

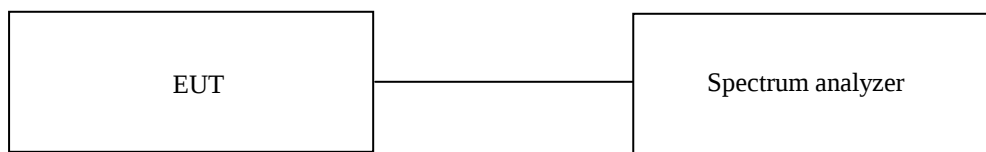
## 9. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

### 9.1 Operating environment

Temperature : 24.3 °C  
Relative humidity : 43.9 % R.H.

### 9.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz, the video bandwidth is set to 3 times the resolution bandwidth and peak detection was used.



### 9.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 3 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

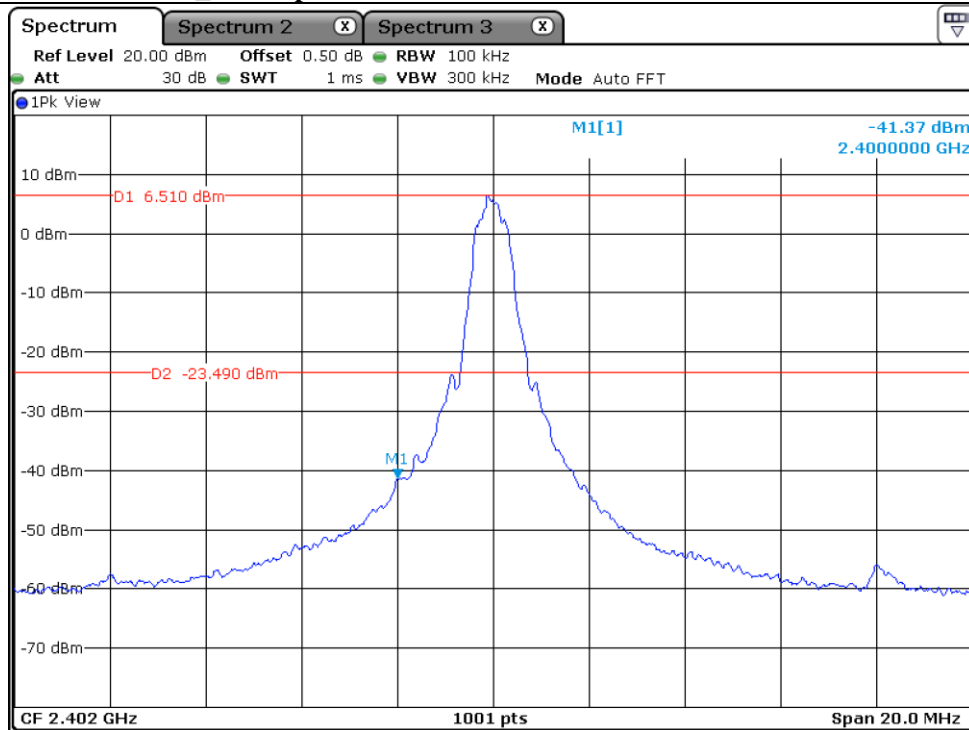
### 9.4 Test equipment used

|     | Model Number | Manufacturer      | Description              | Serial Number | Last Cal.          |
|-----|--------------|-------------------|--------------------------|---------------|--------------------|
| ■ - | FSV40        | Rohde & Schwarz   | Signal Analyzer          | 101009        | Mar. 11, 2019 (1Y) |
| ■ - | ESU          | Rohde & Schwarz   | EMI Test Receiver        | 100261        | Mar. 28, 2019 (1Y) |
| ■ - | 310N         | Sonoma Instrument | Pre-Amplifier            | 312545        | Mar. 18, 2019 (1Y) |
| ■ - | BBV9718      | Schwarzbeck       | Amplifier                | 310           | Mar. 28, 2019 (1Y) |
| ■   | SCU40A       | Rohde & Schwarz   | Signal Conditioning unit | 100436        | Mar. 11, 2019 (1Y) |
| ■ - | DT3000-3t    | Innco System      | Turn Table               | DT3000/093    | N/A                |
| ■ - | MA-4000XPET  | Innco System      | Antenna Master           | MA4000/509    | N/A                |
| ■ - | VULB9163     | Schwarzbeck       | TRILOG Broadband Antenna | 777           | Apr. 13, 2018 (2Y) |
| ■ - | BBHA 9120D   | Schwarzbeck       | Horn Antenna             | 9120D-1366    | Aug. 02, 2017 (2Y) |
| ■ - | BBHA 9170    | Schwarzbeck       | Horn Antenna             | BBHA9170179   | Jan. 16, 2019 (1Y) |

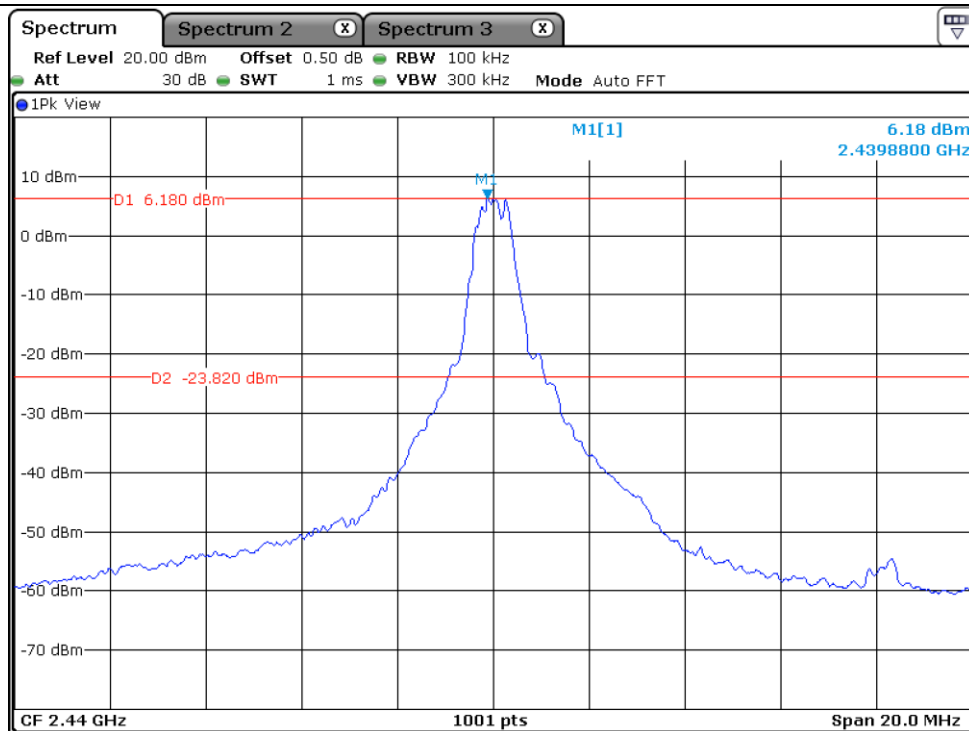
All test equipment used is calibrated on a regular basis.

## 9.5 Test data for conducted emission

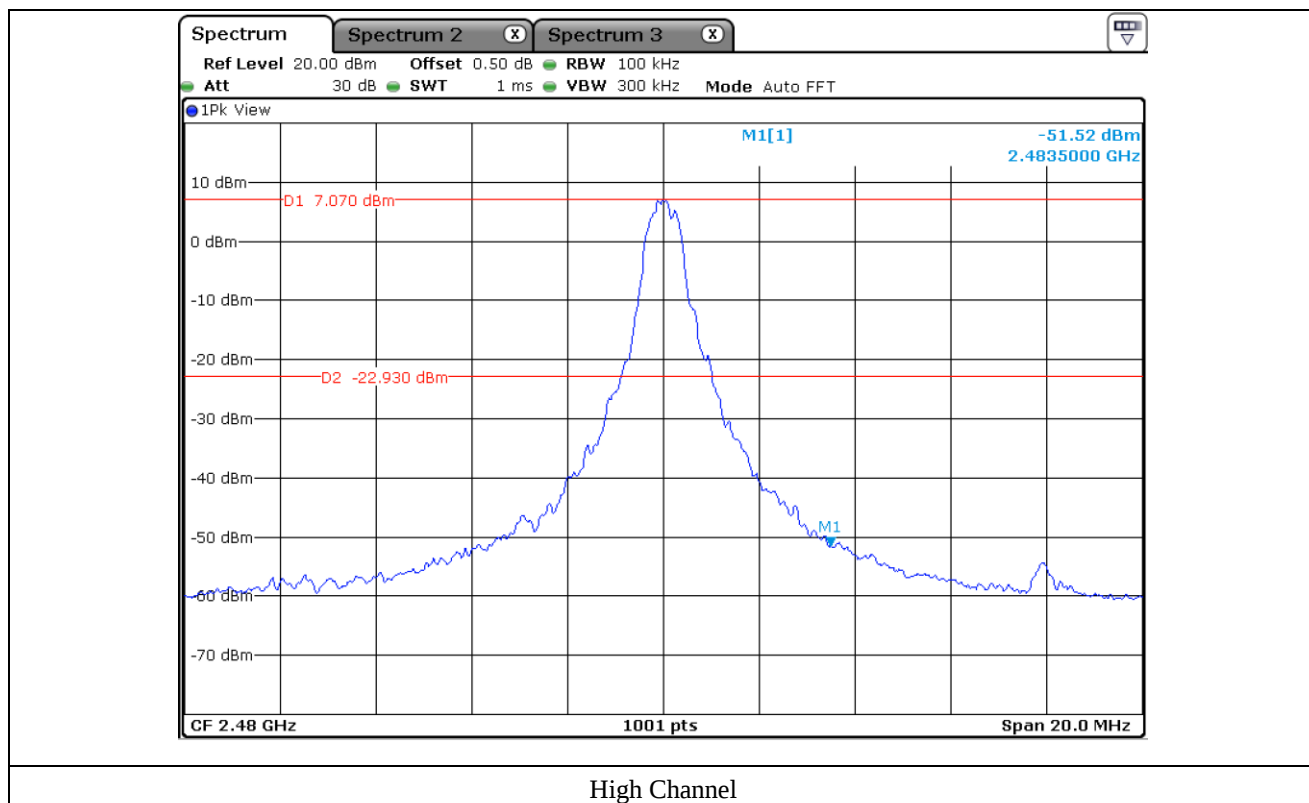
### 9.6.1 Test data for LE Coded\_125 kbps

