

# Appendix

## Bluetooth BLE

# TABLE OF CONTENTS

|          |                                                                  |           |
|----------|------------------------------------------------------------------|-----------|
| <b>1</b> | <b>EQUIPMENT LIST .....</b>                                      | <b>3</b>  |
| <b>2</b> | <b>MEASUREMENT UNCERTAINTY (95% CONFIDENCE LEVELS, K=2).....</b> | <b>3</b>  |
| <b>3</b> | <b>AC POWER LINE CONDUCTED EMISSIONS .....</b>                   | <b>4</b>  |
| <b>4</b> | <b>DUTY CYCLE .....</b>                                          | <b>6</b>  |
|          | 4.1 Test Results .....                                           | 6         |
|          | 4.2 Test Plots.....                                              | 6         |
| <b>5</b> | <b>CONDUCTED OUTPUT POWER.....</b>                               | <b>7</b>  |
|          | 5.1 Test Results .....                                           | 7         |
|          | 5.2 Test plots:.....                                             | 8         |
| <b>6</b> | <b>DTS (6 DB) BANDWIDTH &amp; 99% OCCUPIED BANDWIDTH.....</b>    | <b>10</b> |
|          | 6.1 Test Results .....                                           | 10        |
|          | 6.2 Test plots.....                                              | 11        |
| <b>7</b> | <b>POWER SPECTRAL DENSITY .....</b>                              | <b>14</b> |
|          | 7.1 Test Results .....                                           | 14        |
|          | 7.2 Test plots.....                                              | 15        |
| <b>8</b> | <b>BAND-EDGE FOR RF CONDUCTED EMISSIONS.....</b>                 | <b>17</b> |
|          | 8.1 Test plots.....                                              | 17        |
| <b>9</b> | <b>SPURIOUS RF CONDUCTED EMISSIONS.....</b>                      | <b>18</b> |
|          | 9.1 Test plots:.....                                             | 18        |

## 1 Equipment List

| Conducted Emission   |                                    |                  |               |              |              |
|----------------------|------------------------------------|------------------|---------------|--------------|--------------|
| Test Equipment       | Manufacturer                       | Model No.        | Inventory No. | Cal. date    | Cal.Duedate  |
|                      |                                    |                  |               | (yyyy-mm-dd) | (yyyy-mm-dd) |
| Shielding Room       | ZhongYu Electron                   | GB-88            | SEM001-06     | 2017/5/10    | 2020/5/9     |
| LISN                 | Rohde & Schwarz                    | ENV216           | SEM007-01     | 2018/9/2     | 2019/9/2     |
| LISN                 | ETS-LINDGREN                       | Feb-16           | SEM007-02     | 2019/4/1     | 2020/3/31    |
| Measurement Software | AUDIX                              | e3 V5.4.1221d    | N/A           | N/A          | N/A          |
| Coaxial Cable        | SGS                                | N/A              | SEM024-01     | 2019/6/12    | 2020/6/11    |
| 2 Line ISN           | Fischer Custom Communications Inc. | FCC-TLISN-T2-02  | EMC0122       | 2019/2/11    | 2020/2/10    |
| EMI Test Receiver    | Rohde & Schwarz                    | ESCI             | SEM004-02     | 2019/3/2     | 2020/3/1     |
| RF conducted test    |                                    |                  |               |              |              |
| Test Equipment       | Manufacturer                       | Model No.        | Inventory No. | Cal. date    | Cal.Duedate  |
|                      |                                    |                  |               | (yyyy-mm-dd) | (yyyy-mm-dd) |
| DC Power Supply      | Agilent Technologies Inc           | 66311B           | W009-09       | 2018/9/15    | 2019/9/15    |
| Signal Analyzer      | Rohde & Schwarz                    | FSV              | W025-05       | 2019/1/13    | 2020/1/12    |
| Coaxial Cable        | SGS                                | N/A              | SEM031-01     | 2019/6/12    | 2020/6/11    |
| Attenuator           | Weinschel Associates               | WA41             | SEM021-09     | N/A          | N/A          |
| Signal Generator     | KEYSIGHT                           | N5173B           | SEM006-05     | 2018/9/2     | 2019/9/2     |
| Temperature Chamber  | GIANT FORCE                        | ICT-150-40-CP-AR | W027-03       | 2018/11/27   | 2019/11/27   |
| Power Meter          | Rohde & Schwarz                    | NRVS             | SEM014-02     | 2018/9/2     | 2019/9/2     |

## 2 Measurement Uncertainty (95% confidence levels, k=2)

| No. | Item                          | Measurement Uncertainty |
|-----|-------------------------------|-------------------------|
| 1   | Total RF power, conducted     | ±0.75dB                 |
| 2   | RF power density, conducted   | ±2.84dB                 |
| 3   | Spurious emissions, conducted | ±0.75dB                 |
| 4   | Conduct emission test         | ±3.12 dB (9KHz- 30MHz)  |

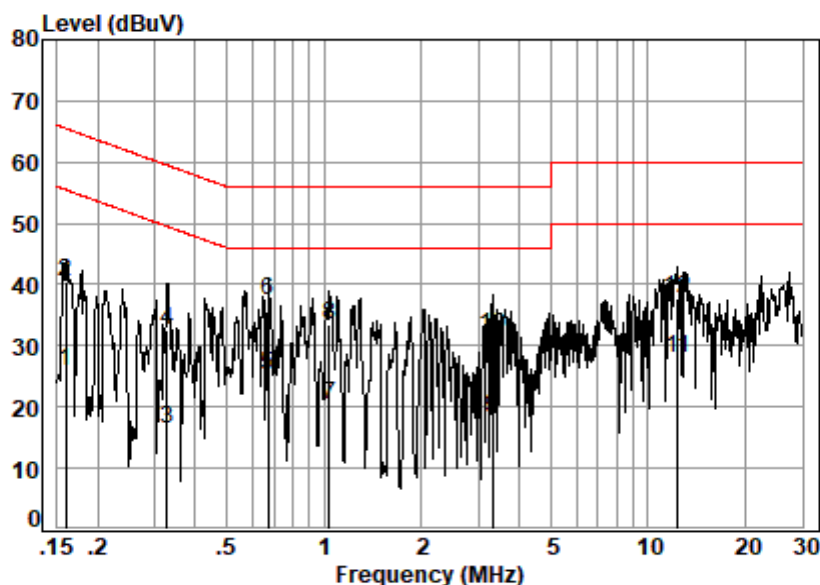
### 3 AC Power Line Conducted Emissions

#### Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

Live line:



Site : Shielding Room

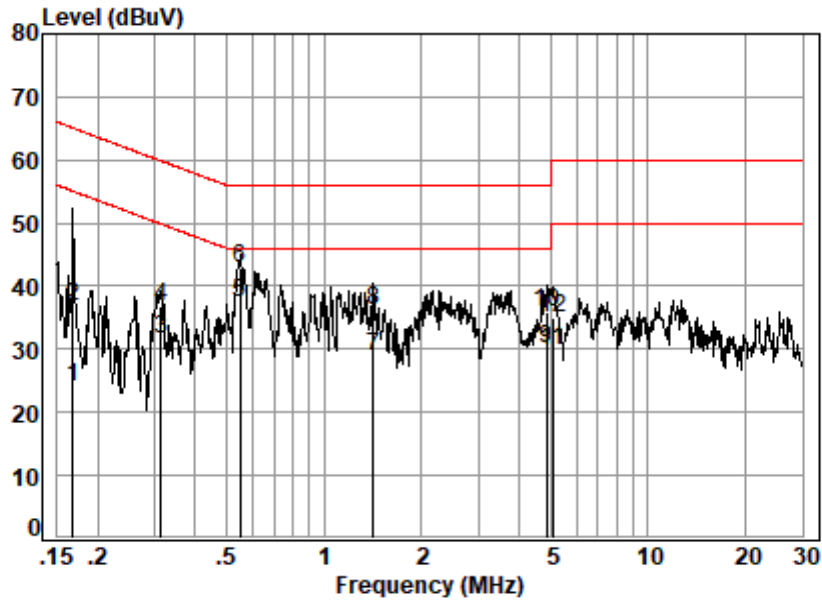
Condition: Line

Job No. : 16957CR

Test mode: c

|    | Freq    | Cable Loss | LISN Factor | Read Level | Level | Limit Line | Over Limit | Remark  |
|----|---------|------------|-------------|------------|-------|------------|------------|---------|
|    | MHz     | dB         | dB          | dBuV       | dBuV  | dBuV       | dB         |         |
| 1  | 0.1598  | 0.01       | 9.66        | 16.33      | 26.00 | 55.47      | -29.47     | Average |
| 2  | 0.1598  | 0.01       | 9.66        | 30.66      | 40.33 | 65.47      | -25.14     | QP      |
| 3  | 0.3268  | 0.04       | 9.67        | 6.72       | 16.43 | 49.53      | -33.10     | Average |
| 4  | 0.3268  | 0.04       | 9.67        | 22.95      | 32.66 | 59.53      | -26.87     | QP      |
| 5  | 0.6719  | 0.07       | 9.68        | 15.56      | 25.31 | 46.00      | -20.69     | Average |
| 6  | 0.6719  | 0.07       | 9.68        | 27.77      | 37.52 | 56.00      | -18.48     | QP      |
| 7  | 1.0375  | 0.09       | 9.74        | 10.41      | 20.24 | 46.00      | -25.76     | Average |
| 8  | 1.0375  | 0.09       | 9.74        | 23.49      | 33.32 | 56.00      | -22.68     | QP      |
| 9  | 3.3105  | 0.16       | 9.71        | 8.51       | 18.38 | 46.00      | -27.62     | Average |
| 10 | 3.3105  | 0.16       | 9.71        | 21.65      | 31.52 | 56.00      | -24.48     | QP      |
| 11 | 12.3837 | 0.19       | 10.11       | 17.77      | 28.07 | 50.00      | -21.93     | Average |
| 12 | 12.3837 | 0.19       | 10.11       | 27.52      | 37.82 | 60.00      | -22.18     | QP      |

