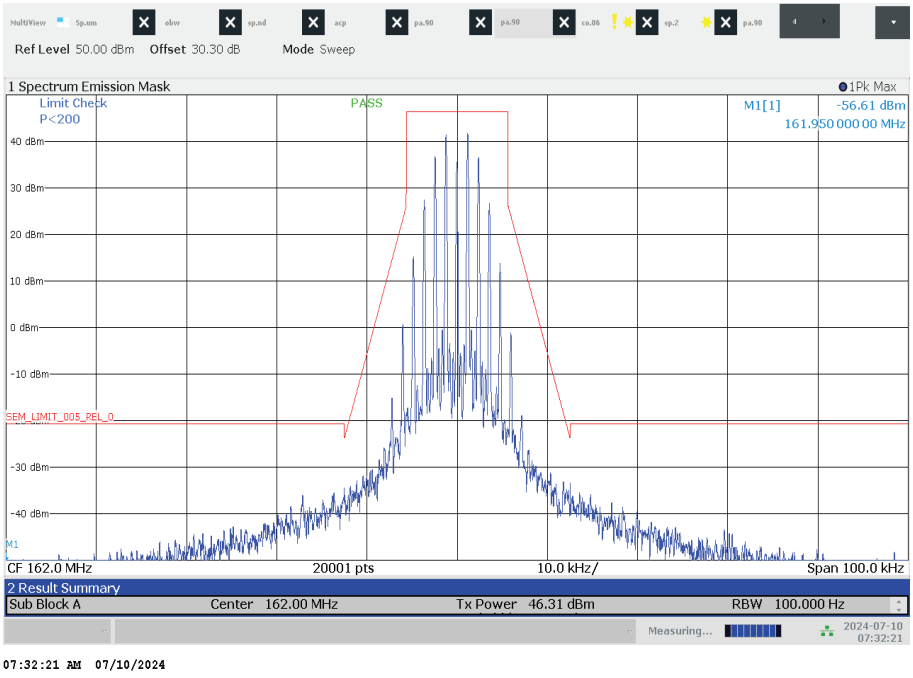
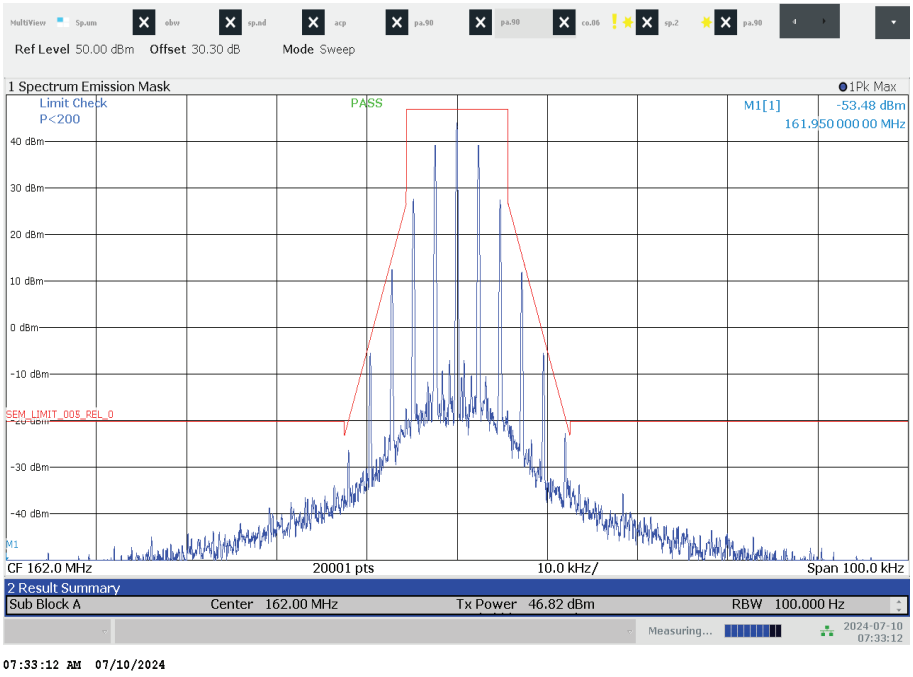
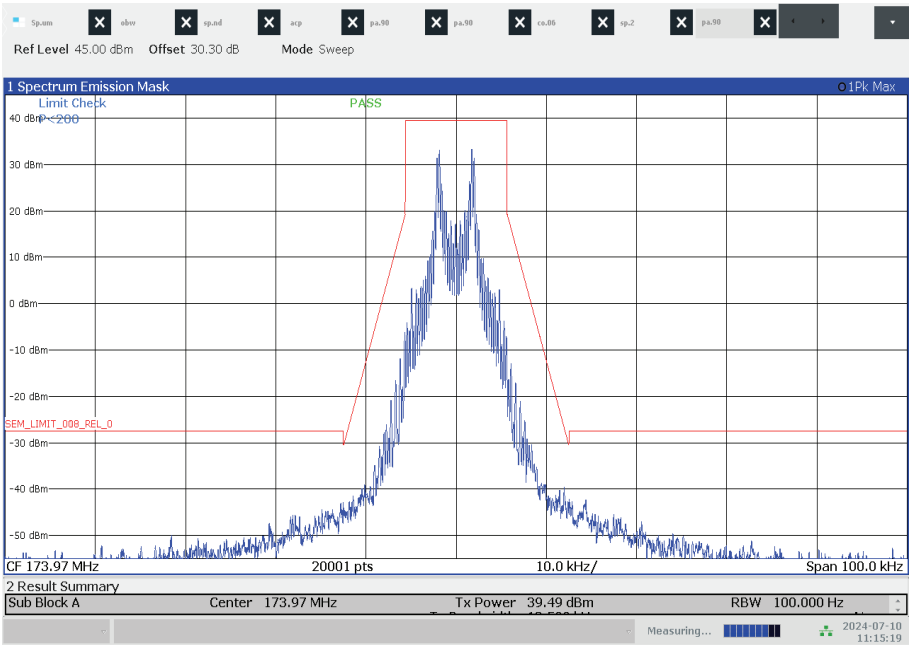
Plot 15: Emission mask D middle channel / 2400 bits per second – high power – carrier modulated



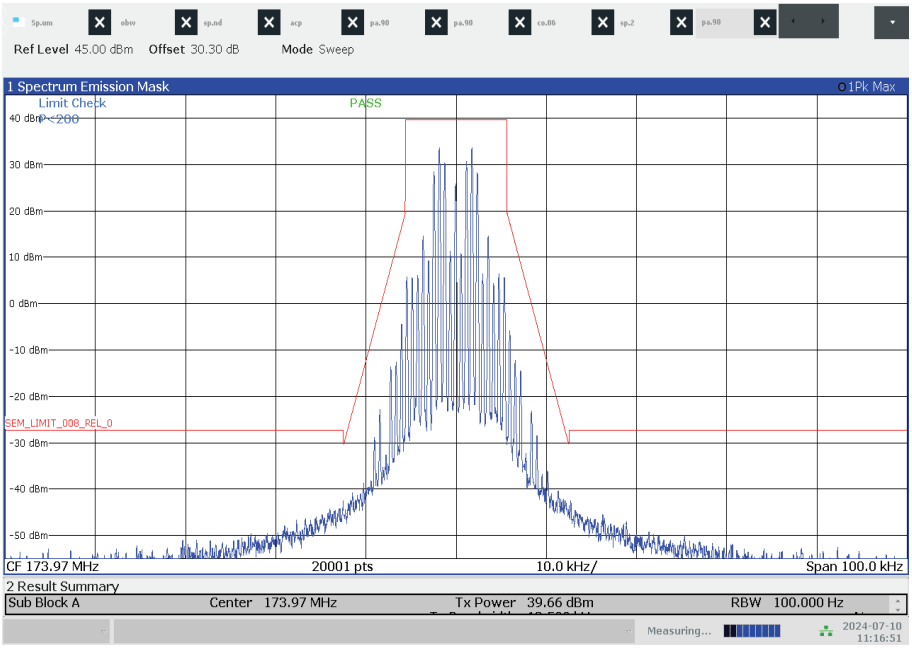
Plot 16: Emission mask D middle channel / 4800 bits per second – high power – carrier modulated



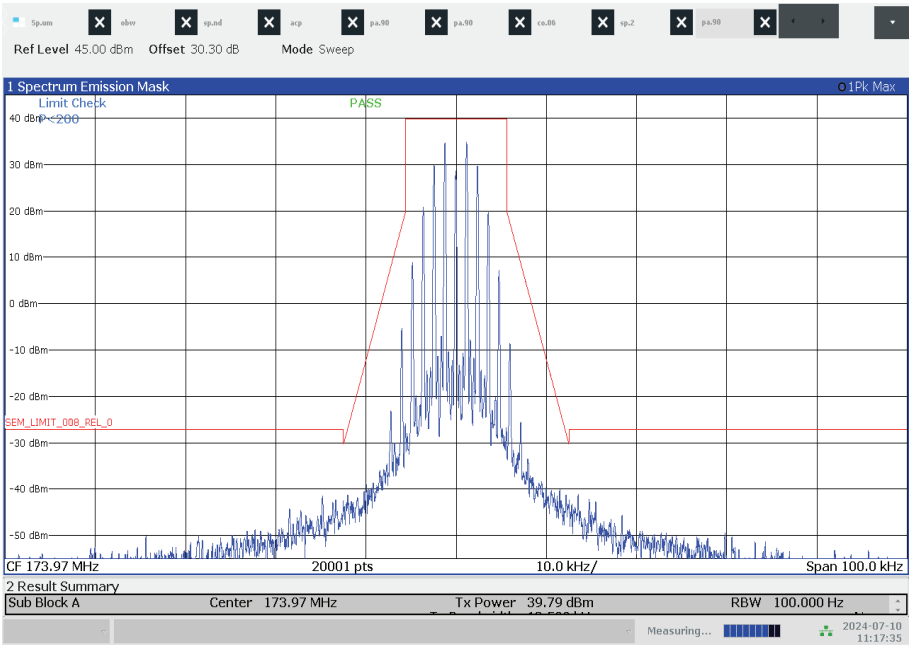
Plot 17: Emission mask D high channel / 512 bits per second – low power – carrier modulated



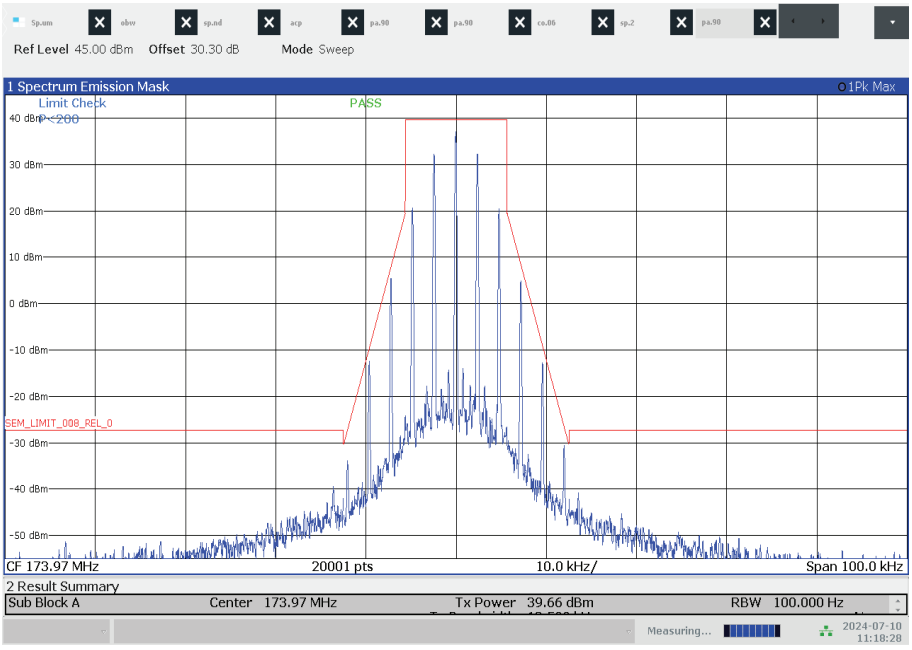
Plot 18: Emission mask D high channel / 1200 bits per second – low power – carrier modulated



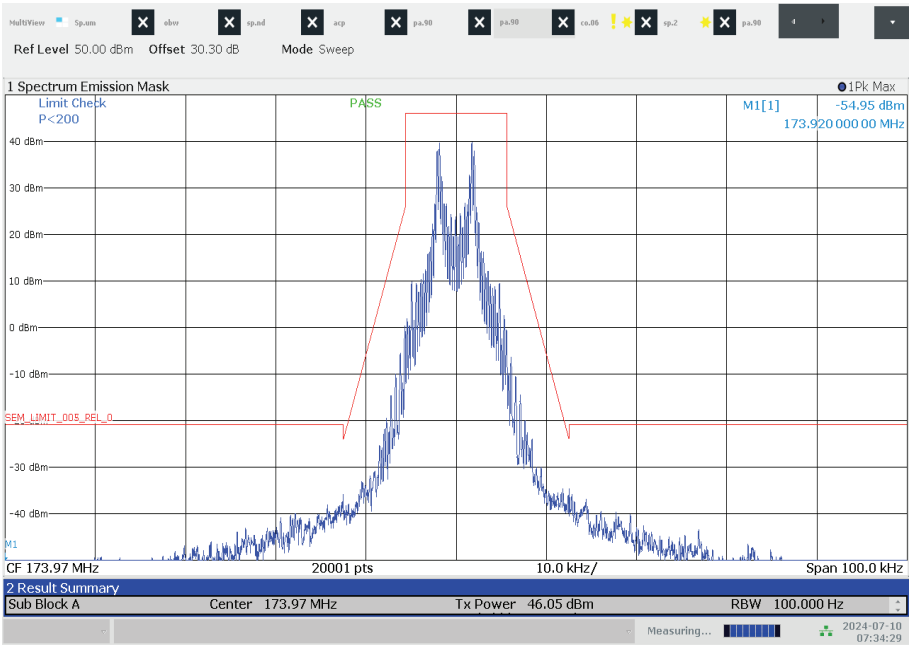
Plot 19: Emission mask D high channel / 2400 bits per second – low power – carrier modulated



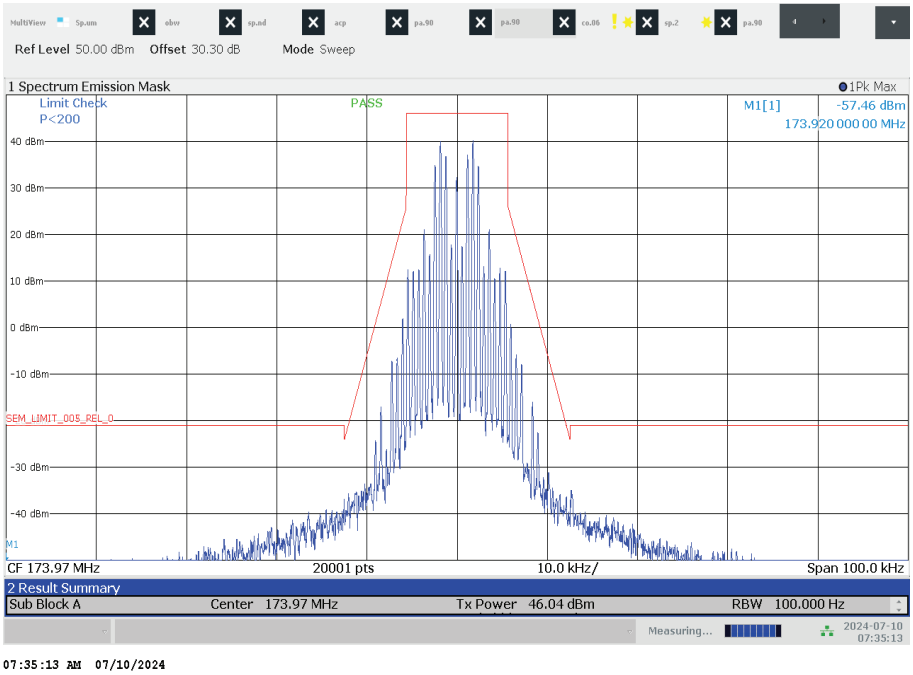
Plot 20: Emission mask D high channel / 4800 bits per second – low power – carrier modulated



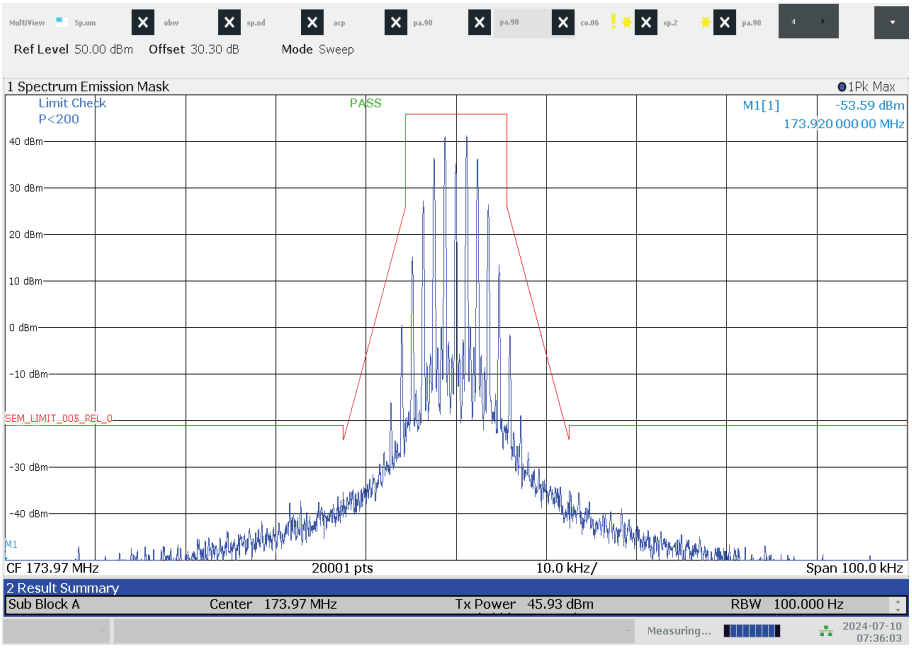
Plot 21: Emission mask D high channel / 512 bits per second – high power – carrier modulated



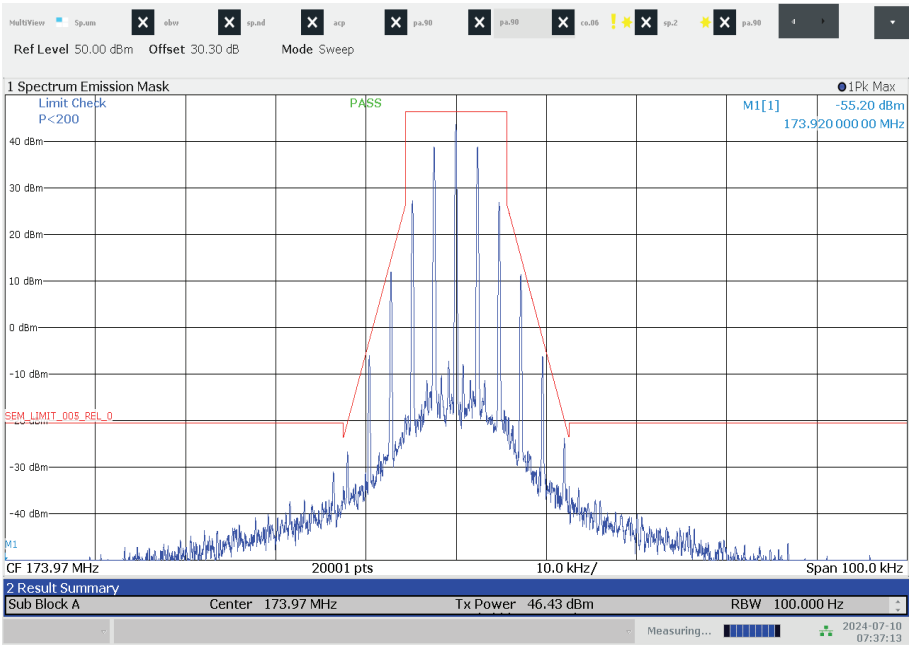
Plot 22: Emission mask D high channel / 1200 bits per second – high power – carrier modulated



Plot 23: Emission mask D high channel / 2400 bits per second – high power – carrier modulated

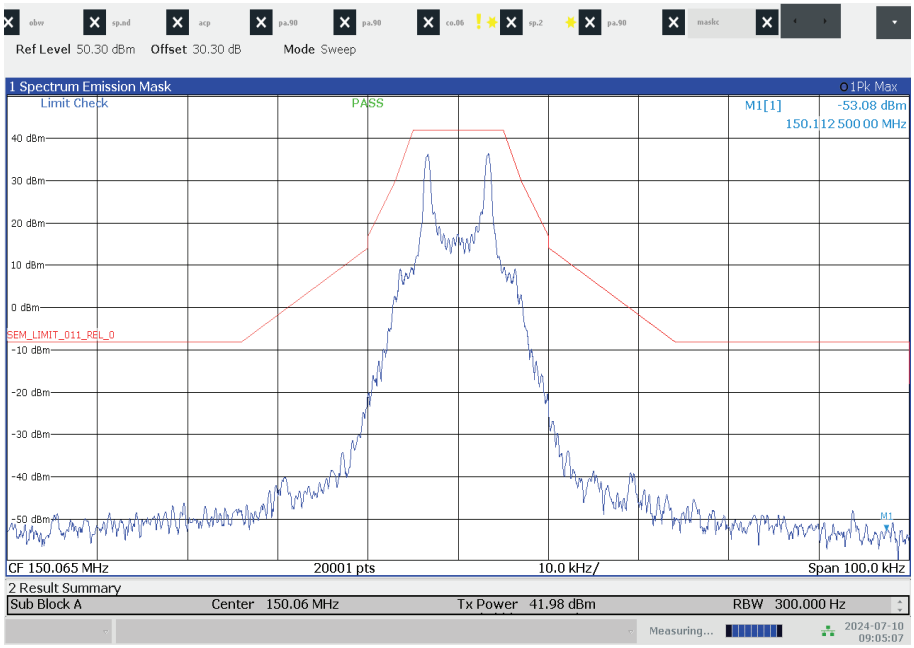


Plot 24: Emission mask D high channel / 4800 bits per second – high power – carrier modulated



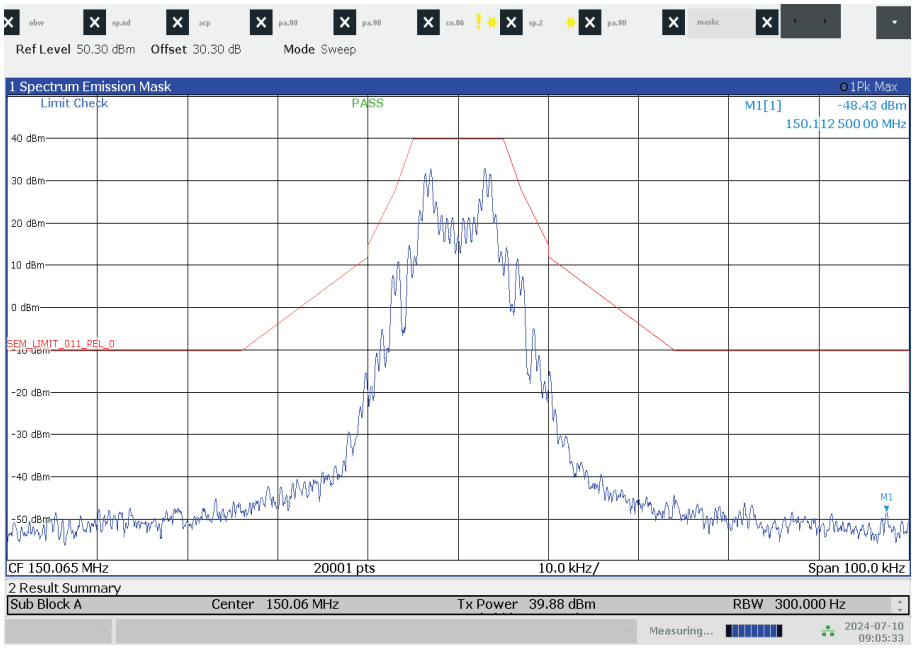
13.4.3 Spectrum masks 20 kHz bandwidth (Emission mask C)

Plot 1: Emission mask C low channel / 512 bits per second – low power – carrier modulated



09:05:07 AM 07/10/2024

Plot 2: Emission mask C low channel / 1200 bits per second – low power – carrier modulated



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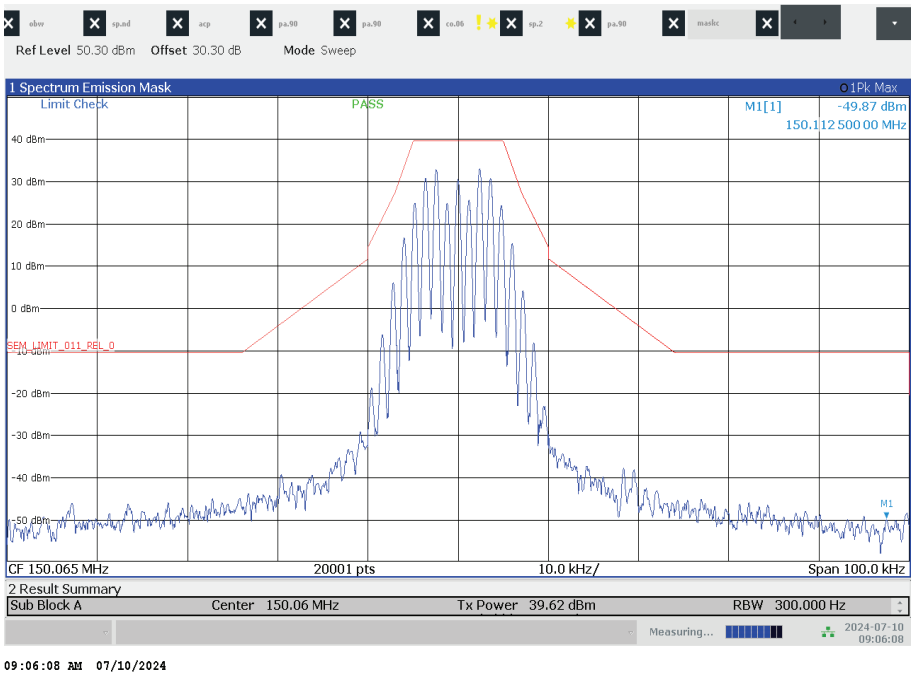
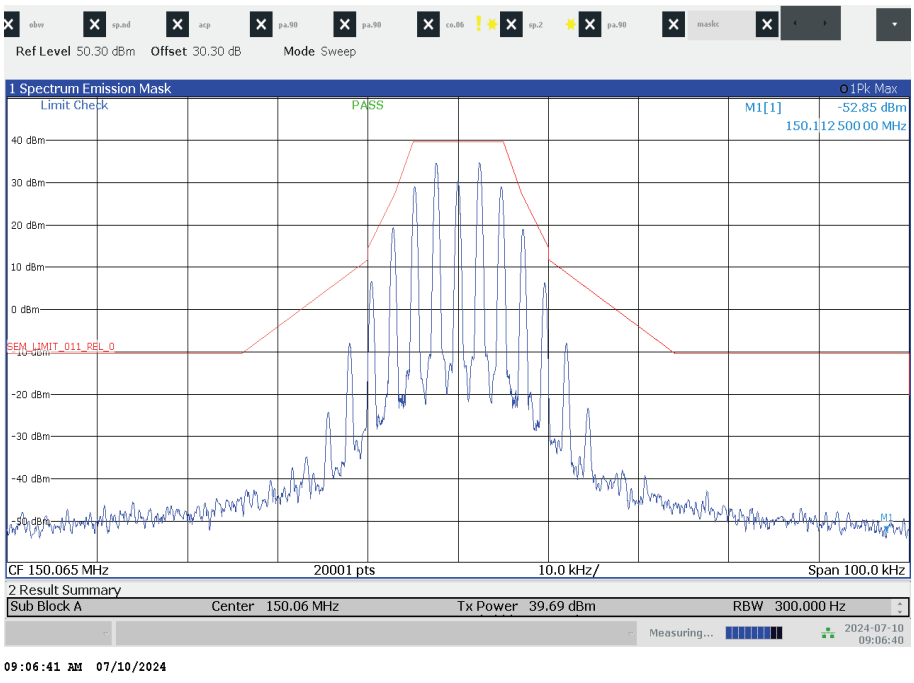
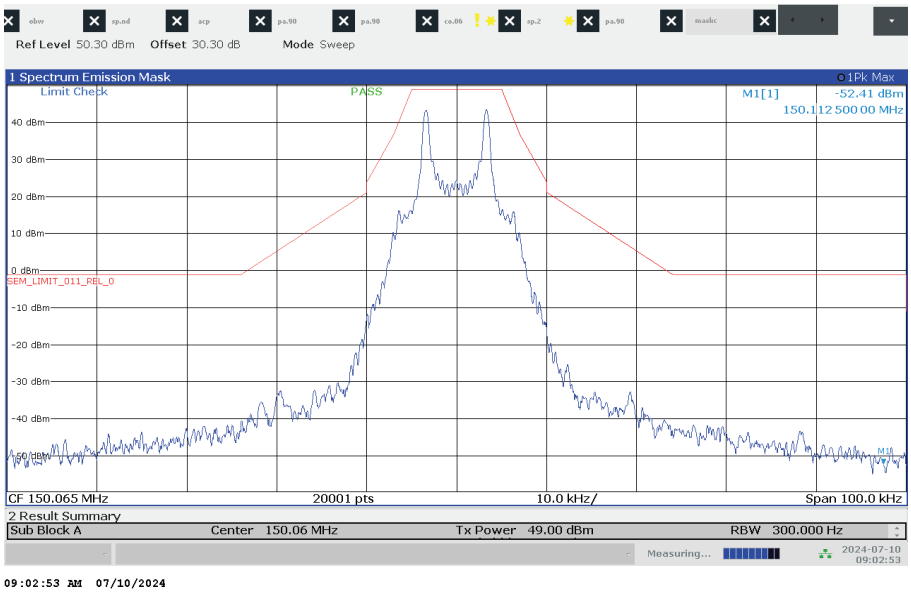
Plot 3: Emission mask C low channel / 2400 bits per second – low power – carrier modulated



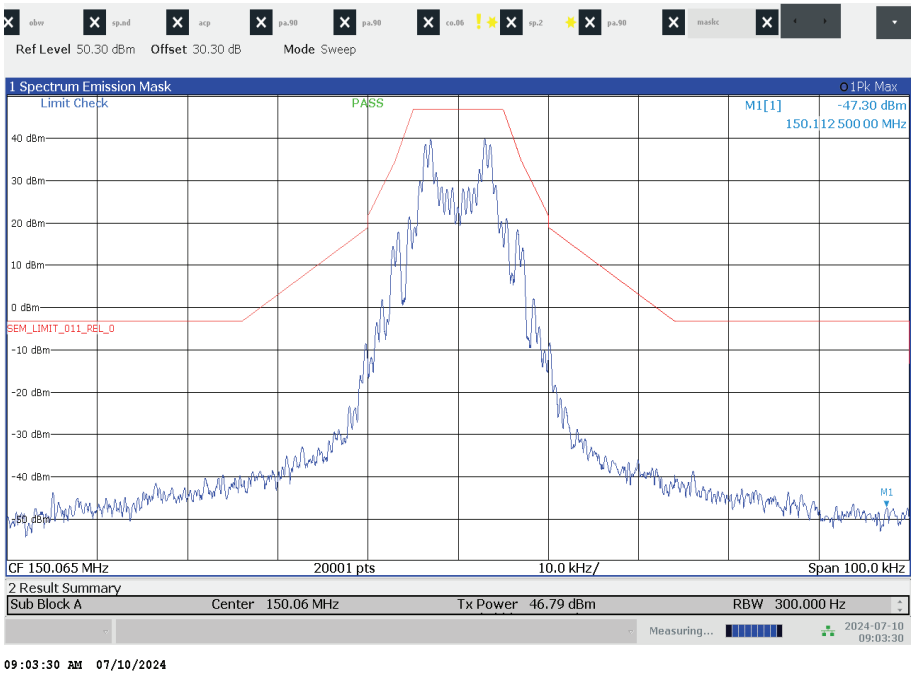
Plot 4: Emission mask C low channel / 4800 bits per second – low power – carrier modulated



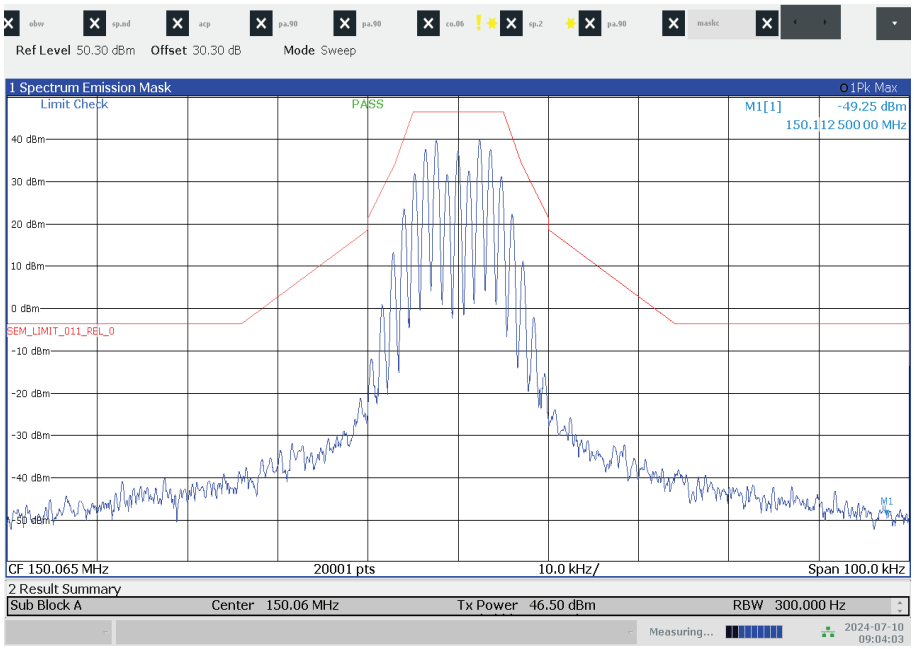
Plot 5: Emission mask C low channel / 512 bits per second – high power – carrier modulated



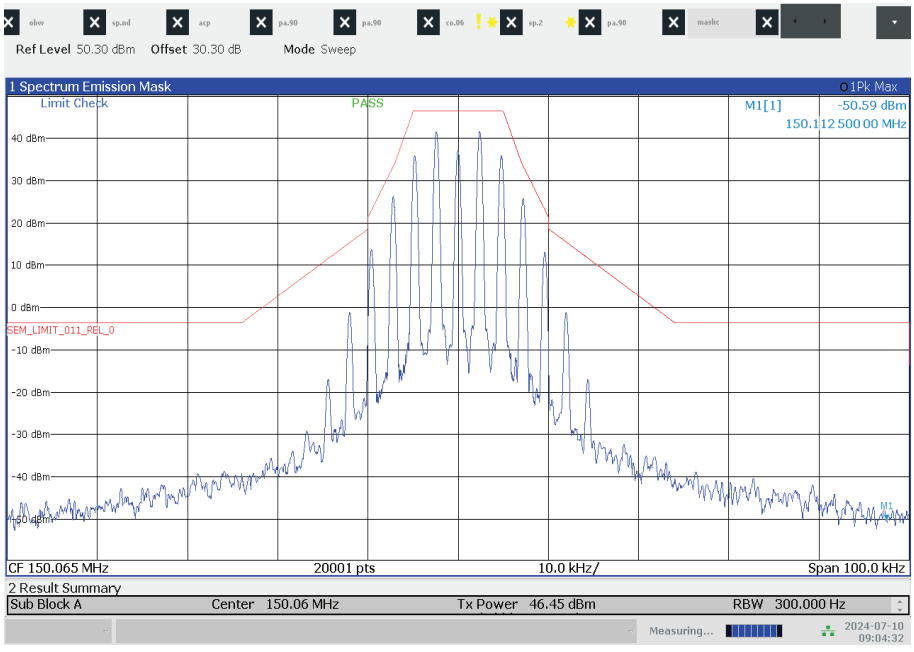
Plot 6: Emission mask C low channel / 1200 bits per second – high power – carrier modulated



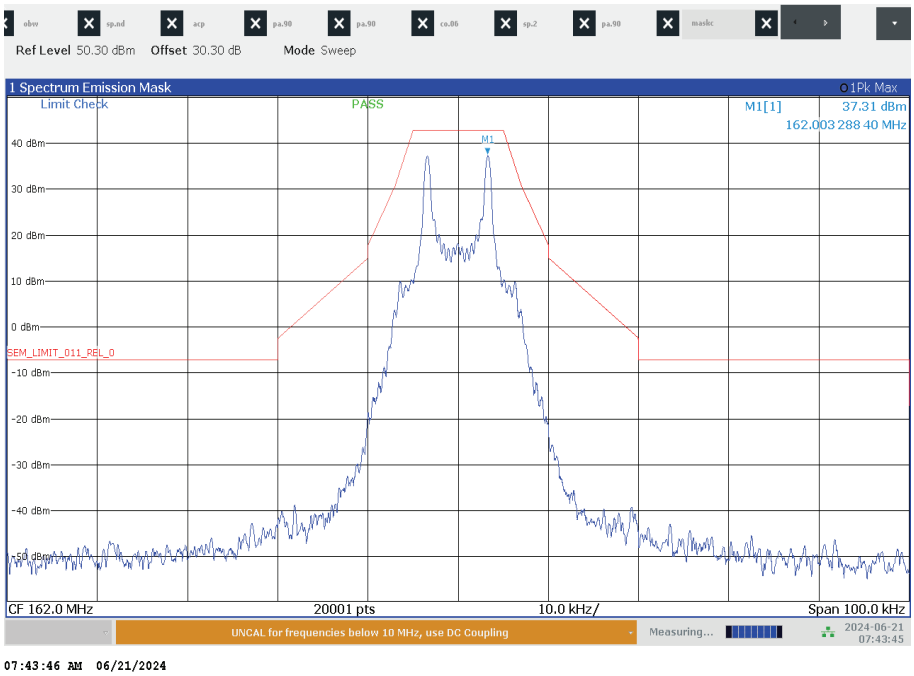
Plot 7: Emission mask C low channel / 2400 bits per second – high power – carrier modulated



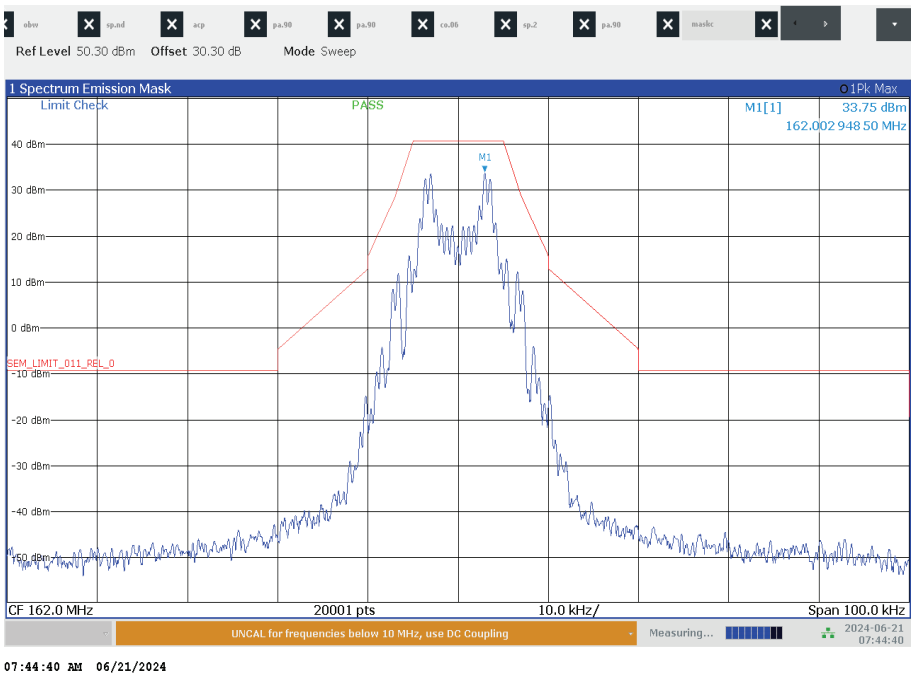
Plot 8: Emission mask C low channel / 4800 bits per second – high power – carrier modulated



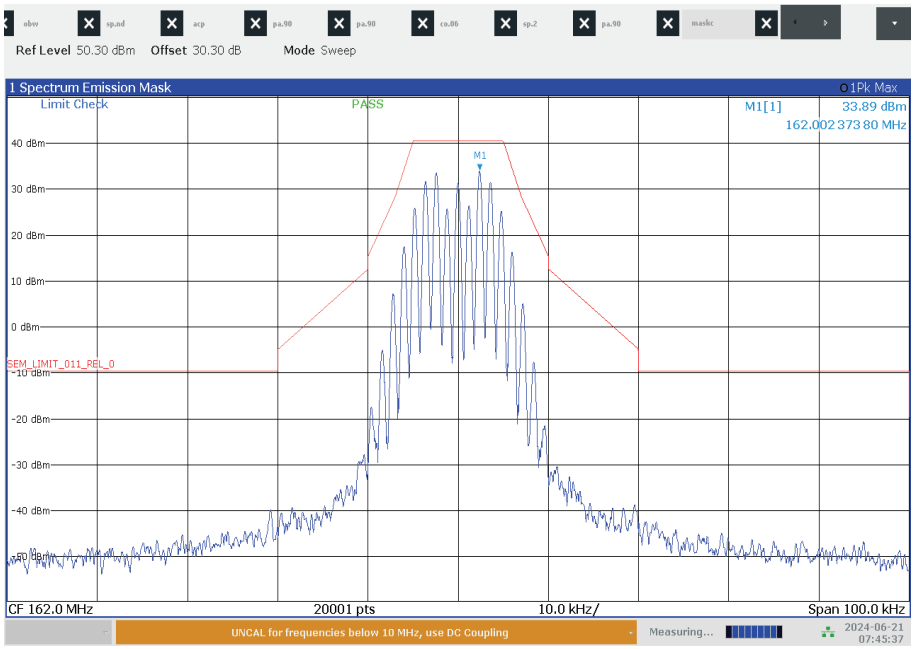
Plot 9: Emission mask C middle channel / 512 bits per second – low power – carrier modulated



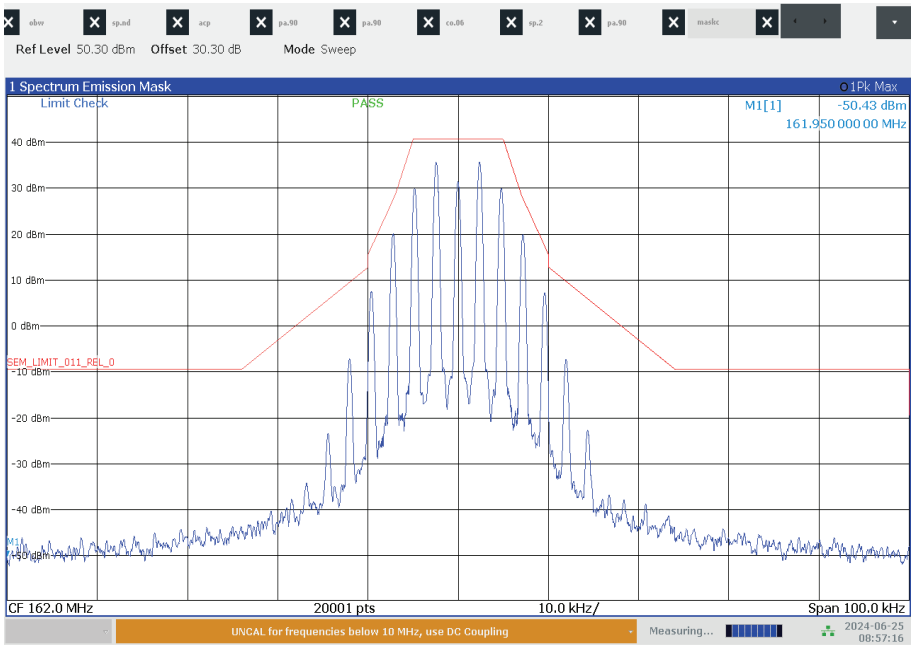
Plot 10: Emission mask C middle channel / 1200 bits per second – low power – carrier modulated



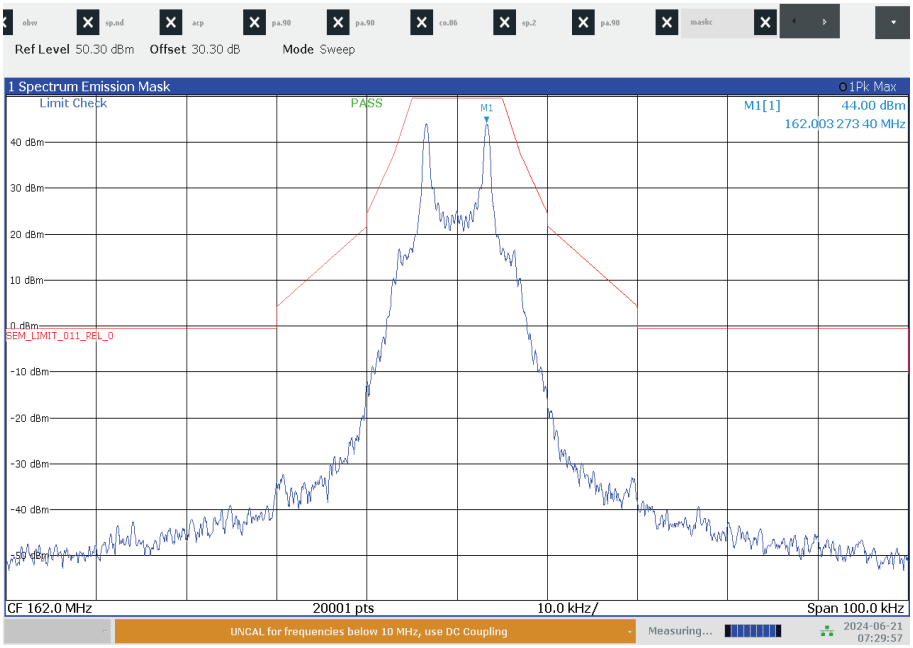
Plot 11: Emission mask C middle channel / 2400 bits per second – low power – carrier modulated



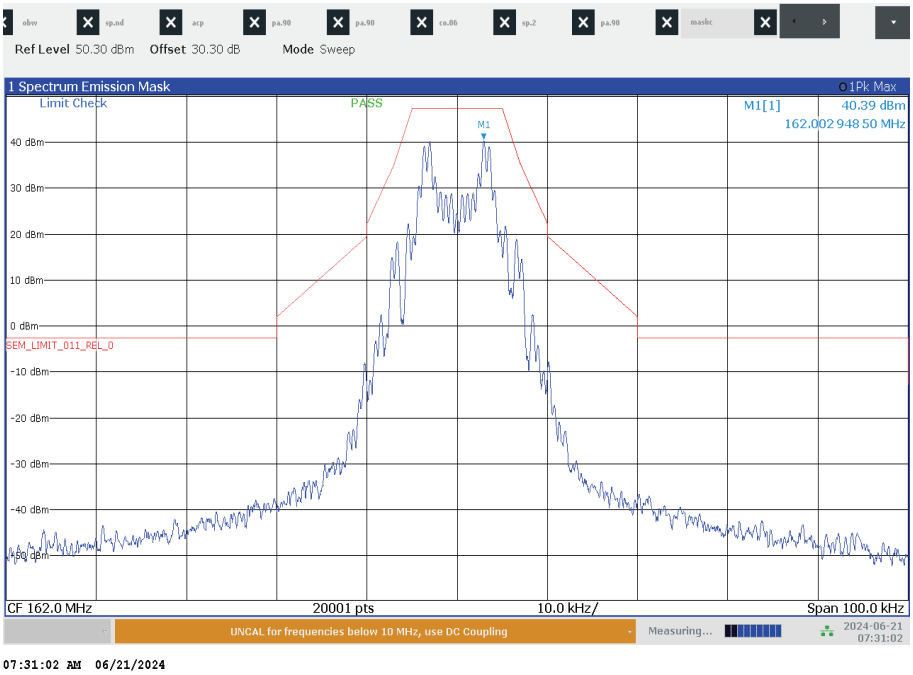
Plot 12: Emission mask C middle channel / 4800 bits per second – low power – carrier modulated



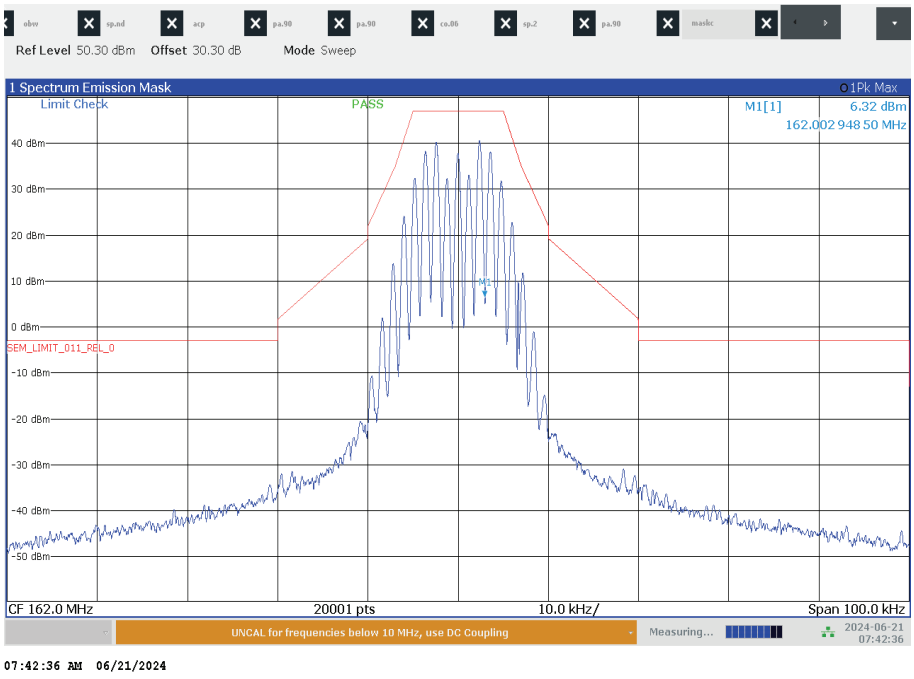
Plot 13: Emission mask C middle channel / 512 bits per second – high power – carrier modulated