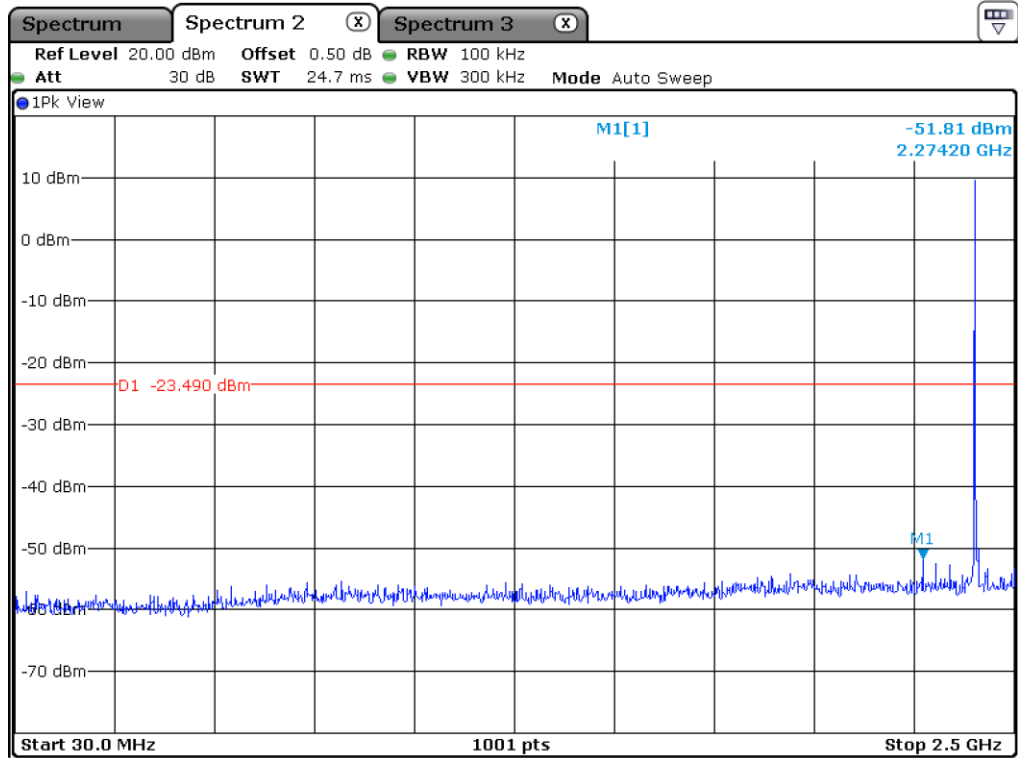


Low Channel

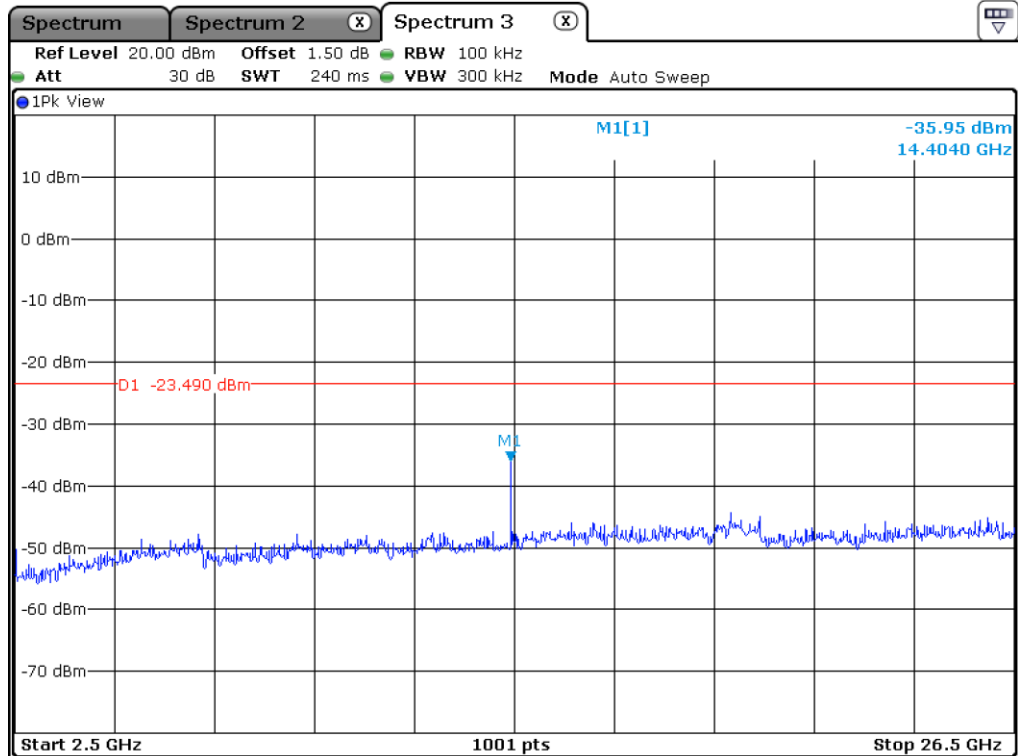


Middle Channel

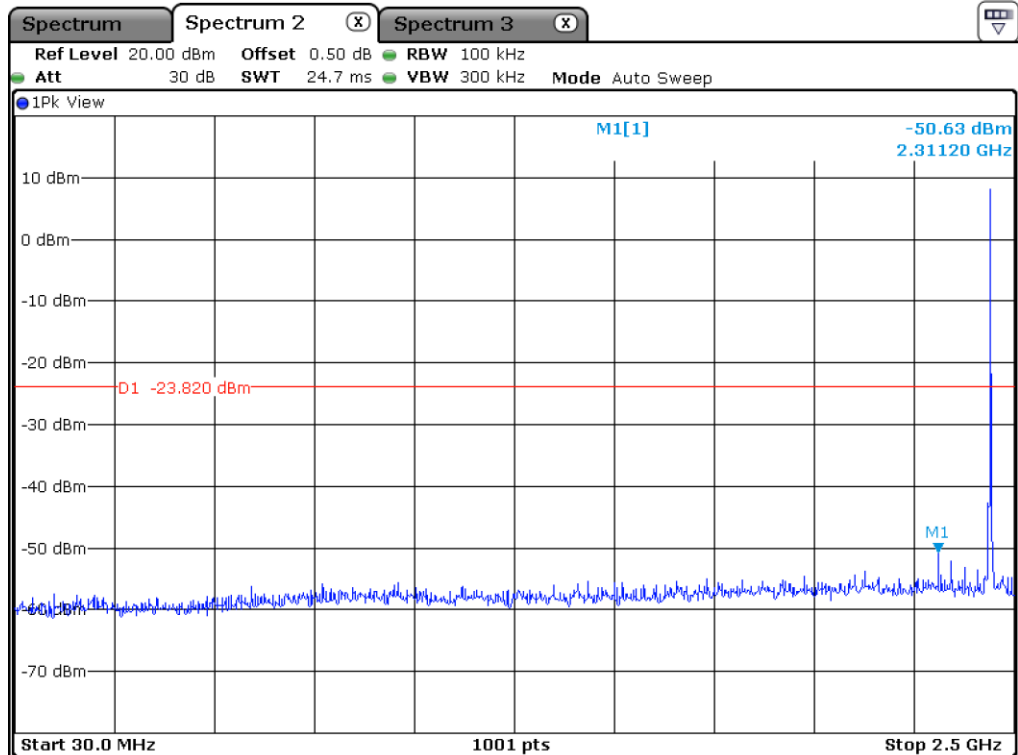




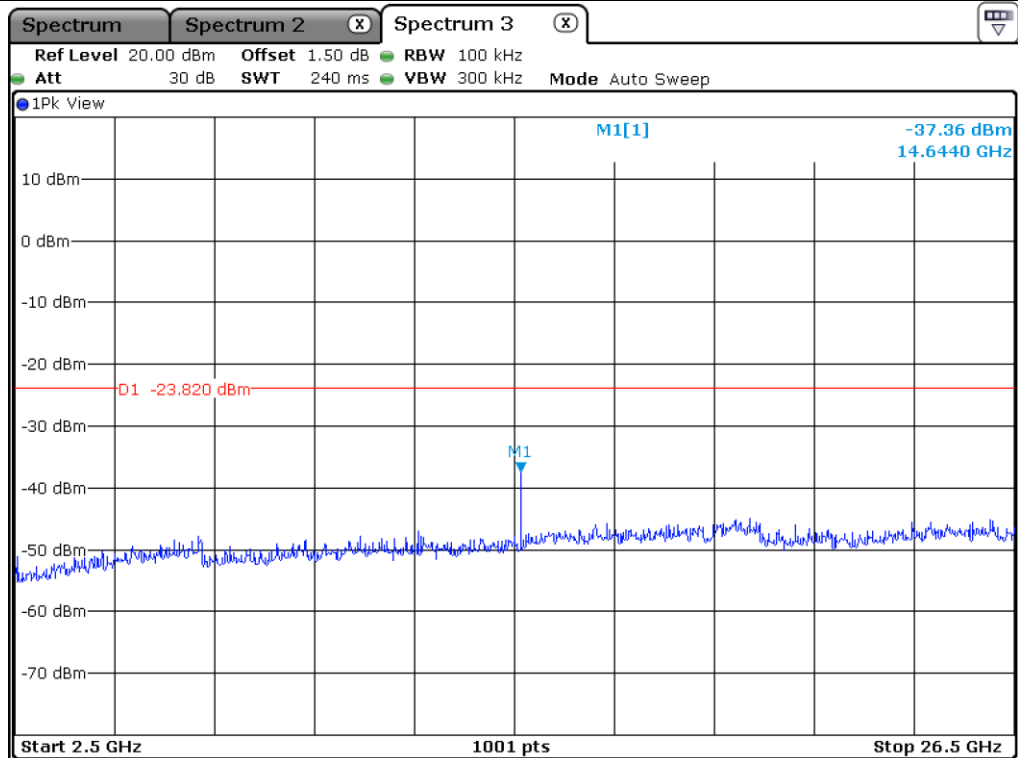
Low Channel



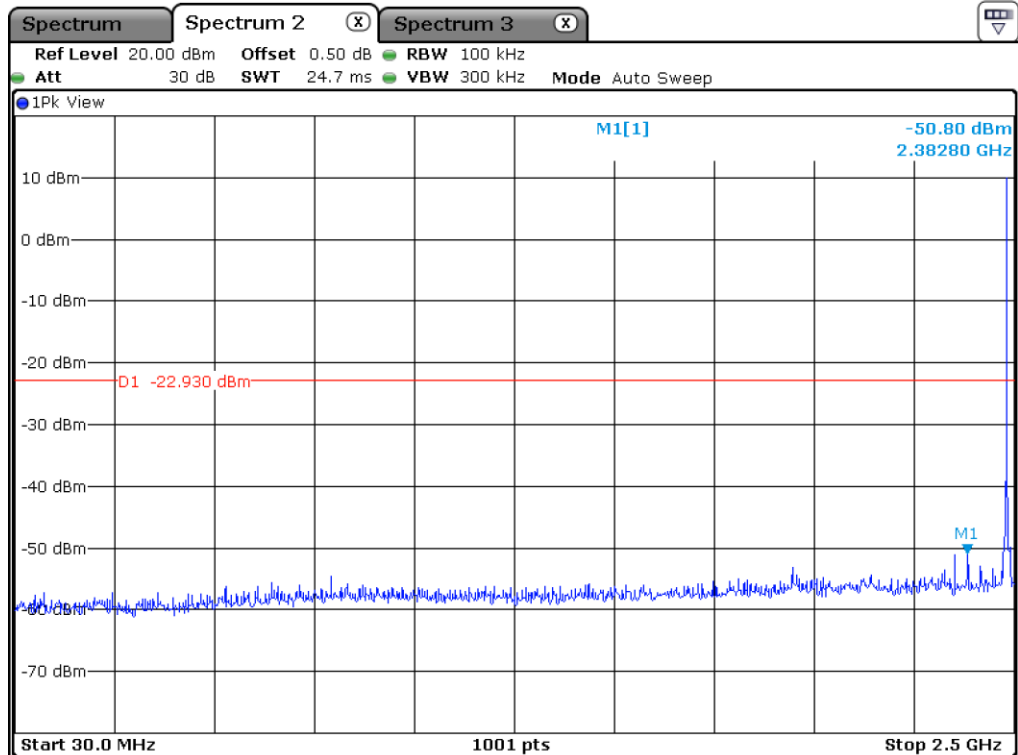
Low Channel



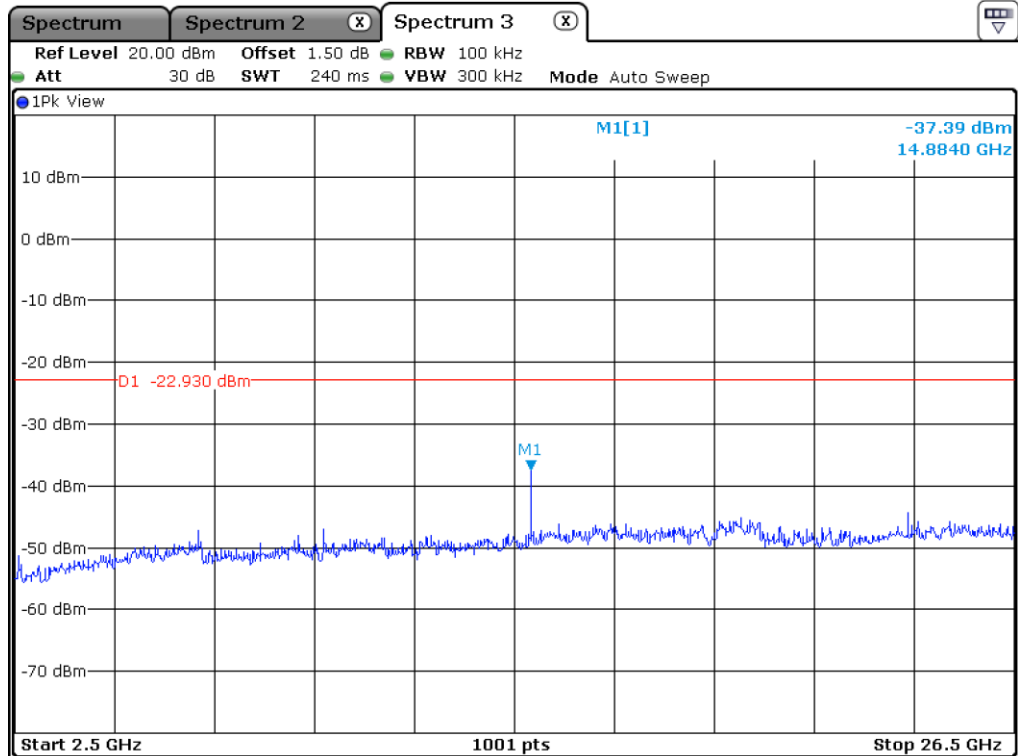
Middle Channel



Middle Channel

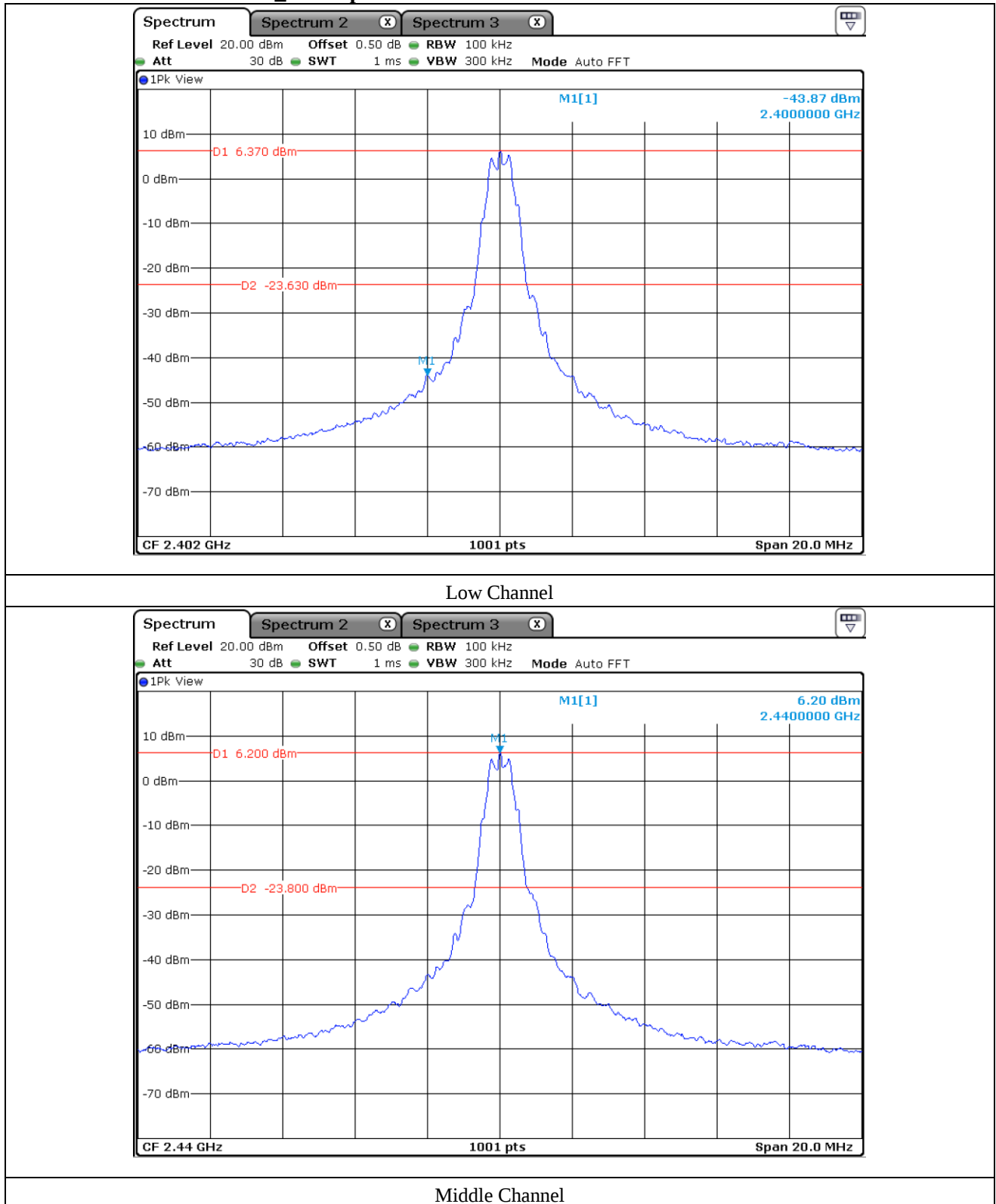


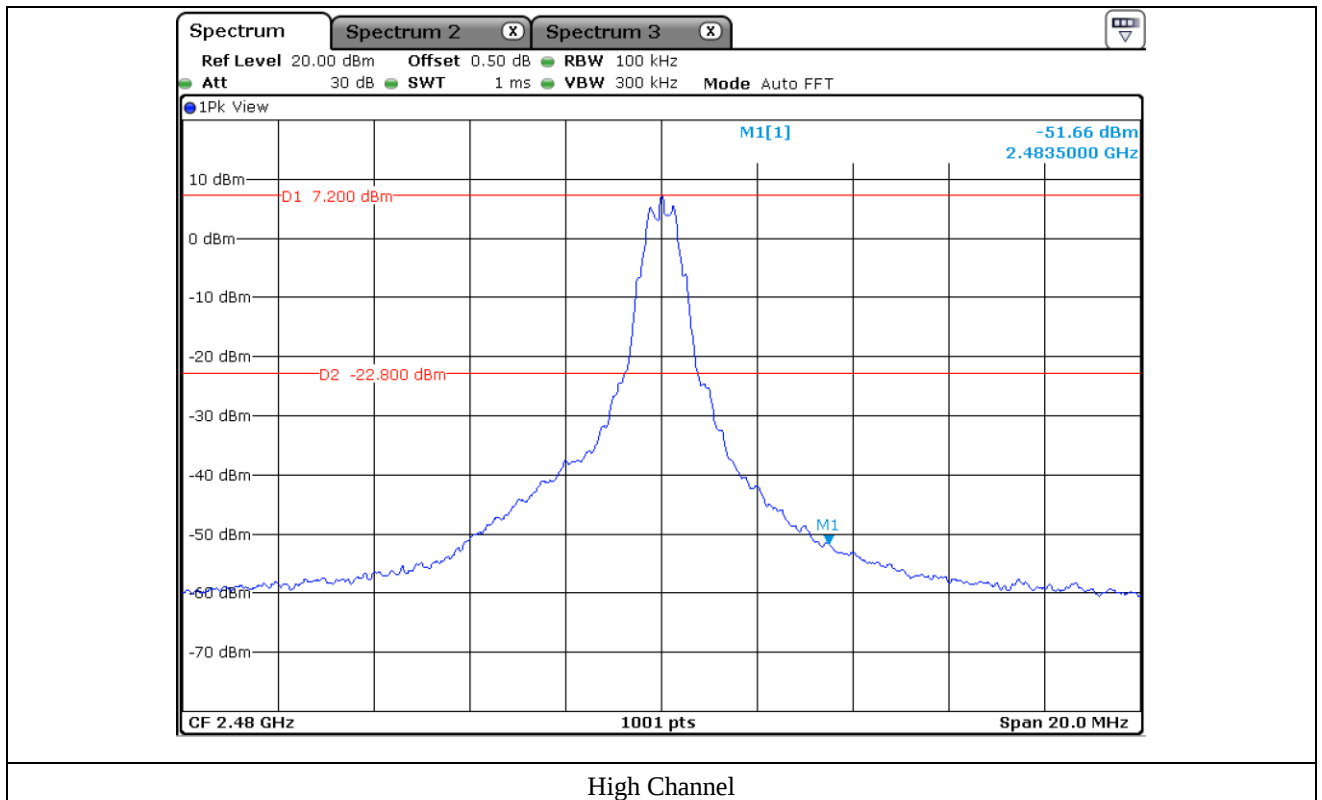
### High Channel

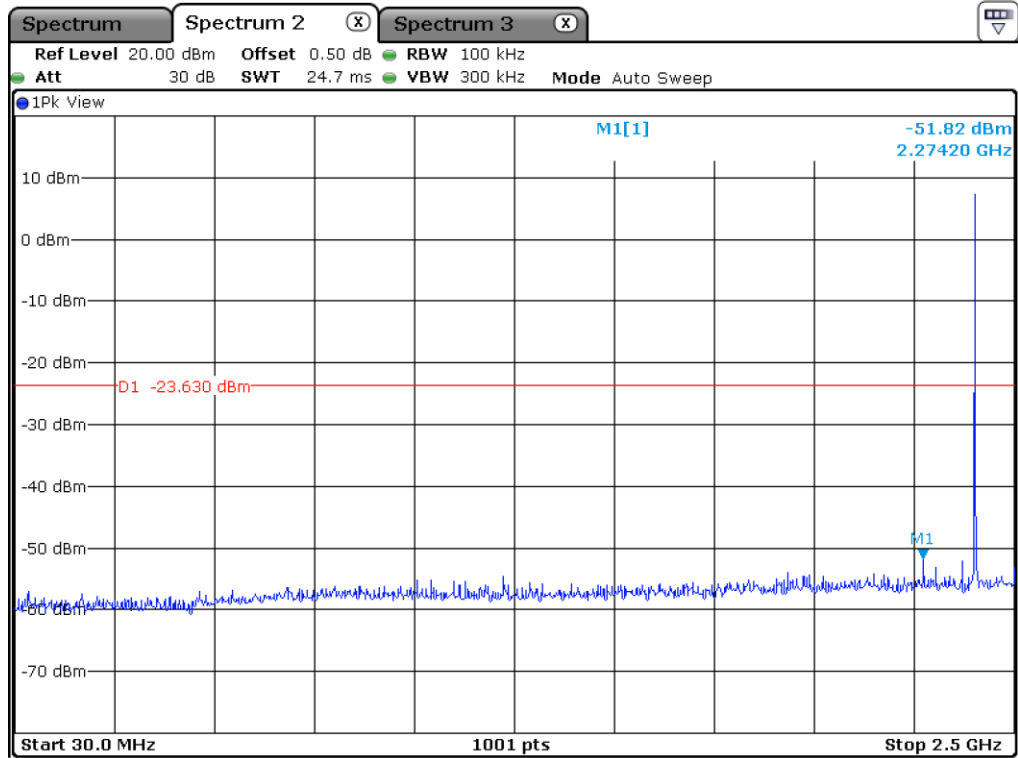


### High Channel

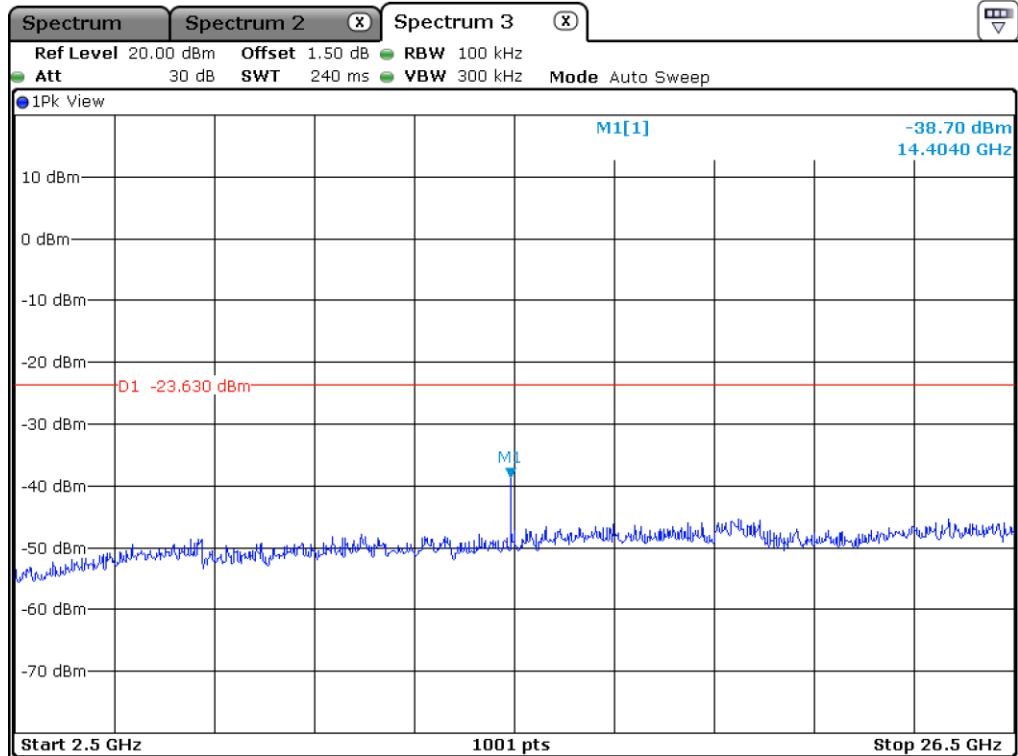
## 9.6.2 Test data for LE Coded\_500 kbps



