RF TEST REPORT

Test item	:	G-PON ONT
Model No.	:	H660W
Order No.	:	DEMC1407-02828
Date of receipt	:	2014-07-11
Test duration	:	2014-08-06 ~ 2014-08-20
Date of issue	:	2014-09-12
Use of report	:	FCC Original Grant

Applicant : Dasan Networks, Inc.
DASAN Tower, 49, Daewangpangyo-ro 644 Beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea

Test laboratory : DT&C Co., Ltd.
42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 449-935

Test specification	:	FCC Part 15 Subpart C 247
Test environment	:	See appended test report
Test result	:	☒ Pass ☐ Fail

Tested by:

Engineer
HyunSu Son

Reviewed by:

General Manager
HongHee Lee

Test Report Version

Test Report No.	Date	Description
DRTFCC1409-1165	Sep. 12, 2014	Initial issue

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1. EUT DESCRIPTION

FCC Equipment Class	Digital Transmission System(DTS)
Product	G-PON ONT
Model Name	H660W
Add Model Name	N/A
Power Supply	DC 12 V
Frequency Range	**2.4 GHz Band** ▪ 802.11b/g/n(HT20): 2412 MHz ~ 2462 MHz ▪ 802.11n(HT40): 2422 MHz ~ 2452 MHz
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Transmissions category	Completely uncorrelated signal
Antenna Specification	**Antenna type**: Internal Antenna **Antenna gain** ▪ 2.4 GHz Band: ANT 1 : 3.300 dBi & ANT 2 : 3.300 dBi **Antenna configuration** ▪ 802.11b/g: Single Transmitting (ANT 1) ▪ 802.11n(MCS0 ~ 7) : Single Transmitting (ANT 1 or ANT 2) ▪ 802.11n(MCS8 ~ 15): Multiple Transmitting (ANT 1 and ANT 2)

2. INFORMATION ABOUT TESTING

2.1 Test mode

Test mode	Worst case data rate	Tested Frequency(MHz)		
		Lowest	Middle	Highest
TM 1	802.11b 1 Mbps	2412	2437	2462
TM 2	802.11g 6 Mbps	2412	2437	2462
TM 3	802.11n(HT20) MCS 0	2412	2437	2462
TM 4	802.11n(HT40) MCS 0	2422	2437	2452

The worst case data rate for each modulation is determined as above test mode. And all tests conducted in this report were made at the worst case data rate of each modulation.

2.3 Auxiliary equipment

Equipment	Model No.	Serial No.	Manufacturer	Note
Laptop	X51RL	85N0AS318314227	ASUS	FCC DoC
-	-	-	-	-

2.4 Tested environment

Temperature	:	23 ~ 24 ℃
Relative humidity content	:	42 ~ 43 % R.H.
Details of power supply	:	DC 12 V

2.5 EMI suppression Device(s) / Modifications

EMI suppression device(s) added and/or modifications made during testing
→ None

3. SUMMARY OF TESTS

FCC Part Section(s)	RSS Section(s)	Parameter	Limit	Test Condition	Status Note 1
I. Transmitter Mode (TX)					
15.247(a)	RSS-210 [A8.2]	6 dB Bandwidth	> 500 kHz	Conducted	C
15.247(b)	RSS-210 [A8.4]	Transmitter Output Power	< 1 Watt		C
15.247(d)	RSS-210 [A8.5]	Out of Band Emissions / Band Edge	20 dBc in any 100 kHz BW		C
15.247(e)	RSS-210 [A8.2]	Transmitter Power Spectral Density	< 8 dBm / 3 kHz		C
-	RSS Gen [4.6.1]	Occupied Bandwidth (99%)	RSS-Gen(4.6.1)		C
15.205 15.209	RSS-210 [A8.5]	General Field Strength Limits (Restricted Bands and Radiated Emission Limits)	FCC 15.209 limits	Radiated	C Note 2
15.207	RSS-Gen [7.2.4]	AC Conducted Emissions	FCC 15.207 limits	AC Line Conducted	C
15.203	-	Antenna Requirements	FCC 15.203 limits	-	C

Note 1: **C**=Comply **NC**=Not Comply **NT**=Not Tested **NA**=Not Applicable

Note 2: This test item was performed in each axis and the worst case data was reported.

4. TEST METHODOLOGY

Generally the tests were performed according to the KDB558074 v03r2. And ANSI C63.10-2009 was used to reference appropriate EUT setup and maximizing procedures of radiated spurious emission and AC line conducted emission testing

4.1 EUT configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

4.2 EUT exercise

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

4.3 General test procedures

Conducted Emissions

The power-line conducted emission test procedure is not described on the KDB 558074 v03r2. So this test was fulfilled with the requirements in Section 6.2 of ANSI C63.10.

The EUT is placed on the turntable, which is 0.8 m above ground plane and the conducted emissions from the EUT measured in the frequency range between 0.15MHz and 30MHz using CISPR Quasi-peak and Average detector.

Radiated Emissions

Basically the radiated tests were performed with KDB 558074 v03r2. But some requirements and procedures like test site requirements, EUT setup and maximizing procedure were fulfilled with the requirements in Section 5 and 6 of the ANSI C63.10 as stated on section 12.1 of the KDB 558074 v03r2.

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the highest emission, the relative positions of the EUT were rotated through three orthogonal axis.

4.4 Description of test modes

A test program is used to control the EUT for staying in continuous transmitting mode.

5. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.

6. FACILITIES AND ACCREDITATIONS

6.1 Facilities

The open area test site(OATS) or semi anechoic chamber and conducted measurement facility used to collect the radiated and conducted test data are located at the 42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 449-935. The site is constructed in conformance with the requirements.

- Semi anechoic chamber registration Number : 596748

6.2 Equipment

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and peak, quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements. All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

7. ANTENNA REQUIREMENTS

7.1 According to FCC 47 CFR §15.203& RSS-Gen [7.1.2]:

An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 internal antenna of this E.U.T is permanently attached on the main PCB.(Refer to Internal Photo.)

Therefore this module Complies with the requirement of §15.203

7.2 Directional antenna gain for MIMO :

Bands	ANT 1 [dBi]	ANT 2 [dBi]	Directional Gain for uncorrelated signals [dBi]
2.4 GHz	3.300	3.300	3.300

Directional gain = 10 log[($10^{G1/10}$ + $10^{G2/10}$ + … + $10^{GN/10}$) /N_{ANT}] dBi for MIMO uncorrelated signal

8. TEST RESULT

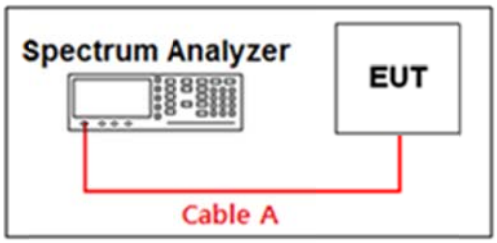
8.1 6dB bandwidth

Test Requirements and limit, §15.247(a) & RSS-210 [A8.2]

The bandwidth at 6dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the receive antenna while the EUT is operating in transmission mode at the appropriate frequencies.

The minimum permissible 6dB bandwidth is 500 kHz.

▣ **TEST CONFIGURATION**



▣ **TEST PROCEDURE**

The transmitter output is connected to the Spectrum Analyzer and used following test procedure of **KDB558074 v03r2**.

1. Set resolution bandwidth (RBW) = 100 kHz
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
   (RBW:100kHz/VBW:300 kHz)
3. Detector = **Peak**.
4. Trace mode = **max hold**.
5. Sweep = **auto couple**.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

▣ **TEST RESULTS:** **Comply**(Refer to next page.)

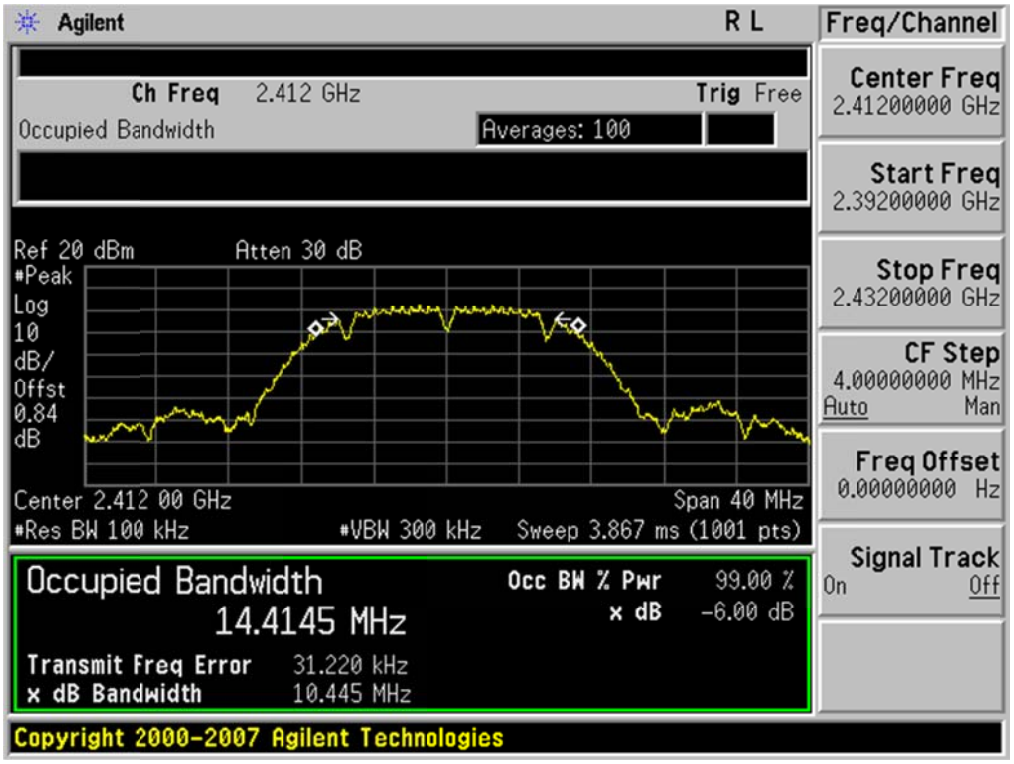
- Measurement Data:

Test Mode	Frequency	Test Results[MHz]	
		ANT 1	ANT 2
TM 1	Lowest	10.445	-
	Middle	11.184	-
	Highest	11.121	-
TM 2	Lowest	16.356	-
	Middle	16.371	-
	Highest	16.317	-
TM 3	Lowest	16.868	16.703
	Middle	17.085	16.927
	Highest	16.921	16.958
TM 4	Lowest	35.240	35.394
	Middle	35.509	35.360
	Highest	35.558	35.340

