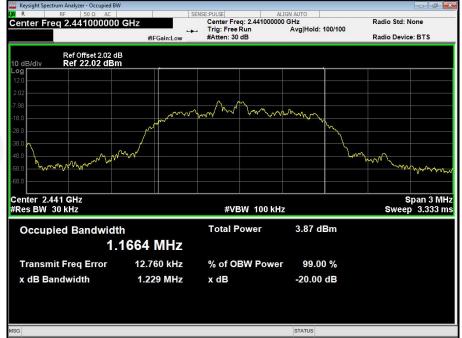


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π/4-DQPSK Low Channel



π/4-DQPSK Middle Channel

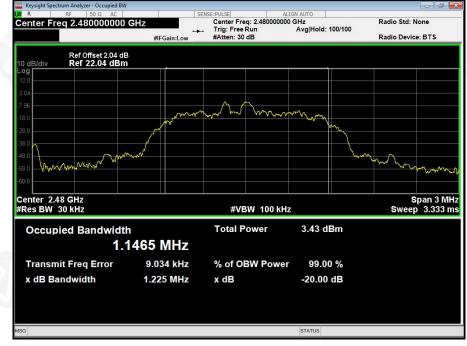








π/4-DQPSK High Channel







8-DPSK Low Channel

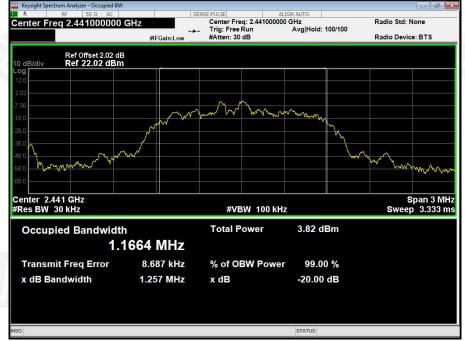




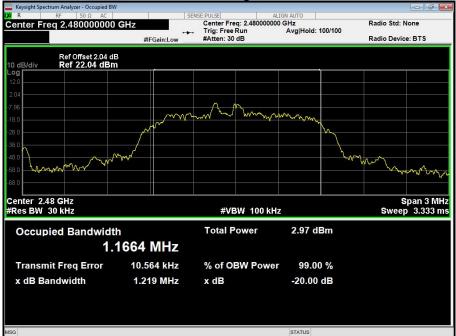


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8-DPSK Middle Channel



8-DPSK High Channel









8. Maximum Peak Output Power

| Test Requirement: | FCC Part15 C Section 15.247 (b)(1) |
|-------------------|------------------------------------|
| Test Method: | ANSI C63.10:2013 |
| Limit: | FCC:20.97 dBm |

8.1 Block Diagram Of Test Setup



8.2 Limit

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

For FHSs operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1.0 W if the hopset uses 75 or more hopping channels; the maximum peak conducted output power shall not exceed 0.125 W if the hopset uses less than 75 hopping channels. The e.i.r.p. shall not exceed 4 W.

8.3 Test procedure

- 1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
- 2. Set the spectrum analyzer: RBW = 2MHz. VBW =6MHz. Sweep = auto; Detector Function = Peak.
- 3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

8.4 DEVIATION FROM STANDARD

No deviation.

8.5 Test Result

| Mode | Test channel | Peak Output Power (dBm) | FCC Limit (dBm) | Result |
|-----------|--------------|----------------------------|--------------------|--------|
| | Lowest | -1.541 | | |
| GFSK | Middle | -1.933 | 30.00 | Pass |
| 55 | Highest | -2.661 | | |
| | Lowest | -0.634 | | |
| π/4-DQPSK | Middle | -1.074 | 21.00 | Pass |
| | Highest | -1.775 | | |
| | Lowest | -1.548 | | |
| 8-DPSK | Middle | -2.037 | 21.00 | Pass |
| | Highest | -2.795 | | |

