

# FCC RF TEST REPORT

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**Test Report Number: SKT-RFC-140003****Date of issue: March 20, 2014****Applicant:****G.I.T Co., Ltd.**

GIT BLDG., 38-5 Garakbon-Dong, Songpa-Gu, Seoul, 138-801 Korea

**Manufacturer:****G.I.T Co., Ltd.**

GIT BLDG., 38-5 Garakbon-Dong, Songpa-Gu, Seoul, 138-801 Korea

**Product:**

Scan Tool

**Model:****GDS Trigger**

(please see P5 for all the model numbers)

**FCC ID:**

TMGG1JDDMN001

**File number:**

SKTEU14-0181

**EUT received:**

February 20, 2014

**Applied standards:**

ANSI C63.10-2009 and ANSI C63.4-2009

**Rule parts:**

FCC Part 15 Subpart C - Intentional radiators

**Equipment Class:****DSS - Part 15 Spread Spectrum Transmitter****Remarks to the standards:** None

The above equipment has been tested by SK Tech Co., Ltd., and found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product or system, which was tested.

Jungtae Kim / **Testing Engineer**Jongsoo Yoon / **Technical Manager**

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## Revision History of Report

| Rev. | Revisions     | Effect page | Reviewed by  | Date           |
|------|---------------|-------------|--------------|----------------|
| -    | Initial issue | All         | Jongsoo Yoon | March 20, 2014 |



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## 1 Summary of test results

| Requirement                                        | CFR 47 Section                  | Result                 |
|----------------------------------------------------|---------------------------------|------------------------|
| Antenna Requirement                                | 15.203, 15.247(b)(4)            | Meets the requirements |
| Maximum Peak Output Power                          | 15.247(b)(1), (4)               | Meets the requirements |
| Carrier Frequency Separation                       | 15.247(a)(1)                    | Meets the requirements |
| 20dB Channel Bandwidth                             | 15.247(a)(1)                    | Meets the requirements |
| Number of Hopping Channels                         | 15.247(a)(iii), 15.247(b)(1)    | Meets the requirements |
| Time of Occupancy (Dwell Time)                     | 15.247(a)(iii)                  | Meets the requirements |
| Spurious Emission, Band Edge, and Restricted bands | 15.247(d), 15.205(a), 15.209(a) | Meets the requirements |
| AC power line Conducted emissions                  | 15.207(a)                       | N/A                    |

\*\* The product is powered from a DC 12 V or 24 V lead-acid battery in a vehicle.



## 2 Description of equipment under test (EUT)

Product: Scan Tool  
Model: GDS Trigger  
Serial number: None (prototype)

### Model differences:

| Model name  | Difference                                   | Tested (checked)                    |
|-------------|----------------------------------------------|-------------------------------------|
| GDS Trigger | Original (basic model that was fully tested) | <input checked="" type="checkbox"/> |
|             |                                              |                                     |

**Note:** All the differences were compared with the tested sample.

### Technical data:

|                           |                                                    |
|---------------------------|----------------------------------------------------|
| Power source              | 12 V/ 24 V lead-acid battery installed in vehicles |
| Local Oscillator or X-Tal | 25 MHz, 26 MHz                                     |
| Transmit Frequency        | 2402 MHz to 2480 MHz (79 channels)                 |
| Antenna Type              | Integral chip antenna, peak gain: 1.99 dBi         |
| Type of Modulation        | GFSK                                               |
| RF Output power           | -1.66 dBm (measured conducted RF power)            |

**Note:**

| I/O port | Type | Q'ty | Remark |
|----------|------|------|--------|
|          |      |      |        |
|          |      |      |        |

### Equipment Modifications

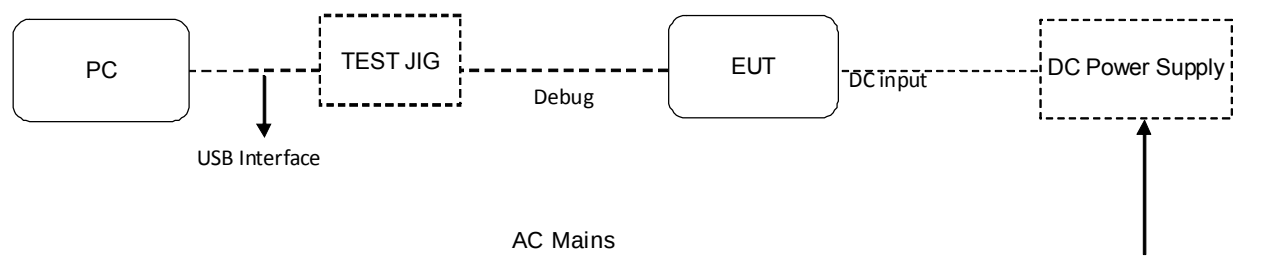
none



### 3 Test and measurement conditions

#### 3.1. Test configuration (arrangement of EUT)

The measurements were taken in continuous transmitting mode using the TEST MODE. For controlling the EUT as TEST MODE, the test program and the cable assembly were provided by the applicant.



#### 3.2. Description of support units (accessory equipment)

The following support units or accessories were used to form a representative test configuration during the tests.

| # | Equipment | Manufacturer | Model No. | Serial No.  |
|---|-----------|--------------|-----------|-------------|
| 1 | PC        | DELL INC.    | 7XH86BX   | 17261795085 |
| 2 | TEST JIG  | -            | -         | -           |

**Note:**

- 1) For control of the RF module via USB interface at the Debug port(SPI) in the EUT.
- 2) For radiated spurious emission measurements, the measurements were performed without PC after setting the radio module to TEST MODE.
- 3) If not otherwise stated, for modulating the transmitter, a pseudo random bit sequence with each pattern type DH5 for GFSK was used. The power setting value of 48 was used as the applicant provided. BC4 (Hardware ID 0x26) firmware version 6705

#### 3.3. Interconnection and I/O cables

The following support units or accessories were used to form a representative test configuration during the tests.

| # | Start    |          | End      |          | Cable      |                |
|---|----------|----------|----------|----------|------------|----------------|
|   | Name     | I/O port | Name     | I/O port | length (m) | shielded (Y/N) |
| 1 | EUT      | Debug    | TEST JIG | RJ-45    | 1.0        | N              |
| 2 | TEST JIG | USB      | PC       | USB      | 2.0        | N              |

**Note:**

- 1) All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
- 2) Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

#### 3.4. Measurement Uncertainty (U)

| Measurement Item      | Combined Standard Uncertainty<br>$U_c$ | Expanded Uncertainty<br>$U = k \times U_c (k = 2)$ |
|-----------------------|----------------------------------------|----------------------------------------------------|
| Conducted RF power    | $\pm 1.49$ dB                          | $\pm 2.98$ dB                                      |
| Radiated disturbance  | $\pm 2.30$ dB                          | $\pm 4.60$ dB                                      |
| Conducted disturbance | $\pm 1.96$ dB                          | $\pm 3.92$ dB                                      |

#### 3.5. Test date

|             |                                |
|-------------|--------------------------------|
| Date Tested | March 3, 2014 – March 13, 2014 |
|-------------|--------------------------------|



## 4 Facilities and accreditations

### 4.1. Facilities

All of the measurements described in this report were performed at SK Tech Co., Ltd

Site I: 88, Geulgaetul-ro 81beon-gil, Wabu-up, Namyangju-si, Kyunggi-do, Korea

Site II: 124-8, Geulgaetul-ro, Wabu-up, Namyangju-si, Kyunggi-do, Korea

The sites are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-4. The sites comply with the Normalized Site Attenuation requirements given in ANSI C63.4, and site VSWR requirements specified in CISPR 16-1-4. The measuring apparatus and ancillary equipment conform to CISPR 16-1 series.

