

6.6 Hopping Channel Number

| | |
|-------------------|--|
| Test Requirement: | FCC Part15 C Section 15.247 (a)(1)(iii) |
| Test Method: | ANSI C63.10:2013 |
| Receiver setup: | RBW=100kHz, VBW=300kHz, Frequency range=2400MHz-2483.5MHz, Detector=Peak |
| Limit: | 15 channels |
| Test setup: | <p style="text-align: center;"> Spectrum Analyzer E.U.T Non-Conducted Table Ground Reference Plane </p> |
| Test Instruments: | Refer to section 5.0 for details |
| Test mode: | Refer to section 4.1 for details |
| Test results: | Pass |

Measurement Data:

| Mode | Hopping channel numbers | Limit | Result |
|--------|-------------------------|-------|--------|
| GFSK | 79 | ≥15CH | Pass |
| 8-DPSK | 79 | ≥15CH | Pass |

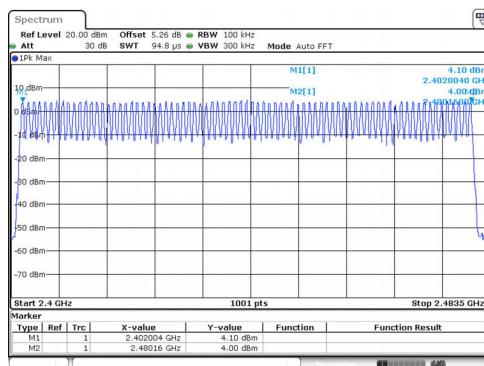
Note:

- During the test, pre-scan the GFSK, $\pi/4$ -DQPSK, 8-DPSK modulation, found the GFSK& 8-DPSK modulation which it is worse case, and show in this report.

Test plot as follows:

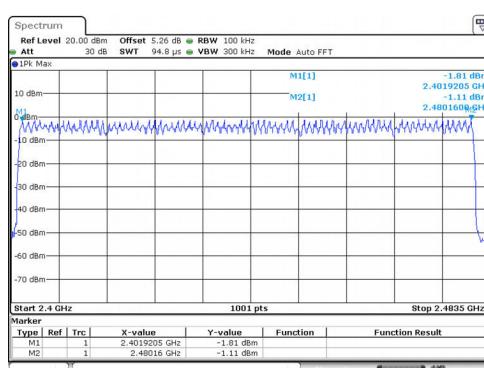
Test mode:

GFSK

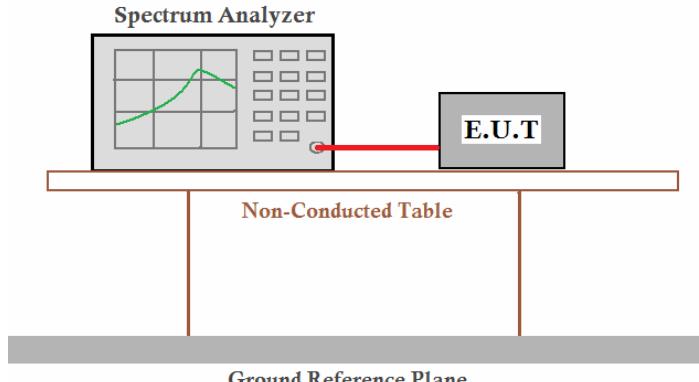


Test mode:

8-DPSK



6.7 Dwell Time

| | |
|-------------------|--|
| Test Requirement: | FCC Part15 C Section 15.247 (a)(1)(iii) |
| Test Method: | ANSI C63.10:2013 |
| Receiver setup: | RBW=1MHz, VBW=1MHz, Span=0Hz, Detector=Peak |
| Limit: | 0.4 Second |
| Test setup: |  |
| Test Instruments: | Refer to section 5.0 for details |
| Test mode: | Refer to section 4.1 for details |
| Test results: | Pass |

Measurement Data**GFSK mode:**

| Frequency | Packet | Dwell time(ms) | Limit(ms) | Result |
|-----------|--------|----------------|-----------|--------|
| 2402MHz | DH1 | 120.08 | 400 | Pass |
| 2402MHz | DH3 | 256.695 | 400 | Pass |
| 2402MHz | DH5 | 302.82 | 400 | Pass |

Remarks:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

Test channel: 2402MHz as blow

DH1 time slot=0.3817(ms)*(1600/ (2*79))*31.6=122.14ms

DH3 time slot=1.635(ms)*(1600/ (4*79))*31.6=261.60ms

DH5 time slot=2.883(ms)*(1600/ (6*79))*31.6=307.52ms

8-DPSK mode:

| Frequency | Packet | Dwell time(ms) | Limit(ms) | Result |
|-----------|--------|----------------|-----------|--------|
| 2402MHz | 3DH1 | 122.535 | 400 | Pass |
| 2402MHz | 3DH3 | 265.842 | 400 | Pass |
| 2402MHz | 3DH5 | 306.34 | 400 | Pass |

Remarks:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s

Test channel: 2402MHz as blow

DH1 time slot=0.390(ms)*(1600/ (2*79))*31.6=124.80ms

DH3 time slot=1.64(ms)*(1600/ (4*79))*31.6=262.40ms

DH5 time slot=2.892(ms)*(1600/ (6*79))*31.6=308.48ms

Note:

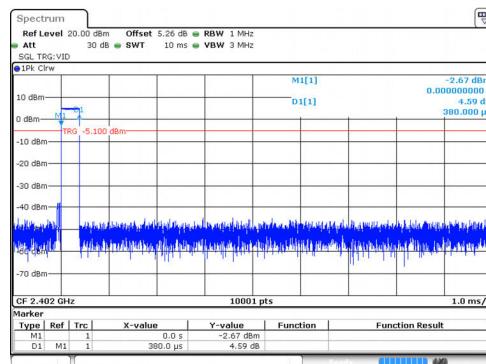
- During the test, pre-scan the GFSK, π/4-DQPSK, 8-DPSK modulation, found the GFSK& 8-DPSK modulation which it is worse case, and show in this report.

