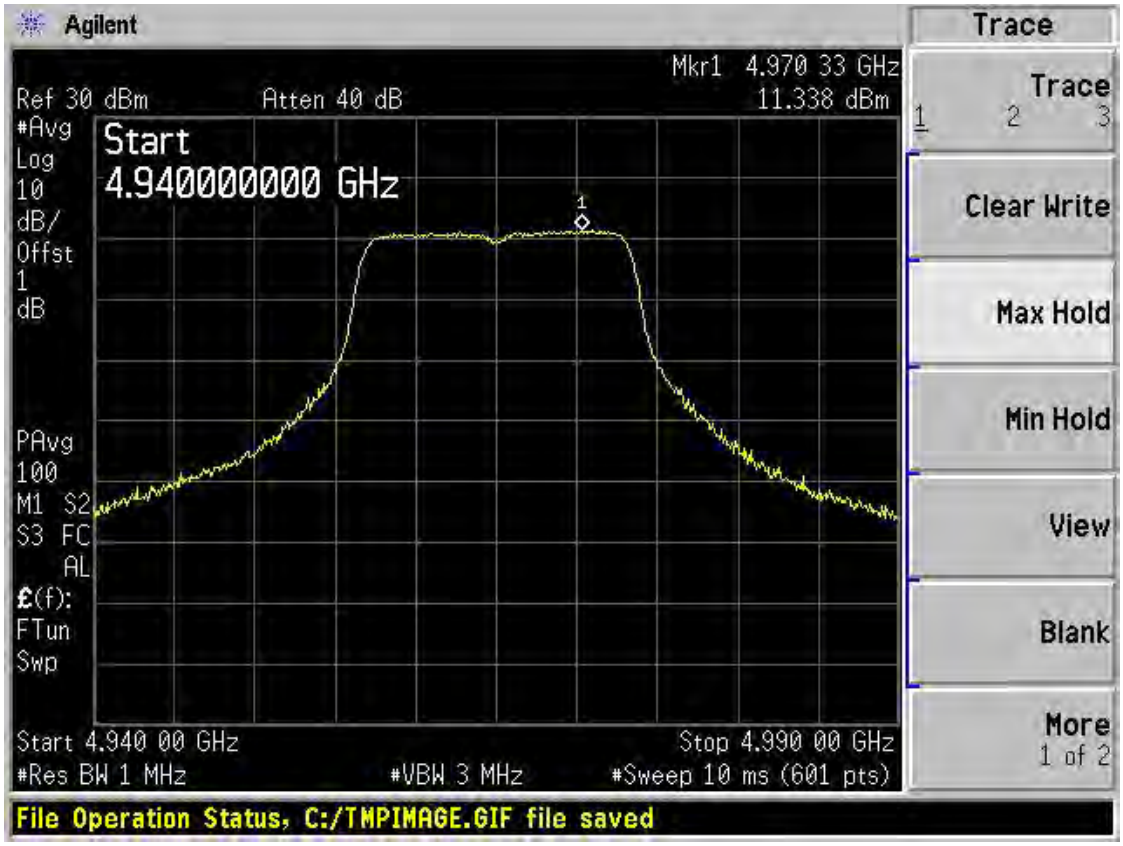
Chain 2 PSD (3 dBi Antenna)-High Channel



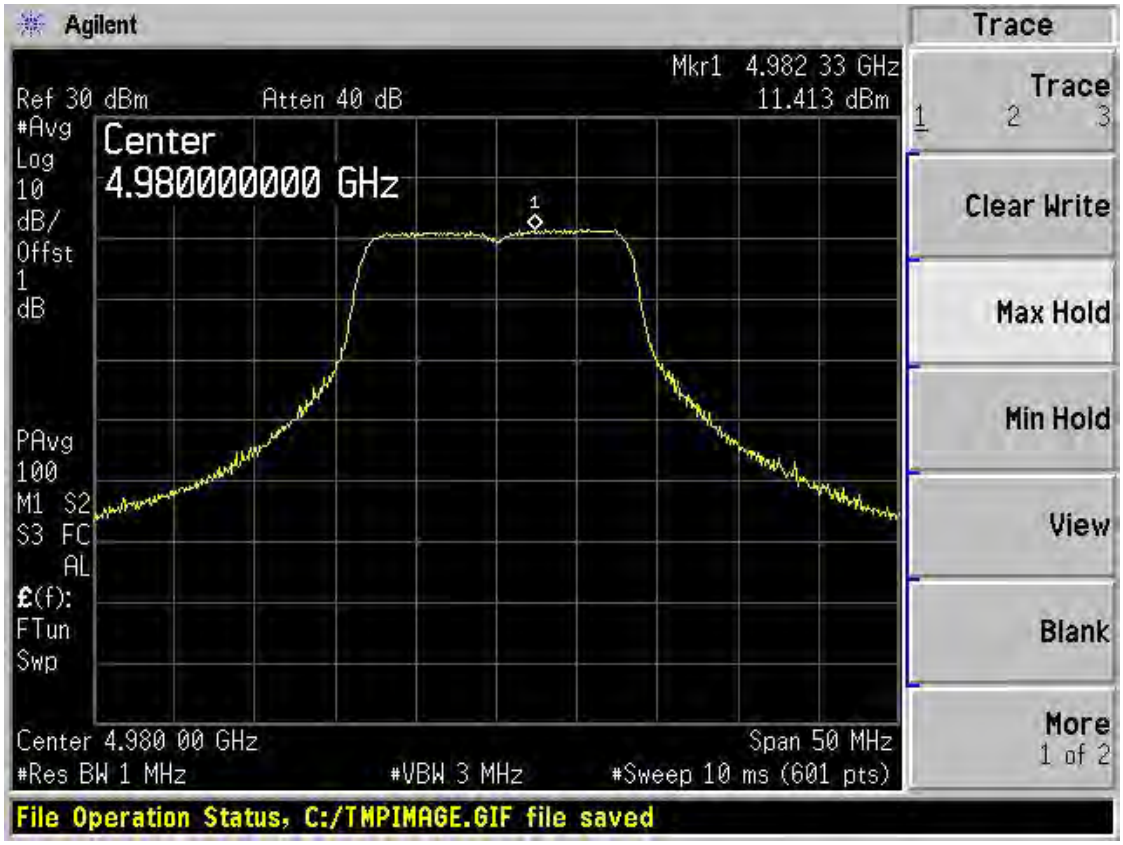
Chain 1 PSD (18 dBi Antenna)-Low Channel



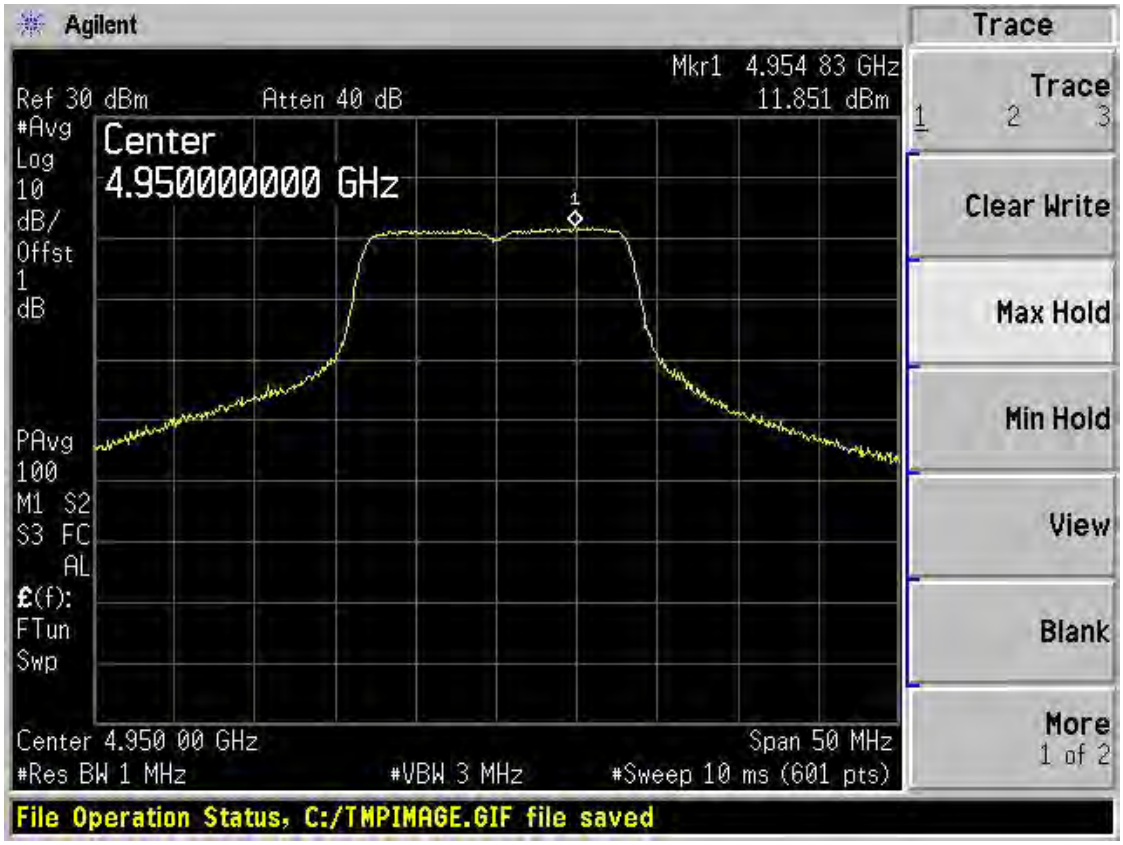
Chain 1 PSD (18 dBi Antenna)-Mid Channel



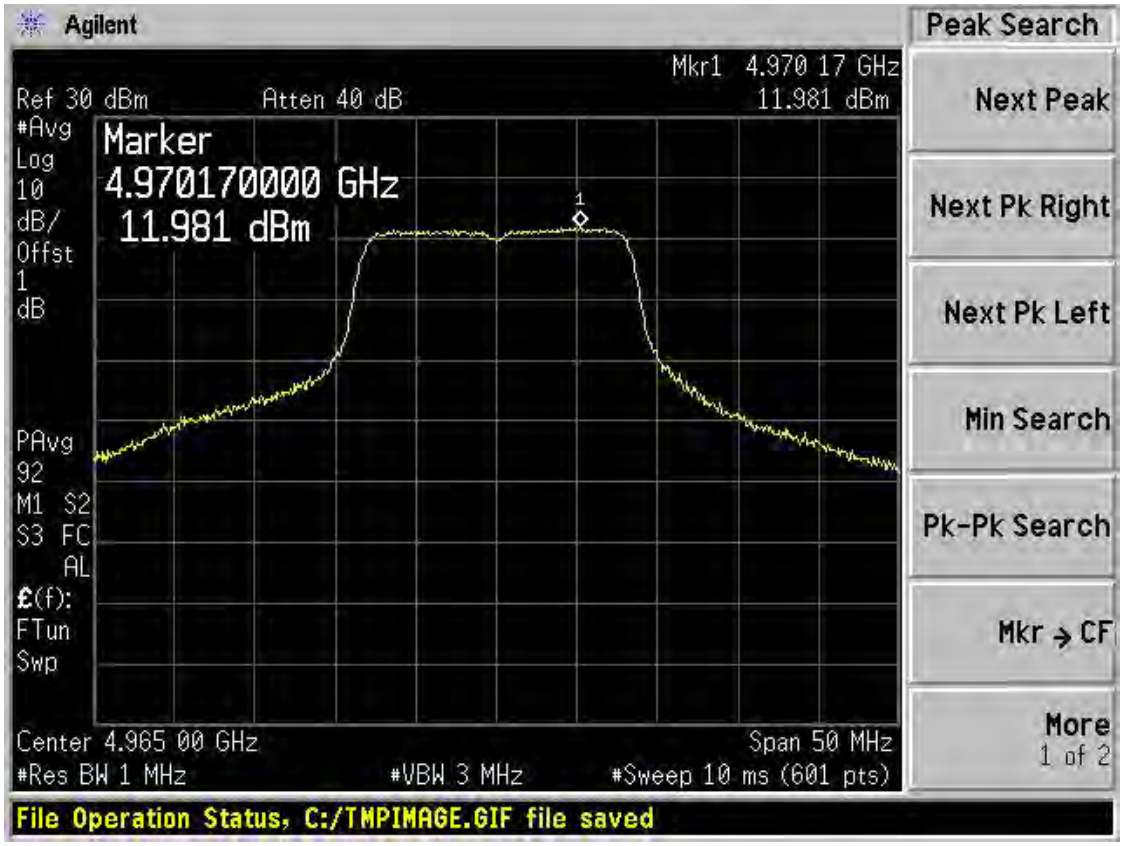
Chain 1 PSD (18 dBi Antenna)-High Channel



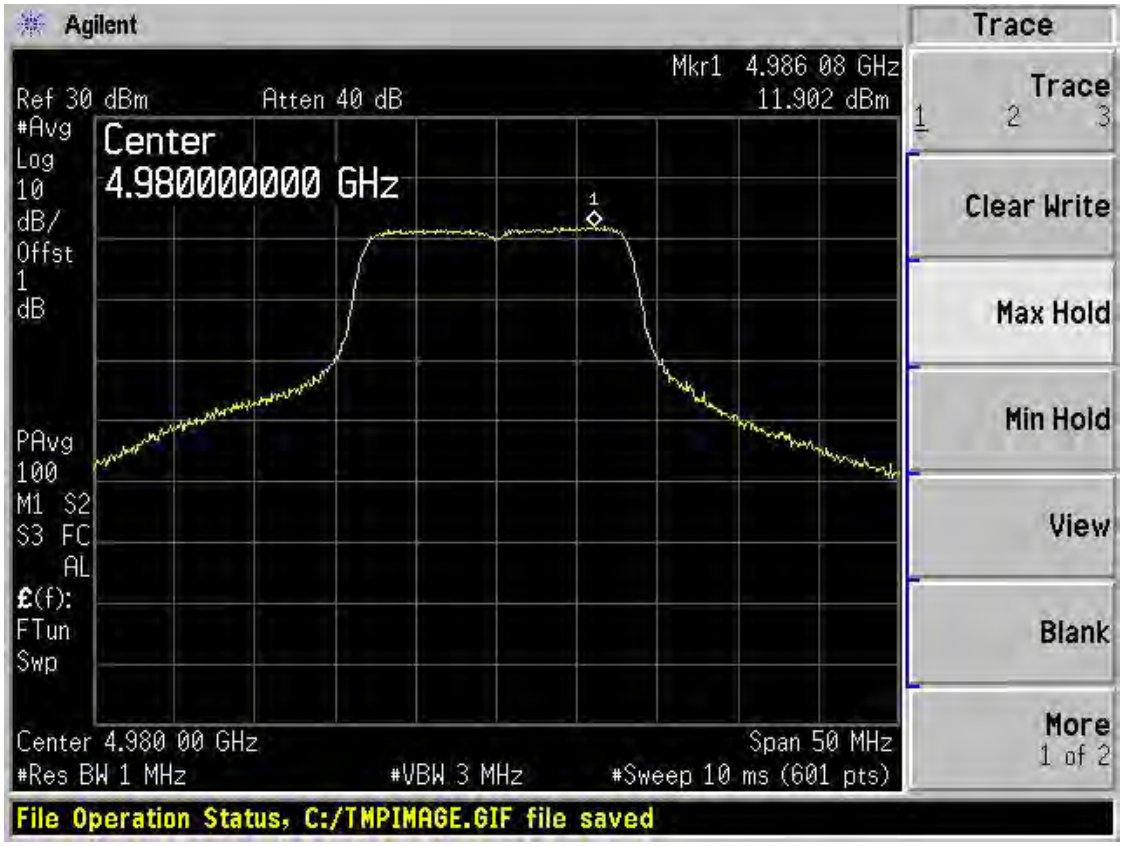
Chain 2 PSD (18 dBi Antenna)-Low Channel



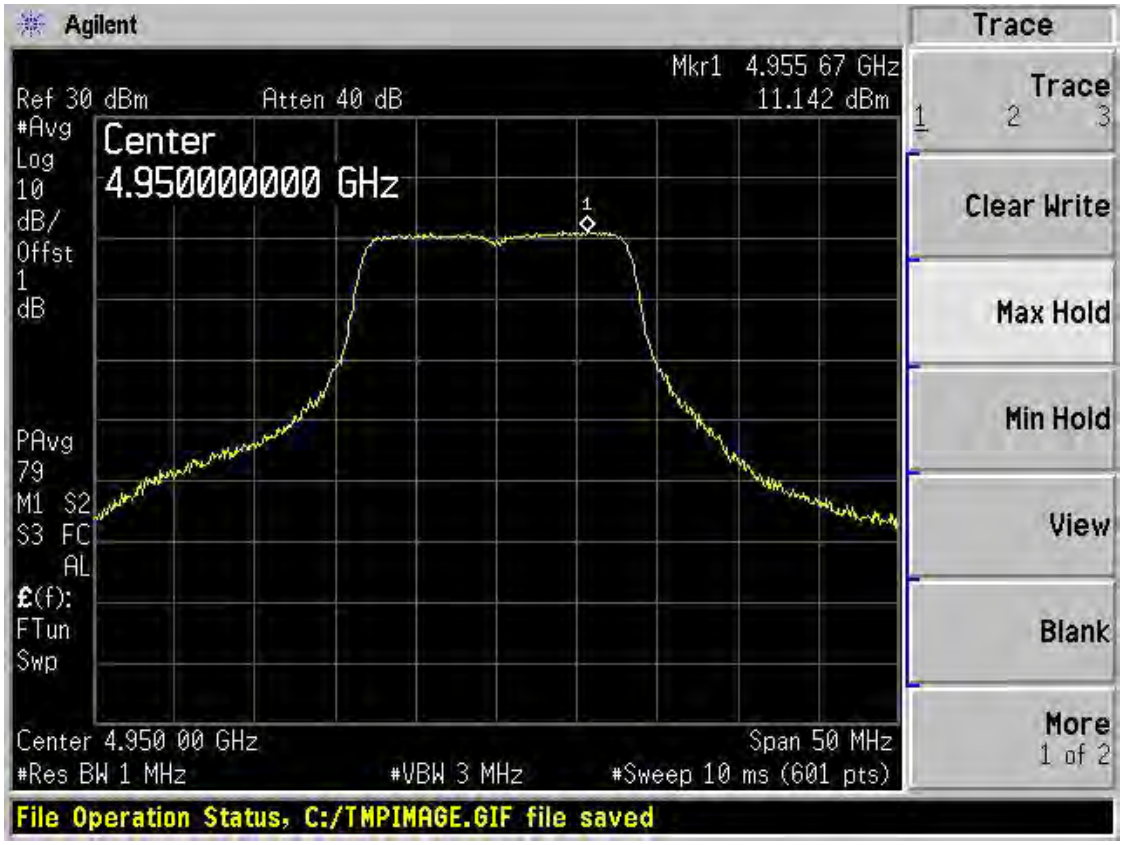
Chain 2 PSD (18 dBi Antenna)-Mid Channel



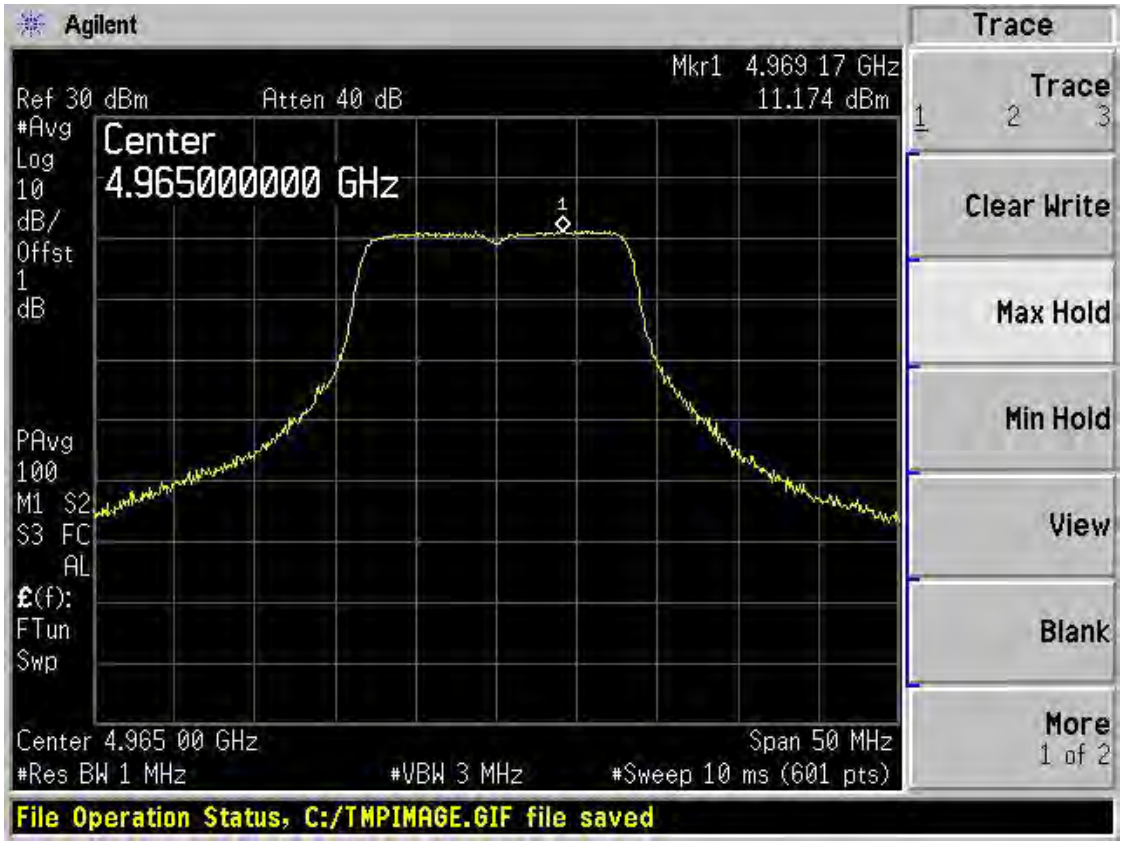
Chain 2 PSD (18 dBi Antenna)-High Channel



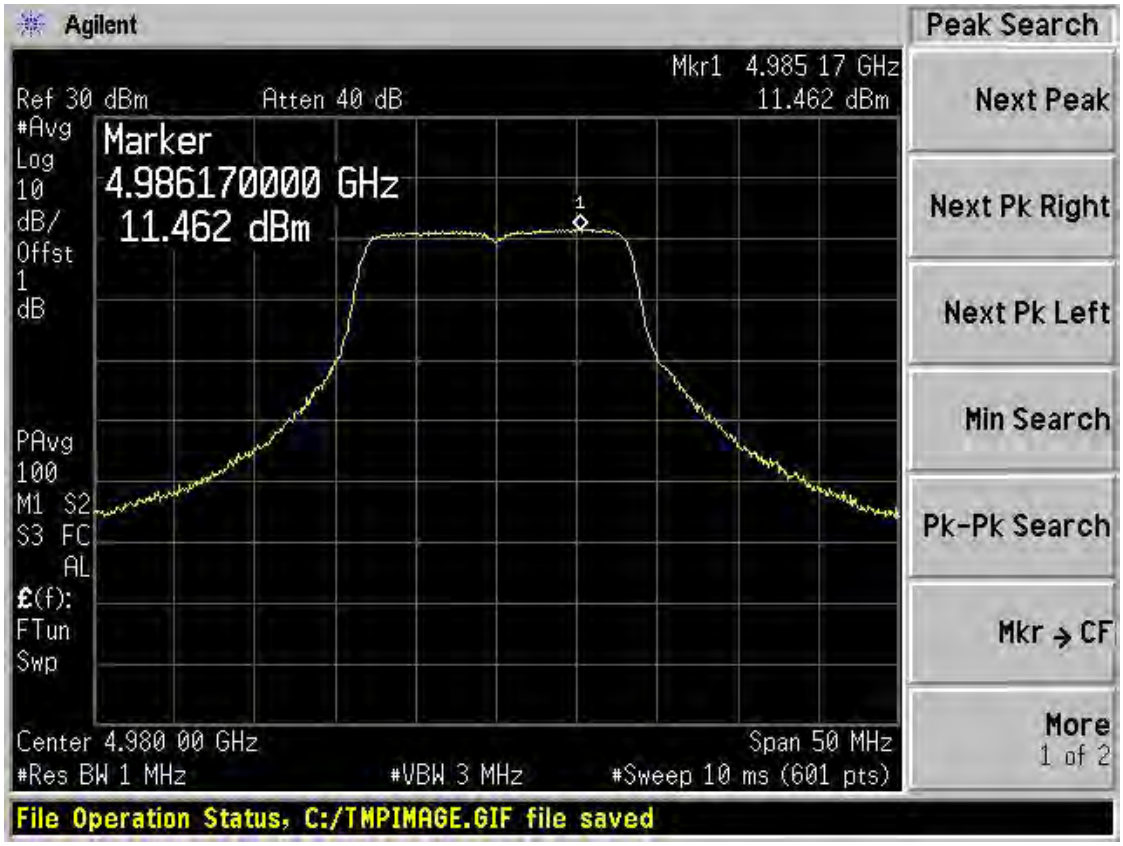
Chain 1 PSD (23 dBi Antenna)-Low Channel



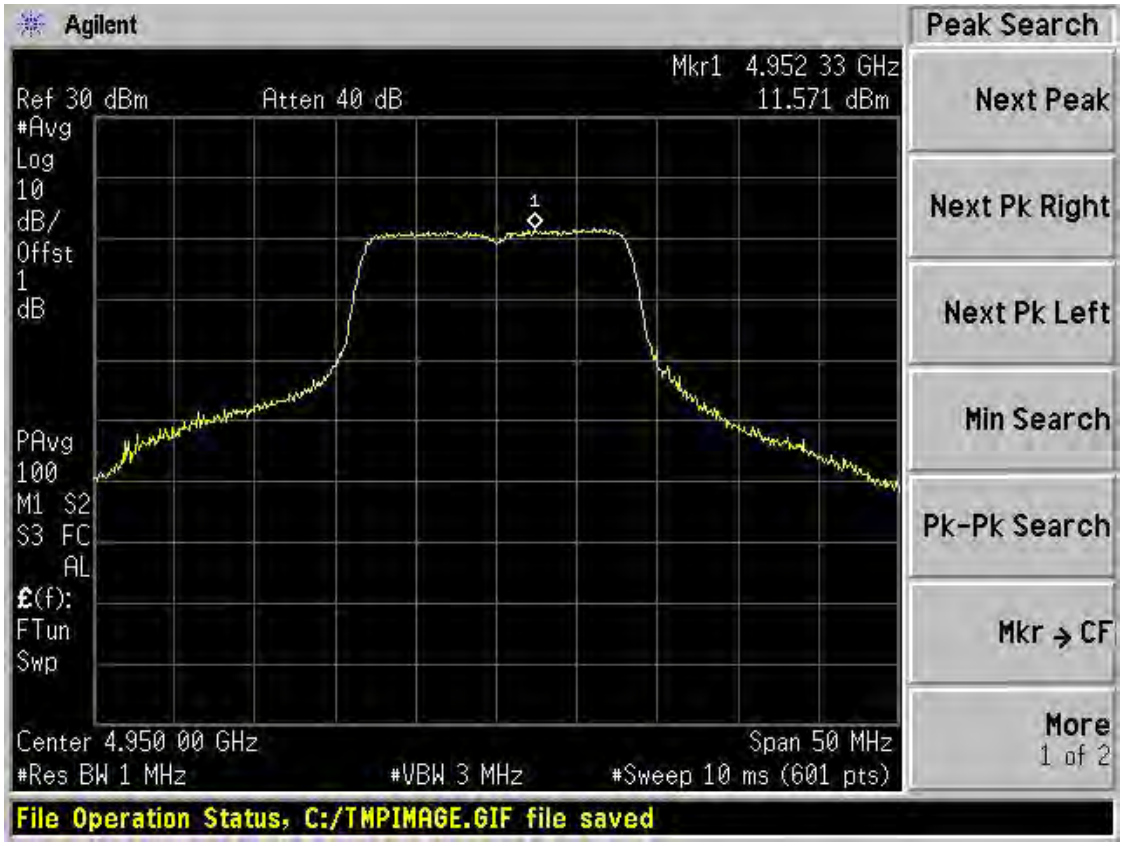
Chain 1 PSD (23 dBi Antenna)-Mid Channel



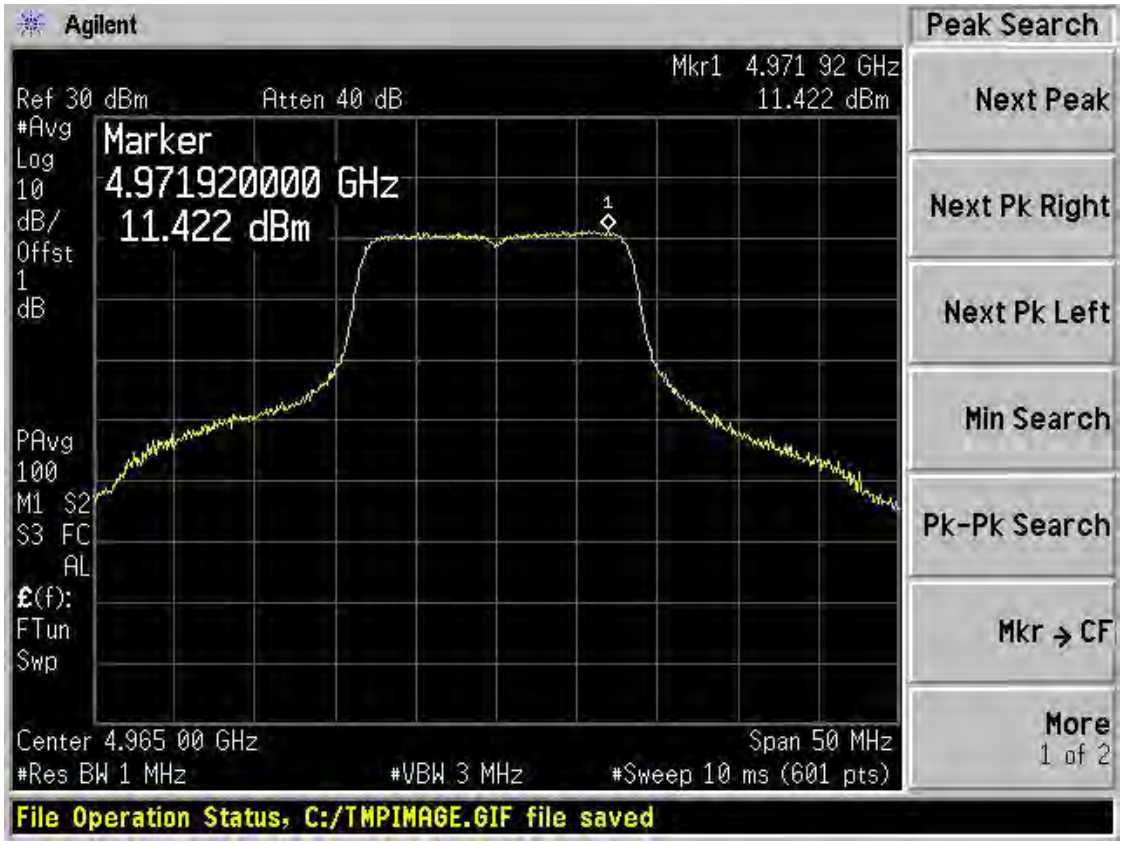
Chain 1 PSD (23 dBi Antenna)-High Channel



