
FCC§22.917(a) & §24.238(a) & §27.53 – Band Edges

Applicable Standard

FCC §22.917, § 24.238, § 27.53

According to § 22.917(a), the power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

According to §24.238(a), the power of any emissions outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

According to FCC §27.53 (h) (m), the power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.

For mobile digital stations, the attenuation factor shall be not less than $40 + 10 \log (P)$ dB on all frequencies between the channel edge and 5 megahertz from the channel edge, $43 + 10 \log (P)$ dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and $55 + 10 \log (P)$ dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less than $43 + 10 \log (P)$ dB on all frequencies between 2490.5 MHz and 2496 MHz and $55 + 10 \log (P)$ dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

The center of the spectrum analyzer was set to block edge frequency.

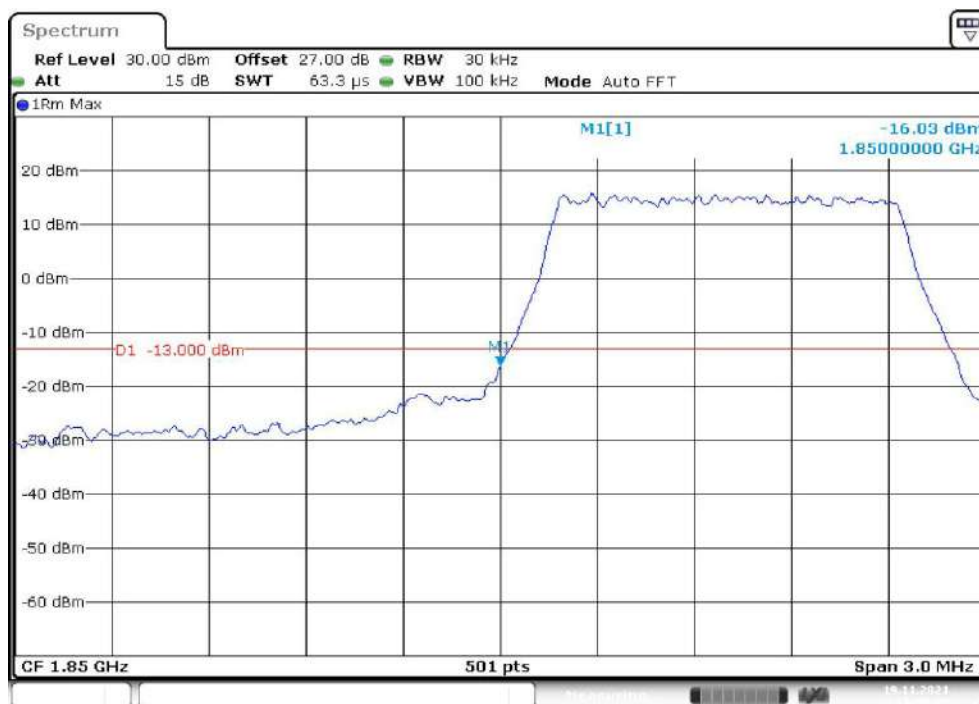
Test Results

Please refer to the following plots

(Worst case is Resource Block & RB offset : Full RB)

