# ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

## INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT AND INDUSTRY CANADA RSS 210

*OF*

| | |
|---|---|
| **Product Name:** | **Juno T41/5** |
| **Brand Name:** | **Trimble** |
| **Marketing Name:** | **RH42G** |
| **Model No.:** | **JUNO/T41/5-BWS** |
| **Model Difference:** | **N/A** |
| **FCC ID:** | **S9E-JNOBWS** |
| **IC:** | **5817A-JNOBWS** |
| **Report No.:** | **EH/2013/70073** |
| **Issue Date:** | **Aug. 14, 2013** |
| **FCC Rule Part:** | **§15.247, Cat: DSS** |
| **IC Rule Part:** | **RSS-210 issue 8 :2010, Annex 8** |
| **Prepared for:** | **Trimble Navigation Limited<br>345 SW Avery Avenue, Corvallis, OR 97333** |
| **Prepared by:** | **SGS Taiwan Ltd.<br>Electronics & Communication Laboratory<br>No.134, Wu Kung Road, New Taipei Industrial Park, Wuku District, New Taipei City, Taiwan 24803** |

Testing Laboratory
0513

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# CERTIFICATION OF COMPLIANCE

| | |
|---|---|
| **Applicant:** | Trimble Navigation Limited<br>345 SW Avery Avenue, Corvallis, OR 97333 |
| **Product Name:** | Juno T41/5 |
| **Brand Name:** | Trimble |
| **Marketing Name:** | RH42G |
| **Model No.:** | JUNO/T41/5-BWS |
| **Model Difference:** | N/A |
| **FCC ID:** | S9E-JNOBWS |
| **IC:** | 5817A-JNOBWS |
| **File Number:** | EH/2013/70073 |
| **Date of test:** | Apr. 11, 2013 ~ Aug. 14, 2013 |
| **Date of EUT Received:** | Apr. 11, 2013 |

## We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.4:2009 and RSS-Gen. issue 3:2010, the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits of FCC Rules Part 15.247 and IC RSS-210 issue 8: 2010 Annex 8.

The test results of this report relate only to the tested sample identified in this report.

| | | | |
|---|---|---|---|
| ***Test By:*** | Nick Lin | ***Date:*** | Aug. 14, 2013 |
| | ***Nick Lin / Engineer*** | | |
| ***Prepared By:*** | Julia Chang | ***Date:*** | Aug. 14, 2013 |
| | ***Julia Chang / Clerk*** | | |
| ***Approved By:*** | Jim Chang | ***Date:*** | Aug. 14, 2013 |
| | ***Jim Chang / Supervisor*** | | |

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# Version

| Version No. | Date | Description |
|---|---|---|
| 00 | Aug. 14, 2013 | Initial creation of document |
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# 1. GENERAL INFORMATION

## 1.1. Product Description

**General:**

| | | |
|---|---|---|
| Product Name: | Juno T41/5 | |
| Brand Name: | Trimble | |
| Marketing Name: | RH42G | |
| Model No.: | JUNO/T41/5-BWS | |
| Model difference: | N/A | |
| Hardware Version: | 2.0 | |
| Software Version: | 2.1 | |
| Data Cable: | Model: A9136939, Supplier: Sinbon | |
| Power Supply: | 3.7Vdc Rechargeable Li-polymer battery or 5Vdc from adapter | |
| | Battery: | Model No.: S11GD103A, Supplier: LICO |
| | Adapter: | Model No.: PSA10F-050Q-R, Supplier: PHIHONG TECHNOLOGY CO., LTD |

**Bluetooth:**

| | |
|---|---|
| Bluetooth Version: | V2.1 + EDR (GFSK + π/4DQPSK + 8DPSK) |
| Channel number: | 79 channels |
| Modulation type: | GFSK+ π /4DQPSK+8DPSK |
| Transmit Power: | 5.05dBm (Peak) |
| Frequency Range: | 2.402GHz – 2.480GHz |
| Dwell Time: | <= 0.4s |
| Operating Mode: | Point-to-Point |
| Antenna Designation: | PIFA Antenna, Gain: 2.5dBi |
| Type of Emission: | BDR:9k02F1D<br>EDR:1M19G1D |

The EUT is compliance with Bluetooth 2.1 Standard.
This report applies for Bluetooth

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## 1.2. Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for **FCC ID: S9E-JNOBWS** filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules and **IC: 5817A-JNOBWS**filing to comply with Industry Canada RSS-210 issue 8: 2010 Annex 8. The composite system (digital device) is compliance with Subpart B is authorized under a Doc procedure.

## 1.3. Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4:2009. Radiated testing was performed at an antenna to EUT distance 3 meters. Tested in accordance with FCC Public Notice DA 00-705 – Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

## 1.4. Test Facility

The measurement facilities used to collect the 3m Radiated Emission and AC power line conducted data are located on the address of SGS Taiwan Ltd. No. 134, Wu Kung Rd., Wuku Industrial Zone, Taipei Country, Taiwan which are constructed and calibrated to meet the FCC requirements in documents ANSI C63.4: 2009. FCC Registration Number are: 990257, Canada Registration Number: 4620A-4.

The 10 m Open Area Test Sites located on the address of SGS Taiwan Ltd. No. 29, Pau-Tou-Tsuo Valley Chia-Pau Tsuen, Linkou Hsiang, Taipei county, which is constructed and calibrated to meet the CISPR 22/EN 55022 requirements. SGS Site No. 1(3 &10 meters) and FCC Registration Number: 94644.

## 1.5. Special Accessories

Not available for this EUT intended for grant.

## 1.6. Equipment Modifications

Not available for this EUT intended for grant.

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# 2. SYSTEM TEST CONFIGURATION

## 2.1. EUT Configuration

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

## 2.2. EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

## 2.3. Test Procedure

### 2.3.1 Conducted Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. According to the requirements in Section 7.3.1 of ANSI C63.4:2009 RSS-Gen Issue3: 2010.Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-Peak and Average detector mode.

### 2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made “while keeping the antenna in the ‘cone of radiation’ from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response.” is still within the 3dB illumination BW of the measurement antenna according to the requirements in Section 8 and 13 of ANSI C63.4:2009 and DA 00-705.

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## 2.4. Configuration of Tested System

**Fig. 2-1 Radiated Emission & Conducted (Antenna Port) Configuration**

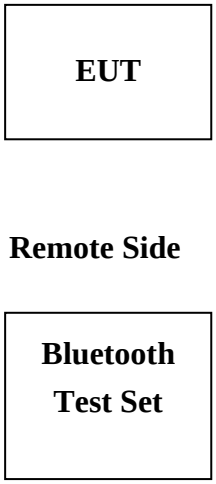


**Table 2-1 Equipment Used in Tested System**

| Item | Equipment | Mfr/Brand | Model/Type No. | Series No. | Data Cable | Power Cord |
|---|---|---|---|---|---|---|
| 1. | Bluetooth Test Set | Anritsu | MT8852B | 6k00006107 | N/A | N/A |

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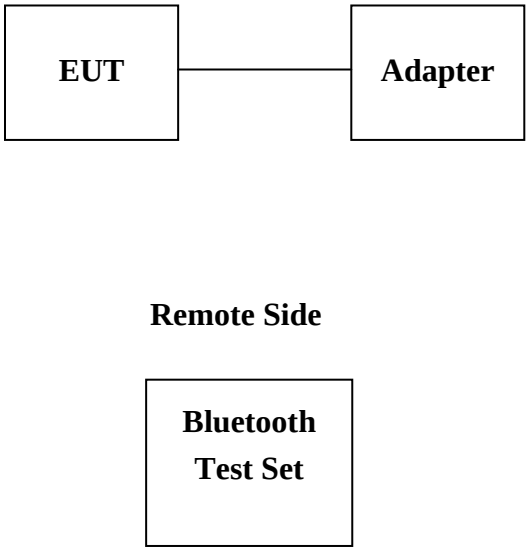
## Fig. 2-2 AC Power line Conducted Emission




## Table 2-2 Equipment Used in Tested System

| Item | Equipment | Mfr/Brand | Model/Type No. | Series No. | Data Cable | Power Cord |
|---|---|---|---|---|---|---|
| 2. | Bluetooth Test Set | Anritsu | MT8852B | 6k00006107 | N/A | N/A |

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# 3. SUMMARY OF TEST RESULTS

| FCC/IC Rules | Description Of Test | Result |
|---|---|---|
| §15.207(a)<br>RSS-Gen §7.2.4 | AC Power Line Conducted Emission | Compliant |
| §15.247(b)(1)<br>RSS-210 issue 8,§A8.4(2) | Peak Output Power | Compliant |
| §15.247(a)(1)<br>RSS210 issue ,§A8.1(b)<br>RSS-Gen §4.6.3<br>RSS-Gen §4.6.1 | 20dB Bandwidth<br>&<br>99% Power Bandwidth | Compliant |
| §15.247(d)<br>RSS-210 issue 8,§A8.5 | 100 kHz Bandwidth Of Frequency Band Edges | Compliant |
| $15.247(d)<br>§15.209(a) (f)<br>RSS-Gen §7.2.5<br>RSS-210 issue 8,§A8.5 | Spurious Emission | Compliant |
| §15.247(a)(1)<br>RSS-210 issue 8,§A8.1(b) | Frequency Separation | Compliant |
| §15.247(a)(1)(iii)<br>RSS-210 issue 8,§A8.1(d) | Number of hopping frequency | Compliant |
| §15.247(a)(1)(iii)<br>RSS-210 issue 8,§A8.1(d) | Time of Occupancy | Compliant |
| §15.203,<br>RSS- Gen issue §7.1.2 | Antenna Requirement | Compliant |

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# 4. DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition.
Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.
Channel Low, Mid and High with DH5 highest rated data rate were chosen as worst case for full testing.

The field strength of spurious radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for Bluetooth Transmitter for channel Low, Mid and High the worst case E2 position was reported.

In comparison with BR and EDR mode, emission carried out by EDR is chosen as the most representative measurement to perform measurement of every test item pursuant to Part 15 C and RSS-210.

The given application is removed WWAN of certified product, S9E-JNOBWCS, 5817A-JNOBWCS. It differs only WWAN module removed that is preserved in the built applicable S9E-JNOBWCS and 5817A-JNOBWCS. Except for the change as aforementioned above, all hardware, software relevant to RF Parameter of Physical layer, I/O signal remains unchanged, and the data as measured in the authorization of S9E-JNOBWCS, 5817A-JNOBWCS, and remains, and entails representative.

This test report demonstrates the result of spot-check on Radiated Spurious Emission in order to reveal of the evidence of compliance record proving the implementation of dual SIM built causes no degradation as compared to build, S9E-JNOBWCS / 5817A-JNOBWCS.

Note: The given application of Bluetooth transmitter is collocated with Wifi transmitter, and capable of transmitting simultaneously. The switch is implemented to allocate only one transmission at a time, and therefore spurious emission impacted with two collocated transmitters is not required to be measured.

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# 5. MEASUREMENT UNCERTAINTY

| Test Items | Uncertainty |
|---|---|
| AC Power Line Conducted Emission | +/- 2.586 dB |
| Peak Output Power | +/- 1.55 dB |
| 20dB Bandwidth & 99% Power Bandwidth | +/- 123.36 Hz |
| 100 KHz Bandwidth Of Frequency Band Edges | +/- 1.55 dB |
| Frequency Separation | +/- 123.36 Hz |
| Number of hopping frequency | +/- 123.36 Hz |
| Time of Occupancy | +/- 123.36 Hz |
| Temperature | +/- 0.8 °C |
| Humidity | +/- 4.7 % |
| DC / AC Power Source | DC= +/- 1%, AC= +/- 0.2% |

Radiated Spurious Emission:

| | |
|---|---|
| Measurement uncertainty (Polarization : **Vertical**) | 30MHz - 180MHz: +/- 3.37dB |
| | 180MHz -417MHz: +/- 3.19dB |
| | 0.417GHz-1GHz: +/- 3.19dB |
| | 1GHz - 18GHz: +/- 4.04dB |
| | 18GHz - 40GHz: +/- 4.04dB |

| | |
|---|---|
| Measurement uncertainty (Polarization : **Horizontal**) | 30MHz - 167MHz: +/- 4.22dB |
| | 167MHz -500MHz: +/- 3.44dB |
| | 0.5GHz-1GHz: +/- 3.39dB |
| | 1GHz - 18GHz: +/- 4.08dB |
| | 18GHz - 40GHz: +/- 4.08dB |

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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# 6. CONDUCTED EMISSION TEST

## 6.1. Standard Applicable:

According to §15.207 and RSS-Gen §7.2.4, frequency range within 150 KHz to 30MHz shall not exceed the Limit table as below.

| Frequency range MHz | Limits dB(uV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56 | 56 to 46 |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

Note
1.The lower limit shall apply at the transition frequencies
2.The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

## 6.2. Measurement Equipment Used:

| Conducted Emission Test Site | | | | | |
|---|---|---|---|---|---|
| **EQUIPMENT TYPE** | **MFR** | **MODEL NUMBER** | **SERIAL NUMBER** | **LAST CAL.** | **CAL DUE.** |
| EMI Test Receiver | R&S | ESCI7 | 100759 | 02/08/2013 | 02/07/2014 |
| EMI Receiver | R&S | ESCS 30 | 828985/004 | 09/23/2012 | 09/22/2013 |
| LISN | Rolf-Heine | NNB-2/16Z | 99012 | 03/23/2013 | 03/22/2014 |
| LISN | FCC | FCC-LISN-50/250-25-2-01 | 04034 | 03/23/2013 | 03/22/2014 |
| Coaxial Cables | N/A | WK CE Cable | N/A | 01/05/2013 | 01/04/2014 |

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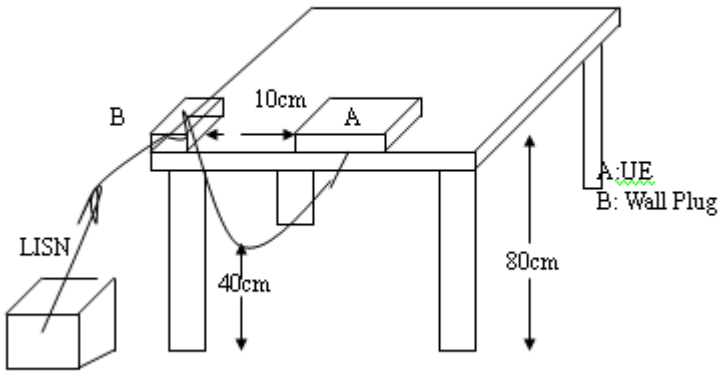
## 6.3. EUT Setup:

1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.4-2009.
2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
3. The LISN was connected with 120Vac/60Hz power source.

## 6.4. Test SET-UP (Block Diagram of Configuration)




## 6.5. Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

## 6.6. Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit.

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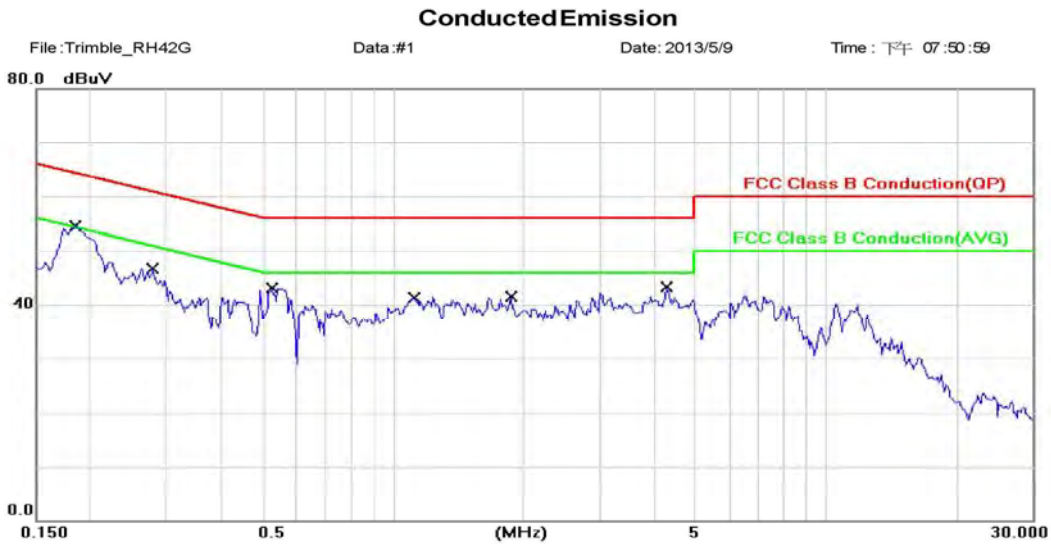
# AC POWER LINE CONDUCTED EMISSION TEST DATA

| | | | | | |
|---|---|---|---|---|---|
| Operation Mode: | Operation Mode | | | Test Date: | May. 07, 2013 |
| Temperature: | 26 ℃ | Humidity: | 60 % | Test By: | Nick |

Site ConductionRoom
Limit: FCC Class B Conduction(QP)
EUT: JunoT41/5
M/N: Trimble
Note:

Phase: L1
Power: AC 120V/60Hz
Distance:
Mode: Operation mode

Temperature: 26 ℃
Humidity: 60%




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | | 0.1852 | 46.34 | 0.14 | 46.48 | 64.25 | -17.77 | QP | |
| 2 | | 0.1852 | 30.14 | 0.14 | 30.28 | 54.25 | -23.97 | AVG | |
| 3 | | 0.2790 | 46.62 | 0.14 | 46.76 | 60.85 | -14.09 | QP | |
| 4 | | 0.5273 | 42.88 | 0.13 | 43.01 | 56.00 | -12.99 | QP | |
| 5 | | 1.1211 | 41.12 | 0.12 | 41.24 | 56.00 | -14.76 | QP | |
| 6 | | 1.8750 | 41.47 | 0.13 | 41.60 | 56.00 | -14.40 | QP | |
| 7 | * | 4.2813 | 43.14 | 0.16 | 43.30 | 56.00 | -12.70 | QP | |
| 8 | | 4.2813 | 23.18 | 0.16 | 23.34 | 46.00 | -22.66 | AVG | |

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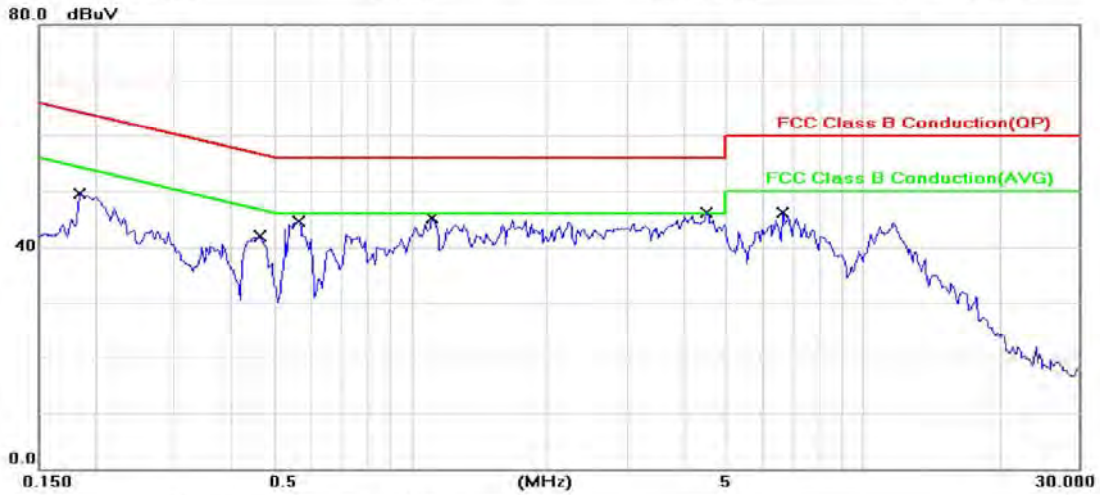
| | | | | | |
|---|---|---|---|---|---|
| Site | ConductionRoom | Phase: | N | Temperature: | 26 ℃ |
| Limit: | FCC Class B Conduction(QP) | Power: | AC 120V/60Hz | Humidity: | 60% |
| EUT: | JunoT41/5 | Distance: | | | |
| M/N: | Trimble | Mode: | Operation mode | | |
| Note: | | | | | |

**Conducted Emission**

File:Trimble_RH42G Data:#2 Date: 2013/5/9 Time : 下午 07:54:02




| No. | Mk. | Freq. | Reading Level | Correct Factor | Measure-ment | Limit | Over | | |
|---|---|---|---|---|---|---|---|---|---|
| | | MHz | dBuV | dB | dBuV | dBuV | dB | Detector | Comment |
| 1 | | 0.1852 | 49.29 | 0.20 | 49.49 | 64.25 | -14.76 | QP | |
| 2 | * | 0.4625 | 41.75 | 0.18 | 41.93 | 56.65 | -14.72 | QP | |
| 3 | | 0.5664 | 39.52 | 0.19 | 39.71 | 56.00 | -16.29 | QP | |
| 4 | | 0.5664 | 23.24 | 0.19 | 23.43 | 46.00 | -22.57 | AVG | |
| 5 | | 1.1133 | 35.63 | 0.20 | 35.83 | 56.00 | -20.17 | QP | |
| 6 | | 1.1133 | 22.49 | 0.20 | 22.69 | 46.00 | -23.31 | AVG | |
| 7 | | 4.5156 | 36.49 | 0.23 | 36.72 | 56.00 | -19.28 | QP | |
| 8 | | 4.5156 | 25.87 | 0.23 | 26.10 | 46.00 | -19.90 | AVG | |
| 9 | | 6.6484 | 38.24 | 0.25 | 38.49 | 60.00 | -21.51 | QP | |
| 10 | | 6.6484 | 28.05 | 0.25 | 28.30 | 50.00 | -21.70 | AVG | |

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# 7. PEAK OUTPUT POWER MEASUREMENT

## 7.1. Standard Applicable:

According to §15.247(b)(1), for frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850MHz band: 1Watt. For all other frequency hopping systems in the 2400 – 2483.5MHz band: 0.125 Watts.

According to RSS-210 issue 8,§A8.4(2), For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W.

## 7.2. Measurement Equipment Used:

| Conducted Emission Test Site | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Power Sensor | Anritsu | ML2495A | 1005007 | 02/08/2012 | 02/07/2014 |
| Power Meter | Anritsu | MA2411B | 917032 | 02/08/2012 | 02/07/2014 |
| Spectrum Analyzer | Agilent | E4446A | MY51100003 | 05/30/2013 | 05/29/2014 |
| Spectrum Analyzer | Agilent | E4440A | MY45304525 | 03/15/2013 | 03/14/2014 |
| DC Block | Mini-Circuits | BLK-18-S+ | 1 | 02/28/2013 | 02/27/2014 |
| Low Loss Cable | HUBER+SUHNER | SUCOFLEX 104PEA | N/A | 01/05/2013 | 01/04/2014 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 002 | 02/28/2013 | 02/27/2014 |
| Splitter | Agilent | 11636B | N/A | 02/28/2013 | 02/27/2014 |

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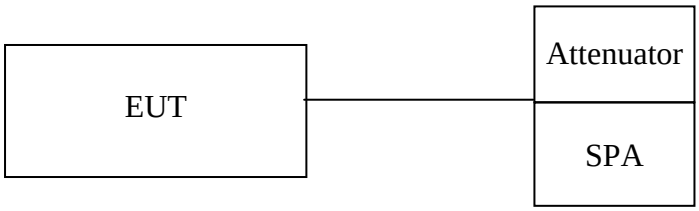
## 7.3. .Test Set-up:




## 7.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter or spectrum. (Max peak function, >20dB bandwidth, >=RBW)
3. Record the max. reading.
4. Repeat above procedures until all frequency measured were complete.

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## 7.5. Measurement Result:

**BR mode (GFSK):**

| Frequency (MHz) | Reading Power (dBm) | Output Power (dBm) | Output Power (W) | Limit (W) |
|---|---|---|---|---|
| 2402.00 | 3.98 | 3.98 | 0.00250 | 1 |
| 2441.00 | 3.93 | 3.93 | 0.00247 | 1 |
| 2480.00 | 4.64 | 4.64 | 0.00291 | 1 |

**EDR mode (π/4DQPSK):**

| Frequency (MHz) | Reading Power (dBm) | Output Power (dBm) | Output Power (W) | Limit (W) |
|---|---|---|---|---|
| 2402.00 | 4.22 | 4.22 | 0.00264 | 0.125 |
| 2441.00 | 4.45 | 4.45 | 0.00279 | 0.125 |
| 2480.00 | 4.85 | 4.85 | 0.00305 | 0.125 |

**EDR mode (8DPSK):**

| Frequency (MHz) | Reading Power (dBm) | Output Power (dBm) | Output Power (W) | Limit (W) |
|---|---|---|---|---|
| 2402.00 | 4.29 | 4.29 | 0.00269 | 0.125 |
| 2441.00 | 4.41 | 4.41 | 0.00276 | 0.125 |
| 2480.00 | 5.05 | 5.05 | 0.00320 | 0.125 |

**Note: offset 4.61dB*

Note: Refer to next page for plots.

