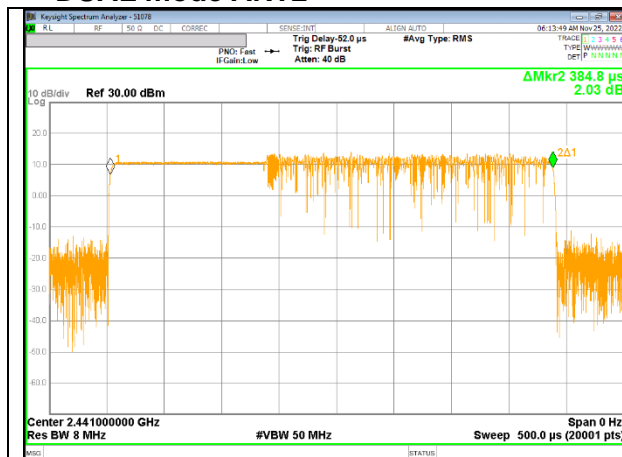
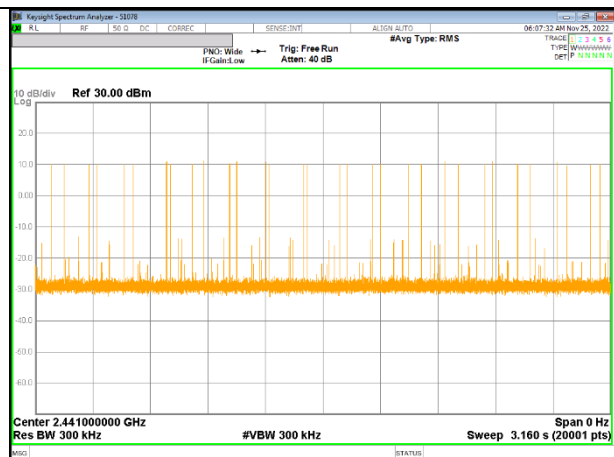


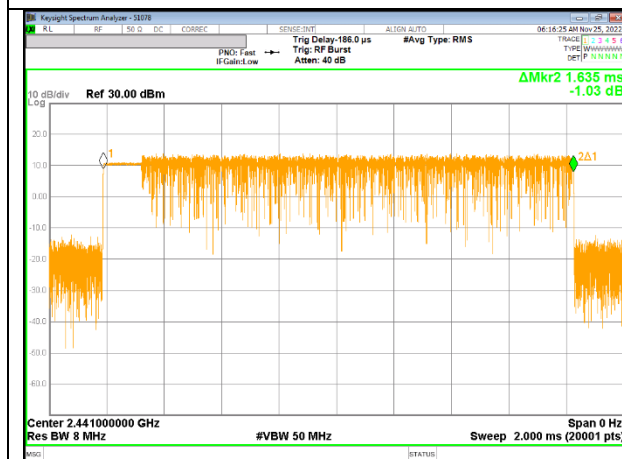
- DUAL mode ANT2



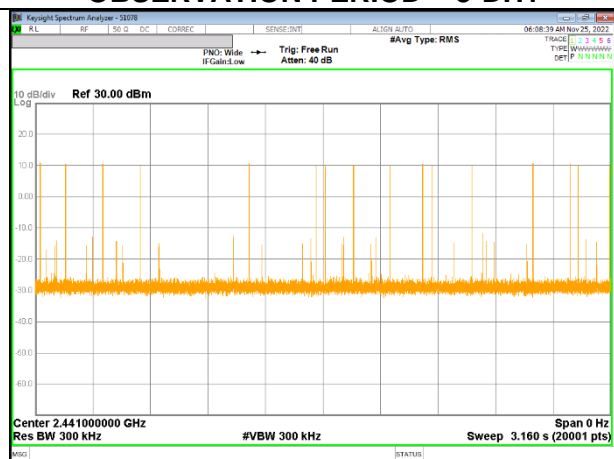
PULSE WIDTH – 3-DH1



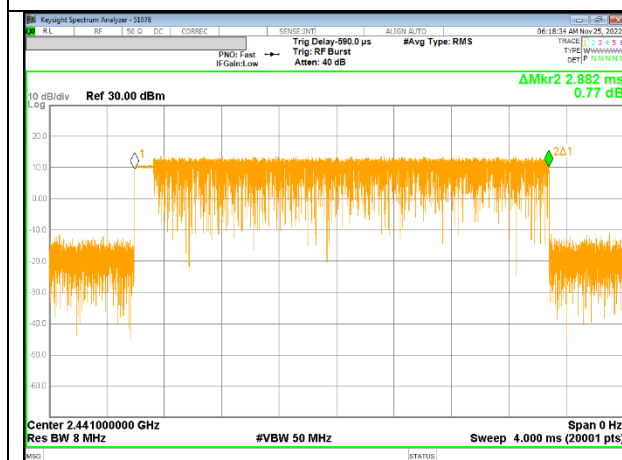
NUMBER OF PULSES IN 3.16 SECOND
OBSERVATION PERIOD – 3-DH1



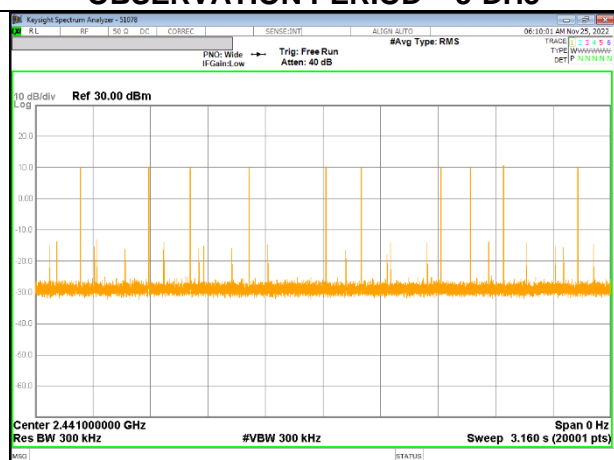
PULSE WIDTH – 3-DH3



NUMBER OF PULSES IN 3.16 SECOND
OBSERVATION PERIOD – 3-DH3



PULSE WIDTH – 3-DH5



NUMBER OF PULSES IN 3.16 SECOND
OBSERVATION PERIOD – 3-DH5

9.6. OUTPUT POWER

LIMITS

§15.247(b)(1) The maximum antenna gain is less than 6 dBi, therefore the limit is 21 dBm.

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 20 dB bandwidth of the EUT.

RESULTS

9.6.1. BASIC DATA RATE GFSK MODULATION

Antenna	Channel	Frequency [MHz]	Peak Output Power [dBm]	Limit [dBm]	Margin [dB]
ANT1	0	2402	17.010	21.000	-3.990
	39	2441	17.710		-3.290
	78	2480	17.010		-3.990
ANT2	0	2402	19.110		-1.890
	39	2441	19.440		-1.560
	78	2480	18.390		-2.610
DUAL mode ANT1	0	2402	12.093		
	39	2441	13.057		
	78	2480	12.850		
DUAL mode ANT2	0	2402	12.522		
	39	2441	12.516		
	78	2480	13.095		
DUAL mode ANT1+2	0	2402	15.323		-5.677
	39	2441	15.805		-5.195
	78	2480	15.985		-5.015
Worst			19.440		-1.560

9.6.2. ENHANCED DATA RATE Pi/4-DPSK MODULATION

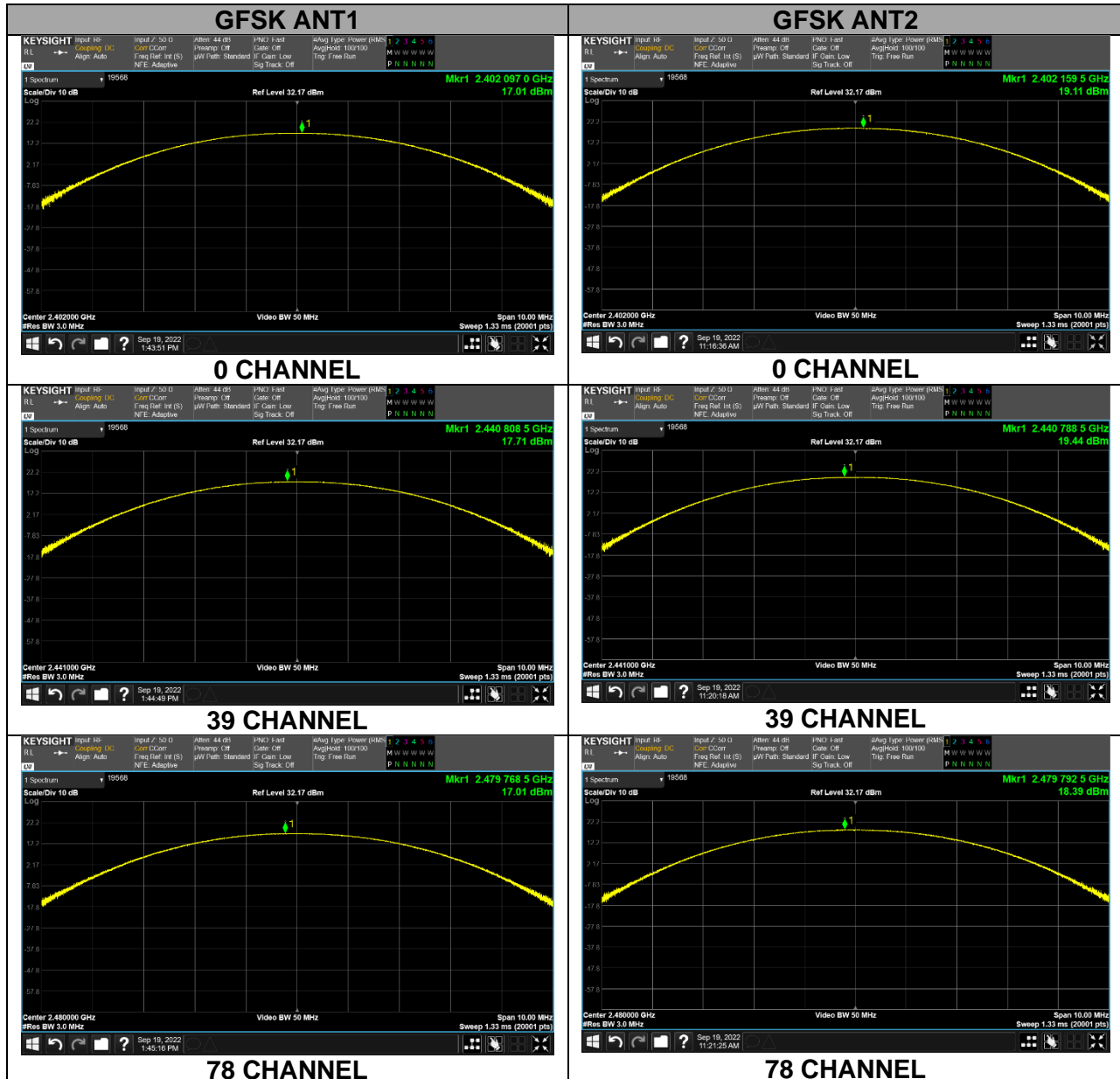
Antenna	Channel	Frequency [MHz]	Peak Output Power [dBm]	Limit [dBm]	Margin [dB]
ANT1	0	2402	16.740	21.000	-4.260
	39	2441	17.363		-3.637
	78	2480	16.463		-4.537
ANT2	0	2402	18.170		-2.830
	39	2441	18.410		-2.590
	78	2480	17.210		-3.790
DUAL mode ANT1	0	2402	12.126		
	39	2441	12.715		
	78	2480	13.203		
DUAL mode ANT2	0	2402	12.595		
	39	2441	13.106		
	78	2480	12.961		
DUAL mode ANT1+2	0	2402	15.377		-5.623
	39	2441	15.925		-5.075
	78	2480	16.094		-4.906
Worst			18.410		-2.590

