

Between 1GHz – 25GHz

Polar (H/V)	Frequency	Reading Level	Correct Factor	Measure- ment	Limits	Over	Detector Type
	(MHz)	(dBuV/m)	(dB)	(dBuV/m)	(dBuV/ m)	(dB)	
GFSK Low channel							
V	4804.00	52.92	-0.43	52.49	74.00	-21.51	PK
V	4804.00	43.39	-0.43	42.96	54.00	-11.04	AV
V	7206.00	43.42	8.31	51.73	74.00	-22.27	PK
V	7206.00	33.82	8.31	42.13	54.00	-11.87	AV
H	4804.00	48.01	-0.43	47.58	74.00	-26.42	PK
H	4804.00	37.37	-0.43	36.94	54.00	-17.06	AV
H	7206.00	42.28	8.31	50.59	74.00	-23.41	PK
H	7206.00	33.49	8.31	41.80	54.00	-12.20	AV
GFSK Middle channel							
V	4880.00	51.70	-0.38	51.32	74.00	-22.68	PK
V	4880.00	45.51	-0.38	45.13	54.00	-8.87	AV
V	7320.00	41.73	8.83	50.56	74.00	-23.44	PK
V	7320.00	32.91	8.83	41.74	54.00	-12.26	AV
H	4880.00	49.85	-0.38	49.47	74.00	-24.53	PK
H	4880.00	38.98	-0.38	38.60	54.00	-15.40	AV
H	7320.00	39.98	8.83	48.81	74.00	-25.19	PK
H	7320.00	32.02	8.83	40.85	54.00	-13.15	AV
GFSK High channel							
V	4960.00	54.45	-0.32	54.13	74.00	-19.87	PK
V	4960.00	44.58	-0.32	44.26	54.00	-9.74	AV
V	7440.00	47.81	9.35	57.16	74.00	-16.84	PK
V	7440.00	37.32	9.35	46.67	54.00	-7.33	AV
H	4960.00	53.17	-0.32	52.85	74.00	-21.15	PK
H	4960.00	43.76	-0.32	43.44	54.00	-10.56	AV
H	7440.00	45.26	9.35	54.61	74.00	-19.39	PK
H	7440.00	36.28	9.35	45.63	54.00	-8.37	AV

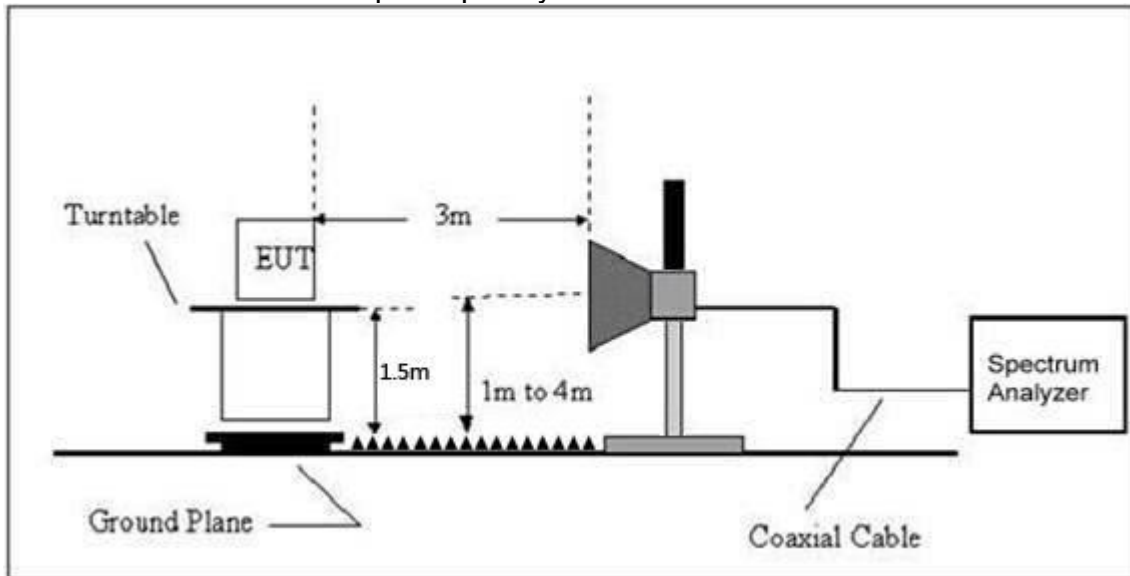
Remark:

1. Emission Level = Meter Reading + Factor,
Factor = Antenna Factor + Cable Loss – Pre-amplifier.
Over = Emission Level - Limit
2. If peak below the average limit, the average emission was no test.
3. In restricted bands of operation, The spurious emissions below the permissible value more than 20dB
4. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.
5. All the Modulation are test, the worst mode is GFSK, the data recording in the report.

8. RADIATED BAND EMISSION MEASUREMENT AND RESTRICTED BANDS OF OPERATION

8.1 Block Diagram Of Test Setup

Radiated Emission Test-Up Frequency Above 1GHz



8.2 Limit

FCC Part15 C Section 15.209 and 15.205

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090-0.110	16.42-16.423	399.9-410	4.5-5.15
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.215-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2690-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	(2)
13.36-13.41			

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

FREQUENCY (MHz)	Limit (dBuV/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.

(2) The tighter limit applies at the band edges.

(3) Emission level (dBuV/m) = $20 \log$ Emission level (uV/m).

8.3 Test procedure

Receiver Parameter	Setting
Attenuation	Auto
Start Frequency	2300MHz
Stop Frequency	2520
RB / VB (emission in restricted band)	1 MHz / 1 MHz for Peak, 1 MHz / 1/T Hz for Average

Above 1GHz test procedure as below:

a. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. Test the EUT in the lowest channel, the Highest channel.

Note:

Both horizontal and vertical antenna polarities were tested and performed pretest to three orthogonal axis. The worst case emissions were reported.

8.4 EUT operating Conditions

The EUT was configured for testing in a typical fashion (as a customer would normally use it). The EUT has been programmed to continuously transmit during test. This operating condition was tested and used to collect the included data.