### 4.2. Accreditations

The laboratory has been also notified to FCC by RRA as a Conformity Assessment Body, and designated to perform compliance testing on equipment subject to Declaration of Conformity (DOC) and Certification under Parts 15 and 18 of the FCC Rules.

Designation No. KR0007

### 4.3. List of test and measurement instruments

| No | Description                          | Manufacturer  | Model         | Serial No.  | Cal. due   | Use |
|----|--------------------------------------|---------------|---------------|-------------|------------|-----|
| 1  | Spectrum Analyzer                    | Agilent       | E4405B        | US40520856  | 2015.03.06 |     |
| 2  | Spectrum Analyzer                    | Agilent       | E4440A        | MY46186322  | 2015.03.07 | ☑   |
| 3  | EMC Spectrum Analyzer                | Agilent       | E7405A        | US40240203  | 2014.07.08 |     |
| 4  | EMI Test Receiver                    | Rohde&Schwarz | ESPI7         | 101206      | 2014.07.08 | ☑   |
| 5  | EMI Test Receiver                    | Rohde&Schwarz | ESHS10        | 835871/002  | 2014.07.08 |     |
| 6  | Artificial Mains Network             | Rohde&Schwarz | ESH2-Z5       | 834549/011  | 2014.07.08 |     |
| 7  | Pre-amplifier                        | HP            | 8447F         | 3113A05153  | 2014.07.08 | ☑   |
| 8  | Pre-amplifier                        | MITEQ         | AFS44         | 1116321     | 2014.12.06 |     |
| 9  | Pre-amplifier                        | MITEQ         | AFS44         | 1116322     | 2015.03.06 | ☑   |
| 10 | Power Meter                          | Agilent       | E4417A        | MY45100426  | 2014.07.09 |     |
| 11 | Power Meter                          | Agilent       | E4418B        | US39402176  | 2014.07.09 |     |
| 12 | Power Sensor                         | Agilent       | E9327A        | MY44420696  | 2014.07.09 |     |
| 13 | Power Sensor                         | Agilent       | 8485A         | 3318A13916  | 2014.07.09 |     |
| 14 | Attenuator (10dB)                    | HP            | 8491B         | 38072       | 2014.07.08 | ☑   |
| 15 | High Pass Filter                     | Wainwright    | WHKX3.0/18G   | 8           | 2014.07.08 | ☑   |
| 16 | VHF Precision Dipole Antenna (TX/RX) | Schwarzbeck   | VHAP          | 1014 / 1015 | 2014.10.25 |     |
| 17 | UHF Precision Dipole Antenna (TX/RX) | Schwarzbeck   | UHAP          | 989 / 990   | 2014.10.25 |     |
| 18 | Loop Antenna                         | Schwarzbeck   | HFH2-Z2       | 863048/019  | 2015.12.04 | ☑   |
| 19 | TRILOG Broadband Antenna             | Schwarzbeck   | VULB9168      | 189         | 2014.05.21 | ☑   |
| 20 | Horn Antenna                         | AH Systems    | SAS-200/571   | 304         | N/A        |     |
| 21 | Horn Antenna                         | EMCO          | 3115          | 00040723    | 2014.03.26 | ☑   |
| 22 | Horn Antenna                         | EMCO          | 3115          | 00056768    | 2014.09.05 |     |
| 23 | Horn Antenna                         | Schwarzbeck   | BBHA9170      | BBHA9170318 | 2015.09.06 | ☑   |
| 24 | Vector Signal Generator              | Agilent       | E4438C        | MY42080359  | 2014.07.09 |     |
| 25 | PSG analog signal generator          | Agilent       | E8257D-520    | MY45141255  | 2014.07.09 |     |
| 26 | DC Power Supply                      | HP            | 6622A         | 3348A03223  | 2014.07.09 | ☑   |
| 27 | DC Power Supply                      | TOYOTECH      | DP30-05A      | -           | N/A        | ☑   |
| 28 | Hygro/Thermo Graph                   | SATO          | PC-5000TRH-II | -           | 2014.07.12 | ☑   |
| 29 | Temperature/Humidity Chamber         | All Three     | ATM-50M       | 20030425    | 2015.03.06 |     |



## 5 Test and measurements

### 5.1. Antenna requirement

#### 5.1.1 Regulation

According to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And according to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

#### 5.1.2 Result:

**PASS**

The transmitter has the internal chip antenna. The directional gain of the antenna is 1.99 dBi.



## 5.2. Maximum peak output power

### 5.2.1 Regulation

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

According to §15.247(b)(4), the conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

### 5.2.2 Test Procedure

1. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable and attenuator.
2. The measurements were taken in TEST MODE provided by the applicant for controlling the EUT.
3. Set the spectrum analyzer as follows:
  - Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
  - RBW > the 20 dB bandwidth of the emission being measured
  - VBW  $\geq$  RBW
  - Sweep = auto
  - Detector function = peak
  - Trace = max hold
4. Measure the highest amplitude appearing on spectral display and record the level to calculate results.
5. Repeat above procedures until all frequencies measured were complete.

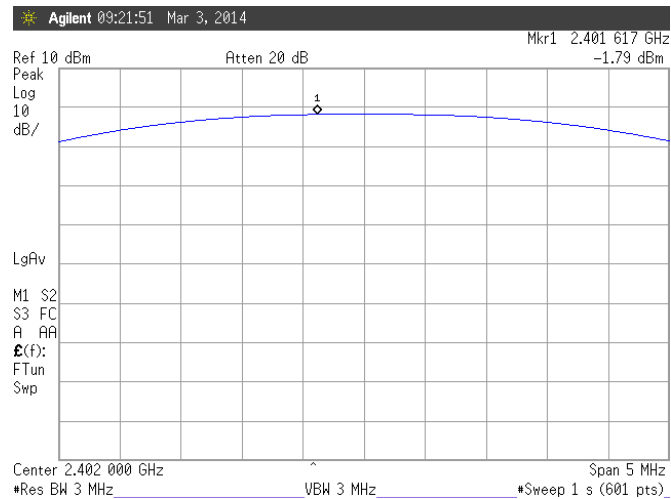
### 5.2.3 Test Results:

**PASS**

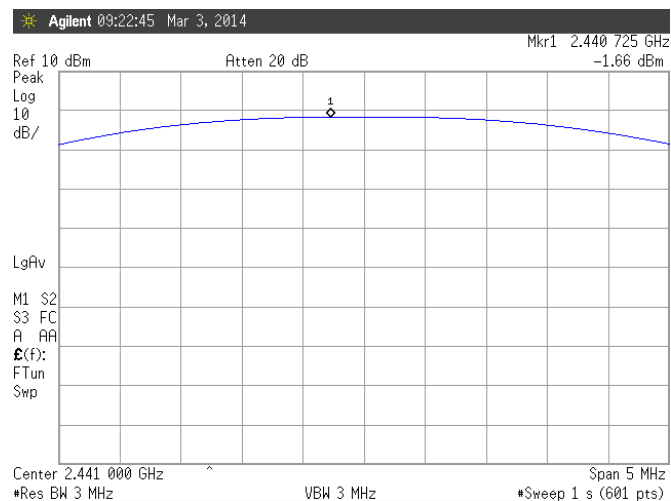
| Table 1: Measured values of the Maximum Peak Conducted Output Power |                     |                      |                |          |                                                                                            |
|---------------------------------------------------------------------|---------------------|----------------------|----------------|----------|--------------------------------------------------------------------------------------------|
| Modulation                                                          | Operating Frequency | Resolution Bandwidth | Measured value |          | Limit                                                                                      |
|                                                                     |                     |                      | dBm            | W        |                                                                                            |
| Basic (GFSK)                                                        | 2402 MHz            | 3 MHz                | -1.79          | 0.000 66 | 1 W<br>(the number of the non-overlapping hopping channels is equal to or greater than 75) |
|                                                                     | 2441 MHz            | 3 MHz                | -1.66          | 0.000 68 |                                                                                            |
|                                                                     | 2480 MHz            | 3 MHz                | -2.02          | 0.000 63 |                                                                                            |

**Figure 1. Plot of the Maximum Peak Conducted Output Power (Conducted)**

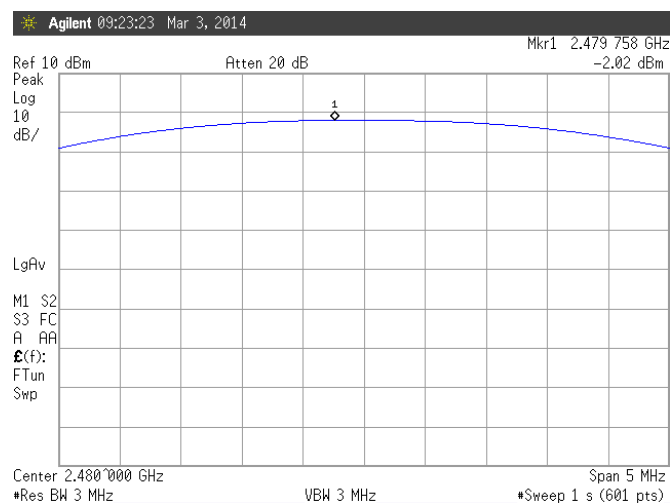
Lowest Channel (2402 MHz)



Middle Channel (2441 MHz)



Highest Channel (2480 MHz)





### 5.3. Carrier frequency separations and 20 dB bandwidth

#### 5.3.1 Regulation

According to §15.247(a)(1), frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

#### 5.3.2 Test Procedure

1. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable and attenuator.
2. The measurements were taken in TEST MODE provided by the applicant for controlling the EUT.
3. Set the spectrum analyzer as follows:

For measurements of Carrier Frequency Separation

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW)  $\geq 1\%$  of the span

Video (or Average) Bandwidth (VBW)  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

For measurements of 20 dB Bandwidth

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW  $\geq 1\%$  of the 20 dB bandwidth

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

4. Measure the separation between the peaks of the adjacent channels using the marker-delta function.
5. Repeat above procedures until all frequencies measured were complete.

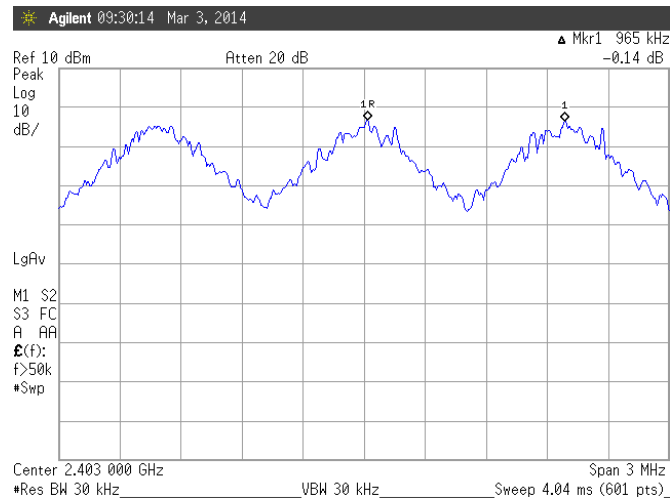
#### 5.3.3 Test Results:

**PASS**

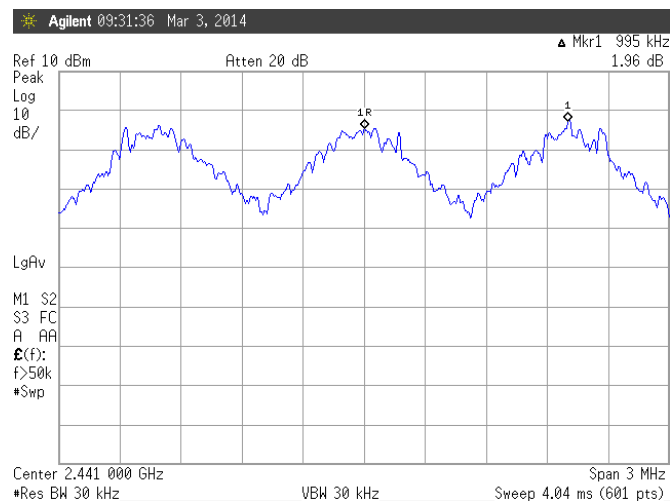
| Table 2: Measured values of the Carrier Frequency Separation and 20 dB Bandwidth |                     |                      |                 |                                                        |
|----------------------------------------------------------------------------------|---------------------|----------------------|-----------------|--------------------------------------------------------|
| Modulation                                                                       | Operating Frequency | Frequency Separation | 20 dB Bandwidth | LIMIT (Frequency Separation)                           |
| Basic (GFSK)                                                                     | 2402 MHz            | 965 kHz              | 933 kHz         | $\geq 25$ kHz or 20 dB bandwidth, whichever is greater |
|                                                                                  | 2441 MHz            | 995 kHz              | 933 kHz         |                                                        |
|                                                                                  | 2480 MHz            | 985 kHz              | 942 kHz         |                                                        |

**Figure 2. Plot of the Carrier Frequency Separation**

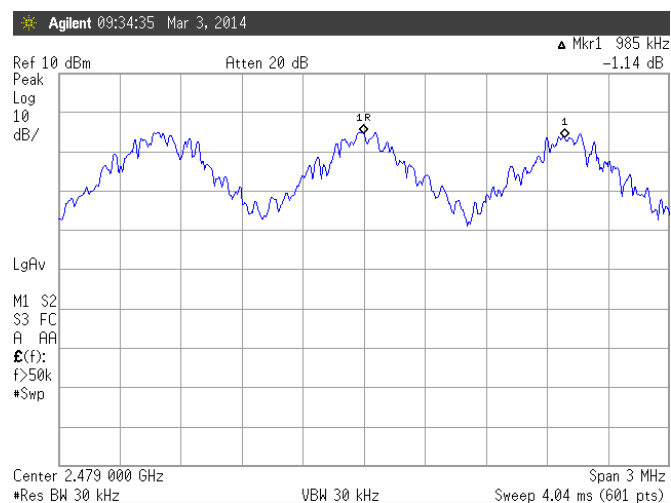
Lowest Channel (2402 MHz)