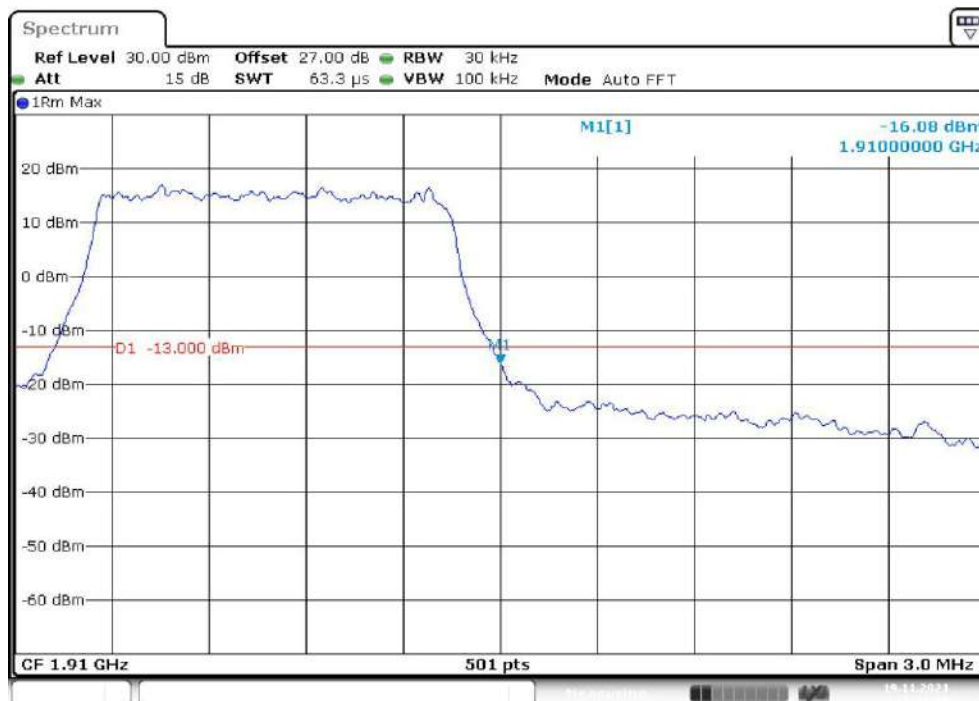
LTE Band 2

QPSK (1.4MHz, RB6) – Left Band Edge

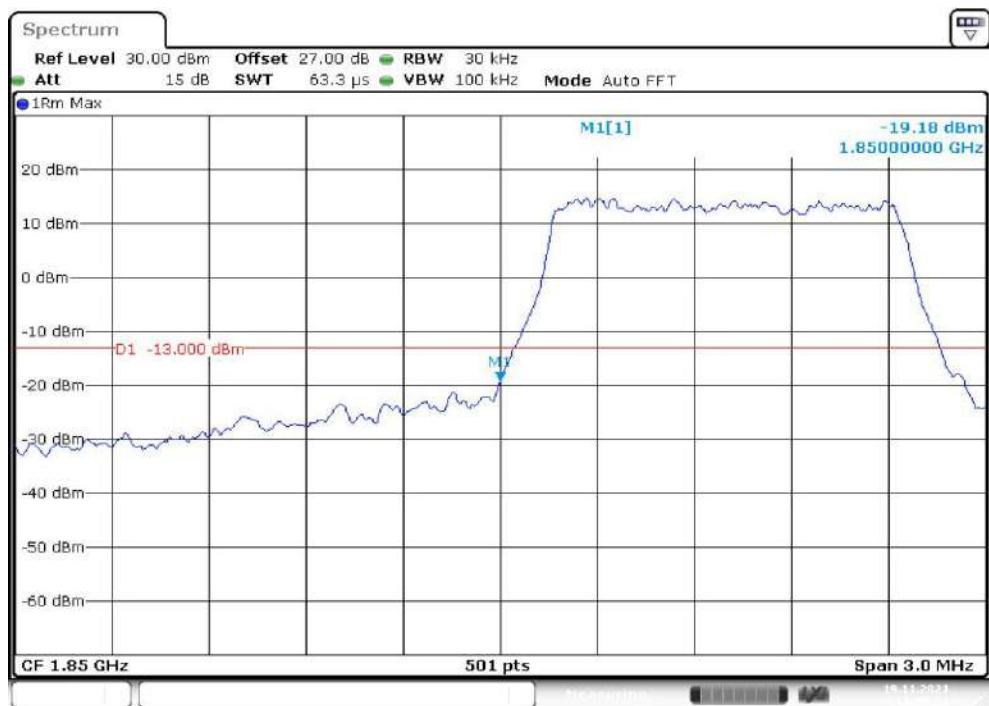


Date: 19.NOV.2021 14:20:35

