

# FCC PART 15 SUBPART C TEST REPORT

# FCC PART 15.247

| Report Reference No  | MWR151101103<br>RQQHLT-L50SCM  |   |
|--|--|---|
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| Date of issue  | Nov. 01, 2015  |   |
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| Testing Laboratory Name  | Shenzhen CTL Testing Technolo  | ogy Co., Ltd.   |
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| Applicant's name   | HYUNDAI CORPORATION  |   |
| Address  | 140-2, Kye-dong, Chongro-ku, Sec   | oul, South Korea  |
| Test specification:  |  |   |
| Standard   | ECC Dort 45 247. Operation with  |   |
|  | 2400-2483.5 MHz and 5725-5850  | nin the bands 902-928 MHz,<br>MHz   |
| TRF Originator   | 2400-2483.5 MHz and 5725-5850<br>Maxwell International Co., Ltd.   |   |
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# **TEST REPORT**

| Test Report No. :    | MWR151101103 |                       | Nov. 01, 2015  |  |
|----------------------|--------------|-----------------------|--|--|
| Equipment under Test | :            | Mobile Phone          |  |  |
| Model /Type          | :            | L505                  |  |  |
| Listed Models        | :            | N/A                   |  |  |
| Applicant            | :            | HYUNDAI CORPORAT      | ION  |  |
| Address              | :            | 140-2, Kye-dong, Chon | gro-ku, Seoul, South Korea                                     |  |
| Manufacturer         | :            | Skycom Telecommuni    | cations Co., Limited   |  |
| Address              | :            |                       | engtang Bldg., No.1, Tairan 9 Rd.,<br>istrict, Shenzhen, China |  |
|                      |              |                       |  |  |

| Test Result: PASS |
|-------------------|
|-------------------|

The test report merely corresponds to the test sample. It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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# 1 <u>TEST STANDARDS</u>

The tests were performed according to following standards:

<u>FCC Rules Part 15.247</u>: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz. <u>ANSI C63.10-2009</u>: American National Standard for Testing Unlicensed Wireless Devices

# 2 <u>SUMMARY</u>

# 2.1 General Remarks

| Date of receipt of test sample | : | Oct. 10, 2015 |
|--------------------------------|---|---------------|
|                                |   |               |
|                                |   |               |
| Testing commenced on           | : | Oct. 11, 2015 |
|                                |   |               |
|                                |   |               |
| Testing concluded on           | : | Nov. 01, 2015 |

# 2.2 Product Description

The **HYUNDAI CORPORATION**'s Model: L505 or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

| Name of EUT                   | Mobile Phone   |
|-------------------------------|--|
| Model Number                  | L505   |
|                               | GMSK for GSM/GPRS, 8-PSK for EDGE,QPSK for UMTS, QPSK,         |
| Modilation Type               | 16QAM for LTE  |
| Antenna Type                  | Internal   |
| UMTS Operation Frequency Band | Device supported UMTS FDD Band II/IV/V                         |
|                               | IEEE 802.11b:2412-2462MHz                                      |
|                               | IEEE 802.11g:2412-2462MHz                                      |
| WLAN FCC Operation frequency  | IEEE 802.11n HT20:2412-2462MHz                                 |
|                               | IEEE 802.11n HT40:2422-2452MHz                                 |
| BT FCC Operation frequency    | 2402MHz-2480MHz  |
| HSDPA Release Version         | Release 10   |
| HSUPA Release Version         | Release 6  |
| DC-HSUPA Release Version      | Not Supported  |
| WCDMA Release Version         | R99  |
| LTE Release Version           | R8   |
| LTE Operation Frequency Band  | Device supported FDD band 2, FDD band 4, FDD band 7, FDD band  |
|                               | 17   |
|                               | IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK)                            |
| WLAN FCC Modulation Type      | IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK)                   |
| WEAN FEE Modulation Type      | IEEE 802.11n HT20: OFDM (64QAM, 16QAM, QPSK,BPSK)              |
|                               | IEEE 802.11n HT40: OFDM (64QAM, 16QAM, QPSK,BPSK)              |
| BT Modulation Type            | GFSK,8DPSK,π/4DQPSK(BT 3.0+EDR)                                |
| Hardware version              | WW818-MB-V0.5  |
| Software version              | HYUNDAI_L505_V4.0.3  |
| Android version               | Android 4.4.2  |
| GPS function                  | Supported  |
| WLAN                          | Supported 802.11b/802.11g/802.11n                              |
| Bluetooth                     | Supported BT 4.0/BT 3.0+EDR                                    |
| GSM/EDGE/GPRS                 | Supported GSM/GPRS/EDGE  |
| GSM/EDGE/GPRS Power Class     | GSM850:Power Class 4/ PCS1900:Power Class 1                    |
| GSM/EDGE/GPRS Operation       | GSM850 :824.2MHz-848.8MHz/PCS1900:1850.2MHz-1909.8MHz          |
| Frequency                     | G310050 .024.210112-048.010112/FC31900.1650.210112-1909.010112 |
| GSM/EDGE/GPRS Operation       | GSM850/PCS1900/GPRS850/GPRS1900/EDGE850/EDGE1900               |
| Frequency Band                |  |
| GSM Release Version           | R99  |
| GPRS/EDGE Multislot Class     | GPRS/EDGE: Multi-slot Class 12                                 |
| Extreme temp. Tolerance       | -30°C to +50°C   |
| Extreme vol. Limits           | 3.40VDC to 4.20VDC (nominal: 3.80VDC)                          |
| GPRS operation mode           | Class B  |

## 2.3 Equipment Under Test

## Power supply system utilised

| Power supply voltage | : | 0 | 120V / 60 Hz                  | 0   | 115V / 60Hz |
|----------------------|---|---|-------------------------------|-----|-------------|
|                      |   | 0 | 12 V DC                       | 0   | 24 V DC     |
|                      |   | • | Other (specified in blank bel | ow) | )           |

DC 3.80V

# 2.4 Short description of the Equipment under Test (EUT)

#### 2.4.1 General Description

L505 is subscriber equipment in the WCDMA/GSM /LTE system. The HSPA/UMTS frequency band is Band II, Band IV and Band V, LTE frequency band is band 2, band 4, band 7,band 17; The GSM/GPRS/EDGE frequency band includes GSM850 and GSM900 and DCS1800 and PCS1900, but only Band II and Band V and GSM850 and PCS1900 bands test data included in this report. The Mobile Phone implements such functions as RF signal receiving/transmitting, HSPA/UMTS ,LTE and GSM/GPRS/EDGE protocol processing, voice, video MMS service, GPS and WIFI etc. Externally it provides micro SD card interface, earphone port (to provide voice service) and SIM card interface. It also provides Bluetooth module to synchronize data between a PC and the phone, or to use the built-in modem of the phone to access the Internet with a PC, or to exchange data with other Bluetooth devices.

NOTE: Unless otherwise noted in the report, the functional boards installed in the units shall be selected from the below list, but not means all the functional boards listed below shall be installed in one unit.

## 2.5 EUT operation mode

The EUT has been tested under typical operating condition. There are EDR (Enhanced Data Rate) and BDR

(Basic Data Rate) mode. The Applicant provides communication tools software to control the EUT for staying

in continous transmitting and receiving mode for testing. There are 79 channels of EUT, and the test carried

out at the lowest channel, middle channel and highest channel .

| Channel | Frequency(MHz) | Channel | Frequency(MHz) |
|---------|----------------|---------|----------------|
| 00      | 2402           | 40      | 2442           |
| 01      | 2403           | 41 2443 |                |
| 02      | 2404           | 42      | 2444           |
| 03      | 2405           | 43      | 2445           |
| 04      | 2406           | 44      | 2446           |
| 05      | 2407           | 45      | 2447           |
| 06      | 2408           | 46      | 2448           |
| 07      | 2409           | 47      | 2449           |
| 08      | 2410           | 48      | 2450           |
| 09      | 2411           | 49      | 2451           |
| 10      | 2412           | 50      | 2452           |
| 11      | 2413           | 51      | 2453           |
| 12      | 2414           | 52      | 2454           |
| 13      | 2415           | 53      | 2455           |
| 14      | 2416           | 54      | 2456           |
| 15      | 2417           | 55      | 2457           |
| 16      | 2418           | 56      | 2458           |
| 17      | 2419           | 57      | 2459           |
| 18      | 2420           | 58      | 2460           |
| 19      | 2421           | 59      | 2461           |
| 20      | 2422           | 60      | 2462           |
| 21      | 2423           | 61      | 2463           |
| 22      | 2424           | 62      | 2464           |
| 23      | 2425           | 63      | 2465           |
| 24      | 2426           | 64      | 2466           |

| 25 | 2427 | 65 | 2467 |
|----|------|----|------|
| 26 | 2428 | 66 | 2468 |
| 27 | 2429 | 67 | 2469 |
| 28 | 2430 | 68 | 2470 |
| 29 | 2431 | 69 | 2471 |
| 30 | 2432 | 70 | 2472 |
| 31 | 2433 | 71 | 2473 |
| 32 | 2434 | 72 | 2474 |
| 33 | 2435 | 73 | 2475 |
| 34 | 2436 | 74 | 2476 |
| 35 | 2437 | 75 | 2477 |
| 36 | 2438 | 76 | 2478 |
| 37 | 2439 | 77 | 2479 |
| 38 | 2440 | 78 | 2480 |
| 39 | 2441 |    |      |

## 2.6 Internal Identification of AE used during the test

| AE ID* | Description |
|--------|-------------|
| AE1    | Charger     |

AE1 Model: TPA-5950100UU INPUT: 100-240V~ 50/60Hz 0.2A OUTPUT: DC 5.0V 1.0A

\*AE ID: is used to identify the test sample in the lab internally.

# 2.7 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for FCC ID: RQQHLT-L50SCM filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

## 2.8 Modifications

No modifications were implemented to meet testing criteria.

# 3 <u>TEST ENVIRONMENT</u>

## 3.1 Address of the test laboratory

### Shenzhen CTL Testing Technology Co., Ltd.

Floor 1-A, Baisha Technology Park, No. 3011, Shahexi Road, Nanshan, Shenzhen 518055 China

There is one 3m semi-anechoic chamber and two line conducted labs for final test. The Test Sites meet the requirements in documents ANSI C63.4 and CISPR 22/EN 55022 requirements.

# 3.2 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

The test facility is recognized, certified, or accredited by the following organizations:

## IC Registration No.: 9618B

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 9618B on November 13, 2013.

## FCC-Registration No.: 970318

Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 970318, December 19, 2013.

