



FCC ID: 2AOG5-6630
Report No.: T190219D04-RP2

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RADIO TEST REPORT

FCC 47 CFR PART 15 SUBPART C

| | |
|--------------------------|---|
| Test Standard | FCC Part 15.247 |
| Product name | WiFi/BT/GPS RF Module |
| Brand Name | ASUKA |
| Model No. | AK-6630 |
| Test Result | Pass |
| Statements of Conformity | Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty. |

The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.

The test results of this report relate only to the tested sample (EUT) identified in this report.

The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc. (Wugu Laboratory)

Approved by:

Tested by:

Kevin Tsai
Deputy Manager

Dally Hong
Engineer

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.
除非另有說明，此報告結果僅對測試之樣品負責，同時此樣品僅保留90天。本報告未經本公司書面許可，不可部分複製。

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Revision History

| Rev. | Issue Date | Revisions | Effect Page | Revised By |
|------|-------------------|---------------------------------|---------------|--------------|
| 00 | September 2, 2019 | Initial Issue | ALL | Allison Chen |
| 01 | September 9, 2019 | See the following note Rev.(01) | P.12, P.34-35 | Allison Chen |

Rev.(01)

- 1. Modify the description of remark 3 in section 3.2.*
- 2. Modify the description of note in section 5.7.4.*



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1. GENERAL INFORMATION

1.1 EUT INFORMATION

| | |
|-------------------|---|
| Applicant | Asuka Autotronics Inc. 2F, No.12, Prosperity Rd. II, SBIP, Hsinchu, Taiwan |
| Manufacturer | Asuka Autotronics Inc. 2F, No.12, Prosperity Rd. II, SBIP, Hsinchu, Taiwan |
| Equipment | WiFi/BT/GPS RF Module |
| Model Name | AK-6630 |
| Model Discrepancy | N/A |
| Trade Name | ASUKA |
| Received Date | February 19, 2019 |
| Date of Test | March 8 ~ 27, 2019 |
| Output Power (W) | GFSK : 0.0049 8DPSK : 0.0039 |
| Power Supply | Vdc from power supply. (DC 12V) |

1.2 INFORMATION ABOUT THE FHSS CHARACTERISTICS

1.2.1 Pseudorandom Frequency Hopping Sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1 600 hops/s.

1.2.2 Equal Hopping Frequency Use

The channels of this system will be used equally over the long-term distribution of the hopsets.

1.2.3 Example of a 79 hopping sequence in data mode:

02, 05, 31, 24, 20, 10, 43, 36, 30, 23, 40, 06, 21, 50, 44, 09, 71, 78, 01, 13, 73, 07, 70, 72, 35, 62, 42, 11, 41, 08, 16, 29, 60, 15, 34, 61, 58, 04, 67, 12, 22, 53, 57, 18, 27, 76, 39, 32, 17, 77, 52, 33, 56, 46, 37, 47, 64, 49, 45, 38, 69, 14, 51, 26, 79, 19, 28, 65, 75, 54, 48, 03, 25, 66, 05, 16, 68, 74, 59, 63, 55

1.2.4 System Receiver Input Bandwidth

Each channel bandwidth is 1MHz.

The system receivers have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

1.2.5 Equipment Description

15.247(a)(1) that the Rx input bandwidths shift frequencies in synchronization with the transmitted signals.

15.247(g): In accordance with the Bluetooth Industry Standard, the system is designed to comply with all of the regulations in Section 15.247 when the transmitter is presented with a continuous data (or information) system.

15.247(h): In accordance with the Bluetooth Industry Standard, the system does not coordinate its channels selection/ hopping sequence with other frequency hopping systems for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters.

1.3 EUT CHANNEL INFORMATION

| | |
|-------------------|--|
| Frequency Range | 2402MHz-2480MHz |
| Modulation Type | 1. GFSK for BDR-1Mbps 2. $\pi/4$ -DQPSK for EDR-2Mbps 3. 8DPSK for EDR-3Mbps |
| Number of channel | 79 Channels |

Remark:

Refer as ANSI C63.10: 2013 clause 5.6.1 Table 4 test channels

| Number of frequencies to be tested | | |
|--|-----------------------|--|
| Frequency range in which device operates | Number of frequencies | Location in frequency range of operation |
| <input type="checkbox"/> 1 MHz or less | 1 | Middle |
| <input type="checkbox"/> 1 MHz to 10 MHz | 2 | 1 near top and 1 near bottom |
| <input checked="" type="checkbox"/> More than 10 MHz | 3 | 1 near top, 1 near middle, and 1 near bottom |

1.4 ANTENNA INFORMATION

| | | | | | | | | | |
|-------------------|---|-----------|--|--|-----|-----------|---------|----------|------|
| Antenna Type | <input type="checkbox"/> PIFA <input type="checkbox"/> PCB <input type="checkbox"/> Dipole <input type="checkbox"/> Coils <input checked="" type="checkbox"/> Mono-pole | | | | | | | | |
| Antenna Gain | <table><tr><td></td><td>P/N</td><td>Peak Gain</td></tr><tr><td>Antenna</td><td>XJH-2.4G</td><td>2dBi</td></tr></table> | | | | P/N | Peak Gain | Antenna | XJH-2.4G | 2dBi |
| | P/N | Peak Gain | | | | | | | |
| Antenna | XJH-2.4G | 2dBi | | | | | | | |
| Antenna connector | SMA (Female inside) | | | | | | | | |

1.5 MEASUREMENT UNCERTAINTY

| PARAMETER | UNCERTAINTY |
|---------------------------------------|-------------|
| AC Powerline Conducted Emission | +/- 1.2575 |
| Emission bandwidth, 20dB bandwidth | +/- 0.0014 |
| RF output power, conducted | +/- 1.14 |
| Power density, conducted | +/- 1.40 |
| 3M Semi Anechoic Chamber / 30M~200M | +/- 4.12 |
| 3M Semi Anechoic Chamber / 200M~1000M | +/- 4.68 |
| 3M Semi Anechoic Chamber / 1G~8G | +/- 5.18 |
| 3M Semi Anechoic Chamber / 8G~18G | +/- 5.47 |
| 3M Semi Anechoic Chamber / 18G~26G | +/- 3.81 |
| 3M Semi Anechoic Chamber / 26G~40G | +/- 3.87 |

Remark:

1. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$
2. ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report.

1.6 FACILITIES AND TEST LOCATION

All measurement facilities used to collect the measurement data are located at
No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)

| Test site | Test Engineer | Remark |
|--------------------|---------------|---|
| AC Conduction Room | - | Not applicable, because EUT doesn't connect to AC Main Source direct. |
| Radiation | Dally Hong | - |
| RF Conducted | Dally Hong | - |

Remark: The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.



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1.7 INSTRUMENT CALIBRATION

| RF Conducted Test Site | | | | | |
|------------------------|--------------|---------|---------|------------|------------|
| Equipment | Manufacturer | Model | S/N | Cal Date | Cal Due |
| Coaxial Cable | Woken | WC12 | CC001 | 06/29/2018 | 06/28/2019 |
| Power Meter | Anritsu | ML2495A | 1149001 | 02/12/2019 | 02/11/2020 |
| Power Seneor | Anritsu | MA2491A | 030982 | 02/12/2019 | 02/11/2020 |
| Signal Analyzer | R&S | FSV 40 | 101073 | 09/27/2018 | 09/26/2019 |
| Software | N/A | | | | |

| 3M 966 Chamber Test Site | | | | | |
|----------------------------------|------------------|-----------------|-------------|------------|------------|
| Equipment | Manufacturer | Model | S/N | Cal Date | Cal Due |
| Band Reject Filters | MICRO TRONICS | BRM 50702 | 120 | 02/26/2019 | 02/25/2020 |
| Bilog Antenna | Sunol Sciences | JB3 | A030105 | 07/13/2018 | 07/12/2019 |
| Cable | HUBER SUHNER | SUCOFLEX 104PEA | 25157 | 02/26/2019 | 02/25/2020 |
| Cable | HUBER SUHNER | SUCOFLEX 104PEA | 20995 | 02/26/2019 | 02/25/2020 |
| Digital Thermo-Hygro Meter | WISEWIND | 1206 | D07 | 01/30/2019 | 01/29/2020 |
| double Ridged Guide Horn Antenna | ETC | MCTD 1209 | DRH13M02003 | 08/20/2018 | 08/19/2019 |
| Loop Antenna | COM-POWER | AL-130 | 121051 | 03/22/2019 | 03/21/2020 |
| Pre-Amplifier | EMEC | EM330 | 060609 | 02/26/2019 | 02/25/2020 |
| Pre-Amplifier | HP | 8449B | 3008A00965 | 02/26/2019 | 02/25/2020 |
| PSA Series Spectrum Analyzer | Agilent | E4446A | MY46180323 | 05/31/2018 | 05/30/2019 |
| Antenna Tower | CCS | CC-A-1F | N/A | N.C.R | N.C.R |
| Controller | CCS | CC-C-1F | N/A | N.C.R | N.C.R |
| Turn Table | CCS | CC-T-1F | N/A | N.C.R | N.C.R |
| Software | e3 6.11-20180413 | | | | |

Remark: Each piece of equipment is scheduled for calibration once a year.



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1.8 SUPPORT AND EUT ACCESSORIES EQUIPMENT

| EUT Accessories Equipment | | | | | |
|---------------------------|-----------|-------|-------|------------|--------|
| No. | Equipment | Brand | Model | Series No. | FCC ID |
| | N/A | | | | |

| Support Equipment | | | | | |
|-------------------|-----------------|----------|--------------------|------------|--------------|
| No. | Equipment | Brand | Model | Series No. | FCC ID |
| 1 | DC Power Source | GWINSTEK | SPS-3610 | N/A | N/A |
| 2 | NB(H) | Acer | Aspire 4320 series | N/A | QDS-BRCM1018 |

1.9 TEST METHODOLOGY AND APPLIED STANDARDS

The test methodology, setups and results comply with all requirements in accordance with ANSI C63.10:2013, FCC Part 2, FCC Part 15.247.



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2. TEST SUMMERY

| FCC Standard Section | Report Section | Test Item | Result |
|----------------------|----------------|-----------------------------|--------|
| 15.203 | 1.4 | Antenna Requirement | Pass |
| 15.207(a) | 5.1 | AC Conducted Emission | N/A |
| 15.247(a)(1) | 5.2 | 20 dB Bandwidth | - |
| - | 5.2 | Occupied Bandwidth (99%) | - |
| 15.247(b)(1) | 5.3 | Output Power Measurement | Pass |
| 15.247(a)(1) | 5.4 | Frequency Separation | Pass |
| 15.247(a)(1)(iii) | 5.5 | Number of Hopping | Pass |
| 15.247(d) | 5.6 | Conducted Band Edge | Pass |
| 15.247(d) | 5.6 | Conducted Spurious Emission | Pass |
| 15.247(a)(1)(iii) | 5.7 | Time of Occupancy | Pass |
| 15.247(d) | 5.8 | Radiation Band Edge | Pass |
| 15.247(d) | 5.8 | Radiation Spurious Emission | Pass |



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3. DESCRIPTION OF TEST MODES

3.1 THE WORST MODE OF OPERATING CONDITION

| | |
|--------------------------|---|
| Operation mode | GFSK for BDR-1Mbps (DH5) 8DPSK for EDR-3Mbps (3DH5) |
| Test Channel Frequencies | GFSK for BDR-1Mbps: 1.Lowest Channel : 2402MHz 2.Middle Channel : 2441MHz 3.Highest Channel : 2480MHz 8DPSK for EDR-3Mbps: 1.Lowest Channel : 2402MHz 2.Middle Channel : 2441MHz 3.Highest Channel : 2480MHz |

3.2 THE WORST MODE OF MEASUREMENT

| Radiated Emission Measurement Above 1G | |
|--|---|
| Test Condition | Band edge, Emission for Unwanted and Fundamental |
| Power supply Mode | Mode 1:EUT power by DC Power supply |
| Worst Mode | <input checked="" type="checkbox"/> Mode 1 <input type="checkbox"/> Mode 2 <input type="checkbox"/> Mode 3 <input type="checkbox"/> Mode 4 |
| Worst Position | <input type="checkbox"/> Placed in fixed position. <input checked="" type="checkbox"/> Placed in fixed position at X-Plane (E2-Plane) <input type="checkbox"/> Placed in fixed position at Y-Plane (E1-Plane) <input type="checkbox"/> Placed in fixed position at Z-Plane (H-Plane) |
| Worst Polarity | <input type="checkbox"/> Horizontal <input checked="" type="checkbox"/> Vertical |

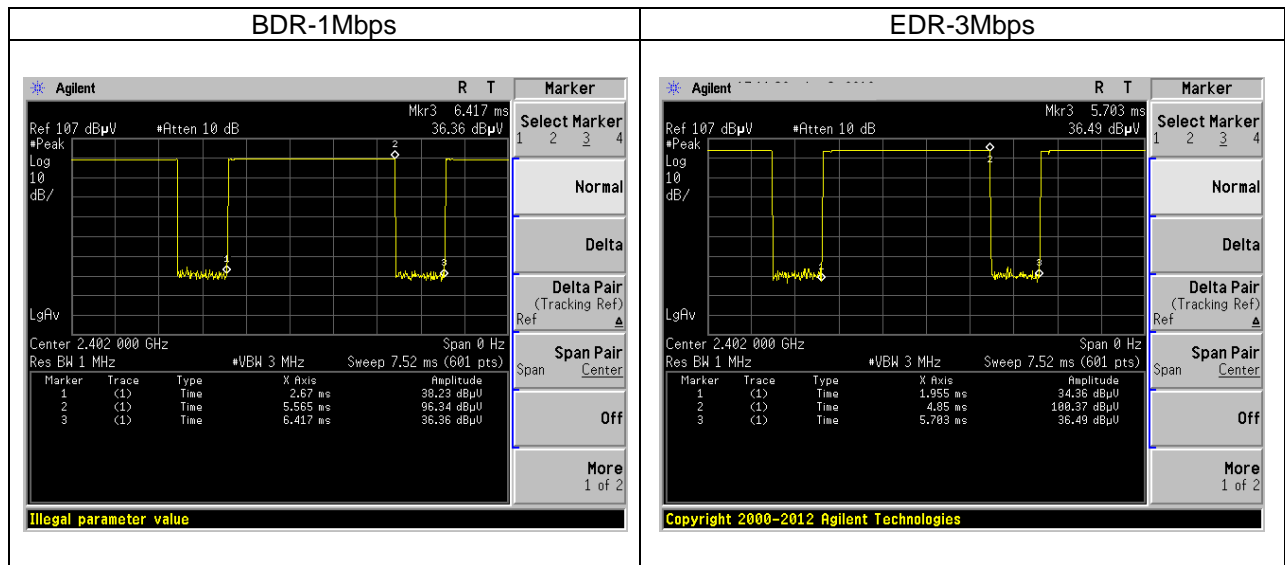
| Radiated Emission Measurement Below 1G | |
|--|--|
| Test Condition | Radiated Emission Below 1G |
| Power supply Mode | Mode 1:EUT power by DC Power supply |
| Worst Mode | <input checked="" type="checkbox"/> Mode 1 <input type="checkbox"/> Mode 2 <input type="checkbox"/> Mode 3 <input type="checkbox"/> Mode 4 |

Remark:

1. The worst mode was record in this test report.
2. EUT pre-scanned in three axis ,X,Y, Z and two polarity, Horizontal and Vertical for radiated measurement. The worst case(X-Plane and Vertical) were recorded in this report
3. For below 1G radiation emission were performed the EUT transmit at the highest output power channel as worse case.