▣ RESULT PLOTS

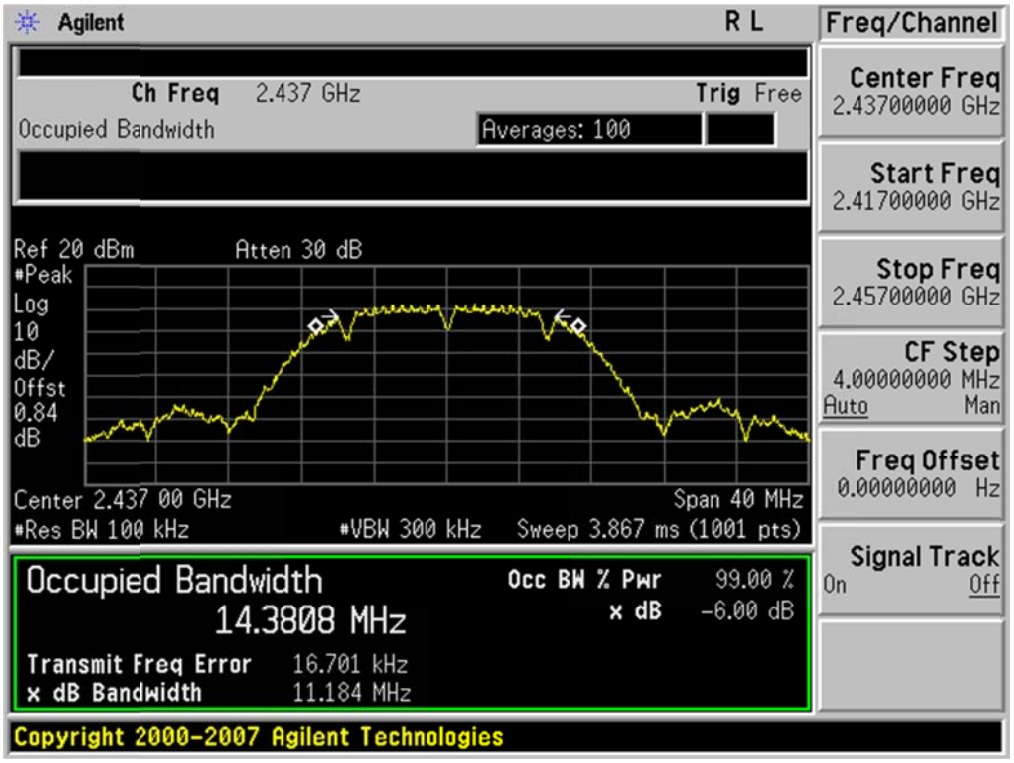
6 dB Bandwidth

TM 1 & ANT 1 & Lowest

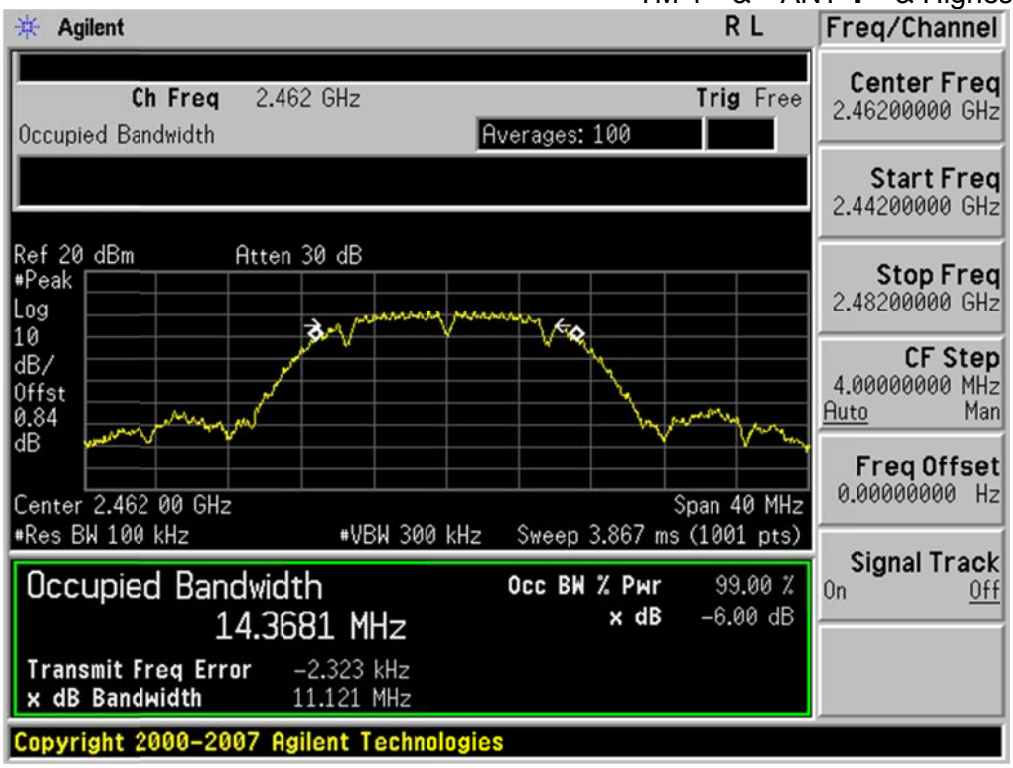


6 dB Bandwidth

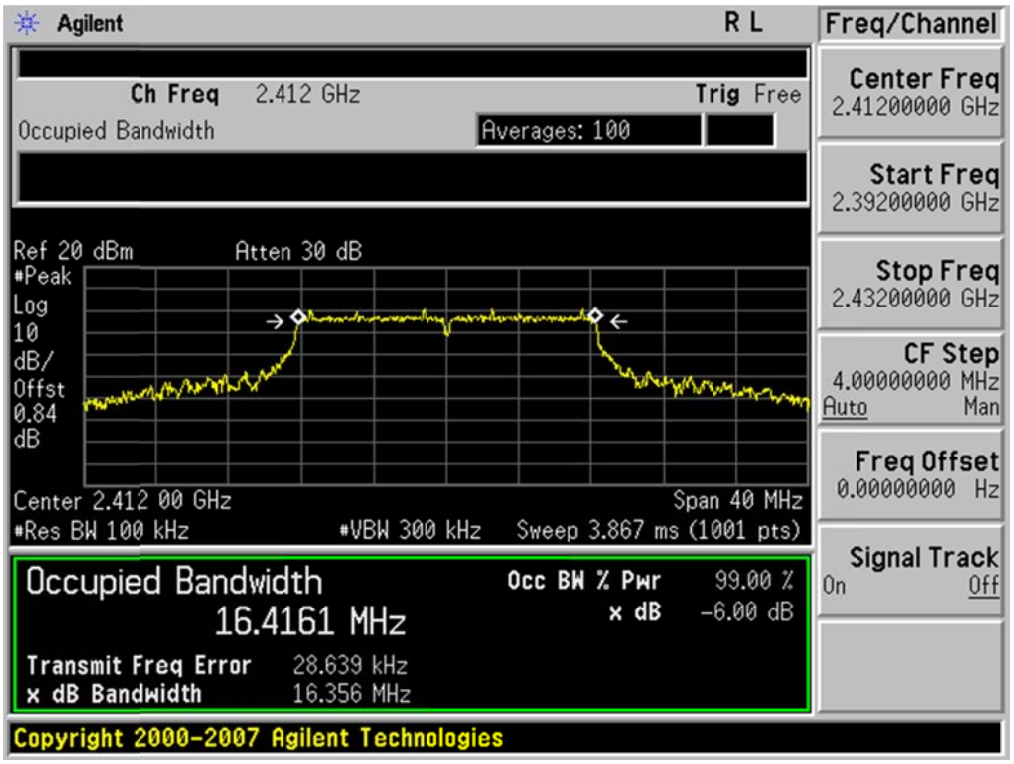
TM 1 & ANT 1 & Middle



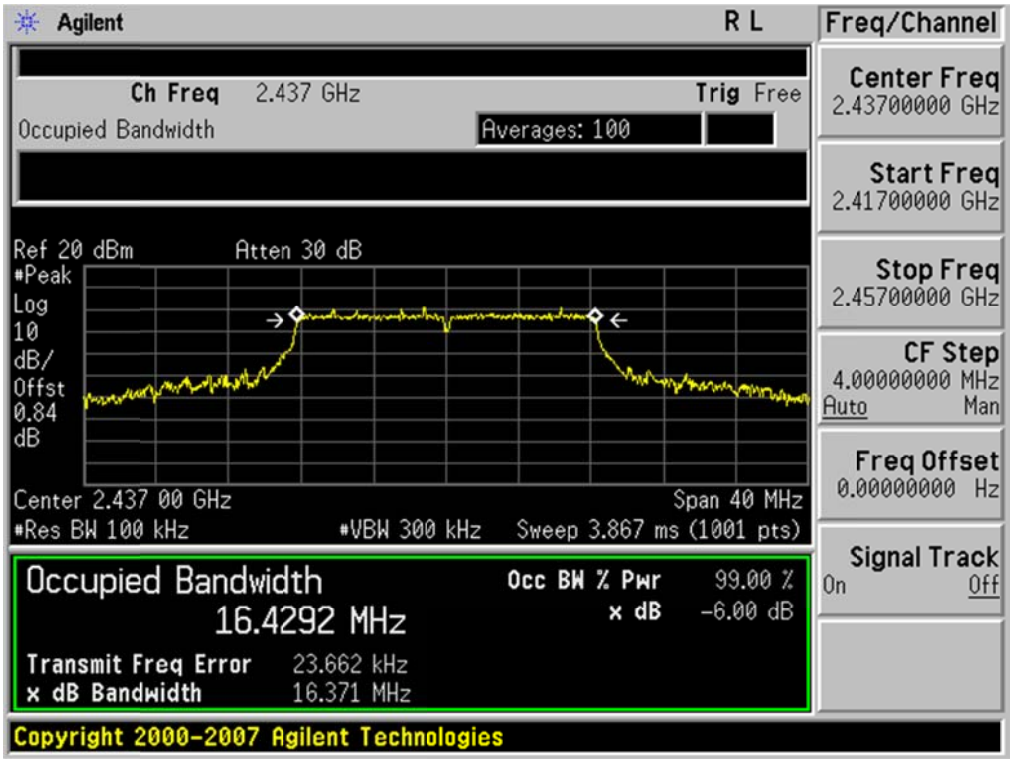
6 dB Bandwidth TM 1 & ANT **1** & Highest