Middle Channel (2441 MHz)

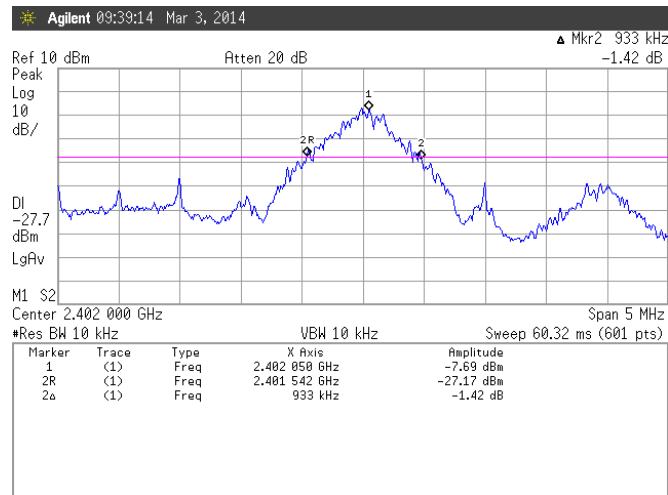


Highest Channel (2480 MHz)

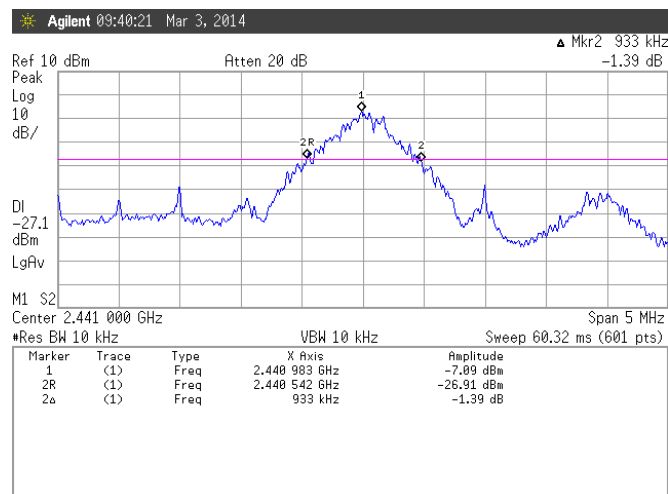


**Figure 3. Plot of the 20 dB Channel Bandwidth**

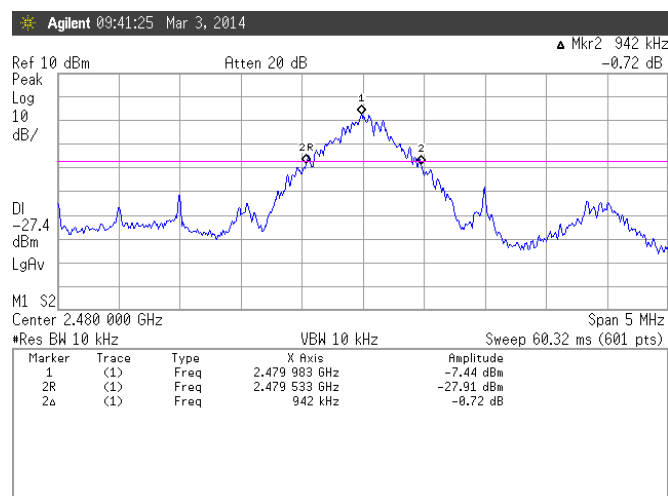
Lowest Channel (2402 MHz)



Middle Channel (2441 MHz)



Highest Channel (2480 MHz)





## 5.4. Number of Hopping channels

### 5.4.1 Regulation

According to §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

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

### 5.4.2 Test Procedure

1. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable and attenuator.
2. The measurements were taken in TEST MODE provided by the applicant for controlling the EUT.
3. Set the spectrum analyzer as follows:
  - Span = the frequency band of operation
  - RBW  $\geq$  1% of the span
  - VBW  $\geq$  RBW
  - Sweep = auto
  - Detector function = peak
  - Trace = max hold
4. Record the number of hopping channels.

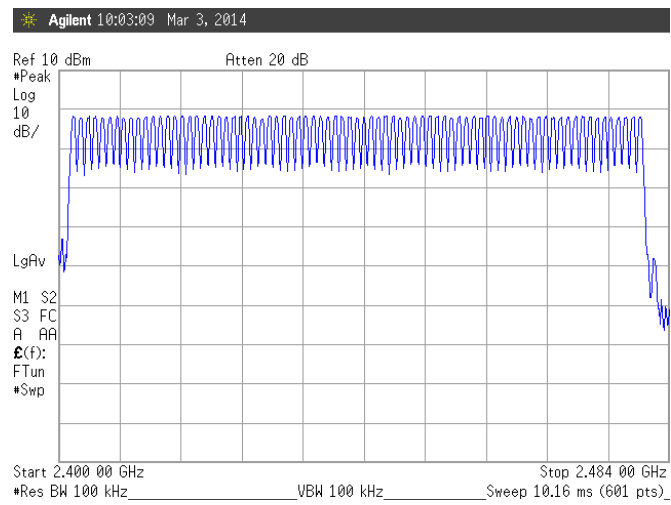
### 5.4.3 Test Results:

**PASS**

| Table 3: Measured values of the Number of Hopping Channels |                     |                            |           |
|------------------------------------------------------------|---------------------|----------------------------|-----------|
| Modulation                                                 | Operating Frequency | Number of hopping channels | LIMIT     |
| Basic (GFSK)                                               | 2402 - 2480 MHz     | 79                         | $\geq 15$ |



Figure 4. Plot of the Number of Hopping Channels





## 5.5. Time of occupancy (Dwell time)

### 5.5.1 Regulation

According to §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

### 5.5.2 Test Procedure

1. Connect the antenna port of the EUT to RF input on the spectrum analyzer via a low loss cable.
2. The measurements were taken in TEST MODE provided by the applicant for controlling the EUT.
3. Set the spectrum analyzer as follows:
  - Span = zero span, centered on a hopping channel
  - RBW = 1 MHz
  - VBW  $\geq$  RBW
  - Sweep = as necessary to capture the entire dwell time per hopping channel
  - Detector function = peak
  - Trace = max hold
4. Measure the dwell time using the marker-delta function.
5. Repeat above procedures until all frequencies measured were complete.
6. Repeat this test for different modes of operation (e.g., data rate, modulation format, etc.), if applicable.

