



## **Certification Test Report**

**FCC ID: 2ADDKFLY4KW11**

**IC: 12404A-FLY4KW01**

**FCC Rule Part: 15.247**

**ISED Canada's Radio Standards Specification: RSS-247**

**Report Number: BO72136175.201**

Applicant: 360fly, Inc.

Model(s): FLY4KW01 and FLY4KW11

Test Begin Date: **September 28, 2017**

Test End Date: **October 19, 2017**

Report Issue Date: March 29, 2018



FOR THE SCOPE OF ACCREDITATION UNDER CERTIFICATE NUMBER 2955.15

This report must not be used by the client to claim product certification, approval, or endorsement by A2LA, ANSI, or any agency of the Federal Government.

**Prepared by:**

**Thierry Jean-Charles**  
**Team Lead**  
**TÜV SÜD America, Inc.**

**Reviewed by:**

**Ryan McGann**  
**Senior Engineer**  
**TÜV SÜD America, Inc.**

This test report shall not be reproduced except in full. This report may be reproduced in part with prior written consent of TÜV SÜD America, Inc. The results contained in this report are representative of the sample(s) submitted for evaluation.

**This report contains 49 pages**

## **TABLE OF CONTENTS**

|       |                                                                                                                                     |    |
|-------|-------------------------------------------------------------------------------------------------------------------------------------|----|
| 1     | GENERAL .....                                                                                                                       | 3  |
| 1.1   | Purpose .....                                                                                                                       | 3  |
| 1.2   | Applicant Information .....                                                                                                         | 3  |
| 1.3   | Product Description .....                                                                                                           | 3  |
| 1.4   | Test Methodology and Considerations .....                                                                                           | 3  |
| 2     | TEST FACILITIES .....                                                                                                               | 5  |
| 2.1   | Location .....                                                                                                                      | 5  |
| 2.2   | Laboratory Accreditations/Recognitions/Certifications.....                                                                          | 5  |
| 2.3   | Radiated & Conducted Emissions Test Site Description .....                                                                          | 6  |
| 2.3.1 | Semi-Anechoic Chamber Test Site .....                                                                                               | 6  |
| 2.3.2 | Conducted Emissions Test Site Description.....                                                                                      | 7  |
| 3     | APPLICABLE STANDARD REFERENCES .....                                                                                                | 8  |
| 4     | LIST OF TEST EQUIPMENT .....                                                                                                        | 9  |
| 5     | SUPPORT EQUIPMENT .....                                                                                                             | 10 |
| 6     | EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM.....                                                                                       | 11 |
| 7     | SUMMARY OF TESTS .....                                                                                                              | 12 |
| 7.1   | Antenna Requirement – FCC: Section 15.203.....                                                                                      | 12 |
| 7.2   | Peak Output Power - FCC Section 15.247(b)(1) IC: RSS-247 5.4(b) .....                                                               | 12 |
| 7.2.1 | Measurement Procedure (Conducted Method) .....                                                                                      | 12 |
| 7.2.2 | Measurement Results .....                                                                                                           | 12 |
| 7.3   | Channel Usage Requirements.....                                                                                                     | 18 |
| 7.3.1 | Carrier Frequency Separation – FCC: Section 15.247(a)(1) IC: RSS-247 5.1(b).....                                                    | 18 |
| 7.3.2 | Number of Hopping Channels – FCC: Section 15.247(a)(1)(iii) IC: RSS-247 5.1(d).....                                                 | 19 |
| 7.3.3 | Channel Dwell Time – FCC: Section 15.247(a)(1)(iii) IC: RSS-247 5.1(d) .....                                                        | 21 |
| 7.3.4 | 20dB / 99% Bandwidth - FCC: Section 15.247(a)(1)(i) IC: RSS-247 5.1(a) .....                                                        | 23 |
| 7.4   | Band-Edge Compliance and Spurious Emissions-FCC 15.247(d) IC: RSS-247 5.5.....                                                      | 29 |
| 7.4.1 | Band-Edge Compliance of RF Conducted Emissions .....                                                                                | 29 |
| 7.4.2 | RF Conducted Spurious Emissions – FCC: Section 15.247(d); ISED Canada: RSS-247 5.5.....                                             | 36 |
| 7.4.3 | Radiated Spurious Emissions into Restricted Frequency Bands – FCC: Sections 15.205,<br>15.209; ISED Canada: RSS-Gen 8.9, 8.10 ..... | 42 |
| 7.4.4 | Sample Calculation: .....                                                                                                           | 44 |
| 7.5   | Power Line Conducted Emissions – FCC: Section 15.207; ISED Canada: RSS-Gen 8.8.....                                                 | 45 |
| 7.5.1 | Measurement Procedure.....                                                                                                          | 45 |
| 7.5.2 | Measurement Results .....                                                                                                           | 45 |
| 8     | MEASUREMENT UNCERTAINTIES .....                                                                                                     | 48 |
| 9     | CONCLUSION.....                                                                                                                     | 49 |

## 1 GENERAL

### 1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations Section 15.247 and Innovation Science and Economic Development Canada's Radio Standards Specification RSS-247 for the tests documented herein.

### 1.2 Applicant Information

360fly, Inc.  
1975 East Sunrise Blvd., Suite 400  
Fort Lauderdale, FL 33304

### 1.3 Product Description

The 360fly, Inc. model FLY4KW01 and FLY4KW11 are 360-degree cameras which can be body-worn or installed in vehicles. The two models are identical and differ only by the top housing design. The cameras provide Bluetooth and 2.4/5 GHz Wi-Fi connectivity. This test report documents the compliance of the Bluetooth Transmitter.

#### Technical Details

|                     |                                           |
|---------------------|-------------------------------------------|
| Mode of Operation:  | Bluetooth 2.1+Enhanced Data Rate (EDR)    |
| Frequency Range:    | 2402 MHz - 2480 MHz                       |
| Number of Channels: | 79                                        |
| Channel Separation: | 1 MHz                                     |
| Modulations:        | GFSK, $\pi/4$ DQPSK (EDR2), 8 DPSK (EDR3) |
| Antenna Type/Gain:  | Loop with parasitic antenna, -0.15 dBi    |
| Input Power:        | 5 VDC USB, 4 VDC Dock.                    |

Model Number: FLY4KW01 and FLY4KW11

Test Sample Serial Number(s): 1708174355 (RF Conducted Measurements), 1709174742 (Radiated and Power Line Conducted Emissions).

Test Sample Condition: The samples were in good operating condition with no physical damages.

### 1.4 Test Methodology and Considerations

The EUT was evaluated for RF Conducted, Radiated and Power Line Conducted emissions. The test power level was not configurable from the test commands provided to support the testing. The EUT was set to operate at the maximum RF Output Power. The test power setting used during the evaluation was 0x09. All the measurements were performed on the FLY4KW01 model and the results are deemed representative of both model variants.

Preliminary radiated emission measurements were performed for the EUT standalone, the EUT powered via USB and the EUT set within the dock. Additionally, the EUT worst position with respect to the ground plane was investigated as well. The configuration with the dock led to the highest emissions. The EUT set sideways on the table top was determined as the worst-case orientation for the band-edge measurements while the EUT flat on the table top led to the highest spurious emissions. The results reported correspond to these two configurations.

The RF conducted measurements were performed on a sample modified with a temporary RF connector to allow direct coupling to the spectrum analyzer.

The power line conducted emission measurements were performed on the EUT powered via USB using an off-the-shelf power supply.

The EUT was also investigated for compliance to the unintentional emission requirements. The results are documented in a verification test report.

**Table 1.4-1: Bluetooth Radio Test configuration**

| Mode of Operations | Frequency (MHz) | Data Rate (kbps) |
|--------------------|-----------------|------------------|
| GFSK               | 2402            | 1000             |
|                    | 2441            | 1000             |
|                    | 2480            | 1000             |
| $\pi/4$ DQPSK      | 2402            | 2000             |
|                    | 2441            | 2000             |
|                    | 2480            | 2000             |
| 8 DPSK             | 2402            | 3000             |
|                    | 2441            | 3000             |
|                    | 2480            | 3000             |

## **2    TEST FACILITIES**

### **2.1    Location**

The radiated and conducted emissions test sites are located at the following address:

TÜV SÜD America, Inc.  
3998 FAU Blvd, Suite 310  
Boca Raton, Florida 33431  
Phone: (561) 961-5585  
Fax: (561) 961-5587  
<http://www.tuv-sud-america.com>

### **2.2    Laboratory Accreditations/Recognitions/Certifications**

TÜV SÜD America, Inc. is accredited to ISO/IEC 17025 by American Association for Laboratory Accreditation (A2LA) and has been issued certificate number 2955.15 in recognition of this accreditation. Unless otherwise specified, all test methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

FCC Test Firm Registration #: 475089  
Innovation, Science and Economic Development Canada Lab Code: 4175C

## 2.3 Radiated & Conducted Emissions Test Site Description

### 2.3.1 Semi-Anechoic Chamber Test Site

The EMC radiated test facility consists of an RF-shielded enclosure. The interior dimensions of the indoor semi-anechoic chamber are approximately 48 feet (14.6 m) long by 36 feet (10.8 m) wide by 24 feet (7.3 m) high and consist of rigid, 1/8 inch (0.32 cm) steel-clad, wood core modular panels with steel framing. In the shielded enclosure, the faces of the panels are galvanized and the chamber is self-supporting. 8-foot RF absorbing cones are installed on 4 walls and the ceiling. The steel-clad ground plane is covered with vinyl flooring.

The turntable is driven by pneumatic motor, which can support a 2000 lb. load. The turntable is flush with the chamber floor which it is connected to, around its circumference, with a continuous metallic loaded spring. An EMCO Model 1060 Multi-device controller controls the turntable position.

A pneumatic motor is used to control antenna polarizations and height relative to the ground. The height information is displayed on the control unit EMCO Model 1050.

The control room is an RF shielded enclosure attached to the semi-anechoic chamber with two bulkhead panels for connecting RF, and control cables. The dimension of the room is 7.3 m x 4.9 m x 3 m high and the entrance doors of both control and conducted rooms are 3 feet (0.91 m) by 7 feet (2.13 m).

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3.1-1 below:

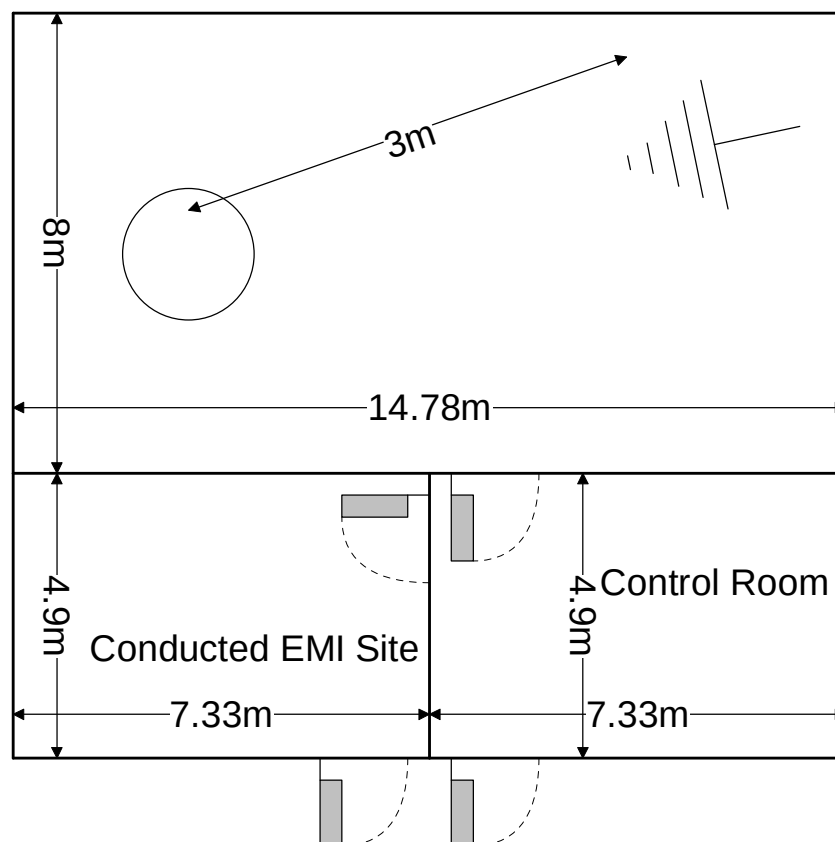


Figure 2.3.1-1: Semi-Anechoic Chamber Test Site

### 2.3.2 Conducted Emissions Test Site Description

The dimensions of the shielded conducted room are 7.3 x 4.9 x 3 m<sup>3</sup>. The power line conducted emission site includes two LISNs: a Solar Model 8028-50 50  $\Omega$ /50  $\mu$ H and an EMCO Model 3825/2R, which are installed as shown in the figure below. For evaluations requiring 230 V, 50 Hz AC input, a Polarad LISN (S/N 879341/048) is used in conjunction with a California Instruments signal generator Model 2001RP-OP1.

A diagram of the room is shown below in figure 2.3.2-1:

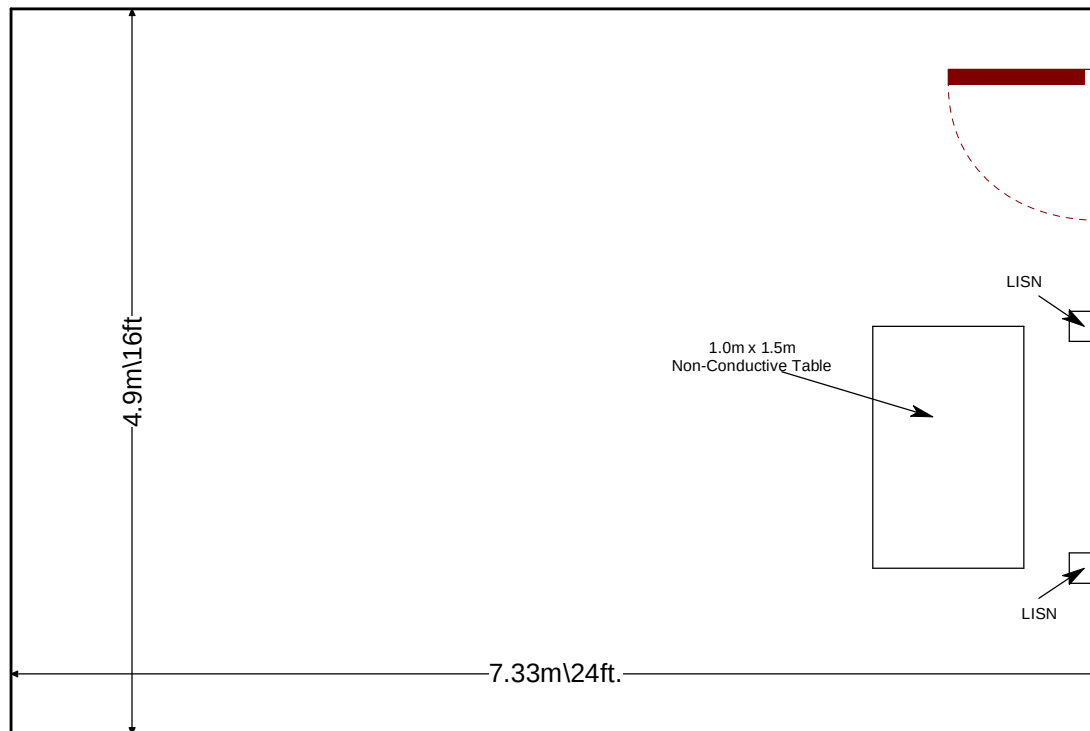


Figure 2.3.2-1: AC Mains Conducted EMI Site

**3    APPLICABLE STANDARD REFERENCES**

The following standards were used:

- ❖ ANSI C63.10-2013: American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2018.
- ❖ US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2018
- ❖ Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-247 — Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices, Issue 2, February 2017.
- ❖ Innovation, Science and Economic Development Canada Radio Standards Specification: RSS-GEN – General Requirements for Compliance of Radio Apparatus, Issue 4, Amendment 1, March 2018.

