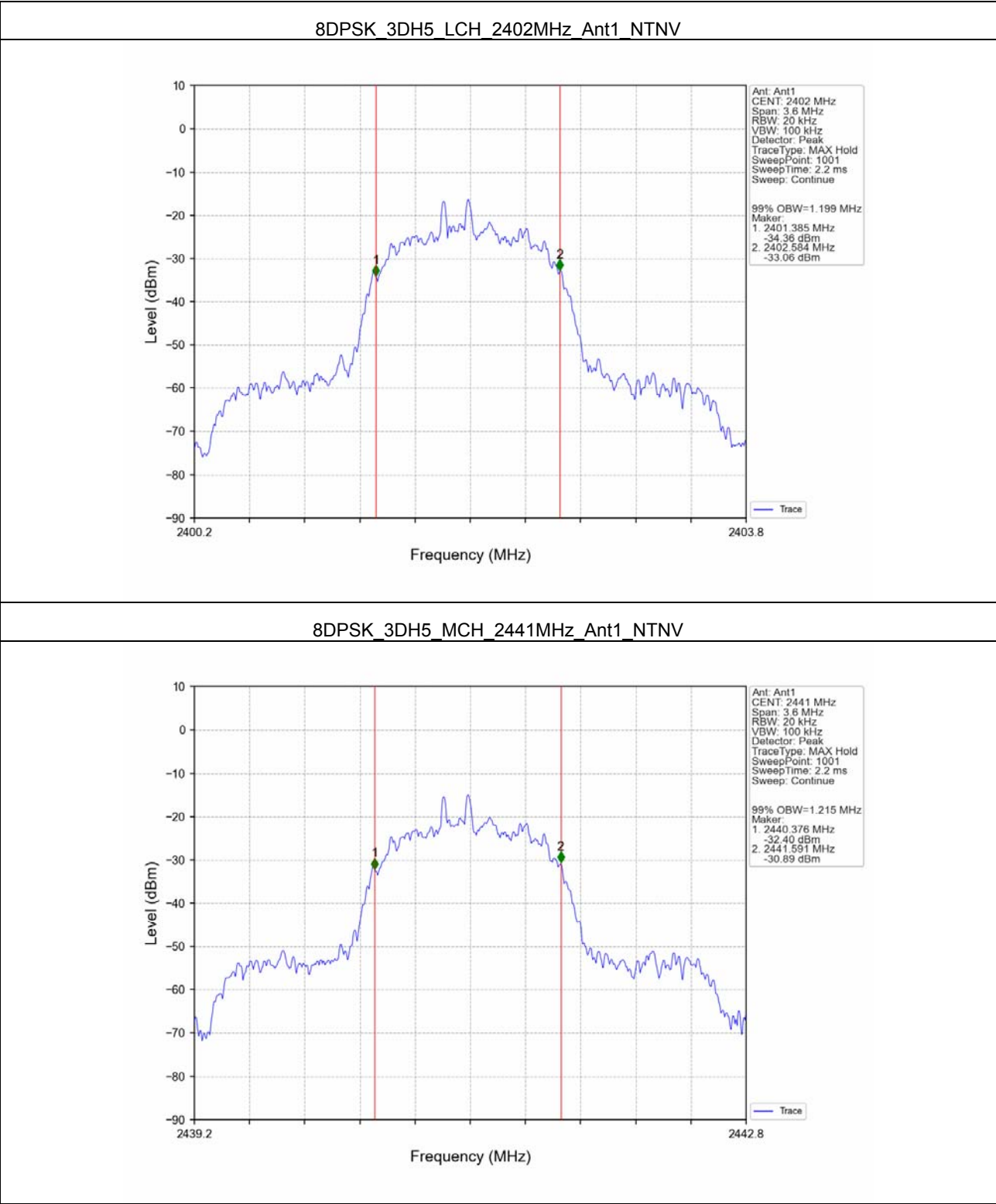
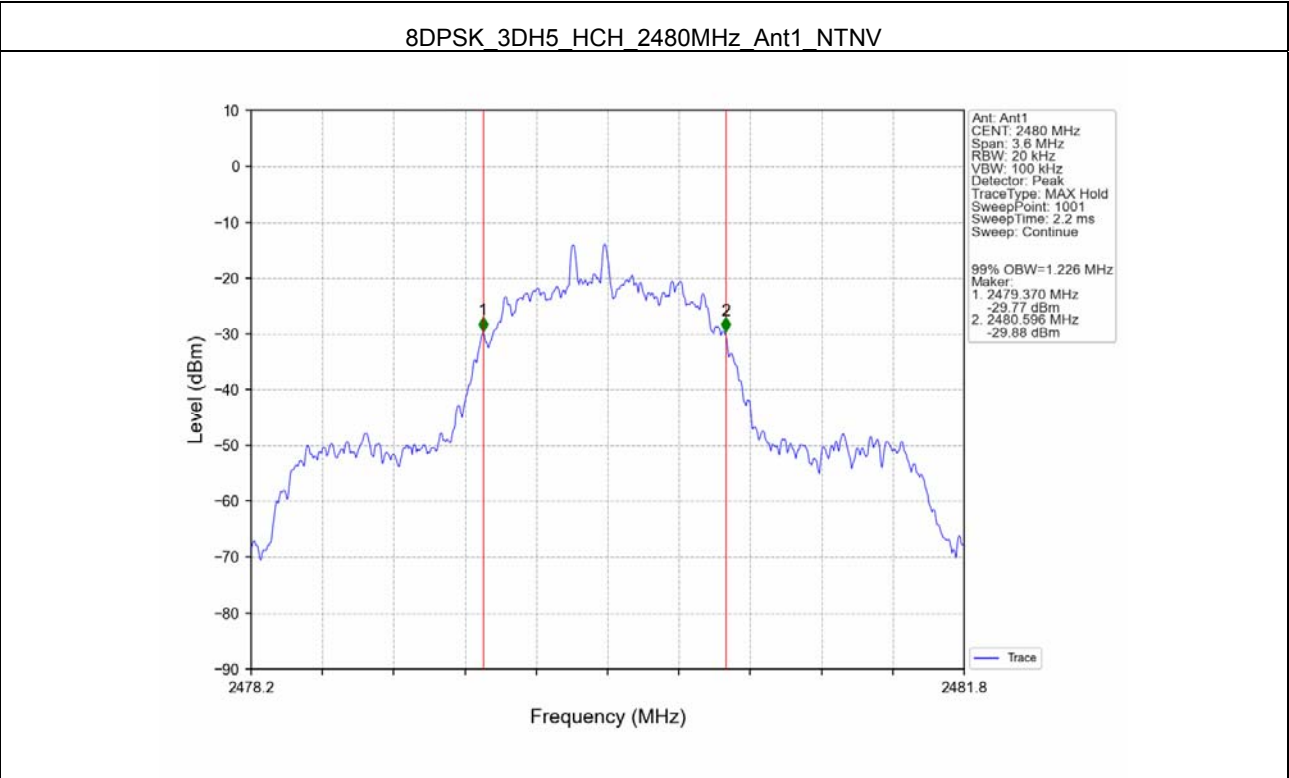






12 Maximum Peak Output Power

Test Requirement:	FCC 47CFR Part 15 Section 15.247
Test Method:	ANSI C63.10-2020
Test Limit:	§15.247(b)(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.
Test Mode:	Test in fixing frequency transmitting mode.

12.1 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:
 - a) Use the following spectrum analyzer settings:
 - 1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
 - 2) RBW $\geq$ 20 dB bandwidth of the emission being measured.
 - 3) VBW $\geq$ RBW.
 - 4) Sweep: Auto.
 - 5) Detector function: Peak.
 - 6) Trace: Max hold.
 - b) Allow trace to stabilize.
 - c) Use the marker-to-peak function to set the marker to the peak of the emission.
 - d) The indicated level is the peak output power, after any corrections for external attenuators and cables.
 - e) A plot of the test results and setup description shall be included in the test report.
3. Keep the EUT in transmitting at lowest, medium and highest channel individually. Record the max value.

12.2 Test Result

Bluetooth1

Mode	TX Type	Frequency (MHz)	Packet Type	Maximum Peak Conducted Output Power (dBm)		Verdict
				ANT1	Limit	
GFSK	SISO	2402	DH5	-11.85	<=30	Pass
		2441	DH5	-11.09	<=30	Pass
		2480	DH5	-10.84	<=30	Pass
$\pi/4$ DQPSK	SISO	2402	2DH5	-11.16	<=20.97	Pass
		2441	2DH5	-10.59	<=20.97	Pass
		2480	2DH5	-10.46	<=20.97	Pass
8DPSK	SISO	2402	3DH5	-10.91	<=20.97	Pass
		2441	3DH5	-10.37	<=20.97	Pass
		2480	3DH5	-10.26	<=20.97	Pass

Bluetooth2

Mode	TX Type	Frequency (MHz)	Packet Type	Maximum Peak Conducted Output Power (dBm)		Verdict
				ANT1	Limit	
GFSK	SISO	2402	DH5	-13.26	<=30	Pass
		2441	DH5	-11.46	<=30	Pass
		2480	DH5	-10.51	<=30	Pass
$\pi/4$ DQPSK	SISO	2402	2DH5	-12.66	<=20.97	Pass
		2441	2DH5	-10.97	<=20.97	Pass
		2480	2DH5	-10.17	<=20.97	Pass
8DPSK	SISO	2402	3DH5	-12.40	<=20.97	Pass
		2441	3DH5	-10.74	<=20.97	Pass
		2480	3DH5	-9.97	<=20.97	Pass

Bluetooth3

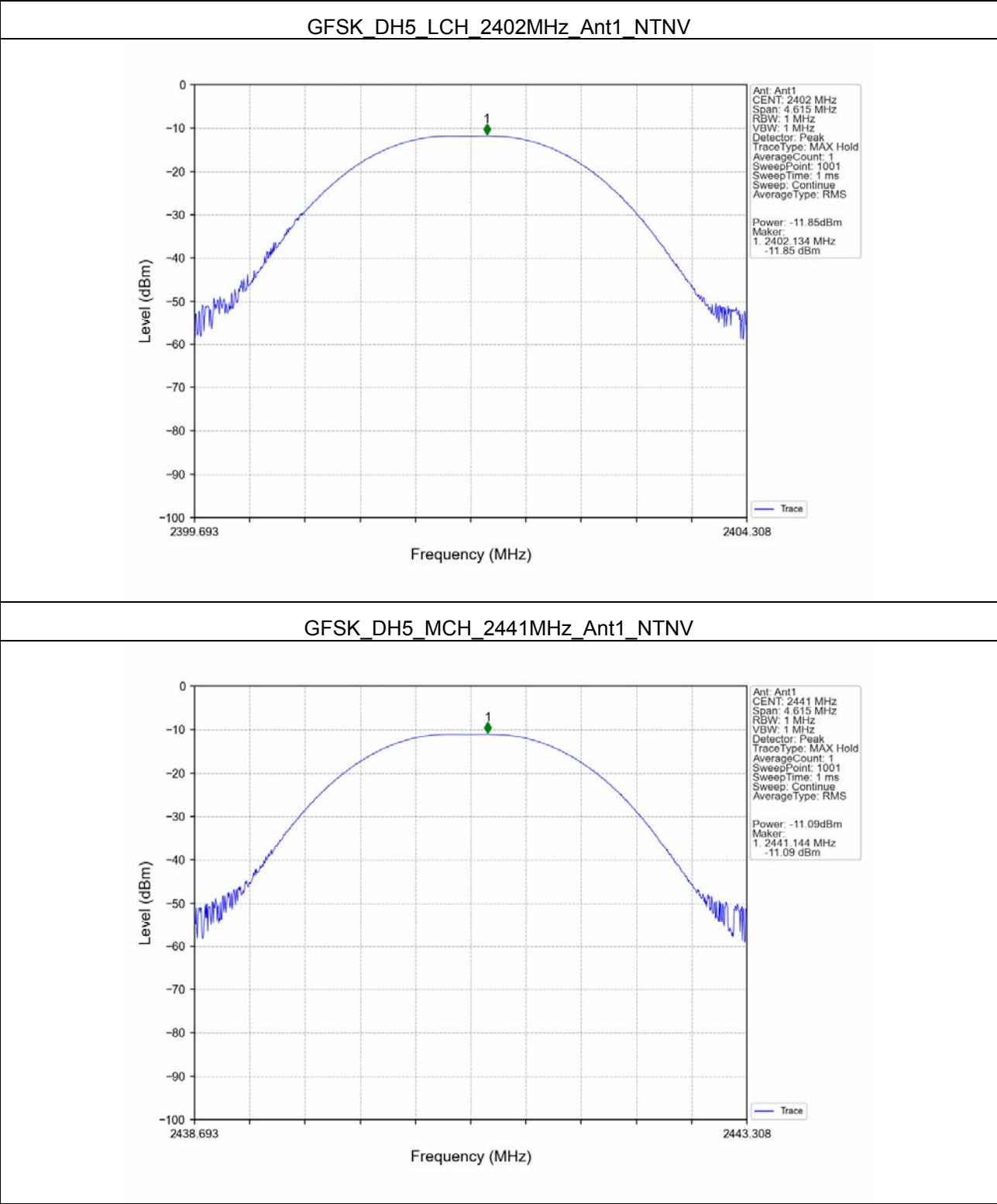
Mode	TX Type	Frequency (MHz)	Packet Type	Maximum Peak Conducted Output Power (dBm)		Verdict
				ANT1	Limit	
GFSK	SISO	2402	DH5	-12.78	<=30	Pass
		2441	DH5	-11.28	<=30	Pass
		2480	DH5	-10.30	<=30	Pass
$\pi/4$ DQPSK	SISO	2402	2DH5	-12.23	<=20.97	Pass
		2441	2DH5	-10.82	<=20.97	Pass
		2480	2DH5	-9.98	<=20.97	Pass
8DPSK	SISO	2402	3DH5	-12.01	<=20.97	Pass
		2441	3DH5	-10.67	<=20.97	Pass
		2480	3DH5	-9.83	<=20.97	Pass

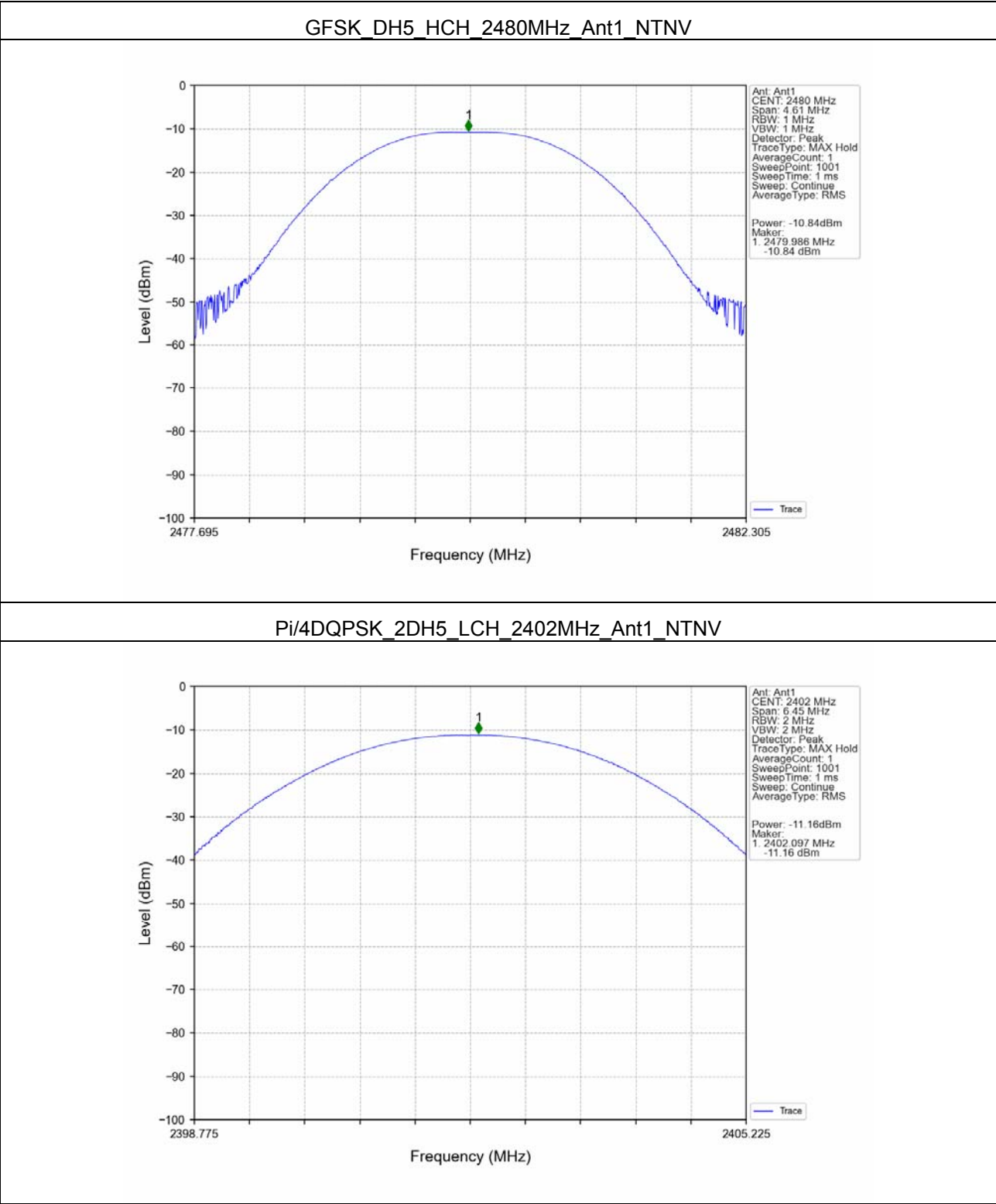
Bluetooth4

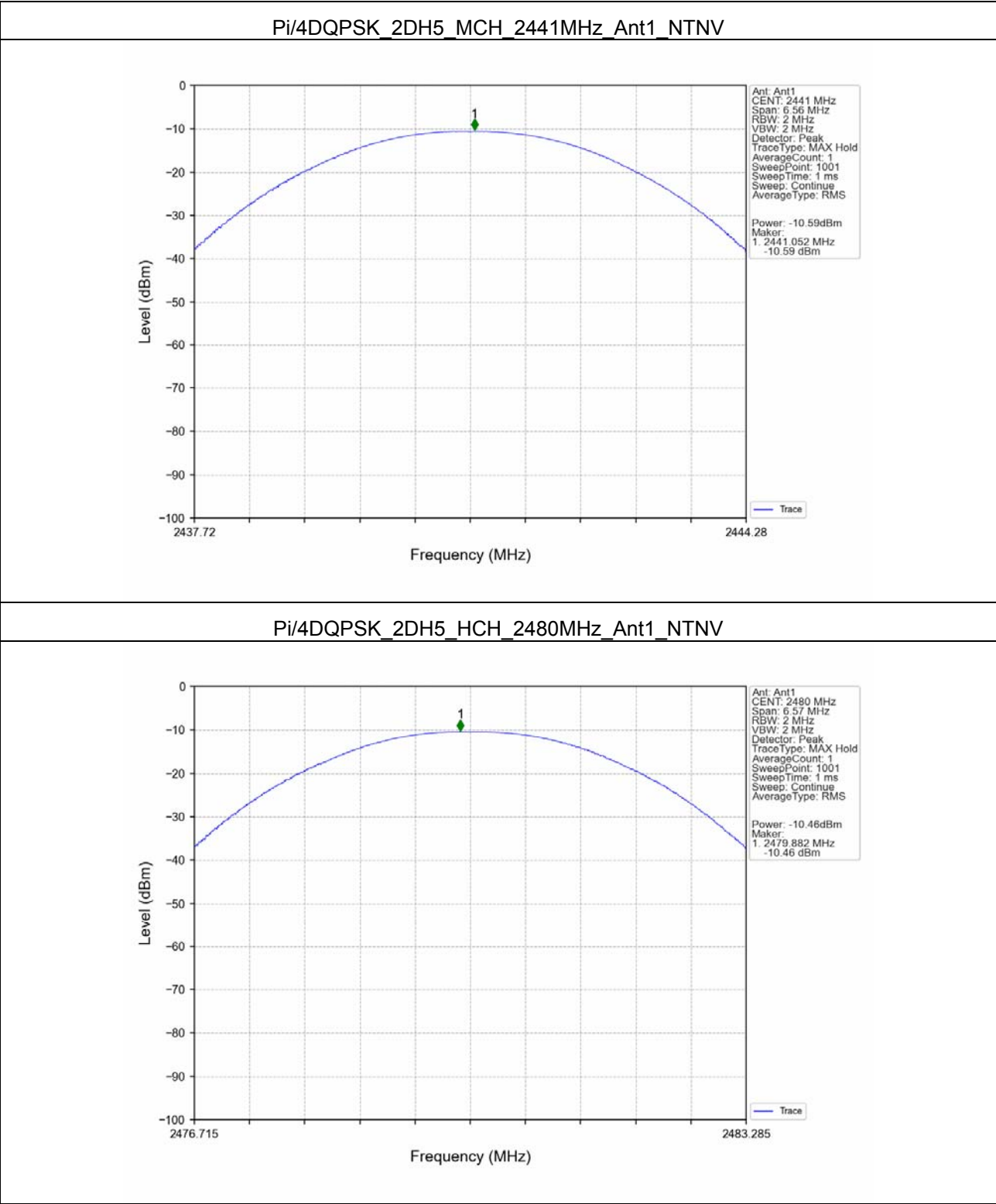
Mode	TX Type	Frequency (MHz)	Packet Type	Maximum Peak Conducted Output Power (dBm)		Verdict
				ANT1	Limit	
GFSK	SISO	2402	DH5	-12.93	<=30	Pass
		2441	DH5	-11.40	<=30	Pass
		2480	DH5	-10.42	<=30	Pass
$\pi/4$ DQPSK	SISO	2402	2DH5	-12.25	<=20.97	Pass
		2441	2DH5	-10.93	<=20.97	Pass
		2480	2DH5	-10.03	<=20.97	Pass
8DPSK	SISO	2402	3DH5	-12.00	<=20.97	Pass
		2441	3DH5	-10.69	<=20.97	Pass
		2480	3DH5	-9.87	<=20.97	Pass

