

Appendix Report

Project No.:	CISR250610059
Test Engineer:	James Wang
Supervised by:	Rory Huang

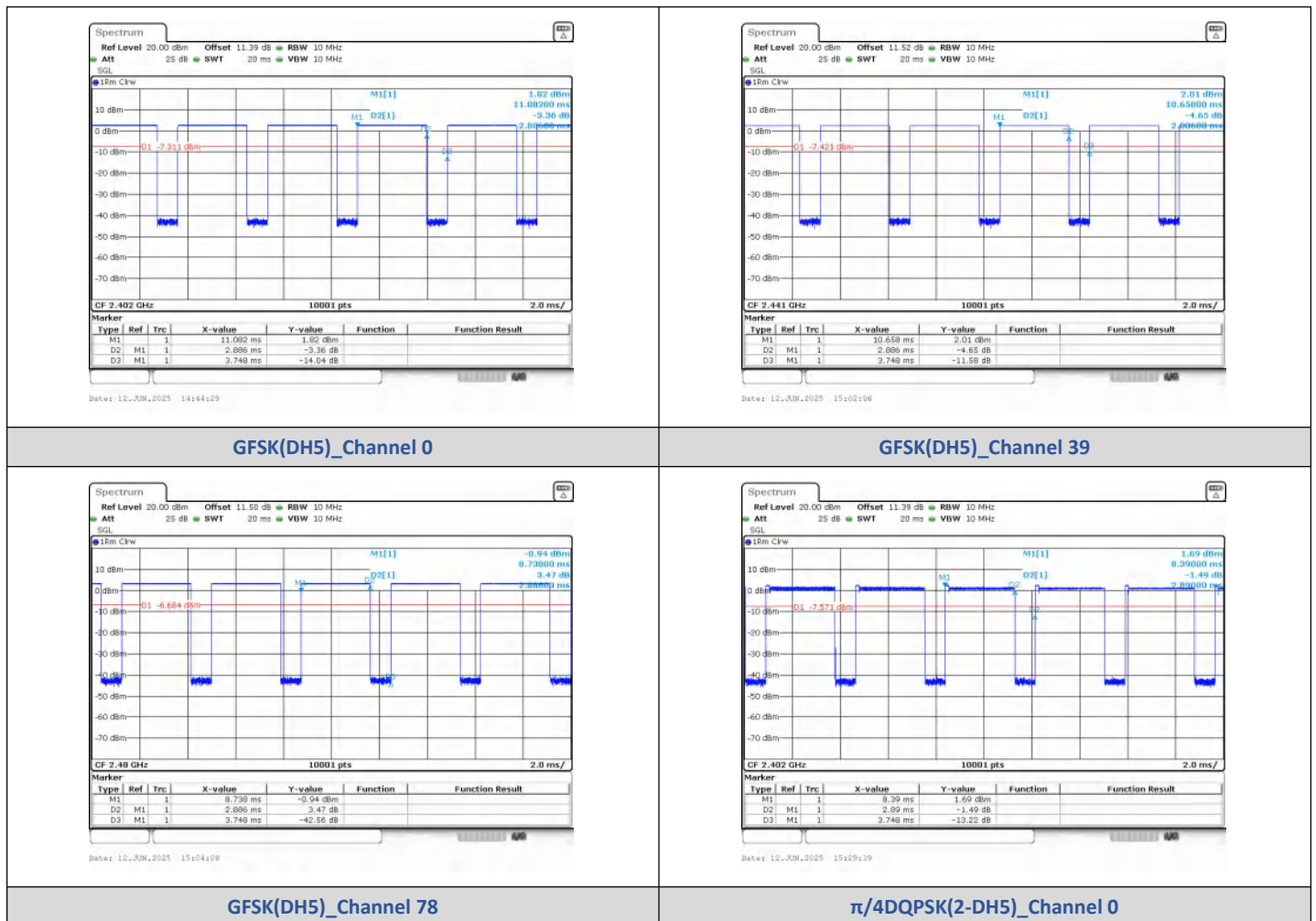
1) Duty Cycle

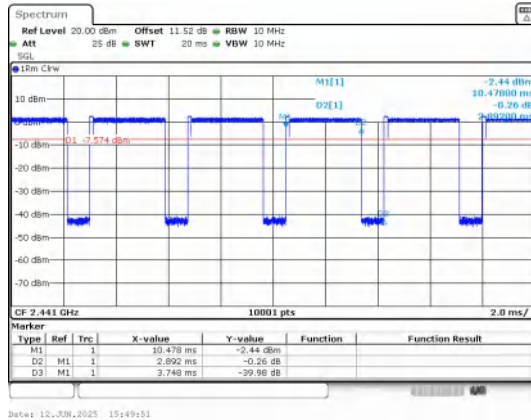
Test Result

Left:

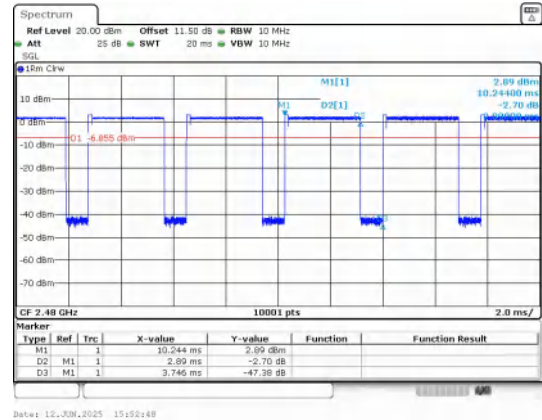
Modulation	Packets	Channel	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle (linear)	Duty Cycle Factor (dB)	1/T
GFSK	DH5	0	2.886	3.748	77.00	0.7700	1.1351	0.3465
		39	2.886	3.748	77.00	0.7700	1.1351	0.3465
		78	2.886	3.748	77.00	0.7700	1.1351	0.3465
$\pi/4$ DQPSK	2-DH5	0	2.890	3.748	77.11	0.7711	1.1289	0.3460
		39	2.892	3.748	77.16	0.7716	1.1261	0.3458
		78	2.890	3.746	77.15	0.7715	1.1266	0.3460
8DPSK	3-DH5	0	2.362	3.748	63.02	0.6302	2.0052	0.4234
		39	2.364	3.748	63.07	0.6307	2.0018	0.4230
		78	2.364	3.748	63.07	0.6307	2.0018	0.4230

Test Graphs

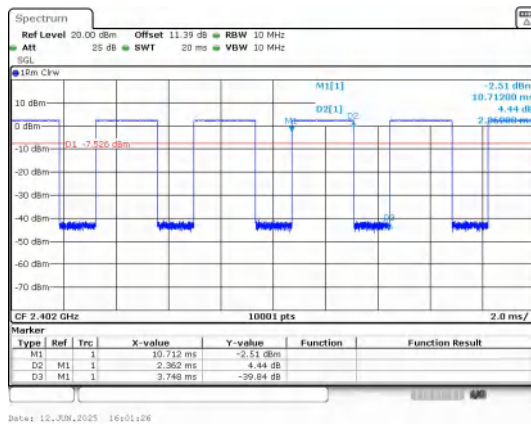




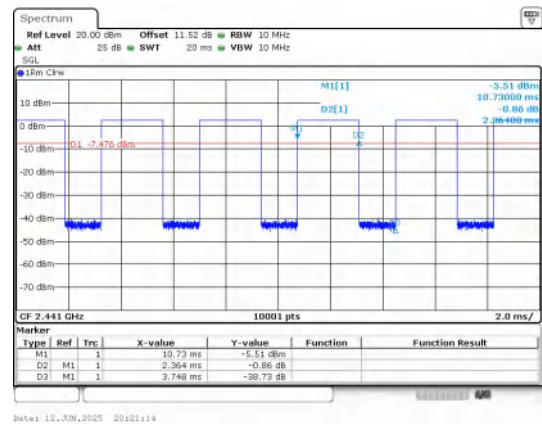
$\pi/4$ DQPSK(2-DH5)_Channel 39



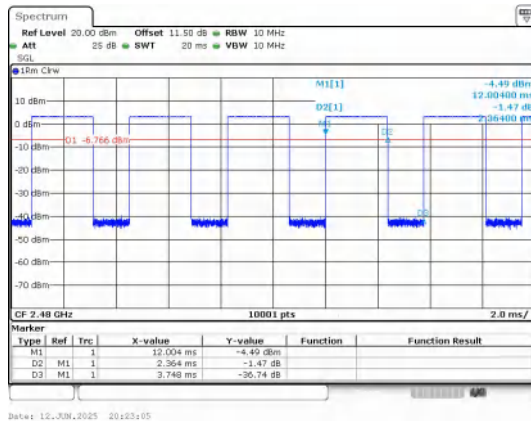
$\pi/4$ DQPSK(2-DH5)_Channel 78



8DPSK(3-DH5)_Channel 0



8DPSK(3-DH5)_Channel 39

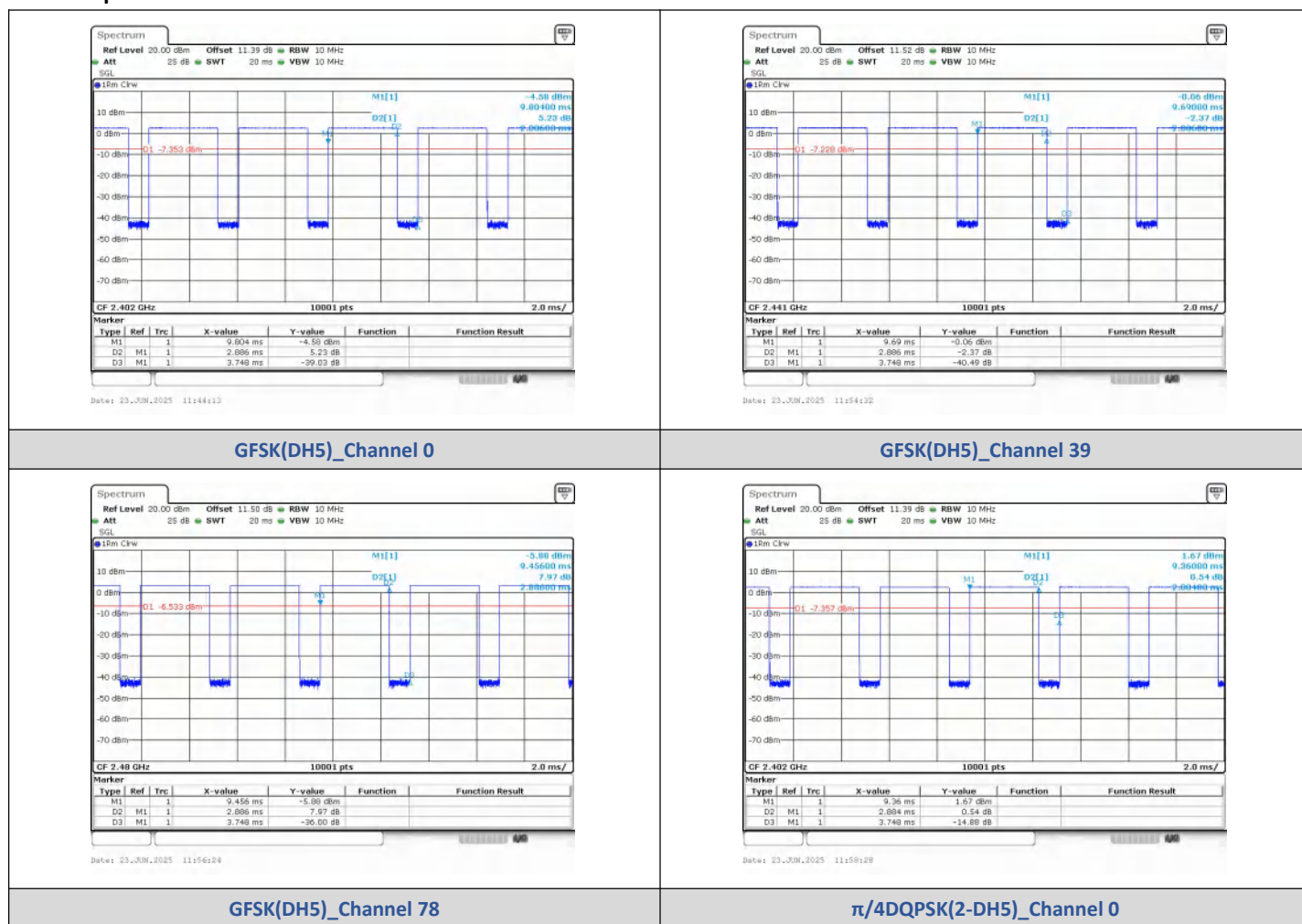


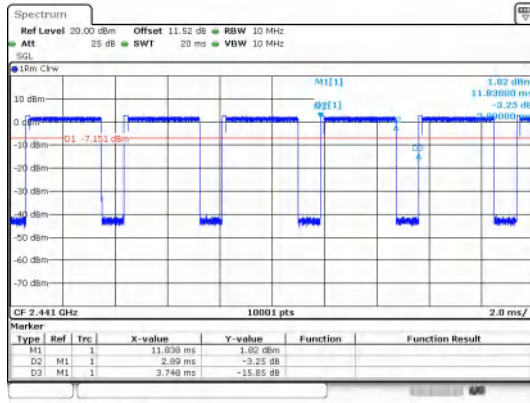
8DPSK(3-DH5)_Channel 78

Right:

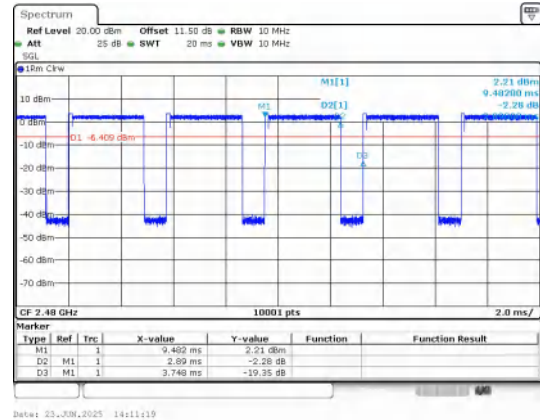
Modulation	Packets	Channel	On Time (ms)	Period (ms)	Duty Cycle (%)	Duty Cycle (linear)	Duty Cycle Factor (dB)	1/T
GFSK	DH5	0	2.886	3.748	77.00	0.7700	1.1351	0.3465
		39	2.886	3.748	77.00	0.7700	1.1351	0.3465
		78	2.886	3.748	77.00	0.7700	1.1351	0.3465
$\pi/4$ DQPSK	2-DH5	0	2.884	3.748	76.95	0.7695	1.1379	0.3467
		39	2.890	3.748	77.11	0.7711	1.1289	0.3460
		78	2.890	3.748	77.11	0.7711	1.1289	0.3460
8DPSK	3-DH5	0	2.362	3.748	63.02	0.6302	2.0052	0.4234
		39	2.360	3.748	62.97	0.6297	2.0087	0.4237
		78	2.360	3.748	62.97	0.6297	2.0087	0.4237