#### 4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

**Table 4-1: Test Equipment List**

| AssetID   | Manufacturer               | Model #                | Equipment Type     | Serial #   | Last Calibration Date | Calibration Due Date |
|-----------|----------------------------|------------------------|--------------------|------------|-----------------------|----------------------|
| 282       | Microwave Circuits         | H2G020G4               | Filters            | 74541      | 5/23/2017             | 5/23/2018            |
| 479       | Electro-Metrics            | ALP-70                 | Antennas           | 158        | 12/3/2015             | 12/3/2017            |
| 523       | Agilent                    | E7405                  | Spectrum Analyzers | MY45103293 | 12/9/2016             | 12/9/2018            |
| 653       | Suhner                     | SF-102A                | Cables             | 0944/2A    | 9/5/2017              | 9/5/2018             |
| 2002      | EMCO                       | 3108                   | Antennas           | 2147       | 11/19/2015            | 11/19/2017           |
| 2004      | EMCO                       | 3146                   | Antennas           | 1385       | 11/19/2015            | 11/19/2017           |
| 2006      | EMCO                       | 3115                   | Antennas           | 2573       | 4/7/2017              | 4/7/2019             |
| 2008      | COM-Power                  | AH-826                 | Antennas           | 81009      | NCR                   | NCR                  |
| 2045      | ACS Boca                   | Conducted Cable Set    | Cable Set          | 2045       | 10/31/2016            | 10/31/2017           |
| 2082      | Teledyne Storm Products    | 90-010-048             | Cables             | 2082       | 4/7/2017              | 4/7/2018             |
| 2086      | Merrimac                   | FAN-6-10K              | Attenuators        | 23148-83-1 | 11/2/2016             | 11/2/2017            |
| 2089      | Agilent Technologies, Inc. | 83017A                 | Amplifiers         | 3123A00214 | 12/2/2016             | 12/2/2017            |
| 2095      | ETS Lindgren               | TILE4! - Version 4.2.A | Software           | 85242      | NCR                   | NCR                  |
| 2111      | Aeroflex Inmet             | 40AH2W-20              | Attenuator         | 2111       | 7/20/2017             | 7/20/2018            |
| 2121      | ACS Boca                   | Radiated Cable Set     | Cable Set          | 2121       | 7/31/2017             | 7/31/2018            |
| 2112      | Teledyne Storm Products    | 921-0101-036           | Cables             | 12-06-698  | 11/2/2016             | 11/2/2017            |
| 3004      | Teseq                      | CFL 9206A              | Attenuators        | 34720      | 8/29/2017             | 8/29/2018            |
| NBLE03366 | Agilent                    | E4440A                 | Spectrum Analyzer  | MY42510427 | 10/18/2016            | 10/18/2017           |
| TEMC00153 | Rohde and Schwarz          | ESH3-Z5                | LISN               | 894785/012 | 9/27/2017             | 9/27/2018            |

**Notes:**

- NCR=No Calibration Required
- The assets were only used during the active period of the calibration cycle.

**5 SUPPORT EQUIPMENT****Table 5-1: EUT and Support Equipment Description – Radiated Emissions**

| Item # | Type Device                     | Manufacturer | Model/Part # | Serial #   |
|--------|---------------------------------|--------------|--------------|------------|
| 1      | EUT                             | 360fly, Inc. | FLY4KW01     | 1709174742 |
| 2      | Car Cradle                      | 360fly, Inc. | FLYCRD01     | N/A        |
| 3      | Cigarette Lighter Adapter (CLA) | N/A          | N/A          | N/A        |
| 4      | Power Supply                    | MPJA         | HY5003       | 3700278    |

**Table 5-2: Cable Description – Radiated Emissions**

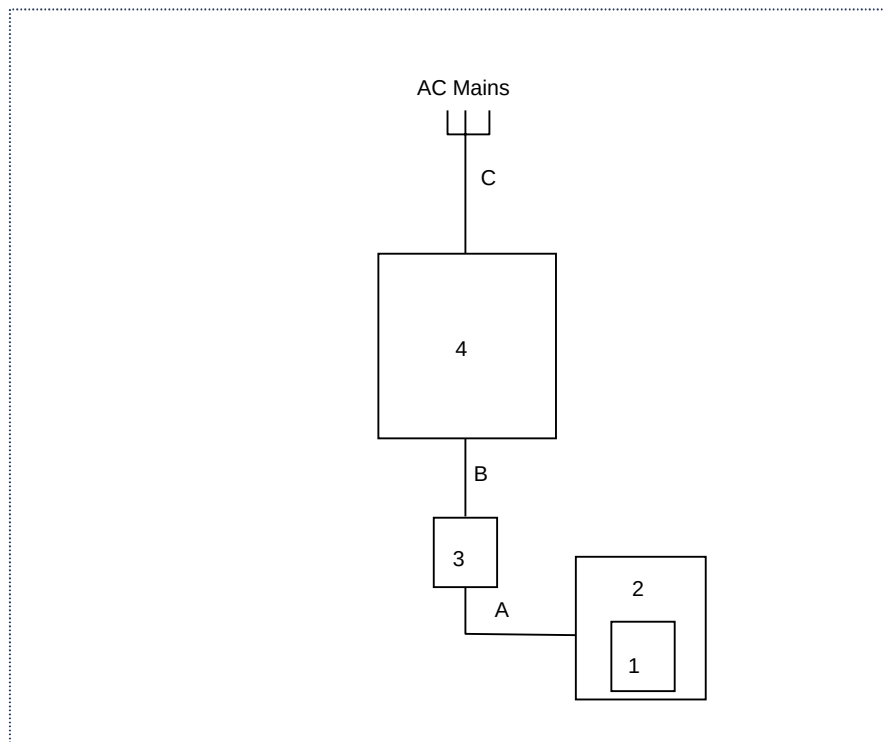
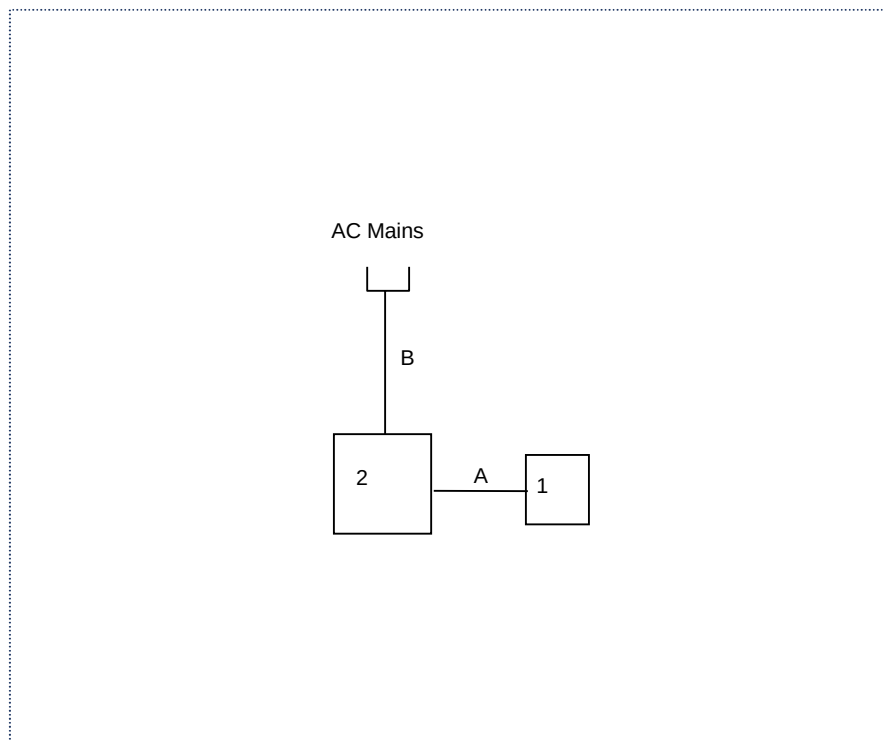
| Cable # | Cable Type | Length | Shield | Termination              |
|---------|------------|--------|--------|--------------------------|
| A       | DC Cable   | 2.05 m | No     | CLA to EUT               |
| B       | DC Leads   | 2.9 m  | No     | CLA to Power Supply      |
| C       | Power Cord | 2.3 m  | No     | Power Supply to AC Mains |

**Table 5-3: EUT and Support Equipment Description – Power Line Conducted Emissions**

| Item # | Type Device        | Manufacturer | Model/Part # | Serial #     |
|--------|--------------------|--------------|--------------|--------------|
| 1      | EUT                | 360fly, Inc. | FLY4KW01     | 1709174742   |
| 2      | 5 VDC Power Supply | VSN Mobil    | C-P06        | 141119001574 |

**Table 5-4: Cable Description – Power Line Conducted Emissions**

| Cable # | Cable Type     | Length | Shield | Termination              |
|---------|----------------|--------|--------|--------------------------|
| A       | USB Cable      | 0.98 m | No     | EUT to Power Supply      |
| B       | Extension Cord | 1.85 m | No     | Power Supply to AC Mains |

**6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM****Figure 6-1: EUT and Support Equipment Block Diagram – Radiated Emissions****Figure 6-2: EUT and Support Equipment Block Diagram – Power Line Conducted Emissions**

## 7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

### 7.1 Antenna Requirement – FCC: Section 15.203

The EUT uses an internal -0.15 dBi loop with parasitic antenna that is connected to the main PCB via contact springs. The antenna is not replacable without damaging the equipment and therefore meets the requirements of FCC Section 15.203.

### 7.2 Peak Output Power - FCC Section 15.247(b)(1) IC: RSS-247 5.4(b)

#### 7.2.1 Measurement Procedure (Conducted Method)

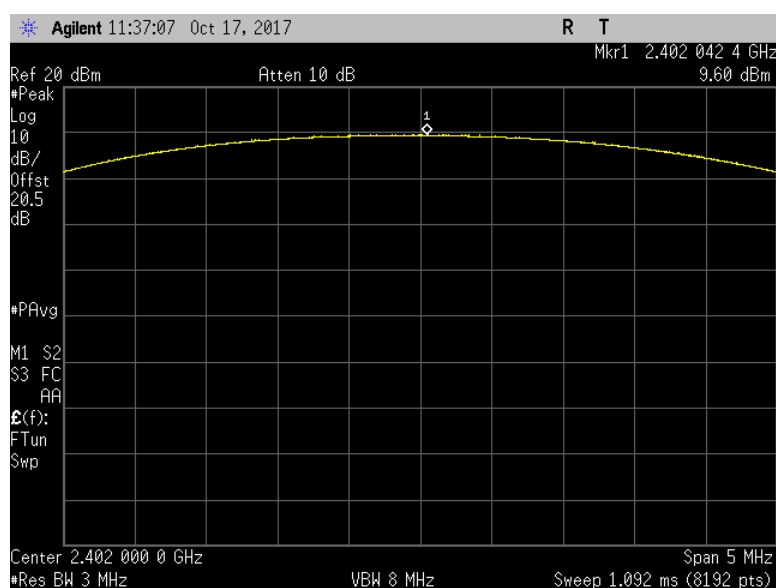
The RF output port of the EUT was directly connected to the input of the spectrum analyzer through suitable attenuation.

#### 7.2.2 Measurement Results

Performed by: Thierry Jean-Charles

**Table 7.2.2-1 RF Output Power (GFSK)**

| Frequency (MHz) | Power (dBm) |
|-----------------|-------------|
| 2402            | 9.60        |
| 2441            | 11.16       |
| 2480            | 9.26        |



**Figure 7.2.2-1: RF Output Power - Low Channel (GFSK)**

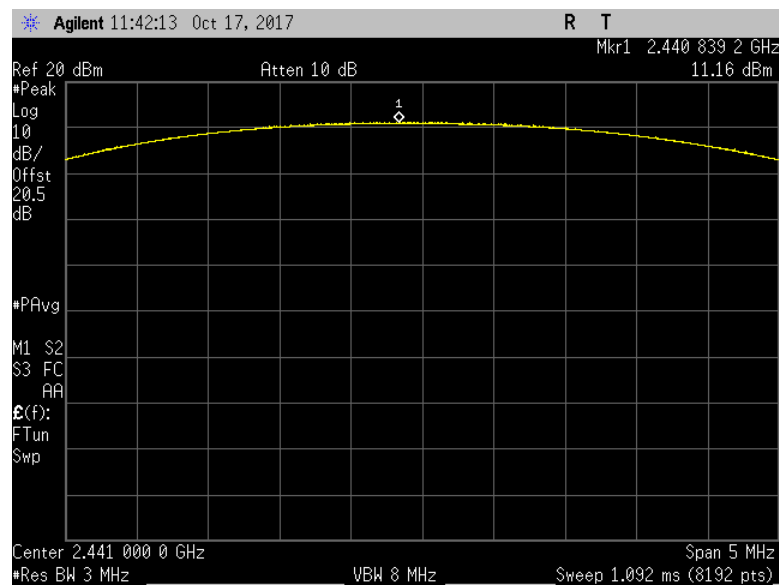


Figure 7.2.2-2: RF Output Power - Middle Channel (GFSK)