## 3.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

| Temperature:          | 15-35 ° C    |
|-----------------------|--------------|
| Humidity:             | 30-60 %      |
| Atmospheric pressure: | 950-1050mbar |

# 3.4 Test Conditions

| Test Case                         | Test Conditions  |  |  |  |
|-----------------------------------|------------------|--|--|--|
| Test Case                         | Configuration    | Description  |  |  |
|                                   | Meas. Method     | ANSI C63.10:2009   |  |  |
| 20dB Emission                     | Test Environment | NTNV   |  |  |
| Bandwidth (EBW)                   | EUT Conf.        | TM1_DH5_Ch00,TM1_DH5_Ch39,TM1_DH5_Ch78,<br>TM3_3DH5_Ch00,TM3_3DH5_Ch39,TM3_3DH5_Ch78,    |  |  |
| Carrier Frequency                 | Meas. Method     | ANSI C63.10:2009   |  |  |
| Carrier Frequency                 | Test Environment | NTNV   |  |  |
| Separation                        | EUT Conf.        | TM1_DH5_Hop, TM3_3DH5_Hop,   |  |  |
| Number of Henning                 | Meas. Method     | ANSI C63.10:2009   |  |  |
| Number of Hopping<br>Channel      | Test Environment | NTNV   |  |  |
| Channel                           | EUT Conf.        | TM1_DH5_Hop ,TM3_3DH5_Hop,   |  |  |
| Time of Occupancy                 | Meas. Method     | ANSI C63.10:2009   |  |  |
| Time of Occupancy<br>(Dwell Time) | Test Environment | NTNV   |  |  |
|                                   | EUT Conf.        | TM1_DH5_Ch39 ,TM3_3DH5_Ch39.   |  |  |
|                                   | Meas. Method     | ANSI C63.10:2009   |  |  |
| Maximum Peak                      | Test Environment | NTNV   |  |  |
| Conducted Output Power            | EUT Conf.        | TM1_DH3_Ch00,TM1_DH3_Ch39,TM1_DH3_Ch78,TM2<br>_2DH3_Ch00,TM2_2DH3_Ch39,TM2_2DH3_Ch78,TM3 |  |  |
|                                   | Maga Mathad      | _3DH3_Ch00,TM3_3DH3_Ch39,TM3_3DH3_Ch78,  |  |  |
| Bandedge spurious                 | Meas. Method     | ANSI C63.10:2009   |  |  |
| emission                          | Test Environment | NTNV   |  |  |
| (Conducted)                       | EUT Conf.        | TM1_DH3_Ch00,TM1_DH3_Ch78,<br>TM3_3DH3_Ch00,TM3_3DH3_Ch78,                               |  |  |

|  | Meas. Method     | ANSI C63.10:2009  |
|--|------------------|---|
| Conducted RF Spurious                      | Test Environment | NTNV  |
| Emission                                   | EUT Conf.        | TM1_DH5_Ch00, TM1_DH5_Ch39, TM1_DH5_Ch78, TM3_3DH5_Ch39, TM3_3DH5_Ch39, TM3_3DH5_Ch78.  |
| Radiated Emissions in the Restricted Bands | Meas. Method     | ANSI C63.10:2009<br>30 MHz to 1 GHz:<br>Pre: RBW=100kHz; VBW=300kHz; Det. = Peak.<br>Final: RBW=120kHz; Det. = CISPR Quasi-Peak.<br>1 GHz to 26.5GHz:<br>Average: RBW=1 MHz; VBW= 10Hz; Det. = Peak;<br>Sweep-time= Auto; Trace = Single.<br>Peak: RBW=1 MHz; VBW= 3 MHz; Det. = Peak; Sweep-<br>time= Auto;<br>Trace≥ MaxHold * 100. |
|  | Test Environment | NTNV  |
|  |                  | 30 MHz-1GHz TM1_DH5_Ch00 (Worst Conf.).   |
|  | EUT Conf.        | 1-18 GHz: TM1_DH5_Ch00, TM1_DH5_Ch39,   |
|  |                  | TM1_DH5_Ch78, (Worst Conf.).  |

| Test Case               | Test Conditions    |                              |
|-------------------------|--------------------|------------------------------|
| Test Case               | Configuration      | Description                  |
| AC Dewer Line Conducted | Measurement Method | AC mains conducted.          |
| AC Power Line Conducted | Test Environment   | NTNV                         |
|                         | EUT Configuration  | TM1_DH5_Ch39. (Worst Conf.). |

#### Note:

1. For Radiated Emissions, By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that "Z axis" position was the worst, then the final test was executed the worst condition and test data were recorded in this report.

2. For  $\pi/4$  QPSK its same modulation type with 8-DPSK, and based exploratory test, there is no significant difference of that two types test result, so except output power, all other items final test were only performed with the worse case 8-DPSK and GFSK.

## 3.5 Summary of measurement results

| Test<br>Specification<br>clause | Test case  | Test<br>Mode              | Test<br>Channel                   | Reco<br>In Re             |                                   | Pass         | Fail | NA | NP | Remark                         |
|---------------------------------|--|---------------------------|-----------------------------------|---------------------------|-----------------------------------|--------------|------|----|----|--------------------------------|
| §15.247(b)(4)                   | Antenna<br>gain  | GFSK                      | ⊠ Lowest<br>⊠ Middle<br>⊠ Highest | GFSK                      | ⊠ Lowest<br>⊠ Middle<br>⊠ Highest |              |      |    |    | complies                       |
| §15.247(e)                      | Power<br>spectral<br>density                                   | -/-                       | -/-                               | -/-                       | -/-                               |              |      |    |    | Not<br>applicable<br>for FHSS! |
| §15.247(a)(1)                   | Carrier<br>Frequency<br>separation                             | GFSK<br>8DPSK             | ⊠ Lowest<br>⊠ Middle<br>⊠ Highest | GFSK<br>8DPSK             | 🛛 Middle                          | $\boxtimes$  |      |    |    | complies                       |
| §15.247(a)(1)                   | Number of<br>Hopping<br>channels                               | GFSK<br>8DPSK             | 🛛 Full                            | GFSK<br>8DPSK             | 🛛 Full                            | $\boxtimes$  |      |    |    | complies                       |
| §15.247(a)(1)                   | Time of<br>Occupancy<br>(dwell time)                           | GFSK<br>8DPSK             | ⊠ Lowest<br>⊠ Middle<br>⊠ Highest | GFSK<br>8DPSK             | 🛛 Middle                          | $\boxtimes$  |      |    |    | complies                       |
| §15.247(a)(1)                   | Spectrum<br>bandwidth of<br>a FHSS<br>system 20dB<br>bandwidth | GFSK<br>8DPSK             | ⊠ Lowest<br>⊠ Middle<br>⊠ Highest | GFSK<br>8DPSK             | ⊠ Lowest<br>⊠ Middle<br>⊠ Highest | $\boxtimes$  |      |    |    | complies                       |
| §15.247(b)(1)                   | Maximum output power   | GFSK<br>П/4DQPSK<br>8DPSK | ⊠ Lowest<br>⊠ Middle<br>⊠ Highest | GFSK<br>П/4DQPSK<br>8DPSK | ⊠ Lowest<br>⊠ Middle<br>⊠ Highest | $\mathbb{X}$ |      |    |    | complies                       |
| §15.247(d)                      | Band edge<br>compliance<br>conducted                           | GFSK<br>8DPSK             | ⊠ Lowest<br>⊠ Highest             | GFSK<br>8DPSK             | ⊠ Lowest<br>⊠ Highest             | $\boxtimes$  |      |    |    | complies                       |
| §15.205                         | Band edge compliance   | GFSK<br>8DPSK             | ⊠ Lowest<br>⊠ Highest             | GFSK                      | ⊠ Lowest<br>⊠ Highest             |              |      |    |    | complies                       |

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|                       | radiated   |               |                                   |               |                                   |             |  |          |
|-----------------------|--|---------------|-----------------------------------|---------------|-----------------------------------|-------------|--|----------|
| §15.247(d)            | TX spurious<br>emissions<br>conducted            | GFSK<br>8DPSK | ⊠ Lowest<br>⊠ Middle<br>⊠ Highest | GFSK<br>8DPSK | ⊠ Lowest<br>⊠ Middle<br>⊠ Highest | $\boxtimes$ |  | complies |
| §15.247(d)            | TX spurious<br>emissions<br>radiated             | GFSK<br>8DPSK | ⊠ Lowest<br>⊠ Middle<br>⊠ Highest | GFSK          | ⊠ Lowest<br>⊠ Middle<br>⊠ Highest | $\boxtimes$ |  | complies |
| §15.109               | RX spurious<br>emissions<br>radiated             | -/-           | -/-                               | -/-           | -/-                               | $\boxtimes$ |  | complies |
| §15.209(a)            | TX spurious<br>Emissions<br>radiated<br>< 30 MHz | GFSK          | -/-                               | GFSK          | -/-                               | $\boxtimes$ |  | complies |
| §15.107(a)<br>§15.207 | Conducted<br>Emissions<br>< 30 MHz               | GFSK          | -/-                               | GFSK          | -/-                               | $\boxtimes$ |  | complies |

Remark:

- The measurement uncertainty is not included in the test result. NA = Not Applicable; NP = Not Performed 1.
- 2.
- 3. We tested all test mode and recorded worst case in report

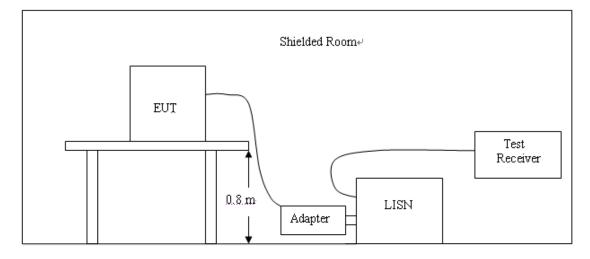
# 3.6 Equipments Used during the Test

| Test Equipment                 | Manufacturer            | Model No.                 | Serial No.   | Calibration<br>Date | Calibration<br>Due Date |
|--------------------------------|-------------------------|---------------------------|--------------|---------------------|-------------------------|
| LISN                           | R&S                     | ENV216                    | 3560.6550.12 | 2015/06/02          | 2016/06/01              |
| LISN                           | R&S                     | ESH2-Z5                   | 860014/010   | 2015/06/02          | 2016/06/01              |
| Bilog Antenna                  | Sunol Sciences<br>Corp. | JB1                       | A061713      | 2015/06/02          | 2016/06/01              |
| EMI Test Receiver              | R&S                     | ESCI                      | 103710       | 2015/06/02          | 2016/06/01              |
| Spectrum<br>Analyzer           | Agilent                 | N9030A                    | MY49430428   | 2015/05/21          | 2016/05/20              |
| Controller                     | EM Electronics          | Controller EM 1000        | N/A          | 2015/05/21          | 2016/05/20              |
| Horn Antenna                   | Sunol Sciences<br>Corp. | DRH-118                   | A062013      | 2015/05/19          | 2016/05/18              |
| Active Loop<br>Antenna         | SCHWARZBECK             | FMZB1519                  | 1519-037     | 2015/05/19          | 2016/05/18              |
| Amplifier                      | Agilent                 | 8349B                     | 3008A02306   | 2015/05/19          | 2016/05/18              |
| Amplifier                      | Agilent                 | 8447D                     | 2944A10176   | 2015/05/19          | 2016/05/18              |
| Temperature/<br>Humidity Meter | Gangxing                | CTH-608                   | 02           | 2015/05/20          | 2016/05/19              |
| High-Pass Filter               | K&L                     | 9SH10-<br>2700/X12750-O/O | N/A          | 2015/05/20          | 2016/05/19              |
| High-Pass Filter               | K&L                     | 41H10-<br>1375/U12750-O/O | N/A          | 2015/05/20          | 2016/05/19              |
| Coaxial Cables                 | HUBER+SUHNER            | SUCOFLEX<br>104PEA-10M    | 10m          | 2015/06/02          | 2016/06/01              |
| Coaxial Cables                 | HUBER+SUHNER            | SUCOFLEX<br>104PEA-3M     | 3m           | 2015/06/02          | 2016/06/01              |
| Coaxial Cables                 | HUBER+SUHNER            | SUCOFLEX<br>104PEA-3M     | 3m           | 2015/06/02          | 2016/06/01              |
| RF Cable                       | Megalon                 | RF-A303                   | N/A          | 2015/06/02          | 2016/06/01              |
| Power Sensor                   | R&S                     | NRP-Z4                    | 823.3618.03  | 2015.06.02          | 2016.06.01              |
| Power Meter                    | R&S                     | NRVS                      | 1020.1809.02 | 2015.06.02          | 2016.06.01              |

# 4 TEST CONDITIONS AND RESULTS

## 4.1 AC Power Conducted Emission

#### **TEST CONFIGURATION**



#### TEST PROCEDURE

- 1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
- 2. Support equipment, if needed, was placed as per ANSI C63.10-2013
- 3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
- 4. The EUT received DC5V power from the adapter, the adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
- 5. All support equipments received AC power from a second LISN, if any.
- 6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
- 7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
- 8. During the above scans, the emissions were maximized by cable manipulation.