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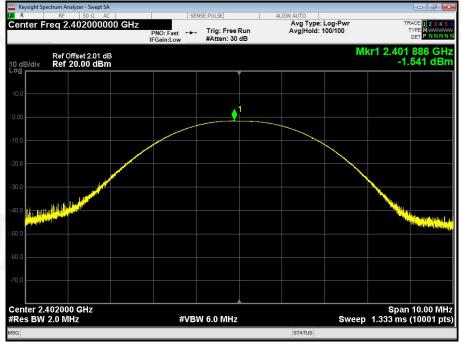
www.zkt-lab.com

F

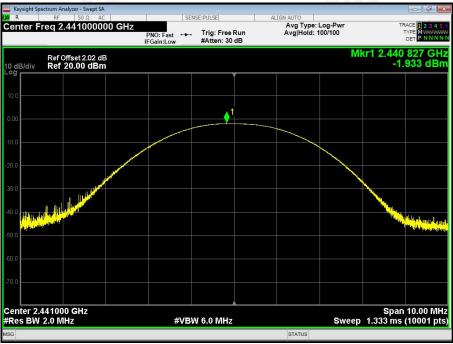


Test plots

GFSK Low Channel



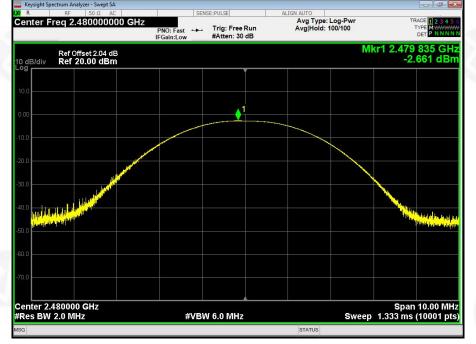
GFSK Middle Channel



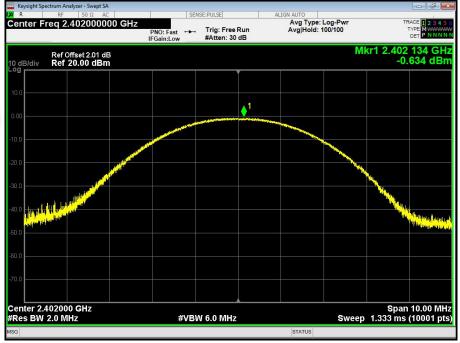




GFSK High Channel



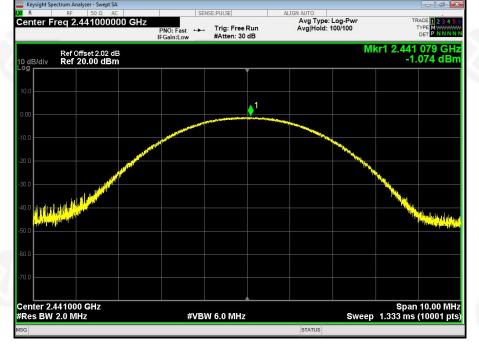
π/4-DQPSK Low Channel



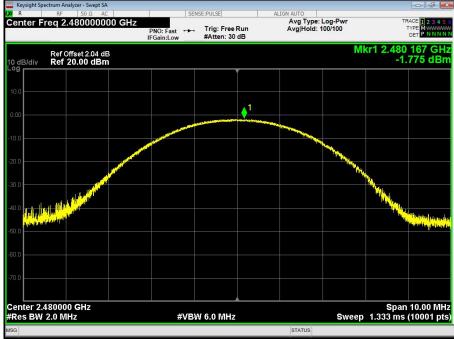




π/4-DQPSK Middle Channel



π/4-DQPSK High Channel



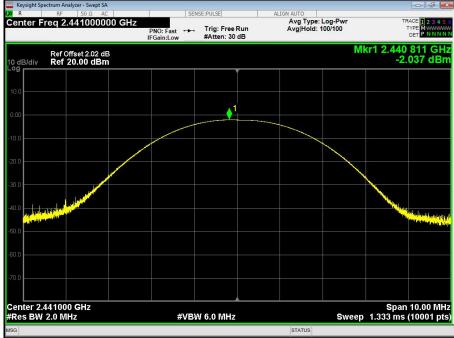




8-DPSK Low Channel



8-DPSK Middle Channel

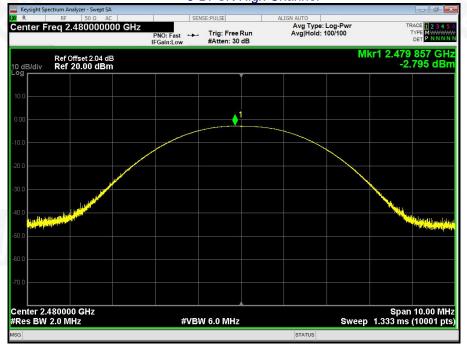


















9. HOPPING CHANNEL SEPARATION

| Test Requirement: | FCC Part15 C Section 15.247 (a)(1) |
|-------------------|--|
| Test Method: | ANSI C63.10:2013 |
| Receiver setup: | RBW=100KHz, VBW=300KHz, detector=Peak |
| Limit: | GFSK: 20dB bandwidth $\pi/4$ -DQPSK & 8DSK: 0.025MHz or 2/3 of the 20dB bandwidth (whichever is greater) |