8.5 Test Result

	Polar (H/V)	Frequency (MHz)	Reading Level (dBuV/m)	Correct Factor (dB)	Measure- ment (dBuV/m)	Limits (dBuV/m)		Result
					PK	PK	AV	
GFSK	Low Channel 2402MHz							
	H	2390.00	56.84	-6.70	50.14	74.00	54.00	PASS
	H	2400.00	48.93	-6.71	42.22	74.00	54.00	PASS
	V	2390.00	57.62	-6.70	50.92	74.00	54.00	PASS
	V	2400.00	49.05	-6.71	42.34	74.00	54.00	PASS
	High Channel 2480MHz							
	H	2483.50	55.53	-6.79	48.74	74.00	54.00	PASS
	H	2485.00	49.25	-6.81	42.44	74.00	54.00	PASS
	V	2483.50	56.53	-6.79	49.74	74.00	54.00	PASS
	V	2485.00	47.77	-6.81	40.96	74.00	54.00	PASS
Pi/4DQPSK	Low Channel 2402MHz							
	H	2390.00	58.00	-6.70	51.30	74.00	54.00	PASS
	H	2400.00	50.92	-6.71	44.21	74.00	54.00	PASS
	V	2390.00	57.92	-6.70	51.22	74.00	54.00	PASS
	V	2400.00	50.32	-6.71	43.61	74.00	54.00	PASS
	High Channel 2480MHz							
	H	2483.50	57.50	-6.79	50.71	74.00	54.00	PASS
	H	2485.00	49.33	-6.81	42.52	74.00	54.00	PASS
	V	2483.50	56.36	-6.79	49.57	74.00	54.00	PASS
	V	2485.00	47.81	-6.81	41.00	74.00	54.00	PASS

Remark:

1. Emission Level = Meter Reading + Factor,
Factor = Antenna Factor + Cable Loss – Pre-amplifier.
Over= Emission Level - Limit
2. If the PK measured levels comply with average limit, then the average level were deemed to comply with average limit.
- 3 In restricted bands of operation, The spurious emissions below the permissible value more than 20dB
4. The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

9. CONDUCTED EMISSION

9.1 Block Diagram Of Test Setup



9.2 Limit

Regulation 15.247 (d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c))

9.3 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:

Below 1GHz:

RBW = 100kHz, VBW = 300kHz, Sweep = auto

Detector function = peak, Trace = max hold

Above 1GHz:

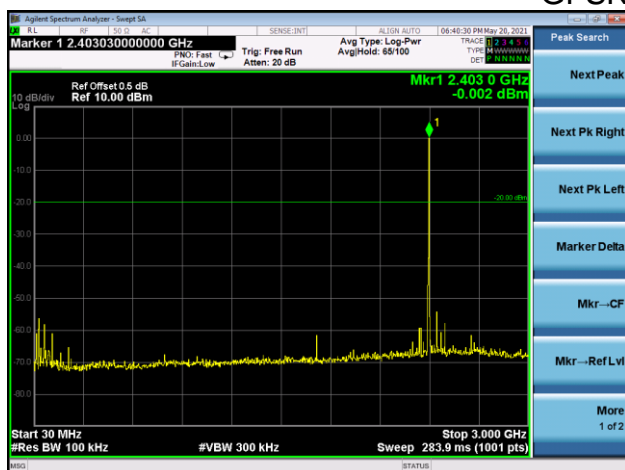
RBW = 1MHz, VBW = 3MHz, Sweep = auto

Detector function = peak, Trace = max hold

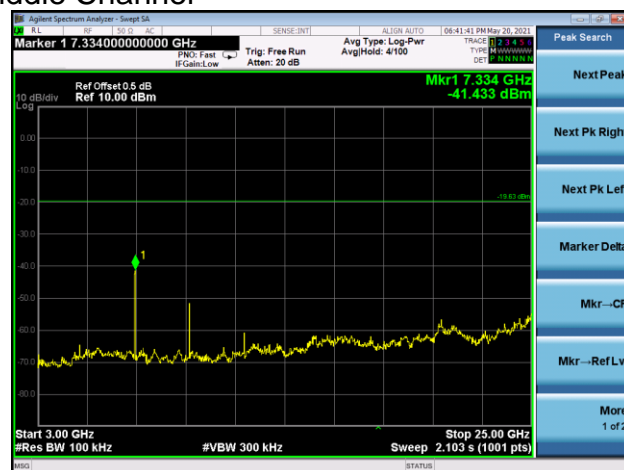
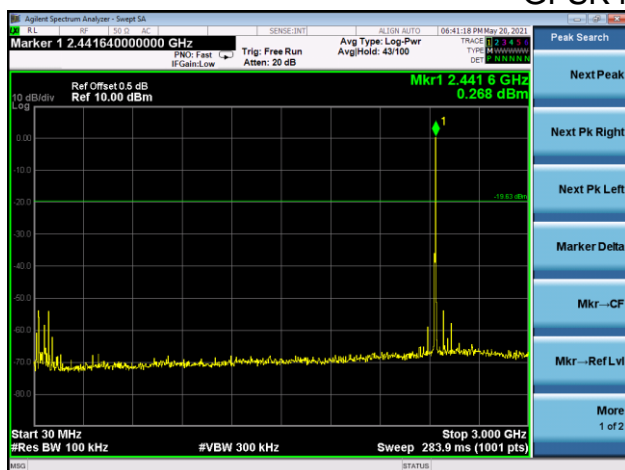
9.4 Test Result