#### AC Power Conducted Emission Limit

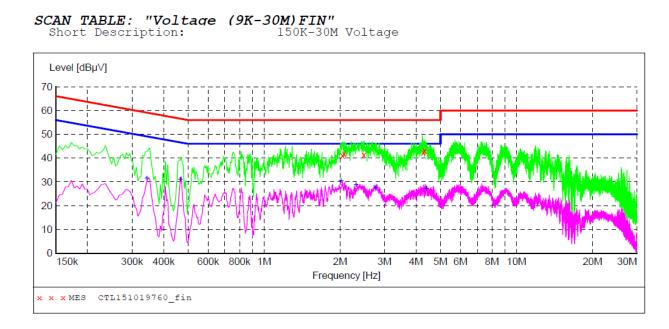
For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following :

| Frequency          | Maximum RF Line Voltage (dBµV) |      |        |        |  |  |  |
|--------------------|--------------------------------|------|--------|--------|--|--|--|
| Frequency<br>(MHz) | CLA                            | SS A | CLA    | SS B   |  |  |  |
|                    | Q.P.                           | Ave. | Q.P.   | Ave.   |  |  |  |
| 0.15 - 0.50        | 79                             | 66   | 66-56* | 56-46* |  |  |  |
| 0.50 - 5.00        | 73                             | 60   | 56     | 46     |  |  |  |
| 5.00 - 30.0        | 73                             | 60   | 60     | 50     |  |  |  |

\* Decreasing linearly with the logarithm of the frequency

#### TEST RESULTS

*Note:* We tested Conducted Emission of GFSK,  $\pi/4$  DQPSK and 8DPSK mode from 0.15 KHz to 30MHz (DH1, DH3 and DH5) and all channels (low, middle and high), recorded the worst case data at GFSK DH5 middle channel.



#### MEASUREMENT RESULT: "CTL151019760 fin"

10/19/2015 7:56PM Level Transd Limit Margin Detector Line Frequency PE dBµV dB dBµV MHz dB 10.4 56 2.044501 41.00 15.0 QP Ν GND 10.4 2.071501 42.00 56 14.0 QP GND Ν 10.4 2.485501 41.30 56 14.7 QP Ν GND 4.267501 42.40 56 13.6 QP Ν GND 10.4 4.321501 Ν 43.10 56 12.9 QP GND

#### MEASUREMENT RESULT: "CTL151019760 fin2"

| 10/19/2015 7<br>Frequency<br>MHz                                     | :56PM<br>Level<br>dBµV                             | Transd<br>dB                                 | Limit<br>dBµV                    | Margin<br>dB | Detector                         | Line                  | PE                                     |
|--|--|--|----------------------------------|--------------|----------------------------------|-----------------------|--|
| 0.343501<br>0.465001<br>2.017501<br>2.314501<br>2.769001<br>4.384501 | 31.30<br>31.00<br>30.40<br>28.50<br>27.30<br>27.20 | 10.2<br>10.2<br>10.4<br>10.4<br>10.4<br>10.4 | 49<br>47<br>46<br>46<br>46<br>46 | 15.6<br>15.6 | AV<br>AV<br>AV<br>AV<br>AV<br>AV | N<br>N<br>N<br>N<br>N | GND<br>GND<br>GND<br>GND<br>GND<br>GND |

L SCAN TABLE: "Voltage (9K-30M) FIN" Short Description: 150K-30M Voltage Level [dBµV] 70 ÷. 60 --+ ļ 50 MAN MARCE 40 30 20 10 0 -10 150k 3M 4M 5M 6M 20M 30M 300k 400k 600k 800k 1M 2M 8M 10M Frequency [Hz] x x x MES CTL151019761\_fin

#### MEASUREMENT RESULT: "CTL151019761 fin"

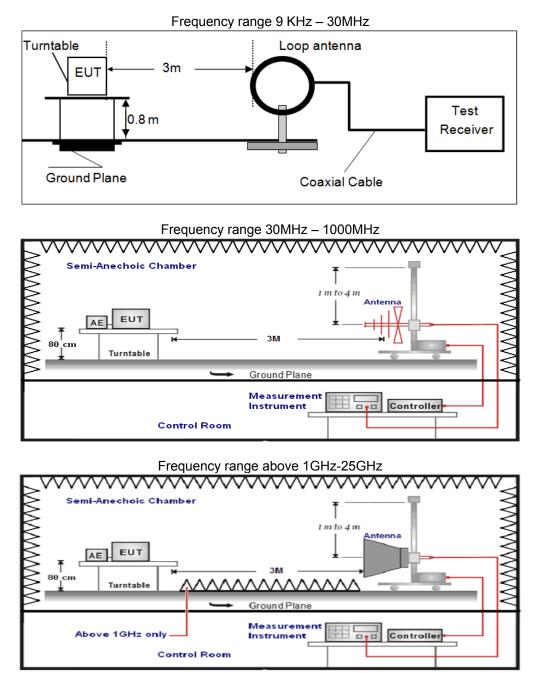
| 10/19/2015 8<br>Frequency<br>MHz                         | :00PM<br>Level<br>dBµV                    | Transd<br>dB                         | Limit<br>dBµV        | Margin<br>dB                         | Detector                   | Line                       | PE                              |
|--|---|--------------------------------------|----------------------|--------------------------------------|----------------------------|----------------------------|---------------------------------|
| 1.338001<br>1.383001<br>1.671001<br>1.774501<br>1.783501 | 43.50<br>44.20<br>43.90<br>45.80<br>45.30 | 10.3<br>10.3<br>10.3<br>10.3<br>10.3 | 56<br>56<br>56<br>56 | 12.5<br>11.8<br>12.1<br>10.2<br>10.7 | QP<br>QP<br>QP<br>QP<br>QP | L1<br>L1<br>L1<br>L1<br>L1 | GND<br>GND<br>GND<br>GND<br>GND |
| 3.318001   | 41.40                                     | 10.4                                 | 56                   | 14.6                                 | QP                         | L1                         | GND                             |

#### MEASUREMENT RESULT: "CTL151019761\_fin2"

| 10/19/2015 8:<br>Frequency<br>MHz |       | Transd<br>dB | Limit<br>dBµV | Margin<br>dB | Detector | Line | PE  |
|-----------------------------------|-------|--------------|---------------|--------------|----------|------|-----|
| 0.460501                          | 35.30 | 10.2         | 47            | 11.4         | AV       | L1   | GND |
| 1.320001                          | 32.40 | 10.3         | 46            | 13.6         |          | L1   | GND |
| 1.387501                          | 32.50 | 10.3         | 46            | 13.5         |          | L1   | GND |
| 1.716001                          | 34.70 | 10.3         | 46            | 11.3         |          | L1   | GND |
| 1.774501                          | 34.70 | 10.3         | 46            | 11.3         |          | L1   | GND |
| 1.792501                          | 34.30 | 10.3         | 46            | 11.3         |          | L1   | GND |

# 4.2 Radiated Emission

# **TEST CONFIGURATION**



## TEST PROCEDURE

- 1. The EUT was placed on a turn table which is 0.8m above ground plane.
- 2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0°C to 360°C to acquire the highest emissions from EUT.
- 3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 4. Repeat above procedures until all frequency measurements have been completed.
- 5. The EUT minimum operation frequency was 32.768 KHz and maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9 KHz to 25GHz.
- 6. The distance between test antenna and EUT as following table states:

| Test Frequency range | Test Antenna Type          | Test Distance |
|----------------------|----------------------------|---------------|
| 9KHz-30MHz           | Active Loop Antenna        | 3             |
| 30MHz-1GHz           | Ultra-Broadband Antenna    | 3             |
| 1GHz-18GHz           | Double Ridged Horn Antenna | 3             |
| 18GHz-25GHz          | Horn Anternna              | 1             |

7. Setting test receiver/spectrum as following table states:

| Test Frequency range | Test Receiver/Spectrum Setting         | Detector   |
|----------------------|--|------------|
| 9KHz-150KHz          | RBW=200Hz/VBW=3KHz,Sweep time=Auto     | QP         |
| 150KHz-30MHz         | RBW=9KHz/VBW=100KHz,Sweep time=Auto    | QP         |
| 30MHz-1GHz           | RBW=120KHz/VBW=1000KHz,Sweep time=Auto | QP         |
|                      | Peak Value: RBW=1MHz/VBW=3MHz,         | Peak       |
| 1GHz-40GHz           | Sweep time=Auto                        | (Receiver) |
| IGHZ-40GHZ           | Average Value: RBW=1MHz/VBW=3MHz,      | Average    |
|                      | Sweep time=Auto                        | (Receiver) |

#### Field Strength Calculation

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

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

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

For example

| Frequency | FS       | RA       | AF   | CL   | AG    | Transd |
|-----------|----------|----------|------|------|-------|--------|
| (MHz)     | (dBµV/m) | (dBµV/m) | (dB) | (dB) | (dB)  | (dB)   |
| 300.00    | 40       | 58.1     | 12.2 | 1.6  | 31.90 |        |

Transd=AF +CL-AG

#### RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

| Frequency (MHz) | Distance (Meters) | Radiated (dBµV/m)      | Radiated (µV/m) |
|-----------------|-------------------|------------------------|-----------------|
| 0.009-0.49      | 300               | 20log(2400/F(KHz))+80  | 2400/F(KHz)     |
| 0.49-1.705      | 30                | 20log(24000/F(KHz))+40 | 24000/F(KHz)    |
| 1.705-30        | 30                | 20log(30)+40           | 30              |
| 30-88           | 3                 | 40.0                   | 100             |
| 88-216          | 3                 | 43.5                   | 150             |
| 216-960         | 3                 | 46.0                   | 200             |
| Above 960       | 3                 | 54.0                   | 500             |

#### TEST RESULTS

Remark:

1. The radiated measurement are performed the each channel (low/mid/high) at all Packet type (DH1, DH3 and DH5) also for difference modulation type (GFSK, 8DPSK), recorded worst case at GFSK\_DH5\_Low channel (Channel 00) for below 1GHz and GFSK\_DH5\_Low channel (Channel 00), GFSK\_DH5\_Middle channel (Channel 39), GFSK\_DH5\_High channel (Channel 78).

2. ULTRA-BROADBAND ANTENNA for the radiation emission test below 1G.

- 3. HORN ANTENNA for the radiation emission test above 1G.
- 4. We tested both battery powered and powered by adapter charging mode at three orientate ones, recorded worst case at powered by adapter charging mode.

5. "---" means not recorded as emission levels lower than limit.

