Appendix: Bluetooth LE for ESP32

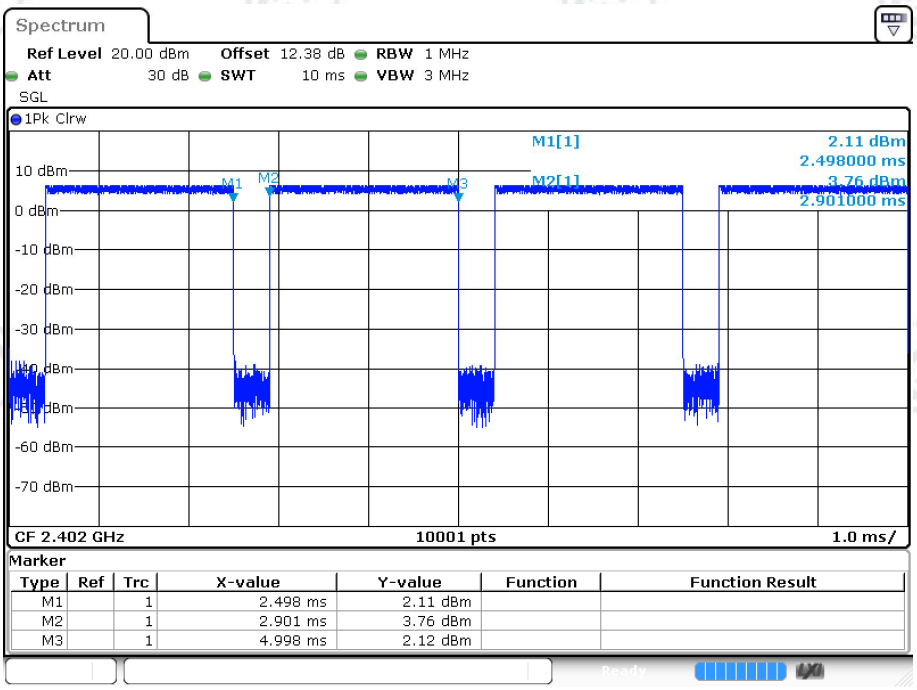
Contents

Duty Cycle

Condition	Mode	Frequency (MHz)	Antenna	Duty Cycle (%)	Correction Factor (dB)	1/T (kHz)
NVNT	BLE 1M	2402	Ant1	83.88	0.76	0.48
NVNT	BLE 1M	2440	Ant1	83.88	0.76	0.48
NVNT	BLE 1M	2480	Ant1	83.88	0.76	0.48
NVNT	BLE 2M	2402	Ant1	56.69	2.46	0.94
NVNT	BLE 2M	2440	Ant1	56.69	2.46	0.94
NVNT	BLE 2M	2480	Ant1	56.69	2.46	0.94

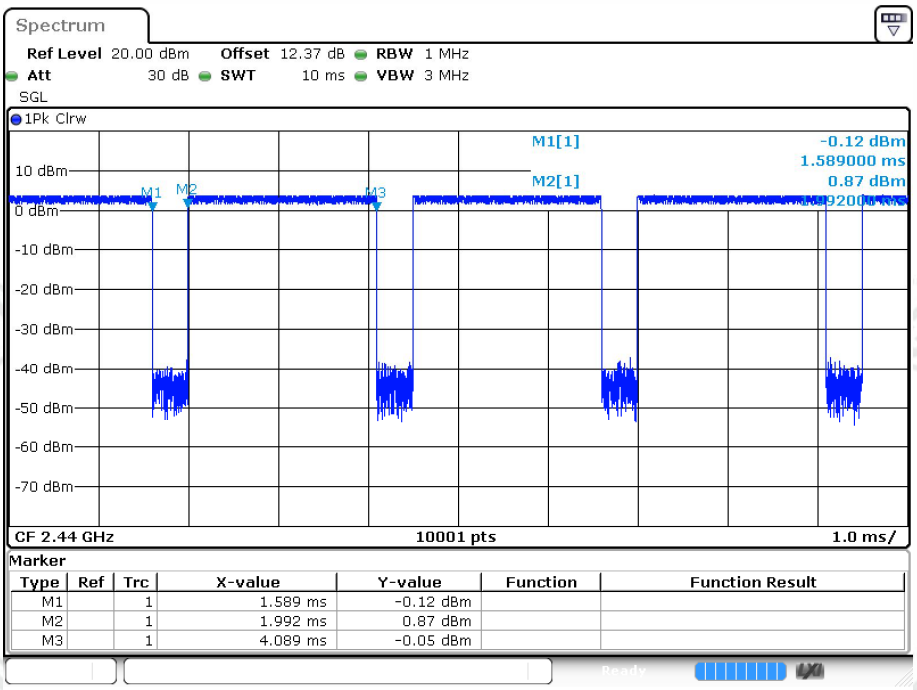
Test Graphs

Duty Cycle NVNT BLE 1M 2402MHz Ant1



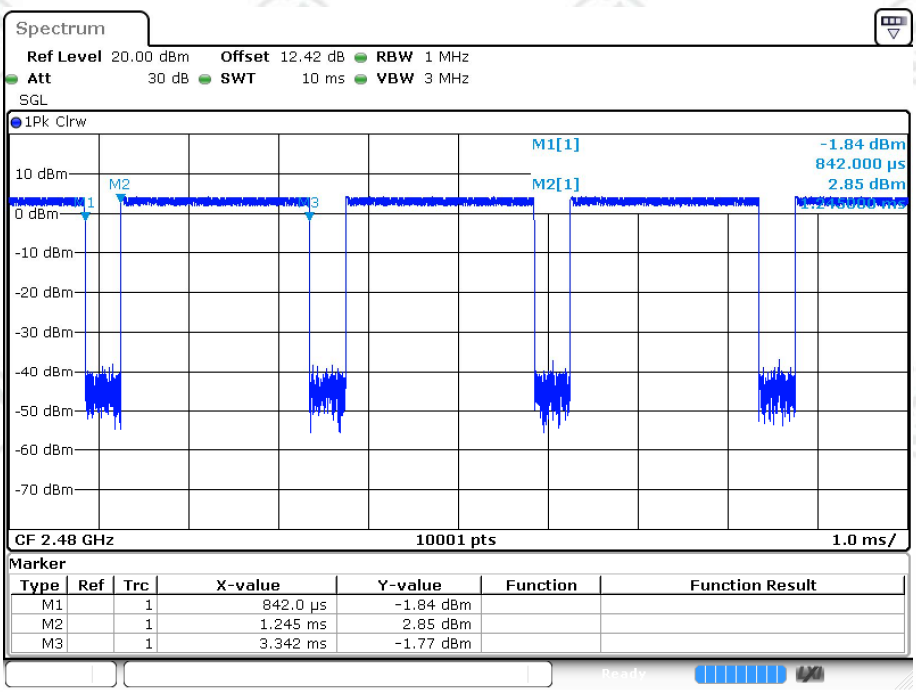
Date: 26.MAY.2025 20:13:07

Duty Cycle NVNT BLE 1M 2440MHz Ant1



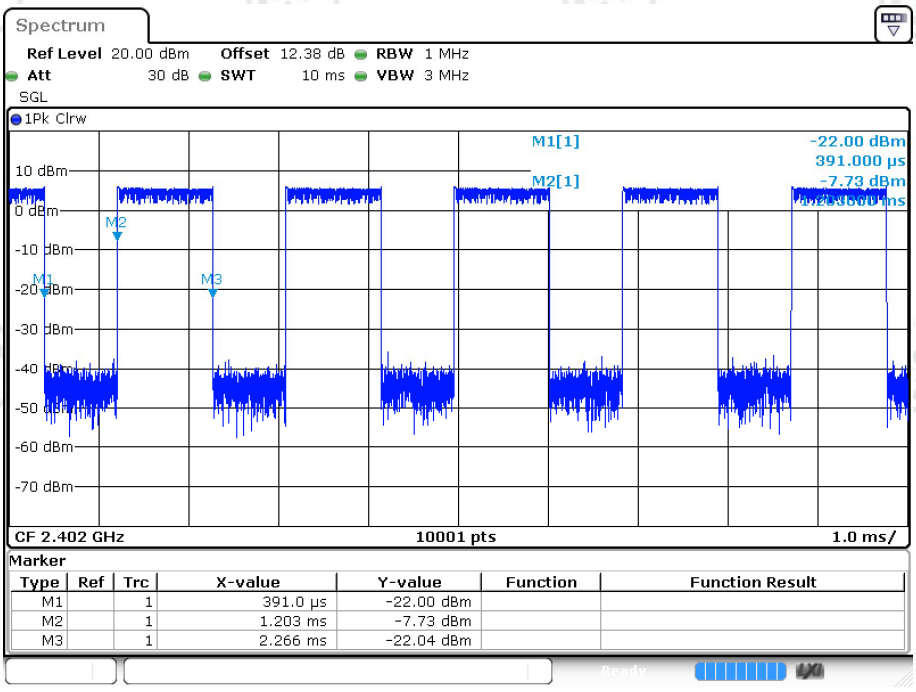
Date: 26.MAY.2025 20:15:52

Duty Cycle NVNT BLE 1M 2480MHz Ant1



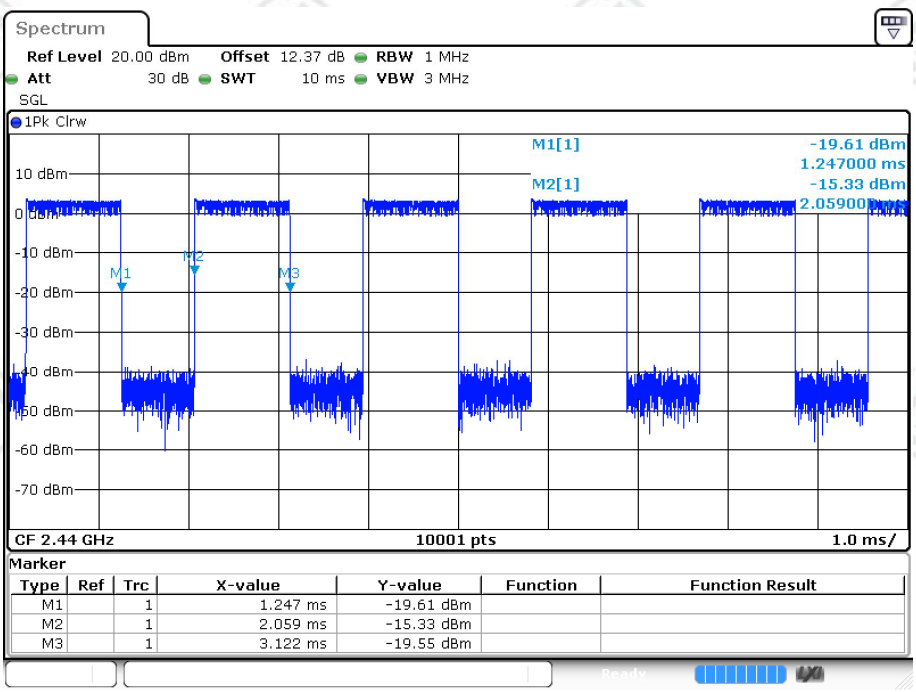
Date: 26.MAY.2025 20:17:32

Duty Cycle NVNT BLE 2M 2402MHz Ant1



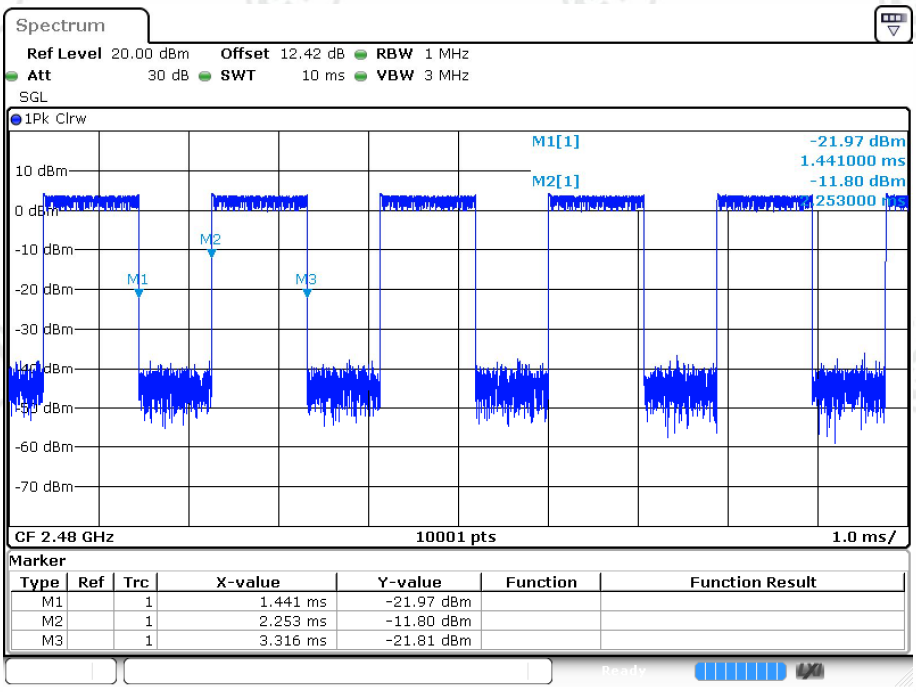
Date: 26.MAY.2025 20:20:08

Duty Cycle NVNT BLE 2M 2440MHz Ant1



Date: 26.MAY.2025 20:21:59

Duty Cycle NVNT BLE 2M 2480MHz Ant1



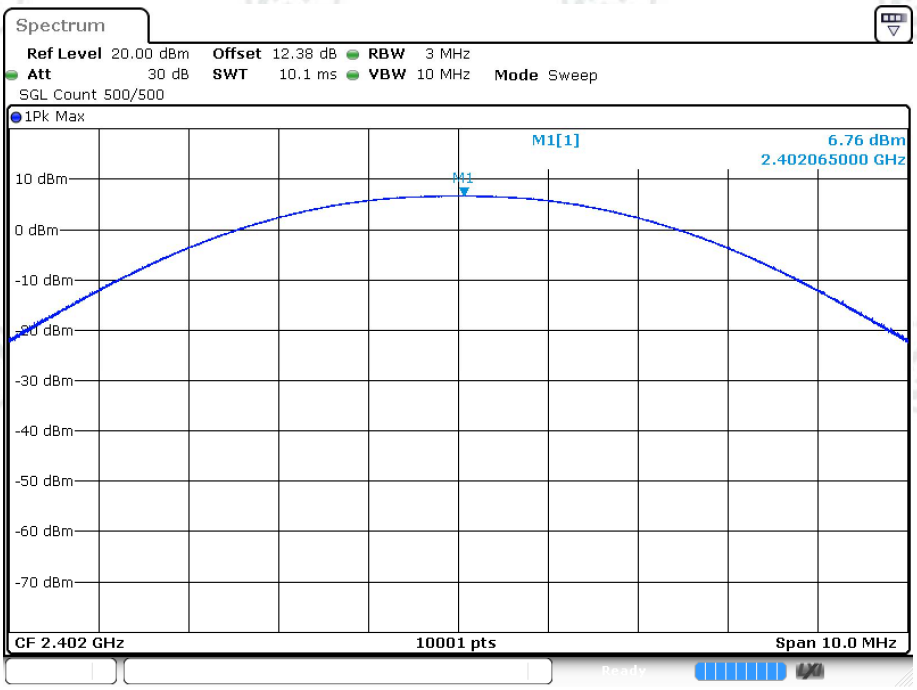
Date: 26.MAY.2025 20:23:54

Maximum Peak Conducted Output Power

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Limit (dBm)	Verdict
NVNT	BLE 1M	2402	Ant1	6.76	30	Pass
NVNT	BLE 1M	2440	Ant1	4.29	30	Pass
NVNT	BLE 1M	2480	Ant1	4.65	30	Pass
NVNT	BLE 2M	2402	Ant1	6.33	30	Pass
NVNT	BLE 2M	2440	Ant1	4	30	Pass
NVNT	BLE 2M	2480	Ant1	4.55	30	Pass

