

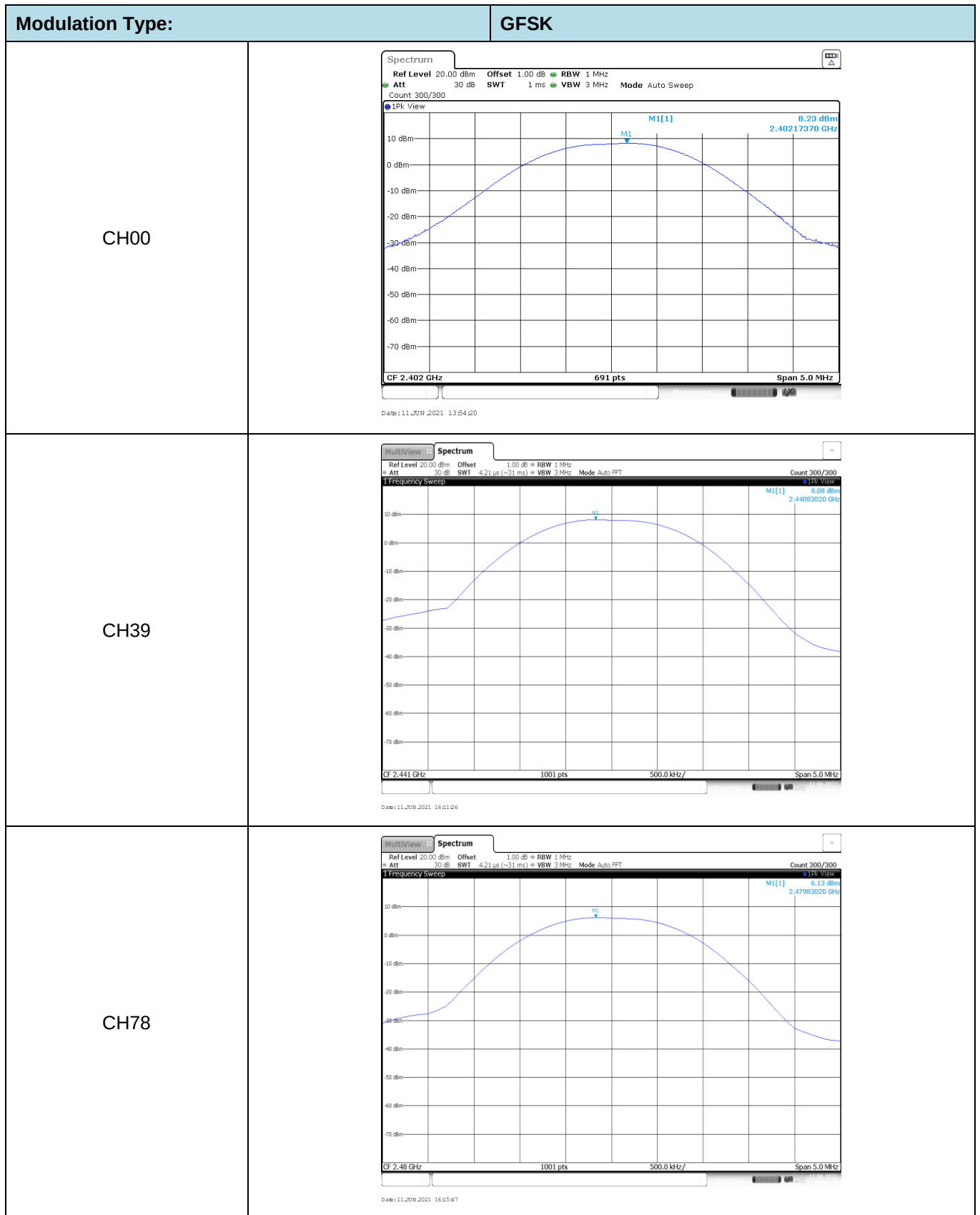
APPENDIX REPORT

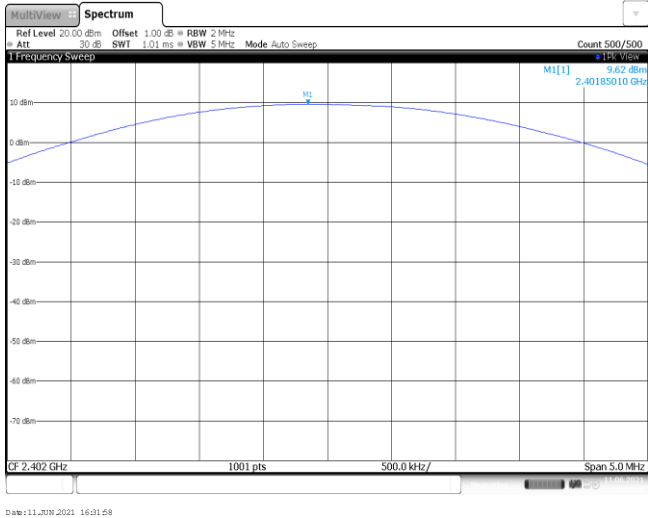
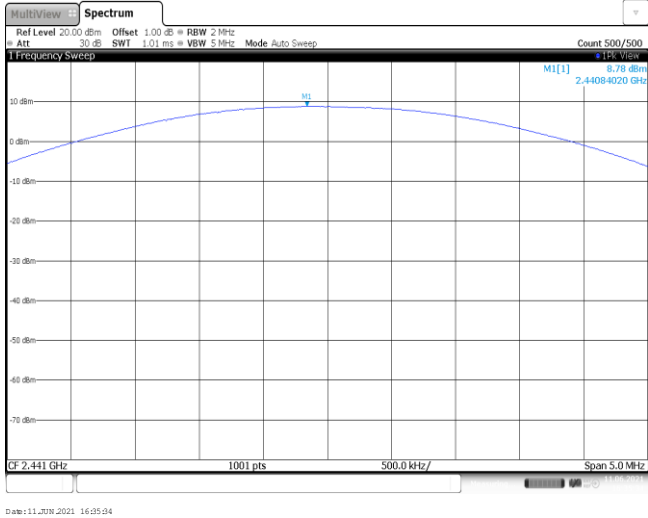
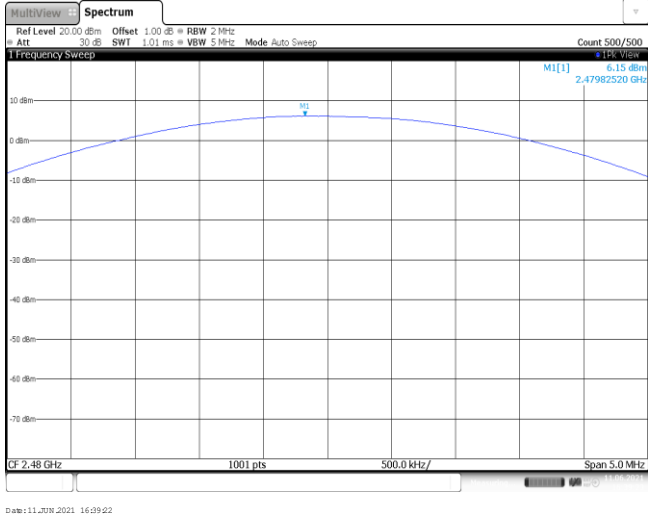
Project No.	SHT2103089402EW	Radio Specification	Bluetooth EDR
Test sample No.	YPHT21030894014	Model No.	SHOCKWAVE
Start test date	2021-06-11	Finish date	2021-06-15
Temperature	26.7°C	Humidity	39%
Test Engineer	Hailey Chen	Auditor	Xiaodong Zheo

Appendix clause	Test item	Result
A	Peak Output Power	PASS
B	20 dB Bandwidth	PASS
C	99% Occupied Bandwidth	PASS
D	Carrier Frequencies Separation	PASS
E	Hopping Channel Number	PASS
F	Dwell Time	PASS
G	Duty Cycle Correction Factor (DCCF)	PASS
H	Band edge and Spurious Emissions(coducted)	PASS

Appendix A: Peak Output Power

Modulation type	Channel	Output power (dBm)	Average Output power (dBm)	Limit (dBm)	Result
GFSK	00	8.23	8.20	≤ 30.00	Pass
	39	8.08	8.07		
	78	6.13	6.12		
$\pi/4$ DQPSK	00	9.62	8.17	≤ 21.00	Pass
	39	8.78	7.93		
	78	6.15	5.21		
8DPSK	00	8.78	7.59	≤ 21.00	Pass
	39	8.63	7.47		
	78	5.94	4.54		

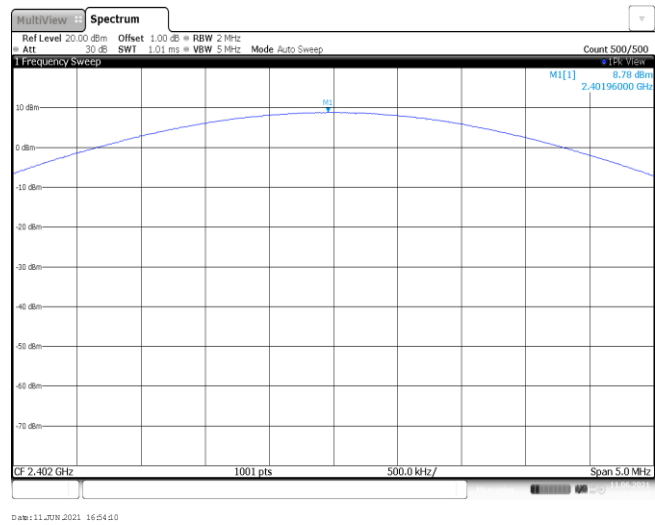


Modulation Type:		$\pi/4$ DQPSK
CH00		
CH39		
CH78		

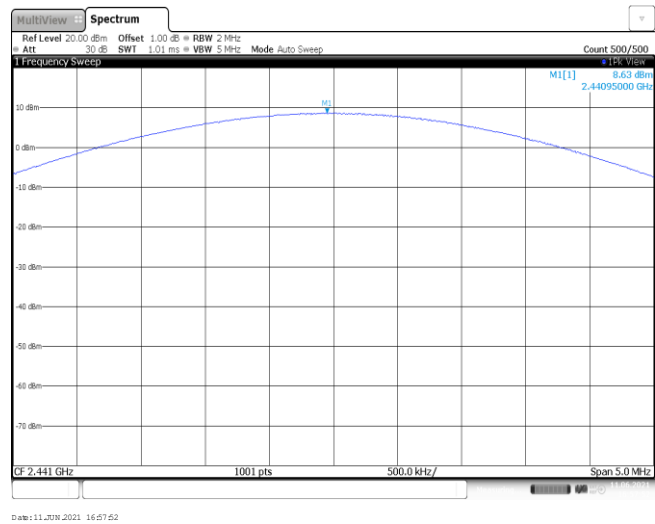
Modulation Type:

8DPSK

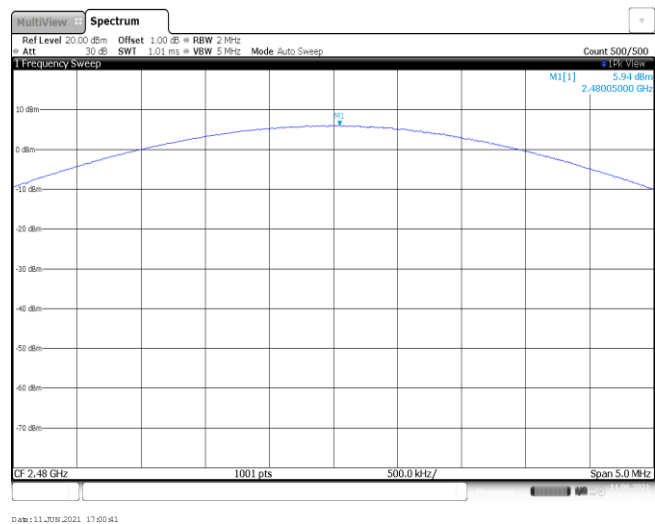
CH00



CH39



CH78



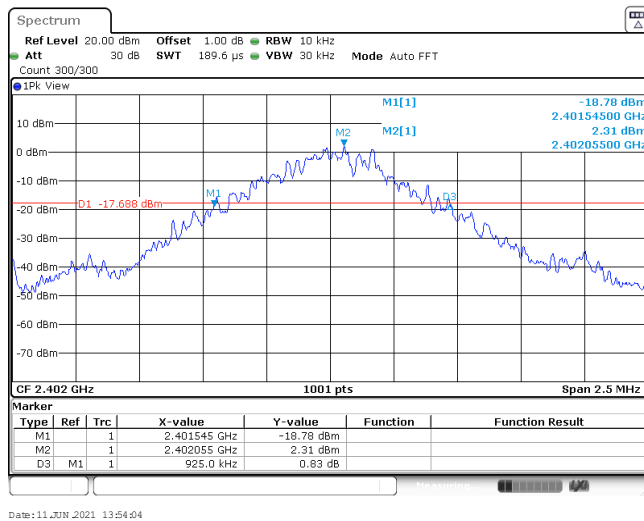
Appendix B : 20 dB Bandwidth

Modulation type	Channel	20 dB Bandwidth (kHz)	Limit (kHz)	Result
GFSK	00	925.00	-	Pass
	39	932.50		
	78	932.50		
$\pi/4$ DQPSK	00	1300.00	-	Pass
	39	1297.50		
	78	1297.50		
8DPSK	00	1282.50	-	Pass
	39	1285.00		
	78	1290.00		