Temperature :	26°C	Relative Humidity :	54%
Test Voltage :	DC 3.7V	Remark:	N/A

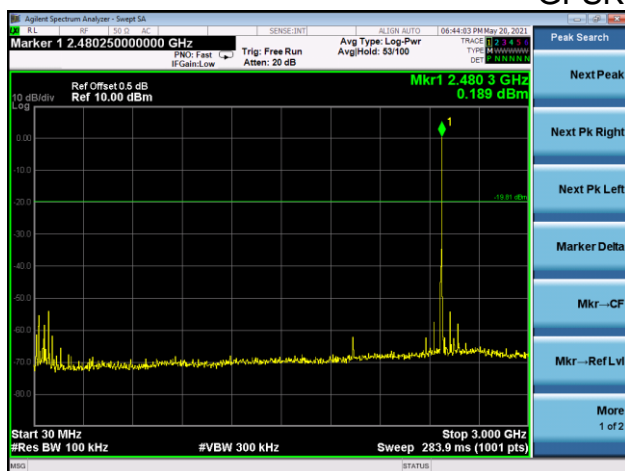
30MHz – 25GHz GFSK Low Channel



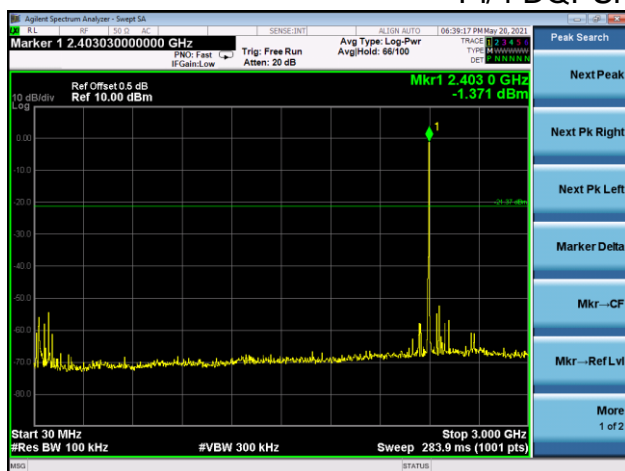
GFSK Middle Channel



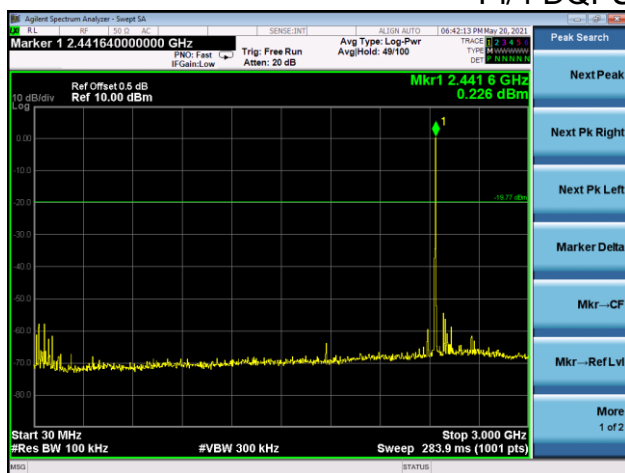
GFSK High Channel



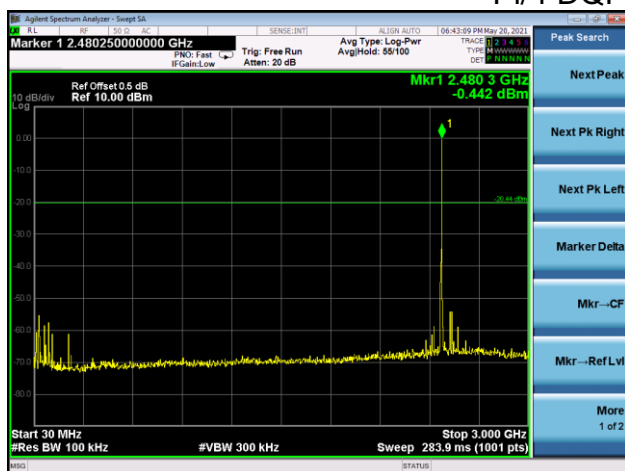
Pi/4 DQPSK Low Channel



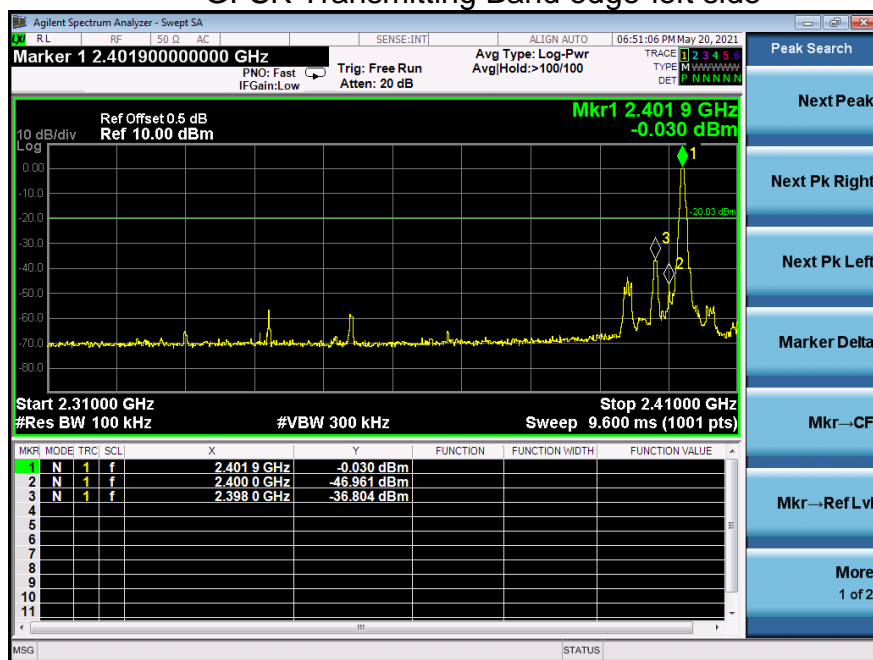
Pi/4 DQPSK Middle Channel