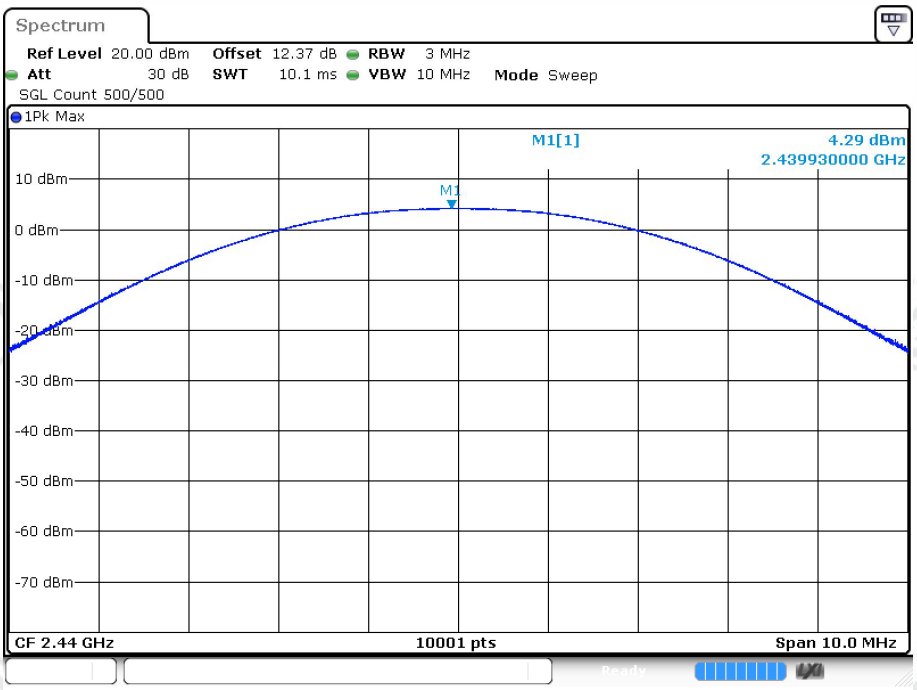
Test Graphs

Peak Power NVNT BLE 1M 2402MHz Ant1



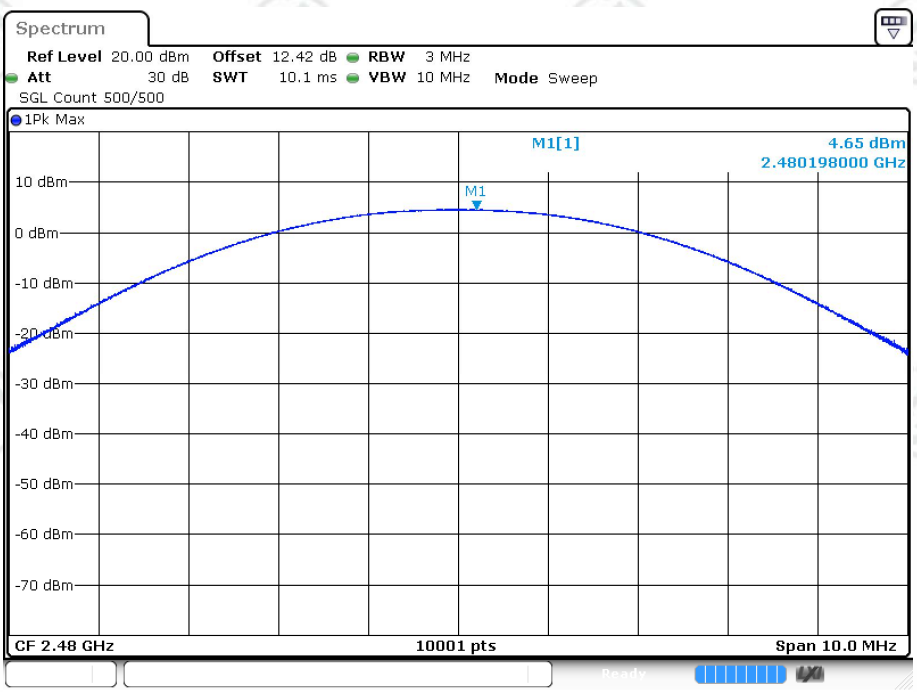
Date: 26.MAY.2025 20:13:21

Peak Power NVNT BLE 1M 2440MHz Ant1



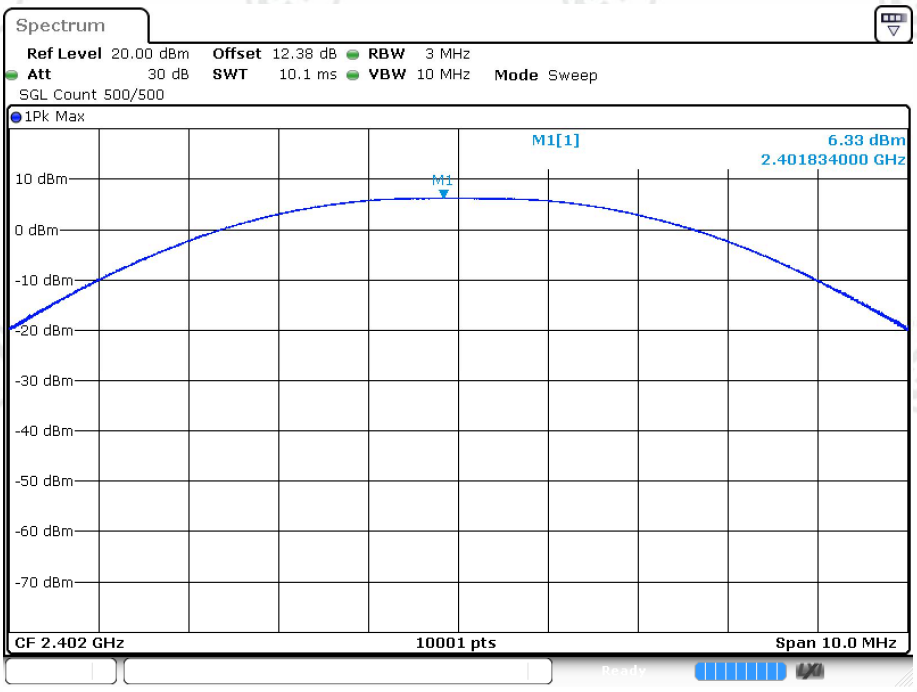
Date: 26.MAY.2025 20:16:02

Peak Power NVNT BLE 1M 2480MHz Ant1



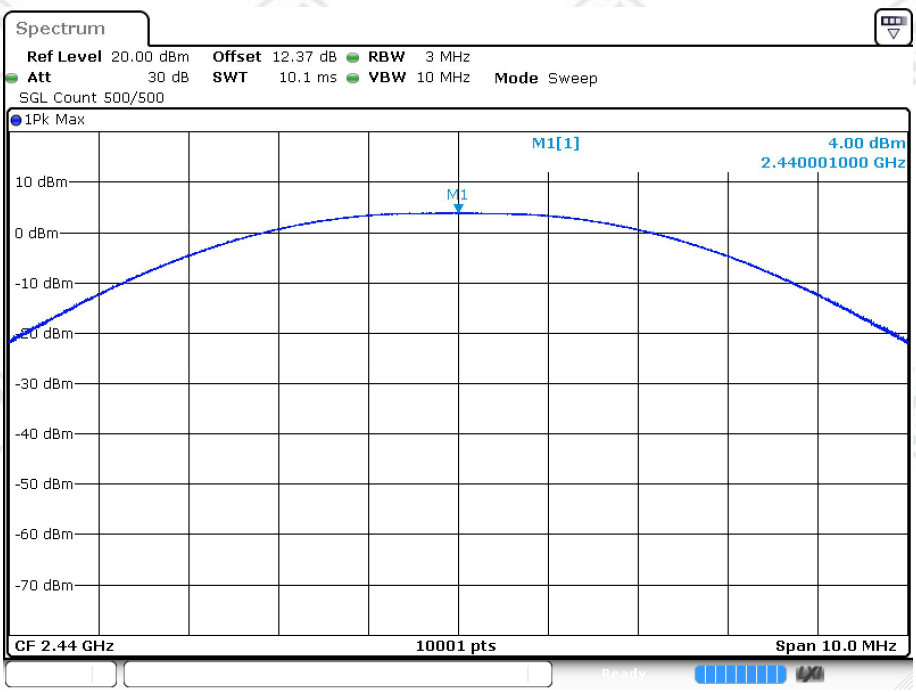
Date: 26.MAY.2025 20:17:42

Peak Power NVNT BLE 2M 2402MHz Ant1



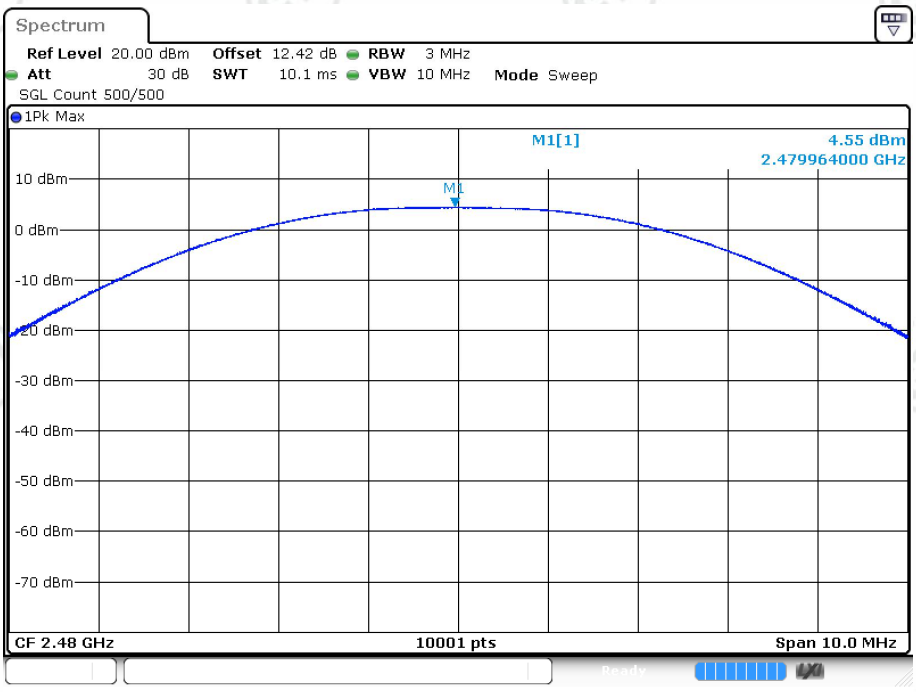
Date: 26.MAY.2025 20:20:18

Peak Power NVNT BLE 2M 2440MHz Ant1



Date: 26.MAY.2025 20:22:09

Peak Power NVNT BLE 2M 2480MHz Ant1



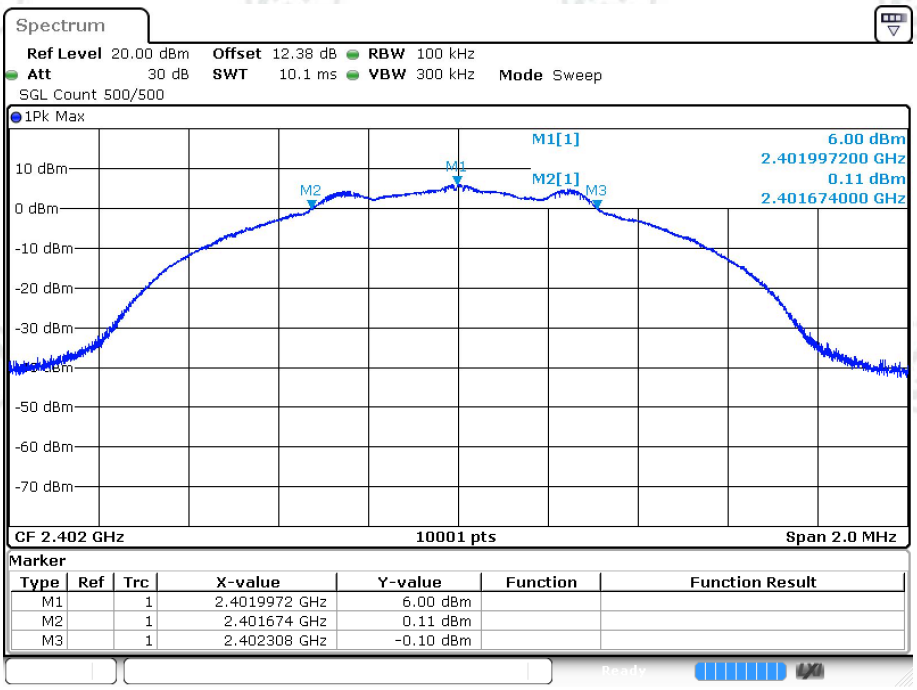
Date: 26.MAY.2025 20:24:04

-6dB Bandwidth

Condition	Mode	Frequency (MHz)	Antenna	-6 dB Bandwidth (MHz)	Limit -6 dB Bandwidth (MHz)	Verdict
NVNT	BLE 1M	2402	Ant1	0.634	0.5	Pass
NVNT	BLE 1M	2440	Ant1	0.632	0.5	Pass
NVNT	BLE 1M	2480	Ant1	0.634	0.5	Pass
NVNT	BLE 2M	2402	Ant1	1.105	0.5	Pass
NVNT	BLE 2M	2440	Ant1	1.106	0.5	Pass
NVNT	BLE 2M	2480	Ant1	1.109	0.5	Pass