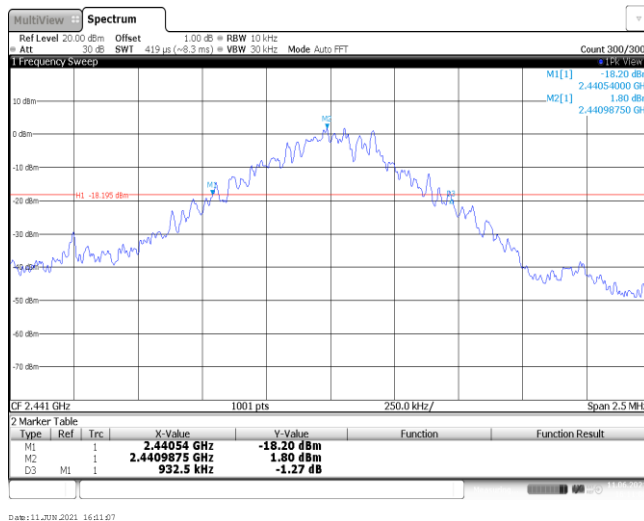
Modulation Type:

GFSK

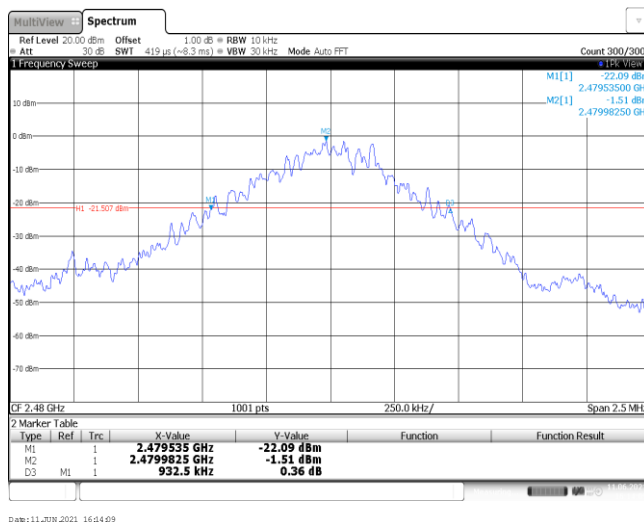
CH00



CH39



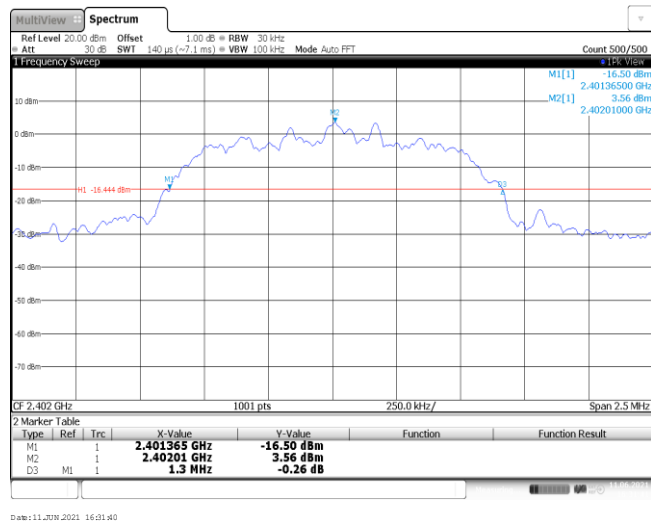
CH78



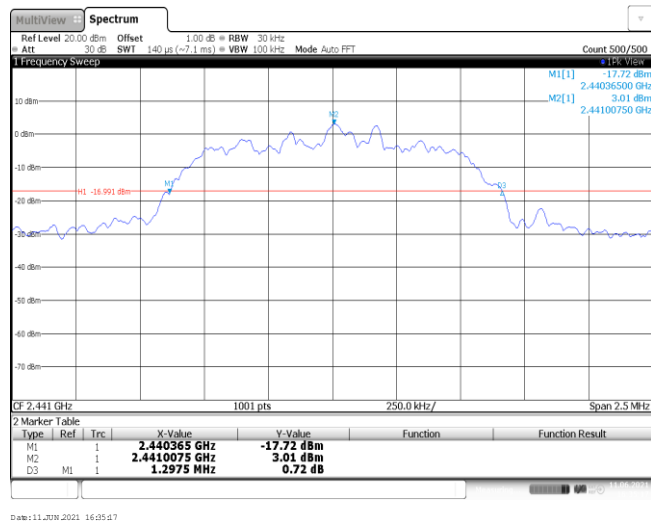
Modulation Type:

 $\pi/4$ DQPSK

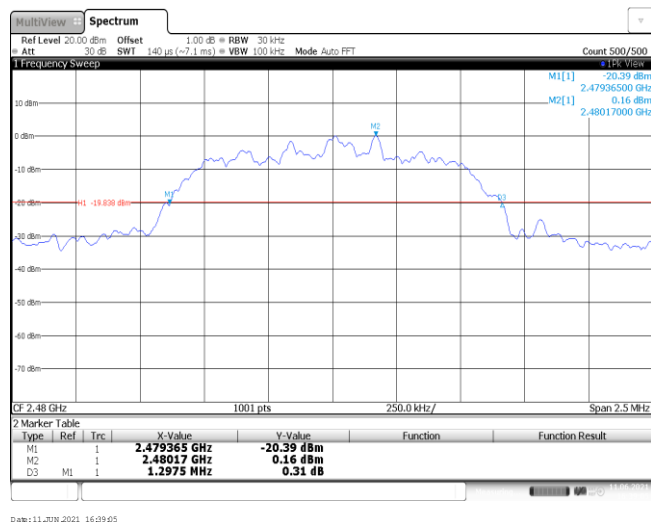
CH00



CH39



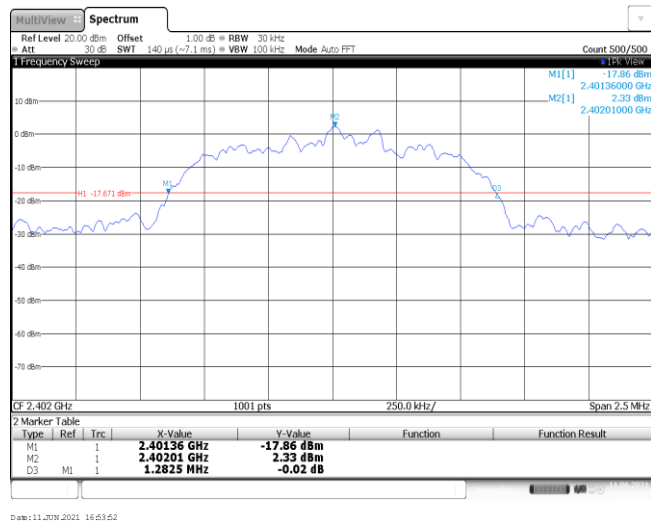
CH78



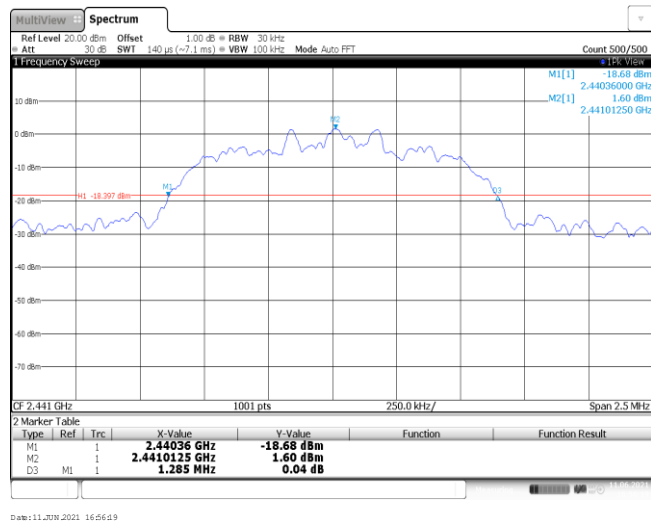
Modulation Type:

8DPSK

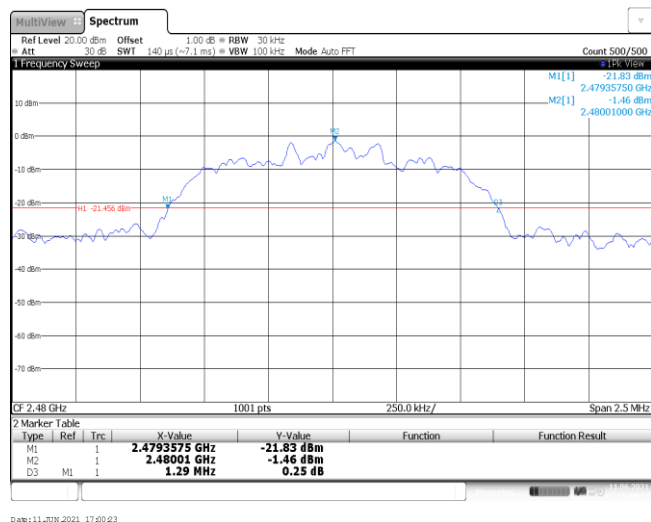
CH00



CH39

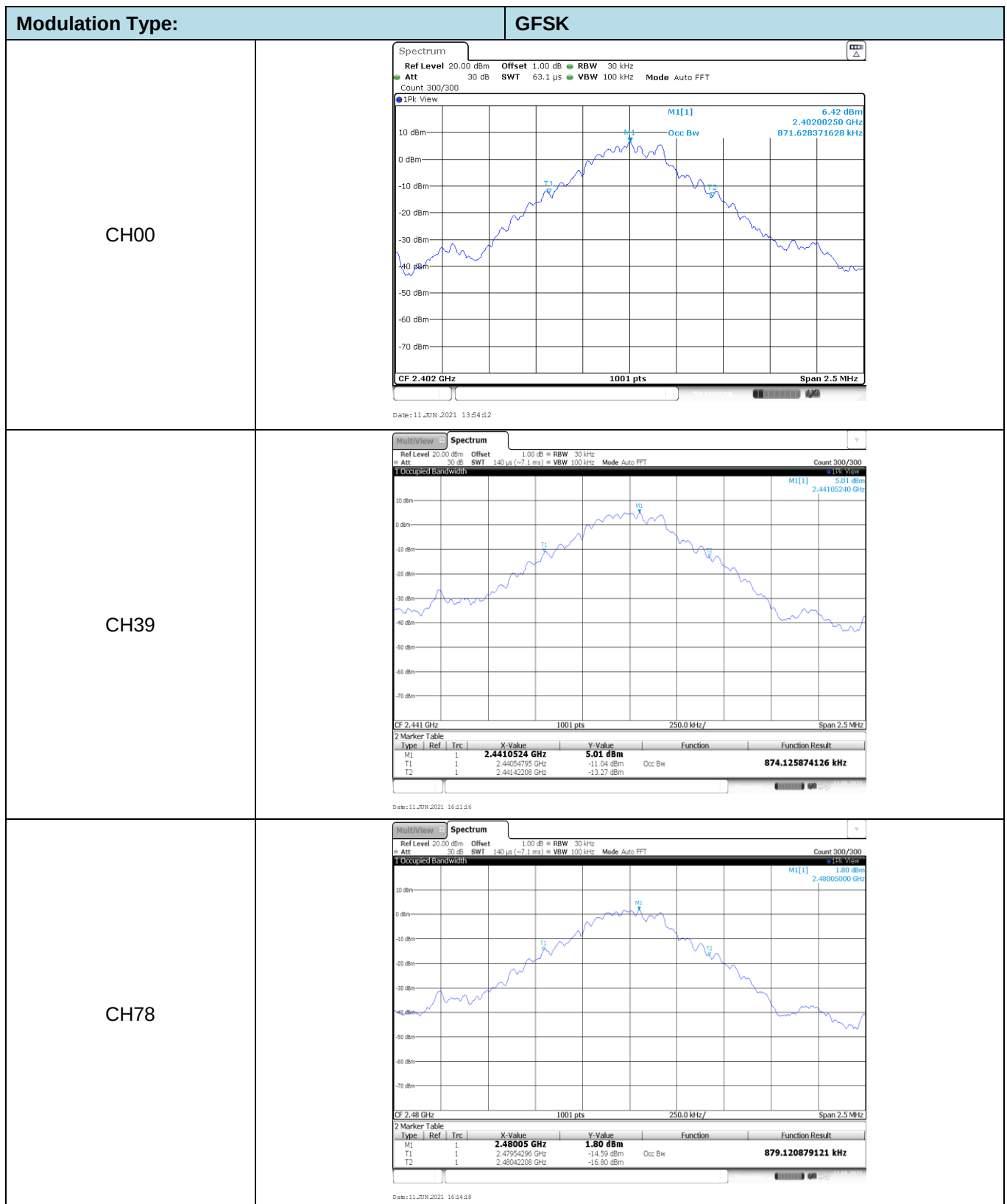


CH78



Appendix C: 99% Occupied Bandwidth

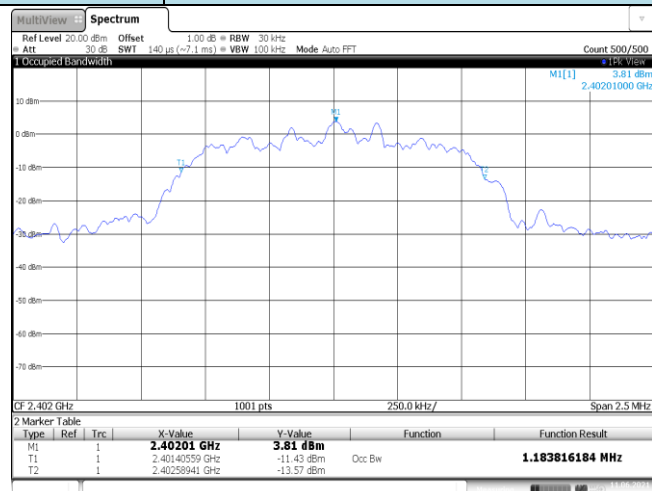
Modulation type	Channel	99% Occupied Bandwidth (MHz)	Limit (MHz)	Result
GFSK	00	0.87	-	Pass
	39	0.87		
	78	0.88		
$\pi/4$ DQPSK	00	1.18	-	Pass
	39	1.19		
	78	1.19		
8DPSK	00	1.19	-	Pass
	39	1.20		
	78	1.20		