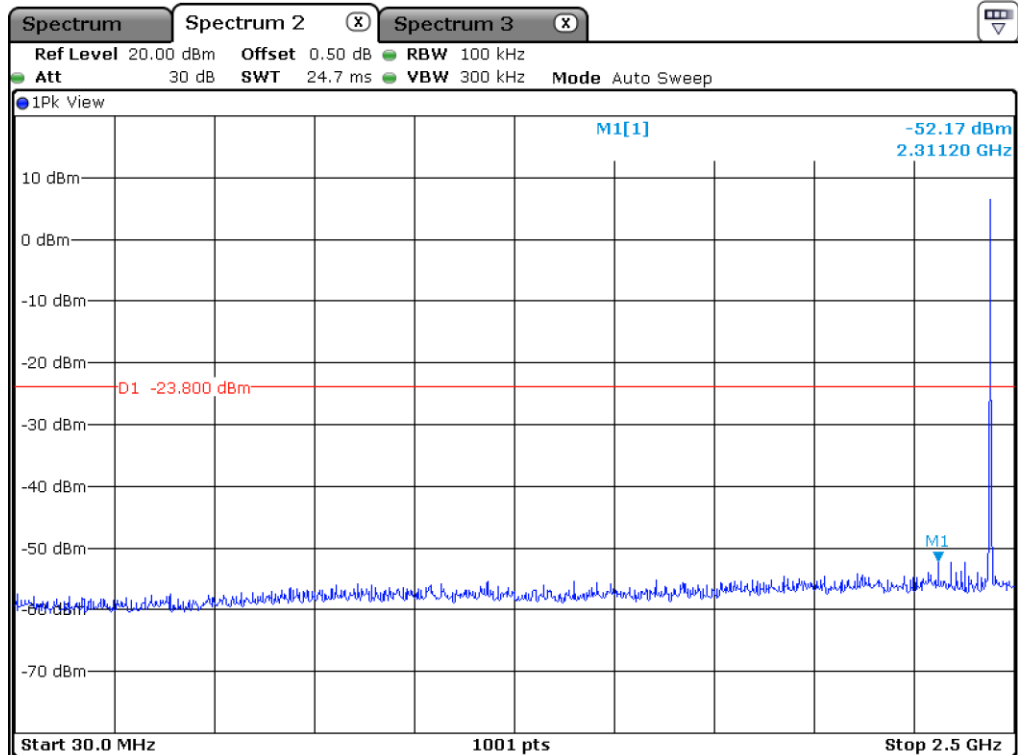




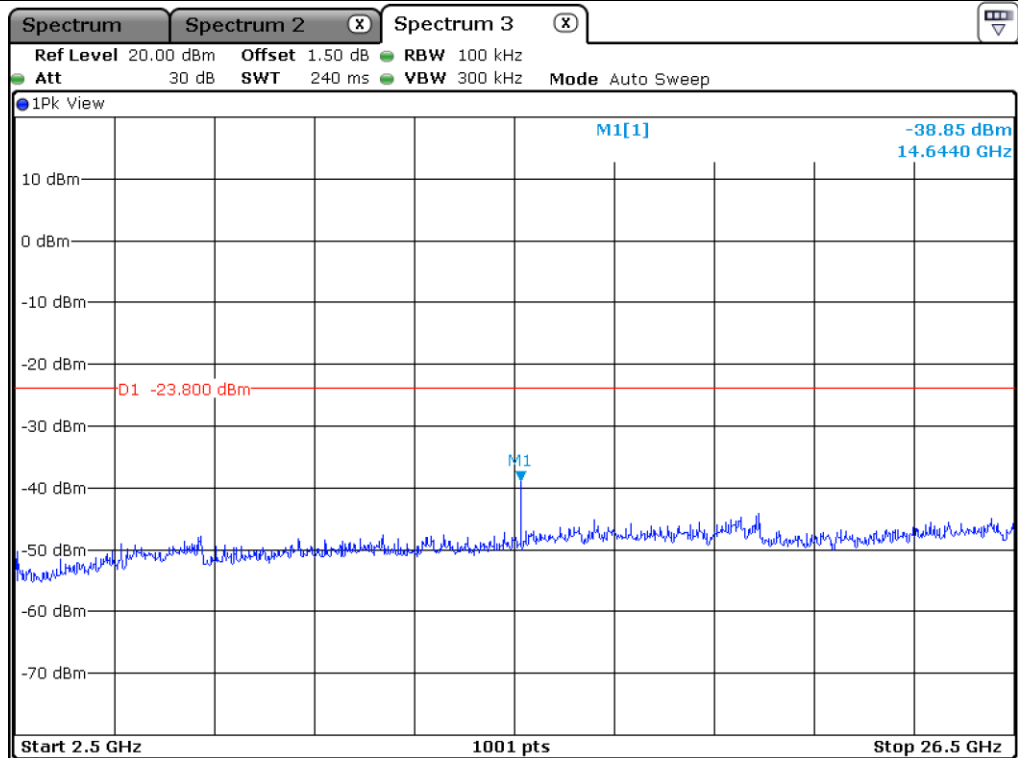
Low Channel



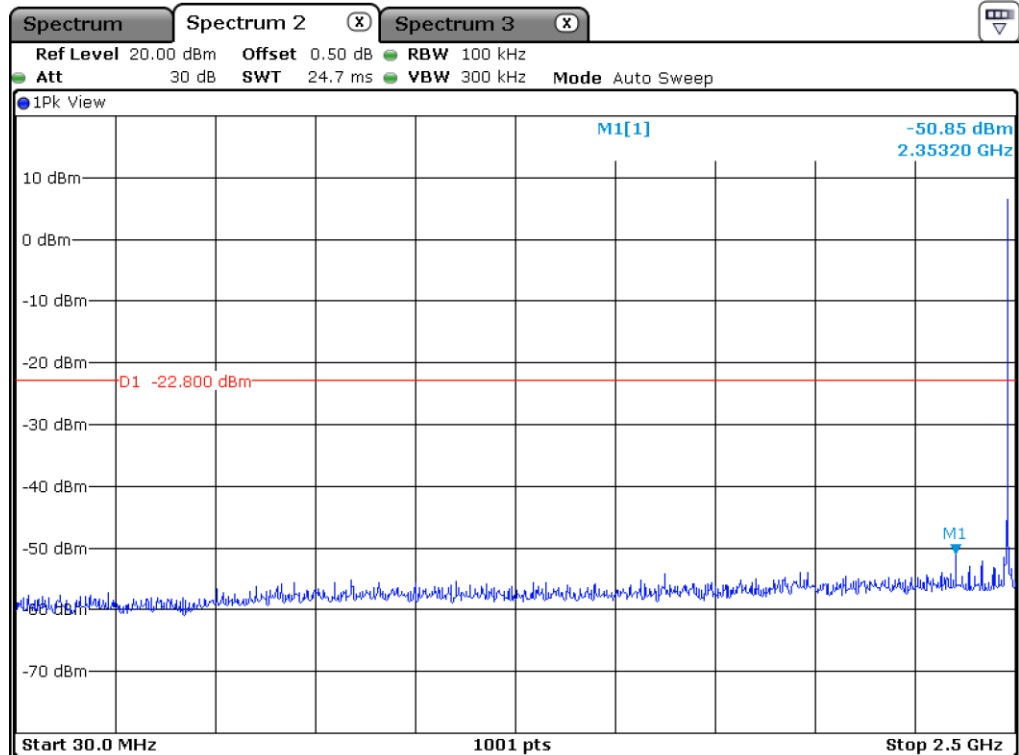
Low Channel



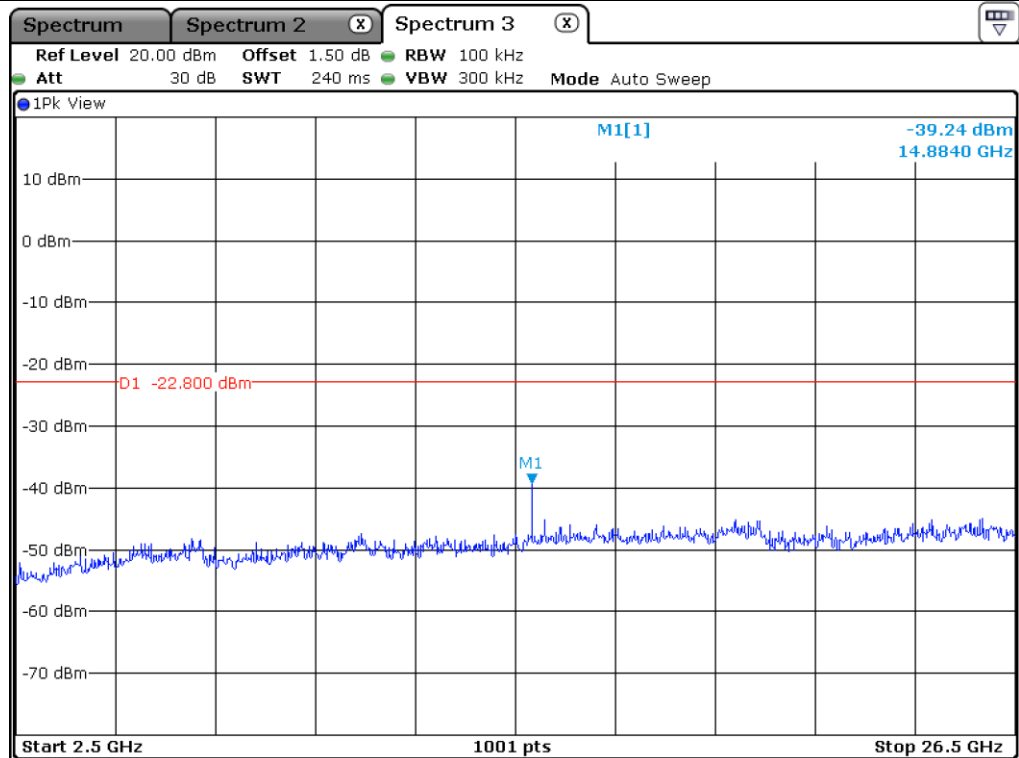
Middle Channel



Middle Channel

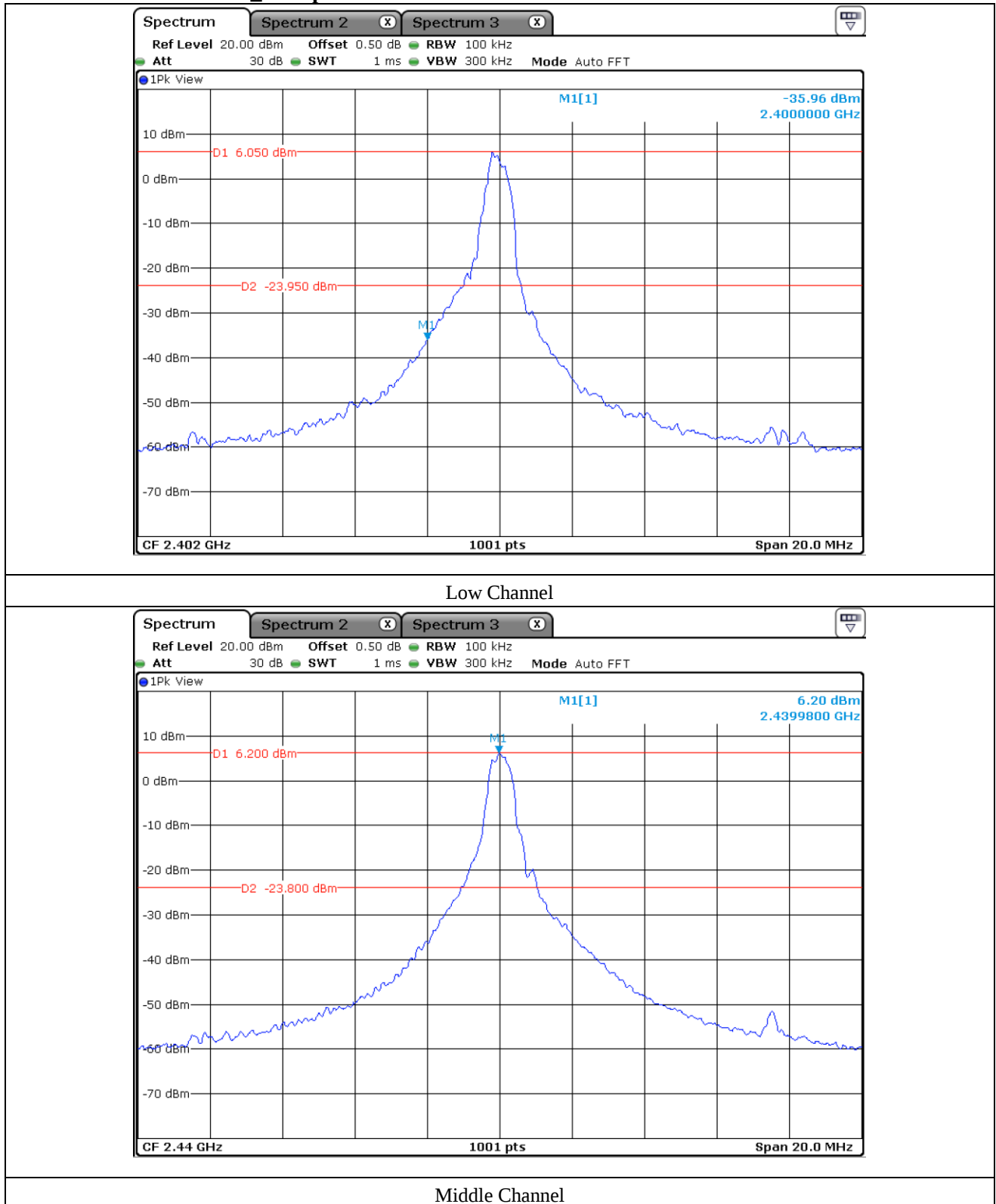


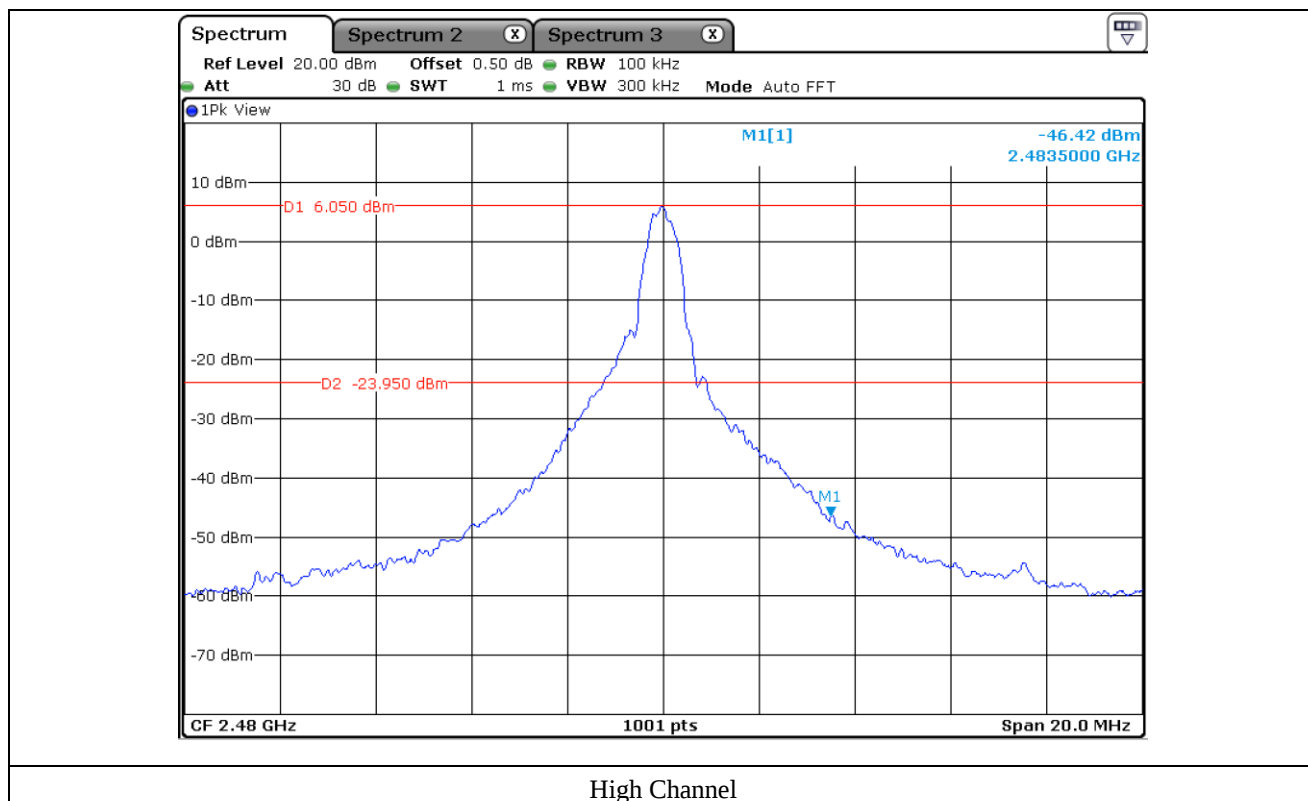
### High Channel

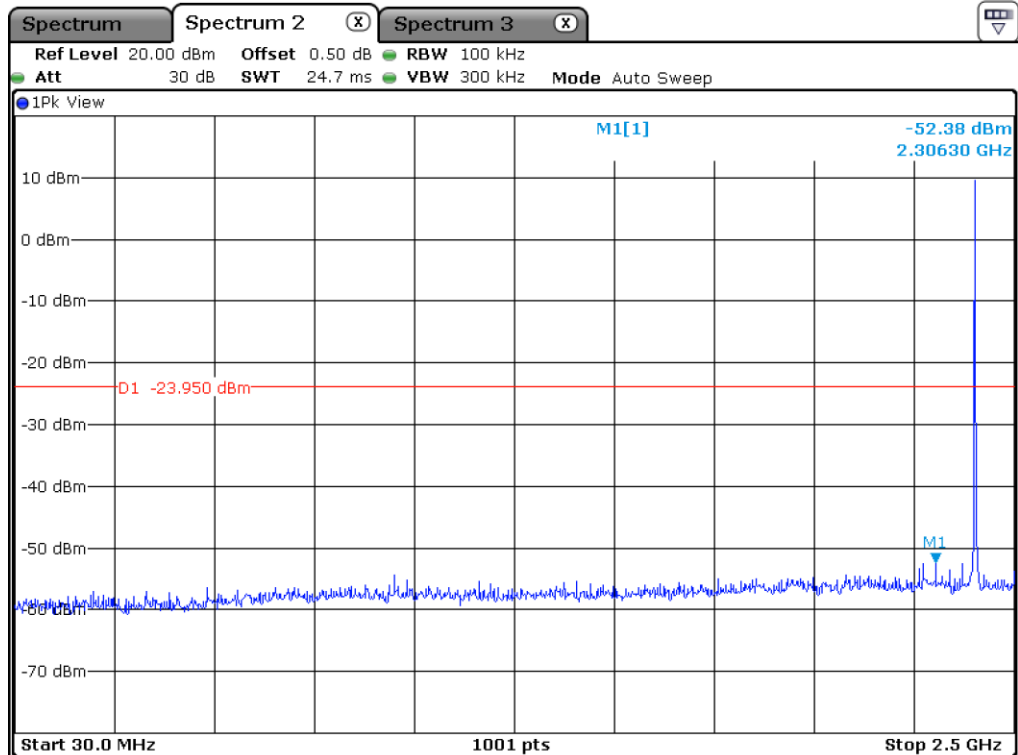


### High Channel

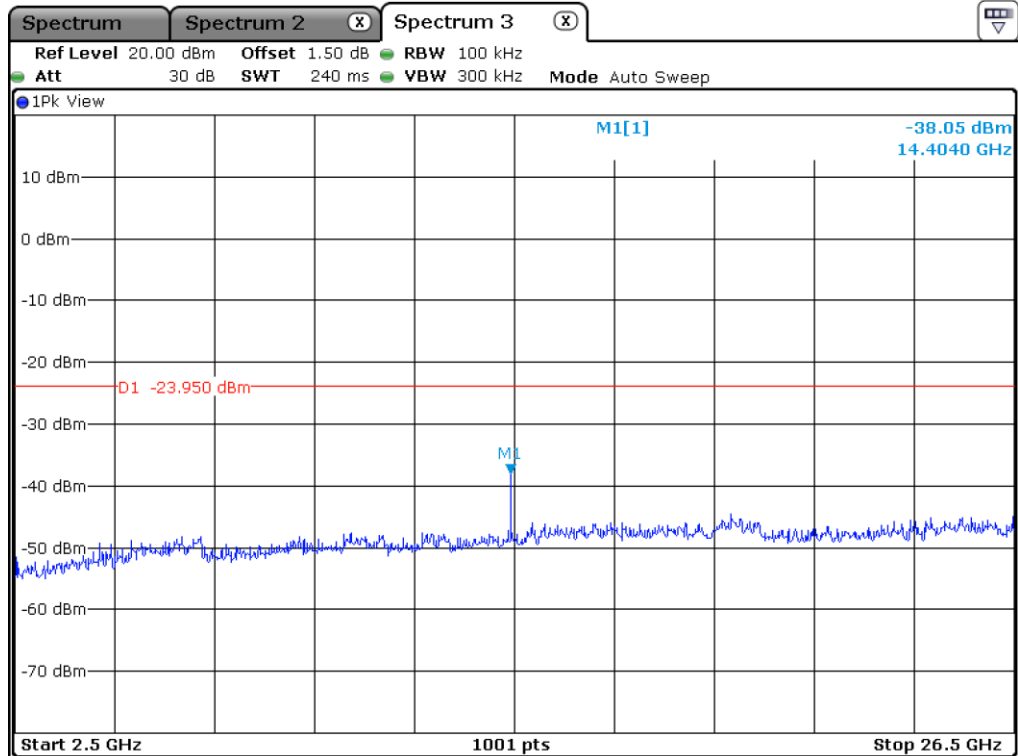
### 9.6.3 Test data for LE 1 M\_1 Mbps



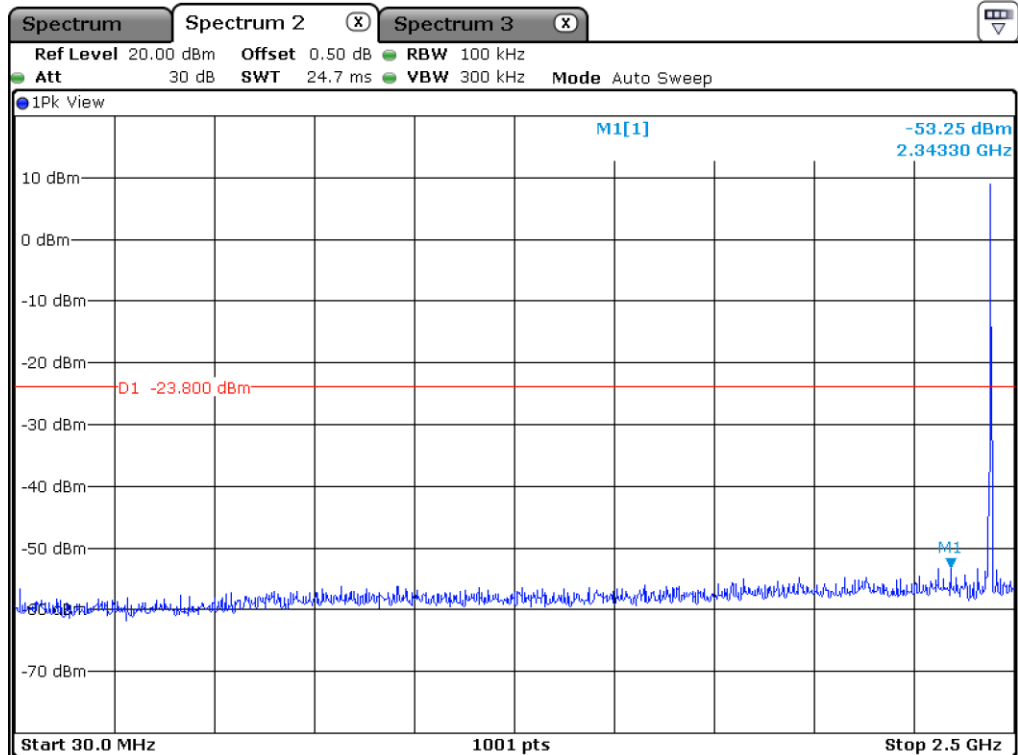




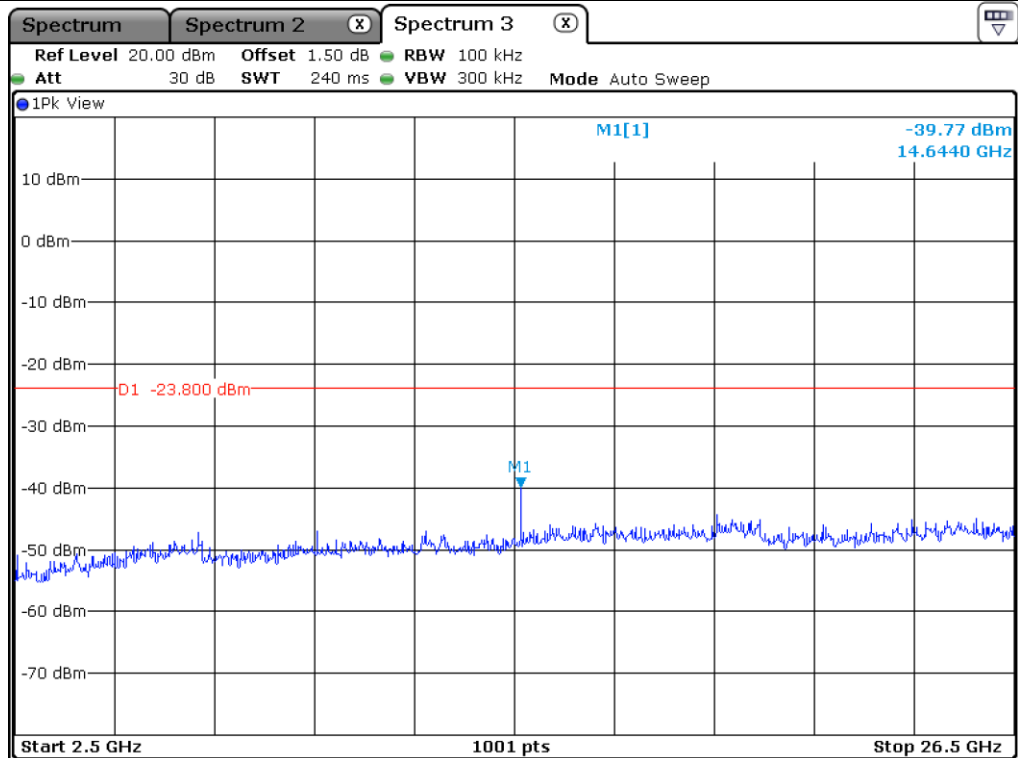
Low Channel



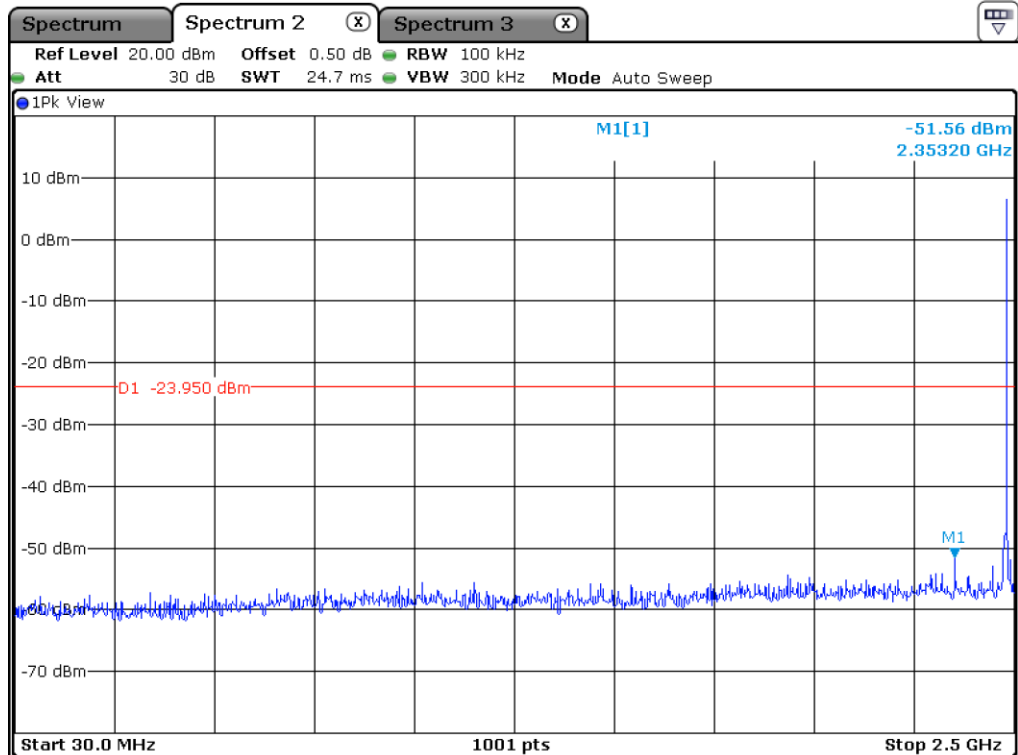
Low Channel



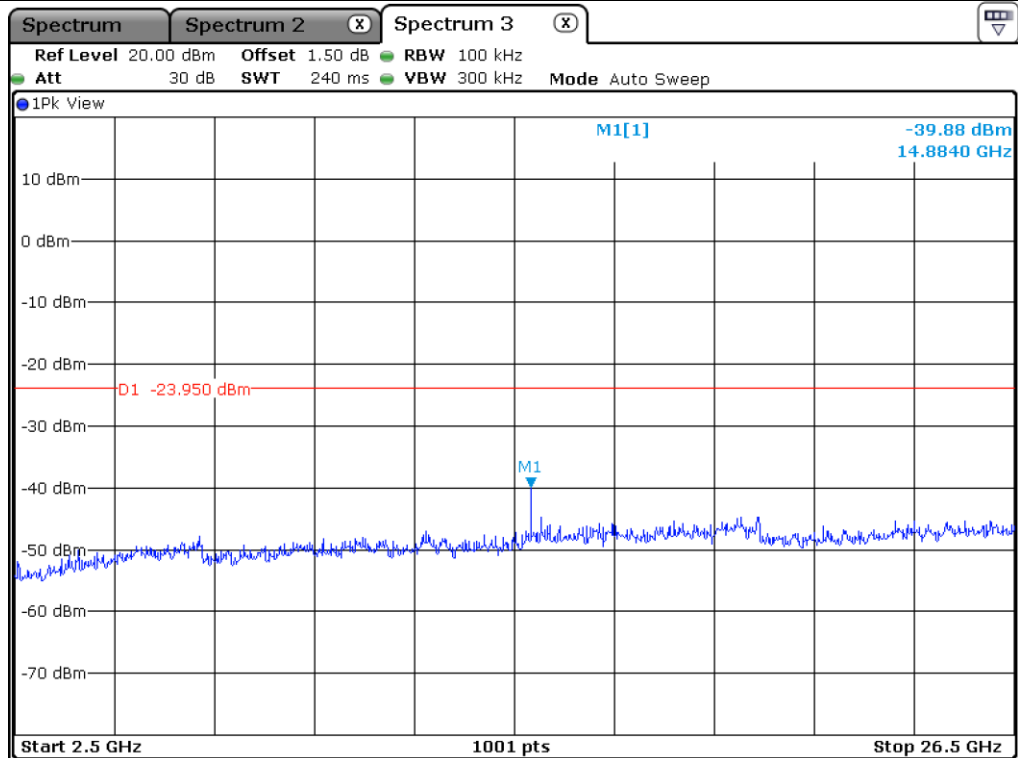
Middle Channel



Middle Channel

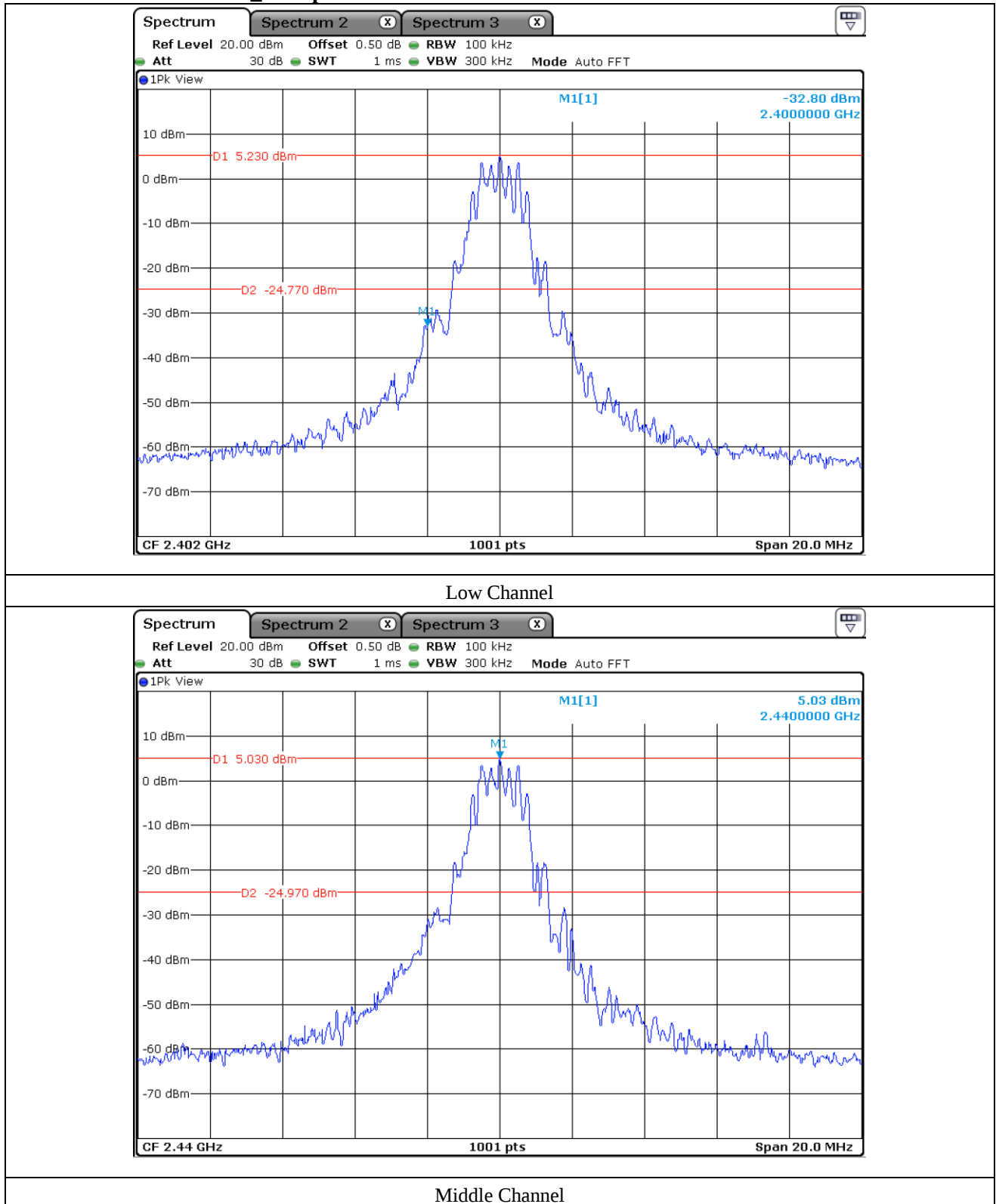


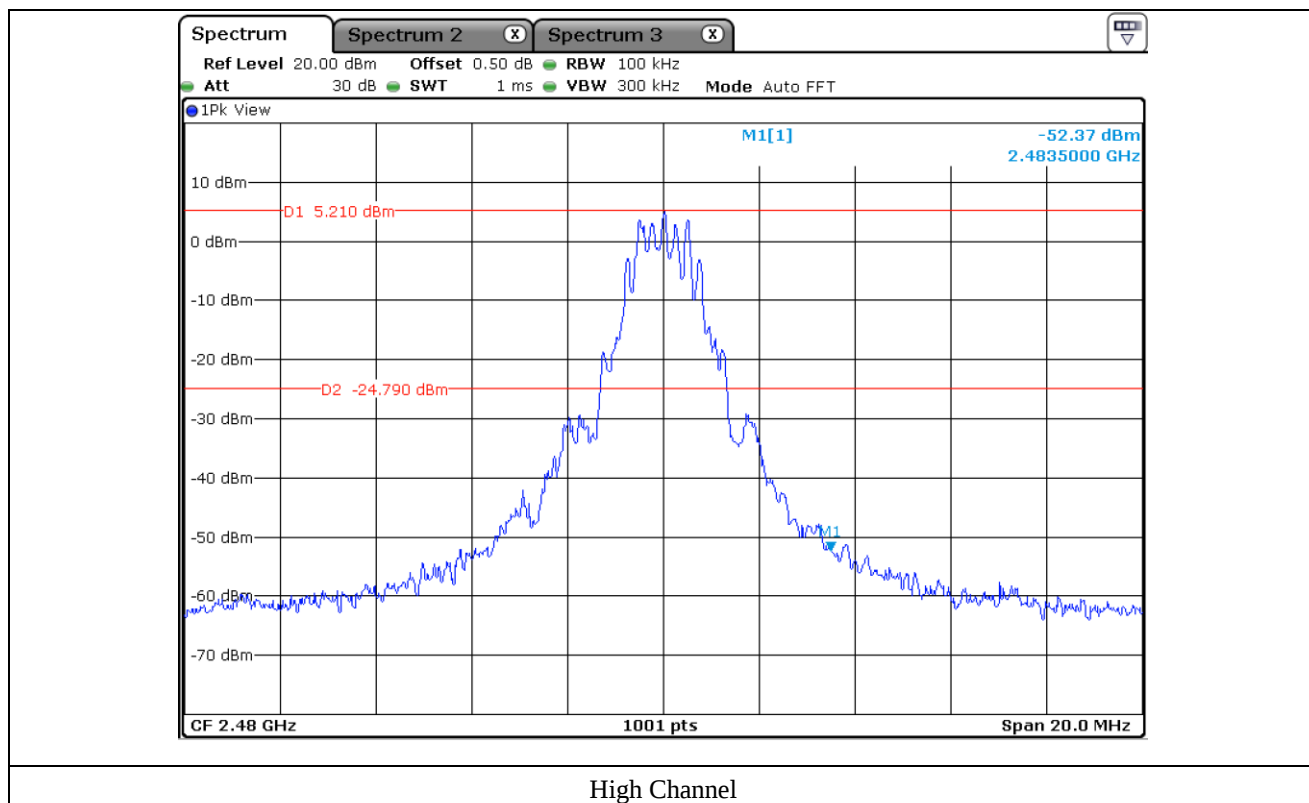
#### High Channel

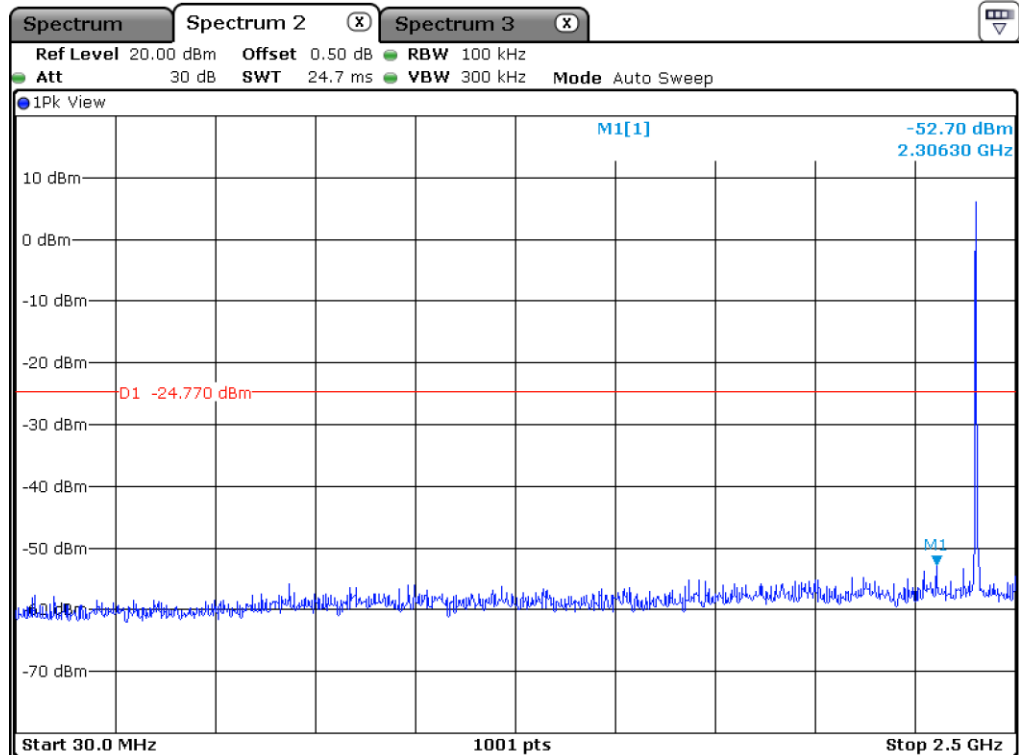


#### High Channel

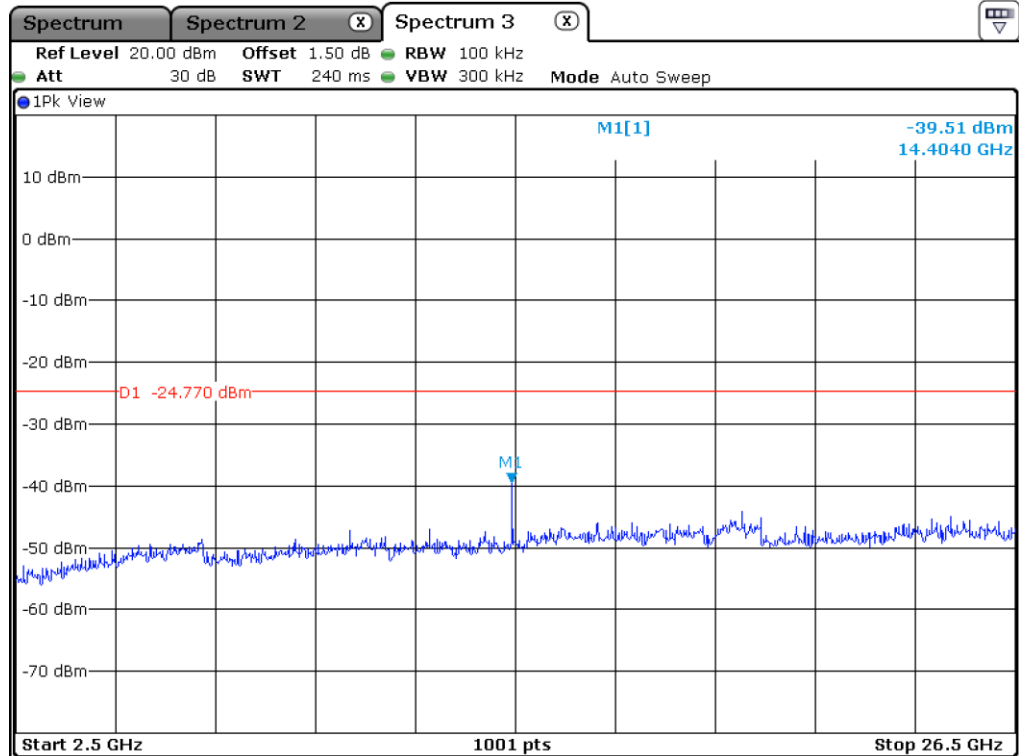
#### 9.6.4 Test data for LE 2 M\_2 Mbps



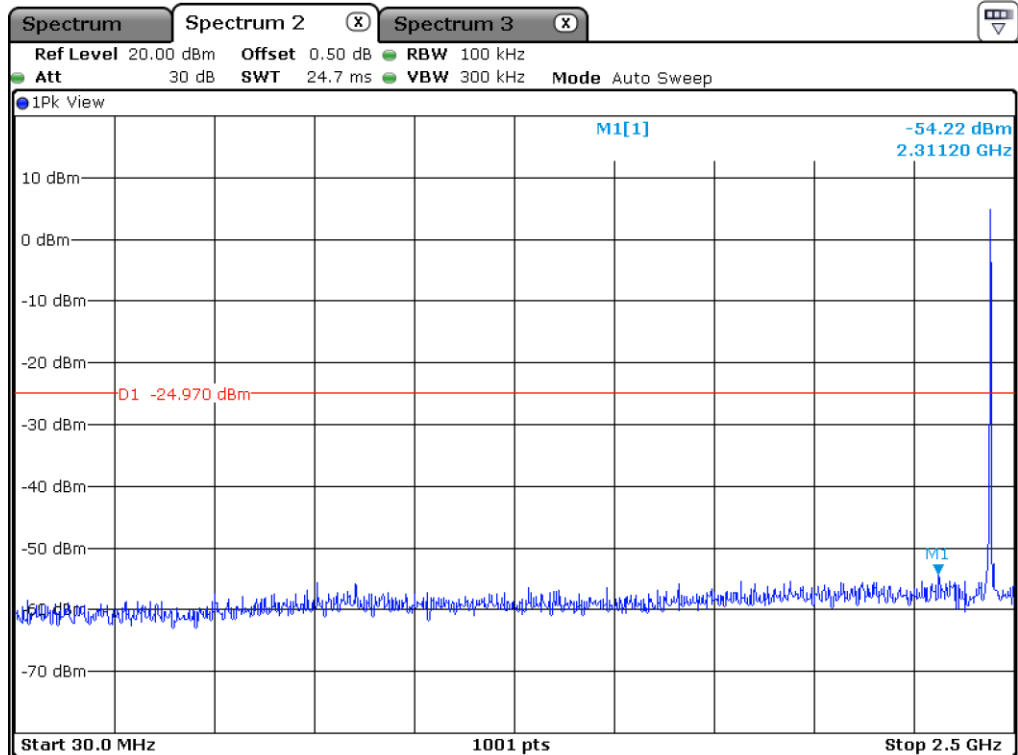




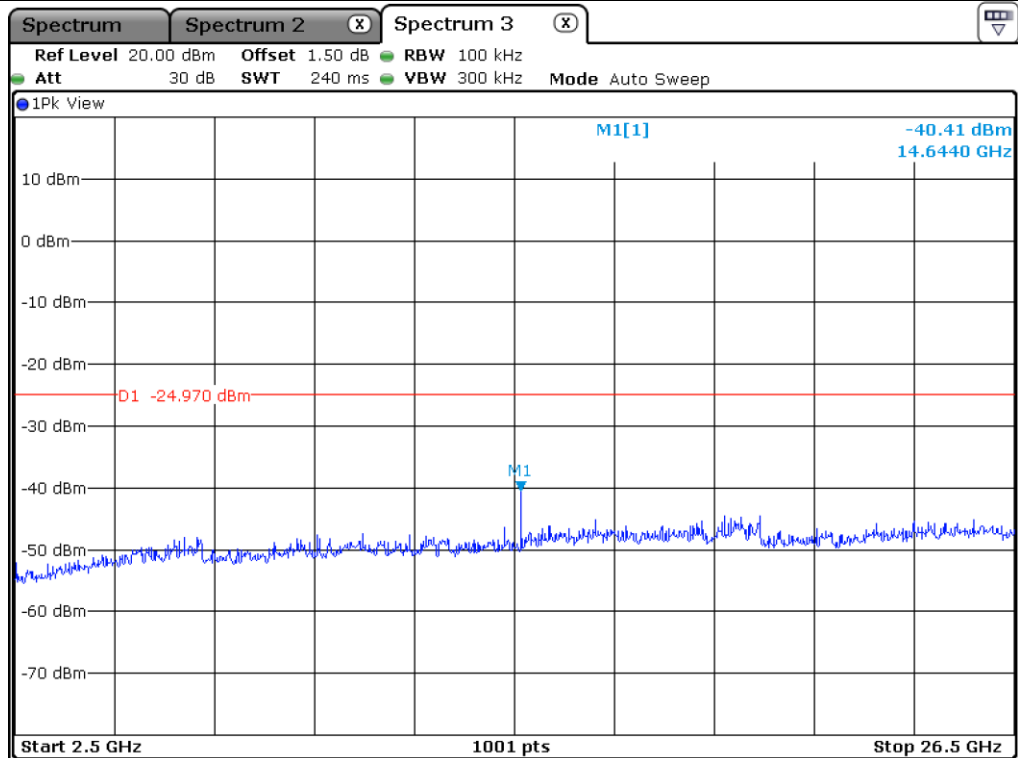
Low Channel



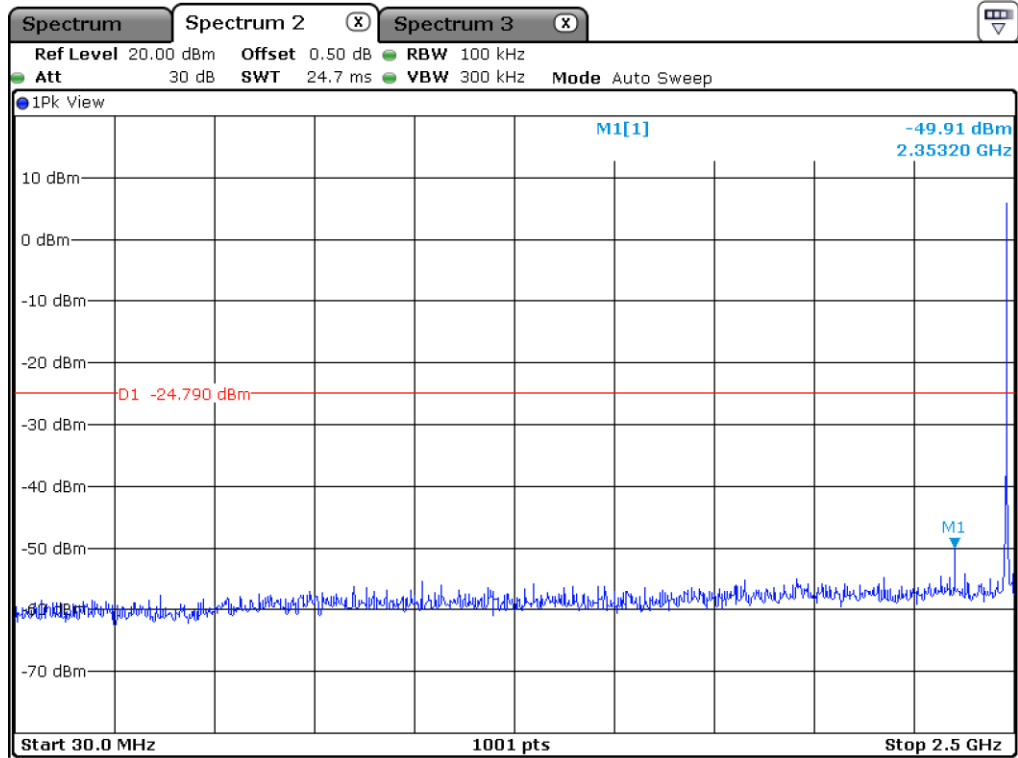
Low Channel



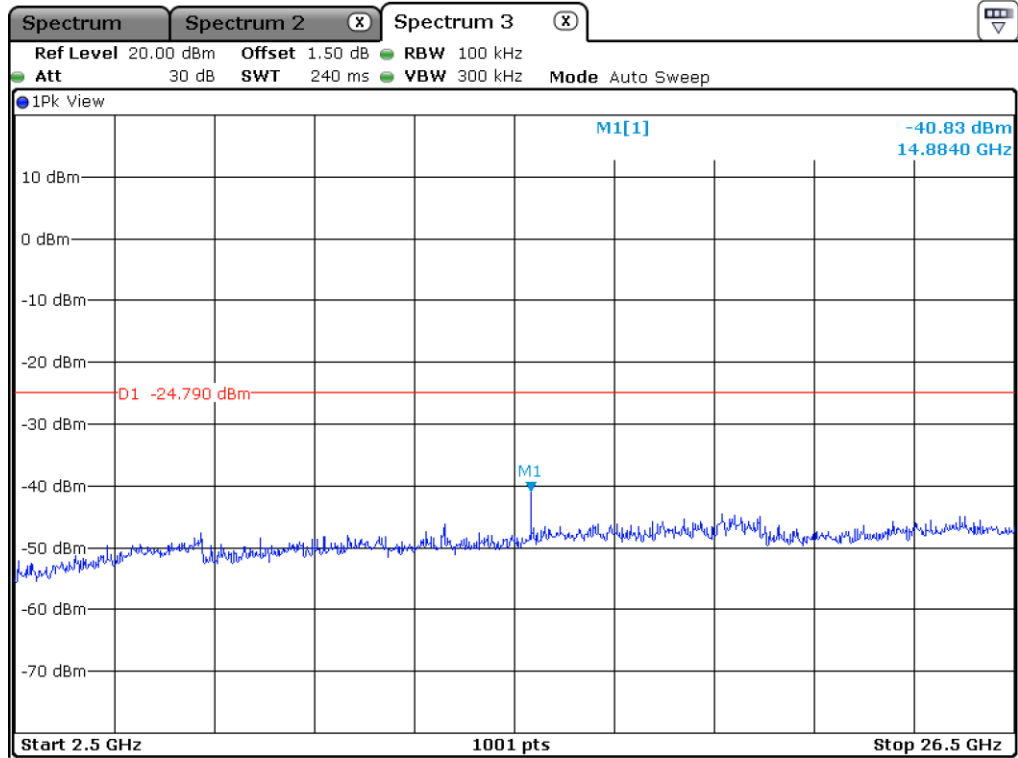
Middle Channel



Middle Channel



### High Channel



### High Channel

## 9.6 Test data for radiated emission

### 9.6.1 Radiated Emission which fall in the Restricted Band

#### 9.6.1.1 Test data for LE Coded\_125 kbps

-. Test Date : June 05, 2019 ~ June 11, 2019  
 -. Resolution bandwidth : 1 MHz for Peak and Average Mode  
 -. Video bandwidth : 3 MHz for Peak and Average Mode  
 -. Measurement distance : 3 m  
 -. Duty Cycle : 67.20 %  
 -. Result : PASSED

| Frequency<br>(MHz)                | Reading<br>(dBμV) | Detector<br>Mode | Ant. Pol.<br>(H/V) | Ant.<br>Factor | Cable<br>Loss | Correction<br>Factor | Total<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) |
|-----------------------------------|-------------------|------------------|--------------------|----------------|---------------|----------------------|-------------------|--------------------|----------------|
| <b>Test Data for Low Channel</b>  |                   |                  |                    |                |               |                      |                   |                    |                |
| 2 389.954                         | 20.78             | Peak             | H                  | 26.94          | 4.75          | -                    | 52.47             | 74.00              | 21.53          |
| 2 382.273                         | 12.31             | Average          | H                  | 26.94          | 4.75          | 1.73                 | 45.73             | 54.00              | 8.27           |
| 2 343.926                         | 17.02             | Peak             | V                  | 26.94          | 4.75          | -                    | 48.71             | 74.00              | 25.29          |
| 2 345.840                         | 7.36              | Average          | V                  | 26.94          | 4.75          | 1.73                 | 40.78             | 54.00              | 13.22          |
| <b>Test Data for High Channel</b> |                   |                  |                    |                |               |                      |                   |                    |                |
| 2 483.510                         | 24.47             | Peak             | H                  | 27.47          | 4.39          | -                    | 54.00             | 15.00              | 4.39           |
| 2 483.510                         | 10.05             | Average          | H                  | 27.47          | 4.39          | 1.73                 | 54.00             | 15.00              | 4.39           |
| 2 484.870                         | 18.73             | Peak             | V                  | 27.47          | 4.39          | -                    | 54.00             | 15.00              | 4.39           |
| 2 484.264                         | 5.41              | Average          | V                  | 27.47          | 4.39          | 1.73                 | 54.00             | 15.00              | 4.39           |

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor

  
 Tested by: Hyung-Kwon, Oh / Assistant Manager

### 9.6.1.2 Test data for LE Coded\_500 kbps

-. Test Date : June 05, 2019 ~ June 11, 2019  
 -. Resolution bandwidth : 1 MHz for Peak and Average Mode  
 -. Video bandwidth : 3 MHz for Peak and Average Mode  
 -. Measurement distance : 3 m  
 -. Duty Cycle : 86.70 %  
 -. Result : PASSED

| Frequency<br>(MHz)                | Reading<br>(dBμV) | Detector<br>Mode | Ant. Pol.<br>(H/V) | Ant.<br>Factor | Cable<br>Loss | Correction<br>Factor | Total<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) |
|-----------------------------------|-------------------|------------------|--------------------|----------------|---------------|----------------------|-------------------|--------------------|----------------|
| <b>Test Data for Low Channel</b>  |                   |                  |                    |                |               |                      |                   |                    |                |
| 2 389.950                         | 20.44             | Peak             | H                  | 26.94          | 4.75          | -                    | 52.13             | 74.00              | 21.87          |
| 2 382.277                         | 11.40             | Average          | H                  | 26.94          | 4.75          | 0.62                 | 43.71             | 54.00              | 10.29          |
| 2 343.920                         | 16.94             | Peak             | V                  | 26.94          | 4.75          | -                    | 48.63             | 74.00              | 25.37          |
| 2 345.841                         | 6.33              | Average          | V                  | 26.94          | 4.75          | 0.62                 | 38.64             | 54.00              | 15.36          |
| <b>Test Data for High Channel</b> |                   |                  |                    |                |               |                      |                   |                    |                |
| 2 483.510                         | 23.84             | Peak             | H                  | 27.47          | 4.39          | -                    | 55.70             | 74.00              | 18.30          |
| 2 483.510                         | 10.43             | Average          | H                  | 27.47          | 4.39          | 0.62                 | 42.91             | 54.00              | 11.09          |