6. Margin= Limit - Level

#### For 9KHz to 30MHz

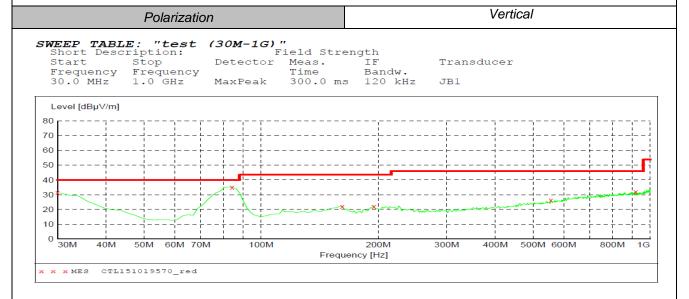
| Frequency<br>(MHz) | Corrected Reading<br>(dBµV/m)@3m | FCC Limit<br>(dBµV/m) @3m | Margin<br>(dB) | Detector | Result |
|--------------------|----------------------------------|---------------------------|----------------|----------|--------|
| 12.65              | 47.55                            | 69.54                     | 21.99          | QP       | PASS   |
| 20.45              | 42.69                            | 69.54                     | 26.85          | QP       | PASS   |

#### For 30MHz to 1000MHz

| Polarizat   | ion                          | Horizontal                                     |  |  |  |  |  |
|---|------------------------------|--|--|--|--|--|--|
| SWEEP TABLE: "test<br>Short Description:<br>Start Stop<br>Frequency Frequency<br>30.0 MHz 1.0 GHz | Field Stre<br>Detector Meas. | IF Transducer<br>Bandw.                        |  |  |  |  |  |
| Level [dBµ∀/m]  |                              |  |  |  |  |  |  |
| 80         70         60         50         40         30         20         10                   | *                            |  |  |  |  |  |  |
| 0 30M 40M 50M 60M 7   |                              | 200M 300M 400M 500M 600M 800M 1G<br>iency [Hz] |  |  |  |  |  |
| × × × MES CTL151019571_red  |                              |  |  |  |  |  |  |

#### MEASUREMENT RESULT: "CTL151019571\_red"

|                  |                 |              |                 | _            |      |              |                |              |  |
|------------------|-----------------|--------------|-----------------|--------------|------|--------------|----------------|--------------|--|
| _ , _ ,          | 06PM            |              |                 |              |      |              |                |              |  |
| Frequency<br>MHz | Level<br>dBµV/m | Transd<br>dB | Limit<br>dBµV/m | Margin<br>dB | Det. | Height<br>cm | Azimuth<br>deg | Polarization |  |
| 30.000000        | 24.70           | 20.8         | 40.0            | 15.3         |      | 0.0          | 0.00           | HORIZONTAL   |  |
| 84.320000        | 19.40           | 8.8          | 40.0            | 20.6         |      | 0.0          | 0.00           | HORIZONTAL   |  |
| 158.040000       | 19.60           | 13.7         | 43.5            | 23.9         |      | 0.0          | 0.00           | HORIZONTAL   |  |
| 202.660000       | 20.30           | 14.1         | 43.5            | 23.2         |      | 0.0          | 0.00           | HORIZONTAL   |  |
| 532.460000       | 26.00           | 20.5         | 46.0            | 20.0         |      | 0.0          | 0.00           | HORIZONTAL   |  |
| 949.560000       | 31.90           | 26.5         | 46.0            | 14.1         |      | 0.0          | 0.00           | HORIZONTAL   |  |
|                  |                 |              |                 |              |      |              |                |              |  |



#### MEASUREMENT RESULT: "CTL151019570\_red"

| 10/19/2015 9 | :04PM  |        |        |        |      |        |         |              |
|--------------|--------|--------|--------|--------|------|--------|---------|--------------|
| Frequency    | Level  | Transd | Limit  | Margin | Det. | Height | Azimuth | Polarization |
| MHz          | dBµV/m | dB     | dBµV/m | dB     |      | cm     | deg     |              |
|              |        |        |        |        |      |        |         |              |
| 30.000000    | 31.50  | 20.8   | 40.0   | 8.5    |      | 0.0    | 0.00    | VERTICAL     |
| 84.320000    | 35.10  | 8.8    | 40.0   | 4.9    |      | 0.0    | 0.00    | VERTICAL     |
| 161.920000   | 22.10  | 13.6   | 43.5   | 21.4   |      | 0.0    | 0.00    | VERTICAL     |
| 194.900000   | 22.00  | 13.2   | 43.5   | 21.5   |      | 0.0    | 0.00    | VERTICAL     |
| 555.740000   | 26.20  | 21.1   | 46.0   | 19.8   |      | 0.0    | 0.00    | VERTICAL     |
| 918.520000   | 32.10  | 26.2   | 46.0   | 13.9   |      | 0.0    | 0.00    | VERTICAL     |
|              |        |        |        |        |      |        |         |              |

#### For 1GHz to 25GHz

Note:We tested GFSK Mode and 8DPSK, rcorded the worst case at the GFSK (DH5) Mode.

|     | Frequency(         | (MHz):         |    | 240               | 2              |                        | Polarity:                   |                         | HORIZO                | NTAL                           |
|-----|--------------------|----------------|----|-------------------|----------------|------------------------|-----------------------------|-------------------------|-----------------------|--------------------------------|
| No. | Frequency<br>(MHz) | (MHz) (dBuV/m) |    | Limit<br>(dBuV/m) | Margin<br>(dB) | Raw<br>Value<br>(dBuV) | Antenna<br>Factor<br>(dB/m) | Cable<br>Factor<br>(dB) | Pre-amplifier<br>(dB) | Correction<br>Factor<br>(dB/m) |
| 1   | 4804.00            | 55.59          | ΡK | 74                | 18.41          | 51.08                  | 33.49                       | 6.91                    | 35.89                 | 4.51                           |
| 1   | 4804.00            | 42.12          | AV | 54                | 11.88          | 37.61                  | 33.49                       | 6.91                    | 35.89                 | 4.51                           |
| 2   | 5175.25            | 43.59          | ΡK | 74                | 30.41          | 36.27                  | 34.49                       | 7.13                    | 34.29                 | 7.32                           |
| 2   | 5175.25            |                | AV | 54                |                |                        |                             |                         |                       |                                |
| 3   | 7206.00            | 46.87          | ΡK | 74                | 27.13          | 35.76                  | 36.95                       | 9.18                    | 35.03                 | 11.11                          |
| 3   | 7206.00            | -              | AV | 54                |                |                        |                             |                         |                       |                                |

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)

2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

3. Margin value = Limit value- Emission level.

4. -- Mean the PK detector measured value is below average limit.

5. The other emission levels were very low against the limit.

|     | Frequency(         | (MHz):                   |    | 240               | 2              |                        | Polarity:                   |                         | VERTICAL              |                                |  |
|-----|--------------------|--------------------------|----|-------------------|----------------|------------------------|-----------------------------|-------------------------|-----------------------|--------------------------------|--|
| No. | Frequency<br>(MHz) | Emissi<br>Leve<br>(dBuV/ | I  | Limit<br>(dBuV/m) | Margin<br>(dB) | Raw<br>Value<br>(dBuV) | Antenna<br>Factor<br>(dB/m) | Cable<br>Factor<br>(dB) | Pre-amplifier<br>(dB) | Correction<br>Factor<br>(dB/m) |  |
| 1   | 4804.00            | 55.47                    | ΡK | 74                | 18.53          | 50.96                  | 33.49                       | 6.91                    | 35.89                 | 4.51                           |  |
| 1   | 4804.00            | 42.87                    | AV | 54                | 11.13          | 38.36                  | 33.49                       | 6.91                    | 35.89                 | 4.51                           |  |
| 2   | 5325.50            | 44.89                    | ΡK | 74                | 29.11          | 37.36                  | 34.67                       | 7.22                    | 34.35                 | 7.53                           |  |
| 2   | 5325.50            |                          | AV | 54                |                |                        |                             |                         |                       |                                |  |
| 3   | 7206.00            | 45.78                    | ΡK | 74                | 28.22          | 34.67                  | 36.95                       | 9.18                    | 35.03                 | 11.11                          |  |
| 3   | 7206.00            |                          | AV | 54                |                |                        |                             |                         |                       |                                |  |

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)

2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

3. Margin value = Limit value- Emission level.

4. -- Mean the PK detector measured value is below average limit.
 5. The other emission levels were very low against the limit.

|     | Frequency(         | MHz):                    |    | 244               | 1              |                        | Polarity:                   |                         | HORIZO                | NTAL                           |
|-----|--------------------|--------------------------|----|-------------------|----------------|------------------------|-----------------------------|-------------------------|-----------------------|--------------------------------|
| No. | Frequency<br>(MHz) | Emissi<br>Leve<br>(dBuV/ | l  | Limit<br>(dBuV/m) | Margin<br>(dB) | Raw<br>Value<br>(dBuV) | Antenna<br>Factor<br>(dB/m) | Cable<br>Factor<br>(dB) | Pre-amplifier<br>(dB) | Correction<br>Factor<br>(dB/m) |
| 1   | 3158.75            | 40.22                    | ΡK | 74                | 33.78          | 39.03                  | 31.14                       | 5.43                    | 35.38                 | 1.19                           |
| 1   | 3158.75            |                          | AV | 54                |                |                        |                             |                         |                       |                                |
| 2   | 4882.00            | 55.66                    | ΡK | 74                | 18.34          | 49.30                  | 33.60                       | 6.95                    | 34.19                 | 6.36                           |
| 2   | 4882.00            | 43.41                    | AV | 54                | 10.59          | 37.05                  | 33.60                       | 6.95                    | 34.19                 | 6.36                           |
| 3   | 5233.60            | 42.69                    | ΡK | 74                | 31.31          | 35.05                  | 34.57                       | 7.16                    | 34.10                 | 7.64                           |
| 3   | 5233.60            |                          | AV | 54                |                |                        |                             |                         |                       |                                |
| 4   | 7323.00            | 46.32                    | ΡK | 74                | 27.68          | 34.62                  | 37.46                       | 9.23                    | 35.00                 | 11.70                          |
| 4   | 7323.00            |                          | AV | 54                |                |                        |                             |                         |                       |                                |

**REMARKS**:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)

2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor

3. Margin value = Limit value- Emission level.

4. -- Mean the PK detector measured value is below average limit.

5. The other emission levels were very low against the limit.

|     | Frequency(         | (MHz):                   |    | 244               | 1              |                        | Polarity:                   |                         | VERTIC                | CAL                            |
|-----|--------------------|--------------------------|----|-------------------|----------------|------------------------|-----------------------------|-------------------------|-----------------------|--------------------------------|
| No. | Frequency<br>(MHz) | Emissi<br>Leve<br>(dBuV/ | l  | Limit<br>(dBuV/m) | Margin<br>(dB) | Raw<br>Value<br>(dBuV) | Antenna<br>Factor<br>(dB/m) | Cable<br>Factor<br>(dB) | Pre-amplifier<br>(dB) | Correction<br>Factor<br>(dB/m) |
| 1   | 3157.75            | 40.44                    | ΡK | 74                | 33.56          | 39.25                  | 31.13                       | 5.43                    | 35.38                 | 1.19                           |
| 1   | 3157.75            |                          | AV | 54                |                |                        |                             |                         |                       |                                |
| 2   | 4882.00            | 56.48                    | ΡK | 74                | 17.52          | 50.12                  | 33.60                       | 6.95                    | 34.19                 | 6.36                           |
| 2   | 4882.00            | 44.75                    | AV | 54                | 9.25           | 38.39                  | 33.60                       | 6.95                    | 34.19                 | 6.36                           |
| 3   | 5125.50            | 43.69                    | ΡK | 74                | 30.31          | 36.36                  | 34.38                       | 7.10                    | 34.16                 | 7.33                           |
| 3   | 5125.50            |                          | AV | 54                |                |                        |                             |                         |                       |                                |
| 4   | 7323.00            | 47.78                    | ΡK | 74                | 26.22          | 36.08                  | 37.46                       | 9.23                    | 35.00                 | 11.70                          |
| 4   | 7323.00            |                          | AV | 54                |                |                        |                             |                         |                       |                                |

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)

Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
 Margin value = Limit value- Emission level.

4. -- Mean the PK detector measured value is below average limit.
 5. The other emission levels were very low against the limit.

|     | Frequency(         | (MHz):                   |    | 2480              |                |                        | Polarity:                   |                         | HORIZONTAL            |                                |
|-----|--------------------|--------------------------|----|-------------------|----------------|------------------------|-----------------------------|-------------------------|-----------------------|--------------------------------|
| No. | Frequency<br>(MHz) | Emissi<br>Leve<br>(dBuV/ | I  | Limit<br>(dBuV/m) | Margin<br>(dB) | Raw<br>Value<br>(dBuV) | Antenna<br>Factor<br>(dB/m) | Cable<br>Factor<br>(dB) | Pre-amplifier<br>(dB) | Correction<br>Factor<br>(dB/m) |
| 1   | 4960.00            | 55.55                    | ΡK | 74                | 18.45          | 50.63                  | 33.84                       | 7.00                    | 35.92                 | 4.92                           |
| 1   | 4960.00            | 43.47                    | AV | 54                | 10.53          | 38.55                  | 33.84                       | 7.00                    | 35.92                 | 4.92                           |
| 2   | 5349.85            | 43.96                    | ΡK | 74                | 30.04          | 36.40                  | 34.69                       | 7.23                    | 34.36                 | 7.56                           |
| 2   | 5349.85            |                          | AV | 54                |                |                        |                             |                         |                       |                                |
| 3   | 7440.00            | 46.51                    | ΡK | 74                | 27.49          | 34.56                  | 37.64                       | 9.28                    | 34.97                 | 11.95                          |
| 3   | 7440.00            |                          | AV | 54                |                |                        |                             |                         |                       |                                |

#### **REMARKS**:

- 1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
- 2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
- 3. Margin value = Limit value- Emission level.
- 4. -- Mean the PK detector measured value is below average limit.
- 5. The other emission levels were very low against the limit.