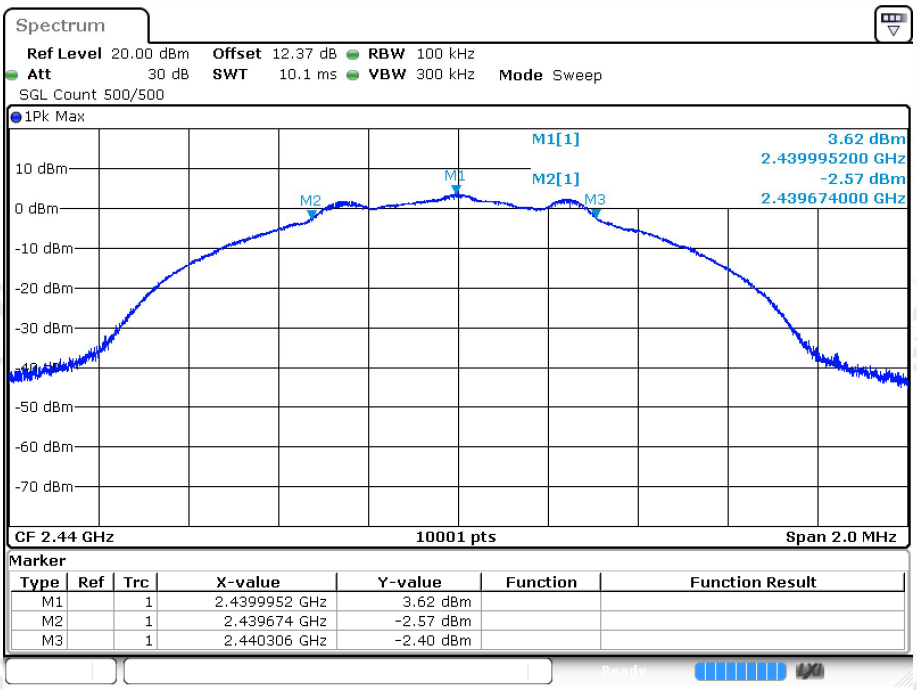
Test Graphs

-6dB Bandwidth NVNT BLE 1M 2402MHz Ant1



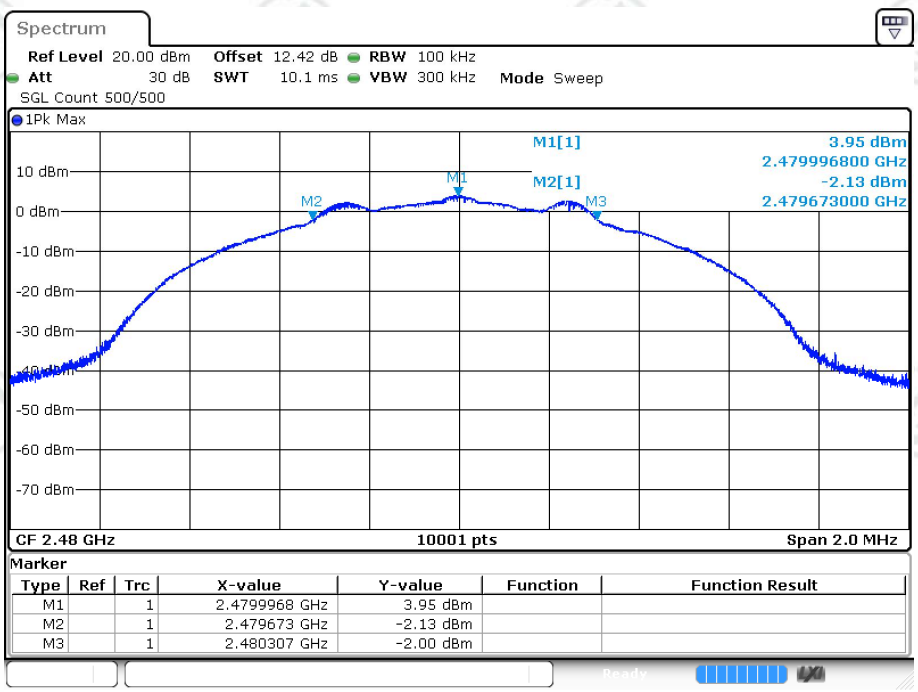
Date: 26.MAY.2025 20:14:31

-6dB Bandwidth NVNT BLE 1M 2440MHz Ant1



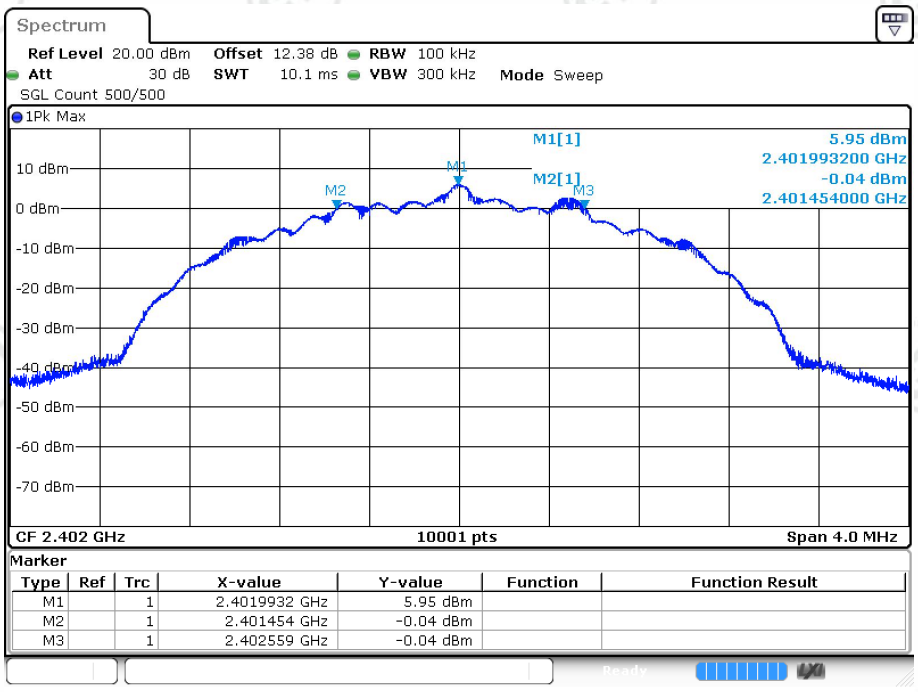
Date: 26.MAY.2025 20:16:25

-6dB Bandwidth NVNT BLE 1M 2480MHz Ant1



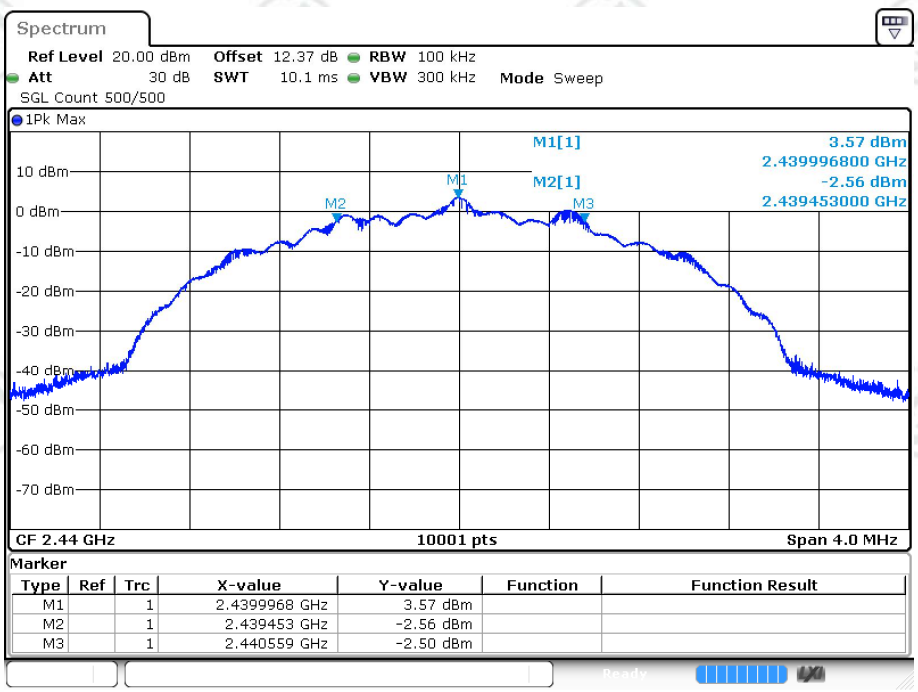
Date: 26.MAY.2025 20:18:04

-6dB Bandwidth NVNT BLE 2M 2402MHz Ant1



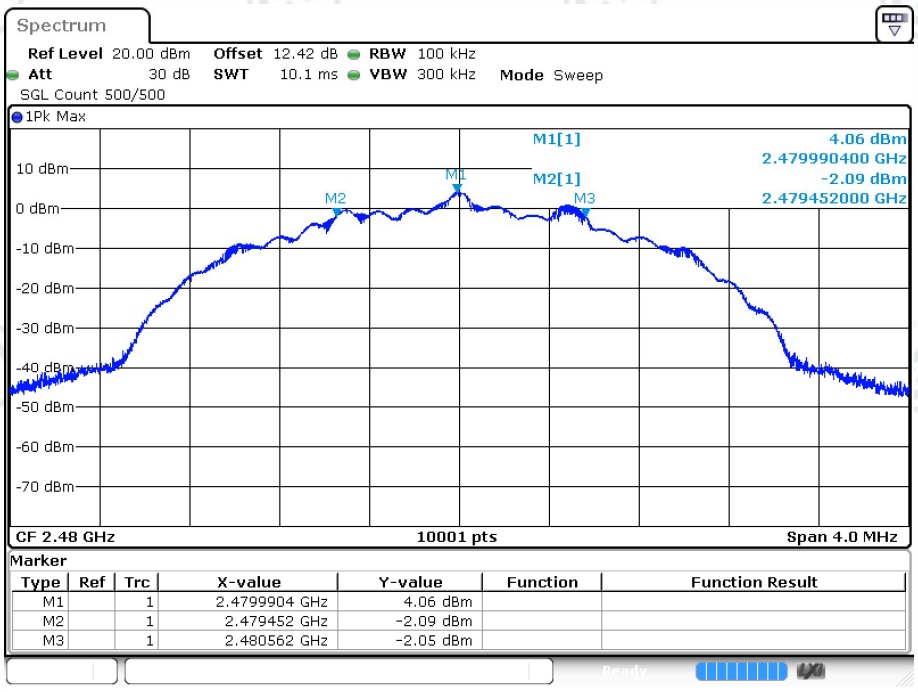
Date: 26.MAY.2025 20:20:40

-6dB Bandwidth NVNT BLE 2M 2440MHz Ant1



Date: 26.MAY.2025 20:22:31

-6dB Bandwidth NVNT BLE 2M 2480MHz Ant1



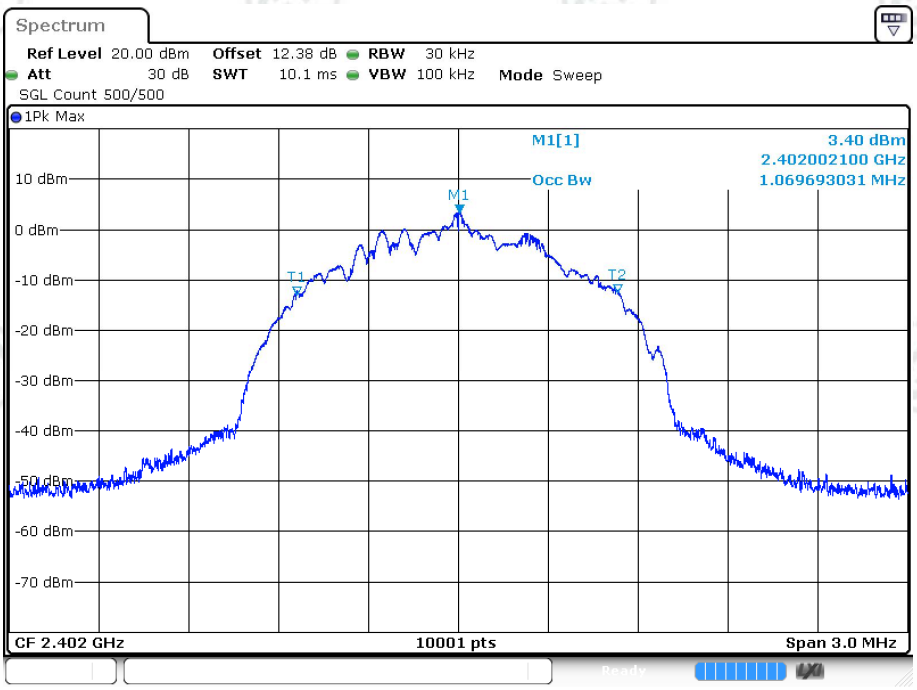
Date: 26.MAY.2025 20:24:26

Occupied Channel Bandwidth

Condition	Mode	Frequency (MHz)	Antenna	99% OBW (MHz)
NVNT	BLE 1M	2402	Ant1	1.07
NVNT	BLE 1M	2440	Ant1	1.068
NVNT	BLE 1M	2480	Ant1	1.067
NVNT	BLE 2M	2402	Ant1	2.084
NVNT	BLE 2M	2440	Ant1	2.085
NVNT	BLE 2M	2480	Ant1	2.086