9.1 Test Setup

| EUT | SPECTRUM |
|------------|----------|
| 523-0054 x | ANALYZER |

9.2 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port

to the spectrum.

2. Set the spectrum analyzer: RBW = 30kHz. VBW = 100kHz , Span = 2.0MHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section Submit this plot.

9.3 DEVIATION FROM STANDARD No deviation.

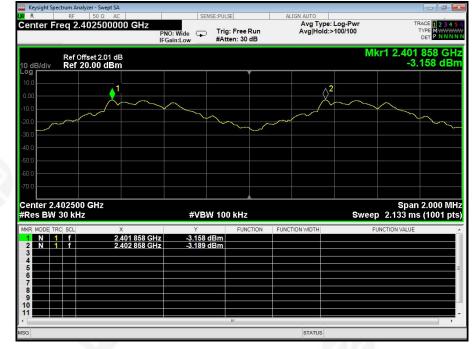






| Modulation | Test Channel | Separation (MHz) | Limit(MHz) | Result |
|------------|--------------|------------------|------------|--------|
| GFSK | Low | 1.000 | 0.869 | PASS |
| GFSK | Middle | 0.998 | 0.873 | PASS |
| GFSK | High | 1.000 | 0.853 | PASS |
| π/4-DQPSK | Low | 0.998 | 0.833 | PASS |
| π/4-DQPSK | Middle | 0.998 | 0.819 | PASS |
| π/4-DQPSK | High | 1.000 | 0.817 | PASS |
| 8-DPSK | Low | 1.000 | 0.824 | PASS |
| 8-DPSK | Middle | 0.998 | 0.838 | PASS |
| 8-DPSK | High | 1.000 | 0.813 | PASS |