Modulation Type:

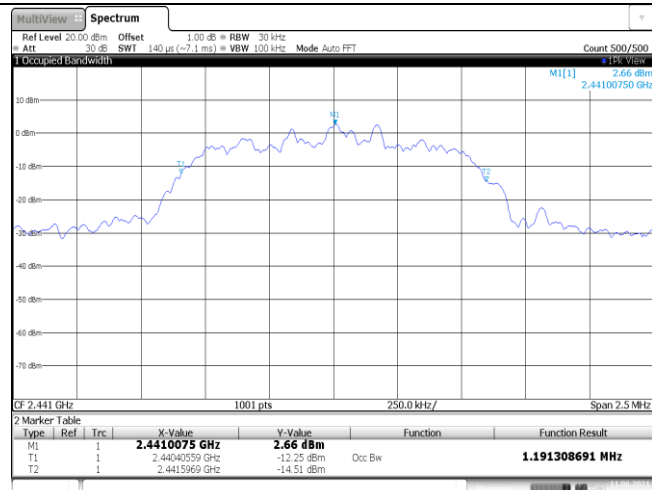
 $\pi/4$ DQPSK

CH00



Date: 11_JUN 2021 16:31:49

CH39



Date: 11_JUN 2021 16:35:25

CH78

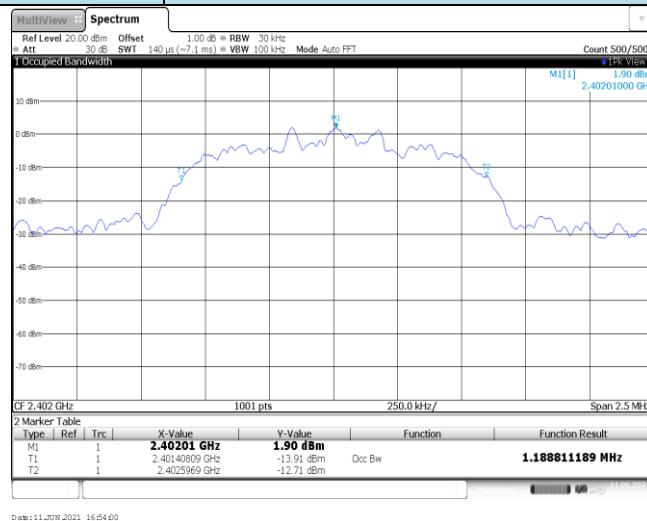


Date: 11_JUN 2021 16:39:43

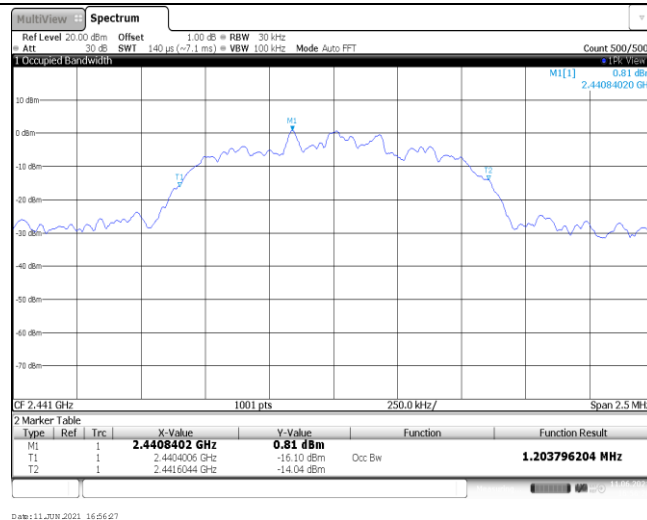
Modulation Type:

8DPSK

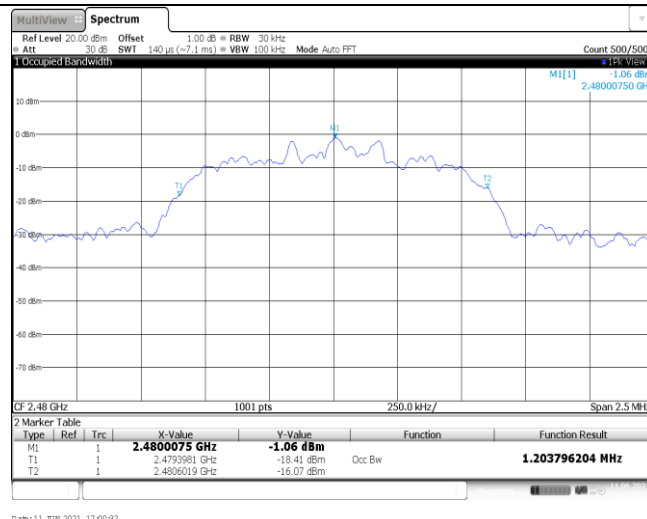
CH00



CH39



CH78



Appendix D: Carrier Frequencies Separation

Modulation type	Channel	Carrier Frequencies Separation (MHz)	Limit (kHz) *	Result
GFSK	39	1.00	≥932.50	Pass
π/4DQPSK	39	1.00	≥866.67	Pass
8DPSK	39	1.00	≥860.00	Pass

Note:

*: GFSK limit = The maximum 20 dB Bandwidth for GFSK modulation on the appendix B.

π/4DQPSK limit = 2/3 * The maximum 20 dB Bandwidth for π/4DQPSK modulation on the appendix B.

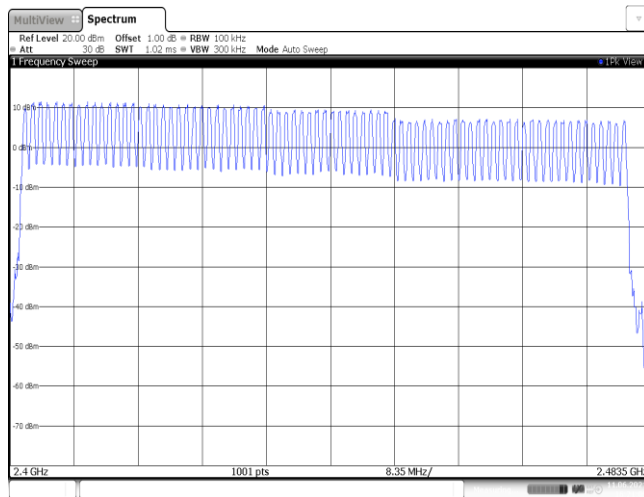
8DPSK limit = 2/3 * The maximum 20 dB Bandwidth for 8DPSK modulation on the appendix B

Appendix report page: 15 of 41

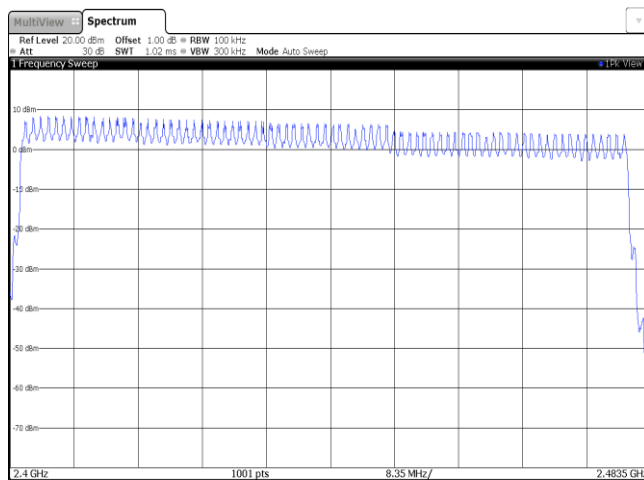
Appendix E: Hopping Channel Number

Modulation type	Channel number	Limit	Result
GFSK	79	≥15.00	Pass
π/4DQPSK	79		
8DPSK	79		

GFSK

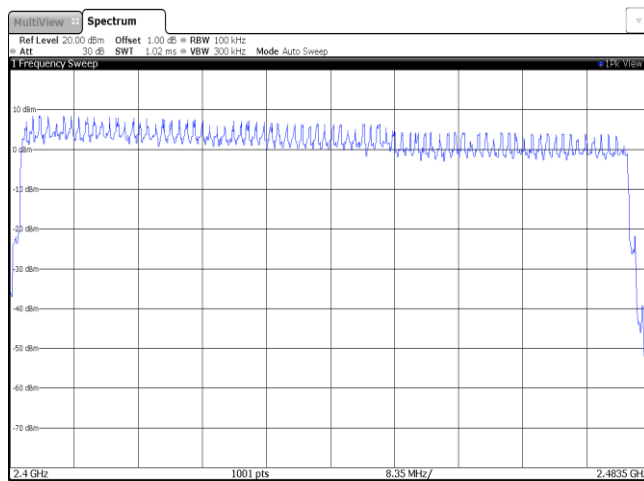


Date: 11 JUN 2021 16:21:09

 $\pi/4$ DQPSK

Date: 11 JUN 2021 16:45:09

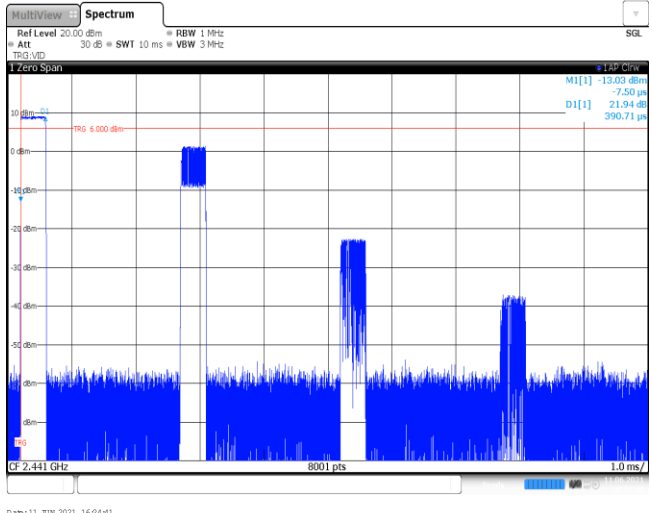
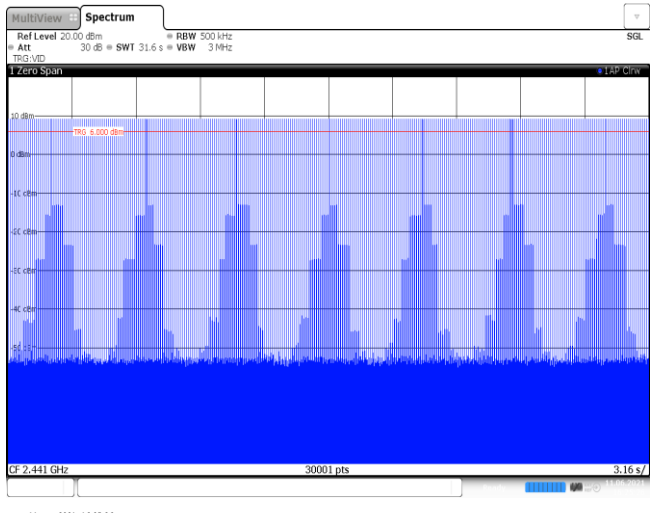
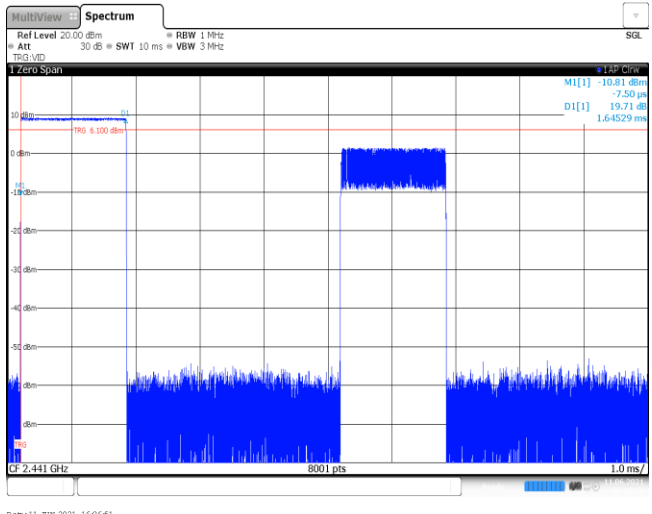
8DPSK