4. EUT DUTY CYCLE

| Duty Cycle | | | |
|---------------|------------|-------------|----------------|
| Configuration | TX ON (ms) | TX ALL (ms) | Duty Cycle (%) |
| BDR-1Mbps | 2.8950 | 3.7470 | 77.26% |
| EDR-3Mbps | 2.8950 | 3.7480 | 77.24% |



5. TEST RESULT

5.1 AC POWER LINE CONDUCTED EMISSION

5.1.1 Test Limit

According to §15.207(a),

| Frequency Range (MHz) | Limits(dB μ V) | |
|--------------------------|--------------------|-----------|
| | Quasi-peak | Average |
| 0.15 to 0.50 | 66 to 56* | 56 to 46* |
| 0.50 to 5 | 56 | 46 |
| 5 to 30 | 60 | 50 |

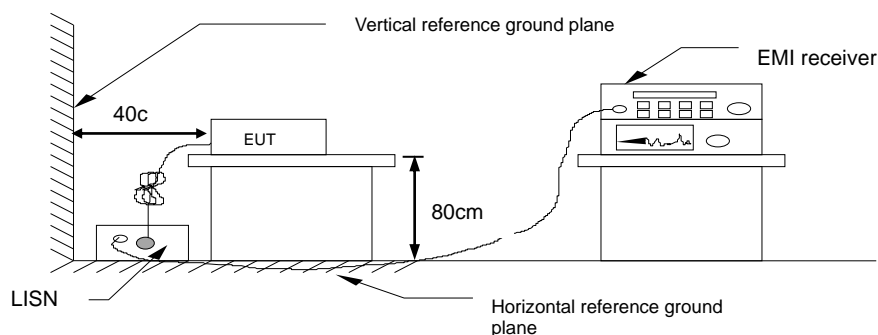
* Decreases with the logarithm of the frequency.

5.1.2 Test Procedure

Test method Refer as ANSI C63.10: 2013 clause 6.2,

1. The EUT was placed on a non-conducted table, which is 0.8m above horizontal ground plane and 0.4m above vertical ground plane.
2. EUT connected to the line impedance stabilization network (LISN)
3. Receiver set RBW of 9kHz and Detector Peak, and note as quasi-peak and average.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. Recorded Line for Neutral and Line.

5.1.3 Test Setup



5.1.4 Test Result

Not applicable, because EUT doesn't connect to AC Main Source direct.

5.2 20dB BANDWIDTH AND OCCUPIED BANDWIDTH (99%)

5.2.1 Test Limit

According to §15.247(a) (1),

20 dB Bandwidth : For reporting purposes only.

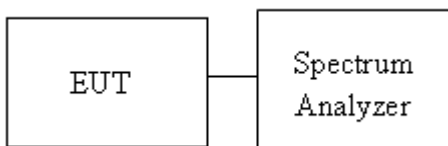
Occupied Bandwidth(99%) : For reporting purposes only.

5.2.2 Test Procedure

Test method Refer as ANSI C63.10: 2013 clause 7.8.7,

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW = 30KHz, VBW = 100KHz and Detector = Peak, to measurement 20dB Bandwidth.
4. SA set RBW = 1% ~ 5% OBW, VBW = three times the RBW and Detector = Peak, to measurement 99% Bandwidth.
5. Measure and record the result of 20 dB Bandwidth and 99% Bandwidth. in the test report.

5.2.3 Test Setup



5.2.4 Test Result

| Test mode: GFSK_BDR-1Mbps mode / 2402-2480 MHz | | | |
|--|-----------------|-----------------|---------------|
| Channel | Frequency (MHz) | OBW (99%) (MHz) | 20dB BW (MHz) |
| Low | 2402 | 0.8075 | 0.8521 |
| Mid | 2441 | 0.8118 | 0.8913 |
| High | 2480 | 0.8118 | 0.8521 |

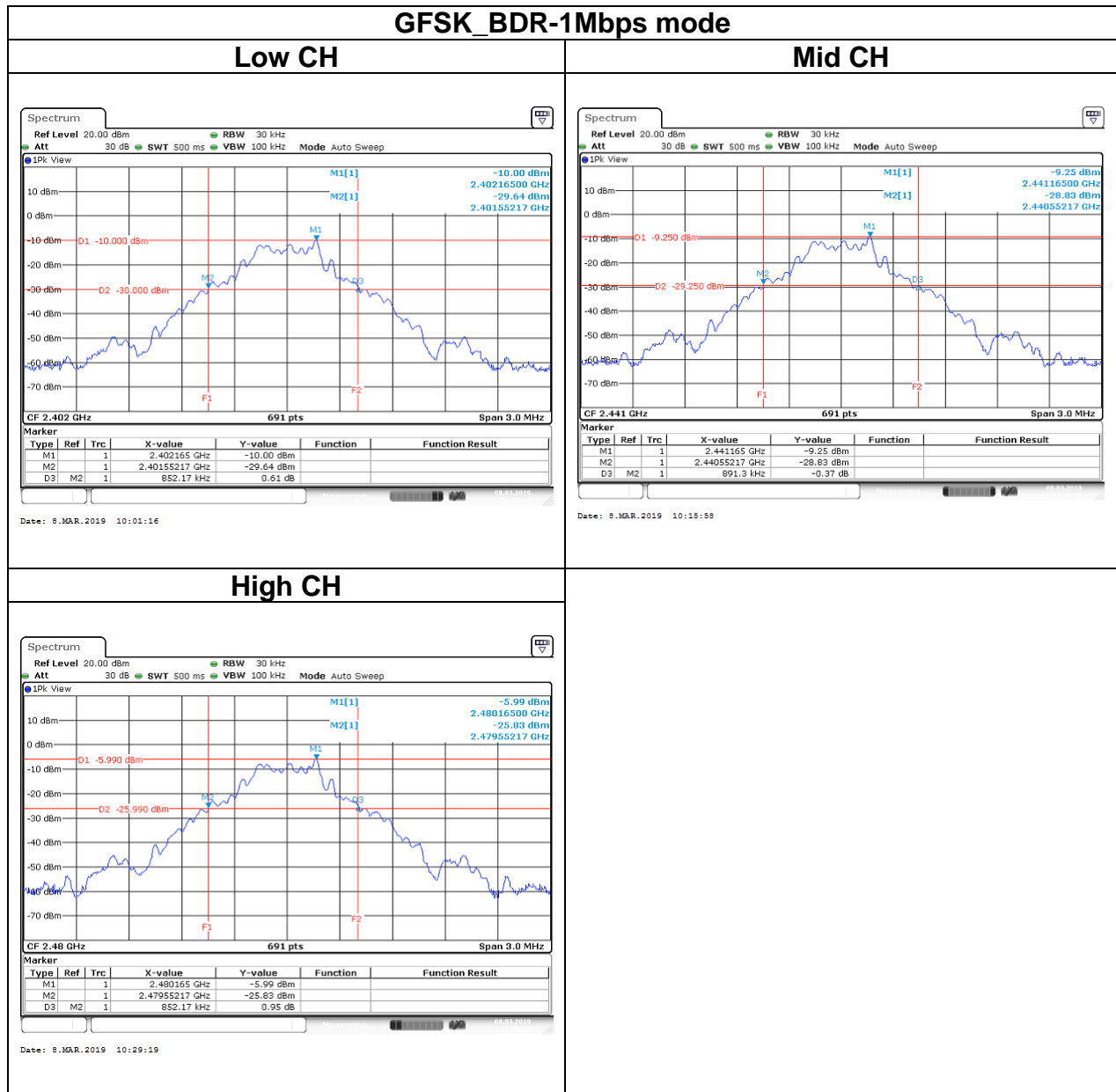
| Test mode: 8DPSK_EDR-3Mbps mode / 2402-2480 MHz | | | |
|---|-----------------|-----------------|---------------|
| Channel | Frequency (MHz) | OBW (99%) (MHz) | 20dB BW (MHz) |
| Low | 2402 | 1.0767 | 1.2043 |
| Mid | 2441 | 1.0767 | 1.2043 |
| High | 2480 | 1.0767 | 1.2043 |



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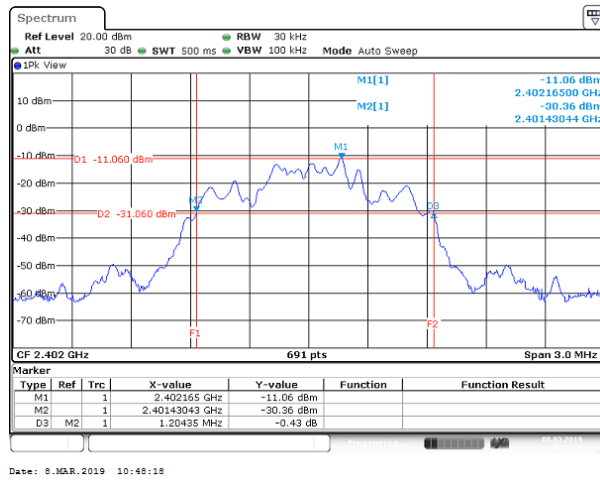
Test Data