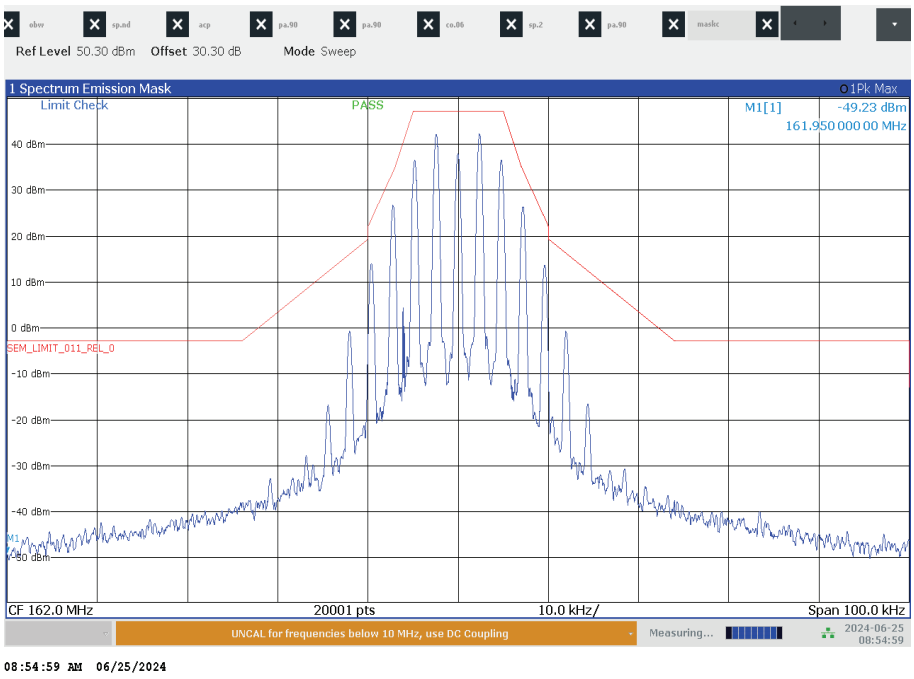
Plot 14: Emission mask C middle channel / 1200 bits per second – high power – carrier modulated



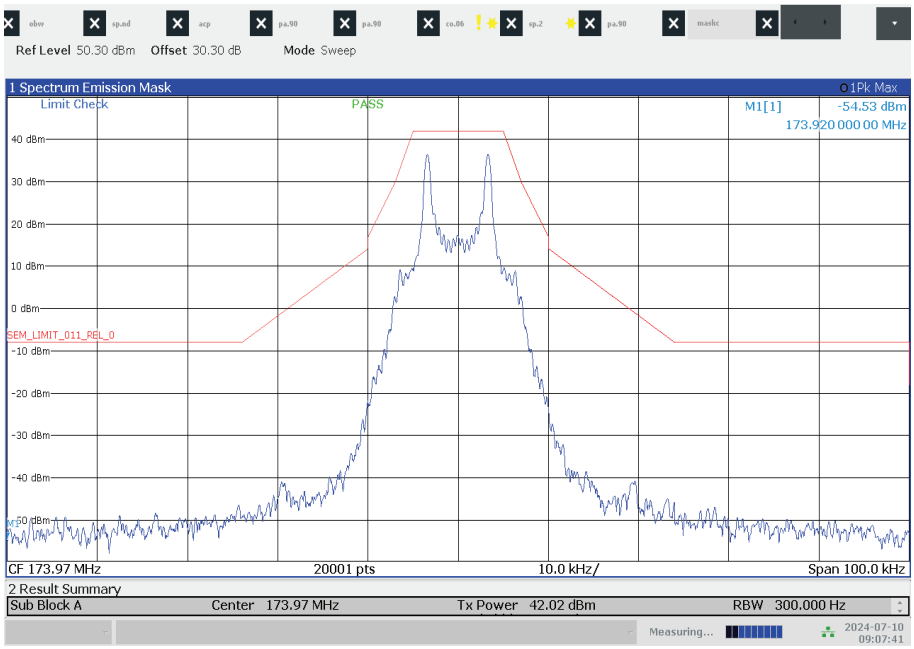
Plot 15: Emission mask C middle channel / 2400 bits per second – high power – carrier modulated



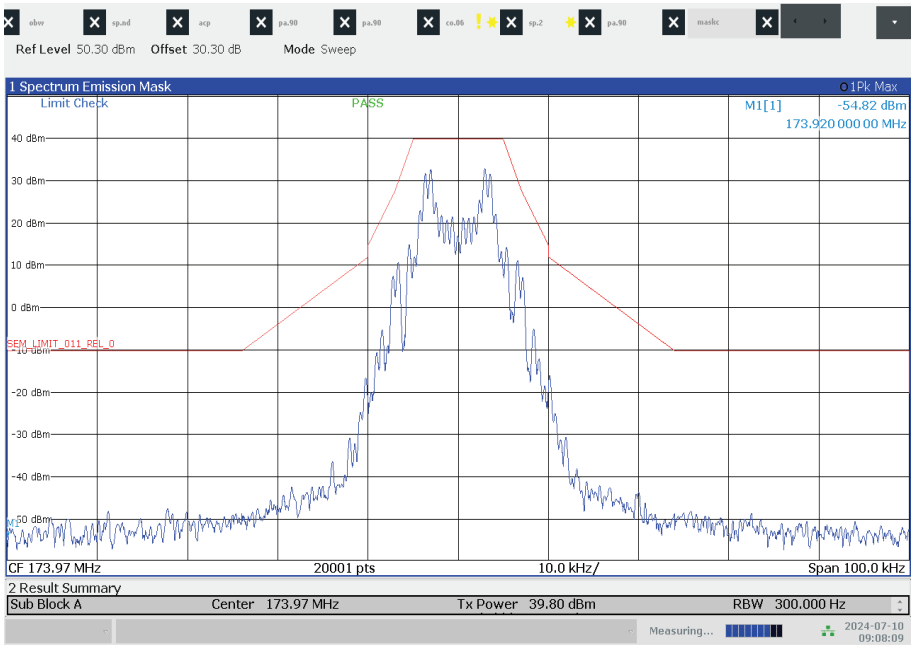
Plot 16: Emission mask C middle channel / 4800 bits per second – high power – carrier modulated



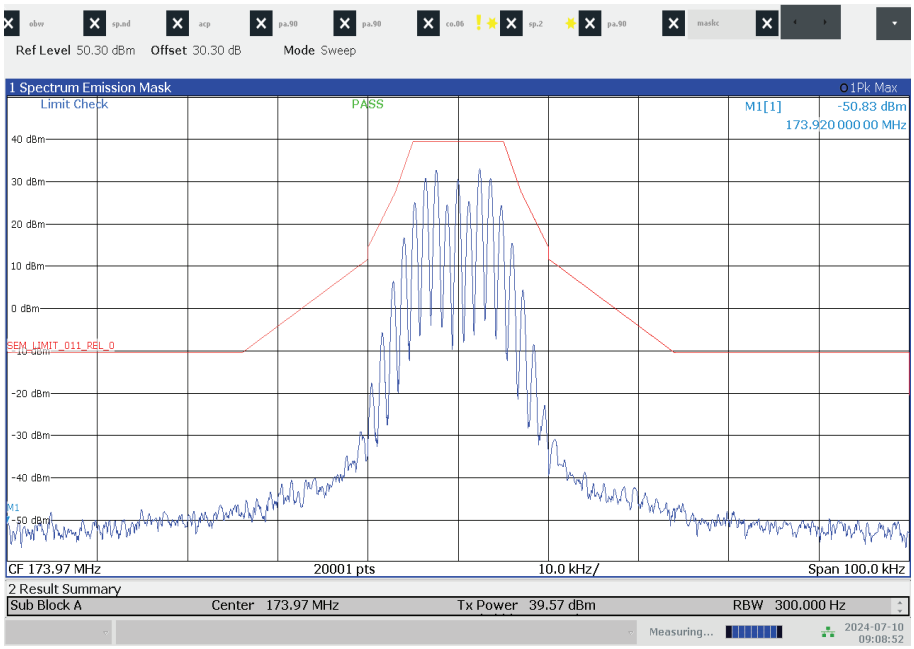
Plot 17: Emission mask C high channel / 512 bits per second – low power – carrier modulated



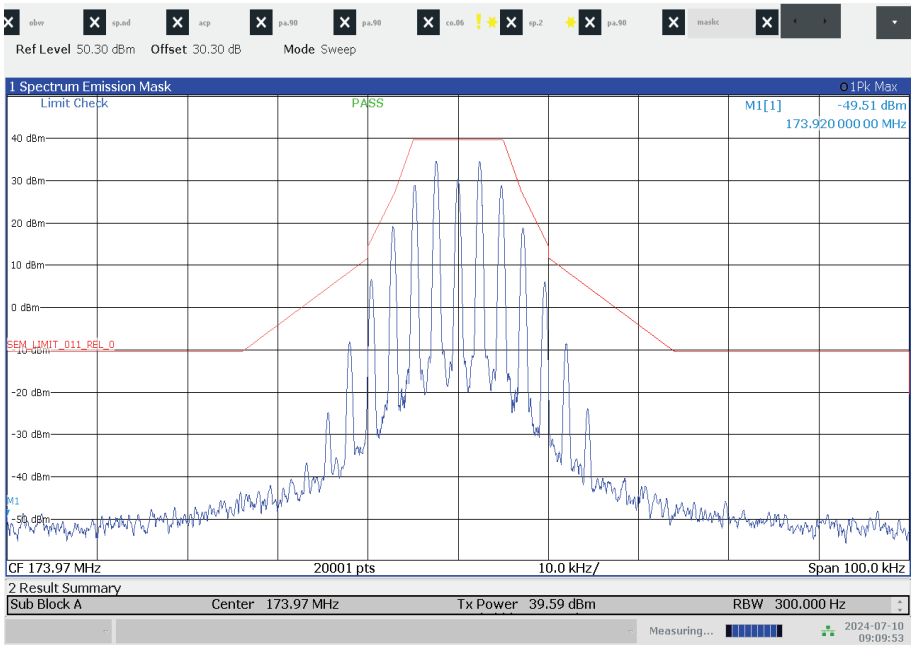
Plot 18: Emission mask C high channel / 1200 bits per second – low power – carrier modulated



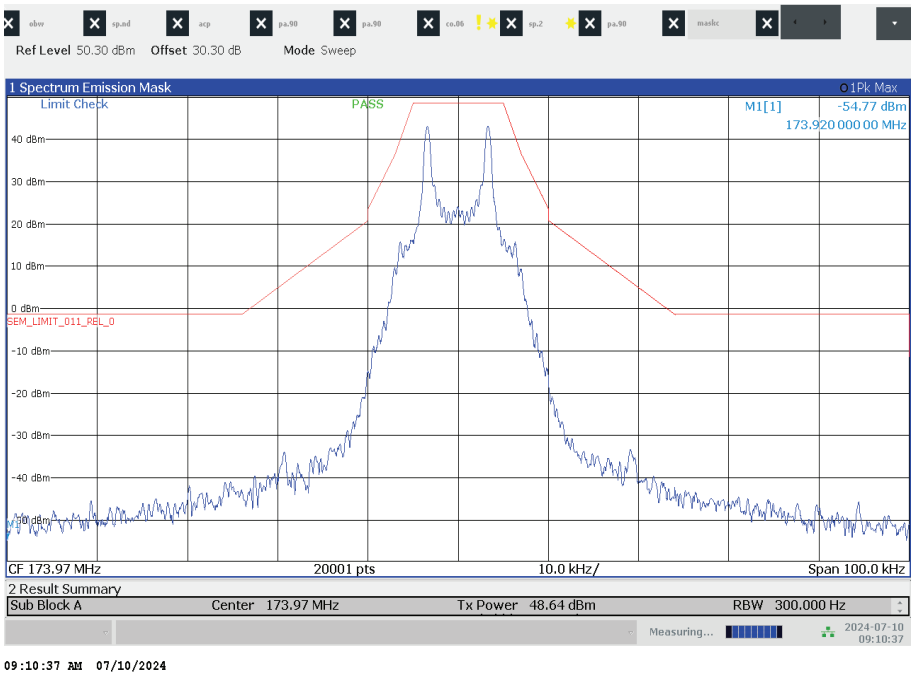
Plot 19: Emission mask C high channel / 2400 bits per second – low power – carrier modulated



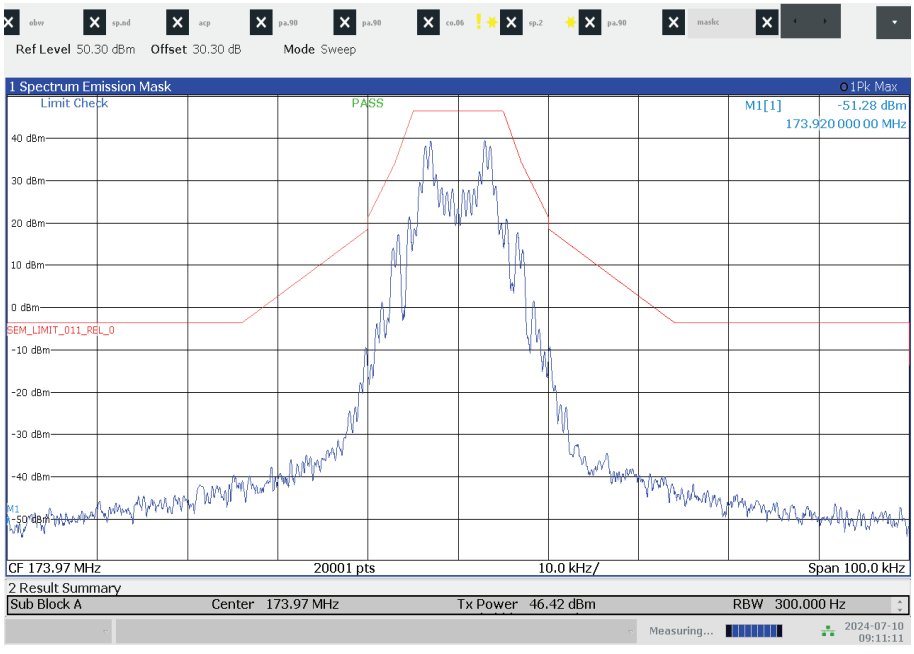
Plot 20: Emission mask C high channel / 4800 bits per second – low power – carrier modulated



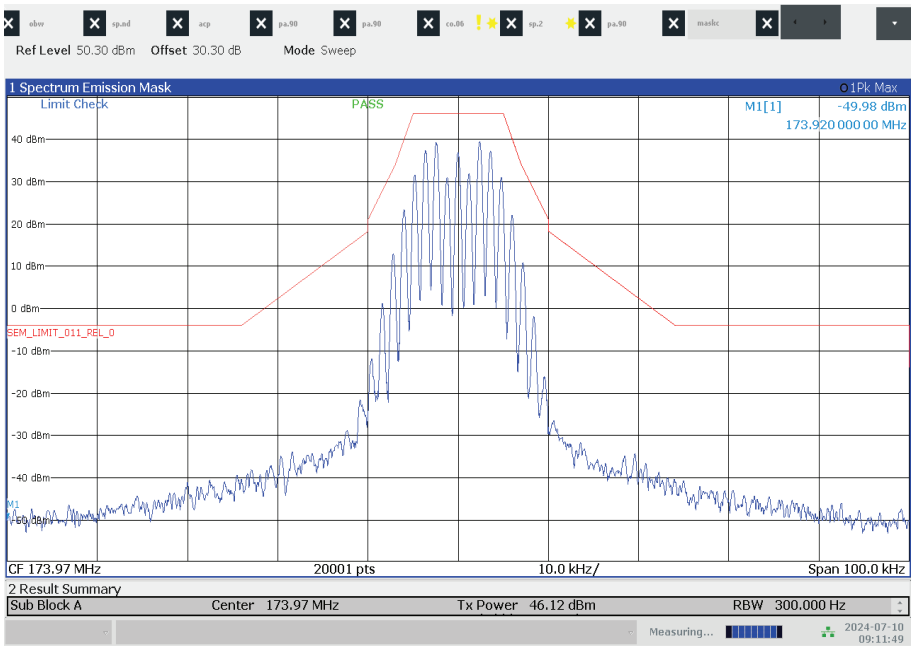
Plot 21: Emission mask C high channel / 512 bits per second – high power – carrier modulated



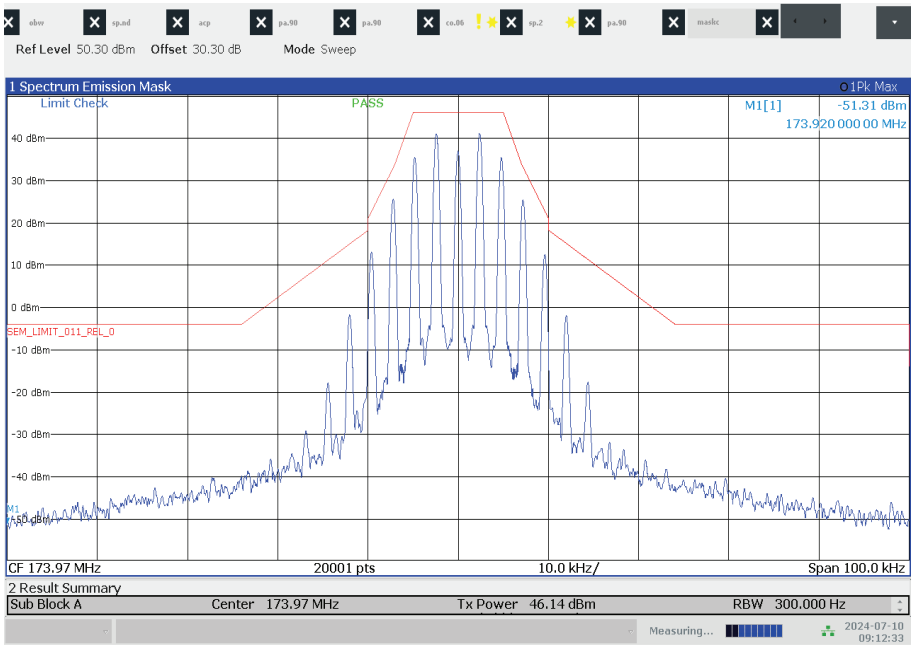
Plot 22: Emission mask C high channel / 1200 bits per second – high power – carrier modulated



Plot 23: Emission mask C high channel / 2400 bits per second – high power – carrier modulated

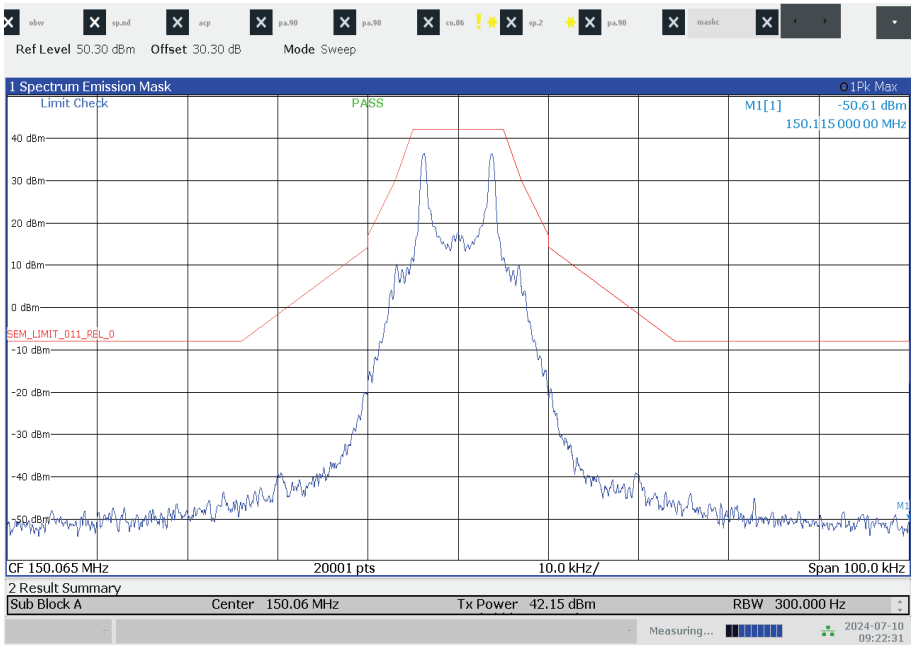


Plot 24: Emission mask C high channel / 4800 bits per second – high power – carrier modulated

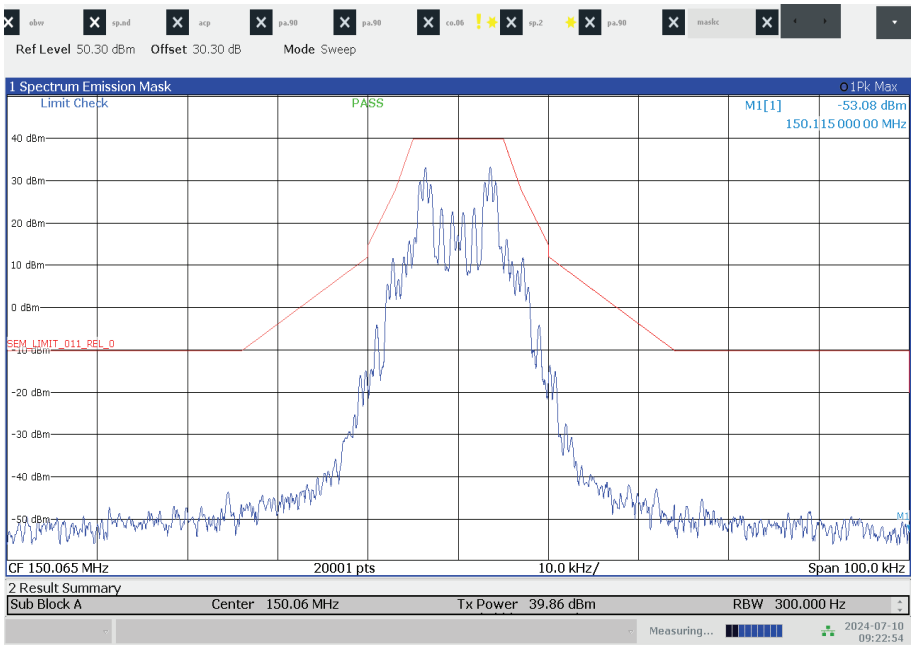


13.4.4 Spectrum masks 25 kHz bandwidth (Emission mask C)

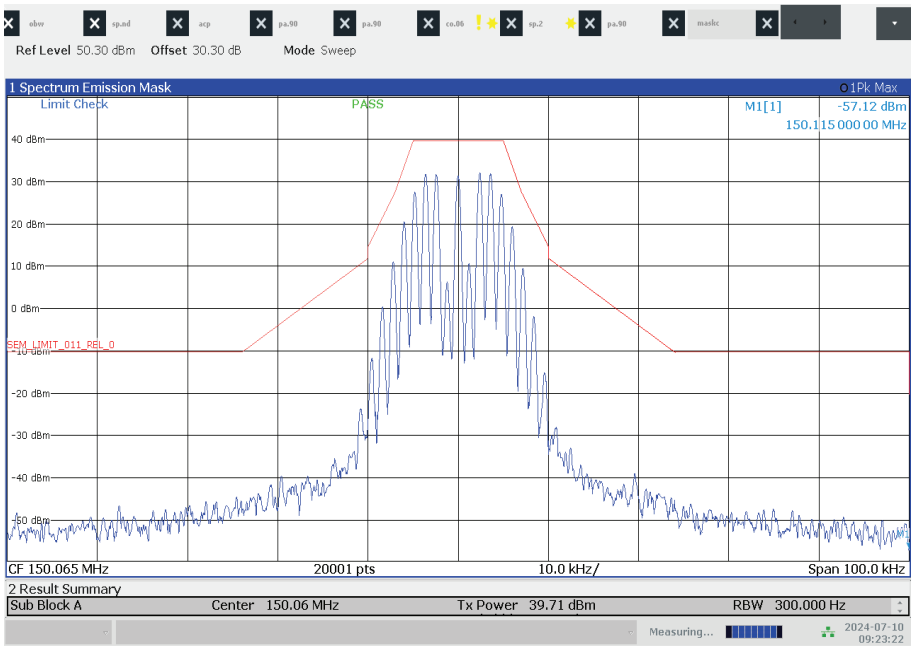
Plot 1: Emission Mask C – low channel – 512 bits per second – low power – Carrier modulated



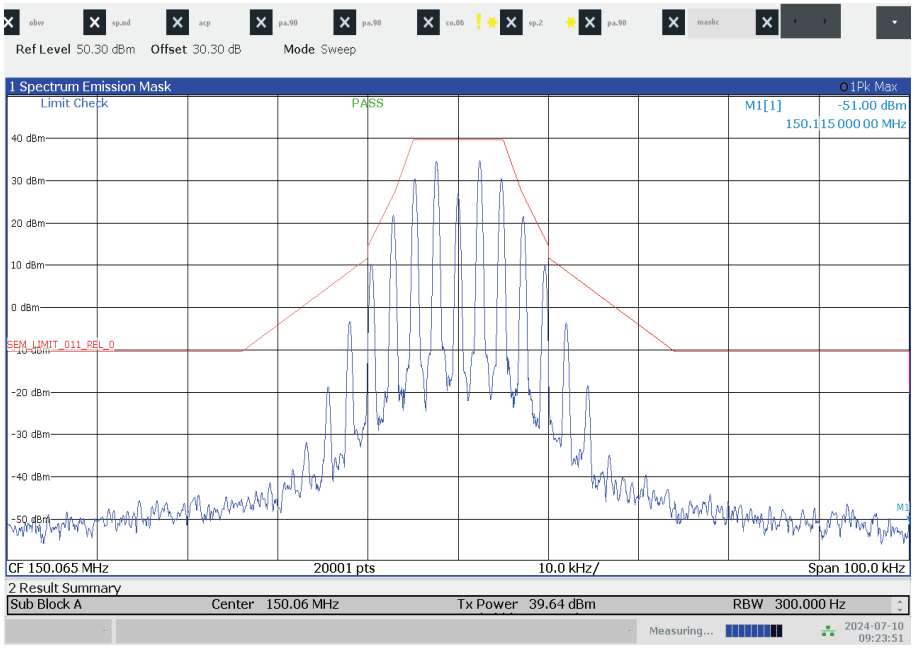
Plot 2: Emission Mask C – low channel – 1200 bits per second – low power – Carrier modulated



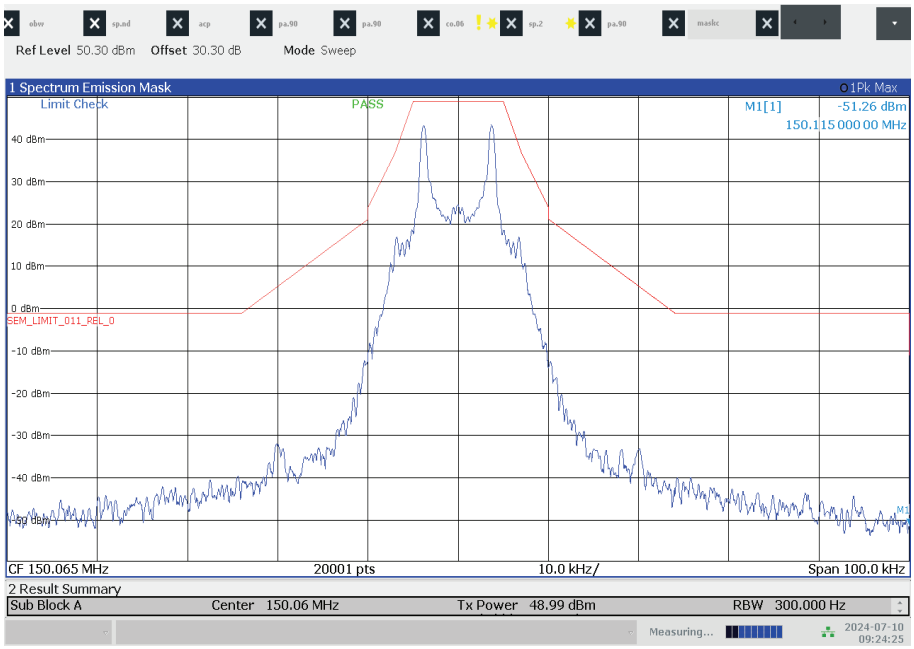
Plot 3: Emission Mask C – low channel – 2400 bits per second – low power – Carrier modulated



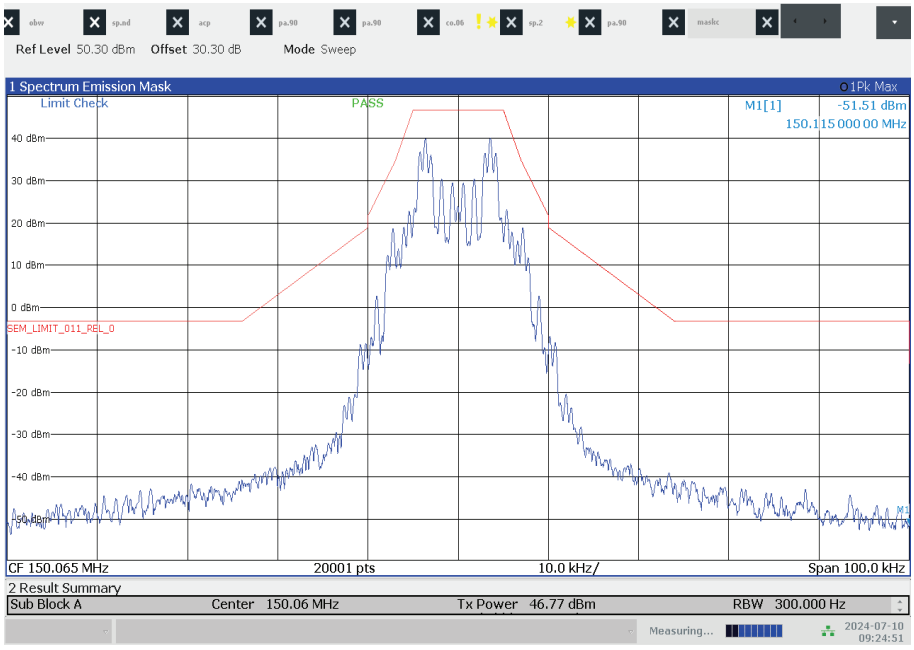
Plot 4: Emission Mask C – low channel – 4800 bits per second – low power – Carrier modulated



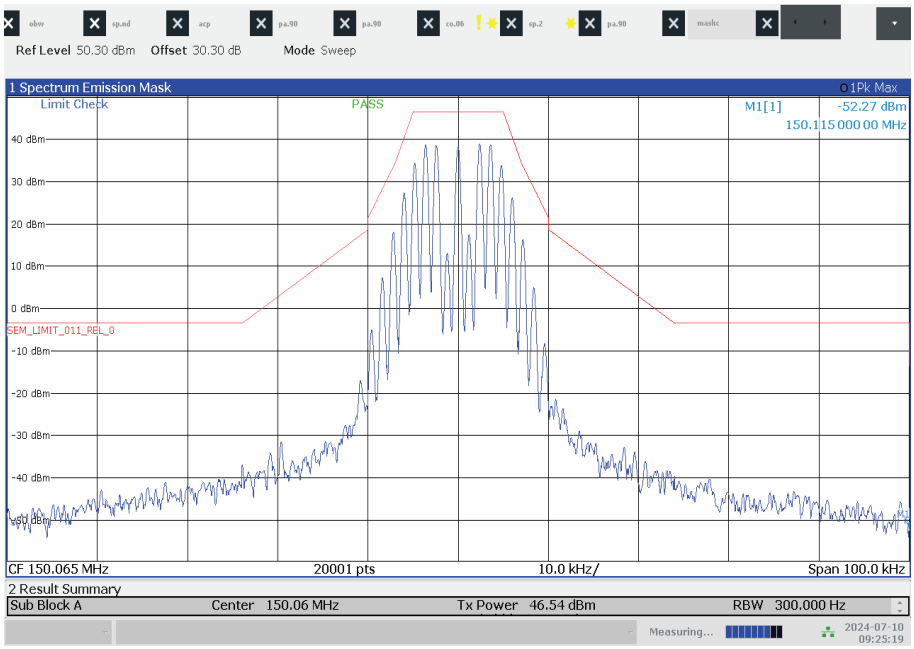
Plot 5: Emission Mask C – low channel – 512 bits per second – high power – Carrier modulated



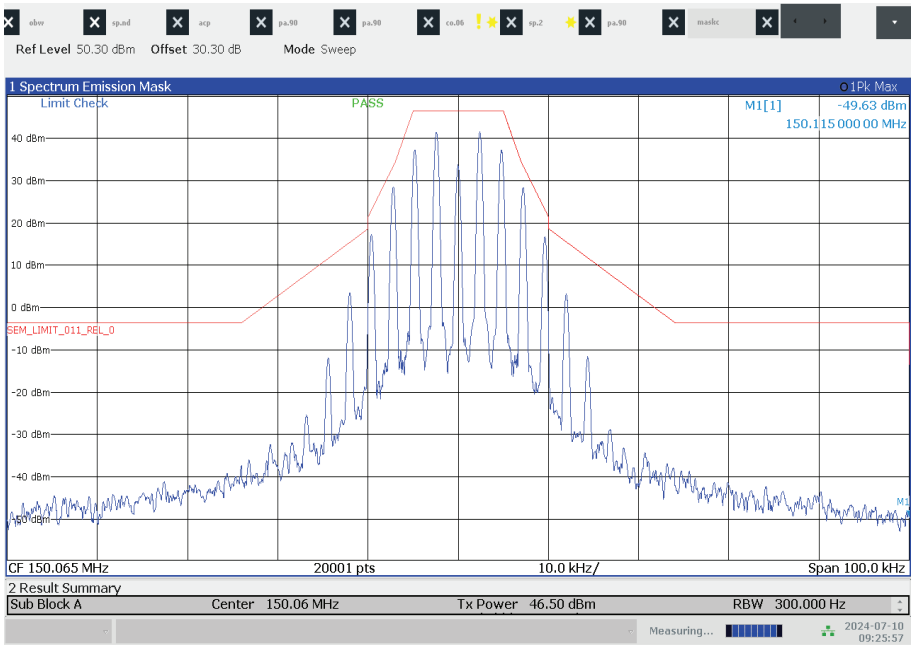
Plot 6: Emission Mask C – low channel – 1200 bits per second – high power – Carrier modulated



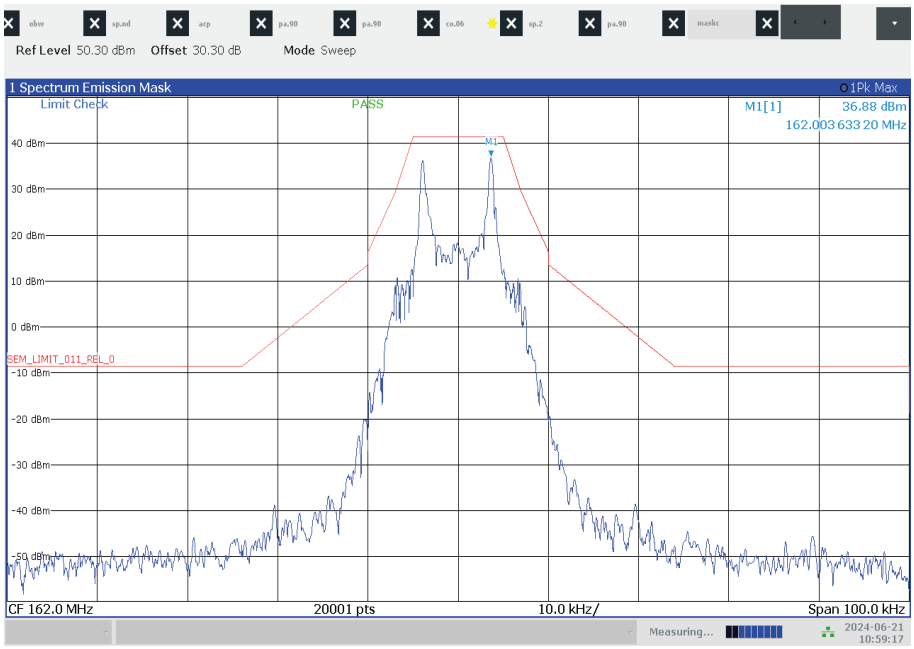
Plot 7: Emission Mask C – low channel – 2400 bits per second – high power – carrier modulated



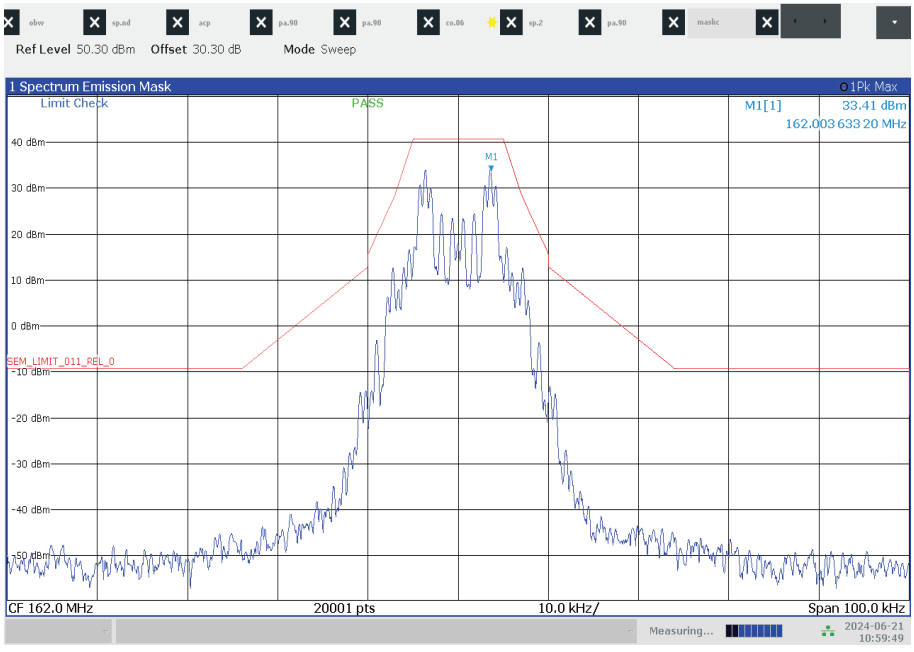
Plot 8: Emission Mask C – low channel – 4800 bits per second – high power – carrier modulated



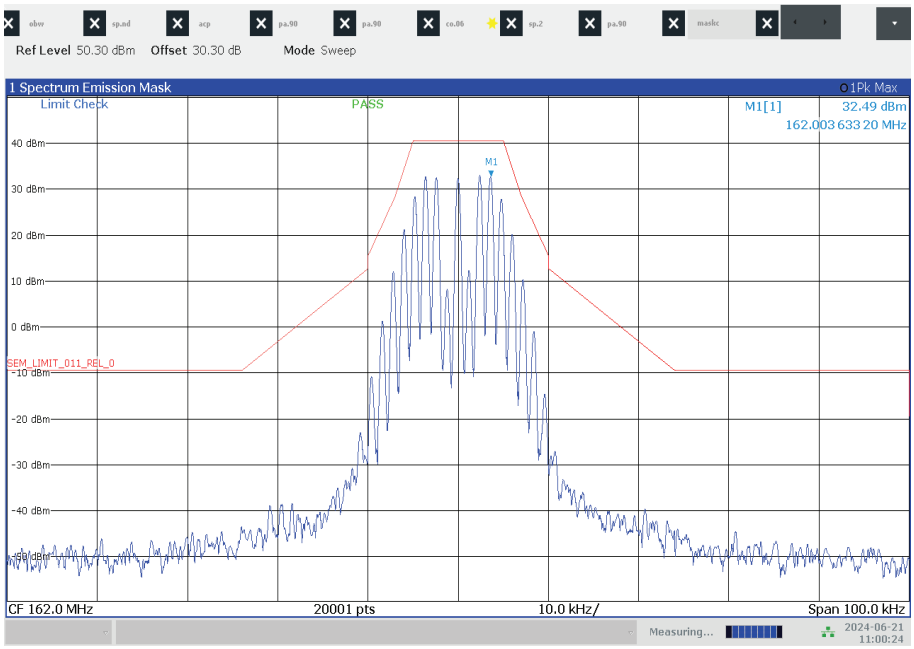
Plot 9: Emission mask C middle channel / 512 bits per second – low power – carrier modulated



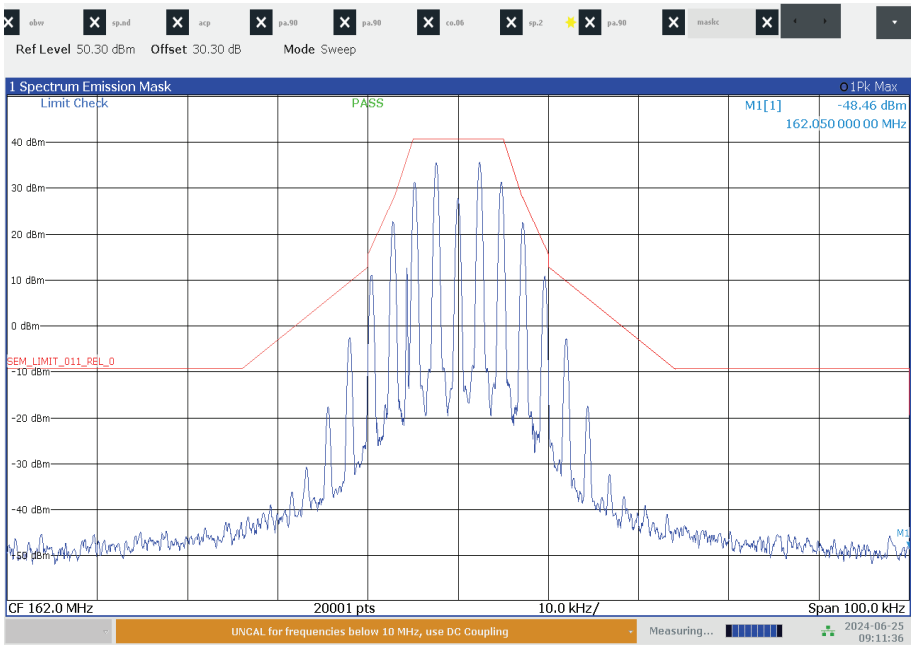
Plot 10: Emission mask C middle channel / 1200 bits per second – low power – carrier modulated



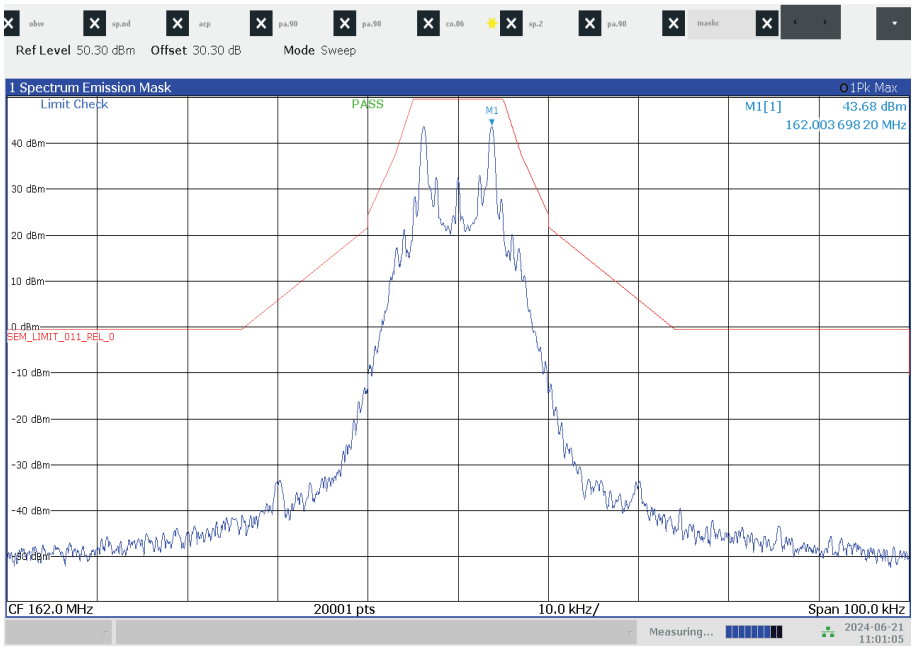
Plot 11: Emission mask C middle channel / 2400 bits per second – low power – carrier modulated



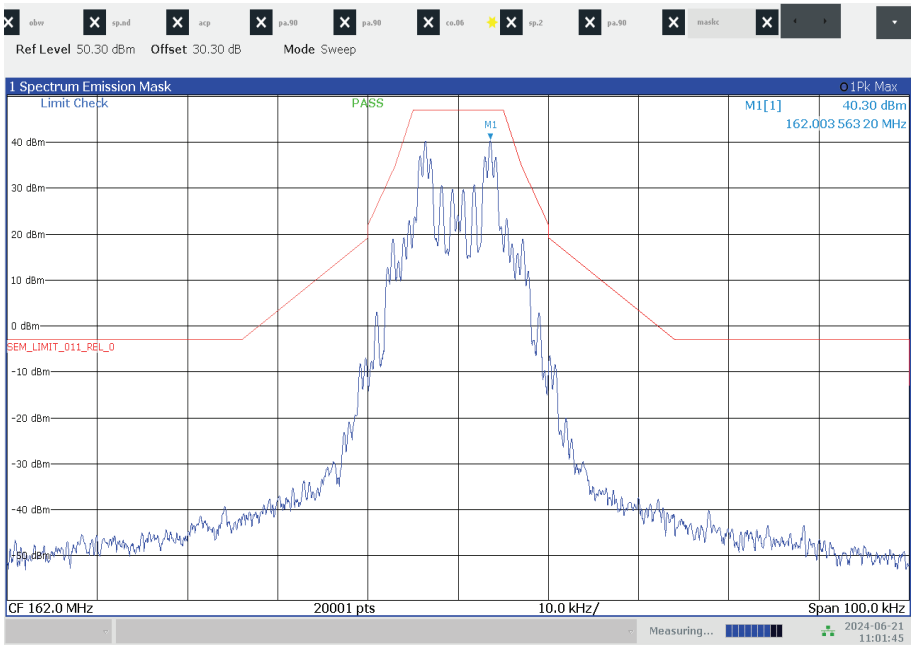
Plot 12: Emission mask C middle channel / 4800 bits per second – low power – carrier modulated



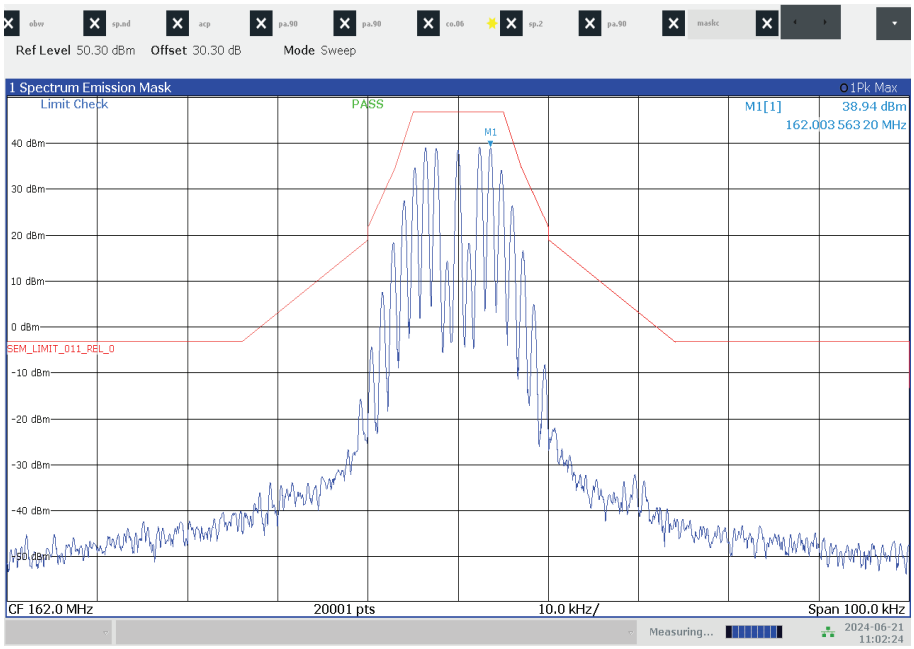
Plot 13: Emission mask C middle channel / 512 bits per second – high power – carrier modulated



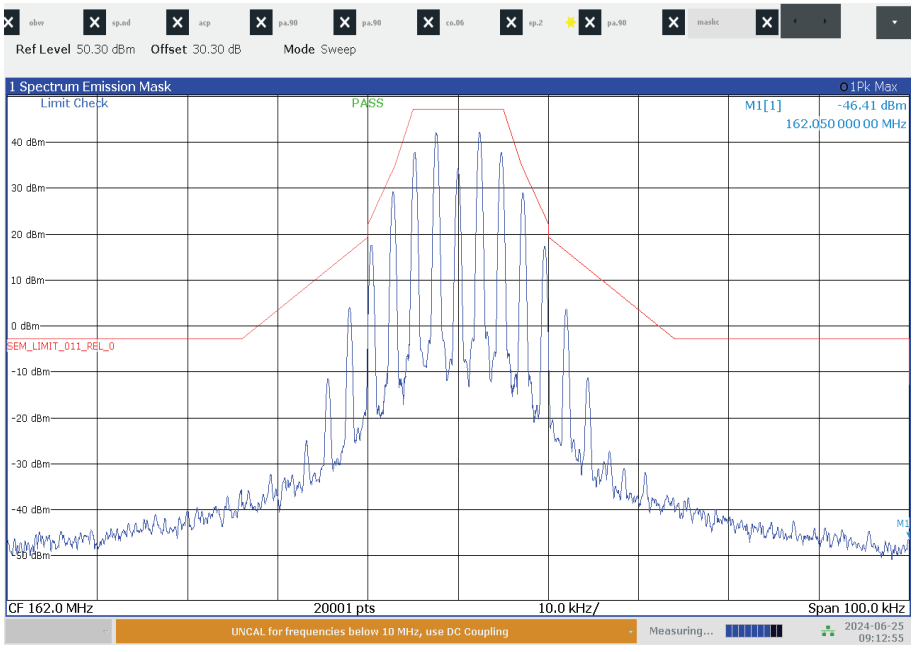
Plot 14: Emission mask C middle channel / 1200 bits per second – high power – carrier modulated