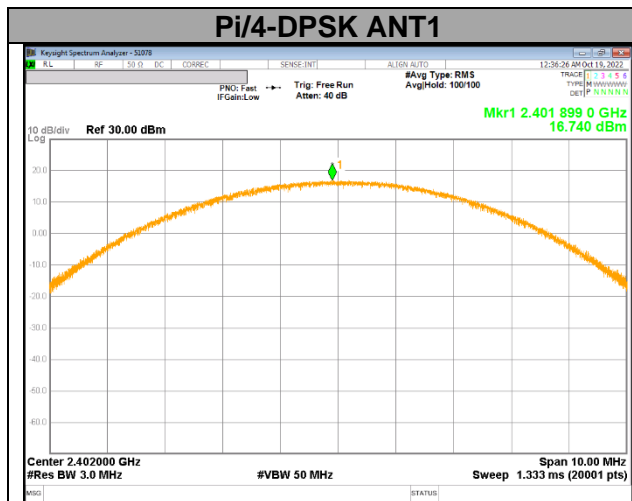
9.6.3. ENHANCED DATA RATE 8PSK MODULATION

Antenna	Channel	Frequency [MHz]	Peak Output Power [dBm]	Limit [dBm]	Margin [dB]
ANT1	0	2402	17.513	21.000	-3.487
	39	2441	18.001		-2.999
	78	2480	16.839		-4.161
ANT2	0	2402	18.970		-2.030
	39	2441	18.870		-2.130
	78	2480	18.000		-3.000
DUAL mode ANT1	0	2402	12.790		
	39	2441	13.460		
	78	2480	13.717		
DUAL mode ANT2	0	2402	13.227		
	39	2441	13.700		
	78	2480	13.983		
DUAL mode ANT1+2	0	2402	16.024		-4.976
	39	2441	16.592		-4.408
	78	2480	16.862		-4.138
Worst			18.970		-2.030