20 dB Bandwidth

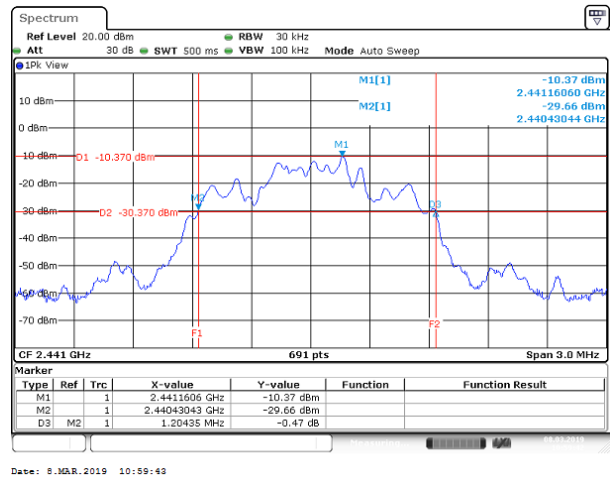


8DPSK_EDR-3Mbps mode

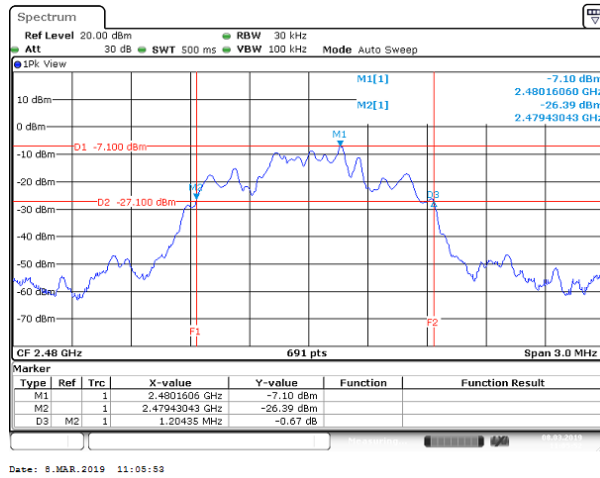
Low CH



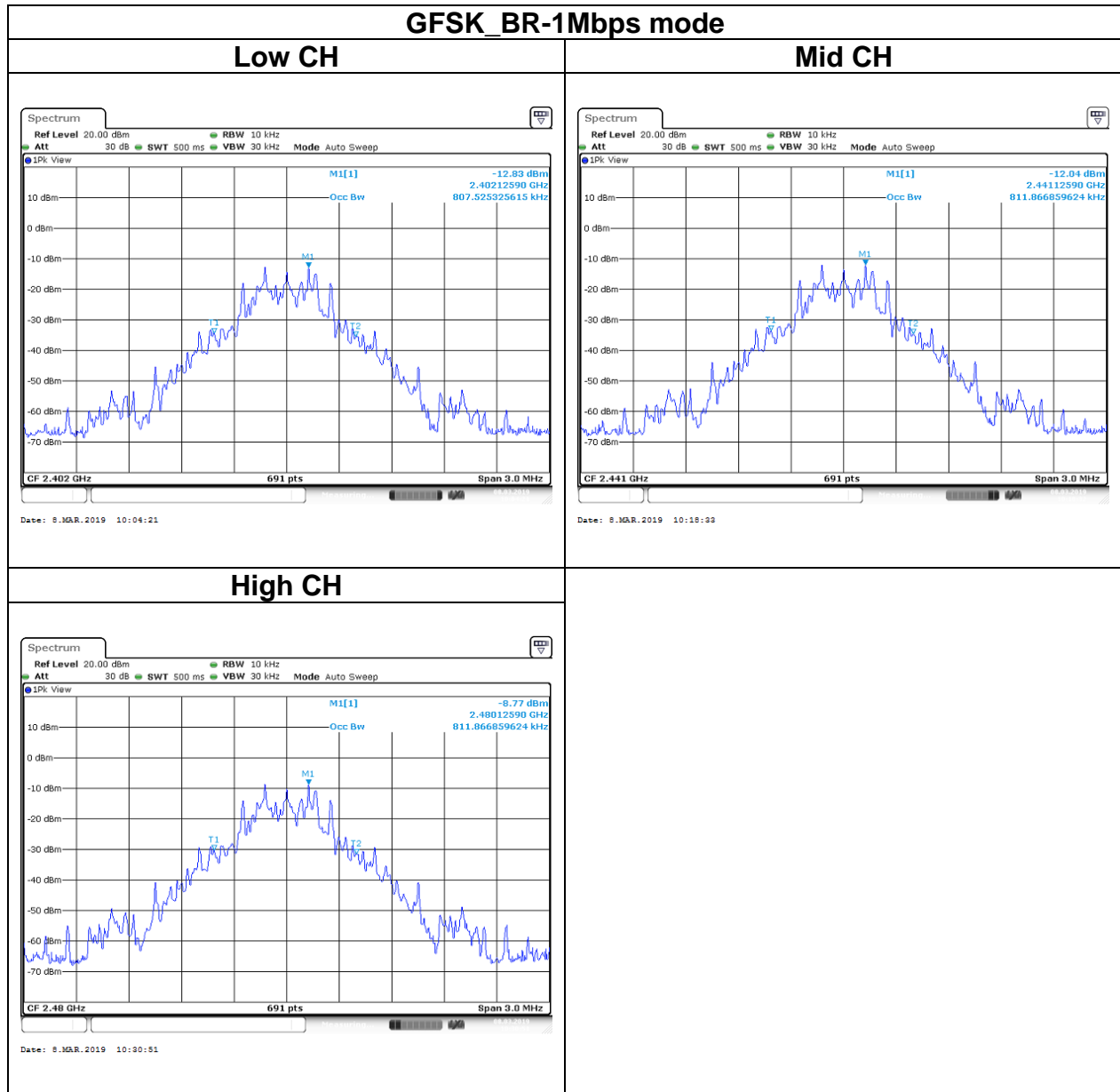
Mid CH

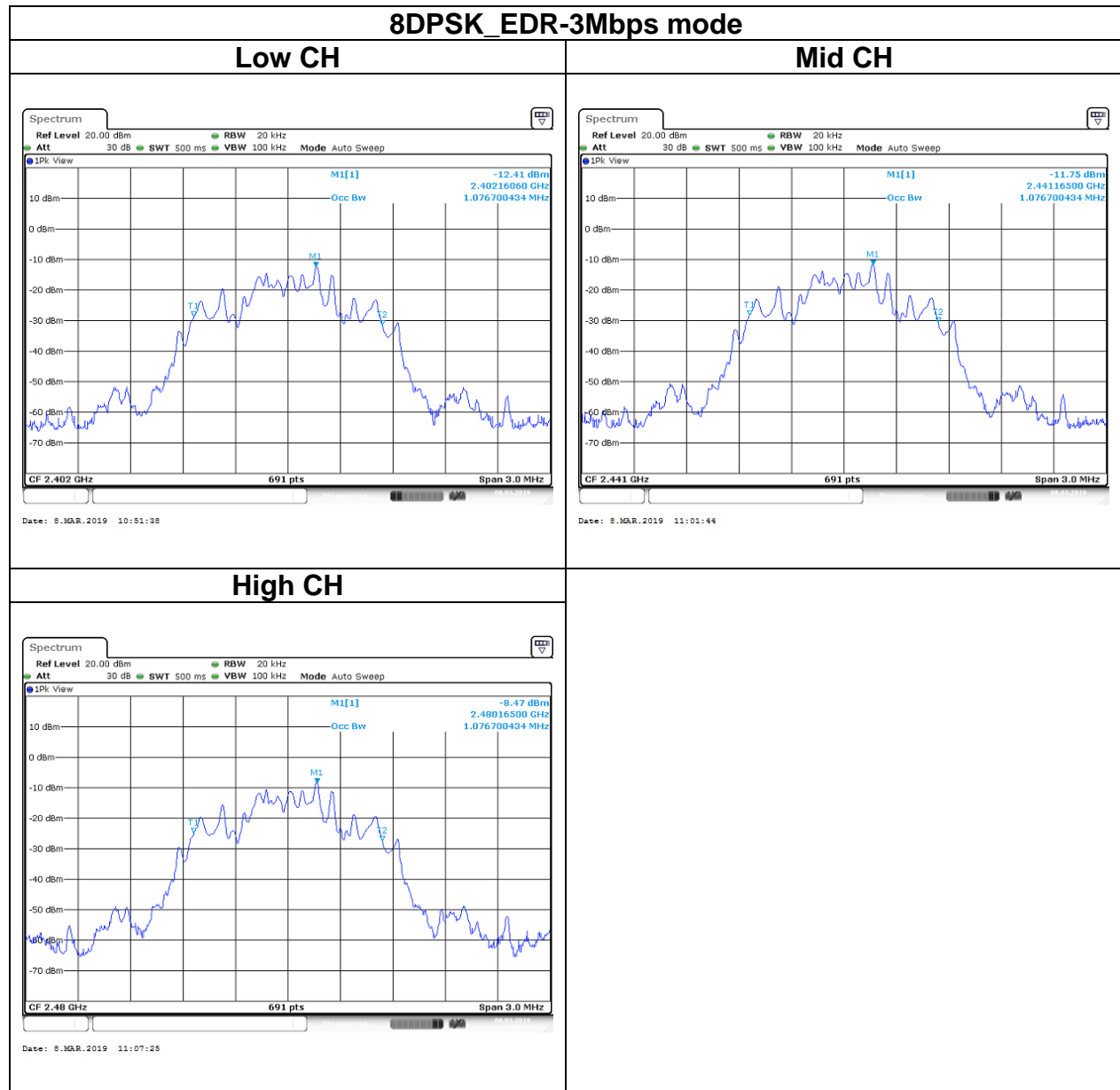


High CH



99% Bandwidth





5.3 OUTPUT POWER MEASUREMENT

5.3.1 Test Limit

According to §15.247(a)(1).

Peak output power :

FCC

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

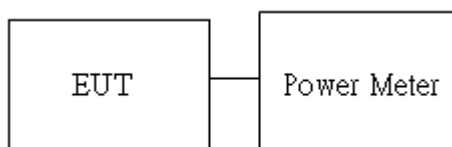
| | |
|-------|---|
| Limit | <input checked="" type="checkbox"/> Antenna not exceed 6 dBi : 21dBm <input type="checkbox"/> Antenna with DG greater than 6 dBi : 21dBm [Limit = 30 – (DG – 6)] |
|-------|---|

Average output power : For reporting purposes only.

5.3.2 Test Procedure

1. The EUT RF output connected to the power meter by RF cable.
2. Setting maximum power transmit of EUT.
3. The path loss was compensated to the results for each measurement.
4. Measure and record the result of Peak output power and Average output power. in the test report.

5.3.3 Test Setup



5.3.4 Test Result

Peak output power :

| BT | | | | | |
|----------------------------------|----|-------------|---------------|----------------|--------------|
| Config. | CH | Freq. (MHz) | Power Setting | PK Power (dBm) | PK Power (W) |
| GFSK BR-1Mbps (DH5) | 0 | 2402 | Default | 2.9 | 0.0019 |
| | 39 | 2441 | Default | 3.57 | 0.0023 |
| | 78 | 2480 | Default | 6.94 | 0.0049 |
| 8DPSK EDR- 3Mbps (3DH5) | 0 | 2402 | Default | -0.14 | 0.0010 |
| | 39 | 2441 | Default | 2.51 | 0.0018 |
| | 78 | 2480 | Default | 5.91 | 0.0039 |

Average output power :

| BT | | | | |
|----------------------------------|----|-------------|---------------|----------------|
| Config. | CH | Freq. (MHz) | Power Setting | AV Power (dBm) |
| GFSK BR-1Mbps (DH5) | 0 | 2402 | Default | 2.6 |
| | 39 | 2441 | Default | 3.33 |
| | 78 | 2480 | Default | 6.62 |
| 8DPSK EDR- 3Mbps (3DH5) | 0 | 2402 | Default | 2.87 |
| | 39 | 2441 | Default | 2.18 |
| | 78 | 2480 | Default | 3.87 |

5.4 FREQUENCY SEPARATION

5.4.1 Test Limit

According to §15.247(a)(1),

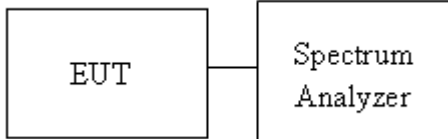
Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

| | |
|-------|-------------------------------------|
| Limit | > two-thirds of the 20 dB bandwidth |
|-------|-------------------------------------|

5.4.2 Test Procedure

1. Place the EUT on the table and set it in transmitting mode.
2. EUT RF output port connected to the SA by RF cable.
3. Set the spectrum analyzer as RBW = 100kHz, VBW = 300kHz, Sweep = auto.
Max hold, mark 3 peaks of hopping channel and record the 3 peaks frequency

5.4.3 Test Setup





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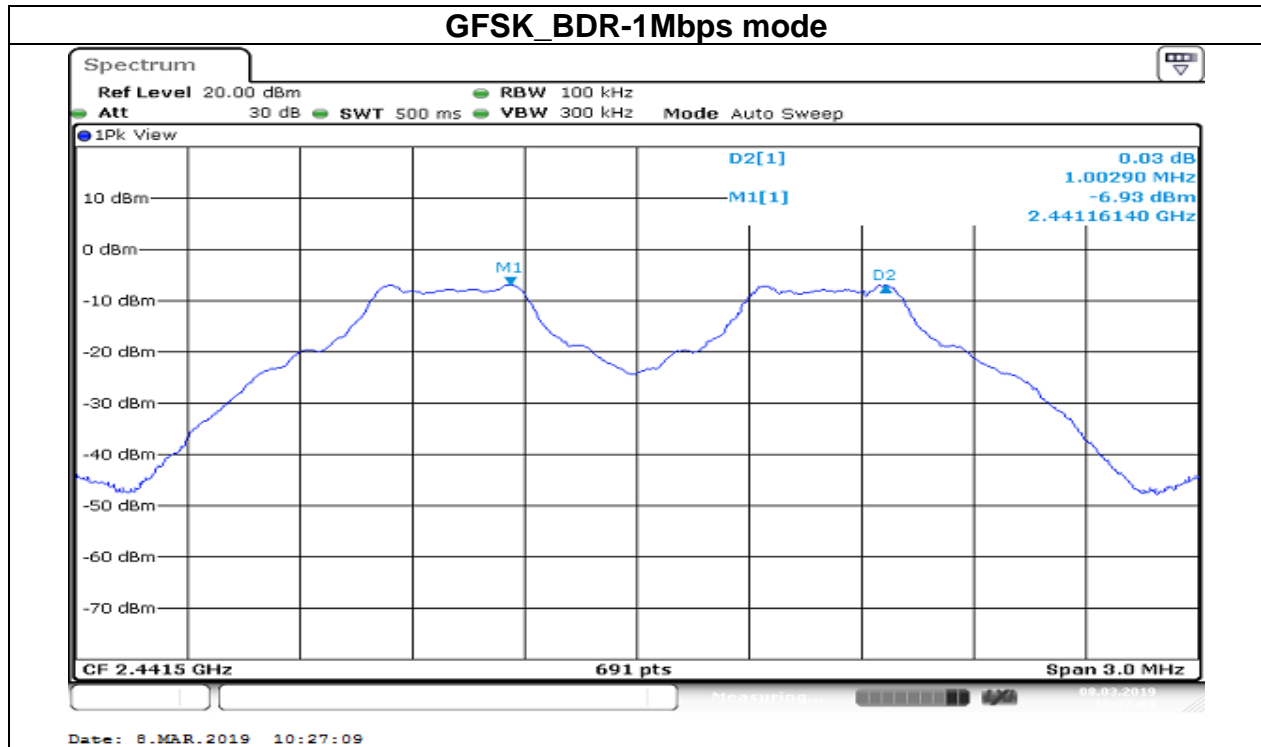
5.4.4 Test Result

| Test mode: GFSK_BDR-1Mbps mode / 2402-2480 MHz | | | | |
|--|-----------------|--------------------------|---------------------------------|--------|
| Channel | Frequency (MHz) | Channel Separation (MHz) | Channel Separation Limits (MHz) | Result |
| Low | 2402 | 1.0029 | 0.568 | PASS |
| Mid | 2441 | 1.0029 | 0.594 | PASS |
| High | 2480 | 1.0029 | 0.568 | PASS |

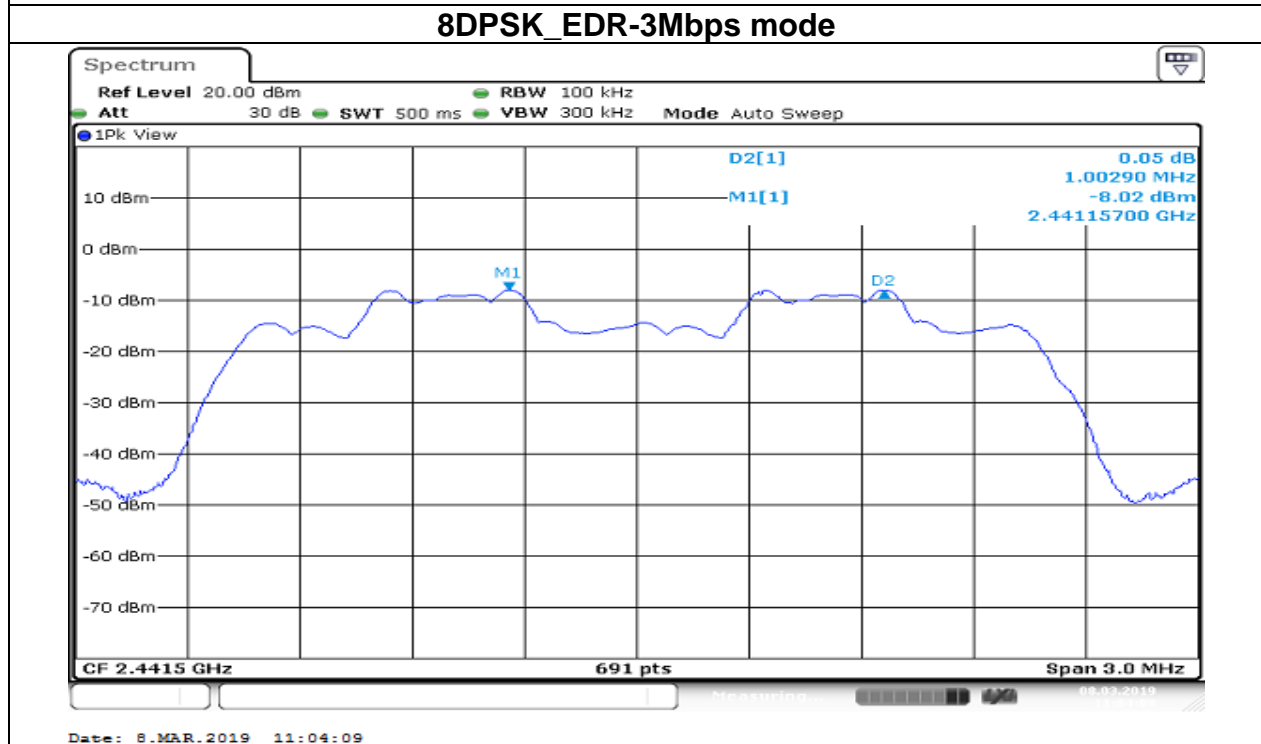
| Test mode: 8DPSK_EDR-3Mbps mode / 2402-2480 MHz | | | | |
|---|-----------------|--------------------------|---------------------------------|--------|
| Channel | Frequency (MHz) | Channel Separation (MHz) | Channel Separation Limits (MHz) | Result |
| Low | 2402 | 1.0029 | 0.803 | PASS |
| Mid | 2441 | 1.0029 | 0.803 | PASS |
| High | 2480 | 1.0029 | 0.803 | PASS |

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Test Data



Note: We selected worst case to performed test in middle channel, The results can be meet other channel.



Note: We selected worst case to performed test in middle channel, The results can be meet other channel.

5.5 NUMBER OF HOPPING

5.5.1 Test Limit

According to §15.247(a)(1)(iii)

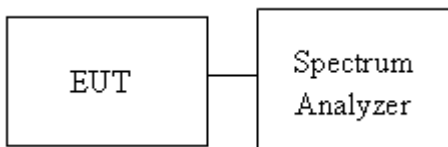
Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

5.5.2 Test Procedure

Test method Refer as ANSI C63.10: 2013 clause 7.8.3

1. Place the EUT on the table and set it in transmitting mode.
2. EUT RF output port connected to the SA by RF cable.
3. Set spectrum analyzer Start Freq. = 2400 MHz, Stop Freq. = 2483.5 MHz, RBW = 100KHz, VBW = 300KHz.
4. Max hold, view and count how many channel in the band.