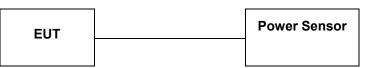
|     | Frequency          | (MHz):                   |    | 2480              |                |                        | Polarity:VERTINAntenna<br>Factor<br>(dB/m)Cable<br>Factor<br>(dB)Pre-amplifier<br>(dB)33.847.0035.9233.847.0035.9234.337.0934.27 |        | VERTICAL |                                |  |
|-----|--------------------|--------------------------|----|-------------------|----------------|------------------------|--|--------|----------|--------------------------------|--|
| No. | Frequency<br>(MHz) | Emissi<br>Leve<br>(dBuV/ | I  | Limit<br>(dBuV/m) | Margin<br>(dB) | Raw<br>Value<br>(dBuV) | Factor   | Factor |          | Correction<br>Factor<br>(dB/m) |  |
| 1   | 4960.00            | 55.66                    | ΡK | 74                | 18.34          | 50.74                  | 33.84  | 7.00   | 35.92    | 4.92                           |  |
| 1   | 4960.00            | 42.98                    | AV | 54                | 11.02          | 38.06                  | 33.84  | 7.00   | 35.92    | 4.92                           |  |
| 2   | 5100.50            | 43.65                    | ΡK | 74                | 30.35          | 36.49                  | 34.33  | 7.09   | 34.27    | 7.16                           |  |
| 2   | 5100.50            |                          | AV | 54                |                |                        |  |        |          |                                |  |
| 3   | 7440.00            | 45.41                    | ΡK | 74                | 28.59          | 33.46                  | 37.64  | 9.28   | 34.97    | 11.95                          |  |
| 3   | 7440.00            |                          | AV | 54                |                |                        |  |        |          |                                |  |

#### REMARKS:

- 1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
- Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)-Pre-amplifier Factor
   Margin value = Limit value- Emission level.
- 4. -- Mean the PK detector measured value is below average limit.
   5. The other emission levels were very low against the limit.

# 4.3 Maximum Peak Output Power

## TEST CONFIGURATION



## TEST PROCEDURE

According to ANSI C63.10:2009 Maximum peak conducted output power: Connent antenna port into power meter and reading Peak values.

## <u>LIMIT</u>

For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 nonoverlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

## TEST RESULTS

Remark: We test maximum peak output power at difference Packet Type (DH1, DH3 and DH5), recorded worst case at DH5

## 4.3.1 GFSK Test Mode

A. Test Verdict

| Channel | Frequency<br>(MHz) | Measured Output Peak Power<br>(dBm) | Limits<br>(dBm) | Verdict |
|---------|--------------------|-------------------------------------|-----------------|---------|
| 00      | 2402               | 2.745                               | 30              | PASS    |
| 39      | 2441               | 2.801                               | 30              | PASS    |
| 78      | 2480               | 3.155                               | 30              | PASS    |

Note:

1. The test results including the cable lose.

## 4.3.2 $\pi/4$ DQPSK Test Mode

A. Test Verdict

| Channel | Frequency<br>(MHz) | Measured Output Peak Power<br>(dBm) | Limits<br>(dBm) | Verdict |
|---------|--------------------|-------------------------------------|-----------------|---------|
| 00      | 2402               | 2.250                               | 30              | PASS    |
| 39      | 2441               | 2.093                               | 30              | PASS    |
| 78      | 2480               | 2.198                               | 30              | PASS    |

Note:

1. The test results including the cable lose.

## 4.3.3 8DPSK Test Mode

A. Test Verdict

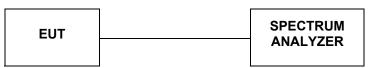
| Channel | Frequency<br>(MHz) | Measured Output Peak Power<br>(dBm) | Limits<br>(dBm) | Verdict |
|---------|--------------------|-------------------------------------|-----------------|---------|
| 00      | 2402               | 1.439                               | 30              | PASS    |
| 39      | 2441               | 1.067                               | 30              | PASS    |
| 78      | 2480               | 2.040                               | 30              | PASS    |

Note:

1. The test results including the cable lose.

# 4.4 20dB Bandwidth

## TEST CONFIGURATION



### TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=30 KHz and VBW=100KHz. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

#### LIMIT

For frequency hopping systems operating in the 2400MHz-2483.5MHz no limit for 20dB bandwith.

## TEST RESULTS

## 4.4.1 GFSK Test Mode

#### A. Test Verdict

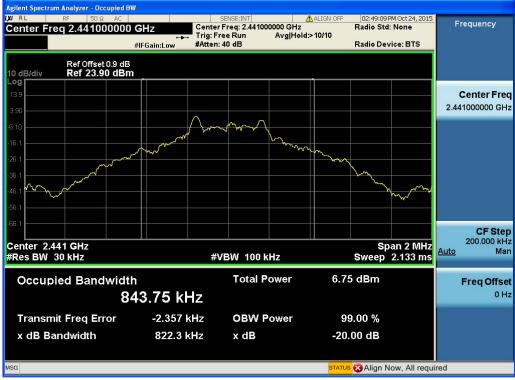
| Channel | Frequency<br>(MHz) | 20dB Bandwidth<br>(MHz) | Refer to Plot | Limits<br>(MHz) | Verdict |
|---------|--------------------|-------------------------|---------------|-----------------|---------|
| 00      | 2402               | 0.8211                  | Plot 4.4.1 A  | /               | PASS    |
| 39      | 2441               | 0.8223                  | Plot 4.4.1 B  | /               | PASS    |
| 78      | 2480               | 0.8281                  | Plot 4.4.1 C  | /               | PASS    |

Note: 1. The test results including the cable lose.

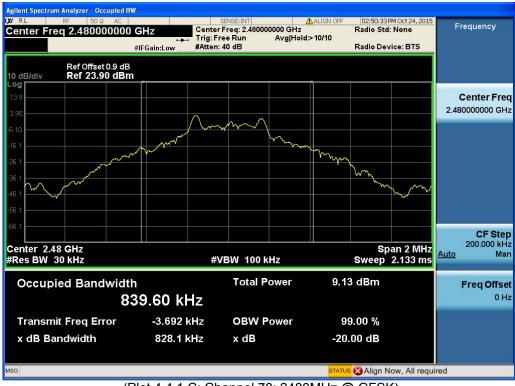
#### B. Test Plots



(Plot 4.4.1 A: Channel 00: 2402MHz @ GFSK)



(Plot 4.4.1 B: Channel 39: 2441MHz @ GFSK)



(Plot 4.4.1 C: Channel 78: 2480MHz @ GFSK)

#### 4.4.2 8DPSKTest Mode

#### A. Test Verdict

| Channel | Frequency<br>(MHz) | 20dB Bandwidth<br>(MHz) | Refer to Plot | Limits<br>(MHz) | Verdict |
|---------|--------------------|-------------------------|---------------|-----------------|---------|
| 00      | 2402               | 1.122                   | Plot 4.4.2 A  | /               | PASS    |
| 39      | 2441               | 1.107                   | Plot 4.4.2 B  | /               | PASS    |
| 78      | 2480               | 1.131                   | Plot 4.4.2 C  | /               | PASS    |

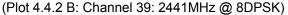
Note: 1.The test results including the cable lose.

#### B. Test Plots



(Plot 4.4.2 A: Channel 00: 2402MHz @ 8DPSK)







(Plot 4.4.2 C: Channel 78: 2480MHz @ 8DPSK)

# 4.5 Band Edge

## Applicable Standard

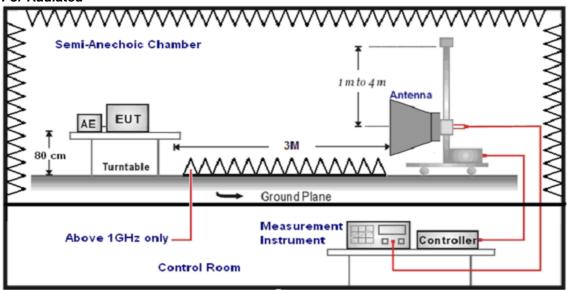
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the 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)).

## TEST PROCEDURE

- 1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- 2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
- 3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge, for Radiated emissions restricted band RBW=1MHz, VBW=3MHz.
- 4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- 5. Repeat above procedures until all measured frequencies were complete.

## TEST CONFIGURATION

For Radiated



## For Conducted



#### TEST PROCEDURE

- 1. The EUT was placed on a turn table which is 0.8m above ground plane.
- 2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from  $0^{\circ}$  to  $360^{\circ}$  to acquire the highest emissions from EUT.

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- 3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 4. Repeat above procedures until all frequency measurements have been completed..
- 5. The distance between test antenna and EUT was 3 meter:
- 6. Setting test receiver/spectrum as following table states:

| Test Frequency range | Test Receiver/Spectrum Setting    | Detector   |
|----------------------|-----------------------------------|------------|
| 104-1004-            | Peak Value: RBW=1MHz/VBW=3MHz,    |            |
| 1GHz-40GHz           | Sweep time=Auto                   | (Receiver) |
| 1GHz-40GHz           | Average Value: RBW=1MHz/VBW=3MHz, | Average    |
| IGHZ-40GHZ           | Sweep time=Auto                   | (Receiver) |

## <u>LIMIT</u>

Below -20dB of the highest emission level in operating band.

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)

#### TEST RESULTS

Remark:

1. We test Band Edge at difference Packet Type (DH1, DH3 and DH5), recorded worst case at DH5. 2. "---" means not recorded as emission levels lower than limit.

## 4.5.1 For Radiated Bandedge Measurement

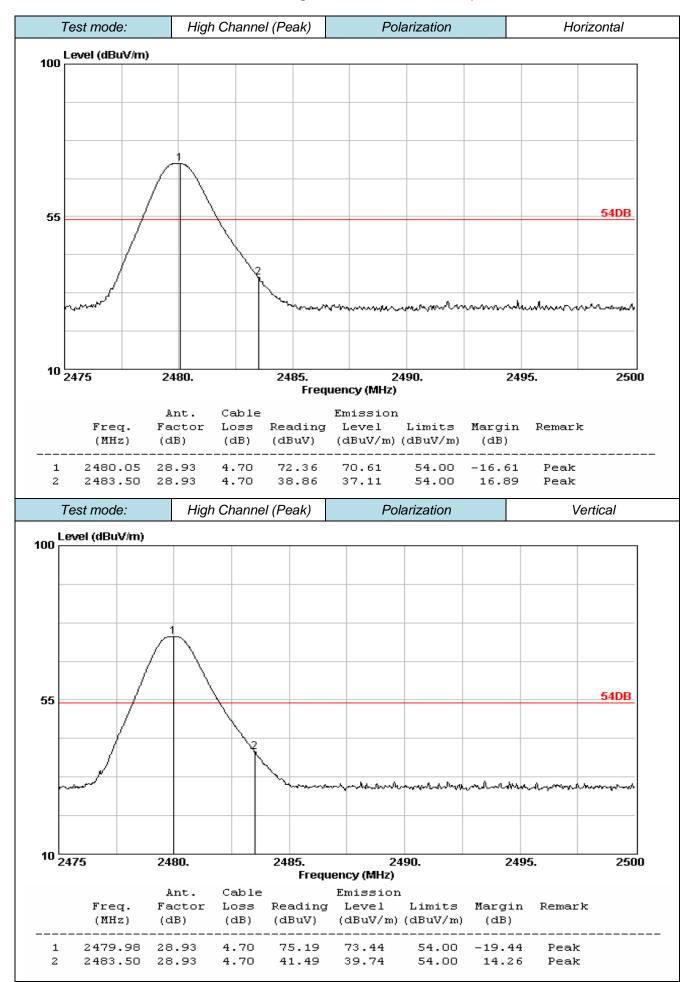
Remark: we tested radiated bandedge at both hopping and no-hopping modes, recorded worst case at no-hopping mode