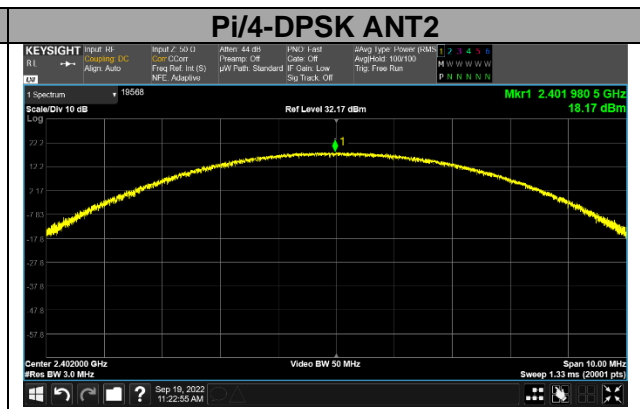
9.6.4. OUTPUT POWER PLOTS

PEAK OUTPUT POWER

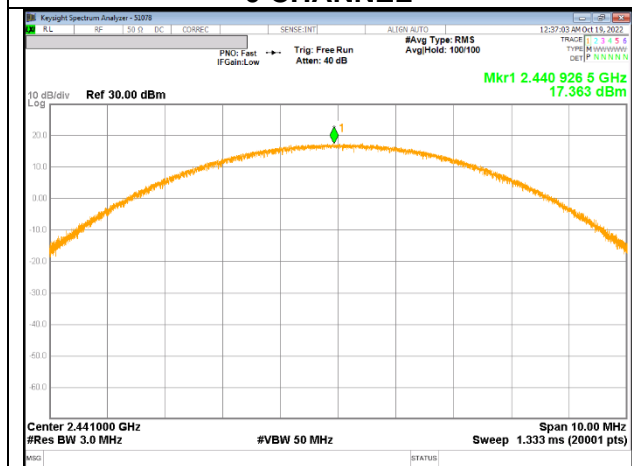




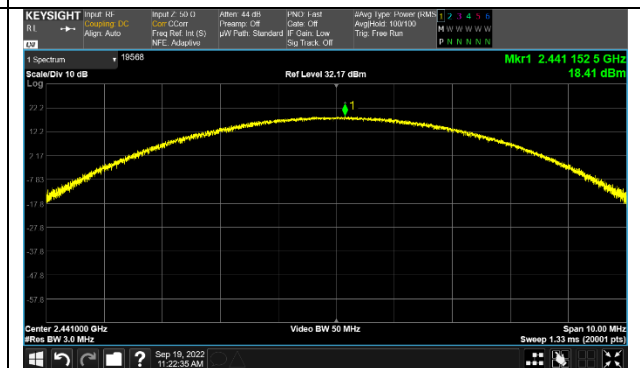
0 CHANNEL



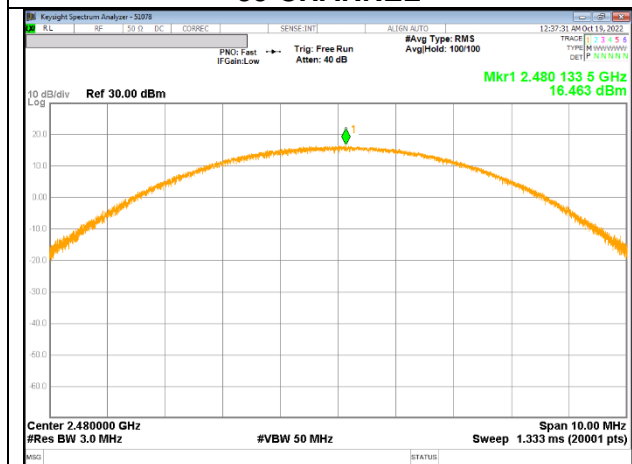
0 CHANNEL



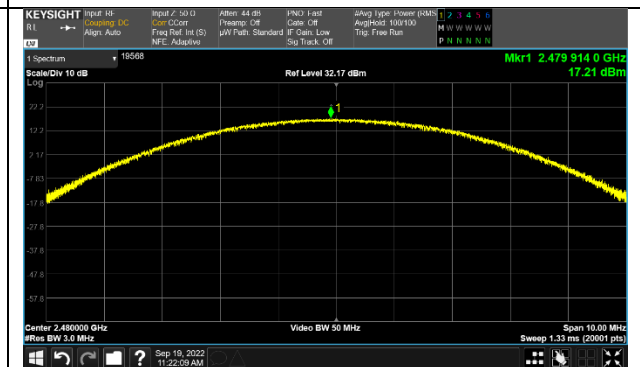
39 CHANNEL



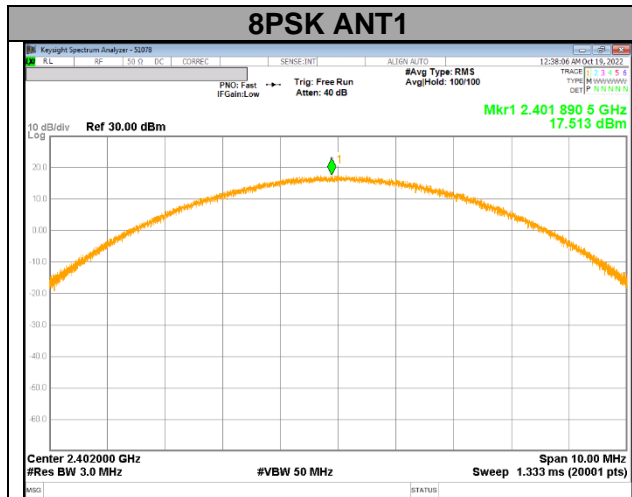
39 CHANNEL



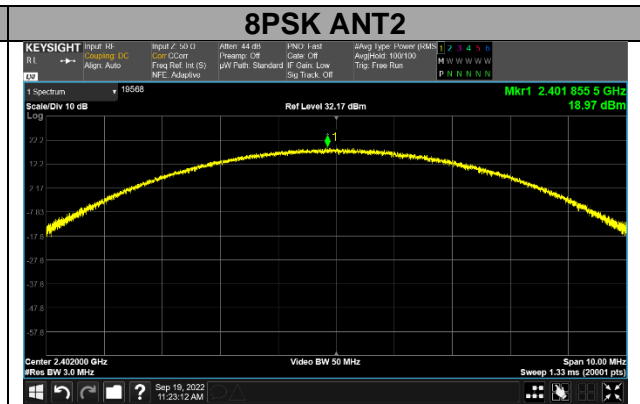
78 CHANNEL



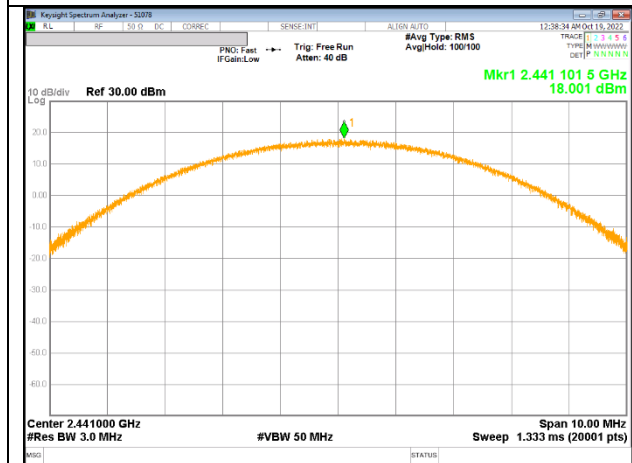
78 CHANNEL



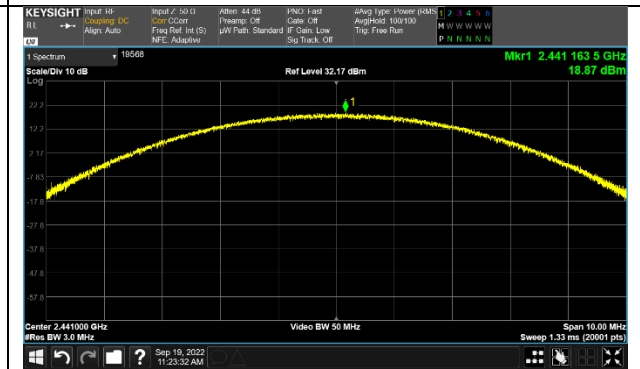
0 CHANNEL



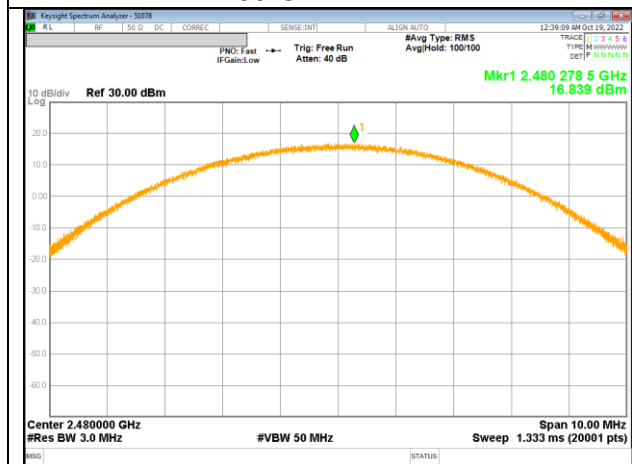
0 CHANNEL



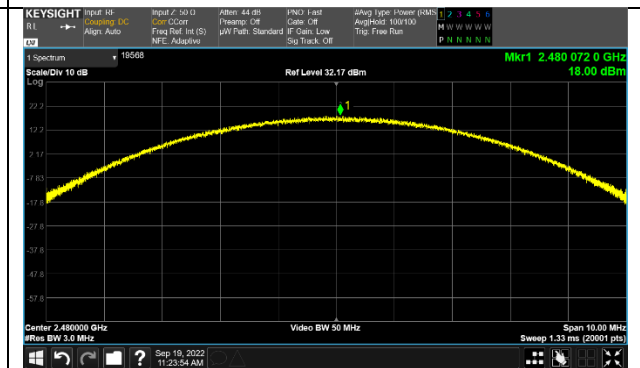
39 CHANNEL



39 CHANNEL

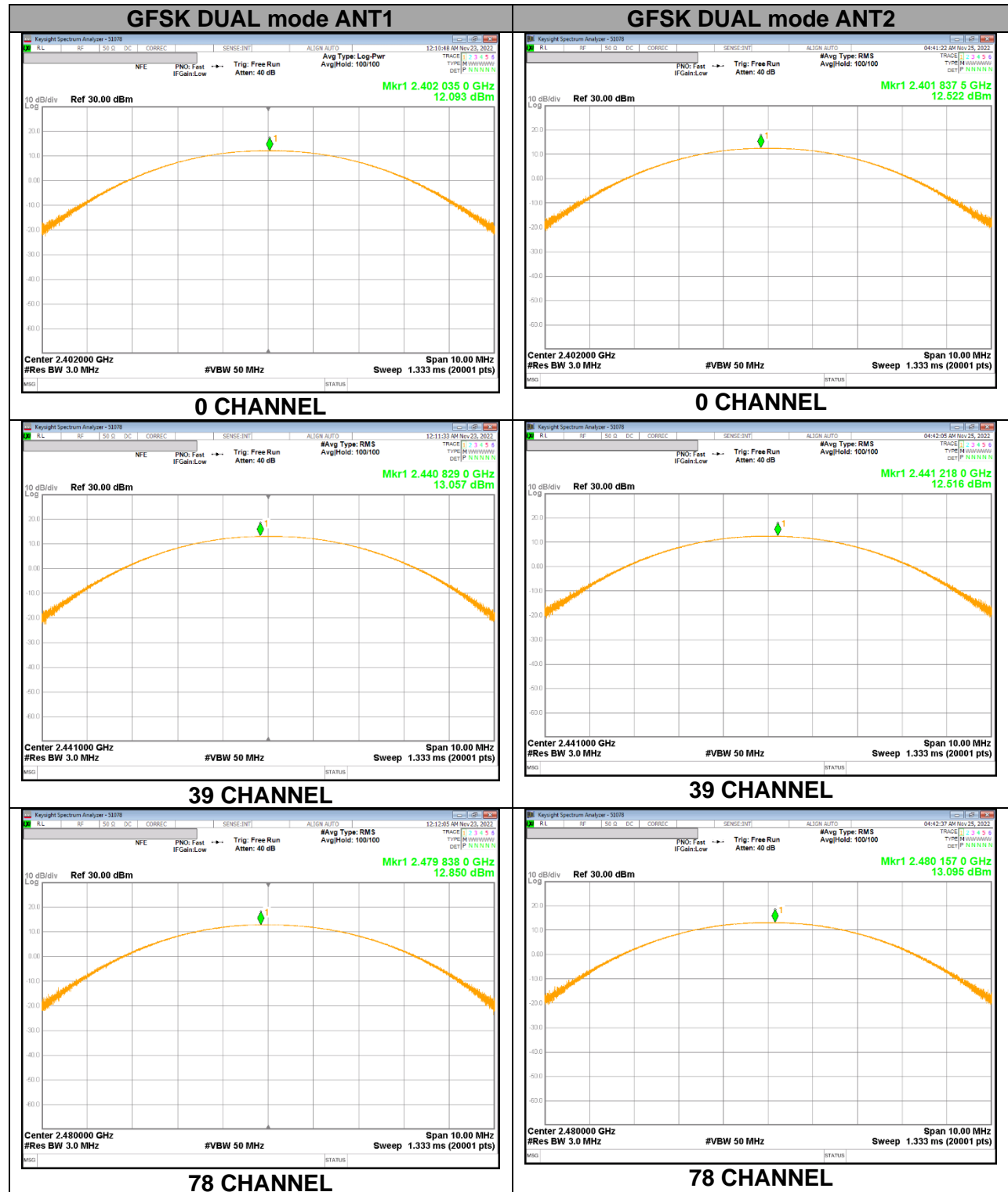


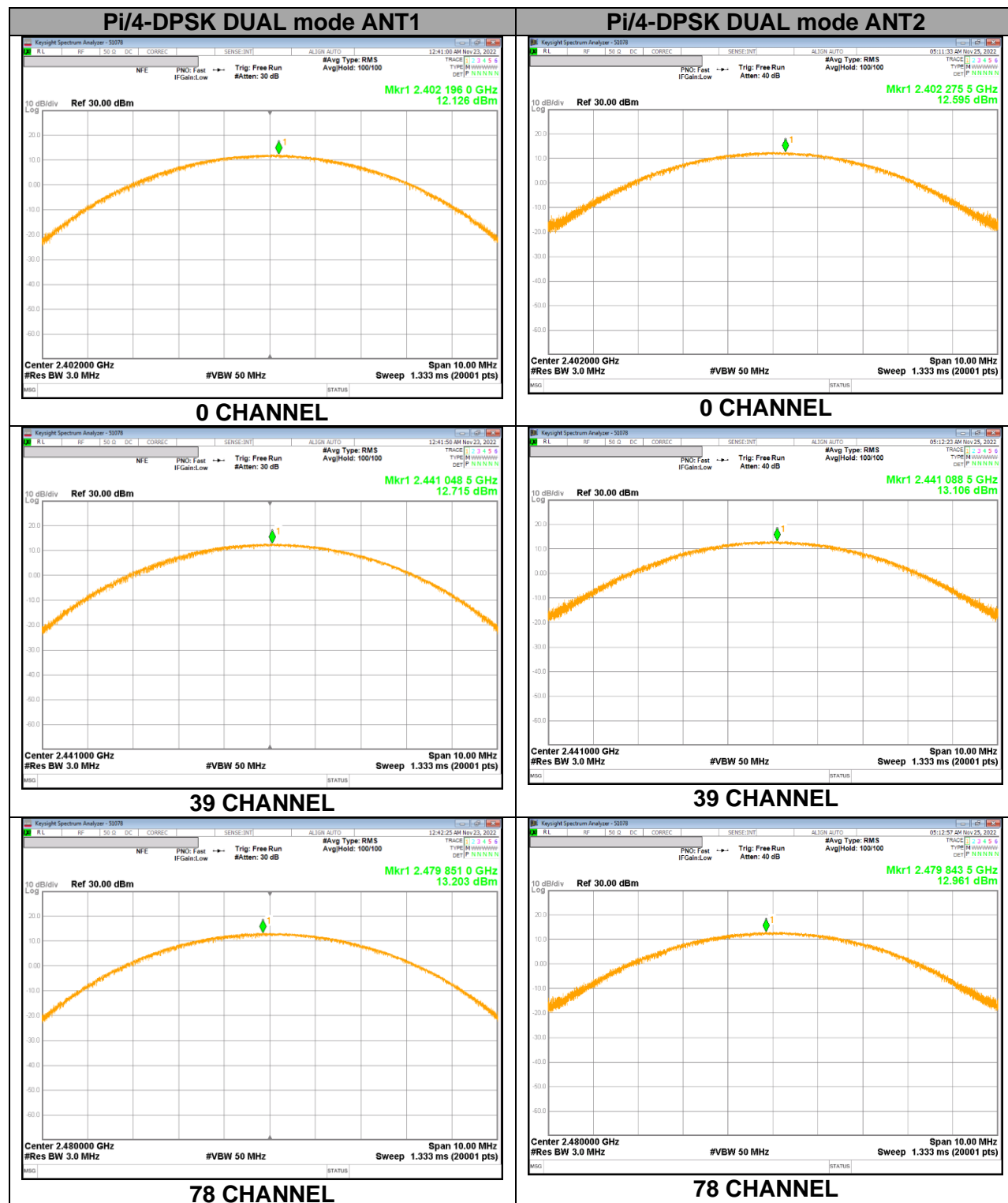
78 CHANNEL

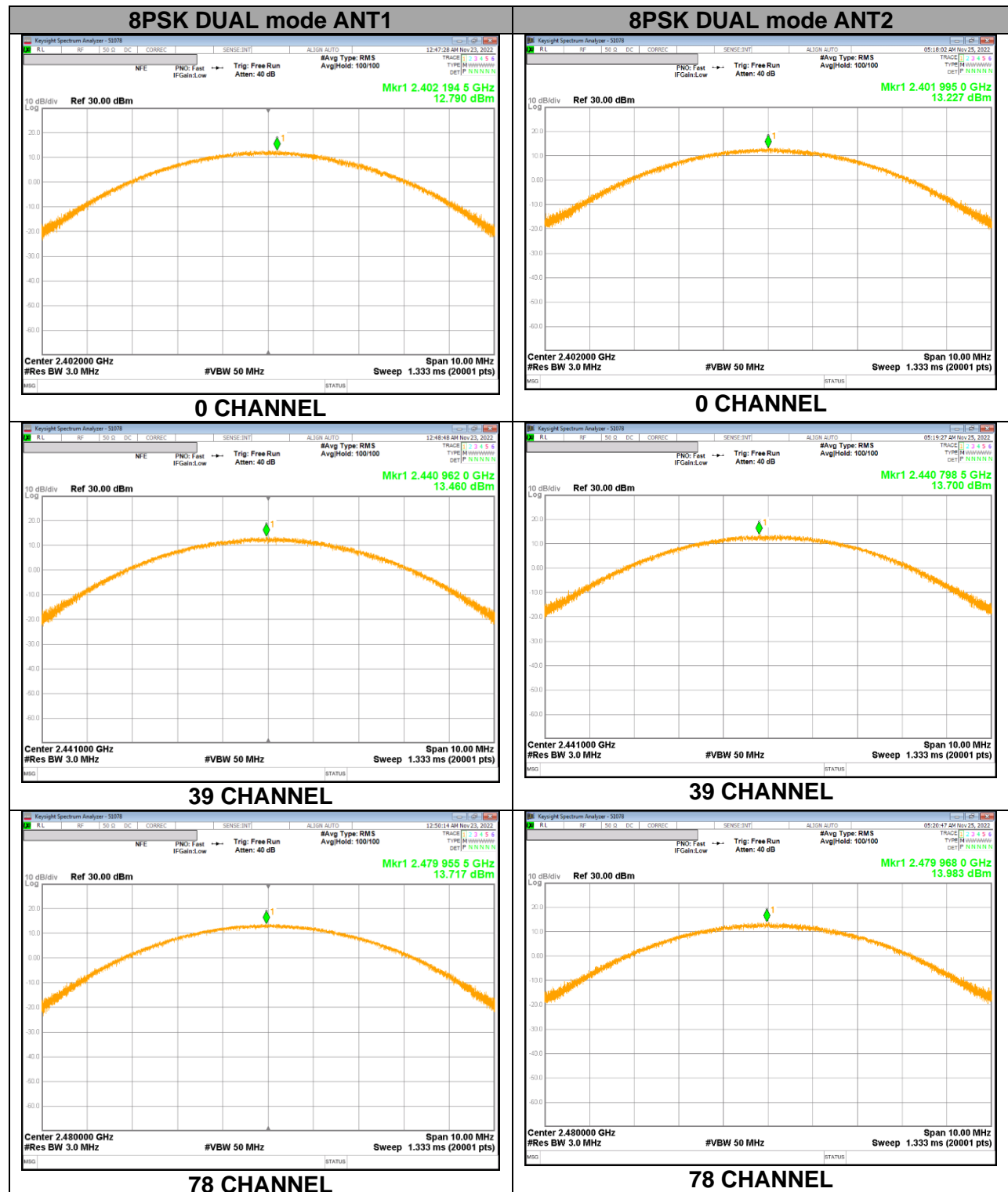


78 CHANNEL

PEAK OUTPUT POWER(BT-DUAL)







9.7. AVERAGE POWER

LIMITS

None; for reporting purposes only

TEST PROCEDURE

Measurements perform using a wideband gated RF power meter.

The cable assembly insertion loss was entered as an offset in the power meter to allow for direct reading of power.

