

# EMC TEST REPORT

**Report No.** : TS12020033-EME**Model No.** : NBG-419N v2**Issued Date** : Apr. 23, 2012

**Applicant:** ZyXEL Communications Corporation  
6, Innovation Rd II, Science-Based Industrial Park,  
Hsin-Chu, Taiwan

**Test Method /  
Standard:** CFR 47 FCC Part 15.247 & ANSI C63.4 2003

**Test By:** Intertek Testing Services Taiwan Ltd.  
No. 11, Lane 275, Ko-Nan 1 Street, Chia-Tung Li,  
Shiang-Shan District, Hsinchu City, Taiwan

It may be duplicated completely for legal use with the allowance of the applicant. It shall not be reproduced except in full, without the written approval of Intertek Laboratory. The test result(s) in this report only applies to the tested sample(s).

**The test report was prepared by:** Sign on File  
Jill Chen / Assistant

**These measurements were taken by:** Sign on File  
Hugo Yeh / Engineer

**The test report was reviewed by:**

**Name** Jimmy Yang  
**Title** Engineer

Table of Contents

1. Summary of Test Data ..... 3

2. General Information ..... 4

3. Maximum 6 dB Bandwidth ..... 8

4. 99 % Occupied Bandwidth..... 44

5. Maximum Output Power ..... 80

6. Power Spectral Density ..... 84

7. RF Antenna conducted Spurious ..... 120

8. Radiated Spurious Emission..... 153

9. Emission on Band Edge ..... 203

10. AC power line conducted emission..... 237

Appendix A: Test Equipment List ..... 243

## 1. Summary of Test Data

| Test/Requirement Description     | Applicable Rule           | Result |
|----------------------------------|---------------------------|--------|
| Minimum 6 dB Bandwidth           | 15.247(a)(2)              | Pass   |
| Maximum Output Power             | 15.247(b)                 | Pass   |
| Power Spectral Density           | 15.247(e)                 | Pass   |
| RF Antenna Conducted Spurious    | 15.247(d)                 | Pass   |
| Radiated Spurious Emission       | 15.247(d), 15.205, 15.209 | Pass   |
| Emission on the Band Edge        | 15.247(d)                 | Pass   |
| AC Power Line Conducted Emission | 15.207                    | Pass   |

## 2. General Information

### Identification of the EUT

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product:         | Wireless N NetUSB Router                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Model No.:       | NBG-419N v2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| FCC ID.:         | I88NBG-419NV2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Frequency Range: | 1. 2412 MHz ~ 2462 MHz for 802.11b, 802.11g, 802.11n HT20<br>2. 2422 MHz ~ 2452 MHz for 802.11n HT40                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Channel Number:  | 1. 11 channels for 2412 MHz ~ 2462 MHz<br>2. 7 channels for 2422 MHz ~ 2452 MHz                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| Rated Power:     | DC 12 V from Adapter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| Power Cord:      | N/A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Data Cable:      | RJ-45 UTP Cat.5 10 meter × 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Sample Received: | Jan. 16, 2012                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Test Date(s):    | Feb. 14, 2012 ~ Apr. 18, 2012                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Note 1:          | This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program. |
| Note 2:          | When determining the test conclusion, the Measurement Uncertainty of test has been considered.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

## Description of EUT

The EUT is Wireless N NetUSB Router, and was defined as information technology equipment.

For more detail features, please refer to User's manual as file name "Installation guide.pdf"

## Antenna description

### 1. Invax 2 dBi Antenna

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain : 2 dBi  
Antenna Type : Dipole antenna  
Connector Type : SMA reverse

### 2. SAYTEC 2 dBi Antenna

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain : 2 dBi  
Antenna Type : Dipole antenna  
Connector Type : SMA reverse

### 3. Invax 5 dBi Antenna

The antenna is affixed to the EUT using a unique connector, which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.

Antenna Gain : 5 dBi  
Antenna Type : Dipole antenna  
Connector Type : SMA reverse

**Adapter information**

The EUT will be supplied with a power supply from below list:

| No.       | Brand | Model no.             | Specification                                     |
|-----------|-------|-----------------------|---------------------------------------------------|
| Adapter 1 | DVE   | DSA-12G-12 FUS 120120 | I/P: 100-240Vac, 50/60Hz, 0.3A<br>O/P: +12Vdc, 1A |
| Adapter 2 | DVE   | DSA-12CA-12 120100    | I/P: 100-240Vac, 50/60Hz, 0.3A<br>O/P: +12Vdc, 1A |

**Peripherals equipment**

| Peripherals | Brand | Model No.     | Serial No. |
|-------------|-------|---------------|------------|
| Notebook PC | DELL  | Latitude D610 | 2YWZK1S    |

## Operation mode

The EUT was pre-tested with two adapters in the flat or upright position. The worst case was found when the EUT was supplied with 12 Vdc from Adapter 2 (Test voltage: 120Vac, 60Hz) in the flat position and it was run in TX mode that was controlled by "RT3352QA" program.

The EUT was transmitted continuously during the test.

With individual verifying, the maximum output power was found out 11 Mbps data rate for 802.11b mode, 54 Mbps data rate for 802.11g mode, 150 Mbps data rate for 802.11n HT 20 mode and 150 Mbps data rate for 802.11n HT 40 mode.

The final tests were executed under these conditions recorded in this report individually. Please refer the details below:

| Chain 0: 802.11b channel 6 |         |
|----------------------------|---------|
| Data rate (Mbps)           | PK(dBm) |
| 1                          | 18.37   |
| 2                          | 18.47   |
| 5.5                        | 18.51   |
| 11                         | 18.64   |

| Chain 0: 802.11n HT20 channel 6 |         |
|---------------------------------|---------|
| Data rate (Mbps)                | PK(dBm) |
| 6.5                             | 18.76   |
| 13                              | 18.97   |
| 19.5                            | 19.29   |
| 26                              | 19.42   |
| 39                              | 21.29   |
| 52                              | 21.21   |
| 58.5                            | 21.46   |
| 65                              | 22.08   |

| Chain 0: 802.11g channel 6 |         |
|----------------------------|---------|
| Data rate (Mbps)           | PK(dBm) |
| 6                          | 21.42   |
| 9                          | 21.59   |
| 12                         | 21.79   |
| 18                         | 21.82   |
| 24                         | 21.93   |
| 36                         | 22.06   |
| 48                         | 22.23   |
| 54                         | 22.36   |

| Chain 0: 802.11n HT40 channel 6 |         |
|---------------------------------|---------|
| Data rate (Mbps)                | PK(dBm) |
| 13                              | 19.14   |
| 26                              | 19.26   |
| 39                              | 19.48   |
| 52                              | 19.81   |
| 78                              | 20.03   |
| 104                             | 20.62   |
| 117                             | 21.14   |
| 130                             | 21.45   |

### 3. Maximum 6 dB Bandwidth

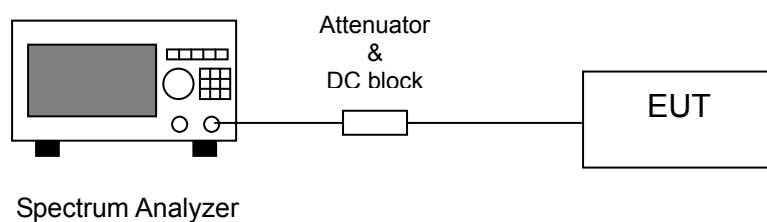
|                      |                        |
|----------------------|------------------------|
| <b>Name of Test</b>  | Maximum 6 dB Bandwidth |
| <b>Base Standard</b> | FCC 15.247 (a)(2)      |

**Test Result:** Complies  
**Measurement Data:** See Table & plots below

#### Method of Measurement:

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW. The 6 dB bandwidth must be greater than 500 kHz.

#### Test Diagram:



**Note:** The EUT was tested while in a continuous transmit mode and the worst case data rates are 11 Mbps data rate for 802.11b mode, 54 Mbps data rate for 802.11g mode, 150 Mbps data rate for 802.11n HT20 mode and 150 Mbps data rate for 802.11n HT40 mode. The EUT was tuned to a low, middle and high channel.

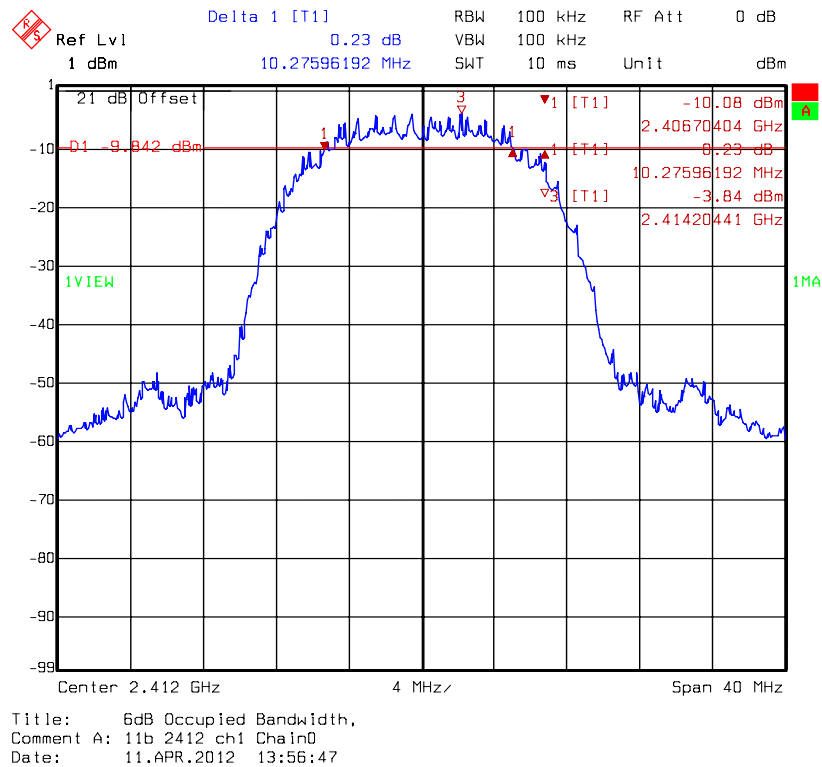
Table: Maximum 6 dB Bandwidth

| Invax 2 dBi Antenna |         |                 |                     |         |                  |           |
|---------------------|---------|-----------------|---------------------|---------|------------------|-----------|
| Mode                | Channel | Frequency (MHz) | 6dB Bandwidth (MHz) |         | Min. Limit (MHz) | Pass/Fail |
| 802.11b             | 1       | 2412            | 10.276              |         | 0.5              | Pass      |
|                     | 6       | 2437            | 11.158              |         | 0.5              | Pass      |
|                     | 11      | 2462            | 10.276              |         | 0.5              | Pass      |
| 802.11g<br>Chain 0  | 1       | 2412            | 16.132              |         | 0.5              | Pass      |
|                     | 6       | 2437            | 16.373              |         | 0.5              | Pass      |
|                     | 11      | 2462            | 16.447              |         | 0.5              | Pass      |
| 802.11g<br>Chain 1  | 1       | 2412            | 16.461              |         | 0.5              | Pass      |
|                     | 6       | 2437            | 16.454              |         | 0.5              | Pass      |
|                     | 11      | 2462            | 16.454              |         | 0.5              | Pass      |
| Mode                | Channel | Frequency (MHz) | 6dB Bandwidth (MHz) |         | Min. Limit (MHz) | Pass/Fail |
|                     |         |                 | Chain 0             | Chain 1 |                  |           |
| 802.11n<br>HT20     | 1       | 2412            | 16.690              | 16.769  | 0.5              | Pass      |
|                     | 6       | 2437            | 16.690              | 16.776  | 0.5              | Pass      |
|                     | 11      | 2462            | 16.610              | 16.776  | 0.5              | Pass      |
| 802.11n<br>HT40     | 3       | 2422            | 35.444              | 35.564  | 0.5              | Pass      |
|                     | 6       | 2437            | 35.444              | 35.564  | 0.5              | Pass      |
|                     | 9       | 2452            | 35.566              | 35.403  | 0.5              | Pass      |

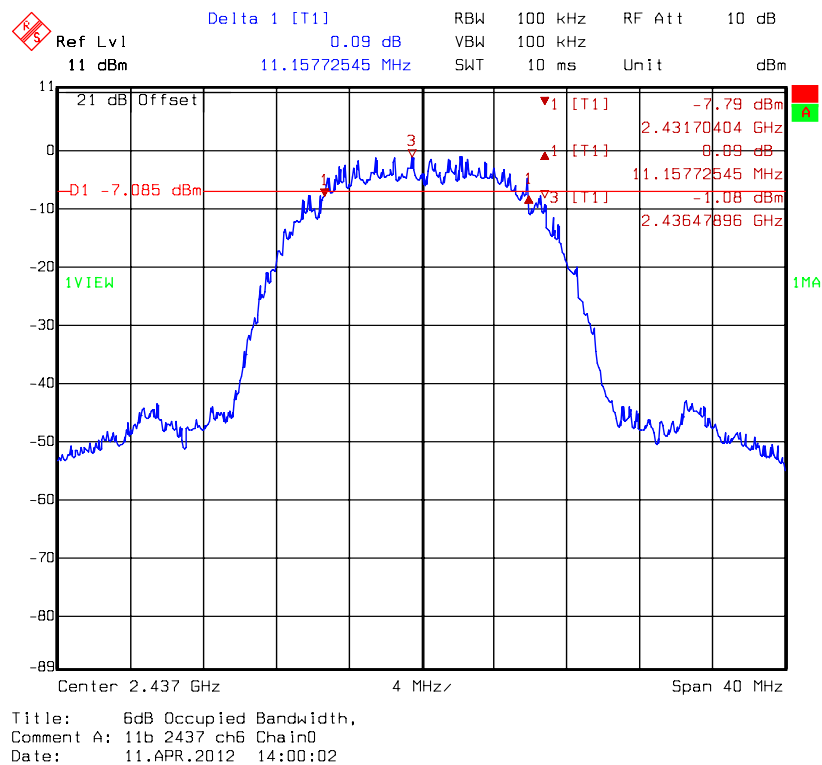
| SAYTEC 2 dBi Antenna |         |                 |                     |         |                  |           |
|----------------------|---------|-----------------|---------------------|---------|------------------|-----------|
| Mode                 | Channel | Frequency (MHz) | 6dB Bandwidth (MHz) |         | Min. Limit (MHz) | Pass/Fail |
| 802.11b              | 1       | 2412            | 10.516              |         | 0.5              | Pass      |
|                      | 6       | 2437            | 11.078              |         | 0.5              | Pass      |
|                      | 11      | 2462            | 11.153              |         | 0.5              | Pass      |
| 802.11g<br>Chain 0   | 1       | 2412            | 16.371              |         | 0.5              | Pass      |
|                      | 6       | 2437            | 16.380              |         | 0.5              | Pass      |
|                      | 11      | 2462            | 16.438              |         | 0.5              | Pass      |
| 802.11g<br>Chain 1   | 1       | 2412            | 16.457              |         | 0.5              | Pass      |
|                      | 6       | 2437            | 16.374              |         | 0.5              | Pass      |
|                      | 11      | 2462            | 16.378              |         | 0.5              | Pass      |
| Mode                 | Channel | Frequency (MHz) | 6dB Bandwidth (MHz) |         | Min. Limit (MHz) | Pass/Fail |
|                      |         |                 | Chain 0             | Chain 1 |                  |           |
| 802.11n<br>HT20      | 1       | 2412            | 16.851              | 16.370  | 0.5              | Pass      |
|                      | 6       | 2437            | 16.690              | 16.934  | 0.5              | Pass      |
|                      | 11      | 2462            | 16.530              | 17.016  | 0.5              | Pass      |
| 802.11n<br>HT40      | 3       | 2422            | 35.604              | 35.607  | 0.5              | Pass      |
|                      | 6       | 2437            | 35.444              | 35.448  | 0.5              | Pass      |
|                      | 9       | 2452            | 35.441              | 35.564  | 0.5              | Pass      |

| Invax 5 dBi Antenna |         |                 |                     |         |                  |           |
|---------------------|---------|-----------------|---------------------|---------|------------------|-----------|
| Mode                | Channel | Frequency (MHz) | 6dB Bandwidth (MHz) |         | Min. Limit (MHz) | Pass/Fail |
| 802.11b             | 1       | 2412            | 11.153              |         | 0.5              | Pass      |
|                     | 6       | 2437            | 10.997              |         | 0.5              | Pass      |
|                     | 11      | 2462            | 10.757              |         | 0.5              | Pass      |
| 802.11g<br>Chain 0  | 1       | 2412            | 16.442              |         | 0.5              | Pass      |
|                     | 6       | 2437            | 16.380              |         | 0.5              | Pass      |
|                     | 11      | 2462            | 16.454              |         | 0.5              | Pass      |
| 802.11g<br>Chain 1  | 1       | 2412            | 16.459              |         | 0.5              | Pass      |
|                     | 6       | 2437            | 16.369              |         | 0.5              | Pass      |
|                     | 11      | 2462            | 16.449              |         | 0.5              | Pass      |
| Mode                | Channel | Frequency (MHz) | 6dB Bandwidth (MHz) |         | Min. Limit (MHz) | Pass/Fail |
|                     |         |                 | Chain 0             | Chain 1 |                  |           |
| 802.11n<br>HT20     | 1       | 2412            | 16.771              | 16.771  | 0.5              | Pass      |
|                     | 6       | 2437            | 16.690              | 17.001  | 0.5              | Pass      |
|                     | 11      | 2462            | 16.530              | 16.610  | 0.5              | Pass      |
| 802.11n<br>HT40     | 3       | 2422            | 35.921              | 35.564  | 0.5              | Pass      |
|                     | 6       | 2437            | 35.608              | 35.564  | 0.5              | Pass      |
|                     | 9       | 2452            | 35.441              | 35.564  | 0.5              | Pass      |

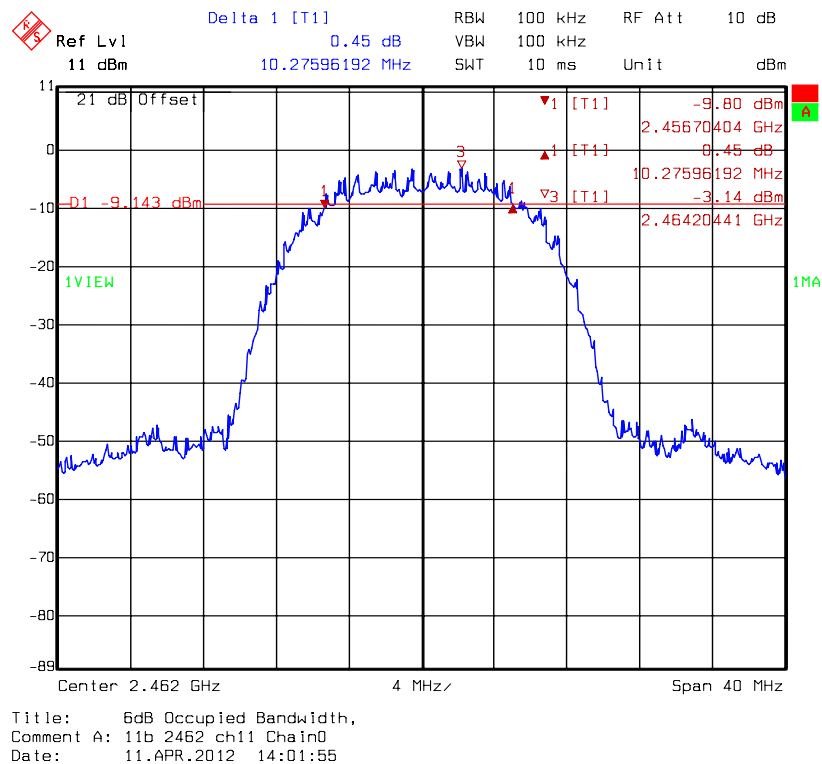
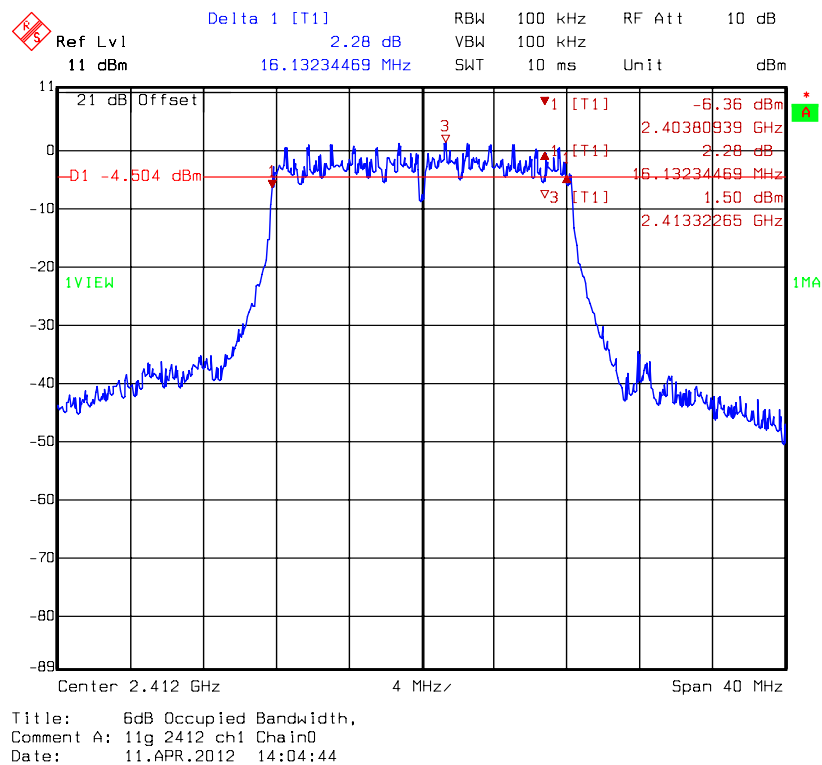
### Invax 2 dBi Antenna: 6 dB Bandwidth @ 802.11b mode channel 1



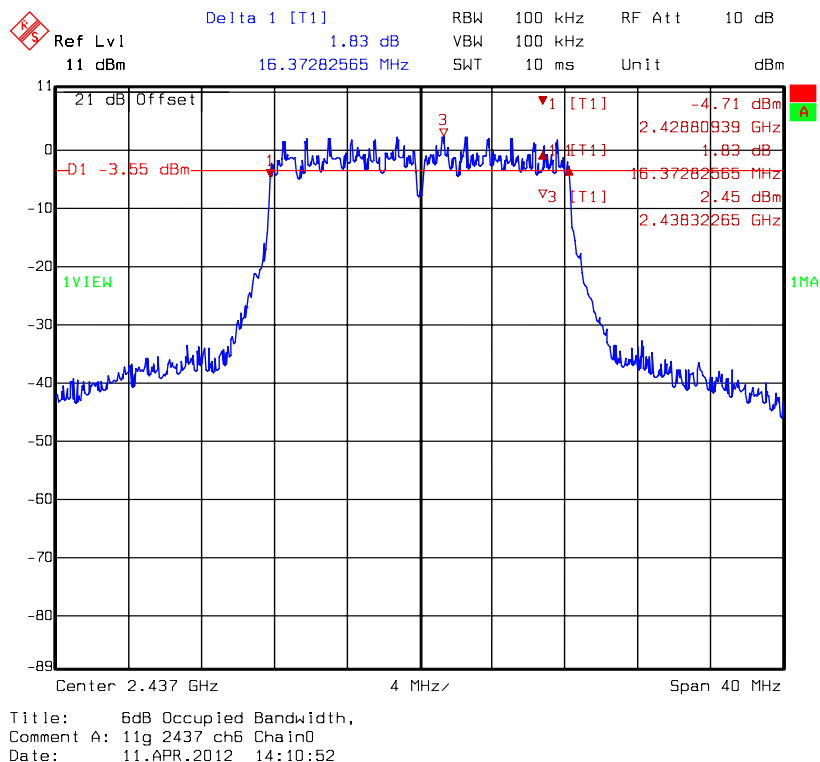
**Invax 2 dBi Antenna: 6 dB Bandwidth @ 802.11b mode channel 6**



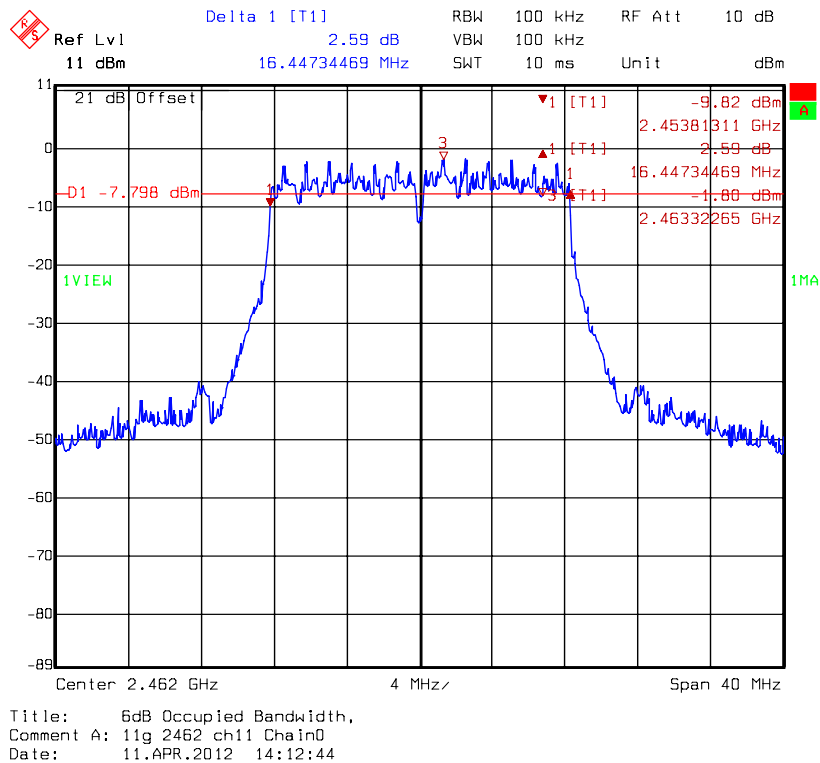
### Invax 2 dBi Antenna: 6 dB Bandwidth @ 802.11b mode channel 11

**Invax 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11g mode channel 1**

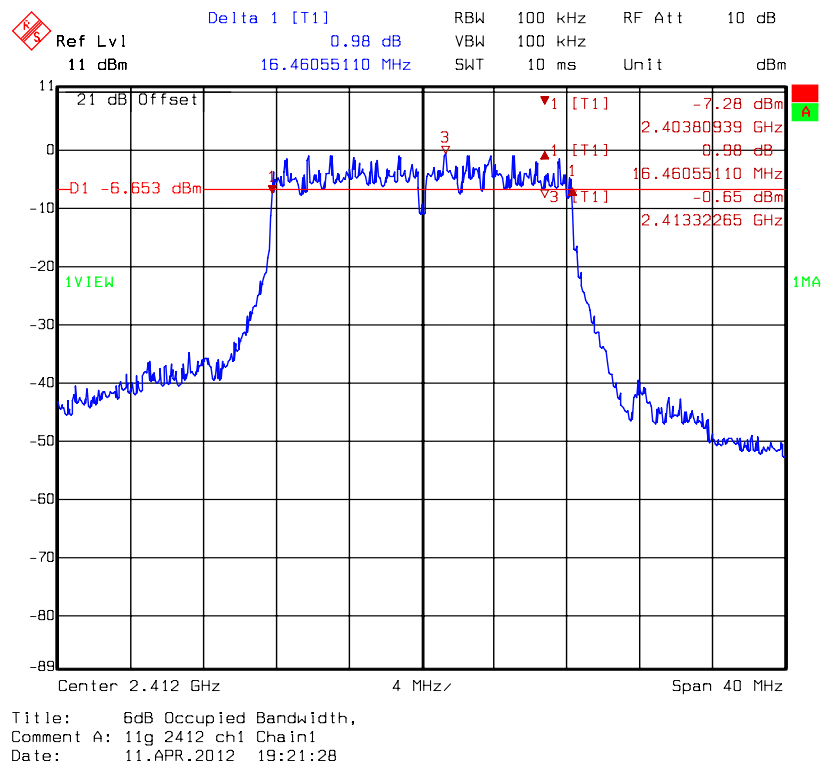
# Invax 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11g mode channel 6



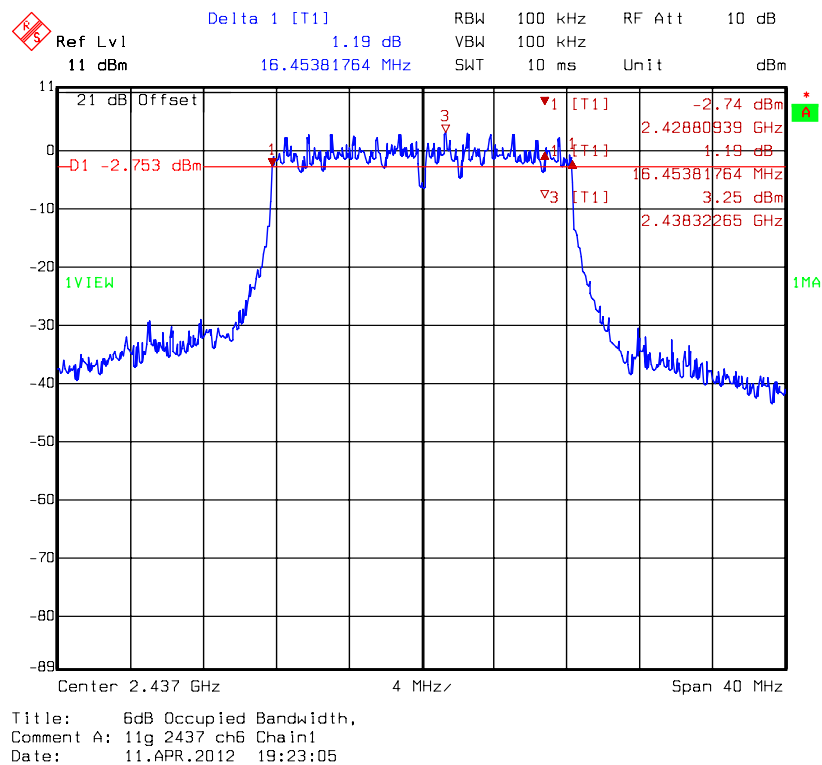
# Invax 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11g mode channel 11