Test Graphs

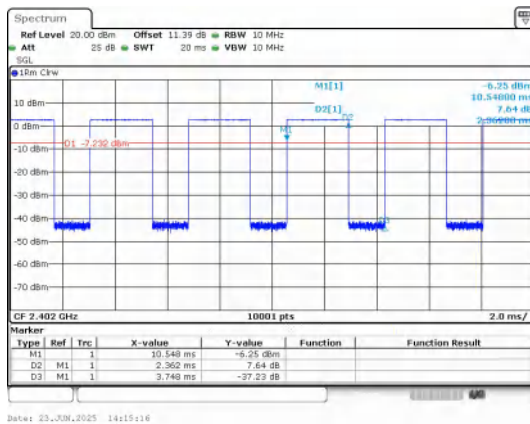




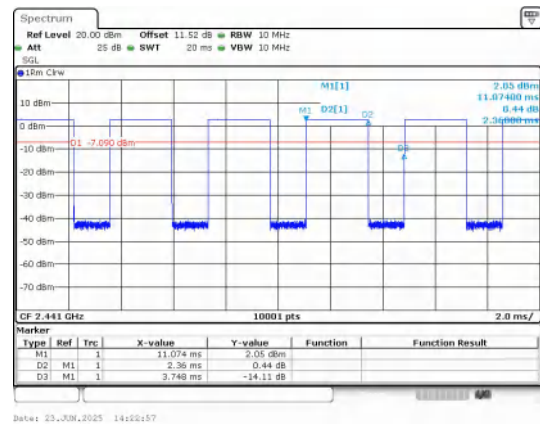
$\pi/4$ DQPSK(2-DH5)_Channel 39



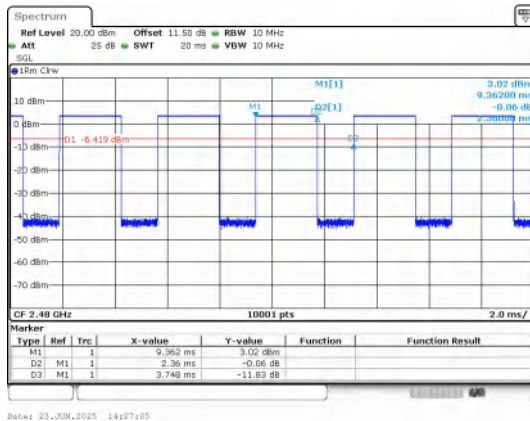
$\pi/4$ DQPSK(2-DH5)_Channel 78



8DPSK(3-DH5)_Channel 0



8DPSK(3-DH5)_Channel 39



8DPSK(3-DH5)_Channel 78

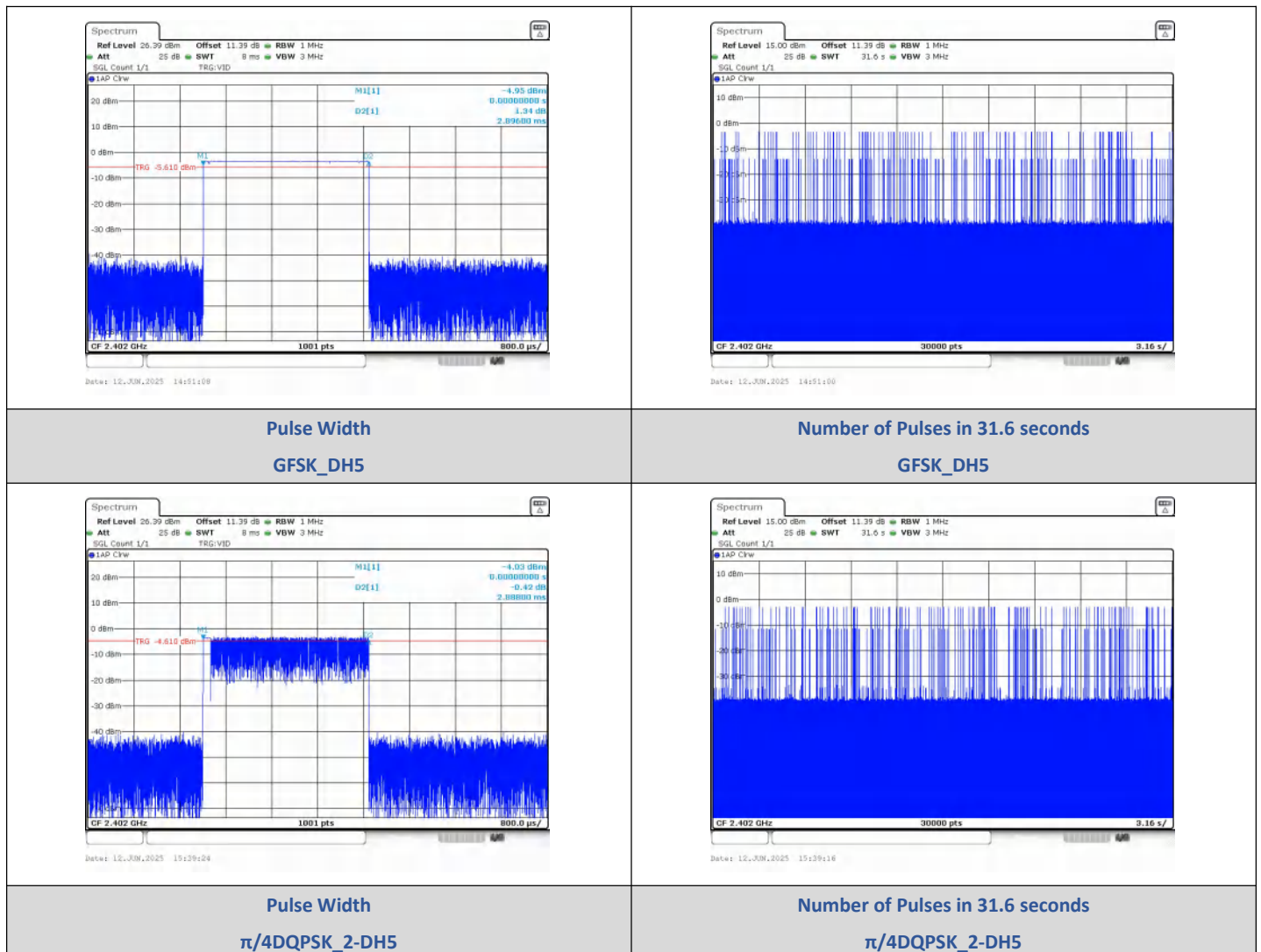
2) Dwell Time

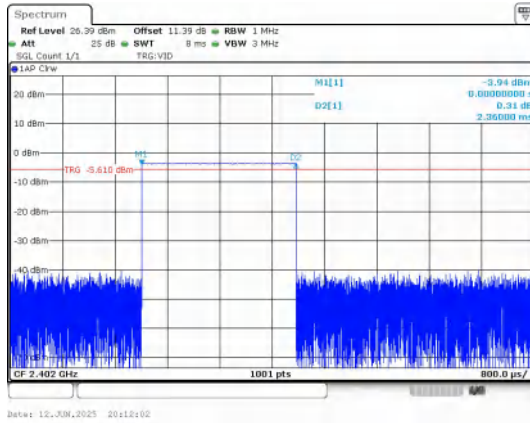
Test Result

Left:

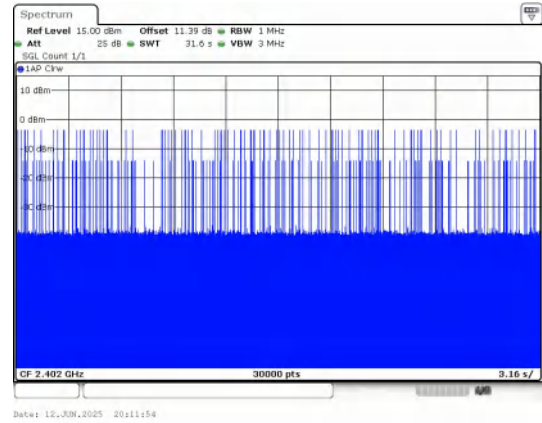
Modulation	Packet	Channel	Pulse Width (ms)	Number of Pulses in 31.6 seconds	Dwell Time (ms)	Limit (ms)	Result
GFSK	DH5	CH0 (2402MHz)	2.896	98	283.81	< 400	PASS
$\pi/4$ DQPSK	2-DH5		2.888	124	358.11		PASS
8DPSK	3-DH5		2.360	99	233.64		PASS

Test Graphs





Pulse Width
8DPSK_3-DH5

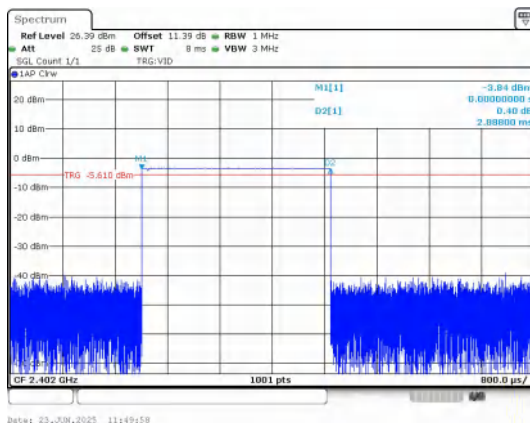


Number of Pulses in 31.6 seconds
8DPSK_3-DH5

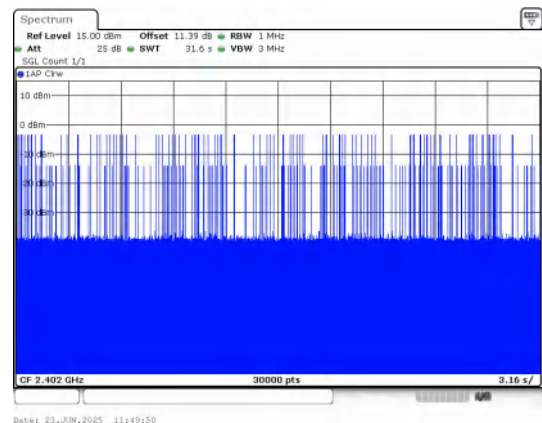
Right:

Modulation	Packet	Channel	Pulse Width (ms)	Number of Pulses in 31.6 seconds	Dwell Time (ms)	Limit (ms)	Result
GFSK	DH5	CH0 (2402MHz)	2.888	102	294.58	< 400	PASS
$\pi/4$ DQPSK	2-DH5		2.888	104	300.35		PASS
8DPSK	3-DH5		2.368	100	236.8		PASS

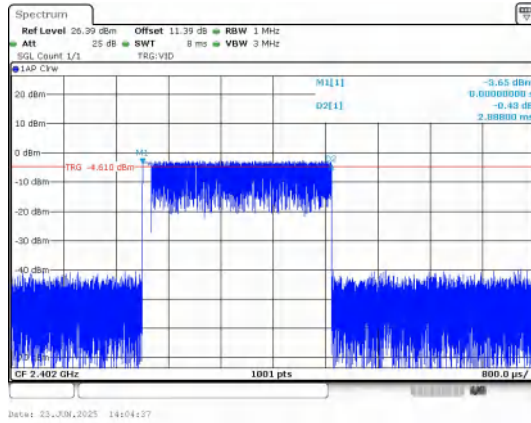
Test Graphs



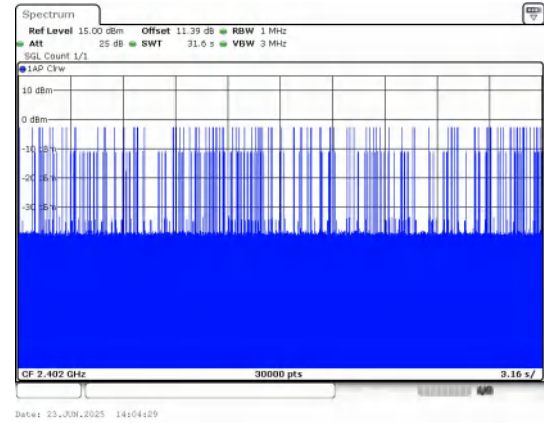
Pulse Width
GFSK_DH5



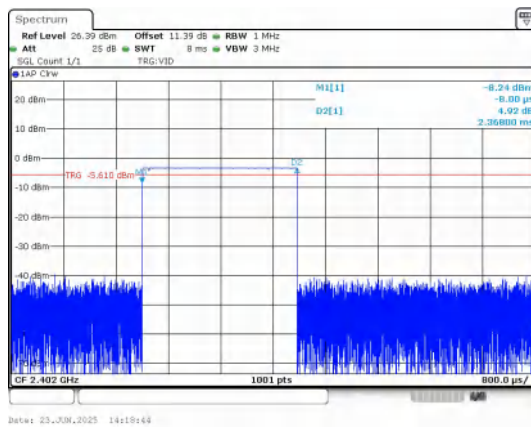
Number of Pulses in 31.6 seconds
GFSK_DH5



