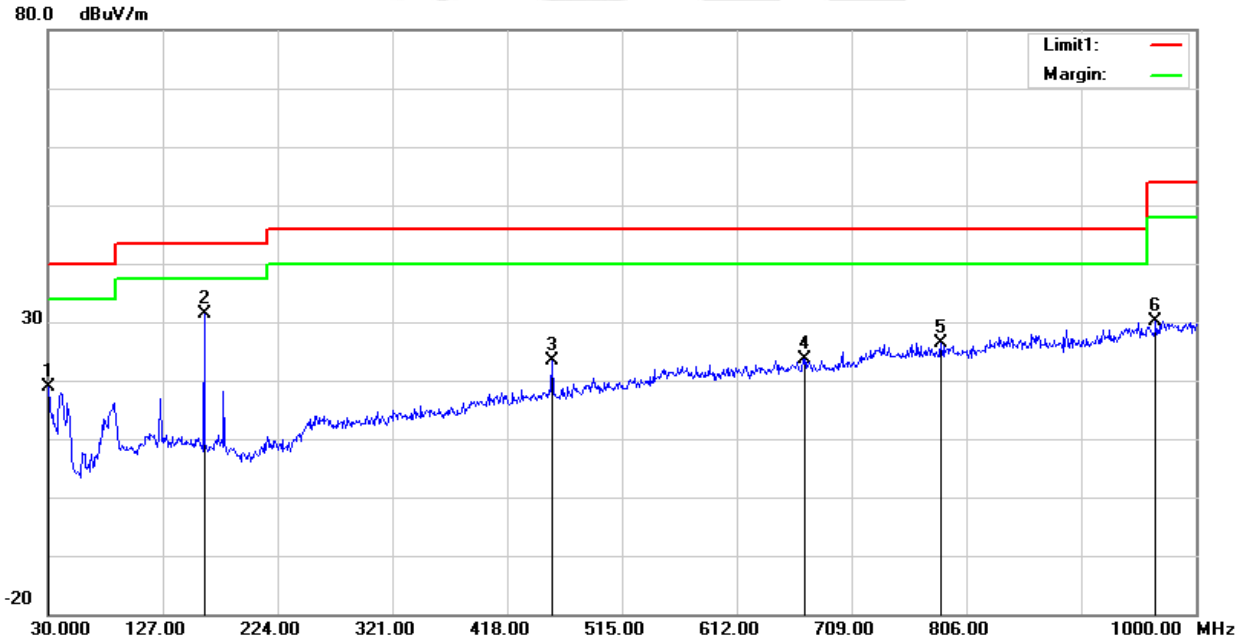
(30MHz-1000MHz)

Temperature:	23.1(C)	Relative Humidity:	60%RH
Test Voltage:	DC 3.85V	Phase:	Horizontal
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 1 worst mode)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	30.9700	32.11	-13.35	18.76	40.00	-21.24	peak
2	161.9200	50.49	-19.01	31.48	43.50	-12.02	peak
3	455.8300	32.88	-9.55	23.33	46.00	-22.67	peak
4	669.2300	28.29	-4.60	23.69	46.00	-22.31	peak
5	784.6600	28.59	-2.10	26.49	46.00	-19.51	peak
6	966.0500	28.22	1.90	30.12	54.00	-23.88	peak

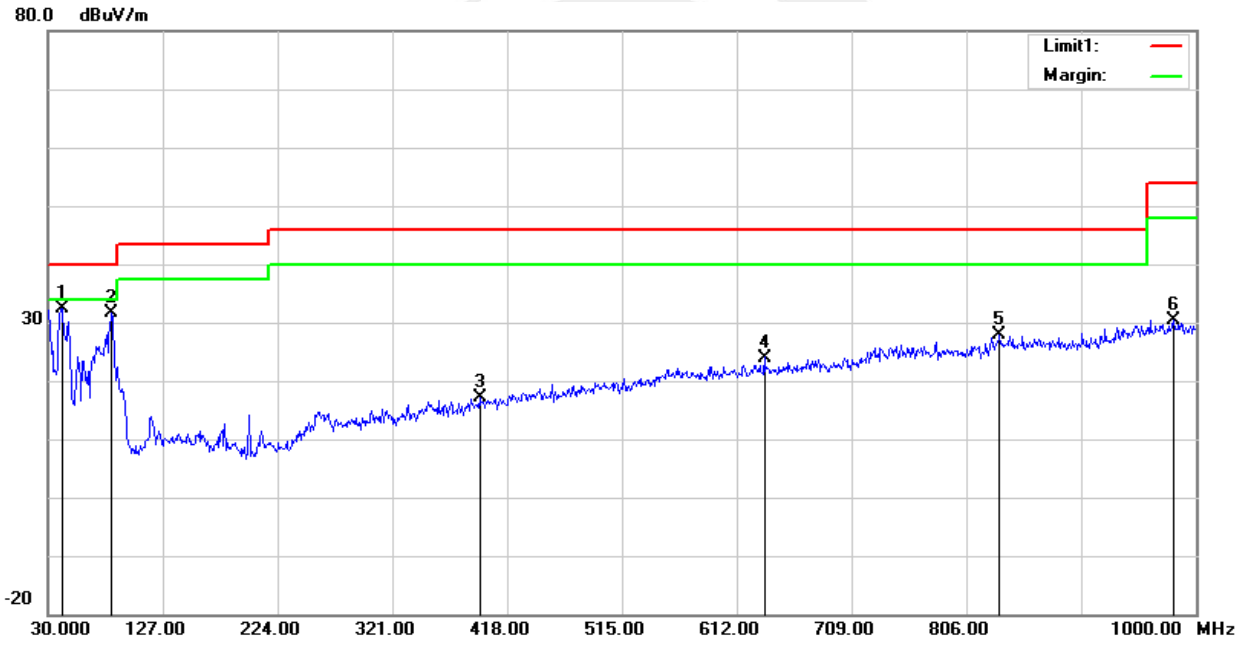
Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



Temperature:	23.1(C)	Relative Humidity:	60%RH
Test Voltage:	DC 3.85V	Phase:	Vertical
Test Mode:	Mode 1/2/3/4/5/6/7/8/9(Mode 1 worst mode)		

No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	41.6400	51.26	-18.93	32.33	40.00	-7.67	peak
2	83.3500	54.16	-22.52	31.64	40.00	-8.36	peak
3	394.7200	28.62	-11.38	17.24	46.00	-28.76	peak
4	635.2800	28.93	-4.93	24.00	46.00	-22.00	peak
5	834.1300	28.39	-0.59	27.80	46.00	-18.20	peak
6	980.6000	27.80	2.63	30.43	54.00	-23.57	peak

Remark:
1. Margin = Result (Result =Reading + Factor)–Limit
2. Factor= Antenna factor+Cable attenuation factor(cable loss)-Amplifier gain



(1GHz~25GHz) Spurious emission Requirements

Frequency	Meter Reading	Amplifier	Loss	Antenna Factor	Corrected Factor	Emission Level	Limits	Margin	Detector	Comment
(MHz)	(dBμV)	(dB)	(dB)	(dB/m)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	Type	
Low Channel (GFSK/2402 MHz)										
3264.77	61.77	44.70	6.70	28.20	-9.80	51.97	74.00	-22.03	PK	Vertical
3264.77	51.16	44.70	6.70	28.20	-9.80	41.36	54.00	-12.64	AV	Vertical
3264.57	60.91	44.70	6.70	28.20	-9.80	51.11	74.00	-22.89	PK	Horizontal
3264.57	51.12	44.70	6.70	28.20	-9.80	41.32	54.00	-12.68	AV	Horizontal
4804.34	59.33	44.20	9.04	31.60	-3.56	55.77	74.00	-18.23	PK	Vertical
4804.34	49.79	44.20	9.04	31.60	-3.56	46.23	54.00	-7.77	AV	Vertical
4804.47	59.35	44.20	9.04	31.60	-3.56	55.79	74.00	-18.21	PK	Horizontal
4804.47	49.53	44.20	9.04	31.60	-3.56	45.97	54.00	-8.03	AV	Horizontal
5359.86	48.48	44.20	9.86	32.00	-2.34	46.14	74.00	-27.86	PK	Vertical
5359.86	39.59	44.20	9.86	32.00	-2.34	37.25	54.00	-16.75	AV	Vertical
5359.68	48.48	44.20	9.86	32.00	-2.34	46.14	74.00	-27.86	PK	Horizontal
5359.68	38.46	44.20	9.86	32.00	-2.34	36.12	54.00	-17.88	AV	Horizontal
7205.78	54.99	43.50	11.40	35.50	3.40	58.39	74.00	-15.61	PK	Vertical
7205.78	44.47	43.50	11.40	35.50	3.40	47.87	54.00	-6.13	AV	Vertical
7205.77	53.67	43.50	11.40	35.50	3.40	57.07	74.00	-16.93	PK	Horizontal
7205.77	43.63	43.50	11.40	35.50	3.40	47.03	54.00	-6.97	AV	Horizontal
Middle Channel (GFSK/2441 MHz)										
3264.83	62.28	44.70	6.70	28.20	-9.80	52.48	74.00	-21.52	PK	Vertical
3264.83	51.36	44.70	6.70	28.20	-9.80	41.56	54.00	-12.44	AV	Vertical
3264.71	61.18	44.70	6.70	28.20	-9.80	51.38	74.00	-22.62	PK	Horizontal
3264.71	49.86	44.70	6.70	28.20	-9.80	40.06	54.00	-13.94	AV	Horizontal
4882.41	58.69	44.20	9.04	31.60	-3.56	55.13	74.00	-18.87	PK	Vertical
4882.41	50.39	44.20	9.04	31.60	-3.56	46.83	54.00	-7.17	AV	Vertical
4882.34	59.18	44.20	9.04	31.60	-3.56	55.62	74.00	-18.38	PK	Horizontal
4882.34	50.34	44.20	9.04	31.60	-3.56	46.78	54.00	-7.22	AV	Horizontal
5359.62	48.99	44.20	9.86	32.00	-2.34	46.65	74.00	-27.35	PK	Vertical
5359.62	39.81	44.20	9.86	32.00	-2.34	37.46	54.00	-16.54	AV	Vertical
5359.59	47.65	44.20	9.86	32.00	-2.34	45.31	74.00	-28.69	PK	Horizontal
5359.59	39.13	44.20	9.86	32.00	-2.34	36.78	54.00	-17.22	AV	Horizontal
7323.86	53.59	43.50	11.40	35.50	3.40	56.99	74.00	-17.01	PK	Vertical
7323.86	43.74	43.50	11.40	35.50	3.40	47.14	54.00	-6.86	AV	Vertical
7323.85	53.60	43.50	11.40	35.50	3.40	57.00	74.00	-17.00	PK	Horizontal
7323.85	43.86	43.50	11.40	35.50	3.40	47.26	54.00	-6.74	AV	Horizontal