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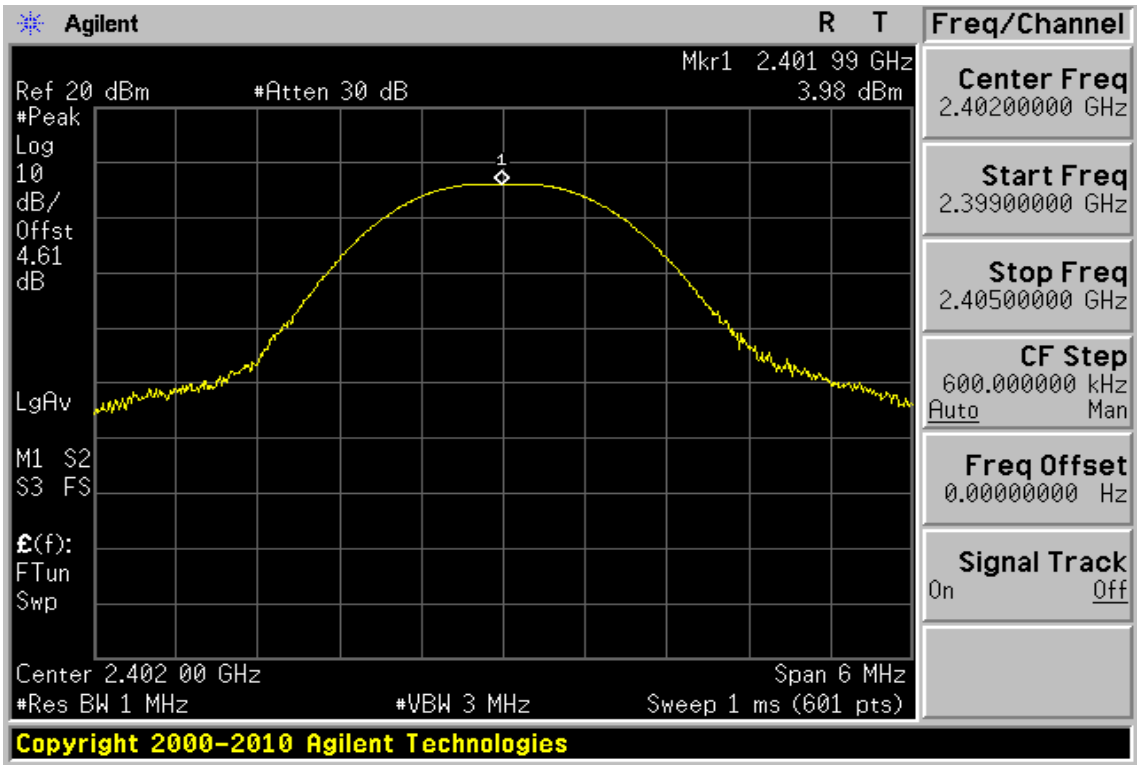
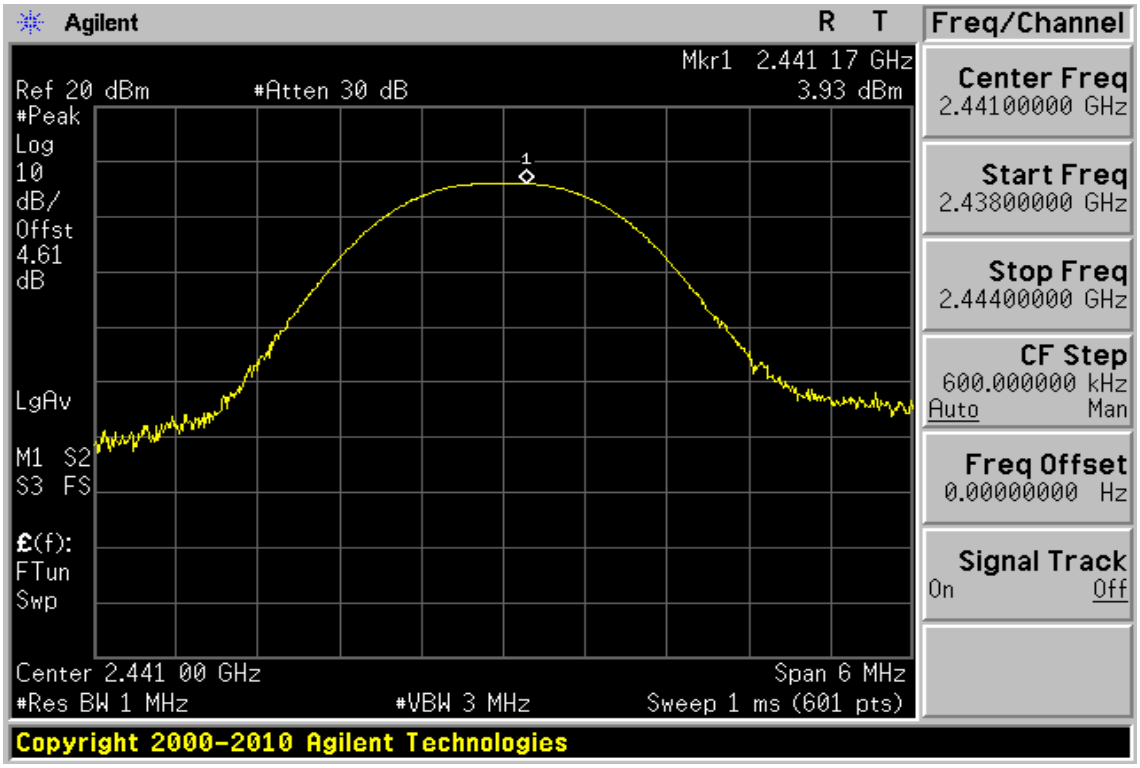
## Peak Power Output Data Plot (CH Low) (BR mode GFSK)




## Peak Power Output Data Plot (CH Mid) (BR mode GFSK)

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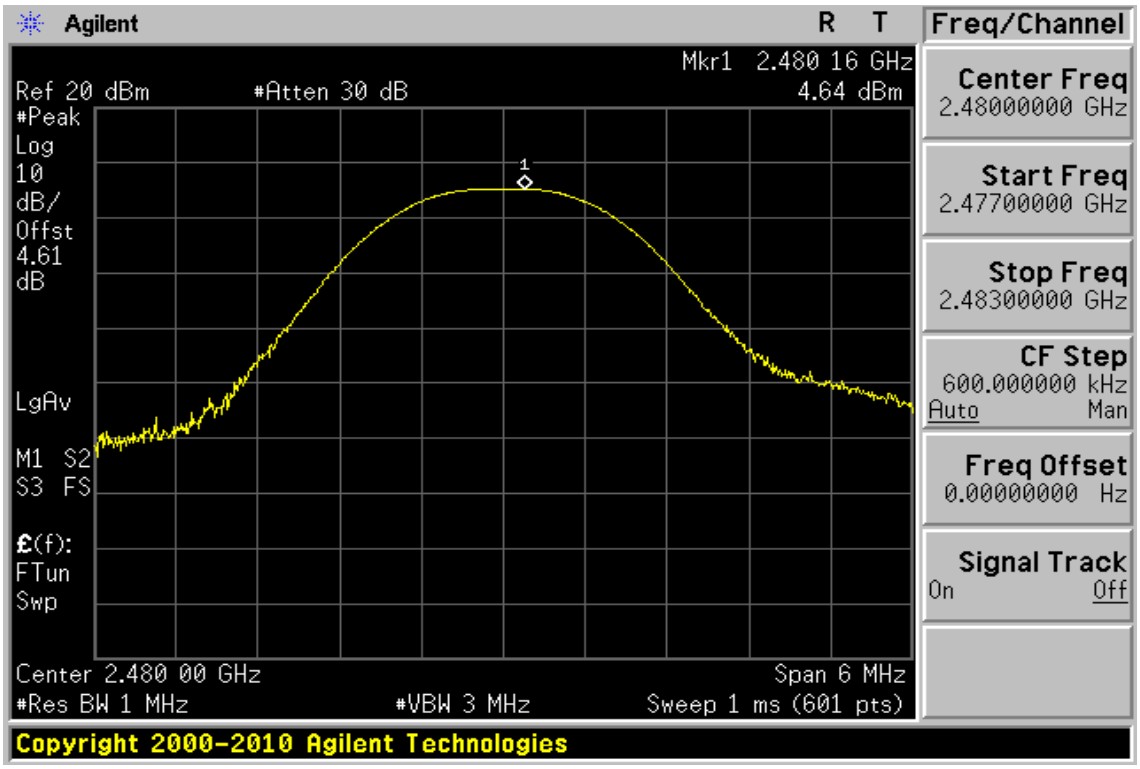
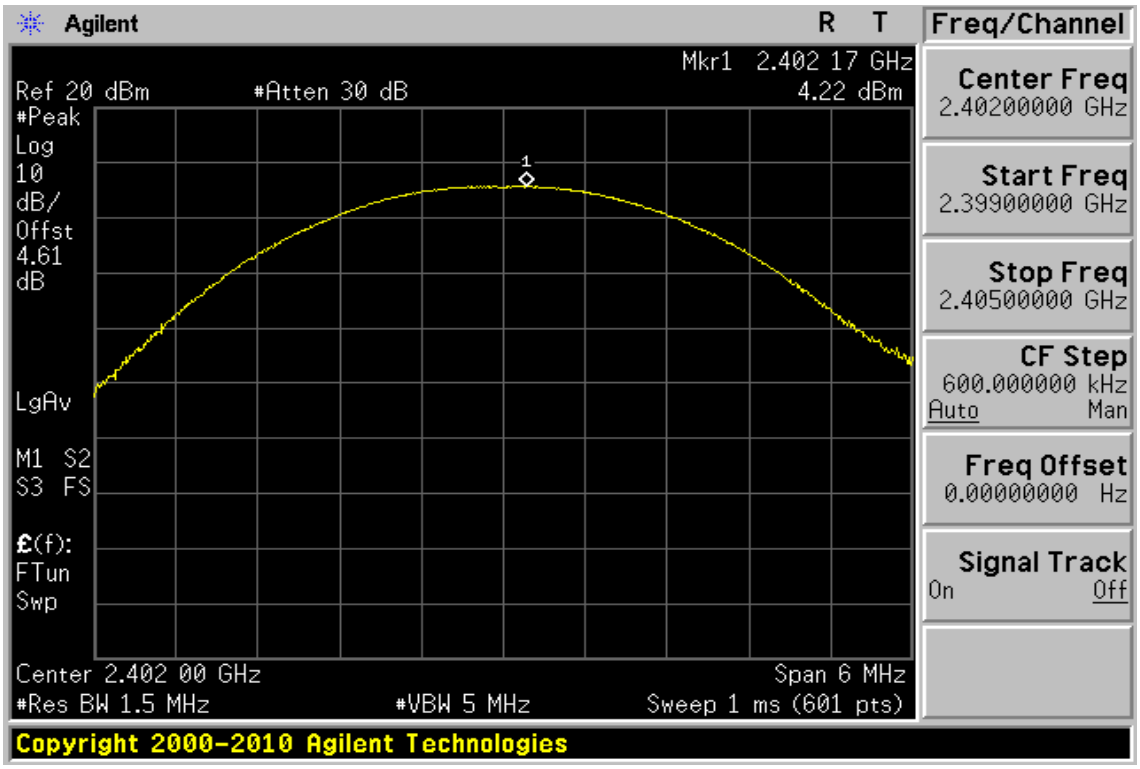
## Peak Power Output Data Plot (CH High) (BR mode GFSK)




## Peak Power Output Data Plot (CH Low) (EDR mode π/4DQPSK)

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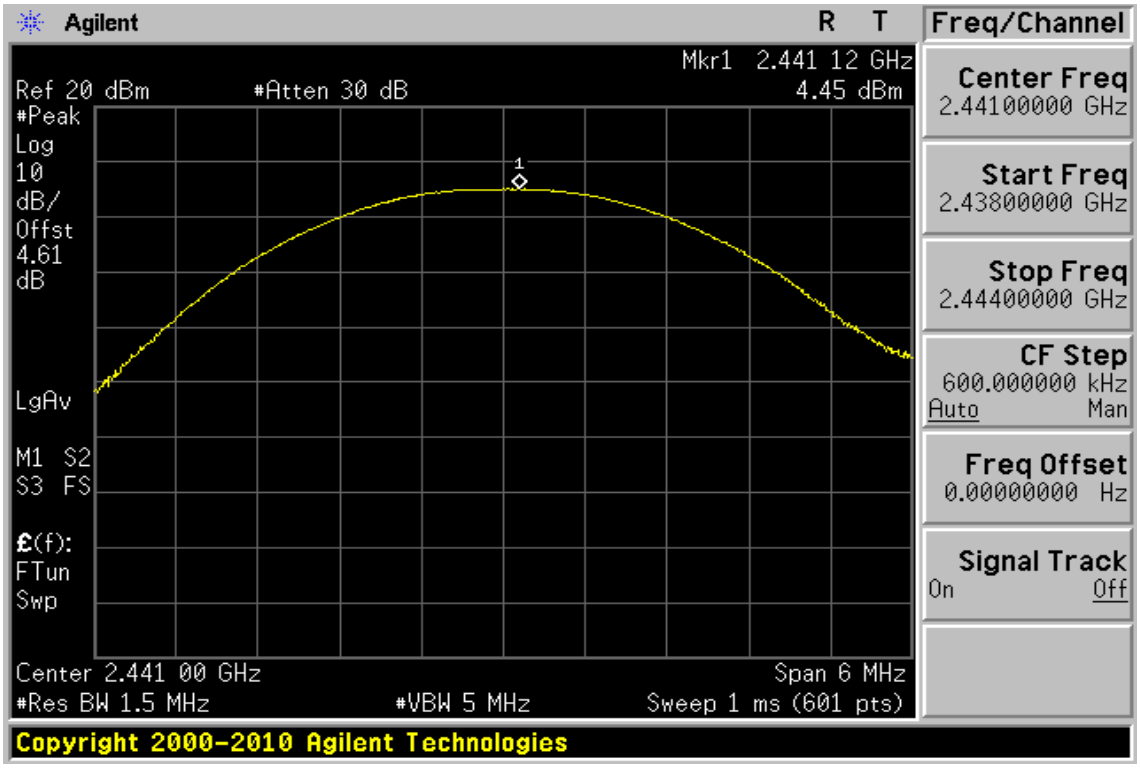
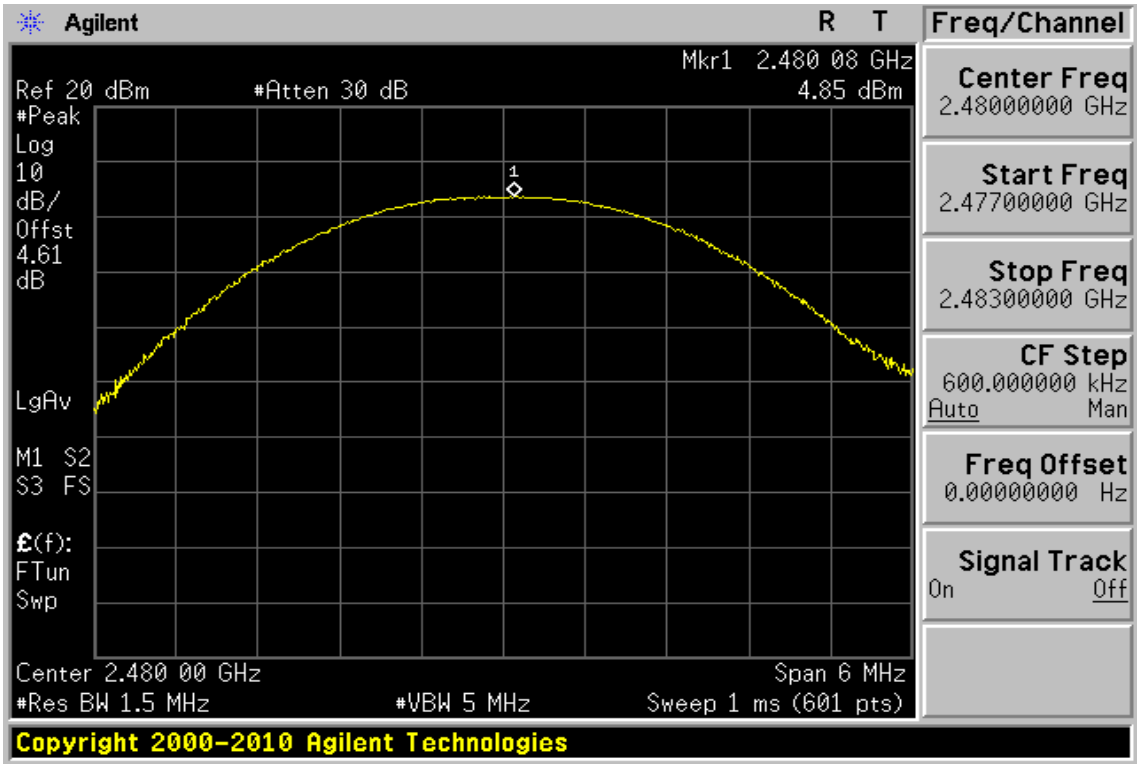
## Peak Power Output Data Plot (CH Mid) (EDR mode π/4DQPSK)




## Peak Power Output Data Plot (CH High) (EDR mode π/4DQPSK)

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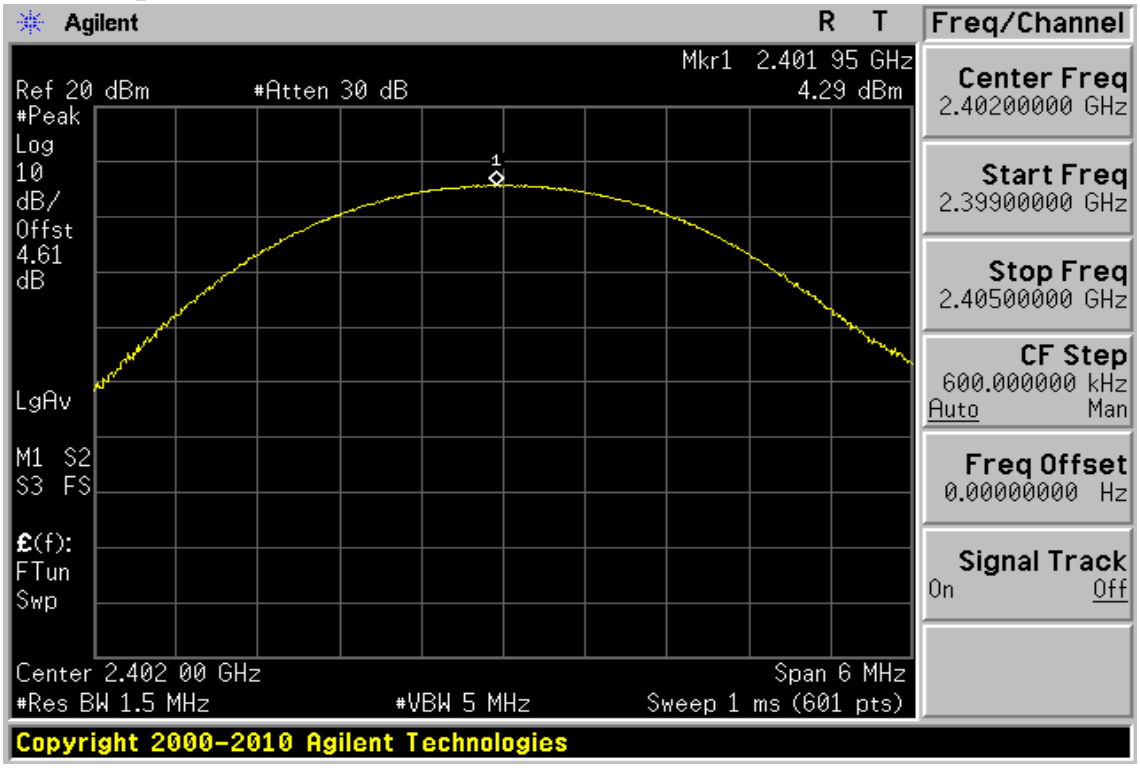
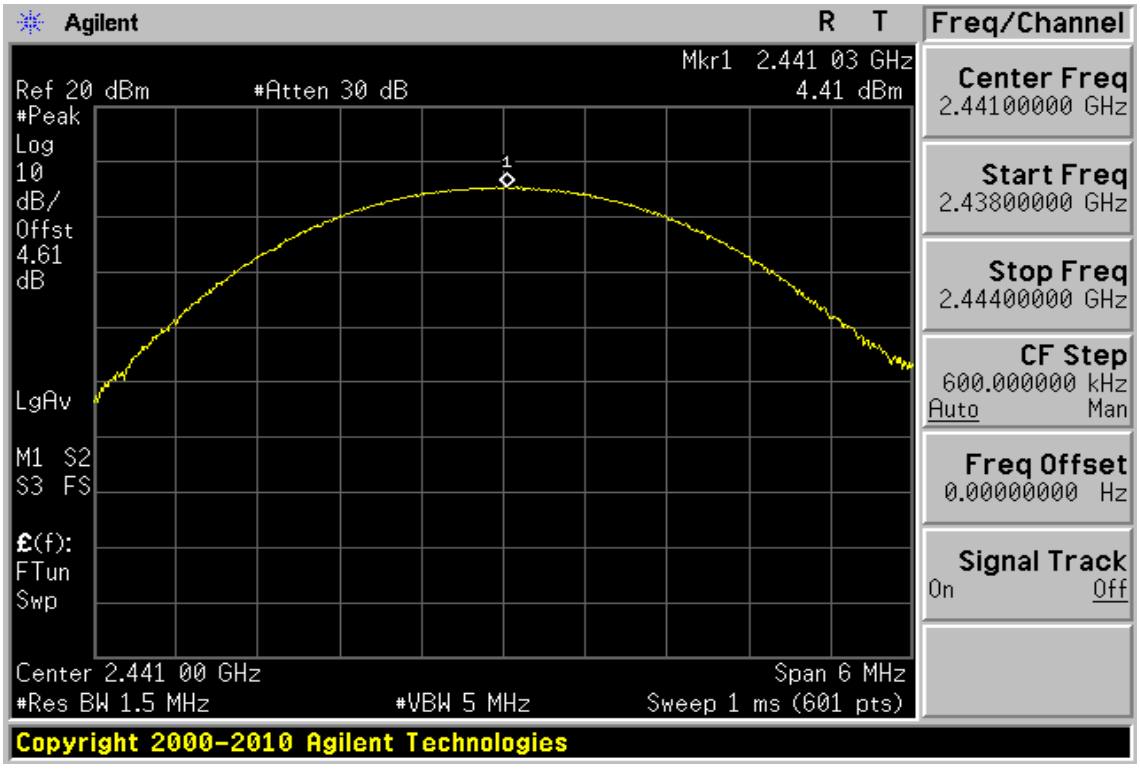
## Peak Power Output Data Plot (CH Low) (EDR mode 8DPSK)




## Peak Power Output Data Plot (CH Mid) (EDR mode 8DPSK)

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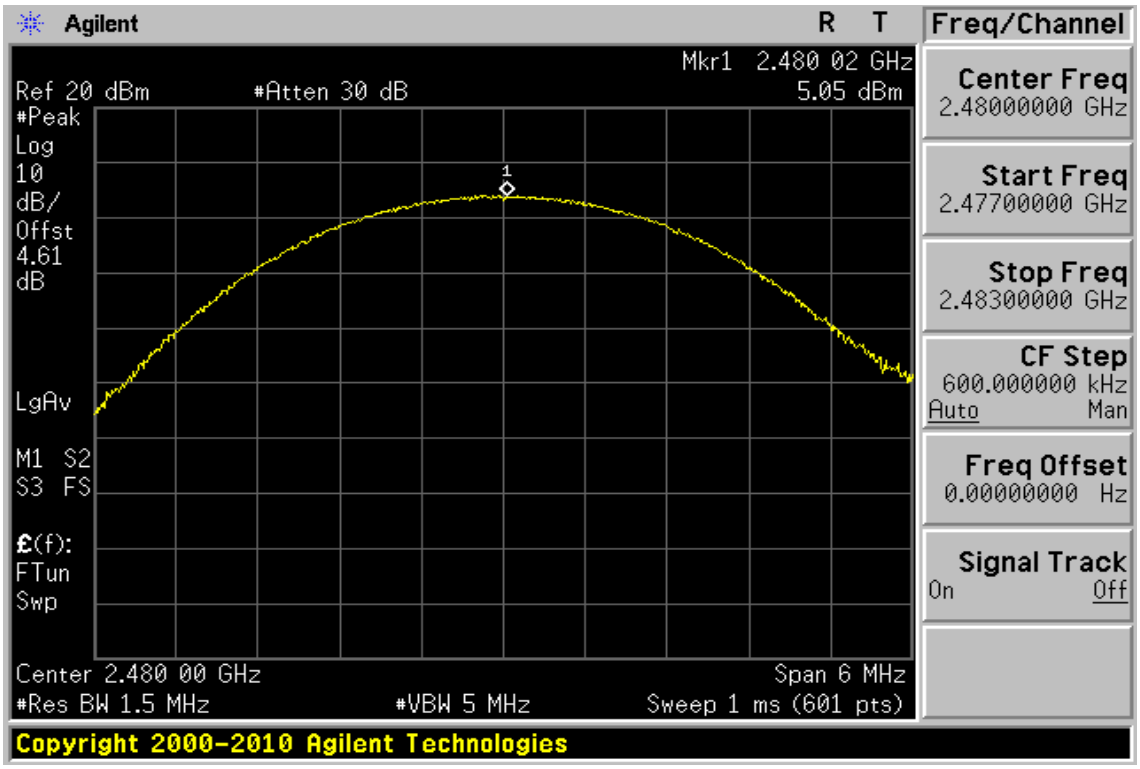
# Peak Power Output Data Plot (CH High) (EDR mode 8DPSK)

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# 8. 100 KHz BANDWIDTH OF BAND EDGES MEASUREMENT

## 8.1 Standard Applicable:

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in15.209(a).