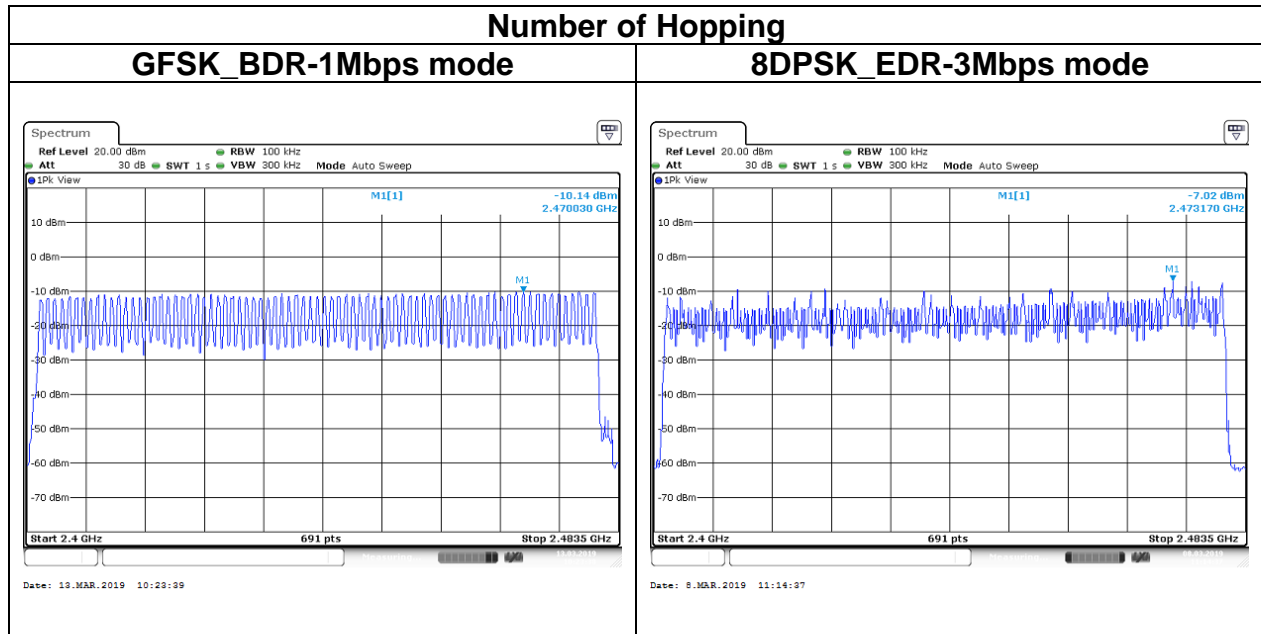
5.5.3 Test Setup



5.5.4 Test Result

| Number of Hopping | | | | |
|-------------------|-----------------|------------------------|-------------------------------|--------|
| Mode | Frequency (MHz) | Hopping Channel Number | Hopping Channel Number Limits | Result |
| BDR-1Mbps | 2402-2480 | 79 | 15 | Pass |
| EDR-3Mbps | 2402-2480 | 79 | 15 | |

Test Data



5.6 CONDUCTED BANDEDGE AND SPURIOUS EMISSION

5.6.1 Test Limit

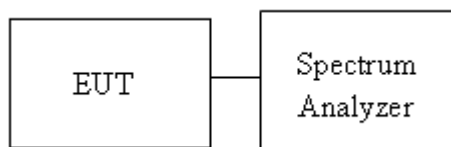
According to §15.247(d),

| | |
|-------|---------|
| Limit | -20 dBc |
|-------|---------|

5.6.2 Test Procedure

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.
2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.
3. The Band Edge at 2.4GHz and 2.4835GHz are investigated with both hopping "ON" and "OFF" modes ".