| 2 484.878                         | 18.79             | Peak             | V                  | 27.47          | 4.39          | -                    | 50.65             | 74.00              | 23.35          |
| 2 484.300                         | 6.07              | Average          | V                  | 27.47          | 4.39          | 0.62                 | 38.55             | 54.00              | 15.45          |

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor



Tested by: Hyung-Kwon, Oh / Assistant Manager

### 9.6.1.3 Test data for LE 1 M\_1 Mbps

-. Test Date : June 05, 2019 ~ June 11, 2019  
 -. Resolution bandwidth : 1 MHz for Peak and Average Mode  
 -. Video bandwidth : 3 MHz for Peak and Average Mode  
 -. Measurement distance : 3 m  
 -. Duty Cycle : 68.42 %  
 -. Result : PASSED

| Frequency<br>(MHz)                | Reading<br>(dBμV) | Detector<br>Mode | Ant. Pol.<br>(H/V) | Ant.<br>Factor | Cable<br>Loss | Correction<br>Factor | Total<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) |
|-----------------------------------|-------------------|------------------|--------------------|----------------|---------------|----------------------|-------------------|--------------------|----------------|
| <b>Test Data for Low Channel</b>  |                   |                  |                    |                |               |                      |                   |                    |                |
| 2 389.960                         | 20.42             | Peak             | H                  | 26.94          | 4.75          | -                    | 52.11             | 74.00              | 21.89          |
| 2 382.287                         | 11.57             | Average          | H                  | 26.94          | 4.75          | 1.65                 | 44.91             | 54.00              | 9.09           |
| 2 343.925                         | 16.97             | Peak             | V                  | 26.94          | 4.75          | -                    | 48.66             | 74.00              | 25.34          |
| 2 345.847                         | 6.45              | Average          | V                  | 26.94          | 4.75          | 1.65                 | 39.79             | 54.00              | 14.21          |
| <b>Test Data for High Channel</b> |                   |                  |                    |                |               |                      |                   |                    |                |
| 2 483.508                         | 23.94             | Peak             | H                  | 27.47          | 4.39          | -                    | 55.80             | 74.00              | 18.20          |
| 2 483.508                         | 11.08             | Average          | H                  | 27.47          | 4.39          | 1.65                 | 44.59             | 54.00              | 9.41           |
| 2 484.876                         | 19.07             | Peak             | V                  | 27.47          | 4.39          | -                    | 50.93             | 74.00              | 23.07          |
| 2 484.270                         | 5.24              | Average          | V                  | 27.47          | 4.39          | 1.65                 | 38.75             | 54.00              | 15.25          |

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor



Tested by: Hyung-Kwon, Oh / Assistant Manager

#### 9.6.1.4 Test data for LE 2 M\_2 Mbps

-. Test Date : June 05, 2019 ~ June 11, 2019  
 -. Resolution bandwidth : 1 MHz for Peak and Average Mode  
 -. Video bandwidth : 3 MHz for Peak and Average Mode  
 -. Measurement distance : 3 m  
 -. Duty Cycle : 38.92 %  
 -. Result : PASSED

| Frequency<br>(MHz)                | Reading<br>(dBμV) | Detector<br>Mode | Ant. Pol.<br>(H/V) | Ant.<br>Factor | Cable<br>Loss | Correction<br>Factor | Total<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) |
|-----------------------------------|-------------------|------------------|--------------------|----------------|---------------|----------------------|-------------------|--------------------|----------------|
| <b>Test Data for Low Channel</b>  |                   |                  |                    |                |               |                      |                   |                    |                |
| 2 389.960                         | 20.95             | Peak             | H                  | 26.94          | 4.75          | -                    | 52.64             | 74.00              | 21.36          |
| 2 382.288                         | 11.87             | Average          | H                  | 26.94          | 4.75          | 4.10                 | 47.66             | 54.00              | 6.34           |
| 2 343.926                         | 17.89             | Peak             | V                  | 26.94          | 4.75          | -                    | 49.58             | 74.00              | 24.42          |
| 2 345.844                         | 7.12              | Average          | V                  | 26.94          | 4.75          | 4.10                 | 42.91             | 54.00              | 11.09          |
| <b>Test Data for High Channel</b> |                   |                  |                    |                |               |                      |                   |                    |                |
| 2 483.508                         | 24.18             | Peak             | H                  | 27.47          | 4.39          | -                    | 56.04             | 74.00              | 17.96          |
| 2 483.508                         | 10.08             | Average          | H                  | 27.47          | 4.39          | 4.10                 | 46.04             | 54.00              | 7.96           |
| 2 484.876                         | 18.07             | Peak             | V                  | 27.47          | 4.39          | -                    | 49.93             | 74.00              | 24.07          |
| 2 484.266                         | 6.08              | Average          | V                  | 27.47          | 4.39          | 4.10                 | 42.04             | 54.00              | 11.96          |

Tabulated test data for Restricted Band

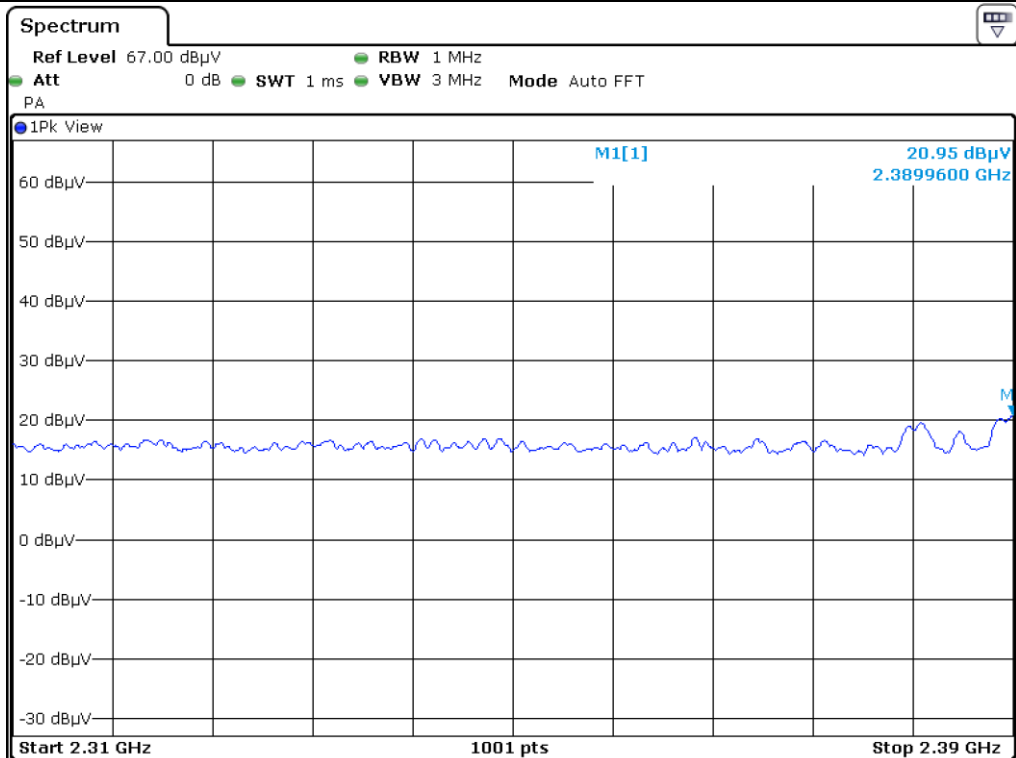
Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

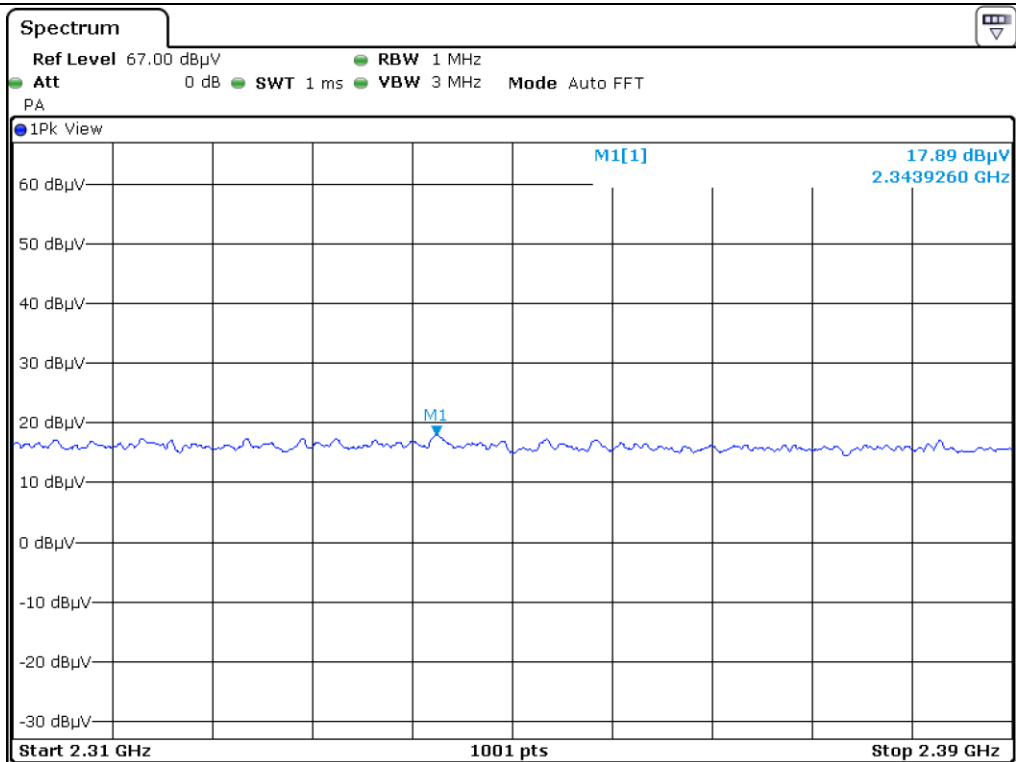
Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor



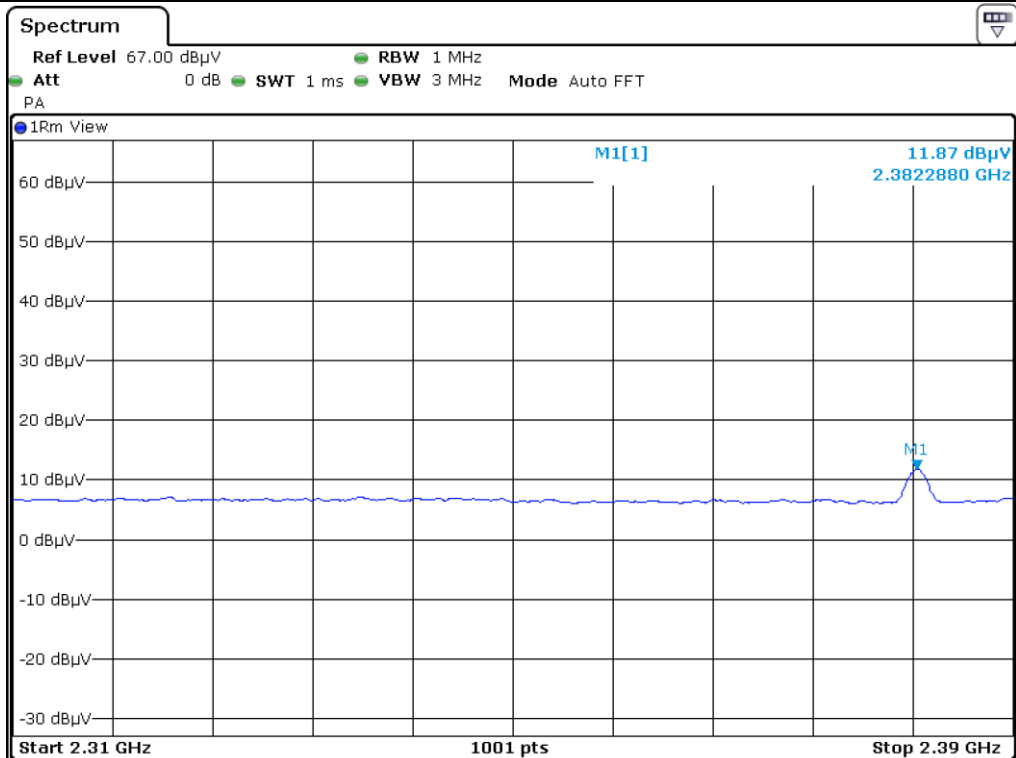
Tested by: Hyung-Kwon, Oh / Assistant Manager