High Channel (GFSK/2480 MHz)										
3264.79	61.93	44.70	6.70	28.20	-9.80	52.13	74.00	-21.87	PK	Vertical
3264.79	50.73	44.70	6.70	28.20	-9.80	40.93	54.00	-13.07	AV	Vertical
3264.64	60.89	44.70	6.70	28.20	-9.80	51.09	74.00	-22.91	PK	Horizontal
3264.64	50.49	44.70	6.70	28.20	-9.80	40.69	54.00	-13.31	AV	Horizontal
4960.33	58.25	44.20	9.04	31.60	-3.56	54.69	74.00	-19.31	PK	Vertical
4960.33	49.72	44.20	9.04	31.60	-3.56	46.16	54.00	-7.84	AV	Vertical
4960.37	59.39	44.20	9.04	31.60	-3.56	55.83	74.00	-18.17	PK	Horizontal
4960.37	49.50	44.20	9.04	31.60	-3.56	45.94	54.00	-8.06	AV	Horizontal
5359.60	48.09	44.20	9.86	32.00	-2.34	45.75	74.00	-28.25	PK	Vertical
5359.60	39.19	44.20	9.86	32.00	-2.34	36.85	54.00	-17.15	AV	Vertical
5359.81	47.65	44.20	9.86	32.00	-2.34	45.30	74.00	-28.70	PK	Horizontal
5359.81	38.18	44.20	9.86	32.00	-2.34	35.84	54.00	-18.16	AV	Horizontal
7439.76	53.73	43.50	11.40	35.50	3.40	57.13	74.00	-16.87	PK	Vertical
7439.76	43.89	43.50	11.40	35.50	3.40	47.29	54.00	-6.71	AV	Vertical
7439.82	54.94	43.50	11.40	35.50	3.40	58.34	74.00	-15.66	PK	Horizontal
7439.82	44.85	43.50	11.40	35.50	3.40	48.25	54.00	-5.75	AV	Horizontal

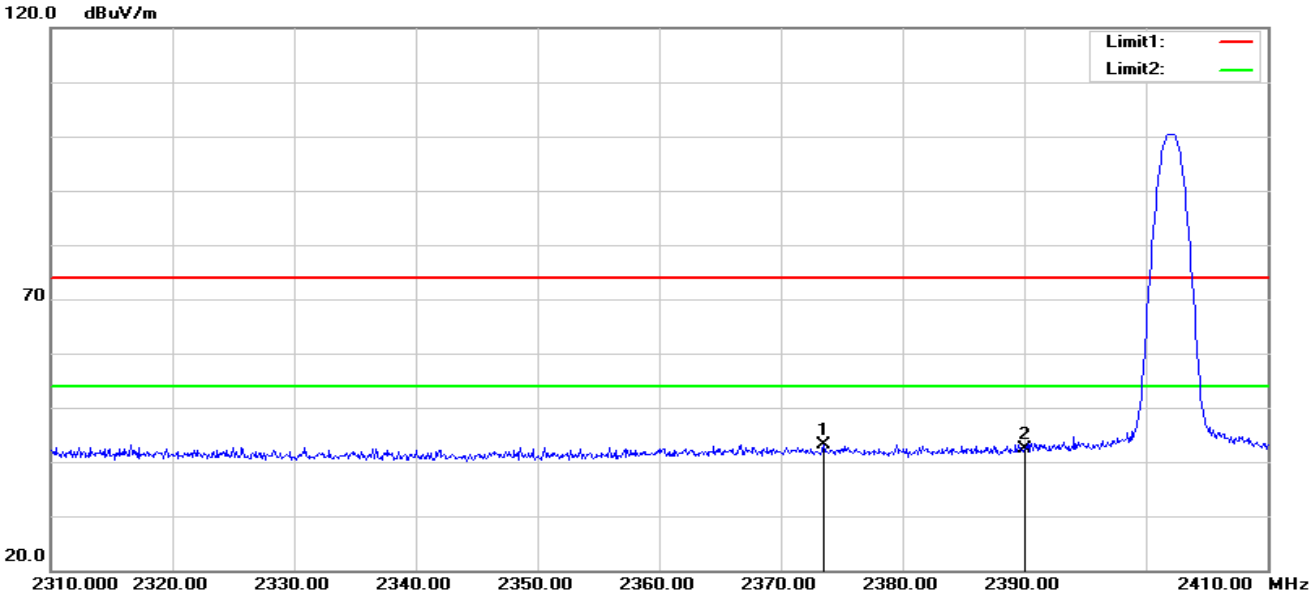
Note:

1) Scan with GFSK, π/4-DQPSK, 8DPSK, the worst case is GFSK Mode.
2) Factor = Antenna Factor + Cable Loss – Pre-amplifier.
   Emission Level = Reading + Factor
3) The frequency emission of peak points that did not show above the forms are at least 20dB below the limit, the frequency emission is mainly from the environment noise.

Restricted band Requirements

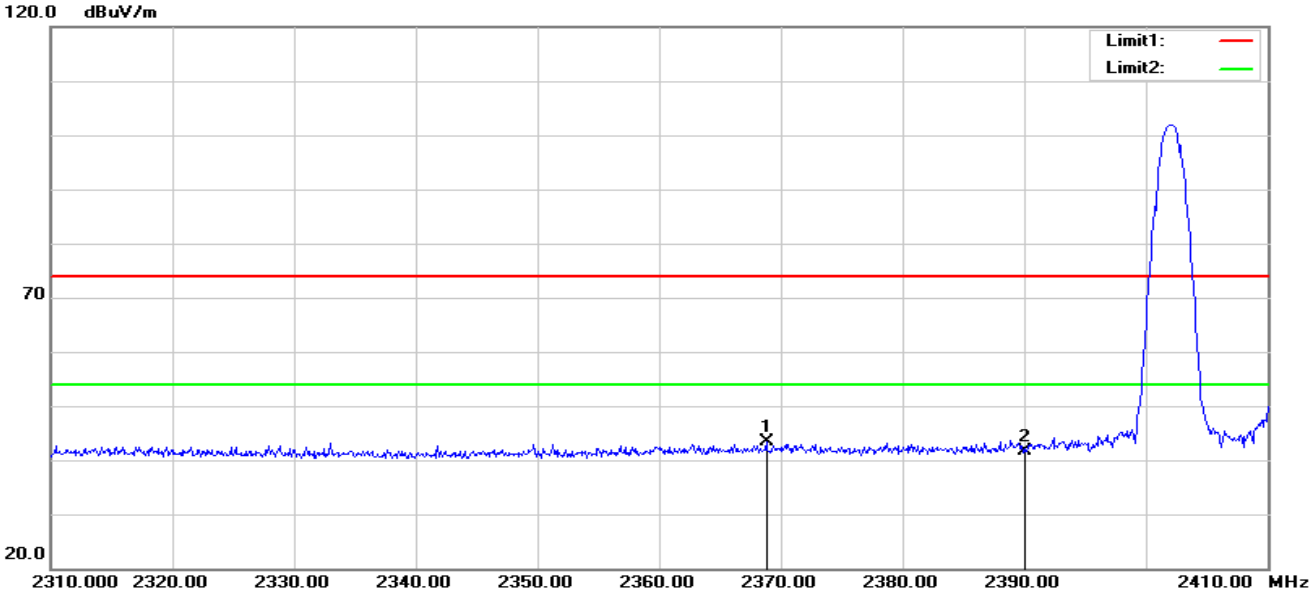
GFSK-Low

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2373.500	38.97	4.09	43.06	74.00	-30.94	peak
2	2390.000	38.09	4.34	42.43	74.00	-31.57	peak

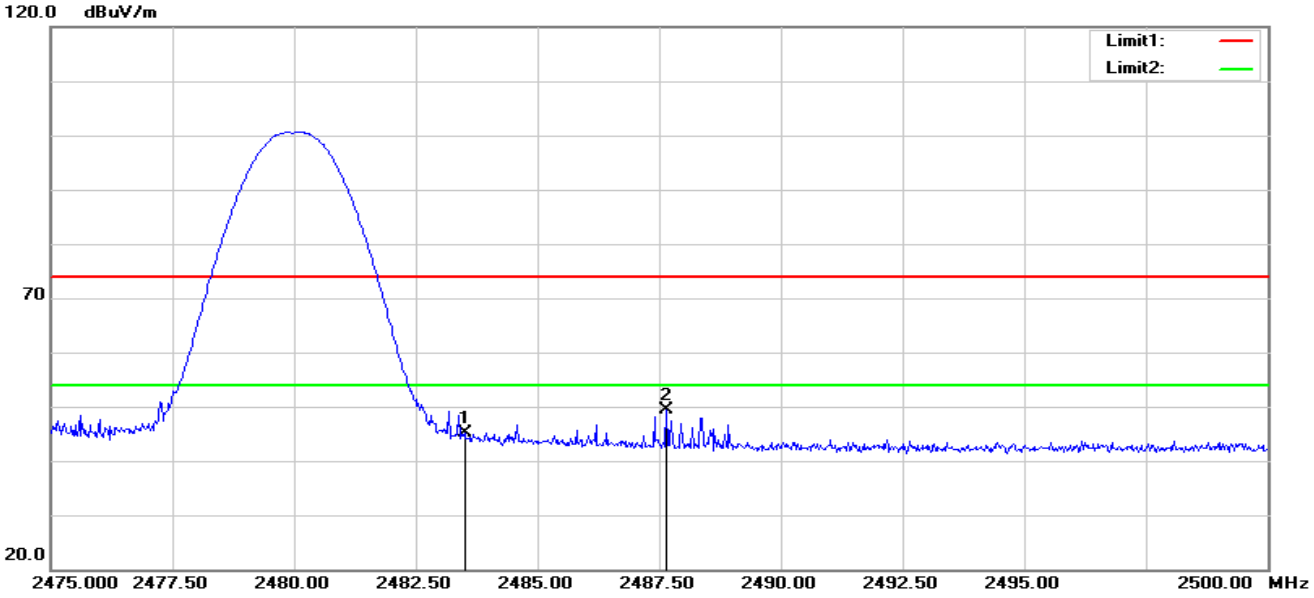
Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2368.800	39.43	4.02	43.45	74.00	-30.55	peak
2	2390.000	37.18	4.34	41.52	74.00	-32.48	peak