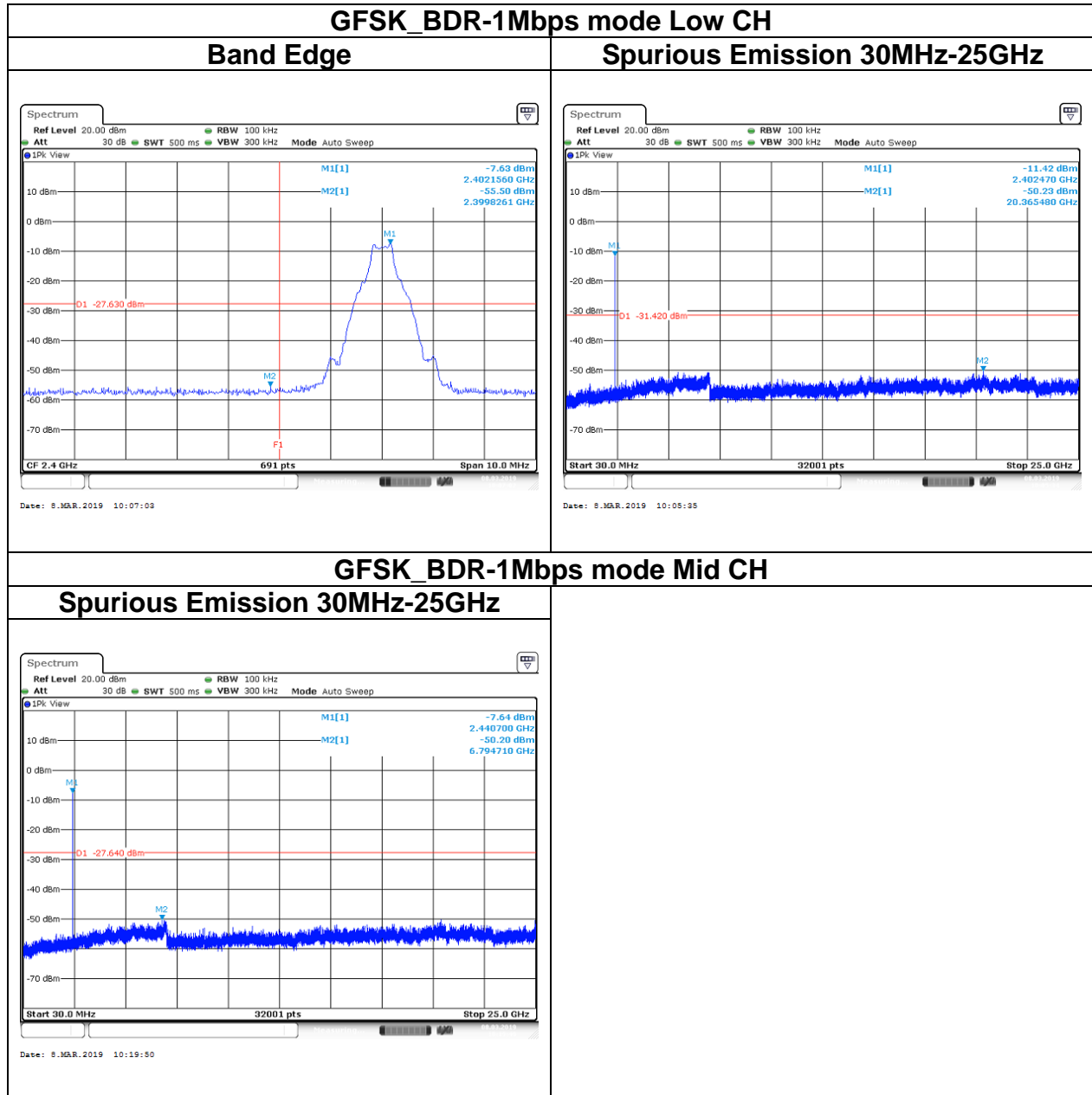
5.6.3 Test Setup

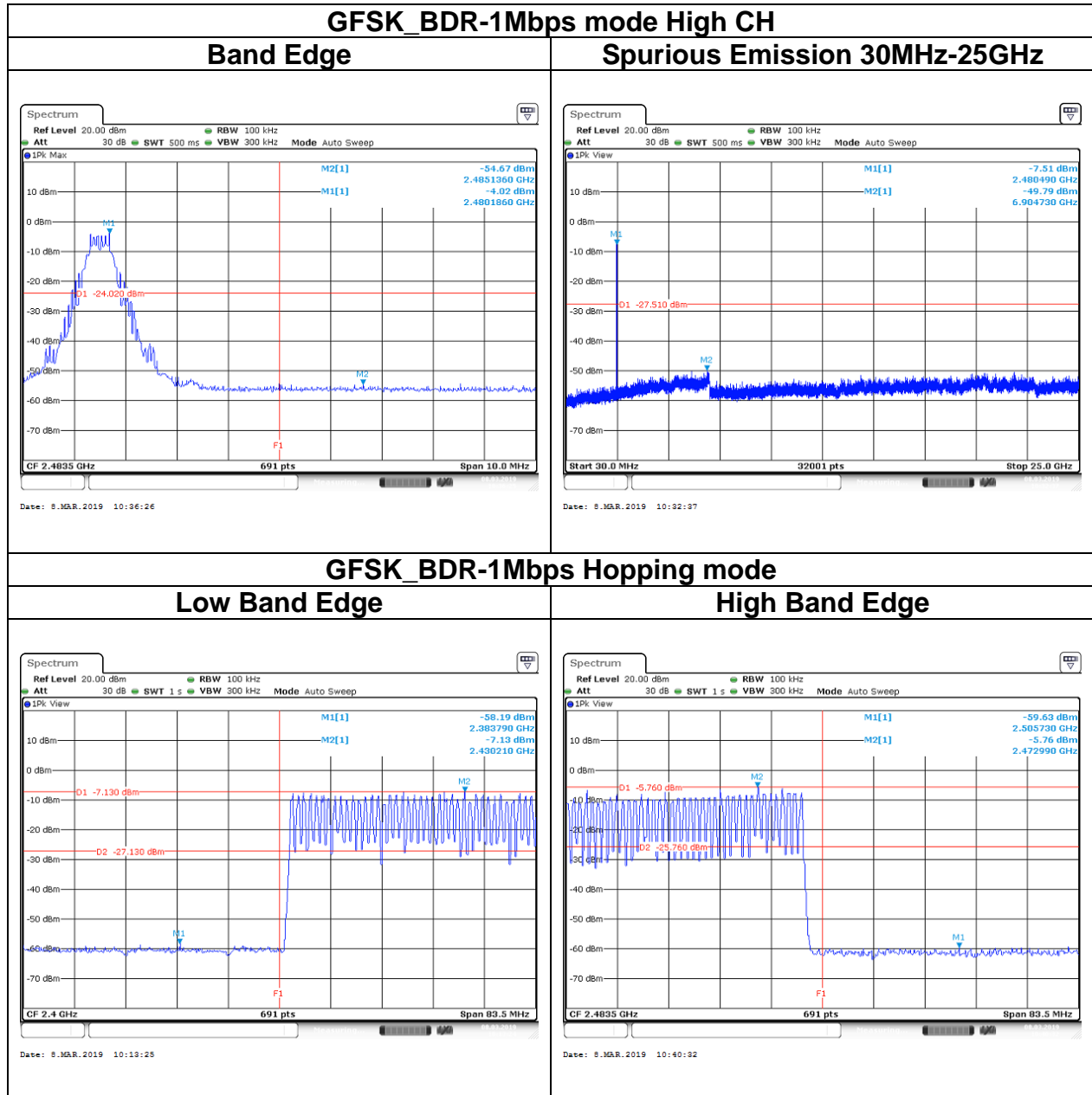


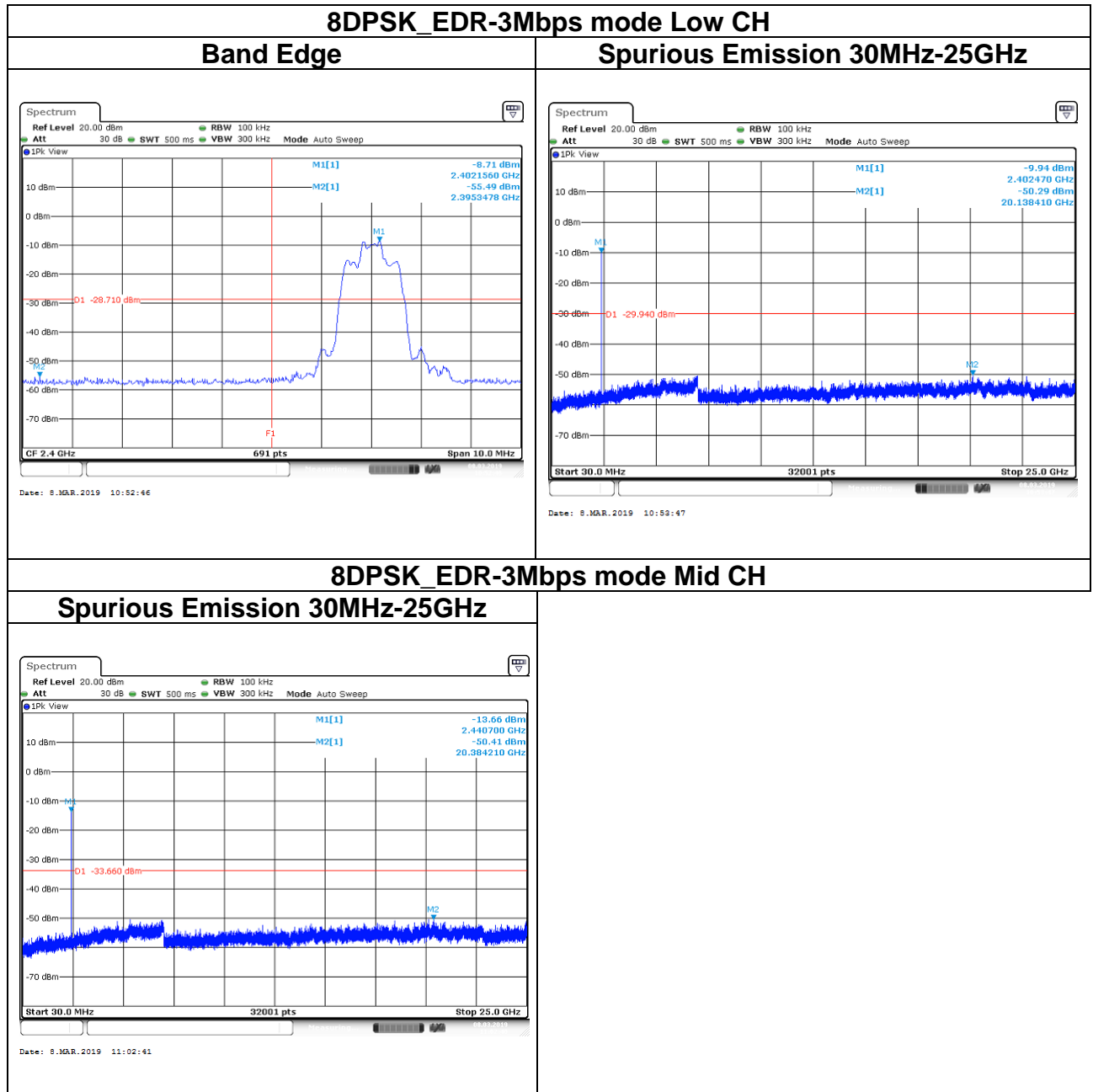
Report No.: T190219D04-RP2

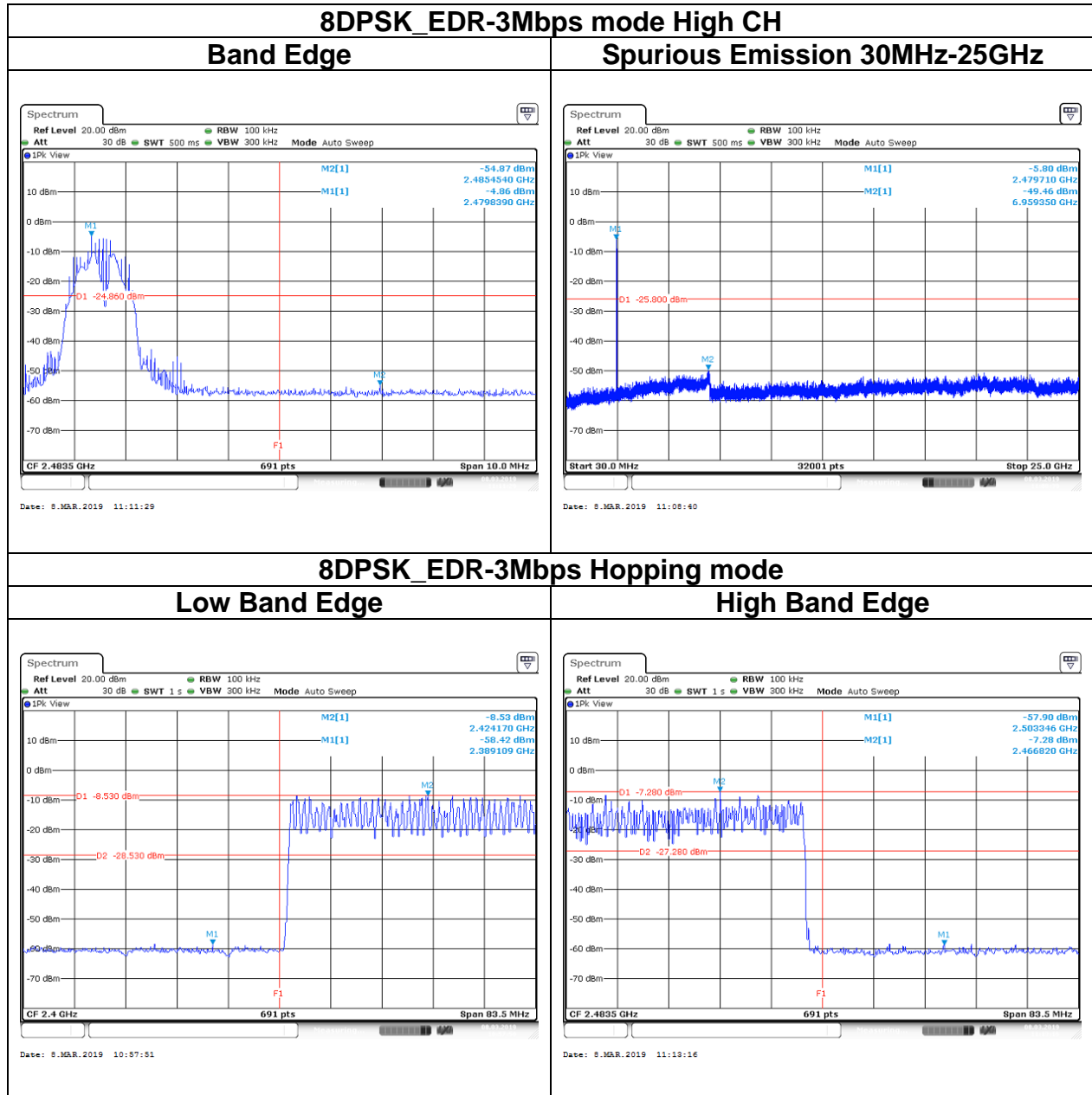
5.6.4 Test Result

Test Data









5.7 TIME OF OCCUPANCY (DWEELL TIME)

5.7.1 Test Limit

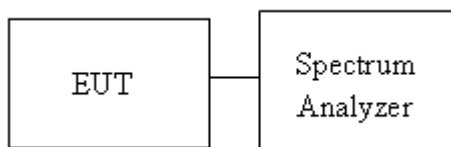
According to §15.247(a)(1)(iii),

The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

5.7.2 Test Procedure

1. EUT RF output port connected to the SA by RF cable.
2. Set center frequency of spectrum analyzer = operating frequency.
3. Set the spectrum analyzer as RBW, VBW=1MHz, Sweep = 1 ms

5.7.3 Test Setup



5.7.4 Test Result

| Time of Occupancy (Dwell Time) | | | | | | | |
|---|-----------------|-----------------------------|---------------------------------|--------------------|---------------|-----------------------|--------|
| Mode | Frequency (MHz) | Pulse Time Per Hopping (ms) | Minimum Number of Hopping Freq. | Number of pulse in | Dwell Time IN | Dwell Time Limits (s) | Result |
| | | | | (0.4 * N sec) | (0.4 * N sec) | | |
| BDR-1Mbps | 2402 | 2.8986 | 79 | 106.67 | 0.3092 | 0.4 | Pass |
| EDR-3Mbps | 2402 | 2.9275 | 79 | 106.67 | 0.3123 | 0.4 | |
| Non-AFH: DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slots RX, 1 time slot TX). So, the dwell time is the time duration of the pulse times 3.37 * 0.4 *79 = 106.6 | | | | | | | |

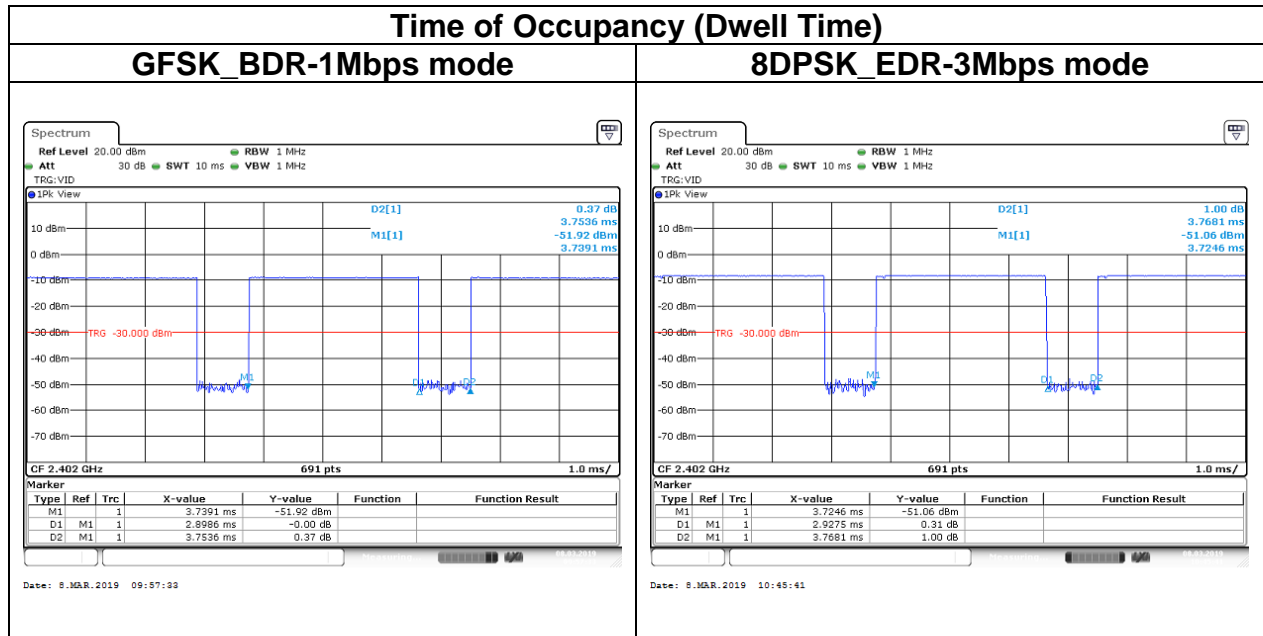


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Test Data



Note: We selected worst case to performed test in low channel. The results can be meet other channel.

5.8 RADIATION BANDEDGE AND SPURIOUS EMISSION

5.8.1 Test Limit

FCC according to §15.247(d), §15.209 and §15.205,

In any 100 kHz bandwidth outside the authorized frequency band, all harmonic and spurious must be least 20 dB below the highest emission level with the authorized frequency band. Radiation emission which fall in the restricted bands must also follow the FCC section 15.209 as below limit in table.

Below 30 MHz

| Frequency | Field Strength (microvolts/m) | Magnetic H-Field (microamperes/m) | Measurement Distance (metres) |
|---------------|----------------------------------|---|-------------------------------------|
| 9-490 kHz | 2,400/F (F in kHz) | 2,400/F (F in kHz) | 300 |
| 490-1,705 kHz | 24,000/F (F in kHz) | 24,000/F (F in kHz) | 30 |
| 1.705-30 MHz | 30 | N/A | 30 |

Above 30 MHz

| Frequency (MHz) | Field Strength microvolts/m at 3 metres (watts, e.i.r.p.) | |
|--------------------|--|--------------|
| | Transmitters | Receivers |
| 30-88 | 100 (3 nW) | 100 (3 nW) |
| 88-216 | 150 (6.8 nW) | 150 (6.8 nW) |
| 216-960 | 200 (12 nW) | 200 (12 nW) |
| Above 960 | 500 (75 nW) | 500 (75 nW) |

Remark:

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

5.8.2 Test Procedure

1. The EUT is placed on a turntable, Above 1 GHz is 1.5m and below 1 GHz is 0.8m above ground plane. The EUT Configured un accordance with ANSI C63.10: 2013, and the EUT set in a continuous mode.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level. And EUT is set 3m away from the receiving antenna, which is scanned from 1m to 4m above the ground plane to find out the highest emissions. Measurement are made polarized in both the vertical and the horizontal positions with antenna.
3. Span shall wide enough to full capture the emission measured. The SA from 9kHz to 26.5GHz set to the low, Mid and High channels with the EUT transmit.
4. For harmonic, the worst case of output power was BDR-1Mbps. Therefore only BDR-1Mbps record in the report.
5. The SA setting following :
 - (1) Below 1G : RBW = 100kHz, VBW \geq 3 RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.
 - (2) Above 1G :
 - (2.1) For Peak measurement : RBW = 1MHz, VBW \geq 3 RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.
 - (2.2) For Average measurement : RBW = 1MHz, VBW
 - If Duty Cycle \geq 98%, VBW=10Hz.
 - If Duty Cycle < 98%, VBW \geq 1/T.

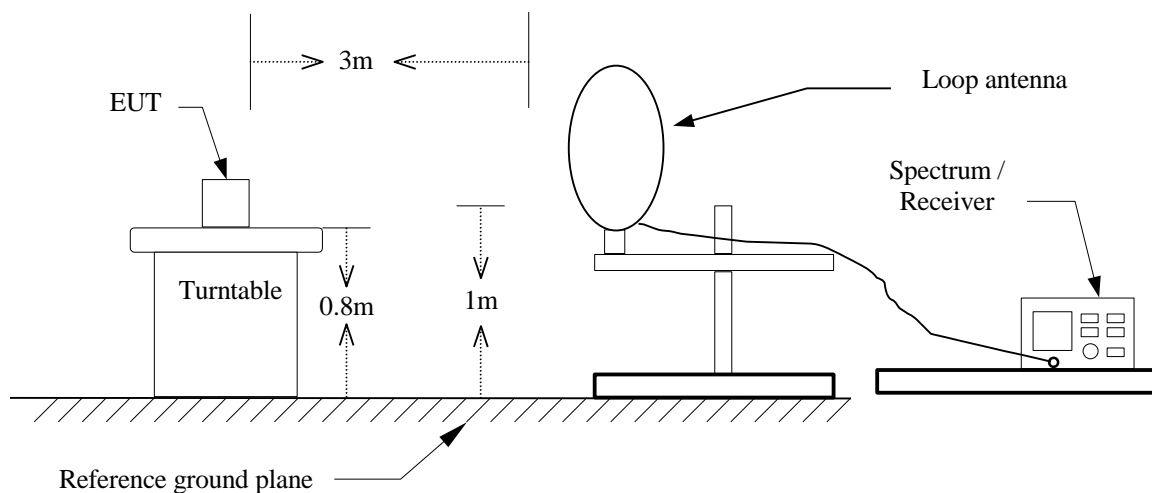
| Configuration | Duty Cycle (%) | T(ms) | 1/T (kHz) | VBW setting |
|-----------------|----------------|--------|-----------|-------------|
| GFSK_BDR-1Mbps | 77.26% | 2.8950 | 0.345 | 360Hz |
| 8DPSK_EDR-3Mbps | 77.24% | 2.8950 | 0.345 | 360Hz |

Remark:

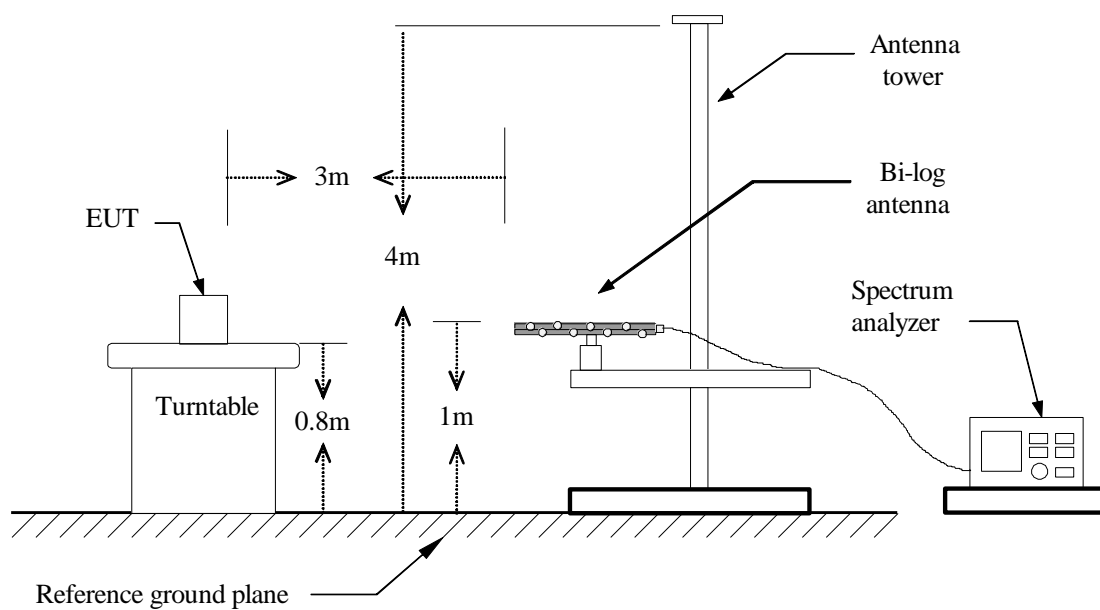
1. Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.
2. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).