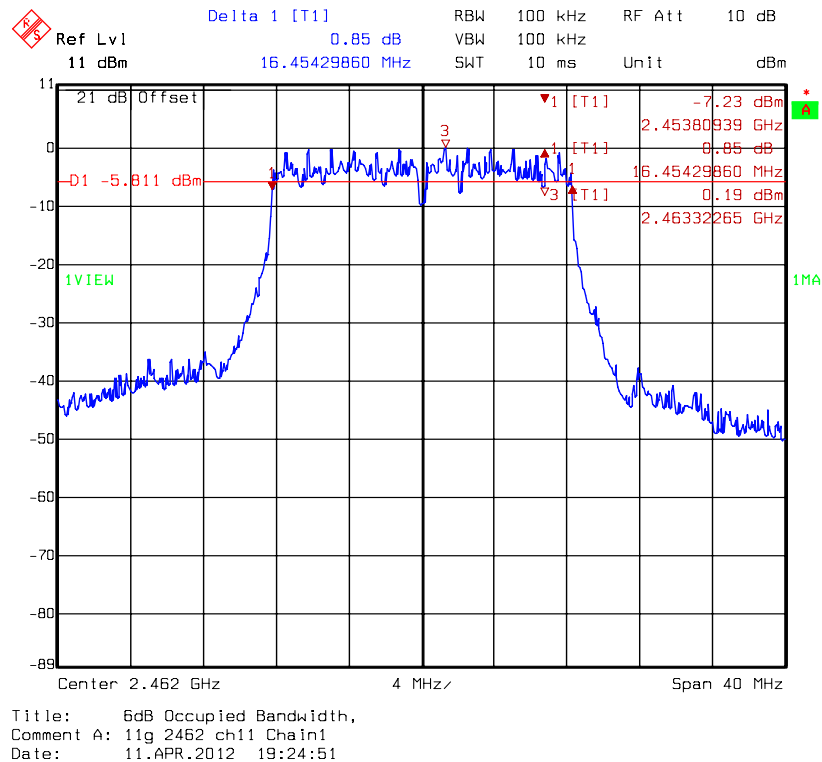
### Invax 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11g mode channel 1



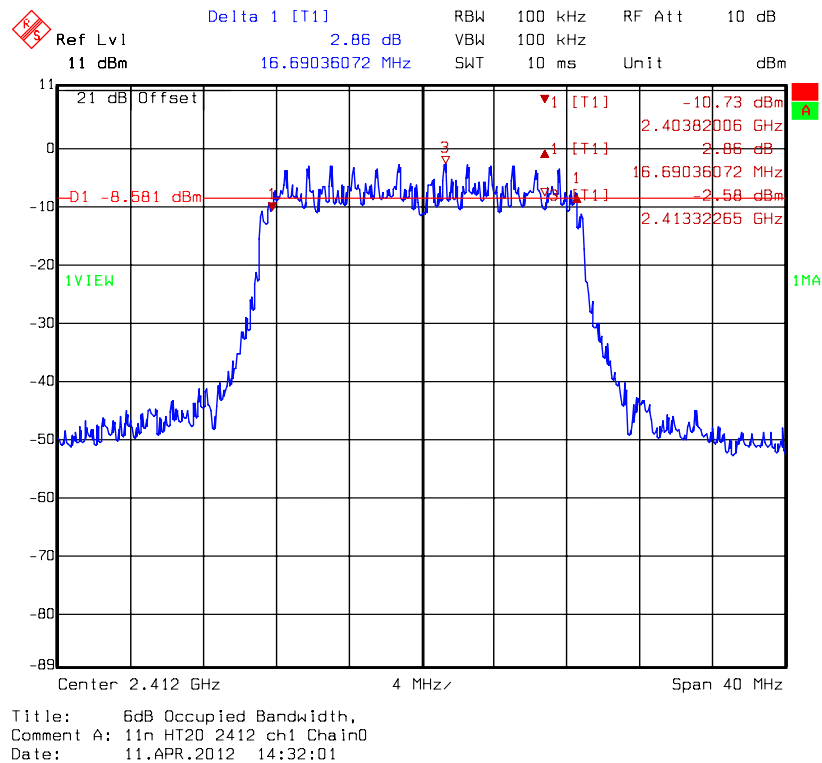
### Invax 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11g mode channel 6



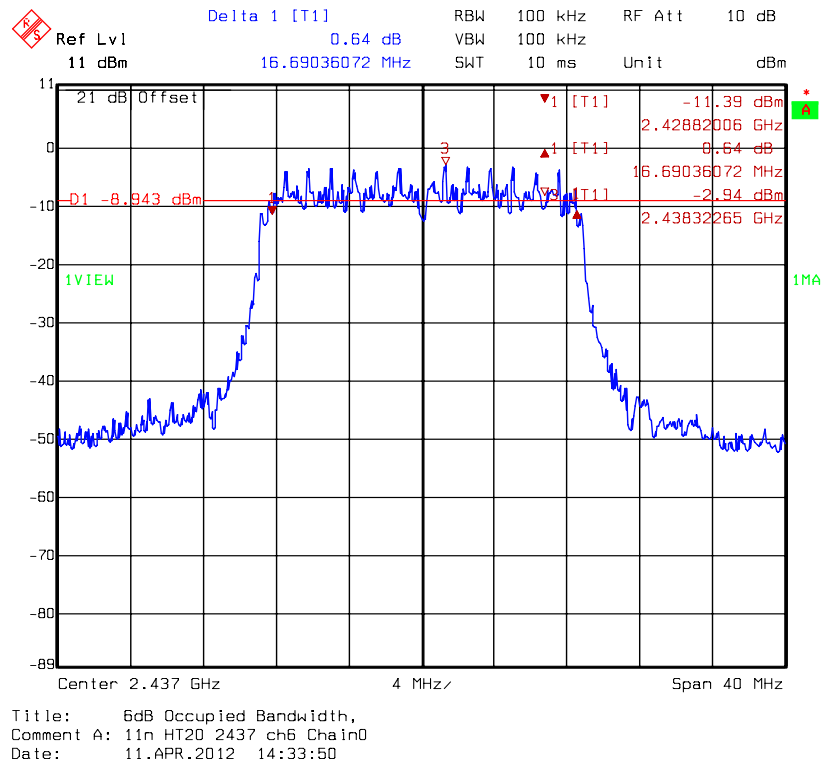
# Invax 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11g mode channel 11



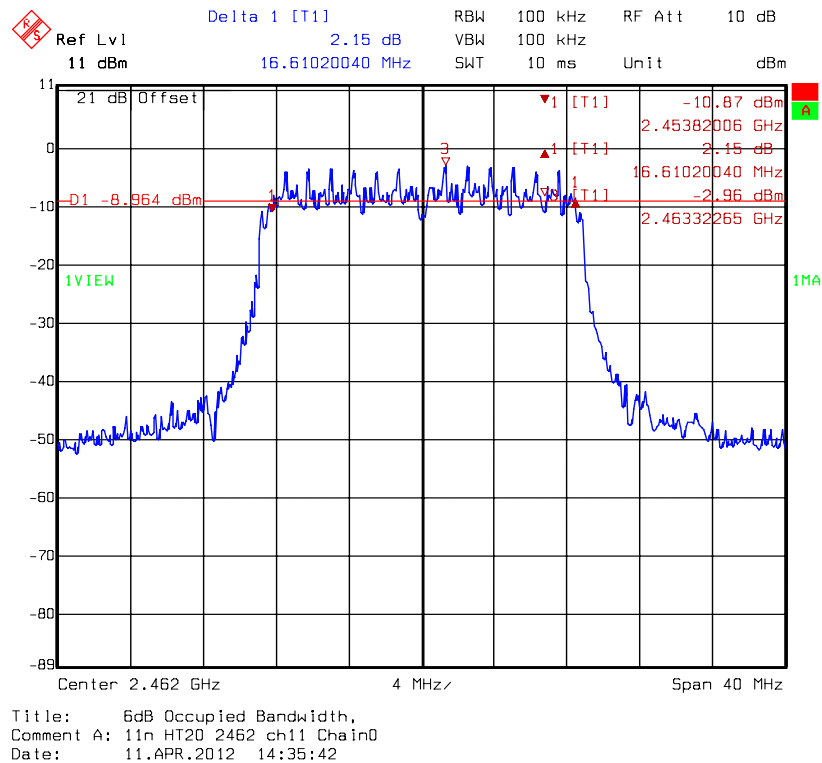
# Invax 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT20 mode channel 1



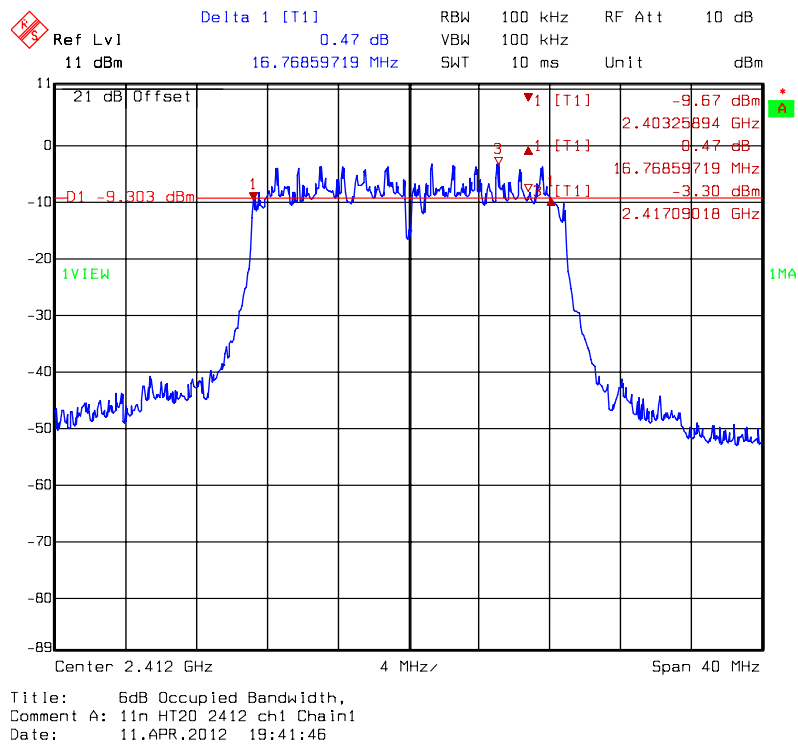
# Invax 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT20 mode channel 6



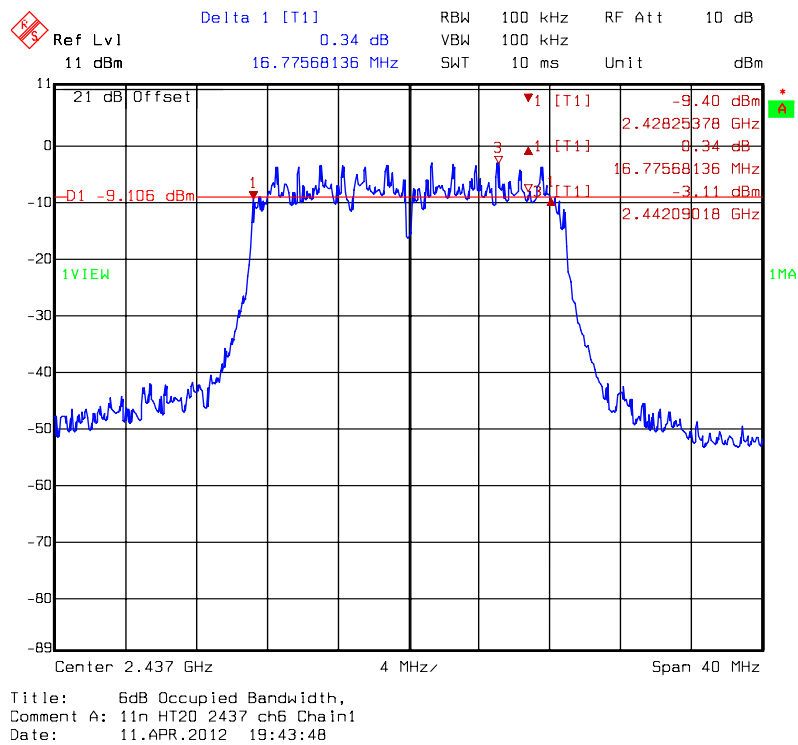
# Invax 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT20 mode channel 11



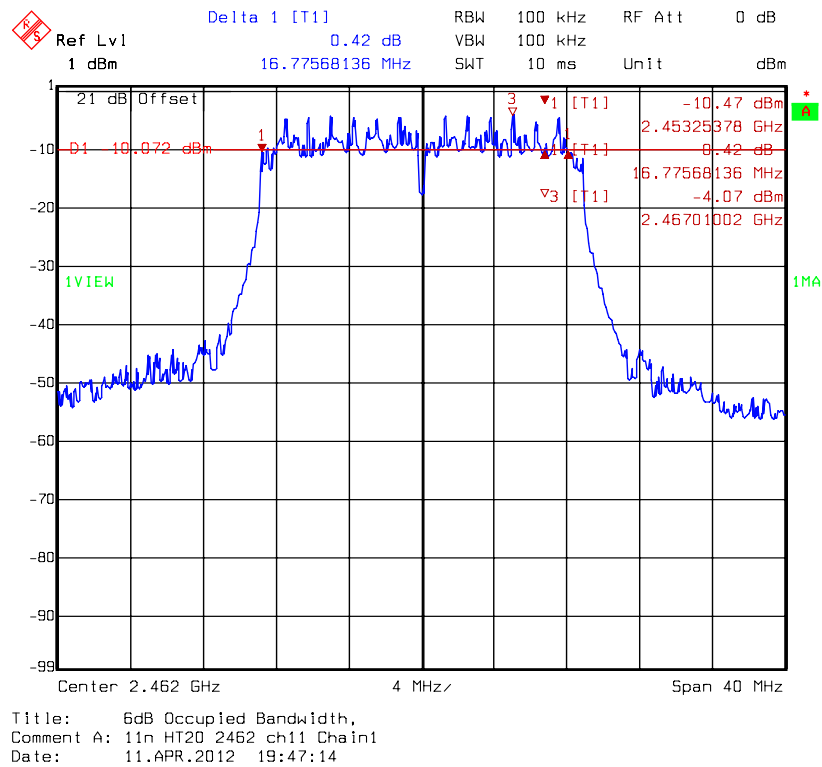
# Invax 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT20 mode channel 1



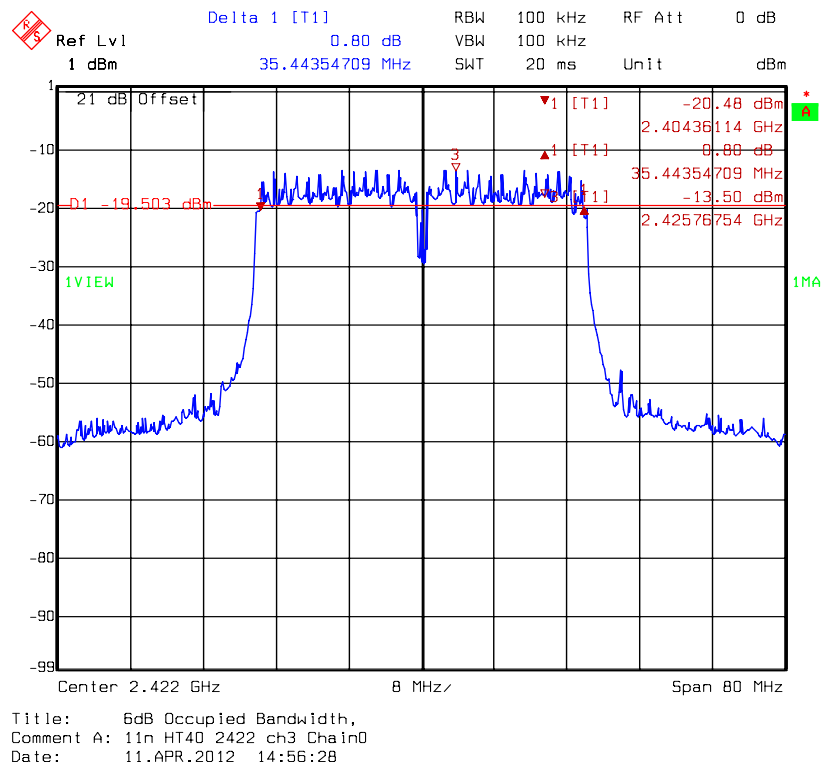
# Invax 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT20 mode channel 6



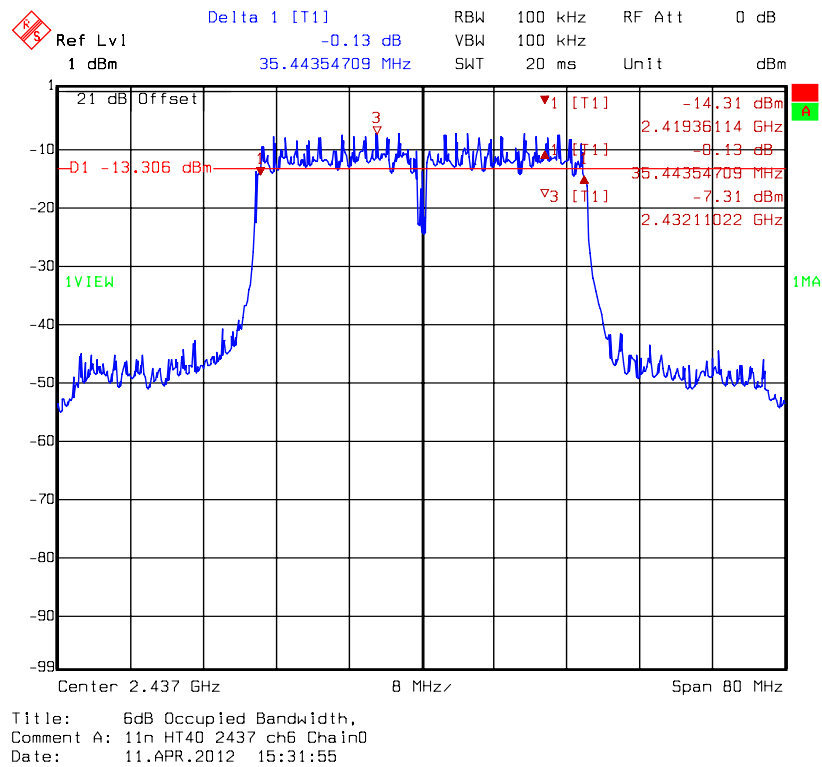
### Invax 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT20 mode channel 11



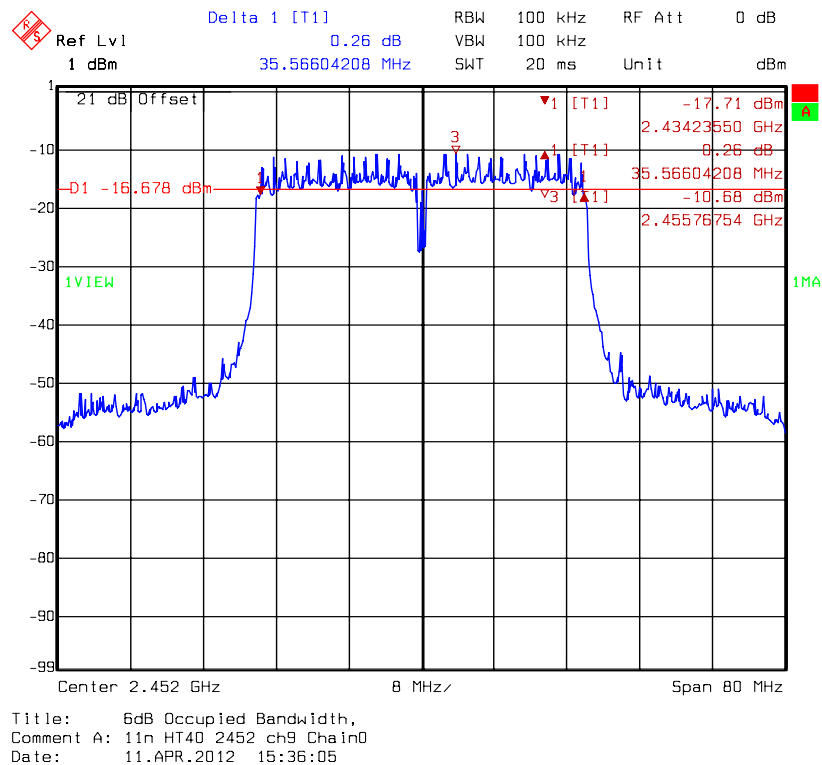
### Invax 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT40 mode channel 3



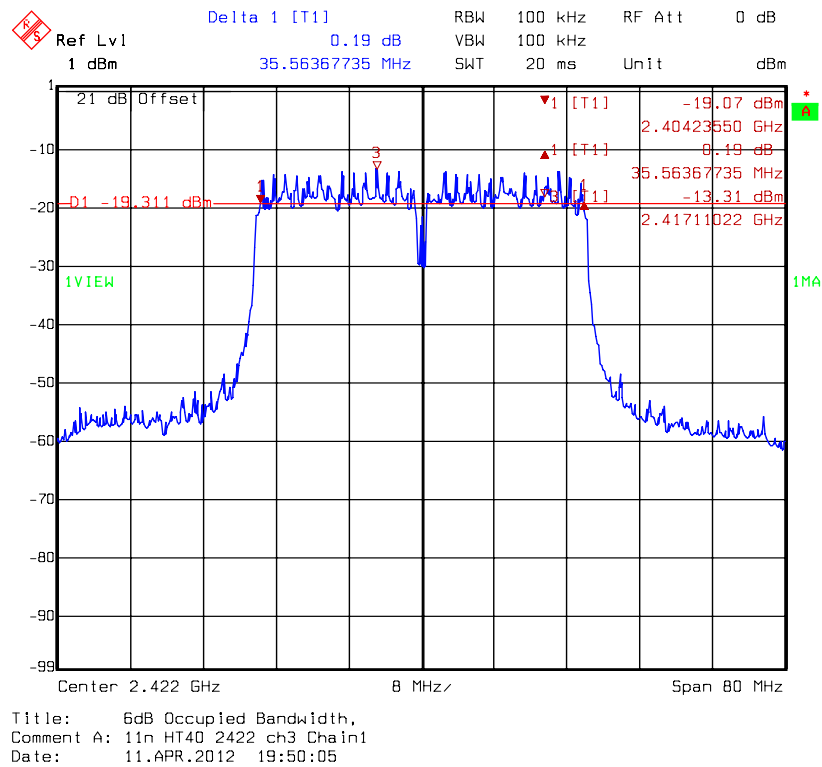
# Invax 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT40 mode channel 6



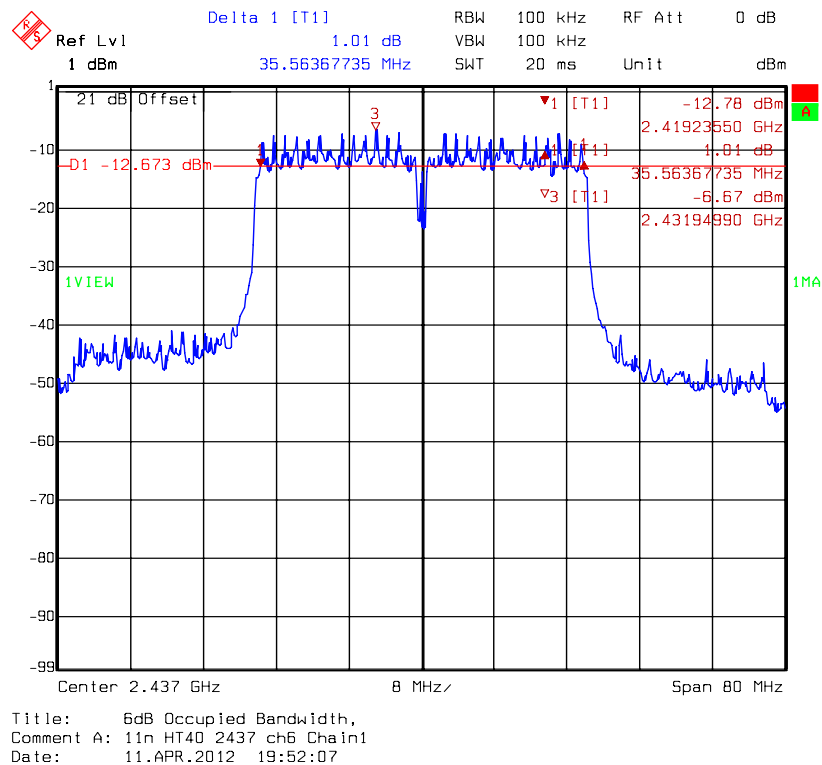
# Invax 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT40 mode channel 9



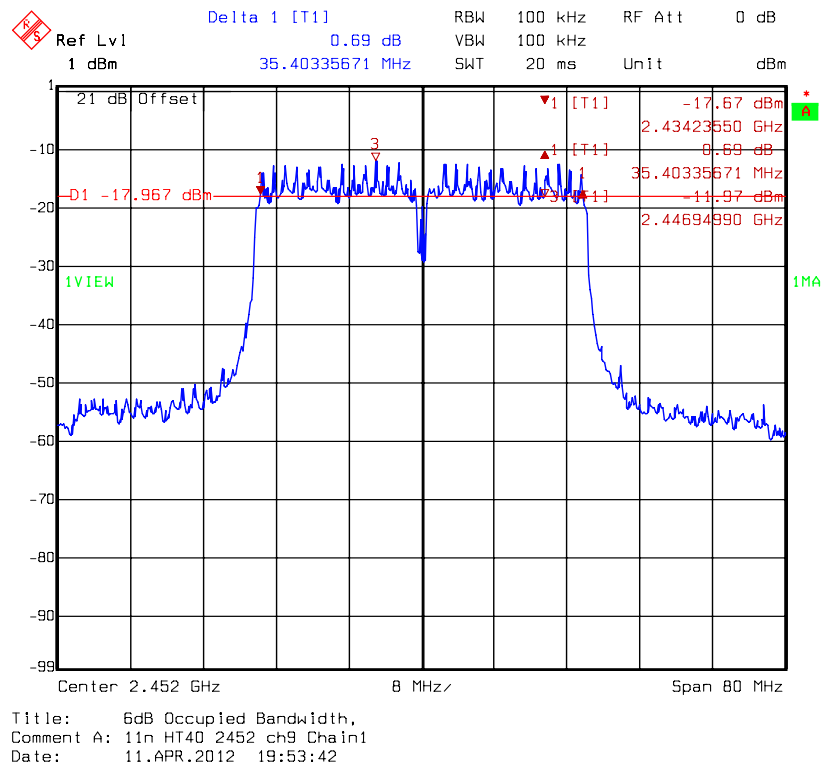
### Invax 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT40 mode channel 3



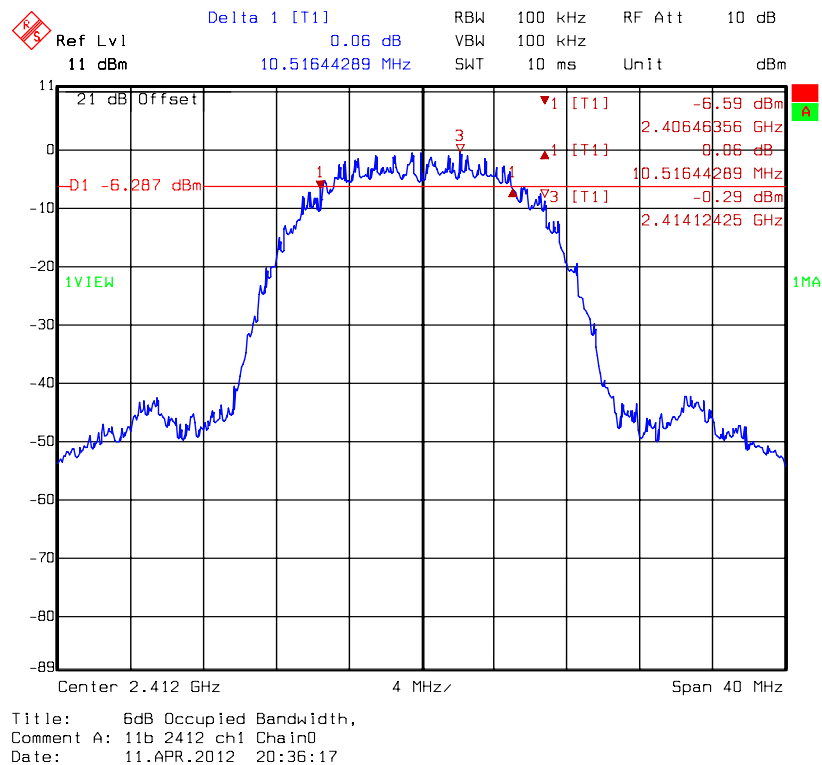
### Invax 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT40 mode channel 6



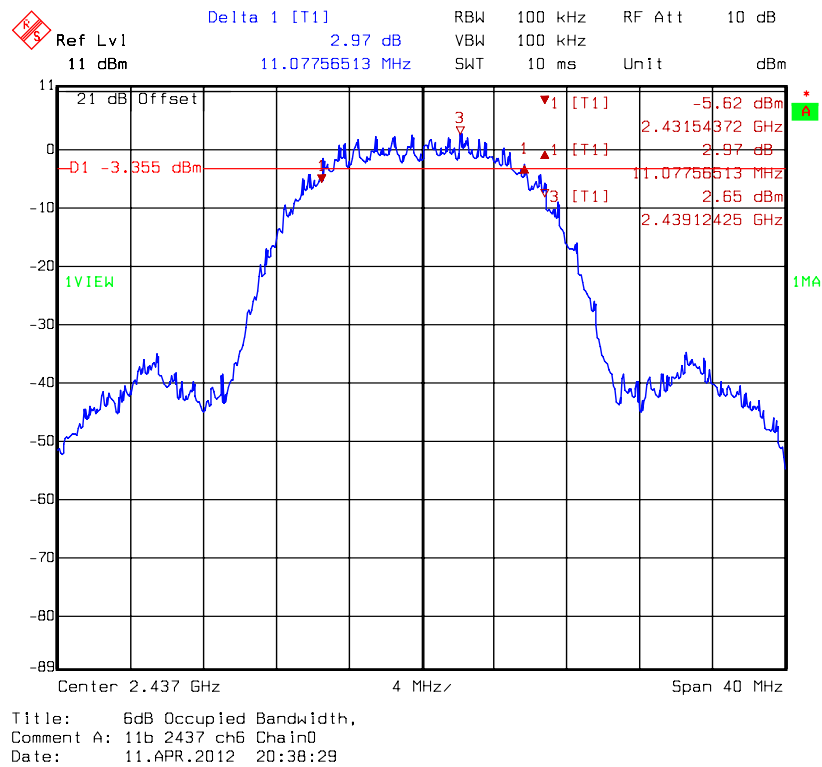
# Invax 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT40 mode channel 9