Test plot as follows:

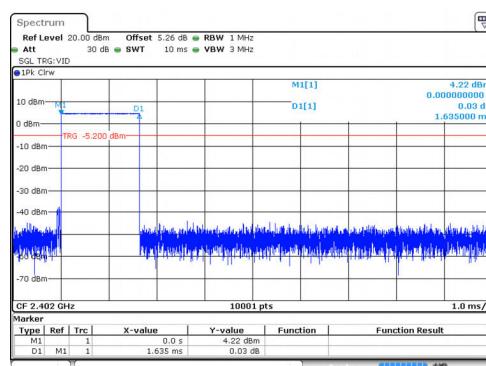
GFSK mode:

Test channel:

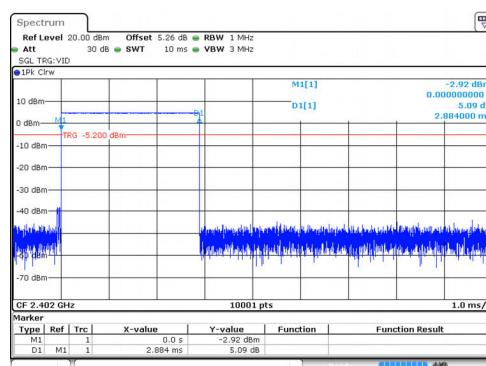
2402MHz



DH1



DH3

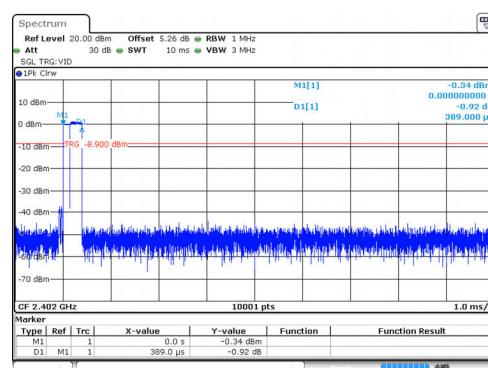
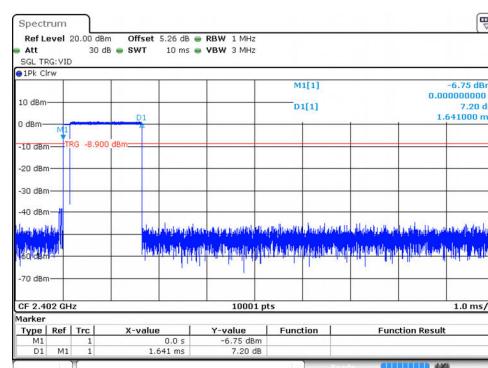
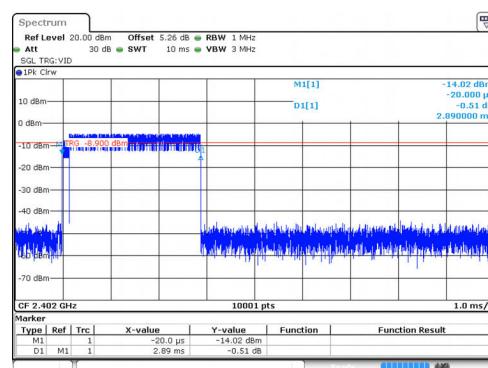


DH5

8-DPSK mode:

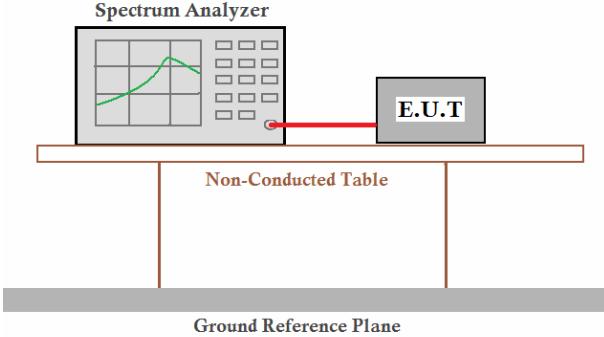
Test channel:

2402MHz


DH1

DH3

DH5

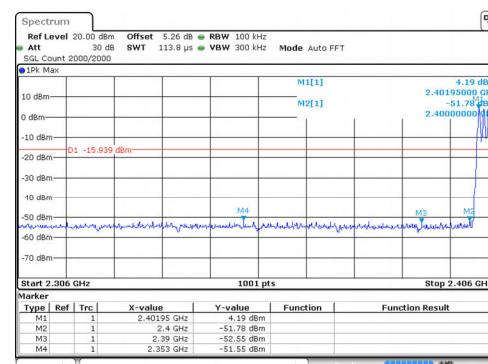
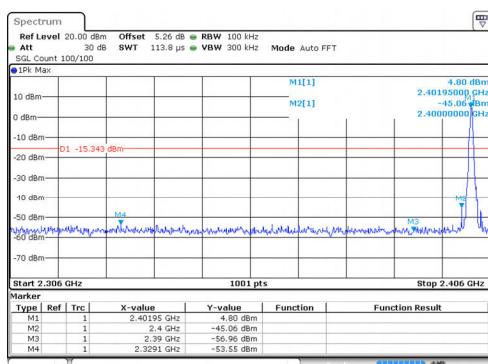
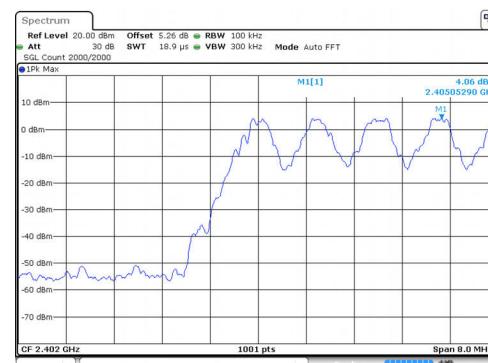
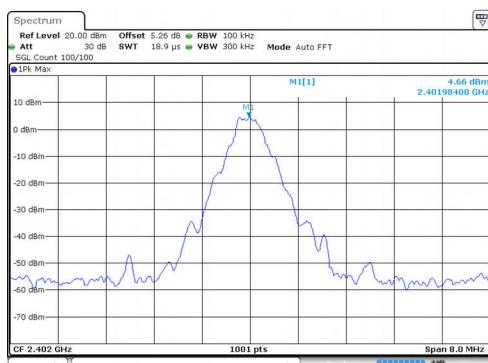
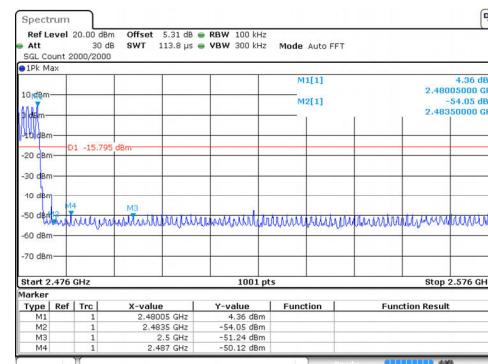
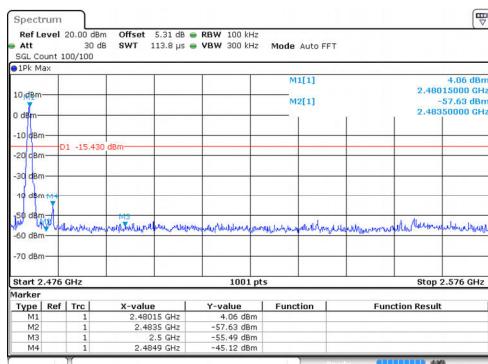
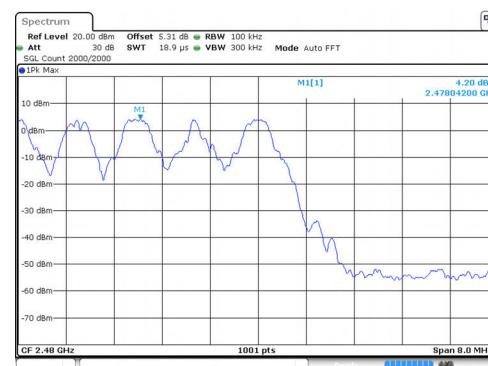
6.8 Band Edge