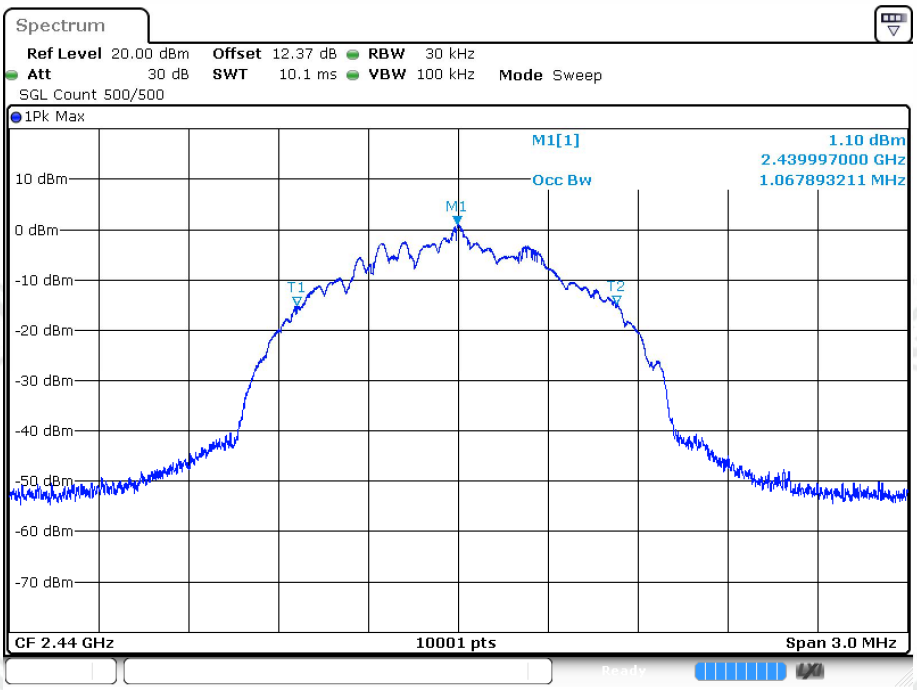
Test Graphs

OBW NVNT BLE 1M 2402MHz Ant1



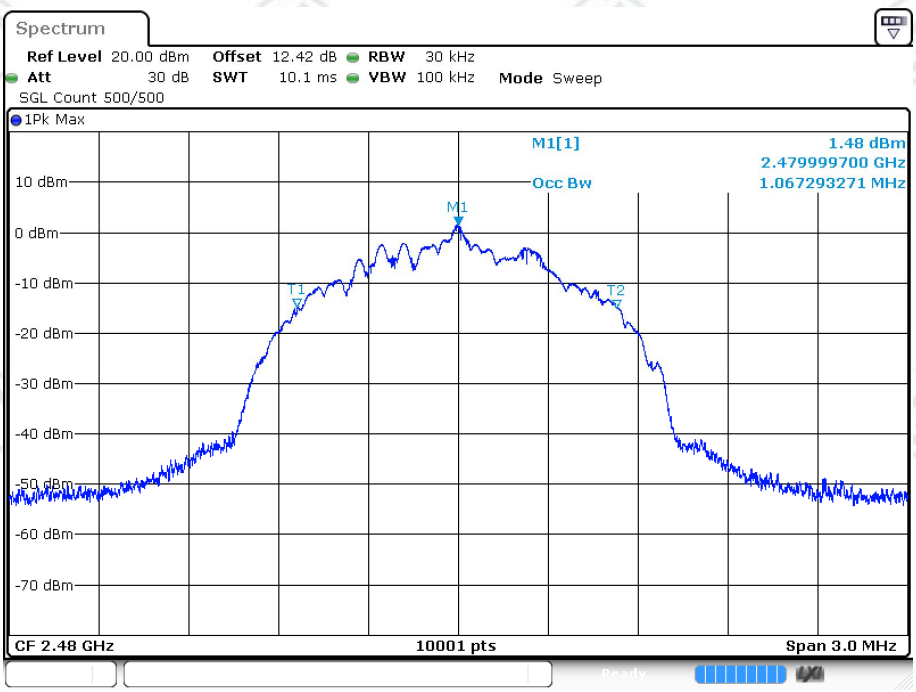
Date: 26.MAY.2025 20:13:36

OBW NVNT BLE 1M 2440MHz Ant1



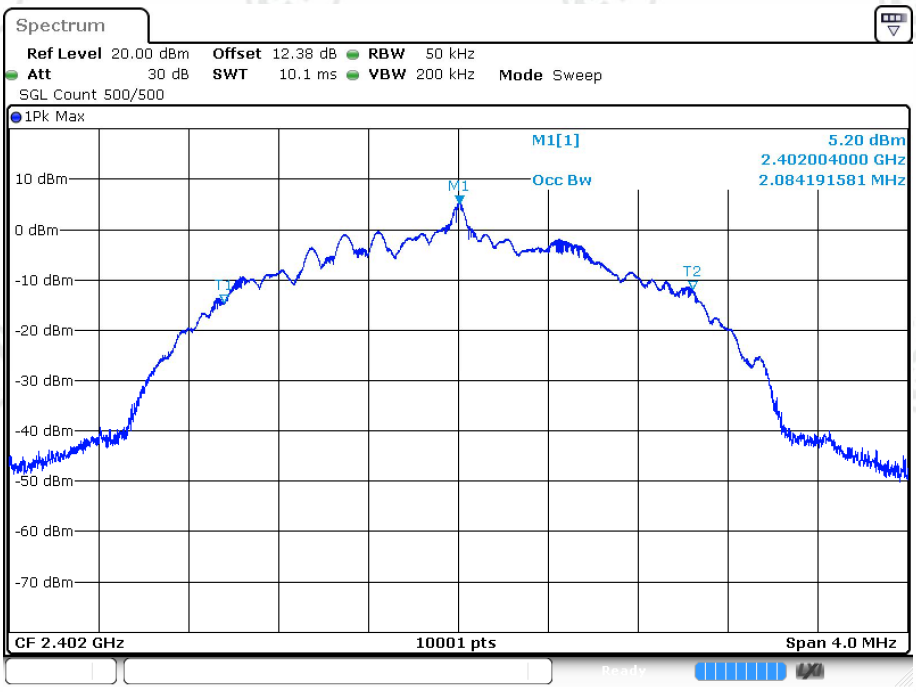
Date: 26.MAY.2025 20:16:14

OBW NVNT BLE 1M 2480MHz Ant1



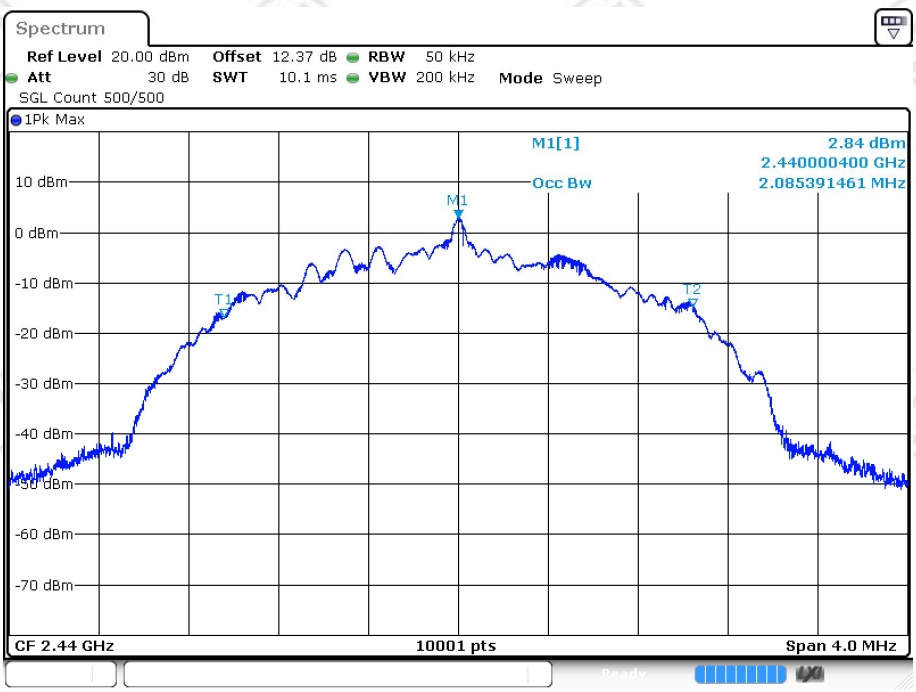
Date: 26.MAY.2025 20:17:53

OBW NVNT BLE 2M 2402MHz Ant1



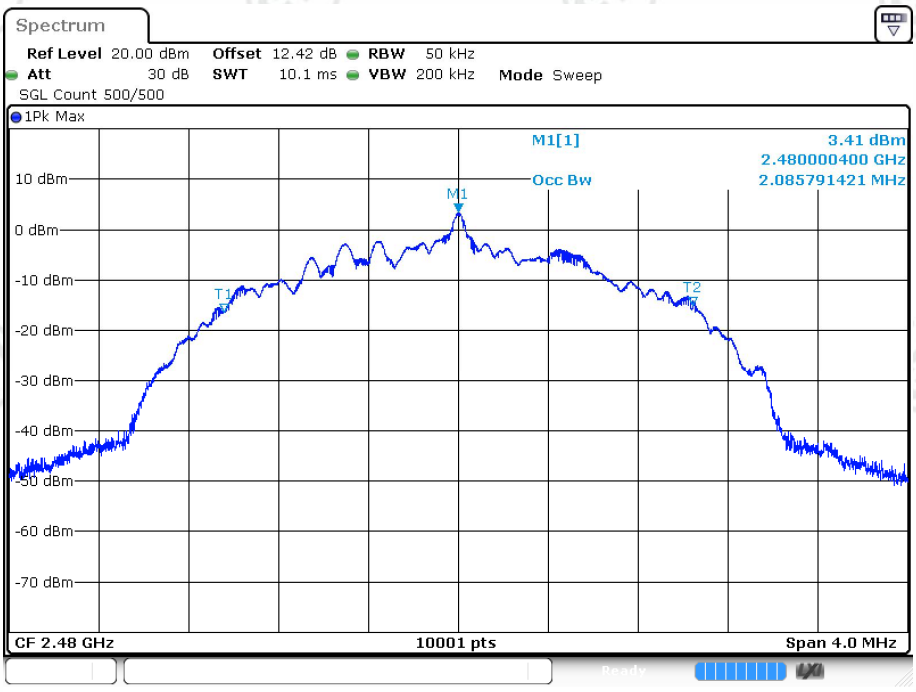
Date: 26.MAY.2025 20:20:29

OBW NVNT BLE 2M 2440MHz Ant1



Date: 26.MAY.2025 20:22:20

OBW NVNT BLE 2M 2480MHz Ant1



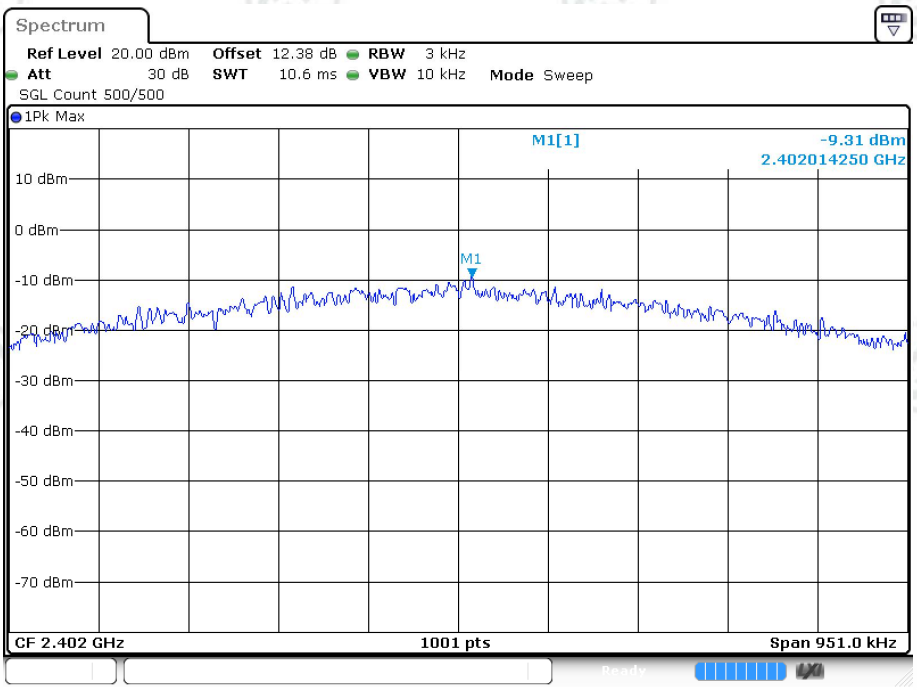
Date: 26.MAY.2025 20:24:15

Maximum Power Spectral Density Level

Condition	Mode	Frequency (MHz)	Antenna	Conducted PSD (dBm/3kHz)	Duty Factor (dB)	Total PSD (dBm/3kHz)	Limit (dBm/3kHz)	Verdict
NVNT	BLE 1M	2402	Ant1	-9.31	0	-9.31	8	Pass
NVNT	BLE 1M	2440	Ant1	-11.82	0	-11.82	8	Pass
NVNT	BLE 1M	2480	Ant1	-11.6	0	-11.6	8	Pass
NVNT	BLE 2M	2402	Ant1	-11.29	0	-11.29	8	Pass
NVNT	BLE 2M	2440	Ant1	-13.67	0	-13.67	8	Pass
NVNT	BLE 2M	2480	Ant1	-13.15	0	-13.15	8	Pass

