

Issued Date : Dec.10, 2012



## FCC Part 15 RF Test Report For Rugged PDA

**Applicant** : WINMATE Communication INC.  

---

**Address** : 9F, No.111-6, Shing-De Rd., San-Chung District, New Taipei  
City, Taiwan  

---

**Equipment** : Rugged PDA  

---

**Model No.** : C350T-3GB2 , C350XXXXXXXX ( X=a~z,A~Z,0~9,''-',blank  
or Slash)  

---

**Trade Name** : WINMATE  

---

This report applied to above tested sample only. This report shall not be reproduced in part without written approval of EMC & Radio Equipment Testing Lab, Chungwha Telecom Co. Ltd.



## CERTIFICATE

|                                |   |
|--------------------------------|---|
| <b>Applicant</b>               | WINMATE Communication INC.  |
| <b>Address</b>                 | 9F, No.111-6, Shing-De Rd., San-Chung District,New Taipei City,Taiwan |
| <b>Equipment</b>               | Rugged PDA  |
| <b>Model No.</b>               | C350T-3GB2 , C350XXXXXXXX ( X=a~z,A~Z,0~9,'-' ,blank or Slash)        |
| <b>Trade Name</b>              | WINMATE   |
| <b>Manufacturer</b>            | WINMATE Communication INC.  |
| <b>Address of Manufacturer</b> | 9F, No.111-6, Shing-De Rd., San-Chung District,New Taipei City,Taiwan |

**I HEREBY CERTIFY THAT :**

The measurements shown in this test report were made in accordance with the procedures given in FCC Part 15 Subpart C §15.247 、 Industry Canada RSS-210

The device described above was tested by EMC & Radio Equipment Testing Lab, Chungwha Telecom Co. 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 603-C.The energy emitted by EUT is tested as described in this report is in compliance with conducted and radiated emission limits of FCC Part 15 Subpart C §15.247 and IC RSS-210 Issue 7

Date of Issue : Dec. 10 , 2012

Date of Test : Dec. 10 , 2012

Tester by : Chi-Min Tzou

*Chi-Min Tzou*

Approved by : Ming-Hong Ko

*Ko Ming Hong*

Technical Manager

Test results given in this report apply only to the specific sample(s) tested under stated test conditions.

This report shall not be reproduced in part without written approval of EMC & Radio Equipment Testing Lab, Chungwha Telecom Co. Ltd.



## TABLE OF CONTENTS

| Description                                       | Page |
|---|------|
| 1. GENERAL INFORMATION .....                      | 5    |
| 1.1 Applicant description .....                   | 5    |
| 1.2 EUT description .....                         | 5    |
| 1.3 Operating Condition of EUT .....              | 5    |
| 1.4 Test Conditions .....                         | 5    |
| 1.5 Test Mode .....                               | 6    |
| 2. Summary of Test Results .....                  | 7    |
| 3. Instrument Calibration .....                   | 7    |
| 3.1 Equipment Used during Test .....              | 8    |
| 4 Measurements .....                              | 8    |
| 4.1. RF output power .....                        | 8    |
| 4.1.1. Required and Limits.....                   | 8    |
| 4.1.2. Test Configuration and Procedure .....     | 9    |
| 4.1.3. Test Results.....                          | 10   |
| 4.2. Number of Channel Measurement .....          | 20   |
| 4.2.1 Required and Limits.....                    | 20   |
| 4.2.2 Test Configuration and Procedure .....      | 20   |
| 4.2.3 Test Results.....                           | 20   |
| 4.3. 20dB and 99% Bandwidth Measurement .....     | 22   |
| 4.3.1. Required and Limits.....                   | 22   |
| 4.3.2. Test Configuration and Procedure .....     | 22   |
| 4.3.3. Test Results.....                          | 23   |
| 4.4. Hopping Channel Separation Measurement ..... | 27   |
| 4.4.1. Required and Limits.....                   | 27   |
| 4.4.2. Test Configuration and Procedure .....     | 27   |
| 4.4.3. Test Results.....                          | 28   |
| 4.5. Dwell Time Measurement.....                  | 30   |
| 4.4.1. Required and Limits.....                   | 30   |
| 4.4.2. Test Configuration and Procedure .....     | 30   |
| 4.4.3. Test Results.....                          | 30   |
| 4.6. Band Edges Measurement .....                 | 41   |
| 4.4.1. Required and Limits.....                   | 41   |
| 4.4.2. Test Configuration and Procedure .....     | 41   |
| 4.4.3. Test Results.....                          | 42   |
| 4.7. Radiated Emission Measurement.....           | 43   |
| 4.4.1. Required and Limits.....                   | 43   |
| 4.4.2. Test Configuration and Procedure .....     | 44   |
| 4.4.3. Test Results.....                          | 45   |
| 4.8. Antenna Requirements.....                    | 58   |
| 4.4.1. Standard Applicable.....                   | 58   |
| 4.4.2. Antenna Connected Construction .....       | 58   |
| 4.4.3. 3.8.3 ntenna Gain .....                    | 58   |





|  |    |
|--|----|
| 5.PHOTOGRAPHS .....                      | 59 |
| 5.1 Photos of Radiated Measurement ..... | 59 |
| 5.2 Photos of EUT.....                   | 61 |



## 1. GENERAL INFORMATION

### 1.1 Applicant description

|           |   |
|-----------|---|
| Applicant | WINMATE Communication INC   |
| Address:  | 9F, No.111-6, Shing-De Rd., San-Chung District,New Taipei City,Taiwan |

### 1.2 EUT description

|   |   |
|---|---|
| Applicant   | WINMATE Communication INC   |
| Product   | Rugged PDA  |
| Brand Name  | WINNATE   |
| Model No  | C350T-3GB2 , C350XXXXXXXX ( X=a~z,A~Z,0~9,''-<br>‘’,blank or Slash) |
| FCC ID  | PX93500WBW  |
| Frequency Range                                   | 2402MHz~2480MHz   |
| Number of Channels                                | 79  |
| Maximum Output Power to Antenna(Normal condition) | -0.9dBm(EIRP)   |
| Modulation ty                                     | G-FSK 、 Pi/4-DQPSK 、 8DPSK  |
| Antenna Type:                                     | Patch Antenna   |
| Power supply                                      | 3.3 Vdc from AC/DC Adapter  |
| Manufacture                                       | WINMATE Communication INC.  |

### 1.3 Operating Condition of EUT

Test mode : Normal Operation

### 1.4 Test Conditions

Temperature : 19 ±2°C

Humidity : 67 ±3 % R.H.

### 1.5 Test Mode

The EUT has been associated with peripherals pursuant to ANSI C63.4-2003 and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction (150 kHz to 30 MHz), radiation (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). Pre-scanned tests were conducted to determine the final configuration from all possible combinations. The following tables are showing the test modes as the worst cases and recorded in this report.

| Test Cases |                           |                                     |                             |
|------------|---------------------------|-------------------------------------|-----------------------------|
| Test Item  | Data Rate / Modulation    |                                     |                             |
|            | Bluetooth GFSK<br>(1Mbps) | Bluetooth $\pi$ /4-DQPSK<br>(2Mbps) | Bluetooth 8-DPSK<br>(3Mbps) |
| Test mode  | Mode 1: CH00_2402 MHz     | Mode 4: CH00_2402 MHz               | Mode 7: CH00_2402 MHz       |
|            | Mode 2: CH39_2441 MHz     | Mode 5: CH39_2441 MHz               | Mode 8: CH39_2441 MHz       |
|            | Mode 3: CH78_2480 MHz     | Mode 6: CH78_2480 MHz               | Mode 9: CH78_2480 MHz       |

## 2. Summary of Test Results

| Report Section | FCC Rule           | IC Rule | Description                | Limit                 | Result |
|----------------|--------------------|---------|----------------------------|-----------------------|--------|
| 4.1            | 15.247(a)(1)       | A8.1(b) | RF output power            | ≤ 1W                  | pass   |
| 4.2            | 15.247(b)(1)       | A8.4(2) | Number of Channel          | ≥ 15Chs               | pass   |
| 4.3            | 15.247(a)(1)       | A8.1(a) | 20dB Bandwidth             | NA                    | Pass   |
| 4.4            | 15.247(a)(1)       | A8.1(b) | Hopping Channel Separation | ≥ 2/3 of 20dB BW      | Pass   |
| 4.5            | 15.247(a)(1)       | A8.1(d) | Dwell Time of Each Channel | ≤ 0.4sec              | Pass   |
| 4.6            | 15.247(d)          | A8.5    | Frequency Band Edges       | ≤ 20dBc               | Pass   |
| 4.7            | 15.247(d)          | A8.5    | Radiated Emission          | 15.209(a) & 15.247(d) | Pass   |
| 4.8            | 15.203 & 15.247(b) | A8.4    | Antenna Requirement        | NA                    | Pass   |

## 3. Instrument Calibration

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

### 3.1 Equipment Used during Test

| Manufacturer       | Description | Model     | Calibration Date | Calibration Due Date |
|--------------------|-------------|-----------|------------------|----------------------|
| EMI Receiver       | R&S         | ESIB 40   | 101.05.17        | 1 year               |
| EMI Receiver       | HP          | 84125C    | 101.06.25        | 1 year               |
| Spectrum Analyzer  | HP          | 8593E     | 101.06.04        | 1 year               |
| Horn Antenna       | EMCO        | 3115      | 101.06.08        | 1 year               |
| Horn Antenna       | EMCO        | 3116      | 101.05.14        | 1 year               |
| Broadband Antenna  | EMCO        | 3142B     | 101.05.22        | 1 year               |
| Preamplifier       | EMCI        | EMC051845 | 101.10.27        | 1 year               |
| LISN               | EMCO        | 3850/2    | 101.06.22        | 1 year               |
| Standard Gain Horn | ETS         | 3160-03   | NA               | NA                   |
| Bluetooth Test Set | Agilent     | N4010A    | NA               | NA                   |

## 4 Measurements

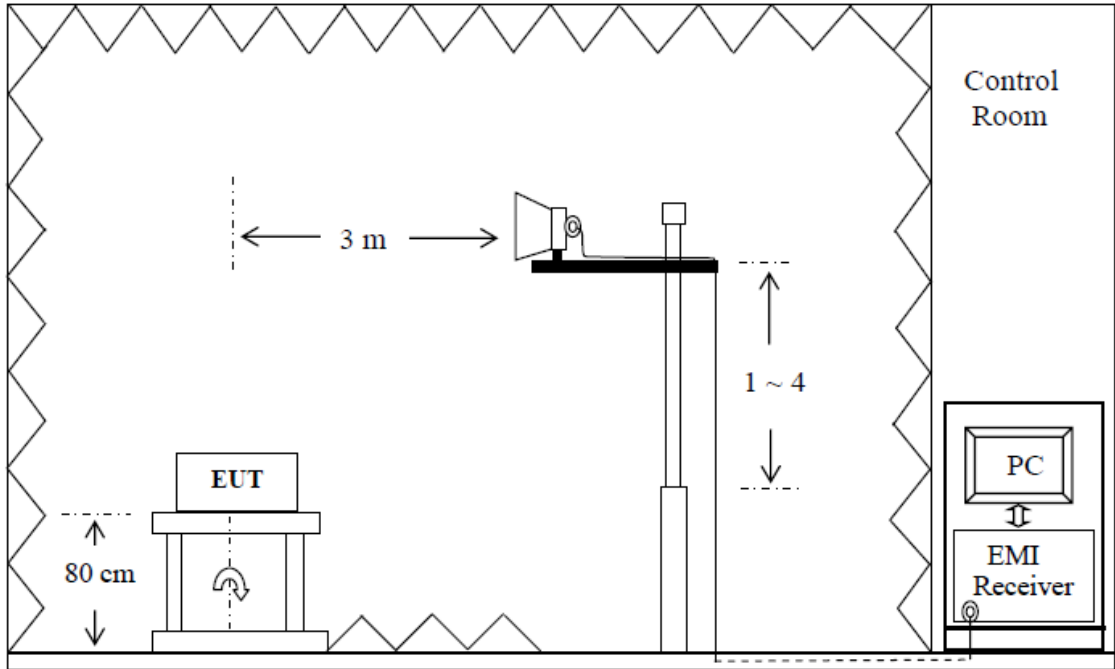
### 4.1. RF output power

#### 4.1.1. Required and Limits

Frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels: 1W (30 dBm).



**4.1.2. Test Configuration and Procedure**



The EUT was placed on a turntable just above ground. The turntable rotates 360 degrees to determine the position of the maximum emission level. EUT was set 3 meters away from the receiving antenna, which were mounted on an antenna tower. The antenna can move up and down between 1 meter and 4 meter to find out the maximum emission level. Broadband antenna was used as receiving antenna. Both horizontal and vertical polarization of the antenna was set on measurement.

$$E = \frac{\sqrt{30 \times P \times G}}{D}$$

$$PG(\text{EIRP}) = \frac{(E \times D)^2}{30}$$

E : Field Strength (V/m)

PG : Equivalent Isotropic Radiated Power (W)

G : Antenna Gain

D : distance (3m)

$$\text{ERP} = \text{EIRP} - 2.15$$

### 4.1.3. Test Results

Modulation : G-FSK (1Mbps)

| Frequency<br>(MHz)    | Reading Value |      | Calibration Factor<br>(dB) | Measure @3m |      | (EIRP) |      | Limit<br>(dBm) | Pass/<br>Fail |
|-----------------------|---------------|------|----------------------------|-------------|------|--------|------|----------------|---------------|
|                       | (dB V)        |      |                            | (dB V/m)    |      | (dBm)  |      |                |               |
|                       | H             | V    |                            | H           | V    | H      | V    |                |               |
| 2402                  | 57.1          | 60.8 | 33.5                       | 90.6        | 94.3 | -4.6   | -0.9 | 30             | Pass          |
| 2440                  | 56.2          | 59.9 | 33.6                       | 89.8        | 93.5 | -5.4   | -1.7 | 30             | Pass          |
| 2480                  | 56.3          | 59.3 | 33.7                       | 90.0        | 93.0 | -5.2   | -2.2 | 30             | Pass          |
| Uncertainty : ± 4.3dB |               |      |                            |             |      |        |      |                |               |

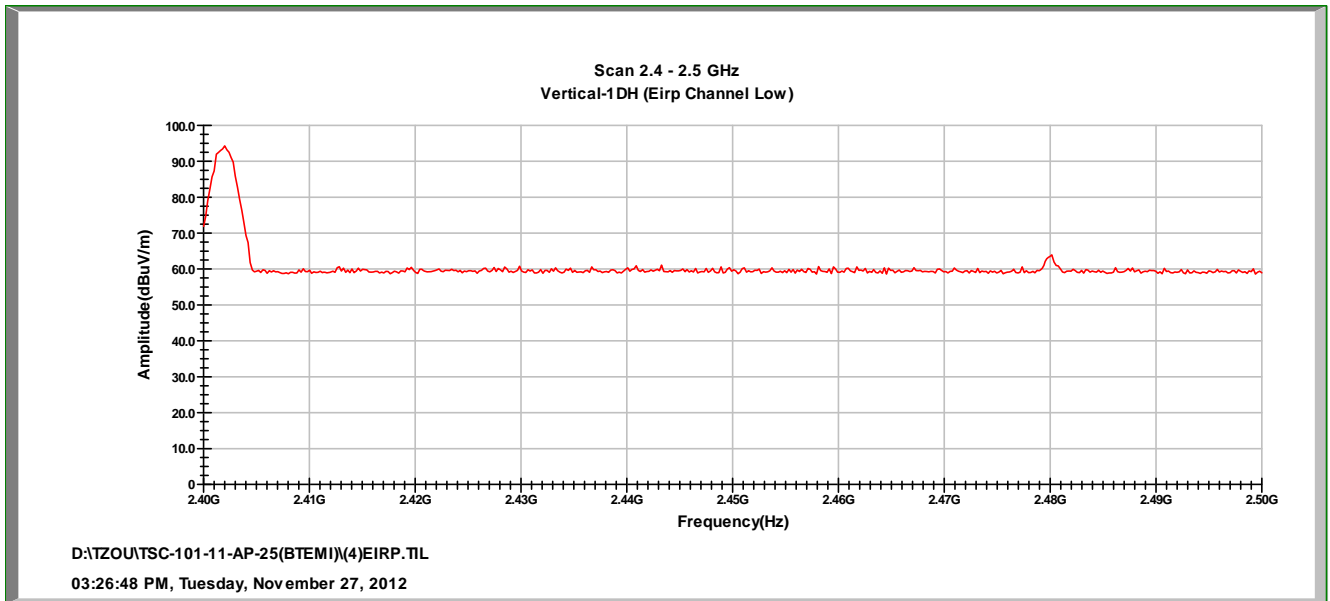
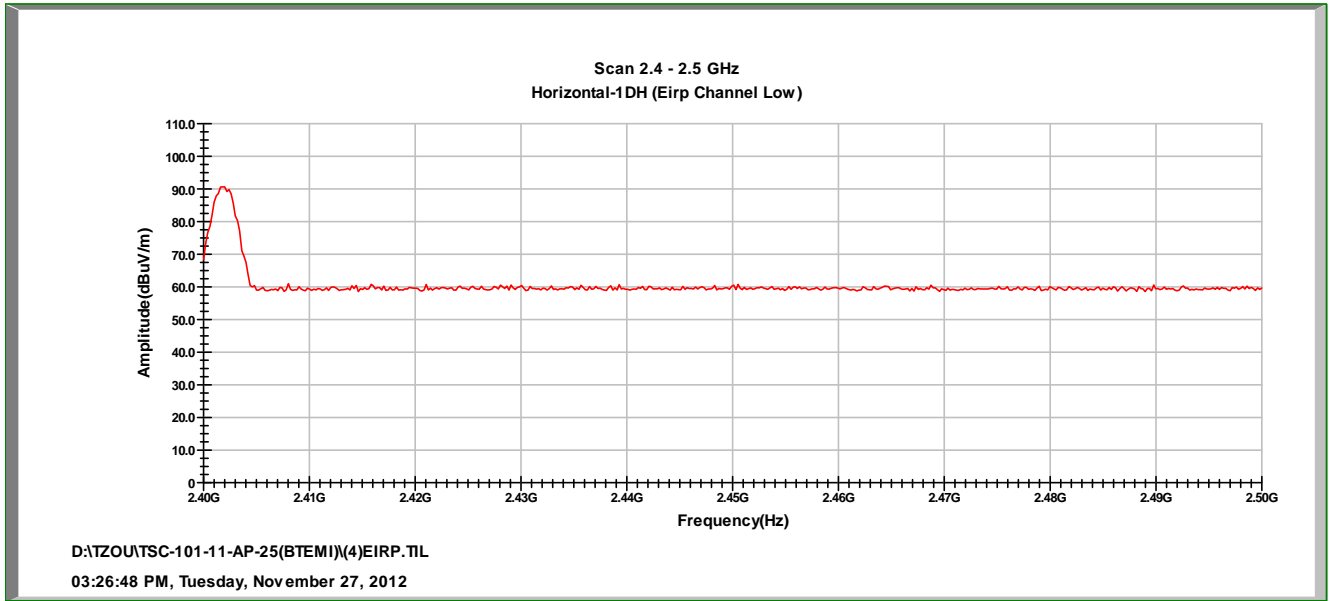
Modulation : Pi/4-DQPSK (2Mbps)

| Frequency<br>(MHz)    | Reading Value |      | Calibration Factor<br>(dB) | Measure @3m |      | (EIRP) |      | Limit<br>(dBm) | Pass/<br>Fail |
|-----------------------|---------------|------|----------------------------|-------------|------|--------|------|----------------|---------------|
|                       | (dB V)        |      |                            | (dB V/m)    |      | (dBm)  |      |                |               |
|                       | H             | V    |                            | H           | V    | H      | V    |                |               |
| 2402                  | 57.0          | 57.0 | 33.5                       | 90.5        | 90.5 | -4.7   | -4.7 | 30             | Pass          |
| 2440                  | 56.3          | 56.2 | 33.6                       | 89.9        | 89.8 | -5.3   | -5.4 | 30             | Pass          |
| 2480                  | 57.3          | 57.1 | 33.7                       | 91.0        | 90.8 | -4.2   | -4.4 | 30             | Pass          |
| Uncertainty : ± 4.3dB |               |      |                            |             |      |        |      |                |               |

Modulation : 8DPSK (3Mbps)

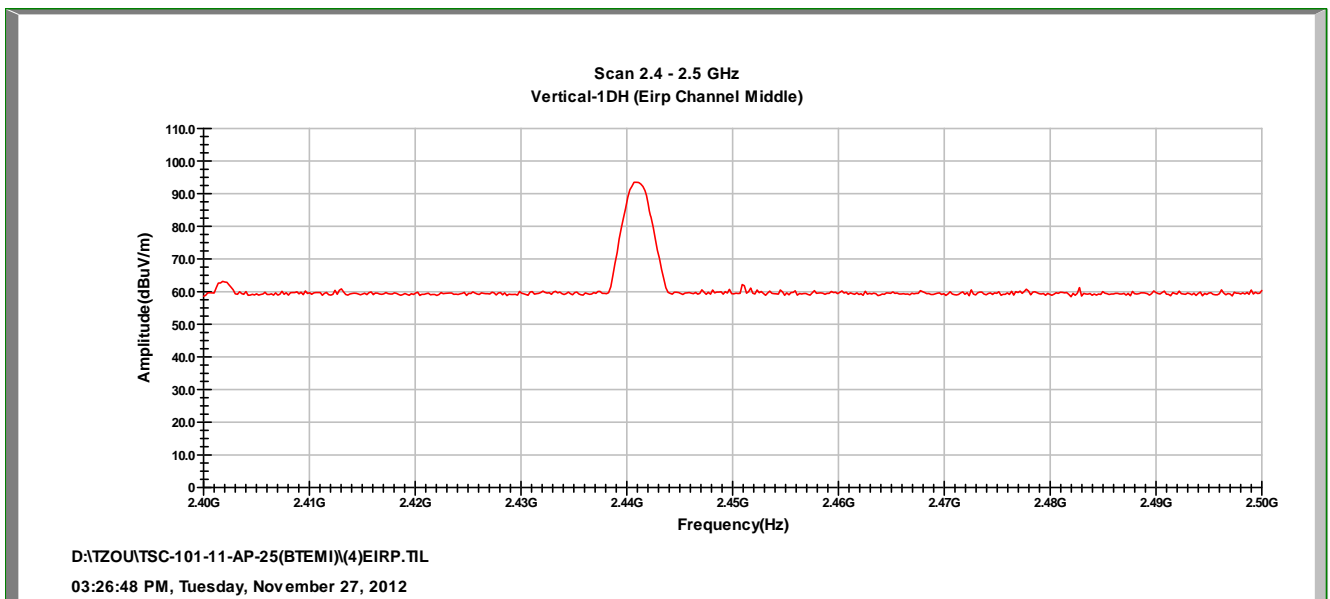
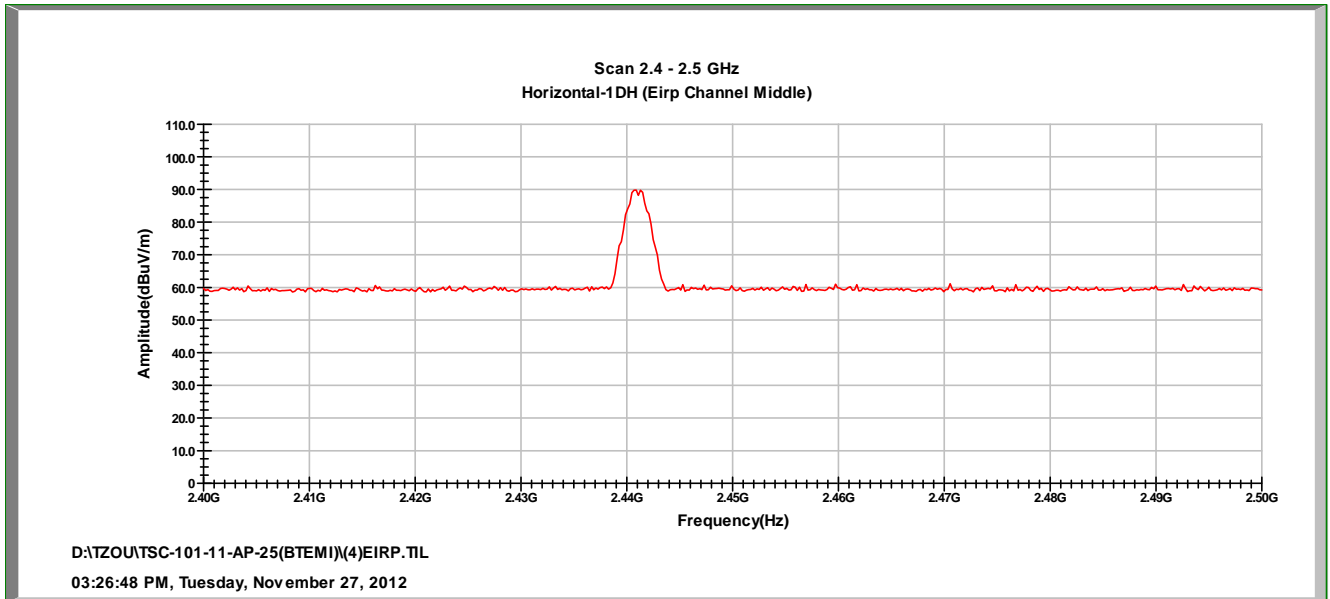
| Frequency<br>(MHz)    | Reading Value |      | Calibration Factor<br>(dB) | Measure @3m |      | (EIRP) |      | Limit<br>(dBm) | Pass/<br>Fail |
|-----------------------|---------------|------|----------------------------|-------------|------|--------|------|----------------|---------------|
|                       | (dB V)        |      |                            | (dB V/m)    |      | (dBm)  |      |                |               |
|                       | H             | V    |                            | H           | V    | H      | V    |                |               |
| 2402                  | 56.5          | 57.2 | 33.5                       | 90.0        | 90.7 | -5.2   | -4.5 | 30             | Pass          |
| 2440                  | 56.3          | 56.8 | 33.6                       | 89.9        | 90.4 | -5.3   | -4.8 | 30             | Pass          |
| 2480                  | 57.0          | 57.1 | 33.7                       | 90.7        | 90.8 | -4.5   | -4.4 | 30             | Pass          |
| Uncertainty : ± 4.3dB |               |      |                            |             |      |        |      |                |               |

Remark: 1. Calibration Factor = Antenna Factor + Cable Loss  
 2.Measure Level = Reading Value + Calibration Factor