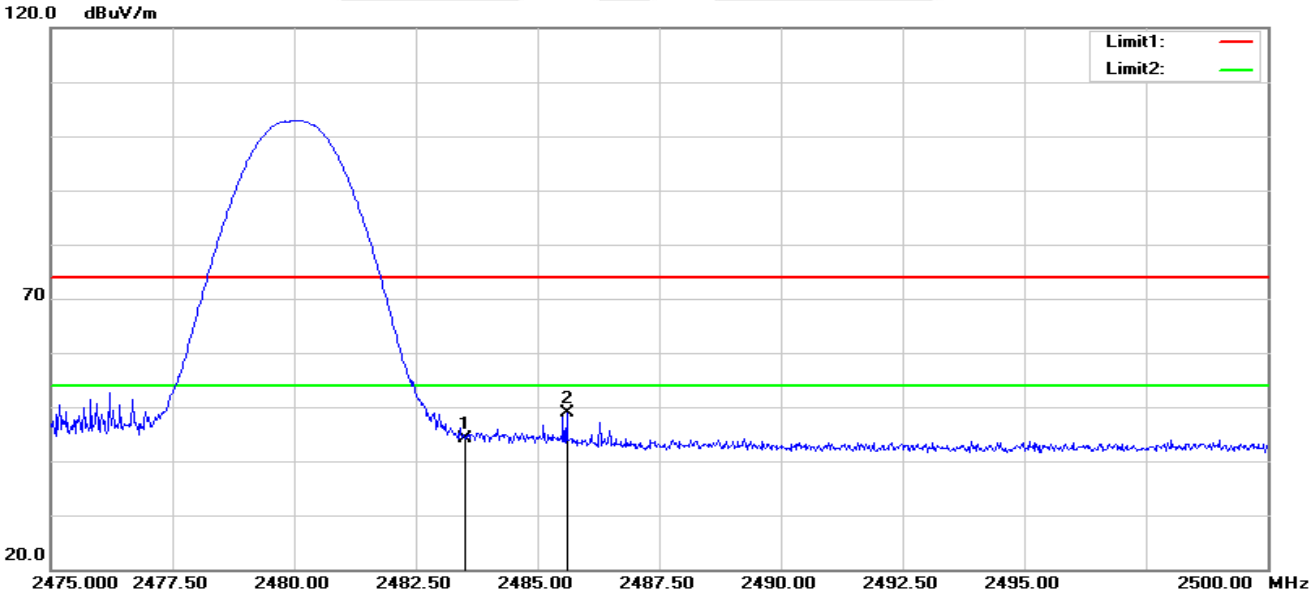
GFSK-High

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	40.55	4.60	45.15	74.00	-28.85	peak
2	2487.650	44.80	4.62	49.42	74.00	-24.58	peak

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
1	2483.500	39.52	4.60	44.12	74.00	-29.88	peak
2	2485.600	44.15	4.61	48.76	74.00	-25.24	peak

Note: GFSK, π/4-DQPSK, 8DPSK of the nohopping and hopping mode all have been test, the worst case is GFSK of the nohopping mode, this report only show the worst case.

4. CONDUCTED SPURIOUS & BAND EDGE EMISSION

4.1 LIMIT

According to FCC section 15.247(d), in any 100kHz 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 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

4.2 TEST PROCEDURE

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	30 MHz to 10th carrier harmonic
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

For Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 2300 – 2407 MHz Upper Band Edge: 2475 – 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

For Hopping Band edge

Spectrum Parameter	Setting
Detector	Peak
Start/Stop Frequency	Lower Band Edge: 2300– 2403 MHz Upper Band Edge: 2479 – 2500 MHz
RB / VB (emission in restricted band)	100 KHz/300 KHz
Trace-Mode:	Max hold

4.3 TEST SETUP

The EUT is connected to the Spectrum Analyzer; the RF load attached to the EUT antenna terminal is 50Ohm; the path loss as the factor is calibrated to correct the reading. Tune the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, the span is set to be greater than RBW.

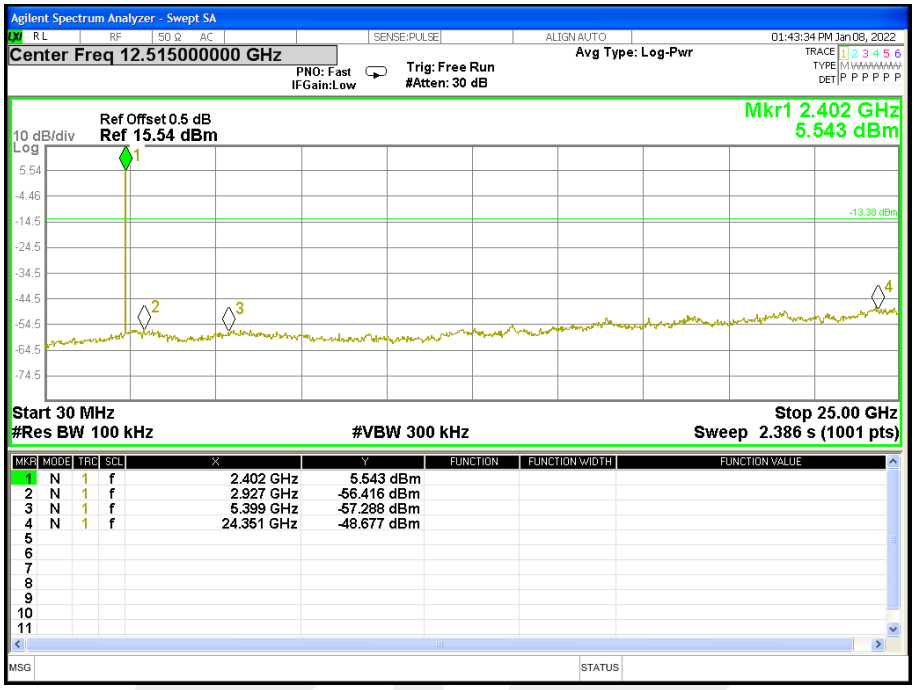
4.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

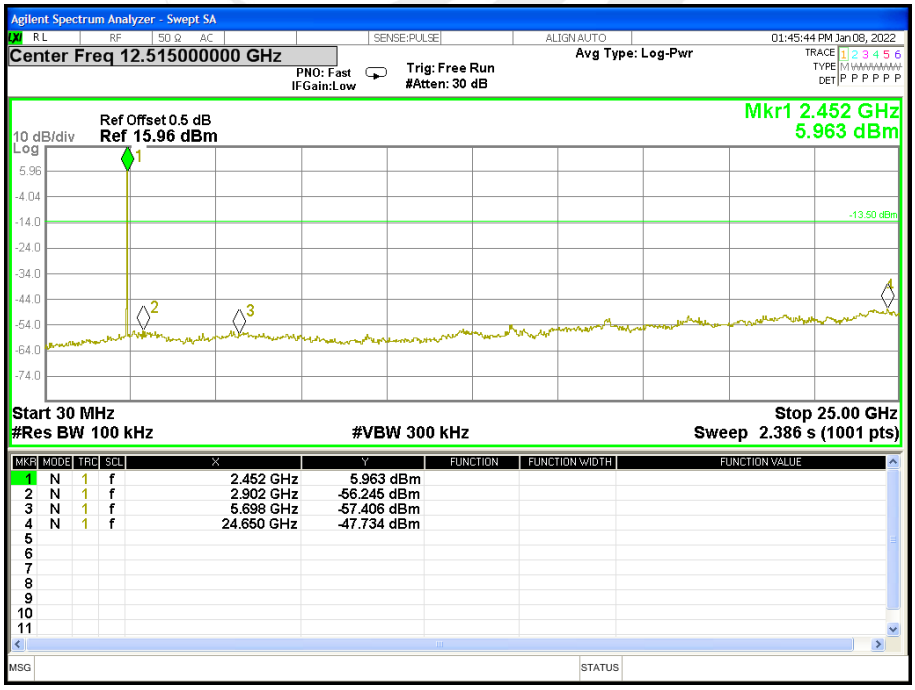
4.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	50%
Test Mode:	GFSK(1Mbps)-00/39/78 CH	Test Voltage:	DC 3.85V