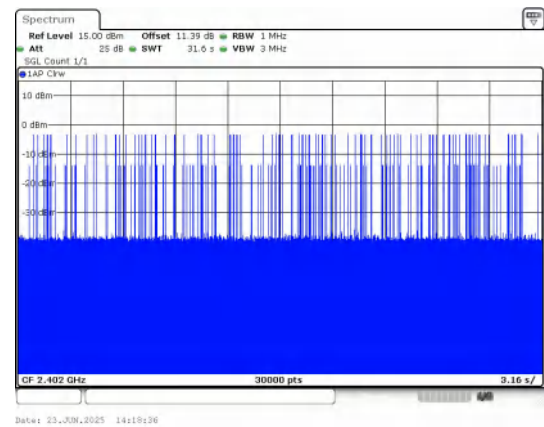
Pulse Width
 $\pi/4$ DQPSK_2-DH5



Number of Pulses in 31.6 seconds
 $\pi/4$ DQPSK_2-DH5



Pulse Width
8DPSK_3-DH5



Number of Pulses in 31.6 seconds
8DPSK_3-DH5

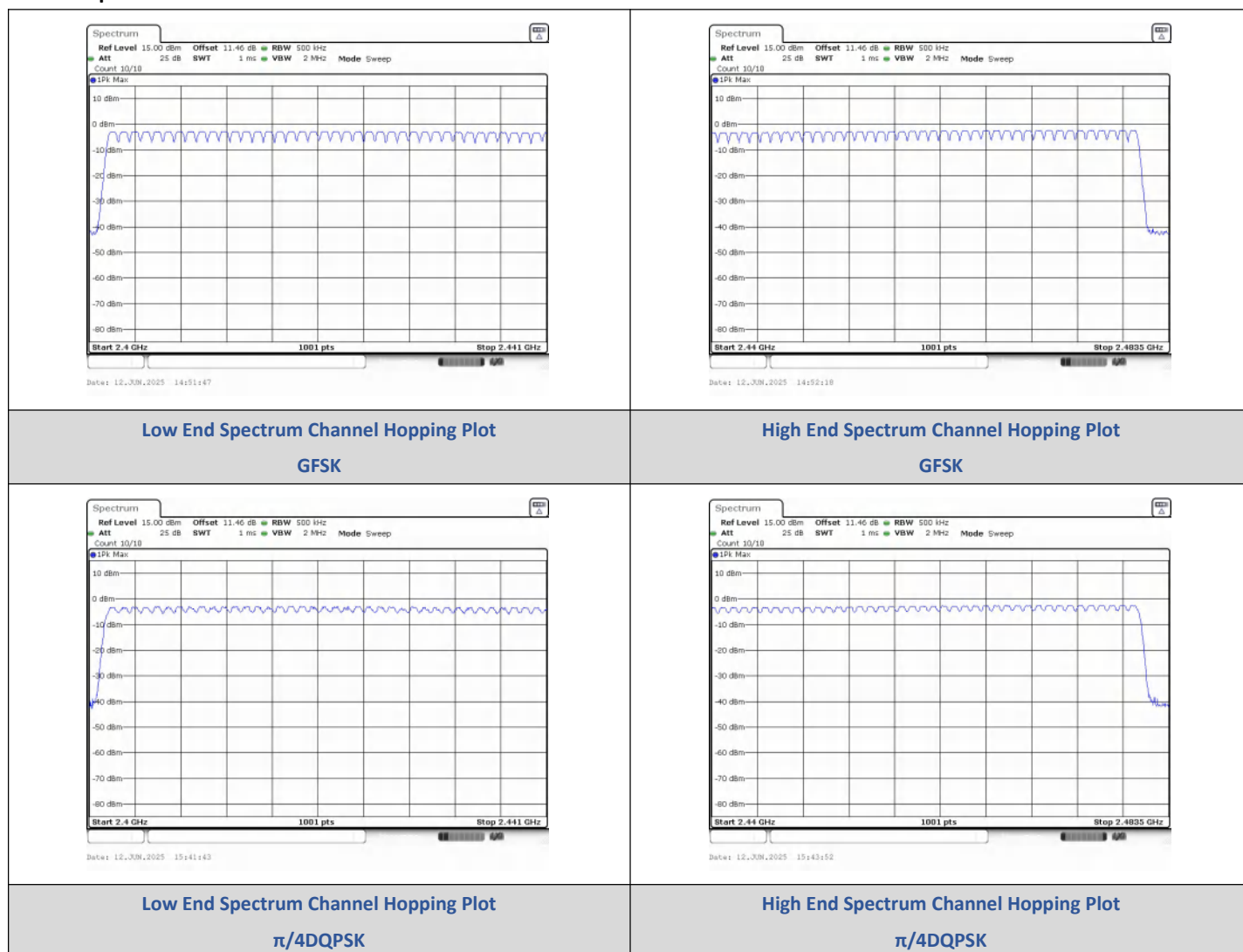
3) Number Of Hopping Channel

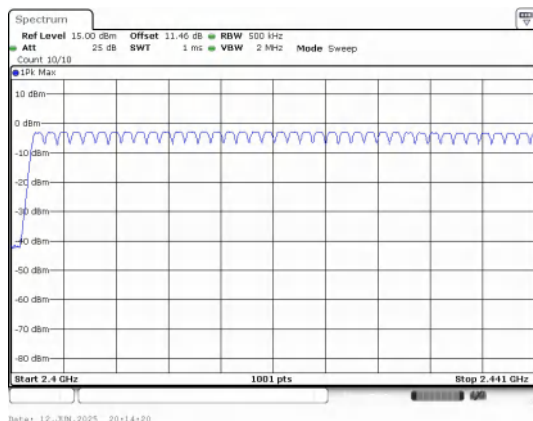
Test Result

Left:

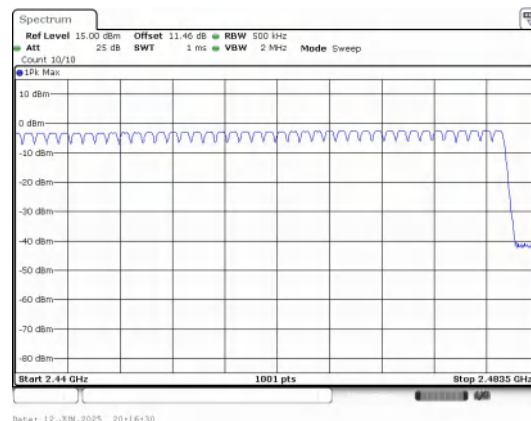
Modulation	Packet	Number of Hopping Channel	Limit	Result
GFSK	DH5	79	15	PASS
$\pi/4$ DQPSK	2-DH5	79	15	PASS
8DPSK	3-DH5	79	15	PASS

Test Graphs





Low End Spectrum Channel Hopping Plot
8DPSK

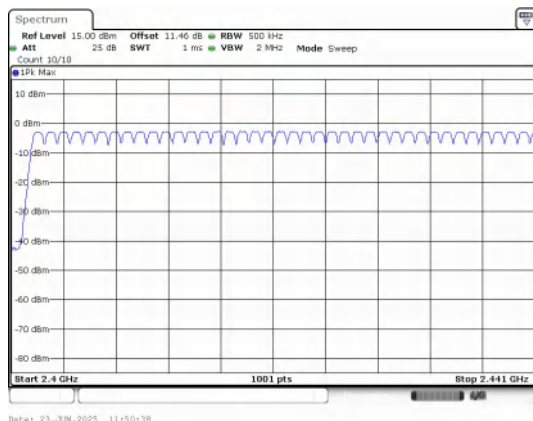


High End Spectrum Channel Hopping Plot
8DPSK

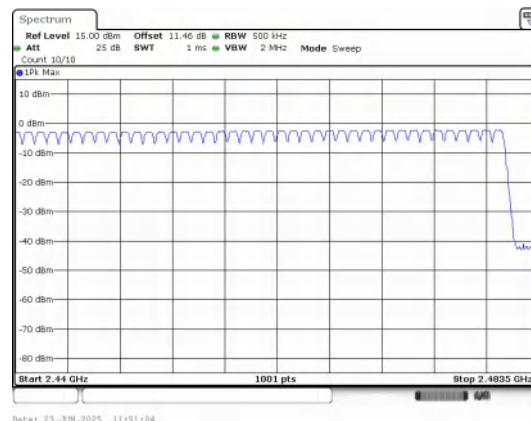
Right:

Modulation	Packet	Number of Hopping Channel	Limit	Result
GFSK	DH5	79	15	PASS
$\pi/4$ DQPSK	2-DH5	79	15	PASS
8DPSK	3-DH5	79	15	PASS

Test Graphs

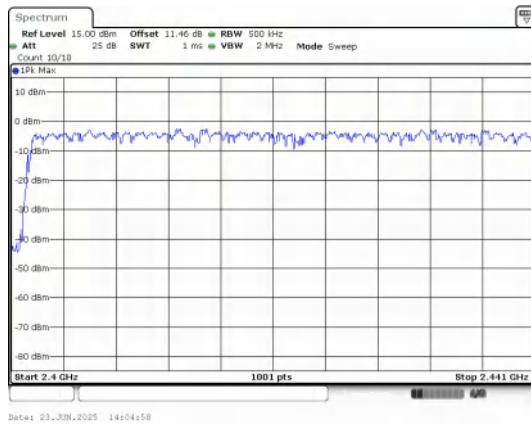


Low End Spectrum Channel Hopping Plot

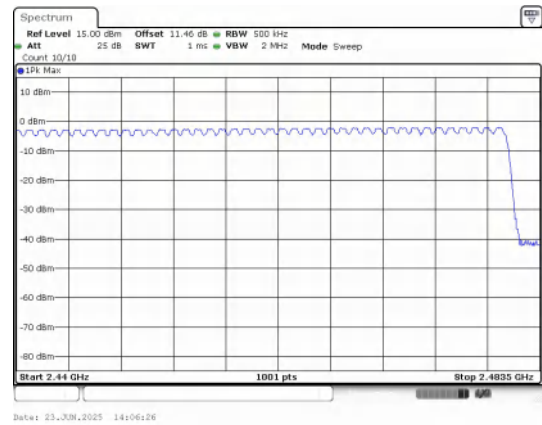


High End Spectrum Channel Hopping Plot

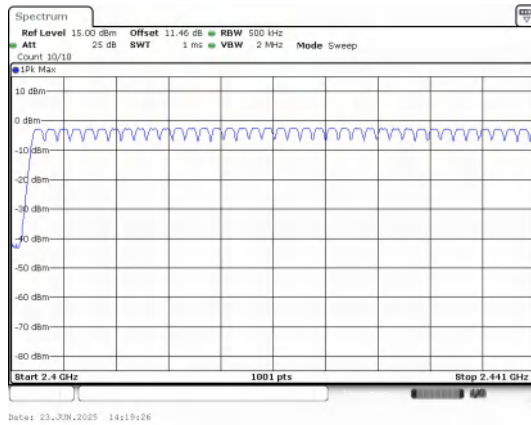
GFSK



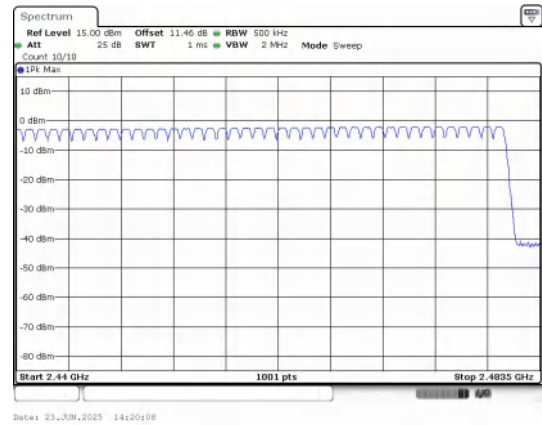
GFSK



Low End Spectrum Channel Hopping Plot
 $\pi/4$ QPSK



High End Spectrum Channel Hopping Plot
 $\pi/4$ QPSK



Low End Spectrum Channel Hopping Plot
8DPSK



High End Spectrum Channel Hopping Plot
8DPSK



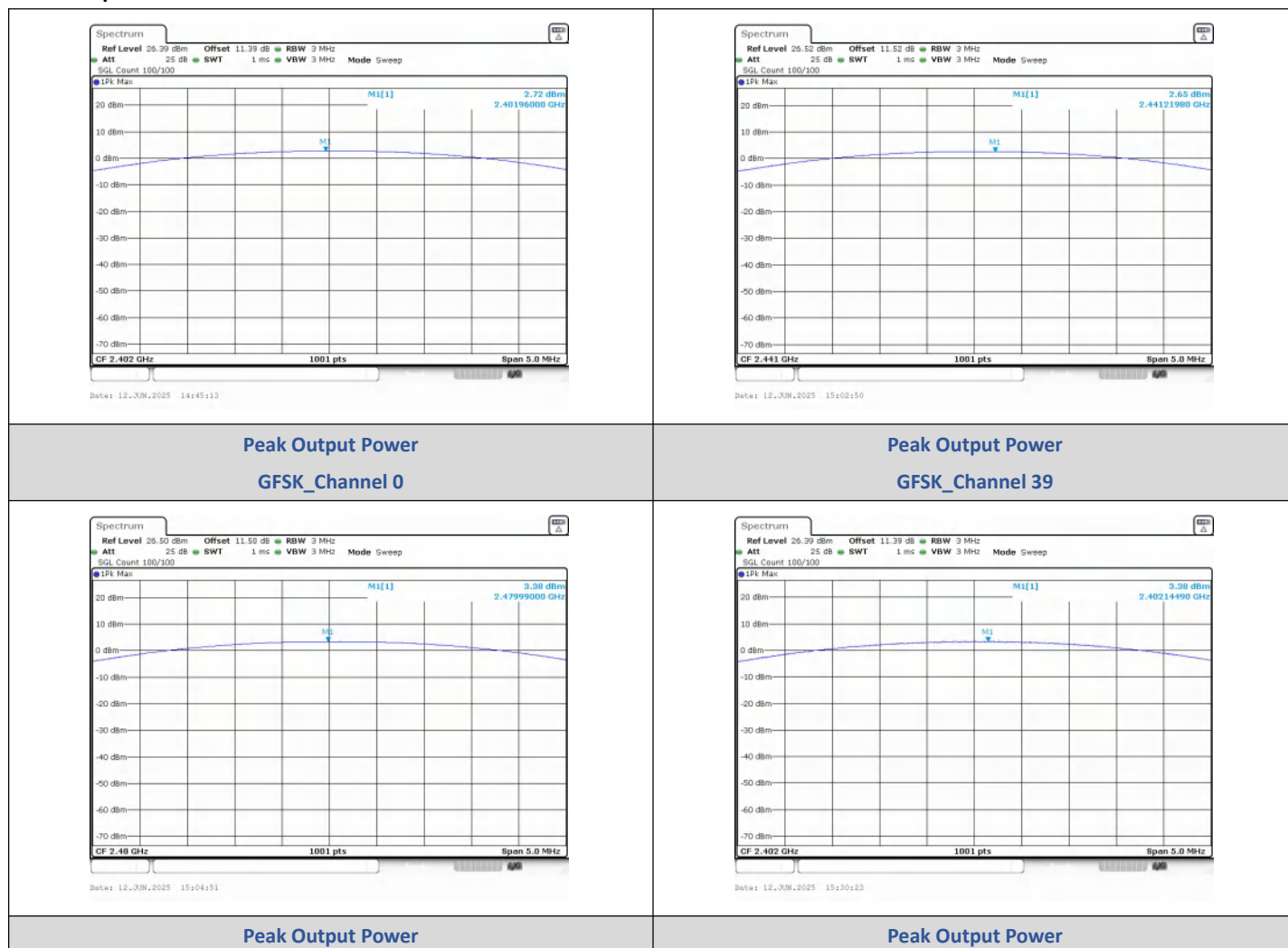
4) Conducted Peak Output Power

Test Result

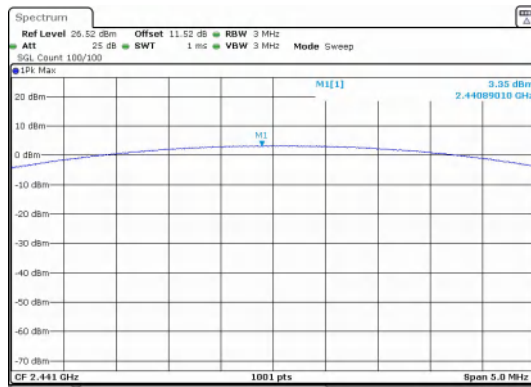
Left:

Modulation	Packet Type	Channel	Peak Output Power (dBm)	Peak Output Power (mW)	Limit (dBm)	Result
GFSK	DH5	0	2.72	1.87	≤30	PASS
		39	2.65	1.84		PASS
		78	3.38	2.18		PASS
$\pi/4$ DQPSK	2-DH5	0	3.38	2.18	≤20.97	PASS
		39	3.35	2.16		PASS
		78	4.07	2.55		PASS
8DPSK	3-DH5	0	2.55	1.80		PASS
		39	2.58	1.81		PASS
		78	3.29	2.13		PASS

