

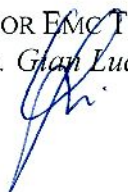

 <p>CE MARKING ELECTROMAGNETIC COMPATIBILITY ELECTRICAL SAFETY LASER SPECTROSCOPY ENVIRONMENTAL PHYSIC</p>  <p>www.tuv.com TÜV Rheinland ID: 9105021519</p> <p>Organizzazione con Sistema di Gestione certificato Company with Management System certified ISO 9001:2008</p> 		
G.S.D. S.r.l. PISA - Italy	Test Report n. 12962-FCC-IC	Rev. 03
Manufacturer	TWS S.r.l.	
Address	Via Zaccagna, 6 54033 Avenza Carrara (MS) Italy	
Test Family Name	6081-001 (WIFI subsystem)	
Testing Laboratory Name	G.S.D. S.r.l.	
Address	Via Marmiceto, 8 56121 Ospedaletto Pisa (PI) Italy	
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http – e-mail	www.gsd.it - info@gsd.it	
	FCC Listed: Registration Number: 424037 IC Listed: Registration Number: 9353A	
Location and Date of Issue	Pisa, 2012 July 16	
<p style="text-align: center;">G.S.D. s.r.l. Via Marmiceto, 8 56121 OSPEDALETTO - PISA Tel. 050.984254 - Fax 050.984262 P. IVA 01343950505</p> <div style="display: flex; justify-content: space-between;"> <div style="text-align: center;"> <p>SENIOR EMC TEST MANAGER Dr. Gian Luca Genovesi</p>  </div> <div style="text-align: center;"> <p>QUALITY MANAGER Dr. David Pelliccia</p>  </div> </div>		

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1. MANUFACTURER AND EUT IDENTIFICATION¹	
Manufacturer	TWS S.r.l..
Address	Via Zaccagna, 6 54033 Avenza Carrara (MS) Italy
Test Family Name	6081-001 (WIFI subsystem)
Date of reception	2012 March 08
Sampling	Laboratory sample for certification
Test Item Description	WiFi Device
	This system is made by a WIFI module (APM6981), a low pass-filter (LFB2H2G45SG7A158), an antenna switch (AS179-92LF), internal antenna and SMA reverse external antenna connector. This system is controlled by an external CPU using a digital signals (SD I/O bus).
Nominal Input Voltage	3.3 Vdc
Auxiliary Equipment	Tests were performed on the FURUNO Mod. GP-1870 sn 2030245 containing 6081-001 (WIFI subsystem)
Software	PDA UniTest eeprom 25u.exe
FCC ID	CU9-6081-001

¹A detailed documentation is preserved in the internal fascicle.

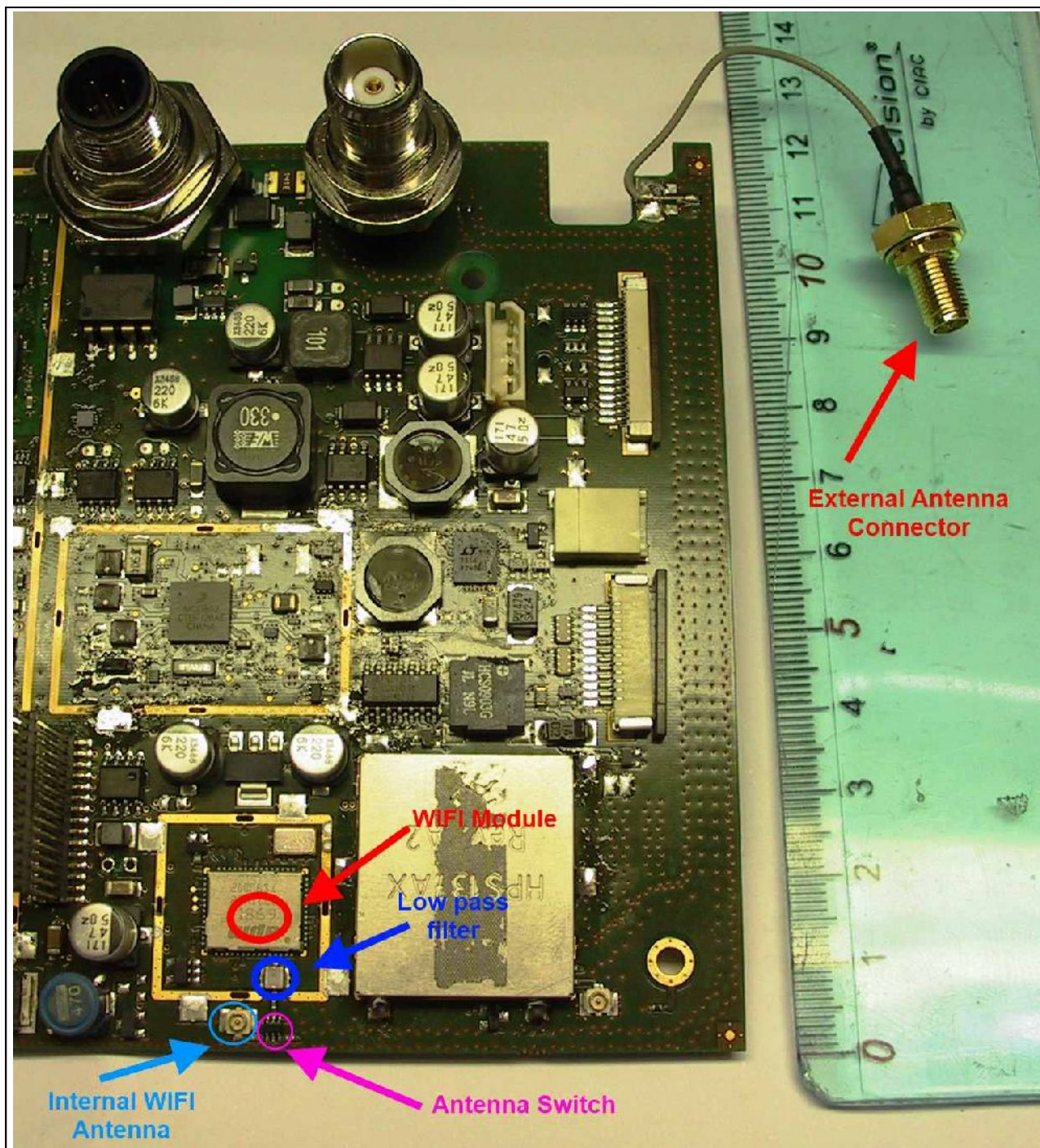


Fig. 1.1
Equipment Under Test - Photo

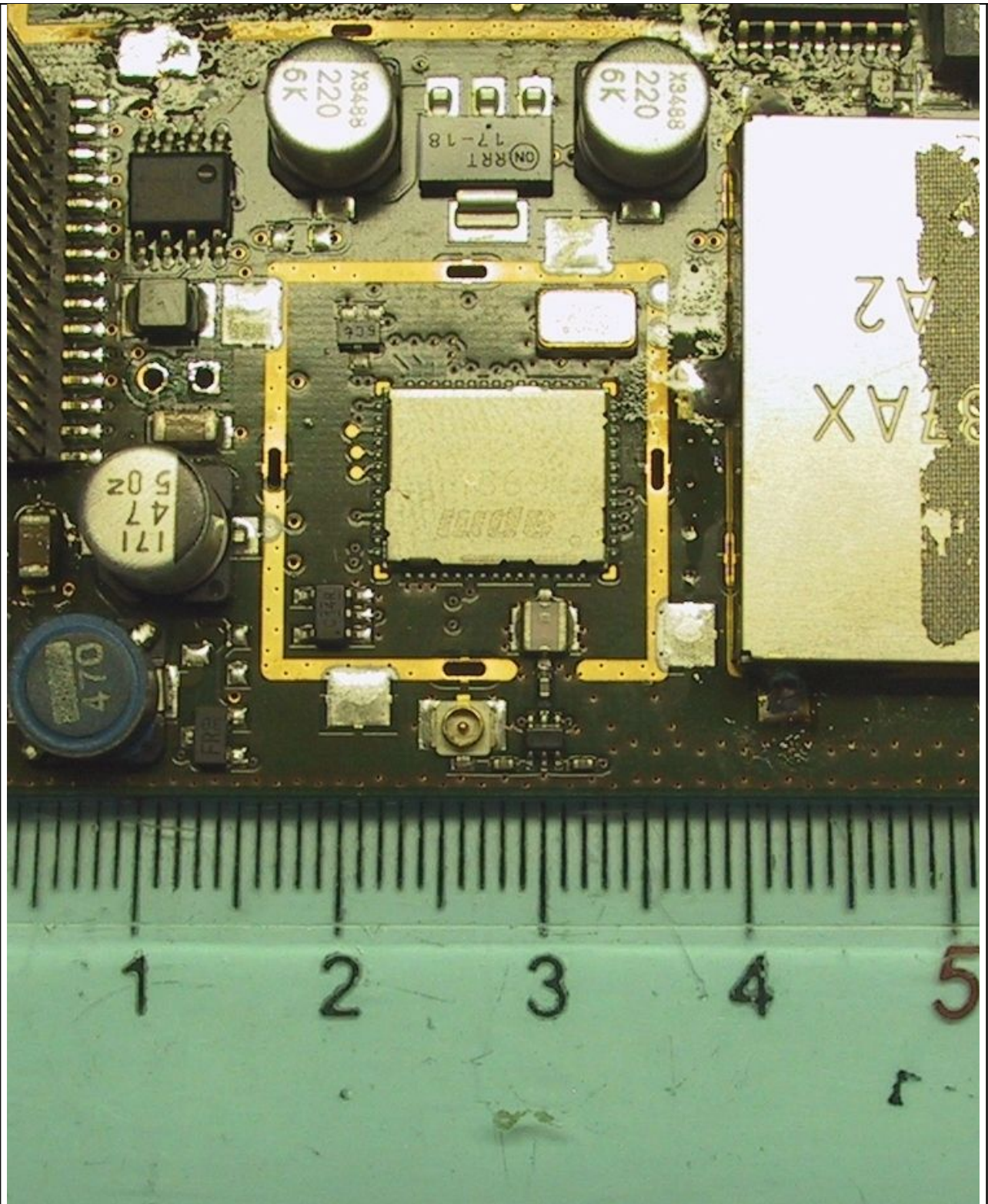


Fig. 1.2
Equipment Under Test - Photo

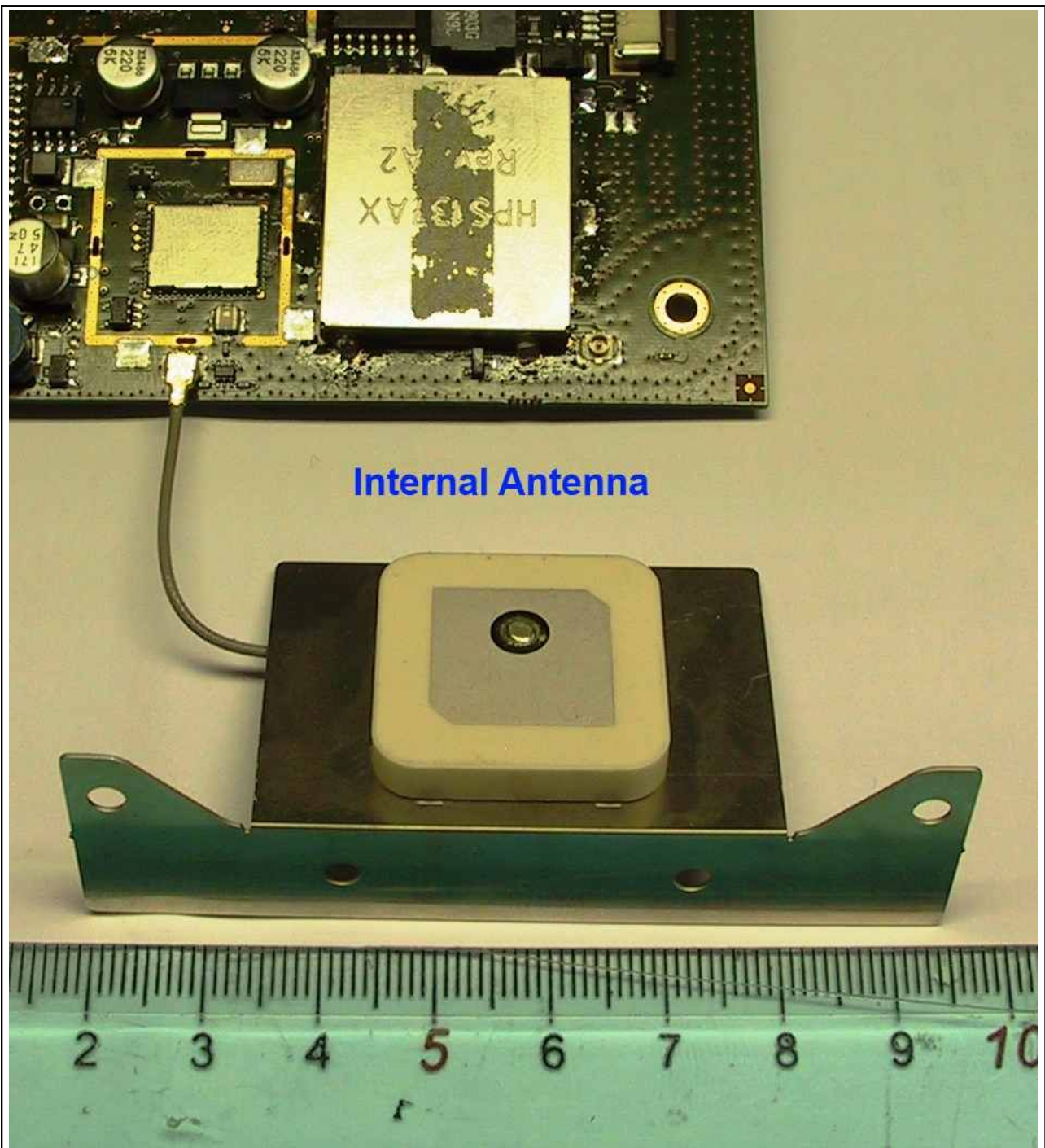


Fig. 1.3
Equipment Under Test - Photo

2. REFERENCE STANDARDS

Tests and measurements are performed accordingly to the reference standards given in the table below:

<i>TEST</i>	<i>STANDARD</i>
Operation within the band 2400-2483,5 MHz: Test Procedures 15.247 (a)(2), (b)(3), (d), (e)	FCC Rules and Regulations, Title 47 (2008) Part 15 – Sub part B ANSI C63.4 – American National Standard for Methods of Measuring of Radio-Noise Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz – 40 GHz
Annex 8, Frequency Hopping and Digital Modulation Systems Operating in the Bands 902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz	RSS-210 Issue 8 Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment
Maximum Permissible Exposure	OET Bulletin 65 Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields FCC Rules and Regulations, Title 47 (2008) Part 15 – Sub part B

3. RESULT, CONDITION, MEASUREMENT UNCERTAINTYSummary of Test Results

<i>TEST</i>	<i>RESULT</i>
6 dB bandwidth Section 15.247 (a) (2)	Pass
Peak Conducted Output Power: Section 15.247 (b) (3)	Pass
Band Edge Section 15.247 (d)	Pass
Power Spectral Density Section 15.247 (e)	Pass
Power Line Conducted Emissions Section 15.207	Pass
Radiated Emissions Section 15.209	Pass

Internal Procedures:

APR01: internal procedure for antenna port measurement Revision 01

CE22R01: internal procedure for power lead port measurement Revision 01

RE22R02: internal procedure for radiated emissions measurement Revision 02

Measurement uncertainty

<i>TEST</i>	<i>EXPANDED UNCERTAINTY</i>
Conducted Emission – 50Ω/50μH AMN (150 kHz - 30 MHz)	± 3.5 dB
Radiated Emission – (Semianechoic Room) (30 MHz - 40 GHz)	± 4.7 dB

Climatic Conditions

<i>PARAMETER</i>	<i>VALUE</i>
Temperature	(293 ± 3) K
Relative humidity	(50 ± 5) %

Power during the tests: 12 Vdc

External Antenna used: INTELLINET - I-WL2-ANT3 - 5dBi

Internal Antenna: TAOGLAS model WLP2450 - 5dBi

Extensions

The results refer only to the sampled EUT and under the specified conditions.

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4. 6 dB BANDWIDTH

Peak Output Power

Equipment shall meet the limits below .

<i>FREQUENCY RANGE</i> (MHz)	Limit
2400 2483,5	The minimum 6 dB Bandwidth shall be at least 500 kHz

Results: 6dB Bandwidth > 500 kHz

802.11b Mode, 11 Mbs

<i>Channel</i>	<i>Frequency</i> (MHz)	<i>6 dB Bandwidth</i> (MHz)	<i>Minimum Limit</i> (MHz)	<i>Margin</i> (MHz)
Low	2412	9,58	0,5	9,08
Mid	2437	9,62	0,5	9,12
High	2462	9,66	0,5	9,16

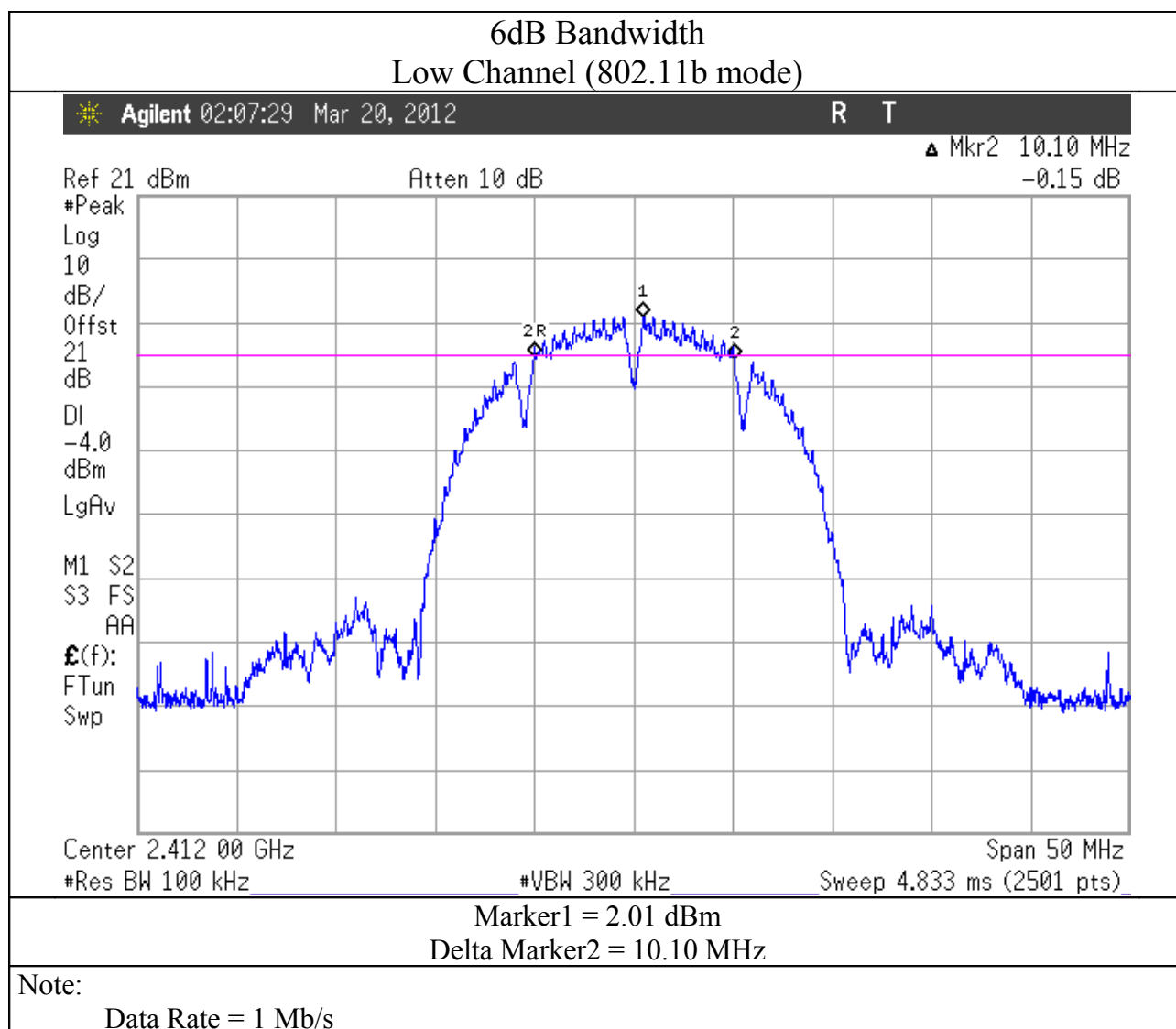
802.11g Mode, 54 Mbs

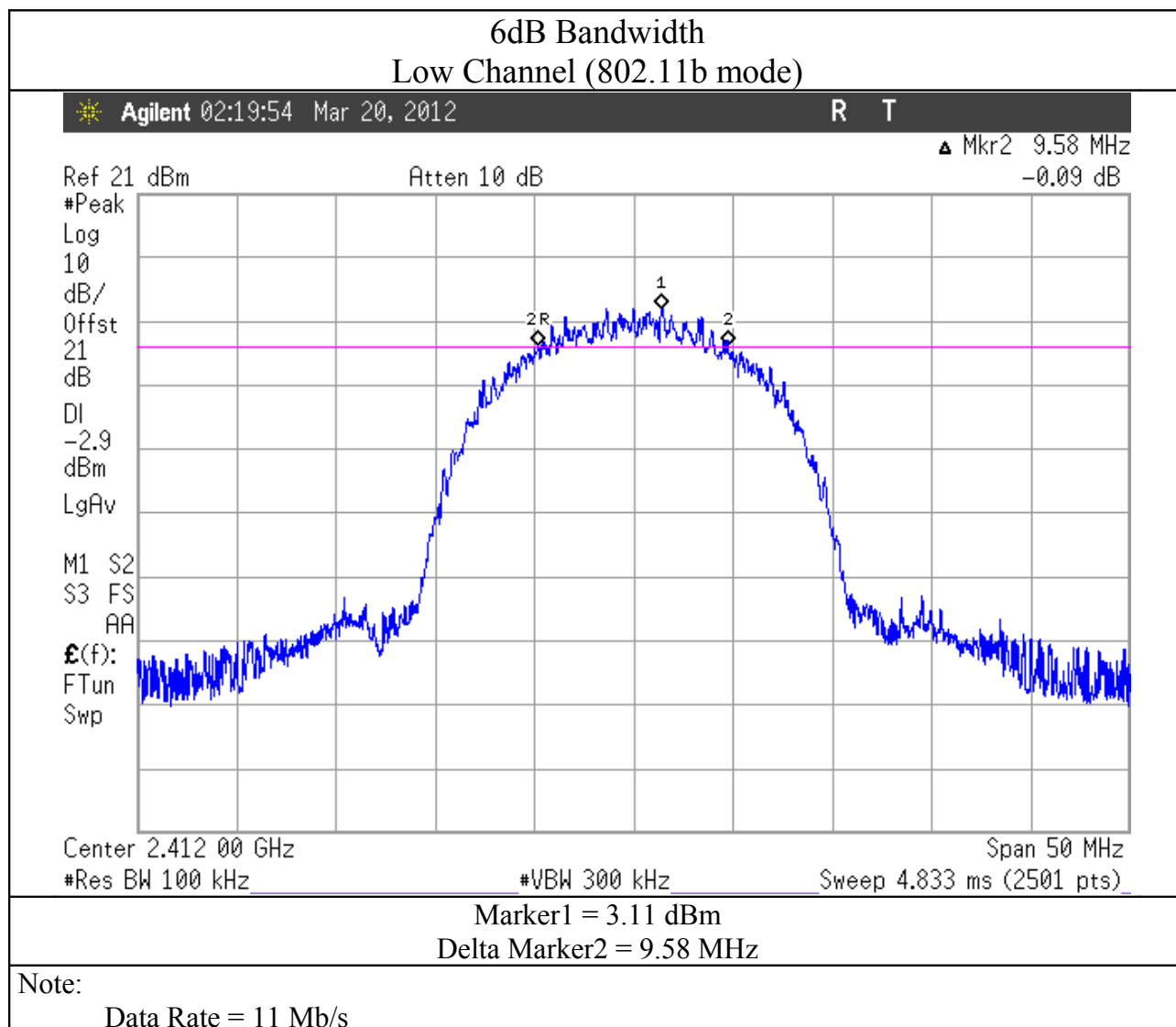
<i>Channel</i>	<i>Frequency</i> (MHz)	<i>6 dB Bandwidth</i> (MHz)	<i>Minimum Limit</i> (MHz)	<i>Margin</i> (MHz)
Low	2412	16,42	0,5	15,92
Mid	2437	16,34	0,5	15,84
High	2462	16,34	0,5	15,84

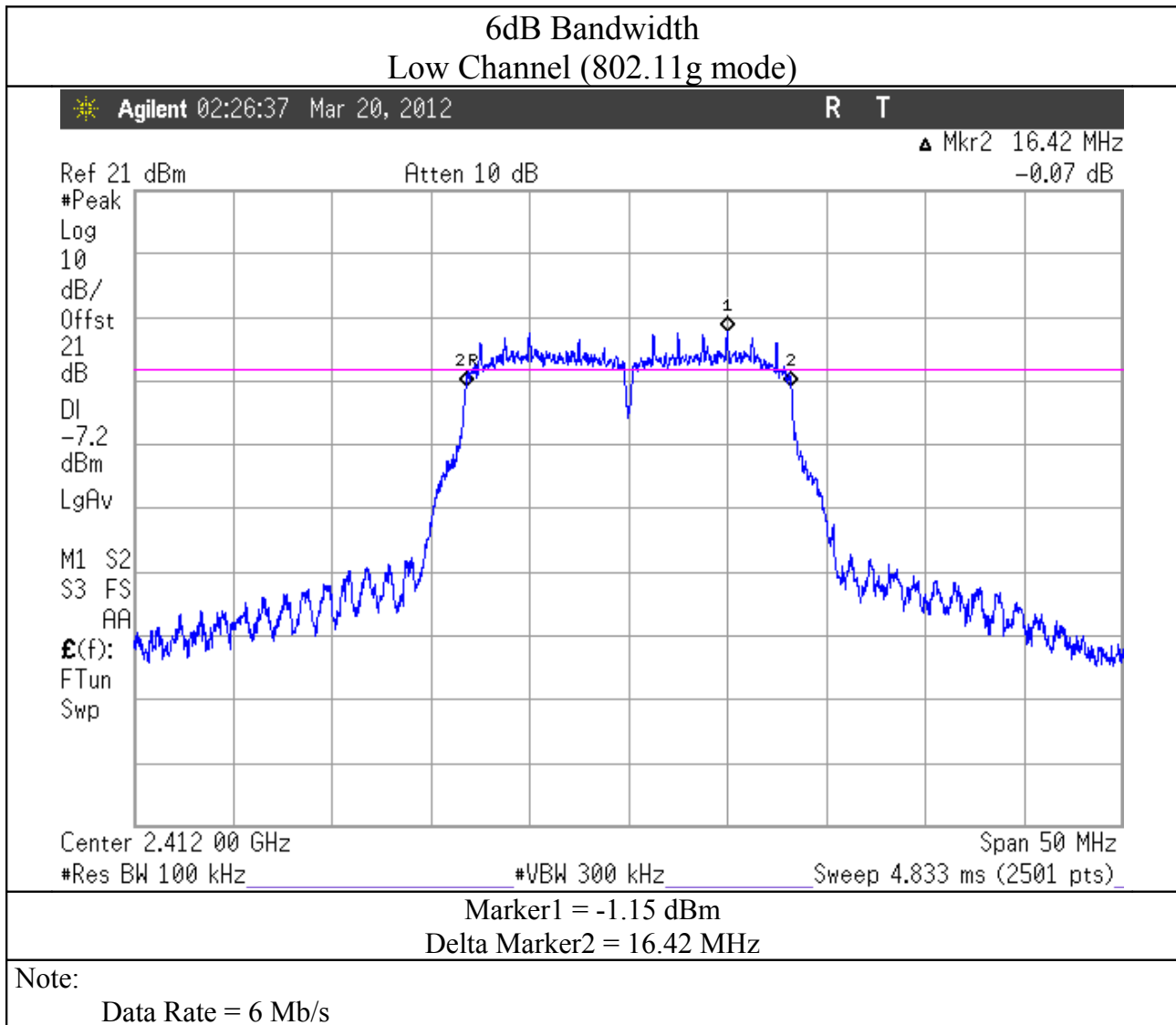
802.11n Mode, 65 Mbs

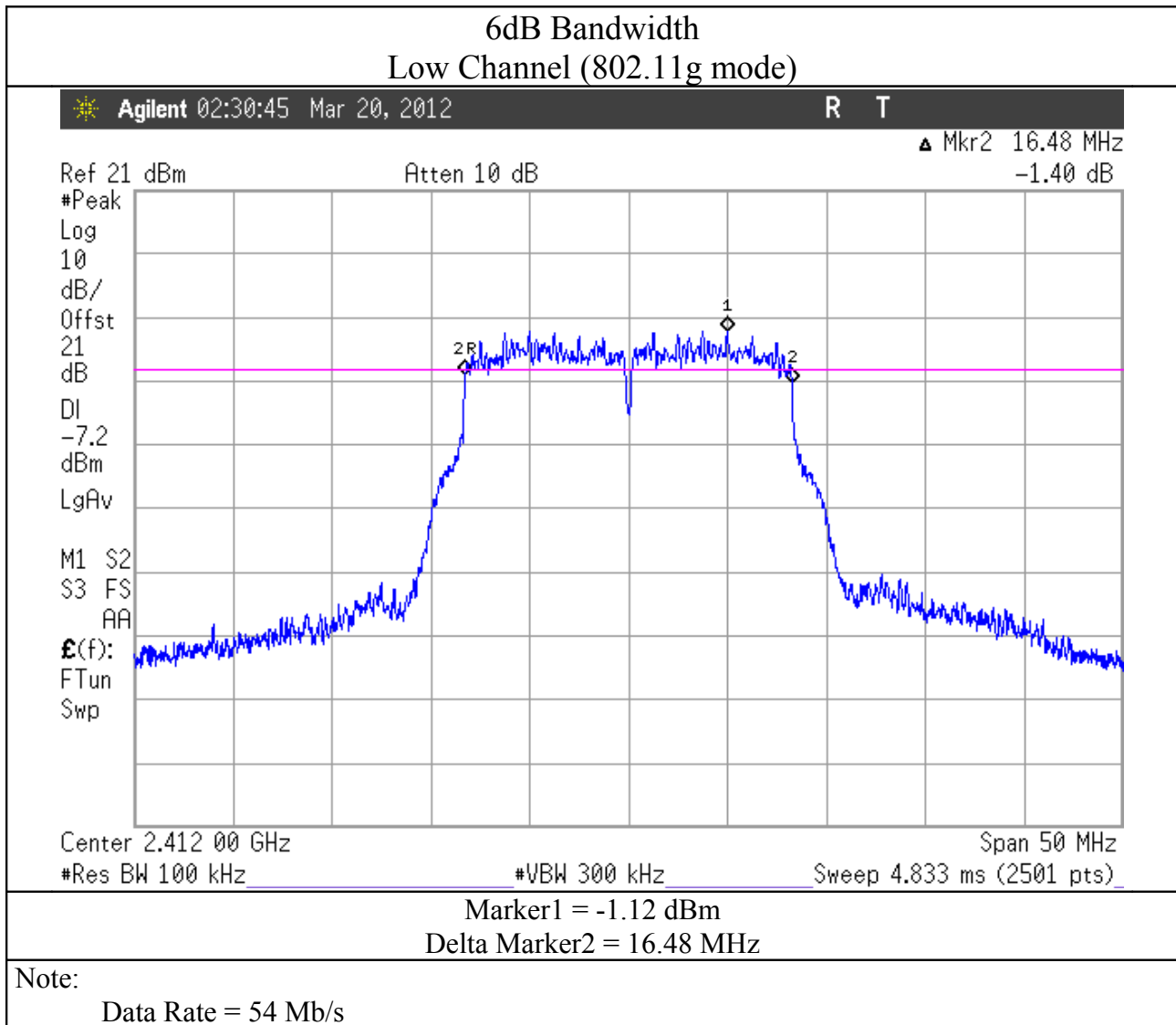
<i>Channel</i>	<i>Frequency</i> (MHz)	<i>6 dB Bandwidth</i> (MHz)	<i>Minimum Limit</i> (MHz)	<i>Margin</i> (MHz)
Low	2412	16,94	0,5	16,44
Mid	2437	17,52	0,5	17,02
High	2462	17,52	0,5	17,02

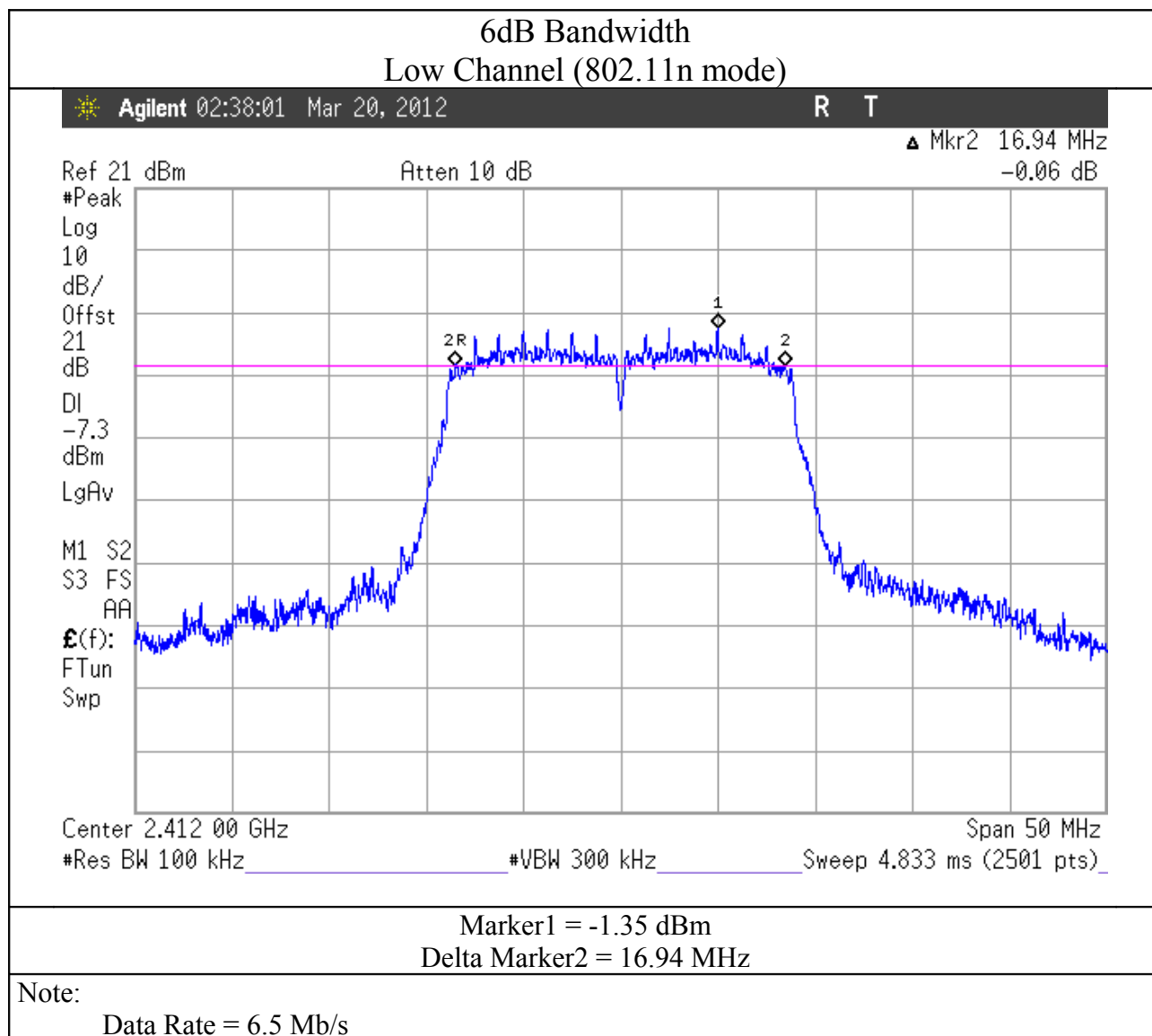
<u>Test Equipment</u>			
EQUIPMENT	MANUFACTURER	MODEL	CAL. DATE
EMI Receiver	Agilent	E4440A	01/2012
<u>Test procedure:</u> APR01			
Test performed on low, middle and high channels and in the b,g,n protocols at maximum and minimum data rate for each protocol.			
In the following graphs results are shown:			

