

# HCT CO., LTD.

## CERTIFICATE OF COMPLIANCE

### FCC Certification

**Applicant Name:**  
HYUNDAI MOBIS CO., LTD.

**Date of Issue:**

May 25, 2012

**Location:**

**Address:**  
80-9, Mabook-Dong, Giheung-Gu Yongin-shi  
Gyeonggi-Do, 446-912 South Korea

HCT CO., LTD., 105-1, Jangam-ri, Majang-Myeon, Icheon-si,  
Kyunggi-Do, Korea

**Test Report No.:** HCTR1205FR34

**HCT FRN:** 0005866421

**IC Recognition No.:** 5944A-3

|                  |                                  |
|------------------|----------------------------------|
| <b>FCC ID</b>    | <b>: TQ8-AV230IXAN</b>           |
| <b>IC</b>        | <b>: 5074A-AV2A0IXKN</b>         |
| <b>APPLICANT</b> | <b>: HYUNDAI MOBIS CO., LTD.</b> |

**FCC Model(s):** AV230IXAN

**IC Model(s):** AV2A0IXKN

**EUT Type:** CAR AVN

**Max. RF Output Power:** 2.90 dBm(1.95 mW)

**Frequency Range:** 2402 - 2480 MHz (Bluetooth)

**Modulation type** GFSK(Normal),  $\pi/4$ DQPSK and 8DPSK(EDR)

**FCC Classification:** FCC Part 15 Spread Spectrum Transceiver

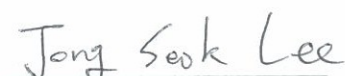
**FCC Rule Part(s):** Part 15 subpart C 15.247

**IC Rule :** RSS-210 , RSS-GEN

#### Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them.

**HCT CO., LTD.** Certifies that no party to this application has subject to a denial of Federal benefits that includes FCC benefits pursuant to section 5301 of the Anti-Drug Abuse Act of 1998, 21 U.S. C.853(a)



**Report prepared by**  
**: Jong Seok Lee**

**Test Engineer of RF Team**



**Approved by**  
**: Sang Jun Lee**

**Manager of RF Team**

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|                                 |                                |                   |                           |  |
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| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

# Version

| TEST REPORT NO. | DATE         | DESCRIPTION             |
|-----------------|--------------|-------------------------|
| HCTR1205FR34    | May 25, 2012 | - First Approval Report |
|                 |              |                         |
|                 |              |                         |
|                 |              |                         |
|                 |              |                         |

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## 1. GENERAL INFORMATION

**Applicant Name:** HYUNDAI MOBIS CO., LTD.  
**Address:** 80-9, Mabook-Dong, Giheung-Gu Yongin-shi  
 Gyunggi-Do, 446-912 South Korea  
  
**FCC ID:** TQ8-AV230IXAN  
**IC** 5074A-AV2A0IXKN  
**EUT:** CAR AVN  
**FCC Model name(s):** AV230IXAN  
**IC Model name(s):** AV2A0IXKN  
**Date(s) of Tests:** May 14, 2012 ~ May 16, 2012  
**Contact Person:** Name: Jong Tae Kim  
 Phone #: +82-31-288-6081  
 Fax #: +82-31-899-1788  
  
**Place of Tests:** HCT Co., Ltd.  
 105-1, Jangam-ri, Majang-Myeon, Icheon-si, Kyunggi-Do, 467-811,  
 KOREA. (IC Recognition No. : 5944A-3)

## 2. EUT DESCRIPTION

|                              |  |
|------------------------------|--|
| <b>EUT Type</b>              | CAR AVN  |
| <b>FCC Model Name</b>        | AV230IXAN  |
| <b>IC Model Name</b>         | AV2A0IXKN  |
| <b>Power Supply</b>          | DC 12 V  |
| <b>Frequency Range</b>       | 2402 - 2480 MHz (Bluetooth)  |
| <b>Transmit Power</b>        | 2.90 dBm(1.95 mW)  |
| <b>BT Operating Mode</b>     | Nomal, EDR, AFH  |
| <b>Modulation Type</b>       | GFSK(Normal), $\pi/4$ DQPSK and 8DPSK(EDR)   |
| <b>Modulation Technique</b>  | FHSS   |
| <b>Number of Channels</b>    | 79Channels, Minimum 20 Channels(AFH)   |
| <b>Antenna Specification</b> | Manufacturer: AMOTECH Co., Ltd.<br>Antenna type: Chip Antenna<br>Peak Gain : 3.5 dBi |

### ※ 15.247 Requirements for Bluetooth transmitter

- This Bluetooth module has been tested by a Bluetooth Qualification Lab, and we confirm the following:
  - 1) This system is hopping pseudo-randomly.
  - 2) Each frequency is used equally on the average by each transmitter.
  - 3) The receiver input bandwidths that match the hopping channel bandwidths of their corresponding transmitters
  - 4) The receiver shifts frequencies in synchronization with the transmitted signals.
- 15.247(g): The system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this Section 15.247 should the transmitter be presented with a continuous data (or information) stream.
- 15.247(h): The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

|  |  |                          |                                  |  |
|--|--|--------------------------|----------------------------------|--|
| <b>FCC PT.15.247<br/>TEST REPORT</b>   | <b>FCC &amp; IC CERTIFICATION REPORT</b> |                          |                                  | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| <b>Test Report No.</b><br>HCTR1205FR34 | <b>Date of Issue:</b><br>May 25, 2012    | <b>EUT Type:</b> CAR AVN | <b>FCC ID :</b><br>TQ8-AV230IXAN | <b>IC :</b><br>5074A-AV2A0IXKN                   |

### 3. TEST METHODOLOGY

The measurement procedure described in the American National Standard for Testing Unlicensed Wireless Devices(ANSI C63.10-2009) and FCC Public Notice DA 00-705 dated March 30, 2000 entitled “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems” were used in the measurement of the **HYUNDAI MOBIS CO., LTD.**

**CAR AVN FCC ID: TQ8-AV230IXAN**

#### 3.1 EUT CONFIGURATION

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

#### 3.2 EUT EXERCISE

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

#### 3.3 GENERAL TEST PROCEDURES

##### Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2009) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

##### Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical according to the requirements in Section 6.3 of ANSI C63.10. (Version: 2009)

#### 3.4 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 highest data rate (worst case) is chosen for full testing.

|  |  |                          |                                  |  |
|--|--|--------------------------|----------------------------------|--|
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## 4. INSTRUMENT CALIBRATION

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

## 5. FACILITIES AND ACCREDITATIONS

### 5.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 105-1, Jangam-ri, Majang-Myeon, Icheon-si, Kyunggi-Do, 467-811, Korea. The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2003) and CISPR Publication 22. Detailed description of test facility was submitted to the Commission and accepted dated March 02, 2011 (Registration Number: 90661)

### 5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

## 6. ANTENNA REQUIREMENTS

### According to FCC 47 CFR §15.203:

"An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section."

\* The antennas of this E.U.T are permanently attached.

\*The E.U.T Complies with the requirement of §15.203

|  |  |                          |                                  |  |
|--|--|--------------------------|----------------------------------|--|
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## 7. SUMMARY OF TEST RESULTS

| Test Description                    | IC Part Section(s)                    | FCC Part Section(s)        | Test Limit                            | Test Condition | Test Result |
|-------------------------------------|---------------------------------------|----------------------------|---------------------------------------|----------------|-------------|
| 20 dB Bandwidth                     | RSS-210, A8.1(a)                      | §15.247(a)(1)(ii) or (iii) | NA                                    | CONDUCTED      | PASS        |
| Occupied Bandwidth                  | RSS-210, A1.1.3                       | NA                         | NA                                    |                | PASS        |
| Conducted Maximum Peak Output Power | RSS-210, A8.4(2)                      | §15.247(b)(1)              | < 1 Watts                             |                | PASS        |
| Carrier Frequency Separation        | RSS-210, A8.1(b)                      | §15.247(a)(1)              | >25 kHz or >2/3 of the 20dB BW        |                | PASS        |
| Number of Hopping Frequencies       | RSS-210, A8.1(d)                      | §15.247(a)(1)(iii)         | >15                                   |                | PASS        |
| Time of Occupancy                   | RSS-210, A8.1(d)                      | §15.247(a)(1)(iii)         | <400 ms                               |                | PASS        |
| Conducted Spurious Emissions        | RSS-210, A 8.5 RSS-GEN, Section 7.2.3 | §15.247(d)                 | < 20 dB for all out-of band emissions |                | PASS        |
| Band Edge(Out of Band Emissions)    | RSS-210, A 8.5                        | §15.247(d)                 | < 20 dB for all out-of band emissions |                | PASS        |
| AC Power line Conducted Emissions   | RSS-GEN, Section 7.2.2                | §15.207(a)                 | cf. Section 8.7                       |                | PASS        |
| Radiated Spurious Emissions         | RSS-210, A2.9, A 8.5                  | §15.247(d), 15.205, 15.209 | cf. Section 8.6.2                     | RADIATED       | PASS        |
| Radiated Restricted Band Edge       | RSS-210, A2.9, A 8.5                  | §15.247(d), 15.205, 15.209 | cf. Section 8.6.4                     |                | PASS        |
| Receiver Spurious Emissions         | RSS-GEN, Section 7.2.3                | §15.109                    | cf. Section 8.6.3                     |                | PASS        |

## 8. FCC PART 15.247 REQUIREMENTS

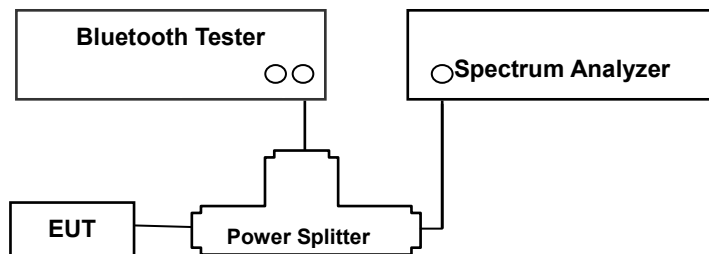
### 8.1 PEAK POWER

#### LIMIT

The maximum peak output power of the intentional radiator shall not exceed the following:

1. For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt.
2. The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi.

#### Test Configuration



#### TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. The Spectrum Analyzer is set to the peak detector mode. This test is performed with hopping off.

1. Span = 2 MHz (GFSK) / 5 MHz ( $\pi/4$ DQPSK and 8DPSK)
2. RBW = 1 MHz (GFSK) / 3 MHz ( $\pi/4$ DQPSK and 8DPSK)
3. VBW = 1 MHz (GFSK) / 3 MHz ( $\pi/4$ DQPSK and 8DPSK)
4. Sweep = auto
5. Packet type= DH5 (GFSK) / 2-DH5 ( $\pi/4$ DQPSK) / 3-DH5 (8DPSK)

#### SAMPLE CALCULATION

$$\begin{aligned} \text{Output Power} &= \text{Spectrum Reading Power} + \text{Power Splitter loss} + \text{Cable loss}(2 \text{ ea}) \\ &= 10 \text{ dBm} + 6 \text{ dB} + 1.5 \text{ dB} = 17.5 \text{ dBm} \end{aligned}$$

Note :

1. Spectrum reading values are not plot data. The power results in plot is already including the actual values of loss for the splitter and cable combination.
2. Spectrum offset = Power Splitter loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. Actual value of loss for the splitter and cable combination is 7.6 dB at 2.4 GHz. We used the particular cable type that is supported by manufacture.

| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
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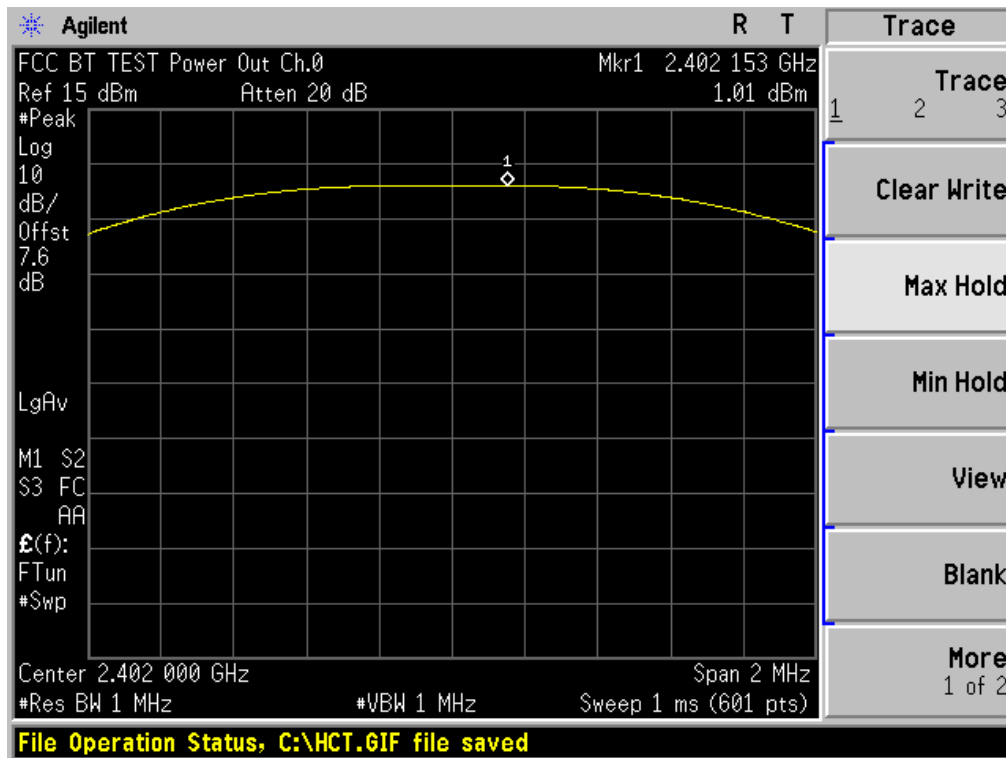
## TEST RESULTS

No non-compliance noted

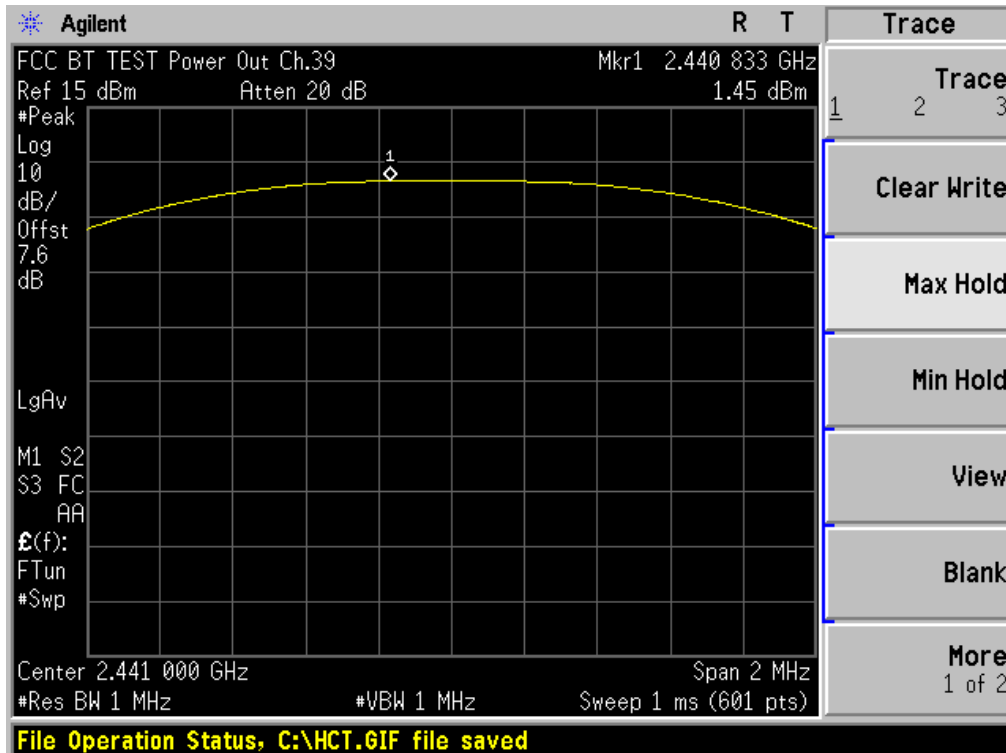
### Test Data

| Channel | Frequency<br>(MHz) | Output Power<br>(GFSK) |      | Output Power<br>(8DPSK) |      | Output Power<br>( $\pi$ /4DQPSK) |      | Limit<br>(W) | Result |
|---------|--------------------|------------------------|------|-------------------------|------|----------------------------------|------|--------------|--------|
|         |                    | (dBm)                  | (mW) | (dBm)                   | (mW) | (dBm)                            | (mW) |              |        |
| Low     | 2402               | 1.01                   | 1.26 | 2.30                    | 1.70 | 2.15                             | 1.64 | 1            | PASS   |
| Mid     | 2441               | 1.45                   | 1.40 | 2.67                    | 1.85 | 2.50                             | 1.78 |              | PASS   |
| High    | 2480               | 1.92                   | 1.56 | 2.90                    | 1.95 | 2.66                             | 1.85 |              | PASS   |

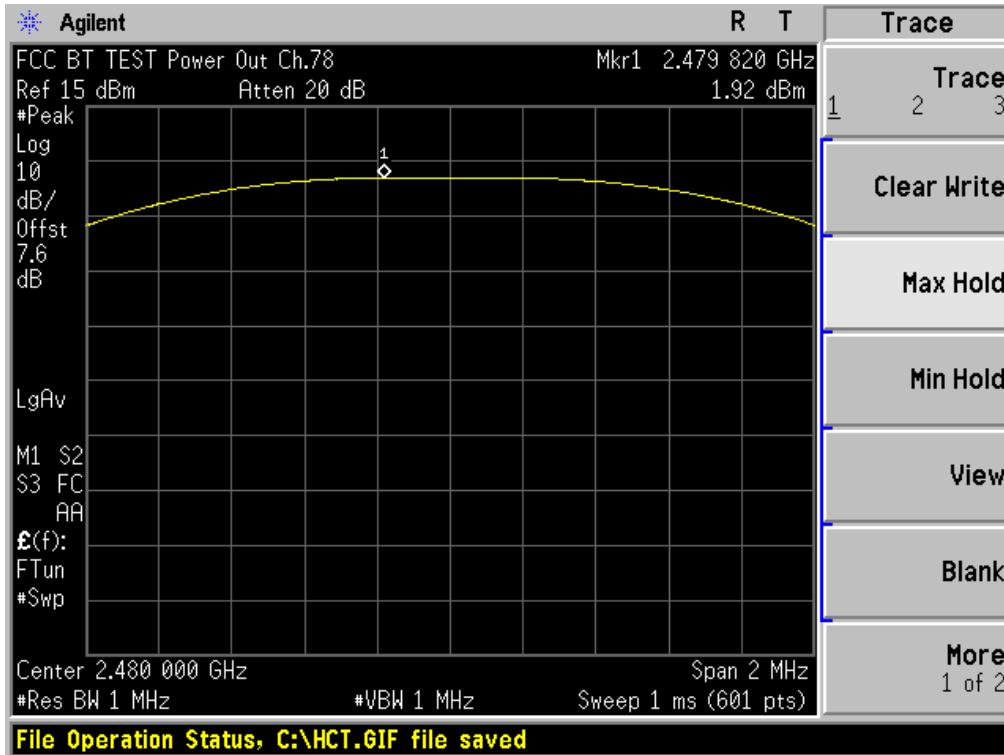
Test Plots (GFSK)  
Peak Power (Low-CH)



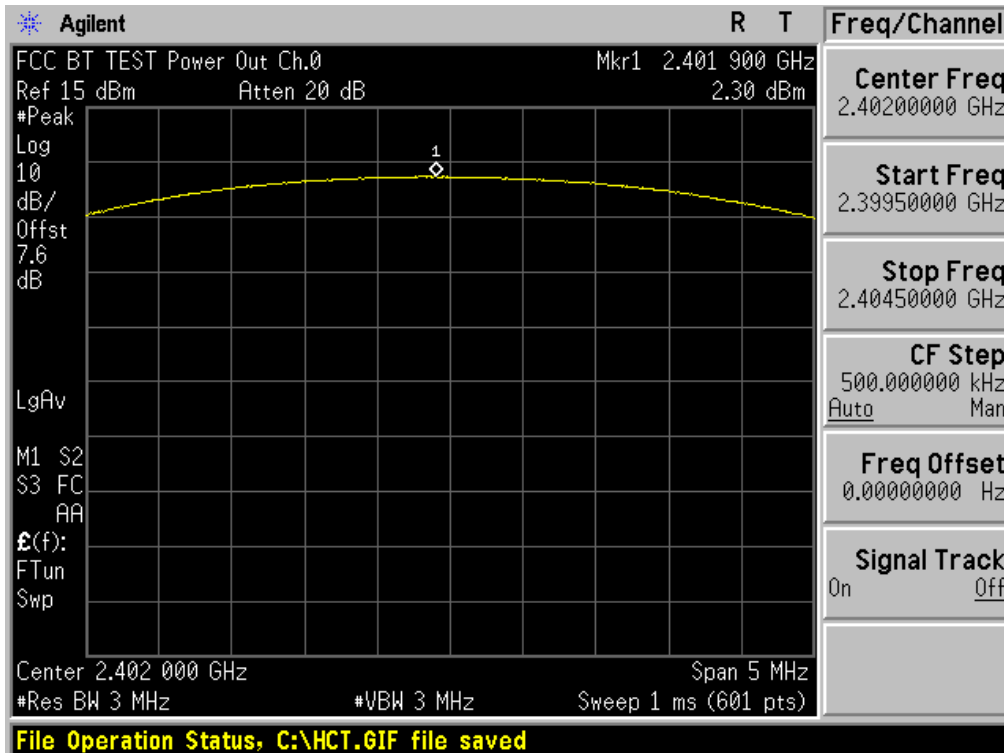
Test Plots (GFSK)  
Peak Power (Mid-CH)



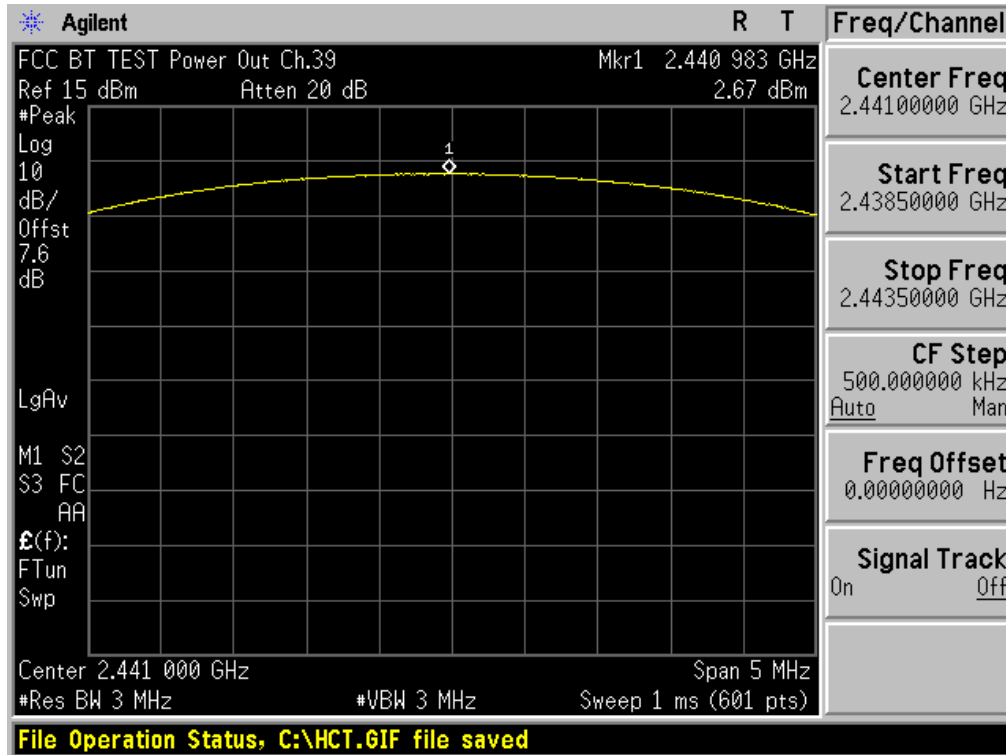
Test Plots (GFSK)  
Peak Power (High-CH)



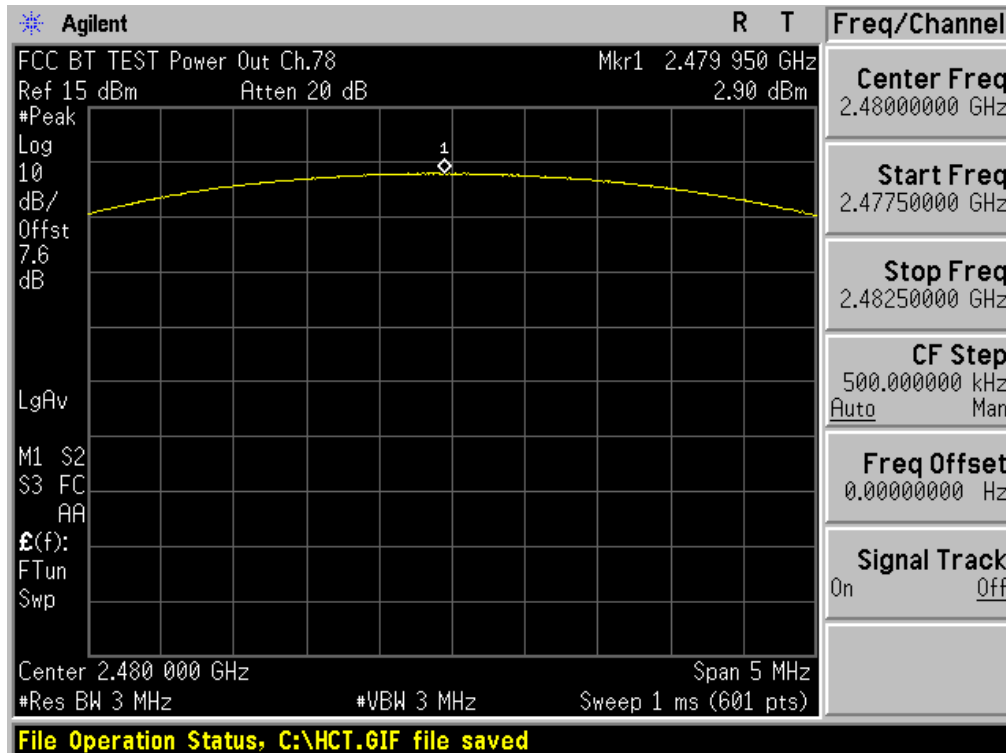
Test Plots (8DPSK)  
Peak Power (Low-CH)



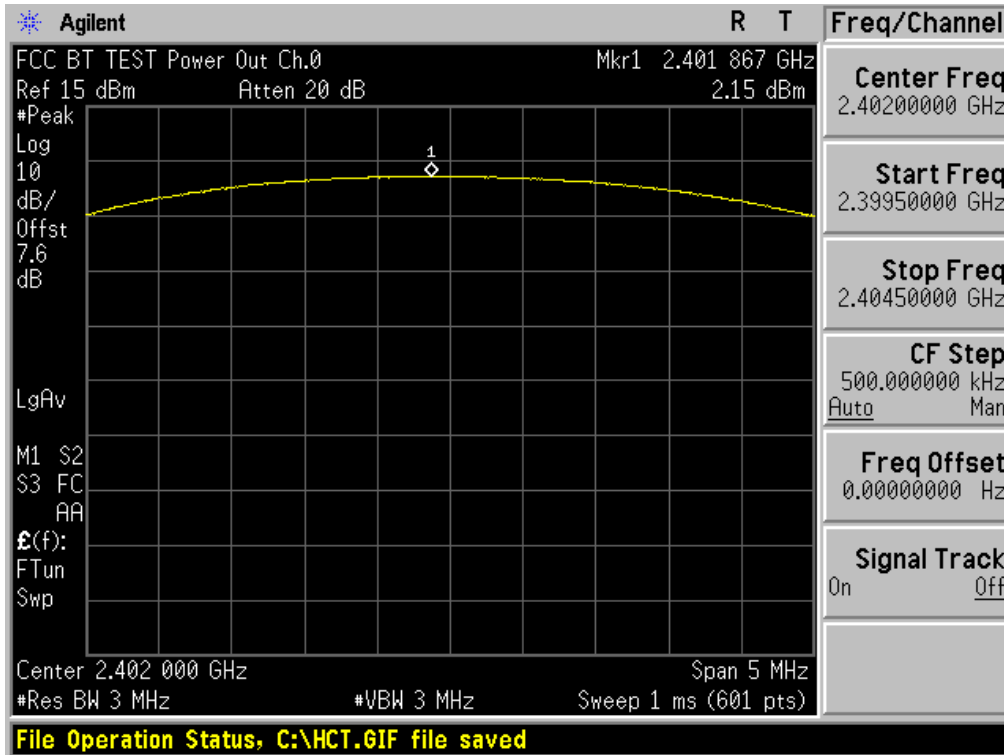
Test Plots (8DPSK)  
Peak Power (Mid-CH)



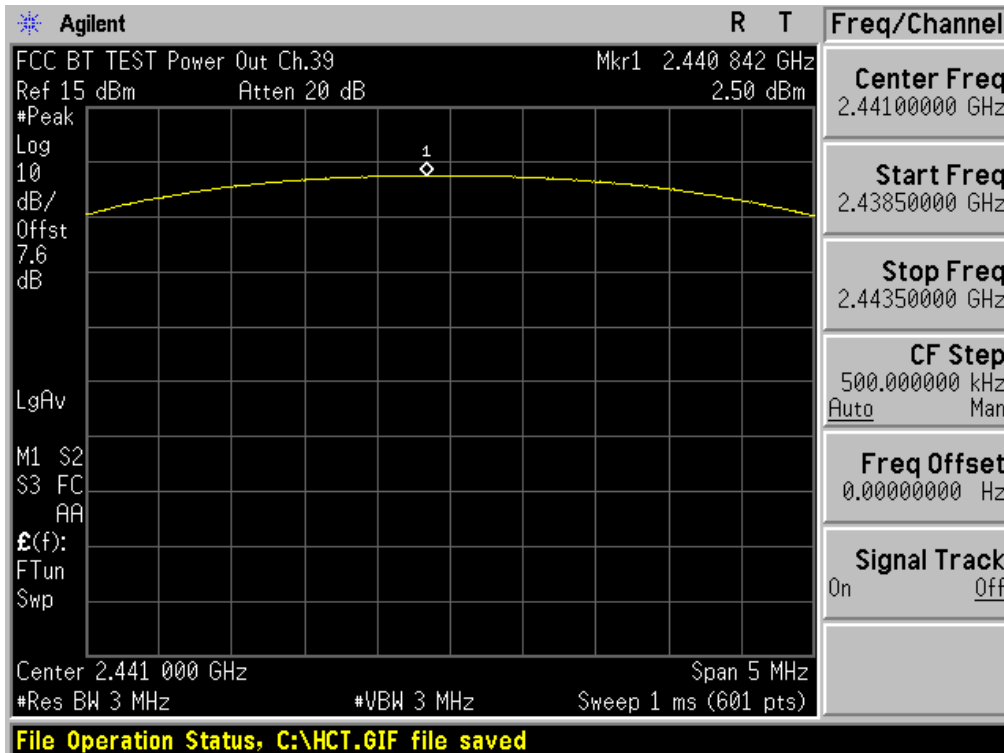
Test Plots (8DPSK)  
Peak Power (High-CH)



Test Plots ( $\pi/4$ DQPSK)  
Peak Power (Low-CH)

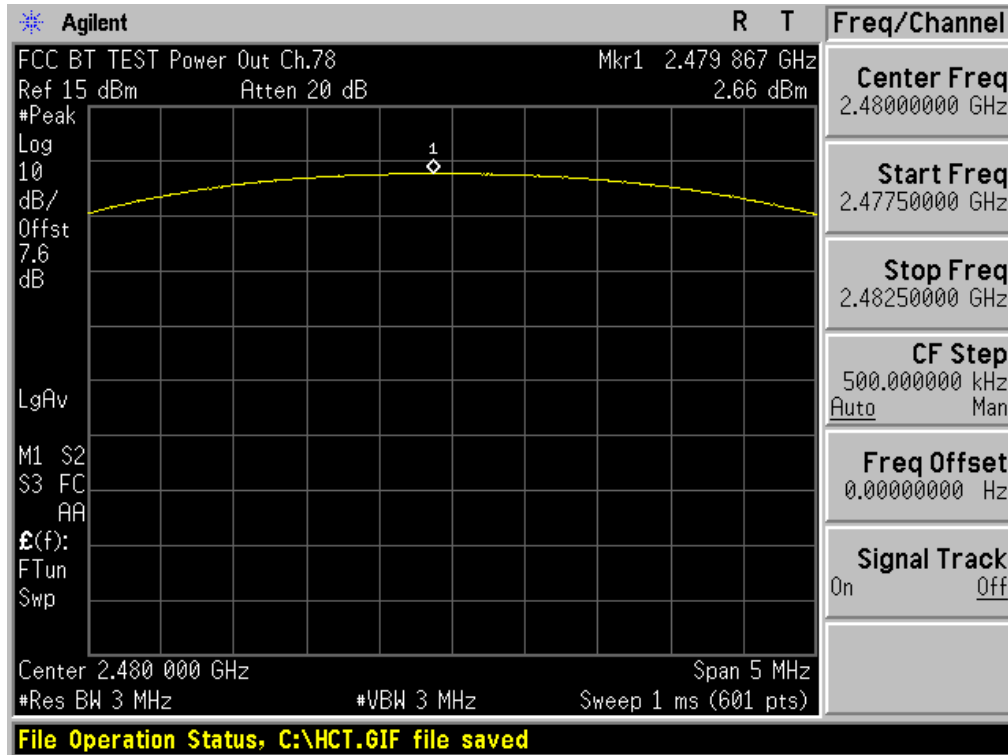


Test Plots ( $\pi/4$ DQPSK)  
Peak Power (Mid-CH)



|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
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Test Plots ( $\pi/4$ DQPSK)  
Peak Power (High-CH)

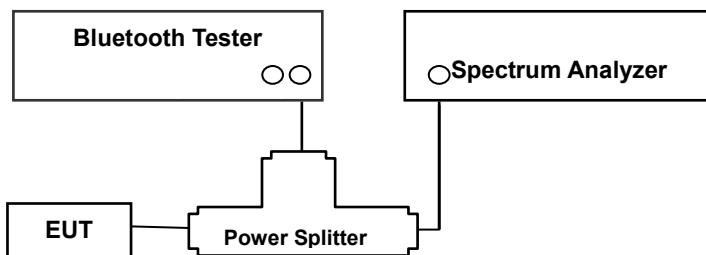


## 8.2 BAND EDGES

### LIMIT

According to §15.247(d), 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.