6.8.1 Conducted Emission Method

| | |
|-------------------|---|
| Test Requirement: | FCC Part15 C Section 15.247 (d) |
| Test Method: | ANSI C63.10:2013 |
| Receiver setup: | RBW=100kHz, VBW=300kHz, Detector=Peak |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. |
| Test setup: | <p style="text-align: center;"> Spectrum Analyzer  Non-Conducted Table Ground Reference Plane </p> |
| Test Instruments: | Refer to section 5.0 for details |
| Test mode: | Refer to section 4.1 for details |
| Test results: | Pass |

Note:

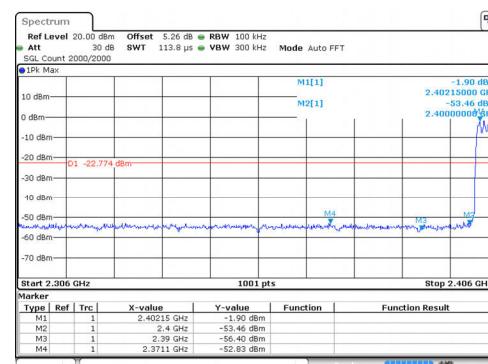
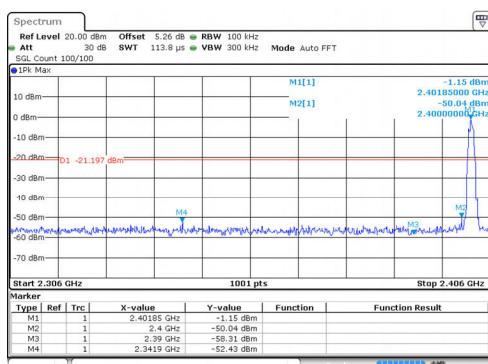
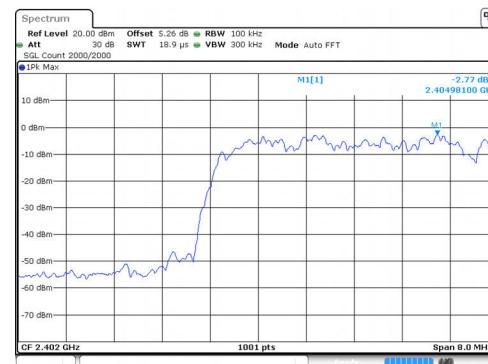
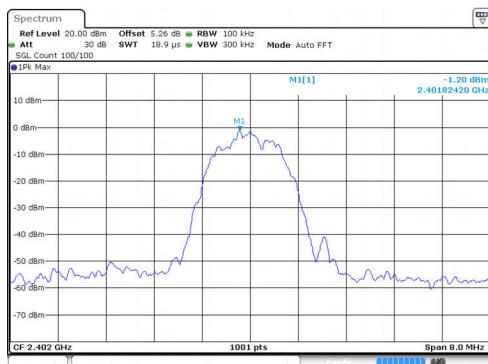
1. During the test, pre-scan the GFSK, $\pi/4$ -DQPSK, 8-DPSK modulation, found the GFSK& 8-DPSK modulation which it is worse case, and show in this report.

Test plot as follows:
Test channel:
Lowest channel

No-hopping mode
Hopping mode
Test channel:
Highest channel

No-hopping mode
Hopping mode

8-DPSK Mode:

Test channel:

Lowest channel

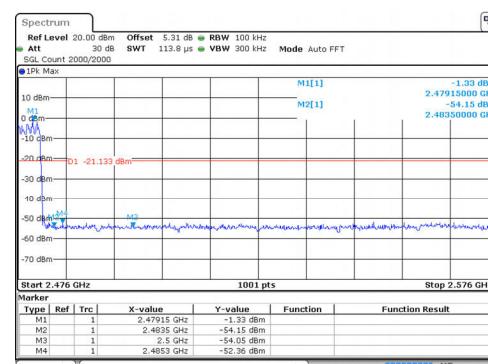
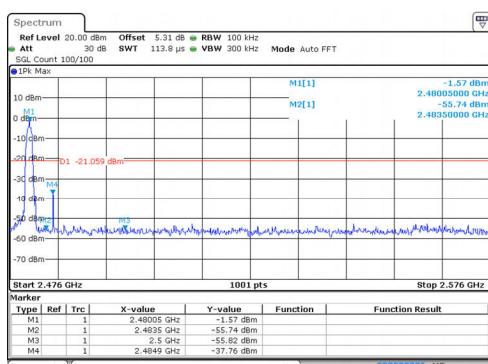
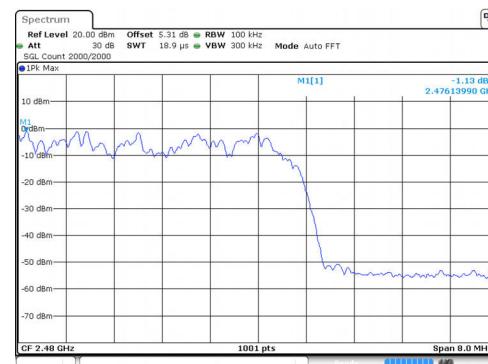
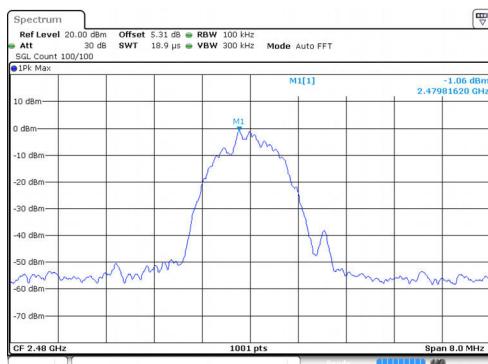


No-hopping mode

Hopping mode

Test channel:

Highest channel



No-hopping mode

Hopping mode

6.8.2 Radiated Emission Method

| | | | | | | | | |
|-----------------------|---|--------------------|------|------|---------------|--|--|--|
| Test Requirement: | FCC Part15 C Section 15.209 and 15.205 | | | | | | | |
| Test Method: | ANSI C63.10:2013 | | | | | | | |
| Test Frequency Range: | All of the restrict bands were tested, only the worst band's (2310MHz to 2500MHz) data was showed. | | | | | | | |
| Test site: | Measurement Distance: 3m | | | | | | | |
| Receiver setup: | Frequency | Detector | RBW | VBW | Remark | | | |
| | Above 1GHz | Peak | 1MHz | 3MHz | Peak Value | | | |
| | | Peak | 1MHz | 10Hz | Average Value | | | |
| Limit: | Frequency | Limit (dBuV/m @3m) | | | Remark | | | |
| | Above 1GHz | 54.00 | | | Average Value | | | |
| | | 74.00 | | | Peak Value | | | |
| Test setup: | | | | | | | | |
| Test Procedure: | <ol style="list-style-type: none"> The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a | | | | | | | |

| | |
|-------------------|----------------------------------|
| | data sheet. |
| Test Instruments: | Refer to section 5.0 for details |
| Test mode: | Refer to section 4.1 for details |
| Test results: | Pass |

| | |
|---------------|----------------|
| Test channel: | Lowest channel |
|---------------|----------------|

Vertical :

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|---------------|
| 2400.000 | 40.34 | -5.70 | 34.64 | 74.00 | -39.36 | |
| 2400.000 | 29.98 | -5.70 | 24.28 | 54.00 | -29.72 | Avg |

Horizontal :

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|---------------|
| 2400.000 | 42.09 | -5.70 | 36.39 | 74.00 | -37.61 | |
| 2400.000 | 29.87 | -5.70 | 24.17 | 54.00 | -29.83 | Avg |

| | |
|---------------|-----------------|
| Test channel: | Highest channel |
|---------------|-----------------|

Vertical :

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|---------------|
| 2483.500 | 41.92 | -4.98 | 36.94 | 74.00 | -37.06 | |
| 2483.500 | 30.87 | -4.98 | 25.89 | 54.00 | -28.11 | Avg |

Horizontal :

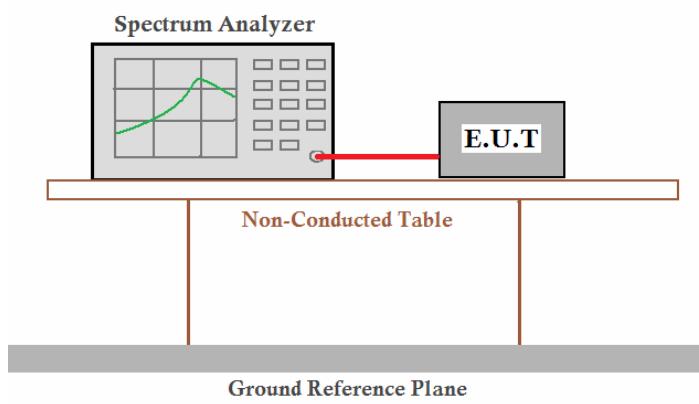
| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|---------------|
| 2483.500 | 42.94 | -4.98 | 37.96 | 74.00 | -36.04 | |
| 2483.500 | 31.56 | -4.98 | 26.58 | 54.00 | -27.42 | Avg |

Remarks:

2. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
3. The emission levels of other frequencies are very lower than the limit and not show in test report.
4. The pre-test were performed on lowest, middle and highest frequencies, only the worst case's (lowest and highest frequencies) data was showed.
5. During the test, pre-scan the GFSK, $\pi/4$ -DQPSK, 8-DPSK modulation, and found the GFSK modulation which it is worse case.

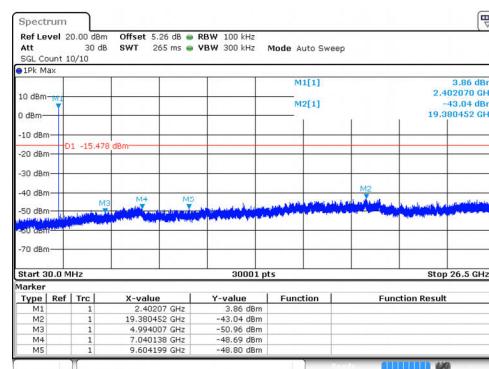
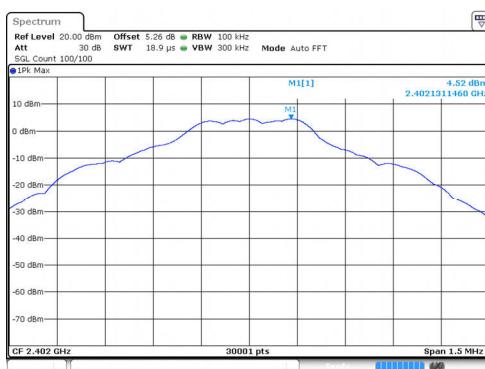
6.9 Spurious Emission