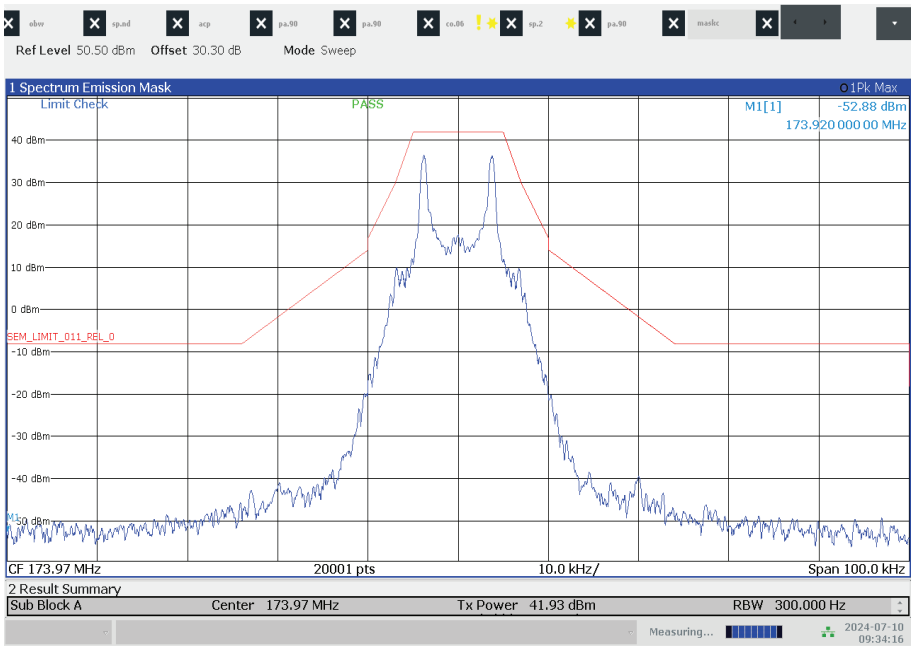
Plot 15: Emission mask C middle channel / 2400 bits per second – high power – carrier modulated



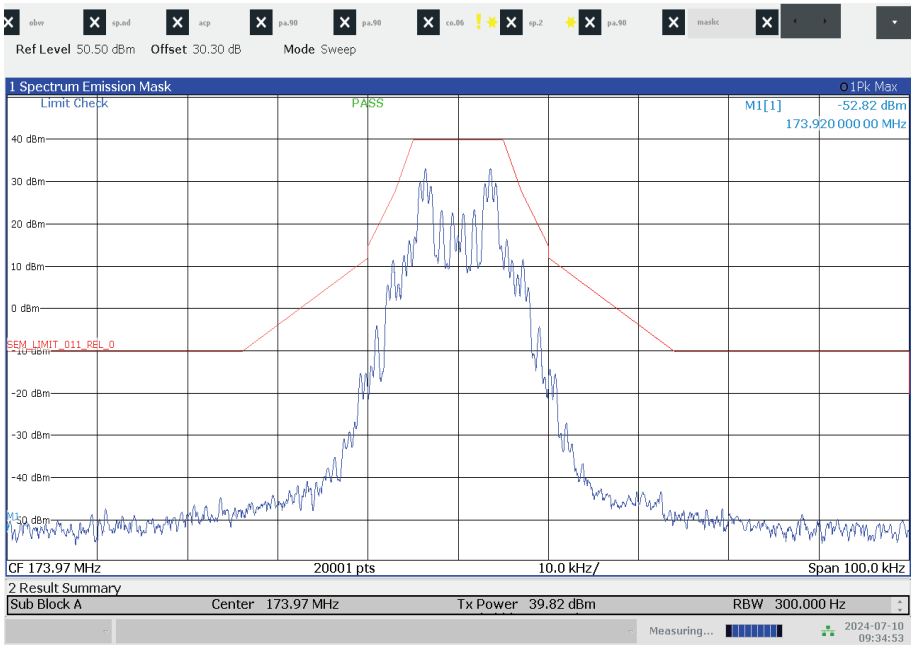
Plot 16: Emission mask C middle channel / 4800 bits per second – high power – carrier modulated



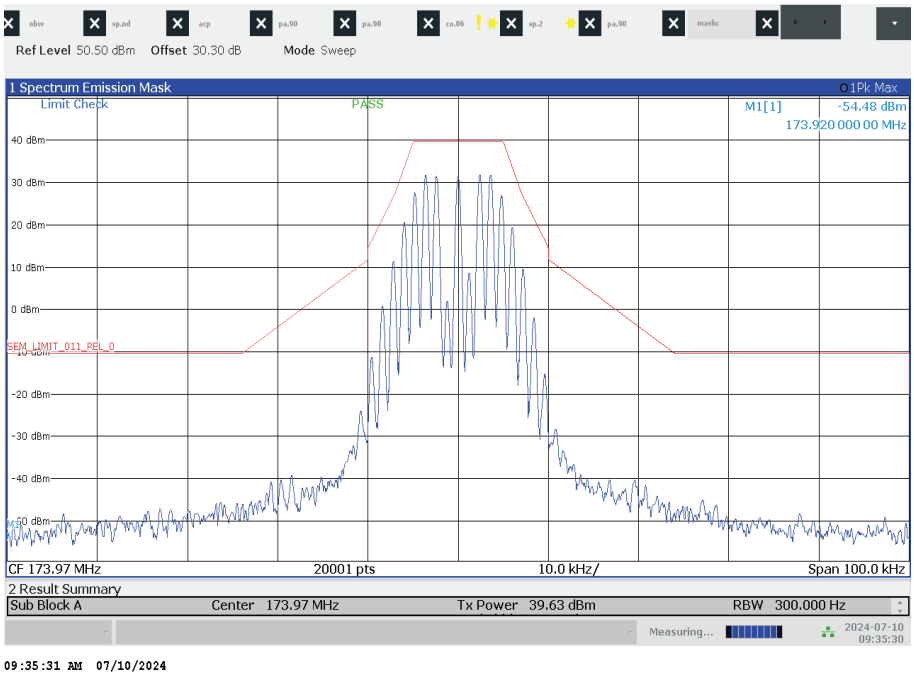
Plot 17: Emission mask C high channel / 512 bits per second – low power – carrier modulated



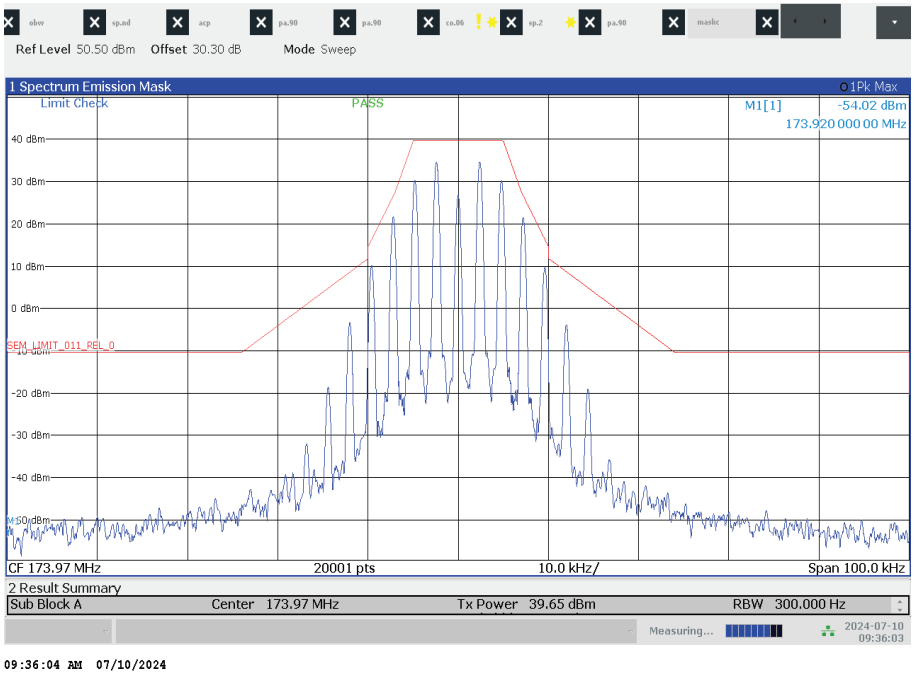
Plot 18: Emission mask C high channel / 1200 bits per second – low power – carrier modulated



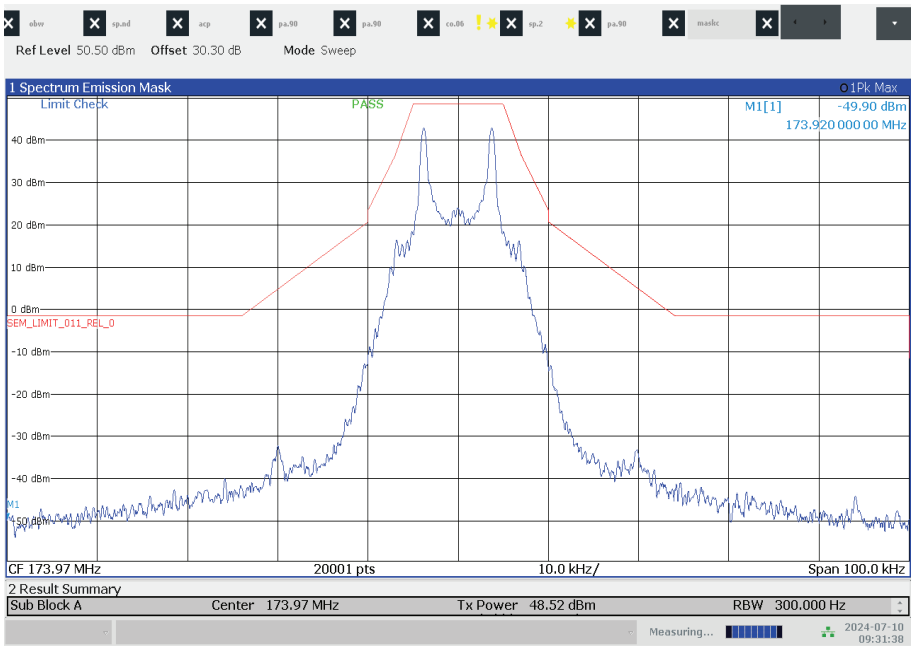
Plot 19: Emission mask C high channel / 2400 bits per second – low power – carrier modulated



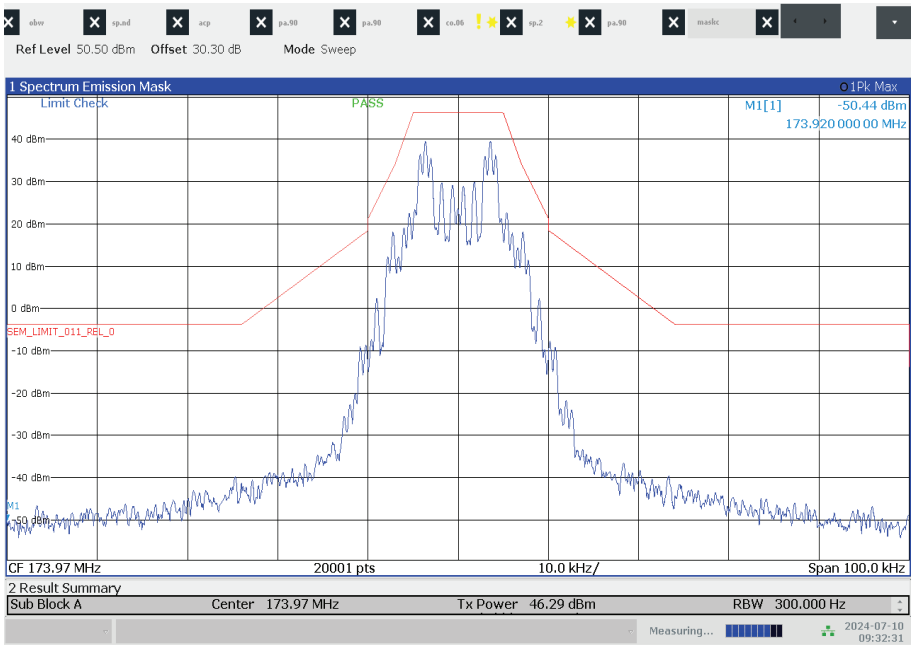
Plot 20: Emission mask C high channel / 4800 bits per second – low power – carrier modulated



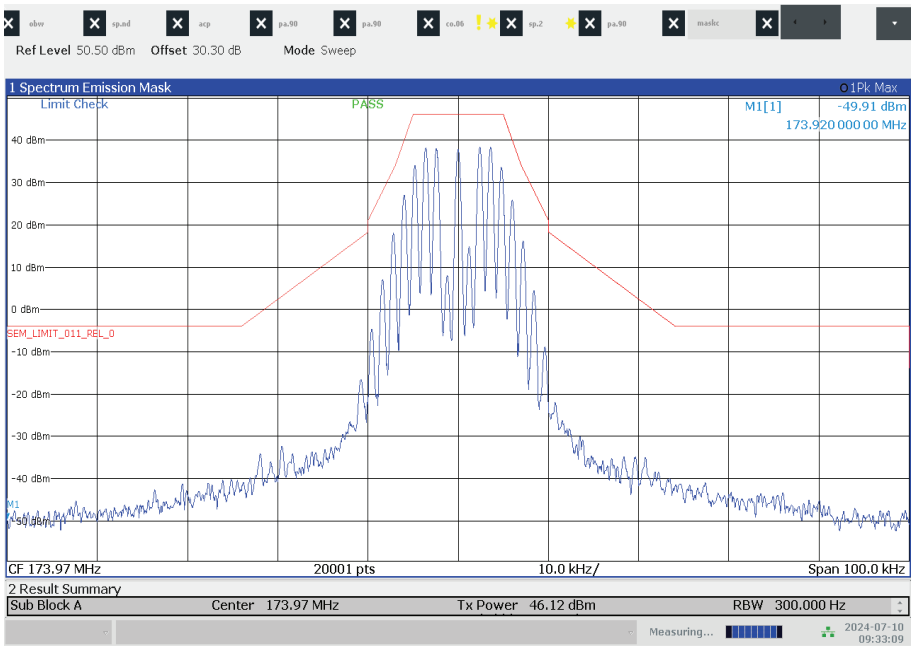
Plot 21: Emission mask C high channel / 512 bits per second – high power – carrier modulated



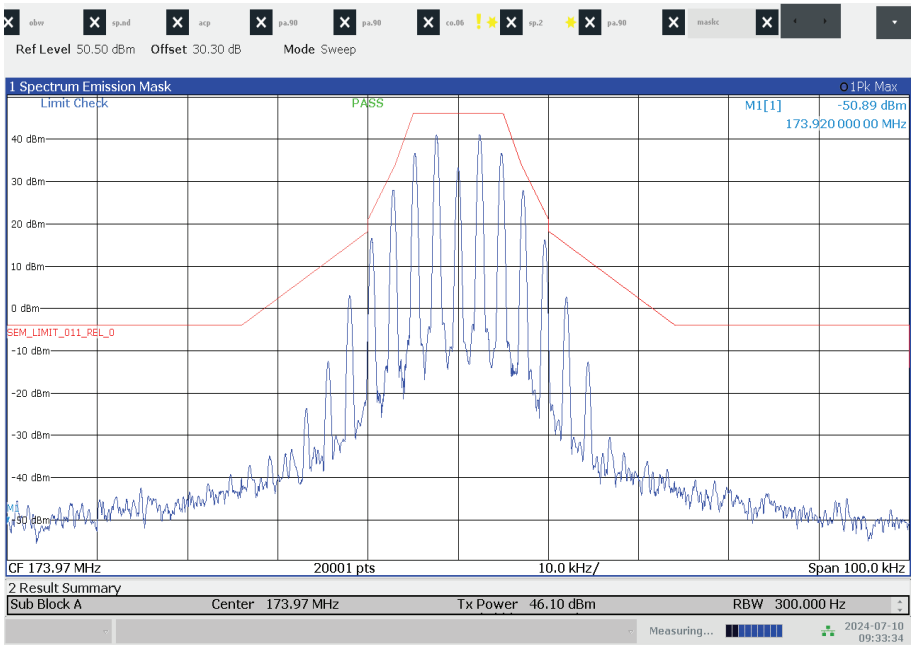
Plot 22: Emission mask C high channel / 1200 bits per second – high power – carrier modulated



Plot 23: Emission mask C high channel / 2400 bits per second – high power – carrier modulated



Plot 24: Emission mask C high channel / 4800 bits per second – high power – carrier modulated



13.5 Transient frequency behavior

13.5.1 Transient frequency behavior 6.25 kHz bandwidth channels

Measurement:

The first plot shows the measurement of the carrier signal to show that a clean carrier is transmitted which results in a measured bandwidth of nearly twice the used RBW.
The following plots show triggered measurements in the time domain with a RBW of 3 kHz (3-dB filter).
A decrease of this power level of 3 dB can be correlated to a frequency error of a half RBW (1.5 kHz).
Therefore the frequency error is less than ± 1.5 kHz as long as the power level is in the 3 dB range. This criteria was taken as worst case condition to show compliance.

Limits:

FCC		IC	
FCC 47 CFR § 90.214		RSS 119 Issue 12 5.9	
Transient frequency behavior			
Time intervals	Maximum frequency difference	Frequency range	
		150 – 174 MHz	421 - 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1	±25.0 kHz	5 ms	10 ms
t_2	±12.5 kHz	20 ms	25 ms
t_3	±25.0 kHz	5 ms	10 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1	±12.5 kHz	5 ms	10 ms
t_2	±6.25 kHz	20 ms	25 ms
t_3	±12.5 kHz	5 ms	10 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1	±6.25 kHz	5 ms	10 ms
t_2	±3.125 kHz	20 ms	25 ms
t_3	±6.25 kHz	5 ms	10 ms

t1 is the time period immediately following ton.
t2 is the time period immediately following t1.
t3 is the time period from the instant when the transmitter is turned off until t_{off}.

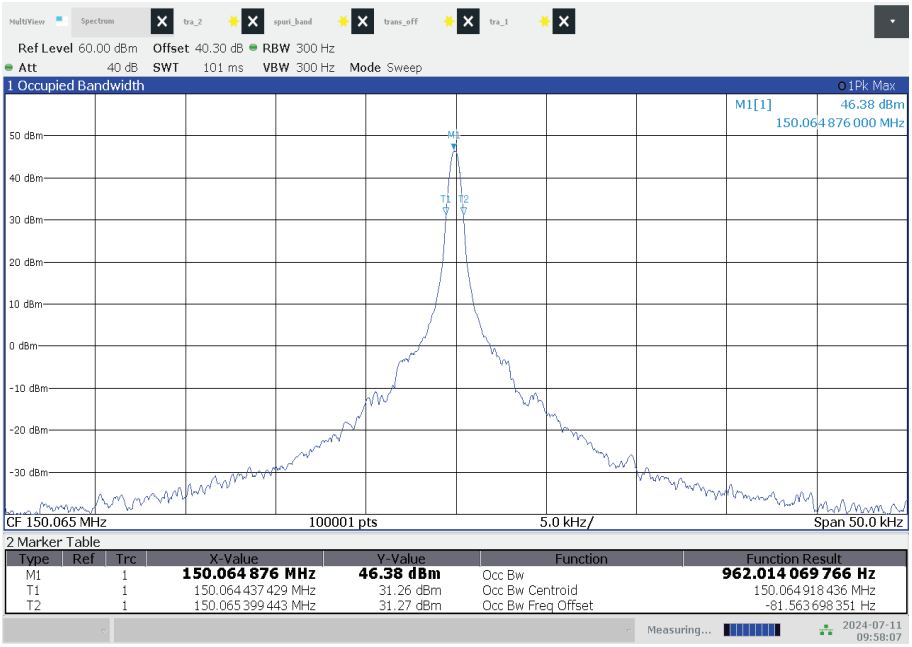
Test scenario	lowest channel	middle channel	highest channel
The frequency stabilizes within the required frequency tolerance range after switching on the transmitter during period t_1 after:	3.73 ms	3.78 ms	3.73 ms
Maximum power deviation during t_2: (power deviation below 3 dB conforms a frequency deviation below ± 1.5 kHz)	1.87 dB	1.52 dB	1.94 dB
Switch off time (t_3):	1.12 ms	1.04 ms	1.14 ms

Result:

Confirm that during periods t_1 and t_3 the frequency difference does not exceed the value of one cannel separation	Passed
Confirm that during period t_2 the frequency difference does not exceed half a cannel separation	Passed
Confirm that during periods t_2 to t_3 the frequency difference does not exceed the frequency error limit	Passed

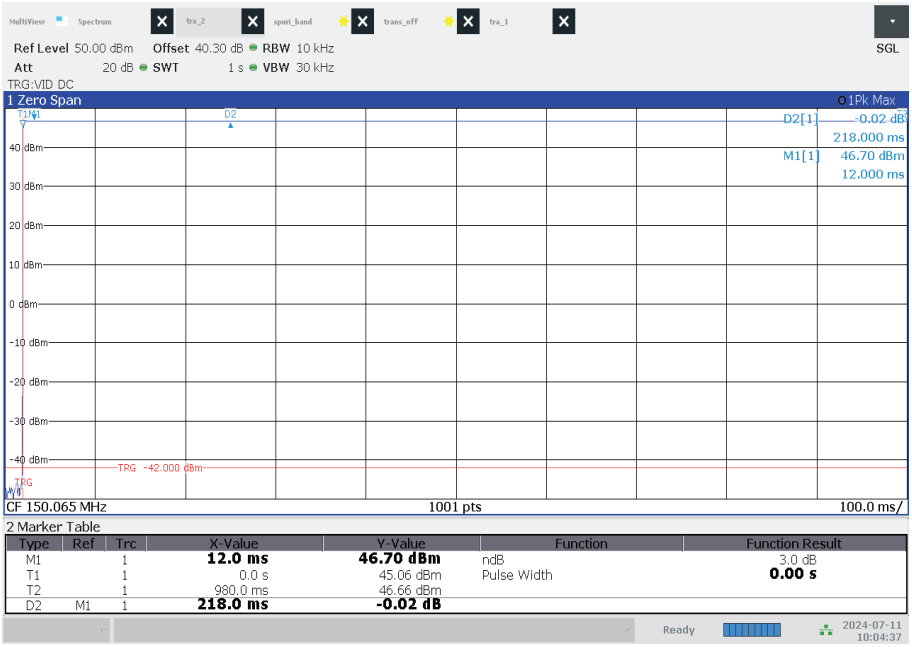
Plots of the measurement (512 bits per second):

Plot 1: lowest channel – carrier

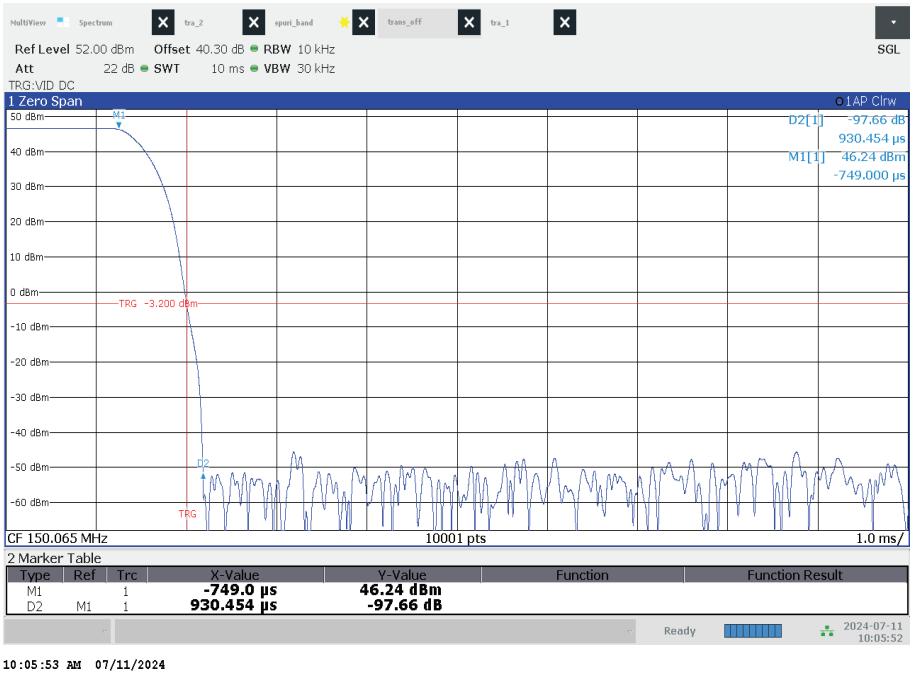


Plot 2: lowest channel – switch on (zoomed)

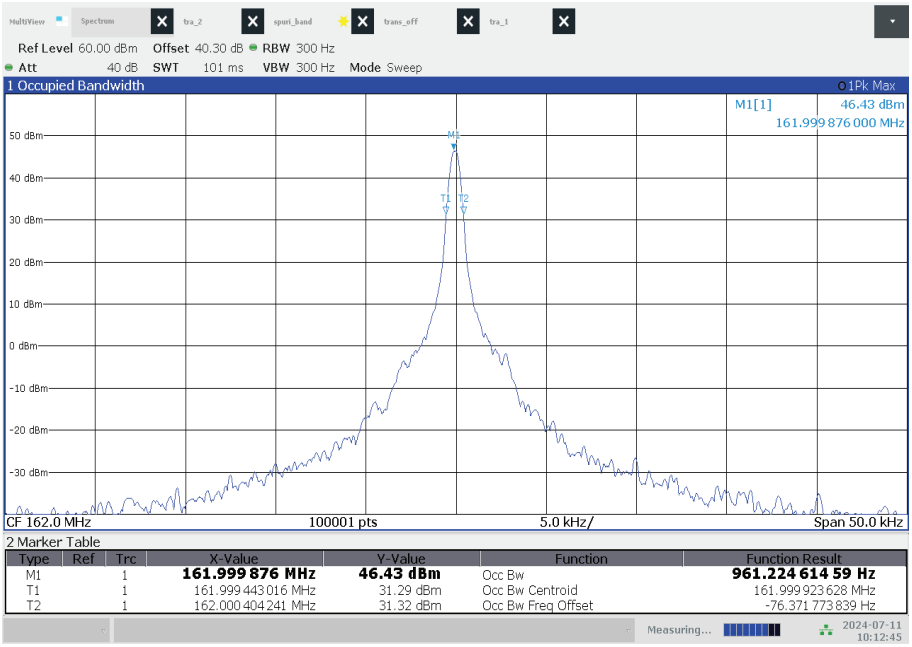
Plot 3: low channel – operating



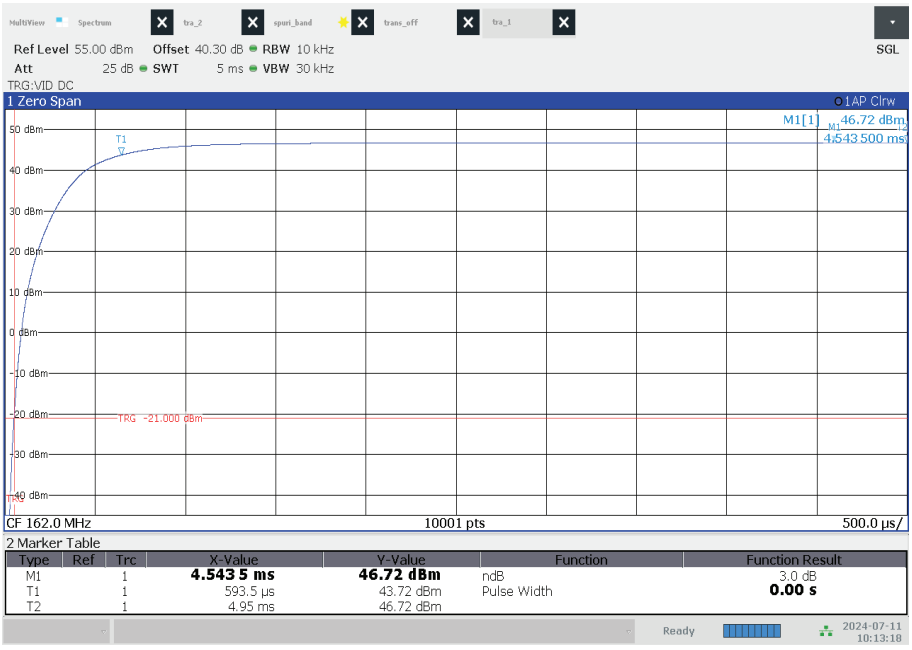
Plot 4: low channel – switch off (zoomed)



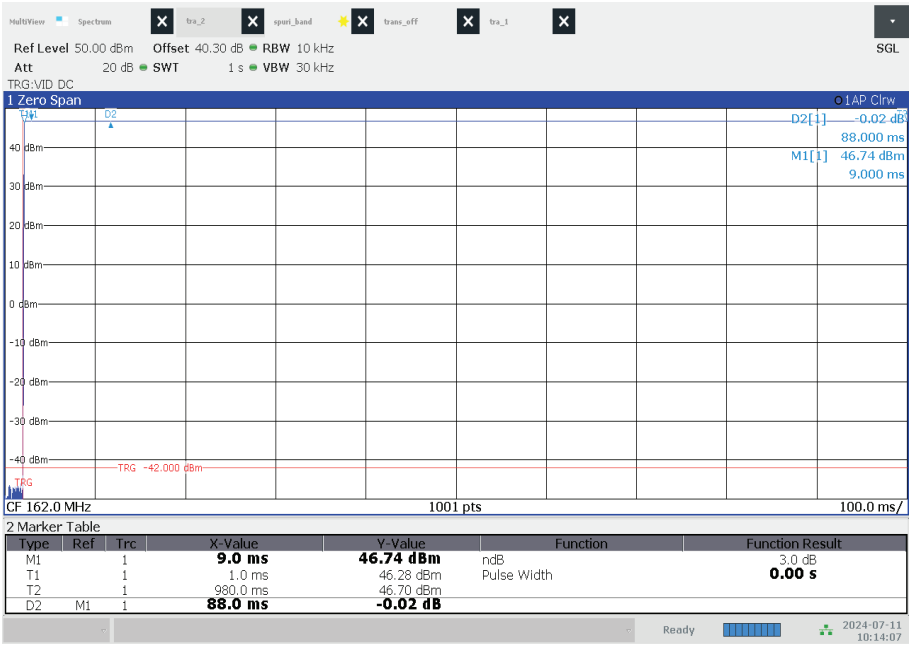
Plot 5: middle channel – carrier



Plot 6: middle channel – switch on (zoomed)



Plot 7: middle channel – operating



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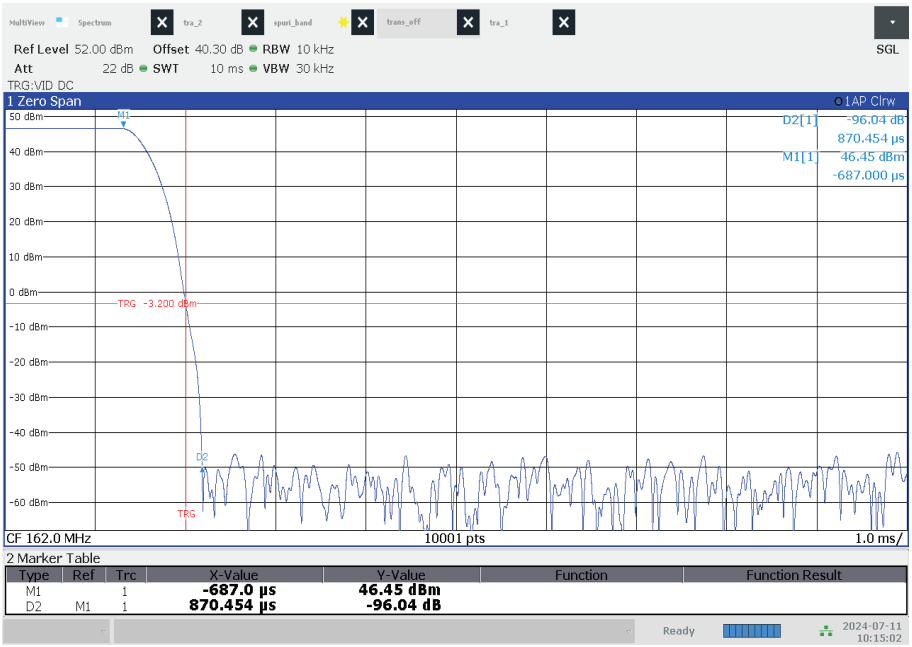
Plot 8: middle channel – switch off (zoomed)



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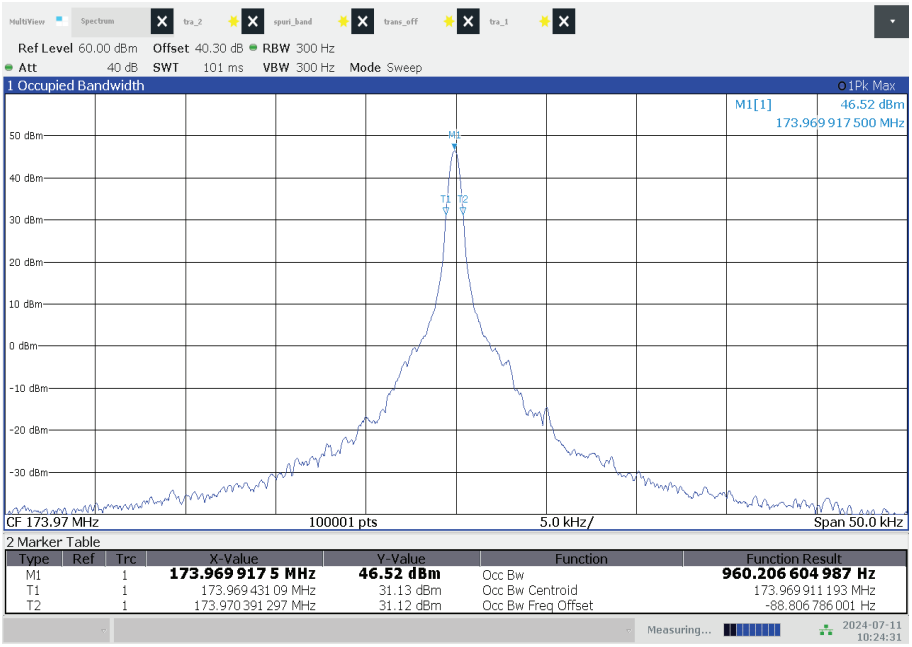
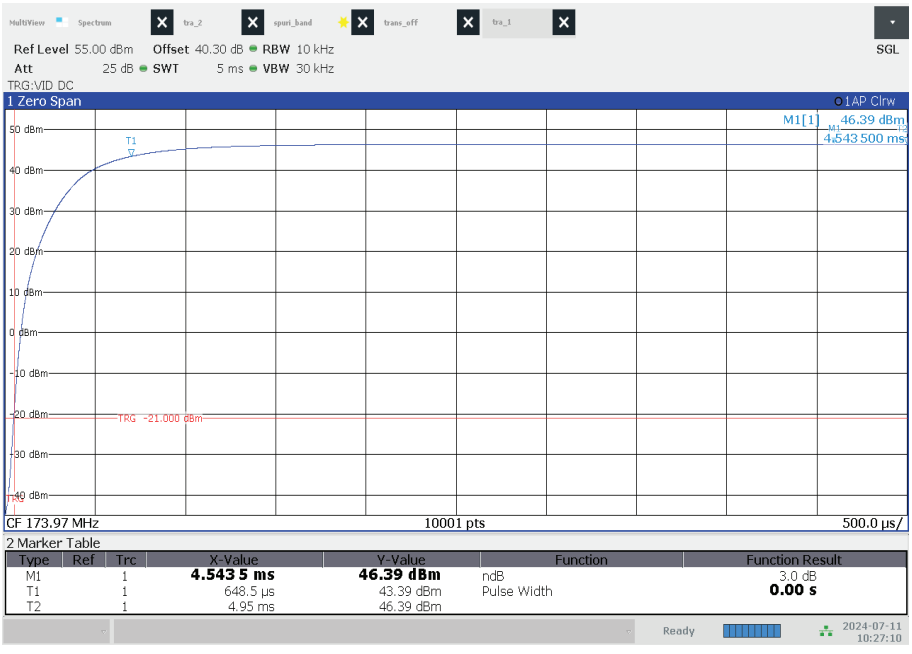
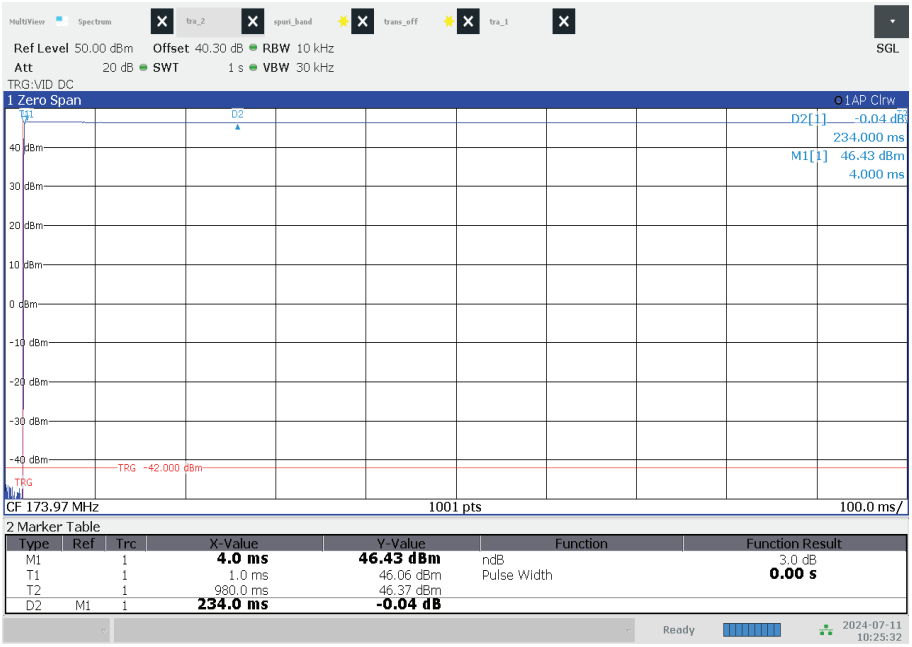
Plot 9: high channel – carrier



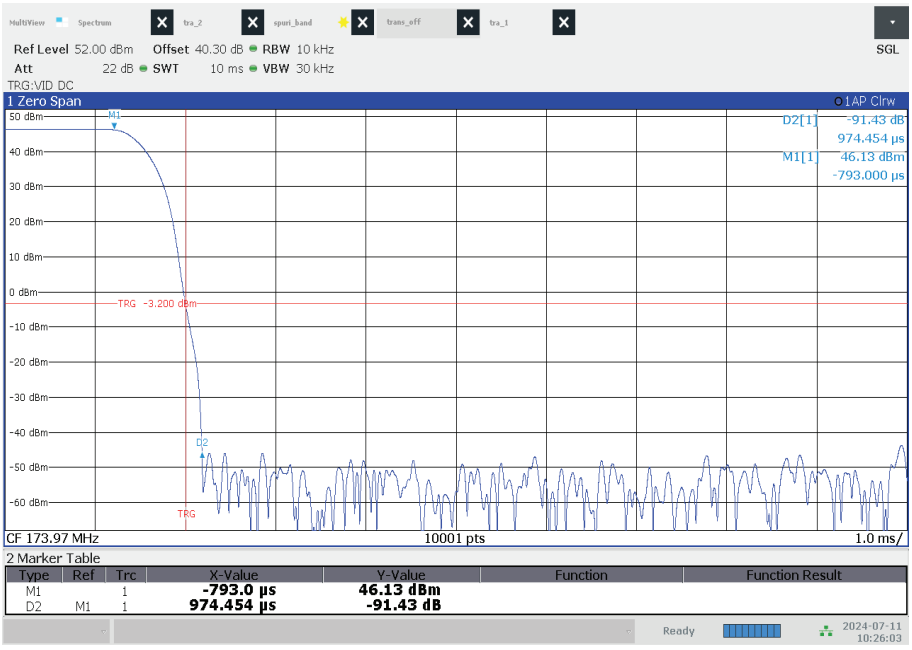
Plot 10: high channel – switch on (zoomed)



Plot 11: high channel – operating



Plot 12: high channel – switch off (zoomed)



13.5.2 Transient frequency behavior 25 kHz bandwidth channels

Measurement:
The first plot shows the measurement of the carrier signal to show that a clean carrier is transmitted which results in a measured bandwidth of nearly twice the used RBW.
The following plots show triggered measurements in the time domain with a RBW of 10 kHz (3-dB filter).
A decrease of this power level of 3 dB can be correlated to a frequency error of a half RBW (5 kHz).
Therefore the frequency error is less than ± 5 kHz as long as the power level is in the 3 dB range. This criteria was taken as worst case condition to show compliance.

Limits:

FCC	IC
FCC 47 CFR § 90.214	RSS 119 Issue 12 5.9
Transient frequency behavior	

Transient periods	Frequency range 150 – 174 MHz	Frequency range 421 - 512 MHz
t_1 (ms)	5 ms	10 ms
t_2 (ms)	20 ms	25 ms
t_3 (ms)	5 ms	10 ms

t1 is the time period immediately following ton.
t2 is the time period immediately following t1.
t3 is the time period from the instant when the transmitter is turned off until toff.

Test szenario	low channel	middle channel	high channel
The frequency stabilizes within the required frequency tolerance range after switching on the transmitter during period t1 after:	3.88 ms	3.94 ms	3.88 ms
Maximum power deviation during t2: (power deviation below 3 dB conforms a frequency deviation below ± 5 kHz)	1.61 dB	1.70 dB	1.49 dB
Switch off time (t3):	1.17 ms	1.01 ms	0.96 ms

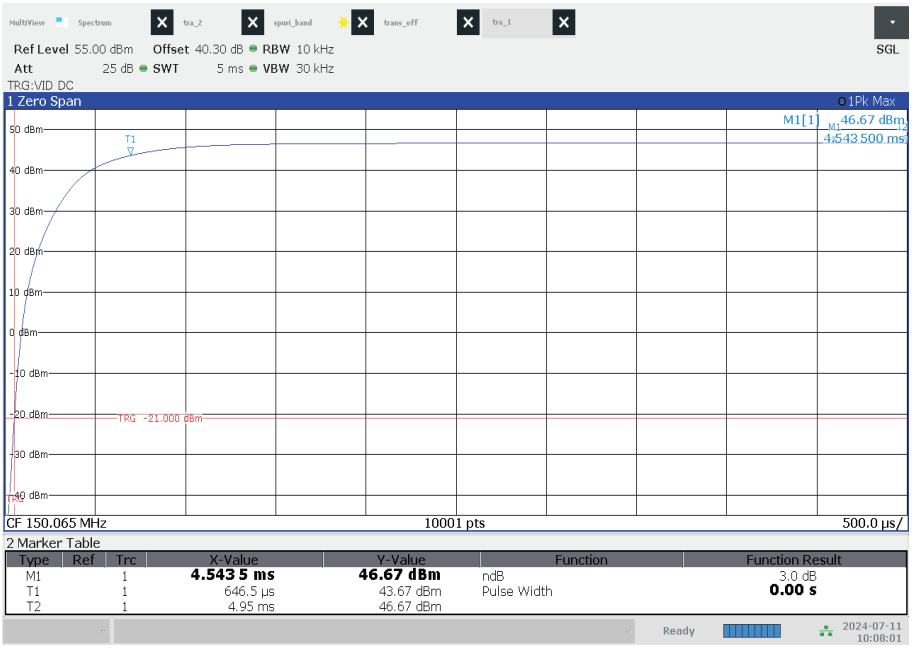
Result:

Confirm that during periods t_1 and t_3 the frequency difference does not exceed the value of one cannel separation	Passed

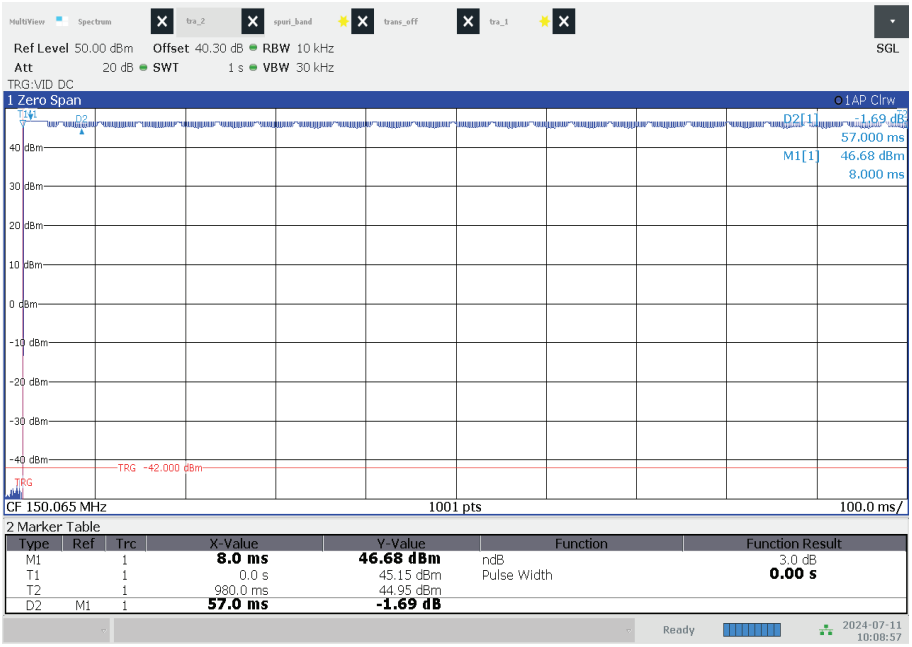
Plots of the measurement (512 bits per second):

Plot 1: low channel – carrier

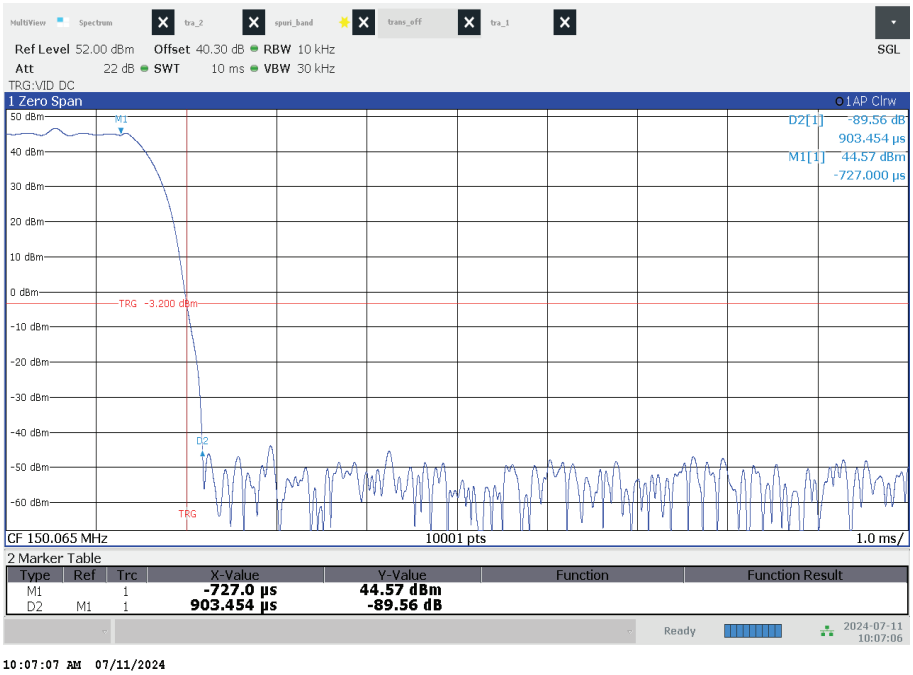
Plot 2: low channel – switch on (zoomed)



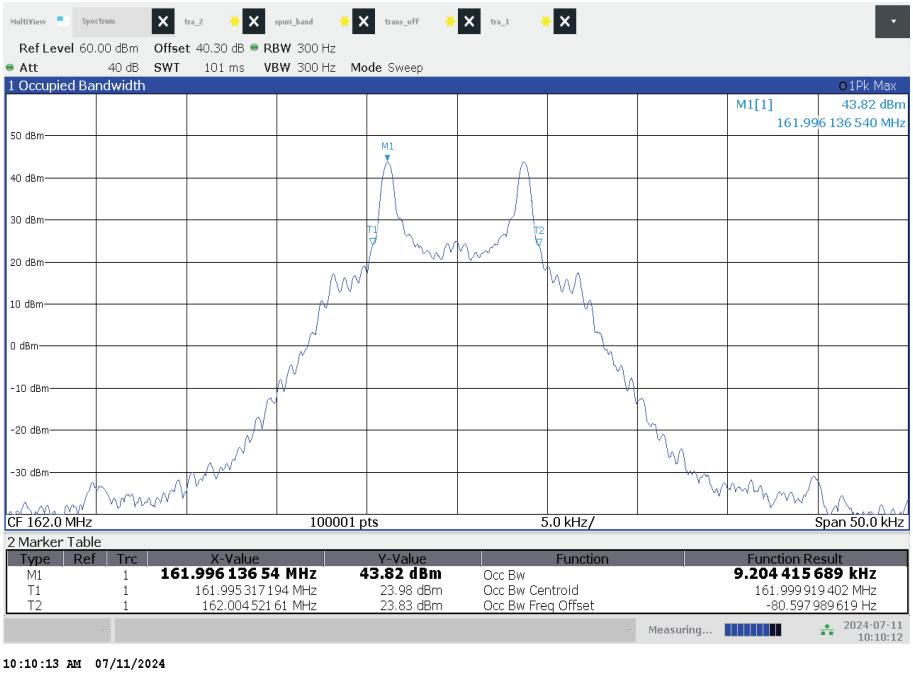
Plot 3: low channel – operating



Plot 4: low channel – switch off (zoomed)