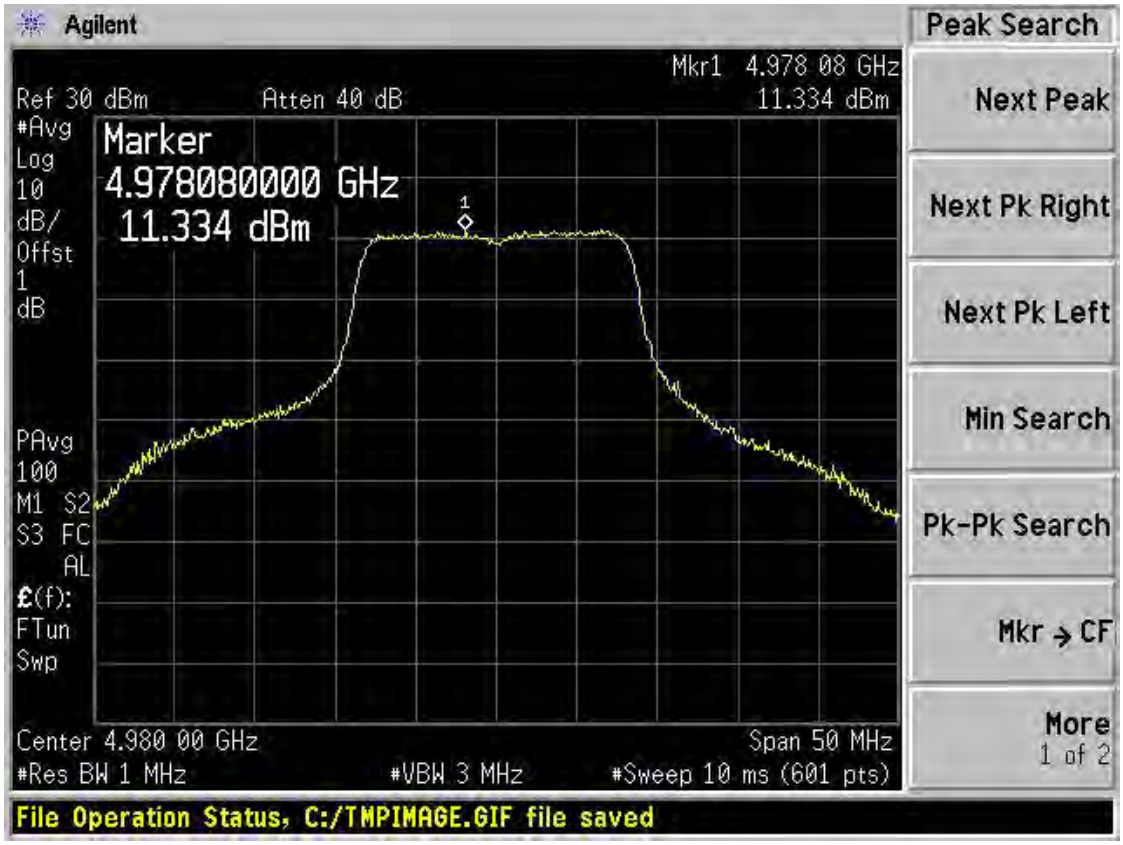
Chain 2 PSD (23 dBi Antenna)-Low Channel



Chain 2 PSD (23 dBi Antenna)-Mid Channel

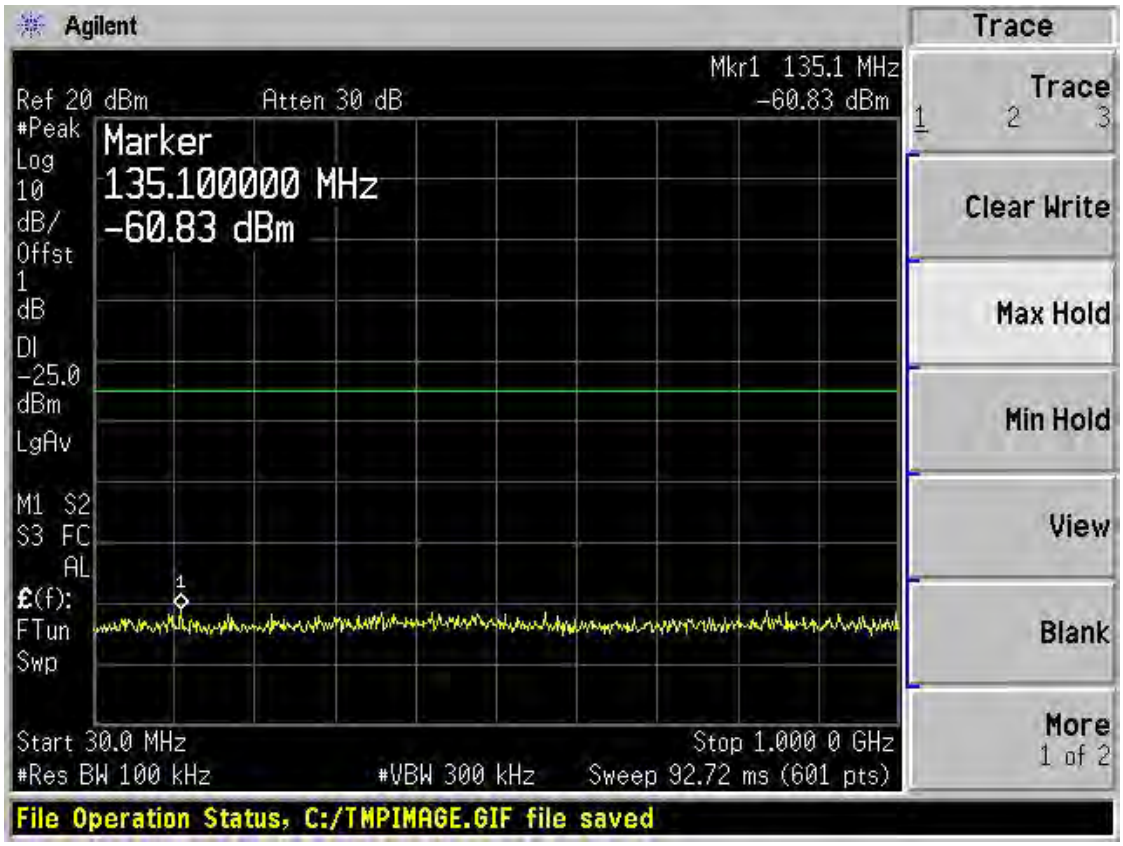


Chain 2 PSD (23 dBi Antenna)-High Channel

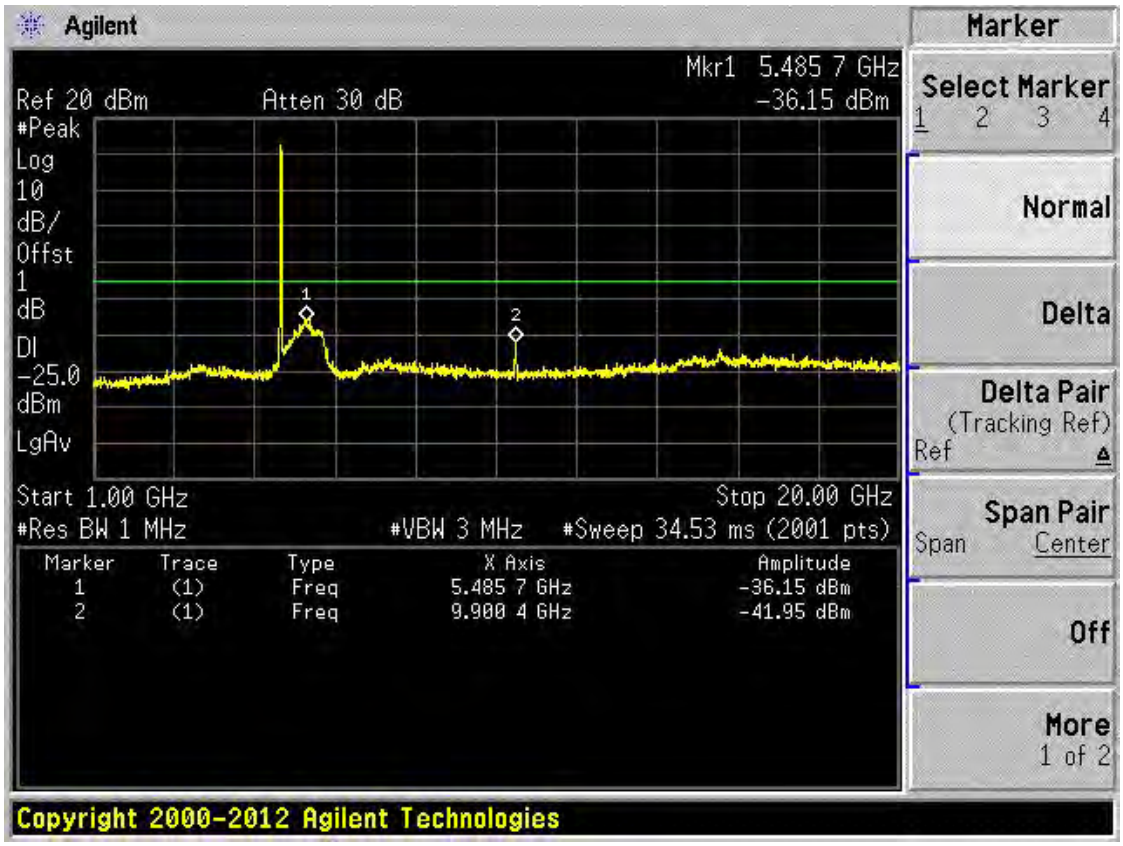


A.5 Conducted Spurious Emission

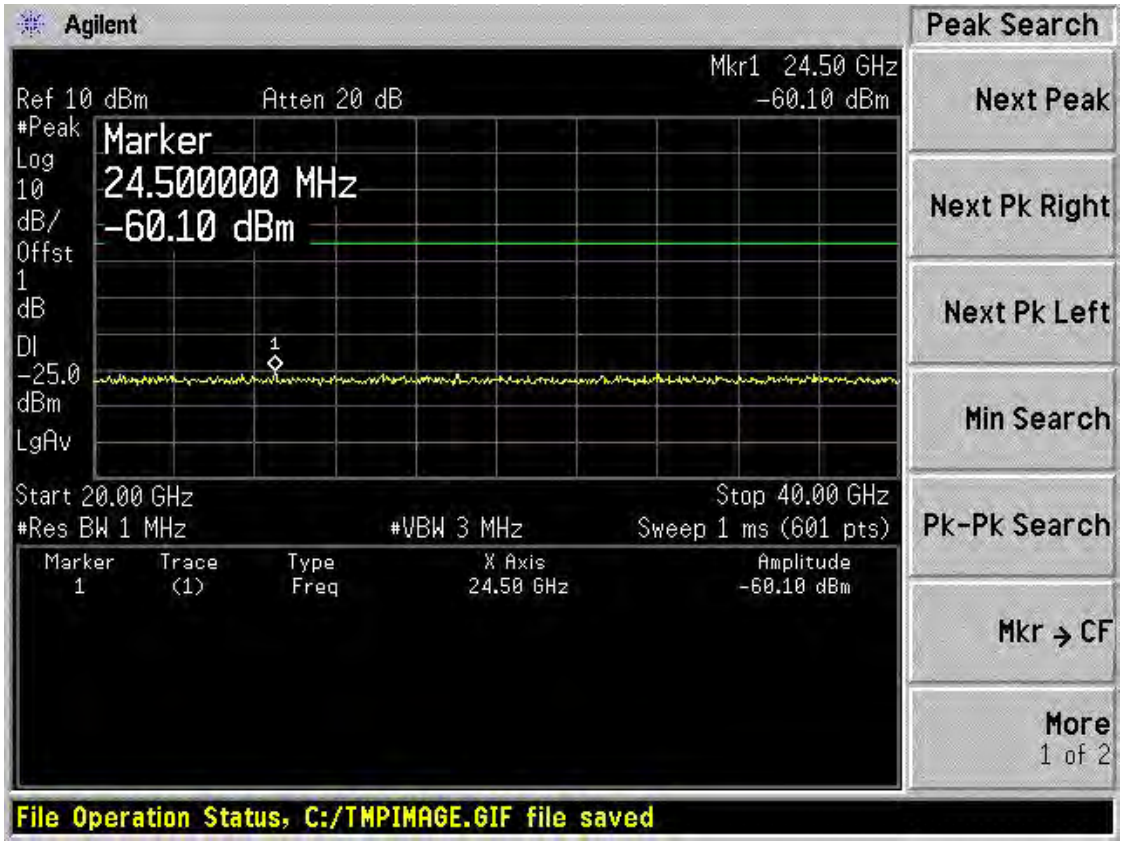
Chain 1 CSE (3dBi Antenna)-Low Channel (30 ~ 1000 MHz)



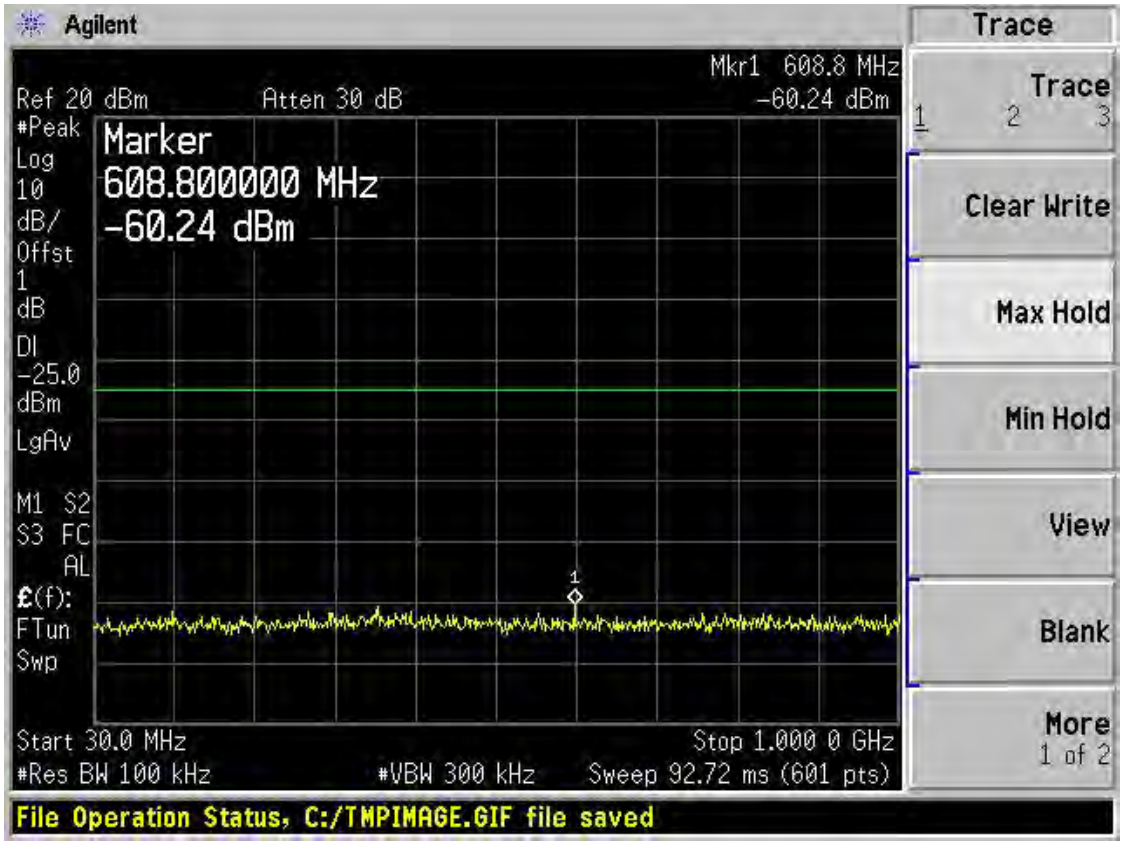
Chain 1 CSE (3dBi Antenna)-Low Channel (1 ~ 20 GHz)



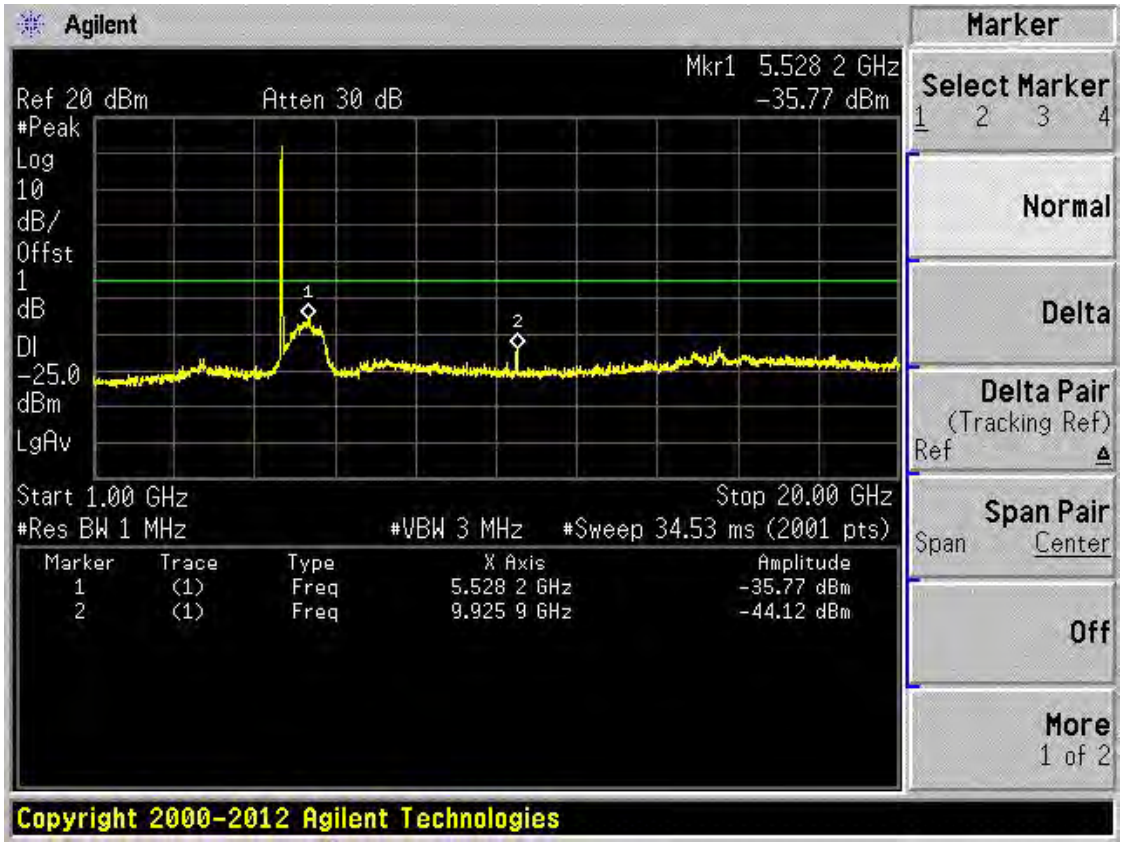
Chain 1 CSE (3dBi Antenna)-Low Channel (20 ~ 40 GHz)



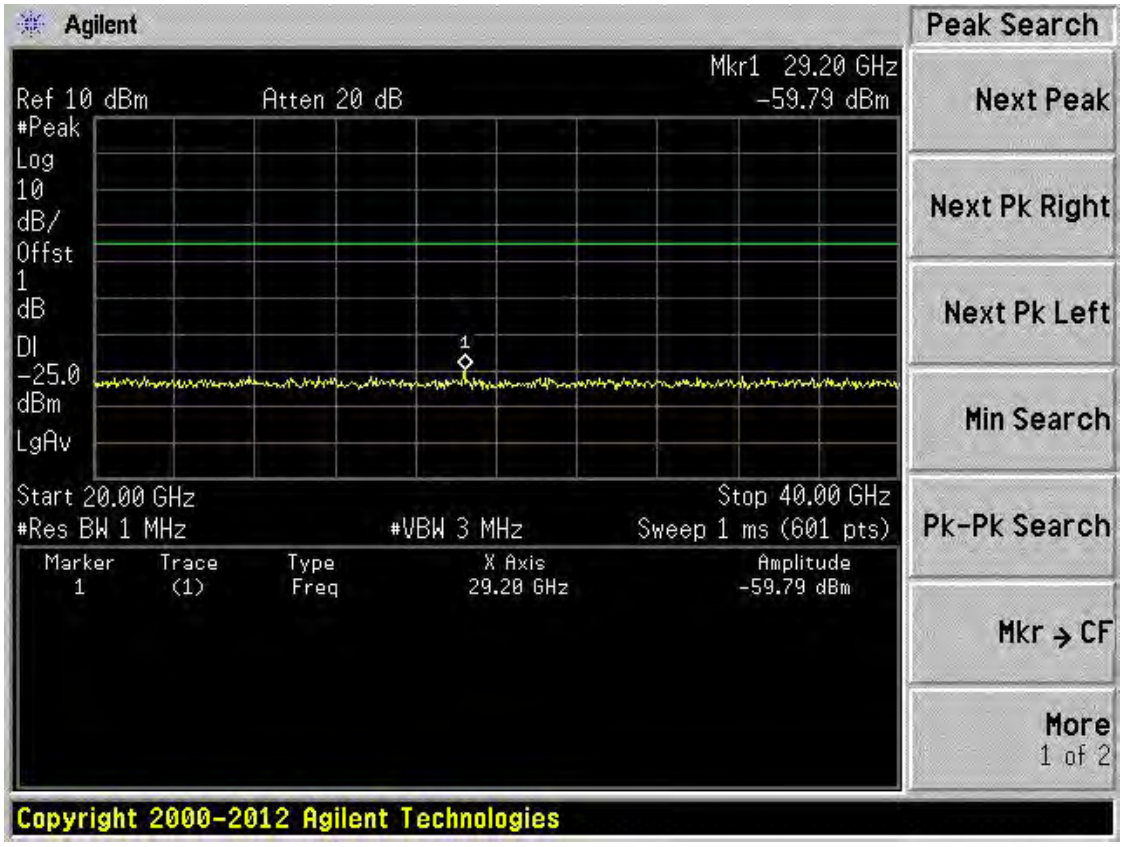
Chain 1 CSE (3dBi Antenna)-Mid Channel (30 ~ 1000 MHz)



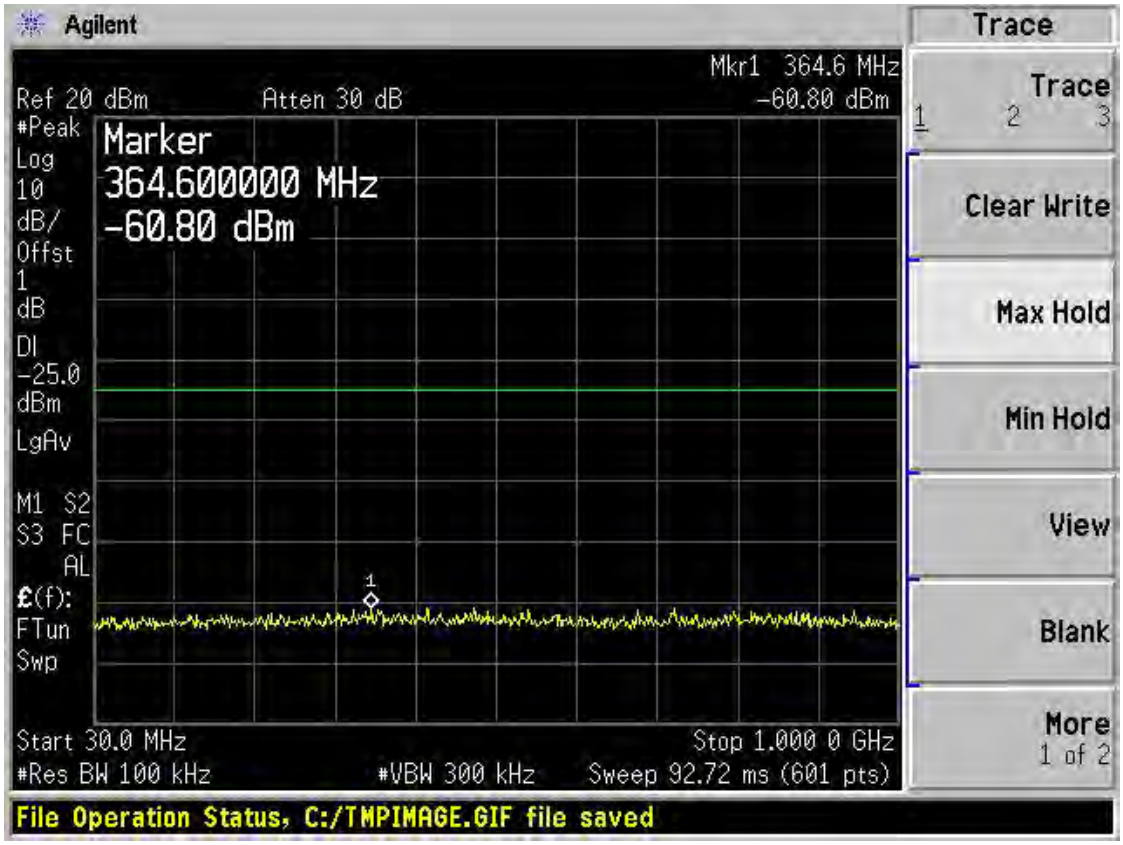
Chain 1 CSE (3dBi Antenna)-Mid Channel (1 ~ 20 GHz)



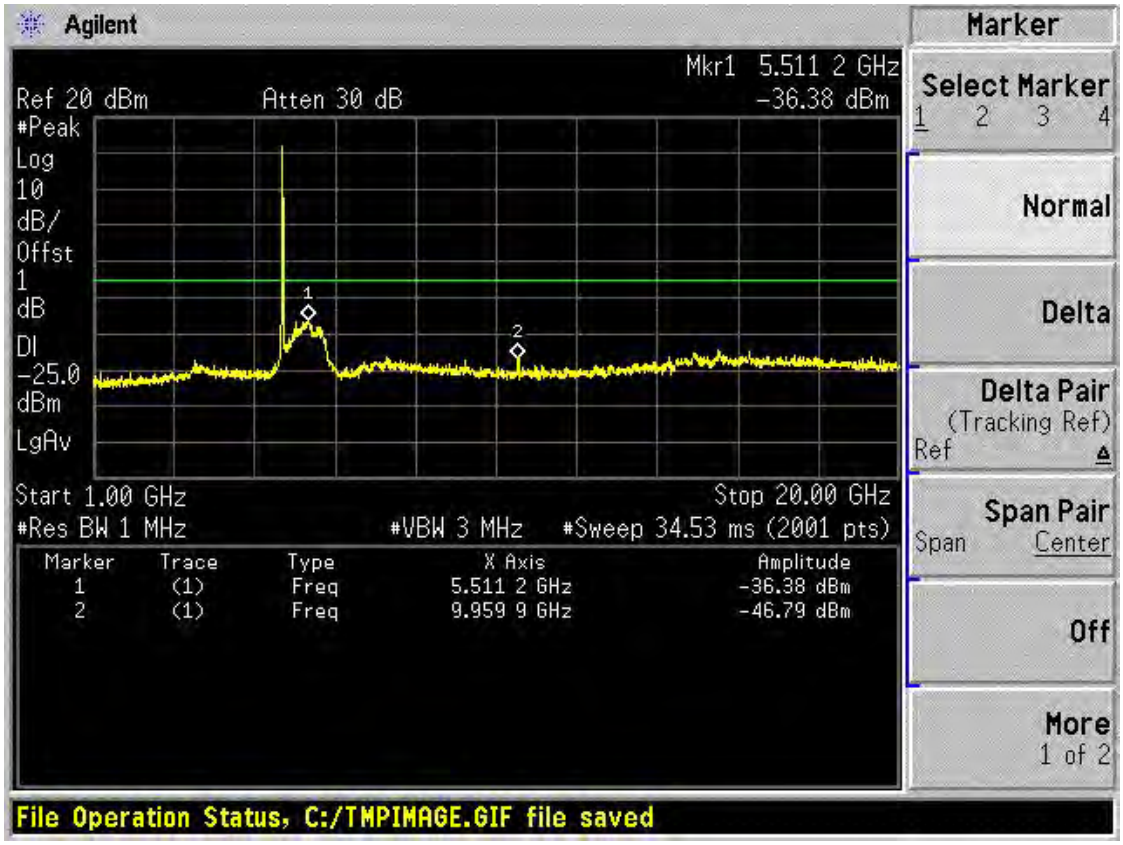
Chain 1 CSE (3dBi Antenna)-Mid Channel (20 ~ 40 GHz)



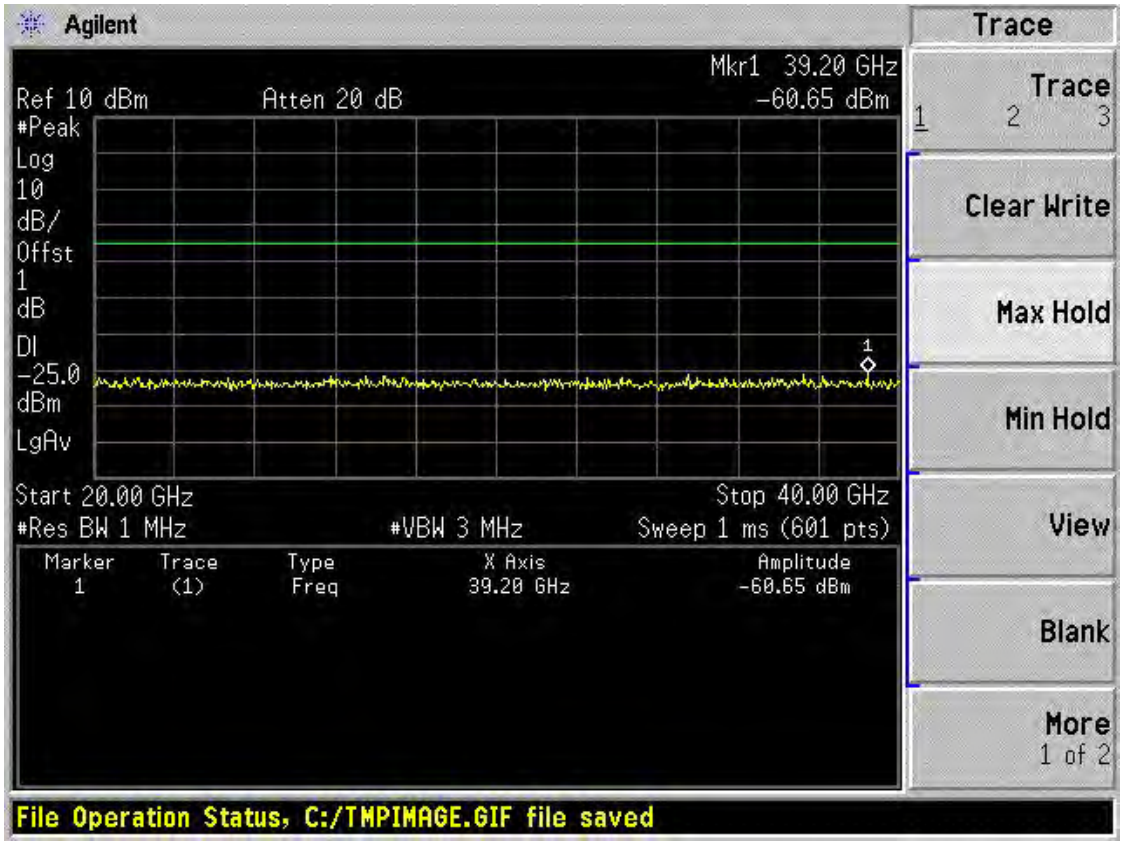
Chain 1 CSE (3dBi Antenna)-High Channel (30 ~ 1000 MHz)