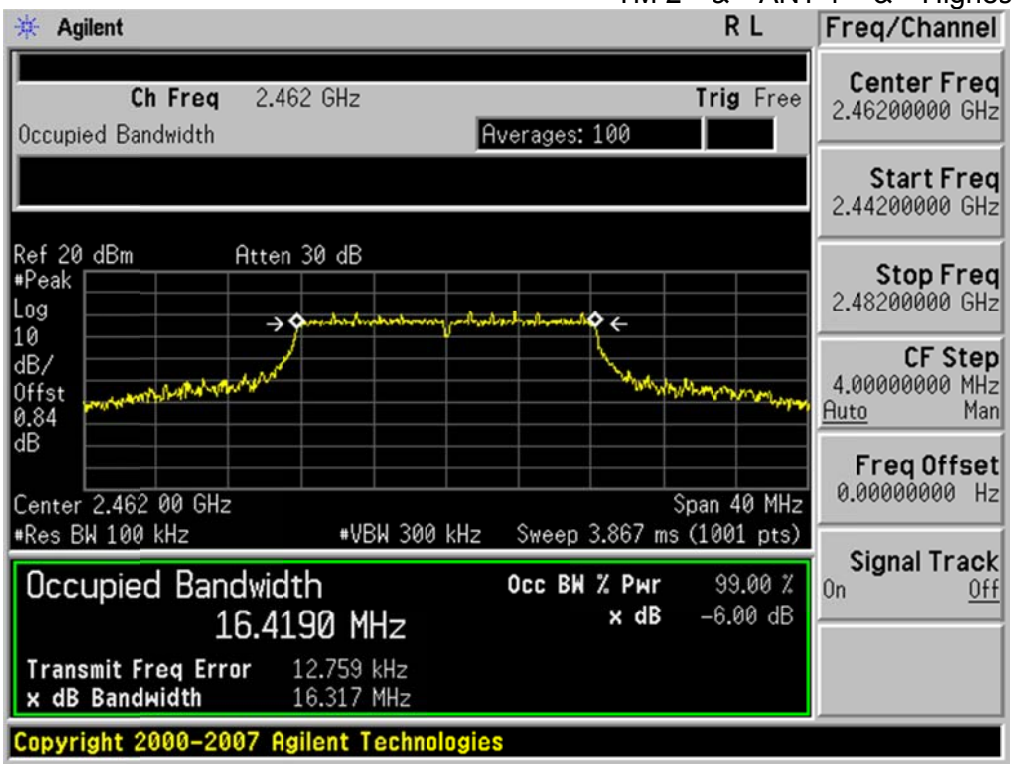
6 dB Bandwidth TM 2 & ANT 1 & Lowest



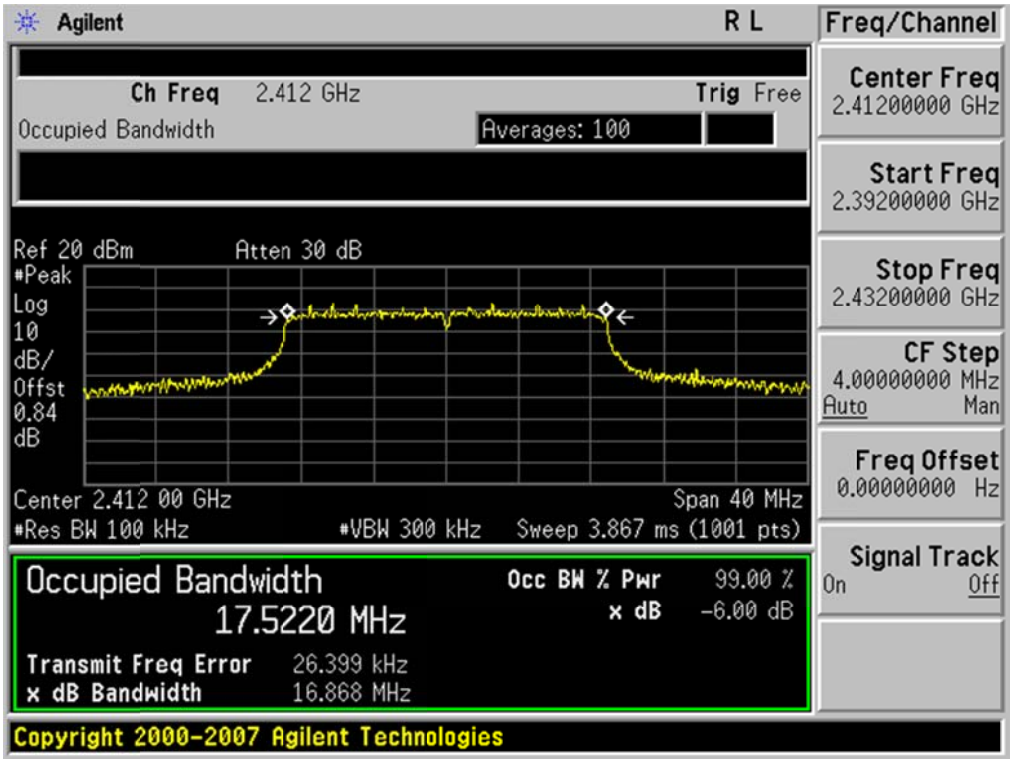
6 dB Bandwidth TM 2 & ANT 1 & Middle



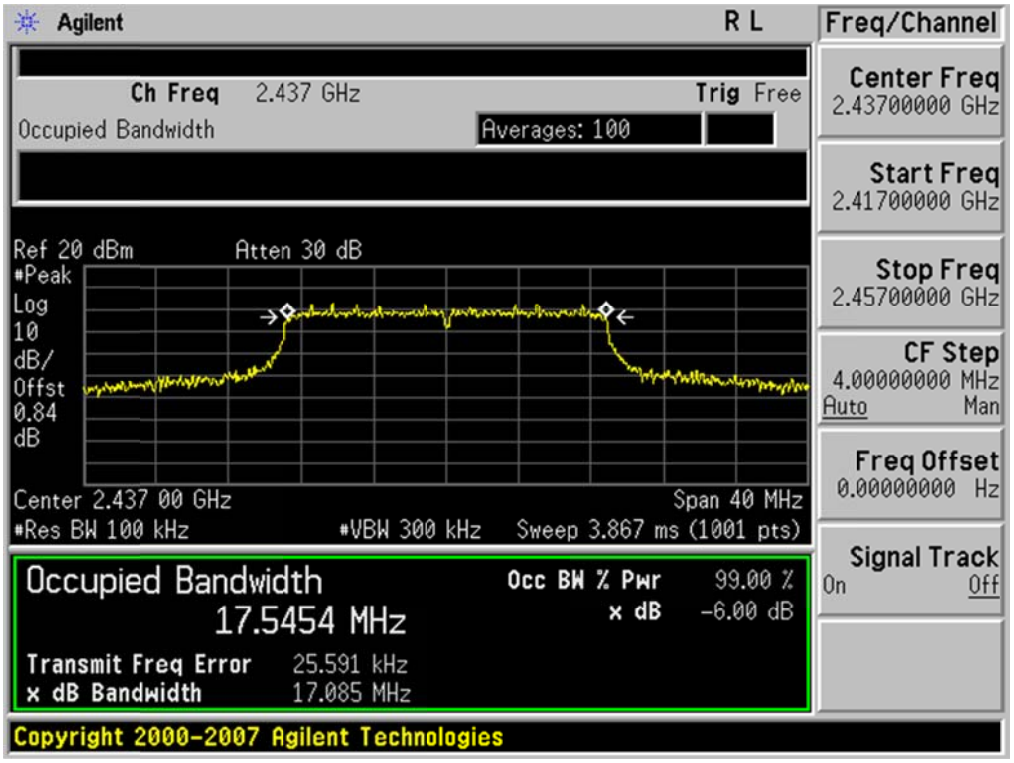
6 dB Bandwidth TM 2 & ANT 1 & Highest



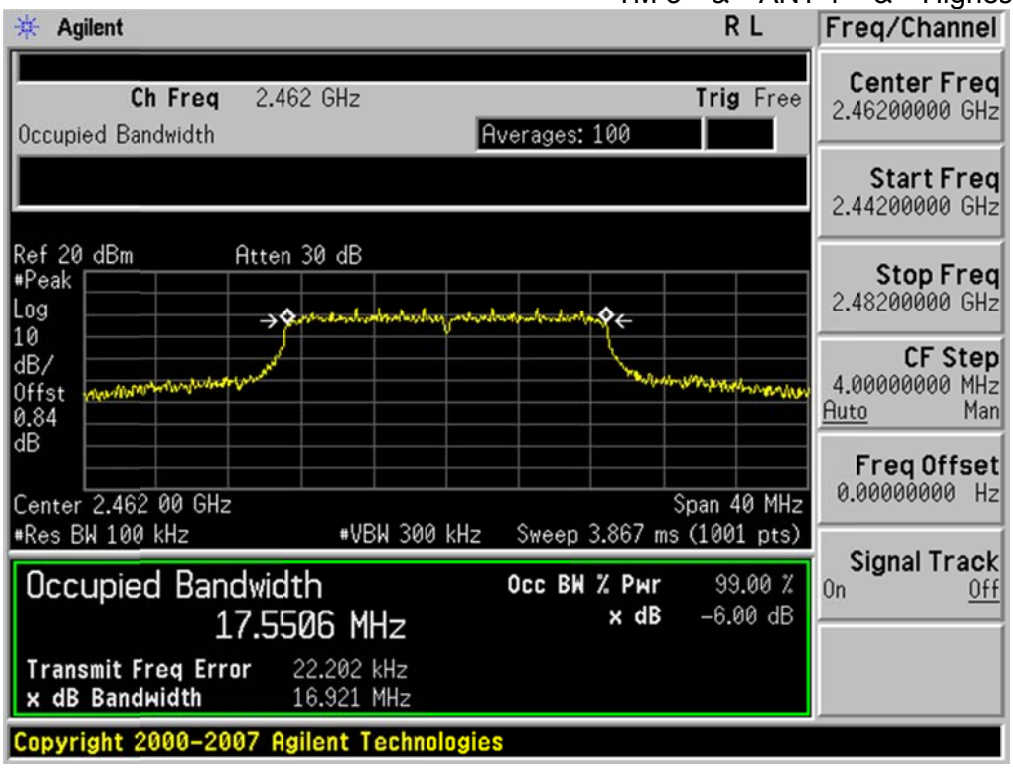
6 dB Bandwidth TM 3 & ANT 1 & Lowest



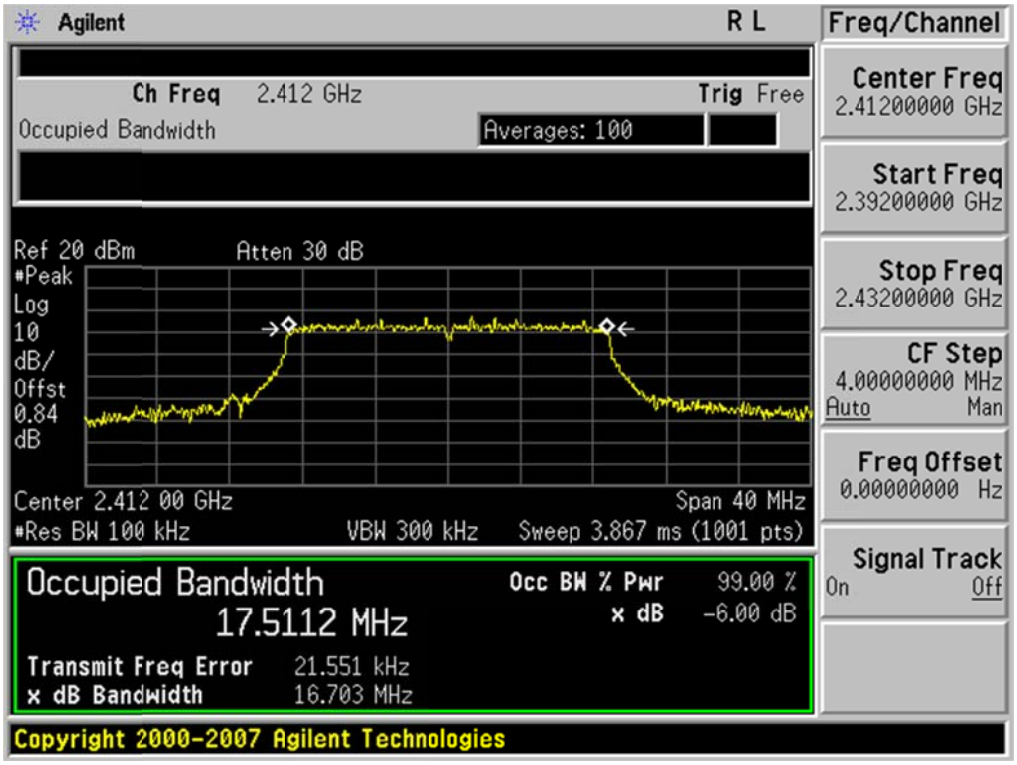
6 dB Bandwidth TM 3 & ANT 1 & Middle



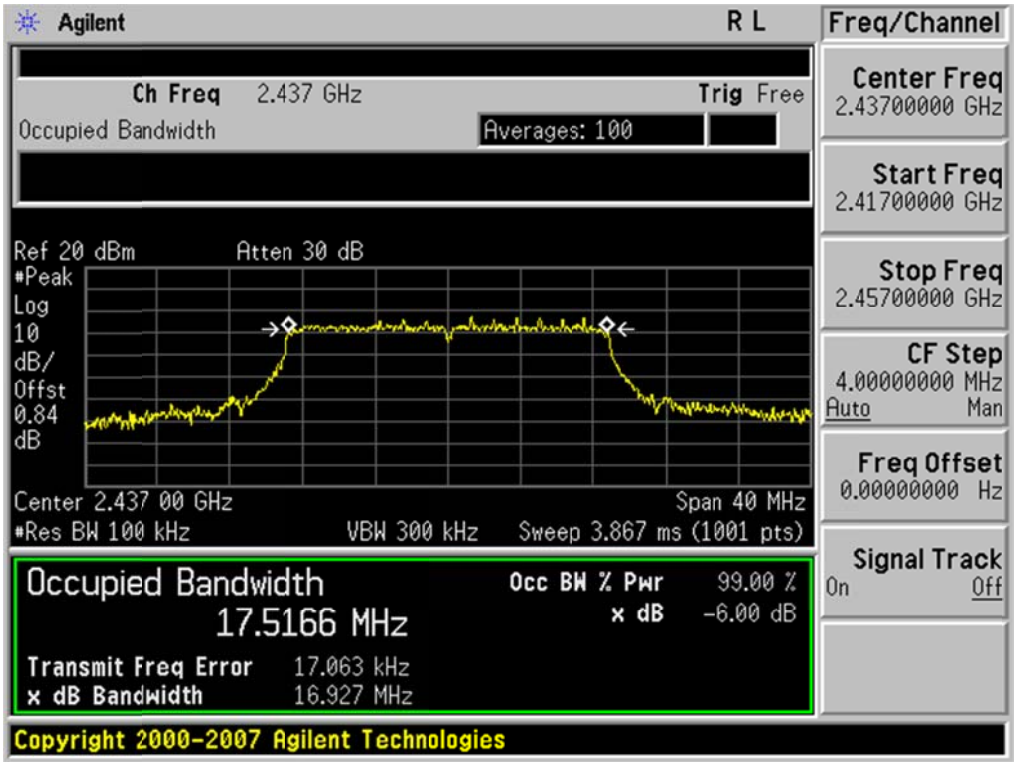
6 dB Bandwidth TM 3 & ANT 1 & Highest



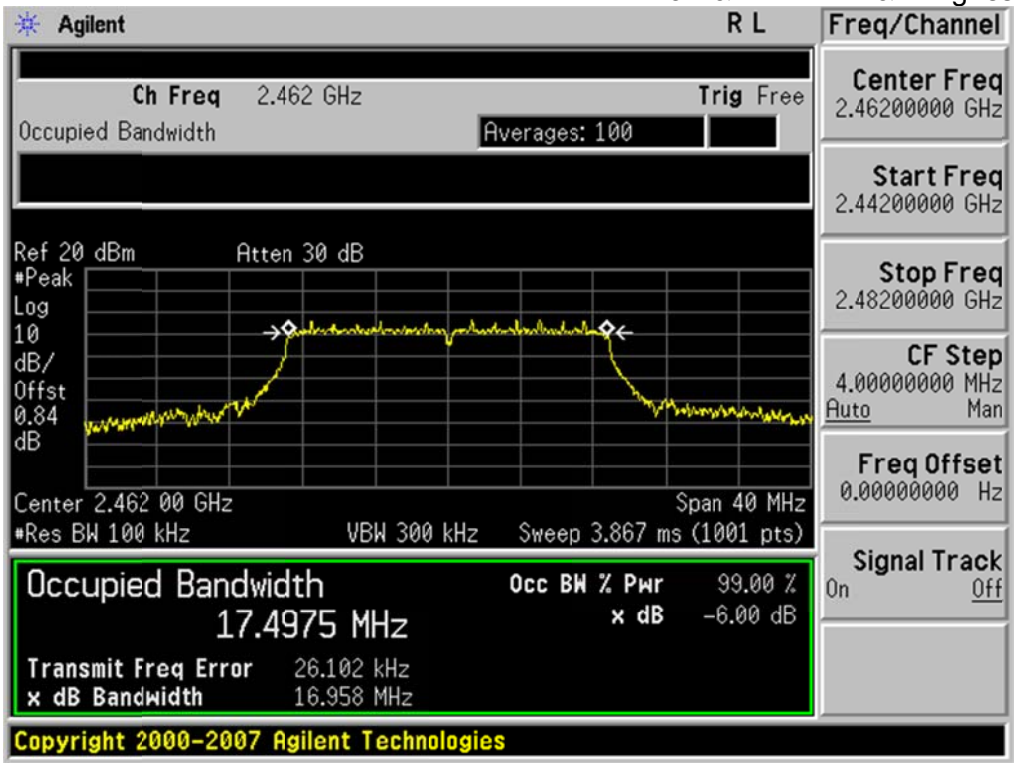
6 dB Bandwidth TM 3 & ANT 2 & Lowest



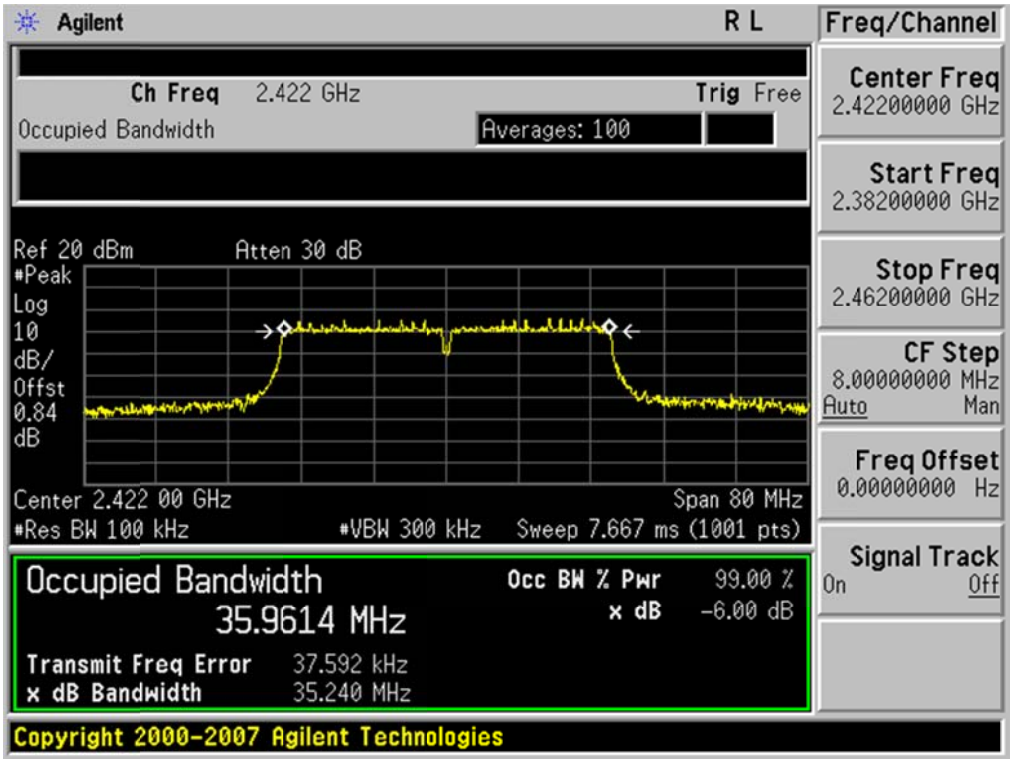
6 dB Bandwidth TM 3 & ANT 2 & Middle