### 5.5.3 Test Results:

**PASS**

| Table 4: Measured values of the Time of Occupancy |                     |              |                       |                    |                  |                 |
|---------------------------------------------------|---------------------|--------------|-----------------------|--------------------|------------------|-----------------|
| Modulation                                        | Operating Frequency | Reading (ms) | Hopping rate (hops/s) | Number of Channels | Actual (seconds) | LIMIT (seconds) |
| Basic (GFSK)                                      | 2402 MHz            | 2.887        | 266.667               | 79                 | 0.31             | 0.4             |
|                                                   | 2441 MHz            | 2.887        | 266.667               | 79                 | 0.31             | 0.4             |
|                                                   | 2480 MHz            | 2.887        | 266.667               | 79                 | 0.31             | 0.4             |

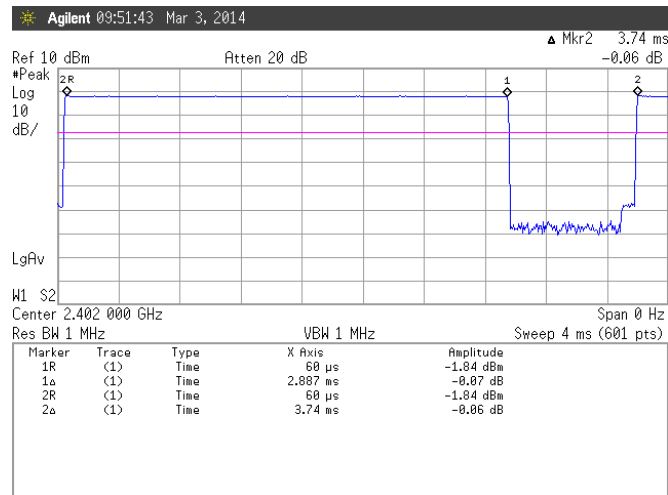
**Actual = Reading  $\times$  (Hopping rate / Number of channels)  $\times$  Test period**

**Test period = 0.4 [seconds / channel]  $\times$  79 [channel] = 31.6 [seconds]**

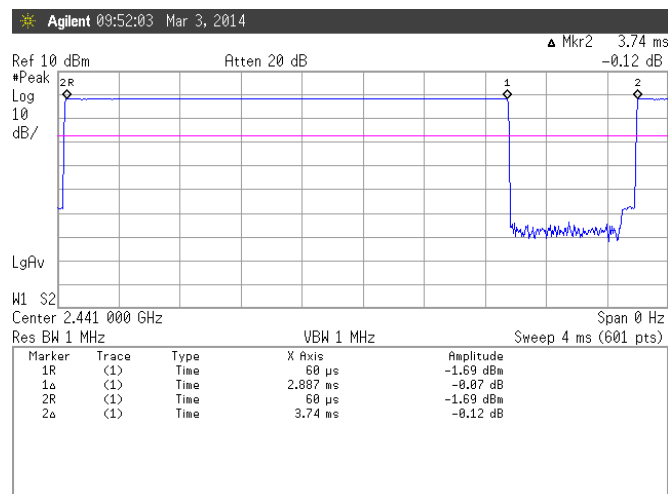
*NOTE: The EUT makes worst case 1600 hops per second or 1 time slot has a length of 625 $\mu$ s with 79 channels. The DH5 Packet needs 5 time slot for transmitting and 1 time slot for receiving. Then the EUT makes worst case 266.667 hops per second with 79 channels.*

**Figure 5. Plot of the Time of Occupancy**

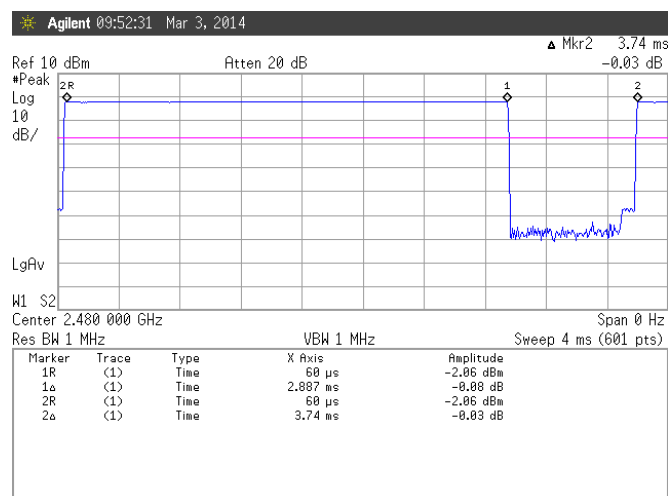
Lowest Channel (2402 MHz)



Middle Channel (2441 MHz)



Highest Channel (2480 MHz)





## 5.6. Spurious emissions, Band edge, and Restricted bands

### 5.6.1 Regulation

According to §15.247(d), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. 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 Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

According to §15.209(a), for an intentional device, the general requirement of field strength of radiated emissions from intentional radiators at a distance of 3 meters shall not exceed the following values:

| Frequency (MHz) | Field strength ( $\mu\text{V/m}$ @ 3m) | Field strength (dB $\mu\text{V/m}$ @ 3m) |
|-----------------|----------------------------------------|------------------------------------------|
| 30–88           | 100                                    | 40.0                                     |
| 88–216          | 150                                    | 43.5                                     |
| 216–960         | 200                                    | 46.0                                     |
| Above 960       | 500                                    | 54.0                                     |

According to §15.109(a), for an unintentional device, except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the above table.

\*\* The emission limits shown in the above table are based on measurement instrumentation employing a CISPR quasi-peak detector and above 1000 MHz are based on the average value of measured emissions.

### 5.6.2 Test Procedure

#### 1) Band-edge measurements for RF conducted emissions

##### 1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation

RBW  $\geq$  1 % of spectrum analyzer display span

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, and then use the marker-to-peak function to move the marker to the peak of the in-band emission.

3. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit.



2) Spurious RF Conducted Emissions:

1. Set the spectrum analyzer as follows:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.

Typically, several plots are required to cover this entire span.

RBW = 100 kHz

VBW  $\geq$  RBW

Sweep = auto

Detector function = peak

Trace = max hold

2. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.

3) Spurious Radiated Emissions:

1. The preliminary radiated measurements were performed to determine the frequency producing the maximum emissions in an anechoic chamber at a distance of 3 meters for above 30 MHz, and at 1 meter / 3 meter distance for below 30 MHz.
2. The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
3. The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 kHz to 30 MHz using the loop antenna, from 30 to 1000 MHz using the Trilog broadband antenna, and from 1 GHz to tenth harmonic of the highest fundamental frequency using the horn antenna.
4. To obtain the final measurement data, the EUT was arranged on a turntable situated on a 4 × 4 meter at the Open Area Test Site. The EUT was tested at a distance 3 meters.
5. Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
6. The EUT is situated in three orthogonal planes (if appropriate)
7. The presence of ambient signals was verified by turning the EUT off. In case an ambient signal was detected, the measurement bandwidth was reduced temporarily and verification was made that an additional adjacent peak did not exist. This ensures that the ambient signal does not hide any emissions from the EUT.
8. If the emission on which a radiated measurement must be made is located at the edge of the authorized band of operation, then the alternative "marker-delta" method may be employed.

