



## FCC / ISED Test Report

For:  
Ezlo Inc.

Model Name:  
e550-US, EzloSecure-US

Product Description:  
Smart Home Controller

FCC ID: 2AIYW-E550  
IC ID: 26382-E550

Applied Rules and Standards:  
47 CFR Part 15.247 (DSS)  
RSS-247 Issue 2 (FHSs) & RSS-Gen Issue 5

REPORT #: EMC\_EZLOI-001-20001\_15.247\_DSS

DATE: 2020-10-20



A2LA Accredited

IC recognized #  
3462B-1

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CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

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## 1 Assessment

The following device was evaluated against the applicable criteria specified in FCC rules Parts 15.247 of Title 47 of the Code of Federal Regulations and the relevant ISED Canada standard RSS-247.

No deviations were ascertained.

| Company   | Description           | Model #                |
|-----------|-----------------------|------------------------|
| Ezlo Inc. | Smart Home Controller | e550-US, EzloSecure-US |

### Responsible for Testing Laboratory:

| 2020-10-20 | Compliance | Cindy Li<br>(EMC Lab Manager) |           |
|------------|------------|-------------------------------|-----------|
| Date       | Section    | Name                          | Signature |

### Responsible for the Report:

| 2020-10-20 | Compliance | Kevin Wang<br>(Senior EMC Engineer) |           |
|------------|------------|-------------------------------------|-----------|
| Date       | Section    | Name                                | Signature |

The test results of this test report relate exclusively to the test item specified in Section 3.

CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

## 2 Administrative Data

### 2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

|                                    |                        |
|------------------------------------|------------------------|
| <b>Company Name:</b>               | CETECOM Inc.           |
| <b>Department:</b>                 | Compliance             |
| <b>Street Address:</b>             | 411 Dixon Landing Road |
| <b>City/Zip Code</b>               | Milpitas, CA 95035     |
| <b>Country</b>                     | USA                    |
| <b>Telephone:</b>                  | +1 (408) 586 6200      |
| <b>Fax:</b>                        | +1 (408) 586 6299      |
| <b>EMC Lab Manager:</b>            | Cindy Li               |
| <b>Responsible Project Leader:</b> | Akanksha Baskaran      |

### 2.2 Identification of the Client

|                        |                     |
|------------------------|---------------------|
| <b>Client's Name:</b>  | Ezlo Inc.           |
| <b>Street Address:</b> | 1255 Broad St.      |
| <b>City/Zip Code</b>   | Clifton, NJ / 07013 |
| <b>Country</b>         | US                  |

### 2.3 Identification of the Manufacturer

|                               |                |
|-------------------------------|----------------|
| <b>Manufacturer's Name:</b>   | Same as Client |
| <b>Manufacturers Address:</b> | -----          |
| <b>City/Zip Code</b>          | -----          |
| <b>Country</b>                | -----          |

### 3 Equipment Under Test (EUT)

#### 3.1 EUT Specifications

|   |   |
|---|---|
| <b>Model No:</b>                                    | e550-US, EzloSecure-US  |
| <b>HW Version :</b>                                 | 1.4   |
| <b>SW Version :</b>                                 | 2.0.1.1112.7  |
| <b>FCC-ID :</b>                                     | 2AIYW-E550  |
| <b>IC-ID:</b>                                       | 26382-E550  |
| <b>FWIN:</b>  | N/A   |
| <b>HVIN:</b>  | e550-US, EzloSecure-US  |
| <b>PMN:</b>   | Ezlo Secure, Smart Home Controller, CC Compass Monitoring Hub, Connect Hub 2.0  |
| <b>Product Description:</b>                         | Smart Home Controller<br>All 4 variant models are electrically identical  |
| <b>Frequency Range / number of channels:</b>        | Nominal band: 2400 MHz – 2483.5 MHz<br>Center to center: 2402 MHz (ch 0) – 2480 MHz (ch 78), 79 Channels                              |
| <b>Radio Information:</b>                           | <u>Bluetooth:</u><br>Module Number: Ampak AP6256<br>Type(s) of Modulation: BDR/EDR: GFSK, $\pi/4$ DQPSK, 8DPSK                        |
| <b>Modes of Operation:</b>                          | Hopping   |
| <b>Antenna Information as declared:</b>             | max gain 2.3 dBi  |
| <b>Max. declared output Powers:</b>                 | Conducted Power 7.06 dBm  |
| <b>Power Supply/ Rated Operating Voltage Range:</b> | 4.8V (Low) / 5.0V (Nominal) / 5.2V (Max)  |
| <b>Operating Temperature Range</b>                  | 0°C to +35°C  |
| <b>Other Radios included in the device:</b>         | Wi-Fi 2.4GHz/5GHz; Cellular; Zigbee; Zwave  |
| <b>Sample Revision</b>                              | <input type="checkbox"/> Prototype Unit; <input checked="" type="checkbox"/> Production Unit; <input type="checkbox"/> Pre-Production |

### 3.2 EUT Sample details

| EUT # | Serial Number | HW Version | SW Version   | Comments  |
|-------|---------------|------------|--------------|---|
| 1     | #1            | 1.4        | 2.0.1.1112.7 | Conducted Sample  |
| 2     | #2            | 1.4        | 2.0.1.1112.7 | Radiated Sample for Wi-Fi, Bluetooth, Zigbee, Zwave and 15B |
| 3     | #3            | 1.4        | 2.0.1.1112.7 | Radiated Sample for Cellular                                |

### 3.3 Accessory Equipment (AE) details

| AE # | Type          | Model         | Manufacturer | Serial Number |
|------|---------------|---------------|--------------|---------------|
| 1    | AC/DC Adaptor | FX18U-050300C | -----        | -----         |

### 3.4 Test Sample Configuration

| Set-up # | EUT / AE used for set-up | Comments  |
|----------|--------------------------|---|
| 1        | EUT#1 + AE#1             | Conducted RF measurements were performed with EUT configured via customer provided commands and instructions. |
| 2        | EUT#2 + AE#1             | Radiated RF measurements were performed with EUT configured via customer provided commands and instructions.  |
| 3        | EUT#3 + AE#1             | Radiated RF measurements were performed with EUT configured via customer provided commands and instructions.  |

### 3.5 Justification for Worst Case Mode of Operation

During the testing process, the EUT was tested with transmitter sets on low, mid and high channels, and max duty cycle.

For radiated measurements, all data in this report shows the worst case between horizontal and vertical antenna polarizations and for all orientations of the EUT.

For conducted measurements, the highest power and the widest occupied bandwidth mode of operation (GFSK), was used to evaluate the worst case performance of the EUT, including the band edge compliance and TX radiated spurious emissions testing. Maximum peak conducted output power and spectrum bandwidth, were measured in all supported modulation modes for the EUT.

#### 4 Subject of Investigation

The objective of the measurements done by CETECOM Inc. was to assess the performance of the EUT according to the relevant requirements specified in FCC rules Part 15.247 of Title 47 of the Code of Federal Regulations and Radio Standard Specification RSS-247 Issue 2 of ISED Canada.

This test report is to support a request for new equipment authorization under the:

- FCC ID: 2AIYW-E550
- IC ID: 26382-E550

Testing procedures are based on ANSI C63.10:2013 including section 7.8 for FHSS systems.

#### 5 Measurement Results Summary

| Test Specification                        | Test Case                           | Temperature and Voltage Conditions | Mode                               | Pass | NA | NP | Result   |
|---|-------------------------------------|------------------------------------|------------------------------------|------|----|----|----------|
| §15.247(b)(1)<br>RSS-247 5.4(b)           | Maximum Peak Conducted Output Power | Nominal                            | GFSK DH5<br>DQPSK DH5<br>8DPSK DH5 | ■    | □  | □  | Complies |
| §15.247(d)<br>RSS-247 5.5<br>RSS-Gen 8.10 | Band Edge Compliance                | Nominal                            | GFSK                               | ■    | □  | □  | Complies |
| §15.247(a)(1)<br>RSS-247 5.1(b)           | Spectrum Bandwidth                  | Nominal                            | GFSK DH5<br>DQPSK DH5<br>8DPSK DH5 | ■    | □  | □  | Complies |
| §15.247(a)(1)<br>RSS-247 5.1(b)           | Carrier Frequency Separation        | Nominal                            | GFSK                               | ■    | □  | □  | Complies |
| §15.247(a)(1)<br>RSS-247 5.1(d)           | Number of Hopping Channels          | Nominal                            | GFSK                               | ■    | □  | □  | Complies |
| §15.247(a)(1)(iii)<br>RSS-247 5.1(d)      | Time of occupancy                   | Nominal                            | GFSK                               | ■    | □  | □  | Complies |
| §15.247(d)<br>§15.209 (a)<br>RSS-Gen 6.13 | TX Spurious emissions-Radiated      | Nominal                            | GFSK                               | ■    | □  | □  | Complies |
| §15.207(a)<br>RSS-Gen 8.8                 | AC Conducted Emissions              | Nominal                            | GFSK                               | ■    | □  | □  | Complies |

**Note:** NA= Not Applicable; NP= Not Performed.

## 6 **Measurements**

### 6.1 **Measurement Uncertainty**

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor  $k=1$ .

#### Radiated measurement

|                    |                                      |
|--------------------|--------------------------------------|
| 9 kHz to 30MHz     | $\pm 2.5$ dB (Magnetic Loop Antenna) |
| 30 MHz to 1000 MHz | $\pm 2.0$ dB (Biconilog Antenna)     |
| 1 GHz to 40 GHz    | $\pm 2.3$ dB (Horn Antenna)          |

#### Conducted measurement

|                          |              |
|--------------------------|--------------|
| RF conducted measurement | $\pm 0.5$ dB |
|--------------------------|--------------|

### 6.2 **Environmental Conditions During Testing:**

The following environmental conditions were maintained during the course of testing:

- Ambient Temperature: 20-25°C
- Relative humidity: 40-60%

### 6.3 **Dates of Testing:**

09/24/2020 – 10/06/2020

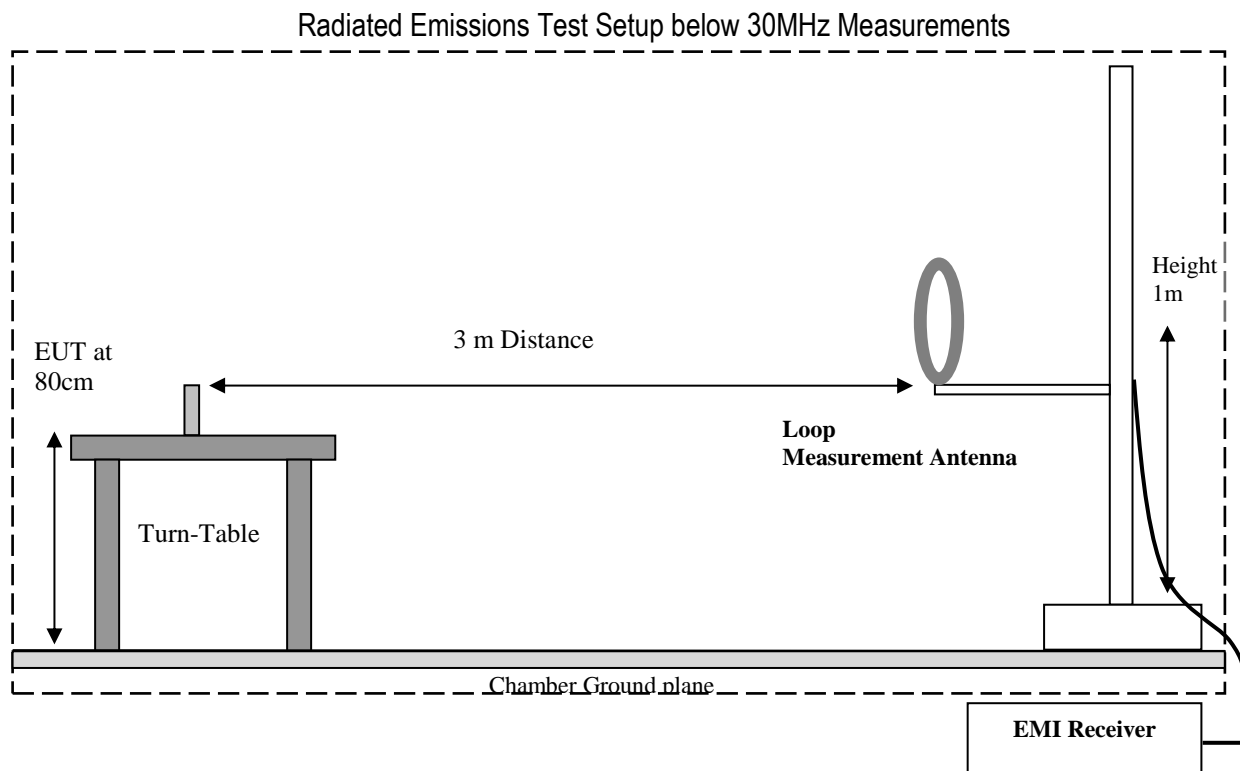


## 7 Measurement Procedures

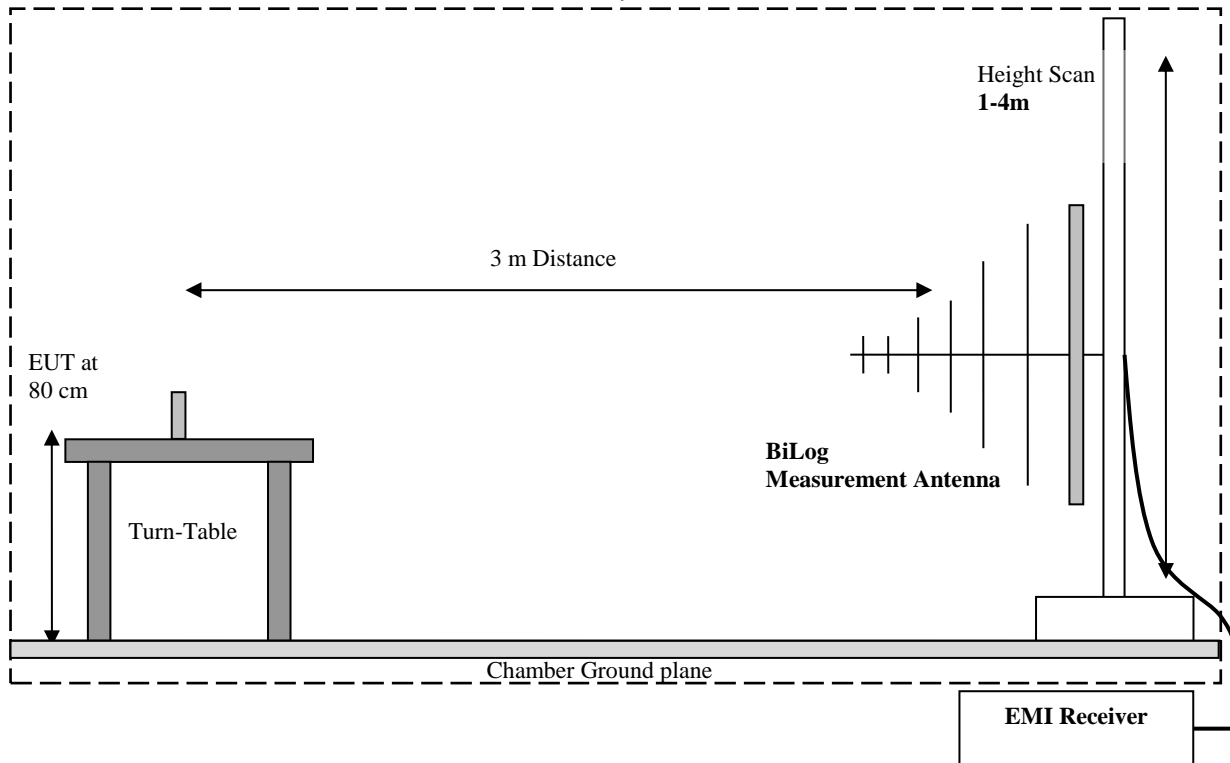
### 7.1 Radiated Measurement

The radiated measurement is performed according to: ANSI C63.10 (2013)

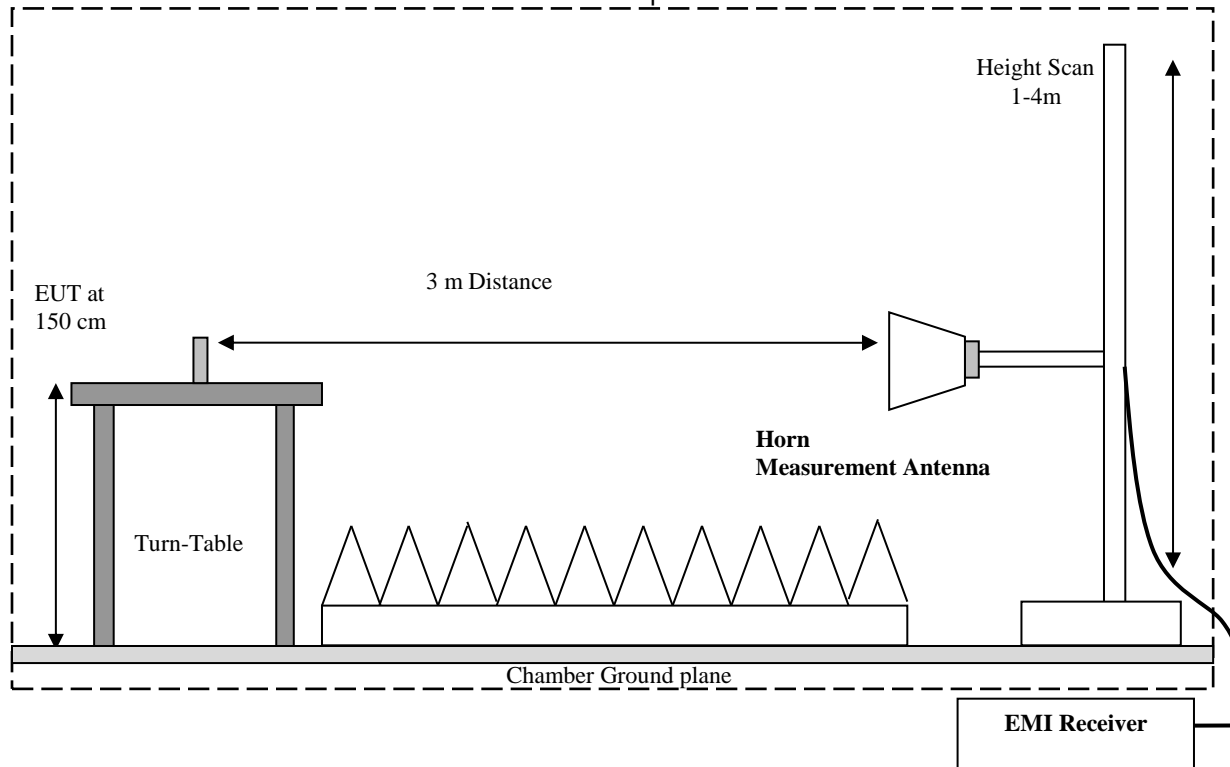
- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.