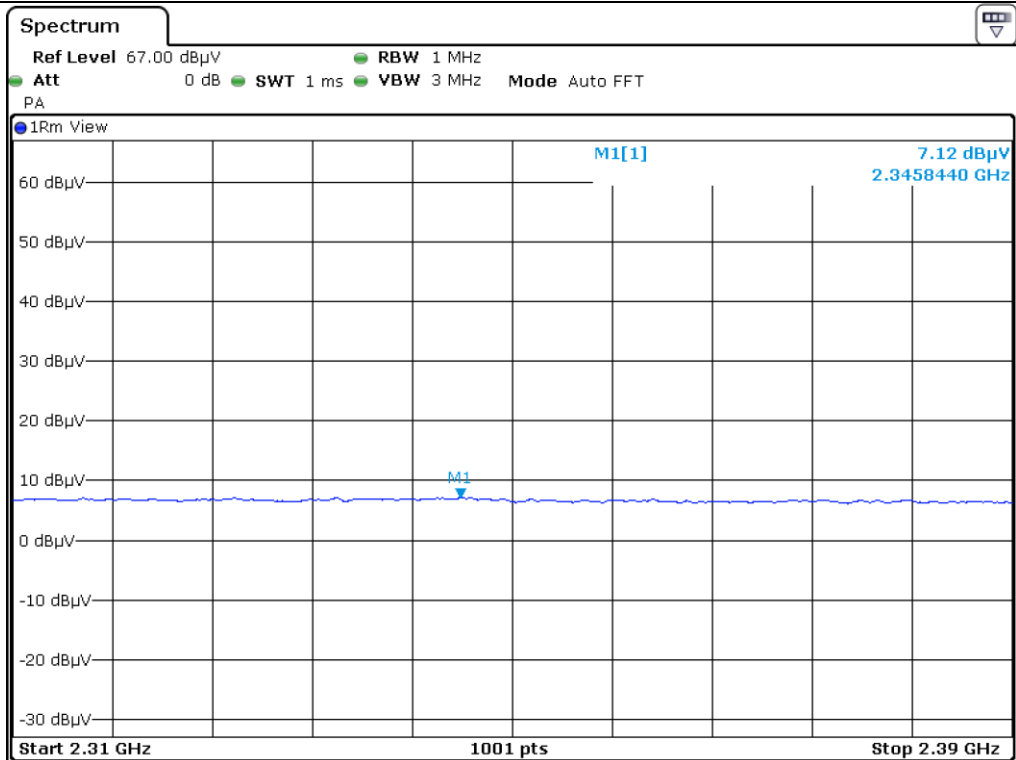
Low Channel\_Peak\_H



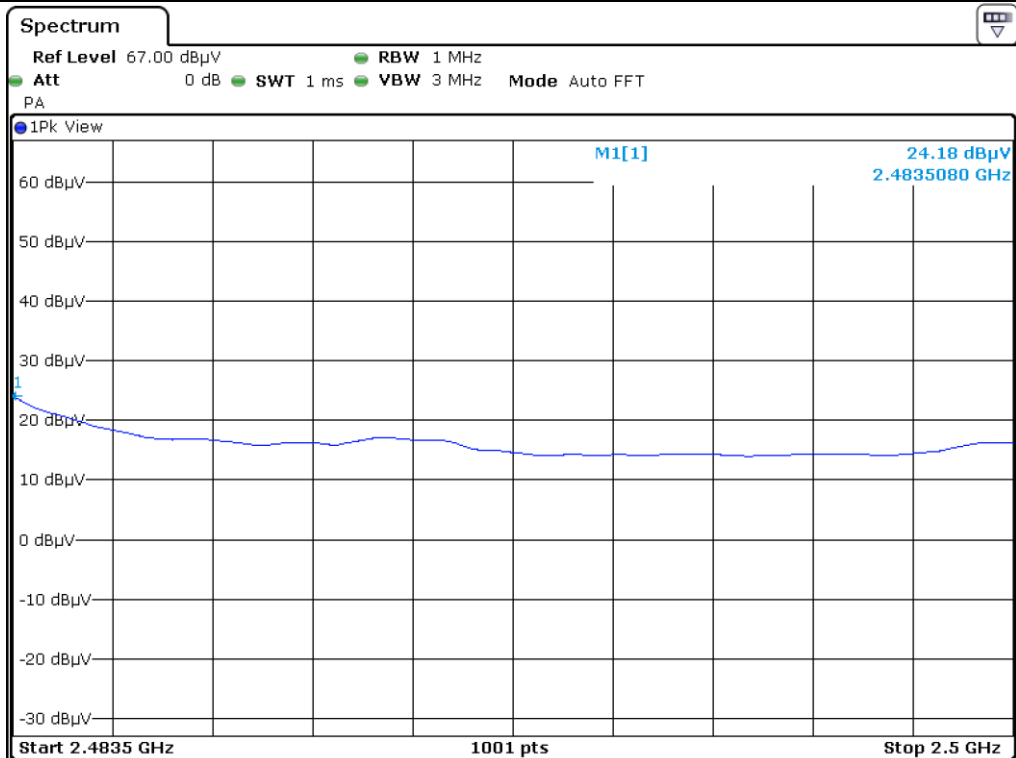
Low Channel\_Peak\_V



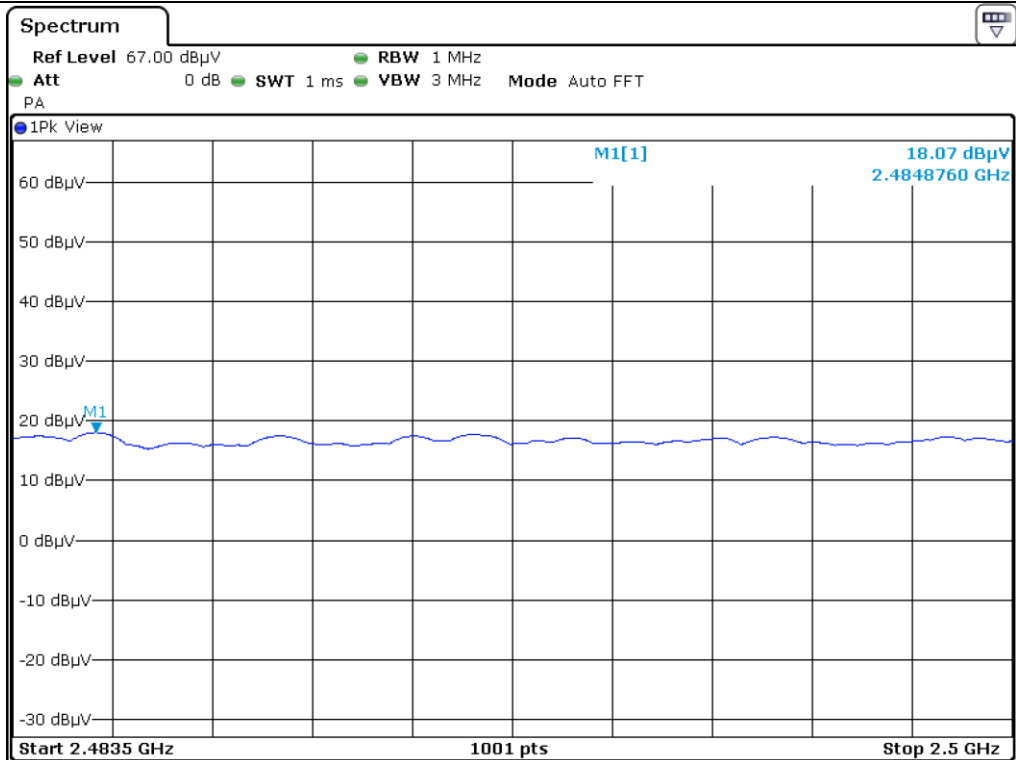
Low Channel\_ Average\_H



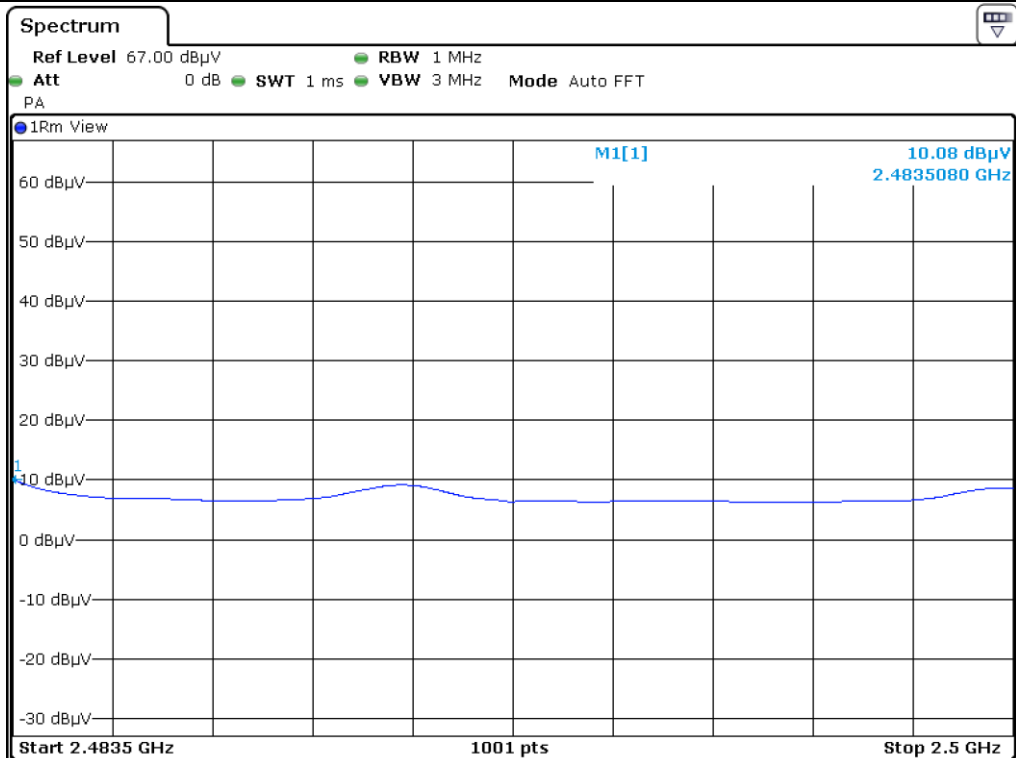
Low Channel\_ Average\_V



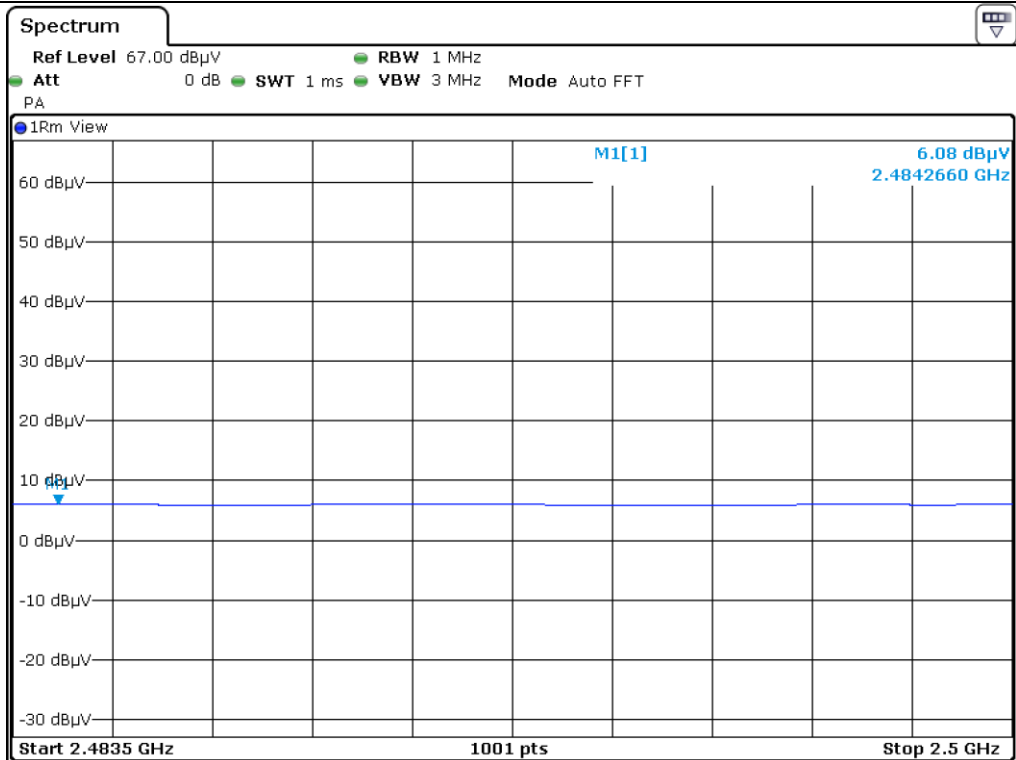
High Channel\_Peak\_H



High Channel\_Peak\_V



High Channel\_Average\_H



High Channel\_Average\_V

## 9.6.2 Spurious & Harmonic Radiated Emission

### 9.6.2.1 Test data for LE Coded\_125 kbps

- . Test Date : June 05, 2019 ~ June 11, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
1 MHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Duty Cycle : 67.20 %
- . Result : PASSED

| Frequency<br>(MHz)                  | Reading<br>(dBμV) | Detector<br>Mode | Ant. Pol.<br>(H/V) | Ant.<br>Factor | Cable<br>Loss | Correction<br>Factor | Total<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) |
|-------------------------------------|-------------------|------------------|--------------------|----------------|---------------|----------------------|-------------------|--------------------|----------------|
| <b>Test Data for Low Channel</b>    |                   |                  |                    |                |               |                      |                   |                    |                |
| 4 804.000                           | 18.15             | Peak             | H                  | 30.84          | 7.28          | -                    | 56.27             | 74.00              | 17.73          |
| 4 804.000                           | 9.21              | Average          | H                  | 30.84          | 7.28          | 1.73                 | 49.06             | 54.00              | 4.94           |
| 4 804.000                           | 16.70             | Peak             | V                  | 30.84          | 7.28          | -                    | 54.82             | 74.00              | 19.18          |
| 4 804.000                           | 9.82              | Average          | V                  | 30.84          | 7.28          | 1.73                 | 49.67             | 54.00              | 4.33           |
| <b>Test Data for Middle Channel</b> |                   |                  |                    |                |               |                      |                   |                    |                |
| 4 880.000                           | 16.46             | Peak             | H                  | 30.01          | 7.42          | -                    | 53.89             | 74.00              | 20.11          |
| 4 880.000                           | 7.98              | Average          | H                  | 30.01          | 7.42          | 1.73                 | 47.14             | 54.00              | 6.86           |
| 4 880.000                           | 16.75             | Peak             | V                  | 30.01          | 7.42          | -                    | 54.18             | 74.00              | 19.82          |
| 4 880.000                           | 8.72              | Average          | V                  | 30.01          | 7.42          | 1.73                 | 47.88             | 54.00              | 6.12           |
| <b>Test Data for High Channel</b>   |                   |                  |                    |                |               |                      |                   |                    |                |
| 4 960.000                           | 17.62             | Peak             | H                  | 31.15          | 7.40          | -                    | 56.17             | 74.00              | 17.83          |
| 4 960.000                           | 9.07              | Average          | H                  | 31.15          | 7.40          | 1.73                 | 49.35             | 54.00              | 4.65           |
| 4 960.000                           | 16.96             | Peak             | V                  | 31.15          | 7.40          | -                    | 55.51             | 74.00              | 18.49          |
| 4 960.000                           | 8.45              | Average          | V                  | 31.15          | 7.40          | 1.73                 | 48.73             | 54.00              | 5.27           |

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor

  
Tested by: Hyung-Kwon, Oh / Assistant Manager

### 9.6.2.2 Test data for LE Coded\_500 kbps

- Test Date : June 05, 2019 ~ June 11, 2019
- Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
1 MHz for Peak Mode for the emissions outside restricted band
- Video bandwidth : 3 MHz for Peak and Average Mode
- Frequency range : 1 GHz ~ 26.5 GHz
- Measurement distance : 3 m
- Duty Cycle : 86.70 %
- Result : PASSED

| Frequency<br>(MHz)                  | Reading<br>(dBμV) | Detector<br>Mode | Ant. Pol.<br>(H/V) | Ant.<br>Factor | Cable<br>Loss | Correction<br>Factor | Total<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) |
|-------------------------------------|-------------------|------------------|--------------------|----------------|---------------|----------------------|-------------------|--------------------|----------------|
| <b>Test Data for Low Channel</b>    |                   |                  |                    |                |               |                      |                   |                    |                |
| 4 804.000                           | 18.73             | Peak             | H                  | 30.84          | 7.28          | -                    | 56.85             | 74.00              | 17.15          |
| 4 804.000                           | 9.48              | Average          | H                  | 30.84          | 7.28          | 0.62                 | 48.22             | 54.00              | 5.78           |
| 4 804.000                           | 18.43             | Peak             | V                  | 30.84          | 7.28          | -                    | 56.55             | 74.00              | 17.45          |
| 4 804.000                           | 8.34              | Average          | V                  | 30.84          | 7.28          | 0.62                 | 47.08             | 54.00              | 6.92           |
| <b>Test Data for Middle Channel</b> |                   |                  |                    |                |               |                      |                   |                    |                |
| 4 880.000                           | 17.93             | Peak             | H                  | 30.01          | 7.42          | -                    | 55.36             | 74.00              | 18.64          |
| 4 880.000                           | 7.78              | Average          | H                  | 30.01          | 7.42          | 0.62                 | 45.83             | 54.00              | 8.17           |
| 4 880.000                           | 17.94             | Peak             | V                  | 30.01          | 7.42          | -                    | 55.37             | 74.00              | 18.63          |
| 4 880.000                           | 8.48              | Average          | V                  | 30.01          | 7.42          | 0.62                 | 46.53             | 54.00              | 7.47           |
| <b>Test Data for High Channel</b>   |                   |                  |                    |                |               |                      |                   |                    |                |
| 4 960.000                           | 17.55             | Peak             | H                  | 31.15          | 7.40          | -                    | 56.10             | 74.00              | 17.90          |
| 4 960.000                           | 8.95              | Average          | H                  | 31.15          | 7.40          | 0.62                 | 48.12             | 54.00              | 5.88           |
| 4 960.000                           | 18.10             | Peak             | V                  | 31.15          | 7.40          | -                    | 56.65             | 74.00              | 17.35          |
| 4 960.000                           | 8.39              | Average          | V                  | 31.15          | 7.40          | 0.62                 | 47.56             | 54.00              | 6.44           |

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor

  
Tested by: Hyung-Kwon, Oh / Assistant Manager

### 9.6.2.3 Test data for LE 1 M\_1 Mbps

- . Test Date : June 05, 2019 ~ June 11, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
1 MHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Duty Cycle : 68.42 %
- . Result : PASSED

| Frequency<br>(MHz)                  | Reading<br>(dBμV) | Detector<br>Mode | Ant. Pol.<br>(H/V) | Ant.<br>Factor | Cable<br>Loss | Correction<br>Factor | Total<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) |
|-------------------------------------|-------------------|------------------|--------------------|----------------|---------------|----------------------|-------------------|--------------------|----------------|
| <b>Test Data for Low Channel</b>    |                   |                  |                    |                |               |                      |                   |                    |                |
| 4 804.000                           | 18.36             | Peak             | H                  | 30.84          | 7.28          | -                    | 56.48             | 74.00              | 17.52          |
| 4 804.000                           | 9.19              | Average          | H                  | 30.84          | 7.28          | 1.65                 | 48.96             | 54.00              | 5.04           |
| 4 804.000                           | 17.85             | Peak             | V                  | 30.84          | 7.28          | -                    | 55.97             | 74.00              | 18.03          |
| 4 804.000                           | 8.12              | Average          | V                  | 30.84          | 7.28          | 1.65                 | 47.89             | 54.00              | 6.11           |
| <b>Test Data for Middle Channel</b> |                   |                  |                    |                |               |                      |                   |                    |                |
| 4 880.000                           | 17.97             | Peak             | H                  | 30.01          | 7.42          | -                    | 55.40             | 74.00              | 18.60          |
| 4 880.000                           | 9.37              | Average          | H                  | 30.01          | 7.42          | 1.65                 | 48.45             | 54.00              | 5.55           |
| 4 880.000                           | 16.76             | Peak             | V                  | 30.01          | 7.42          | -                    | 54.19             | 74.00              | 19.81          |
| 4 880.000                           | 9.27              | Average          | V                  | 30.01          | 7.42          | 1.65                 | 48.35             | 54.00              | 5.65           |
| <b>Test Data for High Channel</b>   |                   |                  |                    |                |               |                      |                   |                    |                |
| 4 960.000                           | 17.01             | Peak             | H                  | 31.15          | 7.40          | -                    | 55.56             | 74.00              | 18.44          |
| 4 960.000                           | 7.95              | Average          | H                  | 31.15          | 7.40          | 1.65                 | 48.15             | 54.00              | 5.85           |
| 4 960.000                           | 16.65             | Peak             | V                  | 31.15          | 7.40          | -                    | 55.20             | 74.00              | 18.80          |
| 4 960.000                           | 8.61              | Average          | V                  | 31.15          | 7.40          | 1.65                 | 48.81             | 54.00              | 5.19           |

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor

  
Tested by: Hyung-Kwon, Oh / Assistant Manager

### 9.6.2.4 Test data for LE 2 M\_2 Mbps

- . Test Date : June 05, 2019 ~ June 11, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode for the emissions fall in restricted band,  
1 MHz for Peak Mode for the emissions outside restricted band
- . Video bandwidth : 3 MHz for Peak and Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Duty Cycle : 38.92 %
- . Result : PASSED

| Frequency<br>(MHz)                  | Reading<br>(dBμV) | Detector<br>Mode | Ant. Pol.<br>(H/V) | Ant.<br>Factor | Cable<br>Loss | Correction<br>Factor | Total<br>(dBμV/m) | Limits<br>(dBμV/m) | Margin<br>(dB) |
|-------------------------------------|-------------------|------------------|--------------------|----------------|---------------|----------------------|-------------------|--------------------|----------------|
| <b>Test Data for Low Channel</b>    |                   |                  |                    |                |               |                      |                   |                    |                |
| 4 804.000                           | 17.77             | Peak             | H                  | 30.84          | 7.28          | -                    | 55.89             | 74.00              | 18.11          |
| 4 804.000                           | 8.89              | Average          | H                  | 30.84          | 7.28          | 4.10                 | 51.11             | 54.00              | 2.89           |
| 4 804.000                           | 17.64             | Peak             | V                  | 30.84          | 7.28          | -                    | 55.76             | 74.00              | 18.24          |
| 4 804.000                           | 8.85              | Average          | V                  | 30.84          | 7.28          | 4.10                 | 51.07             | 54.00              | 2.93           |
| <b>Test Data for Middle Channel</b> |                   |                  |                    |                |               |                      |                   |                    |                |
| 4 880.000                           | 17.33             | Peak             | H                  | 30.01          | 7.42          | -                    | 54.76             | 74.00              | 19.24          |
| 4 880.000                           | 8.70              | Average          | H                  | 30.01          | 7.42          | 4.10                 | 50.23             | 54.00              | 3.77           |
| 4 880.000                           | 17.16             | Peak             | V                  | 30.01          | 7.42          | -                    | 54.59             | 74.00              | 19.41          |
| 4 880.000                           | 8.60              | Average          | V                  | 30.01          | 7.42          | 4.10                 | 50.13             | 54.00              | 3.87           |
| <b>Test Data for High Channel</b>   |                   |                  |                    |                |               |                      |                   |                    |                |
| 4 960.000                           | 17.68             | Peak             | H                  | 31.15          | 7.40          | -                    | 56.23             | 74.00              | 17.77          |
| 4 960.000                           | 8.50              | Average          | H                  | 31.15          | 7.40          | 4.10                 | 51.15             | 54.00              | 2.85           |
| 4 960.000                           | 17.45             | Peak             | V                  | 31.15          | 7.40          | -                    | 56.00             | 74.00              | 18.00          |
| 4 960.000                           | 8.60              | Average          | V                  | 31.15          | 7.40          | 4.10                 | 51.25             | 54.00              | 2.75           |

Tabulated test data for Restricted Band

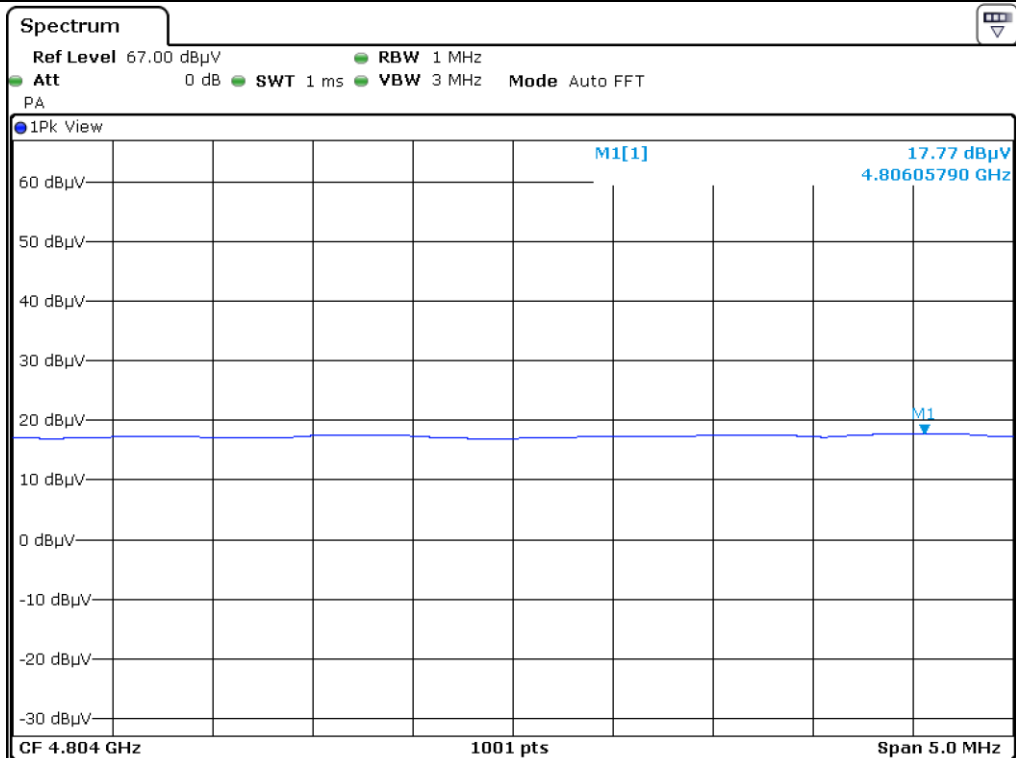
Remark: "H": Horizontal, "V": Vertical

Margin (dB) = Limits (dBμV/m) - Total Level (dBμV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor



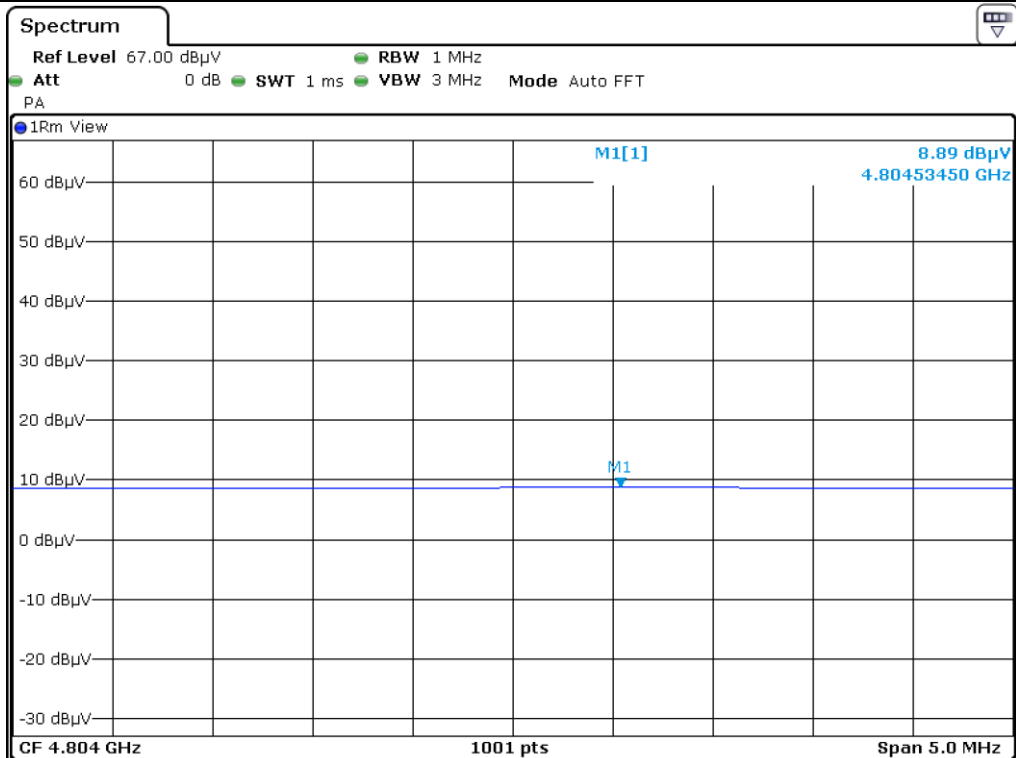
**Tested by: Hyung-Kwon, Oh / Assistant Manager**