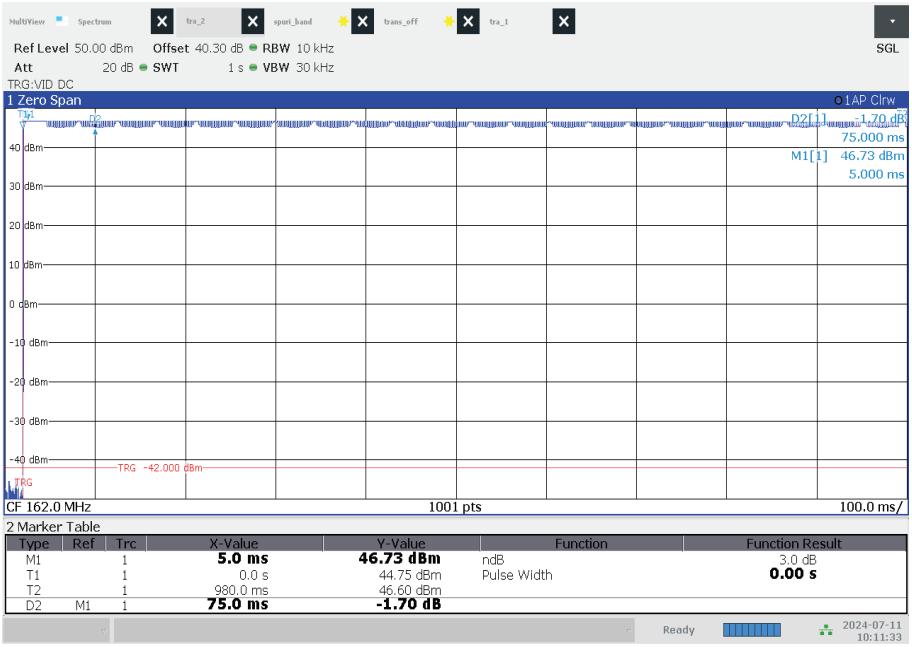


Plot 5: middle channel – carrier

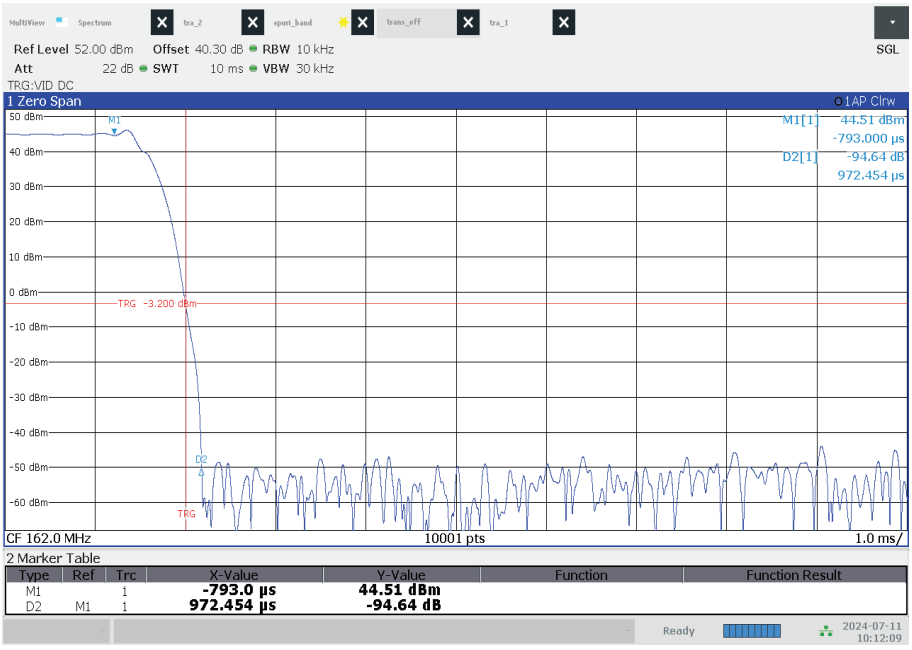


Plot 6: middle channel – switch on (zoomed)

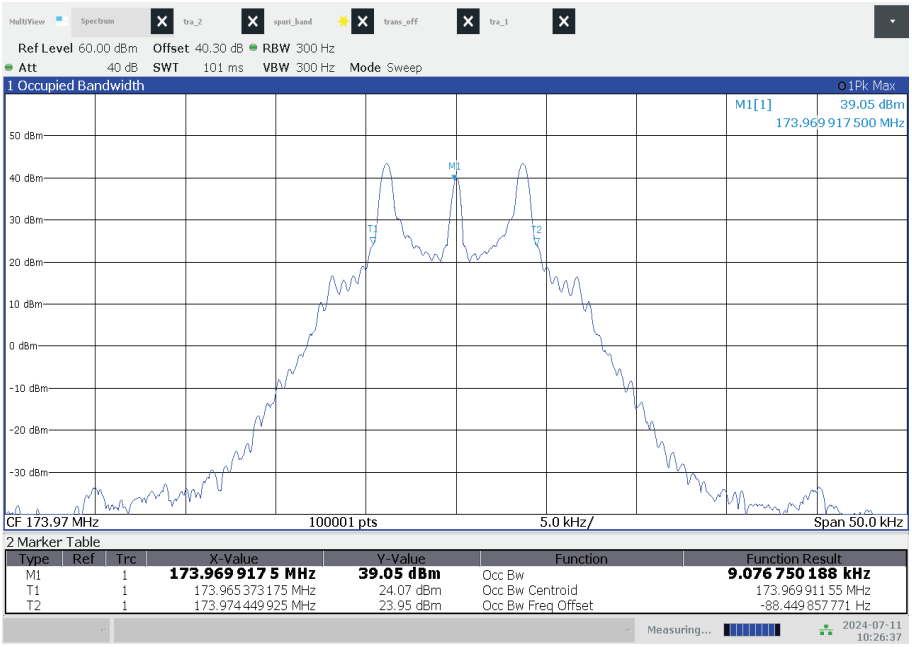
Plot 7: middle channel – operating



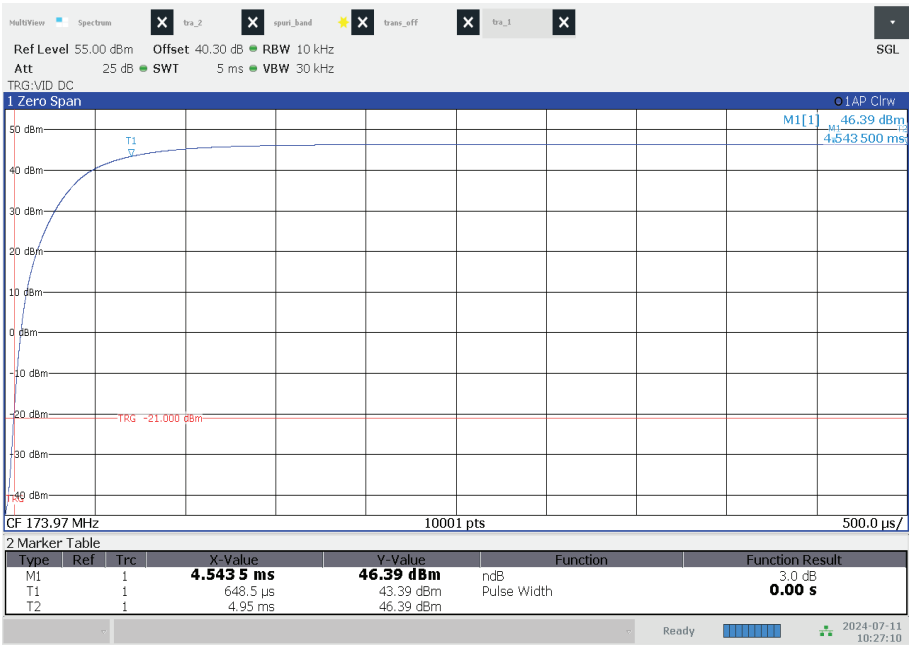
Plot 8: middle channel – switch off (zoomed)



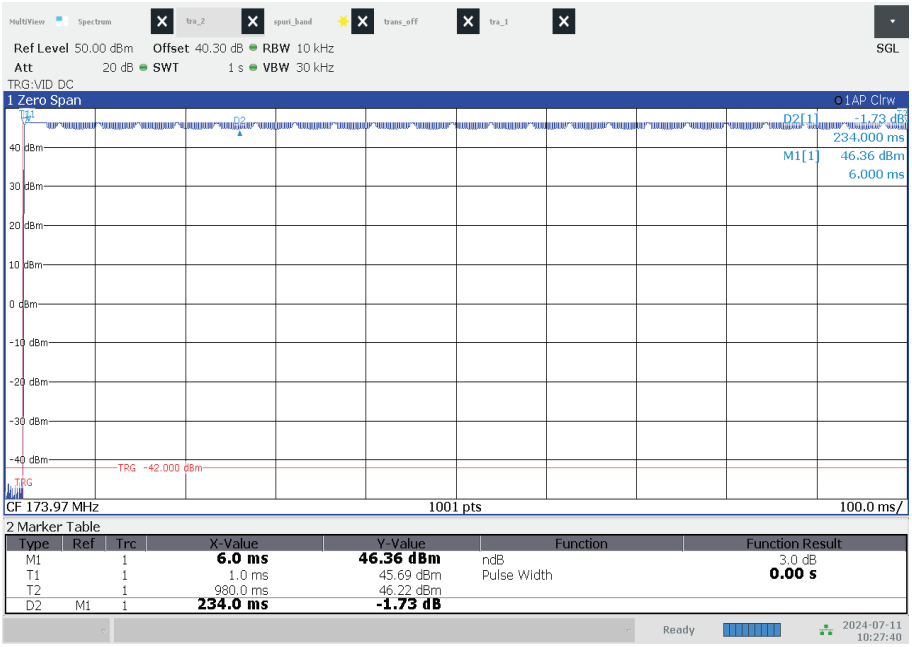
Plot 9: high channel – carrier



Plot 10: high channel – switch on (zoomed)



Plot 11: high channel – operating



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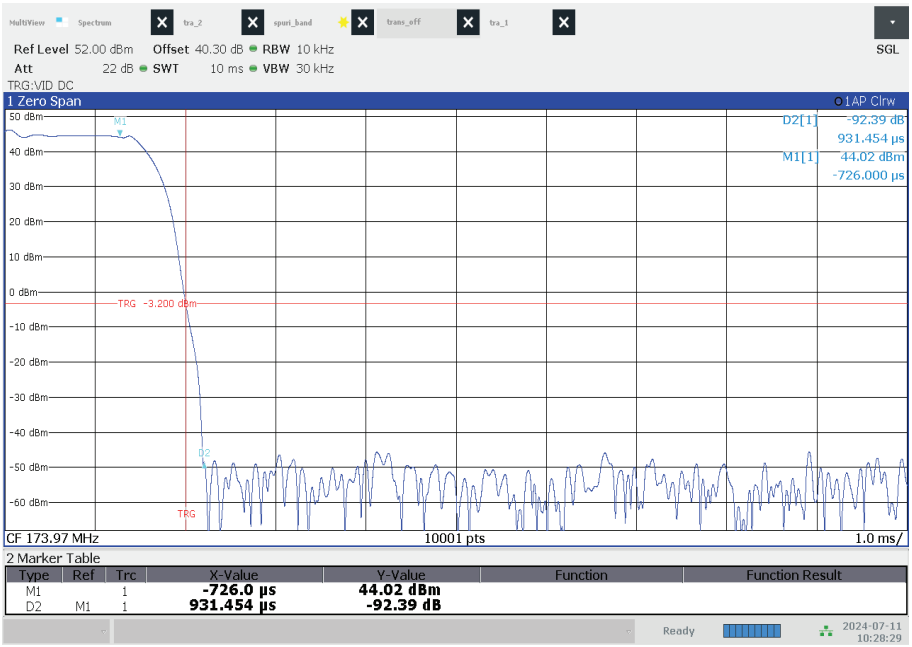
Plot 12: high channel – switch off (zoomed)



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13.6 Frequency stability

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	10 Hz
Video bandwidth:	100 Hz
Span:	50 kHz
Trace-Mode:	Max. hold

Limits:

FCC	IC
FCC 47 CFR § 2.1055 (a)(1) § 90.213	RSS 119 Issue 12 5.3
150–174 MHz band: 5 ppm for 7.5 kHz channel spacing 421–512 MHz band: 2.5 ppm for 12.5 kHz channel spacing	

Results:

Temperature	Deviation (Hz)	Deviation (ppm)	Deviation (Hz)	Deviation (ppm)	Deviation (Hz)	Deviation (ppm)
	low channel		middle channel		high channel	
-20 °C	321	2.14	-309	1.91	-677	3.89
-10 °C	-281	1.87	-626	3.86	-685	3.94
0 °C	-282	1.88	-342	2.11	-108	0.62
10 °C	583	3.89	-25	0.16	-83	0.47
20 °C (V nom)	291	1.94	-305	1.88	-104	0.60
30 °C	309	2.06	242	1.50	483	2.78
40 °C	580	3.86	271	1.67	-366	2.10
50 °C	498	3.32	589	3.63	-352	2.03
Voltage	Deviation (Hz)	Deviation (ppm)	Deviation (Hz)	Deviation (ppm)	Deviation (Hz)	Deviation (ppm)
85 %	37	0.24	-41	0.25	20	0.12
115 %	41	0.27	-46	0.28	10	0.06

13.7 Transmitter spurious emissions conducted

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	f < 1 GHz : 100 kHz f ≥ 1GHz : 1 MHz
Video bandwidth:	f < 1 GHz : 100 kHz f ≥ 1GHz : 1 MHz
Span:	See plots
Trace-Mode:	Max. hold

Limits:

FCC	IC
FCC 47 CFR § 2.1051 § 90.210	RSS 119 Issue 12 5.8.9.2
Emission Mask C On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: $43 + 10\text{Log}_{10}(P)$ dB	
Emission Mask D 12.5 kHz channel spacing 70 dB or 50 m + $10\text{Log}_{10}(P_{Watts})$ – whichever is the lesser	
Emission Mask E 7.5 kHz channel spacing 57 or 55 m + $10\text{Log}_{10}(P_{Watts})$ – whichever is the lesser	

Emission Masks B, C, G, I and J

Unwanted emission measurements can be in peak or averaging mode, provided that the same parameter, peak power or average power, used for the transmitter's output power measurement is also used for the unwanted emission measurements.
Except where otherwise stated, on any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth, a resolution bandwidth of at least 100 kHz must be used for frequencies to be measured at or below 1 GHz, and a resolution bandwidth of at least 1 MHz must be used for frequencies to be measured above 1 GHz. If a narrower resolution bandwidth is used, power integration shall be applied.

Emission Masks D, E, F and Y

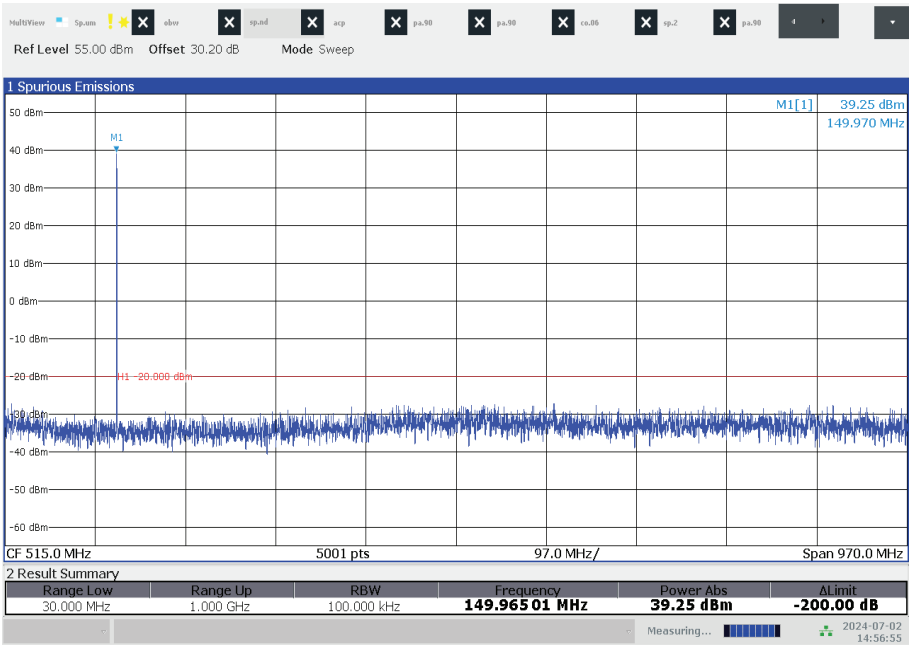
In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak mode. For emissions beyond 50 kHz from the edge of the authorized bandwidth, the resolution bandwidth shall be 100 kHz for frequencies at or below 1 GHz, and 1 MHz for frequencies above 1 GHz.

Results: see table below plots

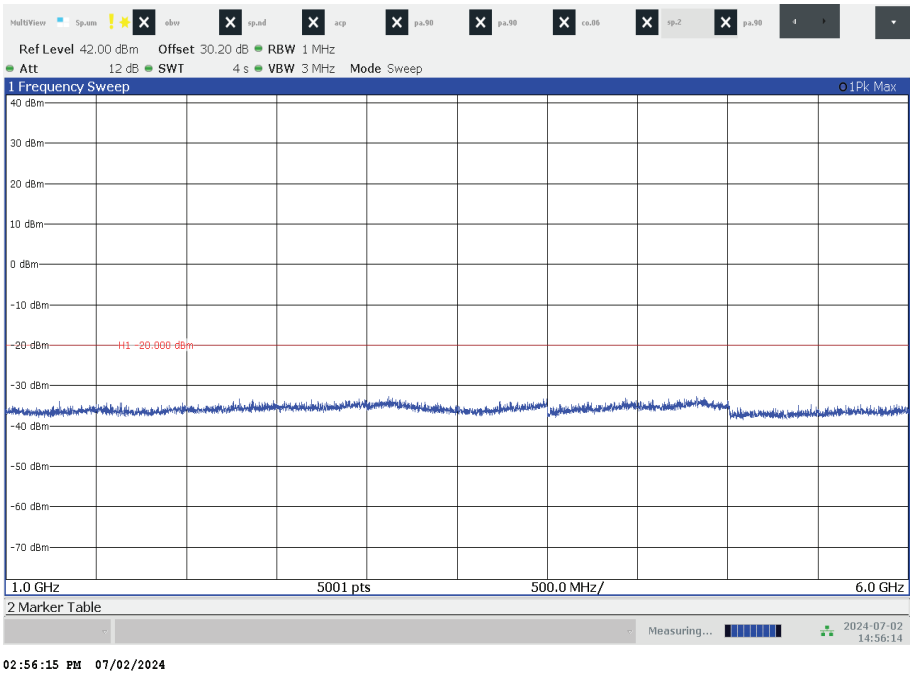
13.7.1 Plots 6.25 kHz bandwidth

Plots of the measurements with low power setting (10W)

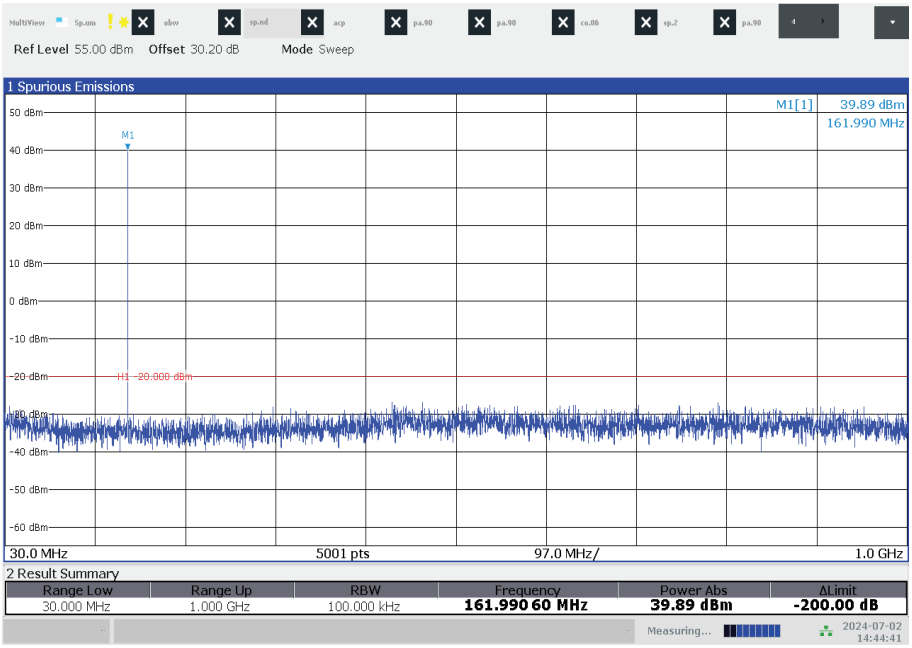
Plot 1: low channel, bandwidth 6.25kHz, low power, 30MHz – 1GHz:



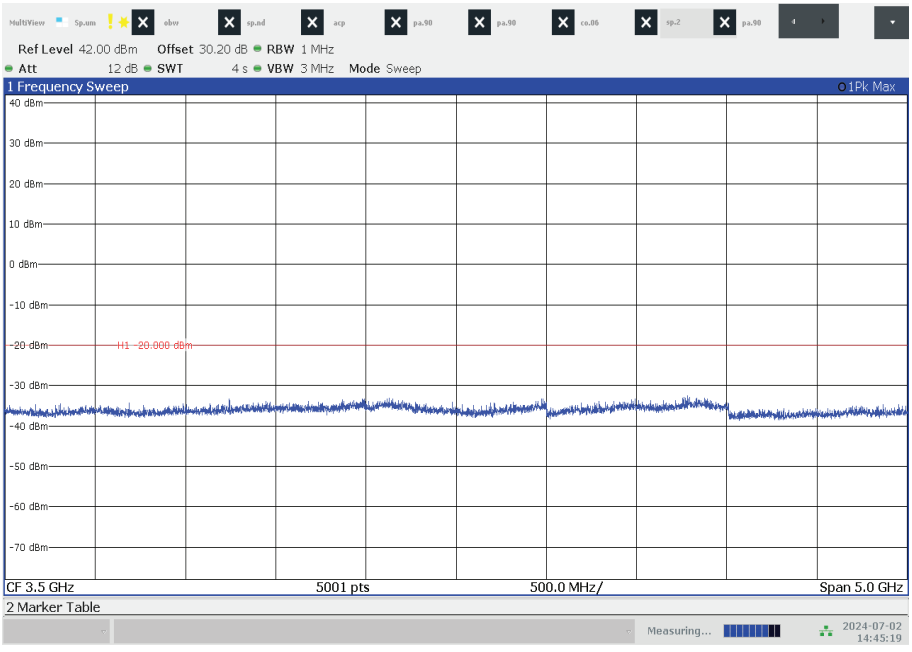
Plot 2: low channel, bandwidth 6.25kHz, low power, 1GHz – 6GHz:



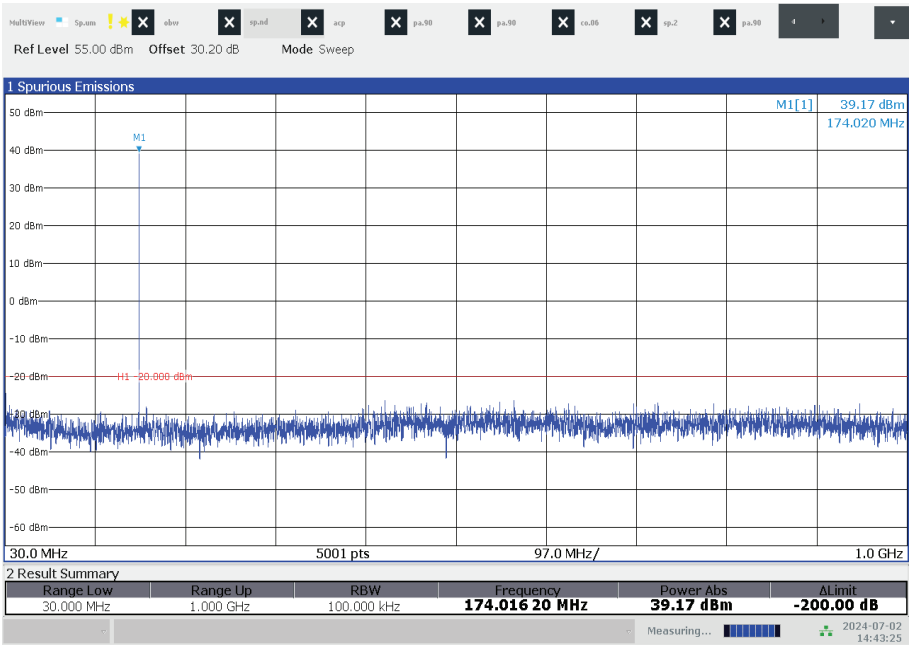
Plot 3: middle channel, bandwidth 6.25kHz, low power, 30MHz – 1GHz:



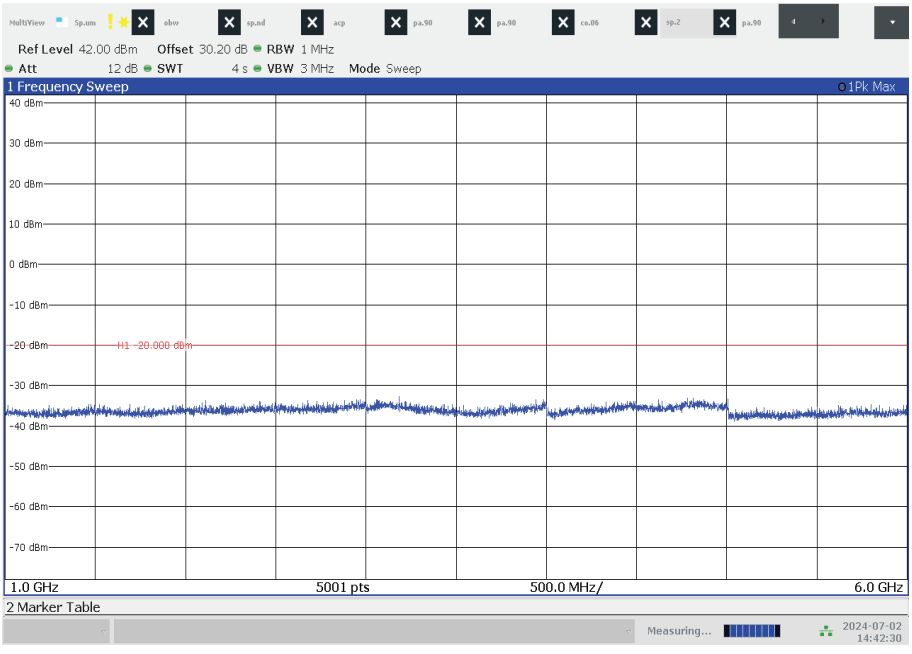
Plot 4: middle channel, bandwidth 6.25kHz, low power, 1GHz – 6GHz:



Plot 5: high channel, bandwidth 6.25kHz, low power, 30MHz – 1GHz:

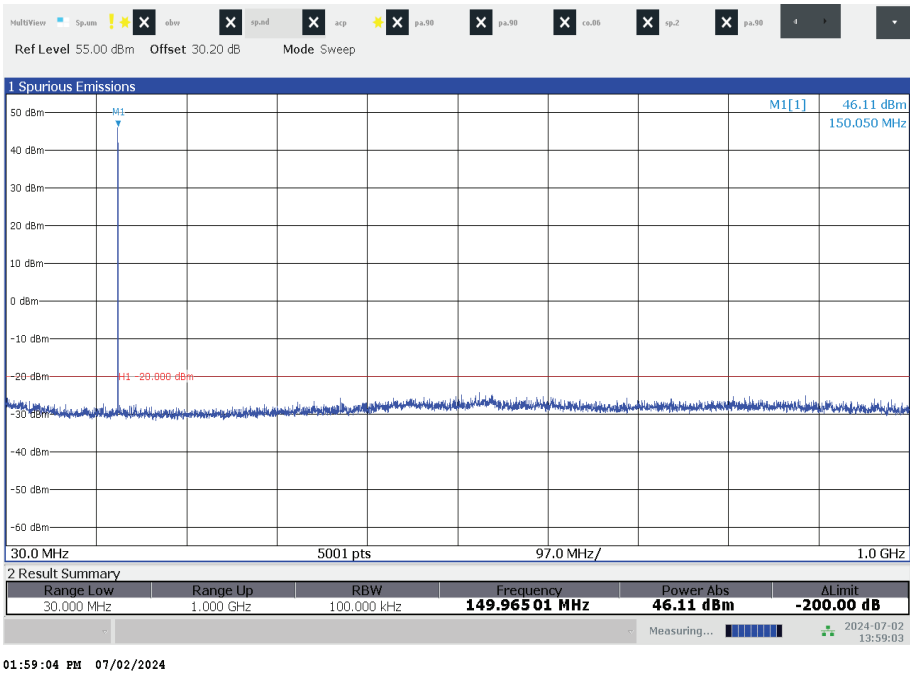


Plot 6: high channel, bandwidth 6.25kHz, low power, 1GHz – 6GHz:

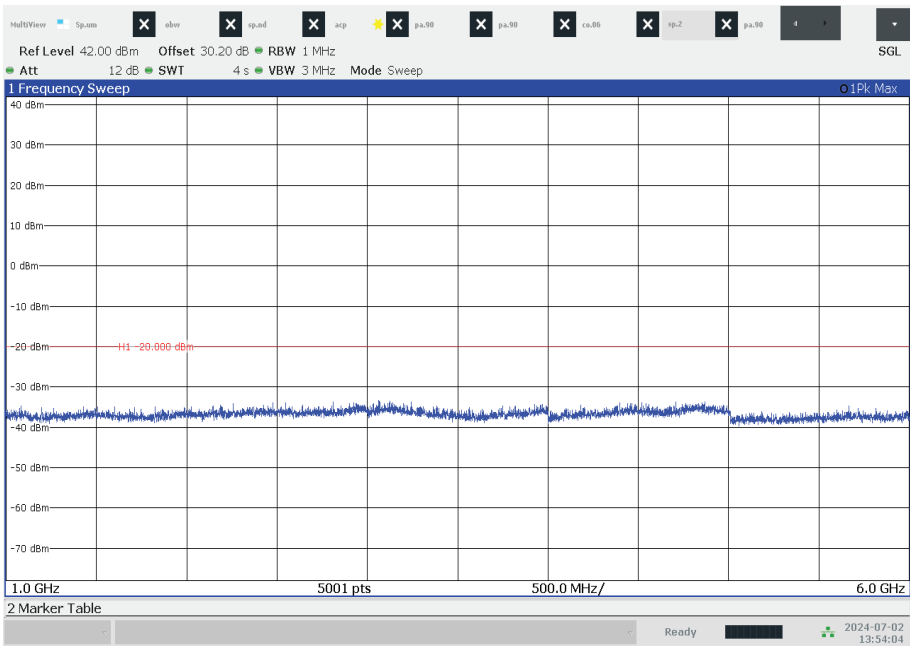


Plots of the measurements with high power setting (50W)

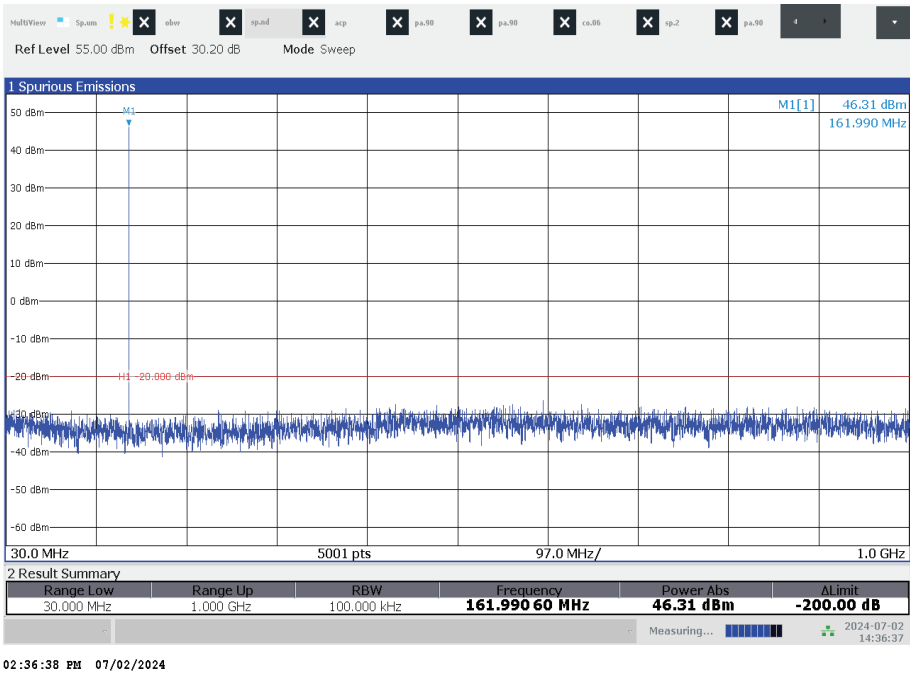
Plot 1: low channel, bandwidth 6.25 kHz, high power, 30MHz – 1GHz:



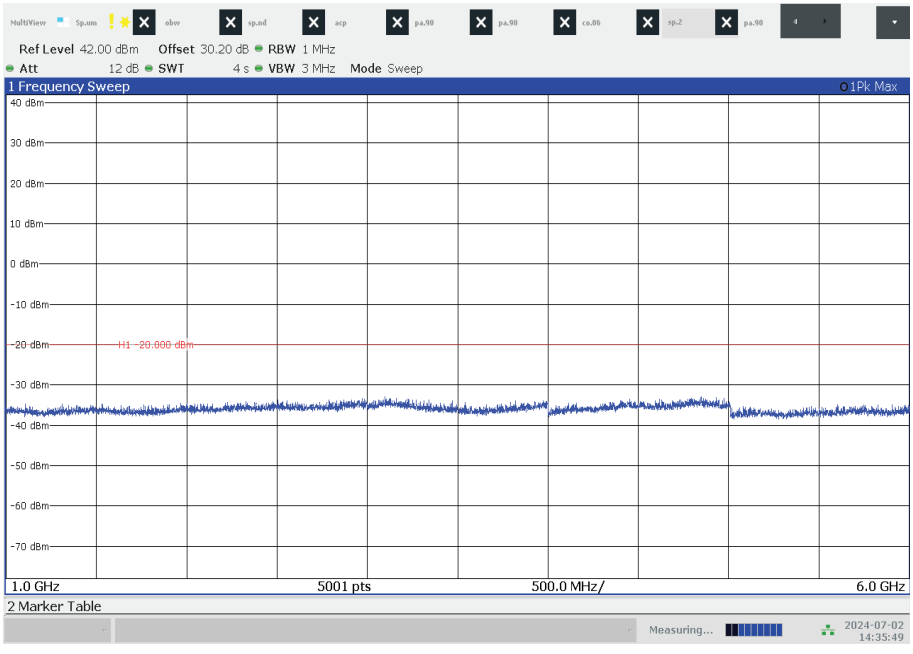
Plot 2: low channel, bandwidth 6.25 kHz, high power, 1GHz – 6GHz:



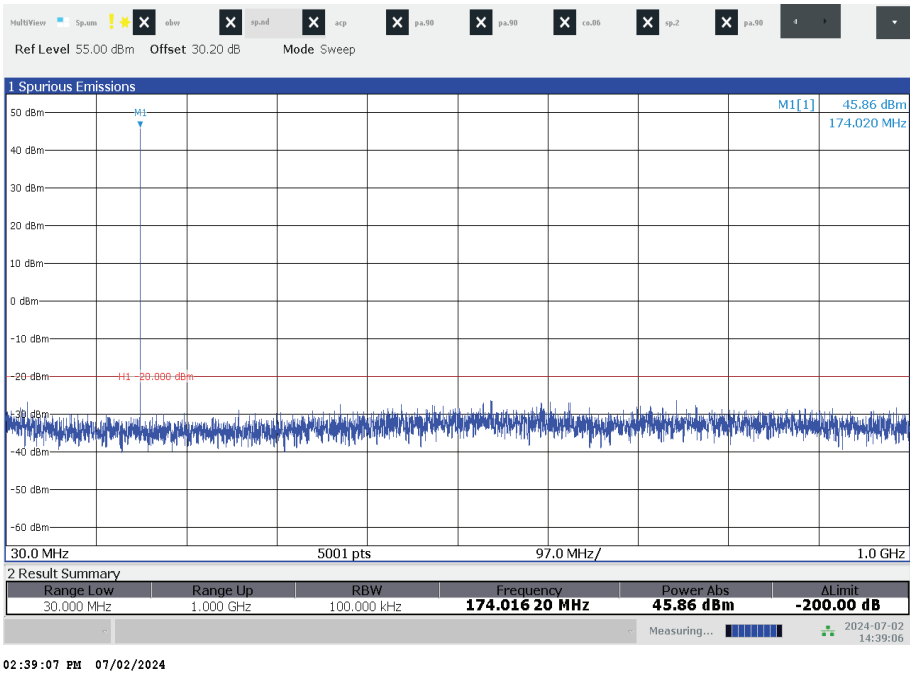
Plot 3: middle channel, bandwidth 6.25 kHz, high power, 30MHz – 1GHz:



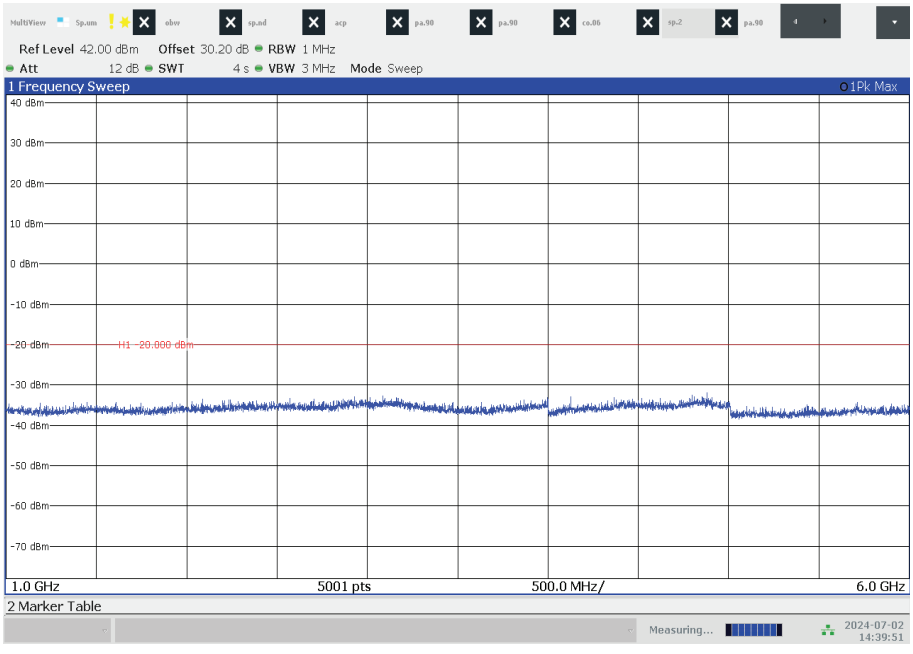
Plot 4: middle channel, bandwidth 6.25 kHz, high power, 1GHz – 6GHz:



Plot 5: high channel, bandwidth 6.25 kHz, high power, 30MHz – 1GHz:



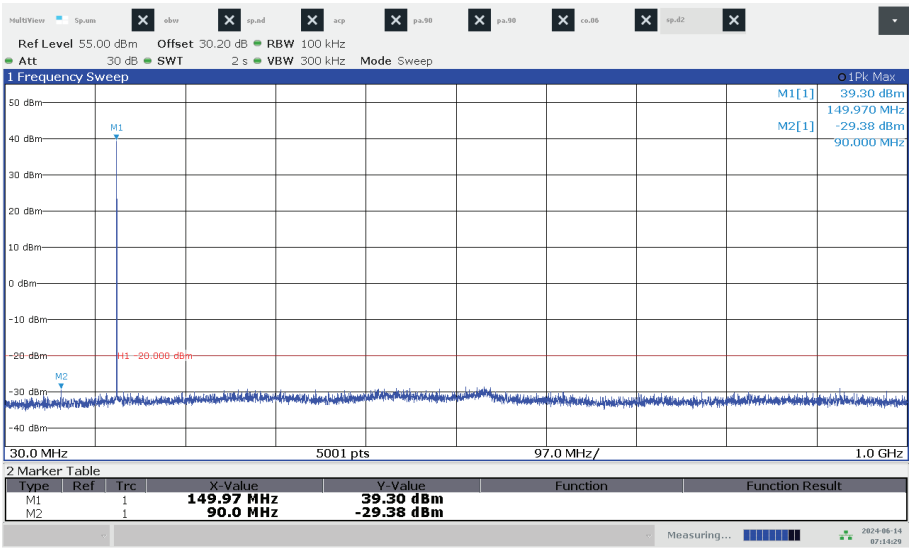
Plot 6: high channel, bandwidth 6.25 kHz, high power, 1GHz – 6GHz:



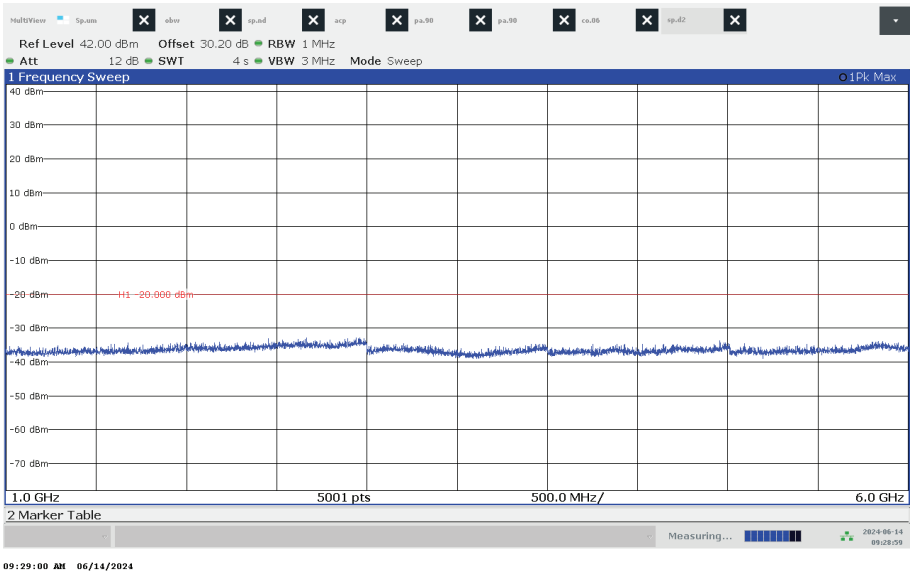
13.7.2 Plots 12.5 kHz bandwidth

Plots of the measurements with low power setting (10W)

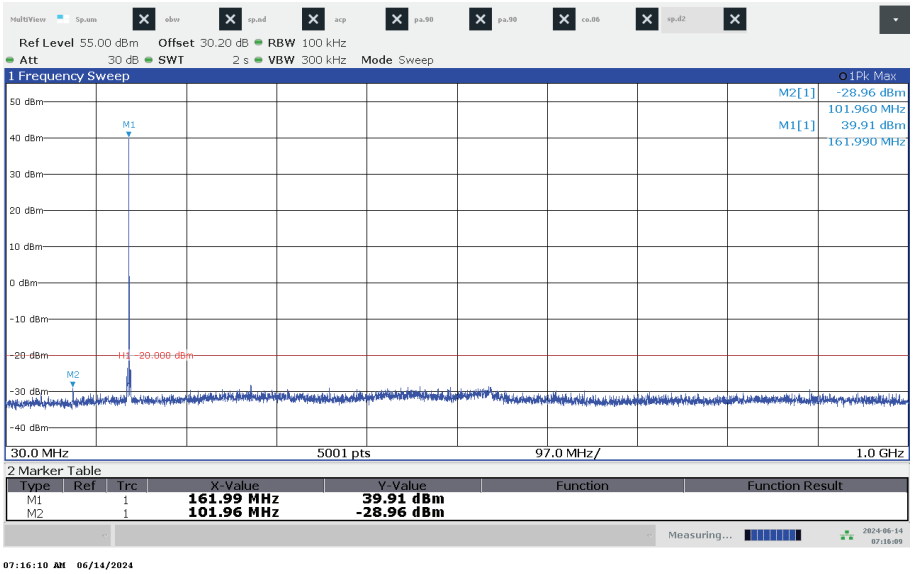
Plot 1: low channel, bandwidth 12.5kHz, low power, 30MHz – 1GHz:



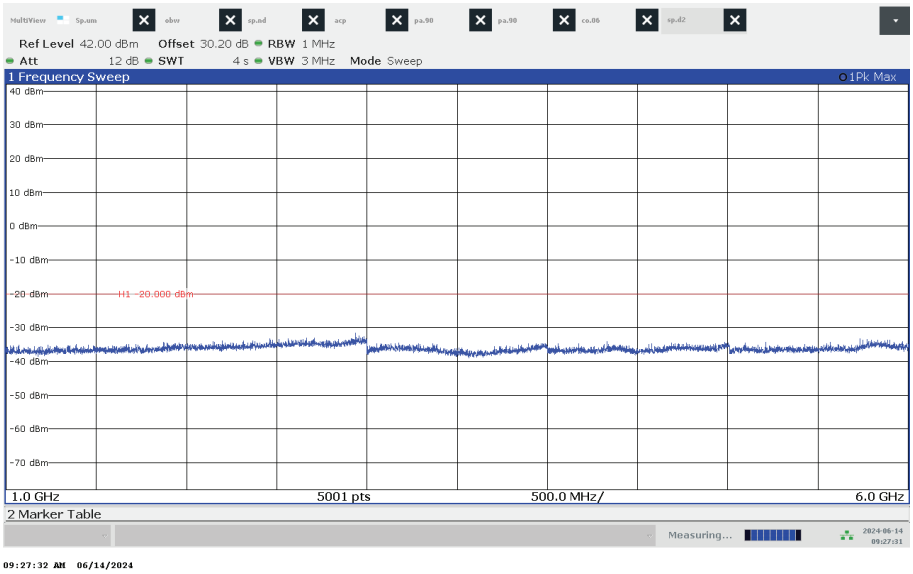
Plot 2: low channel, bandwidth 12.5kHz, low power, 1GHz – 6GHz:



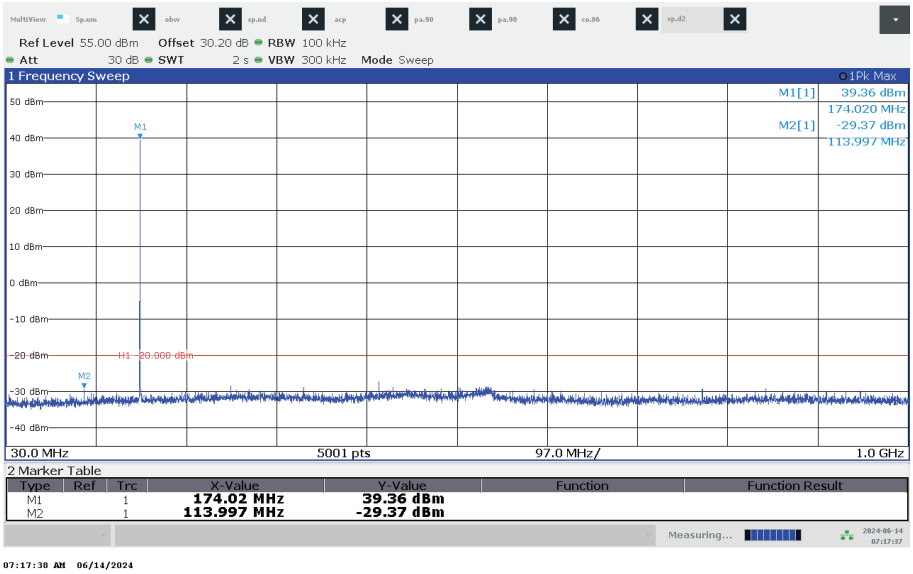
Plot 3: middle channel, bandwidth 12.5kHz, low power, 30MHz – 1GHz:



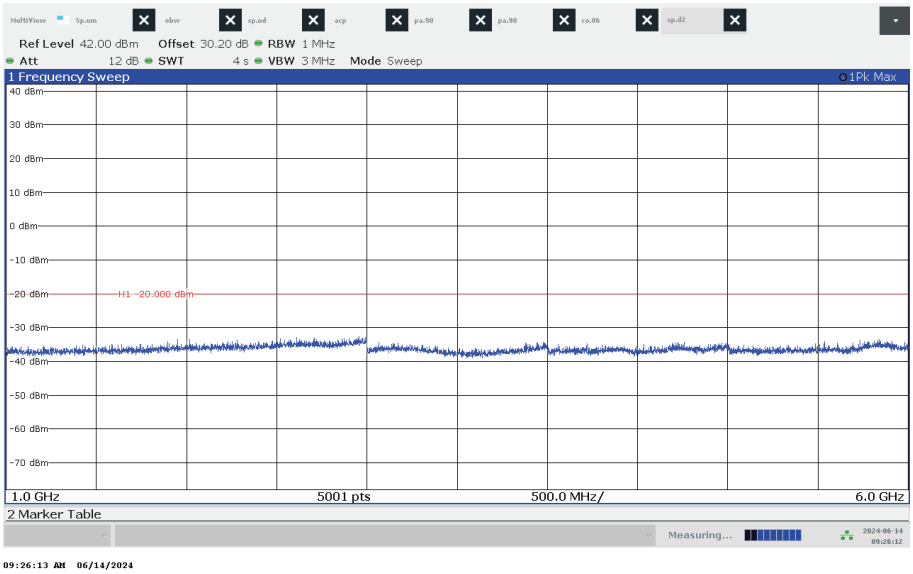
Plot 4: middle channel, bandwidth 12.5kHz, low power, 1GHz – 6GHz:



Plot 5: high channel, bandwidth 12.5kHz, low power, 30MHz – 1GHz:

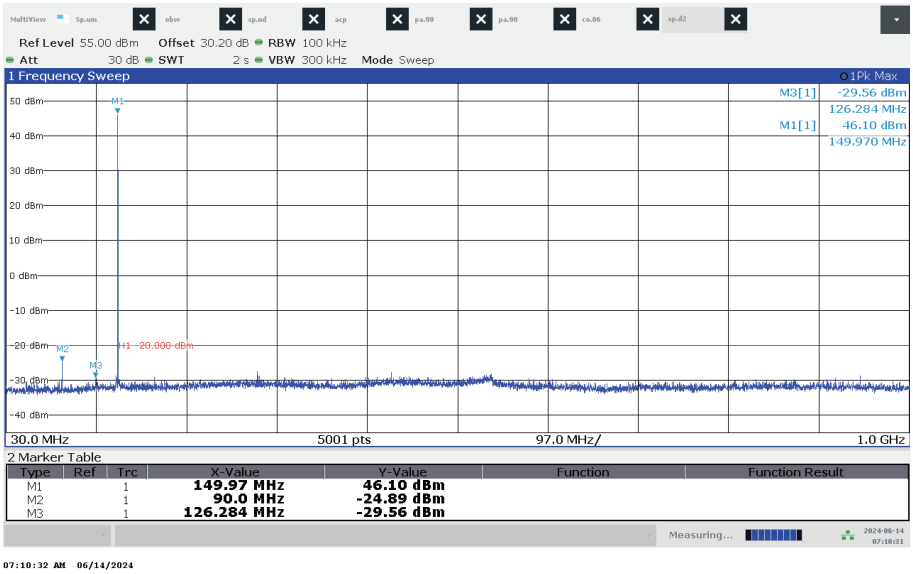


Plot 6: high channel, bandwidth 12.5kHz, low power, 1GHz – 6GHz:

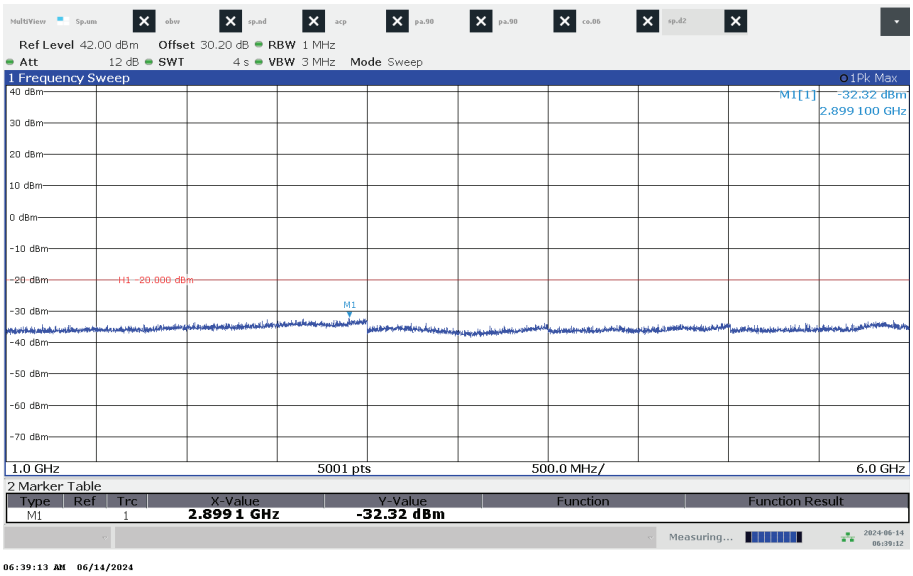


Plots of the measurements with high power setting (50W)

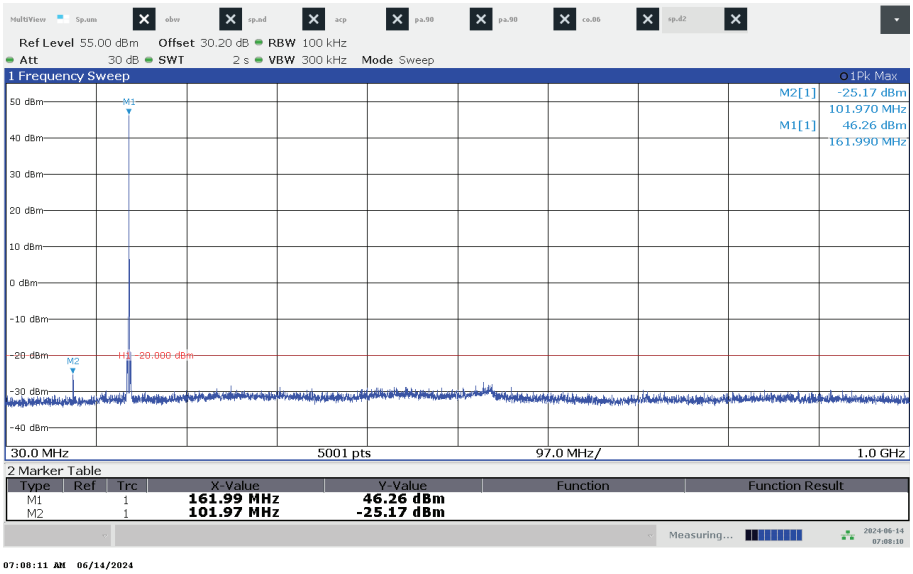
Plot 1: low channel, bandwidth 12.5kHz, high power, 30MHz – 1GHz:



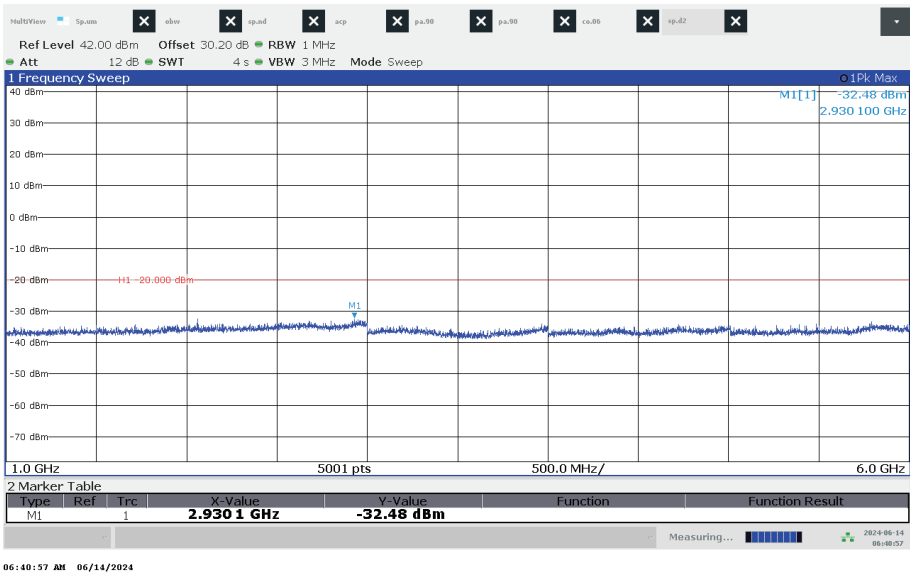
Plot 2: low channel, bandwidth 12.5kHz, high power, 1GHz – 6GHz:



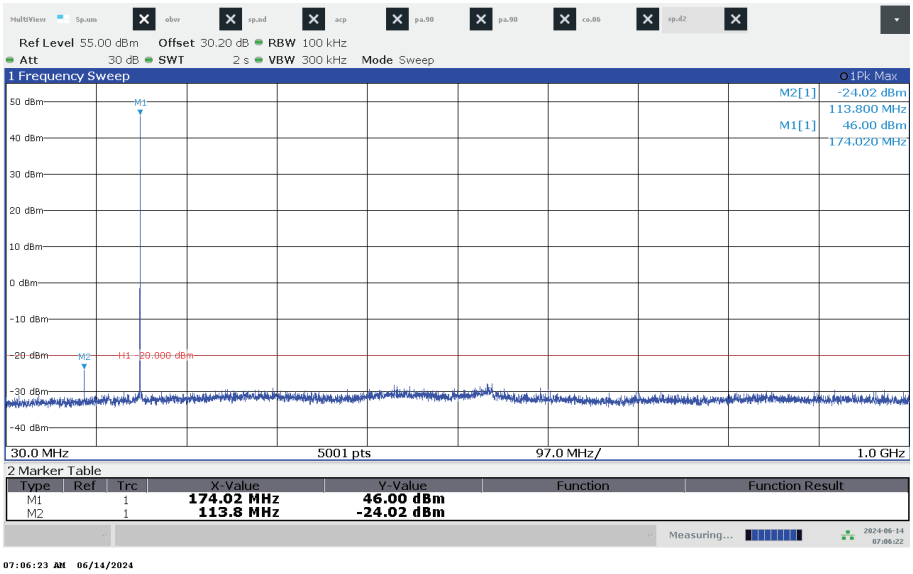
Plot 3: middle channel, bandwidth 12.5kHz, high power, 30MHz – 1GHz:



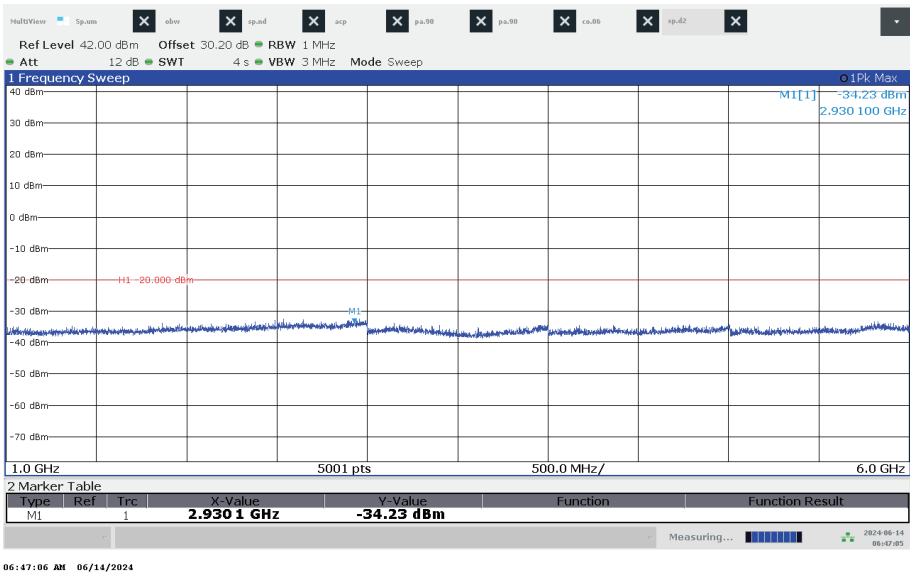
Plot 4: middle channel, bandwidth 12.5kHz, high power, 1GHz – 6GHz:



Plot 5: high channel, bandwidth 12.5kHz, high power, 30MHz – 1GHz:



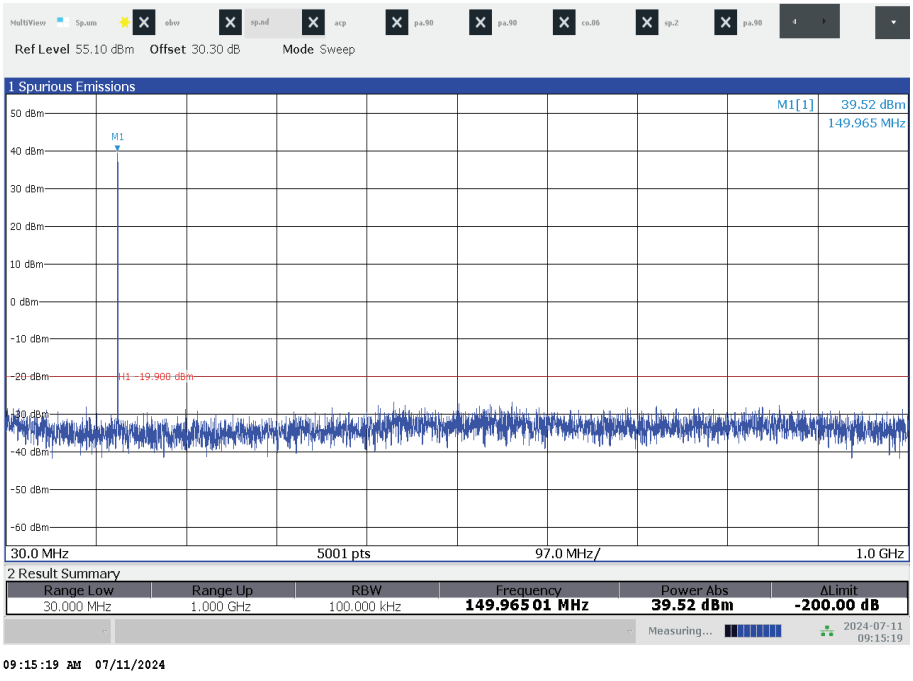
Plot 6: high channel, bandwidth 12.5kHz, high power, 1GHz – 6GHz:



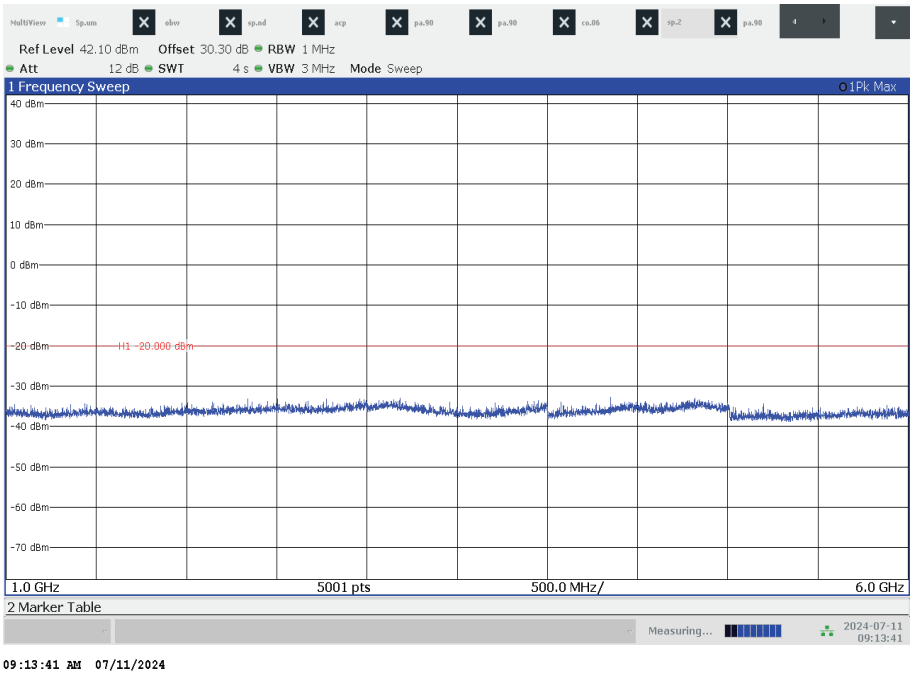
13.7.3 Plots 20 kHz bandwidth

Plots of the measurements with low power setting (10W)

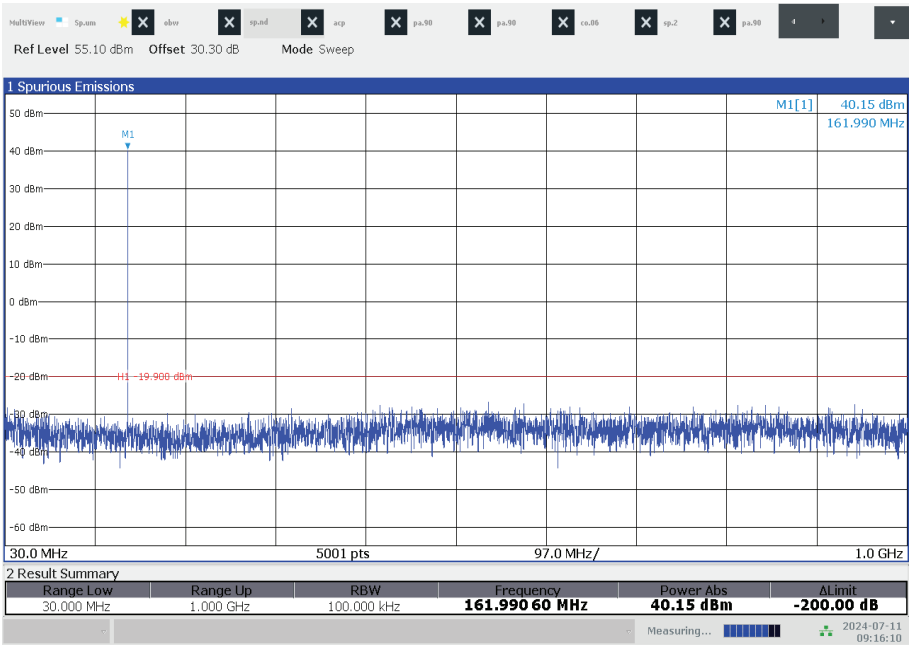
Plot 1: low channel, bandwidth 20kHz, low power, 30MHz – 1GHz:



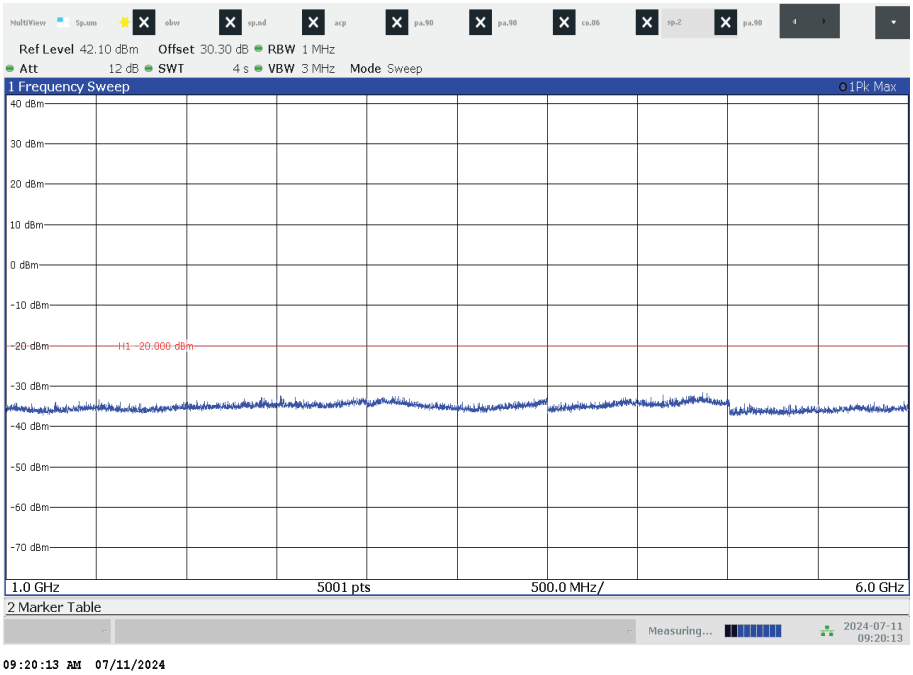
Plot 2: low channel, bandwidth 20kHz, low power, 1GHz – 6GHz:



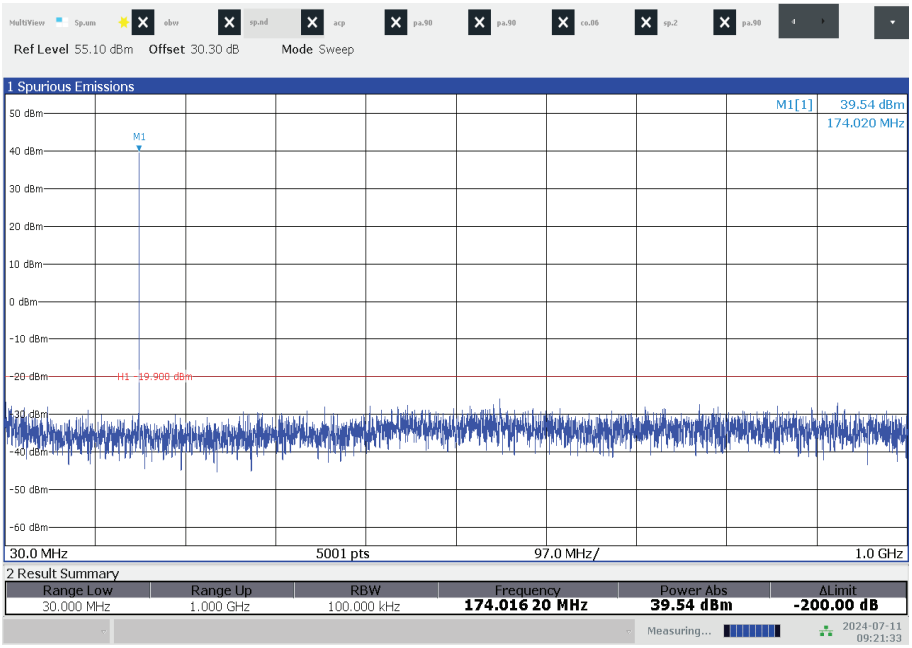
Plot 3: middle channel, bandwidth 20kHz, low power, 30MHz – 1GHz:



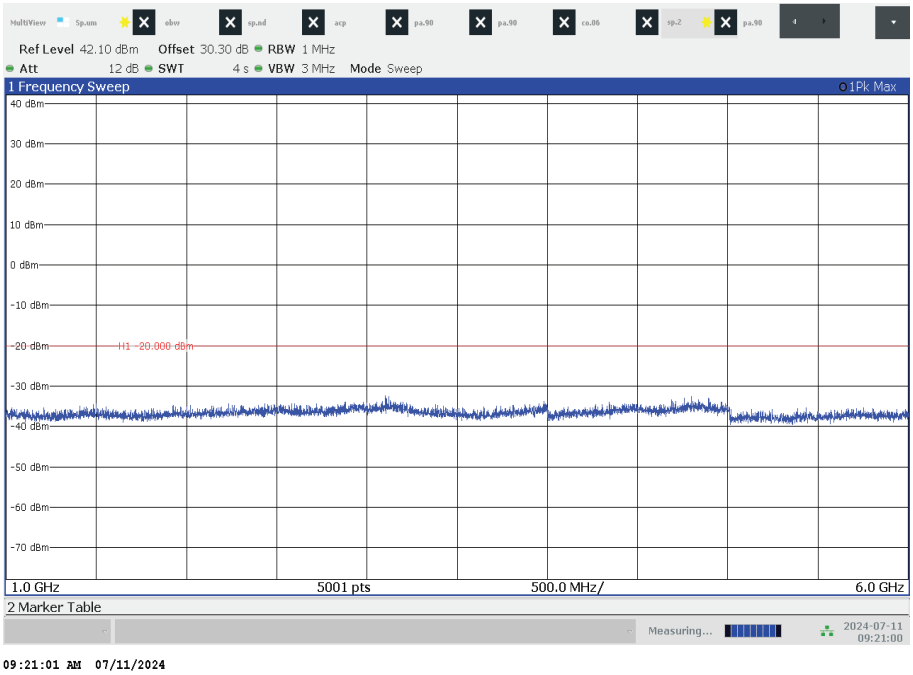
Plot 4: middle channel, bandwidth 20kHz, low power, 1GHz – 6GHz:



Plot 5: high channel, bandwidth 20kHz, low power, 30MHz – 1GHz:

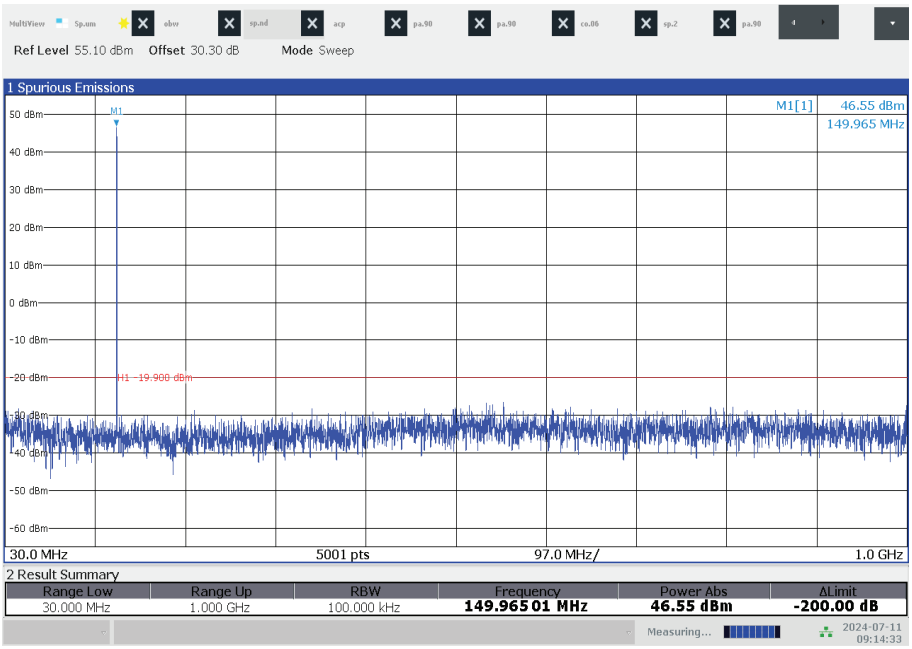


Plot 6: high channel, bandwidth 20kHz, low power, 1GHz – 6GHz:

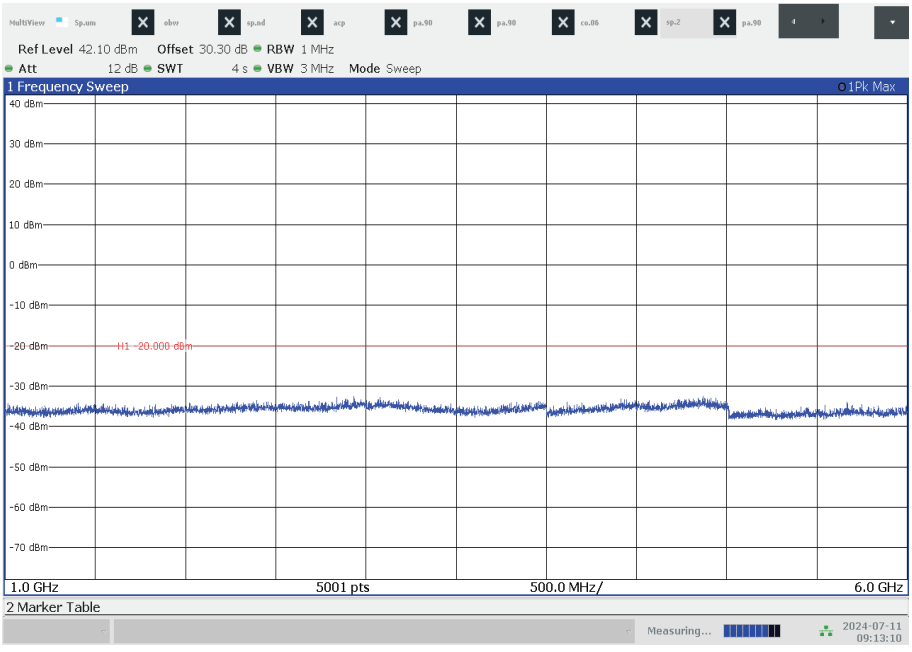


Plots of the measurements with low power setting (50W)

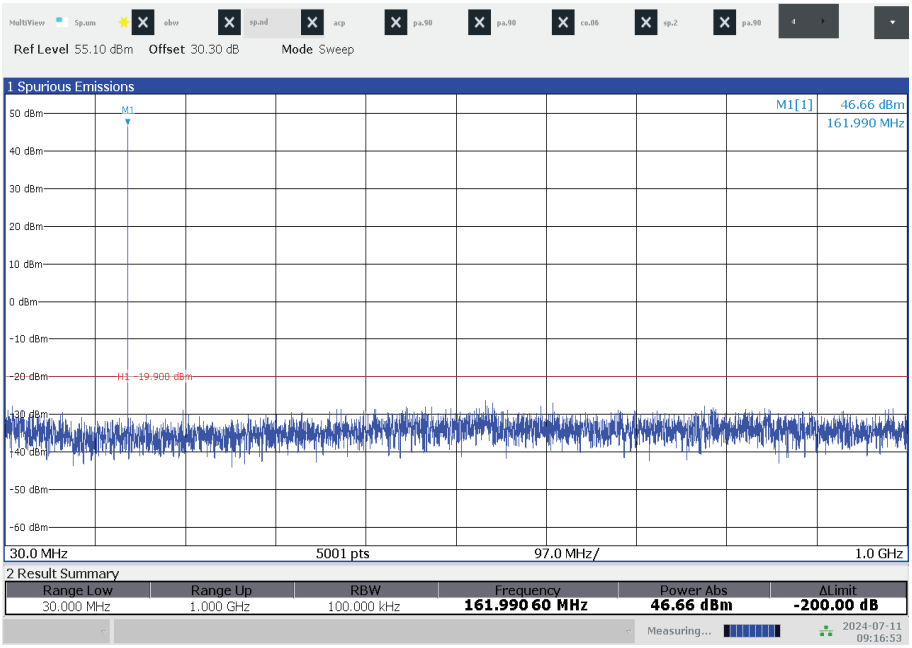
Plot 1: low channel, bandwidth 20kHz, high power, 30MHz – 1GHz:



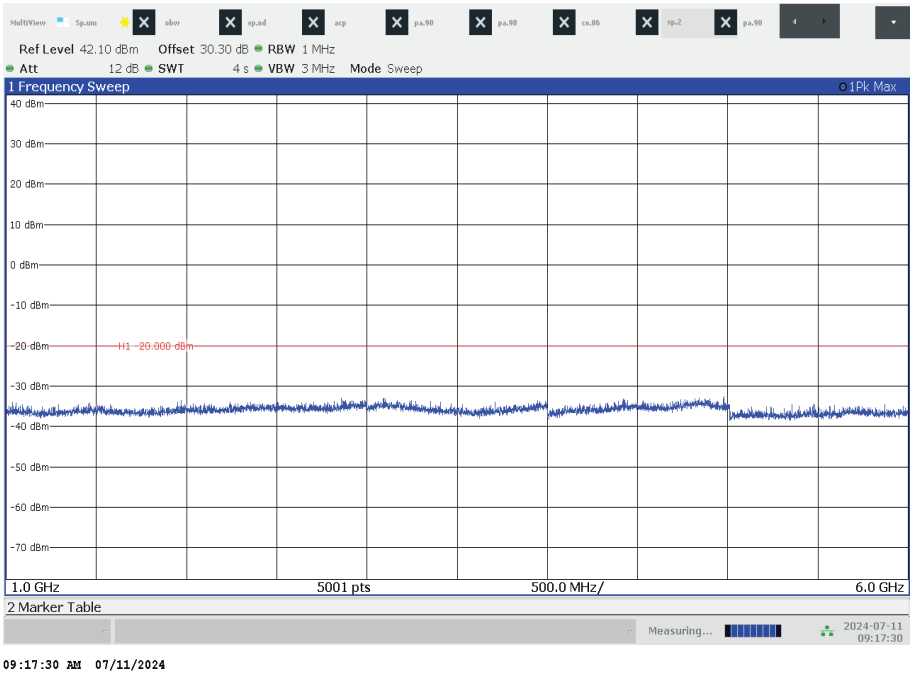
Plot 2: low channel, bandwidth 20kHz, high power, 1GHz – 6GHz:



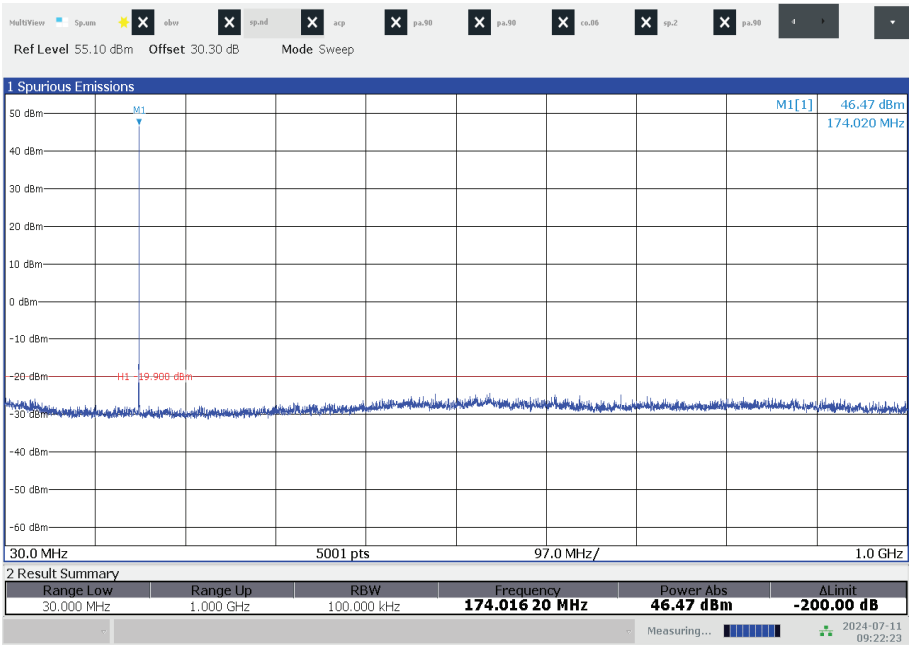
Plot 3: middle channel, bandwidth 20kHz, high power, 30MHz – 1GHz:



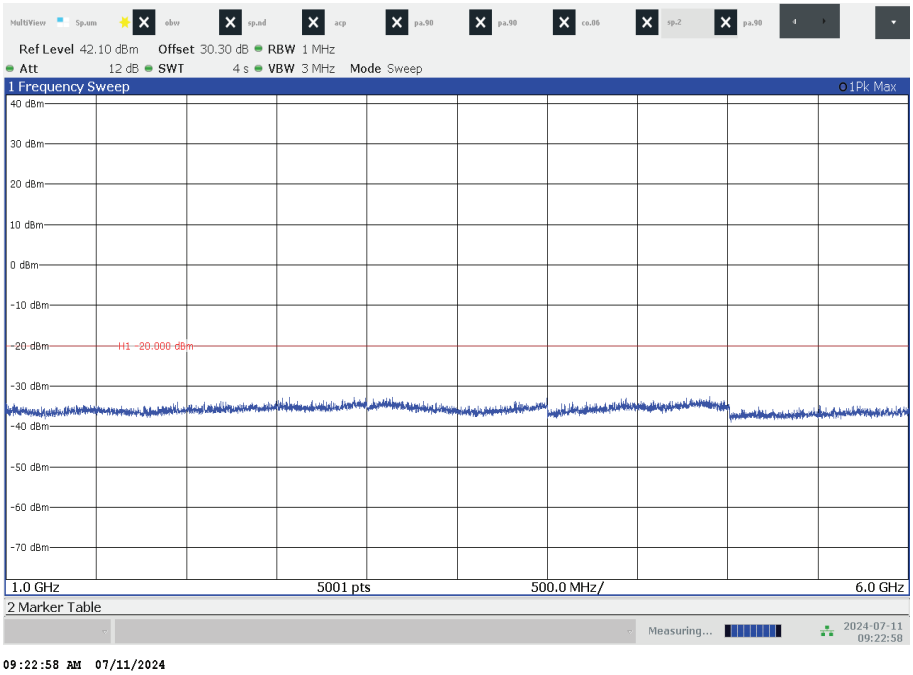
Plot 4: middle channel, bandwidth 20kHz, high power, 1GHz – 6GHz:



Plot 5: high channel, bandwidth 20kHz, high power, 30MHz – 1GHz:



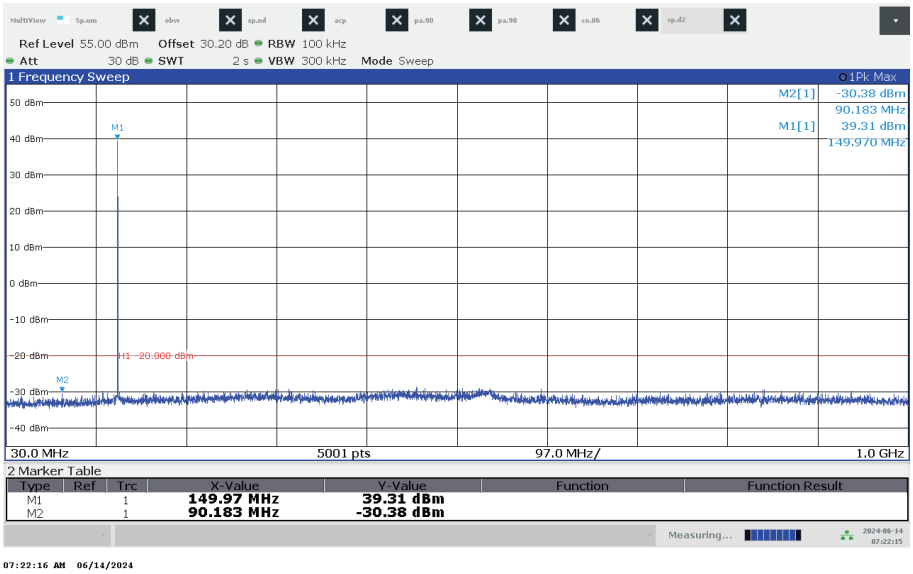
Plot 6: high channel, bandwidth 20kHz, high power, 1GHz – 6GHz:



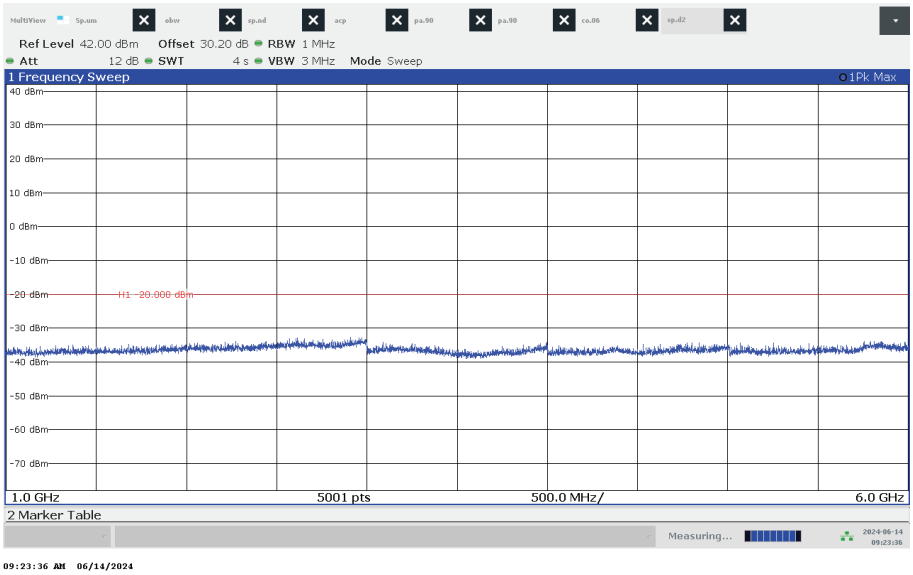
13.7.4 Plots 25 kHz bandwidth

Plots of the measurements with low power setting (10W)

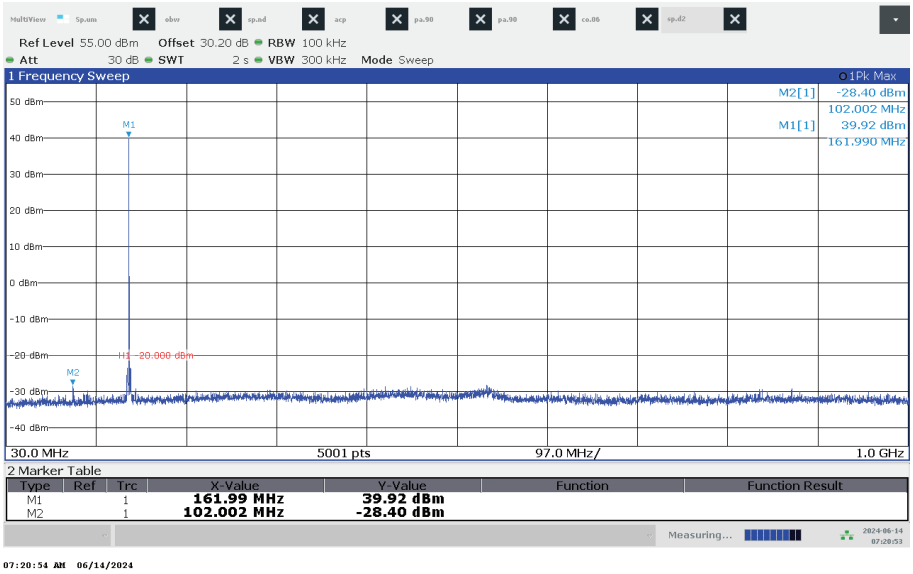
Plot 1: low channel, bandwidth 25kHz, low power, 30MHz – 1GHz:



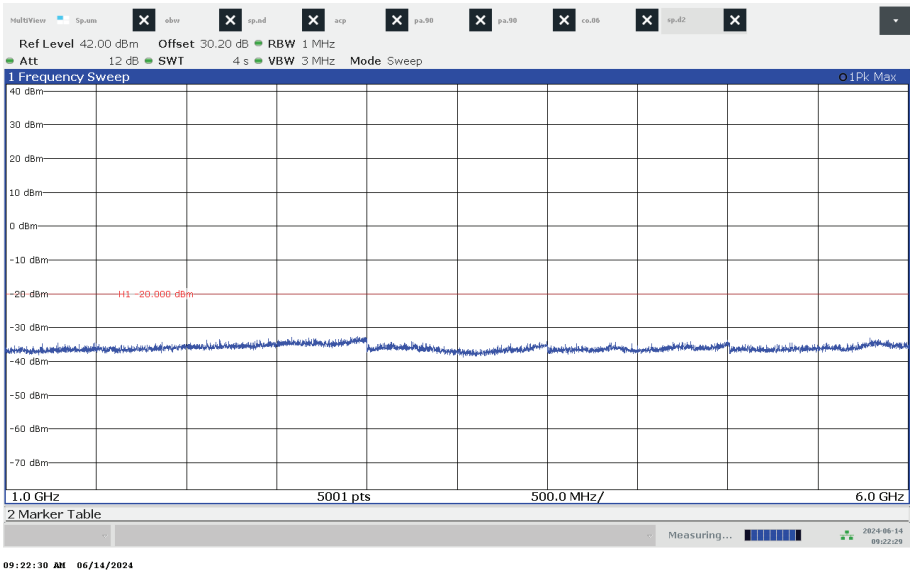
Plot 2: low channel, bandwidth 25kHz, low power, 1GHz – 6GHz:



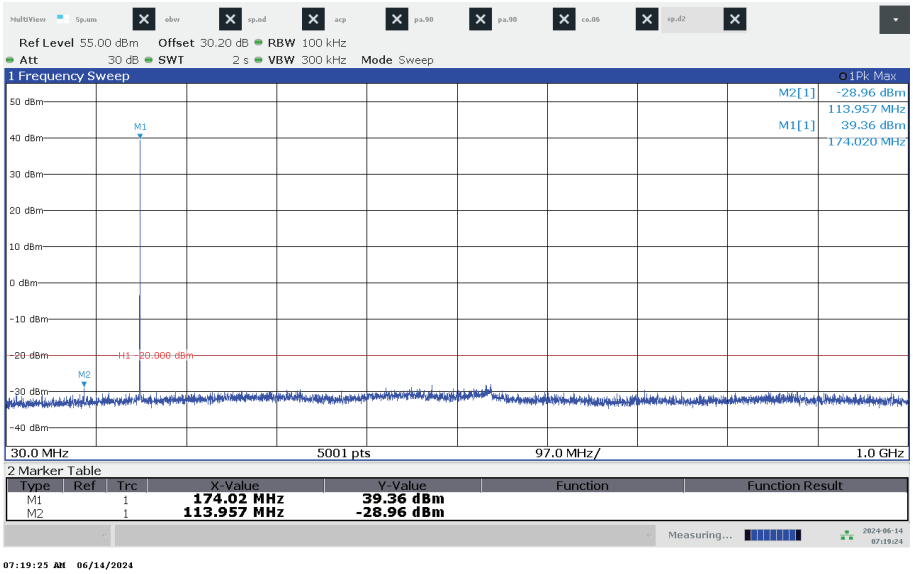
Plot 3: middle channel, bandwidth 25kHz, low power, 30MHz – 1GHz:



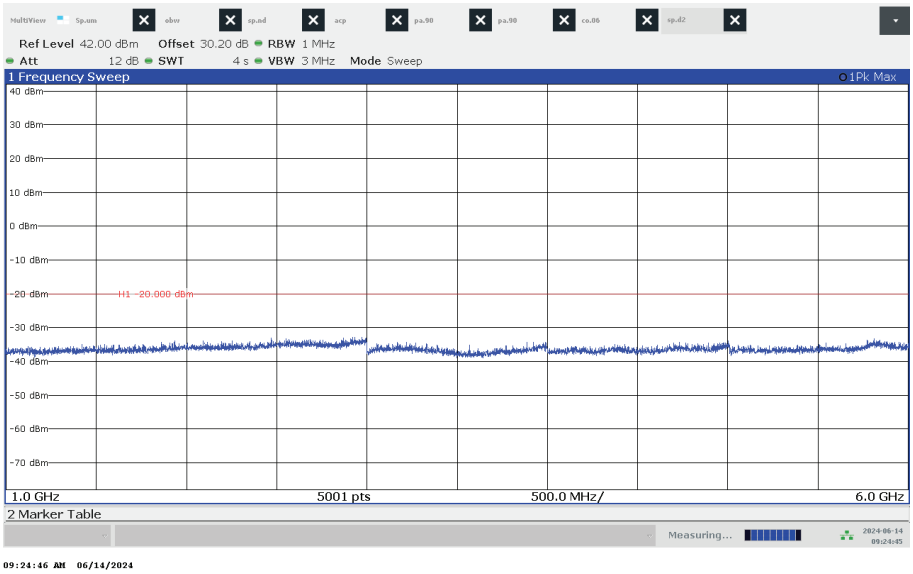
Plot 4: middle channel, bandwidth 25kHz, low power, 1GHz – 6GHz:



Plot 5: high channel, bandwidth 25kHz, low power, 30MHz – 1GHz:

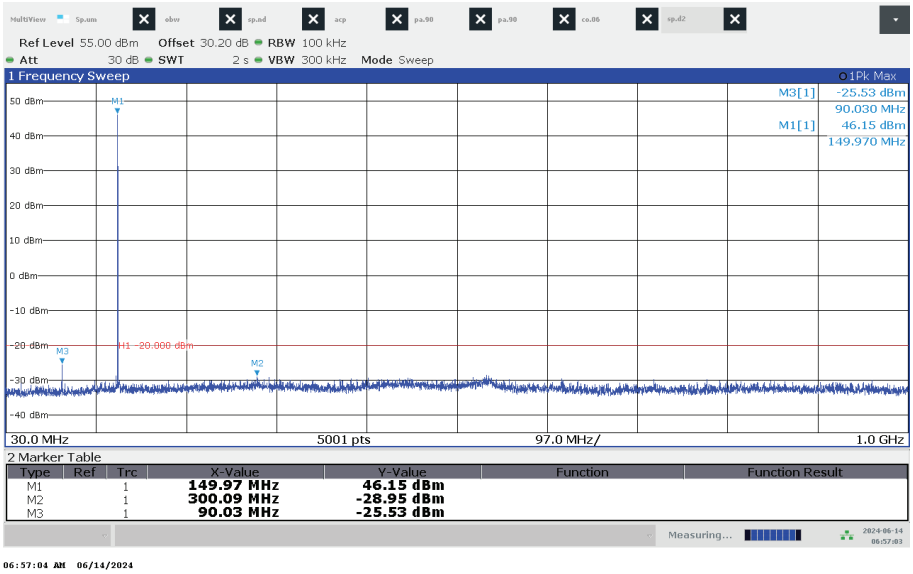


Plot 6: high channel, bandwidth 25kHz, low power, 1GHz – 6GHz:

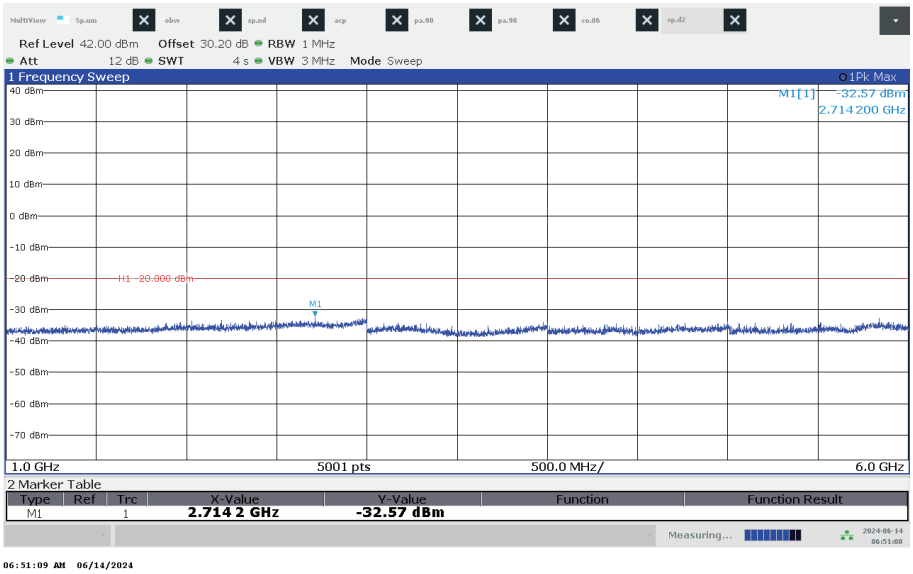


Plots of the measurements with high power setting (50W)

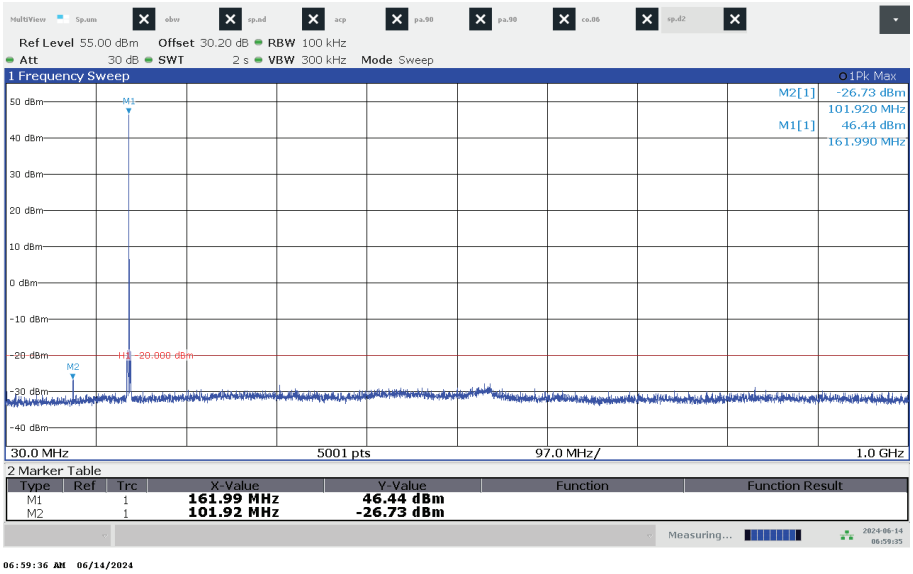
Plot 1: low channel, bandwidth 25kHz, high power, 30MHz – 1GHz:



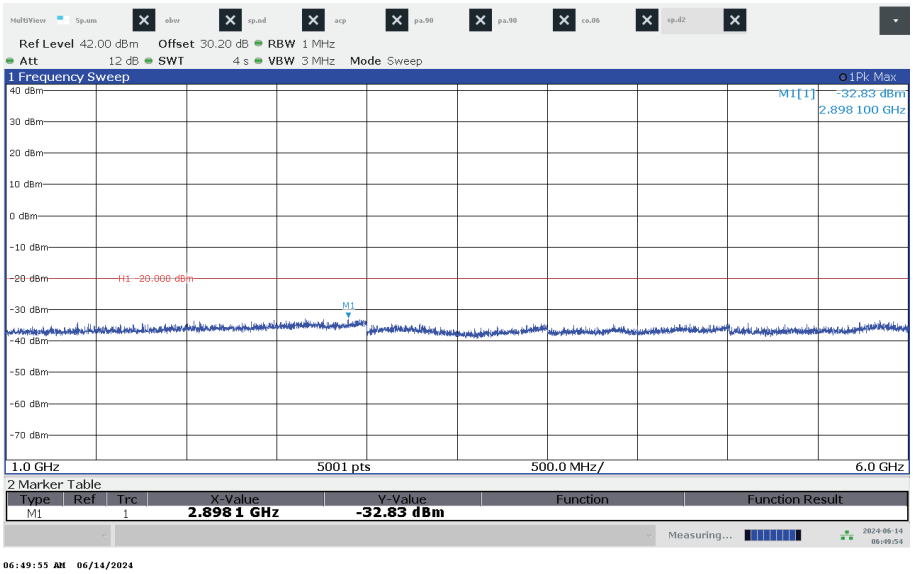
Plot 2: low channel, bandwidth 25kHz, high power, 1GHz – 6GHz:



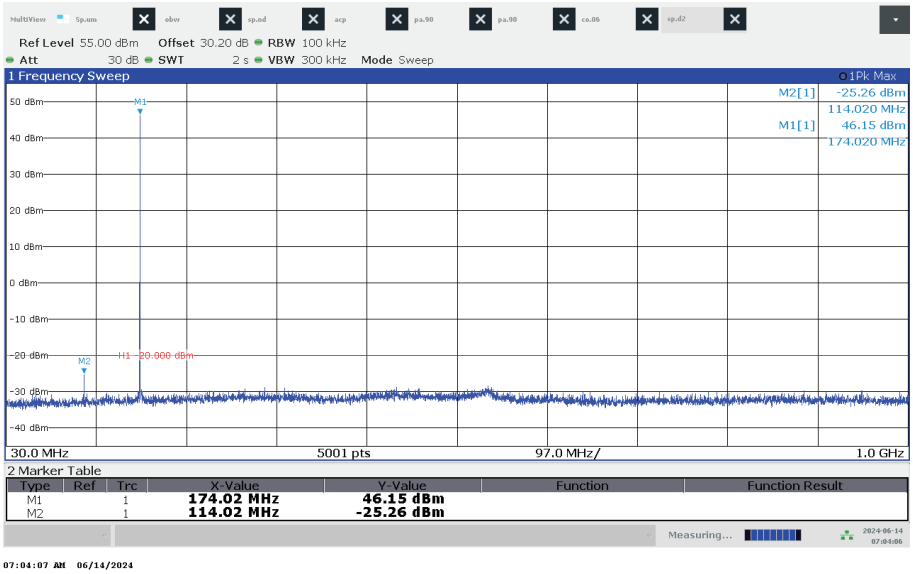
Plot 3: middle channel, bandwidth 25kHz, high power, 30MHz – 1GHz:



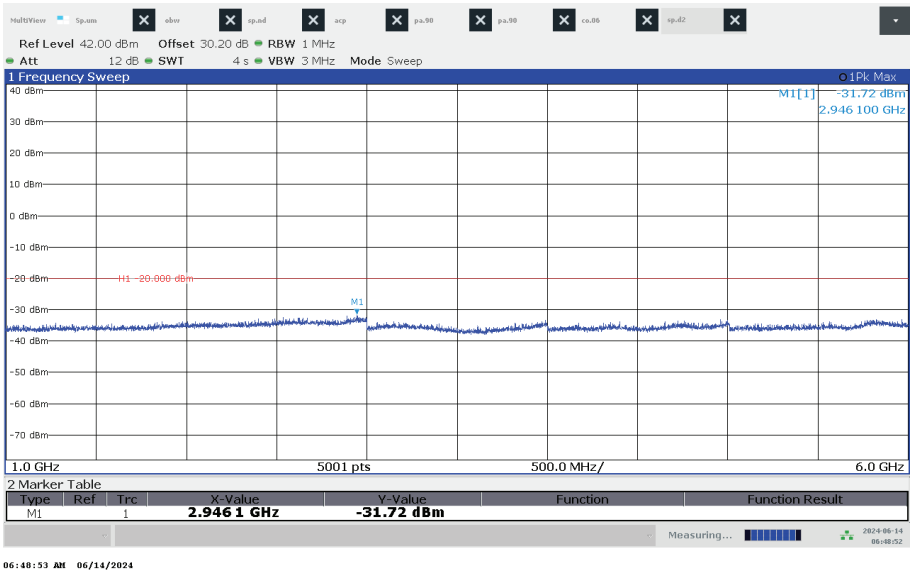
Plot 4: middle channel, bandwidth 25kHz, high power, 1GHz – 6GHz:



Plot 5: high channel, bandwidth 25kHz, high power, 30MHz – 1GHz:



Plot 6: high channel, bandwidth 25kHz, high power, 1GHz – 6GHz:



13.8 Transmitter spurious emissions (radiated)

Measurement:

Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Resolution bandwidth:	f < 1 GHz : 100 kHz f ≥ 1GHz : 1 MHz
Video bandwidth:	f < 1 GHz : 100 kHz f ≥ 1GHz : 1 MHz
Span:	See plots
Trace-Mode:	Max. hold

Limits:

FCC	IC
FCC 47 CFR § 2.1051 § 90.210	RSS 119 Issue 12 5.8.9.2
Emission Mask D 12.5 kHz channel spacing $50 + 10\text{Log}_{10}(P_{Watts})$	

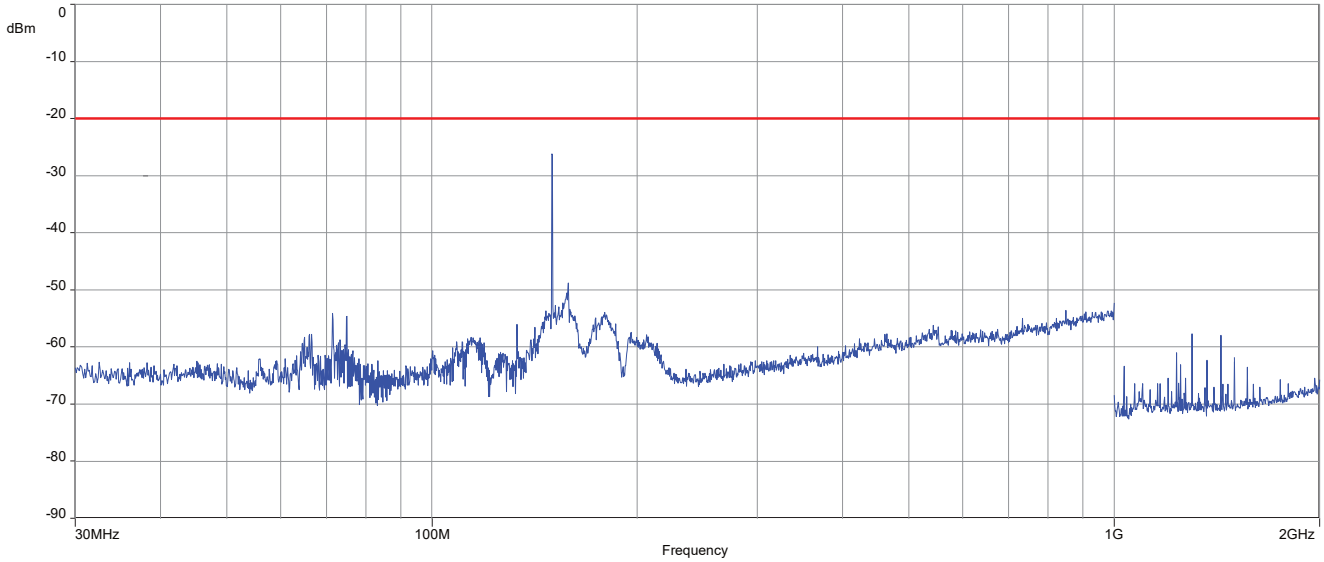
Results:

Transmitter spurious emissions (dBm)								
Lowest channel			Middle channel			Highest channel		
Frequency	Detector	Level	Frequency	Detector	Level	Frequency	Detector	Level
All detected spurious emissions are more than 10 dB below the limit.			All detected spurious emissions are more than 10 dB below the limit.			All detected spurious emissions are more than 10 dB below the limit.		