RESULTS

9.7.1. BASIC DATA RATE GFSK MODULATION

Antenna	Channel	Frequency [MHz]	Average Output Power [dBm]	Average Output Power [mW]
ANT1	0	2402	16.459	44.249
	39	2441	17.088	51.145
	78	2480	16.331	42.964
ANT2	0	2402	18.821	76.225
	39	2441	18.859	76.895
	78	2480	17.801	60.270
DUAL mode ANT1	0	2402	11.956	
	39	2441	12.611	
	78	2480	12.551	
DUAL mode ANT2	0	2402	12.160	
	39	2441	12.069	
	78	2480	12.697	
DUAL mode ANT1+2	0	2402	15.069	32.129
	39	2441	15.359	34.348
	78	2480	15.635	36.602

9.7.2. ENHANCED DATA RATE PI/4-DQPSK MODULATION

Antenna	Channel	Frequency [MHz]	Average Output Power [dBm]	Average Output Power [mW]
ANT1	0	2402	13.612	22.972
	39	2441	14.194	26.266
	78	2480	13.274	21.252
ANT2	0	2402	15.363	34.380
	39	2441	15.474	35.270
	78	2480	14.582	28.721
DUAL mode ANT1	0	2402	9.752	
	39	2441	10.323	
	78	2480	10.628	
DUAL mode ANT2	0	2402	9.679	
	39	2441	10.259	
	78	2480	9.984	
DUAL mode ANT1+2	0	2402	12.726	18.733
	39	2441	13.301	21.385
	78	2480	13.328	21.518

9.7.3. ENHANCED DATA RATE 8PSK MODULATION

Antenna	Channel	Frequency [MHz]	Average Output Power [dBm]	Average Output Power [mW]
ANT1	0	2402	13.681	23.340
	39	2441	14.210	26.363
	78	2480	13.281	21.286
ANT2	0	2402	15.406	34.722
	39	2441	15.484	35.351
	78	2480	14.570	28.642
DUAL mode ANT1	0	2402	9.361	
	39	2441	9.973	
	78	2480	10.667	
DUAL mode ANT2	0	2402	9.743	
	39	2441	10.354	
	78	2480	10.096	
DUAL mode ANT1+2	0	2402	12.566	18.055
	39	2441	13.178	20.787
	78	2480	13.401	21.883

9.8. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

Limit = -20 dBc

TEST PROCEDURE

The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

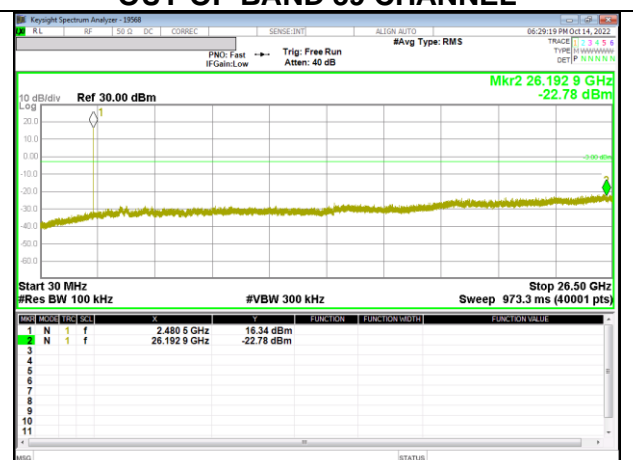
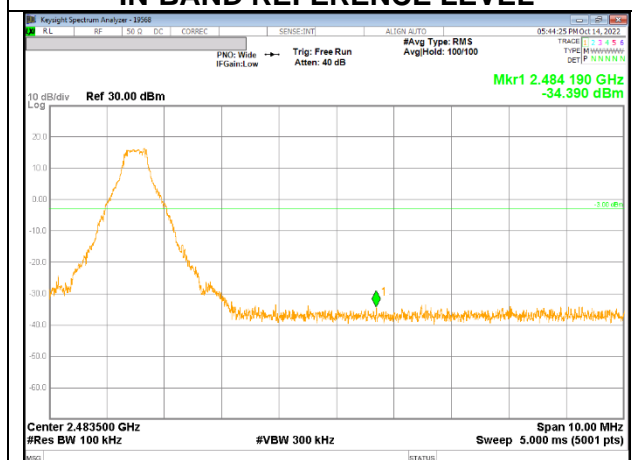
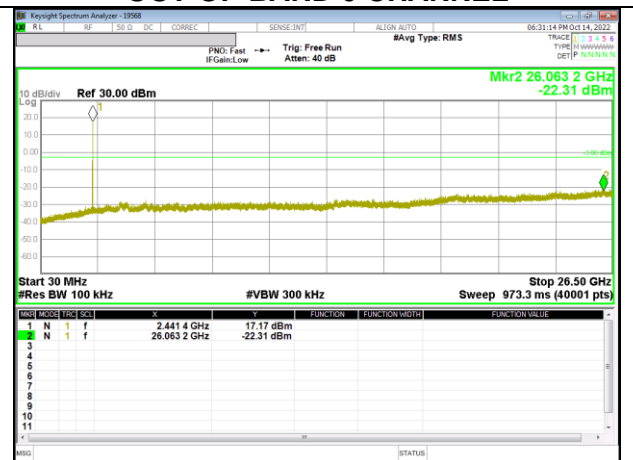
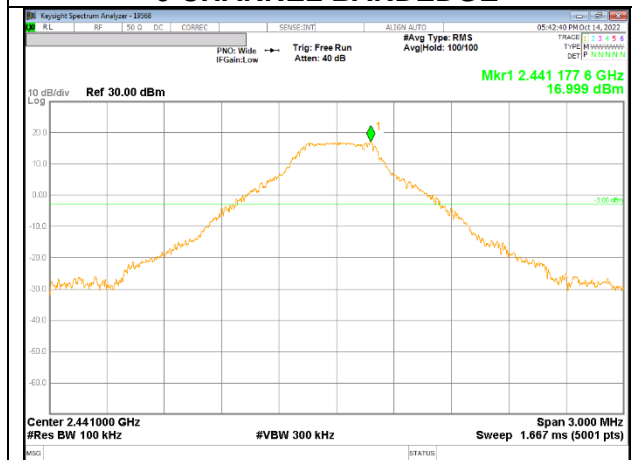
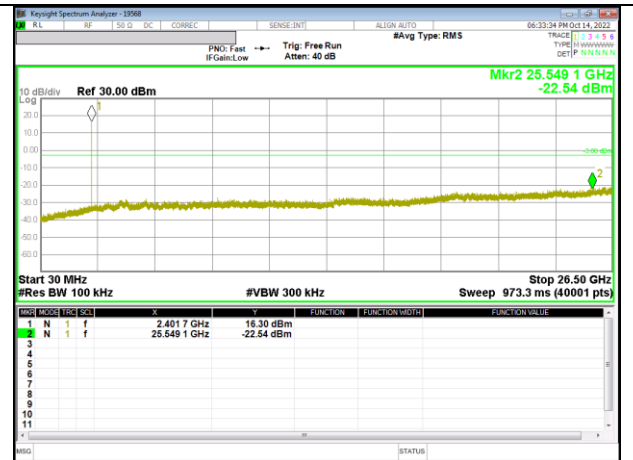
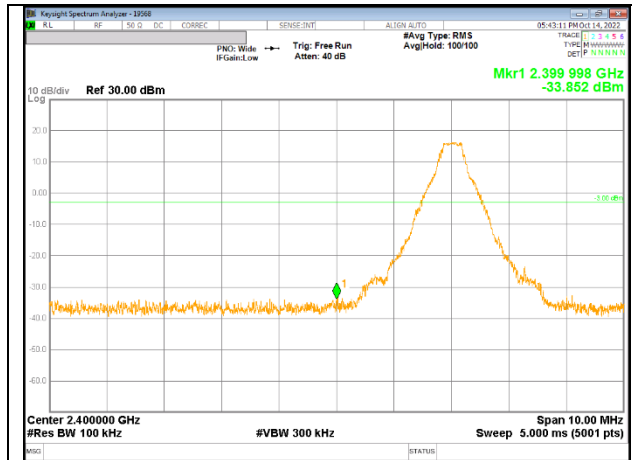
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

The band-edges at 2.4 and 2.4835 GHz are investigated with the transmitter set to the normal hopping mode.

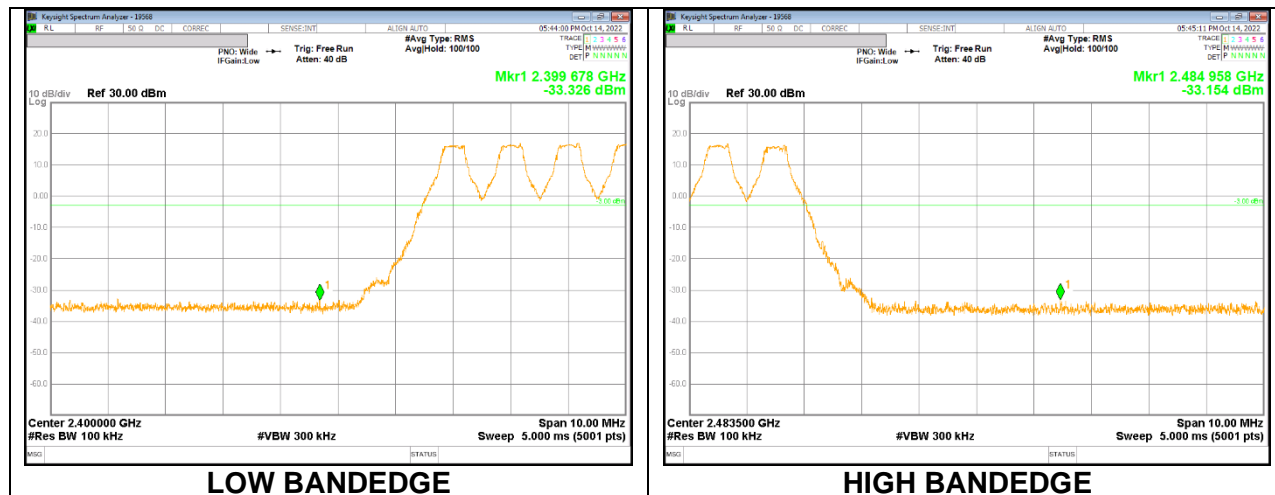
RESULTS

9.8.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

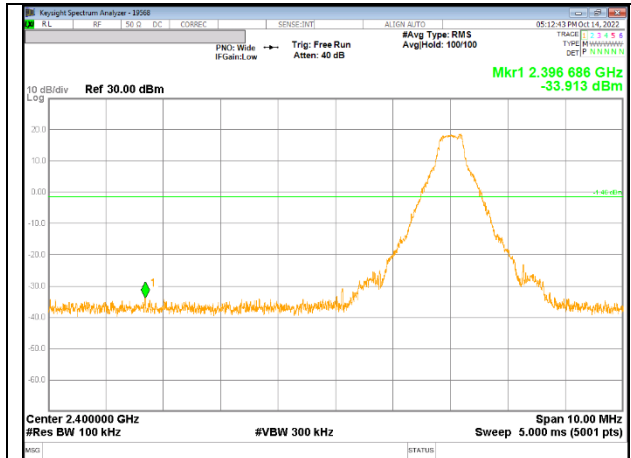
SPURIOUS EMISSIONS, NON-HOPPING - ANT1



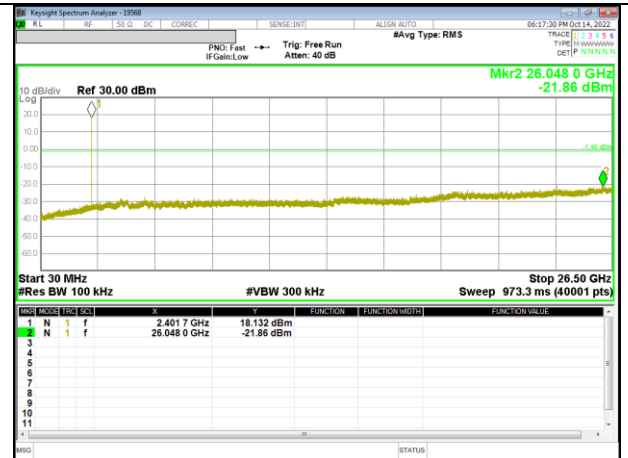
SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