Neutral line:

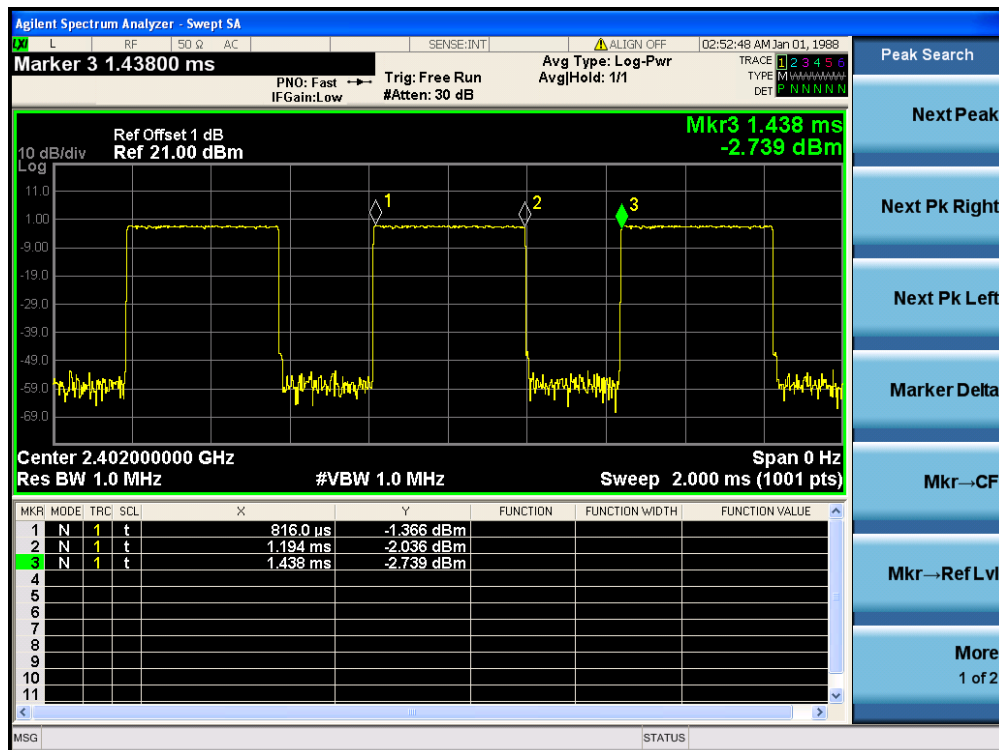


Site : Shielding Room  
Condition: Neutral  
Job No. : 16957CR  
Test mode: c

|    | Freq   | Cable Loss | LISN Factor | Read Level | Level | Limit Line | Over Limit | Remark  |
|----|--------|------------|-------------|------------|-------|------------|------------|---------|
|    | MHz    | dB         | dB          | dBuV       | dBuV  | dBuV       | dB         |         |
| 1  | 0.1677 | 0.01       | 9.64        | 14.24      | 23.89 | 55.08      | -31.19     | Average |
| 2  | 0.1677 | 0.01       | 9.64        | 27.05      | 36.70 | 65.08      | -28.38     | QP      |
| 3  | 0.3133 | 0.04       | 9.64        | 22.03      | 31.71 | 49.88      | -18.17     | Average |
| 4  | 0.3133 | 0.04       | 9.64        | 27.12      | 36.80 | 59.88      | -23.08     | QP      |
| 5  | 0.5523 | 0.06       | 9.64        | 27.58      | 37.28 | 46.00      | -8.72      | Average |
| 6  | 0.5523 | 0.06       | 9.64        | 33.16      | 42.86 | 56.00      | -13.14     | QP      |
| 7  | 1.4182 | 0.12       | 9.70        | 19.12      | 28.94 | 46.00      | -17.06     | Average |
| 8  | 1.4182 | 0.12       | 9.70        | 26.32      | 36.14 | 56.00      | -19.86     | QP      |
| 9  | 4.8738 | 0.17       | 9.71        | 20.22      | 30.10 | 46.00      | -15.90     | Average |
| 10 | 4.8738 | 0.17       | 9.71        | 25.92      | 35.80 | 56.00      | -20.20     | QP      |
| 11 | 5.0580 | 0.17       | 9.71        | 19.93      | 29.81 | 50.00      | -20.19     | Average |
| 12 | 5.0580 | 0.17       | 9.71        | 25.15      | 35.03 | 60.00      | -24.97     | QP      |

Remarks:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.



# 5 Conducted Output Power

## 5.1 Test Results

Measurement Data of Peak Power :

| GFSK mode    |                         |             |        |
|--------------|-------------------------|-------------|--------|
| Test channel | Peak Output Power (dBm) | Limit (dBm) | Result |
| Lowest       | 4.58                    | 30.00       | Pass   |
| Middle       | 5.21                    | 30.00       | Pass   |
| Highest      | 4.45                    | 30.00       | Pass   |

## 5.2 Test plots:

### GFSK\_Lowest Channel



### GFSK\_Middle Channel



GFSK\_Highest Channel



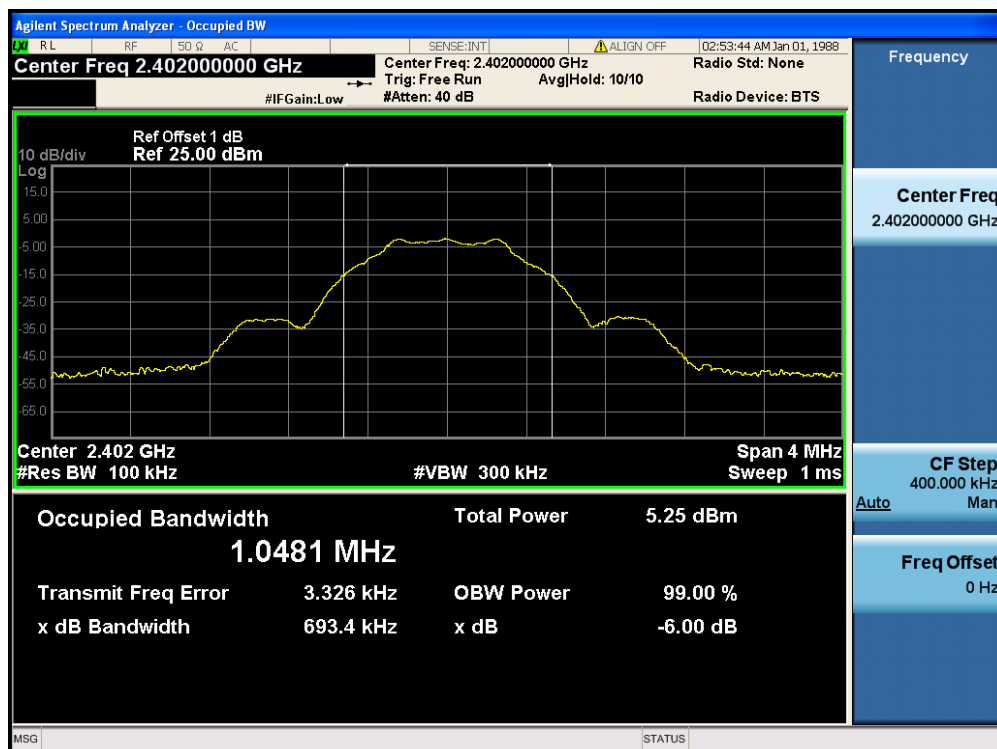
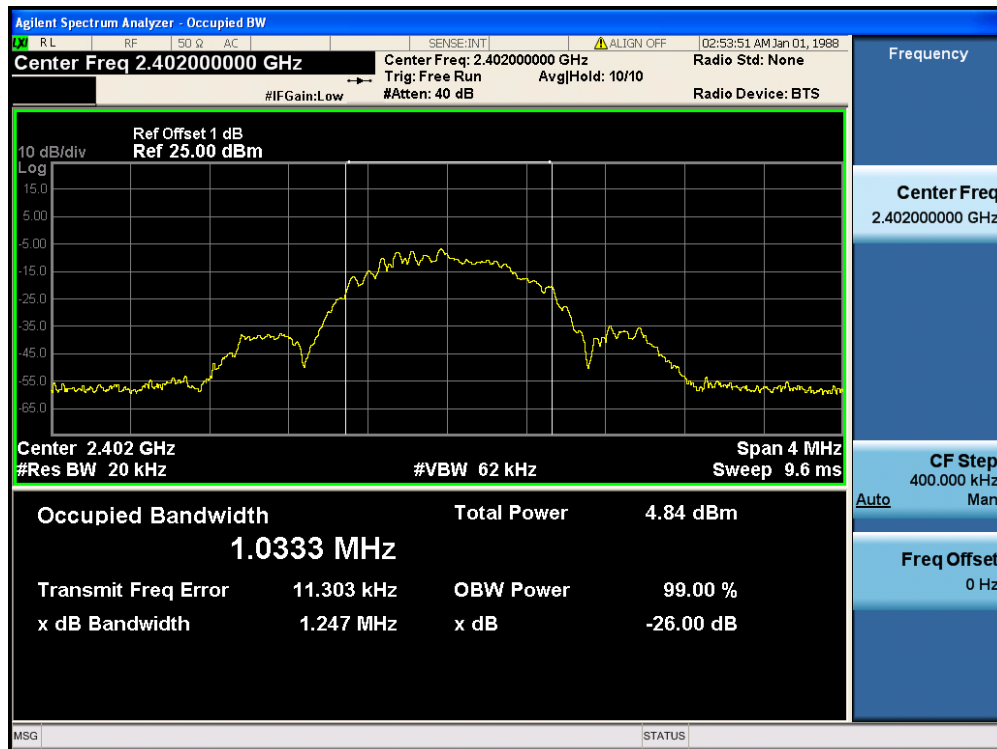
## 6 DTS (6 dB) Bandwidth & 99% Occupied Bandwidth