Test Graphs

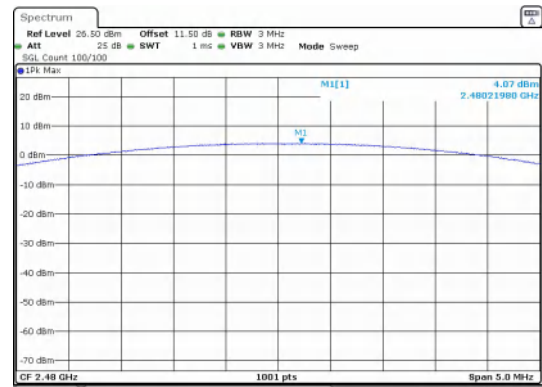


GFSK_Channel 78



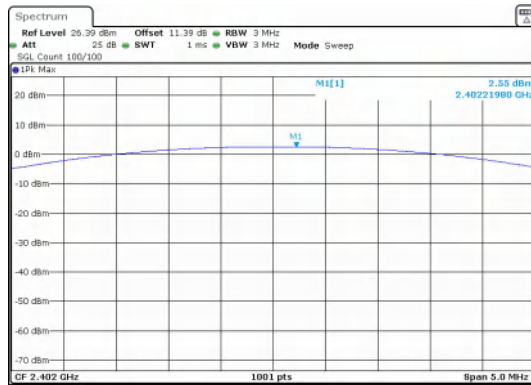
Date: 12 JUN 2025 15:50:35

$\pi/4$ DQPSK_Channel 0



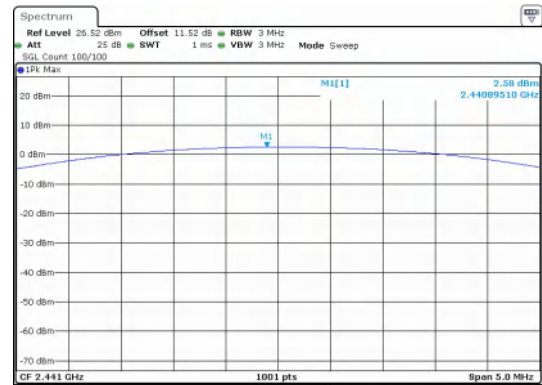
Date: 12 JUN 2025 15:53:02

Peak Output Power
 $\pi/4$ DQPSK_Channel 39



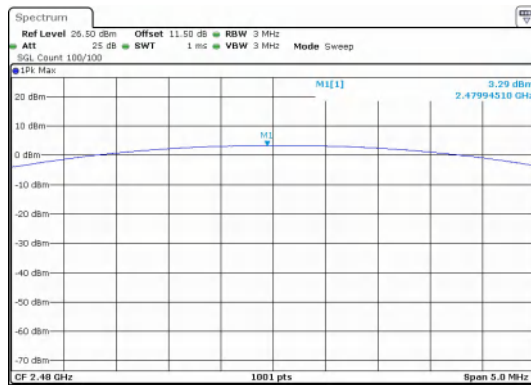
Date: 12 JUN 2025 16:02:10

Peak Output Power
 $\pi/4$ DQPSK_Channel 78



Date: 12 JUN 2025 20:21:58

Peak Output Power
8DPSK_Channel 0



Date: 12 JUN 2025 20:23:48

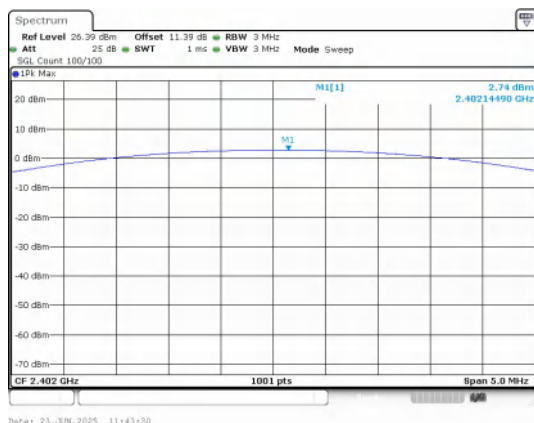
Peak Output Power
8DPSK_Channel 39

Peak Output Power
8DPSK_Channel 78

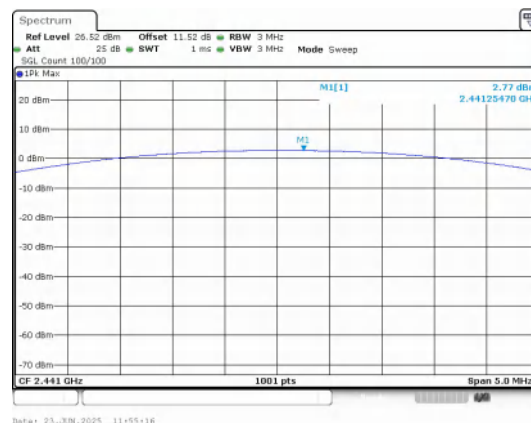
Right:

Modulation	Packet Type	Channel	Peak Output Power (dBm)	Peak Output Power (mW)	Limit (dBm)	Result
GFSK	DH5	0	2.74	1.88	≤30	PASS
		39	2.77	1.89		PASS
		78	3.56	2.27		PASS
$\pi/4$ DQPSK	2-DH5	0	2.62	1.83	≤20.97	PASS
		39	3.77	2.38		PASS
		78	4.49	2.81		PASS
8DPSK	3-DH5	0	2.79	1.90		PASS
		39	2.93	1.96		PASS
		78	3.60	2.29		PASS

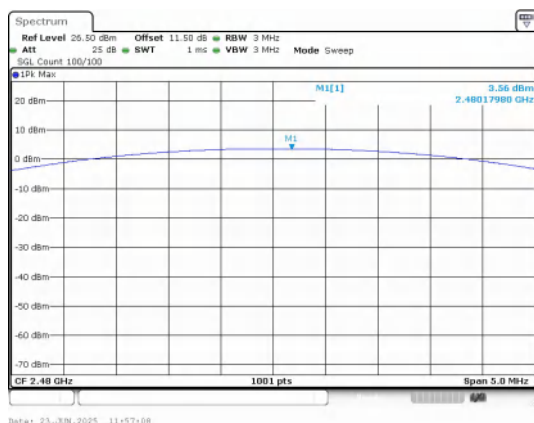
Test Graphs



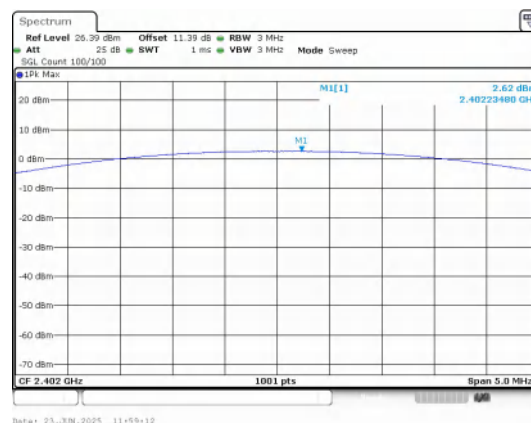
Peak Output Power
GFSK_Channel 0



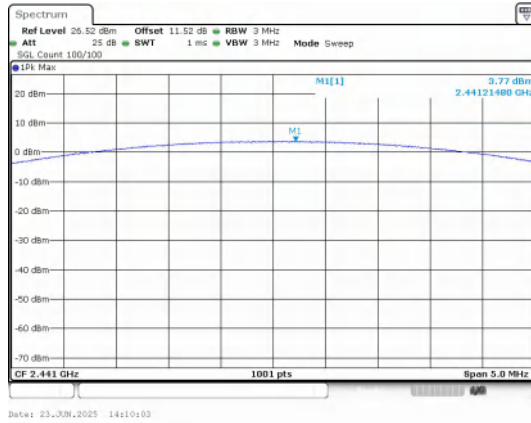
Peak Output Power
GFSK_Channel 39



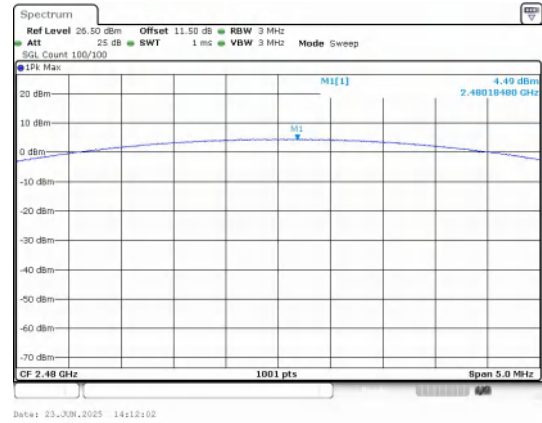
Peak Output Power
GFSK_Channel 78



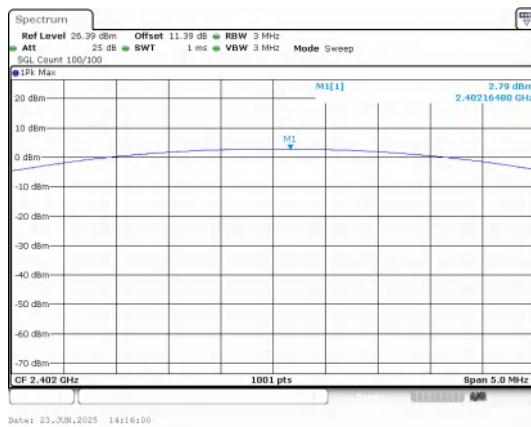
Peak Output Power
 $\pi/4$ DQPSK_Channel 0



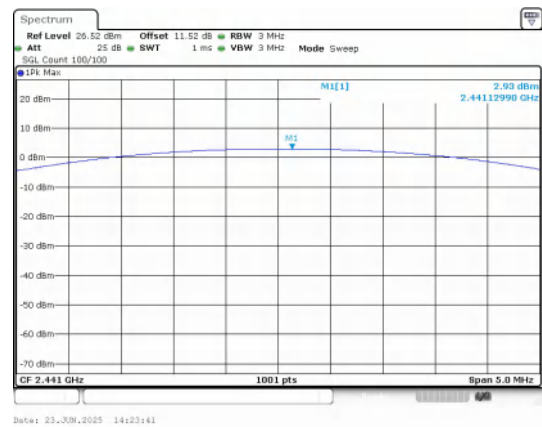
Peak Output Power
 $\pi/4$ DQPSK_Channel 39



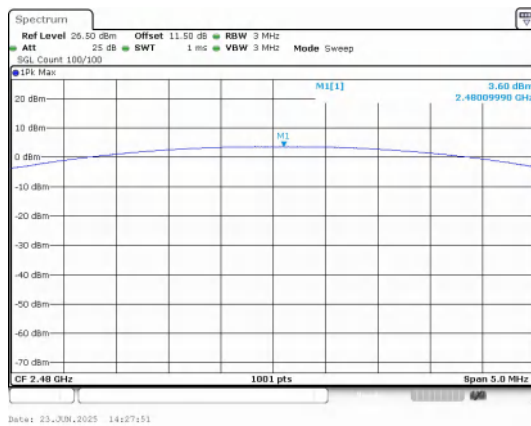
Peak Output Power
 $\pi/4$ DQPSK_Channel 78



Peak Output Power
8DPSK_Channel 0



Peak Output Power
8DPSK_Channel 39



Peak Output Power
8DPSK_Channel 78

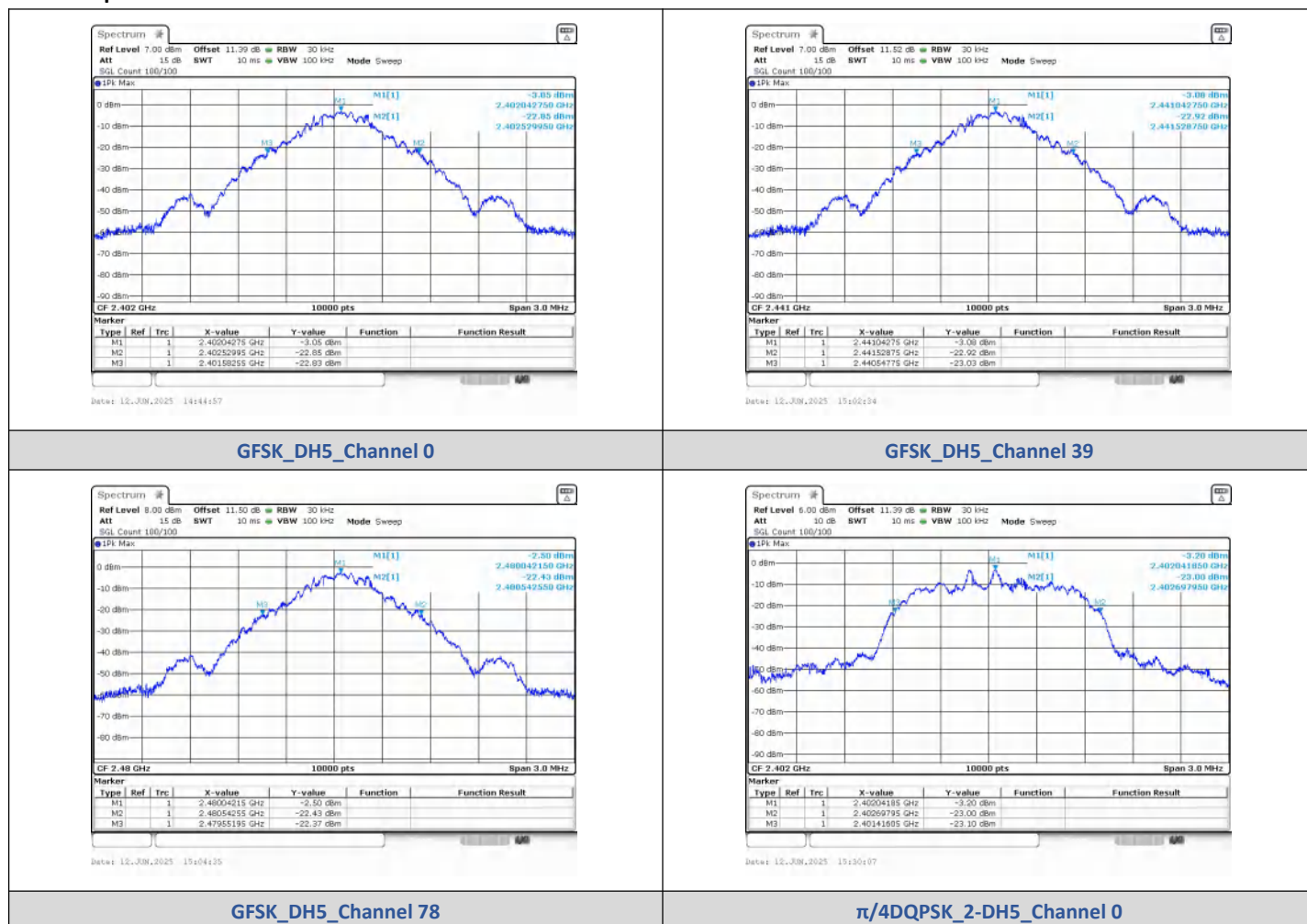
5) 20dB Bandwidth

Test Result

Left:

Modulation	Channel	Center Frequency (MHz)	20 dB Bandwidth (MHz)
GFSK	0	2402 MHz	0.95
	39	2441 MHz	0.95
	78	2480 MHz	0.95
π /4DQPSK	0	2402 MHz	1.280
	39	2441 MHz	1.280
	78	2480 MHz	1.280
8DPSK	0	2402 MHz	0.9900
	39	2441 MHz	1.010
	78	2480 MHz	1.010

Test Graphs

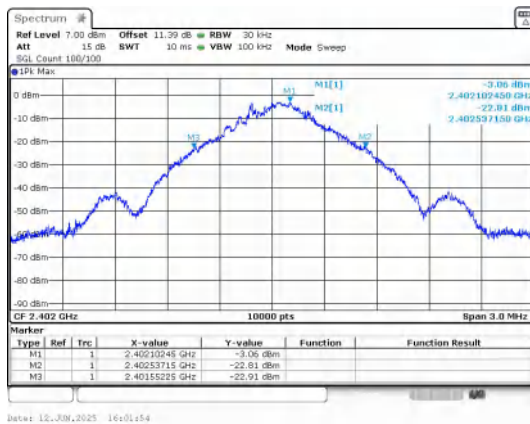




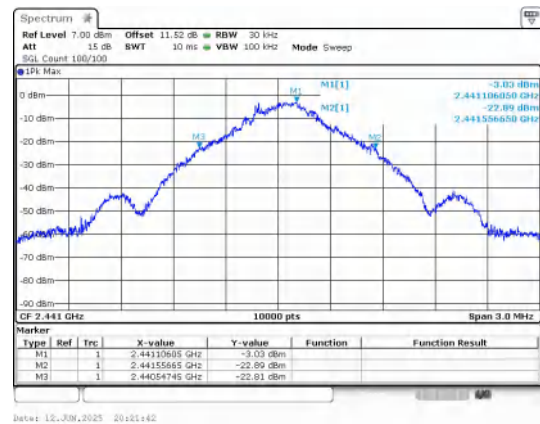
$\pi/4$ DQPSK_2-DH5_Channel 39



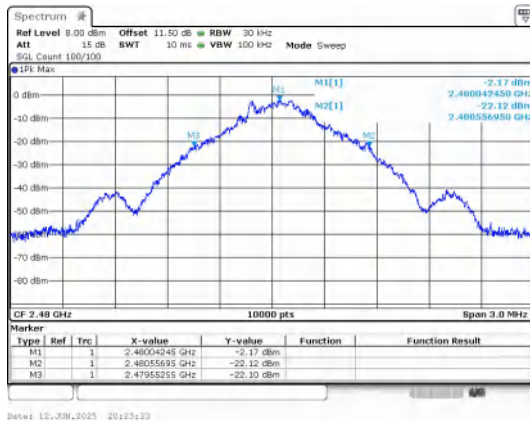
$\pi/4$ DQPSK_2-DH5_Channel 78



8DPSK_3-DH5_Channel 0



8DPSK_3-DH5_Channel 39

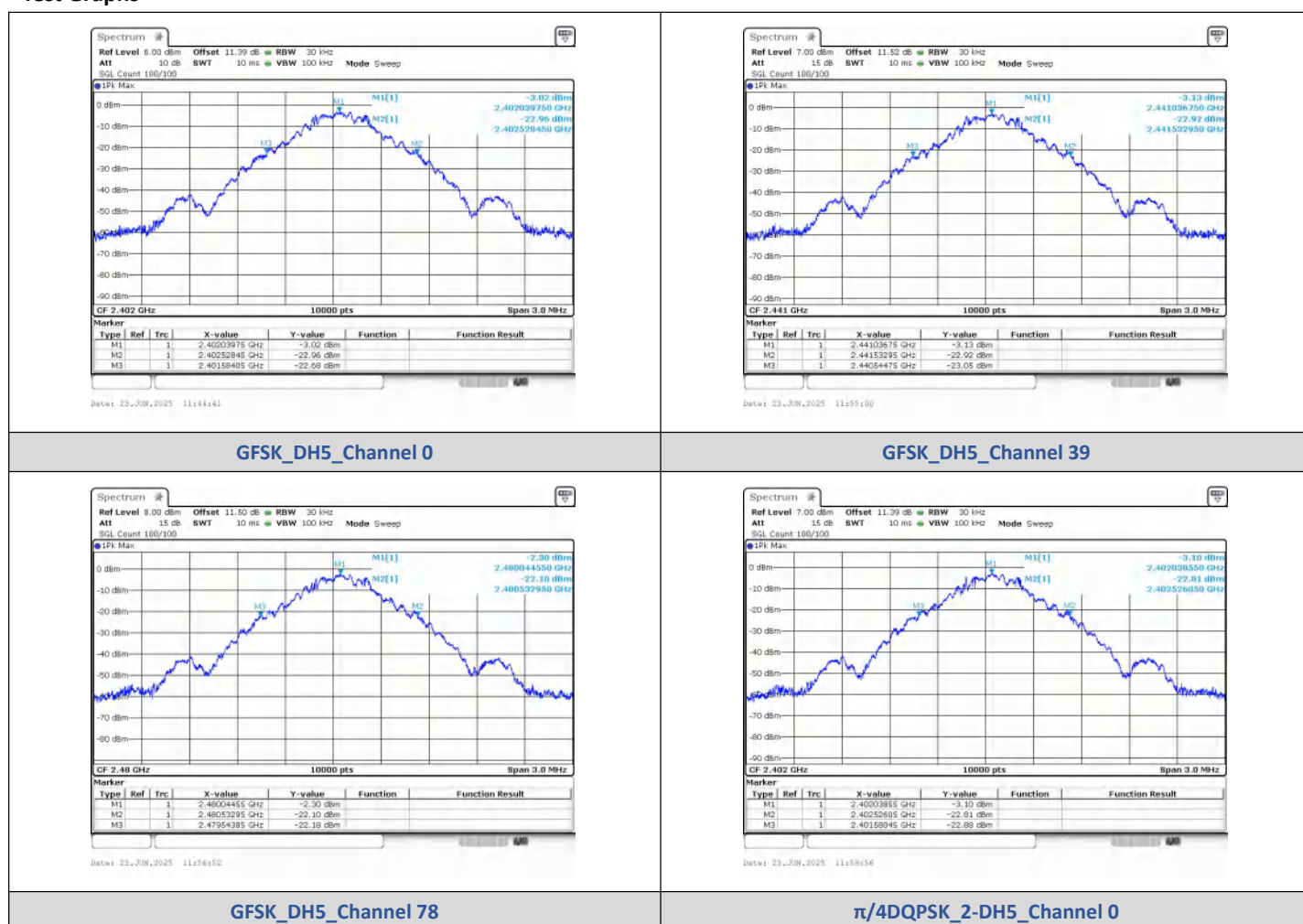


8DPSK_3-DH5_Channel 78

Right:

Modulation	Channel	Center Frequency (MHz)	20 dB Bandwidth (MHz)
GFSK	0	2402 MHz	0.99
	39	2441 MHz	0.99
	78	2480 MHz	0.99
$\pi/4$ DQPSK	0	2402 MHz	0.9500
	39	2441 MHz	1.320
	78	2480 MHz	1.310
8DPSK	0	2402 MHz	0.9900
	39	2441 MHz	1.000
	78	2480 MHz	1.000

Test Graphs

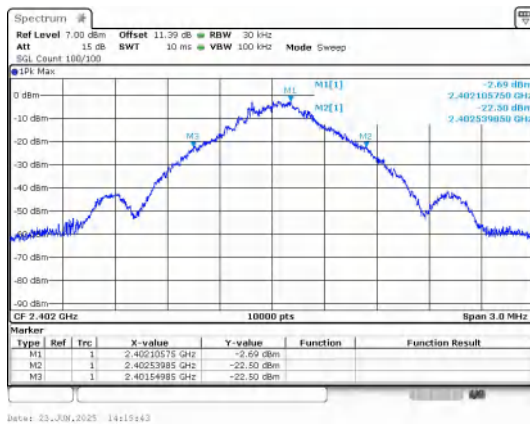




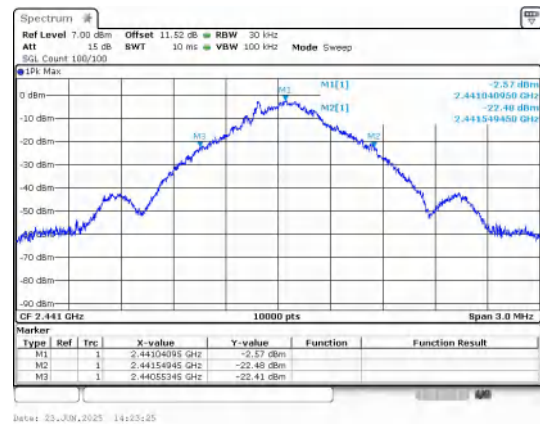
$\pi/4$ DQPSK_2-DH5_Channel 39



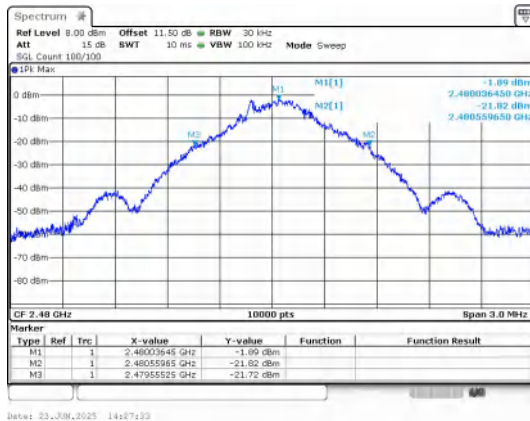
$\pi/4$ DQPSK_2-DH5_Channel 78



8DPSK_3-DH5_Channel 0



8DPSK_3-DH5_Channel 39



8DPSK_3-DH5_Channel 78

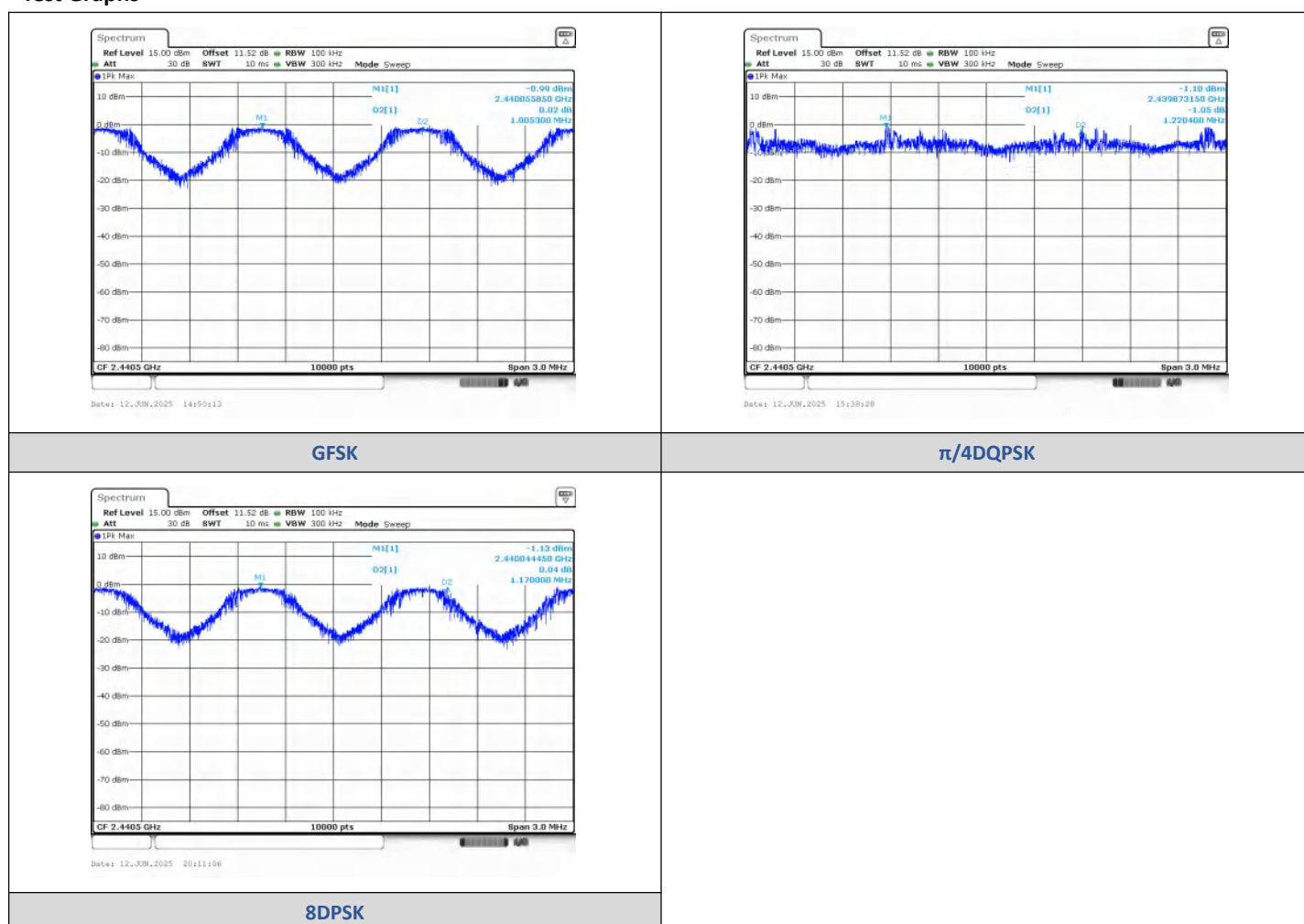
6) Carrier Frequencies Separation

Test Result

Left:

Modulation	Packet	Left Center frequency (MHz)	Right Center frequency (MHz)	Hopping Frequency Separation (MHz)	Limit (MHz)	Result
GFSK	DH5	2440.0559	2441.0611	1.0053	0.95	PASS
$\pi/4$ DQPSK	2-DH5	2439.8731	2441.0936	1.2204	0.853	PASS
8DPSK	3-DH5	2440.0444	2441.2144	1.1700	0.66	PASS

Test Graphs



Modulation	Packet	Left Center frequency (MHz)	Right Center frequency (MHz)	Hopping Frequency Separation (MHz)	Limit (MHz)	Result
GFSK	DH5	2439.8776	2441.0282	1.1505	0.99	PASS
$\pi/4$ DQPSK	2-DH5	2439.9007	2440.8796	0.9789	0.853	PASS
8DPSK	3-DH5	2440.2011	2441.0471	0.8460	0.673	PASS

Figure 1: Comparison of GFSK and $\pi/4$ DQPSK signals. The left plot shows a GFSK signal with a clear sinusoidal waveform. The right plot shows a $\pi/4$ DQPSK signal with a noisy, flat-topped waveform. Both plots include a 'Spectrum' title bar with settings: Ref Level 15.00 dBm, Offset 11.52 dB, RBW 100 kHz, Att 30 dB, SWT 10 ms, VBW 300 kHz, Mode Sweep. The left plot has a CF of 2.4405 GHz, 10000 pts, and a span of 3.0 MHz. The right plot has the same settings but a different waveform. Both plots show a peak level of -0.97 dBm at 2.439877650 GHz.