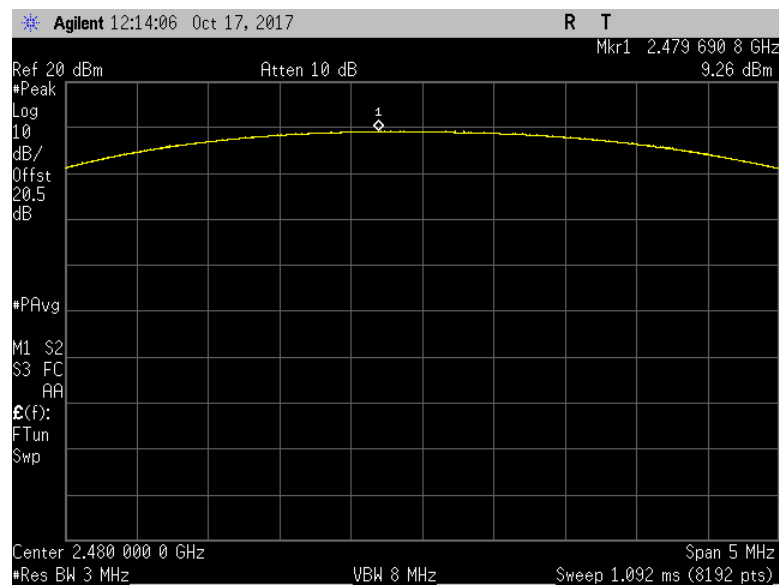
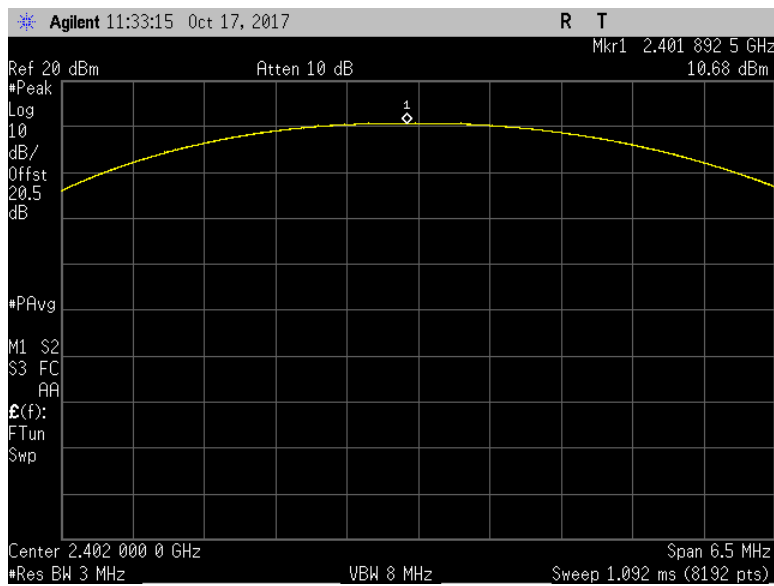
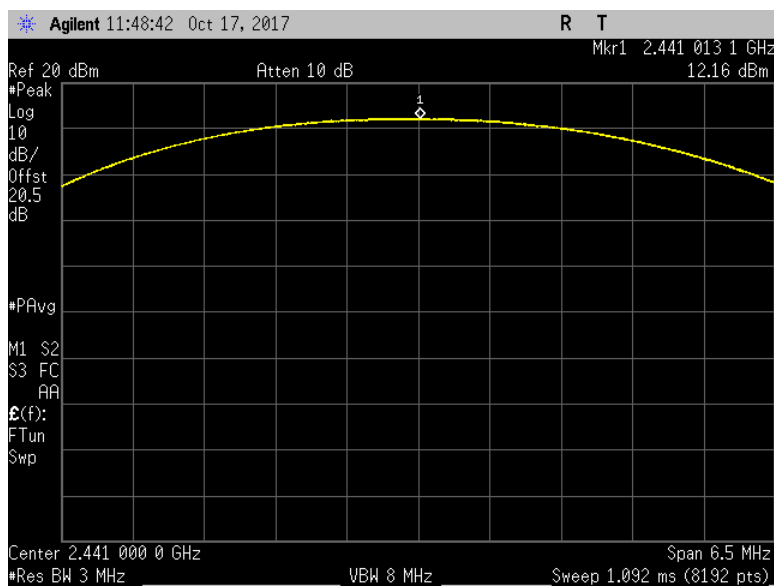


Figure 7.2.2-3: RF Output Power - High Channel (GFSK)

Table 7.2.2-2: RF Output Power ( $\pi/4$  DQPSK)

| Frequency (MHz) | Power (dBm) |
|-----------------|-------------|
| 2402            | 10.68       |
| 2441            | 12.16       |
| 2480            | 10.38       |

Figure 7.2.2-4: RF Output Power - Low Channel ( $\pi/4$  DQPSK)Figure 7.2.2-5: RF Output Power - Middle Channel ( $\pi/4$  DQPSK)

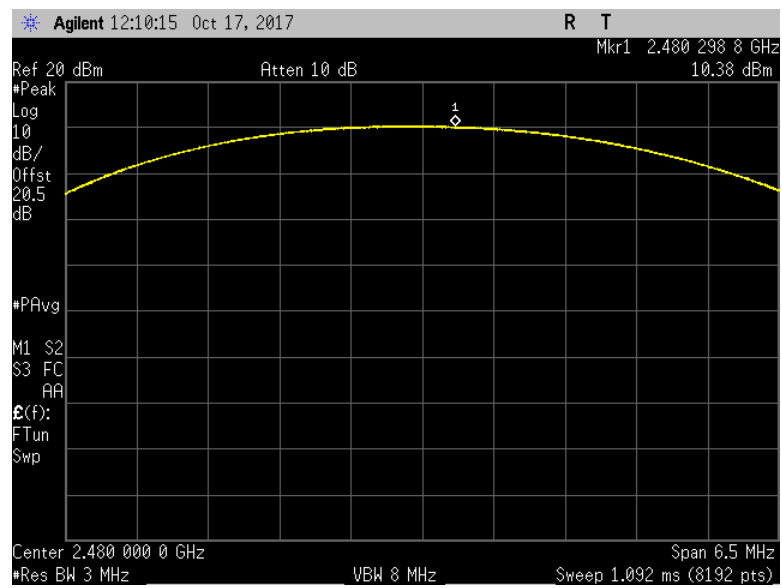
Figure 7.2.2-6: RF Output Power - High Channel ( $\pi/4$  DQPSK)

Table 7.2.2-3: RF Output Power (8DPSK)

| Frequency (MHz) | Power (dBm) |
|-----------------|-------------|
| 2402            | 10.97       |
| 2441            | 12.42       |
| 2480            | 10.81       |

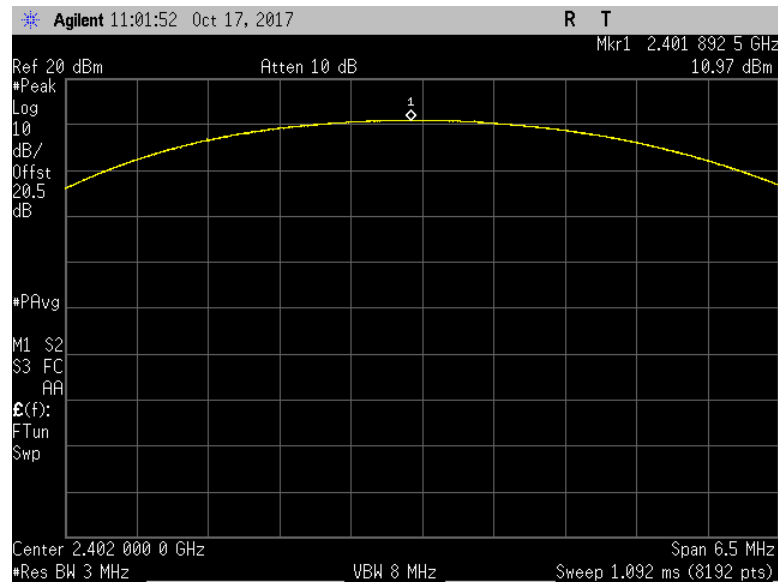


Figure 7.2.2-7: RF Output Power - Low Channel (8DPSK)

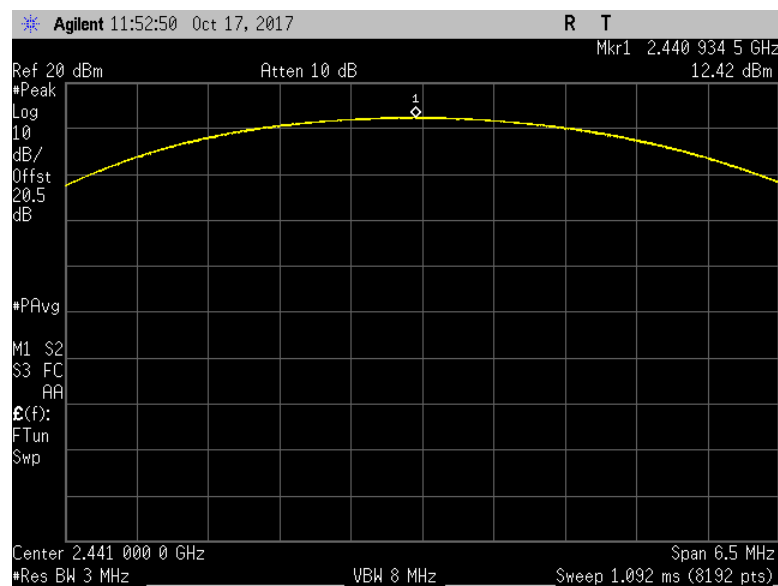
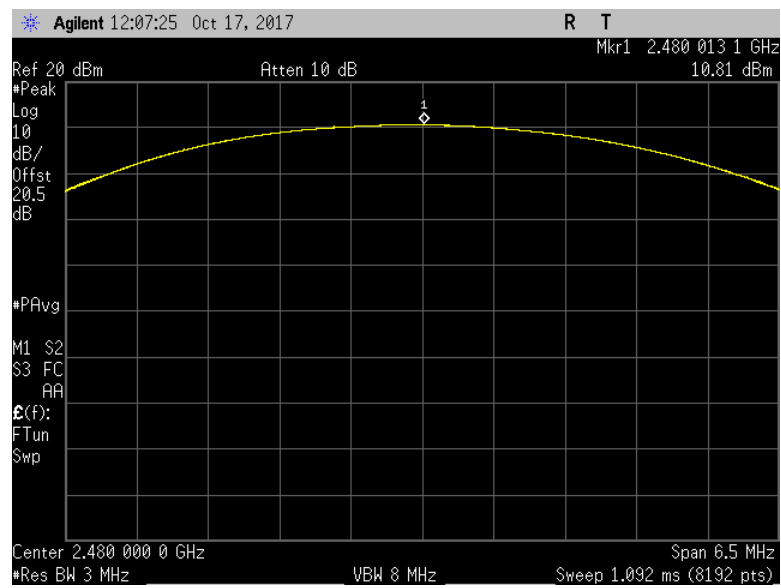


Figure 7.2.2-8: RF Output Power - Middle Channel (8DPSK)



### 7.3 Channel Usage Requirements

#### 7.3.1 Carrier Frequency Separation – FCC: Section 15.247(a)(1) IC: RSS-247 5.1(b)

##### 7.3.1.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture two adjacent peaks and the RBW and VBW were set to approximately 30% of the channel spacing.

##### 7.3.1.2 Measurement Results

Performed by: Thierry Jean-Charles

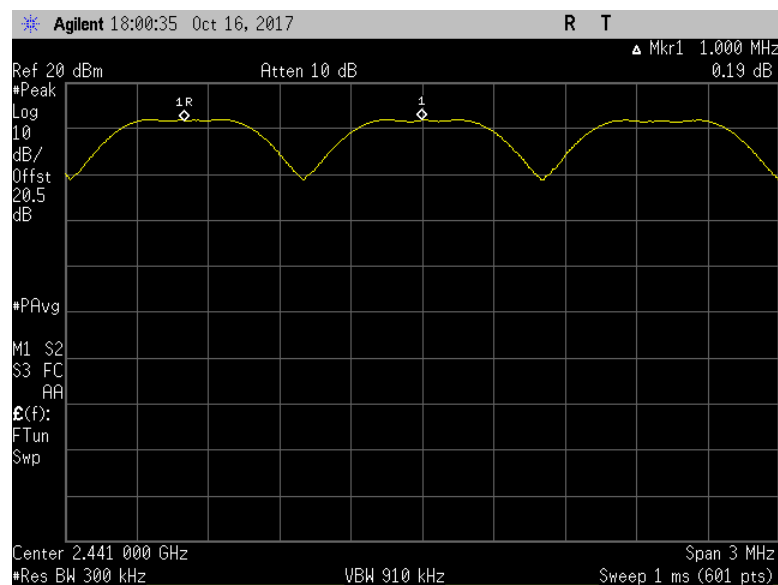


Figure 7.3.1.2-1: Carrier Frequency Separation

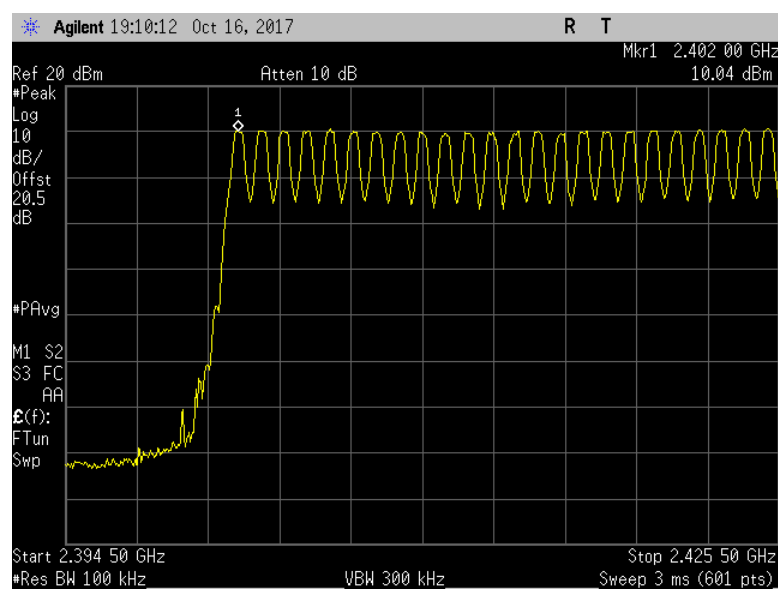
## 7.3.2 Number of Hopping Channels – FCC: Section 15.247(a)(1)(iii) IC: RSS-247 5.1(d)

### 7.3.2.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set wide enough to capture the number of hopping channels. The peak detector max hold function was enabled for the measurements.

### 7.3.2.2 Measurement Results

Performed by: Thierry Jean-Charles



**Figure 7.3.2.2-1: Number of Hopping Channels (1 – 24)**

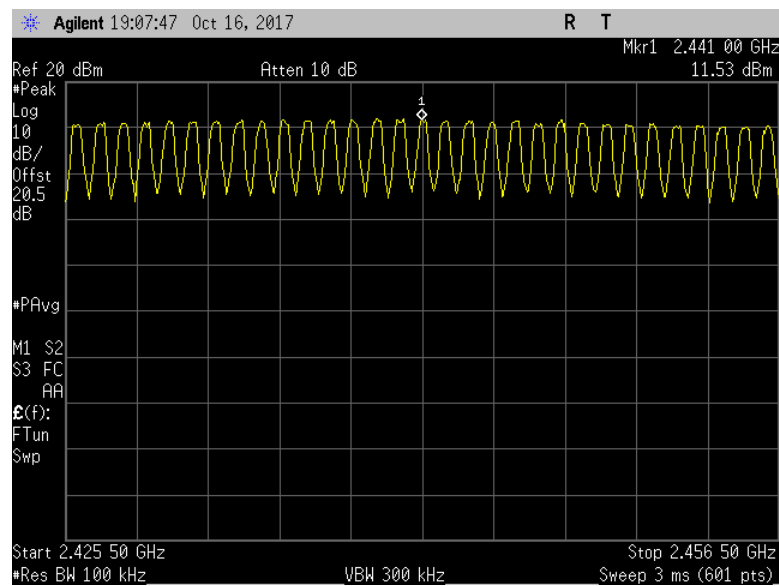


Figure 7.3.2.2-2: Number of Hopping Channels (25 – 55)

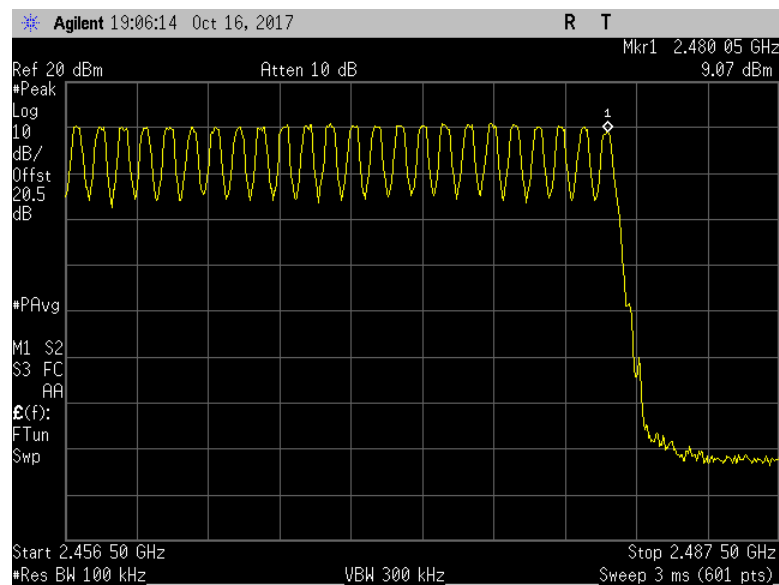


Figure 7.3.2.2-3: Number of Hopping Channels (56 – 79)

### 7.3.3 Channel Dwell Time – FCC: Section 15.247(a)(1)(iii) IC: RSS-247 5.1(d)

#### 7.3.3.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer was set 0 Hz centered on a hopping channel. The RBW was set to less than 30% of the channel spacing and the sweep time adjusted to capture the entire dwell time per channel with peak detector max hold function.