## Radiated Emissions Test Setup 30MHz-1GHz Measurements



## Radiated Emissions Test Setup above 1GHz Measurements



### 7.1.1 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

1. Measured reading in dB $\mu$ V
2. Cable Loss between the receiving antenna and SA in dB and
3. Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

$$FS \text{ (dB}\mu\text{V/m)} = \text{Measured Value on SA (dB}\mu\text{V)} + \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

Example:

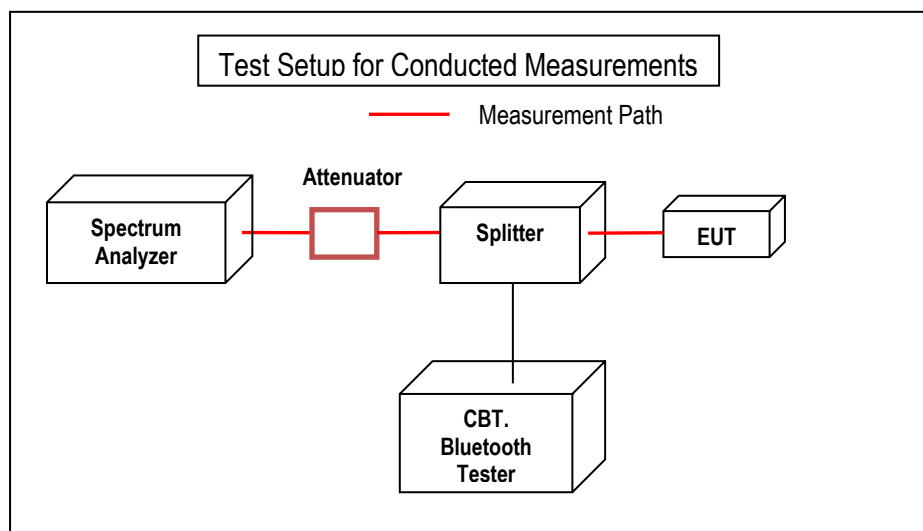
| Frequency (MHz) | Measured SA (dB $\mu$ V) | Cable Loss (dB) | Antenna Factor Correction (dB) | Field Strength Result (dB $\mu$ V/m) |
|-----------------|--------------------------|-----------------|--------------------------------|--------------------------------------|
| 1000            | 80.5                     | 3.5             | 14                             | 98.0                                 |

### 7.2 Power Line Conducted Measurement Procedure

AC Power Line conducted emissions measurements performed according to: ANSI C63.4 (2014)

### 7.3 RF Conducted Measurement Procedure

Reference: ANSI C63.10 (2013) Section 6.9, 6.10, and 7.8



- Connect the equipment as shown in the above diagram.
- Adjust the settings of the SA (Rohde-Schwarz Spectrum Analyzer) to connect the EUT at the required mode of test.
- Measurements are to be performed with the EUT set to the low, middle and high channels and for worst case modulation schemes.

## 8 Test Result Data

### 8.1 Maximum Peak Conducted Output Power

#### 8.1.1 Measurement according to ANSI C63.10 Section 7.8.5

##### Spectrum Analyzer settings:

- Span = approximately 5 times the 20 dB bandwidth
- RBW > the 20 dB bandwidth of the emission being measured
- VBW  $\geq$  RBW
- Sweep = Auto Couple
- Detector function = Peak
- Trace = Max hold
- Use the marker-peak function to set the marker to the peak of the emission.

#### 8.1.2 Limits:

##### Maximum Peak Output Power:

FCC §15.247: (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

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

IC RSS-247 5.4:

- (b) For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels.

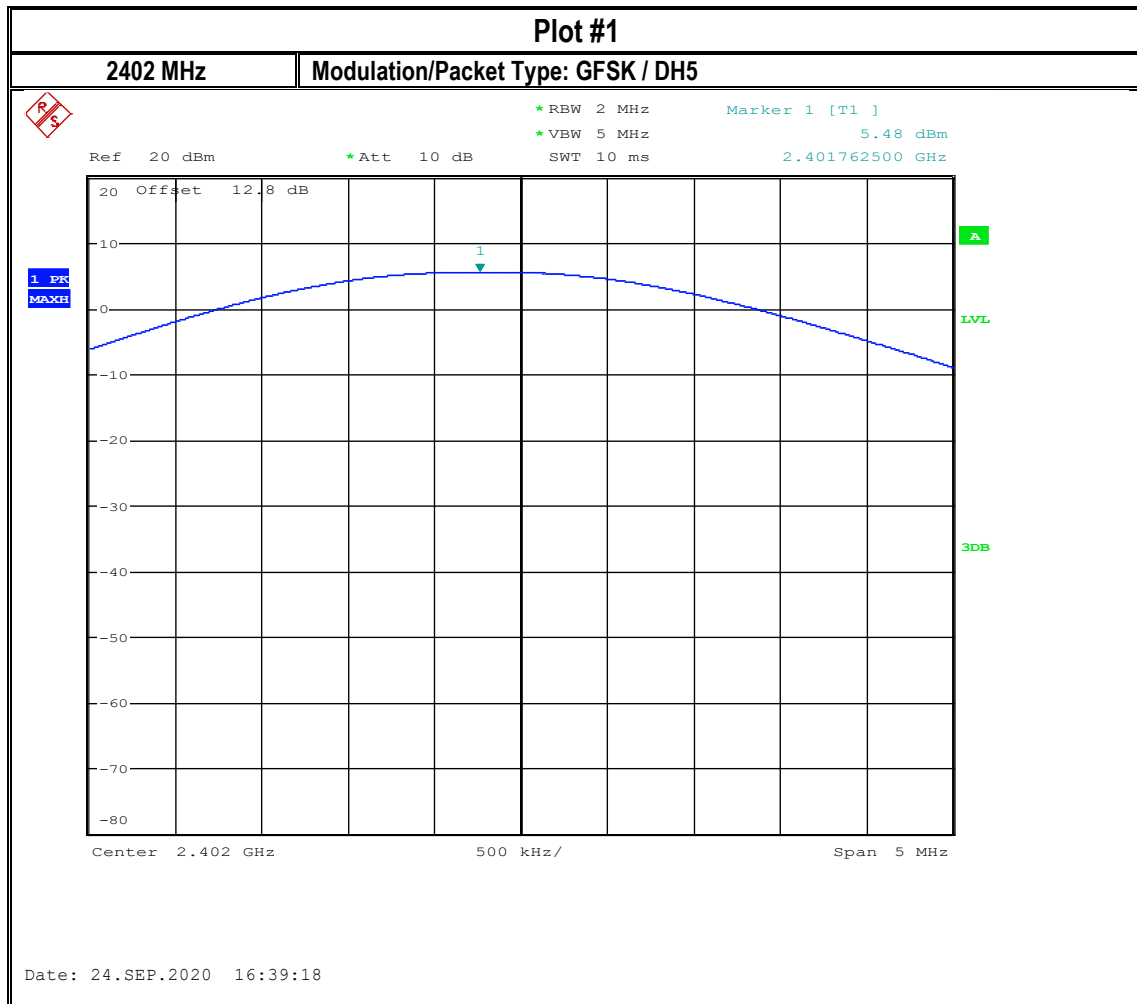
#### 8.1.3 Test conditions and setup:

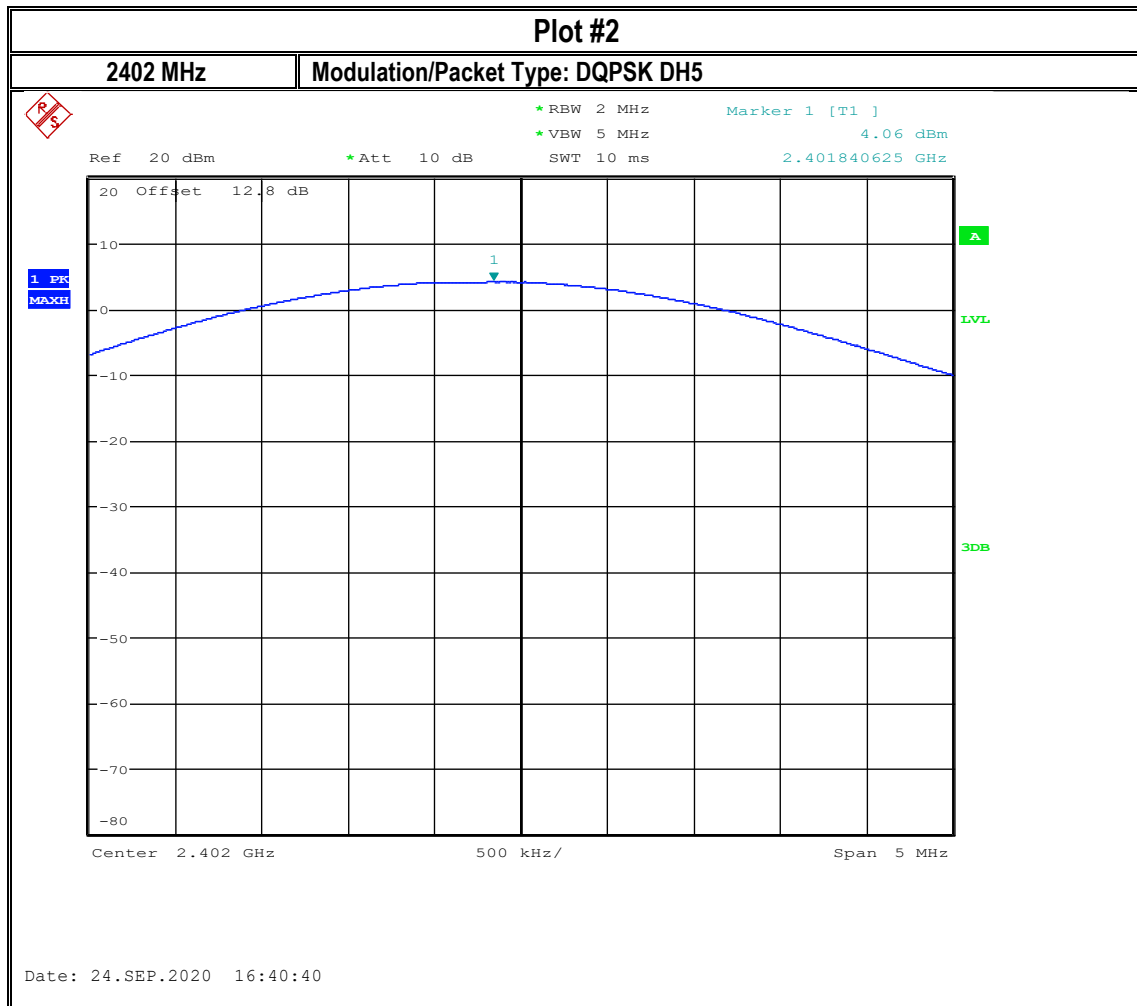
| Ambient Temperature | EUT Set-Up # | EUT operating mode       | Power Input | Antenna Gain |
|---------------------|--------------|--------------------------|-------------|--------------|
| 23° C               | 1            | GFSK, DQPSK, 8DPSK – DH5 | 120 VAC     | 2.3 dBi      |

**8.1.4 Measurement result:**

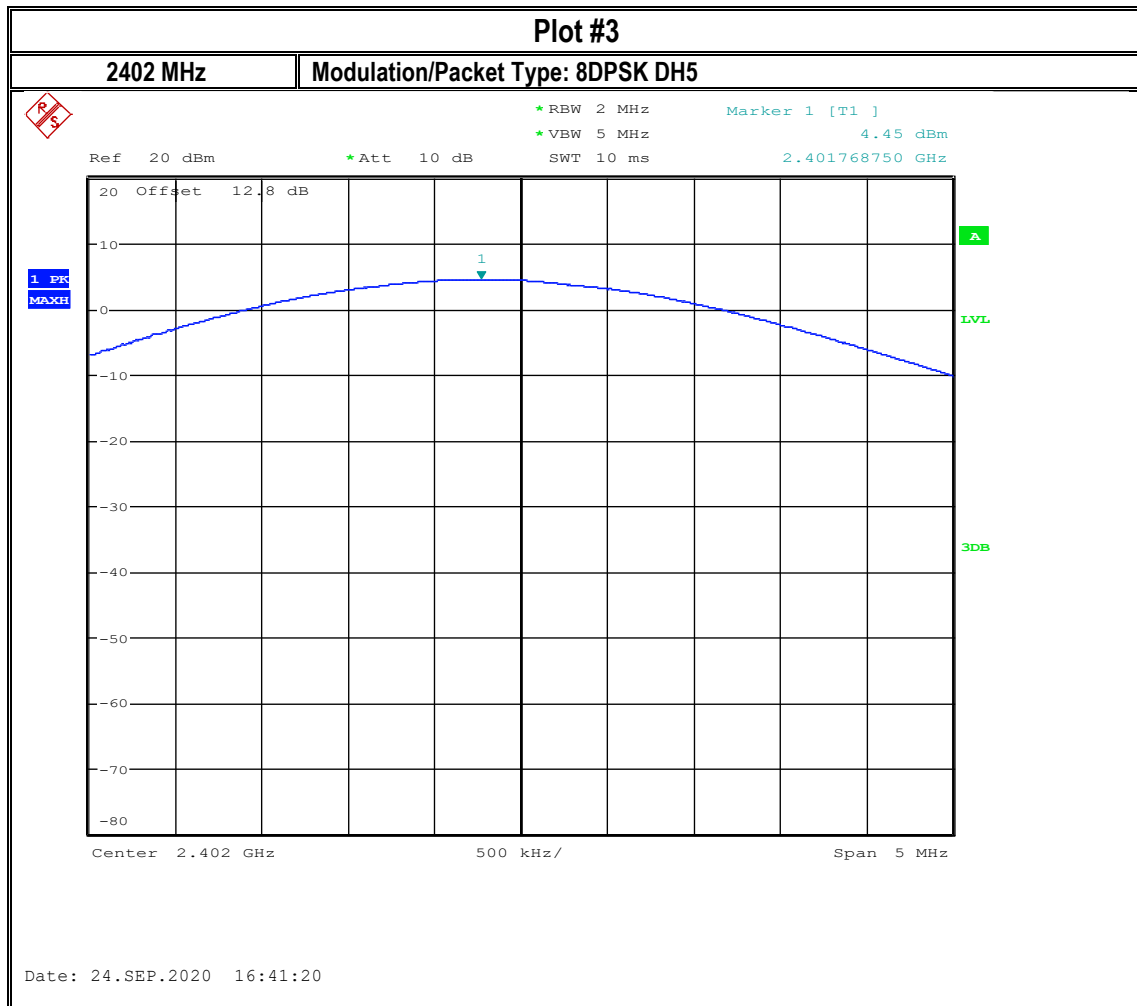
| Plot # | Frequency (MHz) | EUT operating mode | Maximum Peak Conducted Output Power (dBm) | EIRP (dBm) | Limit (dBm)       | Result |
|--------|-----------------|--------------------|---|------------|-------------------|--------|
| 1      | 2402            | GFSK DH5           | 5.48                                      | 7.78       | 30(Pk) / 36(EIRP) | Pass   |
| 2      | 2402            | DQPSK DH5          | 4.06                                      | 6.36       | 30(Pk) / 36(EIRP) | Pass   |
| 3      | 2402            | 8DPSK DH5          | 4.45                                      | 6.75       | 30(Pk) / 36(EIRP) | Pass   |
| 4      | 2441            | GFSK DH5           | 6.76                                      | 9.06       | 30(Pk) / 36(EIRP) | Pass   |
| 5      | 2441            | DQPSK DH5          | 4.95                                      | 7.25       | 30(Pk) / 36(EIRP) | Pass   |
| 6      | 2441            | 8DPSK DH5          | 5.36                                      | 7.66       | 30(Pk) / 36(EIRP) | Pass   |
| 7      | 2480            | GFSK DH5           | 7.06                                      | 9.36       | 30(Pk) / 36(EIRP) | Pass   |
| 8      | 2480            | DQPSK DH5          | 5.07                                      | 7.37       | 30(Pk) / 36(EIRP) | Pass   |
| 9      | 2480            | 8DPSK DH5          | 5.46                                      | 7.76       | 30(Pk) / 36(EIRP) | Pass   |