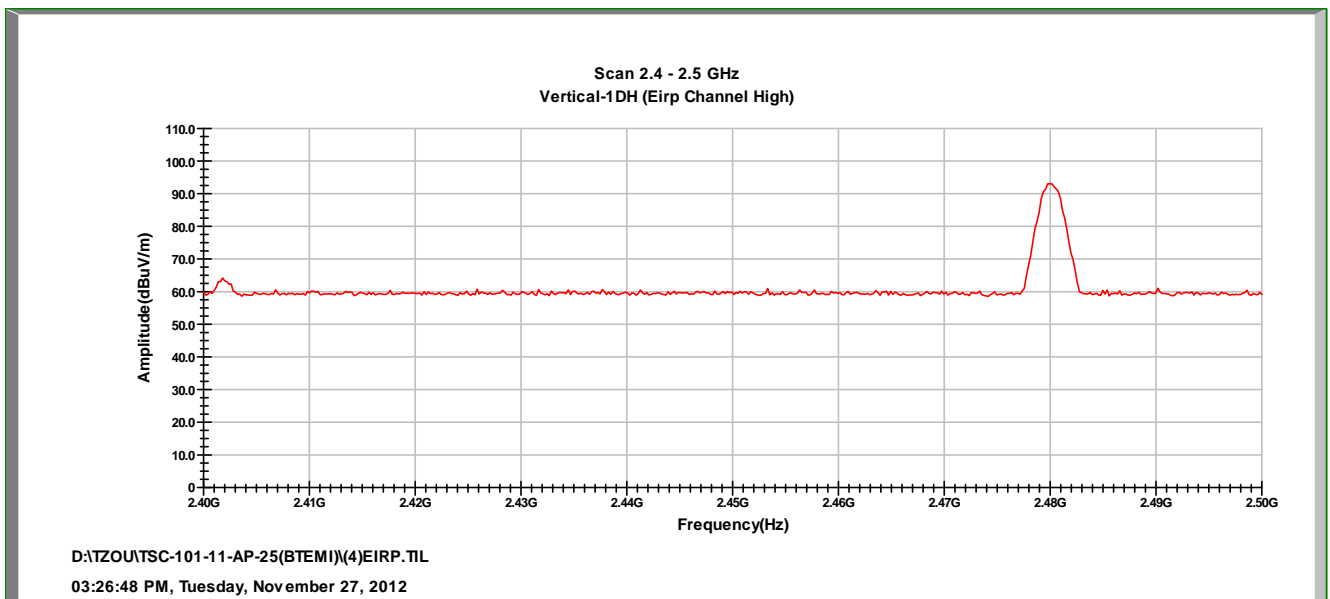
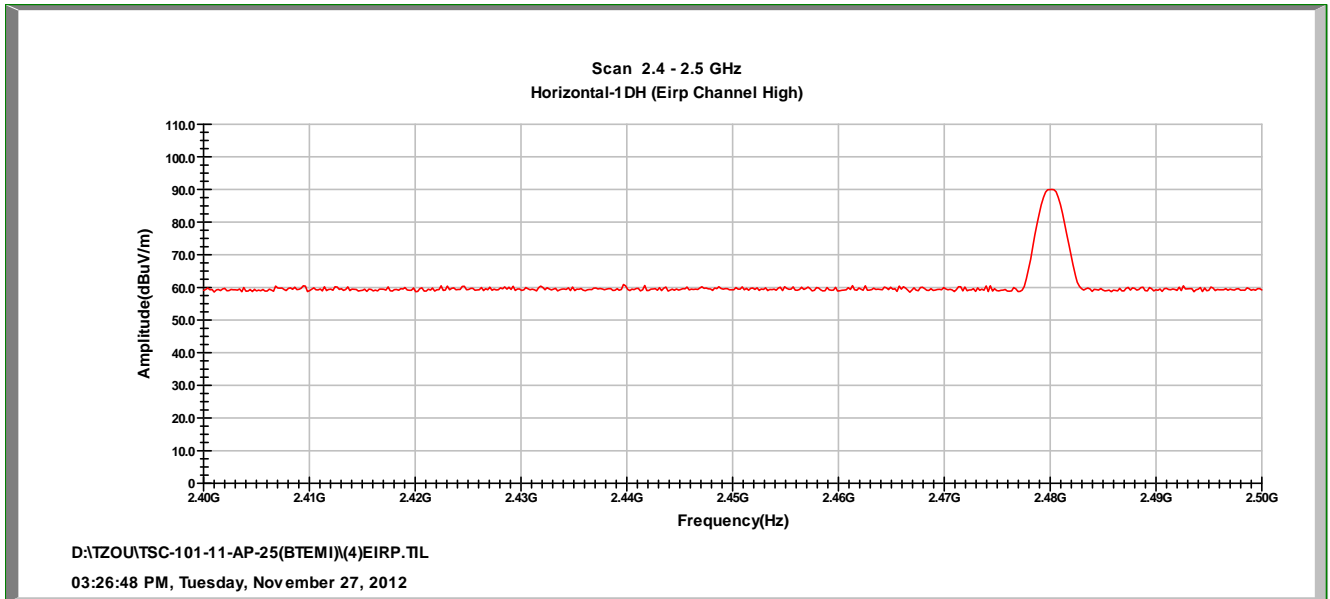


Radiation field strength (Tx: 2402MHz) (GFSK , 1Mbps)

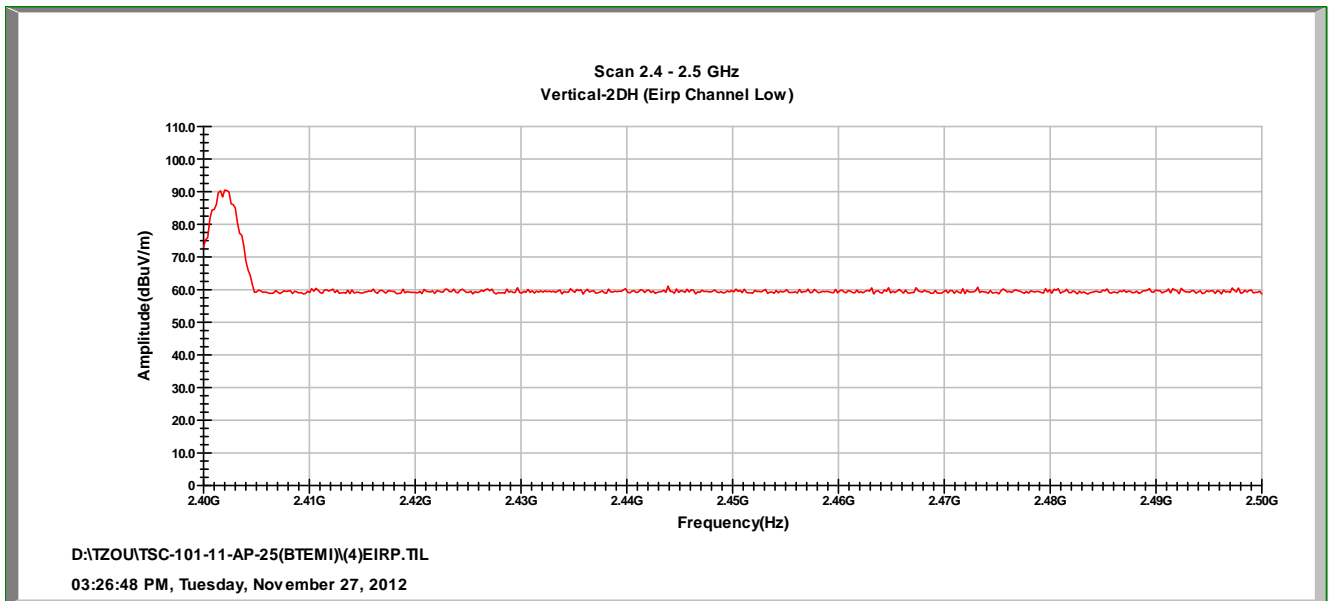
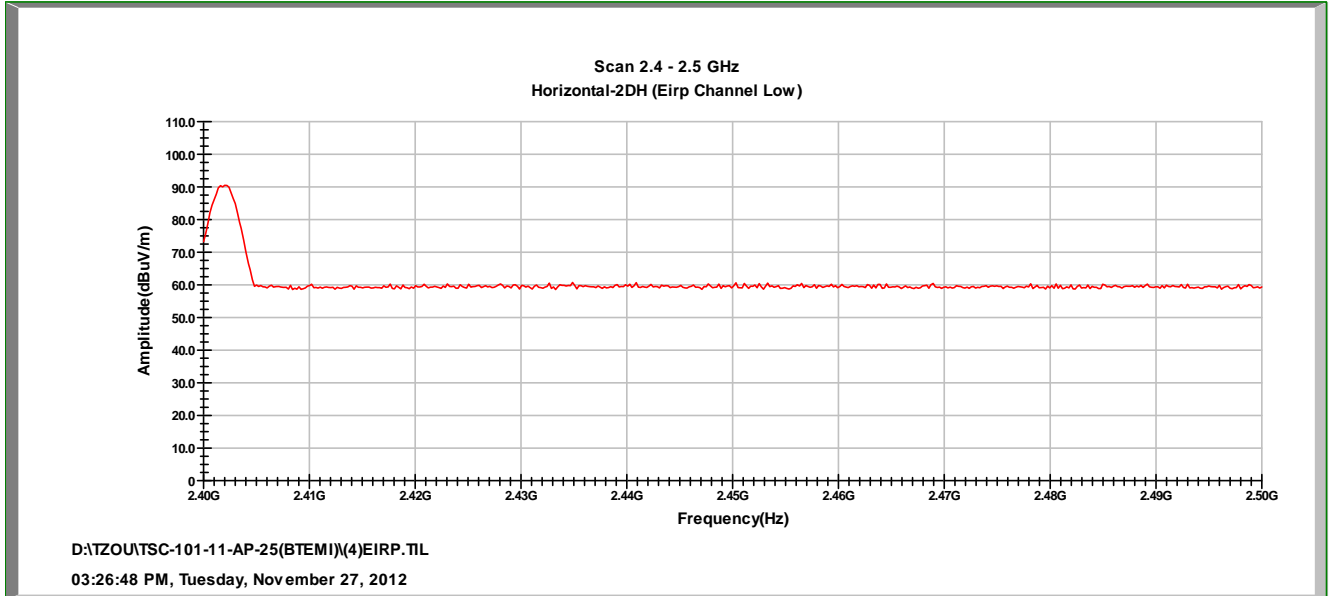




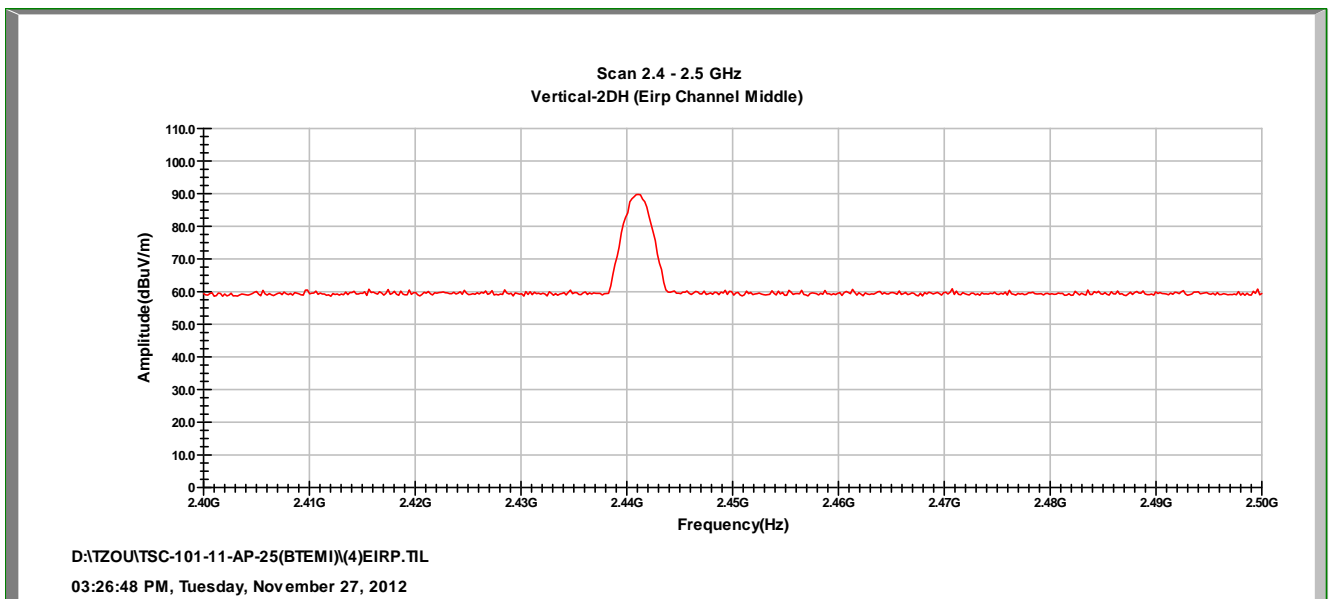
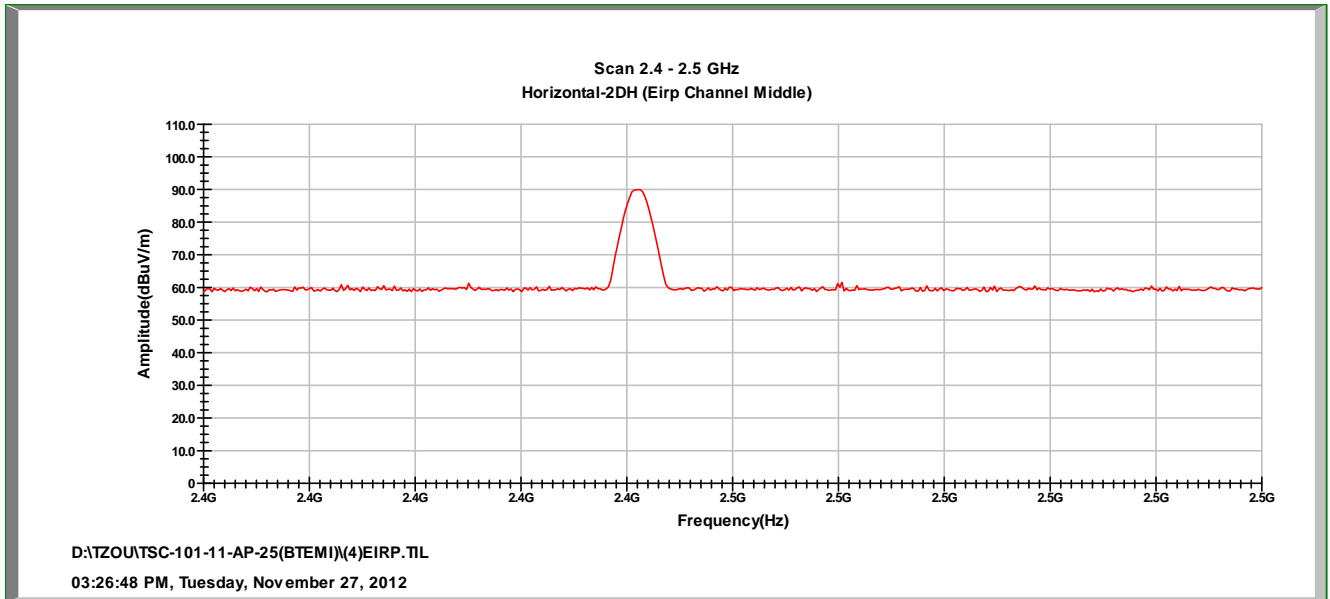
Radiation field strength (Tx: 2441MHz) (GFSK , 1Mbps)



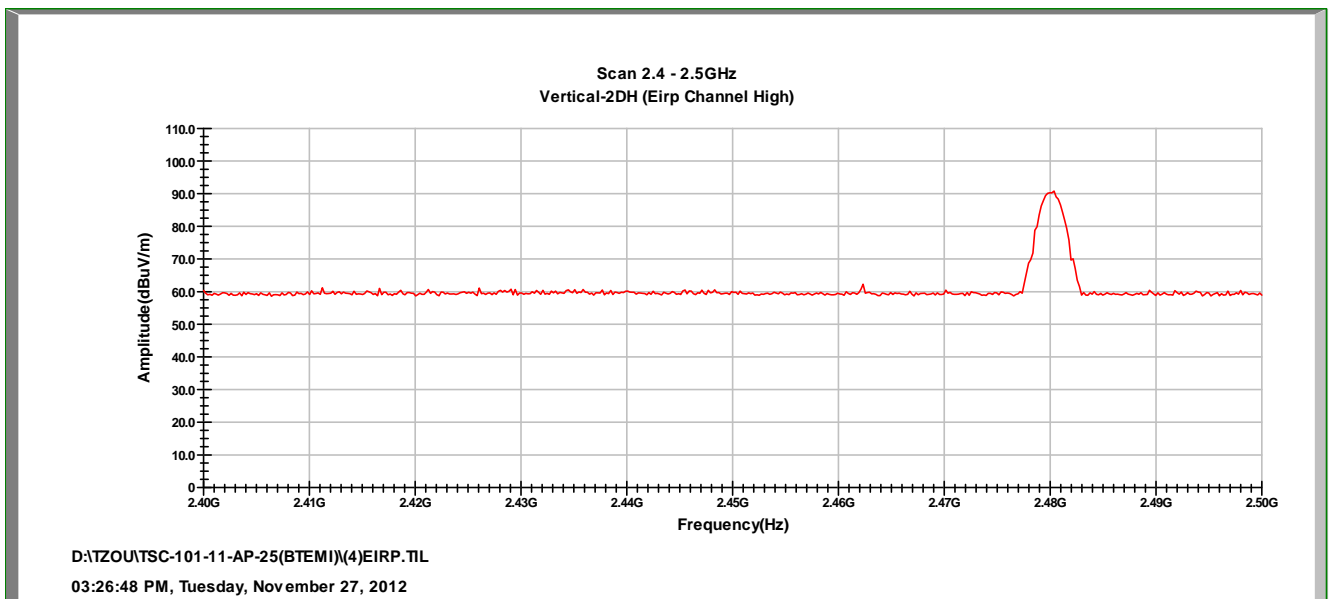
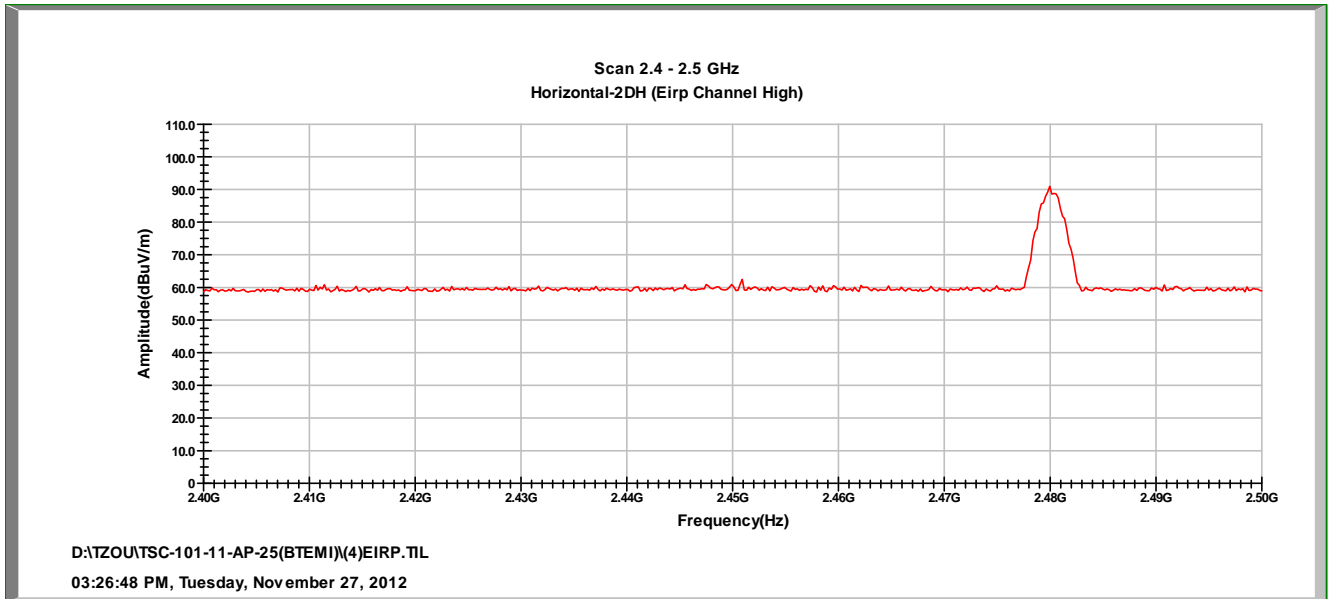
Radiation field strength (Tx: 2480MHz) (GFSK , 1Mbps)



Radiation field strength (Tx: 2402MHz) ( $\pi/4$ -DQPSK , 2Mbps)

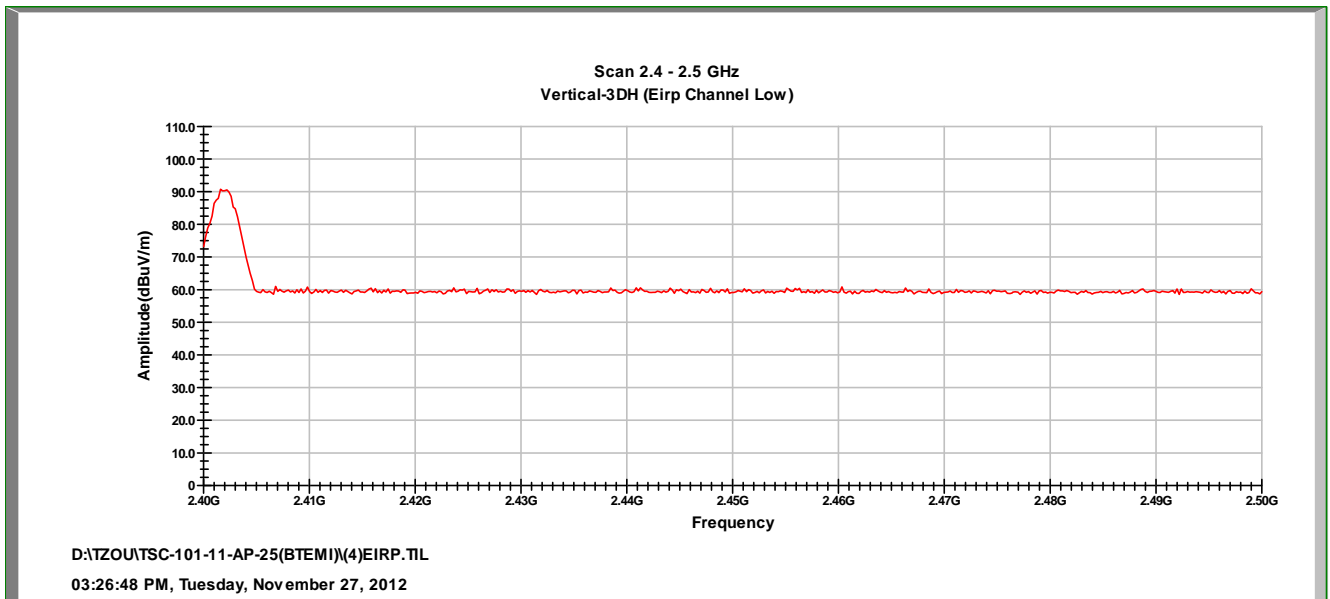
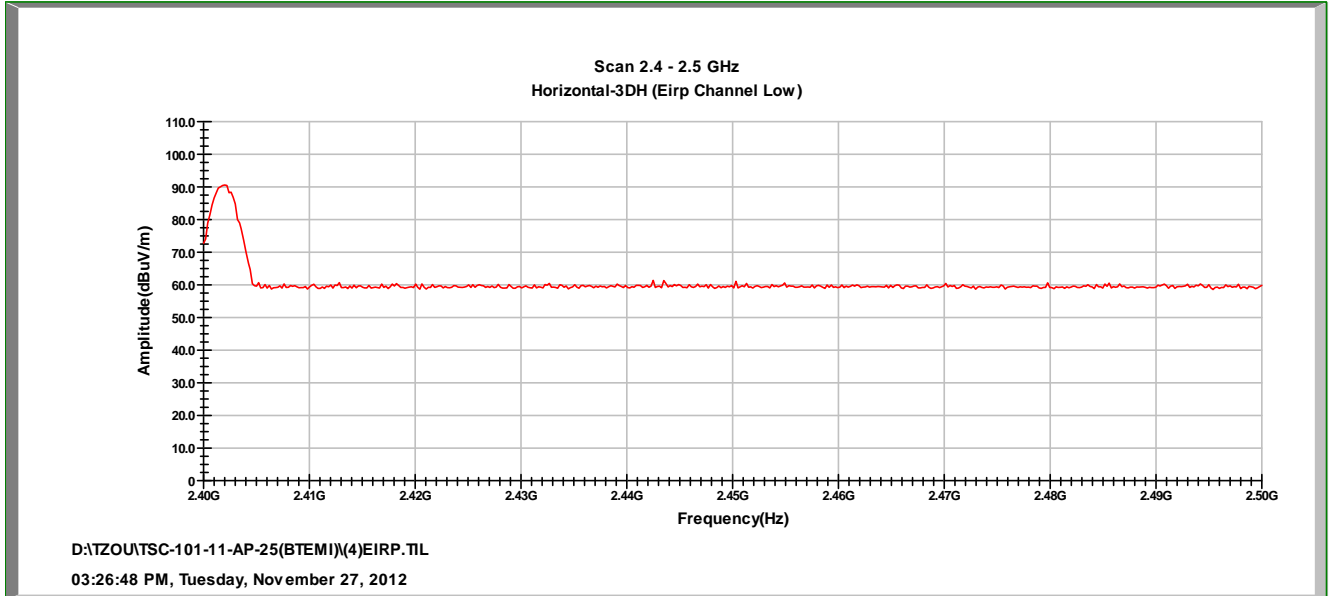


Radiation field strength (Tx: 2441MHz) ( $\pi/4$ -DQPSK , 2Mbps)