5.8.3 Test Setup

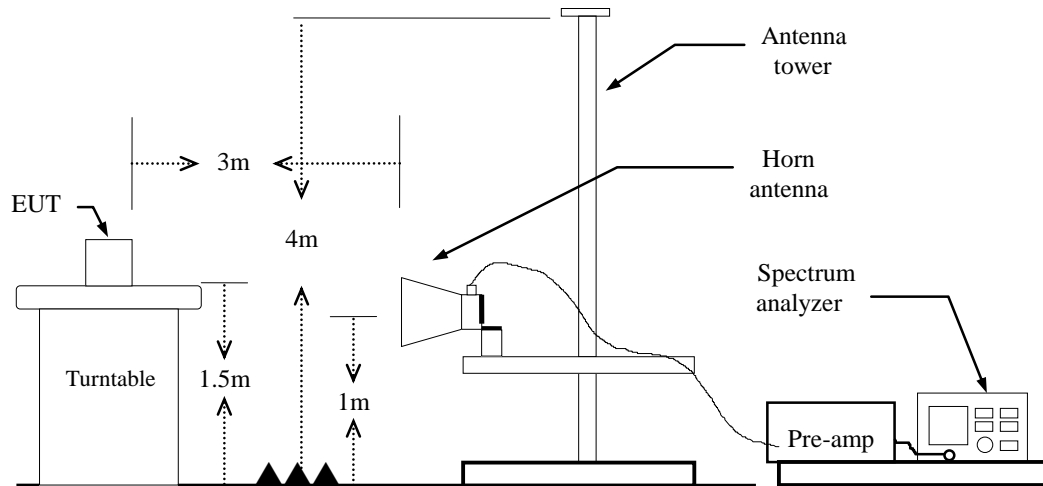
9kHz ~ 30MHz



30MHz ~ 1GHz



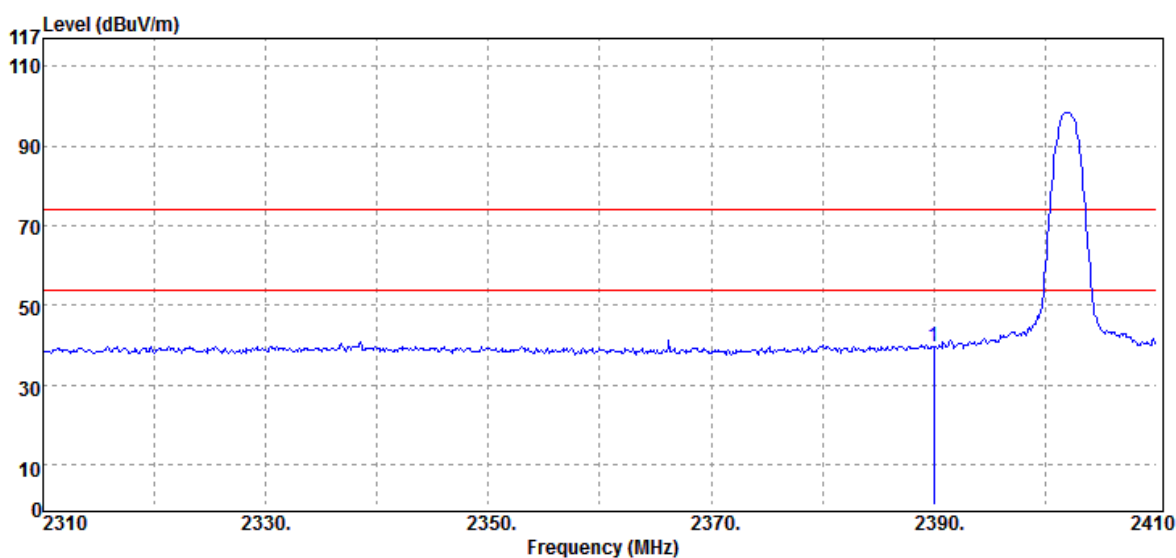
Above 1 GHz



5.8.4 Test Result

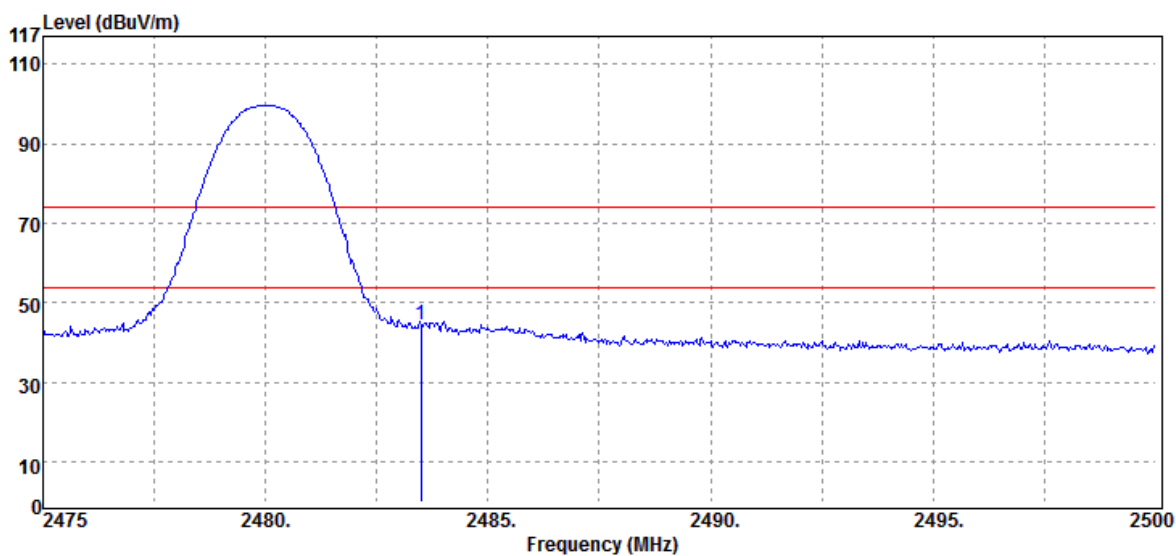
Band Edge Test Data

| | | | |
|------------|-------------------------|---------------|----------------|
| Test Mode: | GFSK_BR-1Mbps Low CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Band Edge | Test Date | March 27, 2019 |
| Polarize | Vertical | Test Engineer | Dally Hong |
| Detector | Peak | | |



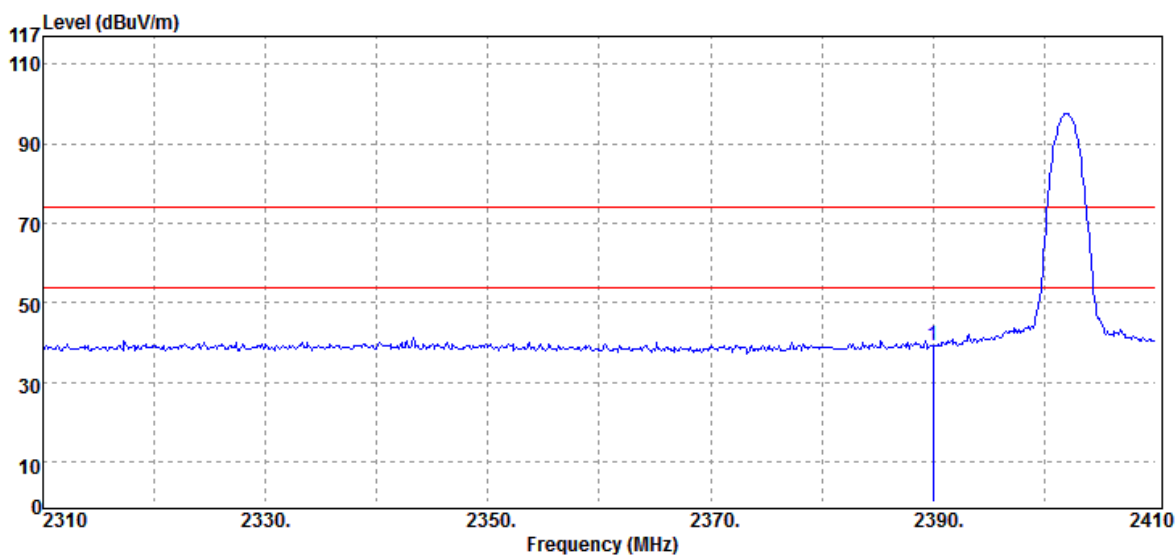
| Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 2390.00 | 42.99 | -3.33 | 39.66 | 74.00 | -34.34 | peak |

| | | | |
|------------|--------------------------|---------------|----------------|
| Test Mode: | GFSK_BR-1Mbps High CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Band Edge | Test Date | March 27, 2019 |
| Polarize | Vertical | Test Engineer | Dally Hong |
| Detector | Peak | | |



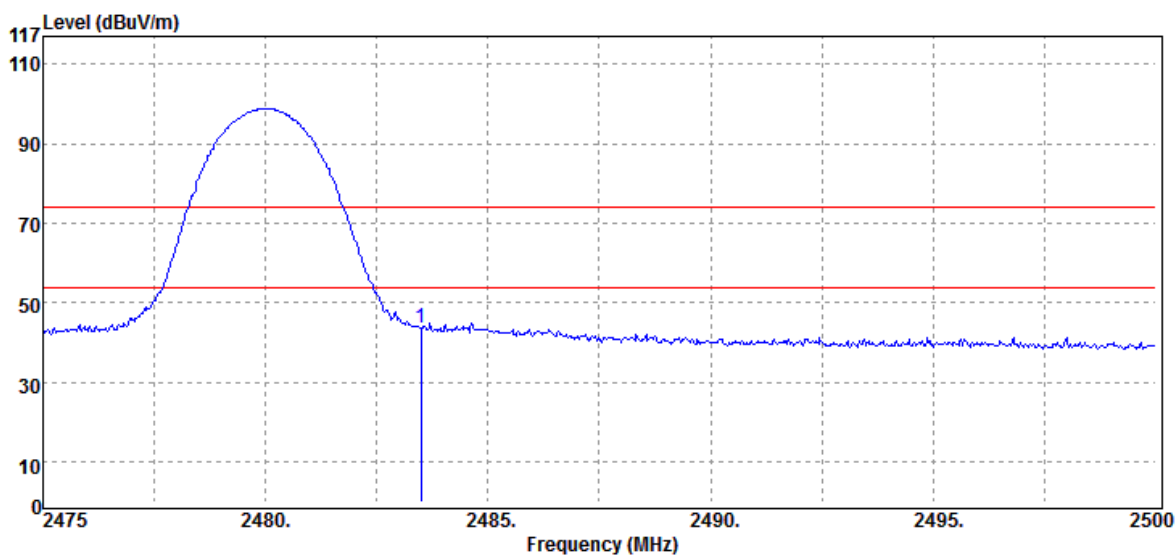
| Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 2483.50 | 47.20 | -2.72 | 44.48 | 74.00 | -29.52 | peak |

| | | | |
|------------|---------------------------|---------------|----------------|
| Test Mode: | 8DPSK_EDR-3Mbps Low CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Band Edge | Test Date | March 27, 2019 |
| Polarize | Vertical | Test Engineer | Dally Hong |
| Detector | Peak | | |



| Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 2390.00 | 42.78 | -3.33 | 39.45 | 74.00 | -34.55 | peak |

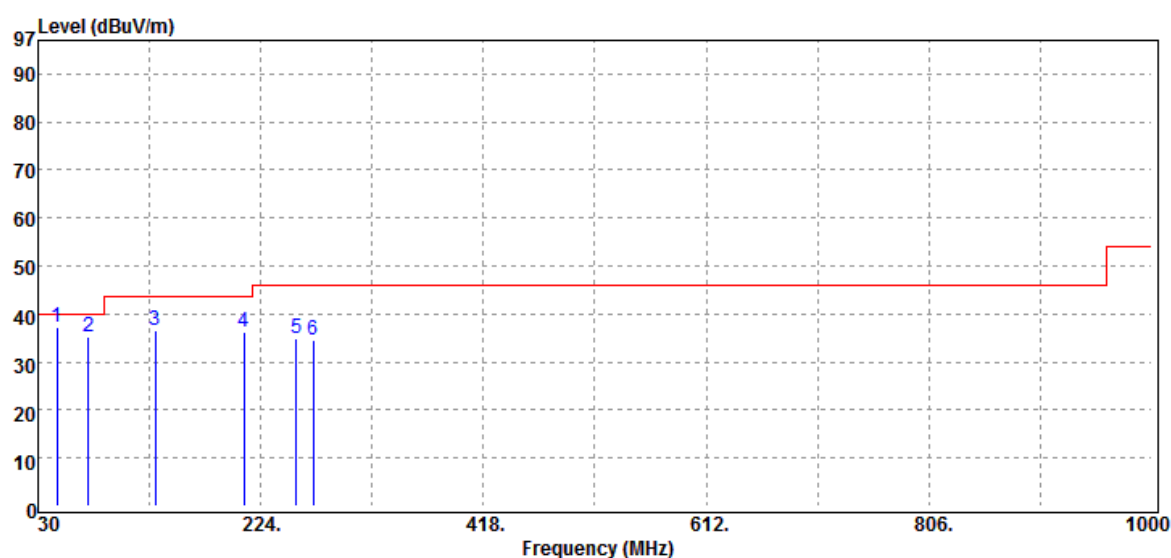
| | | | |
|------------|----------------------------|---------------|----------------|
| Test Mode: | 8DPSK_EDR-3Mbps High CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Band Edge | Test Date | March 27, 2019 |
| Polarize | Vertical | Test Engineer | Dally Hong |
| Detector | Peak | | |



| Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 2483.50 | 46.47 | -2.72 | 43.75 | 74.00 | -30.25 | peak |

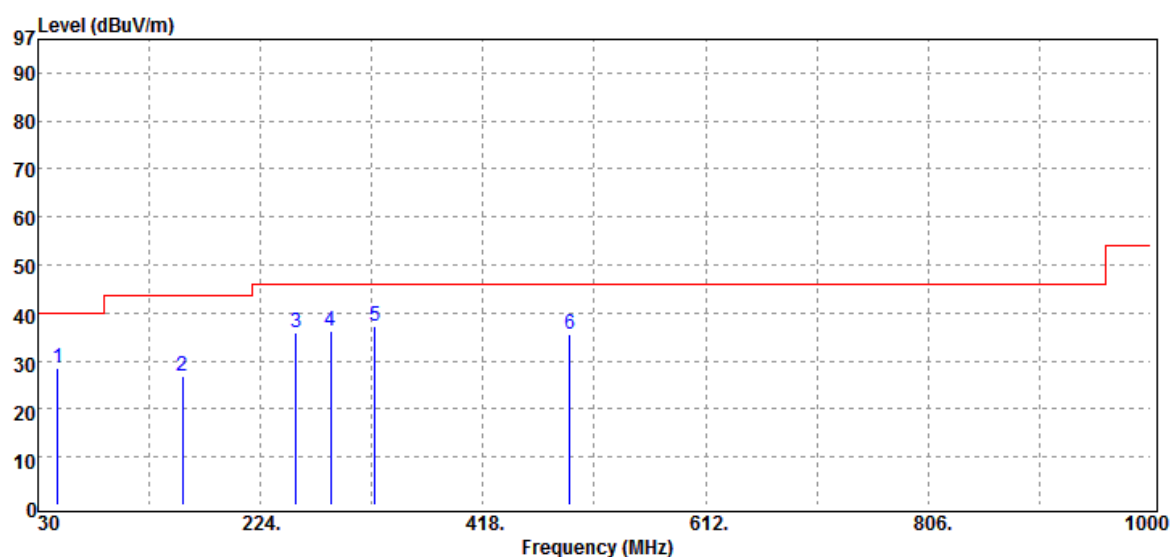
Below 1G Test Data

| | | | |
|------------|------------|---------------|----------------|
| Test Mode: | BT Mode | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | 30MHz-1GHz | Test Date | March 27, 2019 |
| Polarize | Vertical | Test Engineer | Dally Hong |
| Detector | Peak | | |



| Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 46.49 | 50.32 | -13.09 | 37.23 | 40.00 | -2.77 | peak |
| 73.65 | 49.59 | -14.45 | 35.14 | 40.00 | -4.86 | peak |
| 131.85 | 45.10 | -8.60 | 36.50 | 43.50 | -7.00 | peak |
| 209.45 | 47.20 | -10.93 | 36.27 | 43.50 | -7.23 | peak |
| 255.04 | 44.56 | -9.65 | 34.91 | 46.00 | -11.09 | peak |
| 269.59 | 42.37 | -7.87 | 34.50 | 46.00 | -11.50 | peak |