#### 4.5.1.1 GFSK Test Mode Polarization Test mode: Low Channel (Peak) Horizontal 100 Level (dBuV/m) 3 54DB 55 much have been and with the more for more thank a have will write the 10 2310 2390. 2330. 2350. 2370. 2410 Frequency (MHz) Ant. Cable Emission Factor Loss Reading Level Limits Margin Remark (dB) (dB) (dBuV) (dBuV/m) (dBuV/m) (dB) Freq. (MHz) \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ 30.77 23.23 2390.00 28.78 4.61 32.74 54.00 1 Peak 2 2400.00 28.78 4.61 50.05 48.08 54.00 5.92 Peak 71.39 2402.20 28.78 4.61 69.42 54.00 -15.42 Peak з Test mode: Polarization Low Channel (Peak) Vertical Level (dBuV/m) 3 54DB 55 and and march marker when ahaan wu 10 2310 2330. 2350. 2370. 2390. 2410 Frequency (MHz) Ant. Cable Emission Freq. Factor Loss Reading Level Limits Margin Remark (MHz) (dB) (dB) (dBuV) (dBuV/m)(dBuV/m) (dB) \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_ \_\_\_\_\_ 2390.00 28.78 4.61 35.60 33.63 54.00 20.37 Peak 1 4.61 51.02 2 2400.00 28.78 52.99 54.00 2.98 Peak 2402.20 28.78 4.61 74.30 72.33 54.00 -18.33 Peak з

Remark: For the peak measured value complies with the average limit, the average measurement not performed

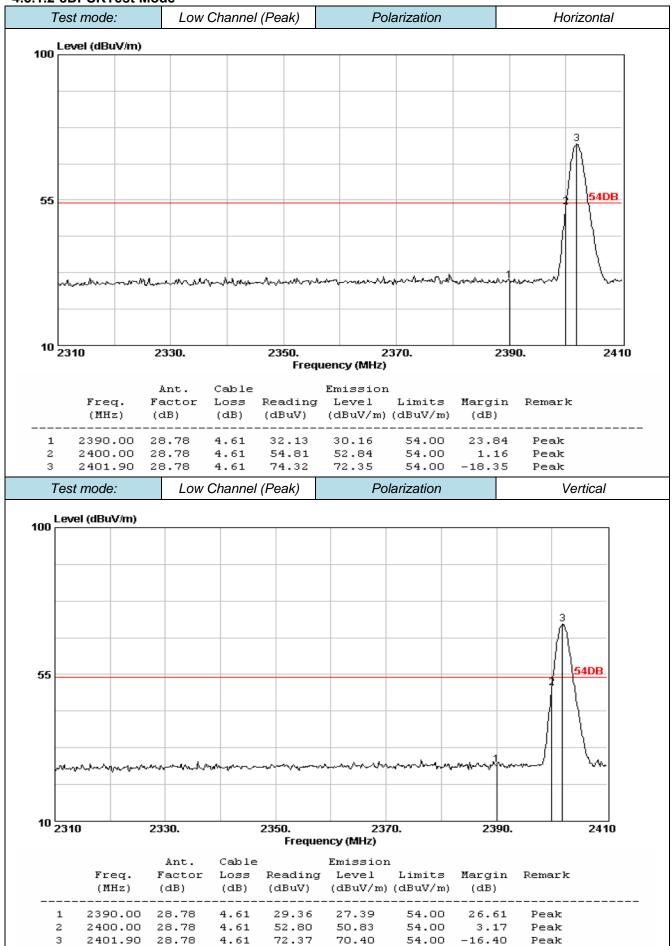
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Report No.: MWR151101103



Remark: For the peak measured value complies with the average limit, the average measurement not performed

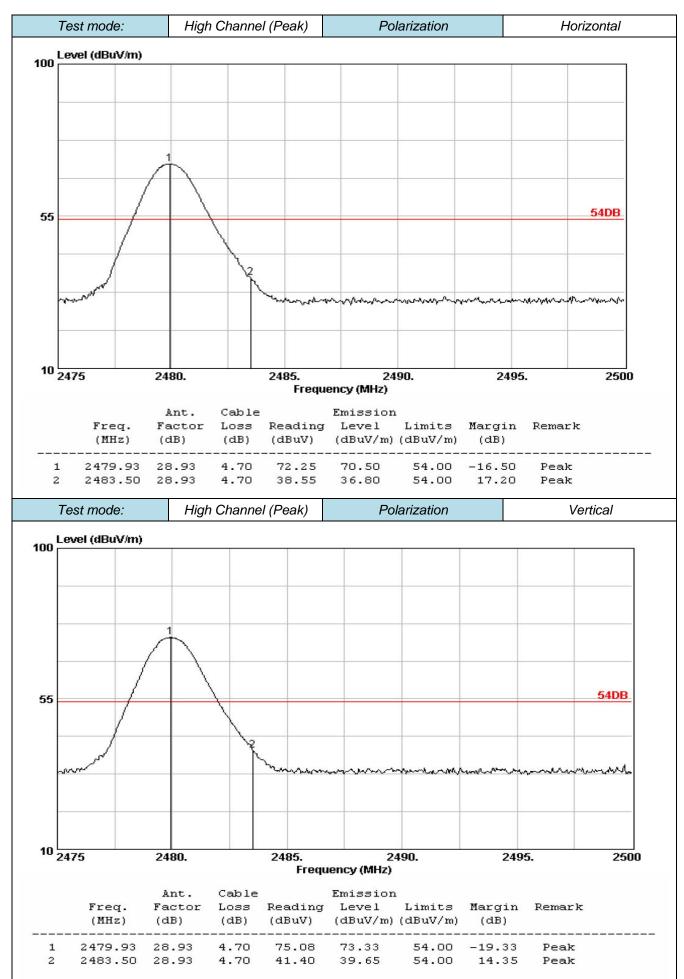
#### 4.5.1.2 8DPSKTest Mode



Remark: For the peak measured value complies with the average limit, the average measurement not performed

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Report No.: MWR151101103



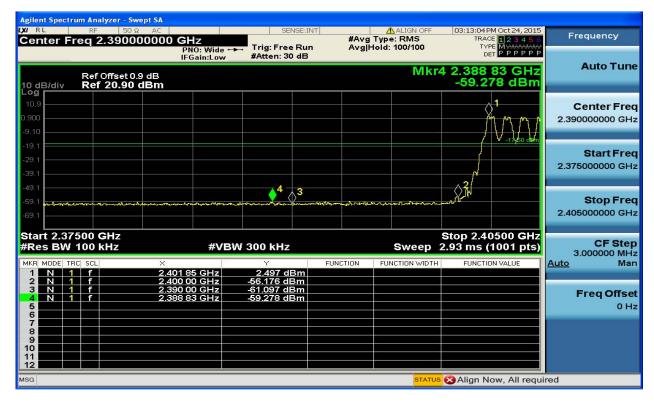
Remark: For the peak measured value complies with the average limit, the average measurement not performed

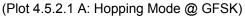
## 4.5.2 For Conducted Bandedge Measurement

#### 4.5.2.1 GFSK Test Mode

We tested hopping mode and non-hopping mode, and recorded the worst case at the hopping mode.

#### A. Test Plots





| Agilent Spectrum Analyzer - Swept SA  |                                    |  |   |   |                                     |
|---|------------------------------------|--|---|---|-------------------------------------|
| X// RL         RF         50 Ω         AC           Center Freq 2.491000000         Γ <thγ< th="">         Γ         Γ</thγ<> |                                    |  | ALIGN OFF<br>7g Type: RMS<br>1Hold: 100/100 | 03:22:04 PM Oct 24, 2015<br>TRACE 1 2 3 4 5 6<br>TYPE MWWWW | Frequency                           |
| Ref Offset 0.9 dB   |                                    | Free Run Avş<br>n: 30 dB                     |   | 4 2.484 13 GHz<br>-58.698 dBm                               | Auto Tune                           |
|   |                                    |  |   |   | Center Freq<br>2.491000000 GHz      |
| -19.1   |                                    |  |   | -17.06 dBm  | Start Freq<br>2.476000000 GHz       |
| -49.1   | · 4<br>muchanneterment             | al-name-strandingto-strandingto-strandingto- |   | 3<br>Automourum particular and an anti-                     | <b>Stop Freq</b><br>2.506000000 GHz |
| Start 2.47600 GHz<br>#Res BW 100 kHz  | #VBW 300 k                         | HZ   |   | Stop 2.50600 GHz<br>2.93 ms (1001 pts)                      | CF Step<br>3.000000 MHz<br>Auto Man |
| 1 N 1 f 2.47<br>2 N 1 f 2.48<br>3 N 1 f 2.50  | 3 50 GHz -61.06<br>0 00 GHz -60.71 | 7 dBm<br>9 dBm<br>5 dBm<br>8 dBm             |   |   | Freq Offset<br>0 Hz                 |
| 7<br>8<br>9<br>10<br>11<br>12   |                                    |  |   |   |                                     |
| MSG   |                                    |  | STATUS                                      | 🔀 Align Now, All requ                                       | ired                                |

(Plot 4.5.2.1 B: Hopping Mode @ GFSK)

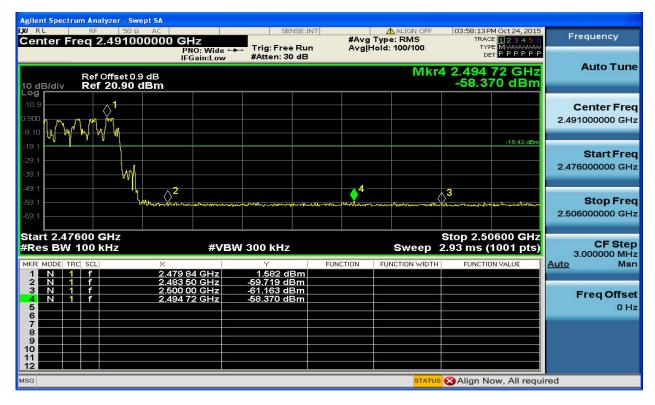
#### 4.5.2.2 8DPSK Test Mode

We tested hopping mode and non-hopping mode, and recorded the worst case at the hopping mode.

A. Test Plots

| Agilent Spectrum Analyzer - Swe         |   |                                 |                             |   |                                      |
|---|---|---------------------------------|-----------------------------|---|--------------------------------------|
| Center Freq 2.39000                     |   | SENSE:INT                       | ALIGN OFF<br>#Avg Type: RMS | 03:49:22 PM Oct 24, 2015<br>TRACE 1 2 3 4 5 5 | Frequency                            |
|   | PNO: Wide ←<br>IFGain:Low                             | Trig: Free Run<br>#Atten: 30 dB | Avg[Hold: 100/100           |   |                                      |
| Ref Offset 0.9<br>10 dB/div Ref 20.90 d |   |                                 | Mkr                         | 4 2.387 21 GHz<br>-59.077 dBm                 | Auto Tune                            |
| Log<br>10.9<br>0.900<br>-9.10           |   |                                 |                             | 1<br>1<br>19 09 dbm                           | Center Freq<br>2.390000000 GHz       |
| -19.1<br>-29.1<br>-39.1<br>-49.1        |   |                                 |                             |   | <b>Start Freq</b><br>2.375000000 GHz |
| -59.1 <b></b>                           | n, manang fasa an | 4 3<br>                         | mander at the second second |   | <b>Stop Freq</b><br>2.405000000 GHz  |
| Start 2.37500 GHz<br>#Res BW 100 kHz    | #VB   | W 300 kHz                       |                             | Stop 2.40500 GHz<br>2.93 ms (1001 pts)        | CF Step<br>3.000000 MHz              |
| MKR MODE TRC SCL                        | ×<br>2.402 15 GHz                                     | ץ<br>0.911 dBm                  | FUNCTION FUNCTION WIDTH     | FUNCTION VALUE                                | <u>Auto</u> Man                      |
| 2 N 1 f<br>3 N 1 f                      | 2.400 00 GHz<br>2.390 00 GHz                          | -53.328 dBm<br>-61.215 dBm      |                             |   | Freq Offset                          |
| 4 N 1 f                                 | 2.387 21 GHz  | -59.077 dBm                     |                             |   | 0 Hz                                 |
| 6<br>7<br>8                             |   |                                 |                             |   |                                      |
| 9                                       |   |                                 |                             |   |                                      |
| 11<br>12                                |   |                                 |                             |   |                                      |
| MSG                                     |   |                                 | STATU                       | s 🐼 Align Now, All requi                      | red                                  |

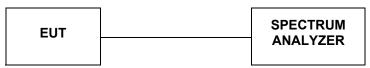




(Plot 4.5.2.2 B: Hopping Mode @ 8DPSK)

## 4.6 Frequency Separation

#### TEST CONFIGURATION



#### TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with RBW=30 KHz and VBW=100KHz.

#### <u>LIMIT</u>

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

#### TEST RESULTS

Remark: 1. We test Frequency Separation at difference Packet Type (DH1, DH3 and DH5) and all test channels, recorded worst case at DH5 and middle channel.