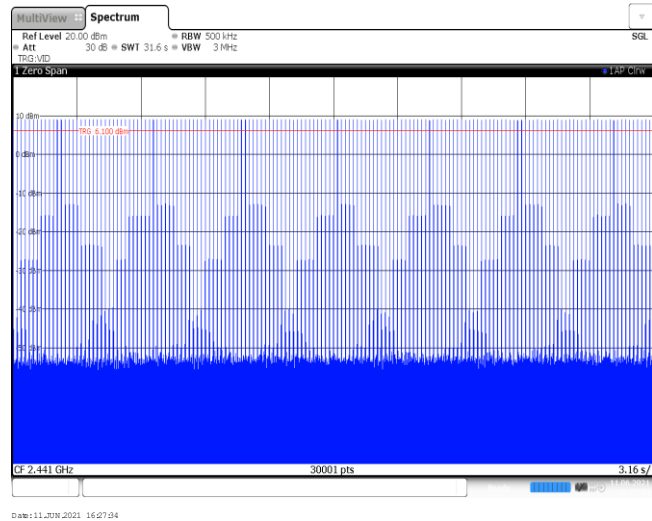
Date: 11 JUN 2021 17:06:53

Appendix F: Dwell Time

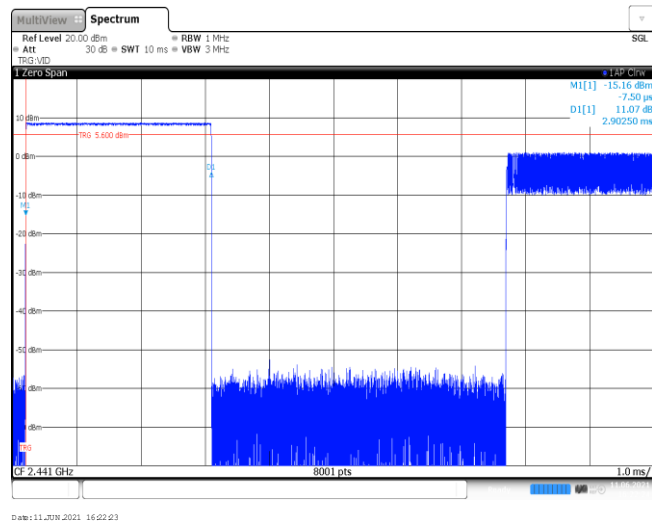
Modulation type	Packet	Burst Width [ms]	Total Hops[hop*ch]	Dwell time (Second)	Limit (Second)	Result
GFSK	DH1	0.39	320	0.12	≤ 0.40	Pass
	DH3	1.65	160	0.26		
	DH5	2.90	107	0.31		
$\pi/4$ DQPSK	2DH1	0.39	320	0.12	≤ 0.40	Pass
	2DH3	1.65	160	0.26		
	2DH5	2.91	107	0.31		
8DPSK	3DH1	0.40	320	0.13	≤ 0.40	Pass
	3DH3	1.66	160	0.27		
	3DH5	2.91	107	0.31		

Modulation Type:	GFSK
DH1 Burst width	 The spectrum plot shows three distinct bursts of signal. The y-axis represents power in dBm, ranging from -60 to 20. The x-axis represents frequency in GHz, centered at 2.441 GHz. A red horizontal line indicates a threshold at -10.03 dBm. The plot shows three bursts of signal, each lasting approximately 1.0 ms. The first burst is at approximately 2.441 GHz, the second at approximately 2.442 GHz, and the third at approximately 2.443 GHz. The plot is titled 'Spectrum' and includes parameters: Ref Level 20.00 dBm, Att 30 dB, SWT 10 ms, VBW 3 MHz, RBW 1 MHz. The plot also shows a 'Zero Span' view and a 'LAP Circle'.
DH1 Burst number	 The spectrum plot shows a series of periodic bursts of signal. The y-axis represents power in dBm, ranging from -60 to 20. The x-axis represents frequency in GHz, centered at 2.441 GHz. A red horizontal line indicates a threshold at -10.03 dBm. The plot shows a series of periodic bursts of signal, each lasting approximately 3.16 s. The plot is titled 'Spectrum' and includes parameters: Ref Level 20.00 dBm, Att 30 dB, SWT 31.6 s, VBW 3 MHz, RBW 500 kHz. The plot also shows a 'Zero Span' view and a 'LAP Circle'.
DH3 Burst width	 The spectrum plot shows a single burst of signal. The y-axis represents power in dBm, ranging from -60 to 20. The x-axis represents frequency in GHz, centered at 2.441 GHz. A red horizontal line indicates a threshold at -10.81 dBm. The plot shows a single burst of signal, lasting approximately 1.0 ms. The plot is titled 'Spectrum' and includes parameters: Ref Level 20.00 dBm, Att 30 dB, SWT 10 ms, VBW 3 MHz, RBW 1 MHz. The plot also shows a 'Zero Span' view and a 'LAP Circle'.

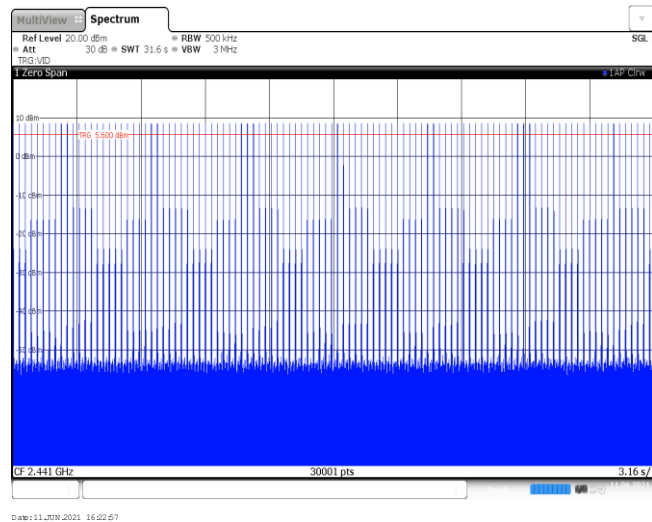
DH3
Burst number



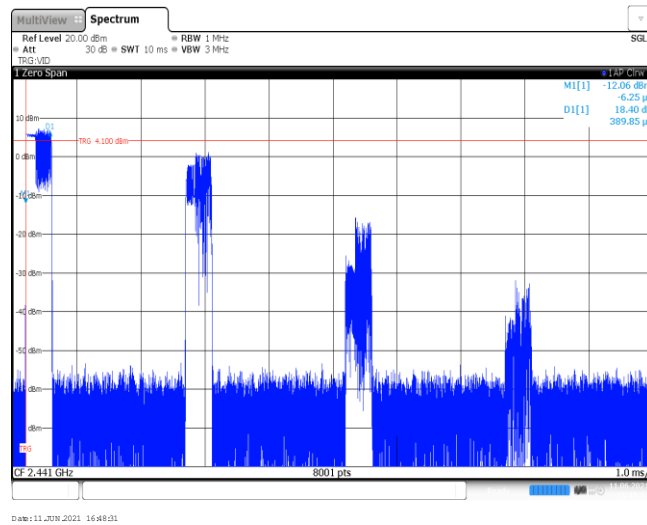
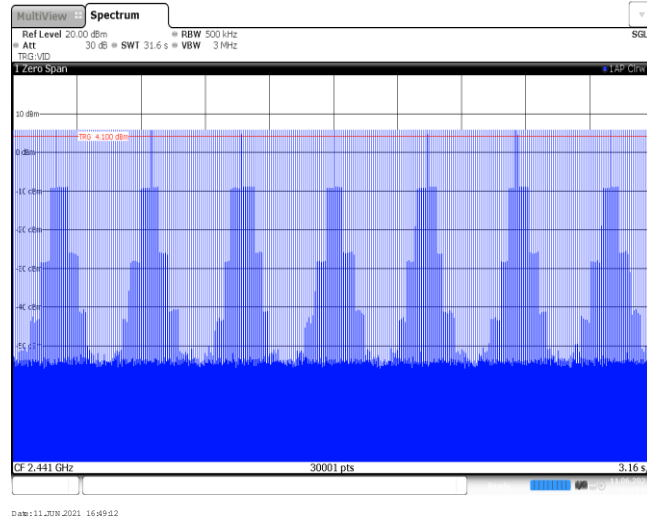
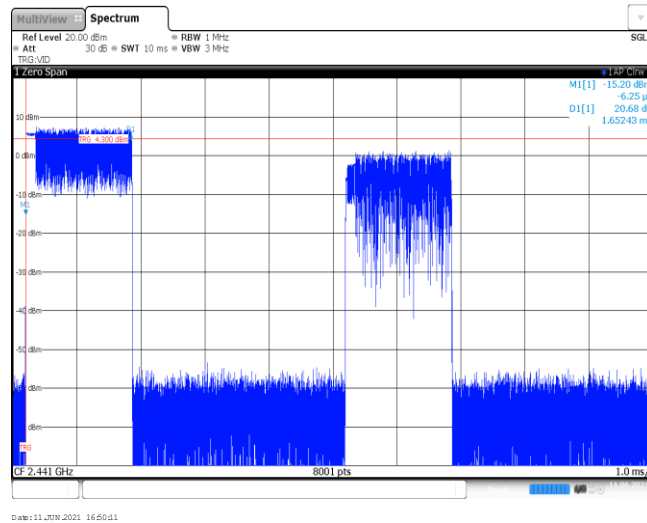
DH5
Burst width



DH5
Burst number



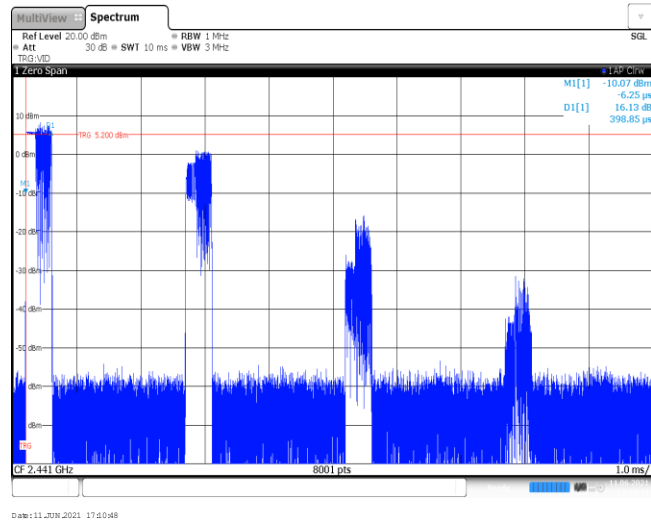
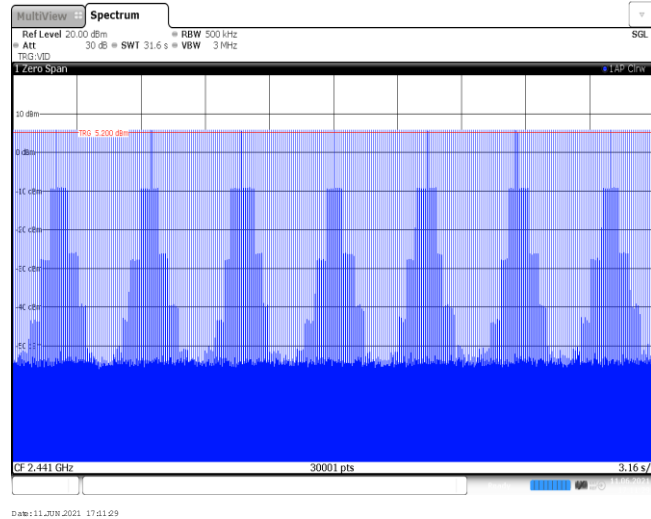
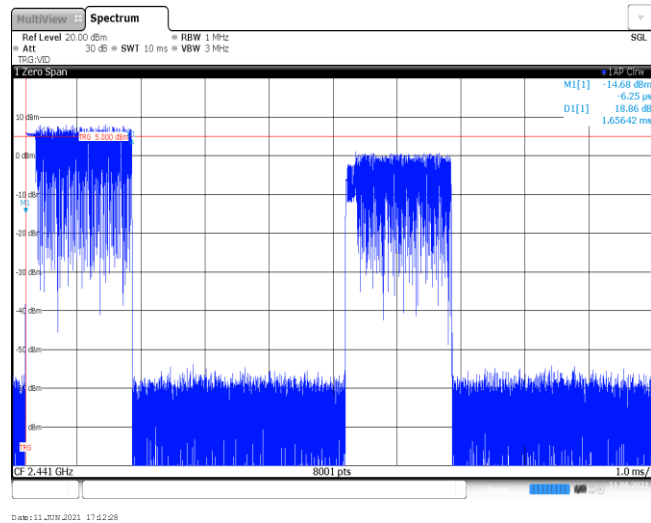
Modulation Type:

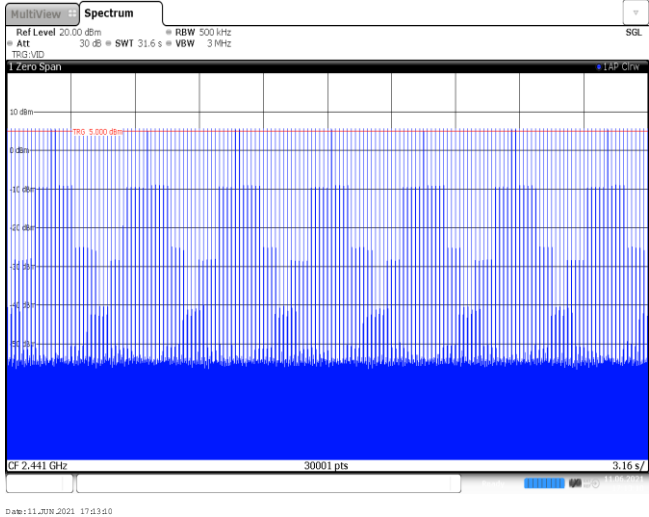
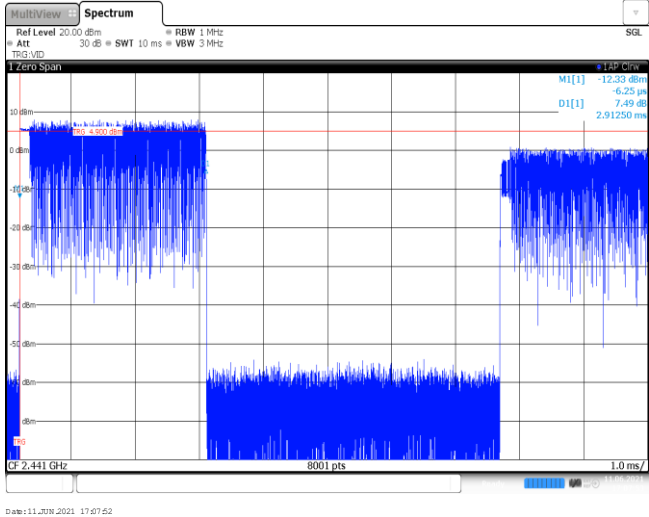
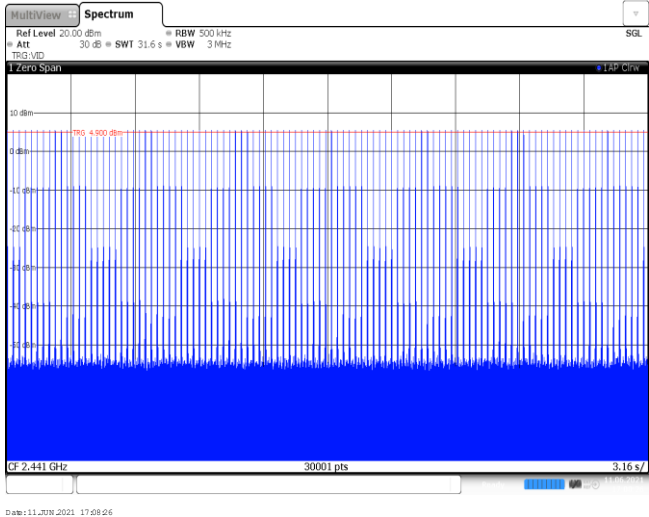
 $\pi/4$ DQPSK2DH1
Burst width2DH1
Burst number2DH3
Burst width

Appendix report page: 22 of 41

Modulation Type:

8DPSK

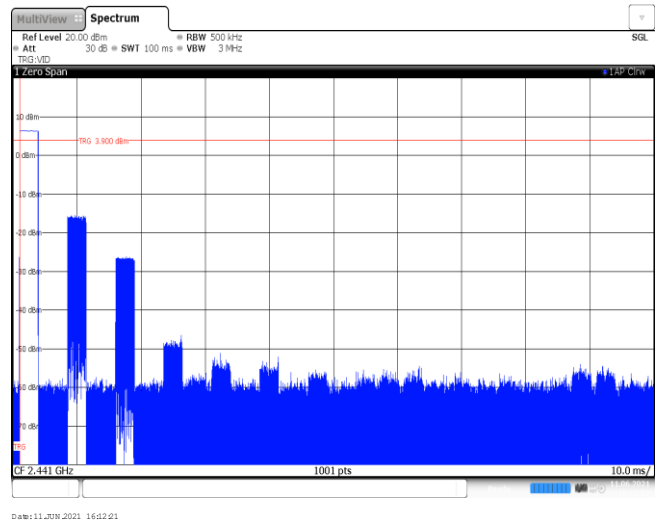
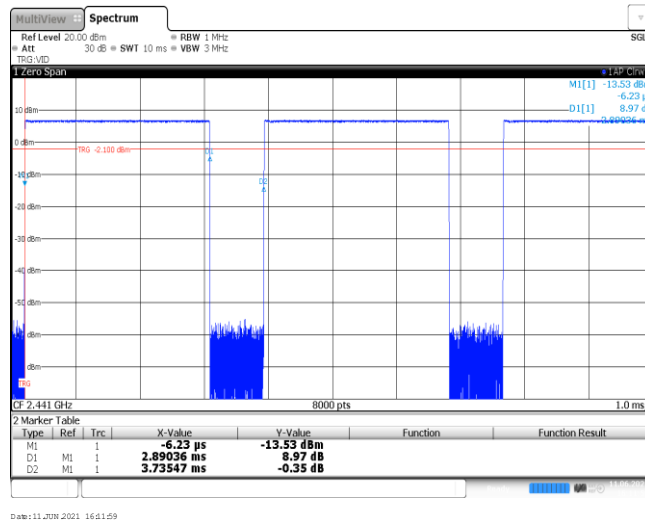
3DH1
Burst width3DH1
Burst number3DH3
Burst width

3DH3 Burst number	 The screenshot shows a spectrum analyzer interface with the title 'Spectrum'. The y-axis represents power in dBm, ranging from -50 to 10. The x-axis represents frequency in GHz, centered at 2.441 GHz. A red horizontal line is drawn at -5.000 dBm. The plot shows a dense, noisy signal across the entire frequency range. The status bar at the bottom indicates 'CF 2.441 GHz', '30001 pts', and '3.16 s'. The date '11_JUN 2021 17:13:40' is displayed at the bottom left.
3DH5 Burst width	 The screenshot shows a spectrum analyzer interface with the title 'Spectrum'. The y-axis represents power in dBm, ranging from -50 to 10. The x-axis represents frequency in GHz, centered at 2.441 GHz. A red horizontal line is drawn at -5.000 dBm. The plot shows a burst of signal that is approximately 1.0 ms wide. The status bar at the bottom indicates 'CF 2.441 GHz', '8001 pts', and '1.0 ms'. The date '11_JUN 2021 17:07:52' is displayed at the bottom left.
3DH5 Burst number	 The screenshot shows a spectrum analyzer interface with the title 'Spectrum'. The y-axis represents power in dBm, ranging from -50 to 10. The x-axis represents frequency in GHz, centered at 2.441 GHz. A red horizontal line is drawn at -5.000 dBm. The plot shows a dense, noisy signal across the entire frequency range. The status bar at the bottom indicates 'CF 2.441 GHz', '30001 pts', and '3.16 s'. The date '11_JUN 2021 17:08:26' is displayed at the bottom left.

Appendix G: Duty Cycle Correction Factor (DCCF)

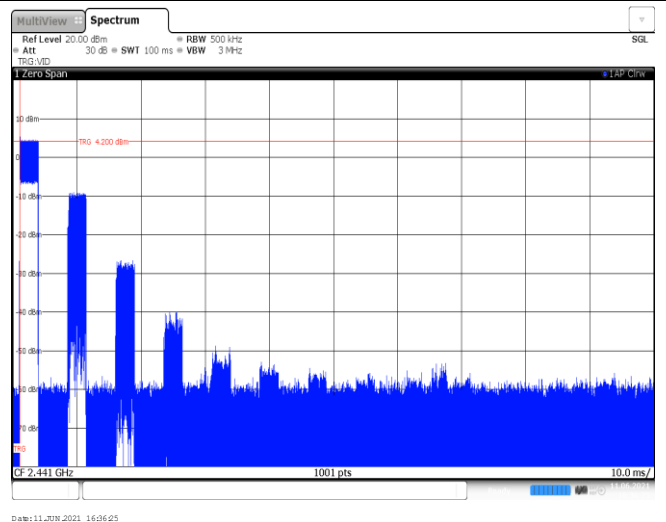
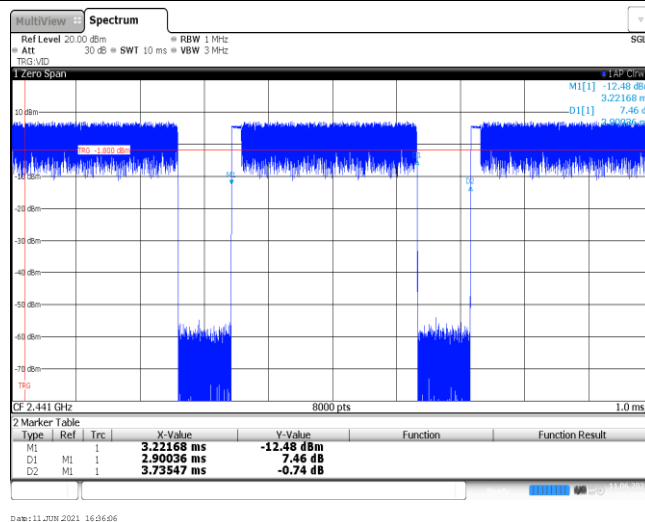
DCCF Calculate Formula					
$DCCF = 20 * \text{Log}(\text{duty cycle}) = 20 * \text{Log}(T_{\text{on time}} / T_{\text{period}})$					
Modulation type	Test Frequency (MHz)	$T_{\text{on time}}$ for single burst [ms]	T_{period} [ms]	Burst Quantity	DCCF [dB]
GFSK	2441	2.89	100	3	-21.24
$\pi/4$ DQPSK	2441	2.90	100	3	-21.21
8DPSK	2441	2.90	100	3	-21.21

GFSK



Ton time for single burst

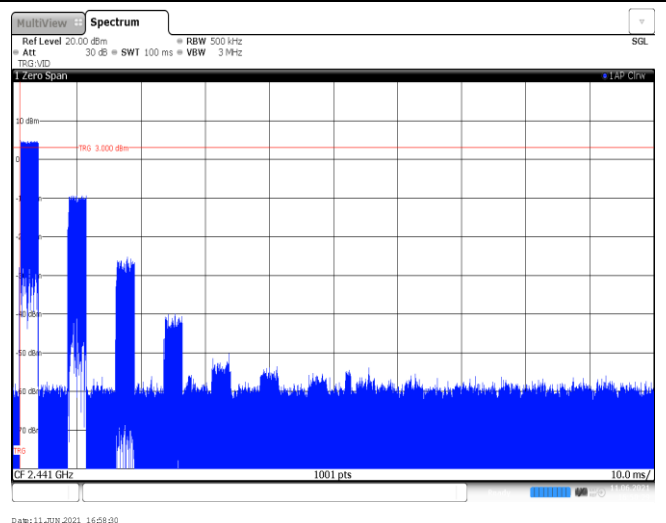
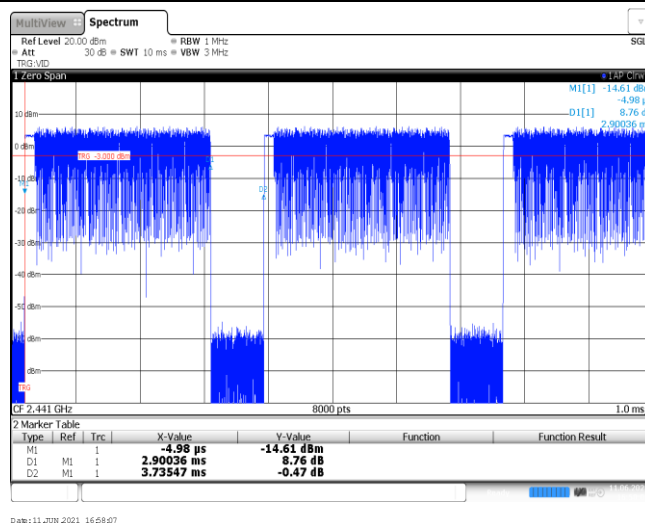
Burst Quantity

 $\pi/4$ DQPSK

Ton time for single burst

Burst Quantity

8DPSK



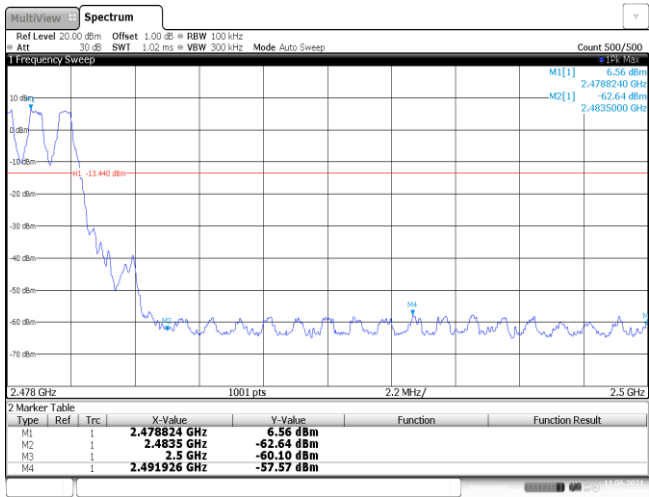
Ton time for single burst

Burst Quantity

Appendix H: Band edge and Spurious Emissions (conducted)