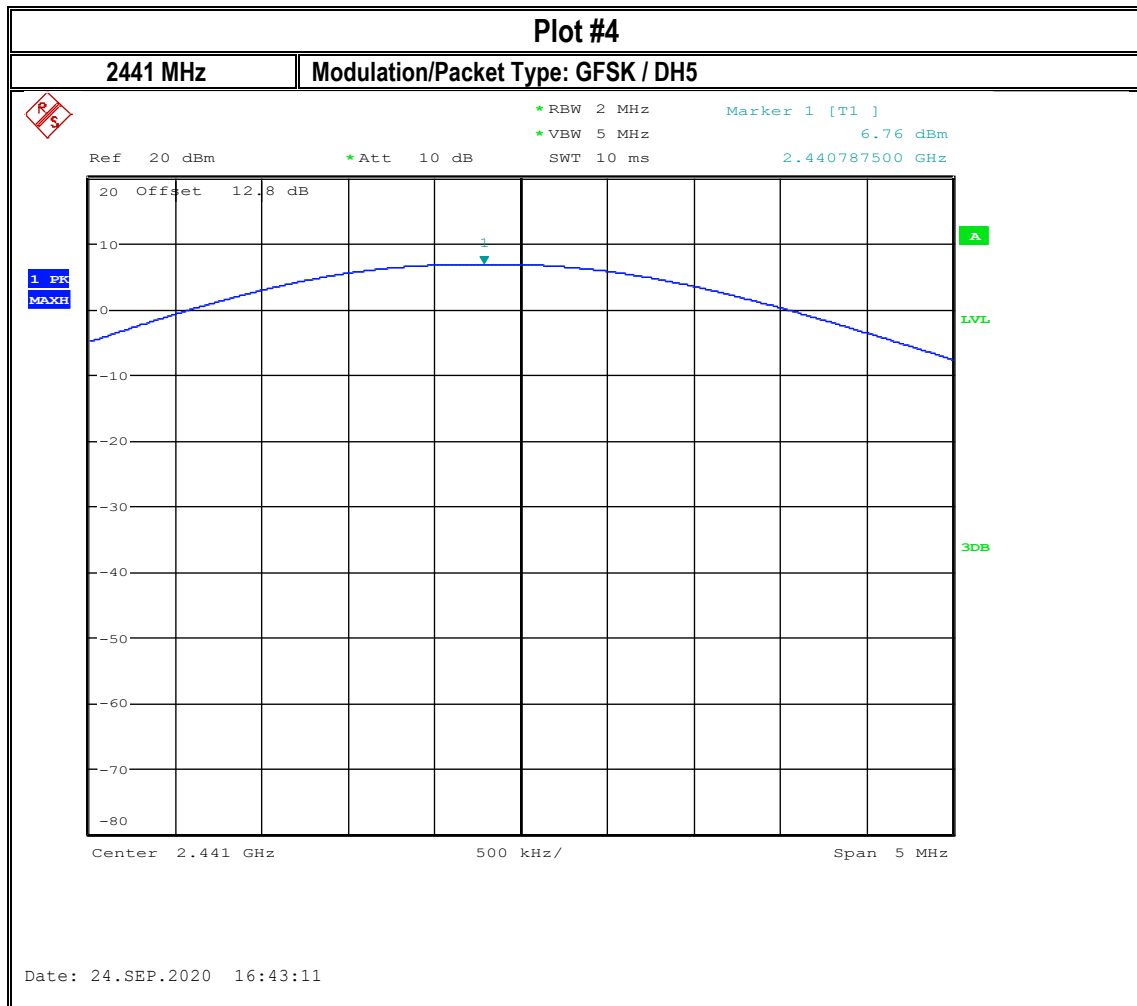
### 8.1.5 Measurement Plots:

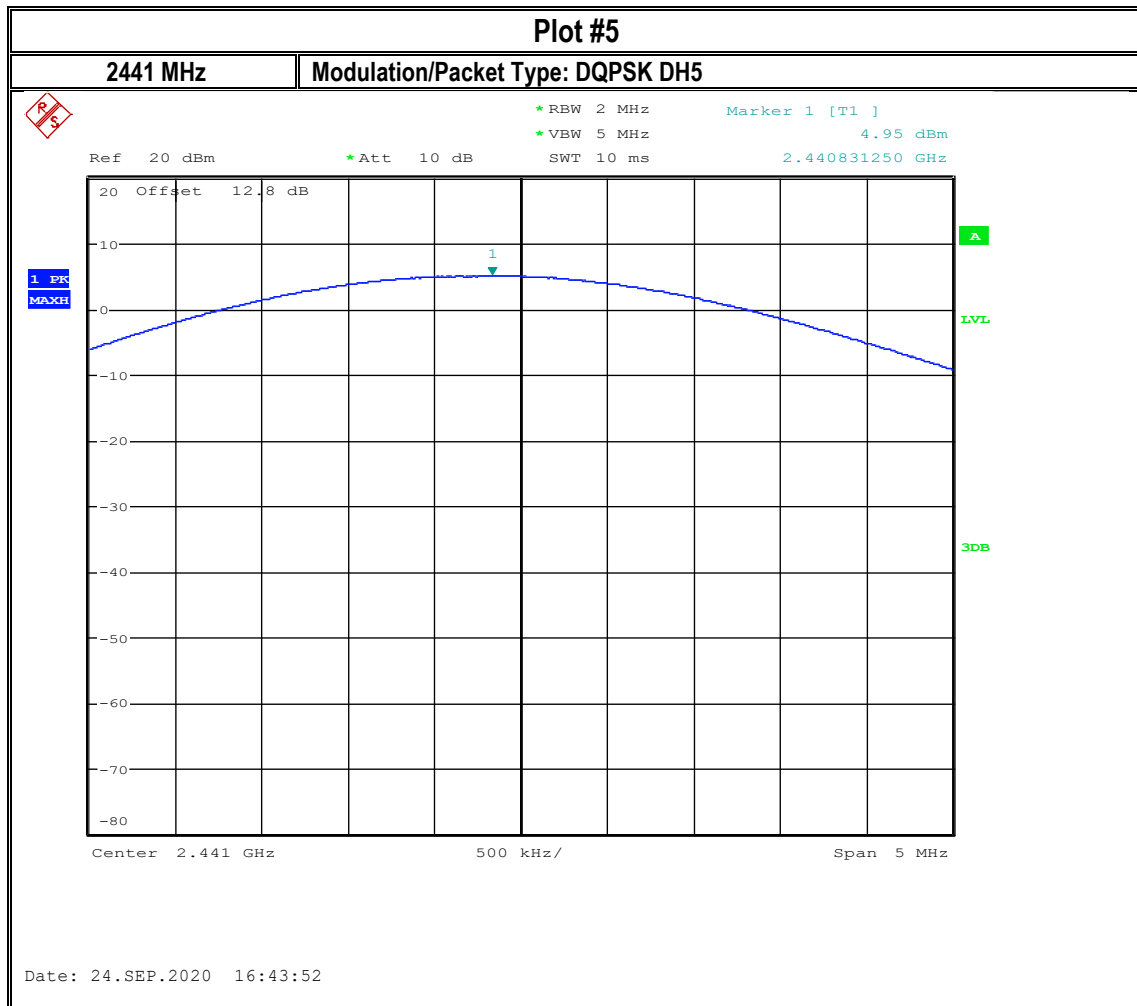


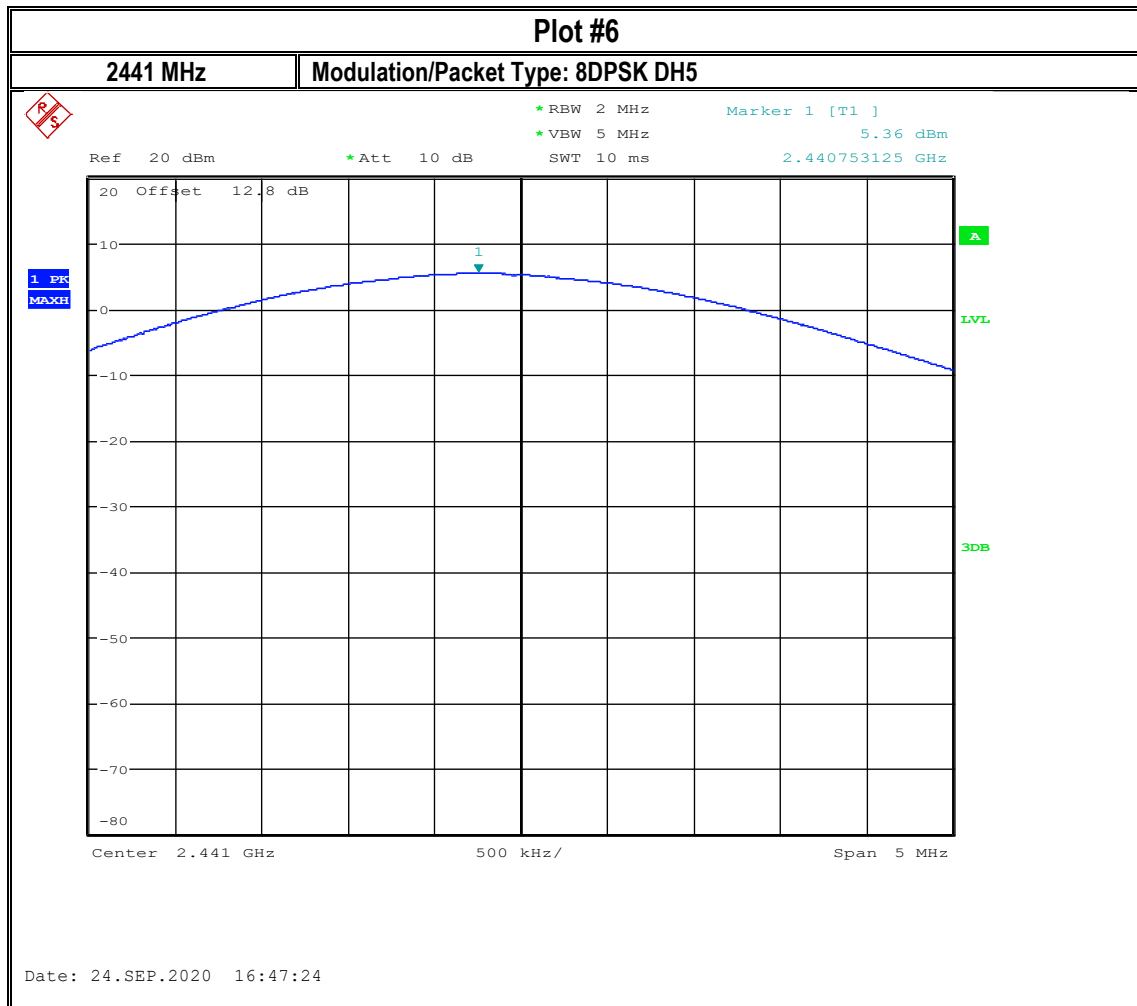


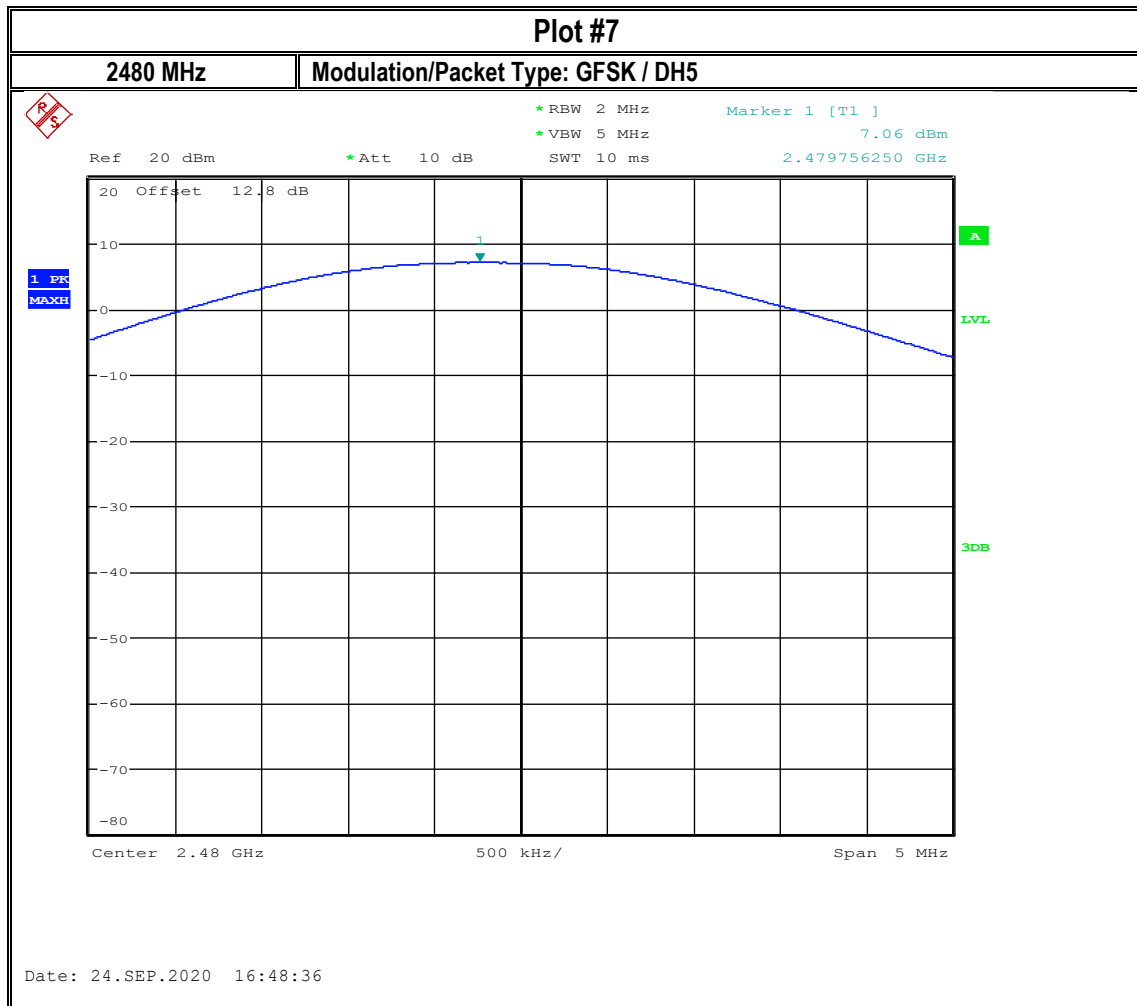


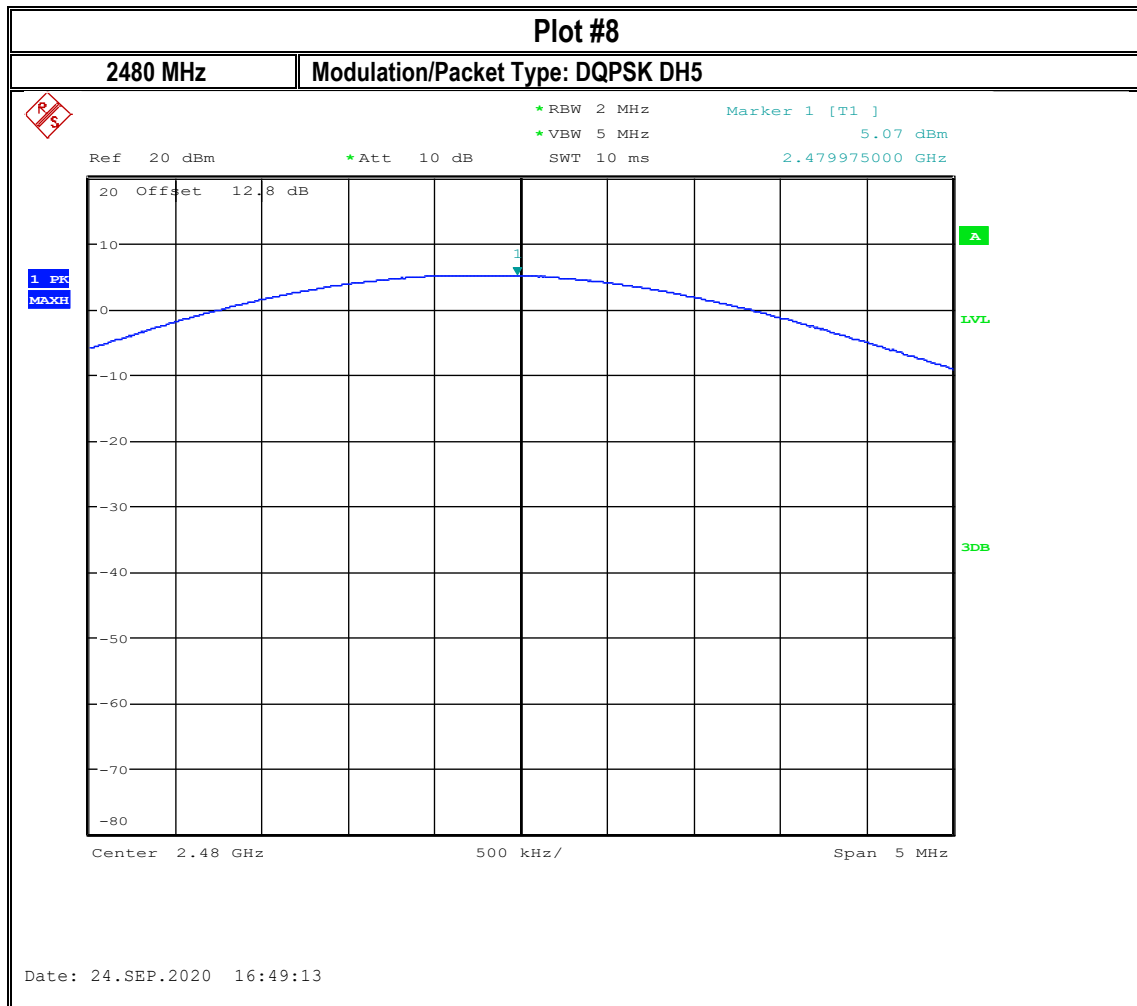


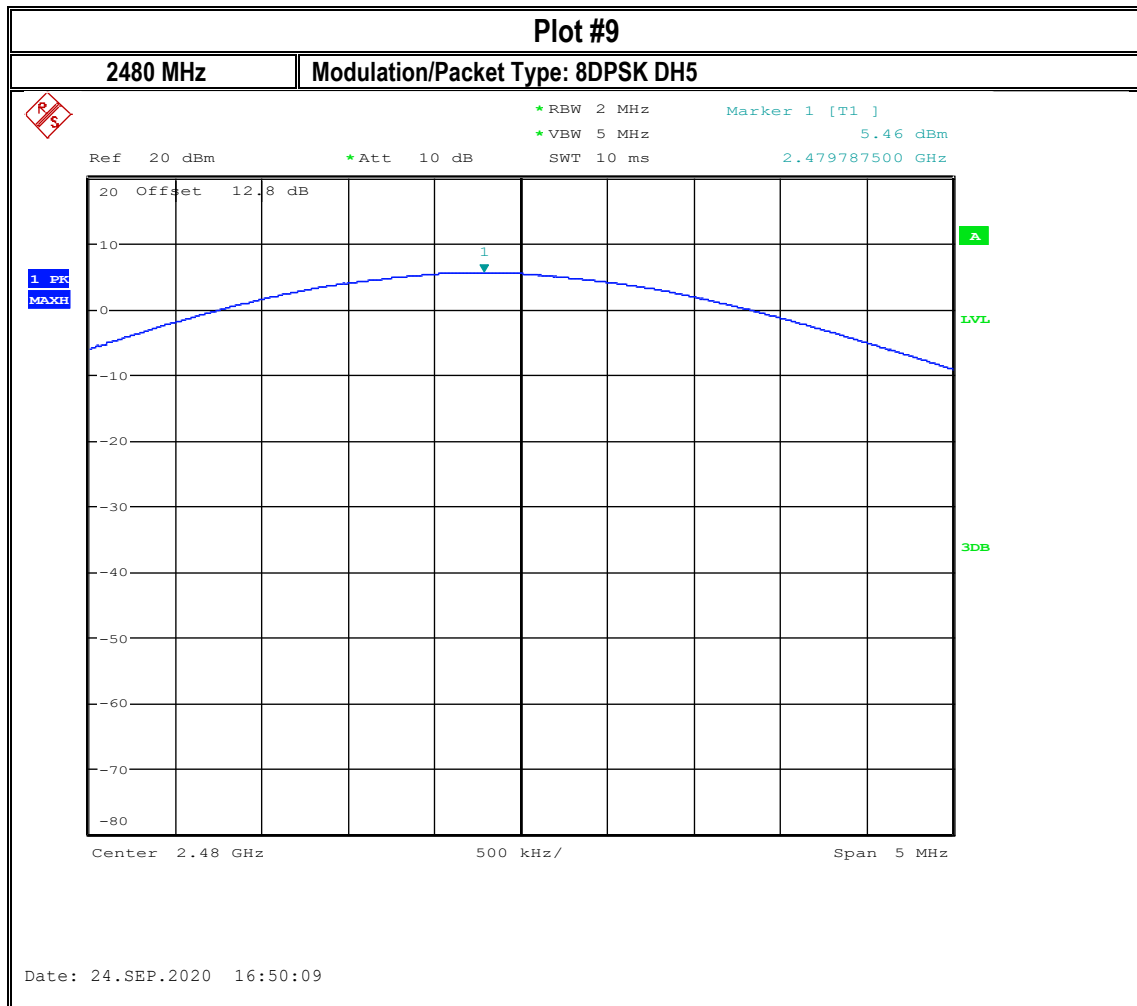












## 8.2 Band Edge Compliance

### 8.2.1 Measurement according to ANSI C63.10 Section 6.10

#### Spectrum Analyzer settings for non-restricted band edge:

- 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 the span
- VBW  $\geq$  RBW
- Sweep Time: Auto couple
- Detector = Peak
- Trace = Max hold
- 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.
- 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.