6.9.1 Conducted Emission Method

| | |
|-------------------|--|
| Test Requirement: | FCC Part15 C Section 15.247 (d) |
| Test Method: | ANSI C63.10:2013 |
| Limit: | In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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. |
| Test setup: |  <p>The diagram illustrates the test setup. A Spectrum Analyzer is connected to the E.U.T (Equipment Under Test) via a probe. The setup is placed on a Non-Conducted Table, which sits above a Ground Reference Plane. The entire assembly is shown in perspective, indicating the relative positions of the equipment and the table.</p> |
| Test Instruments: | Refer to section 5.0 for details |
| Test mode: | Refer to section 4.1 for details |
| Test results: | Pass |

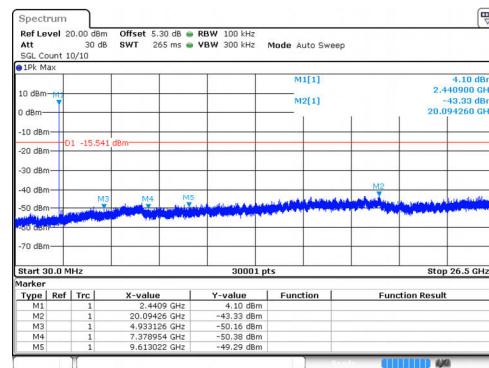
GFSK mode:

| Test channel: | Lowest channel |
|---------------|----------------|
|---------------|----------------|



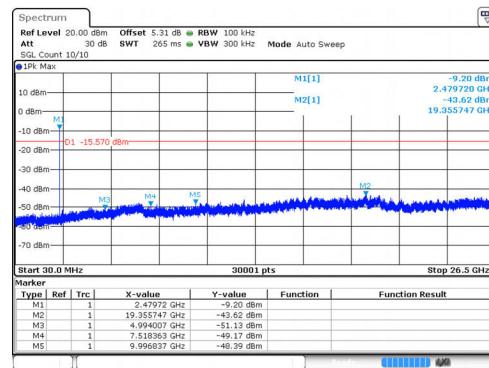
30MHz~25GHz

| Test channel: | Middle channel |
|---------------|----------------|
|---------------|----------------|



30MHz~25GHz

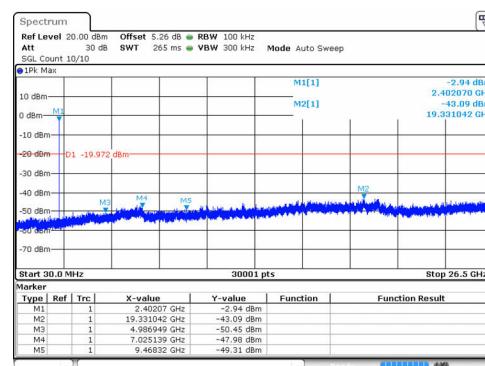
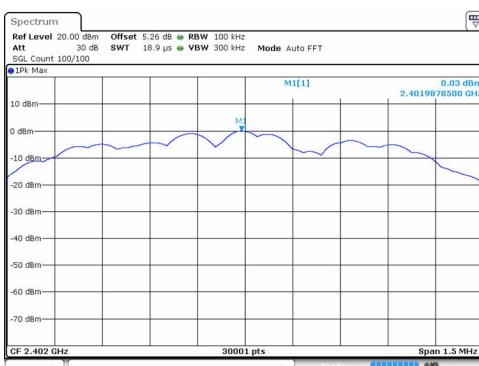
| Test channel: | Highest channel |
|---------------|-----------------|
|---------------|-----------------|



30MHz~25GHz

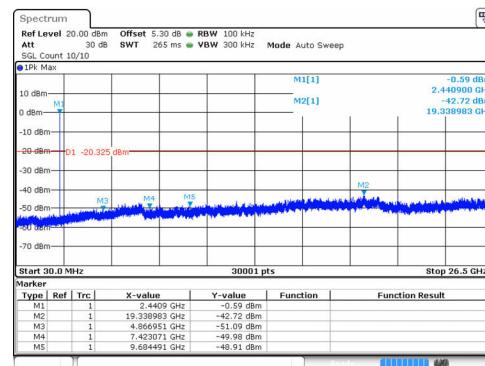
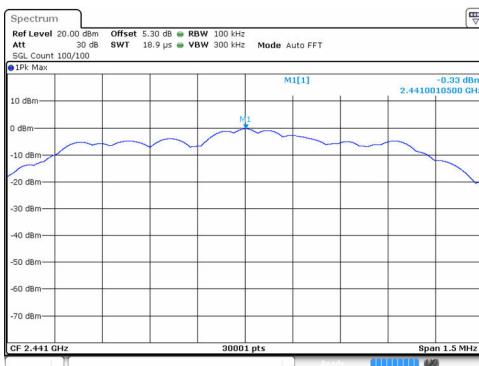
8-DPSK mode:

| Test channel: | Lowest channel |
|---------------|----------------|
|---------------|----------------|



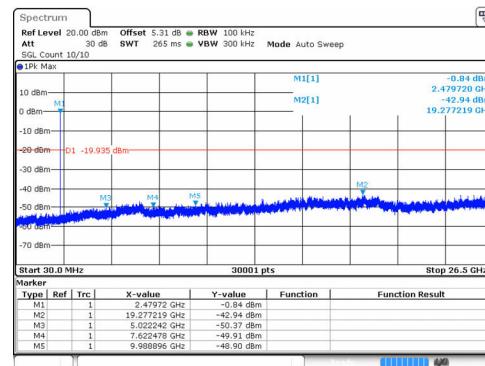
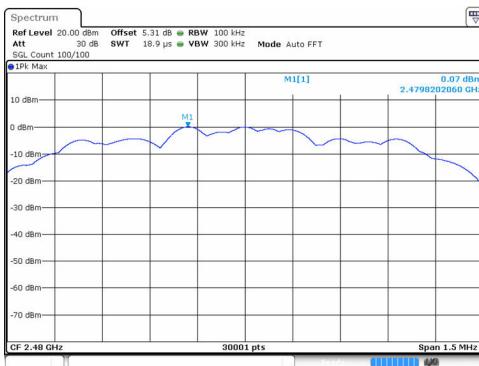
30MHz~25GHz

| Test channel: | Middle channel |
|---------------|----------------|
|---------------|----------------|