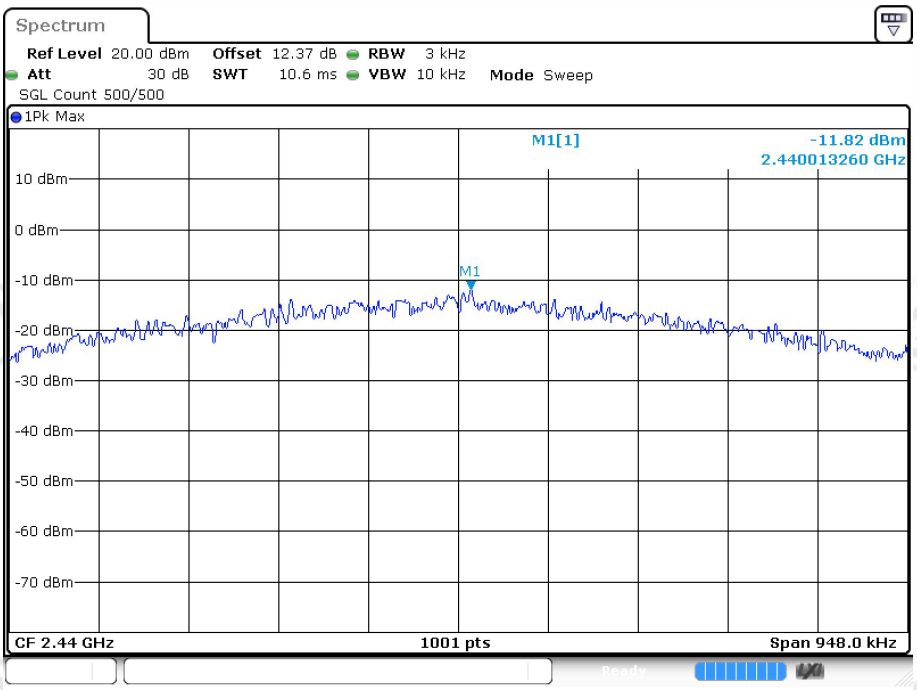
Test Graphs

PSD NVNT BLE 1M 2402MHz Ant1



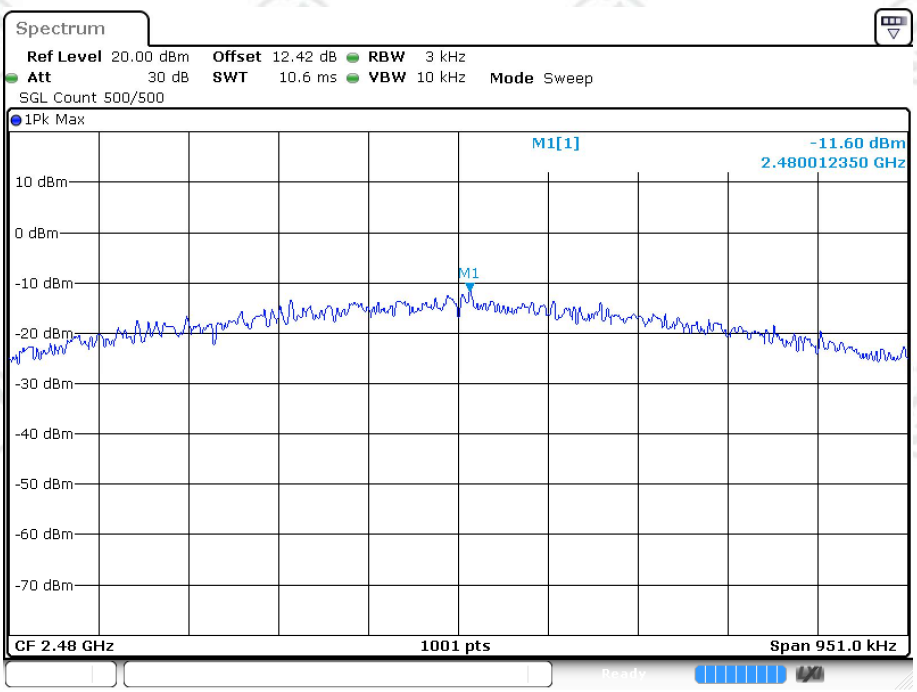
Date: 26.MAY.2025 20:14:44

PSD NVNT BLE 1M 2440MHz Ant1



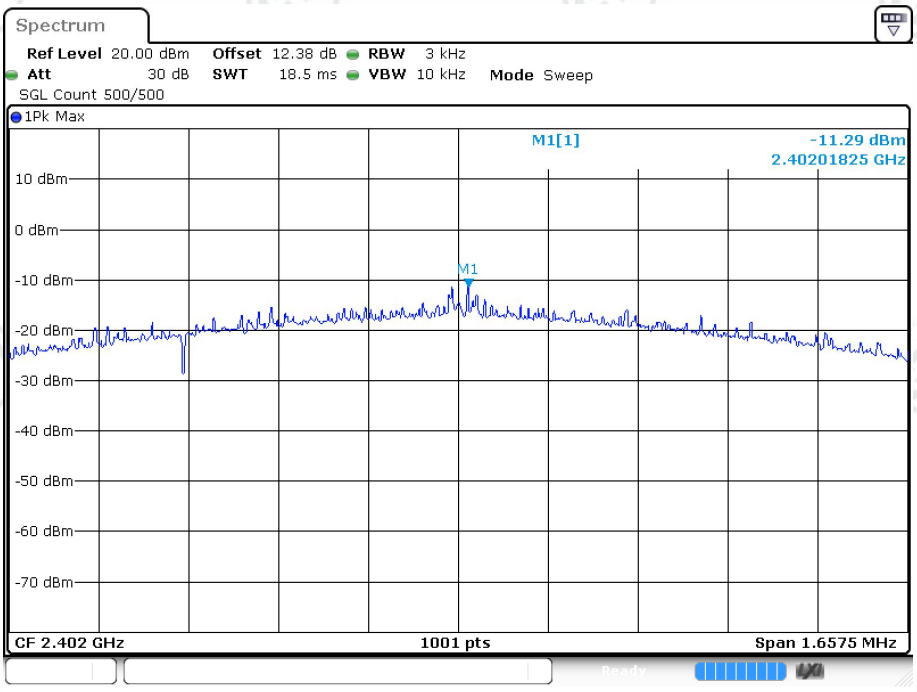
Date: 26.MAY.2025 20:16:38

PSD NVNT BLE 1M 2480MHz Ant1



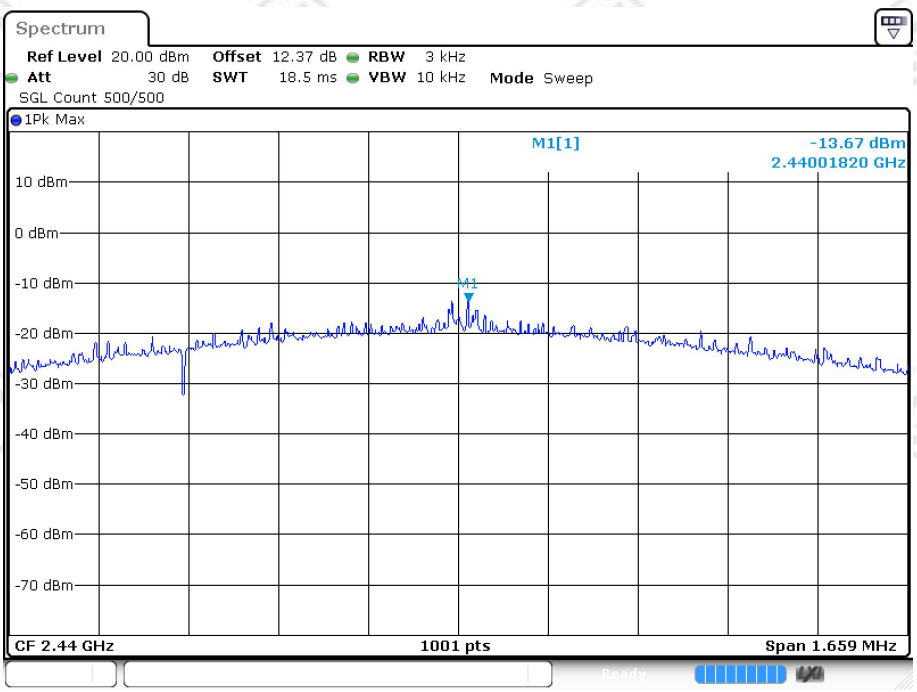
Date: 26.MAY.2025 20:18:17

PSD NVNT BLE 2M 2402MHz Ant1



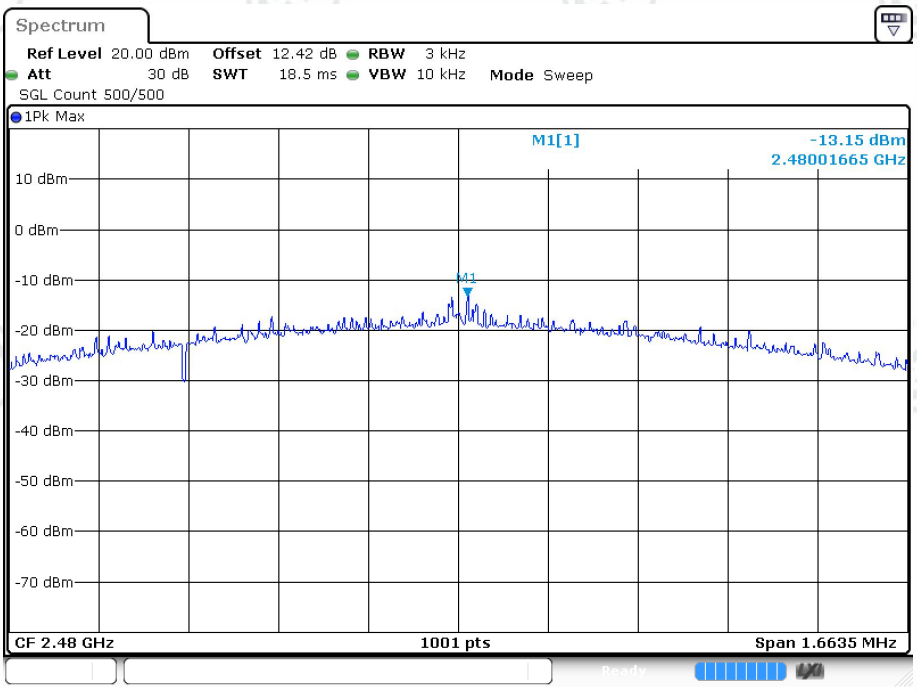
Date: 26.MAY.2025 20:21:01

PSD NVNT BLE 2M 2440MHz Ant1



Date: 26.MAY.2025 20:22:53

PSD NVNT BLE 2M 2480MHz Ant1



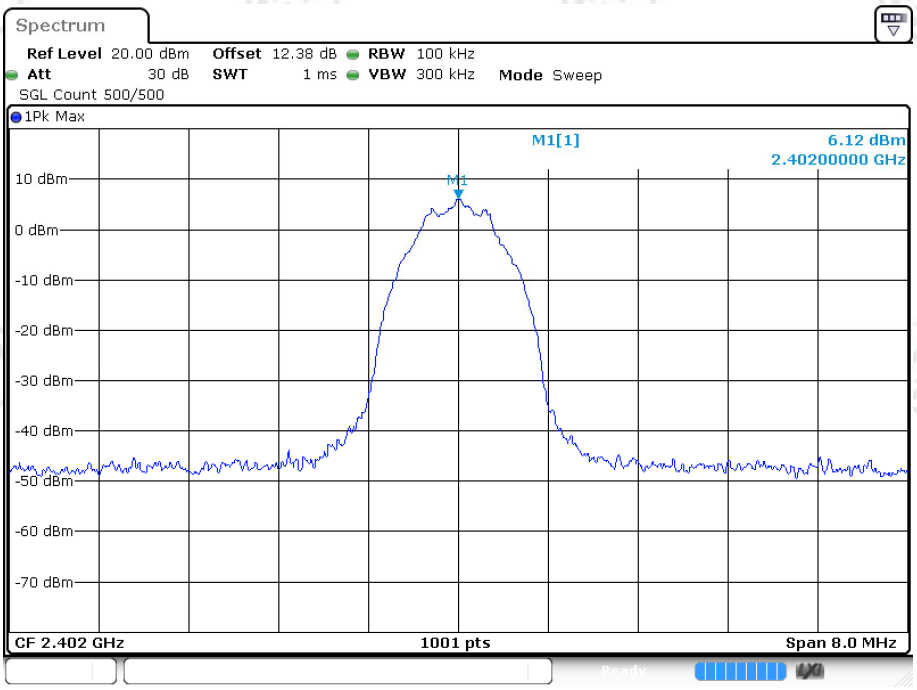
Date: 26.MAY.2025 20:24:48

Band Edge

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE 1M	2402	Ant1	-50.95	-20	Pass
NVNT	BLE 1M	2480	Ant1	-49.66	-20	Pass
NVNT	BLE 2M	2402	Ant1	-50.46	-20	Pass
NVNT	BLE 2M	2480	Ant1	-49.83	-20	Pass