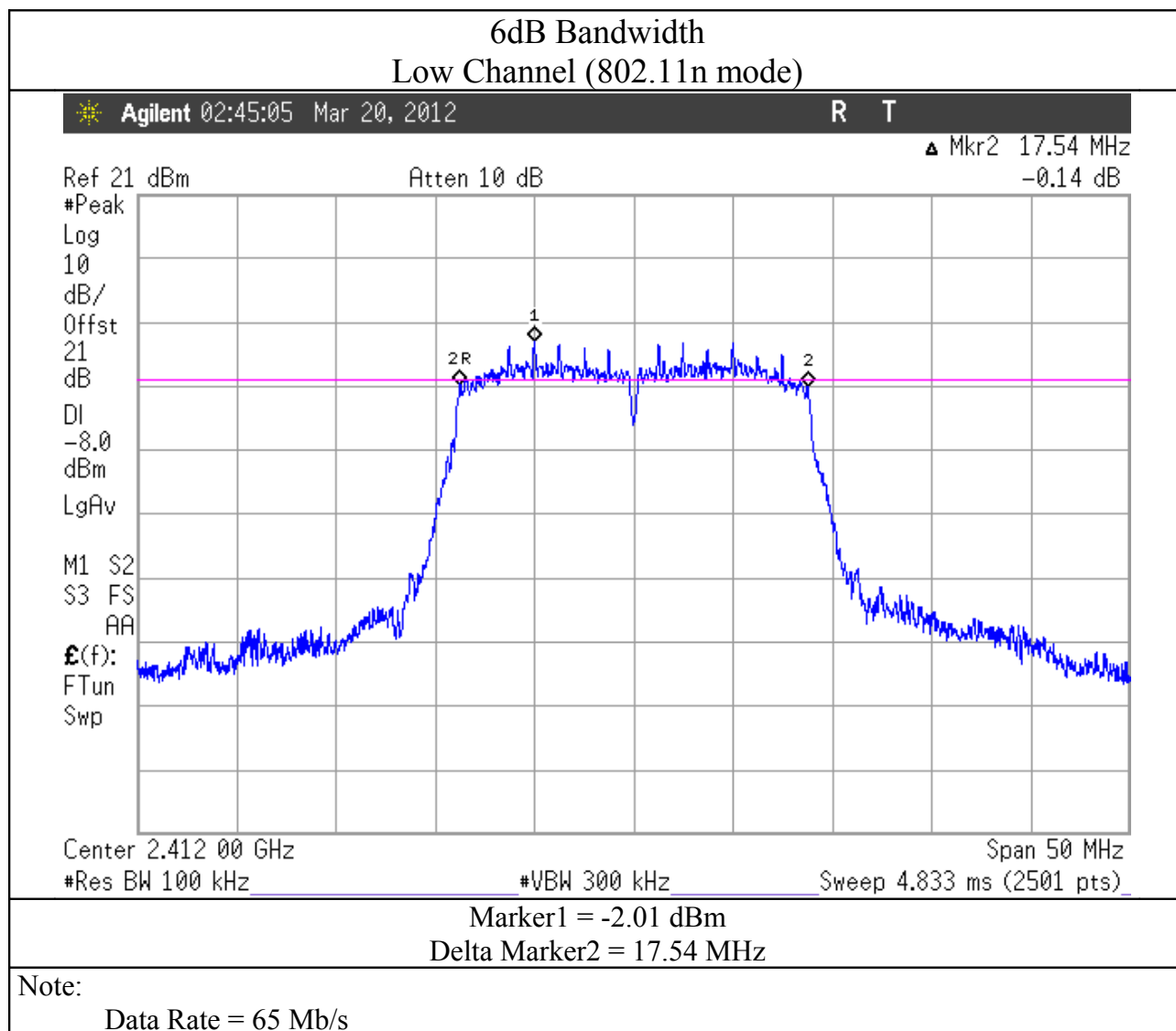


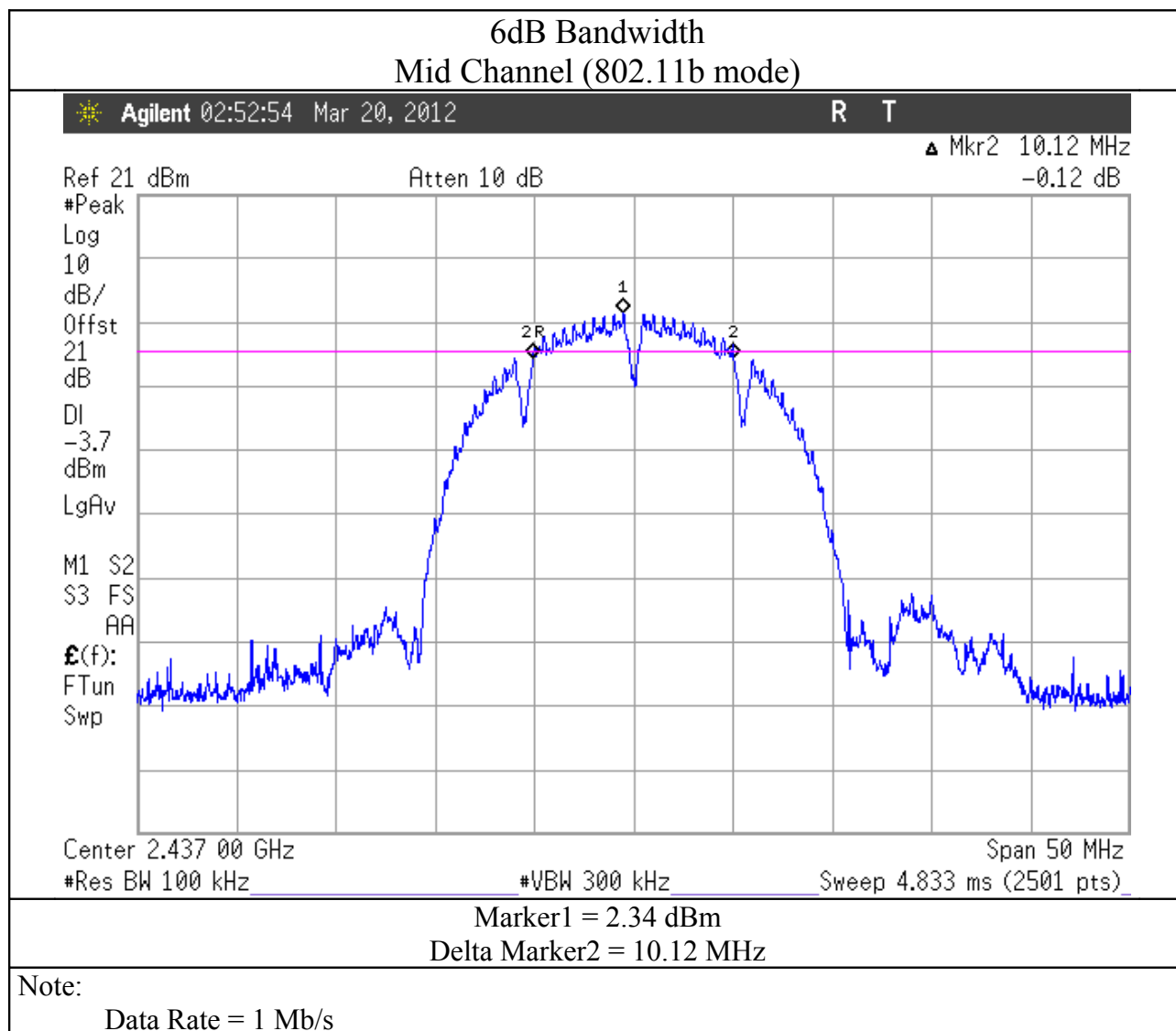


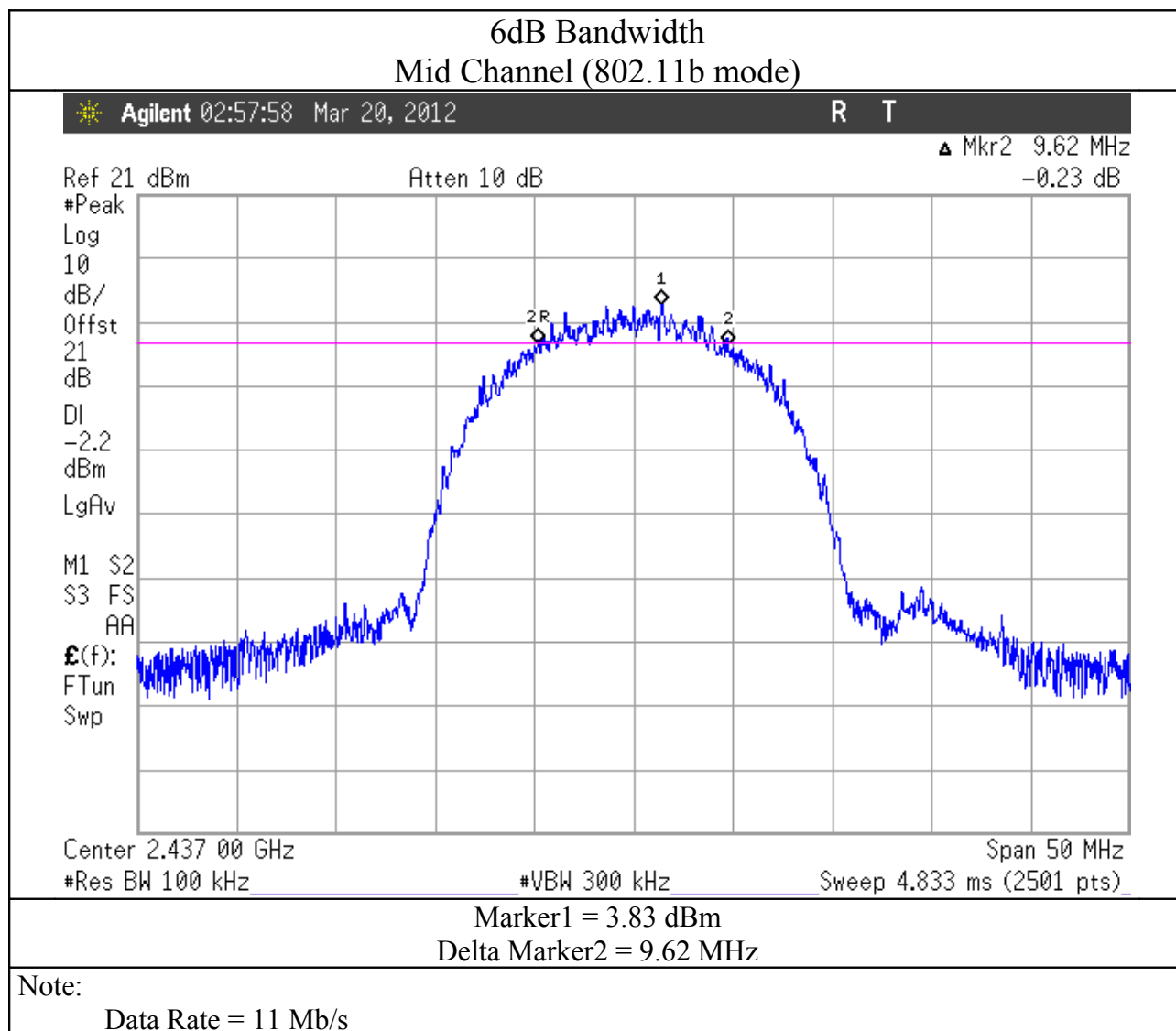


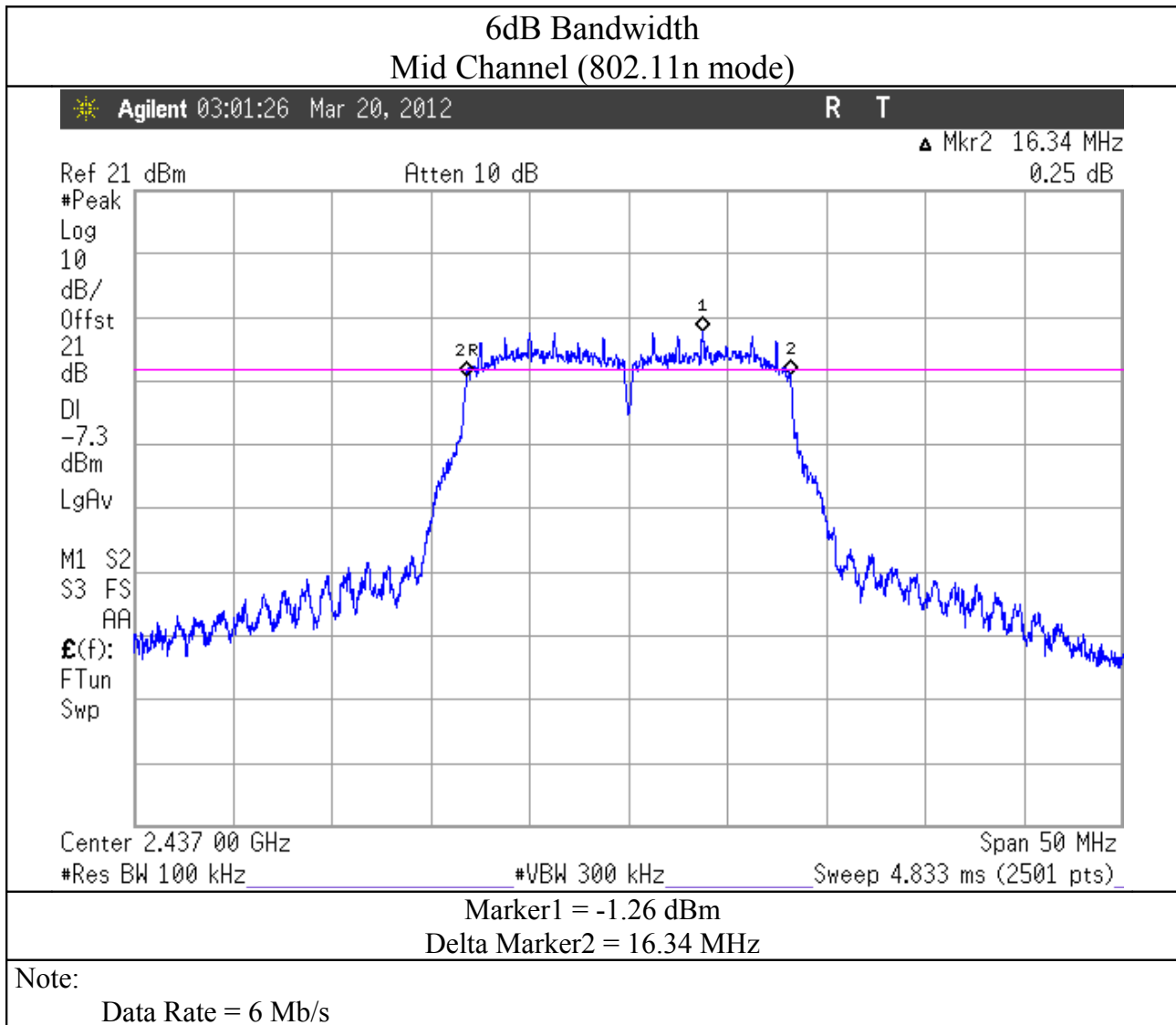


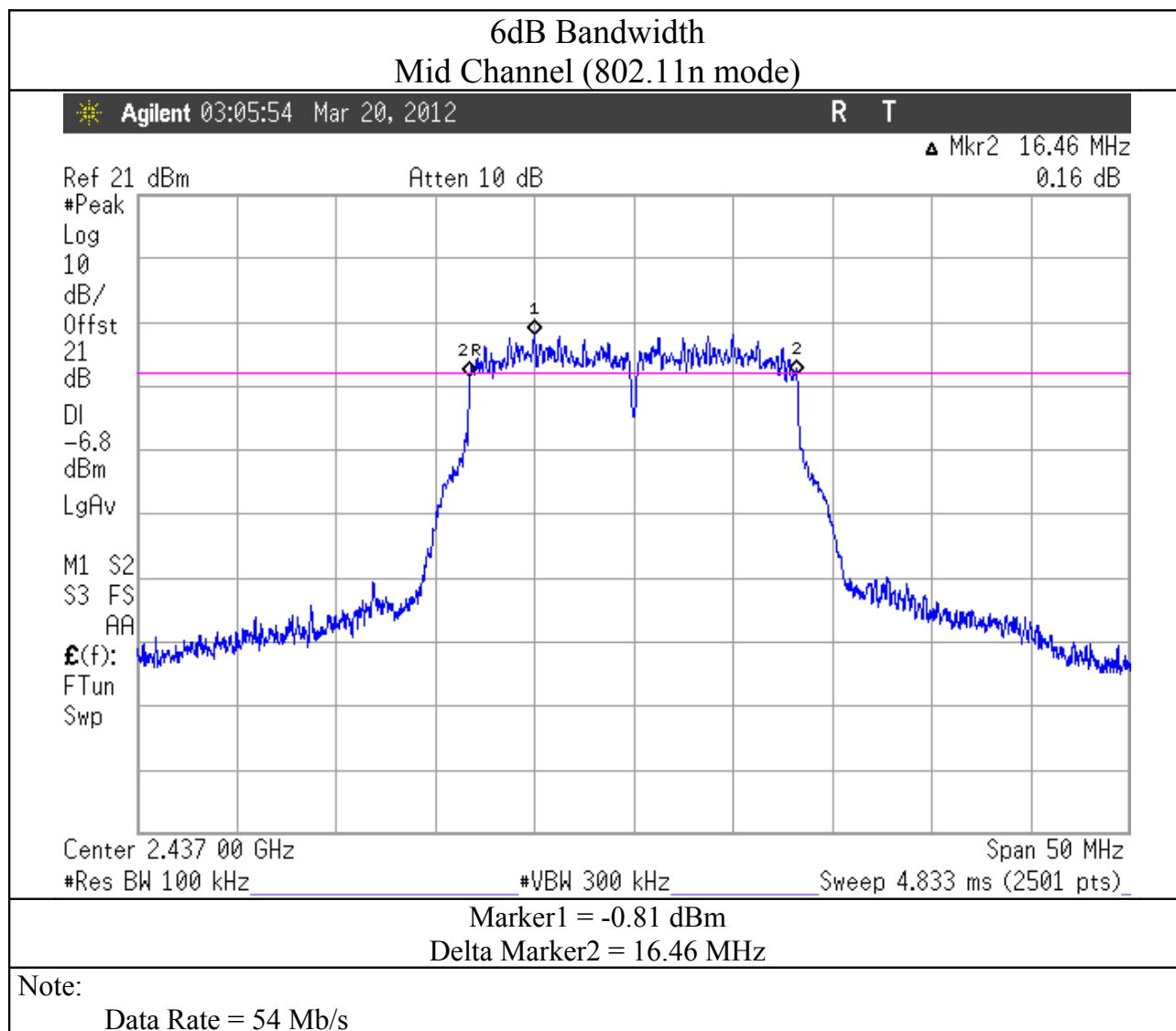


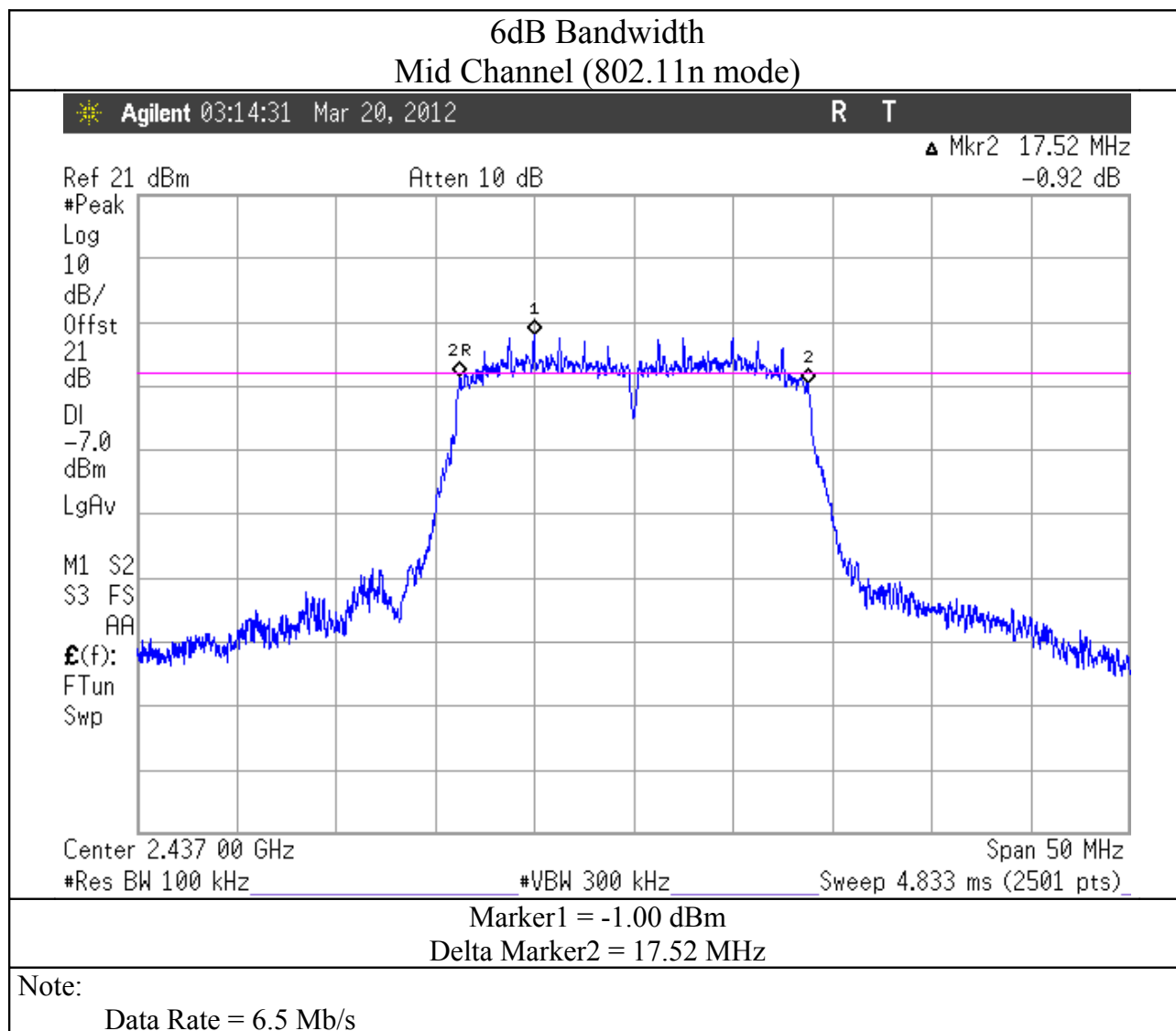


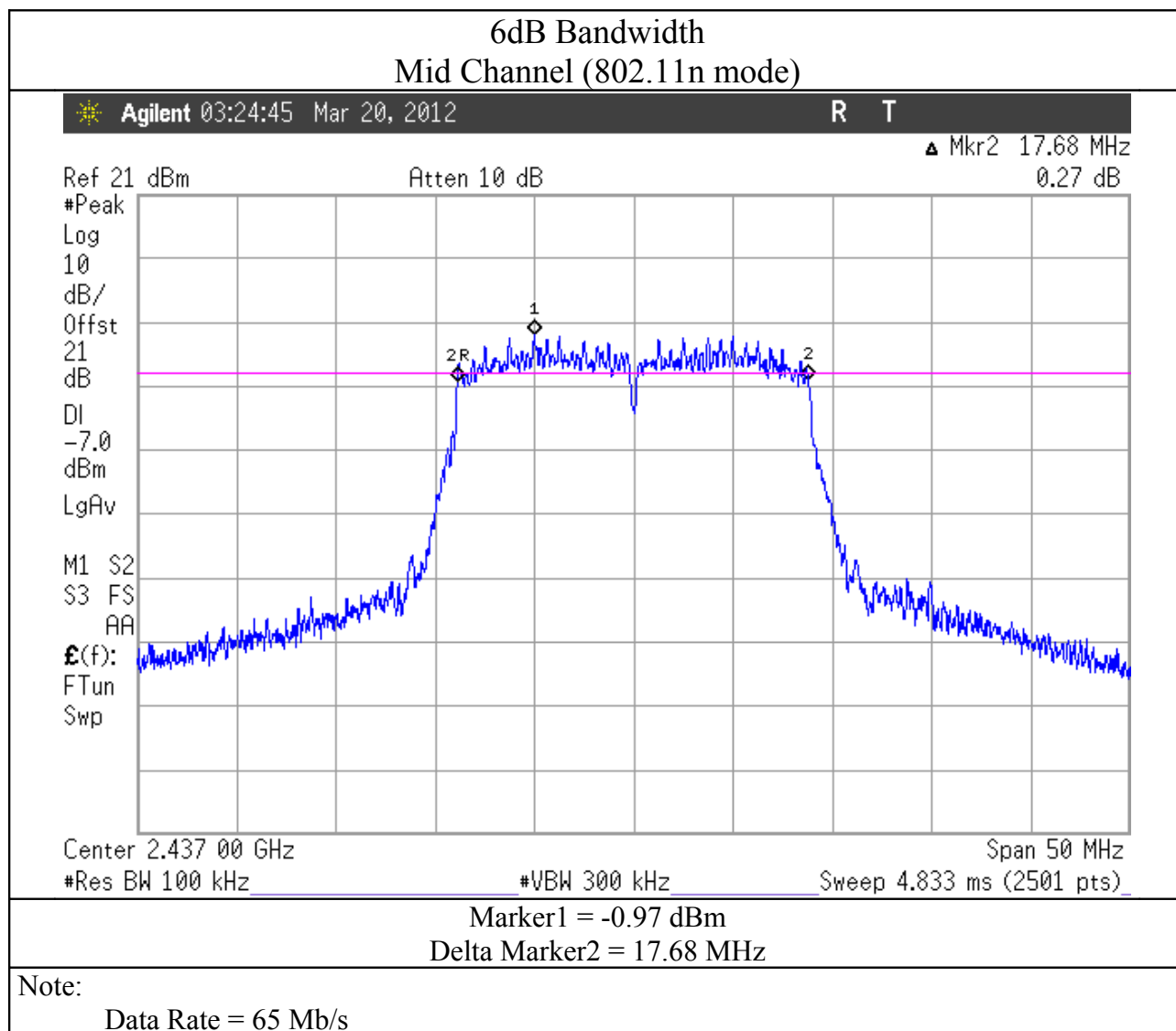


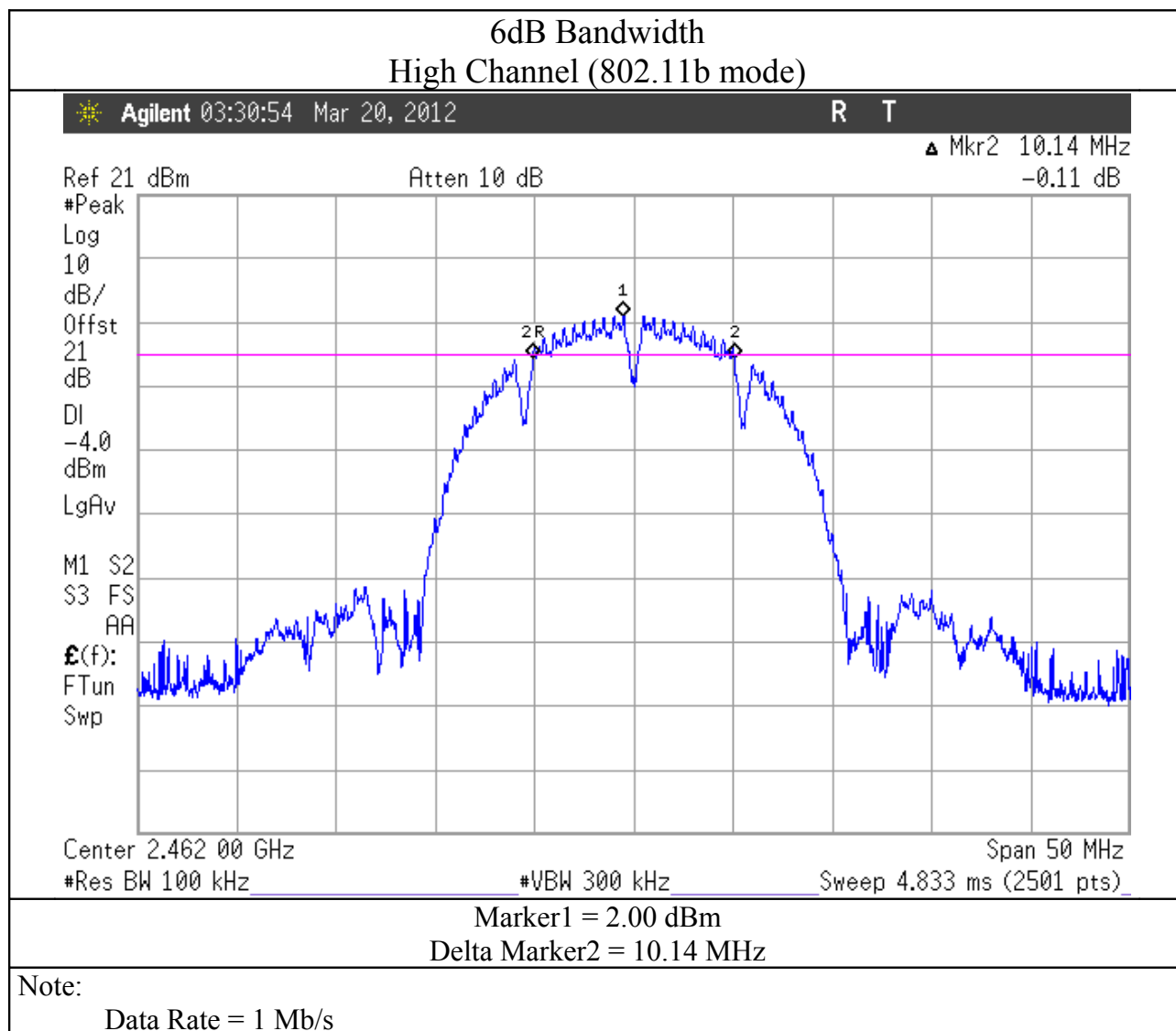


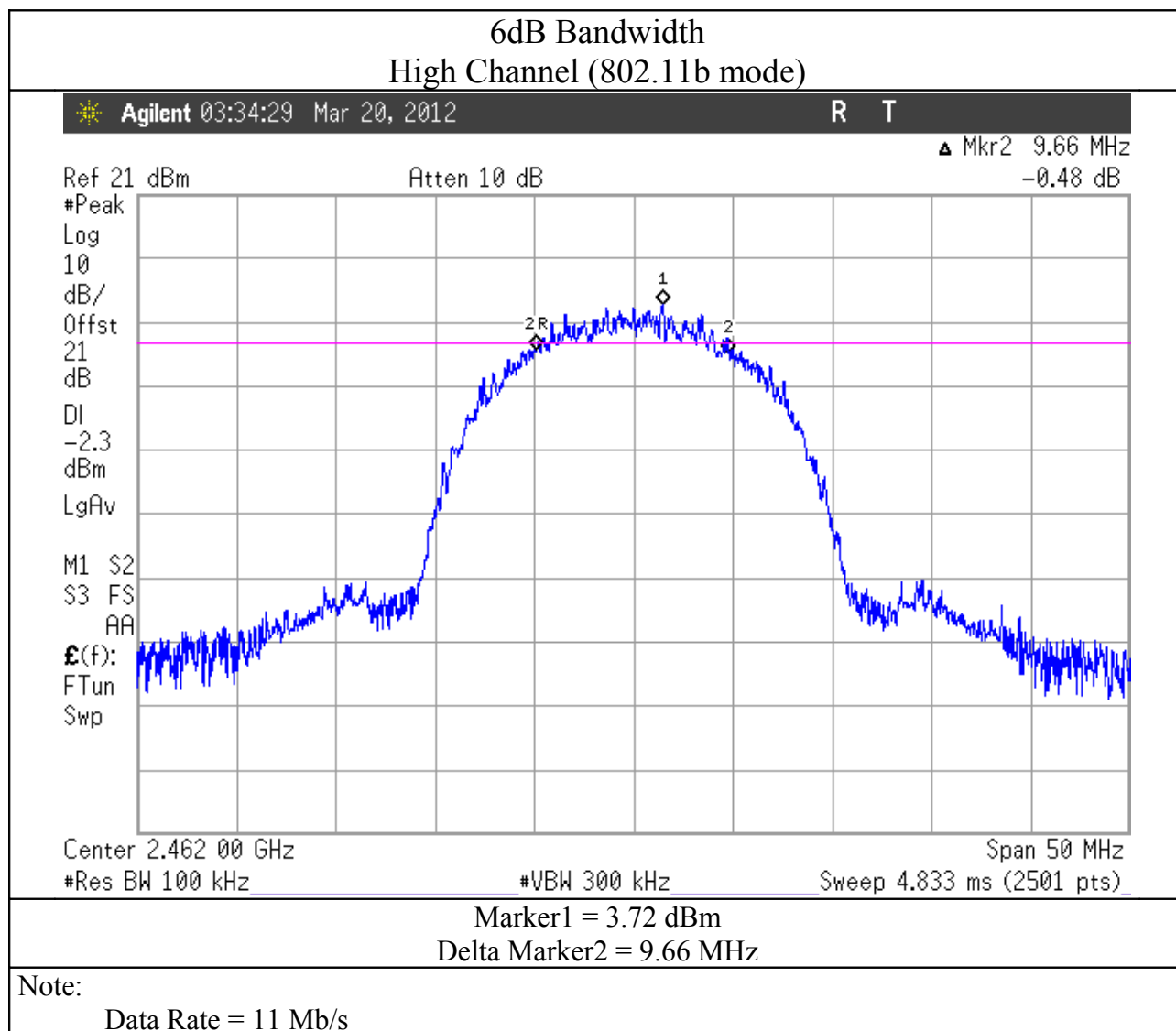


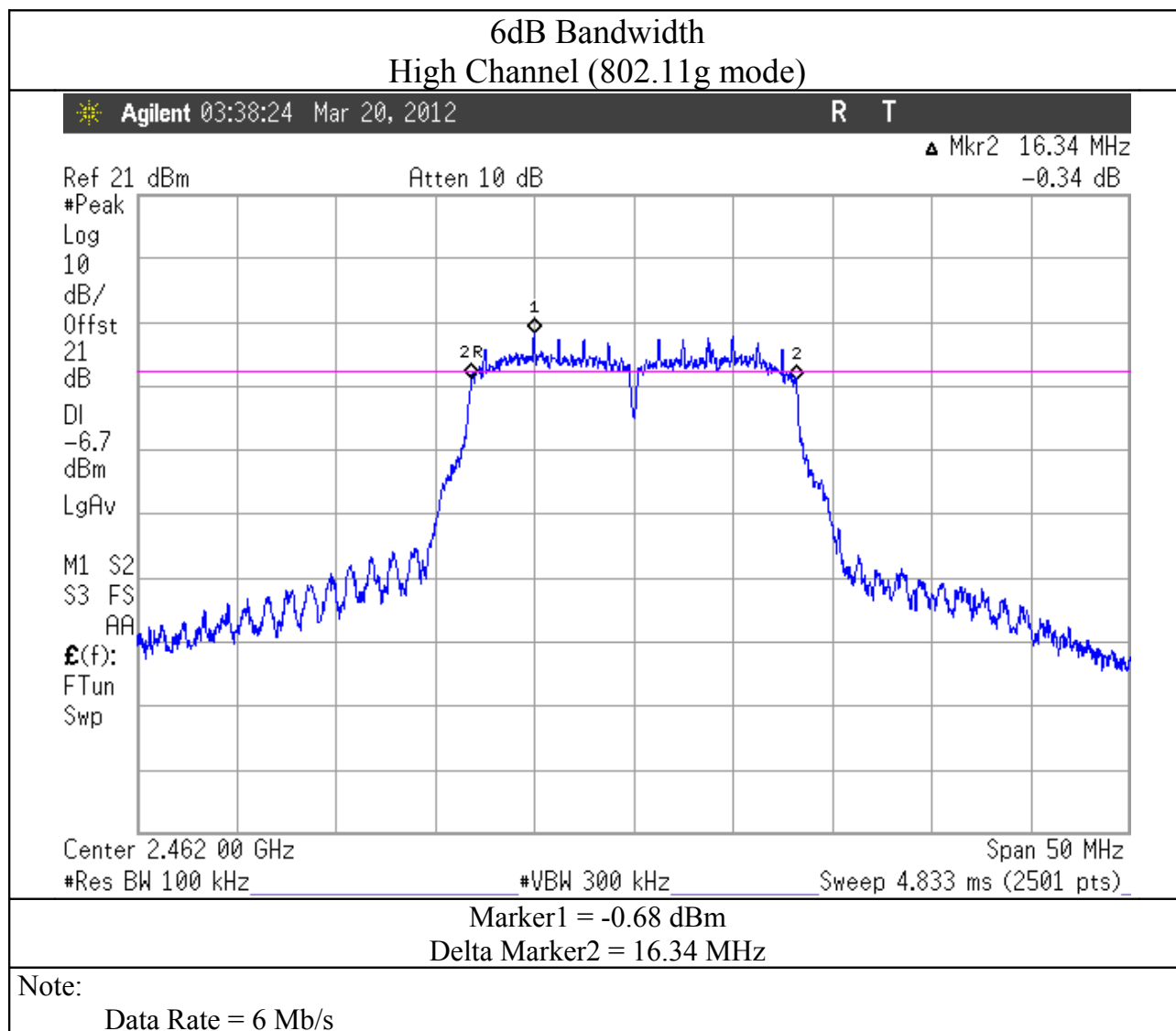


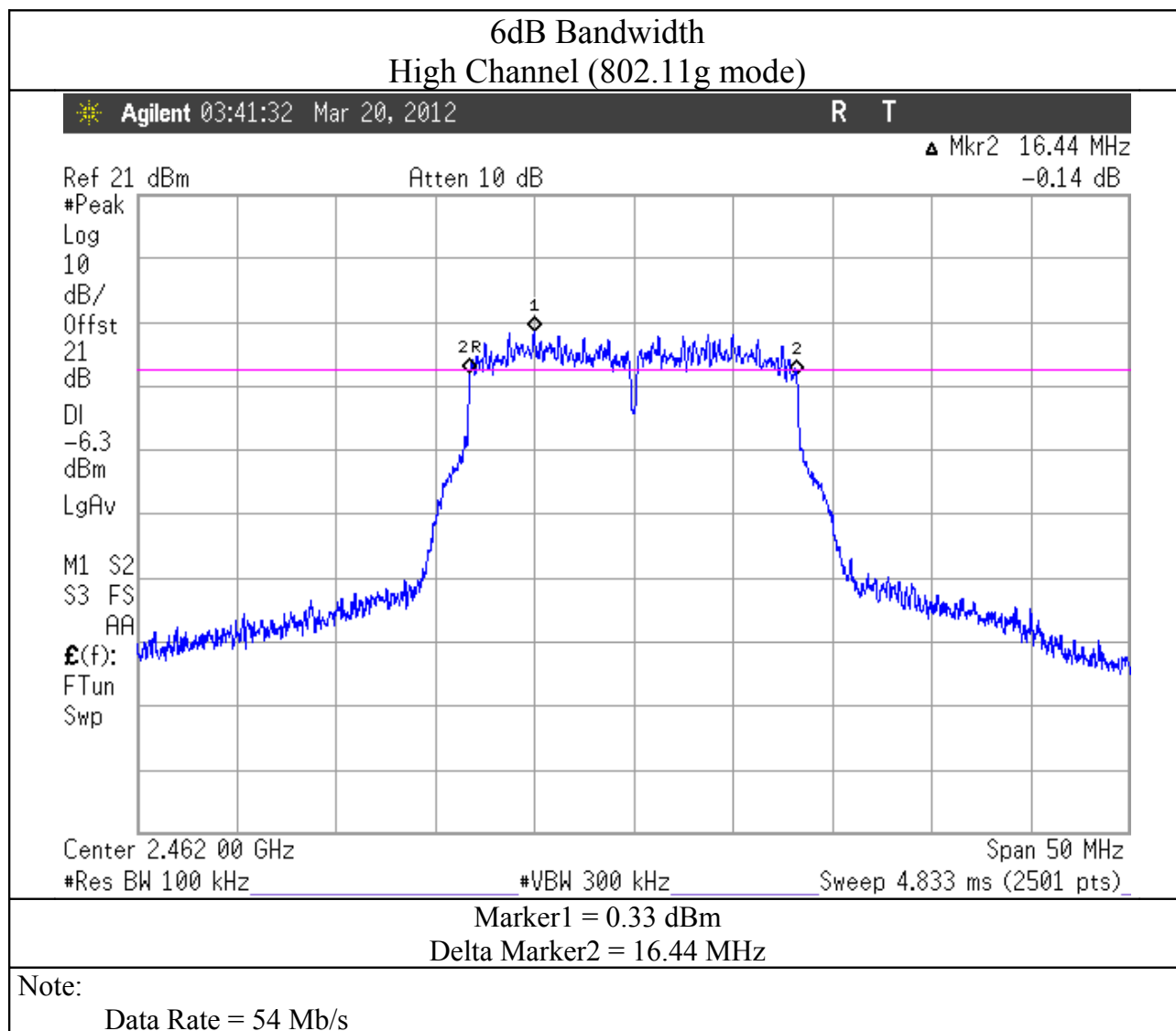


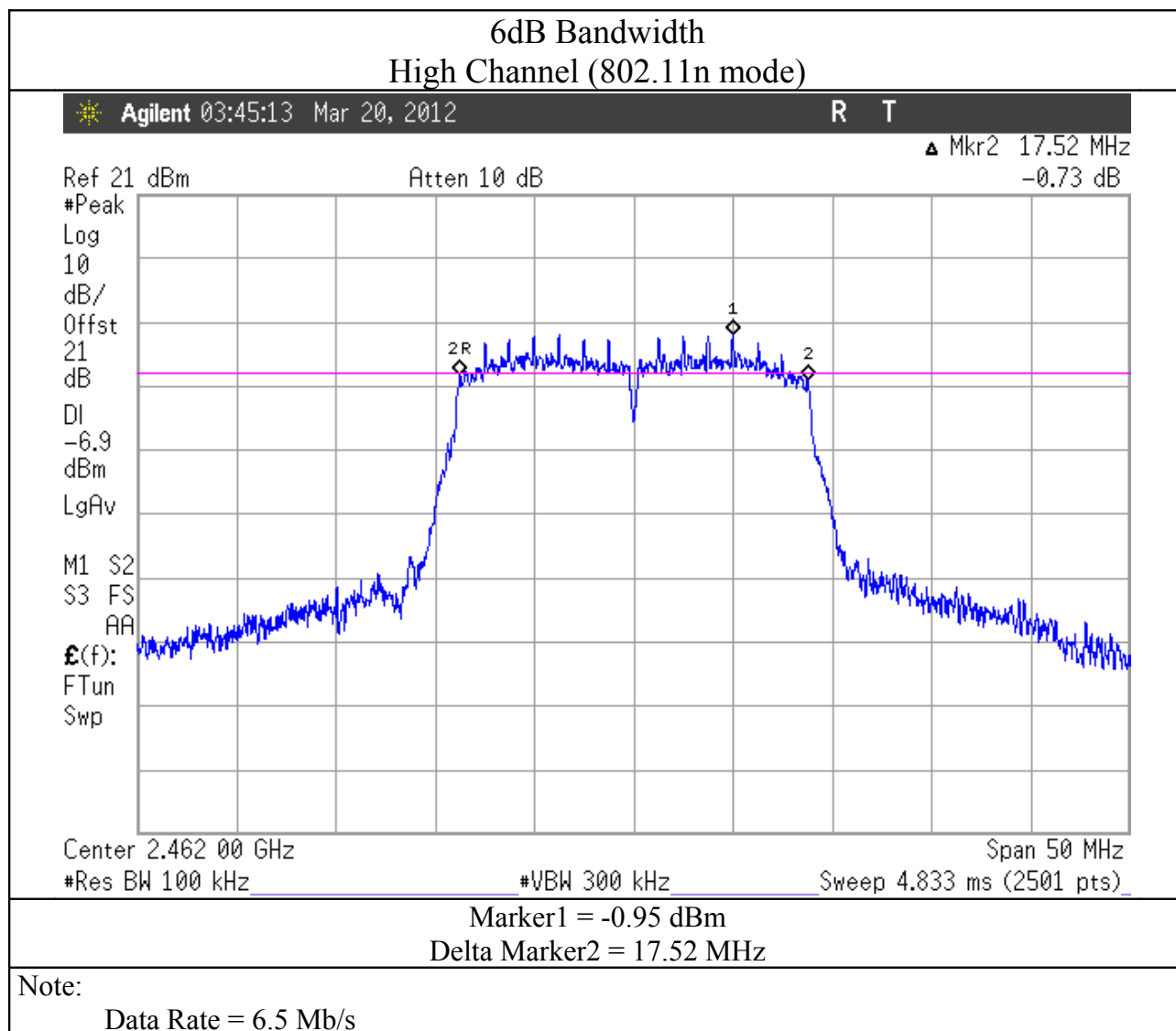


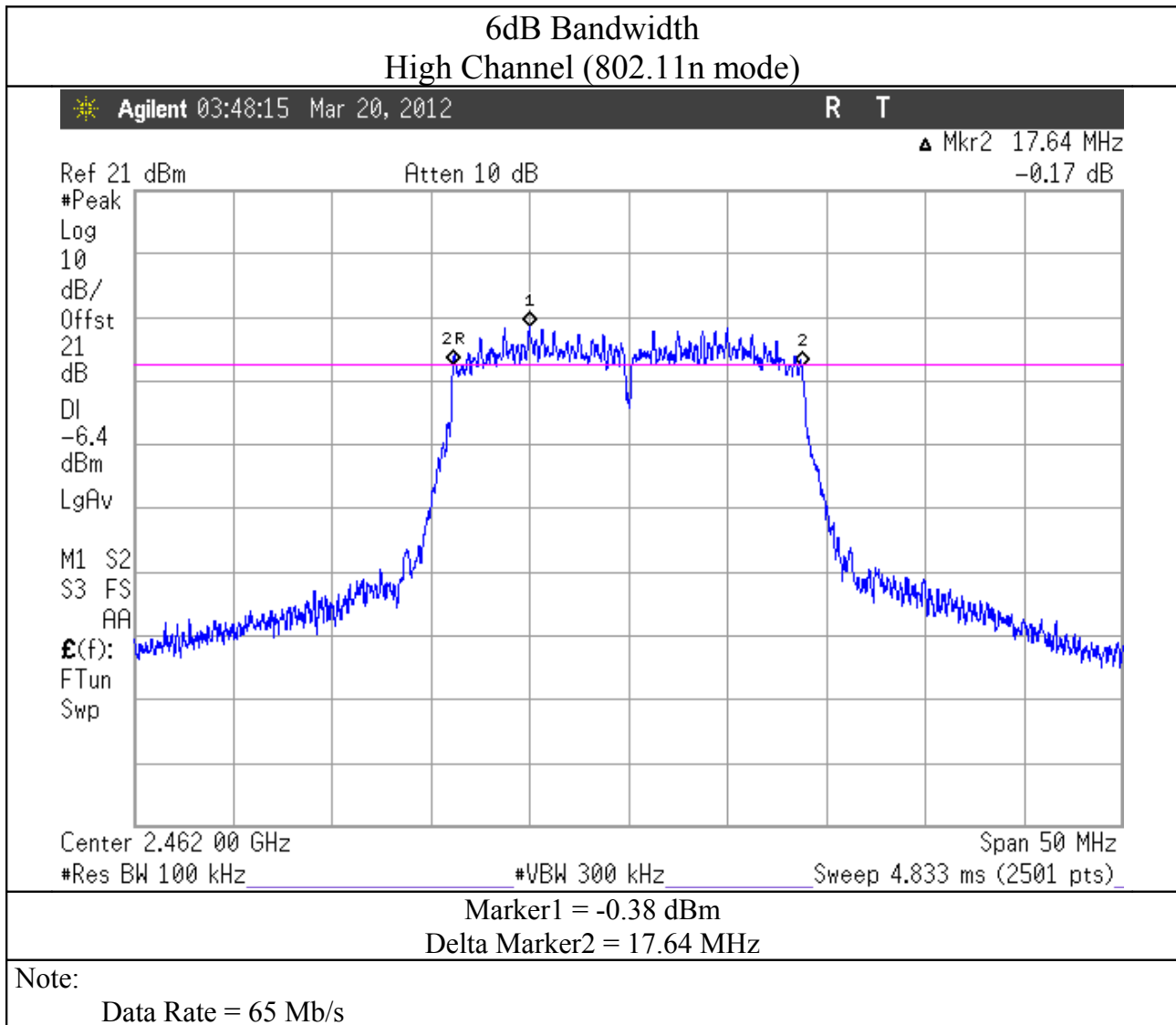












5. MAXIMUM PEAK OUTPUT POWER

Equipment shall meet the limits below .

For systems using digital modulation in the 2400-2483.5 MHz: 1 Watt (+30 dBm).

Test Equipment

EQUIPMENT	MANUFACTURER	MODEL	CAL. DATE
EMI Receiver	Agilent	E4440A	01/2012

Test procedure: APR01

The transmitter output is connected to a spectrum analyzer and the analyzer internal channel power integration is used to integrate the power over a bandwidth greater than or equal to the 26 dB bandwidth.

Test performed on low, middle and high channels and in the b,g,n protocols at maximum data rate for each protocol.

Results:

No non-compliance noted

802.11b Mode, 11 Mbs				
<i>Channel</i>	<i>Frequency (MHz)</i>	<i>Peak Power (dBm)</i>	<i>Limit (dBm)</i>	<i>Margin (dB)</i>
Low	2412	13,62	30	-16,38
Mid	2437	13,97	30	-16,03
High	2462	16,3	30	-13,7
802.11g Mode, 54 Mbs				
<i>Channel</i>	<i>Frequency (MHz)</i>	<i>Peak Power (dBm)</i>	<i>Limit (dBm)</i>	<i>Margin (dB)</i>
Low	2412	11,85	30	-18,15
Mid	2437	11,23	30	-18,77
High	2462	11,66	30	-18,34
802.11n Mode, 65Mbs				
<i>Channel</i>	<i>Frequency (MHz)</i>	<i>Peak Power (dBm)</i>	<i>Limit (dBm)</i>	<i>Margin (dB)</i>
Low	2412	10,91	30	-19,09
Mid	2437	11,23	30	-18,77
High	2462	11,35	30	-18,65

6. BAND EDGE AND CONDUCTED SPURIOUS EMISSIONS

Equipment shall meet the limits below .

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

Test Equipment

EQUIPMENT	MANUFACTURER	MODEL	CAL. DATE
EMI Receiver	Agilent	E4440A	01/2012

Test procedure: APR01

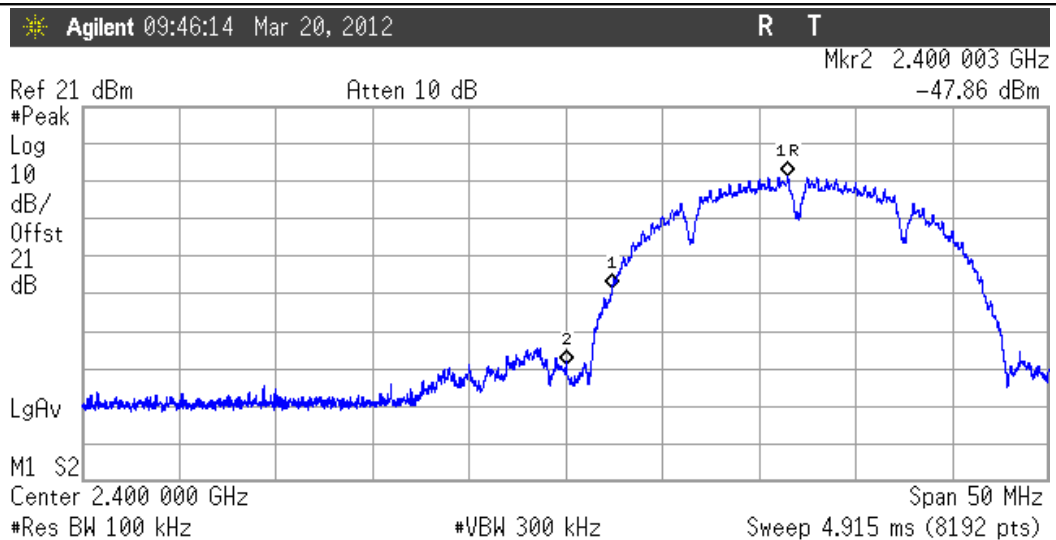
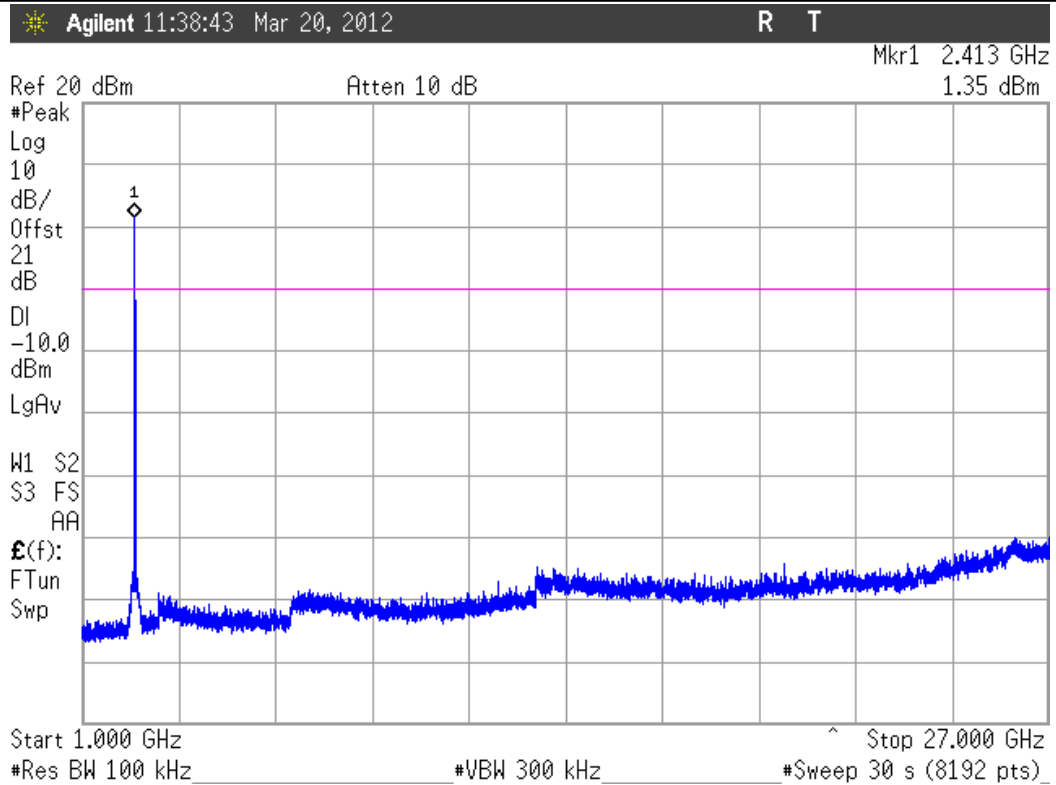
Test performed on low, middle and high channels and in the b,g,n protocols at maximum and minimum data rate for each protocol.

Results:

No non-compliance noted

The following figures show the results.

Conducted Spurious Emissions Low Channel (802.11b mode)

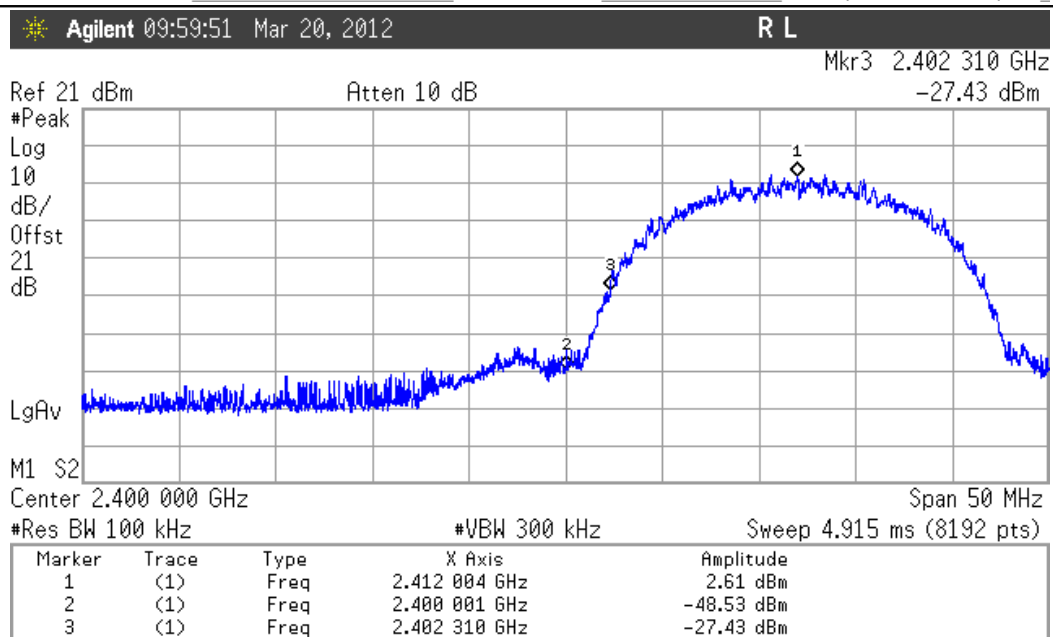
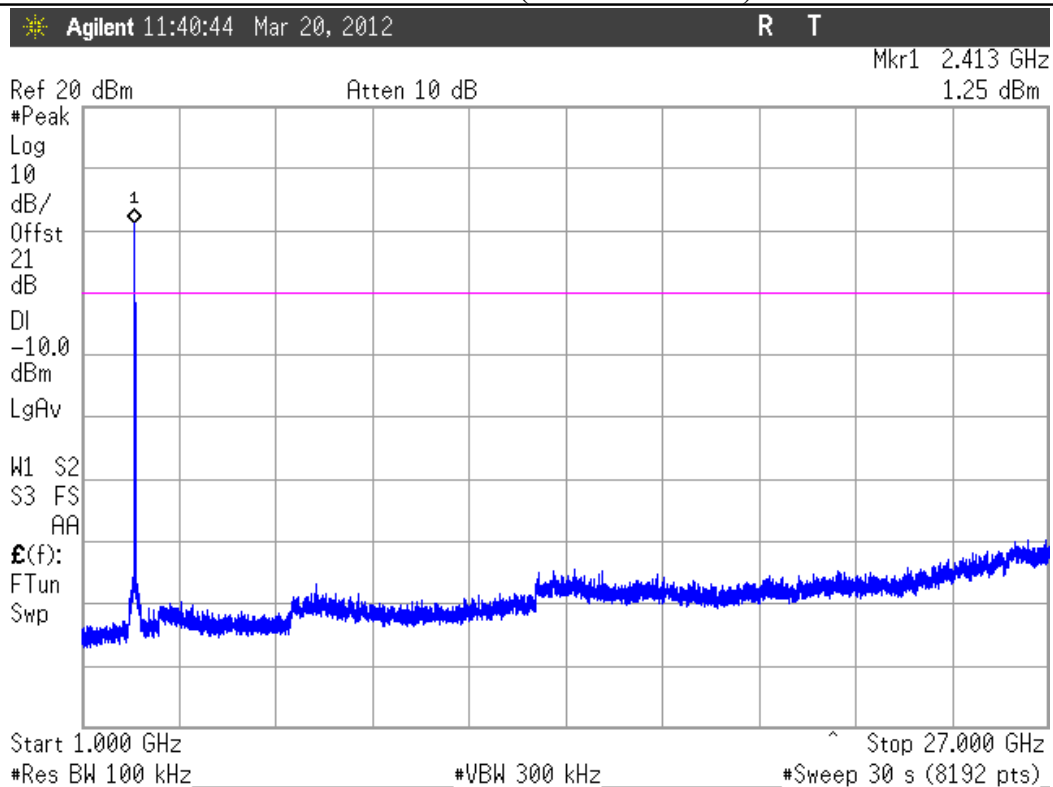


Marker	Trace	Type	X Axis	Amplitude
1R	(1)	Freq	2.411 497 GHz	2.38 dBm
1Δ	(1)	Freq	-9.878 MHz	-29.83 dB
2	(1)	Freq	2.400 003 GHz	-47.86 dBm

Note:

Data Rate = 1 Mb/s

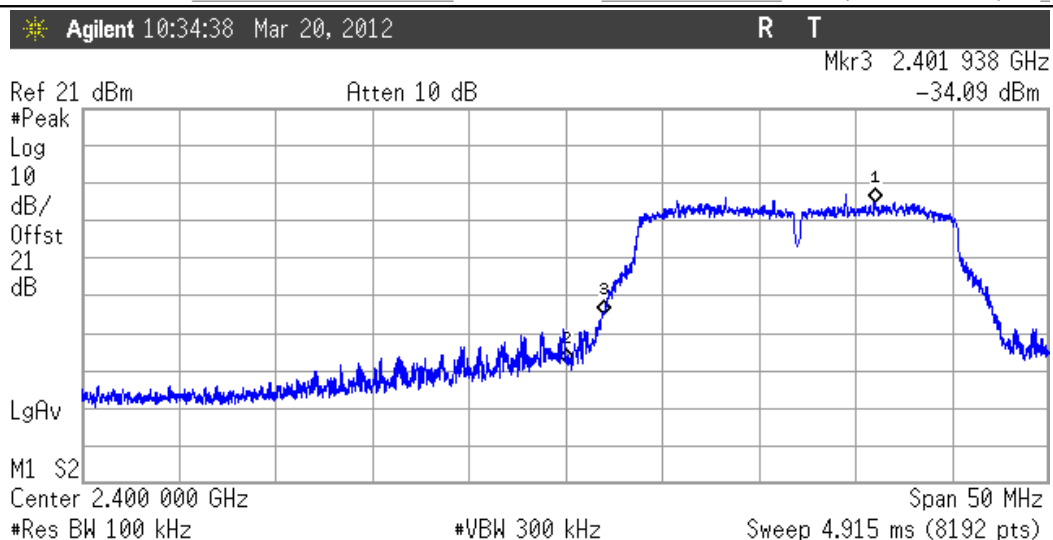
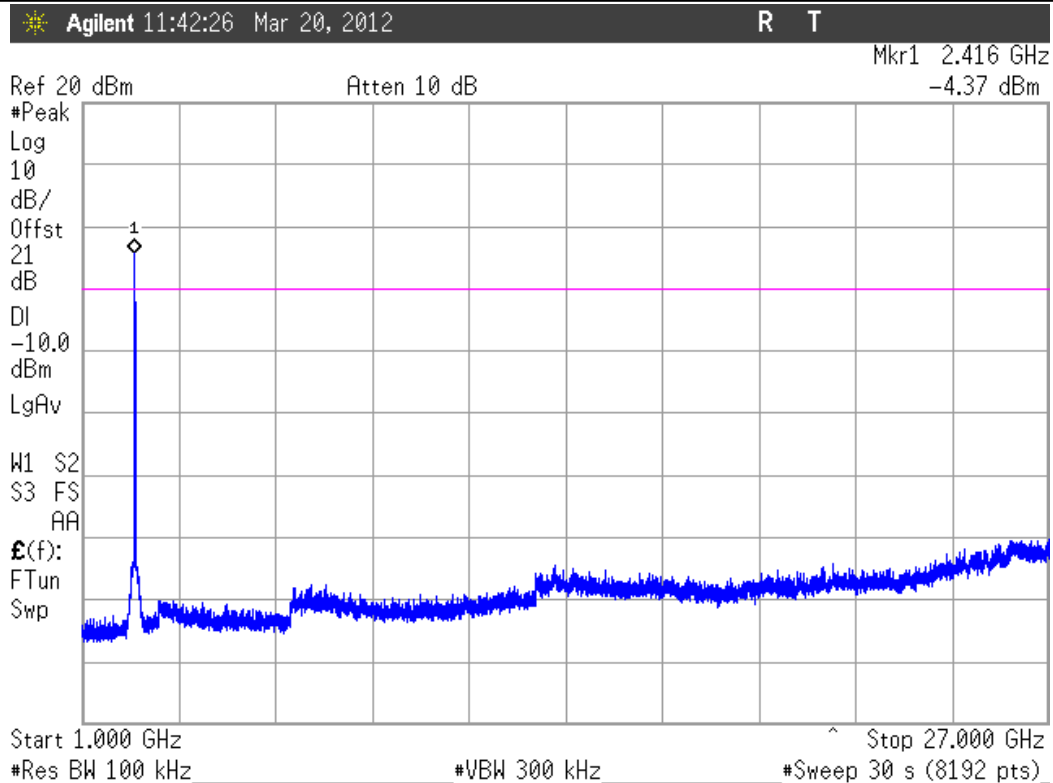
Conducted Spurious Emissions Low Channel (802.11b mode)



Note:

Data Rate = 11 Mb/s

Conducted Spurious Emissions Low Channel (802.11g mode)

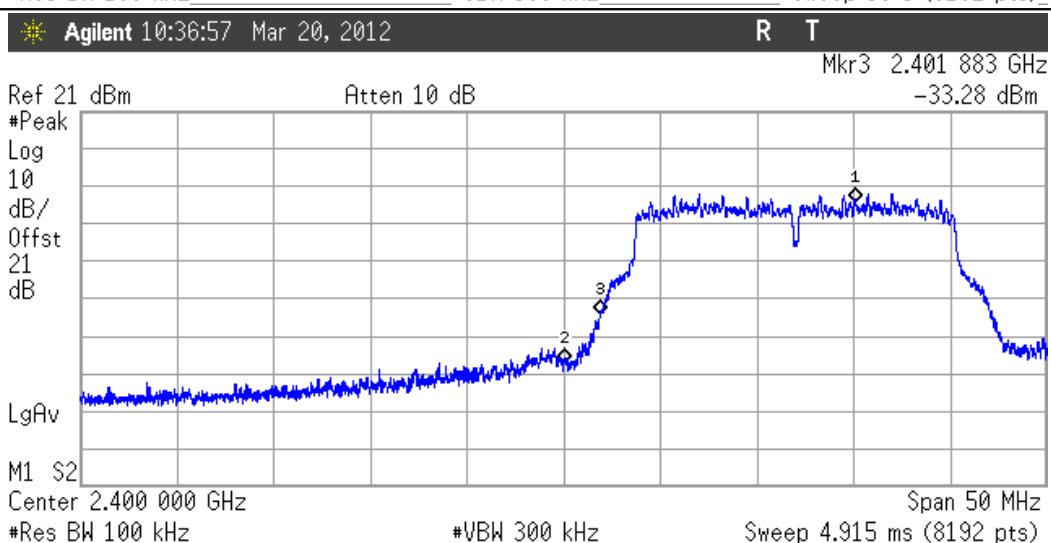
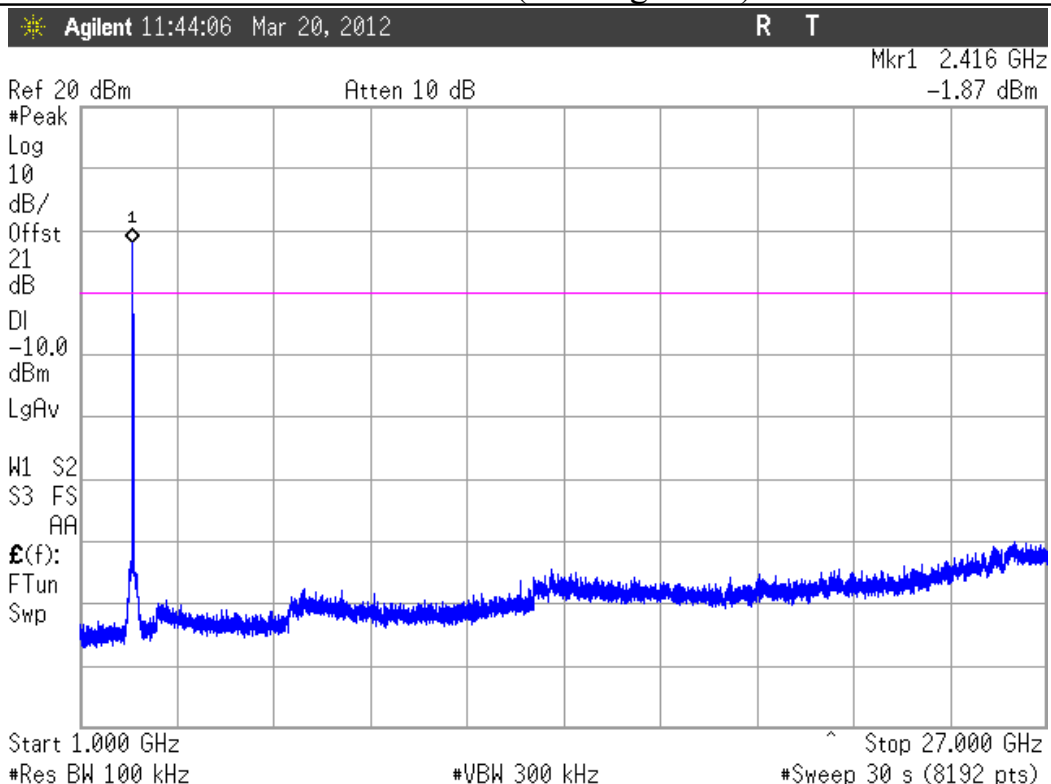


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.415 972 GHz	-4.15 dBm
2	(1)	Freq	2.400 001 GHz	-46.78 dBm
3	(1)	Freq	2.401 938 GHz	-34.09 dBm

Note:

Data Rate = 6 Mb/s

Conducted Spurious Emissions Low Channel (802.11g mode)

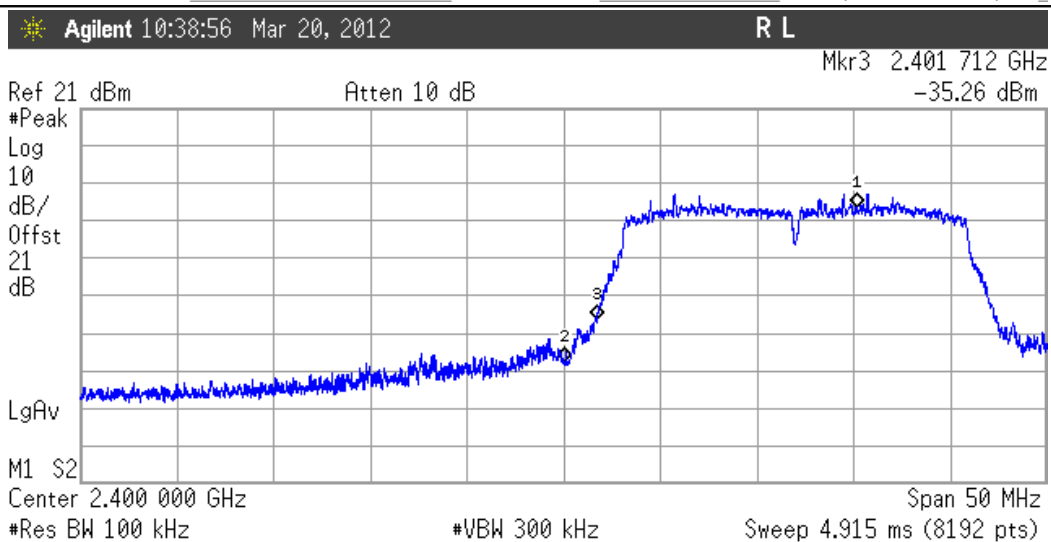
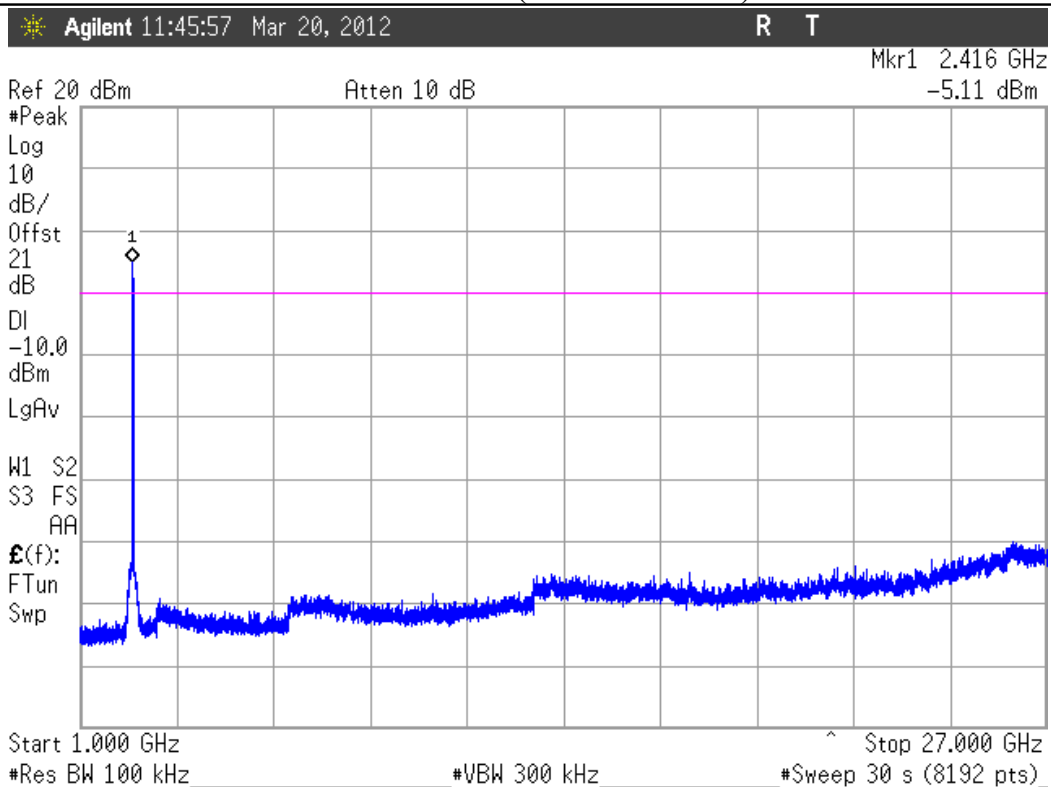


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.415 111 GHz	-3.31 dBm
2	(1)	Freq	2.400 001 GHz	-45.96 dBm
3	(1)	Freq	2.401 883 GHz	-33.28 dBm

Note:

Data Rate = 54 Mb/s

Conducted Spurious Emissions Low Channel (802.11n mode)

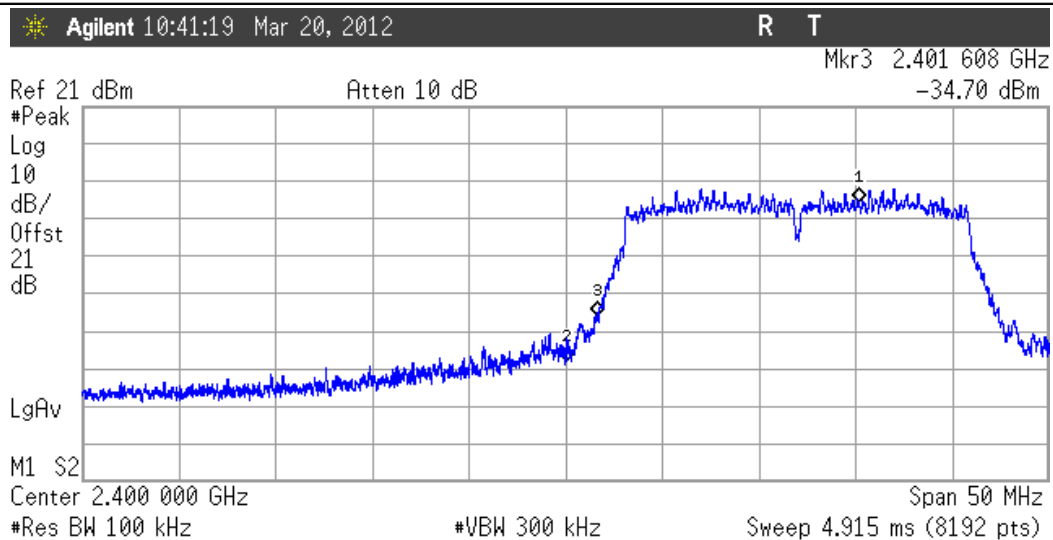
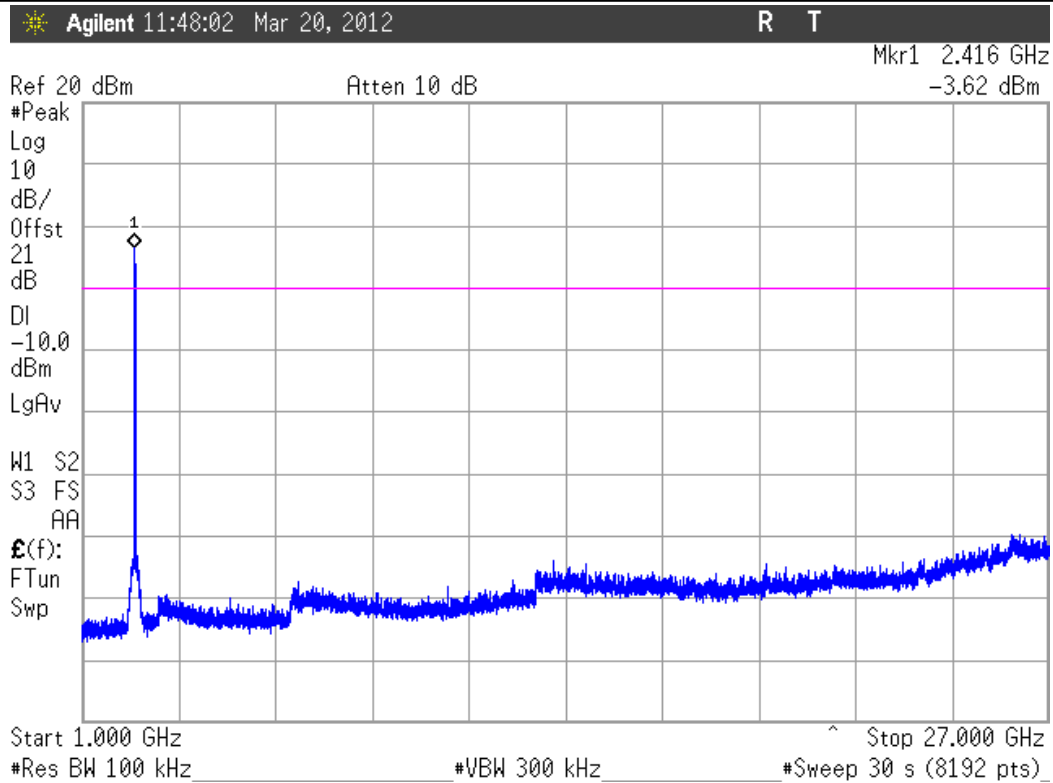


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.415 142 GHz	-5.51 dBm
2	(1)	Freq	2.400 001 GHz	-46.74 dBm
3	(1)	Freq	2.401 712 GHz	-35.26 dBm

Note:

Data Rate = 6.5 Mb/s

Conducted Spurious Emissions Low Channel (802.11n mode)

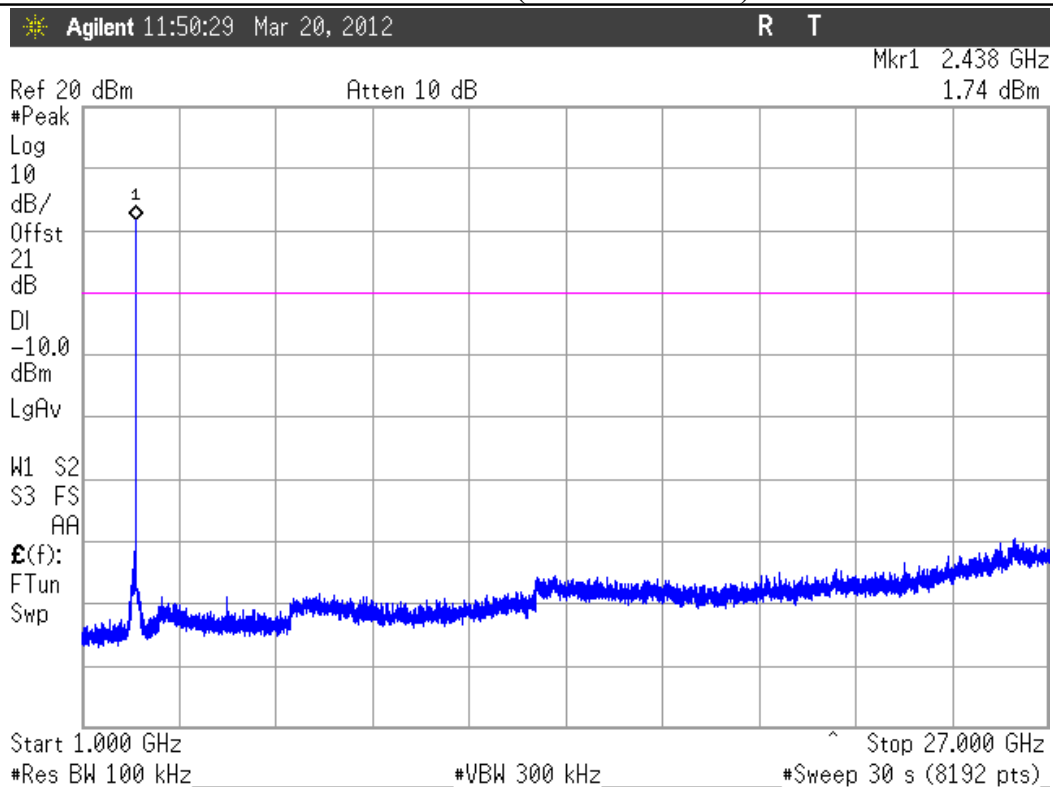


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.415 166 GHz	-4.40 dBm
2	(1)	Freq	2.400 001 GHz	-46.90 dBm
3	(1)	Freq	2.401 608 GHz	-34.70 dBm

Note:

Data Rate = 65 Mb/s

Conducted Spurious Emissions Mid Channel (802.11b mode)



Note:

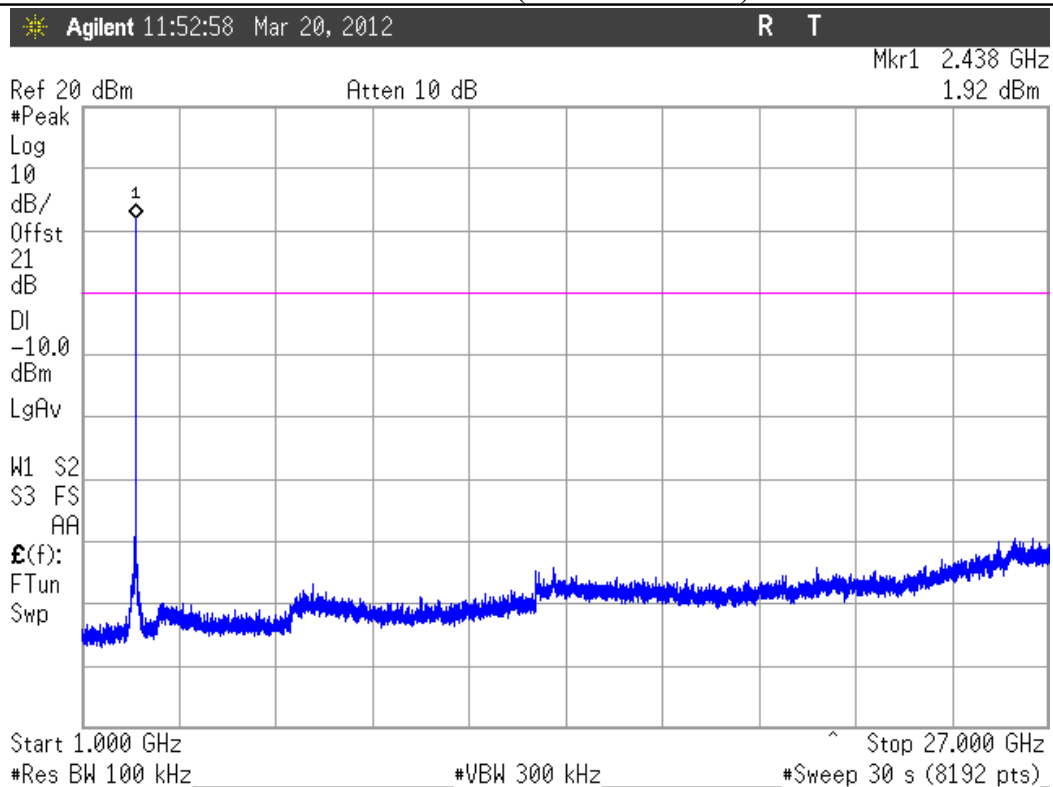
Data Rate = 1 Mb/s

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Conducted Spurious Emissions Mid Channel (802.11b mode)



Note:

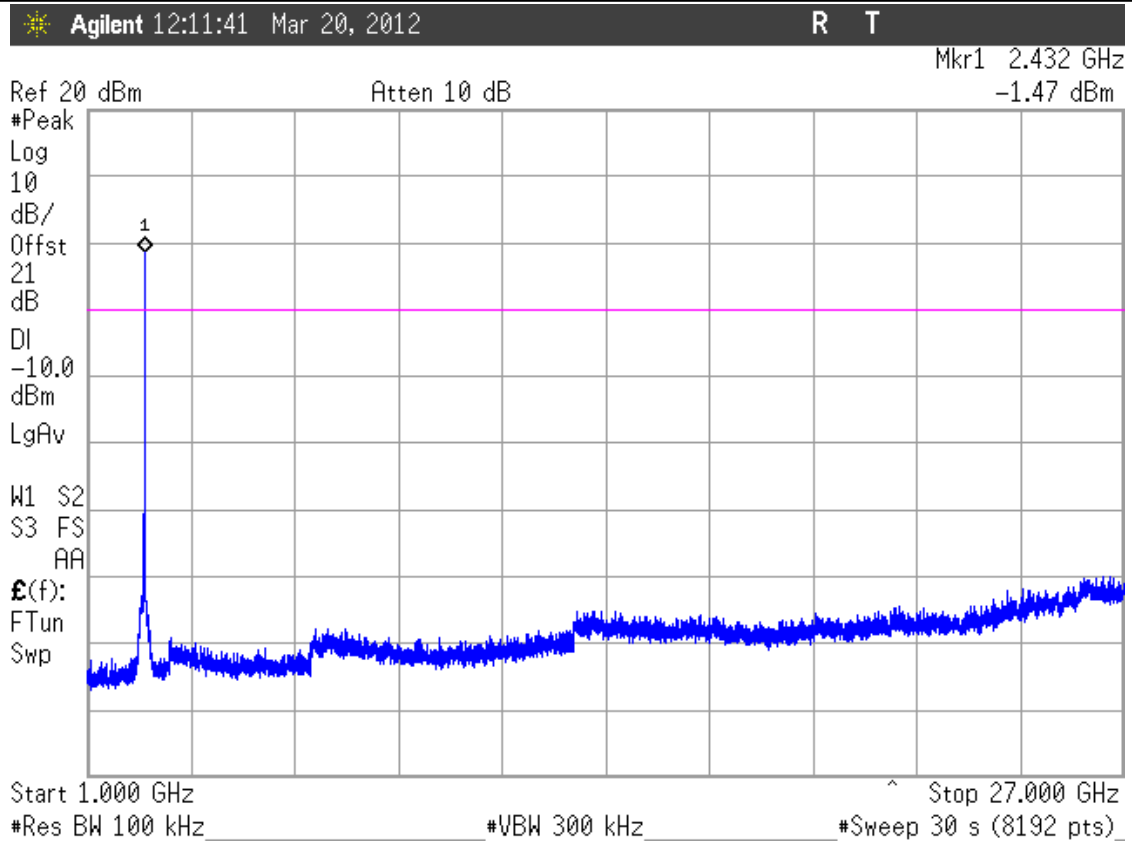
Data Rate = 11 Mb/s

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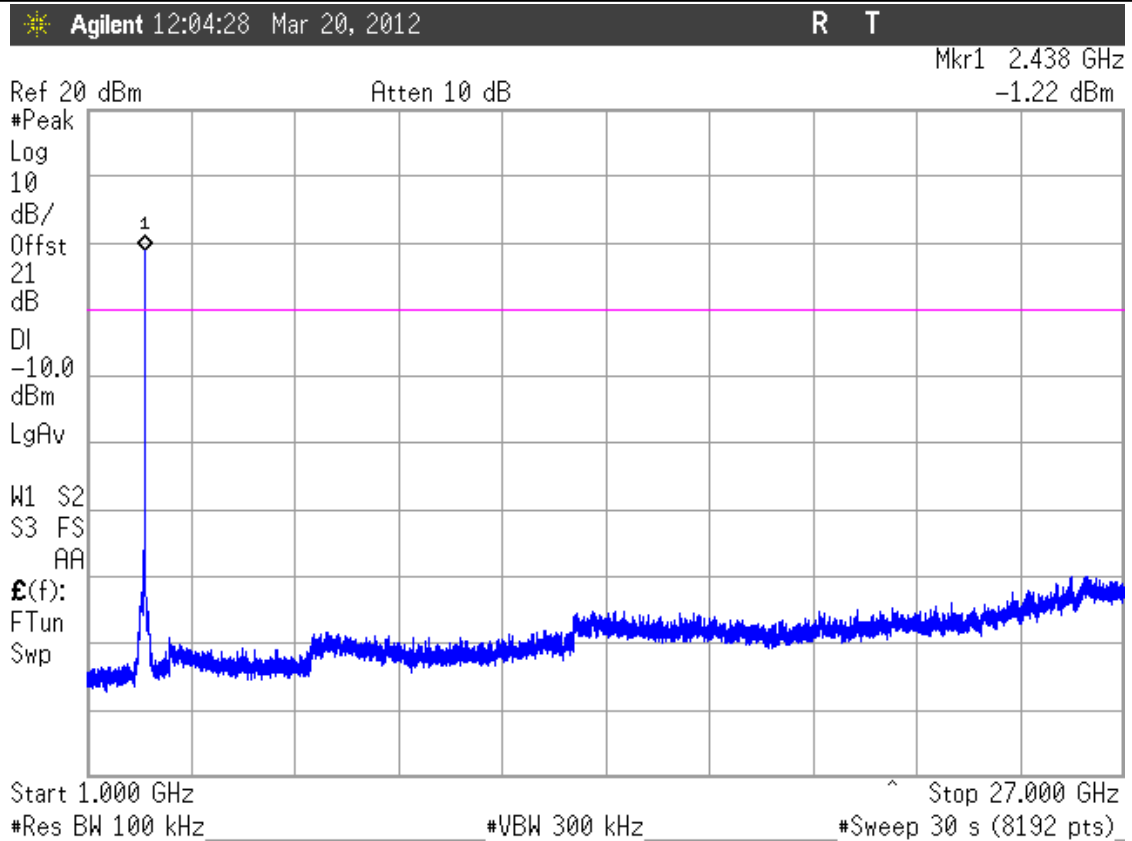
Conducted Spurious Emissions Mid Channel (802.11g mode)



Note:

Data Rate = 6 Mb/s

Conducted Spurious Emissions Mid Channel (802.11g mode)



Note:

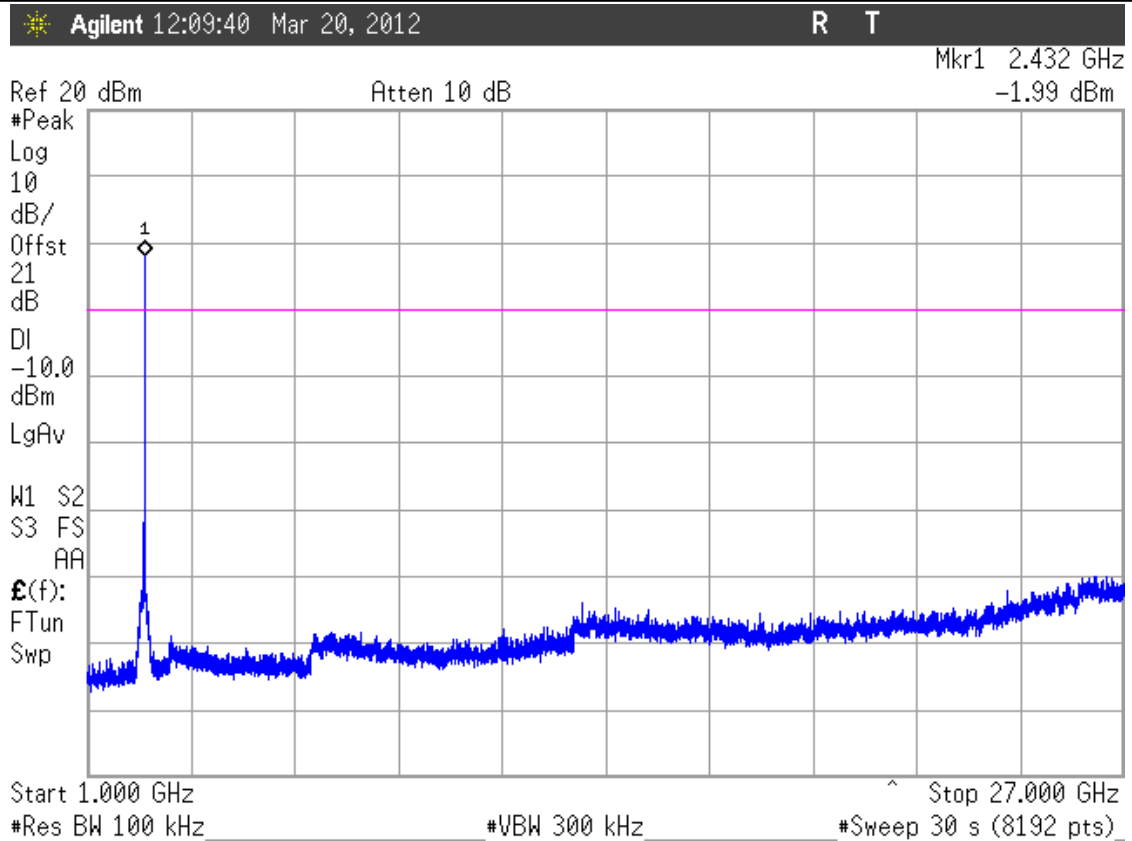
Data Rate = 54 Mb/s

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Conducted Spurious Emissions Mid Channel (802.11n mode)



Note:

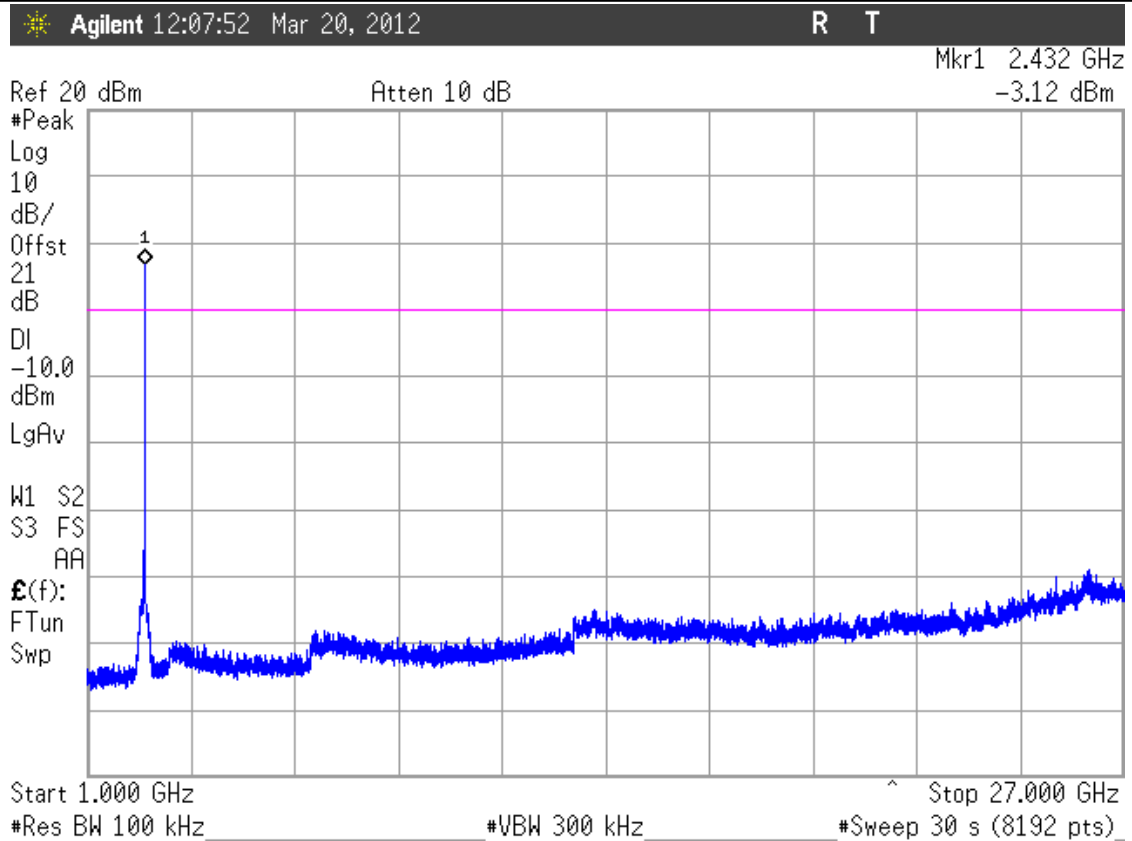
Data Rate = 6.5 Mb/s

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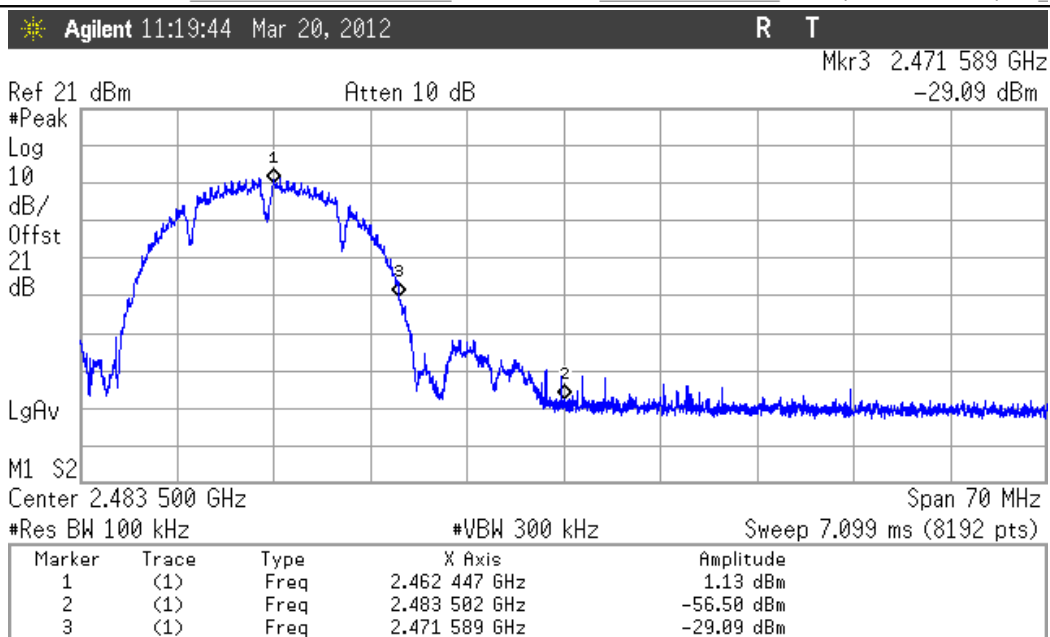
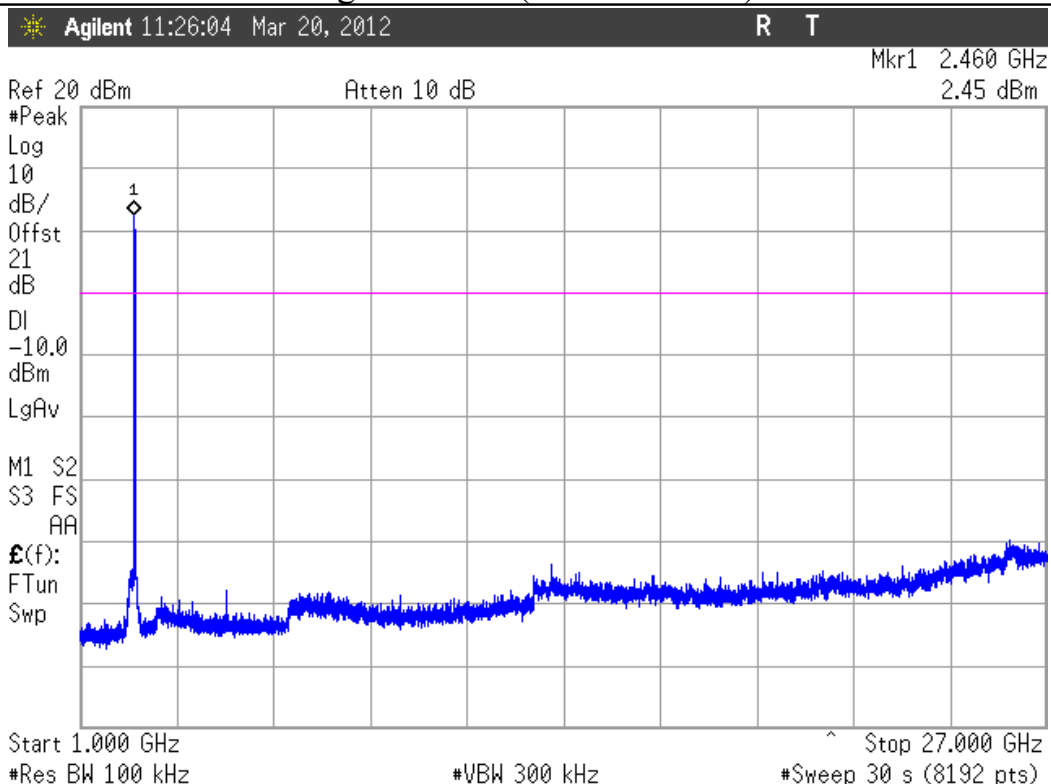
Conducted Spurious Emissions Mid Channel (802.11n mode)



Note:

Data Rate = 65 Mb/s

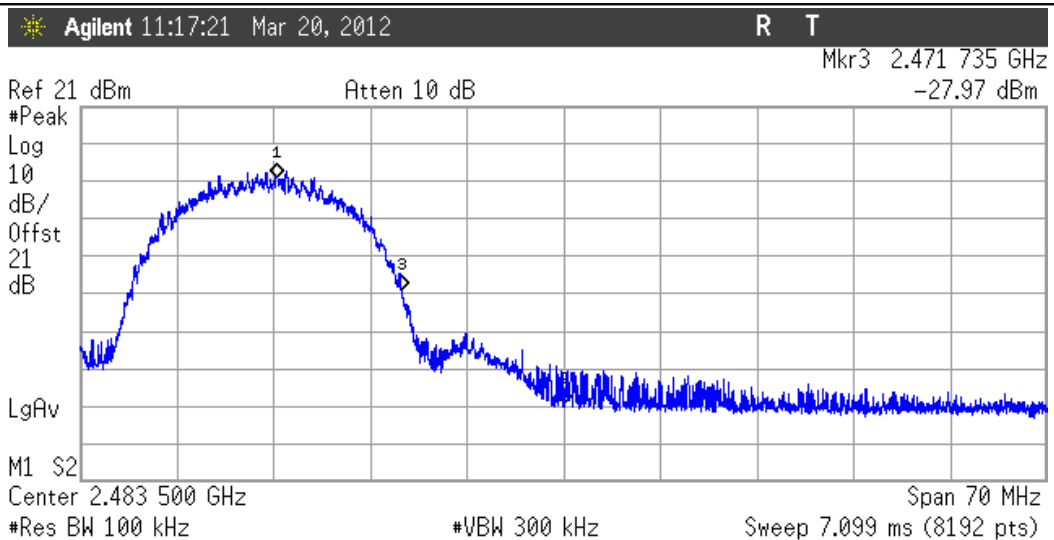
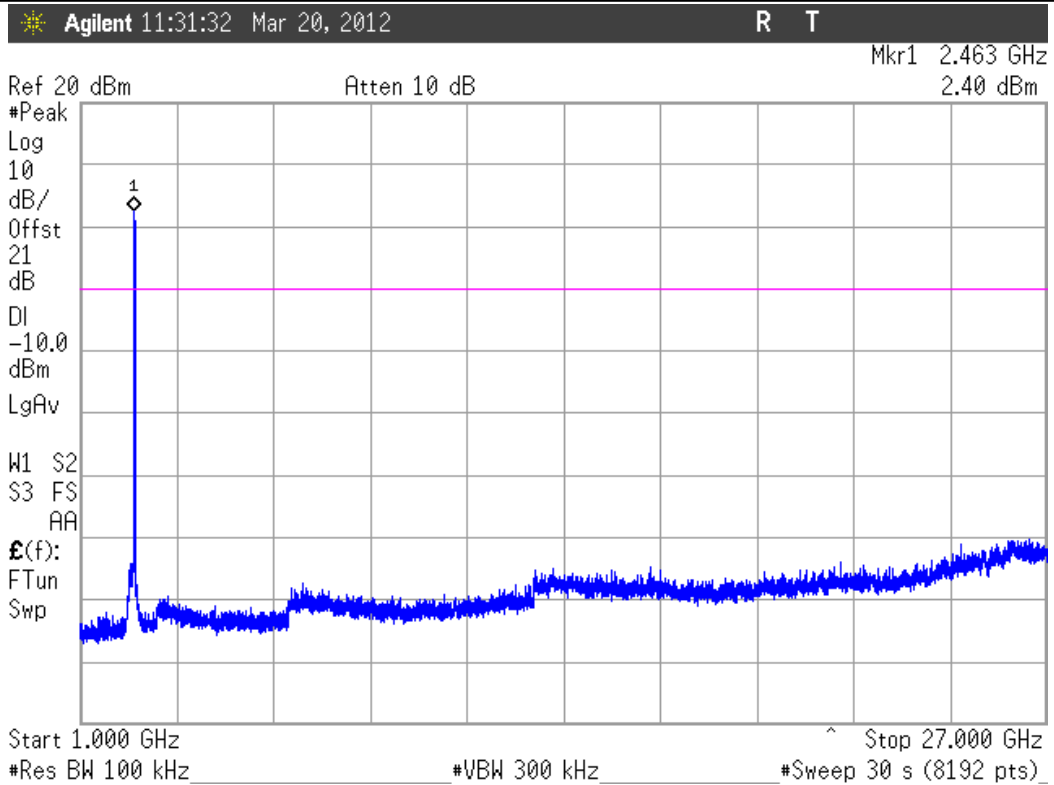
Conducted Spurious Emissions High Channel (802.11b mode)



Note:

Data Rate = 1 Mb/s

Conducted Spurious Emissions High Channel (802.11b mode)

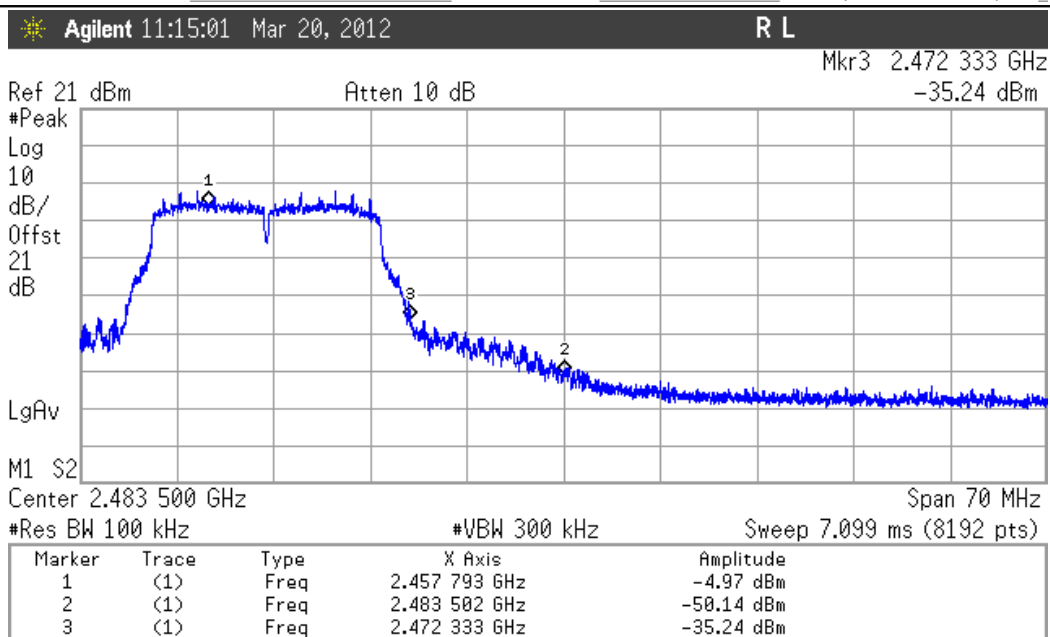
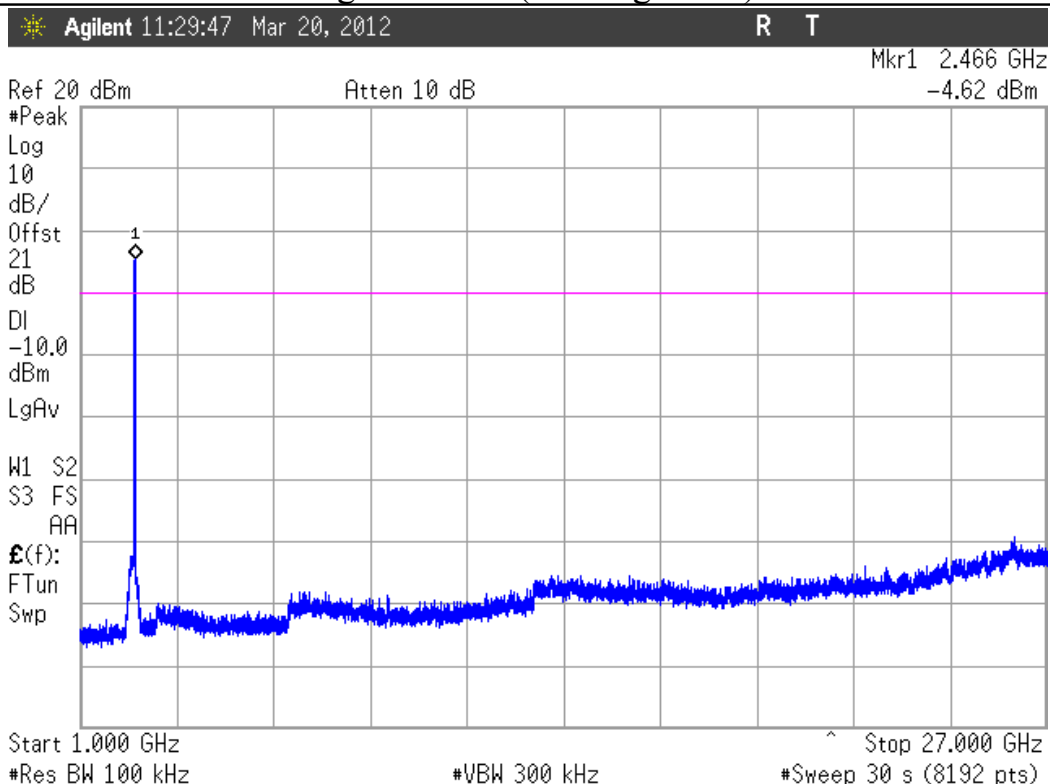


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.462 720 GHz	2.08 dBm
2	(1)	Freq	2.483 502 GHz	-58.33 dBm
3	(1)	Freq	2.471 735 GHz	-27.97 dBm

Note:

Data Rate = 11 Mb/s

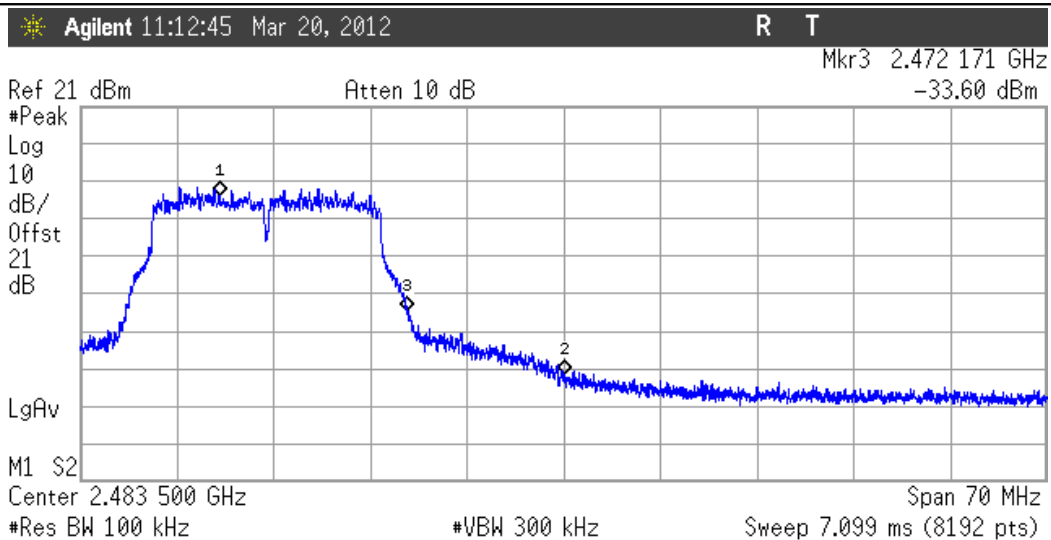
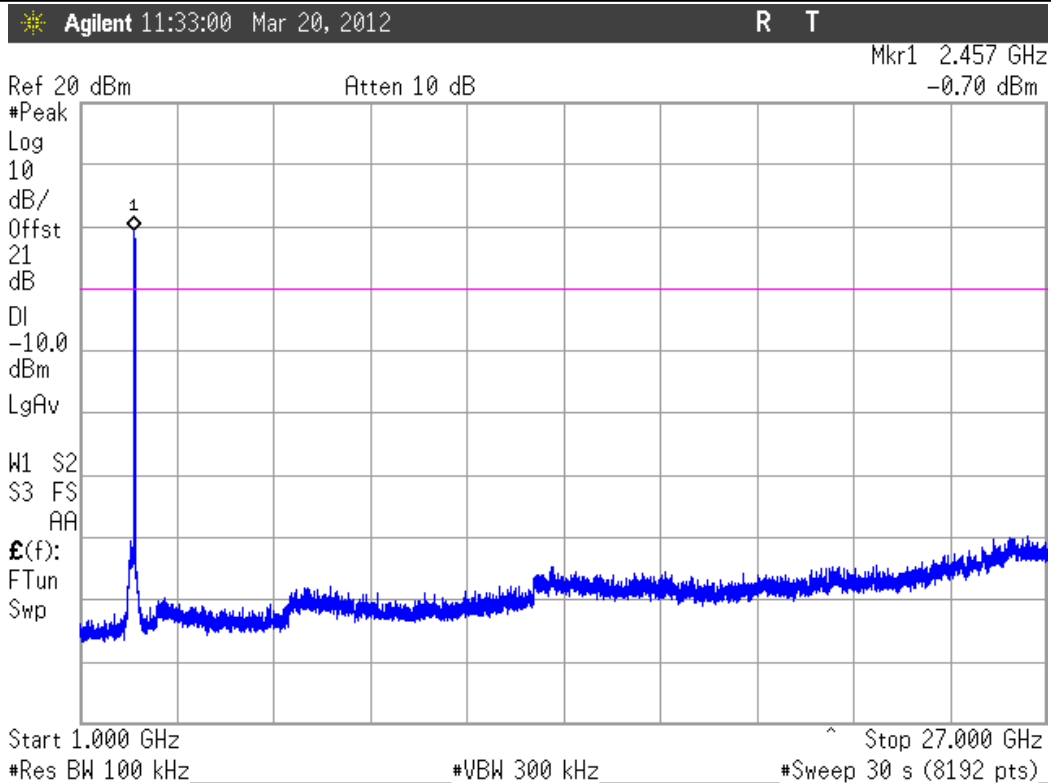
Conducted Spurious Emissions High Channel (802.11g mode)



Note:

Data Rate = 6 Mb/s

Conducted Spurious Emissions High Channel (802.11g mode)

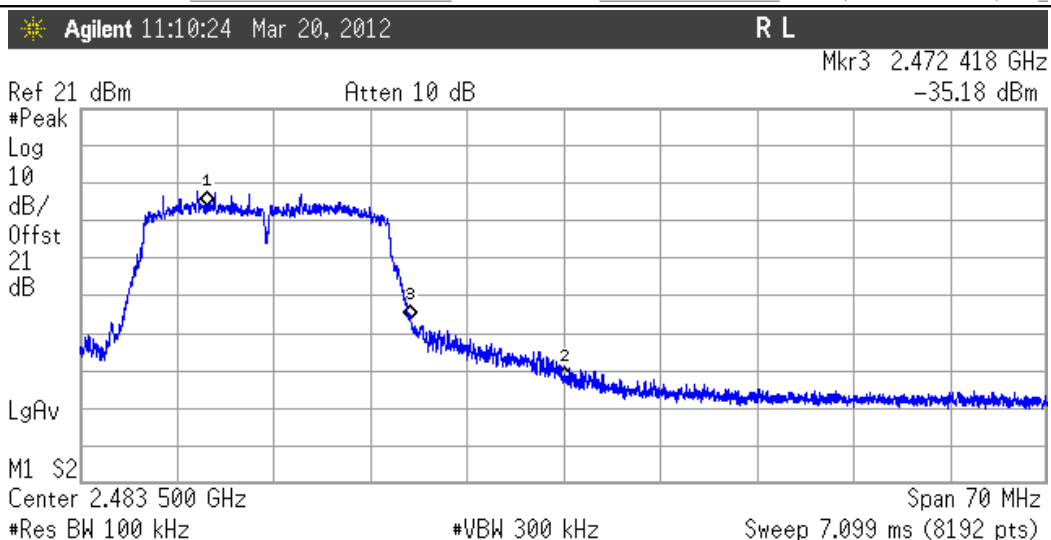
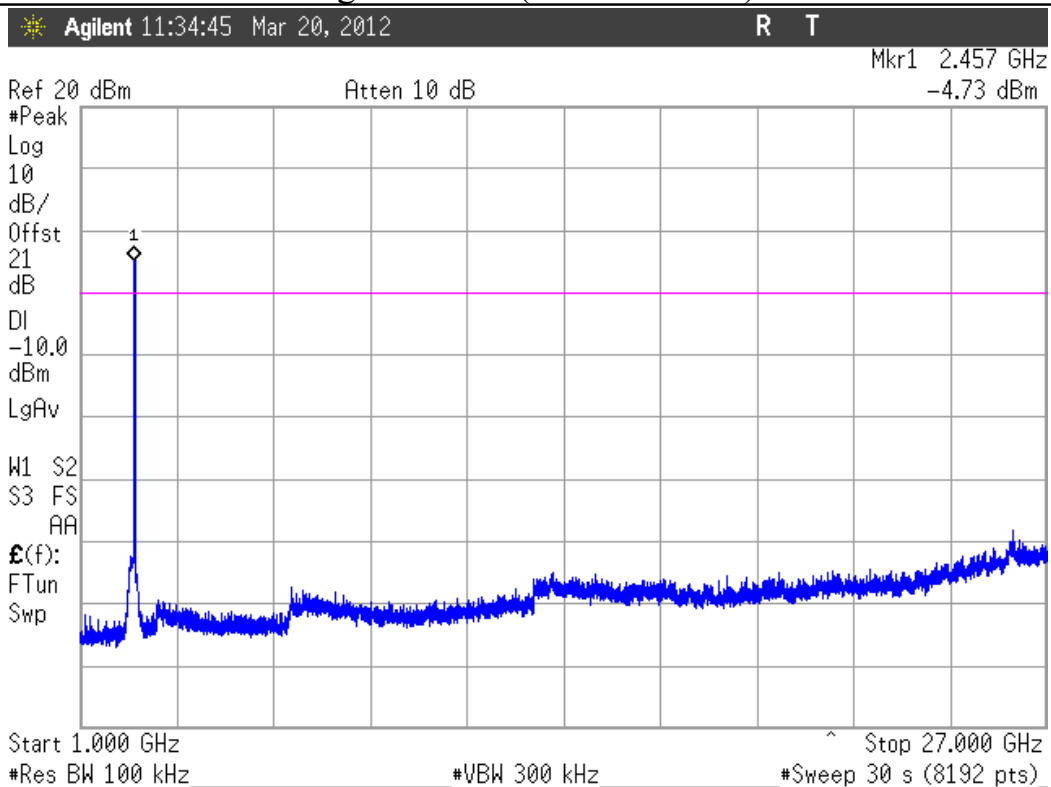


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.458 588 GHz	-2.97 dBm
2	(1)	Freq	2.483 502 GHz	-50.51 dBm
3	(1)	Freq	2.472 171 GHz	-33.60 dBm

Note:

Data Rate = 54 Mb/s

Conducted Spurious Emissions High Channel (802.11n mode)

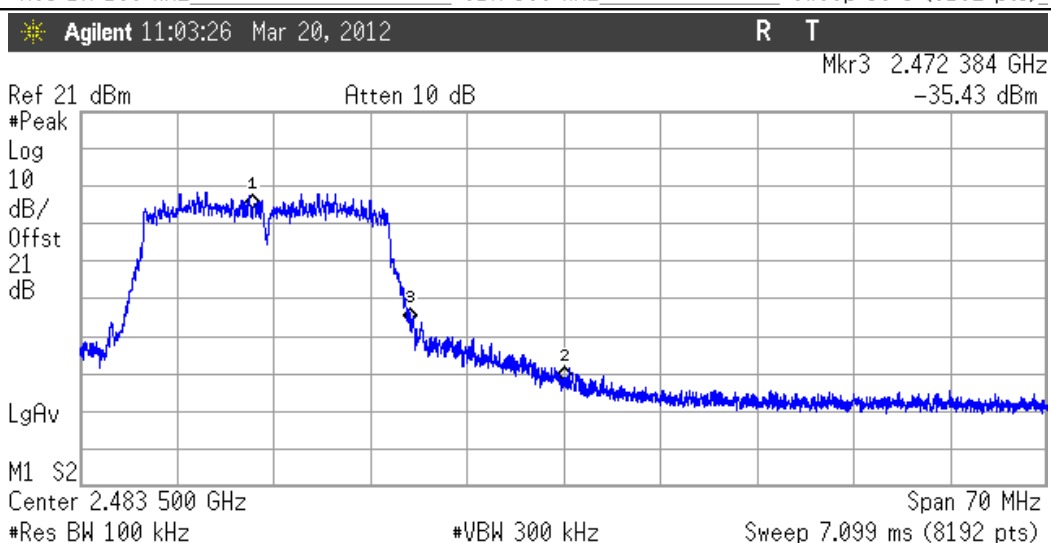
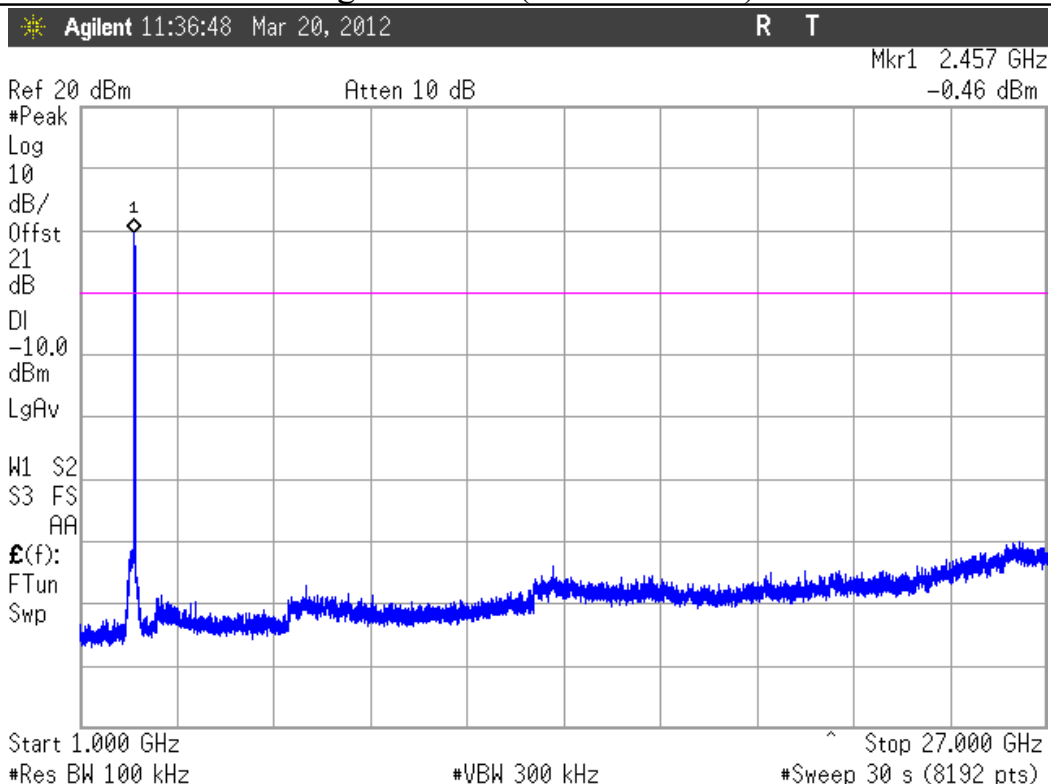


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.457 639 GHz	-5.07 dBm
2	(1)	Freq	2.483 502 GHz	-51.66 dBm
3	(1)	Freq	2.472 418 GHz	-35.18 dBm

Note:

Data Rate = 6.5 Mb/s

Conducted Spurious Emissions High Channel (802.11n mode)

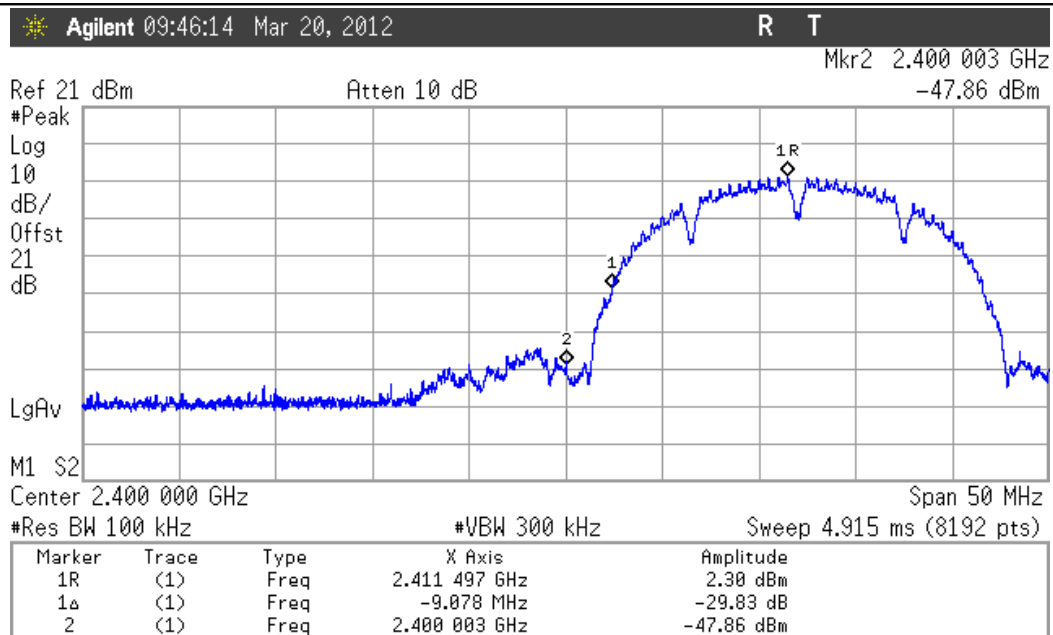
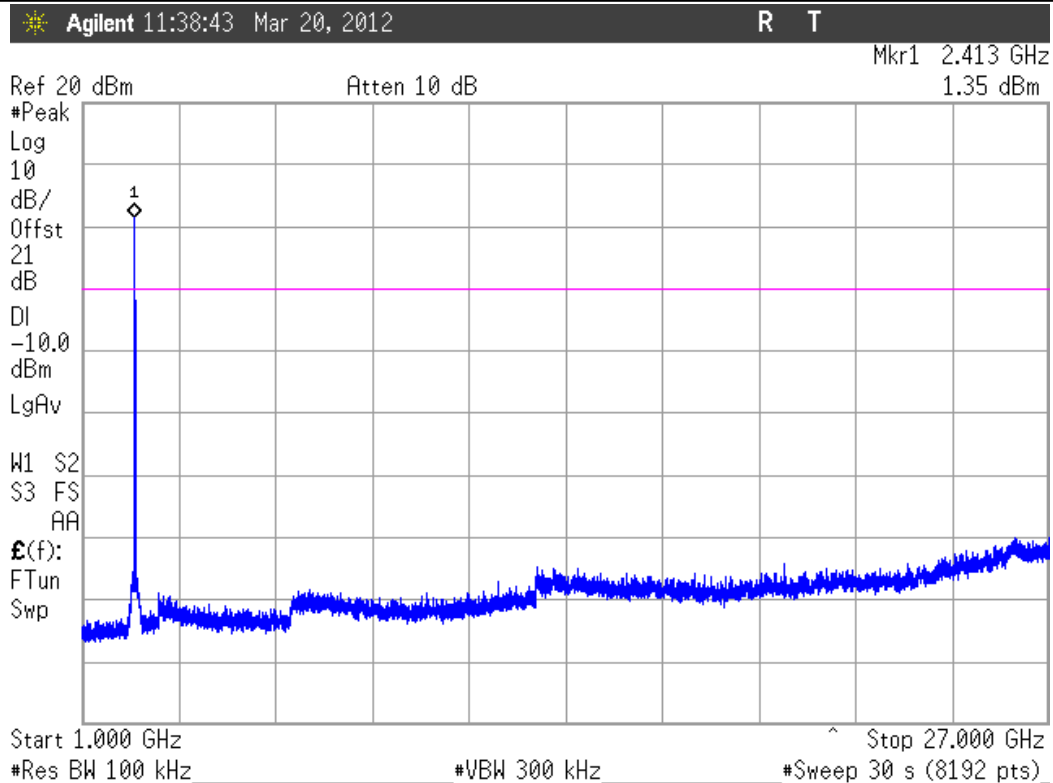


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.461 032 GHz	-4.99 dBm
2	(1)	Freq	2.483 502 GHz	-50.88 dBm
3	(1)	Freq	2.472 384 GHz	-35.43 dBm

Note:

Data Rate = 65 Mb/s

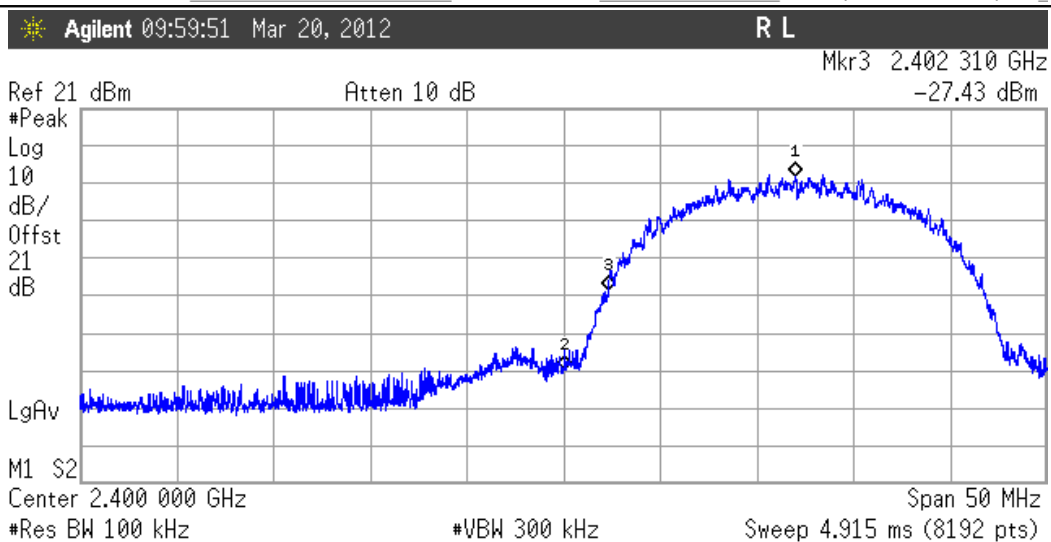
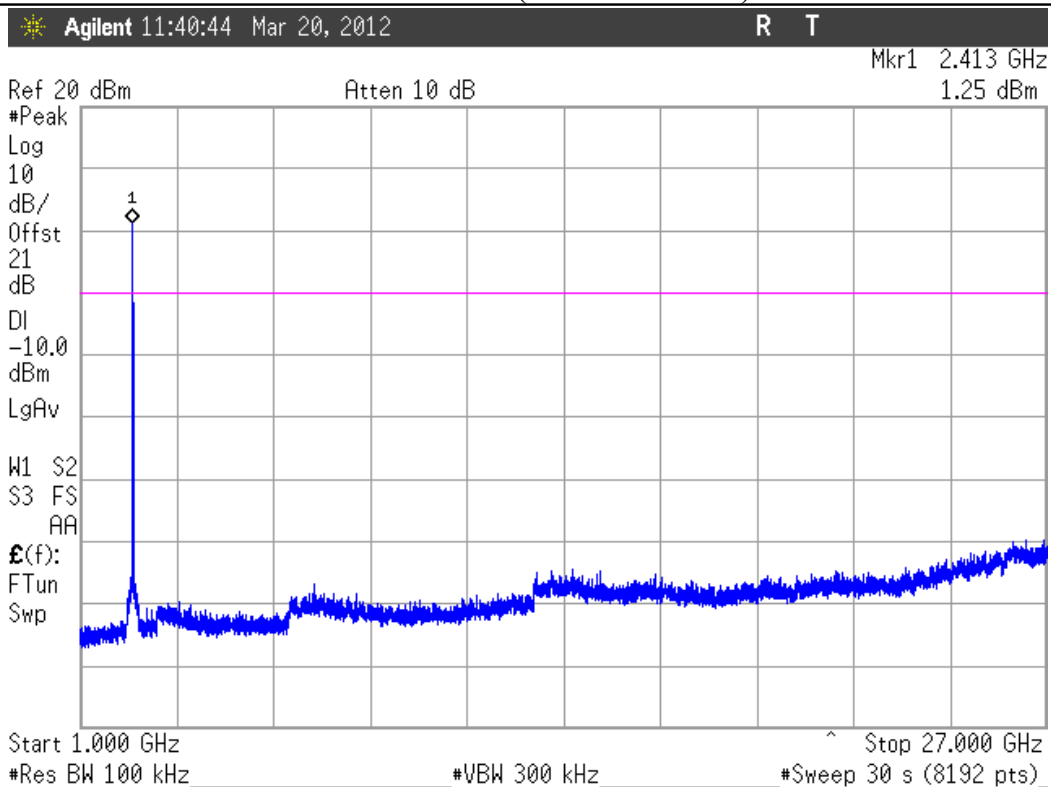
Conducted Spurious Emissions Low Channel (802.11b mode)



Note:

Data Rate = 1 Mb/s

Conducted Spurious Emissions Low Channel (802.11b mode)

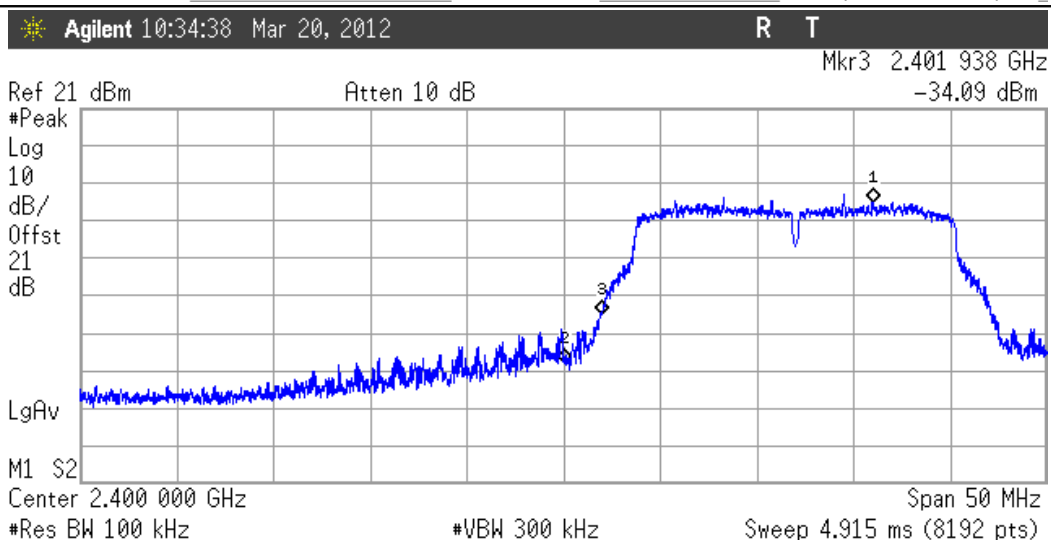
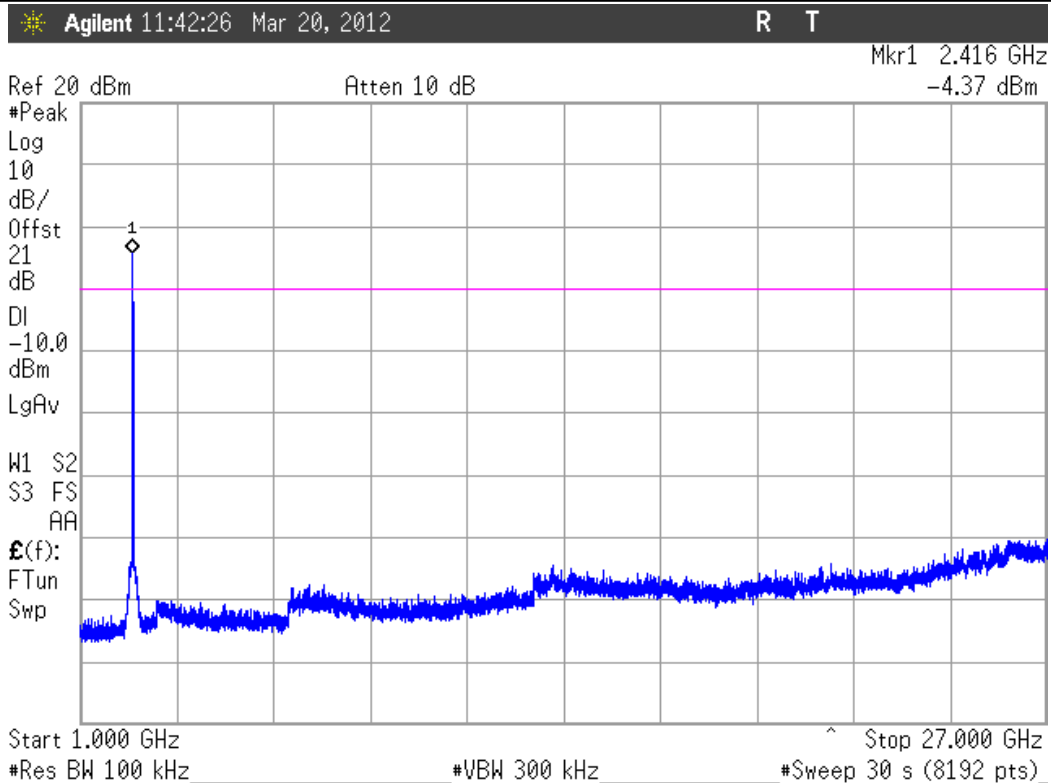


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.412 004 GHz	2.61 dBm
2	(1)	Freq	2.400 001 GHz	-48.53 dBm
3	(1)	Freq	2.402 310 GHz	-27.43 dBm

Note:

Data Rate = 11 Mb/s

Conducted Spurious Emissions Low Channel (802.11g mode)