#### Spectrum Analyzer settings for restricted band:

- Peak measurements are made using a peak detector and RBW=1 MHz

### 8.2.2 Limits: Restricted Band FCC 15.209 and RSS-Gen 8.10

- PEAK LIMIT= 74 dB $\mu$ V/m @3 m =-21.23 dBm
- AVG. LIMIT= 54 dB $\mu$ V/m @3 m =-41.23 dBm
- Start frequency & stop frequency according to frequency range specified in the restricted band table in FCC section 15.205

#### Restricted bands of operation:

- Except as shown in CFR 47 Part 15.205 paragraph (d), only spurious emissions are permitted in any of the frequency bands listed below



| MHz               | MHz                 | MHz           | GHz         |
|-------------------|---------------------|---------------|-------------|
| 0.090-0.110       | 16.42-16.423        | 399.9-410     | 4.5-5.15    |
| 10.495-0.505      | 16.69475-16.69525   | 608-614       | 5.35-5.46   |
| 2.1735-2.1905     | 16.80425-16.80475   | 960-1240      | 7.25-7.75   |
| 4.125-4.128       | 25.5-25.67          | 1300-1427     | 8.025-8.5   |
| 4.17725-4.17775   | 37.5-38.25          | 1435-1626.5   | 9.0-9.2     |
| 4.20725-4.20775   | 73-74.6             | 1645.5-1646.5 | 9.3-9.5     |
| 6.215-6.218       | 74.8-75.2           | 1660-1710     | 10.6-12.7   |
| 6.26775-6.26825   | 108-121.94          | 1718.8-1722.2 | 13.25-13.4  |
| 6.31175-6.31225   | 123-138             | 2200-2300     | 14.47-14.5  |
| 8.291-8.294       | 149.9-150.05        | 2310-2390     | 15.35-16.2  |
| 8.362-8.366       | 156.52475-156.52525 | 2483.5-2500   | 17.7-21.4   |
| 8.37625-8.38675   | 156.7-156.9         | 2690-2900     | 22.01-23.12 |
| 8.41425-8.41475   | 162.0125-167.17     | 3260-3267     | 23.6-24.0   |
| 12.29-12.293      | 167.72-173.2        | 3332-3339     | 31.2-31.8   |
| 12.51975-12.52025 | 240-285             | 3345.8-3358   | 36.43-36.5  |
| 12.57675-12.57725 | 322-335.4           | 3600-4400     | Above 38.6  |
| 13.36-13.41       |                     |               |             |

### 8.2.3 Limits: Non-restricted Band §15.247 and RSS-247 5.5

#### FCC15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

#### RSS-247 5.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

### 8.2.4 Test conditions and setup:

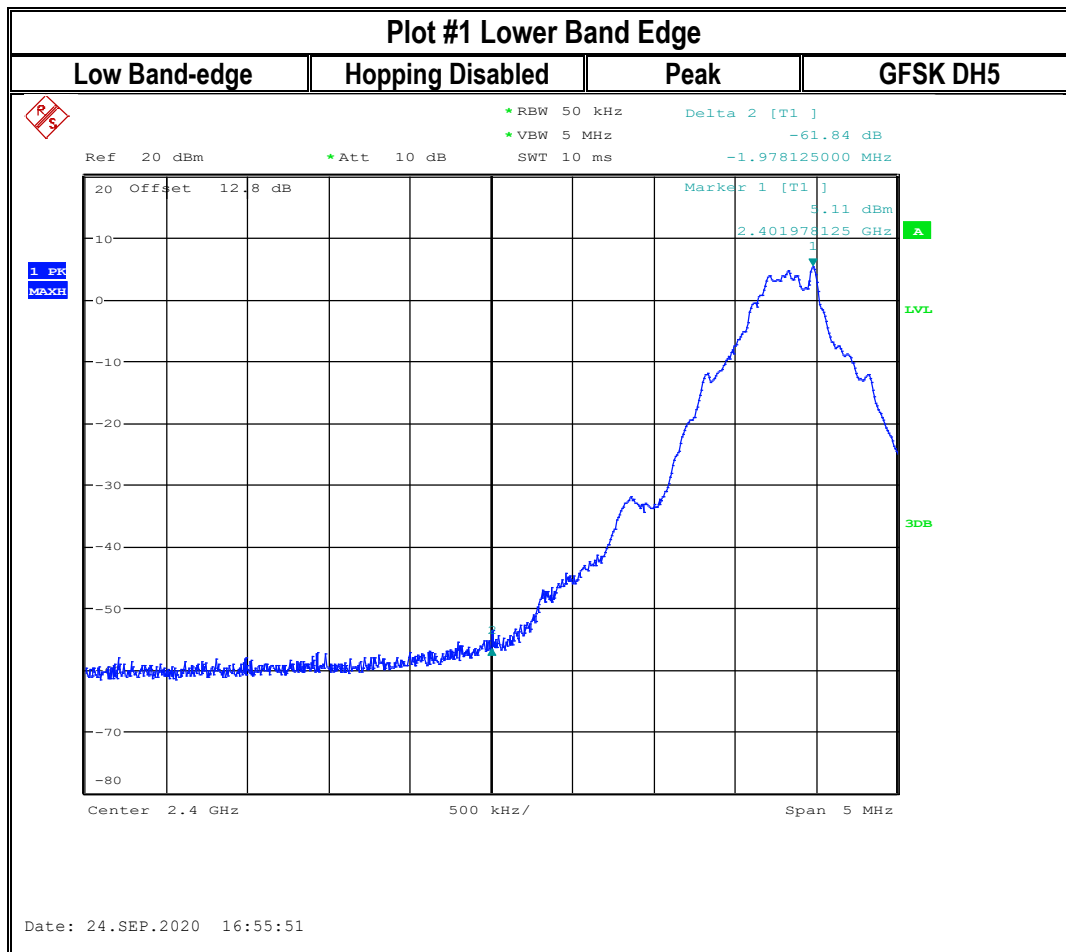
| Ambient Temperature | EUT Set-Up # | EUT operating mode                             | Power Input | Antenna gain |
|---------------------|--------------|--|-------------|--------------|
| 22° C               | 1            | GFSK DH5 - fixed channel<br>GFSK DH5 - hopping | 120 VAC     | 2.3 dBi      |

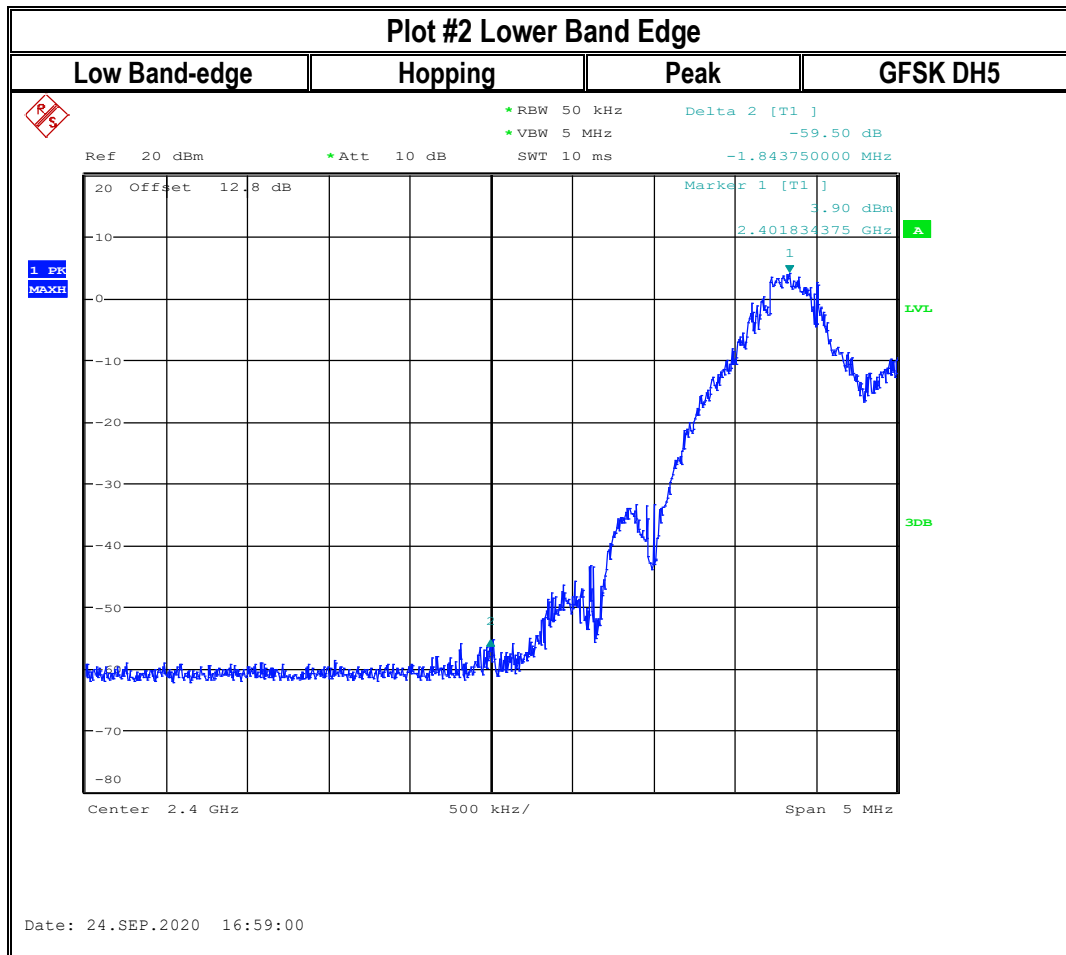
**8.2.5 Measurement result:**

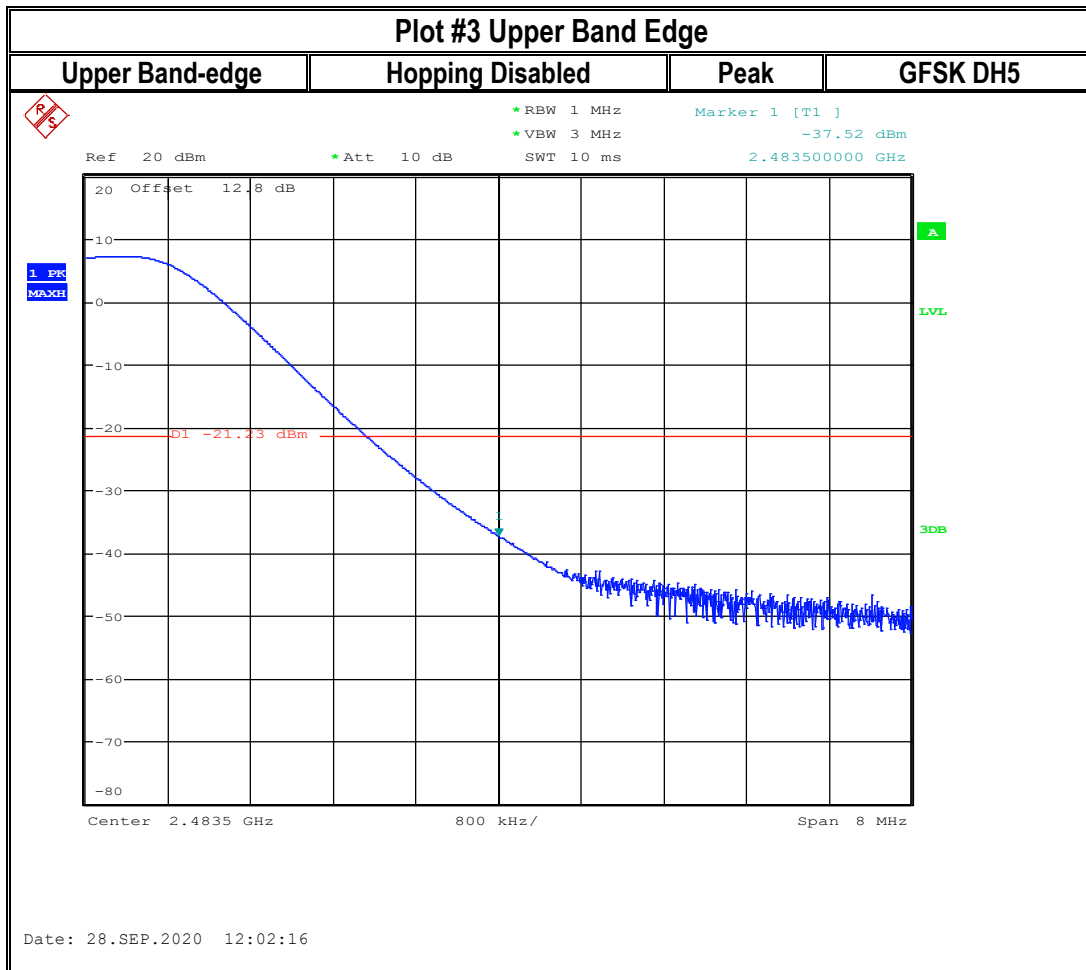
| Plot # | EUT operating mode     | Band Edge             | Band Edge Delta (dBc) | Limit (dBc) | Result |
|--------|------------------------|-----------------------|-----------------------|-------------|--------|
| 1      | GFSK DH5 fixed channel | Lower, non-restricted | 61.84                 | > 20        | Pass   |
| 2      | GFSK DH5 hopping       | Lower, non-restricted | 59.50                 | > 20        | Pass   |

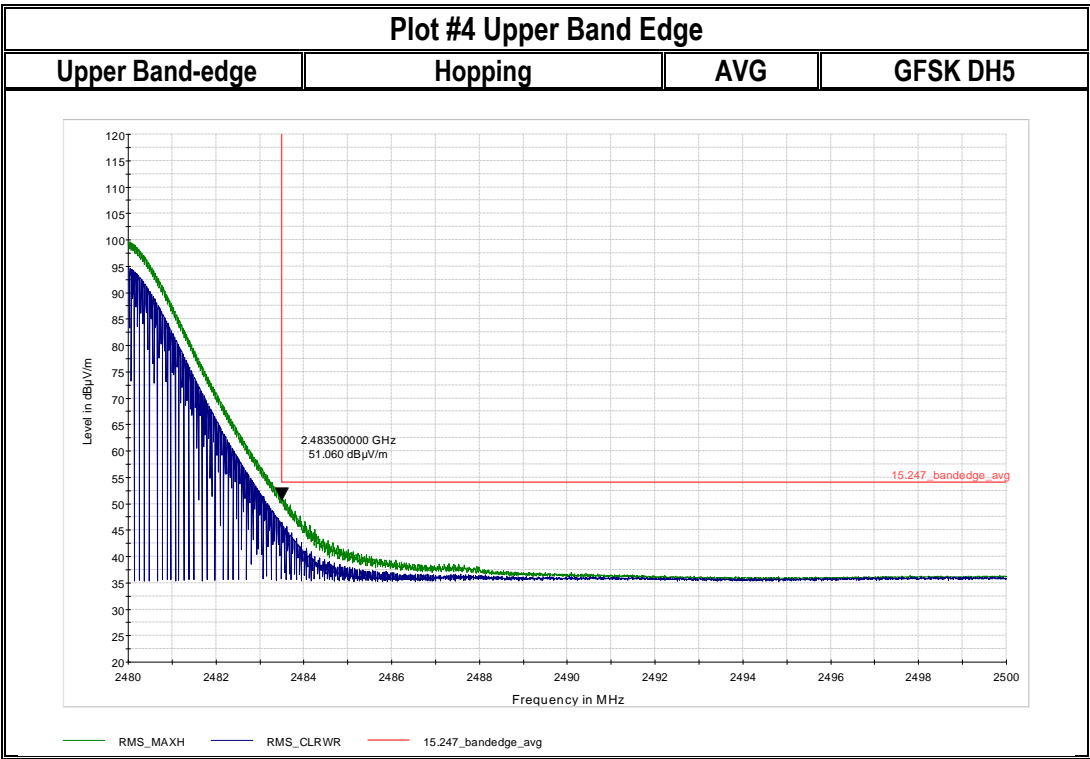
| Plot # | EUT operating mode     | Band Edge                | Measured value | Corrected by duty cycle | Corrected by Antenna gain | Limit (dBm) | Result |
|--------|------------------------|--------------------------|----------------|-------------------------|---------------------------|-------------|--------|
| 3      | GFSK DH5 fixed channel | Upper restricted peak    | -37.52         | NA due to peak detector | -35.22                    | -21.23 Peak | Pass   |
| 4      | GFSK DH5 fixed channel | Upper restricted average | -              | -                       | 51.06dBuV/m               | -41.23 AVG  | Pass   |