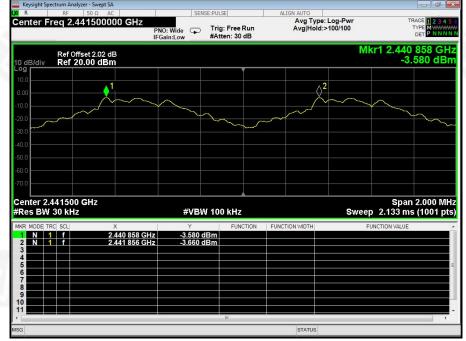
Test plots GFSK Low Channel



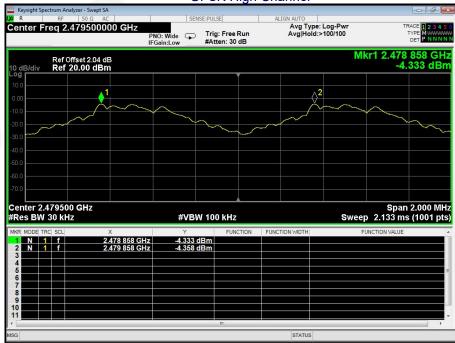




GFSK Middle Channel



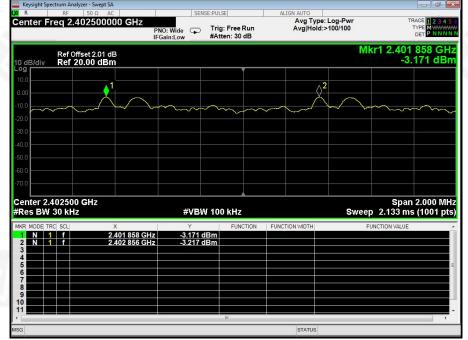
GFSK High Channel



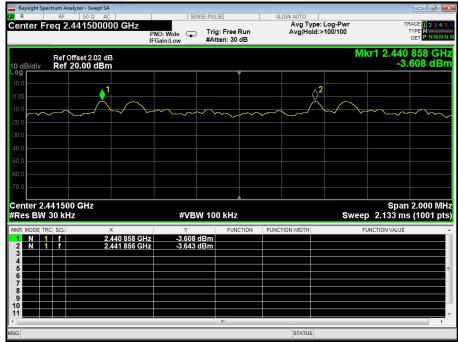




π/4-DQPSK Low Channel



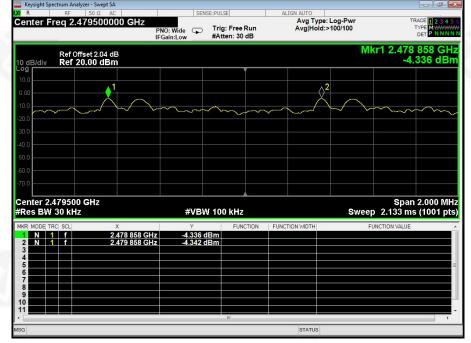
$\pi/4$ -DQPSK Middle Channel



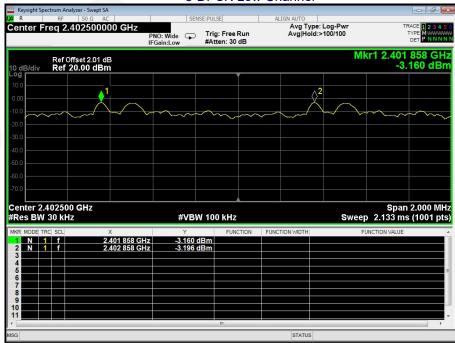




π/4-DQPSK High Channel



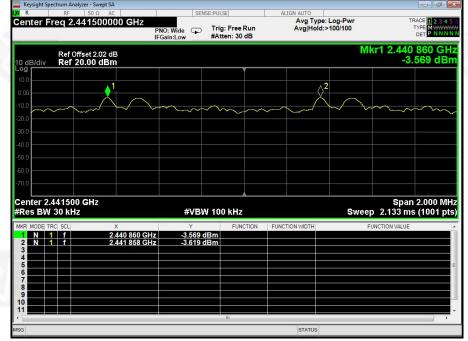
8-DPSK Low Channel



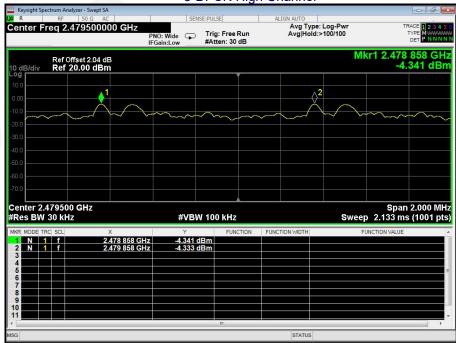




8-DPSK Middle Channel



8-DPSK High Channel







10.NUMBER OF HOPPING FREQUENCY

| 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 |

10.1 Test Setup

| EUT | SPECTRUM |
|-----|----------|
| | ANALYZER |

10.2 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set the spectrum analyzer: RBW = 100kHz. VBW = 300kHz. Sweep = auto; Detector Function = Peak. Trace = Max hold.

3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.

4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

10.3 DEVIATION FROM STANDARD

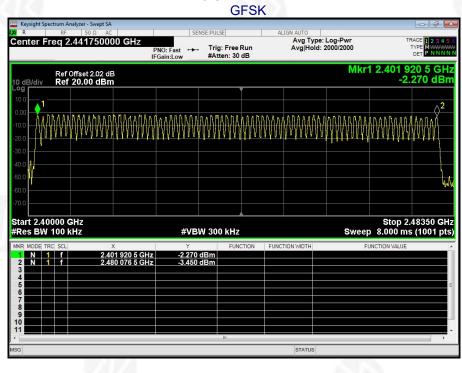
No deviation.