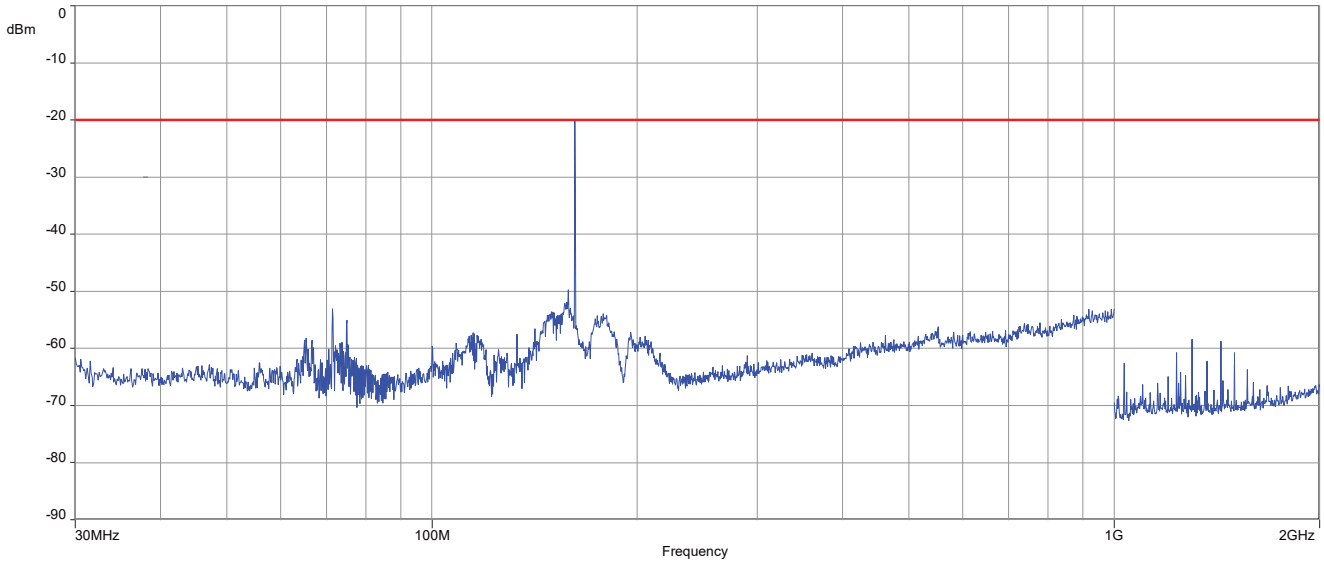
Plots of the measurements (measured with artificial antenna)

6.25 kHz Bandwidth, 10W

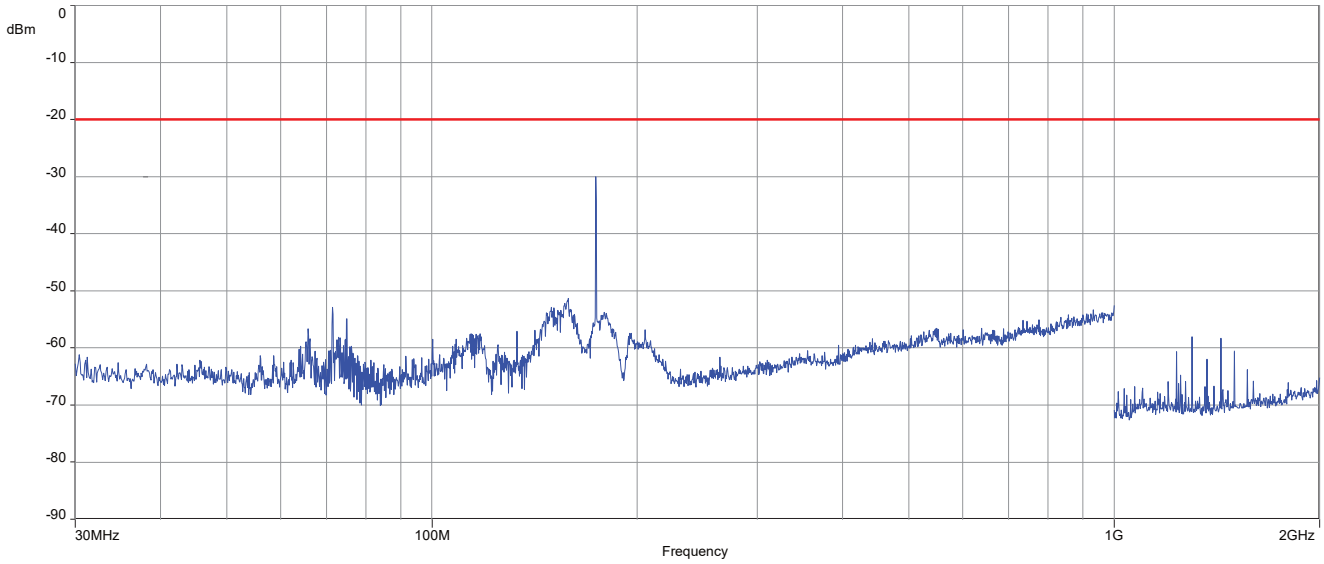
Plot 1: 30 MHz – 2 GHz, low channel, antenna vertical/horizontal, low power



Plot 2: 30 MHz – 2 GHz, middle channel, antenna vertical/horizontal, low power

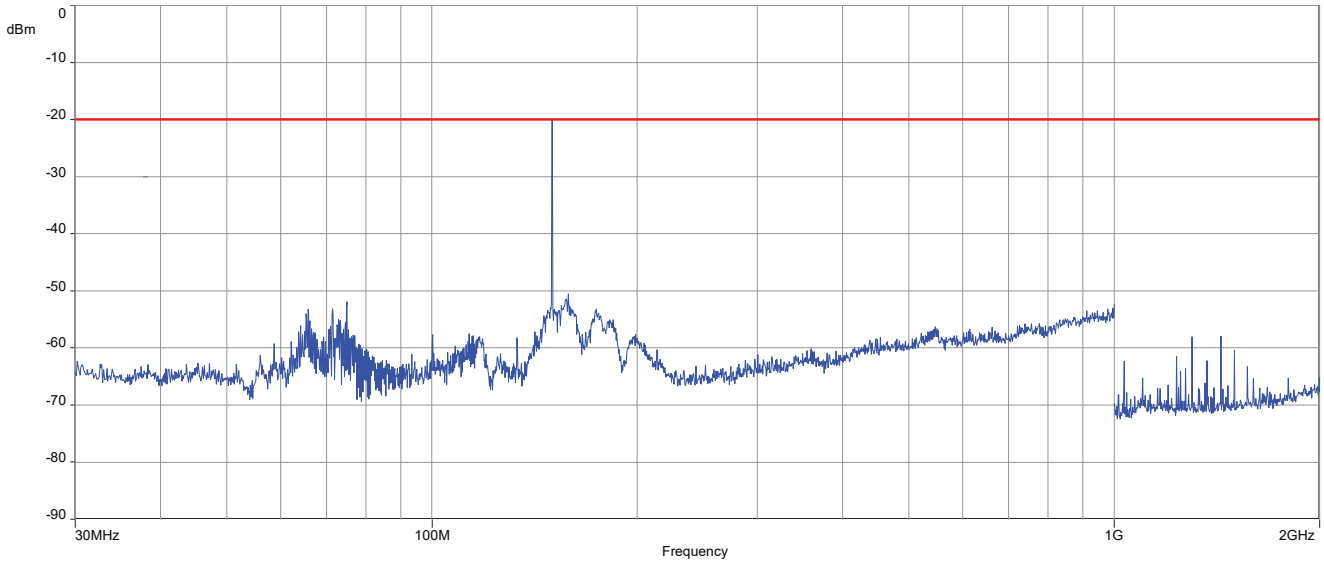


Plot 3: 30 MHz – 2 GHz, high channel, antenna vertical/horizontal, low power

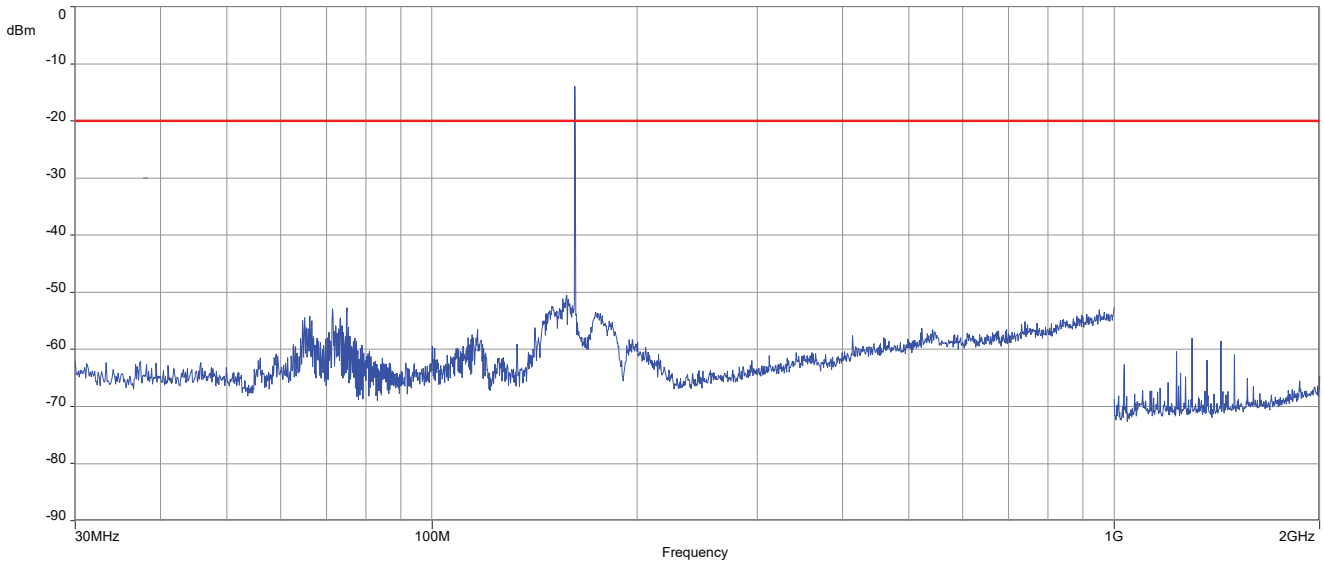


6.25 kHz Bandwidth, 50W

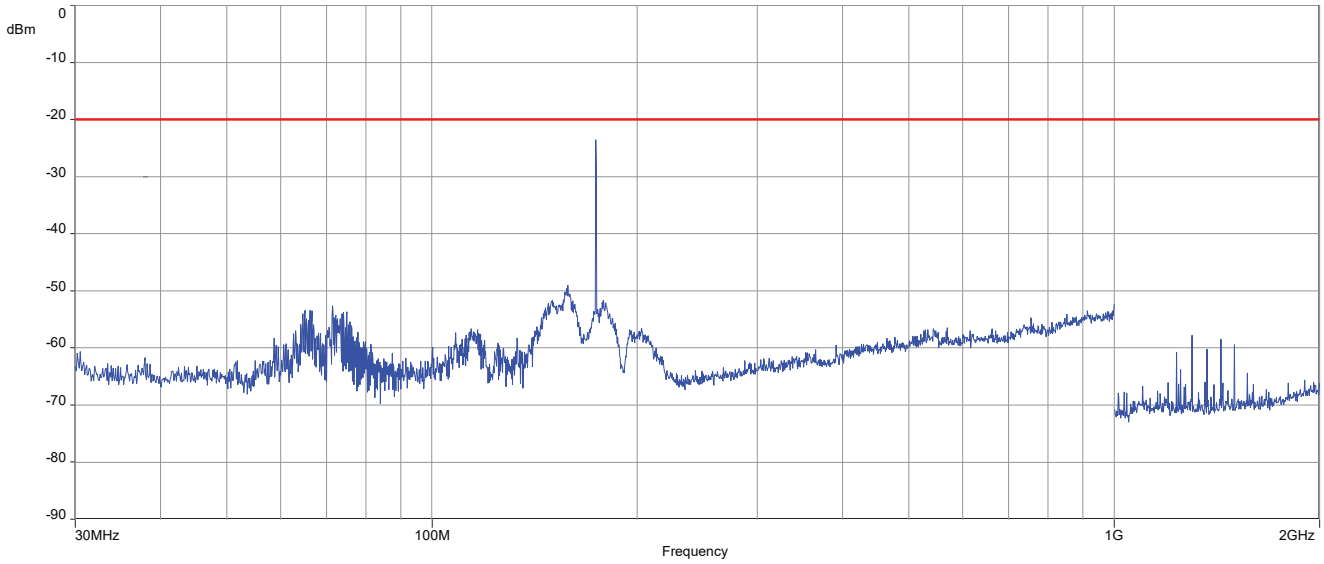
Plot 1: 30 MHz – 2 GHz, low channel, antenna vertical/horizontal, high power



Plot 2: 30 MHz – 2 GHz, middle channel, antenna vertical/horizontal, high power

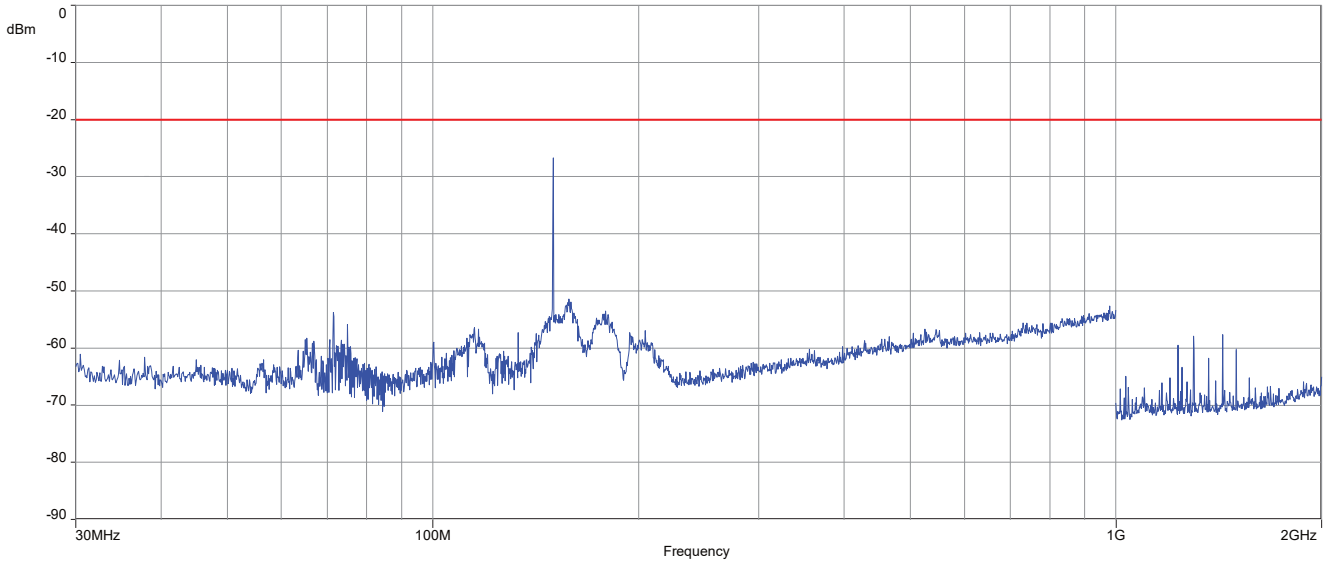


Plot 3: 30 MHz – 2 GHz, high channel, antenna vertical/horizontal, high power

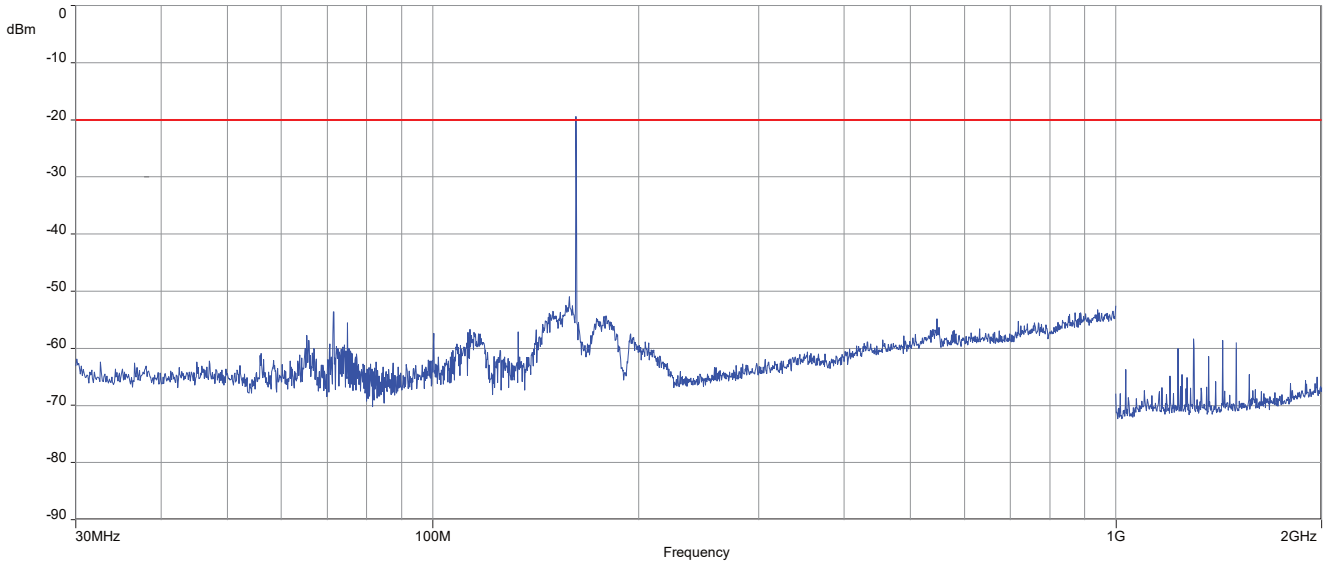


12.5 kHz Bandwidth, 10W

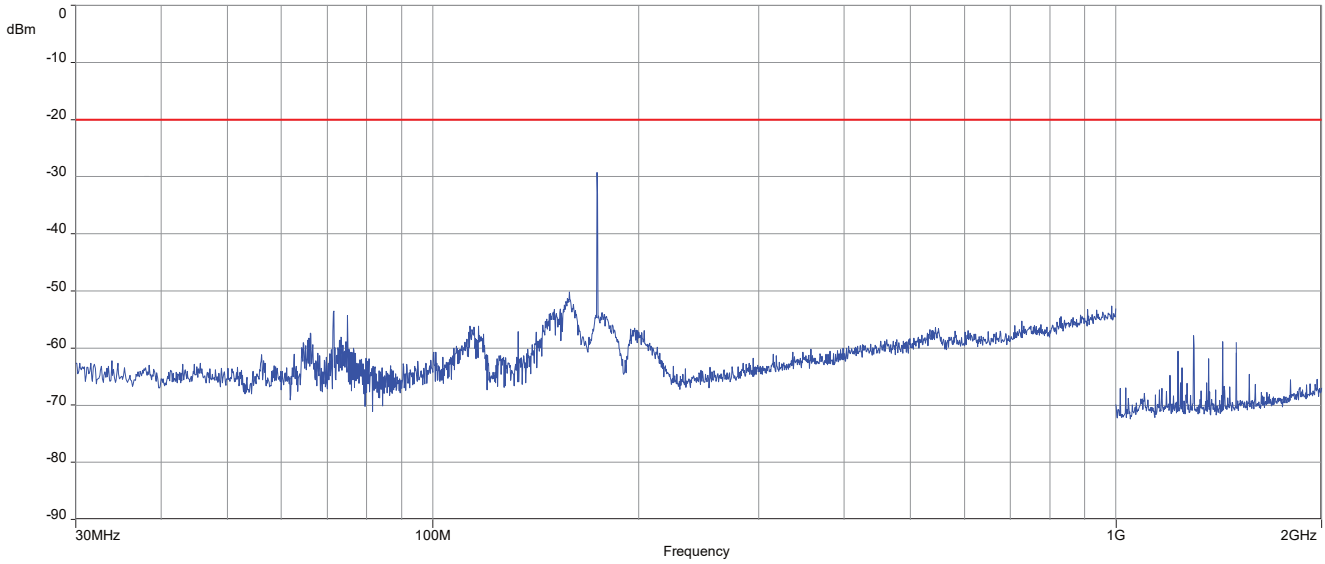
Plot 1: 30 MHz – 2 GHz, low channel, antenna vertical/horizontal, low power



Plot 2: 30 MHz – 2 GHz, middle channel, antenna vertical/horizontal, low power

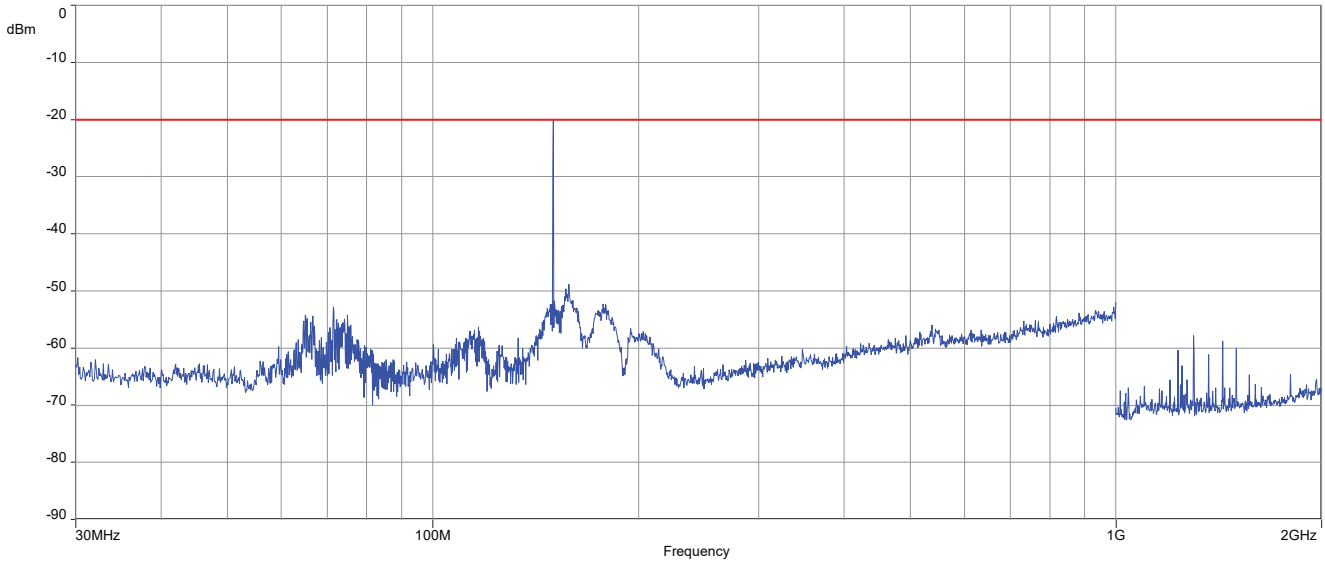


Plot 3: 30 MHz – 2 GHz, high channel, antenna vertical/horizontal, low power

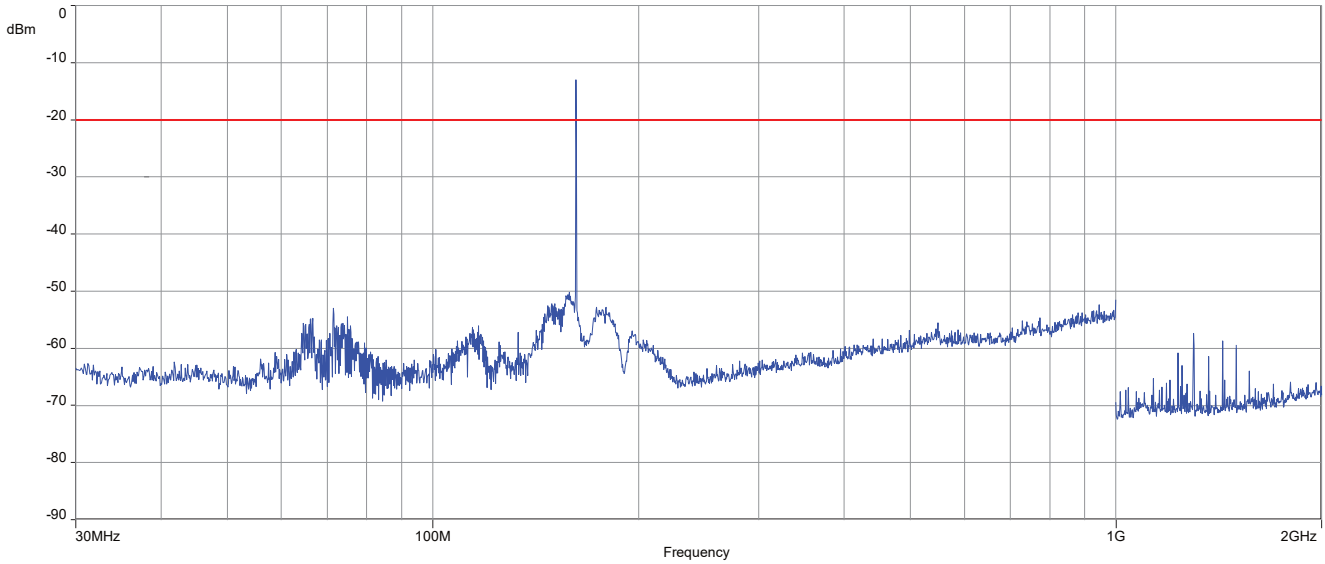


12.5 kHz Bandwidth, 50W

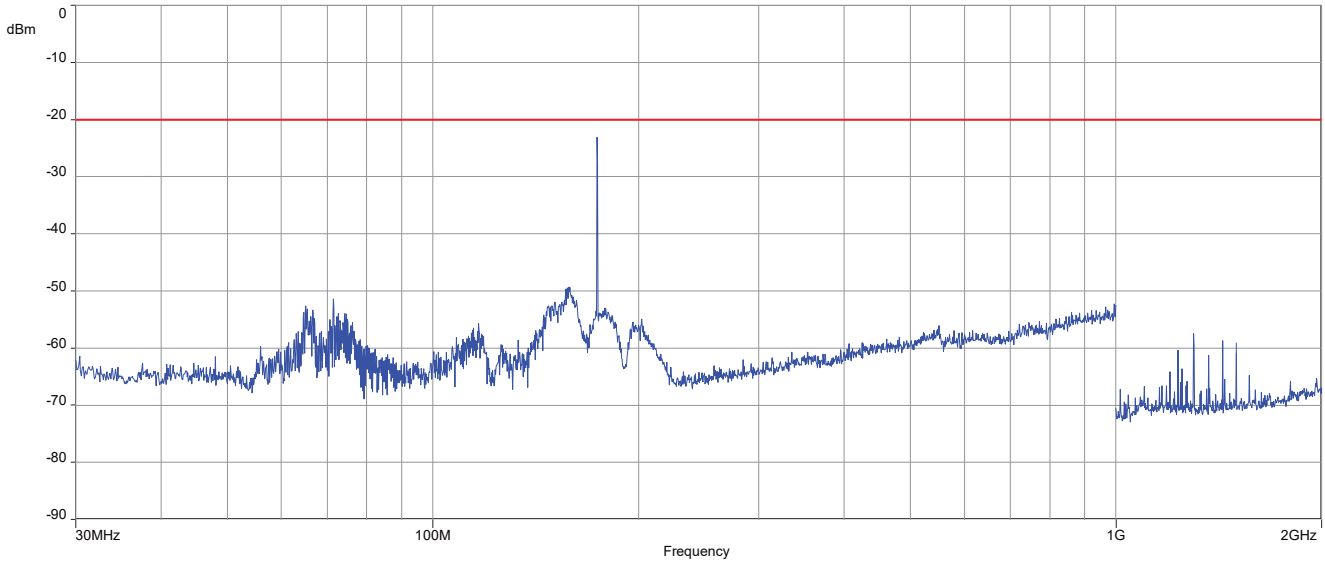
Plot 1: 30 MHz – 2 GHz, low channel, antenna vertical/horizontal, high power



Plot 2: 30 MHz – 2 GHz, middle channel, antenna vertical/horizontal, high power

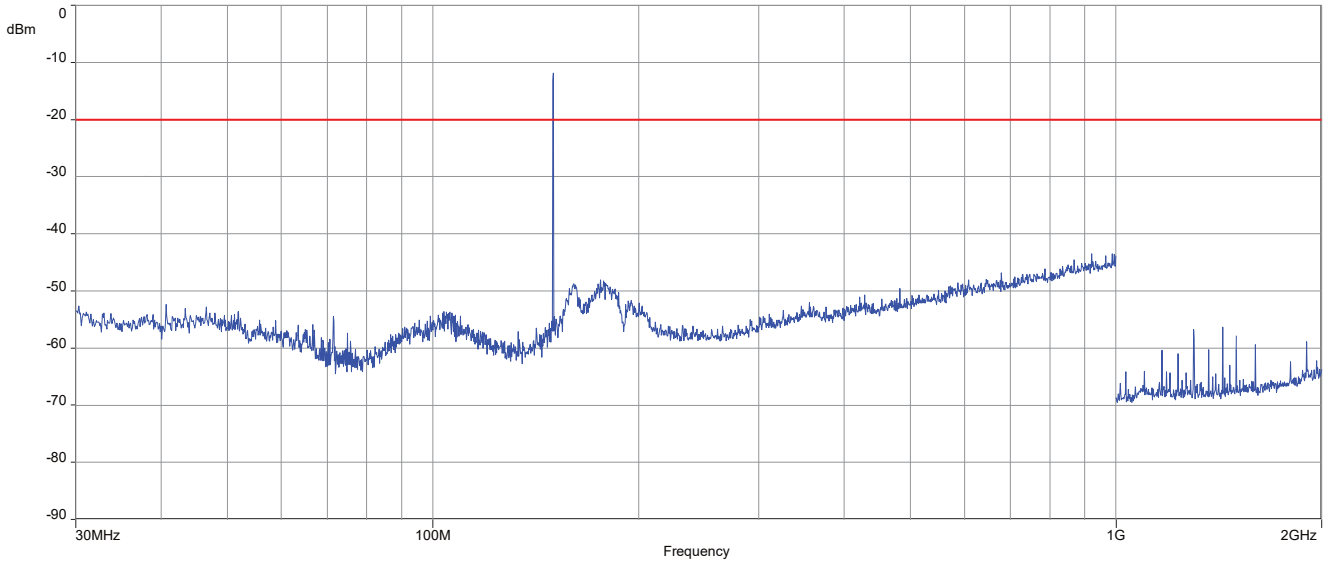


Plot 3: 30 MHz – 2 GHz, high channel, antenna vertical/horizontal, high power

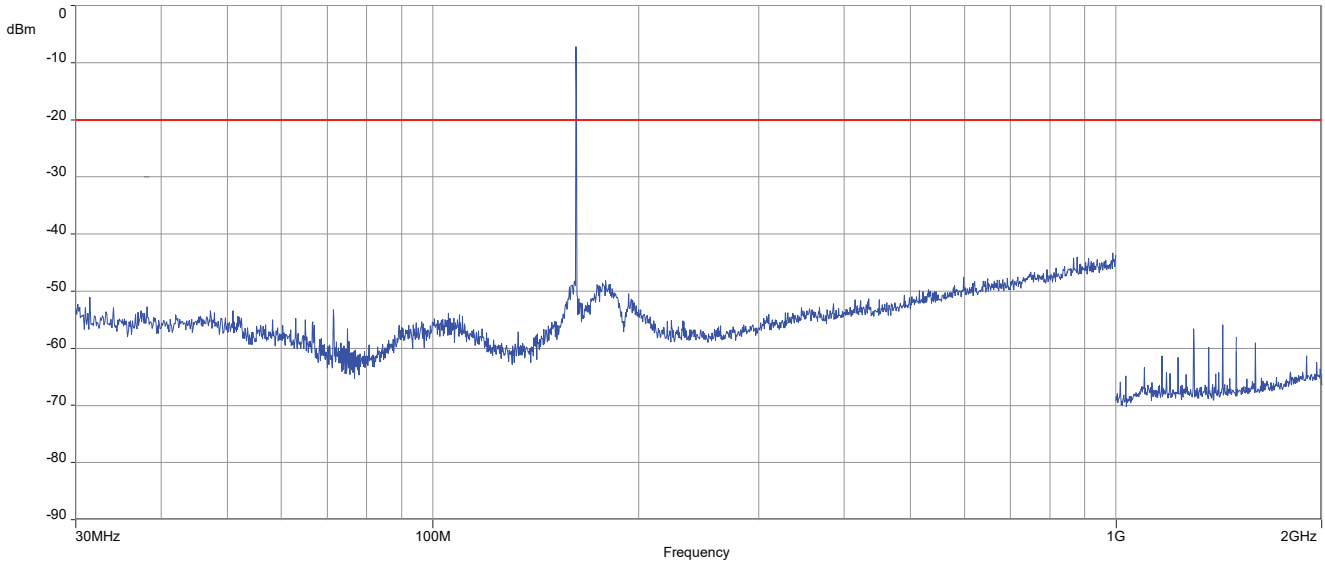


25 kHz Bandwidth, 10W

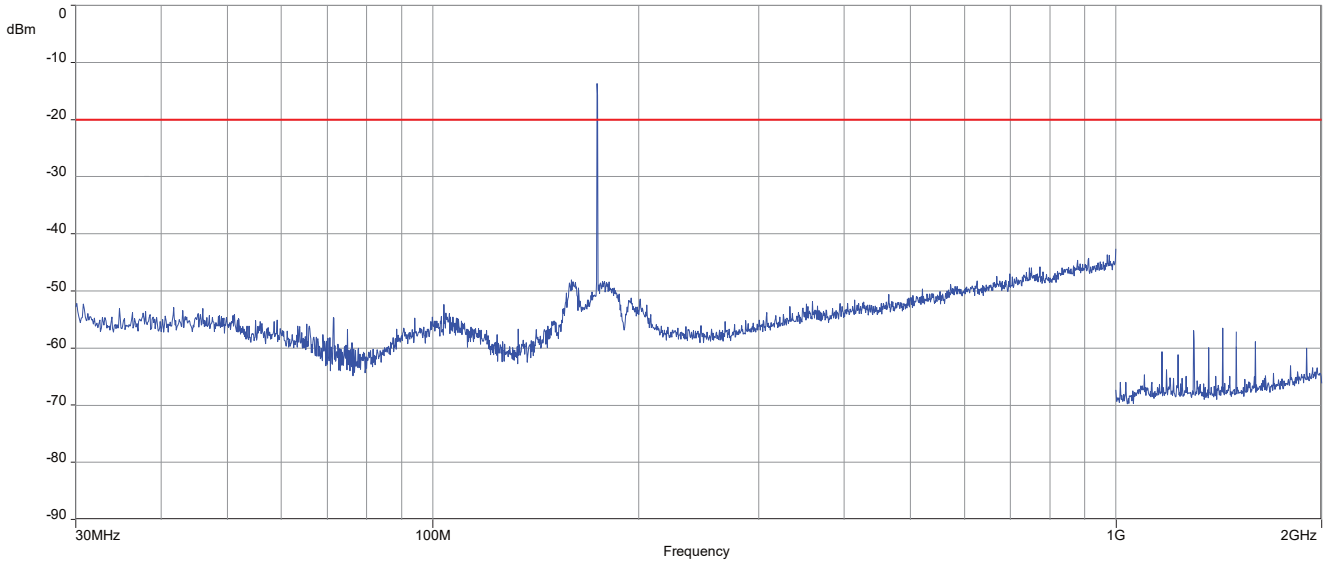
Plot 1: 30 MHz – 2 GHz, low channel, antenna vertical/horizontal, low power



Plot 2: 30 MHz – 2 GHz, middle channel, antenna vertical/horizontal

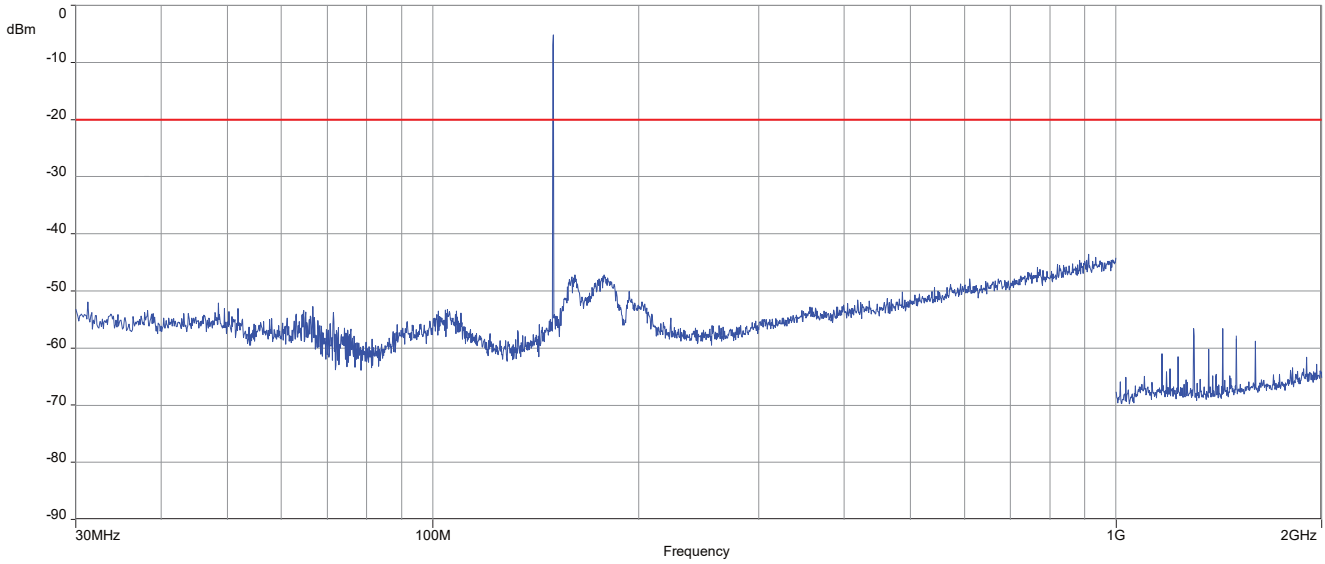


Plot 3: 30 MHz – 2 GHz, high channel, antenna vertical/horizontal

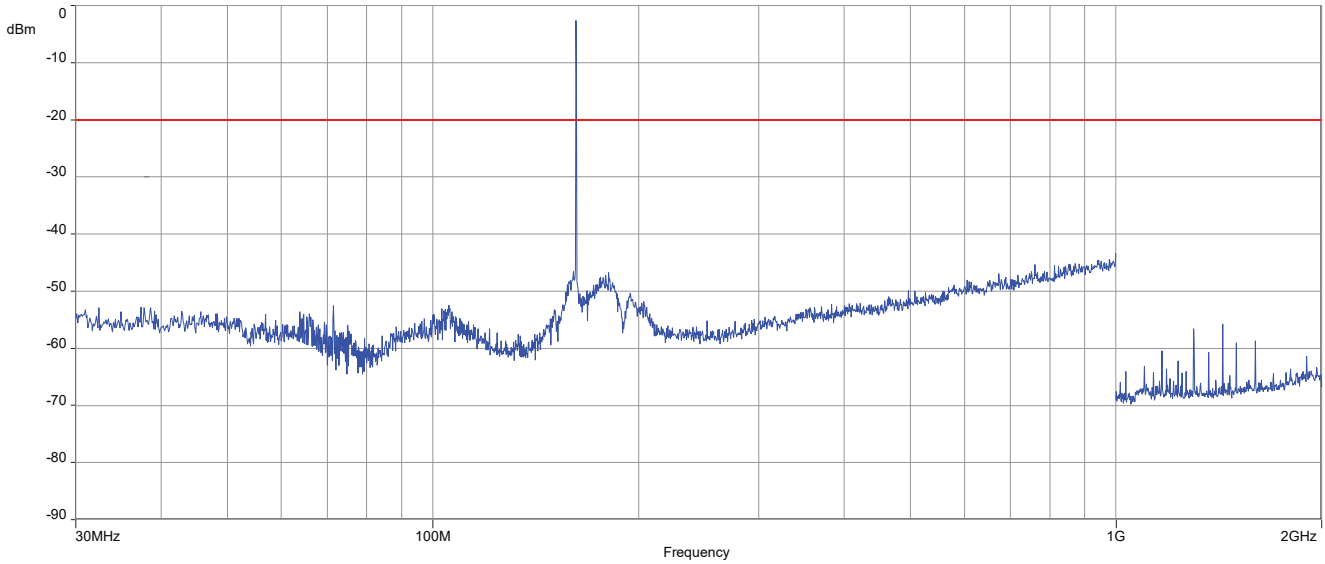


25 kHz Bandwidth, 50W

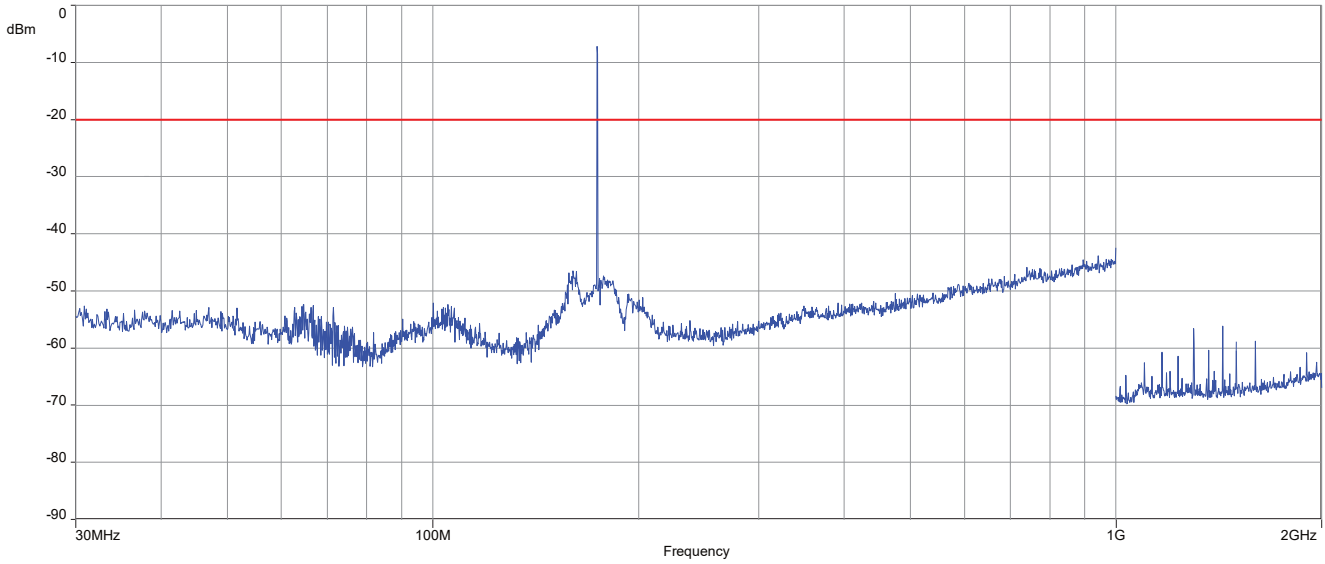
Plot 1: 30 MHz – 2 GHz, low channel, antenna vertical/horizontal



Plot 2: 30 MHz – 2 GHz, middle channel, antenna vertical/horizontal



Plot 3: 30 MHz – 2 GHz, high channel, antenna vertical/horizontal



13.9 Spurious emissions radiated < 30 MHz

Description:

Measurement of the radiated spurious emissions in transmit mode below 30 MHz. The EUT is set to channel 6. This measurement is representative for all channels and modes. If peaks are found channel 1 and channel 11 will be measured too. The measurement is performed with the data rate producing the highest output power. The limits are recalculated to a measurement distance of 3 m with 40 dB/decade according CFR Part 2.