According to RSS-Gen §7.2.5 and RSS-210 issue 8,§A8.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 5 and 6 is not required. In addition, radiated emissions which fall in the restricted bands of Table 3 must also comply with the radiated emission limits specified in Tables 5 and 6.

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## 8.2. Measurement Equipment Used:

### 8.2.1. Conducted Emission at antenna port:

Refer to section 7.2 for details.

### 8.2.2. Radiated emission:

| 966 Chamber | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| EMI Test Receiver | R&S | ESCI7 | 100759 | 02/08/2013 | 02/07/2014 |
| Spectrum Analyzer | Agilent | E4446A | MY51100003 | 04/15/2013 | 04/14/2014 |
| EXA Spectrum Analyzer | Agilent | N9010A | MY50420195 | 02/06/2013 | 02/07/2014 |
| Spectrum Analyzer | R&S | FSV-30 | 101398 | 10/18/2011 | 10/17/2013 |
| Bilog Antenna | SCHWAZBECK | VULB9168 | 378 | 01/10/2012 | 01/09/2014 |
| Horn antenna | ETS.LINDGREN | 3117 | 123995 | 05/19/2013 | 05/18/2014 |
| Horn Antenna | Schwarzbeck | BBHA9170 | 185 | 07/11/2011 | 07/10/2013 |
| Pre-Amplifier | Agilent | 8447D | 2944A07676 | 01/04/2013 | 01/03/2014 |
| Pre-Amplifier | EMC Instruments Corp. | EMC0126530 | 980038 | 01/04/2013 | 01/03/2014 |
| Filter 2400-2483.5 MHz | EWT | EWT-14-0166 | M2 | 02/28/2013 | 02/28/2014 |
| Attenuator | Mini-Circuit | BW-S10W2+ | 004 | 02/28/2013 | 02/27/2014 |
| Turn Table | HD | DT420 | N/A | N.C.R | N.C.R |
| Antenna Tower | HD | MA240-N | 240/657 | N.C.R | N.C.R |
| Controller | HD | HD100 | N/A | N.C.R | N.C.R |
| Low Loss Cable | Huber Suhner | 966_Rx | 9 | 01/04/2013 | 01/03/2014 |
| 3m Site NSA | SGS | 966 chamber | N/A | 07/15/2012 | 07/14/2013 |

| Conducted Emission (measured at antenna port) Test Site | | | | | |
|---|---|---|---|---|---|
| EQUIPMENT TYPE | MFR | MODEL NUMBER | SERIAL NUMBER | LAST CAL. | CAL DUE. |
| Horn Antenna | Schwarzbeck | BBHA9170 | 185 | 07/19/2013 | 07/18/2014 |
| 3m Site NSA | SGS | 966 chamber | N/A | 07/15/2013 | 07/14/2014 |

*Note: The measurement was taken place with the long duration of the time, and additional equipment list as shown above indicate those equipment of which has been subject to undertake the calibration in intermediate period of time of the measurement.*

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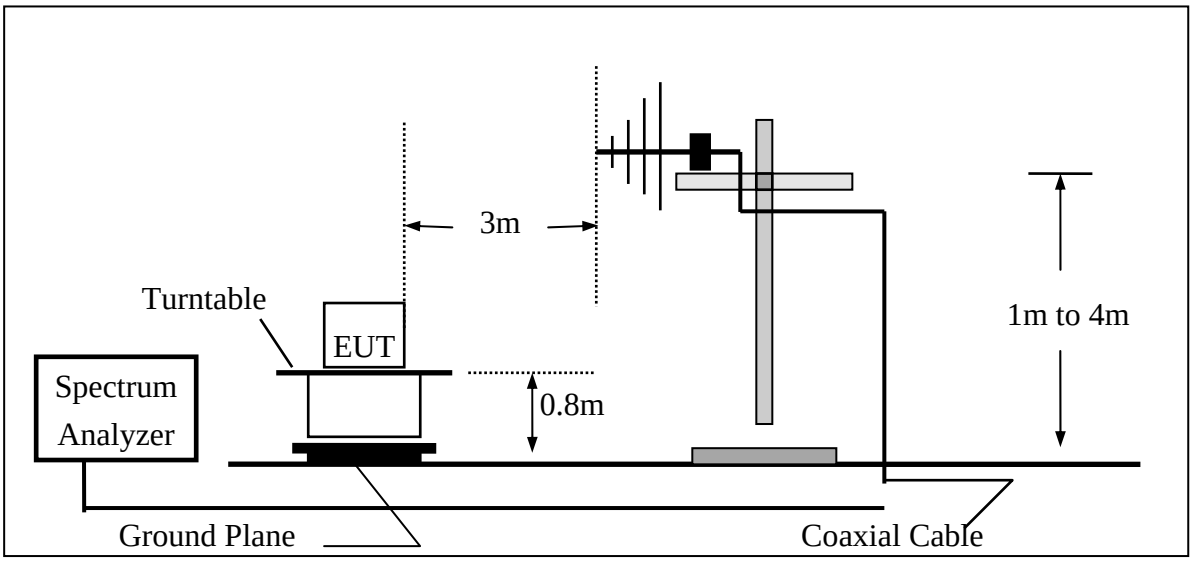
## 8.3. Test SET-UP:

### 8.3.1. Conducted Emission at antenna port:

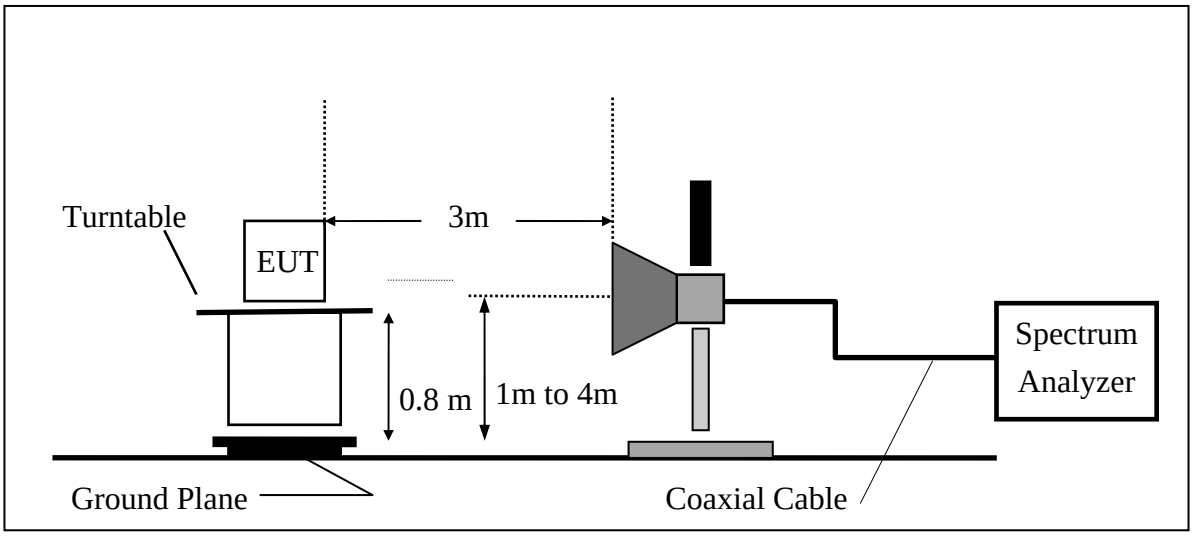
Refer to section 7.3 for details.

### 8.3.2. Radiated emission:

(A) Radiated Emission Test Set-Up, Frequency Below 1000MHz




(B) Radiated Emission Test Set-UP Frequency Over 1 GHz

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## 8.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW, VBW=100KHz, Span=25MHz, Sweep = auto
5. Mark Peak, 2.390GHz and 2.4835GHz and record the max. level.
6. Repeat above procedures until all frequency measured were complete.

## 8.5. Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

**FS = RA + AF + CL - AG**

| | | |
|---|---|---|
| Where | FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| | RA = Reading Amplitude | AG = Amplifier Gain |
| | AF = Antenna Factor | |

## 8.6. Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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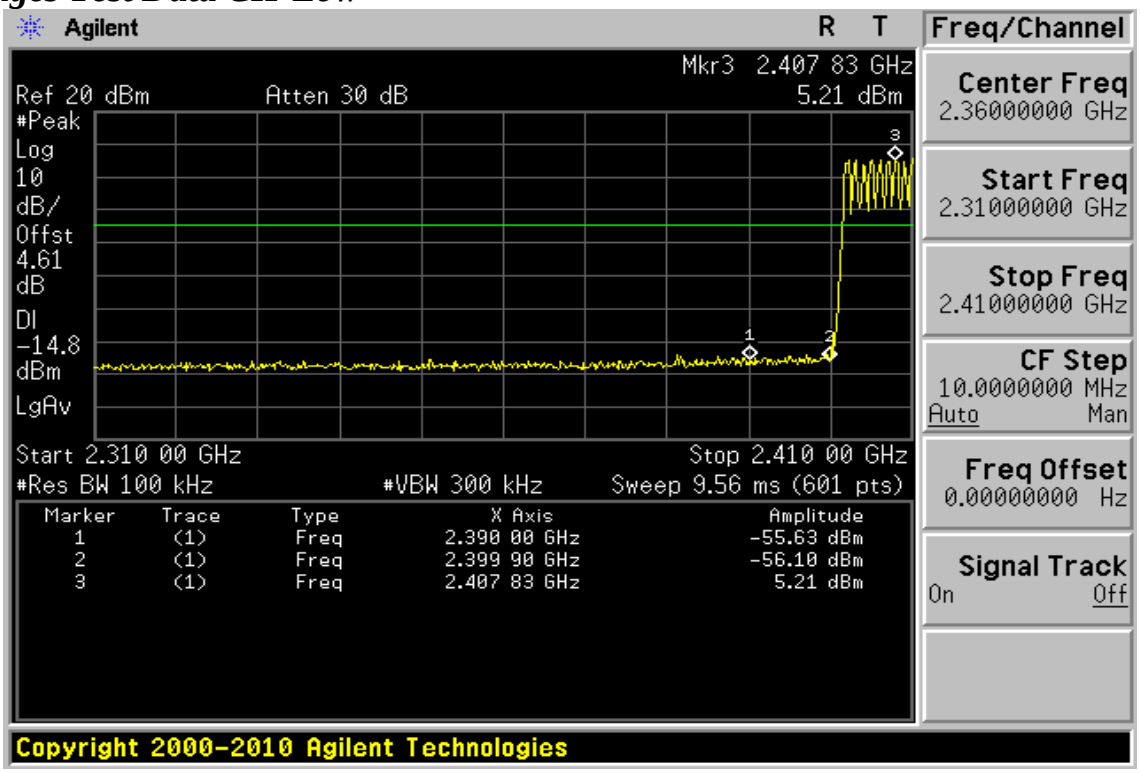
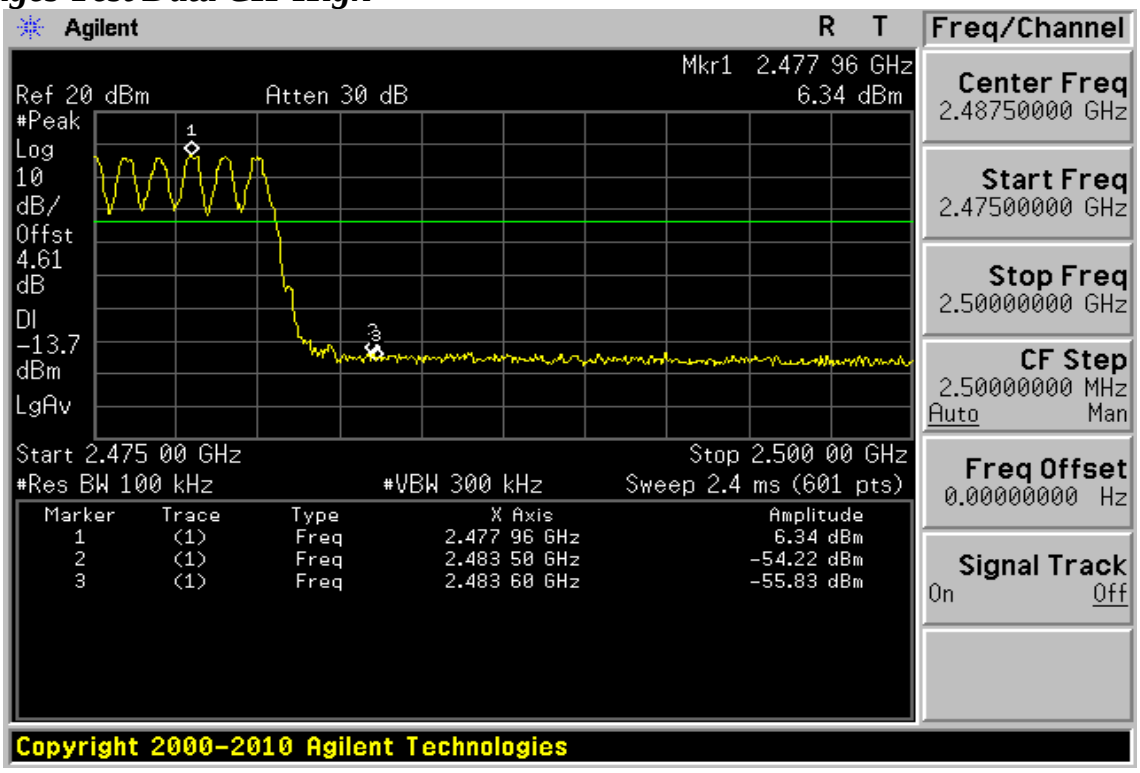
## *BR Mode*

## *Band Edges Test Data CH-Low*




## *Band Edges Test Data CH-High*

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**Radiated Emission: (BR mode)**

| | | | |
|---|---|---|---|
| Operation Band | :BR | Test Date | :2013-04-19 |
| Fundamental Frequency | :2402 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :Bandedge LOW | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :VERTICAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 2390.00 | E | Average | 35.11 | 2.12 | 37.23 | 54.00 | -16.77 |
| 2390.00 | E | Peak | 48.55 | 2.12 | 50.67 | 74.00 | -23.33 |

| | | | |
|---|---|---|---|
| Operation Band | :BR | Test Date | :2013-04-19 |
| Fundamental Frequency | :2402 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :Bandedge LOW | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :HORIZONTAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBμV | dB | dBμV/m | dBμV/m | dB |
| 2390.00 | E | Average | 32.75 | 2.74 | 35.49 | 54.00 | -18.51 |
| 2390.00 | E | Peak | 44.26 | 2.74 | 47.00 | 74.00 | -27.00 |

Actual FS(dBμV/m) = SPA. Reading level(dBμV) + Factor(dB)

Factor(dB) = Antenna Factor(dBμV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector

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| | | | |
|---|---|---|---|
| Operation Band | :BR | Test Date | :2013-04-19 |
| Fundamental Frequency | :2480 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :Bandedge HIGH | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :VERTICAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBµV | dB | dBµV/m | dBµV/m | dB |
| 2483.50 | E | Average | 35.63 | 2.53 | 38.16 | 54.00 | -15.84 |
| 2483.50 | E | Peak | 48.50 | 2.53 | 51.03 | 74.00 | -22.97 |

| | | | |
|---|---|---|---|
| Operation Band | :BR | Test Date | :2013-04-19 |
| Fundamental Frequency | :2480 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :Bandedge HIGH | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :HORIZONTAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBµV | dB | dBµV/m | dBµV/m | dB |
| 2483.50 | E | Average | 35.69 | 3.56 | 39.25 | 54.00 | -14.75 |
| 2483.50 | E | Peak | 47.73 | 3.56 | 51.29 | 74.00 | -22.71 |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.
The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector

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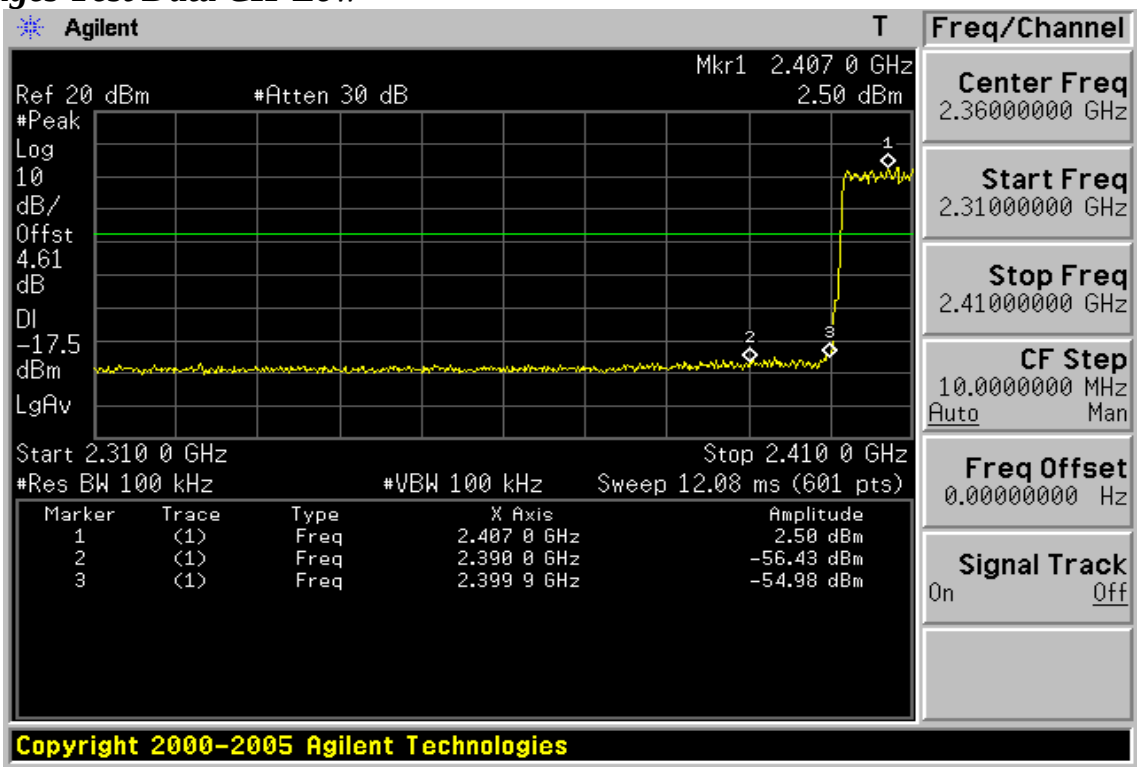
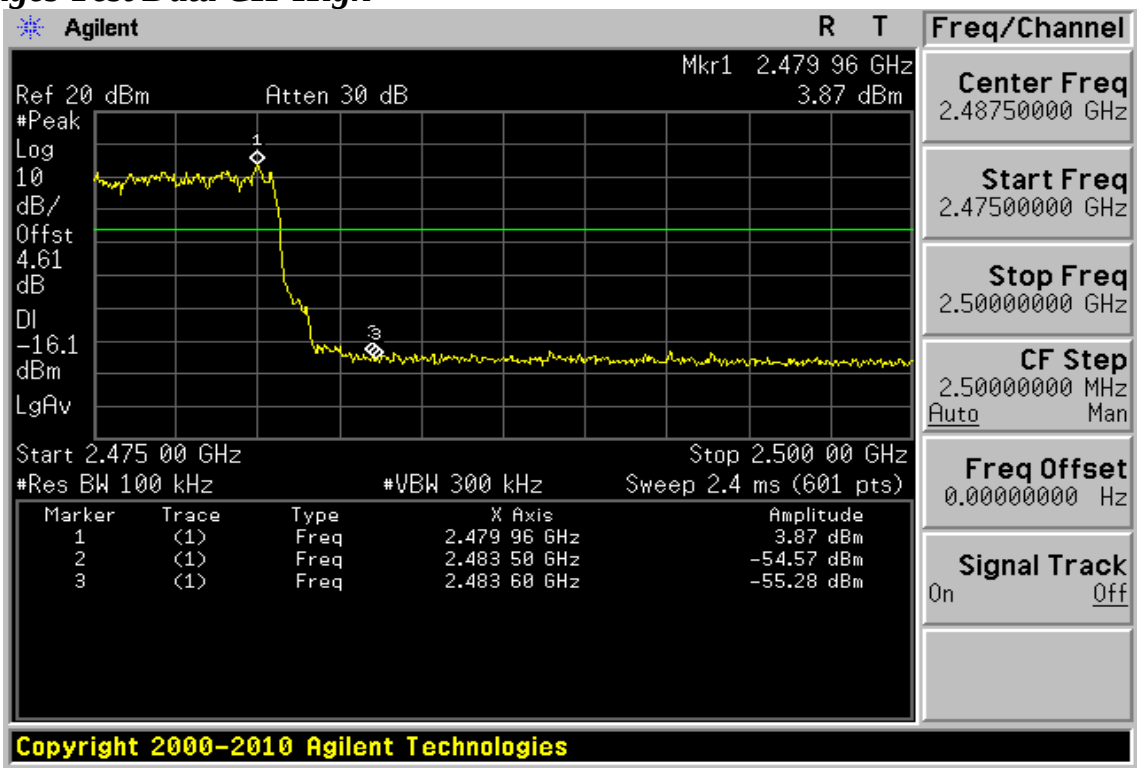
## *EDR Mode*

## *Band Edges Test Data CH-Low*




## *Band Edges Test Data CH-High*

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**Radiated Emission: (EDR mode)**

| | | | |
|---|---|---|---|
| Operation Band | :EDR | Test Date | :2013-04-19 |
| Fundamental Frequency | :2402 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :Bandedge LOW | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :VERTICAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBµV | dB | dBµV/m | dBµV/m | dB |
| 2390.00 | E | Average | 34.22 | 2.12 | 36.34 | 54.00 | -17.66 |
| 2390.00 | E | Peak | 46.38 | 2.12 | 48.50 | 74.00 | -25.50 |

| | | | |
|---|---|---|---|
| Operation Band | :EDR | Test Date | :2013-04-19 |
| Fundamental Frequency | :2402 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :Bandedge LOW | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :HORIZONTAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBµV | dB | dBµV/m | dBµV/m | dB |
| 2390.00 | E | Average | 32.10 | 2.74 | 34.84 | 54.00 | -19.16 |
| 2390.00 | E | Peak | 43.63 | 2.74 | 46.37 | 74.00 | -27.63 |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---" : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we've employed is peak detector.