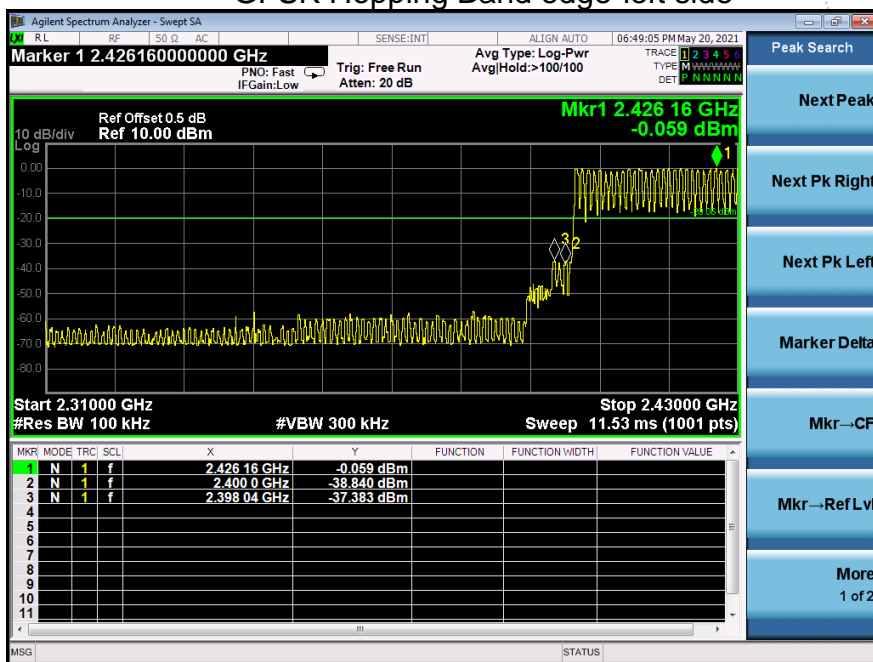
Pi/4 DQPSK High Channel



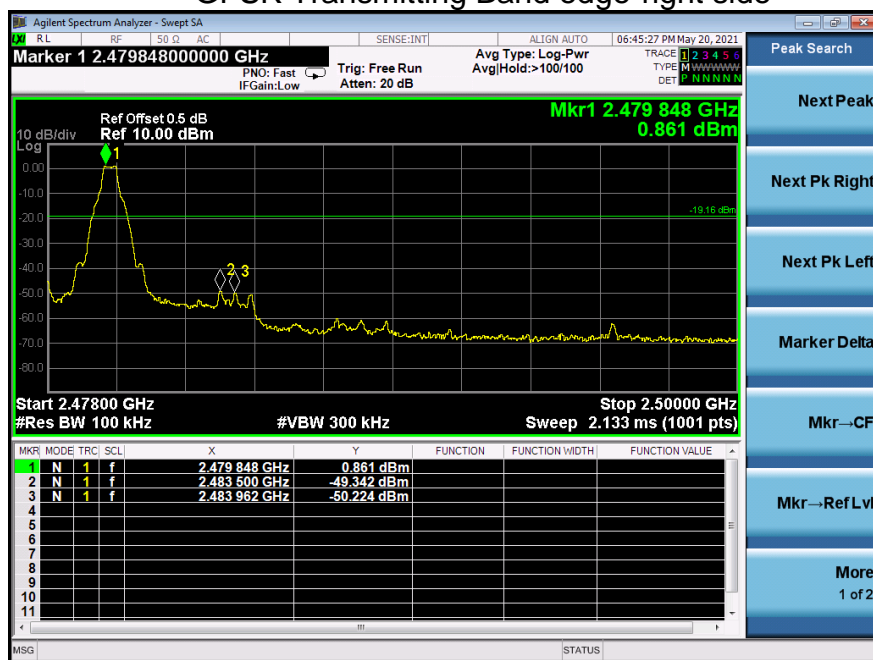
GFSK Transmitting Band edge-left side



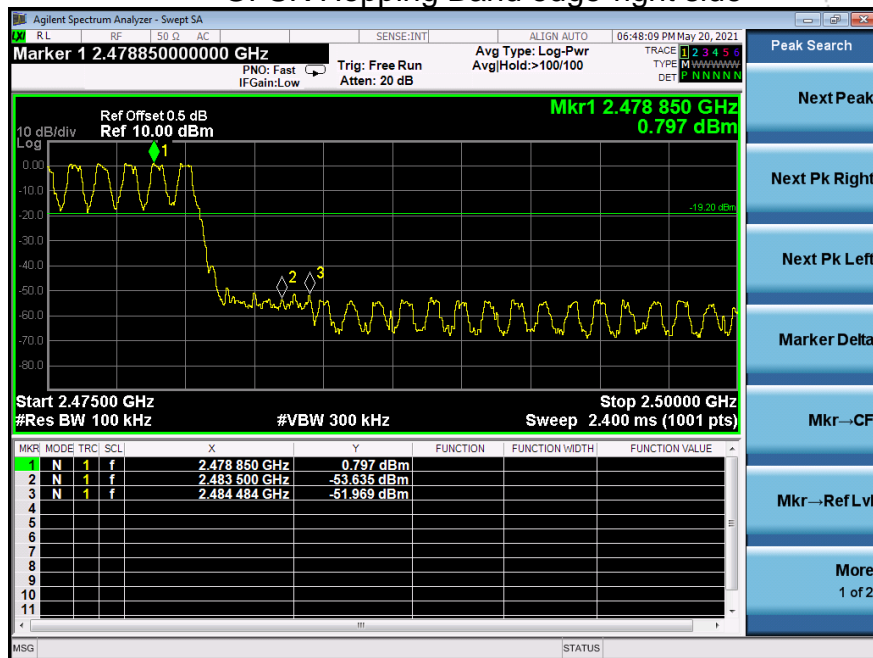
GFSK Hopping Band edge-left side



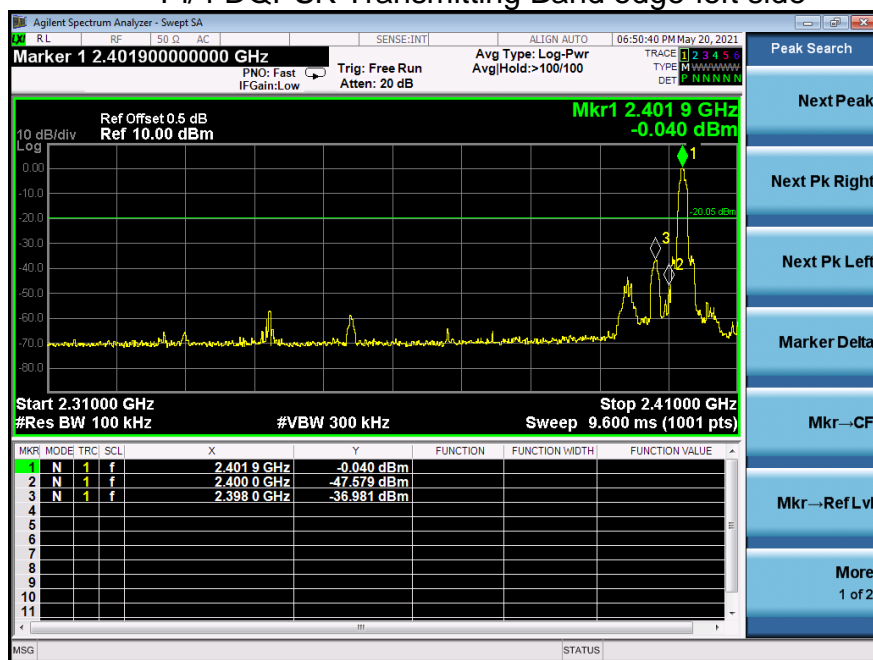
GFSK Transmitting Band edge-right side



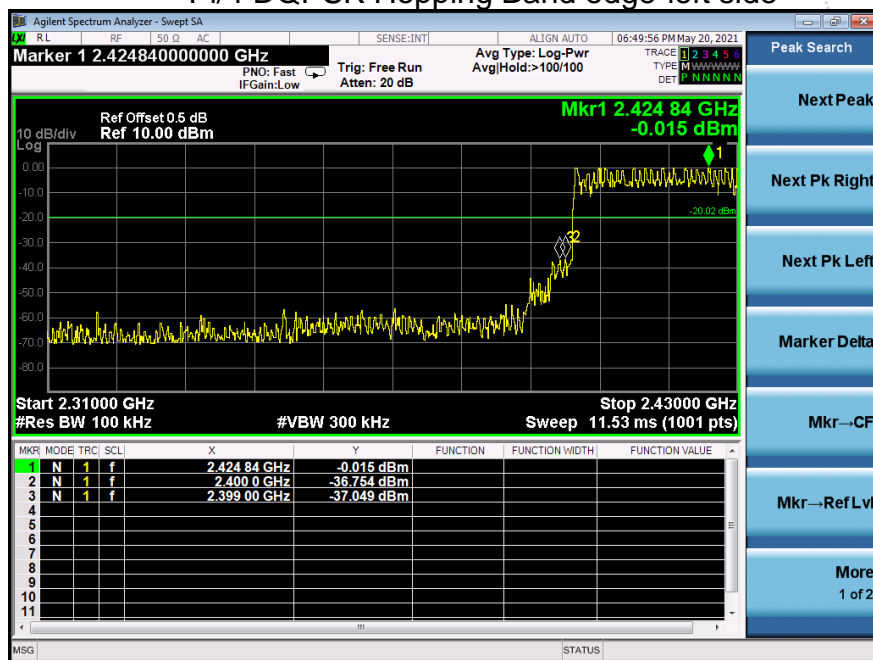
GFSK Hopping Band edge-right side



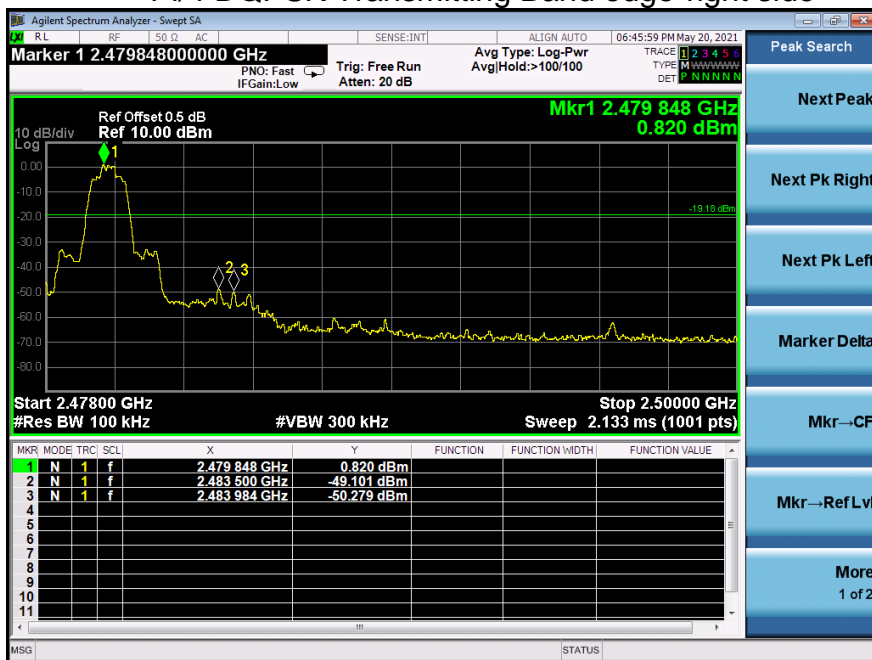