7) Conducted Out Of Band Emission

Test Result

Left:

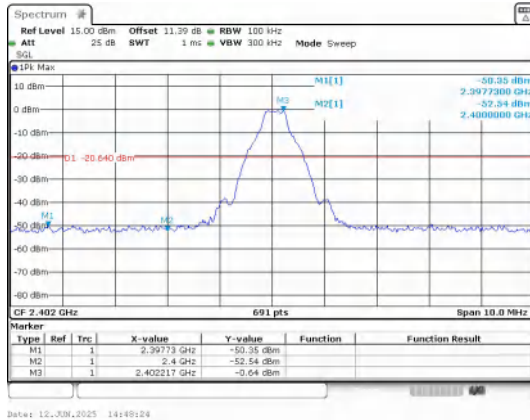
Non-Hopping

Modulation	Packet	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result
GFSK	DH5	0	2397.73	-50.350	-20.64	-29.710	PASS
			2400.00	-52.540	-20.64	-31.900	PASS
			2594.00	-48.344	-20.64	-27.704	PASS
		39	2633.12	-49.839	-20.94	-28.899	PASS
		78	2483.50	-51.910	-20.04	-31.870	PASS
			2672.24	-50.437	-20.04	-30.397	PASS
$\pi/4$ DQPSK	2-DH5	0	2398.05	-49.602	-20.94	-28.662	PASS
			2400.00	-51.040	-20.94	-30.100	PASS
			2594.00	-47.834	-20.94	-26.894	PASS
		39	2633.12	-48.999	-21.17	-27.829	PASS
		78	2483.50	-51.190	-20.15	-31.040	PASS
			2672.24	-53.491	-20.15	-33.341	PASS
8DPSK	3-DH5	0	2397.07	-49.713	-20.83	-28.883	PASS
			2400.00	-52.230	-20.83	-31.400	PASS
			2594.00	-49.049	-20.83	-28.219	PASS
		39	2633.12	-48.521	-20.96	-27.561	PASS
		78	2287.70	-50.813	-19.95	-30.863	PASS
			2483.50	-51.810	-19.95	-31.860	PASS

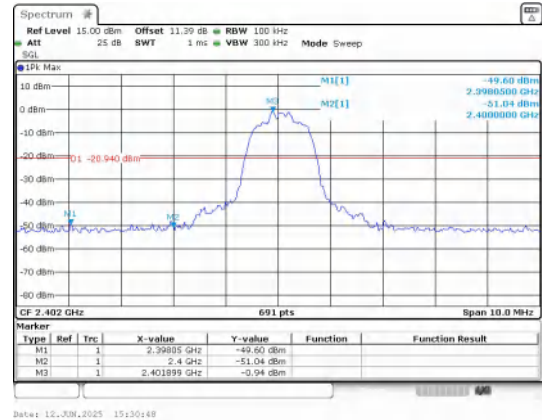
Hopping

Modulation	Packet	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result
GFSK	DH5	Hopping	2398.94	-49.111	-20.6	-28.511	PASS
			2400.00	-50.410	-20.6	-29.810	PASS
			2483.50	-51.130	-19.98	-31.150	PASS
$\pi/4$ DQPSK	2-DH5		2395.43	-49.245	-21.25	-27.995	PASS
			2400.00	-50.260	-21.25	-29.010	PASS
			2483.50	-50.520	-20.14	-30.380	PASS
8DPSK	3-DH5		2396.37	-49.478	-20.58	-28.898	PASS
			2400.00	-50.980	-20.58	-30.400	PASS
			2483.50	-49.620	-20.09	-29.530	PASS

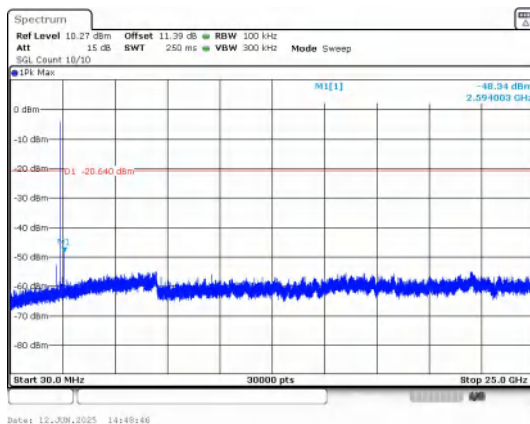
Test Graphs



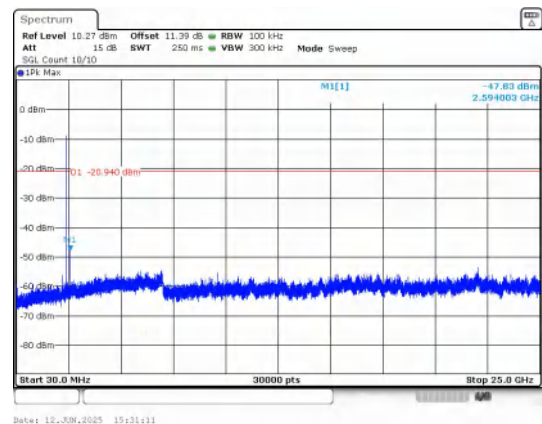
Out Of Band Emission
GFSK_DH5_Channel 0



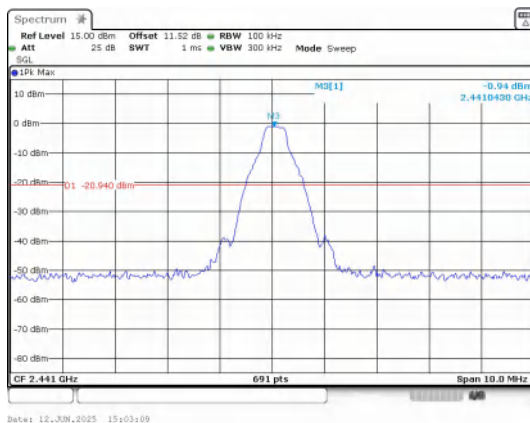
Out Of Band Emission
 $\pi/4$ QPSK_2-DH5_Channel 0



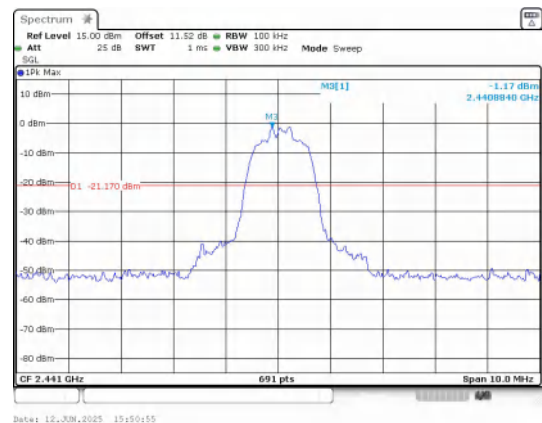
30.0 MHz - 25000.0 MHz
GFSK_DH5_Channel 0



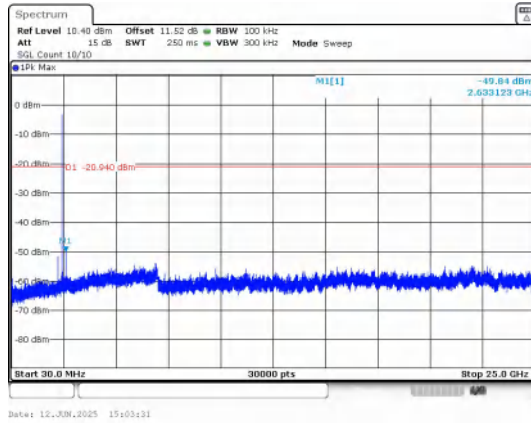
30.0 MHz - 25000.0 MHz
 $\pi/4$ QPSK_2-DH5_Channel 0



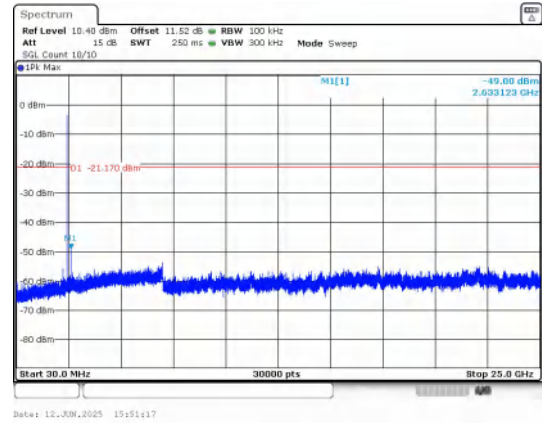
Out Of Band Emission
GFSK_DH5_Channel 39



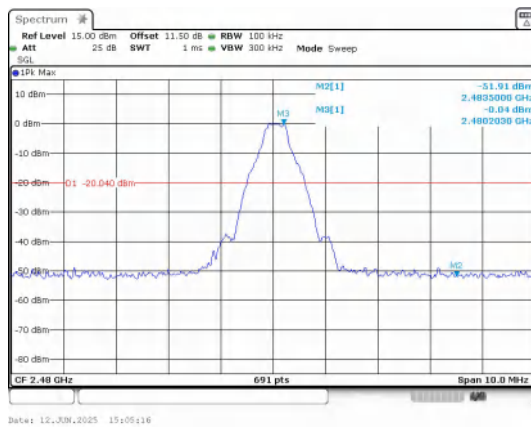
Out Of Band Emission
 $\pi/4$ QPSK_2-DH5_Channel 39



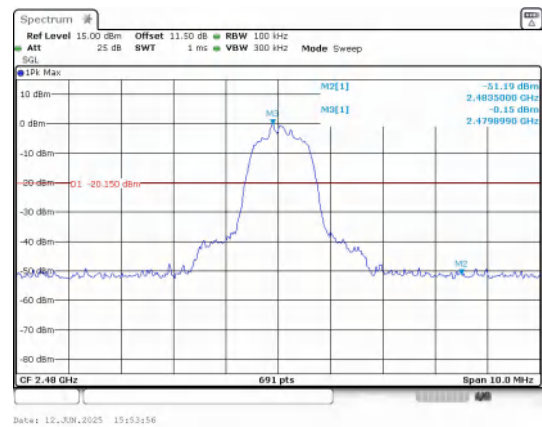
30.0 MHz - 25000.0 MHz
GFSK_DH5_Channel 39



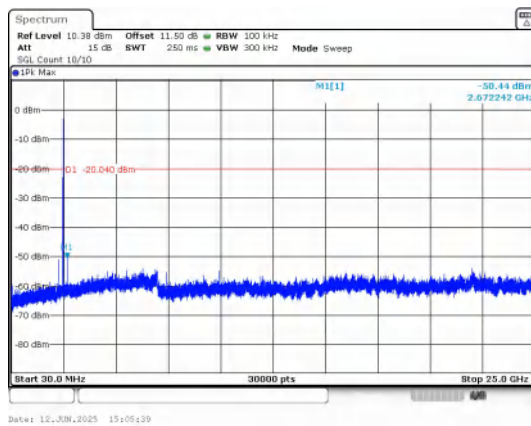
30.0 MHz - 25000.0 MHz
 $\pi/4$ DQPSK_2-DH5_Channel 39



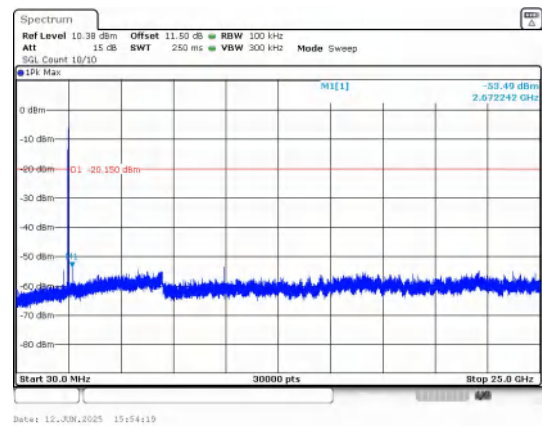
Out Of Band Emission
GFSK_DH5_Channel 78



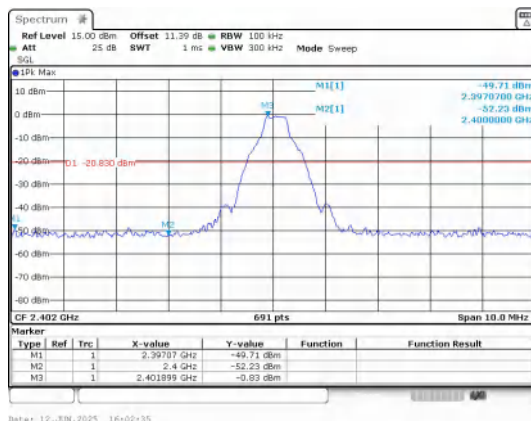
Out Of Band Emission
 $\pi/4$ DQPSK_2-DH5_Channel 78



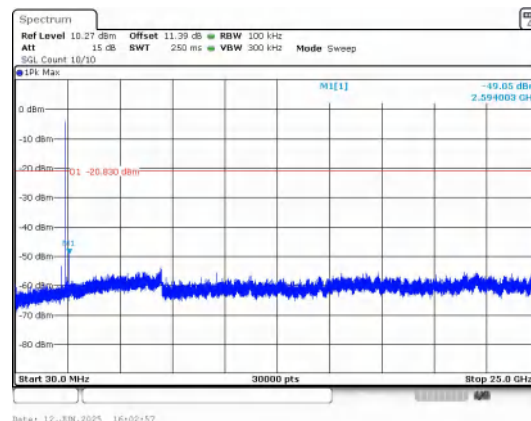
30.0 MHz - 25000.0 MHz
GFSK_DH5_Channel 78



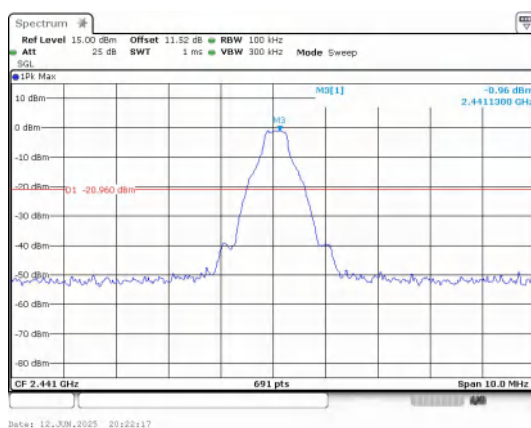
30.0 MHz - 25000.0 MHz
 $\pi/4$ DQPSK_2-DH5_Channel 78