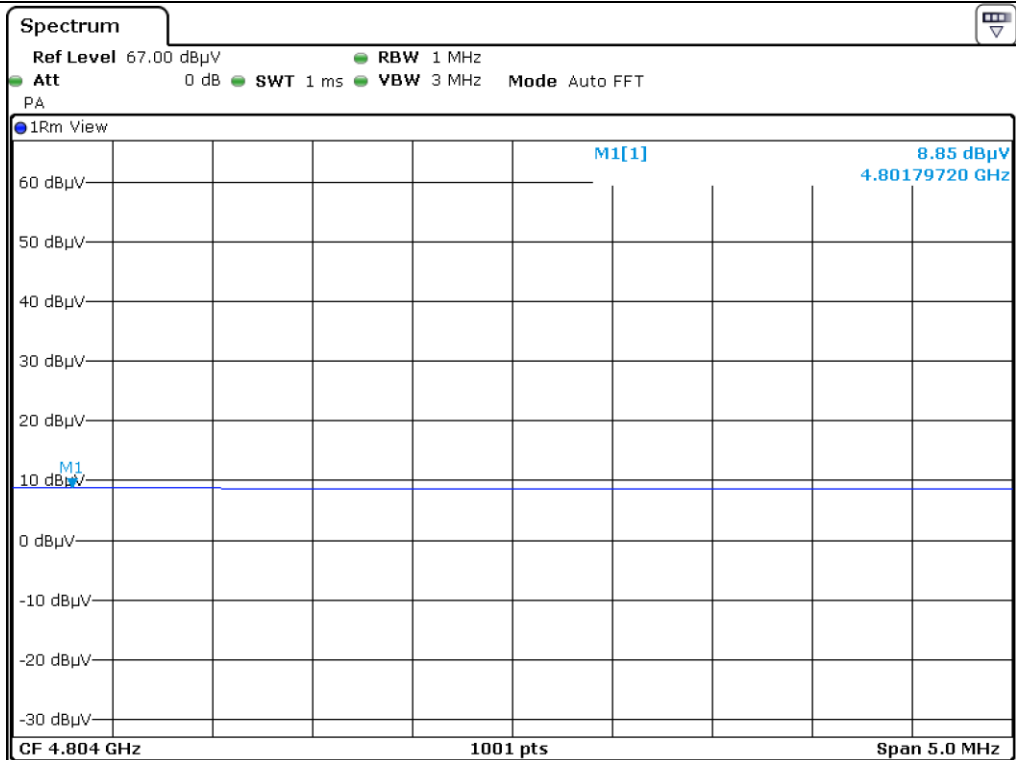
Low Channel\_Peak\_H



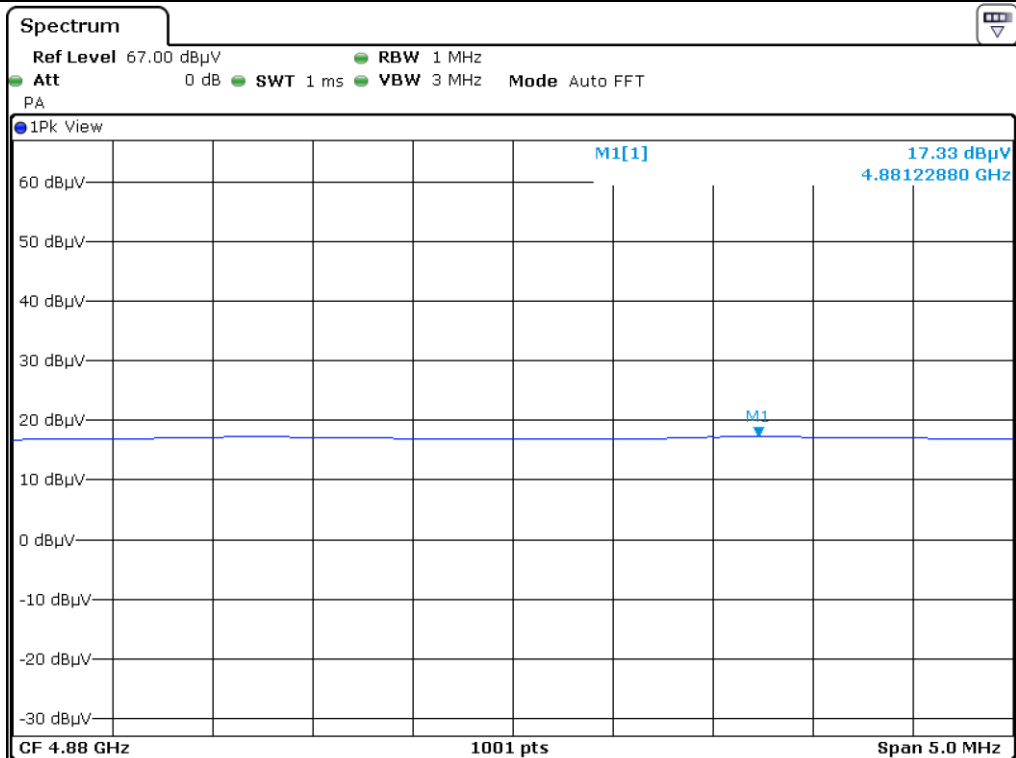
Low Channel\_Peak\_V



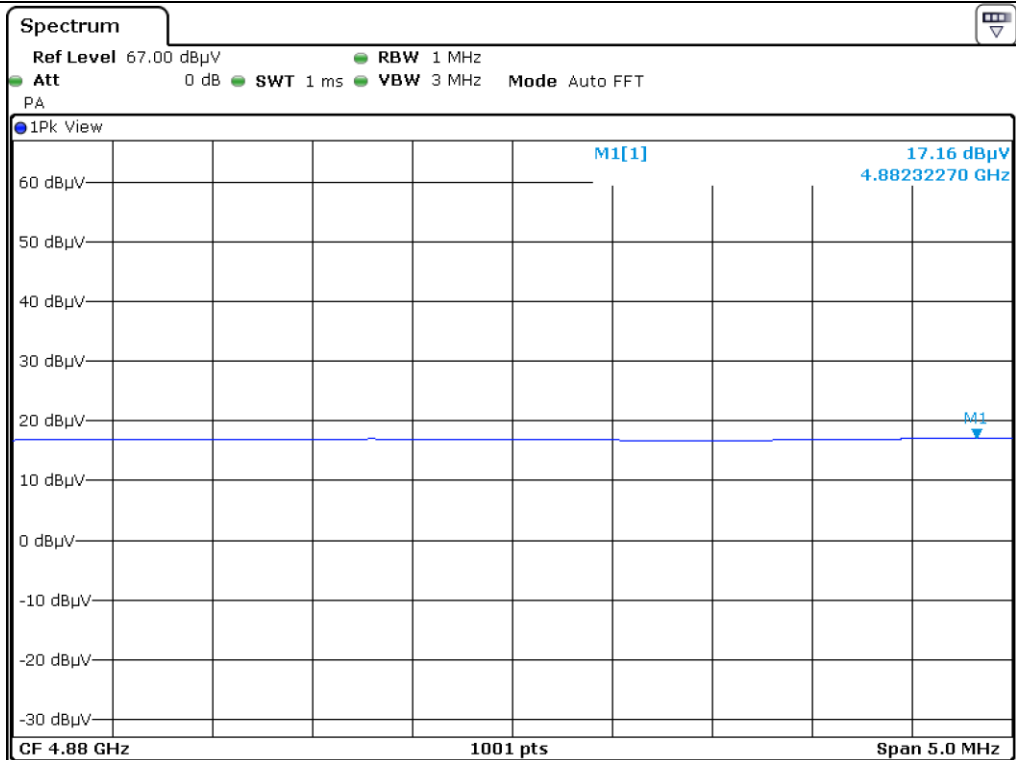
Low Channel\_ Average\_H



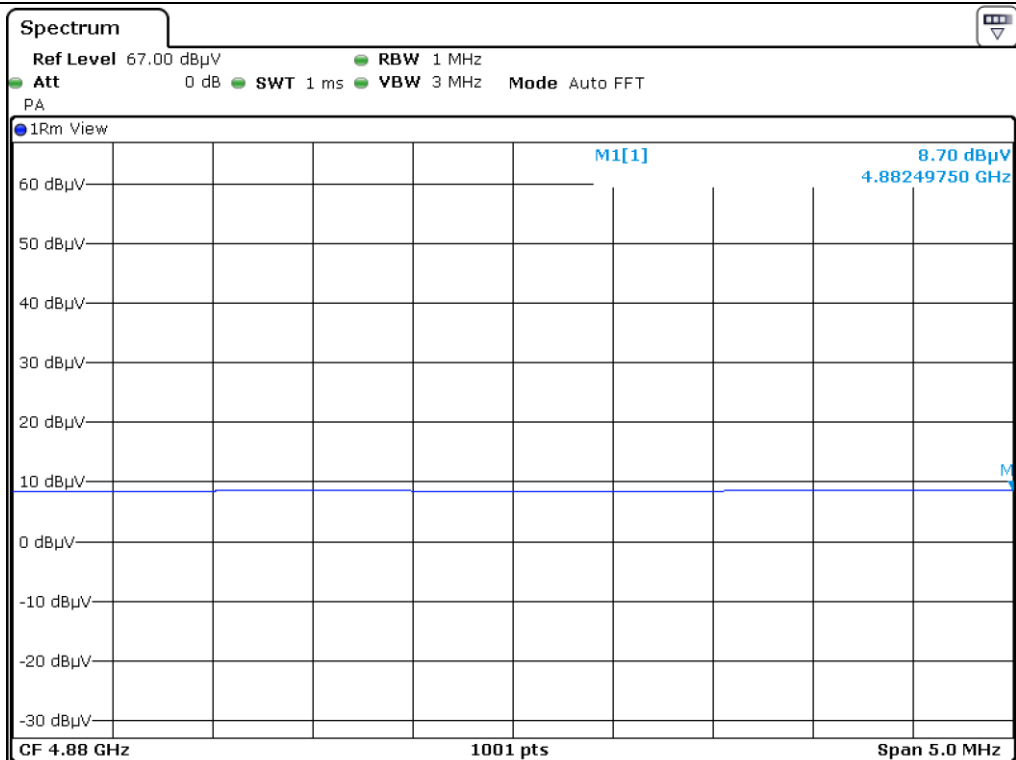
Low Channel\_ Average\_V



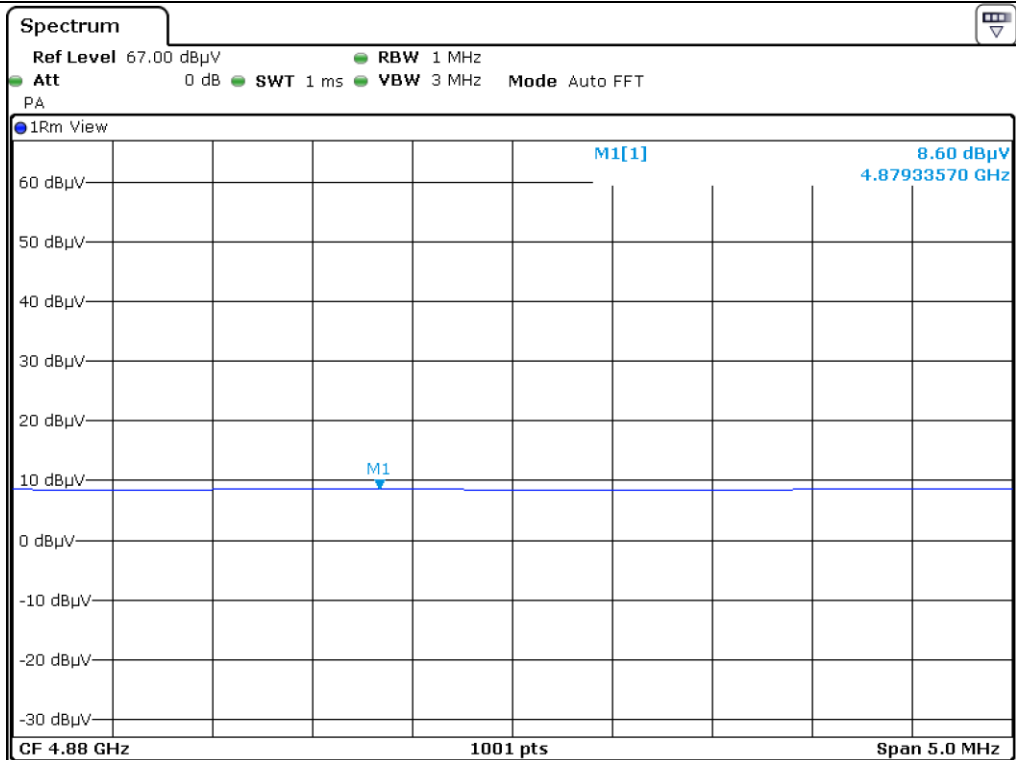
Middle Channel\_Peak\_H



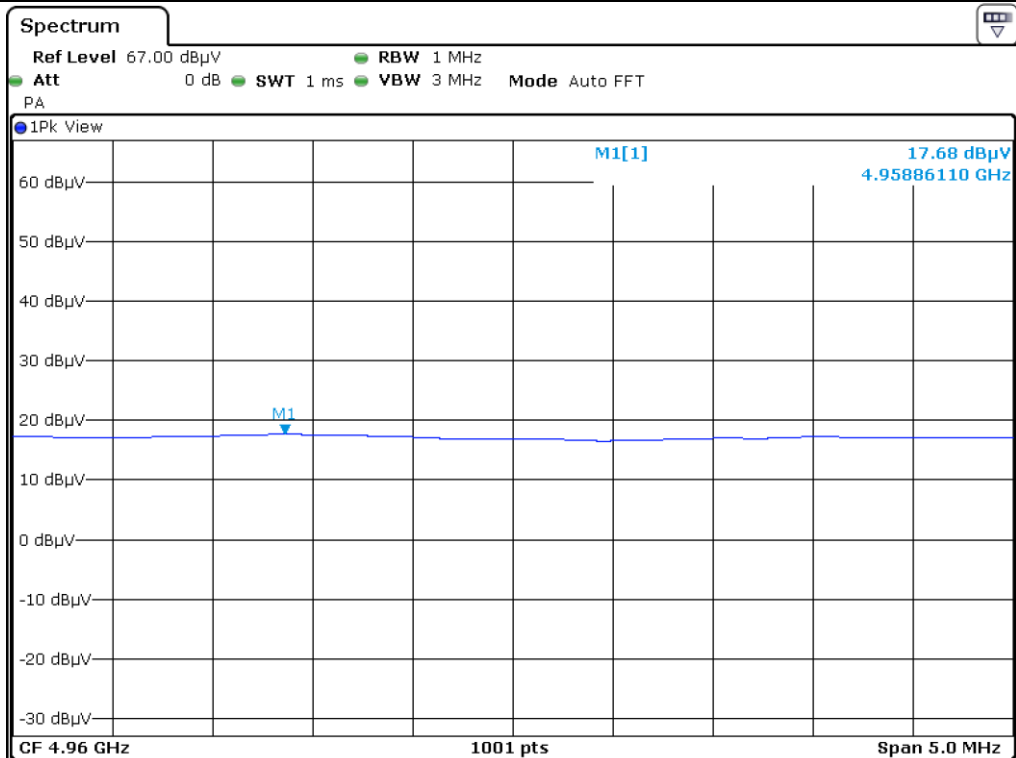
Middle Channel\_Peak\_V



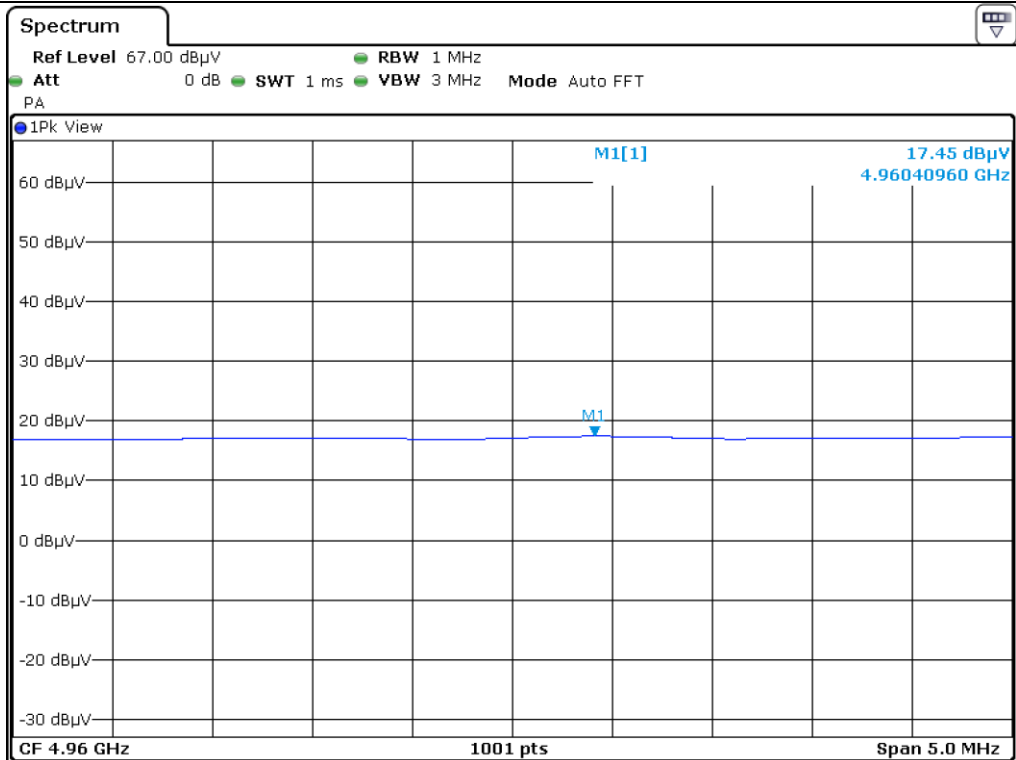
Middle Channel\_Average\_H



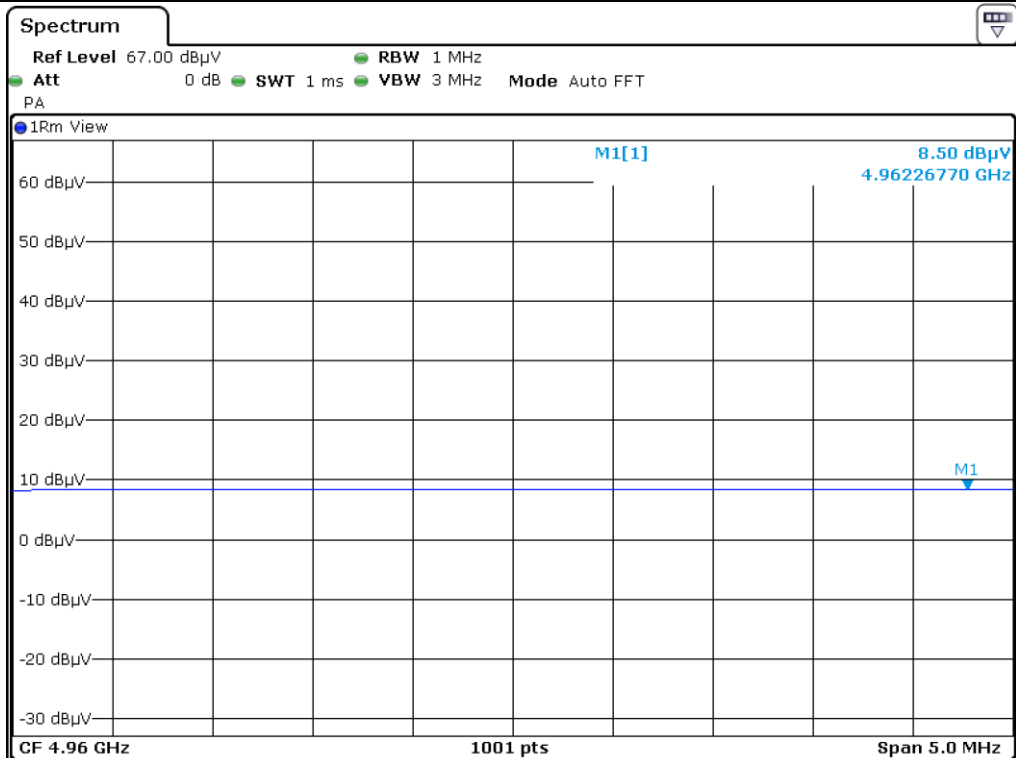
Middle Channel\_Average\_V



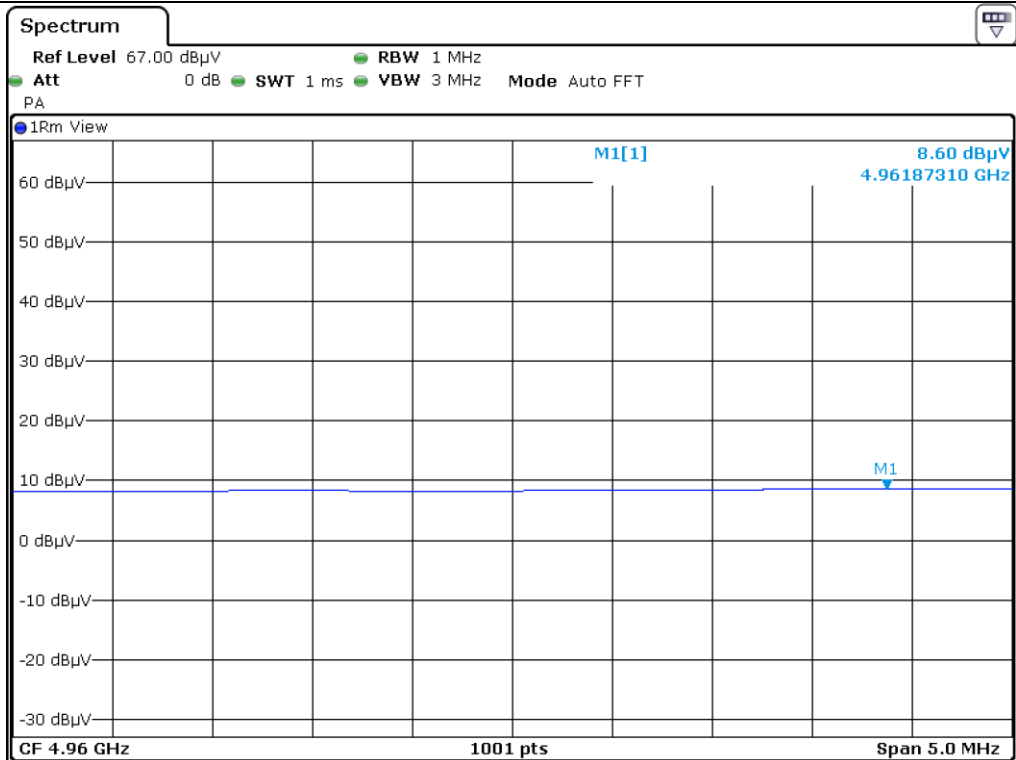
High Channel\_Peak\_H



High Channel\_Peak\_V



High Channel\_Average\_H



High Channel\_Average\_V

## 10. PEAK POWER SPECTRAL DENSITY

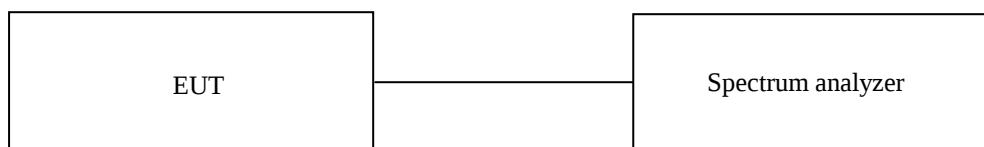
### 10.1 Operating environment

Temperature : 24.3 °C  
Relative humidity : 43.9 % R.H.

### 10.2 Test set-up

The antenna output of the EUT was connected to the spectrum analyzer.

The resolution bandwidth is set to  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ , the video bandwidth is set to 3 times the resolution bandwidth.