### 6.1 Test Results

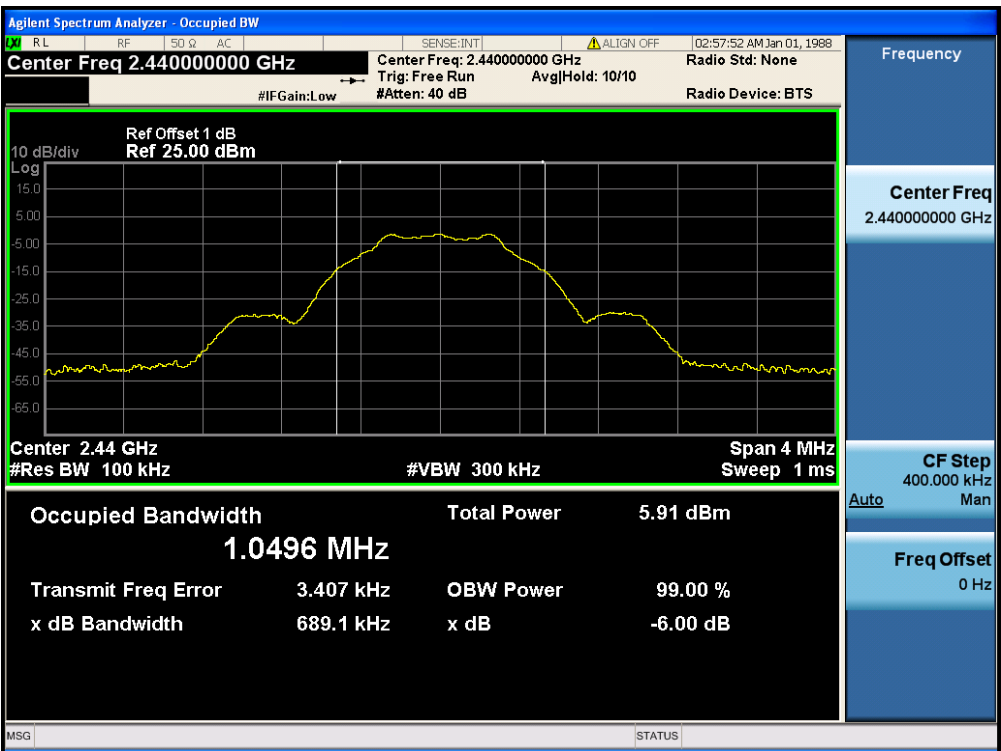
| Mode | Test Channel | 99% Occupied Bandwidth (MHz) | 6dB Emission Bandwidth (MHz) | Limit (kHz) | Result |
|------|--------------|------------------------------|------------------------------|-------------|--------|
| GFSK | Lowest       | 4.84                         | 5.25                         | ≥500        | Pass   |
|      | Middle       | 5.46                         | 5.91                         | ≥500        | Pass   |
|      | Highest      | 4.72                         | 5.12                         | ≥500        | Pass   |