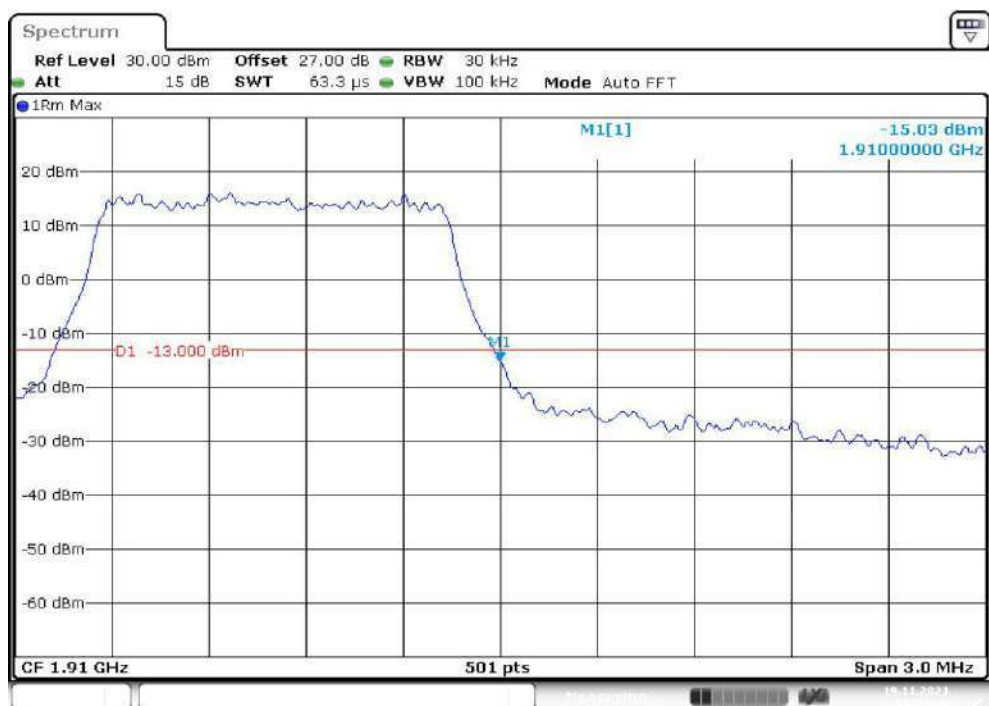
QPSK (1.4MHz, RB6) – Right Band Edge



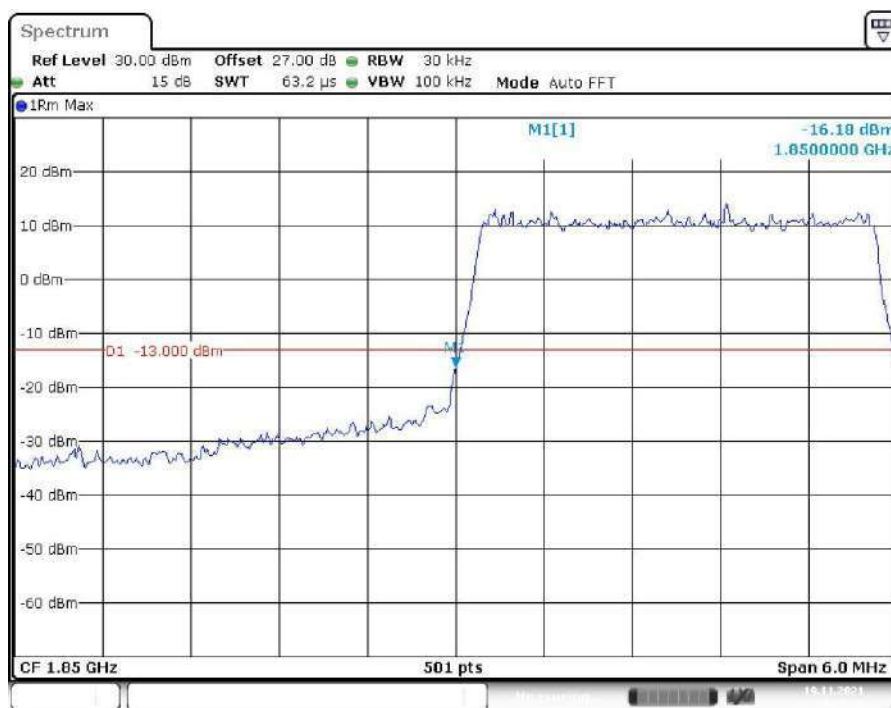
Date: 19.NOV.2021 14:21:07