### Test Configuration



### TEST PROCEDURE

This test is performed with hopping off and hopping on.

The spectrum analyzer is set to :

1. Span = 8 MHz / 10 MHz(with hopping)
2. RBW = 100 kHz
3. VBW = 300 kHz
4. Sweep = auto
5. Detector Mode = Peak

### TEST RESULTS

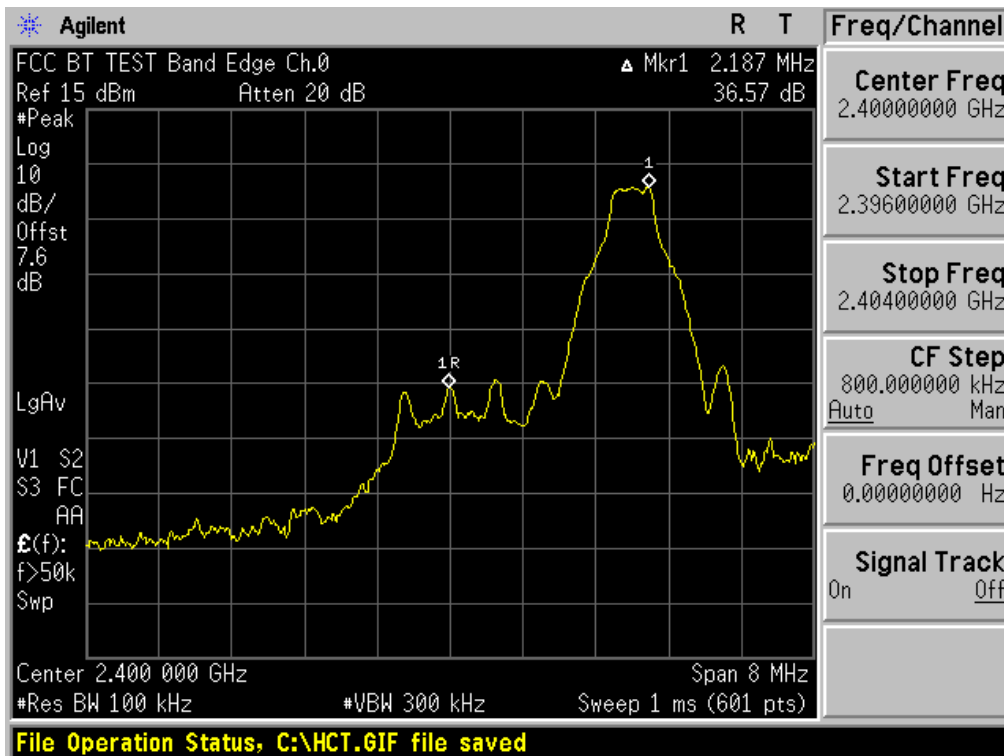
See attached.

Note :

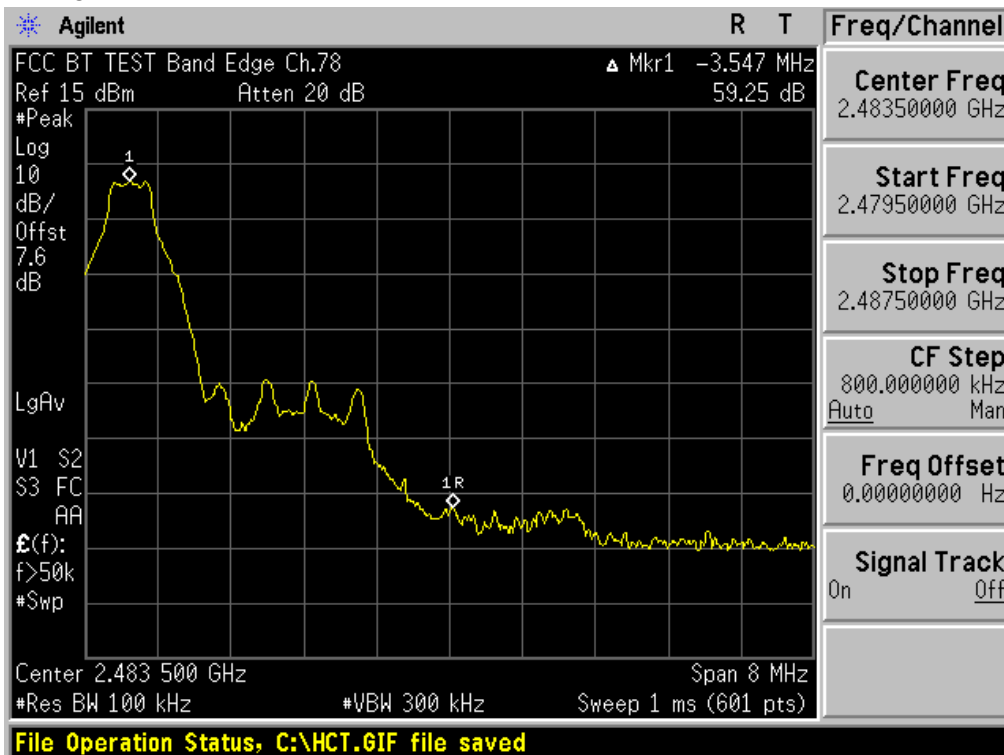
1. The results in plot is already including the actual values of loss for the splitter and cable combination.
2. Spectrum offset = Power Splitter loss + Cable loss
3. We apply to the offset in the 2.4 GHz range that was rounded off to the closest tenth dB. Actual value of loss for the splitter and cable combination is 7.6 dB at 2.4 GHz. We used the particular cable type that is supported by manufacture.

|                                 |                                |                   |                           |  |
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Test Plots without hopping (GFSK)  
Band Edges (Low-CH)

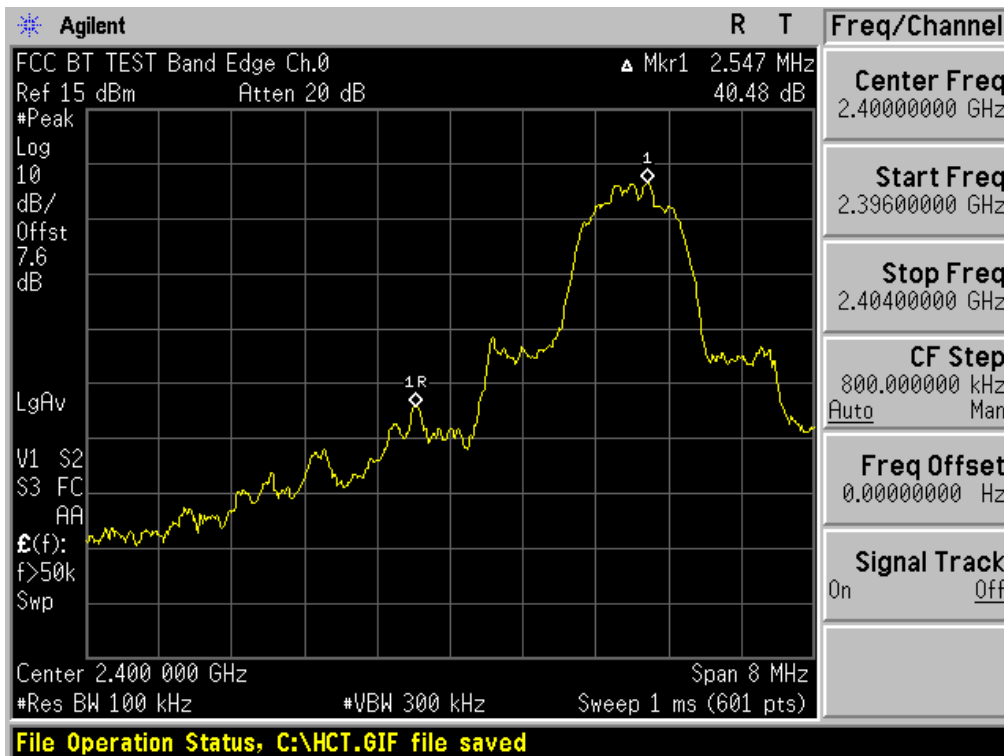


Test Plots without hopping (GFSK)  
Band Edges (High-CH)

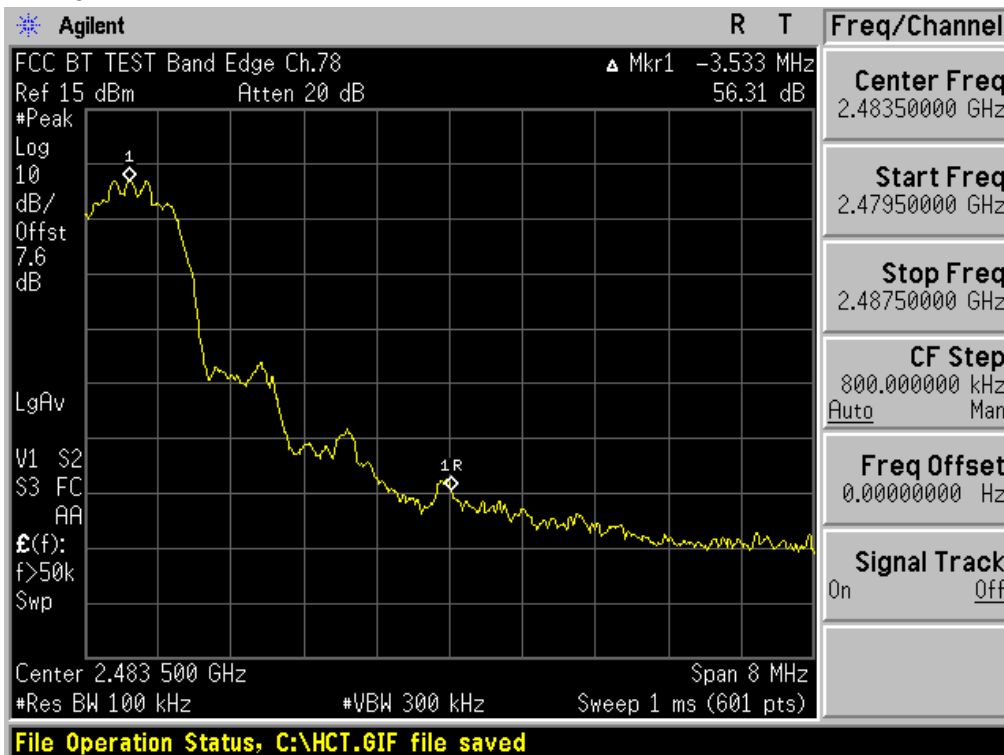




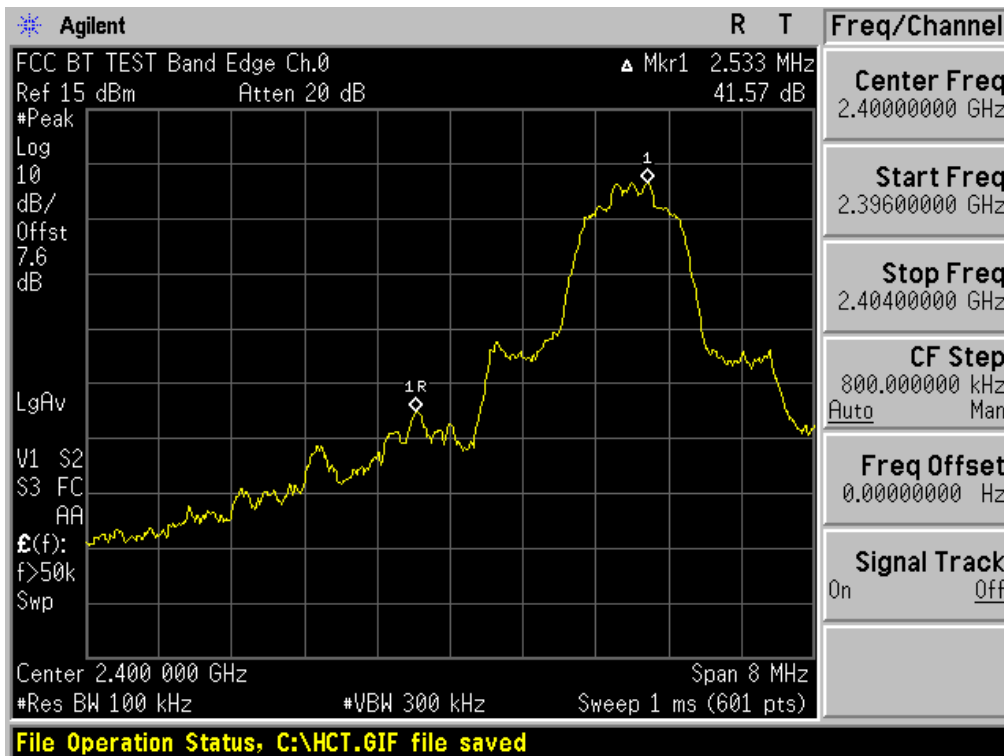
Test Plots without hopping (8DPSK)  
Band Edges (Low-CH)



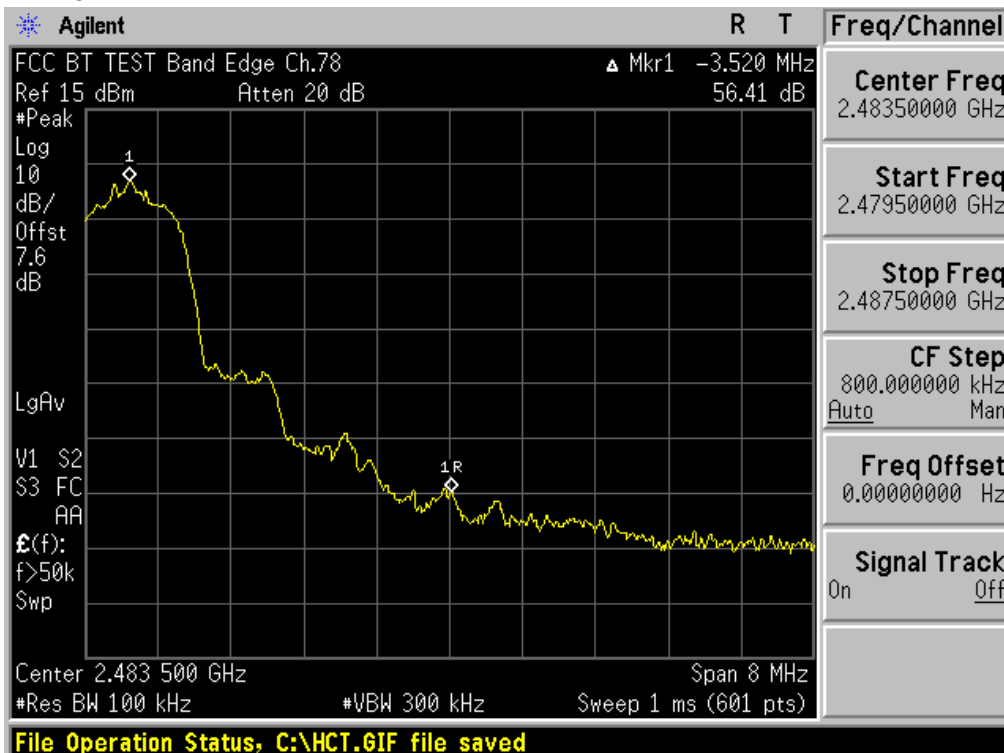
Test Plots without hopping (8DPSK)  
Band Edges (High-CH)



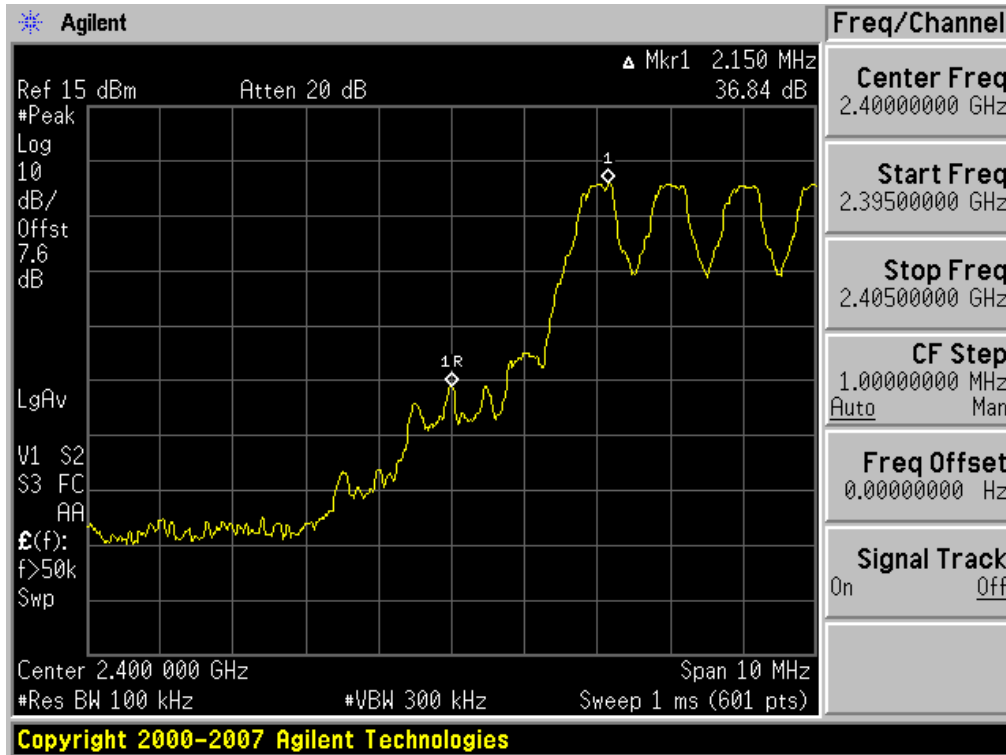
Test Plots without hopping ( $\pi/4$ DQPSK)  
Band Edges (Low-CH)



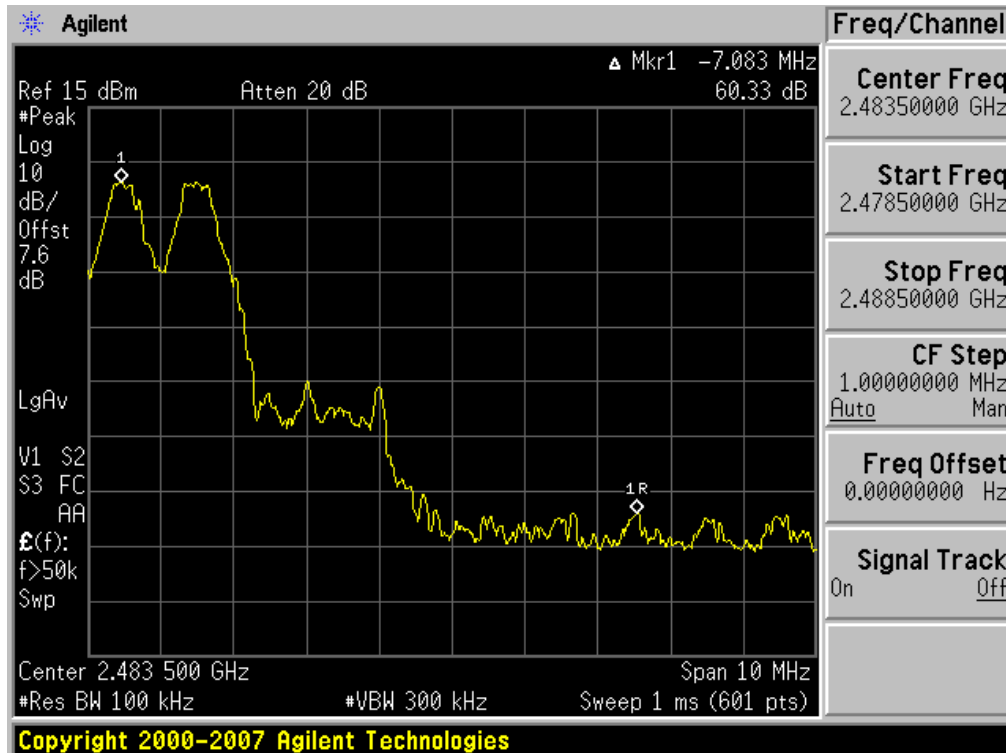
Test Plots without hopping ( $\pi/4$ DQPSK)  
Band Edges (High-CH)



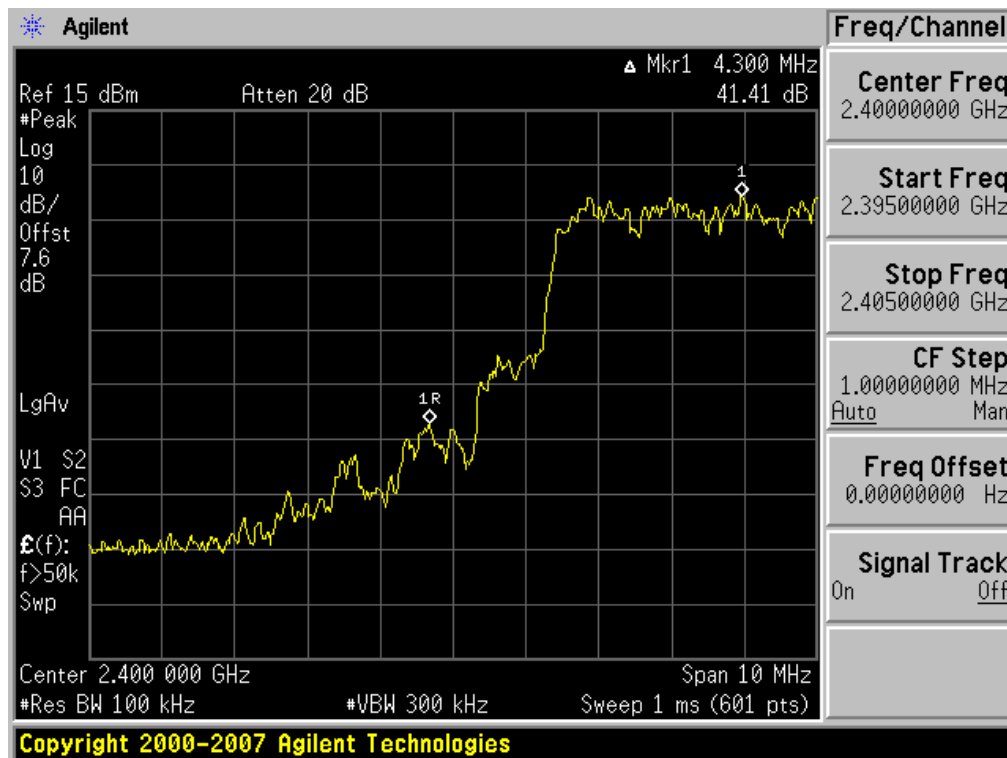
Test Plots with hopping (GFSK)  
Band Edges (Low-CH)



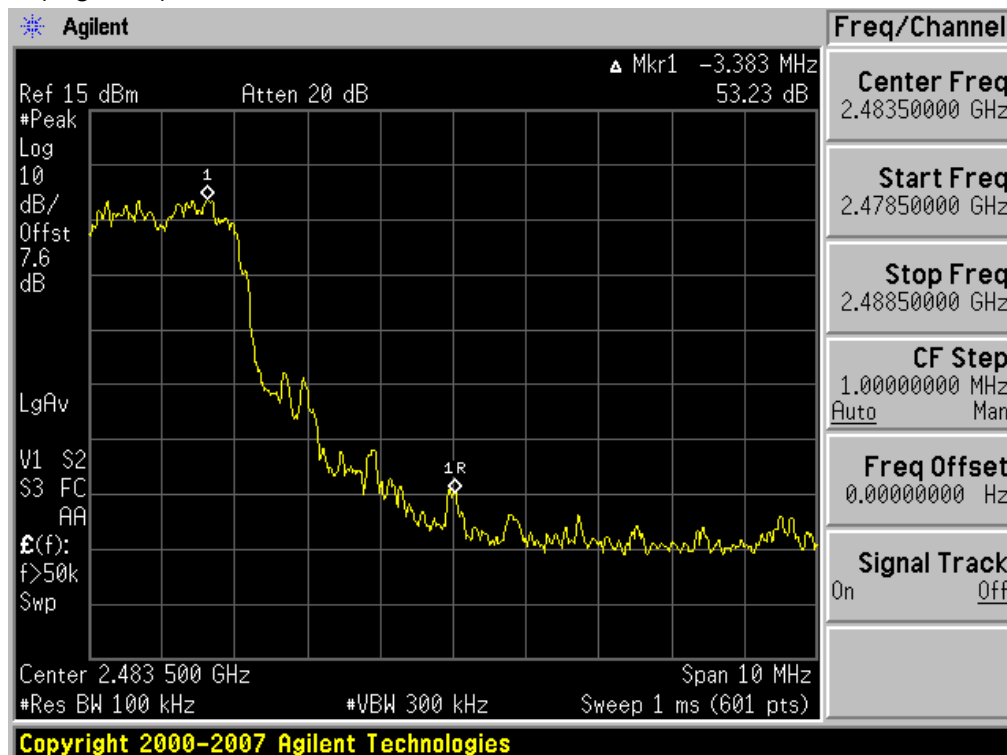
Test Plots with hopping (GFSK)  
Band Edges (High-CH)