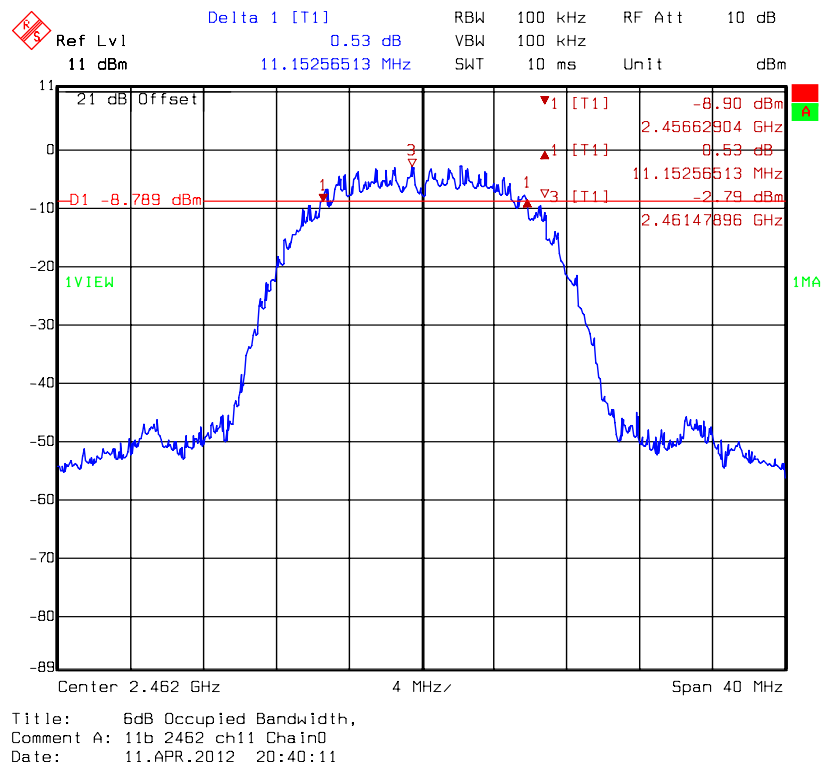
# SAYTEC 2 dBi Antenna: 6 dB Bandwidth @ 802.11b mode channel 1



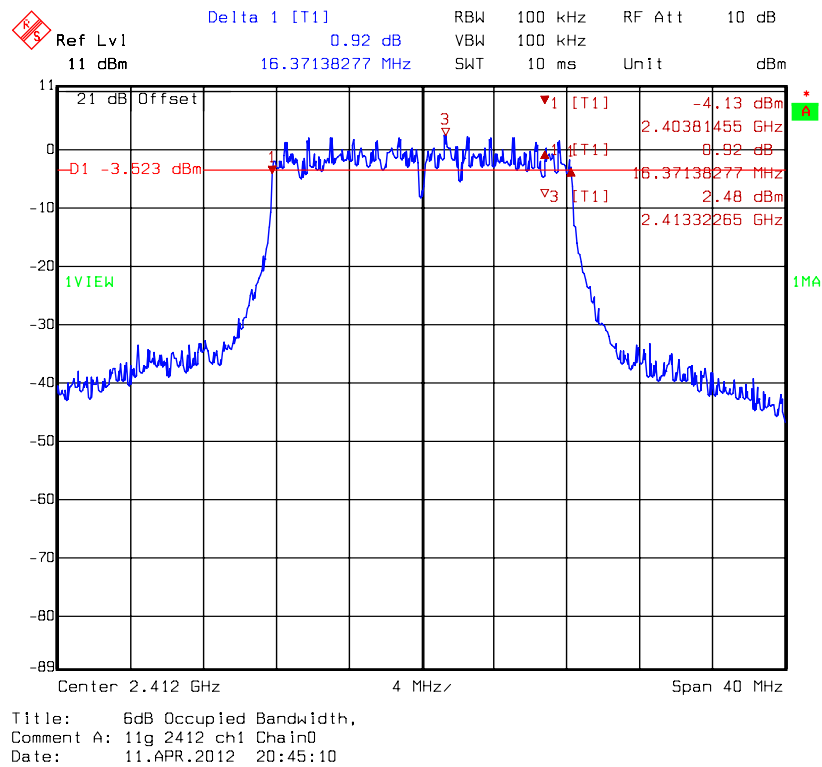
### SAYTEC 2 dBi Antenna: 6 dB Bandwidth @ 802.11b mode channel 6



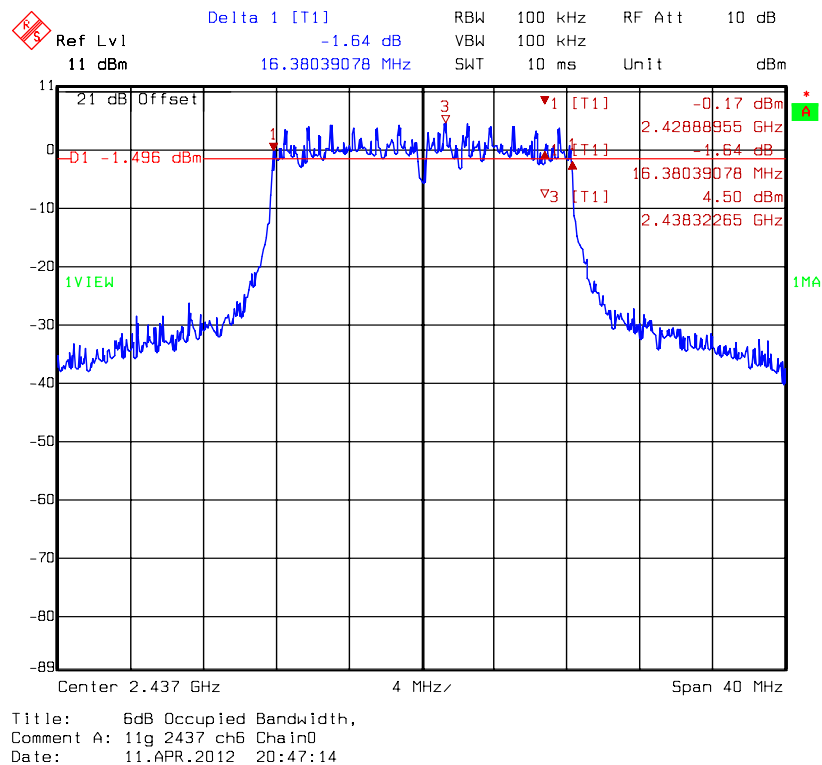
### SAYTEC 2 dBi Antenna: 6 dB Bandwidth @ 802.11b mode channel 11



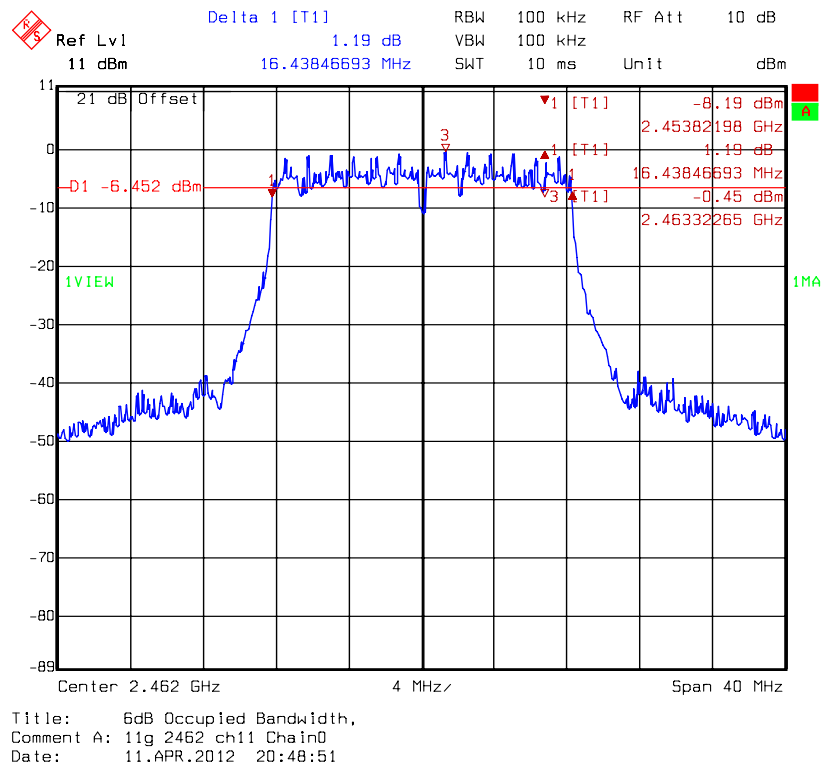
**SAYTEC 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11g mode channel 1**



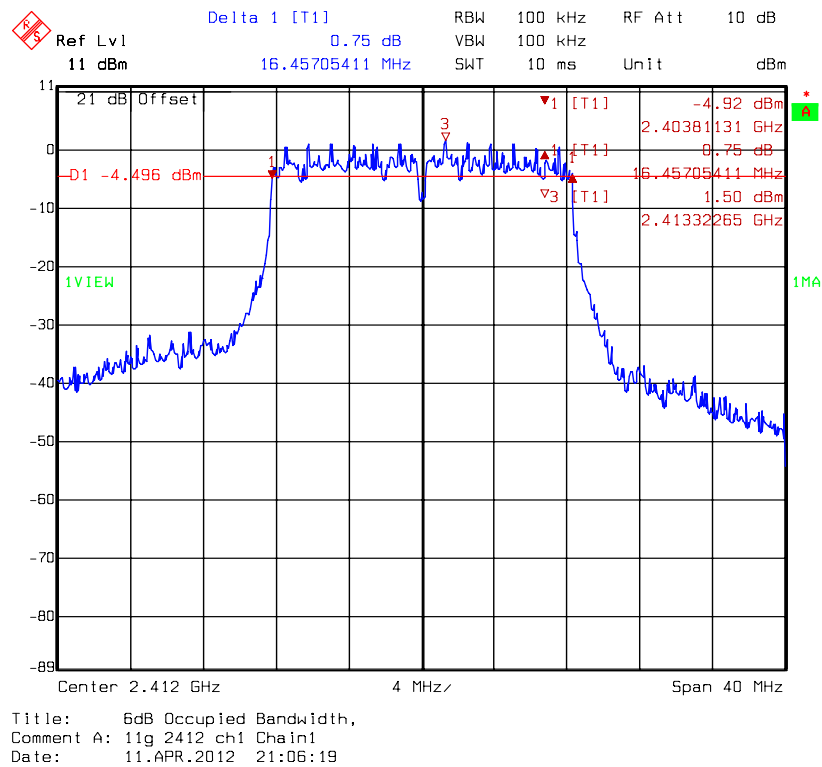
**SAYTEC 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11g mode channel 6**



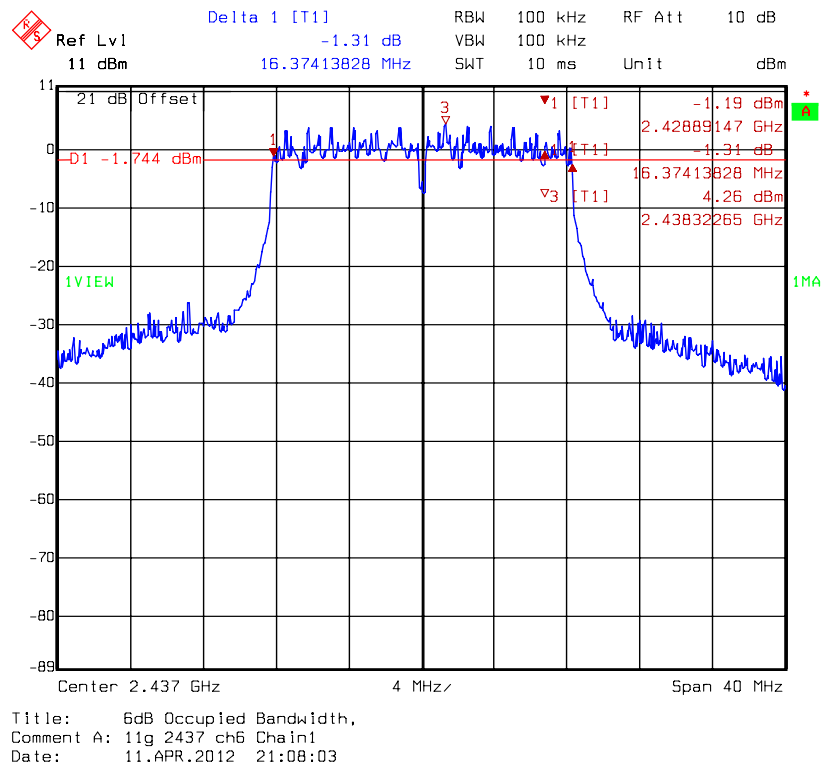
# SAYTEC 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11g mode channel 11



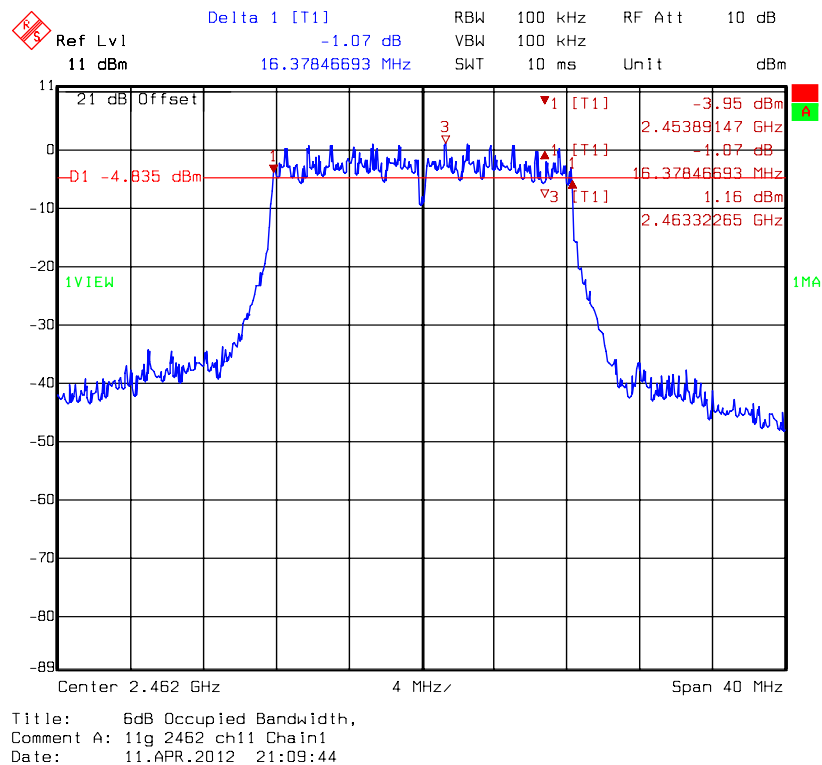
# SAYTEC 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11g mode channel 1



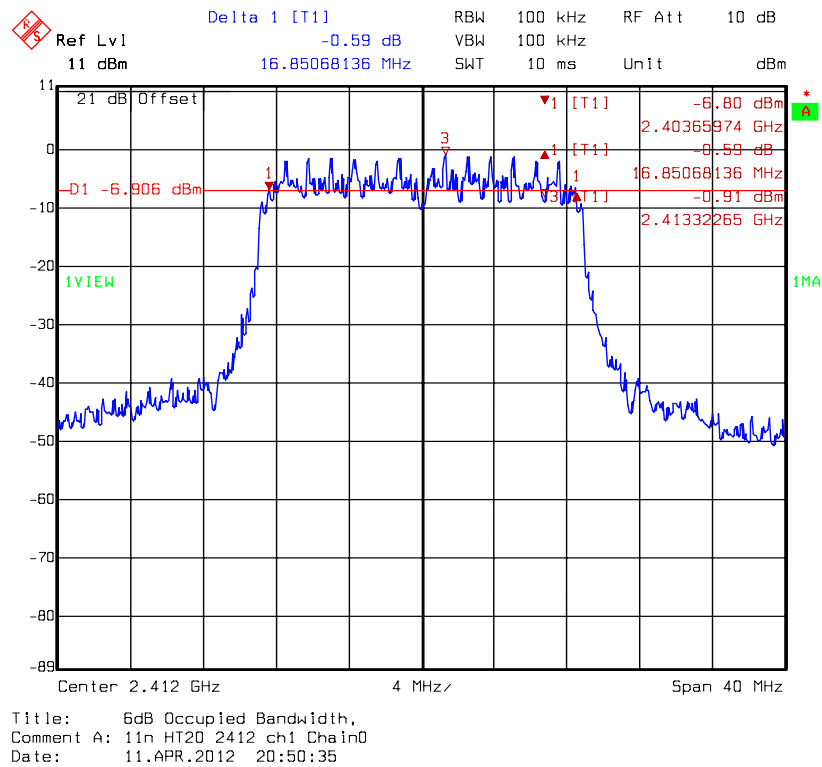
# SAYTEC 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11g mode channel 6



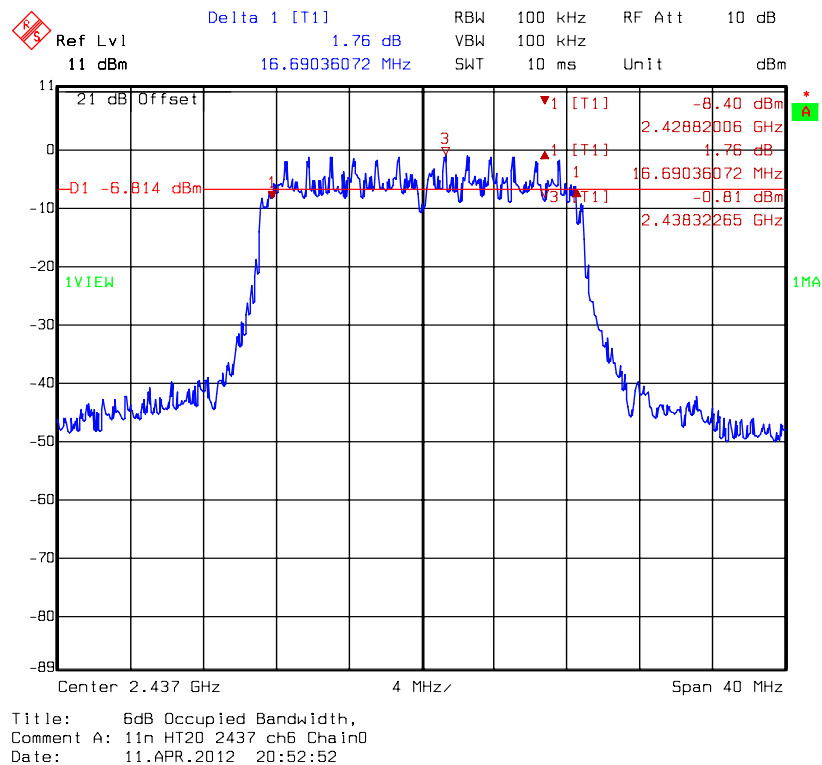
# SAYTEC 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11g mode channel 11



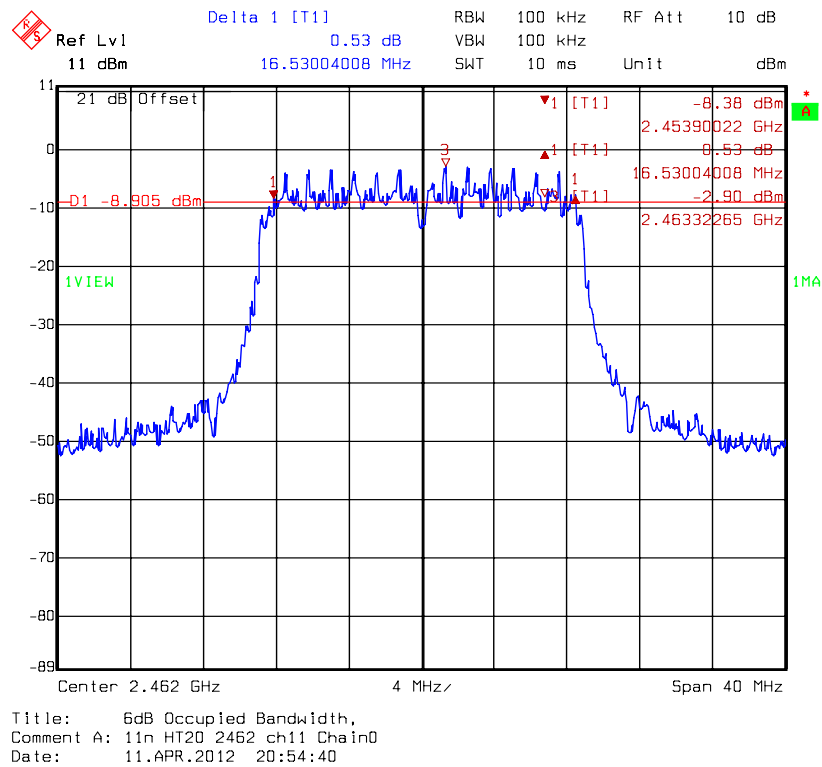
**SAYTEC 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT20 mode channel 1**



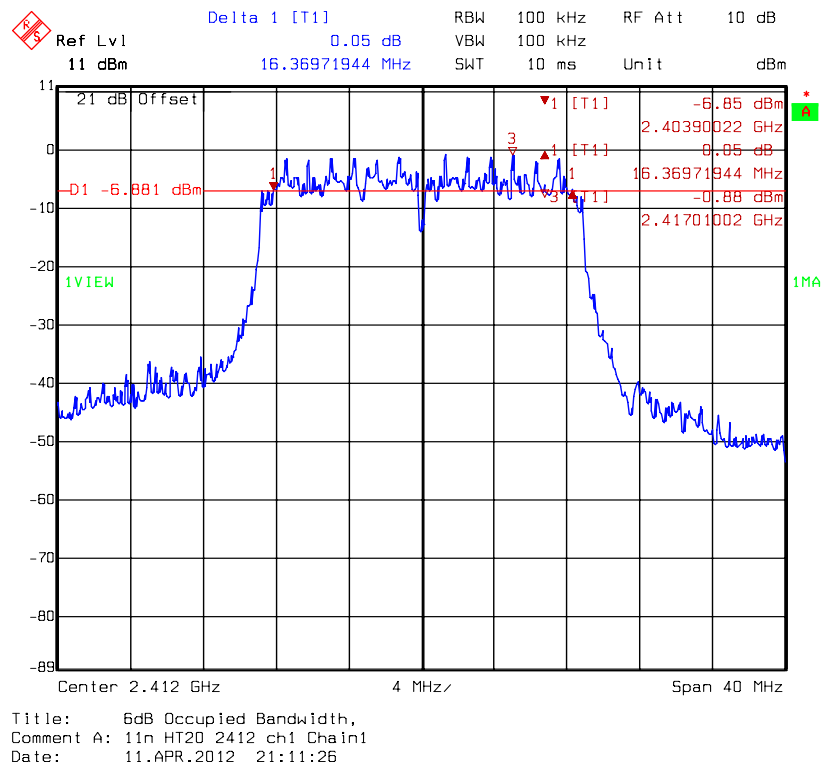
**SAYTEC 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT20 mode channel 6**



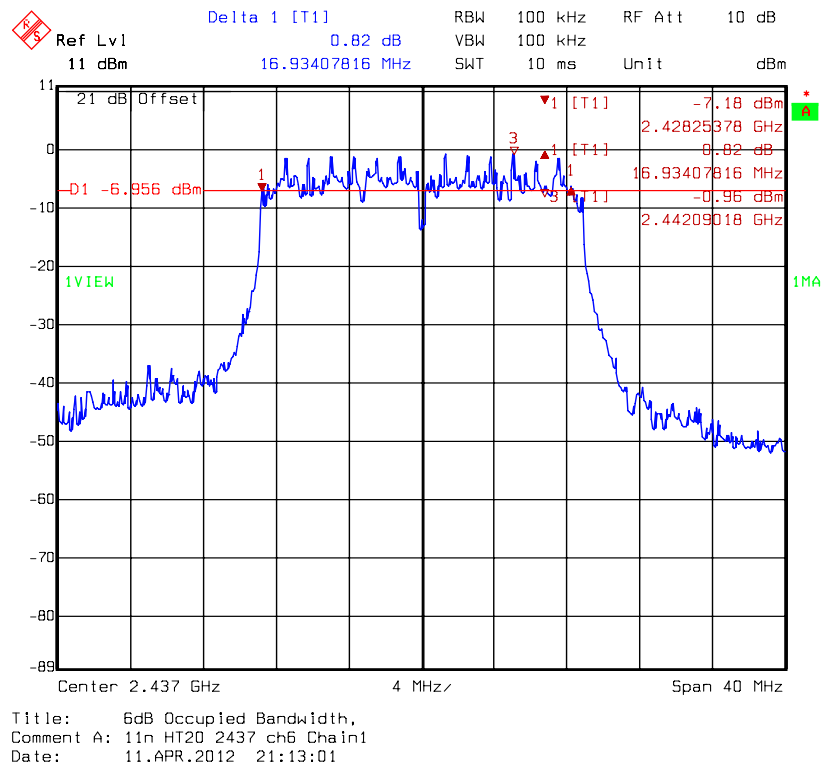
**SAYTEC 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT20 mode channel 11**



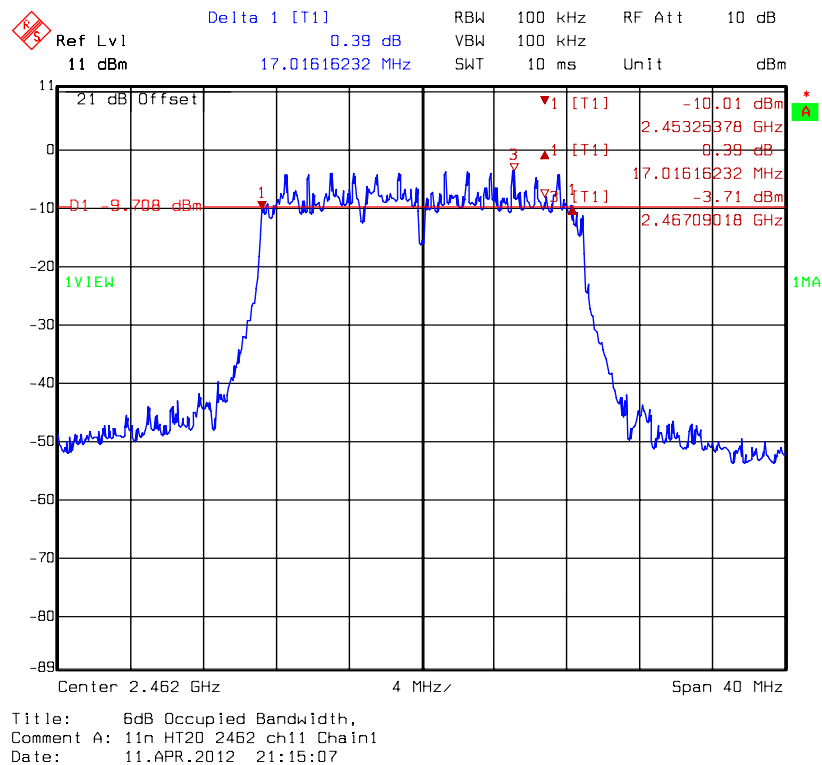
**SAYTEC 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT20 mode channel 1**



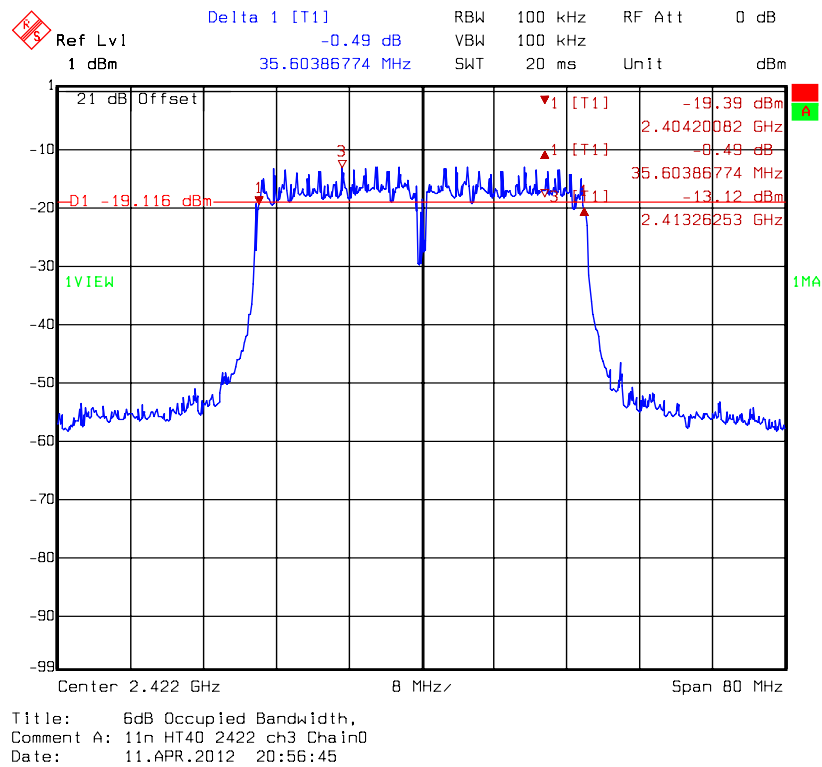
**SAYTEC 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT20 mode channel 6**



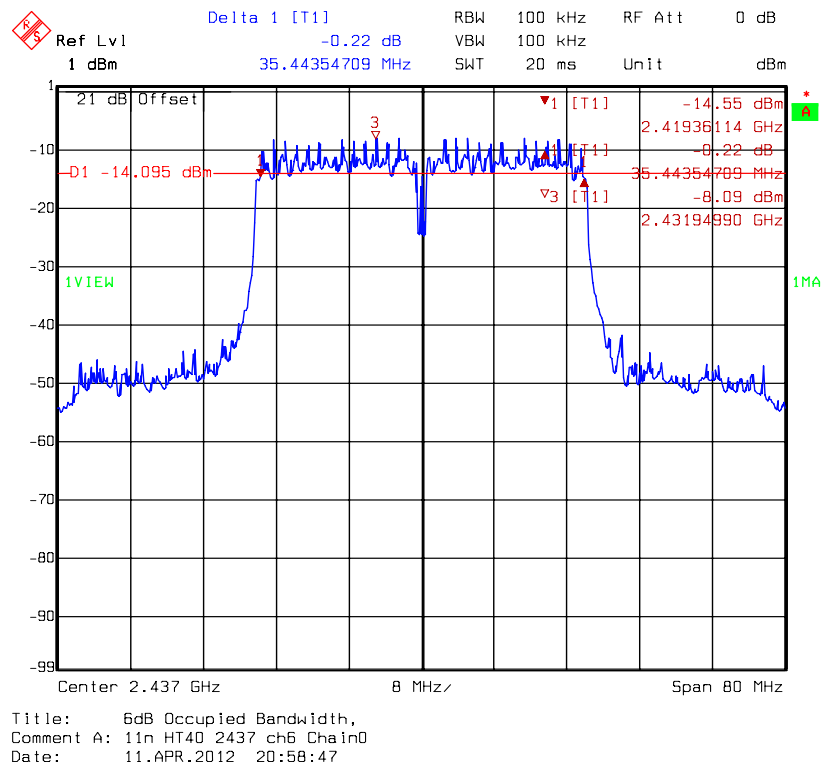
**SAYTEC 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT20 mode channel 11**