#### 7.3.3.2 Measurement Results

Performed by: Thierry Jean-Charles

**Table 7.3.3.2-1: Dwell Time on a 31.6 Second Cycle**

| Packet Format | Number of Hops Per Sec. (NHPS) | Number of Hops per Channel Per Sec. (NHPCPS) | Number of hops on a 31.6 s Cycle (NHPC) | Measured Dwell Times (ms) | Dwell Times on a 31.6 s Cycle | Limit (ms) | Status |
|---------------|--------------------------------|----------------------------------------------|-----------------------------------------|---------------------------|-------------------------------|------------|--------|
| DH1           | 800                            | 10.13                                        | 320                                     | 0.4036                    | 129.15                        | 400        | PASS   |
| DH3           | 400                            | 5.06                                         | 160                                     | 1.657                     | 265.12                        | 400        | PASS   |
| DH5           | 266.67                         | 3.38                                         | 106.67                                  | 2.902                     | 309.56                        | 400        | PASS   |

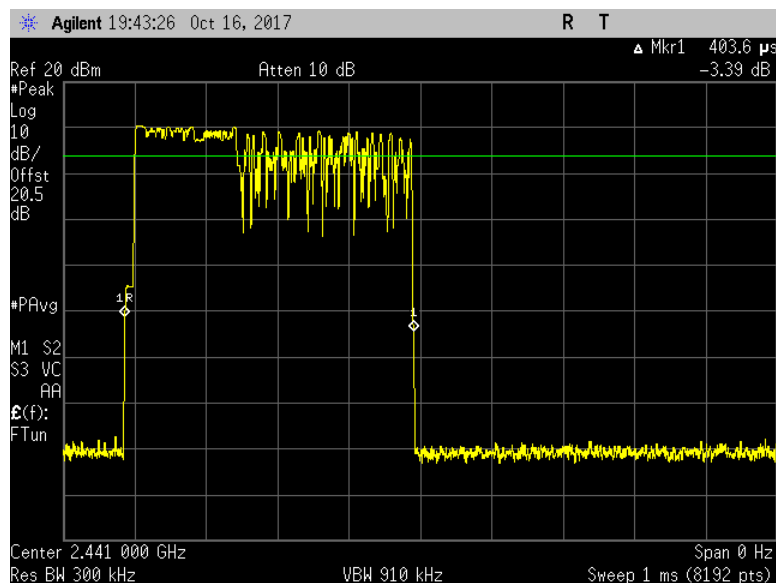
\*Notes:

NHPS = (1600 /sec)/ (NT+NR) (where NT and NR are the number of transmit and receive packets, respectively)

NHPCPS = NHPS/79

NHPC = NHPCPS \* 31.6s

Dwell Time per Cycle = NHPC\* Measured Dwell Time



**Figure 7.3.3.2-1: Channel Dwell Time – DH1**

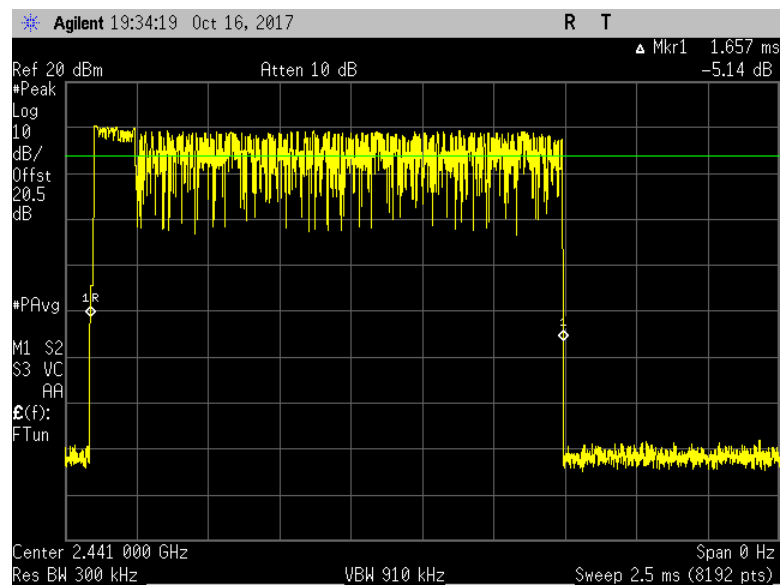


Figure 7.3.3.2-2: Channel Dwell Time - DH3

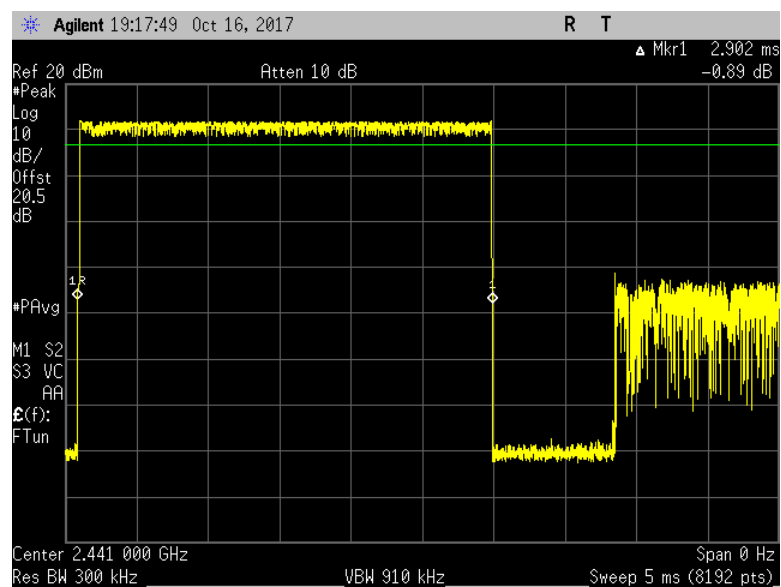


Figure 7.3.3.2-3: Channel Dwell Time - DH5

**7.3.4 20dB / 99% Bandwidth - FCC: Section 15.247(a)(1)(i) IC: RSS-247 5.1(a)****7.3.4.1 Measurement Procedure**

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The spectrum analyzer span was set to 2 to 5 times the estimated bandwidth of the emission. The RBW was set to 1% to 5% of the estimated emission bandwidth. The trace was set to max hold with a peak detector active. For the GFSK modulation, the Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emissions. For the 8 DPSK and Pi/4DQPSK modulations, the N dB function of the spectrum analyzer was used to measure the 20 dB bandwidth.

The 99% occupied bandwidth was measured with the spectrum analyzer span set to fully display the emission. The RBW was set to 1% to 5% of the approximated bandwidth. The occupied 99% bandwidth was measured by using the 99% bandwidth equipment function of the spectrum analyzer.

**7.3.4.2 Measurement Results**

Performed by: Thierry Jean-Charles

**Table 7.3.4.2-1: 20dB / 99% Bandwidth (GFSK)**

| Frequency (MHz) | 20dB Bandwidth (kHz) | 99% Bandwidth (kHz) |
|-----------------|----------------------|---------------------|
| 2402            | 967.021              | 914.585             |
| 2441            | 966.608              | 914.656             |
| 2480            | 967.090              | 915.039             |

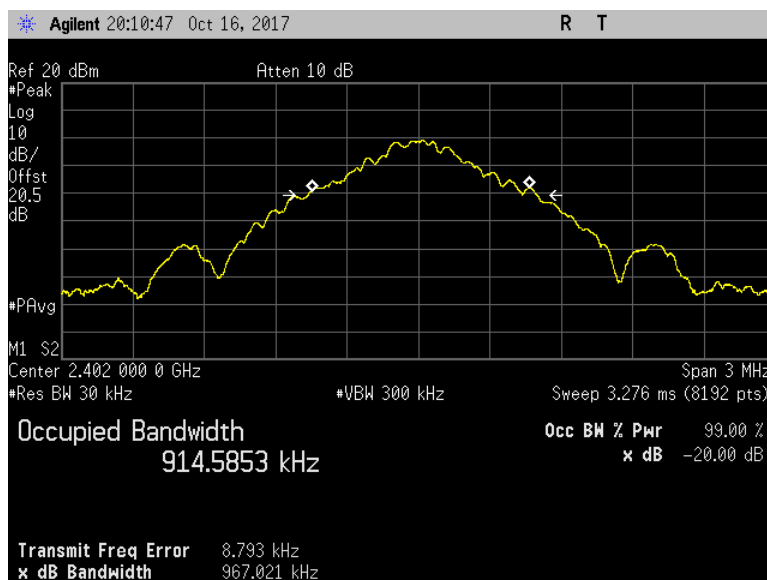
**Figure 7.3.4.2-1: 20 dB / 99% BW – Low Channel (GFSK)**



Figure 7.3.4.2-2: 20 dB / 99% BW – Middle Channel (GFSK)

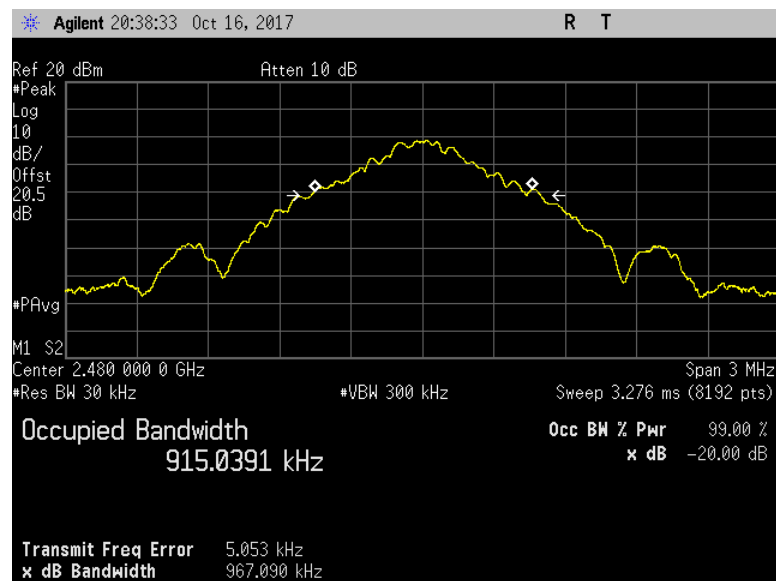
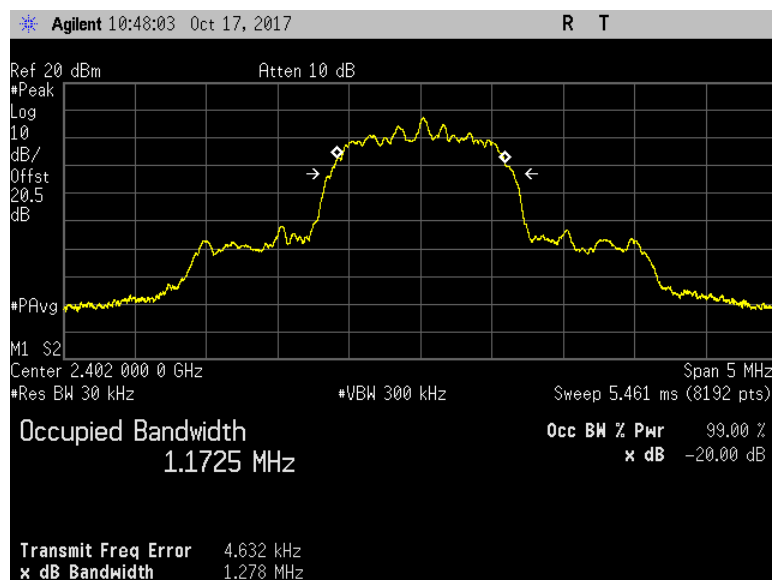
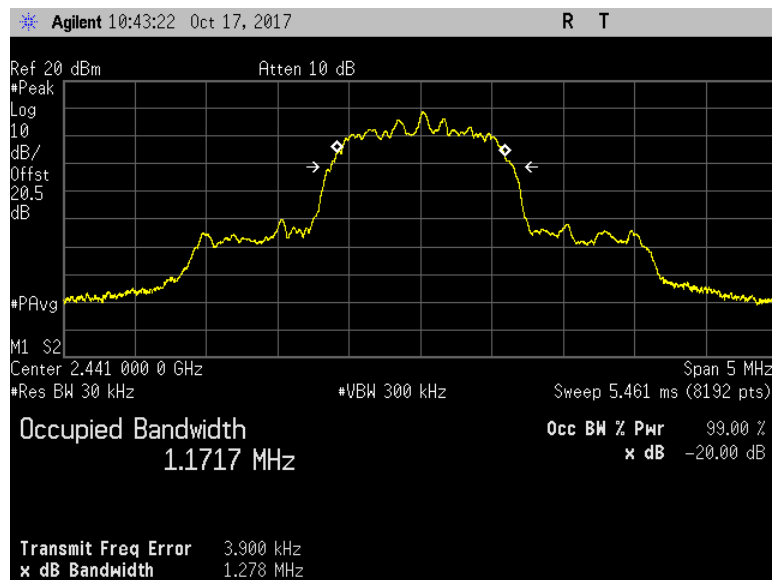


Figure 7.3.4.2-3: 20 dB / 99% BW – High Channel (GFSK)

Table 7.3.4.2-2: 20dB / 99% Bandwidth ( $\pi/4$  DQPSK)

| Frequency (MHz) | 20dB Bandwidth (kHz) | 99% Bandwidth (kHz) |
|-----------------|----------------------|---------------------|
| 2402            | 1278.0               | 1172.5              |
| 2441            | 1278.0               | 1171.7              |
| 2480            | 1278.0               | 1170.8              |

Figure 7.3.4.2-4: 20 dB / 99% BW – Low Channel ( $\pi/4$  DQPSK)Figure 7.3.4.2-5: 20 dB / 99% BW – Middle Channel ( $\pi/4$  DQPSK)

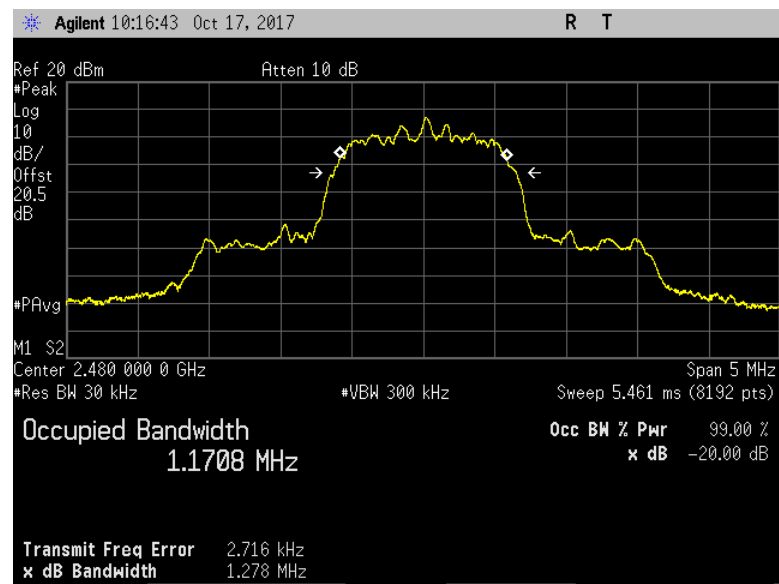
Figure 7.3.4.2-6: 20 dB / 99% BW – High Channel ( $\pi/4$  DQPSK)