4) Marker-Delta Method at the edge of the authorized band of operation:

1. Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function specified in 6.3 and 6.4, 6.5, or 6.6, as applicable, and the appropriate regulatory requirements for the frequency being measured.<sup>43</sup>
2. Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band-edge emission under investigation. Set the analyzer RBW to approximately 1 % to 5 % of the total span, unless otherwise specified, with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band-edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band-edge emission. This is not an absolute field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band edge relative to the highest fundamental emission level.
3. Subtract the delta measured in b) from the field strengths measured in a). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band-edge compliance of the restricted bands, described in 5.9.
4. The above "delta" measurement technique may be used for measuring emissions that are up to two "standard" bandwidths away from the band edge, where a "standard" bandwidth is the bandwidth specified by 4.2.3.2 for the frequency being measured. For example, band-edge measurements in the restricted band that begins at 2483.5 MHz require a measurement bandwidth of at least 1 MHz. Therefore the "delta" technique for measuring emissions up to 2 MHz removed from the band edge may be used. Radiated emissions that are removed by more than two "standard" bandwidths shall be measured in the conventional manner.

### 5.6.3 Test Results:

**PASS**

**Band-edge compliance of RF conducted/radiated emissions was shown in the Figure 6 and 7. Spurious RF conducted emissions were shown in the Figure 8.**

NOTE : for conducted measurement, we took the insertion loss of the cable loss into consideration within the measuring instrument. And for radiated measurement, the results were calibrated to the field strength within the measuring instrument; Table 5 contains the correction factors at the operating frequencies such as antenna factor, cable loss, etc.

Table 5: Measured values of the Field strength of spurious emission (Radiated)

## BELOW 1 GHz

[illegible]
$$\text{Margin (dB)} = \text{Limit} - \text{Actual}$$

**[Actual = Reading – Amp Gain + Attenuator + AF + CL]**

1. H = Horizontal, V = Vertical Polarization

2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.



| Measured values of the Field strength of spurious emission (Radiated) (continued) |                    |       |                |            |          |          |       |           |      |            |                |        |
|-----------------------------------------------------------------------------------|--------------------|-------|----------------|------------|----------|----------|-------|-----------|------|------------|----------------|--------|
| ABOVE 1 GHz                                                                       |                    |       |                |            |          |          |       |           |      |            |                |        |
| Frequency                                                                         | Receiver Bandwidth | Pol.  | Antenna Height | Turn Table | Reading  | Amp Gain | ATT   | AF        | CL   | Actual     | Limit          | Margin |
| [MHz]                                                                             | [kHz]              | [V/H] | [m]            | [degree]   | [dB(μV)] | [dB]     | [dB]  | [dB(1/m)] | [dB] | [dB(μV/m)] | [dB(μV/m)]     | [dB]   |
| PEAK data, emissions above 1000 MHz                                               |                    |       |                |            |          |          |       |           |      |            |                |        |
| 2402.0                                                                            | 1000               | H     | 1.24           | 196        | 103.86   | 48.46    | 10.23 | 28.15     | 6.50 | 100.28     | Not Applicable |        |
| 2402.0                                                                            | 1000               | V     | 1.13           | 223        | 98.90    | 48.46    | 10.23 | 28.15     | 6.50 | 95.32      |                |        |
| 2386.0                                                                            | 1000               | H     | 1.24           | 196        | 61.65    | 48.45    | 10.23 | 28.10     | 6.48 | 58.01      | 74.00          | 15.99  |
| 2386.0                                                                            | 1000               | V     | 1.13           | 223        | 57.34    | 48.45    | 10.23 | 28.10     | 6.48 | 53.70      | 74.00          | 20.30  |
| 4804.1                                                                            | 1000               | H     | 1.10           | 230        | 66.14    | 49.00    | 0.43  | 33.12     | 9.68 | 60.37      | 74.00          | 13.63  |
| 4804.1                                                                            | 1000               | V     | 1.05           | 220        | 63.00    | 49.00    | 0.43  | 33.12     | 9.68 | 57.23      | 74.00          | 16.77  |
| 2441.0                                                                            | 1000               | H     | 1.20           | 210        | 104.23   | 48.48    | 10.23 | 28.28     | 6.56 | 100.82     | Not Applicable |        |
| 2441.0                                                                            | 1000               | V     | 1.10           | 227        | 99.87    | 48.48    | 10.23 | 28.28     | 6.56 | 96.46      |                |        |
| 4881.0                                                                            | 1000               | H     | 1.07           | 227        | 66.32    | 49.02    | 0.38  | 33.17     | 9.76 | 60.61      | 74.00          | 13.39  |
| 4881.0                                                                            | 1000               | V     | 1.13           | 236        | 63.93    | 49.02    | 0.38  | 33.17     | 9.76 | 58.22      | 74.00          | 15.78  |
| 2480.0                                                                            | 1000               | H     | 1.17           | 224        | 102.61   | 48.49    | 10.23 | 28.40     | 6.61 | 99.36      | Not Applicable |        |
| 2480.0                                                                            | 1000               | V     | 1.07           | 230        | 99.29    | 48.49    | 10.23 | 28.40     | 6.61 | 96.04      |                |        |
| 2483.6                                                                            | 1000               | H     | 1.17           | 224        | 60.25    | 48.50    | 10.23 | 28.41     | 6.62 | 57.01      | 74.00          | 16.99  |
| 2483.6                                                                            | 1000               | V     | 1.07           | 230        | 58.16    | 48.50    | 10.23 | 28.41     | 6.62 | 54.92      | 74.00          | 19.08  |
| 4960.0                                                                            | 1000               | H     | 1.03           | 221        | 63.57    | 49.04    | 0.34  | 33.22     | 9.83 | 57.92      | 74.00          | 16.08  |
| 4960.0                                                                            | 1000               | V     | 1.10           | 224        | 62.10    | 49.04    | 0.34  | 33.22     | 9.83 | 56.45      | 74.00          | 17.55  |
|                                                                                   |                    |       |                |            |          |          |       |           |      |            |                |        |
| AVERAGE data, emissions above 1000 MHz                                            |                    |       |                |            |          |          |       |           |      |            |                |        |
| 2402.0                                                                            | 1000               | H     | 1.24           | 196        | 100.91   | 48.46    | 10.23 | 28.15     | 6.50 | 97.33      | Not Applicable |        |
| 2402.0                                                                            | 1000               | V     | 1.13           | 223        | 95.96    | 48.46    | 10.23 | 28.15     | 6.50 | 92.38      |                |        |
| 2386.0                                                                            | 1000               | H     | 1.24           | 196        | 41.21    | 48.45    | 10.23 | 28.10     | 6.48 | 37.57      | 54.00          | 16.43  |
| 2386.0                                                                            | 1000               | V     | 1.13           | 223        | 39.81    | 48.45    | 10.23 | 28.10     | 6.48 | 36.17      | 54.00          | 17.83  |
| 4804.1                                                                            | 1000               | H     | 1.10           | 230        | 52.55    | 49.00    | 0.43  | 33.12     | 9.68 | 46.78      | 54.00          | 7.22   |
| 4804.1                                                                            | 1000               | V     | 1.05           | 220        | 49.33    | 49.00    | 0.43  | 33.12     | 9.68 | 43.56      | 54.00          | 10.44  |
| 2441.0                                                                            | 1000               | H     | 1.20           | 210        | 101.35   | 48.48    | 10.23 | 28.28     | 6.56 | 97.94      | Not Applicable |        |
| 2441.0                                                                            | 1000               | V     | 1.10           | 227        | 96.99    | 48.48    | 10.23 | 28.28     | 6.56 | 93.58      |                |        |
| 4881.0                                                                            | 1000               | H     | 1.07           | 227        | 52.30    | 49.02    | 0.38  | 33.17     | 9.76 | 46.59      | 54.00          | 7.41   |
| 4881.0                                                                            | 1000               | V     | 1.13           | 236        | 49.87    | 49.02    | 0.38  | 33.17     | 9.76 | 44.16      | 54.00          | 9.84   |
| 2480.0                                                                            | 1000               | H     | 1.17           | 224        | 99.73    | 48.49    | 10.23 | 28.40     | 6.61 | 96.48      | Not Applicable |        |
| 2480.0                                                                            | 1000               | V     | 1.07           | 230        | 96.32    | 48.49    | 10.23 | 28.40     | 6.61 | 93.07      |                |        |
| 2483.6                                                                            | 1000               | H     | 1.17           | 224        | 48.58    | 48.50    | 10.23 | 28.41     | 6.62 | 45.34      | 54.00          | 8.66   |
| 2483.6                                                                            | 1000               | V     | 1.07           | 230        | 46.02    | 48.50    | 10.23 | 28.41     | 6.62 | 42.78      | 54.00          | 11.22  |
| 4960.0                                                                            | 1000               | H     | 1.03           | 221        | 48.81    | 49.04    | 0.34  | 33.22     | 9.83 | 43.16      | 54.00          | 10.84  |
| 4960.0                                                                            | 1000               | V     | 1.10           | 224        | 47.27    | 49.04    | 0.34  | 33.22     | 9.83 | 41.62      | 54.00          | 12.38  |
|                                                                                   |                    |       |                |            |          |          |       |           |      |            |                |        |