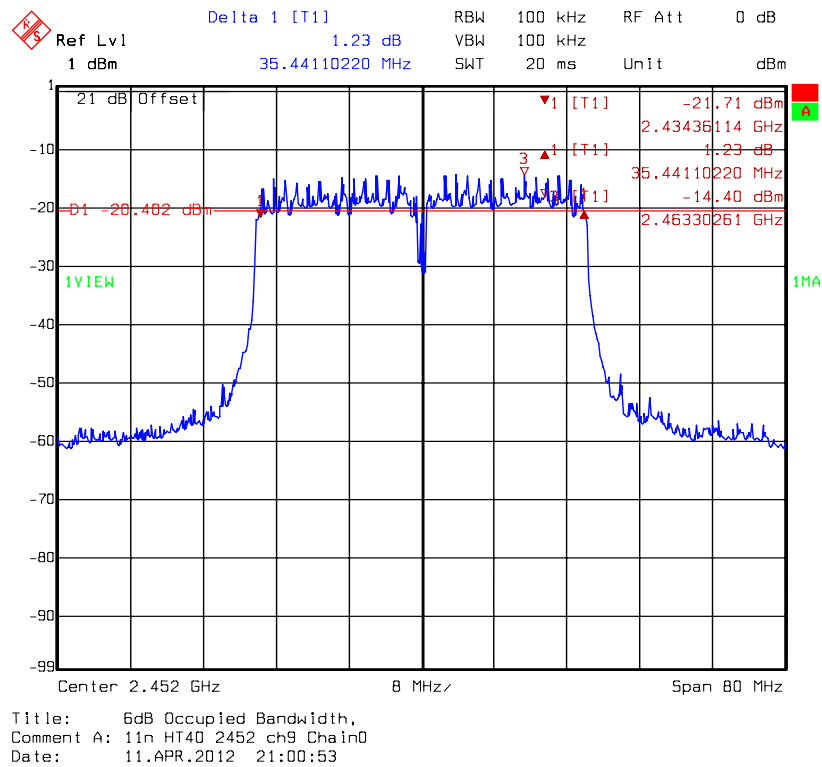
**SAYTEC 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT40 mode channel 3**



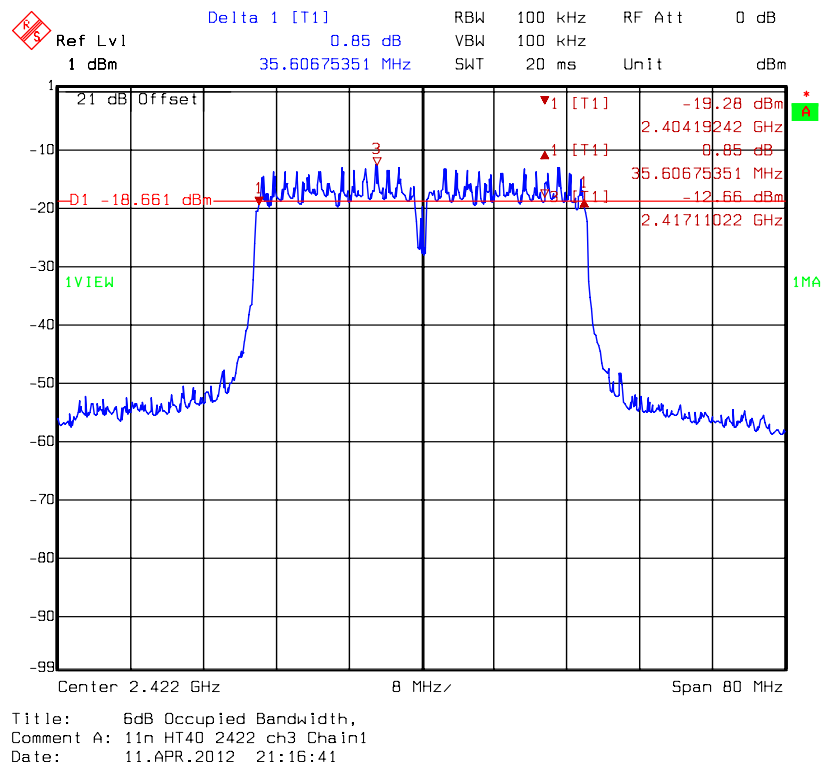
**SAYTEC 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT40 mode channel 6**



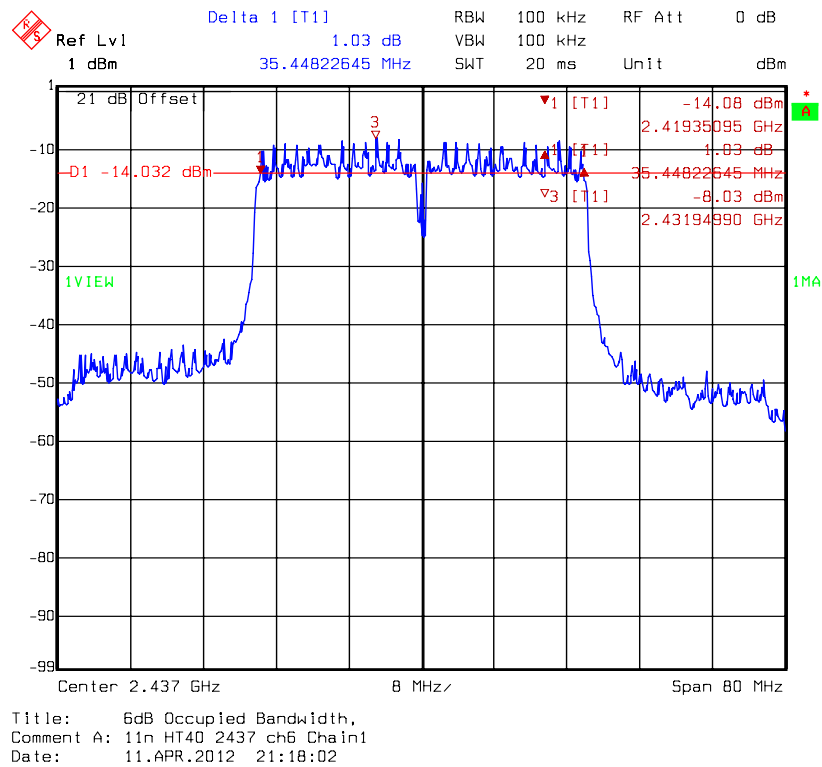
**SAYTEC 2 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT40 mode channel 9**



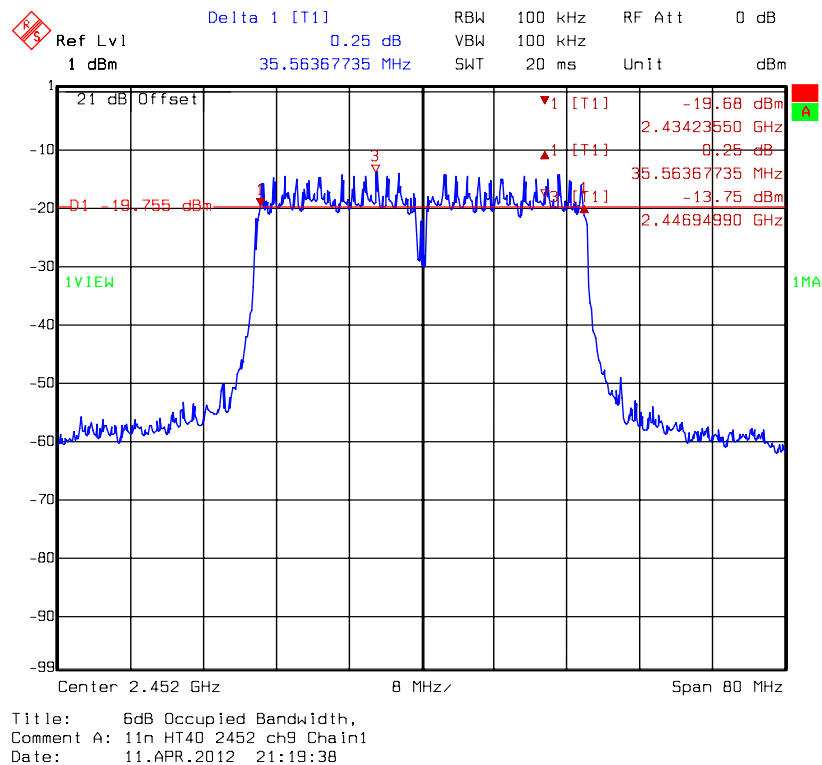
**SAYTEC 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT40 mode channel 3**



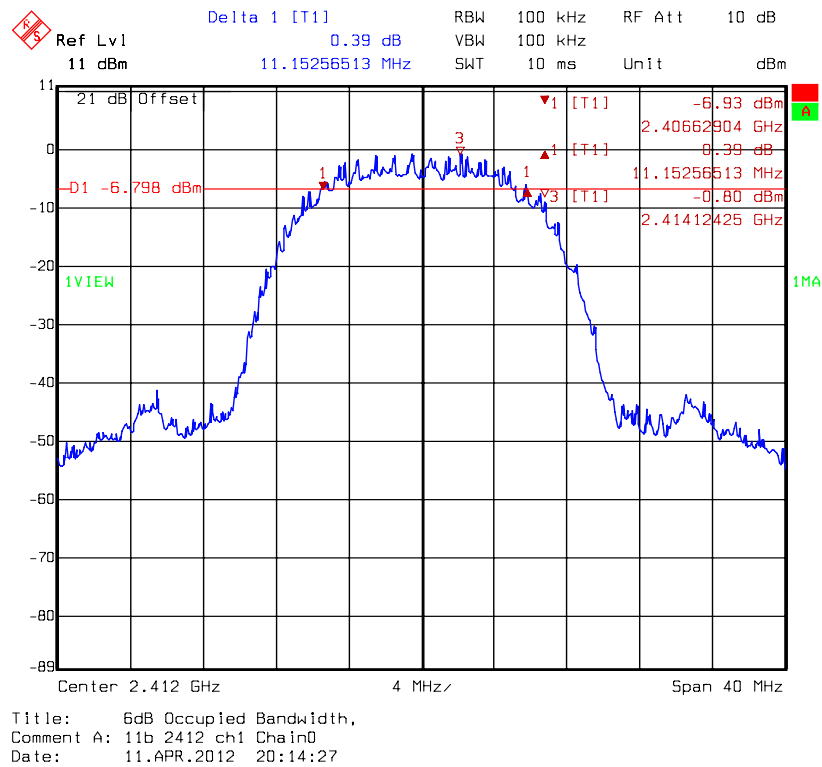
**SAYTEC 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT40 mode channel 6**



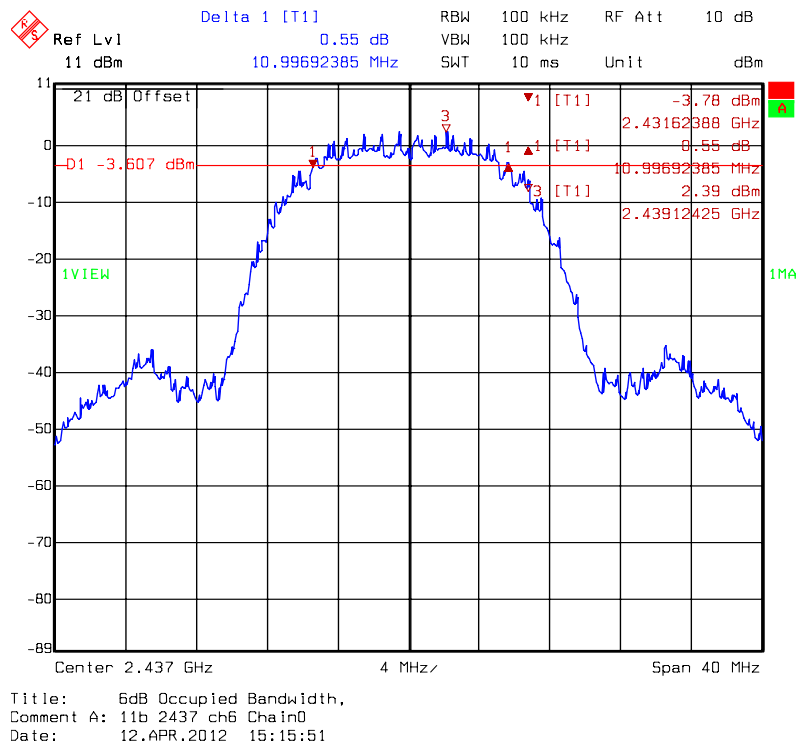
**SAYTEC 2 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT40 mode channel 9**



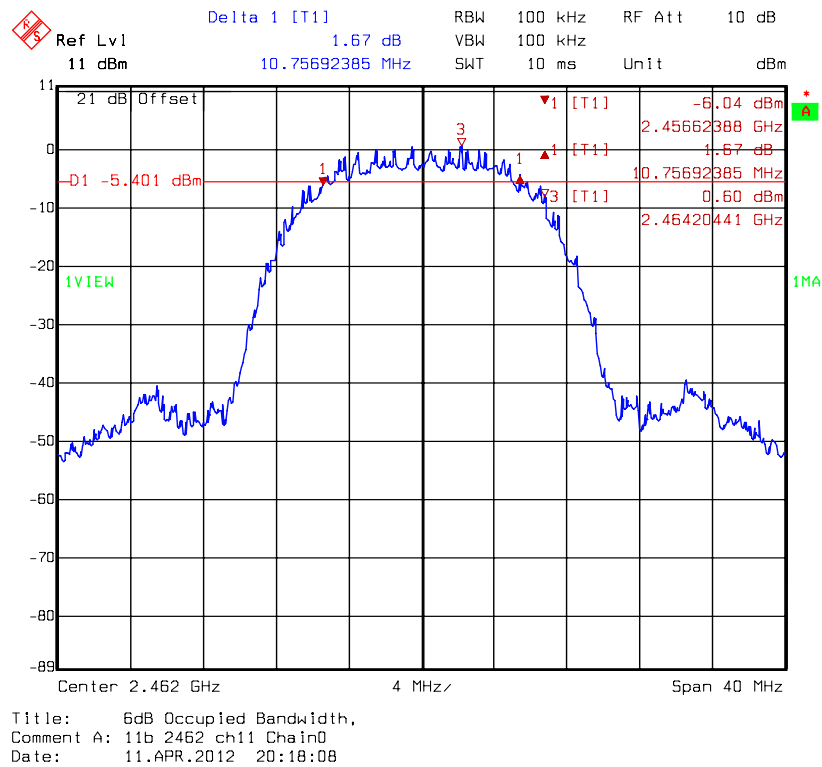
### Invax 5 dBi Antenna: 6 dB Bandwidth @ 802.11b mode channel 1



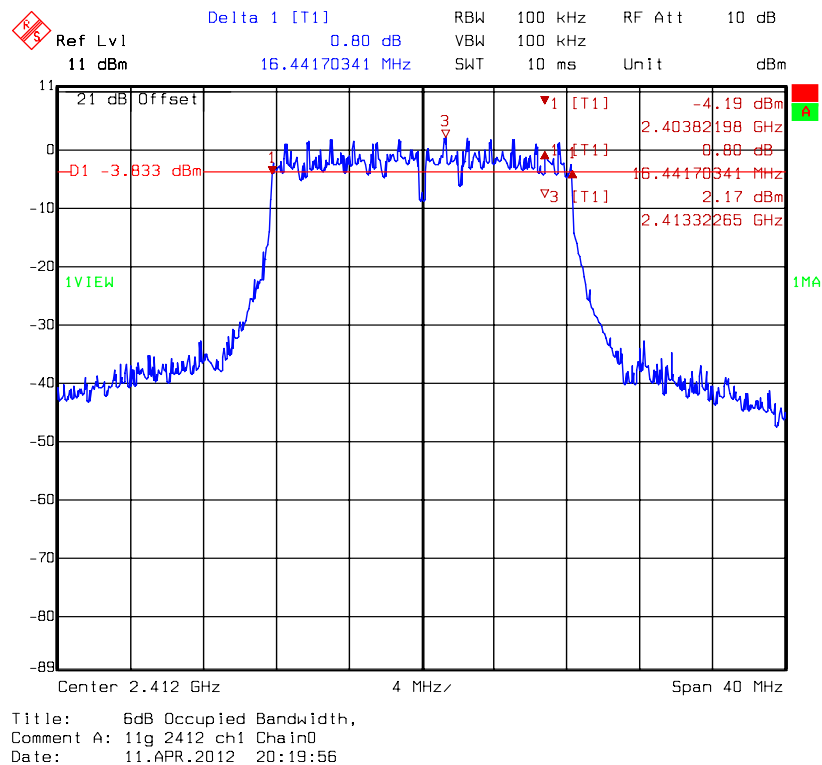
### Invax 5 dBi Antenna: 6 dB Bandwidth @ 802.11b mode channel 6



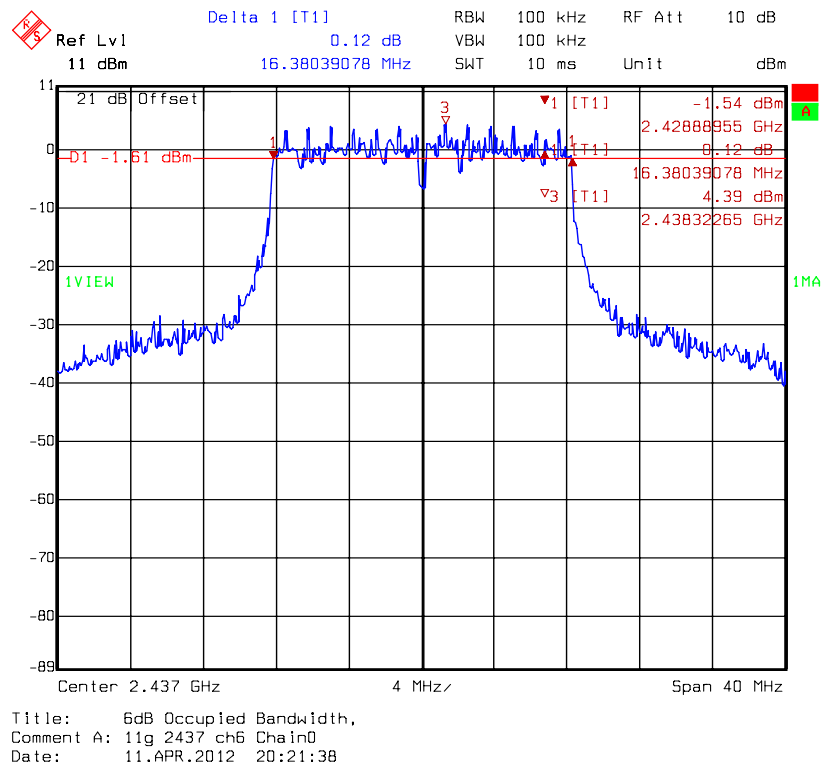
# Invax 5 dBi Antenna: 6 dB Bandwidth @ 802.11b mode channel 11



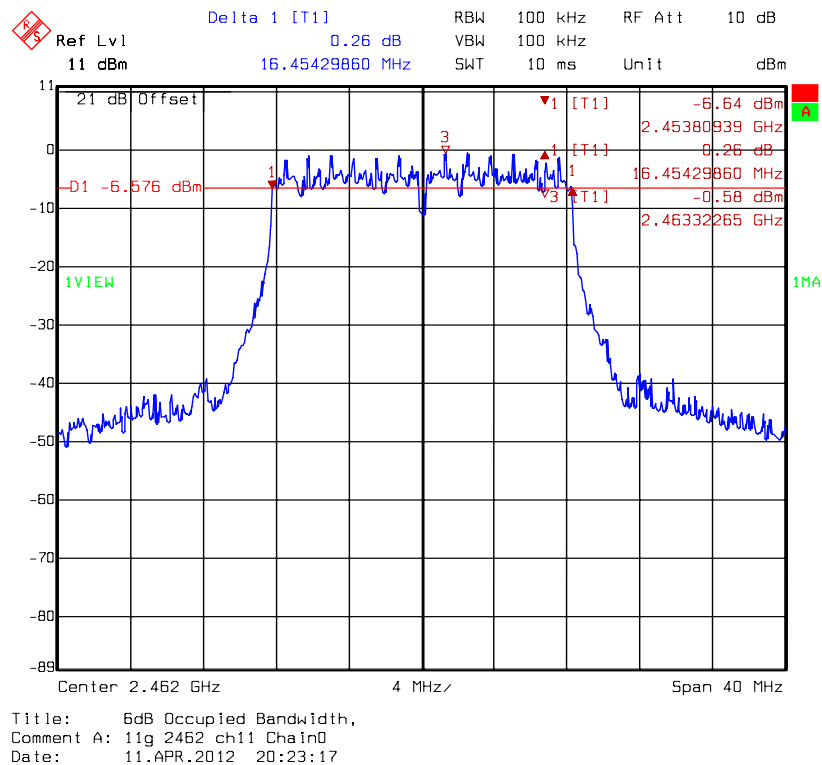
# Invax 5 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11g mode channel 1



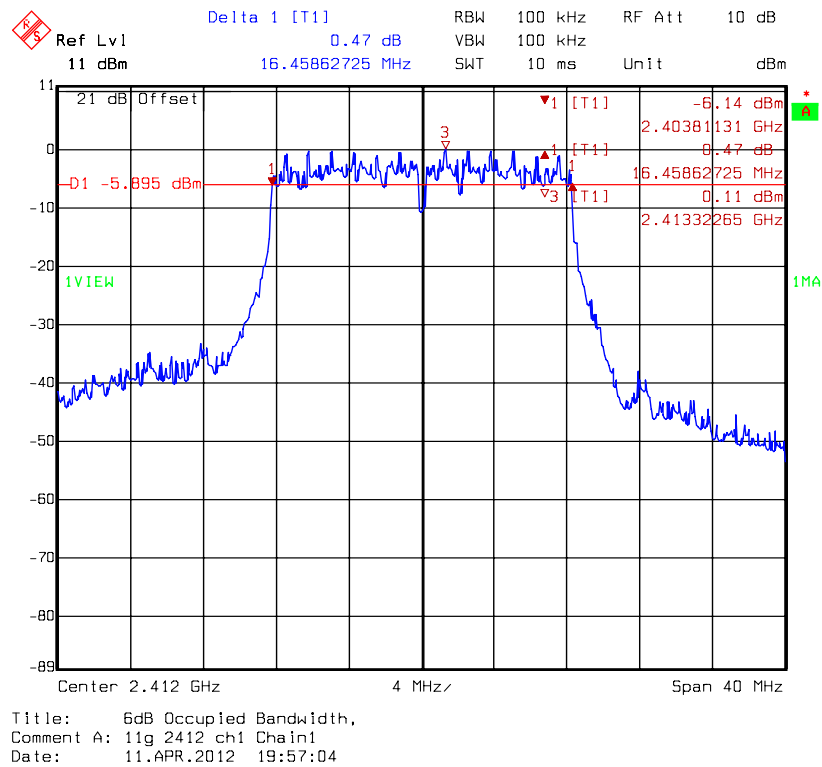
### Invax 5 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11g mode channel 6



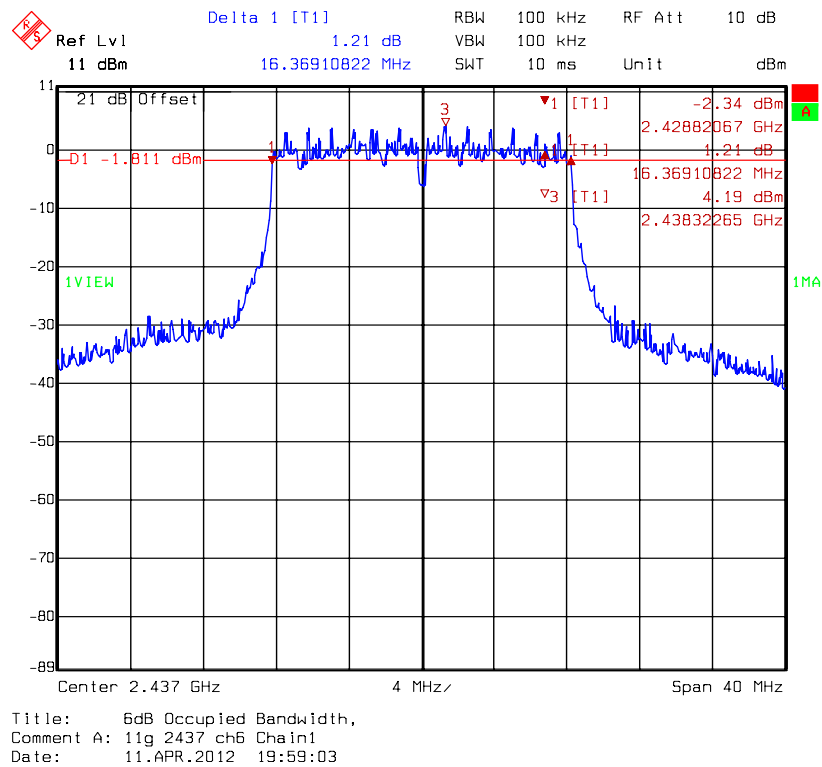
### Invax 5 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11g mode channel 11



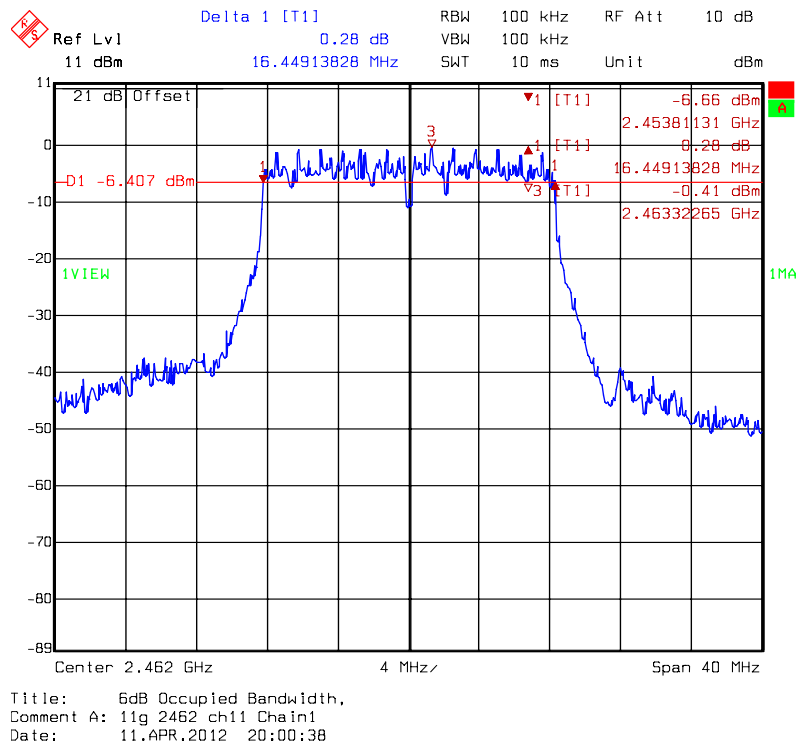
### Invax 5 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11g mode channel 1



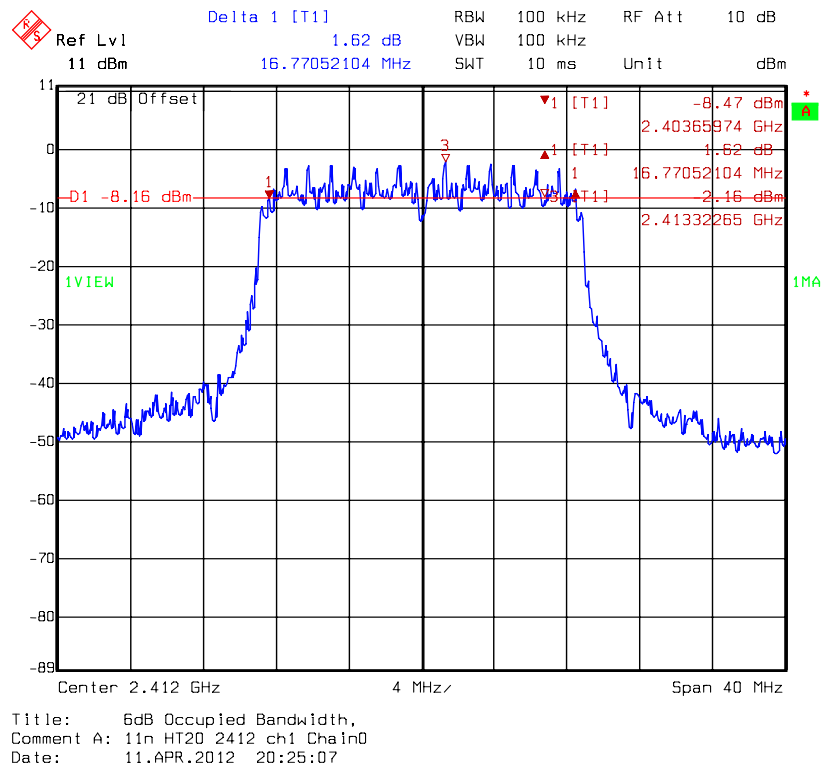
### Invax 5 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11g mode channel 6