Test Plots: 79 Channels in total











π/4-DQPSK SENSE:PULSE Avg Type: Log-Pwr Avg|Hold: 2000/2000 eq 2.441750000 GH Center F PNO: Fast ↔→ IFGain:Low Trig: Free Run #Atten: 30 dB TYPE Mkr1 2.401 586 5 GHz -7.791 dBm Ref Offset 2.02 dB Ref 20.00 dBm Start 2.40000 GHz #Res BW 100 kHz Stop 2.48350 GHz Sweep 8.000 ms (1001 pts) #VBW 300 kHz 2.401 586 5 GHz 2.480 327 0 GHz -7.791 dBm -7.898 dBm N 1 f N 1 f STATUS

8-DPSK

| R RF 50 Ω | AC AC | SENSE:PL | JLSE | ALIGN AUTO | | |
|---|---|------------|-----------------------------|----------------|-----------------------------|---|
| enter Freq 2.441750 | P | | ig: Free Run tten: 30 dB | | be: Log-Pwr d: 2000/2000 | TRACE 1 2 3 4 TYPE M WWW DET P N N N |
| Ref Offset 2.02 dB/div Ref 20.00 dl | | | | | Mkr | 1 2.402 004 0 GH -3.274 dB |
| °g | | | | | | |
| a.o | MANNAN | Markelly | hryphyde | MANA MALAN | h hand the | hpharpharry ² |
| 0.0 | | | | | | |
| 0.0 | | | | | | |
| 0.0 | | | | | | 4 |
| | | | | | | |
| | | #VBW 30 | 00 kHz | | Sweet | Stop 2.48350 GH 8.000 ms (1001 pt |
| Res BW 100 kHz | X | Y | FUNCTION | FUNCTION WIDTH | | Stop 2.48350 GH 8.000 ms (1001 pt UNCTION VALUE |
| Res BW 100 kHz kr mode trc scl 1 N 1 f 2 | X 2.402 004 0 GHz 2.480 494 0 GHz | | FUNCTION | FUNCTION WIDTH | | o 8.000 ms (1001 pt |
| 2 N 1 f 2 3 4 5 6 | 2.402 004 0 GHz | -3.274 dBm | FUNCTION | FUNCTION WIDTH | | o 8.000 ms (1001 pt |
| Res BW 100 kHz kr Mode trcl scl 1 N 1 f 2 2 N 1 f 2 3 4 4 5 5 6 6 6 6 6 8 9 6 6 6 | 2.402 004 0 GHz | -3.274 dBm | FUNCTION | FUNCTION WIDTH | | o 8.000 ms (1001 pt |
| Res BW 100 kHz kr Mode Trcl scl. 1 N 1 f 2 2 N 1 f 2 3 4 5 5 5 | 2.402 004 0 GHz | -3.274 dBm | FUNCTION | FUNCTION WIDTH | | o 8.000 ms (1001 pt |

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11. DWELL TIME

| Test Requirement: | FCC Part15 C Section 15.247 (a)(1)(iii) |
|-------------------|---|
| Test Method: | ANSI C63.10:2013 |
| Receiver setup: | RBW=1MHz, VBW=3MHz, Span=0Hz, Detector=Peak |
| Limit: | 0.4 Second |

11.1 Test Setup

| EUT | SPECTRUM |
|-----|----------|
| | ANALYZER |

11.2 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.

2. Set spectrum analyzer span = 0Hz;

3. Set RBW = 1MHz and VBW = 3MHz.Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.

4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

11.3 DEVIATION FROM STANDARD

No deviation.