Table 7.3.4.2-3: 20dB / 99% Bandwidth (8DPSK)

| Frequency (MHz) | 20dB Bandwidth (kHz) | 99% Bandwidth (kHz) |
|-----------------|----------------------|---------------------|
| 2402            | 1291.0               | 1175.7              |
| 2441            | 1290.0               | 1176.1              |
| 2480            | 1287                 | 1176.0              |

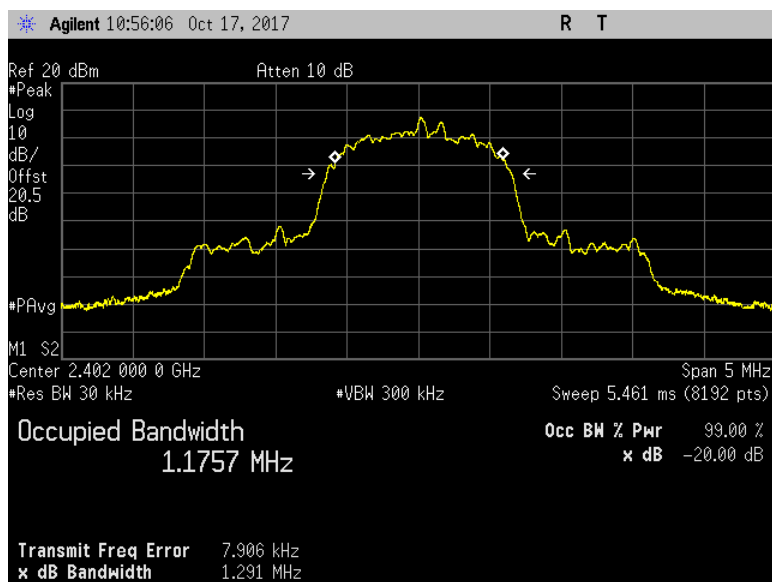


Figure 7.3.4.2-7: 20 dB / 99% BW – Low Channel (8DPSK)

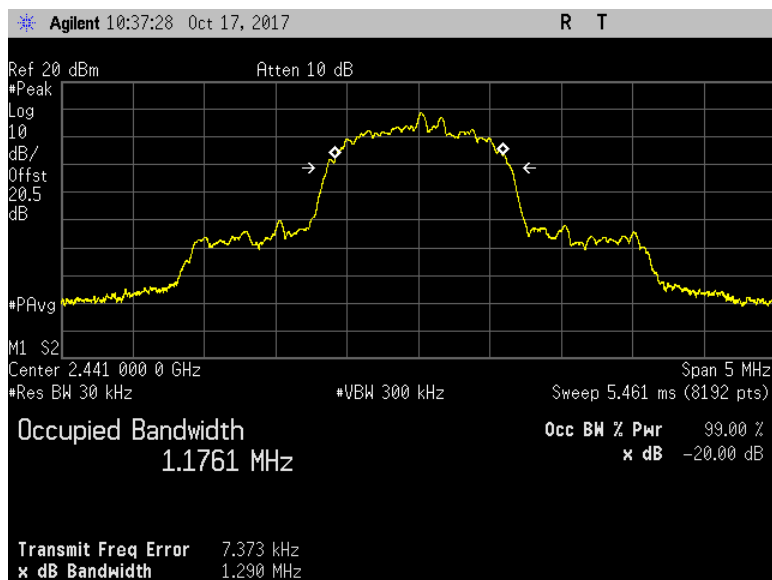


Figure 7.3.4.2-8: 20 dB / 99% BW – Middle Channel (8DPSK)

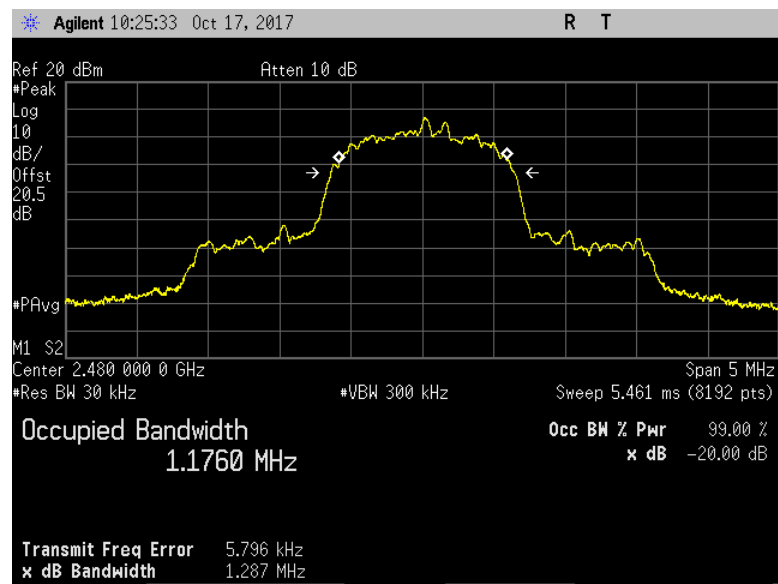


Figure 7.3.4.2-9: 20 dB / 99% BW – High Channel (8DPSK)

## 7.4 Band-Edge Compliance and Spurious Emissions-FCC 15.247(d) IC: RSS-247 5.5

### 7.4.1 Band-Edge Compliance of RF Conducted Emissions

#### 7.4.1.1 Measurement Procedure

The RF output port of the EUT was connected to the input of the spectrum analyzer through suitable attenuation. The EUT was investigated at the lowest and highest channel available to determine band-edge compliance. For each measurement the spectrum analyzer's RBW was set to 100 kHz, which is  $\geq 1\%$  of the span, and the VBW was set to  $\geq 300$  kHz.

#### 7.4.1.2 Measurement Results

Performed by: Thierry Jean-Charles

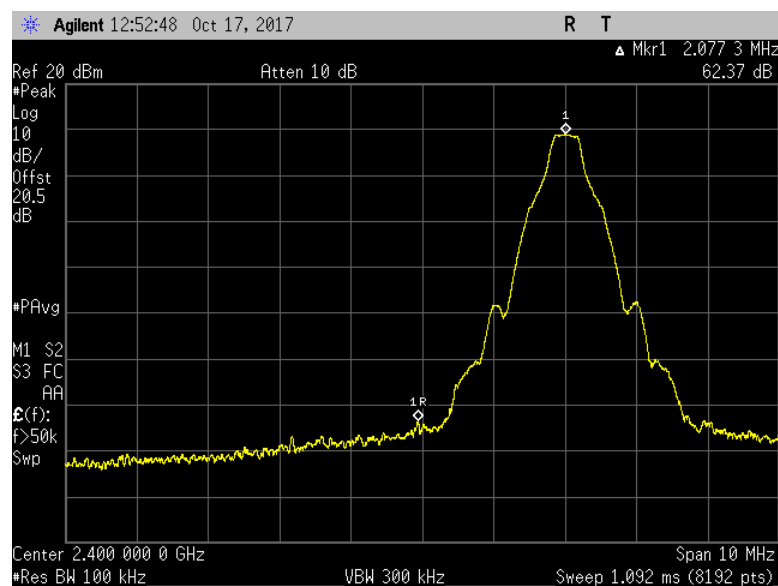


Figure 7.4.1.2-1: Lower Band-edge (GFSK)

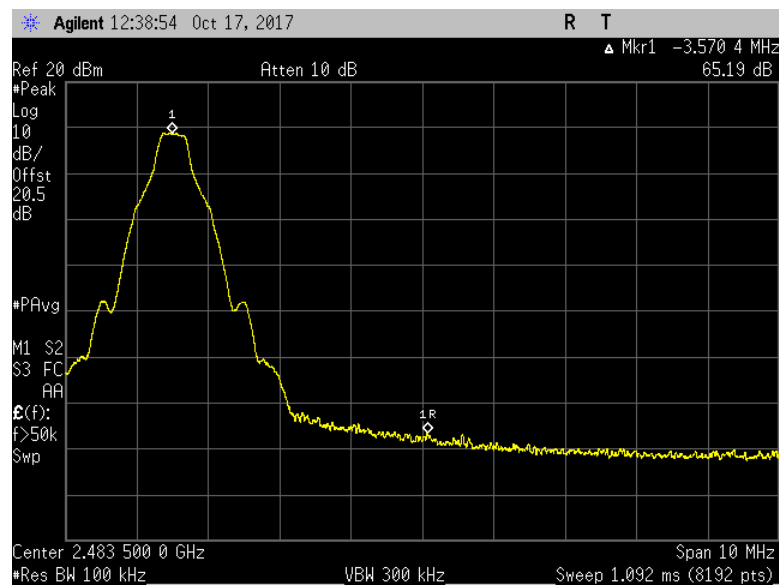


Figure 7.4.1.2-2: Upper Band-edge (GFSK)

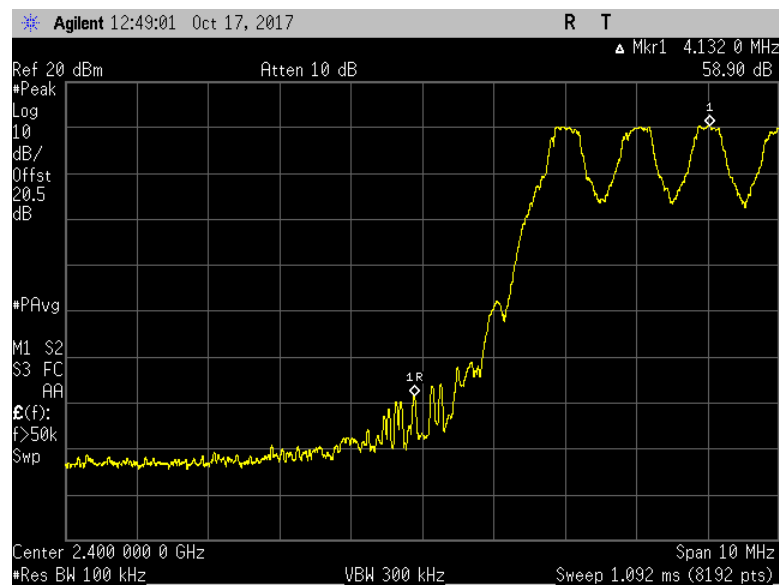
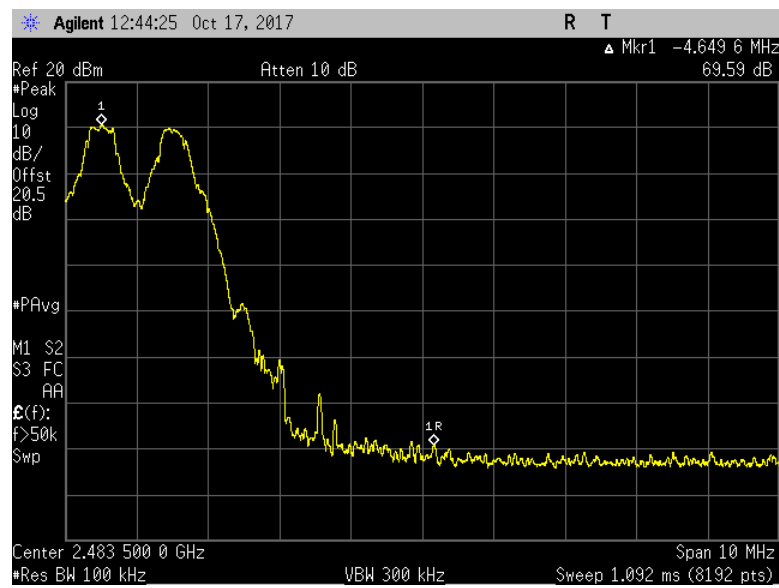
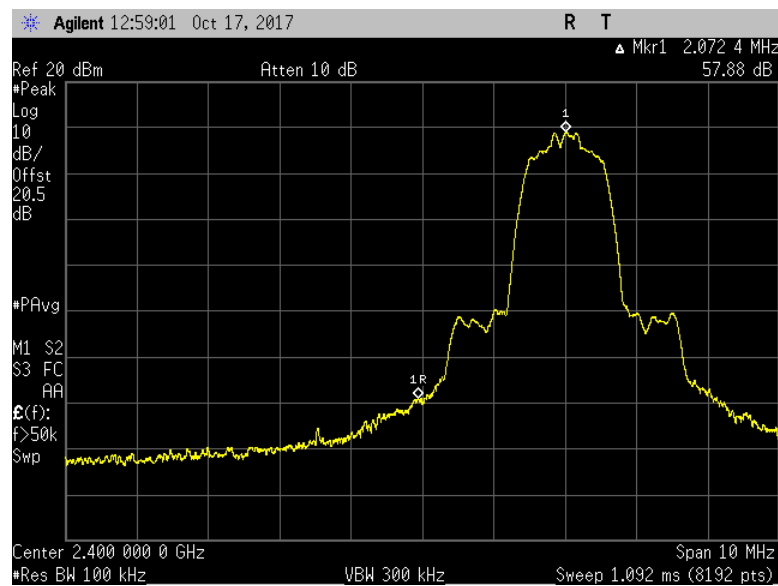
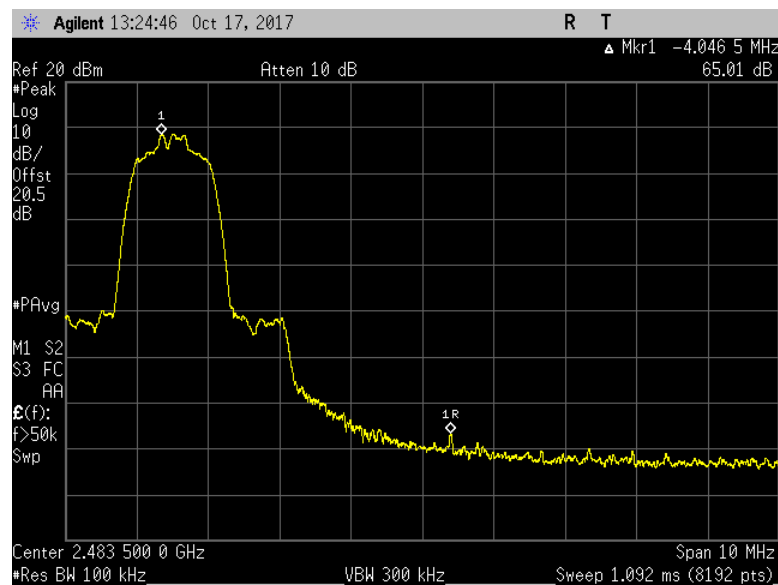
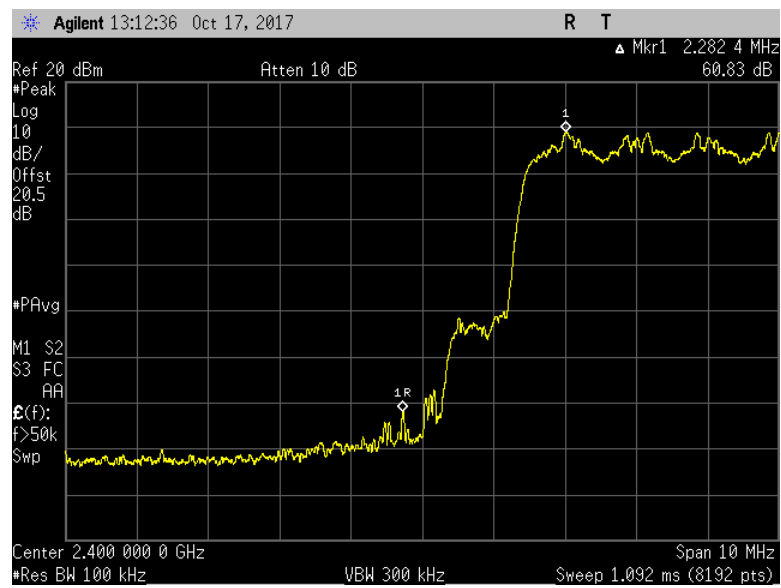
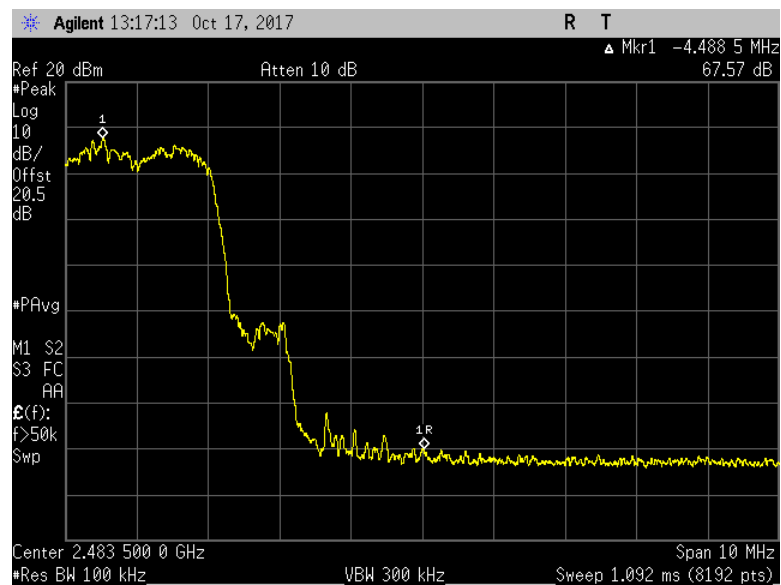