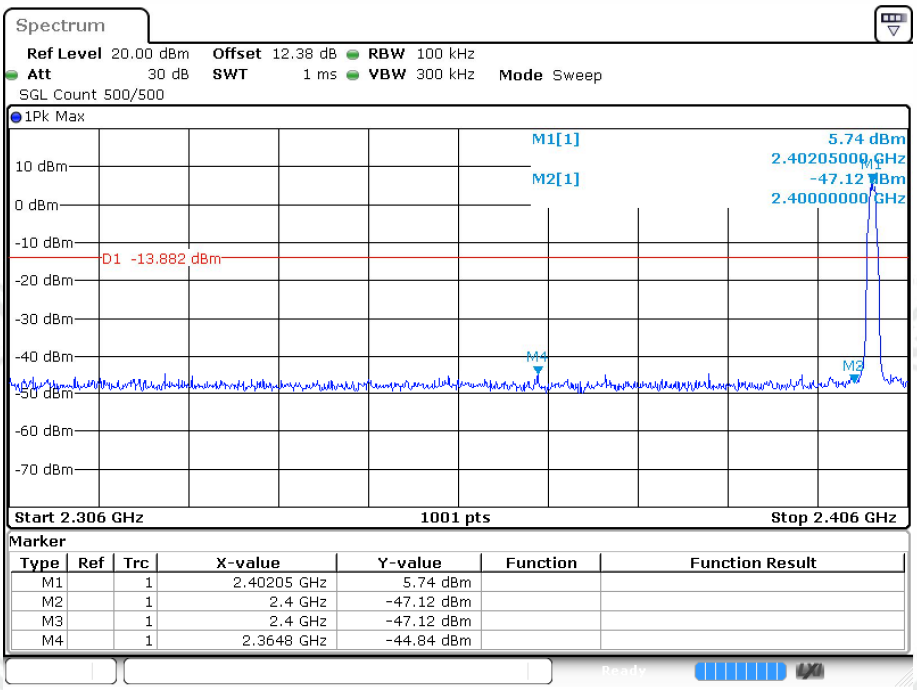
Test Graphs

Band Edge NVNT BLE 1M 2402MHz Ant1 Ref



Date: 26.MAY.2025 20:14:48

Band Edge NVNT BLE 1M 2402MHz Ant1 Emission

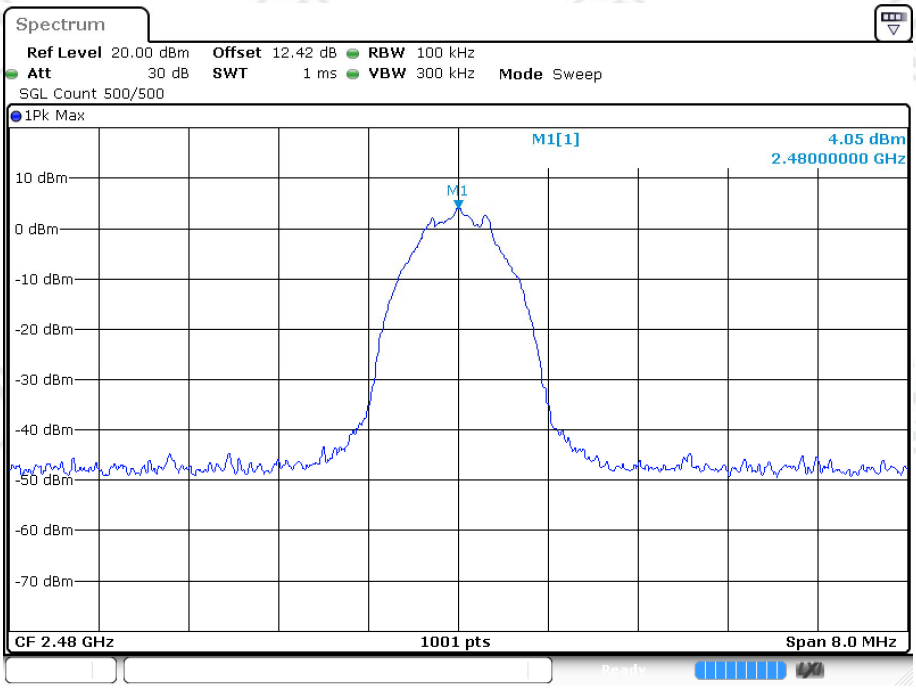


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40205 GHz	5.74 dBm		
M2		1	2.4 GHz	-47.12 dBm		
M3		1	2.4 GHz	-47.12 dBm		
M4		1	2.3648 GHz	-44.84 dBm		

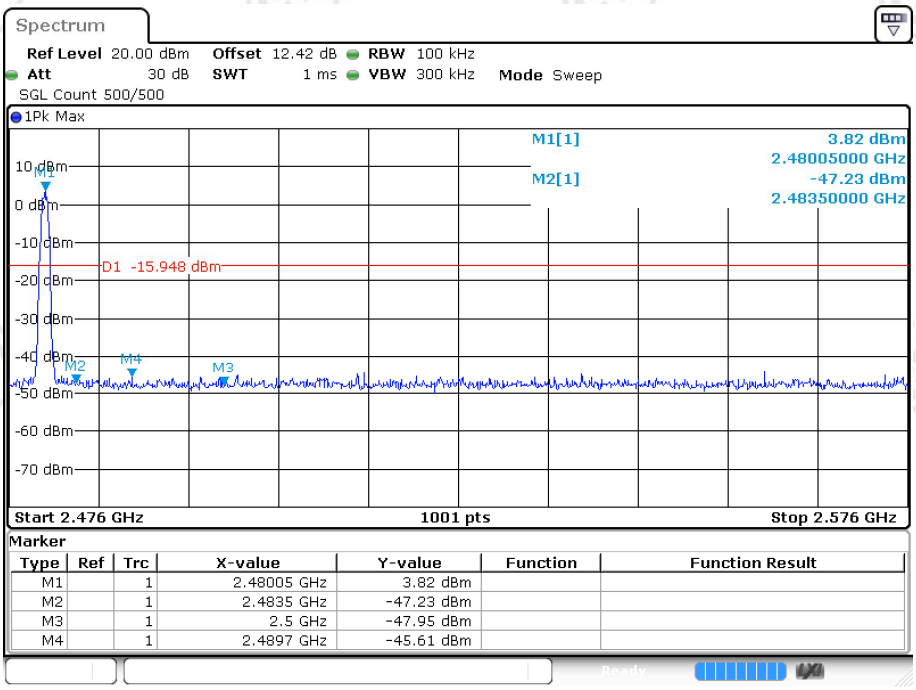
Date: 26.MAY.2025 20:14:51

Band Edge NVNT BLE 1M 2480MHz Ant1 Ref



Date: 26.MAY.2025 20:18:21

Band Edge NVNT BLE 1M 2480MHz Ant1 Emission

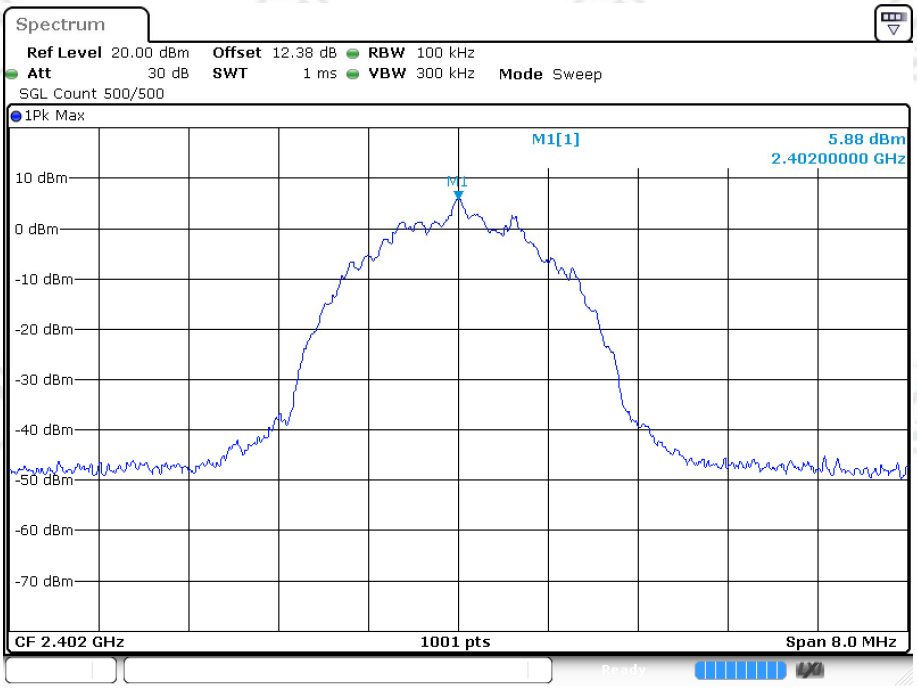


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.48005 GHz	3.82 dBm		
M2		1	2.4835 GHz	-47.23 dBm		
M3		1	2.5 GHz	-47.95 dBm		
M4		1	2.4897 GHz	-45.61 dBm		

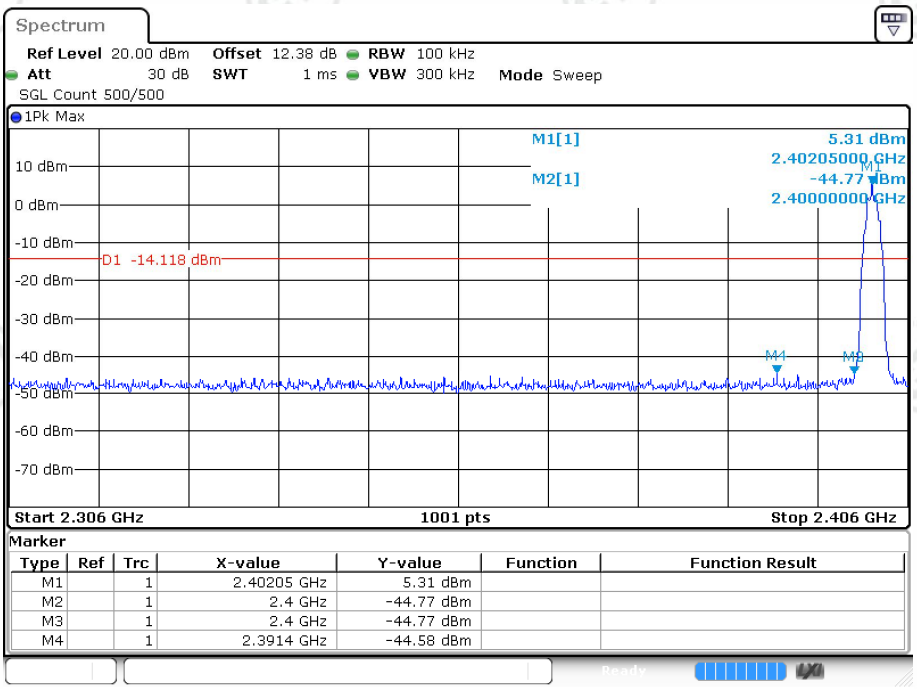
Date: 26.MAY.2025 20:18:23

Band Edge NVNT BLE 2M 2402MHz Ant1 Ref



Date: 26.MAY.2025 20:21:05

Band Edge NVNT BLE 2M 2402MHz Ant1 Emission

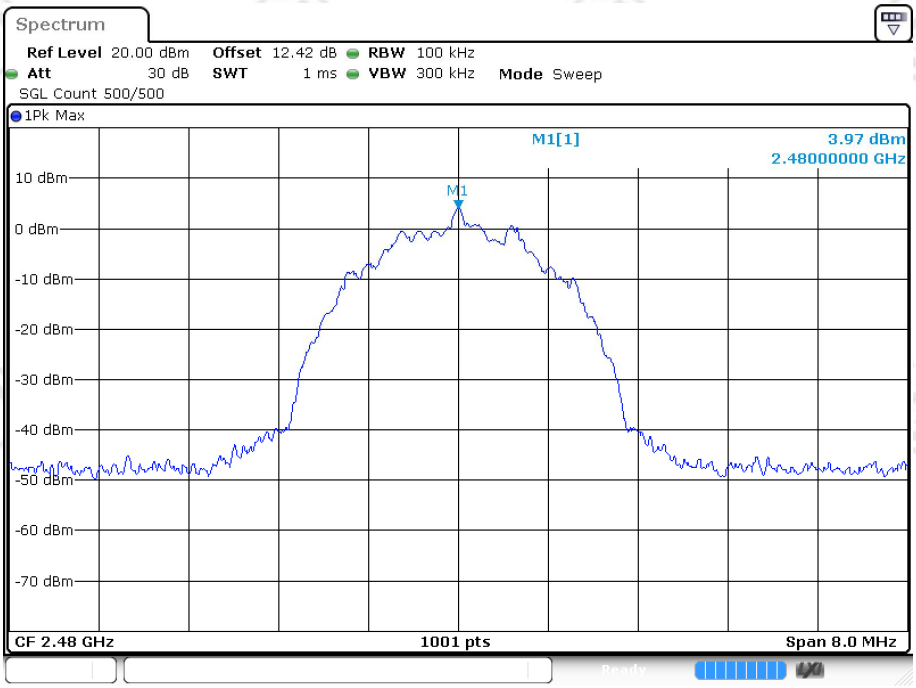


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40205 GHz	5.31 dBm		
M2		1	2.4 GHz	-44.77 dBm		
M3		1	2.4 GHz	-44.77 dBm		
M4		1	2.3914 GHz	-44.58 dBm		

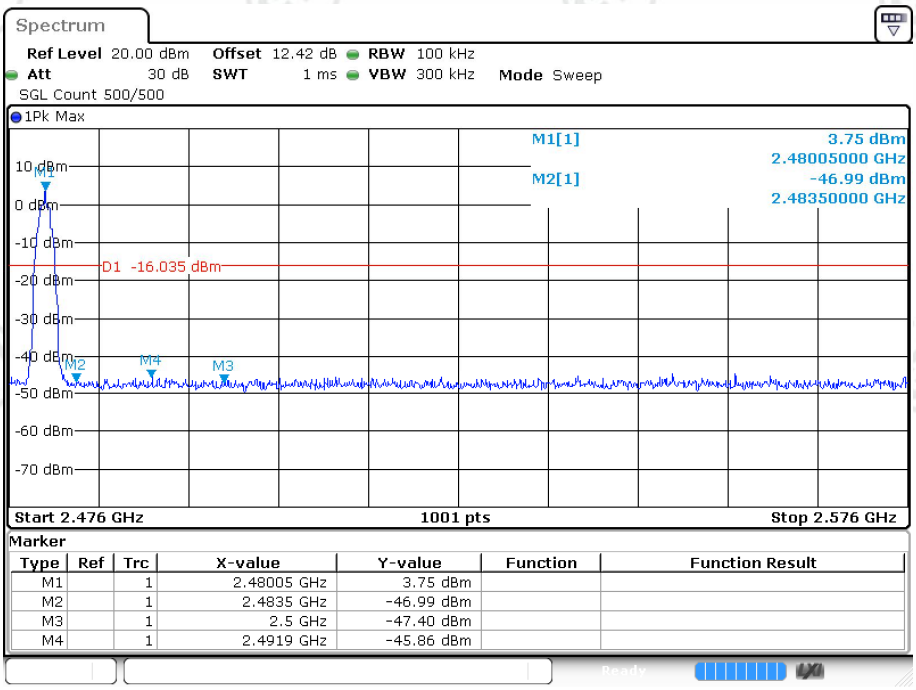
Date: 26.MAY.2025 20:21:08

Band Edge NVNT BLE 2M 2480MHz Ant1 Ref



Date: 26.MAY.2025 20:24:51

Band Edge NVNT BLE 2M 2480MHz Ant1 Emission



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.48005 GHz	3.75 dBm		
M2		1	2.4835 GHz	-46.99 dBm		
M3		1	2.5 GHz	-47.40 dBm		
M4		1	2.4919 GHz	-45.86 dBm		