## 8.2.6 Measurement Plots:









### 8.3 20dB Bandwidth

#### 8.3.1 Measurement according to ANSI C63.10 Section 6.9.2

##### Spectrum Analyzer settings:

- Span: approximately 2 to 5 times the 20 dB bandwidth, centered on the hopping channel
- RBW = 1% to 5% of the 20 dB bandwidth
- VBW = 3 x RBW
- Sweep Time = Auto couple
- Detector = Peak
- Trace = Max hold

#### 8.3.2 Limits: FCC §15.247(a)(1), RSS-247 5.1(b)

##### FCC §15.247(a)(1):

Frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

##### RSS-247 5.1(b):

FHSs operating in the band 2400-2483.5 MHz 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 that the systems operate with an output power no greater than 0.125 W

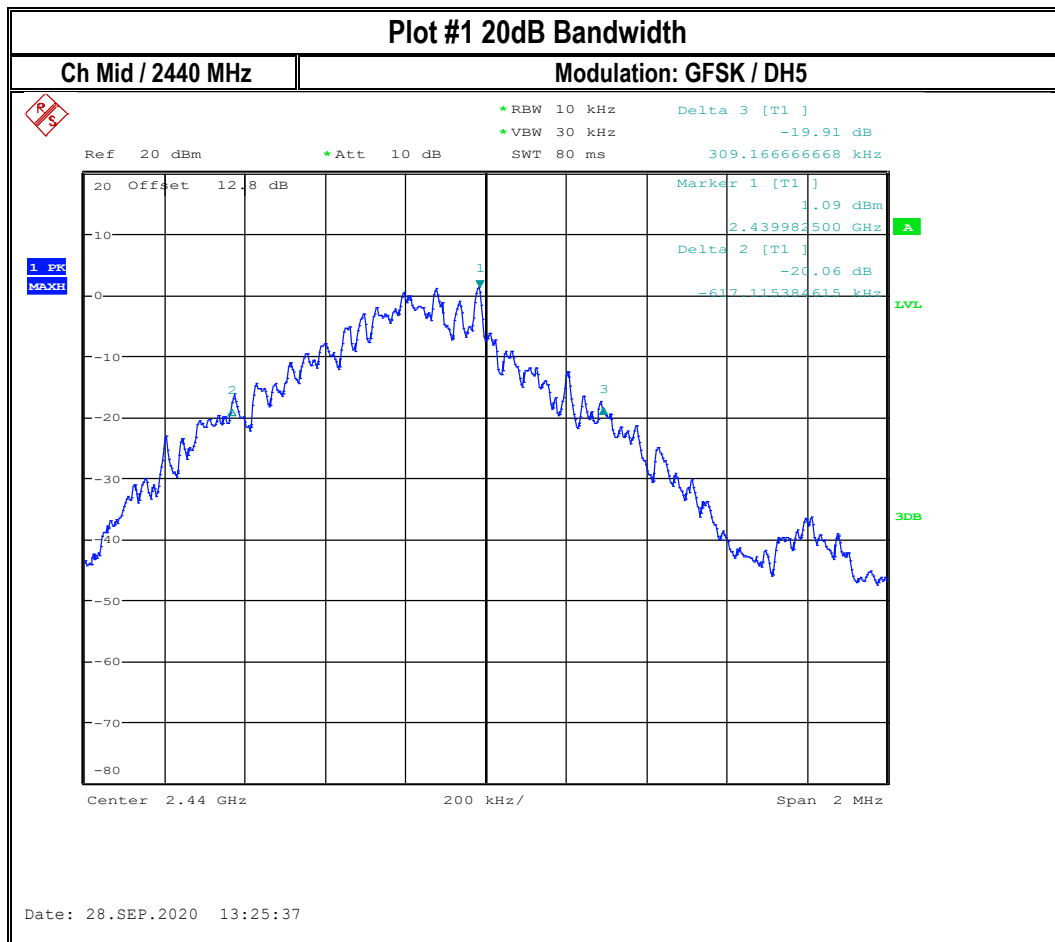
#### 8.3.3 Test conditions and setup:

| Ambient Temperature | EUT Set-Up # | EUT operating mode       | Power Input |
|---------------------|--------------|--------------------------|-------------|
| 22° C               | 1            | GFSK, DQPSK, 8DPSK – DH5 | 120 VAC     |

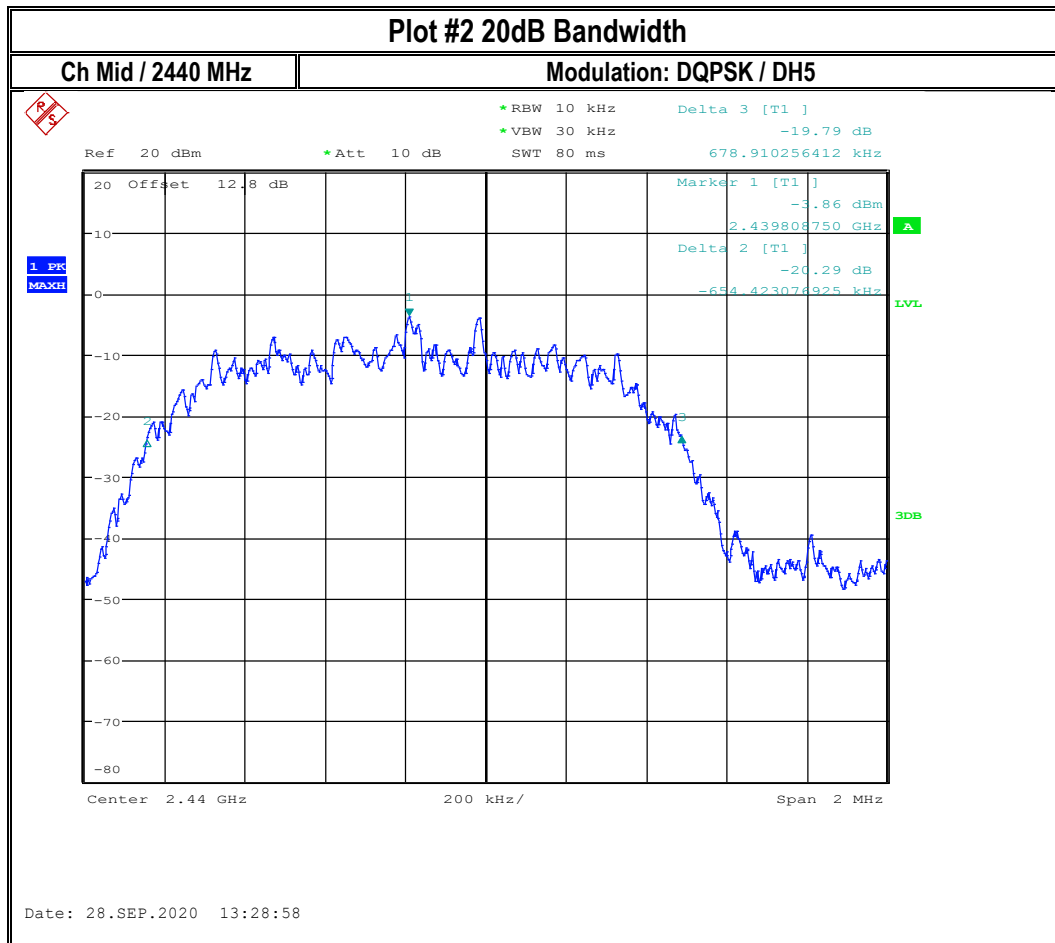
#### 8.3.4 Measurement result:

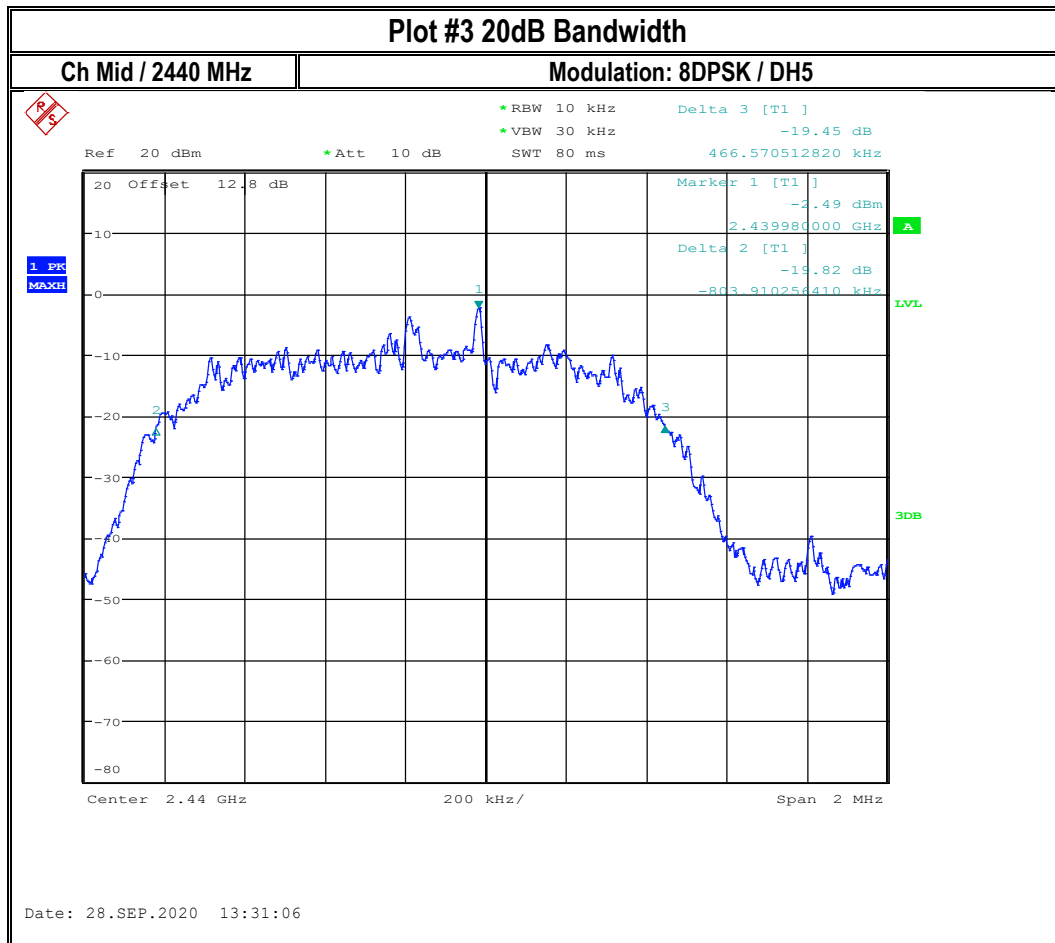
| Plot # | EUT operating mode      | 20 dB Bandwidth (MHz) |
|--------|-------------------------|-----------------------|
| 1      | GFSK DH5 fixed channel  | 0.926                 |
| 2      | DQPSK DH5 fixed channel | 1.333                 |
| 3      | 8DPSK DH5 fixed channel | 1.27                  |

### 8.3.5 Measurement Plots:









A

LVL

3dB

## 8.4 Carrier Frequency Separation

### 8.4.1 Measurement according to ANSI C63.10 Section 7.8.2

#### Spectrum Analyzer settings:

- Span = Wide enough to capture the peaks of the two adjacent channels
- RBW  $\geq$  1% of the span
- VBW  $\geq$  RBW or 3 x
- Sweep = Auto couple
- Detector function = Peak
- Trace = Max hold
- Use marker-delta function to determine the separation between the peaks of the two adjacent channels.

### 8.4.2 Limits: FCC §15.247(a)(1) & RSS-247 5.1(b)

#### FCC §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.

#### RSS-247 5.1(b):

FHSs 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, FHSs operating in the band 2400-2483.5 MHz 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 that the systems operate with an output power no greater than 0.125 W.

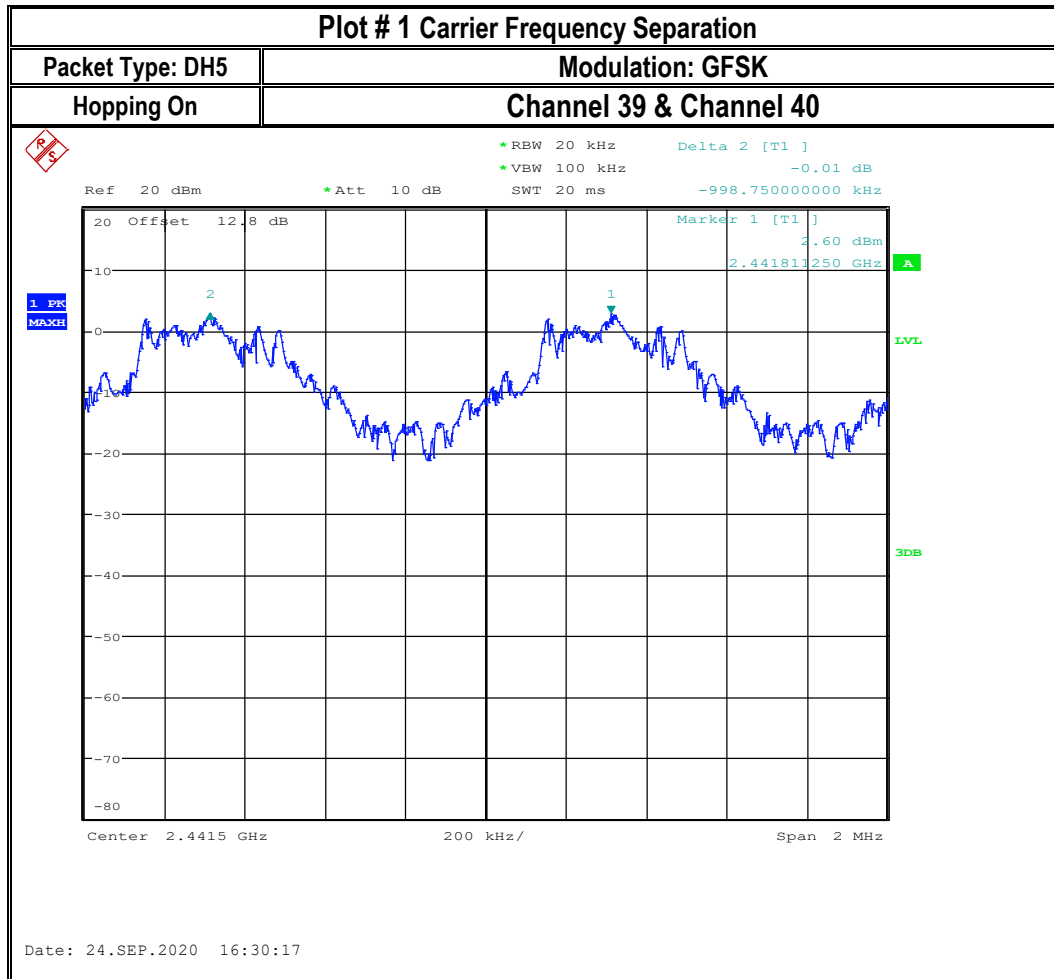
### 8.4.3 Test conditions and setup:

| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input |
|---------------------|--------------|--------------------|-------------|
| 23° C               | 1            | GFSK DH5 Hopping   | 120V AC     |

### 8.4.4 Measurement result:

| Plot # | Carrier Frequency Separation (MHz) | Limit (MHz)                 | Result |
|--------|------------------------------------|-----------------------------|--------|
| 1      | 0.998                              | $> 2/3 * \text{OBW} = 0.63$ | Pass   |

## 8.4.5 Measurement Plots:



## 8.5 Number of hopping channels

### 8.5.1 Measurement according to ANSI C63.10 Section 7.8.3

#### Spectrum Analyzer settings:

- Span = the entire frequency band of operation
- RBW  $\geq$  50 KHz
- VBW  $\geq$  RBW or 3X
- Sweep = Auto couple
- Detector function = Peak
- Trace = Max hold

### 8.5.2 Limits: FCC §15.247(a)(1)(ii)(iii) & RSS-247 5.1(d)

At least 15 non-overlapping channels

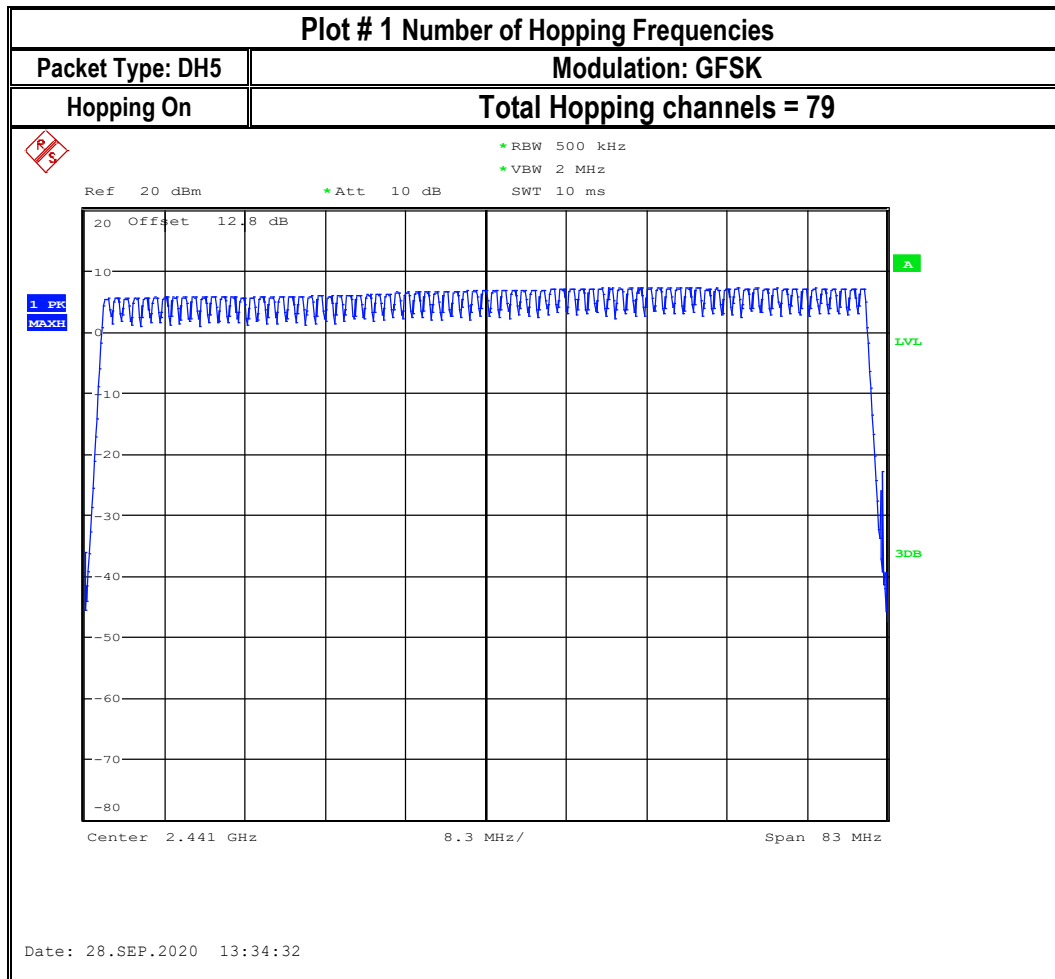
### 8.5.3 Test conditions and setup:

| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input |
|---------------------|--------------|--------------------|-------------|
| 23° C               | 1            | GFSK DH5 hopping   | 120 VAC     |

### 8.5.4 Measurement result:

| Plot # | Number of Hopping Frequencies | Limit                       | Result |
|--------|-------------------------------|-----------------------------|--------|
| 1      | 79                            | 15 non-overlapping channels | Pass   |

### 8.5.5 Measurement Plots:



## 8.6 Time of Occupancy (Dwell Time)

### 8.6.1 Measurement according to ANSI C63.10 Section 7.8.4

#### Spectrum Analyzer settings:

##### Duration of Pulse Measurement

- RBW = 1 MHz
- VBW = 3 MHz
- Span = Zero Span
- Sweep Time = 10 ms
- Sweep Mode = Single
- Detector = Peak
- Trigger = Video

##### Observation Period

- RBW = 1 MHz
- VBW = 3 MHz
- Span = Zero Span
- Sweep Time = 31.6 s
- Sweep Mode = Single
- Detector = Peak
- Trigger = Free Run

**Observation Period** = 0.4s x No. of hopping channels = 0.4 x 79 = 31.6 s

### 8.6.2 Limits: FCC §15.247(a)(1)(iii) & RSS-247 5.1(d)

#### FCC §15.247(a)(1)(iii):

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.