Measurement:

Measurement parameter	
Detector:	Peak / Quasi Peak
Sweep time:	Auto
Video bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Resolution bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace-Mode:	Max Hold
Used equipment:	See chapter 7.2 A
Measurement uncertainty:	See chapter 9

Limits:

FCC		
Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
0.009 – 0.490	2400/(F/kHz)	300
0.490 – 1.705	24000/(F/kHz)	30
1.705 – 30	30 (29.5 dBµV/m)	30

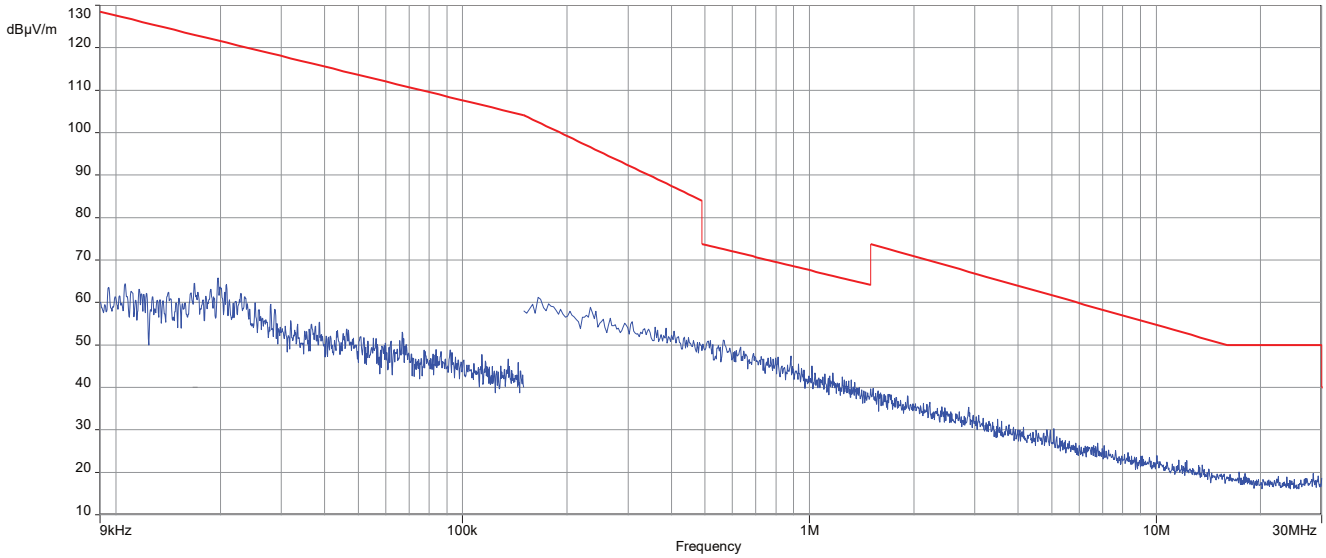
IC		
Frequency (MHz)	Field strength (µA/m)	Measurement distance (m)
0.009 – 0.490	6.37/F (F in kHz)	300
0.490 – 1.705	63.7/F (F in kHz)	30
1.705 – 30	0.08 (-22 dBµA/m)	30

Results:

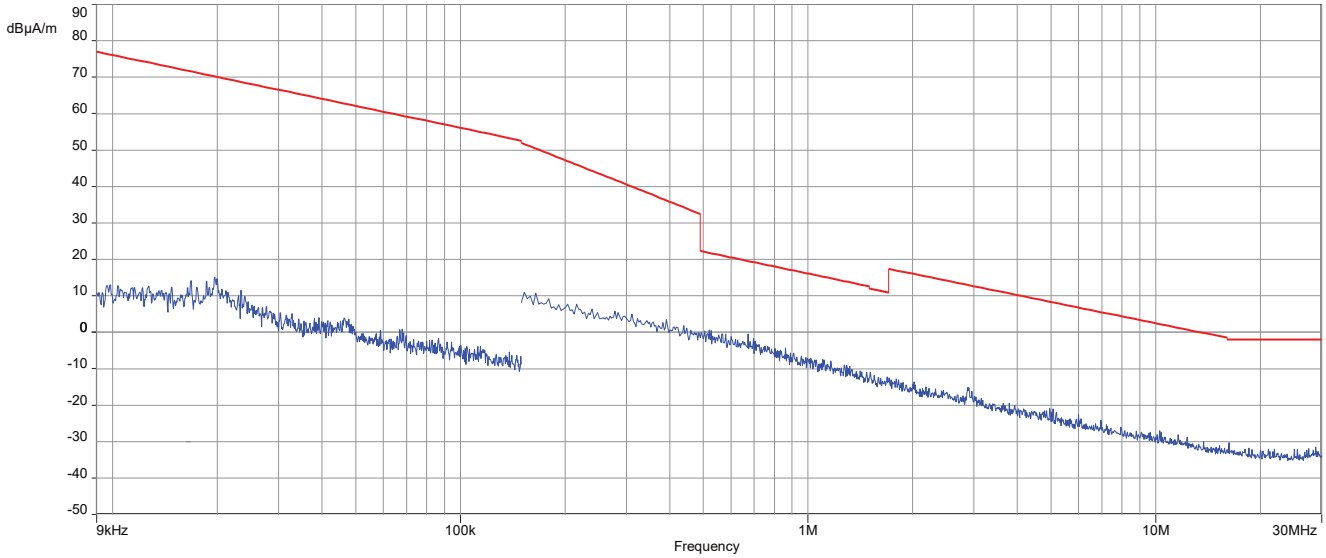
Spurious emission level								
lowest channel			middle channel			highest channel		
Frequency / MHz	Detector	Level / (dBµV/m)	Frequency / MHz	Detector	Level / (dBµV/m)	Frequency / MHz	Detector	Level / (dBµV/m)
no peaks detected			no peaks detected			no peaks detected		

Plots 6.25 kHz bandwidth, 10W:

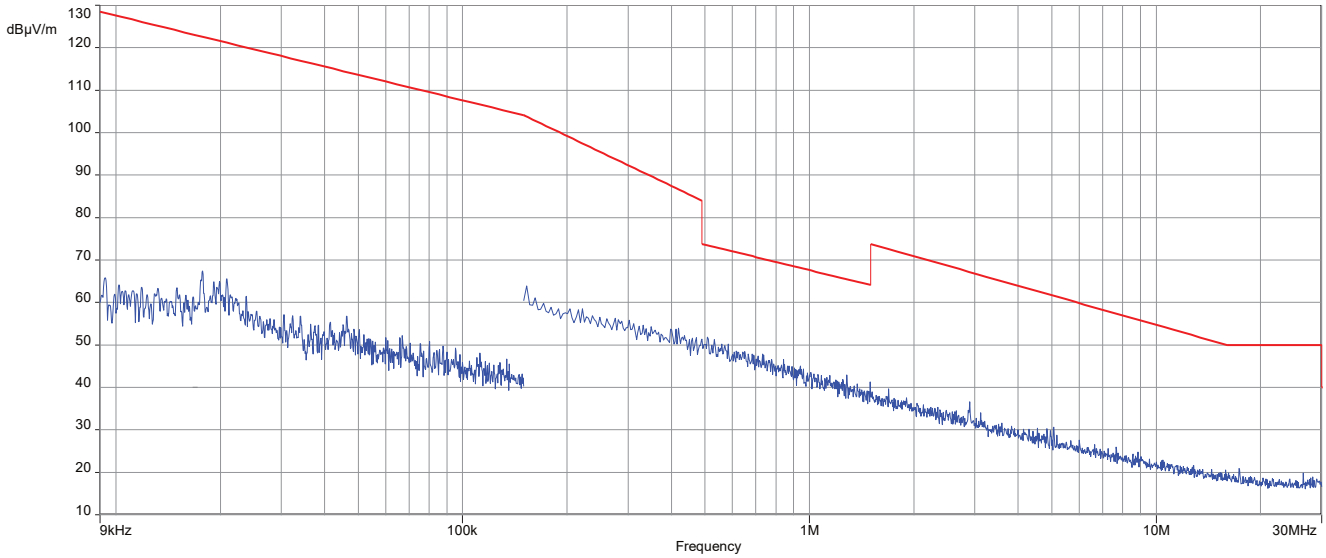
Plot 1: TX-Mode low channel, low power, FCC



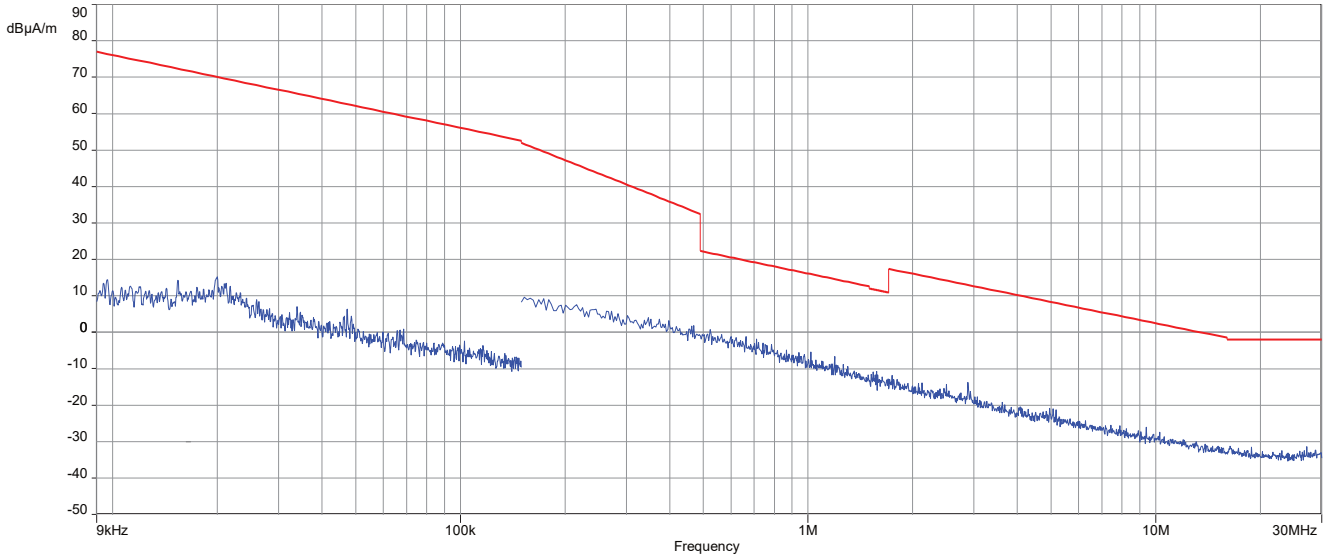
Plot 2: TX-Mode low channel, low power, IC



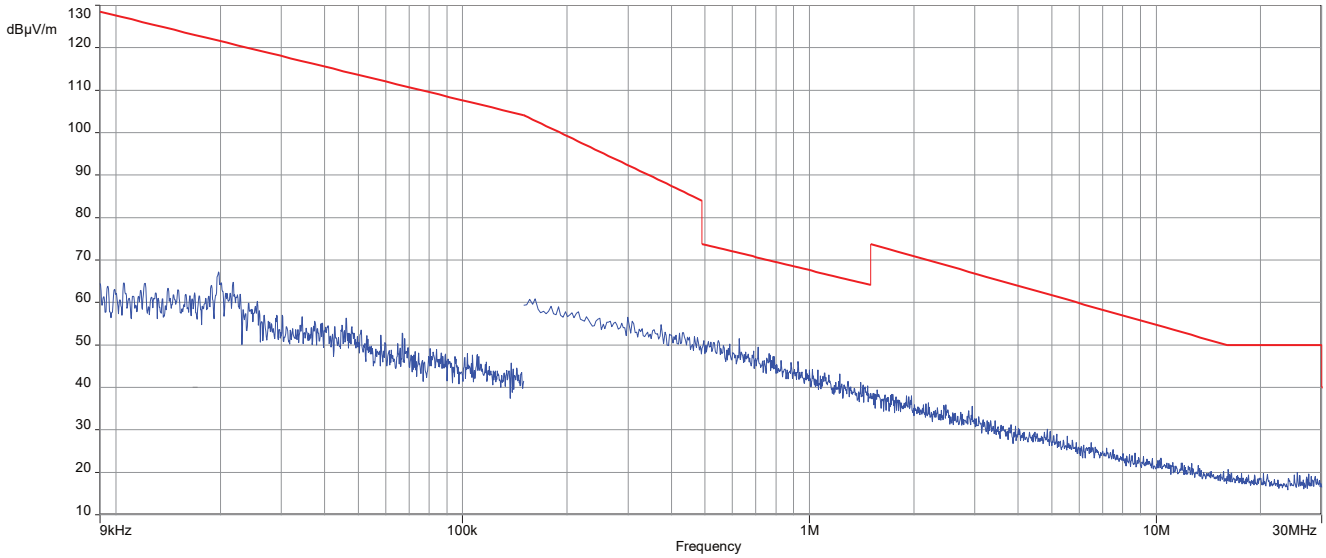
Plot 3: TX-Mode middle channel, low power, FCC



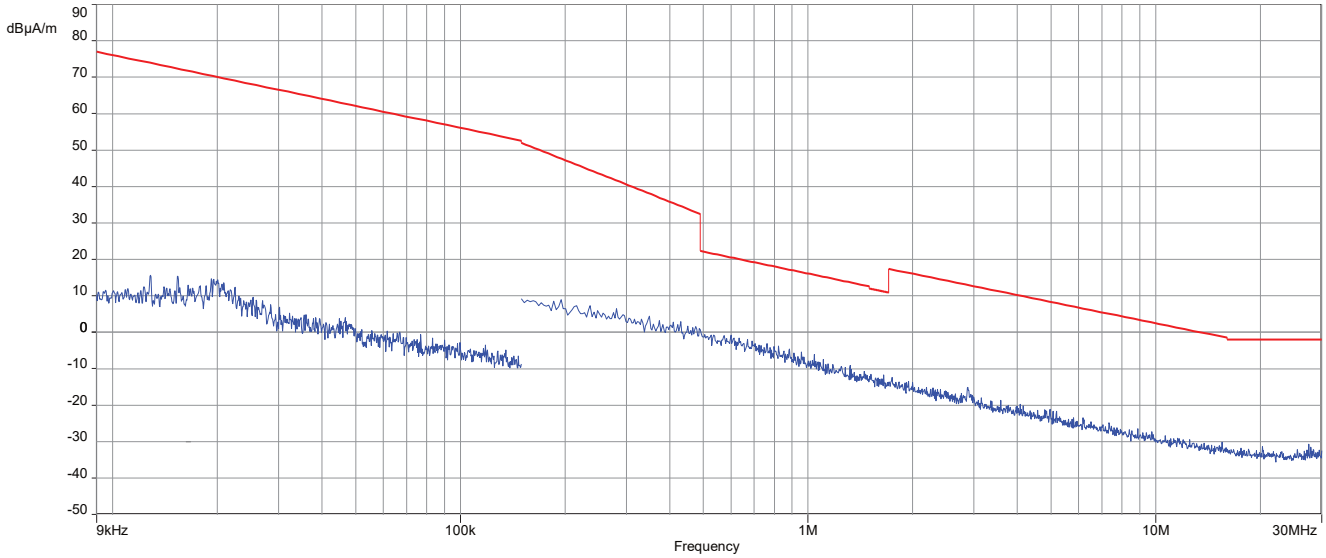
Plot 4: TX-Mode middle channel, low power, IC



Plot 5: TX-Mode high channel, low power, FCC

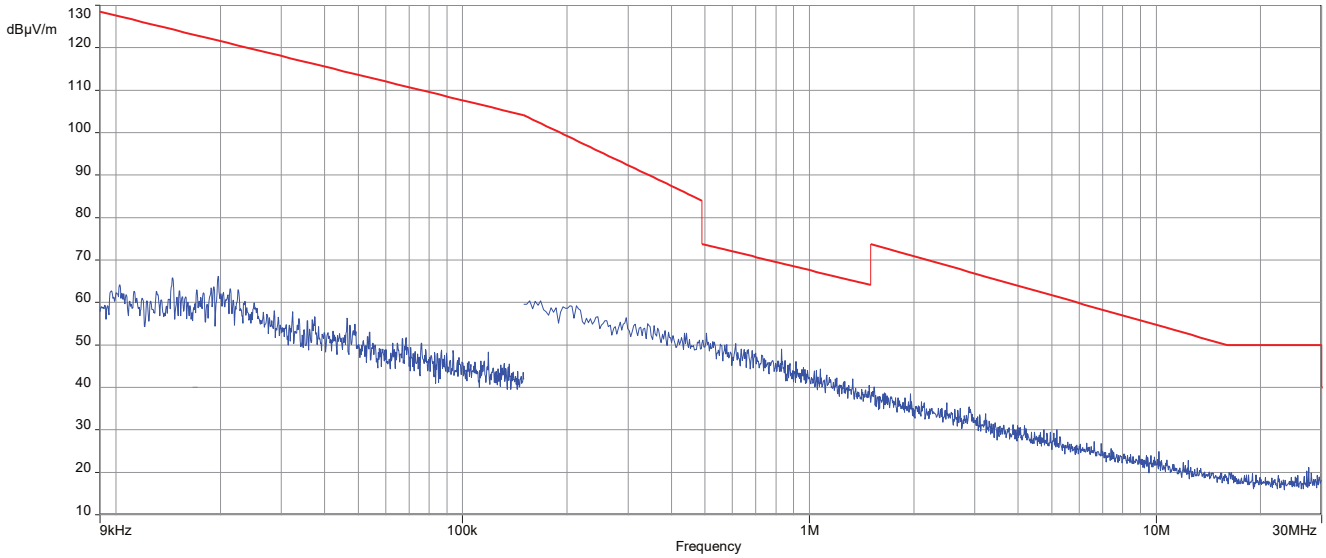


Plot 6: TX-Mode high channel, low power, IC

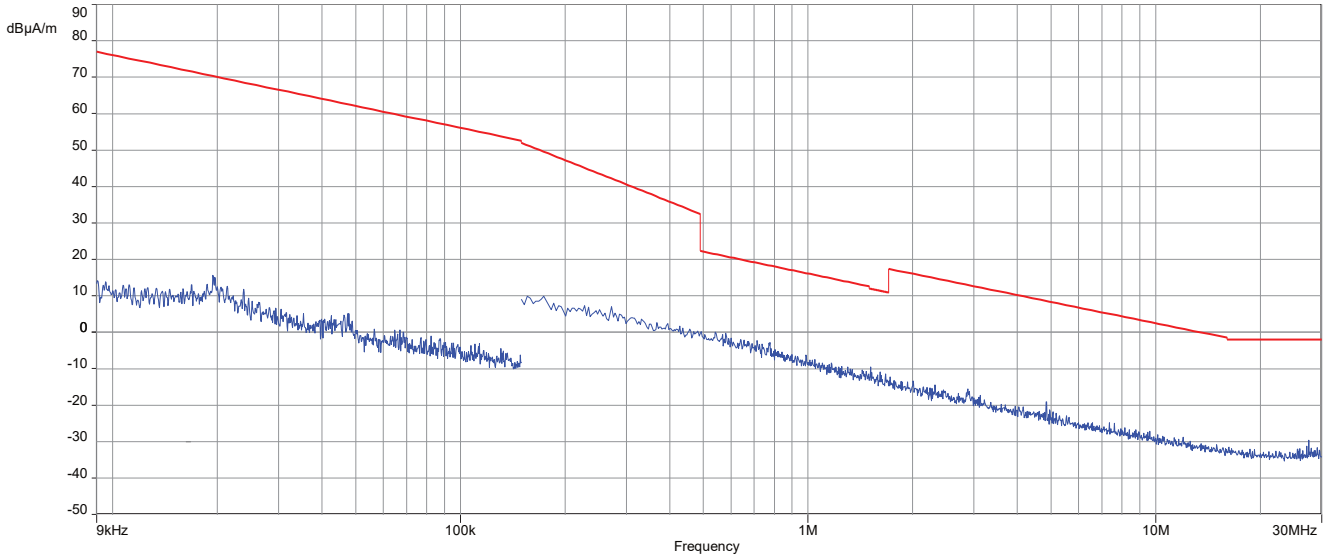


Plots 6.25 kHz bandwidth, 50W:

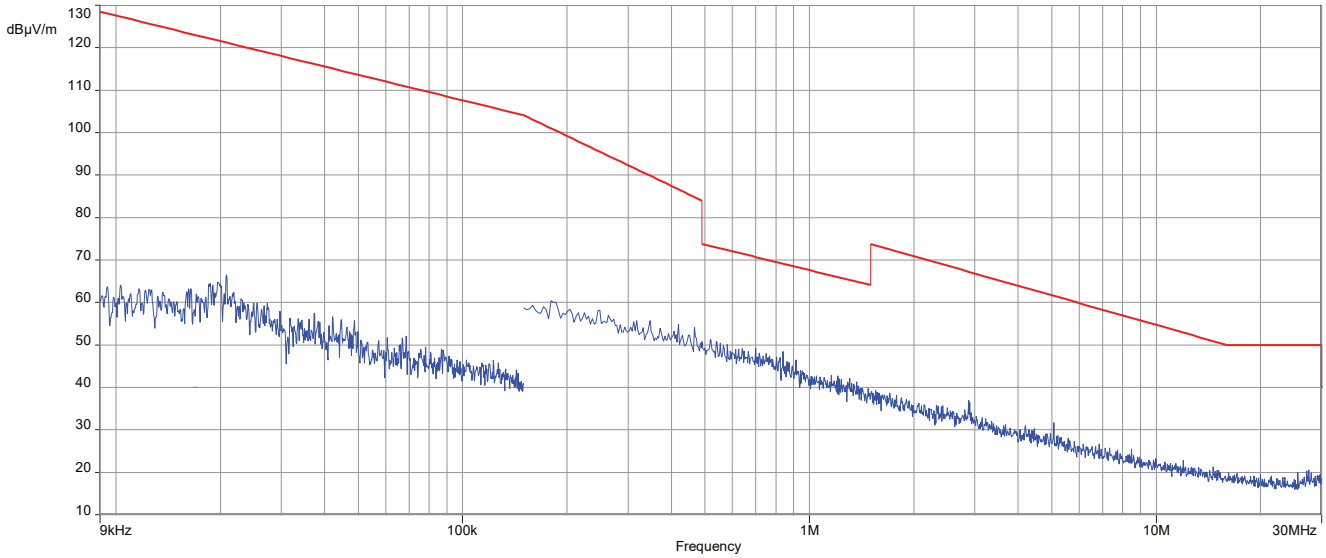
Plot 1: TX-Mode low channel, high power, FCC



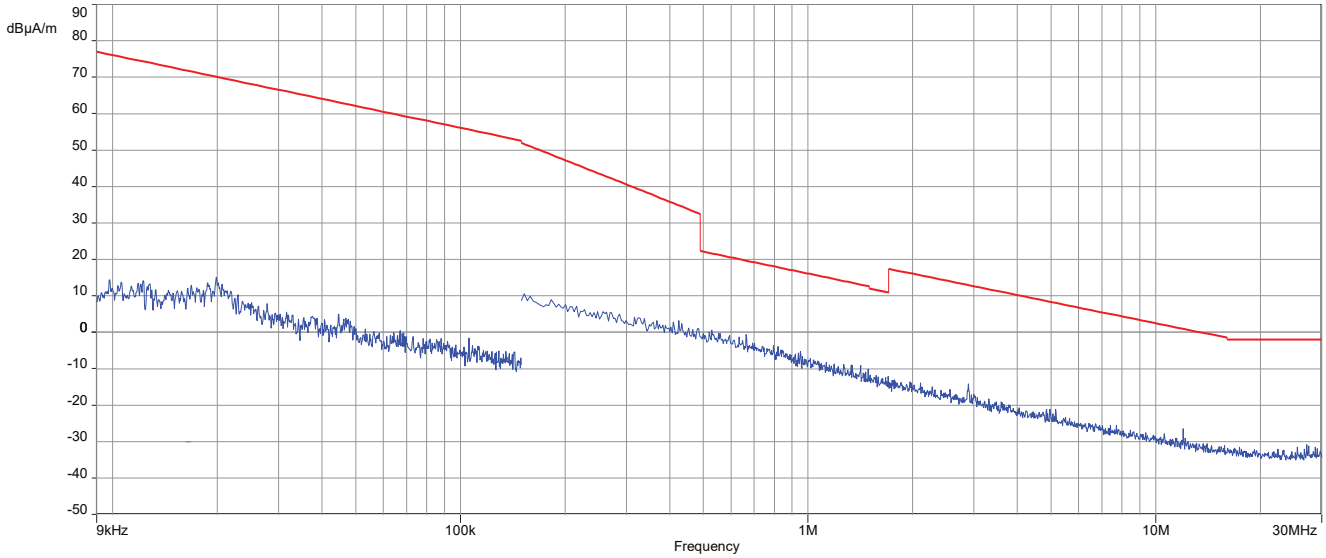
Plot 2: TX-Mode low channel, high power, IC



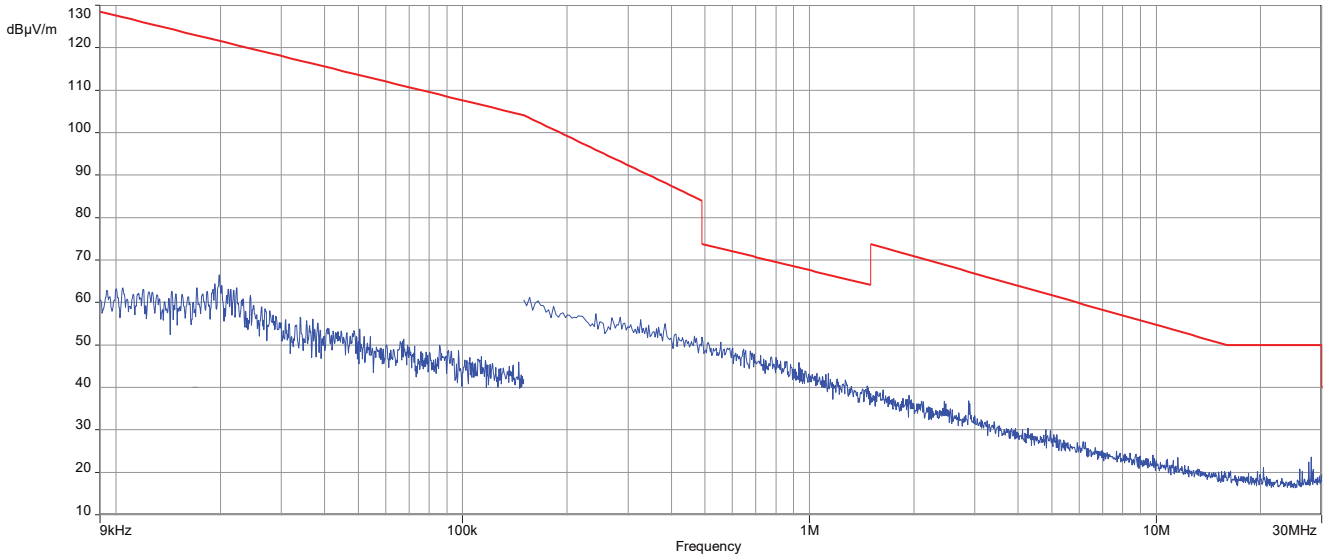
Plot 3: TX-Mode middle channel, high power, FCC



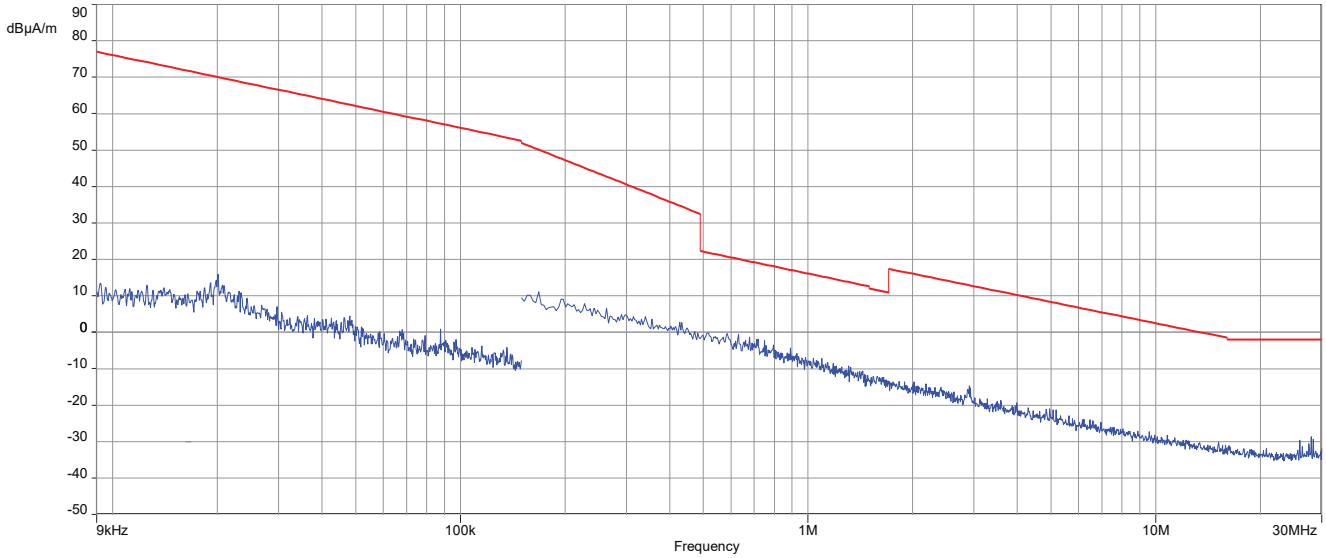
Plot 4: TX-Mode middle channel, high power, IC



Plot 5: TX-Mode high channel, high power, FCC

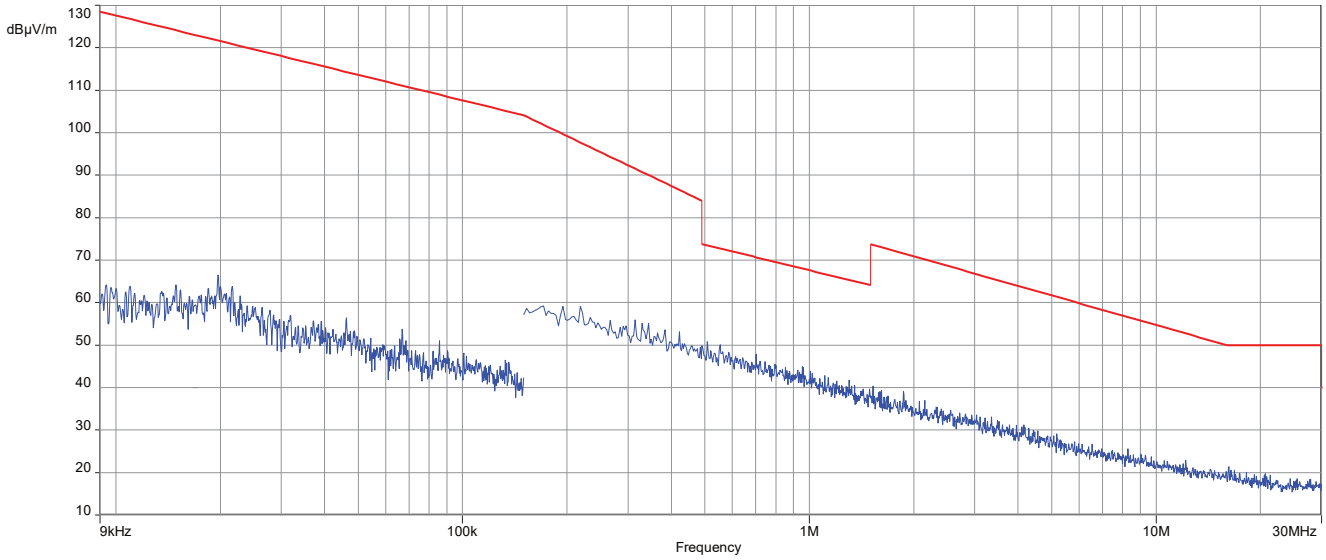


Plot 6: TX-Mode high channel, high power, IC

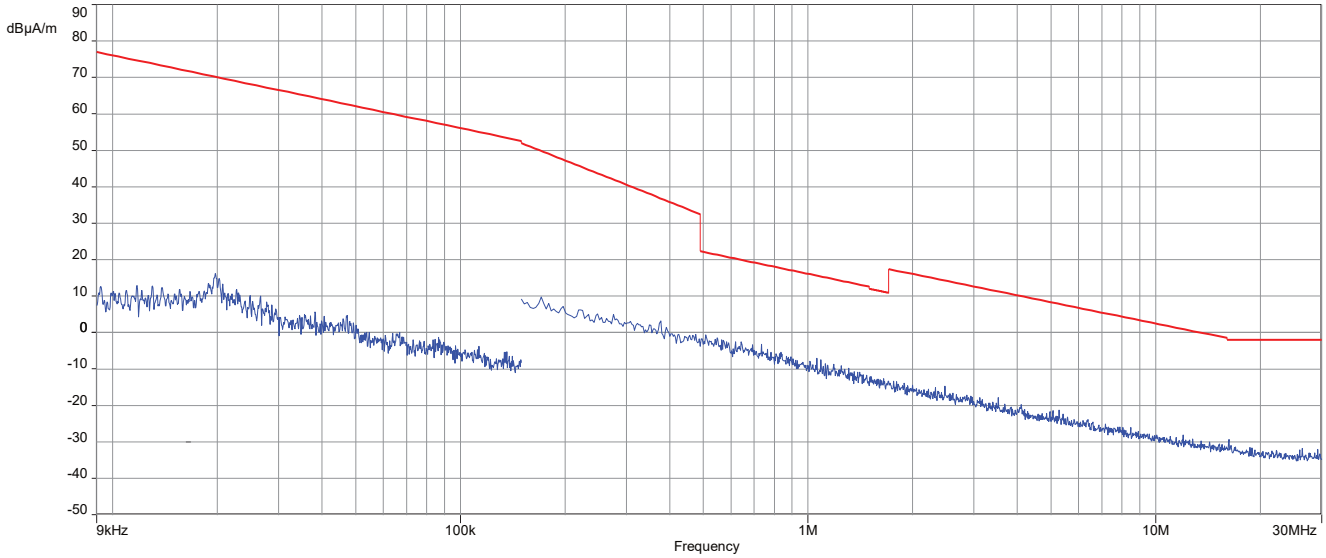


Plots 12.5 kHz bandwidth, 10W:

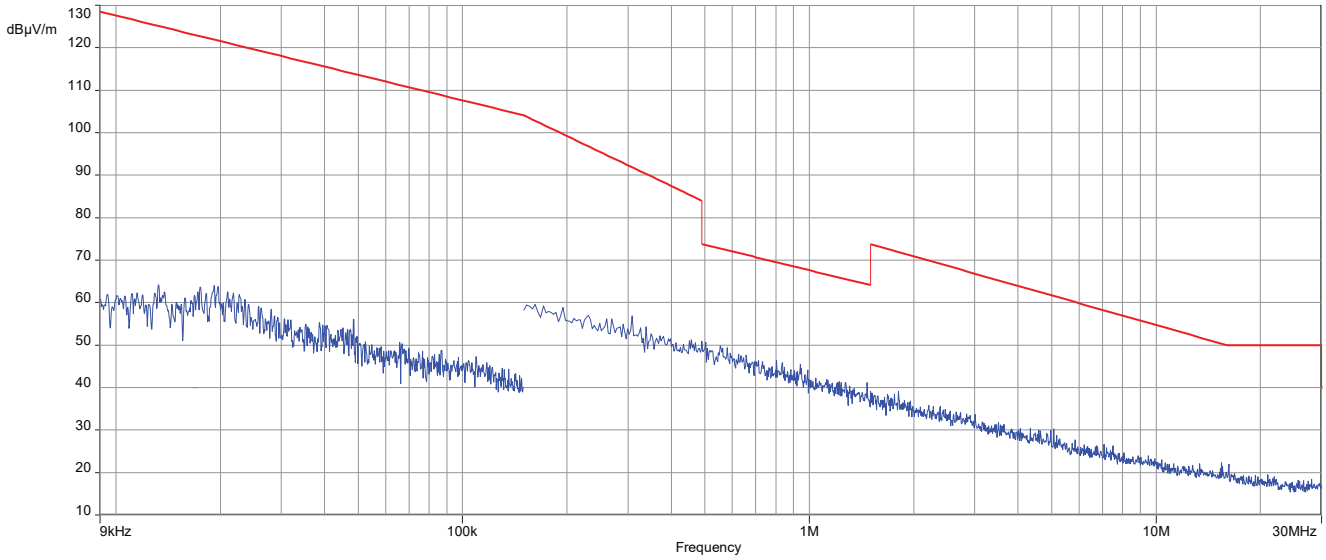
Plot 1: TX-Mode low channel, FCC



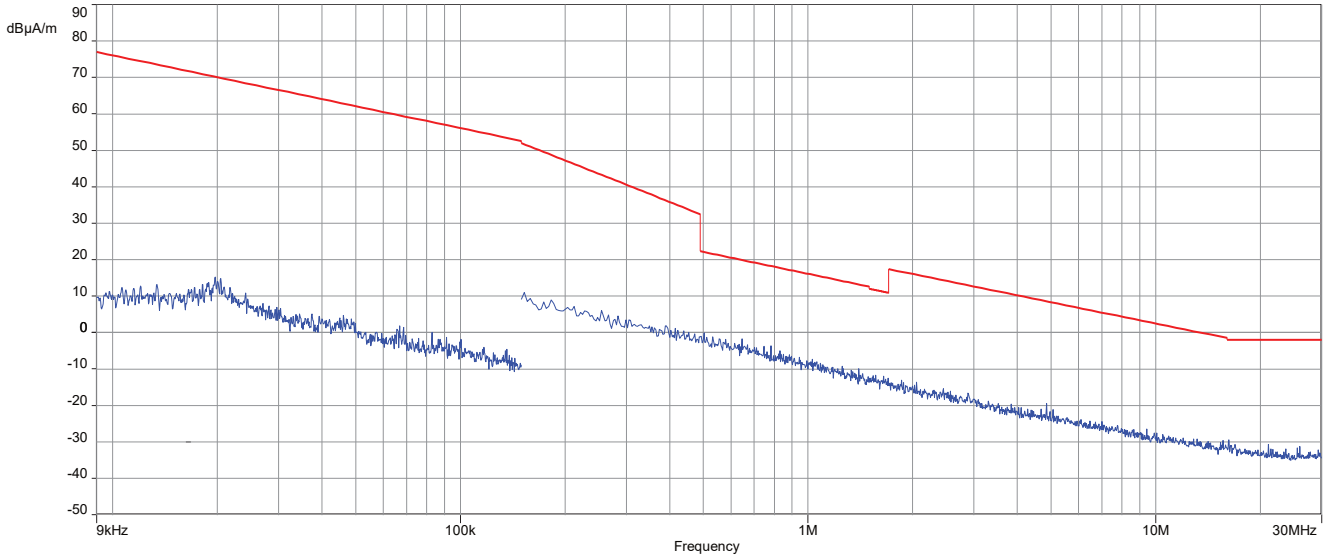
Plot 2: TX-Mode low channel, IC



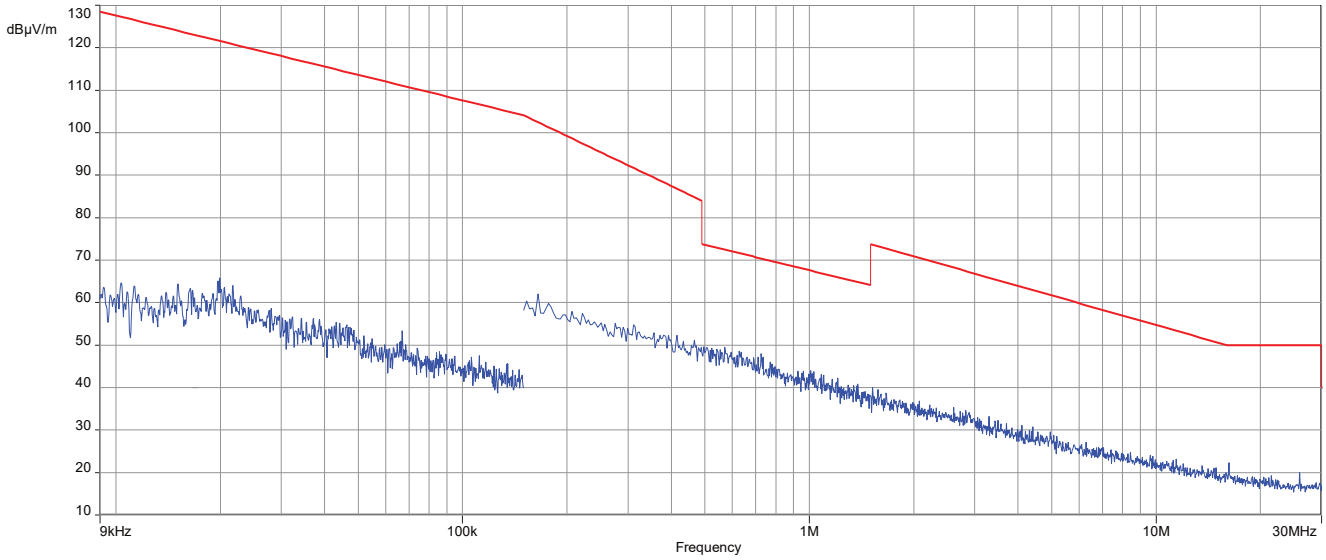
Plot 3: TX-Mode middle channel, FCC



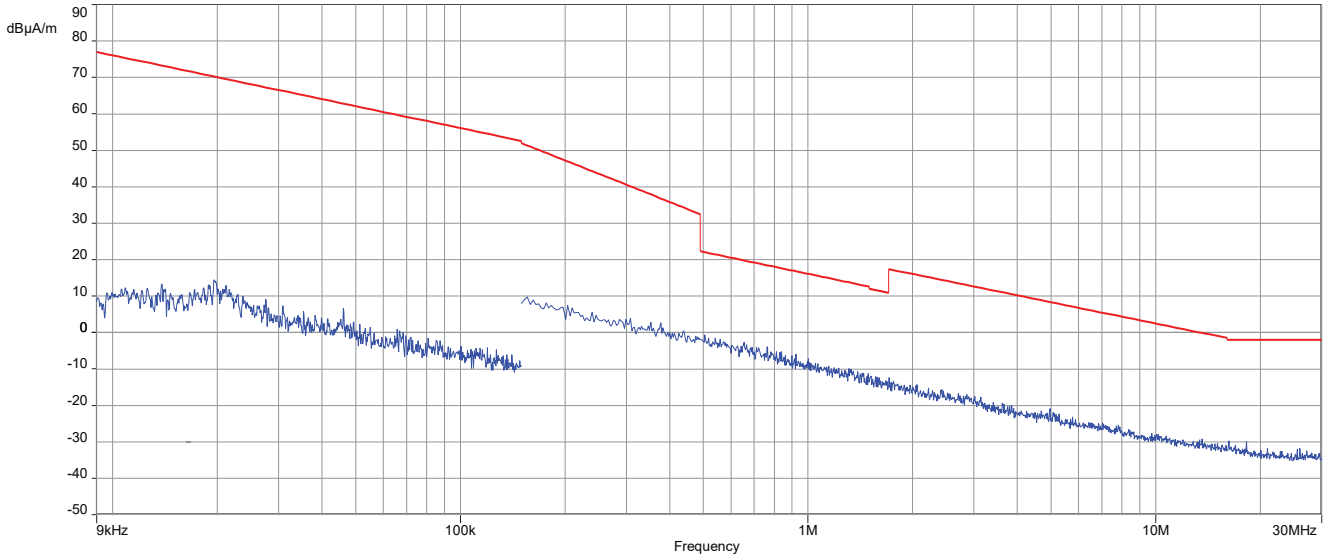
Plot 4: TX-Mode middle channel, IC



Plot 5: TX-Mode high channel, FCC

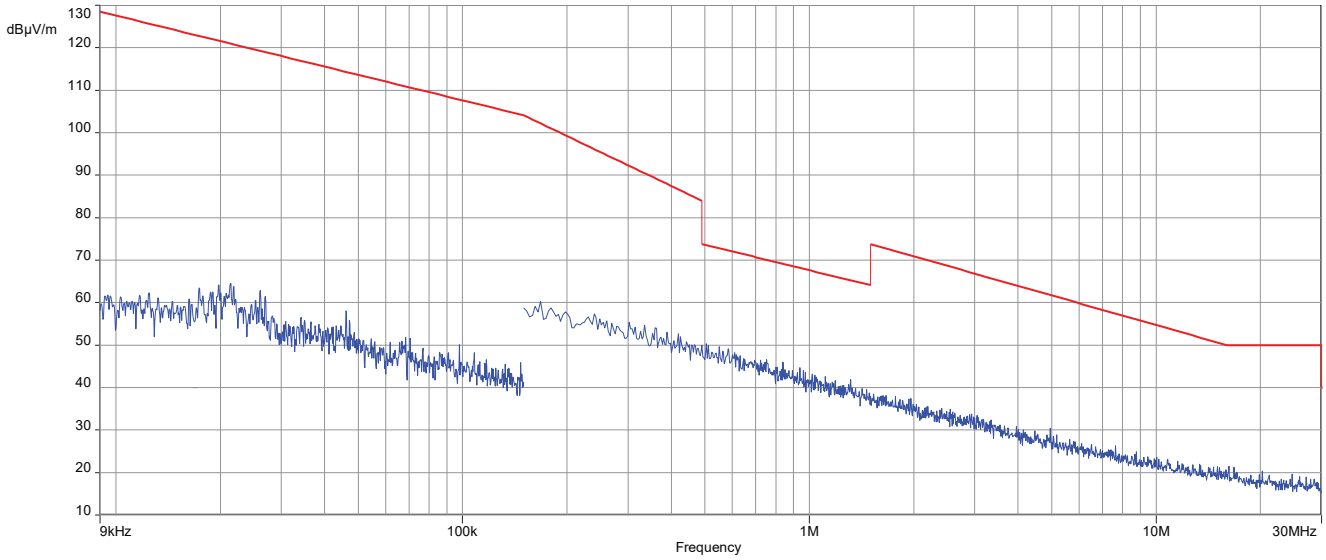


Plot 6: TX-Mode high channel, IC

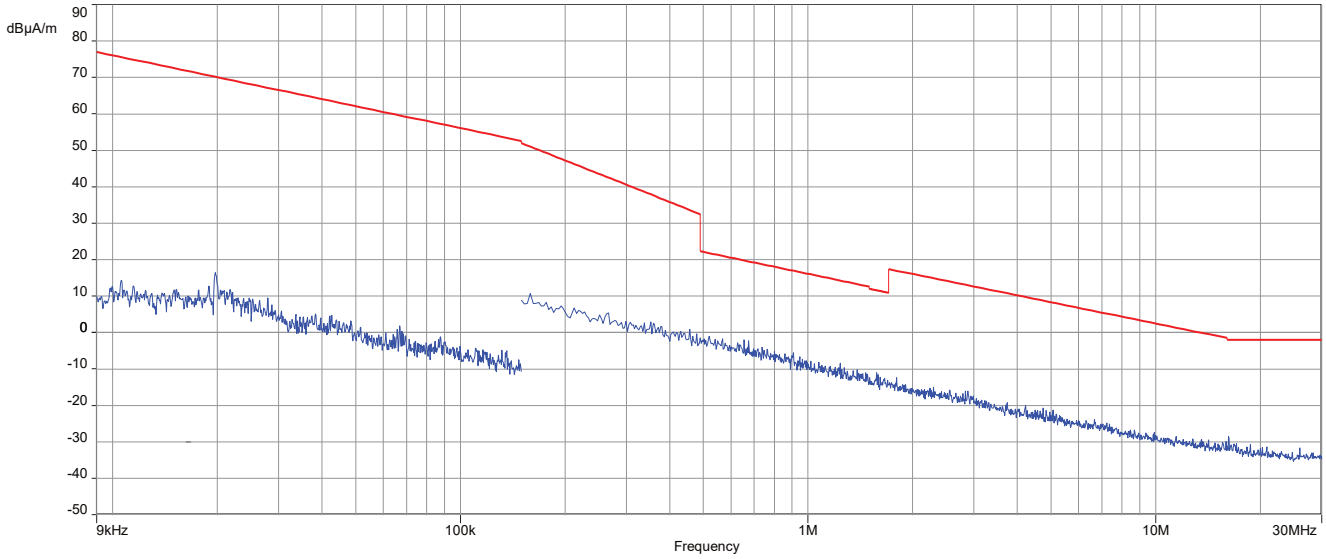


Plots 25 kHz bandwidth, 10W:

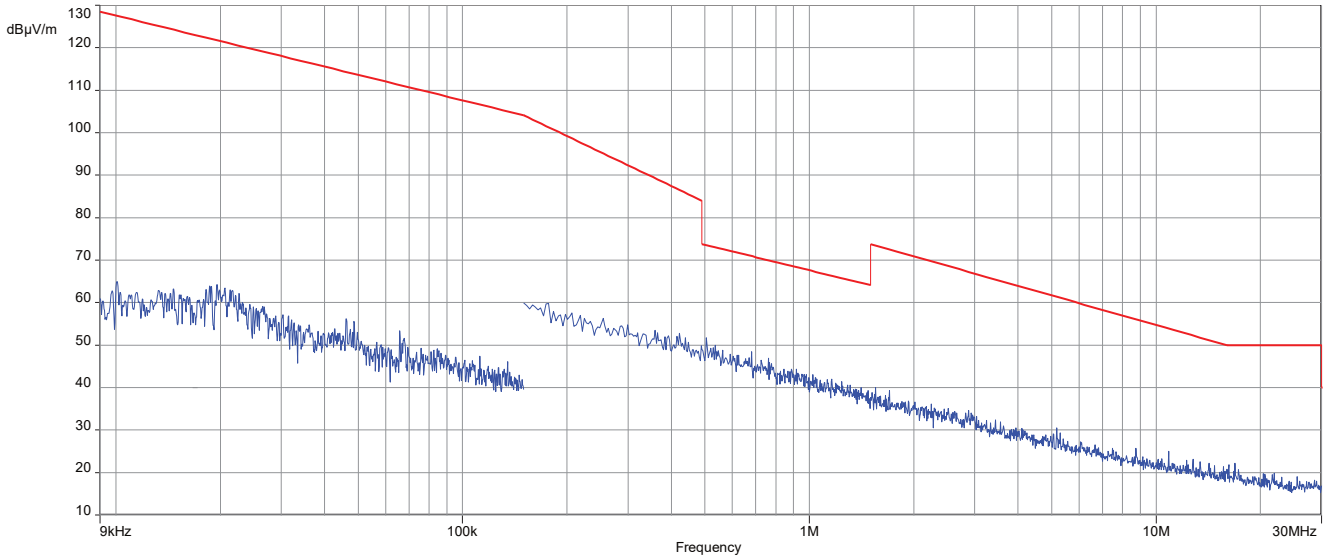
Plot 1: TX-Mode low channel, FCC



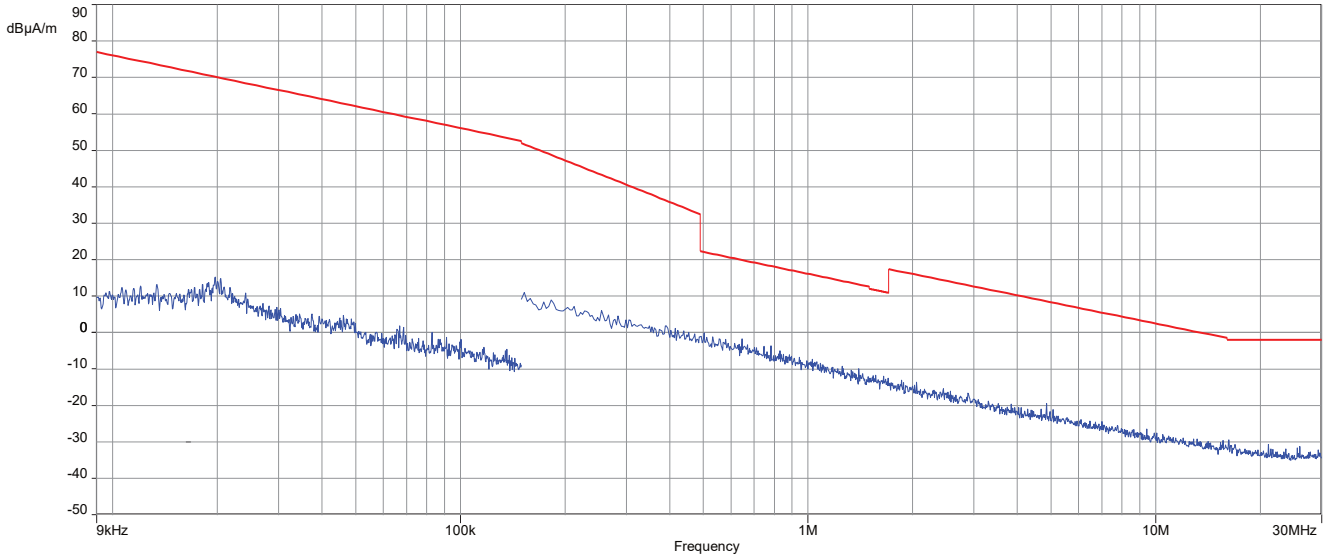
Plot 2: TX-Mode low channel, IC



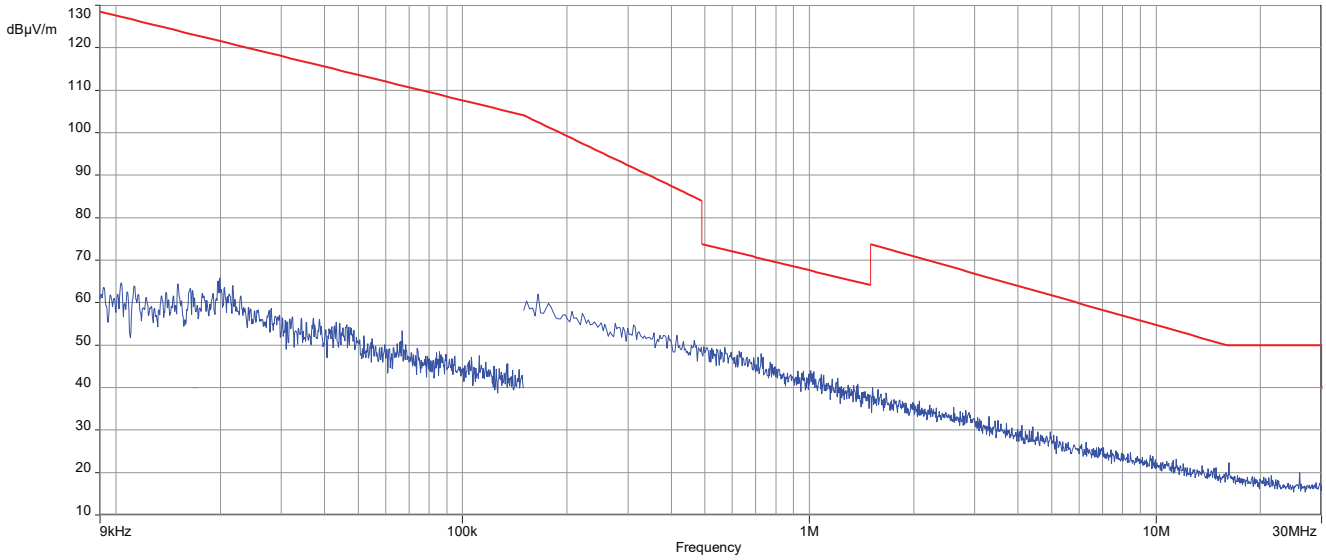
Plot 3: TX-Mode middle channel, FCC



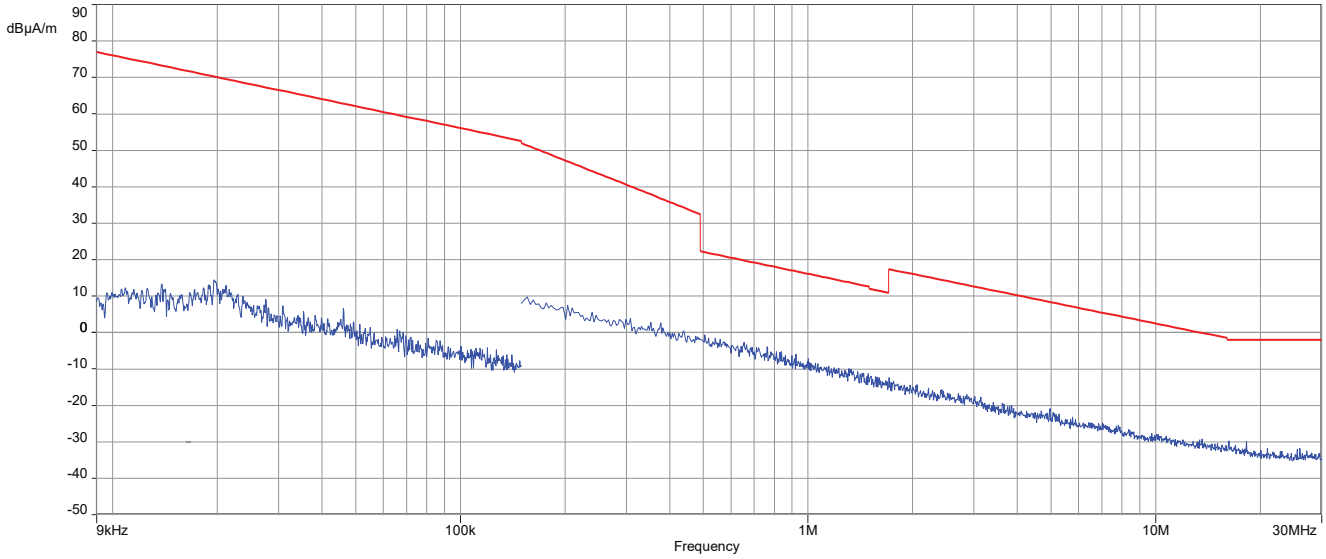
Plot 4: TX-Mode middle channel, IC



Plot 5: TX-Mode high channel, FCC

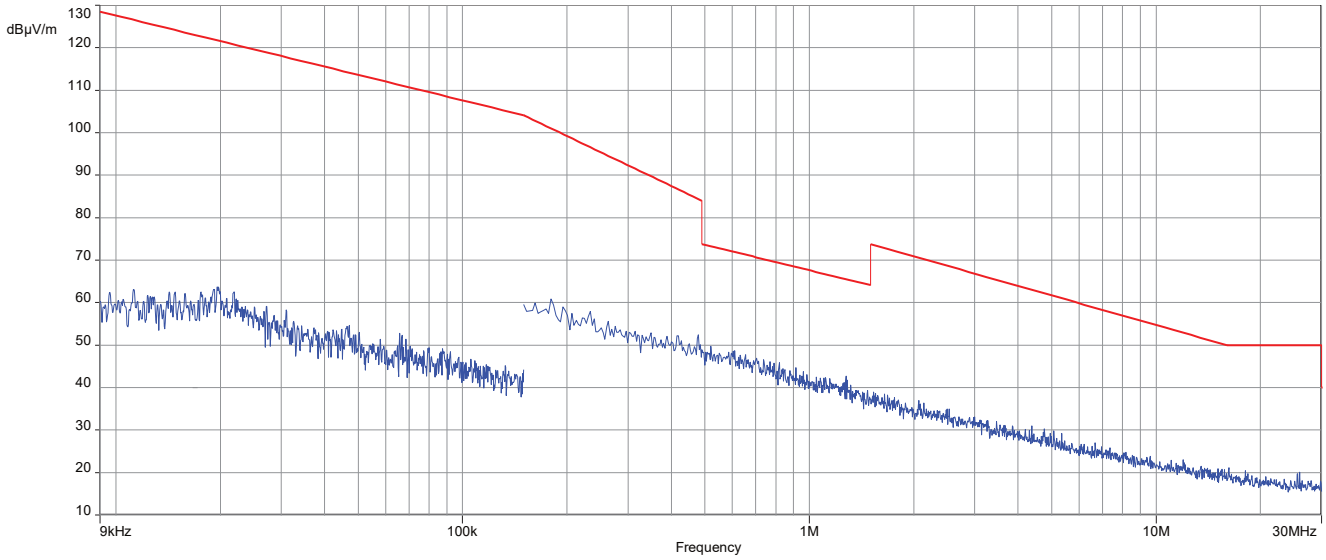


Plot 6: TX-Mode high channel, IC

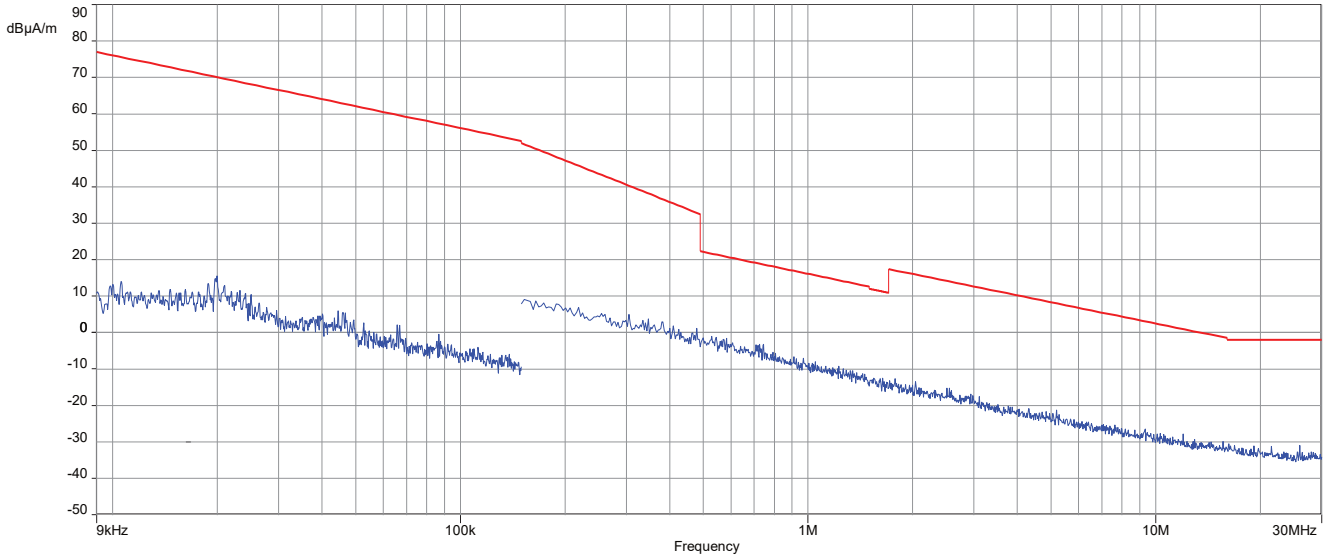


Plots 12.5 kHz bandwidth, 50W:

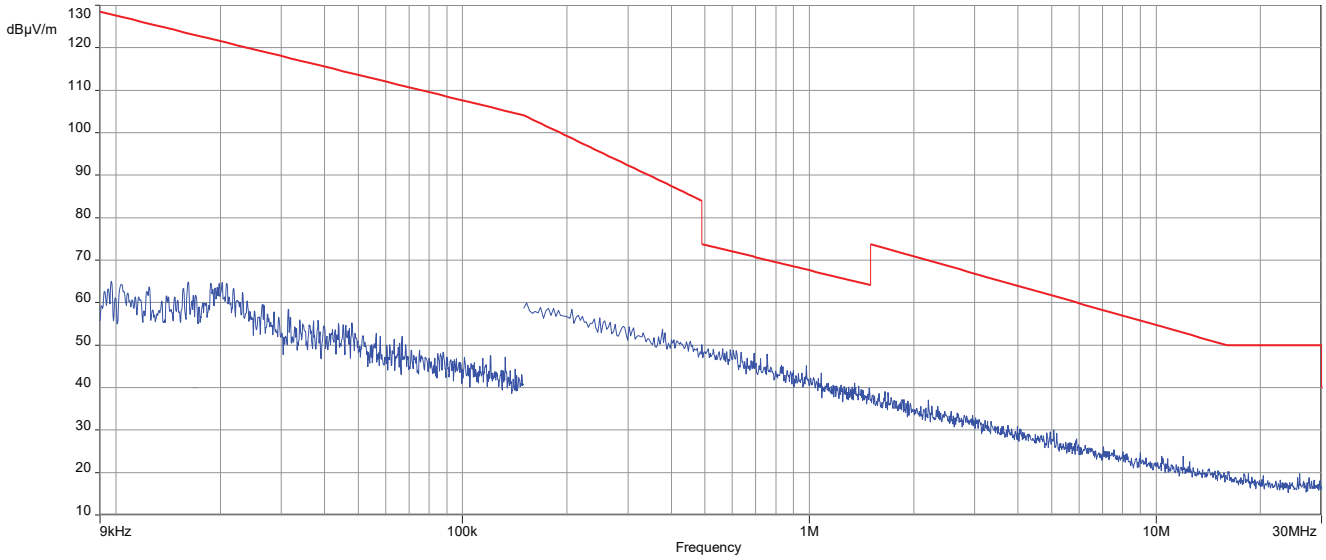
Plot 1: TX-Mode low channel, FCC



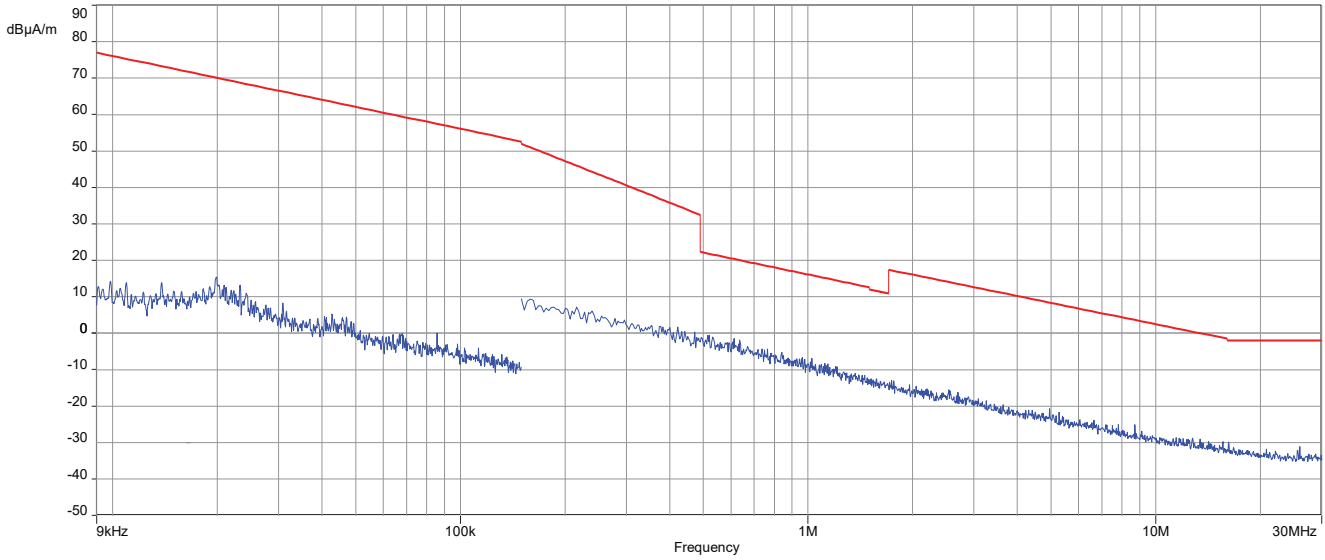
Plot 2: TX-Mode low channel, IC



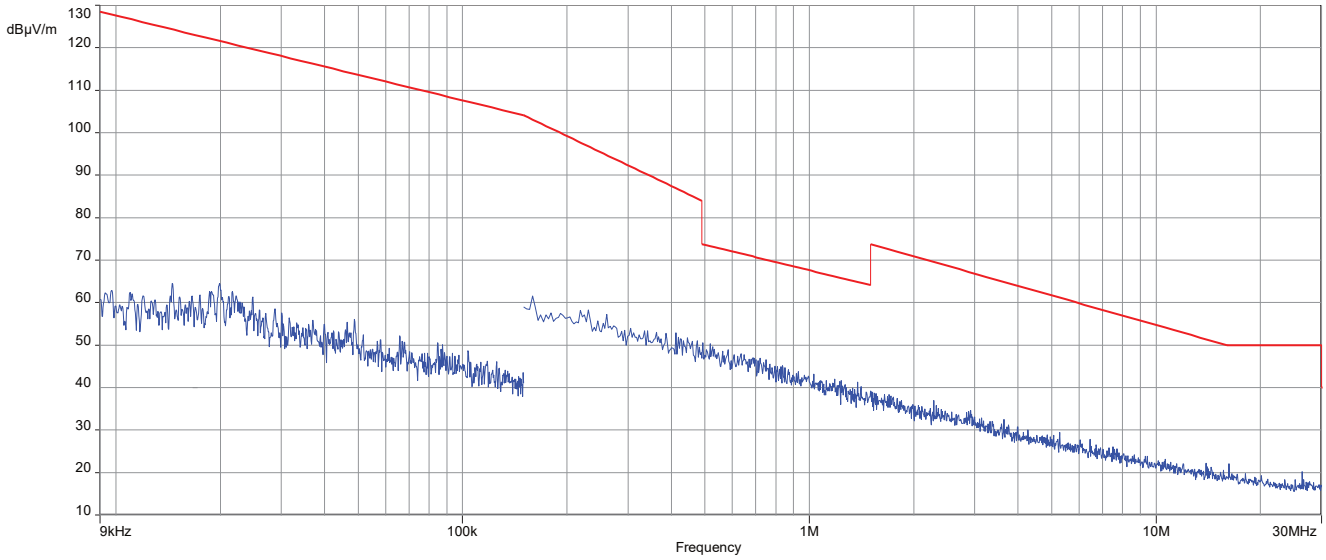
Plot 3: TX-Mode middle channel, FCC



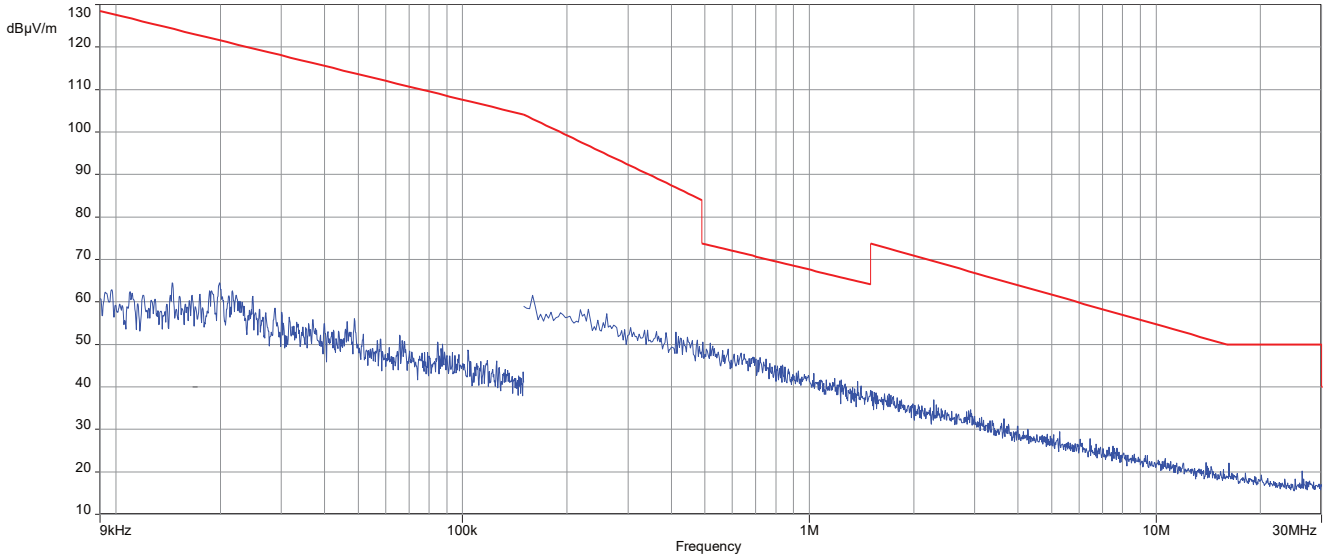
Plot 4: TX-Mode middle channel, IC



Plot 5: TX-Mode high channel, FCC

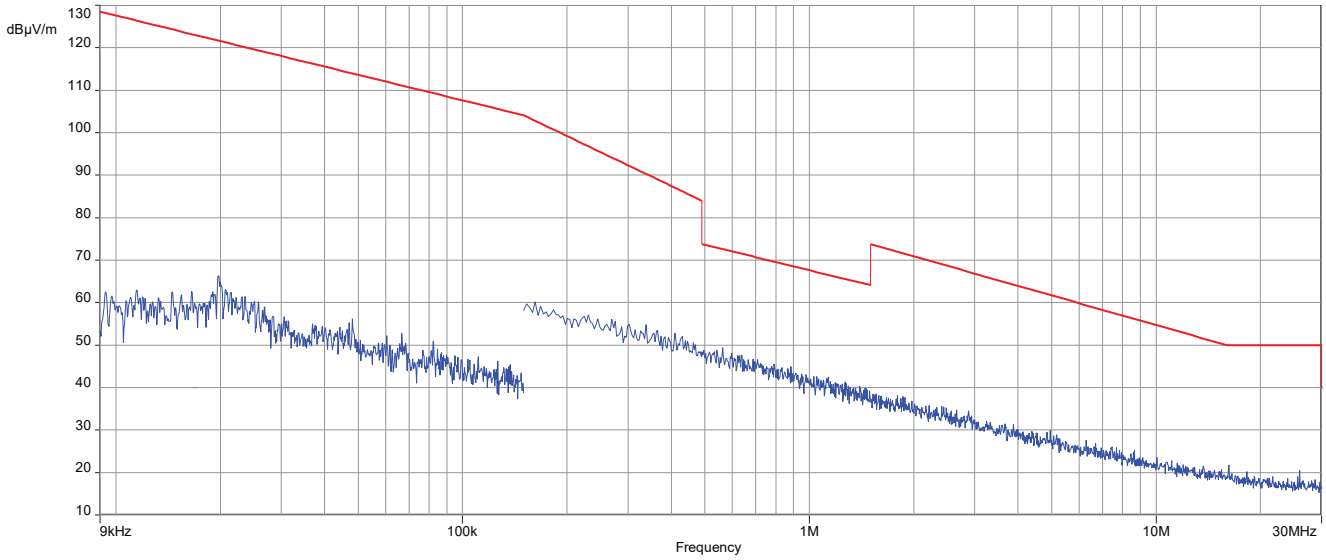


Plot 6: TX-Mode high channel, IC

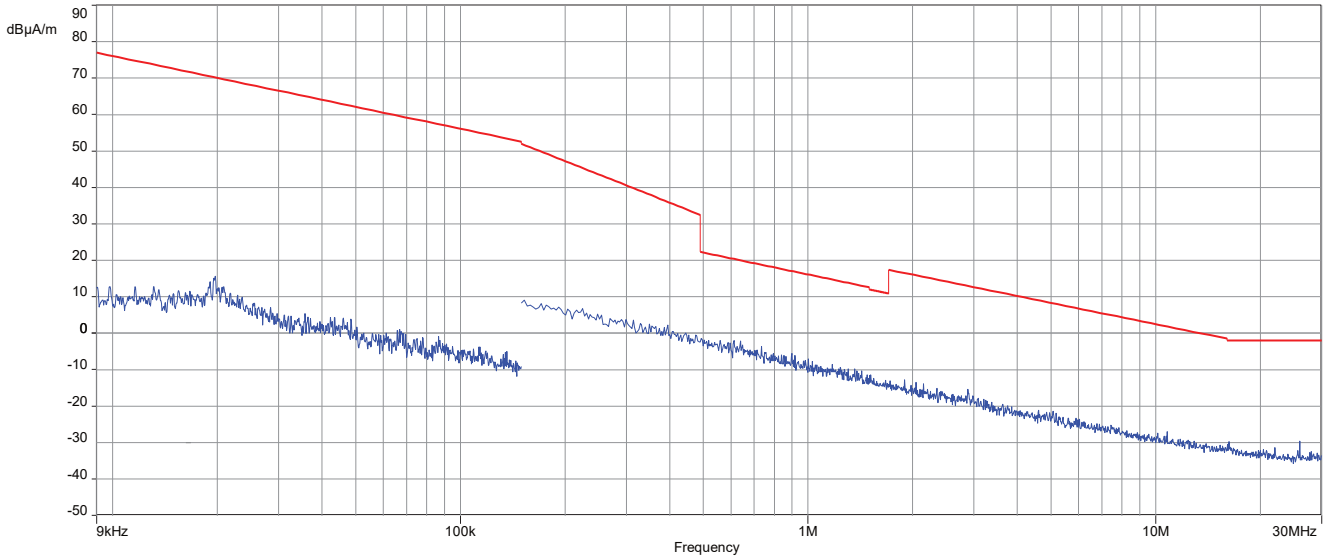


Plots 25 kHz bandwidth, 50W:

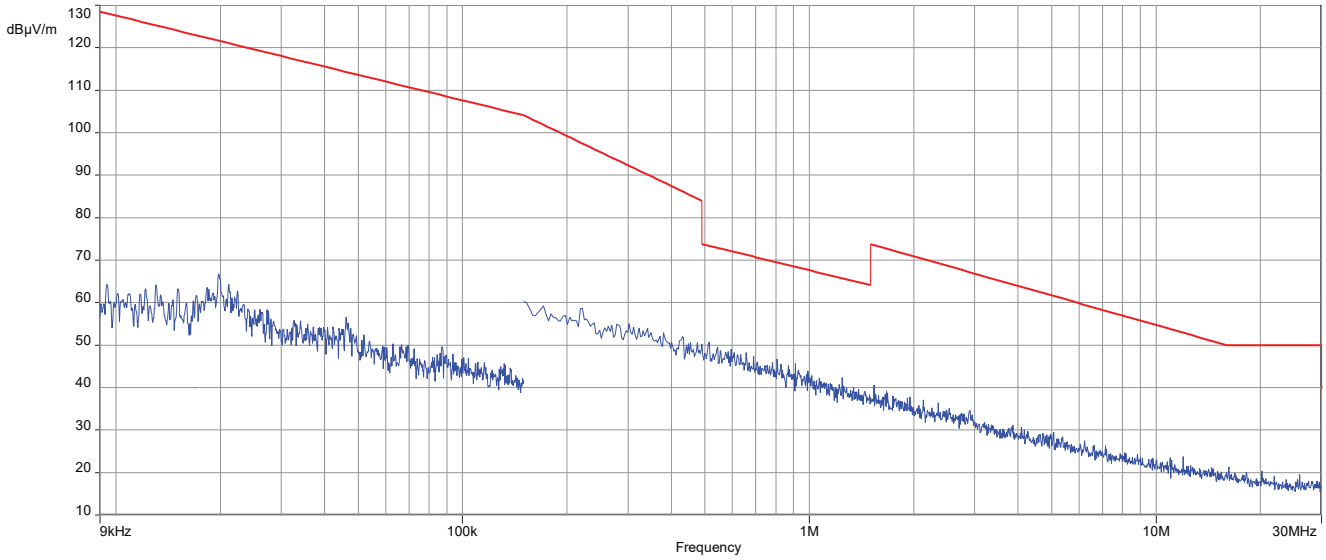
Plot 1: TX-Mode low channel, FCC



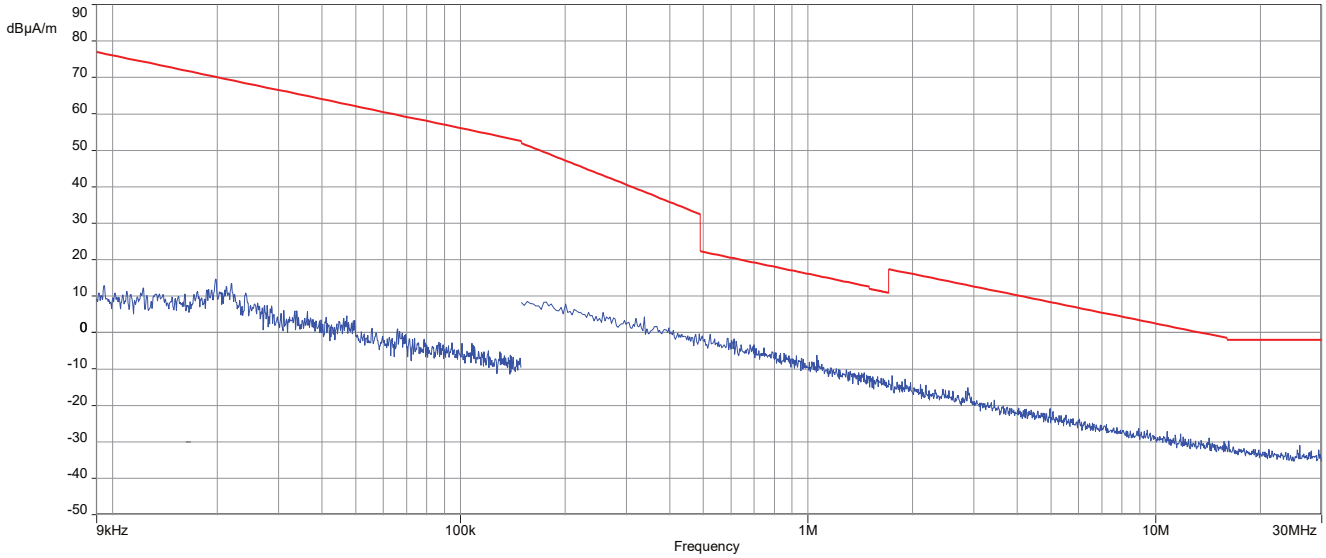
Plot 2: TX-Mode low channel, IC



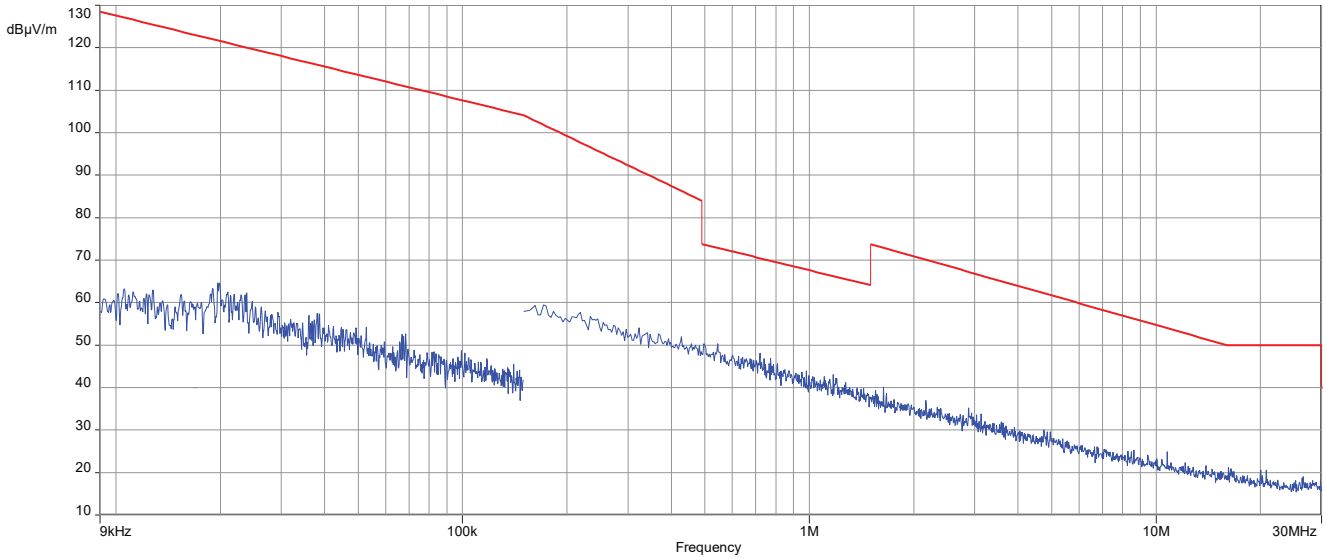
Plot 3: TX-Mode middle channel, FCC



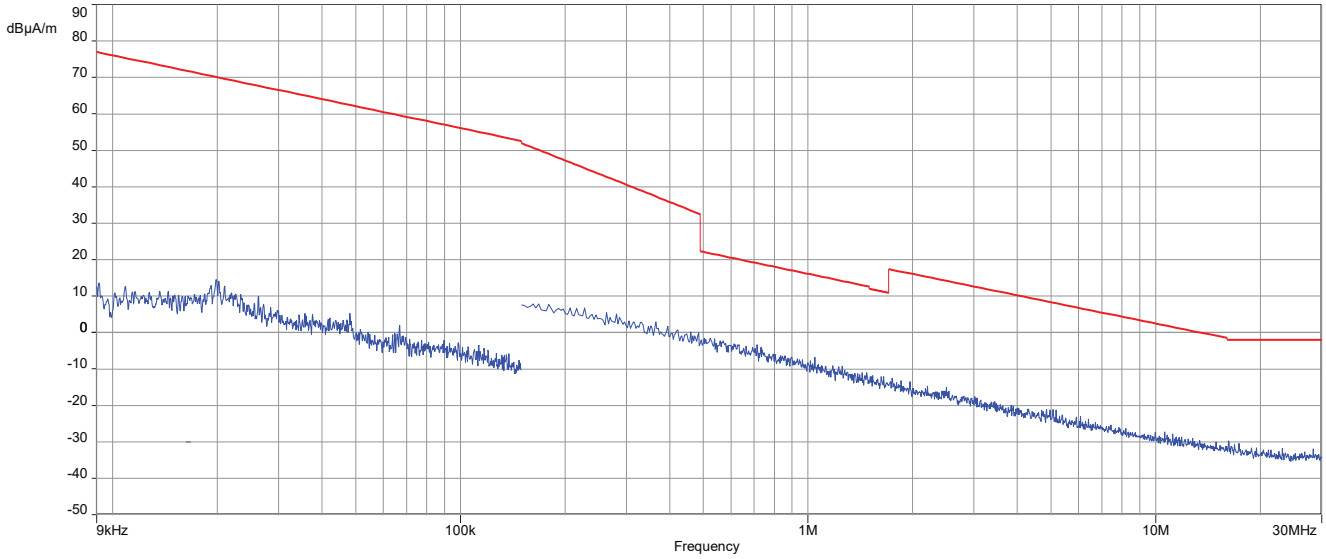
Plot 4: TX-Mode middle channel, IC



Plot 5: TX-Mode high channel, FCC



Plot 6: TX-Mode high channel, IC



13.10 Receiver spurious emissions (radiated)

Measurement:

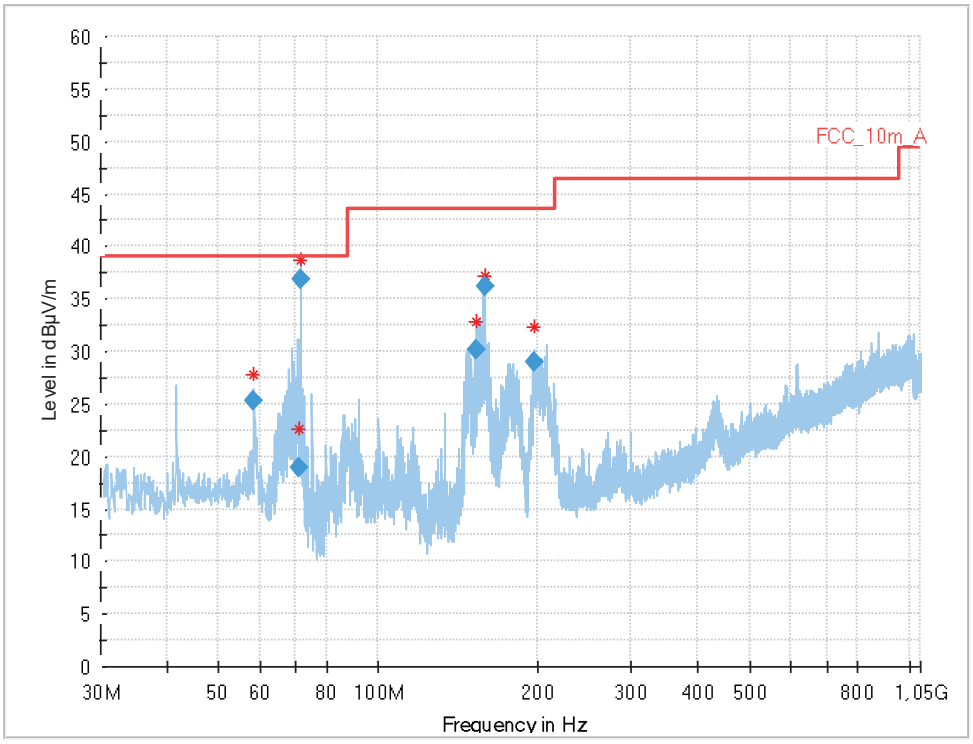
Measurement parameter	
Detector:	Peak
Sweep time:	Auto
Video bandwidth:	f < 1 GHz : 100 kHz f ≥ 1GHz : 1 MHz
Resolution bandwidth:	f < 1 GHz : 100 kHz f ≥ 1GHz : 1 MHz
Span:	See plots
Trace-Mode:	Max. hold

Limits:

FCC		IC
FCC 47 CFR § 15.209		RSS-GEN Issue 5 Section 6
Receiver Spurious Emission (radiated)		
Frequency (MHz)	**Field strength (µV/m)**	**Measurement distance (m)**
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
above 960	500	3

Result: see table below plots

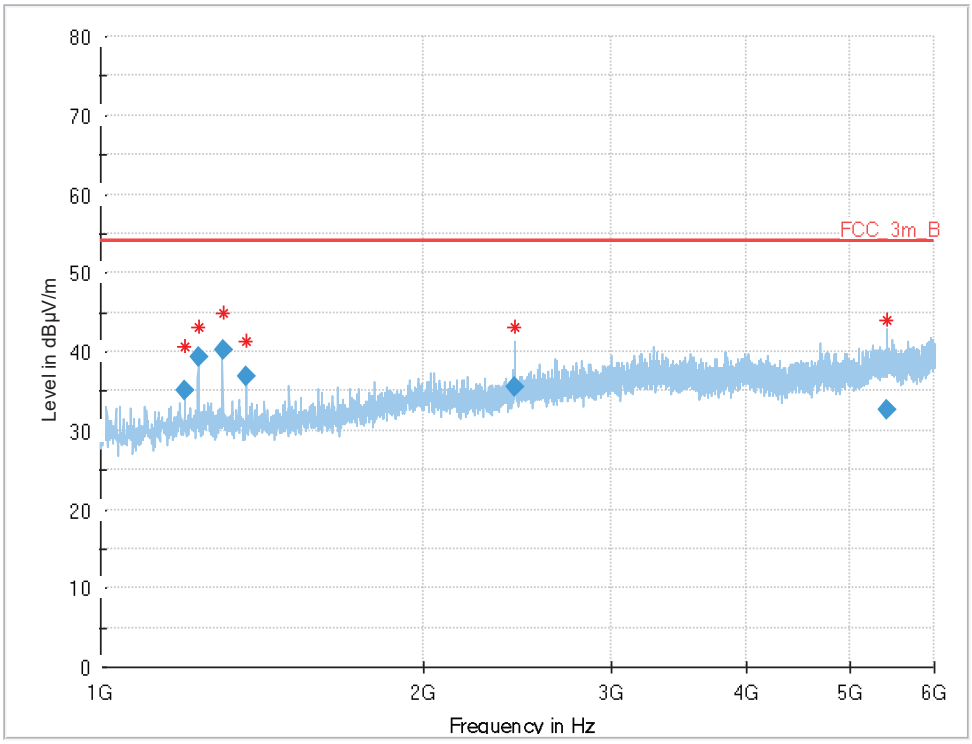
Plot 1: 30 MHz – 1 GHz



Final_Result:

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
58.342	25.24	39.1	13.9	1000	120.0	105.0	V	74	15
70.662	18.93	39.1	20.2	1000	120.0	291.0	V	270	10
71.591	36.93	39.1	2.2	1000	120.0	352.0	V	37	10
153.534	30.10	43.5	13.4	1000	120.0	106.0	V	128	10
158.339	36.23	43.5	7.3	1000	120.0	104.0	V	230	10
196.618	29.02	43.5	14.5	1000	120.0	103.0	V	182	13

Plot 2: 1 GHz – 6 GHz



Final_Result:

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
1200.002	35.09	54.0	18.9	1000	1000.0	H	149	-8
1233.399	39.44	54.0	14.6	1000	1000.0	H	160	-8
1300.070	40.27	54.0	13.7	1000	1000.0	H	106	-8
1366.622	36.95	54.0	17.1	1000	1000.0	H	71	-8
2437.960	35.61	54.0	18.4	1000	1000.0	V	101	-5
5413.621	32.73	54.0	21.3	1000	1000.0	V	102	0

13.11 Spurious emissions AC conducted < 30 MHz

Description:

Measurement of the conducted spurious emissions in transmit mode below 30 MHz. The measurement is performed with the data rate producing the highest output power. Both power lines, phase and neutral line, are measured. Found peaks are remeasured with average and quasi peak detection to show compliance to the limits.

Measurement:

Measurement parameter	
Detector:	Peak - Quasi Peak / Average
Sweep time:	Auto
Video bandwidth:	F < 150 kHz: 200 Hz F > 150 kHz: 9 kHz
Resolution bandwidth:	F < 150 kHz: 1 kHz F > 150 kHz: 100 kHz
Span:	9 kHz to 30 MHz
Trace-Mode:	Max Hold

Limits:

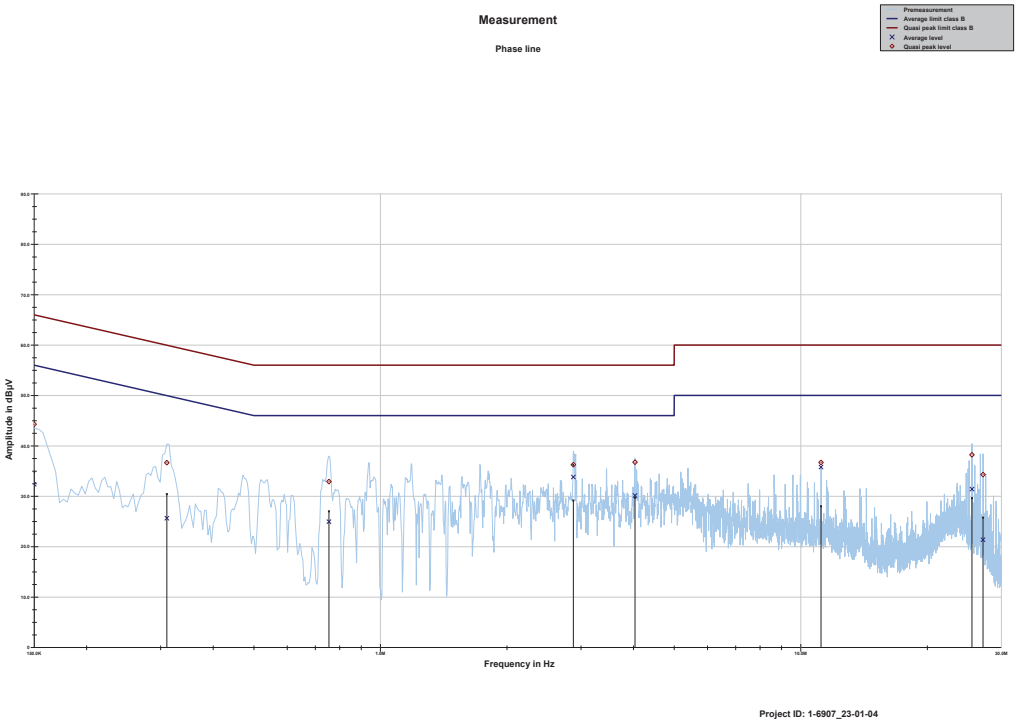
FCC		IC
TX Spurious Emissions Conducted < 30 MHz		
Frequency (MHz)	Quasi-Peak (dBµV/m)	Average (dBµV/m)
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30.0	60	50

*Decreases with the logarithm of the frequency

Results: see table below plots

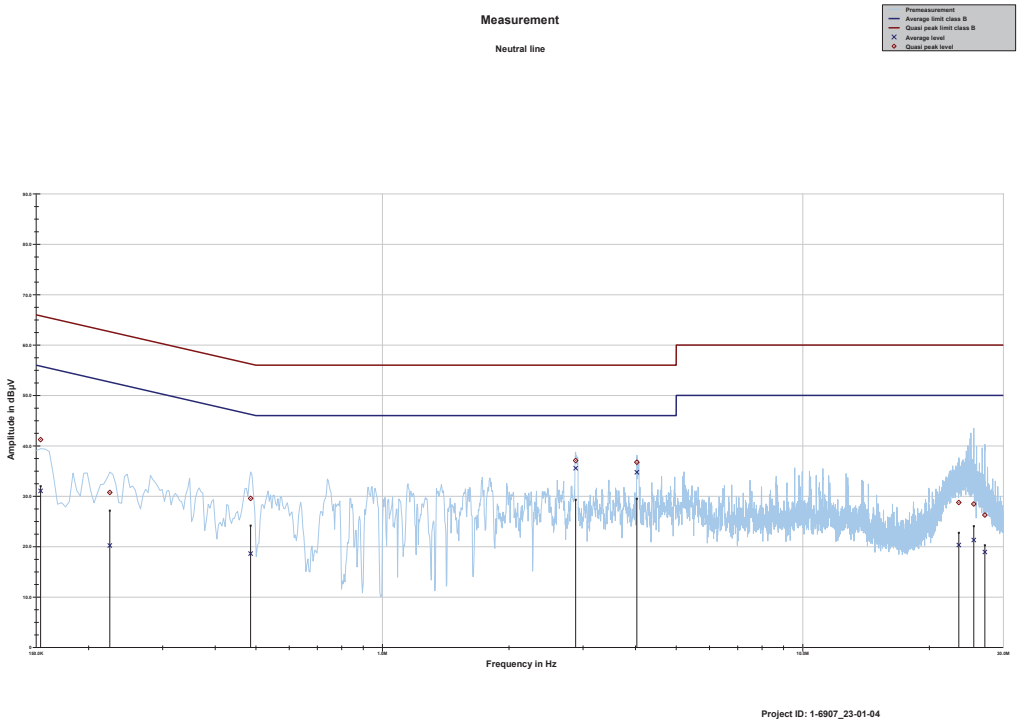
Plots:

Plot 1: TX mode, high power, 150 kHz to 30 MHz, phase line



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.150000	44.28	21.72	66.000	32.37	23.63	56.000
0.310444	36.65	23.31	59.959	25.64	25.77	51.416
0.754463	32.92	23.08	56.000	24.95	21.05	46.000
2.877544	36.25	19.75	56.000	33.81	12.19	46.000
4.034231	36.75	19.25	56.000	30.15	15.85	46.000
11.175844	36.70	23.30	60.000	35.78	14.22	50.000
25.544888	38.23	21.77	60.000	31.41	18.59	50.000
27.138131	34.29	25.71	60.000	21.38	28.62	50.000

Plot 2: TX mode, high power, 150 kHz to 30 MHz, neutral line



Frequency	Quasi peak level	Margin quasi peak	Limit QP	Average level	Margin Average	Limit AV
MHz	dBµV	dB	dBµV	dBµV	dB	dBµV
0.153731	41.23	24.57	65.796	31.07	24.83	55.893
0.224625	30.75	31.89	62.646	20.23	33.64	53.868
0.485812	29.57	26.67	56.239	18.62	27.79	46.405
2.881275	37.07	18.93	56.000	35.56	10.44	46.000
4.030500	36.74	19.26	56.000	34.76	11.24	46.000
23.515087	28.76	31.24	60.000	20.32	29.68	50.000
25.518769	28.45	31.55	60.000	21.31	28.69	50.000
27.115744	26.27	33.73	60.000	18.93	31.07	50.000

14 Glossary

AVG	Average
C	Compliant
C/N_0	Carrier to noise-density ratio, expressed in dB-Hz
CAC	Channel availability check
CW	Clean wave
DC	Duty cycle
DFS	Dynamic frequency selection
DSSS	Dynamic sequence spread spectrum
DUT	Device under test
EN	European Standard
ETSI	European Telecommunications Standards Institute
EMC	Electromagnetic Compatibility
EUT	Equipment under test
FCC	Federal Communications Commission
FCC ID	Company Identifier at FCC
FHSS	Frequency hopping spread spectrum
FVIN	Firmware version identification number
GNSS	Global Navigation Satellite System
GUE	GNSS User Equipment
HMN	Host marketing name
HVIN	Hardware version identification number
HW	Hardware
IC	Industry Canada
Inv. No.	Inventory number
MC	Modulated carrier
NA	Not applicable
NC	Not compliant
NOP	Non occupancy period
NP	Not performed
OBW	Occupied bandwidth
OC	Operating channel
OCW	Operating channel bandwidth
OFDM	Orthogonal frequency division multiplexing
OOB	Out of band
OP	Occupancy period
PER	Packet error rate
PMN	Product marketing name
PP	Positive peak
QP	Quasi peak
RLAN	Radio local area network
S/N or SN	Serial number
SW	Software
UUT	Unit under test
WLAN	Wireless local area network

15 Document history

Version	Applied changes	Date of release
-/-	Initial release	2024-08-12

########## END OF TEST REPORT ##########