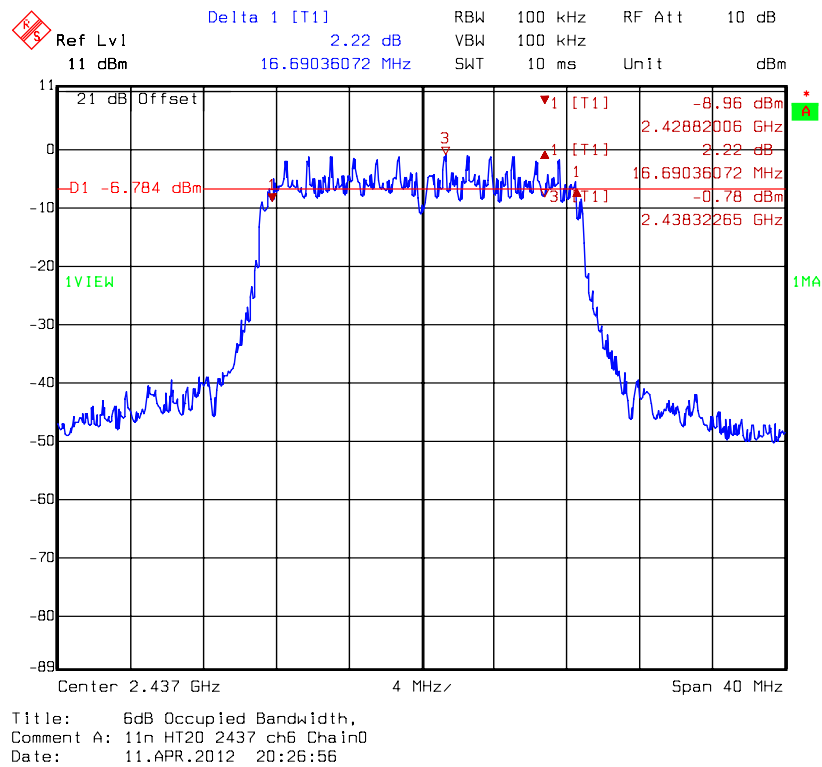


# Invax 5 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11g mode channel 11

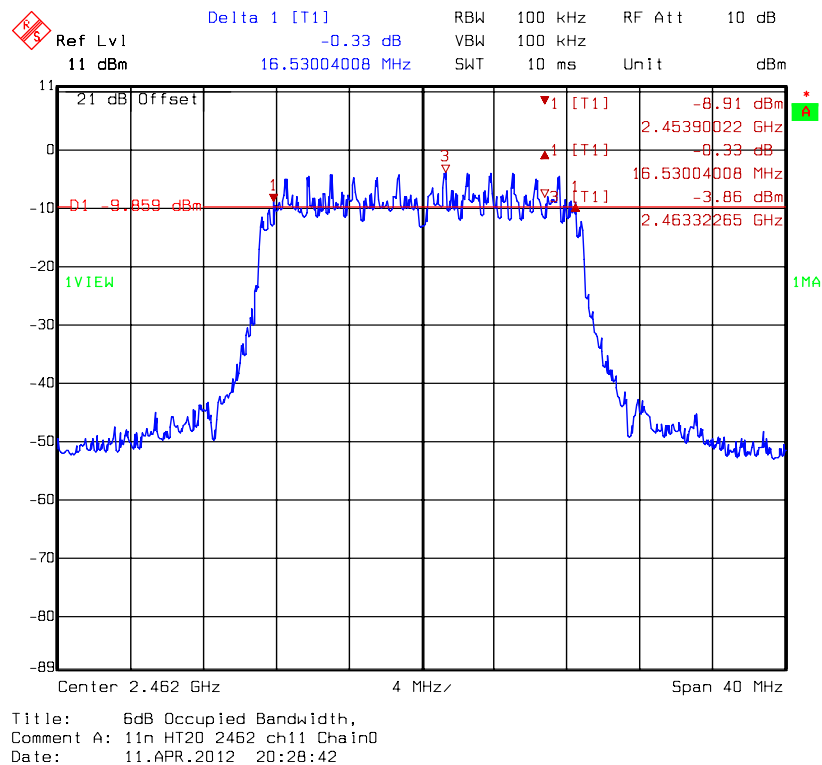


# Invax 5 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT20 mode channel 1

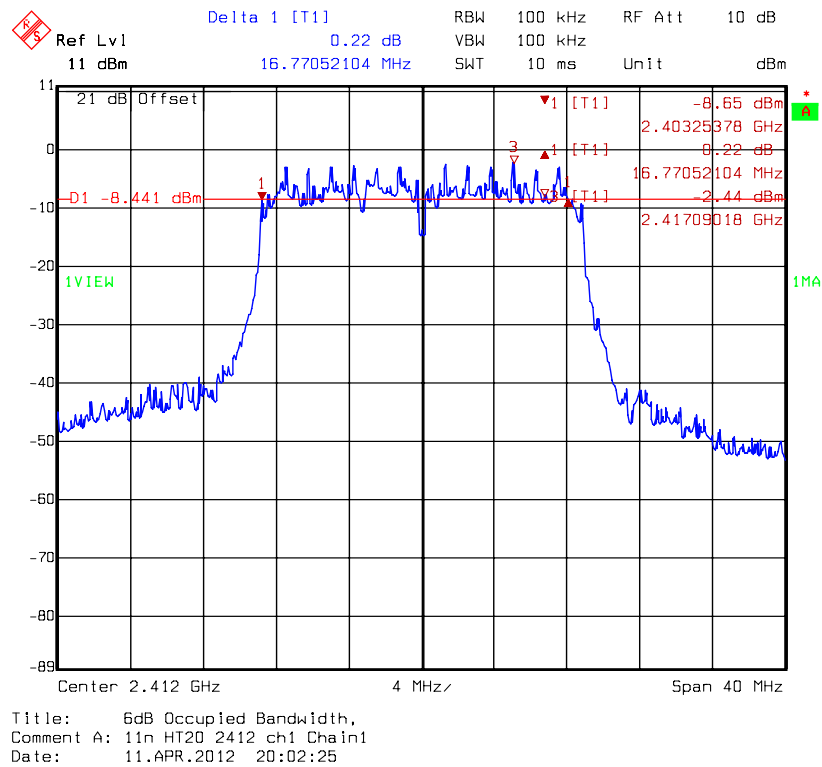


**Invax 5 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT20 mode channel 6**

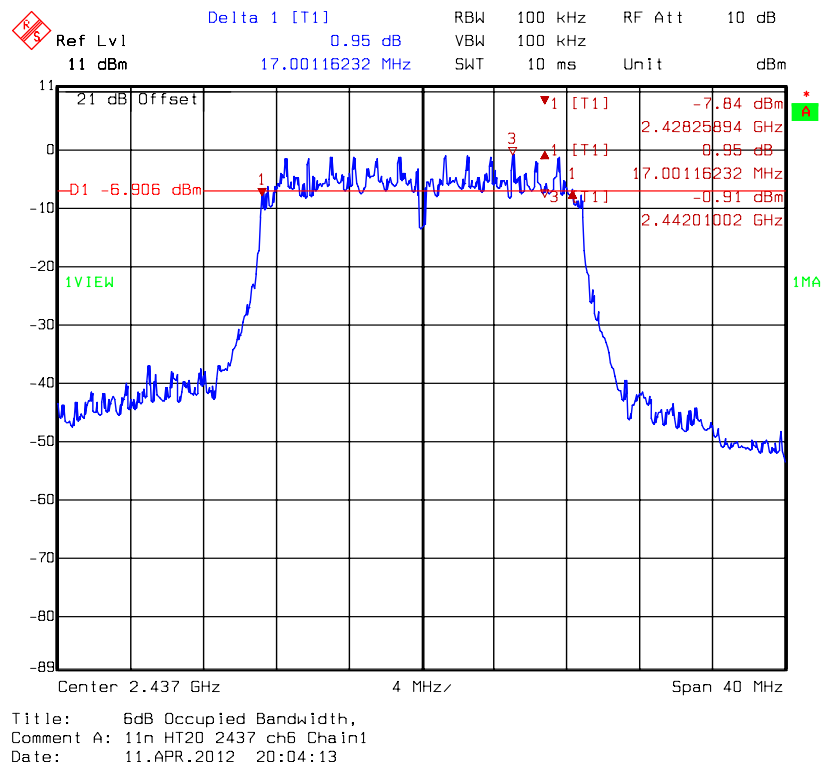
**Invax 5 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT20 mode channel 11**



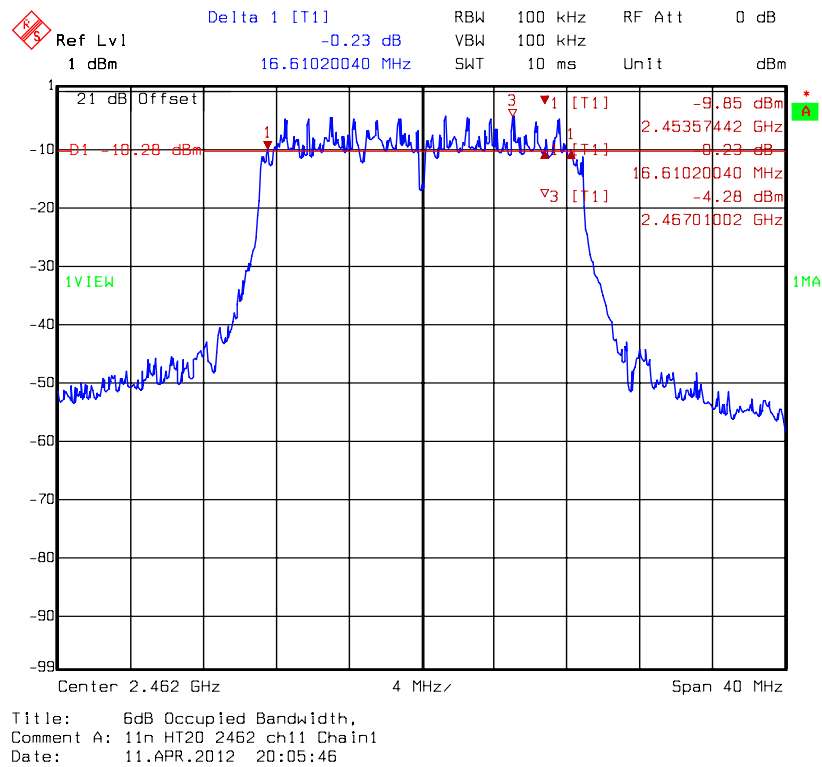
### Invax 5 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT20 mode channel 1



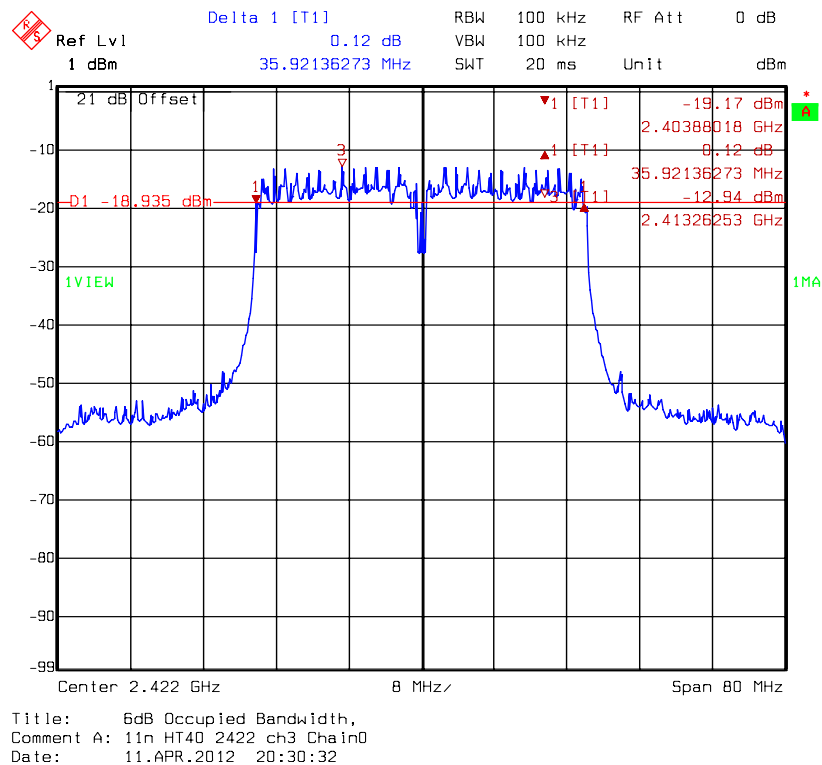
### Invax 5 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT20 mode channel 6



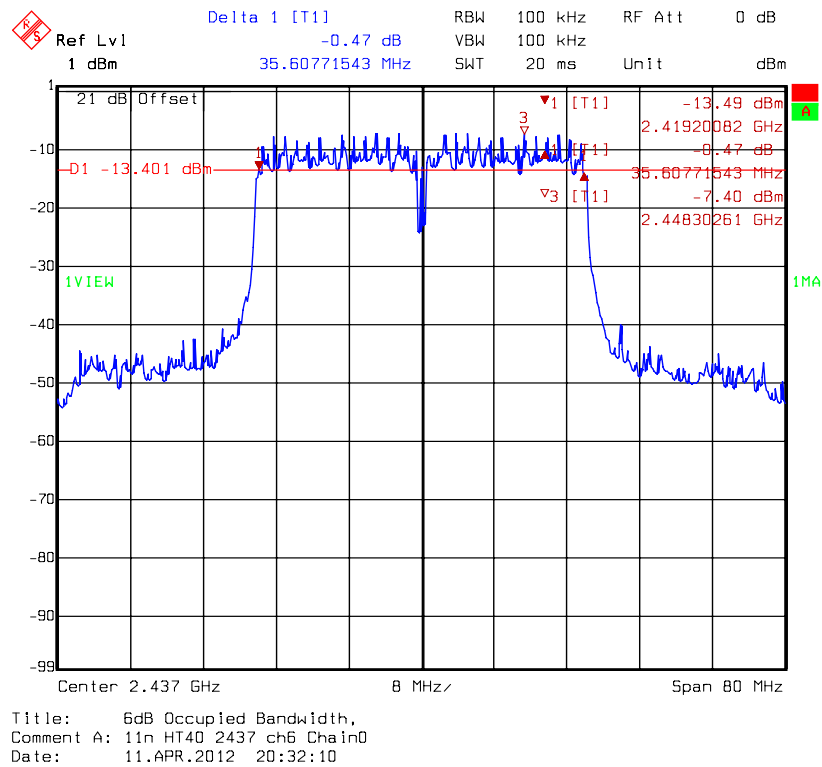
# Invax 5 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT20 mode channel 11



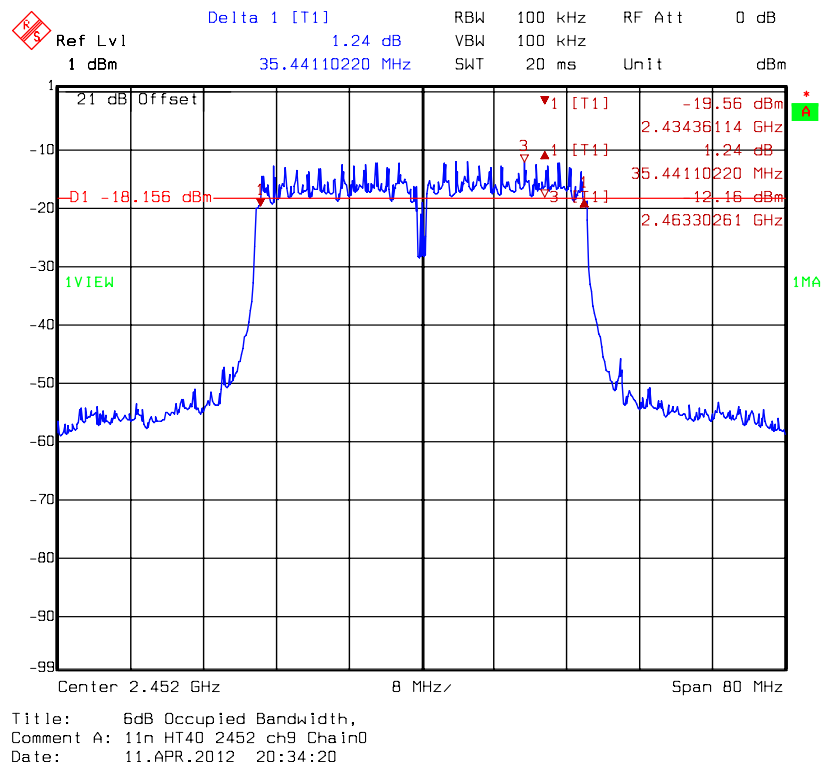
# Invax 5 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT40 mode channel 3



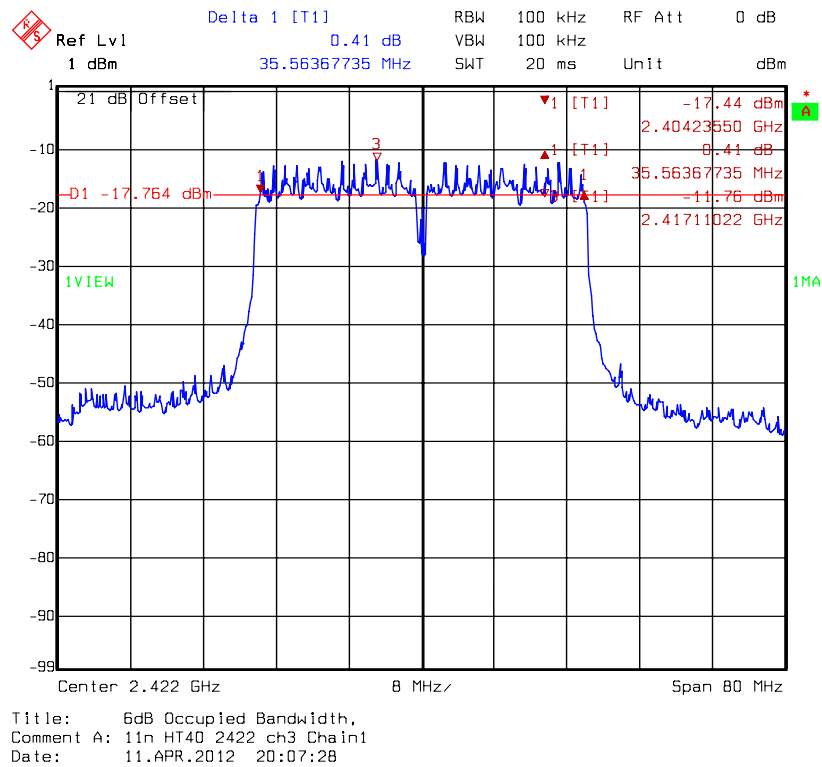
# Invax 5 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT40 mode channel 6



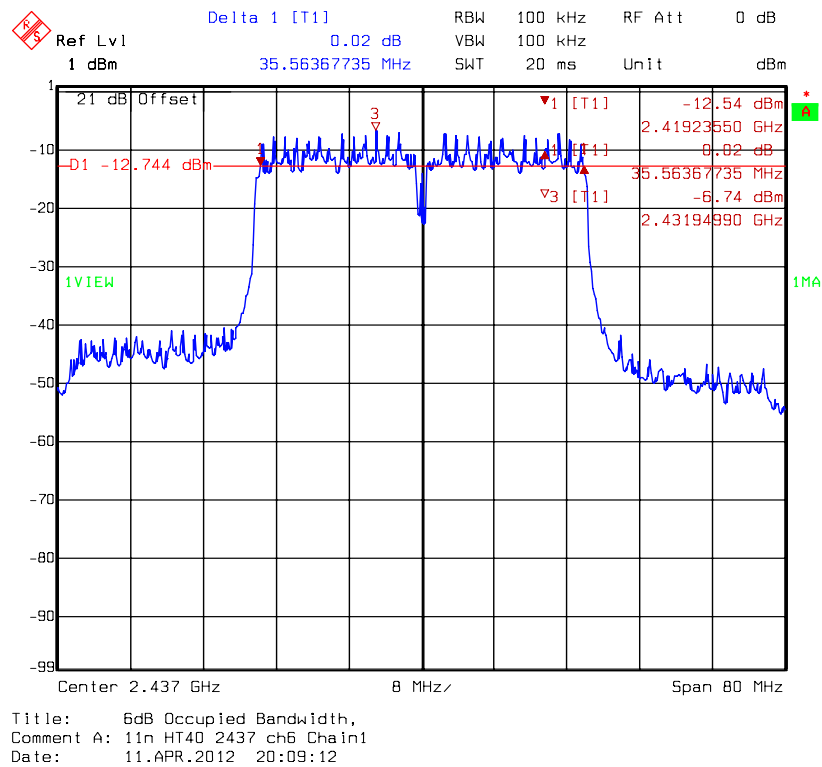
# Invax 5 dBi Antenna: Chain 0: 6 dB Bandwidth @ 802.11n HT40 mode channel 9



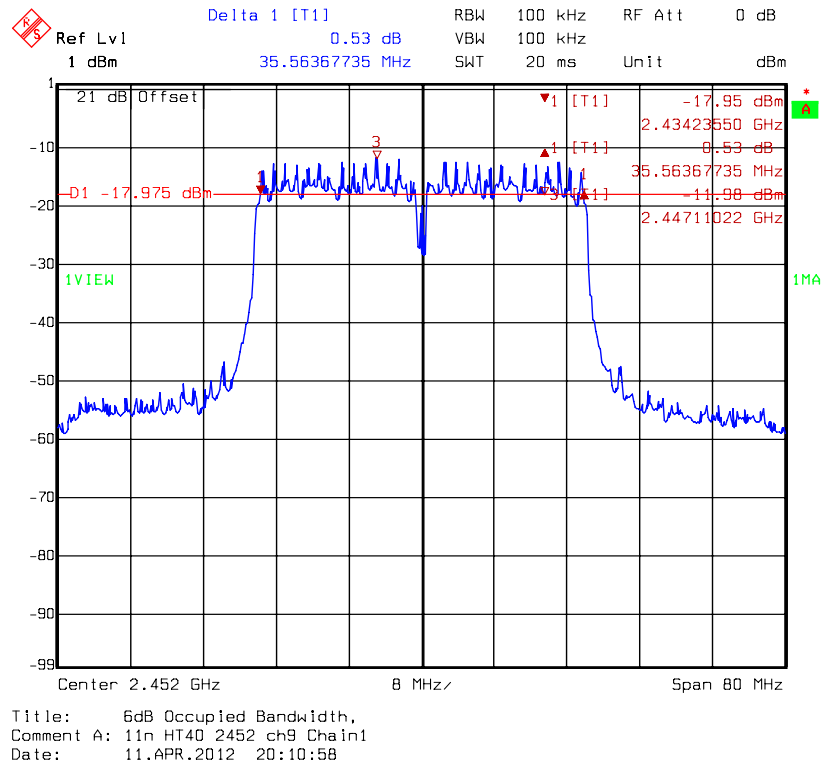
# Invax 5 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT40 mode channel 3



# Invax 5 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT40 mode channel 6



Invax 5 dBi Antenna: Chain 1: 6 dB Bandwidth @ 802.11n HT40 mode channel 9



#### 4. 99 % Occupied Bandwidth

|                      |                                   |
|----------------------|-----------------------------------|
| <b>Name of Test</b>  | 99 % Occupied Bandwidth           |
| <b>Base Standard</b> | None; for reporting purposes only |

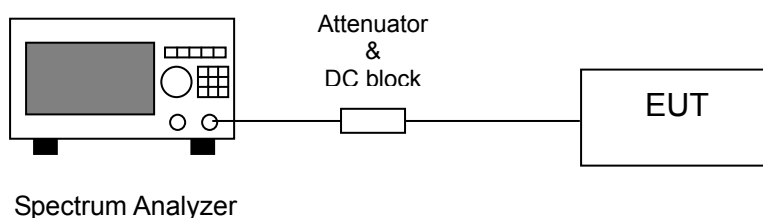
**Test Result:** Complies  
**Measurement Data:** See Table & plots below

#### Method of Measurement:

##### Reference FCC document: KDB558074

A portion of the transmitted signal is coupled to a Spectrum Analyzer with a resolution bandwidth of at least 1 % of the bandwidth of the transmitted signal. The resolution bandwidth is chosen so as not to reduce the peak level of the measured waveform. The appropriate bandwidth mask is applied to the output waveform to verify compliance.

#### Test Diagram:



**Note:** The EUT was tested while in a continuous transmit mode and the worst case data rates are 11 Mbps data rate for 802.11b mode, 54 Mbps data rate for 802.11g mode, 150 Mbps data rate for 802.11n HT20 mode and 150 Mbps data rate for 802.11n HT40 mode. The EUT was tuned to a low, middle and high channel.

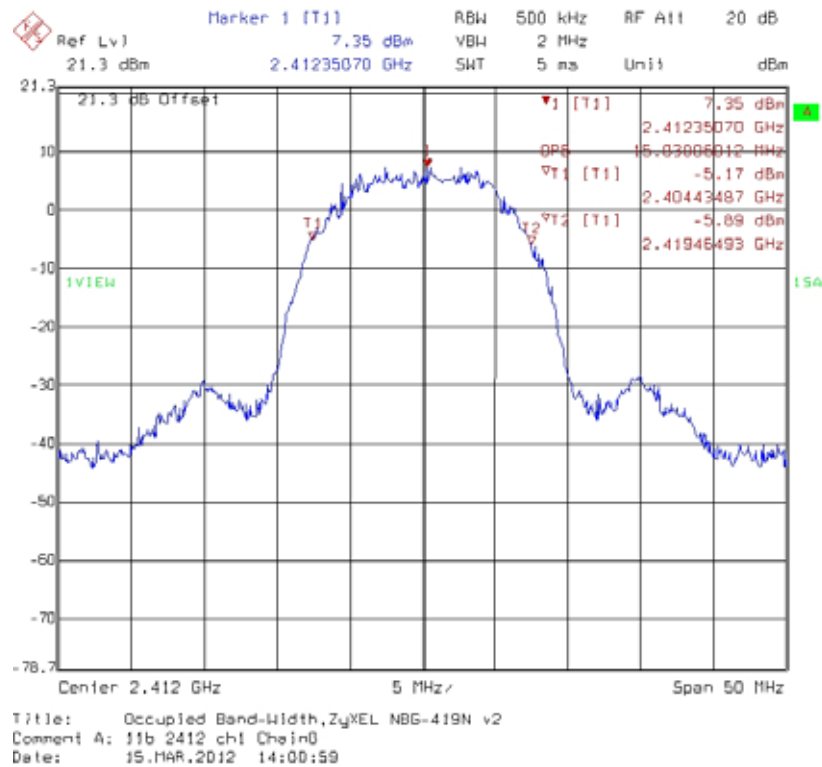
Table: 99 % Occupied Bandwidth

| Invax 2 dBi Antenna |         |                 |                          |         |
|---------------------|---------|-----------------|--------------------------|---------|
| Mode                | Channel | Frequency (MHz) | Occupied Bandwidth (MHz) |         |
| 802.11b             | 1       | 2412            | 15.030                   |         |
|                     | 6       | 2437            | 15.531                   |         |
|                     | 11      | 2462            | 15.130                   |         |
| 802.11g<br>Chain 0  | 1       | 2412            | 16.733                   |         |
|                     | 6       | 2437            | 17.034                   |         |
|                     | 11      | 2462            | 16.833                   |         |
| 802.11g<br>Chain 1  | 1       | 2412            | 16.833                   |         |
|                     | 6       | 2437            | 16.733                   |         |
|                     | 11      | 2462            | 16.733                   |         |
| Mode                | Channel | Frequency (MHz) | Occupied Bandwidth (MHz) |         |
|                     |         |                 | Chain 0                  | Chain 1 |
| 802.11n<br>HT20     | 1       | 2412            | 17.635                   | 17.635  |
|                     | 6       | 2437            | 17.735                   | 17.735  |
|                     | 11      | 2462            | 17.635                   | 17.635  |
| 802.11n<br>HT40     | 3       | 2422            | 36.272                   | 36.272  |
|                     | 6       | 2437            | 36.472                   | 36.472  |
|                     | 9       | 2452            | 36.472                   | 36.272  |

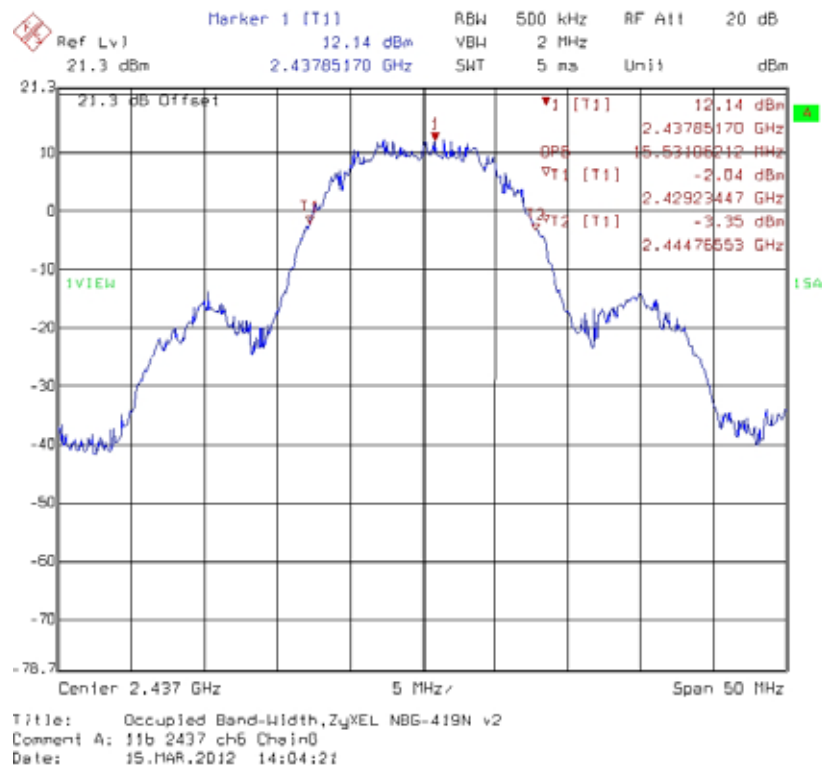
| SAYTEC 2 dBi Antenna |         |                 |                          |         |
|----------------------|---------|-----------------|--------------------------|---------|
| Mode                 | Channel | Frequency (MHz) | Occupied Bandwidth (MHz) |         |
| 802.11b              | 1       | 2412            | 15.030                   |         |
|                      | 6       | 2437            | 15.531                   |         |
|                      | 11      | 2462            | 15.030                   |         |
| 802.11g<br>Chain 0   | 1       | 2412            | 16.733                   |         |
|                      | 6       | 2437            | 16.933                   |         |
|                      | 11      | 2462            | 16.633                   |         |
| 802.11g<br>Chain 1   | 1       | 2412            | 16.633                   |         |
|                      | 6       | 2437            | 16.733                   |         |
|                      | 11      | 2462            | 16.733                   |         |
| Mode                 | Channel | Frequency (MHz) | Occupied Bandwidth (MHz) |         |
|                      |         |                 | Chain 0                  | Chain 1 |
| 802.11n<br>HT20      | 1       | 2412            | 17.635                   | 17.735  |
|                      | 6       | 2437            | 17.535                   | 17.735  |
|                      | 11      | 2462            | 17.735                   | 17.635  |
| 802.11n<br>HT40      | 3       | 2422            | 36.272                   | 36.272  |
|                      | 6       | 2437            | 36.472                   | 36.472  |
|                      | 9       | 2452            | 36.272                   | 36.472  |

| Invax 5 dBi Antenna |         |                 |                          |         |
|---------------------|---------|-----------------|--------------------------|---------|
| Mode                | Channel | Frequency (MHz) | Occupied Bandwidth (MHz) |         |
| 802.11b             | 1       | 2412            | 15.030                   |         |
|                     | 6       | 2437            | 15.130                   |         |
|                     | 11      | 2462            | 15.430                   |         |
| 802.11g<br>Chain 0  | 1       | 2412            | 16.533                   |         |
|                     | 6       | 2437            | 16.833                   |         |
|                     | 11      | 2462            | 16.733                   |         |
| 802.11g<br>Chain 1  | 1       | 2412            | 16.733                   |         |
|                     | 6       | 2437            | 16.833                   |         |
|                     | 11      | 2462            | 16.833                   |         |
| Mode                | Channel | Frequency (MHz) | Occupied Bandwidth (MHz) |         |
|                     |         |                 | Chain 0                  | Chain 1 |
| 802.11n<br>HT20     | 1       | 2412            | 17.635                   | 17.735  |
|                     | 6       | 2437            | 17.635                   | 17.635  |
|                     | 11      | 2462            | 17.635                   | 17.735  |
| 802.11n<br>HT40     | 3       | 2422            | 36.272                   | 36.472  |
|                     | 6       | 2437            | 36.472                   | 36.472  |
|                     | 9       | 2452            | 36.272                   | 36.272  |