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| | | | |
|---|---|---|---|
| Operation Band | :EDR | Test Date | :2013-04-19 |
| Fundamental Frequency | :2480 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :Bandedge HIGH | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :VERTICAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBµV | dB | dBµV/m | dBµV/m | dB |
| 2483.50 | E | Average | 34.57 | 2.53 | 37.10 | 54.00 | -16.90 |
| 2483.50 | E | Peak | 46.52 | 2.53 | 49.05 | 74.00 | -24.95 |

| | | | |
|---|---|---|---|
| Operation Band | :EDR | Test Date | :2013-04-19 |
| Fundamental Frequency | :2480 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :Bandedge HIGH | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :HORIZONTAL |

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBµV | dB | dBµV/m | dBµV/m | dB |
| 2483.50 | E | Average | 34.83 | 3.56 | 38.39 | 54.00 | -15.61 |
| 2483.50 | E | Peak | 47.45 | 3.56 | 51.01 | 74.00 | -22.99 |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : “F” : denotes Fundamental Frequency. ; “H” : denotes Harmonic Frequency.

“E” : denotes Band Edge Frequency. ; “S” : denotes Spurious Frequency.

“---“ : denotes Noise Floor.

The trace on RE(radiation emission) plot is as colored blue, and the detection manner we’ve employed is peak detector.

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# 9. SPURIOUS EMISSION TEST

## 9.1. Standard Applicable:

According to §15.247(d),

Emission at antenna port:

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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

Radiated Spurious Emission

Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a) (see § 15.205(c)).

And according to §15.33(a) (1), for an intentional radiator operates below 10GHz, the frequency range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40GHz, whichever is lower.

According to RSS-Gen §7.2.5 and RSS-210 issue 8,§A8.5, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency power that is produced 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 5 and 6 is not required. In addition, radiated emissions which fall in the restricted bands of Table 3 must also comply with the radiated emission limits specified in Tables 5 and 6 of RSS-GEN.

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## 9.2. Measurement Equipment Used:

### 9.2.1. Conducted Emission at antenna port:

Refer to section 7.2 for details.

### 9.2.2. Radiated emission:

Refer to section 8.2.2 for details.

## 9.3. Test SET-UP:

### 9.3.1. Conducted Emission at antenna port:

Refer to section 7.3 for details.

### 9.3.2. Radiated emission:

Refer to section 8.3.2 for details.

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## 9.4. Measurement Procedure:

**Radiated Emission:**

1. The EUT was placed on a turn table which is 0.8m above ground plane.
2. The turn table shall rotate 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emissions.
4. When measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.
5. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
6. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
7. Repeat above procedures until all frequency measured were complete.

Auxiliary Procedure (Setting on Spectrum to capture the reading of emission level):

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

**Conducted Emission:**

1. To connect Antenna Port of EUT to Spectrum.
2. Set RBW = 100K & VBW = 300K on Spectrum.
3. Sweep the frequency to determine spurious emission as seen on spectrum from span of 30 to 3G, 3G to 8G, 8G to 13G, 13G to 18G and 18G to 26.5GHz.
4. Via Software, combine 5 spans of frequency range into two plots containing the range of 30MHz to 3GHz, and 3GHz to 26.5GHz.

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## 9.5. Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

**FS = RA + AF + CL - AG**

| | | |
|---|---|---|
| Where | FS = Field Strength | CL = Cable Attenuation Factor (Cable Loss) |
| | RA = Reading Amplitude | AG = Amplifier Gain |
| | AF = Antenna Factor | |

Remark:

1. The limit of the emission level is expressed in dBuV/m, which converts 20*log(uV/m)
2. Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

## 9.6. Measurement Result:

Note: Refer to next page spectrum analyzer data chart and tabular data sheets.

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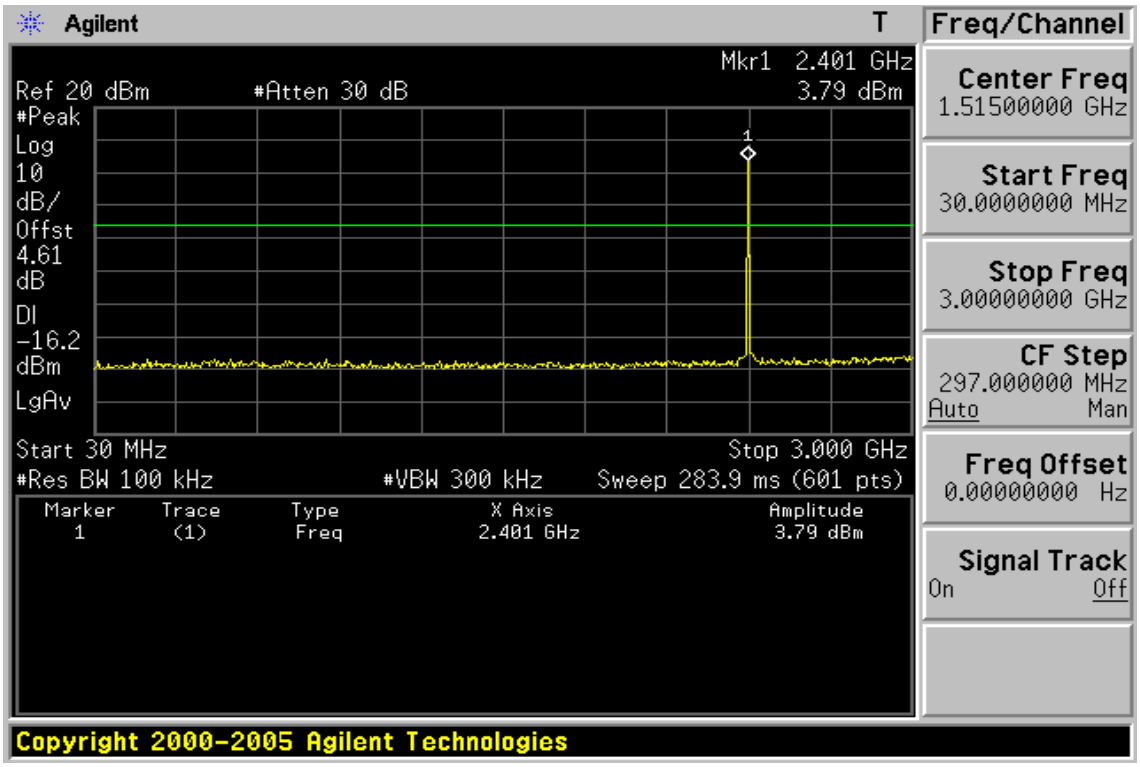
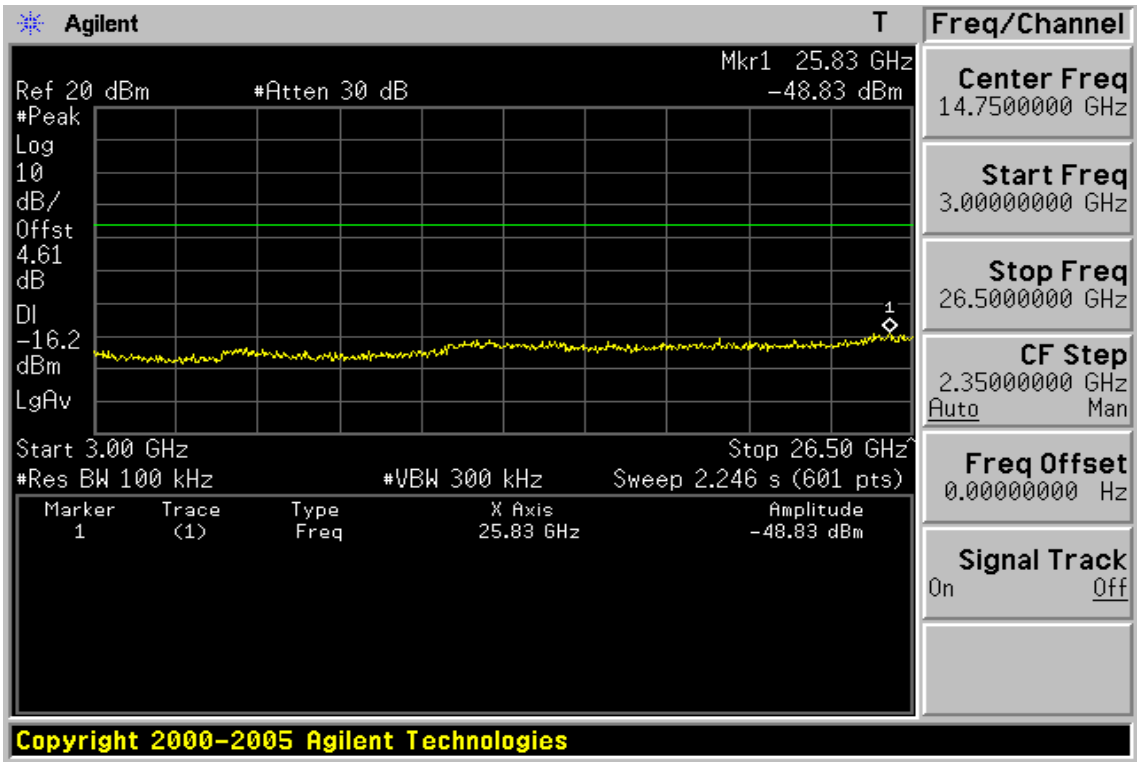
## *Conducted Spurious Emission Measurement Result (EDR Mode)*

## Ch Low 30MHz – 3GHz




## Ch Low 3GHz –26.5GHz

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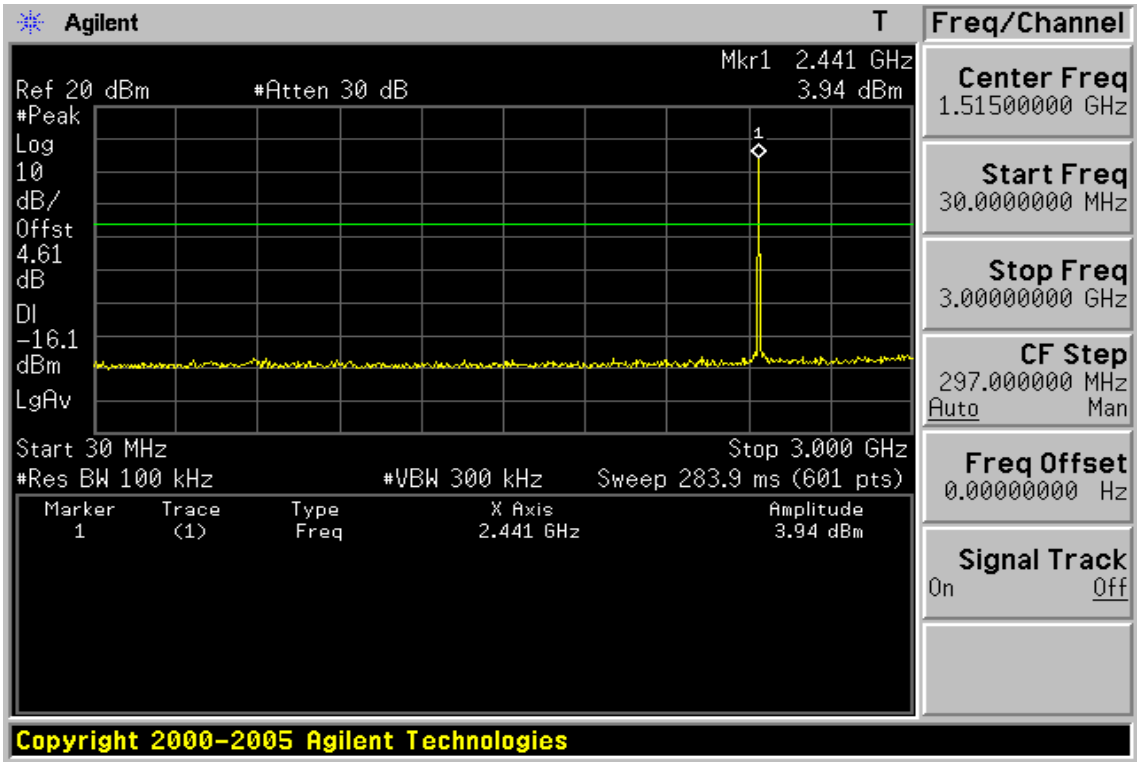
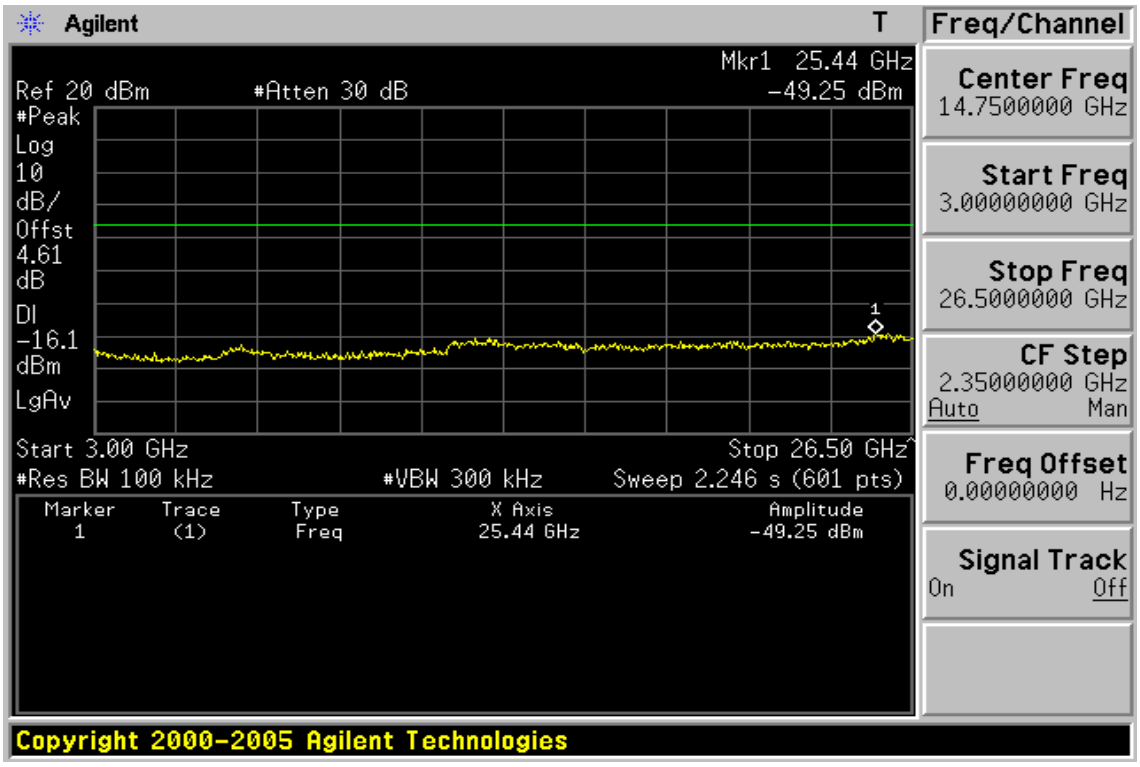
## Ch Mid 30MHz – 3GHz




## Ch Mid 3GHz – 26.5GHz

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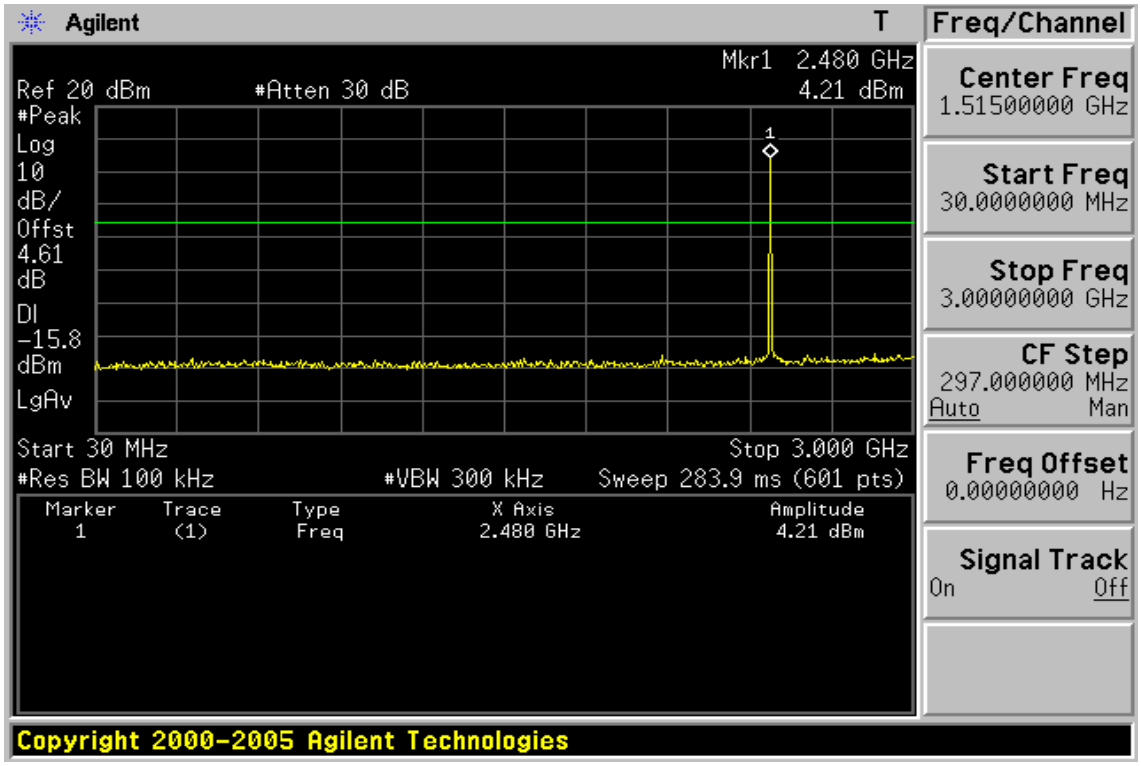
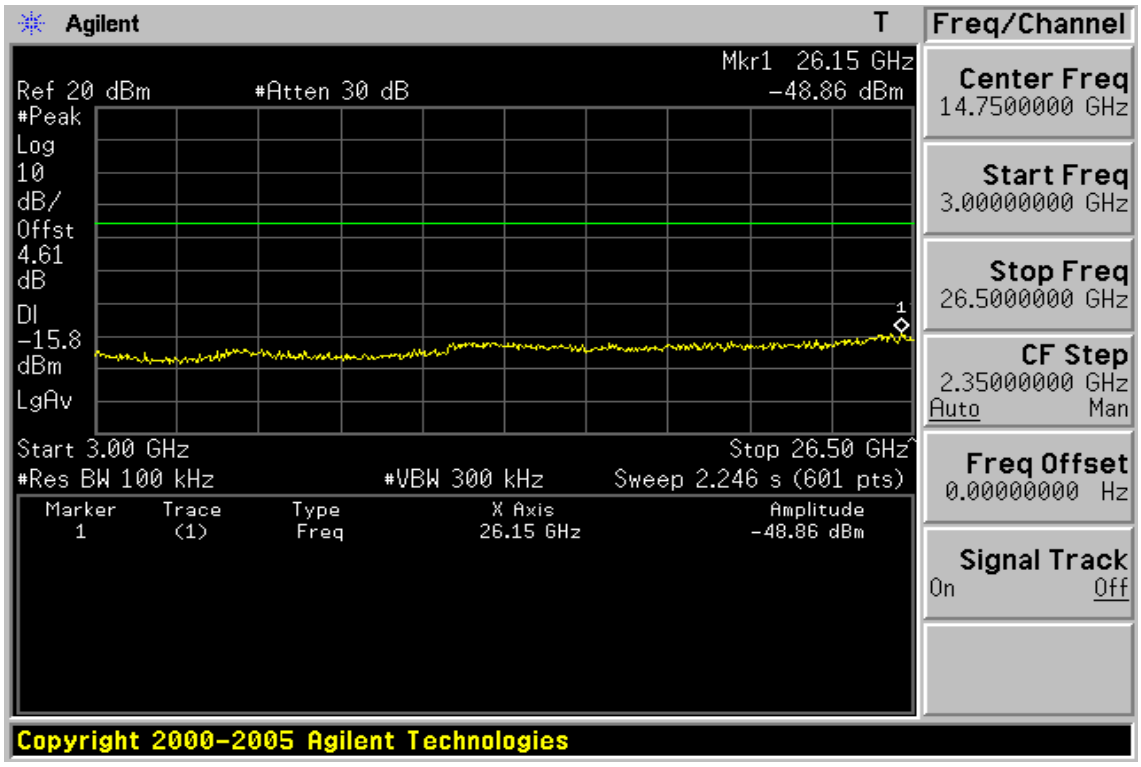
## Ch High 30MHz – 3GHz




## Ch High 3GHz – 26.5GHz

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**Radiated Spurious Emission Measurement Result (Worst EDR mode)**

| | | | |
|---|---|---|---|
| Operation Band | :EDR | Test Date | :2013-05-07 |
| Fundamental Frequency | :2402 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :TX LOW | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :VERTICAL |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBµV | Factor dB | Actual FS dBµV/m | Limit @3m dBµV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 111.48 | S | Peak | 36.21 | -15.56 | 20.65 | 43.50 | -22.85 |
| 343.31 | S | Peak | 27.98 | -11.76 | 16.22 | 46.00 | -29.78 |
| 470.38 | S | Peak | 27.83 | -9.90 | 17.93 | 46.00 | -28.07 |
| 619.76 | S | Peak | 27.84 | -7.13 | 20.71 | 46.00 | -25.29 |
| 775.93 | S | Peak | 27.86 | -4.52 | 23.34 | 46.00 | -22.66 |
| 903.00 | S | Peak | 27.62 | -2.75 | 24.87 | 46.00 | -21.13 |
| 4804.00 | H | Average | 26.96 | 6.99 | 33.95 | 54.00 | -20.05 |
| 4804.00 | H | Peak | 37.91 | 6.99 | 44.90 | 74.00 | -29.10 |

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| | | | |
|---|---|---|---|
| Operation Band | :EDR | Test Date | :2013-05-07 |
| Fundamental Frequency | :2402 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :TX LOW | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :HORIZONTAL |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBµV | Factor dB | Actual FS dBµV/m | Limit @3m dBµV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 155.13 | S | Peak | 28.50 | -12.30 | 16.20 | 43.50 | -27.30 |
| 290.93 | S | Peak | 28.80 | -12.78 | 16.02 | 46.00 | -29.98 |
| 421.88 | S | Peak | 32.61 | -10.61 | 22.00 | 46.00 | -24.00 |
| 596.48 | S | Peak | 28.42 | -7.64 | 20.78 | 46.00 | -25.22 |
| 740.04 | S | Peak | 31.67 | -5.13 | 26.54 | 46.00 | -19.46 |
| 886.51 | S | Peak | 29.53 | -3.07 | 26.46 | 46.00 | -19.54 |
| 4804.00 | H | Average | 29.36 | 7.03 | 36.39 | 54.00 | -17.61 |
| 4804.00 | H | Peak | 39.75 | 7.03 | 46.78 | 74.00 | -27.22 |

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| | | | |
|---|---|---|---|
| Operation Band | :EDR | Test Date | :2013-05-07 |
| Fundamental Frequency | :2441 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :TX MID | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :VERTICAL |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBµV | Factor dB | Actual FS dBµV/m | Limit @3m dBµV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 110.51 | S | Peak | 37.05 | -15.69 | 21.36 | 43.50 | -22.14 |
| 290.93 | S | Peak | 26.85 | -12.78 | 14.07 | 46.00 | -31.93 |
| 461.65 | S | Peak | 27.91 | -9.94 | 17.97 | 46.00 | -28.03 |
| 592.60 | S | Peak | 28.22 | -7.72 | 20.50 | 46.00 | -25.50 |
| 703.18 | S | Peak | 27.76 | -5.70 | 22.06 | 46.00 | -23.94 |
| 854.50 | S | Peak | 28.12 | -3.62 | 24.50 | 46.00 | -21.50 |
| 4882.00 | H | Average | 29.67 | 7.16 | 36.83 | 54.00 | -17.17 |
| 4882.00 | H | Peak | 38.71 | 7.16 | 45.87 | 74.00 | -28.13 |

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| | | | |
|---|---|---|---|
| Operation Band | :EDR | Test Date | :2013-05-07 |
| Fundamental Frequency | :2441 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :TX MID | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :HORIZONTAL |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBµV | Factor dB | Actual FS dBµV/m | Limit @3m dBµV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 159.01 | S | Peak | 28.27 | -12.28 | 15.99 | 43.50 | -27.51 |
| 290.93 | S | Peak | 29.16 | -12.78 | 16.38 | 46.00 | -29.62 |
| 419.94 | S | Peak | 29.56 | -10.65 | 18.91 | 46.00 | -27.09 |
| 602.30 | S | Peak | 27.93 | -7.51 | 20.42 | 46.00 | -25.58 |
| 821.52 | S | Peak | 27.83 | -3.95 | 23.88 | 46.00 | -22.12 |
| 921.43 | S | Peak | 27.56 | -2.39 | 25.17 | 46.00 | -20.83 |
| 4882.00 | H | Average | 28.89 | 7.10 | 35.99 | 54.00 | -18.01 |
| 4882.00 | H | Peak | 39.33 | 7.10 | 46.43 | 74.00 | -27.57 |