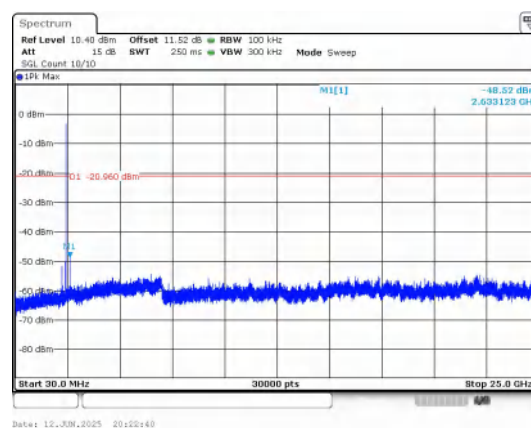
Out Of Band Emission
8DPSK_3-DH5_Channel 0



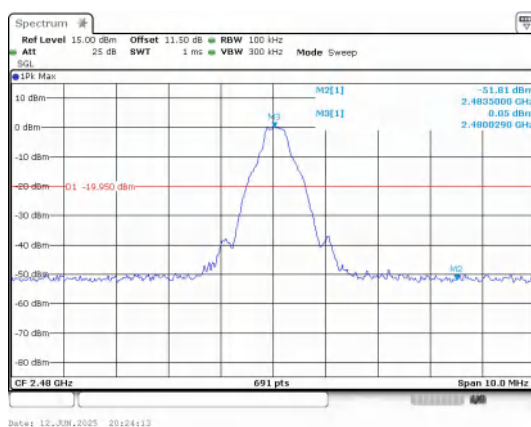
30.0 MHz - 25000.0 MHz
8DPSK_3-DH5_Channel 0



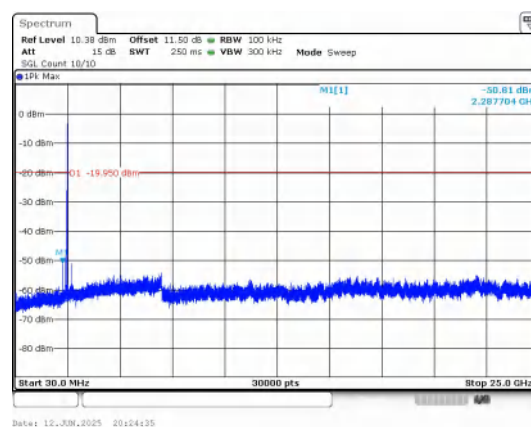
Out Of Band Emission
8DPSK_3-DH5_Channel 39



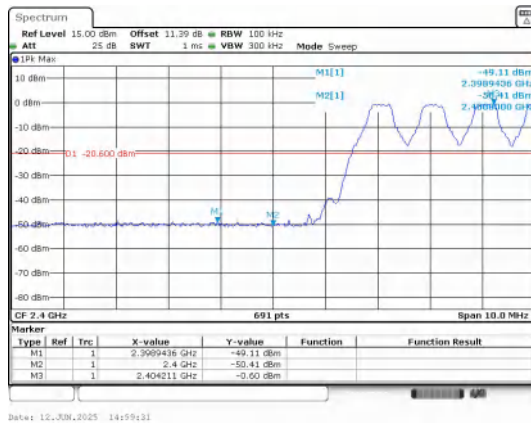
30.0 MHz - 25000.0 MHz
8DPSK_3-DH5_Channel 39



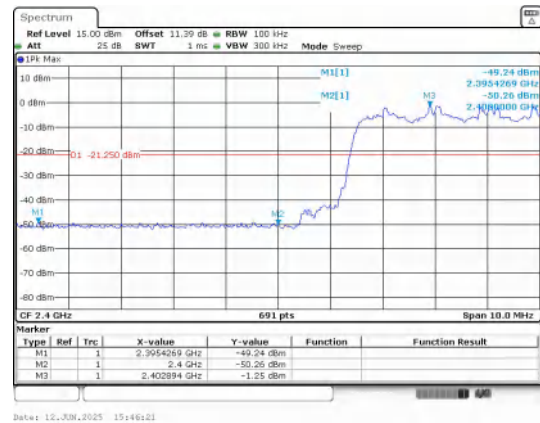
Out Of Band Emission
8DPSK_3-DH5_Channel 78



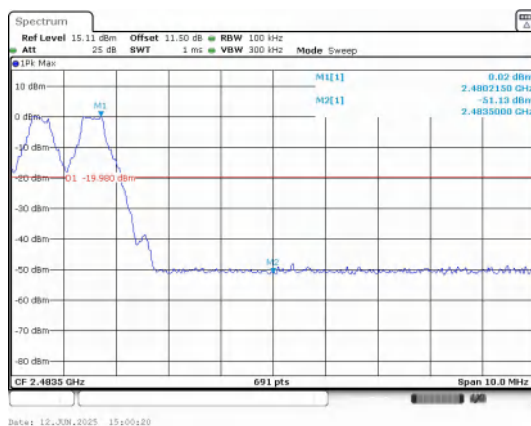
30.0 MHz - 25000.0 MHz
8DPSK_3-DH5_Channel 78



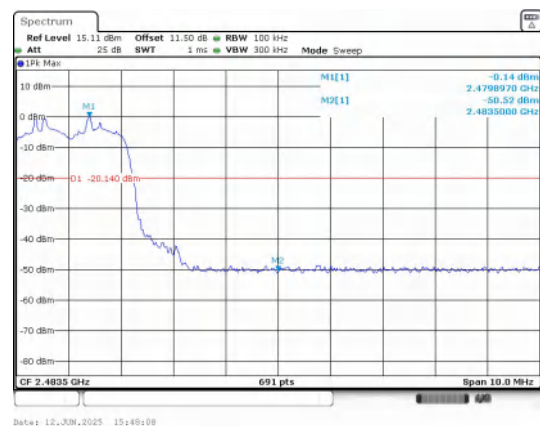
Out Of Band Emission(Left)
GFSK_DH5_Channel Hopping



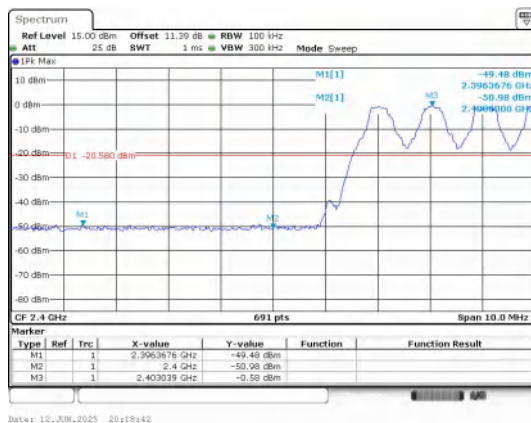
Out Of Band Emission(Left)
 $\pi/4$ DQPSK_2-DH5_Channel Hopping



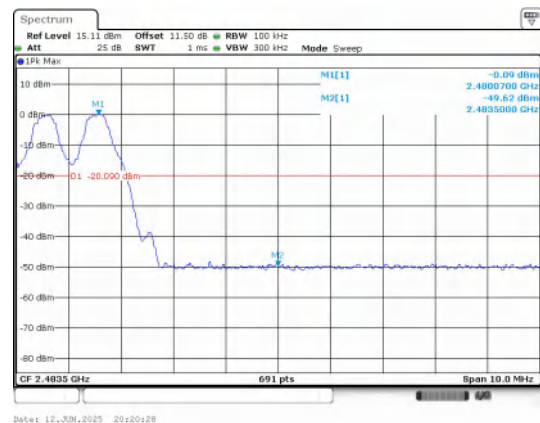
Out Of Band Emission(Right)
GFSK_DH5_Channel Hopping



Out Of Band Emission(Right)
 $\pi/4$ DQPSK_2-DH5_Channel Hopping



Out Of Band Emission(Left)
8DPSK_3-DH5_Channel Hopping



Out Of Band Emission(Right)
8DPSK_3-DH5_Channel Hopping

Right:

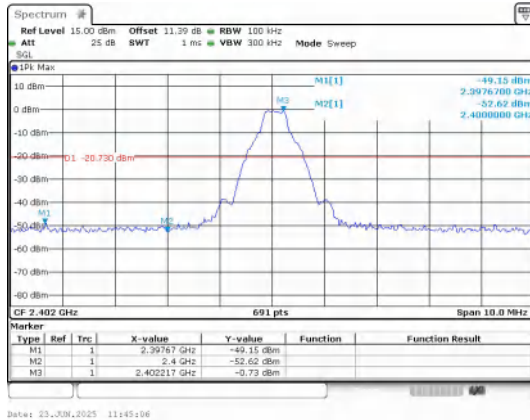
Non-Hopping

Modulation	Packet	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result
GFSK	DH5	0	2397.67	-49.147	-20.73	-28.417	PASS
			2400.00	-52.620	-20.73	-31.890	PASS
			2594.00	-49.384	-20.73	-28.654	PASS
		39	2633.12	-49.256	-20.66	-28.596	PASS
		78	2483.50	-50.500	-19.8	-30.700	PASS
			2672.24	-50.039	-19.8	-30.239	PASS
$\pi/4$ DQPSK	2-DH5	0	2398.93	-49.570	-20.63	-28.940	PASS
			2400.00	-51.520	-20.63	-30.890	PASS
			2594.00	-48.661	-20.63	-28.031	PASS
		39	2633.12	-52.425	-20.5	-31.925	PASS
		78	2483.50	-52.330	-19.68	-32.650	PASS
			2672.24	-52.635	-19.68	-32.955	PASS
8DPSK	3-DH5	0	2397.98	-50.155	-20.55	-29.605	PASS
			2400.00	-52.400	-20.55	-31.850	PASS
			2594.00	-47.547	-20.55	-26.997	PASS
		39	2633.12	-49.660	-20.33	-29.330	PASS
		78	2483.50	-51.090	-19.5	-31.590	PASS
			2672.24	-50.047	-19.5	-30.547	PASS

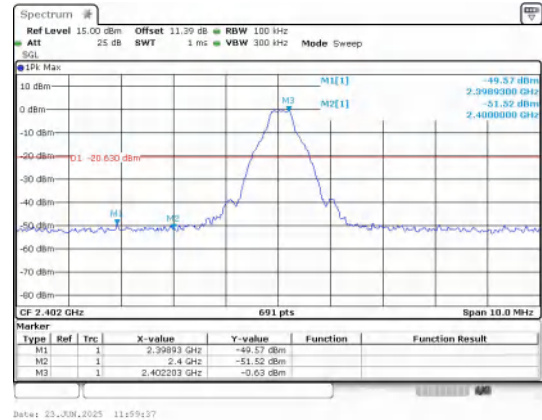
Hopping

Modulation	Packet	Channel	OOB Emission Frequency (MHz)	OOB Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Result
GFSK	DH5	Hopping	2398.45	-48.723	-20.74	-27.983	PASS
			2400.00	-50.060	-20.74	-29.320	PASS
			2483.50	-51.150	-20.01	-31.140	PASS
$\pi/4$ DQPSK	2-DH5		2395.47	-48.954	-20.54	-28.414	PASS
			2400.00	-50.580	-20.54	-30.040	PASS
			2483.50	-50.960	-21.19	-29.770	PASS
8DPSK	3-DH5		2398.02	-49.160	-20.58	-28.580	PASS
			2400.00	-49.690	-20.58	-29.110	PASS
			2483.50	-50.180	-19.68	-30.500	PASS

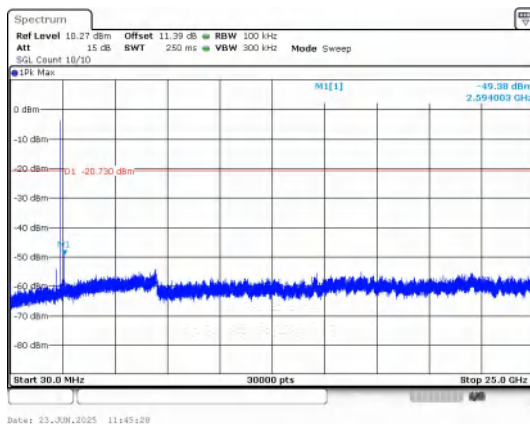
Test Graphs



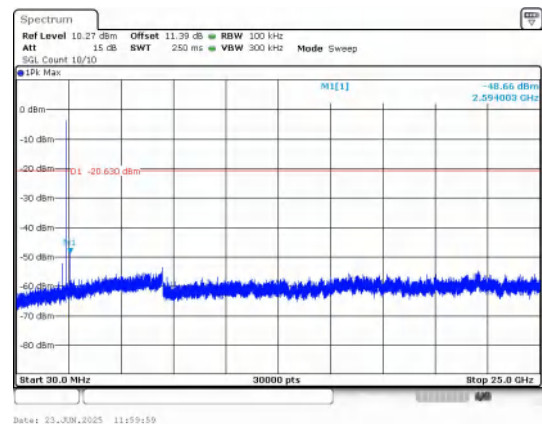
Out Of Band Emission
GFSK_DH5_Channel 0



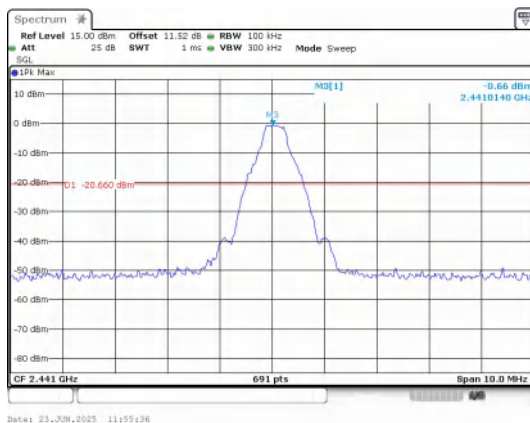
Out Of Band Emission
 $\pi/4$ QPSK_2-DH5_Channel 0



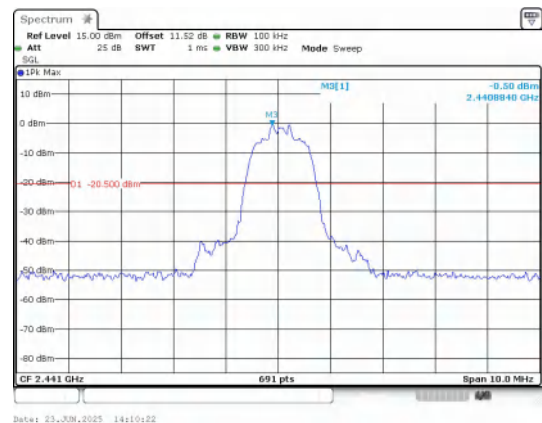
30.0 MHz - 25000.0 MHz
GFSK_DH5_Channel 0