Figure 7.4.1.2-3: Lower Band-edge – Hopping Mode (GFSK)

**Figure 7.4.1.2-4: Upper Band-edge – Hopping Mode (GFSK)**

Figure 7.4.1.2-5: Lower Band-edge ( $\pi/4$  DQPSK)Figure 7.4.1.2-6: Upper Band-edge ( $\pi/4$  DQPSK)

Figure 7.4.1.2-7: Lower Band-edge – Hopping Mode ( $\pi/4$  DQPSK)Figure 7.4.1.2-8: Upper Band-edge – Hopping Mode ( $\pi/4$  DQPSK)

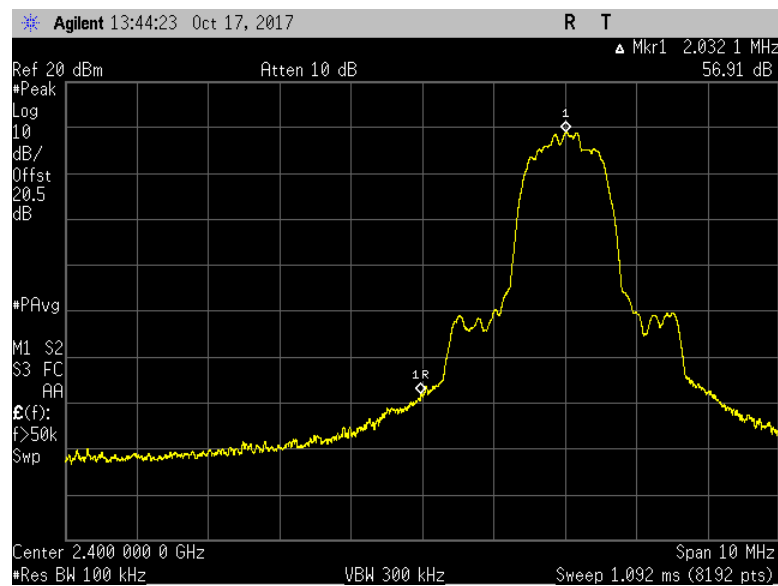


Figure 7.4.1.2-9: Lower Band-edge (8DPSK)

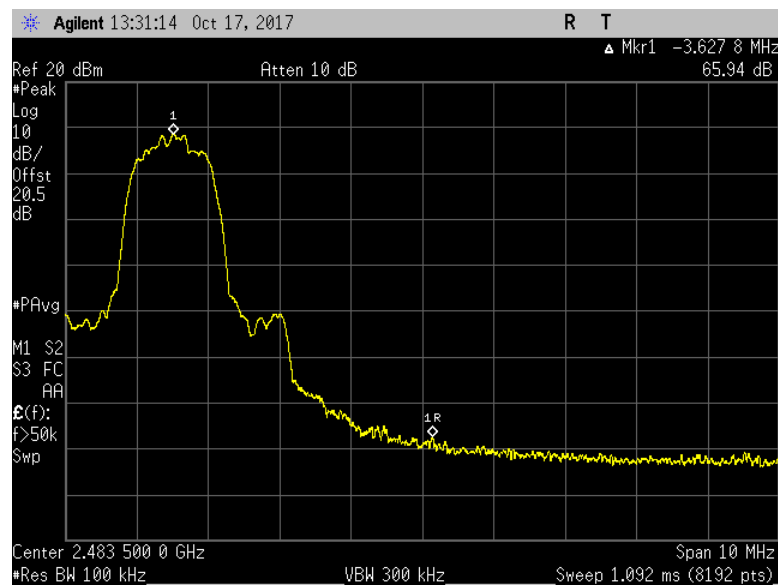


Figure 7.4.1.2-10: Upper Band-edge (8DPSK)

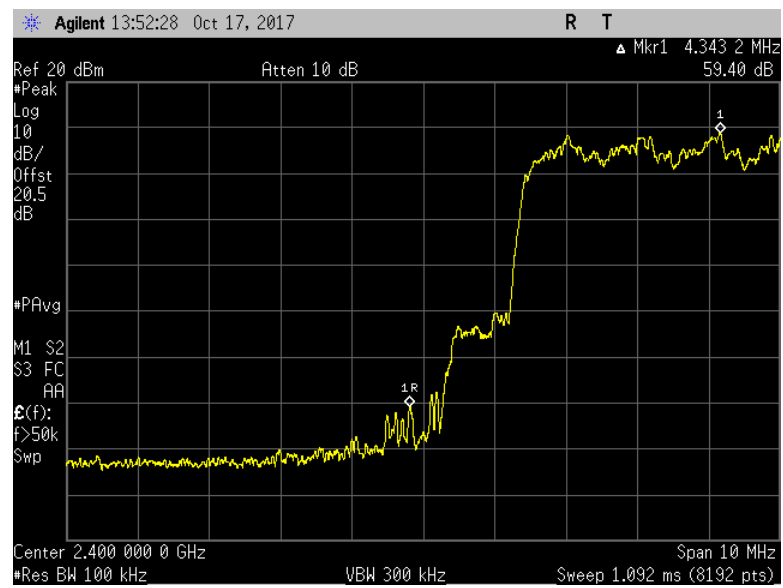


Figure 7.4.1.2-11: Lower Band-edge – Hopping Mode (8DPSK)

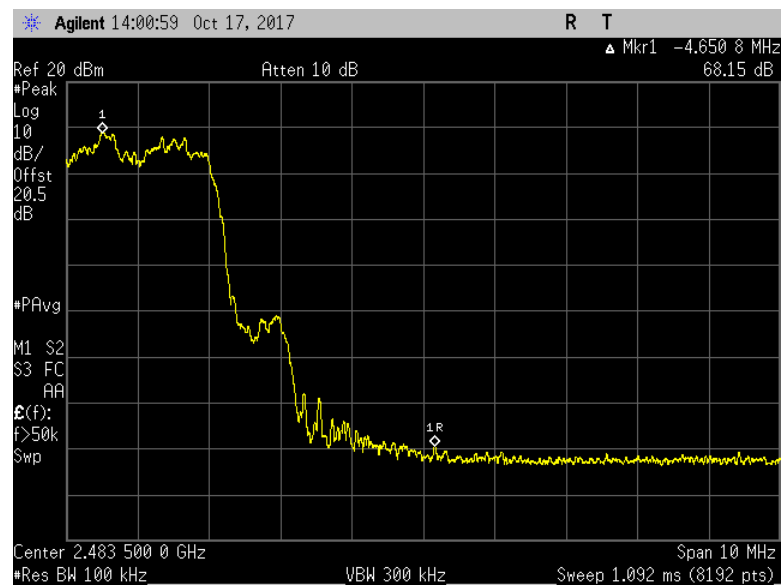


Figure 7.4.1.2-12: Upper Band-edge – Hopping Mode (8DPSK)

## 7.4.2 RF Conducted Spurious Emissions – FCC: Section 15.247(d); ISCED Canada: RSS-247 5.5

### 7.4.2.1 Measurement Procedure

The RF Conducted Spurious Emissions were measured in accordance with the FCC KDB 558074 D01 DTS Meas Guidance v04 Section 11.3 Emission level measurement. The RF output port of the equipment under test was directly connected to the input of the spectrum analyzer. The EUT was investigated for conducted spurious emissions from 30 MHz to 26 GHz, 10 times the highest fundamental frequency. Measurements were made at the low, center and high channels of the EUT. For each measurement, the spectrum analyzer's RBW was set to 100 kHz and the VBW was set to 50 MHz. The peak Max Hold function of the analyzer was utilized. The reference level was determined by measuring the Peak PSD level in any 100-kHz bandwidth within the DTS channel bandwidth.

### 7.4.2.2 Measurement Results

Performed by: Thierry Jean-Charles

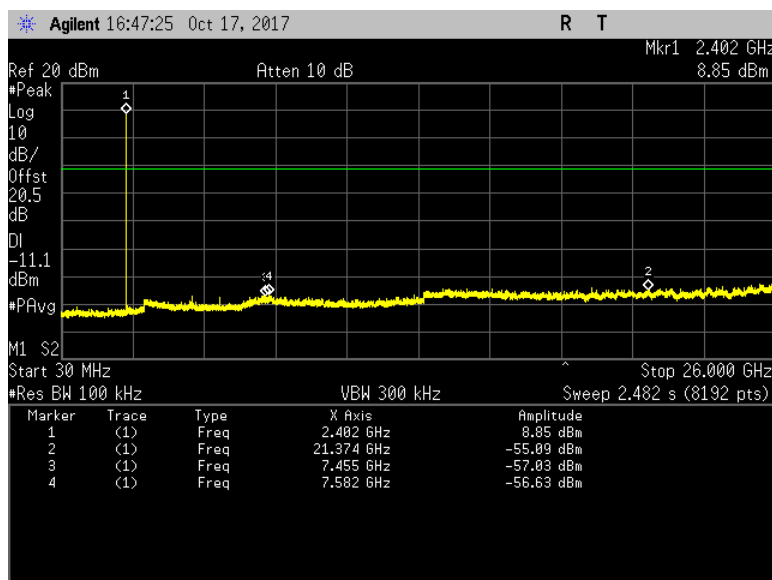


Figure 7.4.2.2-1: 30 MHz – 26 GHz – Low Channel (GFSK)

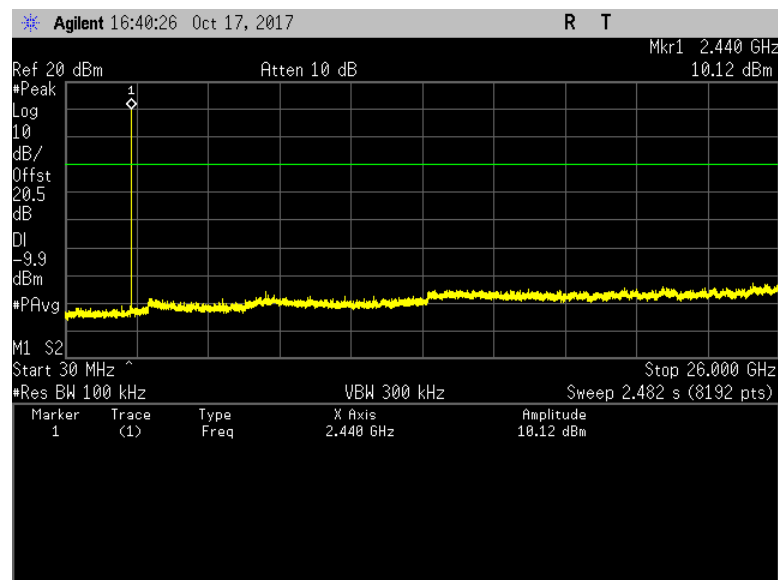


Figure 7.4.2.2-2: 30 MHz – 26 GHz – Middle Channel (GFSK)