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| | | | |
|---|---|---|---|
| Operation Band | :EDR | Test Date | :2013-08-12 |
| Fundamental Frequency | :2441 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :TX MID | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :VERTICAL |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. | Note | Detector Mode | Spectrum Reading Level | Factor | Actual FS | Limit @3m | Margin |
|---|---|---|---|---|---|---|---|
| MHz | F/H/E/S | PK/QP/AV | dBµV | dB | dBµV/m | dBµV/m | dB |
| 4882.00 | H | Average | 29.13 | 7.50 | 36.63 | 54.00 | -17.37 |
| 4882.00 | H | Peak | 38.37 | 7.50 | 45.87 | 74.00 | -28.13 |
| 7323.00 | H | --- | | | | | |
| 9764.00 | H | --- | | | | | |
| 12205.00 | H | --- | | | | | |
| 14646.00 | H | --- | | | | | |
| 17087.00 | H | --- | | | | | |
| 19528.00 | H | --- | | | | | |
| 21969.00 | H | --- | | | | | |
| 24410.00 | H | --- | | | | | |

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| | | | |
|---|---|---|---|
| EUT Model | :Trimble | IMEI | : |
| Operation Band | :EDR | Test Date | :2013-08-12 |
| Fundamental Frequency | :2441 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :TX MID | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :HORIZONTAL |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBµV | Factor dB | Actual FS dBµV/m | Limit @3m dBµV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 4882.00 | H | Average | 28.23 | 7.44 | 35.67 | 54.00 | -18.33 |
| 4882.00 | H | Peak | 38.99 | 7.44 | 46.43 | 74.00 | -27.57 |
| 7323.00 | H | --- | | | | | |
| 9764.00 | H | --- | | | | | |
| 12205.00 | H | --- | | | | | |
| 14646.00 | H | --- | | | | | |
| 17087.00 | H | --- | | | | | |
| 19528.00 | H | --- | | | | | |
| 21969.00 | H | --- | | | | | |
| 24410.00 | H | --- | | | | | |

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| | | | |
|---|---|---|---|
| Operation Band | :EDR | Test Date | :2013-05-07 |
| Fundamental Frequency | :2480 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :TX HIGH | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :VERTICAL |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBµV | Factor dB | Actual FS dBµV/m | Limit @3m dBµV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 114.39 | S | Peak | 35.89 | -15.22 | 20.67 | 43.50 | -22.83 |
| 295.78 | S | Peak | 27.50 | -12.66 | 14.84 | 46.00 | -31.16 |
| 462.62 | S | Peak | 27.54 | -9.94 | 17.60 | 46.00 | -28.40 |
| 612.97 | S | Peak | 28.52 | -7.28 | 21.24 | 46.00 | -24.76 |
| 766.23 | S | Peak | 27.32 | -4.69 | 22.63 | 46.00 | -23.37 |
| 902.03 | S | Peak | 28.07 | -2.77 | 25.30 | 46.00 | -20.70 |
| 4960.00 | H | Average | 27.68 | 7.17 | 34.85 | 54.00 | -19.15 |
| 4960.00 | H | Peak | 36.95 | 7.17 | 44.12 | 74.00 | -29.88 |

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| | | | |
|---|---|---|---|
| Operation Band | :EDR | Test Date | :2013-05-07 |
| Fundamental Frequency | :2480 MHz | Temp./Humi. | :24.1deg_C/63RH |
| Operation Mode | :TX HIGH | Engineer | :Louis |
| EUT Pol. | :H Plan | Measurement Antenna Pol. | :HORIZONTAL |

Actual FS(dBµV/m) = SPA. Reading level(dBµV) + Factor(dB)

Factor(dB) = Antenna Factor(dBµV/m) + Cable Loss(dB) – Pre_Amplifier Gain(dB)

Note : "F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency.
"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.
"---" : denotes Noise Floor.

| Freq. MHz | Note F/H/E/S | Detector Mode PK/QP/AV | Spectrum Reading Level dBµV | Factor dB | Actual FS dBµV/m | Limit @3m dBµV/m | Margin dB |
|---|---|---|---|---|---|---|---|
| 152.22 | S | Peak | 28.60 | -12.32 | 16.28 | 43.50 | -27.22 |
| 290.93 | S | Peak | 29.29 | -12.78 | 16.51 | 46.00 | -29.49 |
| 419.94 | S | Peak | 29.32 | -10.65 | 18.67 | 46.00 | -27.33 |
| 593.57 | S | Peak | 28.65 | -7.70 | 20.95 | 46.00 | -25.05 |
| 779.81 | S | Peak | 29.66 | -4.47 | 25.19 | 46.00 | -20.81 |
| 942.77 | S | Peak | 27.41 | -2.16 | 25.25 | 46.00 | -20.75 |
| 4960.00 | H | Average | 29.97 | 7.02 | 36.99 | 54.00 | -17.01 |
| 4960.00 | H | Peak | 37.68 | 7.02 | 44.70 | 74.00 | -29.30 |

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# 10. FREQUENCY SEPARATION

## 10.1. Standard Applicable:

According to §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by minimum of 25KHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.

According to RSS 210 issue 8, A8.1 (b), frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater.

## 10.2. Measurement Equipment Used:

Refer to section 7.2 for details.

## 10.3. Test Set-up:

Refer to section 7.3 for details.

## 10.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = middle of hopping channel .
4. Set the spectrum analyzer as RBW,VBW=100KHz, Adjust Span to 3.0 MHz, Sweep = auto.
5. Max hold. Mark 3 Peaks of hopping channel and record the 3 peaks frequency.

## 10.5. Measurement Result:

| Channel separation (MHz) | Limit | Result |
|---|---|---|
| 1 | >=25KHz or 2/3 times 20dB bandwidth | PASS |

Note: Refer to next page for plots.

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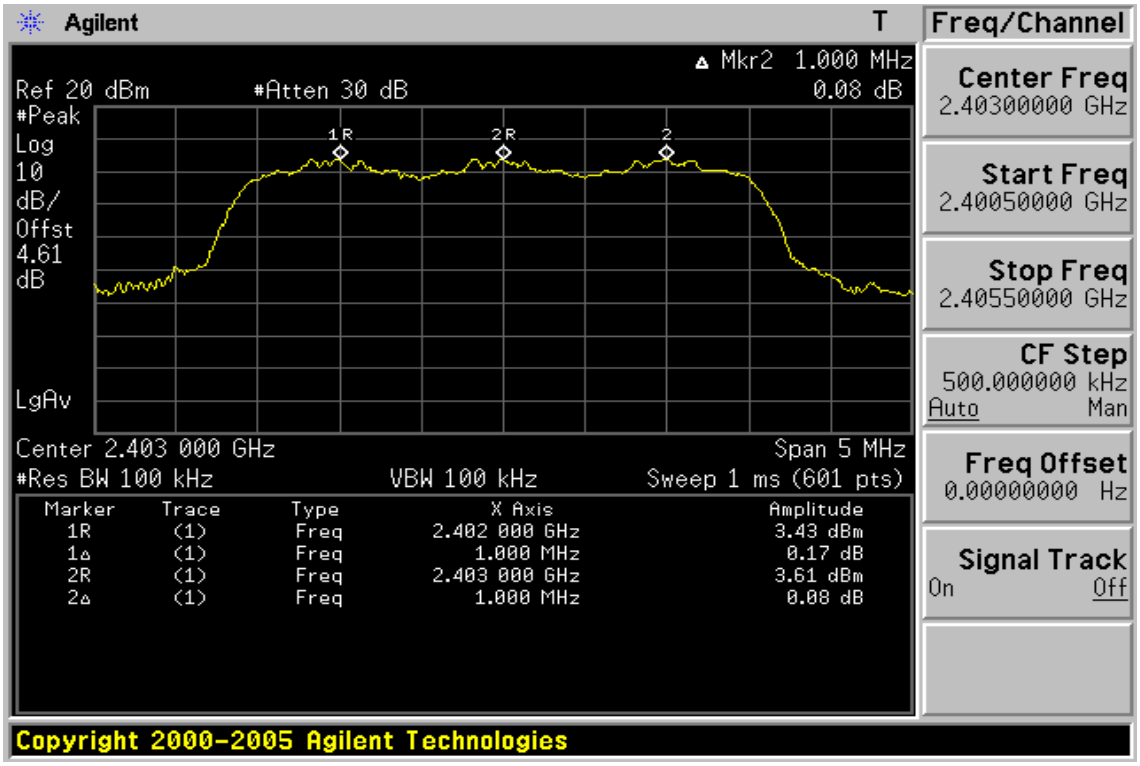
# Frequency Separation Test Data

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# 11. NUMBER OF HOPPING FREQUENCY

## 11.1. Standard Applicable:

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz bands shall use at least 15 hopping frequencies.

According to RSS-210 issue 8,§A8.1(d), For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 hopping channels, the maximum conducted output power shall not exceed 1 W. For all other frequency hopping systems, the maximum peak conducted output power shall not exceed 0.125 W.

## 11.2. Measurement Equipment Used:

Refer to section 7.2 for details.

## 11.3. Test Set-up:

Refer to section 7.3 for details.

## 11.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set spectrum analyzer Start=2400MHz, Stop = 2483.5MHz, Sweep = auto.
4. Set the spectrum analyzer as RBW=430KHz, VBW=1.5MHz,
5. Max hold, view and count how many channel in the band.

## 11.5. Measurement Result:

Note: Refer to next page for plots.

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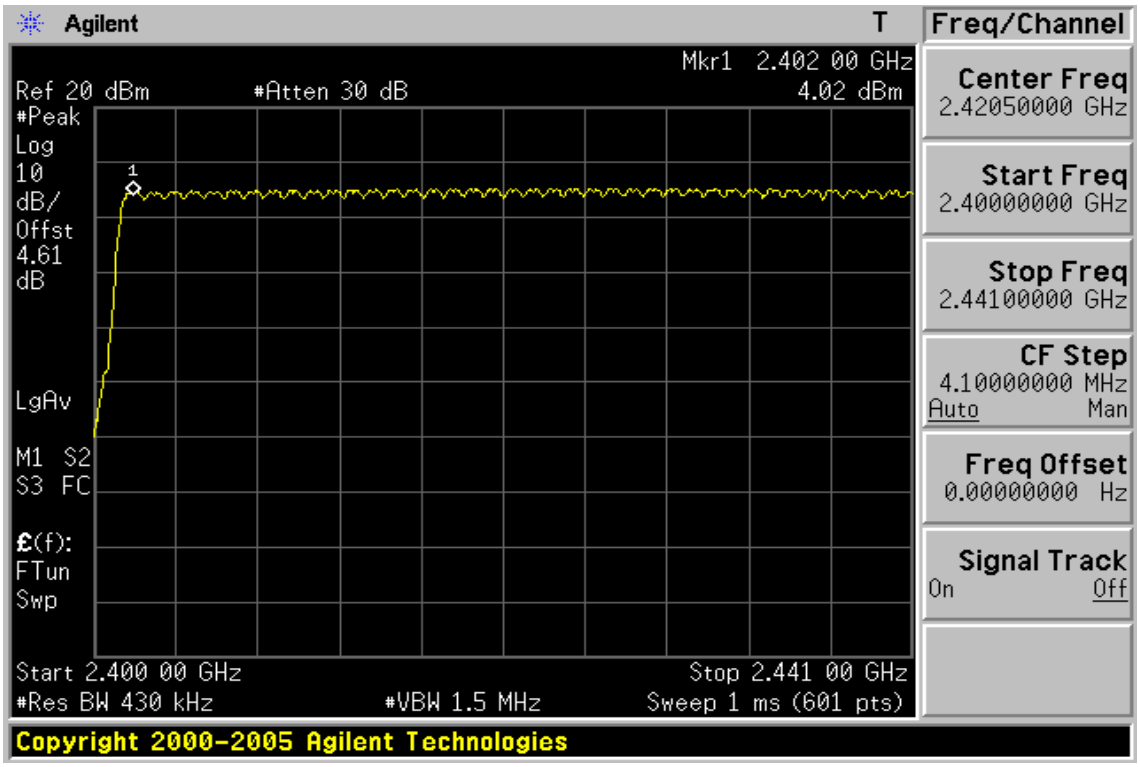
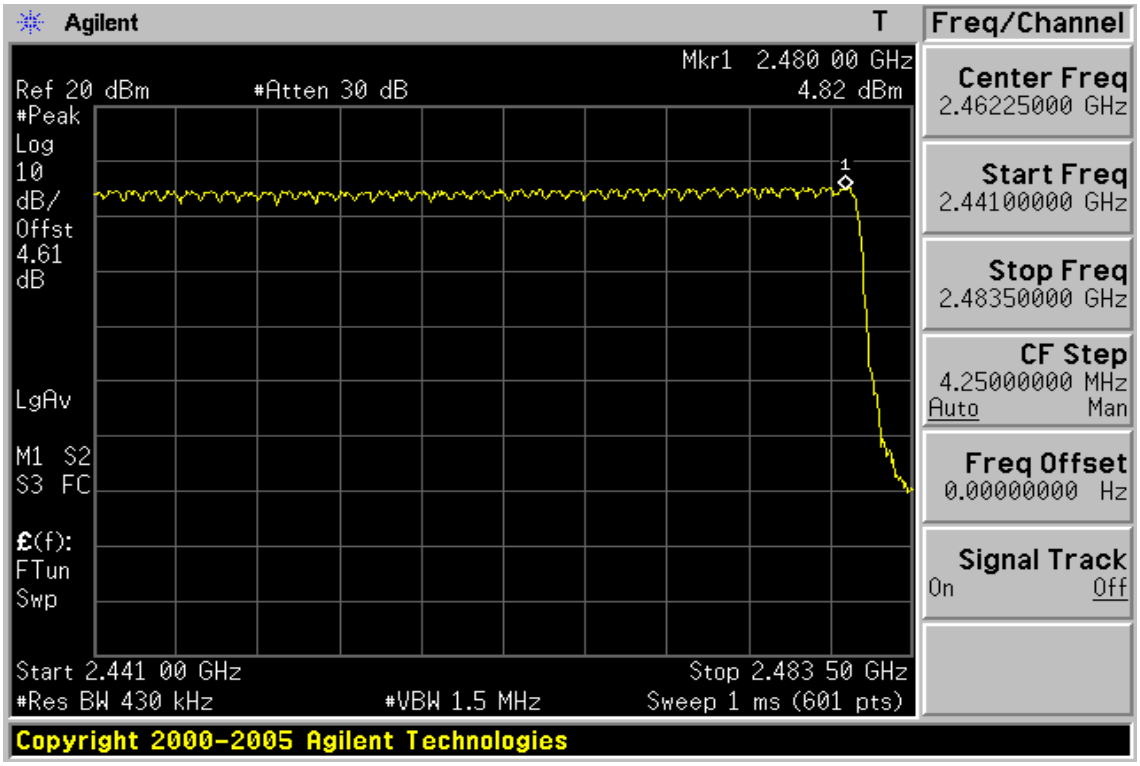
## *Channel Number*

### *2.4 GHz – 2.441GHz*




### *2.441 GHz – 2.4835GHz*

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# 12. TIME OF OCCUPANCY (DWELL TIME)

## 12.1. Standard Applicable:

According to §15.247(a)(1)(iii), Frequency hopping systems operating in the 2400MHz-2483.5 MHz. The average time of occupancy on any frequency shall not greater than 0.4 s within period of 0.4 seconds multiplied by the number of hopping channel employed.

According to RSS-210 issue 8,§A8.1(d), Frequency hopping systems operating in the 2400-2483.5 MHz band shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that a minimum of 15 hopping channels are used.

**Limit: 0.4s = 400ms**

## 12.2. Measurement Equipment Used:

Refer to section 7.2 for details.

## 12.3. Test Set-up:

Refer to section 7.3 for details.

## 12.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set center frequency of spectrum analyzer = operating frequency.
4. Set the spectrum analyzer as RBW:1MHz, VBW=3MHz, Span = 0Hz , Adjust Sweep = 2~7ms.
5. Repeat above procedures until all frequency measured were complete.

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## 12.5. Measurement Result:

A period time = 0.4 (sec) * 79 = 31.6 (s)

| | |
|---|---|
| CH Low: | DH1 time slot = 0.380 (ms) * (1600/(2*79)) * 31.6 = 121.60(ms) |
| | DH3 time slot = 1.633 (ms) * (1600/(4*79)) * 31.6 = 261.28(ms) |
| | DH5 time slot = 2.883 (ms) * (1600/(6*79)) * 31.6 = 307.52 (ms) |
| CH Mid: | DH1 time slot = 0.380 (ms) * (1600/(2*79)) * 31.6 = 121.60 (ms) |
| | DH3 time slot = 1.633 (ms) * (1600/(4*79)) * 31.6 = 261.28 (ms) |
| | DH5 time slot = 2.883 (ms) * (1600/(6*79)) * 31.6 = 307.52 (ms) |
| CH High: | DH1 time slot = 0.380 (ms) * (1600/(2*79)) * 31.6 = 121.60 (ms) |
| | DH3 time slot = 1.633 (ms) * (1600/(4*79)) * 31.6 = 261.28 (ms) |
| | DH5 time slot = 2.883 (ms) * (1600/(6*79)) * 31.6 = 307.52 (ms) |

Note: Refer to next page for plots.

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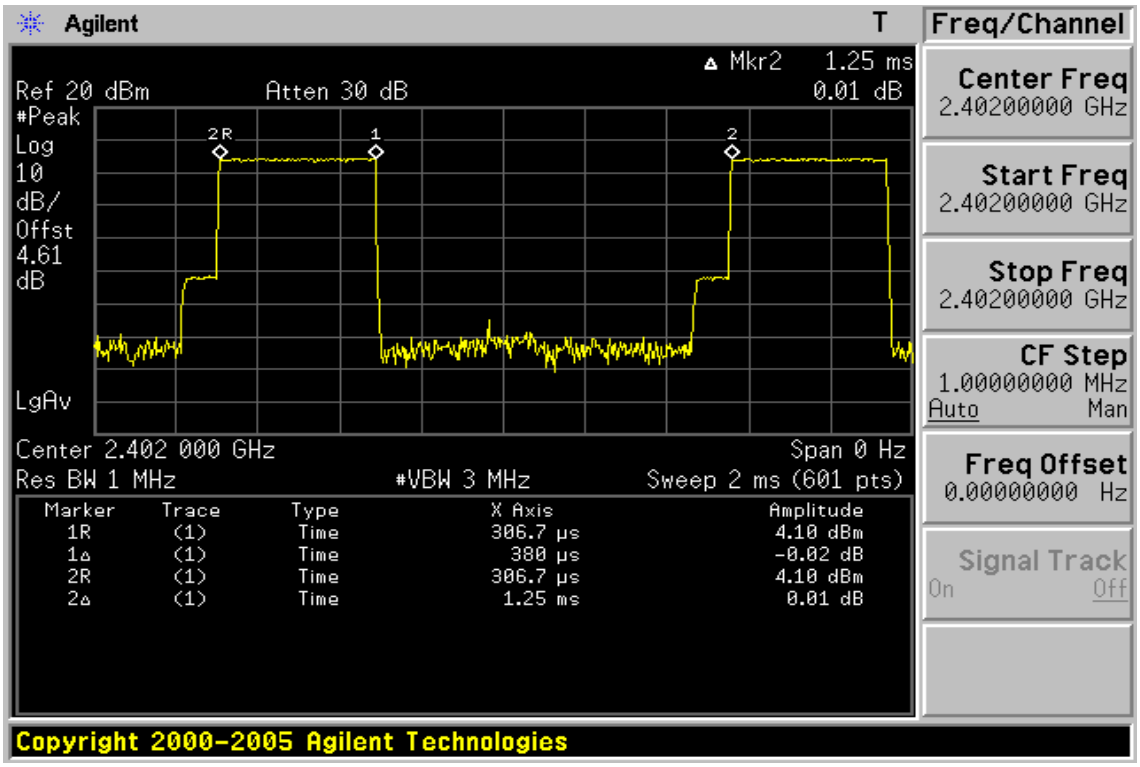
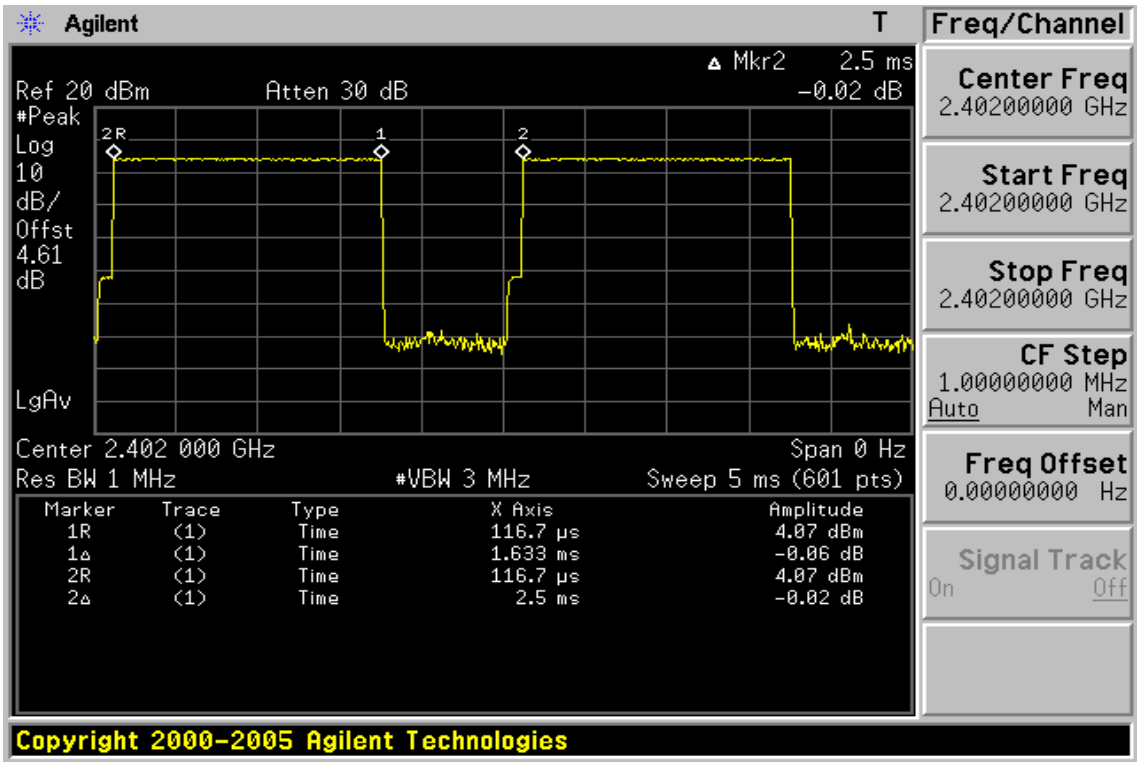
## *CH-Low*