### 10.3 Test equipment used

|     | Model Number | Manufacturer    | Description     | Serial Number | Last Cal.          |
|-----|--------------|-----------------|-----------------|---------------|--------------------|
| ■ - | FSV40        | Rohde & Schwarz | Signal Analyzer | 101009        | Mar. 11, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

#### 10.4 Test data for LE Coded\_125 kbps

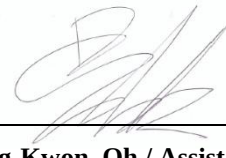
-. Test Date : June 05, 2019 ~ June 11, 2019

-. Test Result : Pass

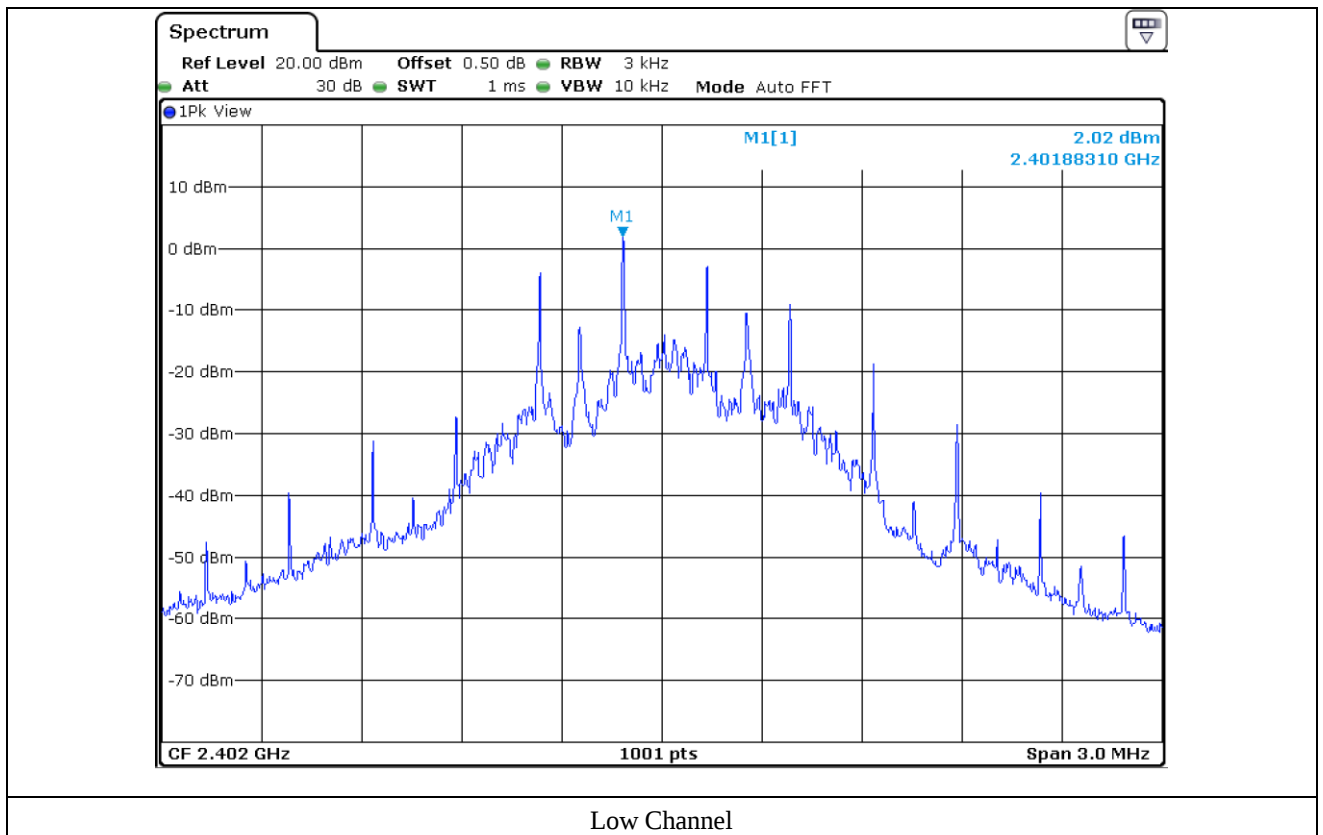
-. Operating Condition : Continuous transmitting mode

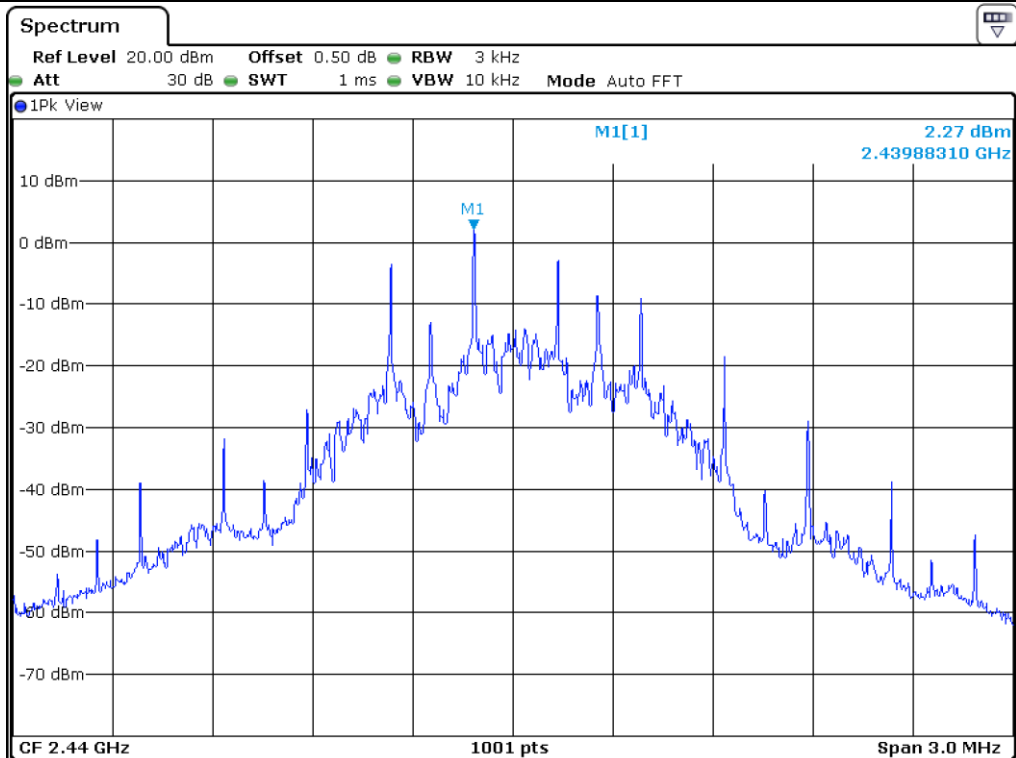
| CHANNEL | FREQUENCY(MHz) | MEASURED VALUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low     | 2 402.00       | 2.02                 | 8.00        | 5.98        |
| Middle  | 2 440.00       | 2.27                 | 8.00        | 5.73        |
| High    | 2 480.00       | 1.80                 | 8.00        | 6.20        |

Remark. Margin = Limit – Measured value

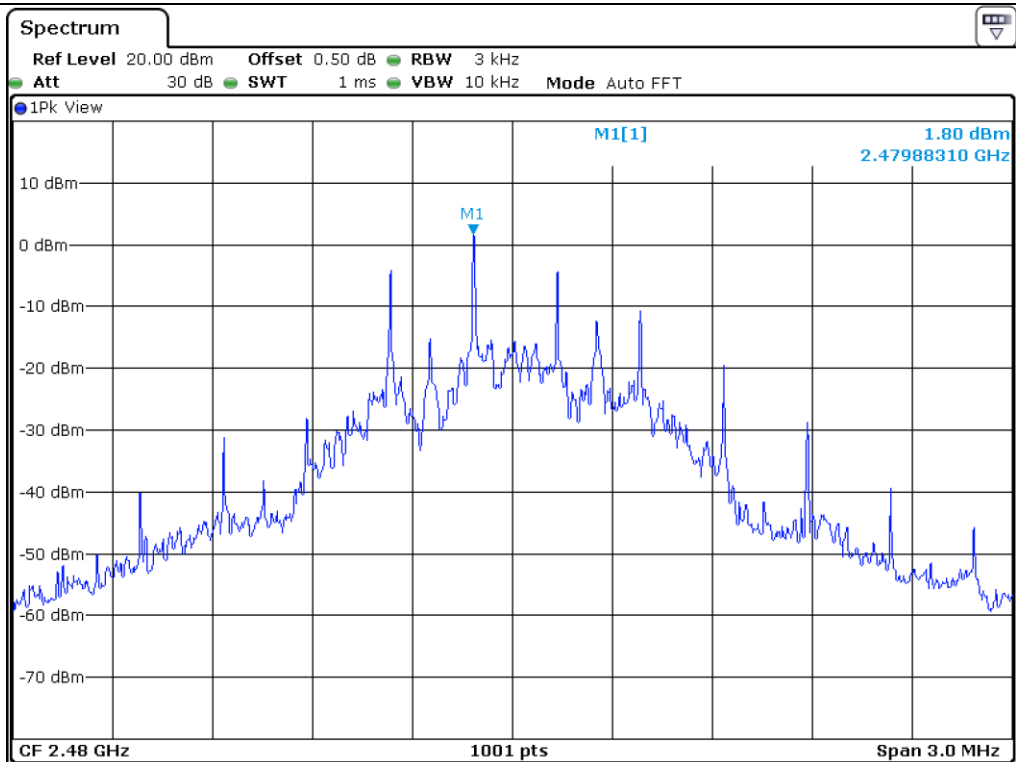


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

### 10.5 Test data for LE Coded\_500 kbps

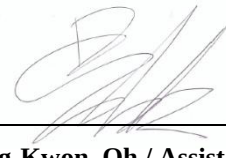
-. Test Date : June 05, 2019 ~ June 11, 2019

-. Test Result : Pass

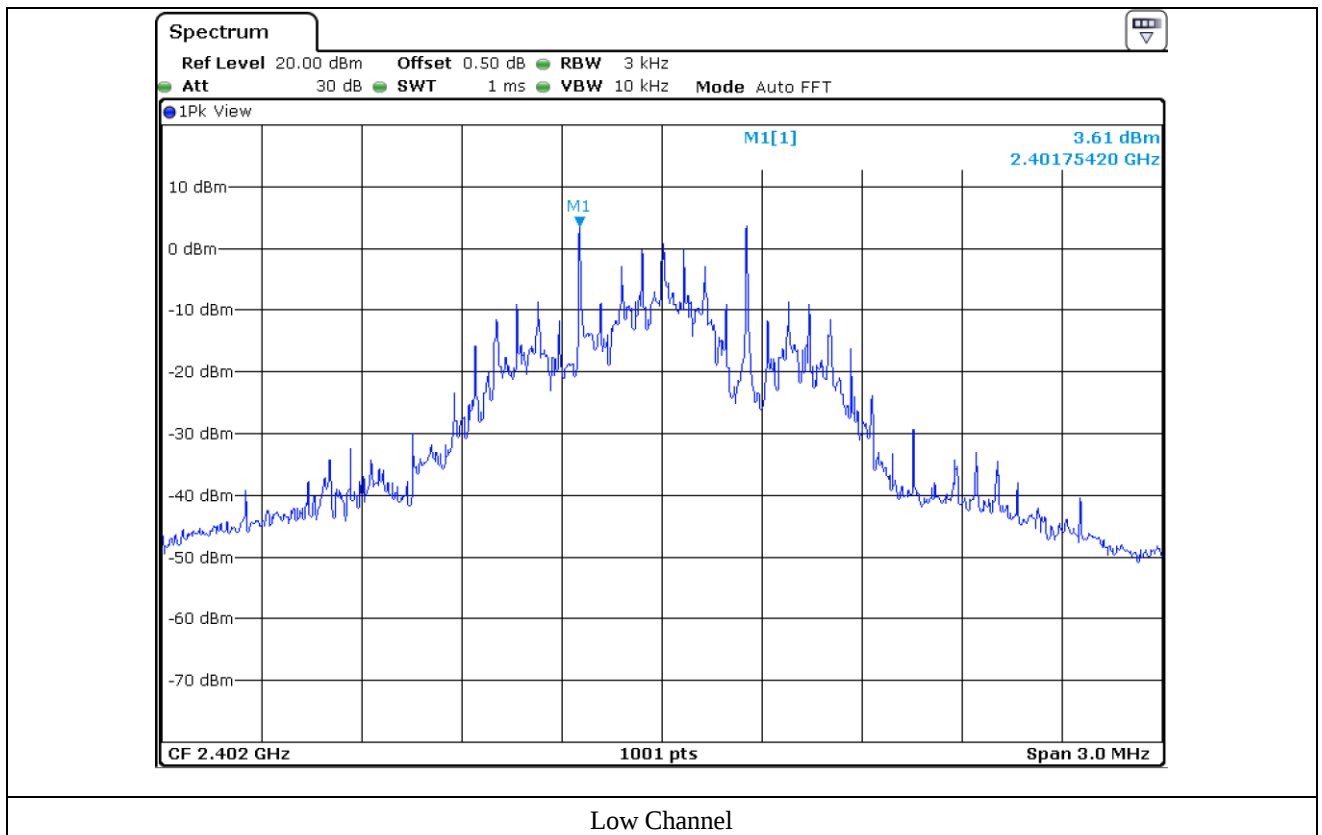
-. Operating Condition : Continuous transmitting mode

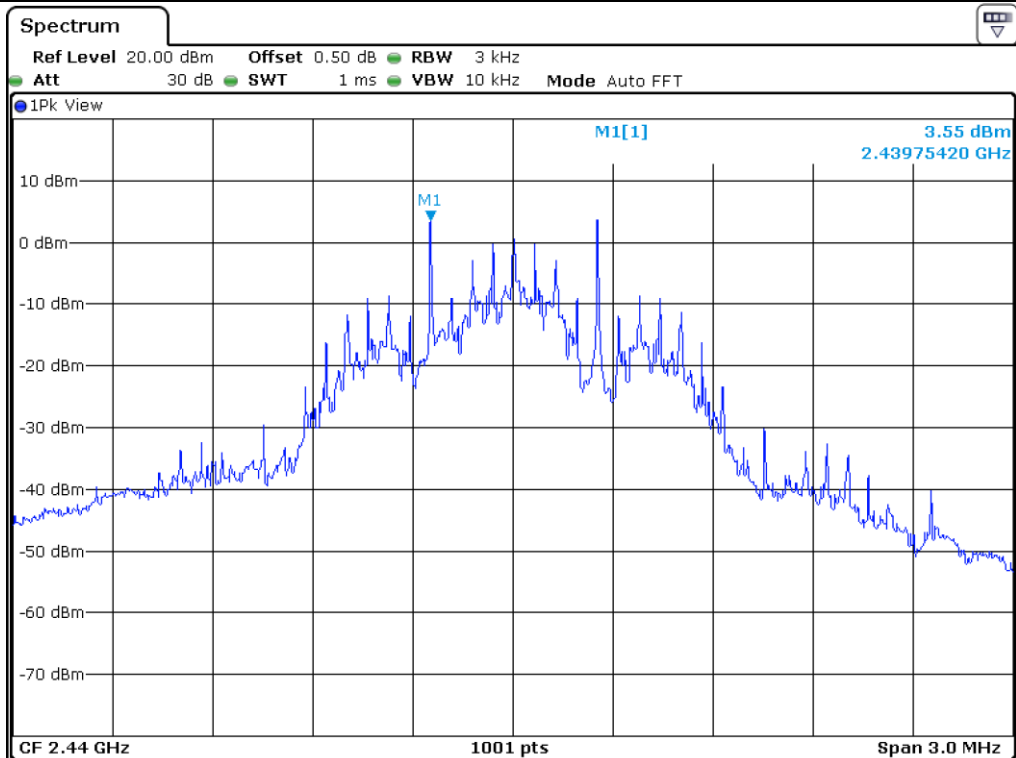
| CHANNEL | FREQUENCY(MHz) | MEASURED VALUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low     | 2 402.00       | 3.61                 | 8.00        | 4.39        |
| Middle  | 2 440.00       | 3.55                 | 8.00        | 4.45        |
| High    | 2 480.00       | 3.72                 | 8.00        | 4.28        |

Remark. Margin = Limit – Measured value

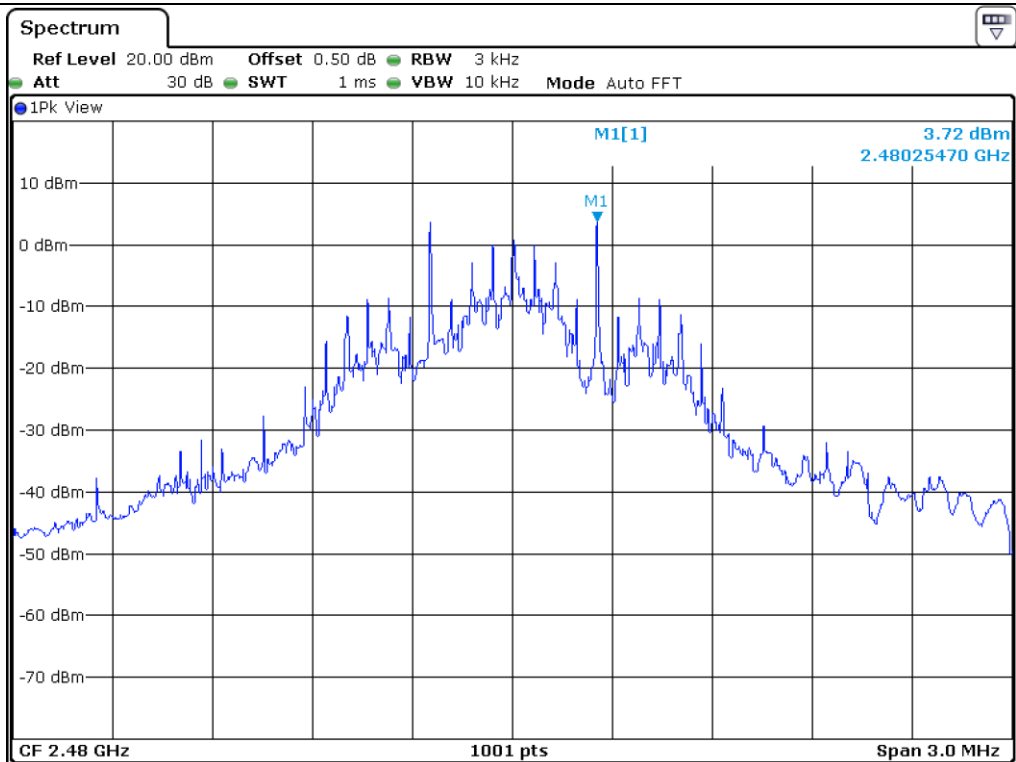


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

## 10.6 Test data for LE 1 M\_1 Mbps

-. Test Date : June 05, 2019 ~ June 11, 2019

-. Test Result : Pass

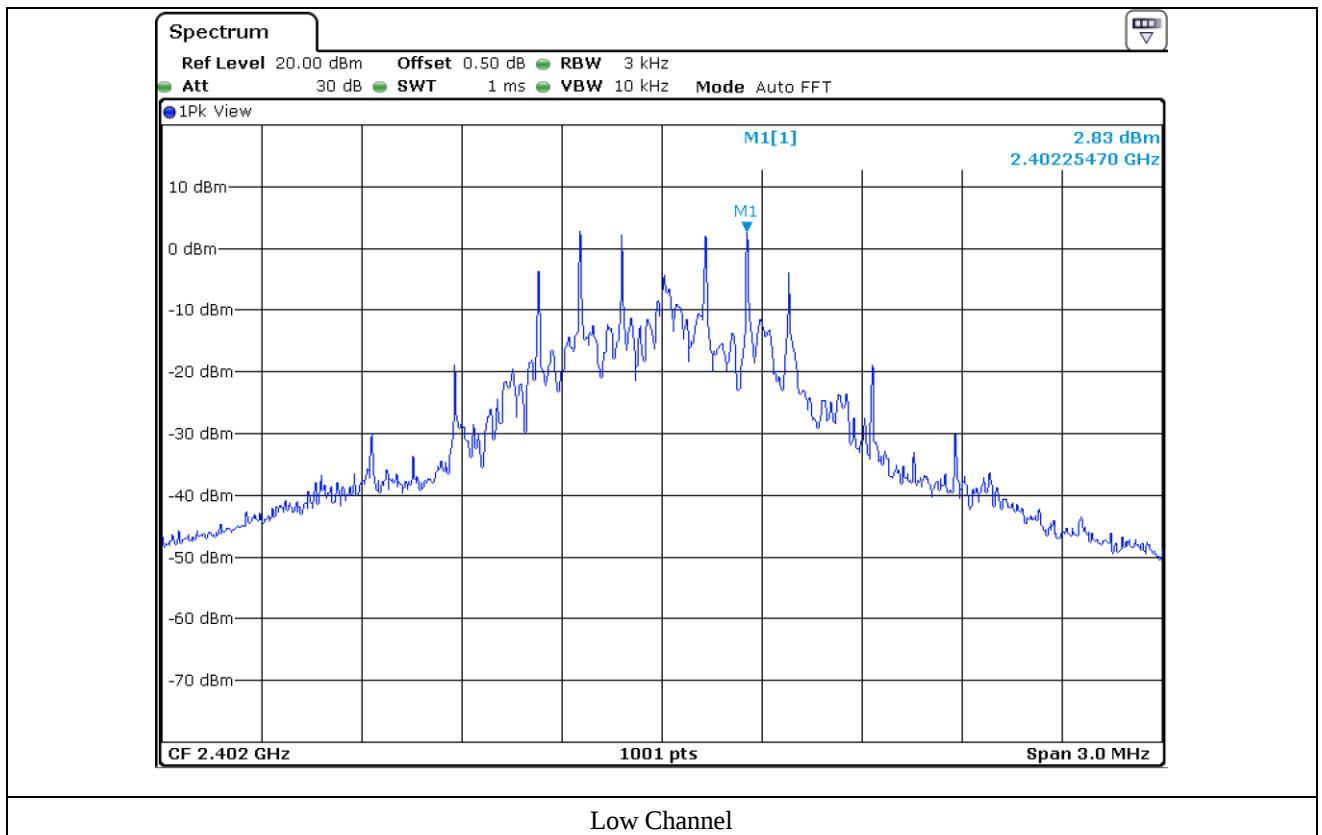
-. Operating Condition : Continuous transmitting mode

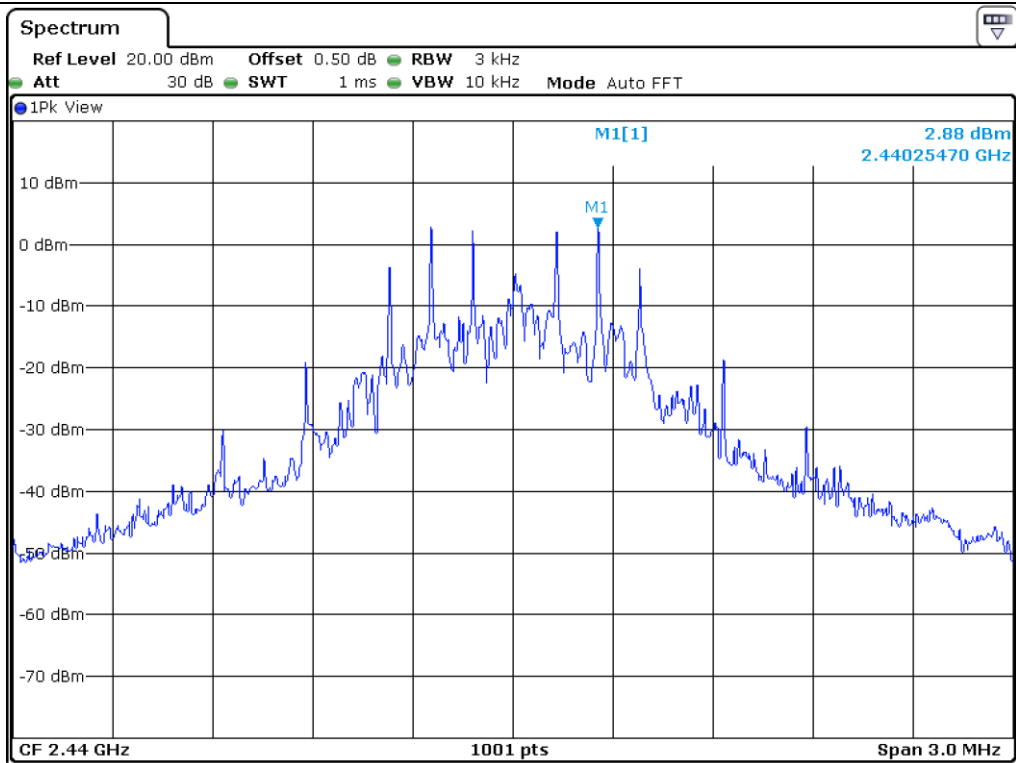
| CHANNEL | FREQUENCY(MHz) | MEASURED VALUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low     | 2 402.00       | 2.83                 | 8.00        | 5.17        |
| Middle  | 2 440.00       | 2.88                 | 8.00        | 5.12        |
| High    | 2 480.00       | 2.96                 | 8.00        | 5.04        |

Remark. Margin = Limit – Measured value

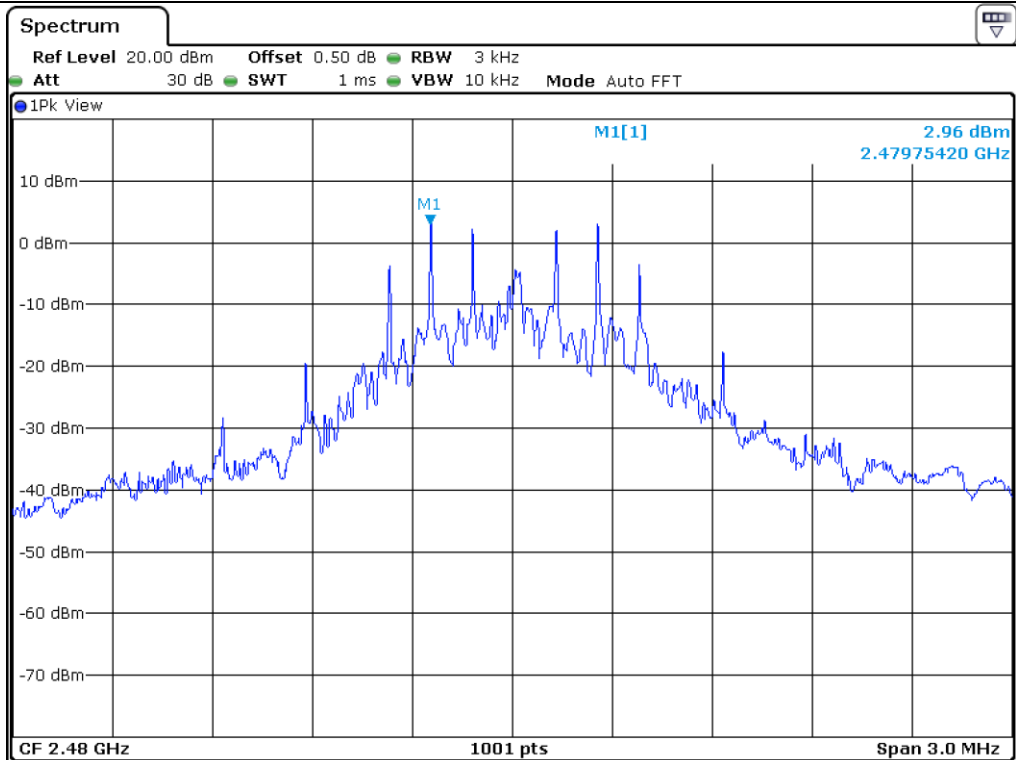


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

### 10.7 Test data for LE 2 M\_2 Mbps

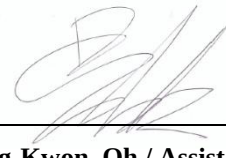
-. Test Date : June 05, 2019 ~ June 11, 2019

-. Test Result : Pass

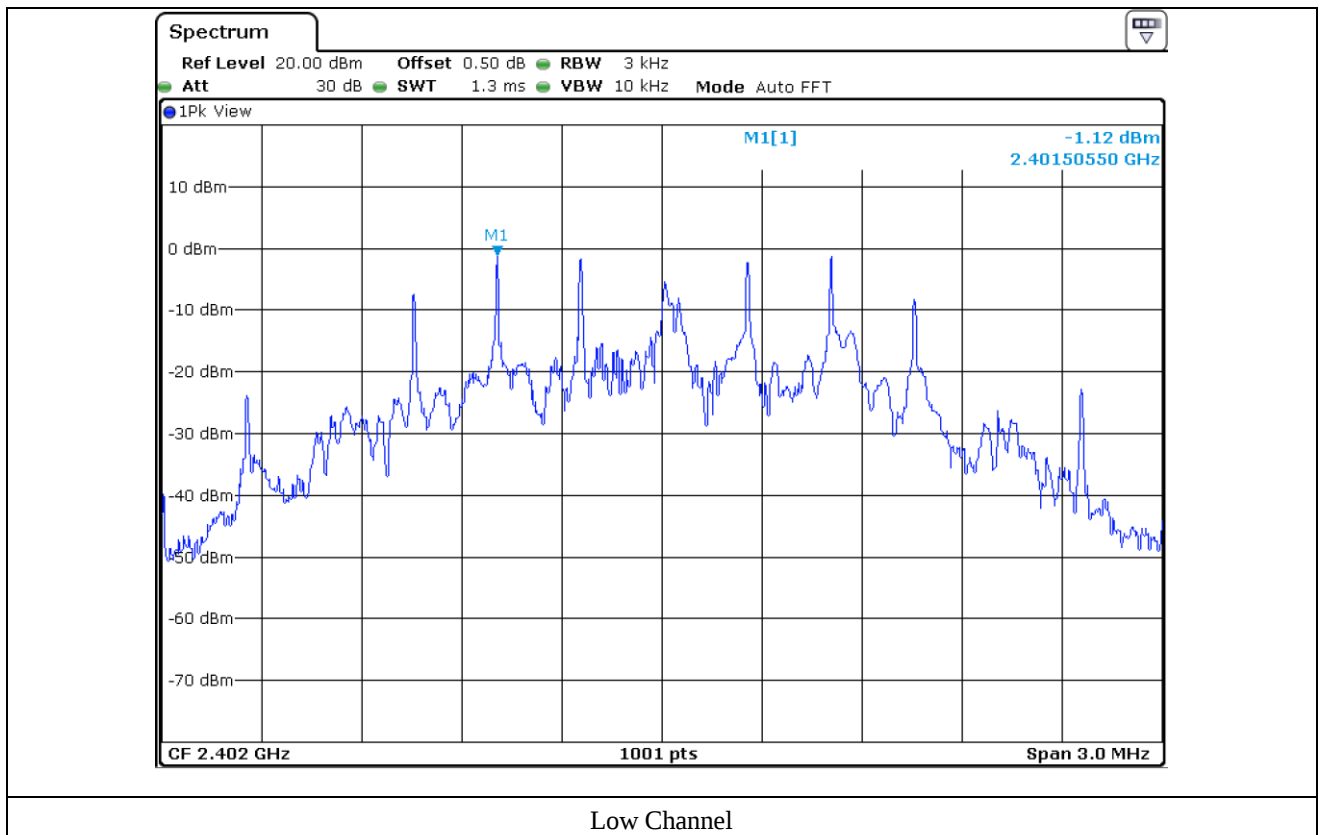
-. Operating Condition : Continuous transmitting mode