Margin (dB) = Limit – Actual

[Actual = Reading – Amp Gain + Attenuator + AF + CL]

1. H = Horizontal, V = Vertical Polarization

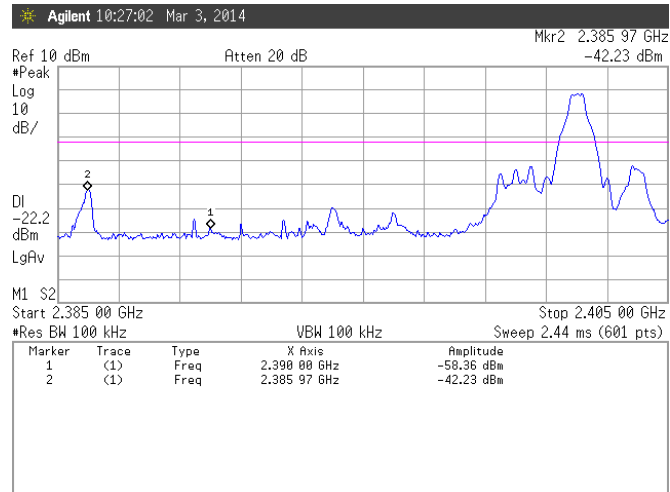
2. ATT = Attenuation (10dB pad and/or Insertion Loss of HPF), AF/CL = Antenna Factor and Cable Loss

NOTE: All emissions not reported were more than 20 dB below the specified limit or in the noise floor.



**Figure 6. Plot of the Band Edge (Conducted)**

Lowest Channel (2402 MHz)



Highest Channel (2480 MHz)

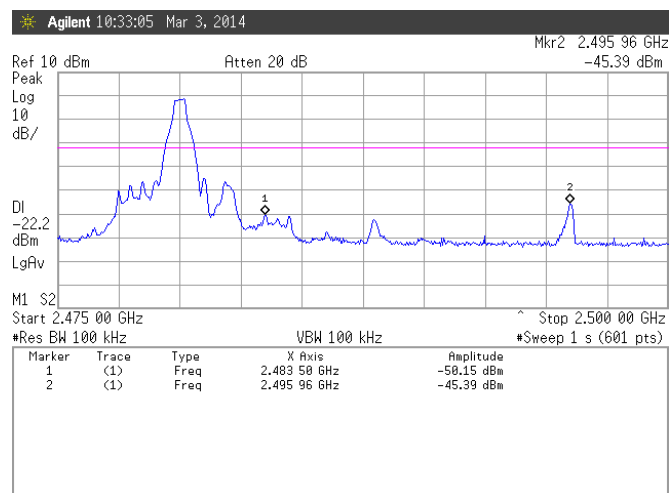
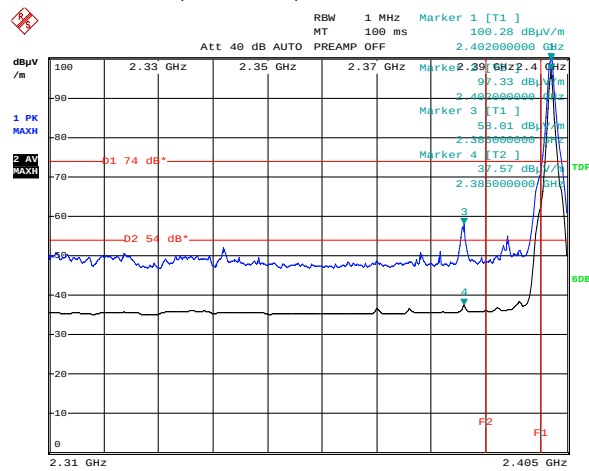




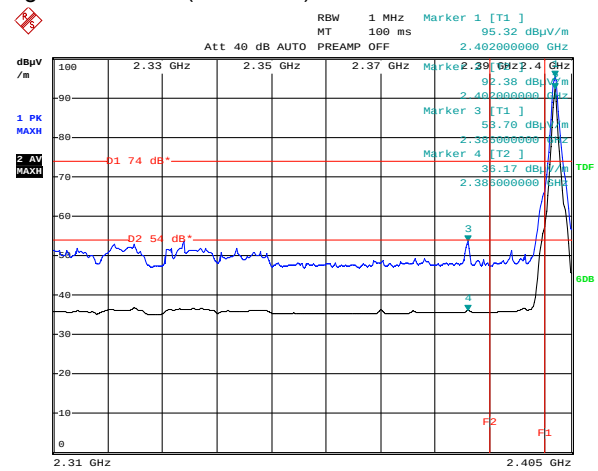
Figure 7. Plot of the Band Edge (Radiated)