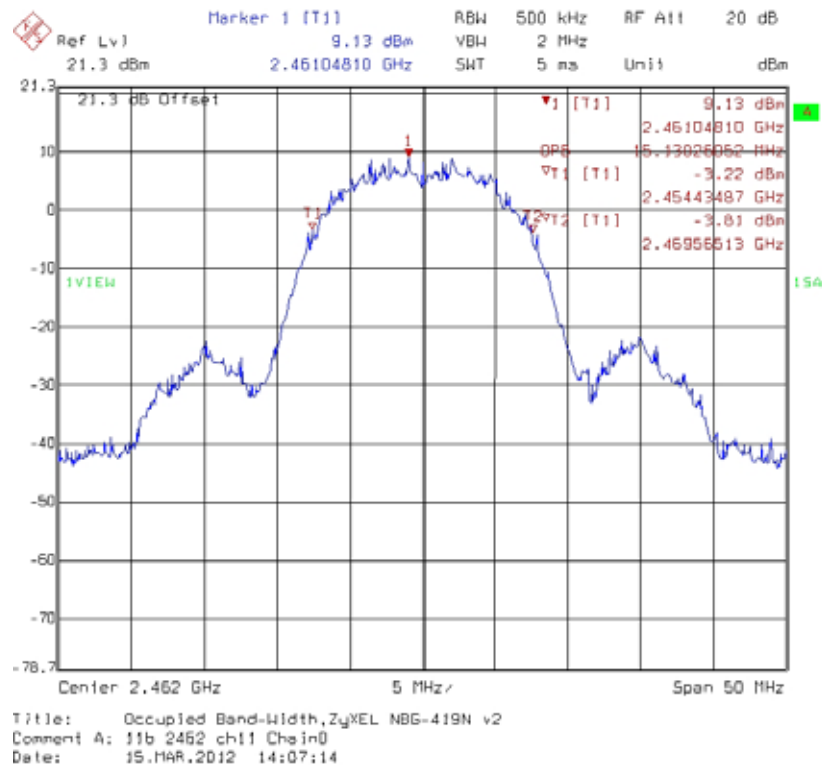
Invax 2 dBi Antenna: 99 % Occupied Bandwidth @ 802.11b mode channel 1



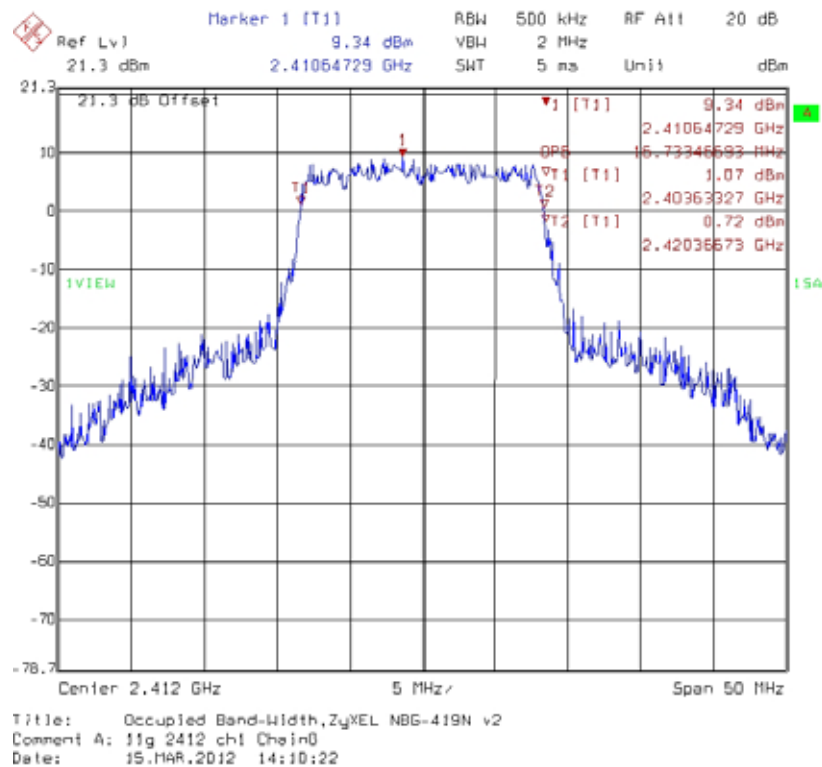
Invax 2 dBi Antenna: 99 % Occupied Bandwidth @ 802.11b mode channel 6



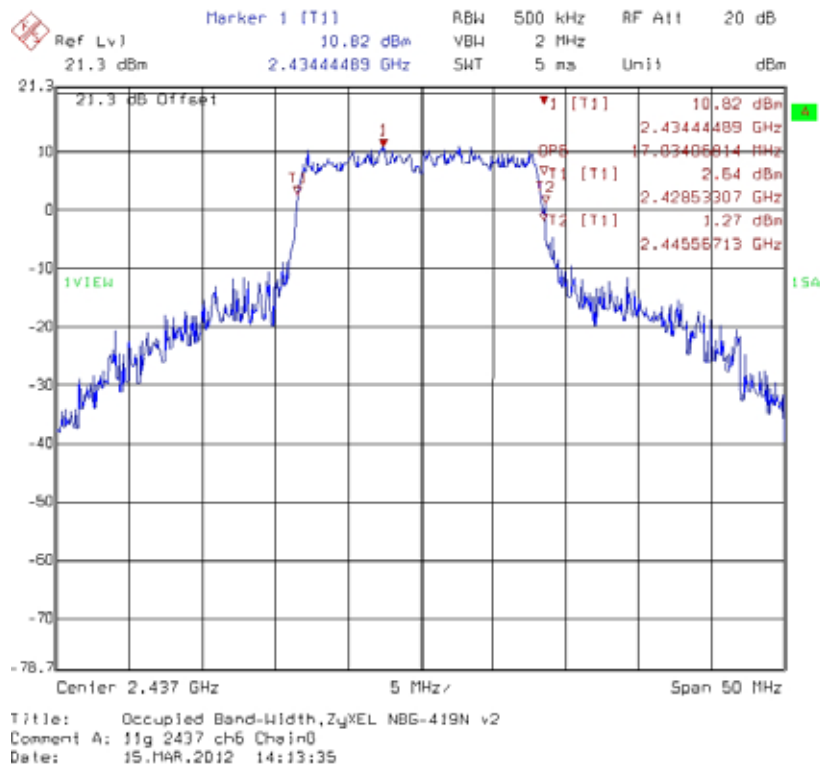
**Invax 2 dBi Antenna: 99 % Occupied Bandwidth @ 802.11b mode channel 11**



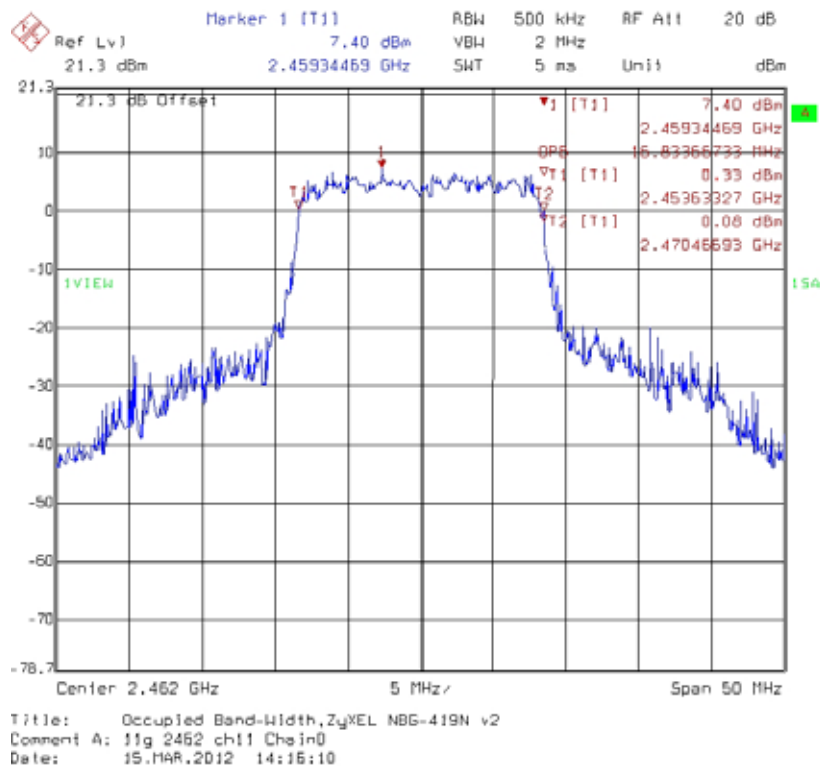
**Invax 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11g mode channel 1**



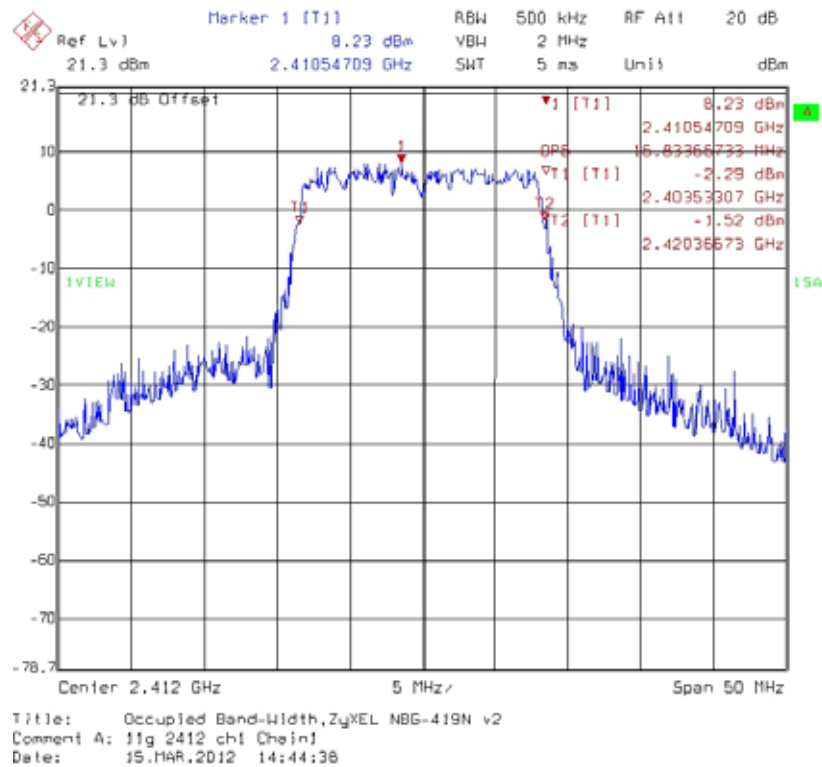
**Invax 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11g mode channel 6**



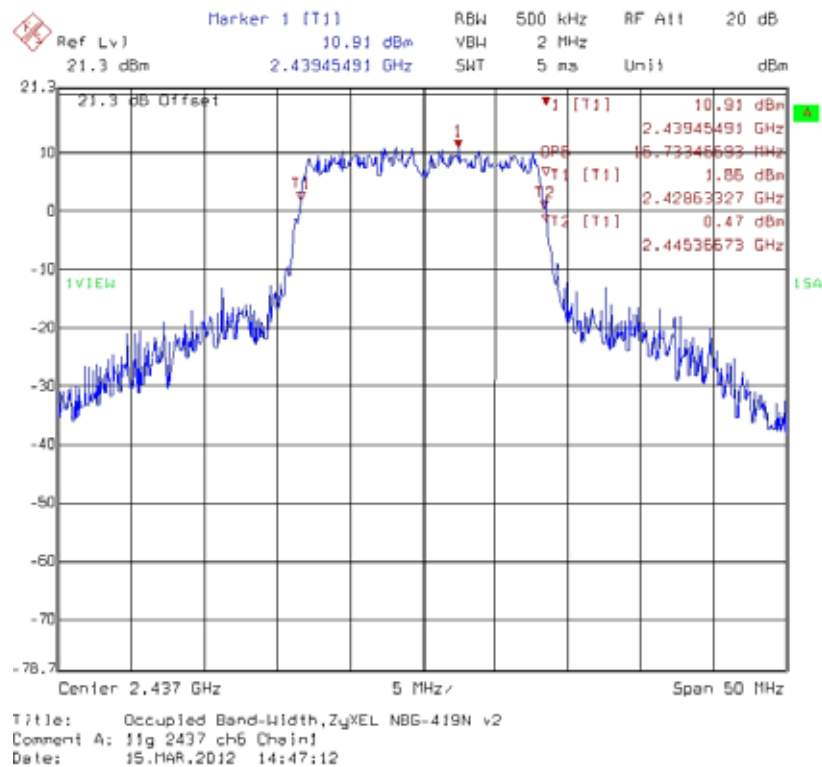
**Invax 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11g mode channel 11**



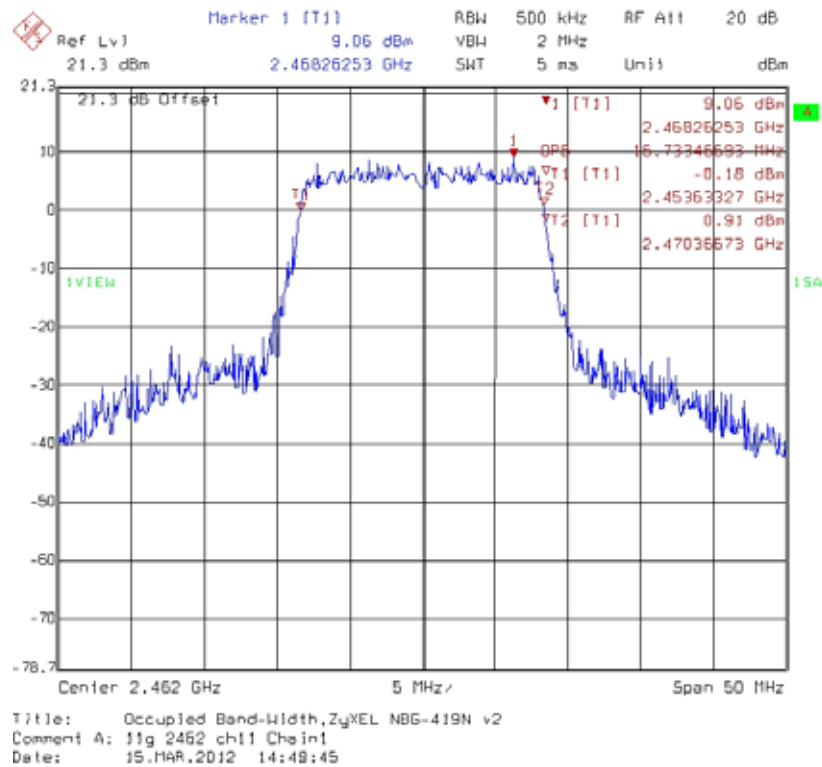
**Invax 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11g mode channel 1**



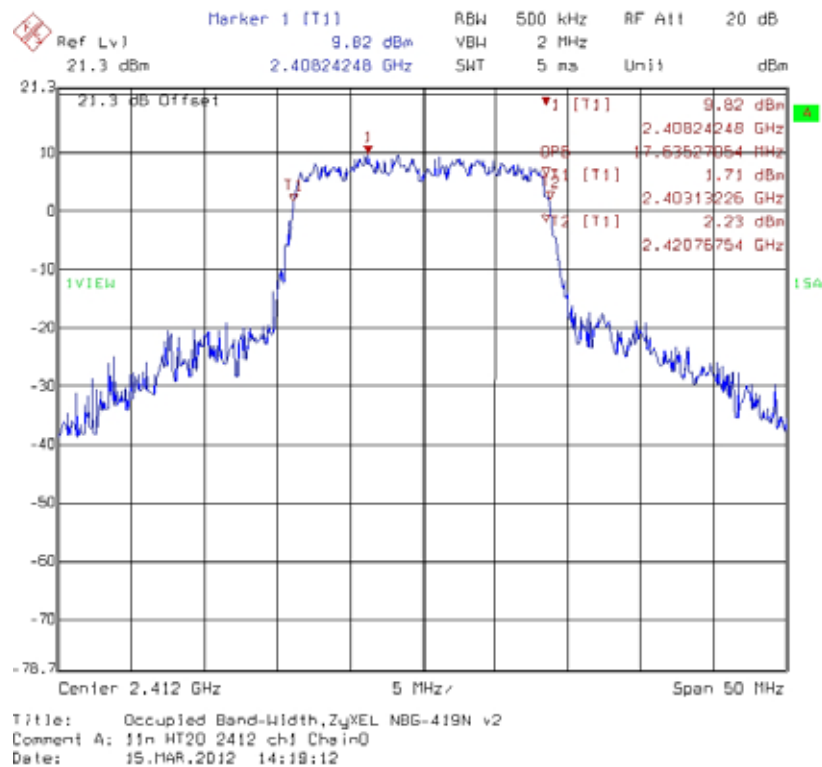
**Invax 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11g mode channel 6**



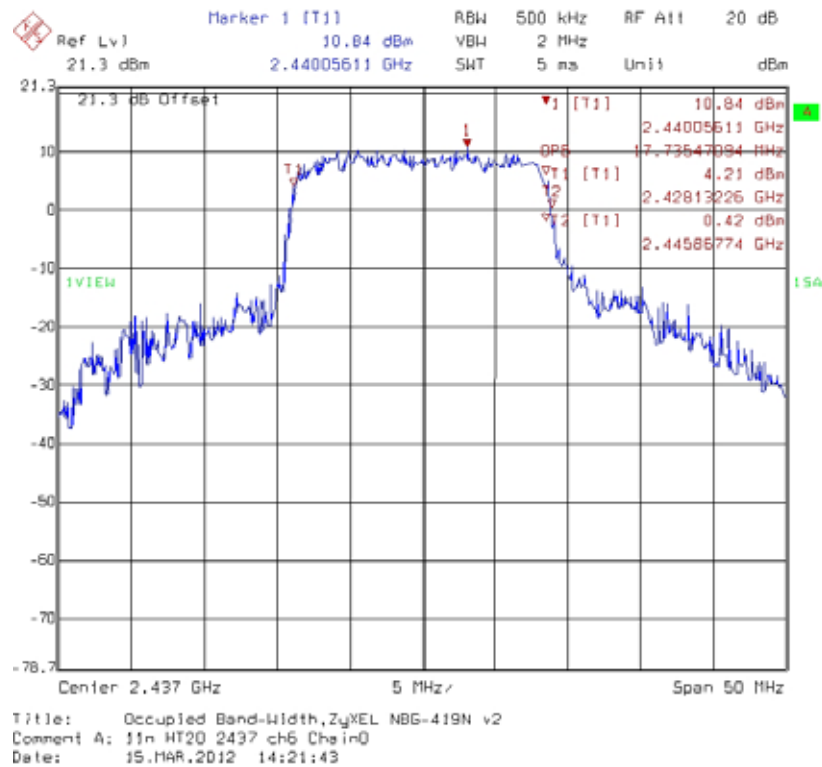
**Invax 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11g mode channel 11**



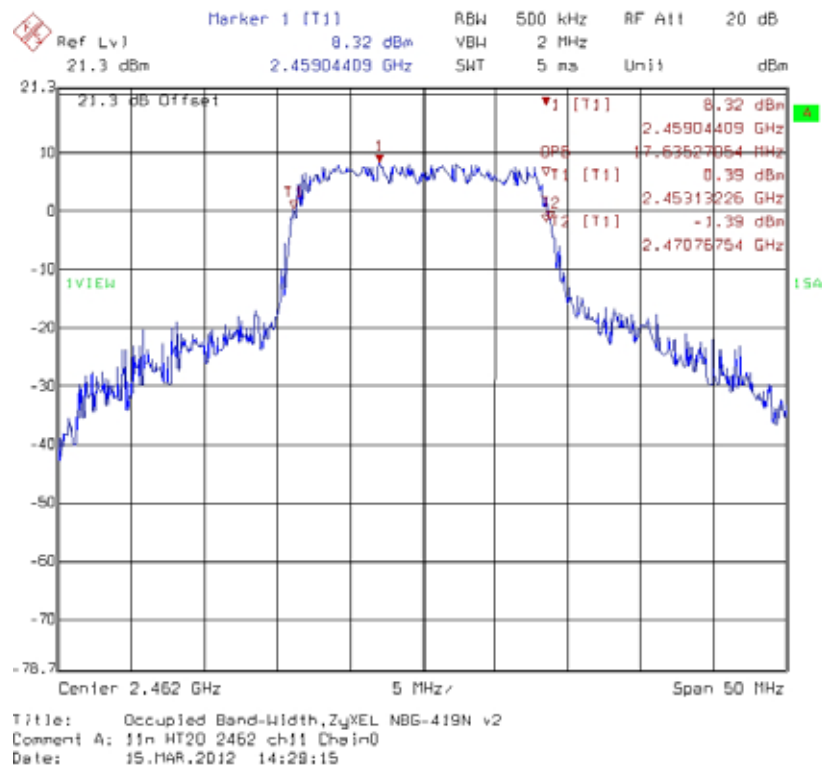
**Invax 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11n HT20 mode channel 1**



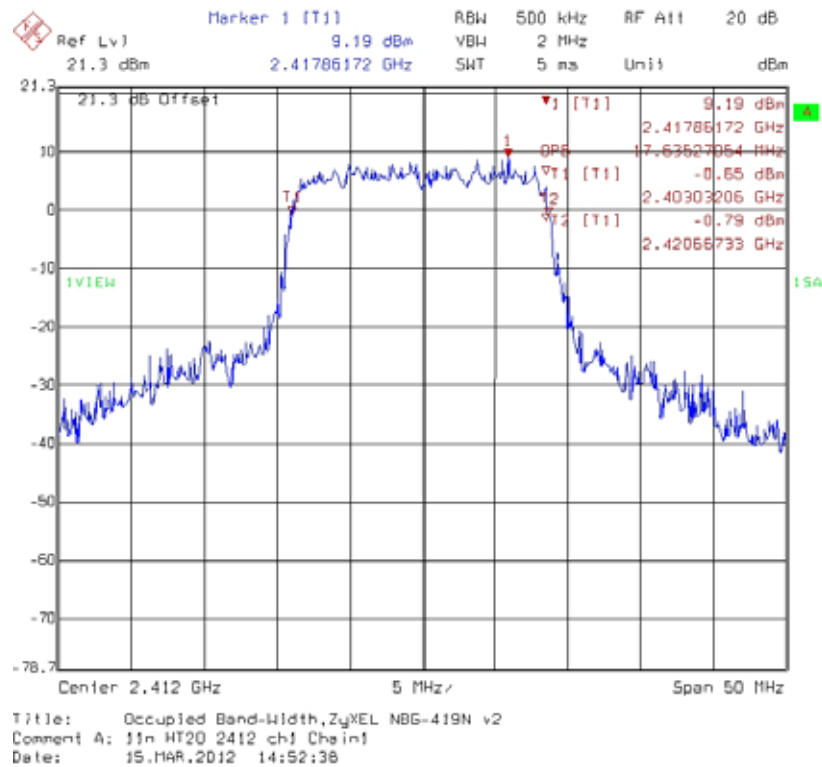
**Invax 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11n HT20 mode channel 6**



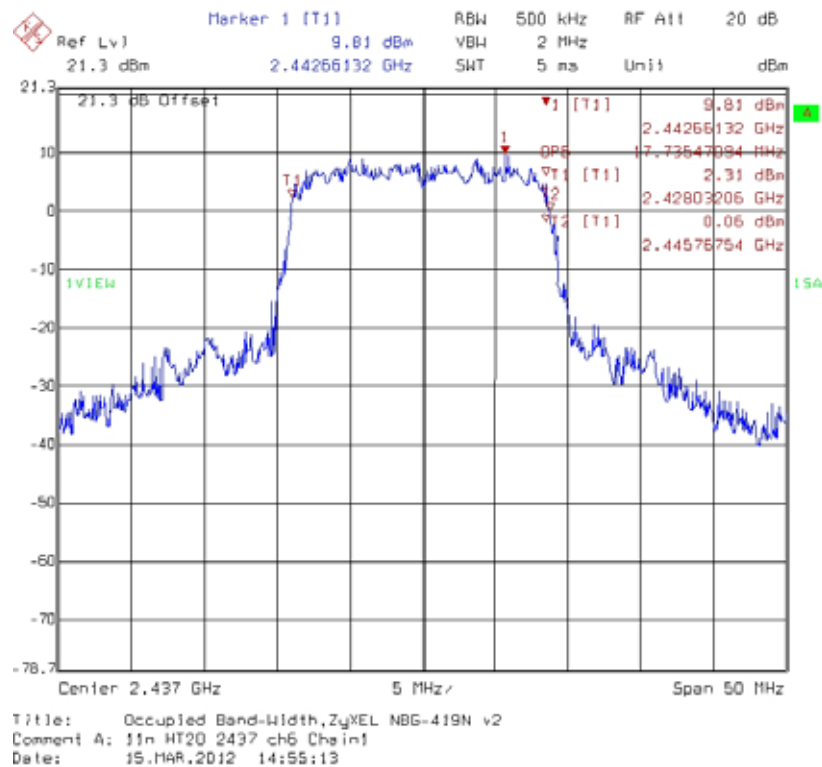
**Invax 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth@802.11n HT20 mode channel 11**



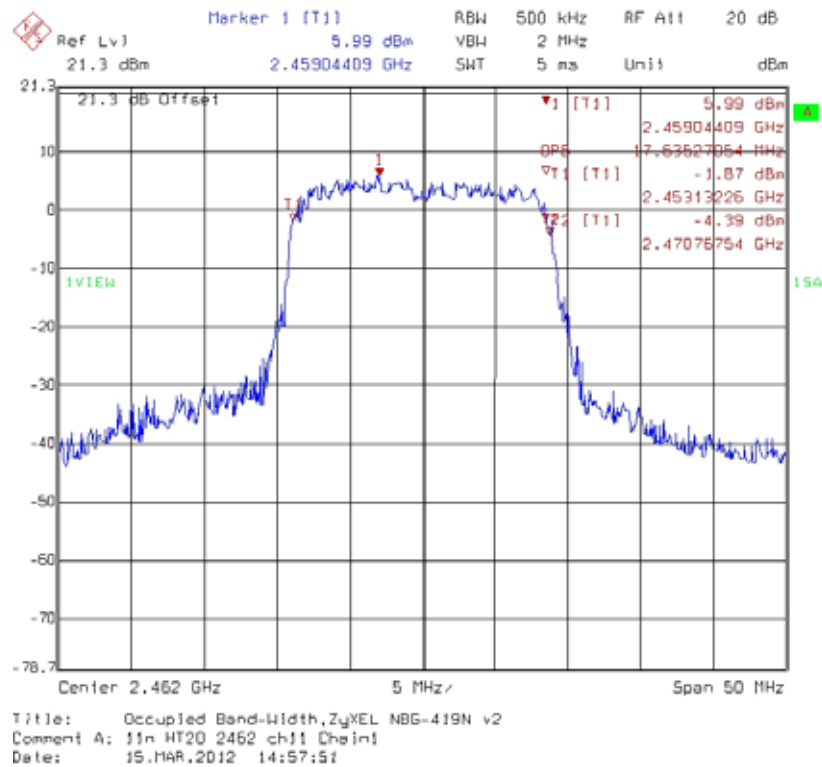
## Invax 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11n HT20 mode channel 1



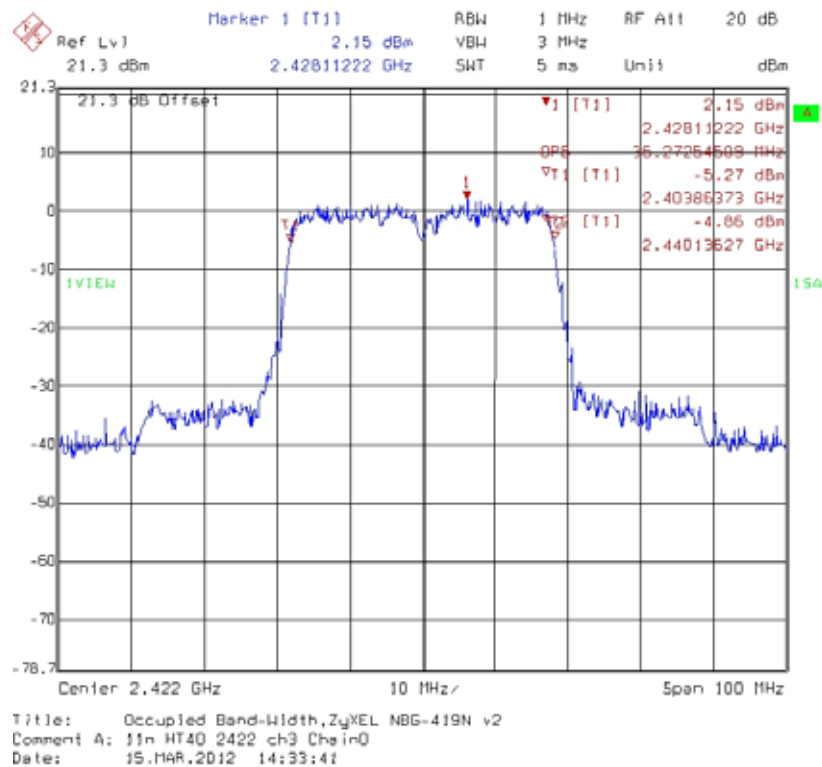
## Invax 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11n HT20 mode channel 6