## 6.2 Test plots

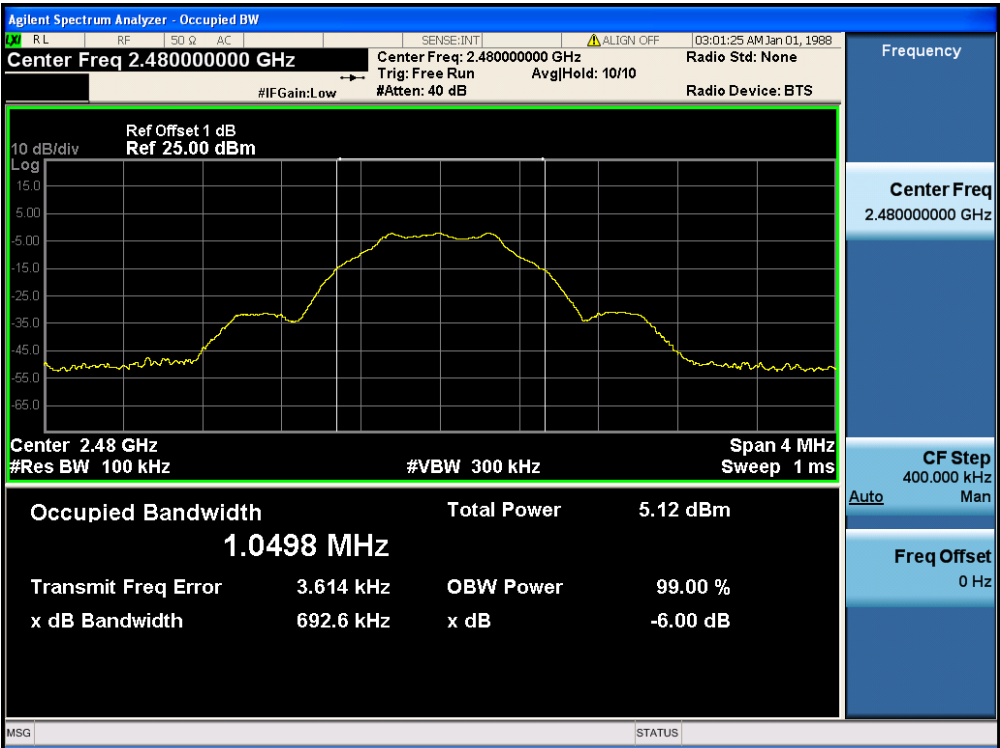
### GFSK\_Lowest Channel



GFSK\_Middle Channel



GFSK\_Highest Channel



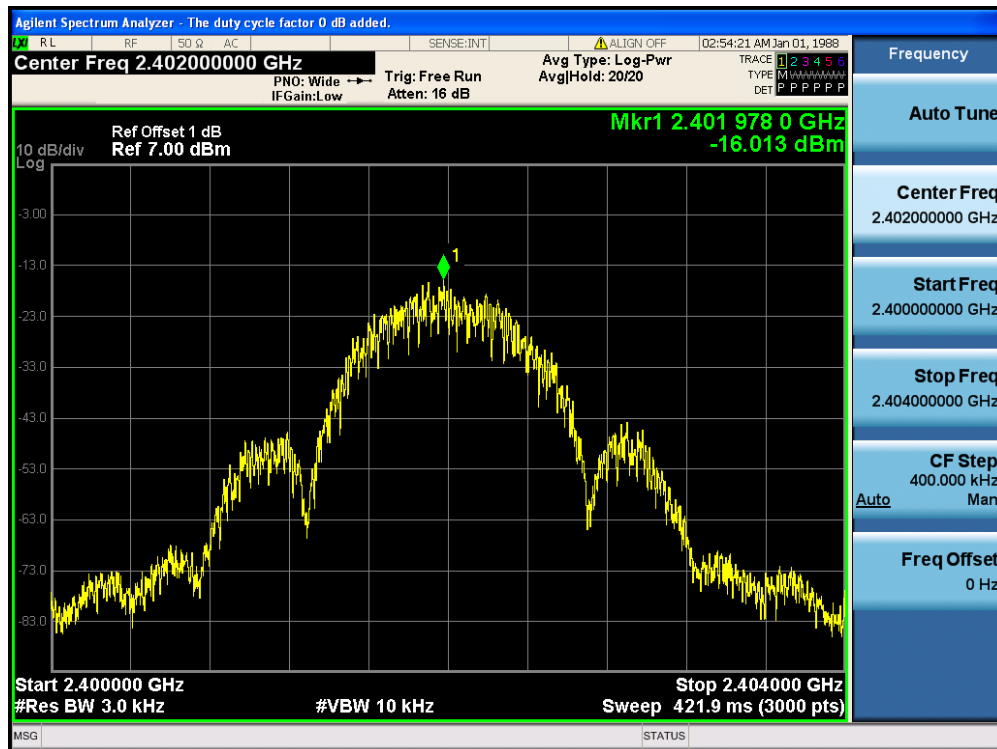
# 7 Power Spectral Density

## 7.1 Test Results

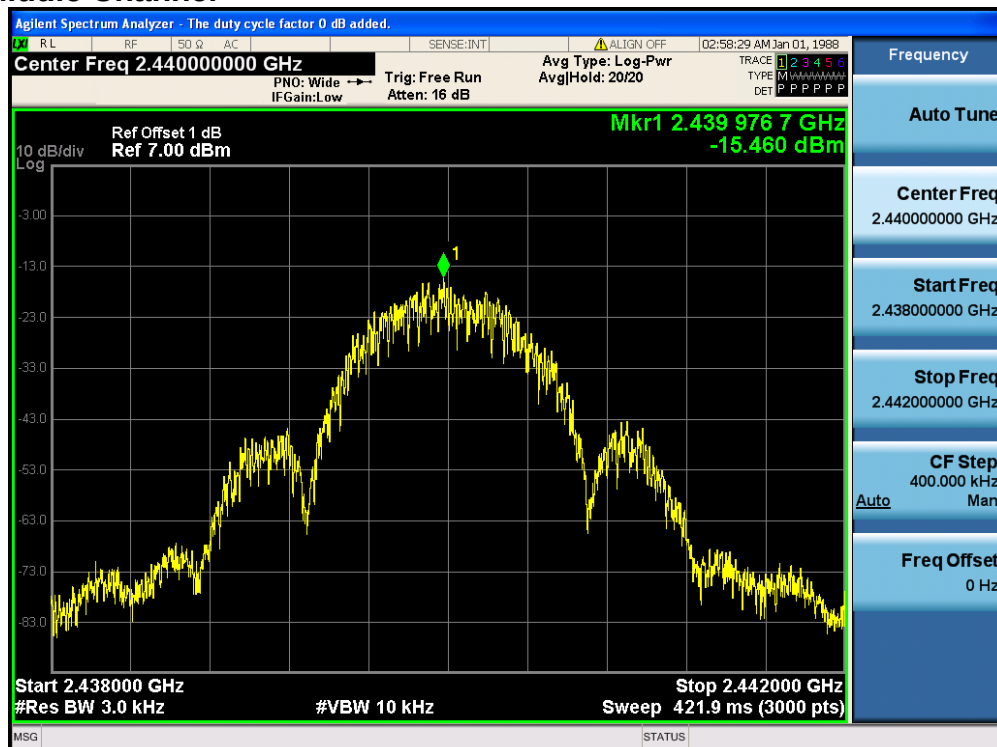
| Mode | Test Channel | Power Spectral Density (dBm/3kHz) | Limit (dBm/3kHz) | Result |
|------|--------------|-----------------------------------|------------------|--------|
| GFSK | Lowest       | -16.01                            | ≤8.00            | Pass   |
|      | Middle       | -15.46                            | ≤8.00            | Pass   |
|      | Highest      | -16.14                            | ≤8.00            | Pass   |

## 7.2 Test plots

### GFSK\_Lowest Channel



### GFSK\_Middle Channel



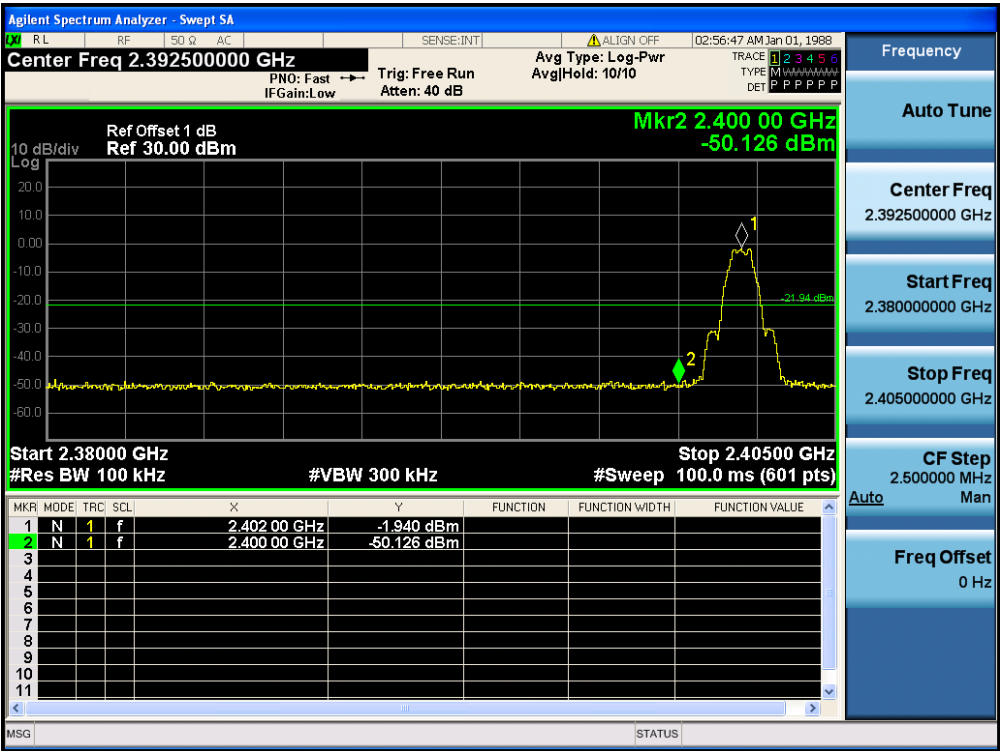
GFSK\_Highest Channel



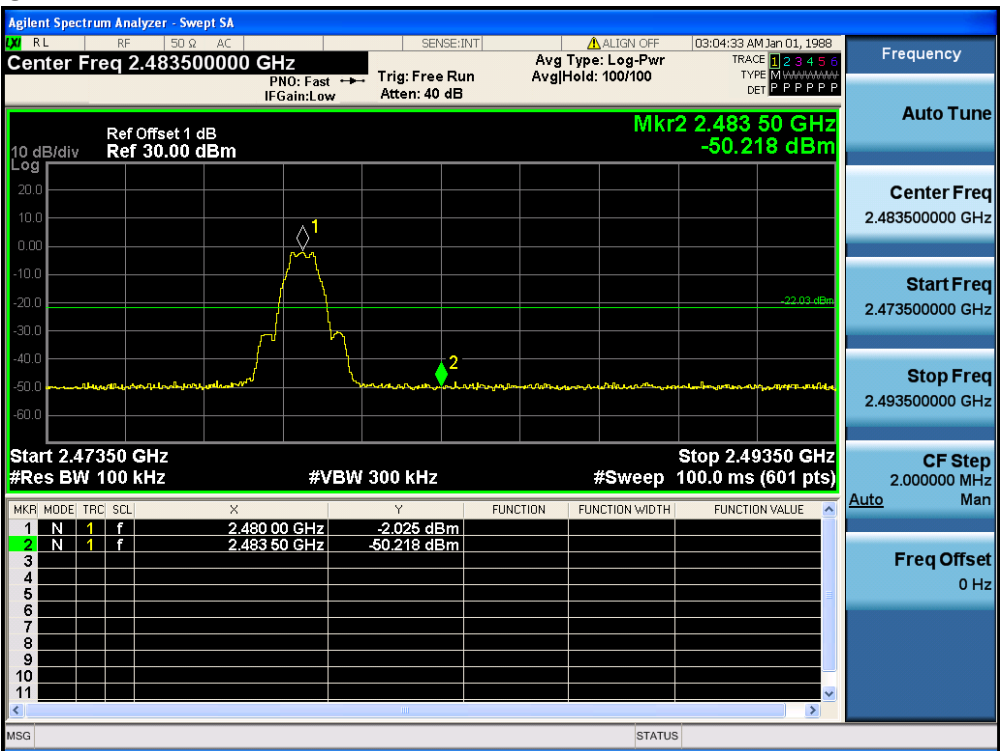
# 8 Band-edge for RF Conducted Emissions

## 8.1 Test plots

### GFSK \_Lowest Channel



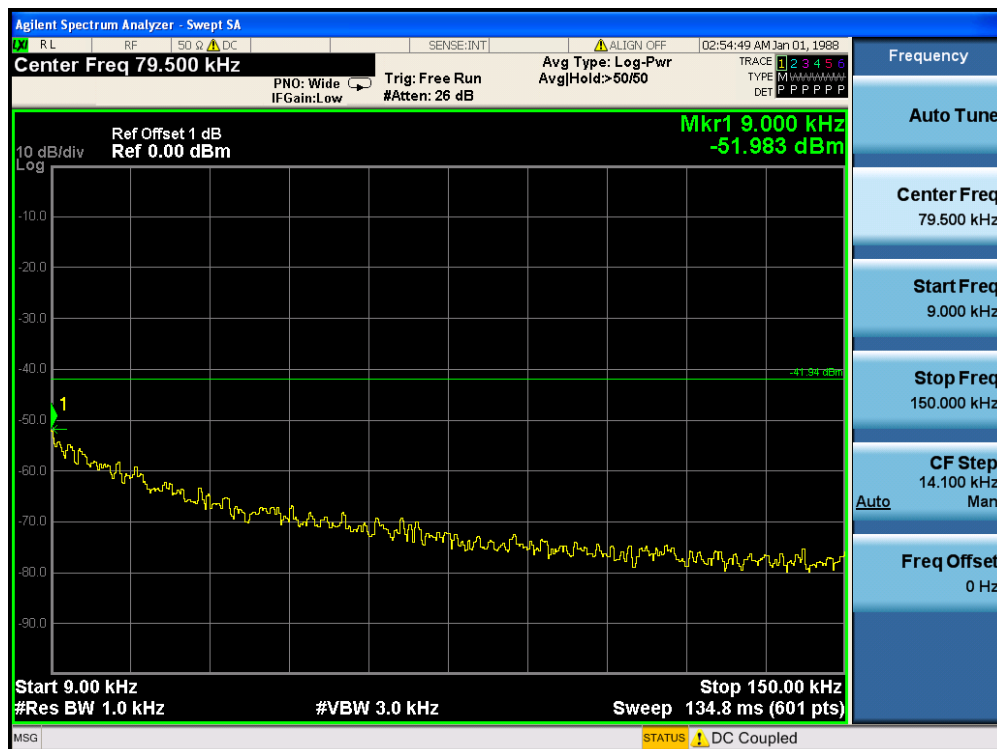
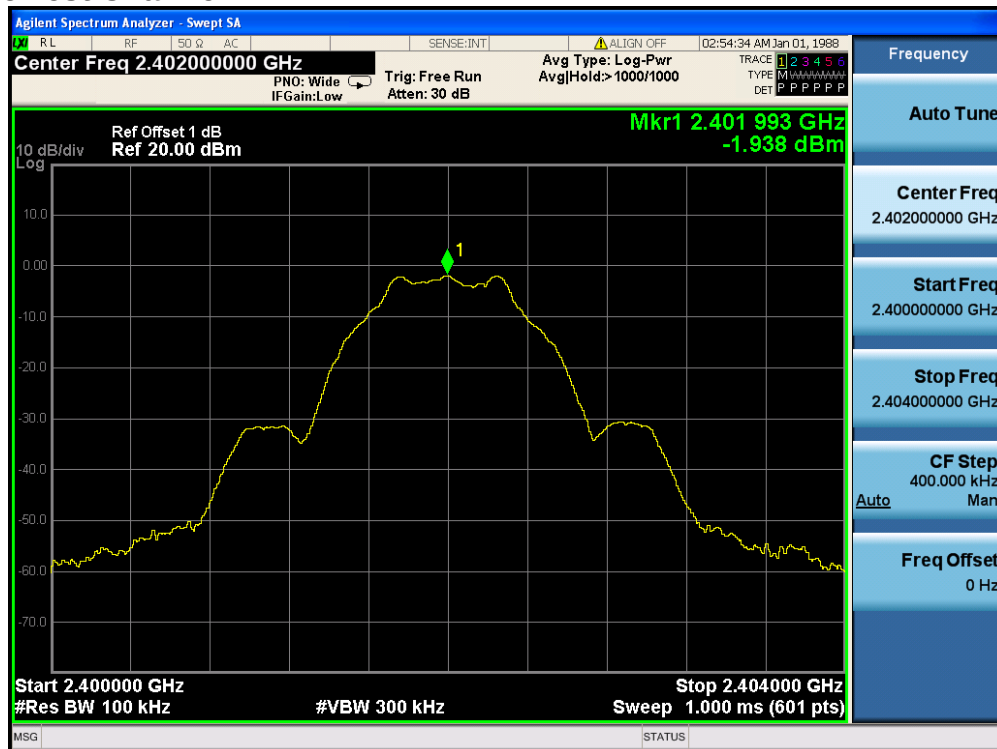
### GFSK \_Highest Channel