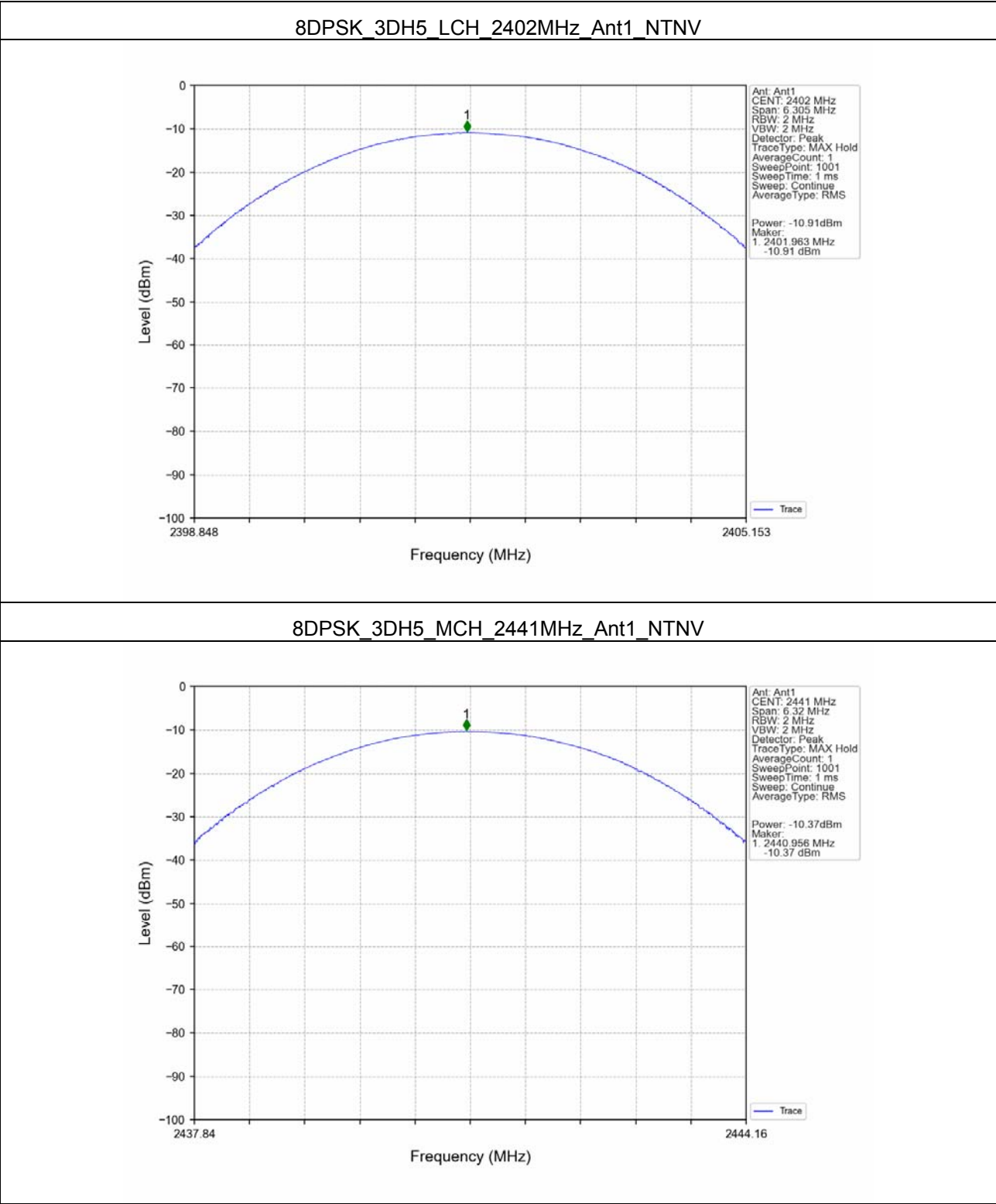
Bluetooth1

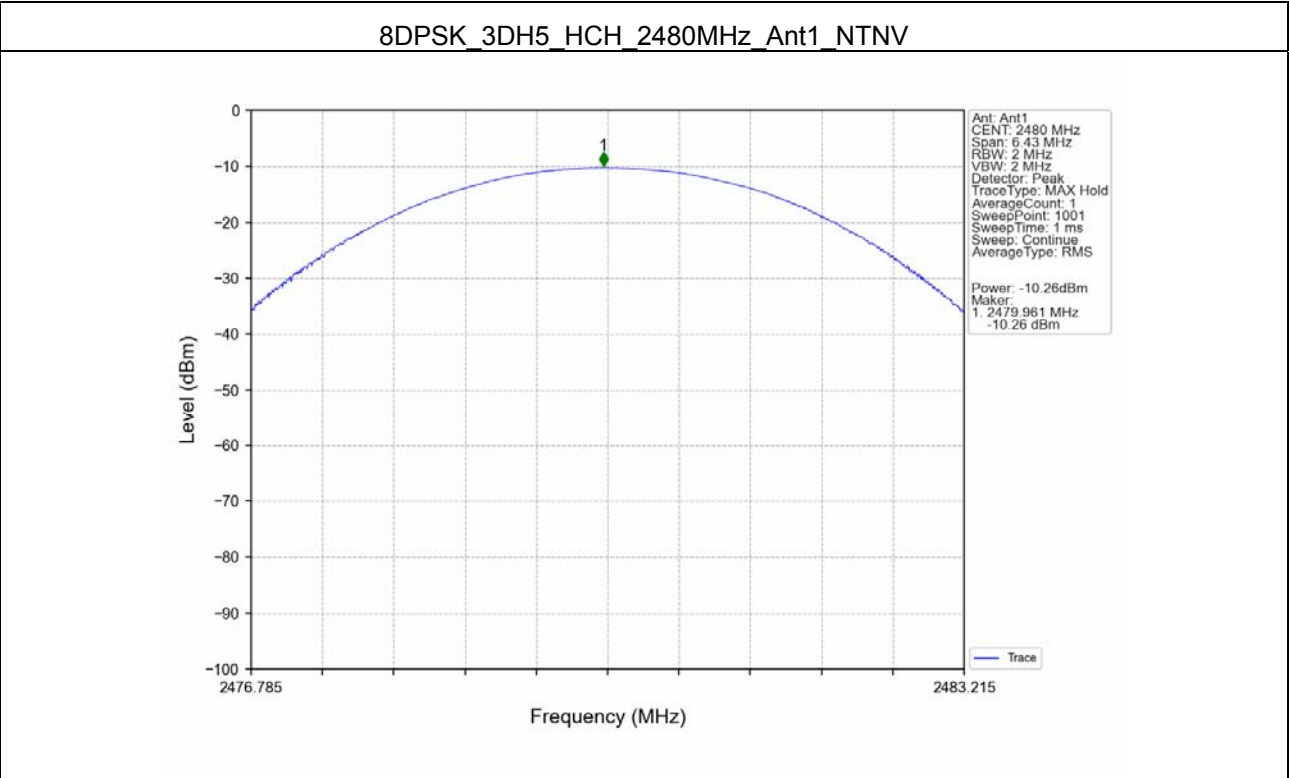
Test plots



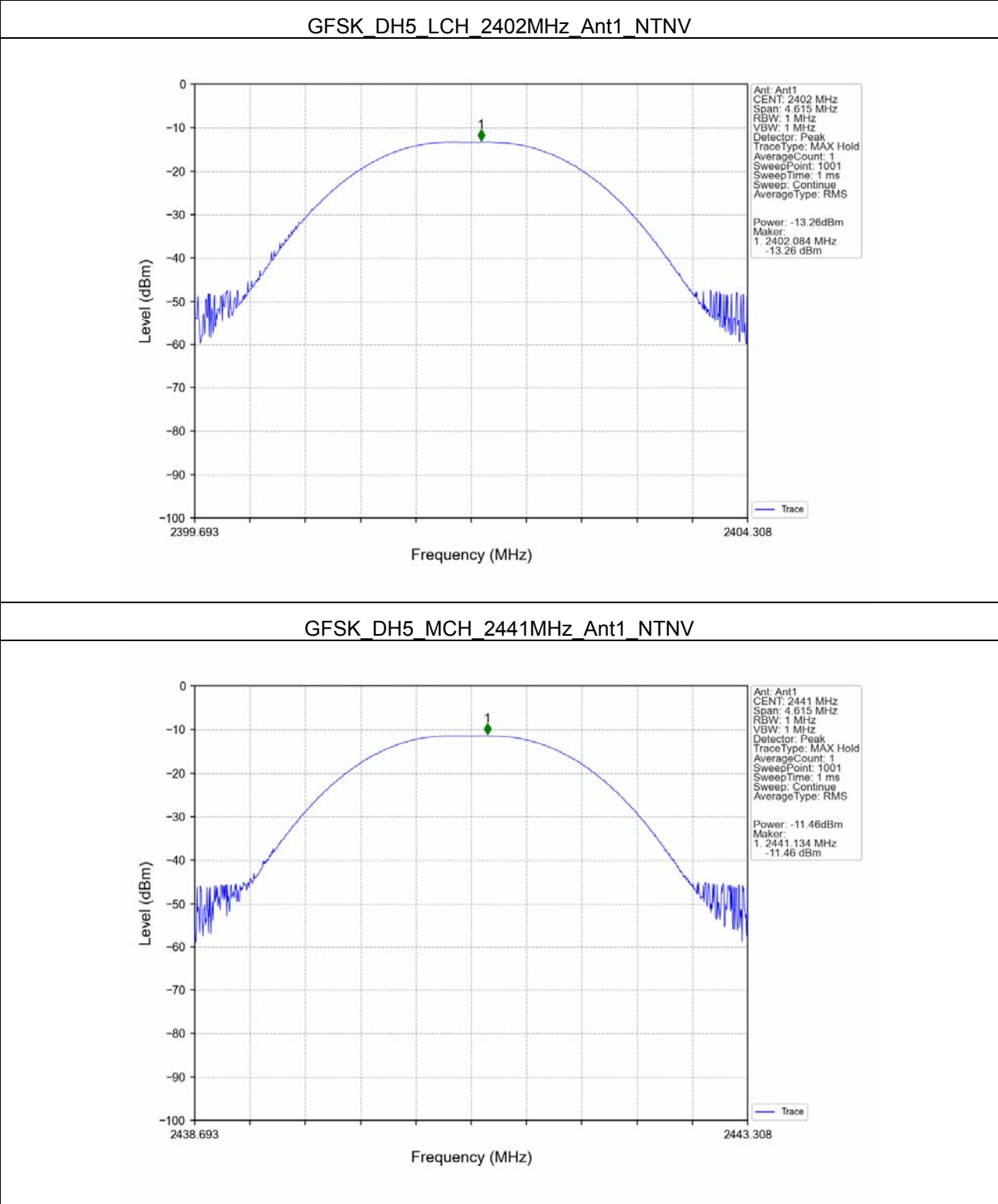


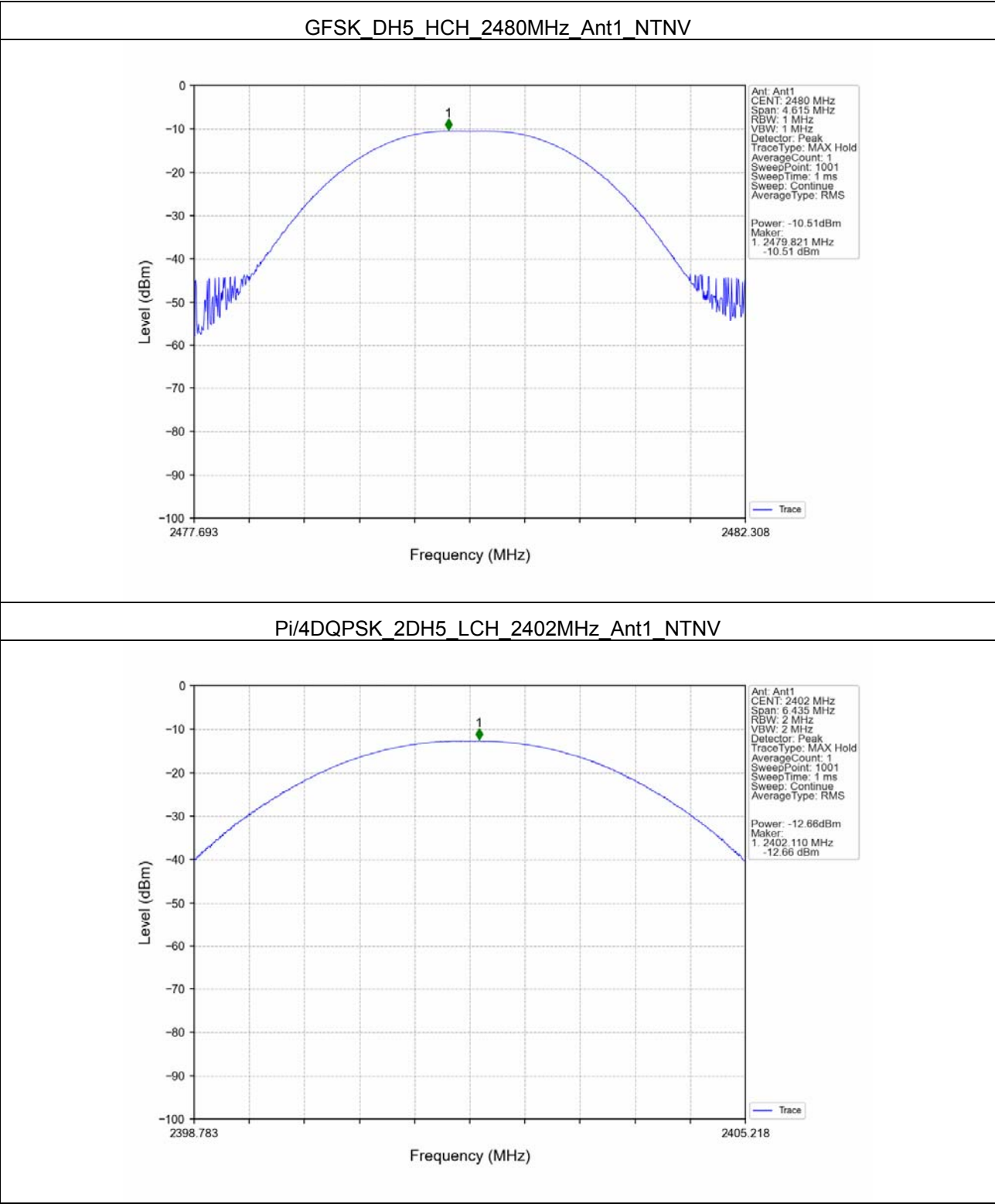


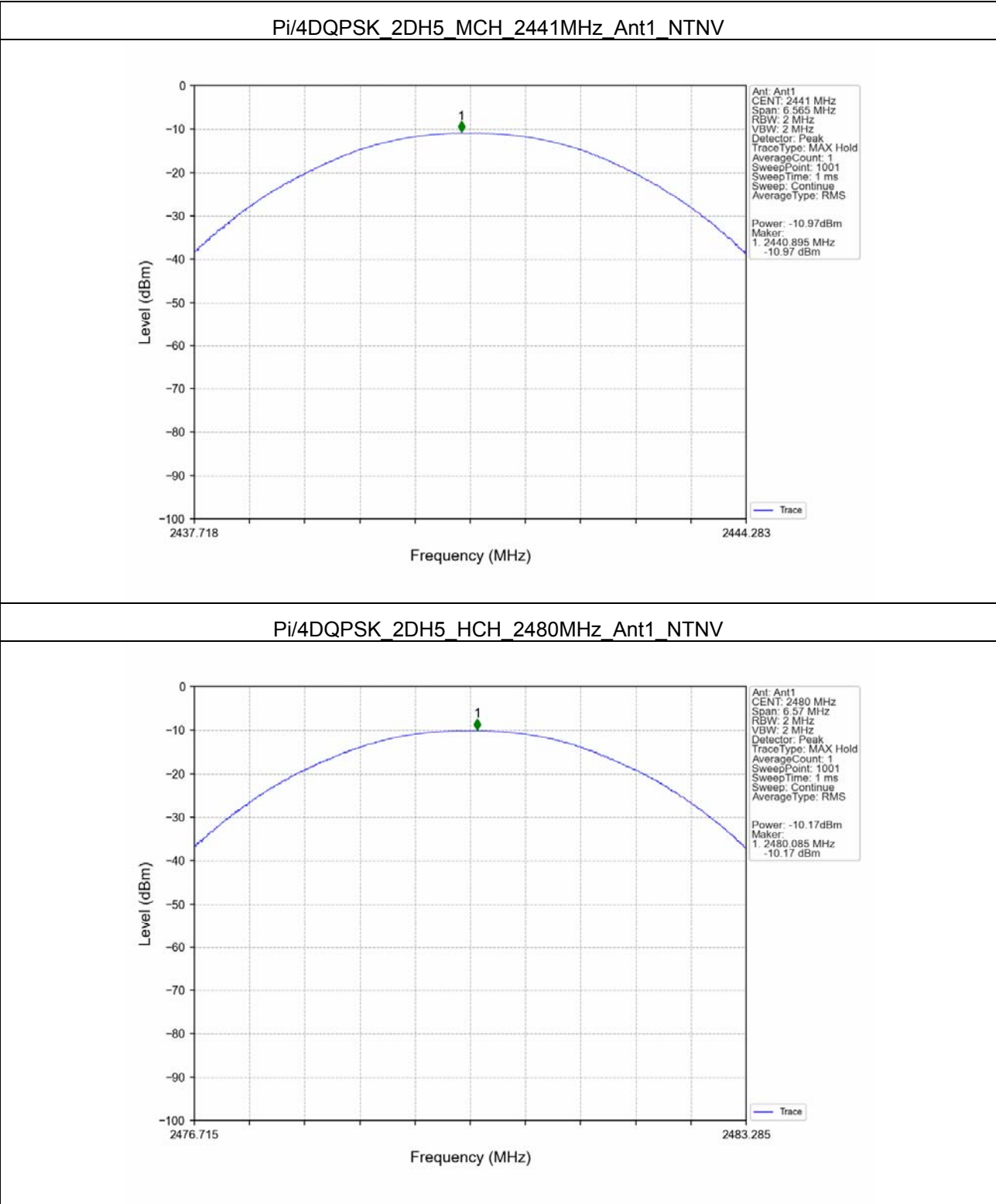


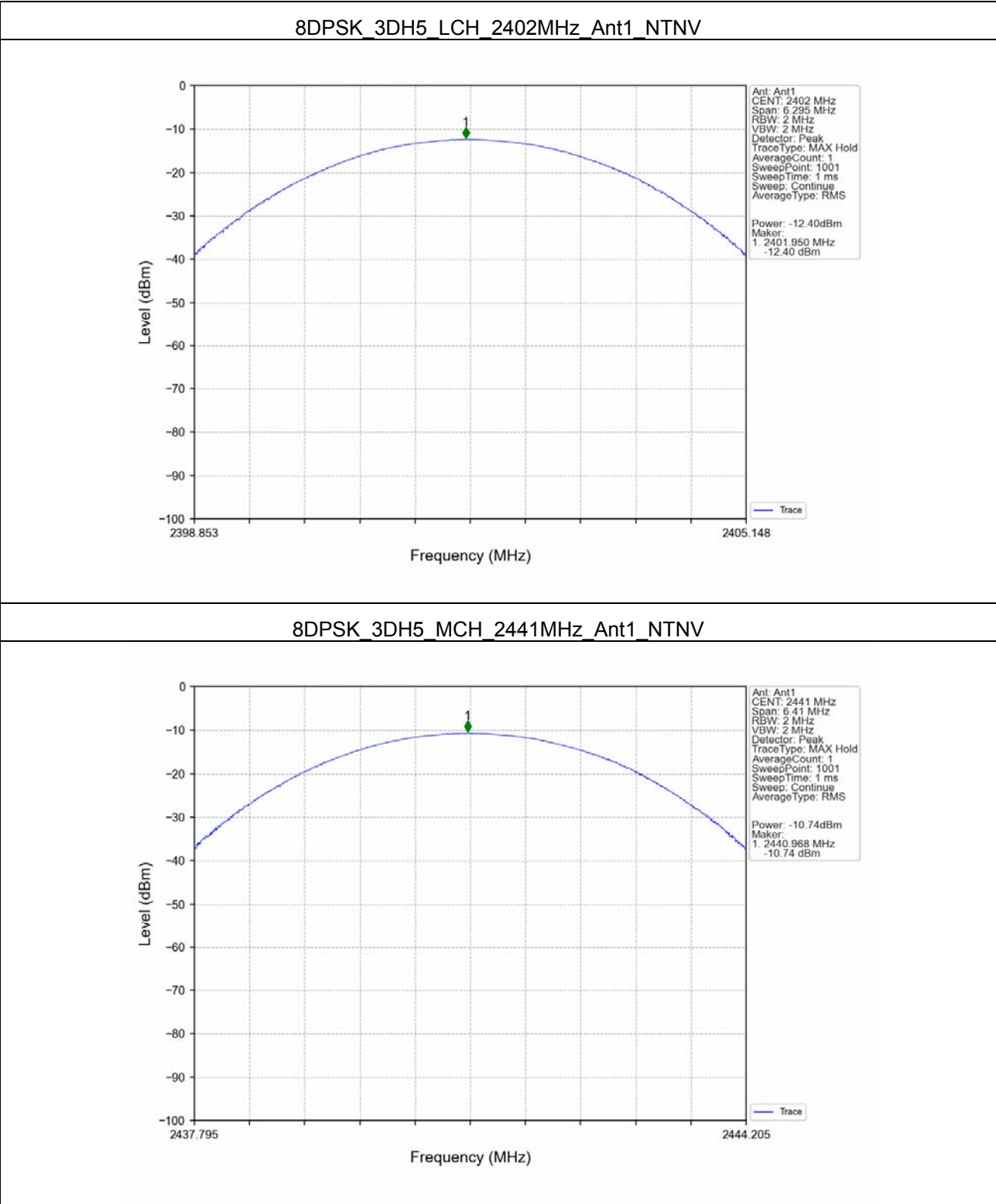


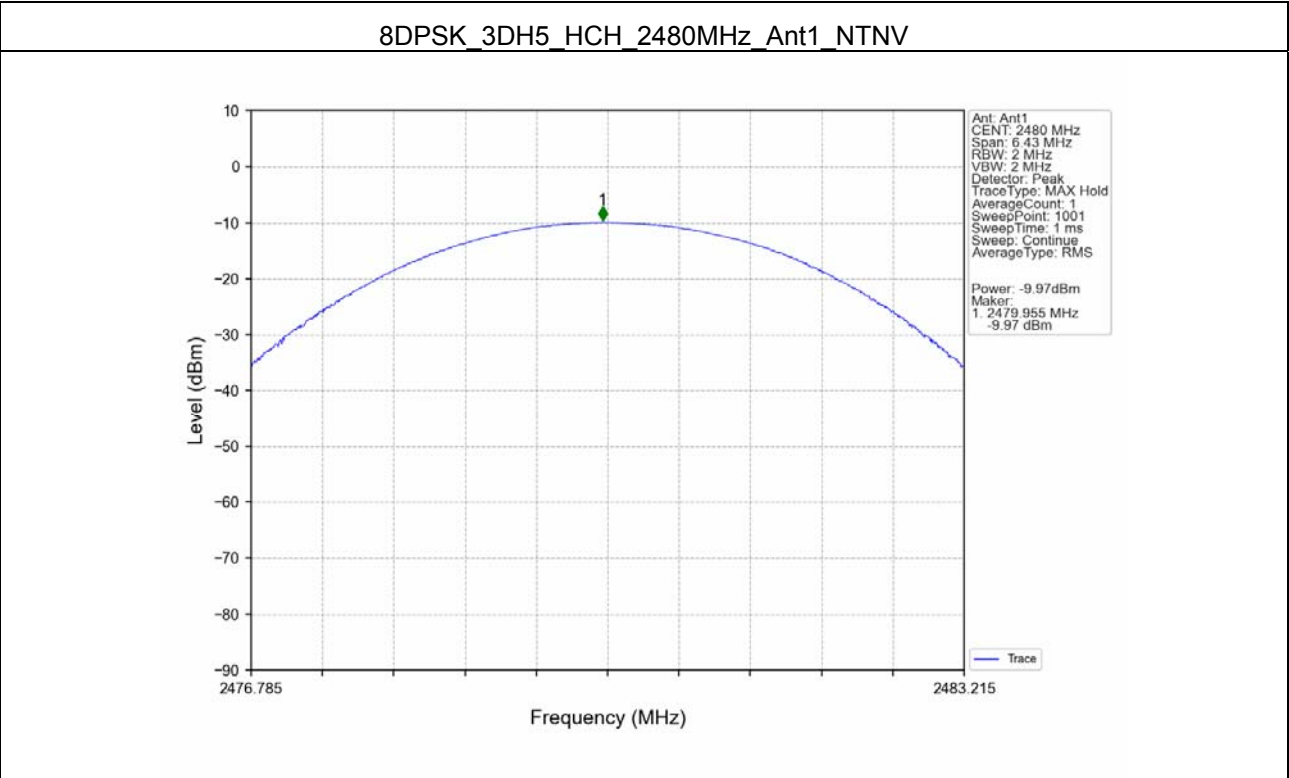
Bluetooth2





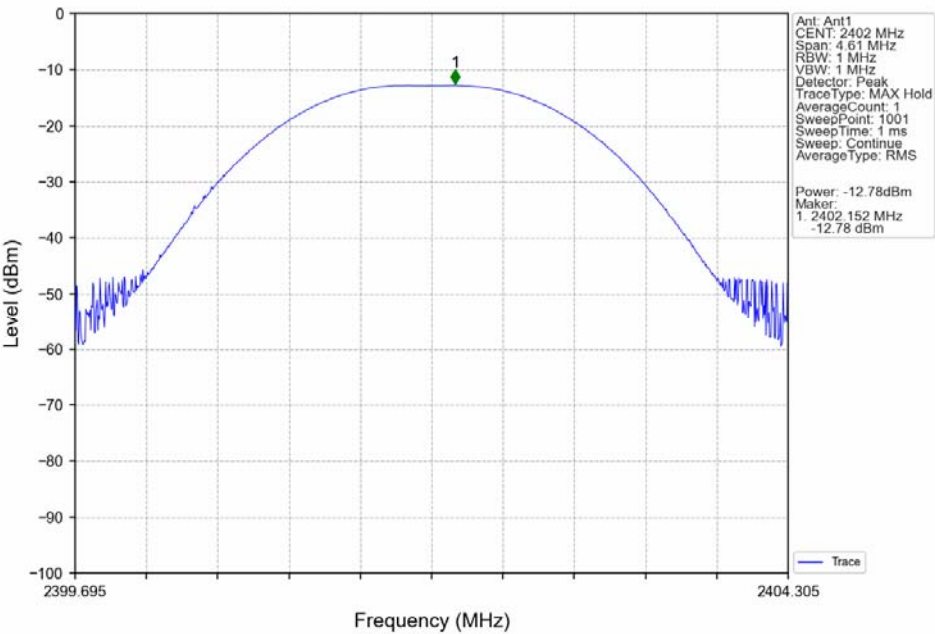




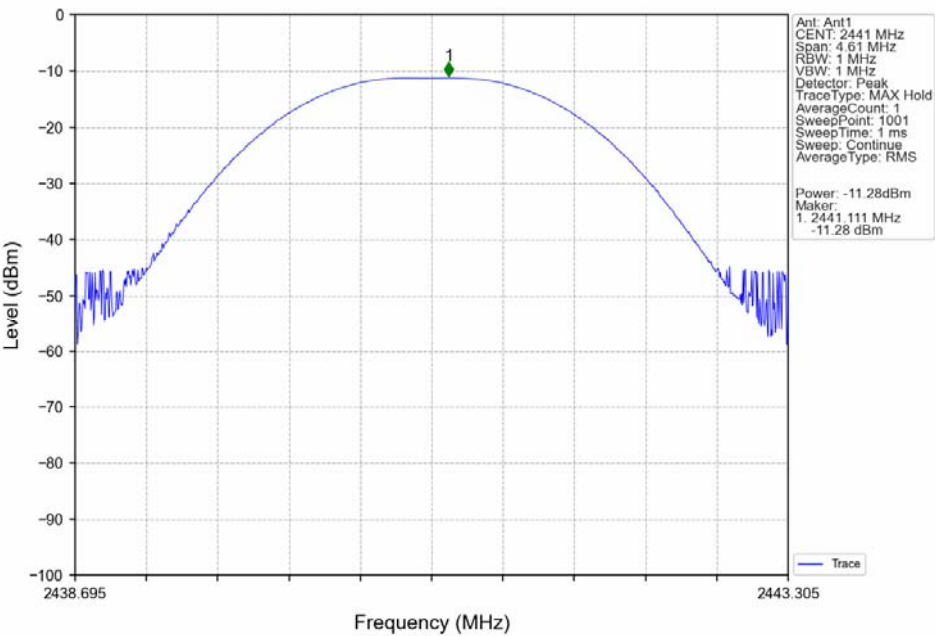


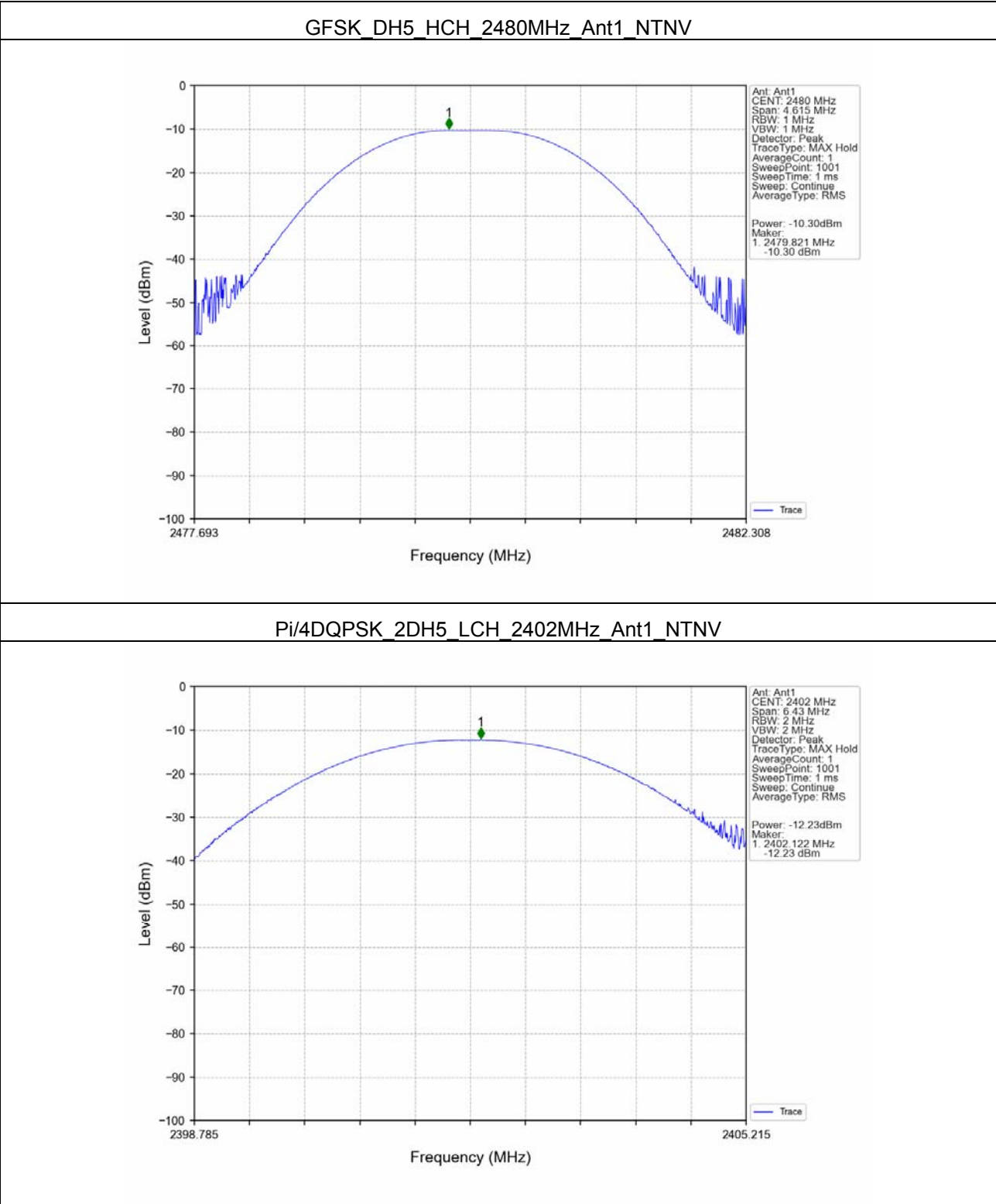
Bluetooth3

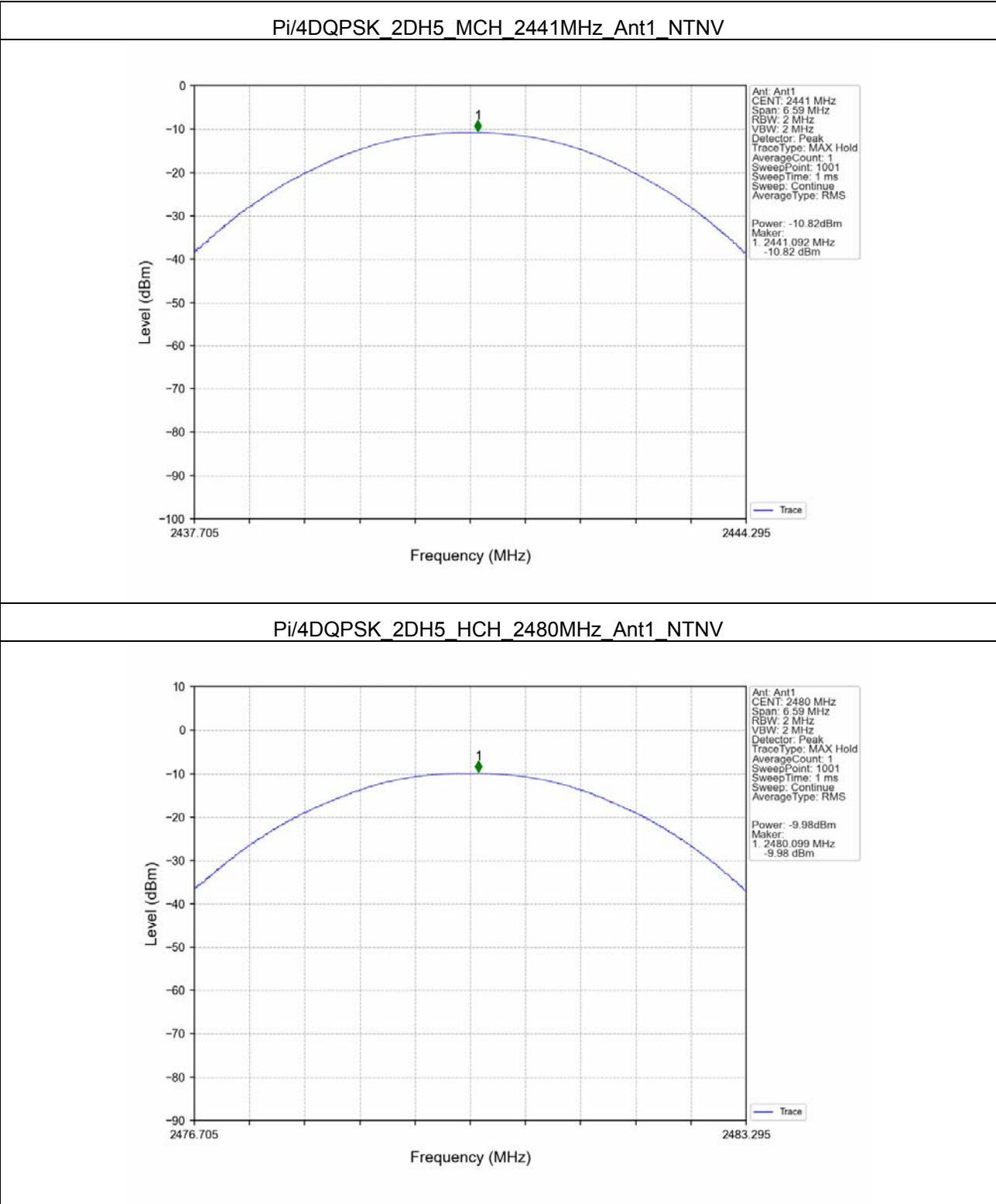
GFSK_DH5_LCH_2402MHz_Ant1_NTNV

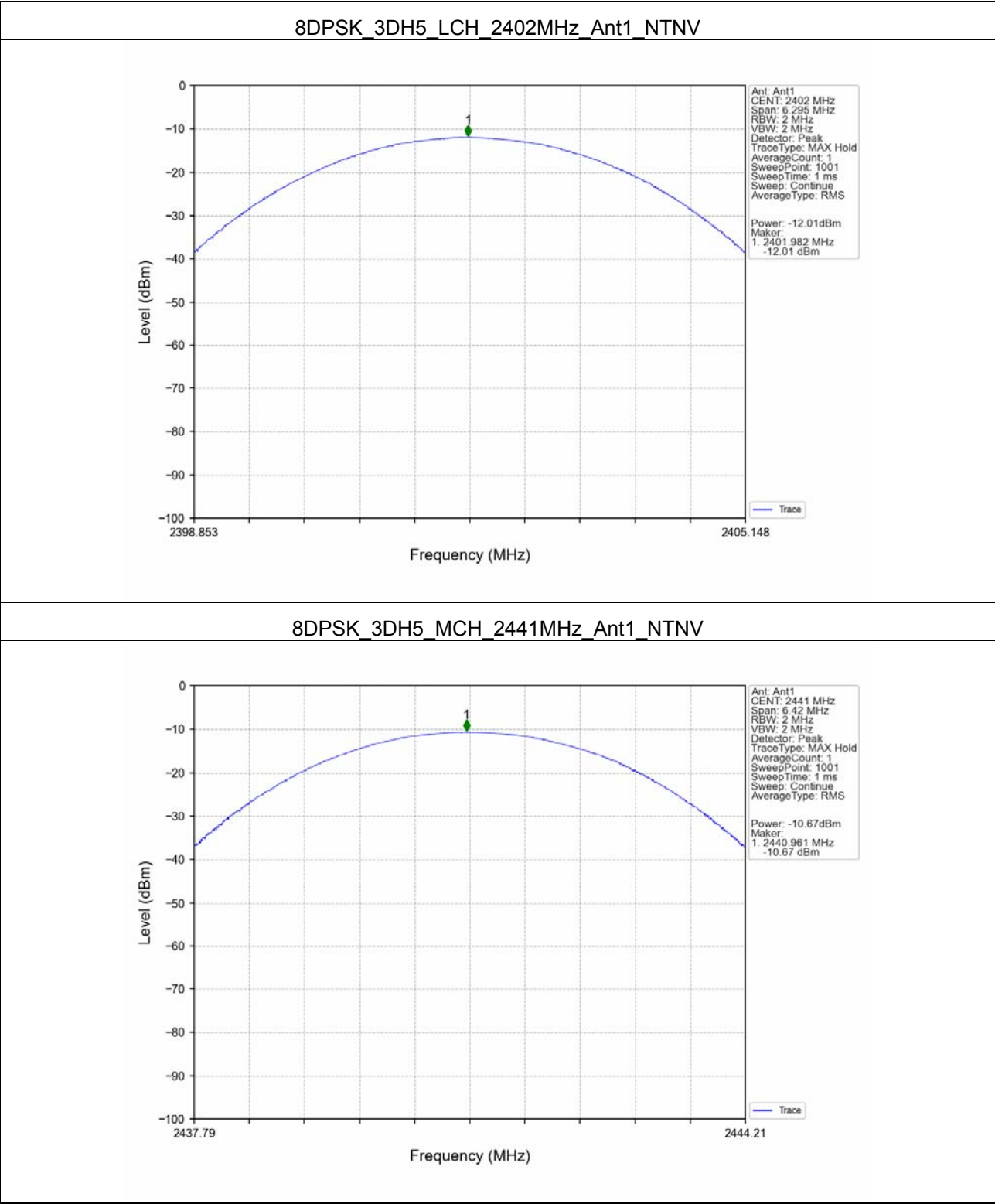


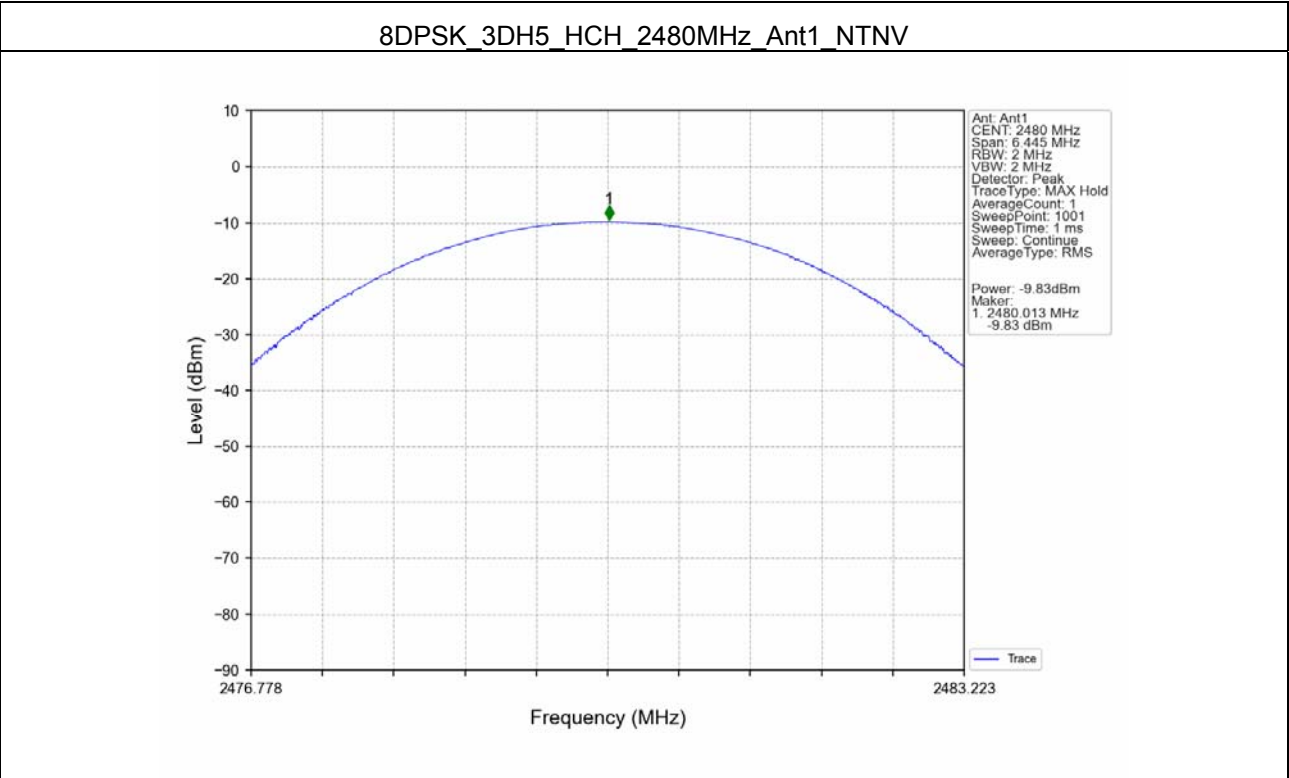
GFSK_DH5_MCH_2441MHz_Ant1_NTNV



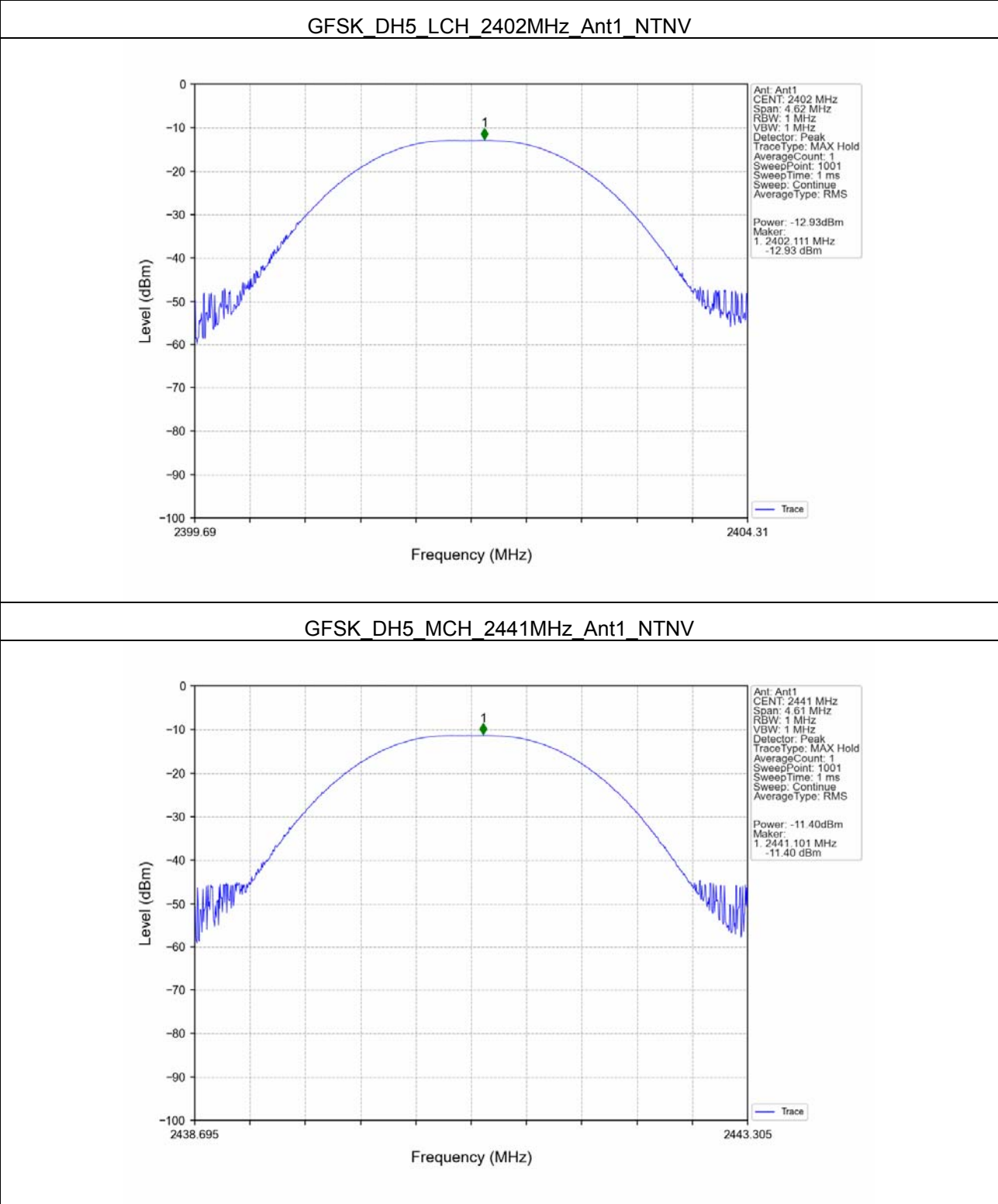


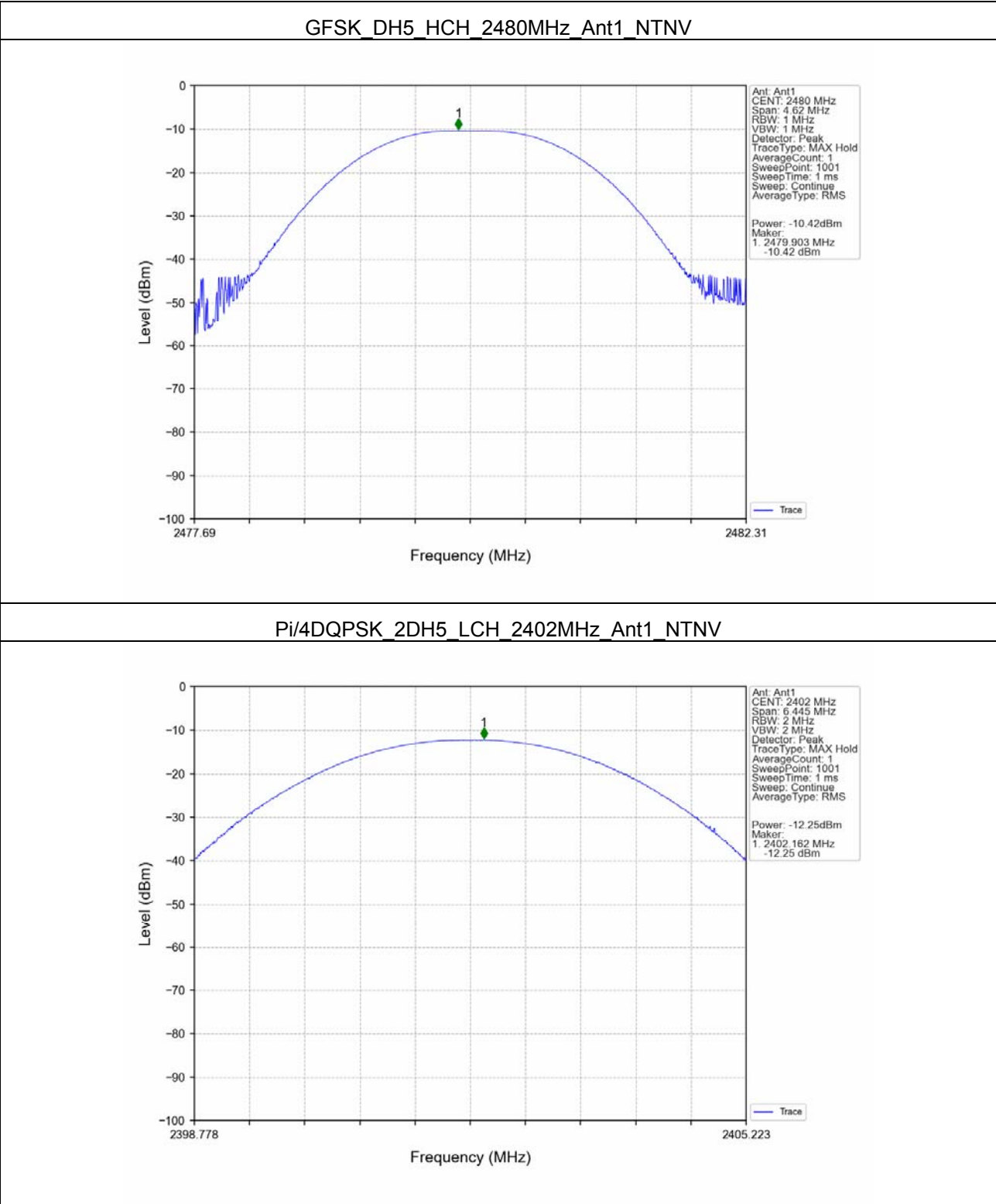


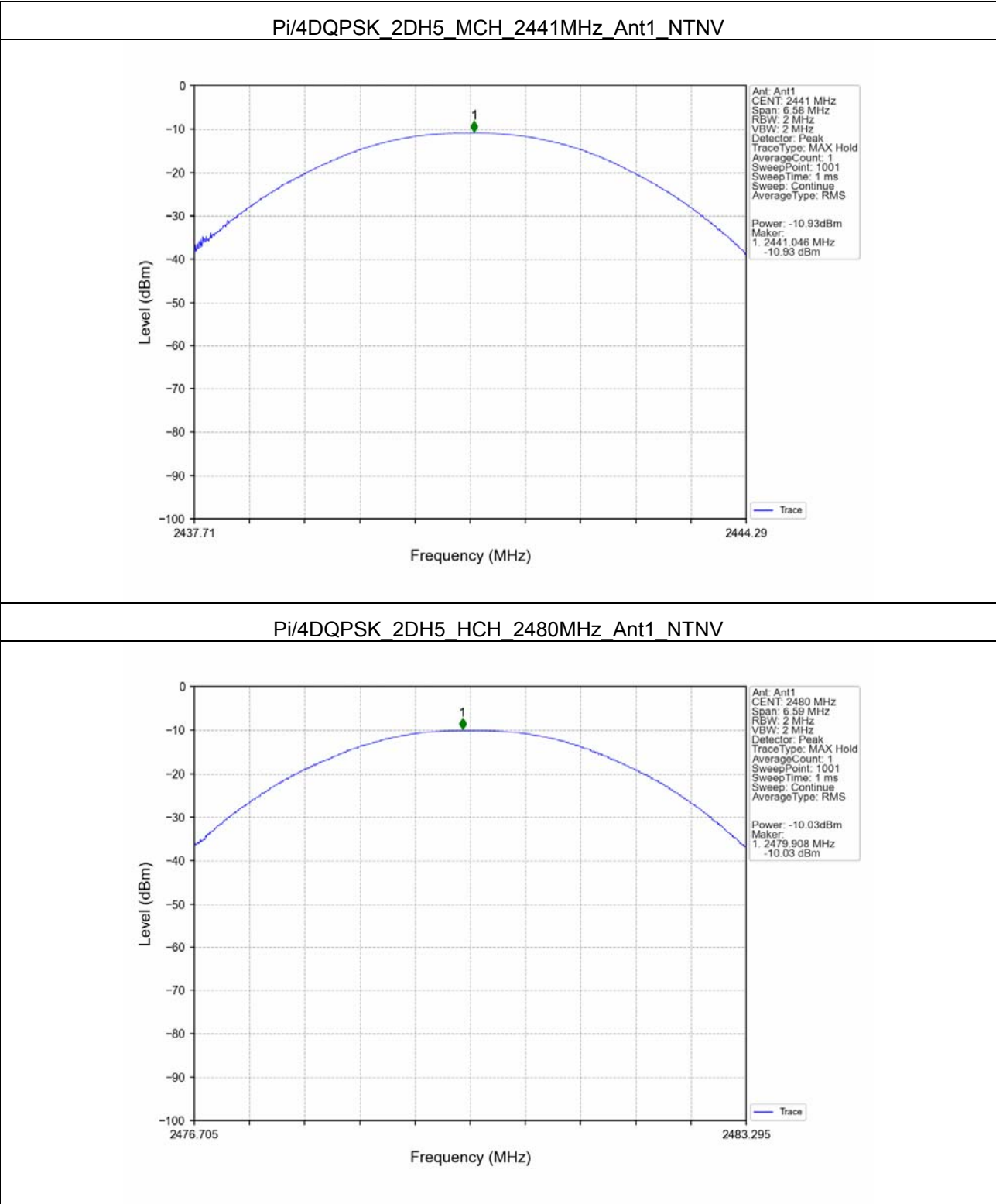


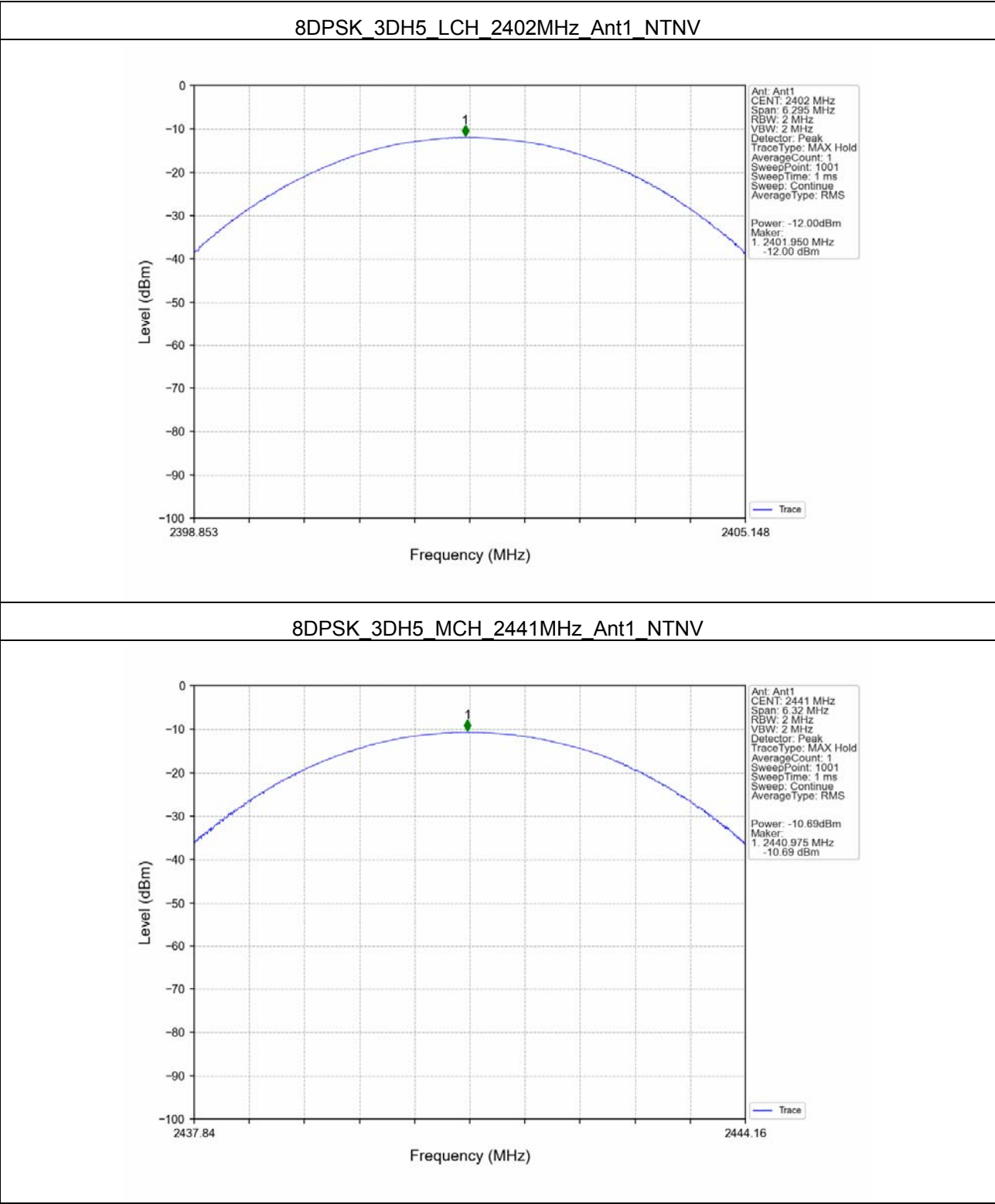


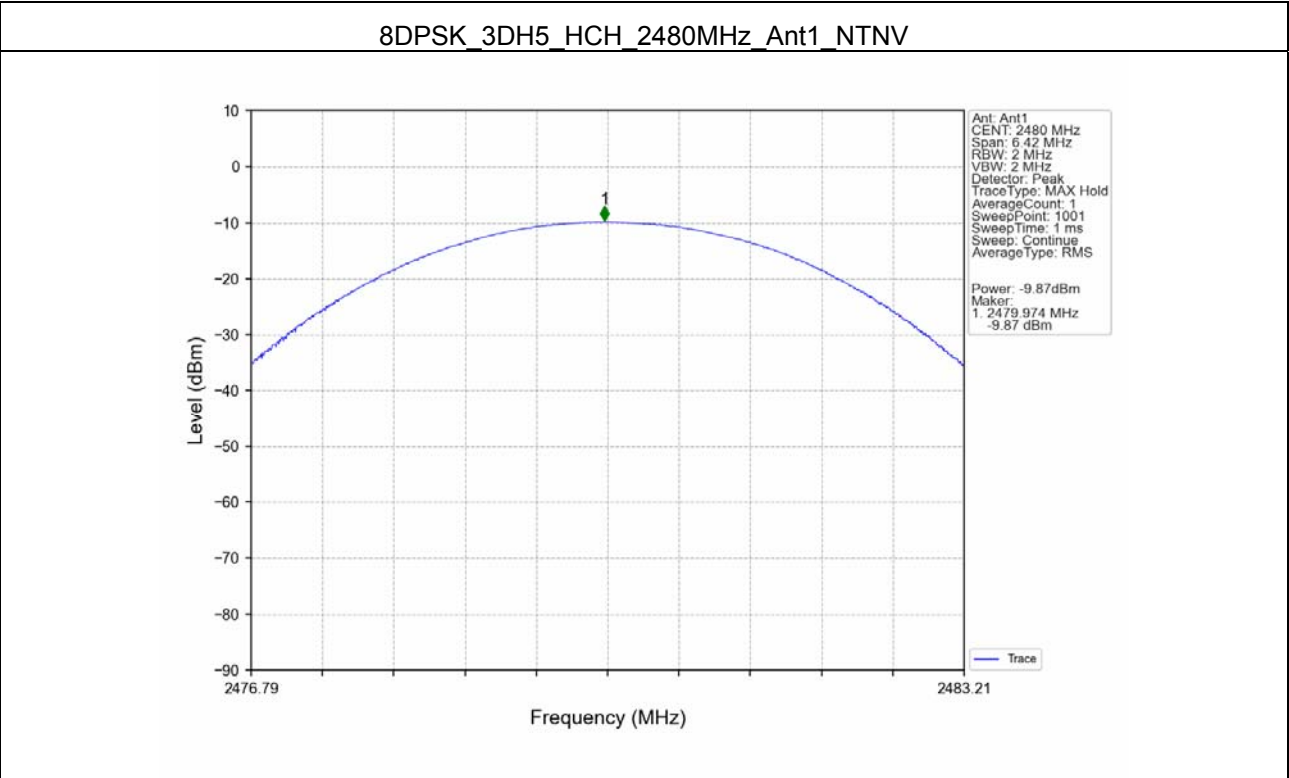
Bluetooth4