Pi/4 DQPSK Transmitting Band edge-left side



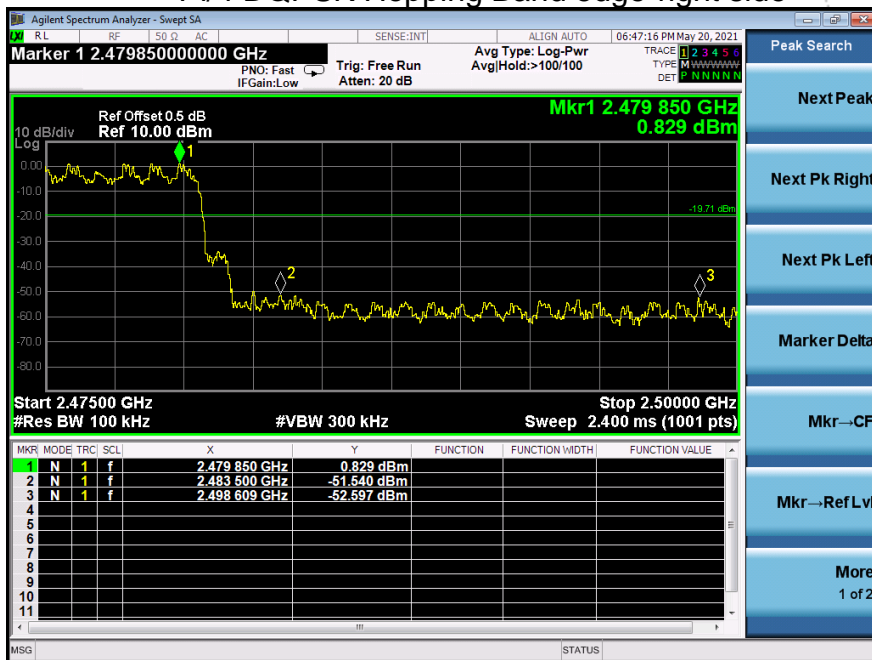
Pi/4 DQPSK Hopping Band edge-left side



Pi/4 DQPSK Transmitting Band edge-right side



Pi/4 DQPSK Hopping Band edge-right side



10. 20 DB BANDWIDTH

10.1 Block Diagram Of Test Setup



10.2 Limit

N/A

10.3 Test procedure

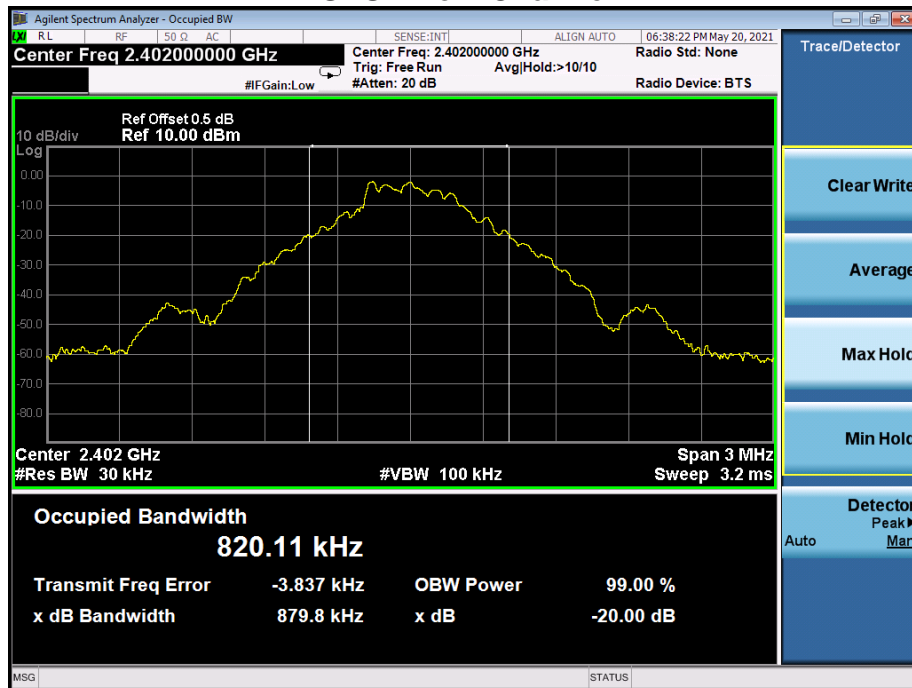
1. Set RBW = 30kHz.
2. Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission. .