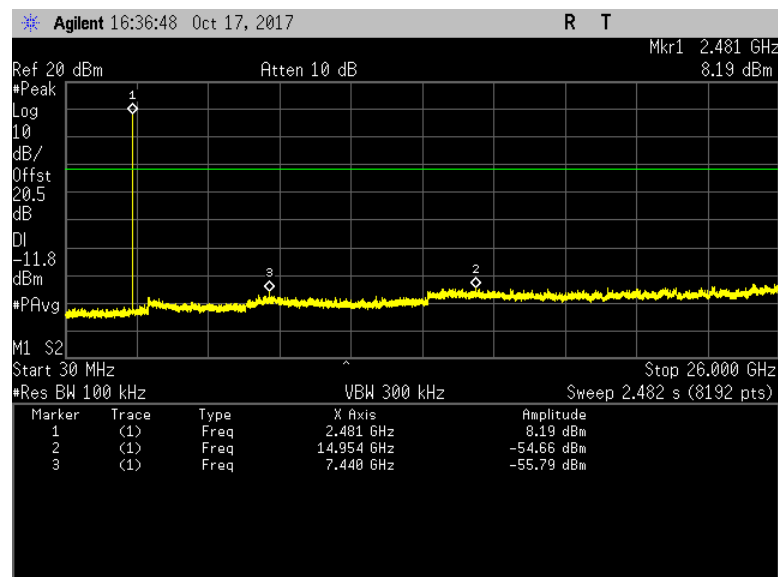
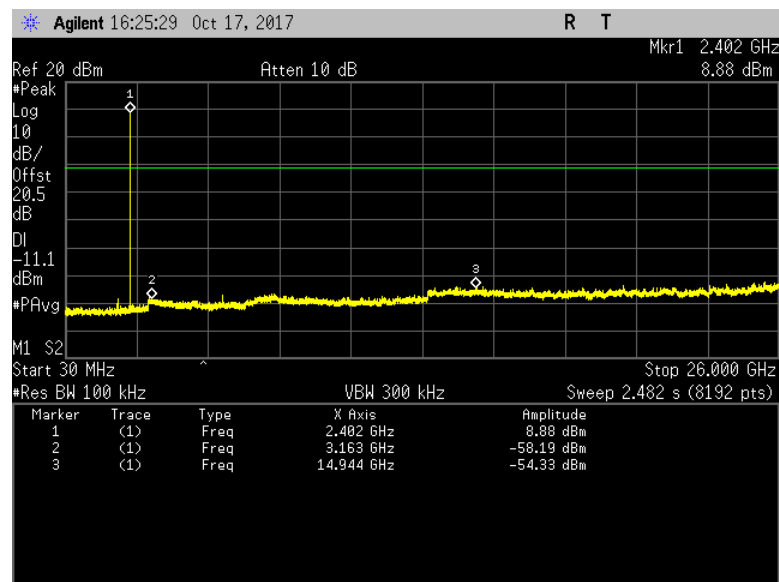
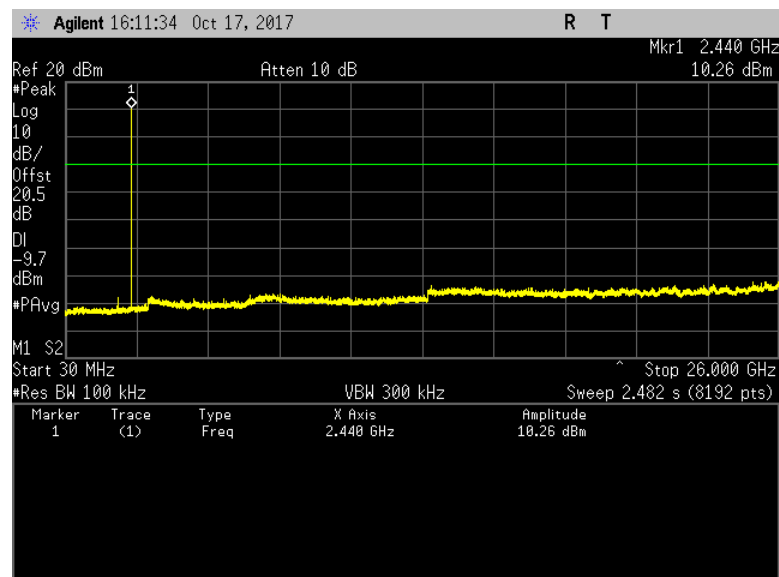
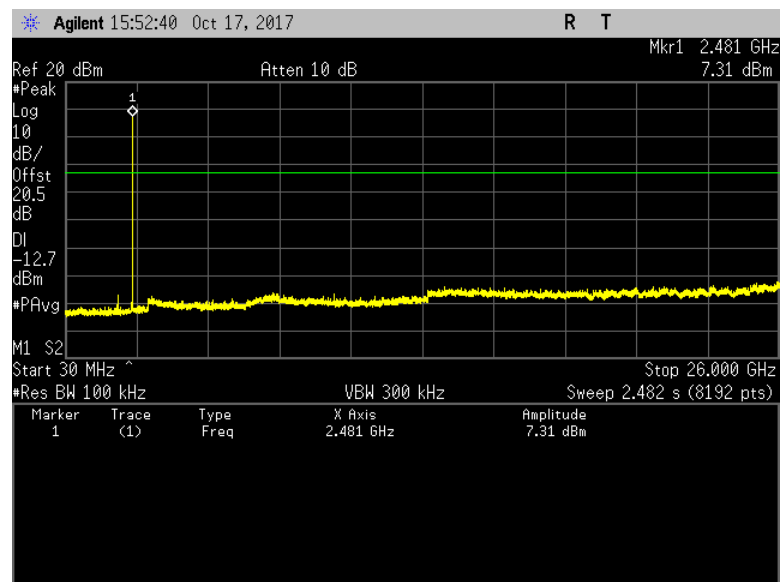


Figure 7.4.2.2-3: 30 MHz – 26 GHz – High Channel (GFSK)

Figure 7.4.2.2-4: 30 MHz – 26 GHz – Low Channel ( $\pi/4$  DQPSK)Figure 7.4.2.2-5: 30 MHz – 26 GHz – Middle Channel ( $\pi/4$  DQPSK)

Figure 7.4.2.2-6: 30 MHz – 26 GHz – High Channel ( $\pi/4$  DQPSK)

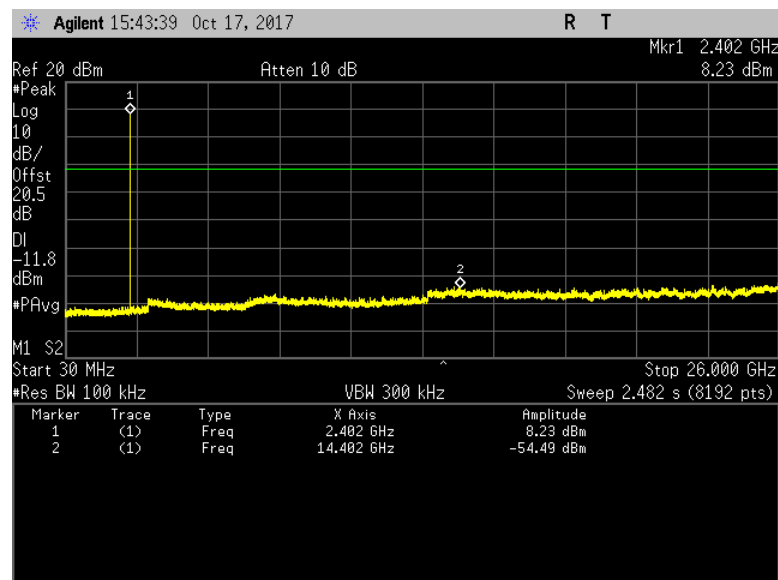


Figure 7.4.2.2-7: 30 MHz – 26 GHz – Low Channel (8DPSK)

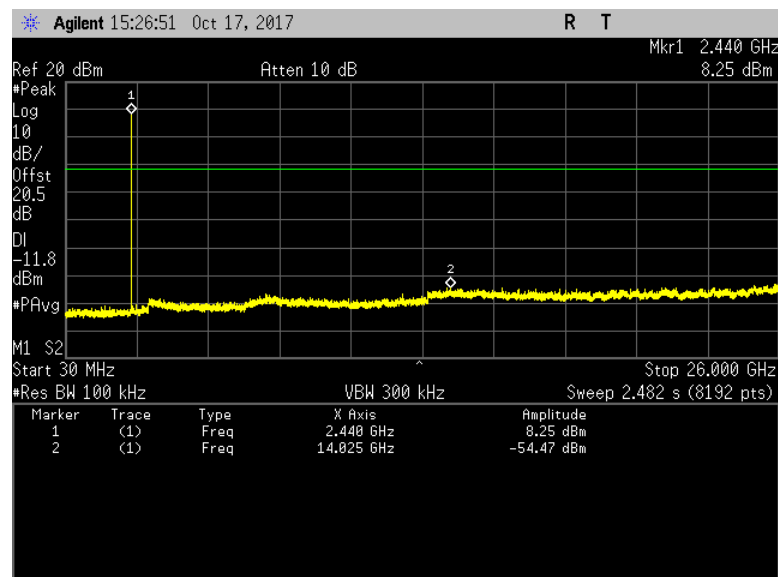


Figure 7.4.2.2-8: 30 MHz – 26 GHz – Middle Channel (8DPSK)

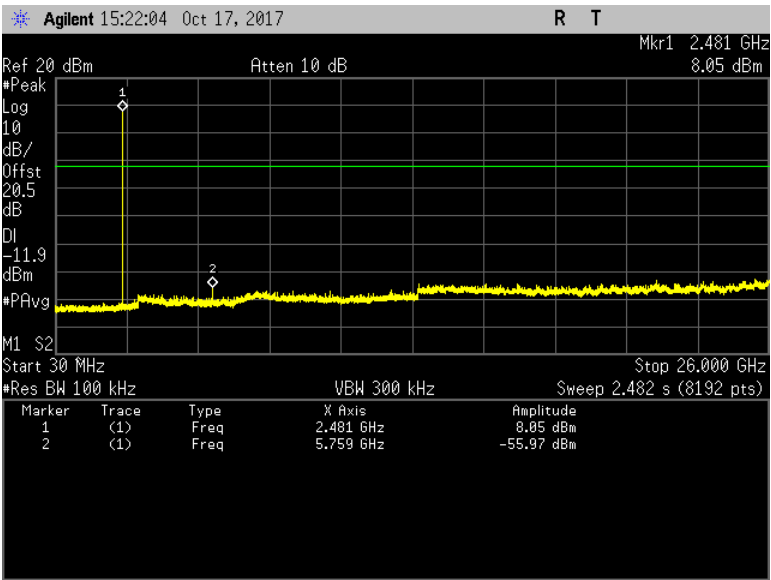


Figure 7.4.2.2-9: 30 MHz – 26 GHz – High Channel (8DPSK)

### 7.4.3 Radiated Spurious Emissions into Restricted Frequency Bands – FCC: Sections 15.205, 15.209; ISD Canada: RSS-Gen 8.9, 8.10

#### 7.4.3.1 Measurement Procedure

Radiated emissions tests were made over the frequency range of 9 kHz to 26 GHz, 10 times the highest fundamental frequency. Each emission found to be in a restricted band as defined by section 15.205, including any emission at the operational band-edge, was compared to the radiated emission limits as defined in Section 15.209.

For measurements below 30 MHz, the receive antenna height was set to 1m and the EUT was rotated through 360 degrees. The resolution bandwidth was set to 200 Hz below 150 kHz and to 9 kHz above 150 kHz.

The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth RBW of 120 kHz and a video bandwidth VBW of 300 kHz. For frequencies above 1000 MHz, peak measurements are made with RBW of 1 MHz and VBW of 3 MHz. Average measurements are performed in the linear scale using VBW of 30 Hz.

#### 7.4.3.2 Measurement Results

Performed by: Jean Rene

Radiated band-edge and spurious emissions found in the restricted frequency bands of 9 kHz to 26 GHz are reported in the tables below.

**Table 7.4.3.2-1: Radiated Spurious Emissions Tabulated Data (GFSK)**

| Frequency<br>(MHz) | Level<br>(dBuV) |         | Antenna<br>Polarity<br>(H/V) | Correction<br>Factors<br>(dB) | Corrected Level<br>(dBuV/m) |         | Limit<br>(dBuV/m) |         | Margin<br>(dB) |         |
|--------------------|-----------------|---------|------------------------------|-------------------------------|-----------------------------|---------|-------------------|---------|----------------|---------|
|                    | pk              | Qpk/Avg |                              |                               | pk                          | Qpk/Avg | pk                | Qpk/Avg | pk             | Qpk/Avg |
| Low Channel        |                 |         |                              |                               |                             |         |                   |         |                |         |
| 4804               | 51.78           | 32.77   | H                            | 4.02                          | 55.80                       | 36.79   | 74.0              | 54.0    | 18.2           | 17.2    |
| 4804               | 52.72           | 33.46   | V                            | 4.02                          | 56.74                       | 37.48   | 74.0              | 54.0    | 17.3           | 16.5    |
| Middle Channel     |                 |         |                              |                               |                             |         |                   |         |                |         |
| 4882               | 49.52           | 30.69   | H                            | 4.35                          | 53.87                       | 35.04   | 74.0              | 54.0    | 20.1           | 19.0    |
| 4882               | 47.92           | 30.98   | V                            | 4.35                          | 52.27                       | 35.33   | 74.0              | 54.0    | 21.7           | 18.7    |
| 7323               | 44.16           | 30.67   | H                            | 9.43                          | 53.59                       | 40.10   | 74.0              | 54.0    | 20.4           | 13.9    |
| 7323               | 44.08           | 30.78   | V                            | 9.43                          | 53.51                       | 40.21   | 74.0              | 54.0    | 20.5           | 13.8    |
| High Channel       |                 |         |                              |                               |                             |         |                   |         |                |         |
| 2483.5             | 57.46           | 46.06   | H                            | -4.51                         | 52.95                       | 41.55   | 74.0              | 54.0    | 21.1           | 12.5    |
| 2483.5             | 58.01           | 48.43   | V                            | -4.51                         | 53.50                       | 43.92   | 74.0              | 54.0    | 20.5           | 10.1    |
| 4960               | 50.56           | 31.60   | H                            | 4.69                          | 55.25                       | 36.29   | 74.0              | 54.0    | 18.8           | 17.7    |
| 4960               | 49.18           | 31.85   | V                            | 4.69                          | 53.87                       | 36.54   | 74.0              | 54.0    | 20.1           | 17.5    |
| 7440               | 44.28           | 30.60   | H                            | 9.72                          | 54.00                       | 40.32   | 74.0              | 54.0    | 20.0           | 13.7    |
| 7440               | 44.37           | 30.66   | V                            | 9.72                          | 54.09                       | 40.38   | 74.0              | 54.0    | 19.9           | 13.6    |

**Notes:**

All emissions above 7.44 GHz were attenuated below the limits and the noise floor of the measurement equipment.

Table 7.4.3.2-2: Radiated Spurious Emissions Tabulated Data ( $\pi/4$  DQPSK)

| Frequency<br>(MHz) | Level<br>(dBuV) |         | Antenna<br>Polarity<br><br>(H/V) | Correction<br>Factors<br><br>(dB) | Corrected Level<br>(dBuV/m) |         | Limit<br>(dBuV/m) |         | Margin<br>(dB) |         |
|--------------------|-----------------|---------|----------------------------------|-----------------------------------|-----------------------------|---------|-------------------|---------|----------------|---------|
|                    | pk              | Qpk/Avg |                                  |                                   | pk                          | Qpk/Avg | pk                | Qpk/Avg | pk             | Qpk/Avg |
| Low Channel        |                 |         |                                  |                                   |                             |         |                   |         |                |         |
| 4804               | 50.50           | 42.67   | H                                | 4.02                              | 54.52                       | 46.69   | 74.0              | 54.0    | 19.5           | 7.3     |
| 4804               | 54.18           | 45.57   | V                                | 4.02                              | 58.20                       | 49.59   | 74.0              | 54.0    | 15.8           | 4.4     |
| Middle Channel     |                 |         |                                  |                                   |                             |         |                   |         |                |         |
| 4882               | 54.26           | 45.97   | H                                | 4.35                              | 58.61                       | 50.32   | 74.0              | 54.0    | 15.4           | 3.7     |
| 4882               | 54.33           | 46.04   | v                                | 4.35                              | 58.68                       | 50.39   | 74.0              | 54.0    | 15.3           | 3.6     |
| 7323               | 43.50           | 31.65   | H                                | 9.43                              | 52.93                       | 41.08   | 74.0              | 54.0    | 21.1           | 12.9    |
| 7323               | 43.85           | 31.63   | V                                | 9.43                              | 53.28                       | 41.06   | 74.0              | 54.0    | 20.7           | 12.9    |
| High Channel       |                 |         |                                  |                                   |                             |         |                   |         |                |         |
| 2483.5             | 58.43           | 51.31   | H                                | -4.51                             | 53.92                       | 46.80   | 74.0              | 54.0    | 20.1           | 7.2     |
| 2483.5             | 60.57           | 54.25   | V                                | -4.51                             | 56.06                       | 49.74   | 74.0              | 54.0    | 17.9           | 4.3     |
| 4960               | 53.05           | 45.36   | H                                | 4.69                              | 57.74                       | 50.05   | 74.0              | 54.0    | 16.3           | 4.0     |
| 4960               | 52.09           | 43.71   | V                                | 4.69                              | 56.78                       | 48.40   | 74.0              | 54.0    | 17.2           | 5.6     |
| 7440               | 43.52           | 31.43   | H                                | 9.72                              | 53.24                       | 41.15   | 74.0              | 54.0    | 20.8           | 12.9    |
| 7440               | 43.86           | 31.62   | V                                | 9.72                              | 53.58                       | 41.34   | 74.0              | 54.0    | 20.4           | 12.7    |

## Notes:

All emissions above 7.44 GHz were attenuated below the limits and the noise floor of the measurement equipment.