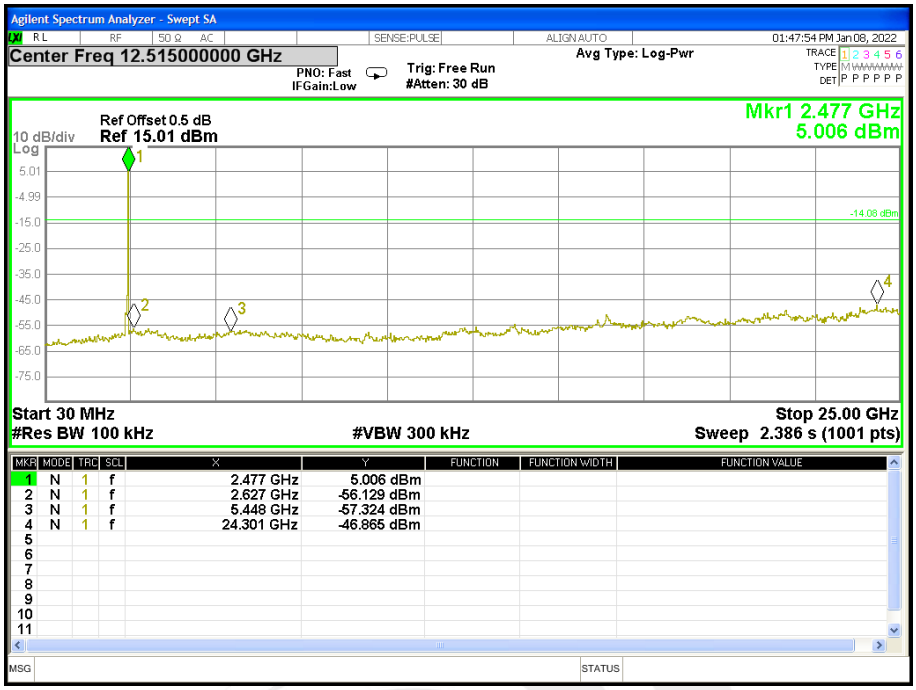
00 CH



39 CH

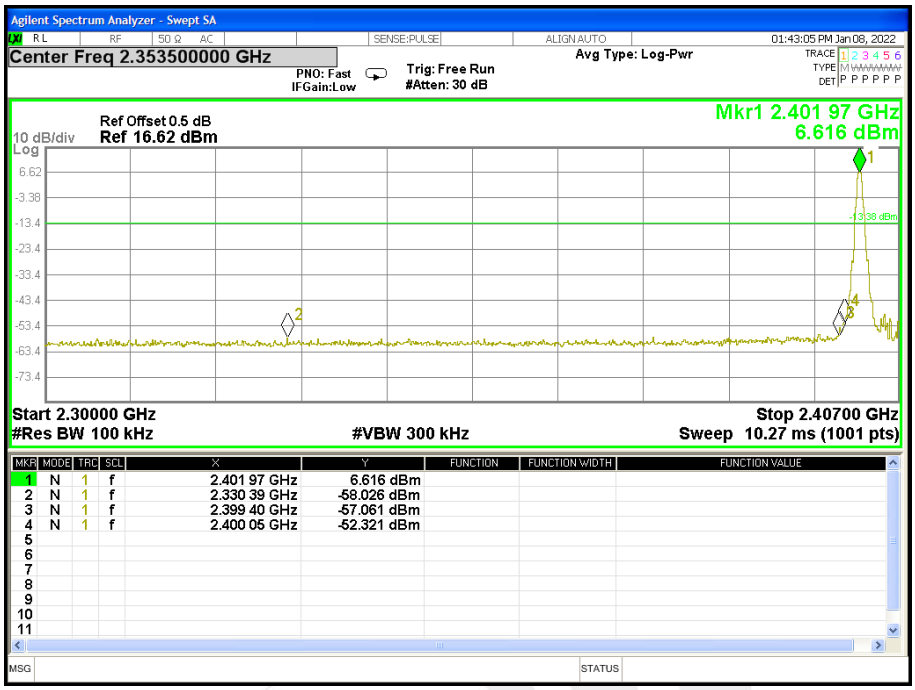


78 CH

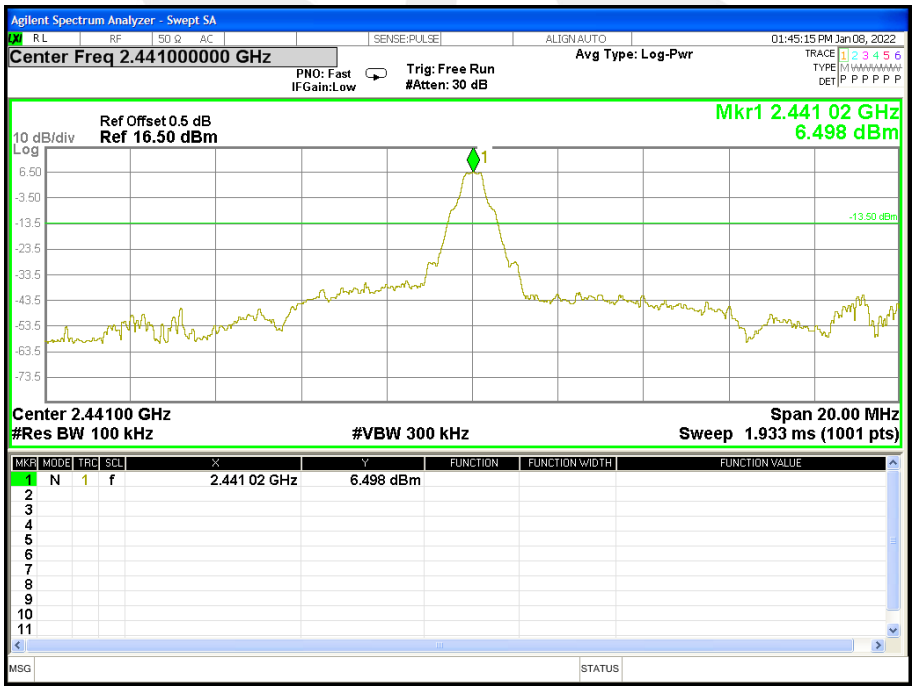

Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:PULSE
ALIGN AUTO
01:47:54 PM Jan 08, 2022
Center Freq 12.515000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE M
DET P P P P P
Ref Offset 0.5 dB
10 dB/div
Log
Ref 15.01 dBm
Mkr1 2.477 GHz
5.006 dBm
5.01
-4.99
-15.0
-25.0
-35.0
-45.0
-55.0
-65.0
-75.0
-14.08 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.386 s (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.477 GHz 5.006 dBm
2 N 1 f 2.627 GHz -56.129 dBm
3 N 1 f 5.448 GHz -57.324 dBm
4 N 1 f 24.301 GHz -46.865 dBm
5
6
7
8
9
10
11
MSG
STATUS

For Band edge(it's also the reference level for conducted spurious emission)