13 Hopping Channel Separation

Test Requirement: FCC 47CFR Part 15 Section 15.247

Test Method: ANSI C63.10-2020

Test Limit: Regulation 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with power no greater than 0.125W.

Test Mode: Test in hopping transmitting operating mode.

13.1 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:
 - a) Span: Wide enough to capture the peaks of two adjacent channels.
 - b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
 - c) Video (or average) bandwidth (VBW) $\geq$ RBW.
 - d) Sweep: Auto.
 - e) Detector function: Peak.
 - f) Trace: Max hold.
 - g) Allow the trace to stabilize.
3. Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

13.2 Test Result

13.3**Bluetooth1**

ANT1							
Mode	TX Type	Frequency (MHz)	Packet Type	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	SISO	HOPP	DH5	1.000	0.923	≥ 0.923	Pass
$\pi/4$ DQPSK	SISO	HOPP	2DH5	1.010	1.314	≥ 0.876	Pass
8DPSK	SISO	HOPP	3DH5	1.001	1.286	≥ 0.857	Pass

Bluetooth2

ANT1							
Mode	TX Type	Frequency (MHz)	Packet Type	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	SISO	HOPP	DH5	0.988	0.923	≥ 0.923	Pass
$\pi/4$ DQPSK	SISO	HOPP	2DH5	1.001	1.314	≥ 0.876	Pass
8DPSK	SISO	HOPP	3DH5	1.010	1.286	≥ 0.857	Pass

Bluetooth3

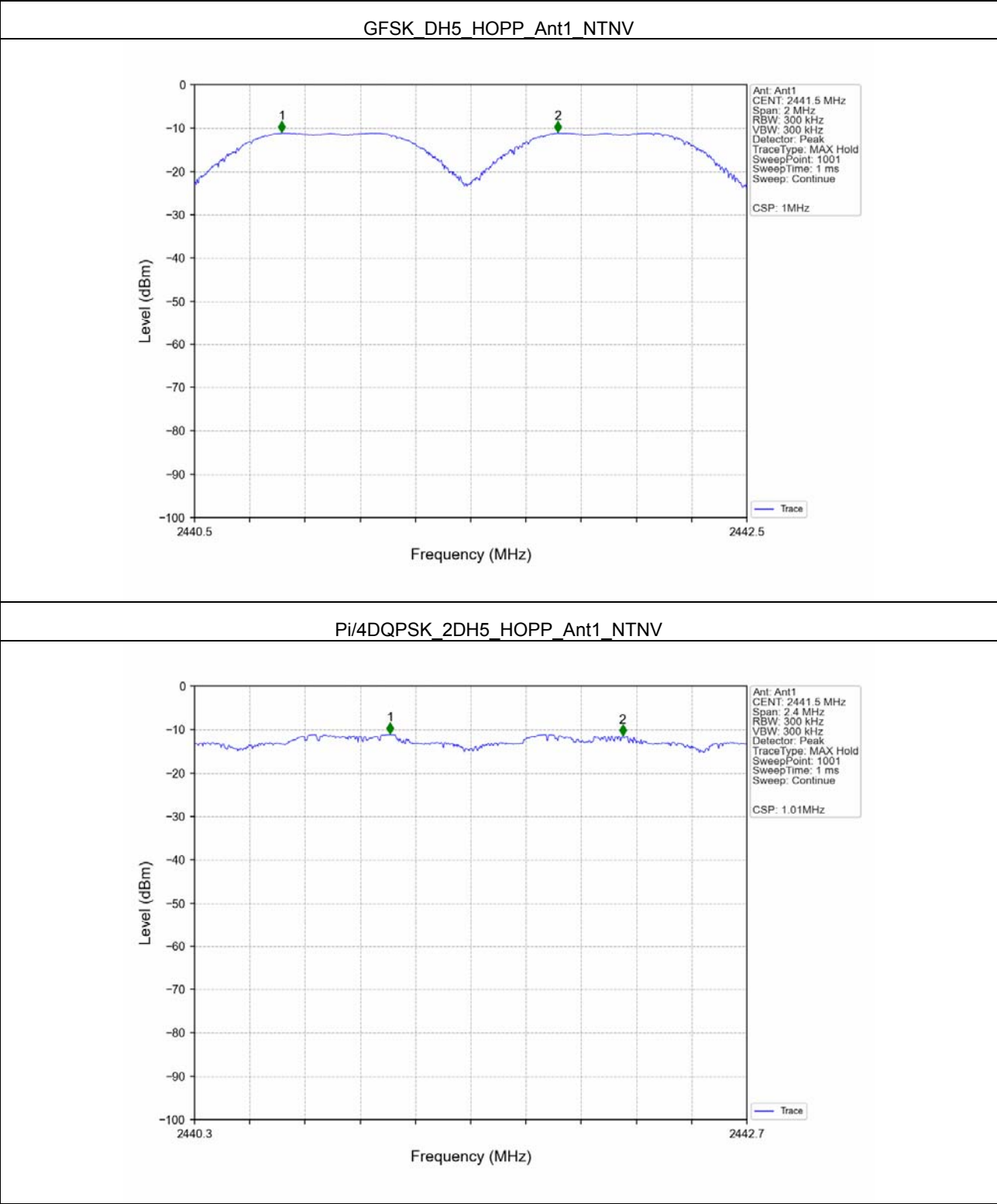
ANT1							
Mode	TX Type	Frequency (MHz)	Packet Type	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	SISO	HOPP	DH5	0.982	0.923	≥ 0.923	Pass
$\pi/4$ DQPSK	SISO	HOPP	2DH5	1.010	1.318	≥ 0.879	Pass
8DPSK	SISO	HOPP	3DH5	0.989	1.289	≥ 0.859	Pass

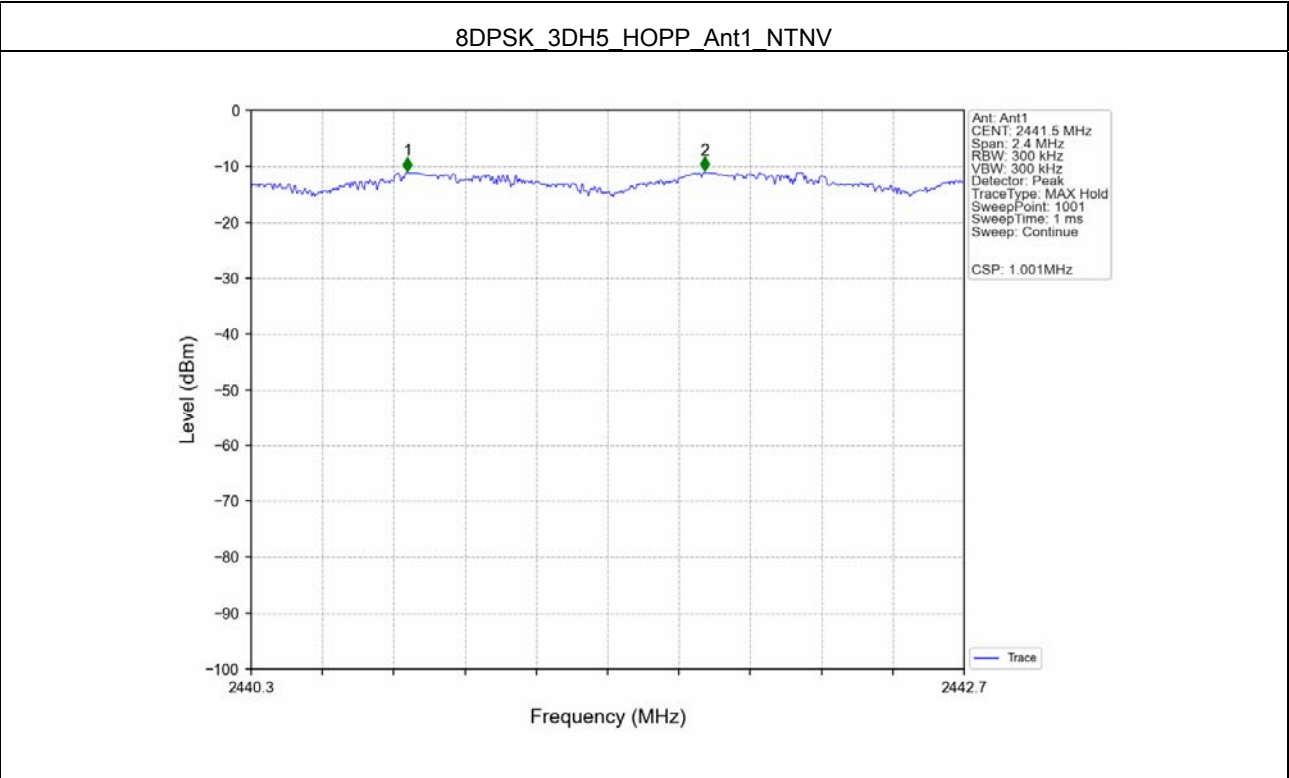
Bluetooth4

ANT1							
Mode	TX Type	Frequency (MHz)	Packet Type	Channel Separation (MHz)	20dB Bandwidth (MHz)	Limit (MHz)	Verdict
GFSK	SISO	HOPP	DH5	1.004	0.924	≥ 0.924	Pass
$\pi/4$ DQPSK	SISO	HOPP	2DH5	1.001	1.318	≥ 0.879	Pass
8DPSK	SISO	HOPP	3DH5	1.010	1.284	≥ 0.856	Pass