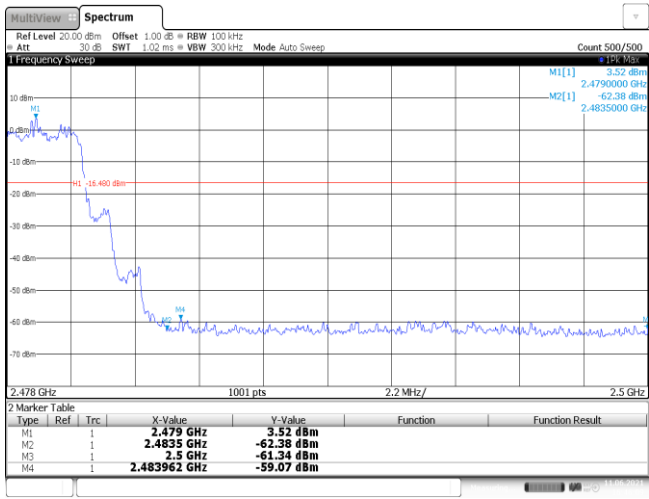
Test Item:	Band edge	Modulation type:	GFSK																																										
CH00 No hopping mode	Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWT 1.1 ms VBW 300 kHz Mode Auto Sweep Count 300/300 IPK Max 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm M1[1] M2[1] M3 M4 M5 7.44 dBm -39.87 dBm -52.38 dBm -53.42 dBm -37.38 dBm 2.402180 GHz 2.400000 GHz 2.399768 GHz D1 -12.560 dBm Start 2.31 GHz 691 pts Stop 2.405 GHz Marker <table><tr><th>Type</th><th>Ref</th><th>Trc</th><th>X-value</th><th>Y-value</th><th>Function</th><th>Function Result</th></tr><tr><td>M1</td><td>1</td><td></td><td>2.40218 GHz</td><td>7.44 dBm</td><td></td><td></td></tr><tr><td>M2</td><td>1</td><td></td><td>2.4 GHz</td><td>-39.87 dBm</td><td></td><td></td></tr><tr><td>M3</td><td>1</td><td></td><td>2.39 GHz</td><td>-52.38 dBm</td><td></td><td></td></tr><tr><td>M4</td><td>1</td><td></td><td>2.31 GHz</td><td>-53.42 dBm</td><td></td><td></td></tr><tr><td>M5</td><td>1</td><td></td><td>2.399768 GHz</td><td>-37.38 dBm</td><td></td><td></td></tr></table> Date: 11 JUN 2021 13:56:11			Type	Ref	Trc	X-value	Y-value	Function	Function Result	M1	1		2.40218 GHz	7.44 dBm			M2	1		2.4 GHz	-39.87 dBm			M3	1		2.39 GHz	-52.38 dBm			M4	1		2.31 GHz	-53.42 dBm			M5	1		2.399768 GHz	-37.38 dBm		
Type	Ref	Trc	X-value	Y-value	Function	Function Result																																							
M1	1		2.40218 GHz	7.44 dBm																																									
M2	1		2.4 GHz	-39.87 dBm																																									
M3	1		2.39 GHz	-52.38 dBm																																									
M4	1		2.31 GHz	-53.42 dBm																																									
M5	1		2.399768 GHz	-37.38 dBm																																									
CH00 Hopping mode	MultiView Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWT 1.05 ms VBW 300 kHz Mode Auto Sweep Count 500/500 1 Frequency Sweep 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm M1[1] M2[1] M3 M4 M5 11.43 dBm -37.92 dBm -57.84 dBm -42.68 dBm -35.24 dBm 2.404003 GHz 2.400000 GHz 2.39968 GHz M1 -8.570 dBm 2.31 GHz 1001 pts 9.5 MHz/ 2.405 GHz 2 Marker Table <table><tr><th>Type</th><th>Ref</th><th>Trc</th><th>X-Value</th><th>Y-Value</th><th>Function</th><th>Function Result</th></tr><tr><td>M1</td><td>1</td><td></td><td>2.404003 GHz</td><td>11.43 dBm</td><td></td><td></td></tr><tr><td>M2</td><td>1</td><td></td><td>2.4 GHz</td><td>-37.92 dBm</td><td></td><td></td></tr><tr><td>M3</td><td>1</td><td></td><td>2.39 GHz</td><td>-57.84 dBm</td><td></td><td></td></tr><tr><td>M4</td><td>1</td><td></td><td>2.31 GHz</td><td>-42.68 dBm</td><td></td><td></td></tr><tr><td>M5</td><td>1</td><td></td><td>2.39968 GHz</td><td>-35.24 dBm</td><td></td><td></td></tr></table> Date: 11 JUN 2021 16:21:58			Type	Ref	Trc	X-Value	Y-Value	Function	Function Result	M1	1		2.404003 GHz	11.43 dBm			M2	1		2.4 GHz	-37.92 dBm			M3	1		2.39 GHz	-57.84 dBm			M4	1		2.31 GHz	-42.68 dBm			M5	1		2.39968 GHz	-35.24 dBm		
Type	Ref	Trc	X-Value	Y-Value	Function	Function Result																																							
M1	1		2.404003 GHz	11.43 dBm																																									
M2	1		2.4 GHz	-37.92 dBm																																									
M3	1		2.39 GHz	-57.84 dBm																																									
M4	1		2.31 GHz	-42.68 dBm																																									
M5	1		2.39968 GHz	-35.24 dBm																																									
CH78 No hopping mode	MultiView Spectrum Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWT 1.02 ms VBW 300 kHz Mode Auto Sweep Count 300/300 1 Frequency Sweep 10 dBm 0 dBm -10 dBm -20 dBm -30 dBm -40 dBm -50 dBm -60 dBm -70 dBm M1[1] M2[1] M3 M4 6.08 dBm -58.96 dBm -58.96 dBm -57.04 dBm 2.479989 GHz 2.4835000 GHz 2.4835000 GHz M1 -13.940 dBm 2.478 GHz 1001 pts 2.2 MHz/ 2.5 GHz 2 Marker Table <table><tr><th>Type</th><th>Ref</th><th>Trc</th><th>X-Value</th><th>Y-Value</th><th>Function</th><th>Function Result</th></tr><tr><td>M1</td><td>1</td><td></td><td>2.479989 GHz</td><td>6.08 dBm</td><td></td><td></td></tr><tr><td>M2</td><td>1</td><td></td><td>2.4835 GHz</td><td>-58.96 dBm</td><td></td><td></td></tr><tr><td>M3</td><td>1</td><td></td><td>2.5 GHz</td><td>-58.60 dBm</td><td></td><td></td></tr><tr><td>M4</td><td>1</td><td></td><td>2.496172 GHz</td><td>-57.04 dBm</td><td></td><td></td></tr></table> Date: 11 JUN 2021 16:16:24			Type	Ref	Trc	X-Value	Y-Value	Function	Function Result	M1	1		2.479989 GHz	6.08 dBm			M2	1		2.4835 GHz	-58.96 dBm			M3	1		2.5 GHz	-58.60 dBm			M4	1		2.496172 GHz	-57.04 dBm									
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CH78
Hopping mode



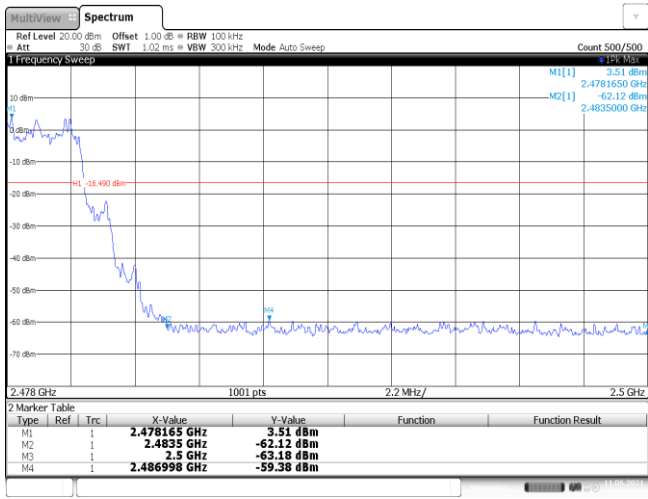
Test Item:	Band edge	Modulation type:	$\pi/4$ DQPSK
CH00 No hopping mode			

CH78
Hopping mode

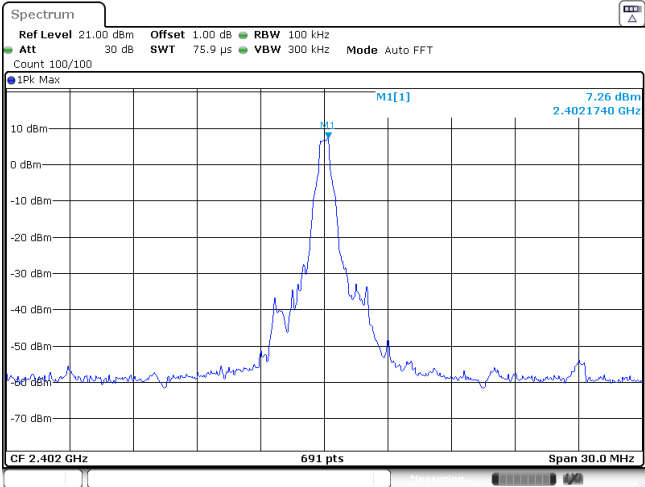
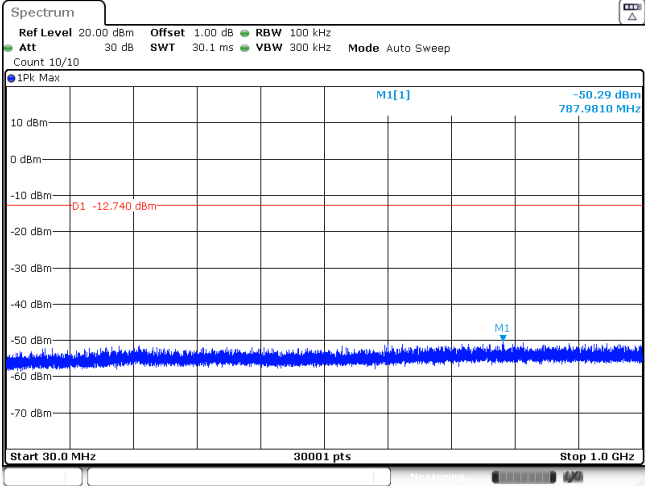
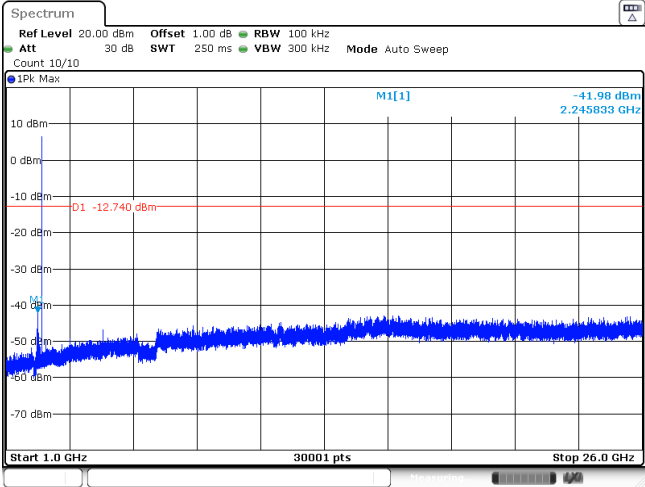


Test Item:	Band edge	Modulation type:	8DPSK
CH00 No hopping mode			

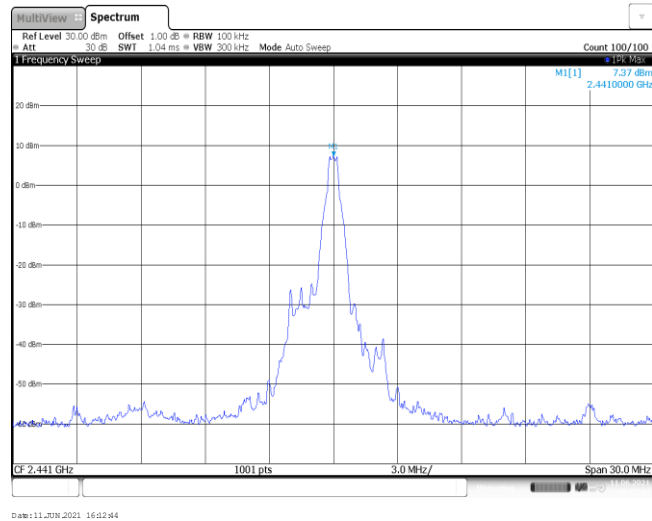
CH78
Hoppig mode



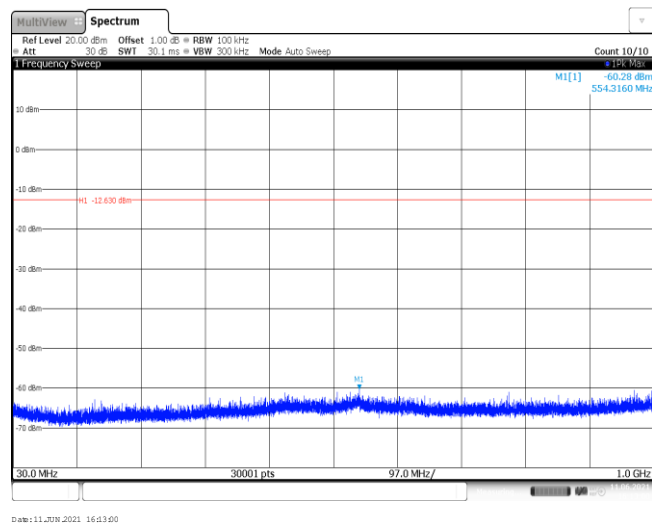
Date: 11 JUN 2021 17:27:26

Test Item:	Spurious Emission	Modulation type:	GFSK
CH00 Reference level	 Date: 11 JUN 2021 13:56:34		
CH00 30MHz~1000MHz	 Date: 11 JUN 2021 13:56:49		
CH00 1GHz~26GHz	 Date: 11 JUN 2021 13:57:04		