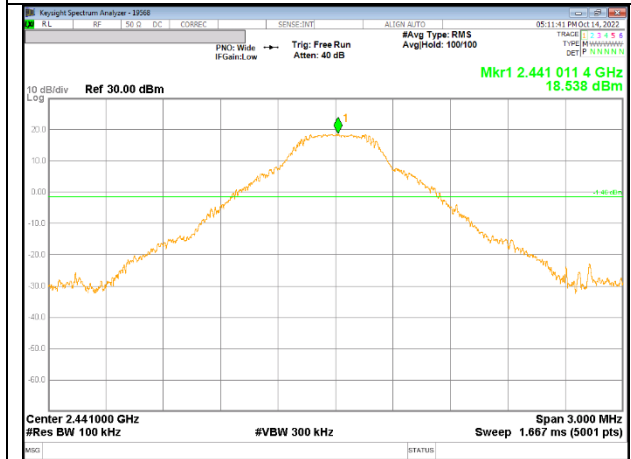
SPURIOUS EMISSIONS, NON-HOPPING - ANT2



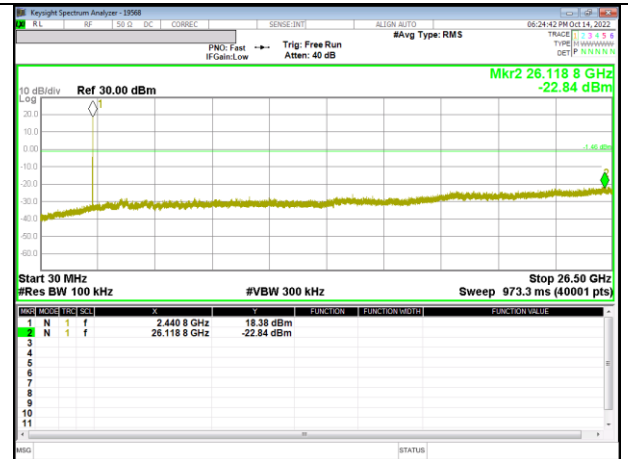
0 CHANNEL BANDEDGE



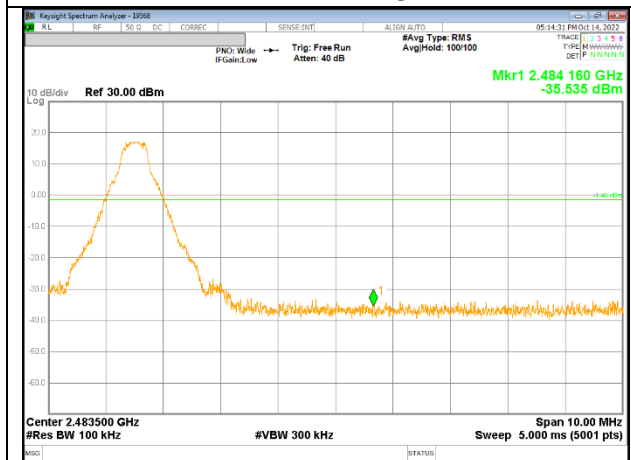
OUT-OF-BAND 0 CHANNEL



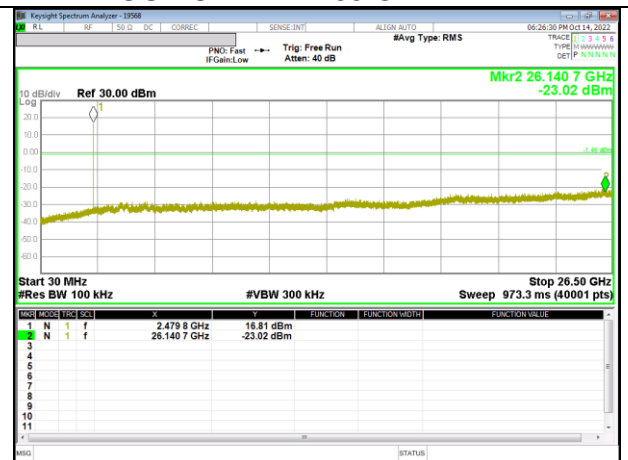
IN-BAND REFERENCE LEVEL



OUT-OF-BAND 39 CHANNEL



78 CHANNEL BANDEDGE



OUT-OF-BAND 78 CHANNEL

The image displays two side-by-side screenshots of a Keysight Spectrum Analyzer interface, illustrating signal characteristics at different frequencies.

Left Screenshot (Low Bandedge):

- Center Frequency:** 2.400000 GHz
- Span:** 10.00 MHz
- Resolution Bandwidth (Res BW):** 100 kHz
- Video Bandwidth (VBW):** 300 kHz
- Sweep:** 5.000 ms (5001 pts)
- Reference Level:** 30.00 dBm
- Marker 1 (Mkr1):** 2.399 822 GHz, -33.340 dBm
- Signal Characteristics:** The spectrum shows a relatively flat noise floor around -40 dBm, with a sharp, narrowband signal appearing at the low bandedge (marked Mkr1).

Right Screenshot (High Bandedge):

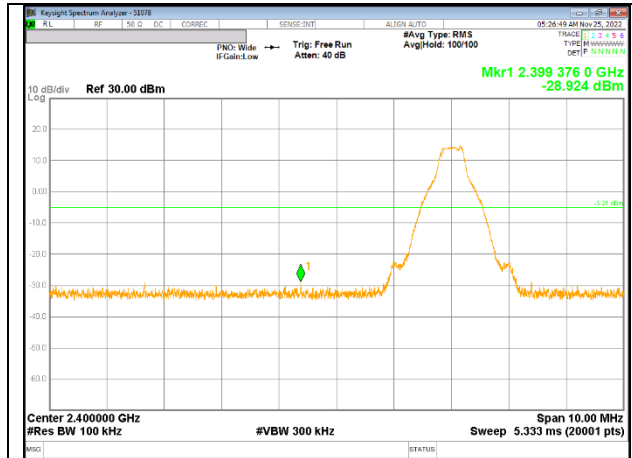
- Center Frequency:** 2.483500 GHz
- Span:** 10.00 MHz
- Resolution Bandwidth (Res BW):** 100 kHz
- Video Bandwidth (VBW):** 300 kHz
- Sweep:** 5.000 ms (5001 pts)
- Reference Level:** 30.00 dBm
- Marker 1 (Mkr1):** 2.485 932 GHz, -32.284 dBm
- Signal Characteristics:** The spectrum shows a relatively flat noise floor around -40 dBm, with a sharp, narrowband signal appearing at the high bandedge (marked Mkr1).

Both screenshots include standard Keysight Spectrum Analyzer controls and readouts, such as PWD (Power), Trig (Trigger), and various measurement parameters.

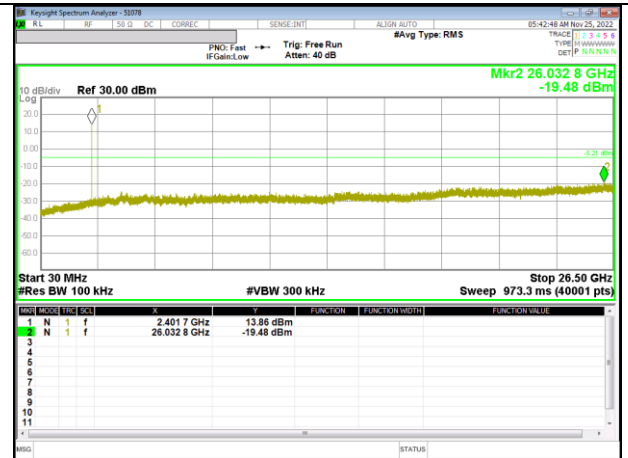
SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



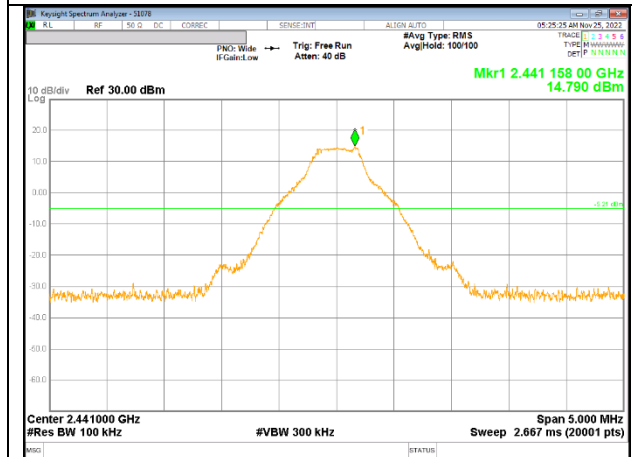
SPURIOUS EMISSIONS, NON-HOPPING – DUAL mode ANT2