## 4.6.1 GFSK Test Mode

#### A. Test Verdict

| Channel | Frequency<br>(MHz) | Channel Separation<br>(MHz) | Refer to Plot | Limits<br>(MHz) | Verdict |
|---------|--------------------|-----------------------------|---------------|-----------------|---------|
| 38      | 2440               | 1 000                       | Plot 4.6.1 A  | 0 9702          | PASS    |
| 39      | 2441               | 1.000                       | PIOL 4.0. I A | 0.8702          | FA33    |

#### B. Test Plots



(Plot 4.6.1 A: Channel 39: 2441MHz @ GFSK)

## 4.6.2 8DPSK Test Mode

A. Test Verdict

| Channel | Frequency<br>(MHz) | Channel Separation<br>(MHz) | Refer to Plot | Limits<br>(MHz) | Verdict |
|---------|--------------------|-----------------------------|---------------|-----------------|---------|
| 38      | 2440               | 0.000                       | Plot 4.6.2 A  | 0 94036         | DASS    |
| 39      | 2441               | 0.982                       |               | 0.84936         | PASS    |

## B. Test Plots

| RL Fre  | RF 50 Ω                          |                                   | SENSE:INT  | ALIGN OFF<br>#Avg Type: RMS | 03:38:27 PM Oct 24, 2015<br>TRACE 1 2 3 4 5 6 | Frequency                        |
|---|----------------------------------|-----------------------------------|--|-----------------------------|---|----------------------------------|
|   | q 2. 110000                      | PNO: Wide ↔<br>IFGain:Low         | <ul> <li>Trig: Free Run<br/>#Atten: 40 dB</li> </ul> | Avg[Hold: 100/100           |   |                                  |
|   | Ref Offset 0.9 d<br>Ref 30.00 dB |                                   |  |                             | ∆Mkr1 982 kHz<br>0.031 dB                     | Auto Tui                         |
|   |                                  |                                   |  |                             | 1Δ2   | Center Fr<br>2.479500000 G       |
|   | www.                             |                                   | manny  | m And a second              | - Martin Martin                               | <b>Start Fr</b><br>2.478500000 G |
| 1.0<br>1.0<br>1.0                                     |                                  |                                   |  |                             |   | <b>Stop Fr</b><br>2.480500000 G  |
| art 2.4785<br>Res BW 10                               |                                  | #VBV                              | / 300 kHz  |                             | Stop 2.480500 GHz<br>1.00 ms (1001 pts)       | CF Sto<br>200.000 k              |
| ADDE     TRC       1     A2     1       2     F     1 | f (∆)                            | ×<br>982 kHz (Δ)<br>2.479 162 GHz |  | UNCTION FUNCTION WIDTH      | FUNCTION VALUE                                | <u>Auto</u> M                    |
|   |                                  |                                   |  |                             |   | Freq Offs<br>0                   |
| 7 B<br>B B<br>9 B                                     |                                  |                                   |  |                             |   |                                  |
| 1   |                                  |                                   |  |                             |   |                                  |

(Plot 4.6.2 A: Channel 39: 2441MHz @ 8DPSK)

# 4.7 Number of hopping frequency

## **TEST CONFIGURATION**



### TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator.Set spectrum analyzer start 2400MHz to 2483.5MHz with RBW=100 KHz and VBW=300 KHz.

#### <u>LIMIT</u>

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

#### TEST RESULTS

Remark: 1. We test Frequency Separation at difference Packet Type (DH1, DH3 and DH5), recorded worst case at DH5.

## 4.7.1 GFSK Test Mode

#### A. Test Verdict

| Hopping Channel Frequency Range<br>(MHz) | Number of<br>Hopping Channel | Refer to Plot | Limit | Verdict |
|--|------------------------------|---------------|-------|---------|
| 2400-2483.5                              | 79                           | Plot 4.7.1 A1 | ≥15   | PASS    |

#### B. Test Plots



(Plot 4.7.1 A1: @ GFSK)

# 4.7.2 8DPSK Test Mode

# A. Test Verdict

| Hopping Channel Frequency Range<br>(MHz) | Number of<br>Hopping Channel | Refer to Plot | Limit | Verdict |
|--|------------------------------|---------------|-------|---------|
| 2400-2483.5                              | 79                           | Plot 4.7.2 A1 | ≥15   | PASS    |

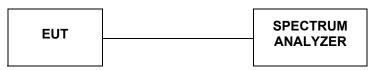
#### B. Test Plots

| RL RF<br>enter Freq 2.4         | 50 Ω AC<br>41750000 GHz           | SENSE:INT                                    | ALIGN OFF<br>#Avg Type: RMS<br>Avg Hold: 100/100 | 03:47:16 PM Oct 24, 2015<br>TRACE 12 3 4 5 6<br>TYPE MWWWWW | Frequency                               |
|---------------------------------|-----------------------------------|--|--|---|---|
|                                 | PNO: Fa<br>IFGain:L<br>set 0.9 dB | at   |  | DET PPPPPP<br>1 77.905 5 MHz<br>-0.241 dB                   | Auto Tur                                |
| 0 dB/div Ref 30                 | 0.00 dBm                          | WWW.MAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA       | wwwwwww  | 162   | Center Fre<br>2.441750000 GH            |
| а.о<br>1.0<br>1.0<br>1.0<br>1.0 | 48494 - 441144                    | <u>AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA</u> | dddwedda is sduddhodd                            | MR(AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA                     | Start Fre<br>2.400000000 GH             |
| J.O                             |                                   |  |  |   | <b>Stop Fre</b><br>2.483500000 GF       |
| art 2.40000 GH<br>Res BW 100 KH | z #                               |  | Sweep  | Stop 2.48350 GHz<br>8.00 ms (1001 pts)<br>FUNCTION VALUE    | CF Ste<br>8.350000 MI<br><u>Auto</u> Mi |
|                                 | 2.402 087 5 GH                    | z 0.722 dBm                                  |  |   | Freq Offs<br>0 I                        |
|                                 |                                   |  |  |   |   |

(Plot 4.7.2 A1: @ 8DPSK)

# 4.8 Time of Occupancy (Dwell Time)

## TEST CONFIGURATION



## TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an attenuator. Set center frequency of spectrum analyzer=operating frequency with RBW=1MHz and VBW=3MHz, Span=0Hz.

## <u>LIMIT</u>

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a pe-riod of 0.4 seconds multiplied by the number of hopping channels employed.

#### TEST RESULTS

The Dwell Time=Burst Width\*Total Hops. The detailed calculations are showed as follows:

The duration for dwell time calculation:0.4[s]\*hopping number=0.4[s]\*79[ch]=31.6[s\*ch];

The burst width [ms/hop/ch], which is directly measured, refers to the duration on one channel hop.

The hops per second for all channels: The selected EUT Conf uses a slot type of 5-Tx&1-Rx and a hopping rate of 1600 [ch\*hop/s] for all channels. So the final hopping rate for all channels is 1600/6=266.67 [ch\*hop/s] The hops per second on one channel: 266.67 [ch\*hop/s]/79 [ch]=3.38 [hop/s];

The total hops for all channels within the dwell time calculation duration: 3.38 [hop/s]\*31.6[s\*ch]=106.67 [hop\*ch];

The dwell time for all channels hopping: 106.67 [hop\*ch]\*Burst Width [ms/hop/ch].

Remark: 1. We test Frequency Separation at all test channels, recorded worst case at middle channel.

A. Test Verdict

| Mode | Frequency<br>(MHz)  | Pulse Width<br>(ms) | Dwell Time<br>(S) | Limit<br>(S) | Refer to Plot | Verdict |  |
|------|---|---------------------|-------------------|--------------|---------------|---------|--|
| DH1  | 2441  | 0.370               | 0.118             | 0.4          | Plot 4.8.1 A  | PASS    |  |
|      | Note: Dwell time=Pulse time (ms) × (1600 ÷ 2 ÷ 79) ×31.6 Second |                     |                   |              |               |         |  |
| DH3  | 2441  | 1.626               | 0.260             | 0.4          | Plot 4.8.1 B  | PASS    |  |
| DHS  | Note: Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second |                     |                   |              |               |         |  |
| DH5  | 2441  | 2.873               | 0.307             | 0.4          | Plot 4.8.1 C  | PASS    |  |
| DHD  | Note: Dwell time=Pulse Time (ms) × (1600 ÷ 6 ÷ 79) ×31.6 Second |                     |                   |              |               |         |  |

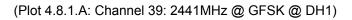
## 4.8.1 GFSK Test Mode

## 4.8.2 8DPSK Test Mode

| Mode | Frequency<br>(MHz)  | Pulse Width<br>(ms) | Dwell Time<br>(S) | Limit<br>(S)    | Refer to Plot | Verdict |  |  |
|------|---|---------------------|-------------------|-----------------|---------------|---------|--|--|
| DH1  | 2441  | 0.378               | 0.121             | 0.4             | Plot 4.8.2 A  | PASS    |  |  |
|      | Note: Dwell tin   | ne=Pulse time (r    | ns) × (1600 ÷ 2 · | ÷ 79) ×31.6 Sec | ond           |         |  |  |
| DH3  | 2441  | 1.628               | 0.260             | 0.4             | Plot 4.8.2 B  | PASS    |  |  |
| DH3  | Note: Dwell time=Pulse time (ms) × (1600 ÷ 4 ÷ 79) ×31.6 Second |                     |                   |                 |               |         |  |  |
| DH5  | 2441  | 2.878               | 0.307             | 0.4             | Plot 4.8.2 C  | PASS    |  |  |
| DHS  | Note: Dwell tin   | ne=Pulse Time (     | ms) × (1600 ÷ 6   | ÷ 79) ×31.6 Se  | cond          |         |  |  |