11.4 Test Result

GFSK mode:

| Frequency | Packet | Dwell time(ms) | Limit(ms) | Result |
|-----------|--------|----------------|-----------|--------|
| 2441MHz | DH1 | 125.44 | 400 | Pass |
| 2441MHz | DH3 | 263.84 | 400 | Pass |
| 2441MHz | DH5 | 309.65 | 400 | Pass |

Remarks:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s Test channel: as blow CH:2441MHz time slot= $0.392(ms)^{*}(1600/(2^{*}79))^{*}31.6=125.44ms$

CH:2441MHz time slot=1.649(ms)*(1600/ (2*79))*31.6=263.84ms

CH:2441MHz time slot=2.903(ms) (1600/ (4 79)) 31.6=309.65ms

π/4-DQPSK mode:

| Frequency | Packet | Dwell time(ms) | Limit(ms) | Result |
|-----------|--------|----------------|-----------|--------|
| 2441MHz | 2DH1 | 127.04 | 400 | Pass |
| 2441MHz | 2DH3 | 264.64 | 400 | Pass |
| 2441MHz | 2DH5 | 309.97 | 400 | Pass |

Remarks:

The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s Test channel: as blow CH:2441MHz time slot= $0.397(ms)^{*}(1600/(2^{*}79))^{*}31.6=127.04ms$

CH:2441MHz time slot=1.654(ms)*(1600/ (4*79))*31.6=264.64ms

CH:2441MHz time slot=2.906(ms)*(1600/ (6*79))*31.6=309.97ms

8-DPSK mode:

| Frequency | Packet | Dwell time(ms) | Limit(ms) | Result |
|-----------|--------|----------------|-----------|--------|
| 2441MHz | 3DH1 | 127.68 | 400 | Pass |
| 2441MHz | 3DH3 | 264.48 | 400 | Pass |
| 2441MHz | 3DH5 | 309.76 | 400 | Pass |

Remarks:

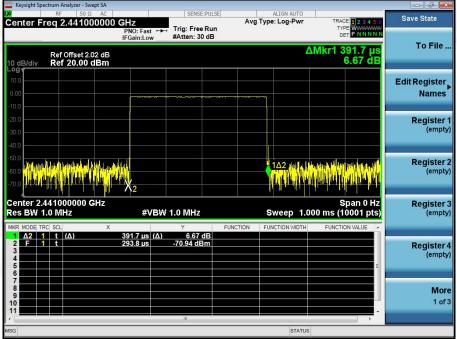
The test period: T= 0.4 Second/Channel x 79 Channel = 31.6 s Test channel: as blow CH:2441MHz time slot=0.399(ms)*(1600/ (2*79))*31.6=127.68ms CH:2441MHz time slot=1.653(ms)*(1600/ (4*79))*31.6=264.48ms CH:2441MHz time slot=2.904(ms)*(1600/ (6*79))*31.6=309.76ms





Test Plots

GFSK DH1 2441MHz



GFSK DH3 2441MHz

| Keysight Spectrum Anal | | | | | | | - 7 × |
|--|--------------------------|----------------------------|------------------------|----------|--------------------------|----------------------------------|--|
| × RF Center Freq 2.4 | 50 Ω AC 41000000 G | SHz | SENSE:PULS | Avg Type | ALIGN AUTO e: Log-Pwr | TRACE 1 2 3 4 5 6 TYPE WWWWWW | Frequency |
| | fset 2.02 dB 0.00 dBm | PNO: Fast ++ IFGain:Low | #Atten: 30 dB | | Δ | /kr1 1.649 ms -1.72 dB | Auto Tune |
| 10.0 0.00 -10.0 | | | | | | | Center Free 2.441000000 GH |
| -20.0 | | | | | | | Start Fre 2.441000000 GH |
| -60.0 -60.0 -70.0 | | X2 | | | | | Stop Fre 2.441000000 GH |
| Center 2.441000 Res BW 1.0 MHz | | #VBW | / 1.0 MHz | | weep 3.00 | Span 0 Hz 00 ms (10001 pts) | CF Ste 1.000000 MH <u>Auto</u> Ma |
| $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | | 1.649 ms (Δ) 843.9 μs | -1.72 dB -61.64 dBm | | | E | Freq Offse 0 H |
| 7 8 9 10 | | | | | | | Scale Type |
| | | | m | | | | |
| MSG | | | | | STATUS | | |