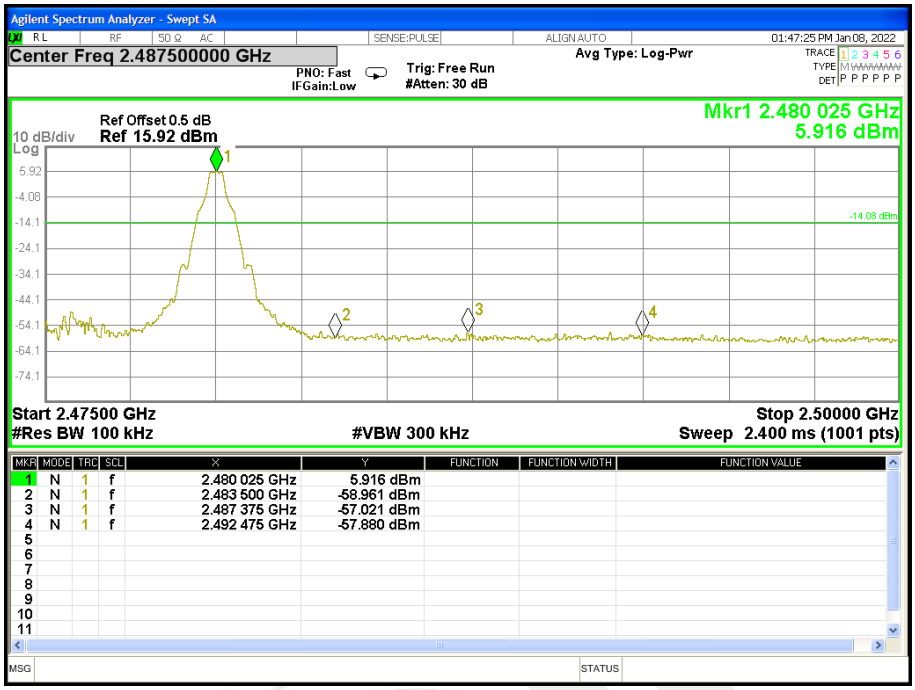
00 CH



39 CH

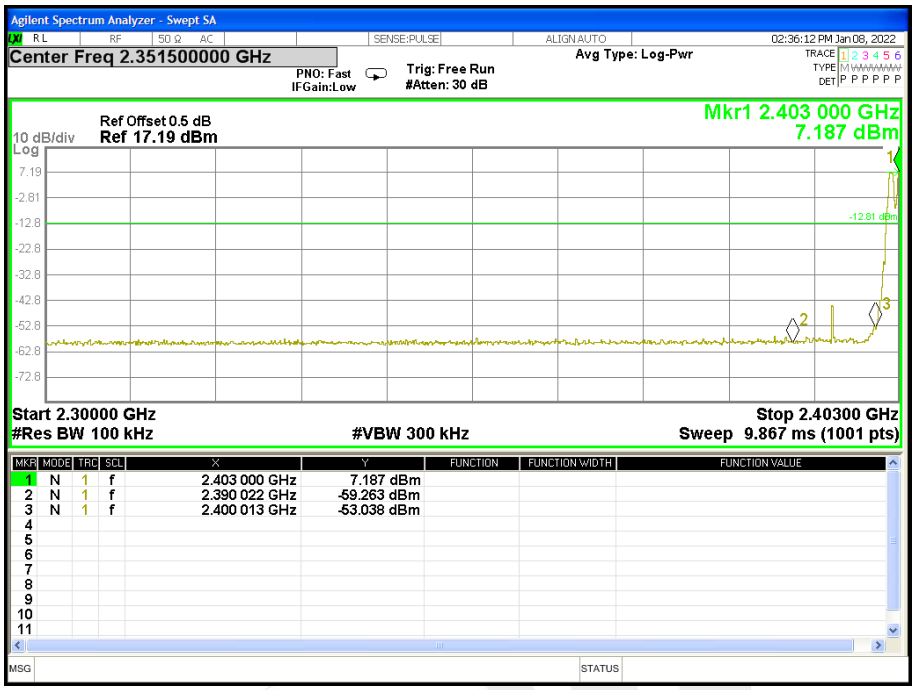


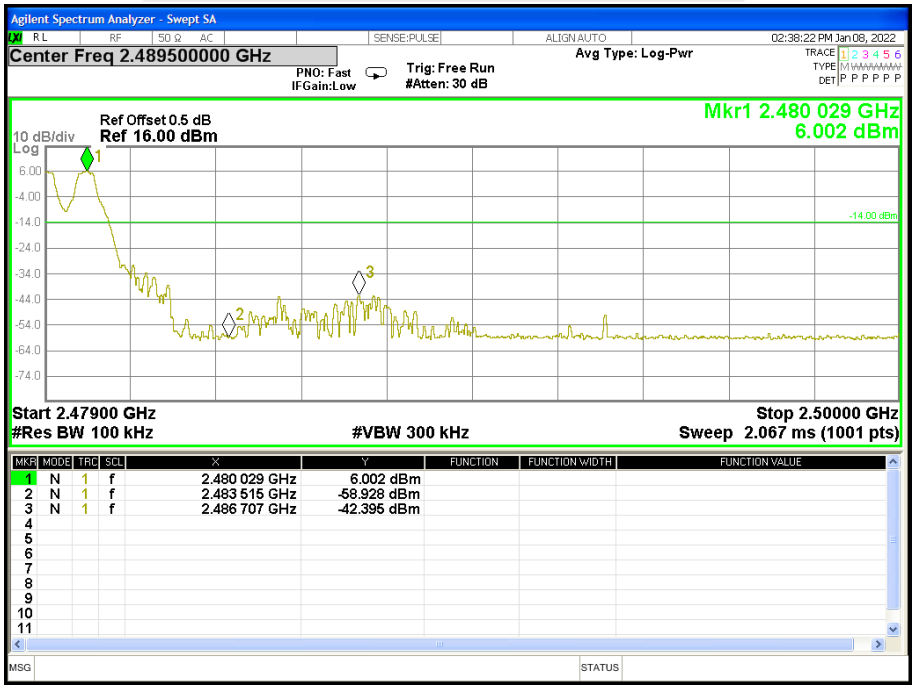
78 CH


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.487500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
01:47:25 PM Jan 08, 2022
Ref Offset 0.5 dB
10 dB/div
Ref 15.92 dBm
Log
Mkr1 2.480 025 GHz
5.916 dBm
-14.08 dBm
Start 2.47500 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 2.400 ms (1001 pts)
1 N 1 f 2.480 025 GHz 5.916 dBm
2 N 1 f 2.483 500 GHz -58.961 dBm
3 N 1 f 2.487 375 GHz -57.021 dBm
4 N 1 f 2.492 475 GHz -57.880 dBm

For Hopping Band edge

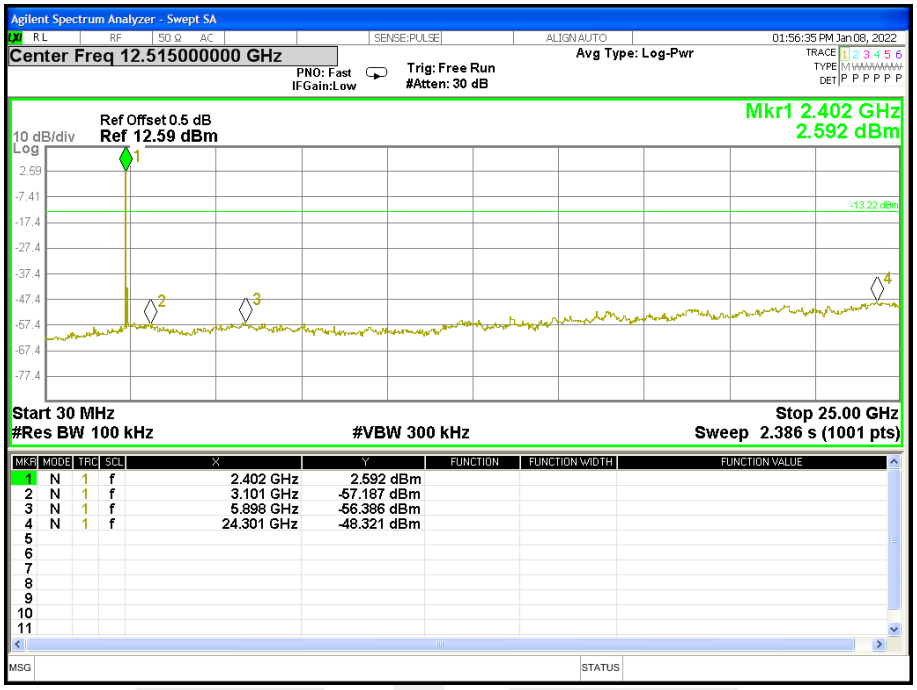
GFSK



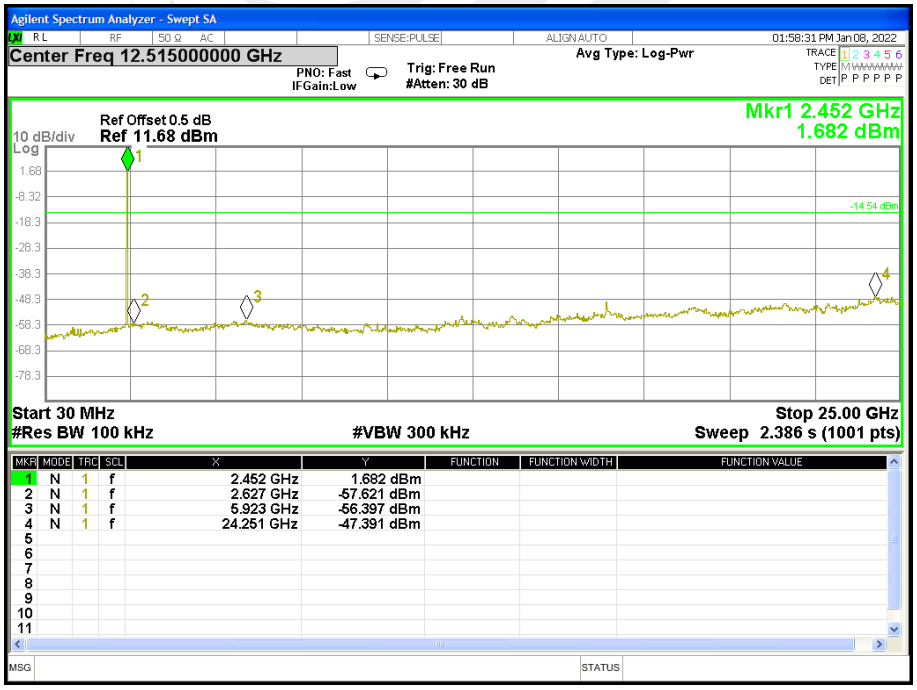


Temperature:	25℃	Relative Humidity:	50%
Test Mode:	π/4-DQPSK(2Mbps)–00/39/78 CH	Test Voltage:	DC 3.85V