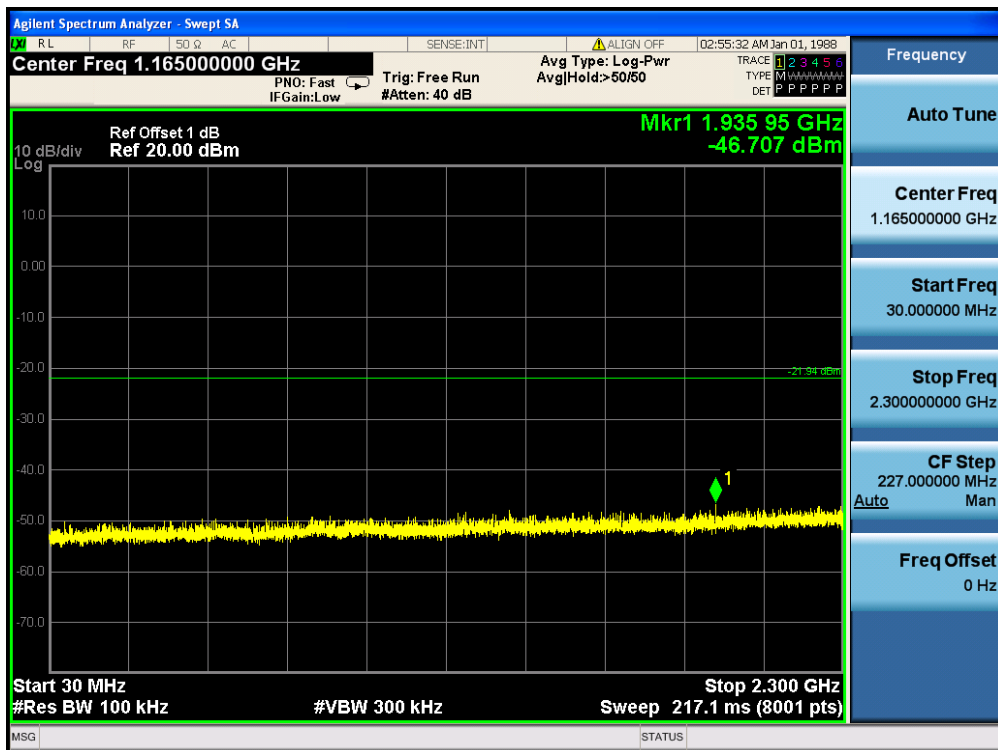
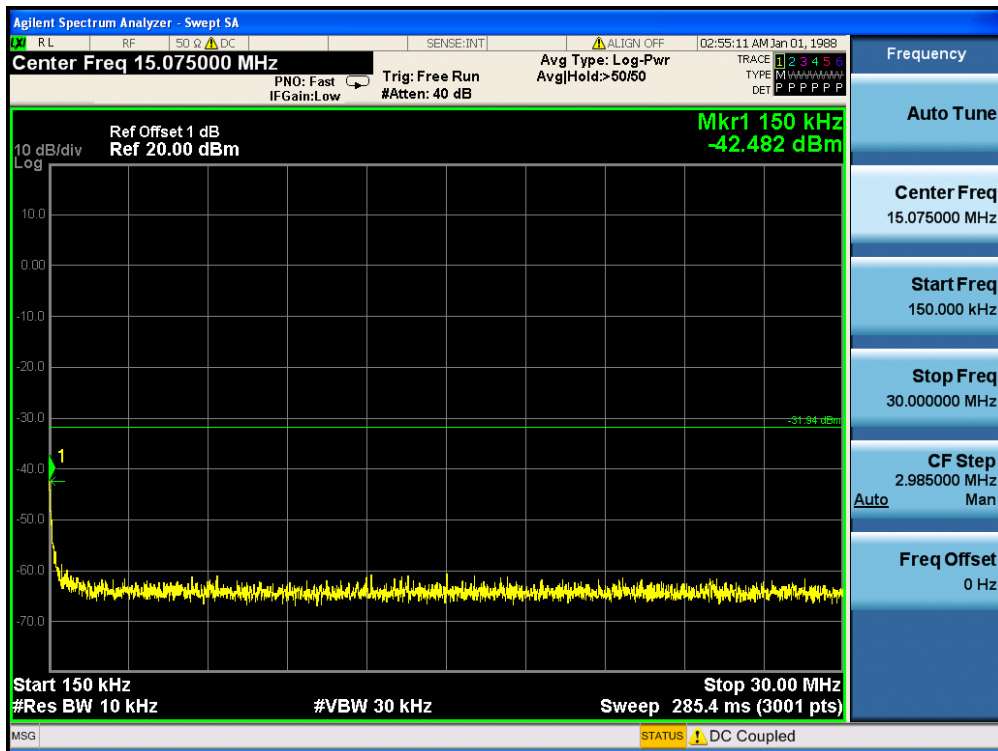


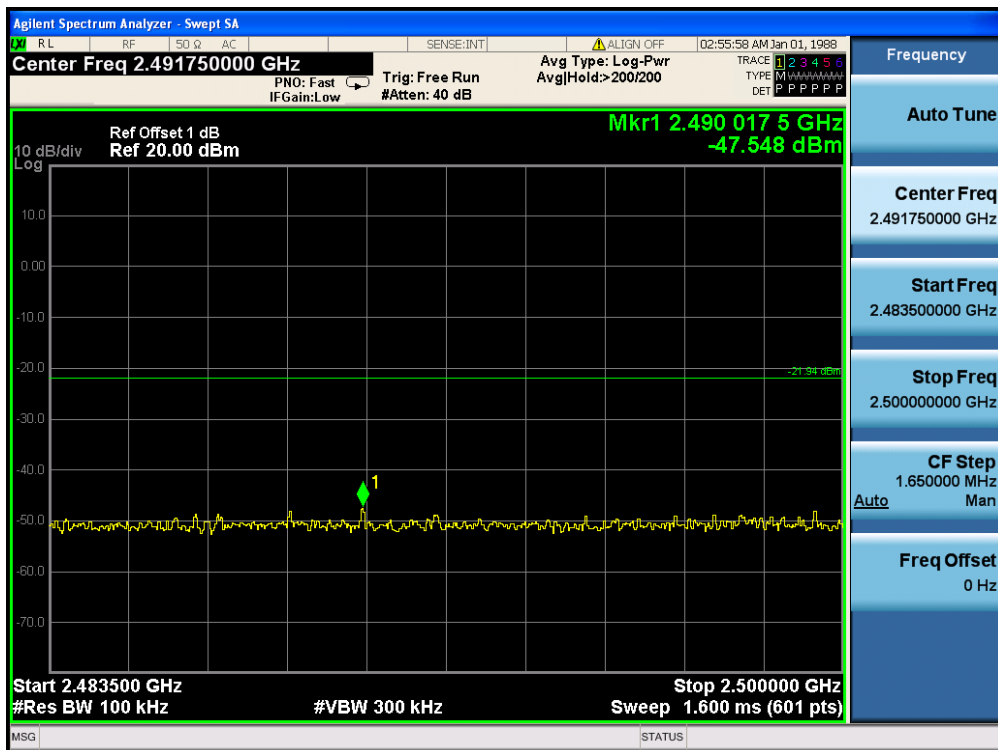
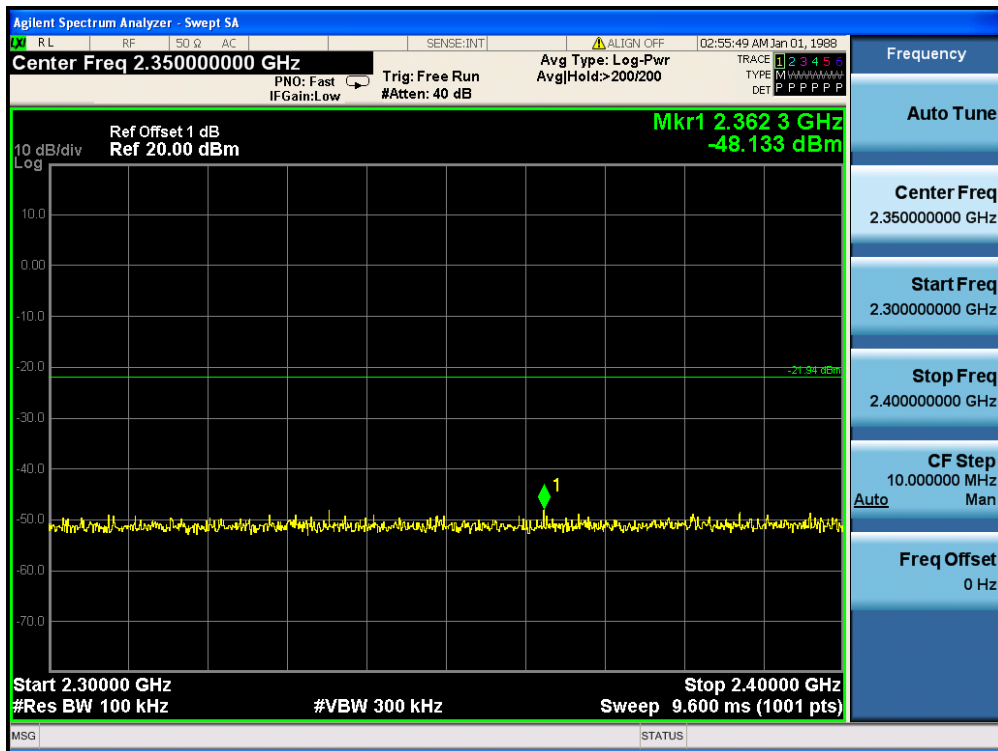
## 9 Spurious RF Conducted Emissions