### *DH1*




### *DH3*

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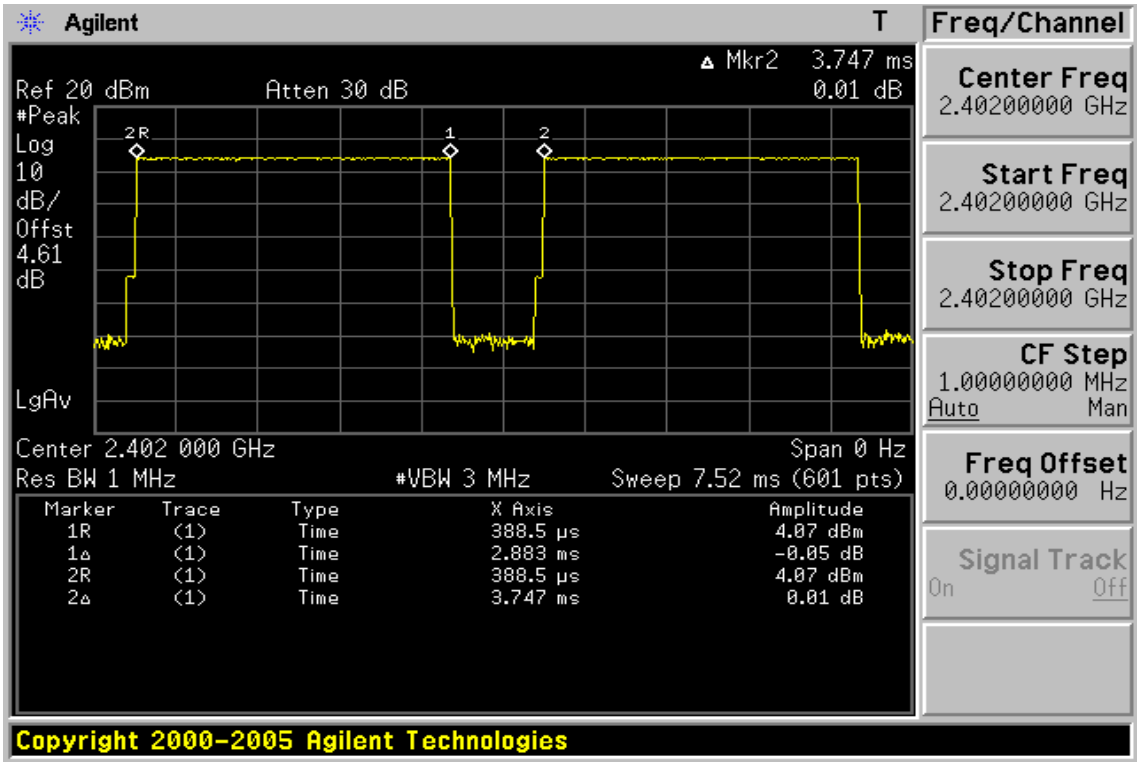
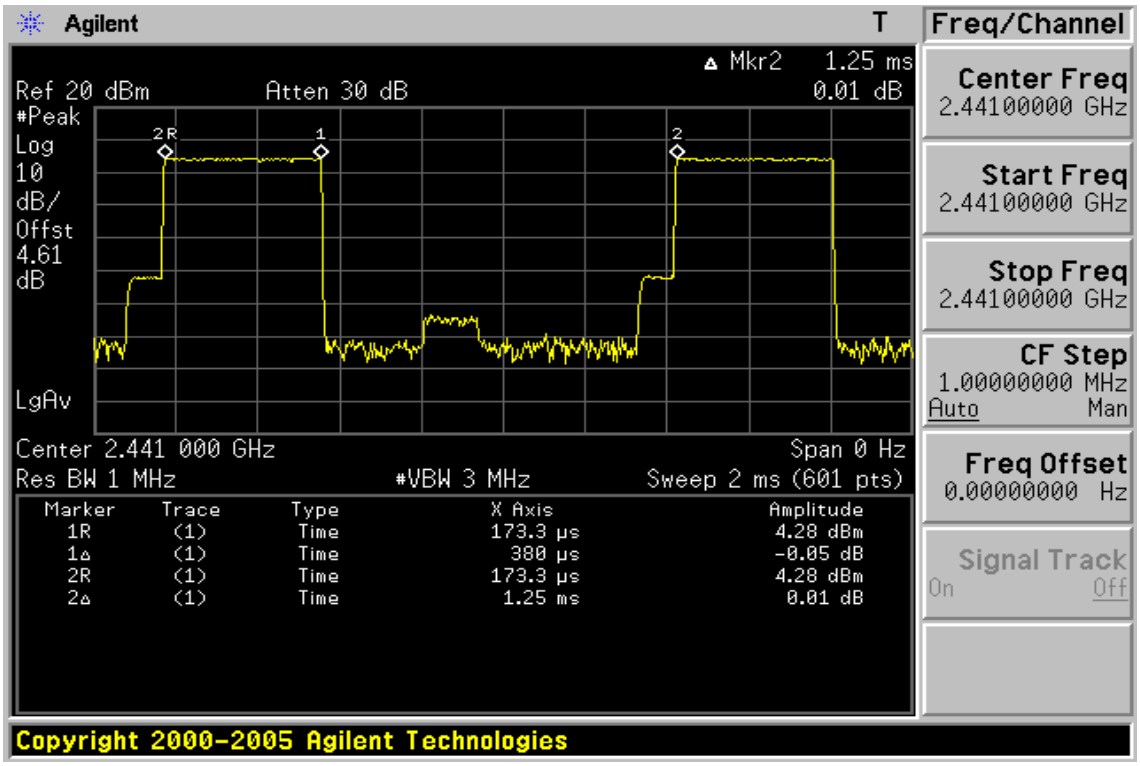
***DH5***




***CH-Mid***

***DH1***

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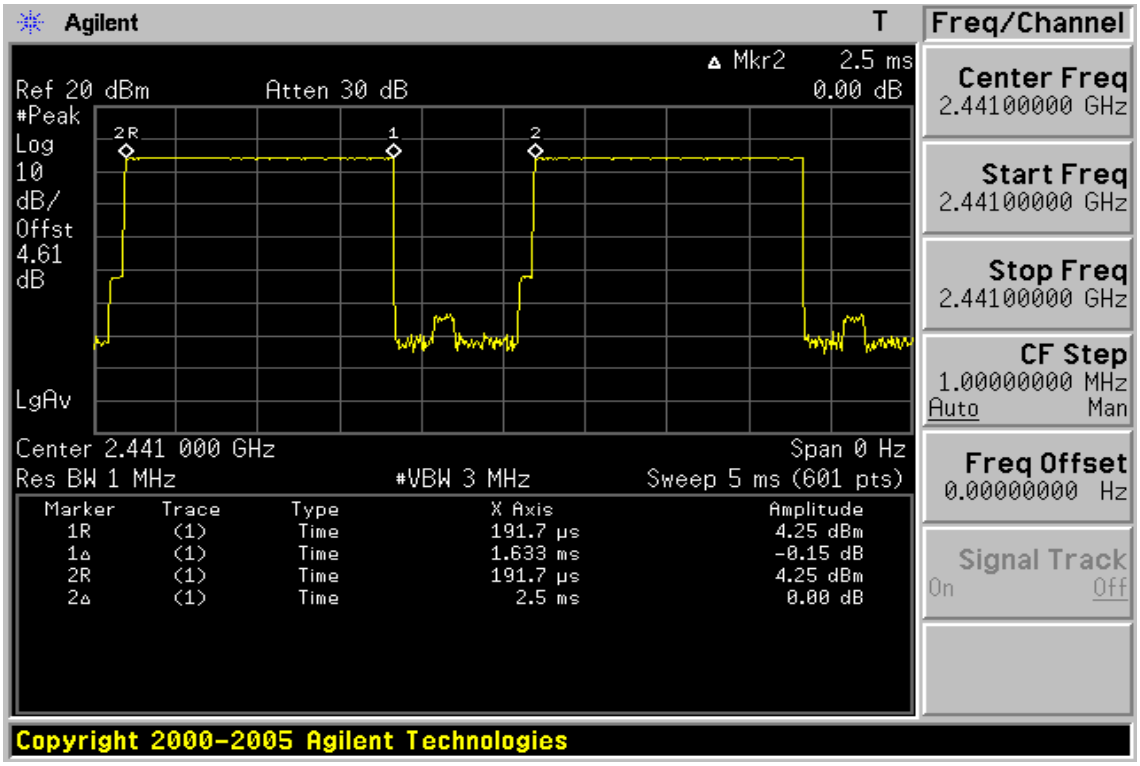
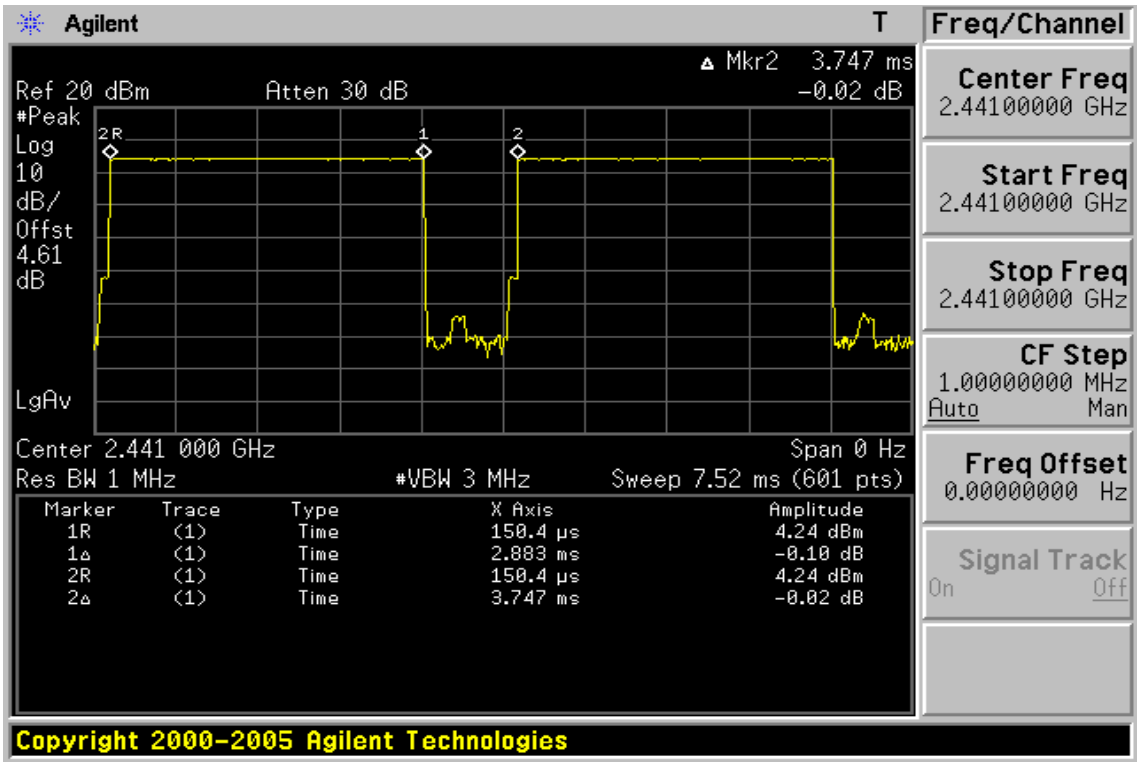
## *DH3*




## *DH5*

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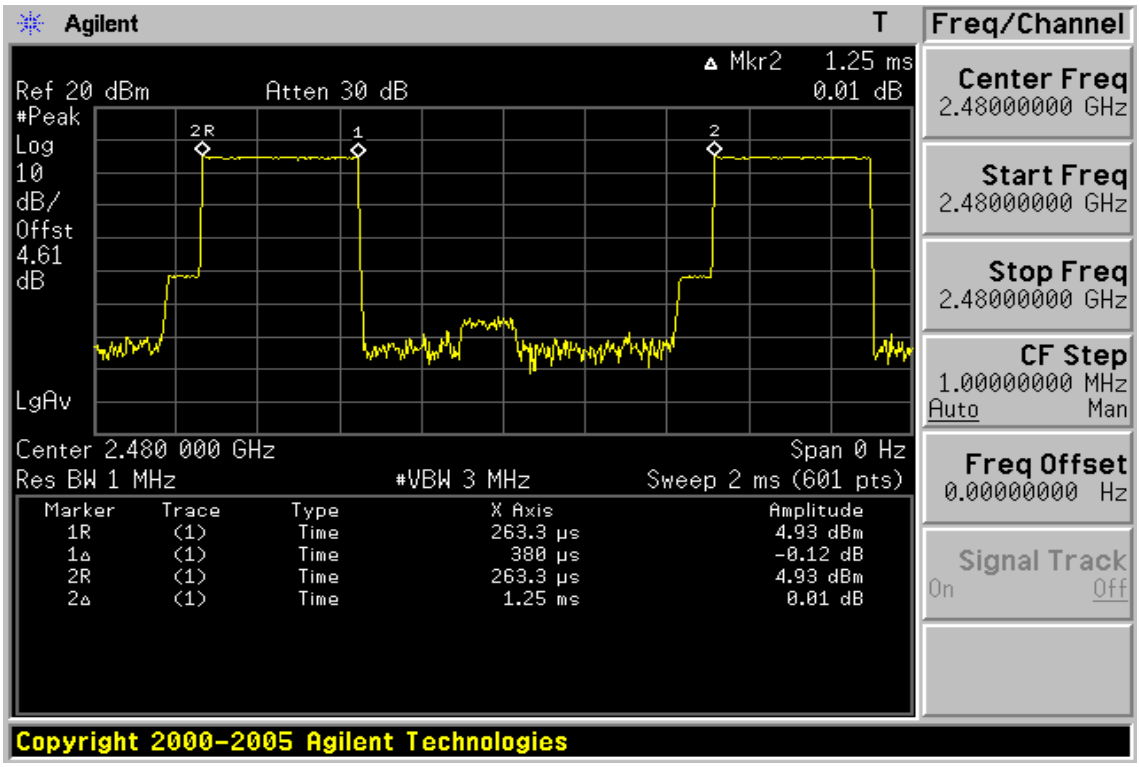
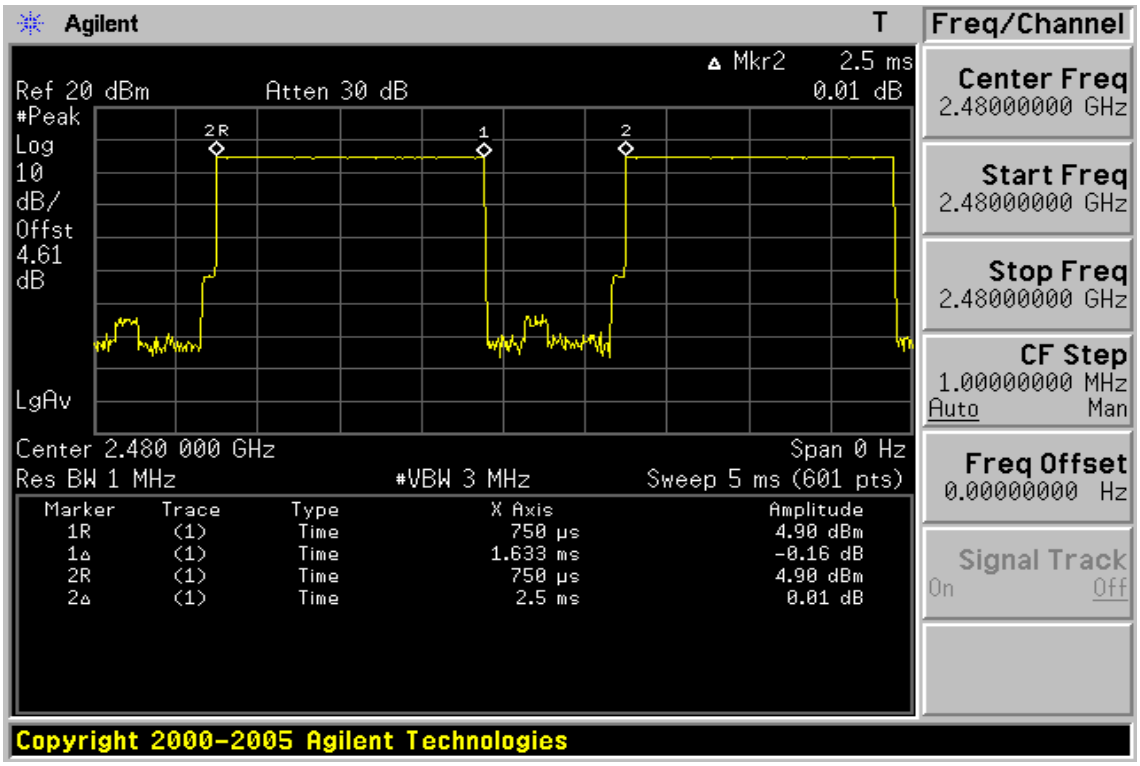
## *CH-High*

### *DH1*




### *DH3*

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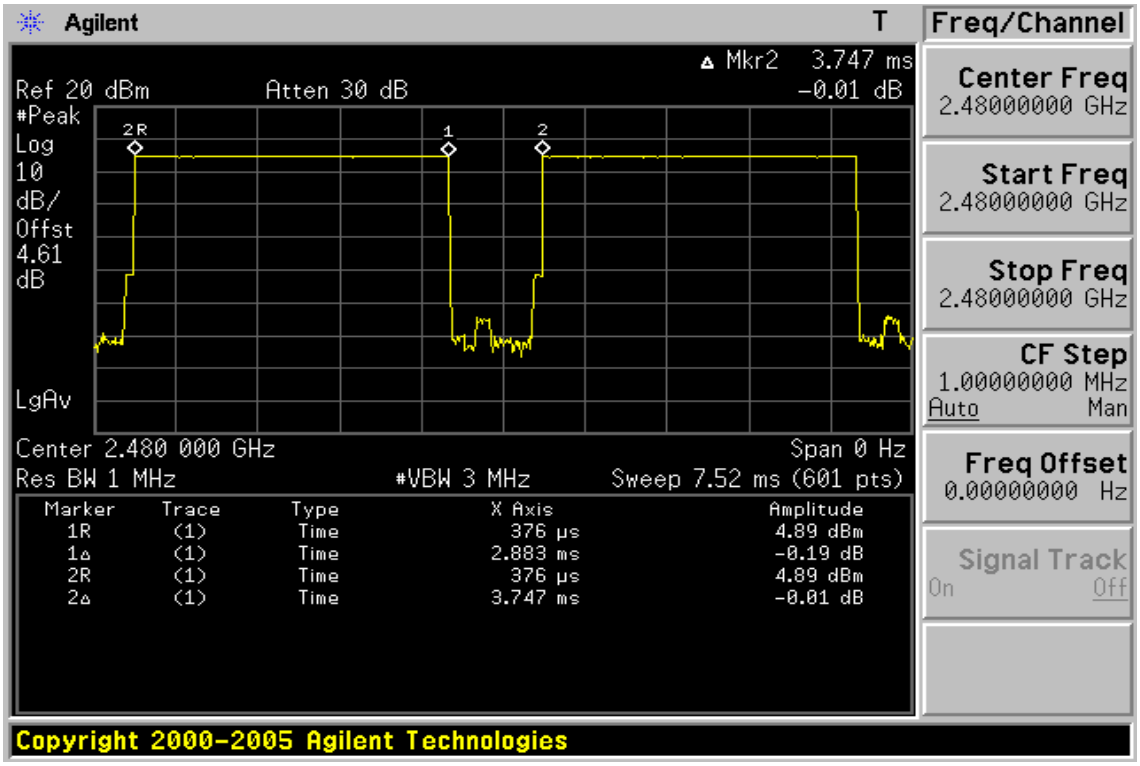
***DH5***

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# 13. 20dB Bandwidth & 99% Bandwidth

## 13.1. Standard Applicable:

For 20 dB Bandwidth

According to §15.247 (a)(1) and RSS210 A8.1(b), for frequency hopping systems operating in the 2400MHz-2483.5 MHz no limit for 20dB bandwidth.

For 99% Bandwidth

RSS-Gen §4.6.1, the transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded.

The span between the two recorded frequencies is the occupied bandwidth.

## 13.2. Measurement Equipment Used:

Refer to section 7.2 for details.

## 13.3. Test Set-up:

Refer to section 7.3 for details.

## 13.4. Measurement Procedure:

1. Place the EUT on the table and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the spectrum analyzer as RBW=10KHz (1 % of Bandwidth.), Span= 3MHz, Sweep=auto for 20dB Bandwidth test.
4. Mark the peak frequency and –20dB (upper and lower) frequency and Turn on the 99% bandwidth function, max reading..
5. Repeat above procedures until all frequency measured were complete.

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## 13.5. Measurement Result:

20dB Bandwidth : BR mode(GFSK)

| CH | Bandwidth (kHz) |
|---|---|
| Lower | 930.8 |
| Mid | 964.2 |
| Higher | 929.1 |

20dB Bandwidth : EDR mode(π/4DQPSK)

| CH | Bandwidth (MHz) | 2/3 Bandwidth (MHz) |
|---|---|---|
| Lower | 1.321 | 0.881 |
| Mid | 1.324 | 0.883 |
| Higher | 1.323 | 0.882 |

20dB Bandwidth : EDR mode(8DPSK)

| CH | Bandwidth (MHz) | 2/3 Bandwidth (MHz) |
|---|---|---|
| Lower | 1.278 | 0.852 |
| Mid | 1.283 | 0.855 |
| Higher | 1.283 | 0.855 |

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99% Bandwidth : BR Mode(GFSK)

| CH | 99% Bandwidth (kHz) |
|---|---|
| Lower | 890.81 |
| Mid | 902.45 |
| Higher | 899.94 |

99% Bandwidth : EDR Mode(π/4DQPSK)

| CH | 99% Bandwidth (MHz) |
|---|---|
| Lower | 1.1823 |
| Mid | 1.1860 |
| Higher | 1.1860 |

99% Bandwidth : EDR Mode(8DPSK)

| CH | 99% Bandwidth (MHz) |
|---|---|
| Lower | 1.1836 |
| Mid | 1.1845 |
| Higher | 1.1829 |

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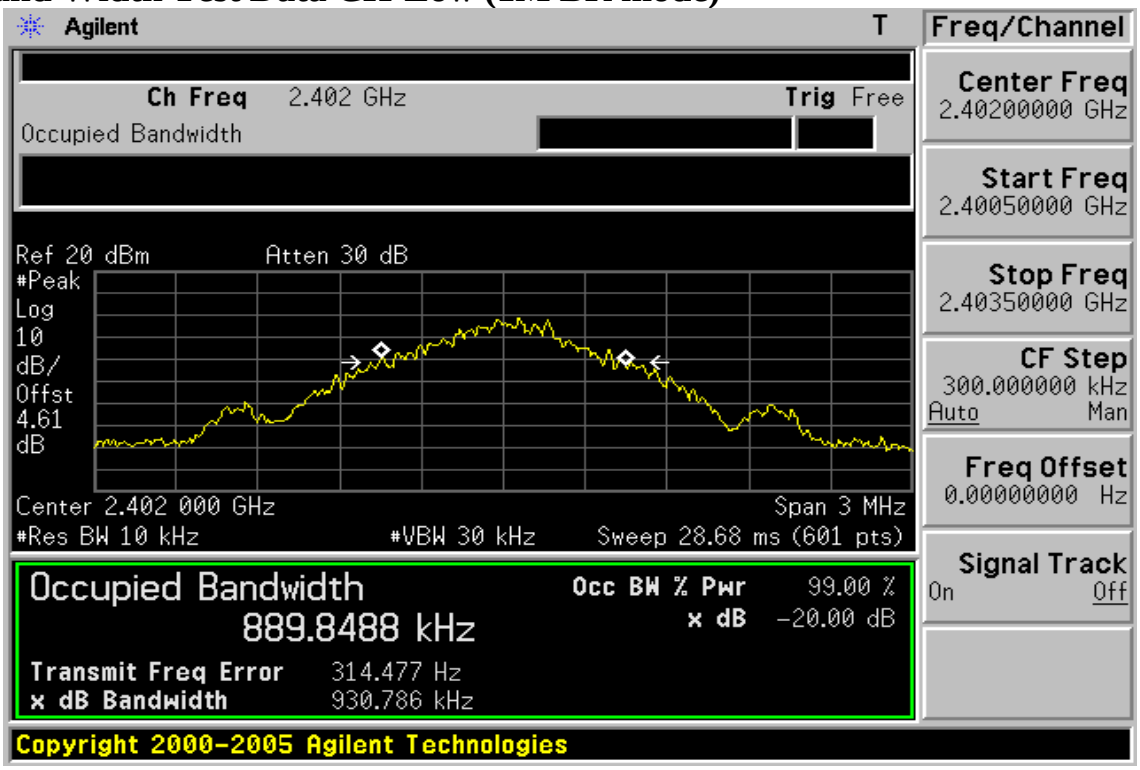
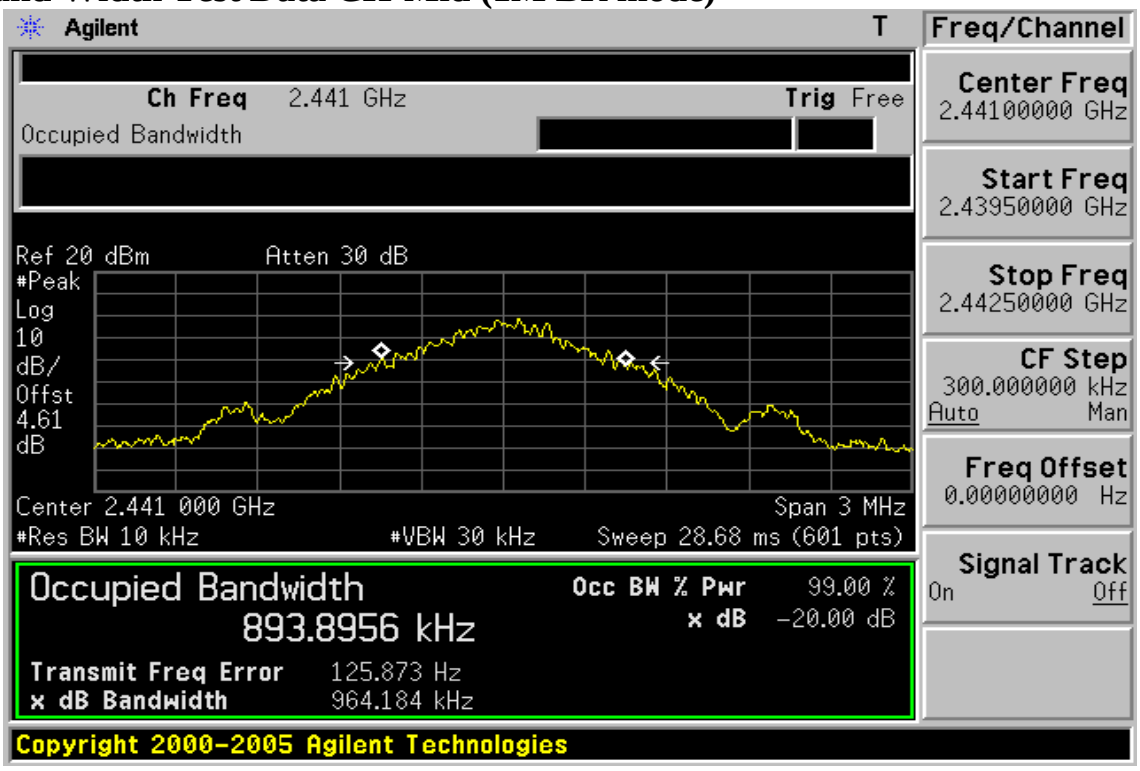
## 20dB Band Width Test Data CH-Low (1M BR mode)