16QAM (1.4MHz, RB6) – Left Band Edge

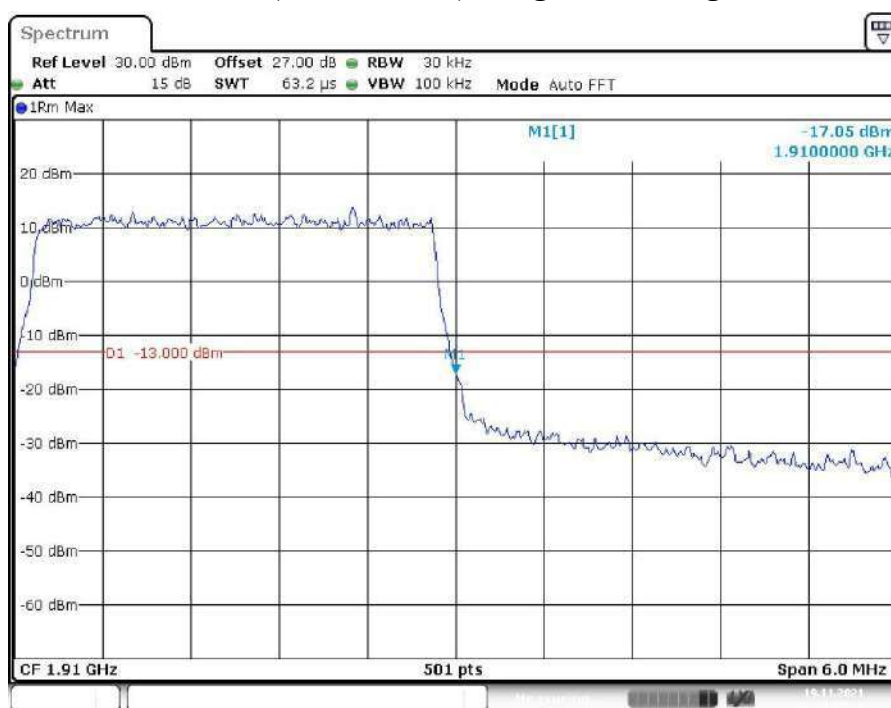
Date: 19.NOV.2021 14:20:52

16QAM (1.4MHz, RB6) – Right Band Edge