10.4 Test Result

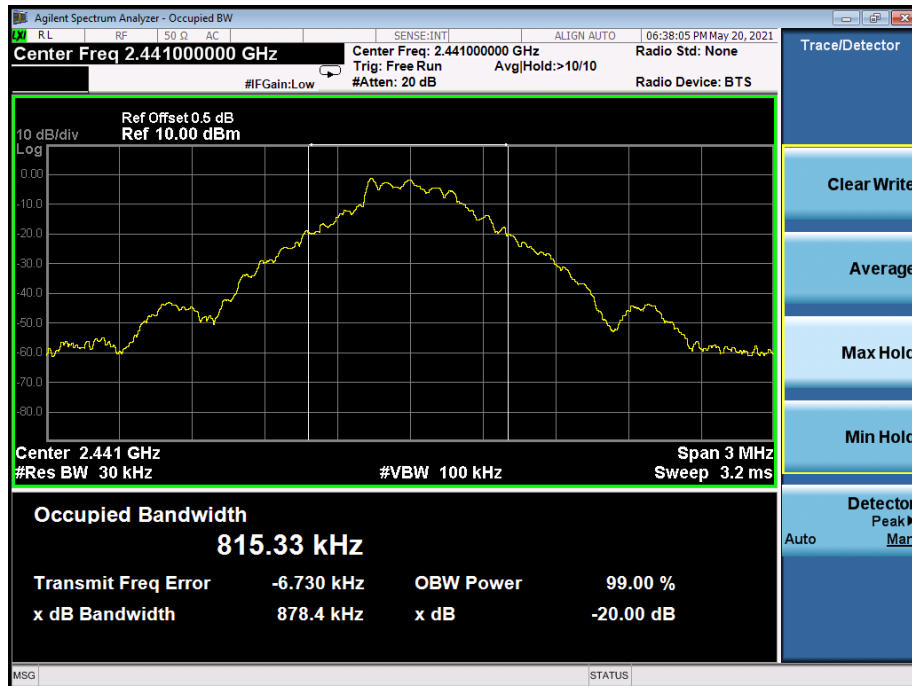
Temperature :	26°C	Relative Humidity :	54%
Test Voltage :	DC 3.7V	Remark	N/A

Modulation	Test Channel	Bandwidth(MHz)
GFSK	Low	0.880
GFSK	Middle	0.878
GFSK	High	0.877
Pi/4 DQPSK	Low	1.230
Pi/4 DQPSK	Middle	1.234
Pi/4 DQPSK	High	1.234