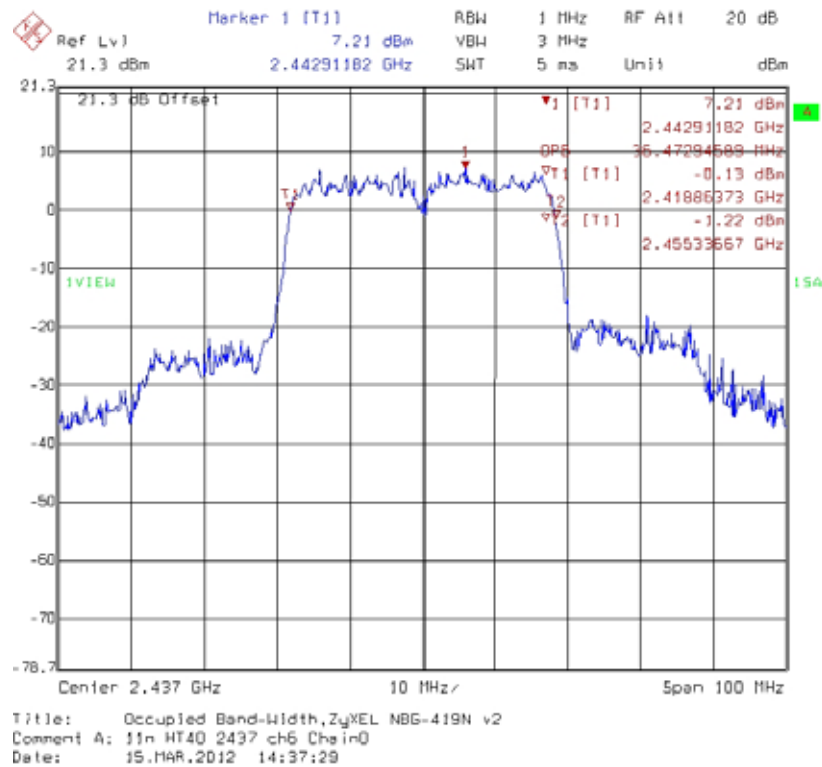
**Invax 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth@802.11n HT20 mode channel 11**



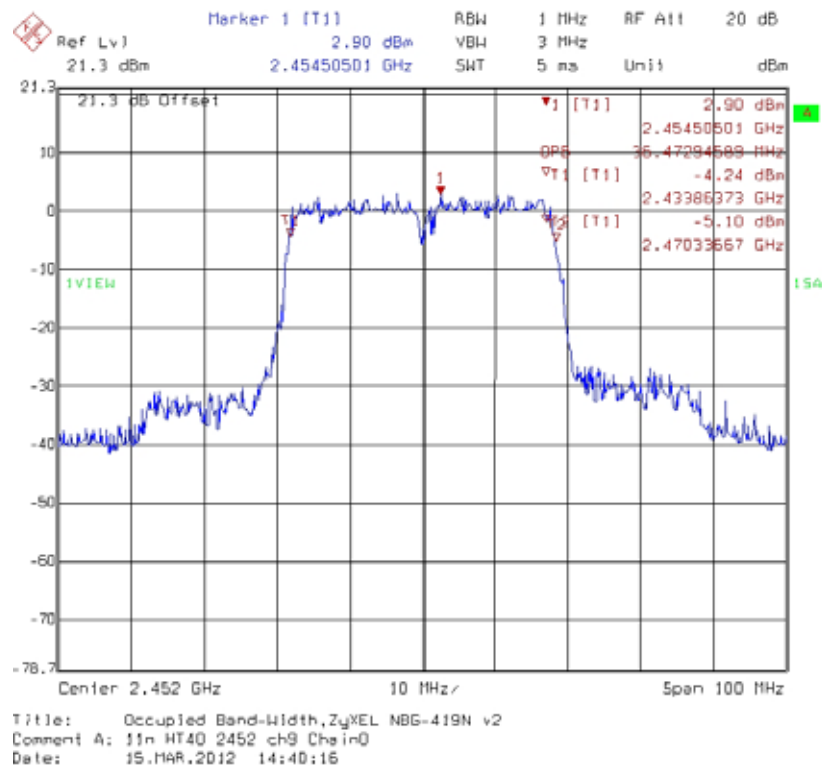
**Invax 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11n HT40 mode channel 3**



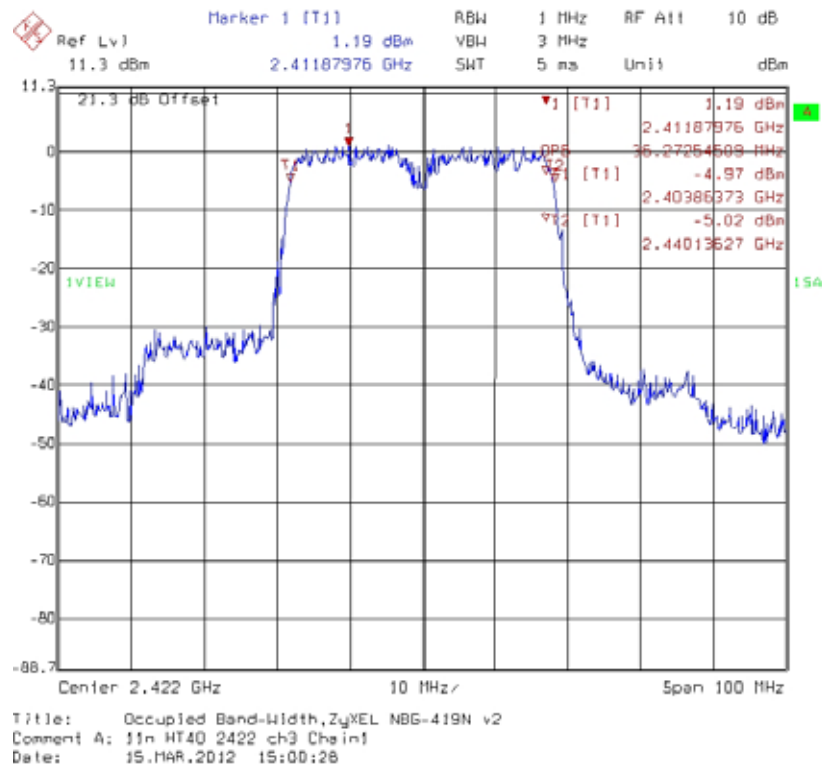
**Invax 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11n HT40 mode channel 6**



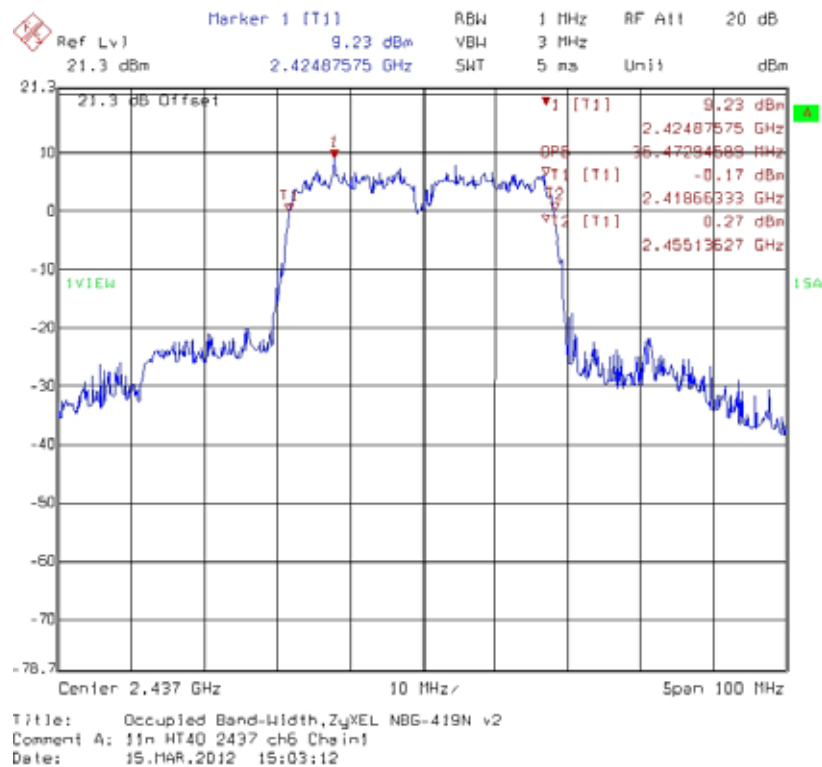
**Invax 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11n HT40 mode channel 9**



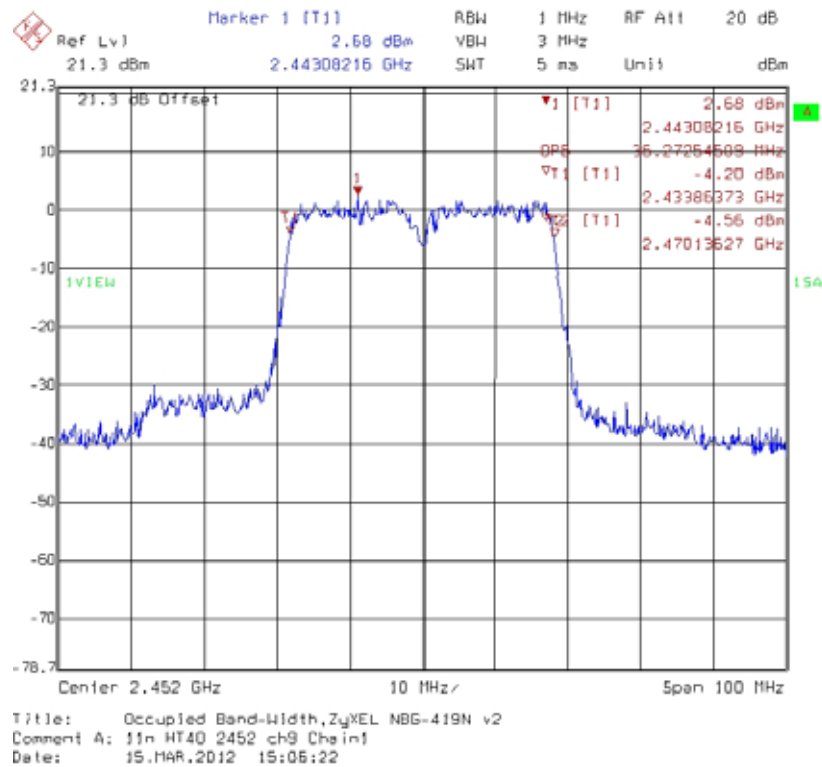
## Invax 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11n HT40 mode channel 3



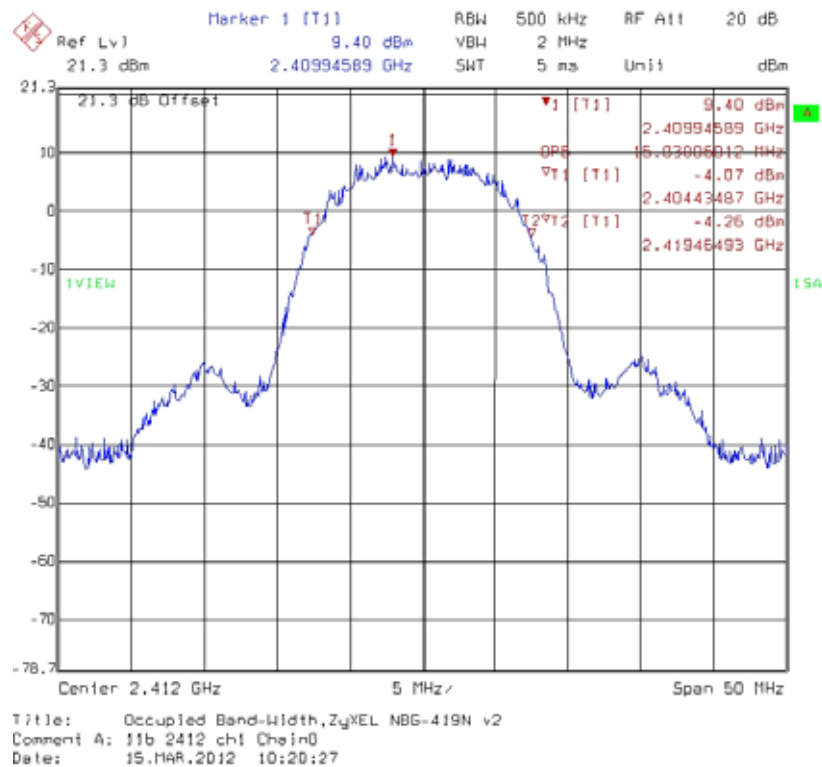
## Invax 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11n HT40 mode channel 6



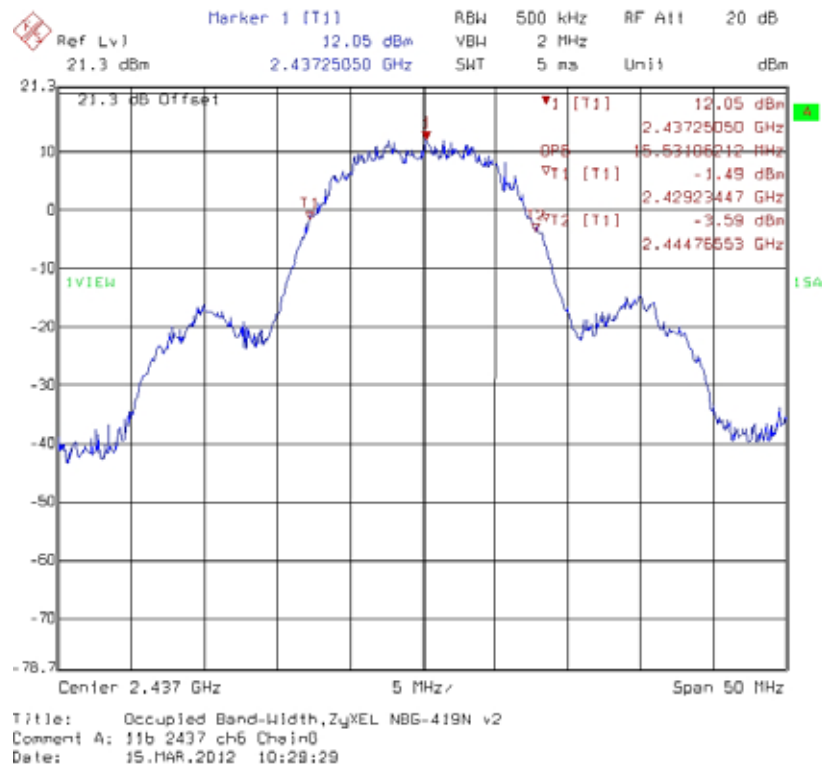
## Invax 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11n HT40 mode channel 9



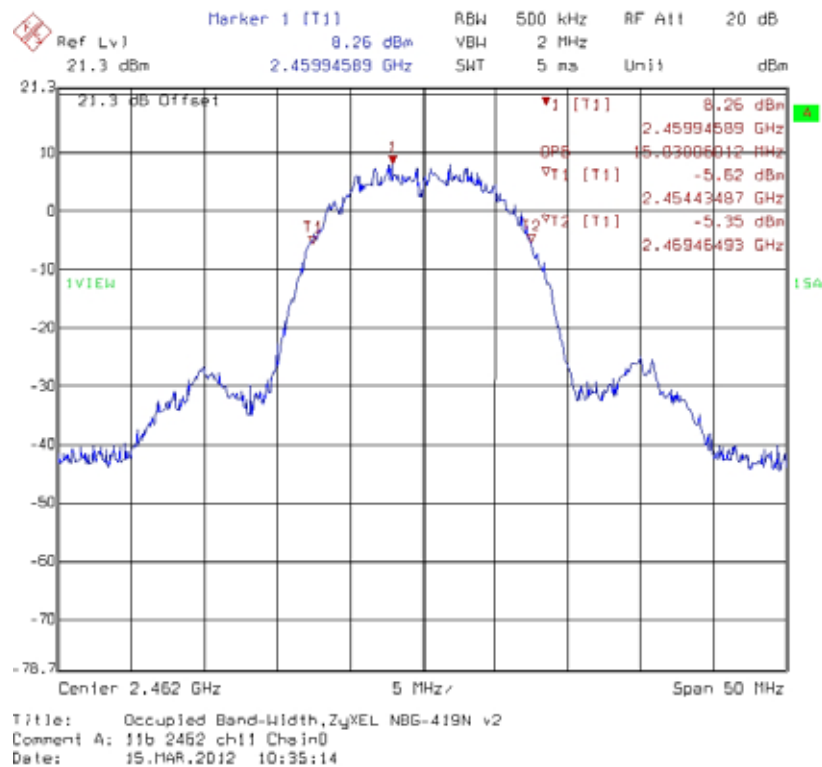
## SAYTEC 2 dBi Antenna: 99 % Occupied Bandwidth @ 802.11b mode channel 1



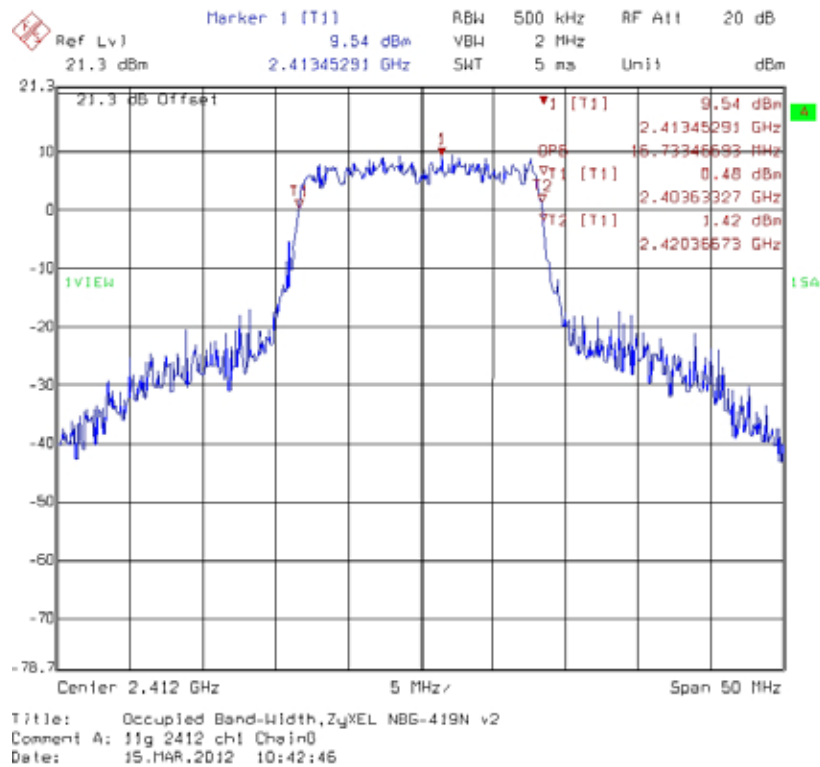
**SAYTEC 2 dBi Antenna: 99 % Occupied Bandwidth @ 802.11b mode channel 6**



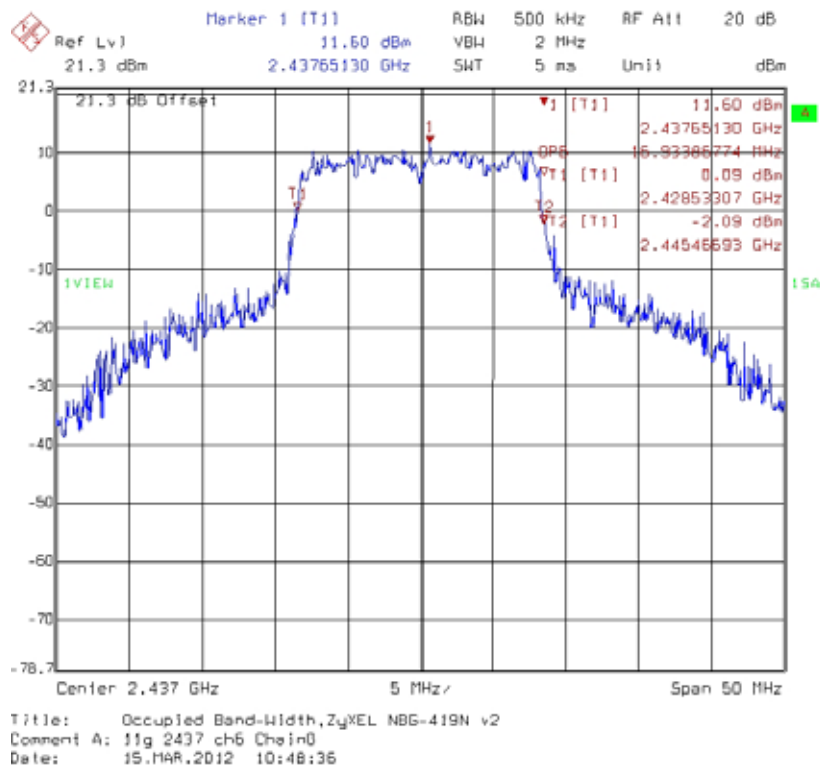
**SAYTEC 2 dBi Antenna: 99 % Occupied Bandwidth @ 802.11b mode channel 11**



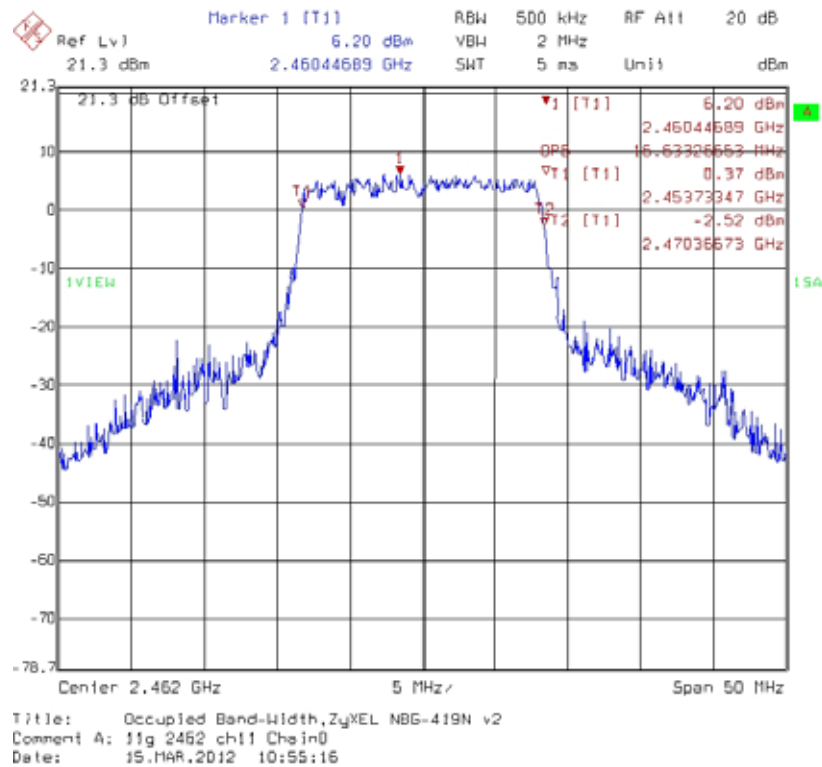
**SAYTEC 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11g mode channel 1**



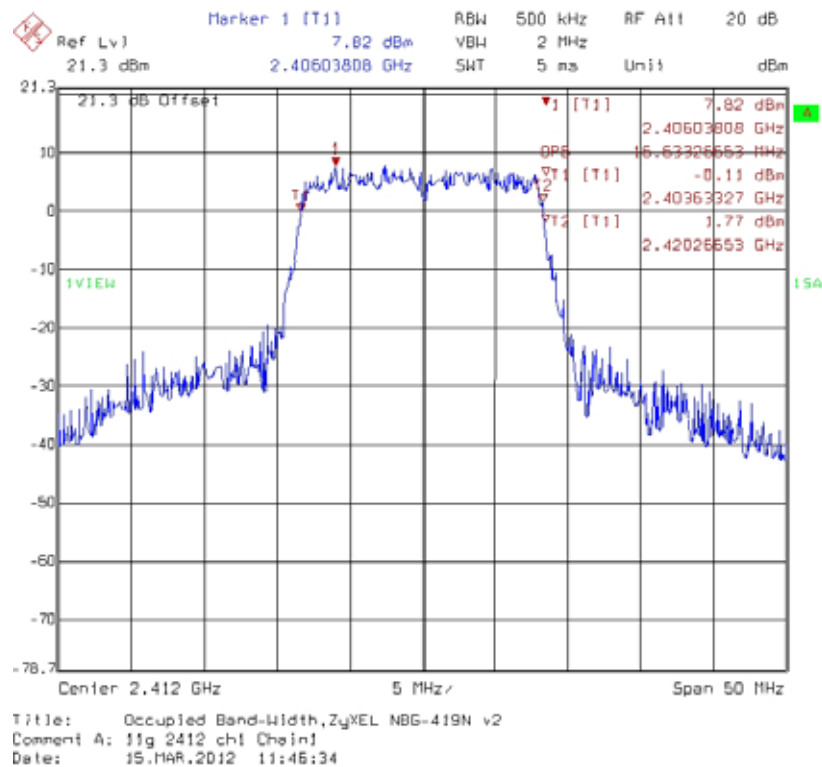
**SAYTEC 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11g mode channel 6**



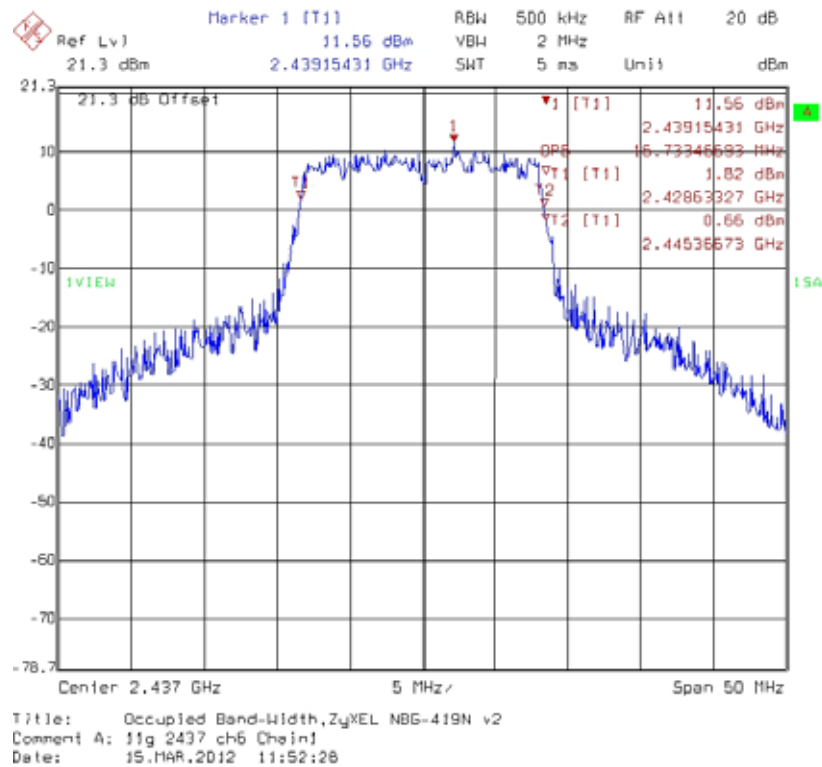
**SAYTEC 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11g mode channel 11**



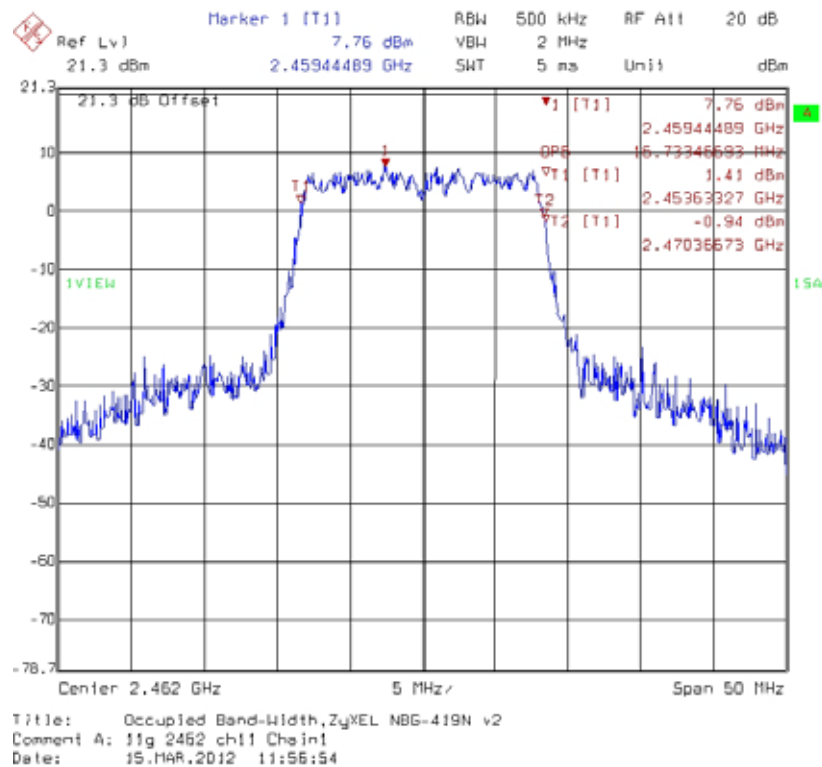
**SAYTEC 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11g mode channel 1**



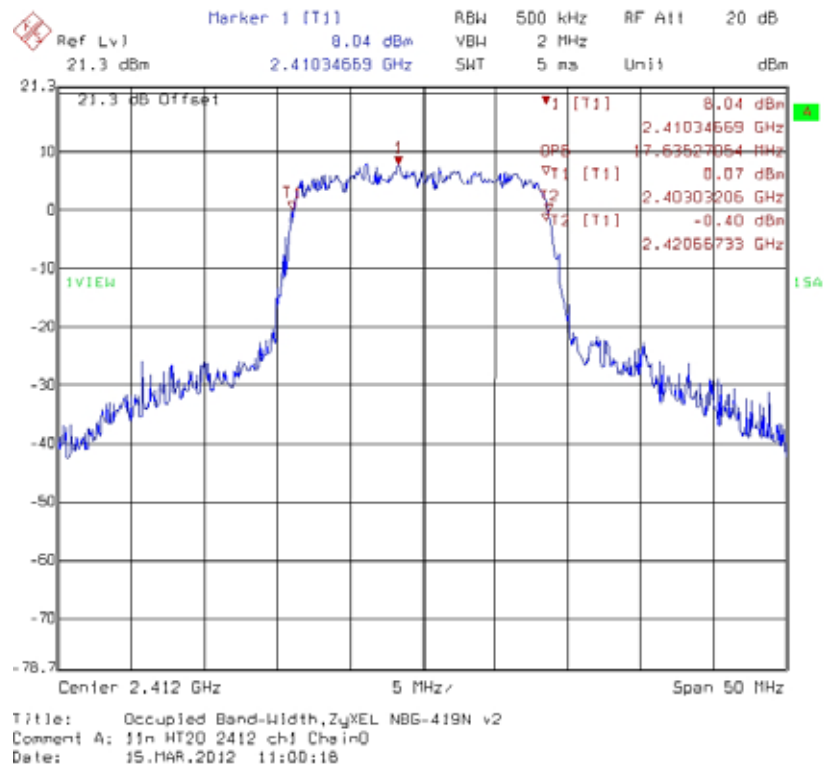
**SAYTEC 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11g mode channel 6**