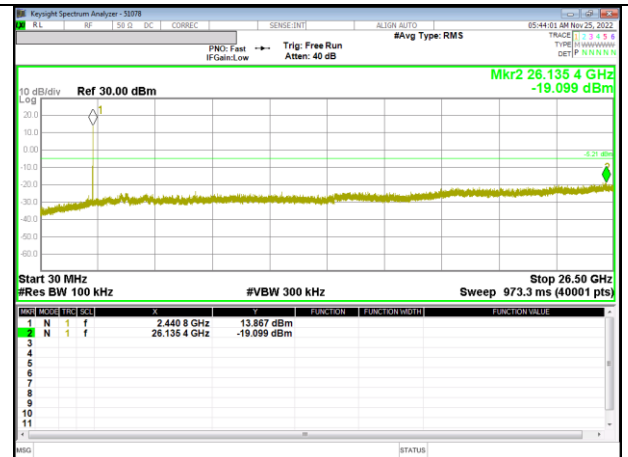
0 CHANNEL BANDEDGE



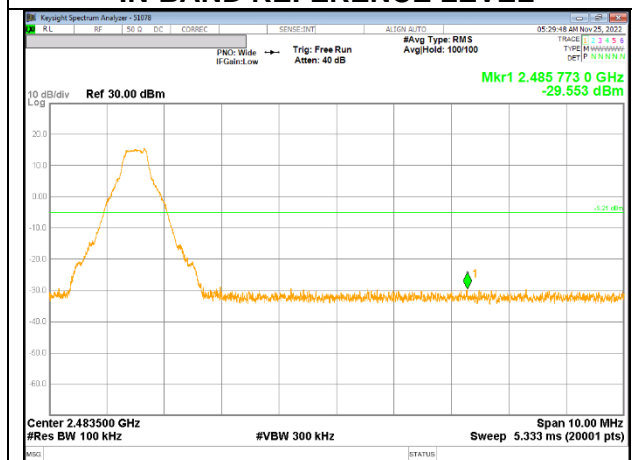
OUT-OF-BAND 0 CHANNEL



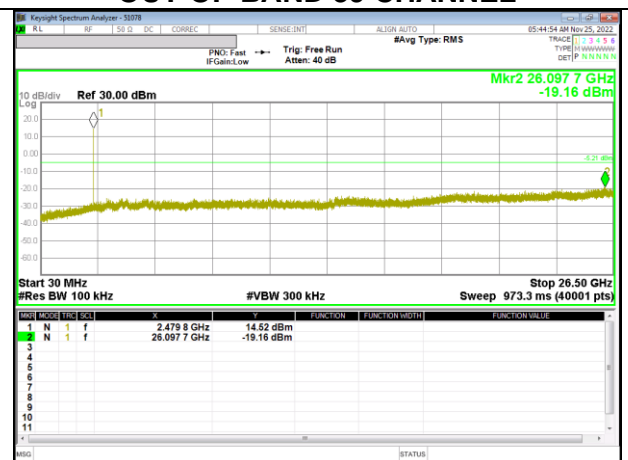
IN-BAND REFERENCE LEVEL



OUT-OF-BAND 39 CHANNEL



78 CHANNEL BANDEDGE



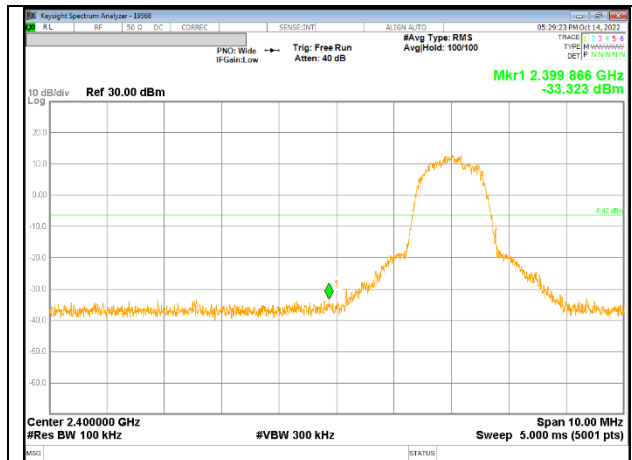
OUT-OF-BAND 78 CHANNEL

SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON

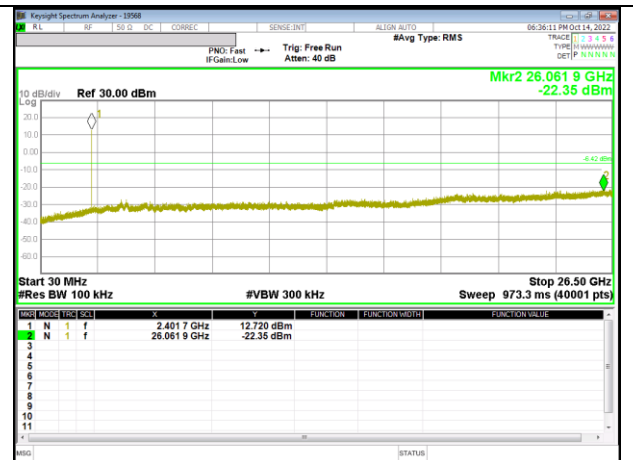


9.8.2. BLUETOOTH ENHANCED DATA RATE 8PSK MODULATION

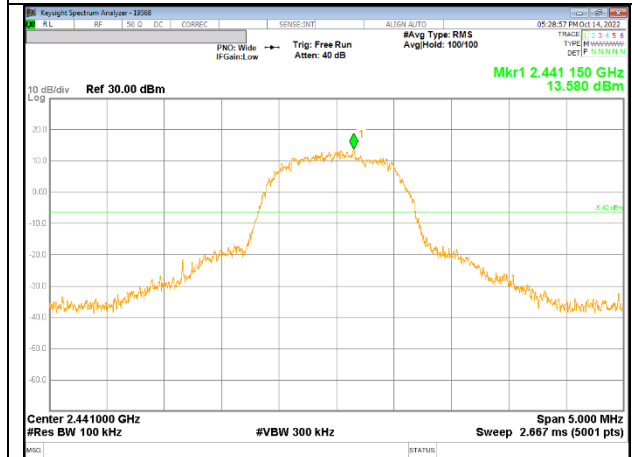
SPURIOUS EMISSIONS, NON-HOPPING - ANT1



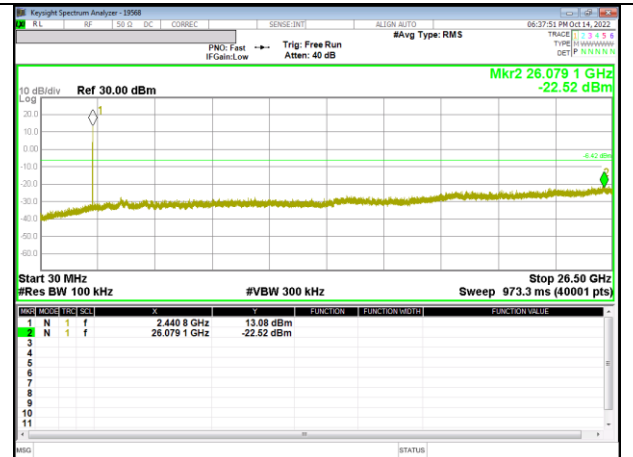
0 CHANNEL BANDEDGE



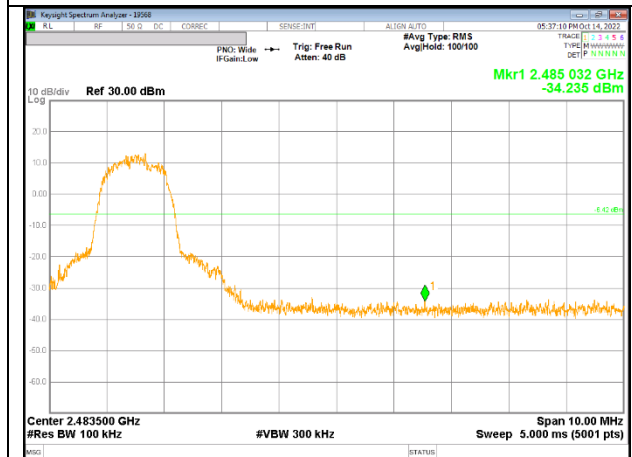
OUT-OF-BAND 0 CHANNEL



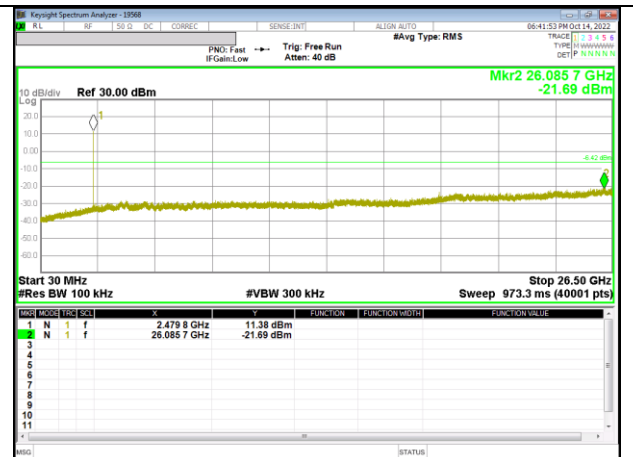
IN-BAND REFERENCE LEVEL



OUT-OF-BAND 39 CHANNEL

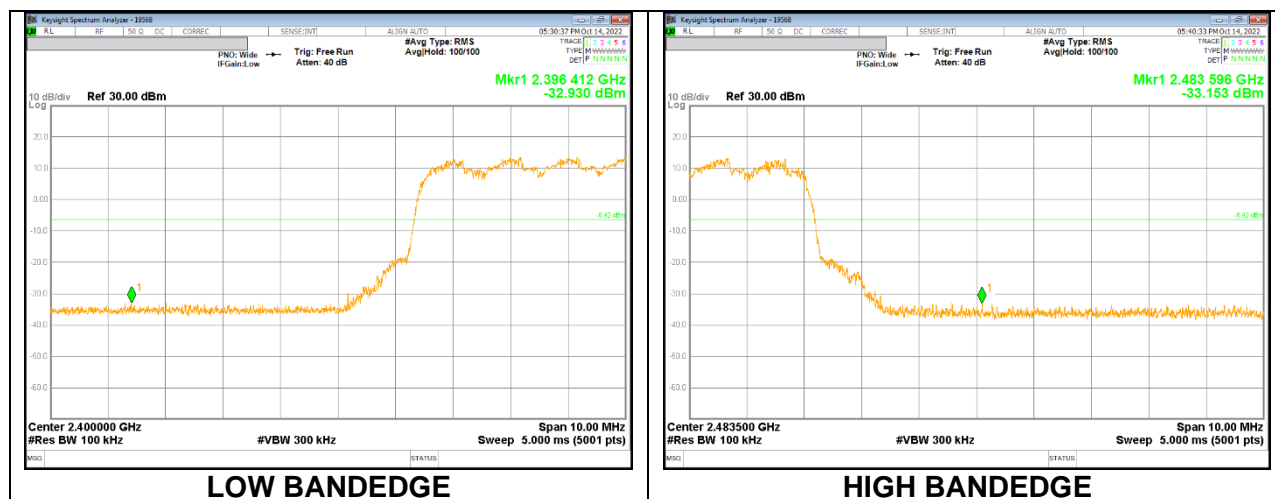


78 CHANNEL BANDEDGE

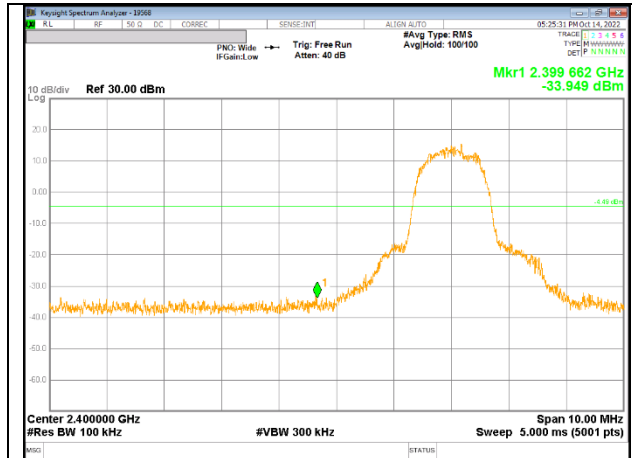


OUT-OF-BAND 78 CHANNEL

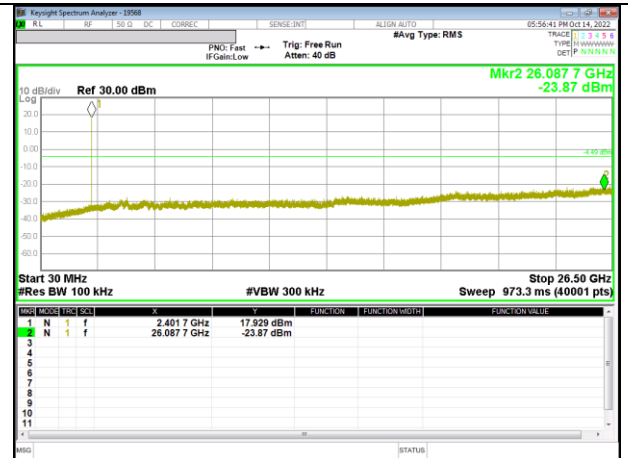
SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