Table 7.4.3.2-3: Radiated Spurious Emissions Tabulated Data (8DPSK)

| Frequency<br>(MHz) | Level<br>(dBuV) |         | Antenna<br>Polarity<br><br>(H/V) | Correction<br>Factors<br><br>(dB) | Corrected Level<br>(dBuV/m) |         | Limit<br>(dBuV/m) |         | Margin<br>(dB) |         |
|--------------------|-----------------|---------|----------------------------------|-----------------------------------|-----------------------------|---------|-------------------|---------|----------------|---------|
|                    | pk              | Qpk/Avg |                                  |                                   | pk                          | Qpk/Avg | pk                | Qpk/Avg | pk             | Qpk/Avg |
| Low Channel        |                 |         |                                  |                                   |                             |         |                   |         |                |         |
| 4804               | 53.17           | 44.87   | H                                | 4.02                              | 57.19                       | 48.89   | 74.0              | 54.0    | 16.8           | 5.1     |
| 4804               | 55.56           | 45.74   | V                                | 4.02                              | 59.58                       | 49.76   | 74.0              | 54.0    | 14.4           | 4.2     |
| Middle Channel     |                 |         |                                  |                                   |                             |         |                   |         |                |         |
| 4882               | 56.05           | 47.57   | H                                | 4.35                              | 60.40                       | 51.92   | 74.0              | 54.0    | 13.6           | 2.1     |
| 4882               | 56.73           | 48.20   | V                                | 4.35                              | 61.08                       | 52.55   | 74.0              | 54.0    | 12.9           | 1.4     |
| 7323               | 43.90           | 32.89   | H                                | 9.43                              | 53.33                       | 42.32   | 74.0              | 54.0    | 20.7           | 11.7    |
| 7323               | 44.01           | 33.53   | V                                | 9.43                              | 53.44                       | 42.96   | 74.0              | 54.0    | 20.6           | 11.0    |
| High Channel       |                 |         |                                  |                                   |                             |         |                   |         |                |         |
| 2483.5             | 58.84           | 50.99   | H                                | -4.51                             | 54.33                       | 46.48   | 74.0              | 54.0    | 19.7           | 7.5     |
| 2483.5             | 60.17           | 54.40   | V                                | -4.51                             | 55.66                       | 49.89   | 74.0              | 54.0    | 18.3           | 4.1     |
| 4960               | 54.09           | 44.65   | H                                | 4.69                              | 58.78                       | 49.34   | 74.0              | 54.0    | 15.2           | 4.7     |
| 4960               | 52.05           | 43.35   | V                                | 4.69                              | 56.74                       | 48.04   | 74.0              | 54.0    | 17.3           | 6.0     |
| 7440               | 43.61           | 31.38   | H                                | 9.72                              | 53.33                       | 41.10   | 74.0              | 54.0    | 20.7           | 12.9    |
| 7440               | 43.39           | 31.45   | V                                | 9.72                              | 53.11                       | 41.17   | 74.0              | 54.0    | 20.9           | 12.8    |

## Notes:

All emissions above 7.44 GHz were attenuated below the limits and the noise floor of the measurement equipment.

**7.4.4 Sample Calculation:**

$$R_C = R_U + CF_T$$

Where:

$CF_T$  = Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)

$R_U$  = Uncorrected Reading

$R_C$  = Corrected Level

AF = Antenna Factor

CA = Cable Attenuation

AG = Amplifier Gain

DC = Duty Cycle Correction Factor

**Example Calculation: Peak**

Corrected Level:  $51.78 + 4.02 = 55.8$  dB $\mu$ V/m

Margin:  $74$  dB $\mu$ V/m –  $55.8$  dB $\mu$ V/m =  $18.2$  dB

**Example Calculation: Average**

Corrected Level:  $32.77 + 4.02 = 36.79$  dB $\mu$ V/m

Margin:  $54$  dB $\mu$ V/m –  $36.79$  dB $\mu$ V/m =  $17.2$  dB

## 7.5 Power Line Conducted Emissions – FCC: Section 15.207; ISED Canada: RSS-Gen 8.8

### 7.5.1 Measurement Procedure

ANSI C63.10 section 6.2 was the guiding document for this evaluation. Conducted emissions were performed from 150 kHz to 30 MHz with the spectrum analyzer's resolution bandwidth set to 9 kHz and the video bandwidth set to 30 kHz. The calculation for the conducted emissions is as follows:

**Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss**

**Margin = Applicable Limit - Corrected Reading**

### 7.5.2 Measurement Results

Performed by: Thierry Jean-Charles

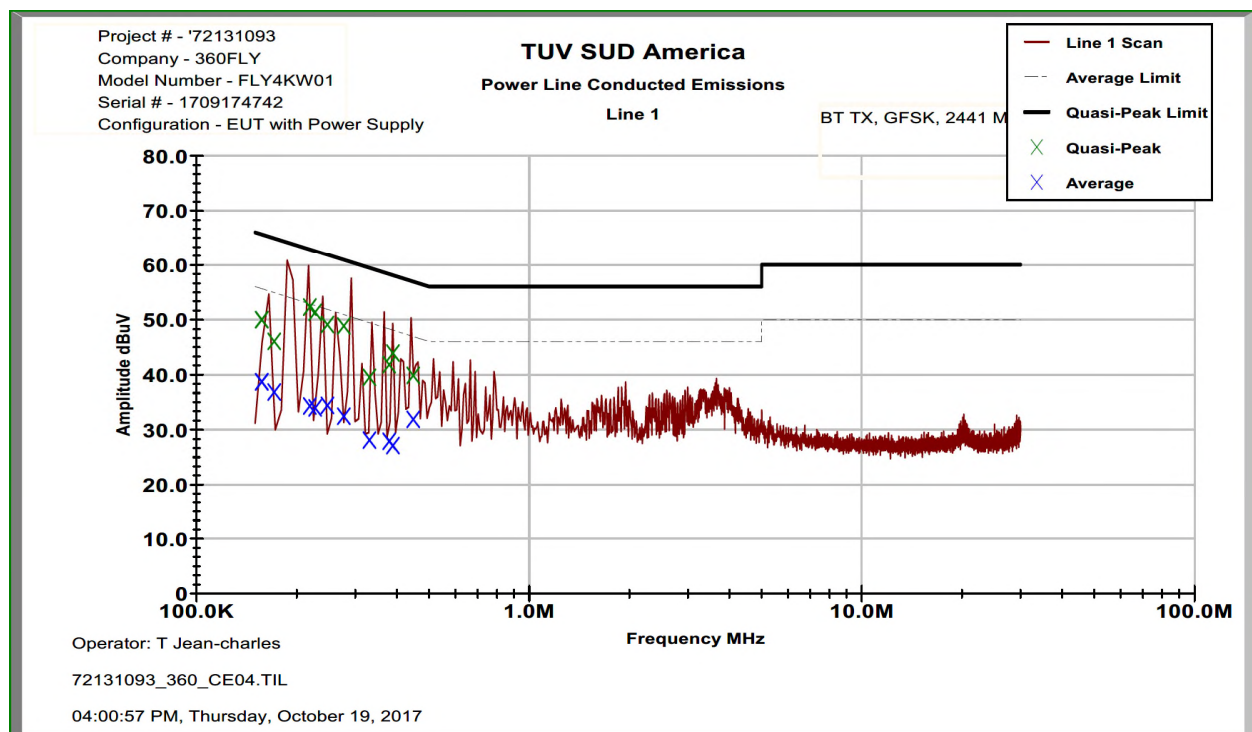


Figure 7.5.2-1: Conducted Emissions Results – Line 1

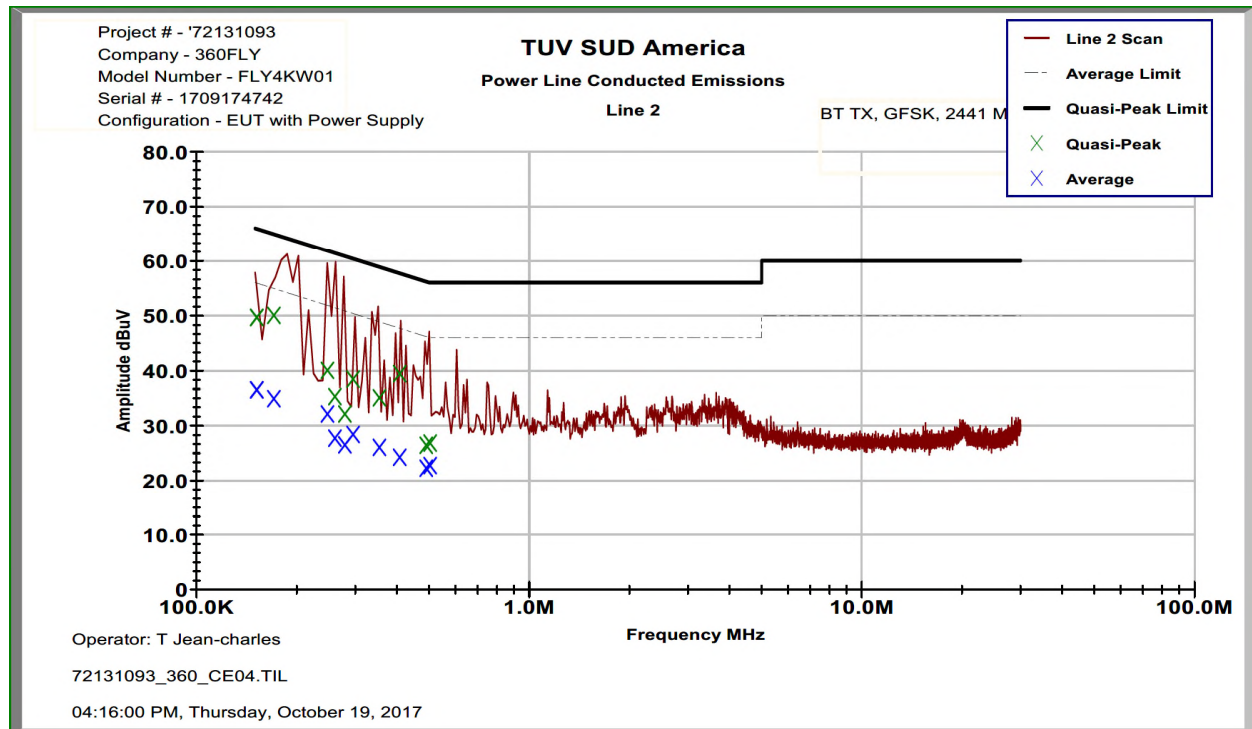


Figure 7.5.2-2: Conducted Emissions Results – Line 2

Table 7.5.2-1: Conducted EMI Results

☒ Line 1
☒ Line 2
☐ Line 3
☐ Line 4
☐ To Ground
☒ Floating
☐ Telecom Port

☒ dBµV
☐ dBµA

Plot Number:  
72131093 360 CE04  
Power Supply Description: 5  
VDC Power Supply

| Frequency (MHz) | Uncorrected Reading |         | Total Correction Factor (dB) | Corrected Level |         | Limit      |         | Margin (dB) |         |
|-----------------|---------------------|---------|------------------------------|-----------------|---------|------------|---------|-------------|---------|
|                 | Quasi-Peak          | Average |                              | Quasi-Peak      | Average | Quasi-Peak | Average | Quasi-Peak  | Average |
| Line 1          |                     |         |                              |                 |         |            |         |             |         |
| 0.156959        | 39.661              | 28.412  | 10.17                        | 49.83           | 38.59   | 65.62      | 55.62   | 15.8        | 17.0    |
| 0.171063        | 35.721              | 26.515  | 10.17                        | 45.89           | 36.69   | 64.91      | 54.91   | 19.0        | 18.2    |
| 0.219063        | 41.968              | 23.979  | 10.18                        | 52.15           | 34.16   | 62.85      | 52.85   | 10.7        | 18.7    |
| 0.227199        | 40.999              | 23.637  | 10.18                        | 51.18           | 33.82   | 62.55      | 52.55   | 11.4        | 18.7    |
| 0.247387        | 38.78               | 24.078  | 10.19                        | 48.97           | 34.27   | 61.84      | 51.84   | 12.9        | 17.6    |
| 0.276937        | 38.52               | 22.093  | 10.18                        | 48.70           | 32.28   | 60.91      | 50.91   | 12.2        | 18.6    |
| 0.330863        | 29.148              | 17.766  | 10.21                        | 39.36           | 27.97   | 59.43      | 49.43   | 20.1        | 21.5    |
| 0.379163        | 31.449              | 17.53   | 10.21                        | 41.66           | 27.74   | 58.30      | 48.30   | 16.6        | 20.6    |
| 0.389049        | 33.563              | 16.736  | 10.21                        | 43.77           | 26.94   | 58.08      | 48.08   | 14.3        | 21.1    |
| 0.447988        | 29.517              | 21.53   | 10.23                        | 39.75           | 31.76   | 56.91      | 46.91   | 17.2        | 15.2    |
| Line 2          |                     |         |                              |                 |         |            |         |             |         |
| 0.15158         | 39.347              | 26.196  | 10.22                        | 49.57           | 36.42   | 65.91      | 55.91   | 16.3        | 19.5    |
| 0.170762        | 39.749              | 24.598  | 10.22                        | 49.97           | 34.82   | 64.92      | 54.92   | 15.0        | 20.1    |
| 0.247312        | 29.749              | 21.784  | 10.24                        | 39.99           | 32.02   | 61.85      | 51.85   | 21.9        | 19.8    |
| 0.260588        | 24.948              | 17.414  | 10.23                        | 35.18           | 27.65   | 61.41      | 51.41   | 26.2        | 23.8    |
| 0.279212        | 21.821              | 16.198  | 10.23                        | 32.06           | 26.43   | 60.84      | 50.84   | 28.8        | 24.4    |
| 0.2955          | 28.119              | 18.109  | 10.24                        | 38.35           | 28.34   | 60.37      | 50.37   | 22.0        | 22.0    |
| 0.354538        | 24.744              | 15.721  | 10.25                        | 34.99           | 25.97   | 58.86      | 48.86   | 23.9        | 22.9    |
| 0.407838        | 29.103              | 13.894  | 10.27                        | 39.37           | 24.16   | 57.69      | 47.69   | 18.3        | 23.5    |
| 0.489988        | 16.118              | 11.915  | 10.27                        | 26.39           | 22.19   | 56.17      | 46.17   | 29.8        | 24.0    |
| 0.50355         | 16.472              | 12.406  | 10.26                        | 26.73           | 22.67   | 56.00      | 46.00   | 29.3        | 23.3    |

## 8 MEASUREMENT UNCERTAINTIES

The expanded laboratory measurement uncertainty figures ( $U_{\text{Lab}}$ ) provided below correspond to an expansion factor (coverage factor)  $k = 1.96$  which provide confidence levels of 95%.

**Table 8-1: Measurement Uncertainties**

| Parameter                             | $U_{\text{lab}}$                     |
|---------------------------------------|--------------------------------------|
| Occupied Channel Bandwidth            | $\pm 0.009 \%$                       |
| RF Conducted Output Power             | $\pm 1.15 \text{ dB}$                |
| Power Spectral Density                | $\pm 1.15 \text{ dB}$                |
| Antenna Port Conducted Emissions      | $\pm 1.15 \text{ dB}$                |
| Radiated Emissions $\leq 1\text{GHz}$ | $\pm 5.86 \text{ dB}$                |
| Radiated Emissions $> 1\text{GHz}$    | $\pm 4.65 \text{ dB}$                |
| Temperature                           | $\pm 0.860 \text{ }^{\circ}\text{C}$ |
| Radio Frequency                       | $\pm 2.832 \times 10^{-8}$           |
| AC Power Line Conducted Emissions     | $\pm 3.72 \text{ dB}$                |

## **9    CONCLUSION**

In the opinion of TÜV SÜD America, Inc. the models FLY4KW01 and FLY4KW11, manufactured by 360fly, Inc., meet the requirements of FCC Part 15.247 and Industry Canada's Radio Standards Specification RSS-247 for the tests documented herein.

**END REPORT**