30MHz~25GHz

| Test channel: | Highest channel |
|---------------|-----------------|
|---------------|-----------------|



30MHz~25GHz

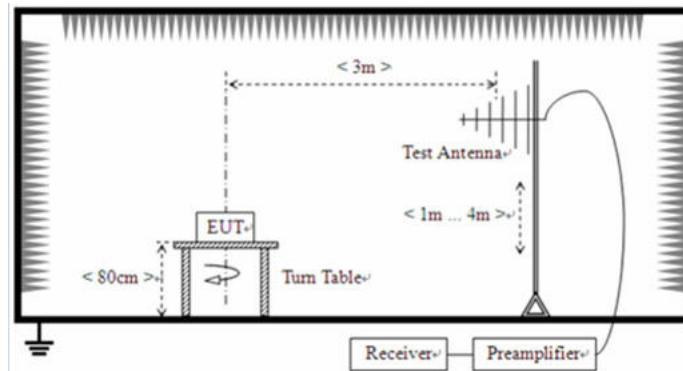
Note:

- During the test, pre-scan the GFSK, $\pi/4$ -DQPSK, 8-DPSK modulation, found the GFSK& 8-DPSK modulation which it is worse case, and show in this report.

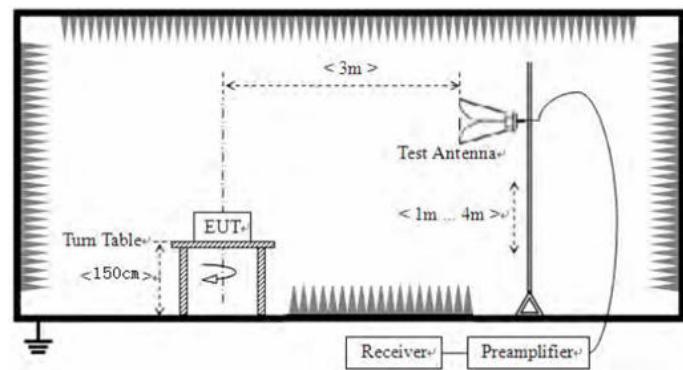
6.9.2 Radiated Emission Method

| Test Requirement: | FCC Part15 C Section 15.209 | | | | | | |
|-----------------------|---|--------------|---------|----------------------|------------|--|--|
| Test Method: | ANSI C63.10:2013 | | | | | | |
| Test Frequency Range: | 9kHz to 25GHz | | | | | | |
| Test site: | Measurement Distance: 3m | | | | | | |
| Receiver setup: | Frequency | Detector | RBW | VBW | Value | | |
| | 9KHz-150KHz | Quasi-peak | 200Hz | 600Hz | Quasi-peak | | |
| | 150KHz-30MHz | Quasi-peak | 9KHz | 30KHz | Quasi-peak | | |
| | 30MHz-1GHz | Quasi-peak | 120KHz | 300KHz | Quasi-peak | | |
| | Above 1GHz | Peak | 1MHz | 3MHz | Peak | | |
| | Above 1GHz | Peak | 1MHz | 10Hz | Average | | |
| Limit: | Frequency | Limit (uV/m) | Value | Measurement Distance | | | |
| | 0.009MHz-0.490MHz | 2400/F(KHz) | QP | 300m | | | |
| | 0.490MHz-1.705MHz | 24000/F(KHz) | QP | 30m | | | |
| | 1.705MHz-30MHz | 30 | QP | 30m | | | |
| | 30MHz-88MHz | 100 | QP | 3m | | | |
| | 88MHz-216MHz | 150 | QP | | | | |
| | 216MHz-960MHz | 200 | QP | | | | |
| | 960MHz-1GHz | 500 | QP | | | | |
| | Above 1GHz | 500 | Average | | | | |
| | Above 1GHz | 5000 | Peak | | | | |
| Test setup: | For radiated emissions from 9kHz to 30MHz | | | | | | |
| | | | | | | | |

For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



Test Procedure:

1. The EUT was placed on the top of a rotating table (0.8m for below 1G and 1.5m for above 1G) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

| | | | | | | |
|-------------------|----------------------------------|---------|---------|-------|---------|---------|
| Test Instruments: | Refer to section 5.0 for details | | | | | |
| Test mode: | Refer to section 4.1 for details | | | | | |
| Test environment: | Temp.: | 24.6 °C | Humid.: | 52.4% | Press.: | 101mbar |
| Test voltage: | AC 120V, 60Hz | | | | | |
| Test results: | Pass | | | | | |