Lowest Channel (2402 MHz) - Horizontal



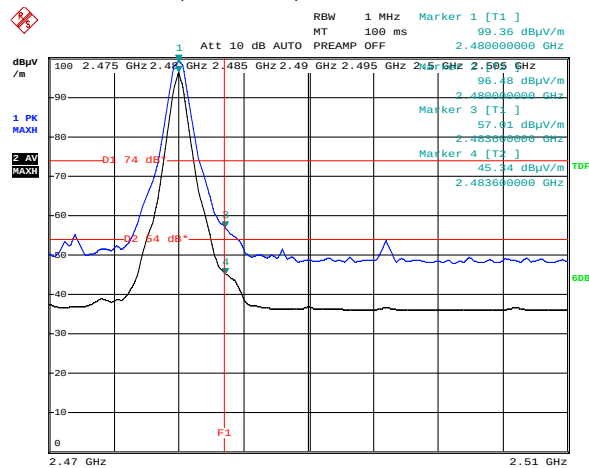
Date: 13.MAR.2014 16:15:31

Highest Channel (2402 MHz) - Vertical



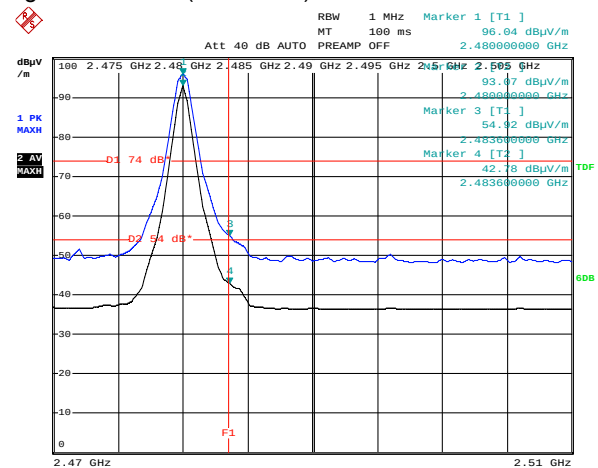
Date: 13.MAR.2014 16:09:39

Lowest Channel (2480 MHz) - Horizontal



Date: 13.MAR.2014 15:59:42

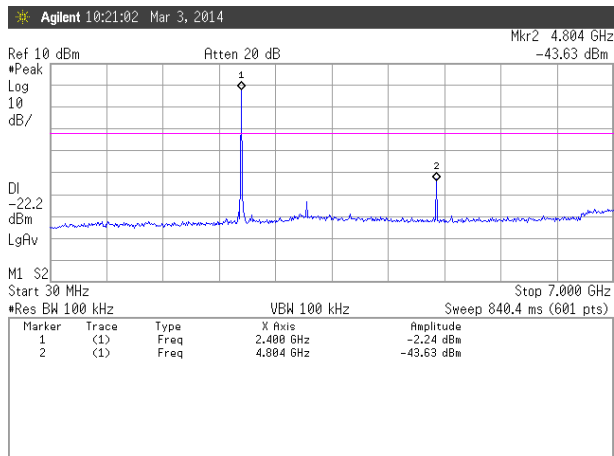
Highest Channel (2480 MHz) - Vertical



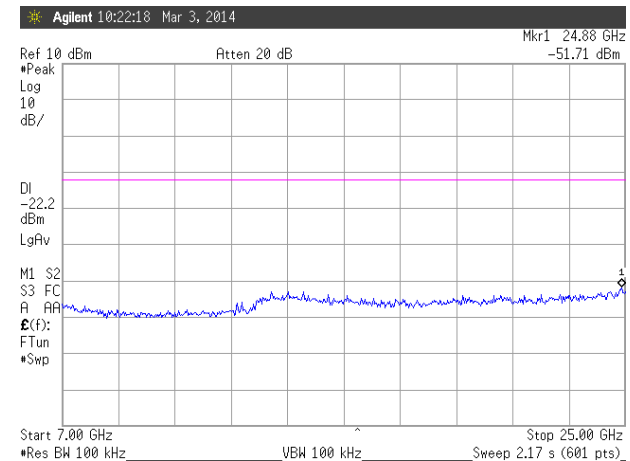
Date: 13.MAR.2014 16:26:27

**Figure 8. Spurious RF conducted emissions**

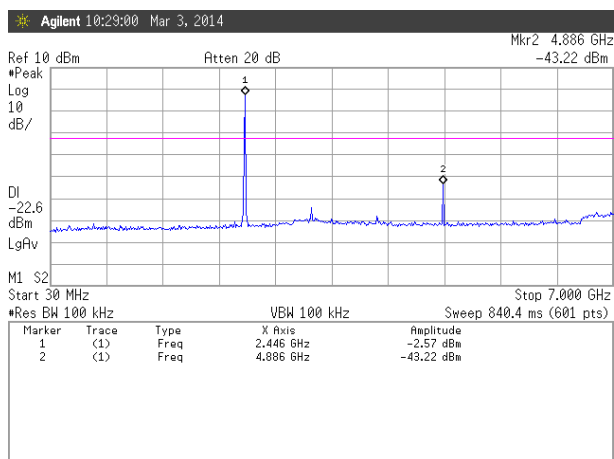
Lowest Channel(2402 MHz): 30 MHz ~ 7 GHz



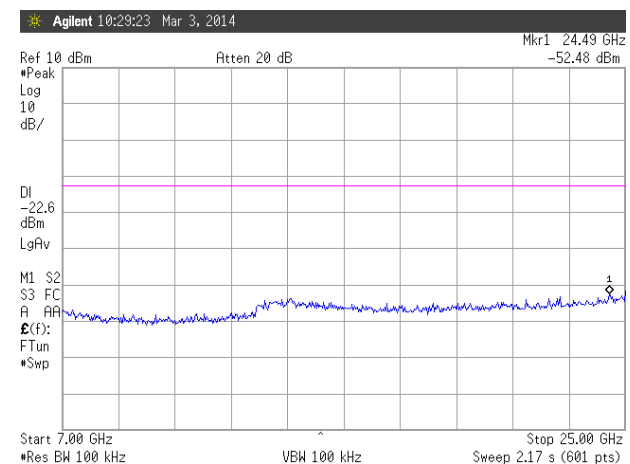
Lowest Channel (2402 MHz): 7 GHz ~ 25 GHz



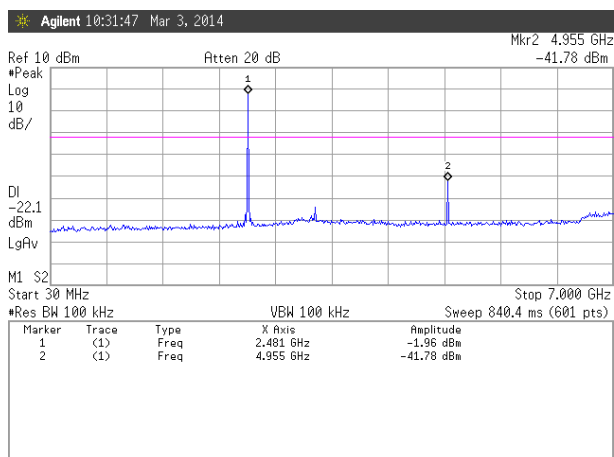
Middle Channel (2441 MHz): 30 MHz ~ 7 GHz



Middle Channel (2441 MHz): 7 GHz ~ 25 GHz



Highest Channel(2480 MHz): 30 MHz ~ 7 GHz



Highest Channel(2480 MHz): 7 GHz ~ 25 GHz