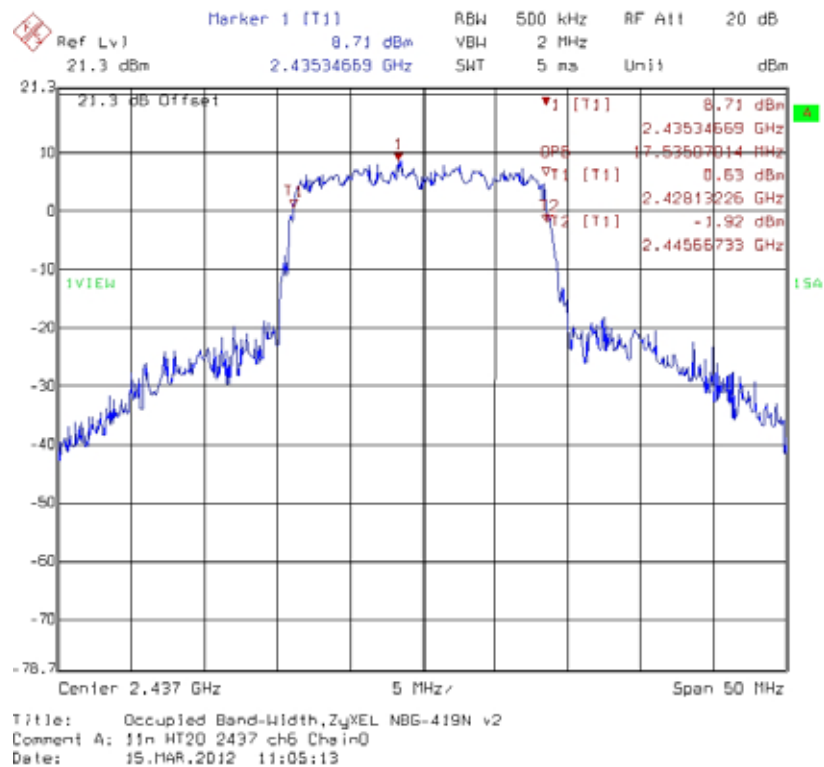
**SAYTEC 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11g mode channel 11**



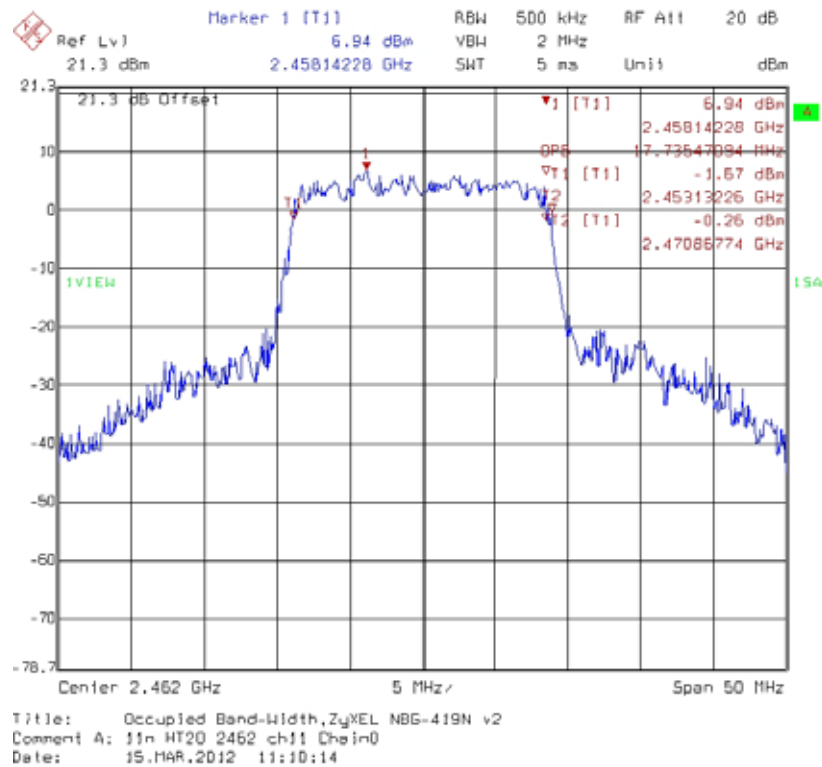
## SAYTEC 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11n HT20 mode channel 1



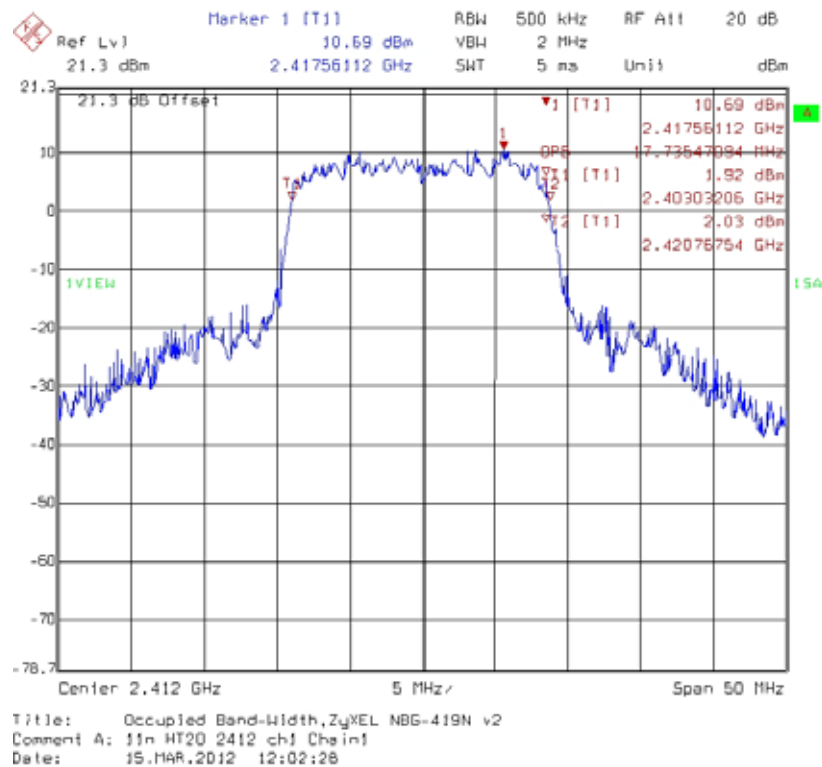
## SAYTEC 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11n HT20 mode channel 6



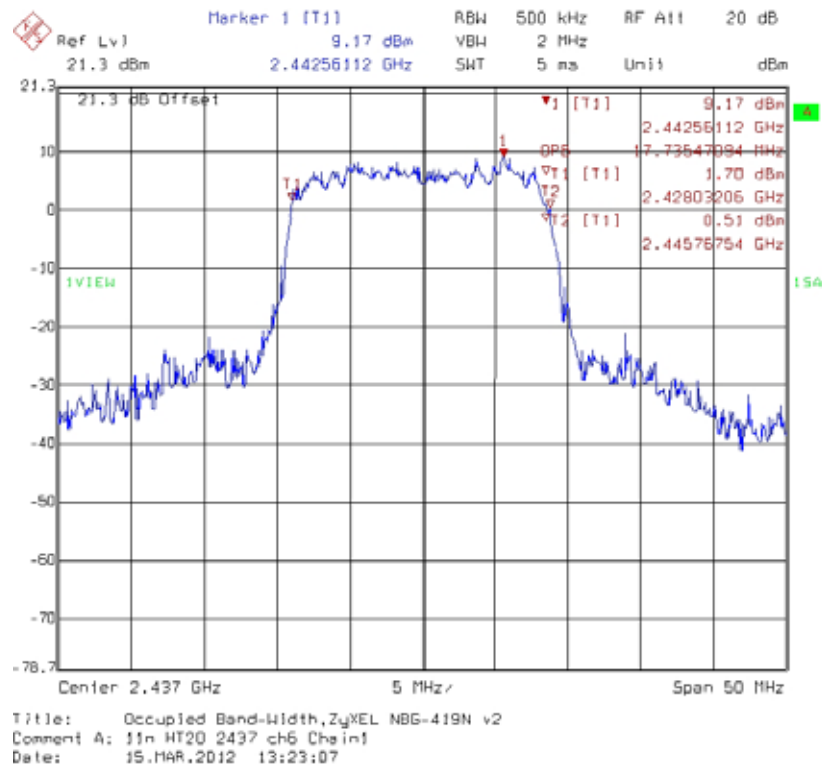
## SAYTEC 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth@802.11n HT20 mode channel 11



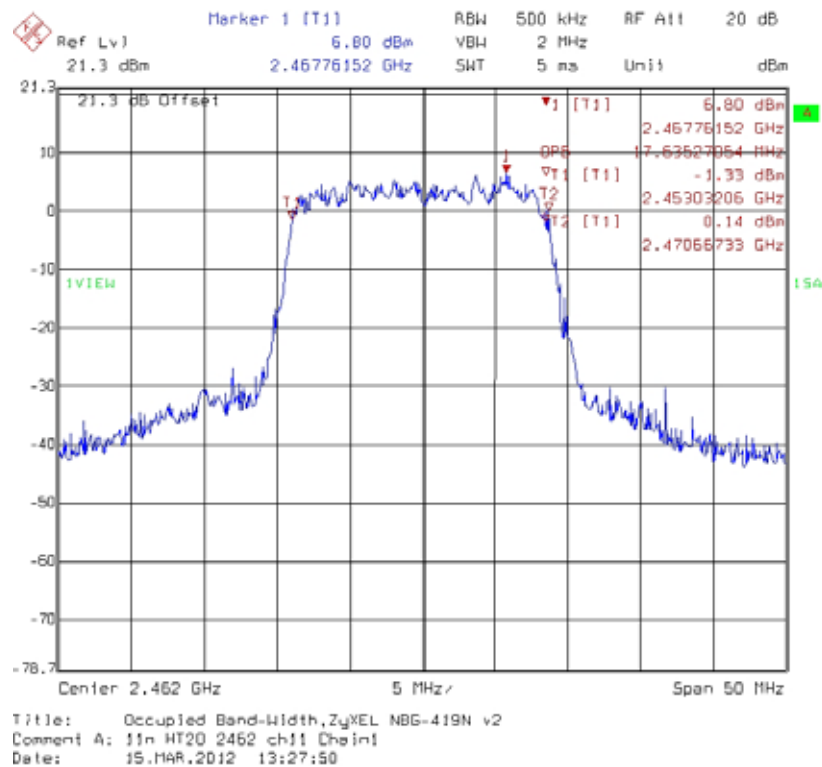
## SAYTEC 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11n HT20 mode channel 1



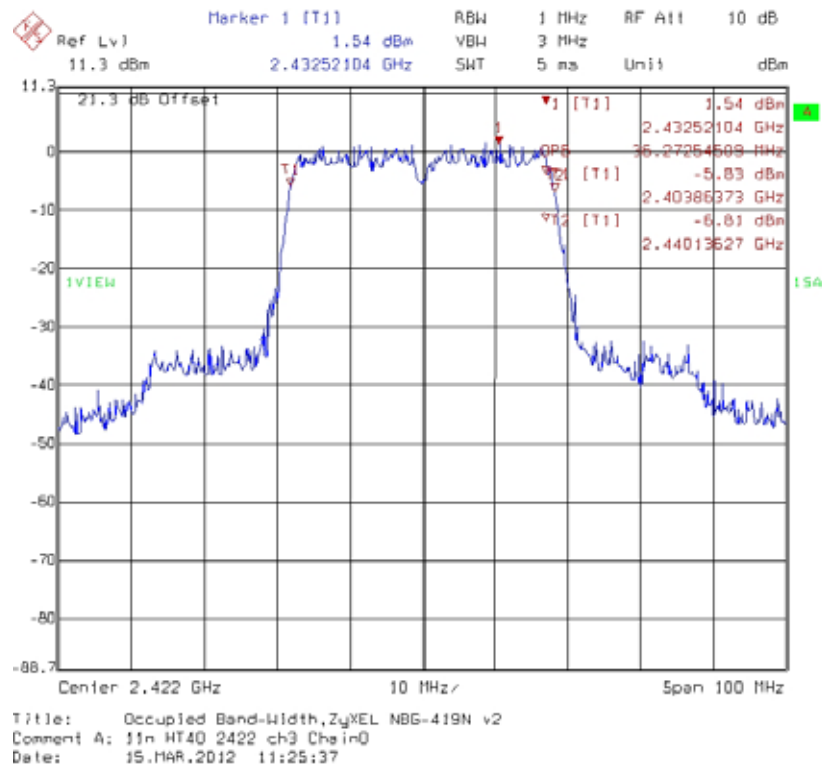
**SAYTEC 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11n HT20 mode channel 6**



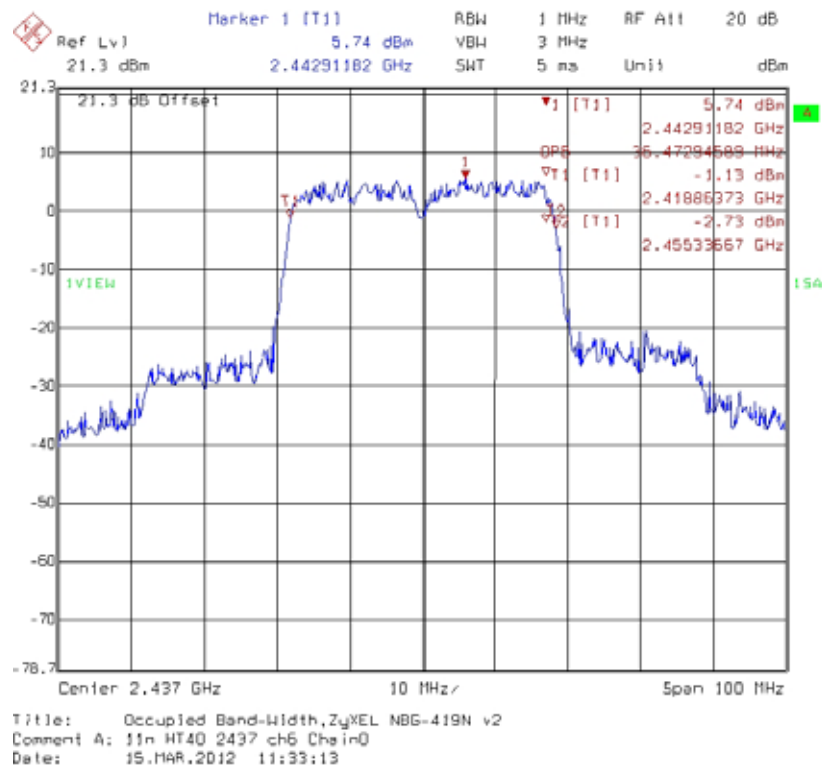
**SAYTEC 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth@802.11n HT20 mode channel 11**



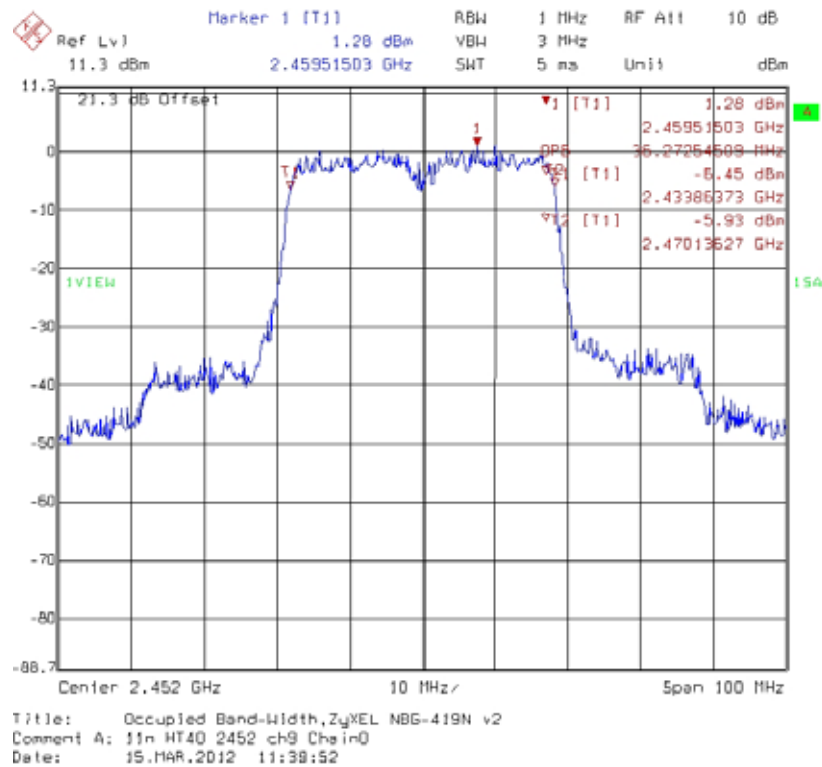
## SAYTEC 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11n HT40 mode channel 3



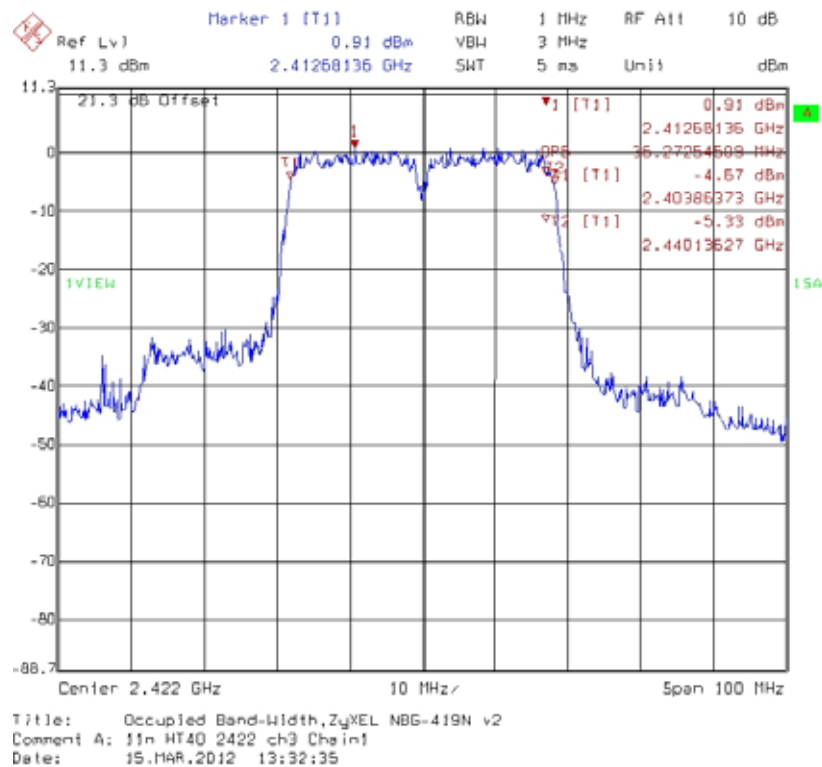
## SAYTEC 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11n HT40 mode channel 6



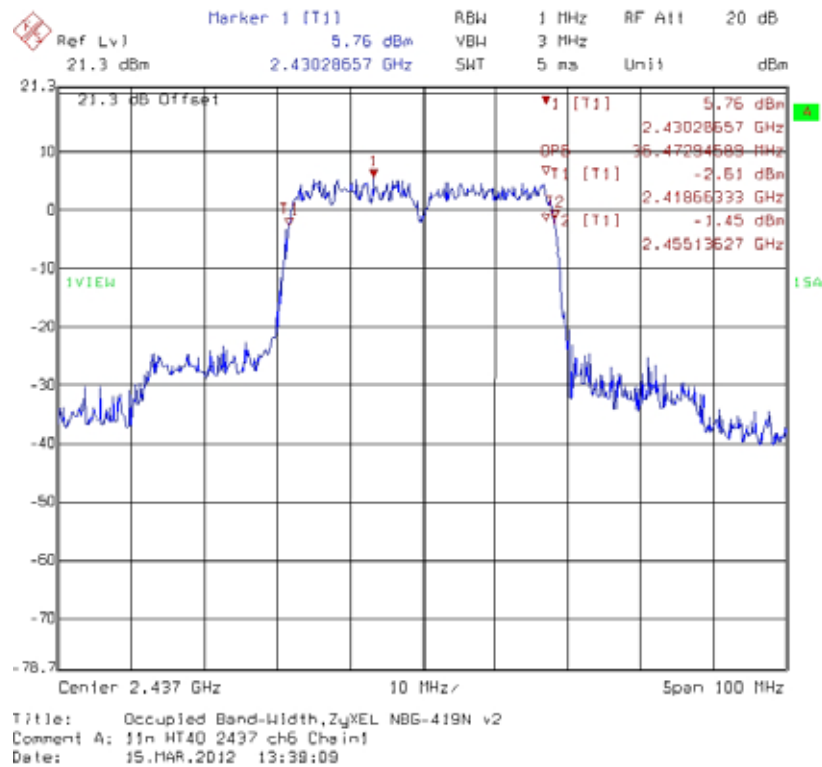
## SAYTEC 2 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11n HT40 mode channel 9



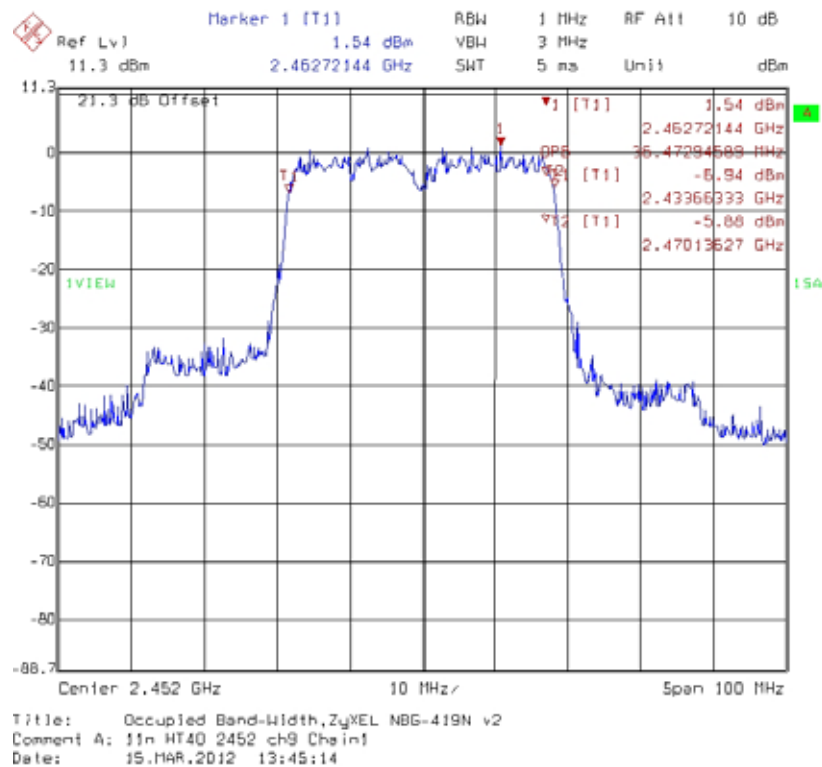
## SAYTEC 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11n HT40 mode channel 3



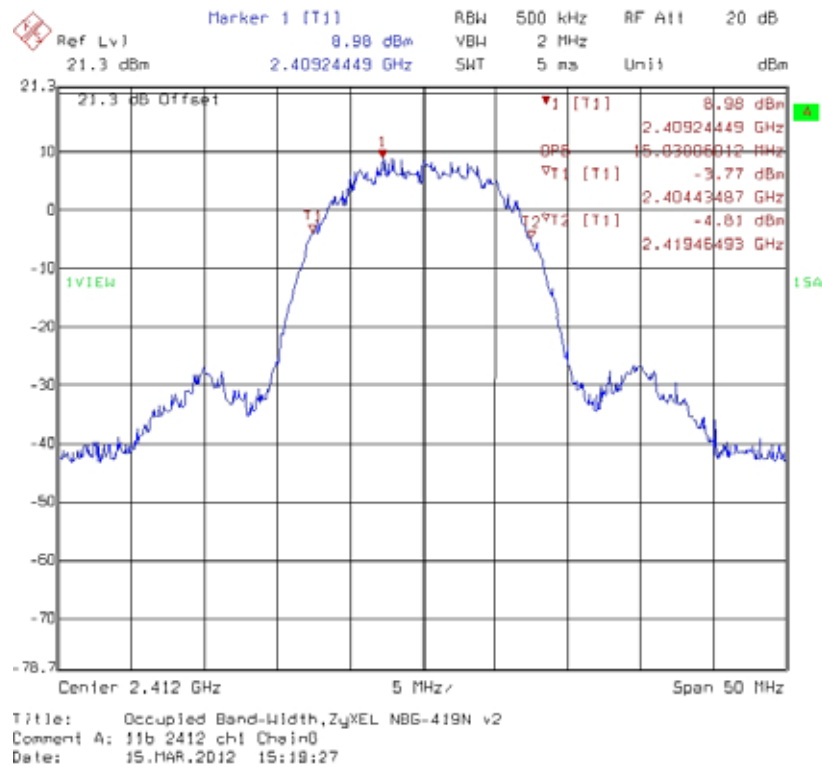
## SAYTEC 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11n HT40 mode channel 6



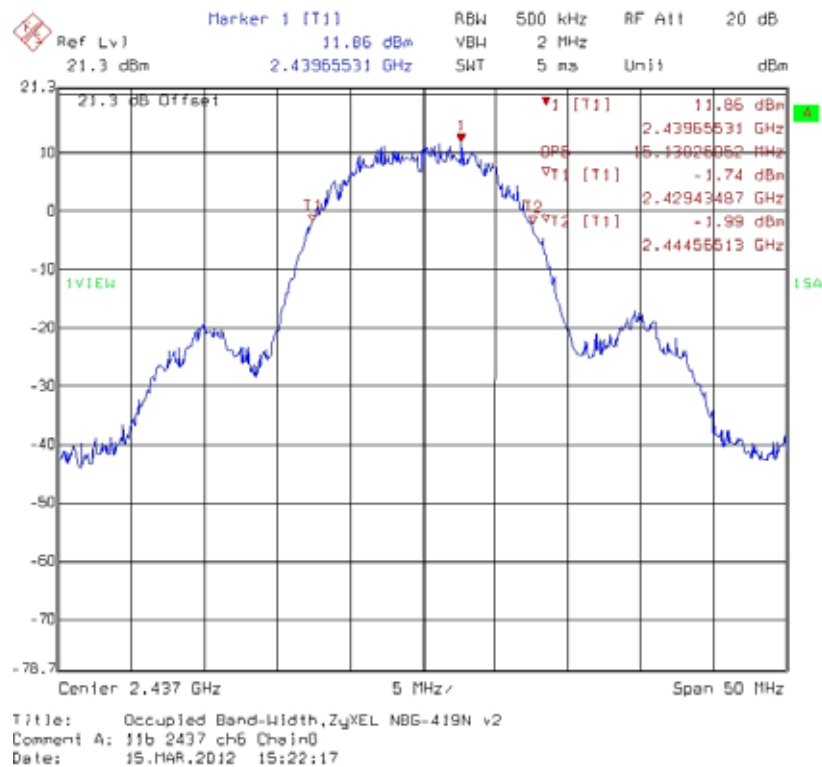
## SAYTEC 2 dBi Antenna: Chain 1: 99 % Occupied Bandwidth @ 802.11n HT40 mode channel 9



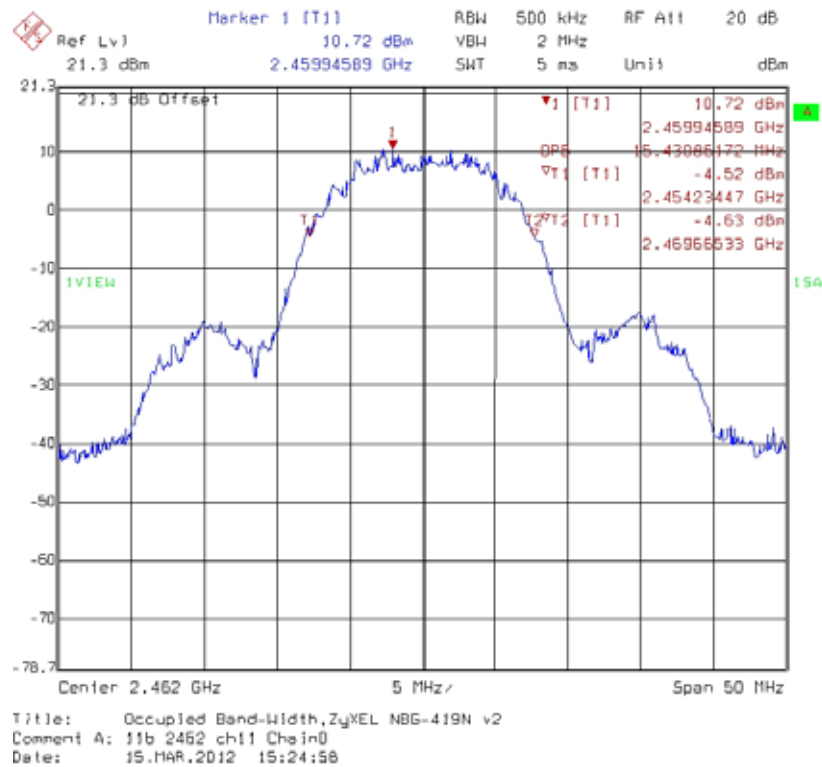
**Invax 5 dBi Antenna: 99 % Occupied Bandwidth @ 802.11b mode channel 1**



**Invax 5 dBi Antenna: 99 % Occupied Bandwidth @ 802.11b mode channel 6**



**Invax 5 dBi Antenna: 99 % Occupied Bandwidth @ 802.11b mode channel 11**



**Invax 5 dBi Antenna: Chain 0: 99 % Occupied Bandwidth @ 802.11g mode channel 1**