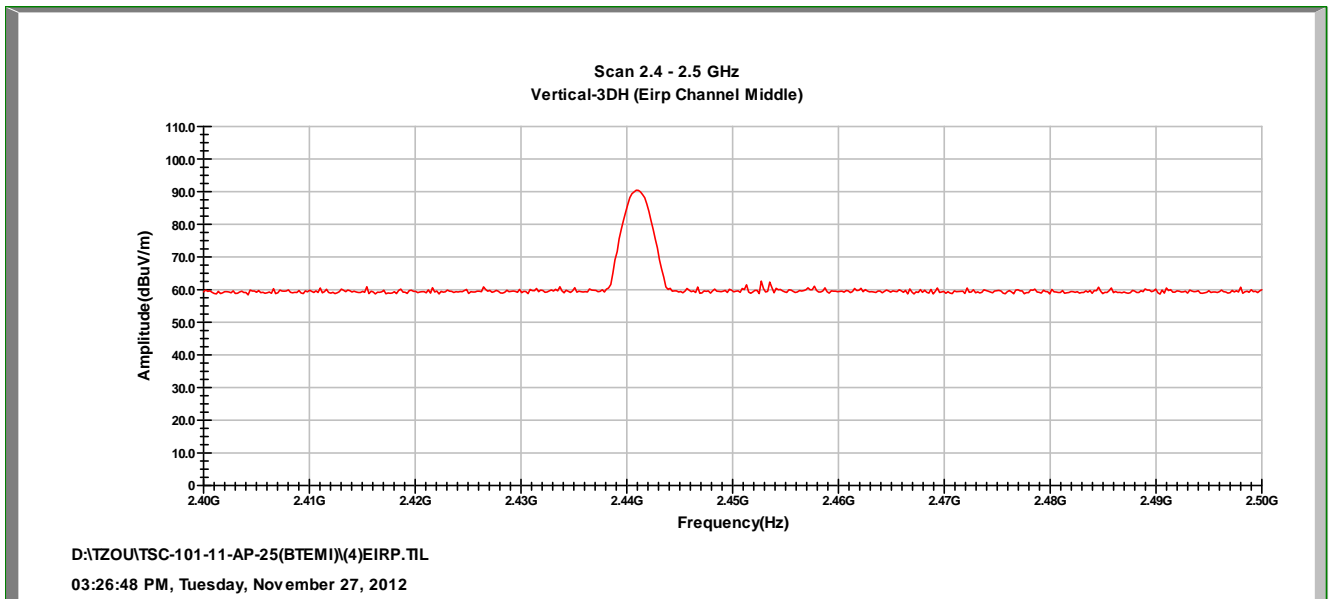
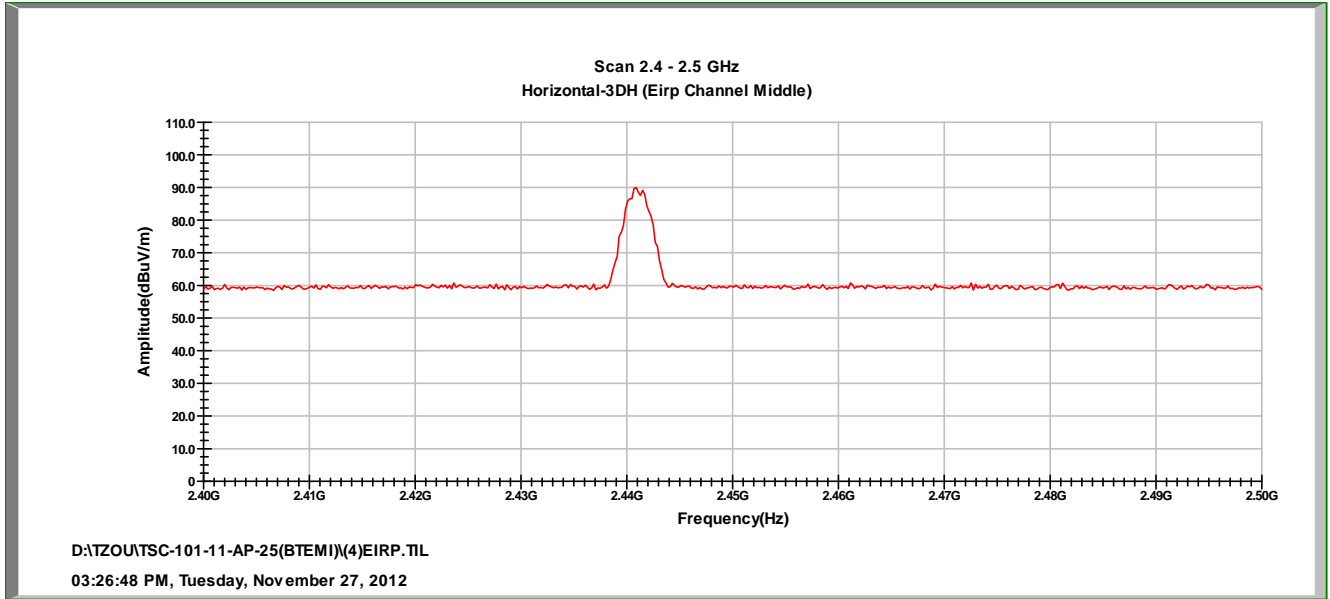


Radiation field strength (Tx: 2480MHz) ( $\pi/4$ -DQPSK , 2Mbps)

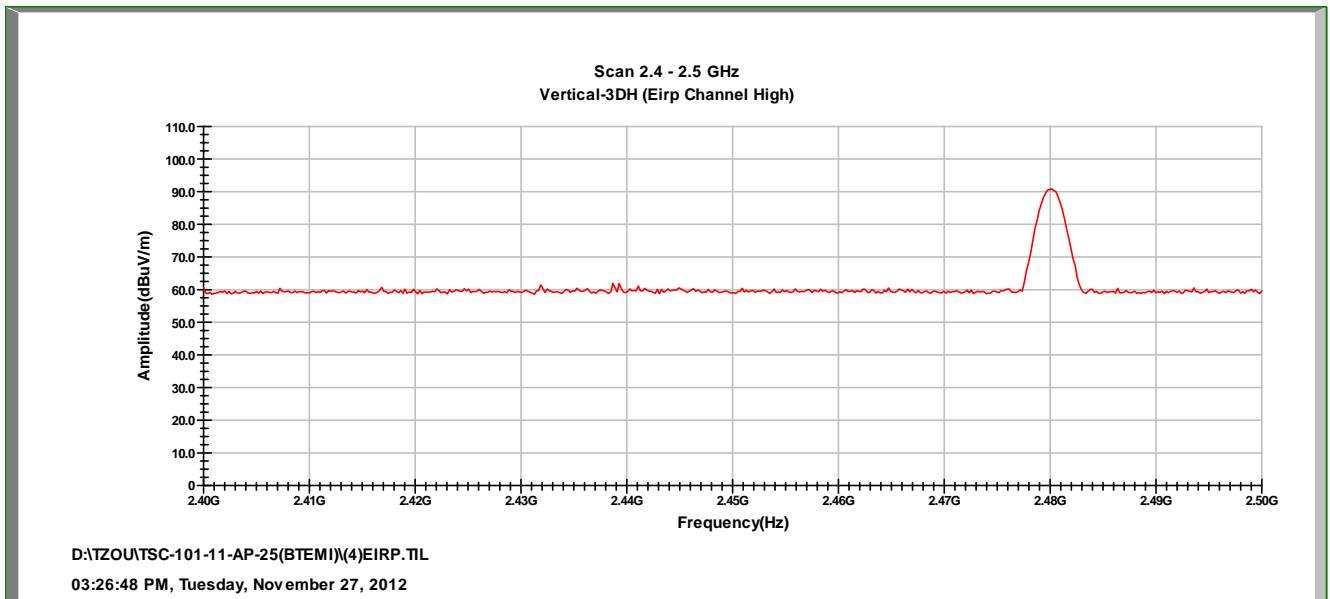
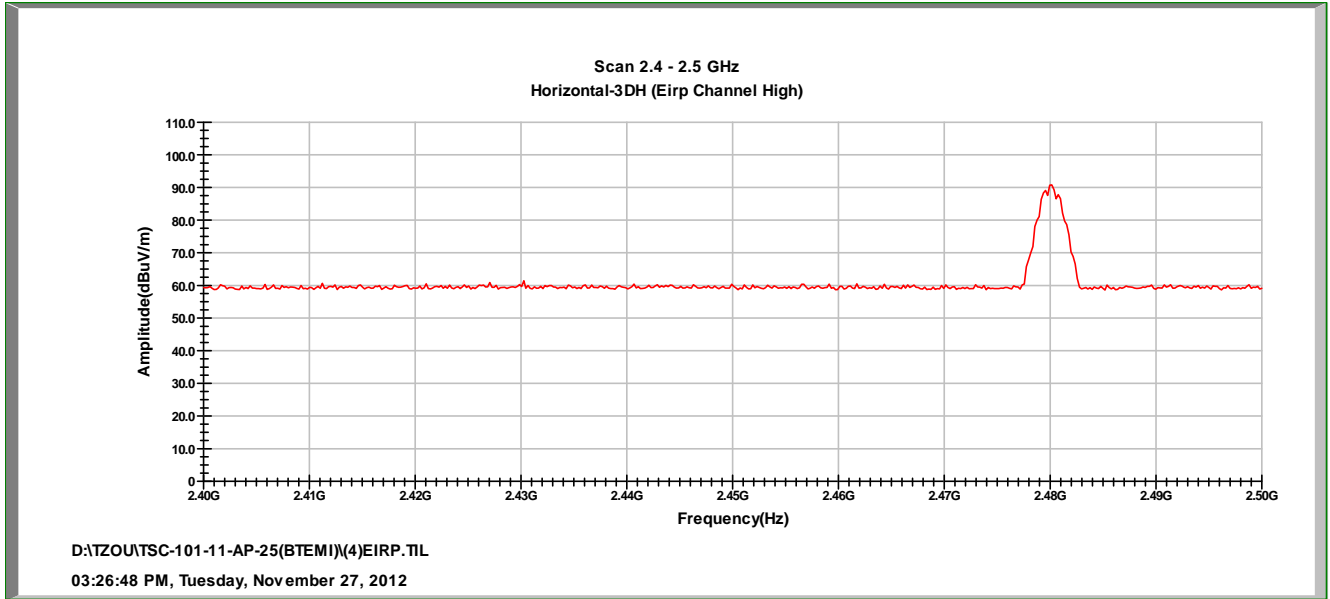




Radiation field strength (Tx: 2402MHz) (8-DPSK , 3Mbps)



Radiation field strength (Tx: 2441MHz) (8-DPSK , 3Mbps)



Radiation field strength (Tx: 2480MHz) (8-DPSK , 3Mbps)

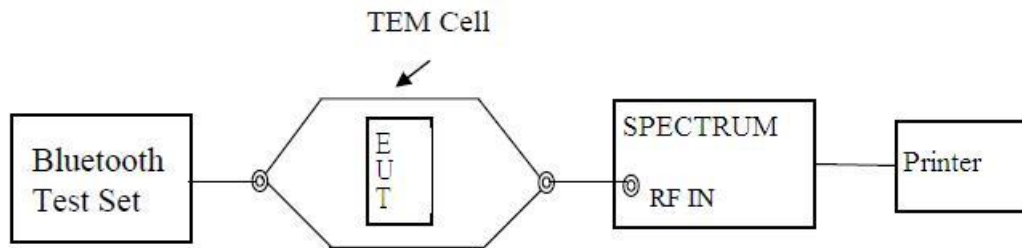


**4.2. Number of Channel Measurement**

**4.2.1 Required and Limits**

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels

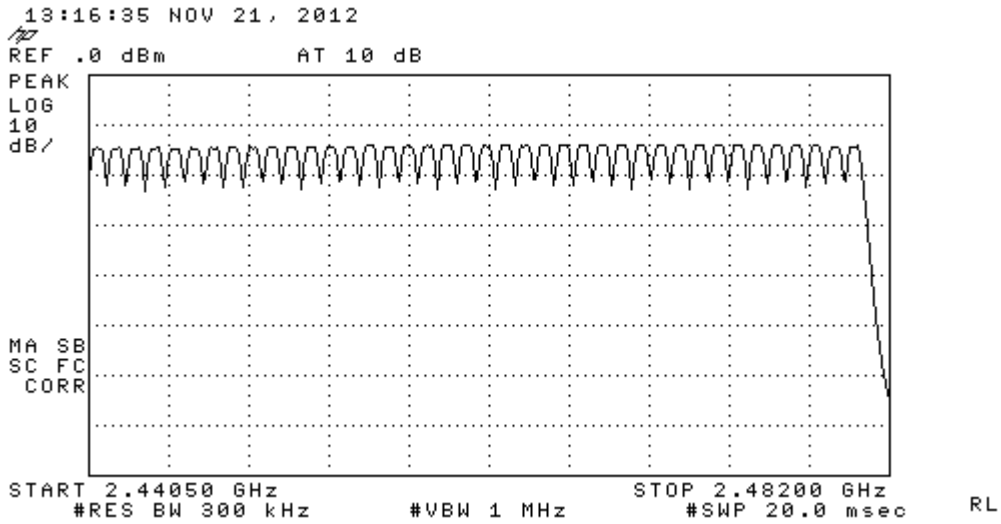
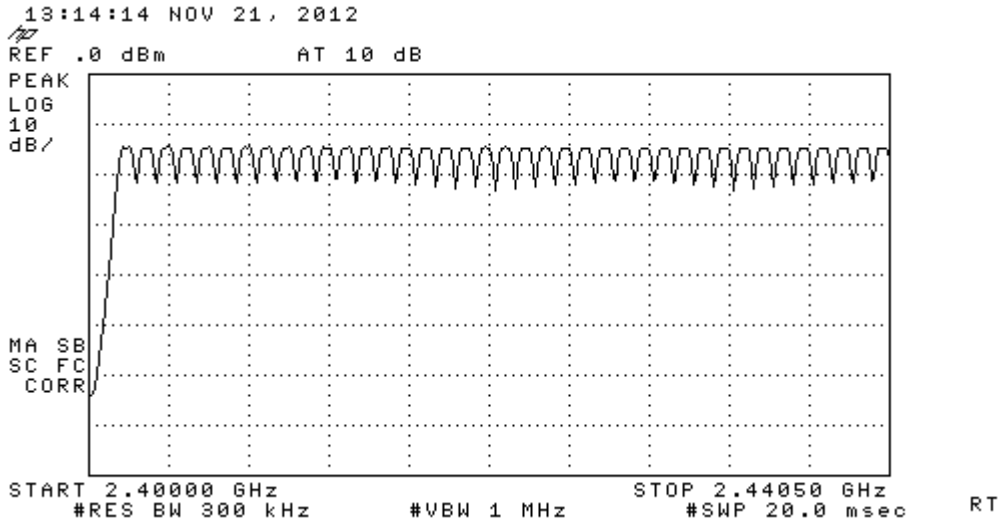
**4.2.2 Test Configuration and Procedure**



1. The EUT was connected to Communication Test Set.
2. The modulation types of EUT are irrelevant to number of hopping channels deviation.
- 3.. The EUT must have its hopping function enabled. Use the following spectrum analyzer settings: Span = the frequency band of operation; RBW  $\geq 1\%$  of the span; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold.
- 4.The number of hopping frequency used is defined as the device has the numbers of total channel.

**4.2.3 Test Results**

| Number of Hopping Channels (Channel)                                    | Limits (Channel)  | Pass/Fail |
|---|---|-----------|
| More than 79 hopping channels and more than 15 non-overlapping channels | More than 75 hopping channels and more than 15 non-overlapping channels | Pass      |



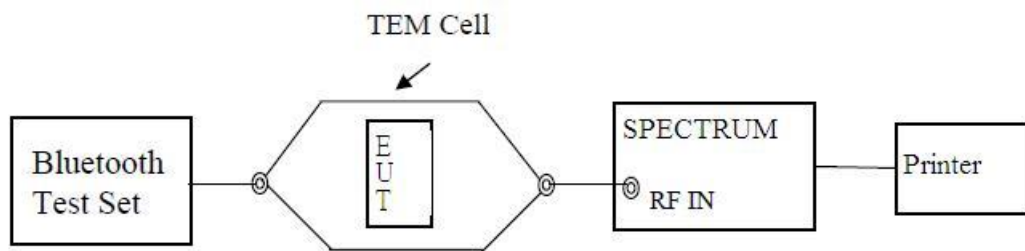
hopping channels number

### 4.3. 20dB and 99% Bandwidth Measurement

#### 4.3.1. Required and Limits

N/A

#### 4.3.2. Test Configuration and Procedure



1. The RF output of EUT was connected to the spectrum analyzer by a low loss cable.
2. The EUT should be transmitting at its maximum data rate as the worst cases.
3. Use the following spectrum analyzer settings:  
Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel;  
RBW  $\geq$  1% of the 20 dB bandwidth; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold.
4. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

### 4.3.3. Test Results

Modulation : G-FSK

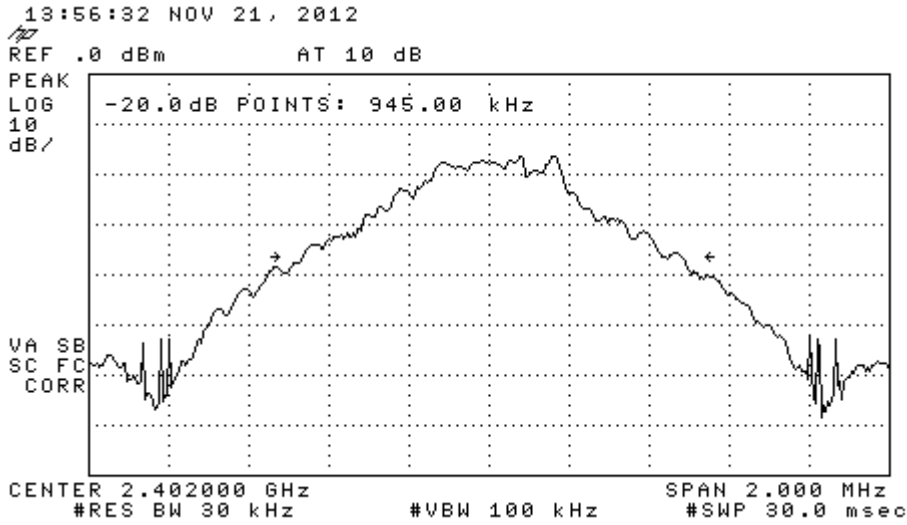
| Frequency          | 20dB Bandwidth | limits    |
|--------------------|----------------|-----------|
| (MHz)              | (kHz)          | (kHz)     |
| 2402               | 945            | Reference |
| 2441               | 945            | Reference |
| 2480               | 945            | Reference |
| Uncertainty± 13.8% |                |           |

Modulation : Pi/4-DQPSK

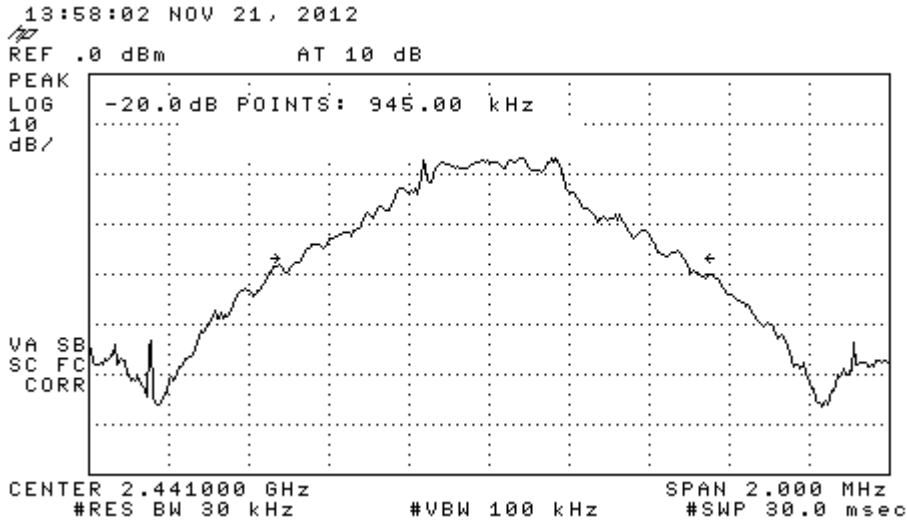
| Frequency          | 20dB Bandwidth | limits    |
|--------------------|----------------|-----------|
| (MHz)              | (kHz)          | (kHz)     |
| 2402               | 1300           | Reference |
| 2441               | 1305           | Reference |
| 2480               | 1295           | Reference |
| Uncertainty± 13.8% |                |           |

Modulation : 8DPSK

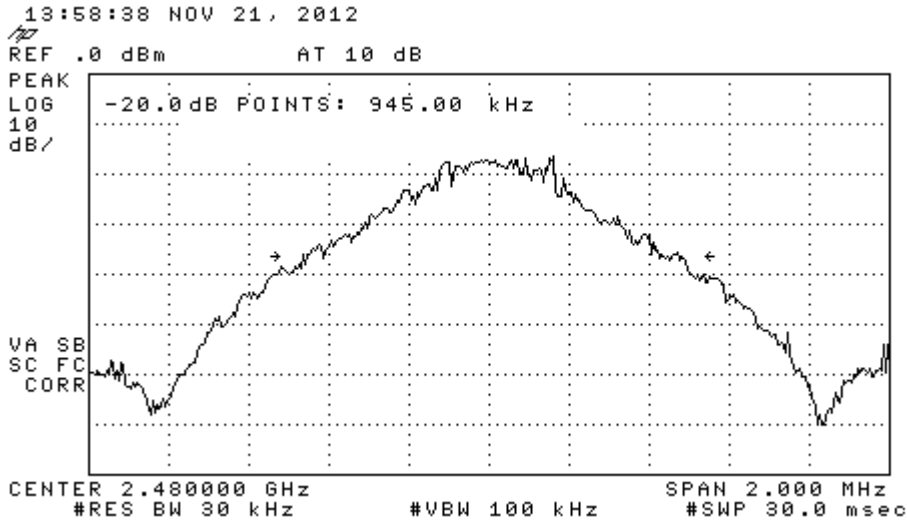
| Frequency          | 20dB Bandwidth | limits    |
|--------------------|----------------|-----------|
| (MHz)              | (kHz)          | (kHz)     |
| 2402               | 1290           | Reference |
| 2441               | 1290           | Reference |
| 2480               | 1290           | Reference |
| Uncertainty± 13.8% |                |           |



RL



RL

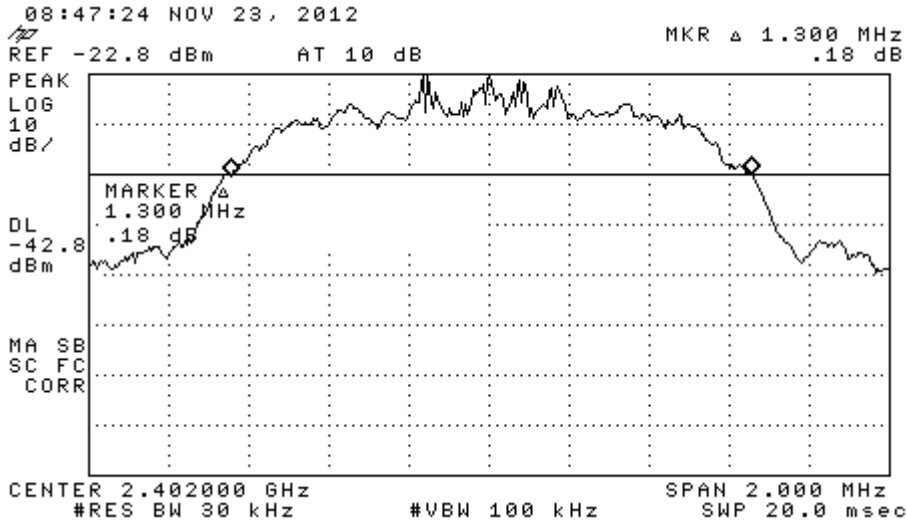


RL

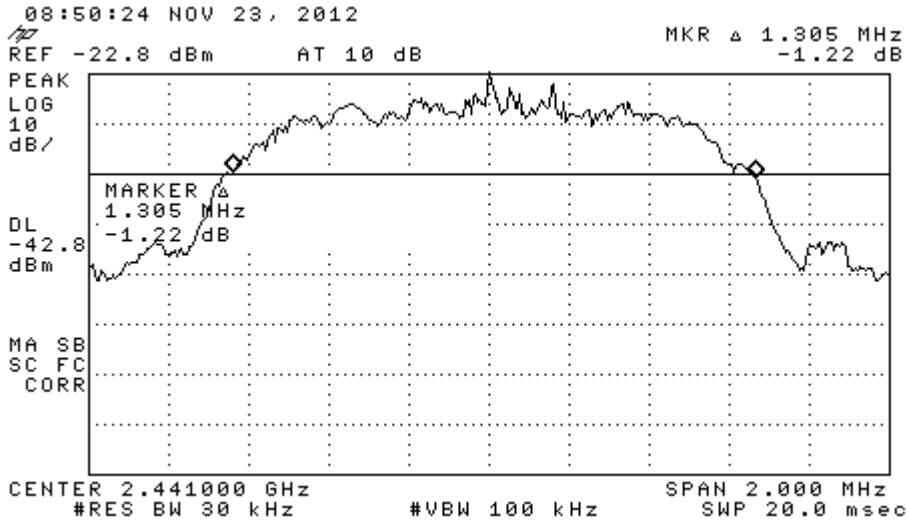
20dB Bandwidth (G-FSK)