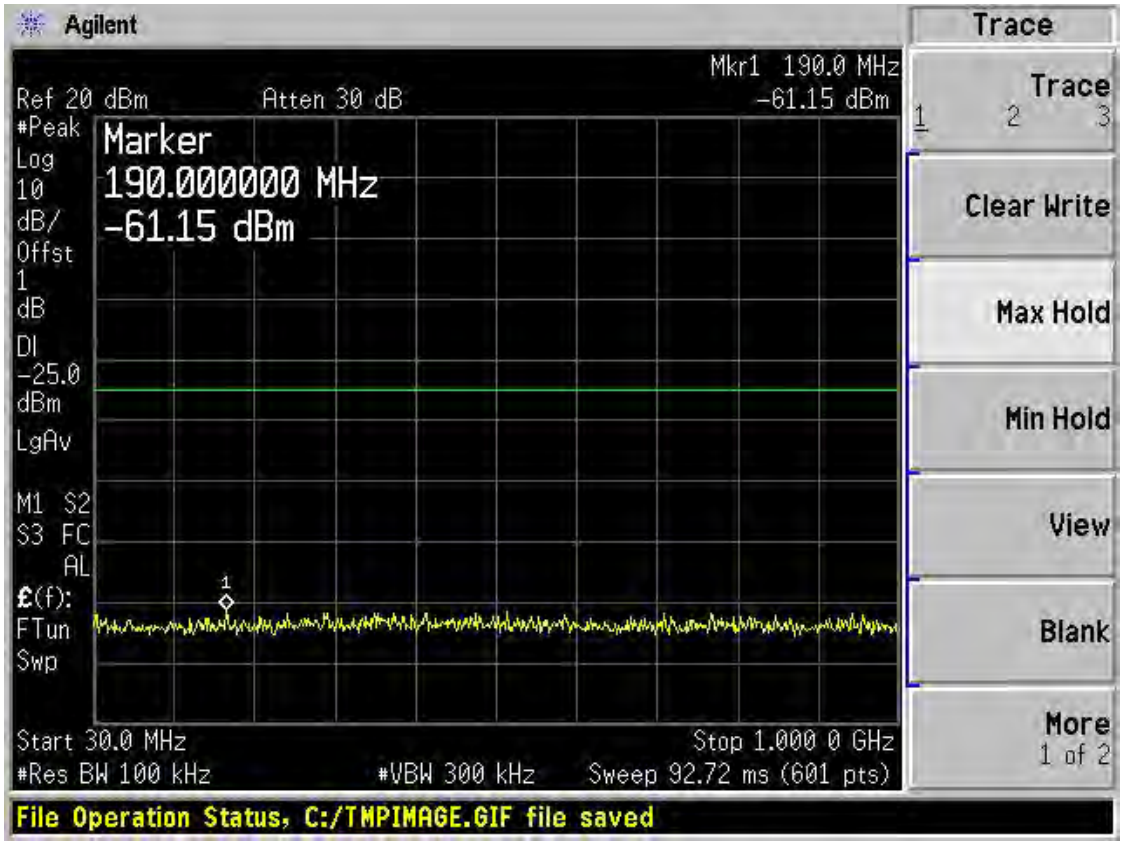
Chain 1 CSE (3dBi Antenna)-High Channel (1 ~ 20 GHz)



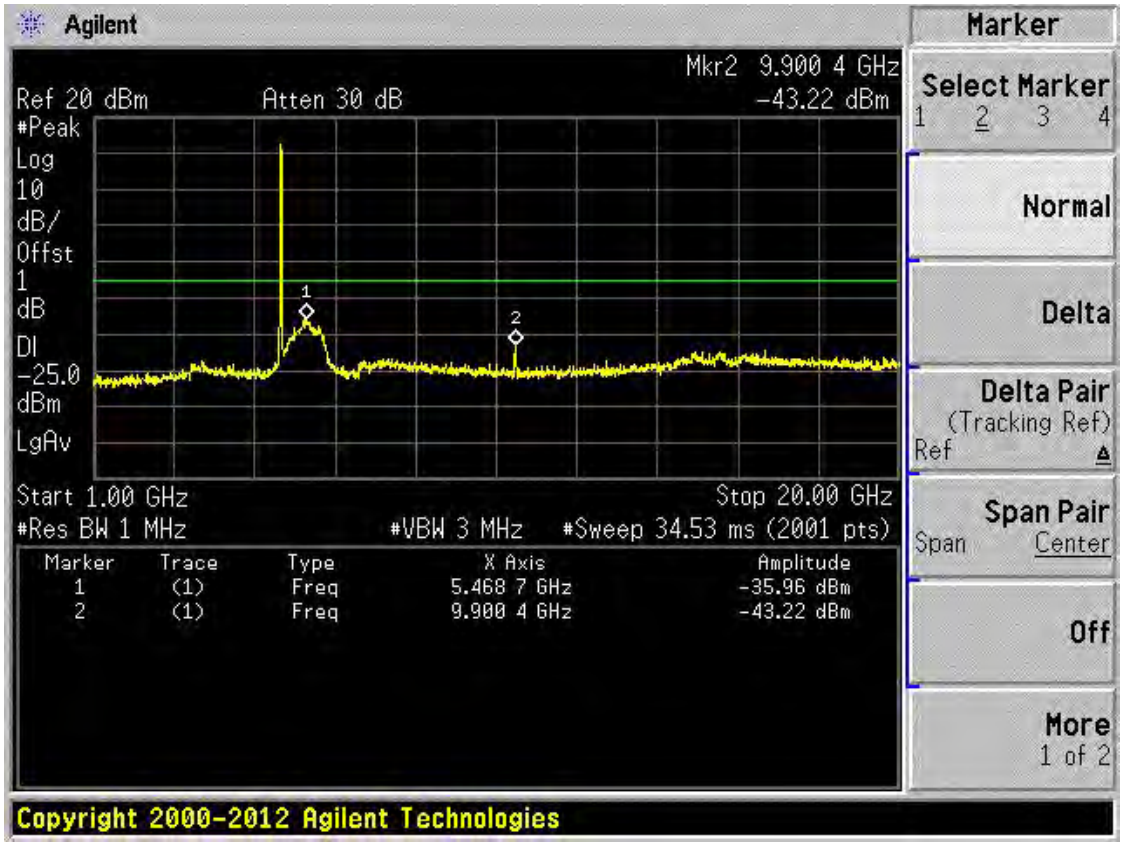
Chain 1 CSE (3dBi Antenna)-High Channel (20 ~ 40 GHz)



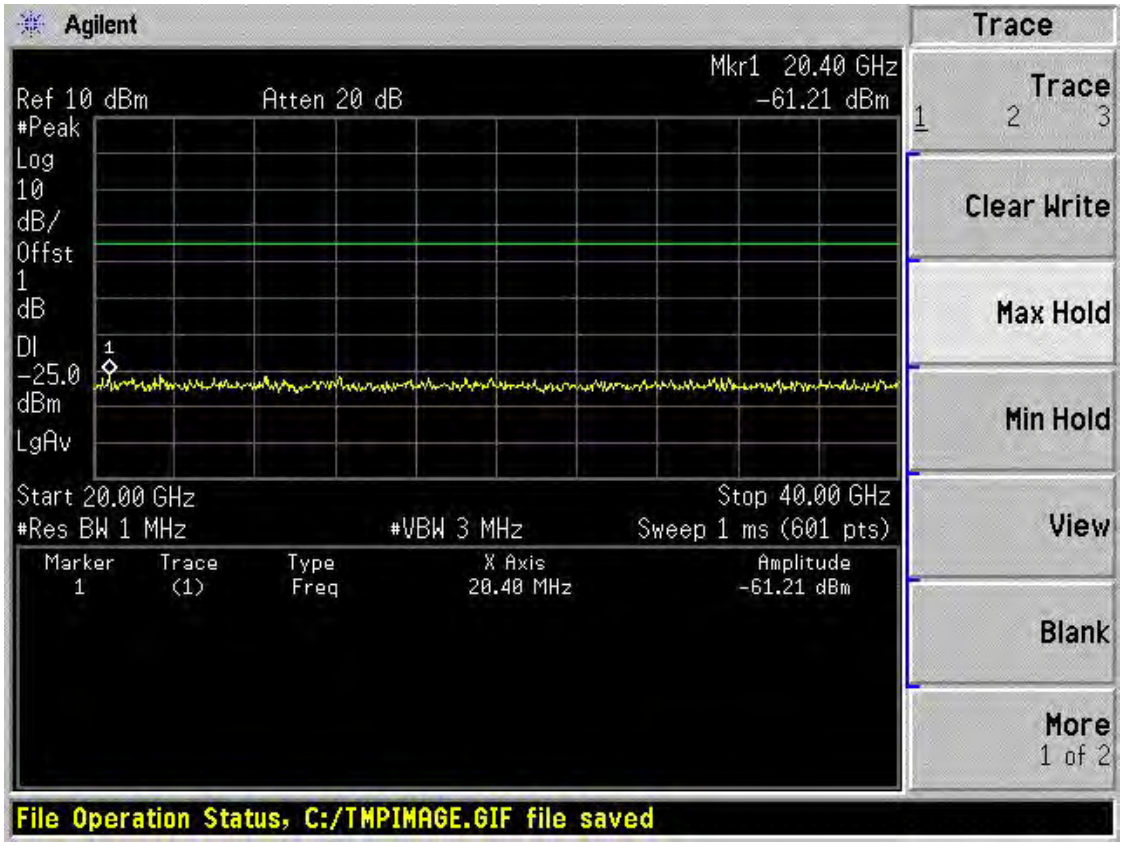
Chain 2 CSE (3dBi Antenna)-Low Channel (30 ~ 1000 MHz)



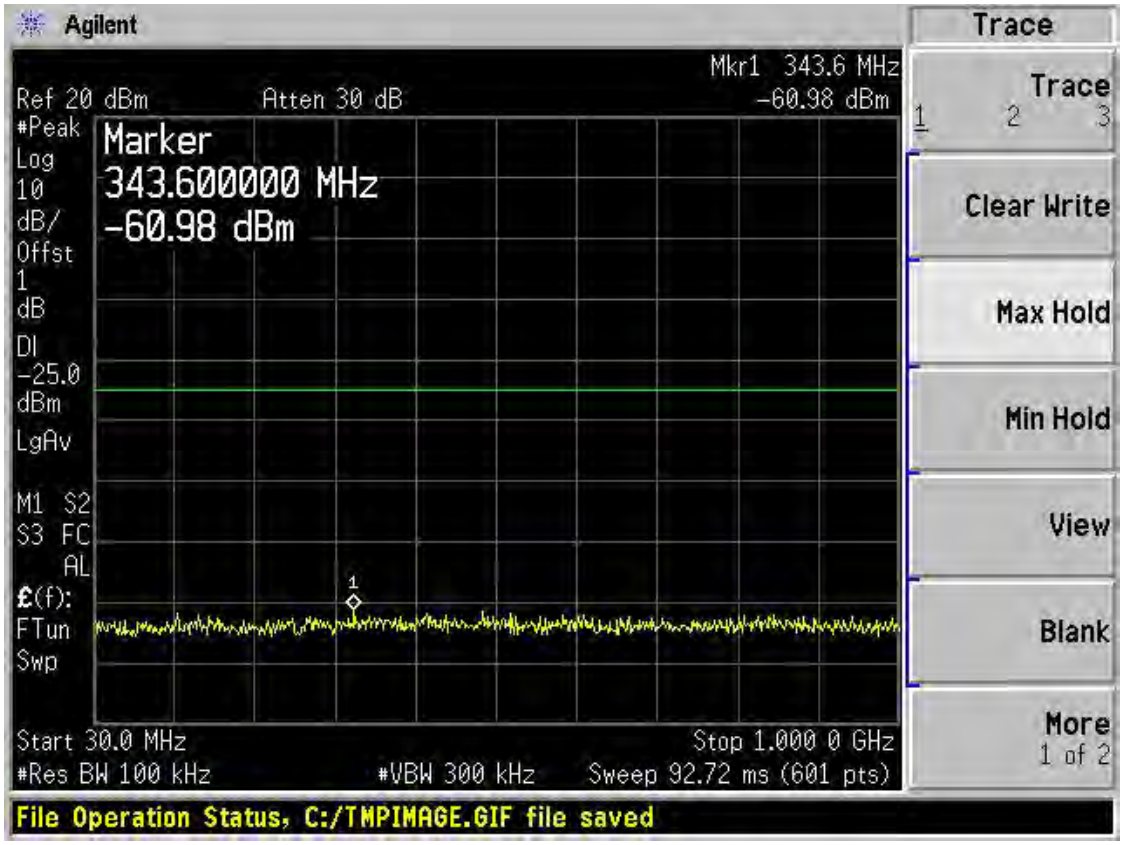
Chain 2 CSE (3dBi Antenna)-Low Channel (1 ~ 20 GHz)



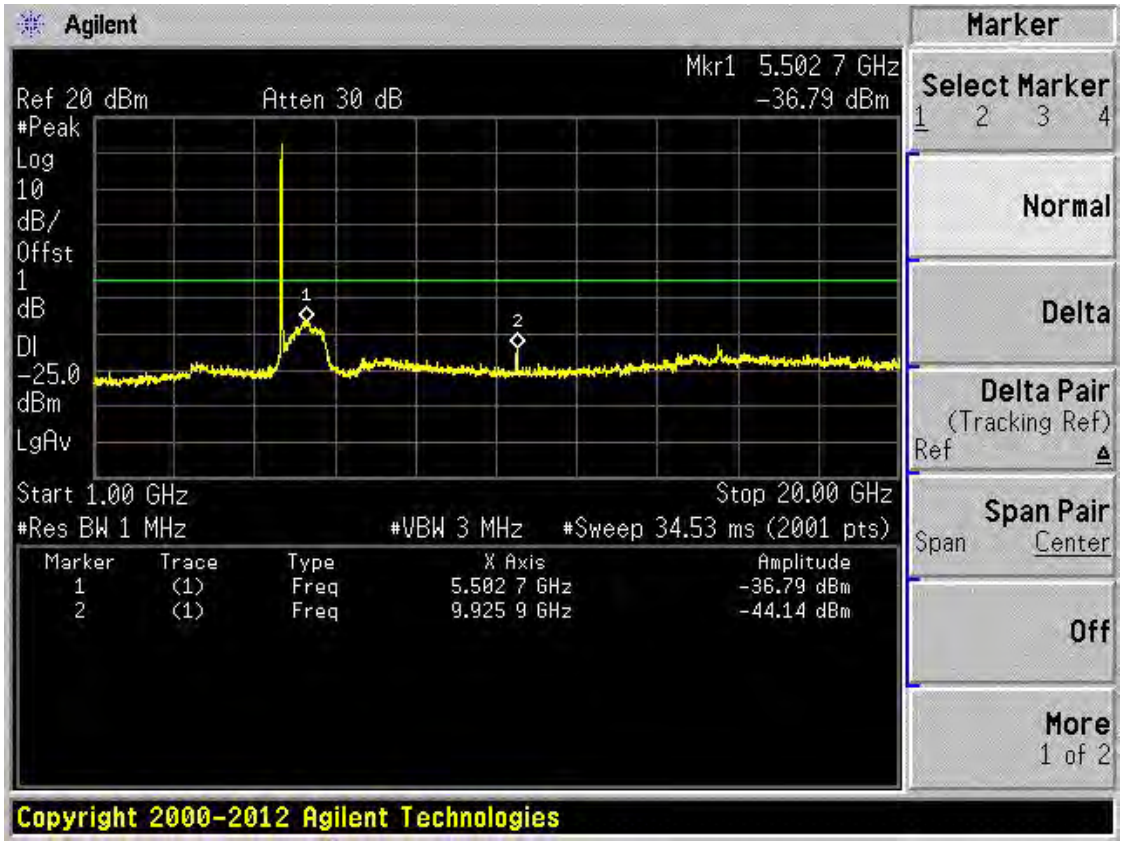
Chain 2 CSE (3dBi Antenna)-Low Channel (20 ~ 40 GHz)



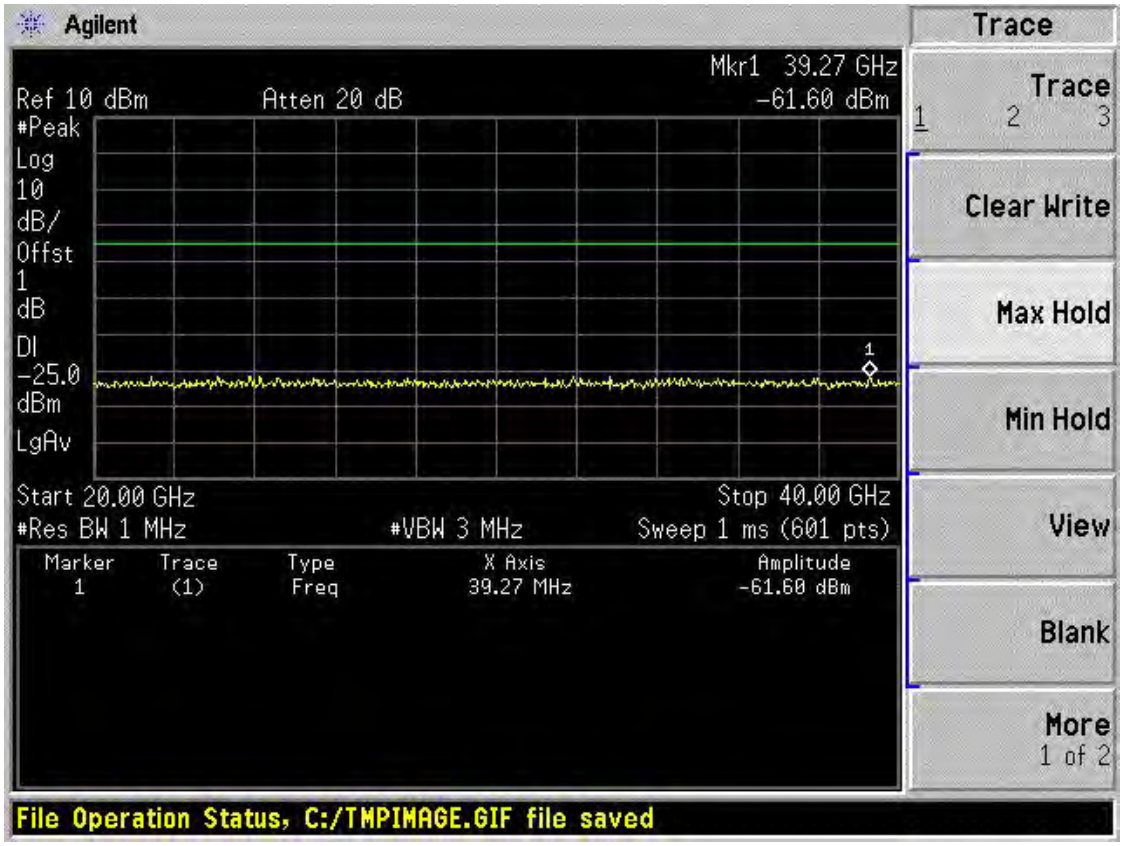
Chain 2 CSE (3dBi Antenna)-Mid Channel (30 ~ 1000 MHz)



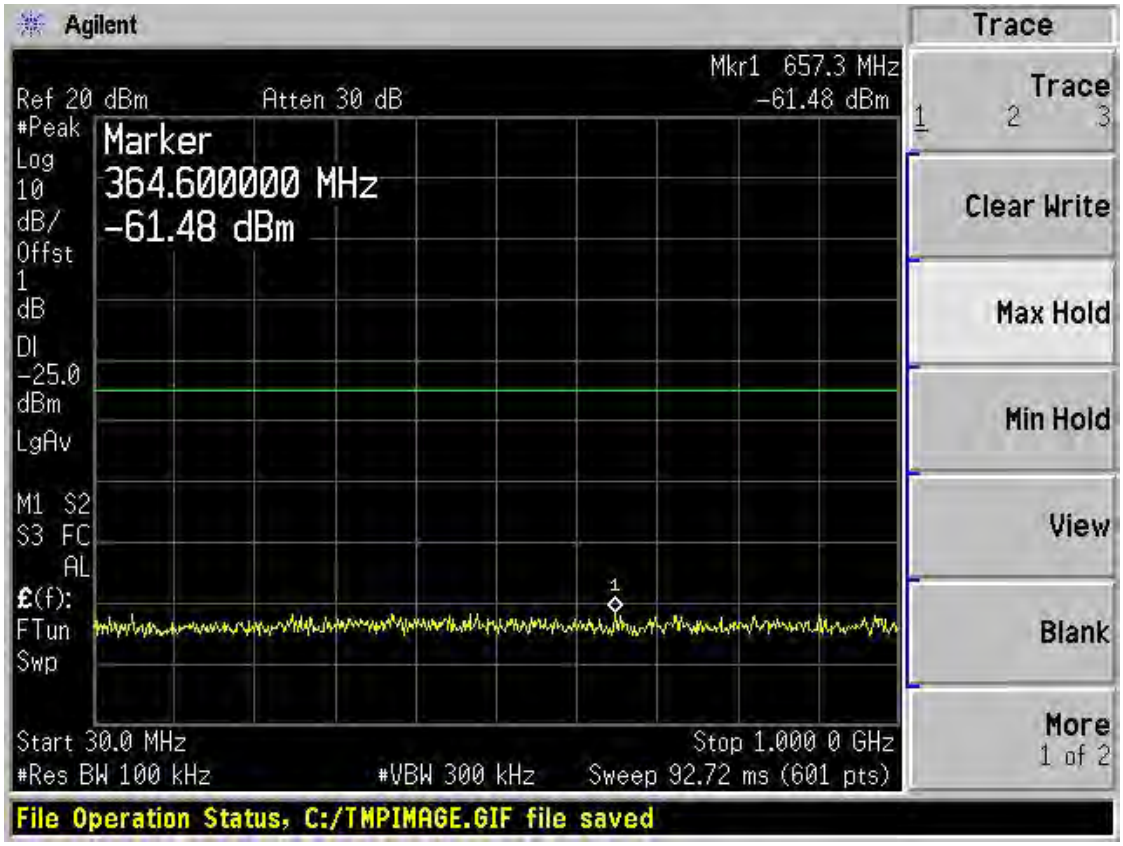
Chain 2 CSE (3dBi Antenna)-Mid Channel (1 ~ 20 GHz)



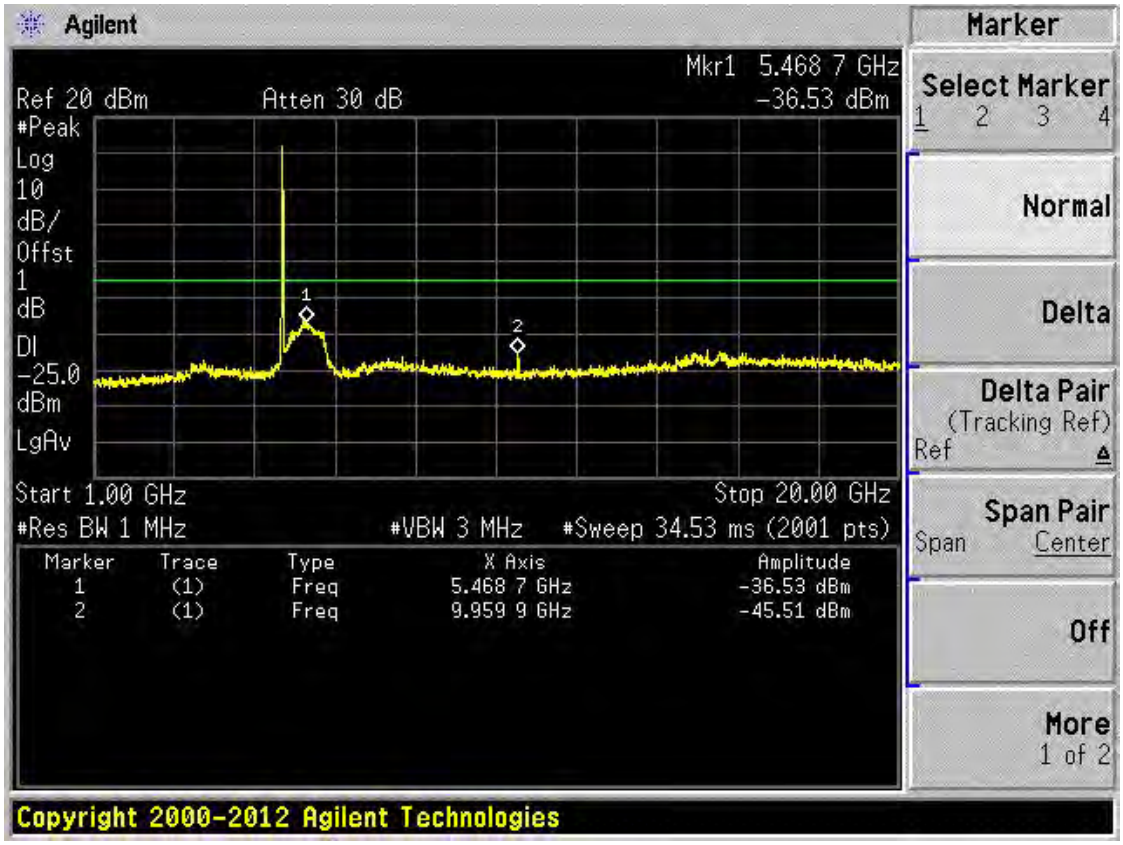
Chain 2 CSE (3dBi Antenna)-Mid Channel (20 ~ 40 GHz)



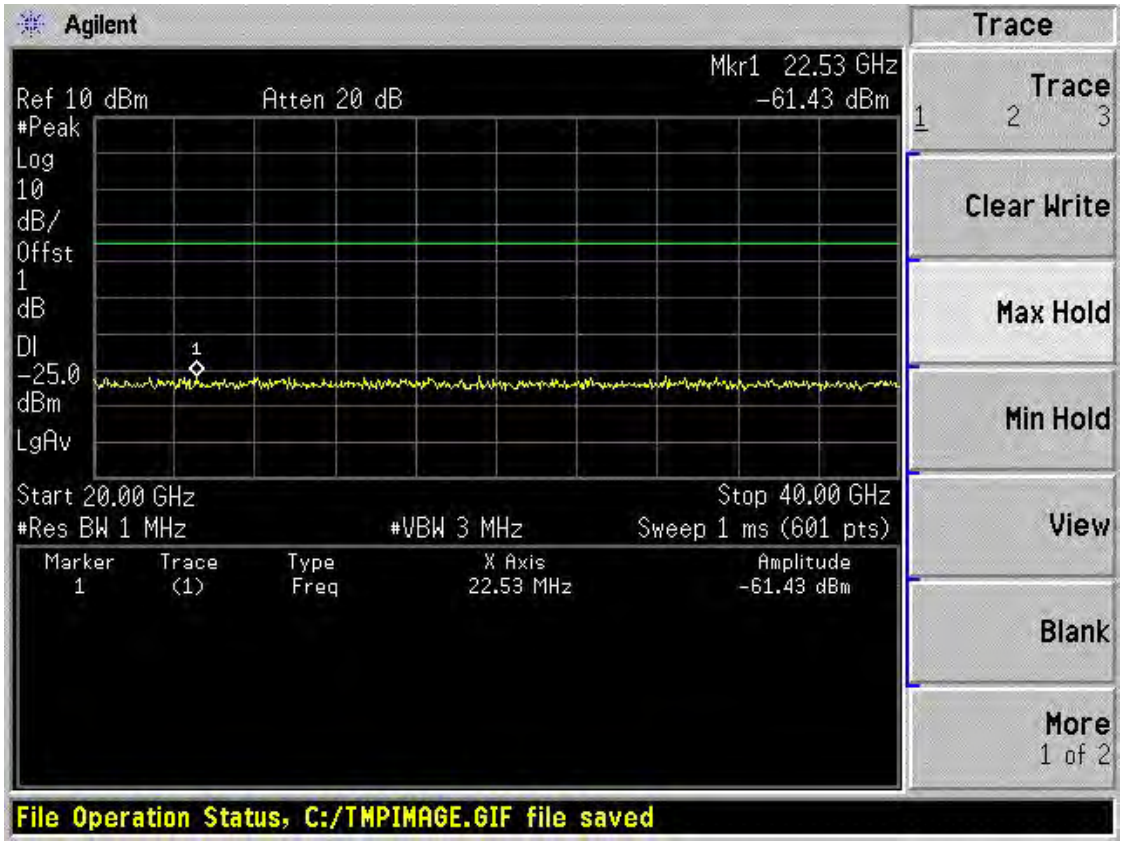
Chain 2 CSE (3dBi Antenna)-High Channel (30 ~ 1000 MHz)