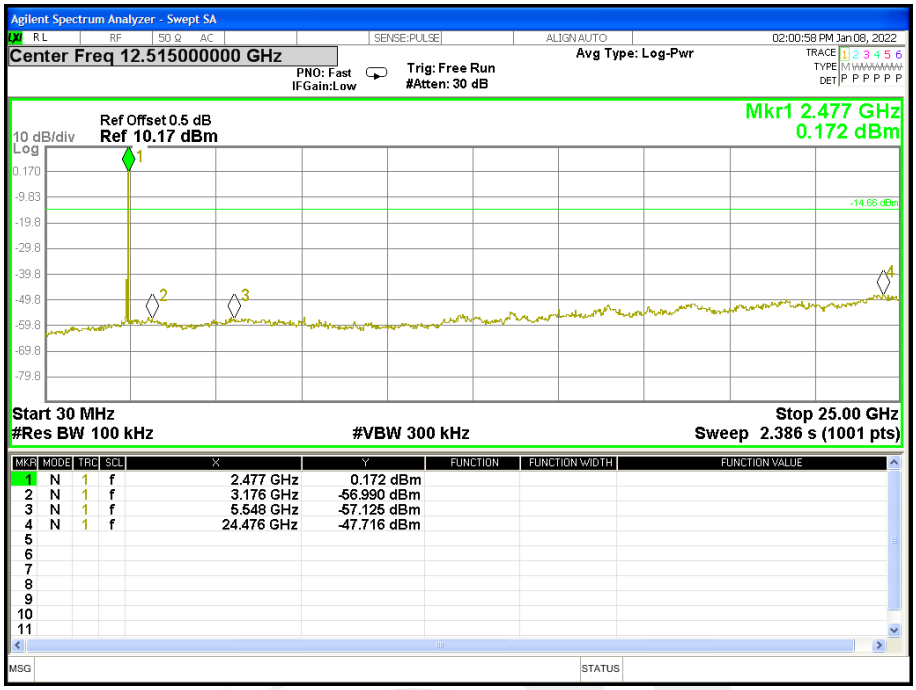
00 CH



39 CH

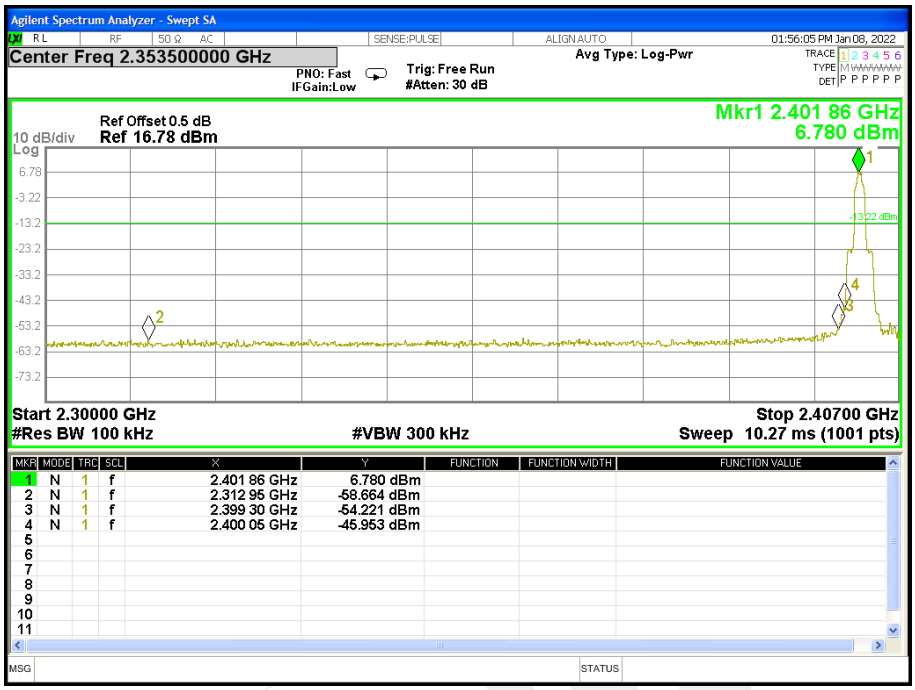


78 CH

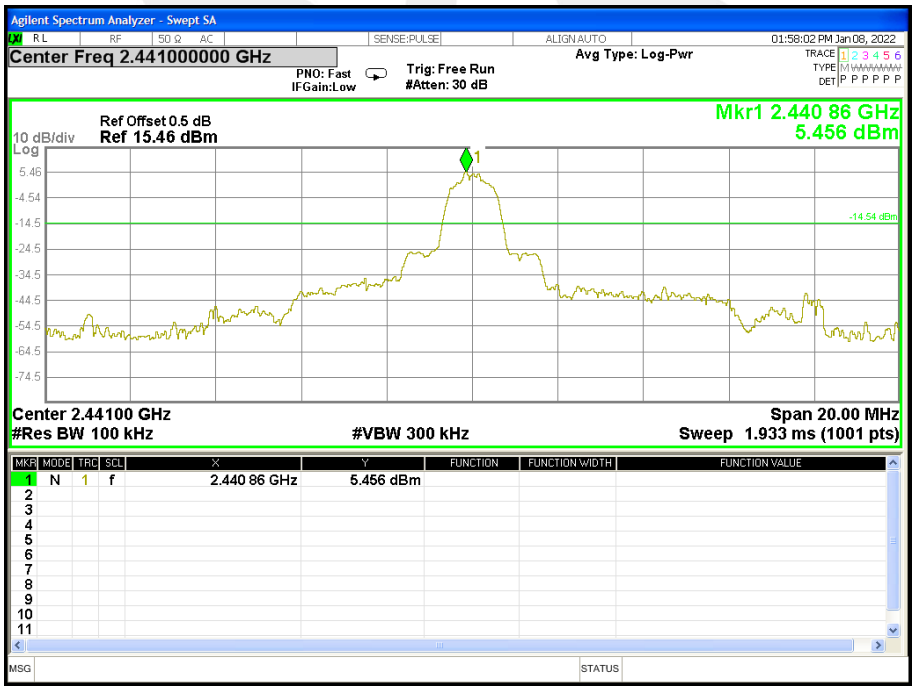

Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:PULSE
ALIGN AUTO
02:00:58 PM Jan 08, 2022
Center Freq 12.515000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE M
DET P P P P P
Ref Offset 0.5 dB
10 dB/div
Log
Ref 10.17 dBm
Mkr1 2.477 GHz
0.172 dBm
0.170
-9.83
-19.8
-29.8
-39.8
-49.8
-59.8
-69.8
-79.8
-14.66 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.386 s (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.477 GHz 0.172 dBm
2 N 1 f 3.176 GHz -56.990 dBm
3 N 1 f 5.548 GHz -57.125 dBm
4 N 1 f 24.476 GHz -47.716 dBm
5
6
7
8
9
10
11
MSG
STATUS

For Band edge(it's also the reference level for conducted spurious emission)

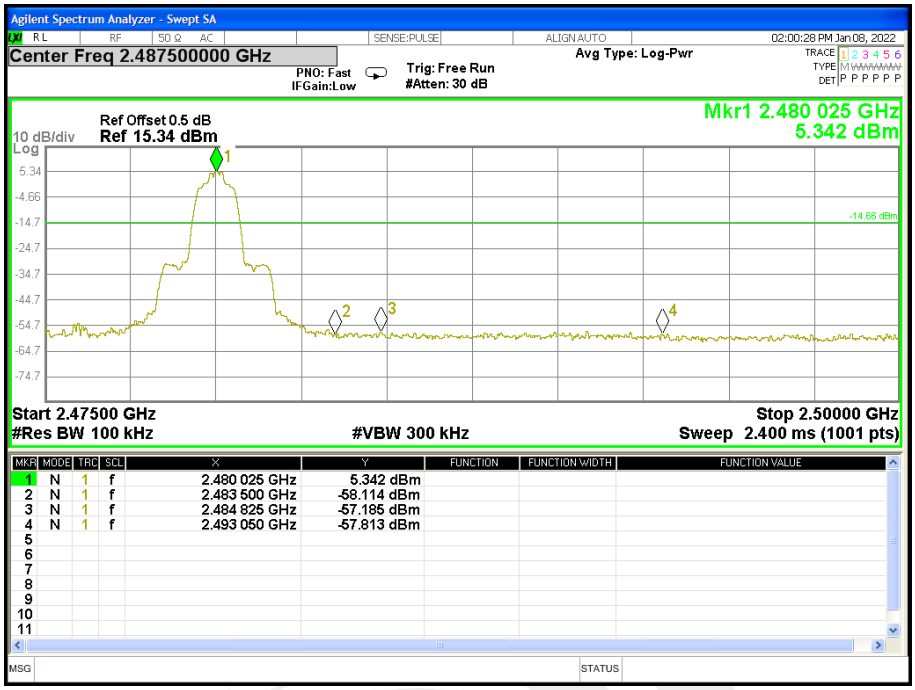
00 CH



39 CH

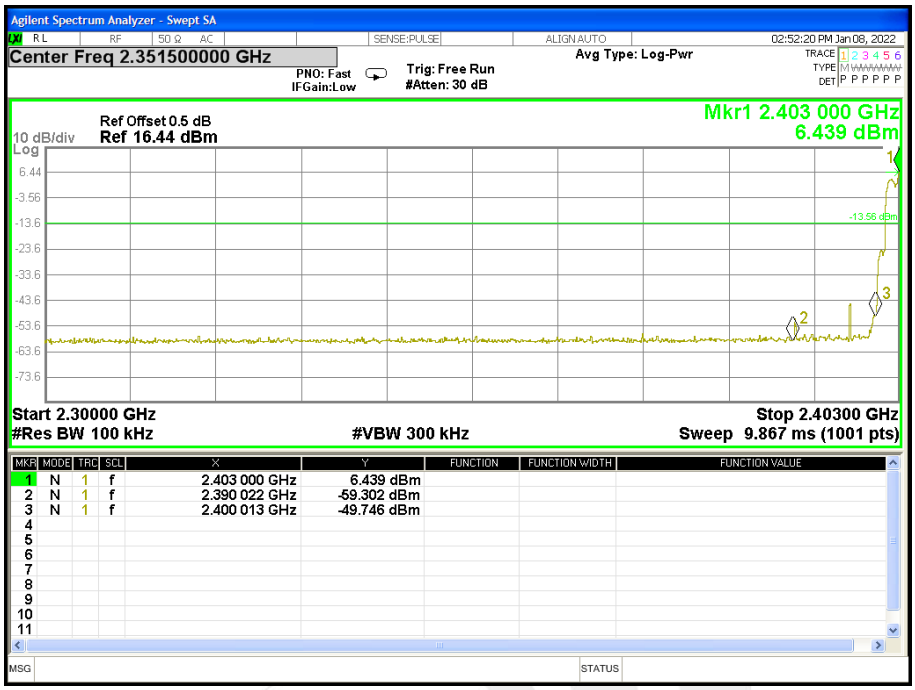


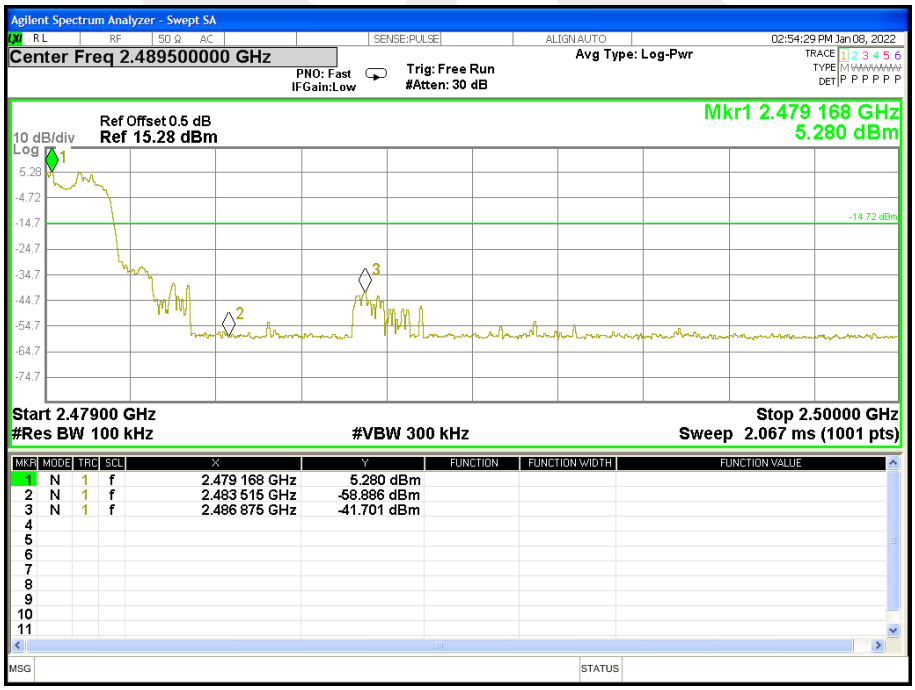
78 CH


Agilent Spectrum Analyzer - Swept SA
Center Freq 2.487500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
02:00:28 PM Jan 08, 2022
Ref Offset 0.5 dB
10 dB/div
Ref 15.34 dBm
Mkr1 2.480 025 GHz
5.342 dBm
-14.66 dBm
Start 2.47500 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 2.400 ms (1001 pts)
1 N 1 f 2.480 025 GHz 5.342 dBm
2 N 1 f 2.483 500 GHz -58.114 dBm
3 N 1 f 2.484 825 GHz -57.185 dBm
4 N 1 f 2.493 050 GHz -57.813 dBm