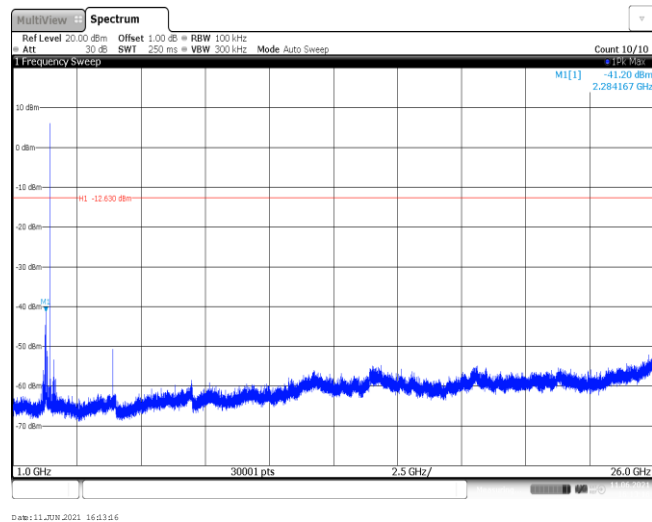
CH39
Reference level



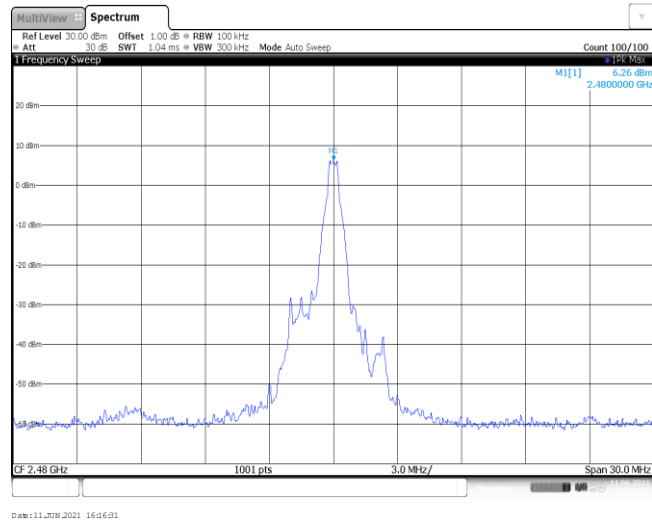
CH39
30MHz~1000MHz



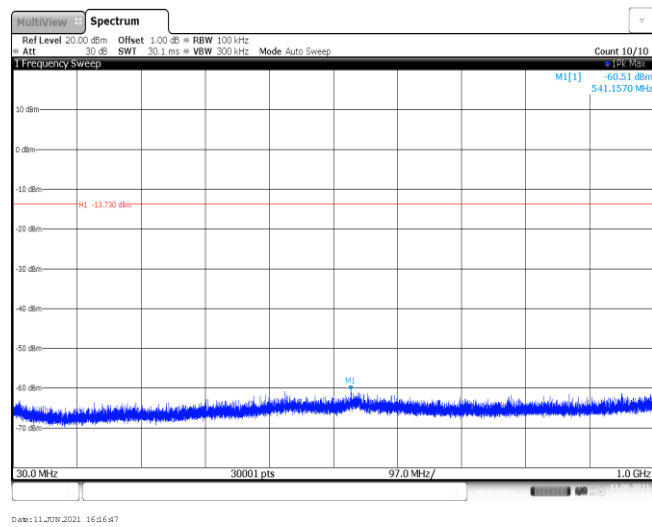
CH39
1GHz~26GHz



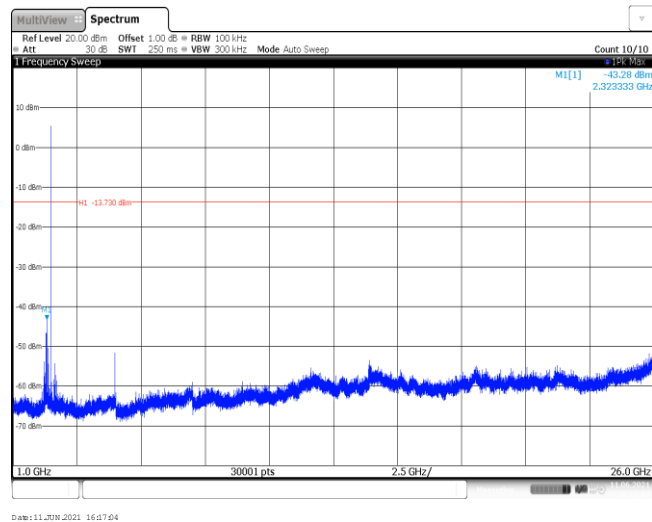
CH78
Reference level

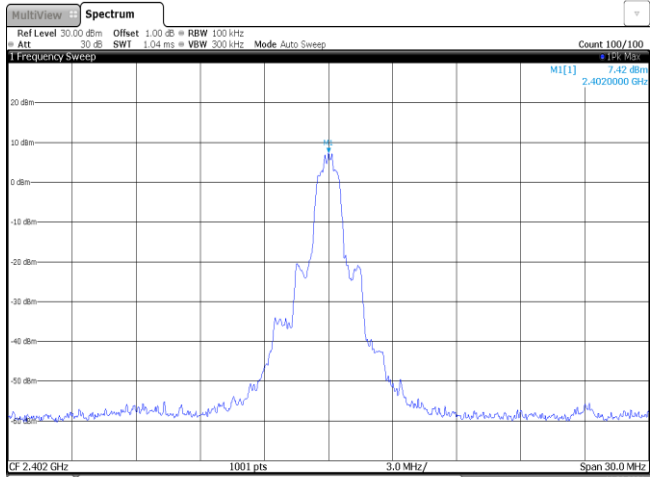
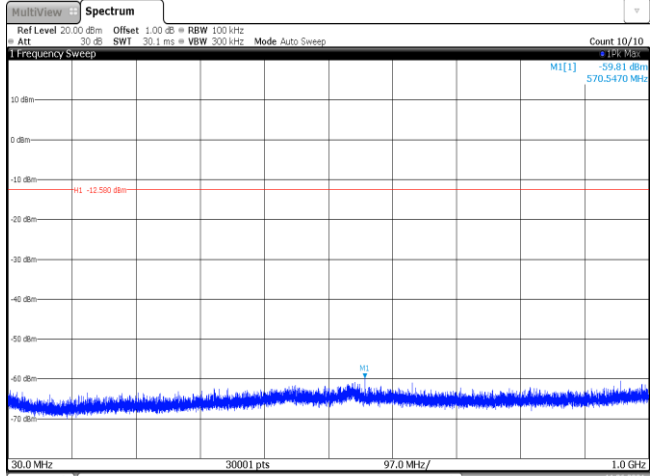
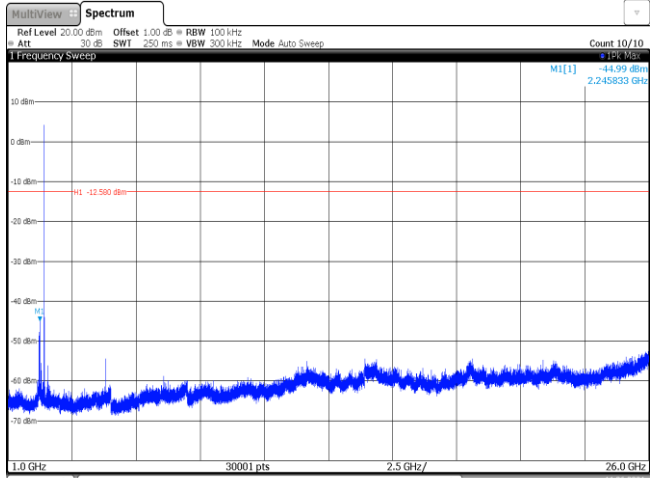


CH78
30MHz~1000MHz

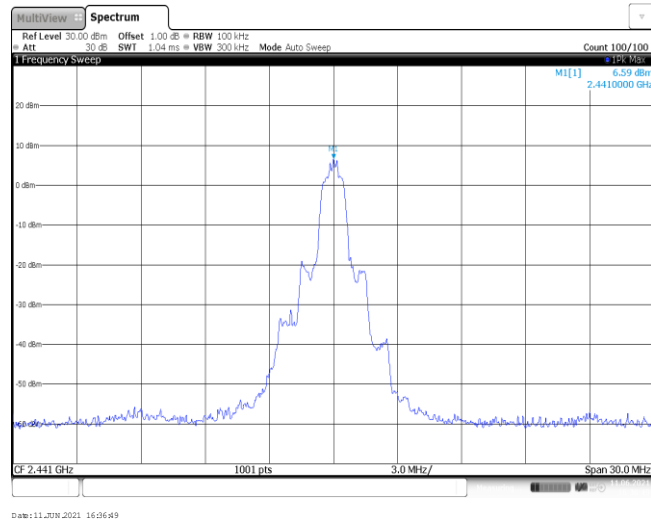


CH78
1GHz~26GHz

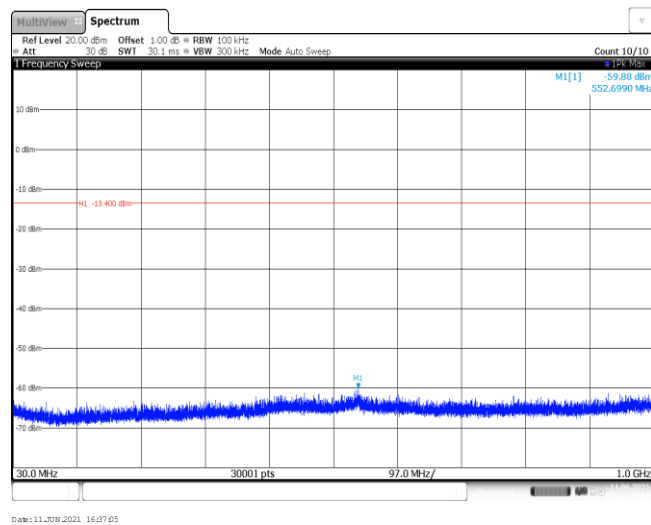


Test Item:	Spurious Emission	Modulation type:	$\pi/4$ DQPSK
CH00 Reference level	 Ref Level 30.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWI 1.04 ms VBW 300 kHz Mode Auto Sweep Count 100/100 MI[1] 7.42 dBm 2.4020000 GHz CF 2.402 GHz 1001 pts 3.0 MHz/ Span 30.0 MHz Date: 11 JUN 2021 16:02:08		
CH00 30MHz~1000MHz	 Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWI 30.1 ms VBW 300 kHz Mode Auto Sweep Count 10/10 MI[1] -59.81 dBm 570.5470 MHz MI -12.580 dBm 30.0 MHz 30001 pts 97.0 MHz/ 1.0 GHz Date: 11 JUN 2021 16:02:04		
CH00 1GHz~26GHz	 Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz Att 30 dB SWI 250 ms VBW 300 kHz Mode Auto Sweep Count 10/10 MI[1] -44.99 dBm 2.245833 GHz MI -12.580 dBm 1.0 GHz 30001 pts 2.5 GHz/ 26.0 GHz Date: 11 JUN 2021 16:03:11		