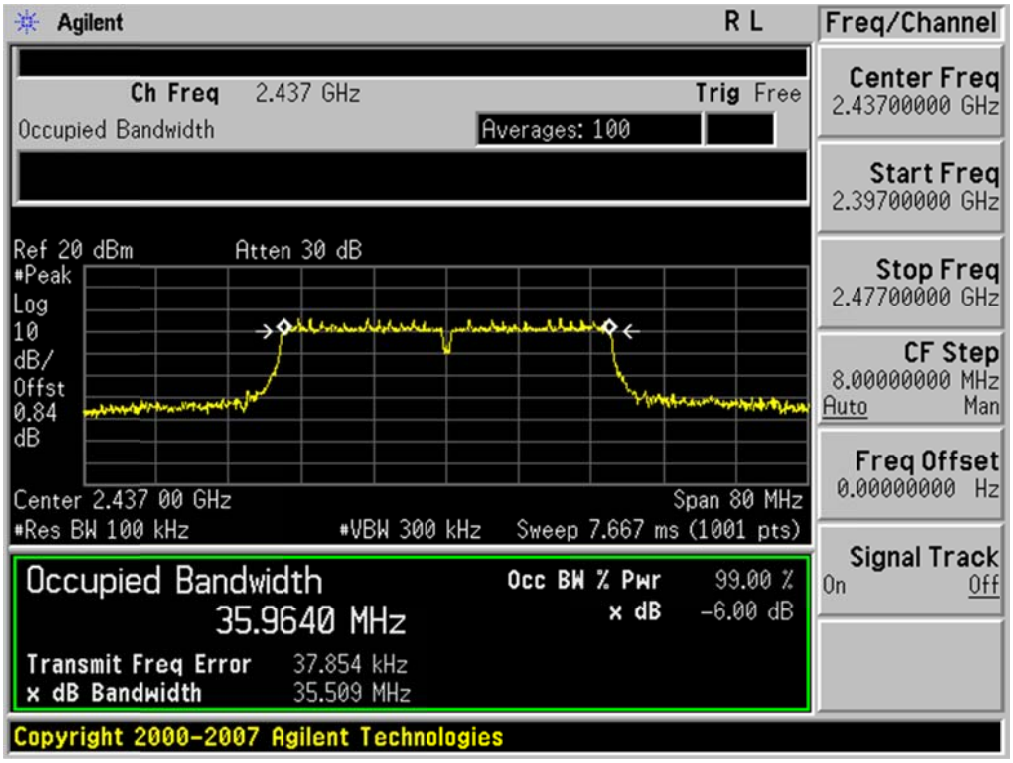
6 dB Bandwidth TM 3 & ANT 2 & Highest



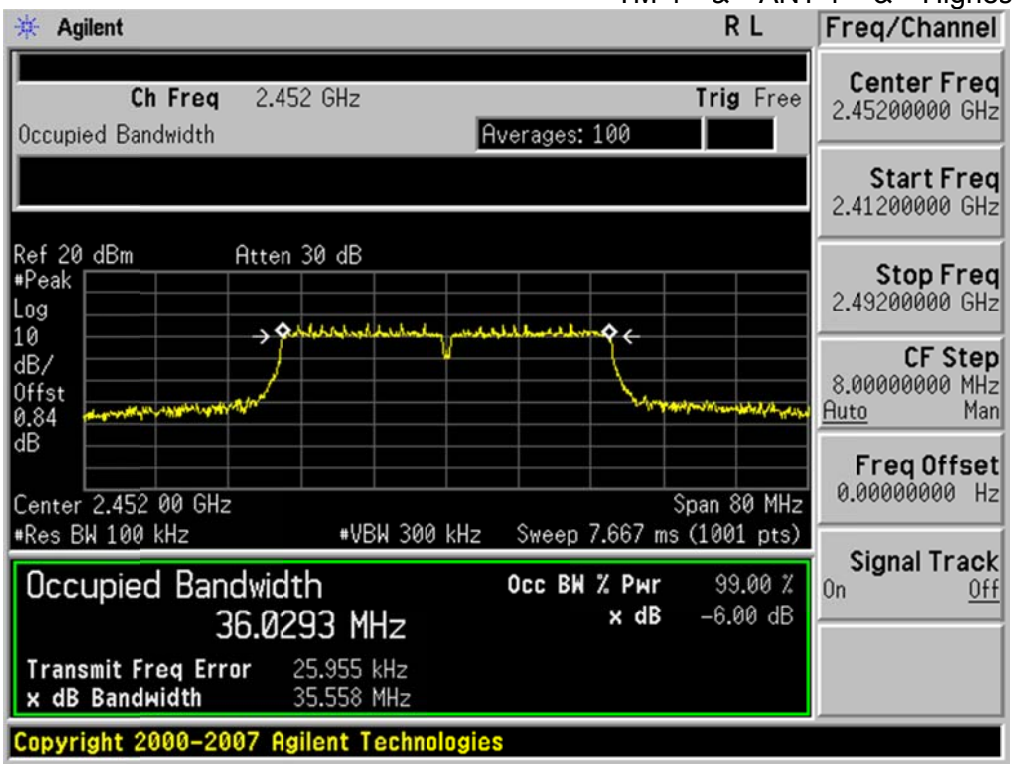
6 dB Bandwidth TM 4 & ANT 1 & Lowest



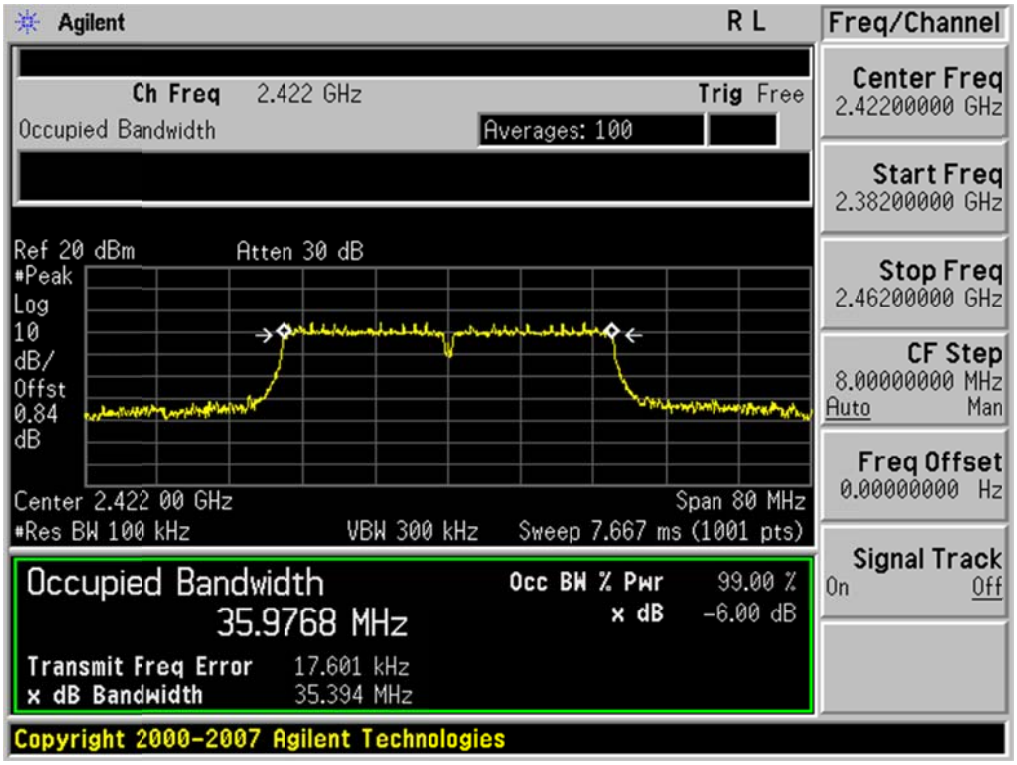
6 dB Bandwidth TM 4 & ANT 1 & Middle



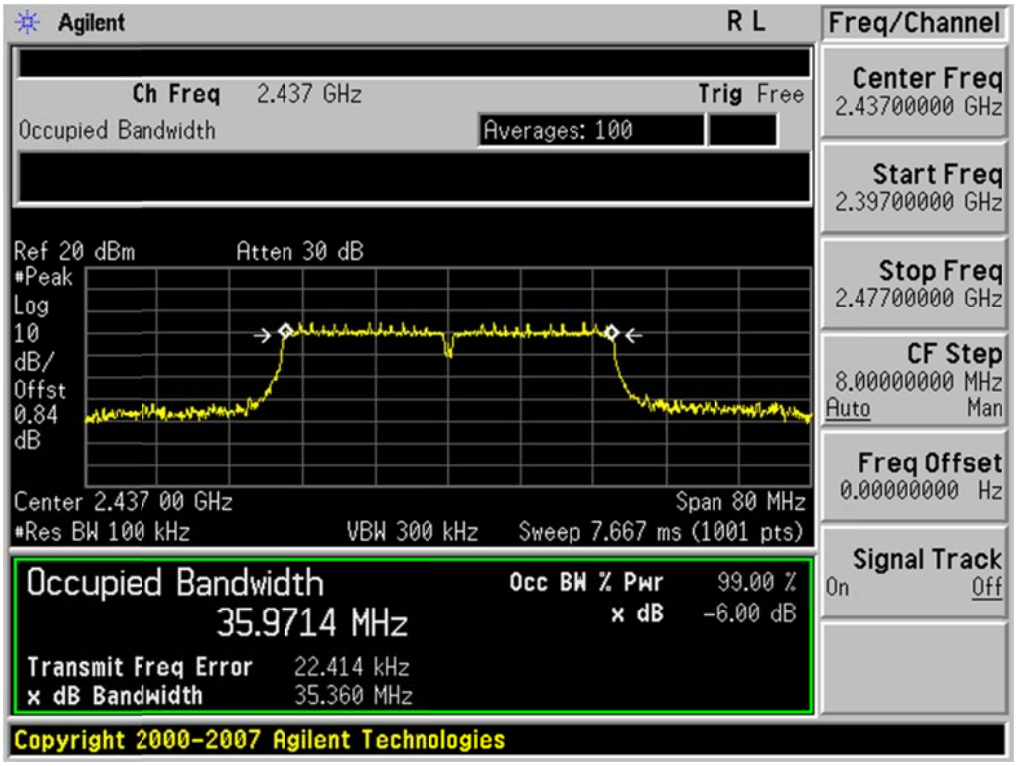
6 dB Bandwidth TM 4 & ANT 1 & Highest



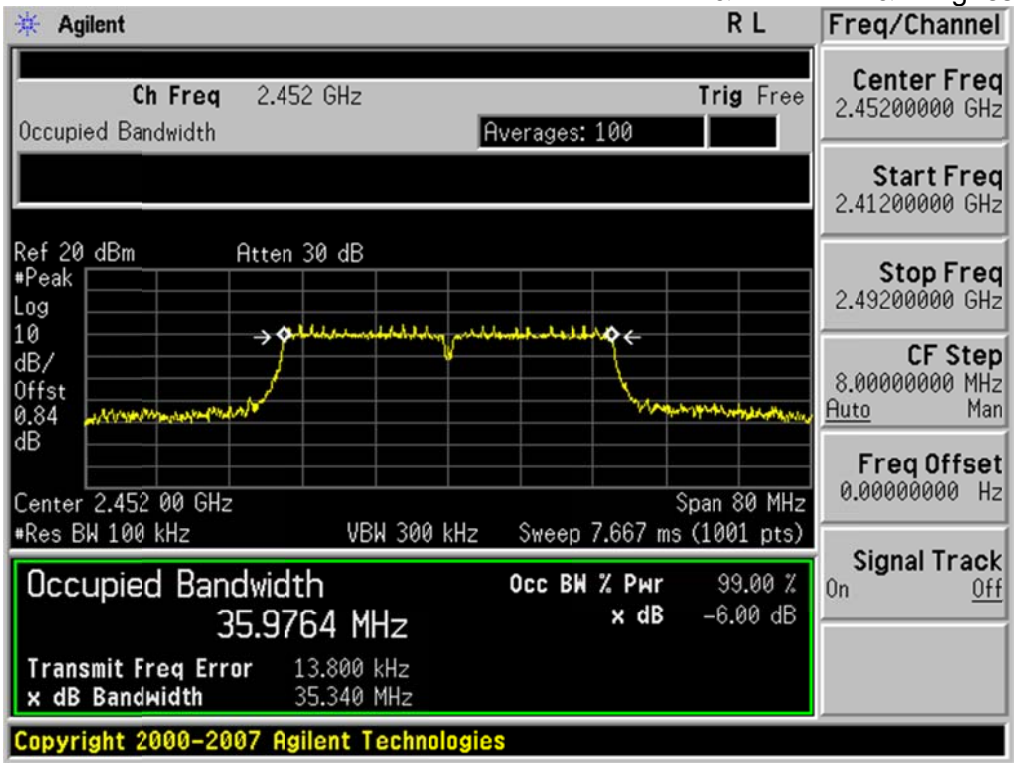
6 dB Bandwidth TM 4 & ANT 2 & Lowest



6 dB Bandwidth TM 4 & ANT 2 & Middle



6 dB Bandwidth TM 4 & ANT 2 & Highest

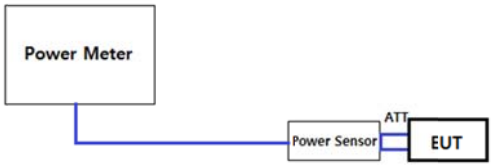


8.2 Maximum peak conducted output power

Test Requirements and limit, §15.247(b) & RSS-210 [A8.4]

The maximum permissible conducted output power is **1 Watt**.