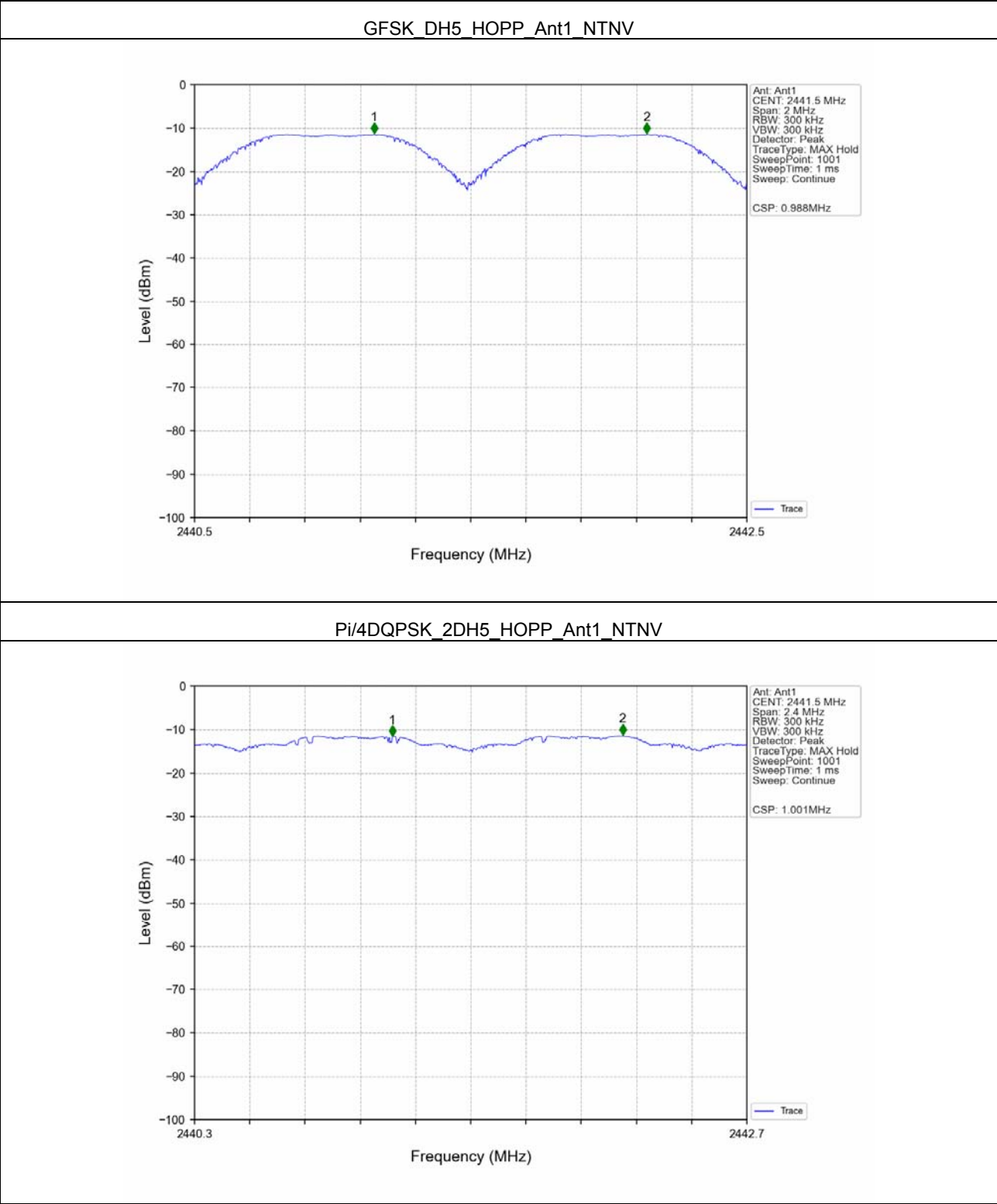
Bluetooth 1

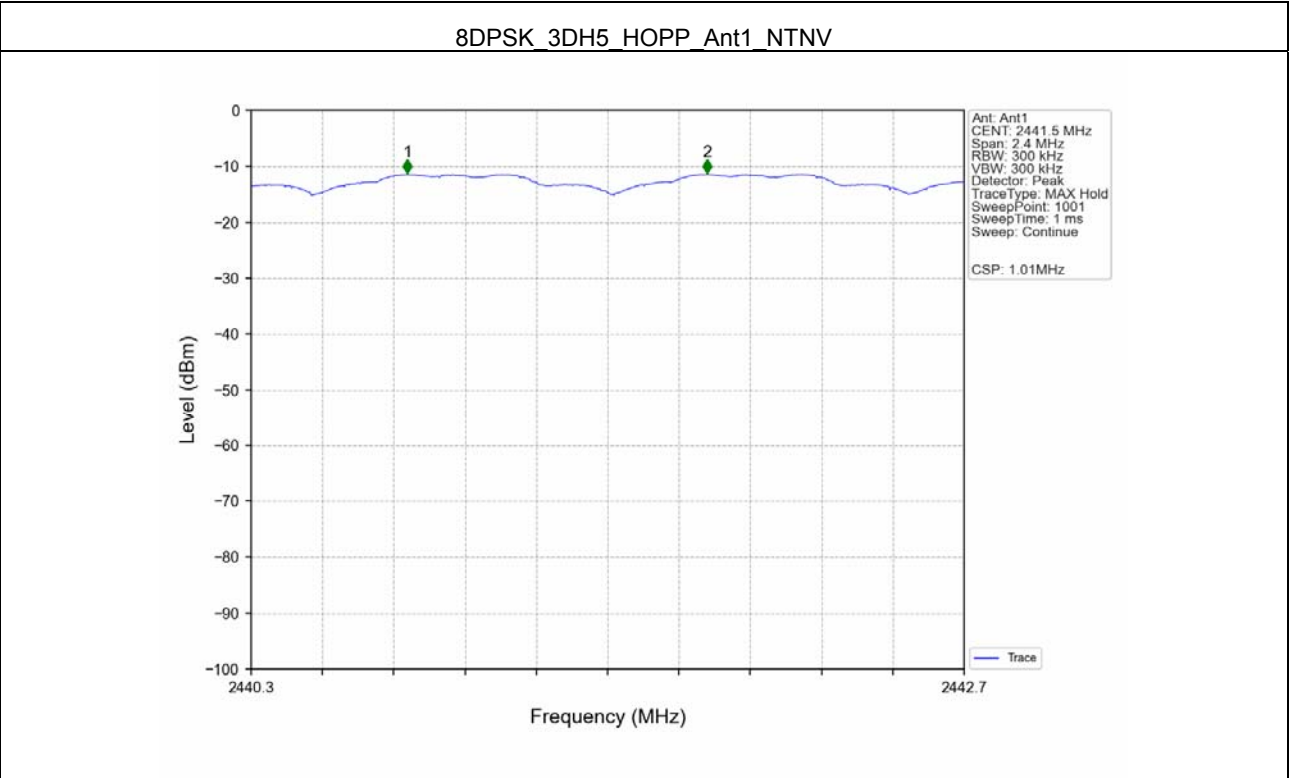
Test plots



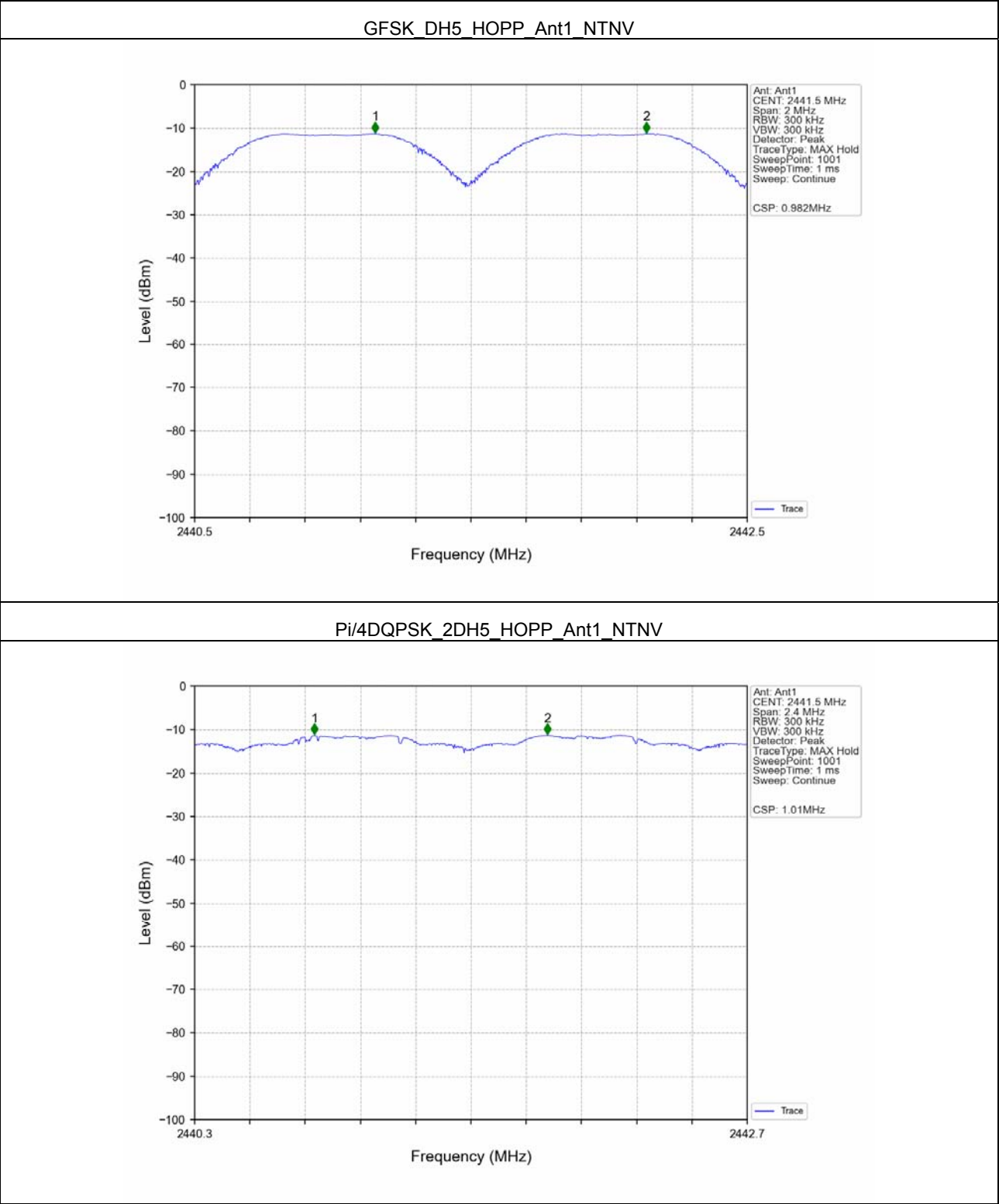


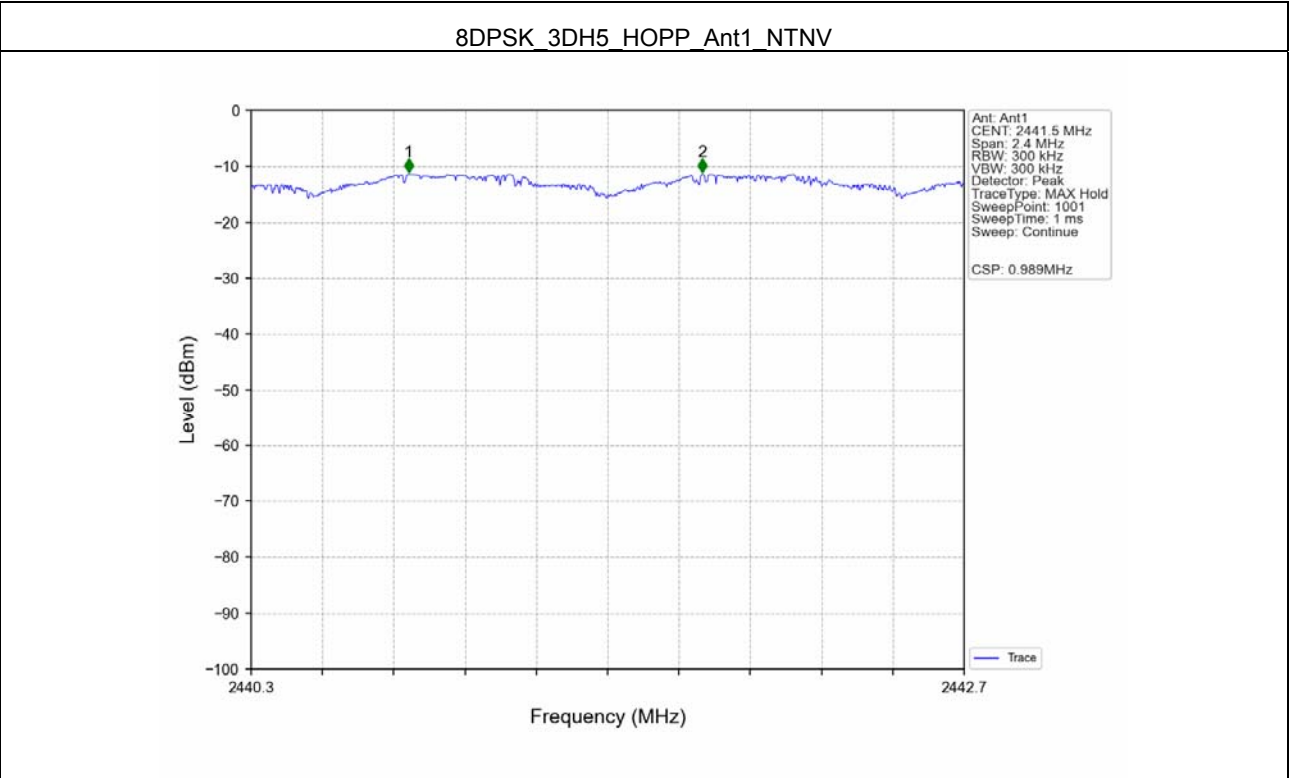
Bluetooth 2
Test plots



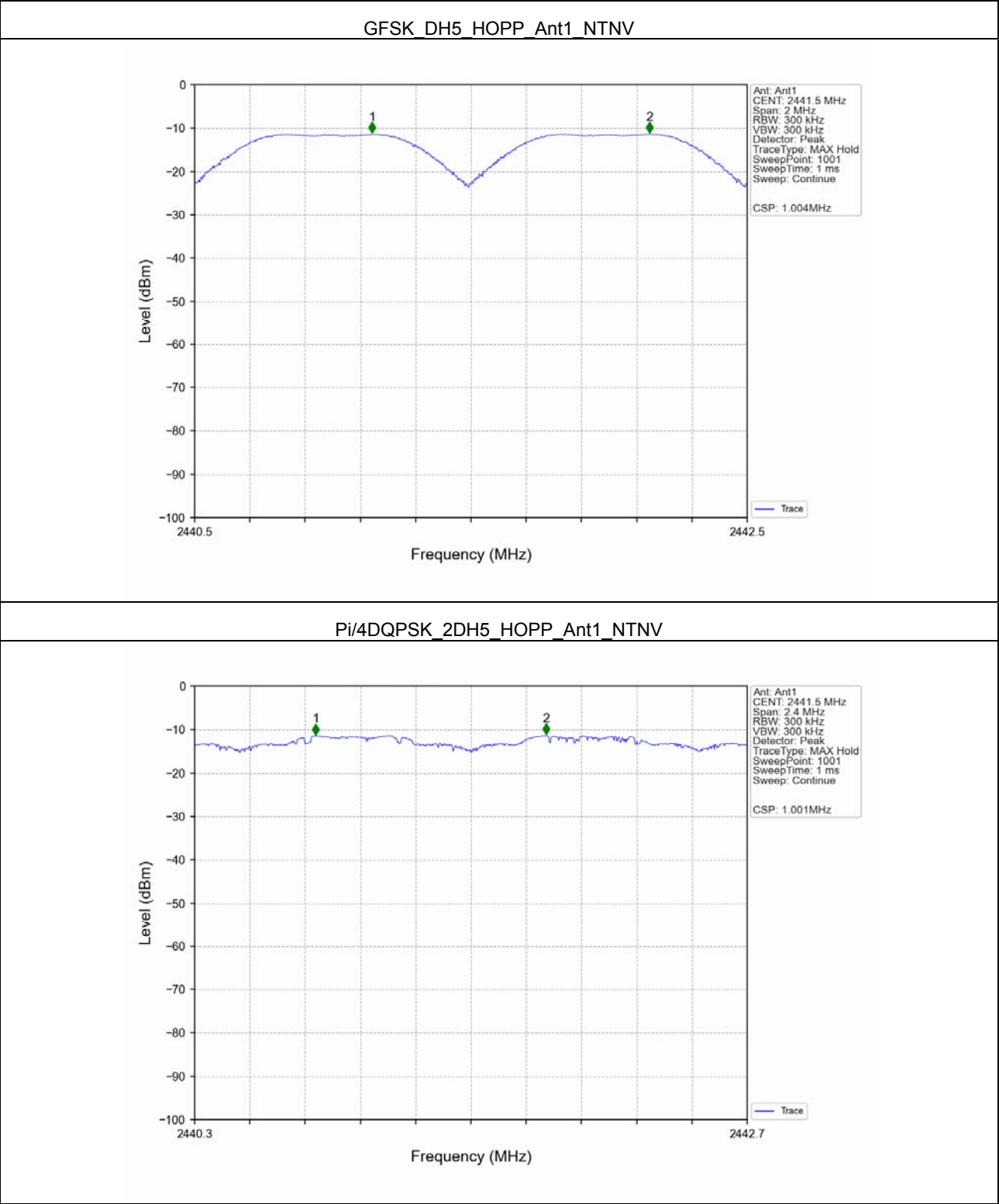


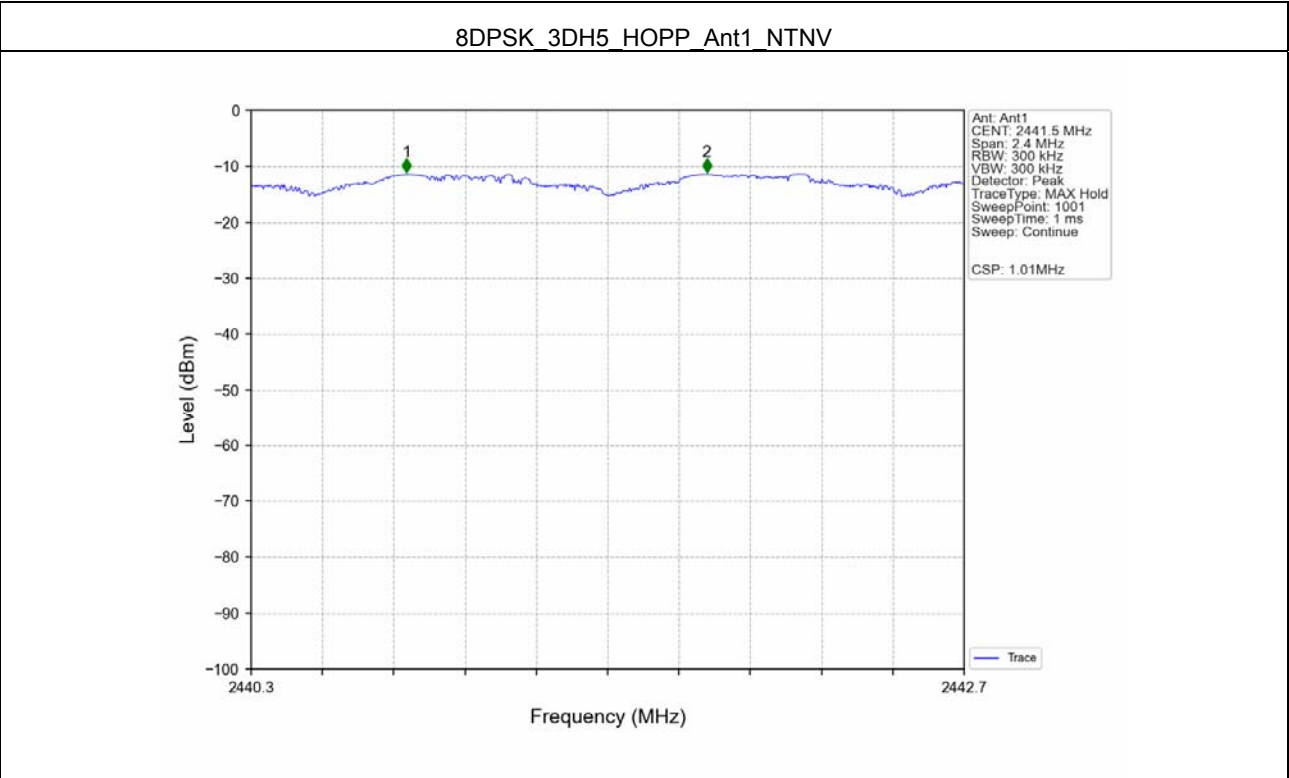
Bluetooth 3
Test plots





Bluetooth 4
Test plots





14 Number of Hopping Frequency

Test Requirement: FCC 47CFR Part 15 Section 15.247

Test Method: ANSI C63.10-2020

Test Limit: Regulation 15.247 (a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

Test Mode: Test in hopping transmitting operating mode.

14.1 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:
 - a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.
 - b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.
 - c) VBW $\geq$ RBW.
 - d) Sweep: Auto.
 - e) Detector function: Peak.
 - f) Trace: Max hold.
 - g) Allow the trace to stabilize..
3. Allow the trace to stabilize. It may prove necessary to break the span up to sections. in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section.
4. Set the spectrum analyzer: Start Frequency = 2.4GHz, Stop Frequency = 2.4835GHz. Sweep=auto;

14.2 Test Result

Bluetooth 1

Mode	TX Type	Frequency (MHz)	Packet Type	Num of Hopping Frequencies		Verdict
				ANT1	Limit	
GFSK	SISO	HOPP	DH5	79	≥ 15	Pass
$\pi/4$ DQPSK	SISO	HOPP	2DH5	79	≥ 15	Pass
8DPSK	SISO	HOPP	3DH5	79	≥ 15	Pass

Bluetooth 2

Mode	TX Type	Frequency (MHz)	Packet Type	Num of Hopping Frequencies		Verdict
				ANT1	Limit	
GFSK	SISO	HOPP	DH5	79	≥ 15	Pass
$\pi/4$ DQPSK	SISO	HOPP	2DH5	79	≥ 15	Pass
8DPSK	SISO	HOPP	3DH5	79	≥ 15	Pass

Bluetooth 3

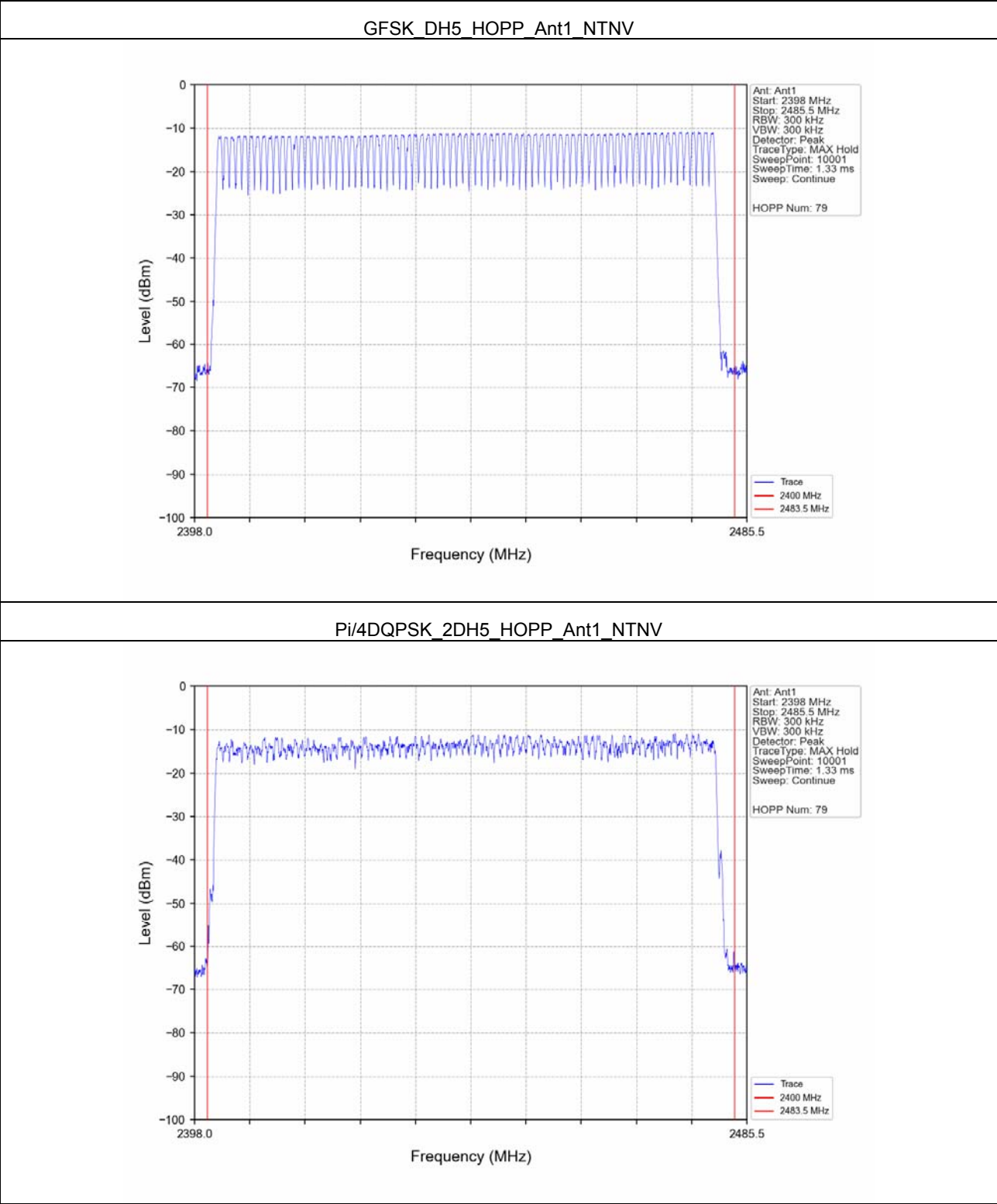
Mode	TX Type	Frequency (MHz)	Packet Type	Num of Hopping Frequencies		Verdict
				ANT1	Limit	
GFSK	SISO	HOPP	DH5	79	≥ 15	Pass
$\pi/4$ DQPSK	SISO	HOPP	2DH5	79	≥ 15	Pass
8DPSK	SISO	HOPP	3DH5	79	≥ 15	Pass