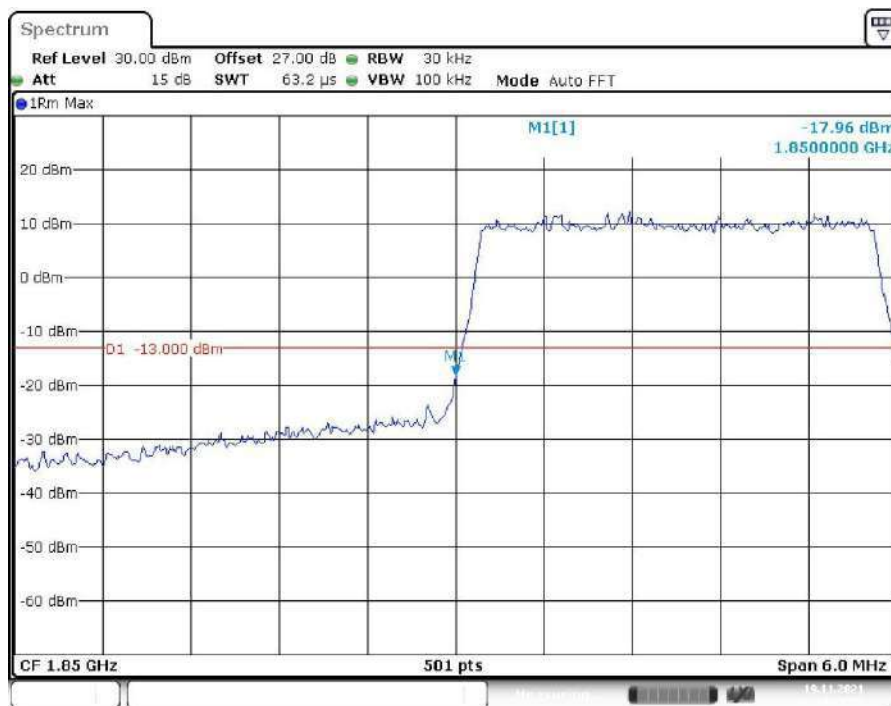
Date: 19.NOV.2021 14:21:24

QPSK (3MHz, RB15) – Left Band Edge

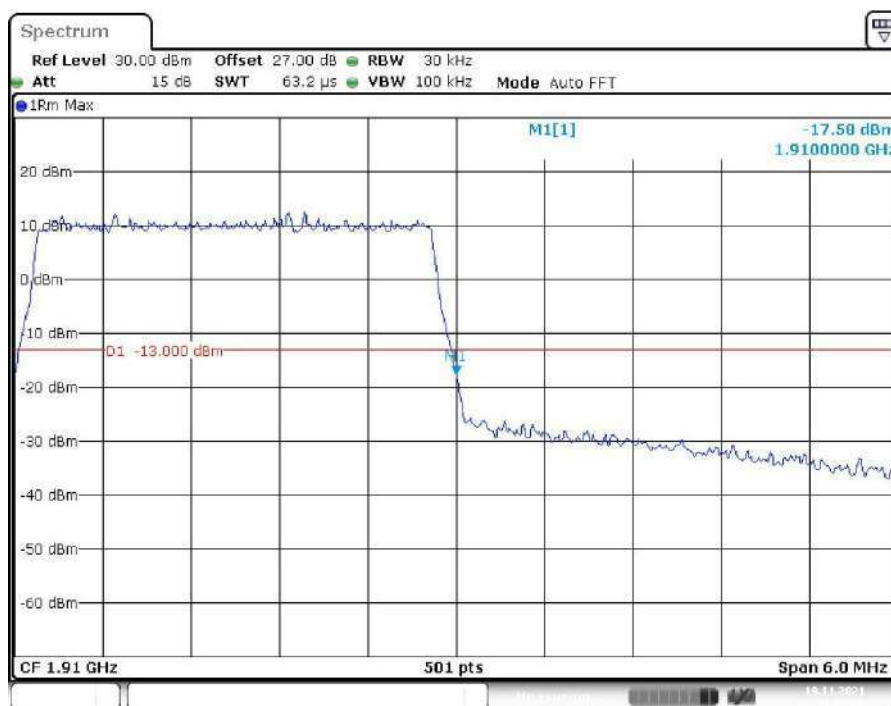
Date: 19.NOV.2021 14:21:41