▣ TEST CONFIGURATION



▣ TEST PROCEDURE:

1. **PKPM1 Peak power meter method of KDB558074 v03r2**
   The maximum conducted output powers were measured using a broadband peak RF power meter which has greater video bandwidth than DUT's DTS bandwidth and utilize a fast-responding diode detector.

2. **Method AVGPM-G (Measurement using a gated RF average power meter) of KDB558074 v03r2**
   The average conducted output powers were measured using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since this measurement is made only during the ON time of the transmitter, no duty cycle correction is required.

▣ TEST RESULTS: Comply

▪ Single transmitting

ANT	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm) for 802.11b			
			Data Rate [Mbps]			
			1	2	5.5	11
ANT 1	2412	PK	***15.184***	15.030	14.936	15.064
		AV	12.994	12.755	12.782	12.883
	2437	PK	15.156	15.054	15.068	15.112
		AV	12.946	12.818	12.911	12.909
	2462	PK	15.025	14.852	14.877	14.807
		AV	12.773	12.585	12.668	12.577

ANT	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm) for 802.11g							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
ANT 1	2412	PK	21.061	20.248	21.034	20.812	20.105	19.953	19.159	18.722
		AV	12.613	12.456	12.534	12.578	10.855	10.919	9.247	9.174
	2437	PK	***21.143***	20.786	20.685	20.931	19.968	19.703	18.557	18.423
		AV	13.163	13.067	13.037	13.227	11.262	11.411	9.727	9.537
	2462	PK	21.108	20.843	20.648	20.896	19.985	20.135	18.468	18.651
		AV	13.034	12.984	12.957	12.983	11.381	11.431	9.787	9.853

ANT	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm) for ***802.11n(HT20)***							
			Modulation and Coding Scheme [MCS]							
			0	1	2	3	4	5	6	7
ANT 1	2412	PK	***22.448***	22.378	22.116	22.051	20.679	20.798	20.219	20.126
		AV	14.948	14.209	14.403	14.501	12.813	12.921	11.102	11.218
	2437	PK	22.163	22.034	21.943	21.584	20.315	20.158	20.067	20.194
		AV	14.482	14.463	14.163	14.486	12.596	12.783	11.307	11.416
	2462	PK	22.187	22.018	21.984	21.943	20.168	20.463	20.153	19.984
		AV	14.714	14.503	14.263	14.531	12.684	12.893	11.167	11.215
ANT 2	2412	PK	18.103	17.948	17.943	18.039	17.241	17.012	15.264	15.179
		AV	10.012	9.861	9.486	9.568	8.324	8.413	6.524	6.519
	2437	PK	***18.247***	18.128	18.039	17.779	16.192	16.097	15.274	15.153
		AV	9.628	9.491	9.648	9.774	7.947	8.051	6.274	6.302
	2462	PK	17.441	17.123	17.343	17.138	16.015	16.161	15.084	15.131
		AV	8.904	8.948	8.783	8.913	7.317	7.512	5.747	5.722

ANT	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm) for ***802.11n(HT40)***							
			Modulation and Coding Scheme [MCS]							
			0	1	2	3	4	5	6	7
ANT 1	2422	PK	18.278	18.137	18.164	18.092	17.337	17.843	15.546	15.671
		AV	10.175	10.073	10.206	10.336	8.719	8.861	6.947	6.937
	2437	PK	19.521	18.751	18.786	18.704	18.543	18.167	17.167	16.741
		AV	10.358	10.475	10.647	10.743	8.875	9.064	7.248	7.227
	2452	PK	***19.527***	18.673	18.883	18.618	18.691	18.348	17.267	16.891
		AV	10.627	10.608	10.480	10.379	9.064	9.163	7.349	7.051
ANT 2	2422	PK	***17.709***	16.930	17.502	16.788	16.639	16.413	14.926	14.528
		AV	8.646	8.316	8.501	8.604	6.741	6.825	5.015	4.995
	2437	PK	17.019	16.451	16.863	16.215	16.310	16.124	14.523	14.259
		AV	8.109	8.035	8.354	8.384	6.536	6.483	5.043	4.843
	2452	PK	17.239	16.591	16.843	16.153	16.064	16.106	14.489	14.194
		AV	7.869	7.566	7.843	7.480	7.348	7.384	5.135	5.094

▪ **Multiple transmitting**

ANT	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm) for ***802.11n(HT20)***							
			Modulation and Coding Scheme [MCS]							
			8	9	10	11	12	13	14	15
ANT 1	2412	PK	20.831	21.167	20.974	21.332	20.558	20.313	18.913	18.624
		AV	13.343	13.435	13.584	13.747	11.747	12.174	10.547	10.571
	2437	PK	20.874	20.984	21.038	21.153	20.348	20.295	18.846	18.376
		AV	13.492	13.438	13.601	13.469	11.783	12.094	10.563	10.367
	2462	PK	21.463	21.563	21.674	***21.691***	20.493	20.138	18.898	18.648
		AV	13.671	13.416	13.518	13.357	11.943	12.153	10.676	10.249
ANT 2	2412	PK	16.831	16.815	16.678	16.549	16.201	16.012	15.137	15.167
		AV	8.721	8.735	8.646	8.684	7.392	7.751	6.112	6.230
	2437	PK	***17.157***	17.017	16.961	17.116	15.920	16.038	14.103	14.076
		AV	9.132	8.571	8.768	8.617	7.294	7.490	5.707	5.816
	2462	PK	16.423	16.348	16.135	16.338	15.291	15.441	14.152	13.764
		AV	8.337	8.135	8.033	8.215	6.713	7.012	5.151	5.097
Sum (ANT 1+2)	2412	PK	22.287	22.526	22.348	22.579	21.915	21.685	20.434	20.242
	2437	PK	22.412	22.449	22.472	22.598	21.686	21.679	20.103	19.749
	2462	PK	22.647	22.706	***22.744***	22.803	21.639	21.407	20.154	19.870

ANT	Freq. (MHz)	Det.	Maximum Peak Conducted Output Power (dBm) for ***802.11n(HT40)***							
			Modulation and Coding Scheme [MCS]							
			8	9	10	11	12	13	14	15
ANT 1	2422	PK	17.677	17.649	17.587	17.751	16.940	17.126	15.996	15.376
		AV	9.384	9.481	9.618	9.875	8.110	8.221	6.291	6.357
	2437	PK	17.761	18.468	18.131	***18.618***	17.764	17.591	16.479	15.091
		AV	9.871	9.874	10.036	10.174	8.501	8.594	6.634	6.559
	2452	PK	18.157	18.318	18.094	18.479	17.483	17.331	16.217	15.497
		AV	9.667	9.861	9.973	10.067	8.409	8.301	6.597	6.698
ANT 2	2422	PK	16.309	***17.209***	16.112	17.219	16.074	15.343	14.339	14.318
		AV	7.781	7.761	7.741	7.951	6.230	6.462	4.422	4.413
	2437	PK	16.812	16.135	15.843	16.463	15.064	14.974	14.218	14.261
		AV	7.684	7.267	7.616	6.972	6.034	6.138	4.136	4.254
	2452	PK	16.313	16.094	15.763	16.137	15.315	15.071	14.354	14.076
		AV	7.516	7.348	7.243	7.466	6.165	6.168	4.264	4.117
Sum (ANT 1+2)	2422	PK	20.057	20.445	19.923	20.504	19.539	19.336	18.257	17.890
	2437	PK	20.323	20.467	20.147	***20.684***	19.631	19.488	18.505	17.707
	2452	PK	20.343	20.358	20.094	20.475	19.544	19.357	18.395	17.855

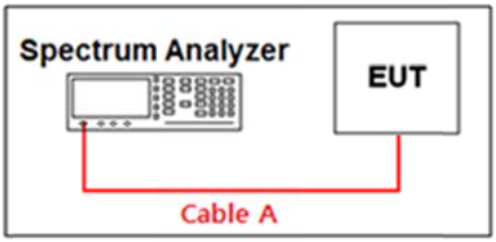
8.3 Maximum power spectral density

Test requirements and limit, §15.247(e) & RSS-210 [A8.2]

The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

Minimum Standard –specifies a conducted power spectral density (PSD) limit of 8 dBm in any 3 kHz band segment within the fundamental EBW during any time interval of continuous transmission.

▣ TEST CONFIGURATION



▣ TEST PROCEDURE:

The Measurement Procedure **Method PKPSD of KDB558074 v03r2** is used.

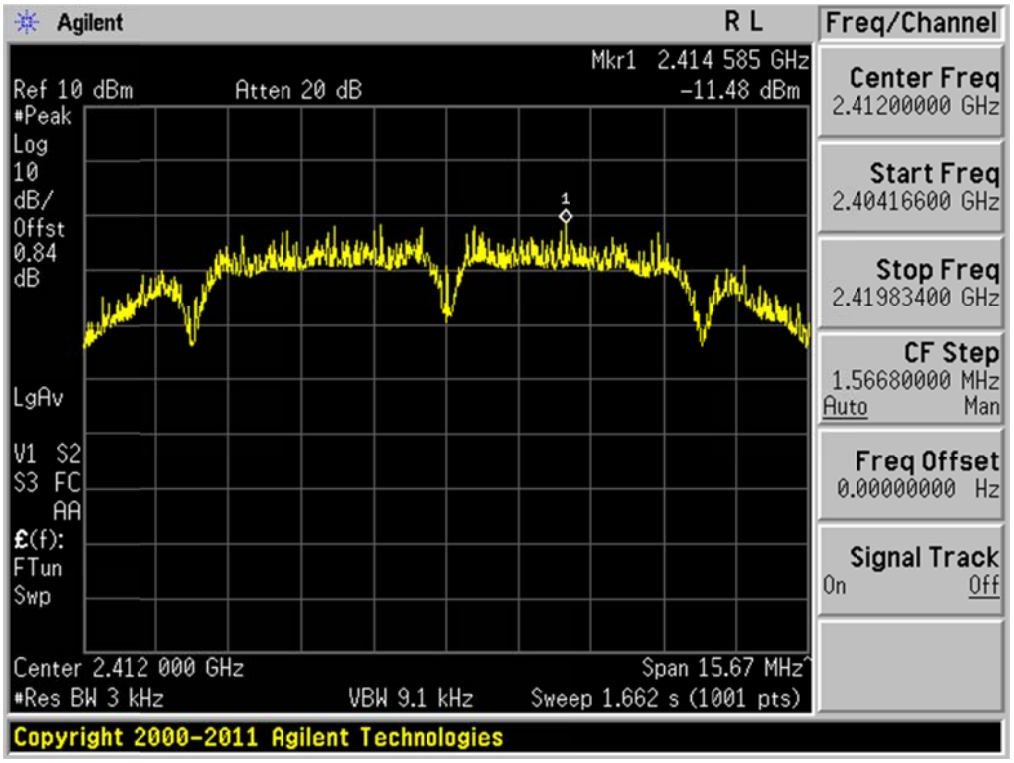
1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to **1.5 times** the DTS bandwidth.
3. Set the RBW to: **3 kHz** ≤ RBW ≤ **100 kHz**
4. Set the VBW ≥ **3 x RBW**
5. Detector = **peak**
6. Sweep time = **auto couple**
7. Trace mode = **max hold.**
8. Allow trace to fully stabilize.
9. Use the **peak marker function** to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