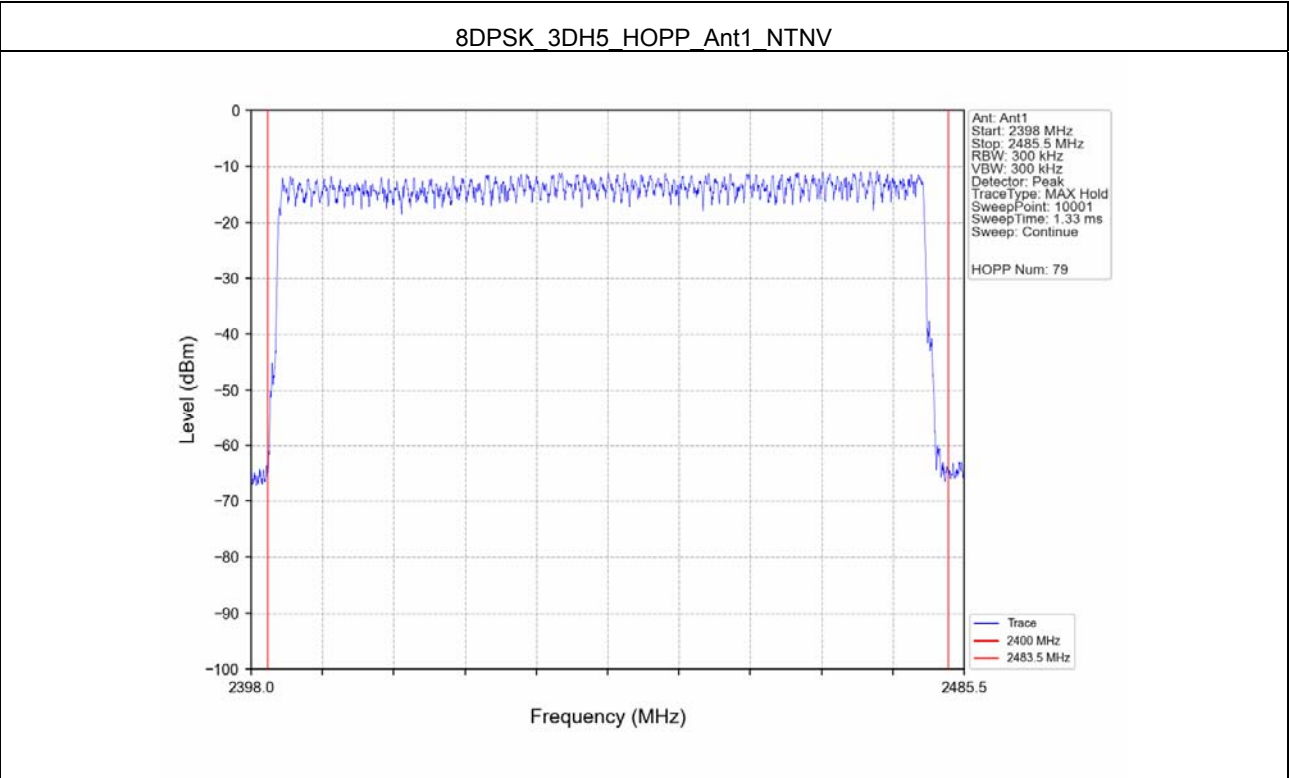
Bluetooth 4

Mode	TX Type	Frequency (MHz)	Packet Type	Num of Hopping Frequencies		Verdict
				ANT1	Limit	
GFSK	SISO	HOPP	DH5	79	≥ 15	Pass
$\pi/4$ DQPSK	SISO	HOPP	2DH5	79	≥ 15	Pass
8DPSK	SISO	HOPP	3DH5	79	≥ 15	Pass

Bluetooth 1

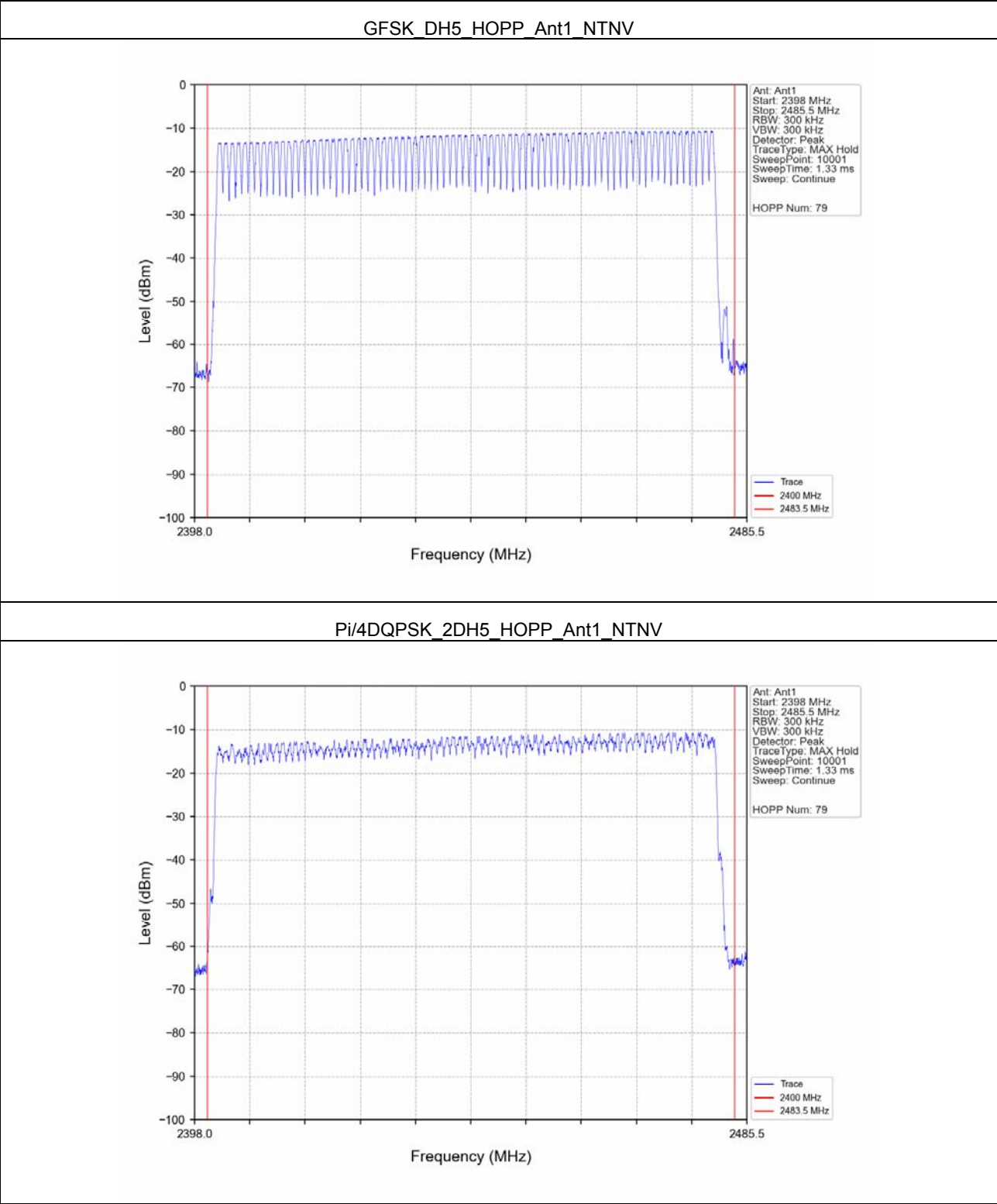
Test Plots:

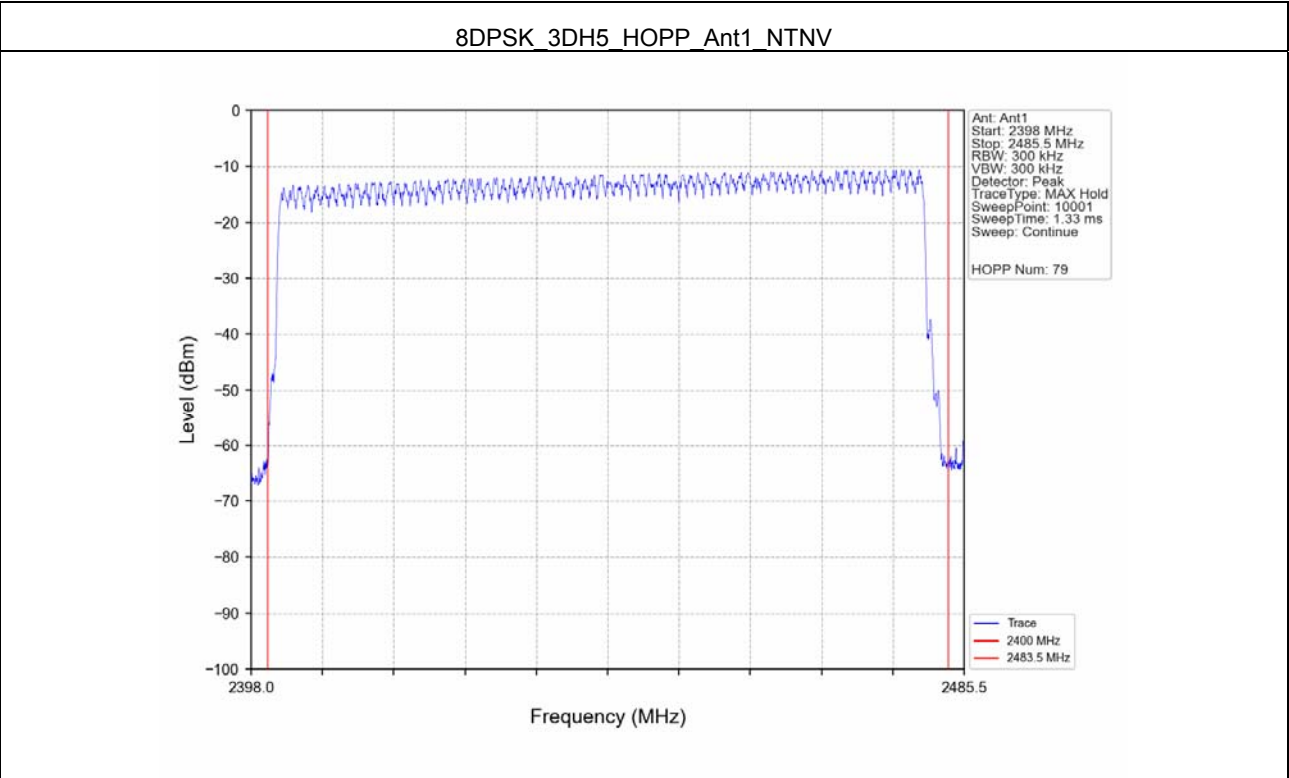




Bluetooth 2

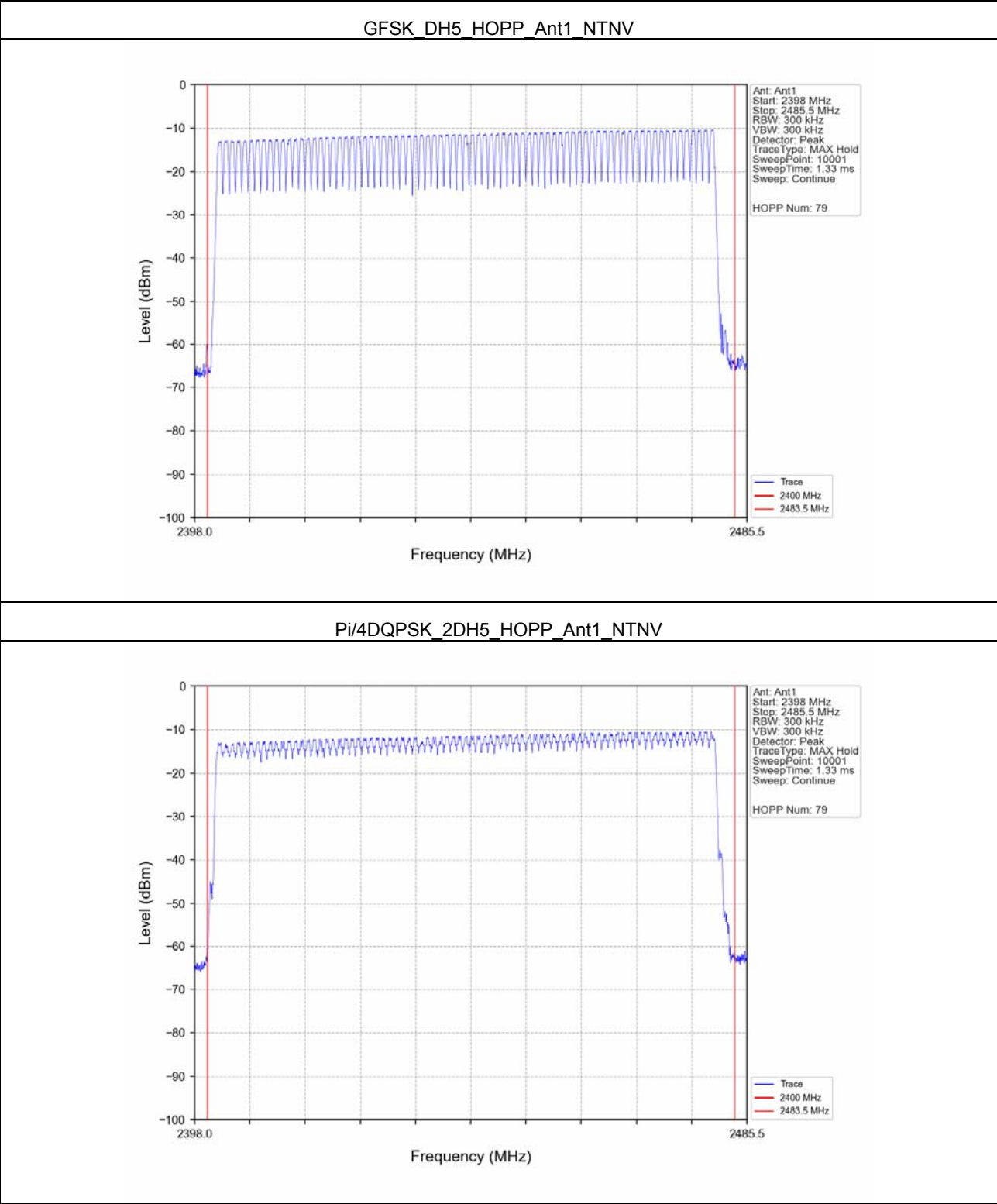
Test Plots:

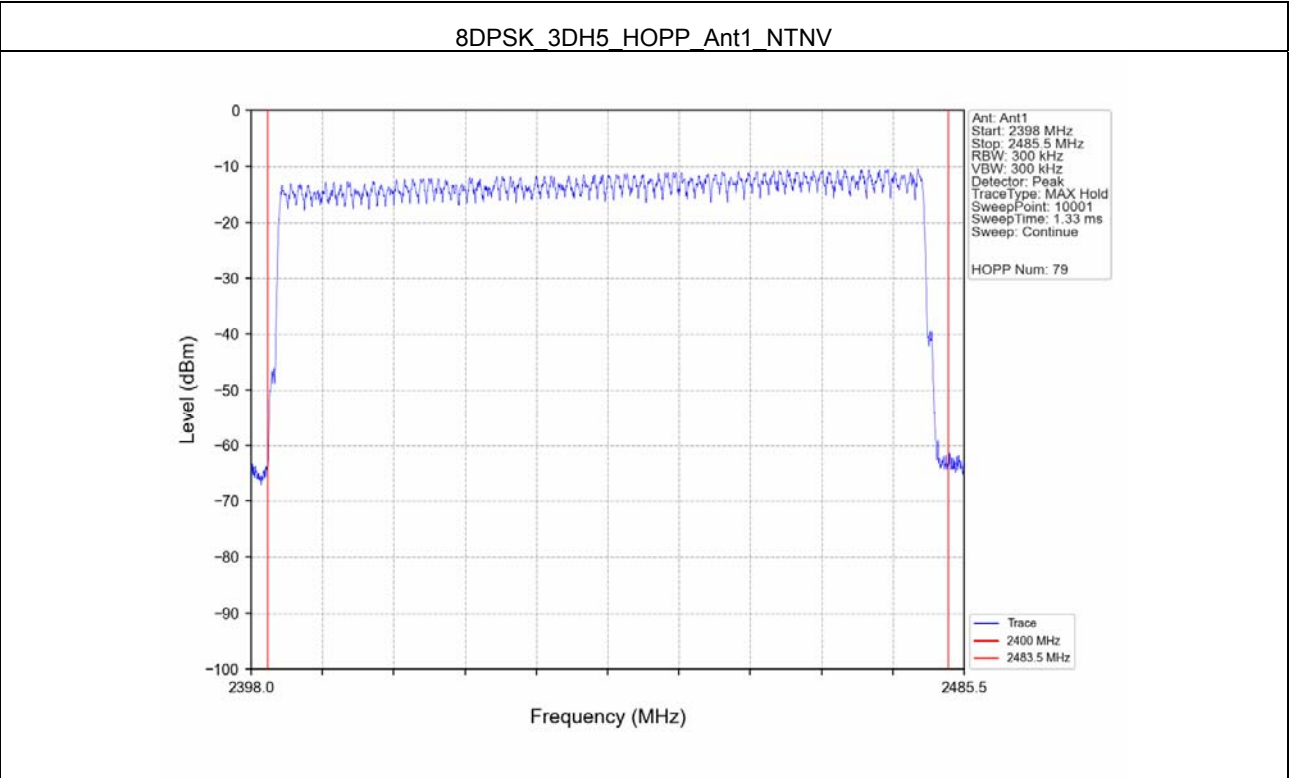




Bluetooth 3

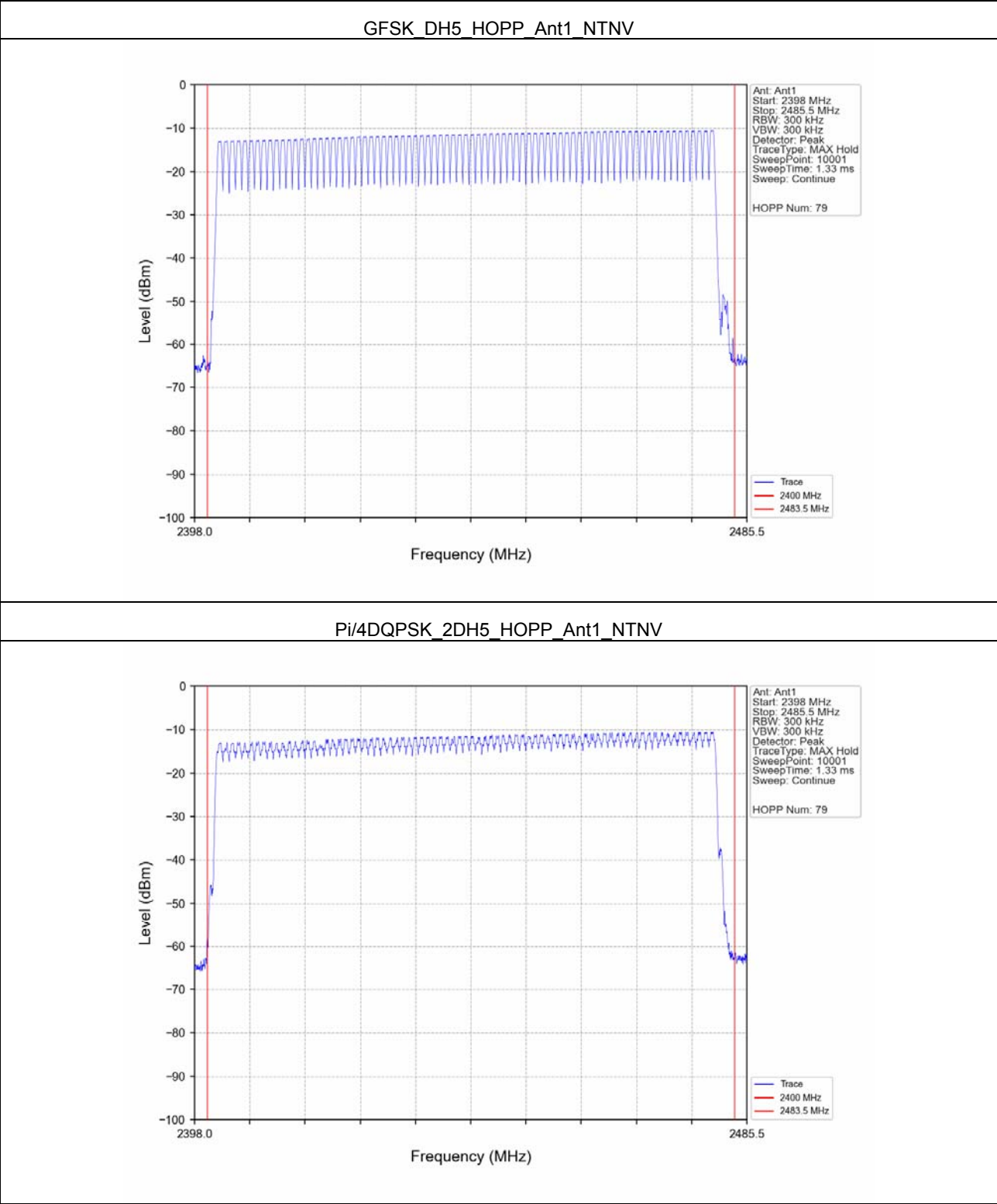
Test Plots:

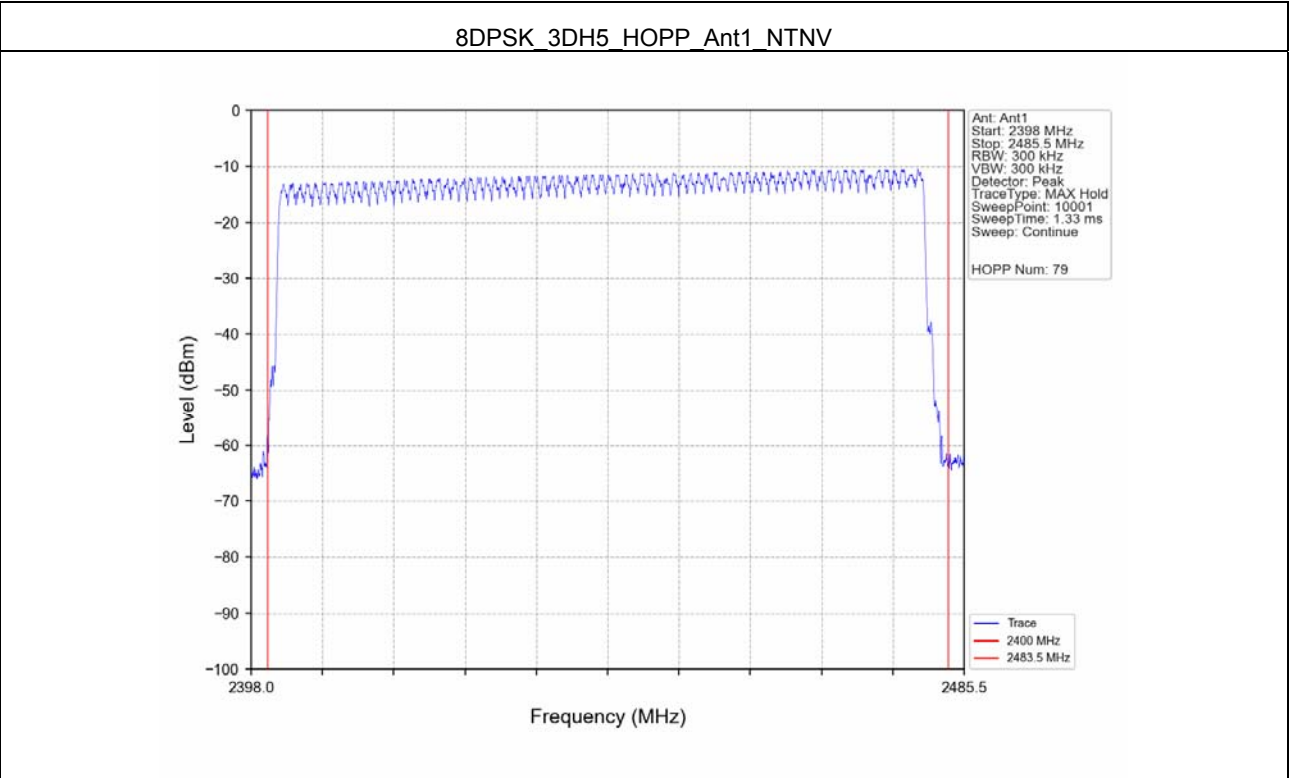




Bluetooth 4

Test Plots:





15 Dwell Time

Test Requirement: FCC 47CFR Part 15 Section 15.247

Test Method: ANSI C63.10-2020

Test Limit: Regulation 15.247(a)(1)(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Mode: Test in hopping transmitting operating mode.

15.1 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 spectrum analyzer span = 0. Centred on a hopping channel;
3. Set RBW = 1MHz and VBW = 3MHz. Sweep = as necessary to capture the entire dwell time per hopping channel. Set the EUT for DH5, DH3 and DH1 packet transmitting.
4. Use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g.. data rate. modulation format. etc.). repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

15.2 Test Result

DH5 Packet permit maximum $1600 / 79 / 6$ hops per second in each channel (5 time slots RX, 1 time slot TX).

DH3 Packet permit maximum $1600 / 79 / 4$ hops per second in each channel (3 time slots RX, 1 time slot TX).