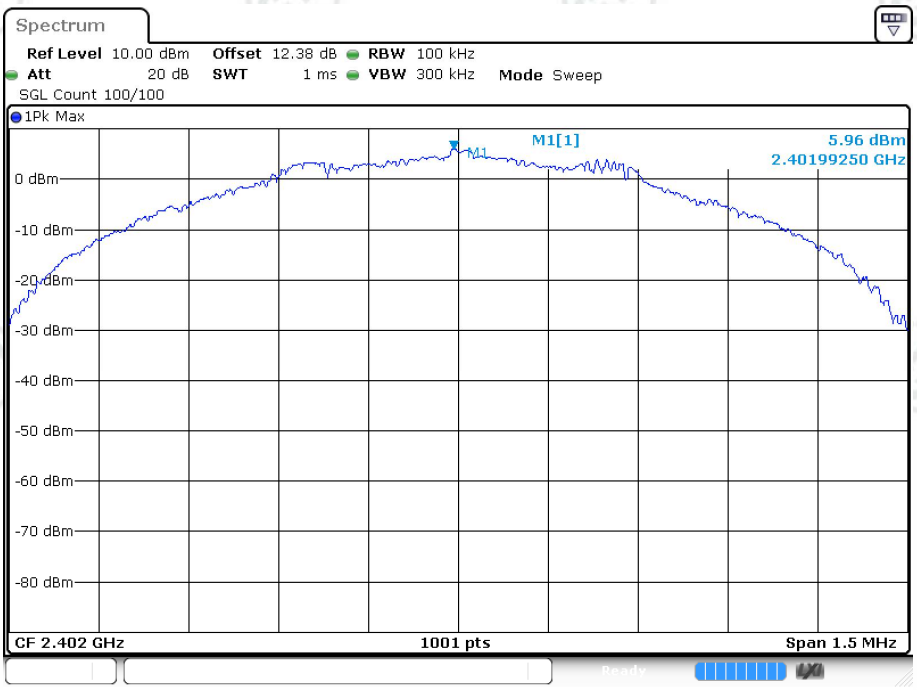
Date: 26.MAY.2025 20:24:54

Conducted RF Spurious Emission

Condition	Mode	Frequency (MHz)	Antenna	Max Value (dBc)	Limit (dBc)	Verdict
NVNT	BLE 1M	2402	Ant1	-54.44	-20	Pass
NVNT	BLE 1M	2440	Ant1	-51.47	-20	Pass
NVNT	BLE 1M	2480	Ant1	-52.7	-20	Pass
NVNT	BLE 2M	2402	Ant1	-52.92	-20	Pass
NVNT	BLE 2M	2440	Ant1	-52.21	-20	Pass
NVNT	BLE 2M	2480	Ant1	-51.76	-20	Pass

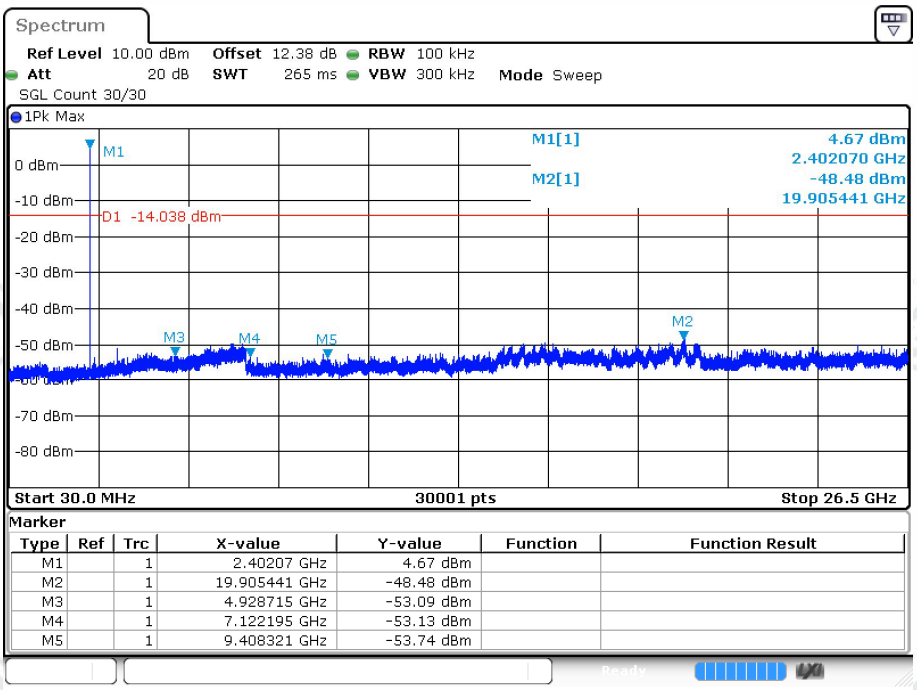
Test Graphs

Tx. Spurious NVNT BLE 1M 2402MHz Ant1 Ref



Date: 26.MAY.2025 20:14:55

Tx. Spurious NVNT BLE 1M 2402MHz Ant1 Emission

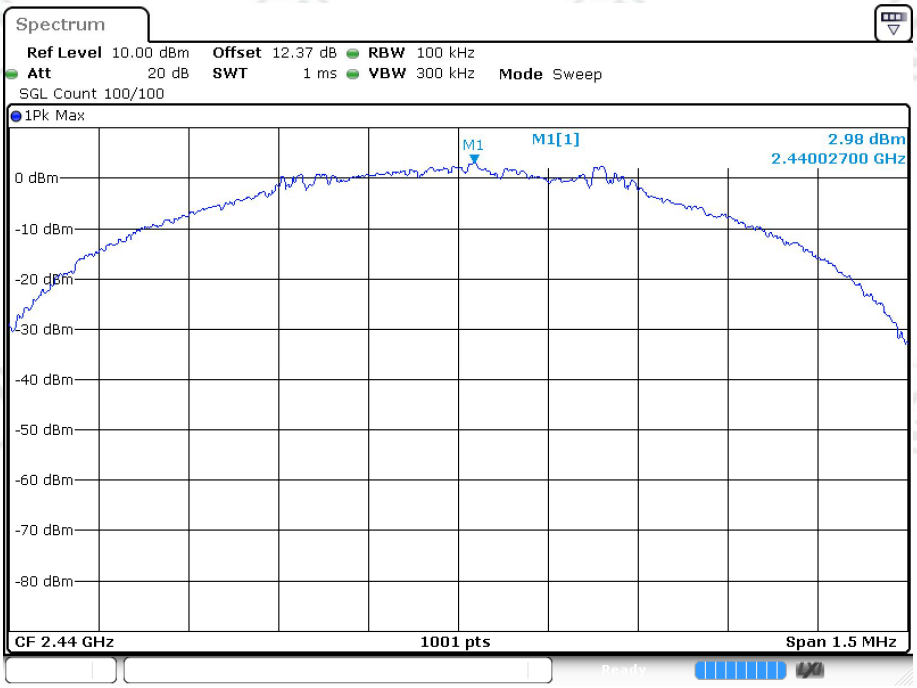


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40207 GHz	4.67 dBm		
M2		1	19.905441 GHz	-48.48 dBm		
M3		1	4.928715 GHz	-53.09 dBm		
M4		1	7.122195 GHz	-53.13 dBm		
M5		1	9.408321 GHz	-53.74 dBm		

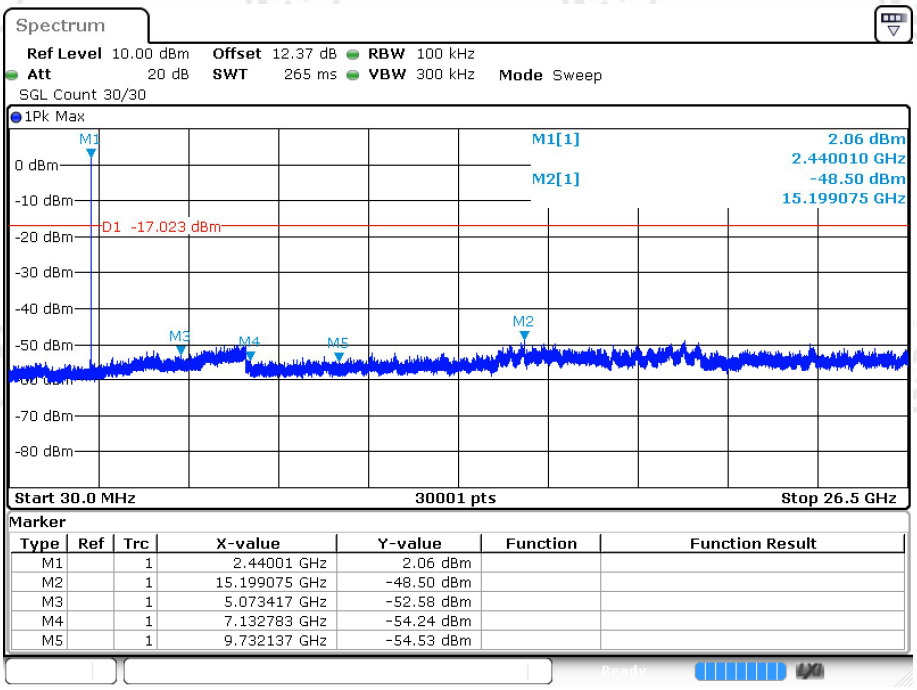
Date: 26.MAY.2025 20:15:24

Tx. Spurious NVNT BLE 1M 2440MHz Ant1 Ref



Date: 26.MAY.2025 20:16:41

Tx. Spurious NVNT BLE 1M 2440MHz Ant1 Emission

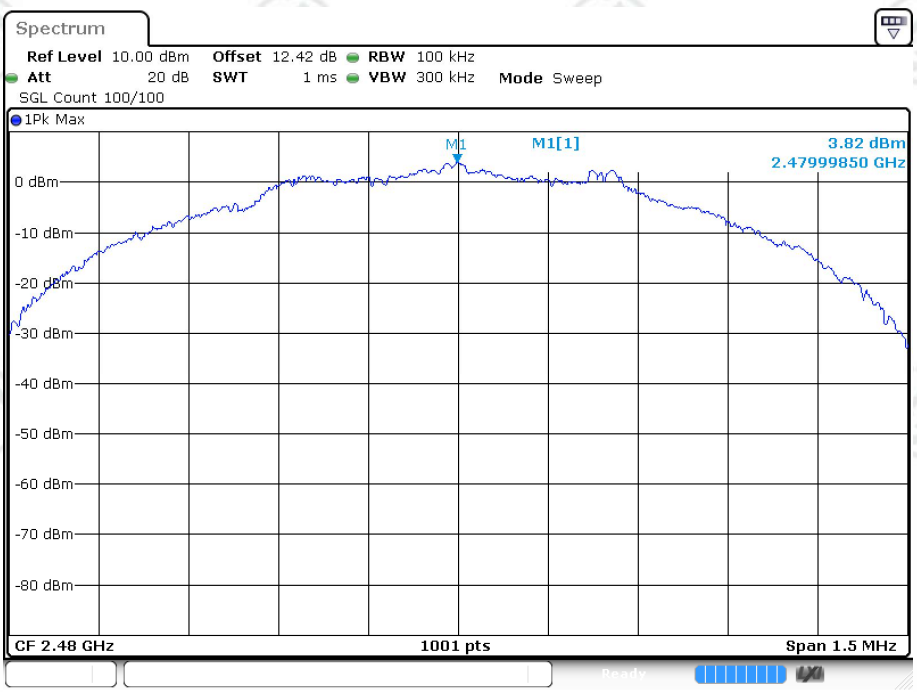


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.44001 GHz	2.06 dBm		
M2		1	15.199075 GHz	-48.50 dBm		
M3		1	5.073417 GHz	-52.58 dBm		
M4		1	7.132783 GHz	-54.24 dBm		
M5		1	9.732137 GHz	-54.53 dBm		