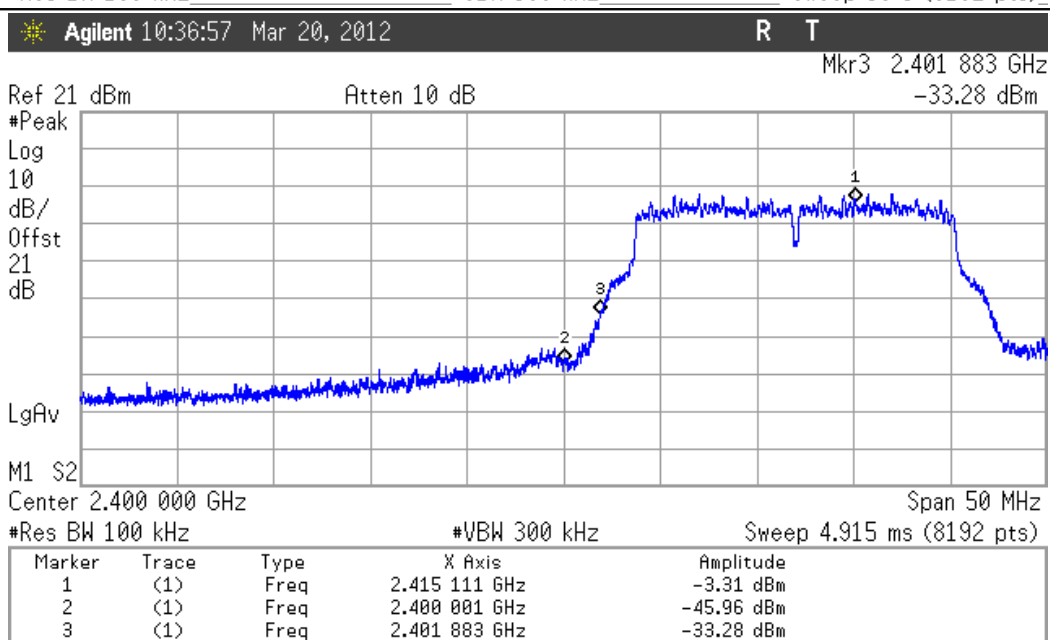
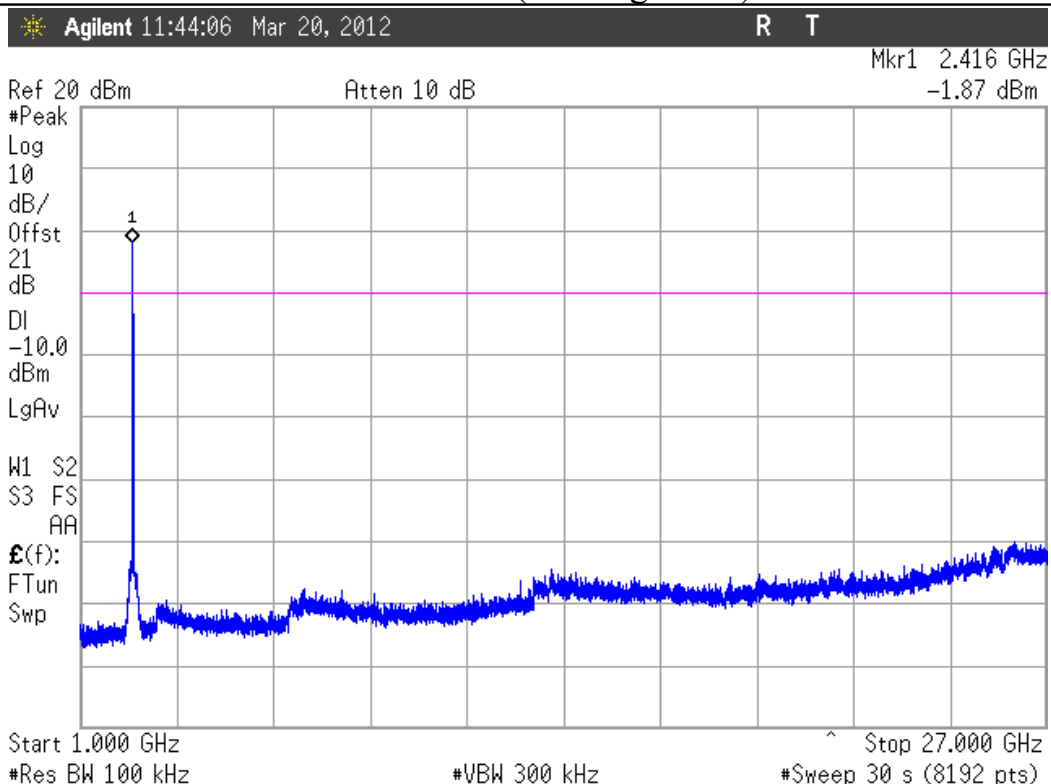


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.415 972 GHz	-4.15 dBm
2	(1)	Freq	2.400 001 GHz	-46.78 dBm
3	(1)	Freq	2.401 938 GHz	-34.09 dBm

Note:

Data Rate = 6 Mb/s

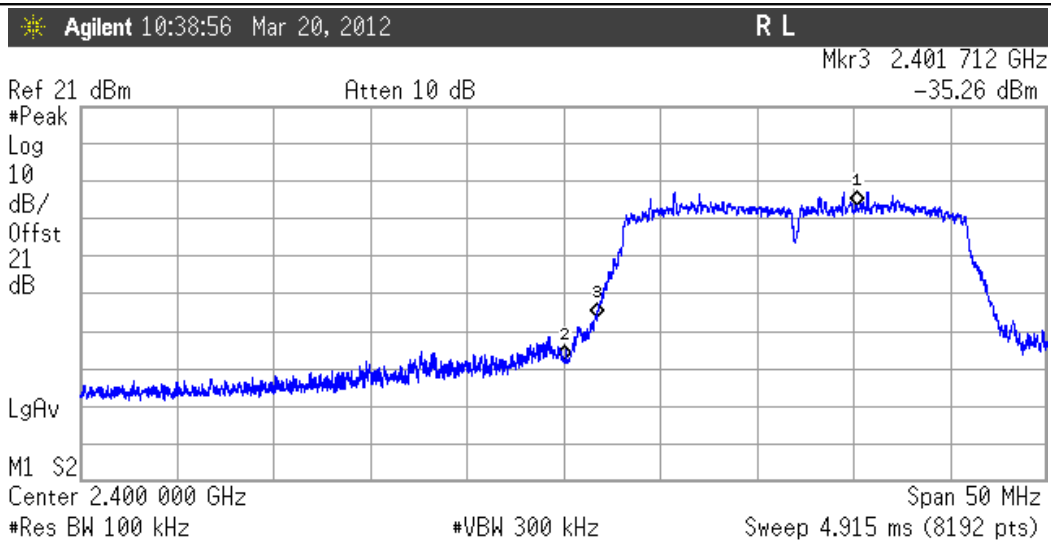
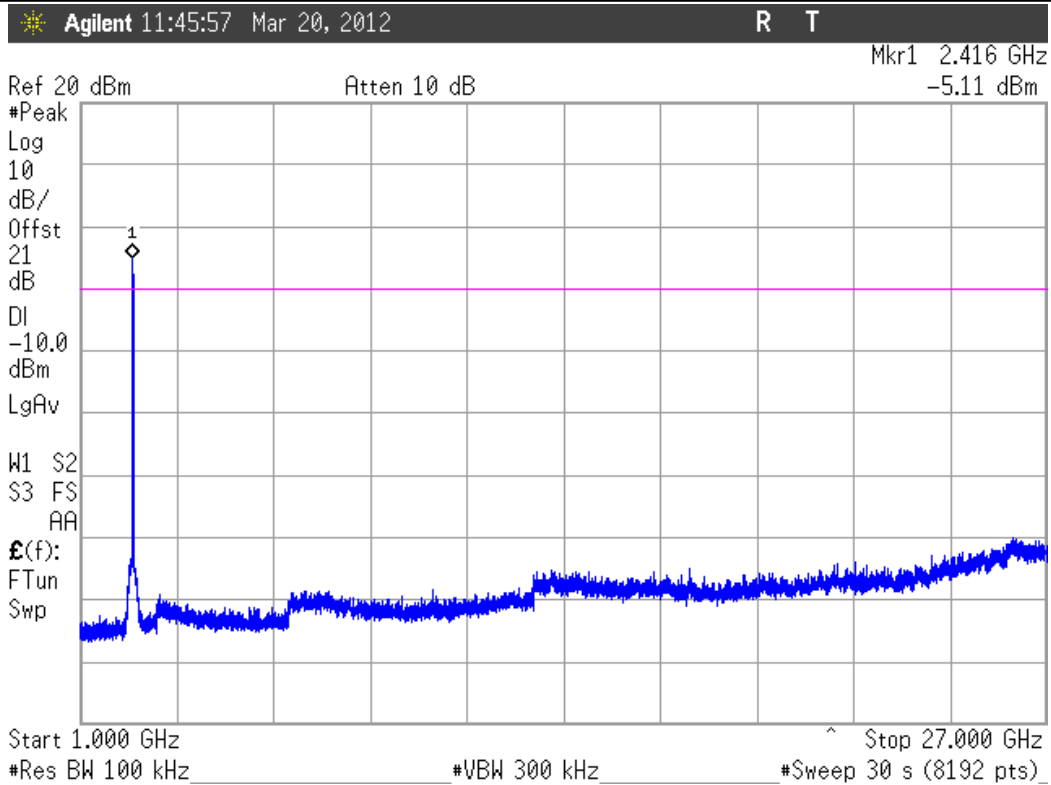
Conducted Spurious Emissions Low Channel (802.11g mode)



Note:

Data Rate = 54 Mb/s

Conducted Spurious Emissions Low Channel (802.11n mode)

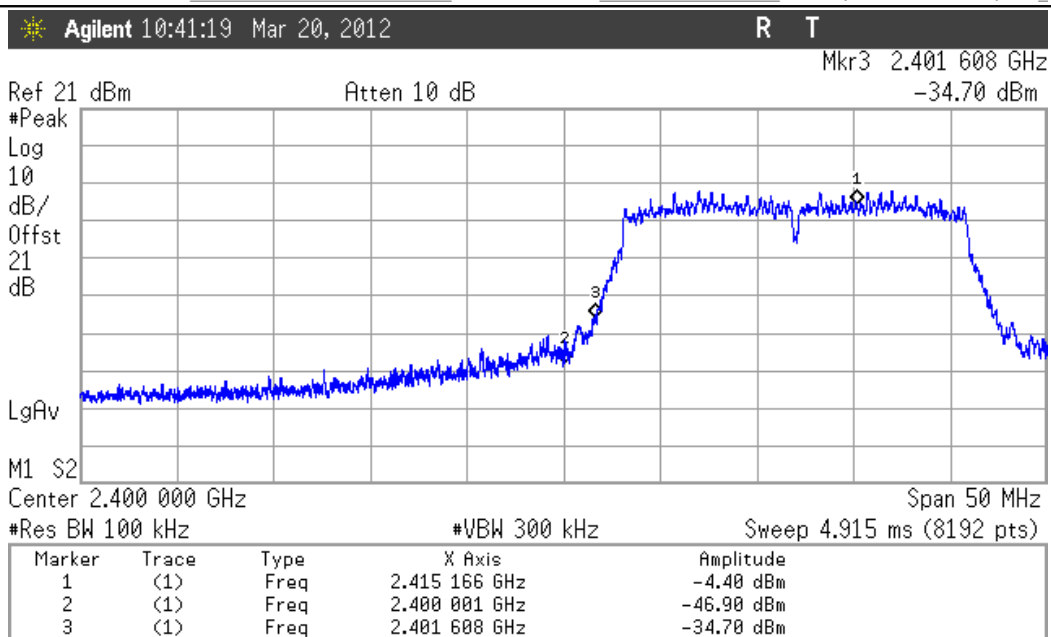
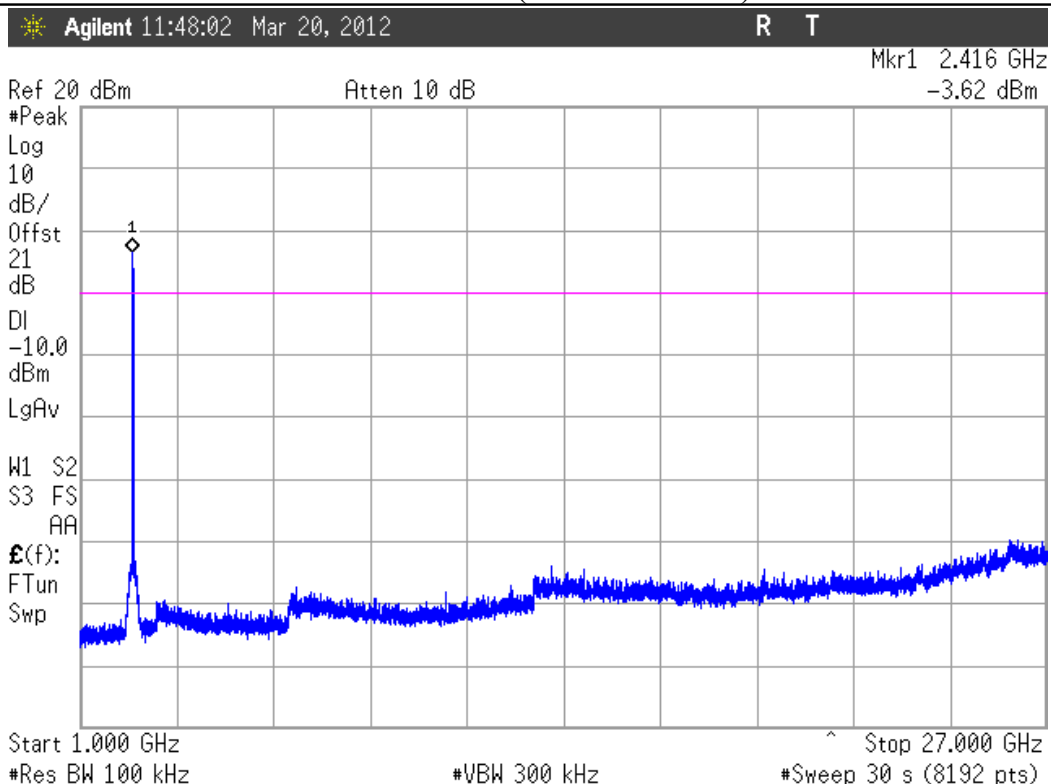


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.415 142 GHz	-5.51 dBm
2	(1)	Freq	2.400 001 GHz	-46.74 dBm
3	(1)	Freq	2.401 712 GHz	-35.26 dBm

Note:

Data Rate = 6.5 Mb/s

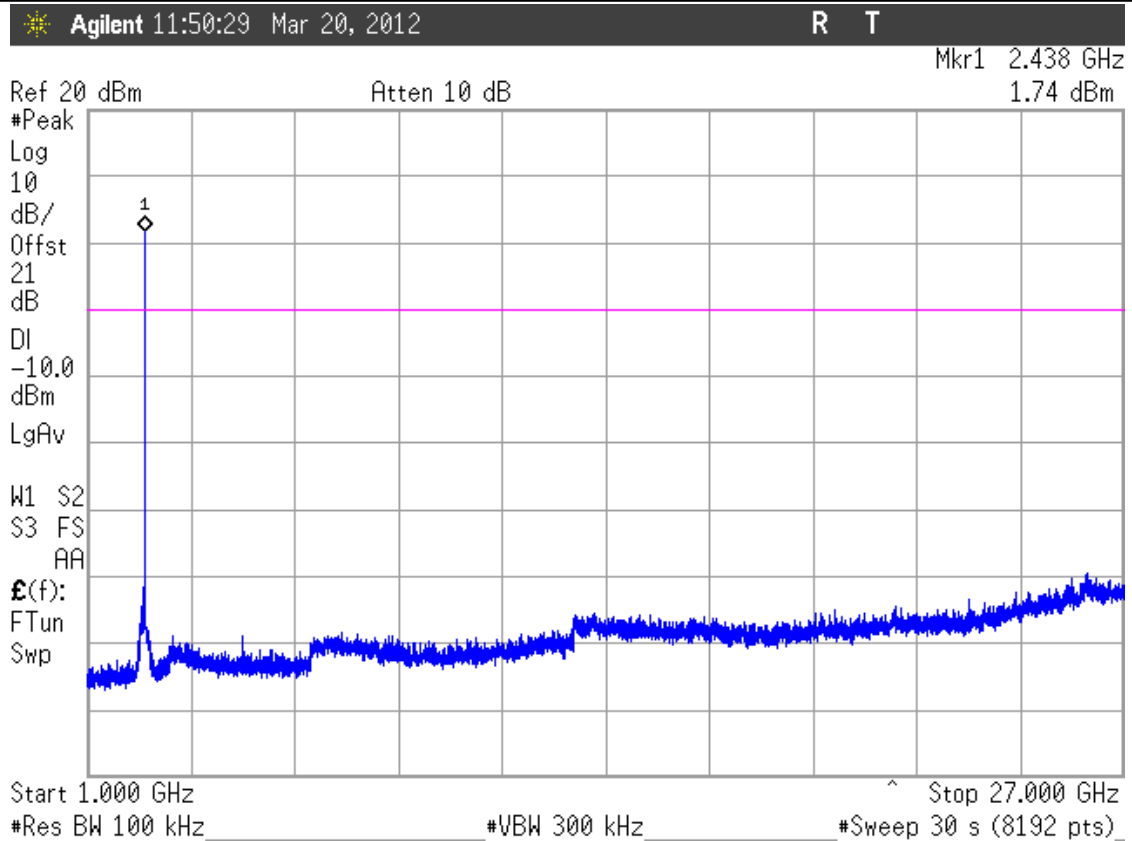
Conducted Spurious Emissions Low Channel (802.11n mode)



Note:

Data Rate = 65 Mb/s

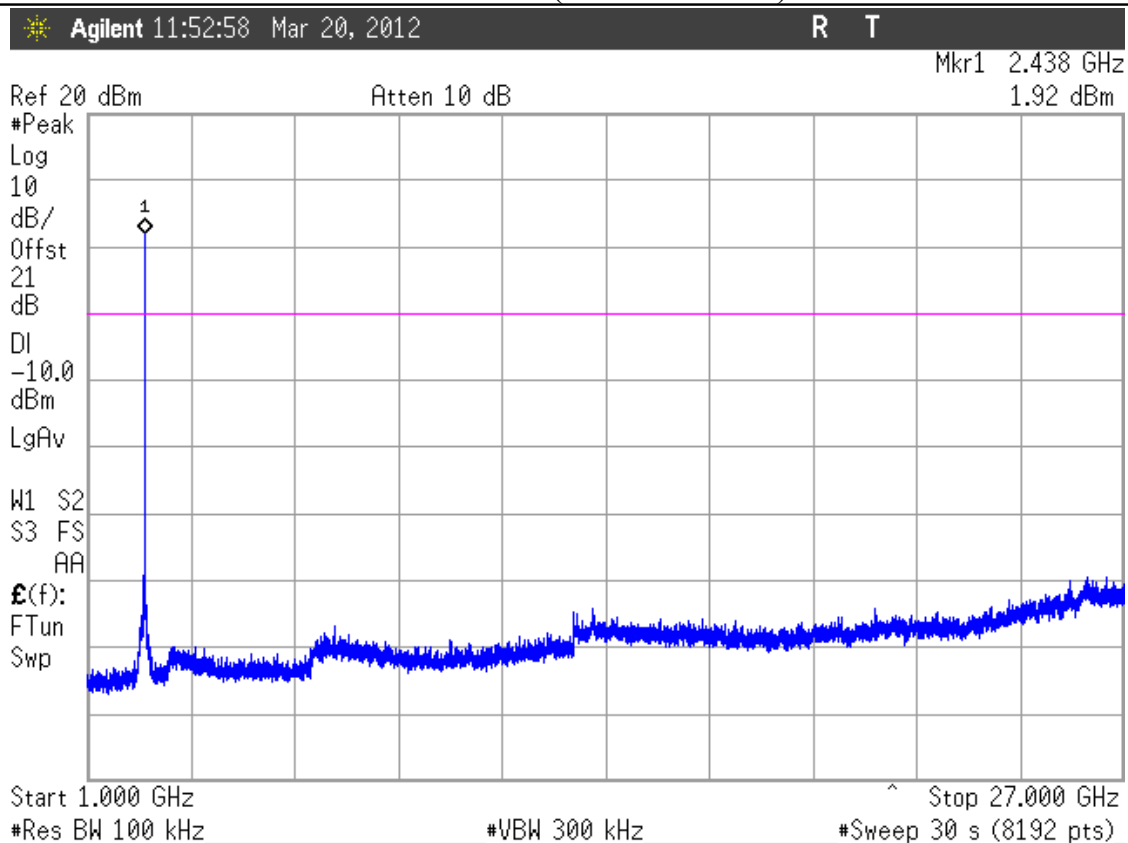
Conducted Spurious Emissions Mid Channel (802.11b mode)



Note:

Data Rate = 1 Mb/s

Conducted Spurious Emissions Mid Channel (802.11b mode)



Note:

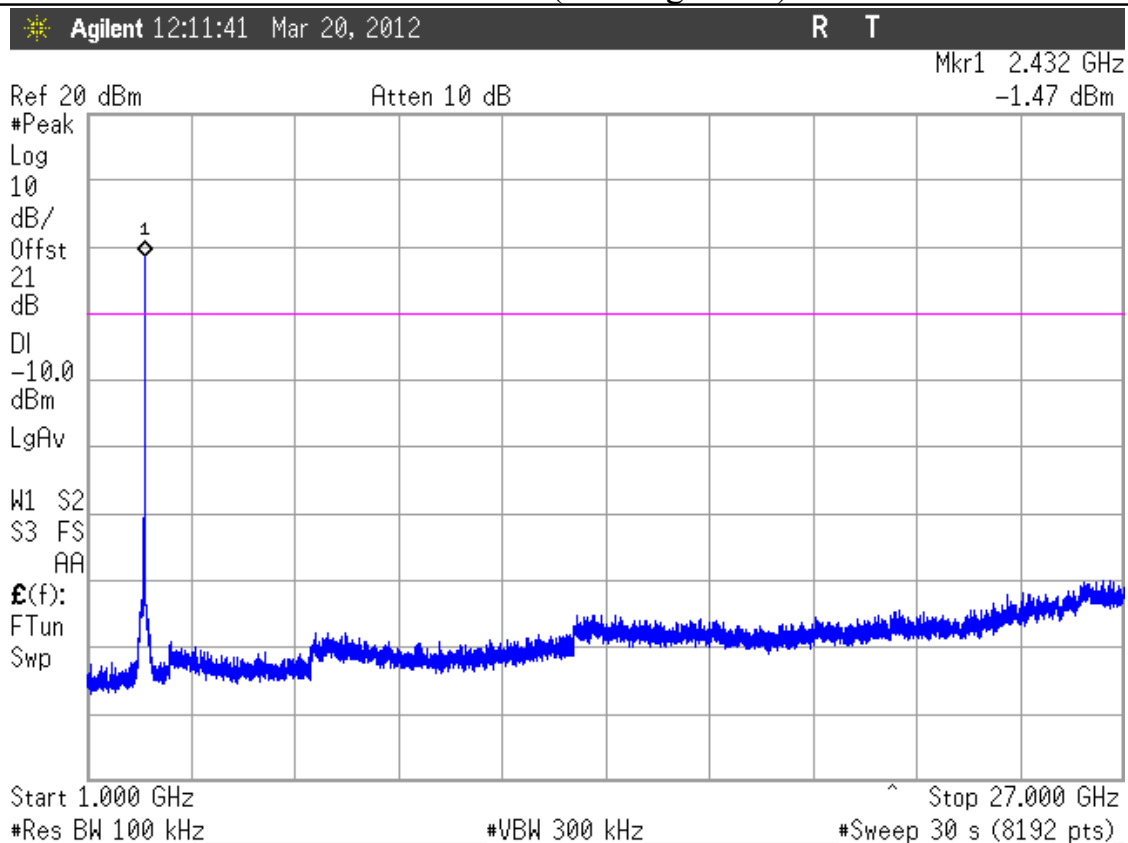
Data Rate = 11 Mb/s

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Conducted Spurious Emissions Mid Channel (802.11g mode)



Note:

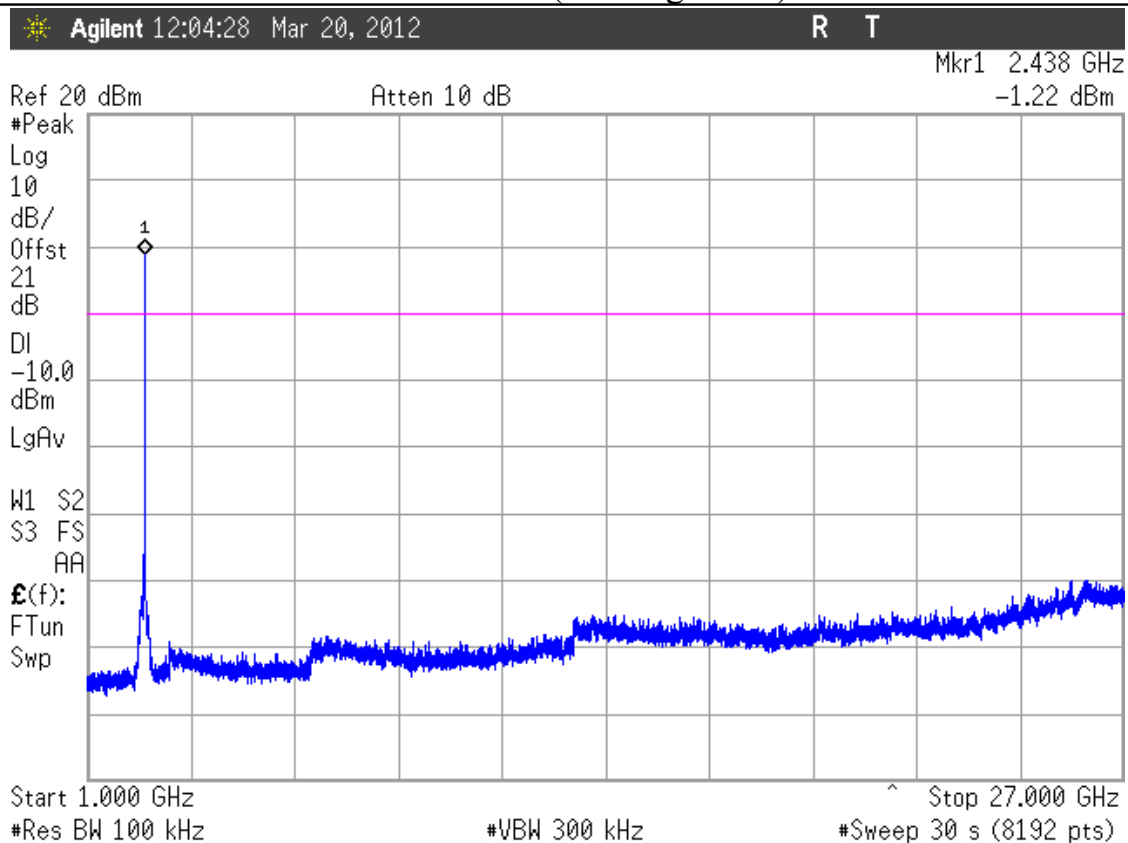
Data Rate = 6 Mb/s

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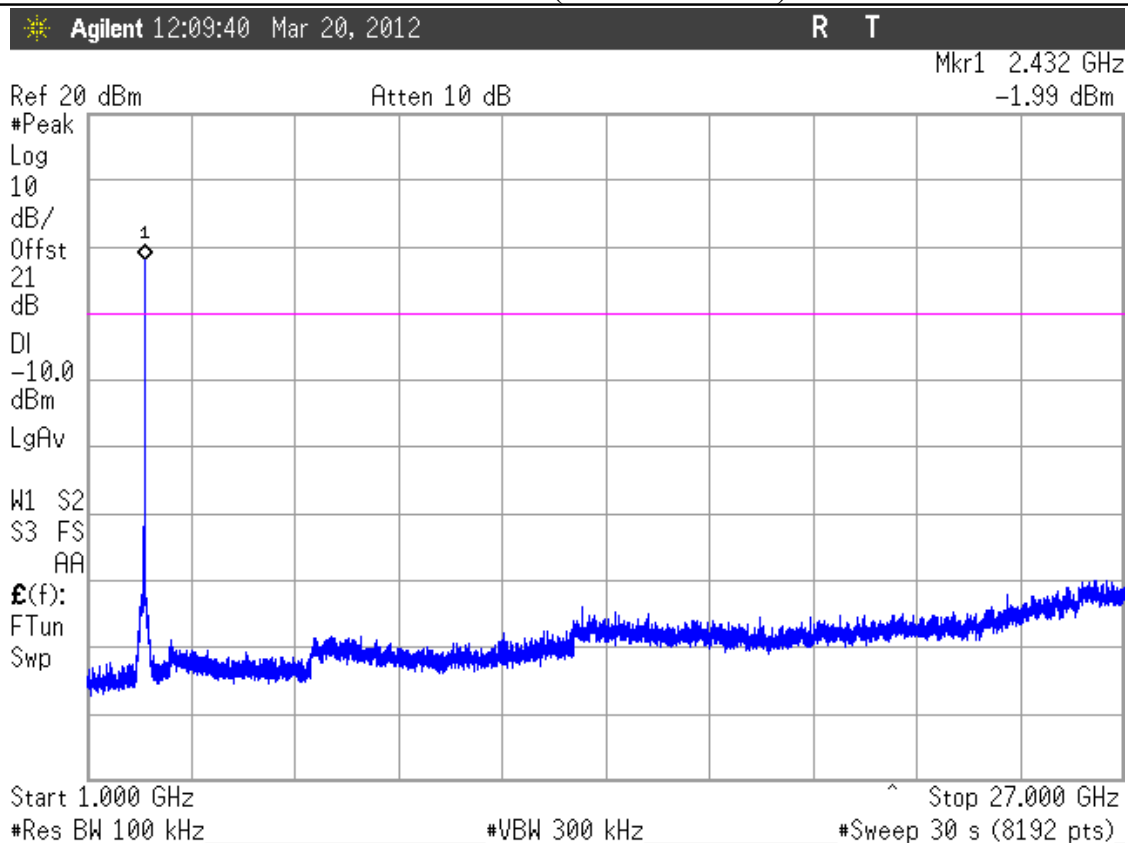
Conducted Spurious Emissions Mid Channel (802.11g mode)



Note:

Data Rate = 54 Mb/s

Conducted Spurious Emissions Mid Channel (802.11n mode)



Note:

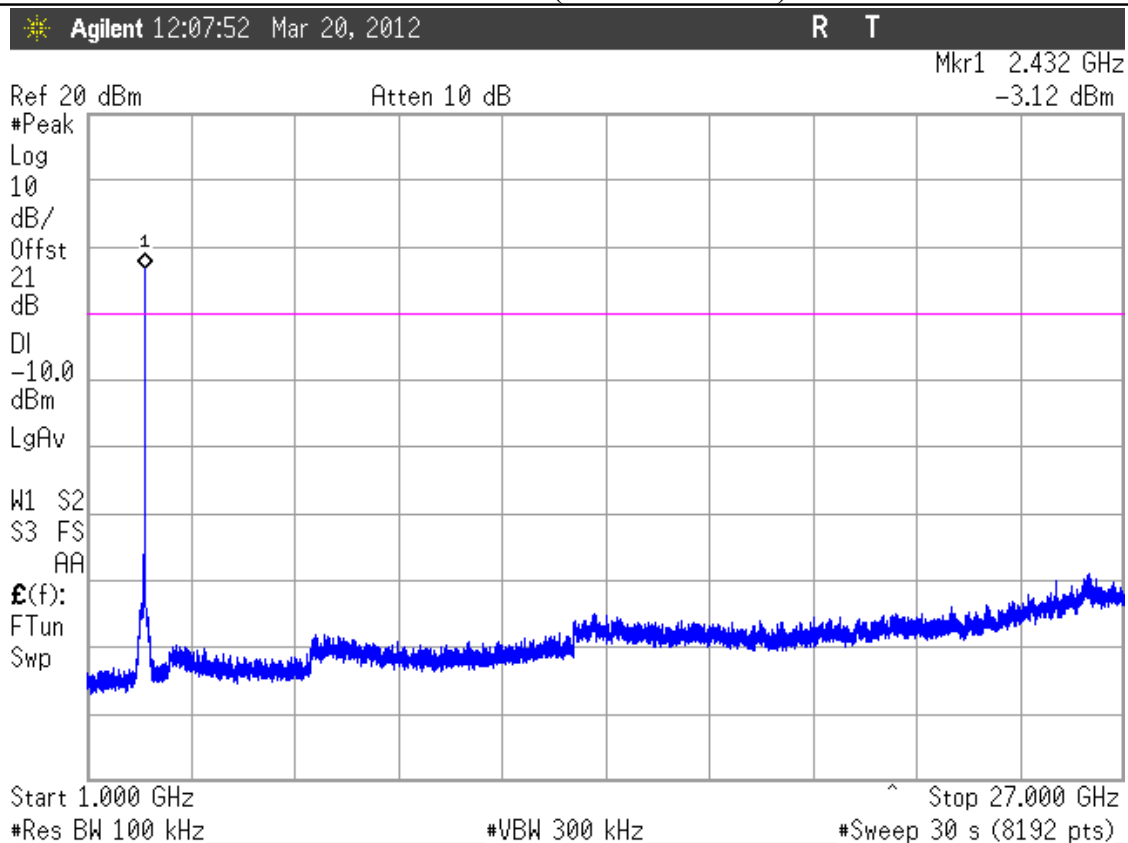
Data Rate = 6.5 Mb/s

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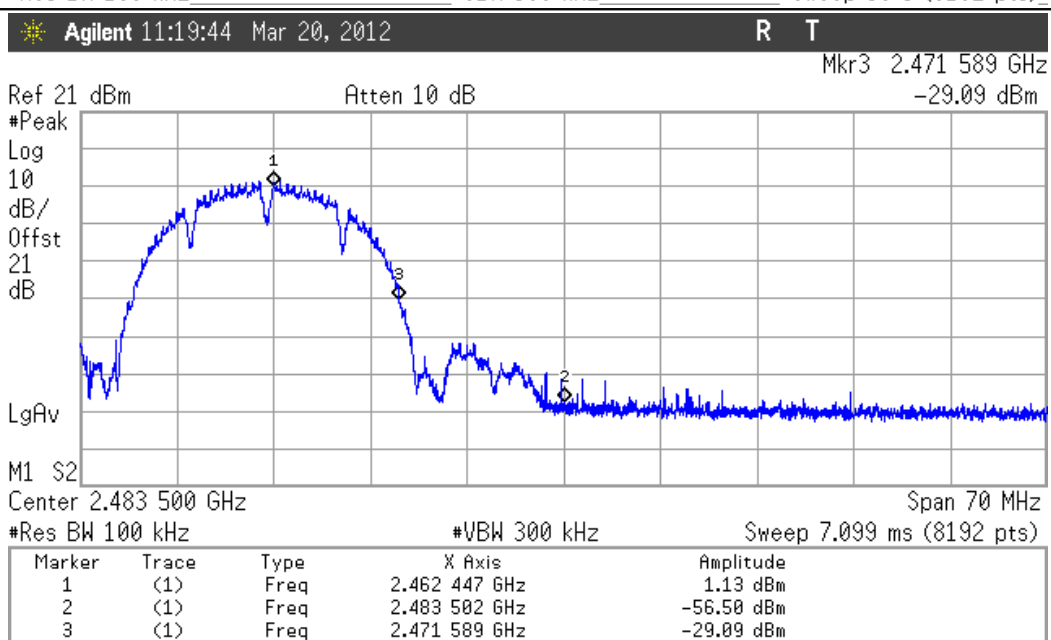
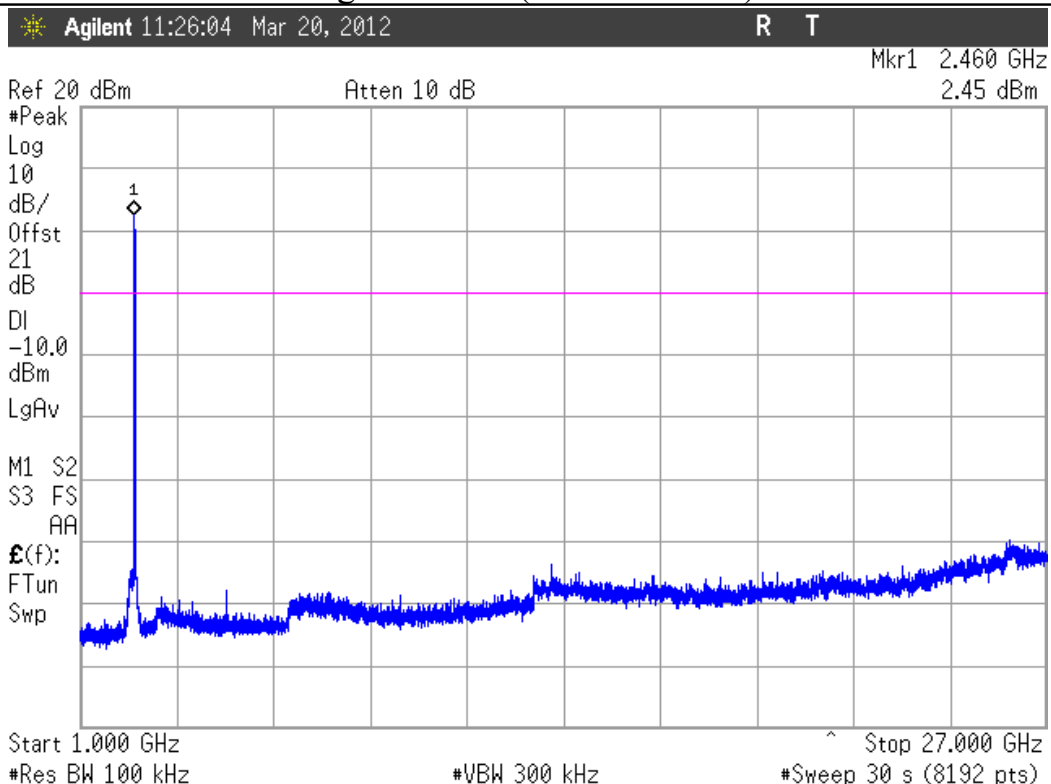
Conducted Spurious Emissions Mid Channel (802.11n mode)



Note:

Data Rate = 65 Mb/s

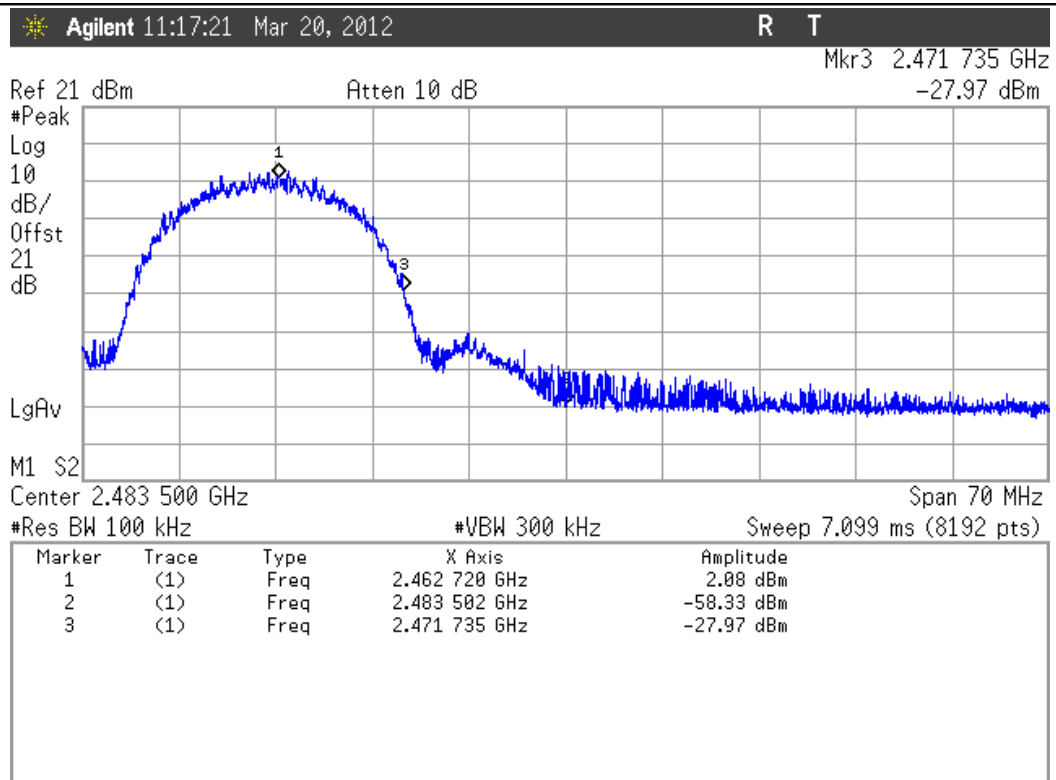
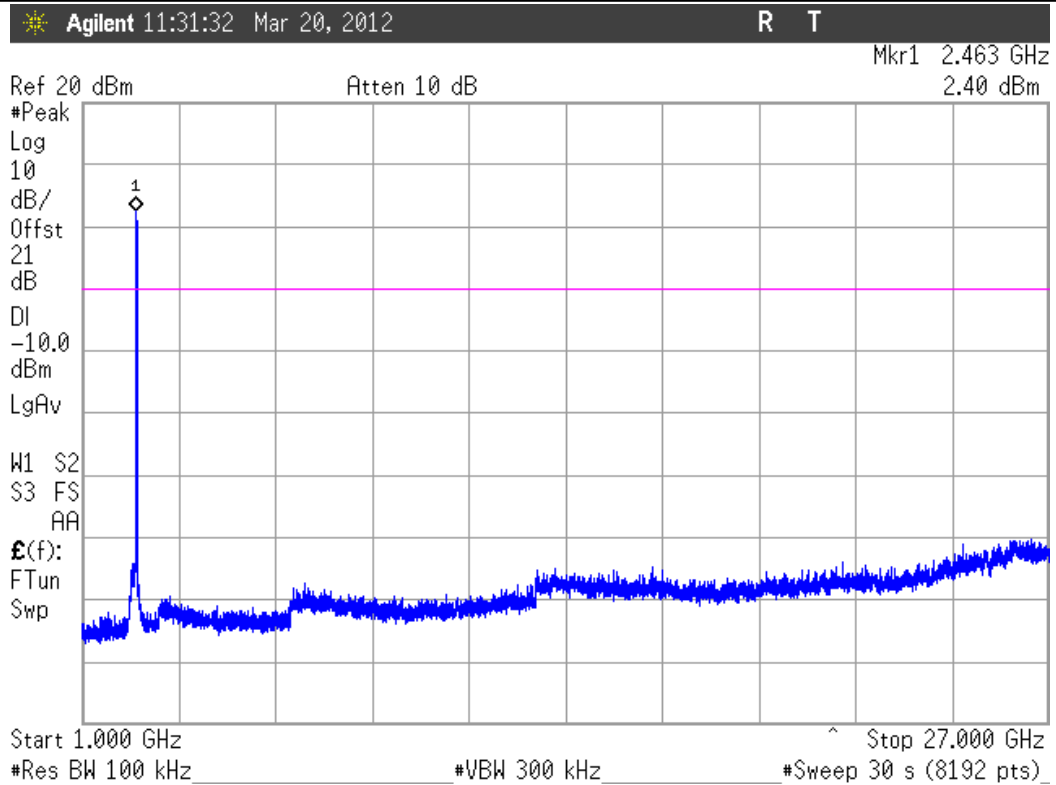
Conducted Spurious Emissions High Channel (802.11b mode)



Note:

Data Rate = 1 Mb/s

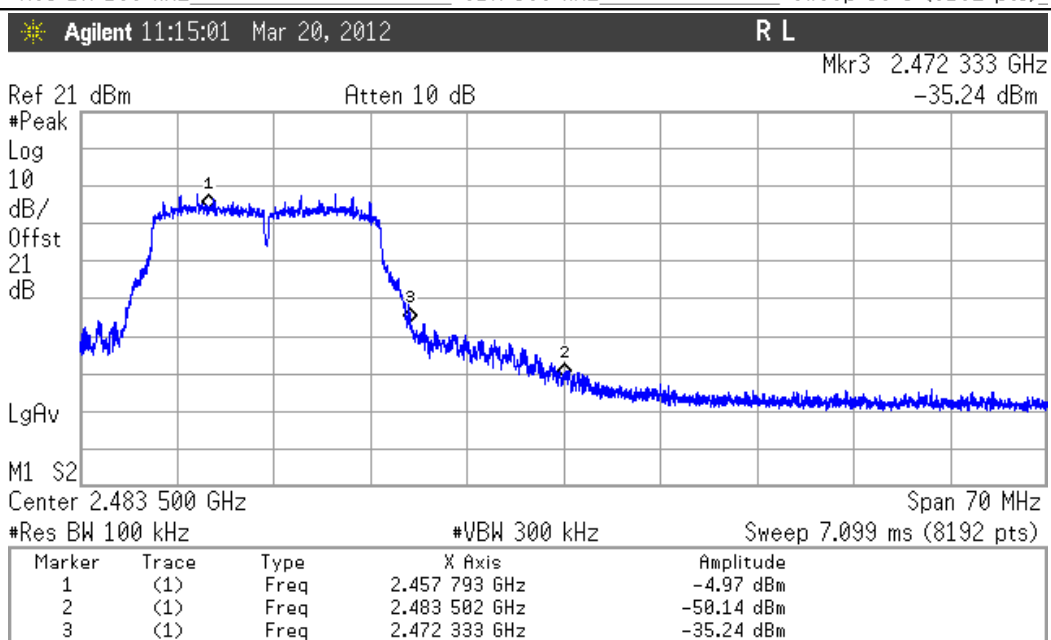
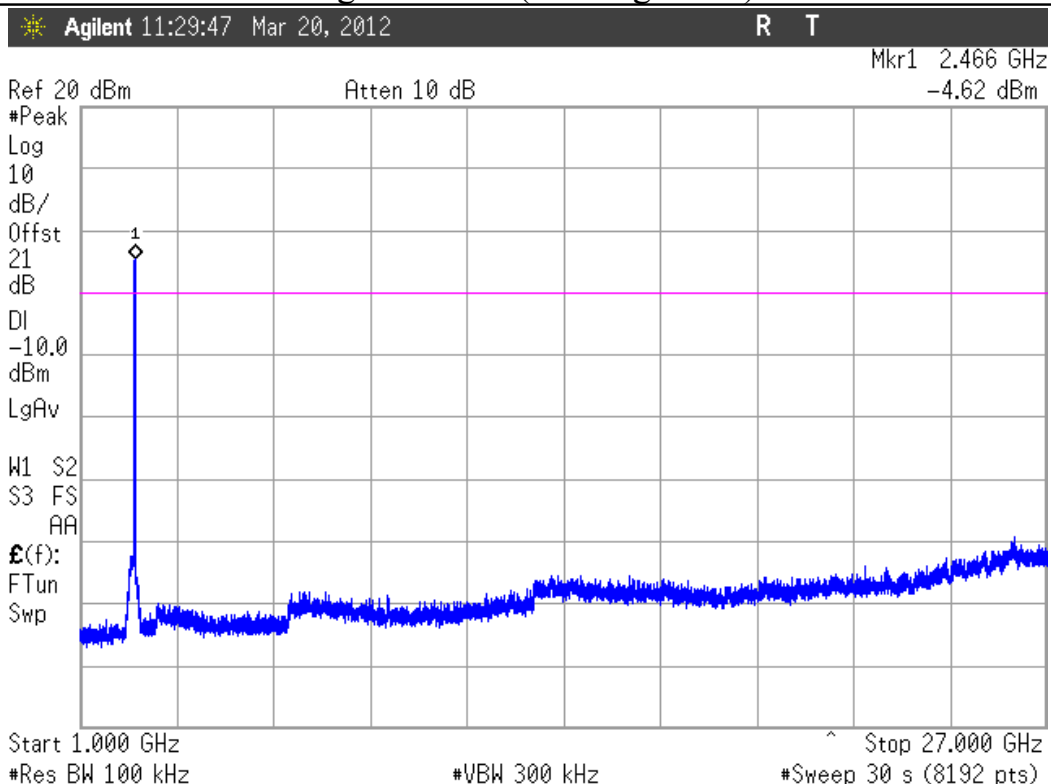
Conducted Spurious Emissions High Channel (802.11b mode)



Note:

Data Rate = 11 Mb/s

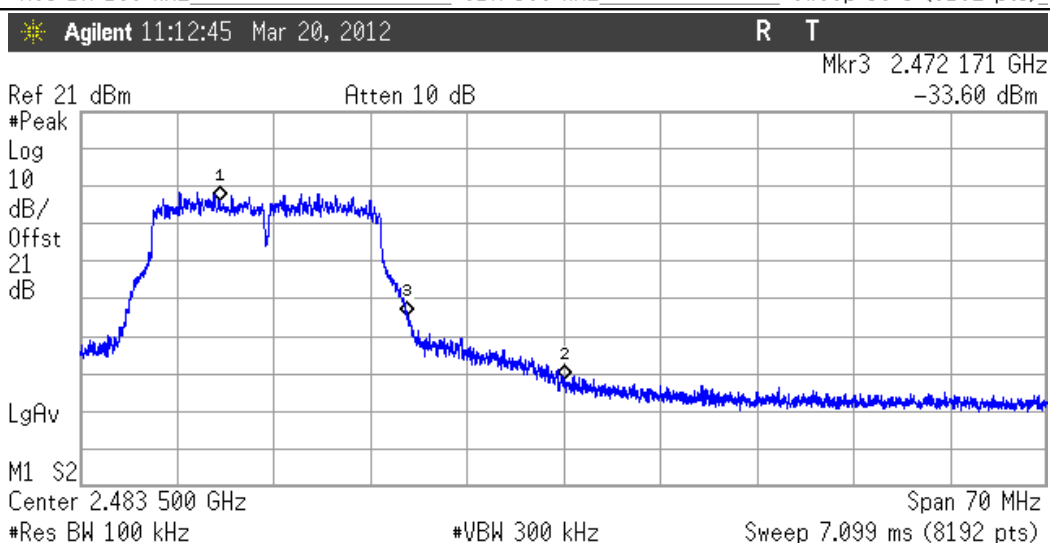
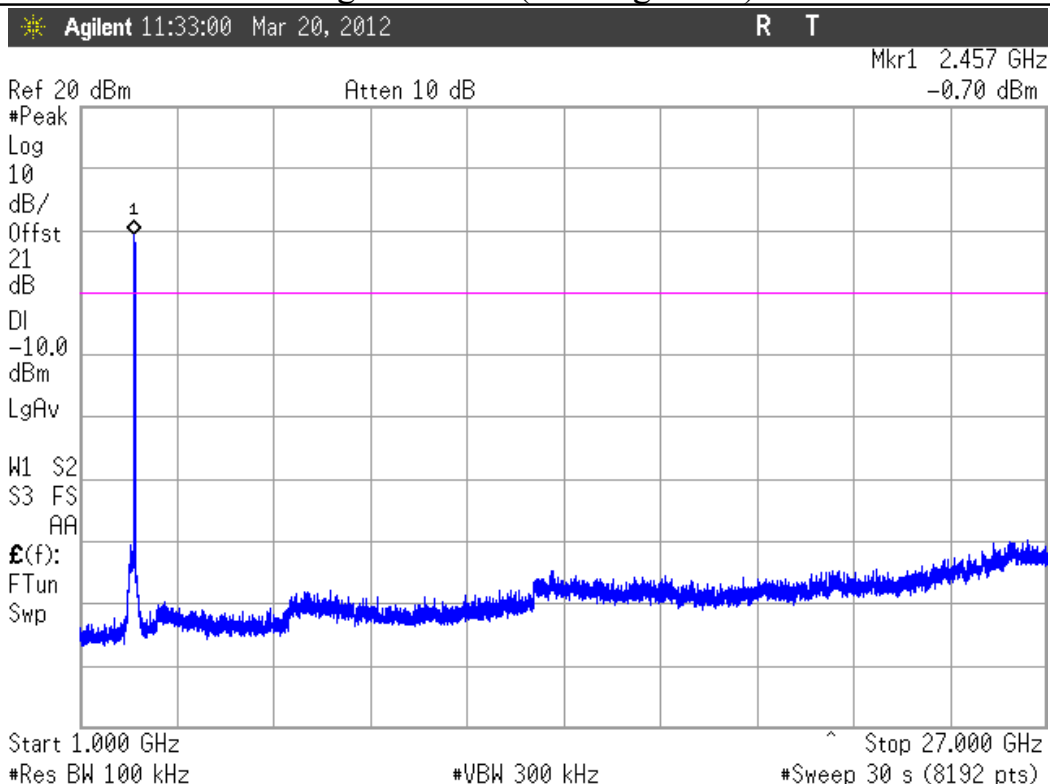
Conducted Spurious Emissions High Channel (802.11g mode)



Note:

Data Rate = 6 Mb/s

Conducted Spurious Emissions High Channel (802.11g mode)

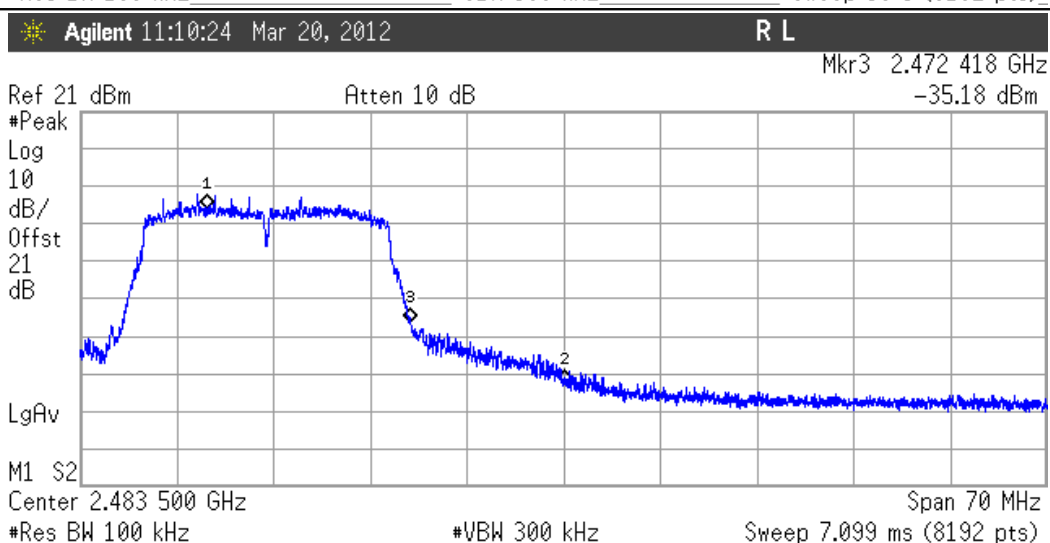
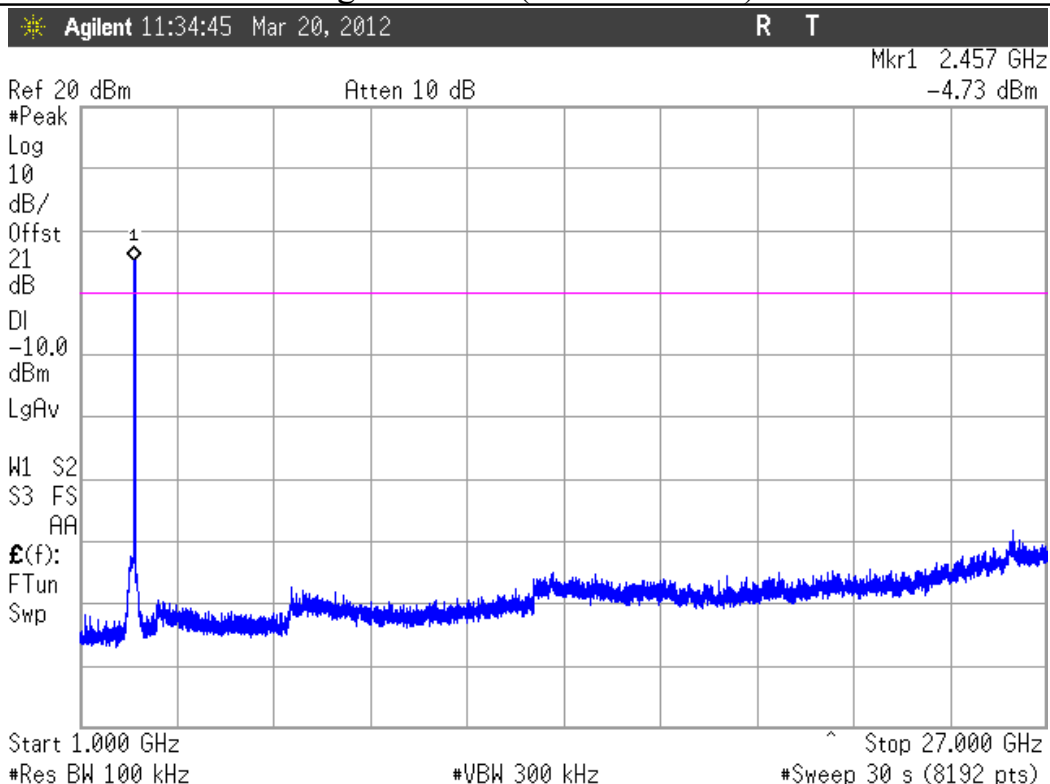


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.458 588 GHz	-2.97 dBm
2	(1)	Freq	2.483 502 GHz	-50.51 dBm
3	(1)	Freq	2.472 171 GHz	-33.60 dBm

Note:

Data Rate = 54 Mb/s

Conducted Spurious Emissions High Channel (802.11n mode)

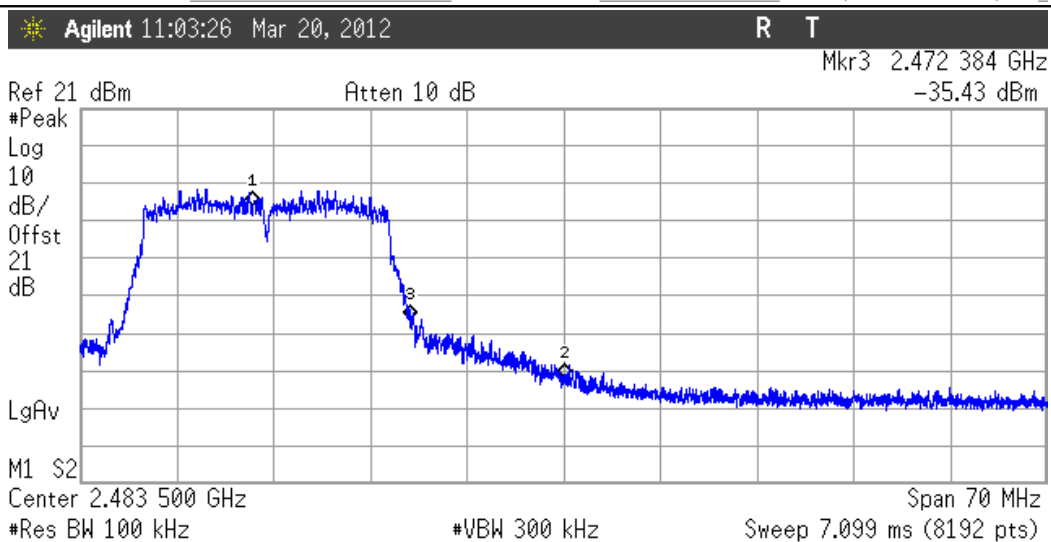
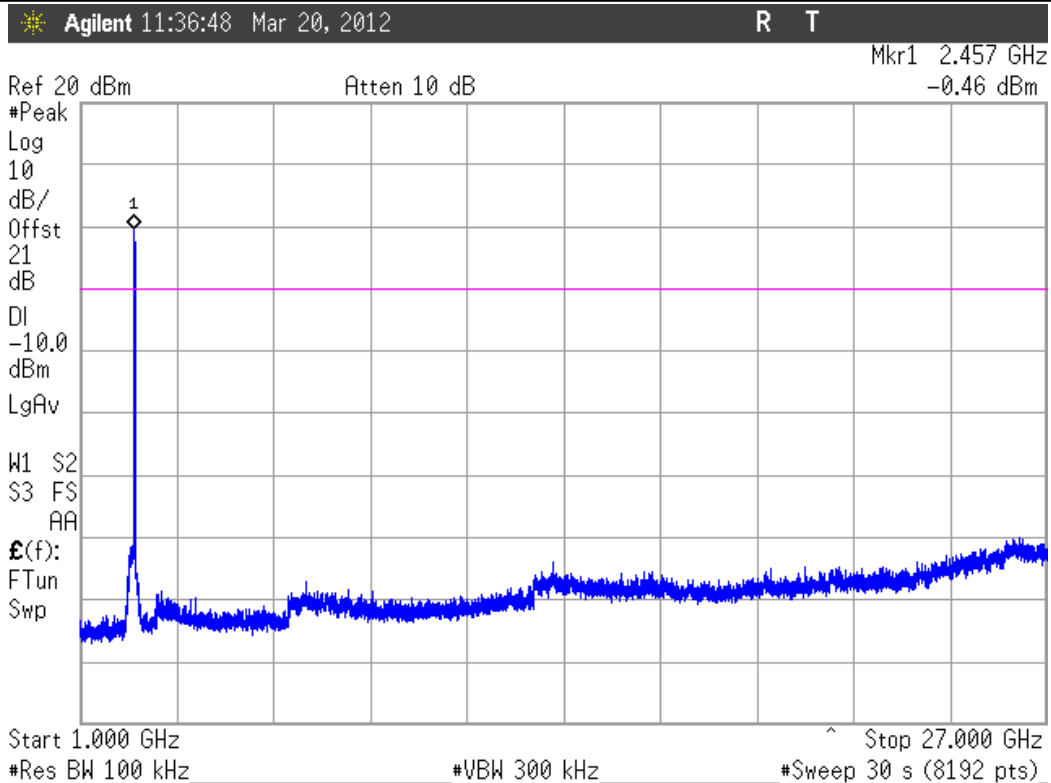


Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.457 639 GHz	-5.07 dBm
2	(1)	Freq	2.483 502 GHz	-51.66 dBm
3	(1)	Freq	2.472 418 GHz	-35.18 dBm

Note:

Data Rate = 6.5 Mb/s

Conducted Spurious Emissions High Channel (802.11n mode)



Marker	Trace	Type	X Axis	Amplitude
1	(1)	Freq	2.461 032 GHz	-4.99 dBm
2	(1)	Freq	2.483 502 GHz	-50.88 dBm
3	(1)	Freq	2.472 384 GHz	-35.43 dBm

Note:

Data Rate = 65 Mb/s

7. PEAK POWER SPECTRAL DENSITY

Equipment shall meet the limits below .