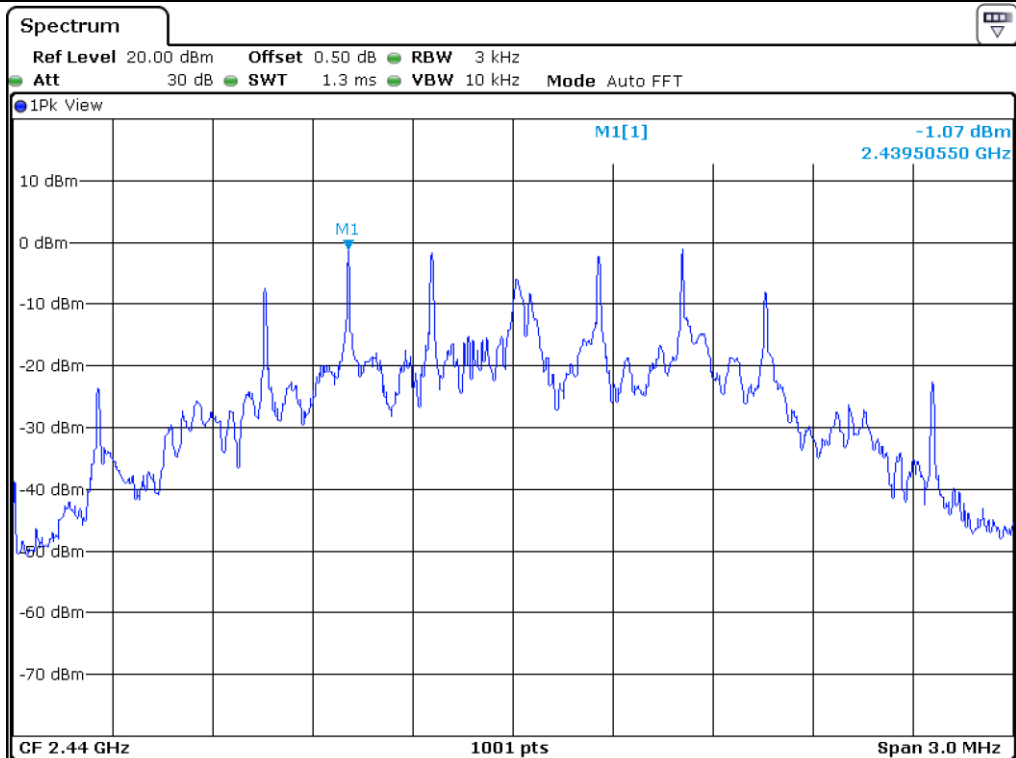
| CHANNEL | FREQUENCY(MHz) | MEASURED VALUE (dBm) | LIMIT (dBm) | MARGIN (dB) |
|---------|----------------|----------------------|-------------|-------------|
| Low     | 2 402.00       | -1.12                | 8.00        | 9.12        |
| Middle  | 2 440.00       | -1.07                | 8.00        | 9.07        |
| High    | 2 480.00       | -1.07                | 8.00        | 9.07        |

Remark. Margin = Limit – Measured value

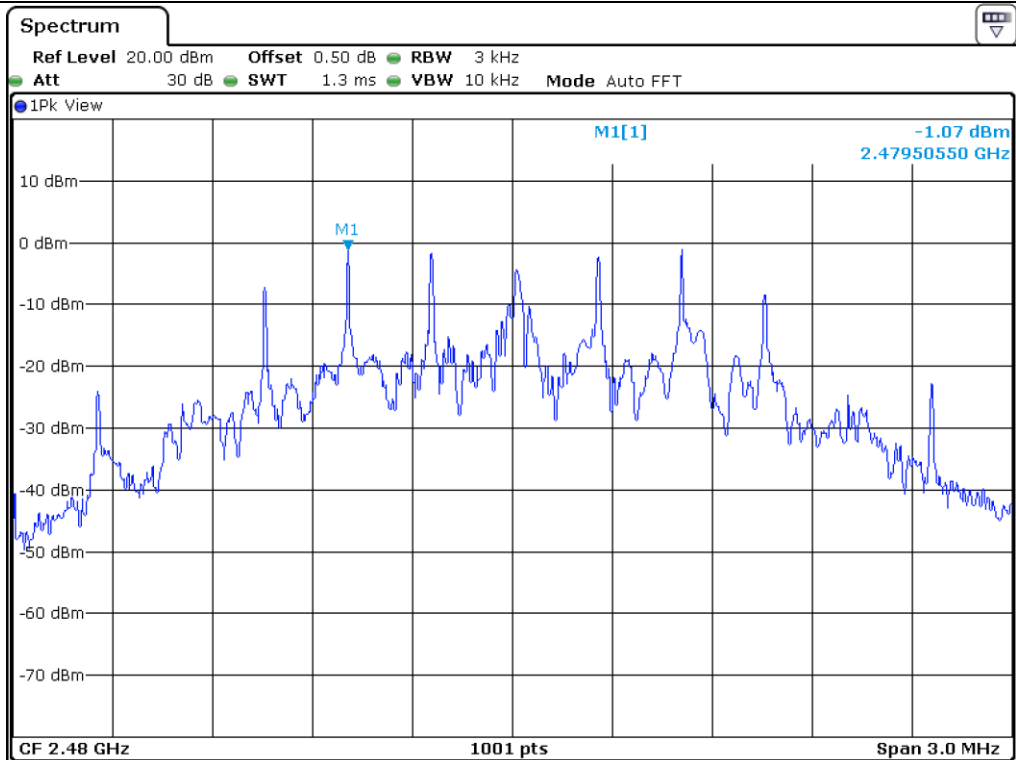


Tested by: Hyung-Kwon, Oh / Assistant Manager





Middle Channel



High Channel

## 11. RADIATED EMISSION TEST

### 11.1 Operating environment

Temperature : 24 °C  
Relative humidity : 43 % R.H.

### 11.2 Test set-up

The radiated emissions measurements were on the 3 m semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

### 11.3 Test equipment used

|     | Model Number | Manufacturer      | Description              | Serial Number | Last Cal.          |
|-----|--------------|-------------------|--------------------------|---------------|--------------------|
| ■ - | FSV40        | Rohde & Schwarz   | Signal Analyzer          | 101009        | Mar. 11, 2019 (1Y) |
| ■ - | ESU          | Rohde & Schwarz   | EMI Test Receiver        | 100261        | Mar. 28, 2019 (1Y) |
| ■ - | 310N         | Sonoma Instrument | Pre-Amplifier            | 312545        | Mar. 18, 2019 (1Y) |
| ■ - | BBV9718      | Schwarzbeck       | Amplifier                | 310           | Mar. 28, 2019 (1Y) |
| ■ - | DT3000-3t    | Innco System      | Turn Table               | DT3000/093    | N/A                |
| ■ - | MA-4000XPET  | Innco System      | Antenna Master           | MA4000/509    | N/A                |
| ■ - | VULB9163     | Schwarzbeck       | TRILOG Broadband Antenna | 777           | Apr. 13, 2018 (2Y) |
| ■ - | BBHA 9120D   | Schwarzbeck       | Horn Antenna             | 9120D-1366    | Aug. 02, 2017 (2Y) |
| ■ - | BBHA 9170    | Schwarzbeck       | Horn Antenna             | BBHA9170179   | Jan. 16, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

## 11.4 Test data

### 11.4.1 Test data for 30 MHz ~ 1 GHz

Humidity Level : 43 % R.H.

Temperature: 24 °C

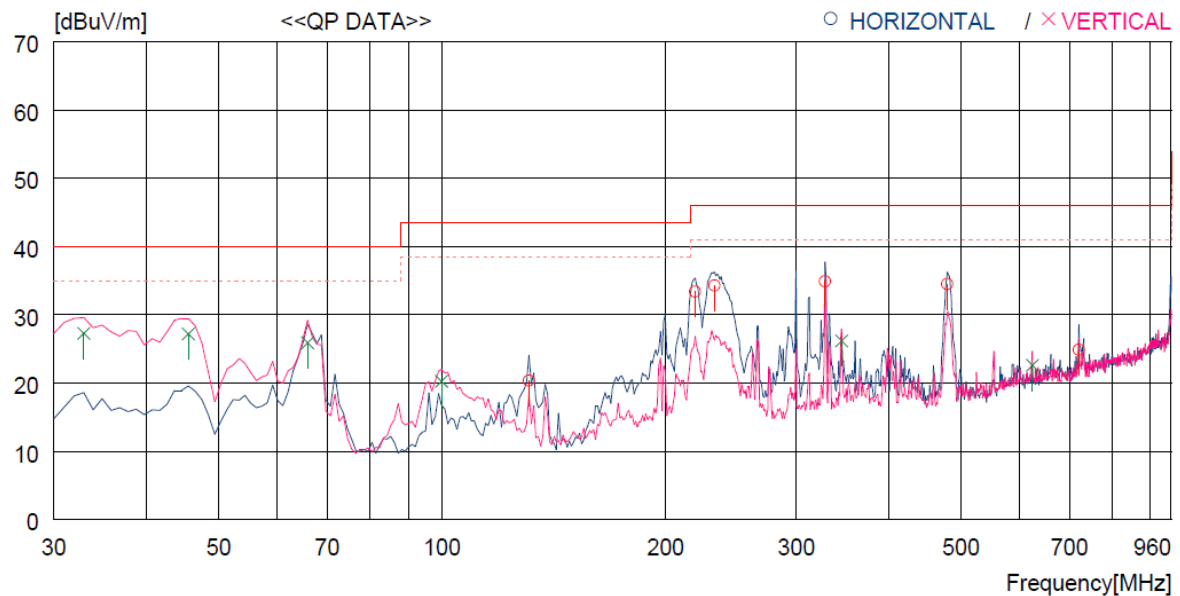
Limits apply to : FCC CFR 47, PART 15, SUBPART C, SECTION 15.247

Result : PASSED

EUT : IoT Module

Date: June 05, 2019 ~ June 11, 2019

Detector : CISPR Quasi-Peak (6 dB Bandwidth: 120 kHz)



| No.                    | FREQ    | READING | ANT    | LOSS | GAIN | RESULT   | LIMIT    | MARGIN | ANTENNA | TABLE |
|------------------------|---------|---------|--------|------|------|----------|----------|--------|---------|-------|
|                        | [MHz]   | [dBuV]  | FACTOR | [dB] | [dB] | [dBuV/m] | [dBuV/m] | [dB]   | [cm]    | [DEG] |
| ----- Horizontal ----- |         |         |        |      |      |          |          |        |         |       |
| 1                      | 130.880 | 41.8    | 9.0    | 2.6  | 33.0 | 20.4     | 43.5     | 23.1   | 300     | 263   |
| 2                      | 219.150 | 51.4    | 11.5   | 3.4  | 32.9 | 33.4     | 46.0     | 12.6   | 200     | 234   |
| 3                      | 232.730 | 51.7    | 11.7   | 4.0  | 33.1 | 34.3     | 46.0     | 11.7   | 200     | 209   |
| 4                      | 479.111 | 45.3    | 16.8   | 5.7  | 33.3 | 34.5     | 46.0     | 11.5   | 100     | 359   |
| 5                      | 720.634 | 31.8    | 19.5   | 7.1  | 33.5 | 24.9     | 46.0     | 21.1   | 300     | 255   |
| 6                      | 327.790 | 49.3    | 14.0   | 4.7  | 33.1 | 34.9     | 46.0     | 11.1   | 100     | 359   |
| ----- Vertical -----   |         |         |        |      |      |          |          |        |         |       |
| 7                      | 32.910  | 46.1    | 12.9   | 1.4  | 33.1 | 27.3     | 40.0     | 12.7   | 100     | 0     |
| 8                      | 45.520  | 44.3    | 14.5   | 1.5  | 33.1 | 27.2     | 40.0     | 12.8   | 100     | 0     |
| 9                      | 65.890  | 46.2    | 10.9   | 1.9  | 33.1 | 25.9     | 40.0     | 14.1   | 100     | 0     |
| 10                     | 99.840  | 38.5    | 12.5   | 2.3  | 33.0 | 20.3     | 43.5     | 23.2   | 100     | 0     |
| 11                     | 345.250 | 39.5    | 15.0   | 4.8  | 33.1 | 26.2     | 46.0     | 19.8   | 200     | 201   |
| 12                     | 623.637 | 30.1    | 19.4   | 6.5  | 33.4 | 22.6     | 46.0     | 23.4   | 100     | 0     |

Tested by: Hyung-Kwon, Oh / Assistant Manager

#### 11.4.2 Test data for Below 30 MHz

- . Test Date : June 05, 2019 ~ June 11, 2019
- . Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)
- . Frequency range : 9 kHz ~ 30 MHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode

| Frequency (MHz)                                 | Reading (dBμV) | Ant. Pol. (H/V) | Ant. Height (m) | Angle (°) | Ant. Factor (dB/m) | Cable Loss | Emission Level(dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|-------------------------------------------------|----------------|-----------------|-----------------|-----------|--------------------|------------|------------------------|-----------------|-------------|
| It was not observed any emissions from the EUT. |                |                 |                 |           |                    |            |                        |                 |             |

#### 11.4.3 Test data for above 1 GHz

- . Test Date : June 05, 2019 ~ June 11, 2019
- . Resolution bandwidth : 1 MHz for Peak and Average Mode
- . Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode
- . Frequency range : 1 GHz ~ 26.5 GHz
- . Measurement distance : 3 m
- . Operating mode : Transmitting mode

| Frequency (MHz)                                 | Reading (dBμV) | Ant. Pol. (H/V) | Ant. Height (m) | Angle (°) | Ant. Factor (dB/m) | Cable Loss | Emission Level(dBμV/m) | Limits (dBμV/m) | Margin (dB) |
|-------------------------------------------------|----------------|-----------------|-----------------|-----------|--------------------|------------|------------------------|-----------------|-------------|
| It was not observed any emissions from the EUT. |                |                 |                 |           |                    |            |                        |                 |             |

  
 Tested by: Hyung-Kwon, Oh / Assistant Manager

## 12. CONDUCTED EMISSION TEST

### 12.1 Operating environment

Temperature : 24 °C  
Relative humidity : 43 % R.H.

### 12.2 Test set-up

The EUT was placed on a wooden table, 0.8 m height above the floor. Power was fed to the EUT through a 50  $\Omega$  / 50  $\mu$ H + 5  $\Omega$  Artificial Mains Network (AMN). The ground plane was electrically bonded to the reference ground system and all power lines were filtered from ambient.

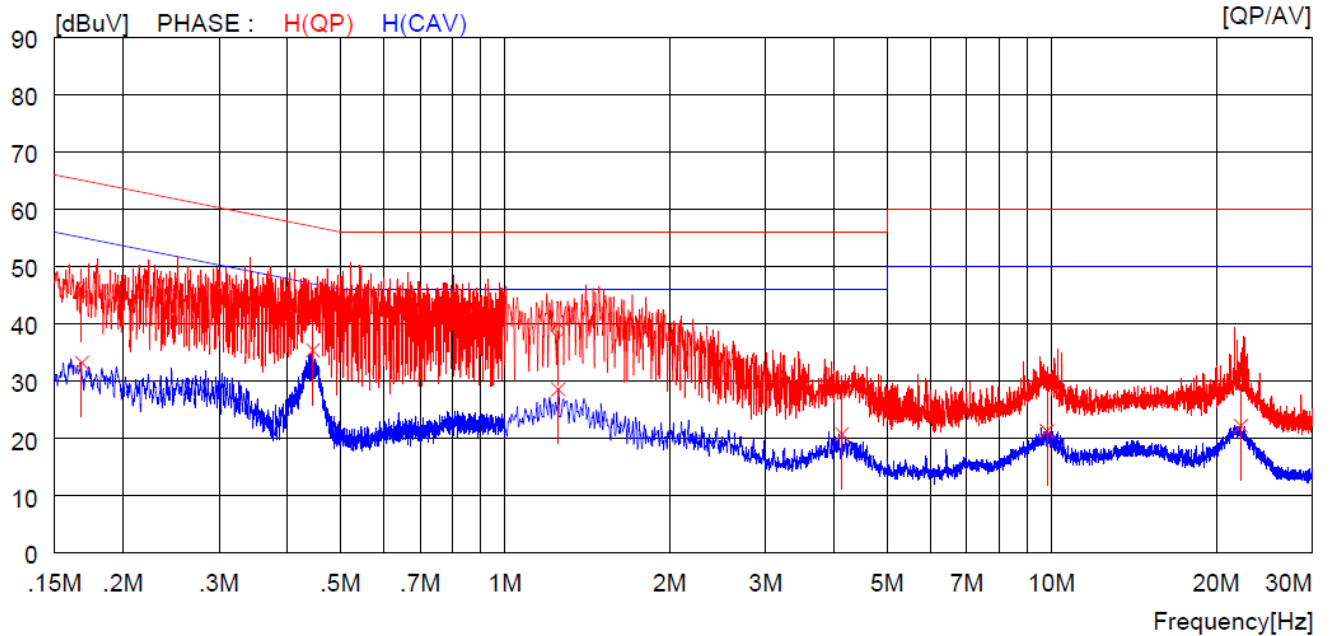
### 12.3 Test equipment used

|     | Model Number | Manufacturer    | Description   | Serial Number | Last Cal. (Interval) |
|-----|--------------|-----------------|---------------|---------------|----------------------|
| ■ - | ESCI         | Rohde & Schwarz | Test Receiver | 101012        | Oct. 22, 2018 (1Y)   |
| □ - | NSLK8128     | Schwarzbeck     | AMN           | 8128-216      | Mar. 20, 2019 (1Y)   |
| ■ - | NSLK8126     | Schwarzbeck     | AMN           | 8126-404      | Mar. 19, 2019 (1Y)   |
| □ - | 3825/2       | EMCO            | AMN           | 9109-1869     | Mar. 19, 2019 (1Y)   |
| ■ - | 3825/2       | EMCO            | AMN           | 9109-1867     | Mar. 27, 2019 (1Y)   |

All test equipment used is calibrated on a regular basis.

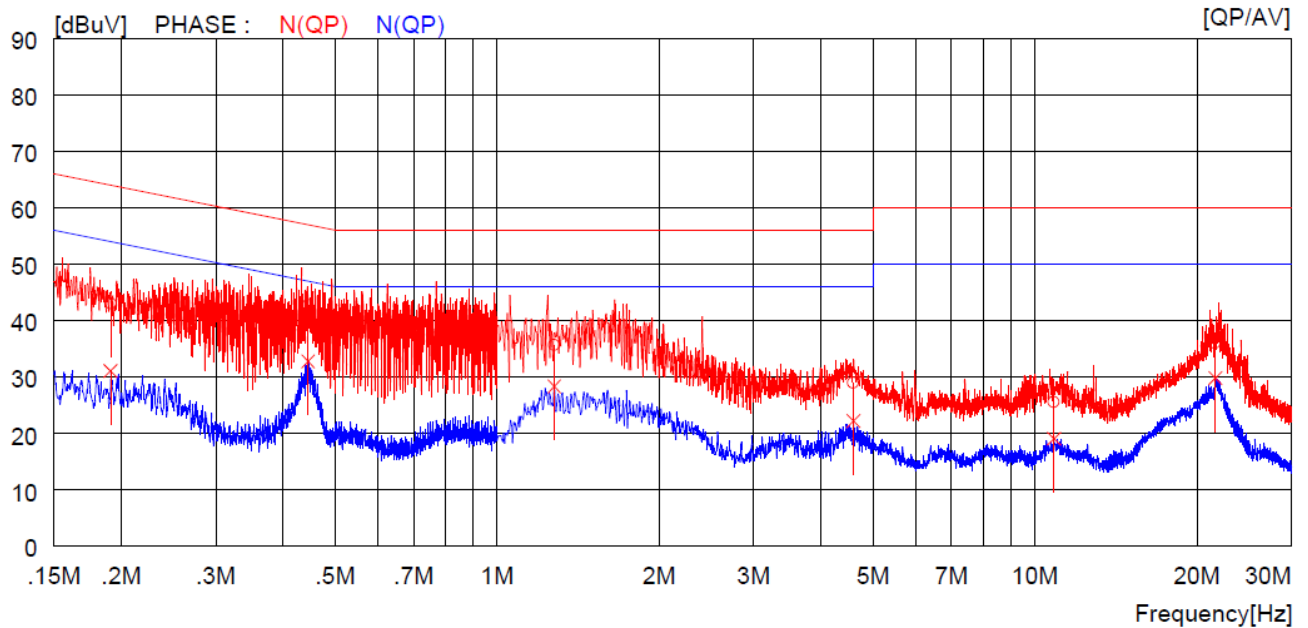
## 12.4 Test data

- Test Date : June 05, 2019 ~ June 11, 2019
- Resolution bandwidth : 9 kHz
- Frequency range : 0.15 MHz ~ 30 MHz
- Tested Line : HOT LINE



| NO | FREQ<br>[MHz] | READING      |              | C.FACTOR<br>[dB] | RESULT       |              | LIMIT        |              | MARGIN       |              | PHASE   |
|----|---------------|--------------|--------------|------------------|--------------|--------------|--------------|--------------|--------------|--------------|---------|
|    |               | QP<br>[dBuV] | AV<br>[dBuV] |                  | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[dBuV] |         |
| 1  | 0.16800       | 36.3         | ----         | 10.0             | 46.3         | ----         | 65.1         | ----         | 18.8         | ----         | H (QP)  |
| 2  | 0.44500       | 31.4         | ----         | 10.0             | 41.4         | ----         | 57.0         | ----         | 15.6         | ----         | H (QP)  |
| 3  | 1.25200       | 28.7         | ----         | 10.1             | 38.8         | ----         | 56.0         | ----         | 17.2         | ----         | H (QP)  |
| 4  | 4.13600       | 18.9         | ----         | 10.1             | 29.0         | ----         | 56.0         | ----         | 27.0         | ----         | H (QP)  |
| 5  | 9.80500       | 19.9         | ----         | 10.3             | 30.2         | ----         | 60.0         | ----         | 29.8         | ----         | H (QP)  |
| 6  | 22.17000      | 18.7         | ----         | 10.7             | 29.4         | ----         | 60.0         | ----         | 30.6         | ----         | H (QP)  |
| 7  | 0.16800       | ----         | 23.2         | 10.0             | ----         | 33.2         | ----         | 55.1         | ----         | 21.9         | H (CAV) |
| 8  | 0.44500       | ----         | 25.4         | 10.0             | ----         | 35.4         | ----         | 47.0         | ----         | 11.6         | H (CAV) |
| 9  | 1.25200       | ----         | 18.5         | 10.1             | ----         | 28.6         | ----         | 46.0         | ----         | 17.4         | H (CAV) |
| 10 | 4.13600       | ----         | 10.6         | 10.1             | ----         | 20.7         | ----         | 46.0         | ----         | 25.3         | H (CAV) |
| 11 | 9.80500       | ----         | 11.0         | 10.3             | ----         | 21.3         | ----         | 50.0         | ----         | 28.7         | H (CAV) |
| 12 | 22.17000      | ----         | 11.5         | 10.7             | ----         | 22.2         | ----         | 50.0         | ----         | 27.8         | H (CAV) |

-. Tested Line : NEUTRAL LINE



| NO | FREQ<br>[MHz] | READING      |              | C.FACTOR<br>[dB] | RESULT       |              | LIMIT        |              | MARGIN       |              | PHASE   |
|----|---------------|--------------|--------------|------------------|--------------|--------------|--------------|--------------|--------------|--------------|---------|
|    |               | QP<br>[dBuV] | AV<br>[dBuV] |                  | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[dBuV] | QP<br>[dBuV] | AV<br>[dBuV] |         |
| 1  | 0.19100       | 33.1         | ----         | 10.0             | 43.1         | ----         | 64.0         | ----         | 20.9         | ----         | N (QP)  |
| 2  | 0.44500       | 32.7         | ----         | 10.0             | 42.7         | ----         | 57.0         | ----         | 14.3         | ----         | N (QP)  |
| 3  | 1.27600       | 25.6         | ----         | 10.1             | 35.7         | ----         | 56.0         | ----         | 20.3         | ----         | N (QP)  |
| 4  | 4.59600       | 18.9         | ----         | 10.1             | 29.0         | ----         | 56.0         | ----         | 27.0         | ----         | N (QP)  |
| 5  | 10.85000      | 15.2         | ----         | 10.4             | 25.6         | ----         | 60.0         | ----         | 34.4         | ----         | N (QP)  |
| 6  | 21.65000      | 25.3         | ----         | 10.7             | 36.0         | ----         | 60.0         | ----         | 24.0         | ----         | N (QP)  |
| 7  | 0.19100       | ----         | 21.1         | 10.0             | ----         | 31.1         | ----         | 54.0         | ----         | 22.9         | N (CAV) |
| 8  | 0.44500       | ----         | 22.8         | 10.0             | ----         | 32.8         | ----         | 47.0         | ----         | 14.2         | N (CAV) |
| 9  | 1.27600       | ----         | 18.3         | 10.1             | ----         | 28.4         | ----         | 46.0         | ----         | 17.6         | N (CAV) |
| 10 | 4.59600       | ----         | 12.1         | 10.1             | ----         | 22.2         | ----         | 46.0         | ----         | 23.8         | N (CAV) |
| 11 | 10.85000      | ----         | 8.7          | 10.4             | ----         | 19.1         | ----         | 50.0         | ----         | 30.9         | N (CAV) |
| 12 | 21.65000      | ----         | 19.1         | 10.7             | ----         | 29.8         | ----         | 50.0         | ----         | 20.2         | N (CAV) |

Remark: Margin (dB) = Limit – Level (Result)

The emission level in above table is included the transducer factor that means insertion loss (LISN), cable loss and attenuator.

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