GFSK DH5 2441MHz

| Keysight Spectrum Analyzer - Swept SA | | | |
|--|---|-------------------|-----------------------------------|
| Center Freq 2.441000000 | PNO: Fast +++ Irig: Free Run | TY | E 123455 WWWWWWW F NNNNN |
| Ref Offset 2.02 dB 0 dB/div Ref 20.00 dBm | IFGain:Low #Atten: 30 dB | ΔMkr1 2 | 903 ms 0.23 dB |
| 0.00 | | | Center Fre 2.441000000 GH |
| 20.0 | | | Start Fre 2.441000000 GH |
| | | | Stop Fre |
| enter 2.441000000 GHz les BW 1.0 MHz | #VBW 1.0 MHz | Sweep 4.000 ms (1 | pan 0 Hz 0001 pts) NVALUE A |
| Δ2 1 t (Δ) 2 F 1 t 3 - - - 4 - - - 5 - - - 6 - - - | 2.903 ms (Δ) 0.23 dB 302.8 μs -61.73 dBm | | Freq Offs |
| 7 8 9 10 | | | Log L |
| 56 | UI. | STATUS | |

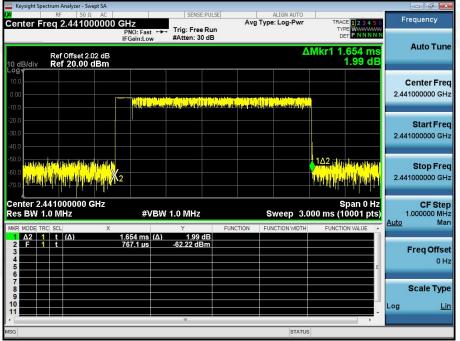
π/4-DQPSK 2DH1 2441MHz

| Keysight Spectrum Analyzer - Swept SA | | | | |
|--|---|---------------------------------------|---|--|
| Center Freq 2.441000000 | | Avg Type: Log-Pwr | TRACE 1 2 3 4 5 6 TYPE WWWWWW | Frequency |
| Ref Offset 2.02 dB | PNO: Fast ++ Trig: Free Run IFGain:Low #Atten: 30 dB | · · · · · · · · · · · · · · · · · · · | ΔMkr1 396.8 μs 2.35 dB | Auto Tune |
| 10.0 0.00 -10.0 | | vy dly day water day ye day a say t | | Center Fred 2.441000000 GHz |
| -20.0 | | | | Start Free 2.441000000 GH: |
| -60.0 -60.0 Apply (11) (11) (11) (11) (11) (11) (11) (11 | | 12 | | Stop Fred 2.441000000 GH: |
| Center 2.441000000 GHz Res BW 1.0 MHz MKR MODE TRC SCL X | #VBW 1.0 MHz | Sweep 1.0 | Span 0 Hz 000 ms (10001 pts) FUNCTION VALUE | CF Step 1.000000 MH <u>Auto</u> Mar |
| 1 Δ2 1 t (Δ) 2 F 1 t 3 3 - - - - 4 - - - - 5 - - - - - 6 - - - - - | 396.8 µs (Δ) 2.35 dB 369.6 µs -65.34 dBm | | E | Freq Offse 0 H |
| 7 8 9 10 11 | | | | Scale Type Log <u>Li</u> i |
| MSG | | STATUS | | |