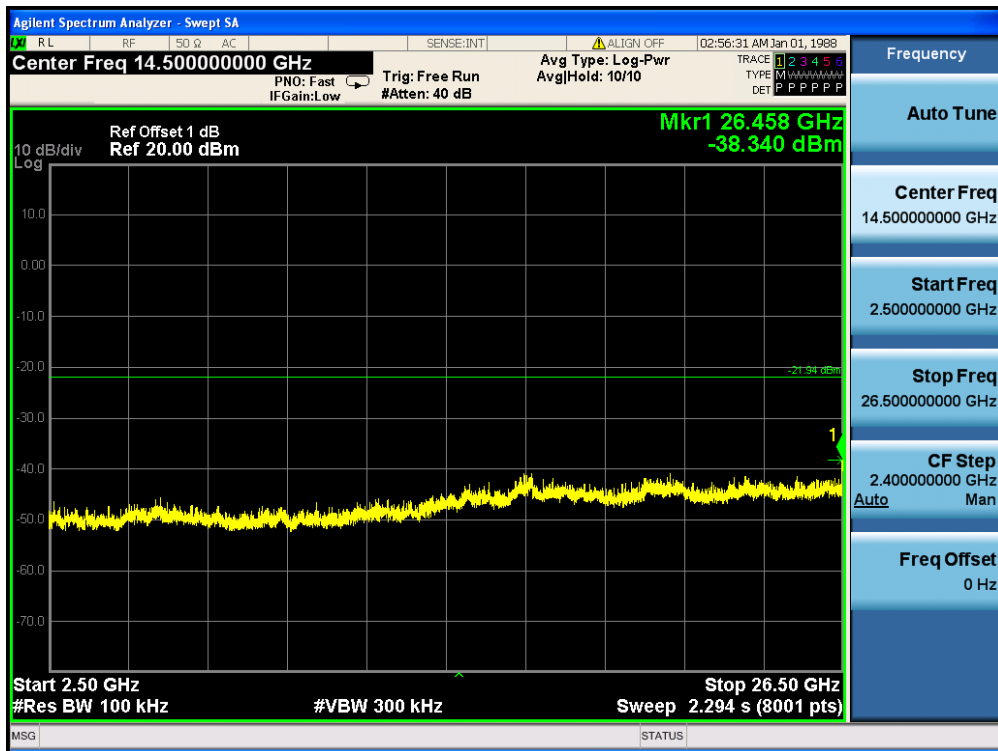
### 9.1 Test plots:

#### GFSK\_Lowest Channel



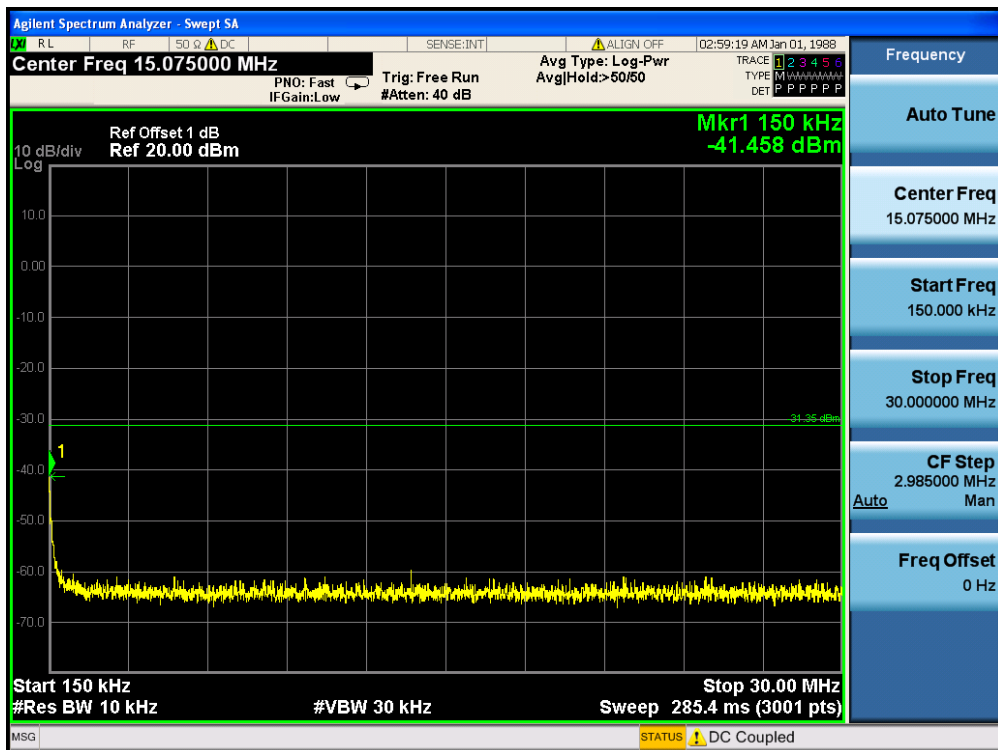
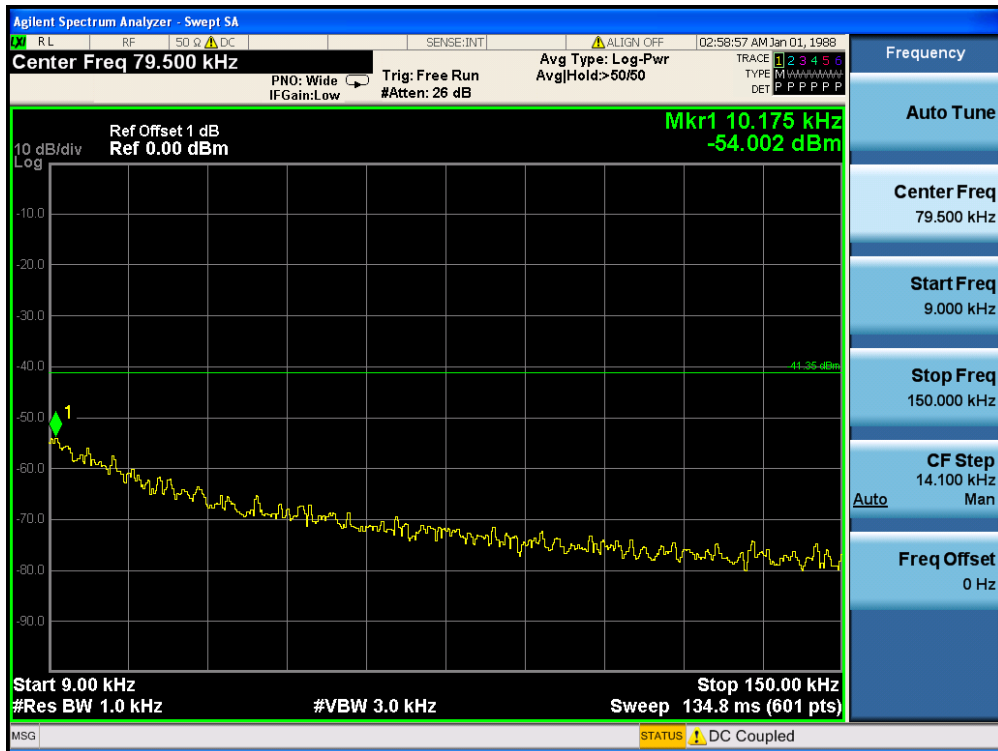