For Hopping Band edge

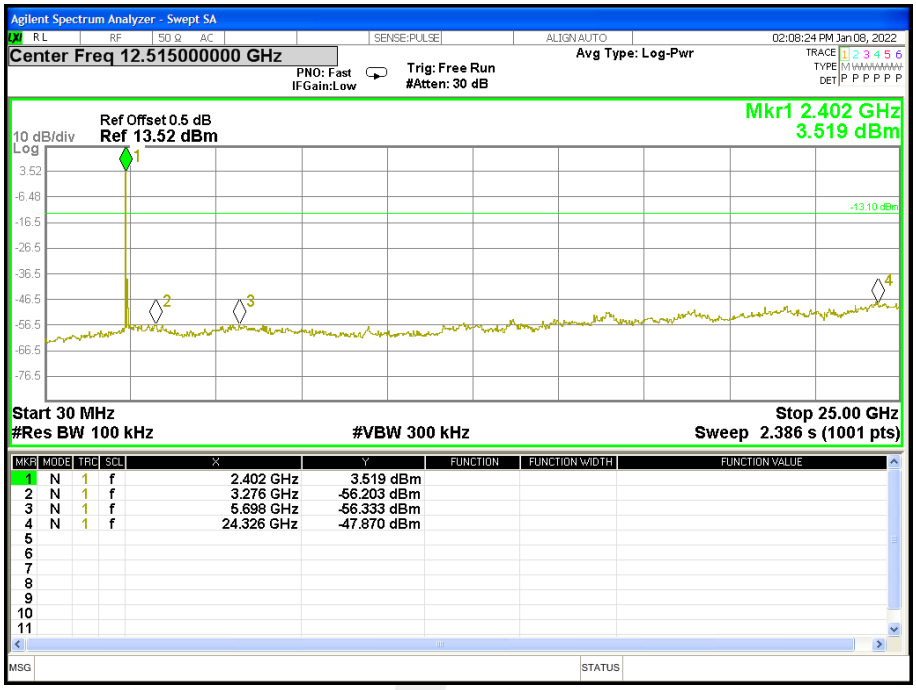
π/4-DQPSK



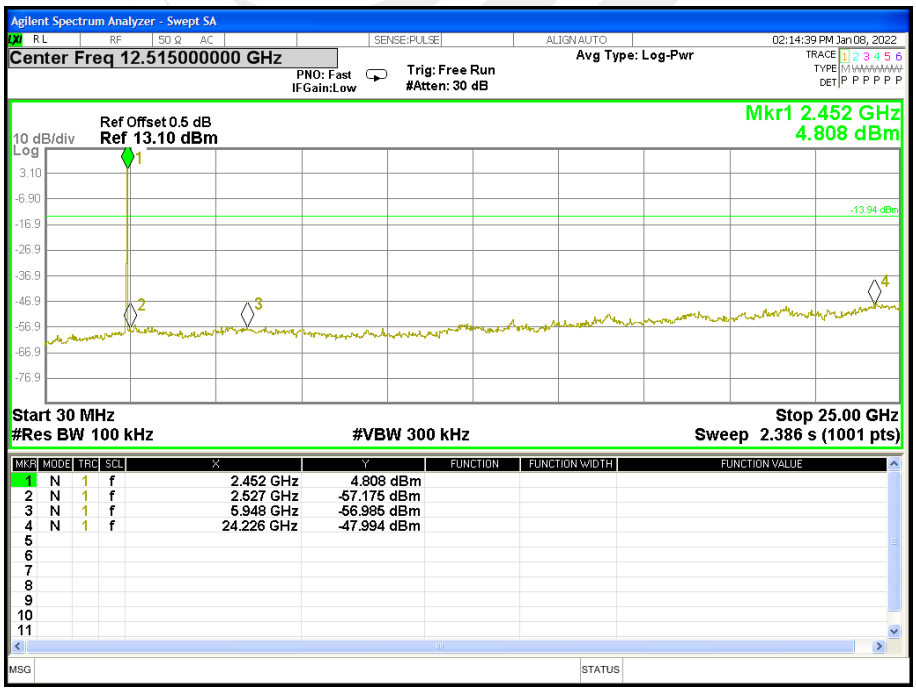


Temperature:	25℃	Relative Humidity:	50%
Test Mode:	8DPSK(3Mbps) -00/39/78 CH	Test Voltage:	DC 3.85V