▣ **TEST RESULTS:** Comply

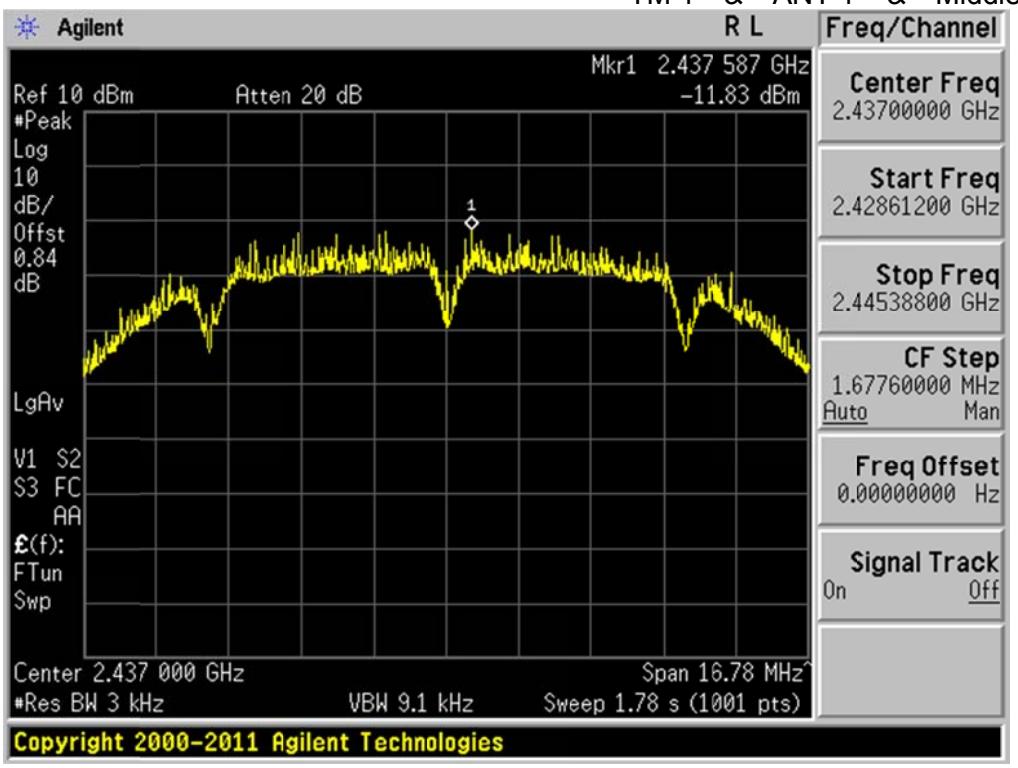
Test Mode	Frequency	RBW	PKPSD [dBm]		
			ANT 1	ANT 2	SUM (ANT 1 + ANT 2)
TM 1	Lowest	3 kHz	-11.480	-	-
	Middle	3 kHz	-11.830	-	-
	Highest	3 kHz	-11.450	-	-
TM 2	Lowest	3 kHz	-15.700	-	-
	Middle	3 kHz	-14.410	-	-
	Highest	3 kHz	-14.680	-	-
TM 3	Lowest	3 kHz	-13.880	-18.050	-12.473
	Middle	3 kHz	-14.400	-17.580	-12.695
	Highest	3 kHz	-12.440	-18.730	-11.524
TM 4	Lowest	3 kHz	-17.080	-19.060	-14.948
	Middle	3 kHz	-16.960	-19.400	-15.001
	Highest	3 kHz	-16.980	-19.980	-15.216