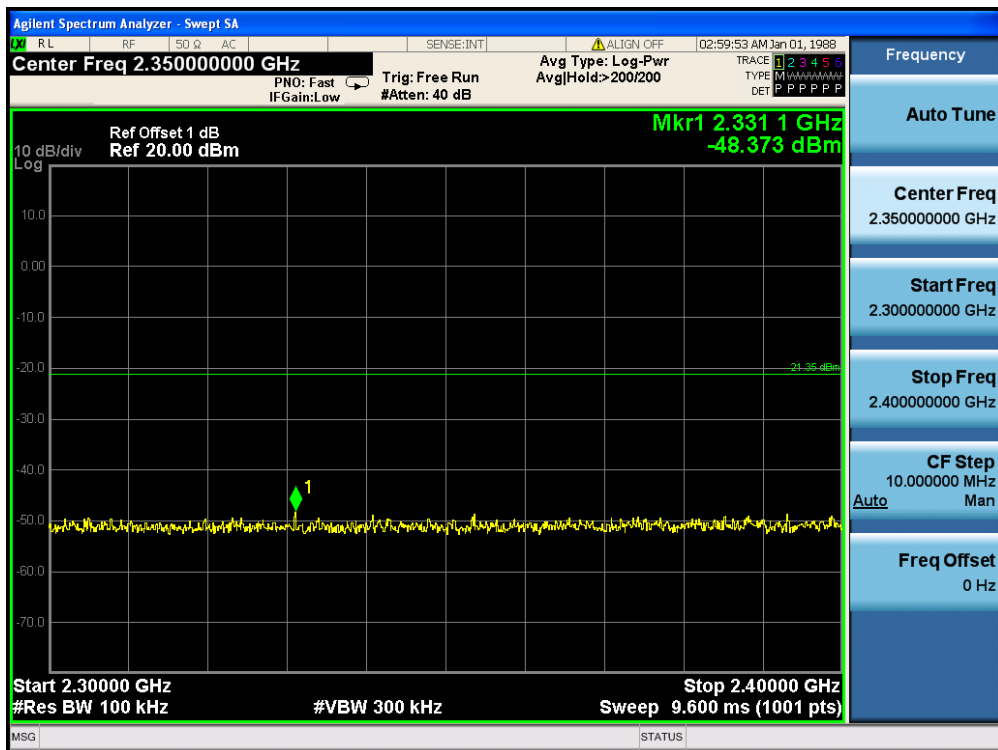
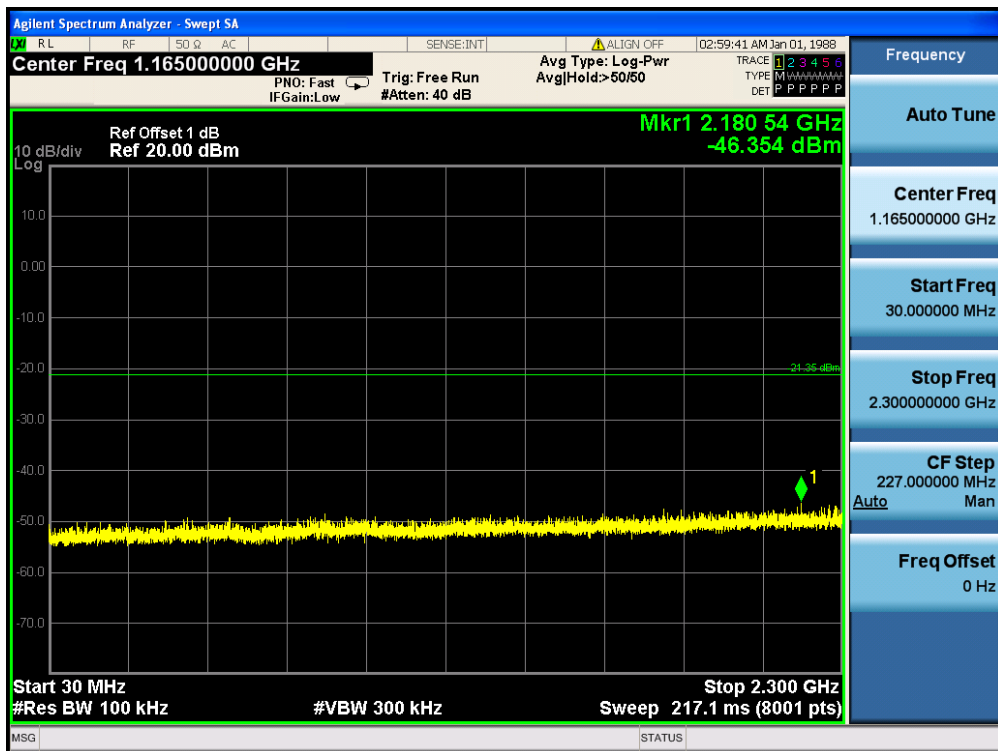


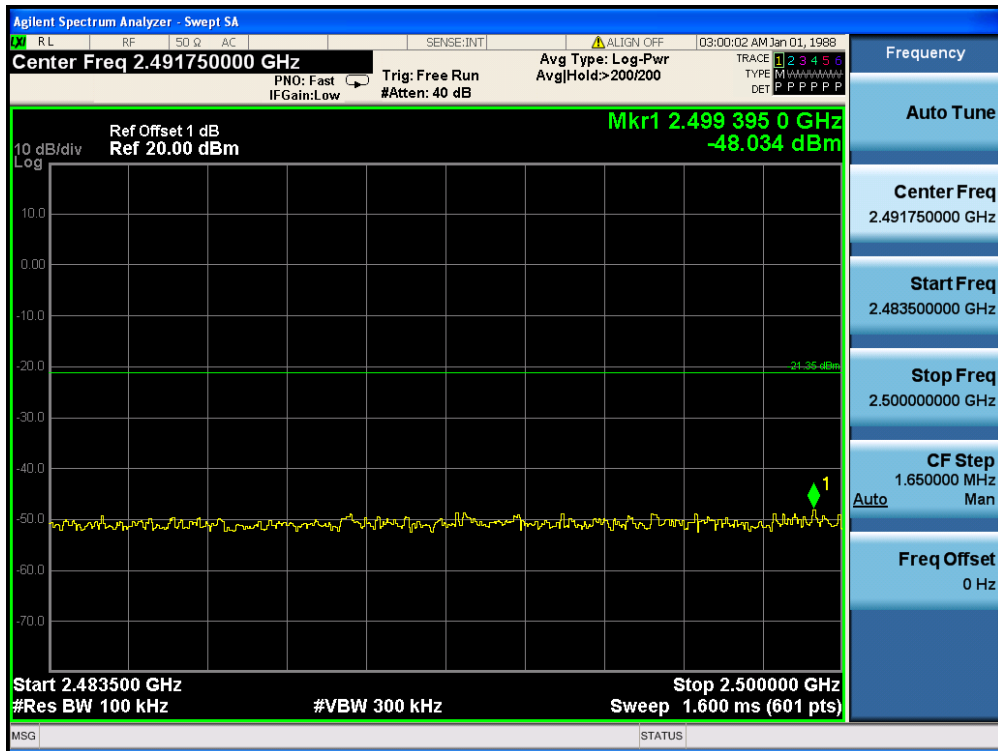


## GFSK\_Middle Channel



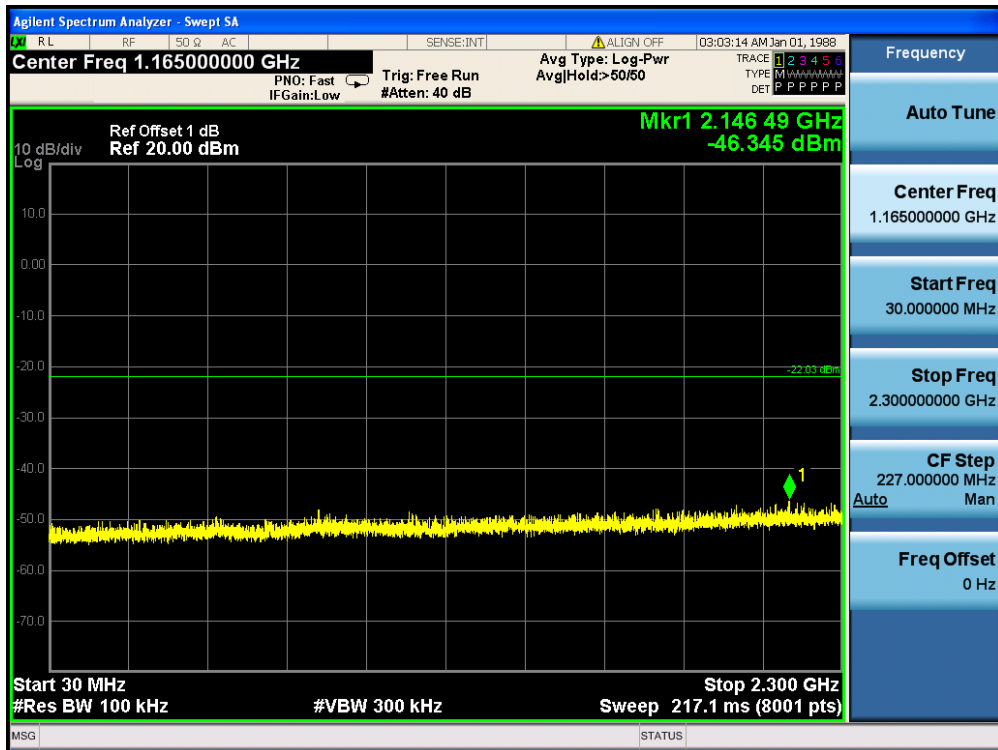
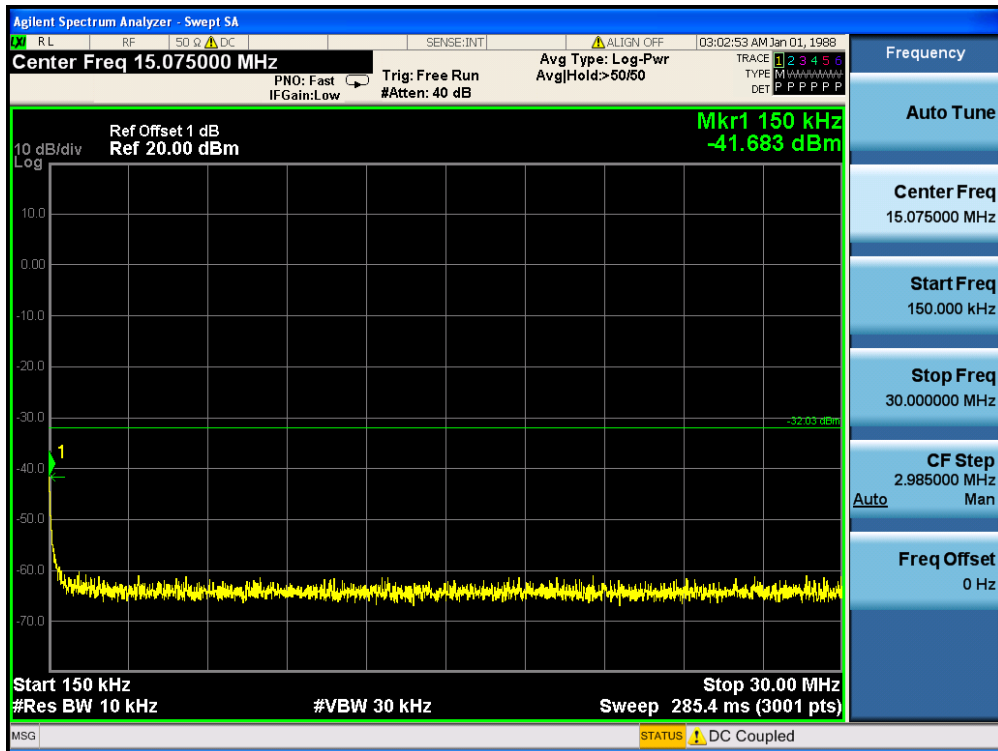