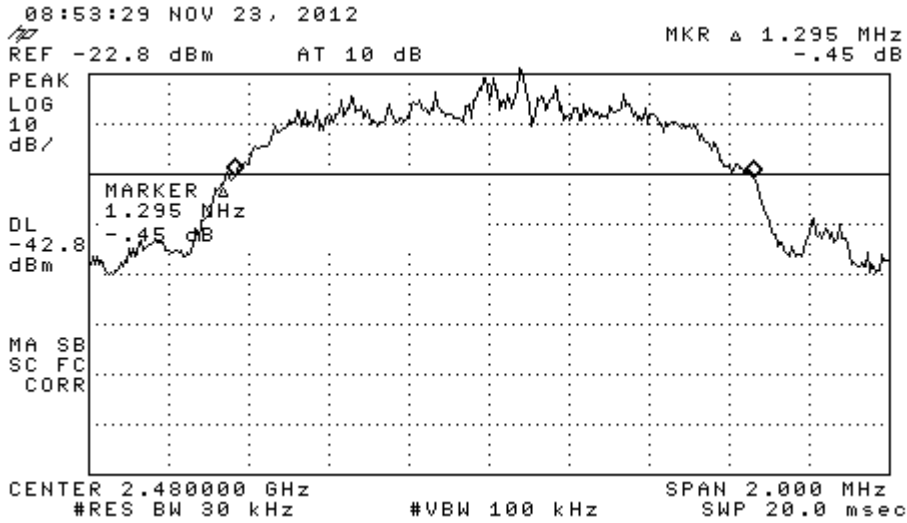




RT



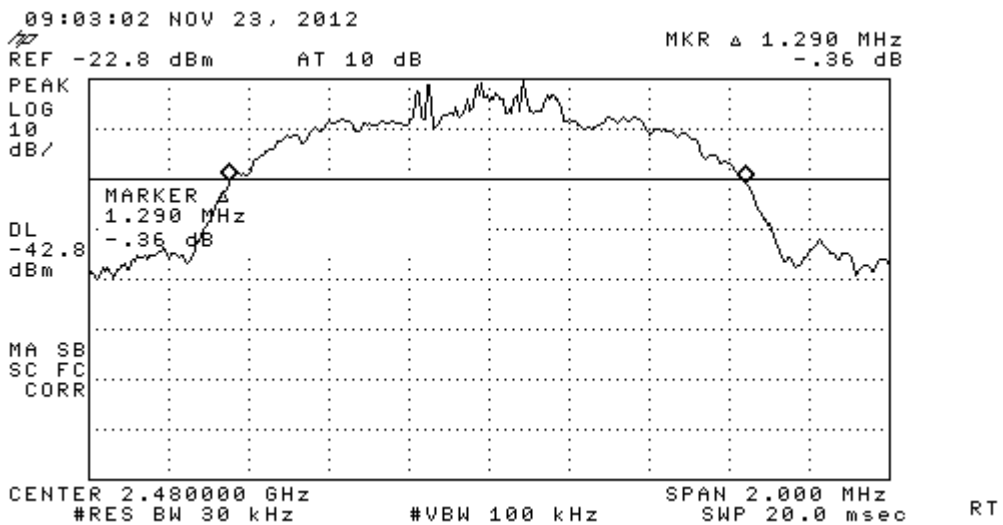
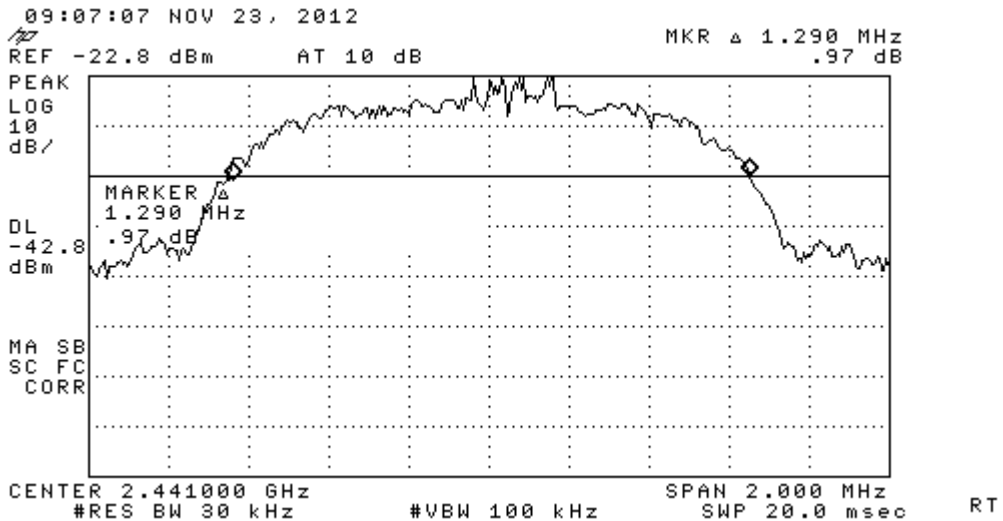
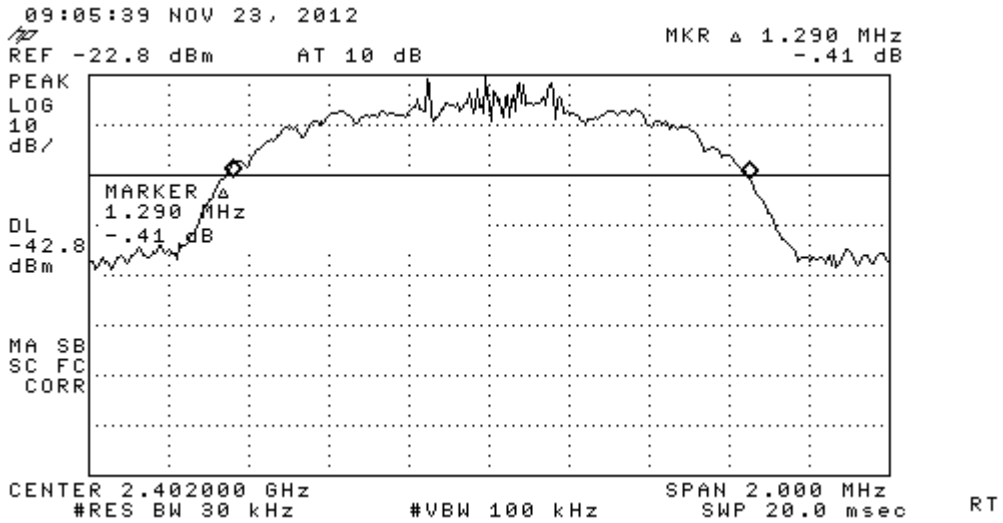
RT



RT

20dB Bandwidth (Pi/4-DQPSK)





20dB Bandwidth (8DPSK)

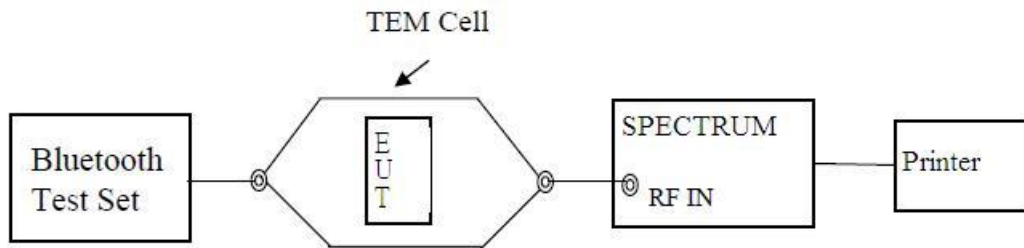


#### 4.4. Hopping Channel Separation Measurement

##### 4.4.1. Required and Limits

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

##### 4.4.2. Test Configuration and Procedure



- 1.The RF output of EUT was connected to the spectrum analyzer by a low loss cable.
2. The EUT should be transmitting at its maximum data rate as the worst cases.
3. Use the following spectrum analyzer settings:  
Span = wide enough to capture the peaks of two adjacent channels; RBW 1% of the span; VBW RBW; Sweep = auto; Detector function = peak; Trace = max hold.
4. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

**4.4.3. Test Results**

Modulation : G-FSK

| Frequency          | 20dB Bandwidth | limits    |
|--------------------|----------------|-----------|
| (MHz)              | (kHz)          | (kHz)     |
| 2402               | 945            | Reference |
| 2441               | 945            | Reference |
| 2480               | 945            | Reference |
| Uncertainty± 13.8% |                |           |

| Adjacent channel spacing | limits | Result |
|--------------------------|--------|--------|
| (kHz)                    | (kHz)  |        |
| 1005                     | > 630  | pass   |
| 1005                     | > 630  | pass   |
| 1005                     | > 630  | pass   |
| Uncertainty± 13.8%       |        |        |

Modulation : Pi/4-DQPSK

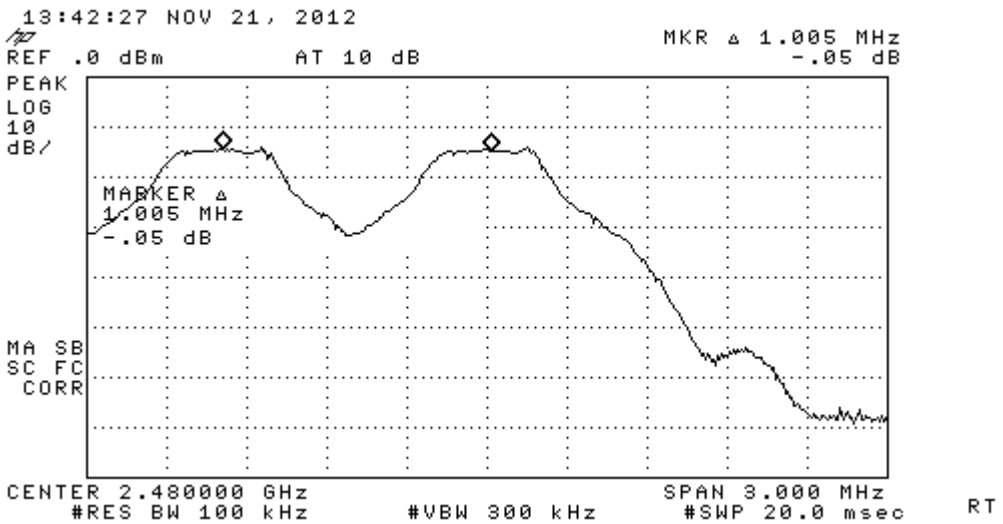
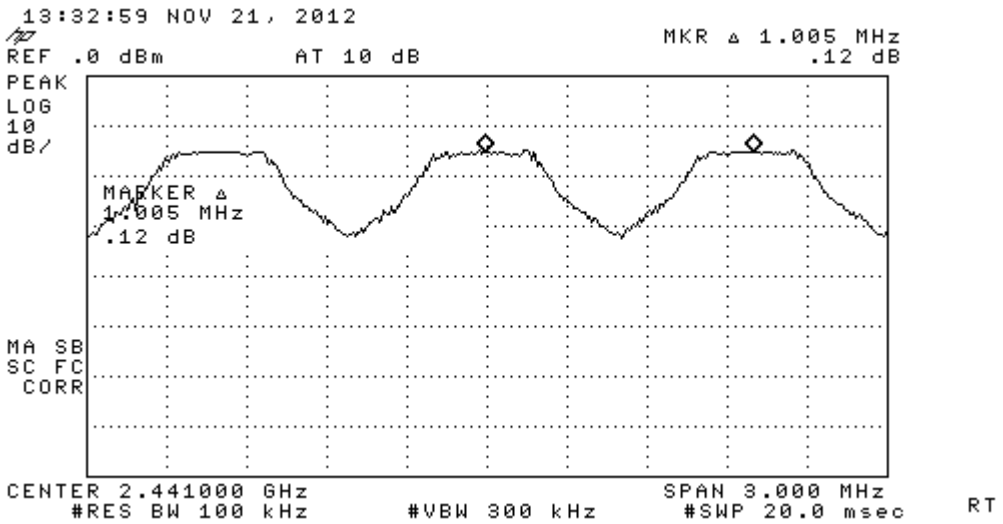
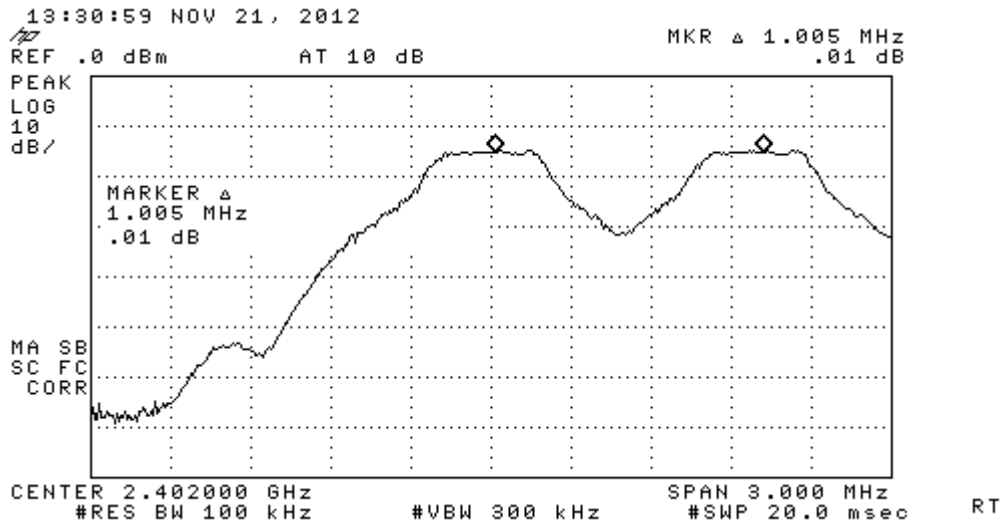
| Frequency          | 20dB Bandwidth | limits    |
|--------------------|----------------|-----------|
| (MHz)              | (kHz)          | (kHz)     |
| 2402               | 1300           | Reference |
| 2441               | 1305           | Reference |
| 2480               | 1295           | Reference |
| Uncertainty± 13.8% |                |           |

| Adjacent channel spacing | limits | Result |
|--------------------------|--------|--------|
| (kHz)                    | (kHz)  |        |
| 1005                     | > 867  | pass   |
| 1005                     | > 870  | pass   |
| 1005                     | > 863  | pass   |
| Uncertainty± 13.8%       |        |        |

Modulation : 8DPSK

| Frequency          | 20dB Bandwidth | limits    |
|--------------------|----------------|-----------|
| (MHz)              | (kHz)          | (kHz)     |
| 2402               | 1290           | Reference |
| 2441               | 1290           | Reference |
| 2480               | 1290           | Reference |
| Uncertainty± 13.8% |                |           |

| Adjacent channel spacing | limits | Result |
|--------------------------|--------|--------|
| (kHz)                    | (kHz)  |        |
| 1005                     | > 860  | pass   |
| 1005                     | > 860  | pass   |
| 1005                     | > 860  | pass   |
| Uncertainty± 13.8%       |        |        |



Adjacent channel spacing

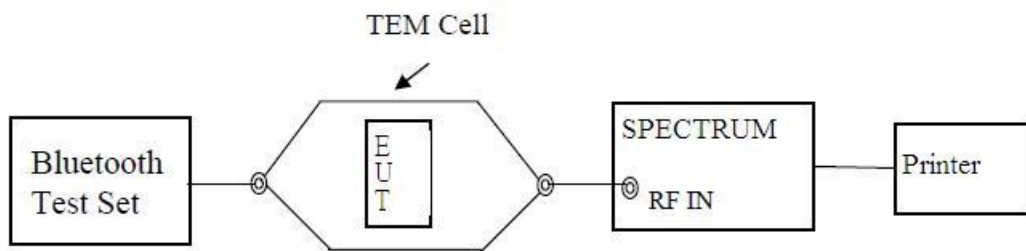


**4.5. Dwell Time Measurement**

**4.4.1. Required and Limits**

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

**4.4.2. Test Configuration and Procedure**



- 1.The RF output of EUT was connected to the spectrum analyzer by a low loss cable.
2. The EUT should be transmitting at its maximum data rate as the worst cases.
3. Use the following spectrum analyzer settings:  
 Span = wide enough to capture the peaks of two adjacent channels; RBW 1% of the span; VBW RBW; Sweep = auto; Detector function = peak; Trace = max hold.
5. Use the marker-delta function to calculate the dwell time.

**4.4.3. Test Results**

mode : G-FSK

| Frequency<br>(MHz)  | Result (mS)         |                   |                     | Limits<br>(mS) | Pass/<br>Fail |
|---------------------|---------------------|-------------------|---------------------|----------------|---------------|
|                     | DH1-Packet          | DH3-Packet        | DH5-Packet          |                |               |
| 2402                | 0.36×10.12×31.6=115 | 1.6×5.06×31.6=256 | 2.9×3.37×31.6=309   | 400            | <b>Pass</b>   |
| 2441                | 0.36×10.12×31.6=115 | 1.6×5.06×31.6=256 | 2.9×3.37×31.6=309   | 400            | <b>Pass</b>   |
| 2480                | 0.36×10.12×31.6=115 | 1.6×5.06×31.6=256 | 2.873×3.37×31.6=306 | 400            | <b>Pass</b>   |
| Uncertainty : ± 10% |                     |                   |                     |                |               |





mode : Pi/4-DQPSK

| Frequency<br>(MHz)       | Result (mS)                           |                                      |                                      | Limits<br>(mS) | Pass/<br>Fail |
|--------------------------|---------------------------------------|--------------------------------------|--------------------------------------|----------------|---------------|
|                          | DH1-Packet                            | DH3-Packet                           | DH5-Packet                           |                |               |
| 2402                     | $0.39 \times 10.12 \times 31.6 = 125$ | $1.65 \times 5.06 \times 31.6 = 264$ | $2.87 \times 3.37 \times 31.6 = 306$ | 400            | <b>Pass</b>   |
| 2441                     | $0.39 \times 10.12 \times 31.6 = 125$ | $1.65 \times 5.06 \times 31.6 = 264$ | $2.87 \times 3.37 \times 31.6 = 306$ | 400            | <b>Pass</b>   |
| 2480                     | $0.39 \times 10.12 \times 31.6 = 125$ | $1.65 \times 5.06 \times 31.6 = 264$ | $2.87 \times 3.37 \times 31.6 = 306$ | 400            | <b>Pass</b>   |
| Uncertainty : $\pm 10\%$ |                                       |                                      |                                      |                |               |

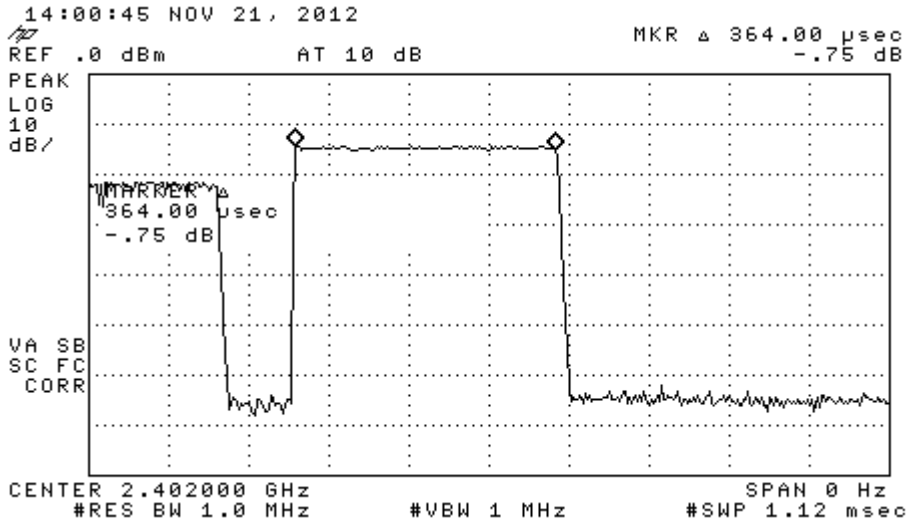
mode : 8DPSK

| Frequency<br>(MHz)       | Result (mS)                           |                                      |                                      | Limits<br>(mS) | Pass/<br>Fail |
|--------------------------|---------------------------------------|--------------------------------------|--------------------------------------|----------------|---------------|
|                          | DH1-Packet                            | DH3-Packet                           | DH5-Packet                           |                |               |
| 2402                     | $0.39 \times 10.12 \times 31.6 = 125$ | $1.65 \times 5.06 \times 31.6 = 264$ | $2.87 \times 3.37 \times 31.6 = 306$ | 400            | <b>Pass</b>   |
| 2441                     | $0.39 \times 10.12 \times 31.6 = 125$ | $1.65 \times 5.06 \times 31.6 = 264$ | $2.87 \times 3.37 \times 31.6 = 306$ | 400            | <b>Pass</b>   |
| 2480                     | $0.39 \times 10.12 \times 31.6 = 125$ | $1.65 \times 5.06 \times 31.6 = 264$ | $2.87 \times 3.37 \times 31.6 = 306$ | 400            | <b>Pass</b>   |
| Uncertainty : $\pm 10\%$ |                                       |                                      |                                      |                |               |

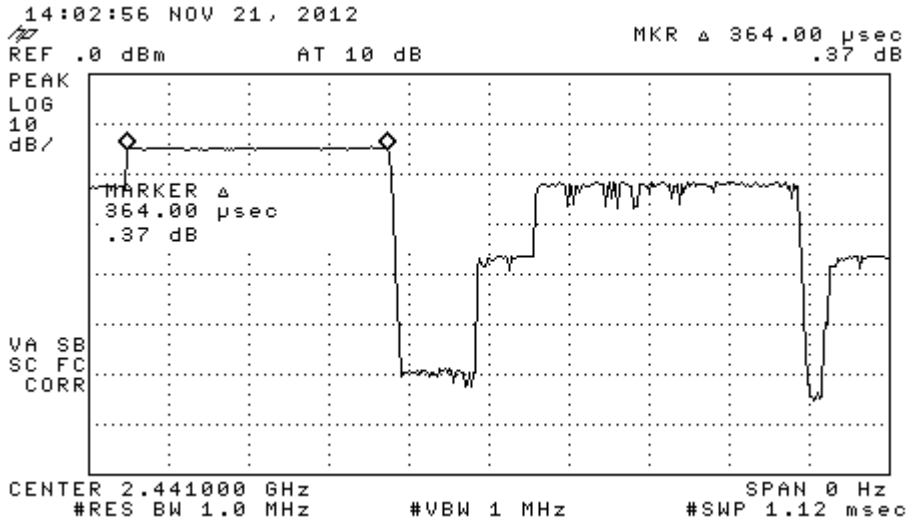
note :

1. DH1-Packet : Each channel hopping number of times per second ( $1600 \div 79 \div 2 = 10.12$ )
2. DH3-Packet : Each channel hopping number of times per second ( $1600 \div 79 \div 4 = 5.06$ )
3. DH5-Packet : Each channel hopping number of times per second ( $1600 \div 79 \div 6 = 3.37$ )
4. 0.4 seconds multiplied by the the hopping cycles ( $0.4 \times 79 = 31.6$  seconds)

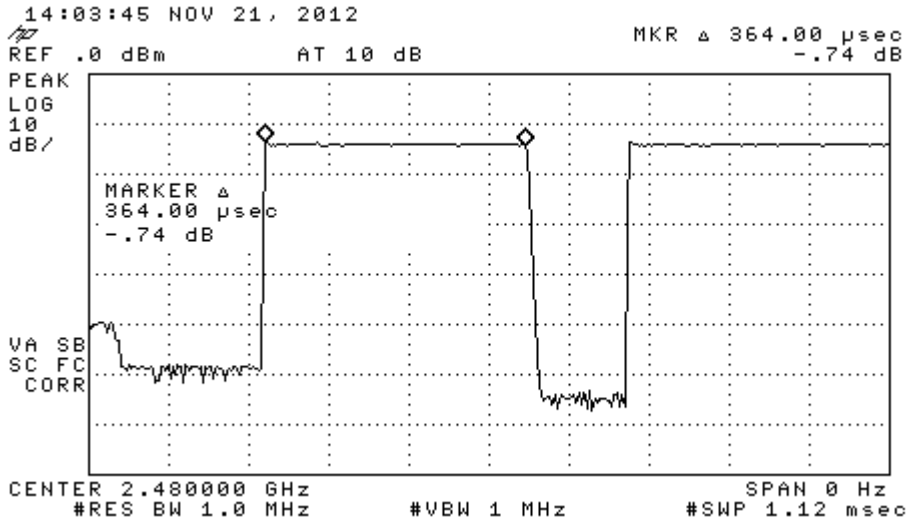




RL



RL

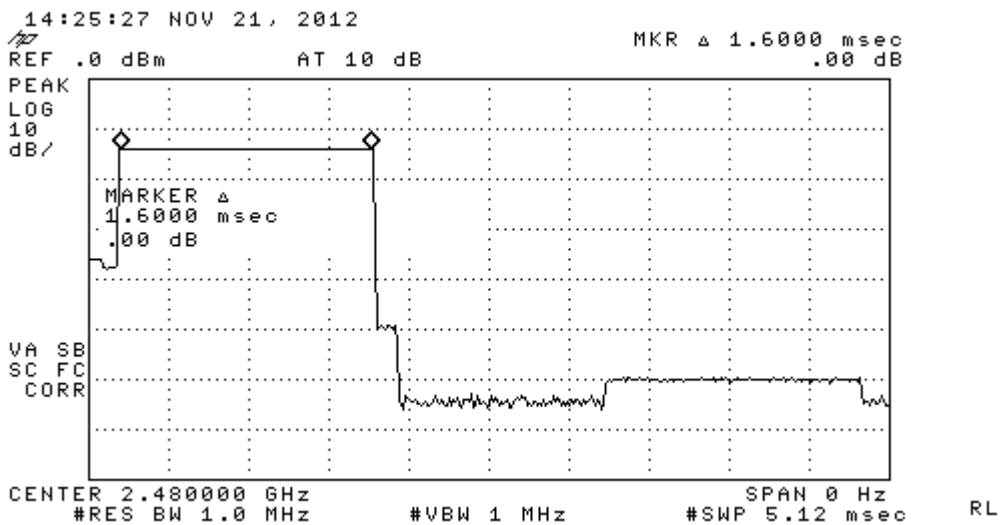
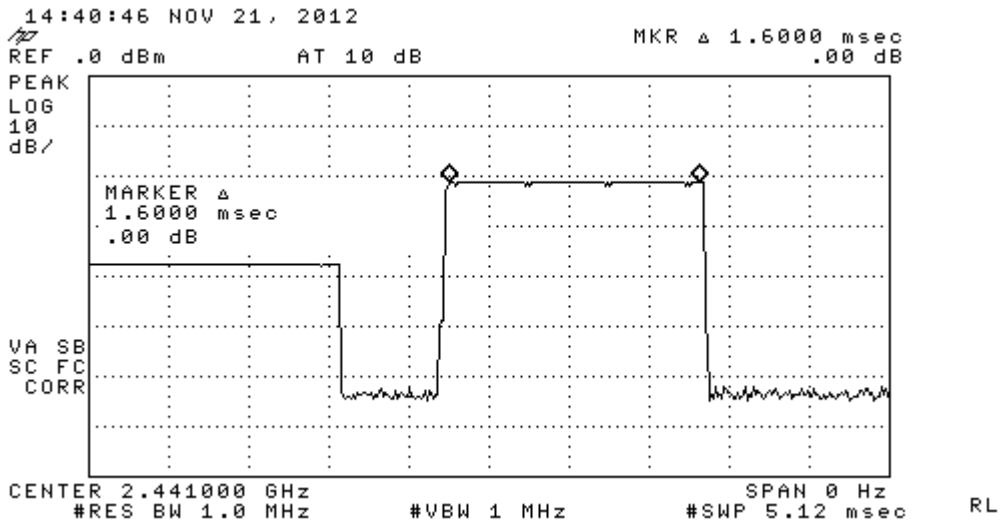
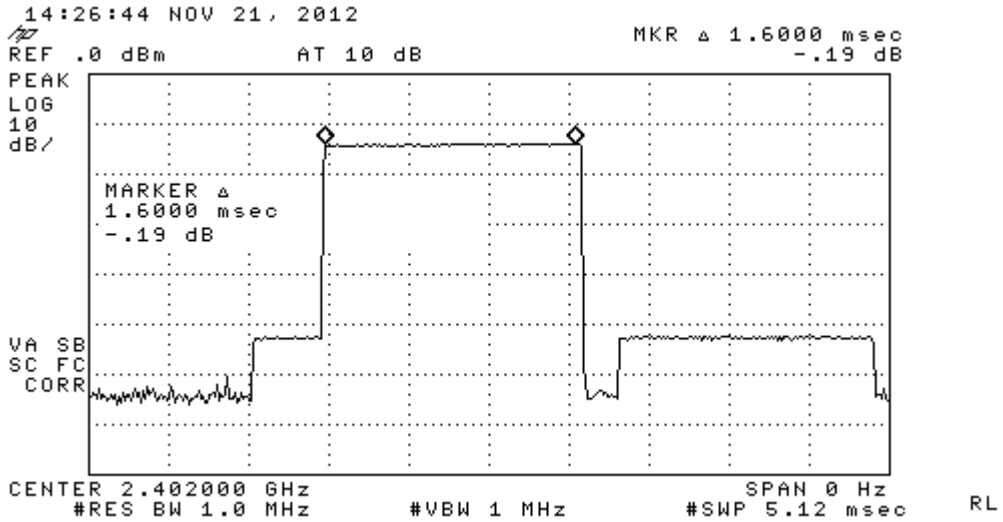


RL

DH1-Packet Dwell Time (G-FSK)