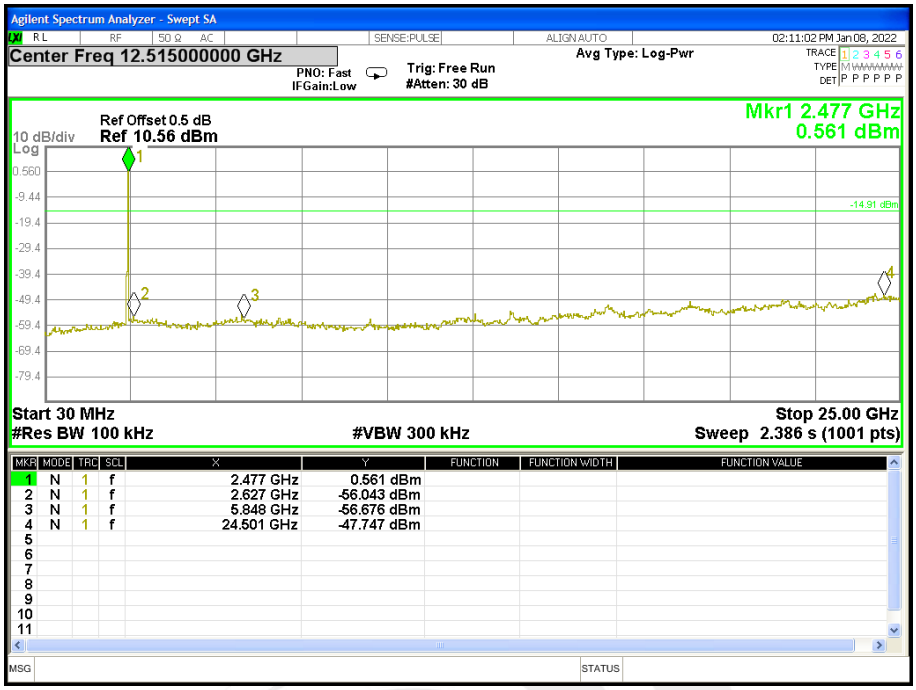
00 CH



39 CH

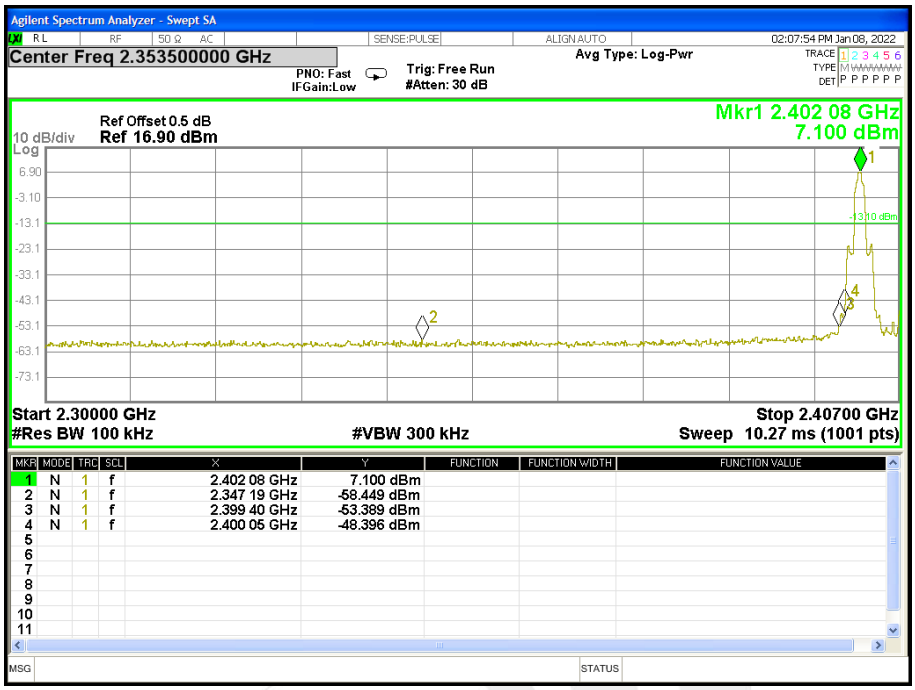


78 CH

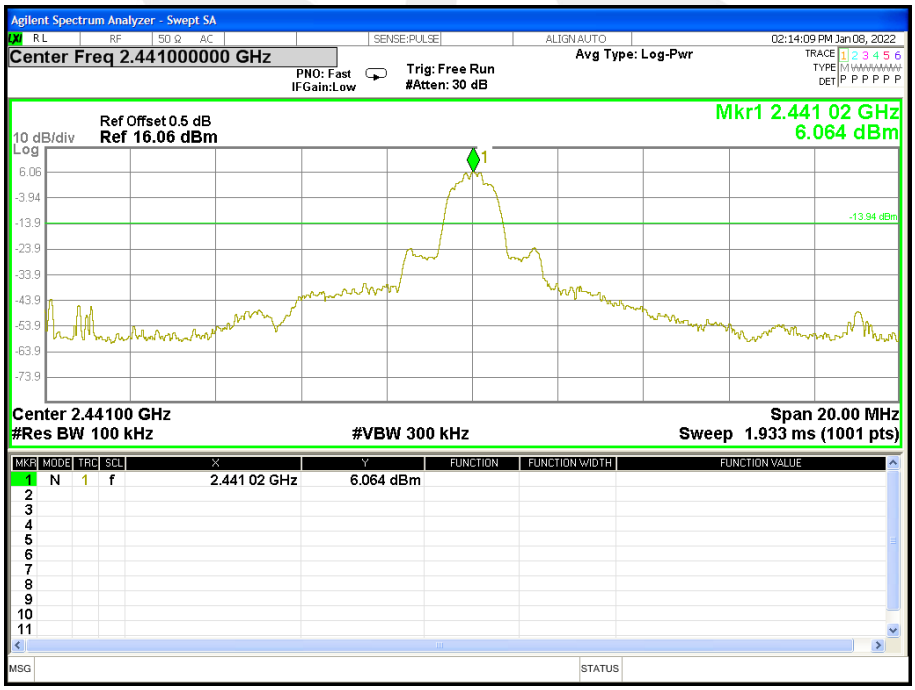

Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:PULSE
ALIGN AUTO
02:11:02 PM Jan 08, 2022
Center Freq 12.515000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE M
DET P P P P P
Ref Offset 0.5 dB
10 dB/div
Log
Ref 10.56 dBm
Mkr1 2.477 GHz
0.561 dBm
0.560
-9.44
-19.4
-29.4
-39.4
-49.4
-59.4
-69.4
-79.4
-14.91 dBm
Start 30 MHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 25.00 GHz
Sweep 2.386 s (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.477 GHz 0.561 dBm
2 N 1 f 2.627 GHz -56.043 dBm
3 N 1 f 5.848 GHz -56.676 dBm
4 N 1 f 24.501 GHz -47.747 dBm
5
6
7
8
9
10
11
MSG
STATUS

For Band edge(it's also the reference level for conducted spurious emission)

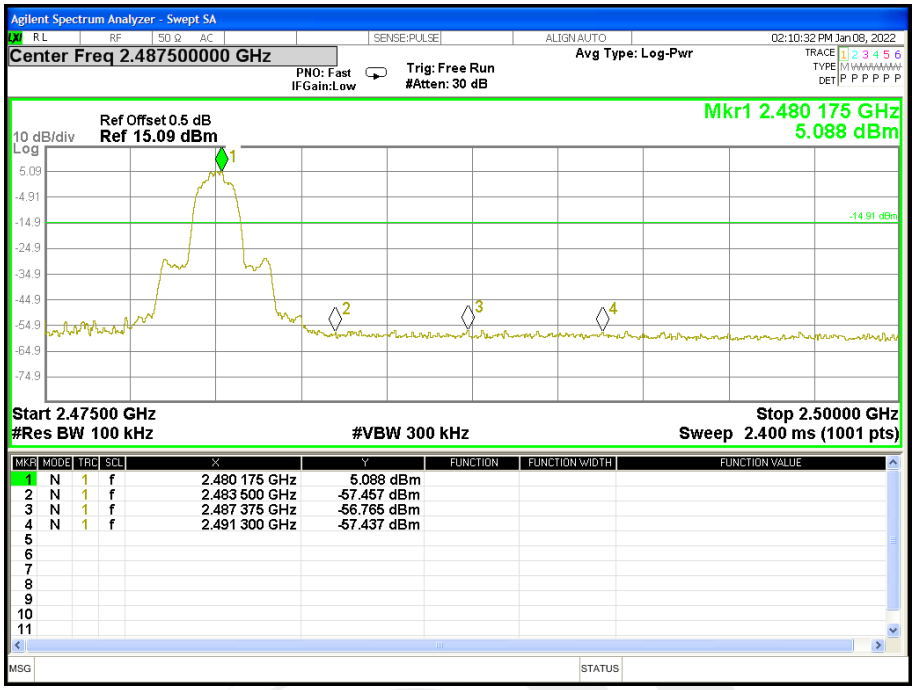
00 CH



39 CH

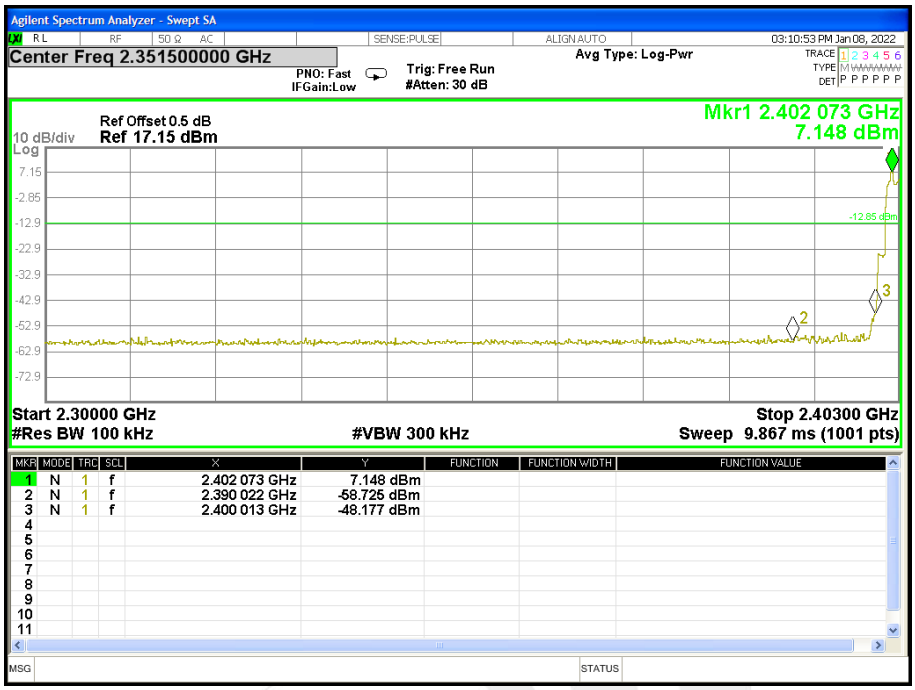


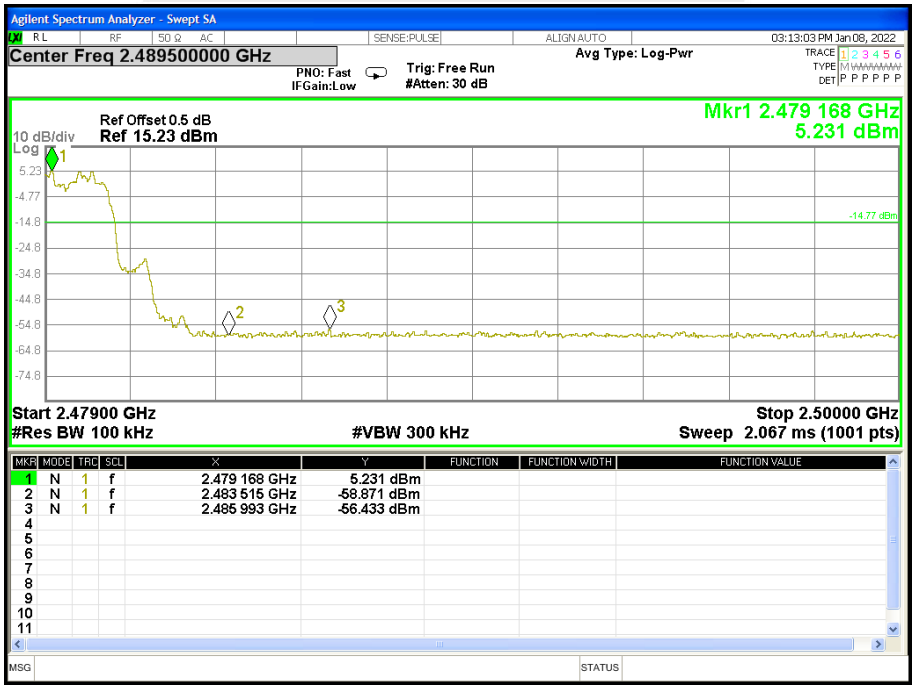
78 CH


Agilent Spectrum Analyzer - Swept SA
RL
RF
50 Ω AC
SENSE:PULSE
ALIGN AUTO
02:10:32 PM Jan 08, 2022
Center Freq 2.487500000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 30 dB
Avg Type: Log-Pwr
TRACE 1 2 3 4 5 6
TYPE M
DET P P P P P
Ref Offset 0.5 dB
10 dB/div
Log
Ref 15.09 dBm
Mkr1 2.480 175 GHz
5.088 dBm
5.09
-4.91
-14.9
-24.9
-34.9
-44.9
-54.9
-64.9
-74.9
-14.91 dBm
Start 2.47500 GHz
#Res BW 100 kHz
#VBW 300 kHz
Stop 2.50000 GHz
Sweep 2.400 ms (1001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.480 175 GHz 5.088 dBm
2 N 1 f 2.483 500 GHz -57.457 dBm
3 N 1 f 2.487 375 GHz -56.765 dBm
4 N 1 f 2.491 300 GHz -57.437 dBm
5
6
7
8
9
10
11
MSG
STATUS

For Hopping Band edge

8DPSK





5. NUMBER OF HOPPING CHANNEL

5.1 LIMIT

FCC Part 15.247,Subpart C				
Section	Test Item	Limit	FrequencyRange (MHz)	Result
15.247 (a)(1)(iii)	Number of Hopping Channel	≥15	2400-2483.5	PASS

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> Operating FrequencyRange
RB	300KHz
VB	300KHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

5.2 TEST PROCEDURE

a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
b. Spectrum Setting: RBW= 300KHz, VBW=300KHz, Sweep time = Auto.

5.3 TEST SETUP

5.4 EUT OPERATION CONDITIONS

Please refer to section 3.1.4 of this report.

5.5 TEST RESULTS

Temperature:	25℃	Relative Humidity:	60%
Test Mode:	Hopping Mode -GFSK Mode	Test Voltage:	DC 3.85V

Number of Hopping Channel 79

Hopping channel