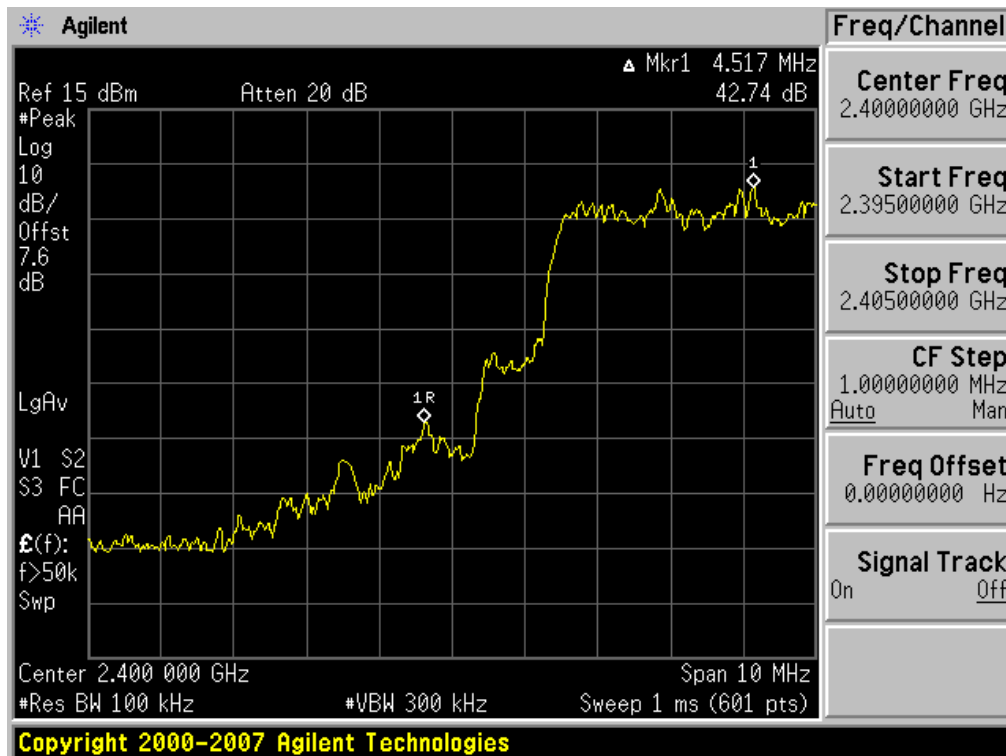
Test Plots with hopping (8DPSK)  
Band Edges (Low-CH)



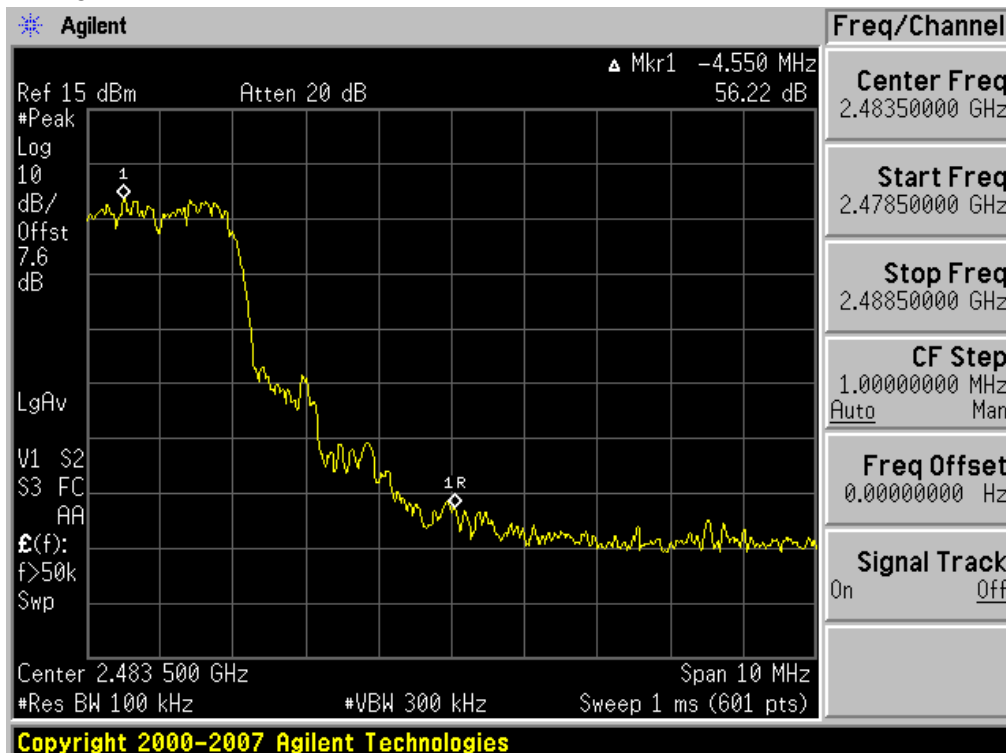
Test Plots with hopping (8DPSK)  
Band Edges (High-CH)



# Test Plots with hopping ( $\pi/4$ DQPSK) Band Edges (Low-CH)



# Test Plots with hopping ( $\pi/4$ DQPSK) Band Edges (High-CH)

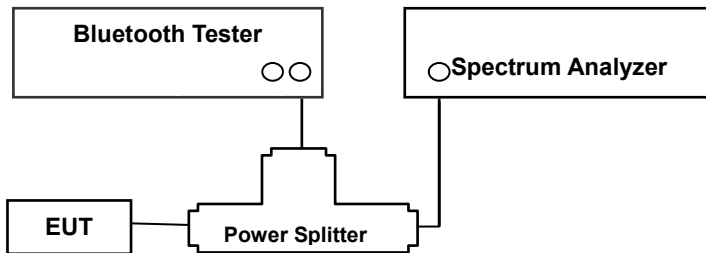


### 8.3 FREQUENCY SEPARATION / OCCUPIED BANDWIDTH (99% BW)

#### LIMIT

According to §15.247(a)(1), 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.

#### Test Configuration



#### TEST PROCEDURE

The Channel Separation test is performed with hopping on. And the 20 dB Bandwidth test is performed with hopping off.

The spectrum analyzer is set to :

1. Span = 3 MHz
2. RBW = 30 kHz
3. VBW = 100 kHz
4. Sweep = auto

The trace was allowed to stabilize. The marker-delta function was used to determine the separation between the peaks of the adjacent channels.

#### TEST RESULTS

No non-compliance noted

#### Test Data

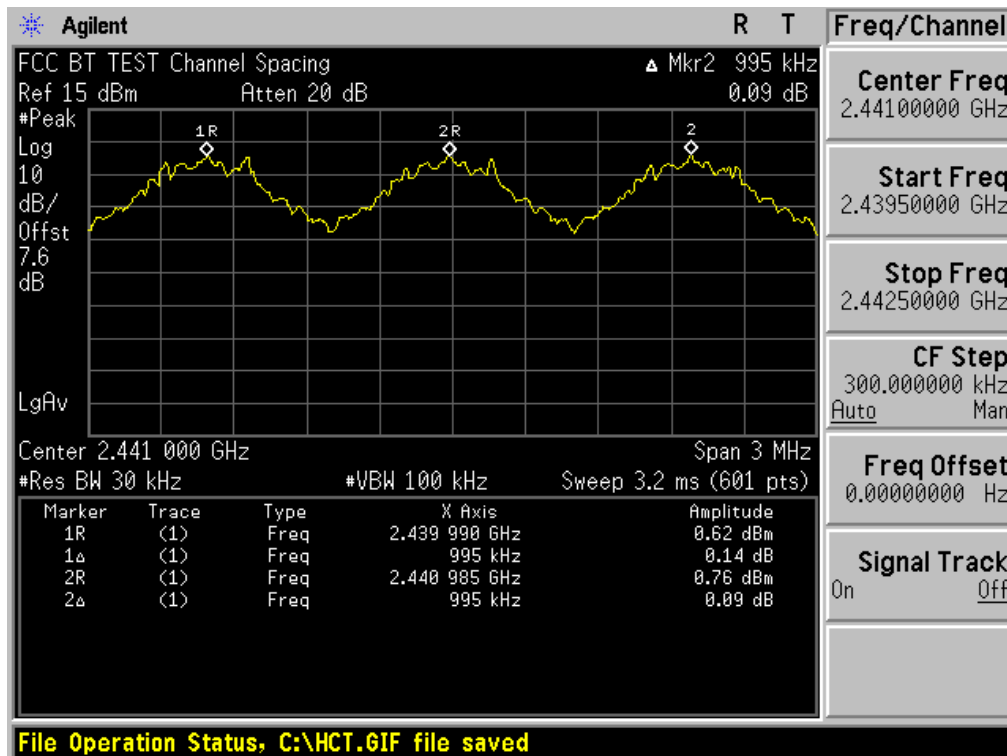
| Channel Separation (kHz) |       |               | 20dB Bandwidth (kHz) |       |        |        | Limit (kHz)                      | Result |
|--------------------------|-------|---------------|----------------------|-------|--------|--------|----------------------------------|--------|
| GFSK                     | 8DPSK | $\pi/4$ DQPSK | Channel              | GFSK  | 8DPSK  | 4DQPSK |                                  |        |
| 995                      | 1005  | 1000          | Low CH               | 933.4 | 1289.0 | 1262.0 | >25 or<br>>2/3 of the<br>20dB BW | Pass   |
|                          |       |               | Middle CH            | 933.2 | 1292.0 | 1265.0 |                                  |        |
|                          |       |               | High CH              | 933.6 | 1269.0 | 1267.0 |                                  |        |

#### Occupied Bandwidth (99% BW )

| 99% BW (kHz) |       |        |        |
|--------------|-------|--------|--------|
| Channel      | GFSK  | 8DPSK  | 4DQPSK |
| Low CH       | 854.1 | 1212.7 | 1198.2 |
| Middle CH    | 853.4 | 1198.6 | 1190.3 |
| High CH      | 854.7 | 1184.6 | 1177.3 |

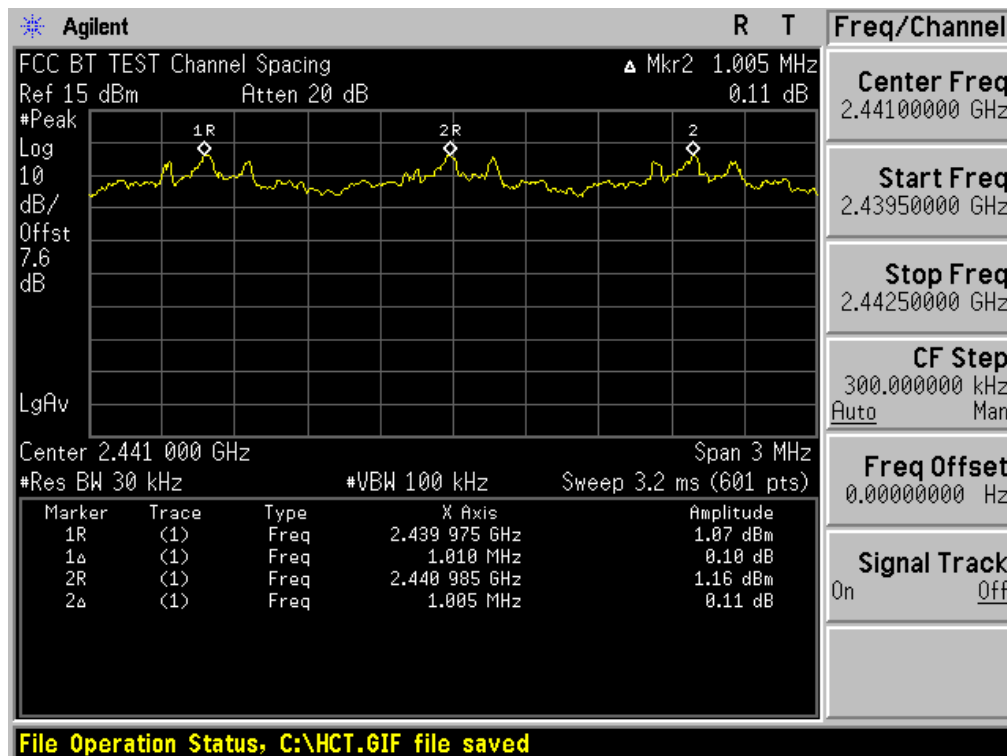
## Test Plots (GFSK)

### Channel Separation



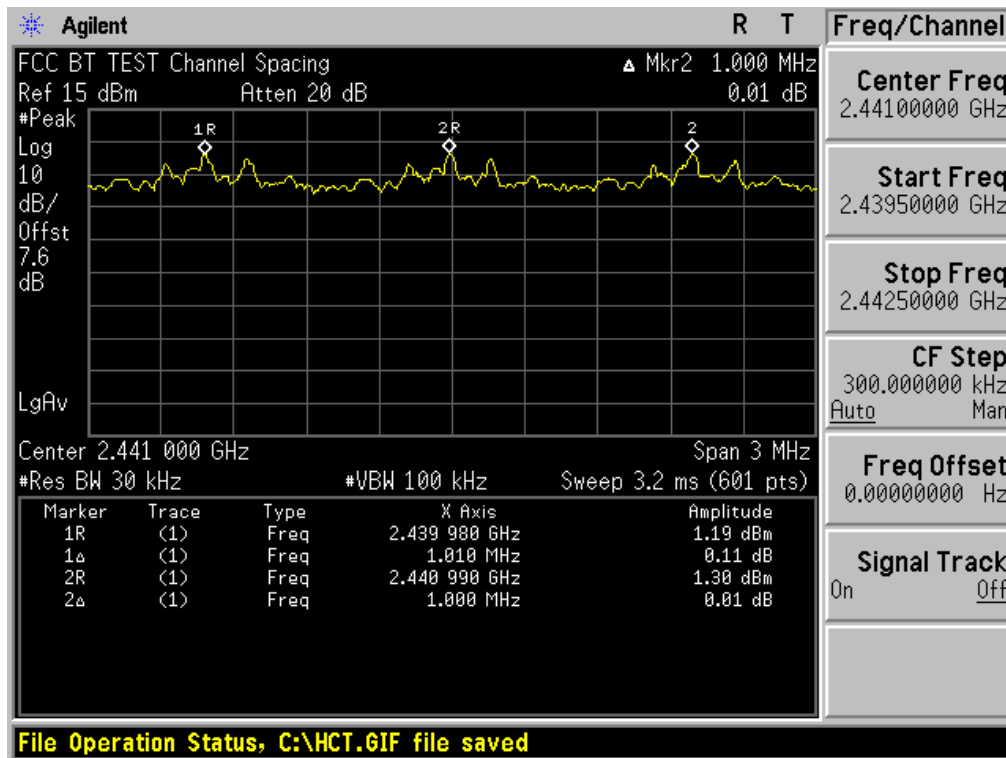
## Test Plots (8DPSK)

### Channel Separation



## Test Plots ( $\pi/4$ DQPSK)

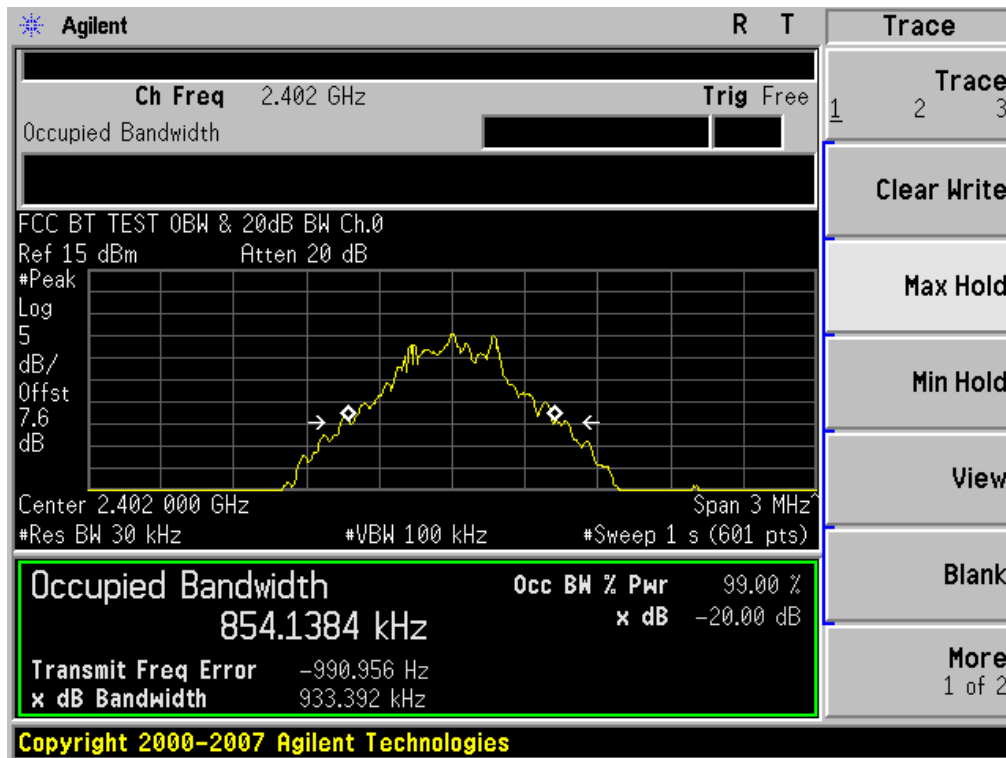
### Channel Separation





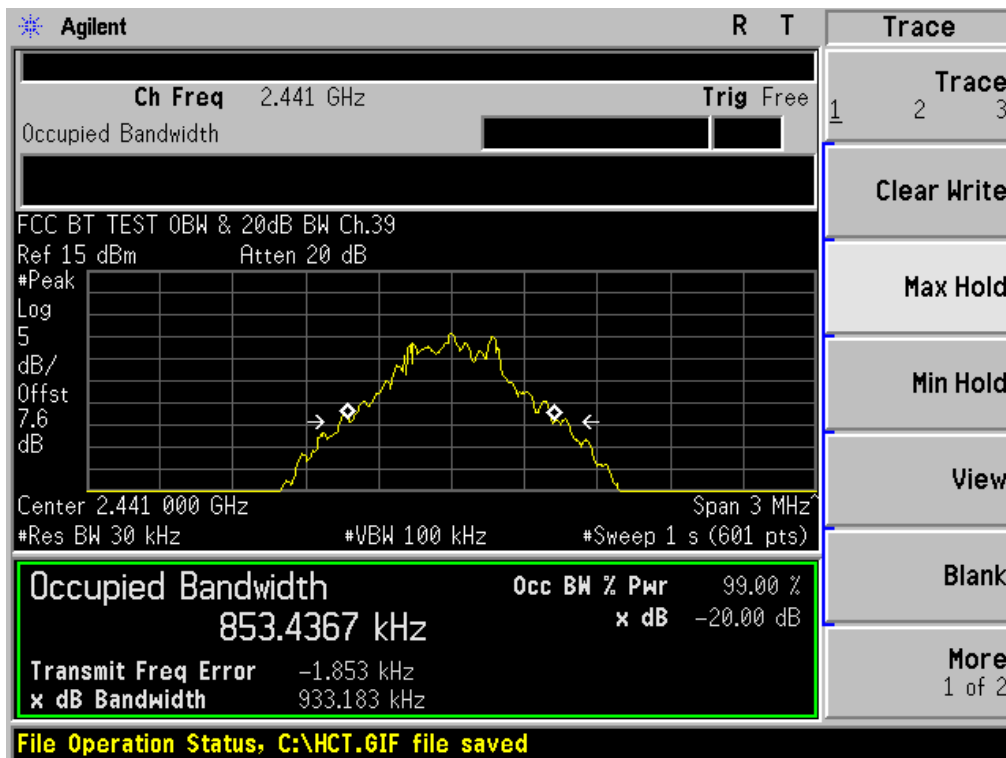
## Test Plots (GFSK)

### 20 dB Bandwidth & Occupied Bandwidth (Low-CH)



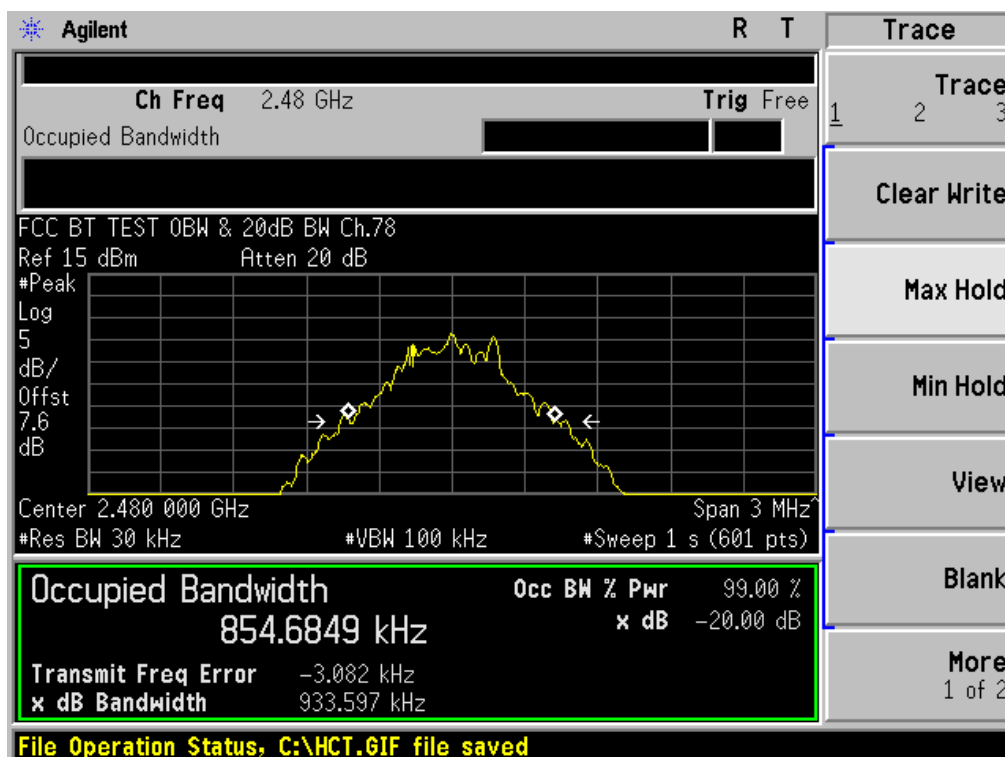
## Test Plots (GFSK)

### 20 dB Bandwidth & Occupied Bandwidth (Mid-CH)



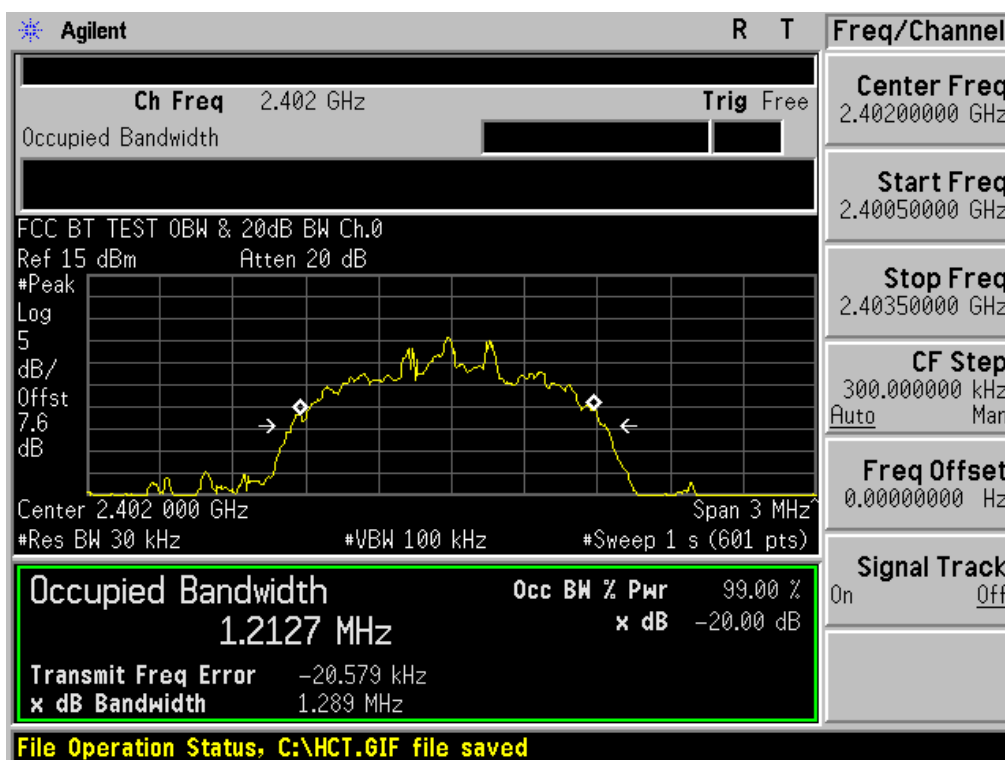
## Test Plots (GFSK)

### 20 dB Bandwidth & Occupied Bandwidth (High-CH)



## Test Plots (8DPSK)

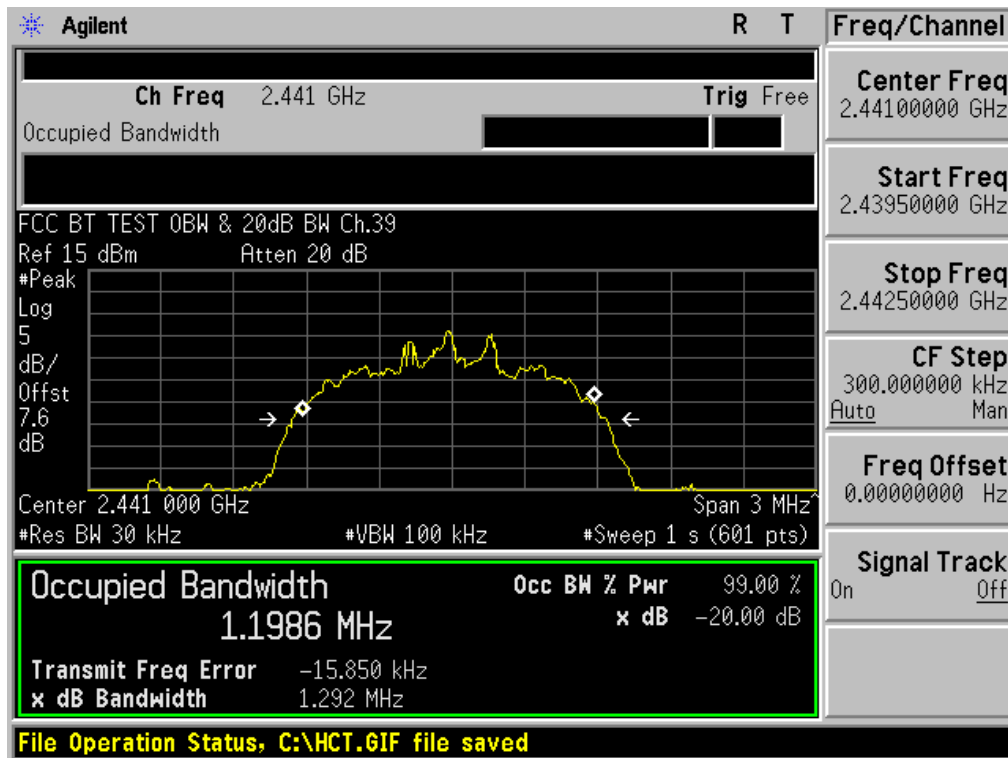
### 20 dB Bandwidth & Occupied Bandwidth (Low-CH)



|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

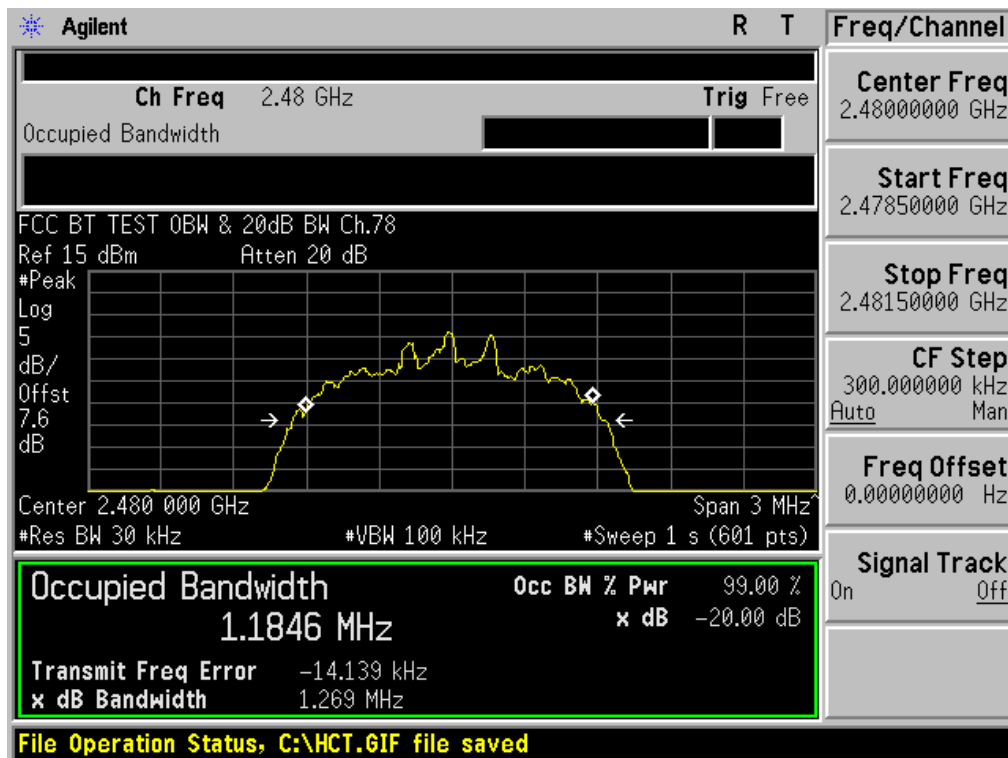
## Test Plots (8DPSK)

### 20 dB Bandwidth & Occupied Bandwidth (Mid-CH)



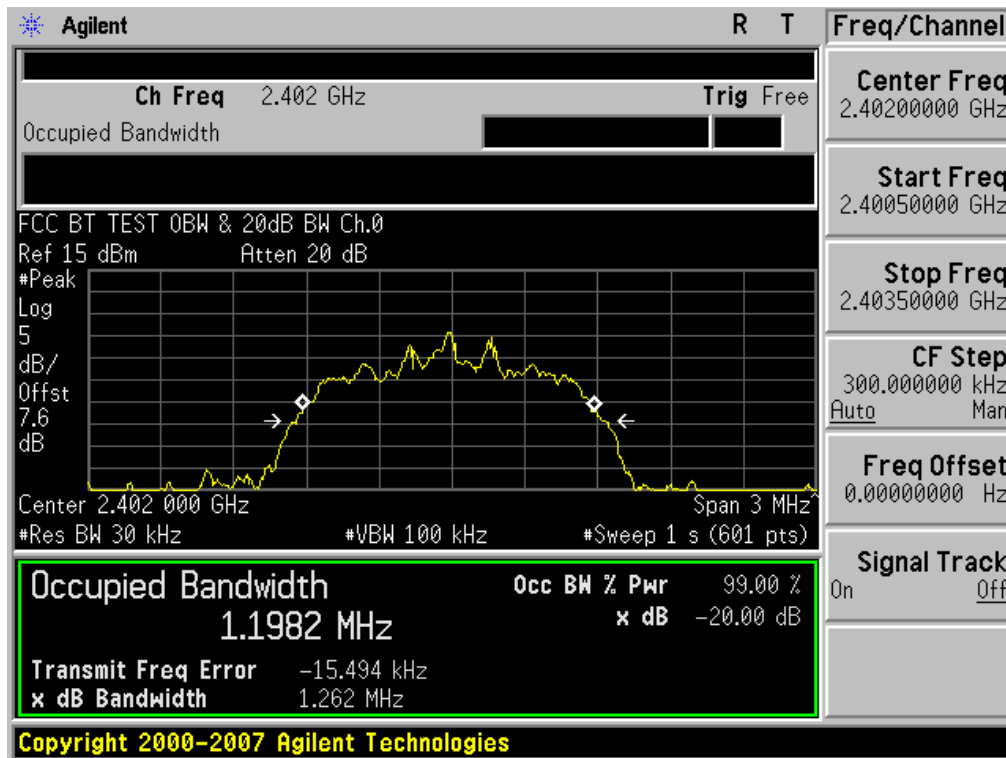
## Test Plots (8DPSK)