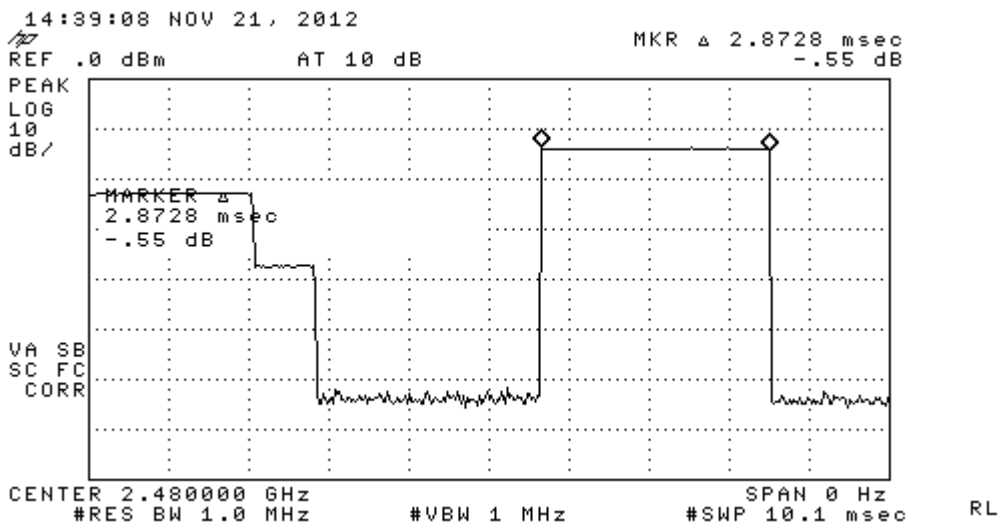
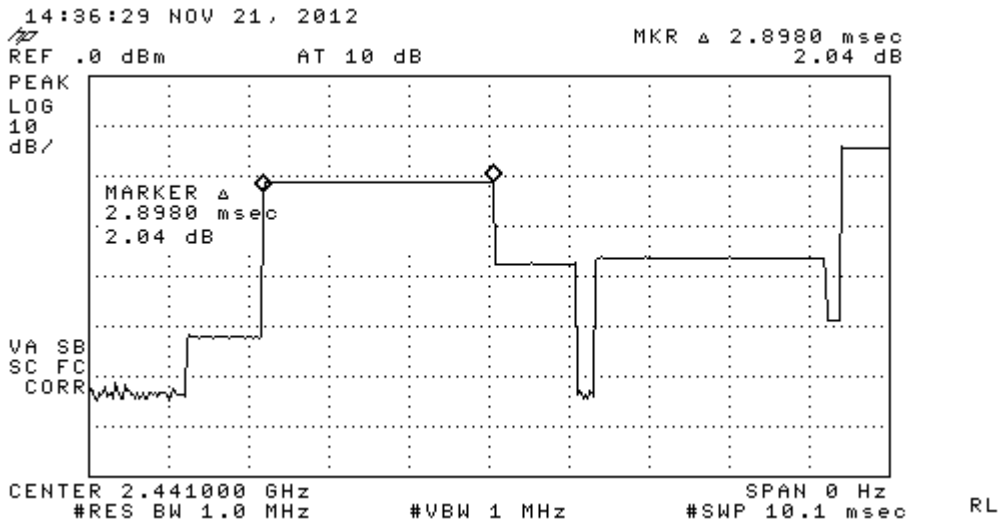
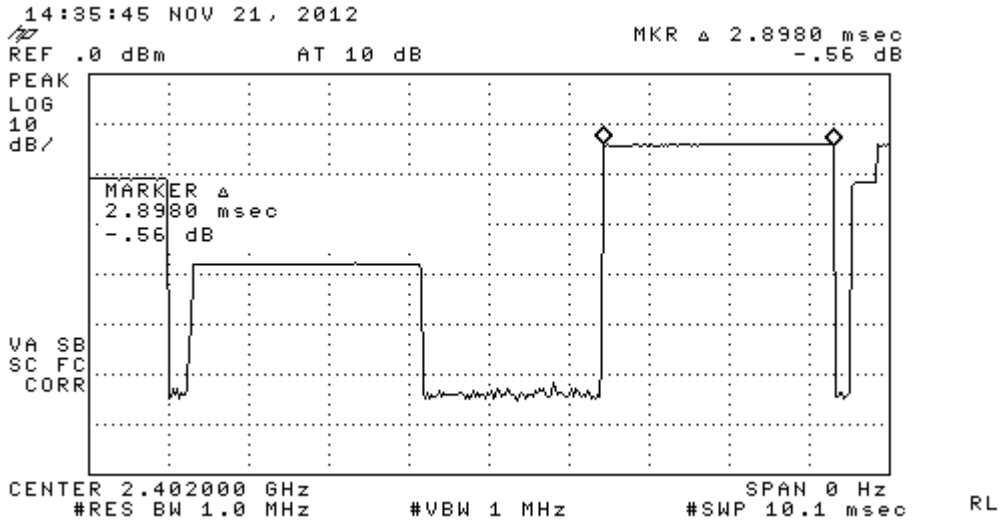






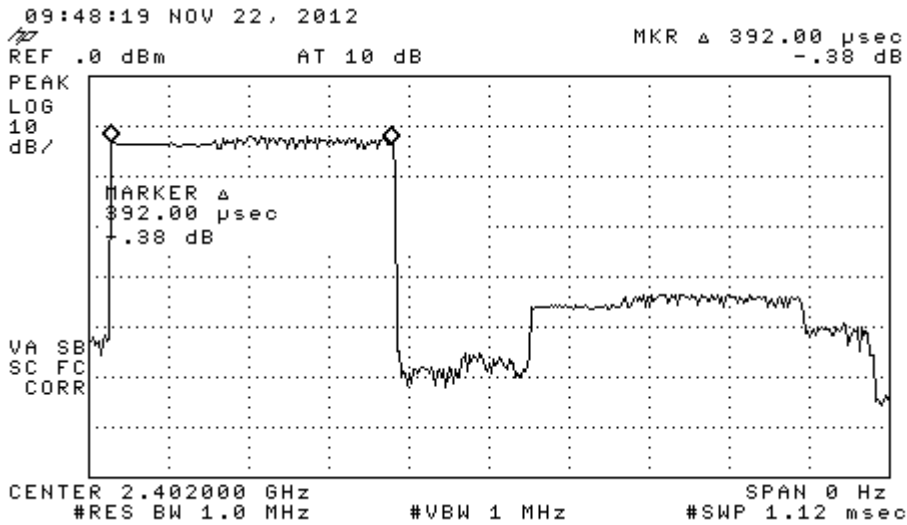
DH3-Packet Dwell Time (G-FSK)



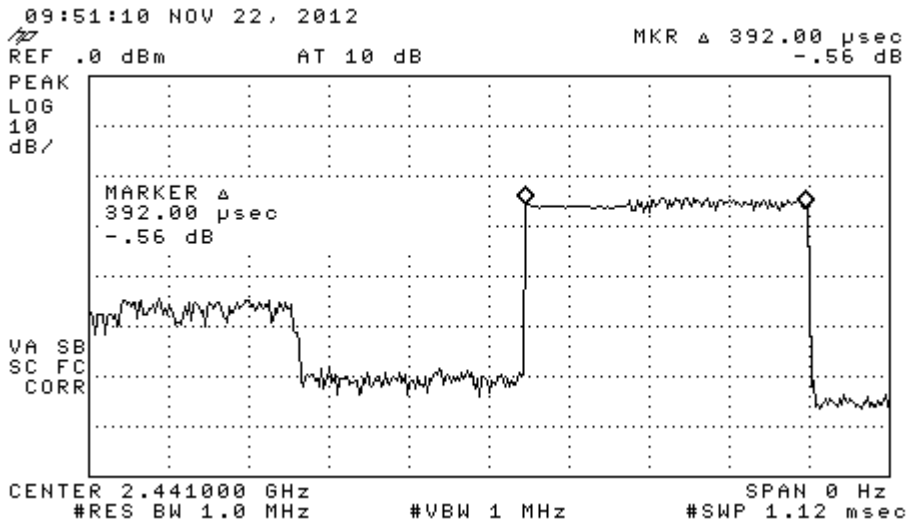


DH5-Packet Dwell Time (G-FSK)

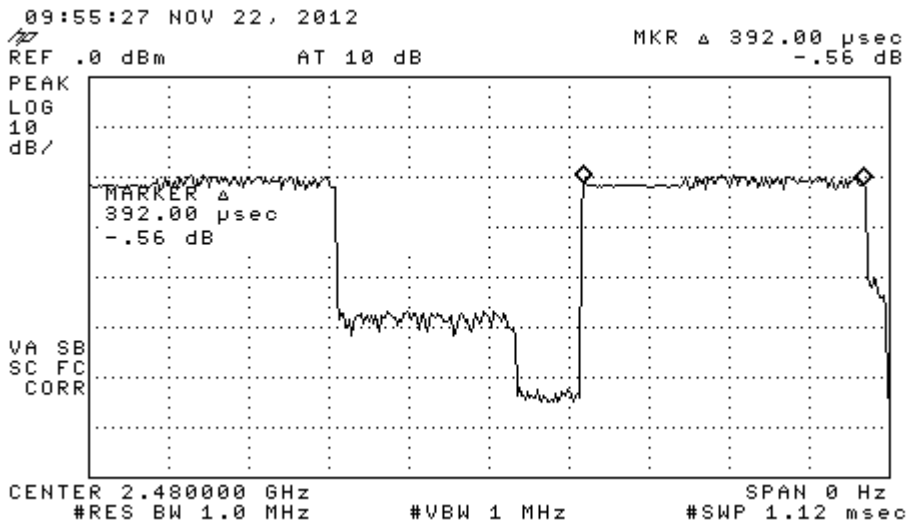




RL



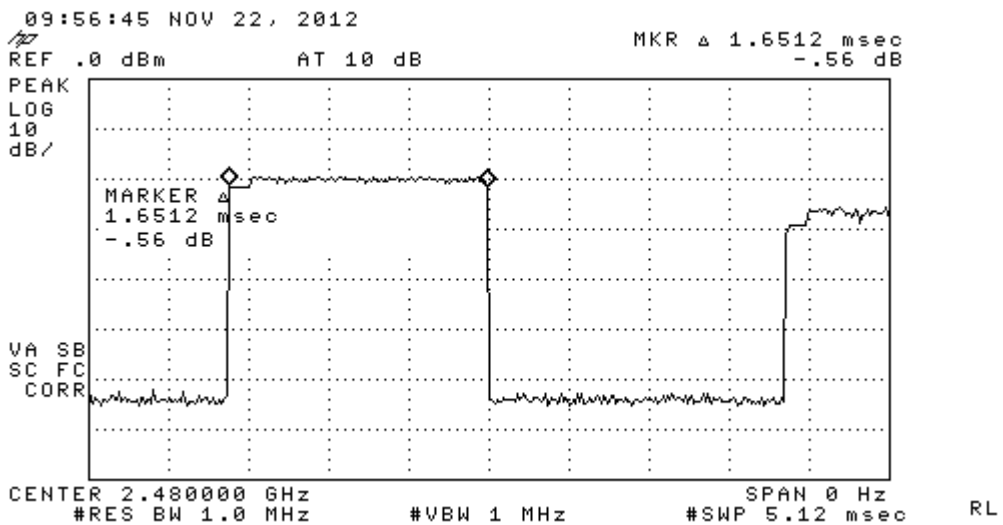
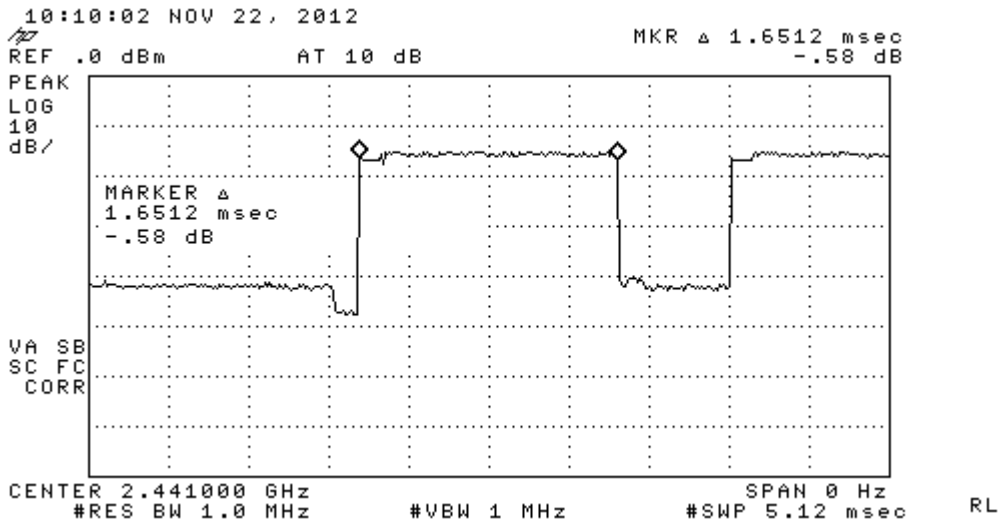
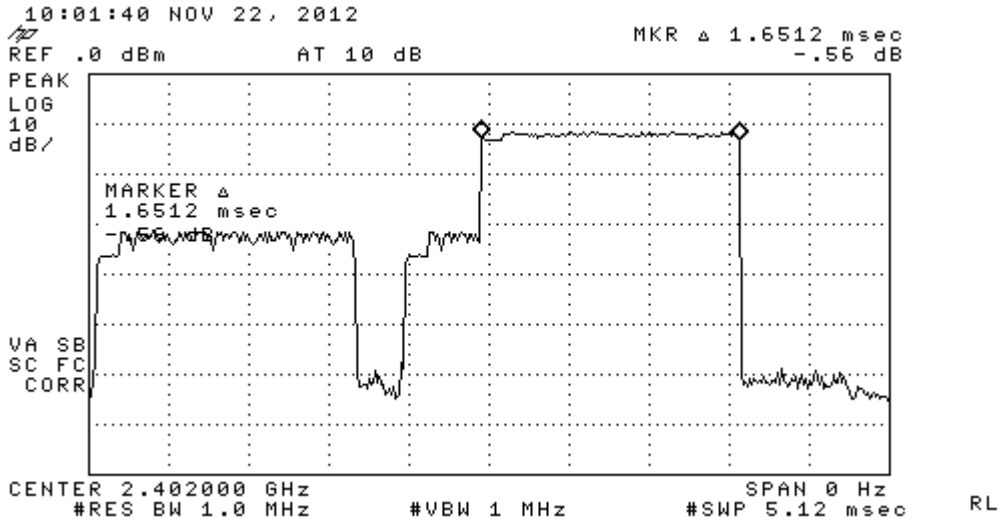
RL



RL

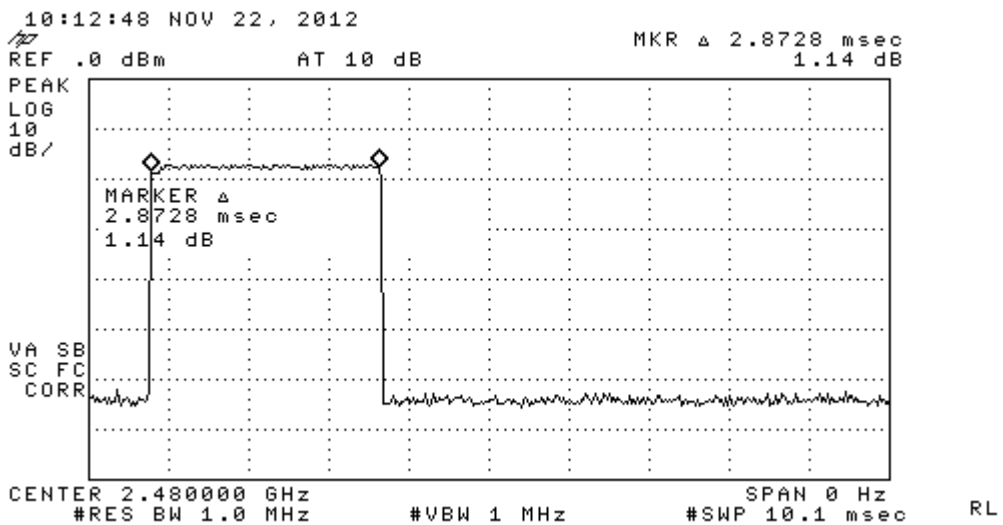
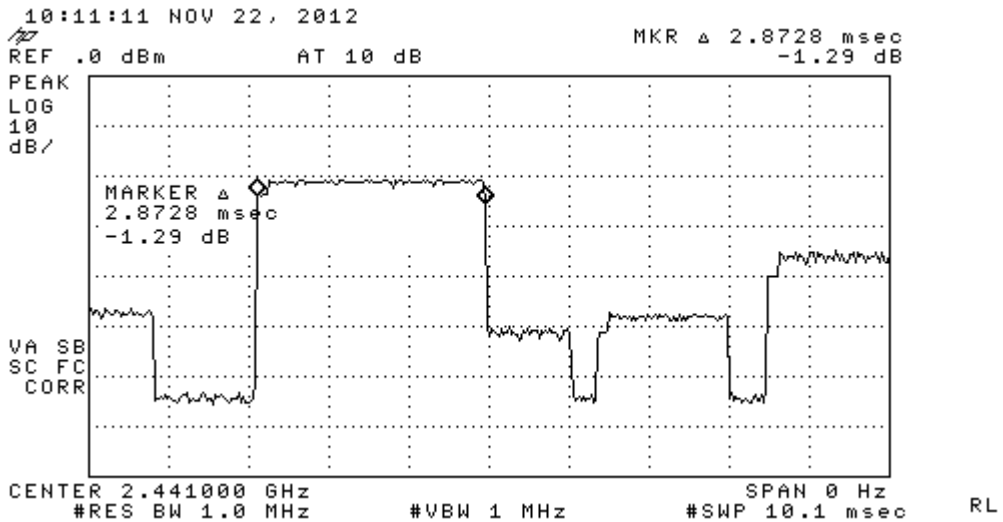
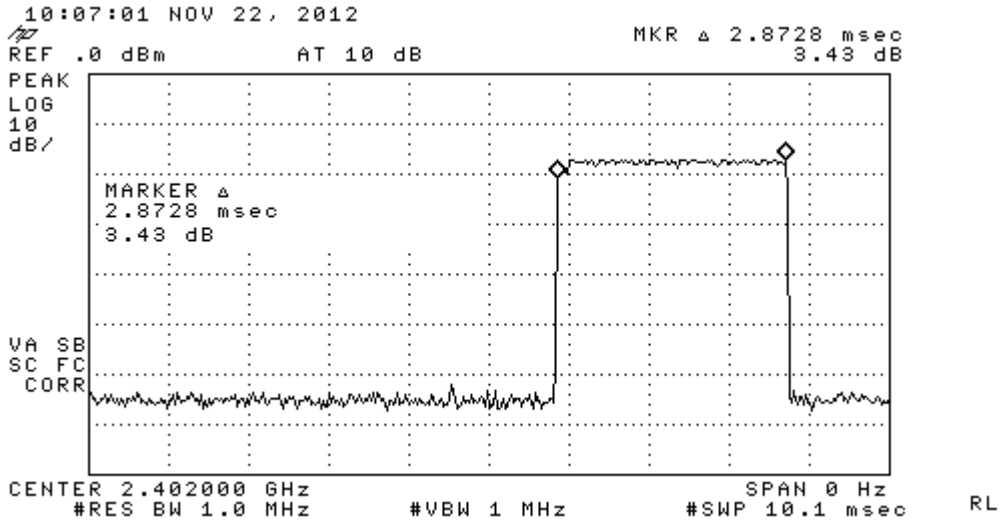
**DH1-Packet Dwell Time (Pi/4-DQPSK)**





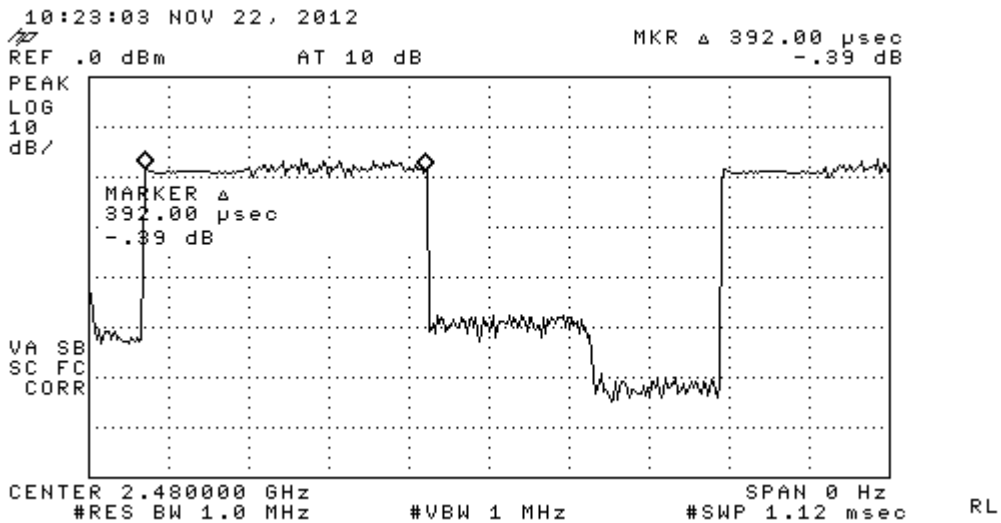
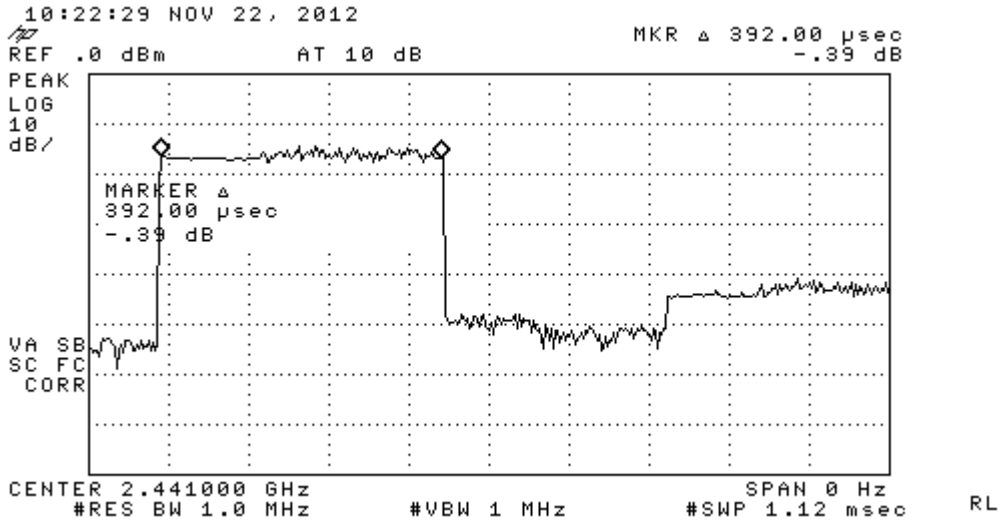
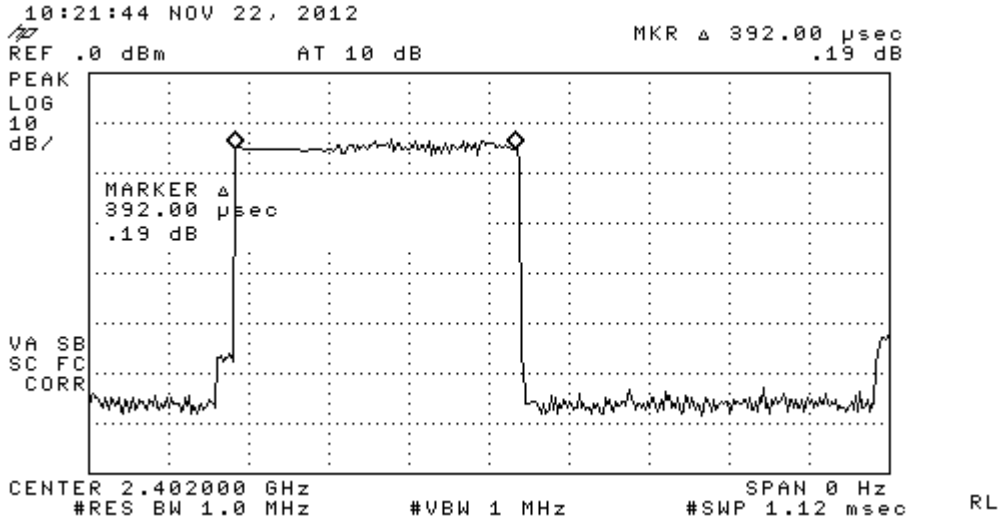
**DH3-Packet Dwell Time (Pi/4-DQPSK)**





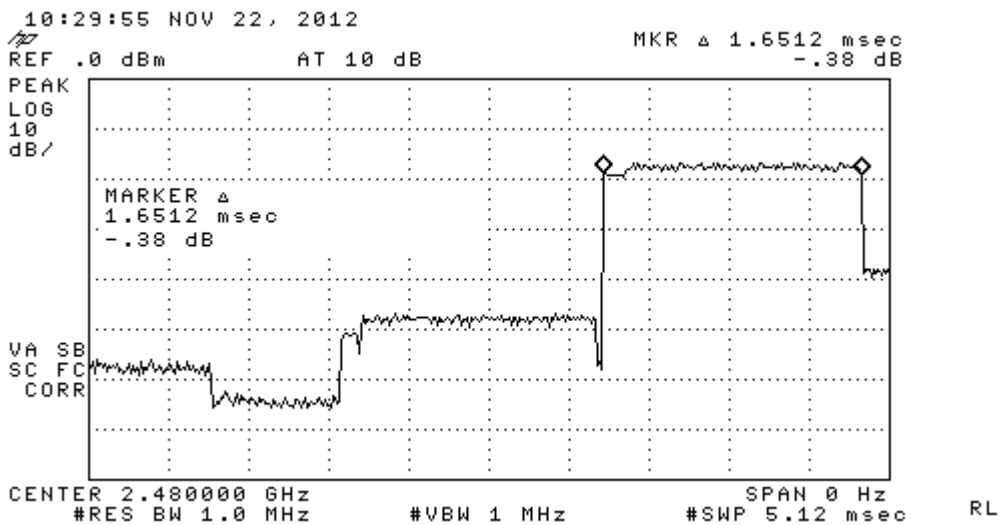
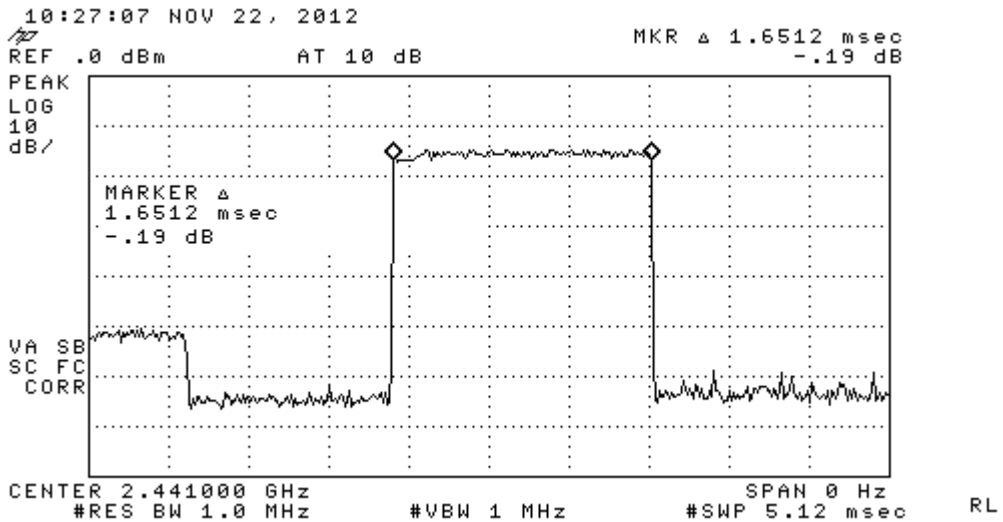
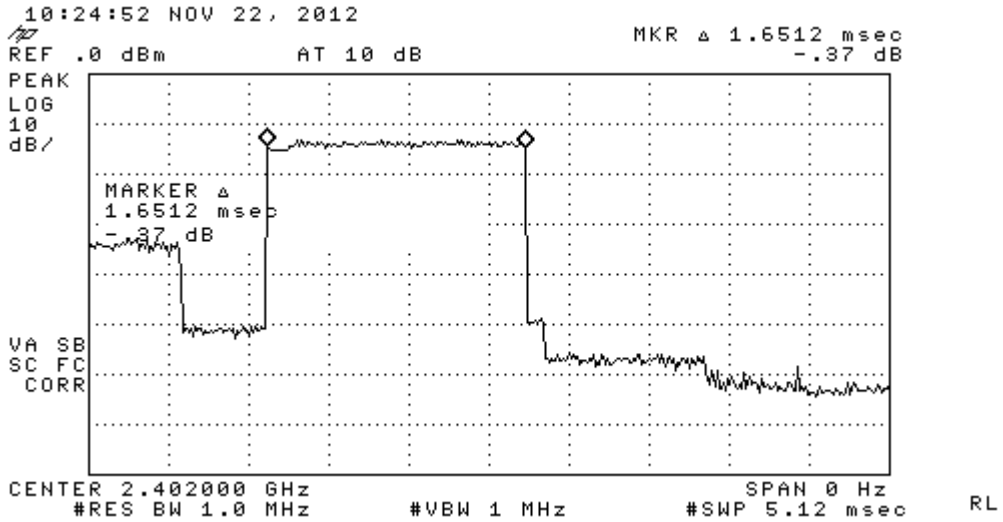
DH5-Packet Dwell Time (Pi/4-DQPSK)