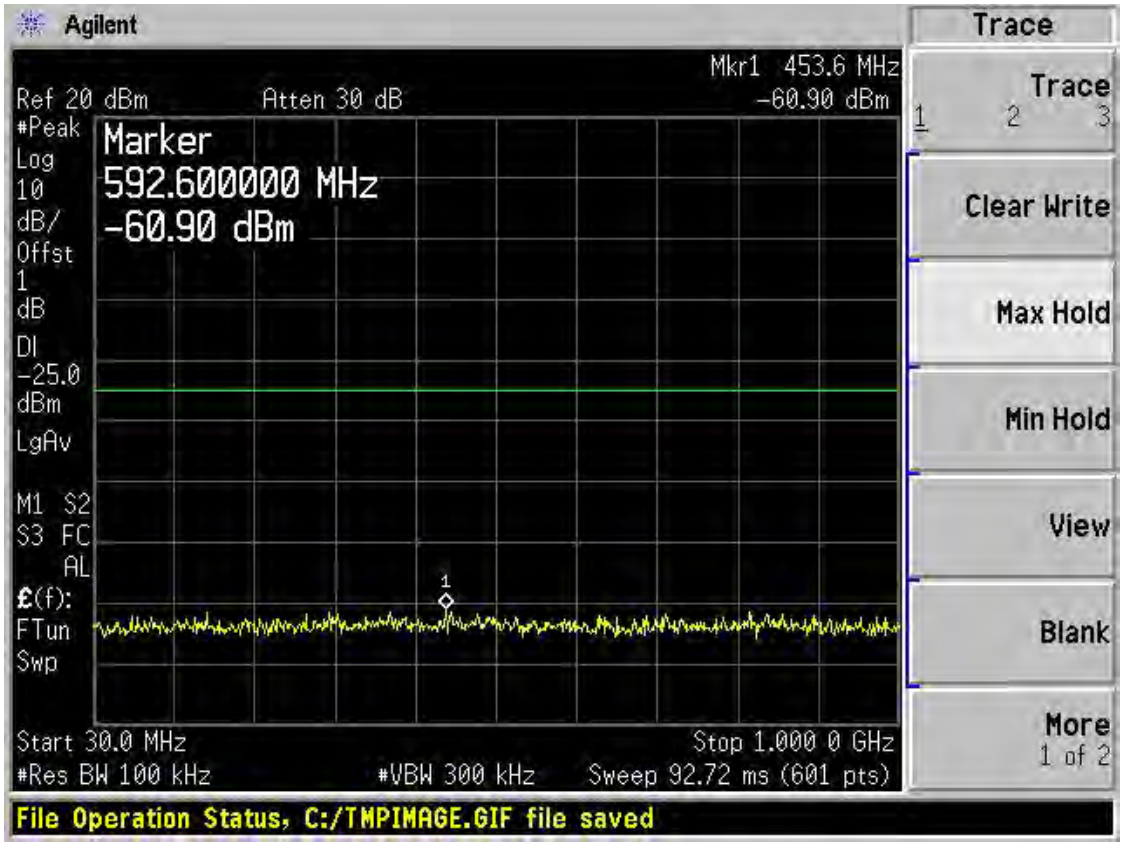
Chain 2 CSE (3dBi Antenna)-High Channel (1 ~ 20 GHz)



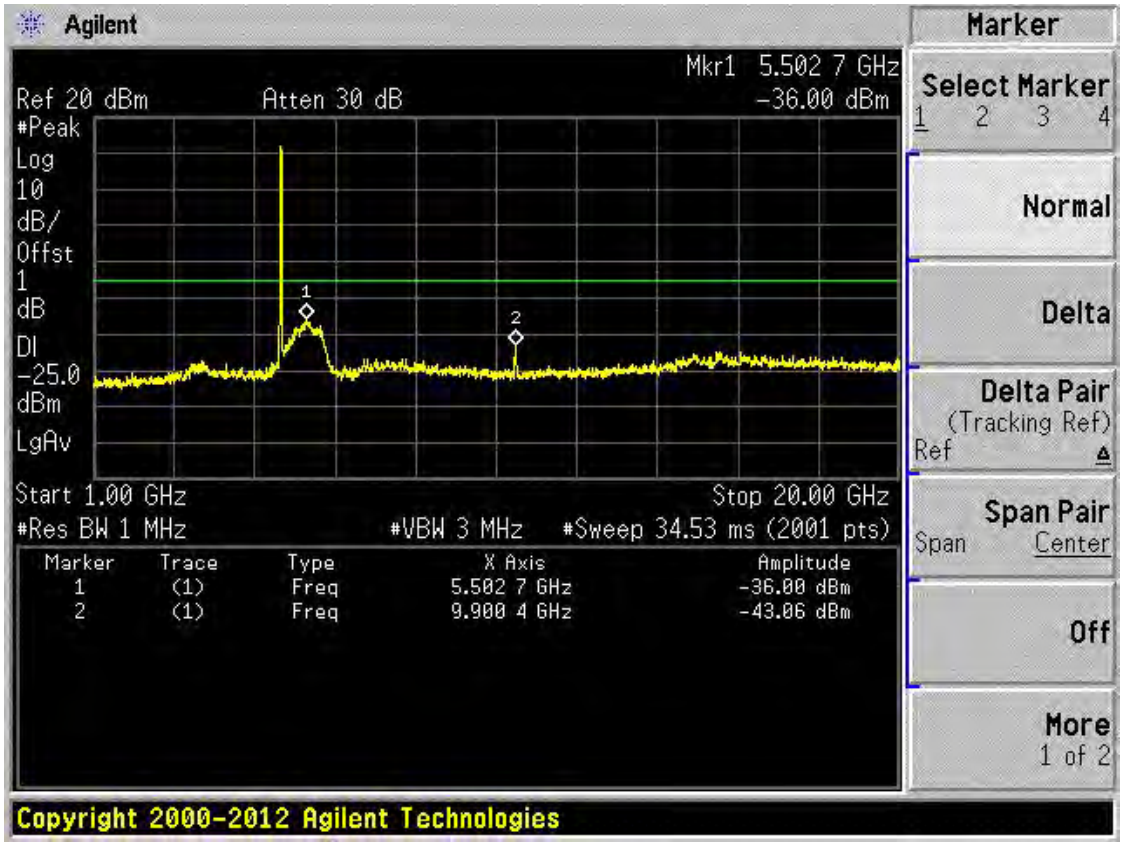
Chain 2 CSE (3dBi Antenna)-High Channel (20 ~ 40 GHz)



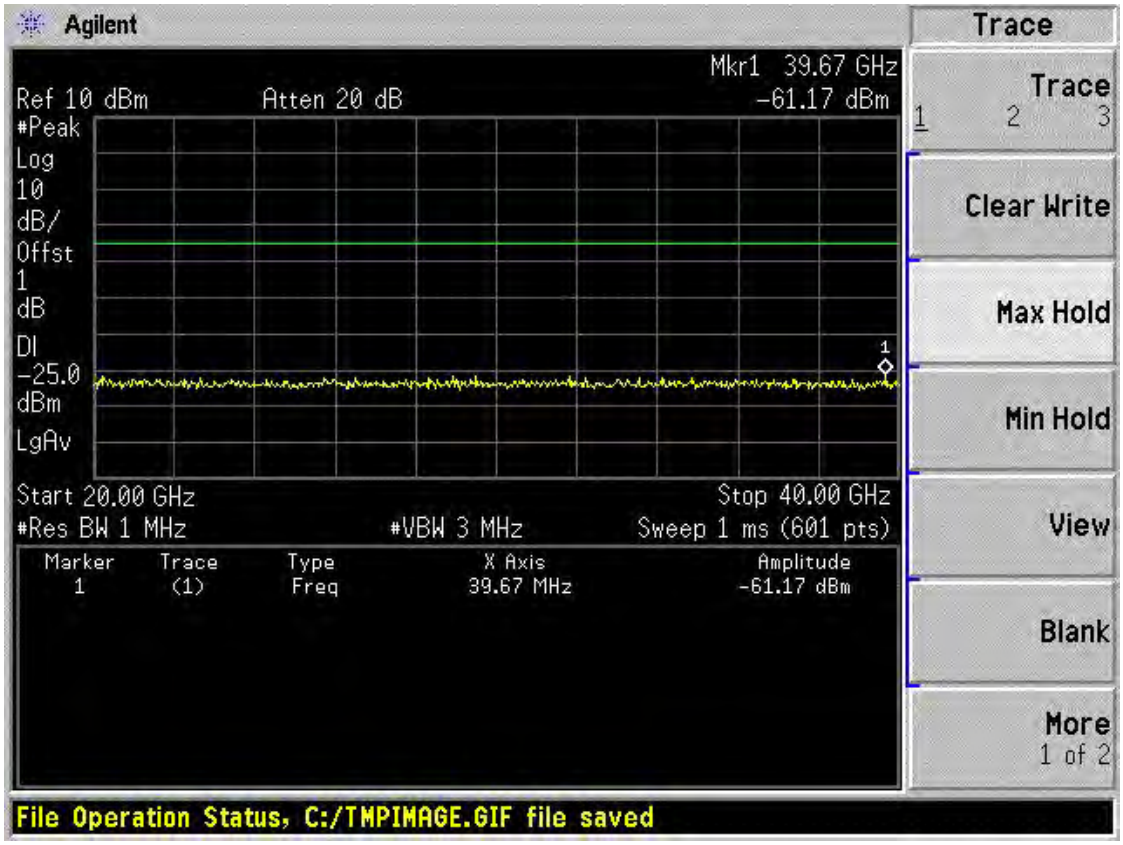
Chain 1 CSE (18dBi Antenna)-Low Channel (30 ~ 1000 MHz)



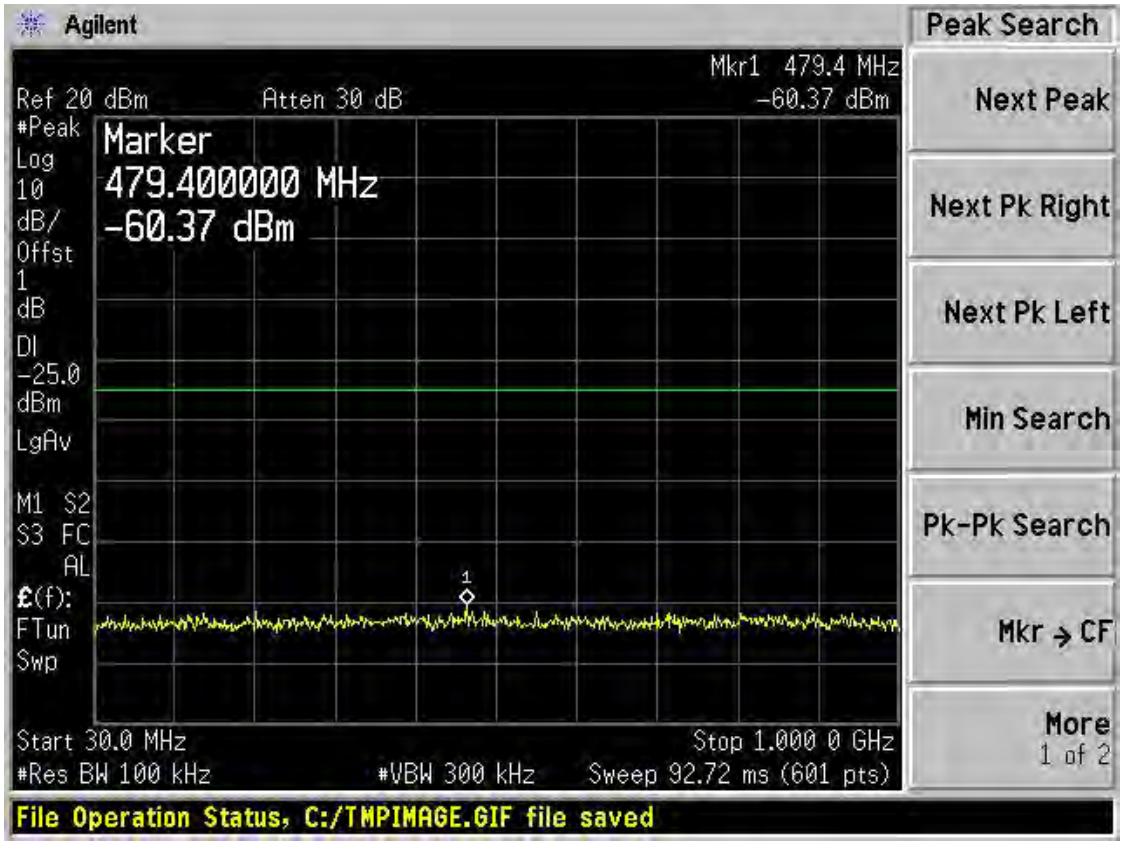
Chain 1 CSE (18dBi Antenna)-Low Channel (1 ~ 20 GHz)



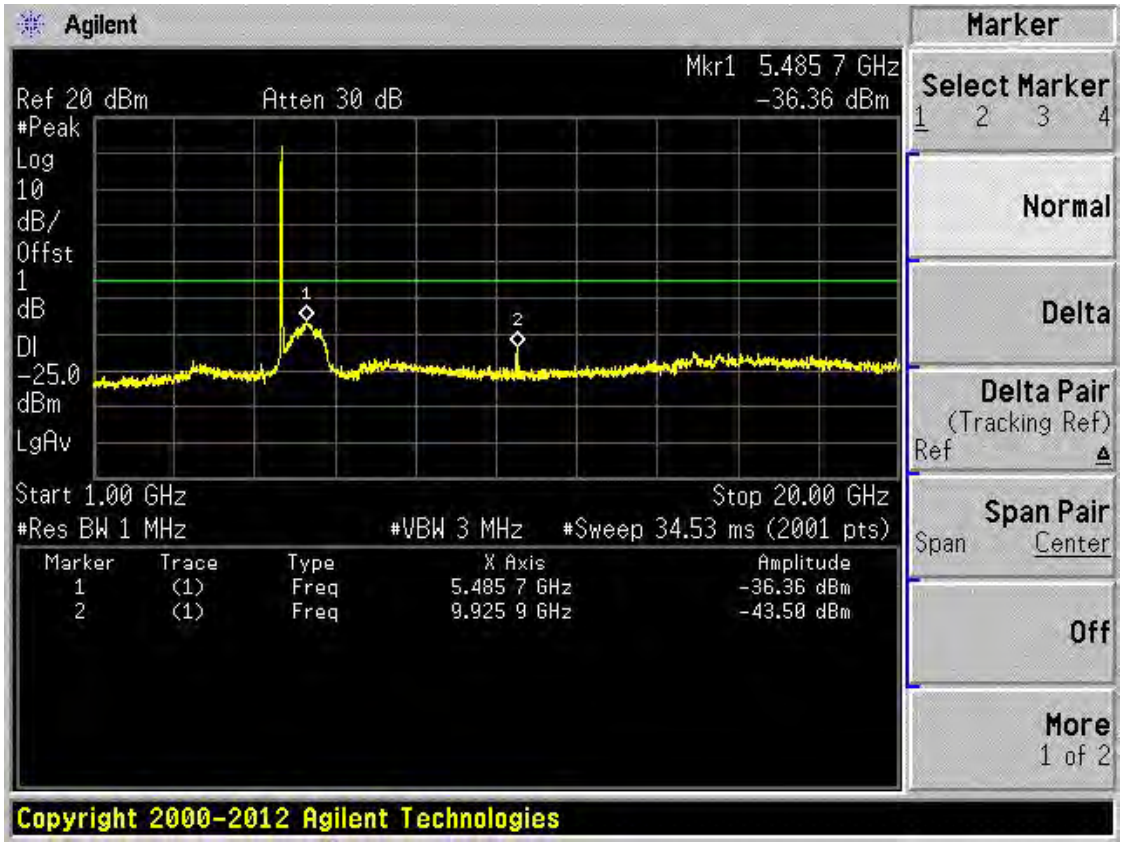
Chain 1 CSE (18dBi Antenna)-Low Channel (20 ~ 40 GHz)



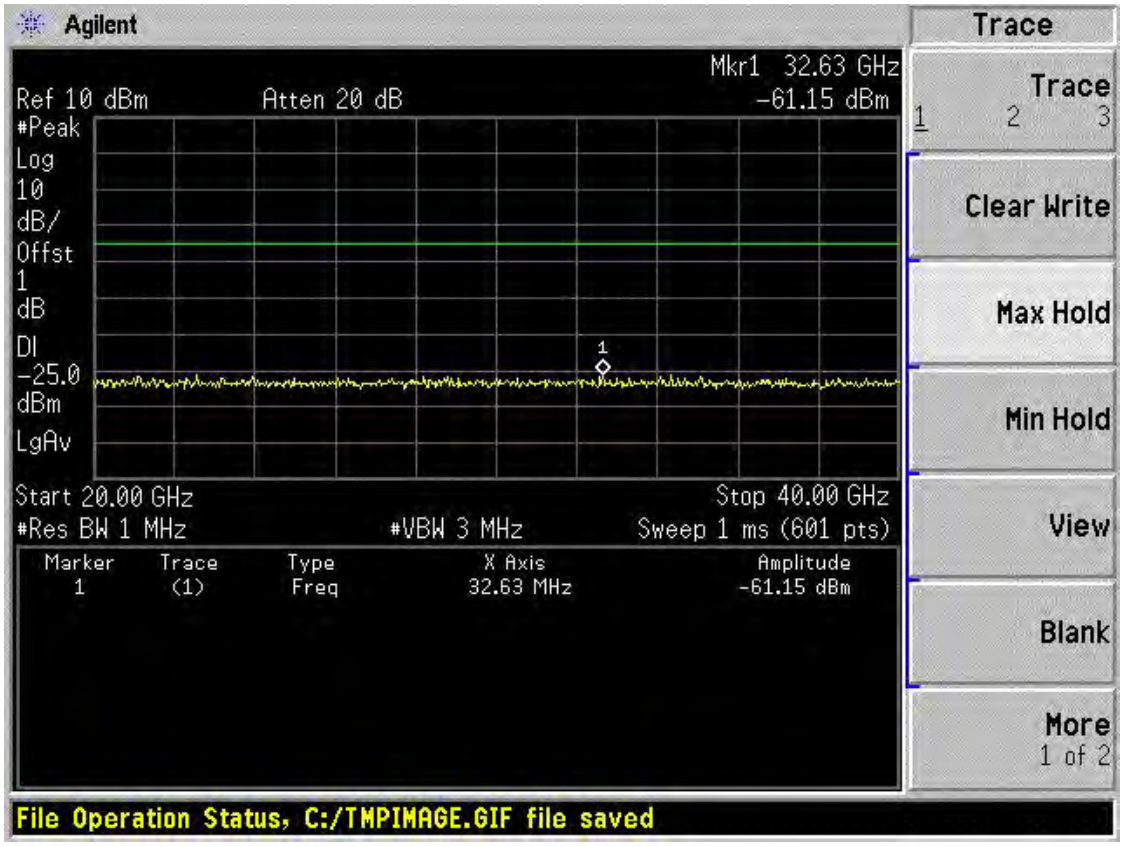
Chain 1 CSE (18dBi Antenna)-Mid Channel (30 ~ 1000 MHz)



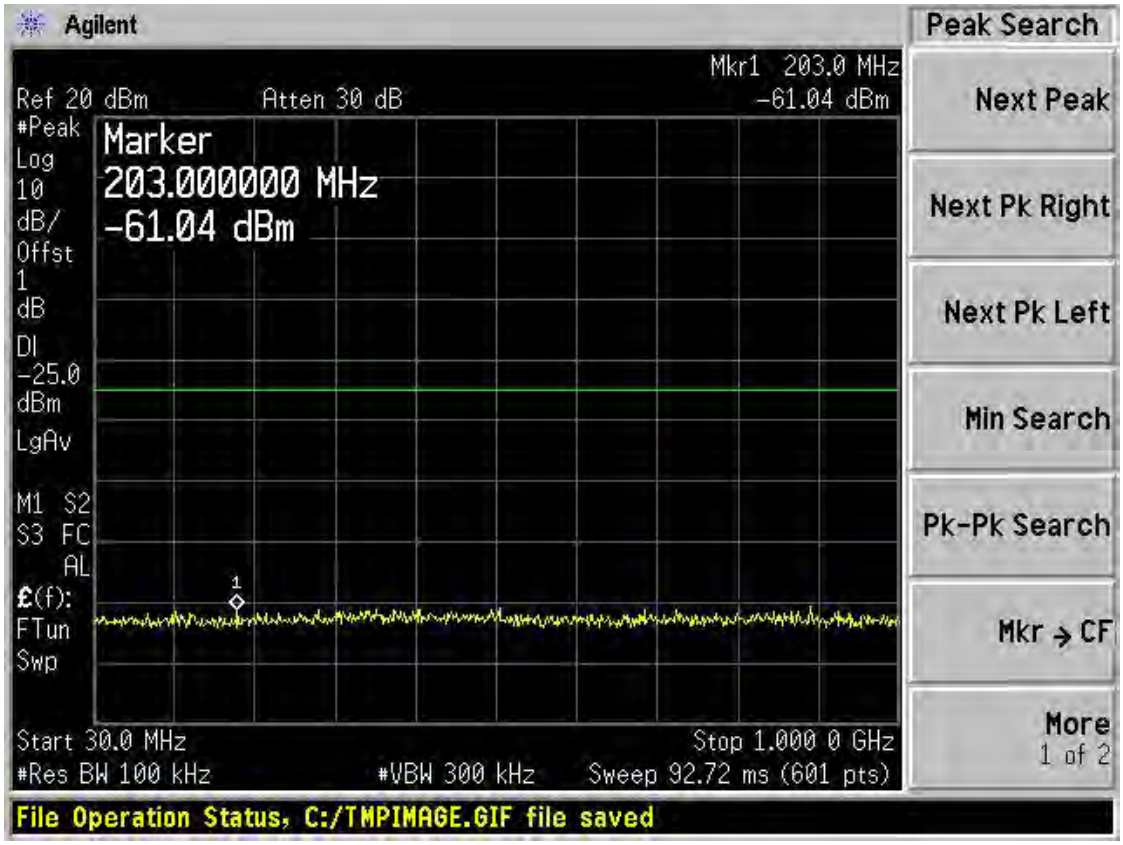
Chain 1 CSE (18dBi Antenna)-Mid Channel (1 ~ 20 GHz)



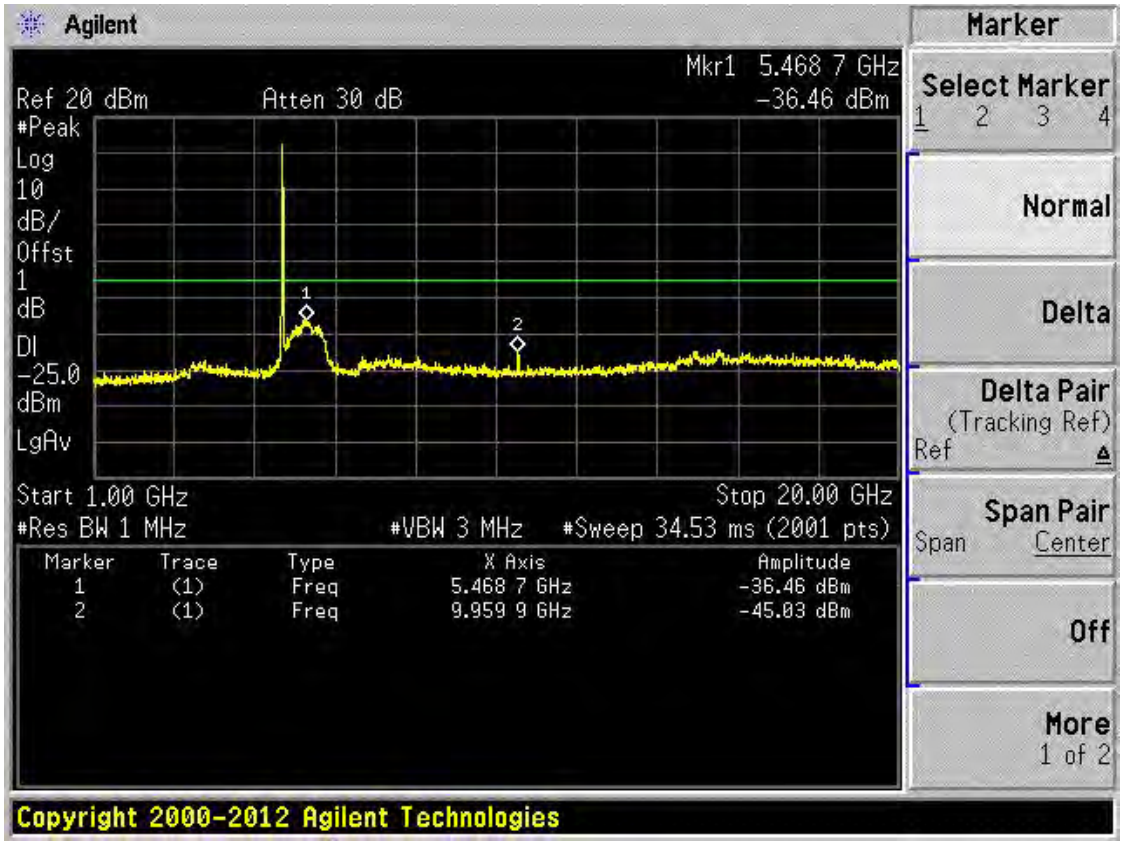
Chain 1 CSE (18dBi Antenna)-Mid Channel (20 ~ 40 GHz)



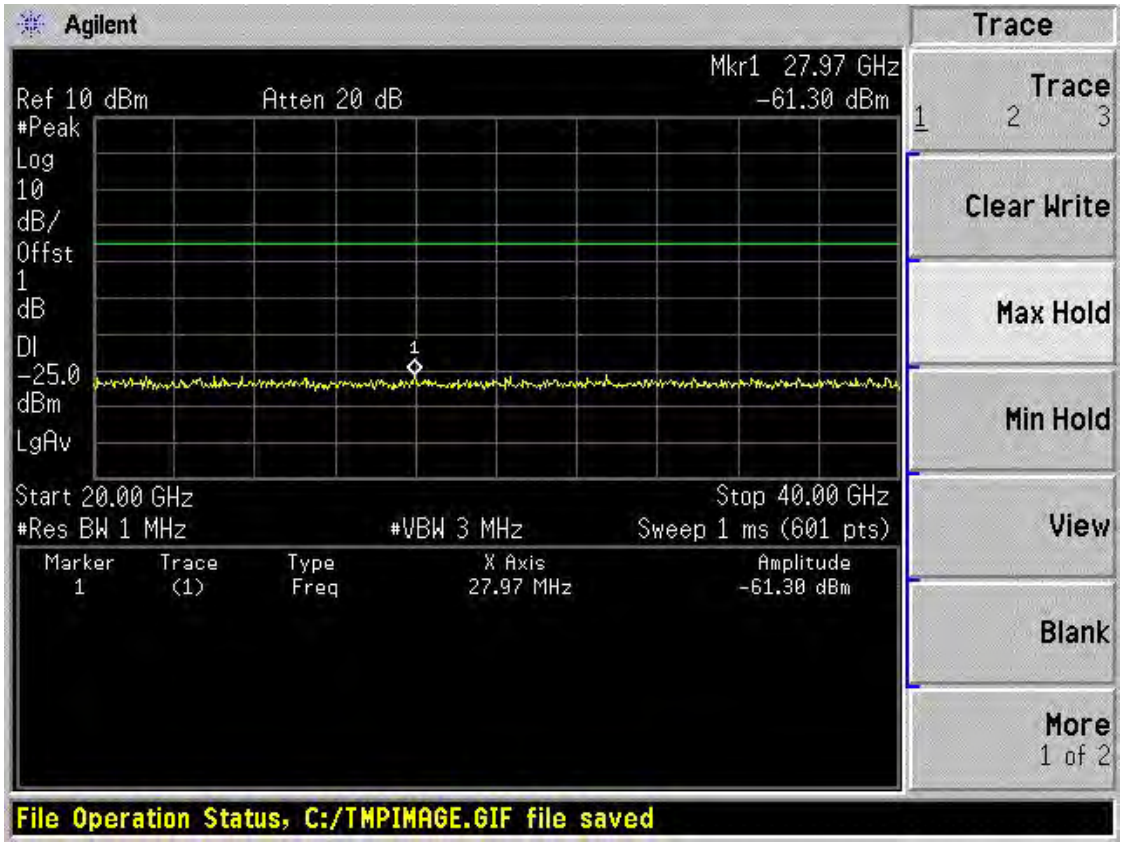
Chain 1 CSE (18dBi Antenna)-High Channel (30 ~ 1000 MHz)



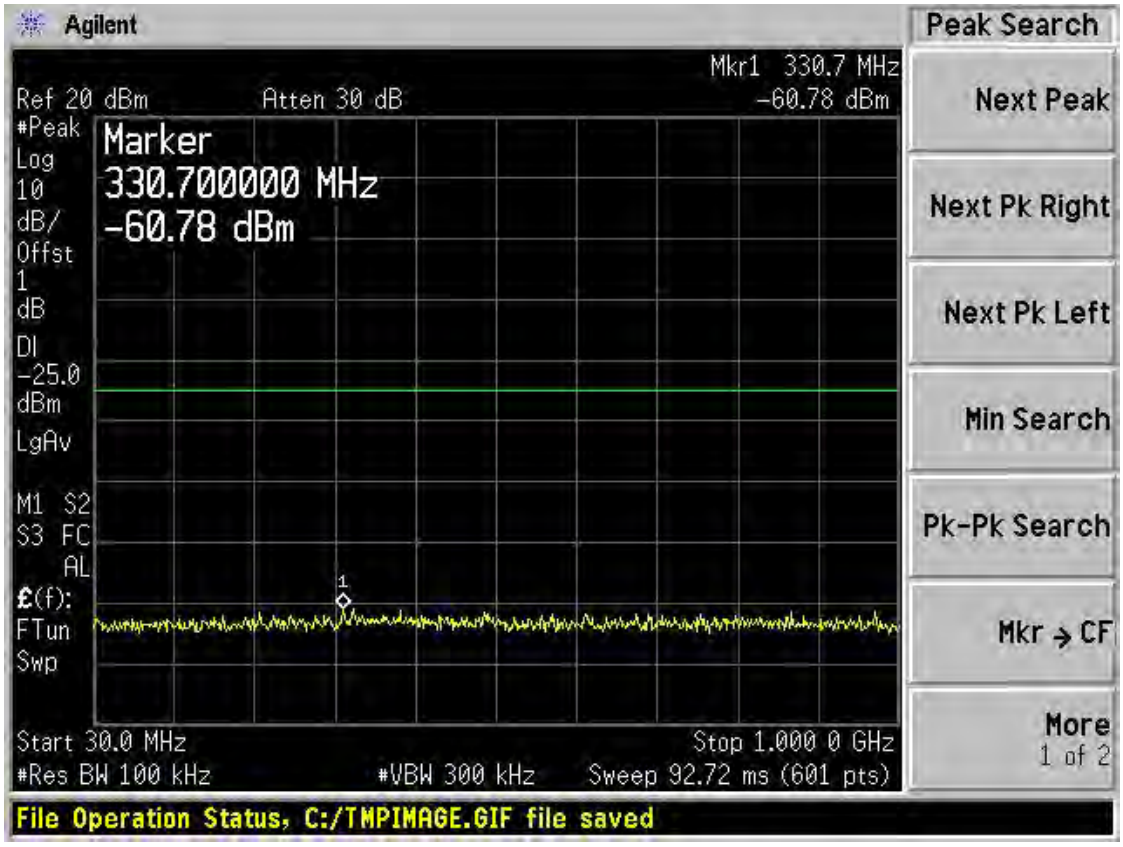
Chain 1 CSE (18dBi Antenna)-High Channel (1 ~ 20 GHz)