### 20 dB Bandwidth & Occupied Bandwidth (High-CH)



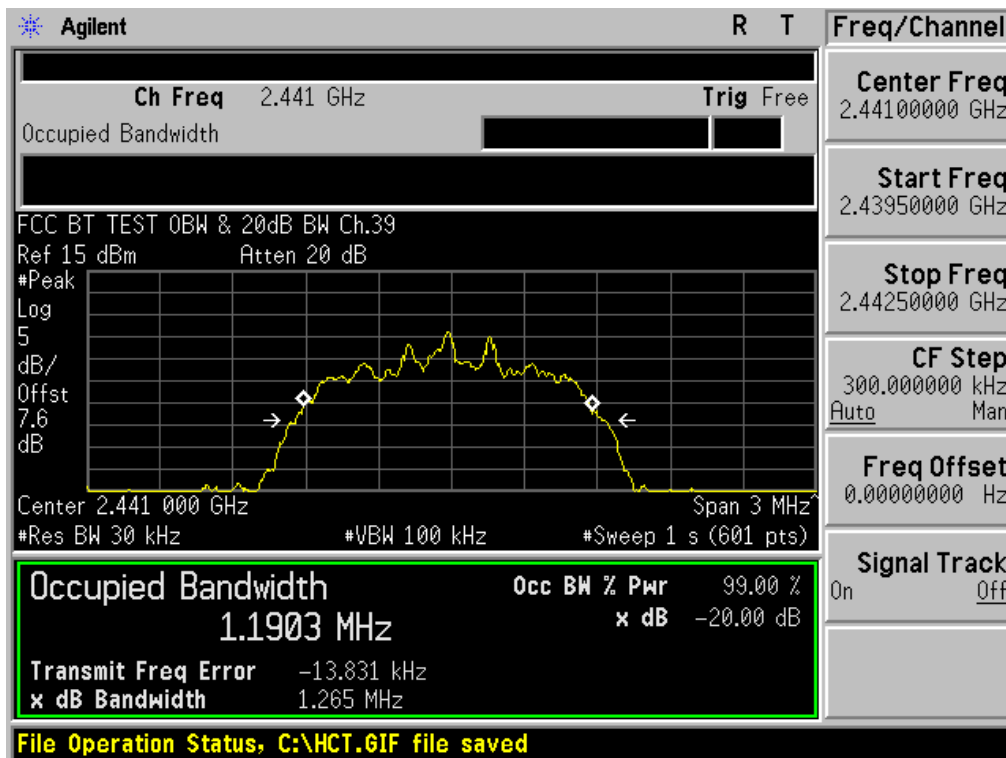
### Test Plots ( $\pi/4$ DQPSK)

#### 20 dB Bandwidth & Occupied Bandwidth (Low-CH)



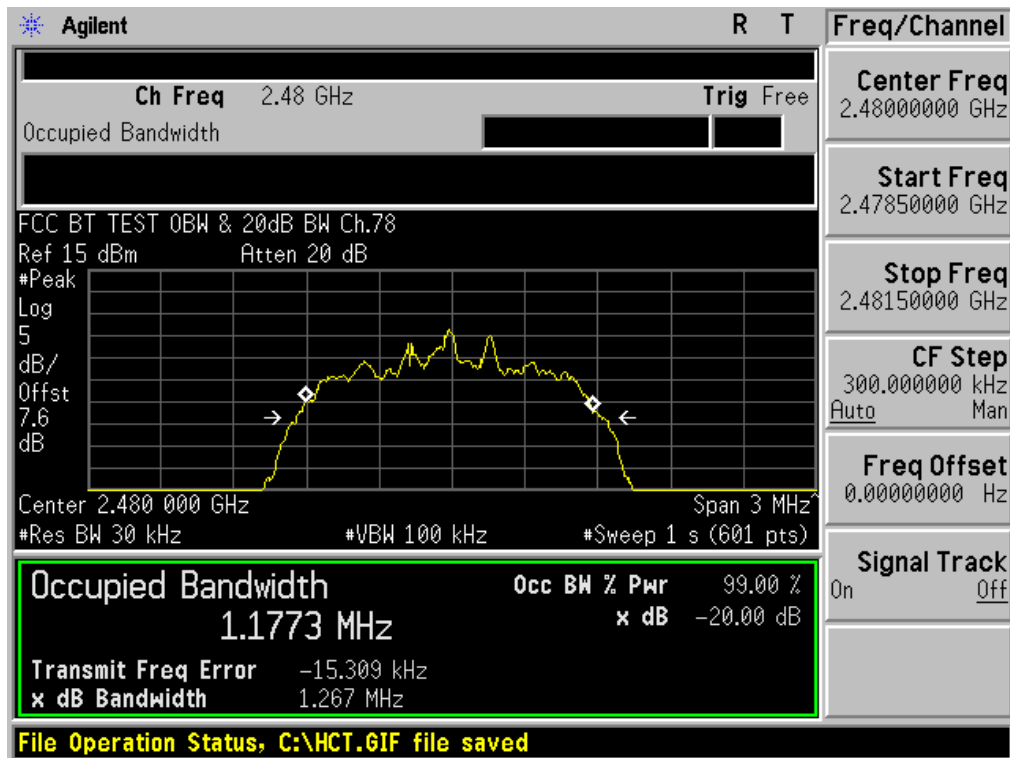
### Test Plots ( $\pi/4$ DQPSK)

#### 20 dB Bandwidth & Occupied Bandwidth (Mid-CH)



# Test Plots ( $\pi/4$ DQPSK)

## 20 B Bandwidth & Occupied Bandwidth (High-CH)

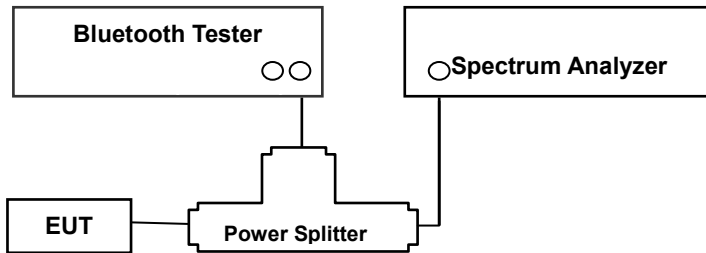


## 8.4 NUMBER OF HOPPING FREQUENCY

### LIMIT

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

### Test Configuration



### TEST PROCEDURE

The Bluetooth frequency hopping function of the EUT was enabled. The spectrum analyzer was set to :

1. Span = the frequency band of operation ( Start = 2400 MHz, Stop = 2483.5 MHz )
2. RBW = 300 kHz
3. VBW = 300 kHz
4. Sweep = auto

The trace was allowed to stabilize.

### TEST RESULTS

No non-compliance noted

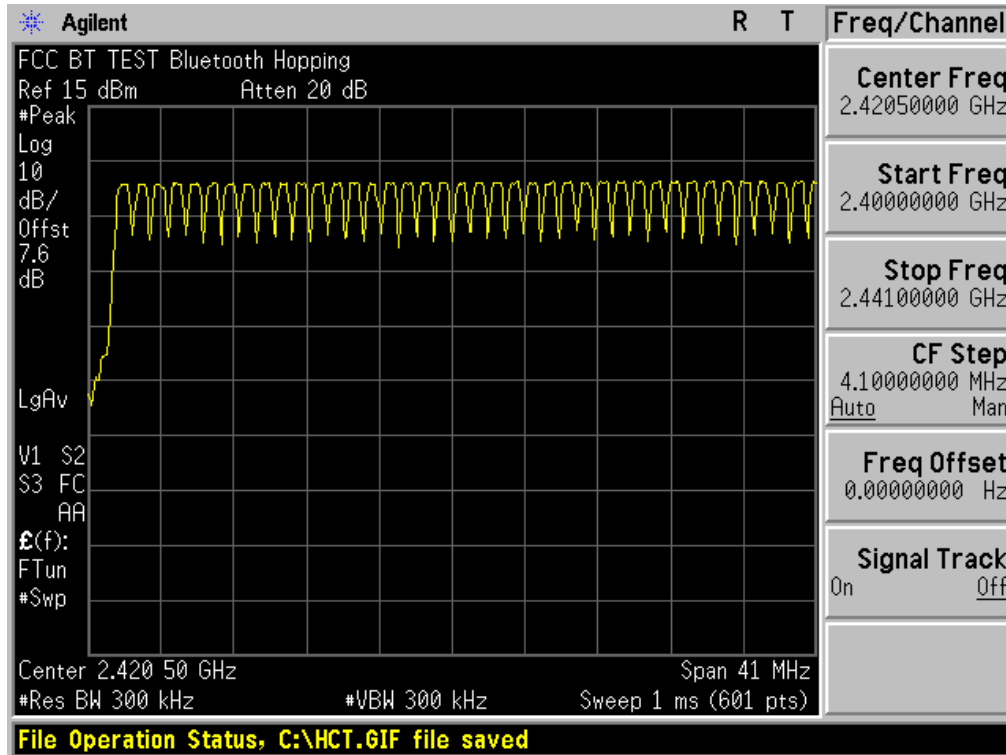
### Test Data

| Result (No. of CH) |       |               | Limit | Result |
|--------------------|-------|---------------|-------|--------|
| GFSK               | 8DPSK | $\pi/4$ DQPSK |       |        |
| 79                 | 79    | 79            | >15   | Pass   |

**Note :** In case of AFH mode, minimum number of hopping channels is 20.

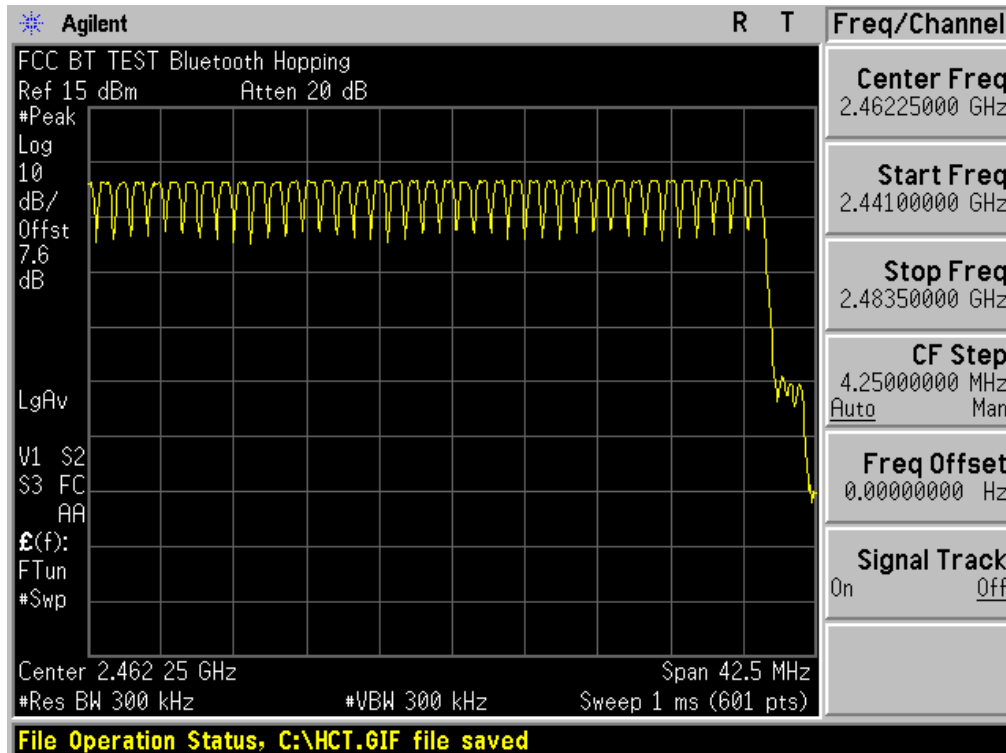
## Test Plots (GFSK)

Number of Channels (2.4 GHz - 2.441 GHz)



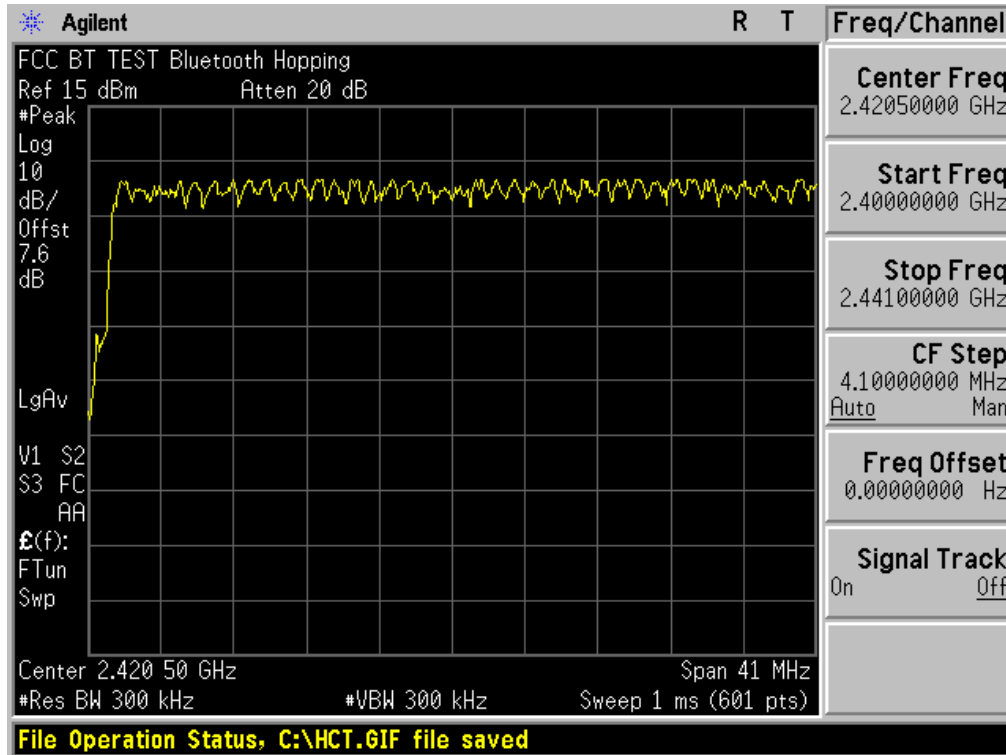
## Test Plots (GFSK)

Number of Channels (2.441 GHz - 2.4835 GHz)



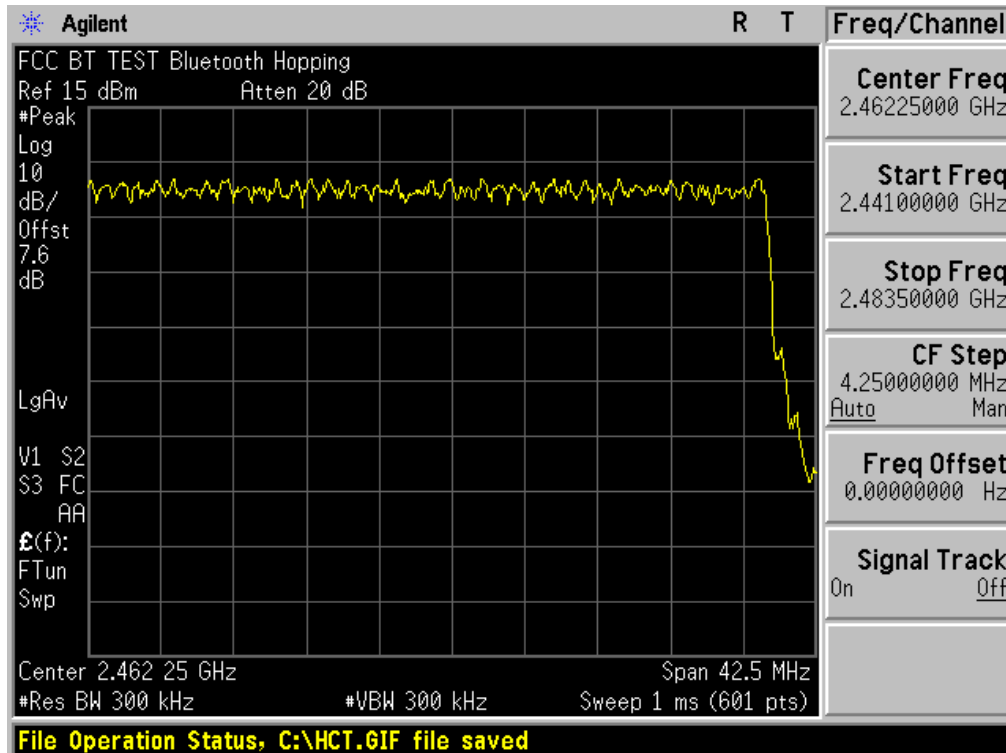
### Test Plots (8DPSK)

Number of Channels (2.4 GHz - 2.441 GHz)



### Test Plots (8DPSK)

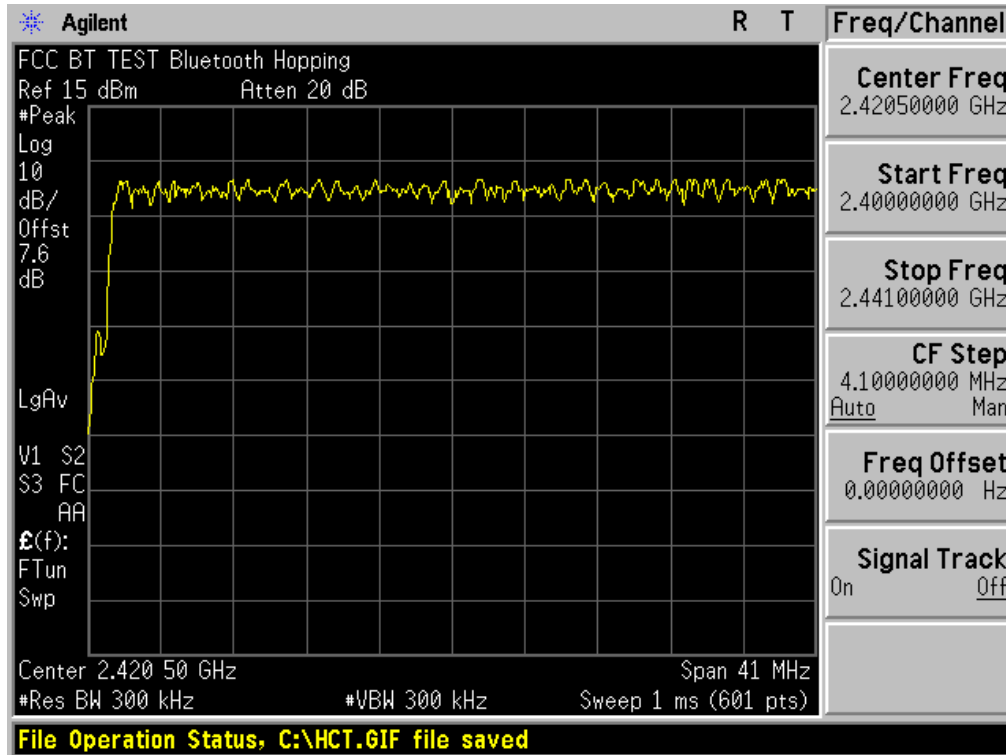
Number of Channels (2.441 GHz - 2.4835 GHz)





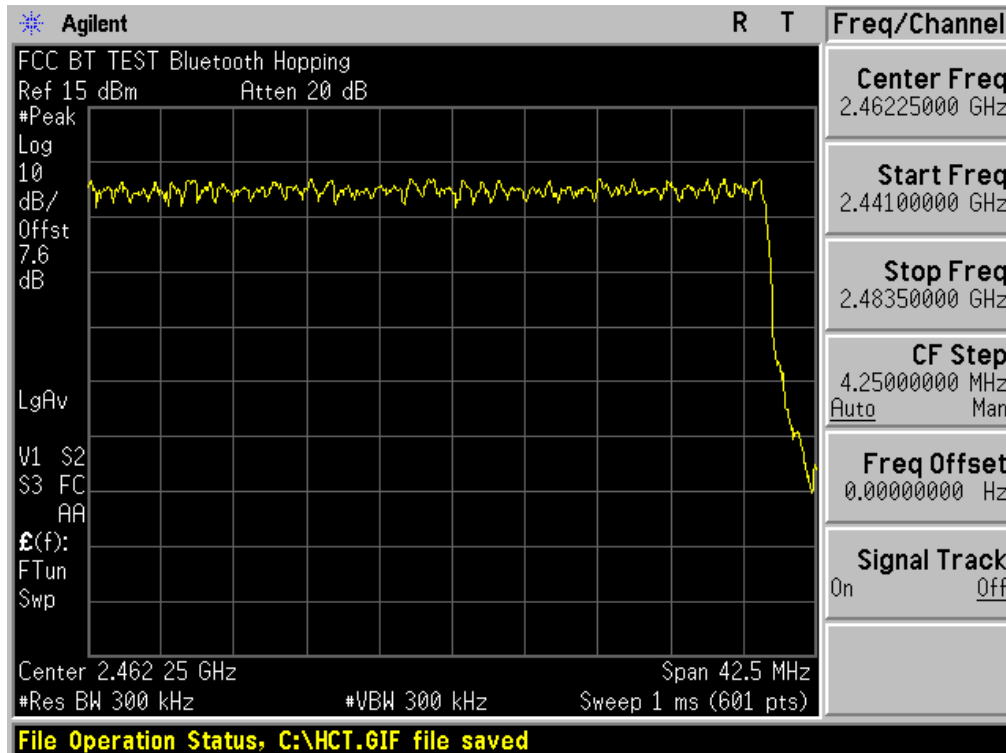
Test Plots ( $\pi/4$ DQPSK)

Number of Channels (2.4 GHz - 2.441 GHz)



Test Plots ( $\pi/4$ DQPSK)

Number of Channels (2.441 GHz - 2.4835 GHz)



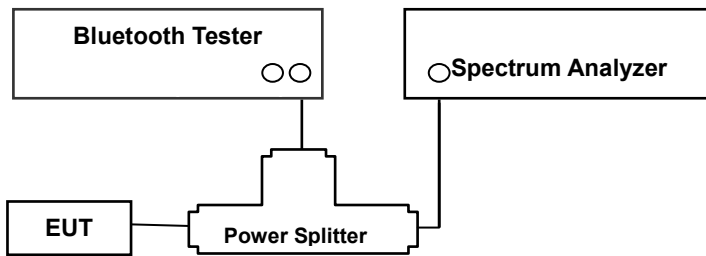
|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

## 8.5 TIME OF OCCUPANCY (DWELL TIME)

### LIMIT

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

### Test Configuration



### TEST PROCEDURE

This test is performed with hopping off.

EUT was set to transmit the longest packet type (DH5)

1. Span = zero span
2. RBW = 1 MHz
3. VBW = 1 MHz
4. Sweep = as necessary to capture the entire dwell time per channel

The marker-delta function was used to determine the dwell time.

#### Normal Mode / EDR Mode

**DH 5**(The longest packet type for GFSK)

CH Mid :  $2.900 * (1600/6)/79 * 31.6 = 309.33 \text{ (ms)}$

**2-DH 5**(The longest packet type for  $\pi/4$ DQPSK)

CH Mid :  $2.908 * (1600/6)/79 * 31.6 = 310.19 \text{ (ms)}$

**3-DH 5**(The longest packet type for 8DPSK)

CH Mid :  $2.917 * (1600/6)/79 * 31.6 = 311.15 \text{ (ms)}$

#### AFH Mode

**DH 5**(The longest packet type for GFSK)

CH Mid :  $2.900 * (1600/6)/20 * 8.0 = 309.33 \text{ (ms)}$

**2-DH 5**(The longest packet type for  $\pi/4$ DQPSK)

CH Mid :  $2.908 * (1600/6)/20 * 8.0 = 310.19 \text{ (ms)}$

**3-DH 5**(The longest packet type for 8DPSK)

CH Mid :  $2.917 * (1600/6)/20 * 8.0 = 311.15 \text{ (ms)}$

| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

Note :

A DH5 Packet need 5 time slot for transmitting and 1 time slot for receiving. Then the system makes worst case 1600/6 hops per second with 79 channels. So the system have each channel 3.3755 times per second and so for 31.6 seconds the system have 106.7 times of appearance.

Each tx-time per appearance of DH5 is 2.883 ms.

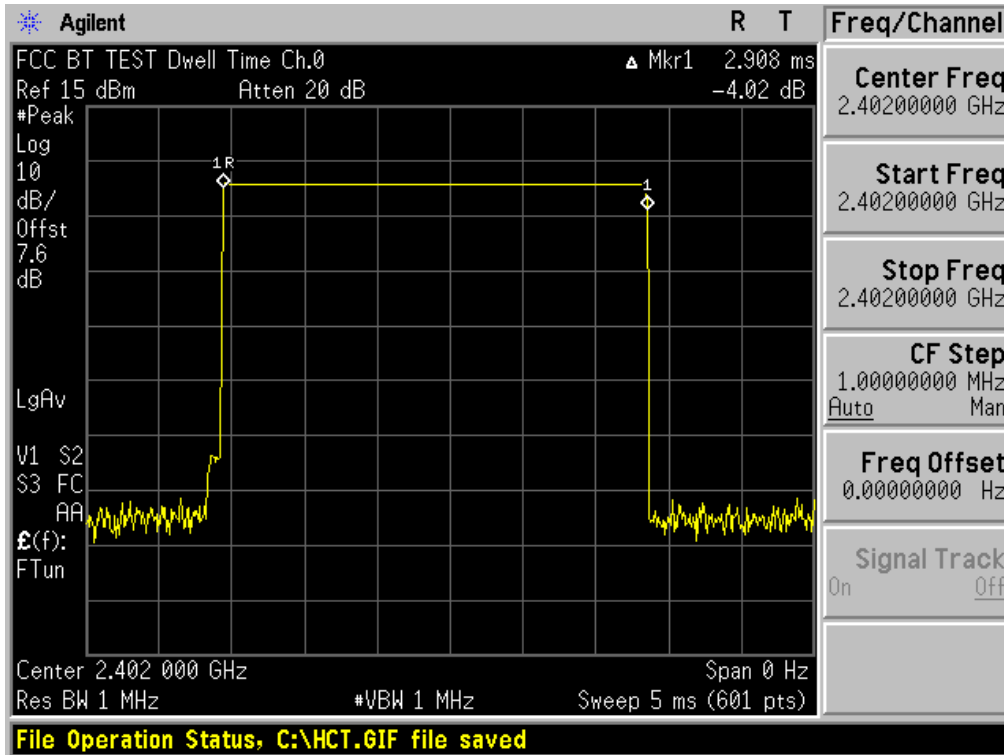
Dwell time = Tx-time \* 106.7

## TEST RESULTS

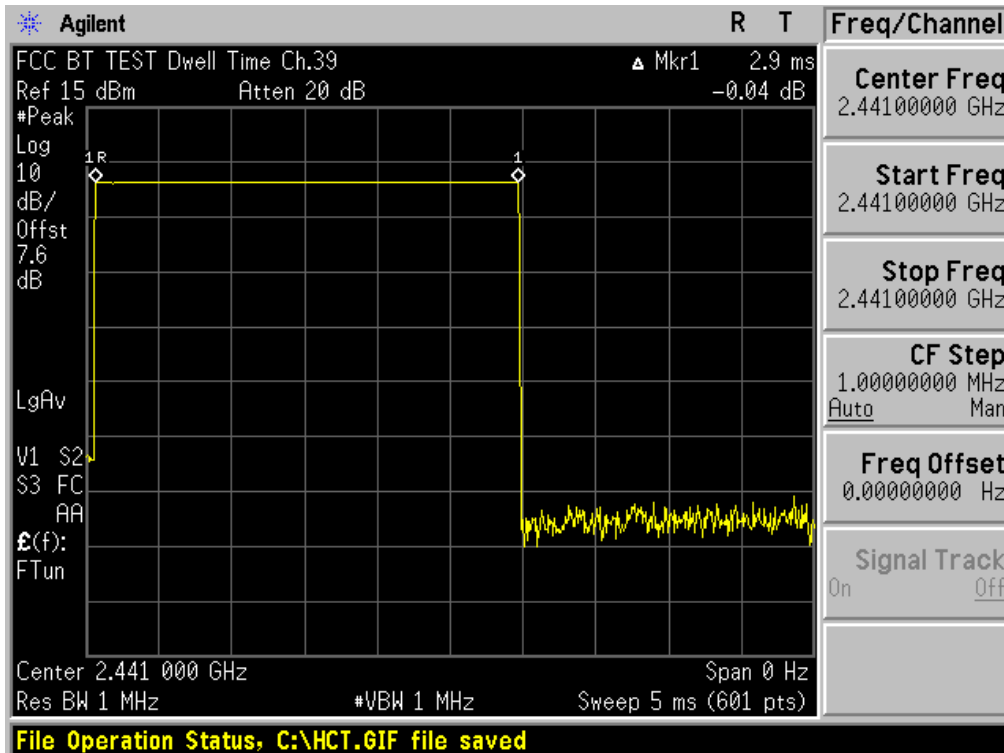
See the table.

| Channel | Pulse Time (ms) |       |               | Total of Dwell (ms) |        |               | Period Time (s) | Limit (ms) | Result |
|---------|-----------------|-------|---------------|---------------------|--------|---------------|-----------------|------------|--------|
|         | GFSK            | 8DPSK | $\pi/4$ DQPSK | GFSK                | 8DPSK  | $\pi/4$ DQPSK |                 |            |        |
| Low     | 2.908           | 2.908 | 2.908         | 310.19              | 310.19 | 310.19        | 31.6            | 400        | PASS   |
| Mid     | 2.900           | 2.917 | 2.908         | 309.33              | 311.15 | 310.19        | 31.6            |            | PASS   |
| High    | 2.900           | 2.908 | 2.908         | 309.33              | 310.19 | 310.19        | 31.6            |            | PASS   |