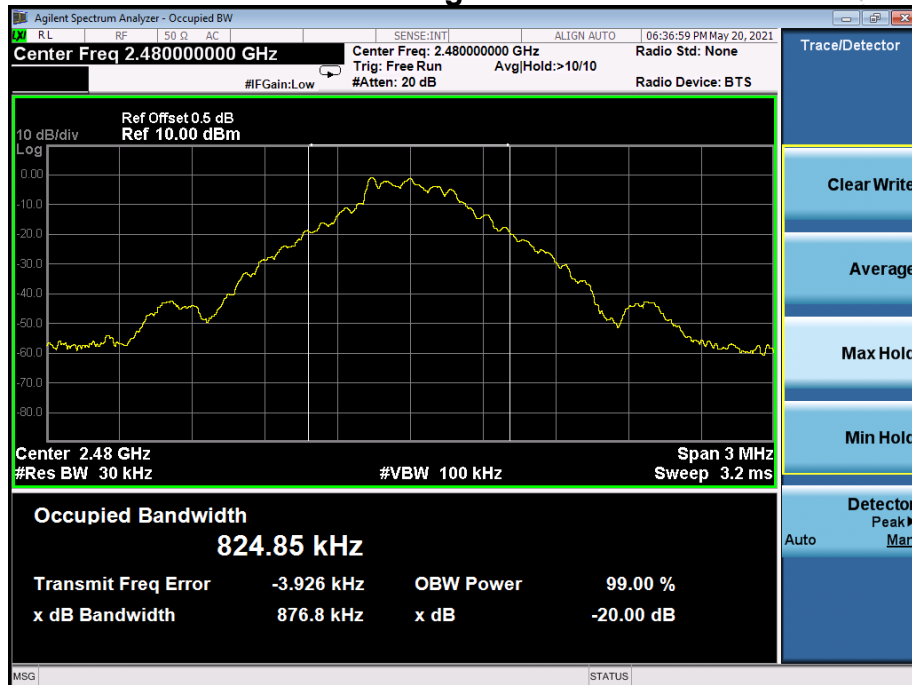
Test plots GFSK Low Channel



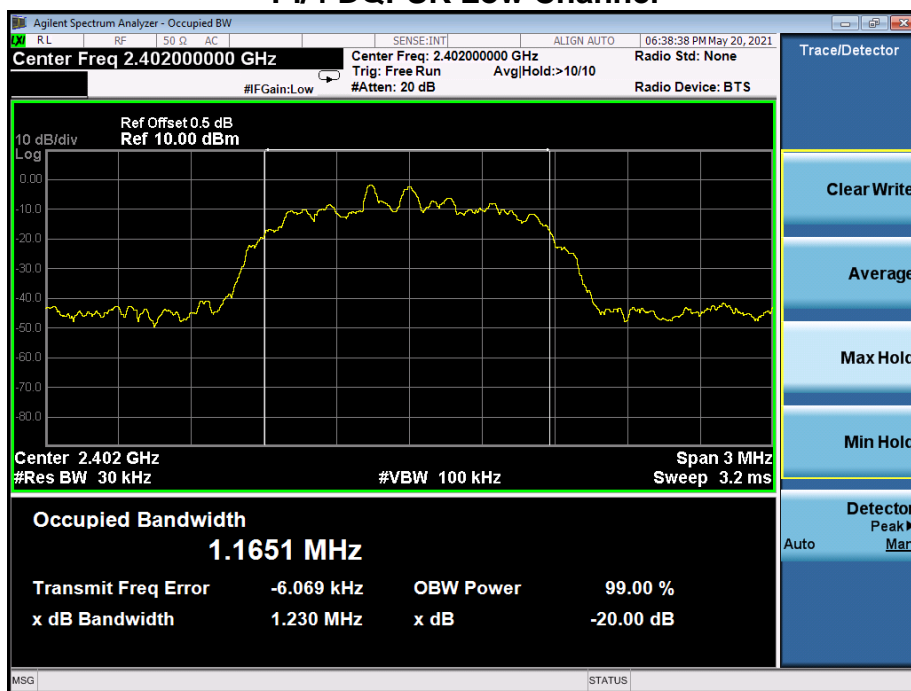
GFSK Middle Channel



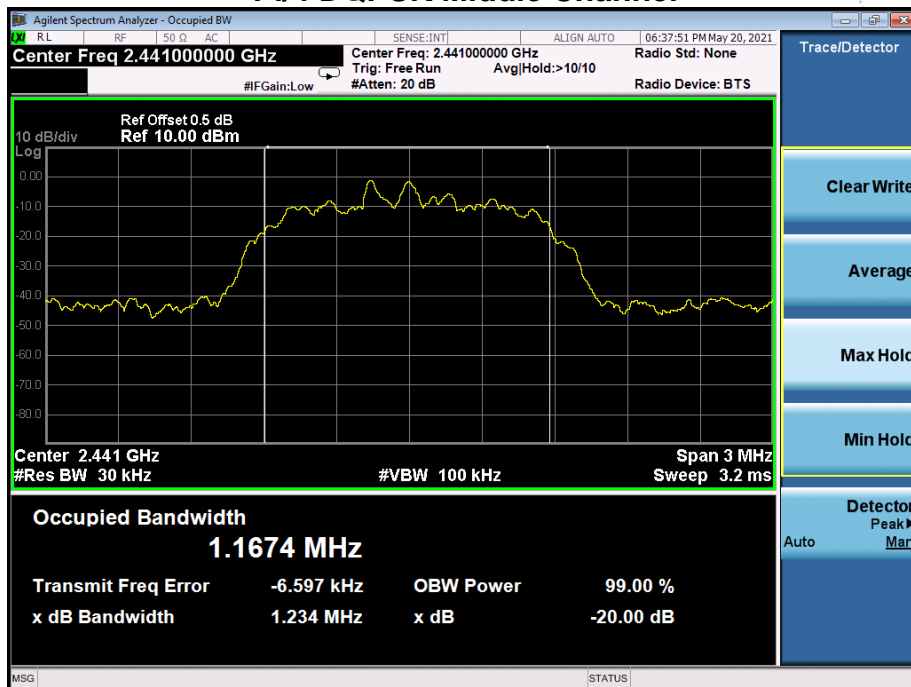
GFSK High Channel



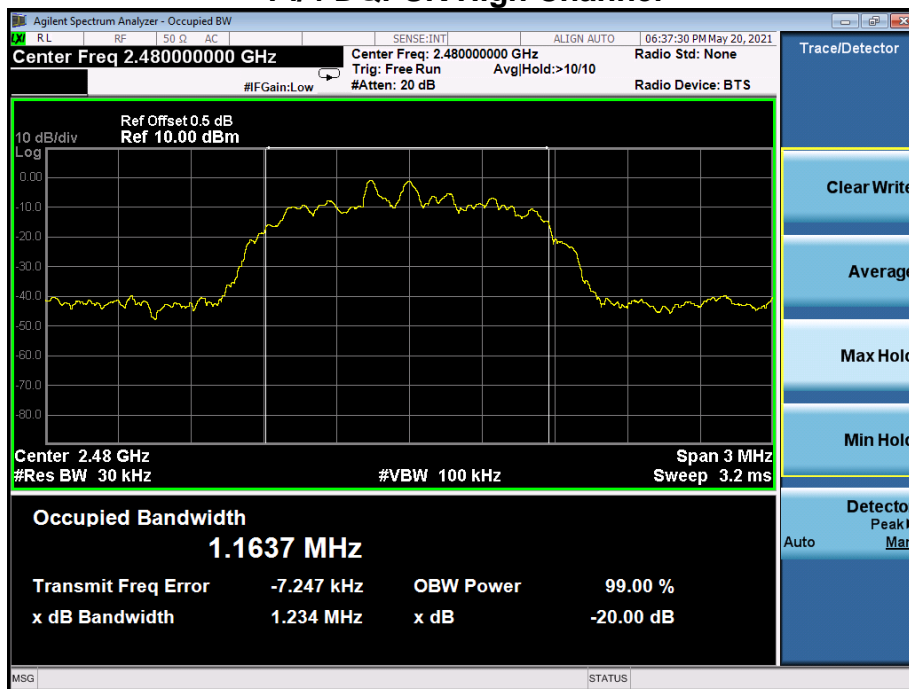
Pi/4 DQPSK Low Channel



Pi/4 DQPSK Middle Channel



Pi/4 DQPSK High Channel



11. MAXIMUM PEAK OUTPUT POWER

11.1 Block Diagram Of Test Setup



11.2 Limit

FCC Part15 (15.247), Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(1)	Peak Output Power	0.125 watt or 21dBm	2400-2483.5	PASS

11.3 Test procedure

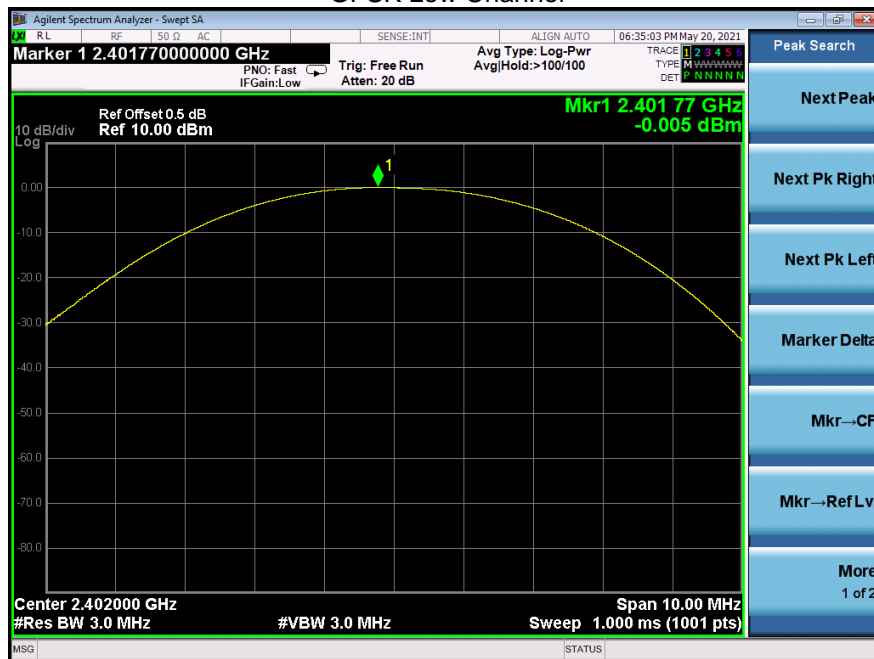
1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 3MHz. VBW = 3MHz. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