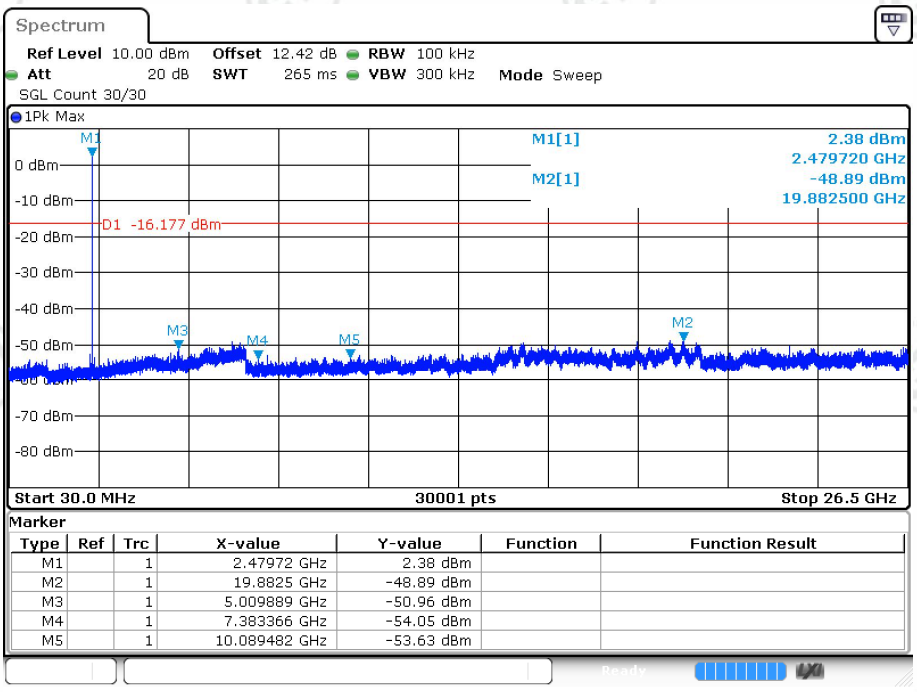
Date: 26.MAY.2025 20:17:10

Tx. Spurious NVNT BLE 1M 2480MHz Ant1 Ref



Date: 26.MAY.2025 20:18:26

Tx. Spurious NVNT BLE 1M 2480MHz Ant1 Emission

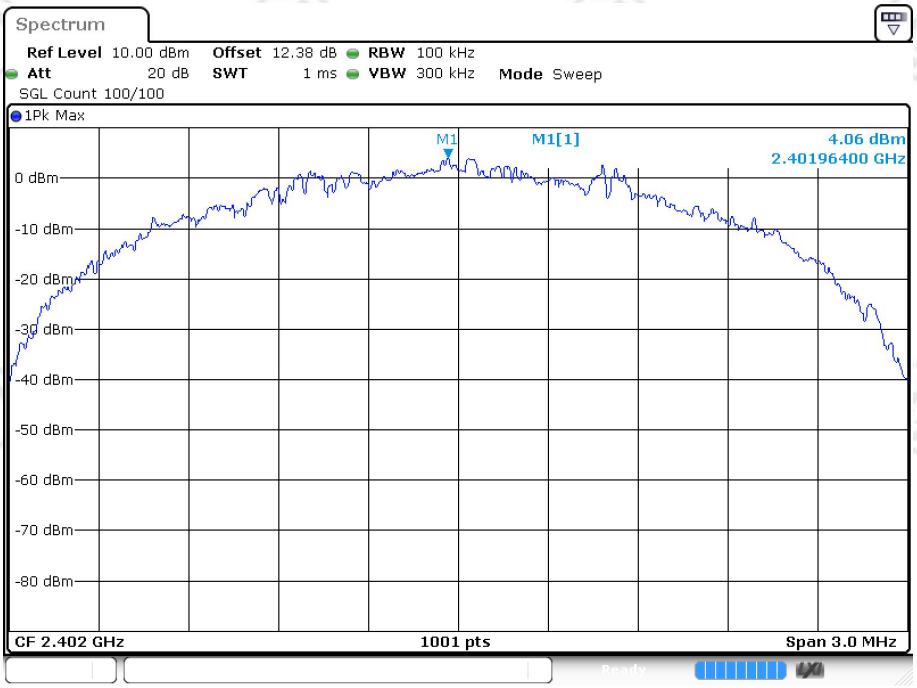


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47972 GHz	2.38 dBm		
M2		1	19.8825 GHz	-48.89 dBm		
M3		1	5.009889 GHz	-50.96 dBm		
M4		1	7.383366 GHz	-54.05 dBm		
M5		1	10.089482 GHz	-53.63 dBm		

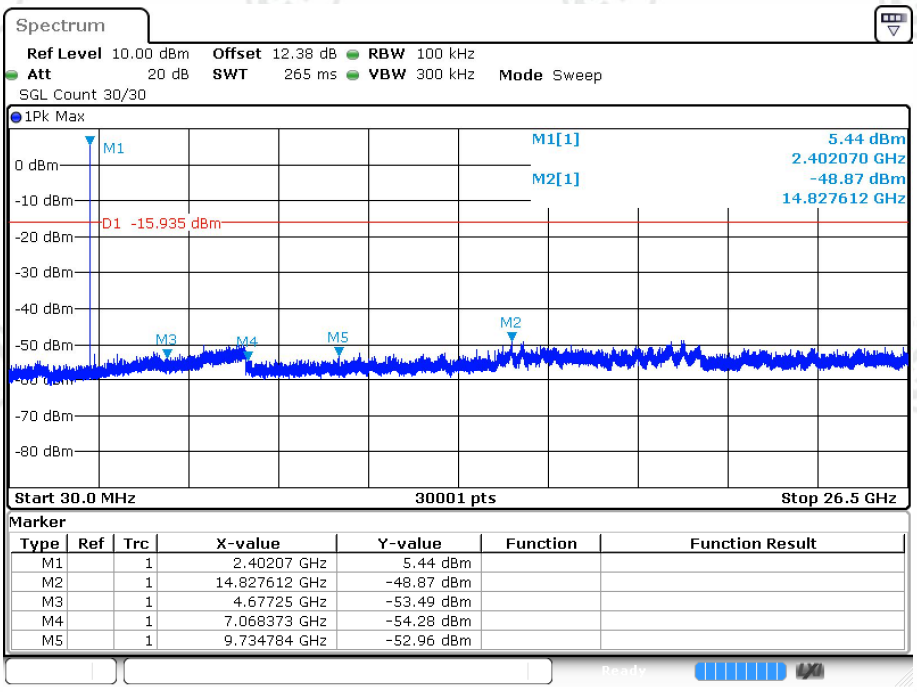
Date: 26.MAY.2025 20:18:55

Tx. Spurious NVNT BLE 2M 2402MHz Ant1 Ref



Date: 26.MAY.2025 20:21:12

Tx. Spurious NVNT BLE 2M 2402MHz Ant1 Emission

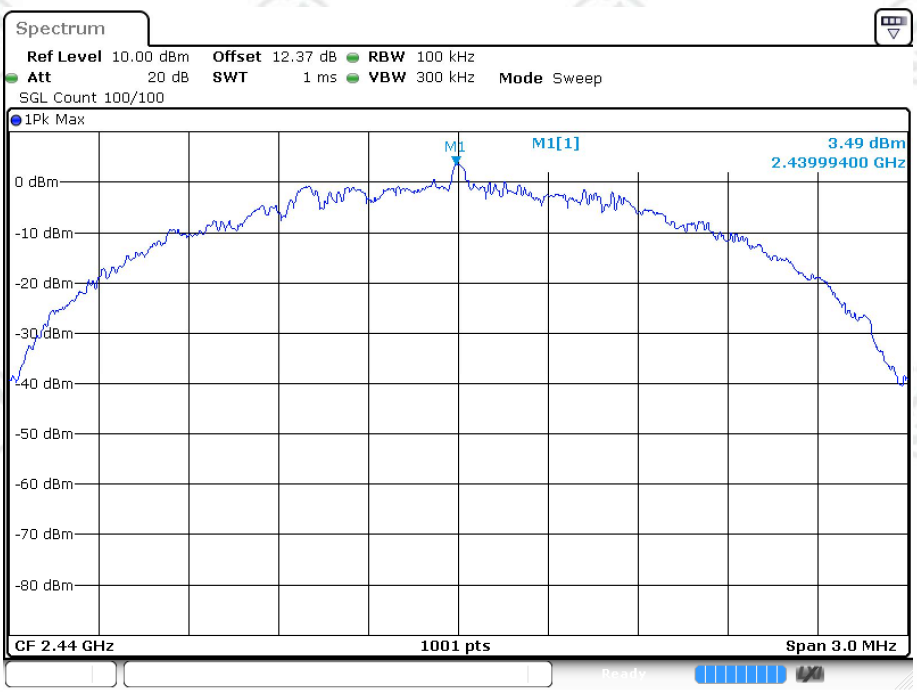


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40207 GHz	5.44 dBm		
M2		1	14.827612 GHz	-48.87 dBm		
M3		1	4.67725 GHz	-53.49 dBm		
M4		1	7.068373 GHz	-54.28 dBm		
M5		1	9.734784 GHz	-52.96 dBm		

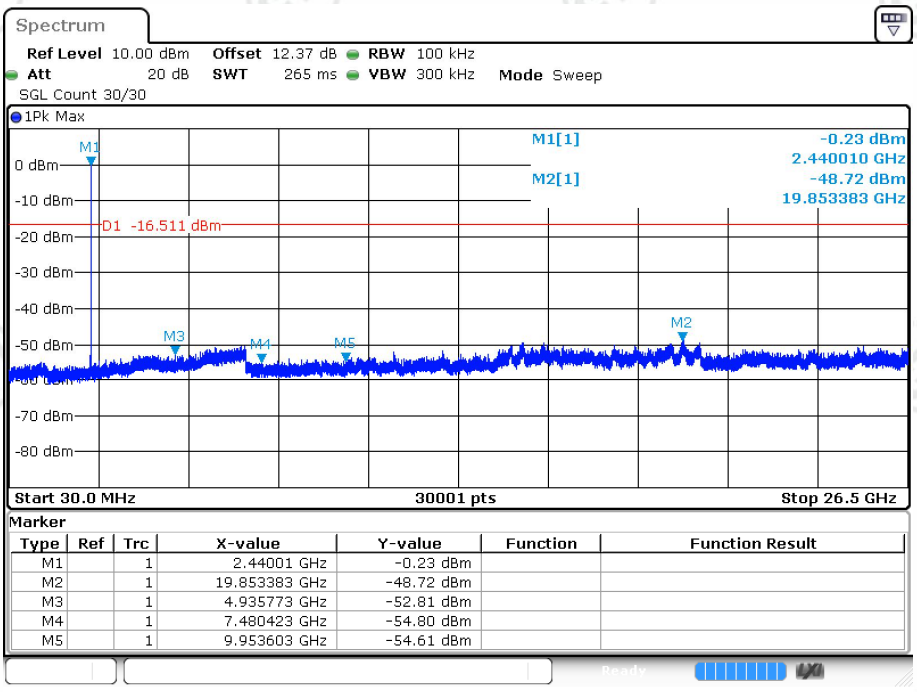
Date: 26.MAY.2025 20:21:41

Tx. Spurious NVNT BLE 2M 2440MHz Ant1 Ref



Date: 26.MAY.2025 20:22:55

Tx. Spurious NVNT BLE 2M 2440MHz Ant1 Emission

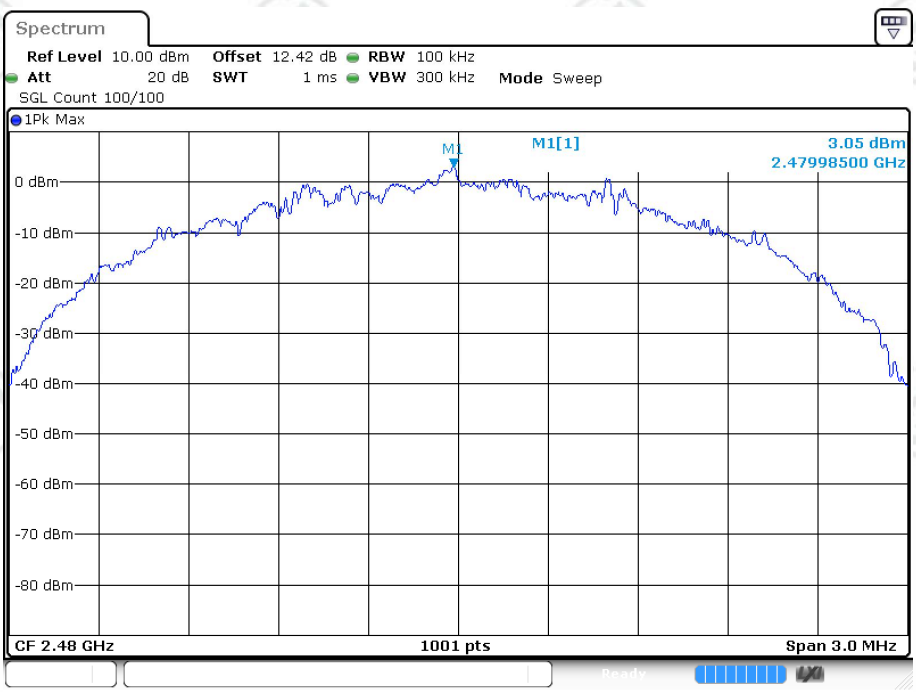


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.44001 GHz	-0.23 dBm		
M2		1	19.853383 GHz	-48.72 dBm		
M3		1	4.935773 GHz	-52.81 dBm		
M4		1	7.480423 GHz	-54.80 dBm		
M5		1	9.953603 GHz	-54.61 dBm		

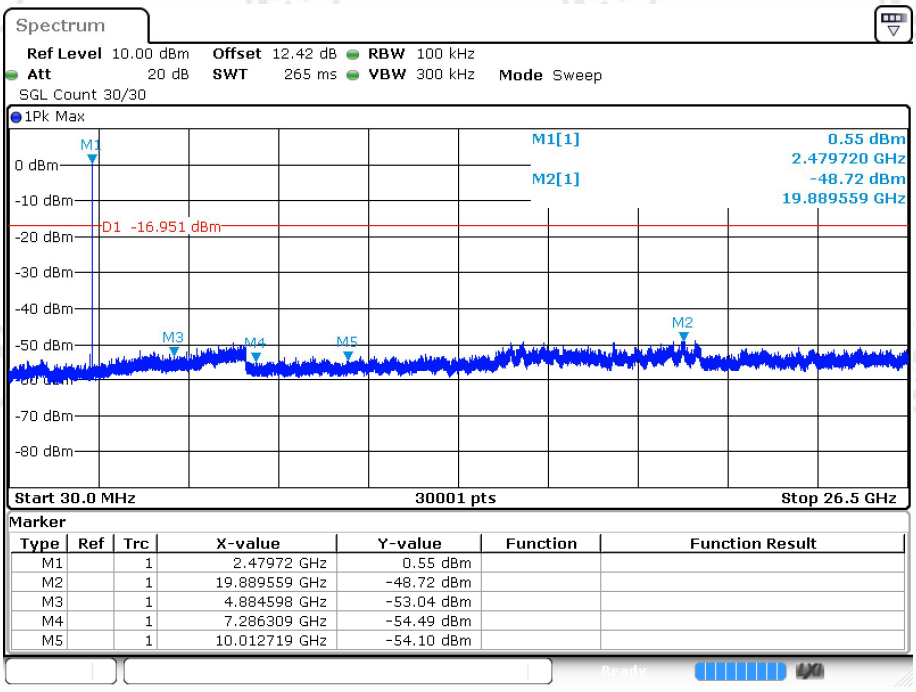
Date: 26.MAY.2025 20:23:24

Tx. Spurious NVNT BLE 2M 2480MHz Ant1 Ref



Date: 26.MAY.2025 20:24:57

Tx. Spurious NVNT BLE 2M 2480MHz Ant1 Emission



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47972 GHz	0.55 dBm		
M2		1	19.889559 GHz	-48.72 dBm		
M3		1	4.884598 GHz	-53.04 dBm		
M4		1	7.286309 GHz	-54.49 dBm		
M5		1	10.012719 GHz	-54.10 dBm		

Date: 26.MAY.2025 20:25:26