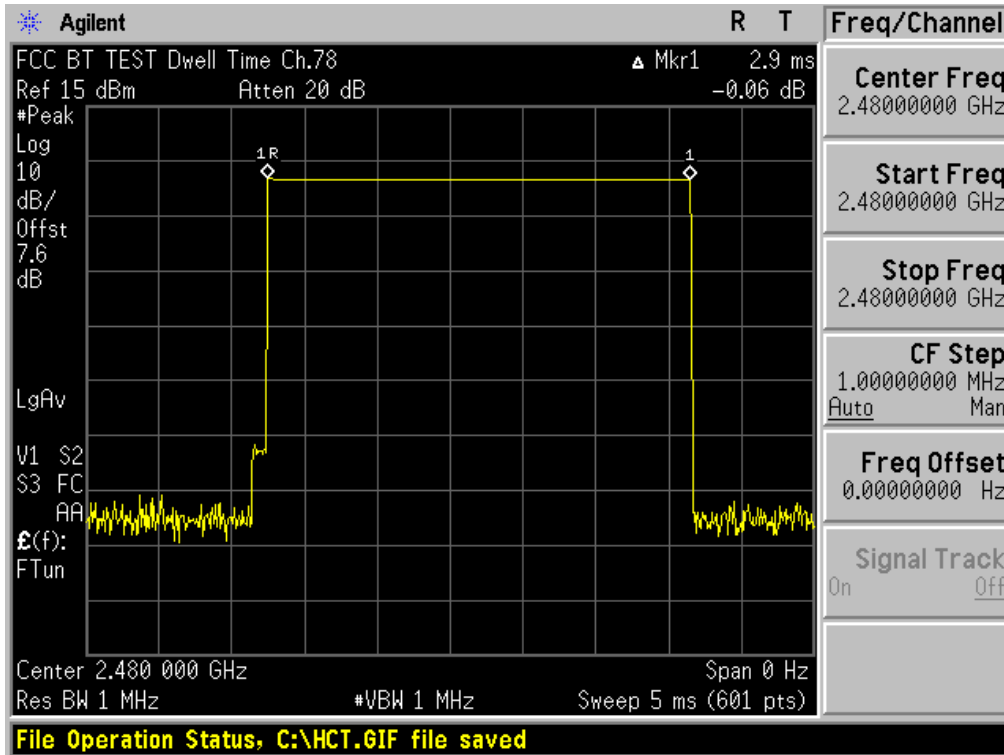
Test Plots (GFSK)  
Dwell Time (Low-CH)



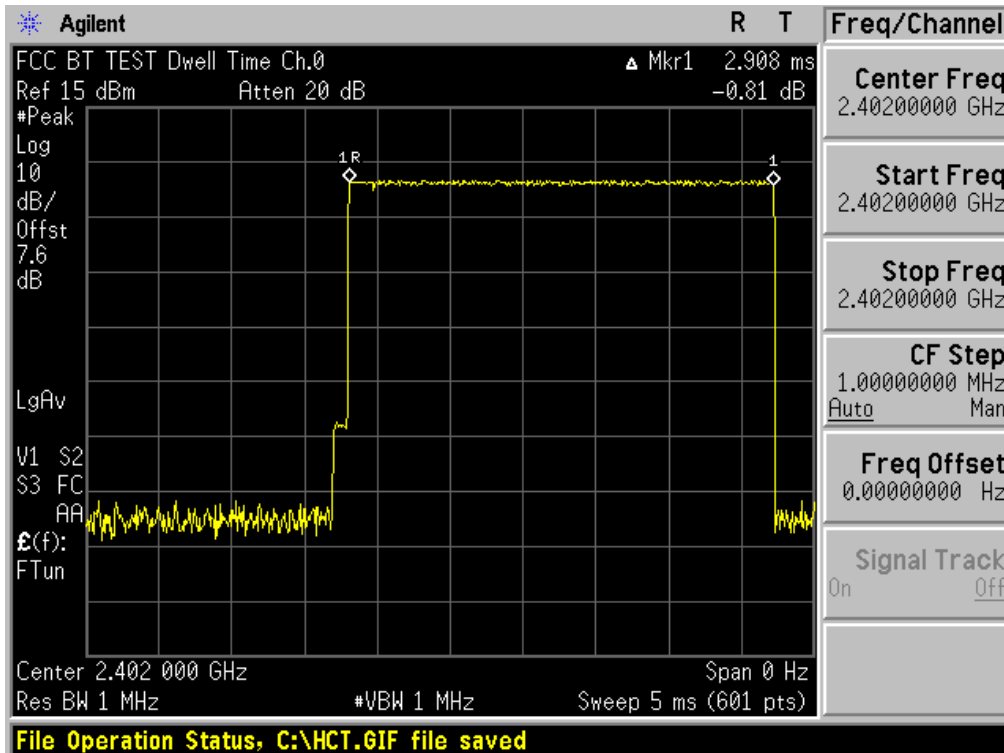
Test Plots (GFSK)  
Dwell Time (Mid-CH)



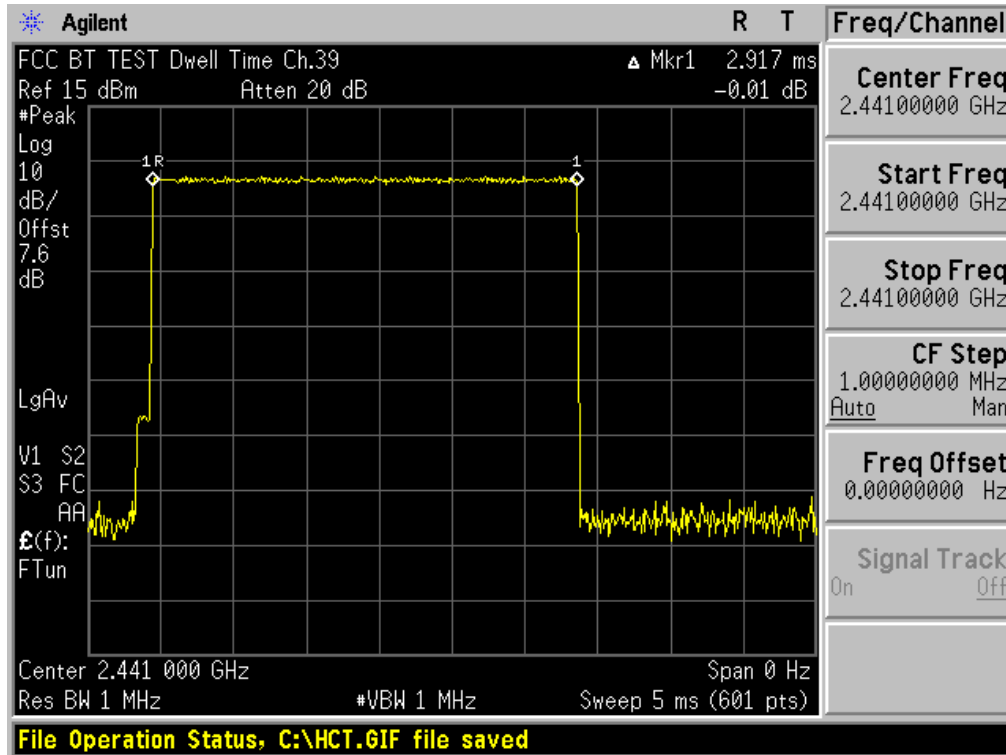
Test Plots (GFSK)  
Dwell Time (High-CH)



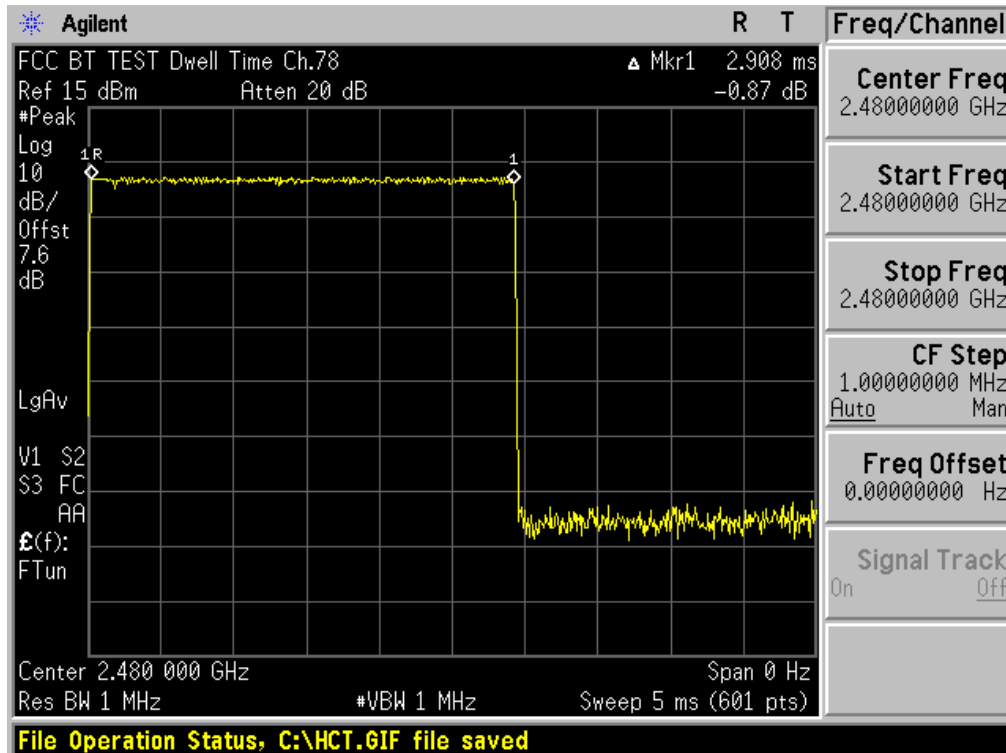
Test Plots (8DPSK)  
Dwell Time (Low-CH)



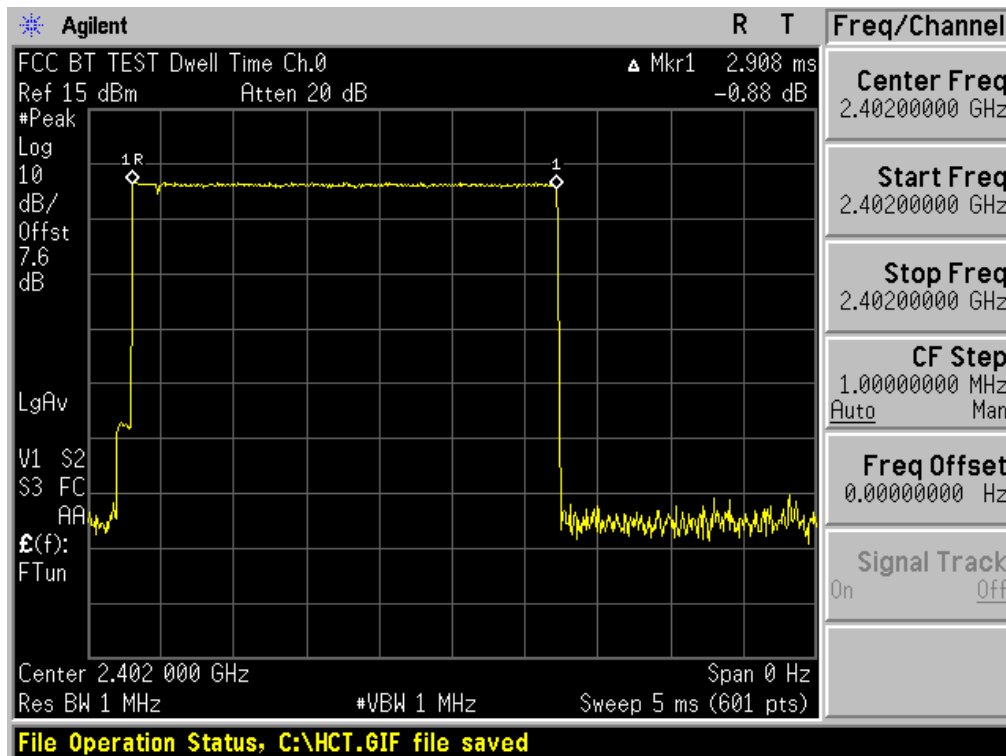
Test Plots (8DPSK)  
Dwell Time (Mid-CH)



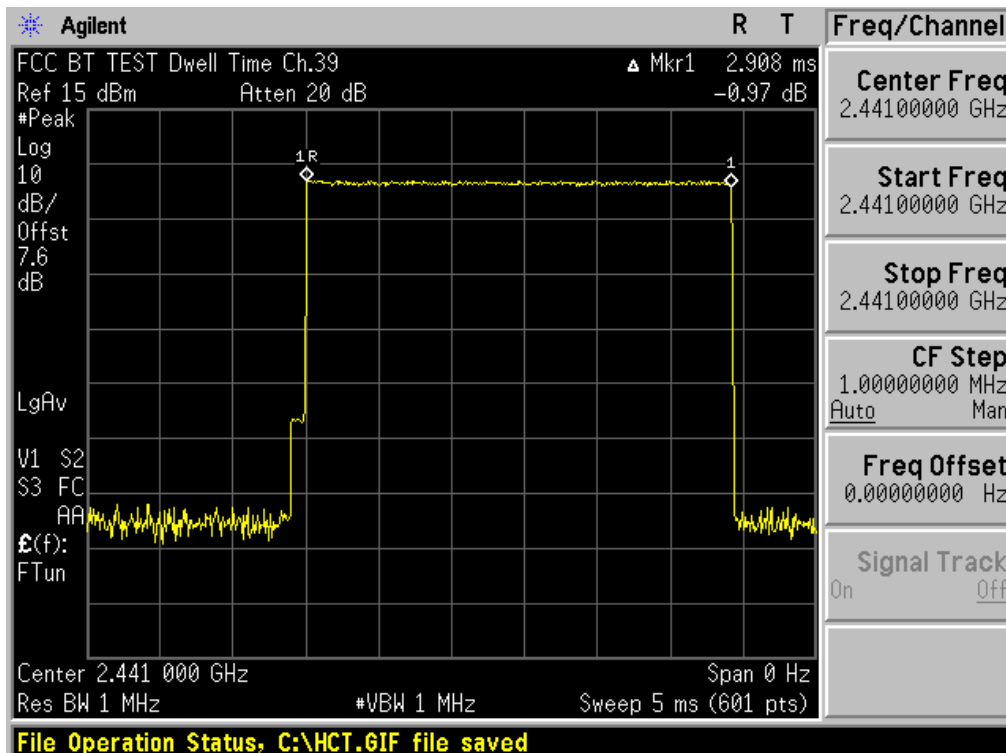
Test Plots (8DPSK)  
Dwell Time (High-CH)



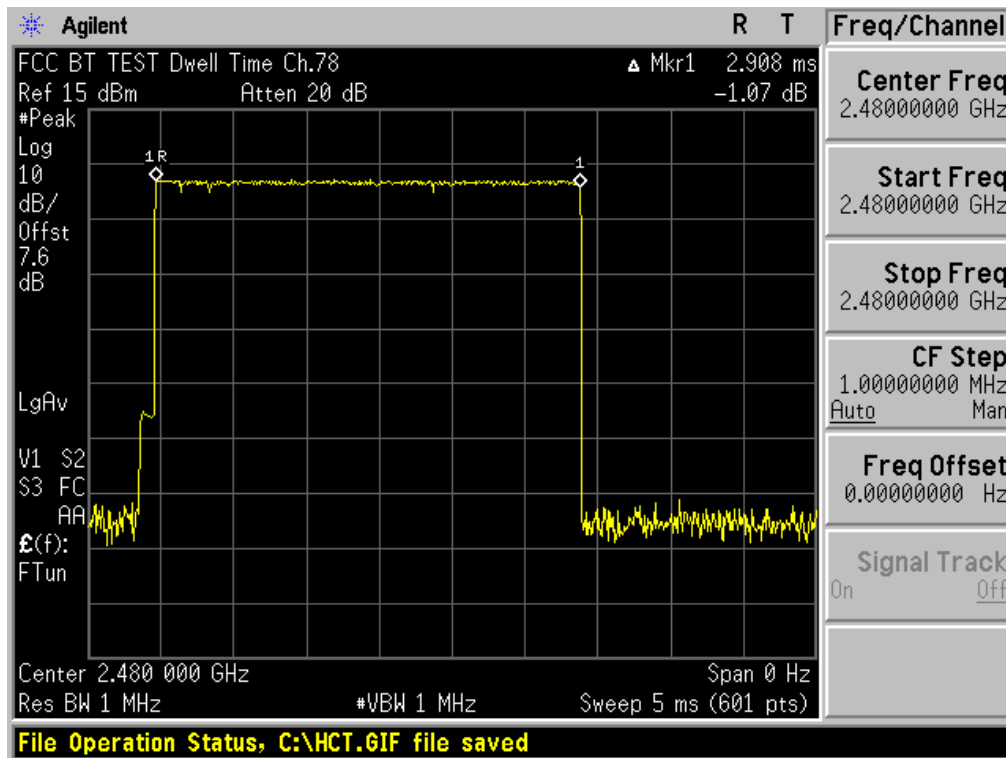
Test Plots ( $\pi/4$ DQPSK)  
Dwell Time (Low-CH)



Test Plots ( $\pi/4$ DQPSK)  
Dwell Time (Mid-CH)



Test Plots ( $\pi/4$ DQPSK)  
Dwell Time (High-CH)



|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |



## 8.6 SPURIOUS EMISSIONS

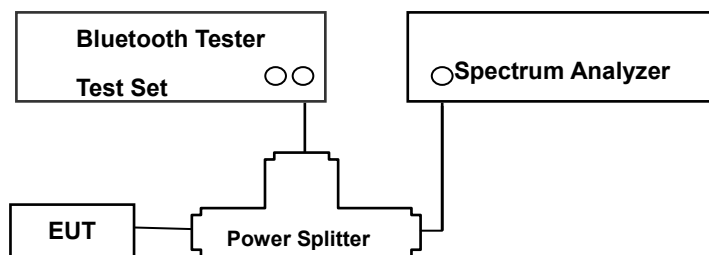
### 8.6.1 CONDUCTED SPURIOUS EMISSIONS

#### Test Requirements and limit, §15.247(d)

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. 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)).

**Limit : 20 dBc**

#### Test Configuration



## TEST PROCEDURE

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

Detector Mode is set to a peak detector Mode.

Measurements are made over the 30 MHz to 26 GHz range with the transmitter set to the lowest, middle, and highest channels.

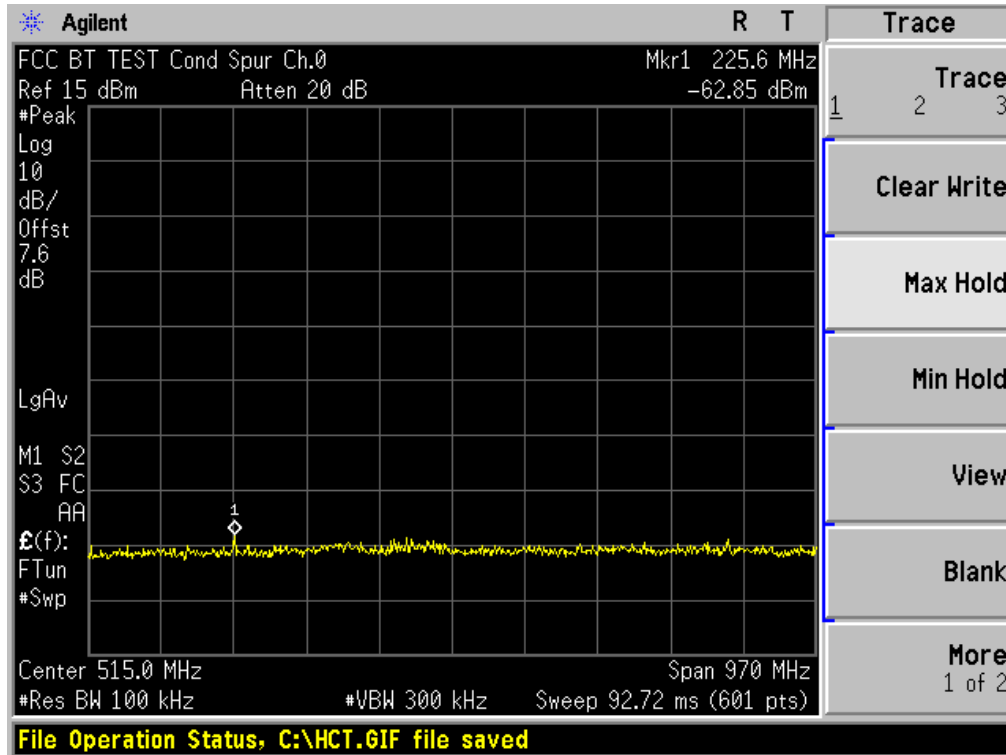
This test is performed with hopping off.

## TEST RESULTS

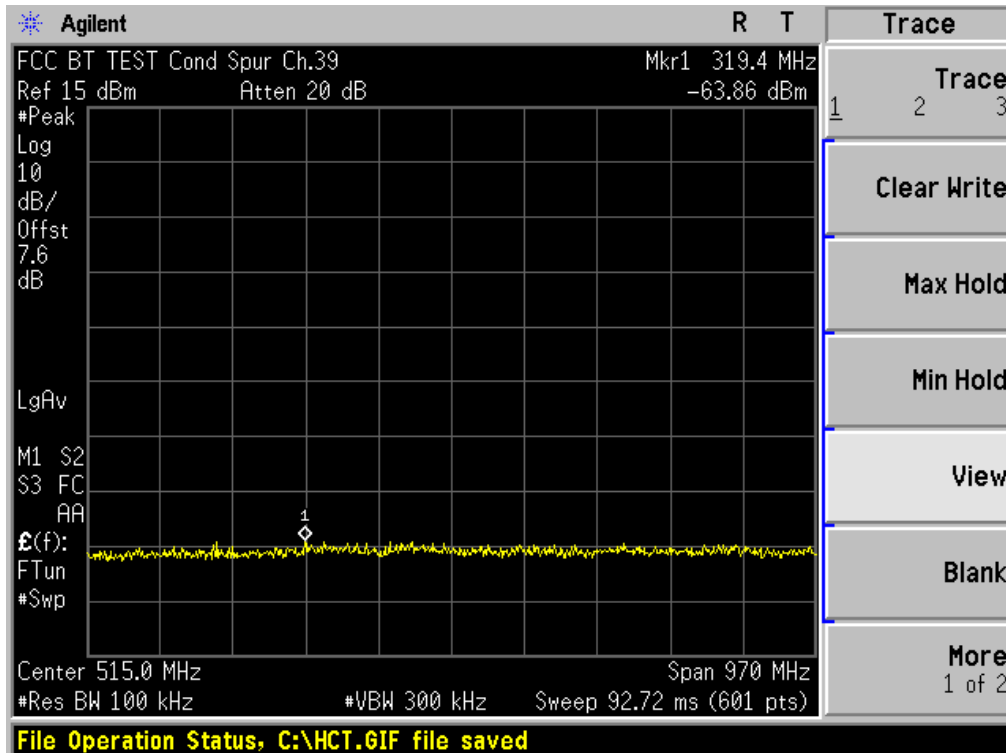
No non-compliance noted.

| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

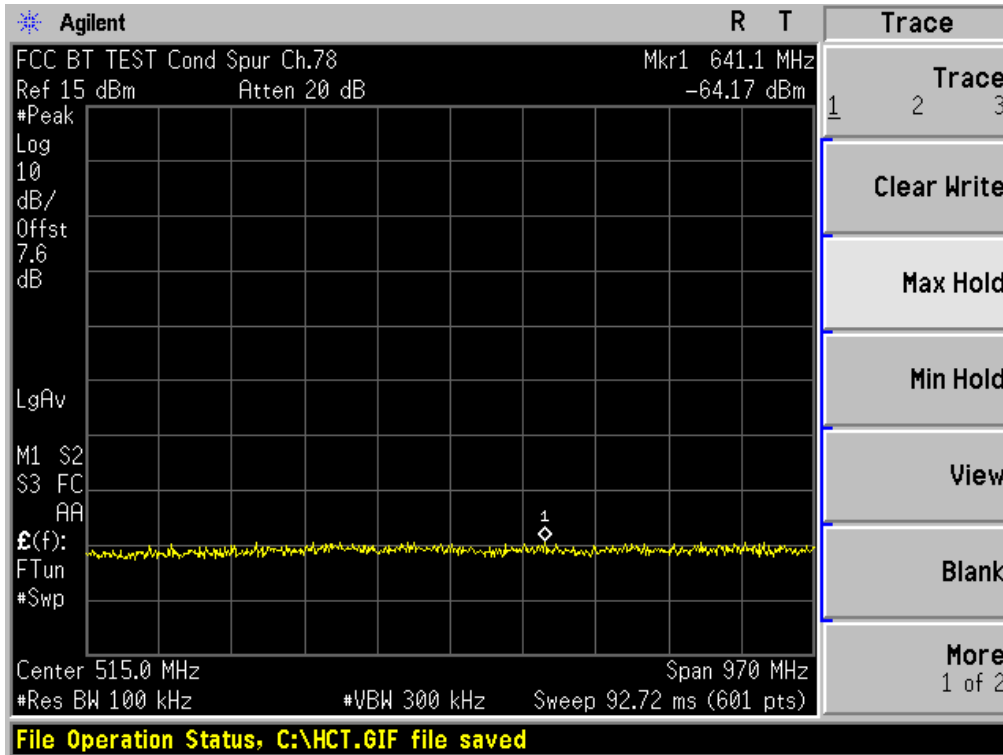
Test Plots (GFSK) - 30 MHz - 1 GHz (RBW:100 kHz, VBW: 300 kHz)  
Spurious Emission (Low-CH)



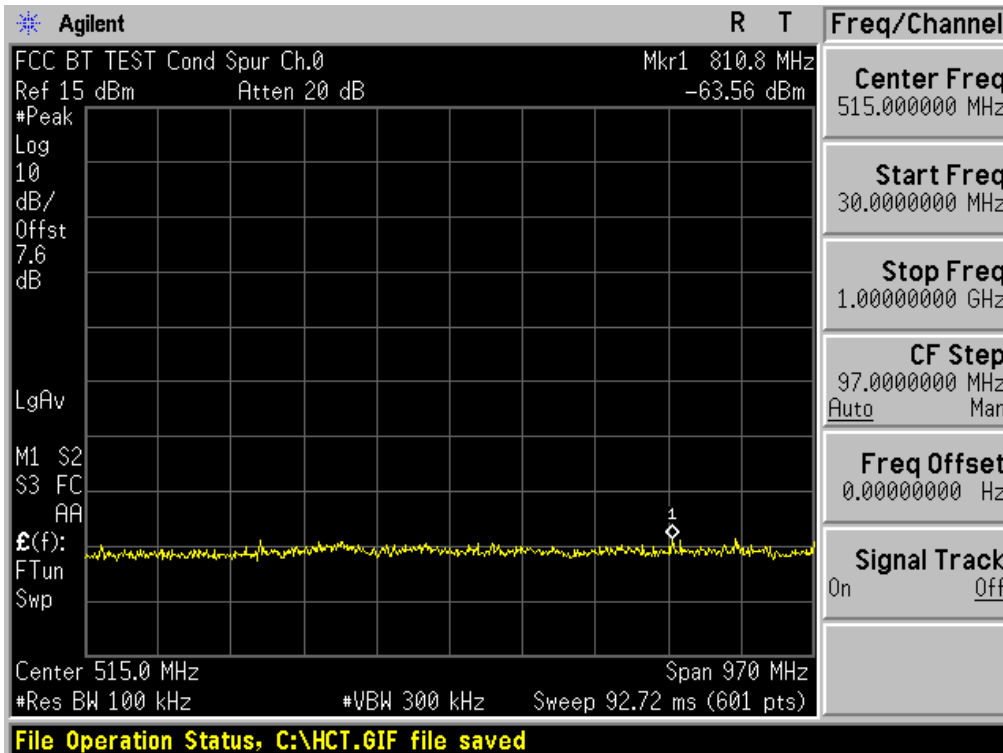
Test Plots (GFSK) - 30 MHz - 1 GHz (RBW:100 kHz, VBW: 300 kHz)  
Spurious Emission (Mid-CH)



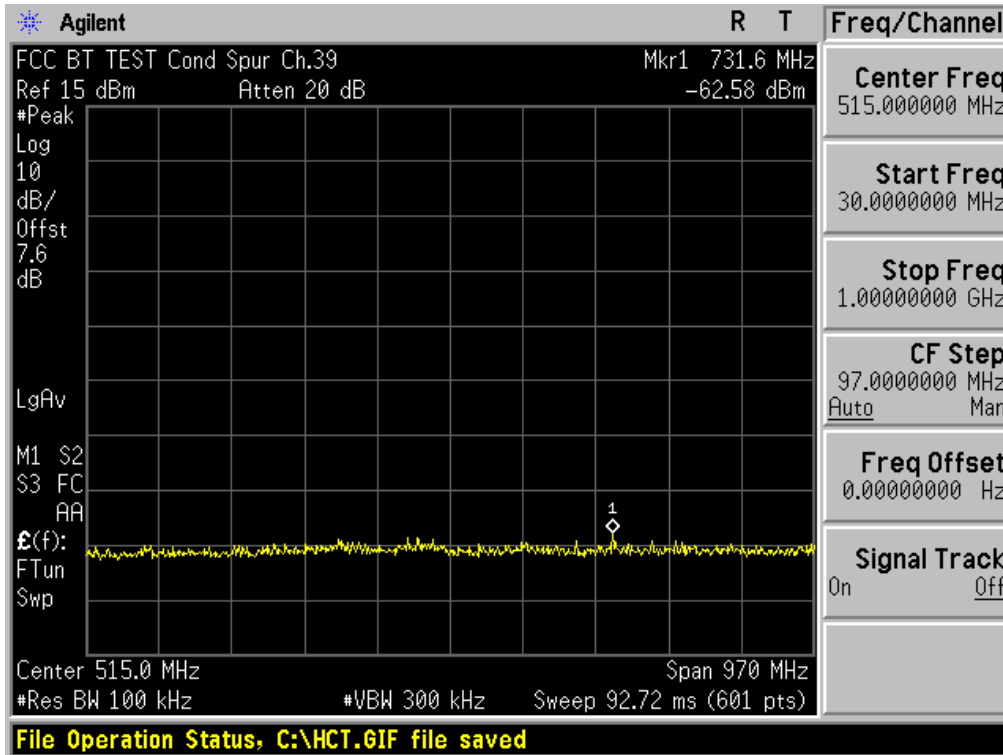
Test Plots (GFSK) - 30 MHz - 1 GHz (RBW:100 kHz, VBW: 300 kHz)  
Spurious Emission (High-CH)