QPSK (3MHz, RB15) – Right Band Edge

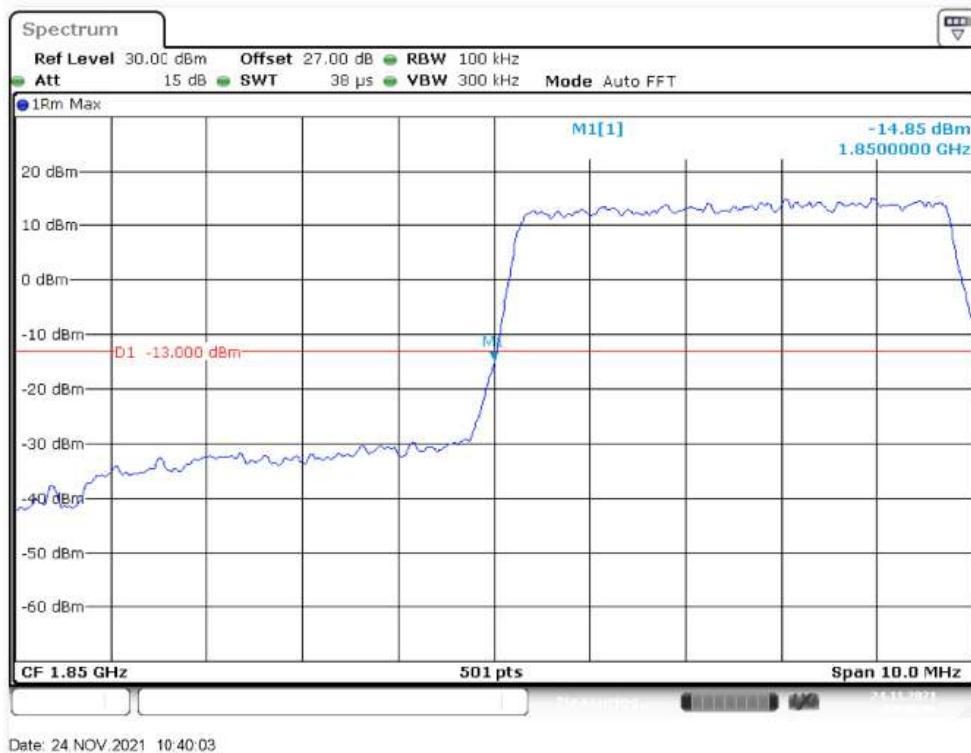
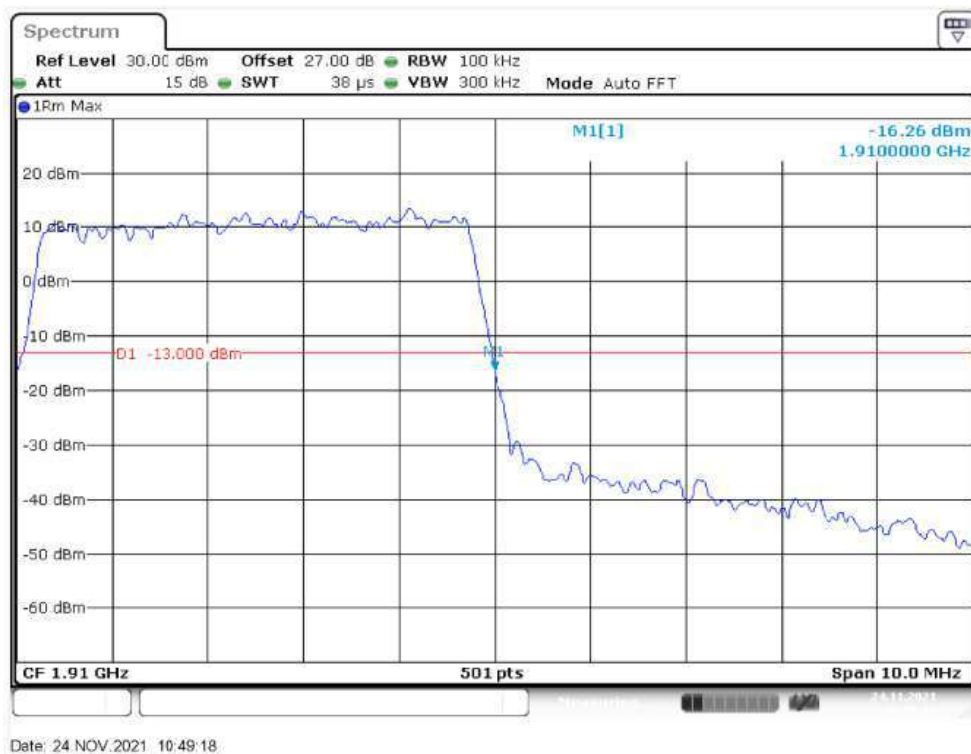
Date: 19.NOV.2021 14:22:13