DH1 Packet permit maximum $1600 / 79 / 2$ hops per second in each channel (1 time slot RX, 1 time slot TX). So, the Dwell Time can be calculated as follows:

Data Packet	Dwell Time(s)
DH5	$1600/79/6*0.4*79*(MkrDelta)/1000$
DH3	$1600/79/4*0.4*79*(MkrDelta)/1000$
DH1	$1600/79/2*0.4*79*(MkrDelta)/1000$
Remark: Mkr Delta is once pulse time.	

Bluetooth 1

Ant1									
Mode	TX Type	Frequency (MHz)	Packet Type	Duration of Single Pulse (ms)	Observation Period (s)	Num of Pulse in Observation Period	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	SISO	HOPP	DH5	2.890	31.600	101	291.890	<=400	Pass
$\pi/4$ DQPSK	SISO	HOPP	2DH5	2.886	31.600	111	320.346	<=400	Pass
8DPSK	SISO	HOPP	3DH5	2.898	31.600	109	315.882	<=400	Pass

Bluetooth 2

Ant1									
Mode	TX Type	Frequency (MHz)	Packet Type	Duration of Single Pulse (ms)	Observation Period (s)	Num of Pulse in Observation Period	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	SISO	HOPP	DH5	2.890	31.600	112	323.680	<=400	Pass
$\pi/4$ DQPSK	SISO	HOPP	2DH5	0.348	31.600	159	55.332	<=400	Pass
8DPSK	SISO	HOPP	3DH5	0.342	31.600	165	56.430	<=400	Pass

Bluetooth 3

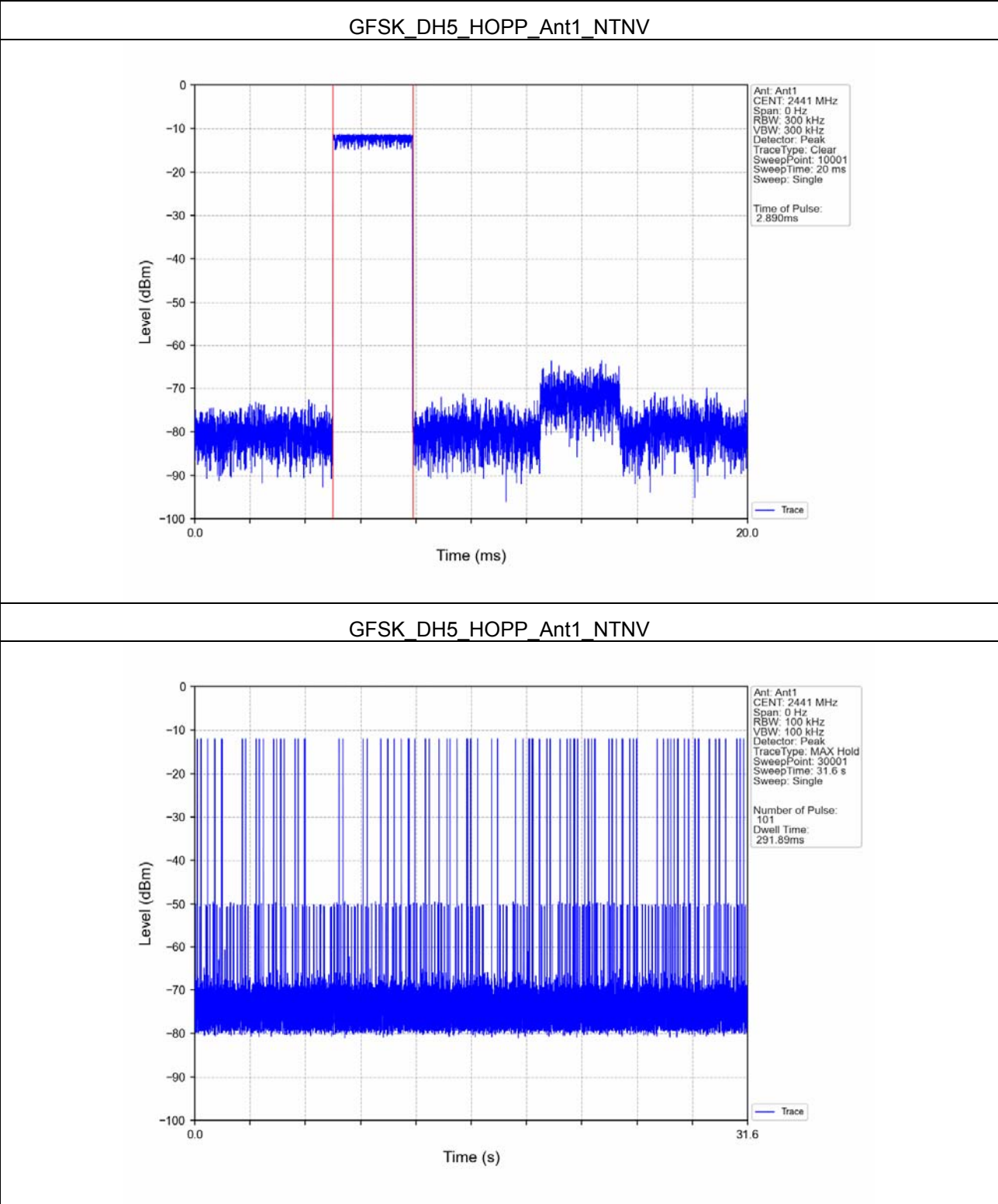
Ant1									
Mode	TX Type	Frequency (MHz)	Packet Type	Duration of Single Pulse (ms)	Observation Period (s)	Num of Pulse in Observation Period	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	SISO	HOPP	DH5	2.890	31.600	111	320.790	<=400	Pass
$\pi/4$ DQPSK	SISO	HOPP	2DH5	2.896	31.600	105	304.080	<=400	Pass
8DPSK	SISO	HOPP	3DH5	2.900	31.600	99	287.100	<=400	Pass

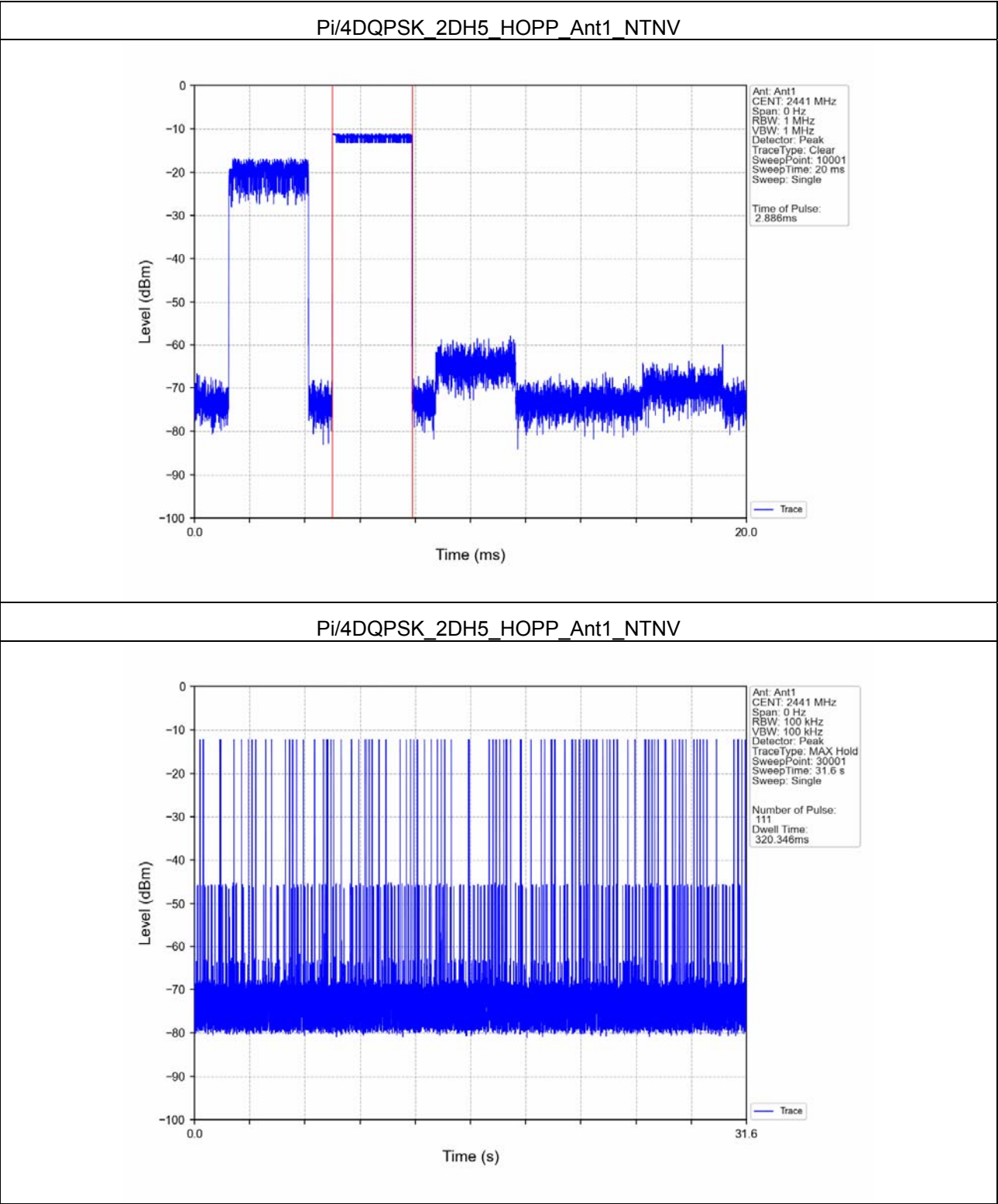
Bluetooth 4

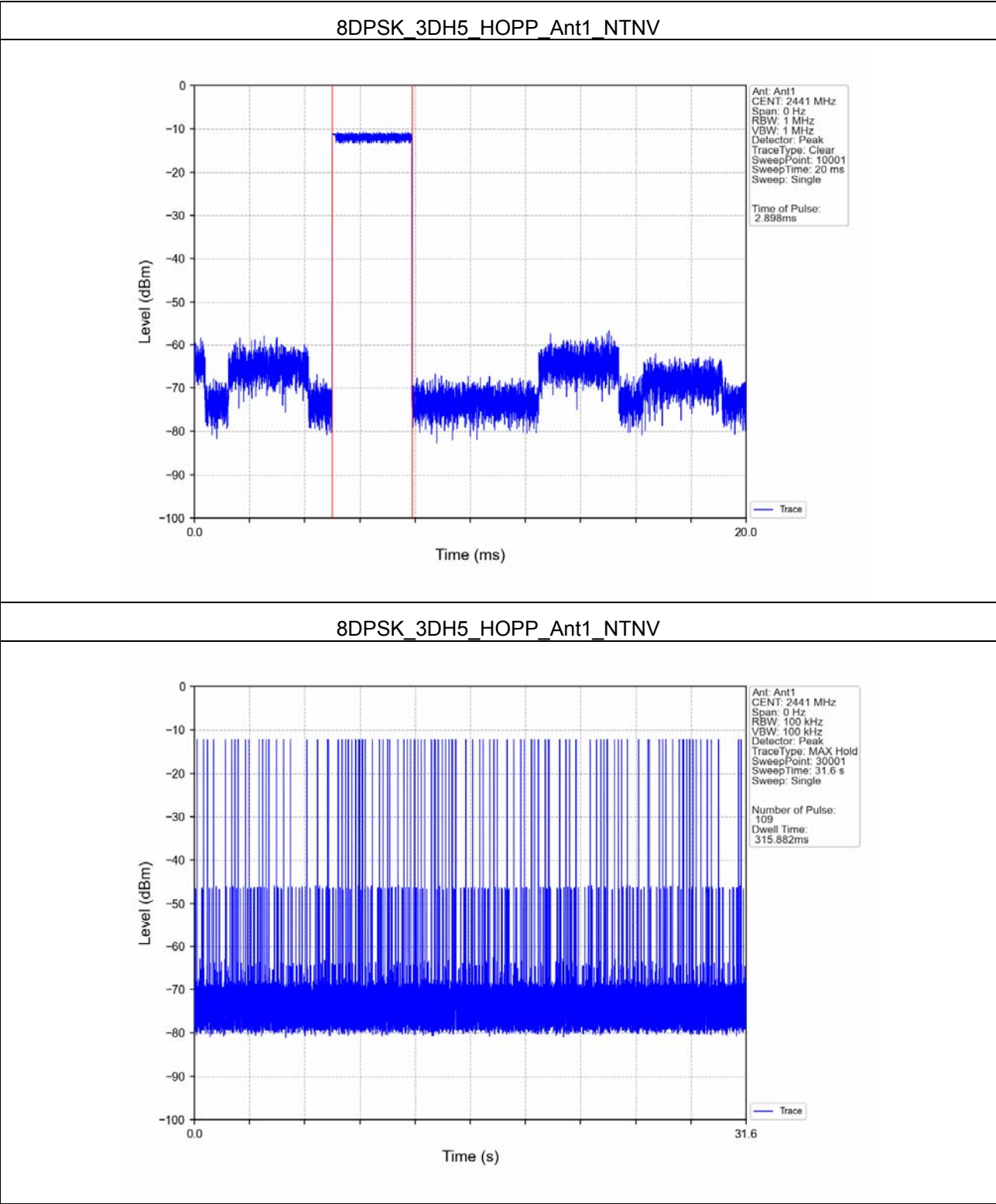
Ant1									
Mode	TX Type	Frequency (MHz)	Packet Type	Duration of Single Pulse (ms)	Observation Period (s)	Num of Pulse in Observation Period	Dwell Time (ms)	Limit (ms)	Verdict
GFSK	SISO	HOPP	DH5	2.890	31.600	104	300.560	<=400	Pass
$\pi/4$ DQPSK	SISO	HOPP	2DH5	2.890	31.600	90	260.100	<=400	Pass
8DPSK	SISO	HOPP	3DH5	2.896	31.600	100	289.600	<=400	Pass

Remark: Only the worst-case mode DH5, 2DH5 and 3DH5 were recorded.