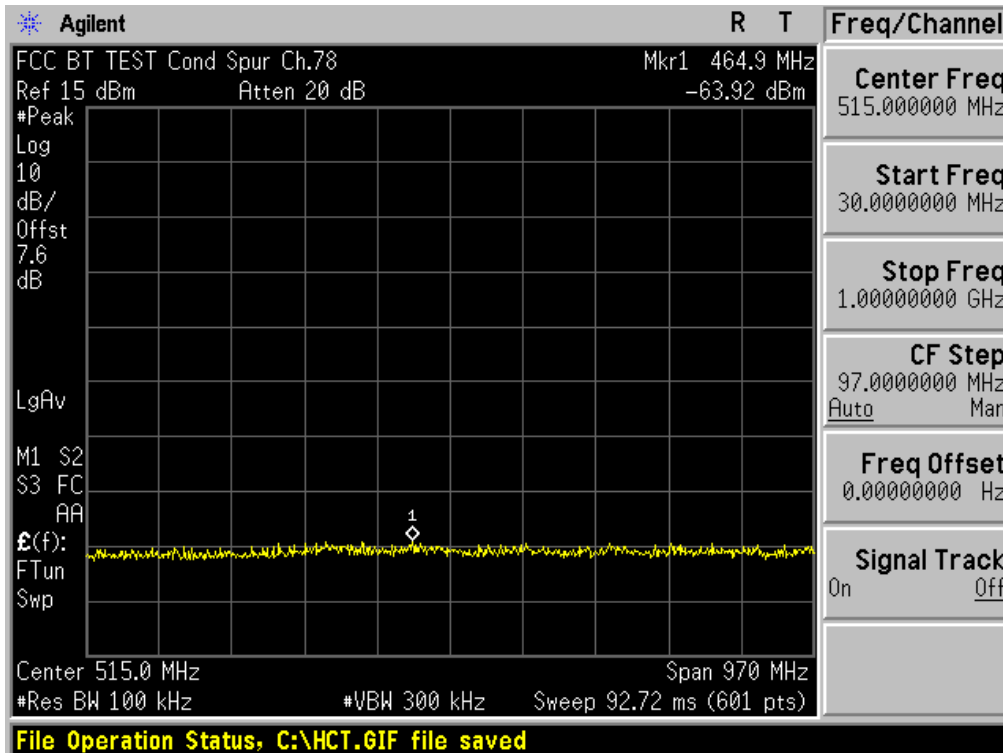
Test Plots (8DPSK) - 30 MHz - 1 GHz (RBW:100 kHz, VBW: 300 kHz)  
Spurious Emission (Low-CH)



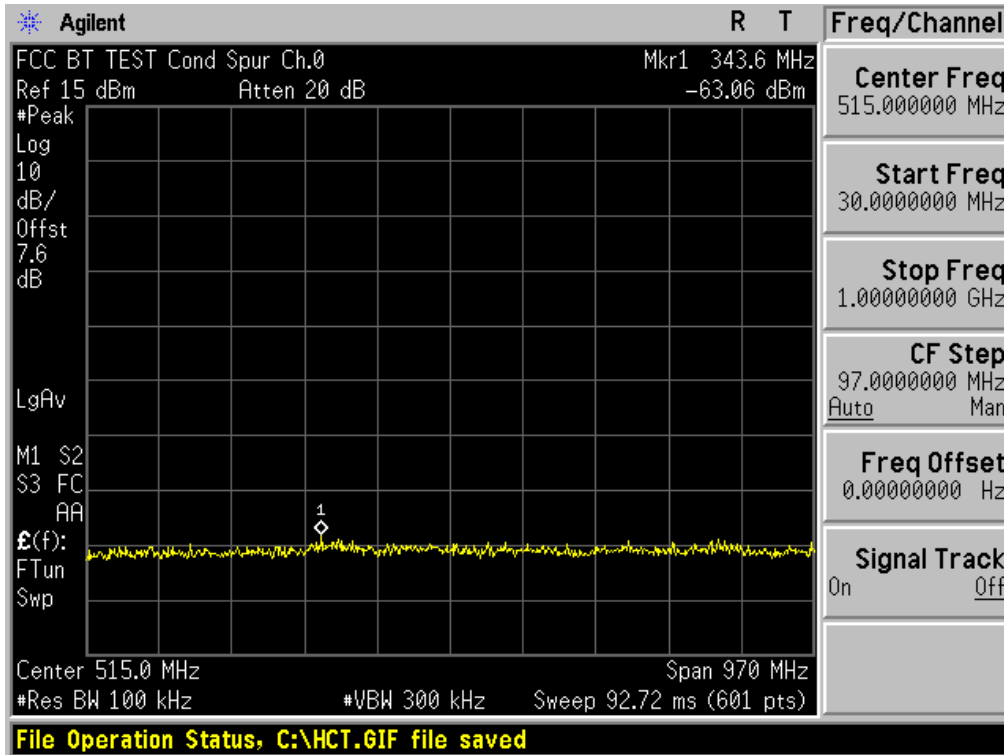
Test Plots (8DPSK) - 30 MHz - 1 GHz (RBW:100 kHz, VBW: 300 kHz)  
Spurious Emission (Mid-CH)



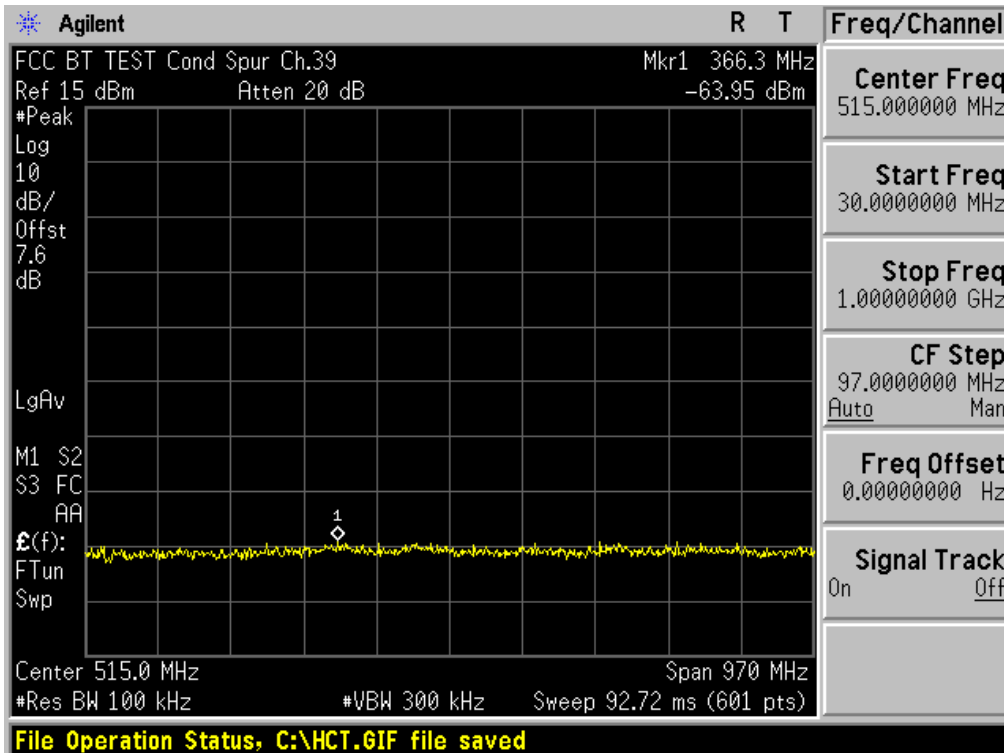
Test Plots (8DPSK) - 30 MHz - 1 GHz (RBW:100 kHz, VBW: 300 kHz)  
Spurious Emission (High-CH)



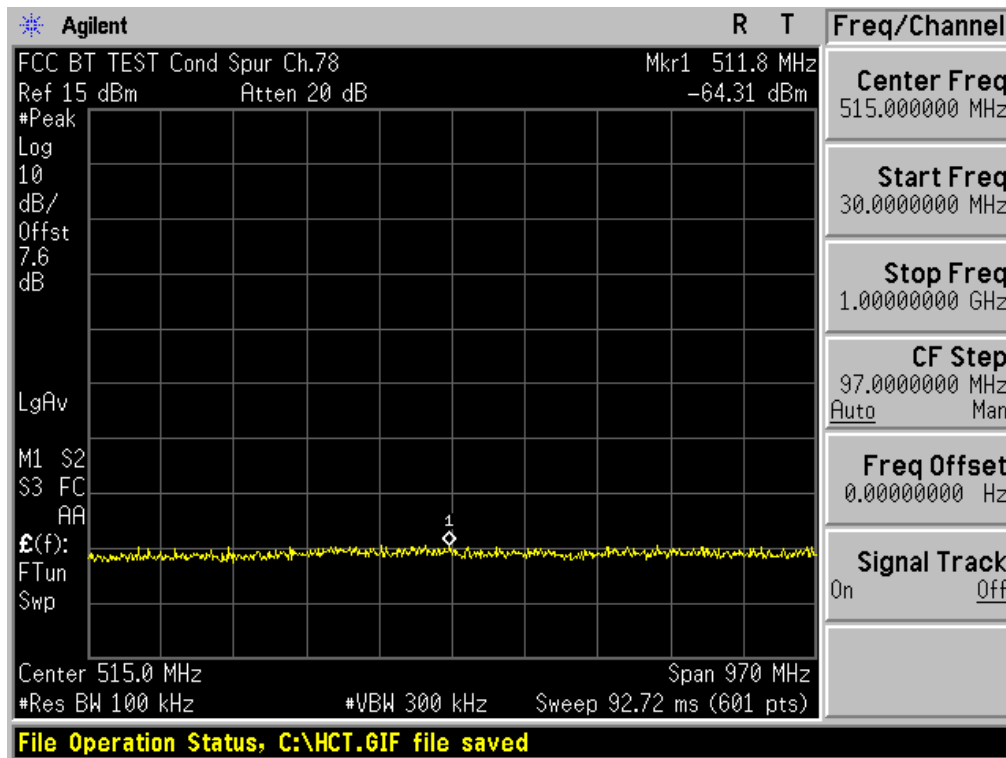
Test Plots ( $\pi/4$ DQPSK) - 30 MHz - 1 GHz (RBW:100 kHz, VBW: 300 kHz)  
Spurious Emission (Low-CH)



Test Plots ( $\pi/4$ DQPSK) - 30 MHz - 1 GHz (RBW:100 kHz, VBW: 300 kHz)  
Spurious Emission (Mid-CH)

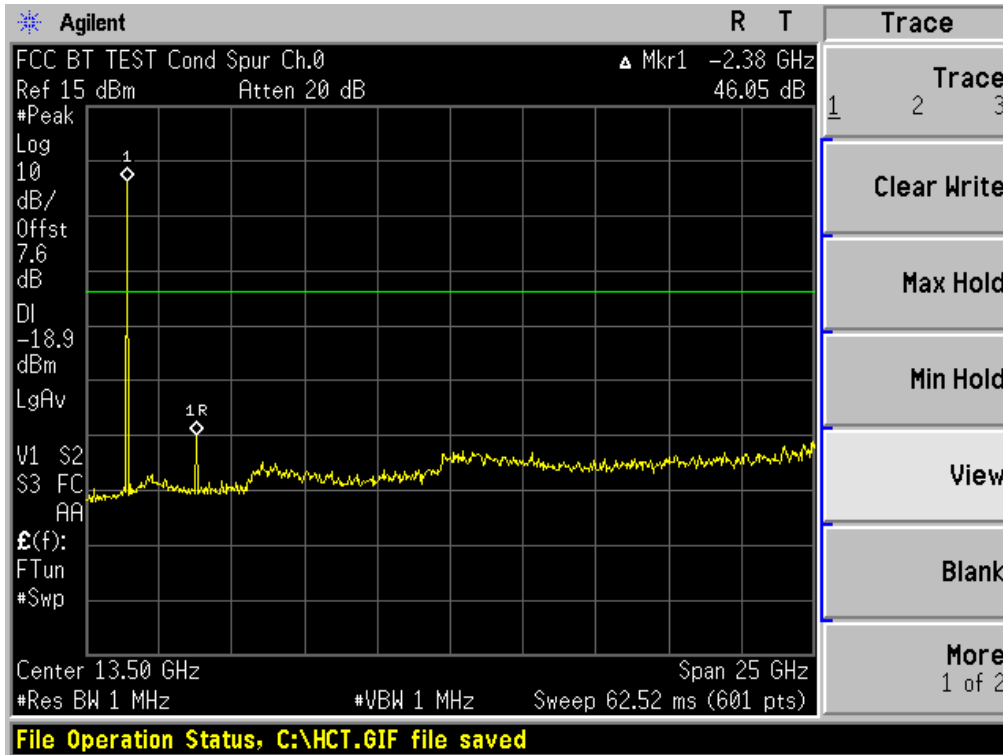


Test Plots ( $\pi/4$ DQPSK) - 30 MHz - 1 GHz (RBW:100 kHz, VBW: 300 kHz)  
Spurious Emission (High-CH)

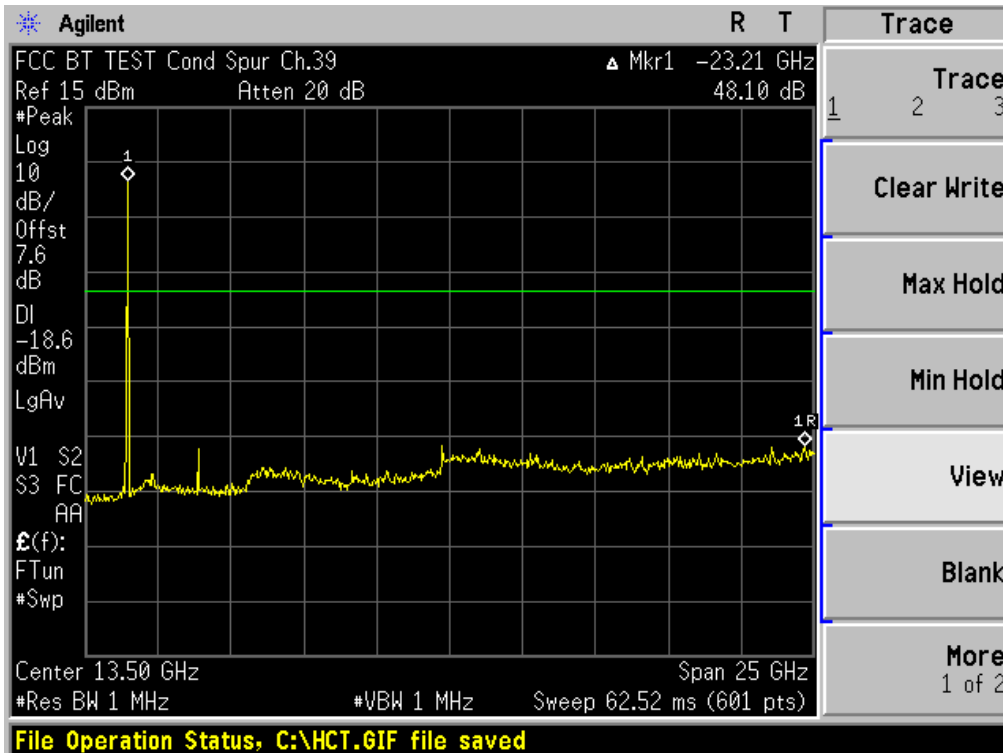


|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

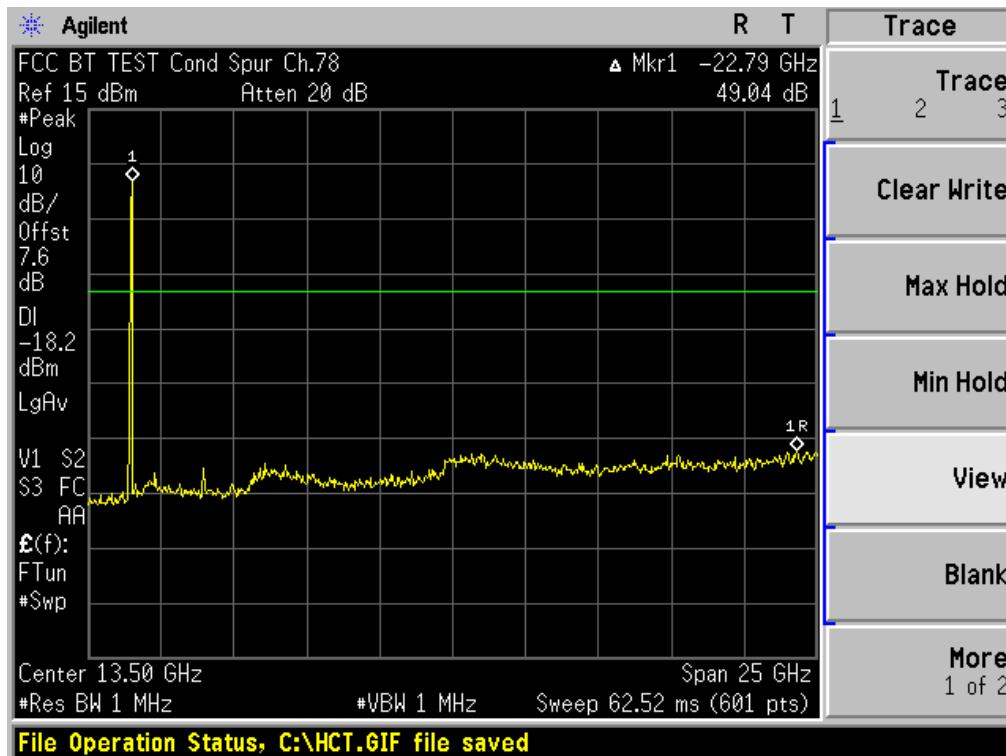
Test Plots (GFSK) - 1 GHz - 26 GHz (RBW:1 MHz, VBW: 1 MHz)  
Spurious Emission (Low-CH)



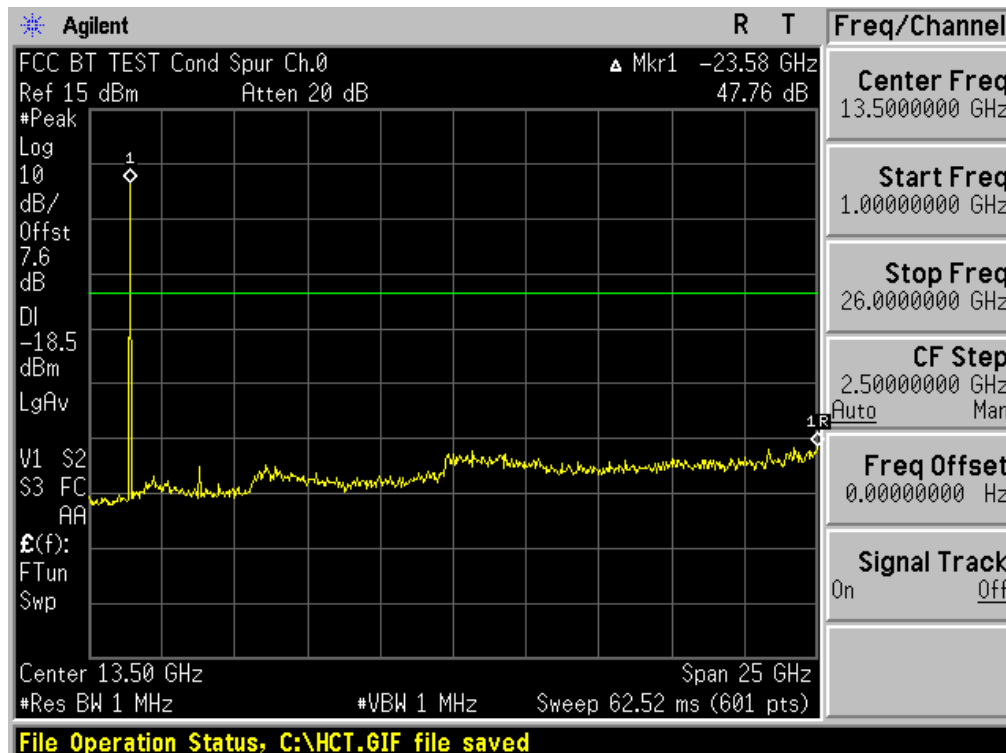
Test Plots (GFSK) - 1 GHz - 26 GHz (RBW:1 MHz, VBW: 1 MHz)  
Spurious Emission (Mid-CH)



Test Plots (GFSK) - 1 GHz - 26 GHz (RBW:1 MHz, VBW: 1 MHz)  
Spurious Emission (High-CH)

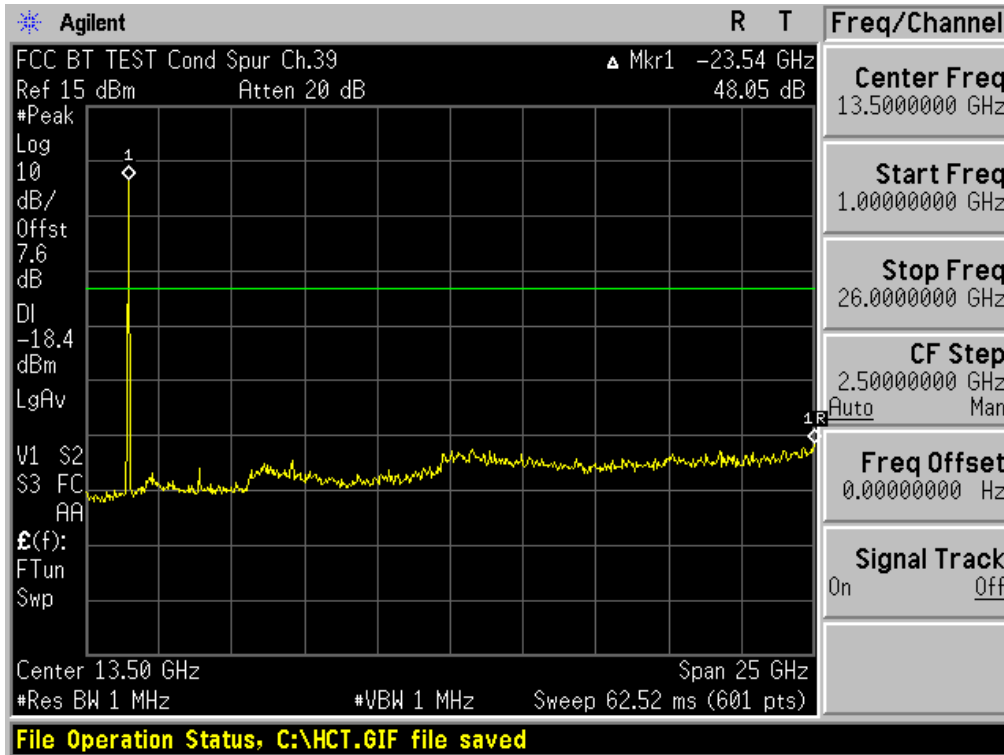


Test Plots (8DPSK) - 1 GHz - 26 GHz (RBW:1 MHz, VBW: 1 MHz)  
Spurious Emission (Low-CH)

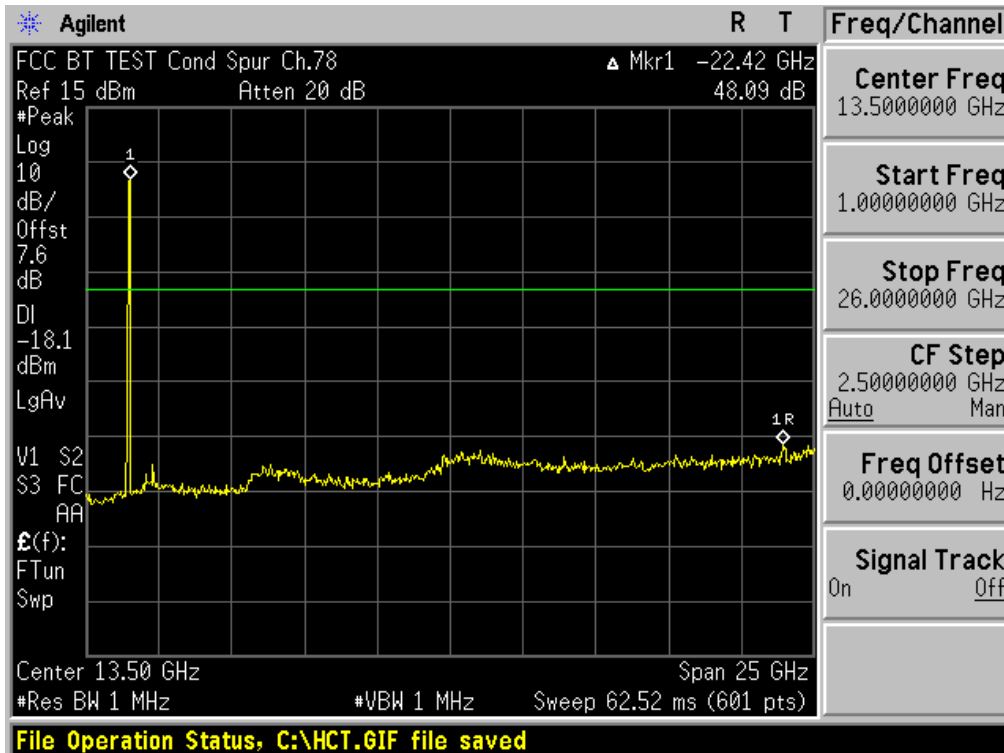




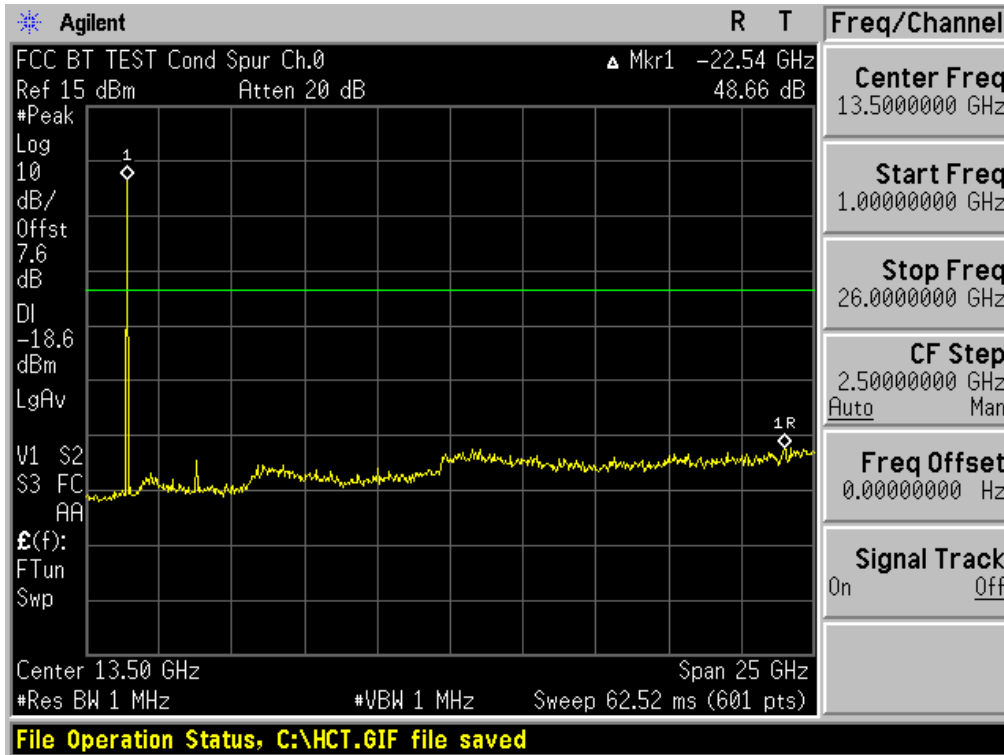
Test Plots (8DPSK) - 1 GHz - 26 GHz (RBW:1 MHz, VBW: 1 MHz)  
Spurious Emission (Mid-CH)



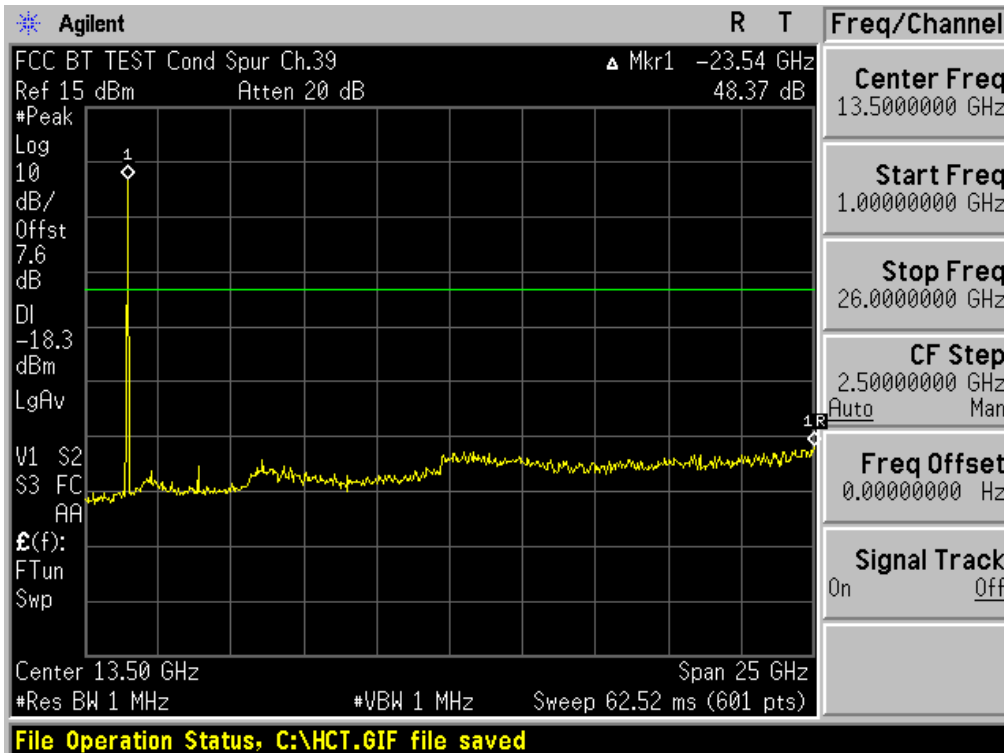
Test Plots (8DPSK) - 1 GHz - 26 GHz (RBW:1 MHz, VBW: 1 MHz)  
Spurious Emission (High-CH)