▣RESULT PLOTS

Maximum PPSD TM 1 & ANT 1 & Lowest

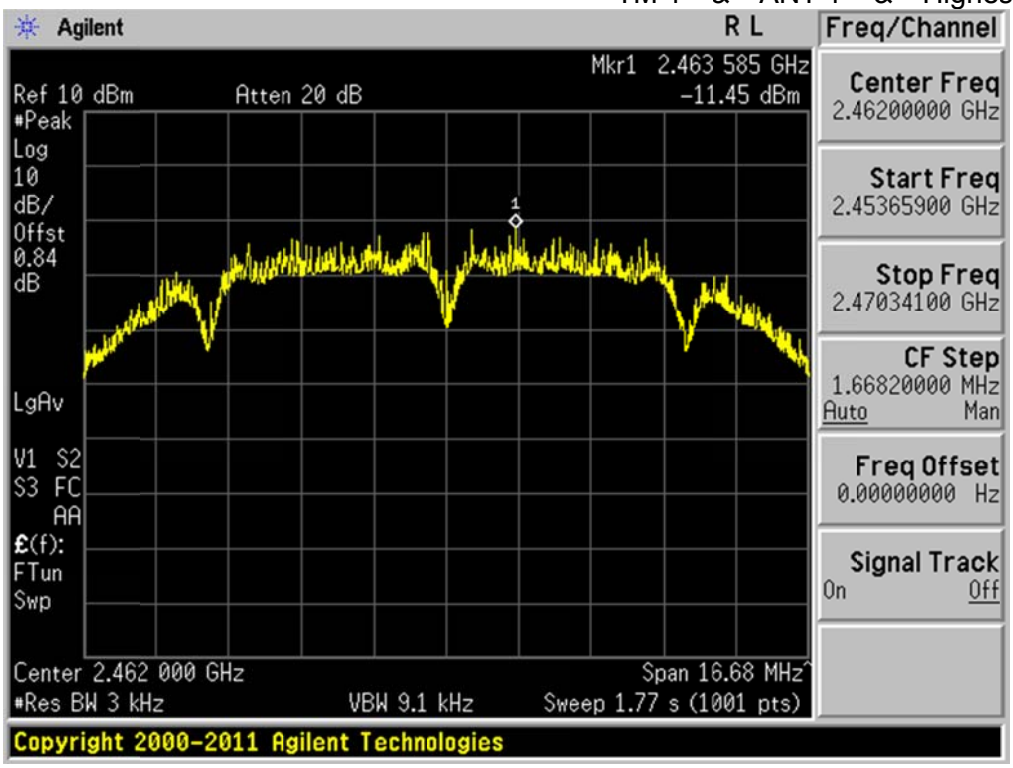


Maximum PPSD TM 1 & ANT 1 & Middle

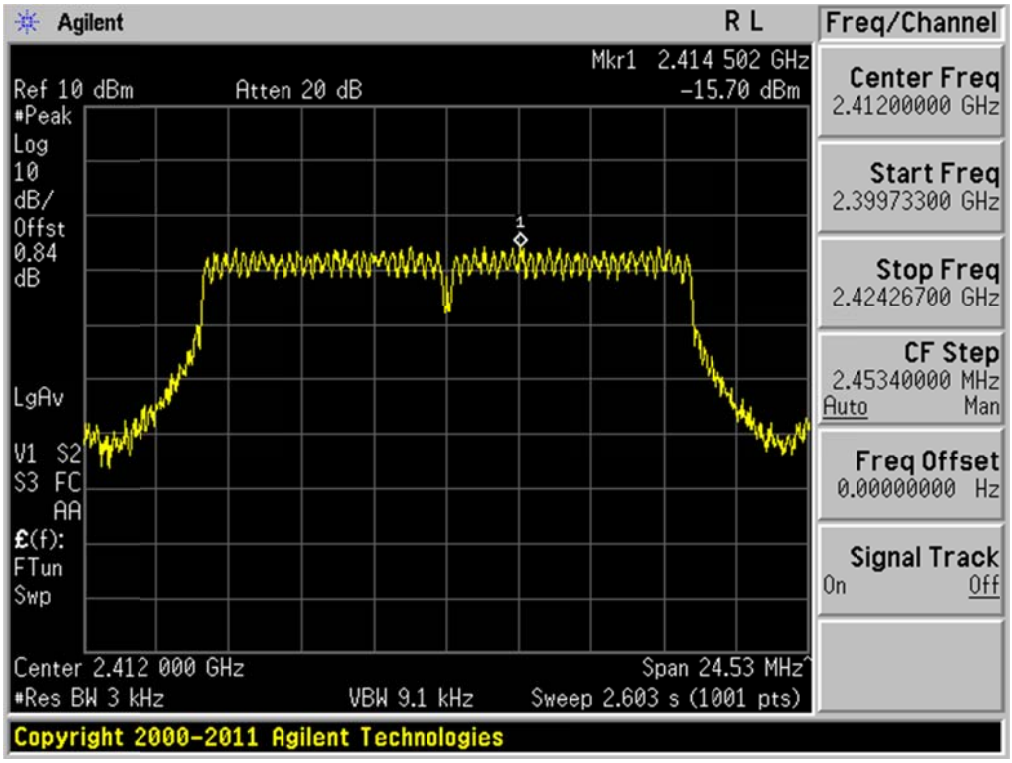


Maximum PPSD

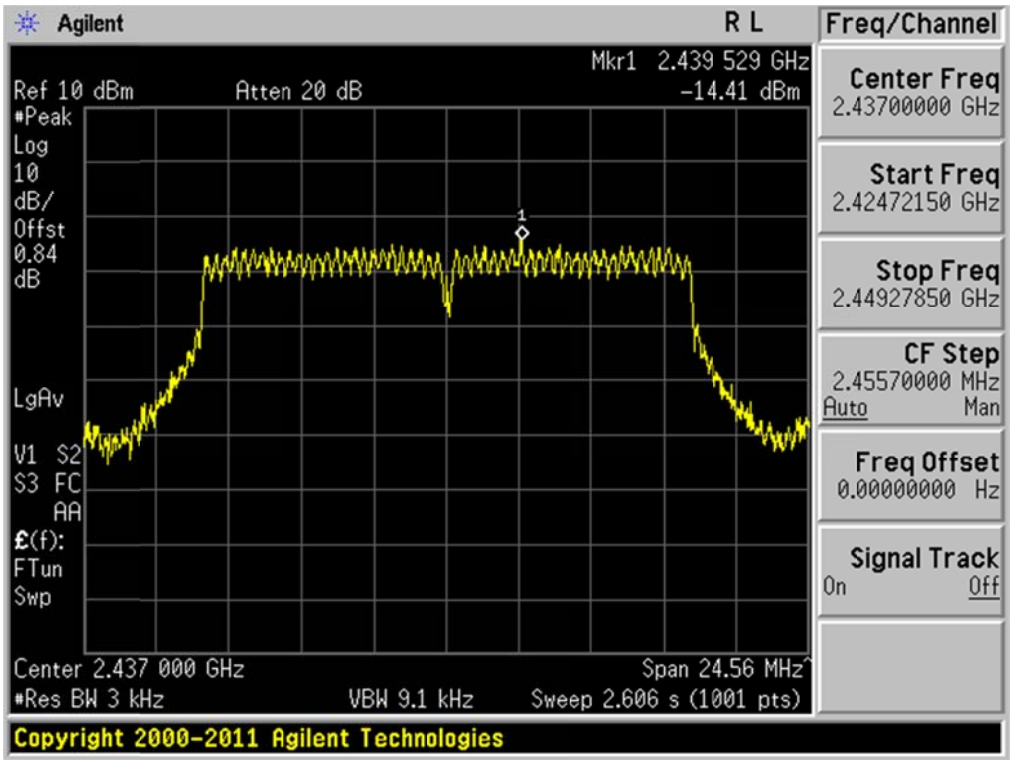
TM 1 & ANT 1 & Highest



Maximum PPSD TM 2 & ANT 1 & Lowest

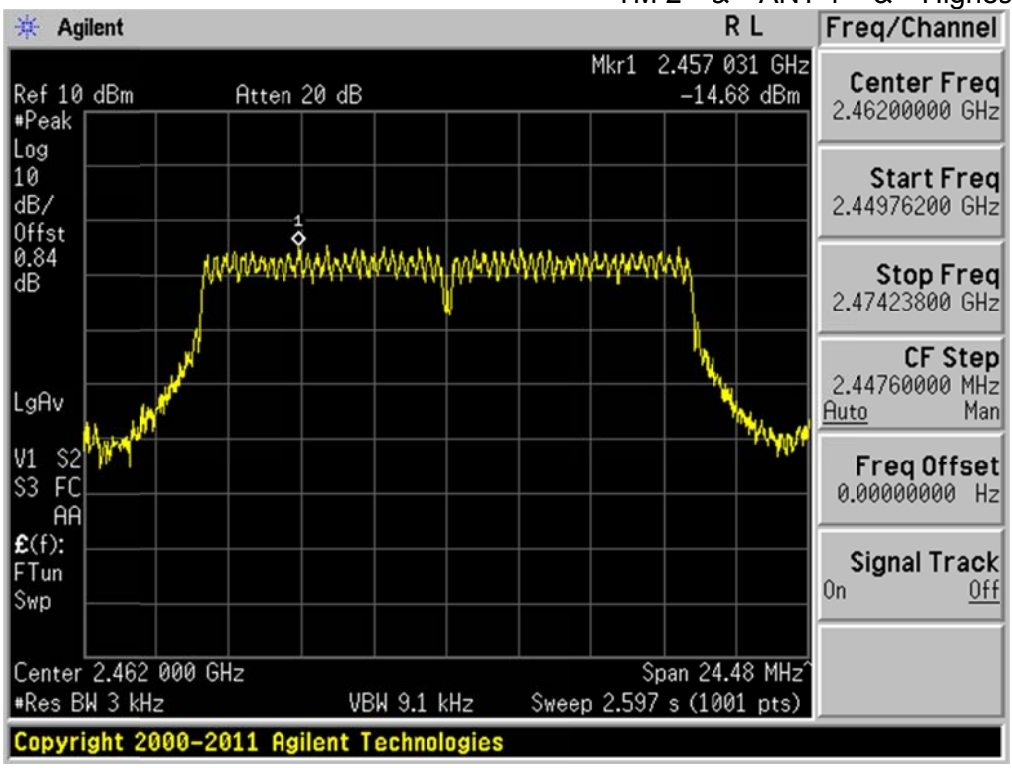


Maximum PPSD TM 2 & ANT 1 & Middle

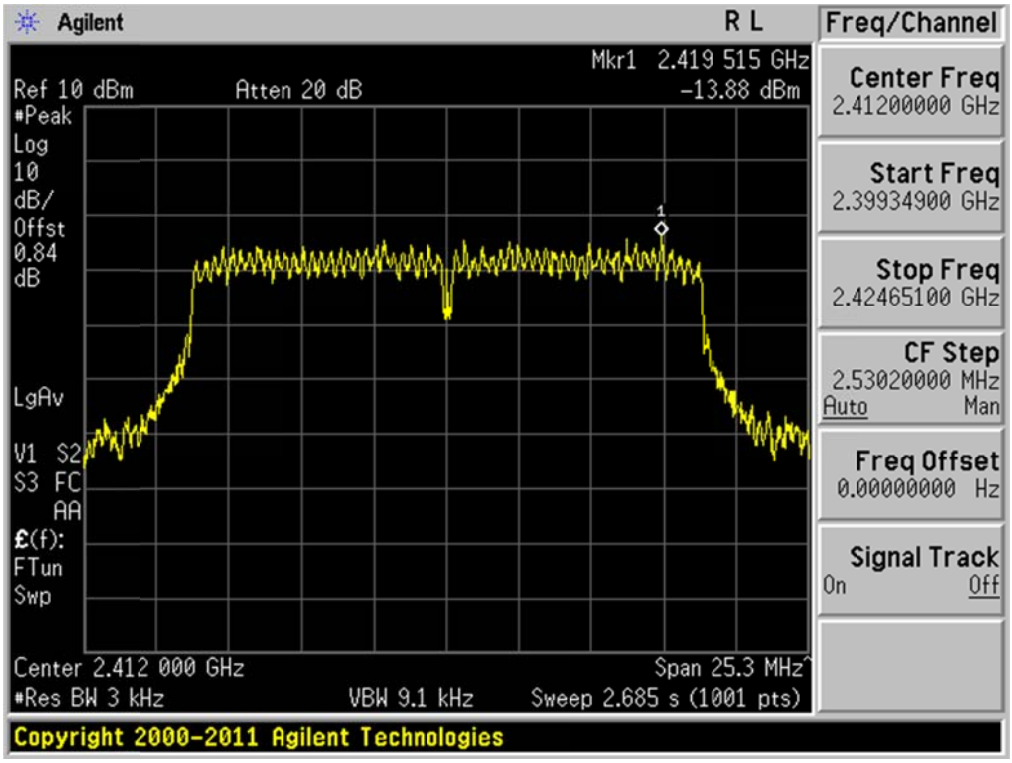


Maximum PPSD

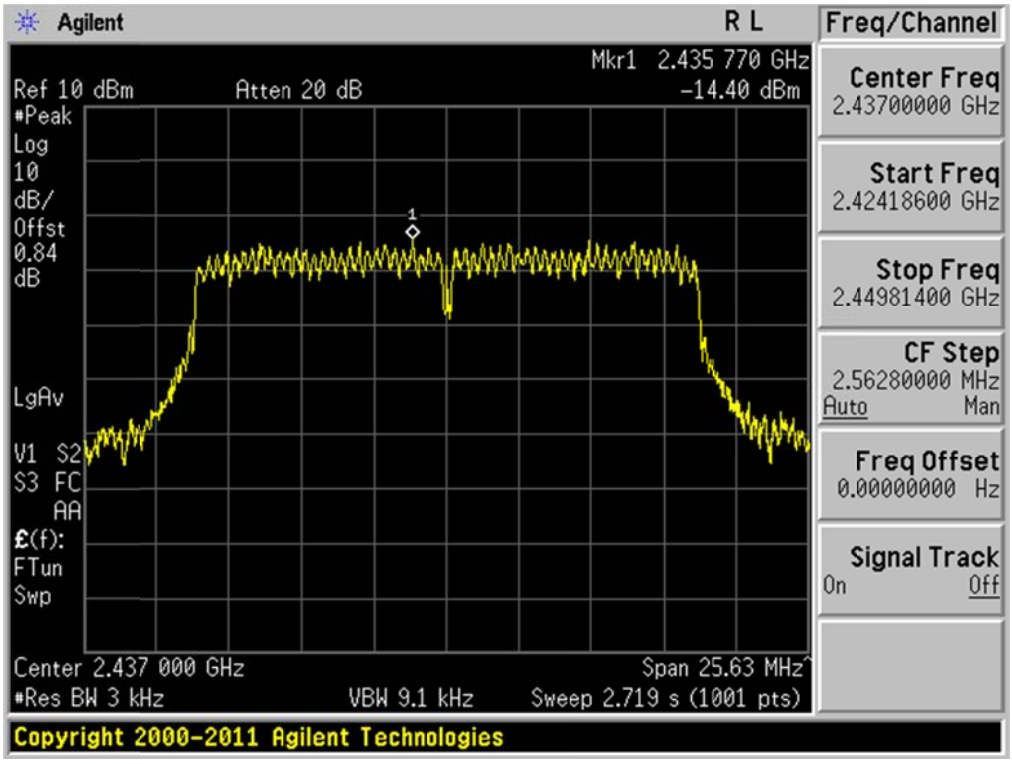
TM 2 & ANT 1 & Highest



Maximum PPSD TM 3 & ANT 1 & Lowest

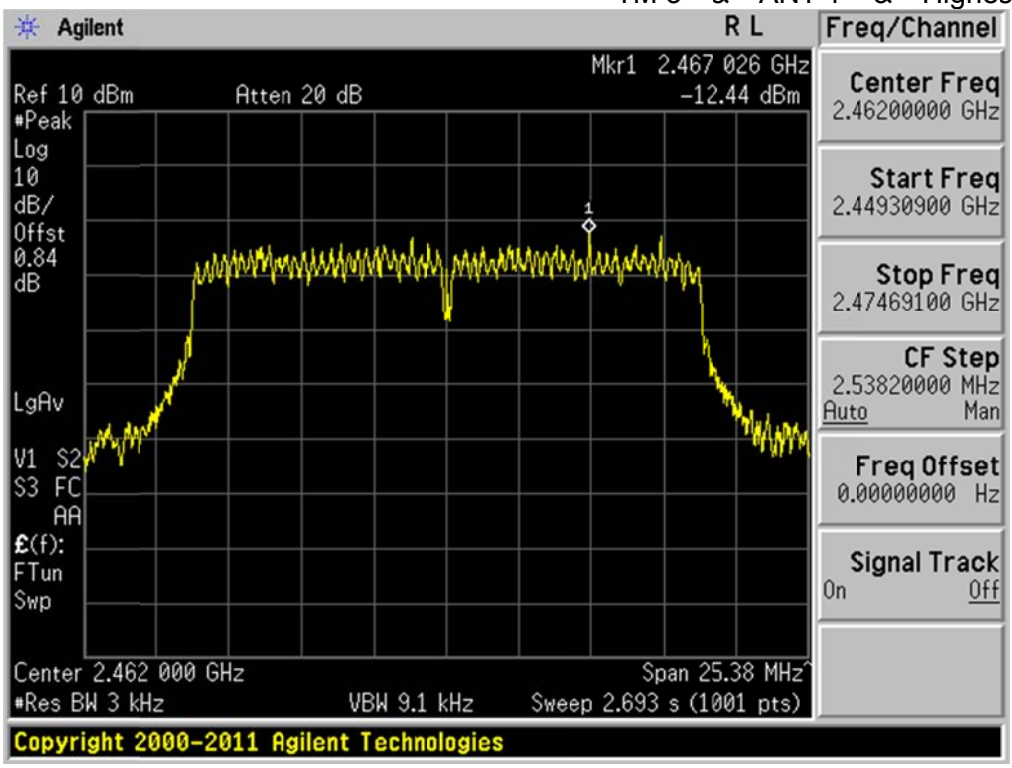


Maximum PPSD TM 3 & ANT 1 & Middle

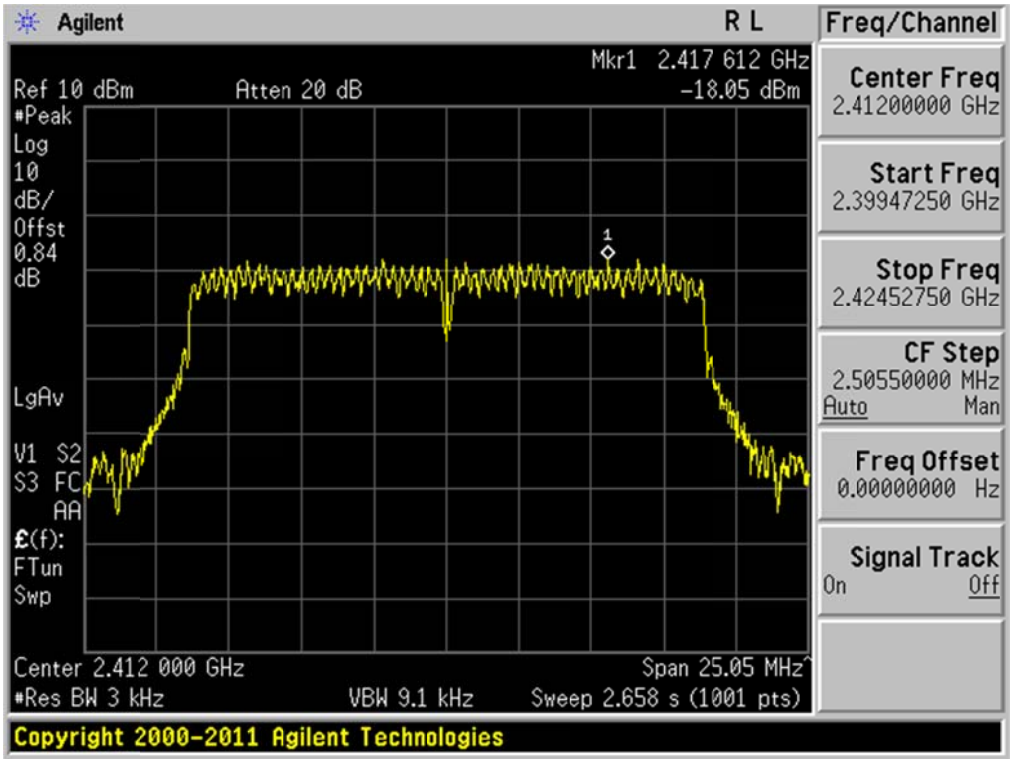


Maximum PPSD