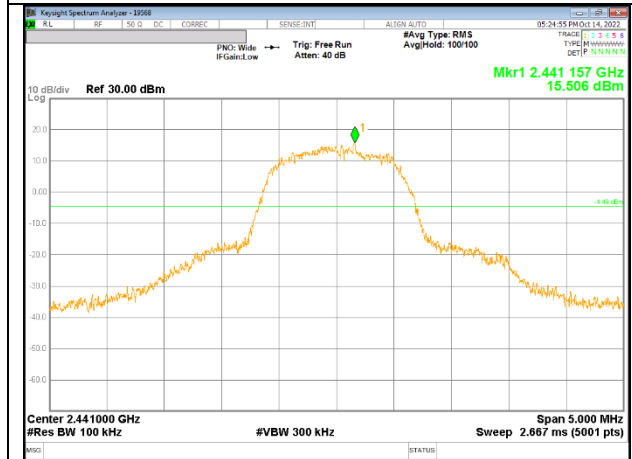
SPURIOUS EMISSIONS, NON-HOPPING - ANT2



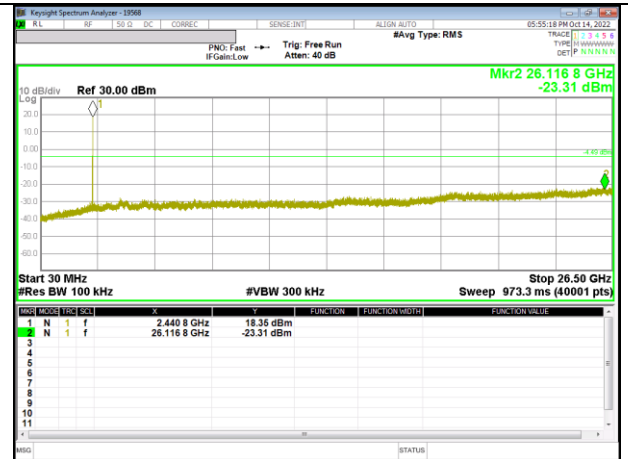
0 CHANNEL BANDEDGE



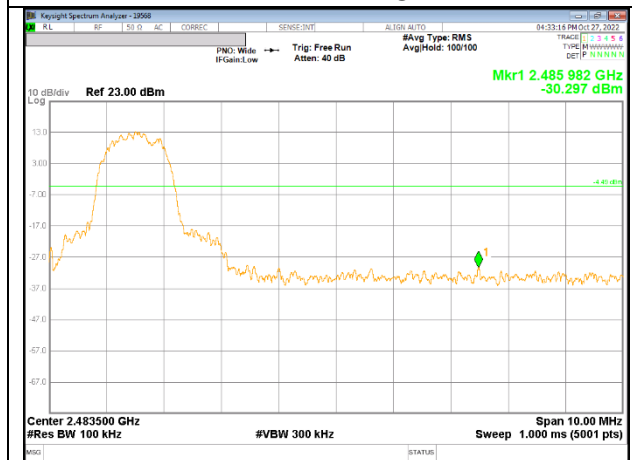
OUT-OF-BAND 0 CHANNEL



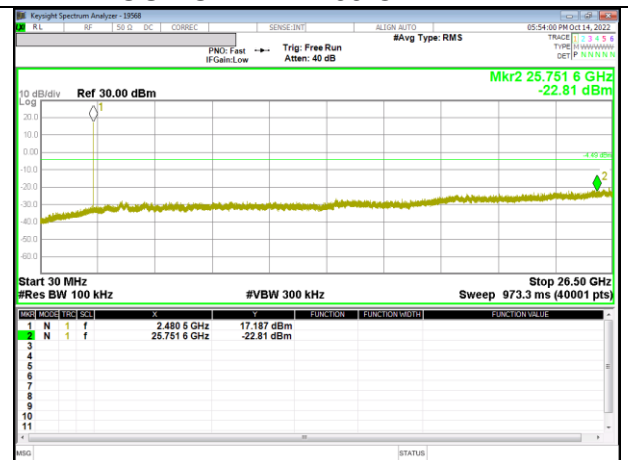
IN-BAND REFERENCE LEVEL



OUT-OF-BAND 39 CHANNEL

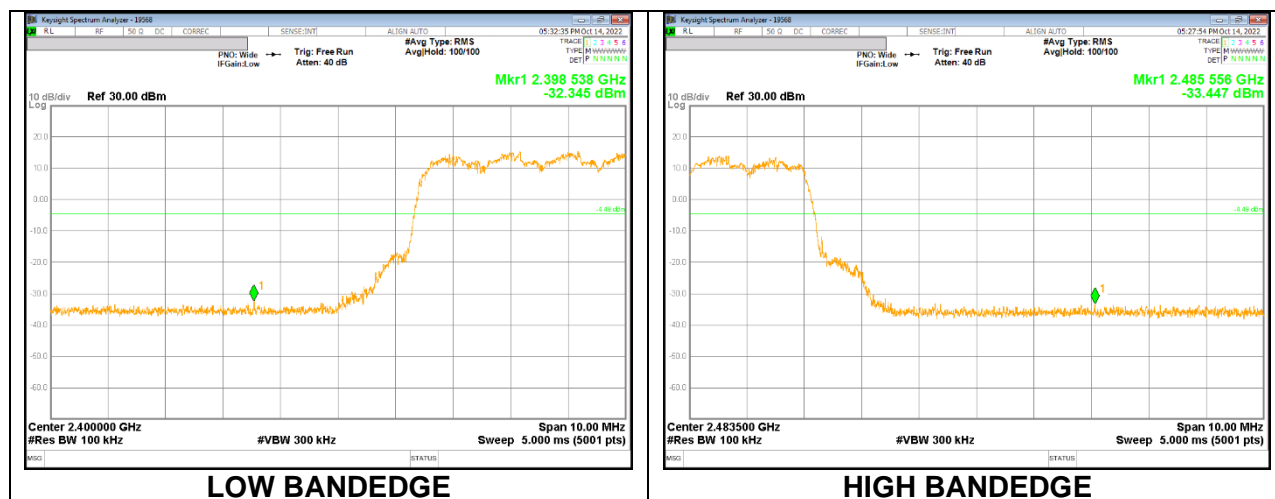


78 CHANNEL BANDEDGE



OUT-OF-BAND 78 CHANNEL

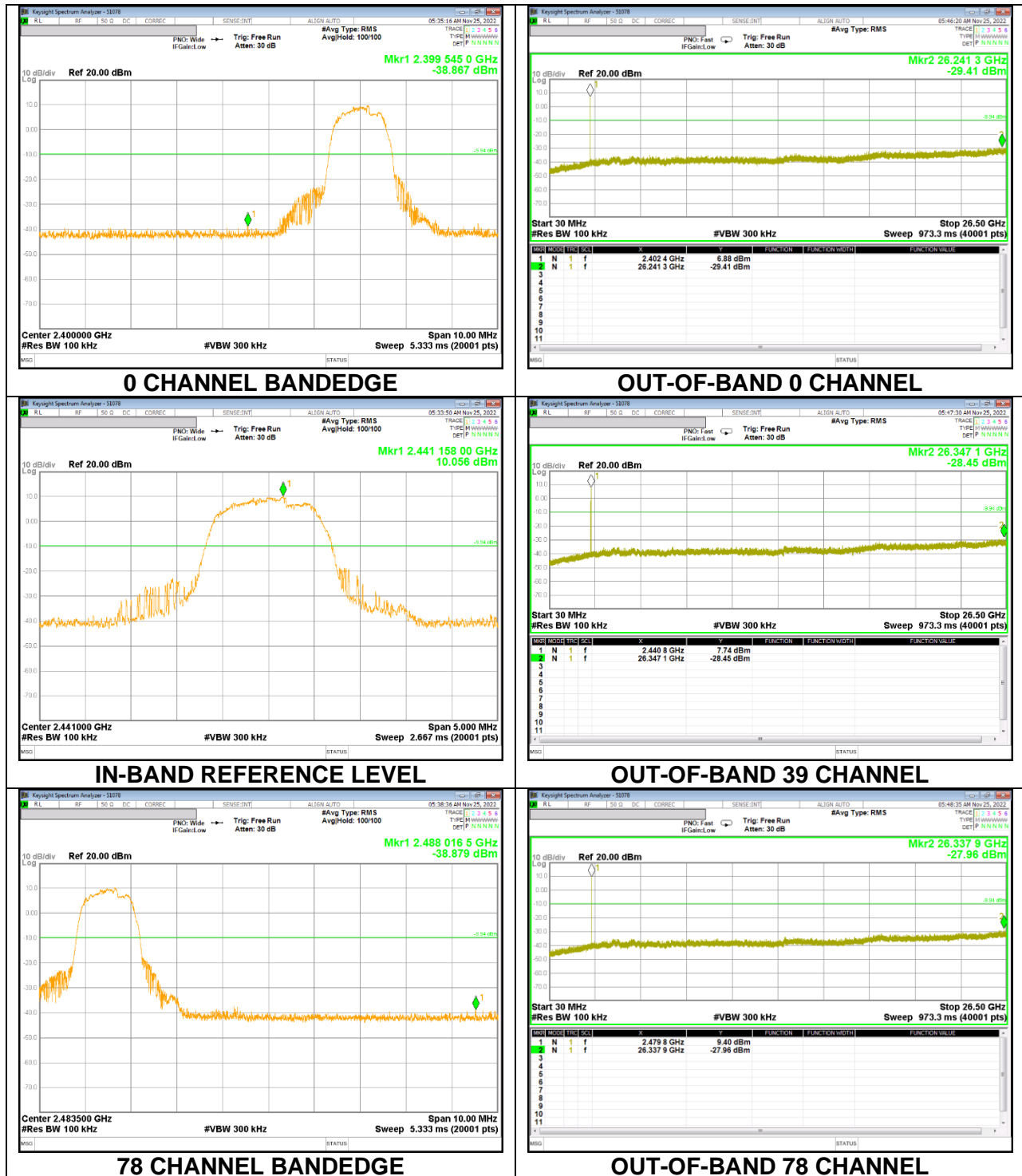
SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



SPURIOUS EMISSIONS, NON-HOPPING – DUAL mode ANT2



SPURIOUS BANDEDGE EMISSIONS WITH HOPPING ON



10. RADIATED TEST RESULTS

LIMITS

FCC §15.205 and §15.209

Limits for radiated disturbance of an intentional radiator		
Frequency range (MHz)	Limits (µV/m)	Measurement Distance (m)
0.009 – 0.490	2400 / F (kHz)	300
0.490 – 1.705	24000 / F (kHz)	30
1.705 – 30.0	30	30
30 – 88	100**	3
88 - 216	150**	3
216 – 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g. §§ 15.231 and 15.241.

FCC Part 15.205 (a) : Only spurious emissions are permitted in any of the frequency bands listed below :

MHz	MHz	MHz	MHz	GHz	GHz
0.009 ~ 0.110	8.41425 ~ 8.41475	108 ~ 121.94	1300 ~ 1427	4.5 ~ 5.15	14.47 ~ 14.5
0.495 ~ 0.505	12.29 ~ 12.293	123 ~ 138	1435 ~ 1626.5	5.35 ~ 5.46	15.35 ~ 16.2
2.1735 ~ 2.1905	12.51975 ~ 12.52025	149.9 ~ 150.05	1645.5 ~ 1646.5	7.25 ~ 7.75	17.7 ~ 21.4
4.125 ~ 4.128	12.57675 ~ 12.57725	156.52475 ~	1660 ~ 1710	8.025 ~ 8.5	22.01 ~ 23.12
4.17725 ~ 4.17775	13.36 ~ 13.41	156.52525	1718.8 ~ 1722.2	9.0 ~ 9.2	23.6 ~ 24.0
4.20725 ~ 4.20775	16.42 ~ 16.423	156.7 ~ 156.9	2200 ~ 2300	9.3 ~ 9.5	31.2 ~ 31.8
6.215 ~ 6.218	16.69475 ~ 16.69525	162.0125 ~	2310 ~ 2390	10.6 ~ 12.7	36.43 ~ 36.5
6.26775 ~ 6.26825	16.80425 ~ 16.80475	167.17	2483.5 ~ 2500	13.25 ~ 13.4	Above 38.6
6.31175 ~ 6.31225	25.5 ~ 25.67	167.72 ~ 173.2	2655 ~ 2900		
8.291 ~ 8.294	37.5 ~ 38.25	240 ~ 285	3260 ~ 3267		
8.362 ~ 8.366	73 ~ 74.6	322 ~ 335.4	3332 ~ 3339		
8.37625 ~ 8.38675	74.8 ~ 75.2	399.90 ~ 410	3345.8 ~ 3358		
		608 ~ 614	3600 ~ 4400		
		960 ~ 1240			

▪ FCC Part 15.205(b) : The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane for below 1GHz and 150 cm for above 1GHz. The EUT is configured in accordance with ANSI C63.10. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements.(Pre-scans to detect harmonic and spurious emissions, the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 30 kHz for peak measurements.)

For band edge measurements and above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 3 MHz for peak measurements and 1/T (on time) for average measurement.

GFSK = $1/T = 1 / 0.002883s = 347Hz$.

8PSK = $1/T = 1 / 0.002898s = 345Hz$

The minimum VBW was 347Hz, but test receiver(ESU40) couldn't set value 348Hz. Due to this reason, testing VBW was set to 500Hz(Worst cases).

The spectrum from 1GHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.
(From 30MHz to 1GHz, test was performed with the EUT set to transmit at the channel with highest output power)

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

NOTE

Emission was pre-scanned from 9kHz to 30MHz; No emissions were detected which was at least 20dB below the specification limit (consider distance correction factor).

Per FCC part 15.31(o), test results were not reported.

Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open are test site.