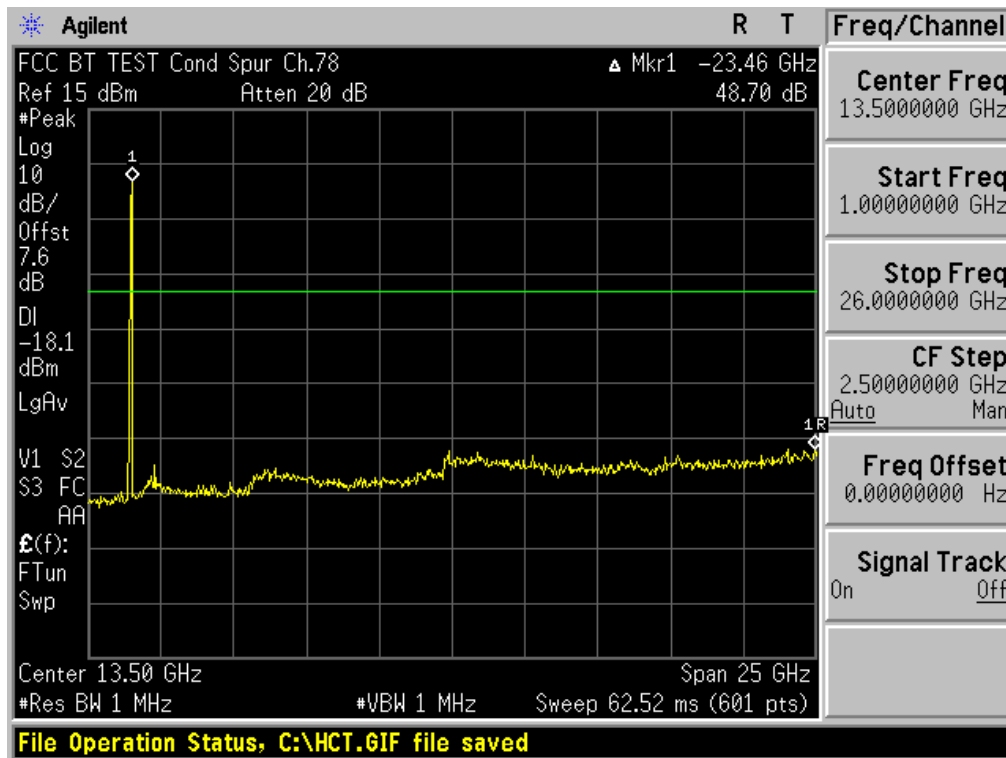
Test Plots ( $\pi/4$ DQPSK) - 1 GHz - 26 GHz (RBW:1 MHz, VBW: 1 MHz)  
Spurious Emission (Low-CH)



Test Plots ( $\pi/4$ DQPSK) - 1 GHz - 26 GHz (RBW:1 MHz, VBW: 1 MHz)  
Spurious Emission (Mid-CH)



Test Plots ( $\pi/4$ DQPSK) - 1 GHz - 26 GHz (RBW:1 MHz, VBW: 1 MHz)  
Spurious Emission (High-CH)



## 8.6.2 RADIATED SPURIOUS EMISSIONS

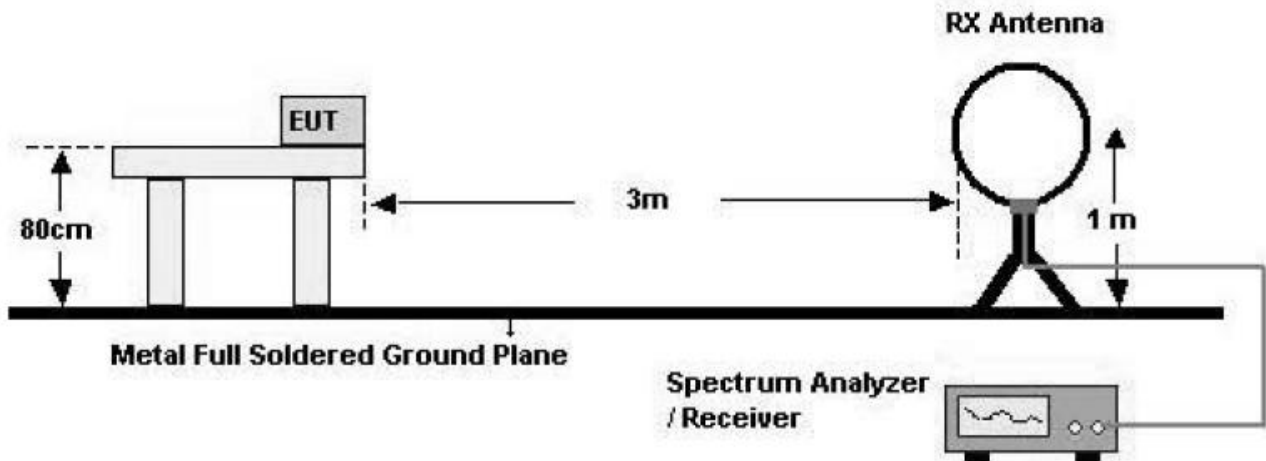
**LIMIT : §15.247(d), §15.205, §15.209**

1. 20dBc in any 100kHz bandwidth outside the operating frequency band. In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

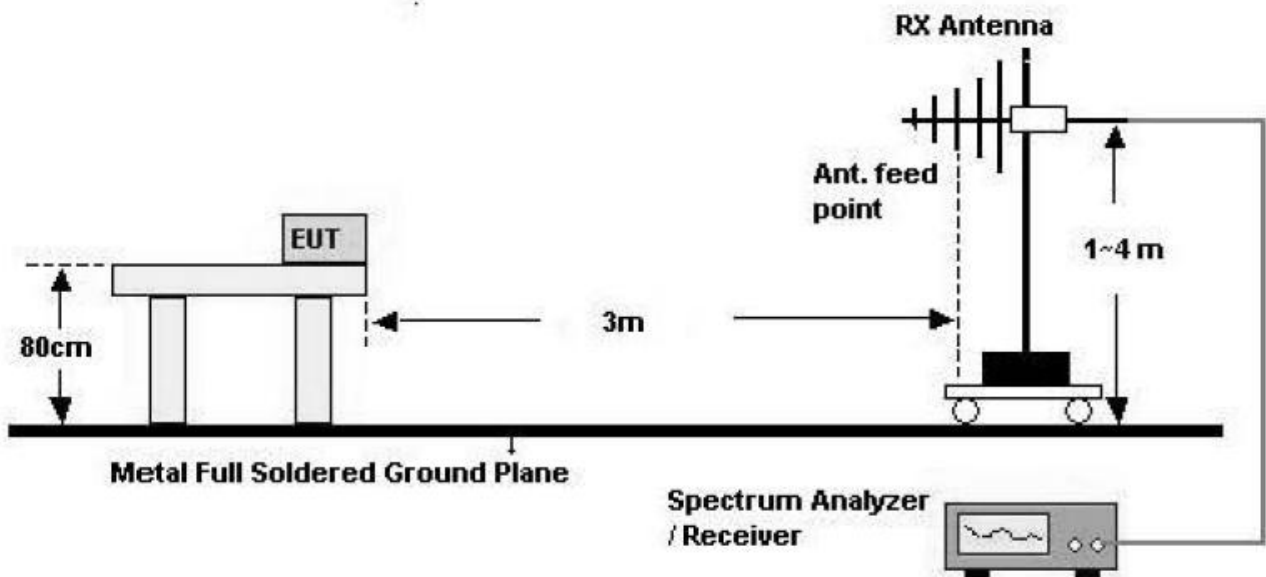
| Frequency (MHz) | Field Strength (uV/m) | Measurement Distance (m) |
|-----------------|-----------------------|--------------------------|
| 0.009 – 0.490   | 2400/F(kHz)           | 300                      |
| 0.490 – 1.705   | 24000/F(kHz)          | 30                       |
| 1.705 – 30      | 30                    | 30                       |
| 30-88           | 100                   | 3                        |
| 88-216          | 150                   | 3                        |
| 216-960         | 200                   | 3                        |
| Above 960       | 500                   | 3                        |

## Test Configuration

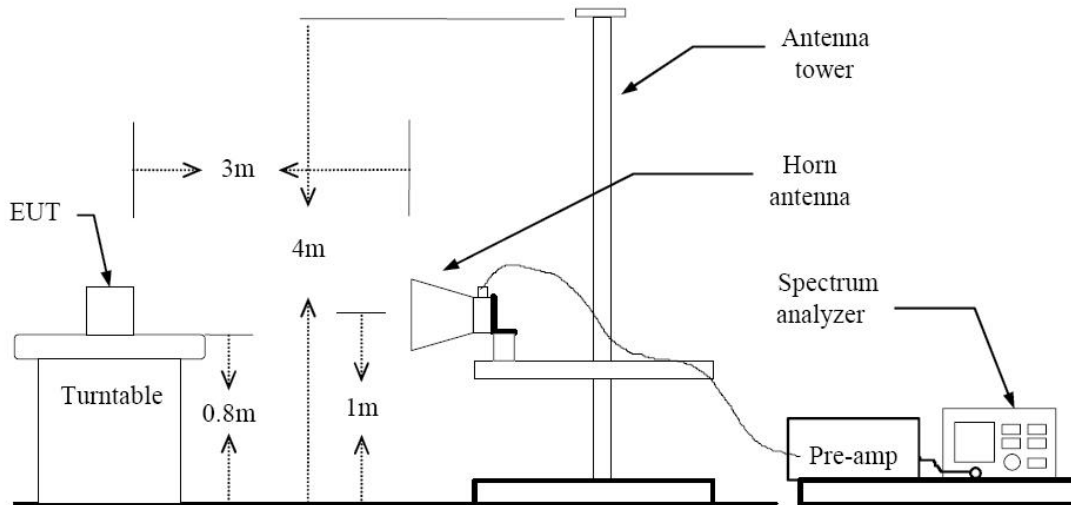
### Below 30 MHz



### 30 MHz - 1 GHz



## Above 1 GHz



## TEST PROCEDURE

1. The EUT is placed on a turntable, which is 0.8 m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

|  |  |                          |                                  |  |
|--|--|--------------------------|----------------------------------|--|
| <b>FCC PT.15.247<br/>TEST REPORT</b>   | <b>FCC &amp; IC CERTIFICATION REPORT</b> |                          |                                  | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| <b>Test Report No.</b><br>HCTR1205FR34 | <b>Date of Issue:</b><br>May 25, 2012    | <b>EUT Type:</b> CAR AVN | <b>FCC ID :</b><br>TQ8-AV230IXAN | <b>IC :</b><br>5074A-AV2A0IXKN                   |

## TEST RESULTS

9 kHz – 30MHz

Operation Mode: Normal Mode

| Frequency               | Reading    | Ant. factor | Cable loss | Ant. POL | Total        | Limit        | Margin |
|-------------------------|------------|-------------|------------|----------|--------------|--------------|--------|
| MHz                     | dB $\mu$ V | dB /m       | dB         | (H/V)    | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| No Critical peaks found |            |             |            |          |              |              |        |

### Notes:

1. Measuring frequencies from 9 kHz to the 30MHz.
2. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
3. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
4. Limit line = specific Limits (dB $\mu$ V) + Distance extrapolation factor
5. This test is performed with hopping off.

## TEST RESULTS

**Below 1 GHz**

**Operation Mode:** Normal Mode

| Frequency | Reading    | Ant. factor | Cable loss | Ant. POL | Total        | Limit        | Margin |
|-----------|------------|-------------|------------|----------|--------------|--------------|--------|
| MHz       | dB $\mu$ V | dB /m       | dB         | (H/V)    | dB $\mu$ V/m | dB $\mu$ V/m | dB     |
| 111.48    | 26.32      | 9.95        | 1.06       | H        | 37.3         | 43.5         | 6.2    |
| 111.48    | 26.56      | 9.95        | 1.06       | V        | 37.6         | 43.5         | 5.9    |
| 251.16    | 25.49      | 11.78       | 1.70       | V        | 39.0         | 46.0         | 7.0    |
| 276.38    | 25.60      | 12.39       | 1.77       | H        | 39.8         | 46.0         | 6.2    |
| 299.66    | 25.92      | 13.20       | 1.88       | H        | 41.0         | 46.0         | 5.0    |
| 299.66    | 26.44      | 13.20       | 1.88       | V        | 41.5         | 46.0         | 4.5    |

### Notes:

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. This test is performed with hopping off.



## Above 1 GHz

### Operation Mode: CH Low(GFSK)

| Frequency<br>[MHz] | Reading<br>dBuV | ※A.F+CL-AMP GAIN<br>[dB] | ANT. POL<br>[H/V] | Duty Cycle Correction<br>[dB] | Total<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Detect |
|--------------------|-----------------|--------------------------|-------------------|-------------------------------|-------------------|-------------------|----------------|--------|
| 4804               | 58.41           | -0.2                     | V                 | 0                             | 58.21             | 74                | 15.79          | PK     |
| 4804               | 54.58           | -0.2                     | V                 | -30.73                        | 23.65             | 54                | 30.35          | AV     |
| 7206               | 48.28           | 10.34                    | V                 | 0                             | 58.62             | 74                | 15.38          | PK     |
| 7206               | 35.16           | 10.34                    | V                 | -30.73                        | 14.77             | 54                | 39.23          | AV     |
| 4804               | 56.64           | -0.2                     | H                 | 0                             | 56.44             | 74                | 17.56          | PK     |
| 4804               | 51.00           | -0.2                     | H                 | -30.73                        | 20.07             | 54                | 33.93          | AV     |
| 7206               | 47.97           | 10.34                    | H                 | 0                             | 58.31             | 74                | 15.69          | PK     |
| 7206               | 35.25           | 10.34                    | H                 | -30.73                        | 14.86             | 54                | 39.14          | AV     |

※ A.F: ANTENNA FACTOR

C.L: CABLE LOSS

AMP GAIN: AMPLIFIER GAIN

#### Notes:

- Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
- Radiated emissions measured in frequency above 1000 MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
- Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction Factor
- Spectrum setting:
  - Peak Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 MHz.
  - AV Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 kHz  $\geq 1/\tau$  Hz, where  $\tau$  = pulse width in seconds.
- Duty Cycle Correction Factor (79 channel hopping)
  - Time to cycle through all channels=  $\Delta t = \tau$  [ms] x 79 channels = 229.732 ms, where  $\tau$  = pulse width
  - $100 \text{ ms} / \Delta t$  [ms] =  $H \rightarrow$  Round up to next highest integer,  $H' = 1$
  - Worst Case Dwell Time =  $\tau$  [ms] x  $H' = 2.908$  ms
  - Duty Cycle Correction =  $20 \log (\text{Worst Case Dwell Time} / 100 \text{ ms}) \text{ dB} = -30.728 \text{ dB}$
  - We applied DCCF in the test result which hopping channel number is 79.
- FYI : Duty Cycle Correction Factor(AFH mode – minimum channel number case - 20 channels)
  - Time to cycle through all channels=  $\Delta t = \tau$  [ms] x 20 channels = 58.16 ms, where  $\tau$  = pulse width
  - $100 \text{ ms} / \Delta t$  [ms] =  $H \rightarrow$  Round up to next highest integer,  $H' = 1.719395$
  - Worst Case Dwell Time =  $\tau$  [ms] x  $H' = 5.0$  ms
  - Duty Cycle Correction(AFH) =  $20 \log (\text{Worst Case Dwell Time} / 100 \text{ ms}) \text{ dB} = -26.02 \text{ dB}$

|                                 |                                |                   |                           |                         |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|-------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           |                         | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN |  |

8. We have done Normal Mode and EDR Mode test. Worst case of EUT is Normla Mode.
9. This test is performed with hopping off.
10. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

|  |  |                          |                                  |  |
|--|--|--------------------------|----------------------------------|--|
| <b>FCC PT.15.247<br/>TEST REPORT</b>   | <b>FCC &amp; IC CERTIFICATION REPORT</b> |                          |                                  | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| <b>Test Report No.</b><br>HCTR1205FR34 | <b>Date of Issue:</b><br>May 25, 2012    | <b>EUT Type:</b> CAR AVN | <b>FCC ID :</b><br>TQ8-AV230IXAN | <b>IC :</b><br>5074A-AV2A0IXKN                   |

# Operation Mode: CH Mid(GFSK)

| Frequency<br>[MHz] | Reading<br>dBuV | ※A.F+CL-AMP GAIN<br>[dB] | ANT. POL<br>[H/V] | Duty Cycle Correction<br>[dB] | Total<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Detect |
|--------------------|-----------------|--------------------------|-------------------|-------------------------------|-------------------|-------------------|----------------|--------|
| 4882               | 53.78           | 0.25                     | V                 | 0                             | 54.03             | 74                | 19.97          | PK     |
| 4882               | 46.56           | 0.25                     | V                 | -30.73                        | 16.08             | 54                | 37.92          | AV     |
| 7323               | 47.96           | 10.01                    | V                 | 0                             | 57.97             | 74                | 16.03          | PK     |
| 7323               | 35.19           | 10.01                    | V                 | -30.73                        | 14.47             | 54                | 39.53          | AV     |
| 4882               | 54.87           | 0.25                     | H                 | 0                             | 55.12             | 74                | 18.88          | PK     |
| 4882               | 48.25           | 0.25                     | H                 | -30.73                        | 17.77             | 54                | 36.23          | AV     |
| 7323               | 48.28           | 10.01                    | H                 | 0                             | 58.29             | 74                | 15.71          | PK     |
| 7323               | 35.14           | 10.01                    | H                 | -30.73                        | 14.42             | 54                | 39.58          | AV     |

※ A.F: ANTENNA FACTOR

C.L: CABLE LOSS

AMP GAIN: AMPLIFIER GAIN

## Notes:

- Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
- Radiated emissions measured in frequency above 1000 MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
- Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction Factor
- Spectrum setting:
  - Peak Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 MHz.
  - AV Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 kHz  $\geq 1/\tau$  Hz, where  $\tau$  = pulse width in seconds.
- Duty Cycle Correction Factor (79 channel hopping)
  - Time to cycle through all channels=  $\Delta t = \tau$  [ms] x 79 channels = 229.732 ms, where  $\tau$  = pulse width
  - $100 \text{ ms} / \Delta t$  [ms] =  $H \rightarrow$  Round up to next highest integer,  $H' = 1$
  - Worst Case Dwell Time =  $\tau$  [ms] x  $H' = 2.908$  ms
  - Duty Cycle Correction =  $20\log$  (Worst Case Dwell Time/ 100ms) dB = -30.728 dB
  - We applied DCCF in the test result which hopping channel number is 79.
- FYI : Duty Cycle Correction Factor(AFH mode – minimum channel number case - 20 channels)
  - Time to cycle through all channels=  $\Delta t = \tau$  [ms] x 20 channels = 58.16 ms, where  $\tau$  = pulse width
  - $100 \text{ ms} / \Delta t$  [ms] =  $H \rightarrow$  Round up to next highest integer,  $H' = 1.719395$
  - Worst Case Dwell Time =  $\tau$  [ms] x  $H' = 5.0$  ms
  - Duty Cycle Correction(AFH) =  $20\log$  (Worst Case Dwell Time/ 100ms) dB = -26.02 dB
- We have done Normal Mode and EDR Mode test. Worst case of EUT is Normla Mode.

|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

9. This test is performed with hopping off.
10. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.

|  |  |                          |                                  |  |
|--|--|--------------------------|----------------------------------|--|
| <b>FCC PT.15.247<br/>TEST REPORT</b>   | <b>FCC &amp; IC CERTIFICATION REPORT</b> |                          |                                  | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| <b>Test Report No.</b><br>HCTR1205FR34 | <b>Date of Issue:</b><br>May 25, 2012    | <b>EUT Type:</b> CAR AVN | <b>FCC ID :</b><br>TQ8-AV230IXAN | <b>IC :</b><br>5074A-AV2A0IXKN                   |

### Operation Mode: CH High(GFSK)

| Frequency [MHz] | Reading dBuV | ※A.F+CL-AMP GAIN [dB] | ANT. POL [H/V] | Duty Cycle Correction [dB] | Total [dBuV/m] | Limit [dBuV/m] | Margin [dB] | Detect |
|-----------------|--------------|-----------------------|----------------|----------------------------|----------------|----------------|-------------|--------|
| 4960            | 53.04        | 0.75                  | V              | 0                          | 53.79          | 74             | 20.21       | PK     |
| 4960            | 46.62        | 0.75                  | V              | -30.73                     | 16.64          | 54             | 37.36       | AV     |
| 7440            | 47.07        | 10.11                 | V              | 0                          | 57.18          | 74             | 16.82       | PK     |
| 7440            | 34.65        | 10.11                 | V              | -30.73                     | 14.03          | 54             | 39.97       | AV     |
| 4960            | 52.89        | 0.75                  | H              | 0                          | 53.64          | 74             | 20.36       | PK     |
| 4960            | 44.33        | 0.75                  | H              | -30.73                     | 14.35          | 54             | 39.65       | AV     |
| 7440            | 47.79        | 10.11                 | H              | 0                          | 57.90          | 74             | 16.10       | PK     |
| 7440            | 34.70        | 10.11                 | H              | -30.73                     | 14.08          | 54             | 39.92       | AV     |

※ A.F: ANTENNA FACTOR

C.L: CABLE LOSS

AMP GAIN: AMPLIFIER GAIN

### Notes:

- Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
- Radiated emissions measured in frequency above 1000 MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
- Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Duty Cycle Correction Factor
- Spectrum setting:
  - Peak Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 MHz.
  - AV Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 kHz  $\geq 1/\tau$  Hz, where  $\tau$  = pulse width in seconds.
- Duty Cycle Correction Factor (79 channel hopping)
  - Time to cycle through all channels=  $\Delta t = \tau$  [ms] x 79 channels = 229.732 ms, where  $\tau$  = pulse width
  - $100 \text{ ms} / \Delta t$  [ms] =  $H \rightarrow$  Round up to next highest integer,  $H' = 1$
  - Worst Case Dwell Time =  $\tau$  [ms] x  $H' = 2.908$  ms
  - Duty Cycle Correction =  $20\log$  (Worst Case Dwell Time/ 100ms) dB = -30.728 dB
  - We applied DCCF in the test result which hopping channel number is 79.
- FYI : Duty Cycle Correction Factor(AFH mode – minimum channel number case - 20 channels)
  - Time to cycle through all channels=  $\Delta t = \tau$  [ms] x 20 channels = 58.16 ms, where  $\tau$  = pulse width
  - $100 \text{ ms} / \Delta t$  [ms] =  $H \rightarrow$  Round up to next highest integer,  $H' = 1.719395$
  - Worst Case Dwell Time =  $\tau$  [ms] x  $H' = 5.0$  ms
  - Duty Cycle Correction(AFH) =  $20\log$  (Worst Case Dwell Time/ 100ms) dB = -26.02 dB
- We have done Normal Mode and EDR Mode test. Worst case of EUT is Normla Mode.

|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

9. This test is performed with hopping off.
10. We have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna..

|  |  |                          |                                  |  |
|--|--|--------------------------|----------------------------------|--|
| <b>FCC PT.15.247<br/>TEST REPORT</b>   | <b>FCC &amp; IC CERTIFICATION REPORT</b> |                          |                                  | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| <b>Test Report No.</b><br>HCTR1205FR34 | <b>Date of Issue:</b><br>May 25, 2012    | <b>EUT Type:</b> CAR AVN | <b>FCC ID :</b><br>TQ8-AV230IXAN | <b>IC :</b><br>5074A-AV2A0IXKN                   |

### 8.6.3 RECEIVER SPURIOUS EMISSIONS

**FCC Rule(s)** §15.109 (see Table Below)  
**Test Requirements:** Emission Level shall not exceed §15.109 limits  
**Operating conditions:** Under normal test conditions  
**Method of testing:** Radiated

**S/A. Settings:** F < 1 GHz: RBW: 120 kHz, VBW: 300 kHz (Quasi Peak)  
 F > 1 GHz: RBW: 1 MHz, VBW: 1 MHz (Peak)  
**Mode of operation:** Receive

| Frequency (MHz) | Field Strength (mV/m) | Measurement Distance (m) |
|-----------------|-----------------------|--------------------------|
| 30 – 88         | 100 (40 dBuV)         | 3                        |
| 88 - 216        | 150 (43.5 dBuV))      | 3                        |
| 216 – 960       | 200 (46 dBuV)         | 3                        |
| Above 960       | 500 (54 dBuV)         | 3                        |

Operation Mode: Receive:

30 MHz ~ 1 GHz

| Frequency<br>MHz | Reading<br>dBuV | Ant. Factor<br>dB/m | Cable Loss<br>dB | ANT POL<br>(H/V) | Total<br>dBuV/m | Limit<br>dBuV/m | Margin<br>dB |
|------------------|-----------------|---------------------|------------------|------------------|-----------------|-----------------|--------------|
| 111.31           | 26.1            | 9.95                | 1.06             | H                | 37.1            | 43.5            | 6.4          |
| 111.31           | 27.3            | 9.95                | 1.06             | V                | 38.3            | 43.5            | 5.2          |
| 253.00           | 25.6            | 11.85               | 1.71             | V                | 39.2            | 46.0            | 6.8          |
| 275.20           | 26.3            | 12.39               | 1.77             | H                | 40.5            | 46.0            | 5.5          |
| 300.10           | 25.0            | 13.36               | 1.91             | H                | 40.3            | 46.0            | 5.7          |
| 300.10           | 26.2            | 13.36               | 1.91             | V                | 41.5            | 46.0            | 4.5          |

Above 1 GHz

| Frequency<br>MHz        | Reading<br>dBuV | Ant. Factor<br>dB/m | Cable Loss<br>dB | ANT POL<br>(H/V) | Total<br>dBuV/m | Limit<br>dBuV/m | Margin<br>dB |
|-------------------------|-----------------|---------------------|------------------|------------------|-----------------|-----------------|--------------|
| No Critical peaks found |                 |                     |                  |                  |                 |                 |              |

#### 8.6.4 RADIATED RESTRICTED BAND EDGES

##### Test Requirements and limit, §15.247(d), §15.205, §15.209

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a) (See section 15.205(c)).

|                     |                    |
|---------------------|--------------------|
| Operation Mode      | Normal(GFSK)       |
| Operating Frequency | 2402 MHz, 2480 MHz |
| Channel No          | CH 0, CH 78        |

| Frequency<br>[MHz] | *Fund. Reading<br>dBuV | ※ A.F.+CL<br>[dB] | Ant. Pol.<br>[H/V] | *Fundamental<br>[dBuV/m] | Delta Value<br>[dBuV/m] | Duty Cycle Correction<br>[dB] | Total<br>[dBuV/m] | Limit<br>[dBuV/m] | Margin<br>[dB] | Detect |
|--------------------|------------------------|-------------------|--------------------|--------------------------|-------------------------|-------------------------------|-------------------|-------------------|----------------|--------|
| 2390.0             | 53.53                  | 33.86             | H                  | 87.39                    | 34.36                   | 0                             | 53.03             | 74                | 20.97          | PK     |
| 2390.0             | 53.04                  | 33.86             | H                  | 86.90                    | 34.36                   | -30.73                        | 21.81             | 54                | 32.19          | AV     |
| 2390.0             | 54.52                  | 33.86             | V                  | 88.38                    | 35.75                   | 0                             | 52.63             | 74                | 21.37          | PK     |
| 2390.0             | 53.59                  | 33.86             | V                  | 87.45                    | 35.75                   | -30.73                        | 20.97             | 54                | 33.03          | AV     |
| 2483.5             | 54.43                  | 34.02             | H                  | 88.45                    | 38.86                   | 0                             | 49.59             | 74                | 24.41          | PK     |
| 2483.5             | 53.85                  | 34.02             | H                  | 87.87                    | 38.86                   | -30.73                        | 18.28             | 54                | 35.72          | AV     |
| 2483.5             | 56.14                  | 34.02             | V                  | 90.16                    | 41.68                   | 0                             | 48.48             | 74                | 25.52          | PK     |
| 2483.5             | 55.64                  | 34.02             | V                  | 89.66                    | 41.68                   | -30.73                        | 17.25             | 54                | 36.75          | AV     |

※ A.F: ANTENNA FACTOR

C.L: CABLE LOSS

AMP GAIN: AMPLIFIER GAIN

##### Notes:

- Total = Fundamental Reading Value + Antenna Factor + Cable Loss – Delta Value + Duty Cycle Correction Factor
- Spectrum setting:
  - Peak Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 MHz.
  - AV Setting 1 GHz – 26 GHz, RBW = 1 MHz, VBW = 1 kHz  $\geq 1/\tau$  Hz, where  $\tau$  = pulse width in seconds.
- Duty Cycle Correction Factor (79 channel hopping)
  - Time to cycle through all channels=  $\Delta t = \tau$  [ms] x 79 channels = 229.732 ms, where  $\tau$  = pulse width
  - $100 \text{ ms} / \Delta t$  [ms] =  $H \rightarrow$  Round up to next highest integer,  $H' = 1$
  - Worst Case Dwell Time =  $\tau$  [ms] x  $H' = 2.908$  ms
  - Duty Cycle Correction =  $20 \log (\text{Worst Case Dwell Time} / 100 \text{ ms}) \text{ dB} = -30.728 \text{ dB}$
  - We applied DCCF in the test result which hopping channel number is 79.

|                                 |                                |                   |                           |                         |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|-------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           |                         | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN |  |



4. FYI : Duty Cycle Correction Factor(AFH mode – minimum channel number case - 20 channels)
  - a. Time to cycle through all channels=  $\Delta t = \tau$  [ms] x 20 channels = 58.16 ms, where  $\tau$  = pulse width
  - b.  $100 \text{ ms} / \Delta t$  [ms] =  $H \rightarrow$  Round up to next highest integer,  $H' = 1.719395$
  - c. Worst Case Dwell Time =  $\tau$  [ms] x  $H' = 5.0$  ms
  - d. Duty Cycle Correction(AFH) =  $20\log(\text{Worst Case Dwell Time} / 100\text{ms})$  dB = -26.02 dB
5. Radiated Restricted Band Edge measures by marker-delta method according to ANSI C63.10(version : 2009)
6. We have done Normal Mode, EDR Mode. Worst case of EUT is Normla Mode.
7. This test is performed with hopping off.
8. we have done x, y, z planes in EUT and horizontal and vertical polarization in detecting antenna.
9. Marker-Delta Method

In making radiated band-edge measurements, there can be a problem obtaining meaningful data because a measurement instrument that is tuned to a band-edge frequency may also capture some in-band signals when using the resolution bandwidth (RBW). In an effort to compensate for this problem, the following technique for determining band-edge compliance shall be used.