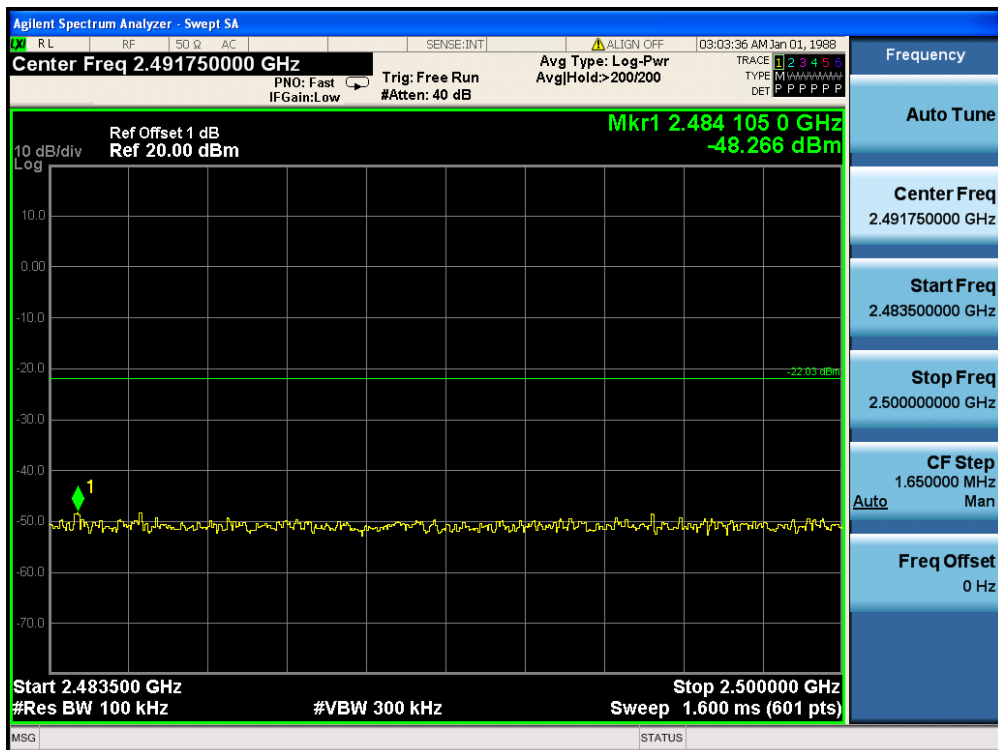
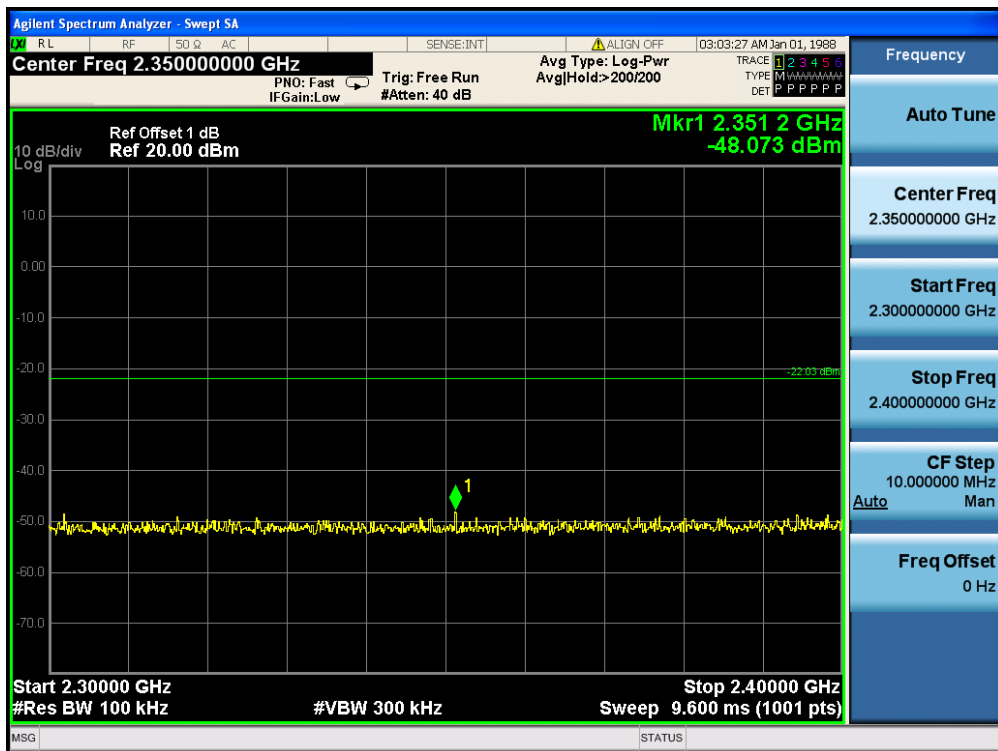


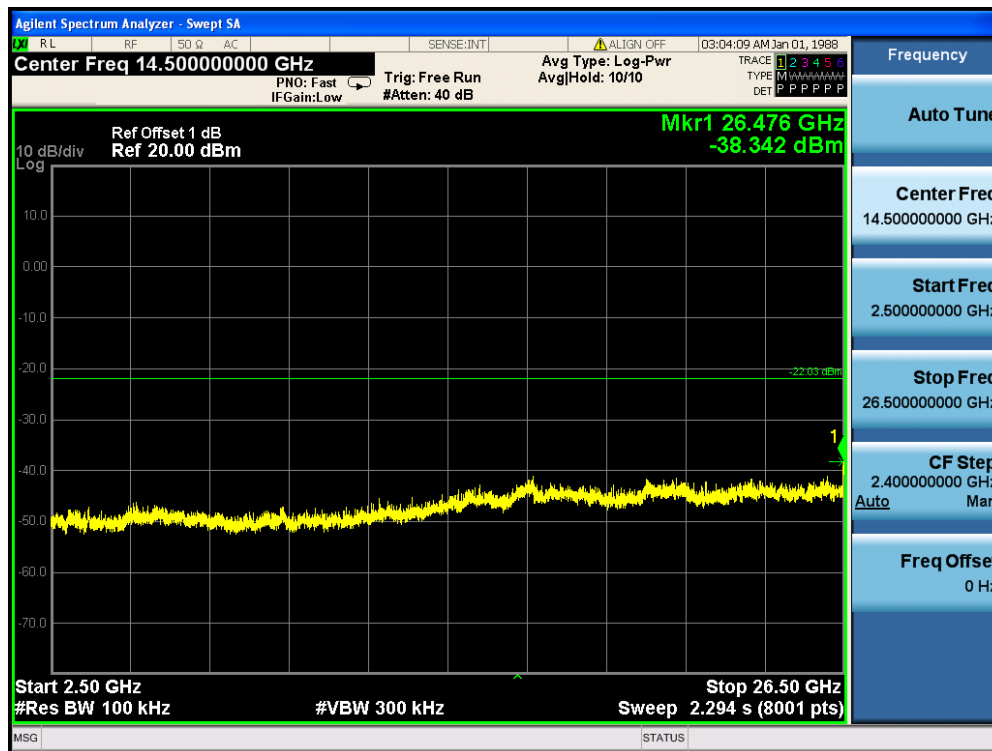


GFSK\_Highest Channel









Remark:

Scan from 9kHz to 25GHz, the disturbance between 9KHz to 30MHz was very low, and the above harmonics were the highest point could be found when testing, The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

The End