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

Test Equipment

EQUIPMENT	MANUFACTURER	MODEL	CAL. DATE
EMI Receiver	Agilent	E4440A	01/2012

Test procedure: APR01

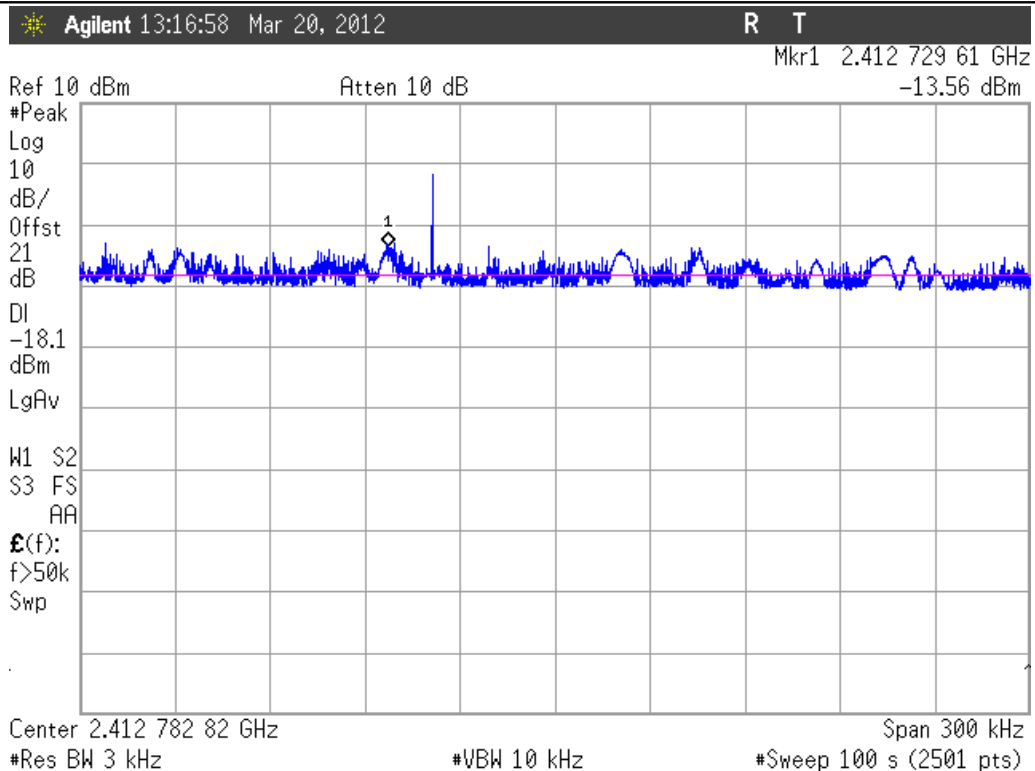
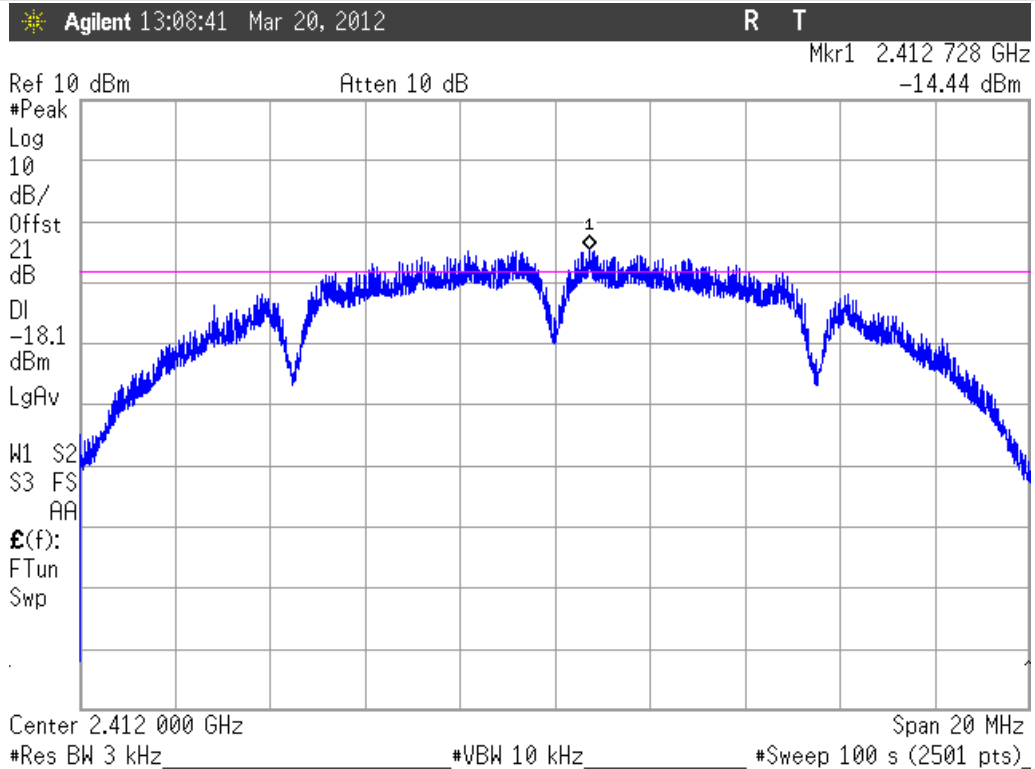
Test performed on low, middle and high channels and in the b,g,n protocols at maximum and minimum data rate for each protocol.

Results:

No non-compliance noted

802.11b Mode, 11 Mbs				
<i>Channel</i>	<i>Frequency (MHz)</i>	<i>PPSD (dBm)</i>	<i>Limit (dBm)</i>	<i>Margin (dB)</i>
Low	2412	1,88	8	-6,12
Mid	2437	2,17	8	-5,83
High	2462	2,66	8	-5,34
802.11g Mode, 54 Mbs				
<i>Channel</i>	<i>Frequency (MHz)</i>	<i>PPSD (dBm)</i>	<i>Limit (dBm)</i>	<i>Margin (dB)</i>
Low	2412	-14,52	8	-22,52
Mid	2437	-14,52	8	-22,52
High	2462	-13,99	8	-21,99
802.11n Mode, 65 Mbs				
<i>Channel</i>	<i>Frequency (MHz)</i>	<i>PPSD (dBm)</i>	<i>Limit (dBm)</i>	<i>Margin (dB)</i>
Low	2412	-15,31	8	-23,31
Mid	2437	-15,3	8	-23,3
High	2462	-15,31	8	-23,31
The following figures show the results.				

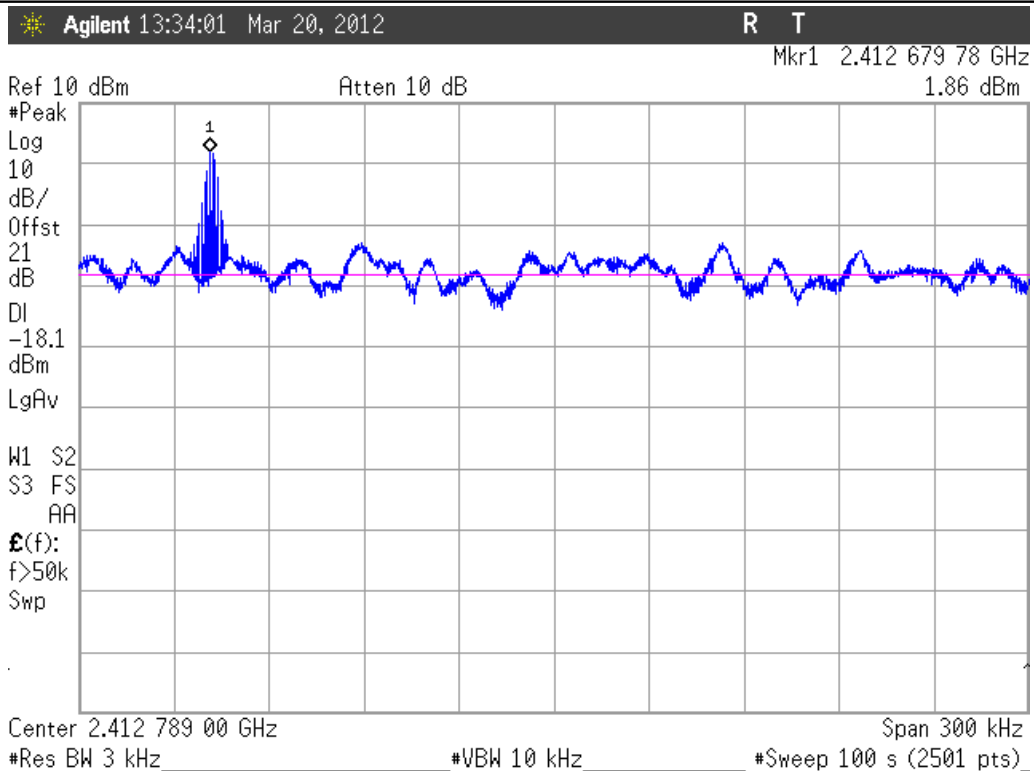
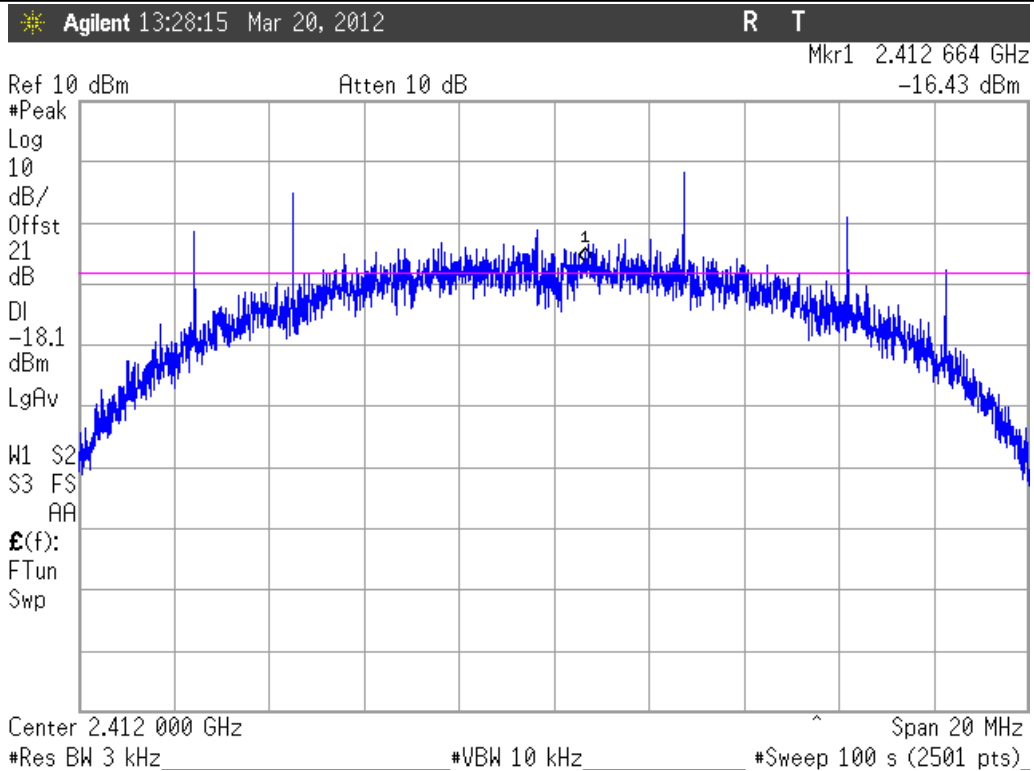
Peak Power Spectral Density Low Channel (802.11b mode)

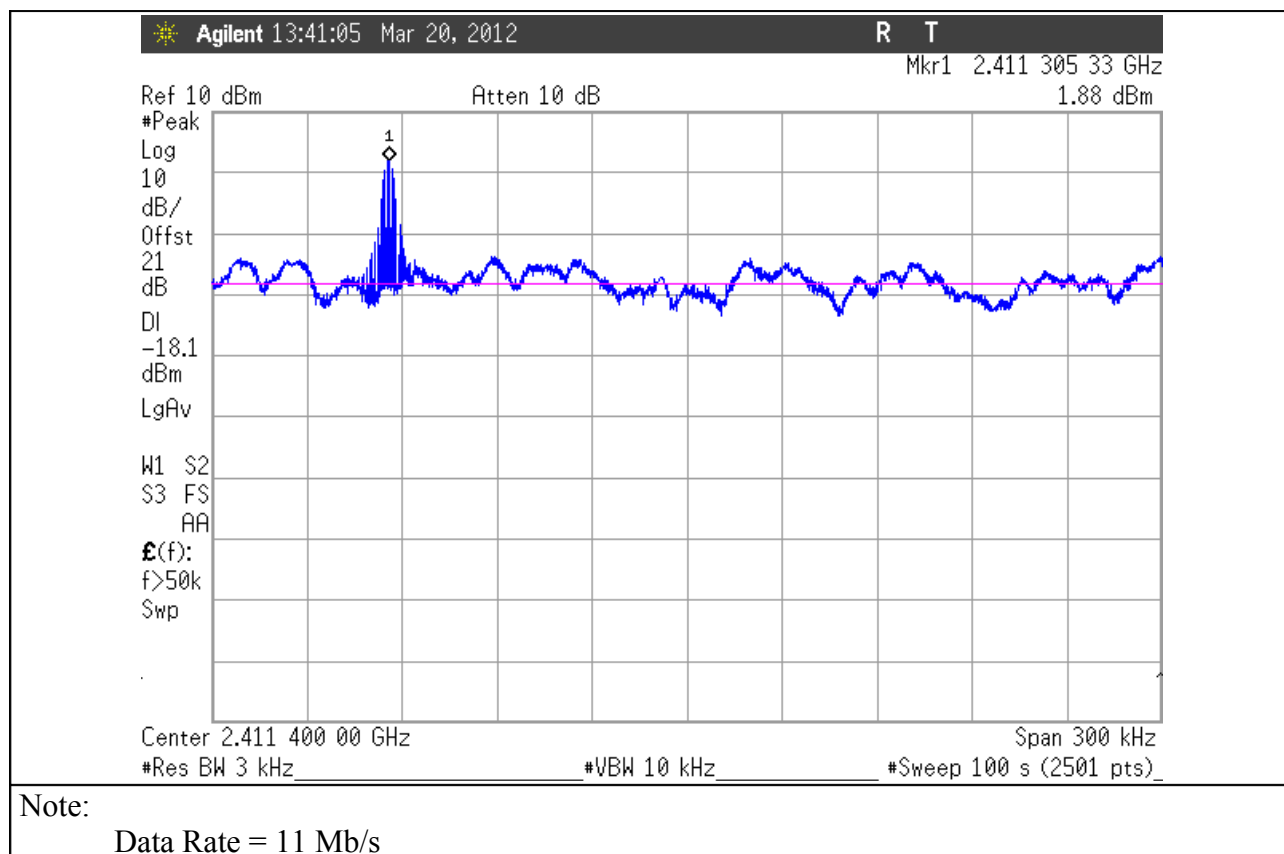


Note:

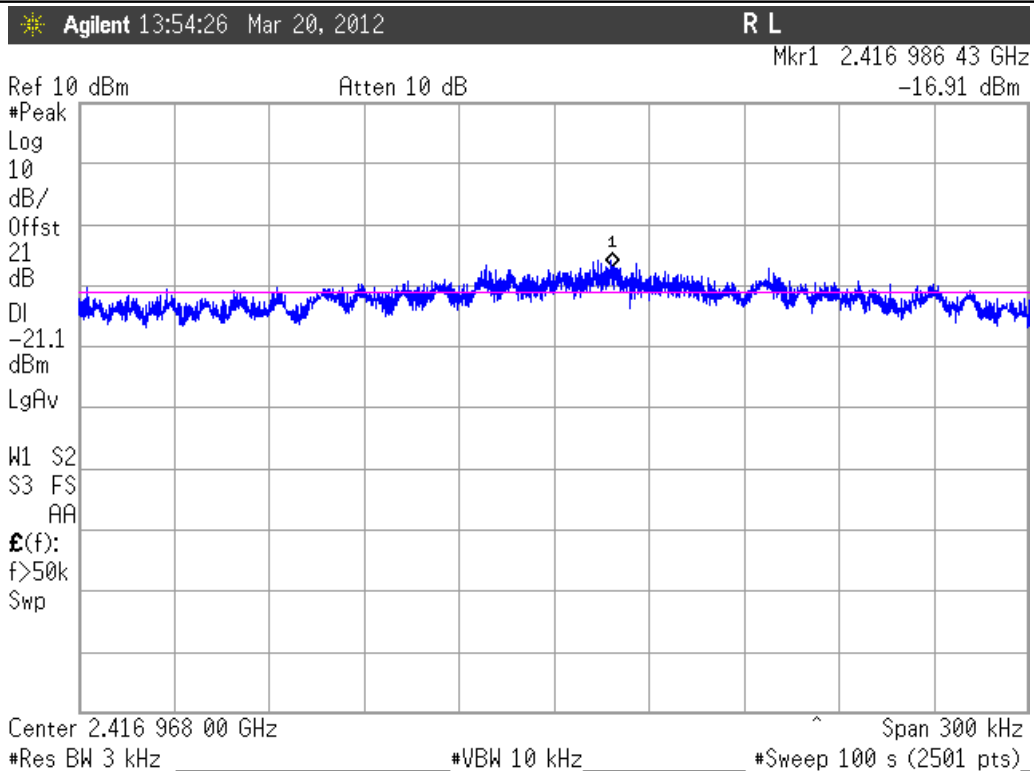
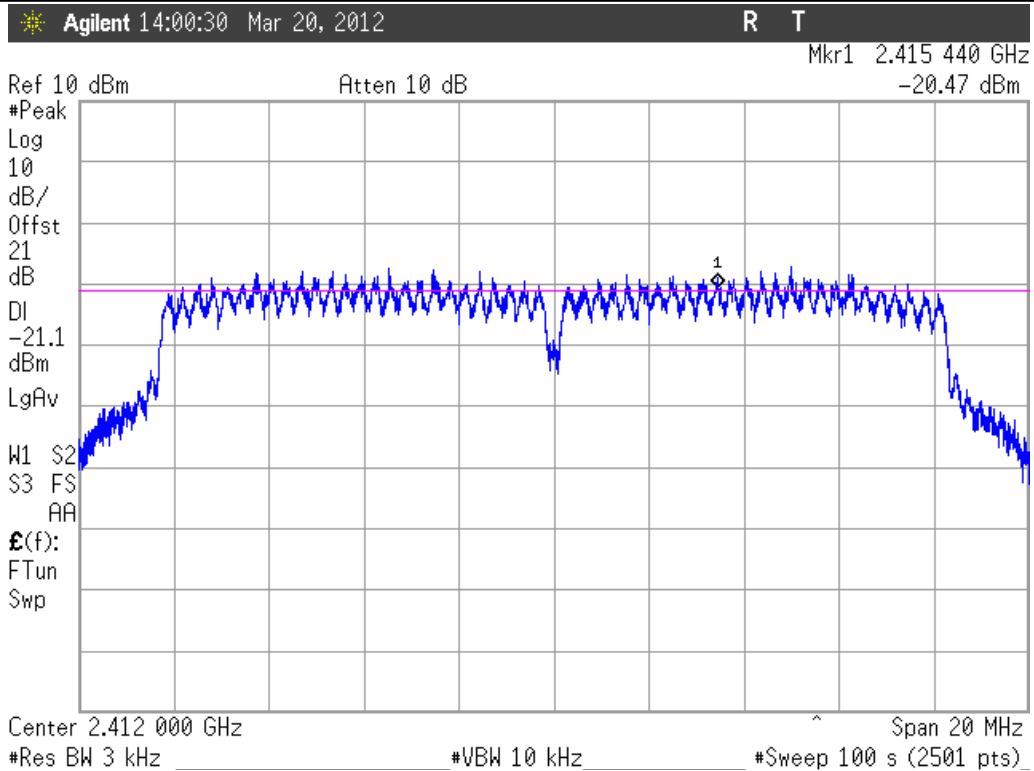
Data Rate = 1 Mb/s

Peak Power Spectral Density Low Channel (802.11b mode)





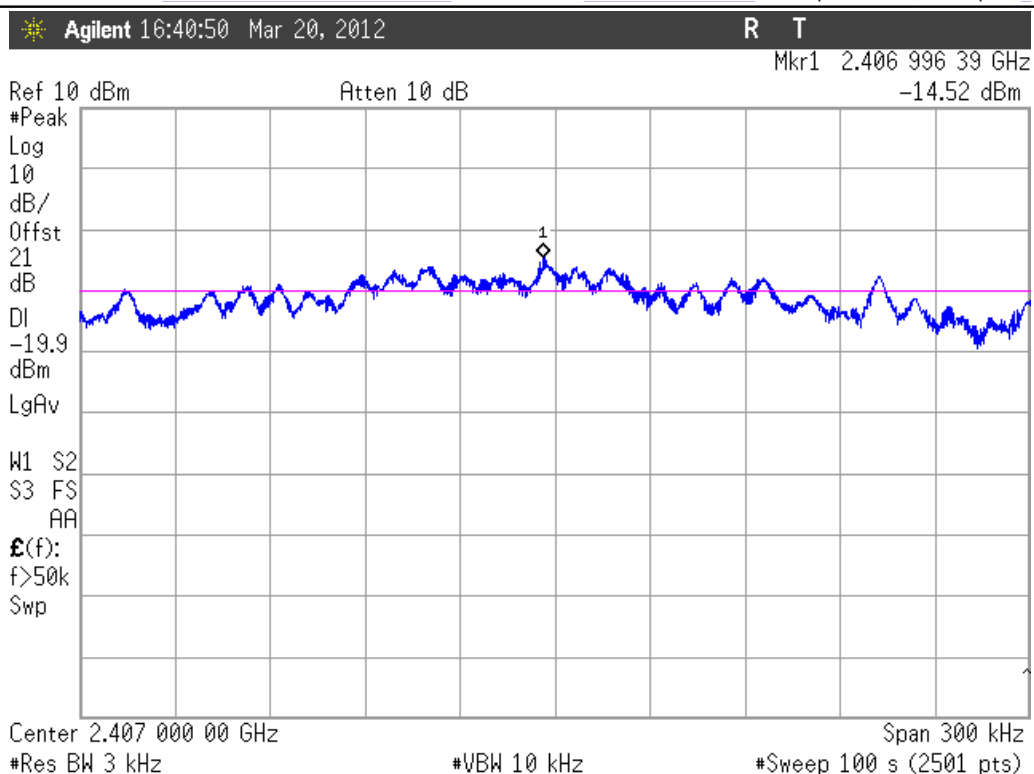
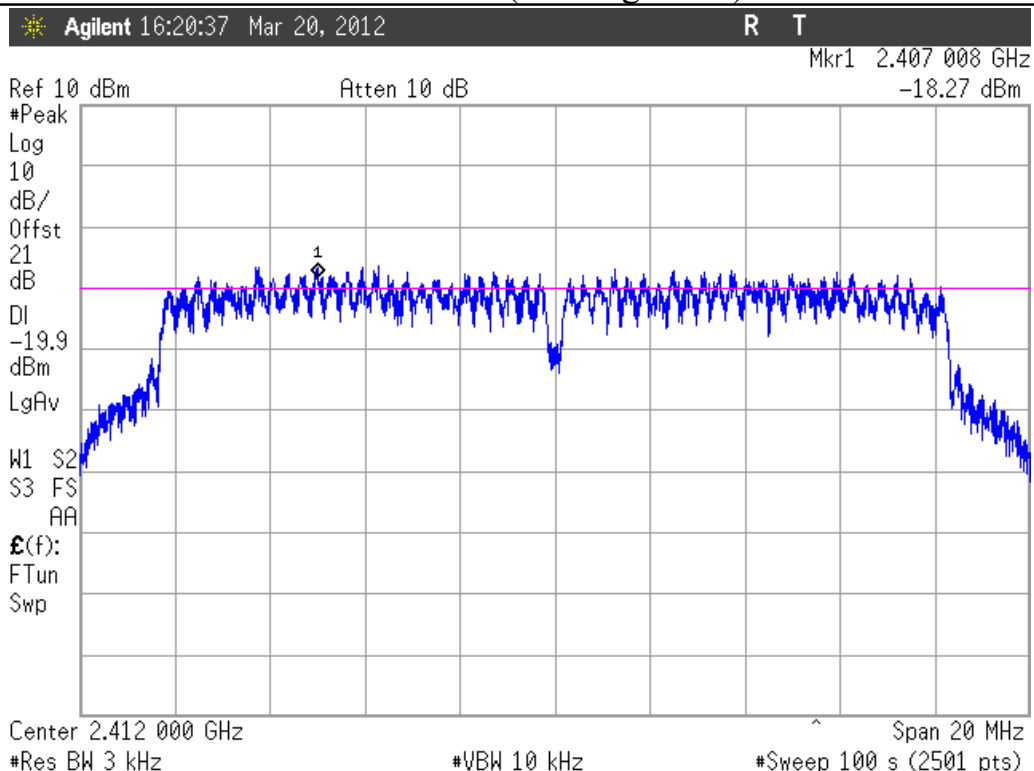
Peak Power Spectral Density Low Channel (802.11g mode)



Note:

Data Rate = 6 Mb/s

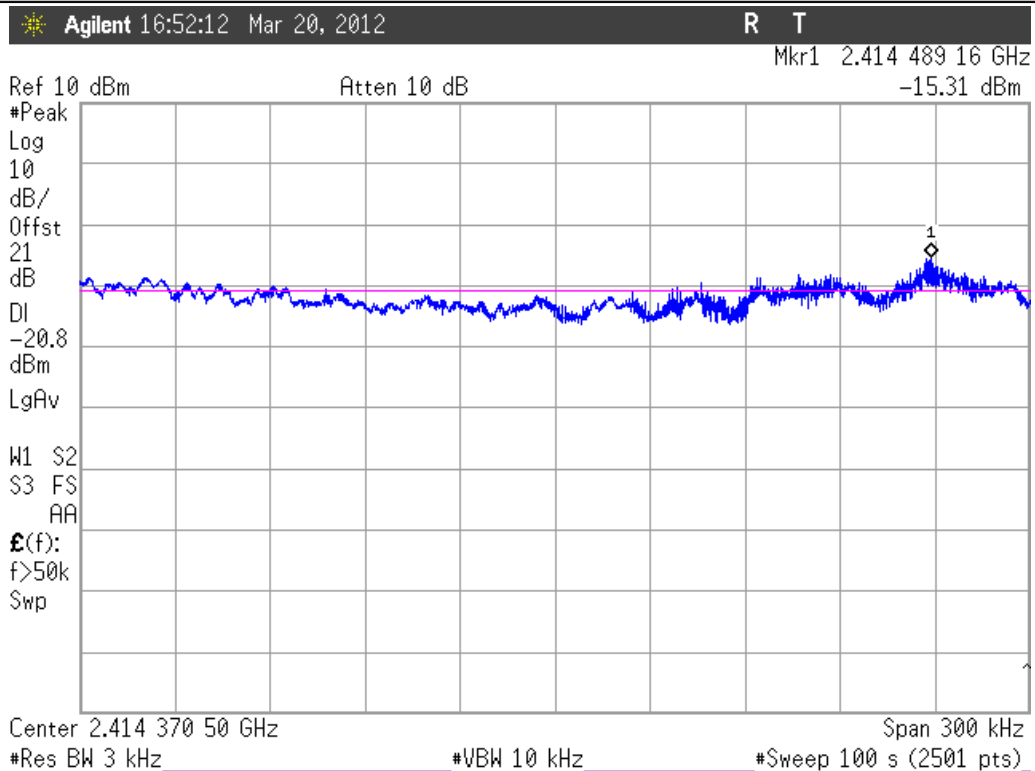
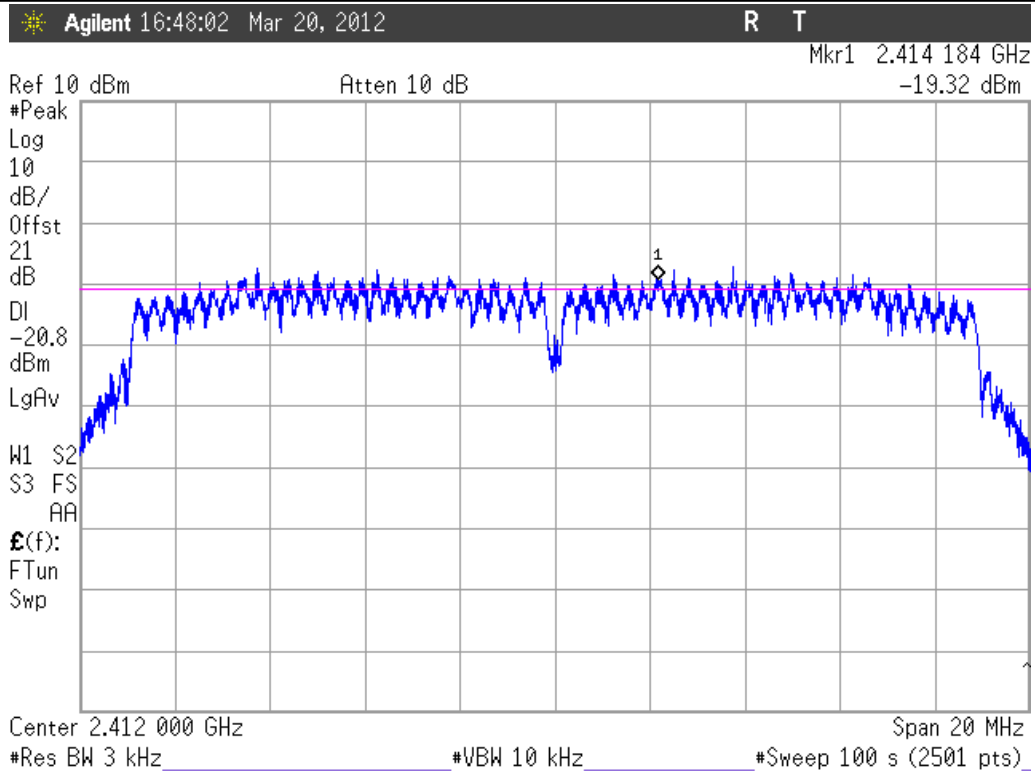
Peak Power Spectral Density Low Channel (802.11g mode)



Note:

Data Rate = 54 Mb/s

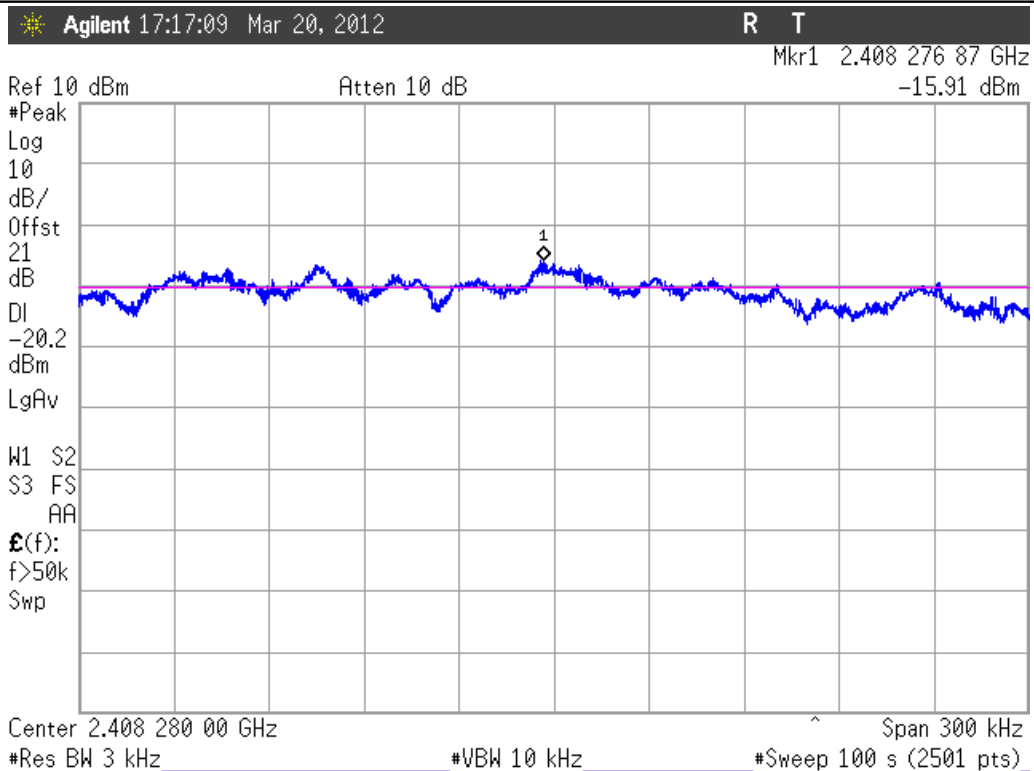
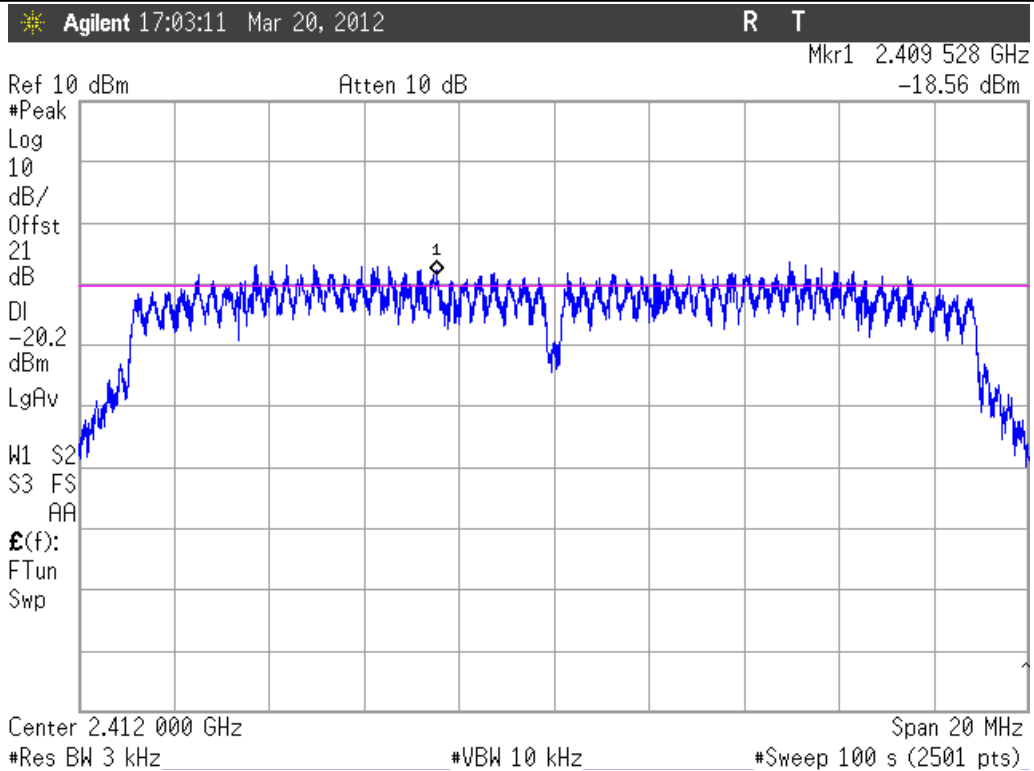
Peak Power Spectral Density Low Channel (802.11n mode)



Note:

Data Rate = 6.5 Mb/s

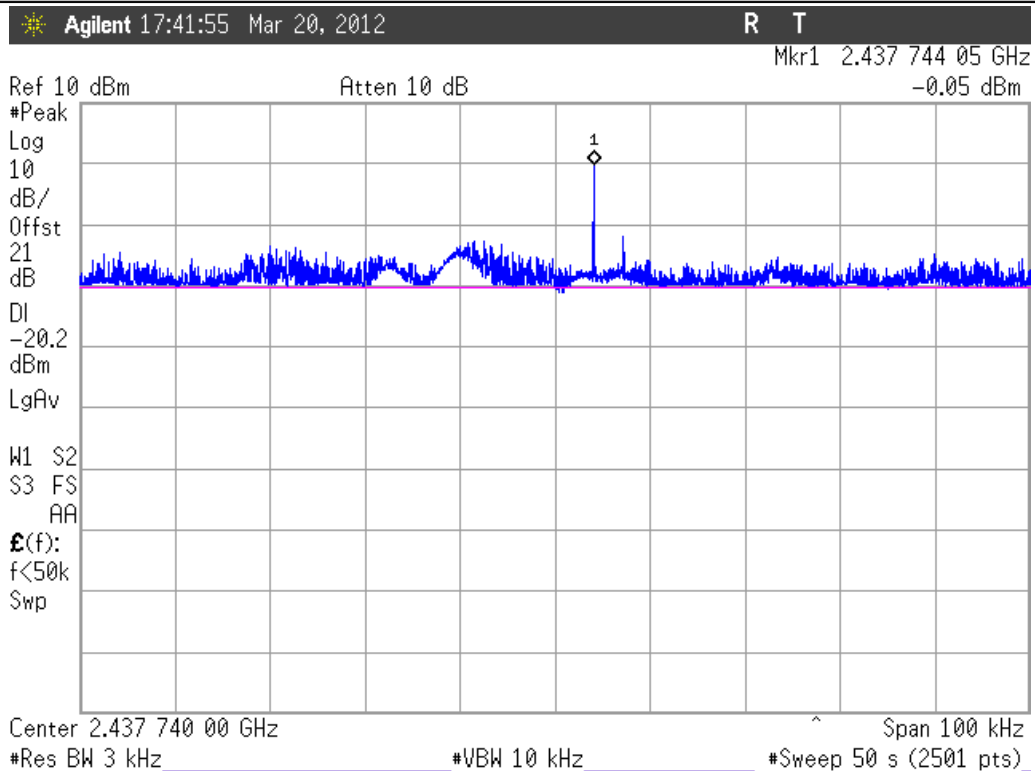
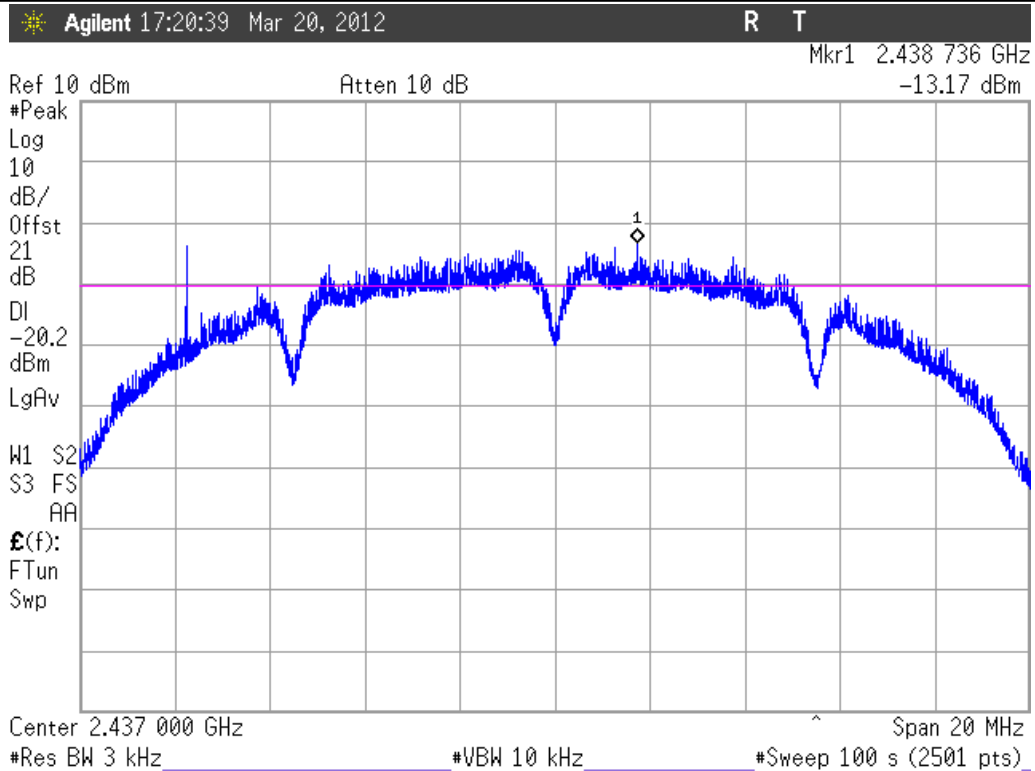
Peak Power Spectral Density Low Channel (802.11n mode)



Note:

Data Rate = 65 Mb/s

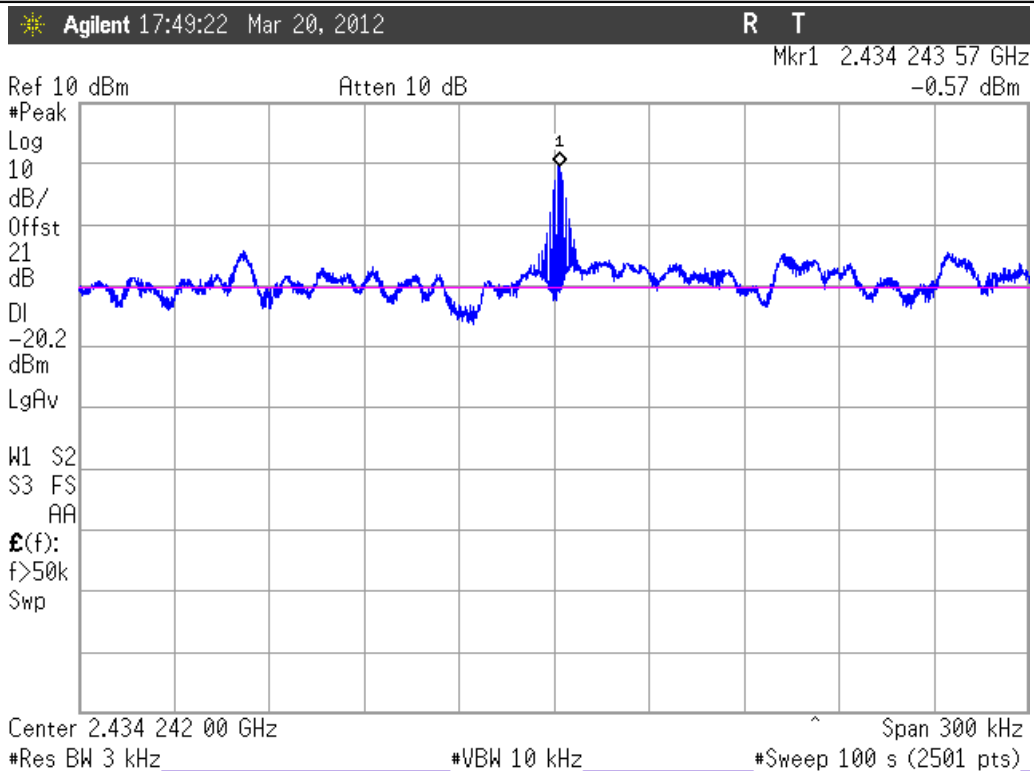
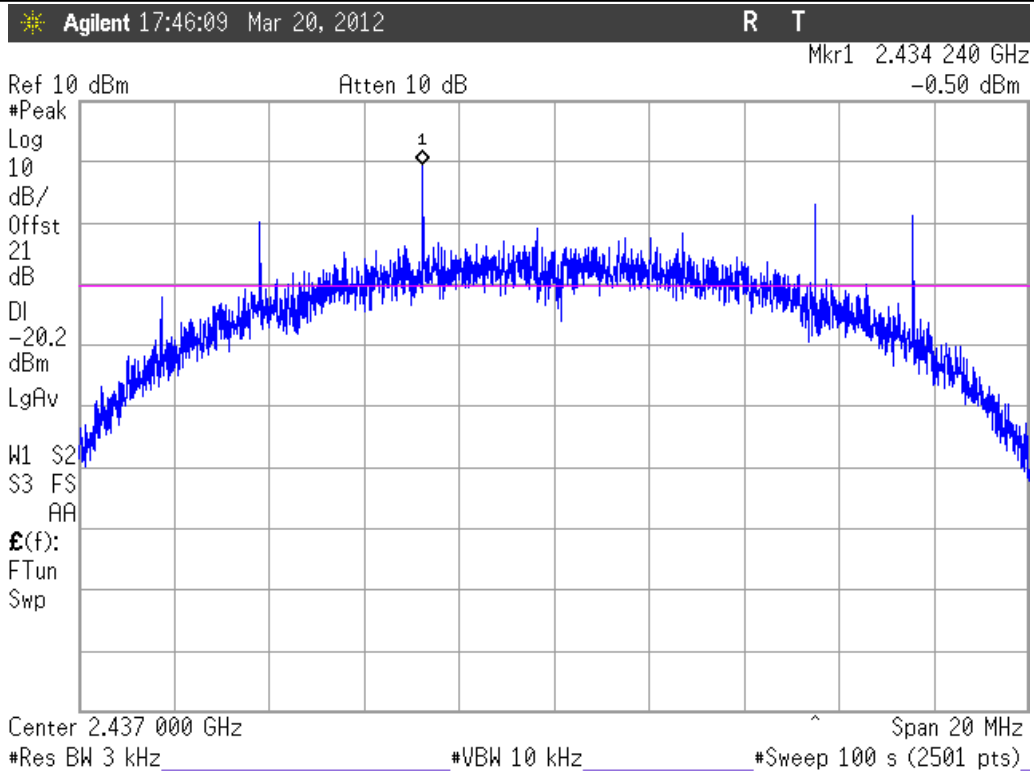
Peak Power Spectral Density Mid Channel (802.11b mode)

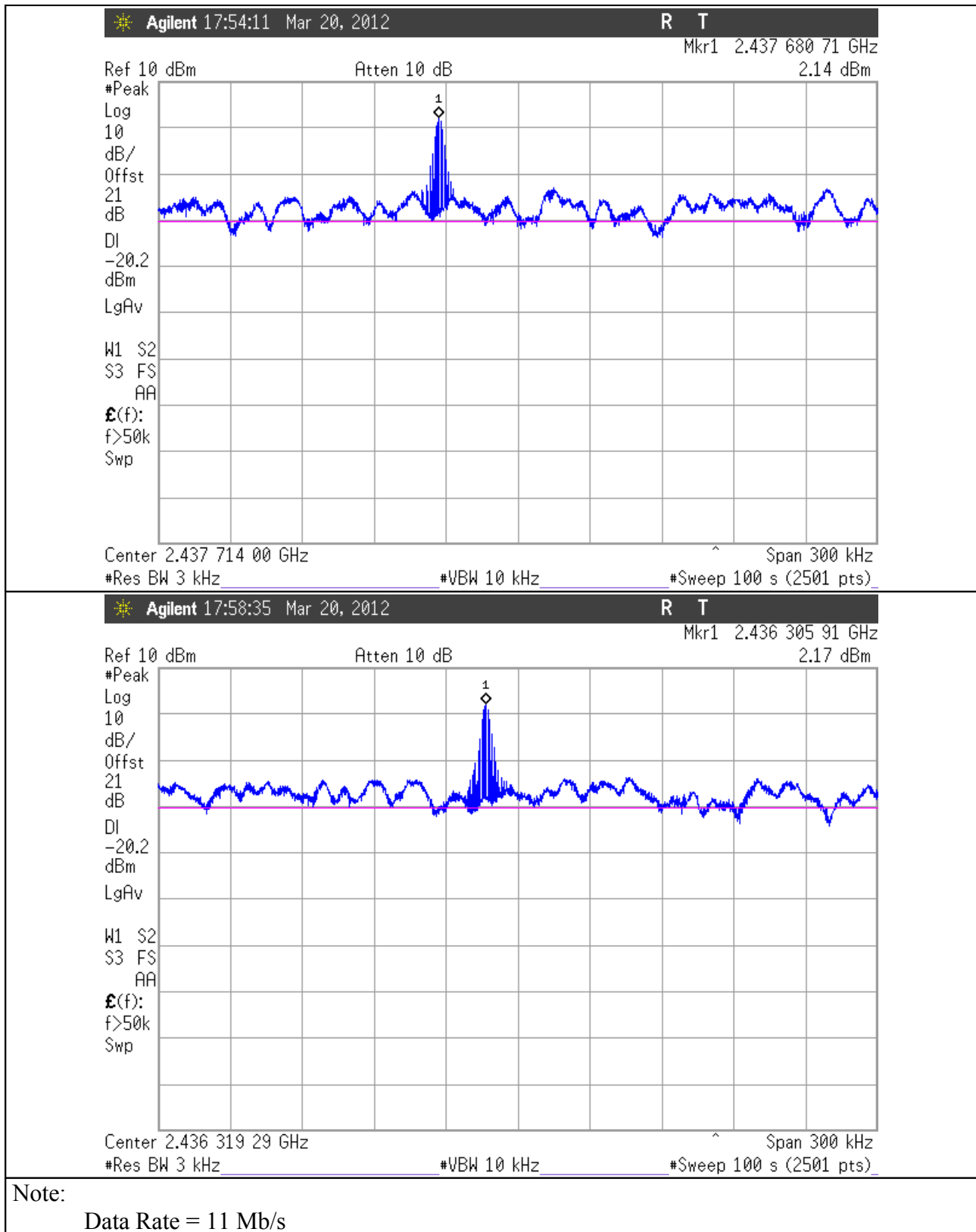


Note:

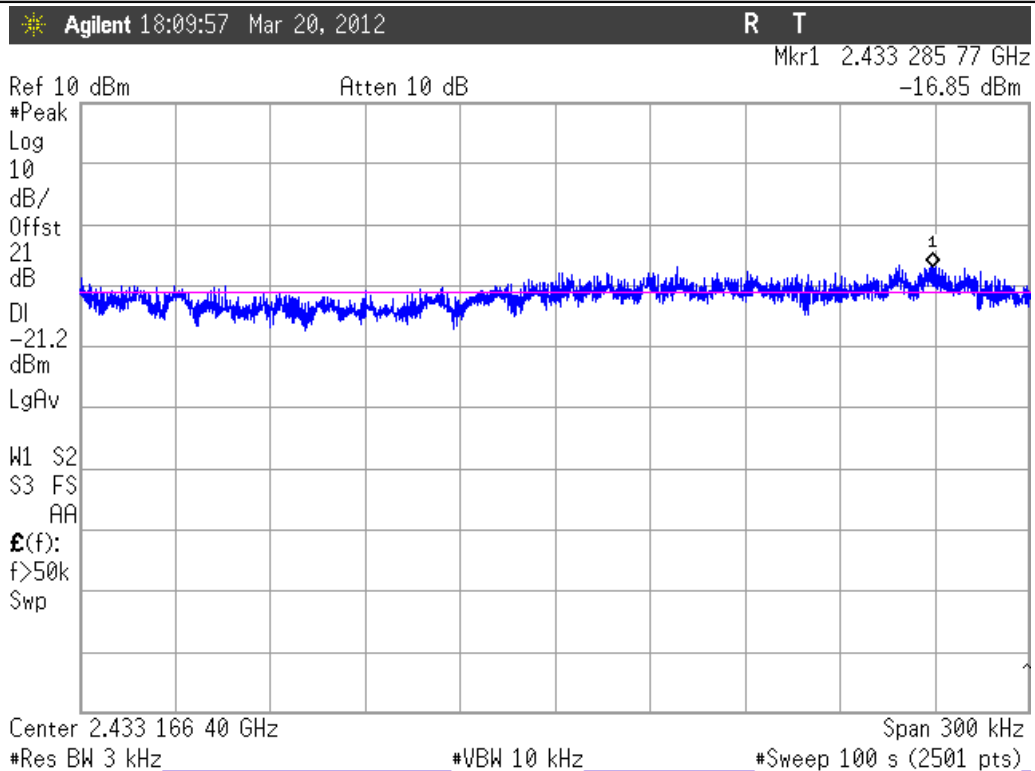
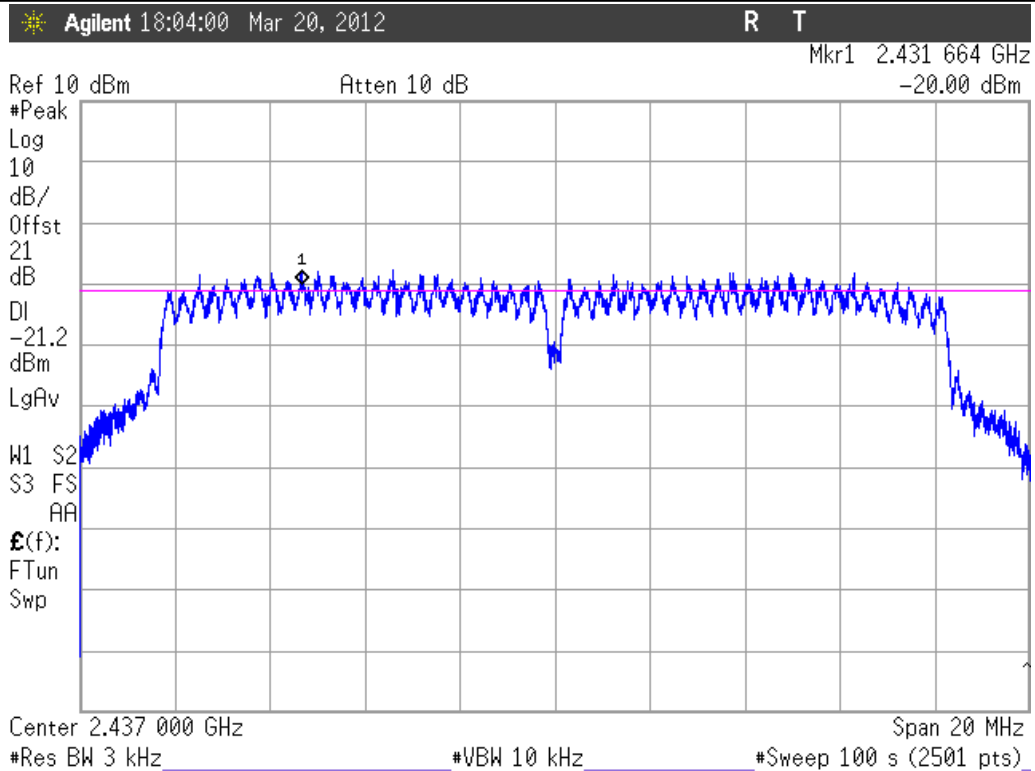
Data Rate = 1 Mb/s

Peak Power Spectral Density Mid Channel (802.11b mode)





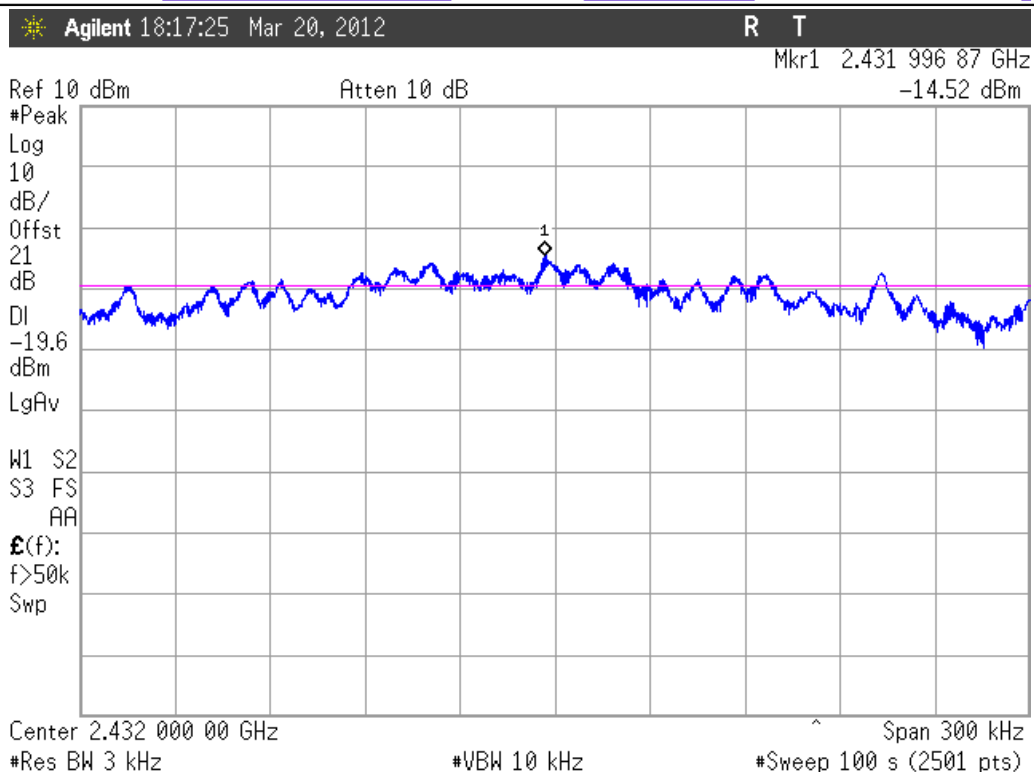
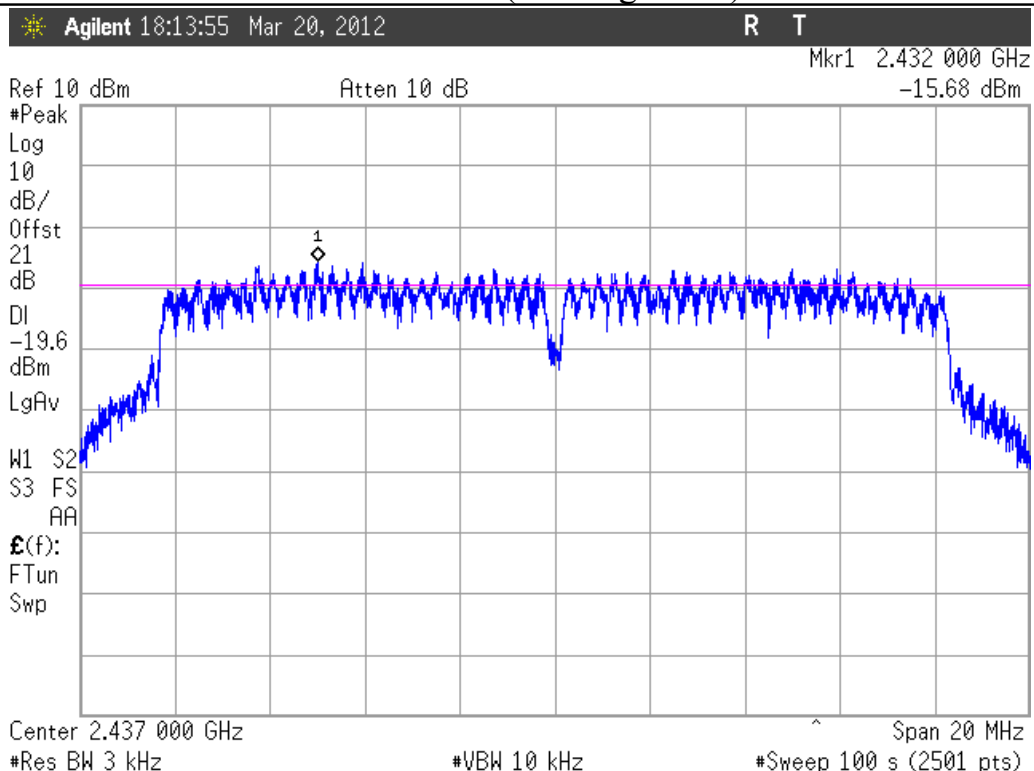
Peak Power Spectral Density Mid Channel (802.11g mode)