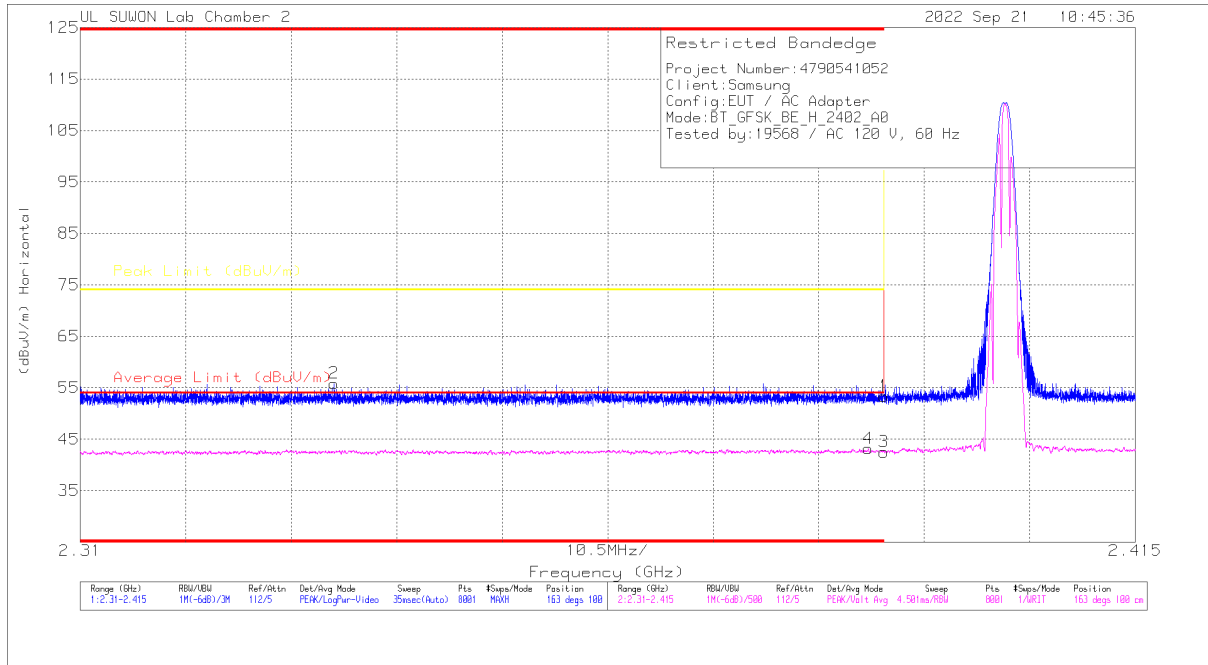
Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the one of tests made in an open field based on KDB 414788.

10.1. TRANSMITTER ABOVE 1 GHz

10.1.1. BLUETOOTH BASIC DATA RATE GFSK MODULATION

- ANT1
BANDEDGE (0 CHANNEL)

HORIZONTAL RESULT



Trace Markers

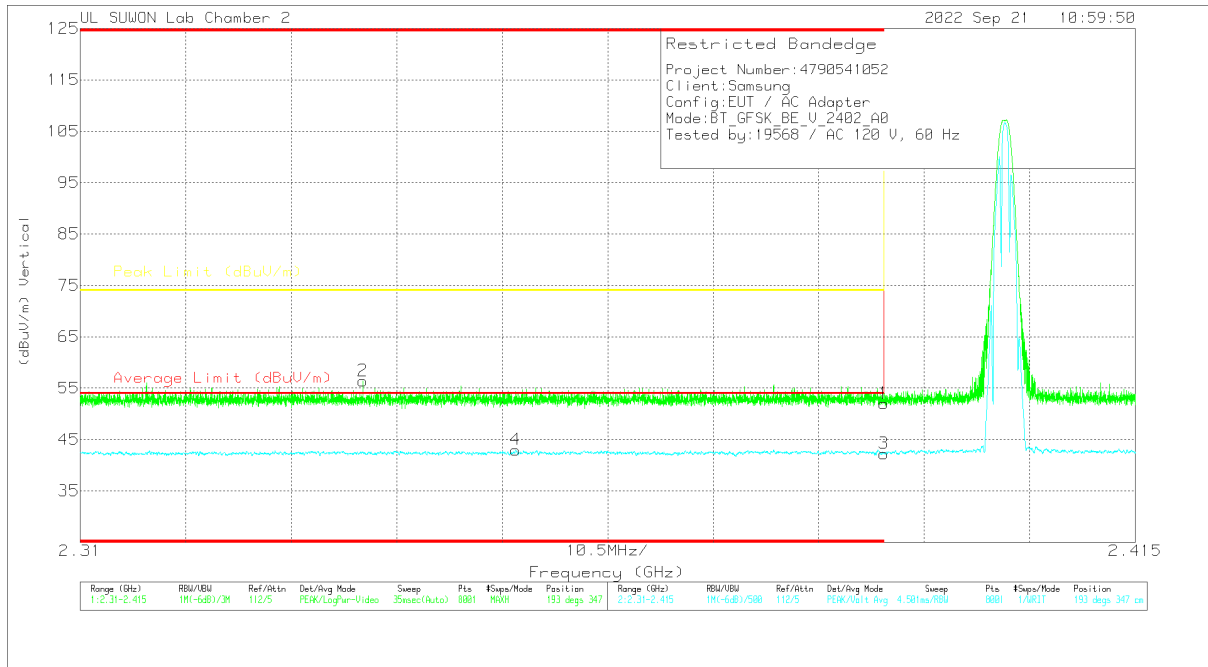
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117_00168724	10dB_ATT[dB]	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	41.35	Pk	31.7	-19.7	53.35	-	-	74	-20.65	163	100	H
2	* 2.33524	43.85	Pk	31.6	-19.6	55.85	-	-	74	-18.15	163	100	H
3	* 2.39	30.53	VA1T	31.7	-19.7	42.53	54	-11.47	-	-	163	100	H
4	* 2.38841	31.08	VA1T	31.7	-19.6	43.18	54	-10.82	-	-	163	100	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average VB=1/Ton where: Ton is transmit duration

VERTICAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117_00168724	10dB_ATT[dB]	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.39	40.04	Pk	31.7	-19.7	52.04	-	-	74	-21.96	193	347	V
2	* 2.33814	44.43	Pk	31.6	-19.6	56.43	-	-	74	-17.57	193	347	V
3	* 2.39	30.27	VA1T	31.7	-19.7	42.27	54	-11.73	-	-	193	347	V
4	* 2.35331	31	VA1T	31.6	-19.6	43	54	-11	-	-	193	347	V

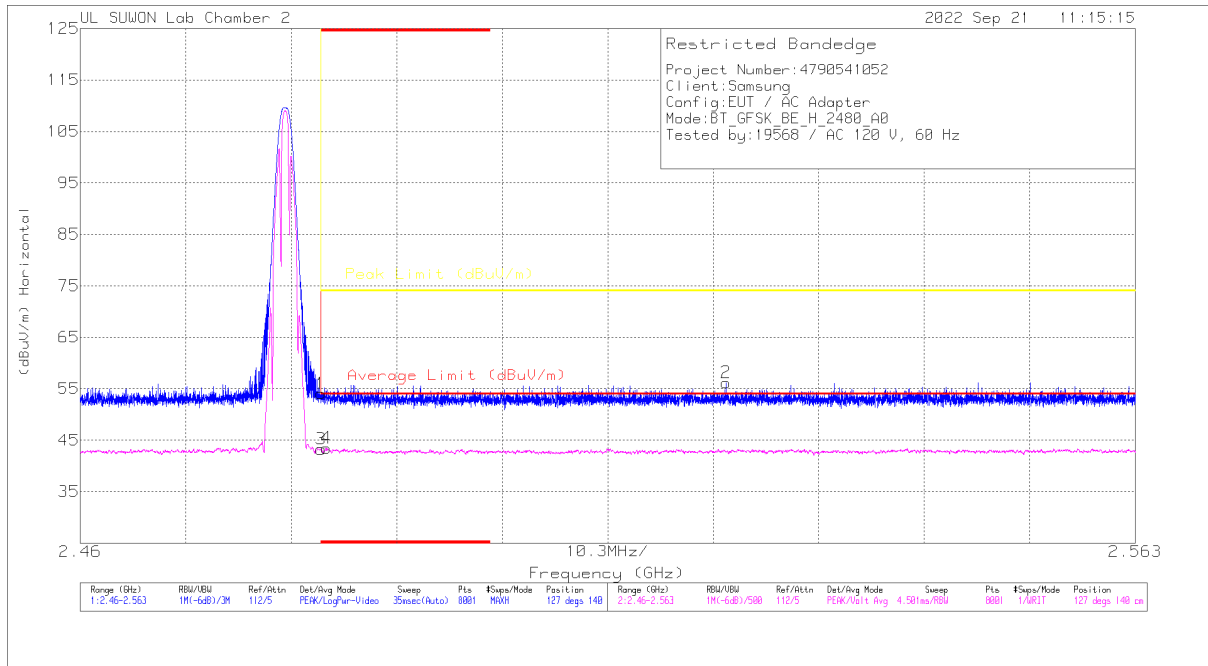
* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B = 1/T_{on}$ where: T_{on} is transmit duration

BANDEDGE (78 CHANNEL)

HORIZONTAL RESULT



Trace Markers

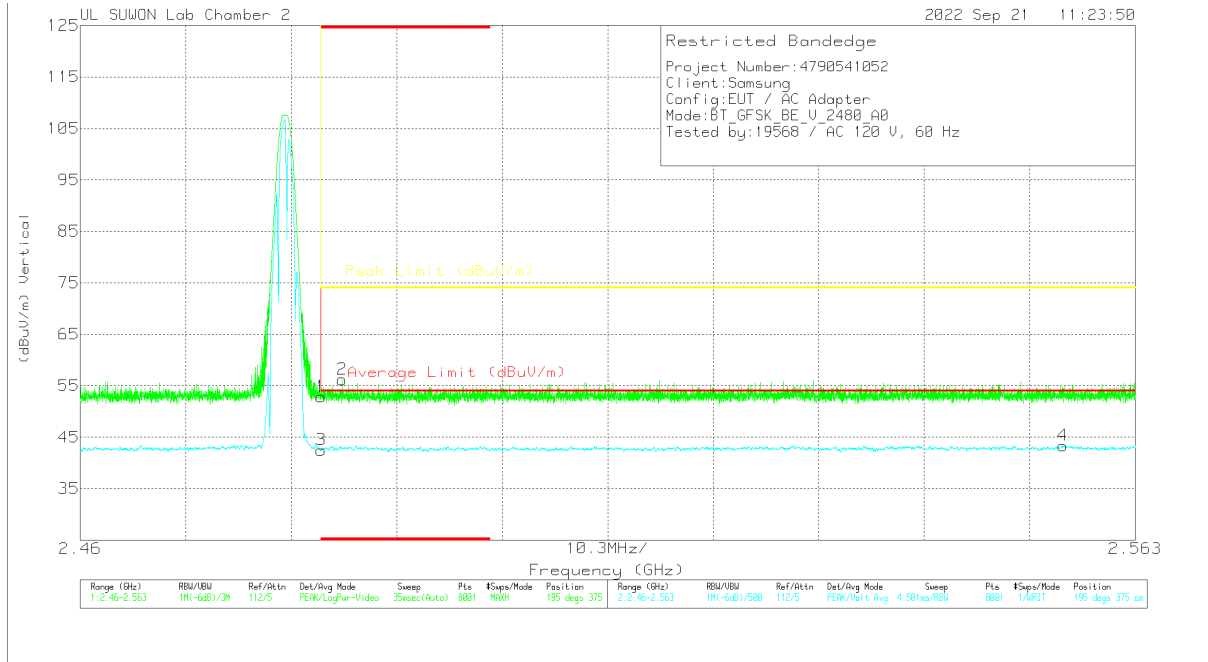
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117_00168724	10dB_ATT[dB]	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	41.76	Pk	31.9	-19.6	54.06	-	-	74	-19.94	127	140	H
2	2.52304	43.8	Pk	31.9	-19.5	56.2	-	-	74	-17.8	127	140	H
3	* 2.48351	30.97	VA1T	31.9	-19.6	43.27	54	-10.73	-	-	127	140	H
4	* 2.48402	31.17	VA1T	31.9	-19.6	43.47	54	-10.53	-	-	127	140	H

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B=1/T_{on}$ where: T_{on} is transmit duration

VERTICAL RESULT



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	3117_00168724	10dB_ATT[dB]	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.48351	40.56	Pk	31.9	-19.6	52.86	-	-	74	-21.14	195	375	V
2	* 2.48558	43.92	Pk	31.9	-19.6	56.22	-	-	74	-17.78	195	375	V
3	* 2.48351	30.22	VA1T	31.9	-19.6	42.52	54	-11.48	-	-	195	375	V
4	2.55596	30.67	VA1T	32	-19.3	43.37	54	-10.63	-	-	195	375	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band

Pk - Peak detector

VA1T - FHSS: Linear Voltage Average $V_B = 1/T_{on}$ where: T_{on} is transmit duration