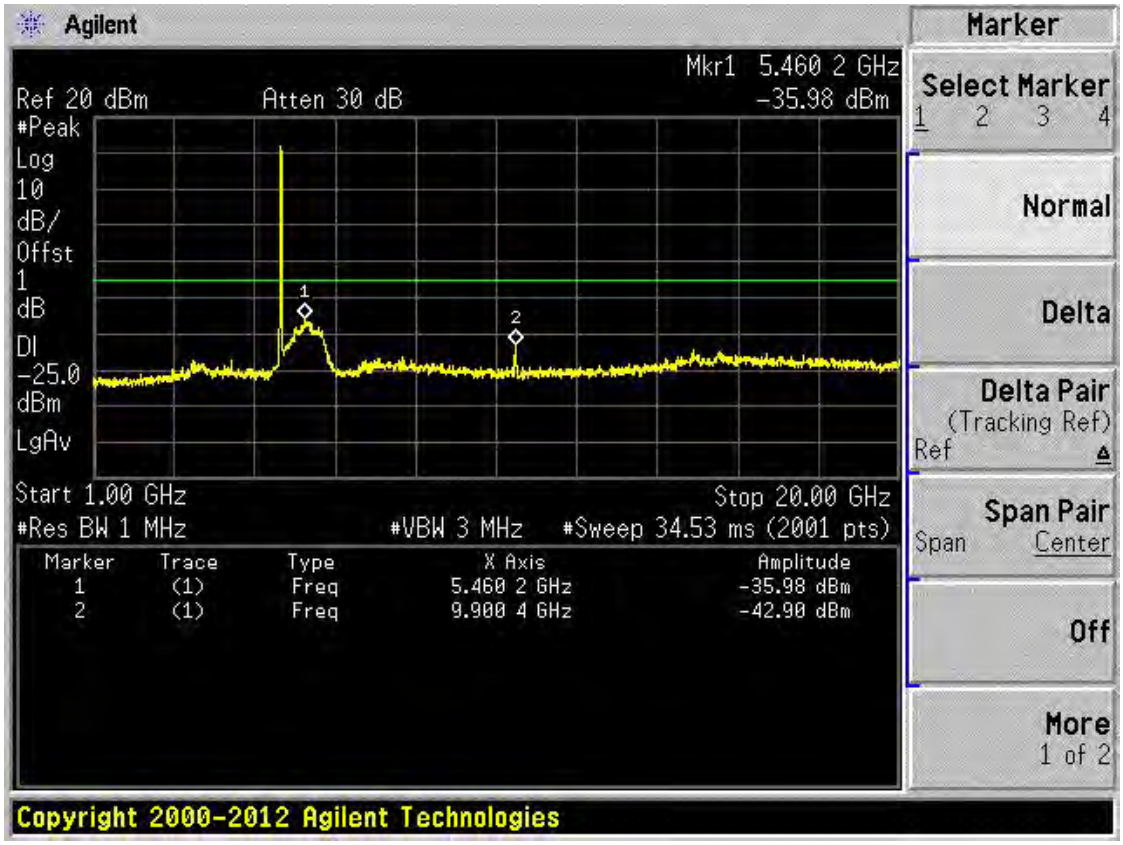
Chain 1 CSE (18dBi Antenna)-High Channel (20 ~ 40 GHz)



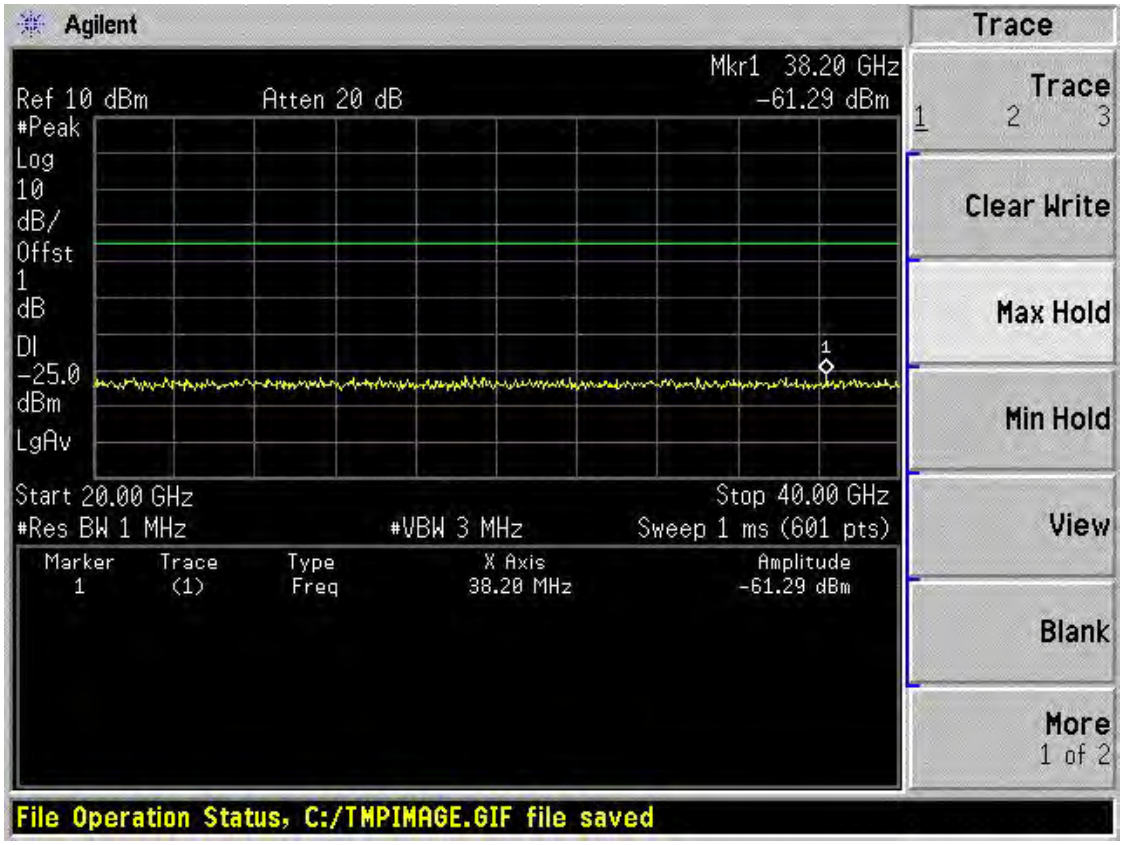
Chain 2 CSE (18dBi Antenna)-Low Channel (30 ~ 1000 MHz)



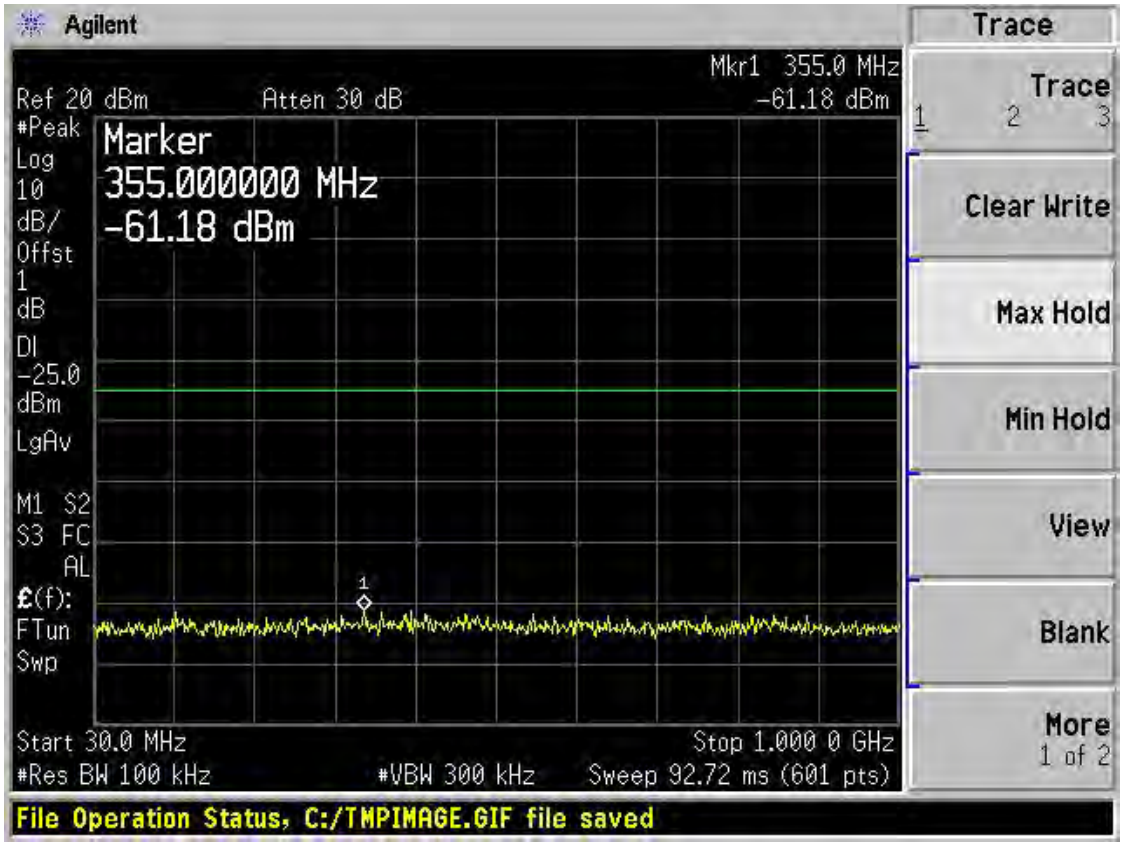
Chain 2 CSE (18dBi Antenna)-Low Channel (1 ~ 20 GHz)



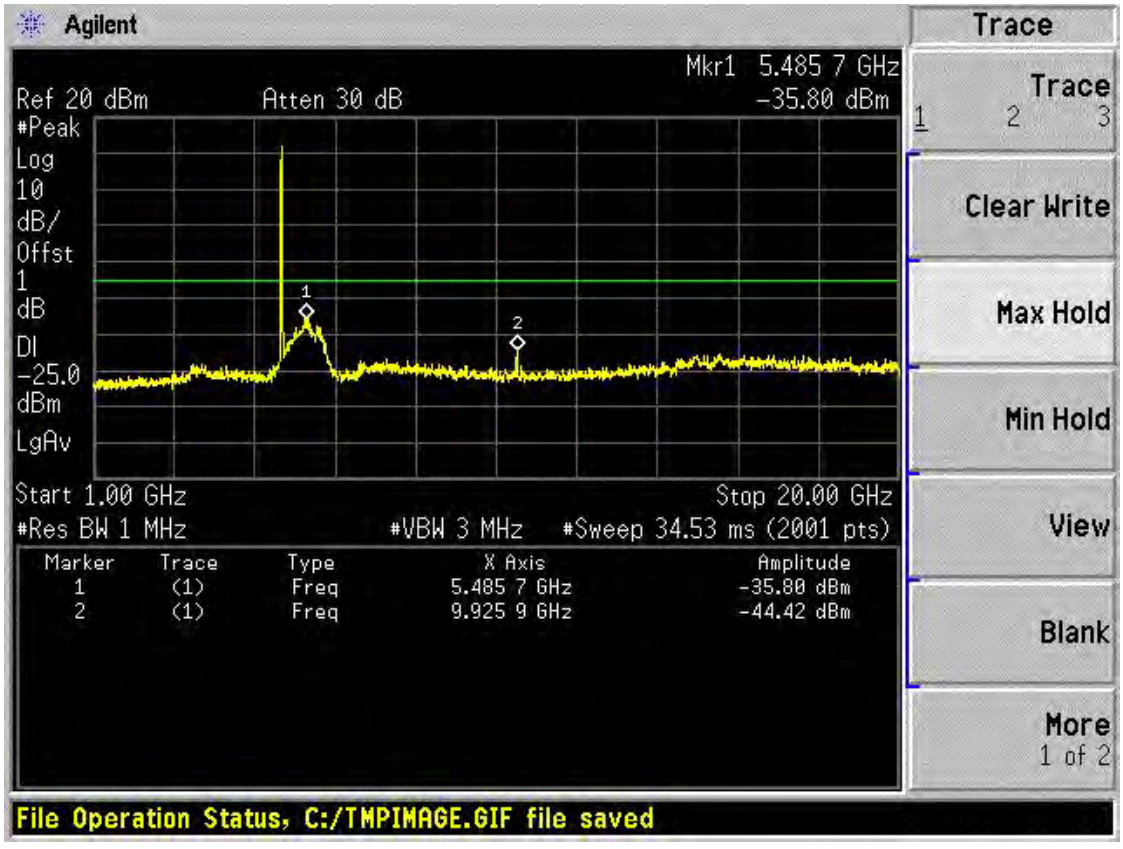
Chain 2 CSE (18dBi Antenna)-Low Channel (20 ~ 40 GHz)



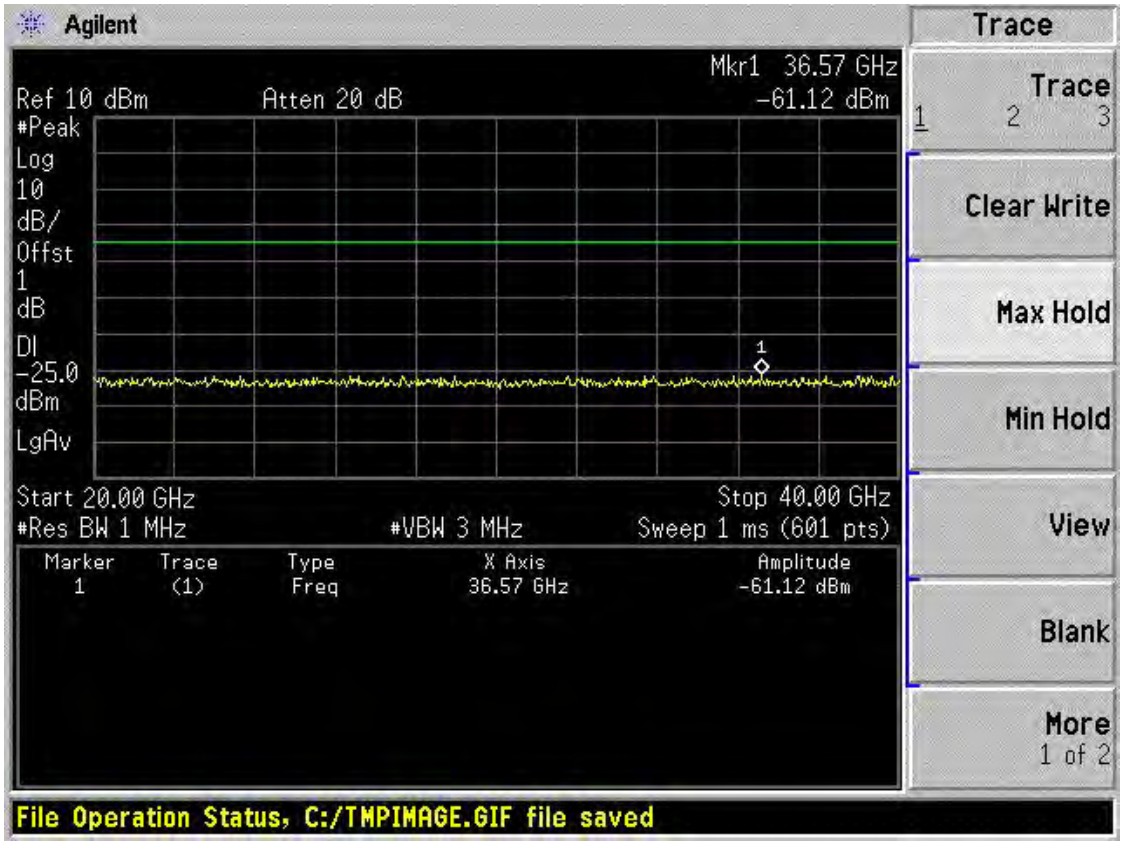
Chain 1 CSE (18dBi Antenna)-Mid Channel (30 ~ 1000 MHz)



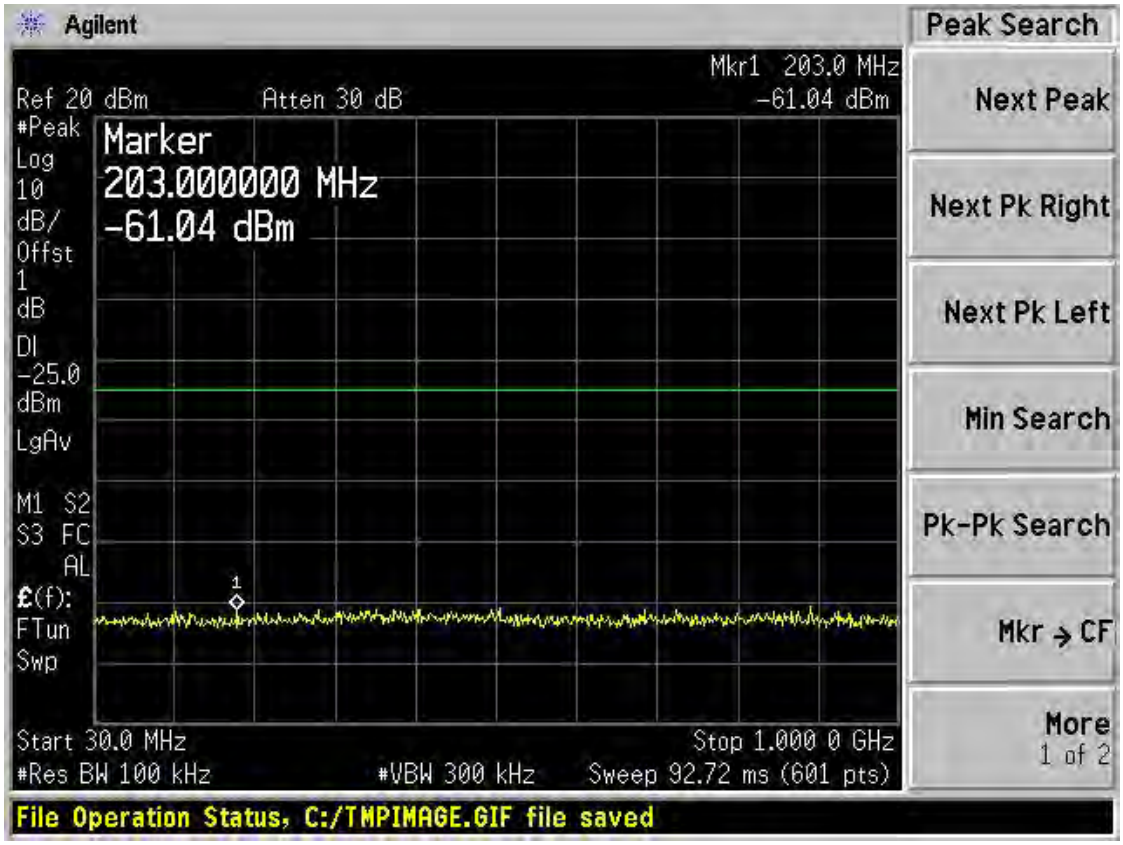
Chain 2 CSE (18dBi Antenna)-Mid Channel (1 ~ 20 GHz)



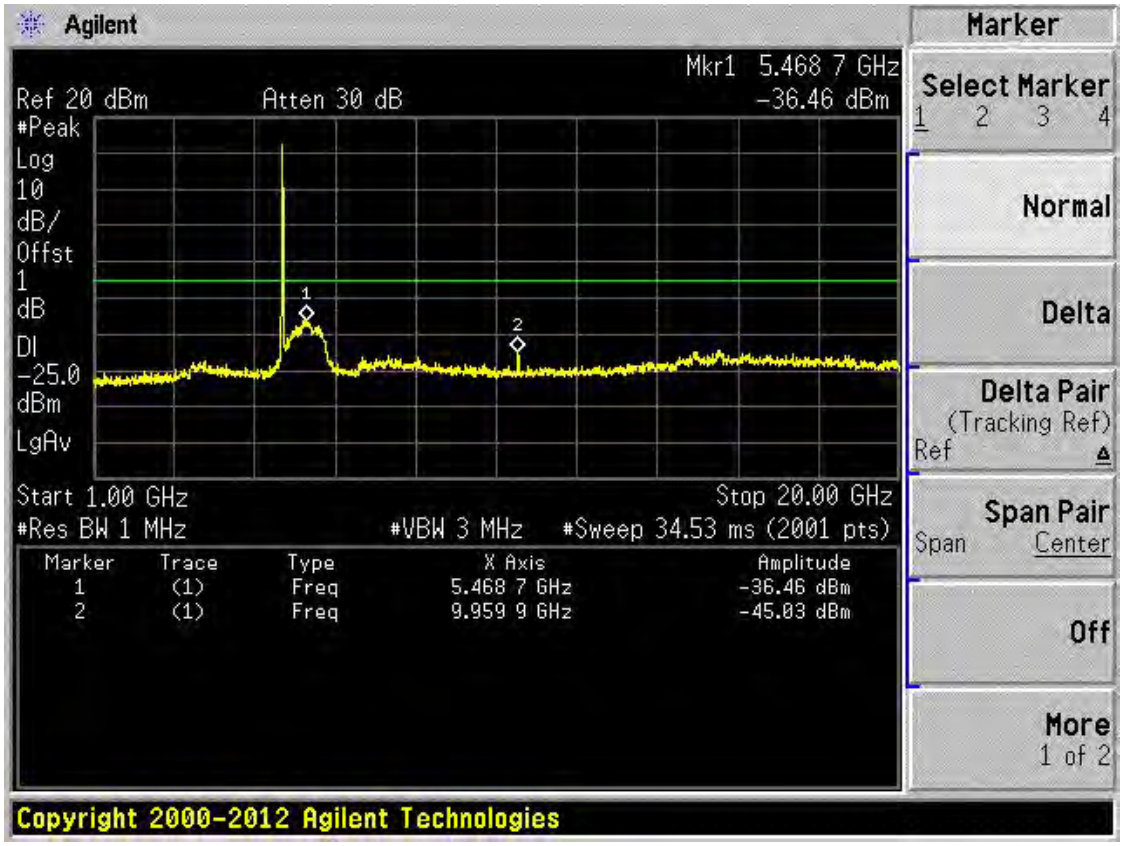
Chain 2 CSE (18dBi Antenna)-Mid Channel (20 ~ 40 GHz)



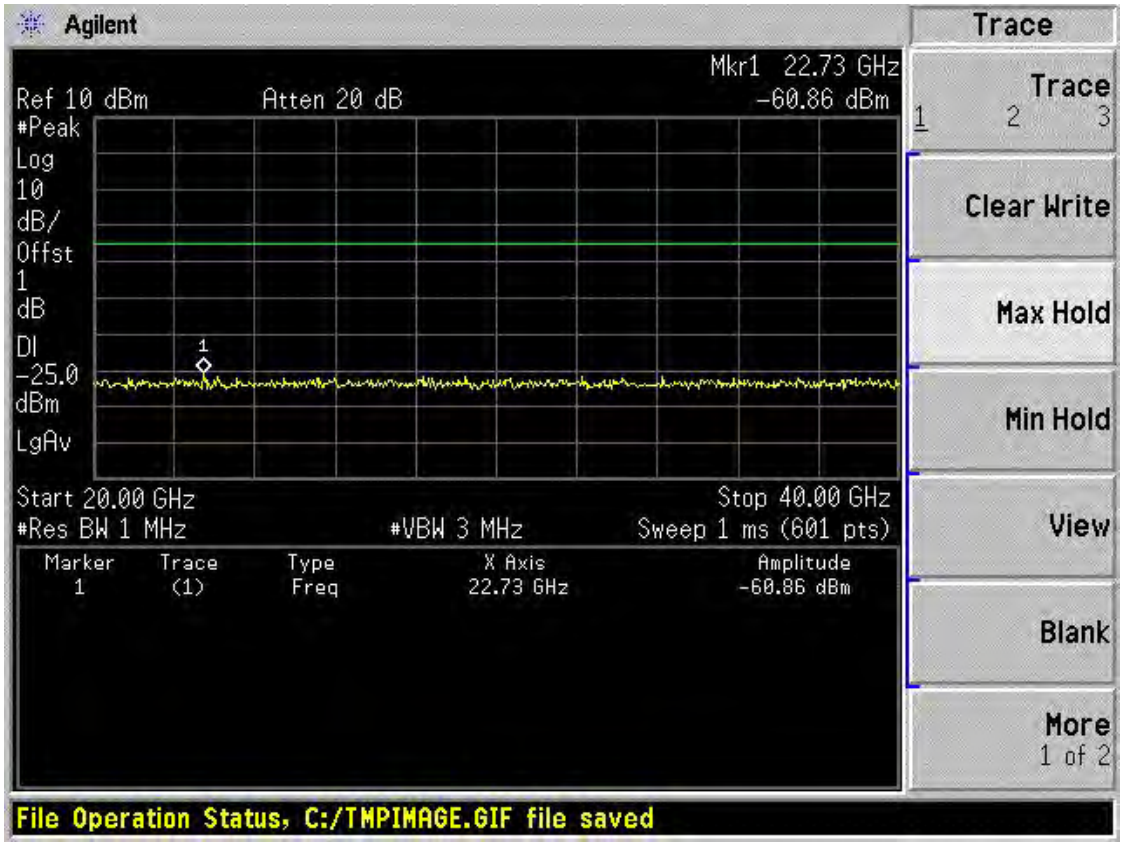
Chain 2 CSE (18dBi Antenna)-High Channel (30 ~ 1000 MHz)



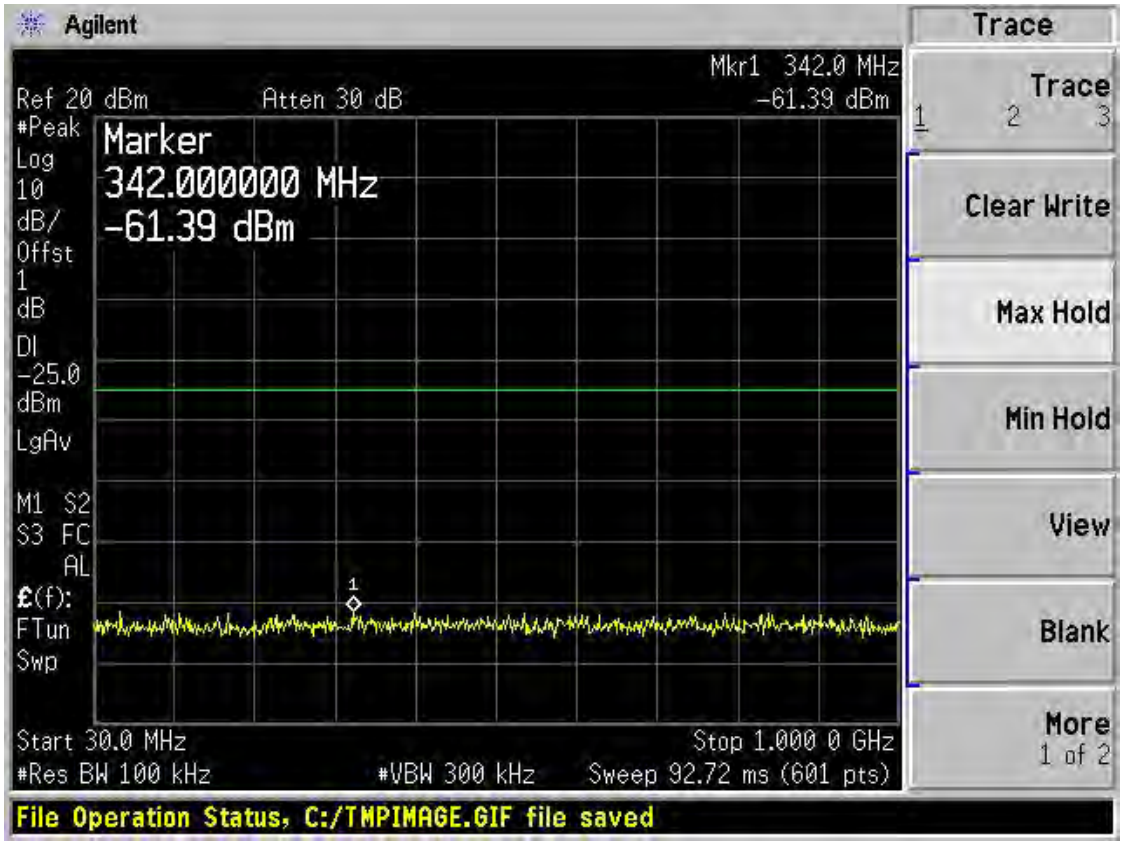
Chain 2 CSE (18dBi Antenna)-High Channel (1 ~ 20 GHz)



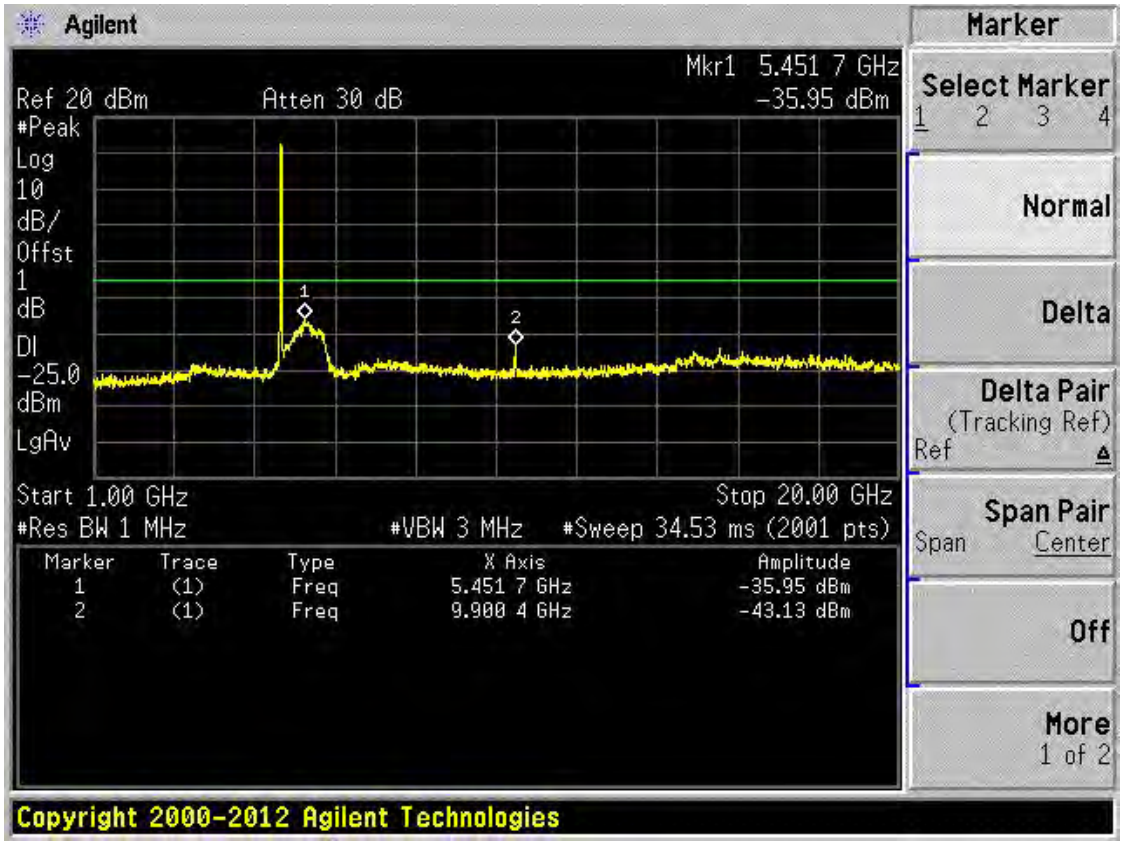
Chain 2 CSE (18dBi Antenna)-High Channel (20 ~ 40 GHz)