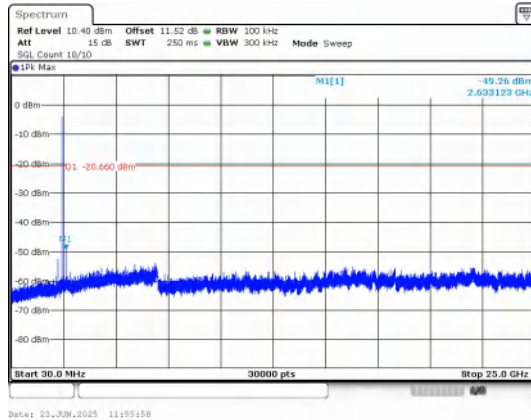
30.0 MHz - 25000.0 MHz
 $\pi/4$ QPSK_2-DH5_Channel 0



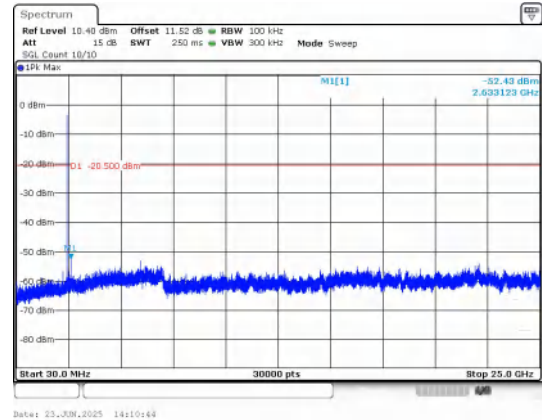
Out Of Band Emission
GFSK_DH5_Channel 39



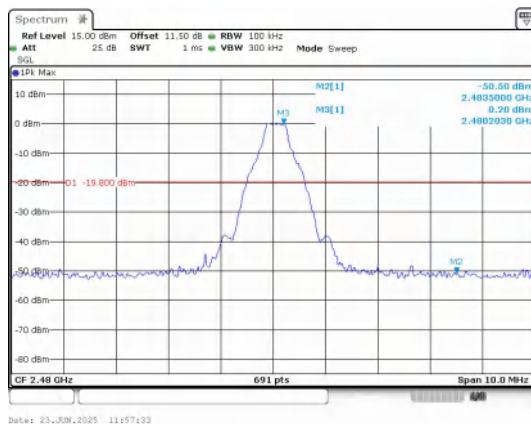
Out Of Band Emission
 $\pi/4$ QPSK_2-DH5_Channel 39



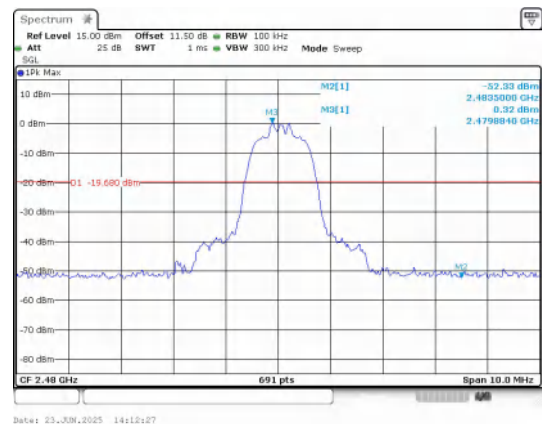
30.0 MHz - 25000.0 MHz
GFSK_DH5_Channel 39



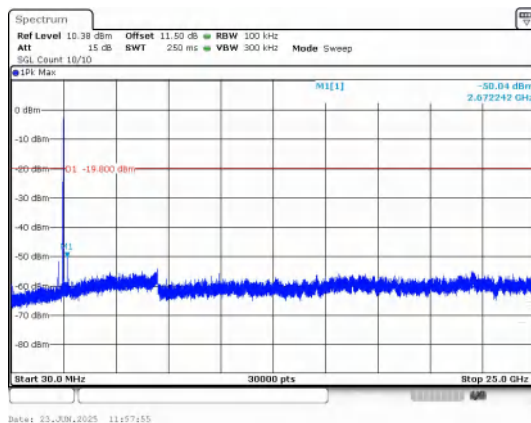
30.0 MHz - 25000.0 MHz
 $\pi/4$ DQPSK_2-DH5_Channel 39



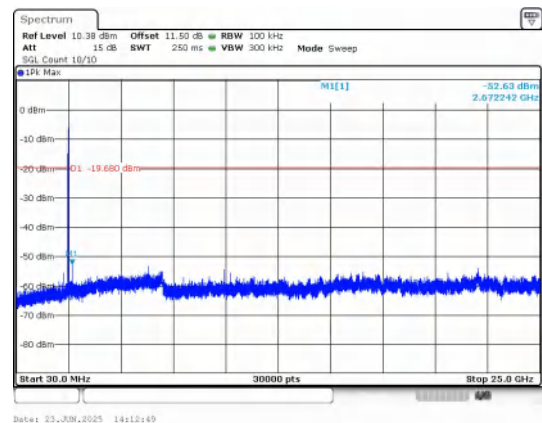
Out Of Band Emission
GFSK_DH5_Channel 78



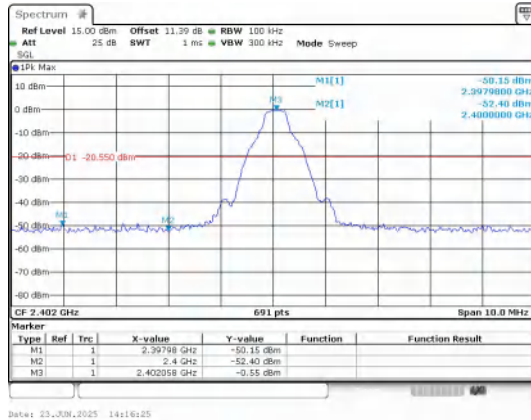
Out Of Band Emission
 $\pi/4$ DQPSK_2-DH5_Channel 78



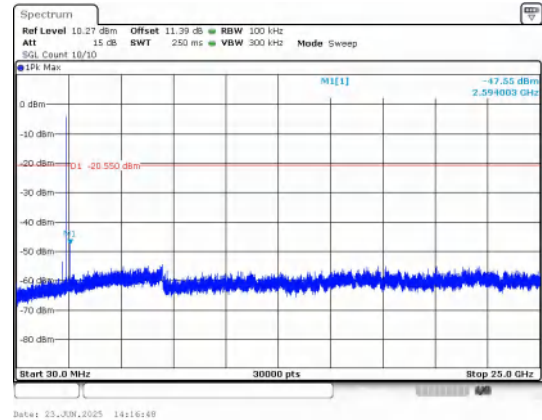
30.0 MHz - 25000.0 MHz
GFSK_DH5_Channel 78



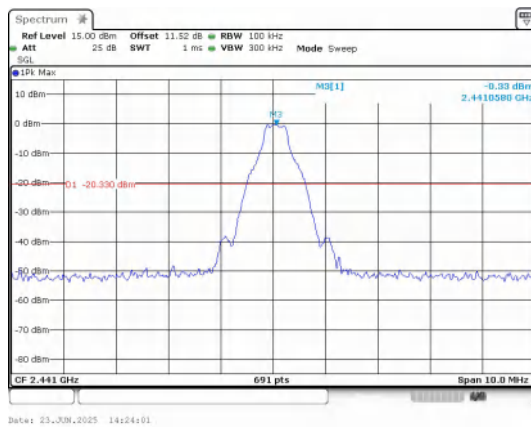
30.0 MHz - 25000.0 MHz
 $\pi/4$ DQPSK_2-DH5_Channel 78



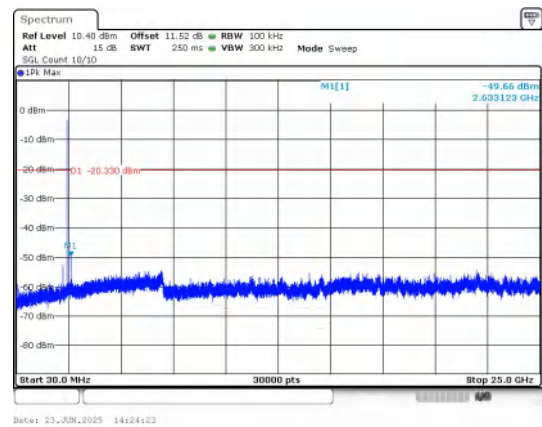
Out Of Band Emission
8DPSK_3-DH5_Channel 0



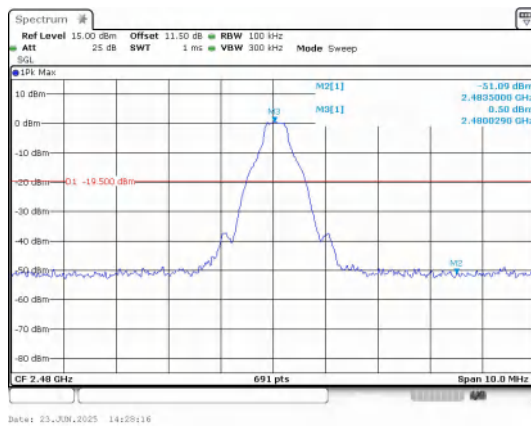
30.0 MHz - 25000.0 MHz
8DPSK_3-DH5_Channel 0



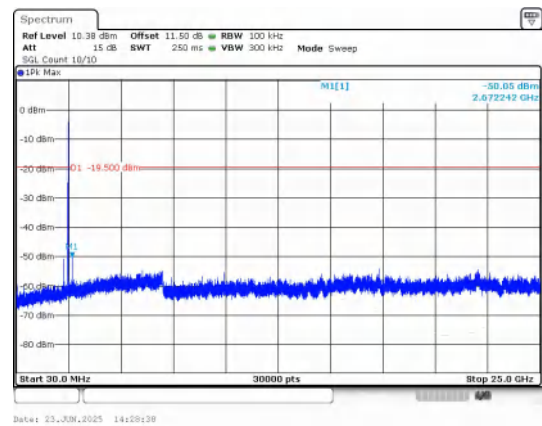
Out Of Band Emission
8DPSK_3-DH5_Channel 39



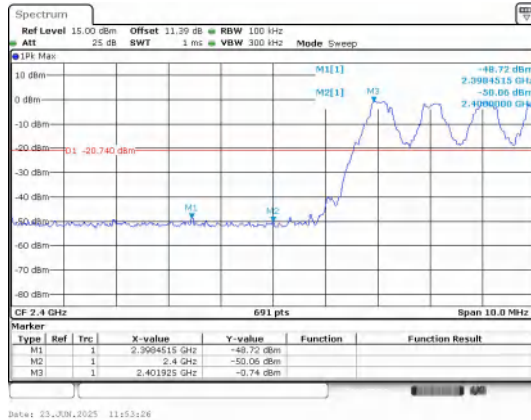
30.0 MHz - 25000.0 MHz
8DPSK_3-DH5_Channel 39



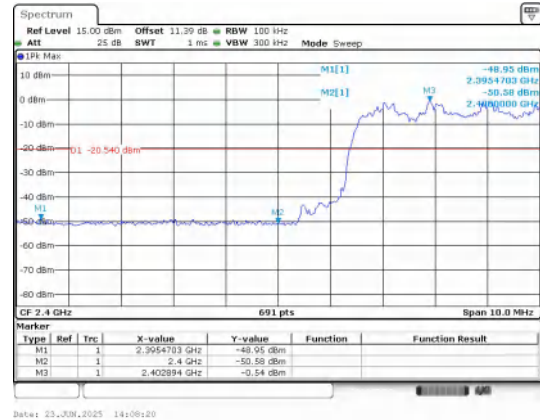
Out Of Band Emission
8DPSK_3-DH5_Channel 78



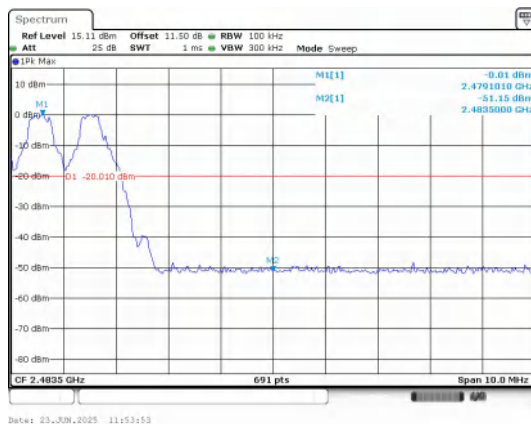
30.0 MHz - 25000.0 MHz
8DPSK_3-DH5_Channel 78



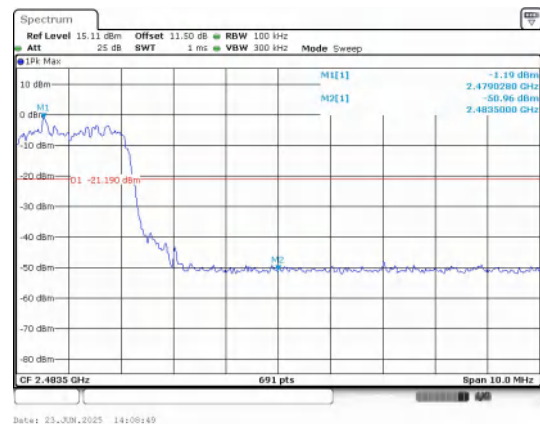
Out Of Band Emission(Left)
GFSK_DH5_Channel Hopping



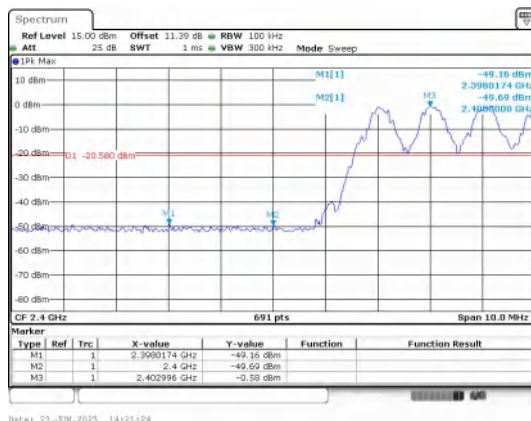
Out Of Band Emission(Left)
 $\pi/4$ DQPSK_2-DH5_Channel Hopping



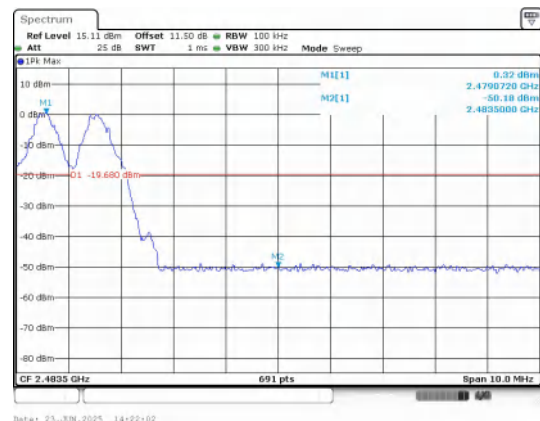
Out Of Band Emission(Right)
GFSK_DH5_Channel Hopping



Out Of Band Emission(Right)
 $\pi/4$ DQPSK_2-DH5_Channel Hopping



Out Of Band Emission(Left)
8DPSK_3-DH5_Channel Hopping



Out Of Band Emission(Right)
8DPSK_3-DH5_Channel Hopping

-----End of the report-----