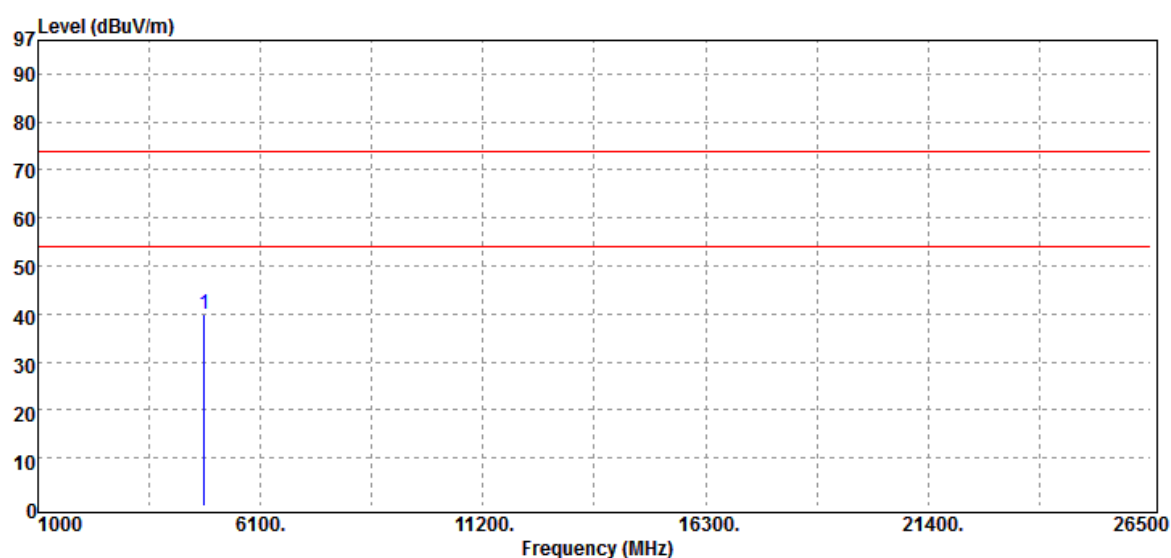
| | | | |
|------------|------------|---------------|----------------|
| Test Mode: | BT Mode | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | 30MHz-1GHz | Test Date | March 27, 2019 |
| Polarize | Horizontal | Test Engineer | Dally Hong |
| Detector | Peak | | |



| Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 47.46 | 42.19 | -13.59 | 28.60 | 40.00 | -11.40 | peak |
| 156.10 | 36.32 | -9.40 | 26.92 | 43.50 | -16.58 | peak |
| 255.04 | 45.49 | -9.65 | 35.84 | 46.00 | -10.16 | peak |
| 285.11 | 44.07 | -7.75 | 36.32 | 46.00 | -9.68 | peak |
| 323.91 | 43.92 | -6.59 | 37.33 | 46.00 | -8.67 | peak |
| 493.66 | 37.60 | -2.14 | 35.46 | 46.00 | -10.54 | peak |

Above 1G Test Data

| | | | |
|------------|-------------------------|---------------|----------------|
| Test Mode: | GFSK_BR-1Mbps Low CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Harmonic | Test Date | March 27, 2019 |
| Polarize | Vertical | Test Engineer | Dally Hong |
| Detector | Peak | | |

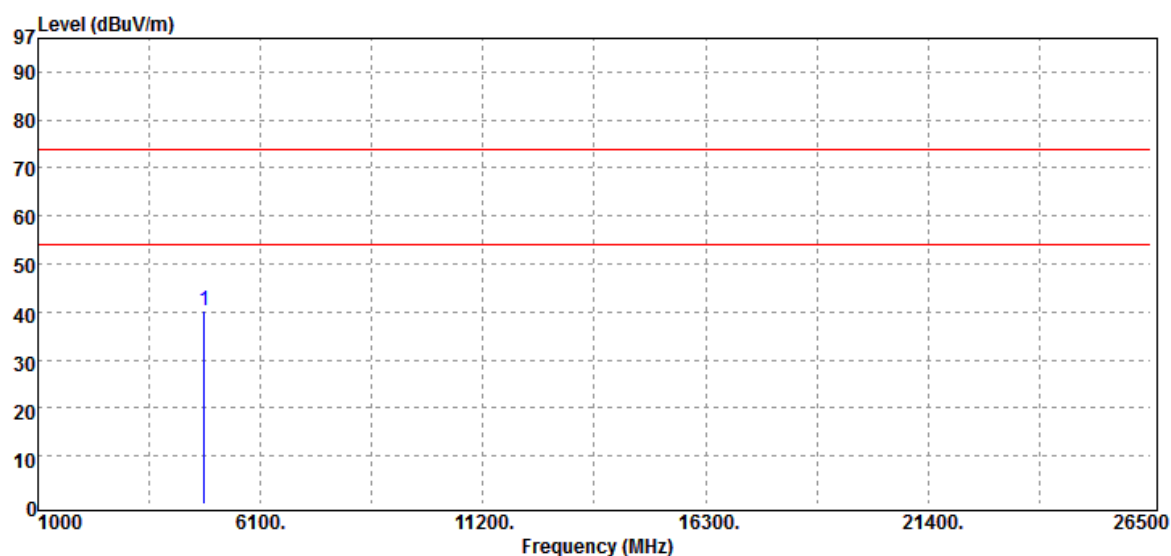


| Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 4804.00 | 36.93 | 3.11 | 40.04 | 74.00 | -33.96 | peak |
| N/A | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remark:

- Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

| | | | |
|------------|-------------------------|---------------|----------------|
| Test Mode: | GFSK_BR-1Mbps Low CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Harmonic | Test Date | March 27, 2019 |
| Polarize | Horizontal | Test Engineer | Dally Hong |
| Detector | Peak | | |

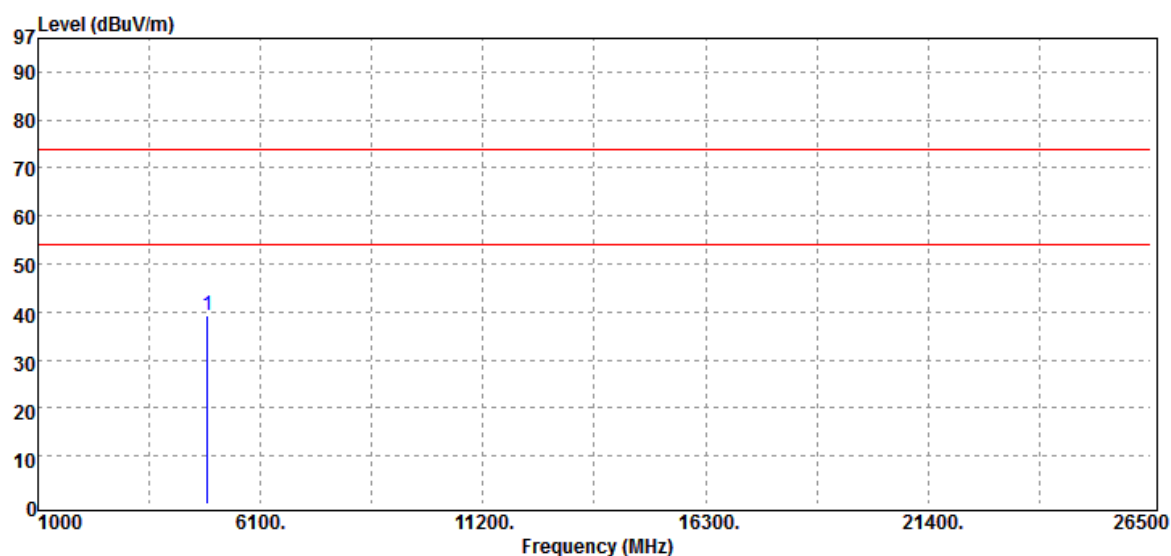


| Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 4804.00 | Peak | 37.06 | 3.11 | 40.17 | 74.00 | peak |
| N/A | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

| | | | |
|------------|-------------------------|---------------|----------------|
| Test Mode: | GFSK_BR-1Mbps Mid CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Harmonic | Test Date | March 27, 2019 |
| Polarize | Vertical | Test Engineer | Dally Hong |
| Detector | Peak | | |

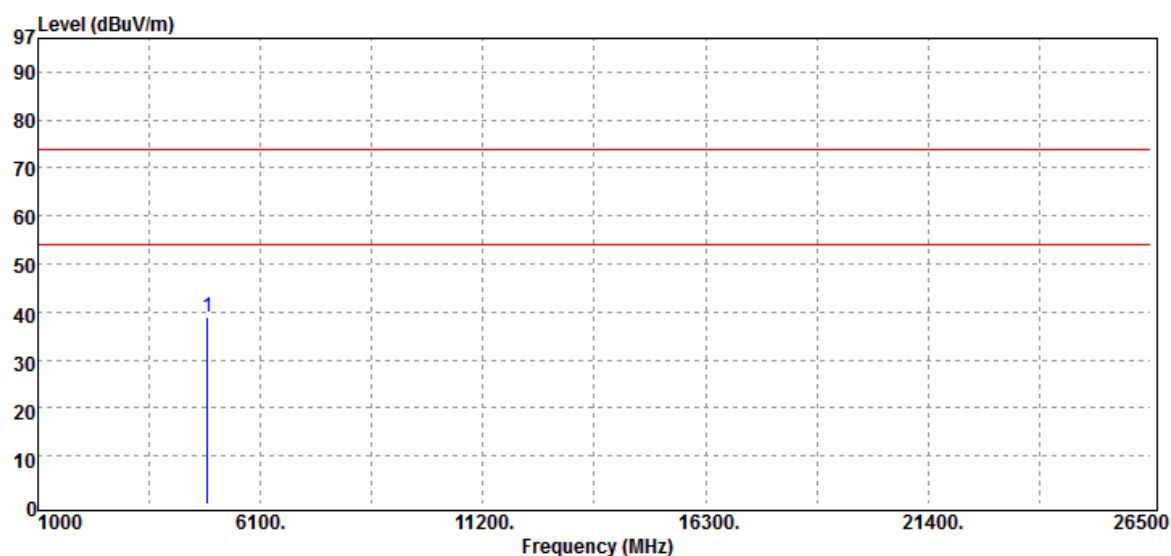


| Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 4882.00 | 35.86 | 3.46 | 39.32 | 74.00 | -34.68 | peak |
| N/A | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

| | | | |
|------------|-------------------------|---------------|----------------|
| Test Mode: | GFSK_BR-1Mbps Mid CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Harmonic | Test Date | March 27, 2019 |
| Polarize | Horizontal | Test Engineer | Dally Hong |
| Detector | Peak | | |

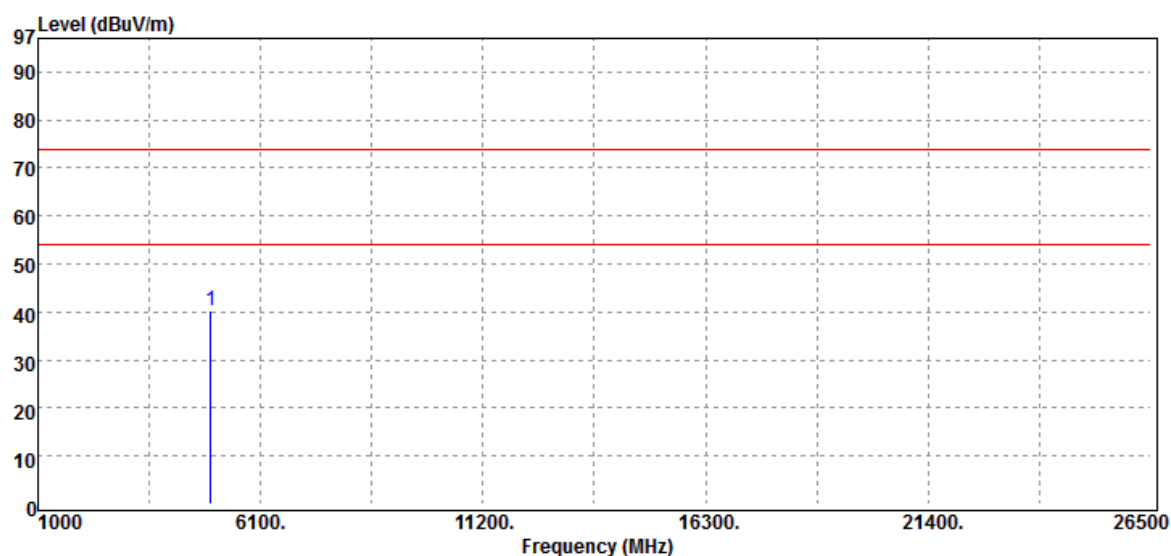


| Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 4882.00 | 35.33 | 3.46 | 38.79 | 74.00 | -35.21 | peak |
| N/A | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

| | | | |
|------------|--------------------------|---------------|----------------|
| Test Mode: | GFSK_BR-1Mbps High CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Harmonic | Test Date | March 27, 2019 |
| Polarize | Vertical | Test Engineer | Dally Hong |
| Detector | Peak | | |

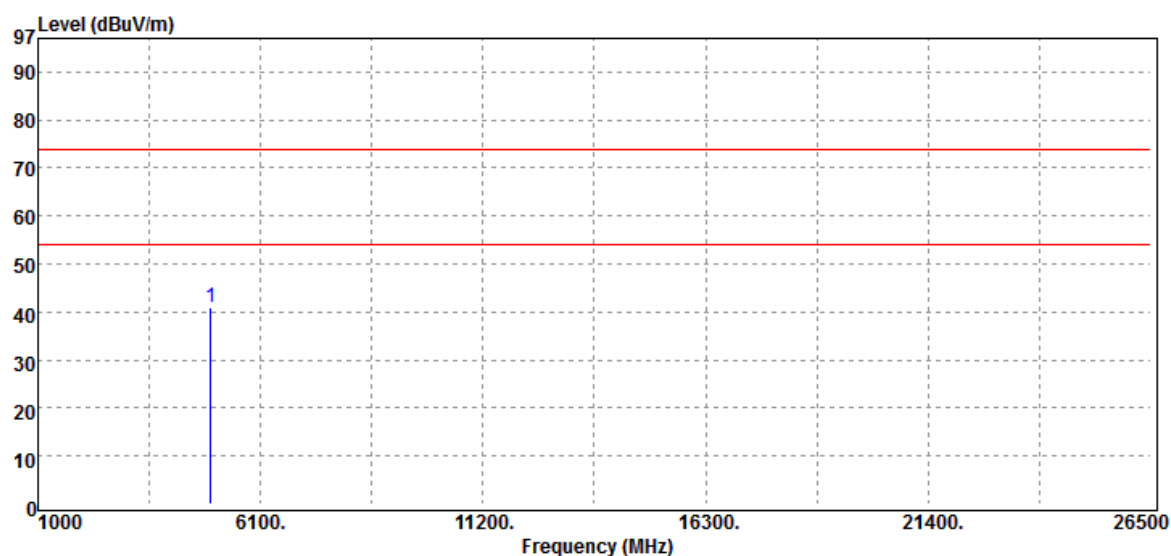


| Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 4960.00 | 35.92 | 4.48 | 40.40 | 74.00 | -33.60 | peak |
| N/A | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remark:

- Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

| | | | |
|------------|--------------------------|---------------|----------------|
| Test Mode: | GFSK_BR-1Mbps High CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Harmonic | Test Date | March 27, 2019 |
| Polarize | Horizontal | Test Engineer | Dally Hong |
| Detector | Peak | | |