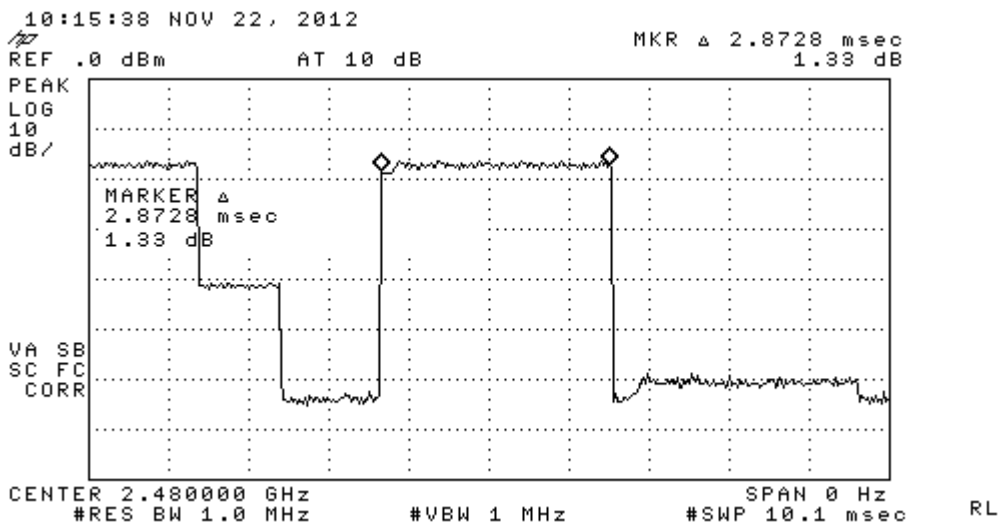
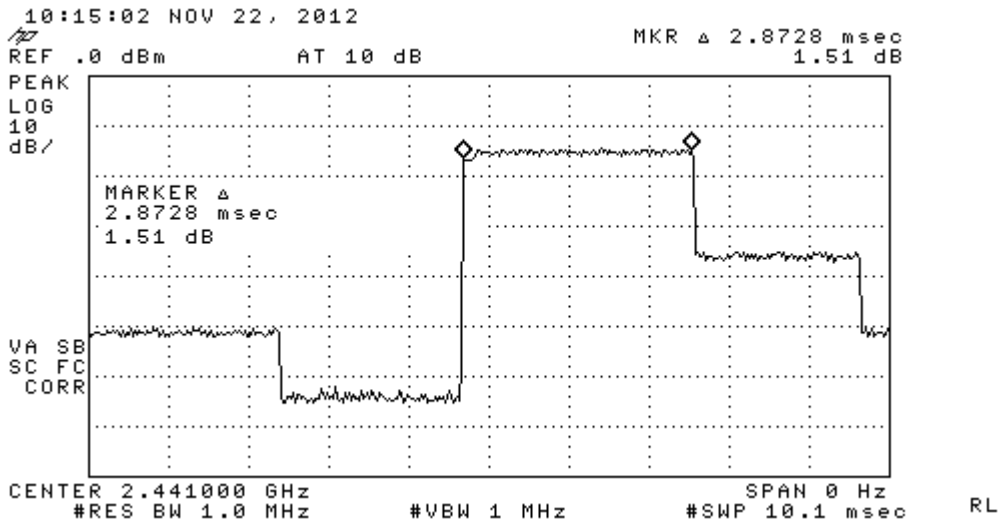
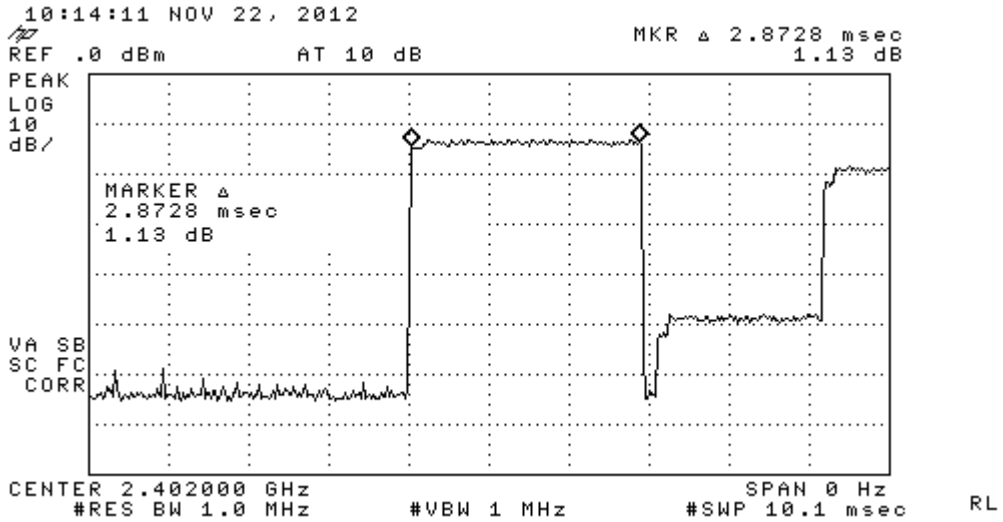
DH1-Packet Dwell Time (8DPSK)





DH3-Packet Dwell Time (8DPSK)





DH5-Packet Dwell Time (8DPSK)



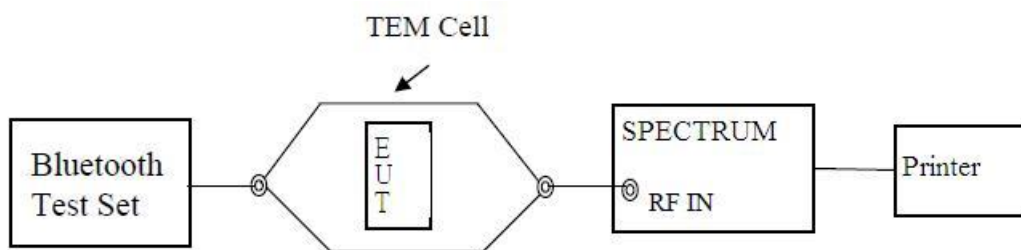


## 4.6. Band Edges Measurement

### 4.4.1. Required and Limits

In any 100 kHz bandwidth outside the intentional radiation frequency band, the radio frequency power shall be at least 20 dB below the highest level of the radiated power. In addition, radiated emissions which fall in the restricted bands must also comply with the radiated emission limits

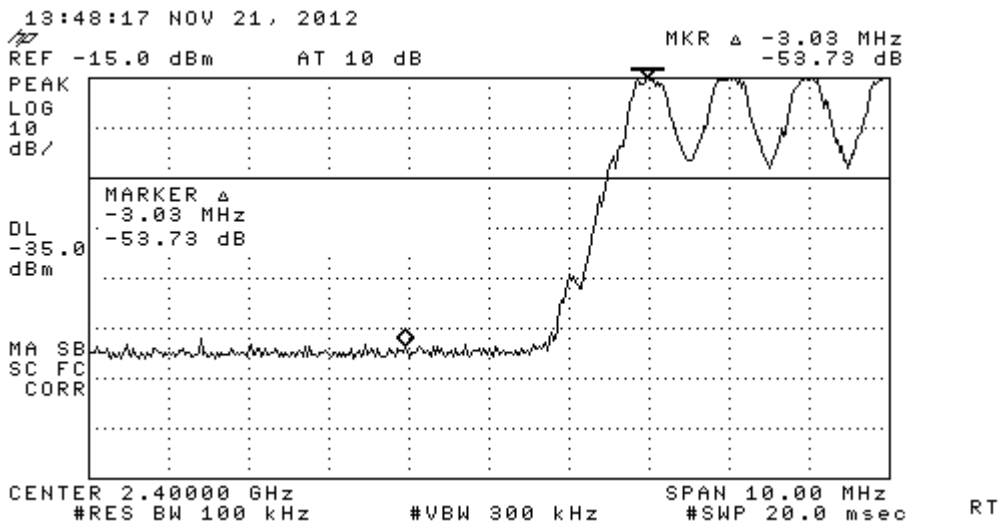
### 4.4.2. Test Configuration and Procedure



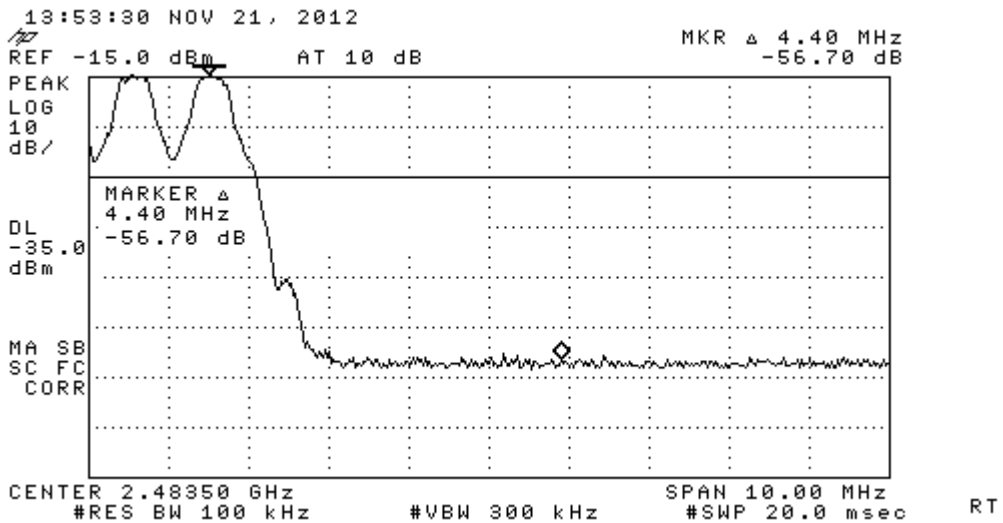
1. The RF output of EUT was connected to the spectrum analyzer by a low loss cable.
2. RF antenna conducted test: Set RBW = 100 kHz, Video bandwidth (VBW) > RBW, scan up through 10th harmonic. Band edge emissions must be at least 20 dB down from the highest emission level within the authorized band as measured with a 100 kHz RBW. Note: If the device complies with the use of power option 2 the attenuation under this paragraph shall be 30 dB instead of 20 dB.
3. Radiated emission test: Applies to band edge emissions that fall in the restricted bands listed in FCC Section 15.205. The maximum permitted average field strength is listed in FCC Section 15.209. A pre-amp is necessary for this measurement. For measurements above 1 GHz, set RBW = 1MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation; use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation. See FCC Section 15.35(b) and (c).

**4.4.3. Test Results**

| Result                           |                         |  |             |
|----------------------------------|-------------------------|--|-------------|
| Low Band Edge emission           | High Band Edge emission | Limits (dB)  | Pass/Fai    |
| 53.7 dB                          | 56.7 dB                 | least 20 dB below the highest level of the radiated powe | <b>Pass</b> |
| Uncertainty : $\pm 0.9\text{dB}$ |                         |  |             |



**Low Band Edge**





**High Band Edge**

**4.7. Radiated Emission Measurement**

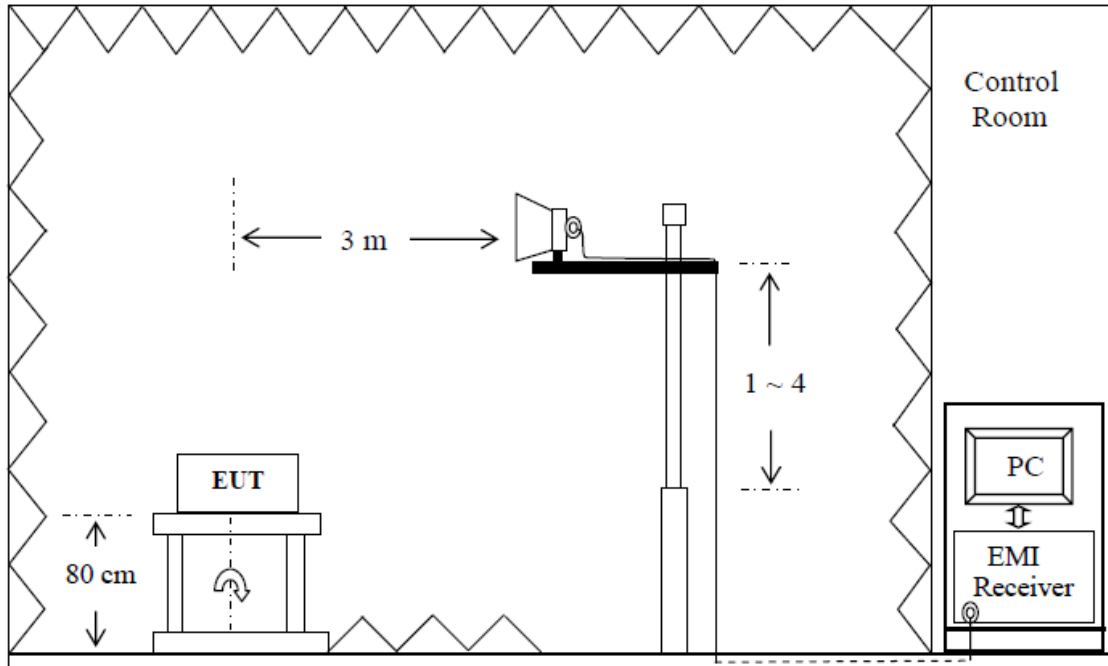
**4.4.1. Required and Limits**

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

| Frequency (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|-----------------|-----------------------------------|-------------------------------|
| 30 – 88         | 100                               | 3                             |
| 88 – 216        | 150                               | 3                             |
| 216 - 960       | 200                               | 3                             |
| Above 960       | 500                               | 3                             |



#### 4.4.2. Test Configuration and Procedure



note : 1. 30~1000MHz use Broadband antenna

2. 1GHz~3.5GHz use Horn antenna

1. Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured; RBW = 1 MHz for  $f \geq 1$  GHz, 100 kHz for  $f < 1$  GHz; VBW  $\geq$  RBW; Sweep = auto; Detector function = peak; Trace = max hold.

2. Follow the guidelines in ANSI C63.4-2003 with respect to maximizing the emission by rotating the EUT, measuring the emission for three EUT orthogonal planes, and adjusting the measurement antenna height and polarization. A pre-amp and a high pass filter are used for this test in order to get the good signal level..

**4.4.3. Test Results**

Emission frequency : 2402 MHz

| Har-<br>moni<br>c | Frequ-<br>ency<br>(MHz) | Reading<br>Vaule<br>(dB $\mu$ V) |               | Calibra-<br>-tion<br>Factor<br>(dB) | Measure @3m<br>(dB $\mu$ V/m) |               | Limit<br>(dB $\mu$ V/m) | Margin<br>(dB)  |               | Pass<br>/Fail |
|-------------------|-------------------------|----------------------------------|---------------|-------------------------------------|-------------------------------|---------------|-------------------------|-----------------|---------------|---------------|
|                   |                         | Hori-<br>zontal                  | Verti-<br>cal |                                     | Hori-<br>zontal               | Verti-<br>cal |                         | Hori-<br>zontal | Verti-<br>cal |               |
| 2                 | 4804                    | ---                              | ---           | ---                                 | ---                           | ---           | ---                     | ---             | ---           | ---           |
| 3                 | 7206                    | ---                              | ---           | ---                                 | ---                           | ---           | ---                     | ---             | ---           | ---           |
| 4                 | 9608                    | ---                              | ---           | ---                                 | ---                           | ---           | ---                     | ---             | ---           | ---           |
| 5                 | 12010                   | ---                              | ---           | ---                                 | ---                           | ---           | ---                     | ---             | ---           | ---           |
| 6                 | 14412                   | ---                              | ---           | ---                                 | ---                           | ---           | ---                     | ---             | ---           | ---           |
| 7                 | 16814                   | ---                              | ---           | ---                                 | ---                           | ---           | ---                     | ---             | ---           | ---           |
| 8                 | 19216                   | ---                              | ---           | ---                                 | ---                           | ---           | ---                     | ---             | ---           | ---           |
| 9                 | 21618                   | ---                              | ---           | ---                                 | ---                           | ---           | ---                     | ---             | ---           | ---           |
| 10                | 24020                   | ---                              | ---           | ---                                 | ---                           | ---           | ---                     | ---             | ---           | ---           |

Outside band

| Frequ-<br>ency<br>(MHz)    | Polarity<br>(H/V) | Reading<br>Vaule<br>(dB $\mu$ V) | Calibra-<br>-tion<br>Factor<br>(dB) | Measure @3m<br>(dB $\mu$ V/m) | Limit<br>(dB $\mu$ V/m) | Margin<br>(dB) | Pass<br>/Fail |
|----------------------------|-------------------|----------------------------------|-------------------------------------|-------------------------------|-------------------------|----------------|---------------|
| 189.4                      | H                 | 16.8                             | 11.3                                | 28.1                          | 43.5                    | -15.4          | Pass          |
| 239.9                      | H                 | 17.3                             | 13.3                                | 30.6                          | 46.0                    | -15.4          | Pass          |
| 300.2                      | H                 | 19.7                             | 15.0                                | 34.7                          | 46.0                    | -11.3          | Pass          |
| 311.9                      | H                 | 18.7                             | 15.4                                | 34.1                          | 46.0                    | -11.9          | Pass          |
| 420.7                      | H                 | 14.7                             | 18.6                                | 33.3                          | 46.0                    | -12.7          | Pass          |
| 541.2                      | H                 | 14.3                             | 21.0                                | 35.3                          | 46.0                    | -10.7          | Pass          |
| 59.2                       | V                 | 19.6                             | 8.3                                 | 27.9                          | 40.0                    | -12.1          | Pass          |
| 70.8                       | V                 | 17.1                             | 8.3                                 | 25.4                          | 40.0                    | -14.6          | Pass          |
| 360.5                      | V                 | 15.7                             | 16.9                                | 32.6                          | 46.0                    | -13.4          | Pass          |
| 370.2                      | V                 | 14.6                             | 17.2                                | 31.8                          | 46.0                    | -14.2          | Pass          |
| 420.7                      | V                 | 16.1                             | 18.6                                | 34.7                          | 46.0                    | -11.3          | Pass          |
| 978.6                      | V                 | 15.7                             | 26.3                                | 42.0                          | 54.0                    | -12.0          | Pass          |
| Uncertainty : $\pm 4.3$ dB |                   |                                  |                                     |                               |                         |                |               |

- note : 1. measure=reading value + calibration factor  
 2. calibration factor=antenna factor +cable loss(below 3.5GHz)  
 3. calibration factor= antenna factor +cable loss-preamp gain(above 3.5GHz)  
 4. margin=measure - limit °

Emission frequency : 2441 MHz

| Harmonic | Frequency (MHz) | Reading Vaule (dB $\mu$ V) |          | Calibration Factor (dB) | Measure @3m (dB $\mu$ V/m) |          | Limit (dB $\mu$ V/m) | Margin (dB) |          | Pass /Fail |
|----------|-----------------|----------------------------|----------|-------------------------|----------------------------|----------|----------------------|-------------|----------|------------|
|          |                 | Horizontal                 | Vertical |                         | Horizontal                 | Vertical |                      | Horizontal  | Vertical |            |
| 2        | 4882            | ---                        | ---      | ---                     | ---                        | ---      | ---                  | ---         | ---      | ----       |
| 3        | 7323            | ---                        | ---      | ---                     | ---                        | ---      | ---                  | ---         | ---      | ----       |
| 4        | 9764            | ---                        | ---      | ---                     | ---                        | ---      | ---                  | ---         | ---      | ----       |
| 5        | 12205           | ---                        | ---      | ---                     | ---                        | ---      | ---                  | ---         | ---      | ----       |
| 6        | 14646           | ---                        | ---      | ---                     | ---                        | ---      | ---                  | ---         | ---      | ----       |
| 7        | 17087           | ---                        | ---      | ---                     | ---                        | ---      | ---                  | ---         | ---      | ----       |
| 8        | 19528           | ---                        | ---      | ---                     | ---                        | ---      | ---                  | ---         | ---      | ----       |
| 9        | 21969           | ---                        | ---      | ---                     | ---                        | ---      | ---                  | ---         | ---      | ----       |
| 10       | 24410           | ---                        | ---      | ---                     | ---                        | ---      | ---                  | ---         | ---      | ----       |

Outside band

| Frequency (MHz)            | Polarity (H/V) | Reading Vaule (dB $\mu$ V) | Calibration Factor (dB) | Measure @3m (dB $\mu$ V/m) | Limit (dB $\mu$ V/m) | Margin (dB) | Pass /Fail |
|----------------------------|----------------|----------------------------|-------------------------|----------------------------|----------------------|-------------|------------|
| 300.2                      | H              | 18.7                       | 15.0                    | 33.7                       | 46.0                 | -12.3       | Pass       |
| 311.9                      | H              | 16.2                       | 15.4                    | 31.6                       | 46.0                 | -14.4       | Pass       |
| 420.7                      | H              | 14.3                       | 18.6                    | 32.9                       | 46.0                 | -13.1       | Pass       |
| 617.1                      | H              | 14.8                       | 22.6                    | 37.4                       | 46.0                 | -8.6        | Pass       |
| 648.2                      | H              | 14.5                       | 23.0                    | 37.5                       | 46.0                 | -8.5        | Pass       |
| 918.4                      | H              | 15.4                       | 25.9                    | 41.3                       | 46.0                 | -4.7        | Pass       |
| 33.9                       | V              | 13.5                       | 18.9                    | 32.4                       | 40.0                 | -7.6        | Pass       |
| 53.3                       | V              | 21.1                       | 8.5                     | 29.6                       | 40.0                 | -10.4       | Pass       |
| 420.7                      | V              | 16.2                       | 18.6                    | 34.8                       | 46.0                 | -11.2       | Pass       |
| 453.8                      | V              | 15.0                       | 19.2                    | 34.2                       | 46.0                 | -11.8       | Pass       |
| 615.1                      | V              | 15.3                       | 22.6                    | 37.9                       | 46.0                 | -8.1        | Pass       |
| 918.4                      | V              | 16.2                       | 25.9                    | 42.1                       | 46.0                 | -3.9        | Pass       |
| Uncertainty : $\pm 4.3$ dB |                |                            |                         |                            |                      |             |            |

- note : 1. measure=reading value + calibration factor  
 2. calibration factor=antenna factor +cable loss(below 3.5GHz)  
 3. calibration factor= antenna factor +cable loss-preamp gain(above 3.5GHz)  
 4. margin=measure - limit °