Note:

Data Rate = 6 Mb/s

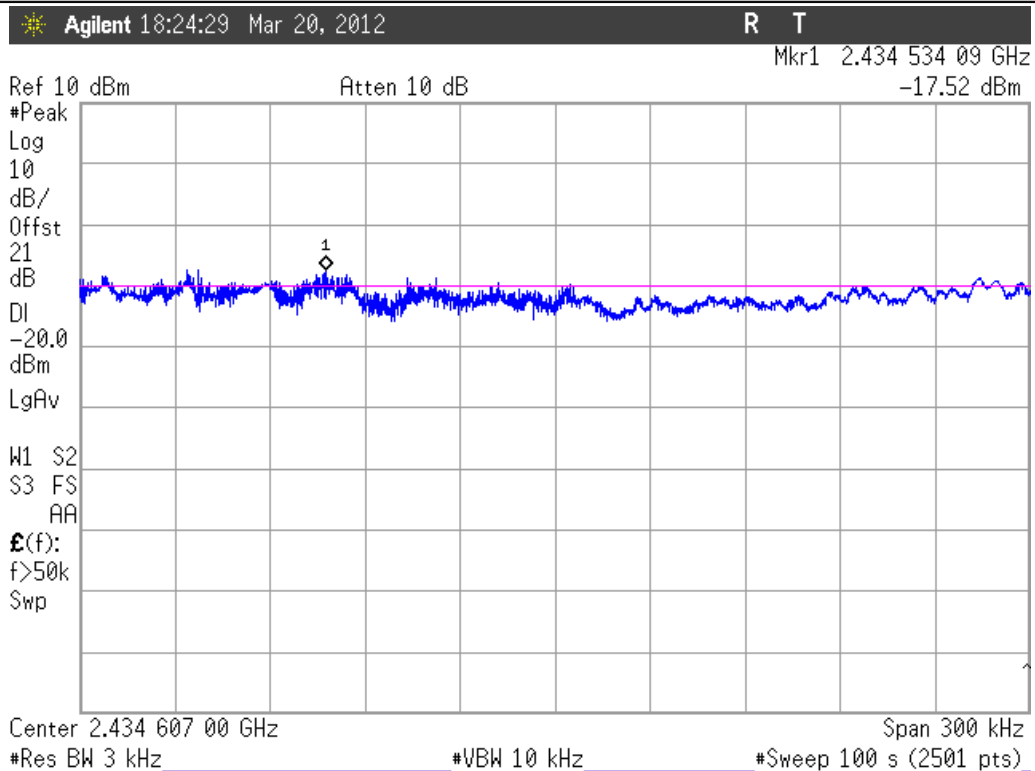
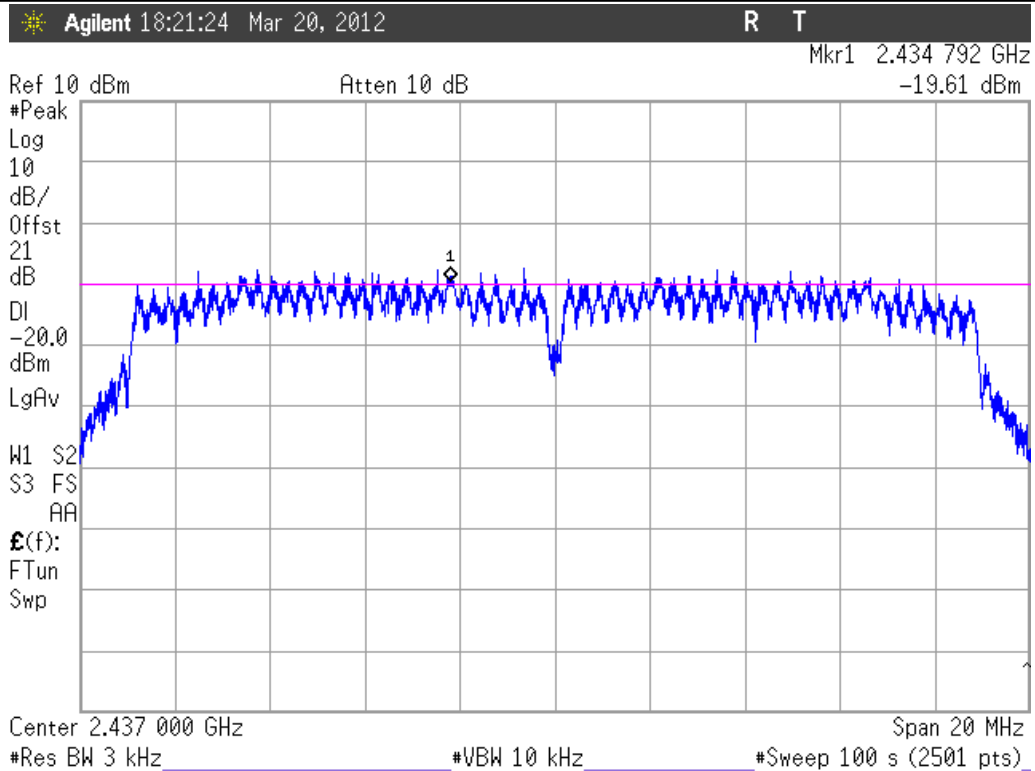
Peak Power Spectral Density Mid Channel (802.11g mode)



Note:

Data Rate = 54 Mb/s

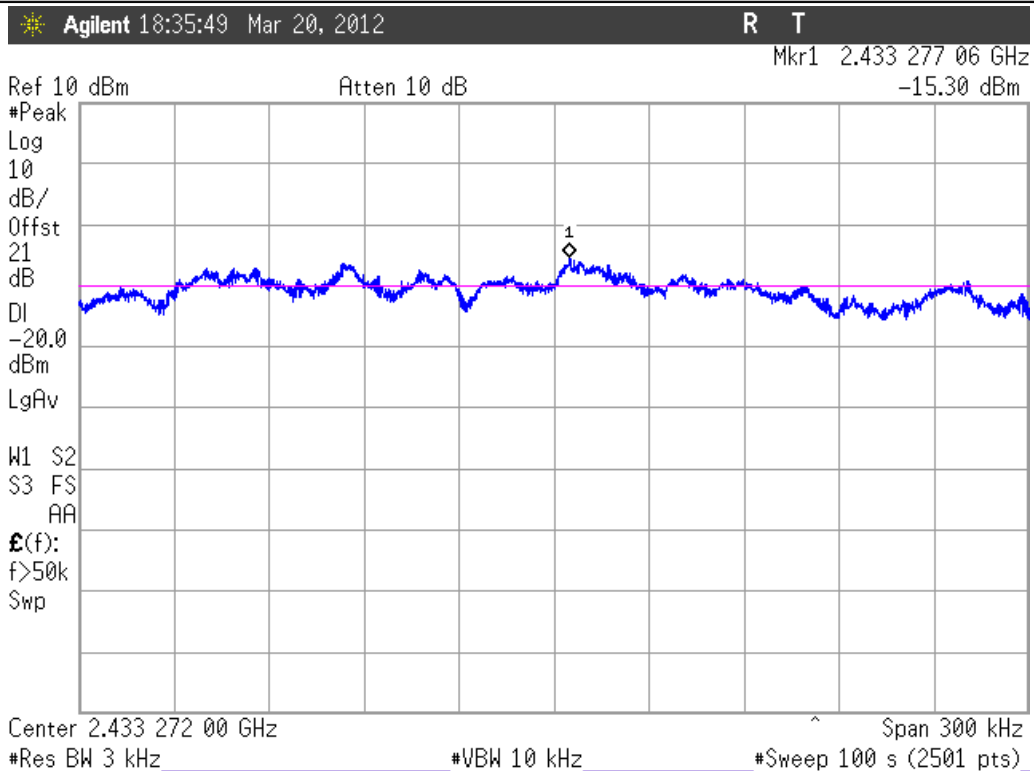
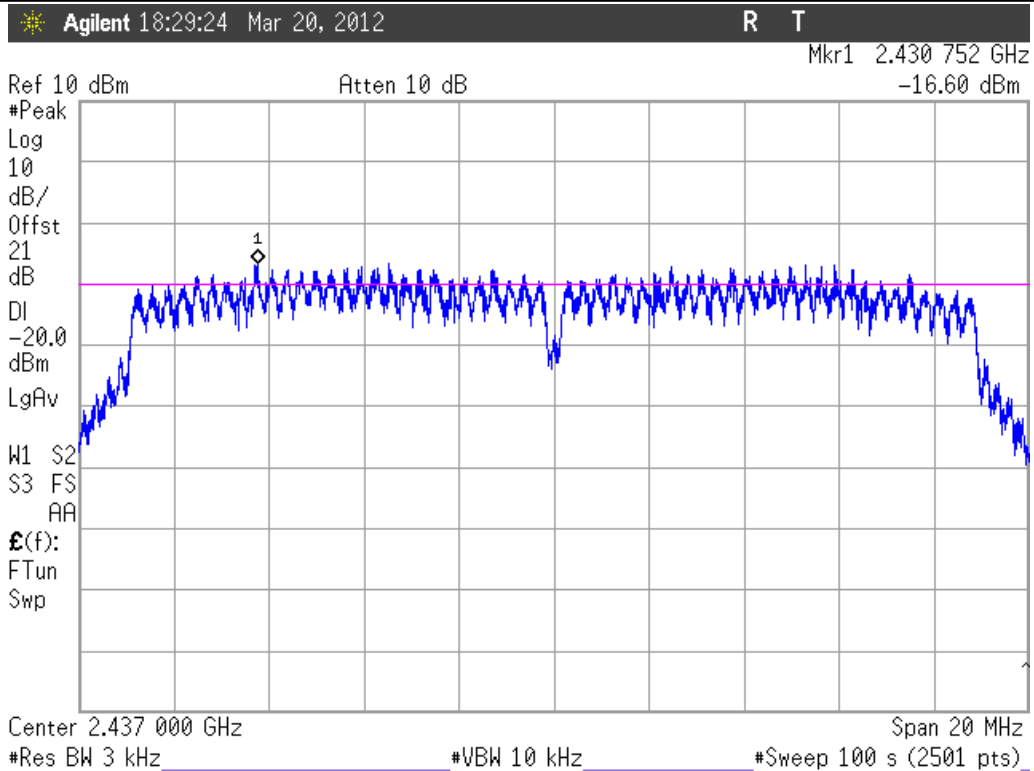
Peak Power Spectral Density Mid Channel (802.11n mode)



Note:

Data Rate = 6.5 Mb/s

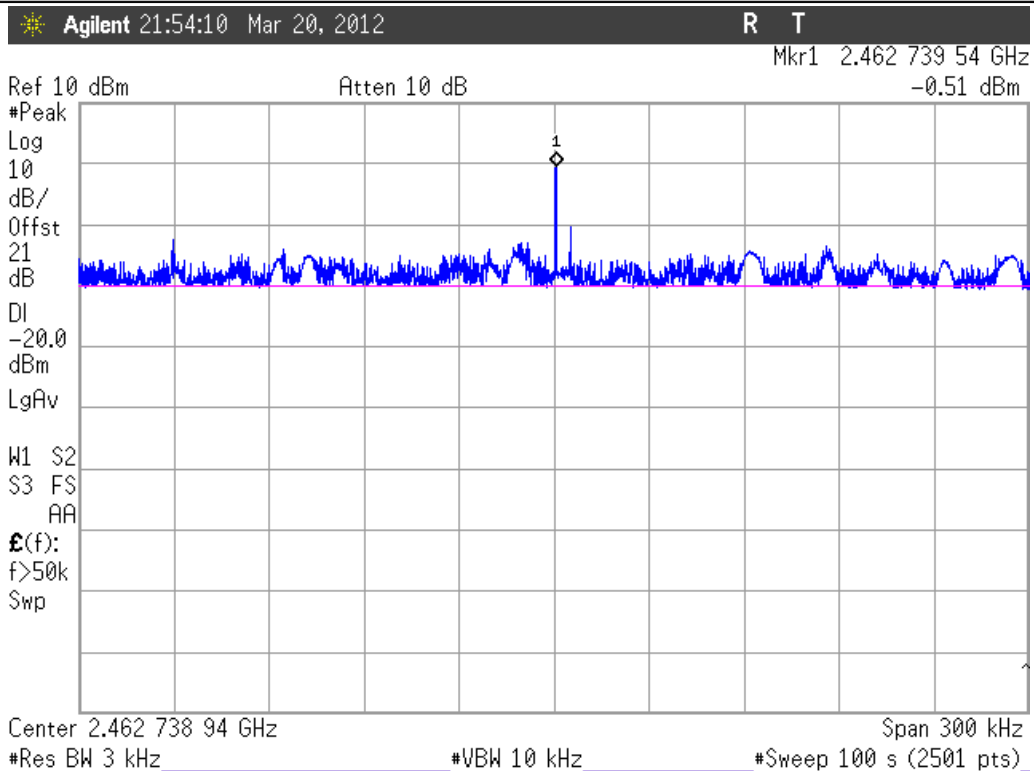
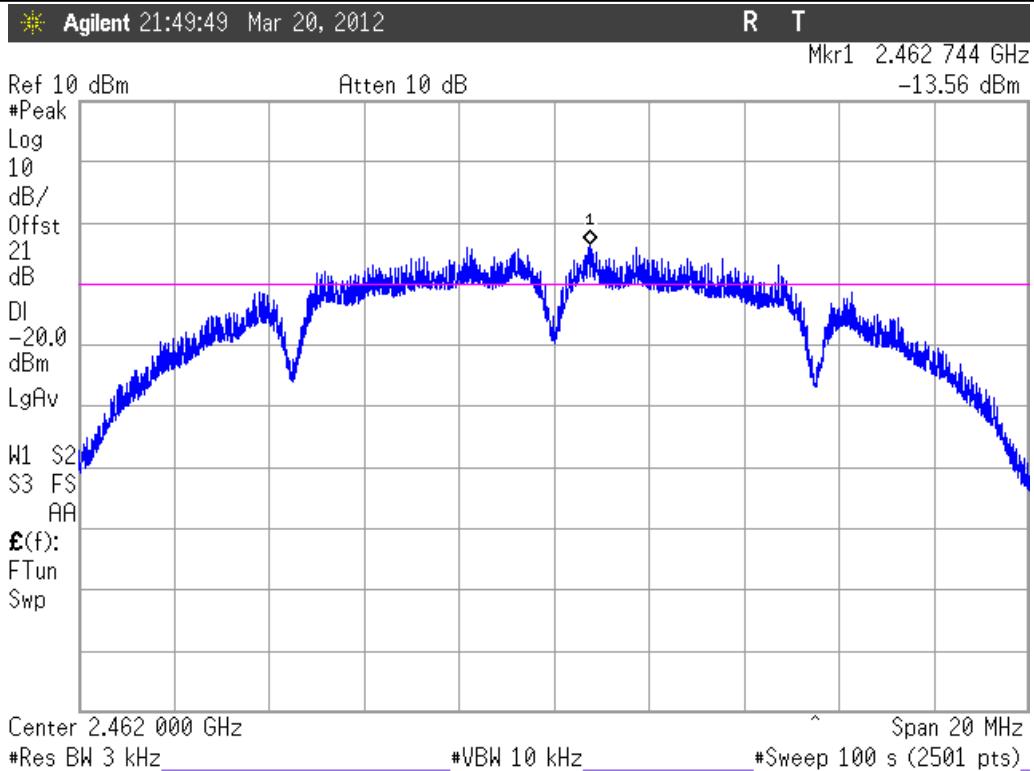
Peak Power Spectral Density Mid Channel (802.11n mode)



Note:

Data Rate = 65 Mb/s

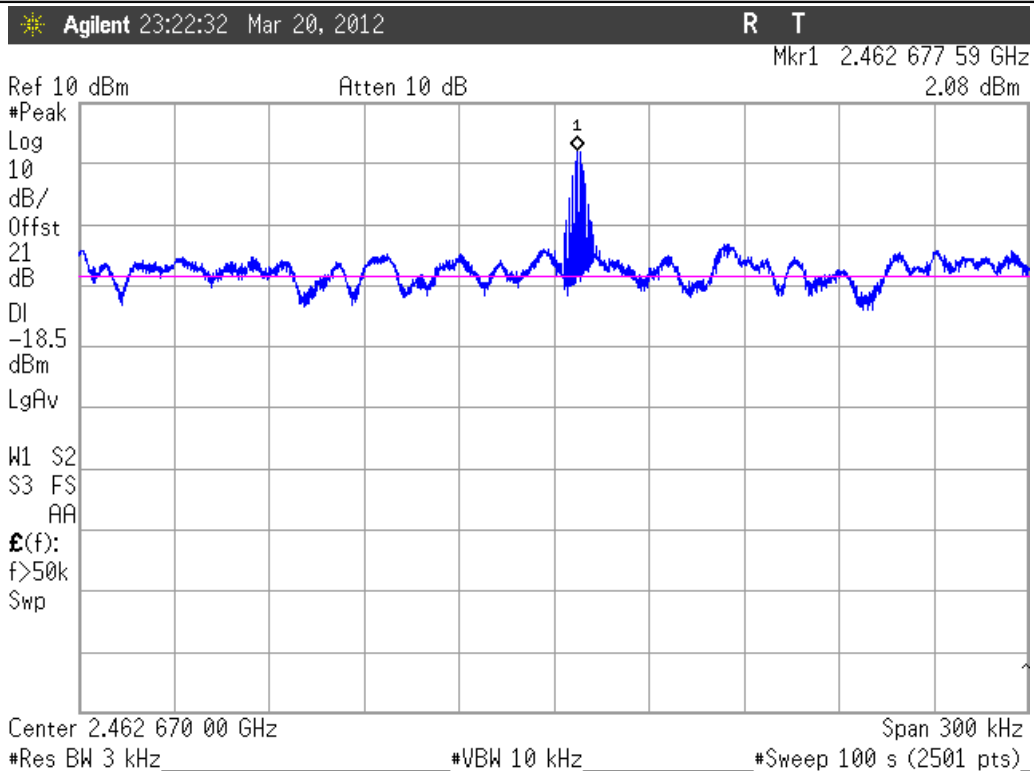
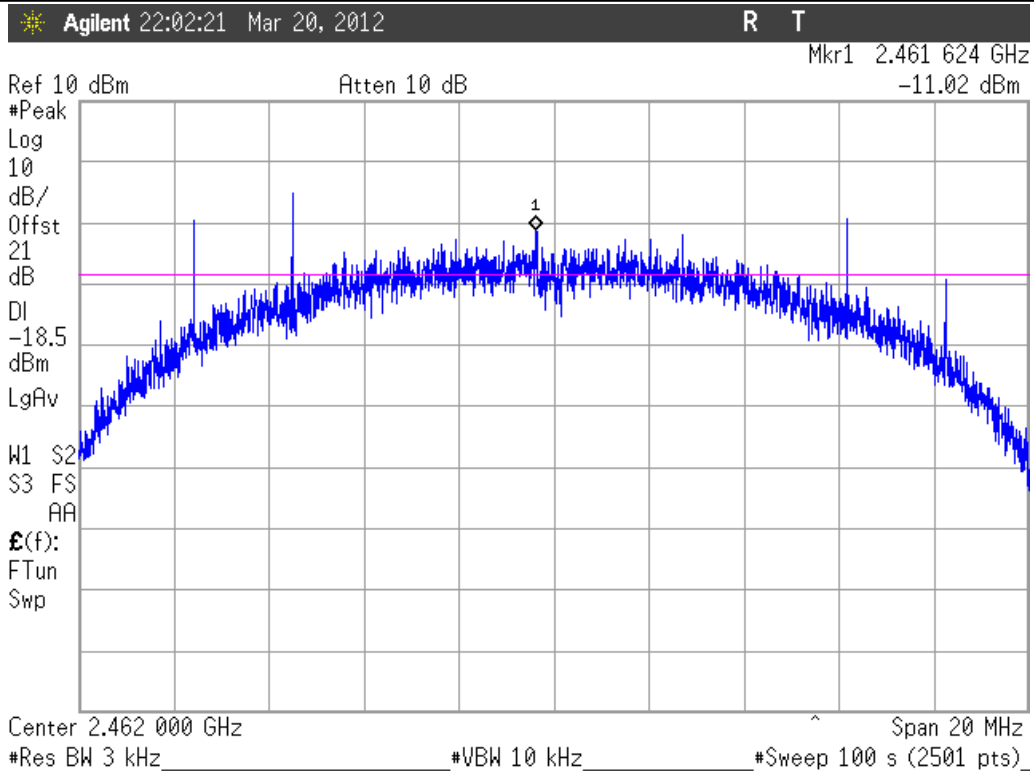
Peak Power Spectral Density High Channel (802.11b mode)

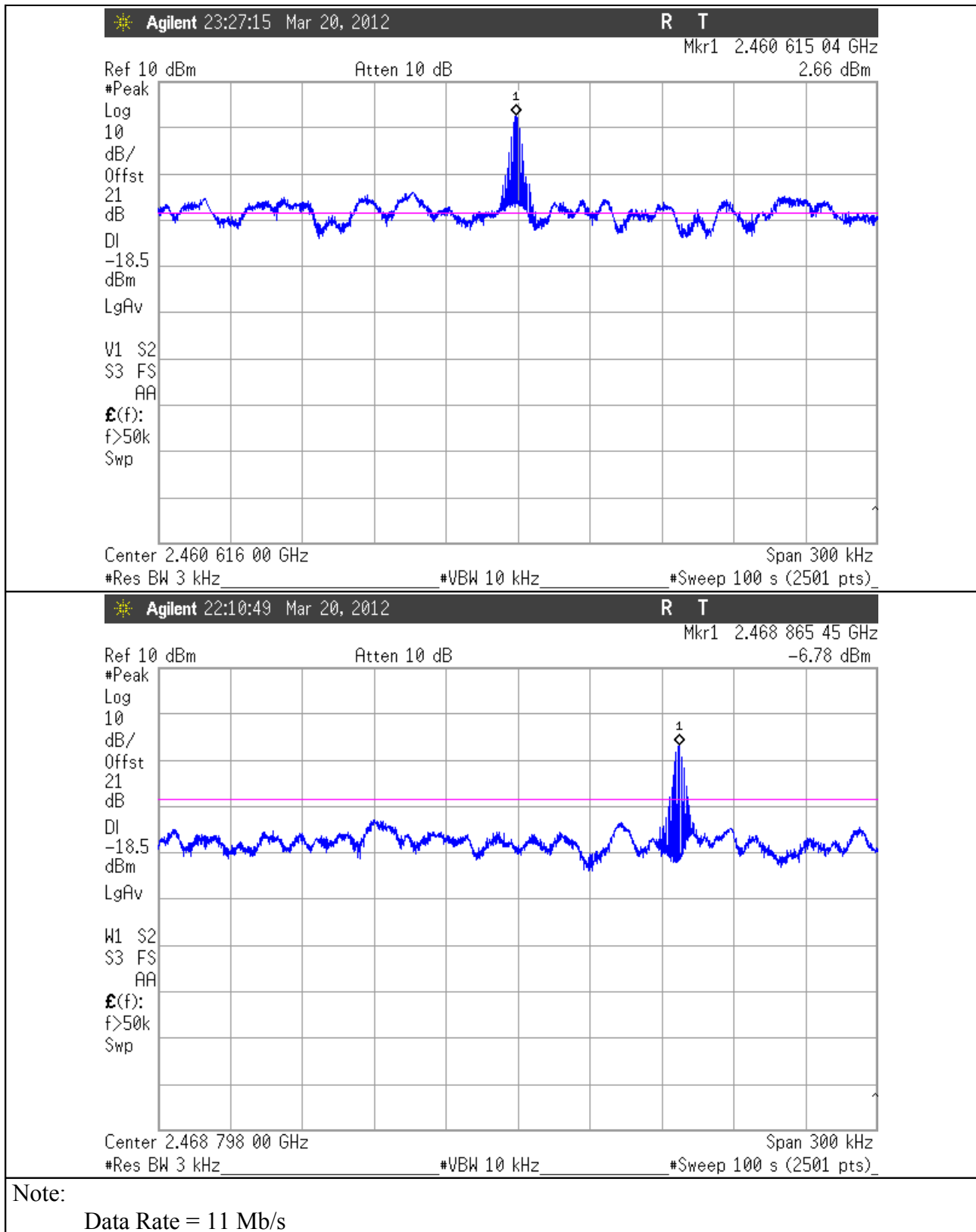


Note:

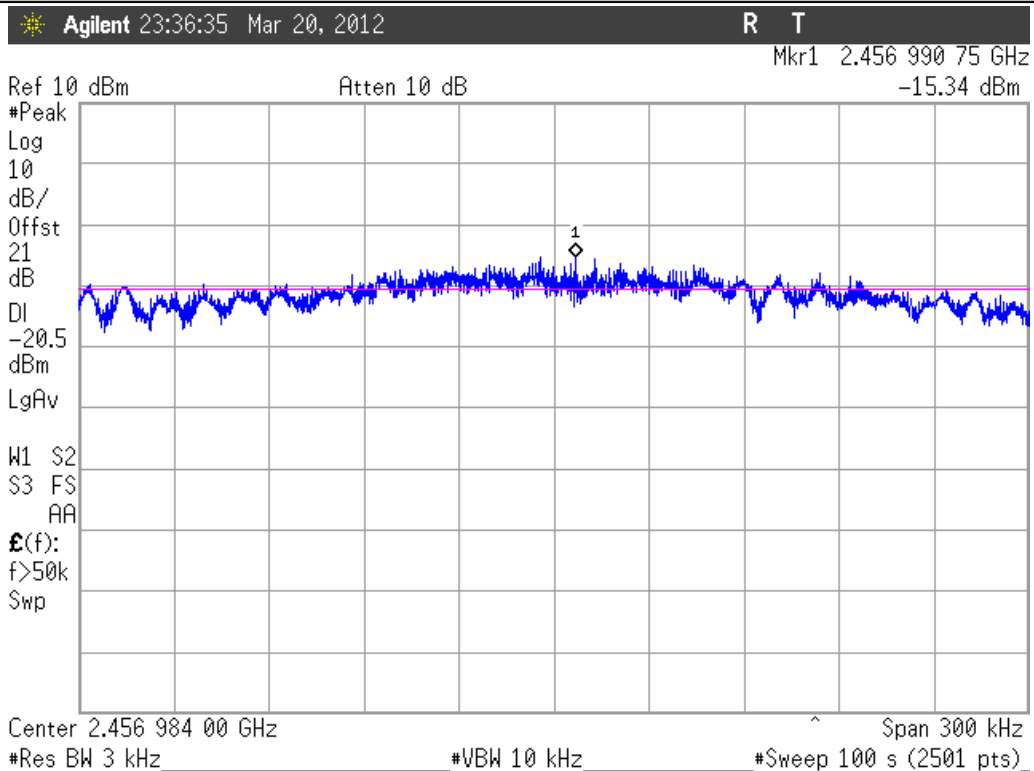
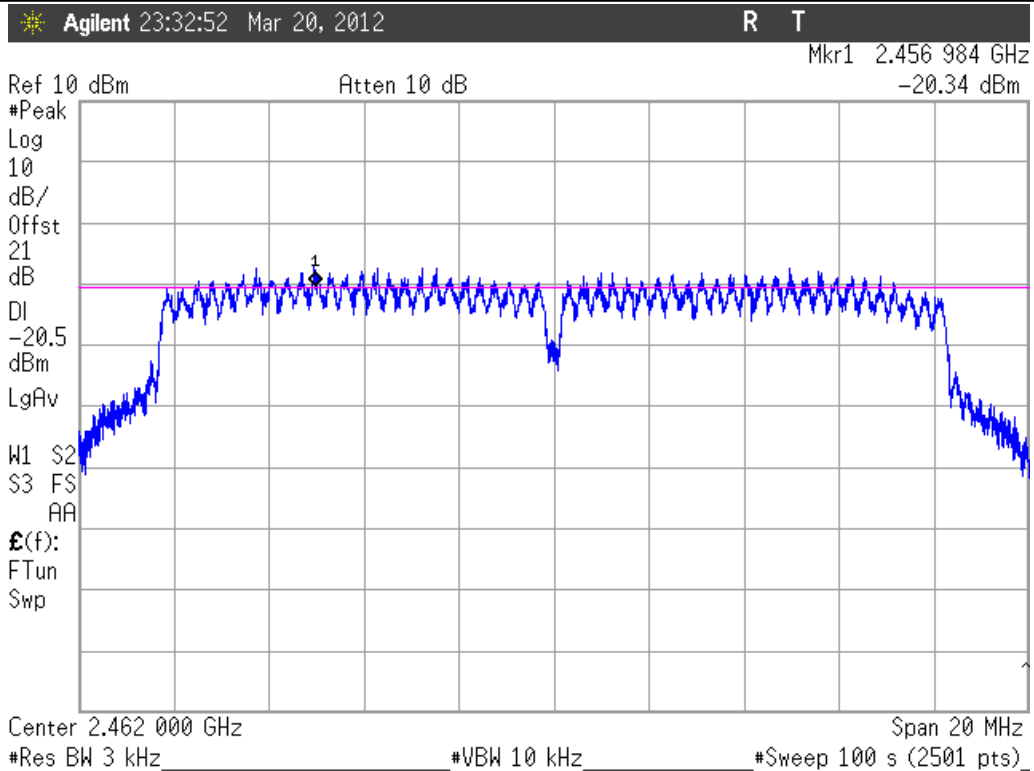
Data Rate = 1 Mb/s

Peak Power Spectral Density High Channel (802.11b mode)





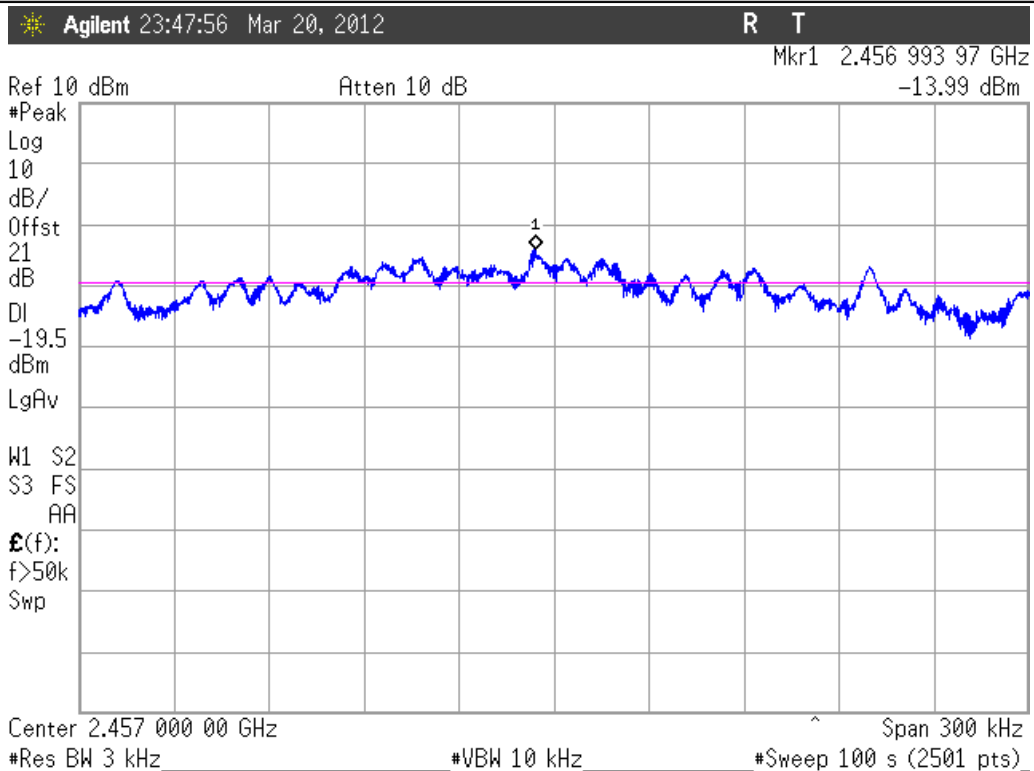
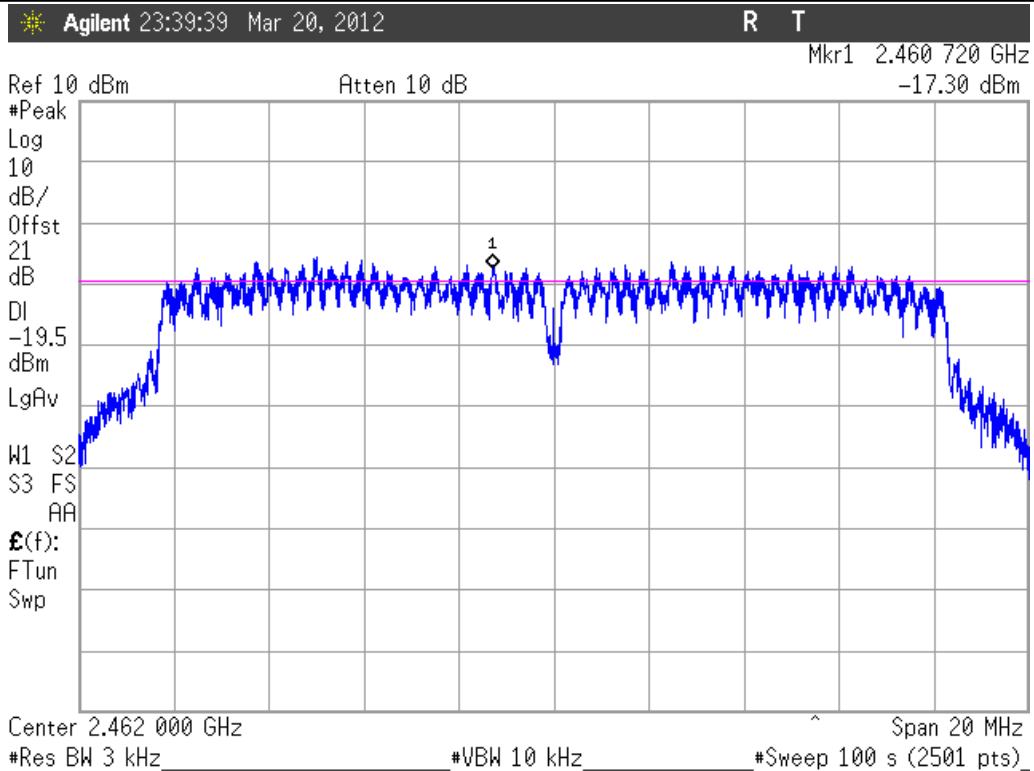
Peak Power Spectral Density High Channel (802.11g mode)



Note:

Data Rate = 6 Mb/s

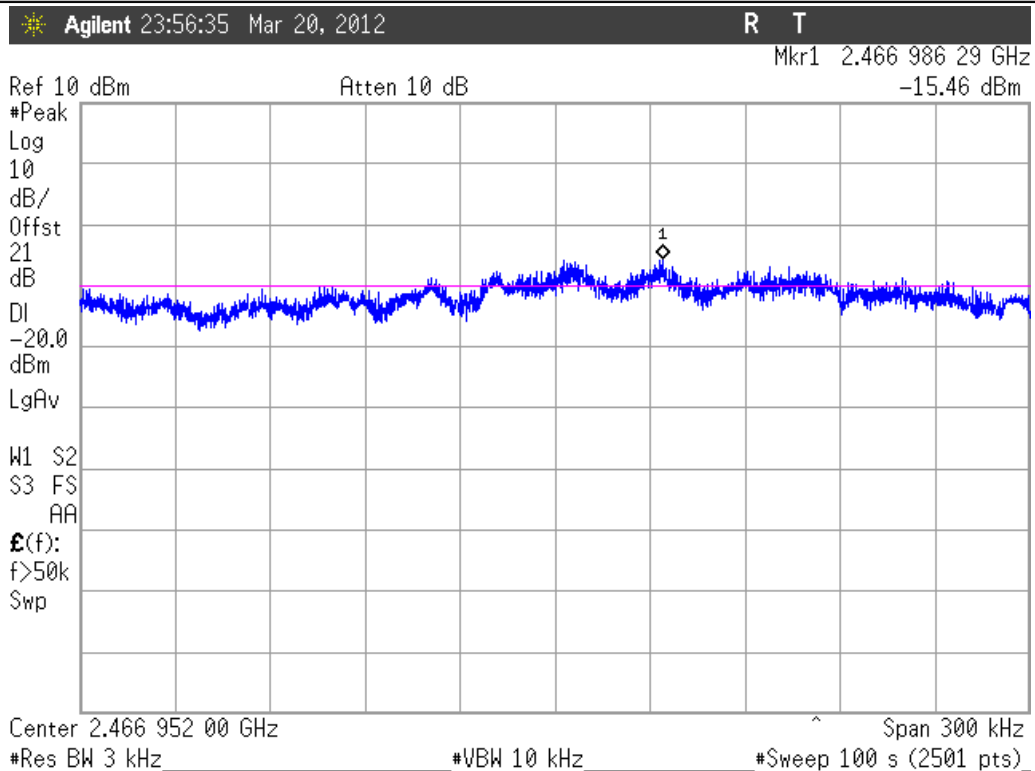
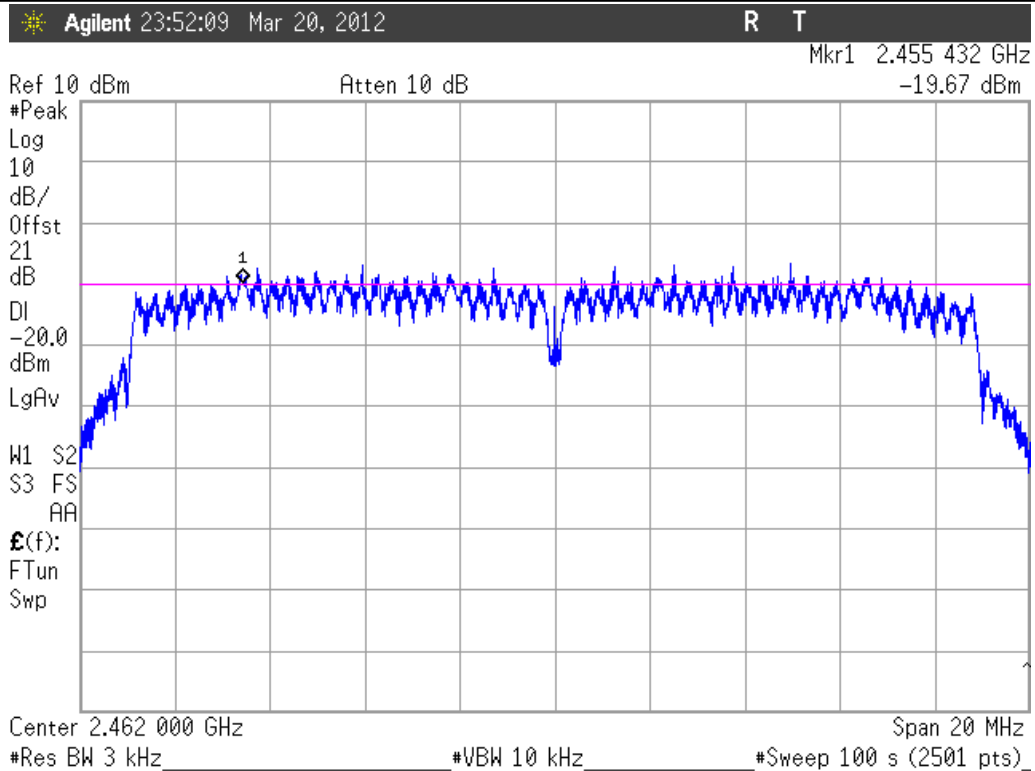
Peak Power Spectral Density High Channel (802.11g mode)



Note:

Data Rate = 54 Mb/s

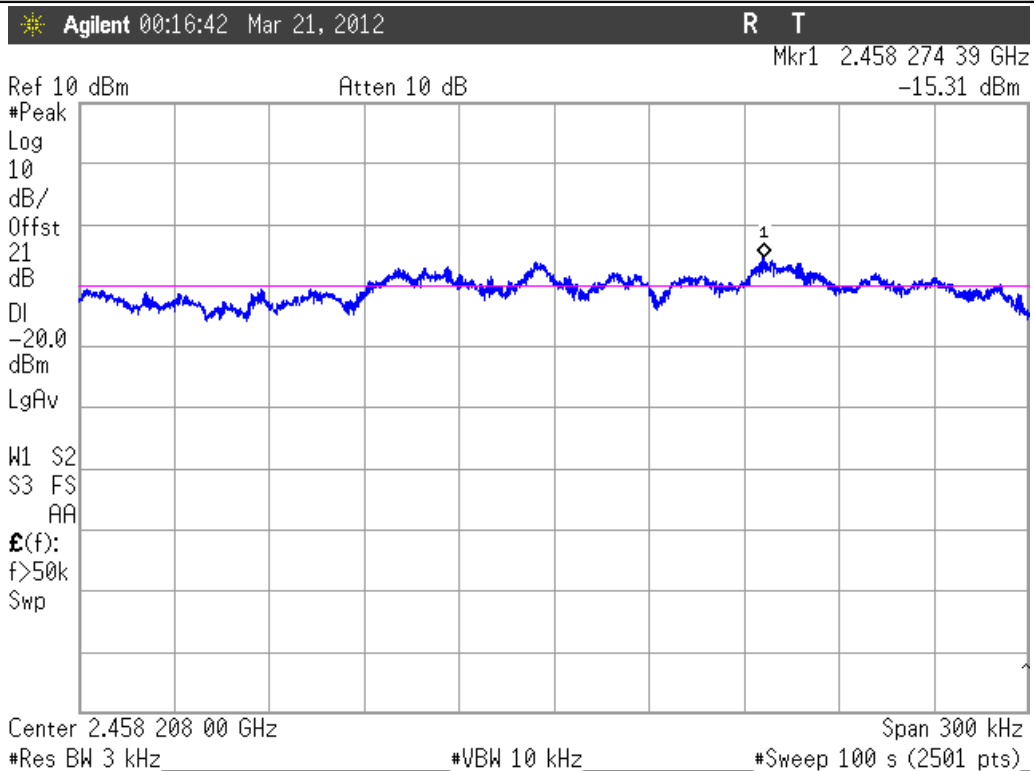
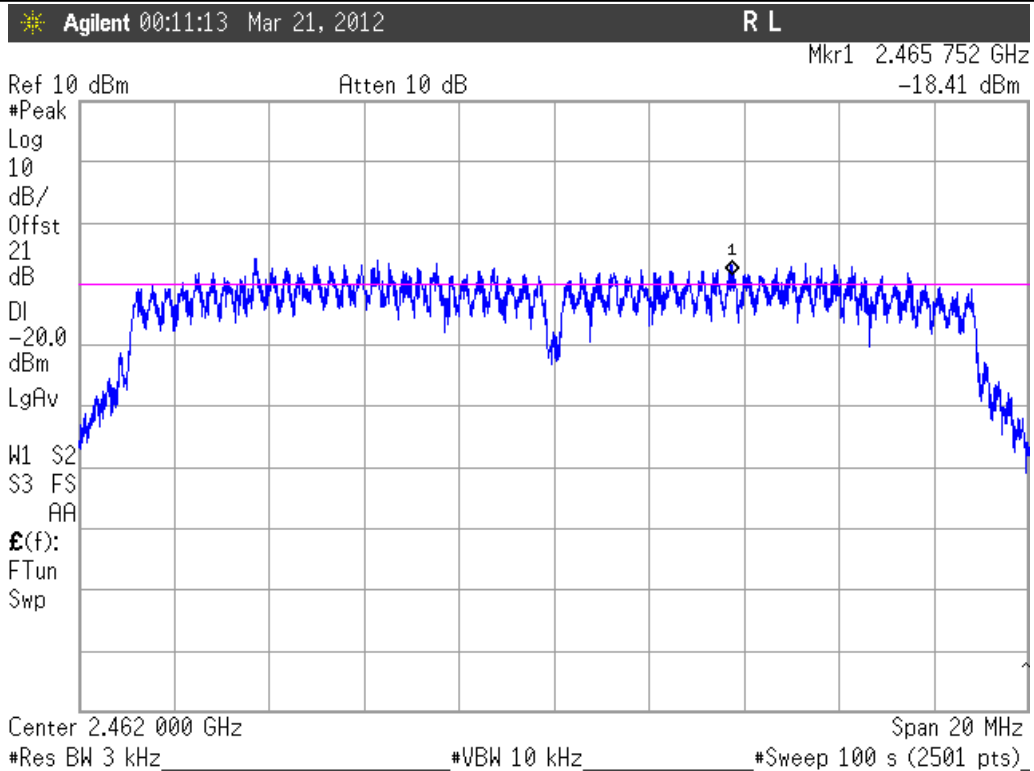
Peak Power Spectral Density High Channel (802.11n mode)



Note:

Data Rate = 6.5 Mb/s

Peak Power Spectral Density High Channel (802.11n mode)



Note:

Data Rate = 65 Mb/s

8. CONDUCTED EMISSIONS

Equipment shall meet the limits below when using a CISPR16 quasi-peak and average detector receivers.

^(*) Limit decreasing linearly with logarithm of frequency

FCC, EN 55022 Class B Limit

FREQUENCY RANGE (MHz)	QUASI-PEAK LIMIT [dB (μV)]	AVERAGE LIMIT [dB (μV)]
0.15 – 0.50	66 – 56 ^(*)	59 – 46 ^(*)
0.50 – 5	56	46
5 – 30	60	50

^(*) Limit decreasing linearly with logarithm of frequency

Test Equipment

EQUIPMENT	MANUFACTURER	MODEL	CAL. DATE
EMI Receiver	HP	HP8546A	01/2012
EMI Receiver Filter Section	HP	HP85460A	01/2012
LISN	GSD	NTW01	01/2012
Screened Room	GSD	CSC01	01/2012

Test procedure: CE22R01

Test method

Test method was in accordance with the reference standard.

EUT modes of operations were tested in order to achieve the maximum level of emission.

Results

Equipment complied with the test specification limits.

Graphics in following figures show some registrations of the frequency spectrum of the conducted emissions.

1/2

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 15.53 MHz
33.15 dBμV

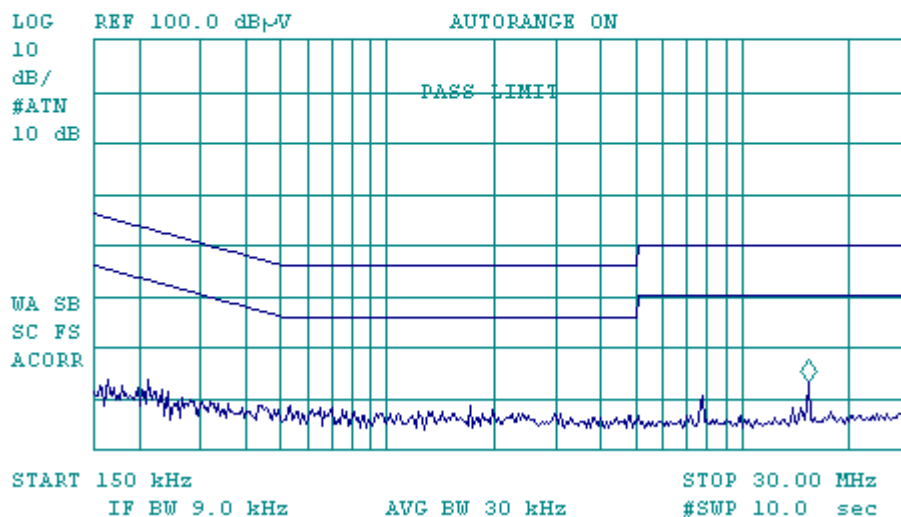


Fig. 8.1

B Band (0.15 – 30 MHz): phase 1

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1/2

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 15.53 MHz
32.71 dBμV

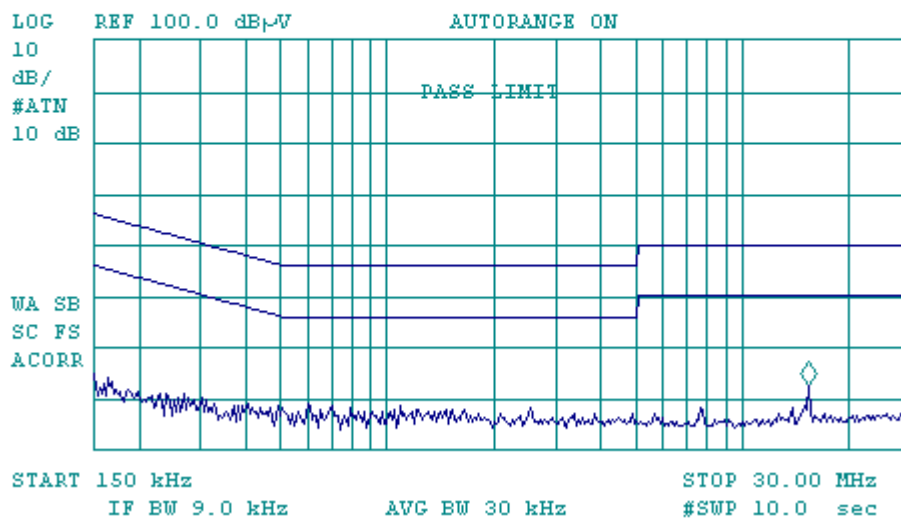
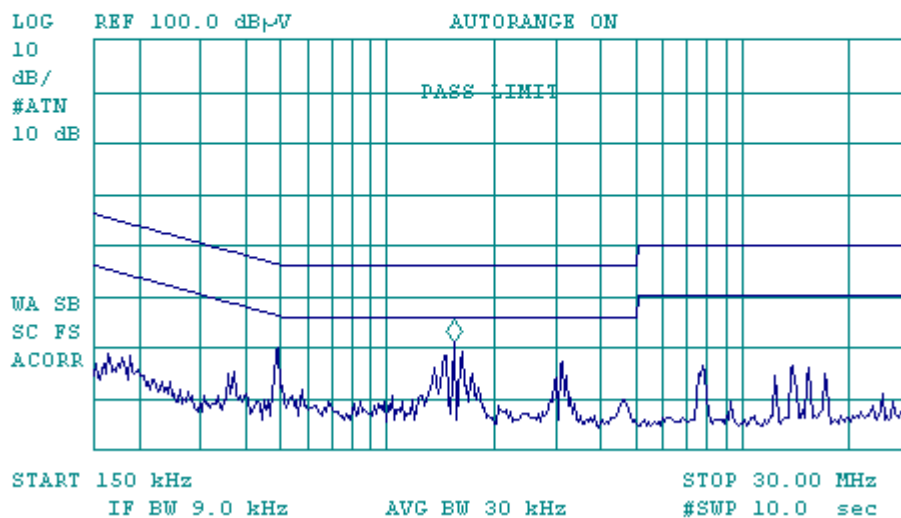


Fig. 8.2

B Band (0.15 – 30 MHz): phase 2

1/2

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 1.56 MHz
41.00 dBμV



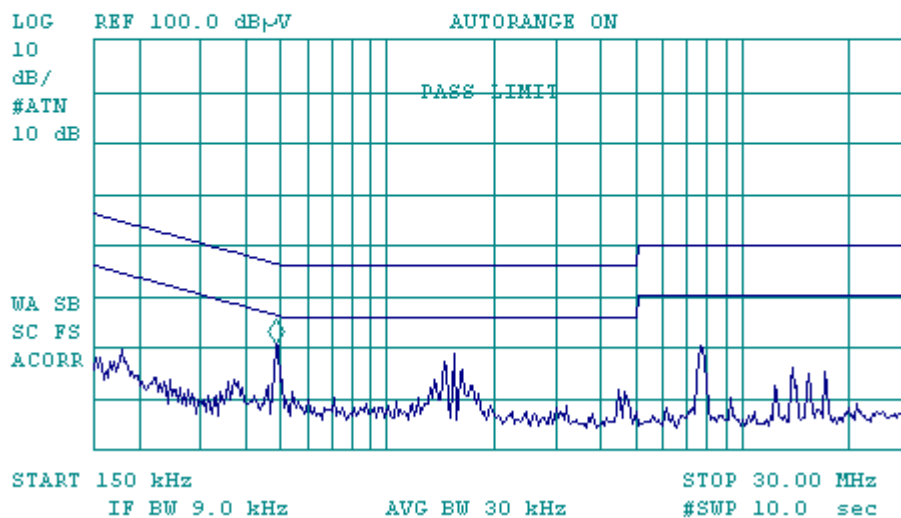
Notes:
NMEA 2000 power

Fig. 8.3

B Band (0.15 – 30 MHz): phase 1

1/2

ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 490 kHz
40.92 dBμV



Notes:
NMEA 2000 power

Fig. 8.4

B Band (0.15 – 30 MHz): phase 2

9. RADIATED EMISSIONS

In the following table you can find the limits established by the reference standard:

FCC

<i>DISTANCE</i> (m)	<i>FREQUENCY RANGE</i> (MHz)	<i>QUASI-PEAK LIMITS</i> [dB (μV/m)]	<i>AVERAGE LIMITS</i> [dB (μV/m)]
300	0,009 – 0,49	48,52 – 13,8	
30	0,049 – 1,705	33,8 – 22,97	
30	1,705 - 30	29,54	
3	30 – 88	40	--
3	88 – 216	43,5	--
3	216 – 960	46	--
3	960 – 1000	54	--
3	Above 1000	--	54

Test Equipment

EQUIPMENT	MANUFACTURER	MODEL	CAL. DATE
EMI Receiver	HP	HP8546A	01/2012
EMI Receiver Filter Section	HP	HP85460A	01/2012
EMI Receiver	Agilent	E4440A	01/2012
EMI Receiver Filter Section	Agilent	N9039A	01/2012
Anechoic Chamber	Comtest	CSA01	01/2012
Horn Antenna (1-18 GHz)	EMCO	3115	01/2012
Loop Antenna	EMCO	6512	01/2012
Horn Antenna (18-26.5 GHz)	Alpha Ind. Inc.	100655A	01/2012
Bilog Antenna	Schaffner	CBL6112B	01/2012
Controller	Deisel	HD100	01/2012
Turn Table	Deisel	MA240	01/2012

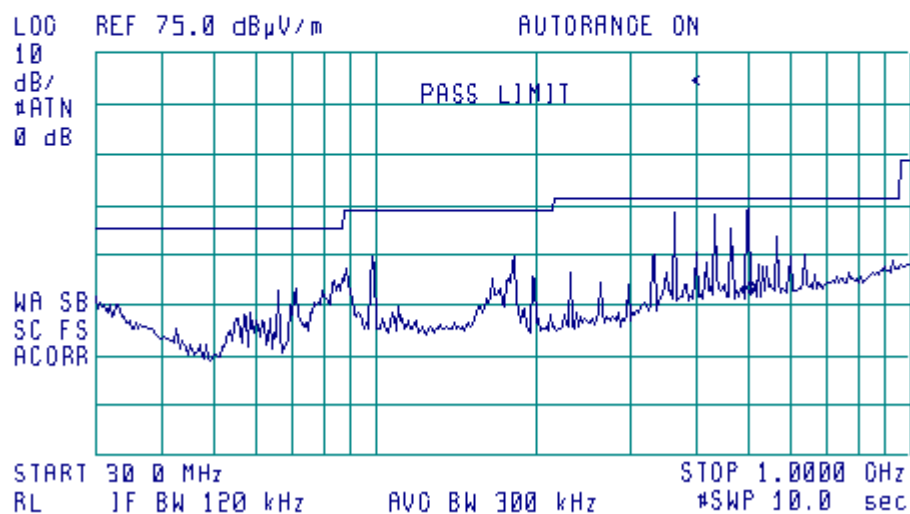
Test procedure: RE22R02**Notes**

Azimuth position EUT-Antenna corresponding to 0° identifies the rotating table orientation (TT) in which the instrument to be tested shows the front part turned towards the antenna. Positive grades individuate clockwise rotations of TT when this one is observed from the top. For negative

degrees, TT rotation is anticlockwise.
Antenna height respect to the mass plane is conventionally individuated with: MA=XXX where XXX indicates the height (always positive for e>100) expressed in cm.
Antenna horizontal polarisation is indicated by POL=H.
Antenna vertical polarisation is indicated by POL=V.
Accordingly to reference standard, a limit relaxing factor equal to 20 dB for decade for measurements performed at 3 m has been used.
<u>Results and conclusions</u>
In all the operative conditions, equipment complied with the standard limits. Graphics in following figures show the most significant registrations of the performed measurements.



FREQ 498.8 MHz
 PEAK 44.8 dBμV/m
 QP 43.0 dBμV/m
 AVG 41.1 dBμV/m



Notes:
 POL V

Fig. 9.1

Record of the measurement of radiated emissions.

One of the maximum disturbance determined in the frequency range 30MHz – 1 GHz.

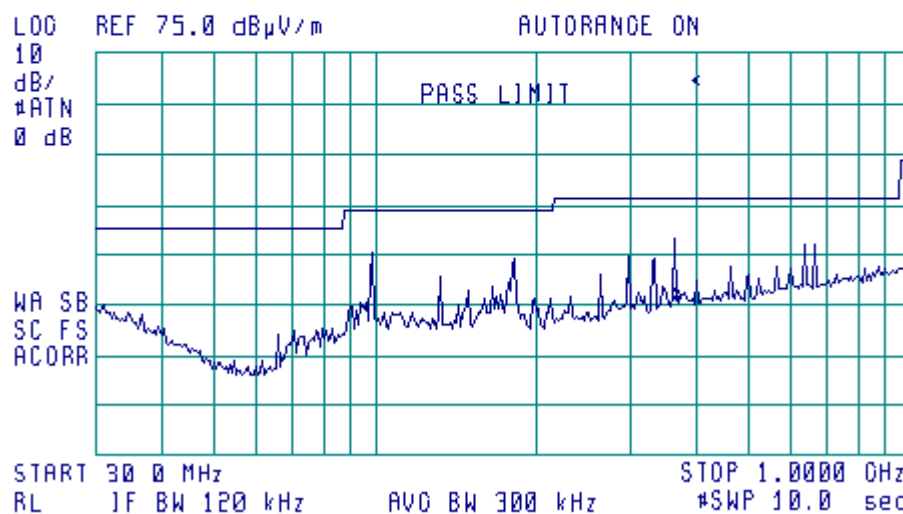
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FREQ 365.8 MHz
 PEAK 40.3 dB μ V/m
 QP 37.9 dB μ V/m
 AVG 36.7 dB μ V/m



Notes:
 POL H

Fig. 9.2

Record of the measurement of radiated emissions.