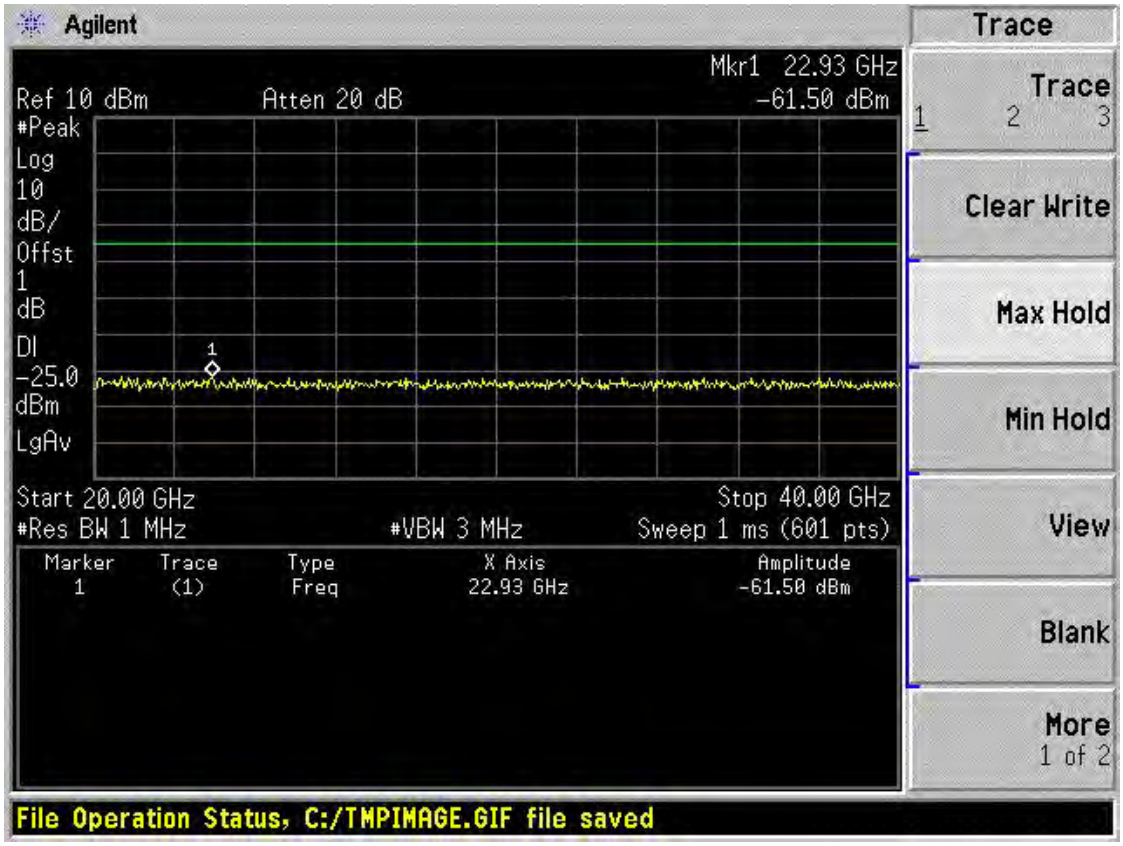
Chain 1 CSE (23dBi Antenna)-Low Channel (30 ~ 1000 MHz)



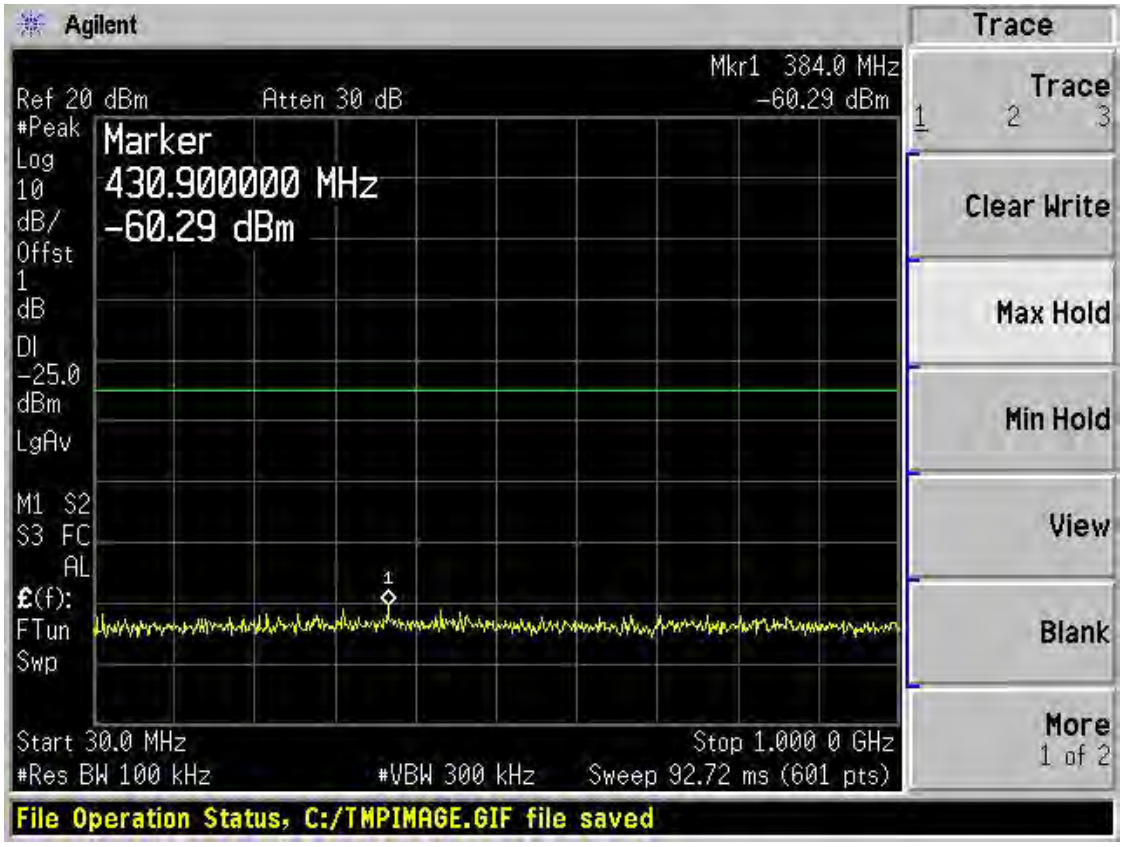
Chain 1 CSE (23dBi Antenna)-Low Channel (1 ~ 20 GHz)



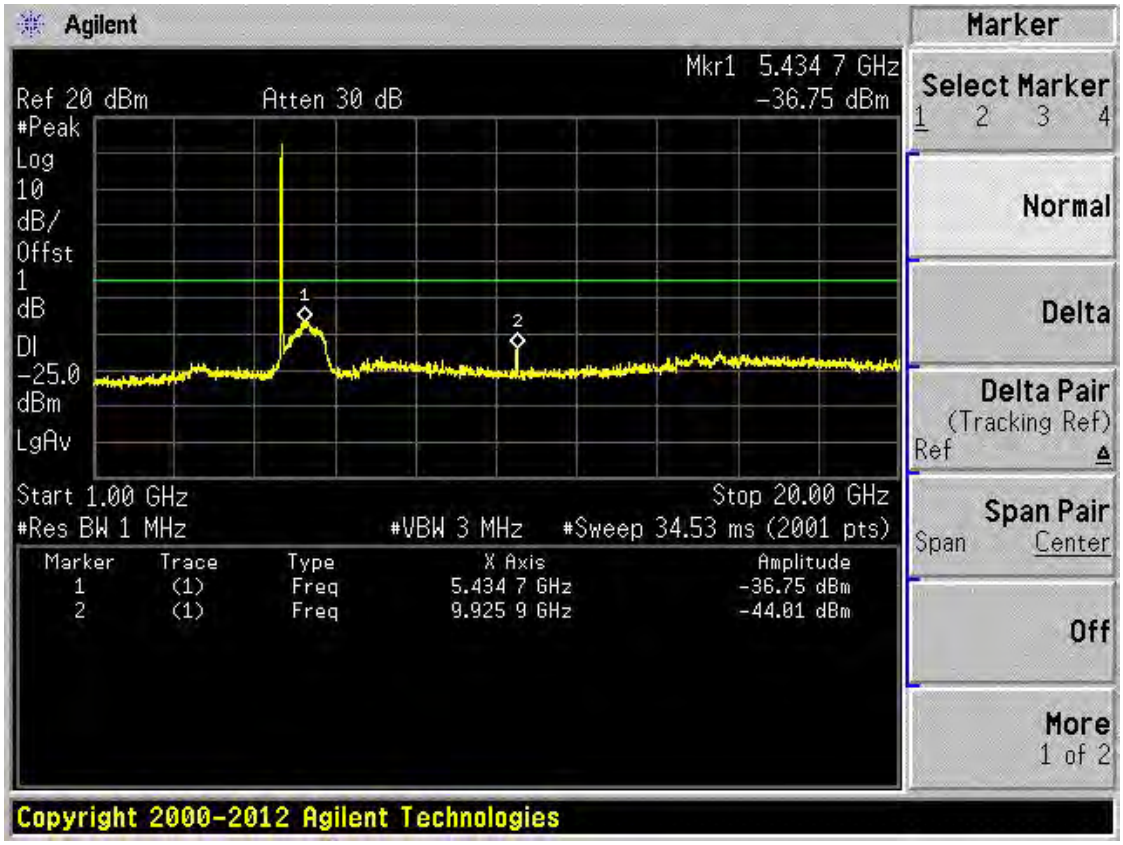
Chain 1 CSE (23dBi Antenna)-Low Channel (20 ~ 40 GHz)



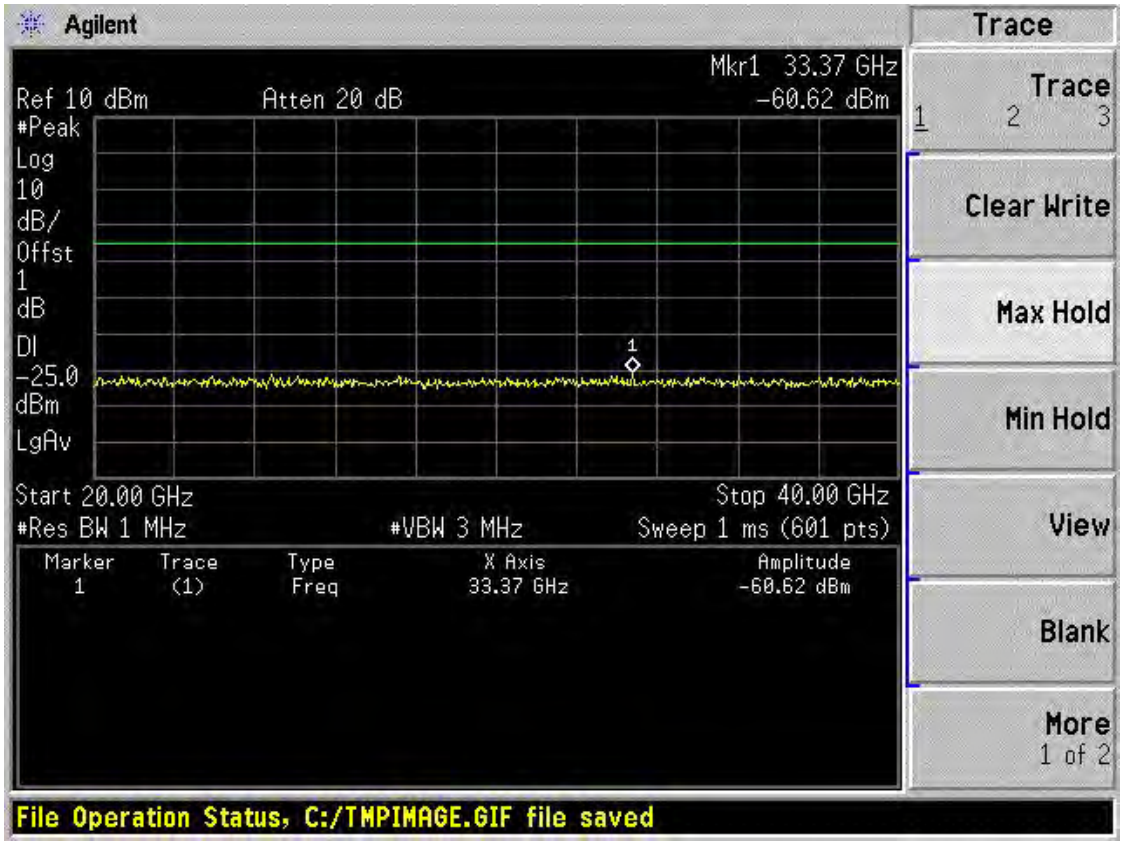
Chain 1 CSE (23dBi Antenna)-Mid Channel (30 ~ 1000 MHz)



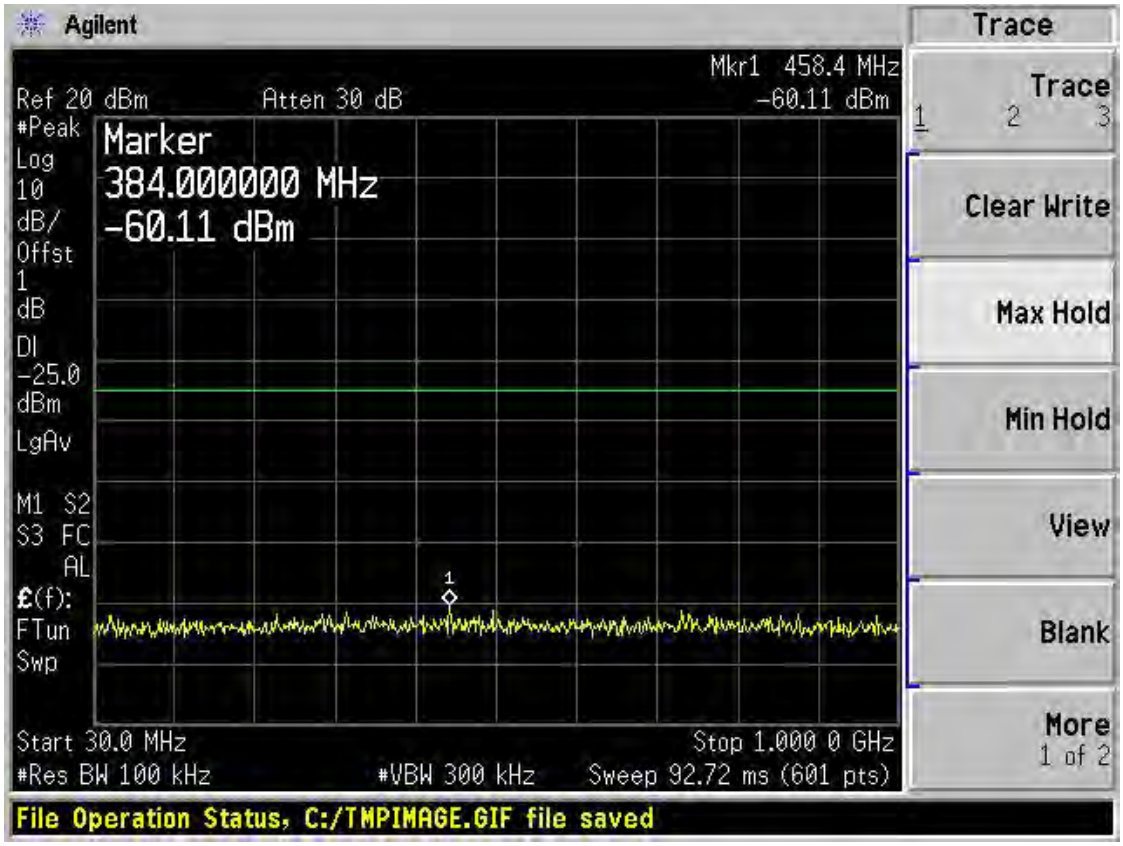
Chain 1 CSE (23dBi Antenna)-Mid Channel (1 ~ 20 GHz)



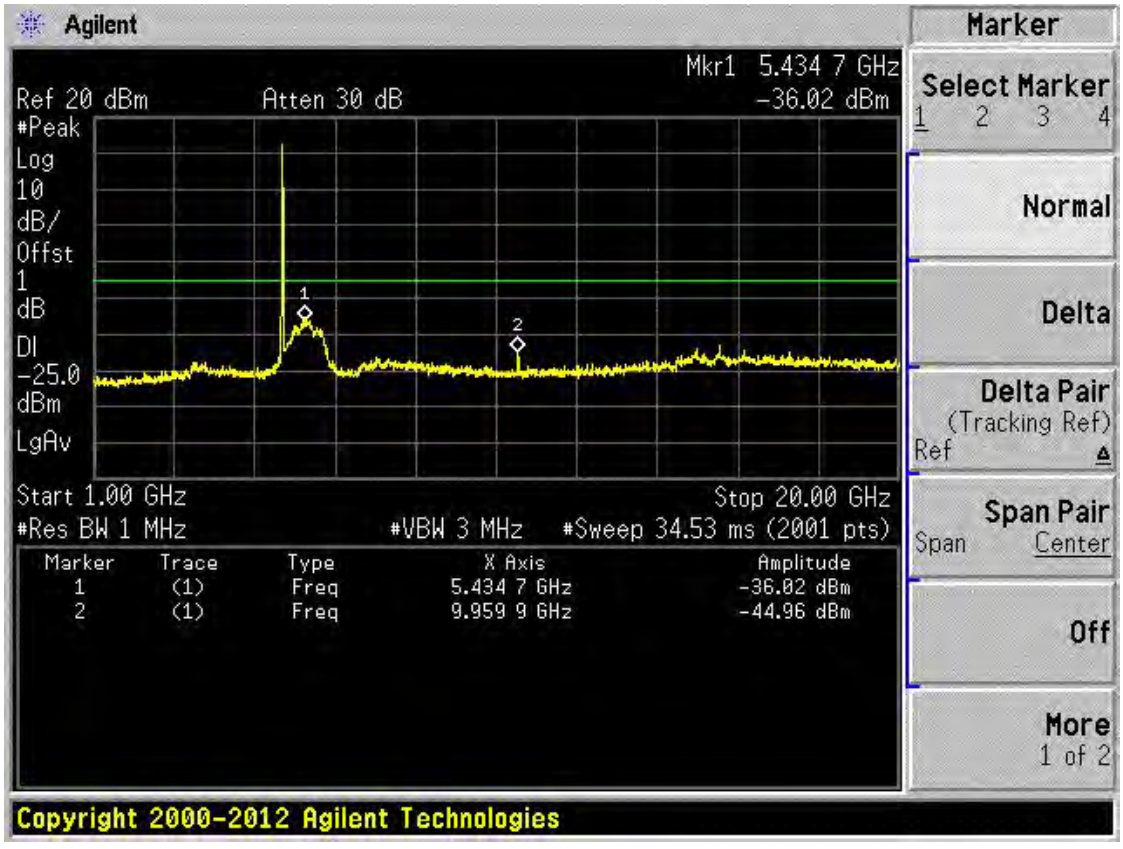
Chain 1 CSE (23dBi Antenna)-Mid Channel (20 ~ 40 GHz)



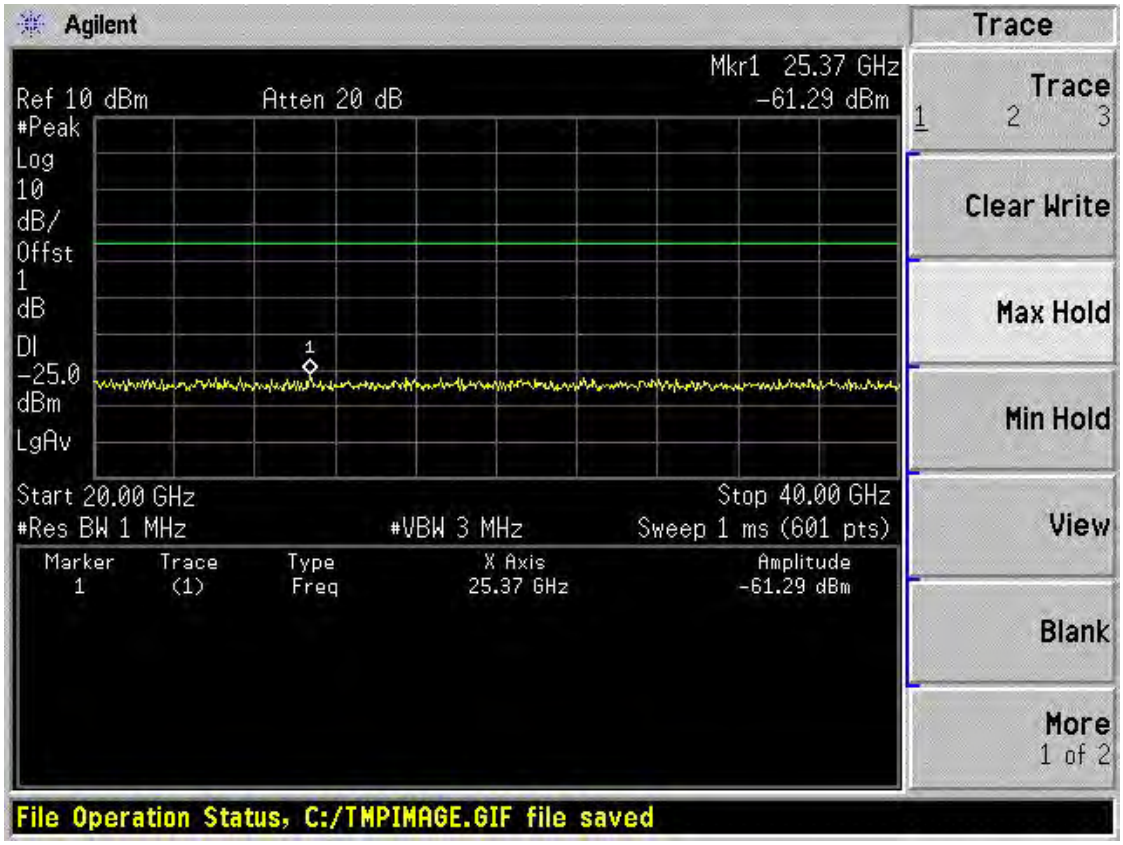
Chain 1 CSE (23dBi Antenna)-High Channel (30 ~ 1000 MHz)



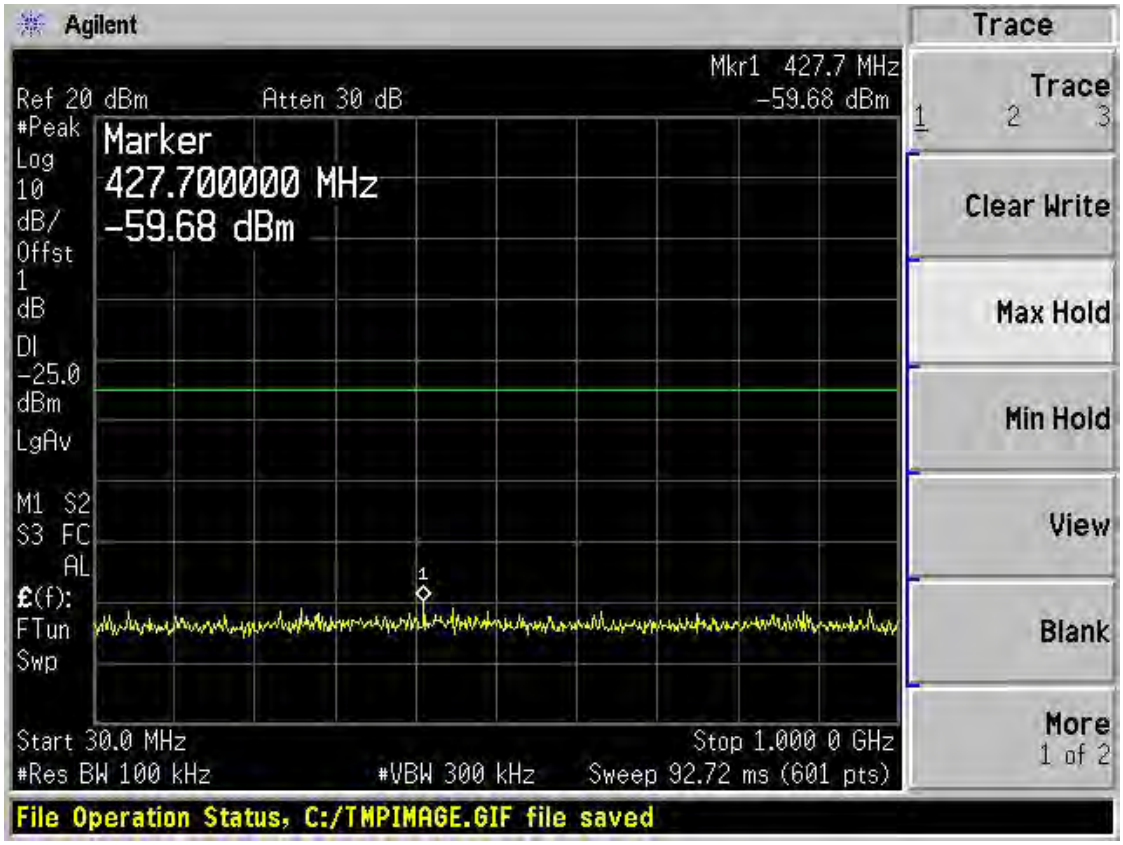
Chain 1 CSE (23dBi Antenna)-High Channel (1 ~ 20 GHz)



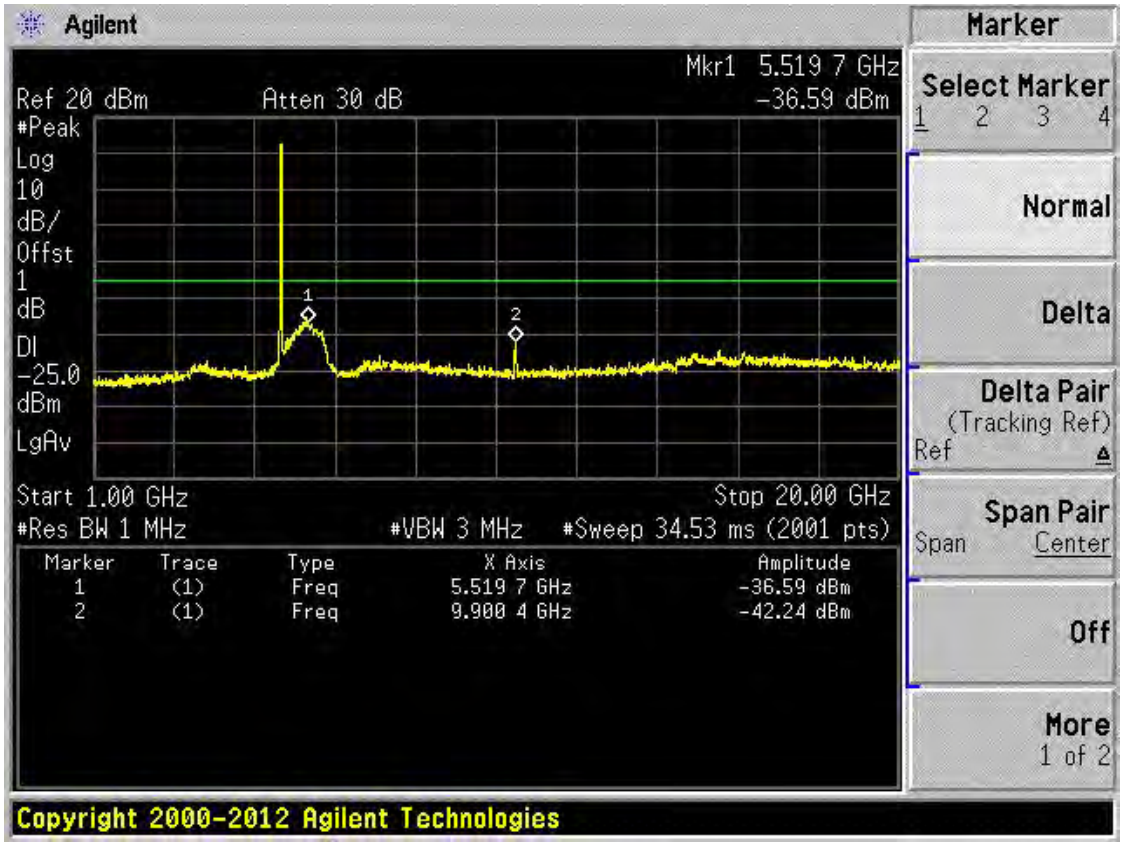
Chain 1 CSE (23dBi Antenna)-High Channel (20 ~ 40 GHz)



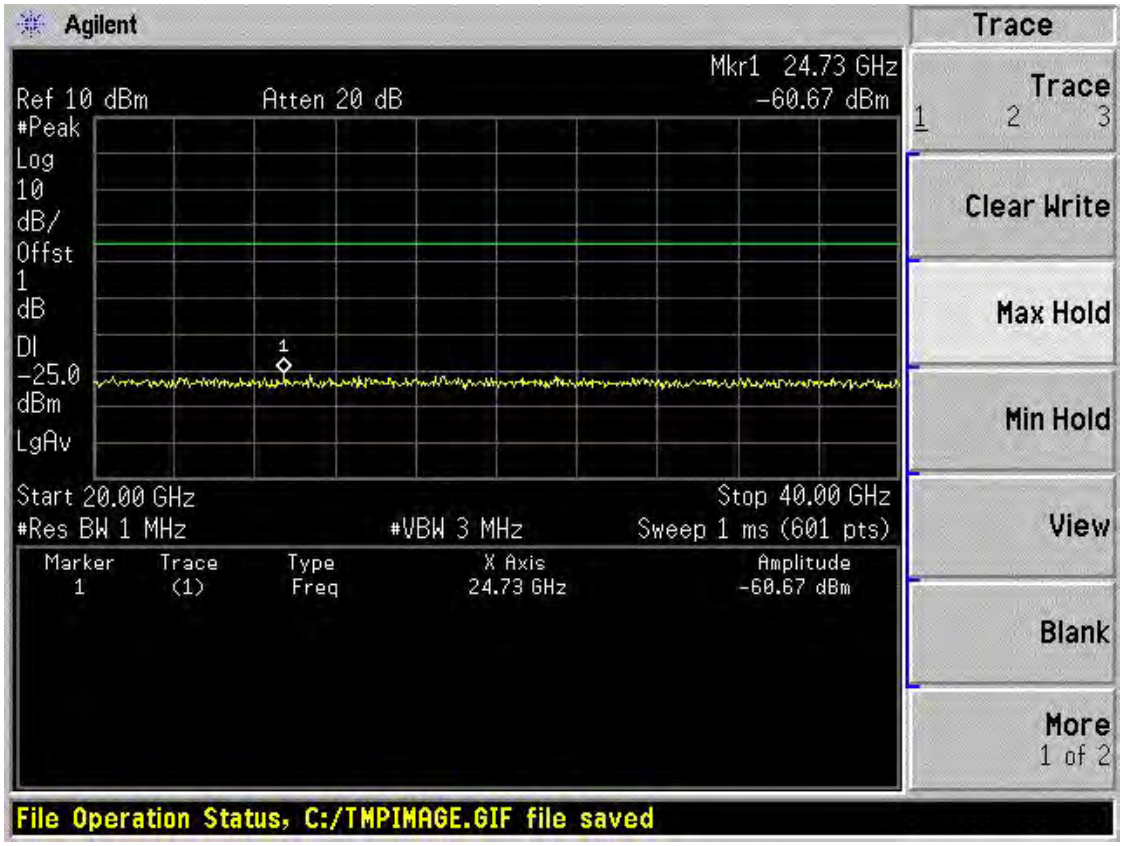
Chain 2 CSE (23dBi Antenna)-Low Channel (30 ~ 1000 MHz)