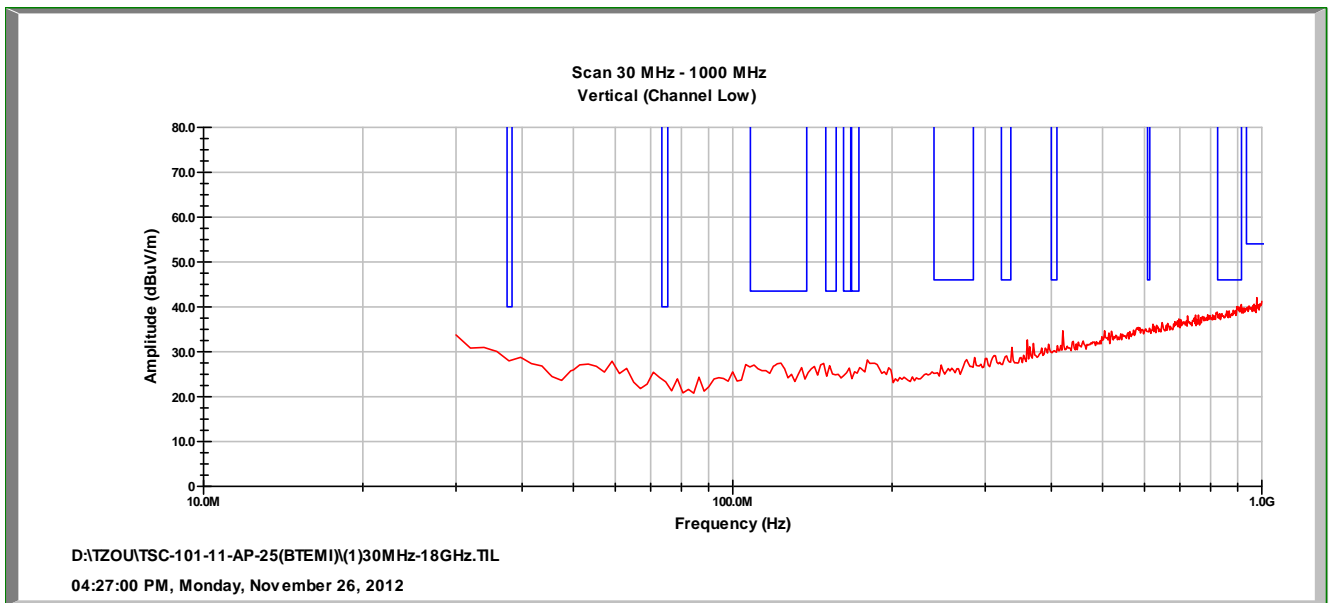
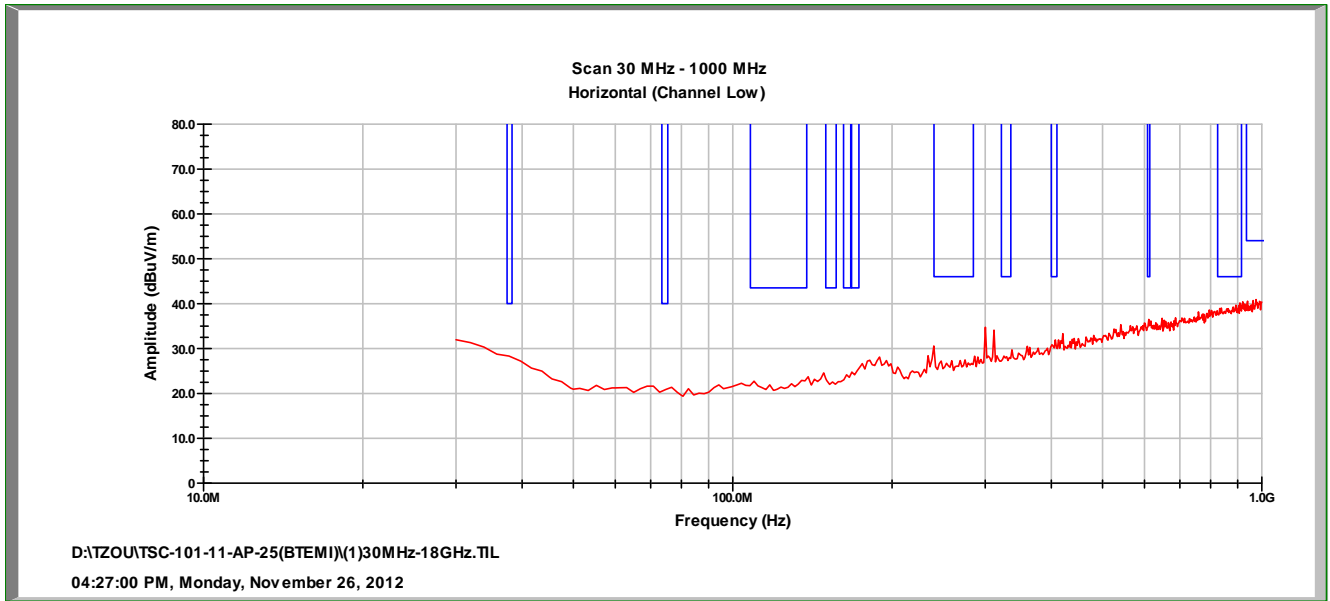
Emission frequency : 2480 MHz

| Har-<br>monic | Freque-<br>ncy<br>(MHz) | Reading<br>Vaule<br>(dB $\mu$ V) |              | Calibra-<br>-tion<br>Factor<br>(dB) | Measure @3m<br>(dB $\mu$ V/m) |              | Limit<br>(dB $\mu$ V/m) | Margin<br>(dB)  |              | Pass<br>/Fail |
|---------------|-------------------------|----------------------------------|--------------|-------------------------------------|-------------------------------|--------------|-------------------------|-----------------|--------------|---------------|
|               |                         | Hori-<br>zontal                  | Vertica<br>l |                                     | Hori-<br>zontal               | Vertica<br>l |                         | Hori-<br>zontal | Vertica<br>l |               |
| 2             | 4960                    | ---                              | ---          | ---                                 | ---                           | ---          | ---                     | ---             | ---          | ----          |
| 3             | 7440                    | ---                              | ---          | ---                                 | ---                           | ---          | ---                     | ---             | ---          | ----          |
| 4             | 9920                    | ---                              | ---          | ---                                 | ---                           | ---          | ---                     | ---             | ---          | ----          |
| 5             | 12400                   | ---                              | ---          | ---                                 | ---                           | ---          | ---                     | ---             | ---          | ----          |
| 6             | 14880                   | ---                              | ---          | ---                                 | ---                           | ---          | ---                     | ---             | ---          | ----          |
| 7             | 17360                   | ---                              | ---          | ---                                 | ---                           | ---          | ---                     | ---             | ---          | ----          |
| 8             | 19840                   | ---                              | ---          | ---                                 | ---                           | ---          | ---                     | ---             | ---          | ----          |
| 9             | 22320                   | ---                              | ---          | ---                                 | ---                           | ---          | ---                     | ---             | ---          | ----          |
| 10            | 24800                   | ---                              | ---          | ---                                 | ---                           | ---          | ---                     | ---             | ---          | ----          |

Outside band

| Freque-<br>ncy<br>(MHz)    | Polarity<br>(H/V) | Reading<br>Vaule<br>(dB $\mu$ V) | Calibra-<br>-tion<br>Factor<br>(dB) | Measure @3m<br>(dB $\mu$ V/m) | Limit<br>(dB $\mu$ V/m) | Margin<br>(dB) | Pass<br>/Fail |
|----------------------------|-------------------|----------------------------------|-------------------------------------|-------------------------------|-------------------------|----------------|---------------|
| 199.1                      | H                 | 17.1                             | 11.7                                | 28.8                          | 43.5                    | -14.7          | Pass          |
| 300.2                      | H                 | 17.9                             | 15.0                                | 32.9                          | 46.0                    | -13.1          | Pass          |
| 311.9                      | H                 | 16.3                             | 15.4                                | 31.7                          | 46.0                    | -14.3          | Pass          |
| 420.7                      | H                 | 15.0                             | 18.6                                | 33.6                          | 46.0                    | -12.4          | Pass          |
| 541.2                      | H                 | 15.2                             | 21.0                                | 36.2                          | 46.0                    | -9.8           | Pass          |
| 914.5                      | H                 | 15.6                             | 25.9                                | 41.5                          | 46.0                    | -4.5           | Pass          |
| 59.2                       | V                 | 19.4                             | 8.3                                 | 27.7                          | 40.0                    | -12.3          | Pass          |
| 78.6                       | V                 | 16.7                             | 8.0                                 | 24.7                          | 40.0                    | -15.3          | Pass          |
| 420.7                      | V                 | 15.6                             | 18.6                                | 34.2                          | 46.0                    | -11.8          | Pass          |
| 519.9                      | V                 | 15.0                             | 20.5                                | 35.5                          | 46.0                    | -10.5          | Pass          |
| 770.6                      | V                 | 15.4                             | 24.1                                | 39.5                          | 46.0                    | -6.5           | Pass          |
| 961.1                      | V                 | 16.5                             | 26.2                                | 42.7                          | 54.0                    | -11.3          | Pass          |
| Uncertainty : $\pm 4.3$ dB |                   |                                  |                                     |                               |                         |                |               |

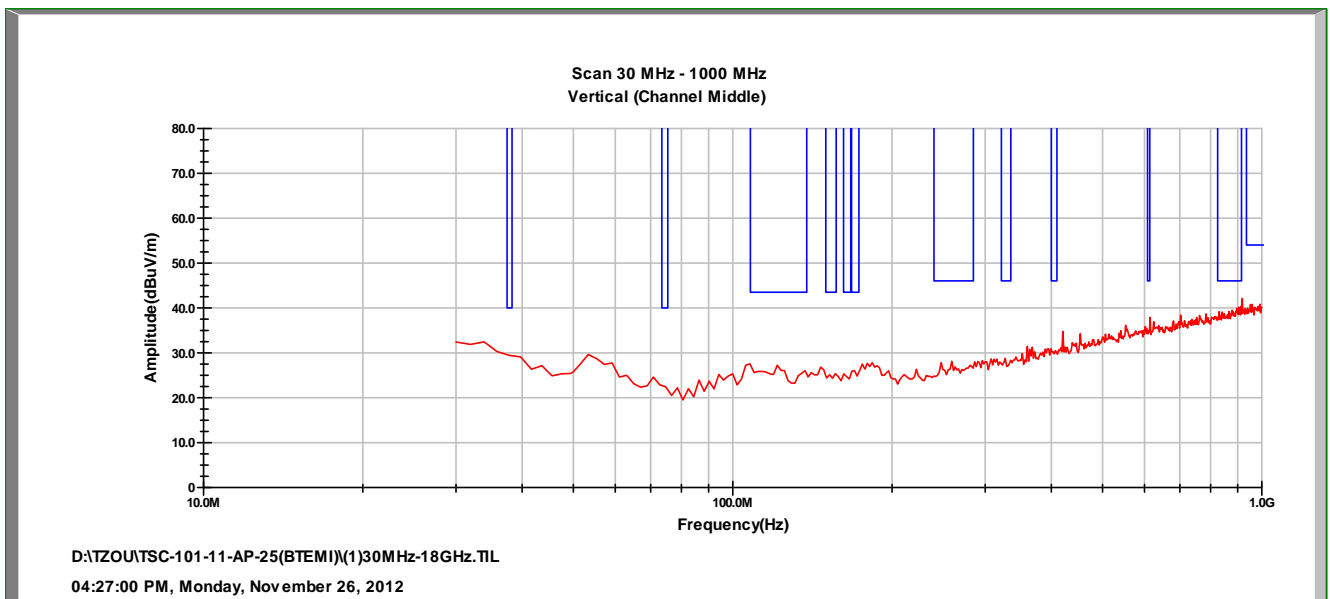
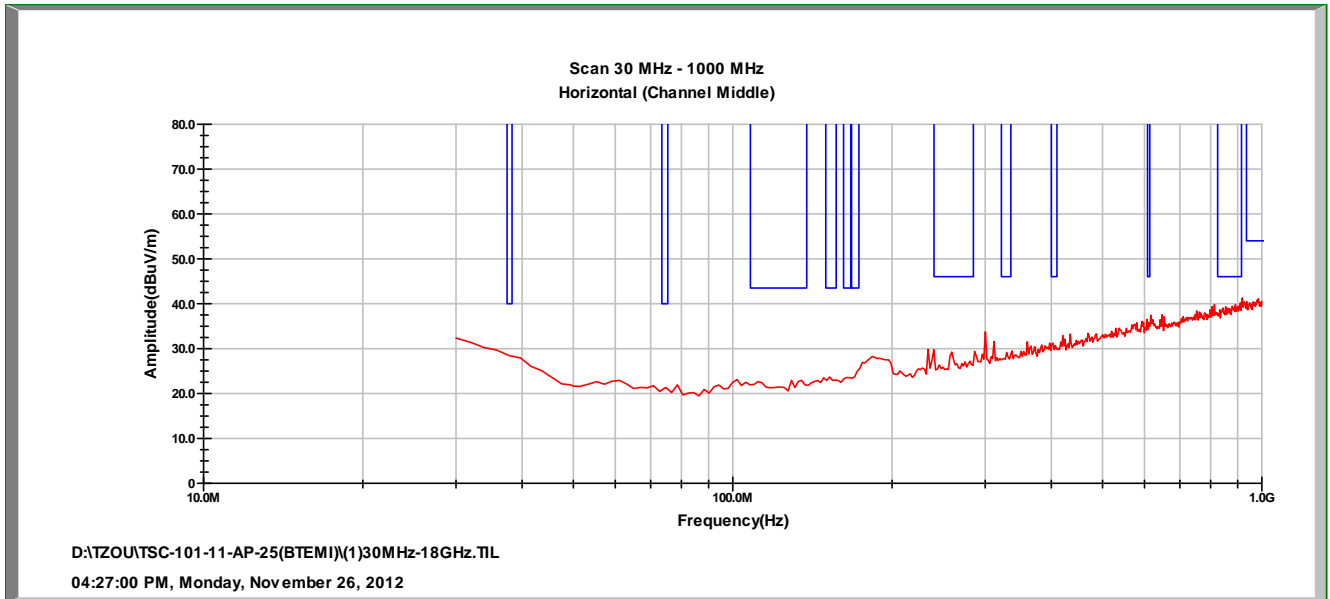
- note : 1. measure=reading value + calibration factor  
 2. calibration factor=antenna factor +cable loss(below 3.5GHz)  
 3. calibration factor= antenna factor +cable loss-preamp gain(above 3.5GHz)  
 4. margin=measure - limit °



Below 1GHz radiated emission( emission frequency2402MHz)

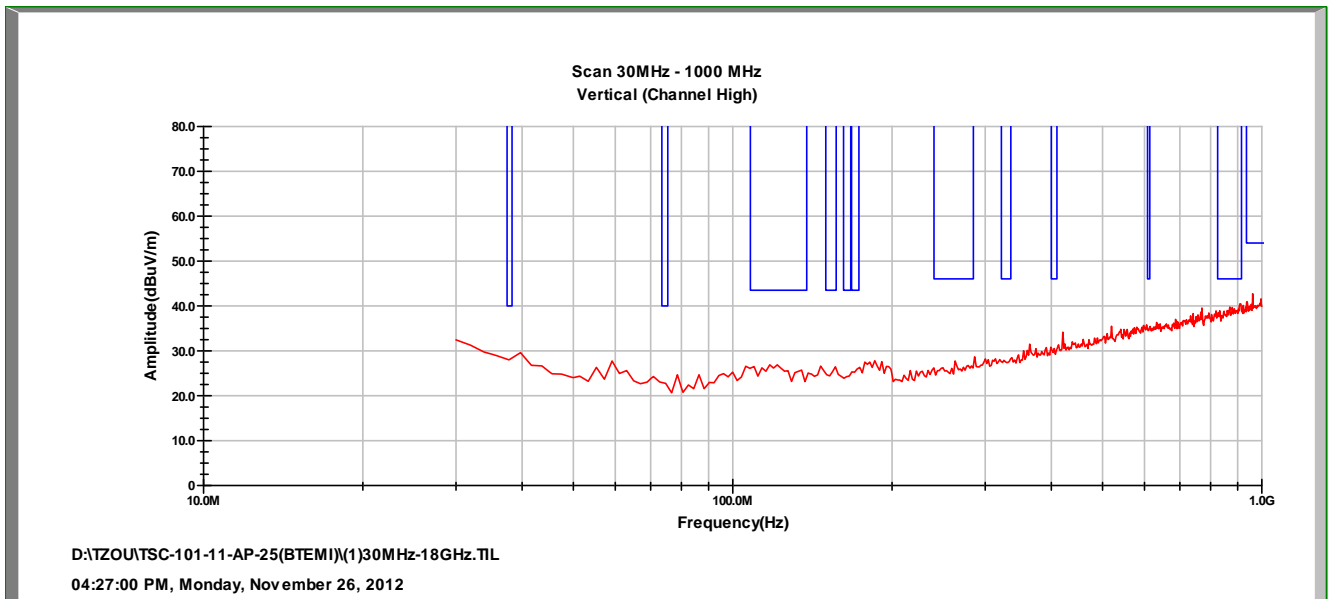
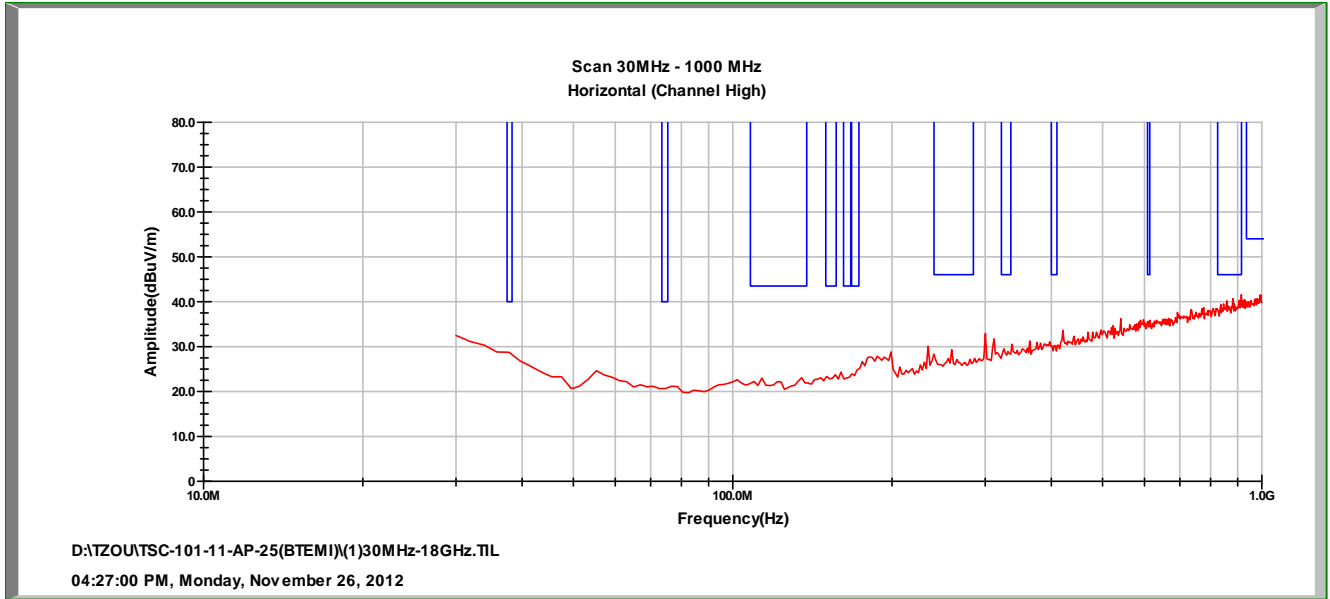




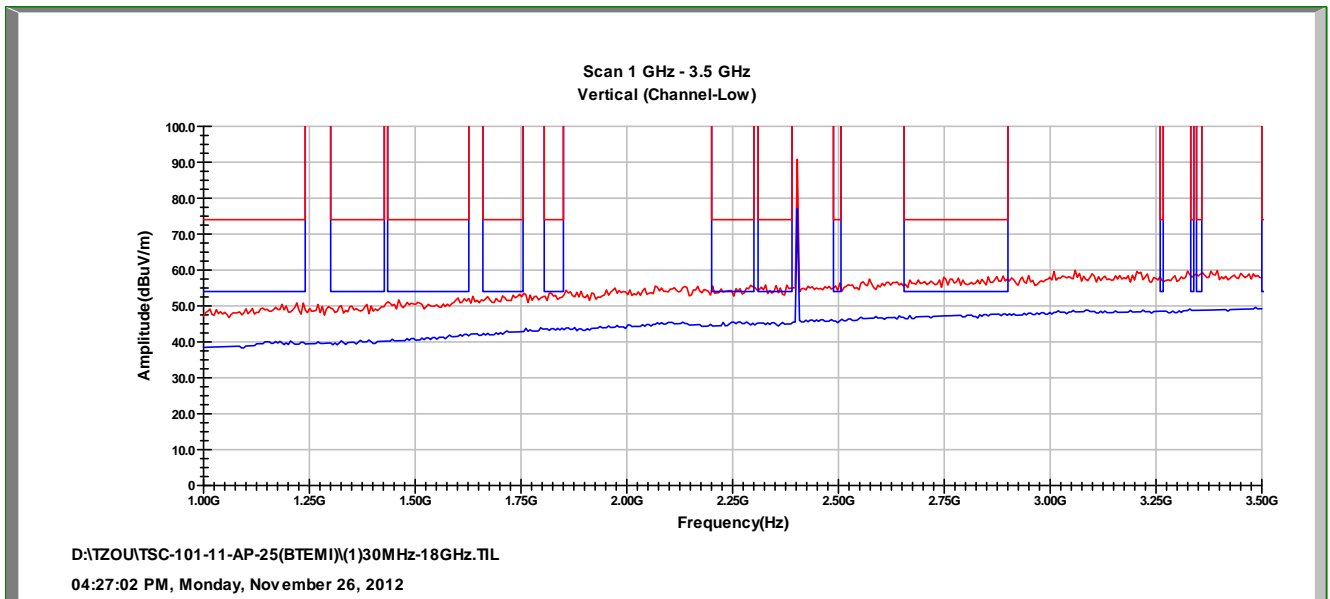
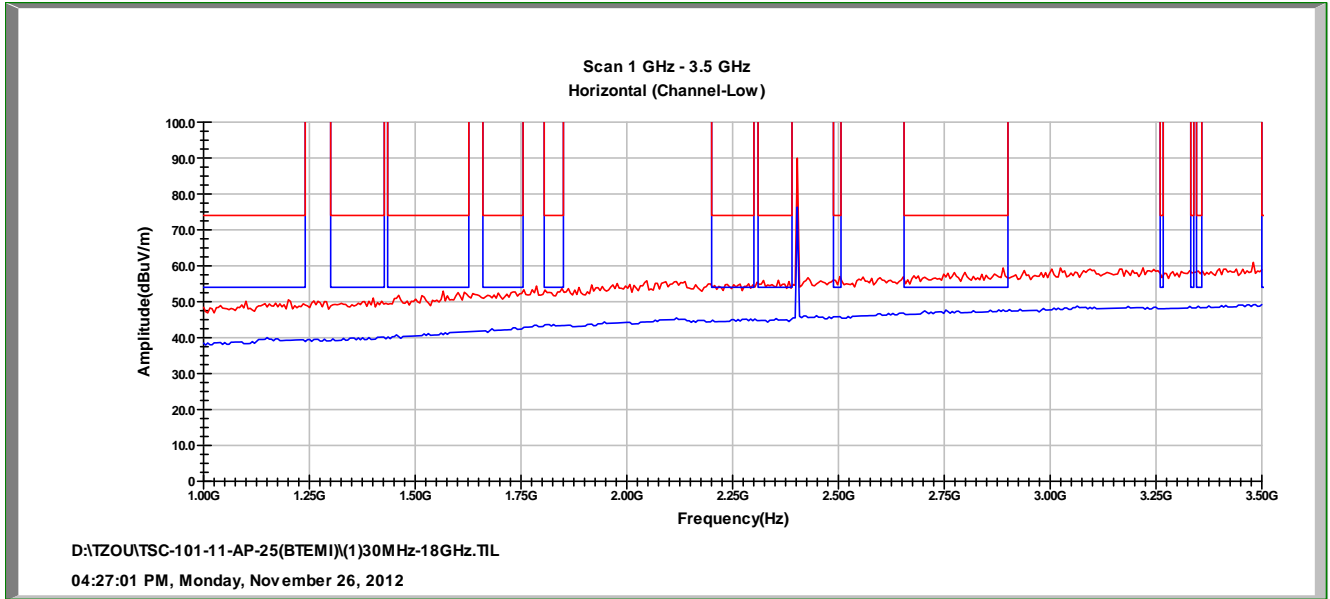


Below 1GHz radiated emission( emission frequency2441MHz)



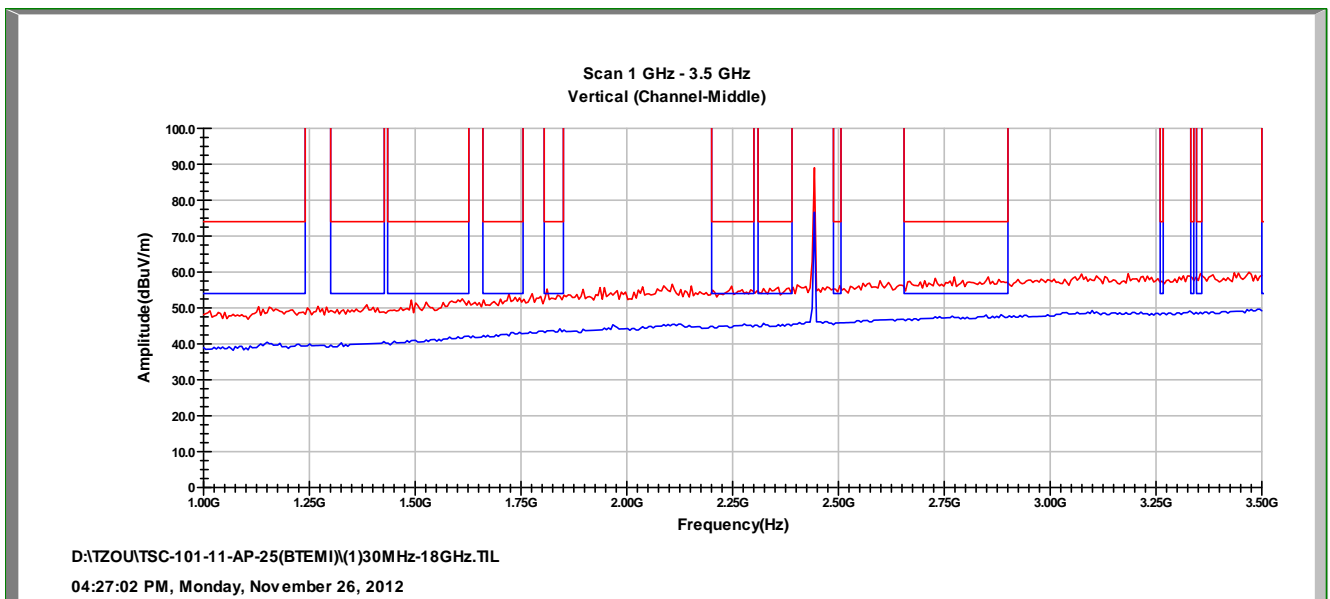
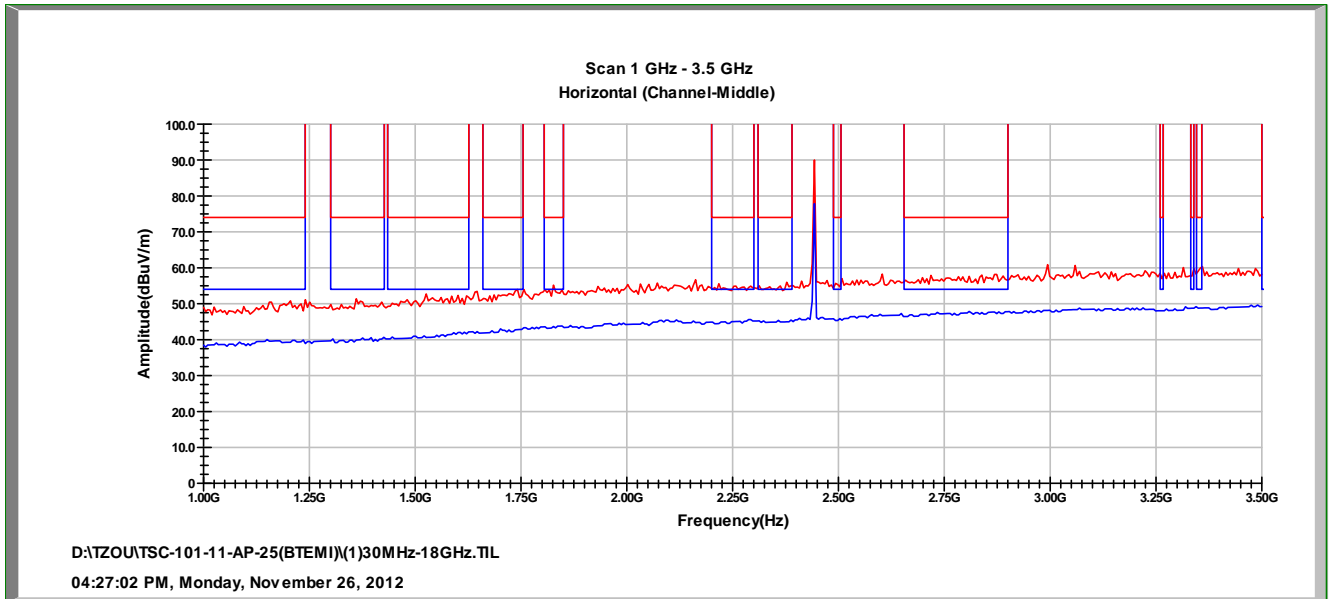