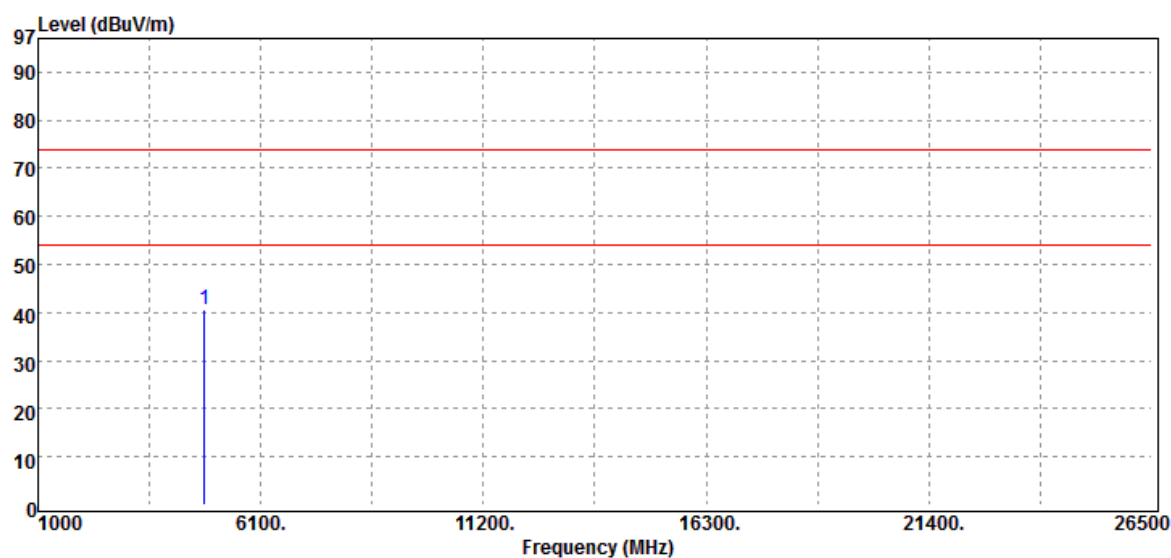


| Frequency (MHz) | Reading (dBuV) | Correct Factor (dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|-----------------------|-----------------|----------------|-------------|--------|
| 4960.00 | 36.47 | 4.48 | 40.95 | 74.00 | -33.05 | peak |
| N/A | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remark:

- Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

| | | | |
|-----------|---------------------------|---------------|----------------|
| Test Mode | 8DPSK_EDR-3Mbps Low CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Harmonic | Test Date | March 27, 2019 |
| Polarize | Vertical | Test Engineer | Dally Hong |
| Detector | Peak | | |

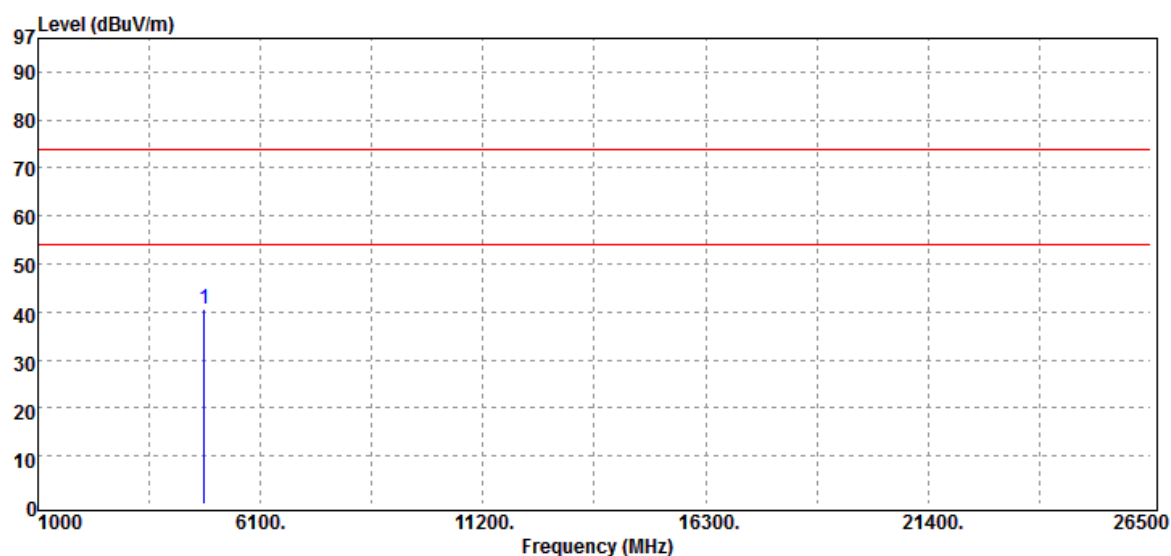


| Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (BuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|----------------------|-----------------|----------------|-------------|--------|
| 4804.00 | 37.40 | 3.11 | 40.51 | 74.00 | -33.49 | peak |
| N/A | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

| | | | |
|-----------|---------------------------|---------------|----------------|
| Test Mode | 8DPSK_EDR-3Mbps Low CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Harmonic | Test Date | March 27, 2019 |
| Polarize | Horizontal | Test Engineer | Dally Hong |
| Detector | Peak | | |

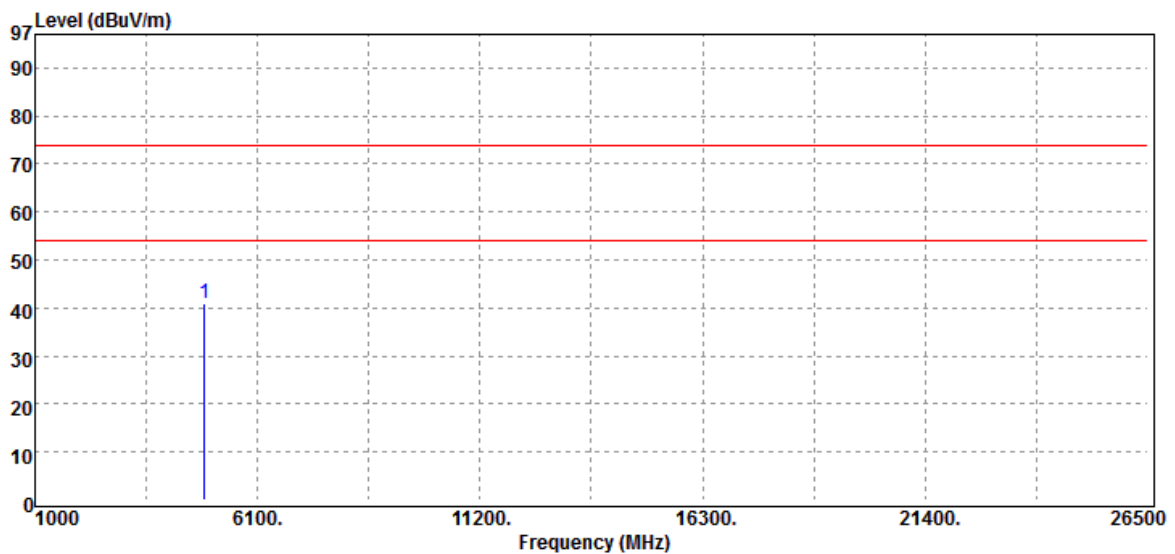


| Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|----------------------|-----------------|----------------|-------------|--------|
| 4804.00 | 37.63 | 3.11 | 40.74 | 74.00 | -33.26 | peak |
| N/A | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

| | | | |
|-----------|---------------------------|---------------|----------------|
| Test Mode | 8DPSK_EDR-3Mbps Mid CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Harmonic | Test Date | March 27, 2019 |
| Polarize | Vertical | Test Engineer | Dally Hong |
| Detector | Peak | | |

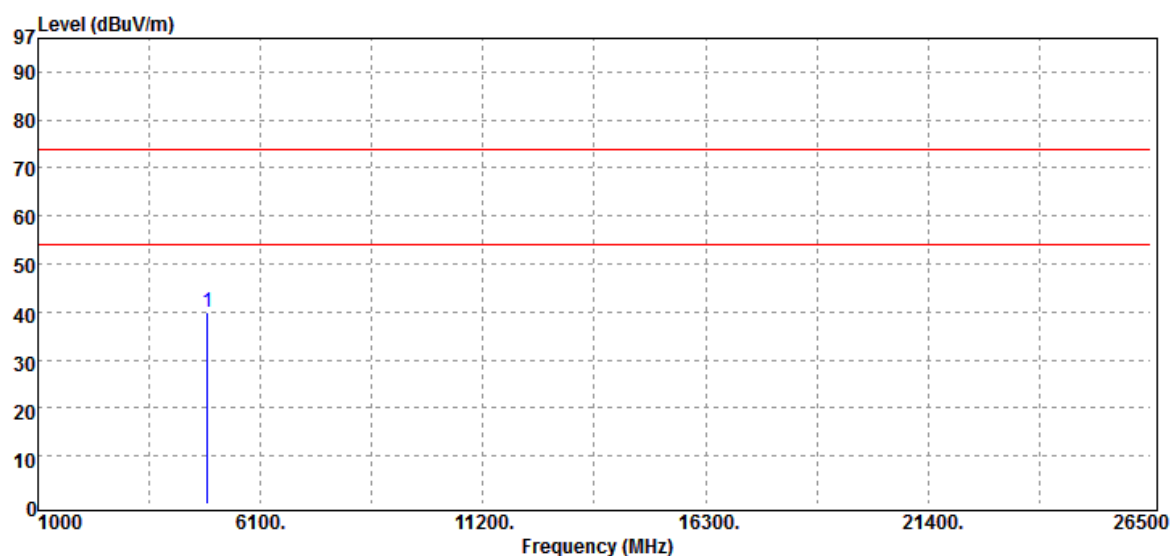


| Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|----------------------|-----------------|----------------|-------------|--------|
| 4882.00 | 37.58 | 3.46 | 41.04 | 74.00 | -32.96 | peak |
| N/A | | | | | | |
| | | | | | | |
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| | | | | | | |

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

| | | | |
|-----------|---------------------------|---------------|----------------|
| Test Mode | 8DPSK_EDR-3Mbps Mid CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Harmonic | Test Date | March 27, 2019 |
| Polarize | Horizontal | Test Engineer | Dally Hong |
| Detector | Peak | | |

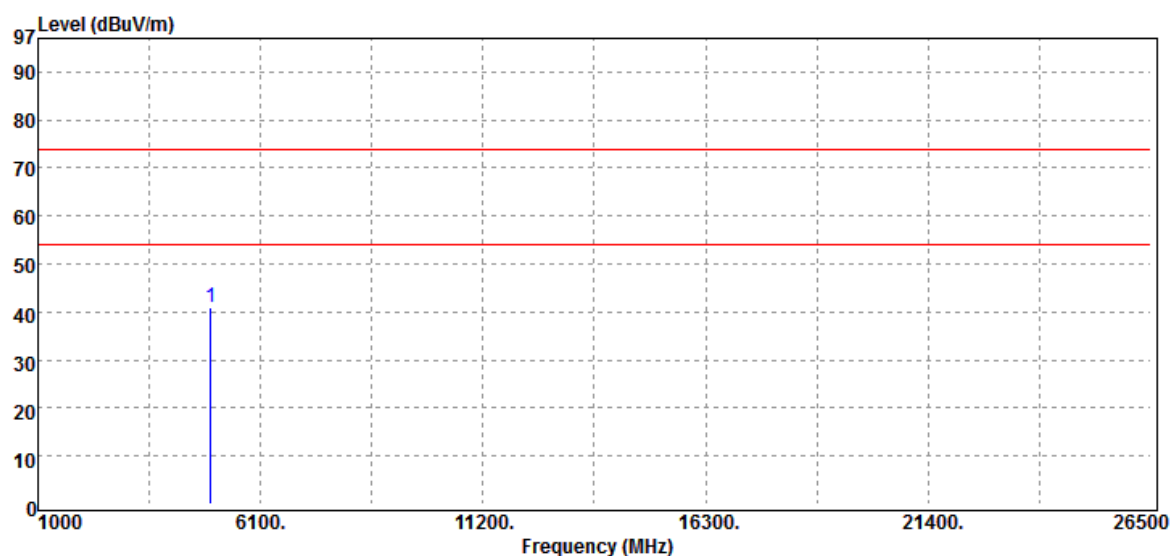


| Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|----------------------|-----------------|----------------|-------------|--------|
| 4882.00 | 36.45 | 3.46 | 39.91 | 74.00 | -34.09 | peak |
| N/A | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

| | | | |
|-----------|----------------------------|---------------|----------------|
| Test Mode | 8DPSK_EDR-3Mbps High CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Harmonic | Test Date | March 27, 2019 |
| Polarize | Vertical | Test Engineer | Dally Hong |
| Detector | Peak | | |

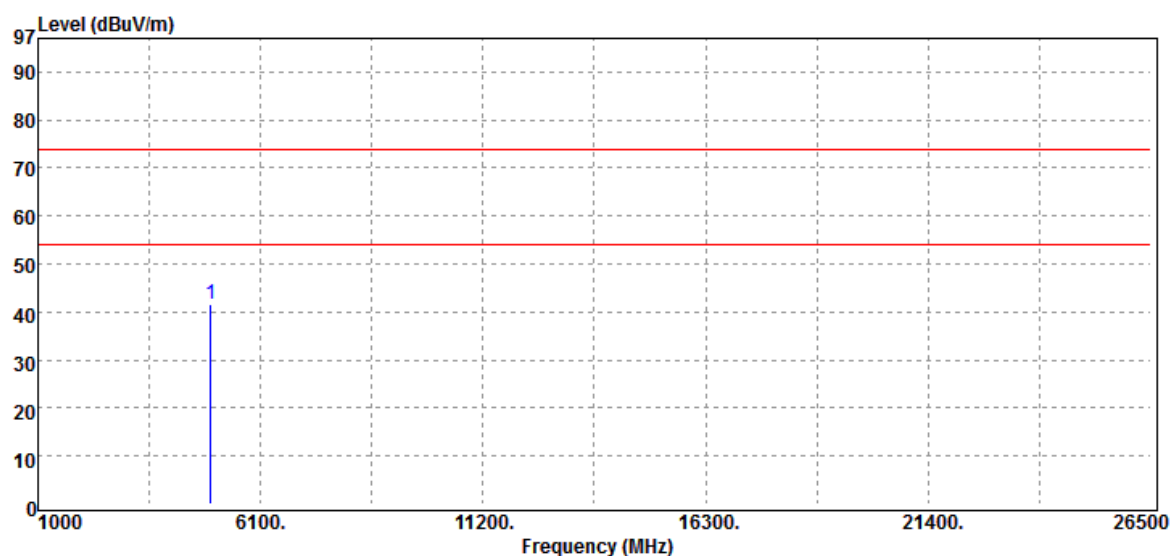


| Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|----------------------|-----------------|----------------|-------------|--------|
| 4960.00 | 36.57 | 4.48 | 41.05 | 74.00 | -32.95 | peak |
| N/A | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

Remark:

- Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
- For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

| | | | |
|-----------|----------------------------|---------------|----------------|
| Test Mode | 8DPSK_EDR-3Mbps High CH | Temp/Hum | 23(°C)/ 62%RH |
| Test Item | Harmonic | Test Date | March 27, 2019 |
| Polarize | Horizontal | Test Engineer | Dally Hong |
| Detector | Peak | | |



| Frequency (MHz) | Reading (dBuV) | Correct Factor(dB/m) | Result (dBuV/m) | Limit (dBuV/m) | Margin (dB) | Remark |
|-----------------|----------------|----------------------|-----------------|----------------|-------------|--------|
| 4960.00 | 37.26 | 4.48 | 41.74 | 74.00 | -32.26 | peak |
| N/A | | | | | | |
| | | | | | | |
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Remark:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. For above 1GHz, the EUT peak value was under average limit, therefore the Average value compliance with the average limit

--End of Test Report--