#### RSS-247 5.1(d):

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. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

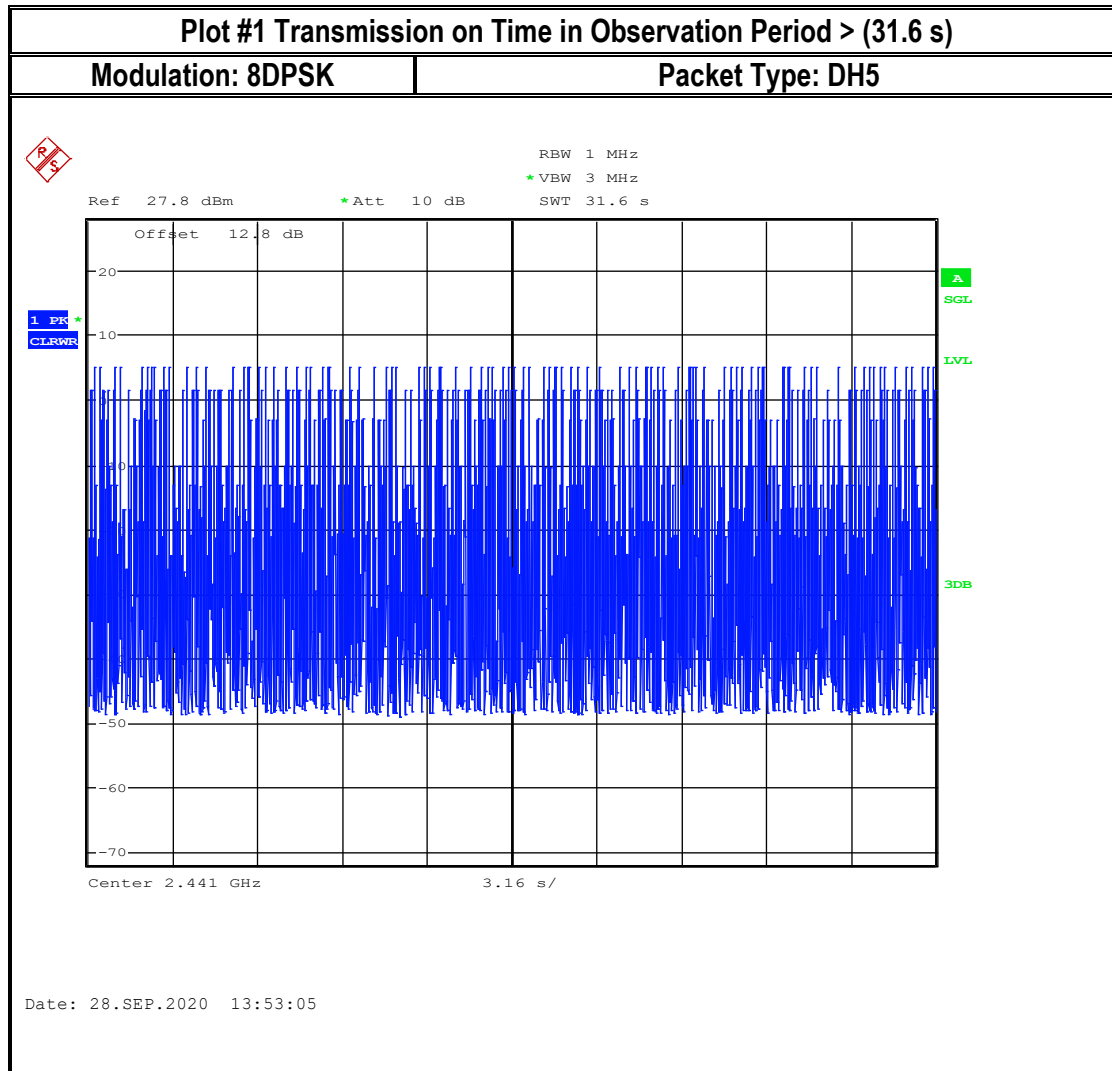
### 8.6.3 Test conditions and setup:

| Ambient Temperature | EUT Set-Up # | EUT operating mode | Power Input |
|---------------------|--------------|--------------------|-------------|
| 23° C               | 1            | GFSK hopping       | 120 VAC     |

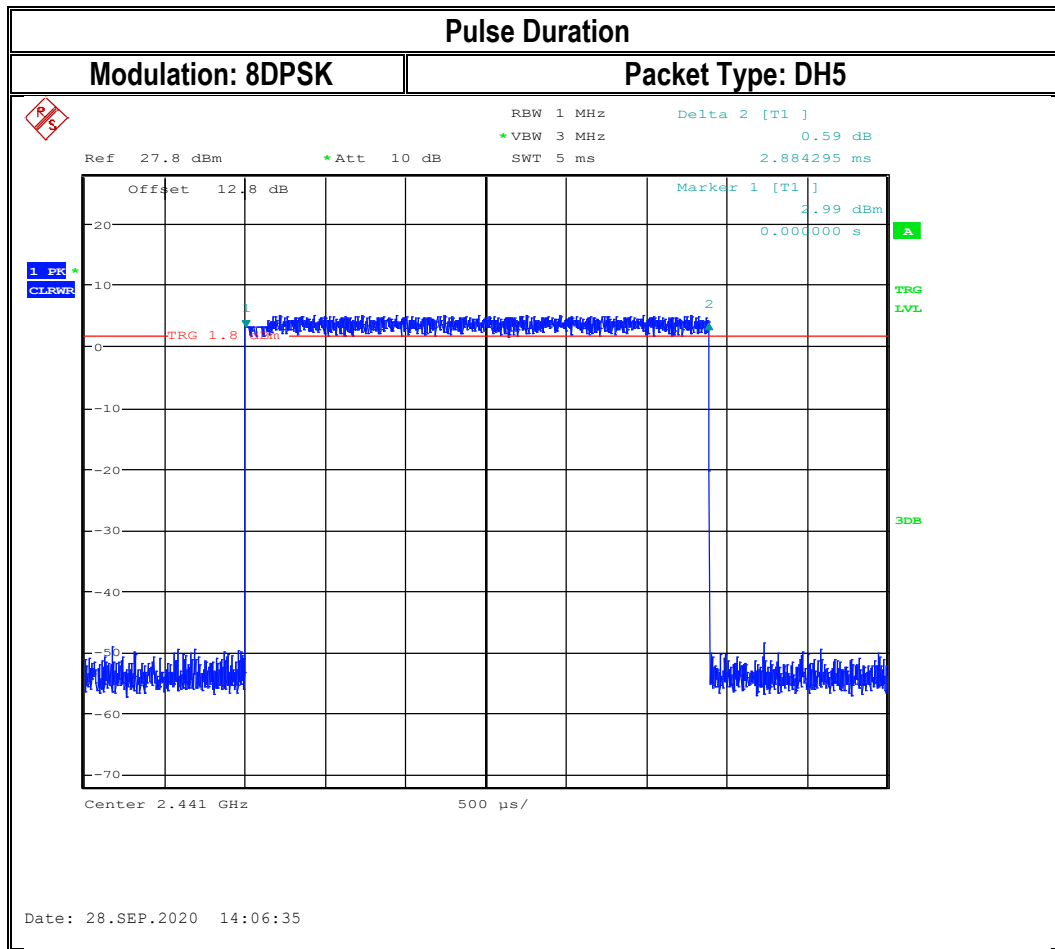
#### 8.6.4 Measurement result:

| Plot # | Modulation | Timing | Number of hops 31.6s | Pulse Width (ms) | Total Dwell Time in 31.6s (ms) | Limit (ms)     | Result |
|--------|------------|--------|----------------------|------------------|--------------------------------|----------------|--------|
| 1, 2   | 8DPSK      | DH5    | 100                  | 2.88             | 288                            | < 400 in 31.6s | Pass   |

#### 8.6.5 Measurement Plots:







## 8.7 Transmitter Spurious Emissions and Restricted Bands

### 8.7.1 Measurement according to ANSI C63.10

#### Analyzer Settings:

- Frequency = 9 KHz – 30 MHz
- RBW = 9 KHz
- Detector = Peak
  
- Frequency = 30 MHz – 1 GHz
- Detector = Peak / Quasi-Peak
- RBW = 120 KHz (<1 GHz)
  
- Frequency > 1 GHz
- Detector = Peak / Average
- RBW = 1MHz
  
- Radiated spurious emissions shall be measured for the transmit frequencies, transmit power, and data rate for the lowest, middle and highest channel in each frequency band of operation and for the highest gain antenna for each antenna type, and using the appropriate parameters and test requirements.
- The highest (or worst-case) data rate shall be recorded for each measurement.
- For testing frequencies below 30 MHz at distance other than the specified in the standard, the limit conversion is calculated by using the FCC materials for the ANSI 63 committee issued on January, 27 1991.

### 8.7.2 Limits: FCC 15.247(d)/15.209(a) /RSS-Gen 6.13

| MHz               | MHz                 | MHz           | GHz         |
|-------------------|---------------------|---------------|-------------|
| 0.090-0.110       | 16.42-16.423        | 399.9-410     | 4.5-5.15    |
| 10.495-0.505      | 16.69475-16.69525   | 608-614       | 5.35-5.46   |
| 2.1735-2.1905     | 16.80425-16.80475   | 960-1240      | 7.25-7.75   |
| 4.125-4.128       | 25.5-25.67          | 1300-1427     | 8.025-8.5   |
| 4.17725-4.17775   | 37.5-38.25          | 1435-1626.5   | 9.0-9.2     |
| 4.20725-4.20775   | 73-74.6             | 1645.5-1646.5 | 9.3-9.5     |
| 6.215-6.218       | 74.8-75.2           | 1660-1710     | 10.6-12.7   |
| 6.26775-6.26825   | 108-121.94          | 1718.8-1722.2 | 13.25-13.4  |
| 6.31175-6.31225   | 123-138             | 2200-2300     | 14.47-14.5  |
| 8.291-8.294       | 149.9-150.05        | 2310-2390     | 15.35-16.2  |
| 8.362-8.366       | 156.52475-156.52525 | 2483.5-2500   | 17.7-21.4   |
| 8.37625-8.38675   | 156.7-156.9         | 2690-2900     | 22.01-23.12 |
| 8.41425-8.41475   | 162.0125-167.17     | 3260-3267     | 23.6-24.0   |
| 12.29-12.293      | 167.72-173.2        | 3332-3339     | 31.2-31.8   |
| 12.51975-12.52025 | 240-285             | 3345.8-3358   | 36.43-36.5  |
| 12.57675-12.57725 | 322-335.4           | 3600-4400     | Above 38.6  |
| 13.36-13.41       |                     |               |             |

- Radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
- PEAK LIMIT= 74dB  $\mu$ V/m
- AVG. LIMIT= 54dB  $\mu$ V/m
- Except as shown in CFR 47 Part 15.205 paragraph (d), only spurious emissions are permitted in any of the frequency bands listed below

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) |
|-----------------|-----------------------------------|-------------------------------|
| 0.009-0.490     | 2400/F(kHz)                       | 300                           |
| 0.490-1.705     | 24000/F(kHz)                      | 30                            |
| 1.705-30.0      | 30                                | 30                            |
| 30-88           | 100**                             | 3                             |
| 88-216          | 150**                             | 3                             |
| 216-960         | 200**                             | 3                             |
| Above 960       | 500                               | 3                             |

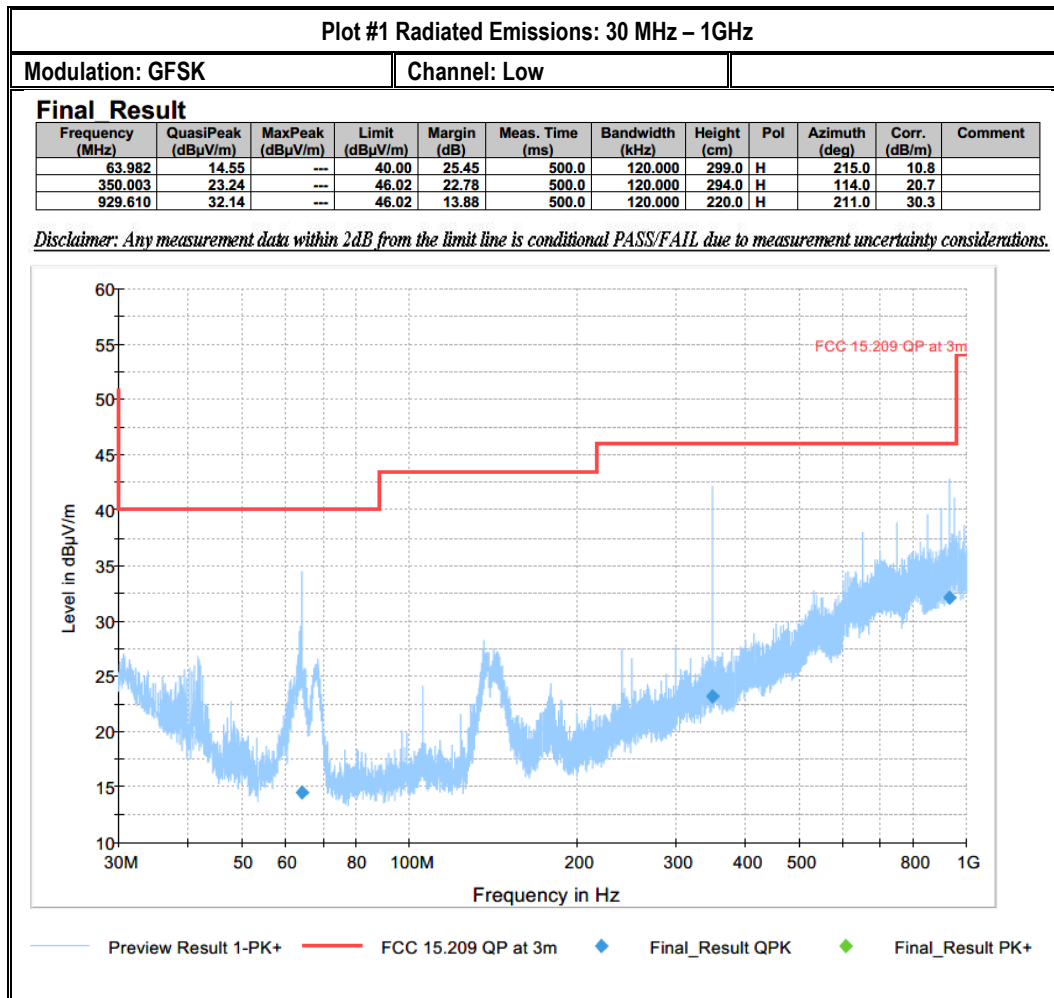
### 8.7.3 Test conditions and setup:

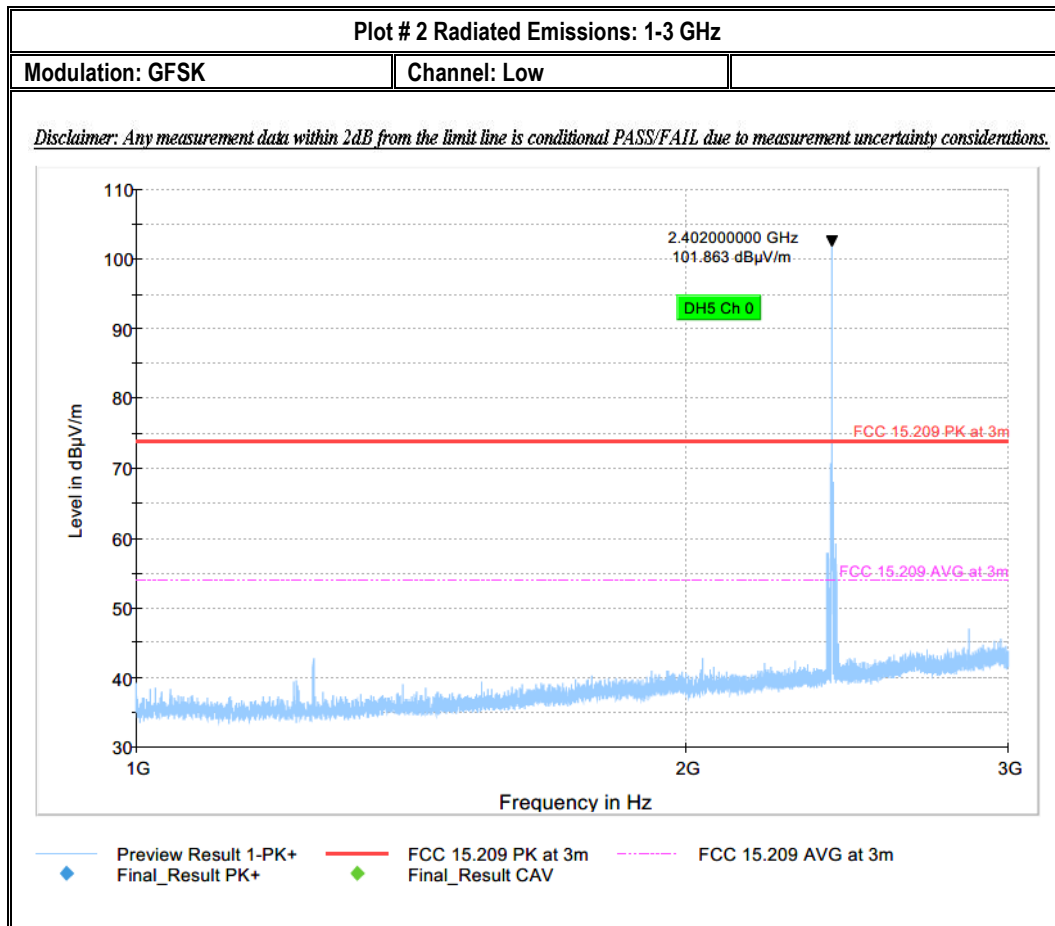
| Ambient Temperature | EUT Set-Up # | EUT operating mode     | Power Input |
|---------------------|--------------|------------------------|-------------|
| 23° C               | 2            | GFSK DH5 fixed channel | 120 VAC     |

### 8.7.4 Measurement result:

| Plot # | Channel # | Scan Frequency  | Limit             | Result |
|--------|-----------|-----------------|-------------------|--------|
| 1-3    | Low       | 30 MHz – 18 GHz | See section 8.7.2 | Pass   |
| 4-8    | Mid       | 9 kHz – 26 GHz  | See section 8.7.2 | Pass   |
| 9-11   | High      | 30 MHz – 18 GHz | See section 8.7.2 | Pass   |

## 8.7.5 Measurement Plots:





## Plot # 3 Radiated Emissions: 3-18 GHz

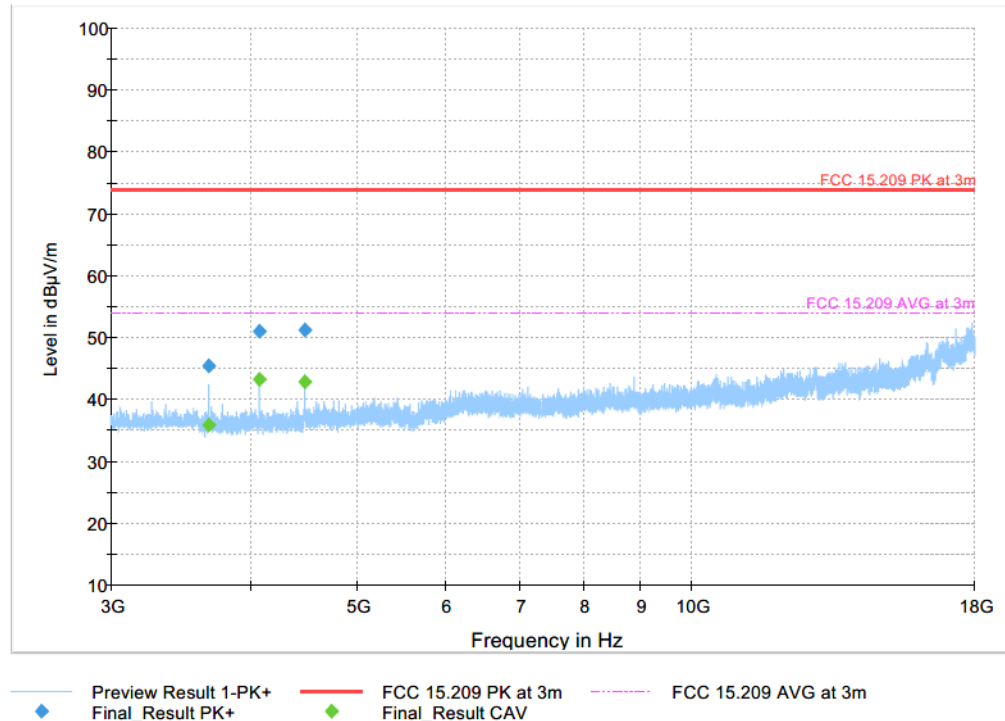
Modulation: GFSK

Channel: Low

## Final Result

| Frequency (MHz) | MaxPeak (dBμV/m) | CAverage (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|-----------------|------------------|-------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|---------|
| 3672.500        | ---              | 35.90             | 53.98          | 18.08       | 500.0           | 1000.000        | 205.0       | V   | 103.0         | -6.6         |         |
| 3672.500        | 45.45            | ---               | 73.98          | 28.53       | 500.0           | 1000.000        | 205.0       | V   | 103.0         | -6.6         |         |
| 4080.000        | ---              | 43.34             | 53.98          | 10.64       | 500.0           | 1000.000        | 287.0       | V   | 124.0         | -5.4         |         |
| 4080.000        | 51.12            | ---               | 73.98          | 22.86       | 500.0           | 1000.000        | 287.0       | V   | 124.0         | -5.4         |         |
| 4488.000        | ---              | 42.78             | 53.98          | 11.20       | 500.0           | 1000.000        | 263.0       | V   | 301.0         | -5.3         |         |
| 4488.000        | 51.22            | ---               | 73.98          | 22.76       | 500.0           | 1000.000        | 263.0       | V   | 301.0         | -5.3         |         |

*Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.*



## Plot # 4 Radiated Emissions: 9 KHz - 30 MHz

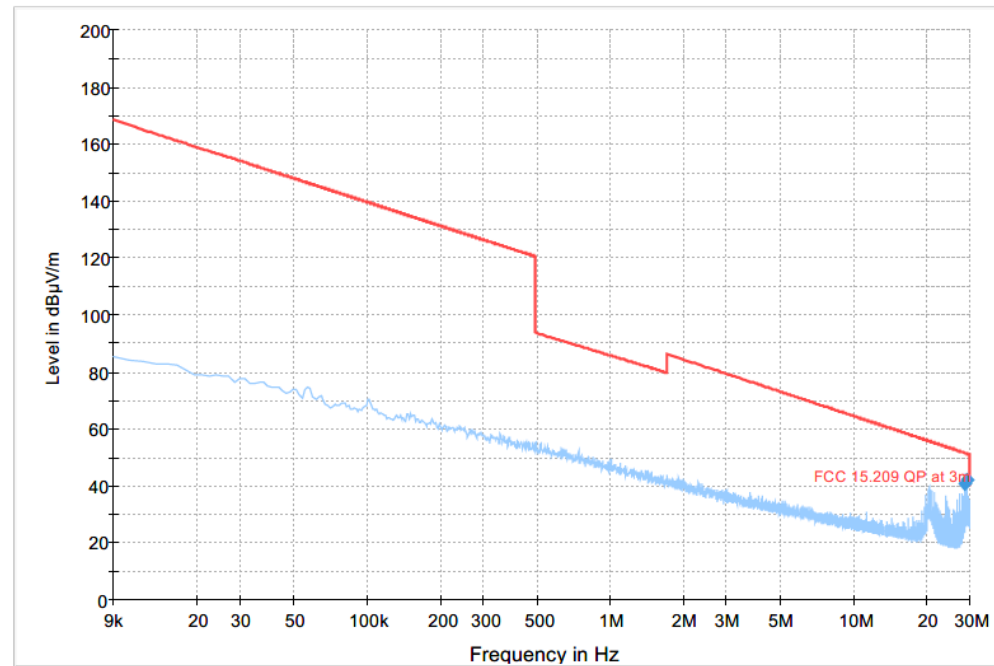
Modulation: GFSK

Channel: Mid

## Final Result

| Frequency (MHz) | QuasiPeak (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|-----------------|--------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|---------|
| 28.686          | 40.62              | 51.59          | 10.97       | 500.0           | 9.000           | 100.0       | V   | 154.0         | 16.3         |         |
| 29.237          | 41.91              | 51.36          | 9.45        | 500.0           | 9.000           | 100.0       | V   | 53.0          | 16.3         |         |

Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.



Preview Result 1-PK+    FCC 15.209 QP at 3m    Final\_Result QPK

## Plot #5 Radiated Emissions: 30 MHz – 1GHz

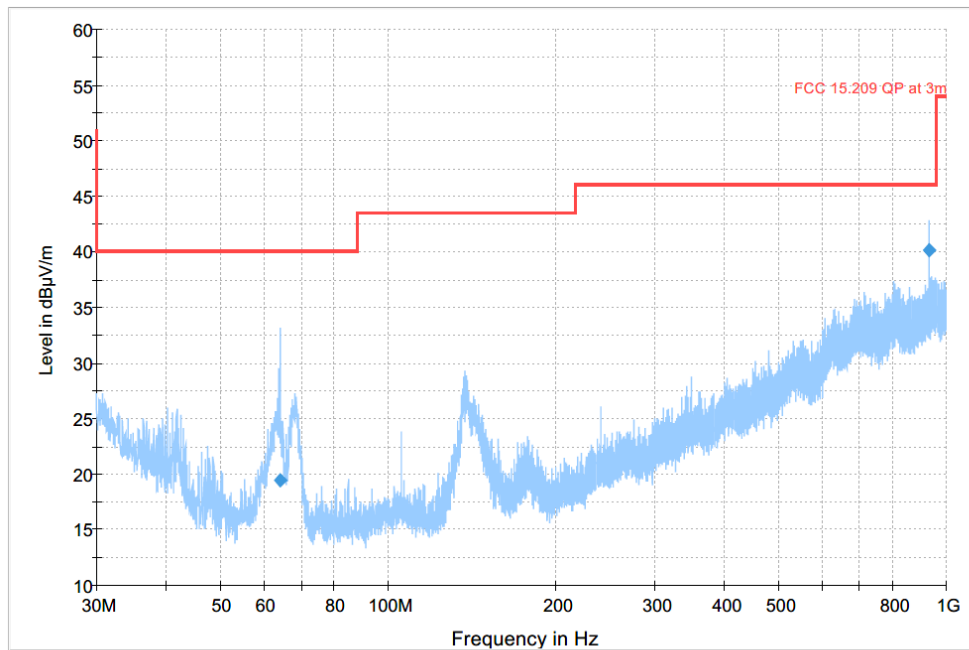
Modulation: GFSK

Channel: Mid

## Final Result

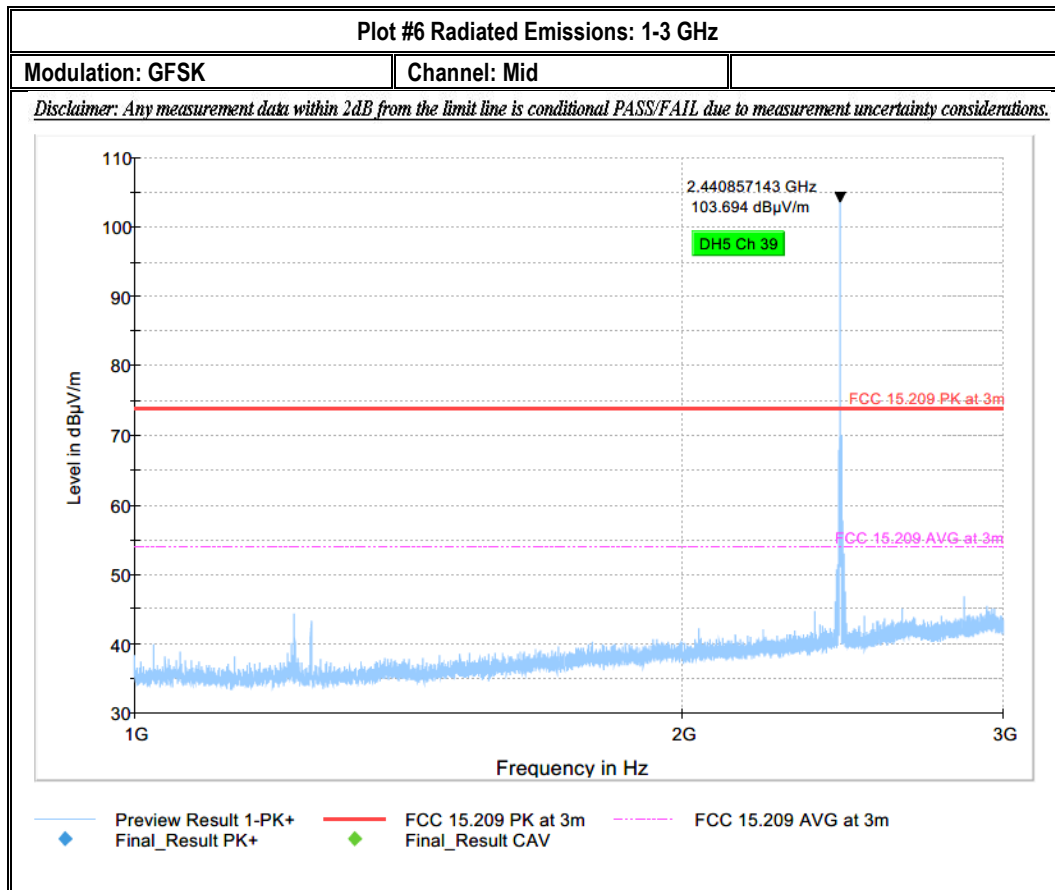
| Frequency (MHz) | QuasiPeak (dBμV/m) | MaxPeak (dBμV/m) | Limit (dBμV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|-----------------|--------------------|------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|---------|
| 64.015          | 19.39              | ---              | 40.00          | 20.61       | 500.0           | 120.000         | 297.0       | V   | 240.0         | 10.9         |         |
| 929.610         | 40.17              | ---              | 46.02          | 5.85        | 500.0           | 120.000         | 172.0       | V   | 16.0          | 30.3         |         |

*Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.*



— Preview Result 1-PK+    — FCC 15.209 QP at 3m    ◆ Final\_Result QPK    ◆ Final\_Result PK+



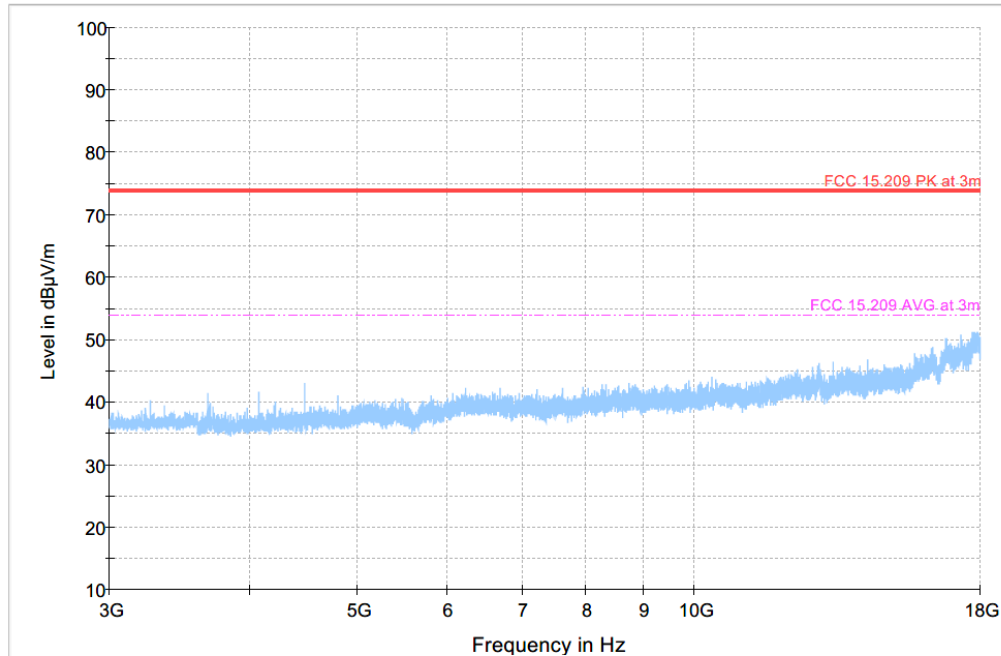


## Plot #7 Radiated Emissions: 3-18 GHz

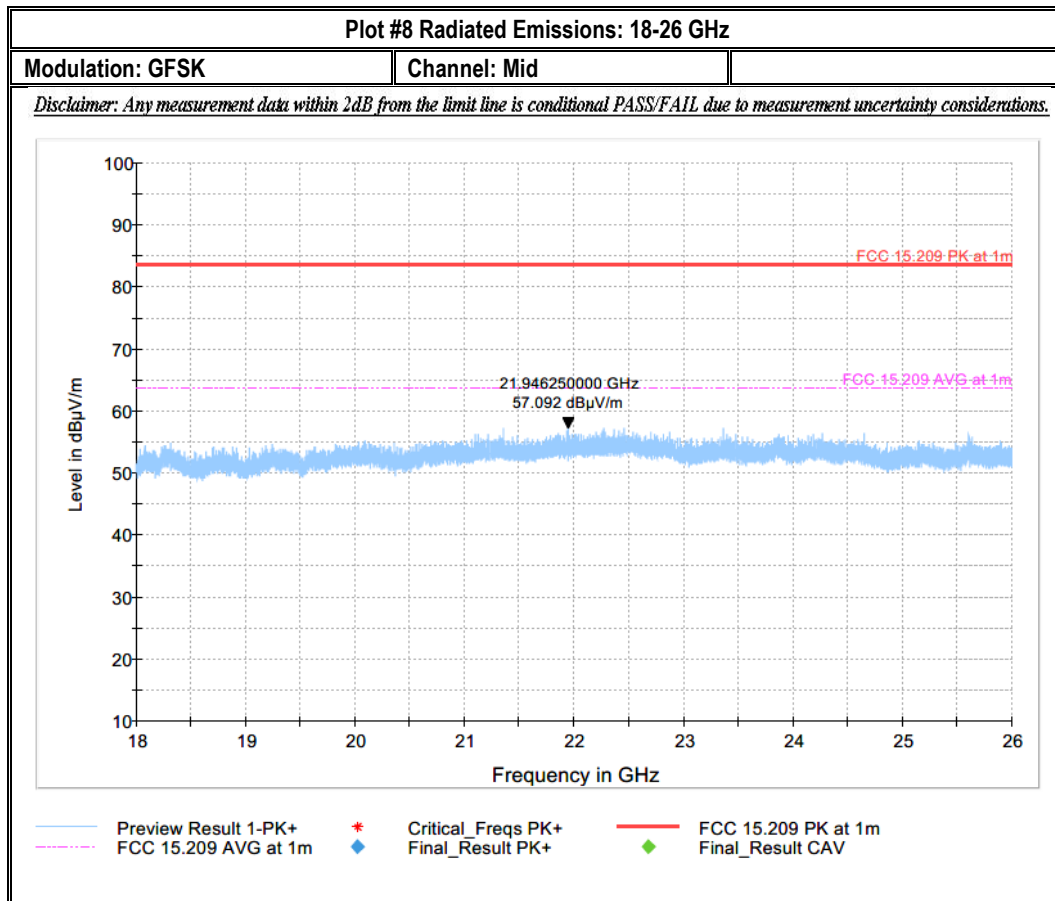
Modulation: GFSK

Channel: Mid

*Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.*



Preview Result 1-PK+ Final\_Result PK+    FCC 15.209 PK at 3m Final\_Result CAV    FCC 15.209 AVG at 3m