Below 1GHz radiated emission( emission frequency2480MHz)

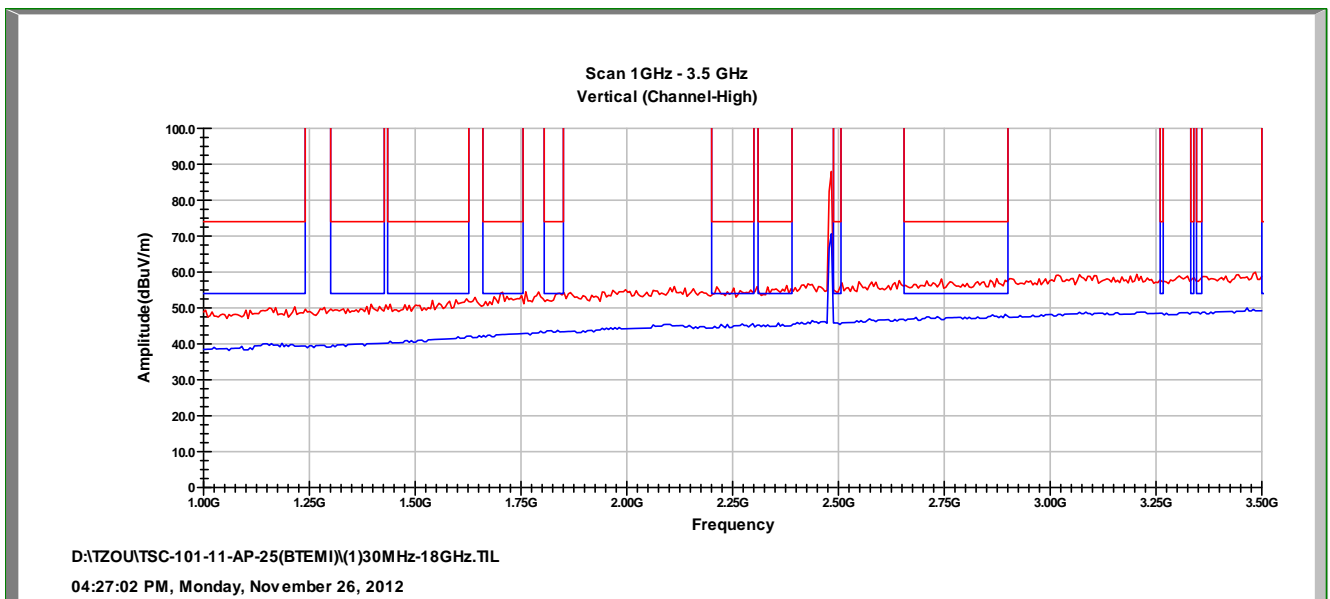
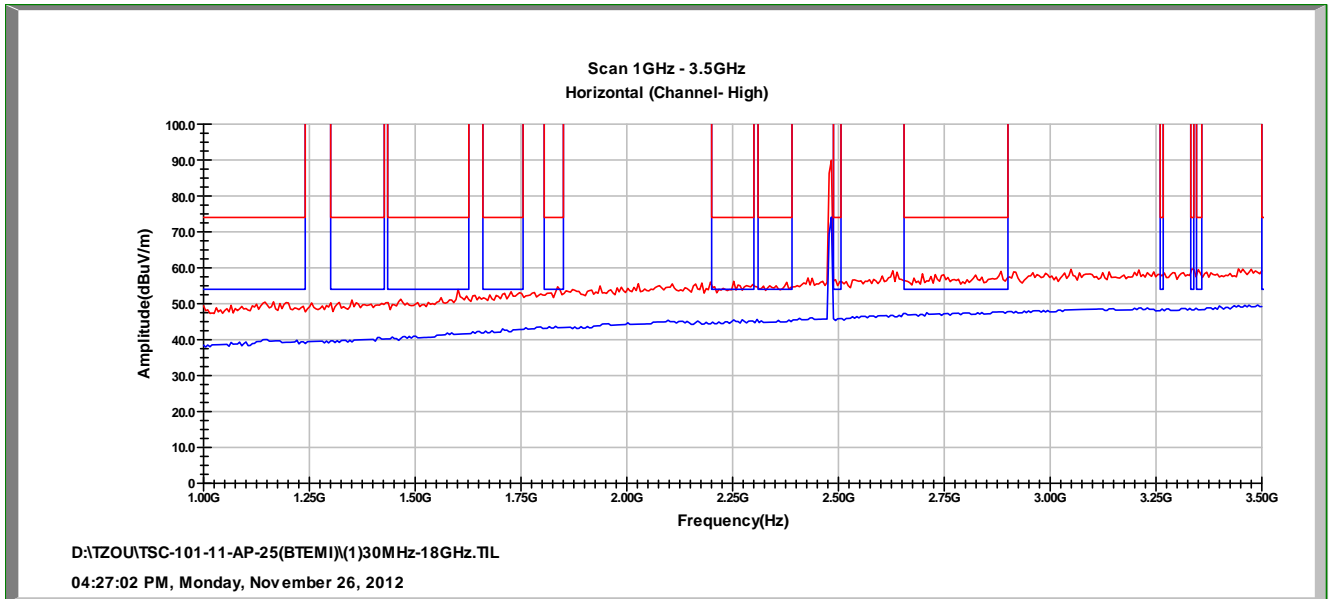


1~3.5GHz radiated emission( emission frequency2402MHz)

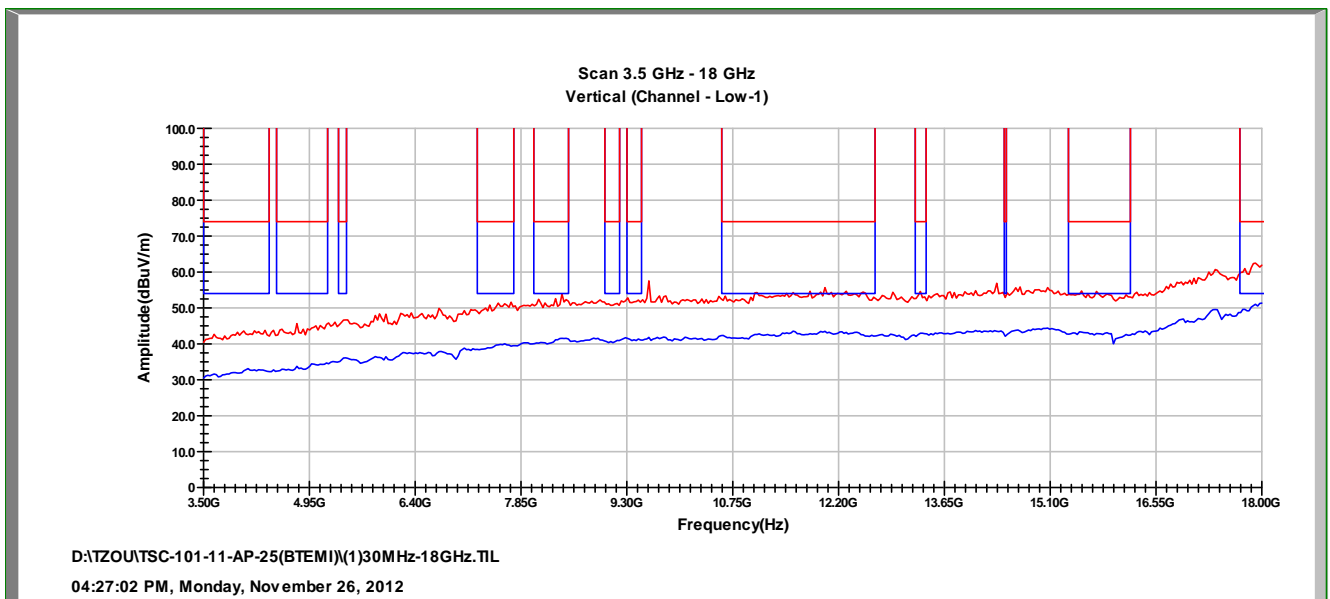
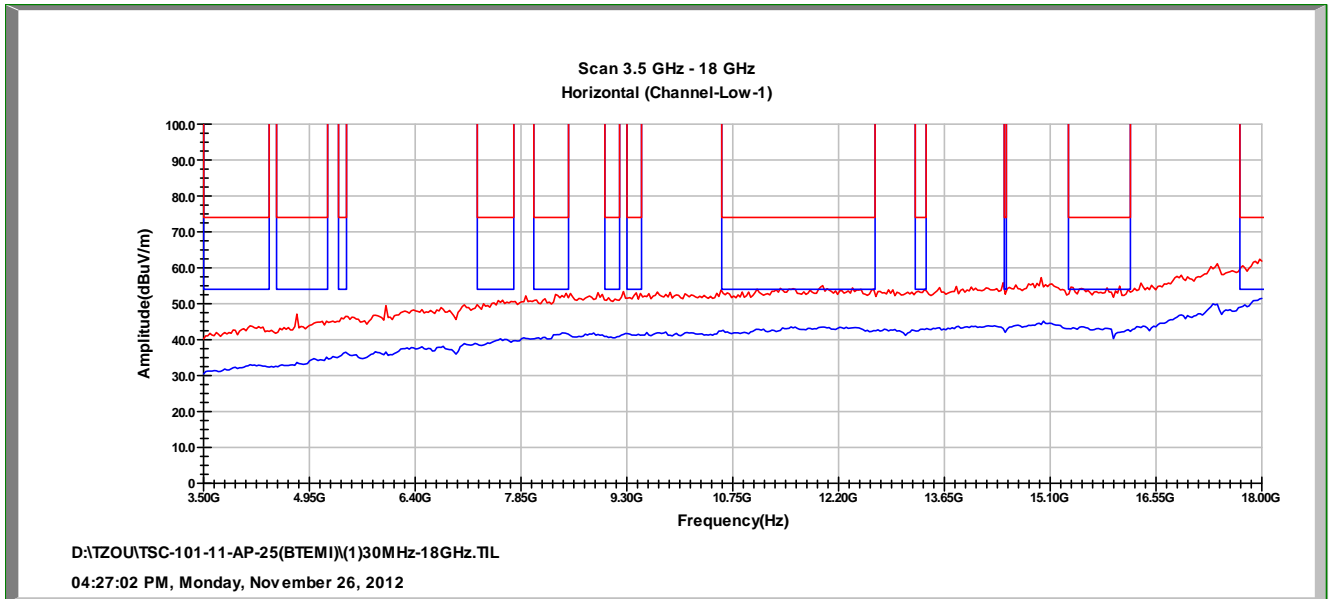




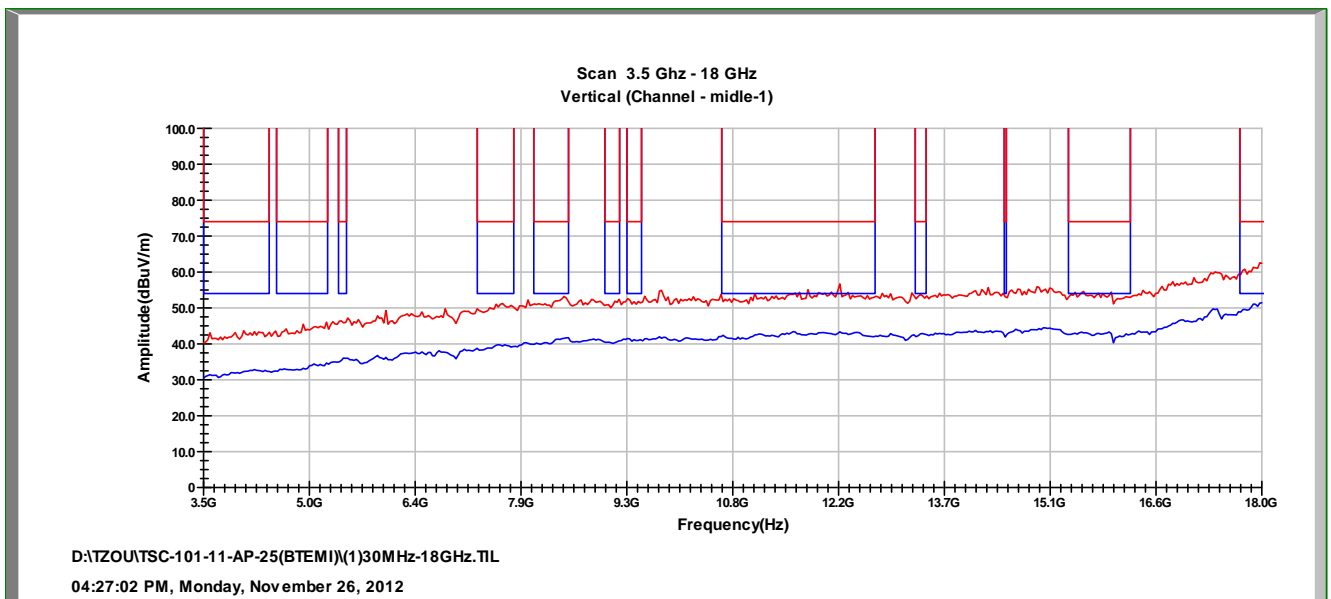
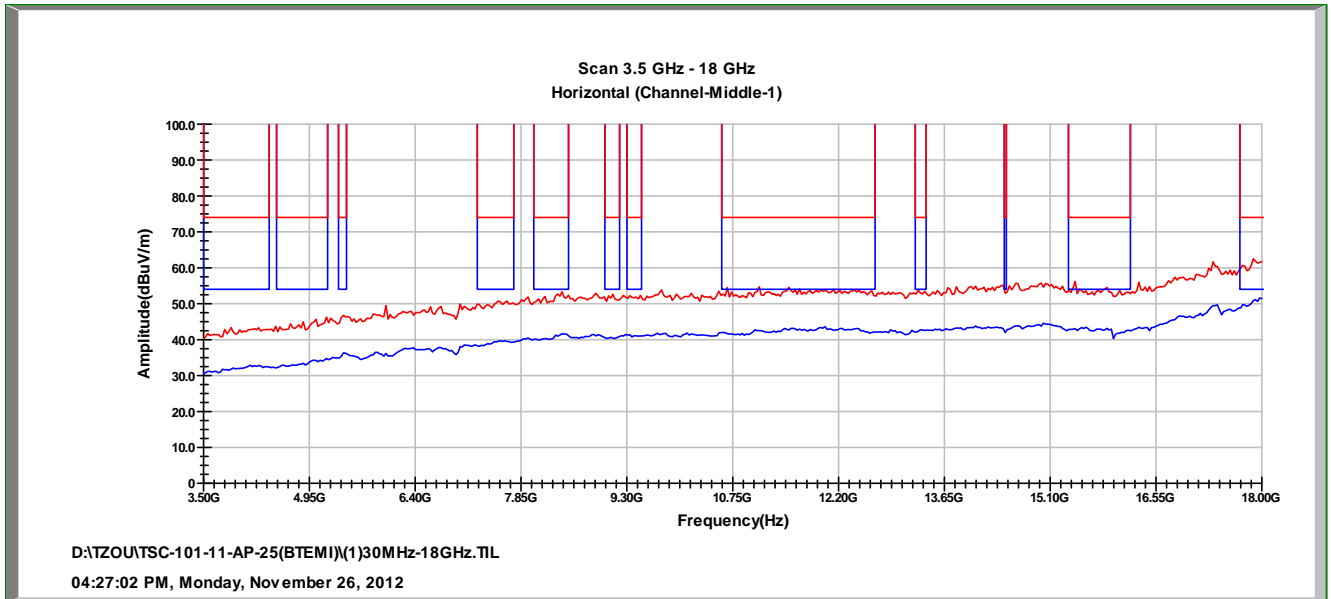
1~3.5GHz radiated emission( emission frequency2441MHz)



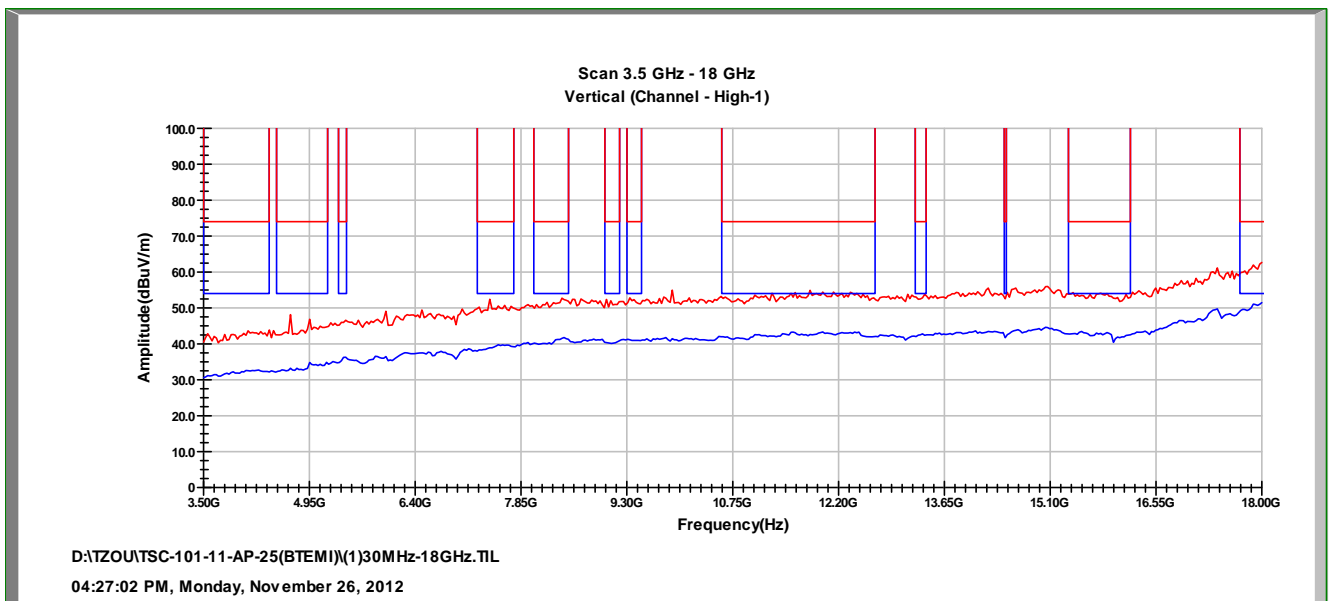
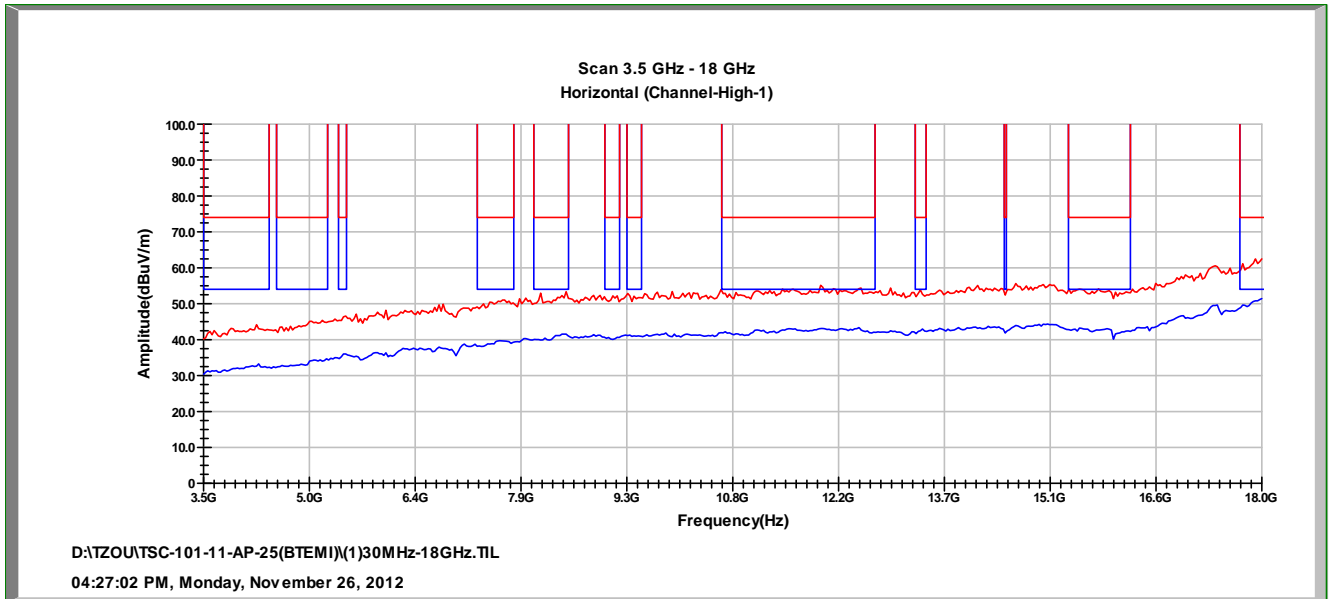
1~3.5GHz radiated emission( emission frequency2480MHz)



3.5~18GHz radiated emission( emission frequency2402MHz)



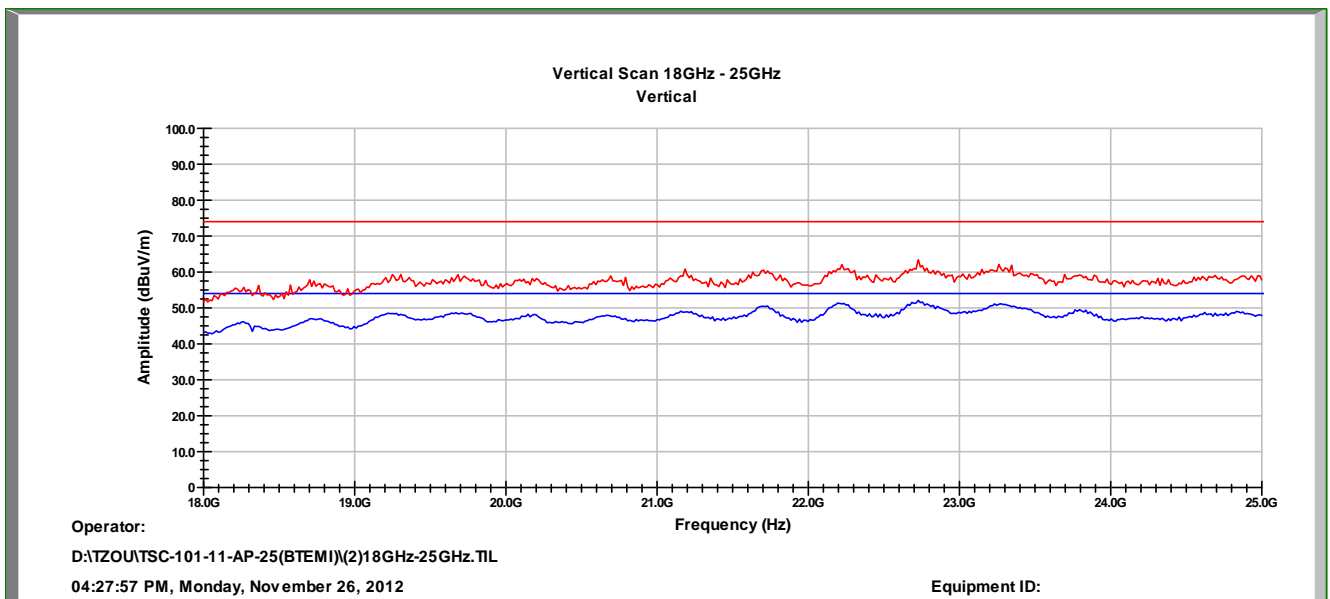
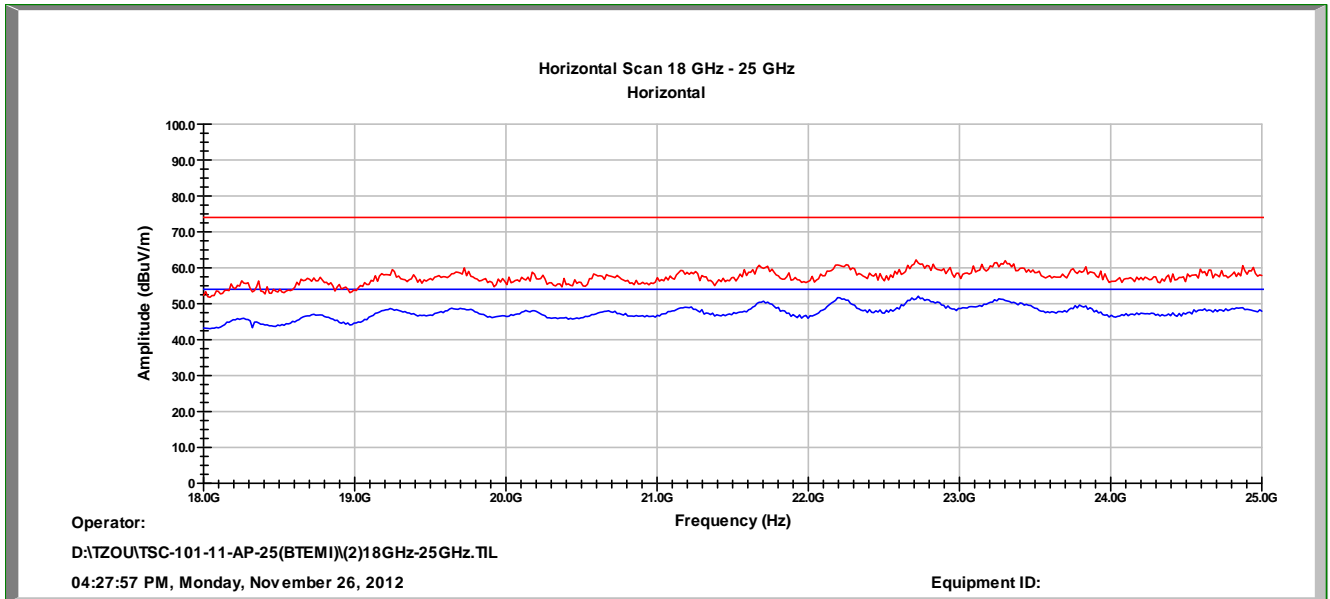
3.5~18GHz radiated emission( emission frequency2441MHz)



3.5~18GHz radiated emission( emission frequency2480MHz)







18~25GHz radiated emission( low 、 mid 、 high emission frequency)



## 4.8. Antenna Requirements

### 4.4.1. Standard Applicable

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

### 4.4.2. Antenna Connected Construction

The antennas type used in this product is Chip Antenna without connector and it is considered to meet antenna requirement.

### 4.4.3. 3.8.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.