- a) Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function specified in 6.3 and 6.4, 6.5, or 6.6, as applicable, and the appropriate regulatory requirements for the frequency being measured. and our Rules for the frequency being measured.

For example, for a device operating in the 902-928 MHz band under 47 CFR 15.249, use a 120 kHz RBW with a CISPR QP detector (a peak detector with 100 kHz RBW may alternatively be used). For unlicensed wireless devices operating above 1 GHz, use a 1 MHz RBW, a 1 MHz VBW, and a peak detector as required by 47 CFR 15.35. Repeat the measurement with an average detector (i.e., 1 MHz RBW with 10 Hz VBW). For pulsed emissions, other factors must be included. For example note that radiated measurements of the fundamental emission of a spread spectrum unlicensed wireless device operating under 47 CFR 15.247 are not normally required, but they are necessary in connection with this procedure.

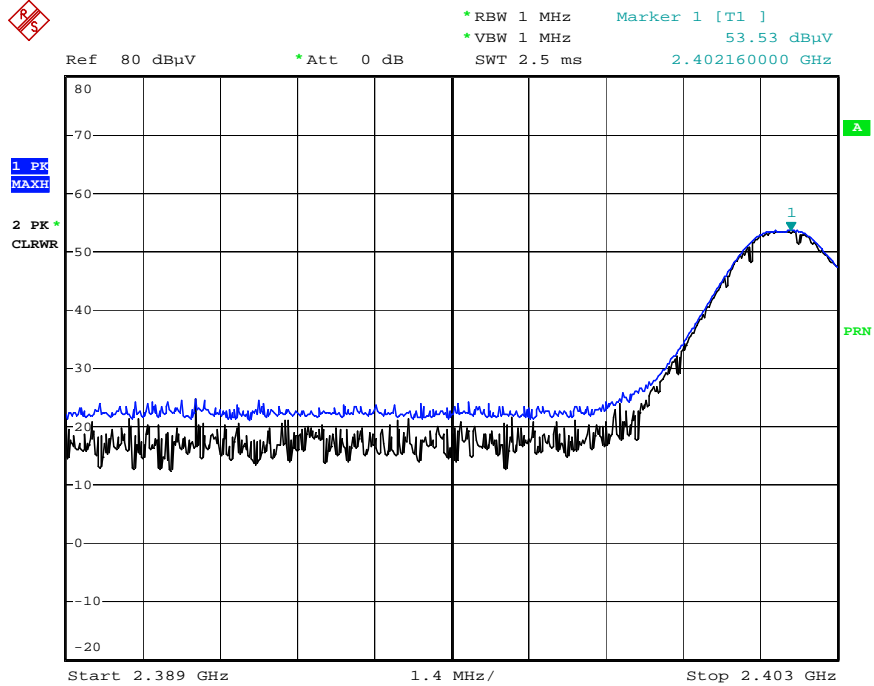
- b) Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to approximately 1% to 5 % of the total span, unless otherwise specified, with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not an absolute field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band-edge relative to the highest fundamental emission level.

- c) Subtract the delta measured in b) from the field strengths measured in a). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance of the restricted bands, described in 5.9.

|  |  |                          |                                  |  |
|--|--|--------------------------|----------------------------------|--|
| <b>FCC PT.15.247<br/>TEST REPORT</b>   | <b>FCC &amp; IC CERTIFICATION REPORT</b> |                          |                                  | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| <b>Test Report No.</b><br>HCTR1205FR34 | <b>Date of Issue:</b><br>May 25, 2012    | <b>EUT Type:</b> CAR AVN | <b>FCC ID :</b><br>TQ8-AV230IXAN | <b>IC :</b><br>5074A-AV2A0IXKN                   |

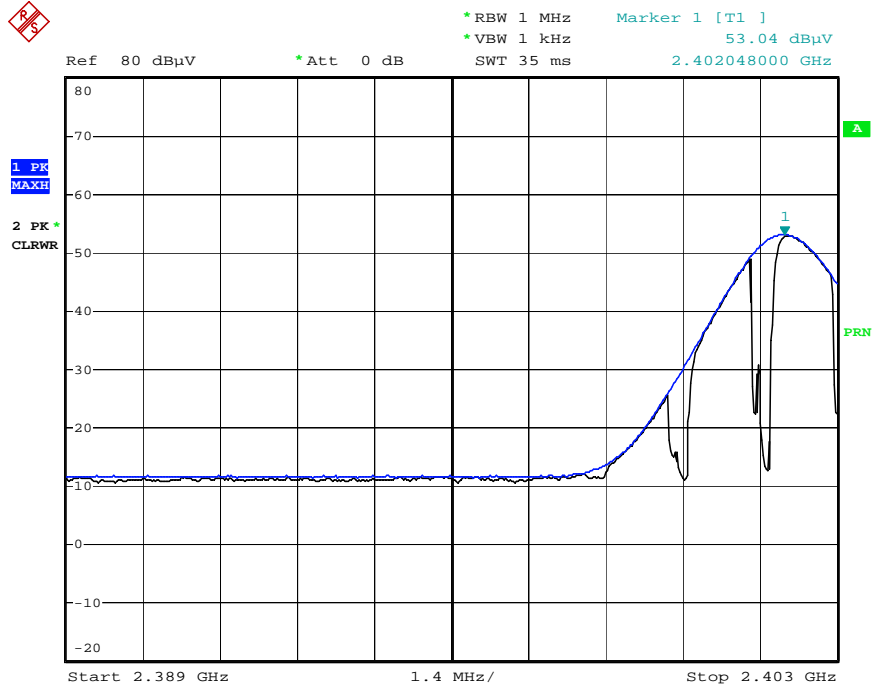
## Test Plots (GFSK)

Fund. (Peak\_Horizontal\_CH 0)



Date: 15.MAY.2012 15:34:45

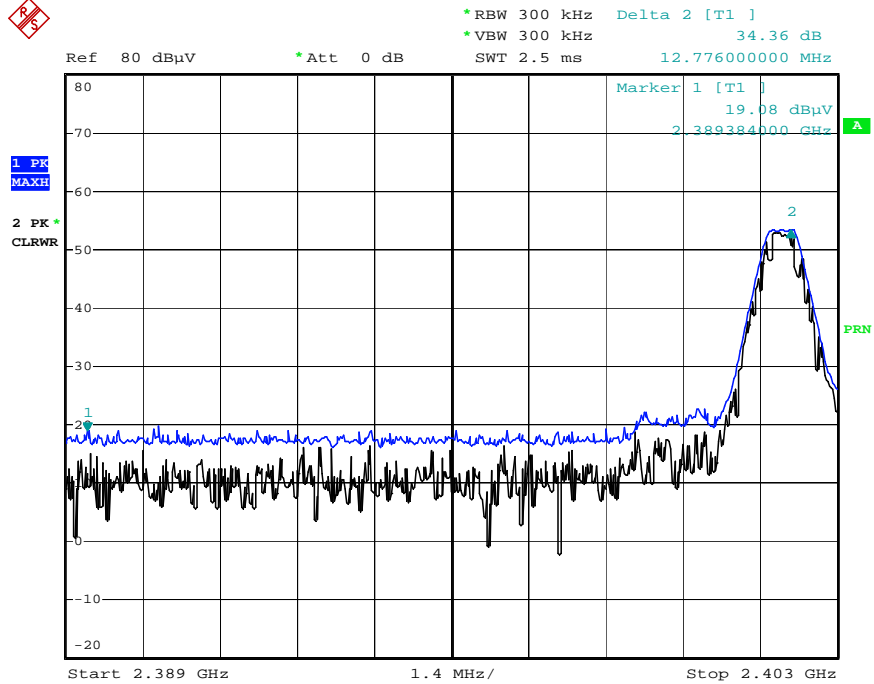
Fund. (Average\_Horizontal\_CH 0)



Date: 15.MAY.2012 15:35:05

|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

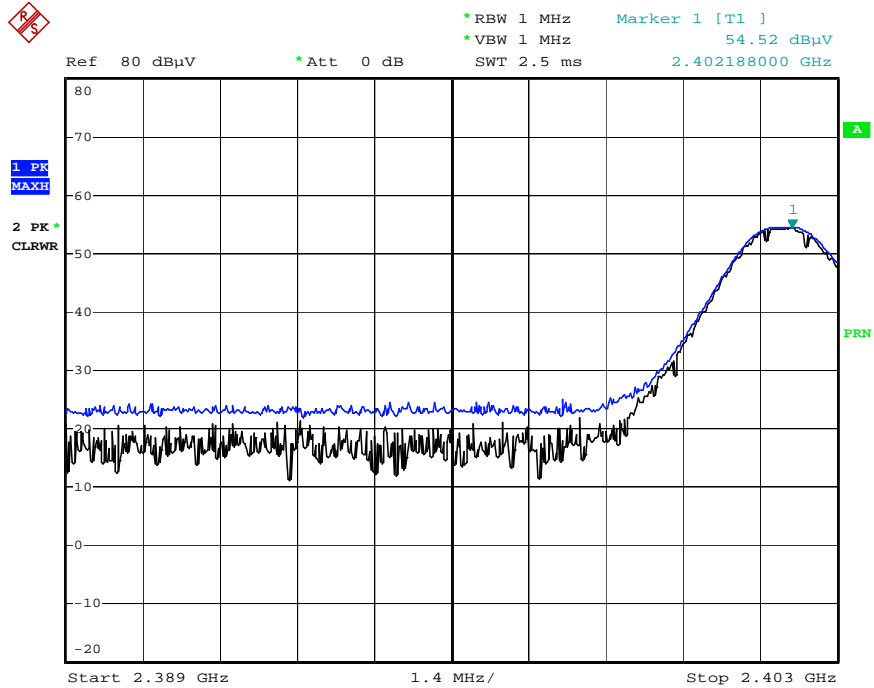
Delta (Horizontal \_CH 0)



Date: 15.MAY.2012 15:35:51

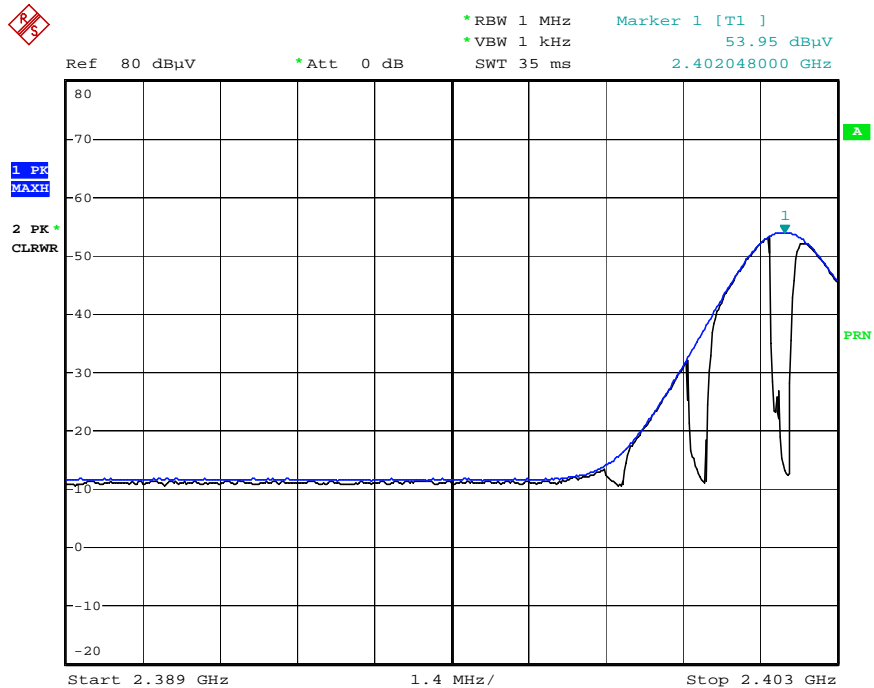
|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

# Fund. (Peak\_Vertical\_CH 0)



Date: 15.MAY.2012 15:37:13

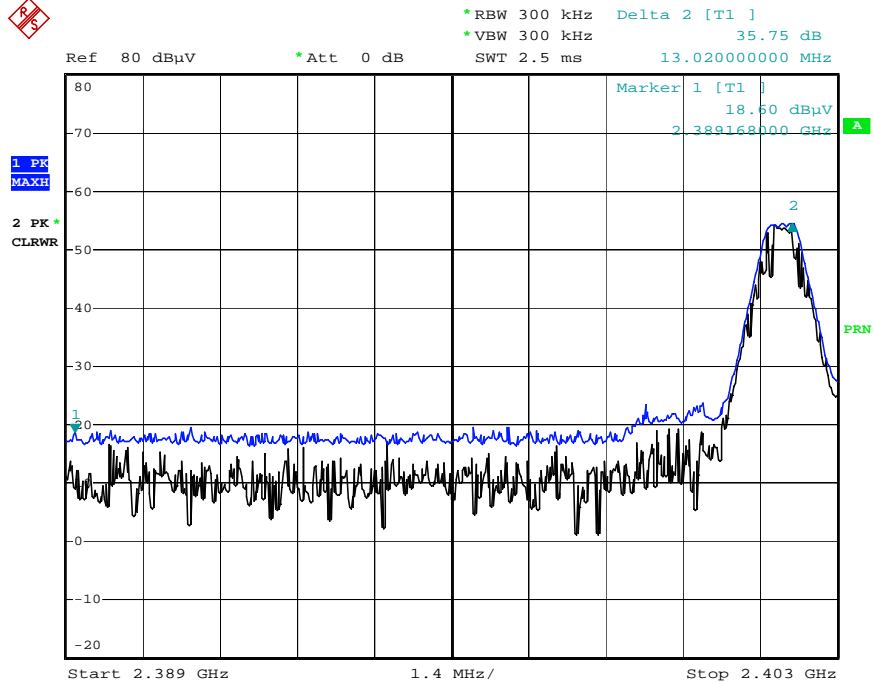
# Fund. (Average\_Vertical\_CH 0)



Date: 15.MAY.2012 15:37:34

|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

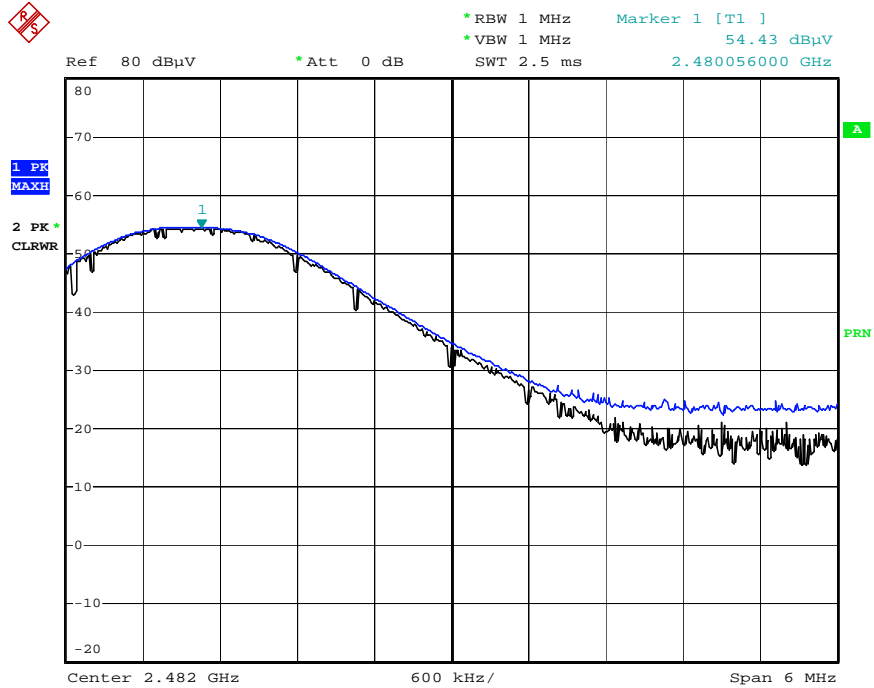
Delta (Vertical\_CH 0)



Date: 15.MAY.2012 15:38:30

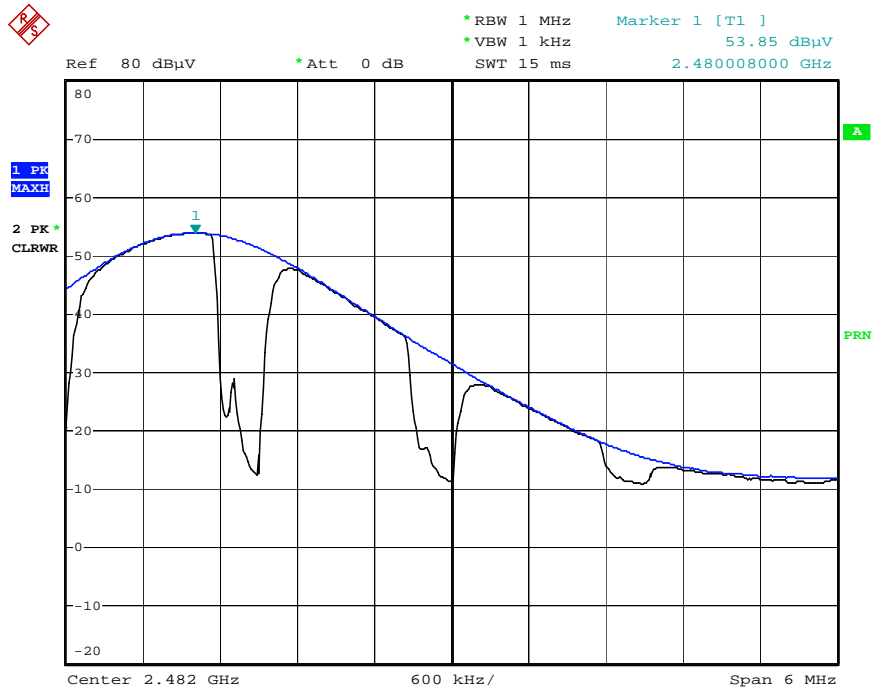
|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

Fund. (Peak\_Horizontal\_CH 79)



Date: 15.MAY.2012 15:31:25

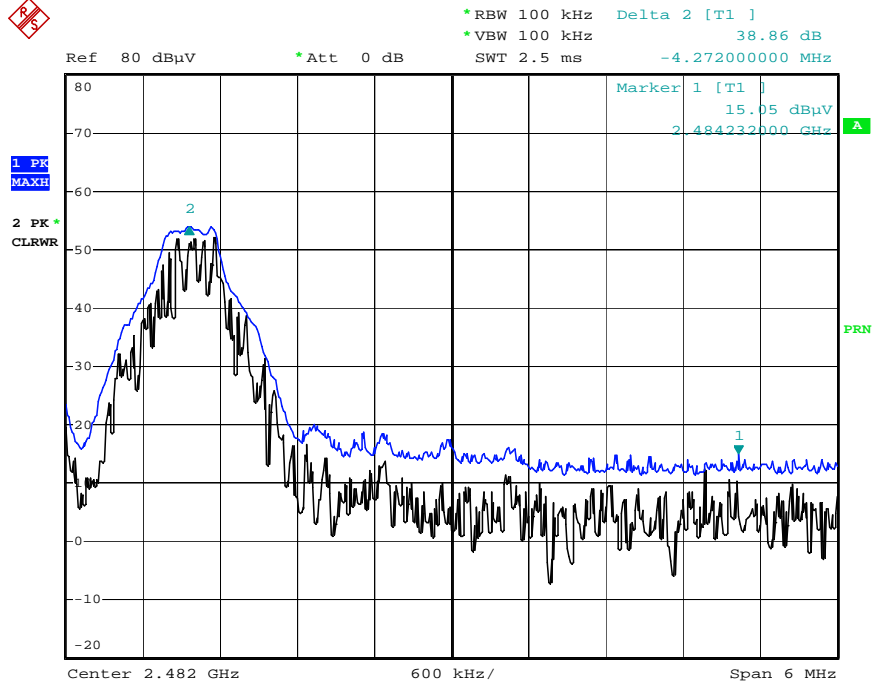
Fund. (Average\_Horizontal\_CH 79)



Date: 15.MAY.2012 15:31:51

|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

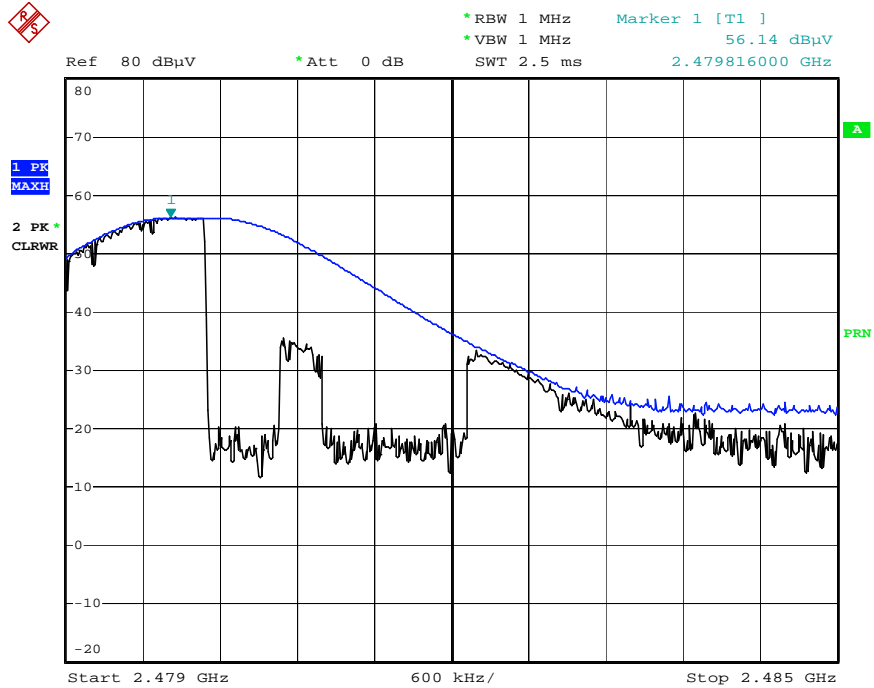
Delta (Horizontal\_CH 79)



Date: 15.MAY.2012 15:32:37

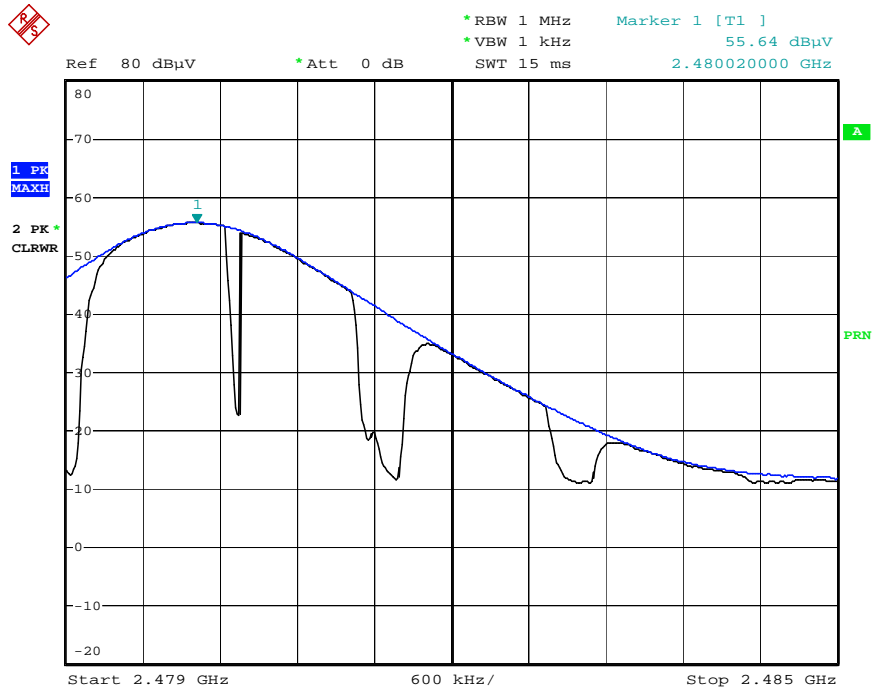
|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

Fund. (Peak\_Vertical\_CH 79)



Date: 15.MAY.2012 15:27:21

Fund. (Average\_Vertical\_CH 79)

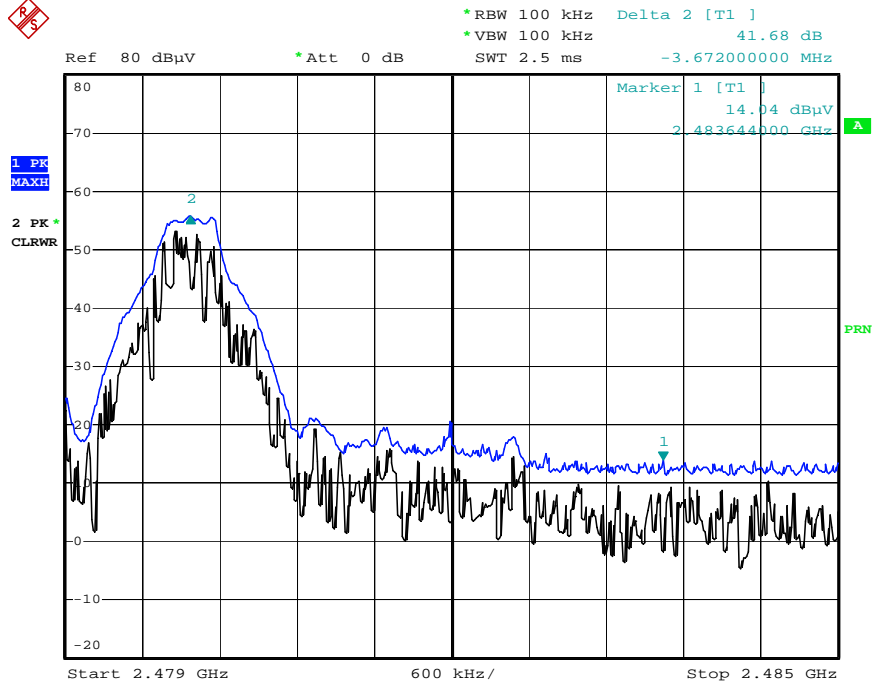


Date: 15.MAY.2012 15:27:40

|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |



Delta (Vertical\_CH 79)



Date: 15.MAY.2012 15:28:25

|                                 |                                |                   |                           |  |
|---------------------------------|--------------------------------|-------------------|---------------------------|--|
| FCC PT.15.247<br>TEST REPORT    | FCC & IC CERTIFICATION REPORT  |                   |                           | <a href="http://www.hct.co.kr">www.hct.co.kr</a> |
| Test Report No.<br>HCTR1205FR34 | Date of Issue:<br>May 25, 2012 | EUT Type: CAR AVN | FCC ID :<br>TQ8-AV230IXAN | IC :<br>5074A-AV2A0IXKN                          |

## 8.7 POWERLINE CONDUCTED EMISSIONS

### LIMIT

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolt (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

| Frequency Range (MHz) | Limits (dBμV) |          |
|-----------------------|---------------|----------|
|                       | 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       |

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

### Test Configuration

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

### TEST PROCEDURE

1. The EUT is placed on a wooden table 80 cm above the reference ground plane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.

**Note :** We don't perform powerline conducted emission test. Because this EUT is used with vehicle.

## 9. LIST OF TEST EQUIPMENT

| Manufacturer          | Model / Equipment                                      | Calibration Interval | Calibration Due | Serial No.         |
|-----------------------|--|----------------------|-----------------|--------------------|
| Rohde & Schwarz       | ESH2-Z5/ LISN  | Annual               | 02/03/2013      | 861741/013         |
| Schwarzbeck           | VULB 9168/ TRILOG Antenna                              | Biennial             | 02/09/2013      | 200                |
| Rohde & Schwarz       | ESI 40 / EMI TEST RECEIVER                             | Annual               | 05/03/2013      | 831564103          |
| Agilent               | E4440A/ Spectrum Analyzer                              | Annual               | 05/02/2013      | US45303008         |
| Agilent               | N9020A/ SIGNAL ANALYZER                                | Annual               | 09/23/2012      | MY51110020         |
| HD                    | MA240/ Antenna Position Tower                          | N/A                  | N/A             | 556                |
| EMCO                  | 1050/ Turn Table                                       | N/A                  | N/A             | 114                |
| HD GmbH               | HD 100/ Controller                                     | N/A                  | N/A             | 13                 |
| HD GmbH               | KMS 560/ SlideBar                                      | N/A                  | N/A             | 12                 |
| Rohde & Schwarz       | ESH3-Z2/ PULSE LIMITER                                 | Annual               | 08/01/2012      | 375.8810.352       |
| Rohde & Schwarz       | SCU-18/ Signal Conditioning Unit                       | Annual               | 09/19/2012      | 10094              |
| MITEQ                 | AFS44-00102650-42-10P-44-PS/ POWER AMP                 | Annual               | 09/23/2012      | 1532439            |
| Schwarzbeck           | BBHA 9120D/ Horn Antenna                               | Biennial             | 10/17/2013      | 937                |
| Schwarzbeck           | BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)               | Biennial             | 10/26/2012      | BBHA9170342        |
| Rohde & Schwarz       | FSP / Spectrum Analyzer                                | Annual               | 02/09/2013      | 839117/011         |
| Agilent               | E4416A /Power Meter                                    | Annual               | 11/07/2012      | GB41291412         |
| Agilent               | E9327A /POWER SENSOR                                   | Annual               | 05/02/2013      | MY4442009          |
| Wainwright Instrument | WHF3.3/18G-10EF / High Pass Filter                     | Annual               | 05/02/2013      | 1                  |
| Wainwright Instrument | WRCJ2400/2483.5-2370/2520-60/14SS / Band Reject Filter | Annual               | 05/02/2013      | 1                  |
| Hewlett Packard       | 11636B/Power Divider                                   | Annual               | 11/07/2012      | 11377              |
| Hewlett Packard       | 11667B / Power Splitter                                | Annual               | 11/04/2012      | 10126              |
| DIGITAL               | EP-3010 /DC POWER SUPPLY                               | Annual               | 11/07/2012      | 3110117            |
| ITECH                 | IT6720 / DC POWER SUPPLY                               | Annual               | 11/07/2012      | 010002156287001199 |
| TESCOM                | TC-3000C / BLUETOOTH TESTER                            | Annual               | 11/14/2012      | 3000C000276        |
| Rohde & Schwarz       | CBT / BLUETOOTH TESTER                                 | Annual               | 05/02/2013      | 100422             |
| EMCO                  | 6502.LOOP ANTENNA                                      | Biennial             | 01/11/2014      | 9009-2536          |
| MITEQ                 | AMF-6D-001180-35-20P/ POWER AMP                        | Annual               | 12/26/2012      | 990893             |