Measurement data:**Remarks:**

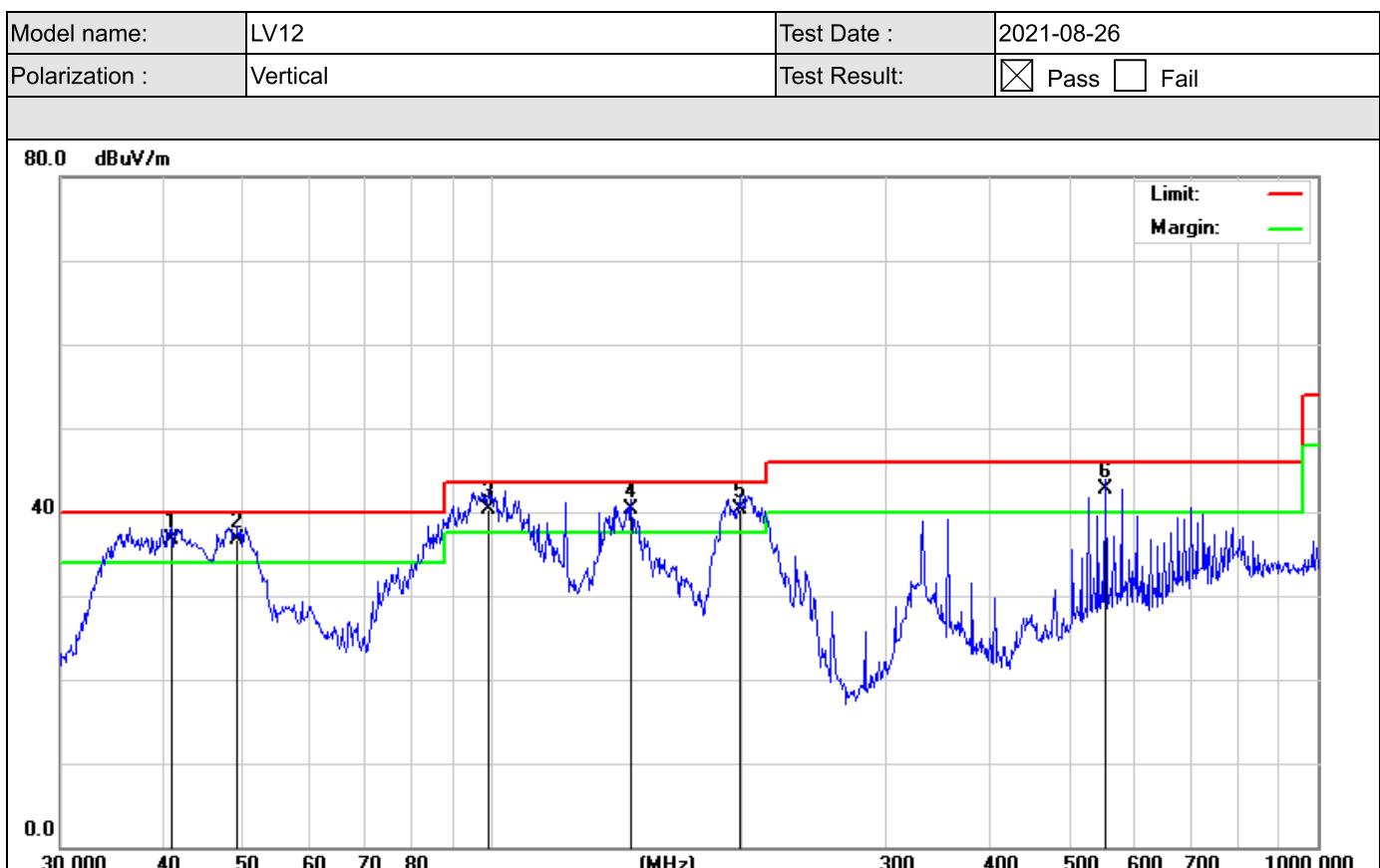
1. During the test, pre-scan the GFSK, $\pi/4$ -DQPSK, 8-DPSK modulation, and found the GFSK modulation which it is worse case.
2. Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.

■ 9kHz~30MHz

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

■ Below 1GHz

Pre-scan all test modes, found worst case at GFSK 2480MHz, and so only show the test result of GFSK 2480MHz



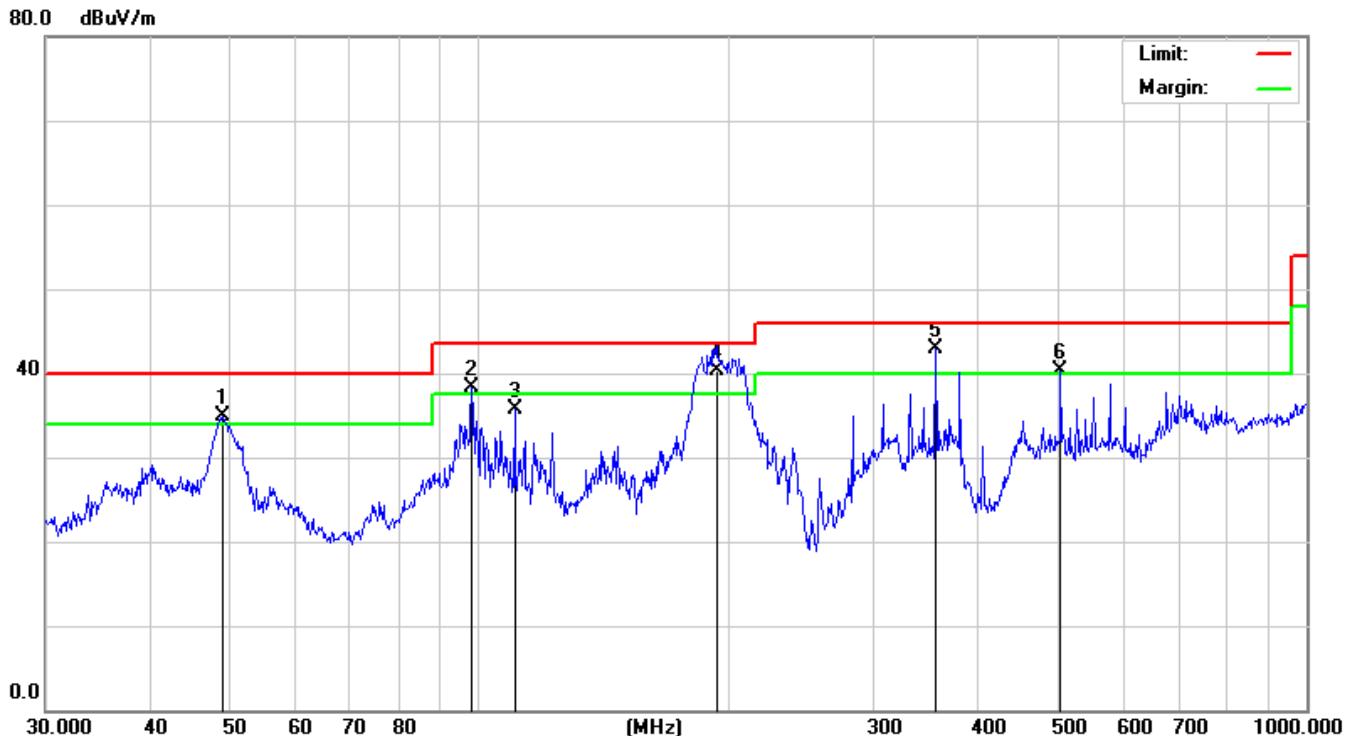
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Measurement Result=Reading Level +Correct Factor;