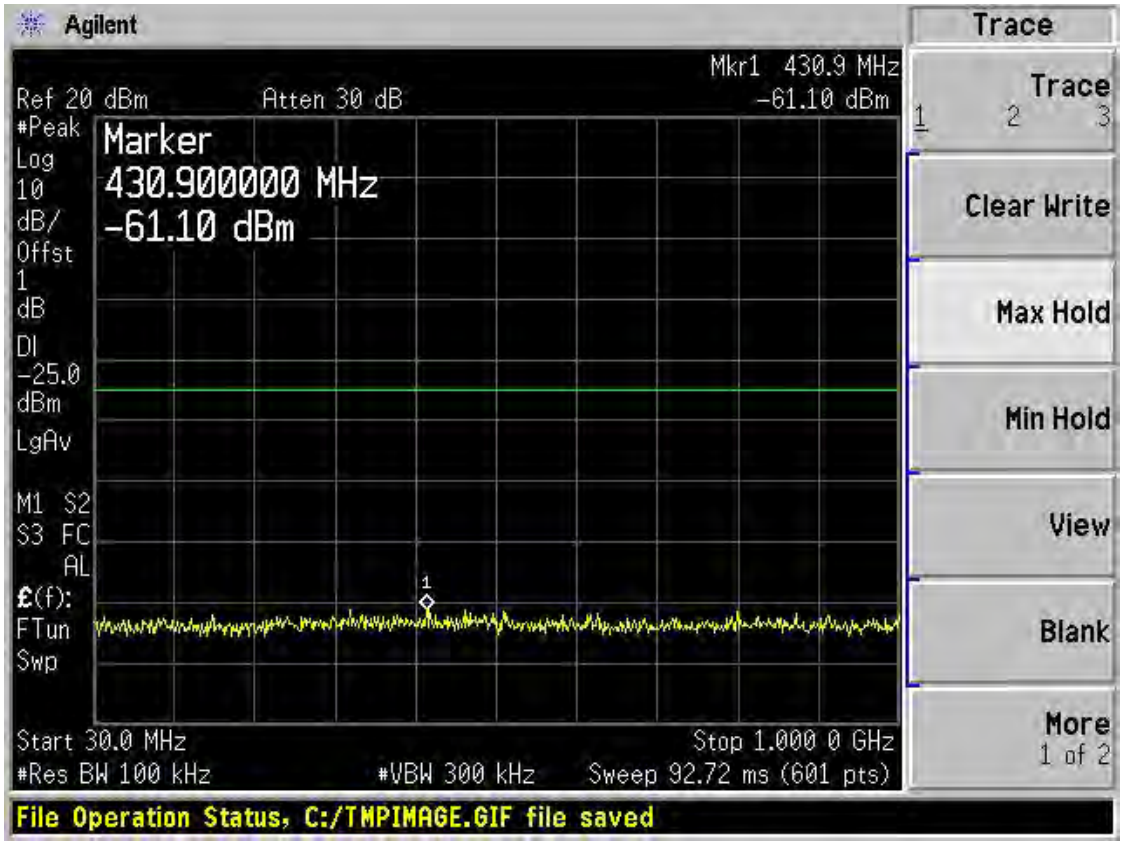
Chain 2 CSE (23dBi Antenna)-Low Channel (1 ~ 20 GHz)



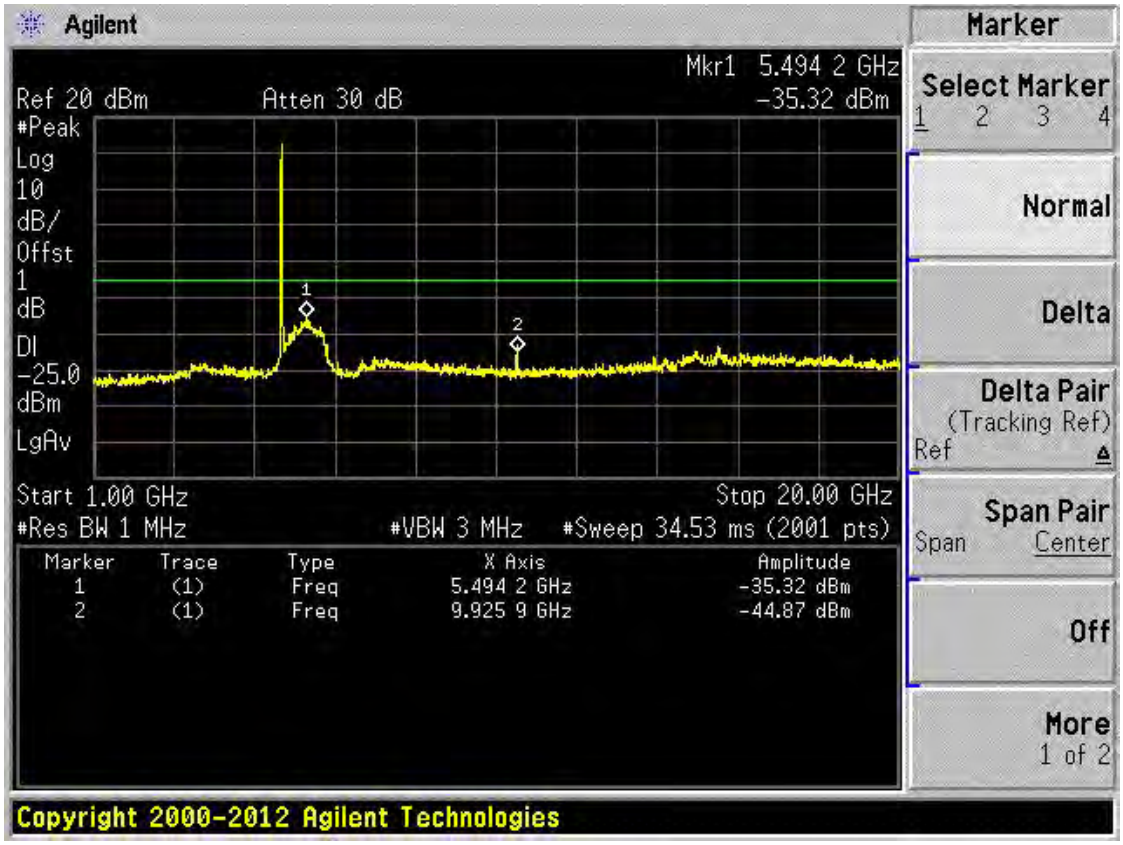
Chain 2 CSE (23dBi Antenna)-Low Channel (20 ~ 40 GHz)



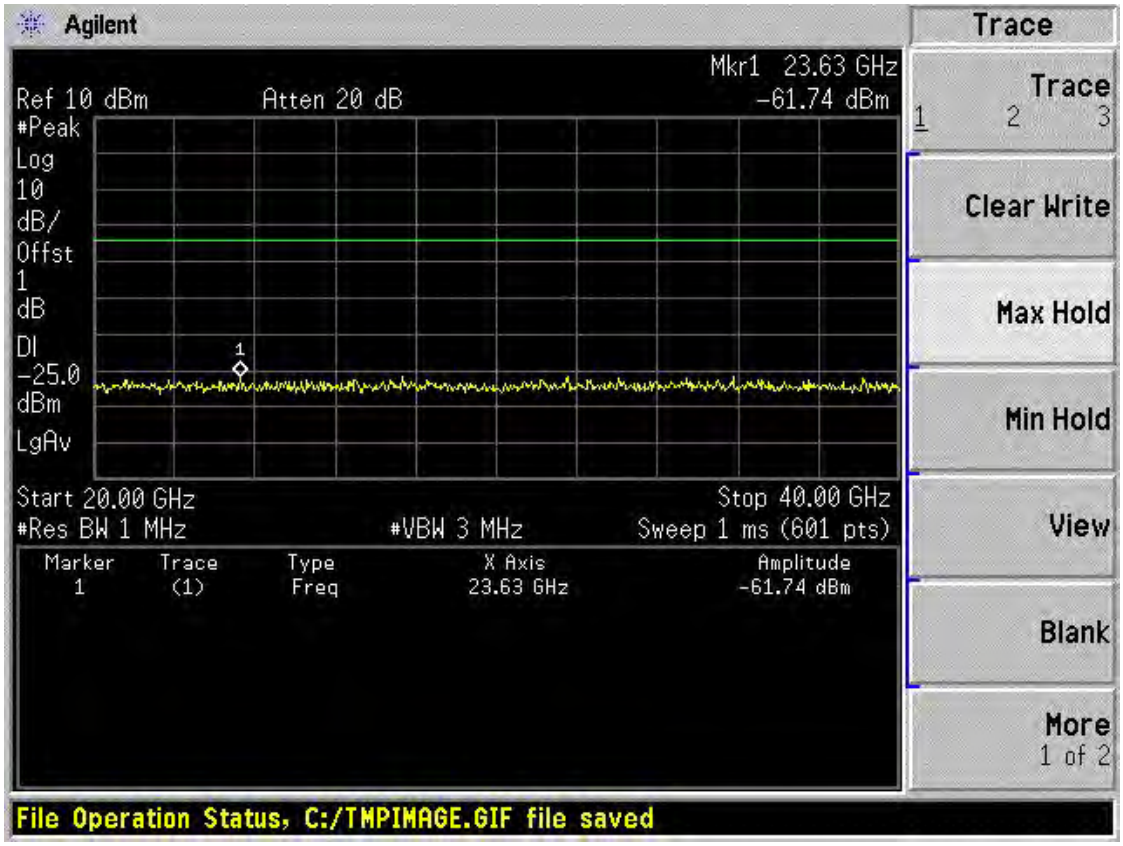
Chain 1 CSE (23dBi Antenna)-Mid Channel (30 ~ 1000 MHz)



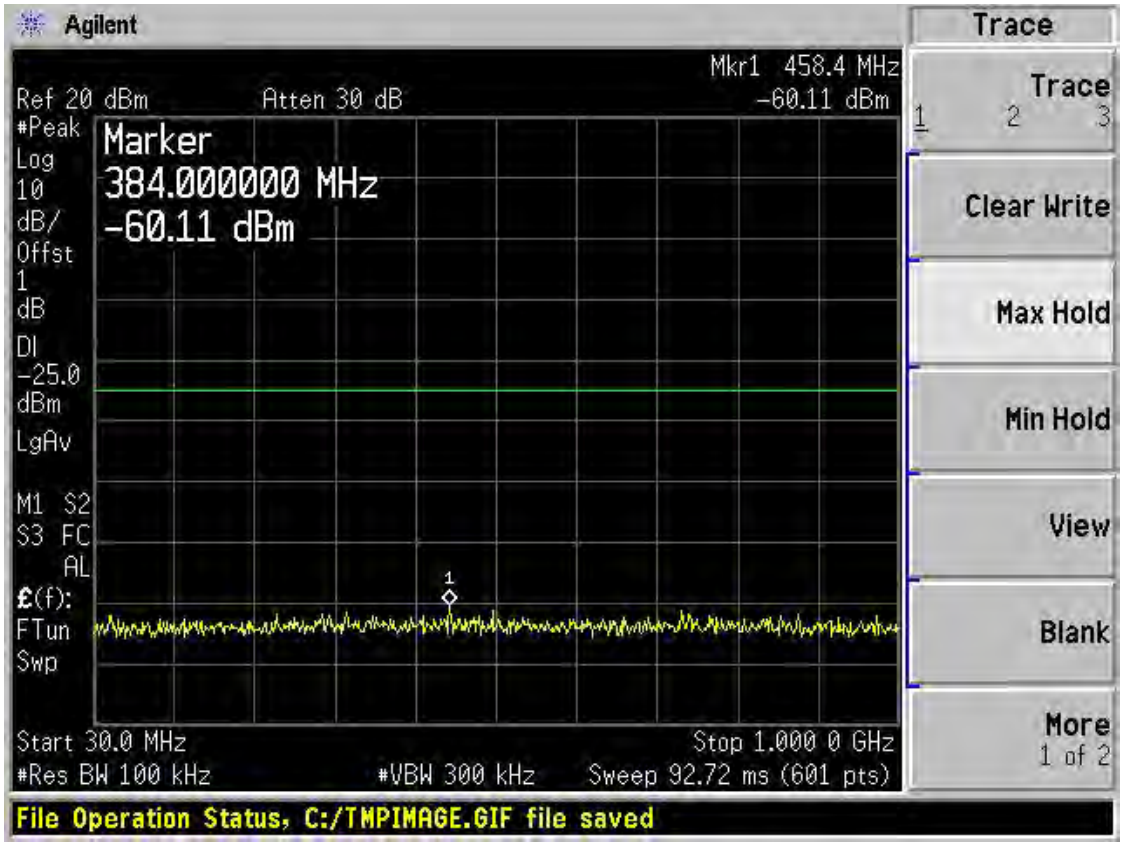
Chain 2 CSE (23dBi Antenna)-Mid Channel (1 ~ 20 GHz)



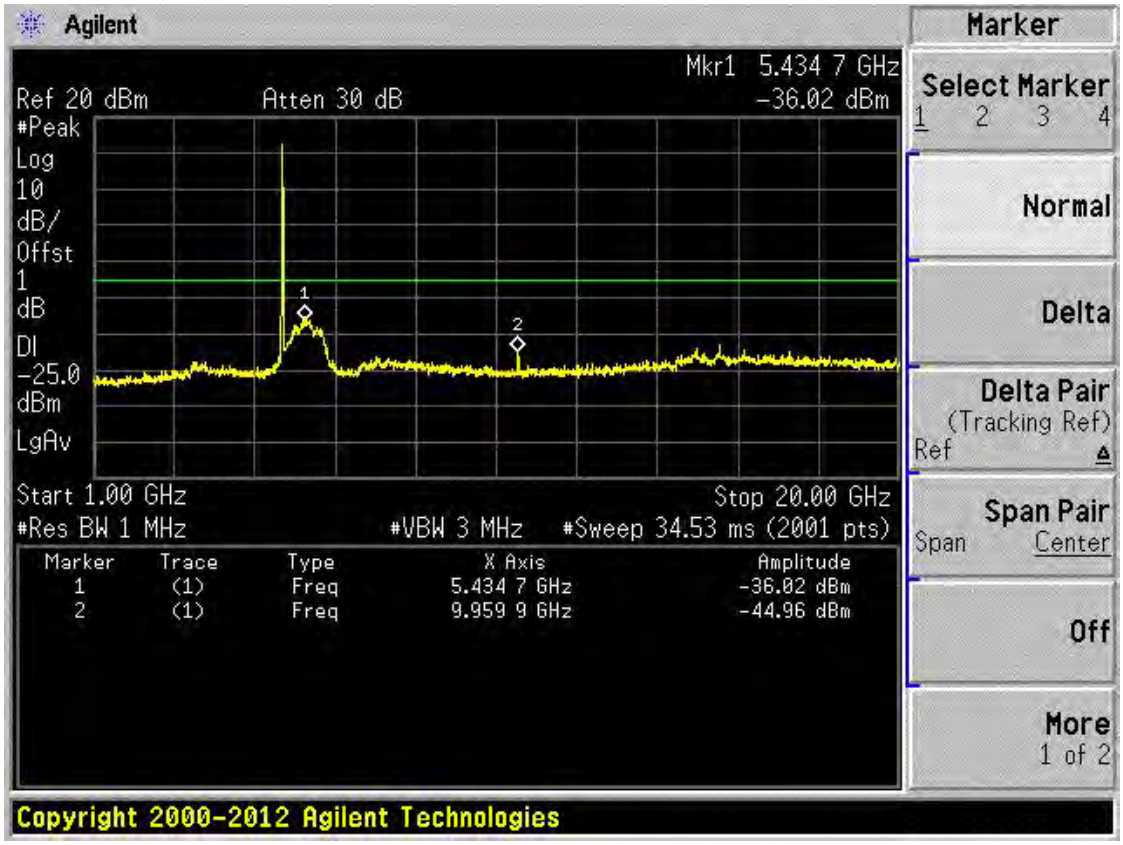
Chain 2 CSE (23dBi Antenna)-Mid Channel (20 ~ 40 GHz)



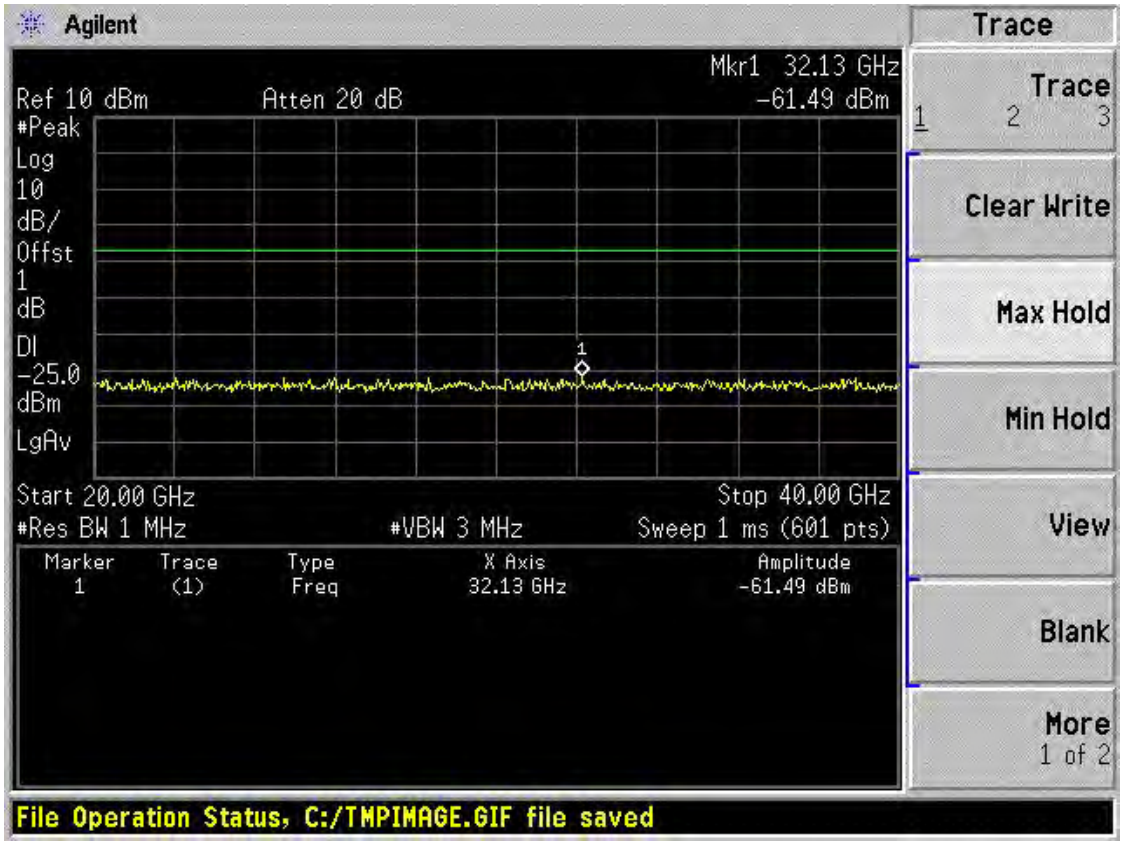
Chain 2 CSE (23dBi Antenna)-High Channel (30 ~ 1000 MHz)



Chain 2 CSE (23dBi Antenna)-High Channel (1 ~ 20 GHz)



Chain 2 CSE (23dBi Antenna)-High Channel (20 ~ 40 GHz)



A.6 Radiated Spurious Emission

Antenna-port Conducted test data

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.

EIRP= Measure Conducted output power Value (dBm) + Maximum transmit antenna gain (dBi) + The appropriate maximum ground reflection factor(dB)

The worst data (Test frequency: below 6 GHz with 23 dBi Antenna gain)

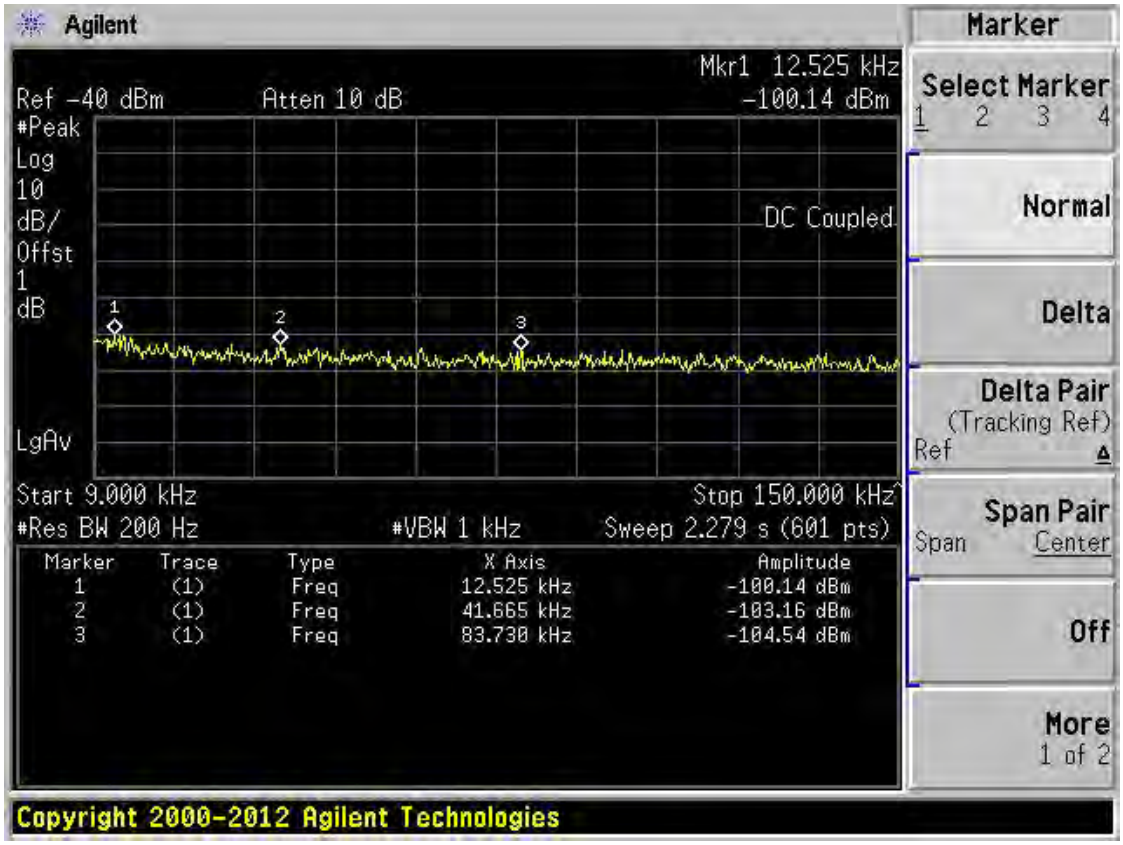
The EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2dBi, whichever is greater.
And the maximum in-band gain of the antenna is 23 dBi.
Note 1: The limit line is -25 dBm (70.2 dBuV/m@3m).
Note 2: Average measurement was not performed if peak level went lower than the average limit.
Note 3: The harmonic (2th, 3th, 4th, etc.) and other spurious are not reported, because those levels are lower than average limit line and background noise.
Note 4: The frequency is fundamental signal which can be ignored.

Low Channel

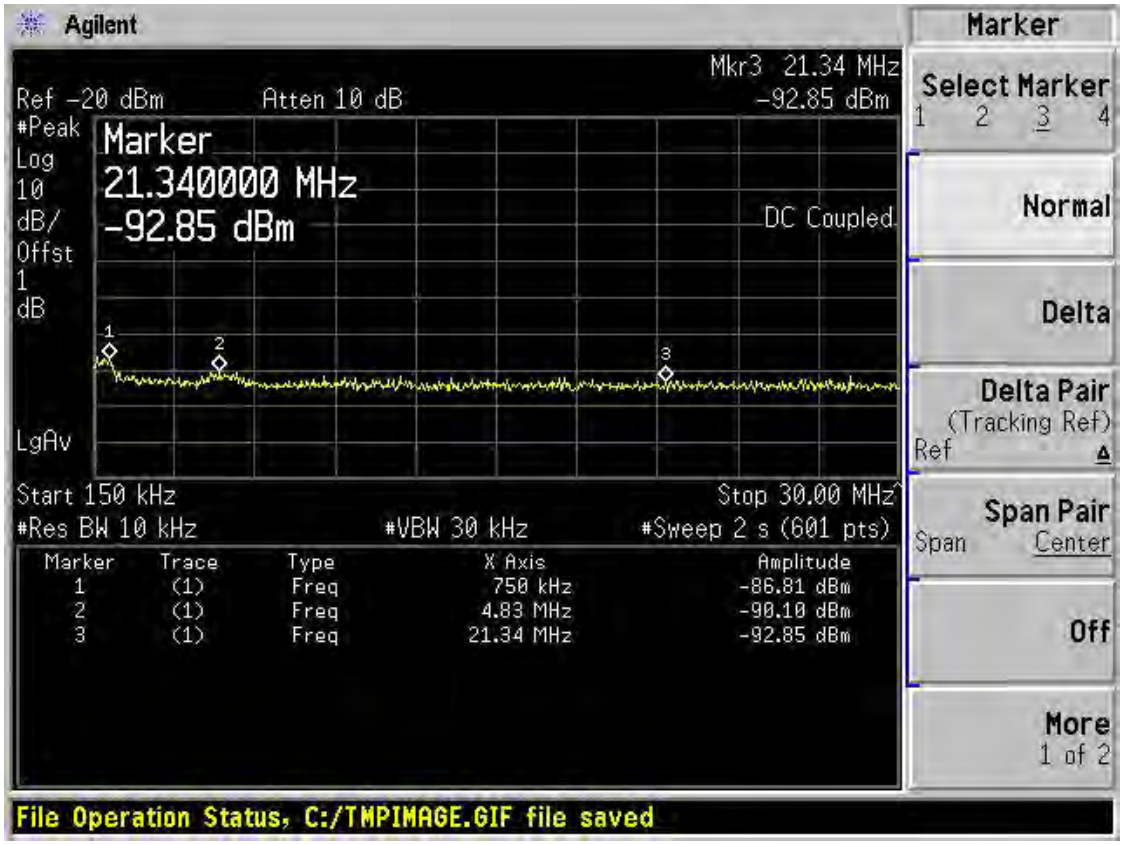
Frequency (MHz)	Value (dBm)	Ground Reflection Factor (dB)	D (m)	Max gain (dBi)	Detector	E (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Remark	Verdict
0.012525	-100.14	6	3	23	QP	24.12	70.20	46.08	Note 1	PASS
0.75	-86.81	6	3	23	QP	37.45	70.20	32.75	Note 1	PASS
392.1	-81.61	4.7	3	23	QP	41.35	70.20	28.85	Note 1	PASS
743	-80.8	4.7	3	23	QP	42.16	70.20	28.04	Note 1	PASS
3350	-56.58	0	3	23	PK	61.68	70.20	8.52	Note 1	PASS
	-72.16		3	23	AV	46.10	54.00	7.90	--	PASS
5633	-56.84	0	3	23	PK	61.42	70.20	8.78	Note 1	PASS
	-70.68		3	23	AV	47.58	54.00	6.42	--	PASS
4950	23.85	0	3	23	PK	142.11	N/A	N/A	--	N/A
	N/A		3	23	AV	N/A	N/A	N/A		