## Plot #9 Radiated Emissions: 30 MHz – 1GHz

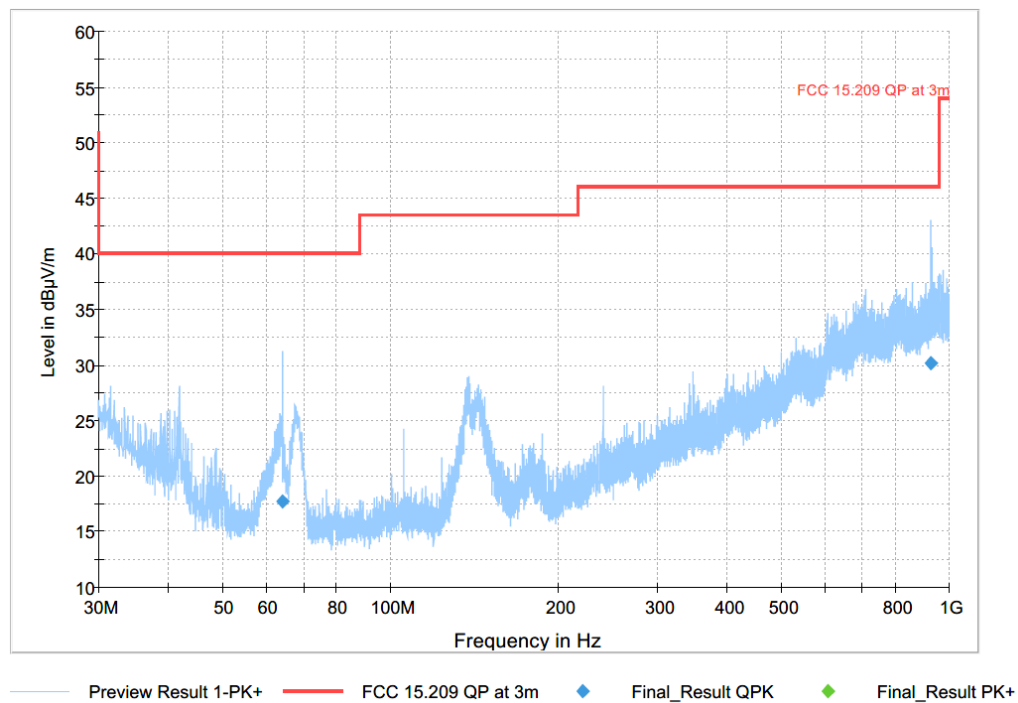
Modulation: GFSK

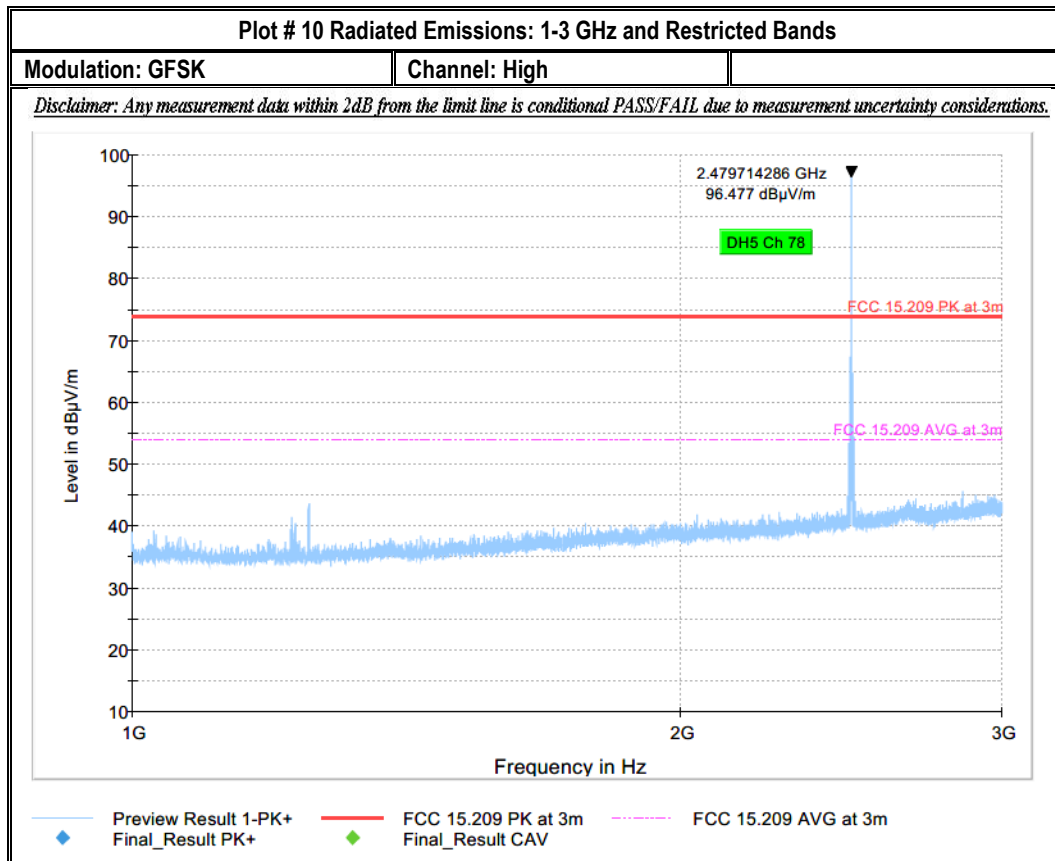
Channel: High

## Final Result

| Frequency (MHz) | QuasiPeak (dBµV/m) | MaxPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) | Comment |
|-----------------|--------------------|------------------|----------------|-------------|-----------------|-----------------|-------------|-----|---------------|--------------|---------|
| 63.982          | 17.77              | ---              | 40.00          | 22.23       | 500.0           | 120.000         | 295.0       | V   | 314.0         | 10.8         |         |
| 928.220         | 30.18              | ---              | 46.02          | 15.84       | 500.0           | 120.000         | 269.0       | H   | -44.0         | 30.2         |         |

*Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.*



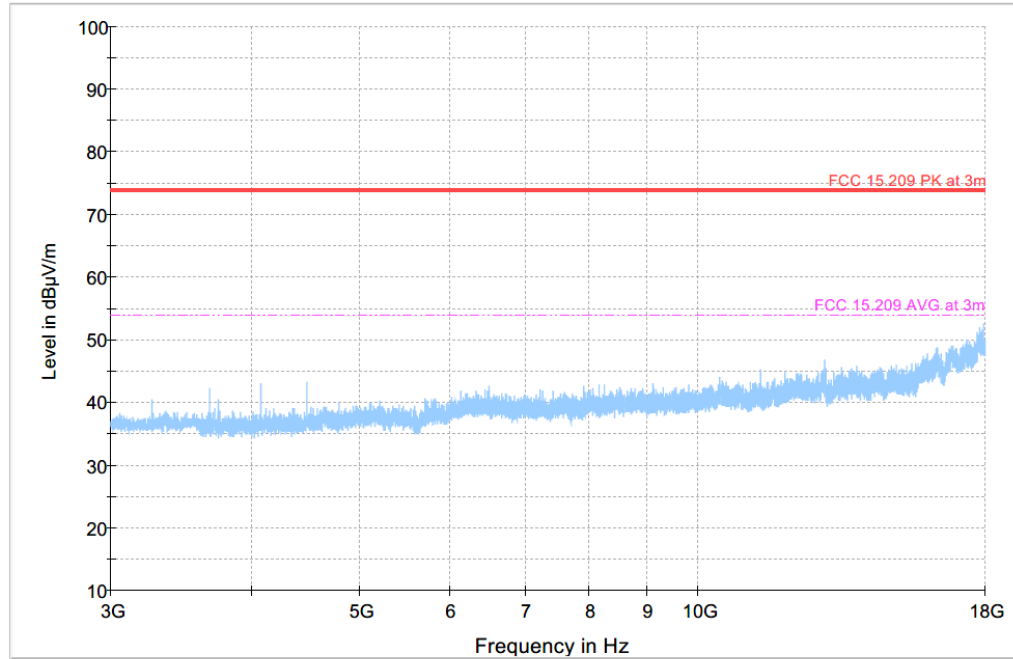


## Plot #11 Radiated Emissions: 3-18 GHz

Modulation: GFSK

Channel: High

*Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.*



Preview Result 1-PK+ Final\_Result PK+    FCC 15.209 PK at 3m    FCC 15.209 AVG at 3m  
Final\_Result CAV

## 8.8 AC Power Line Conducted Emissions

### 8.8.1 Measurement according to ANSI C63.4

Analyzer Settings:

- RBW = 9 KHz (CISPR Bandwidth)
- Pre-scan Detector = Peak / Average for
- Final Measurements Detector = Quasi-Peak / Average

### 8.8.2 Limits: FCC 15.207 & RSS-Gen 8.8

(a) Except as shown in paragraphs (b) and (c) of this section of the CFR, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table (1), as measured using a 50  $\mu$ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between frequency ranges.

| Frequency of emission (MHz) | Conducted limit (dB $\mu$ V) |           |
|-----------------------------|------------------------------|-----------|
|                             | Quasi-peak                   | Average   |
| 0.15–0.5                    | 66 to 56*                    | 56 to 46* |
| 0.5–5                       | 56                           | 46        |
| 5–30                        | 60                           | 50        |

\*Decreases with the logarithm of the frequency.

### 8.8.3 Test conditions and setup:

| Ambient Temperature (C) | EUT Set-Up # | EUT operating mode            | Power line (L1, L2, L3, N) | Power Input   |
|-------------------------|--------------|-------------------------------|----------------------------|---------------|
| 22                      | 2            | GFSK continuous fixed channel | Line & Neutral             | 110 V / 60 Hz |

### 8.8.4 Measurement Result:

| Plot # | Port     | EUT Set-Up # | EUT operating mode            | Scan Frequency   | Limit             | Result |
|--------|----------|--------------|-------------------------------|------------------|-------------------|--------|
| 1      | AC Mains | 2            | GFSK continuous fixed channel | 150 kHz – 30 MHz | See section 8.8.2 | Pass   |

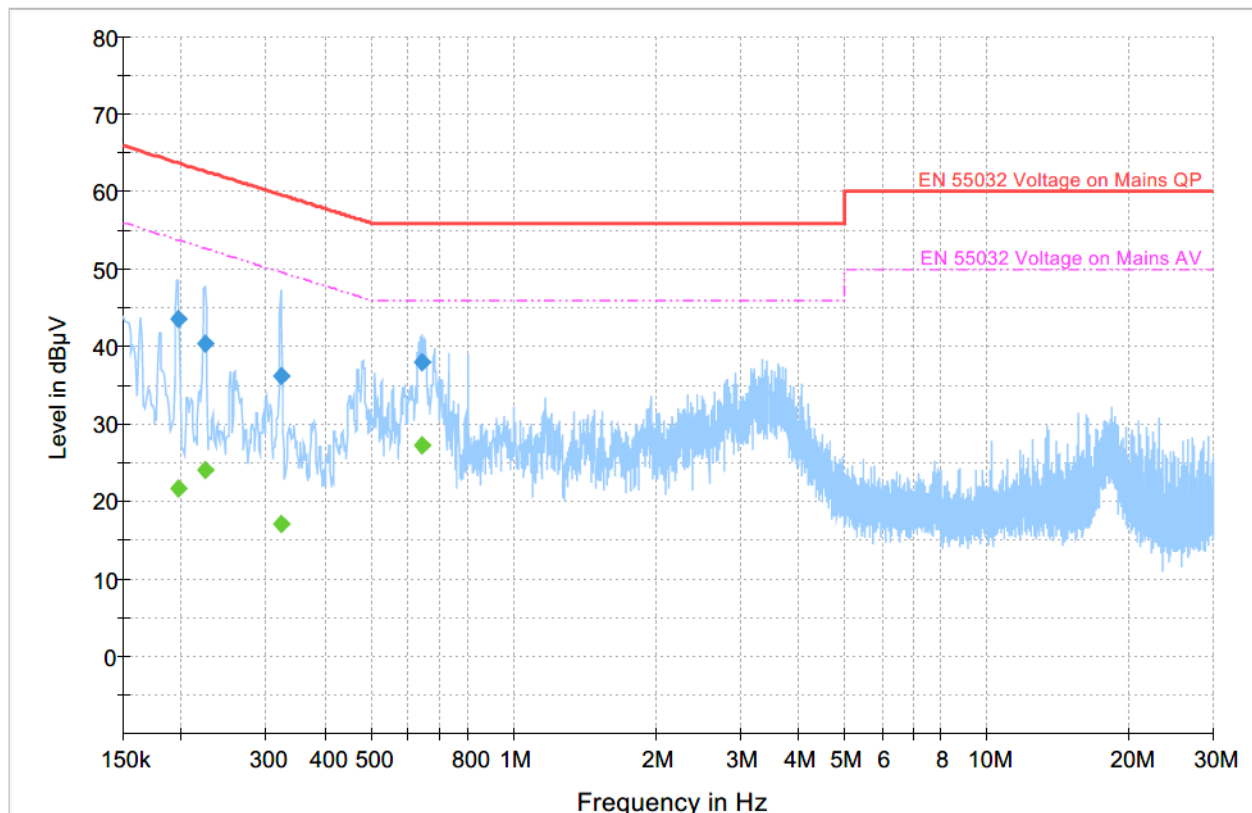
## 8.8.5 Measurement Plots:

## Plot # 1

## Final Result

| Frequency (MHz) | QuasiPeak (dBμV) | CAverage (dBμV) | Limit (dBμV) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Line | PE  | Corr. (dB) | Comment |
|-----------------|------------------|-----------------|--------------|-------------|-----------------|-----------------|------|-----|------------|---------|
| 0.196           | ---              | 21.72           | 53.79        | 32.06       | 500.0           | 9.000           | L1   | GND | 10.3       |         |
| 0.196           | 43.55            | ---             | 63.79        | 20.23       | 500.0           | 9.000           | L1   | GND | 10.3       |         |
| 0.224           | 40.32            | ---             | 62.69        | 22.36       | 500.0           | 9.000           | N    | GND | 10.2       |         |
| 0.224           | ---              | 24.12           | 52.69        | 28.57       | 500.0           | 9.000           | N    | GND | 10.2       |         |
| 0.324           | 36.13            | ---             | 59.61        | 23.48       | 500.0           | 9.000           | L1   | GND | 10.0       |         |
| 0.324           | ---              | 17.06           | 49.61        | 32.55       | 500.0           | 9.000           | L1   | GND | 10.0       |         |
| 0.639           | ---              | 27.25           | 46.00        | 18.75       | 500.0           | 9.000           | N    | GND | 10.0       |         |
| 0.639           | 37.98            | ---             | 56.00        | 18.02       | 500.0           | 9.000           | N    | GND | 10.0       |         |

*Disclaimer: Any measurement data within 2dB from the limit line is conditional PASS/FAIL due to measurement uncertainty considerations.*



Preview Result 1-PK+  
Final\_Result QPK

EN 55032 Voltage on Mains QP  
Final\_Result CAV

EN 55032 Voltage on Mains AV



## 9 Test setup photos

Setup photos are included in supporting file name: "EMC\_EZLOI-001-20001\_FCC\_IC\_Setup\_Photos.pdf"

## 10 Test Equipment And Ancillaries Used For Testing

| Item Name                  | Equipment Type                       | Manufacturer    | Model               | Serial #  | Calibration Cycle | Last Calibration Date |
|----------------------------|--------------------------------------|-----------------|---------------------|-----------|-------------------|-----------------------|
| Antenna Biconilog 3142E    | Biconlog Antenna                     | EMCO            | 3142E               | 166067    | 3 years           | 03/12/2020            |
| Magnetic Loop Antenna      | Loop Antenna                         | ETS Lindgren    | 6507                | 161344    | 3 years           | 10/26/2017            |
| Antenna Horn 3115 SN 35111 | Horn Antenna                         | EMCO            | 3115                | 35111     | 3 years           | 04/17/2019            |
| Antenna Horn 3116          | Horn Antenna                         | ETS Lindgren    | 3116                | 70497     | 3 years           | 10/31/2017            |
| Antenna Horn 3117          | Horn Antenna                         | ETS Lindgren    | 3117-PA             | 169547    | 3 years           | 09/01/2020            |
| FSU26                      | Spectrum Analyzer                    | R&S             | FSU26               | 200302    | 3 years           | 7/16/2019             |
| LISN                       | Line Impedance Stabilization Network | FCC             | FCC-LISN-50-25-2-08 | 8014      | 3 Year            | 7/19/2019             |
| Thermometer Humidity       | Thermometer Humidity                 | Control Company | 36934-164           | 191871994 | 2 Year            | 1/10/2019             |

**Note:** Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels. Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

**11 Revision History**

| Date       | Report Name                    | Changes to report | Report prepared by |
|------------|--------------------------------|-------------------|--------------------|
| 2020-10-20 | EMC_EZLOI-001-20001_15.247_DSS | Initial Version   | Kevin Wang         |
|            |                                |                   |                    |

&lt;&lt;&lt; The End &gt;&gt;&gt;