11.4 Test Result

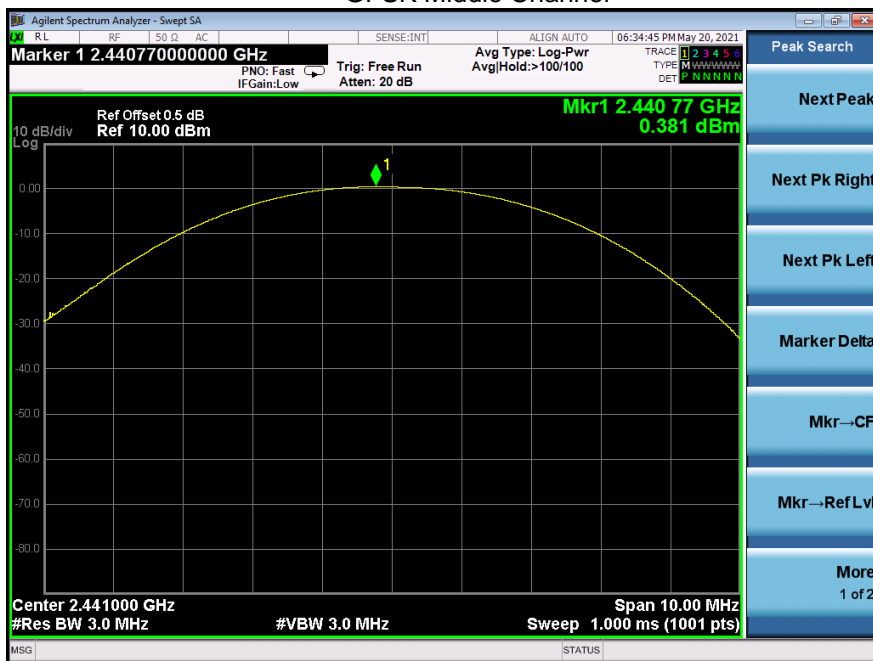
Temperature :	26°C	Relative Humidity :	54%
Test Voltage :	DC 3.7V	Remark:	N/A

Modulation	Test Channel	Output Power (dBm)	Limit (dBm)
GFSK	Low	-0.005	21
GFSK	Middle	0.381	21
GFSK	High	0.826	21
Pi/4 DQPSK	Low	0.756	21
Pi/4 DQPSK	Middle	1.127	21
Pi/4 DQPSK	High	1.499	21

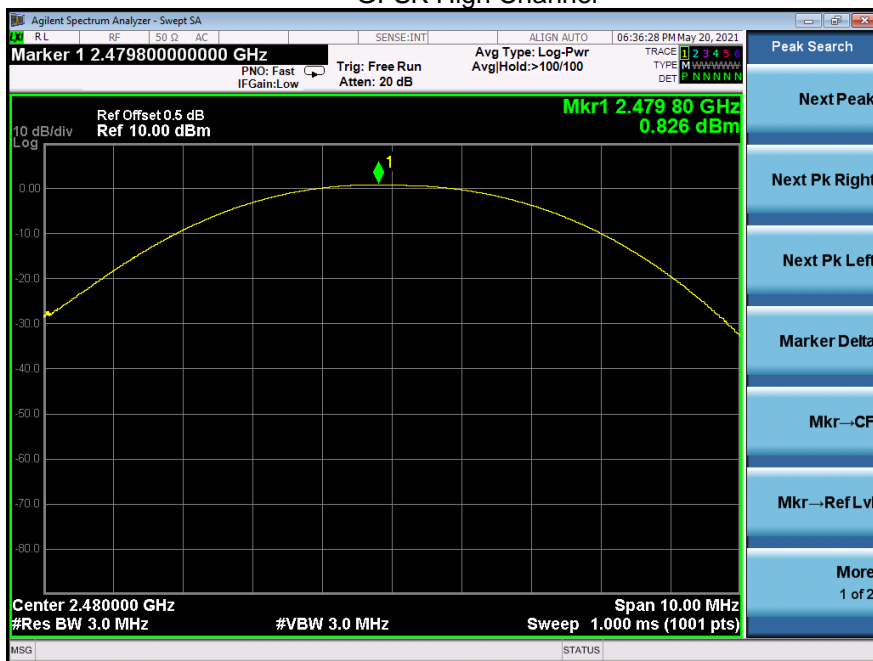
Test plots
GFSK Low Channel



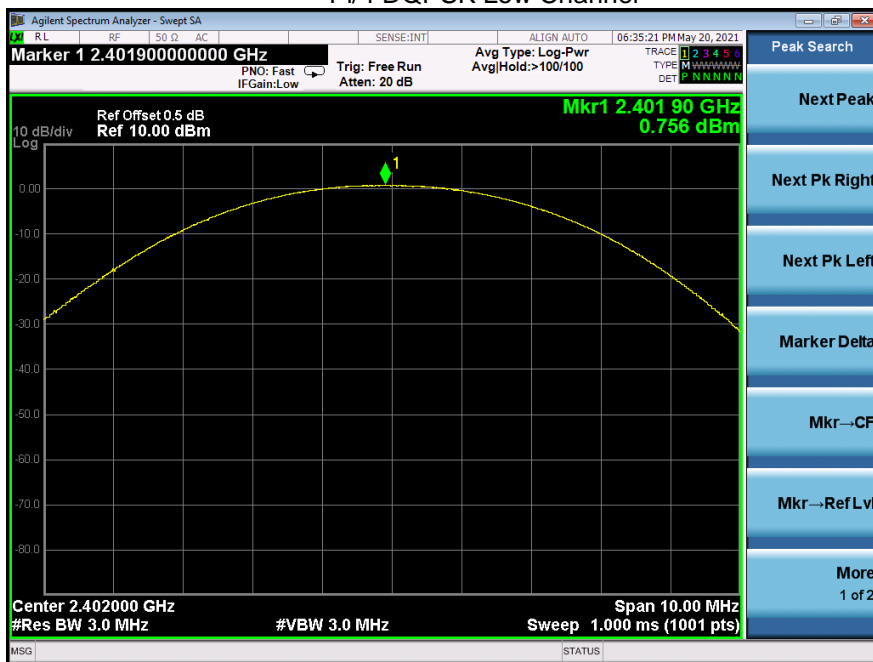
GFSK Middle Channel



GFSK High Channel



Pi/4 DQPSK Low Channel



Pi/4 DQPSK Middle Channel