Test Plots

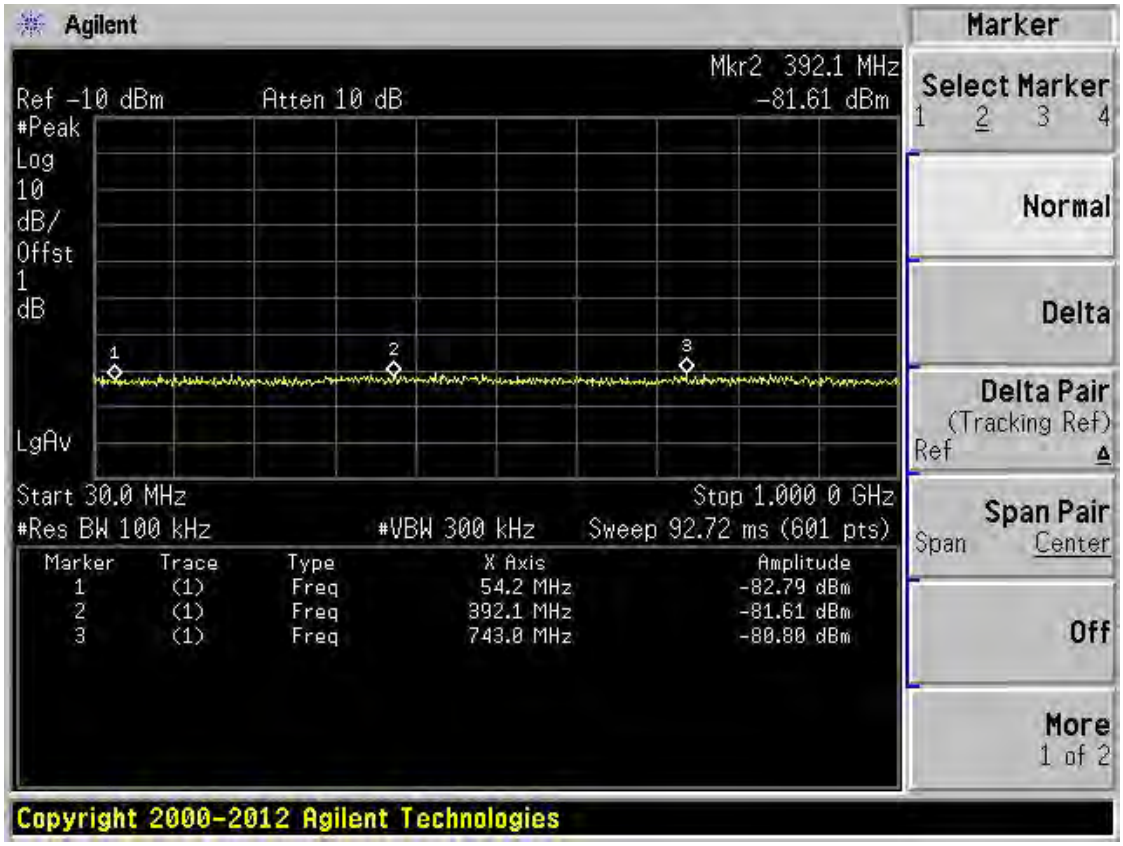
Low Channel, SPURIOUS 9 kHz ~ 150 kHz



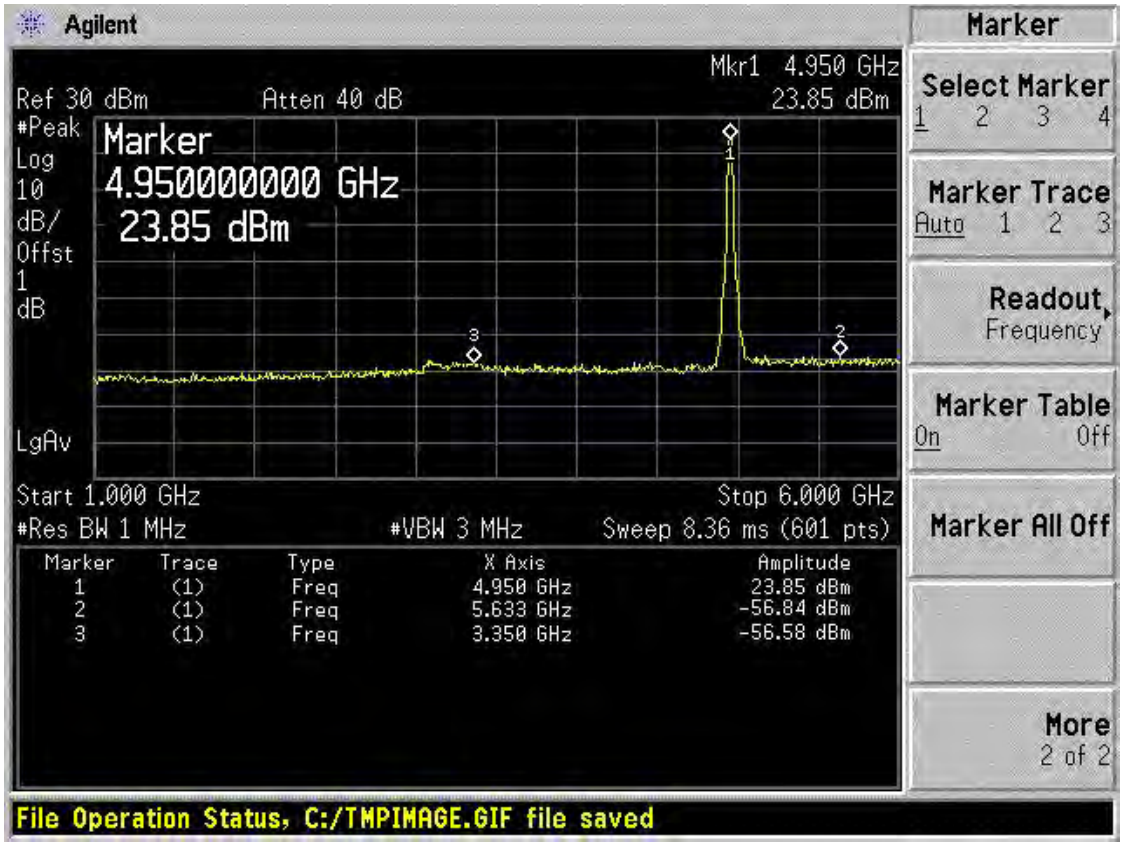
Low Channel, SPURIOUS 150 kHz ~ 30 MHz



Low Channel, SPURIOUS 30 MHz ~ 1 GHz



Low Channel, SPURIOUS 1 GHz ~ 6 GHz



Test Data (Test frequency: 6 - 20 GHz with 23 dBi Antenna gain)

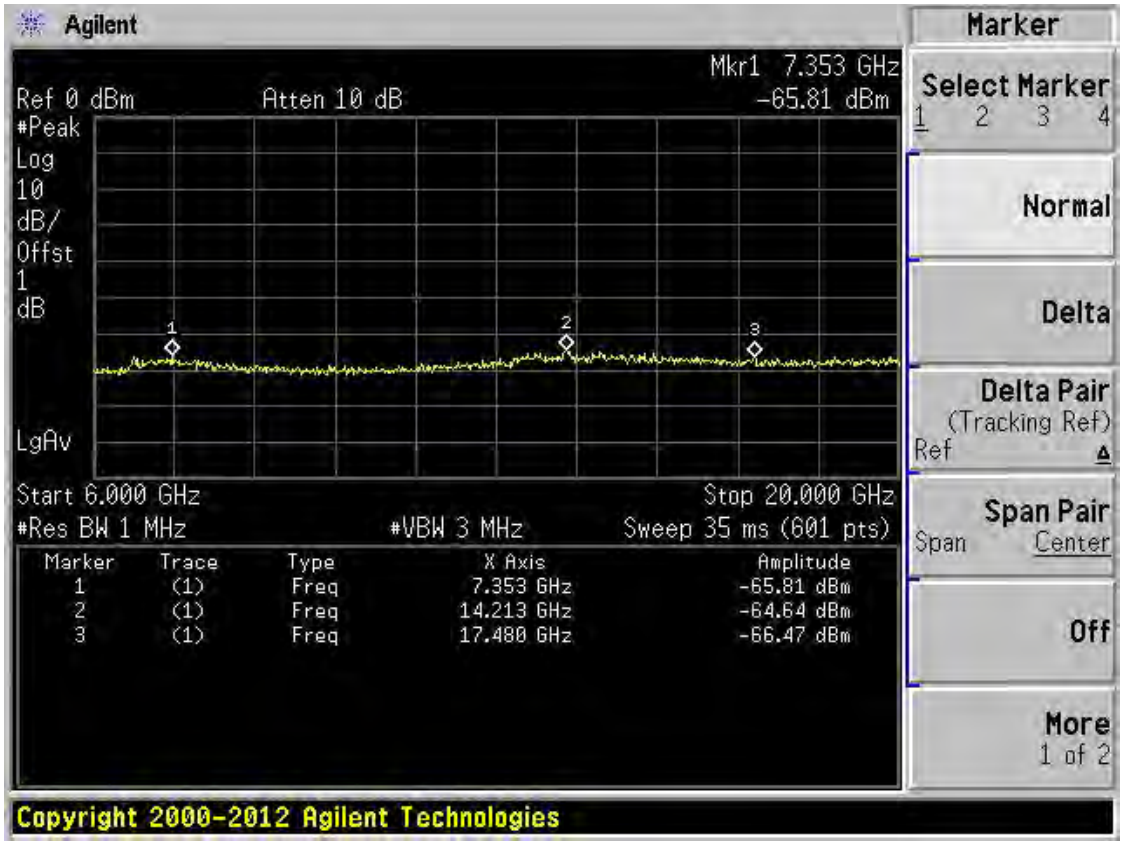
The EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2dBi, whichever is greater.
And the maximum in-band gain of the antenna is 23 dBi.
Note 1: The limit line is -25 dBm (70.2 dBuV/m@3m).
Note 2: Average measurement was not performed if peak level went lower than the average limit.
Note 3: The harmonic (2th, 3th, 4th, etc.) and other spurious are not reported, because those levels are lower than average limit line and background noise.

Low Channel

Frequency (MHz)	Value (dBm)	Ground Reflection Factor (dB)	D (m)	Max gain (dBi)	Detector	E (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Remark	Verdict
7353	-65.81	0	3	23	PK	52.45	74.00	21.55	Note 1	PASS
	N/A		3	23	AV	N/A	54.00	N/A	Note 2	PASS
14213	-64.64	0	3	23	PK	53.62	70.20	16.58	Note 1	PASS
	N/A		3	23	AV	N/A	54.00	N/A	Note 2	PASS
17480	-66.47	0	3	23	PK	51.79	70.20	18.41	Note 1	PASS
	N/A		3	23	AV	N/A	54.00	N/A	Note 2	PASS

Test Plots

Low Channel, SPURIOUS 6 GHz ~ 20 GHz



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 2dBi, whichever is greater.

And the maximum in-band gain of the antenna is 23 dBi.

Note 1: The limit line is -25 dBm (70.2 dBuV/m@3m).

Note 2: Average measurement was not performed if peak level went lower than the average limit.

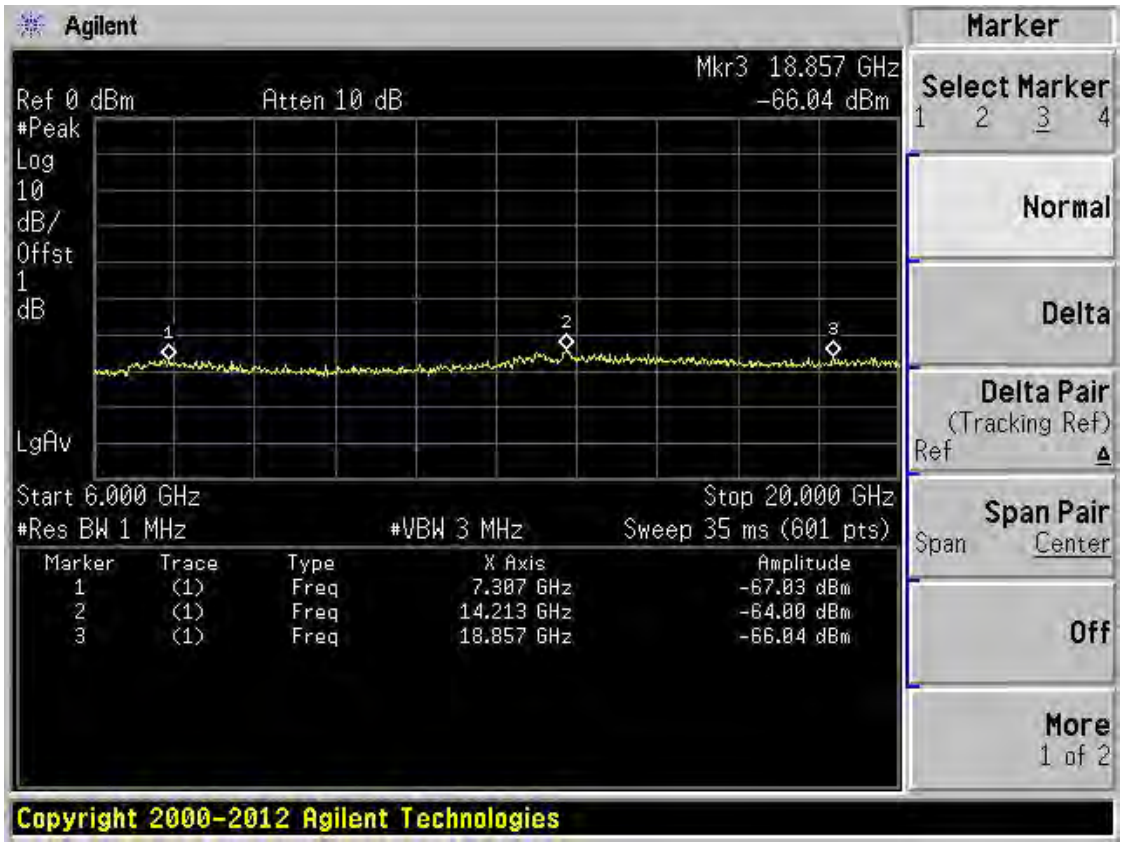
Note 3: The harmonic (2th, 3th, 4th, etc.) and other spurious are not reported, because those levels are lower than average limit line and background noise.

Mid Channel

Frequency (MHz)	Value (dBm)	Ground Reflection Factor (dB)	D (m)	Max gain (dBi)	Detector	E (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Remark	Verdict
7307	-67.03	0	3	23	PK	51.23	74.00	22.77	Note 1	PASS
	N/A		3	23	AV	N/A	54.00	N/A	Note 2	PASS
14213	-64	0	3	23	PK	54.26	70.20	15.94	Note 1	PASS
	-78.15		3	23	AV	40.11	54.00	13.89	--	PASS
18857	-67.03	0	3	23	PK	51.23	74.00	22.77	Note 1	PASS
	N/A		3	23	AV	N/A	54.00	N/A	Note 2	PASS

Test Plots

Mid Channel, SPURIOUS 6 GHz ~ 20 GHz



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 2dBi, whichever is greater.

And the maximum in-band gain of the antenna is 23 dBi.

Note 1: The limit line is -25 dBm (70.2 dBuV/m@3m).

Note 2: Average measurement was not performed if peak level went lower than the average limit.

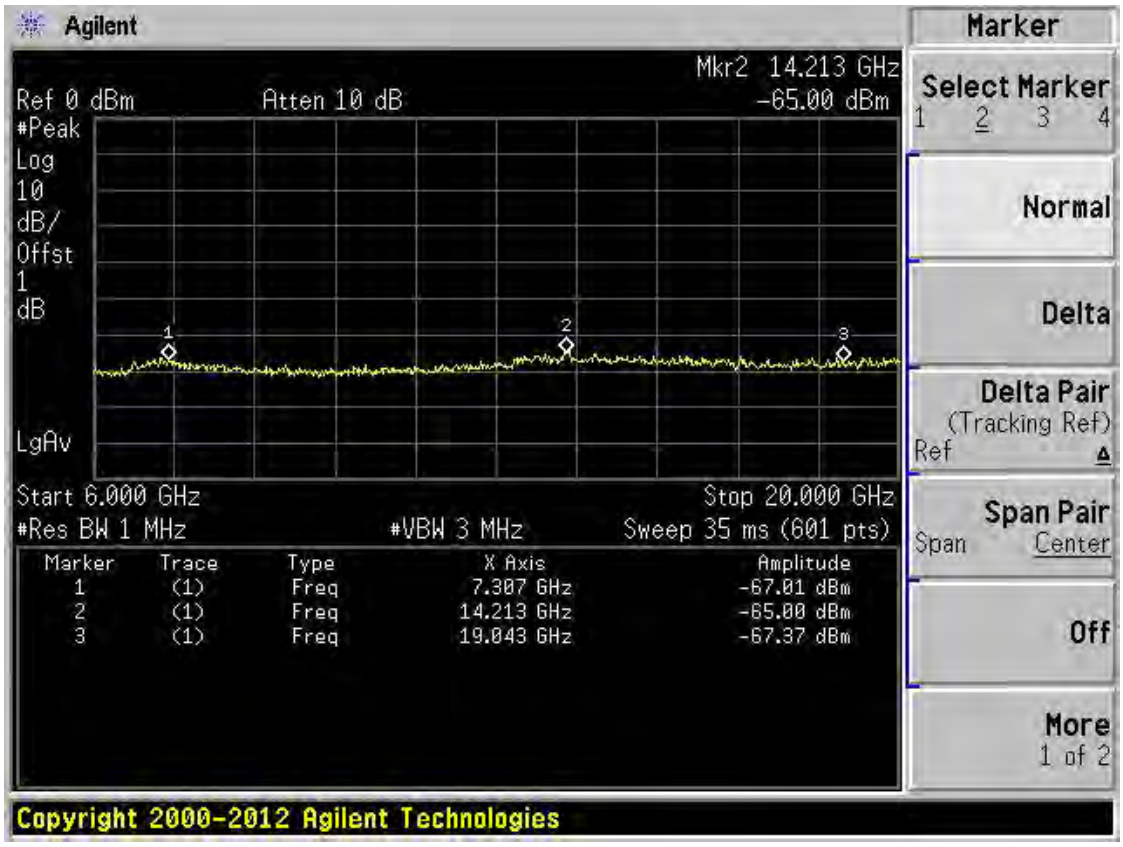
Note 3: The harmonic (2th, 3th, 4th, etc.) and other spurious are not reported, because those levels are lower than average limit line and background noise.

High Channel

Frequency (MHz)	Value (dBm)	Ground Reflection Factor (dB)	D (m)	Max gain (dBi)	Detector	E (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Remark	Verdict
7307	-67.01	0	3	23	PK	51.25	74.00	22.75	Note 1	PASS
	N/A		3	23	AV	N/A	54.00	N/A	Note 2	PASS
14213	-65	0	3	23	PK	53.26	70.20	16.94	Note 1	PASS
	-78.15		3	23	AV	40.11	54.00	13.89	Note 2	PASS
19043	-67.37	0	3	23	PK	50.89	74.00	23.11	Note 1	PASS
	N/A		3	23	AV	N/A	54.00	N/A	Note 2	PASS

Test Plots

High Channel, SPURIOUS 6 GHz ~ 20 GHz



Test Frequency: 20 GHz ~ 40 GHz

Note: Only noise floor was seen above 20 GHz and not reported.

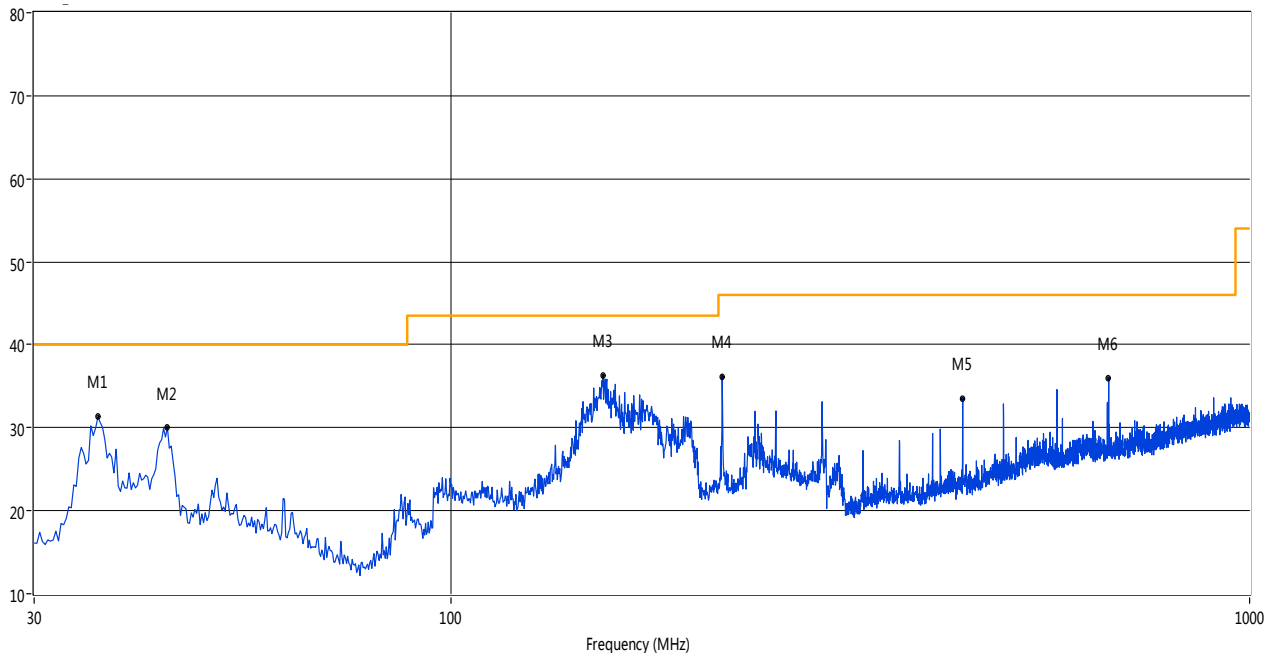
Cabinet Radiated spurious emission test

Note 1: The symbol of "--" in the table which means not application.

Note 2: For the test data above 1 GHz，According the ANSI C63.4, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

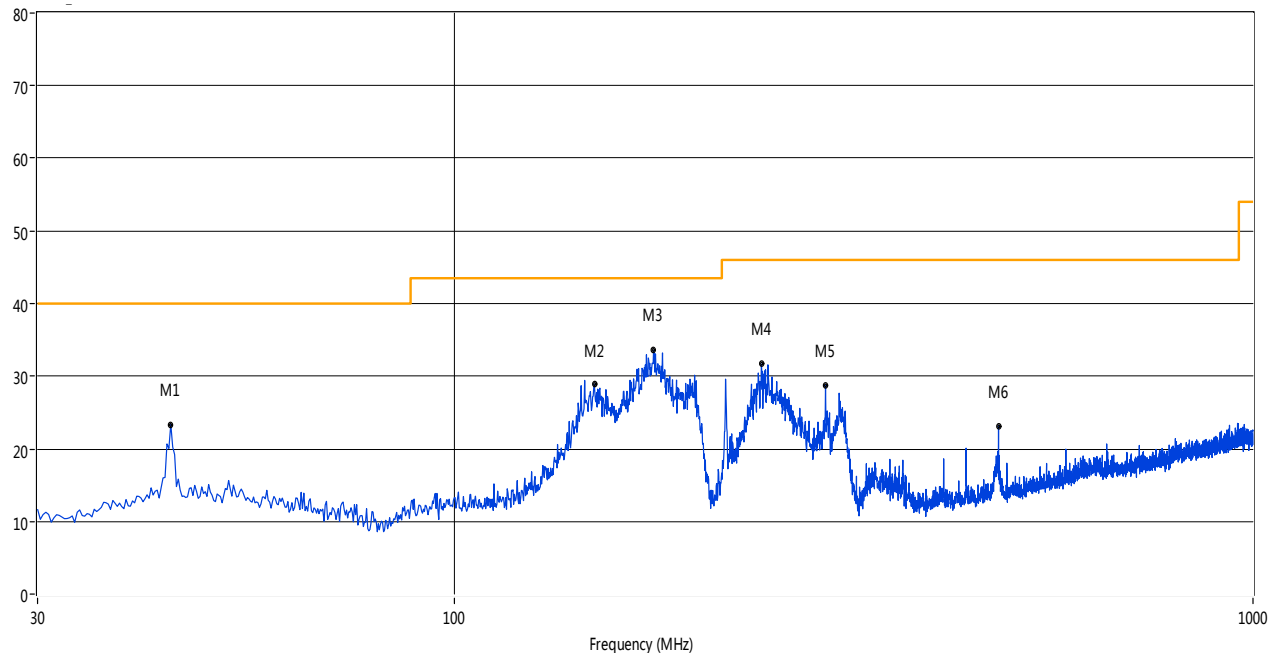
Note 3: The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

30 MHz to 1 GHz, ANT V



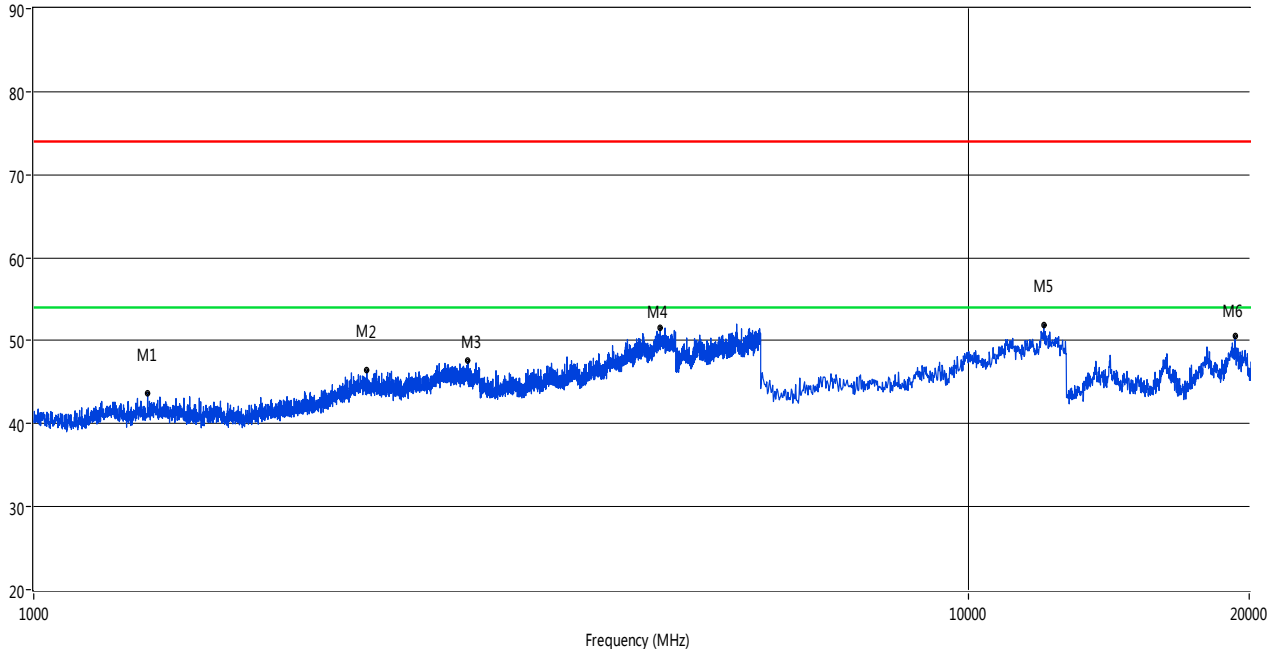
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	36.06	31.30	-21.00	40.0	8.70	Peak	339.00	100	Vertical	PASS
2	44.06	30.04	-18.90	40.0	9.96	Peak	92.70	100	Vertical	PASS
3	154.86	36.32	-23.33	43.5	7.18	Peak	243.40	100	Vertical	PASS
4	218.37	26.18	-20.04	46.0	19.82	Peak	243.40	100	Vertical	PASS
5	437.06	23.57	-14.59	46.0	22.43	Peak	348.50	100	Vertical	PASS
6	665.92	25.98	-10.02	46.0	20.02	Peak	260.40	100	Vertical	PASS

30 MHz to 1 GHz, ANT H



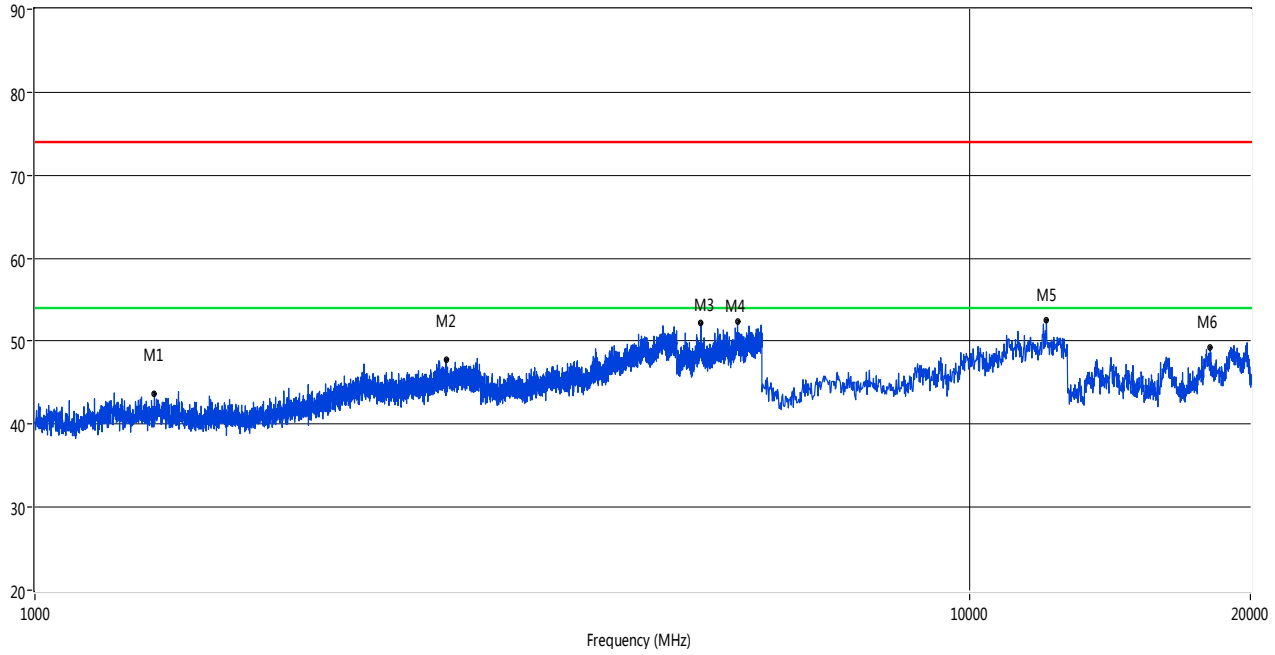
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	44.06	23.37	-18.90	40.0	16.63	Peak	41.00	100	Horizontal	PASS
2	149.52	28.91	-23.48	43.5	14.59	Peak	16.00	100	Horizontal	PASS
3	177.40	33.56	-22.22	43.5	9.94	Peak	113.00	100	Horizontal	PASS
4	242.13	31.68	-19.13	46.0	14.32	Peak	302.00	100	Horizontal	PASS
5	291.35	28.80	-17.96	46.0	17.20	Peak	89.00	100	Horizontal	PASS
6	479.97	23.18	-13.81	46.0	22.82	Peak	225.00	100	Horizontal	PASS

1 GHz to 20 GHz, ANT V



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1323.92	43.72	-4.79	74.0	30.28	Peak	132.30	100	Vertical	PASS
2	2272.68	46.40	-0.51	74.0	27.60	Peak	99.30	100	Vertical	PASS
3	2916.52	47.56	2.27	74.0	26.44	Peak	243.60	100	Vertical	PASS
4	4683.33	51.48	13.17	74.0	22.52	Peak	271.00	100	Vertical	PASS
5	12053.66	51.91	20.82	74.0	22.09	Peak	269.70	100	Vertical	PASS
6	19309.48	50.49	13.46	74.0	23.51	Peak	57.40	100	Vertical	PASS

1 GHz to 20 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (o)	Height (cm)	ANT	Verdict
1	1342.41	43.65	-4.64	74.0	30.35	Peak	43.90	100	Horizontal	PASS
2	2754.56	47.81	1.76	74.0	26.19	Peak	288.60	100	Horizontal	PASS
3	5164.71	52.16	14.92	74.0	21.84	Peak	0.10	100	Horizontal	PASS
4	5650.59	52.30	15.71	74.0	21.70	Peak	359.40	100	Horizontal	PASS
5	12098.59	52.61	20.77	74.0	21.39	Peak	355.00	100	Horizontal	PASS
6	18116.06	49.29	12.97	74.0	24.71	Peak	359.30	100	Horizontal	PASS

Test Frequency: 20 GHz ~ 40 GHz

Note: Only noise floor was seen above 20 GHz and not reported.

A.7 Frequency Stability

Test Conditions		Frequency Deviation						Verdict
Power (VDC)	Temperature (°C)	Low Channel 4950 MHz		Mid Channel 4965 MHz		High Channel 4980 MHz		
		Hz	Limits	Hz	Limits	Hz	Limits	
48	-30	21.88	±12375	21.88	±12412.5	39.43	±12450	Pass
	-20	17.62		17.62		39.04		
	-10	-1.53		-1.53		37.00		
	0	-6.03		-6.03		17.81		
	+10	9.99		9.99		42.53		
	+20	35.96		35.96		38.33		
	+30	10.10		10.10		19.75		
	+40	51.32		51.32		32.86		
	+50	14.47		14.47		4.44		
55.2	+25	-2.21		-2.21		52.20		
40.8	+25	26.45		26.45		53.04		

--END OF REPORT--