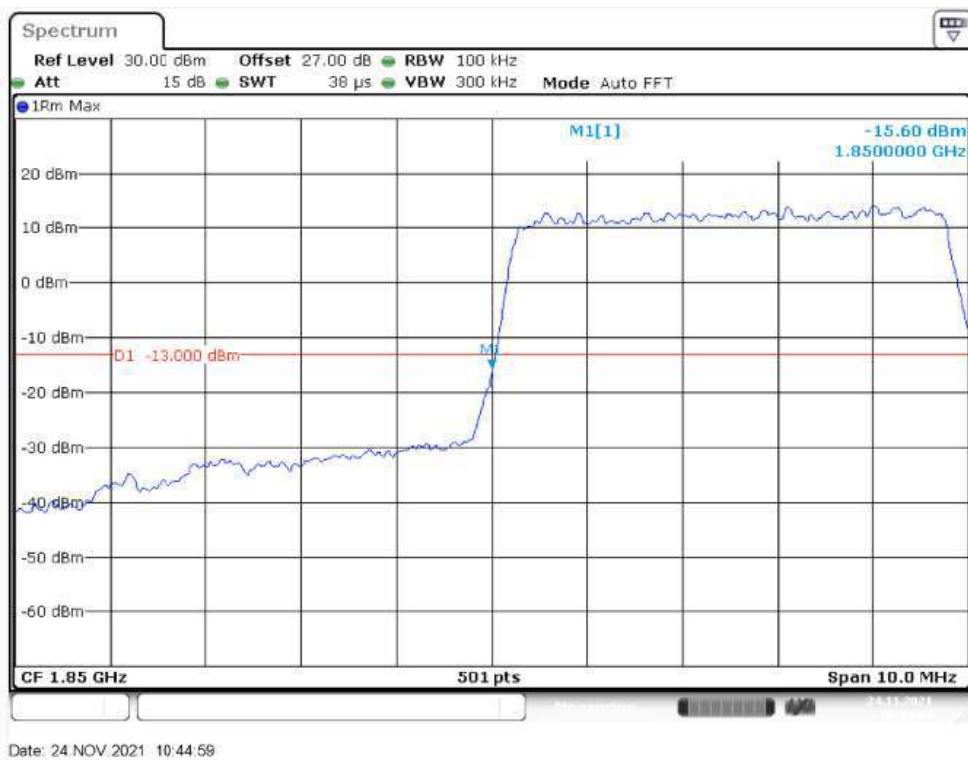
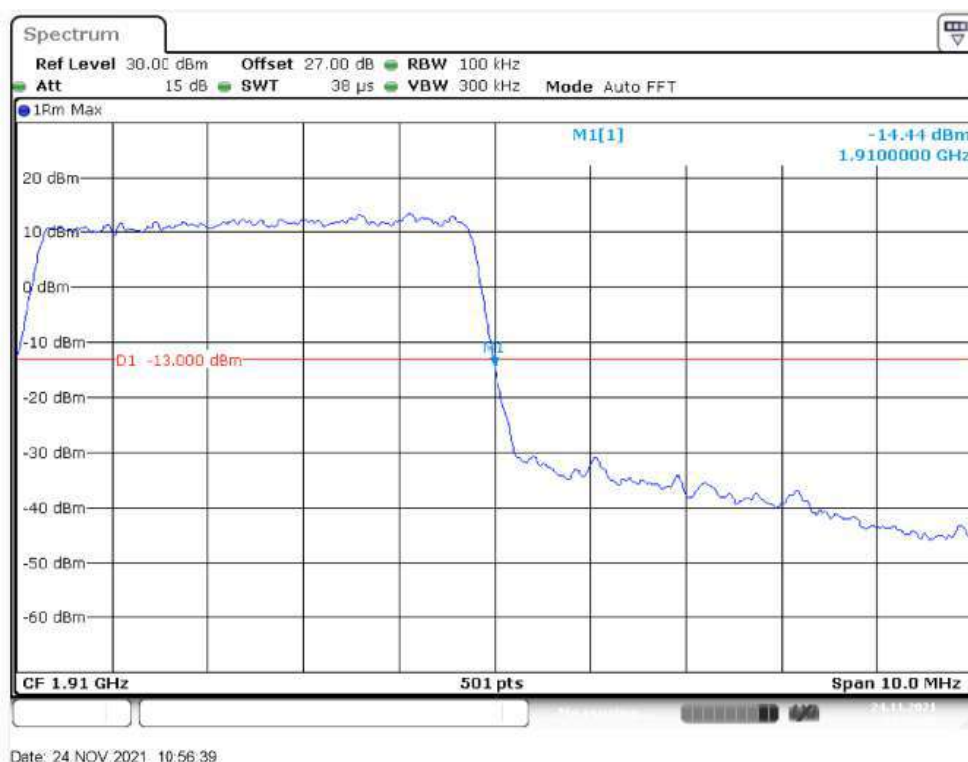
16QAM (3MHz, RB15) – Left Band Edge