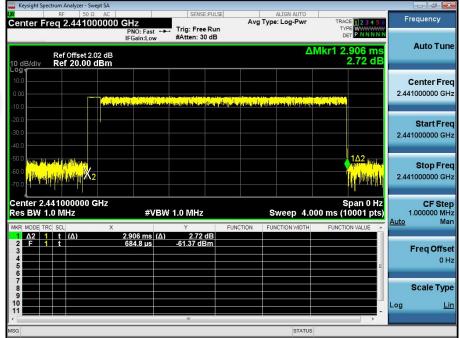




π/4-DQPSK 2DH3 2441MHz



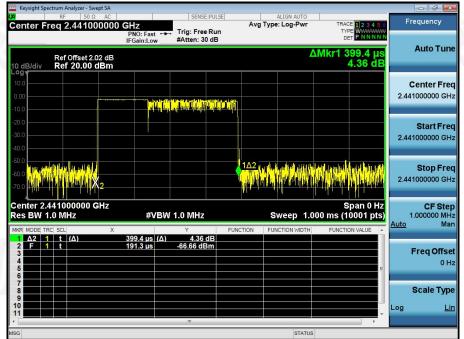
π/4-DQPSK 2DH5 2441MHz







8-DPSK 3DH1 2441MHz



8-DPSK 3DH3 2441MHz

| Keysight Spectrum Analyzer - Swept SA | | | |
|--|--|---------------------------------|--|
| enter Freg 2.441000000 | GHz SENSE:PULS | ALIGN AUTO Avg Type: Log-Pwr | TRACE 2 3 4 5 6 Frequency |
| Ref Offset 2.02 dB | PNO: Fast +++ Trig: Free Run IFGain:Low #Atten: 30 dB | ΔMkr | TYPE WWWWWWWWW DET PINNNN 1 1.653 ms -3.48 dB |
| - 0g v 10.0 0.00 | | | Center Fre 2.44100000 GH |
| 20.0 30.0 40.0 | | | Start Fre 2.44100000 GH |
| | | | Stop Fre 2.44100000 GF |
| Center 2.441000000 GHz Res BW 1.0 MHz | #VBW 1.0 MHz | Sweep 3.000 m | Span 0 Hz is (10001 pts) UNCTION VALUE |
| 1 Δ2 1 t (Δ) 2 F 1 t 3 3 4 5 5 6 <td>1.653 ms (Δ) -3.48 dB 626.1 μs -61.68 dBm</td> <td></td> <td>Freq Offs</td> | 1.653 ms (Δ) -3.48 dB 626.1 μs -61.68 dBm | | Freq Offs |
| 7 8 9 10 | | | Scale Typ |
| < | m | STATUS | Þ |

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8-DPSK 3DH5 2441MHz

| RF 50 Ω AC | | SENSE:PULSE | ALIGN AUTO | | |
|-----------------------|--------------|---------------------------------|---|---------------------------------|----------------|
| nter Freg 2.441000000 | GHz | [JENSE POLSE] | Avg Type: Log-Pwi | TRACE 1 2 3 4 5 6 | Frequency |
| | PNO: Fast + | Trig: Free Run #Atten: 30 dB | • ,, • • | TYPE WWWWWWW DET P N N N N N | |
| | IFGain:Low | #Atten: 30 dB | | | Auto Tun |
| Ref Offset 2.02 dB | | | | ΔMkr1 2.904 ms | |
| dB/div Ref 20.00 dBm | | | | 2.68 dB | |
| | | | | | Center Fre |
| | | | | | 2.441000000 GH |
| | | | <mark>Warden bergene bereiten bereiten</mark> | | 2.44100000 811 |
| | | | | المحدي تقنيحيا و | |
| | | | | | Start Fre |
| 0 | | | | | 2.441000000 GH |
| 0 | | | | | |
| | | | | 1∆2 <u>1400</u> 00 | |
| | | | | | Stop Fre |
| 0 1111 111 X2 | | | | | 2.441000000 GH |
| | | | | | |
| nter 2.441000000 GHz | | | | Span 0 Hz | CF Ste |
| s BW 1.0 MHz | #VBV | V 1.0 MHz | Sweep 4 | .000 ms (10001 pts) | 1.000000 MH |
| N MODE TRC SCL X | | Y | FUNCTION FUNCTION WIDT | H FUNCTION VALUE | Auto Ma |
| Δ2 1 t (Δ) F 1 t | 2.904 ms (Δ) | 2.68 dB | | | |
| F 1 t | 594.8 µs | -64.03 dBm | | | Freq Offse |
| | | | | | 0 H |
| | | | | | |
| | | | | | Scale Typ |
| | | | | | ocale Typ |
| | | | | | |
| | | | | | Log <u>Li</u> |
| | | | | | Log <u>Li</u> |
| | | m | STAT | + + | Log <u>Li</u> |















12. Antenna Requirement

| Standard requirement: | FCC Part15 C Section 15.203 /247(c) |
|-----------------------|-------------------------------------|
|-----------------------|-------------------------------------|

15.203 requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(c) (1)(i) requirement:

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

EUT Antenna:

The antenna is PCB permanent antenna, the best case gain of the antennas is 0 dBi, reference to the appendix II for details





Reference to the appendix I for details.

14. EUT Constructional Details

Reference to the appendix II for details.

***** END OF REPORT *****