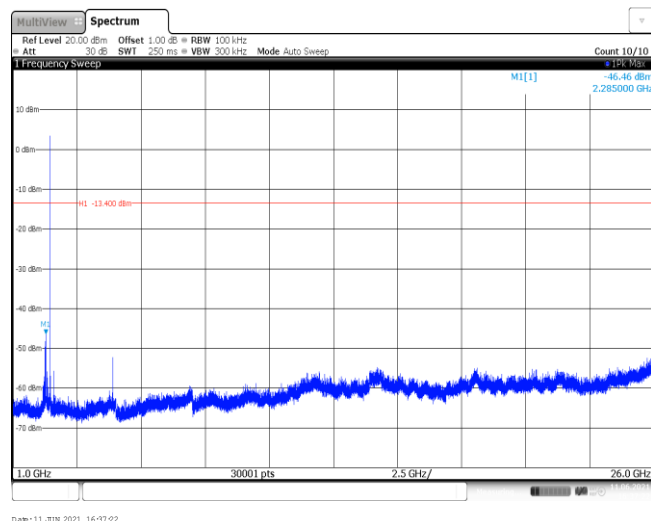
CH39
Reference level



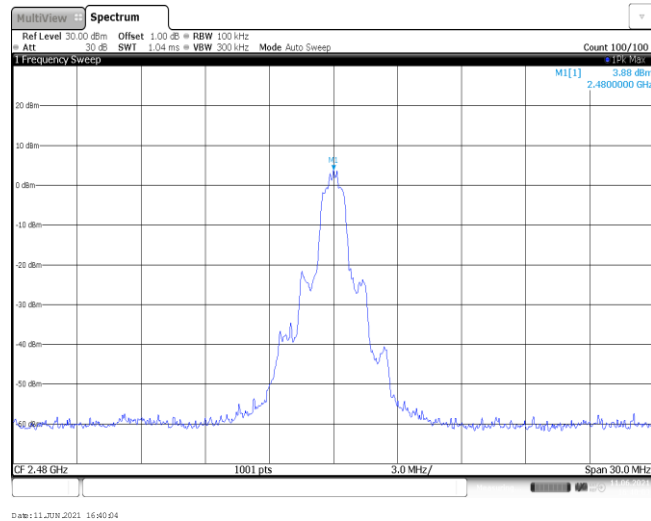
CH39
30MHz~1000MHz



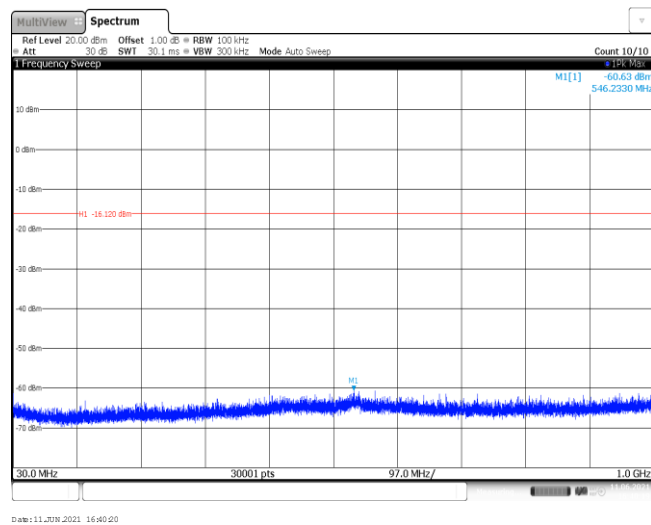
CH39
1GHz~26GHz



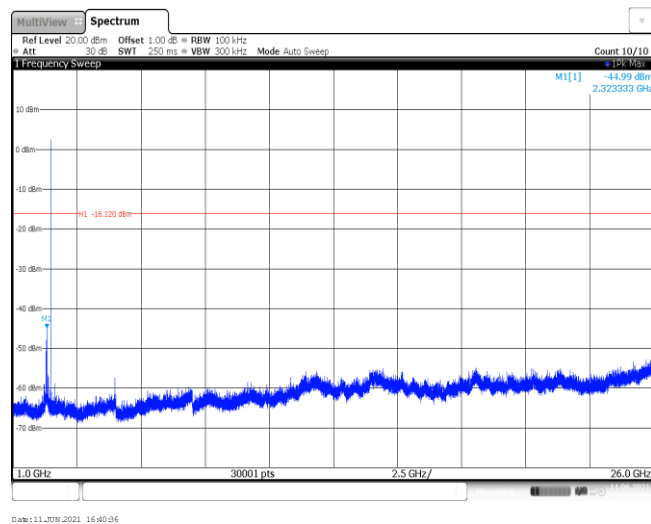
CH78
Reference level

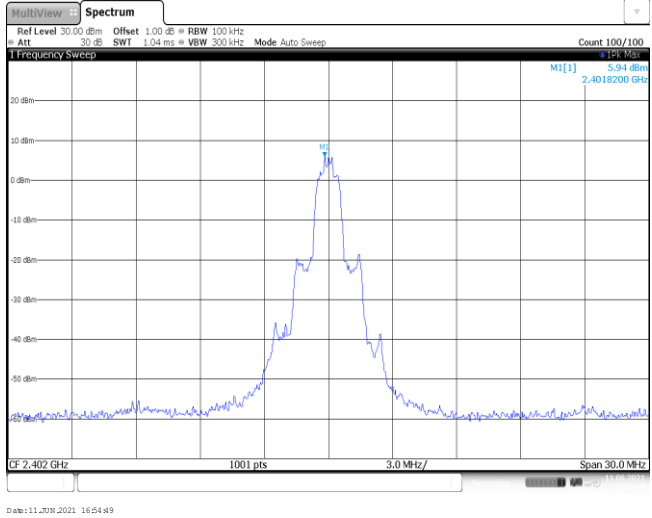
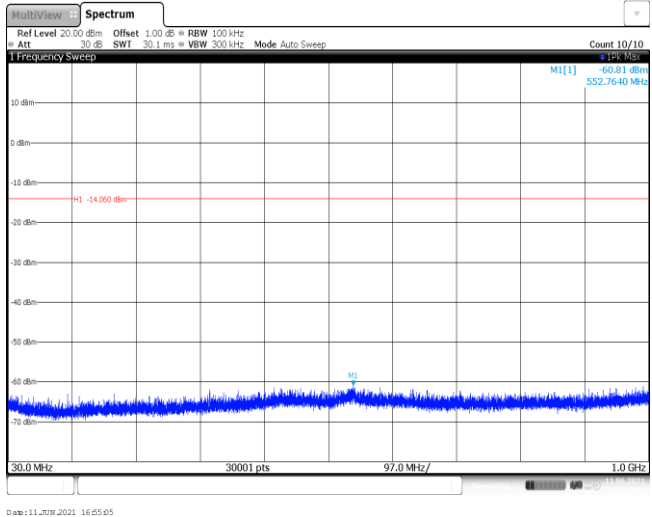
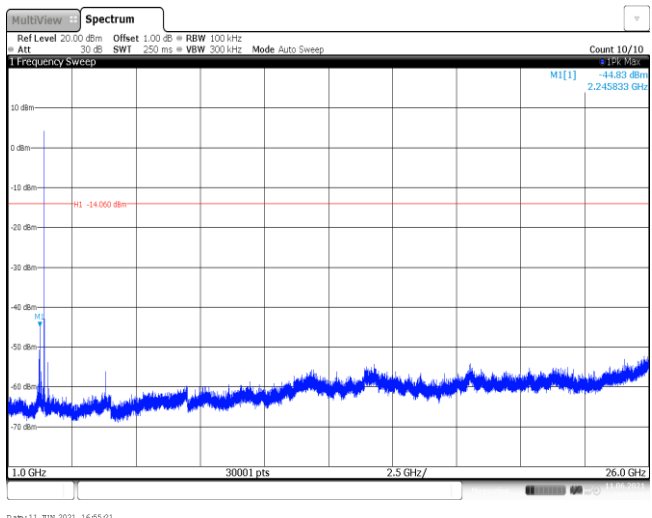


CH78
30MHz~1000MHz

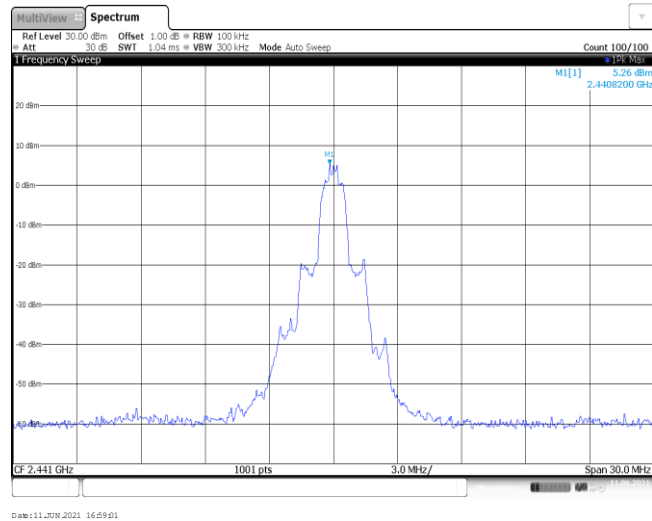


CH78
1GHz~26GHz

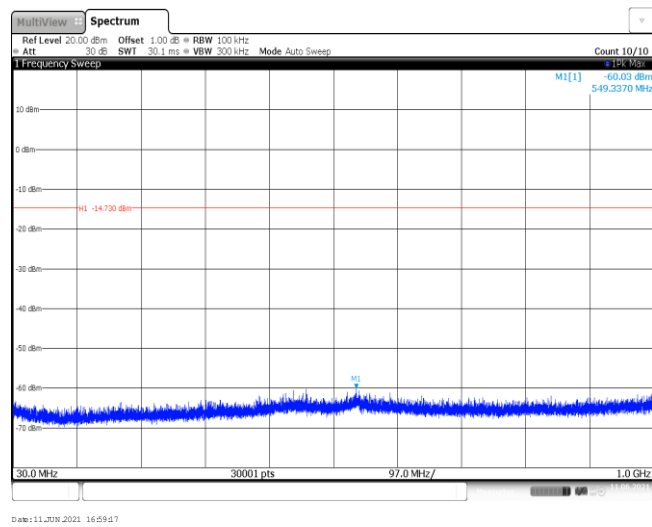


Test Item:	Spurious Emission	Modulation type:	8DPSK
CH00 Reference level			
CH00 30MHz~1000MHz			
CH00 1GHz~26GHz			

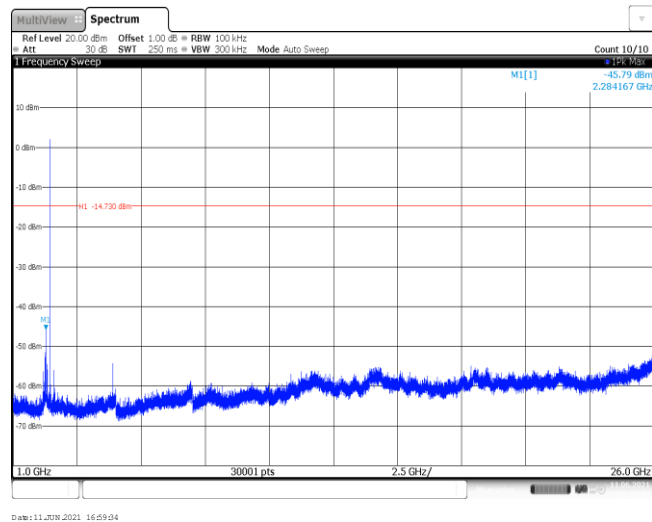
CH39
Reference level



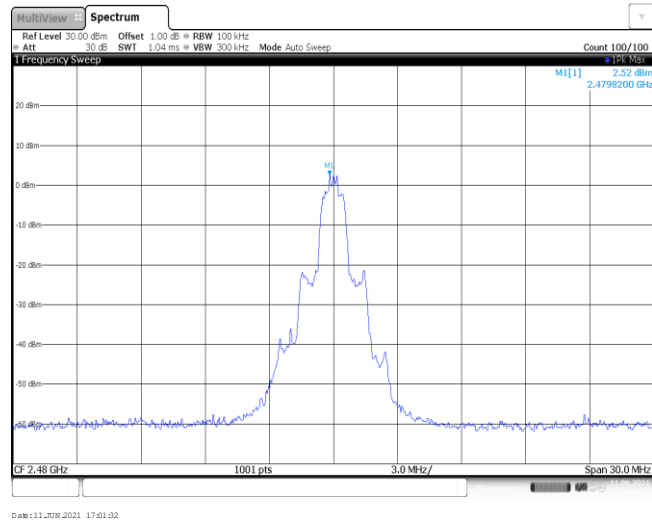
CH39
30MHz~1000MHz



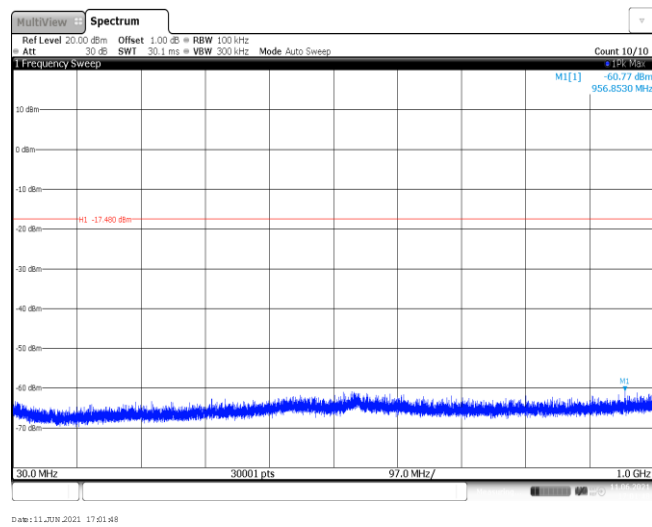
CH39
1GHz~26GHz



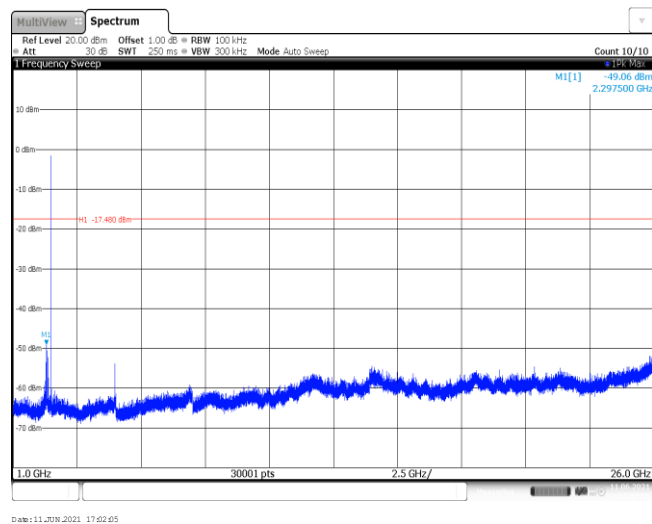
CH78
Reference level



CH78
30MHz~1000MHz



CH78
1GHz~26GHz



-----End of Report-----