B. Test Plots

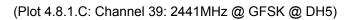
|                        | um Analyzer - Swept SA        |                            |  |                |  |                                |
|------------------------|-------------------------------|----------------------------|--|----------------|--|--------------------------------|
| DU RL                  | RF 50 Ω AC<br>reg 2.441000000 | GH7                        | SENSE:INT #A   |                | 03:59:06 PM Oct 24, 2015<br>TRACE 1 2 3 4 5 6                    | Frequency                      |
| Genter m               | eq 2.44 100000                | PNO: Wide Tr               | ig: Free Run<br>tten: 30 dB  | 3 . ,,         | DET P P P P P  |                                |
|                        |                               | II Gam.cow                 |  | N              | lkr3 1.447 ms  | Auto Tune                      |
| 10 dB/div              | Ref 20.00 dBm                 |                            |  |                | -4.83 dBm  |                                |
| Log<br>10.0            |                               |                            |  |                |  |                                |
|                        | 1∆23                          |                            |  |                |  | Center Freq<br>2.441000000 GHz |
| -10.0                  |                               |                            |  |                |  | 2.441000000 GH2                |
| -20.0                  |                               |                            |  |                |  |                                |
| -30.0                  |                               |                            |  |                |  | Start Freq                     |
| -40.0                  |                               |                            |  |                |  | 2.441000000 GHz                |
| -50.0                  | Lines to b                    | datette astanadet a cadata |  |                | 10.00 · · · · · · · · · · · · · · · · · ·                        |                                |
| -60.0                  | All AND A LARGENING           |                            | han dela deve de propio de la composición de la  |                | <mark>li</mark> kineten kineten ale da.<br>Tarriar barrar barrar | Stop Freq                      |
| -70.0                  | . In a state for a state      | In the part of the second  | a series and a series of the s | n at an in the | liktinatak pilatak bi  | 2.441000000 GHz                |
| Center 2.4             | 41000000 GHz                  |                            |  |                | Span 0 Hz  |                                |
| Res BW 1               | .0 MHz                        | #VBW 3.0                   | MHz  | Sweep 6.4      | 00 ms (8001 pts)   | CF Step<br>1.000000 MHz        |
| MKR MODE TR            |                               |                            | Y FUNCTION   | FUNCTION WIDTH | FUNCTION VALUE   | Auto Man                       |
| 1 <u>Δ2</u> 1<br>2 F 1 | t (∆)<br>t                    |                            | -2.54 dB<br>2.69 dBm   |                |  |                                |
| 3 N 1                  | t                             | 1.447 ms                   | 4.83 dBm   |                |  | Freq Offset                    |
| 5                      |                               |                            |  |                |  | 0 Hz                           |
| 7                      |                               |                            |  |                |  |                                |
| 8 9                    |                               |                            |  |                |  |                                |
| 10                     |                               |                            |  |                |  |                                |
| 12                     |                               |                            |  |                |  | 4                              |
| MSG                    |                               |                            |  | STATUS S       | Align Now, All requi   | red                            |



| RL                    | RF 50 Ω AC                                  |                                    | SENSE:INT   |             | ALIGN OFF   | 03:59:34 PM Oct 24, 20  |                            |
|-----------------------|---|------------------------------------|---|-------------|-------------|---|----------------------------|
| nter Fre              | q 2.44100000                                | 0 GHz<br>PNO: Wide ↔<br>IFGain:Low | <ul> <li>Trig: Free Run</li> <li>#Atten: 30 dB</li> </ul> | #Avg Type   | : RMS       | TRACE 12345<br>TYPE WWWWW<br>DET PPPP                           | M+                         |
| lB/div                | Ref 20.00 dBm                               | IFGain:Luw                         | Whiten of all   |             |             | Mkr3 3.764 m<br>-4.15 dBr                                       |                            |
|                       | X2  |                                    | 1∆2   | 3           |             |   | Center<br>2.441000000      |
| )                     |   |                                    |   |             |             |   | Start<br>2.441000000       |
|                       | an daadad amaa daa<br>Taraha ahaa ahaa ahaa |                                    | tratikostat Abada a<br>aluta talar estat pak              |             |             | da na sing dala dalam da na si<br>Parting Tapara da Anja (14) a | <b>Stop</b><br>2.441000000 |
| nter 2.44<br>5 BW 1.0 | 1000000 GHz<br>MHz                          | #VBN                               | ( 3.0 MHz   | s           | weep 6.     | Span 0 H<br>400 ms (8001 pt                                     | z<br>s) 1.000000           |
| MODE TRC              | scl X                                       | 1.626 ms (Δ)                       | Y F<br>0.86 dB  | UNCTION FUN | CTION WIDTH | FUNCTION VALUE  | Auto                       |
| F 1<br>N 1            | t   | 1.264 ms<br>3.764 ms               | -4.15 dBm<br>-4.15 dBm                                    |             |             |   | Freq O                     |
|                       |   |                                    |   |             |             |   |                            |
|                       |   |                                    |   |             |             |   |                            |

(Plot 4.8.1.B: Channel 39: 2441MHz @ GFSK @ DH3)

| Agilent Spectrum Analyzer - Swept SA           W RL         RF         50 Ω         AC           Center Freq 2.44100000   |   | SENSE:IM                          | #Avg Type: RM                              | IS TRACE          | 1 Oct 24, 2015 | Frequency                              |
|---|---|-----------------------------------|--|-------------------|----------------|--|
| 10 dB/div Ref 10.00 dBm   | IFGain:Low  | #Atten: 20 dB                     |  | Mkr3 7.           | PPPPP          | Auto Tune                              |
| -10.0   | X2  |                                   | <u></u>                                    |                   |                | Center Freq<br>2.441000000 GHz         |
| -30.0   |   |                                   |  |                   |                | <b>Start Freq</b><br>2.441000000 GHz   |
| -80.0<br>-70.0<br>-80.0   | <mark>u ballida Aldala</mark><br>Aprilan su da <mark>b</mark> |                                   | tinterial produces in<br>Proceeding (1997) |                   |                | <b>Stop Freq</b><br>2.441000000 GHz    |
| Center 2.441000000 GHz<br>Res BW 1.0 MHz  |   | √ 3.0 MHz                         |  | ep 10.13 ms (8    |                | CF Step<br>1.000000 MHz<br>Auto Man    |
| MR         MODE         THC         XL         Y           1         Δ2         1         t         (Δ)         Z         T         t         (Δ)         Z         T         t         (Δ)         Z         T         t         (Δ)         Z         T         t         T | 2.873 ms (∆)<br>3.504 ms<br>7.254 ms                          | 0.41 dB<br>-1.14 dBm<br>-0.65 dBm |  |                   | VALUE          | <u>Auto</u> Man<br>Freq Offsel<br>0 Hz |
| 7<br>8<br>9<br>10<br>11<br>12   |   |                                   |  |                   |                |  |
| MSG   |   |                                   |  | STATUS 🐼 Align No | w, All require | ed                                     |



| RL  | RF 50 Ω             | AC                                    | SENSE:INT                       | 🚹 ALIGN OFF   | 04:00:59 PM Oct 24, 2015                  |                                  |
|---|---------------------|---------------------------------------|---------------------------------|---|---|----------------------------------|
| enter Fre   | eq 2.44100          | 0000 GHz<br>PNO: Wide -<br>IFGain:Low | Trig: Free Run<br>#Atten: 30 dB | #Avg Type: RMS  | TRACE 123456<br>TYPE WWWWWWW<br>DET PPPPP | Frequency                        |
| ) dB/div  | Ref 20.00 d         | IBm                                   |                                 |   | Mkr3 2.303 ms<br>-2.84 dBm                | Auto Tur                         |
|   | X3                  |                                       |                                 | <b>P1</b>   |   | Center Fre<br>2.441000000 GH     |
| 0.0   |                     |                                       |                                 |   |   | <b>Start Fr</b><br>2.441000000 G |
| 0.0   hithey  |                     |                                       |                                 | davati od konstanti od podu<br><mark>, jugi konstanti dina potos, in p</mark> o |   | <b>Stop Fr</b><br>2.441000000 G  |
| enter 2.44<br>es BW 1.0                                   | 41000000 G<br>0 MHz |                                       | W 3.0 MHz                       | Sweep 6   | Span 0 Hz<br>i.400 ms (8001 pts)          | CF St<br>1.000000 M              |
| KR MODE TRC   | scl                 | ×<br>378.4 µs (∆                      |                                 | UNCTION FUNCTION WIDTH  | FUNCTION VALUE                            | <u>Auto</u> N                    |
| 2 F 1<br>3 N 1<br>4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 |                     | 1.053 ms<br>2.303 ms                  | -4.72 dBm<br>-2.84 dBm          |   |   | Freq Offs<br>0                   |
| 7<br>8<br>9<br>0<br>1                                     |                     |                                       |                                 |   |   |                                  |
| 2   |                     |                                       |                                 |   |   |                                  |

(Plot 4.8.2.A: Channel 39: 2441MHz @ 8DPSK @ DH1)

| Agilent Spectrum Analyzer - Swept SA                        |  |                             |   |                                     |
|---|--|-----------------------------|---|-------------------------------------|
| KF 50 Ω AC     Center Freq 2.441000000                      | GHz SENSE:INT  | ALIGN OFF<br>#Avg Type: RMS | 04:01:25PM Oct 24, 2015<br>TRACE 1 2 3 4 5 6<br>TYPE WWWWWW | Frequency                           |
| 10 dB/div Ref 20.00 dBm                                     | PNO: Wide Trig: Free Run<br>IFGain:Low #Atten: 30 dB |                             | Mkr3 3.584 ms<br>-3.03 dBm                                  | Auto Tune                           |
| 10.0 10.0 10.0 10.0 10.0 10.0 10.0 10.0                     | 1Δ2  | 3                           |   | Center Freq<br>2.441000000 GHz      |
| -20.0<br>   |  |                             |   | Start Freq<br>2.441000000 GHz       |
| -50.0<br>-60.0 Uppeden in higher<br>-70.0 Uppeden in higher |  |                             | u filmi ali an da filmi an<br>Mang ta, taj pel diplanta     | <b>Stop Freq</b><br>2.441000000 GHz |
| Center 2.441000000 GHz<br>Res BW 1.0 MHz                    | #VBW 3.0 MHz   | Sweep 6                     | Span 0 Hz<br>i.400 ms (8001 pts)                            | CF Step<br>1.000000 MHz             |
| MKR MODE TRC SCL X  | Y<br>1.628 ms (Δ) -1.36 dB                           | FUNCTION FUNCTION WIDTH     | FUNCTION VALUE  | <u>Auto</u> Man                     |
| 2 F 1 t<br>3 N 1 t<br>4                                     | 1.084 ms -3.02 dBm<br>3.584 ms -3.03 dBm             |                             |   | Freq Offset<br>0 Hz                 |
| 7 8<br>8 9<br>10 11   |  |                             |   |                                     |
| 12<br>MSG   |  | STATU                       | s 🔀 Align Now, All requi                                    | ired                                |



| RL                      | RF 50 Ω AC    |                                      | SENSE:INT                          |          | ALIGN OFF | 03:00:36 PM O                    | ct 24, 2015              |                                  |
|-------------------------|---------------|--------------------------------------|------------------------------------|----------|-----------|----------------------------------|--------------------------|----------------------------------|
| enter Fred              | q 2.441000000 | GHz<br>PNO: Wide ++-<br>IFGain:Low   | Trig: Free Run<br>#Atten: 26 dB    | #Avg T   | ype: RMS  | TRACE 1<br>TYPE V<br>DET P       | 23456<br>WWWWWW<br>PPPPP | Frequency                        |
| ) dB/div                | lef 15.00 dBm |                                      |                                    |          |           | Mkr3 6.64<br>-2.25               | 11 ms<br>dBm             | Auto Tur                         |
| og<br>.00<br>.00<br>5.0 |               | X <sub>2</sub>                       |                                    |          |           |                                  |                          | Center Fre<br>2.441000000 GF     |
| 5.0<br>5.0<br>5.0       |               |                                      |                                    |          |           |                                  |                          | <b>Start Fr</b><br>2.441000000 G |
| 5.0<br>5.0<br>5.0       |               |                                      |                                    |          |           |                                  | NG 464<br>1103/041       | <b>Stop Fr</b><br>2.441000000 G  |
| enter 2.44<br>es BW 1.0 |               | #VBW                                 | 3.0 MHz                            | FUNCTION | Sweep 1   | Spa<br>0.13 ms (80<br>FUNCTION V |                          | CF Sto<br>1.000000 M<br>Auto M   |
| 2 F 1                   | t             | 2.878 ms (Δ)<br>2.892 ms<br>6.641 ms | -1.00 dB<br>-1.71 dBm<br>-2.25 dBm |          |           |                                  |                          | Freq Offs<br>0                   |

(Plot 4.8.2.C: Channel 39: 2441MHz @ 8DPSK @ DH5)