Over Limit= Measurement Result- Limit;

| No. | Mk. | Freq. | Reading | Correct | Measure- | Limit | Over | |
|-----|-----|----------|---------|---------|----------|--------|-------|----------|
| | | | Level | Factor | ment | | | |
| | | MHz | dBuV | dB | dBuV/m | dBuV/m | dB | Detector |
| 1 | ! | 40.8445 | 40.90 | -4.25 | 36.65 | 40.00 | -3.35 | QP |
| 2 | ! | 49.1865 | 42.60 | -5.80 | 36.80 | 40.00 | -3.20 | QP |
| 3 | * | 99.1796 | 49.10 | -8.79 | 40.31 | 43.50 | -3.19 | QP |
| 4 | ! | 147.4036 | 47.70 | -7.41 | 40.29 | 43.50 | -3.21 | QP |
| 5 | ! | 199.2855 | 46.80 | -6.59 | 40.21 | 43.50 | -3.29 | QP |
| 6 | ! | 552.8831 | 40.90 | 1.78 | 42.68 | 46.00 | -3.32 | QP |

| | | | |
|----------------|----------|--------------|--|
| Model name: | LV12 | Test Date : | 2021-08-26 |
| Polarization : | Vertical | Test Result: | <input checked="" type="checkbox"/> Pass <input type="checkbox"/> Fail |



Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.

Measurement Result=Reading Level +Correct Factor;

Over Limit= Measurement Result- Limit;

| No. | Mk. | Freq. | Reading | Correct | Measure- | Limit | Over | |
|-----|-----|----------|---------|---------|----------|--------|-------|----------|
| | | | Level | Factor | ment | | | |
| | | MHz | dBuV | dB | dBuV/m | dBuV/m | dB | Detector |
| 1 | ! | 49.0144 | 38.08 | -3.11 | 34.97 | 40.00 | -5.03 | QP |
| 2 | ! | 98.1419 | 46.27 | -8.03 | 38.24 | 43.50 | -5.26 | QP |
| 3 | | 110.5687 | 42.83 | -7.08 | 35.75 | 43.50 | -7.75 | QP |
| 4 | ! | 193.7727 | 47.80 | -7.56 | 40.24 | 43.50 | -3.26 | QP |
| 5 | * | 356.6757 | 49.68 | -6.84 | 42.84 | 46.00 | -3.16 | QP |
| 6 | ! | 504.7062 | 38.58 | 1.80 | 40.38 | 46.00 | -5.62 | QP |

■ Above 1GHz

| | |
|---------------|----------------|
| Test channel: | Lowest channel |
|---------------|----------------|

H

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|---------------|
| 4804.000 | 51.03 | 5.06 | 56.09 | 74.00 | -17.91 | PEAK |
| 4804.000 | 40.10 | 5.06 | 45.16 | 54.00 | -8.84 | Avg |
| 7206.000 | 43.29 | 7.03 | 50.32 | 74.00 | -23.68 | PEAK |
| 7206.000 | 32.41 | 7.03 | 39.44 | 54.00 | -14.56 | Avg |

V

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|---------------|
| 4804.000 | 50.89 | 5.06 | 55.95 | 74.00 | -18.05 | PEAK |
| 4804.000 | 41.80 | 5.06 | 46.86 | 54.00 | -7.14 | Avg |
| 7206.000 | 43.36 | 7.03 | 50.39 | 74.00 | -23.61 | PEAK |
| 7206.000 | 32.00 | 7.03 | 39.03 | 54.00 | -14.97 | Avg |

| | |
|---------------|----------------|
| Test channel: | Middle channel |
|---------------|----------------|

H

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|---------------|
| 4882.000 | 50.03 | 5.14 | 55.17 | 74.00 | -18.83 | PEAK |
| 4882.000 | 41.95 | 5.14 | 47.09 | 54.00 | -6.91 | Avg |
| 7323.000 | 45.01 | 7.52 | 52.53 | 74.00 | -21.47 | PEAK |
| 7323.000 | 31.09 | 7.52 | 38.61 | 54.00 | -15.39 | Avg |

V

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|---------------|
| 4882.000 | 49.21 | 5.14 | 54.35 | 74.00 | -19.65 | PEAK |
| 4882.000 | 41.54 | 5.14 | 46.68 | 54.00 | -7.32 | Avg |
| 7323.000 | 43.77 | 7.52 | 51.29 | 74.00 | -22.71 | PEAK |
| 7323.000 | 32.99 | 7.52 | 40.51 | 54.00 | -13.49 | Avg |

| | |
|---------------|-----------------|
| Test channel: | Highest channel |
|---------------|-----------------|

H

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|---------------|
| 4960.000 | 50.91 | 5.22 | 56.13 | 74.00 | -17.87 | PEAK |
| 4960.000 | 40.50 | 5.22 | 45.72 | 54.00 | -8.28 | Avg |
| 7440.000 | 44.20 | 8.06 | 52.26 | 74.00 | -21.74 | PEAK |
| 7440.000 | 31.81 | 8.06 | 39.87 | 54.00 | -14.13 | Avg |

V

| Frequency (MHz) | Meter Reading (dB μ V) | Factor (dB) | Emission Level (dB μ V/m) | Limits (dB μ V/m) | Margin (dB) | Detector Type |
|--------------------|-------------------------------|----------------|----------------------------------|--------------------------|----------------|---------------|
| 4960.000 | 49.78 | 5.22 | 55.00 | 74.00 | -19.00 | PEAK |
| 4960.000 | 41.08 | 5.22 | 46.30 | 54.00 | -7.70 | Avg |
| 7440.000 | 43.68 | 8.06 | 51.74 | 74.00 | -22.26 | PEAK |
| 7440.000 | 32.17 | 8.06 | 40.23 | 54.00 | -13.77 | Avg |

Remarks:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor
2. “**”, means this data is the too weak instrument of signal is unable to test.
3. The emission levels of other frequencies are very lower than the limit and not show in test report.
4. The test data shows only the worst case GFSK mode

7 Test Setup Photo

Reference to the **appendix I** for details.

8 EUT Constructional Details

Reference to the **appendix II** for details.

End of report