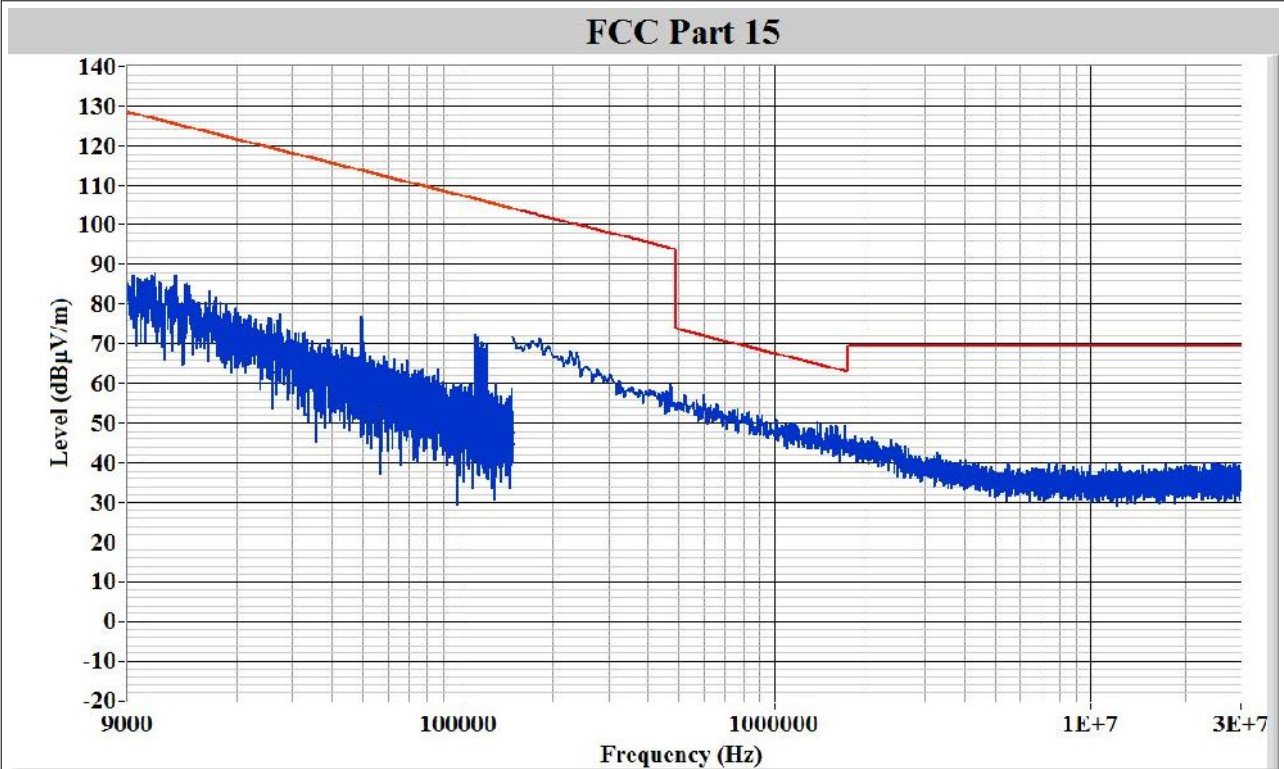
One of the maximum disturbance determined in the frequency range 30MHz – 1 GHz.

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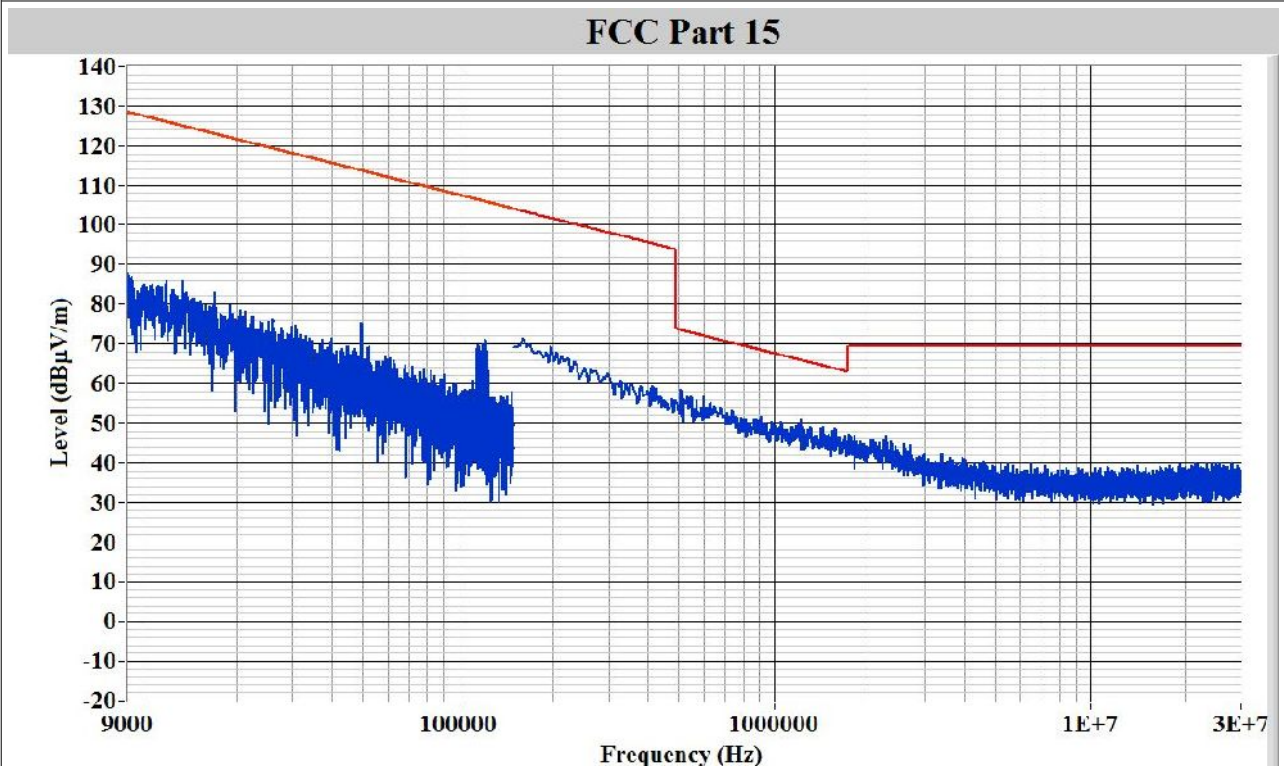
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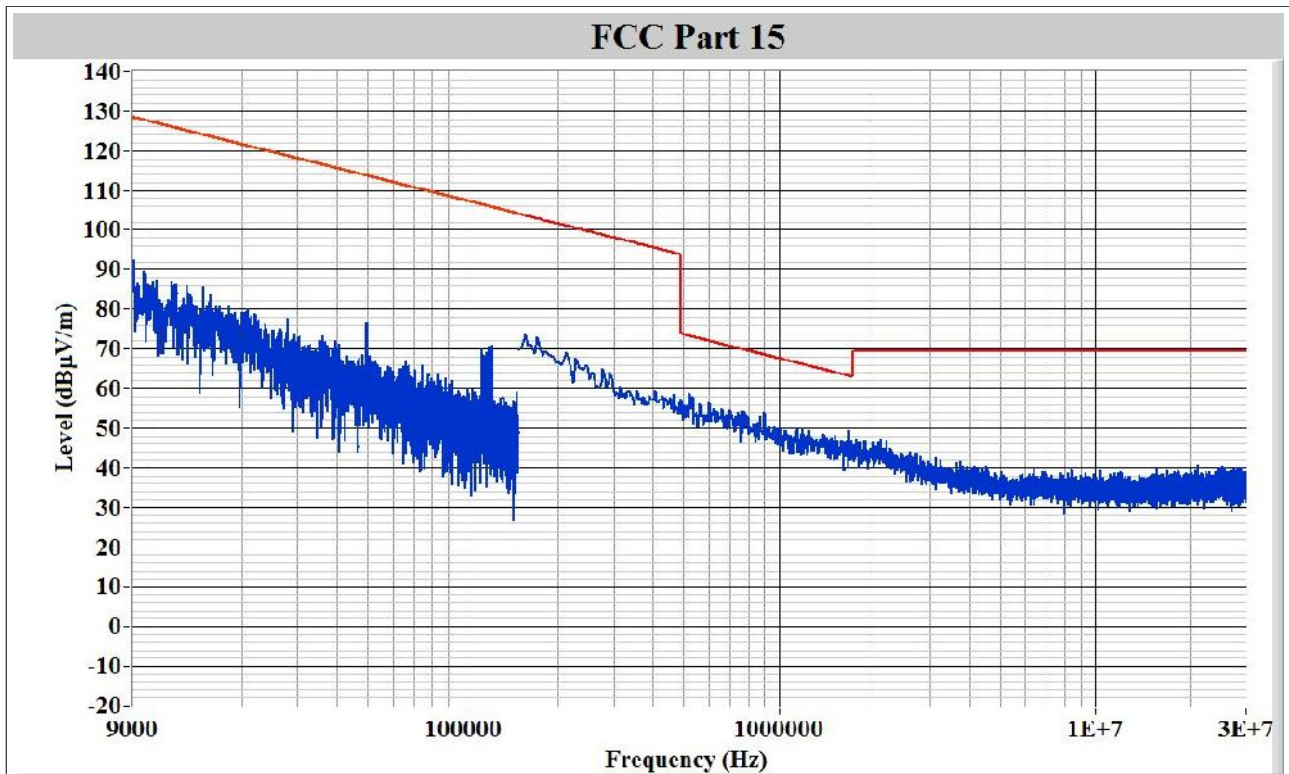
MAGNETIC FIELD EMISSIONS:



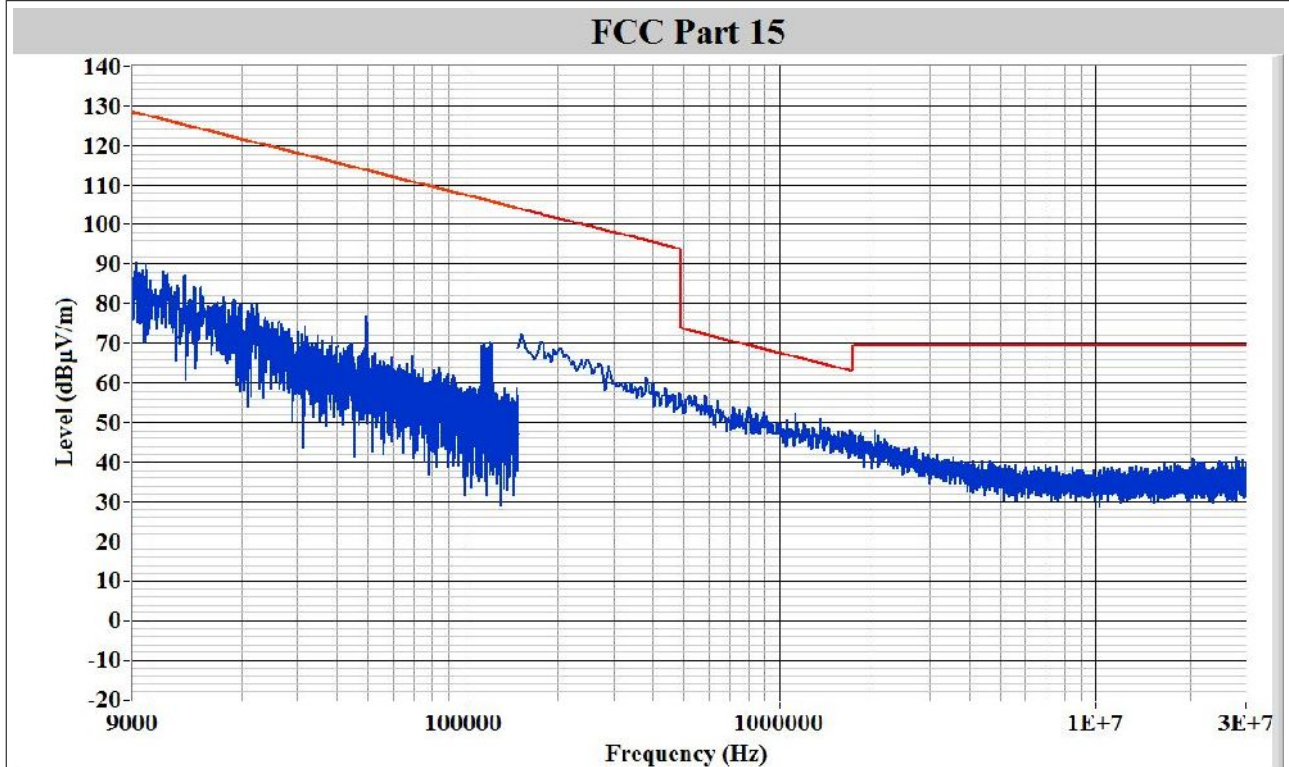
EUT FRONT SIDE, LOOP ANTENNA PARALLEL



EUT FRONT SIDE, LOOP ANTENNA ORTHOGONAL

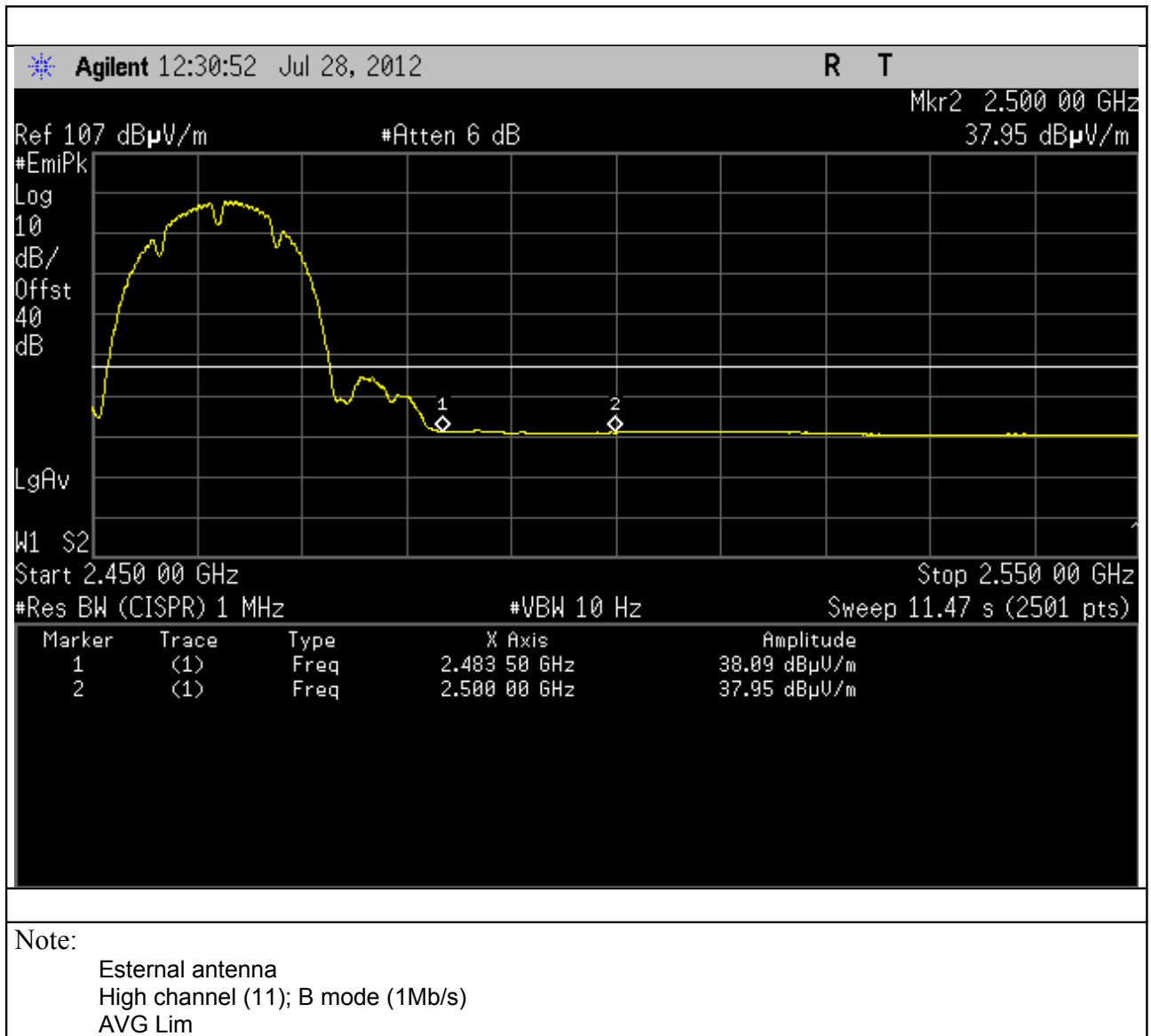


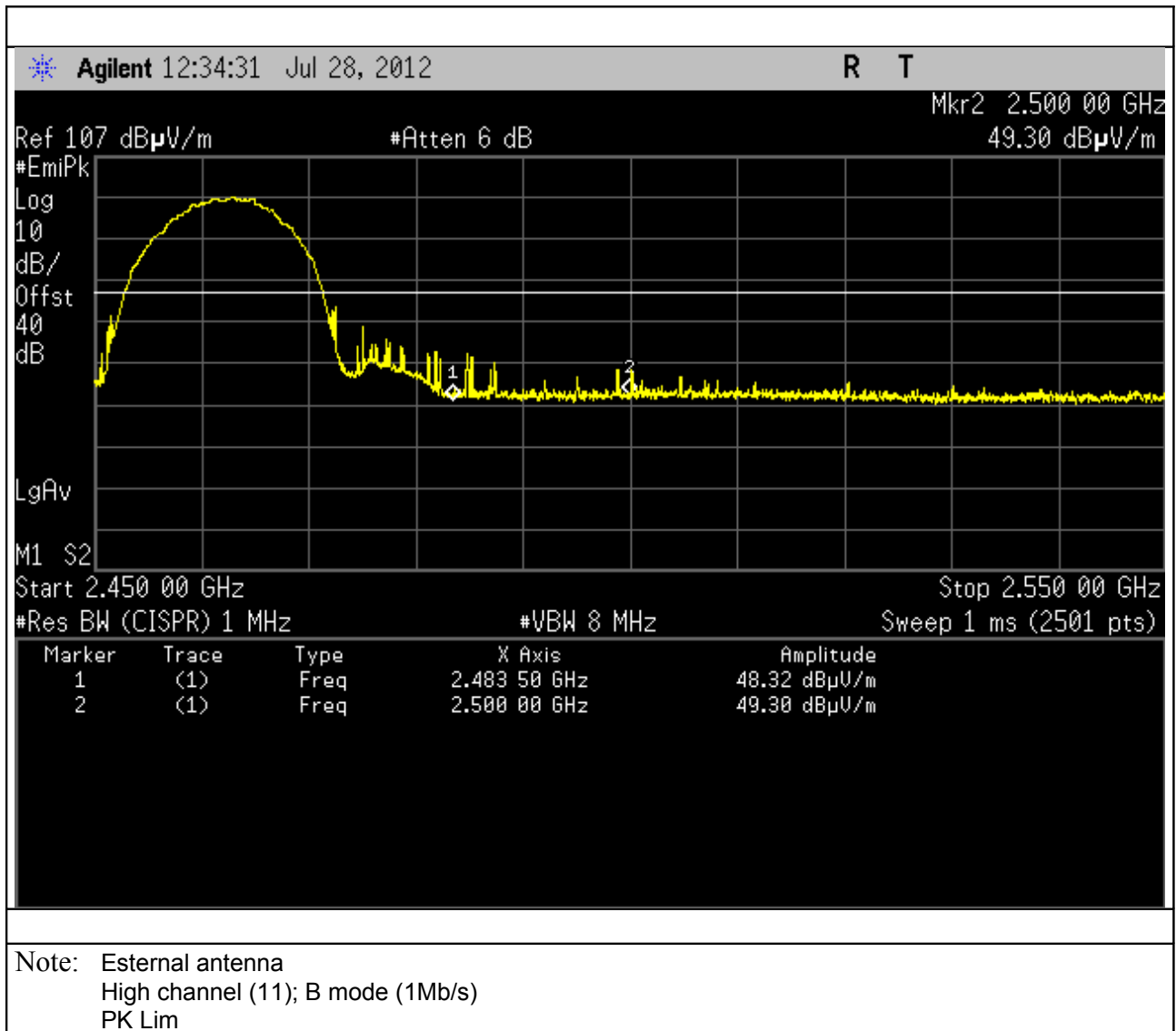
EUT LATERAL SIDE, LOOP ANTENNA ORTHOGONAL

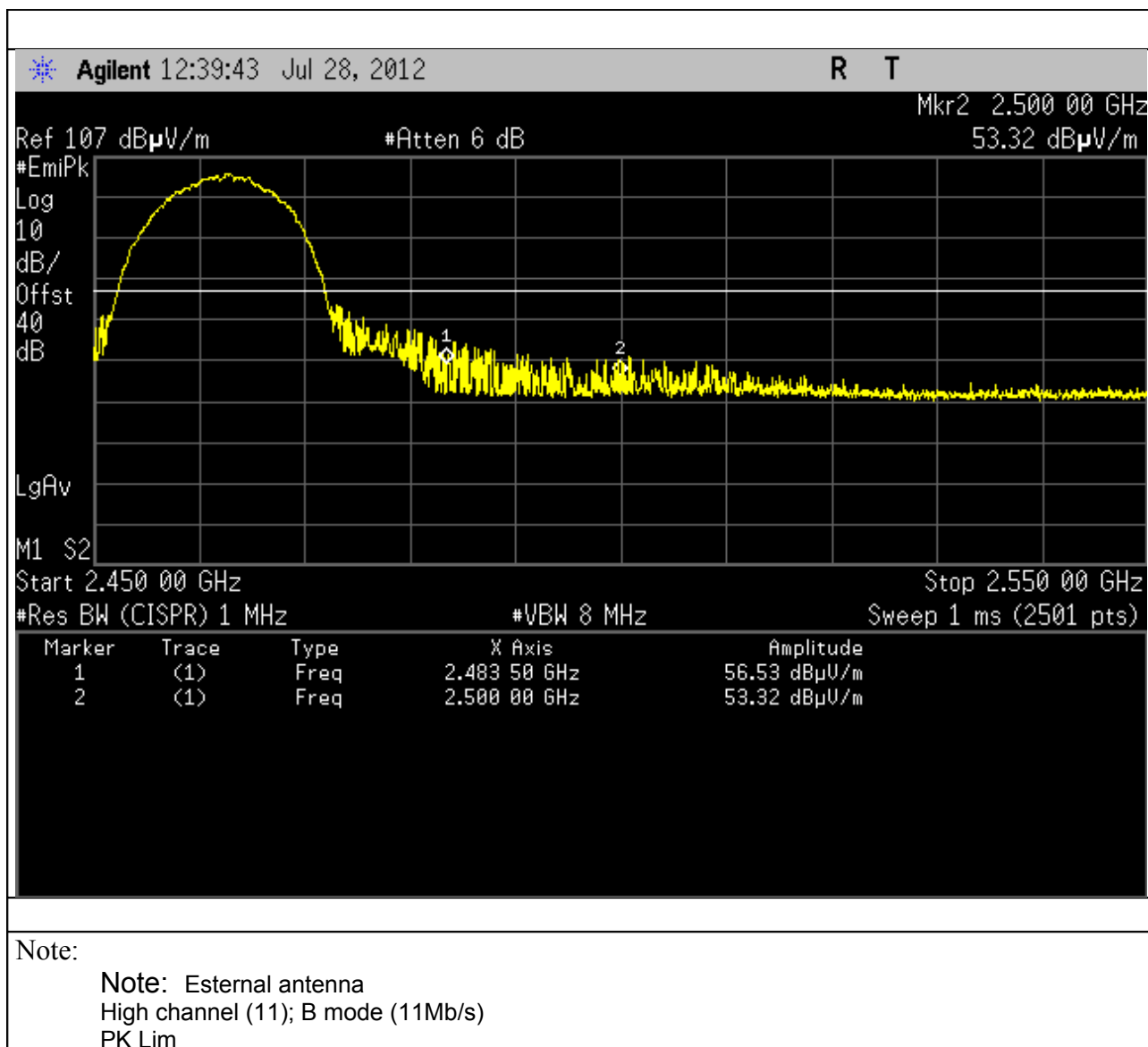


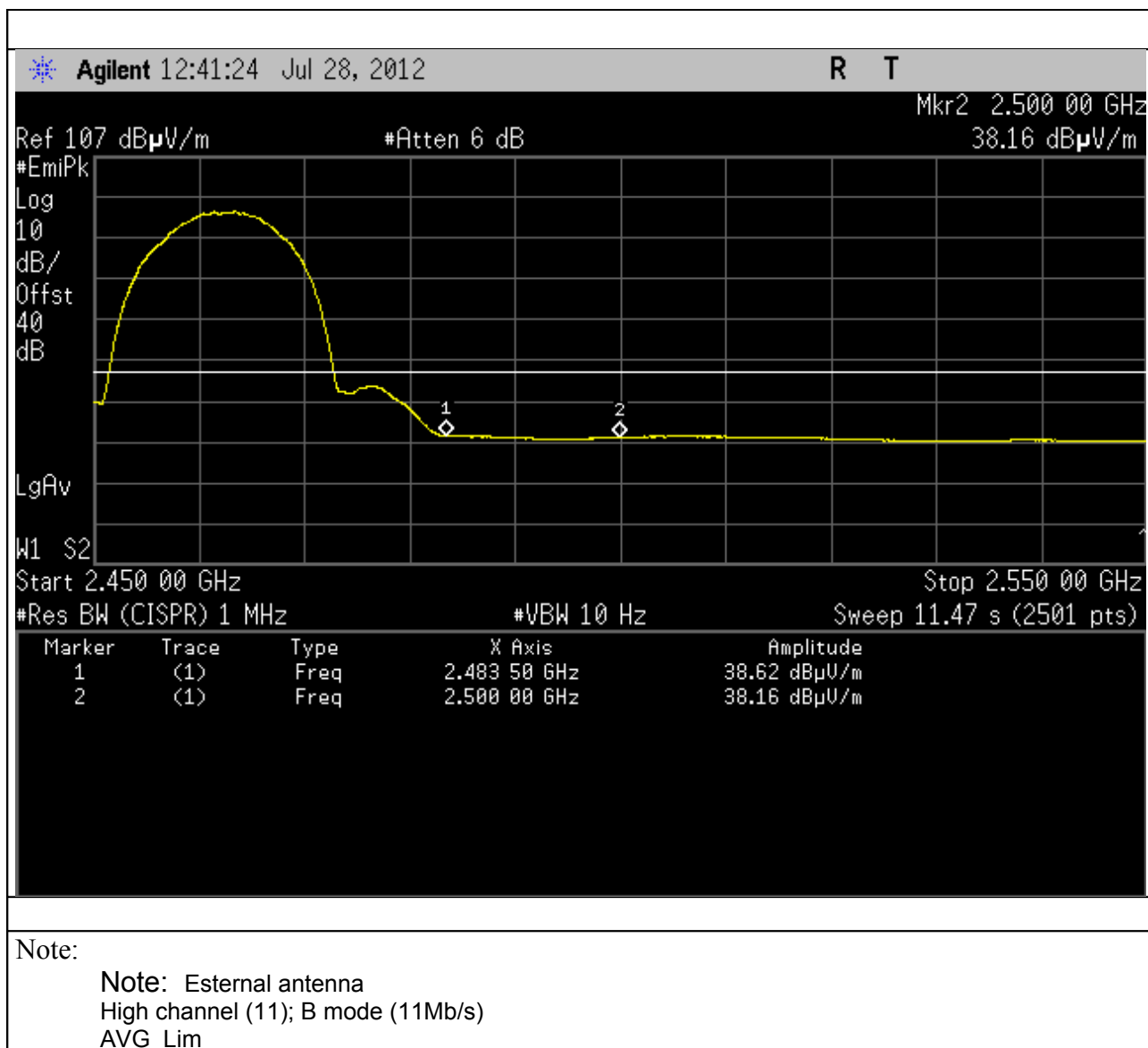
EUT LATERAL SIDE, LOOP ANTENNA PARALLEL

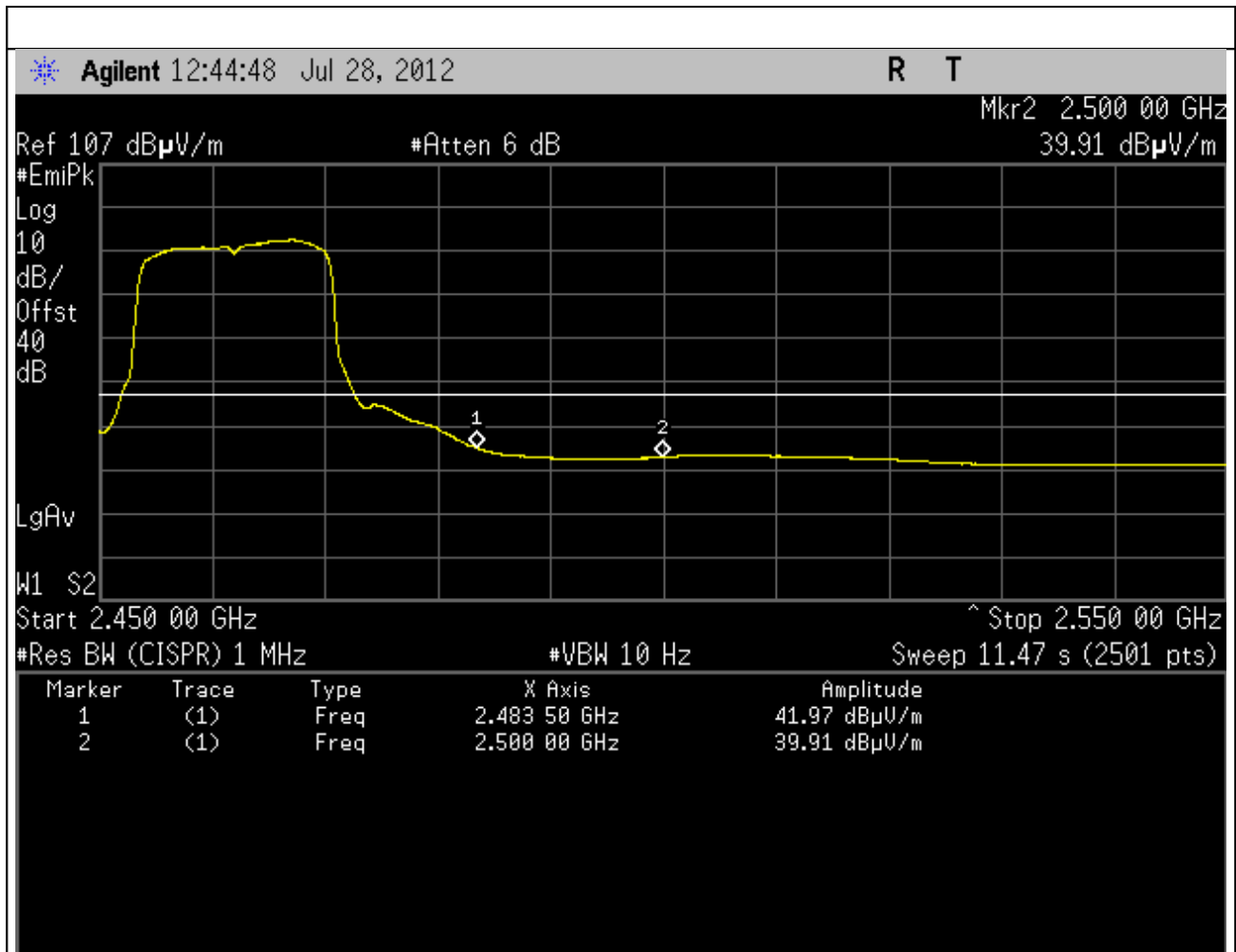
RESTRICTED BAND EDGE MEASUREMENT: 2483.5 – 2500 MHz BAND EXTERNAL AND INTERNAL ANTENNA – WITH MODULATION





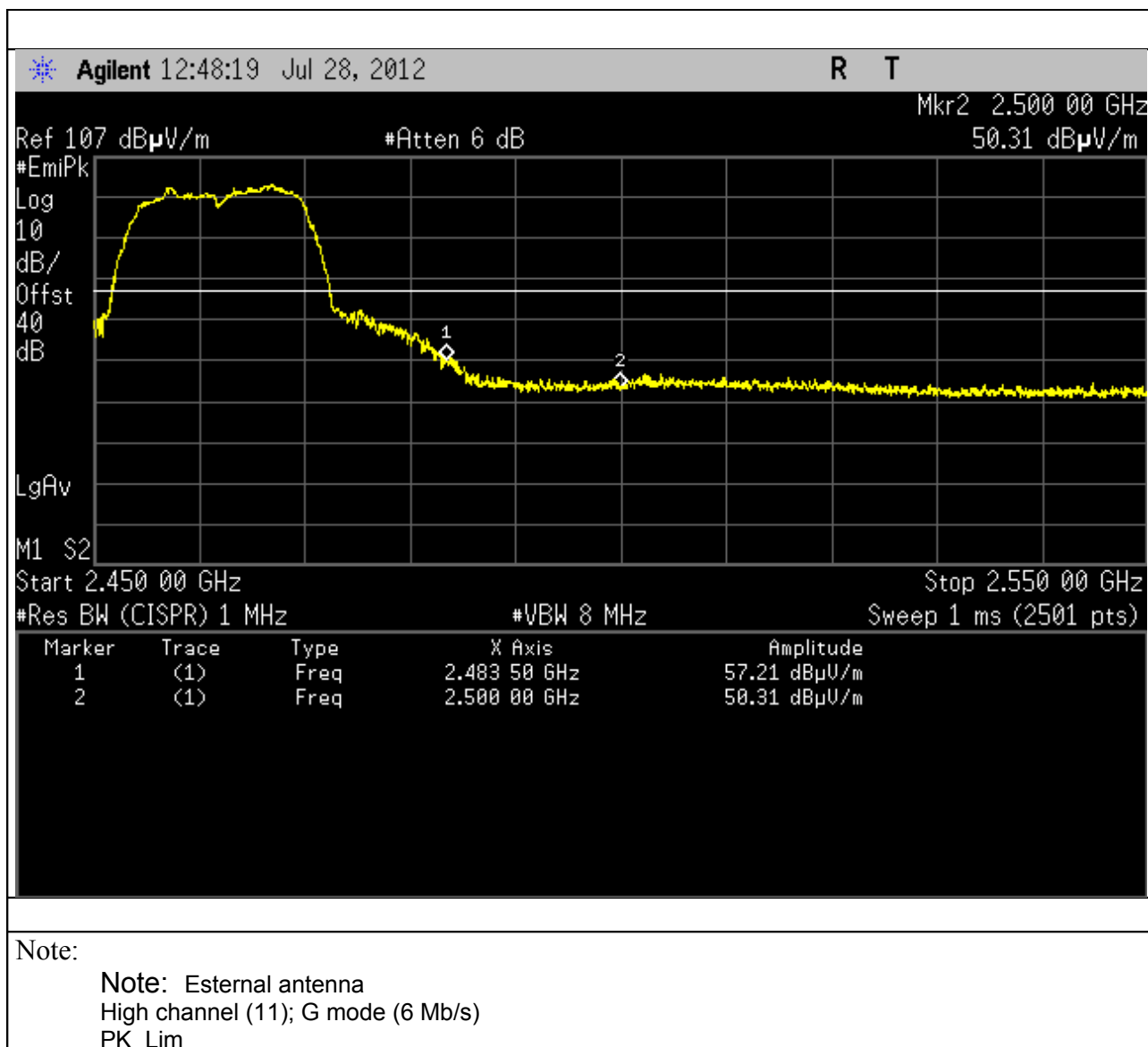


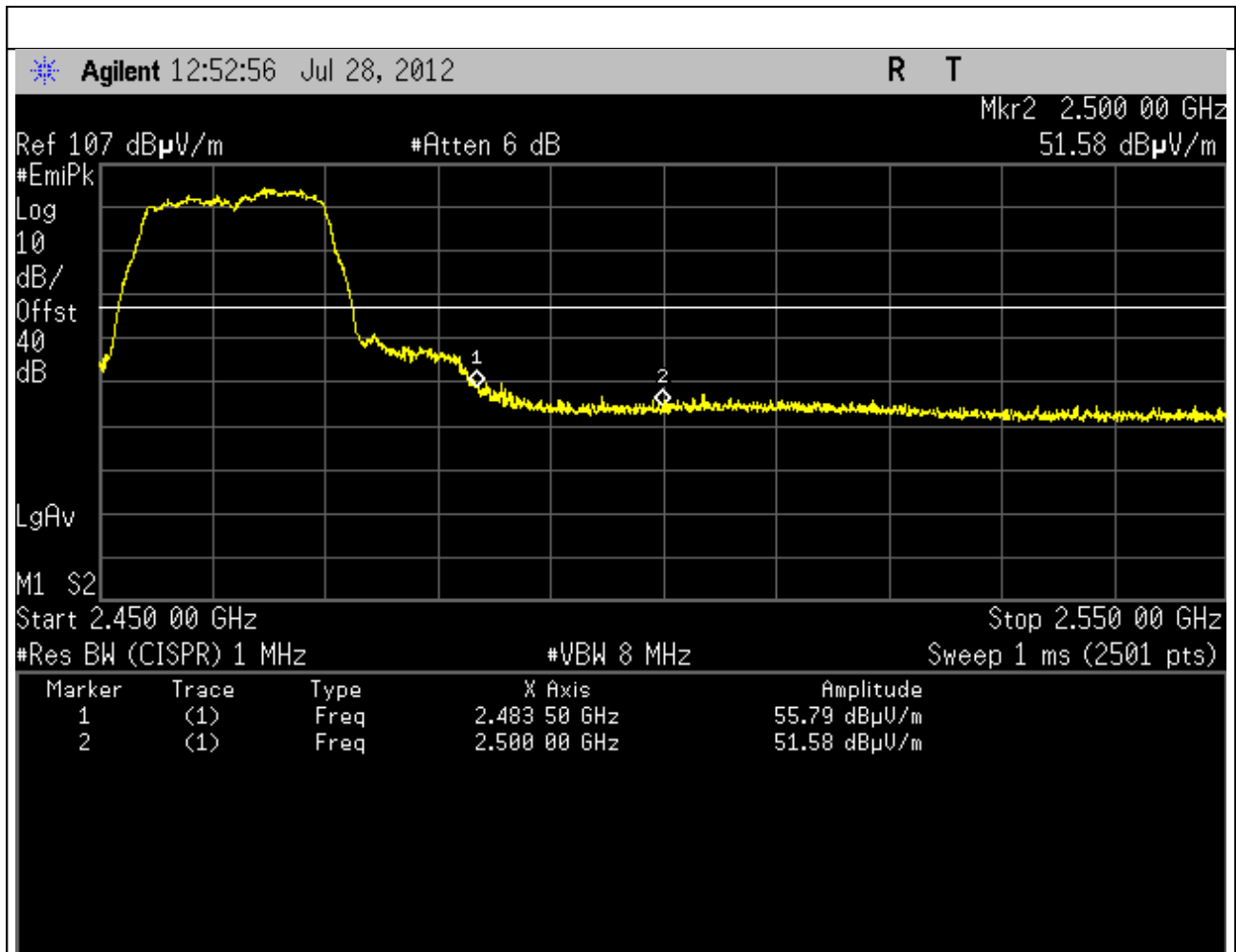




Note:

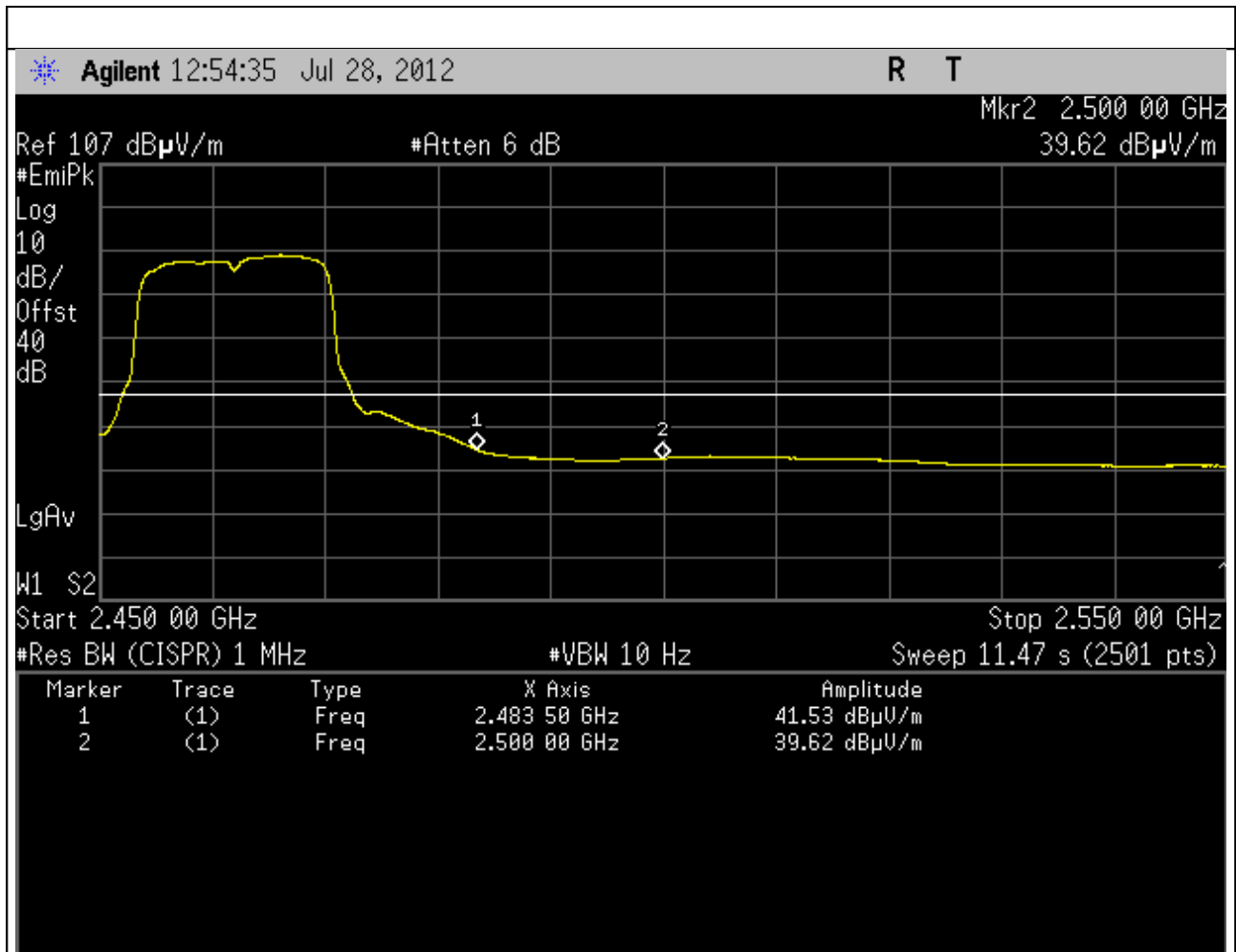
Note: External antenna
High channel (11); G mode (6 Mb/s)
AVG Lim





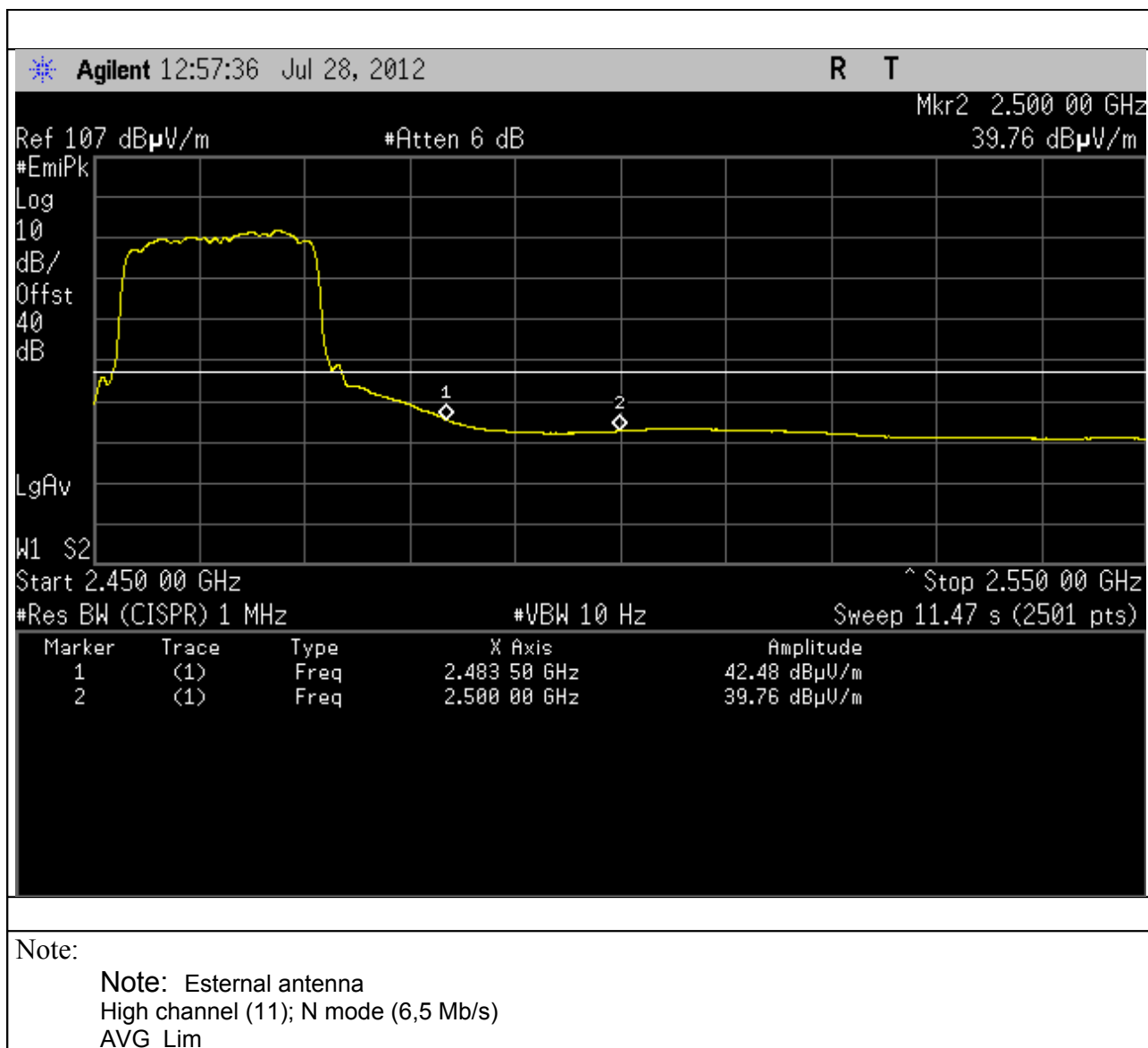
Note:

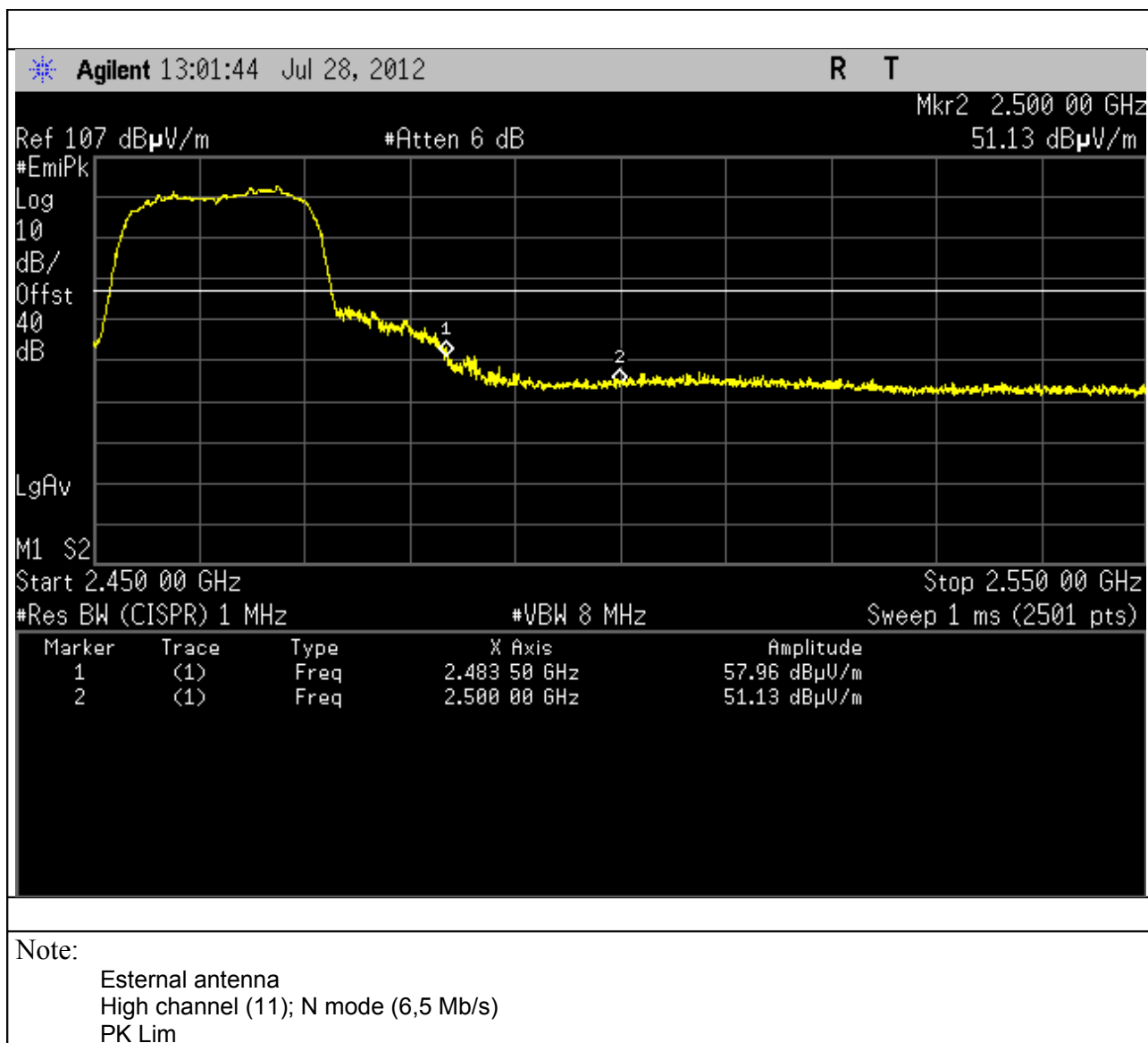
Note: External antenna
High channel (11); G mode (54 Mb/s)
PK Lim

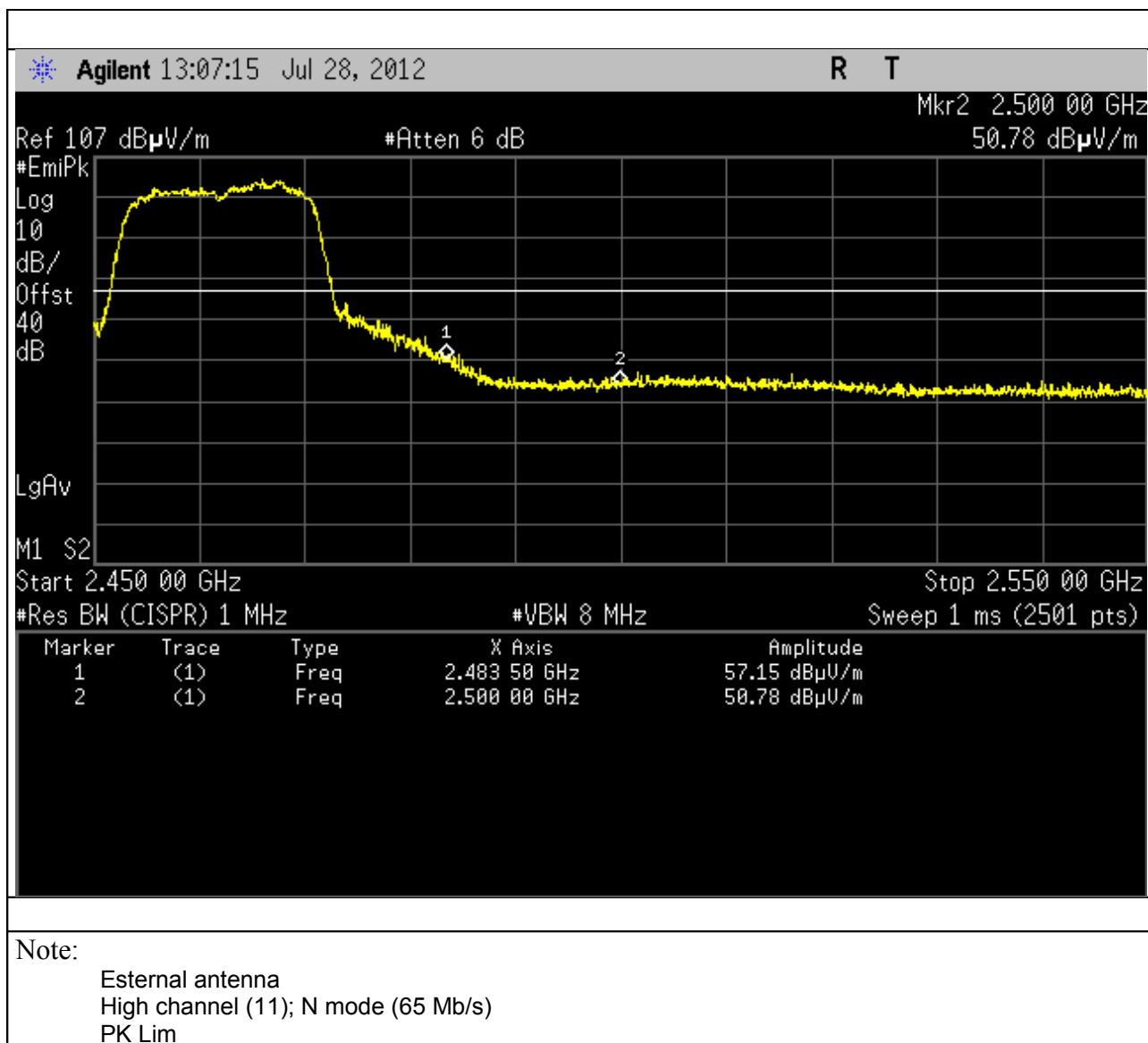


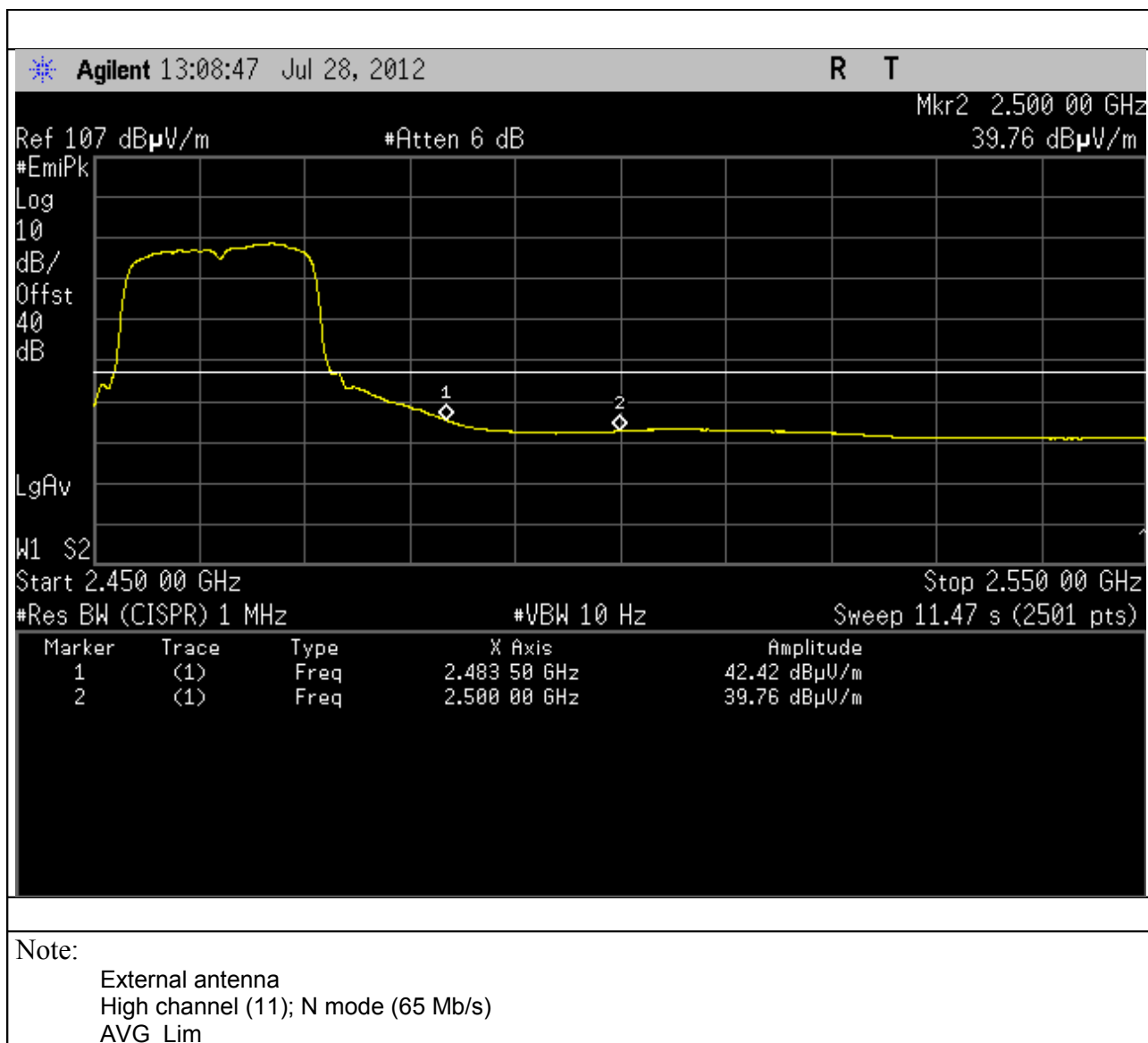
Note:

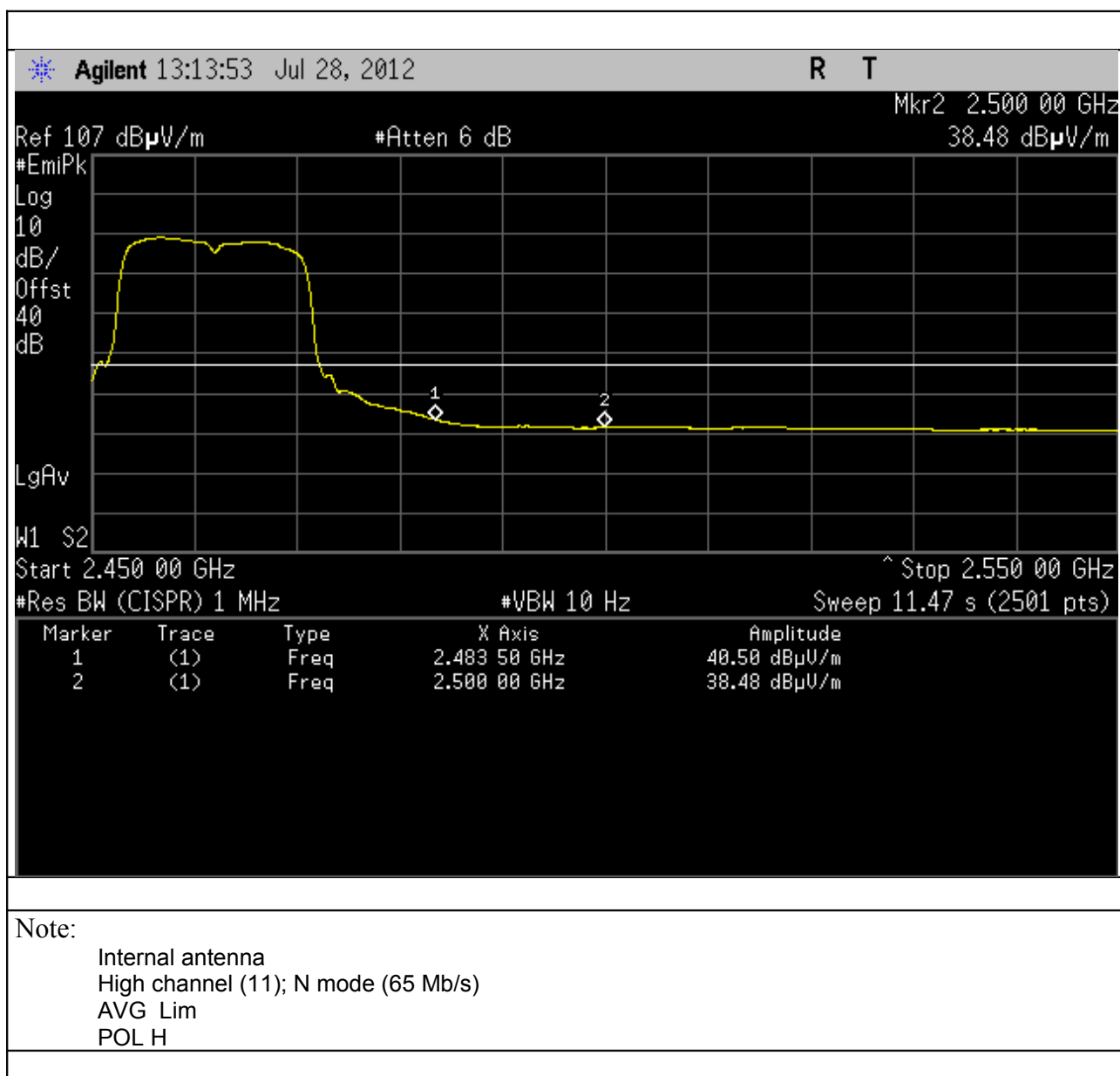
Note: External antenna
High channel (11); G mode (54 Mb/s)
AVG Lim

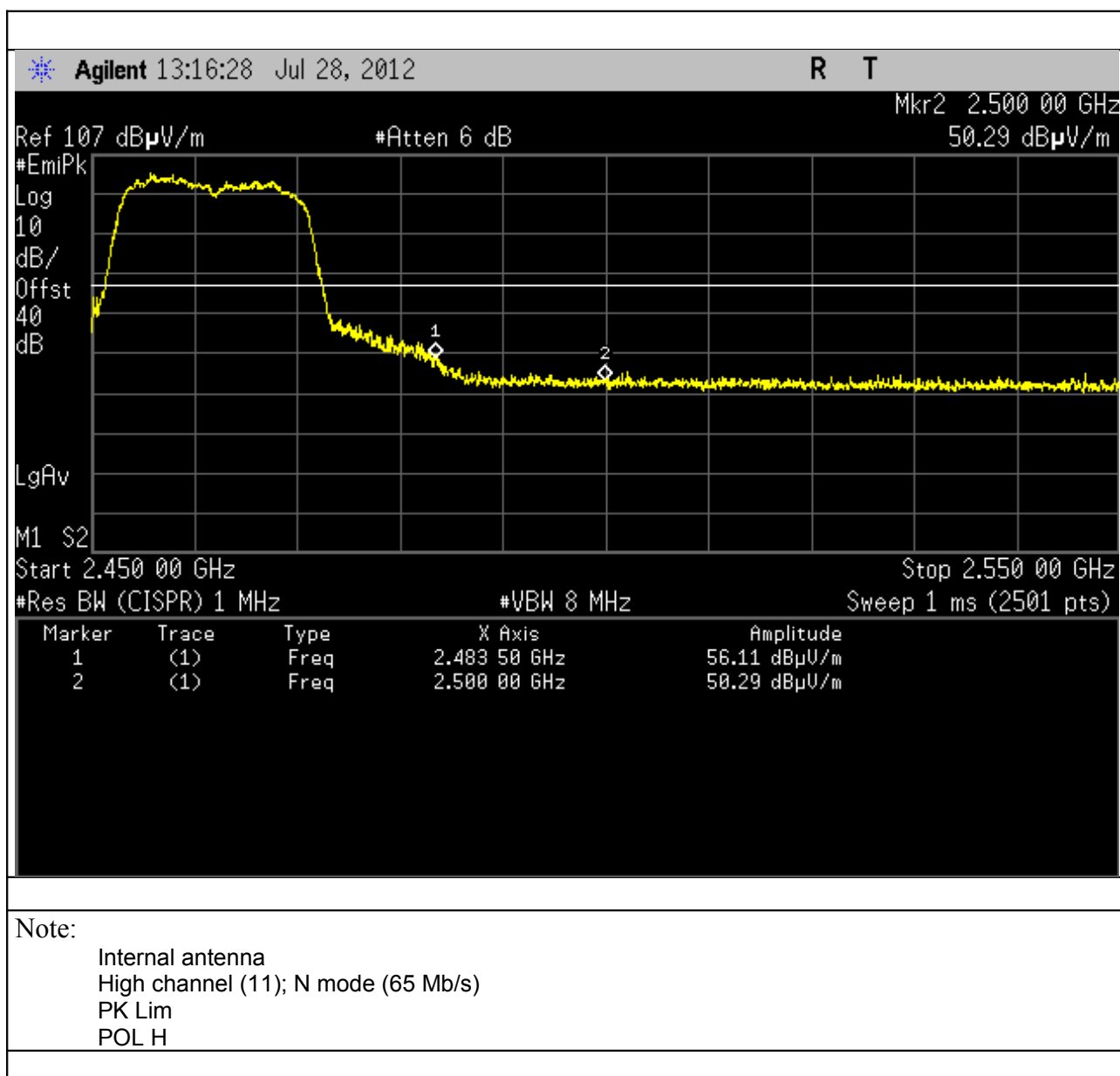


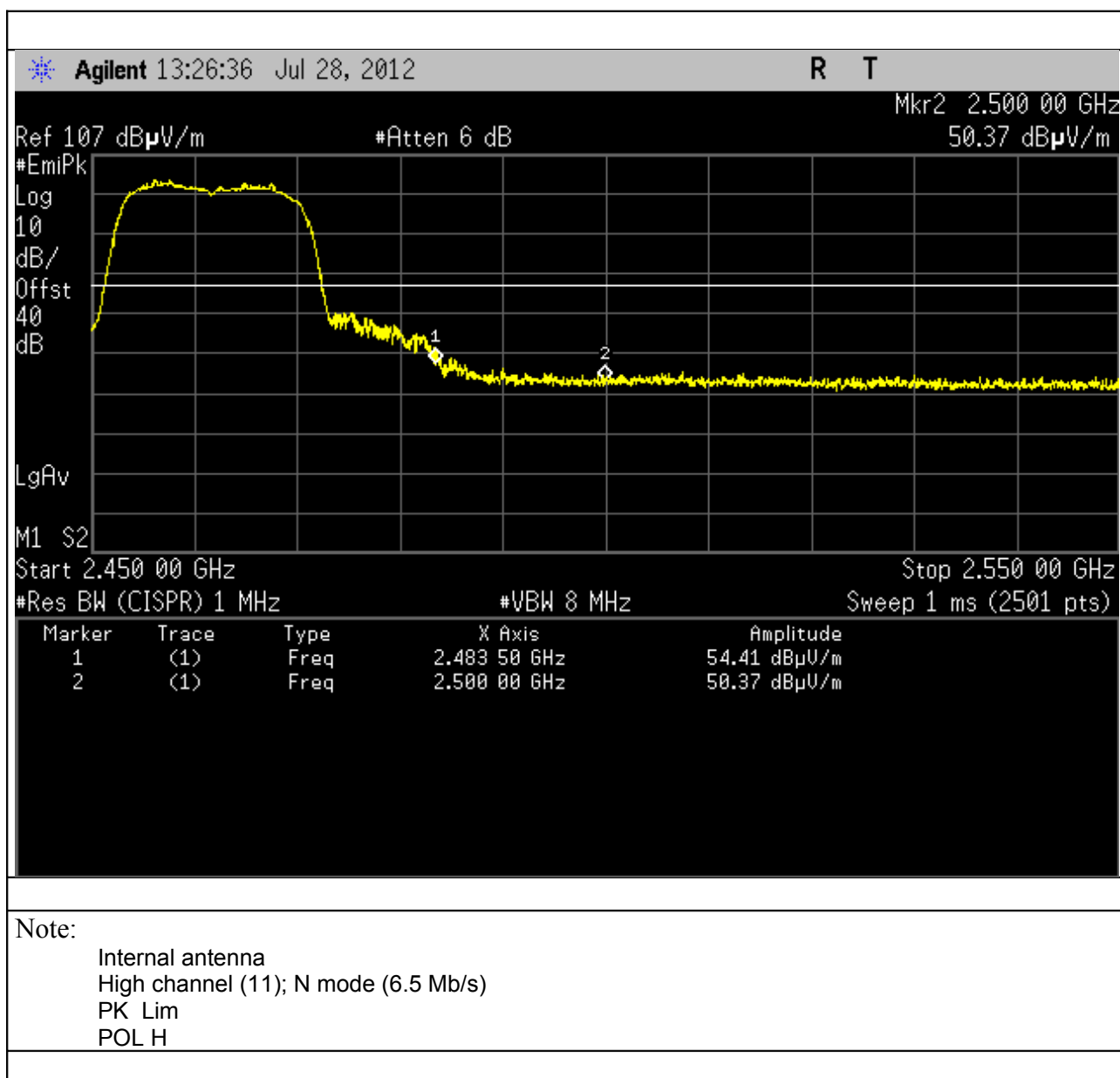


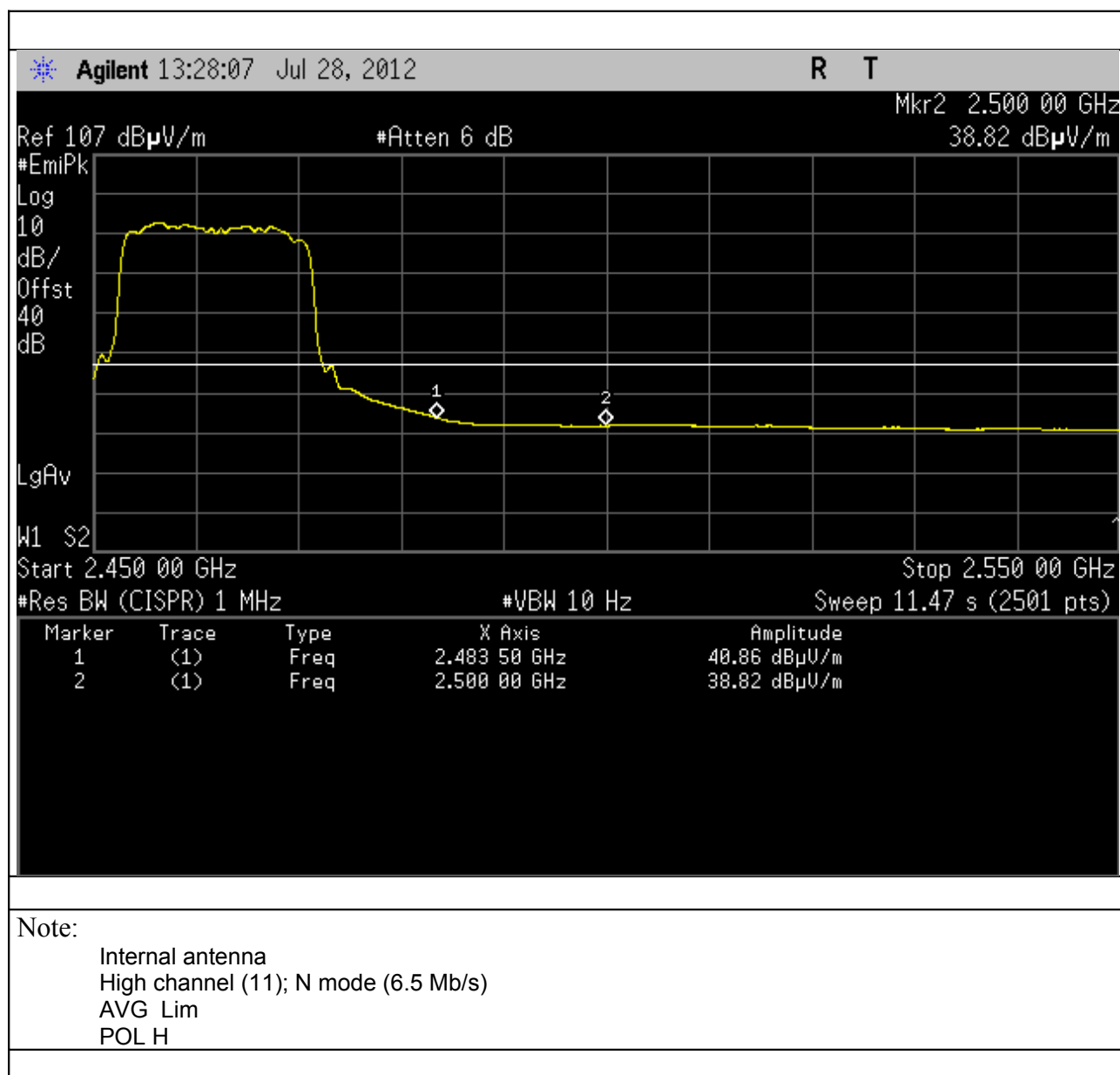


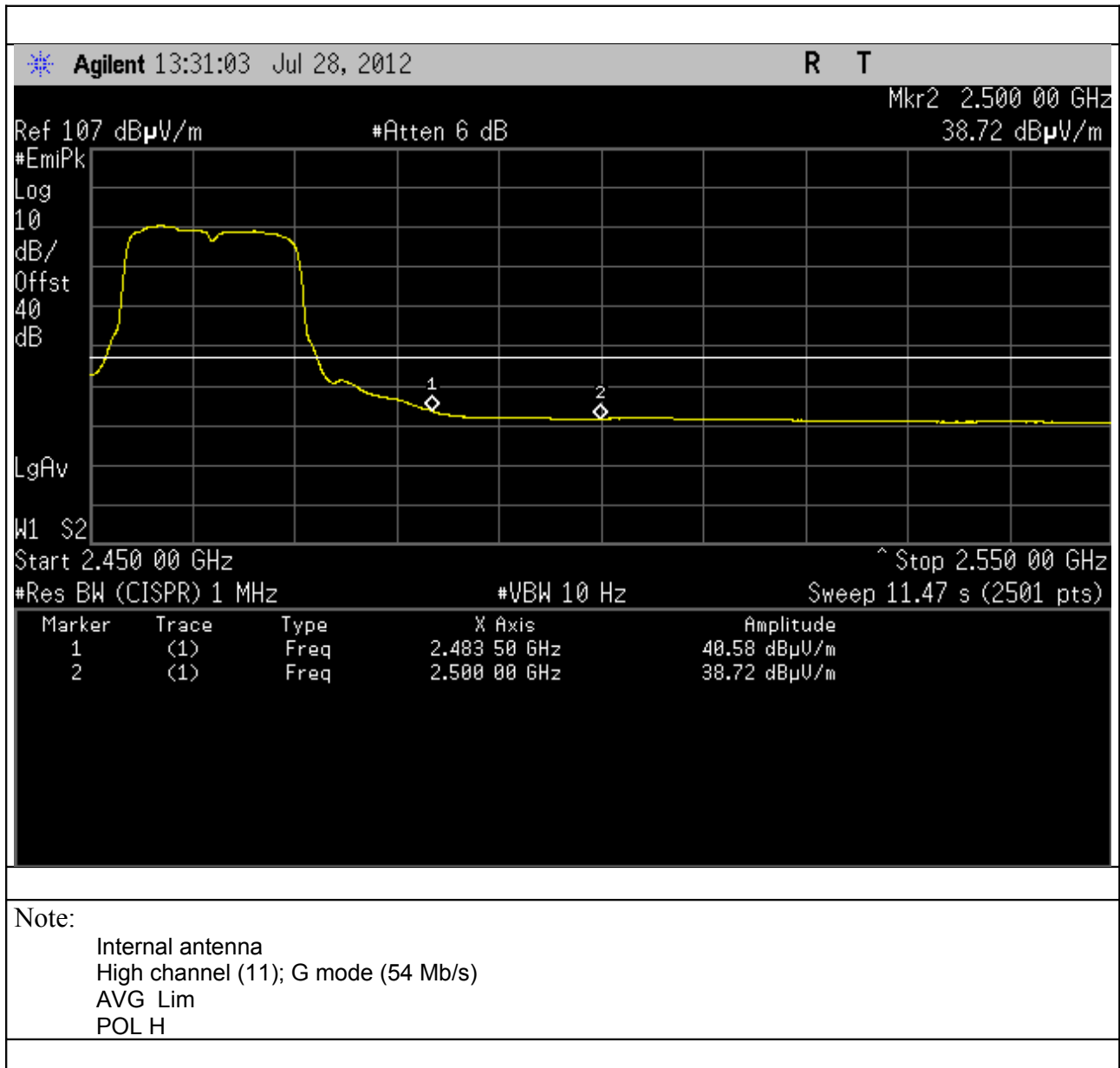


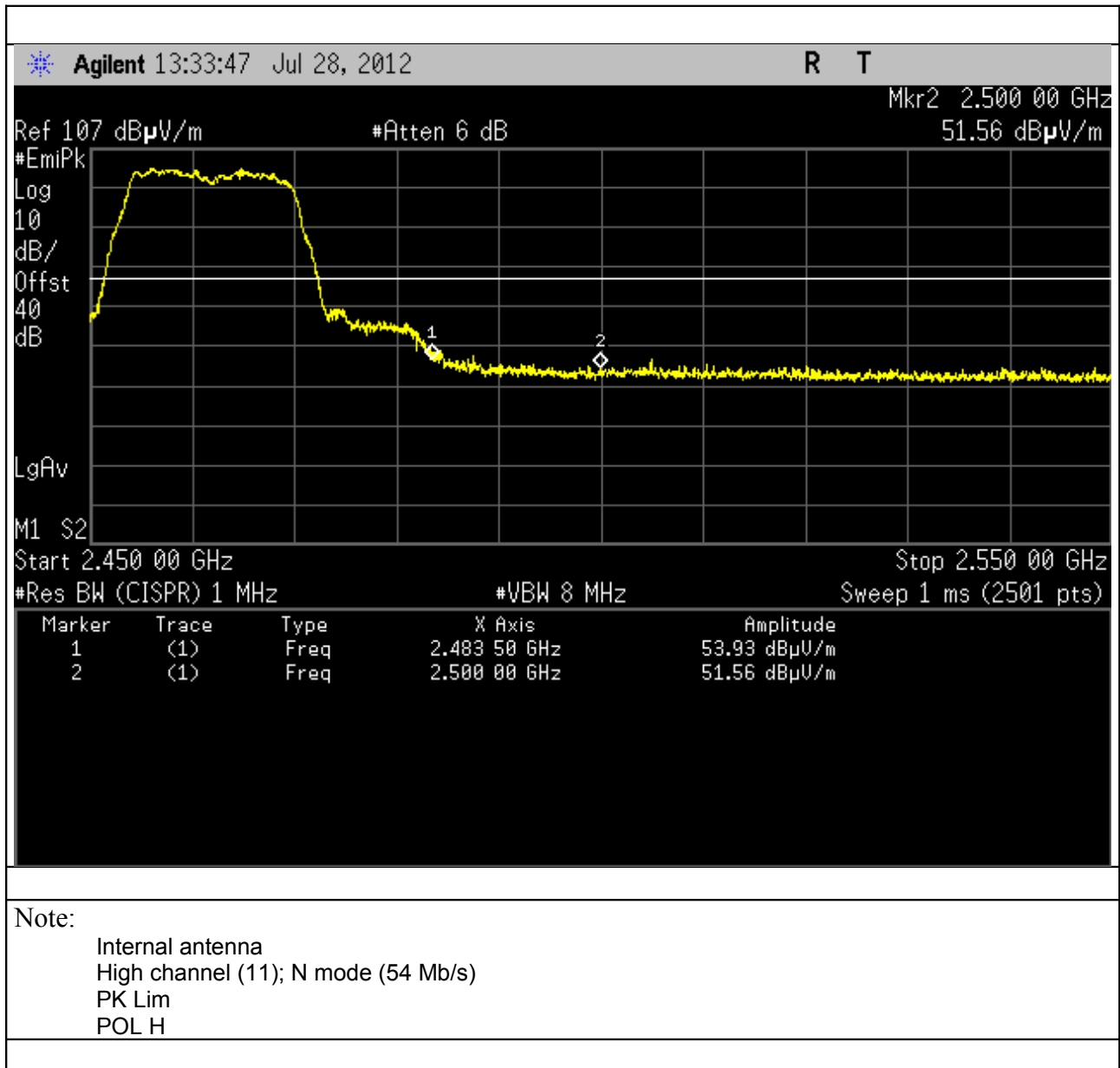


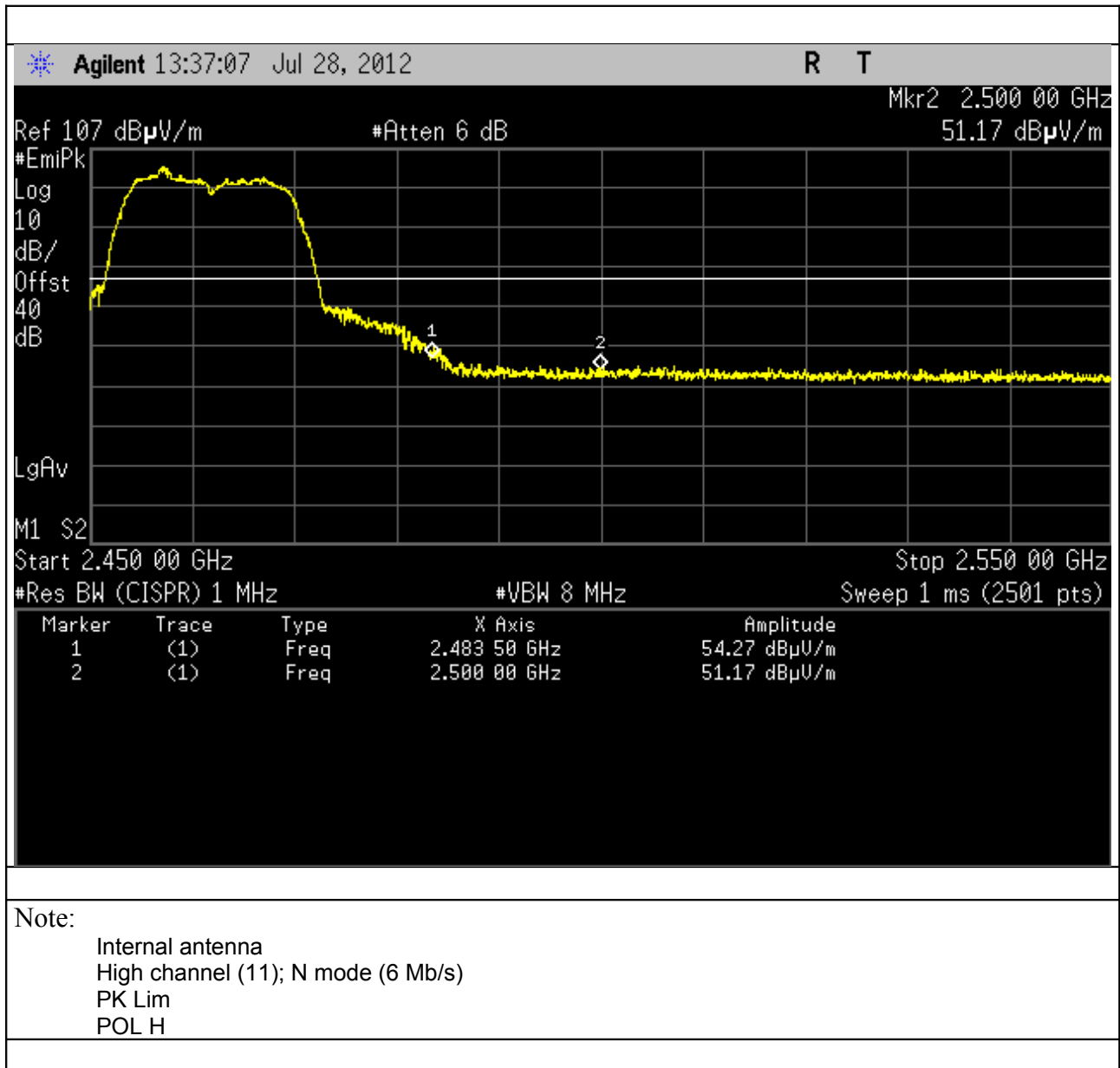


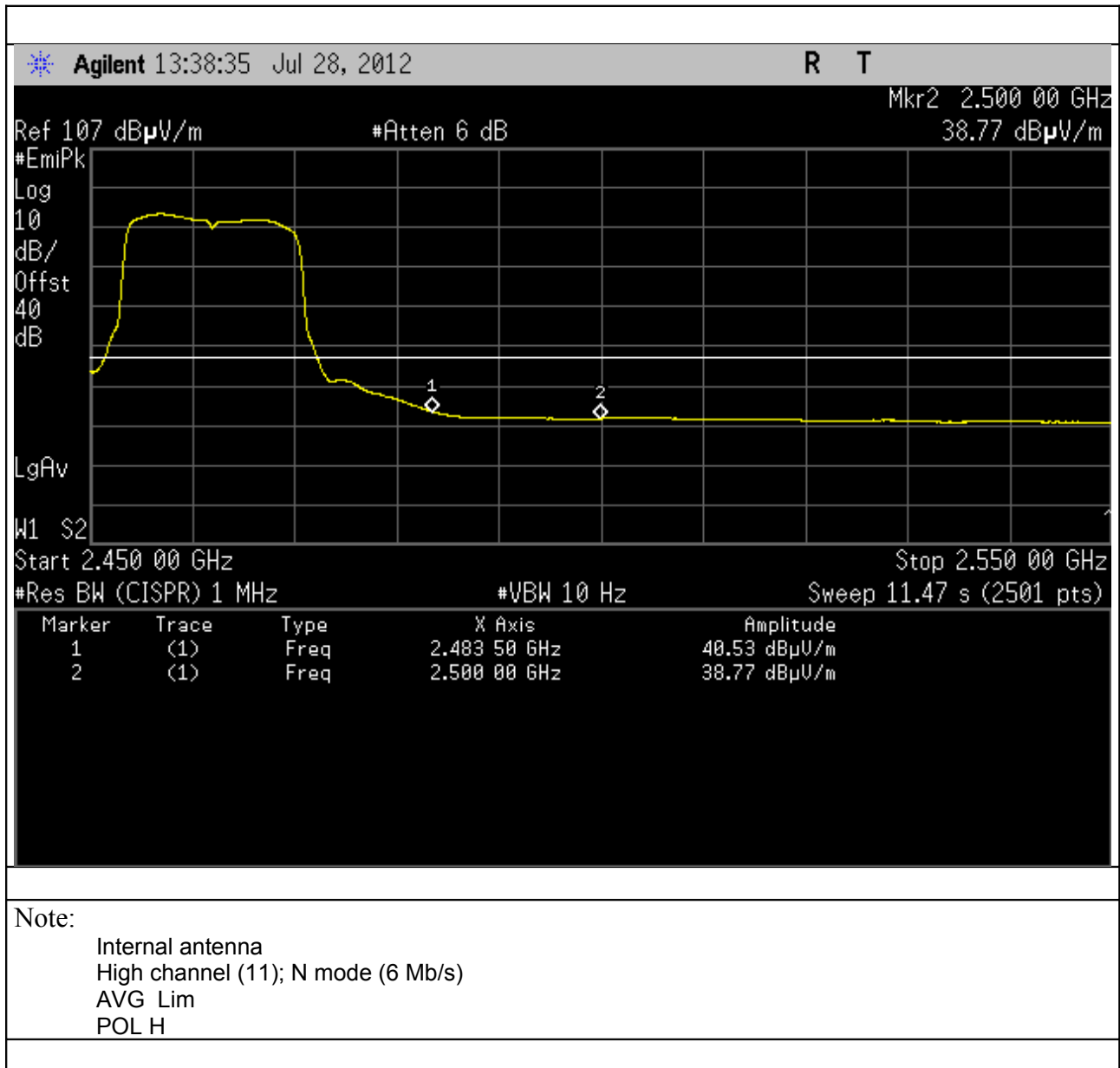


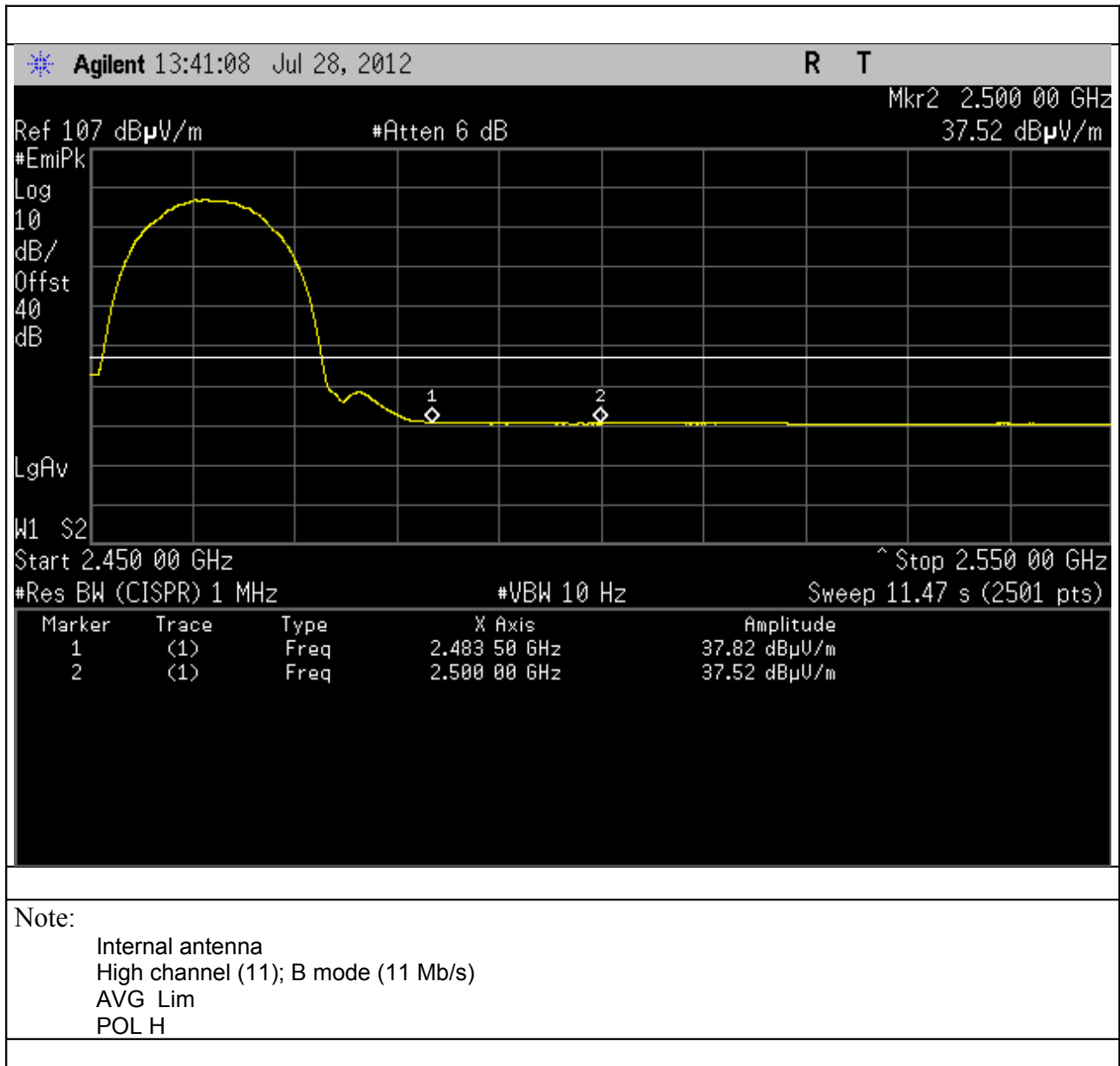


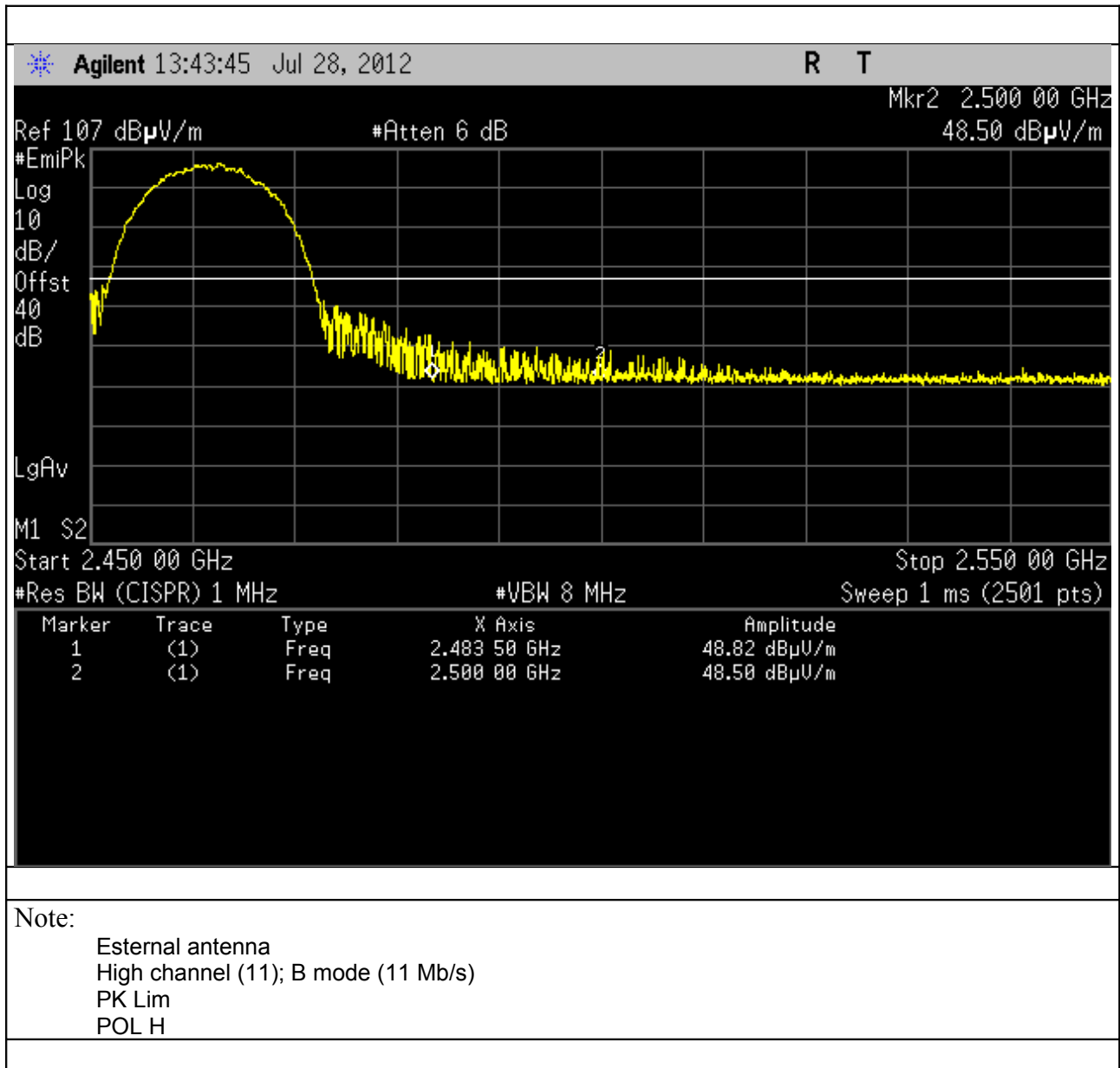


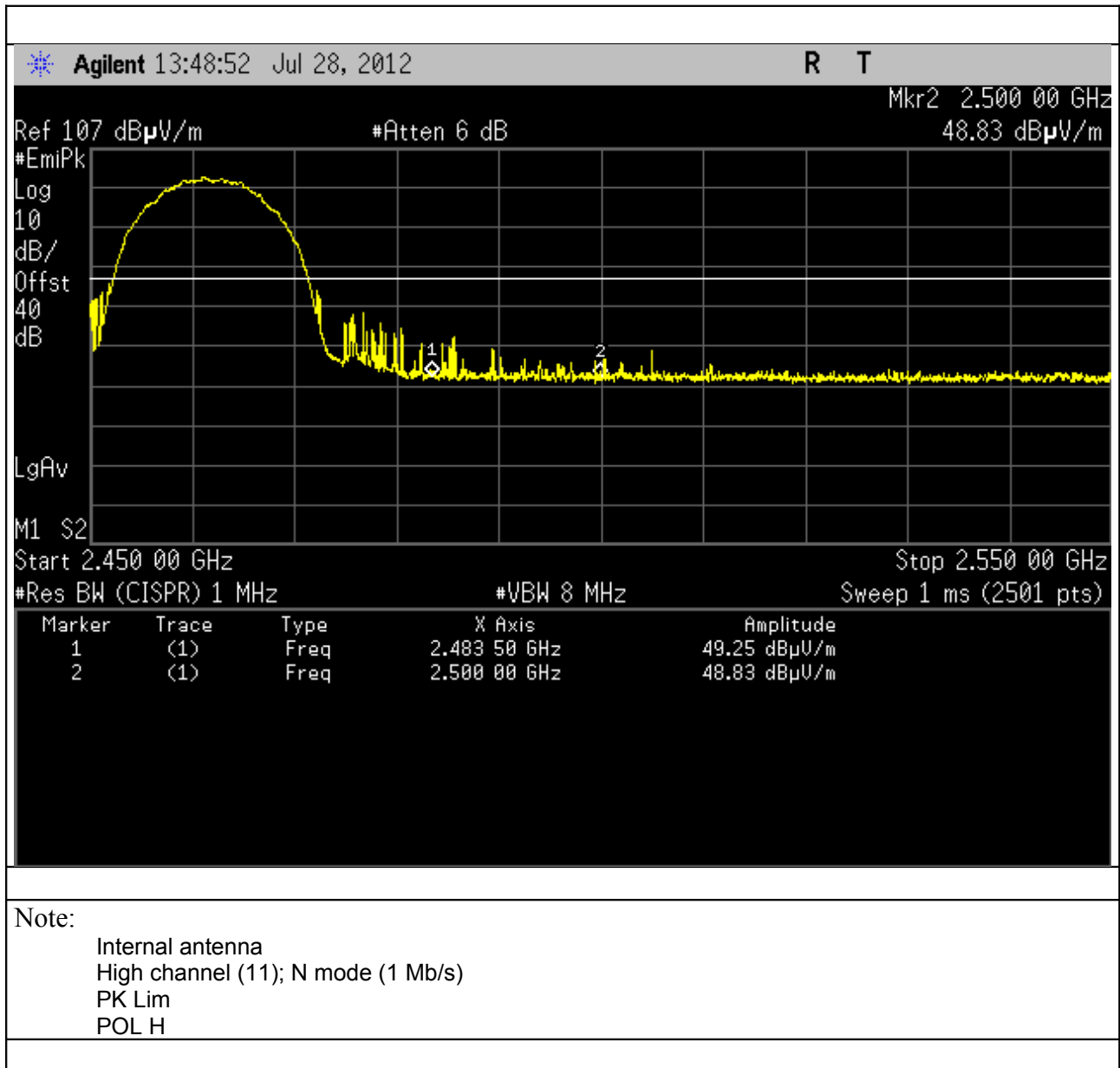


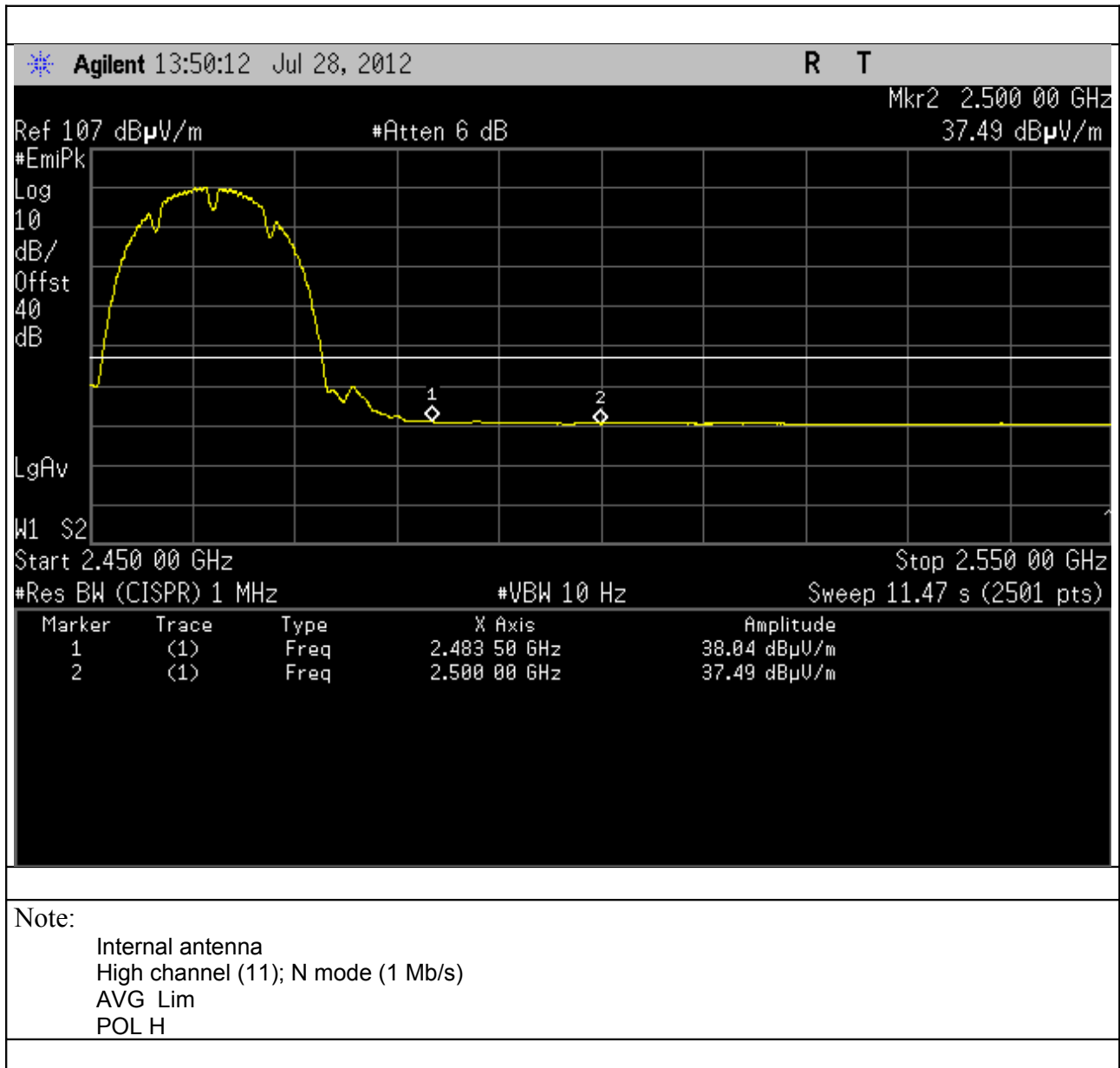












RADIATED SPURIOUS EMISSIONS EXTERNAL ANTENNA					
Low Channel 802.11b mode, 11 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,824	H	51,7	-	74,0	54,0
4,824	V	55,8	49,2	74,0	54,0
7,236	H	56,5	43,3	74,0	54,0
7,236	V	60,7	47,9	74,0	54,0
9,648	H	61,1	48,8	74,0	54,0
9,648	V	62,2	50,7	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					
Low Channel 802.11g mode, 54 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,824	H	51,2	-	74,0	54,0
4,824	V	55,7	48,1	74,0	54,0
7,236	H	56,4	44,8	74,0	54,0
7,236	V	60,2	48,2	74,0	54,0
9,648	H	61,5	49,5	74,0	54,0
9,648	V	63,1	51,8	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					

Low Channel 802.11n mode, 65 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,824	H	51,1	-	74,0	54,0
4,824	V	55,3	48,5	74,0	54,0
7,236	H	55,9	44,3	74,0	54,0
7,236	V	60,1	48,6	74,0	54,0
9,648	H	61,2	49,8	74,0	54,0
9,648	V	63,5	51,3	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					
Mid Channel 802.11b mode, 11 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,874	H	53,4	-	74,0	54,0
4,824	V	50,2	-	74,0	54,0
7,311	H	57,5	45,9	74,0	54,0
7,311	V	58,1	46,8	74,0	54,0
9,748	H	59,1	47,3	74,0	54,0
9,748	V	62,3	50,1	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOORS					

Mid Channel 802.11g mode, 54 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,874	H	52,9	-	74,0	54,0
4,824	V	56,9	40,7	74,0	54,0
7,311	H	58,0	44,2	74,0	54,0
7,311	V	58,2	44,1	74,0	54,0
9,748	H	60,4	47,1	74,0	54,0
9,748	V	59,7	47,8	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					
Mid Channel 802.11n mode, 65 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,874	H	52,3	-	74,0	54,0
4,824	V	56,5	40,2	74,0	54,0
7,311	H	58,2	44,9	74,0	54,0
7,311	V	58,2	44,8	74,0	54,0
9,748	H	60,5	47,9	74,0	54,0
9,748	V	59,1	47,5	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					

High Channel 802.11b mode, 11 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,924	H	53,2	-	74,0	54,0
4,924	V	50,8	-	74,0	54,0
7,386	H	57,7	45,8	74,0	54,0
7,386	V	58,5	46,7	74,0	54,0
9,848	H	59,3	47,4	74,0	54,0
9,848	V	62,8	50,8	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					
High Channel 802.11g mode, 54 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,924	H	52,5	-	74,0	54,0
4,924	V	52,9	-	74,0	54,0
7,386	H	56,7	44,8	74,0	54,0
7,386	V	58,5	46,7	74,0	54,0
9,848	H	58,4	47,8	74,0	54,0
9,748	V	62,4	50,3	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					

High Channel 802.11n mode, 65 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,924	H	53,8	-	74,0	54,0
4,924	V	53,4	-	74,0	54,0
7,386	H	58,1	43,8	74,0	54,0
7,386	V	58,2	46,1	74,0	54,0
9,848	H	58,2	47,8	74,0	54,0
9,748	V	61,5	50,9	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					

RADIATED SPURIOUS EMISSIONS INTERNAL ANTENNA					
Low Channel 802.11b mode, 11 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,824	H	50,2	48,4	74,0	54,0
4,824	V	54,8	48,5	74,0	54,0
7,236	H	55,5	42,6	74,0	54,0
7,236	V	59,1	47,2	74,0	54,0
9,648	H	60,2	47,8	74,0	54,0
9,648	V	61,4	50,5	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					
Low Channel 802.11g mode, 54 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,824	H	50,2	47,1	74,0	54,0
4,824	V	54,1	48,2	74,0	54,0
7,236	H	54,9	43,4	74,0	54,0
7,236	V	59,9	46,1	74,0	54,0
9,648	H	60,1	45,2	74,0	54,0
9,648	V	62,1	50,5	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					

Low Channel 802.11n mode, 65 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,824	H	50,8	48,3	74,0	54,0
4,824	V	53,1	47,4	74,0	54,0
7,236	H	55,6	43,2	74,0	54,0
7,236	V	59,1	47,0	74,0	54,0
9,648	H	60,9	48,8	74,0	54,0
9,648	V	62,8	50,2	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					
Mid Channel 802.11b mode, 11 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,874	H	52,4	43,2	74,0	54,0
4,824	V	50,2	42,2	74,0	54,0
7,311	H	55,6	44,8	74,0	54,0
7,311	V	57,1	45,6	74,0	54,0
9,748	H	59,5	48,4	74,0	54,0
9,748	V	62,4	50,2	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOORS					

Mid Channel 802.11g mode, 54 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,874	H	52,2	43,5	74,0	54,0
4,824	V	56,2	40,2	74,0	54,0
7,311	H	57,5	43,4	74,0	54,0
7,311	V	58,2	43,2	74,0	54,0
9,748	H	59,8	47,5	74,0	54,0
9,748	V	59,1	46,0	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					
Mid Channel 802.11n mode, 65 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,874	H	51,4	42,4	74,0	54,0
4,824	V	52,6	40,5	74,0	54,0
7,311	H	58,8	43,2	74,0	54,0
7,311	V	56,5	43,1	74,0	54,0
9,748	H	59,5	45,2	74,0	54,0
9,748	V	59,3	46,1	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					

High Channel 802.11b mode, 11 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,924	H	52,6	43,2	74,0	54,0
4,924	V	50,2	43,8	74,0	54,0
7,386	H	55,6	44,3	74,0	54,0
7,386	V	57,4	45,5	74,0	54,0
9,848	H	58,4	47,3	74,0	54,0
9,848	V	61,8	50,4	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					
High Channel 802.11g mode, 54 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,924	H	52,6	43,2	74,0	54,0
4,924	V	51,4	42,5	74,0	54,0
7,386	H	56,5	44,1	74,0	54,0
7,386	V	57,5	46,9	74,0	54,0
9,848	H	58,2	47,2	74,0	54,0
9,748	V	61,8	50,5	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					

High Channel 802.11n mode, 65 Mbs					
F GHz	Polarization	Peak dBuV/m	Avg dBuV/m	Limit Peak	Limit Avg
4,924	H	53,2	42,2	74,0	54,0
4,924	V	52,1	43,9	74,0	54,0
7,386	H	56,6	43,1	74,0	54,0
7,386	V	57,8	45,4	74,0	54,0
9,848	H	57,9	47,4	74,0	54,0
9,748	V	61,5	50,6	74,0	54,0
NO OTHER EMISSIONS WERE DETECTED ABOVE SYSTEM NOISE FLOOR					

10. MAXIMUM PERMISSIBLE EXPOSURE

Equipment shall meet the limits below .

1mW/cm² max at 20 cm of distance

Calculation:

$$E = \frac{\sqrt{30PG}}{d}$$

$$S = \frac{(E)^2}{3770}$$

E= Field Strength in Volts/meter

P=Power in watt

G= Numeric Antenna Gain

d= Distance in meter

S= power Density in milliwatts/square centimeter

Arranging terms to calculate the power density at a specific distance yields:

$$S = 0.0795 \cdot 10^{((P+G)/10)} / (d^2)$$

The power density in units of mW/cm² is converted to units of W/m² multiplying by a factor of 10.

Result

Power Density Limit mW/cm ²	Output Power (erp) mW	Power Density at 20cm mW/cm ²	Remark
1	29	0,087	-

(*) OET Bulletin 65

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11. PHOTO



Fig. 11.1

Radiated Emissions Test Set-up

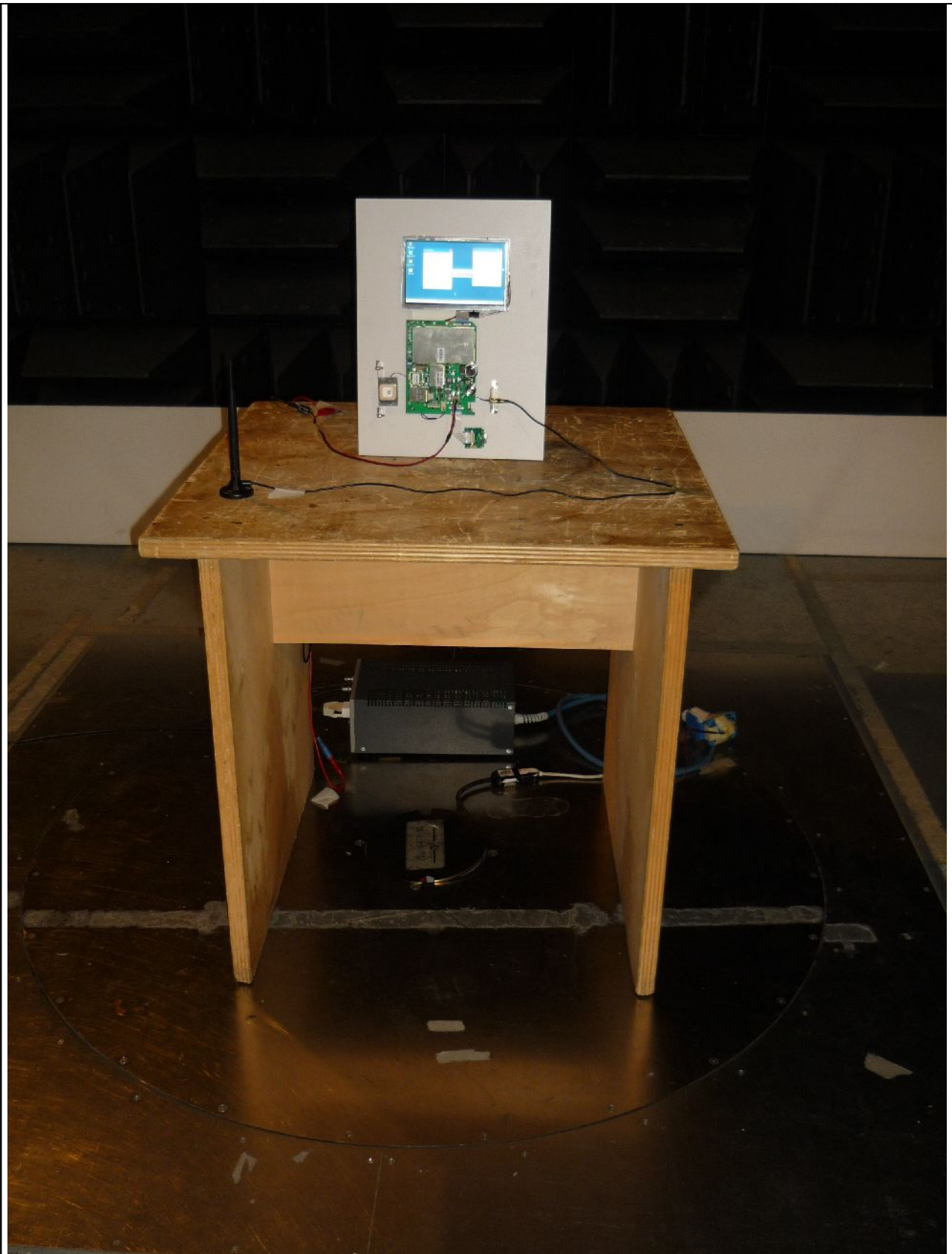


Fig. 11.2

Power Line Conducted Emissions Test Set-up

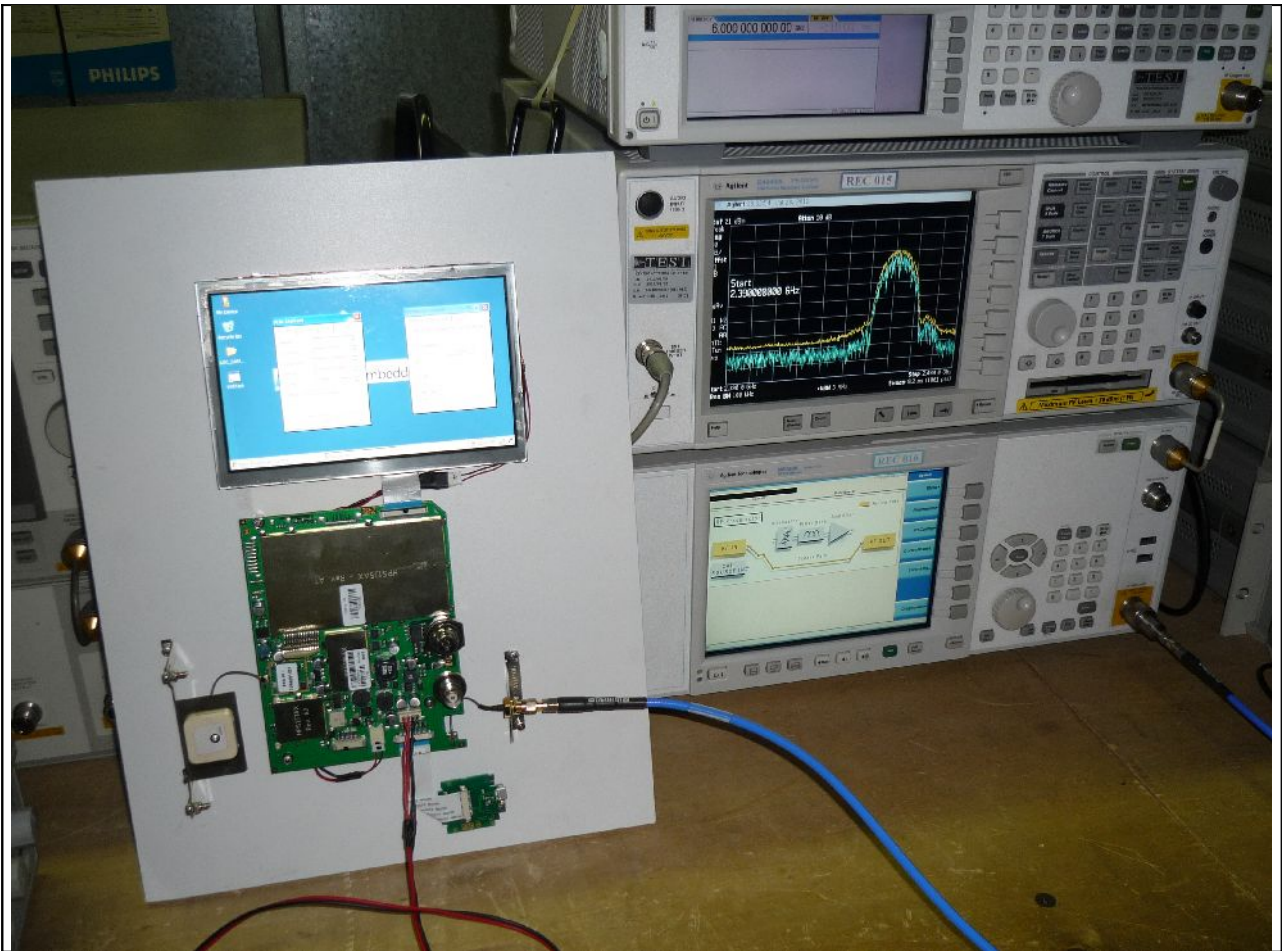


Fig. 11.3

Antenna Port Conducted Emissions Test Set-up