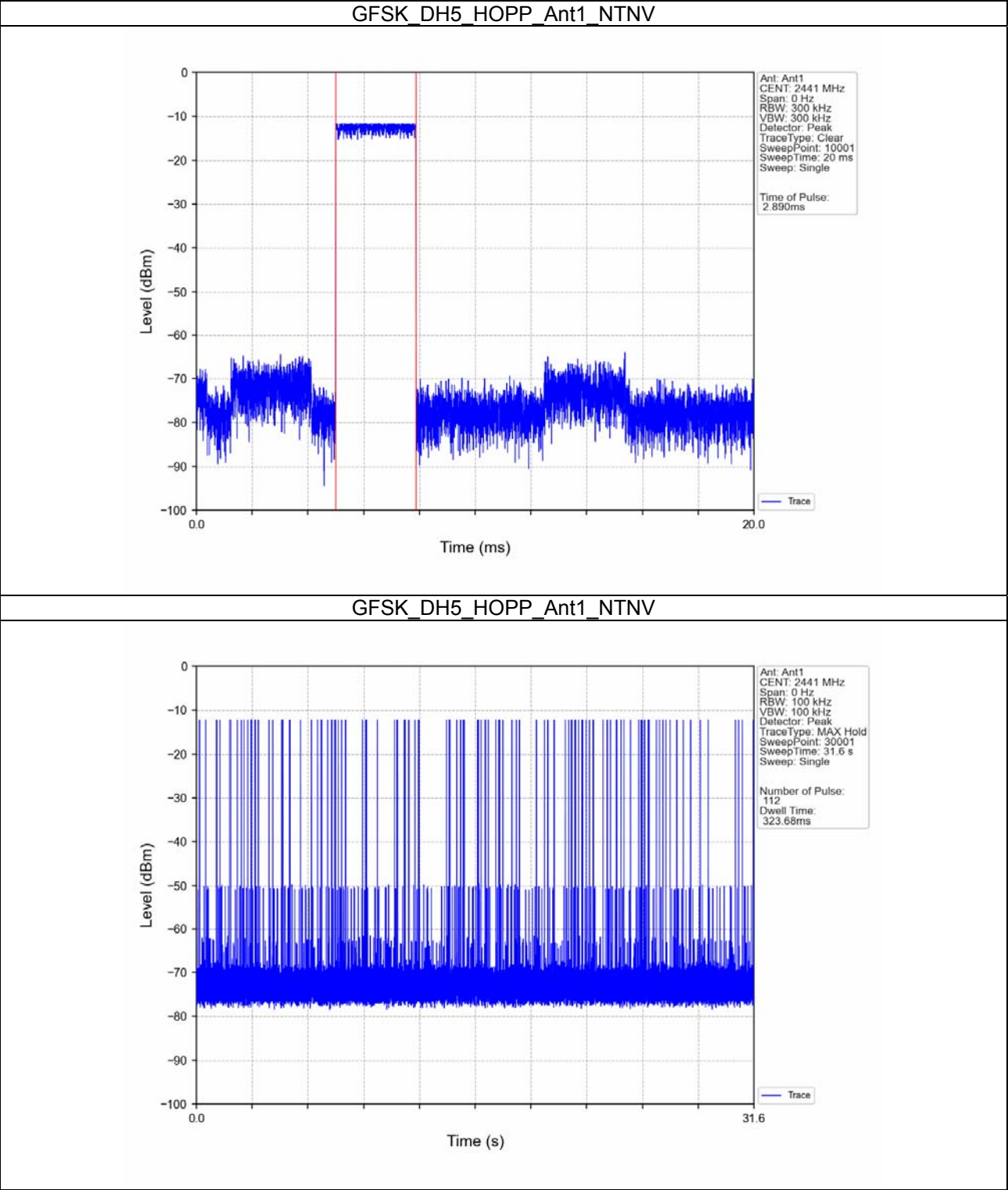
Bluetooth 1
Test Plots

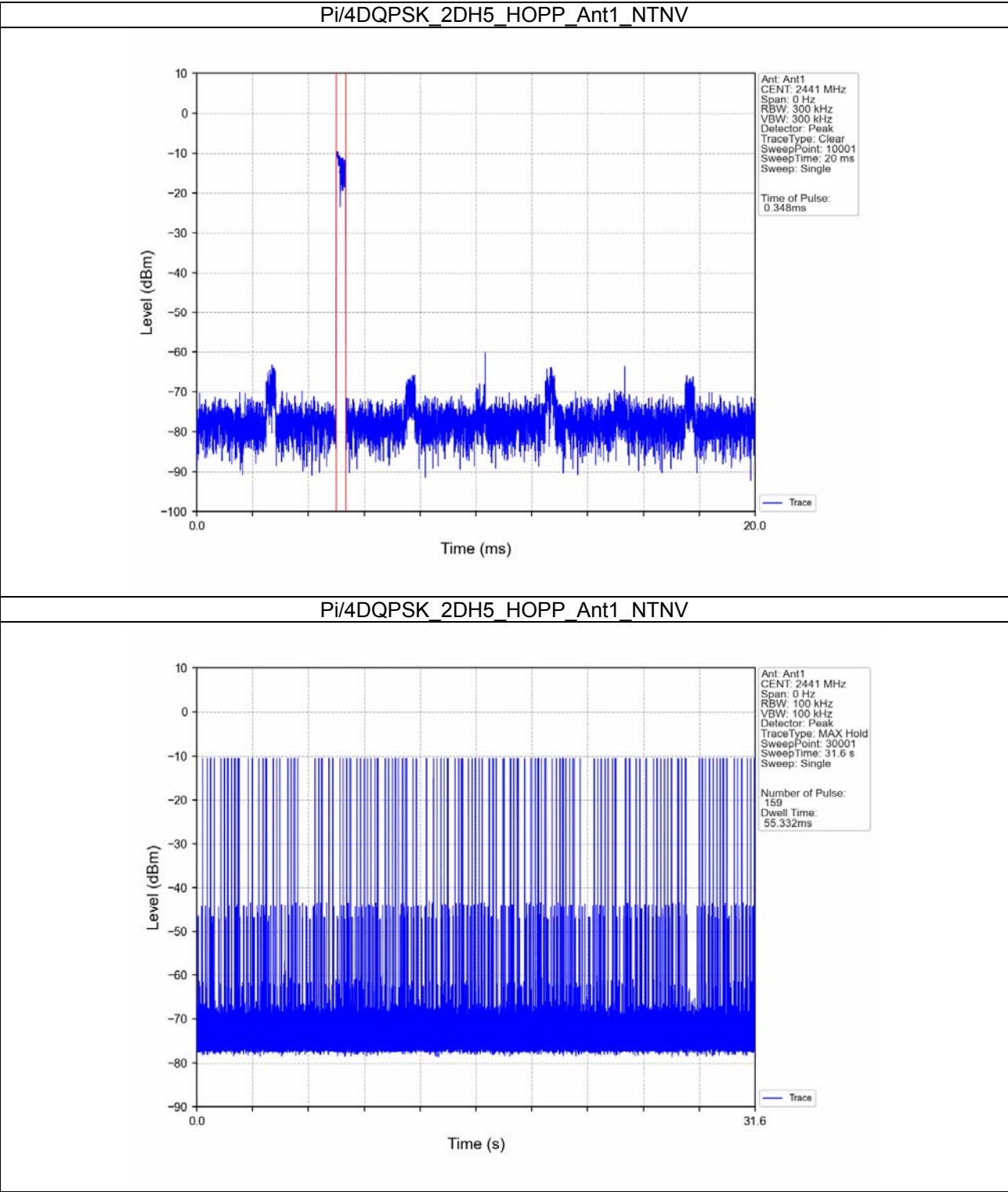


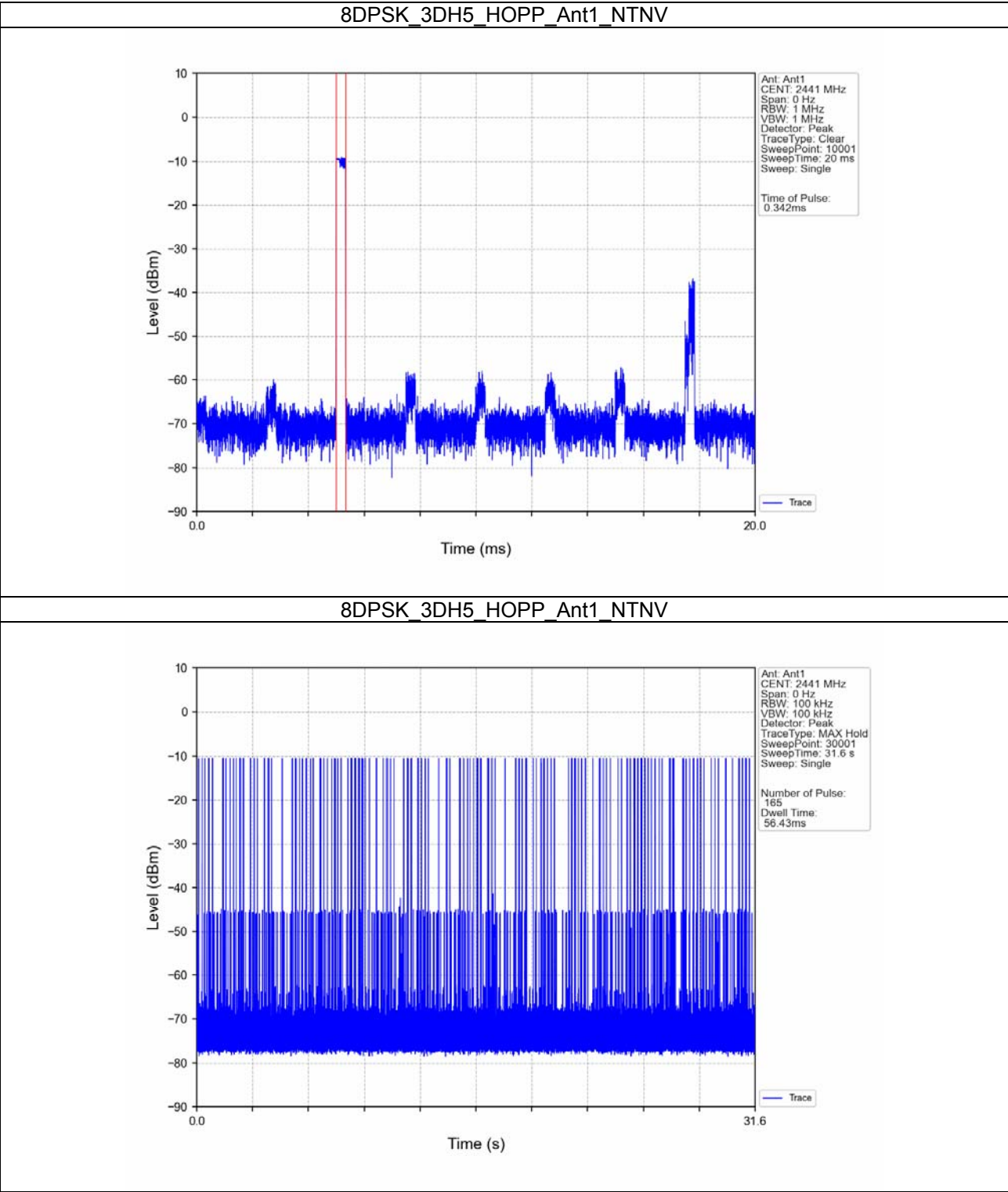




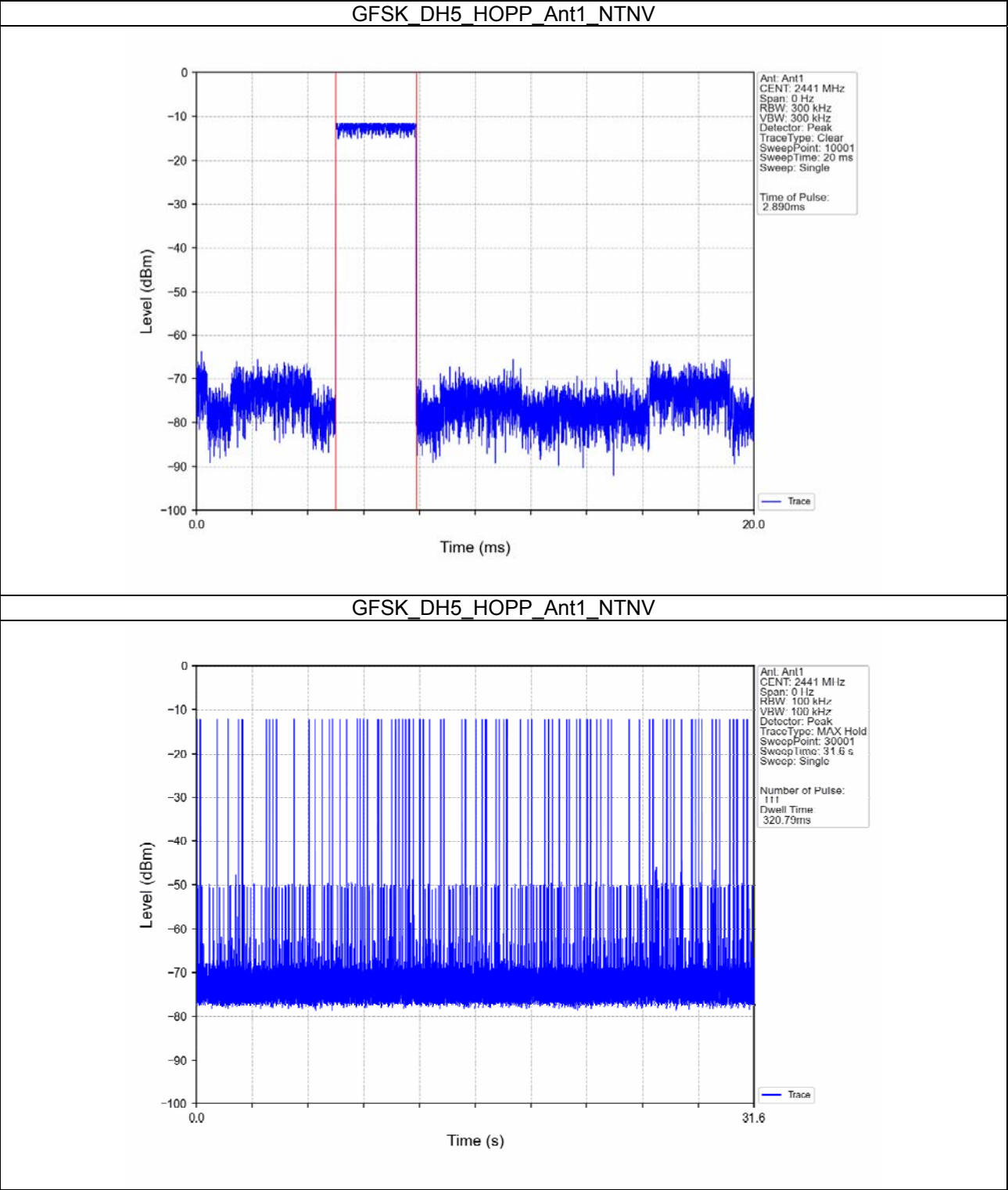
Bluetooth 2
Test Plots

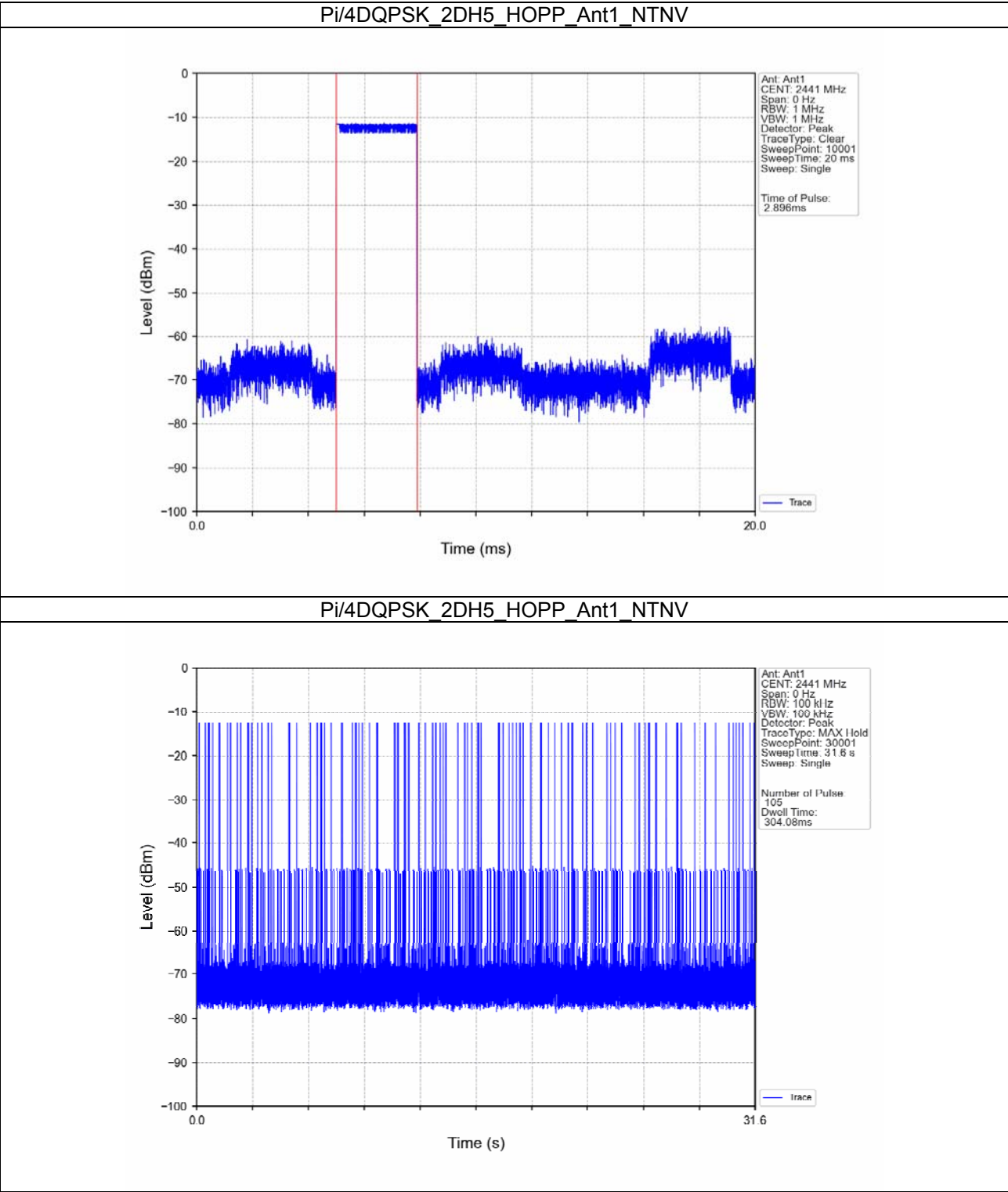


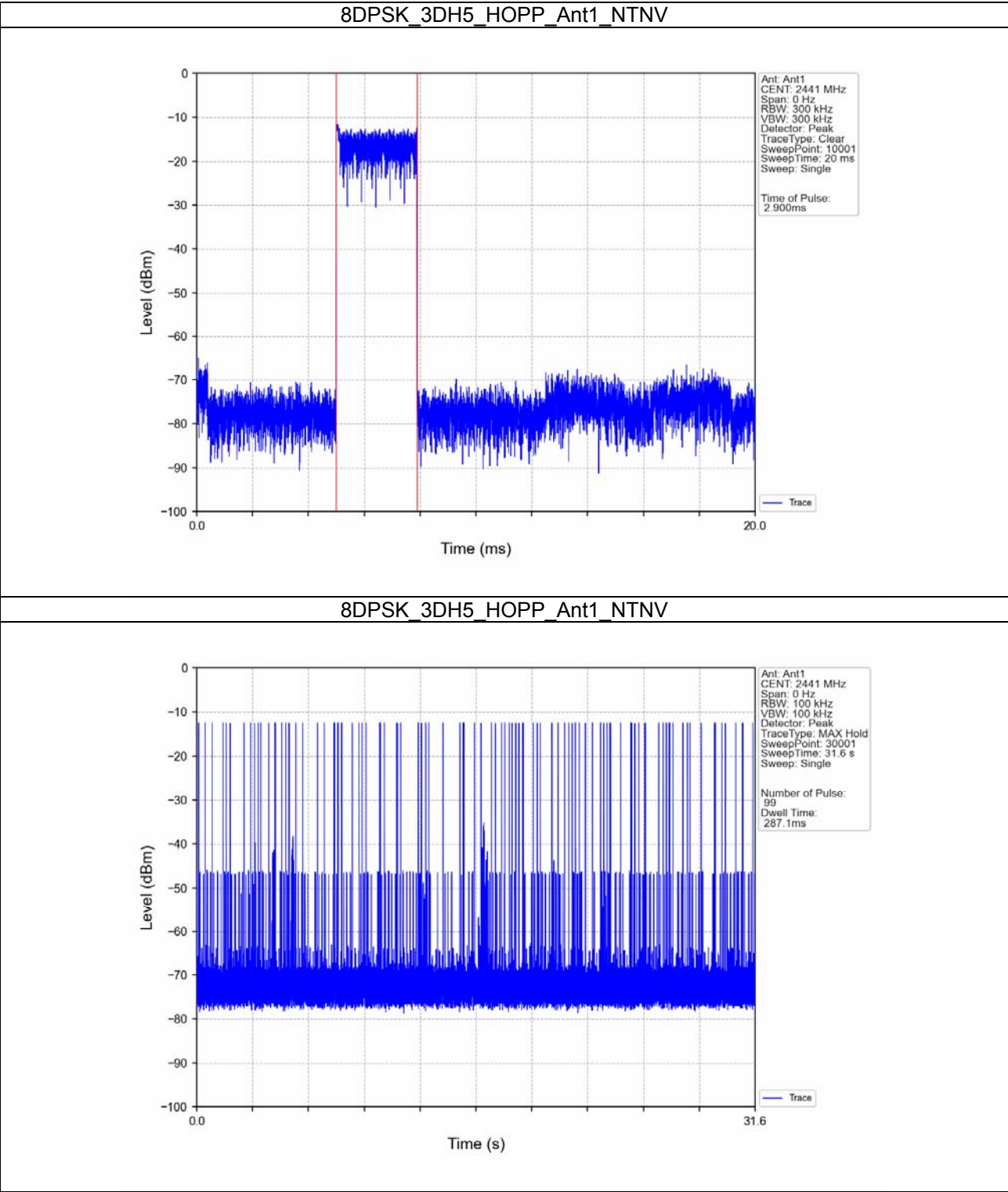




Bluetooth 3
Test Plots

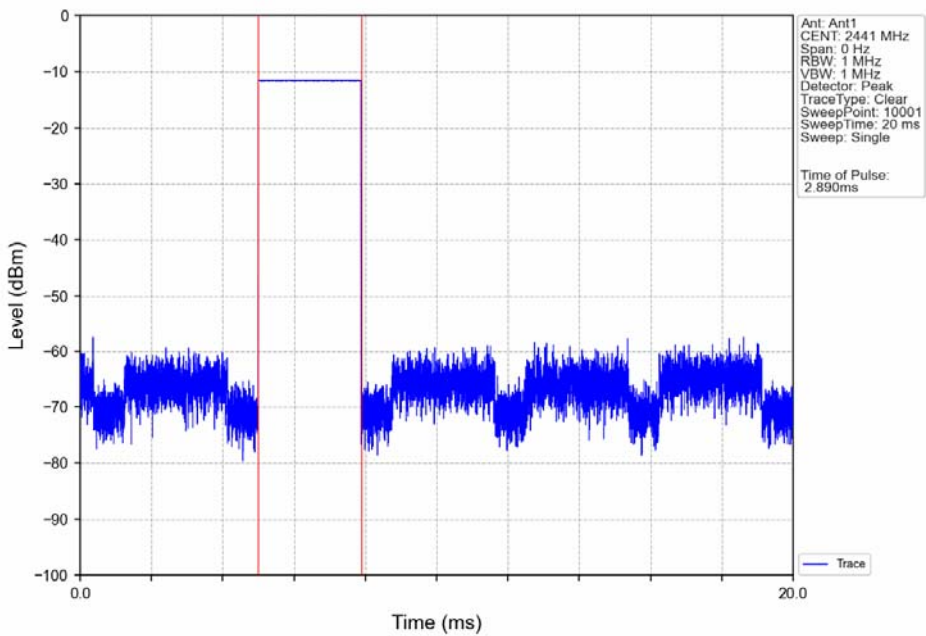




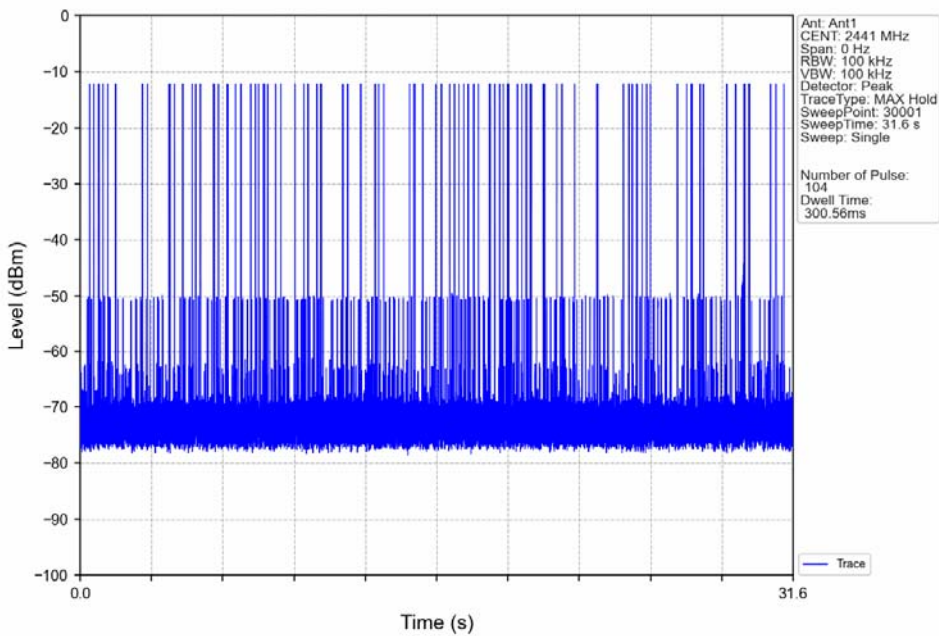


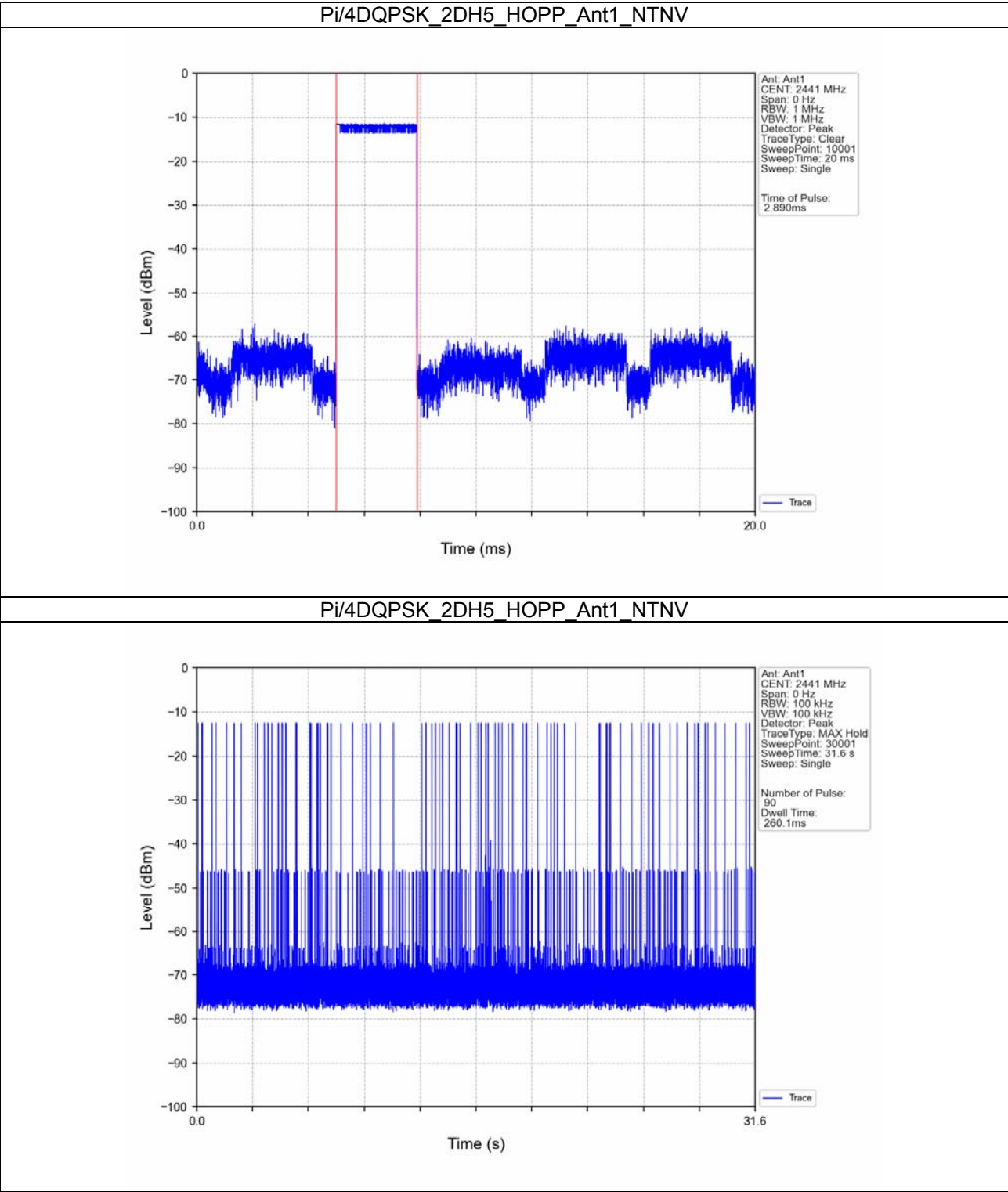
Bluetooth 4
Test Plots

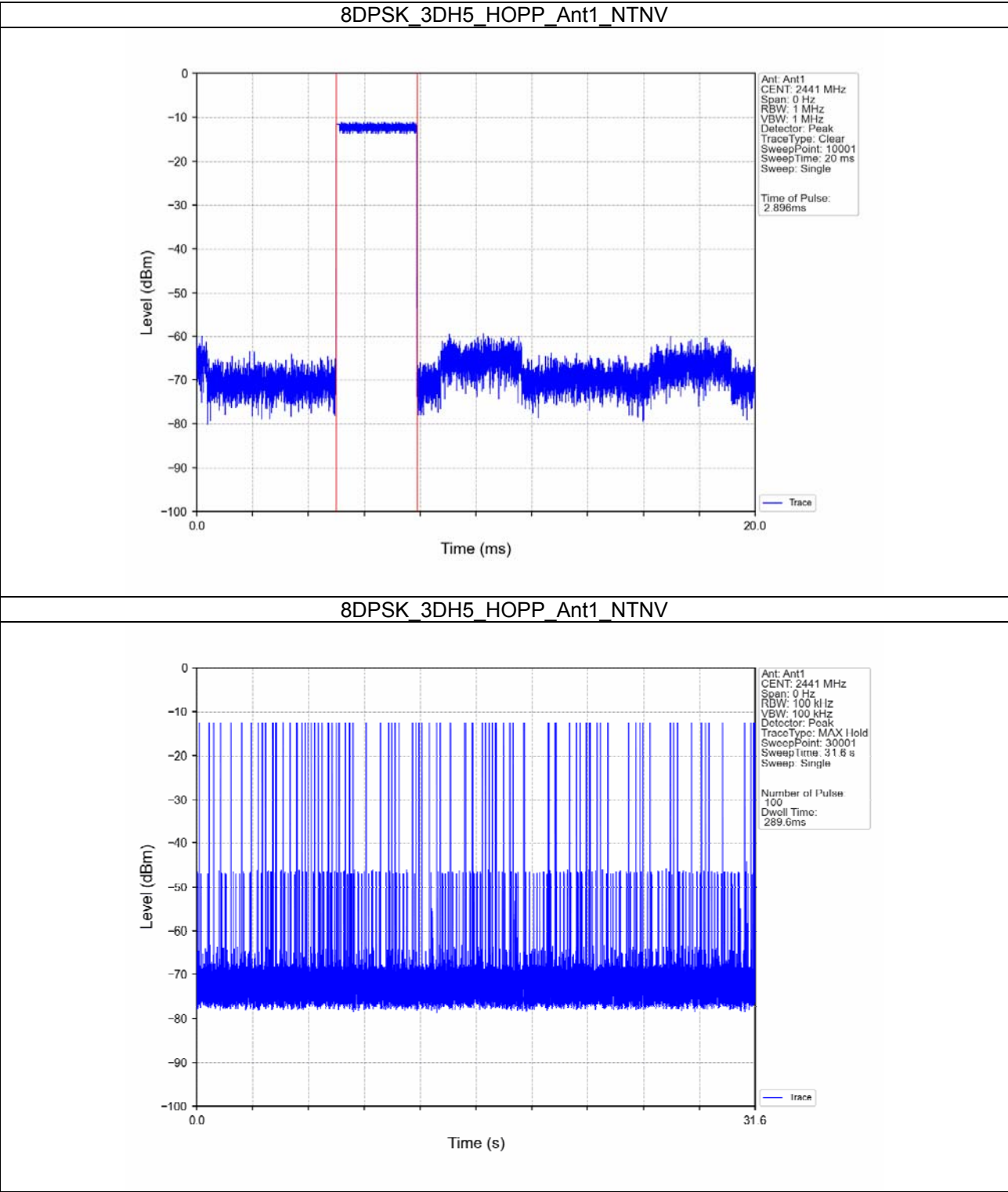
GFSK_DH5_HOPP_Ant1_NTNV



GFSK_DH5_HOPP_Ant1_NTNV







16 Antenna Requirement

According to the FCC Part 15 Paragraph 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. This product has a PCB Antenna fulfil the requirement of this section.

Note: Please refer to EUT photos for more details.

17 RF Exposure

Remark: refer to RF Exposure Report: WTD26D07202289W004.

18 Photographs of test setup and EUT.

Note: Please refer to appendix: AppendixVX254343*-Photos.

=====End of Report=====