## 20dB Band Width Test Data CH-Mid (1M BR mode)

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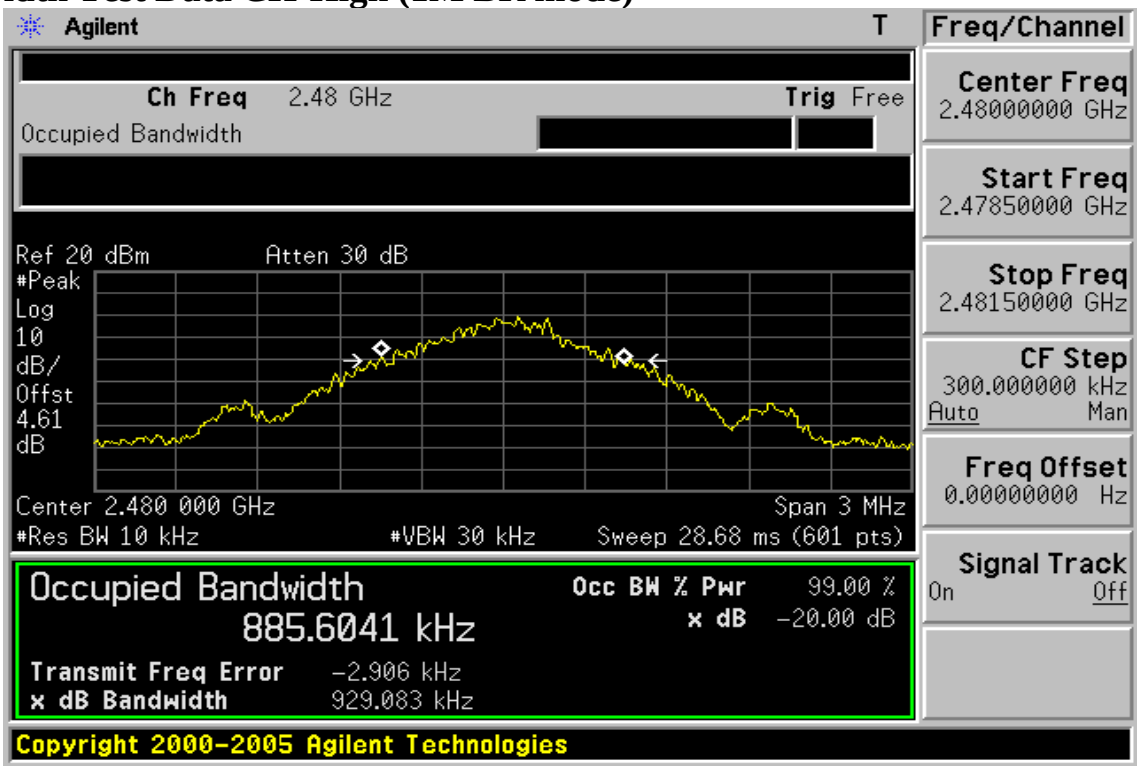
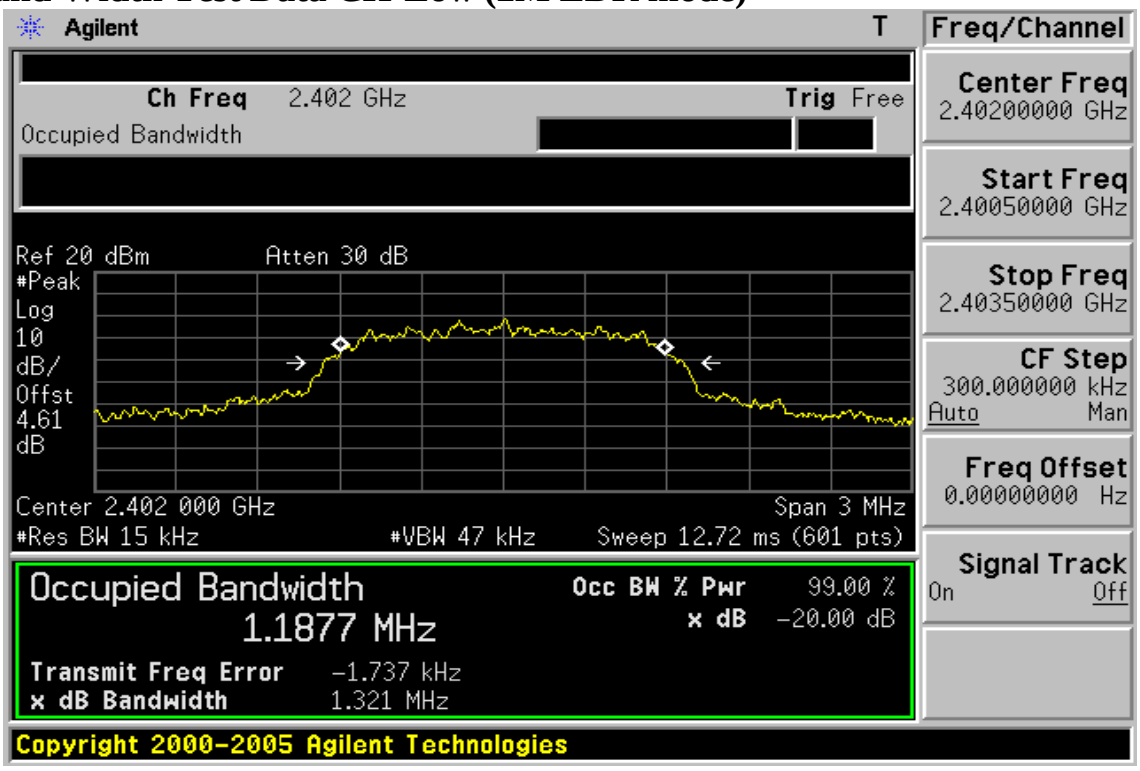
## 20dB Width Test Data CH-High (1M BR mode)




## 20dB Band Width Test Data CH-Low (2M EDR mode)

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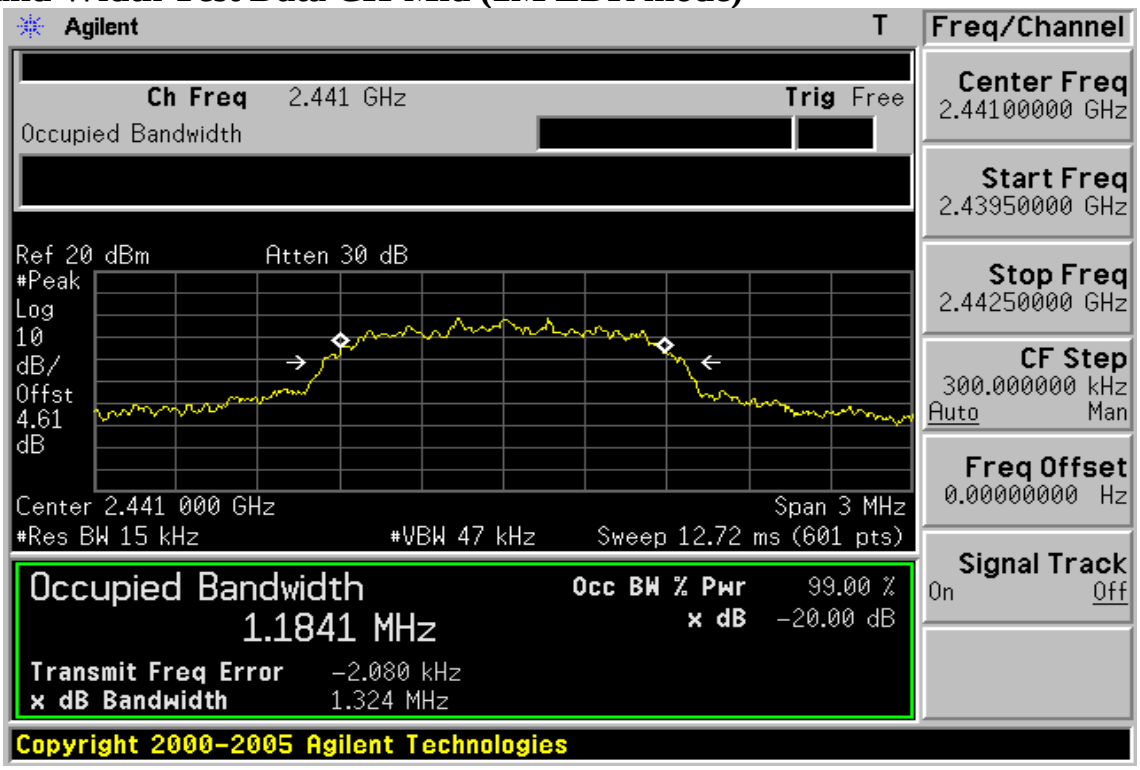
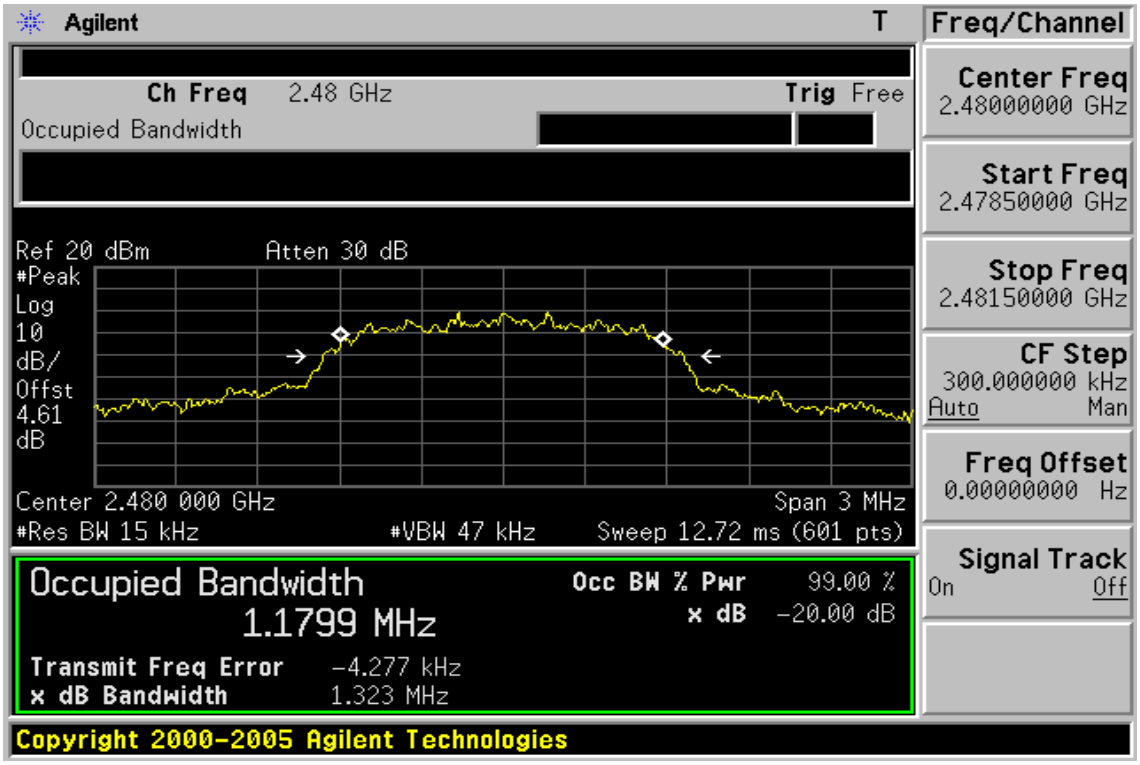
## 20dB Band Width Test Data CH-Mid (2M EDR mode)




## 20dB Band Width Test Data CH-High (2M EDR mode)

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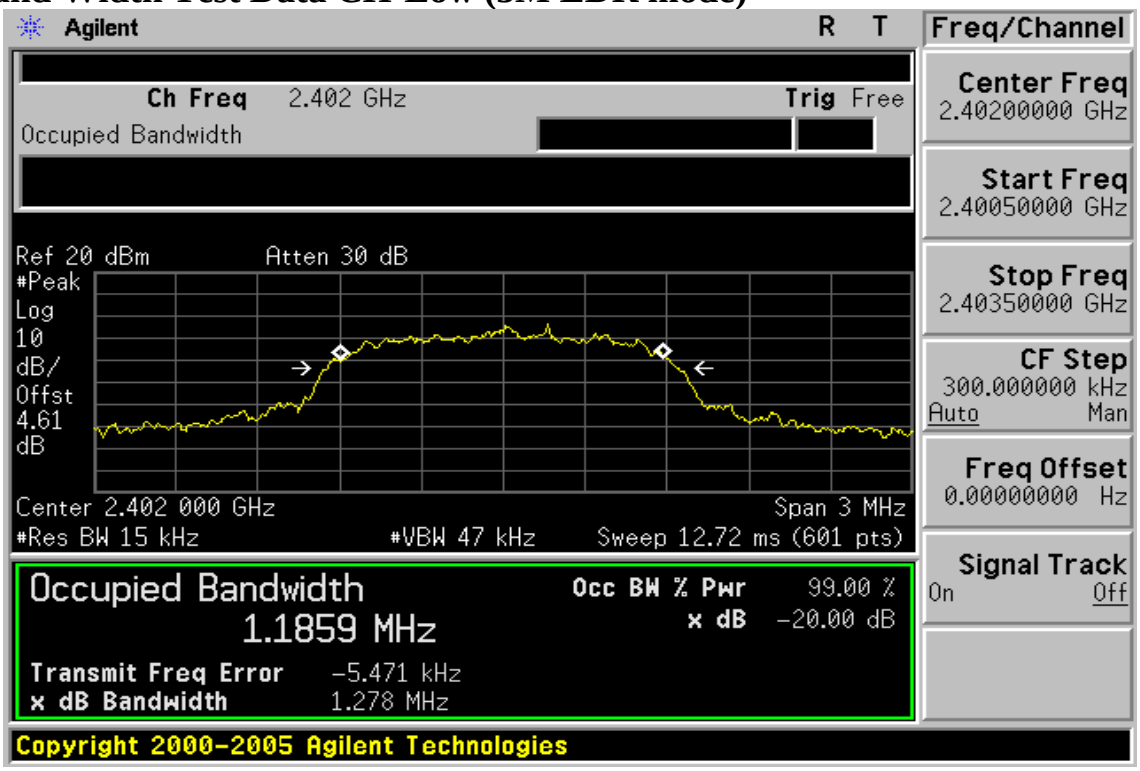
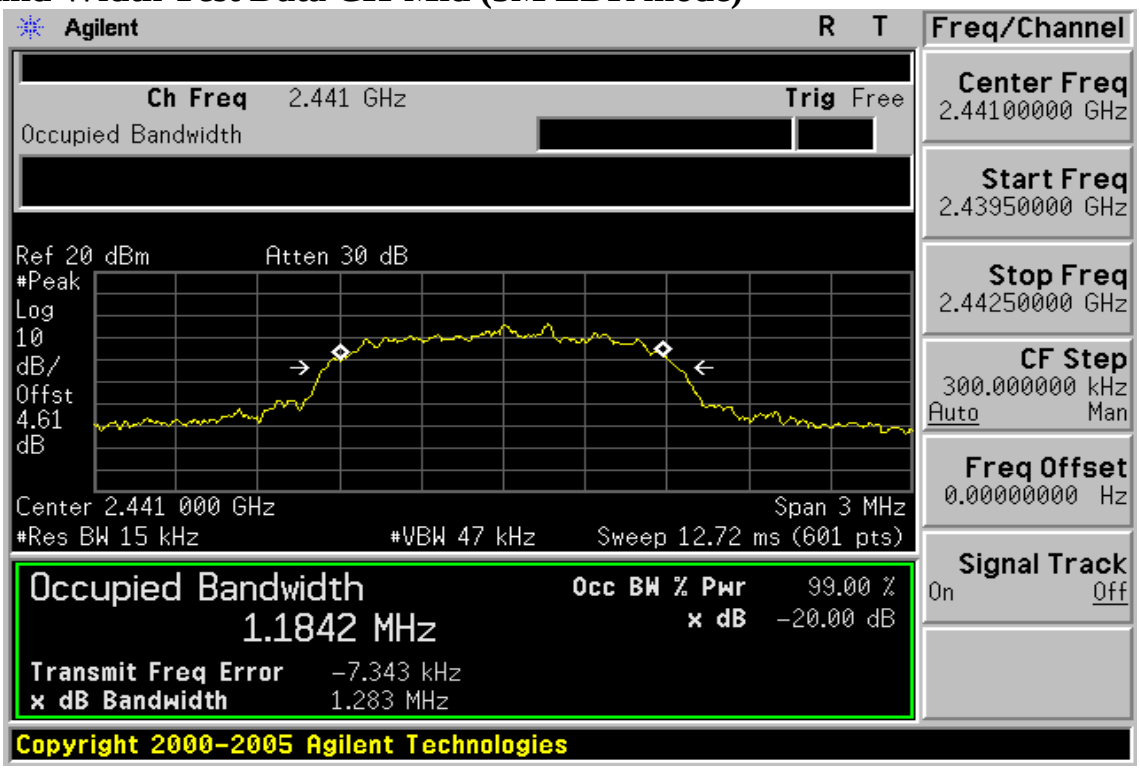
## 20dB Band Width Test Data CH-Low (3M EDR mode)




## 20dB Band Width Test Data CH-Mid (3M EDR mode)

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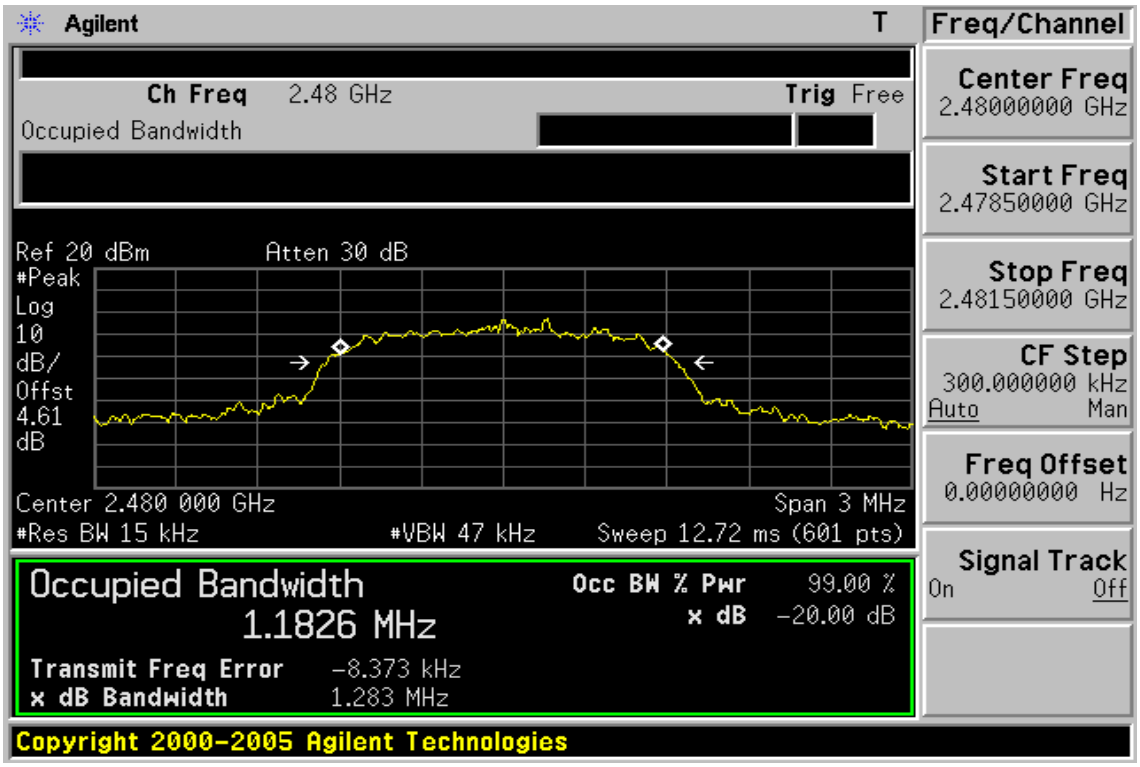
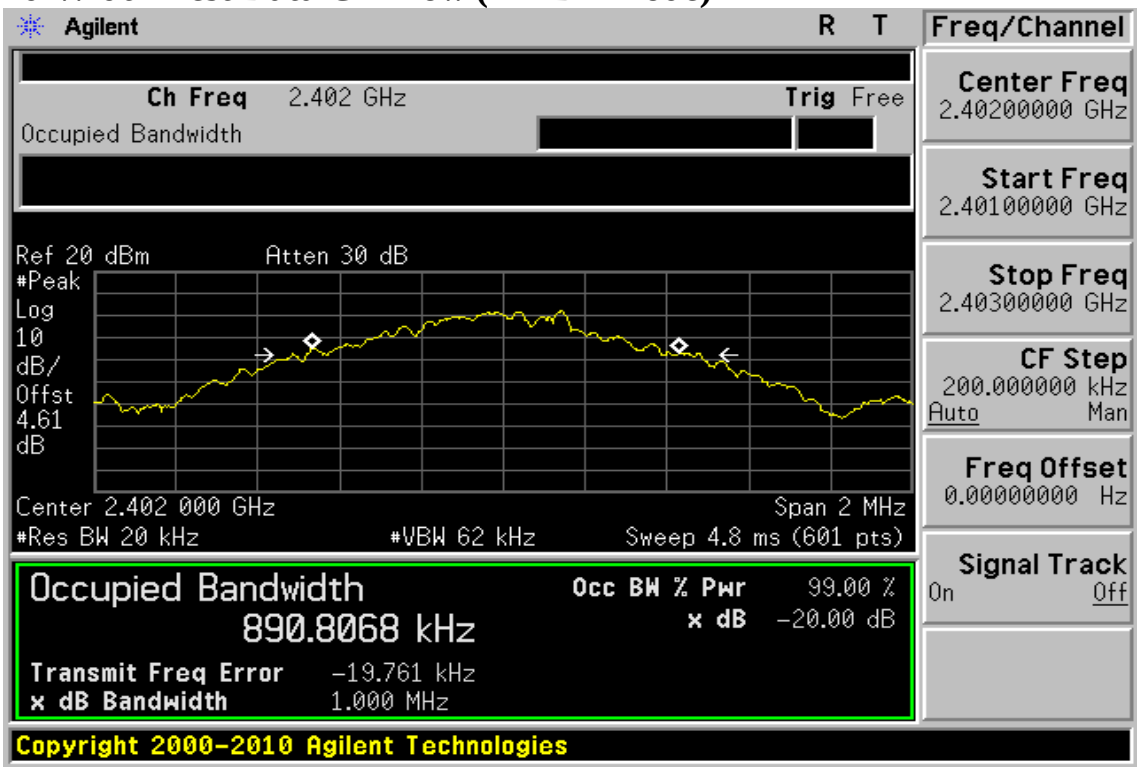
## 20dB Width Test Data CH-High (3M EDR mode)