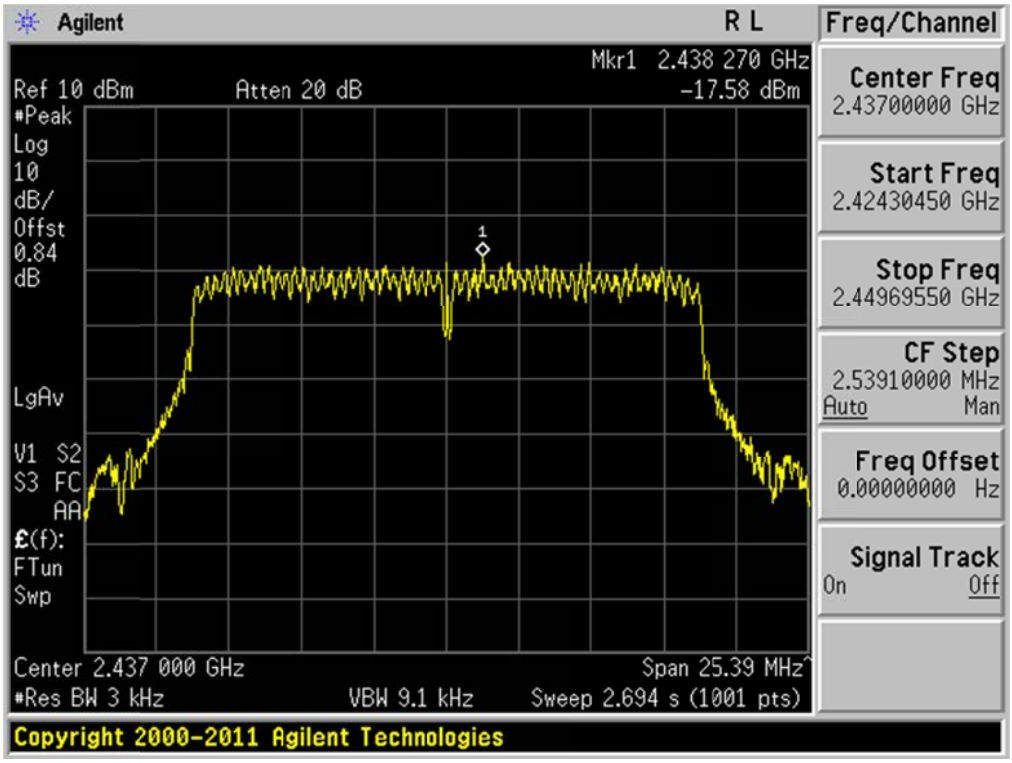
TM 3 & ANT 1 & Highest



Maximum PPSD TM 3 & ANT 2 & Lowest

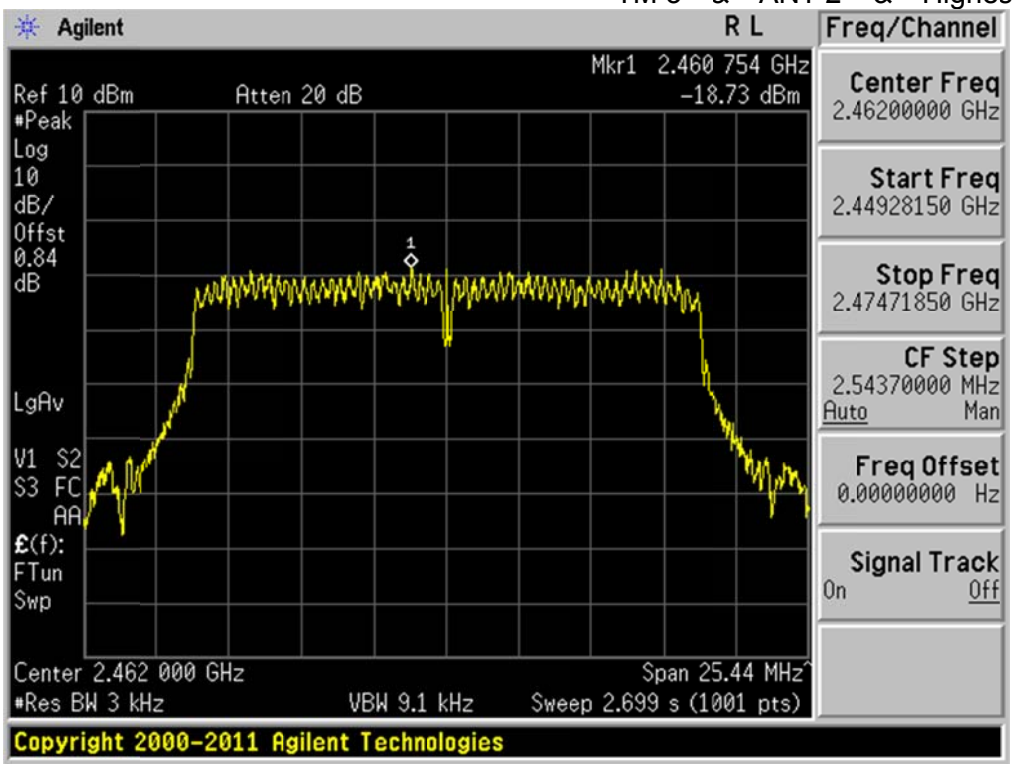


Maximum PPSD TM 3 & ANT 2 & Middle

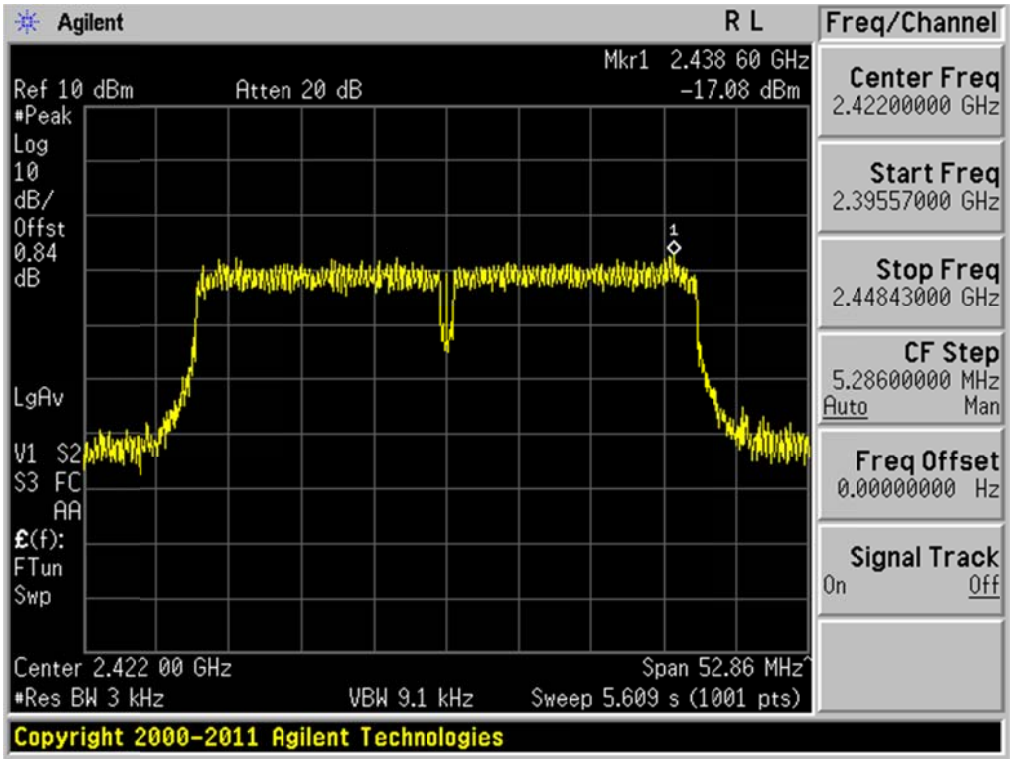


Maximum PPSD

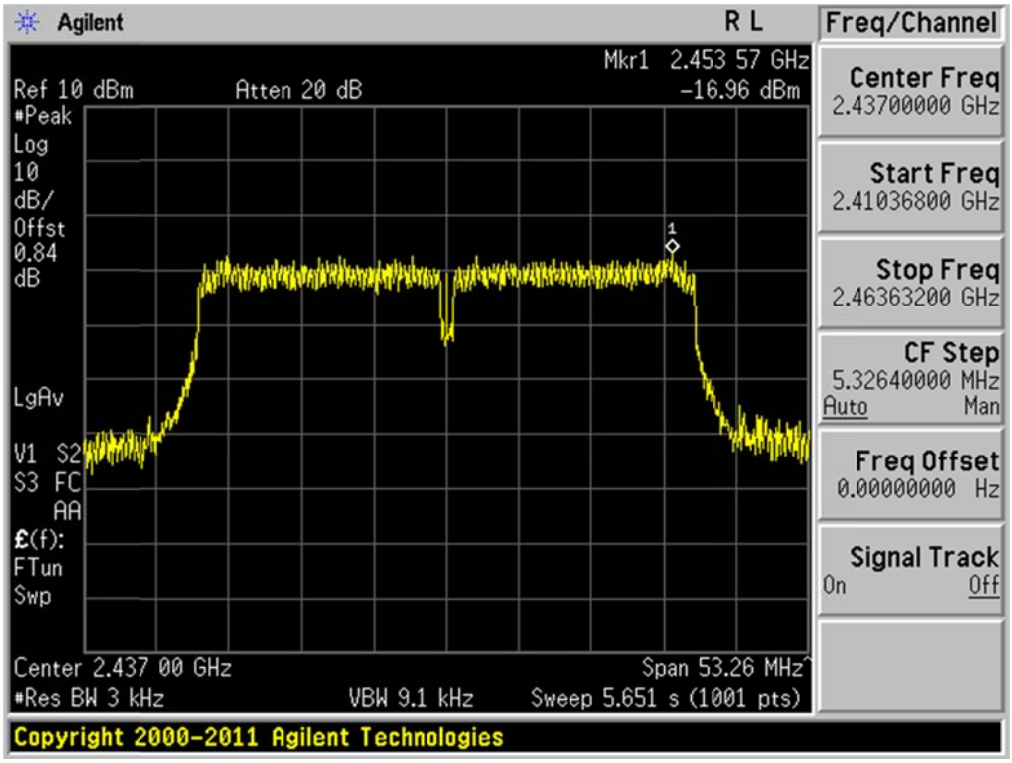
TM 3 & ANT 2 & Highest



Maximum PPSD TM 4 & ANT 1 & Lowest

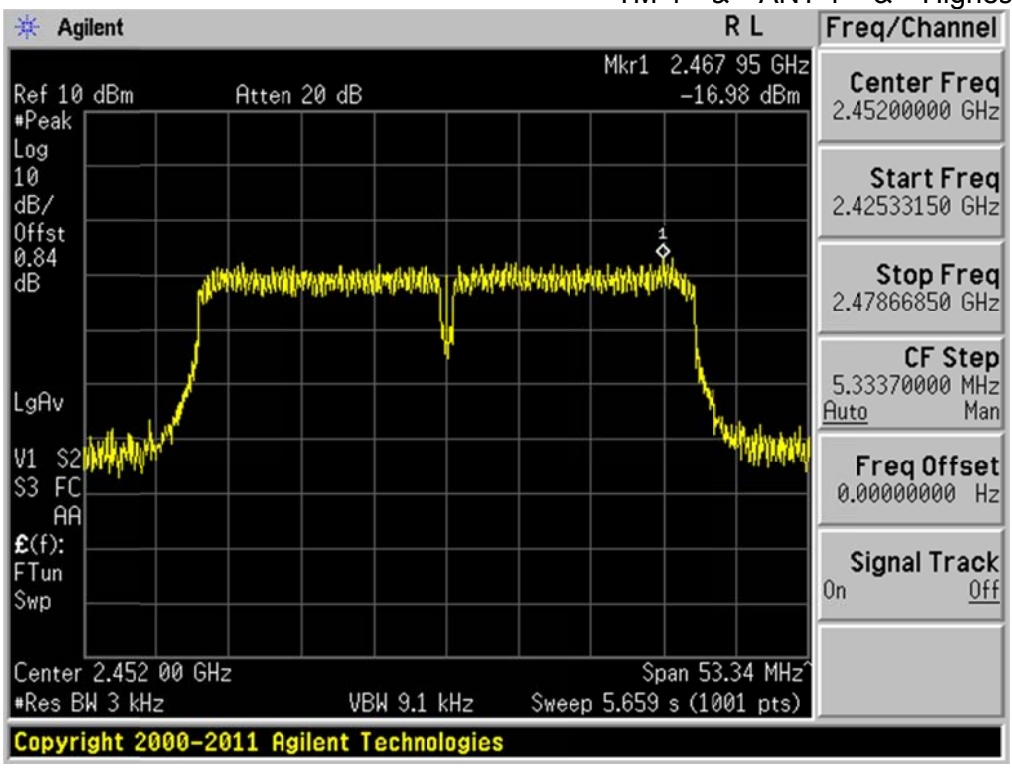


Maximum PPSD TM 4 & ANT 1 & Middle

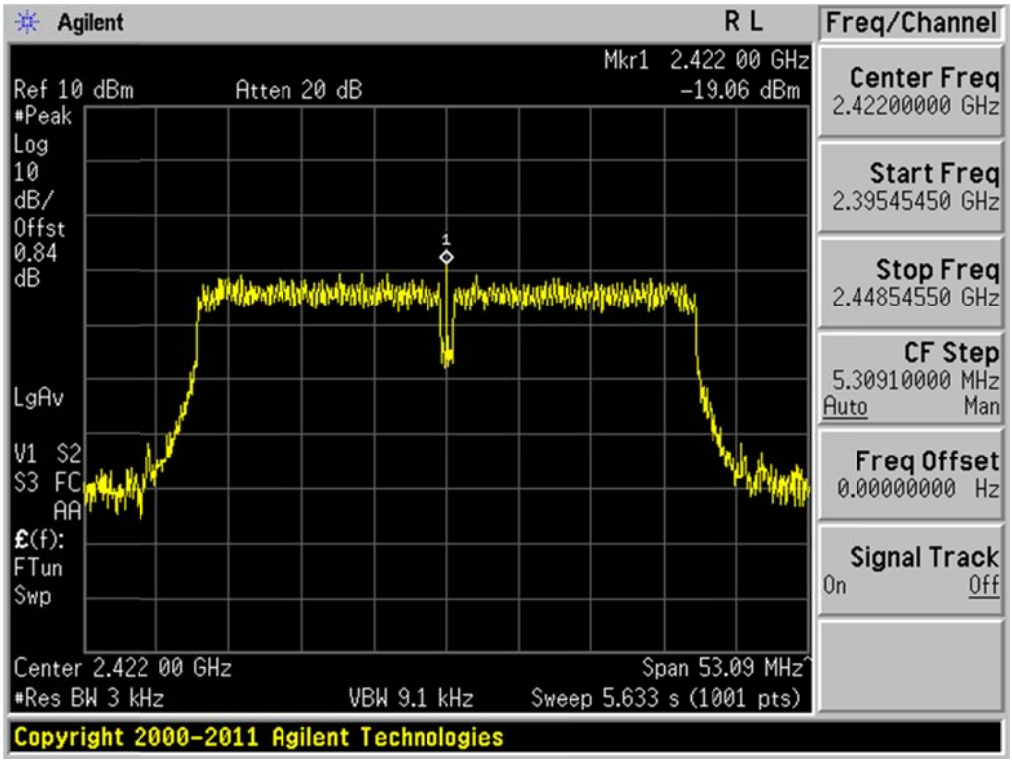


Maximum PPSD

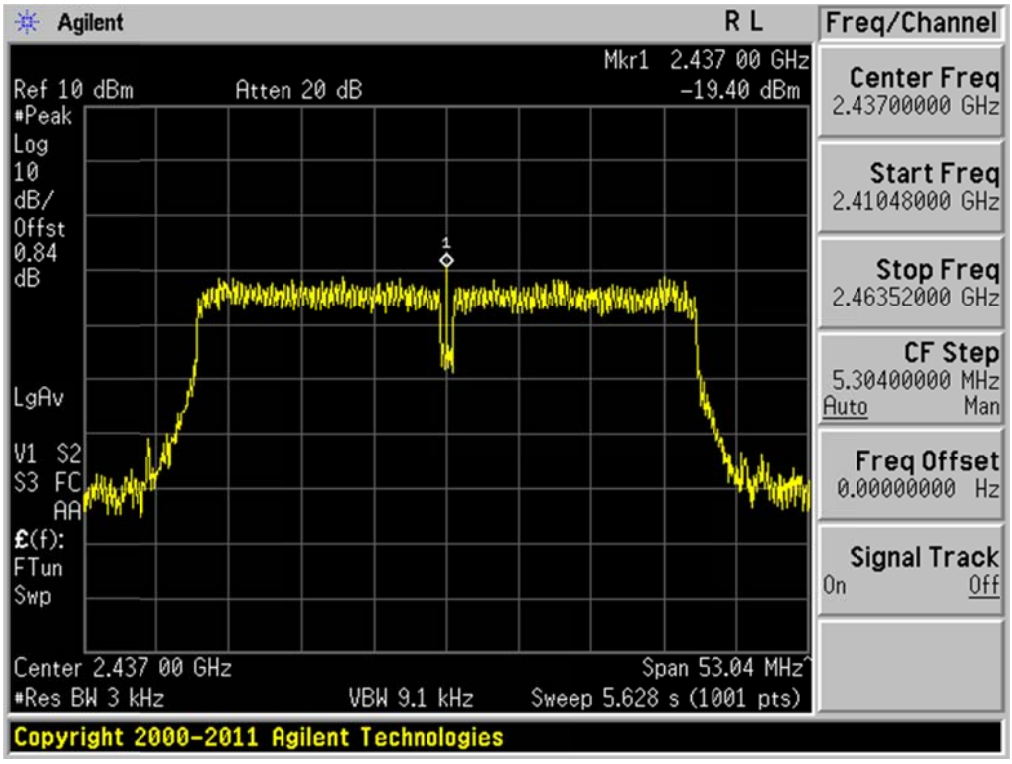
TM 4 & ANT 1 & Highest



Maximum PPSD TM 4 & ANT 2 & Lowest



Maximum PPSD TM 4 & ANT 2 & Middle



Maximum PPSD

TM 4 & ANT 2 & Highest