## 99% Band Width Test Data CH-Low (1M BR mode)

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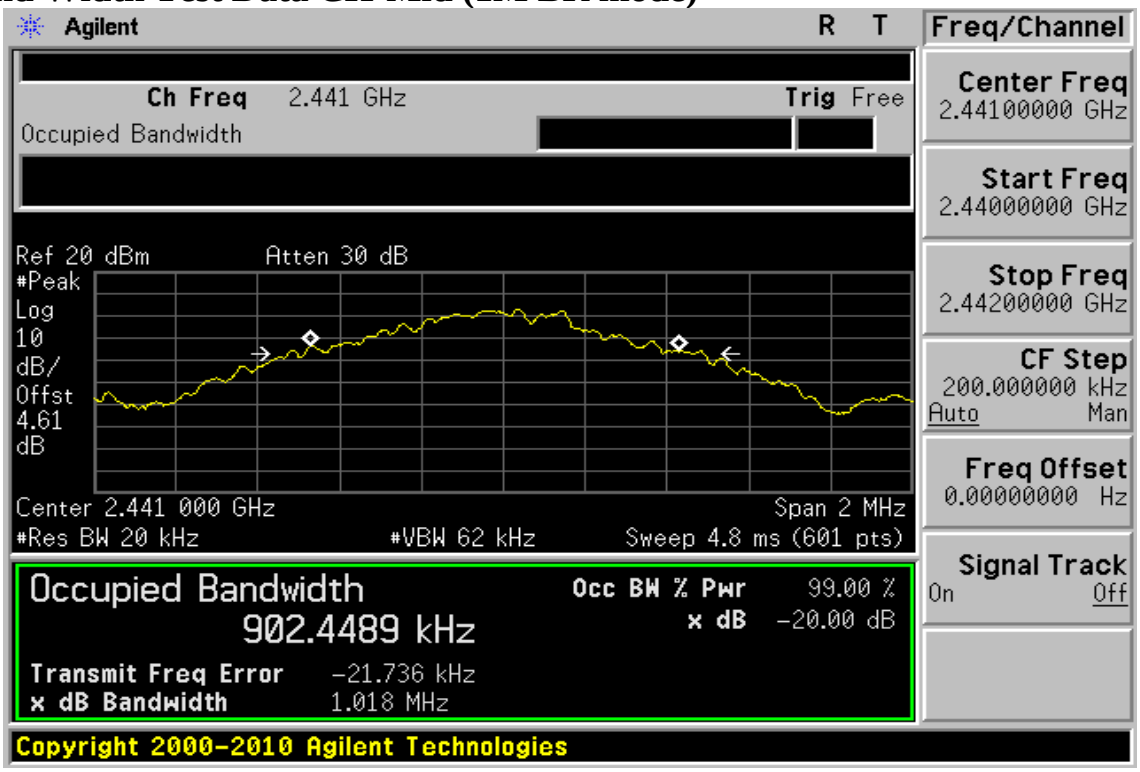
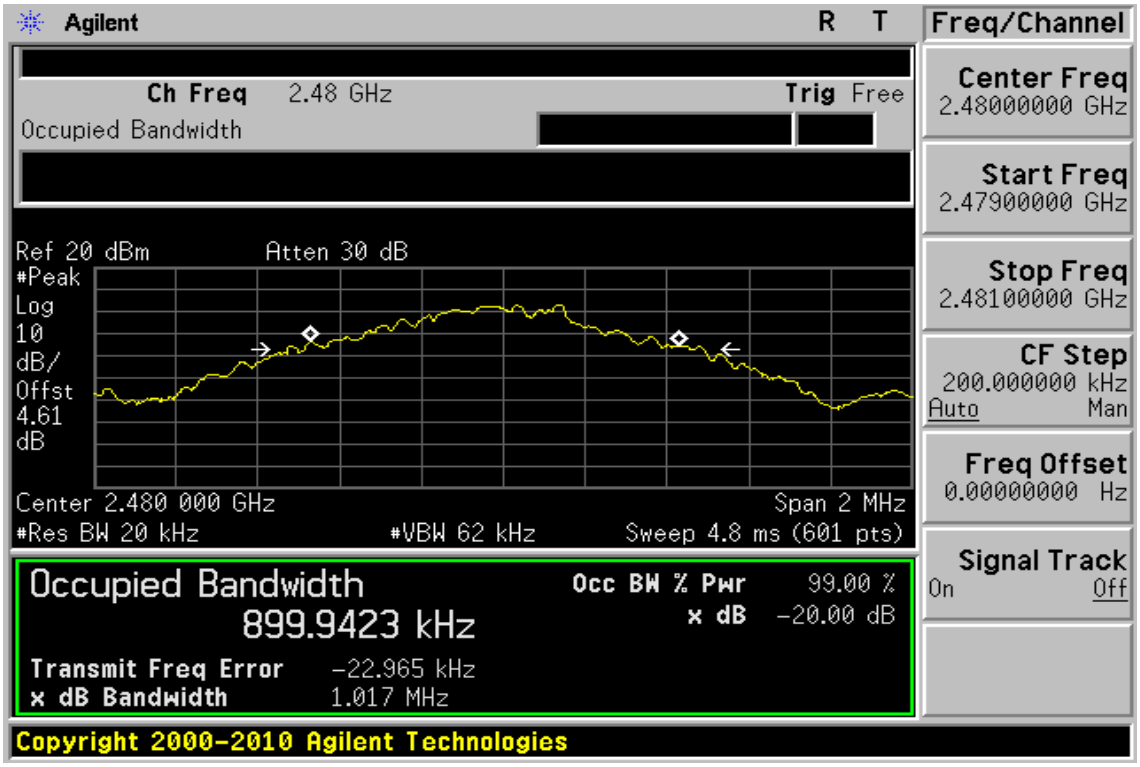
## 99%Band Width Test Data CH-Mid (1M BR mode)




## 99% Band Width Test Data CH-High (1M BR mode)

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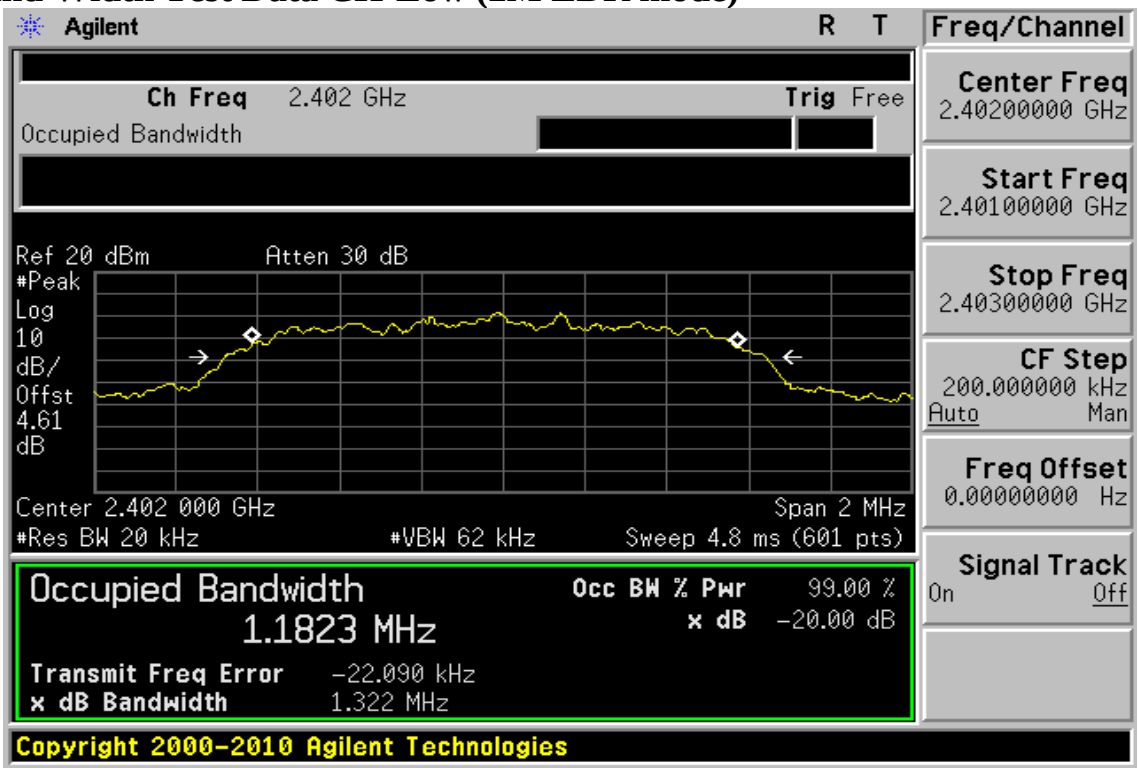
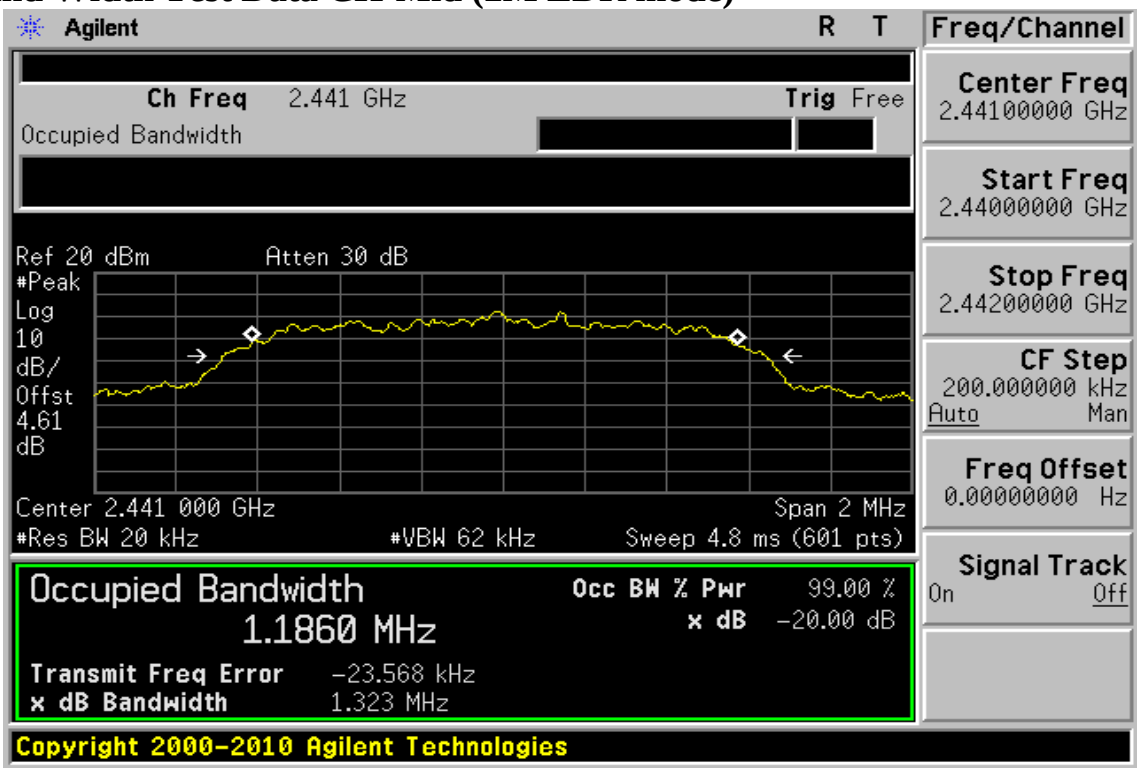
## 99% Band Width Test Data CH-Low (2M EDR mode)




## 99% Band Width Test Data CH-Mid (2M EDR mode)

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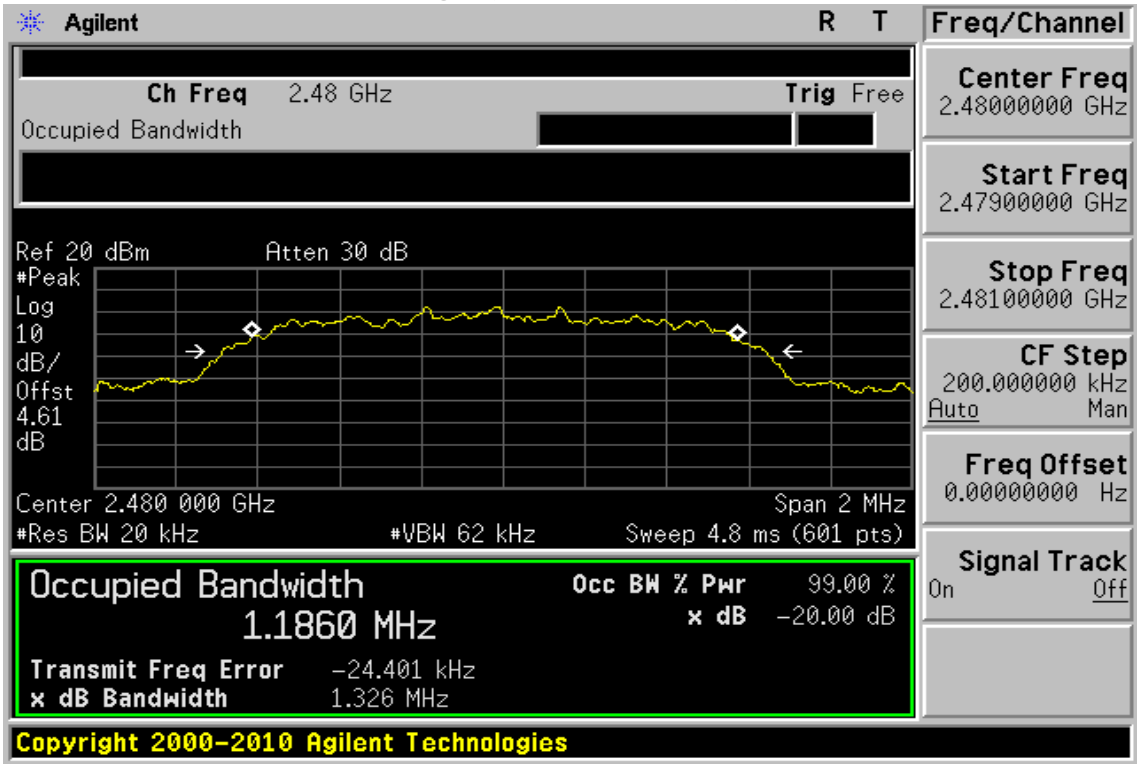
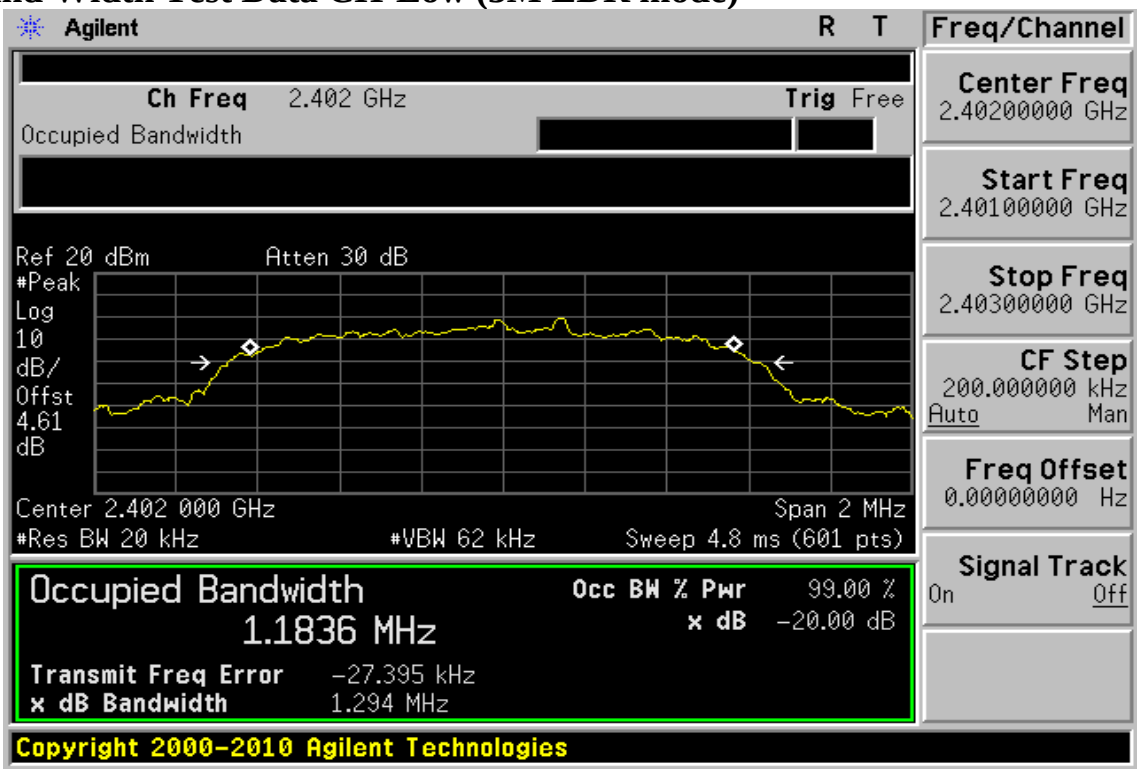
## 99% Band Width Test Data CH-High (2M EDR mode)




## 99% Band Width Test Data CH-Low (3M EDR mode)

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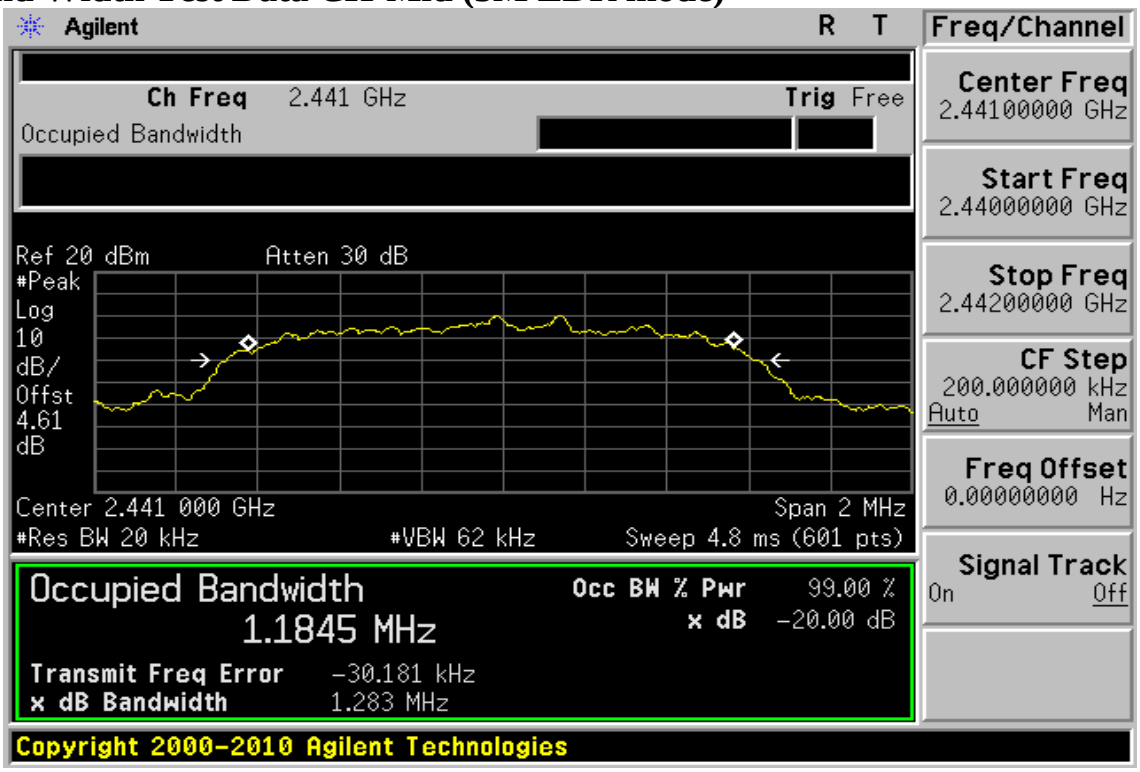
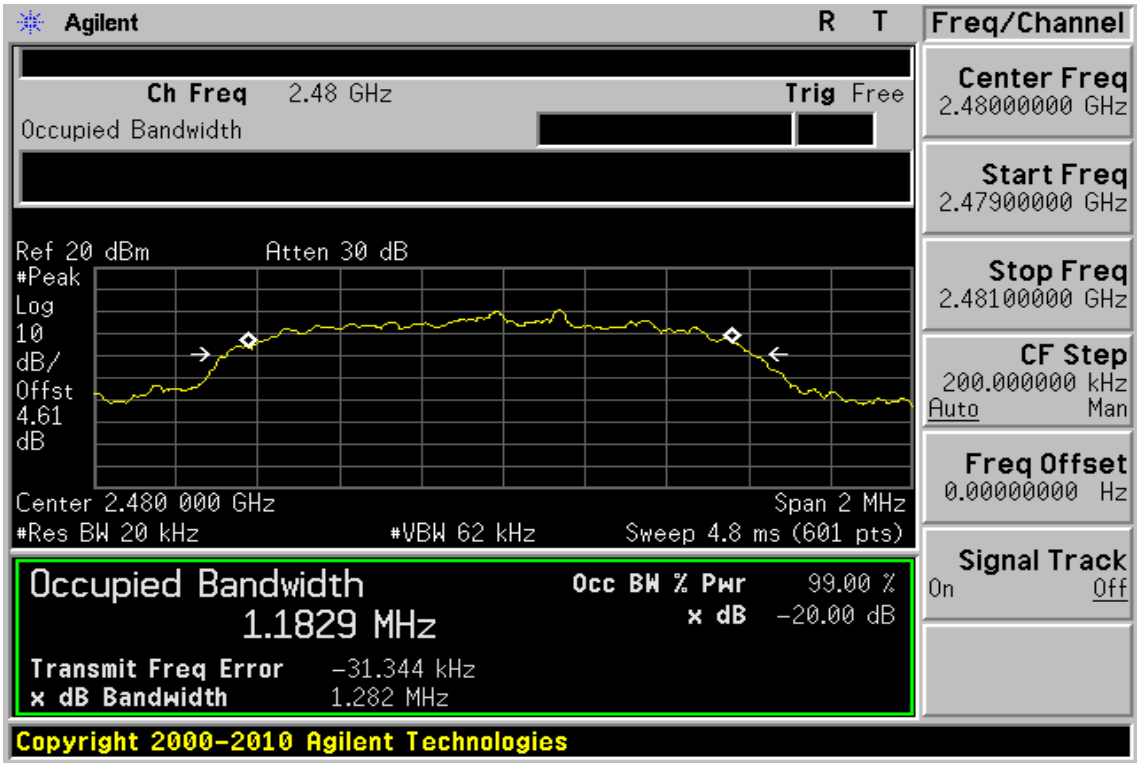
## 99%Band Width Test Data CH-Mid (3M EDR mode)




## 99%Band Width Test Data CH-High (3M EDR mode)

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# 14. ANTENNA REQUIREMENT

## 14.1. Standard Applicable:

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by the responsible party shall be used with the device.

According to RSS-GEN 7.1.2, a transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns. Testing shall be performed using the highest-gain antenna of each combination of transmitter and antenna type for which certification is being sought, with the transmitter output power set at the maximum level. Any antenna of the same type and having equal or lesser gain as an antenna that had been successfully tested for certification with the transmitter, will also be considered certified with the transmitter, and may be used and marketed with the transmitter. The manufacturer shall include with the application for certification a list of acceptable antenna types to be used with the transmitter.

When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on measurement or on data from the antenna manufacturer. Any antenna gain in excess of 6 dBi (6 dB above isotropic gain) shall be added to the measured RF output power before using the power limits specified in RSS-210 or RSS-310 for devices of RF output powers of 10 milliwatts or less. For devices of output powers greater than 10 milliwatts, except devices subject to RSS-210 Annex 8 (Frequency Hopping and Digital Modulation Systems Operating in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz Bands) or RSS-210 Annex 9 (Local Area Network Devices), the total antenna gain shall be added to the measured RF output power before using the specified power limits. For devices subject to RSS-210 Annex 8 or Annex 9, the antenna gain shall not be added.

## 14.2. Antenna Connected Construction

The directional gains of antenna used for transmitting is 2.5 dBi, and the antenna connector is designed with unique type RF connector and no consideration of replacement. Please see EUT photo and antenna spec. for details.

***~ End of Report ~***

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