Date: 19.NOV.2021 14:21:58

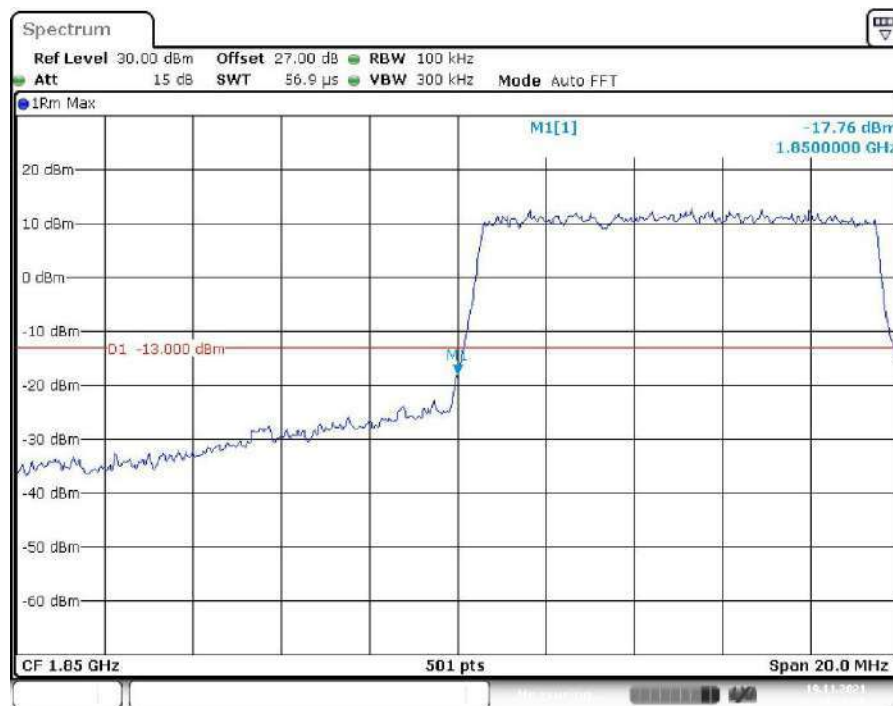
16QAM (3MHz, RB15) – Right Band Edge

Date: 19.NOV.2021 14:22:26

QPSK (5MHz, RB25) – Left Band Edge**QPSK (5MHz, RB25) – Right Band Edge**

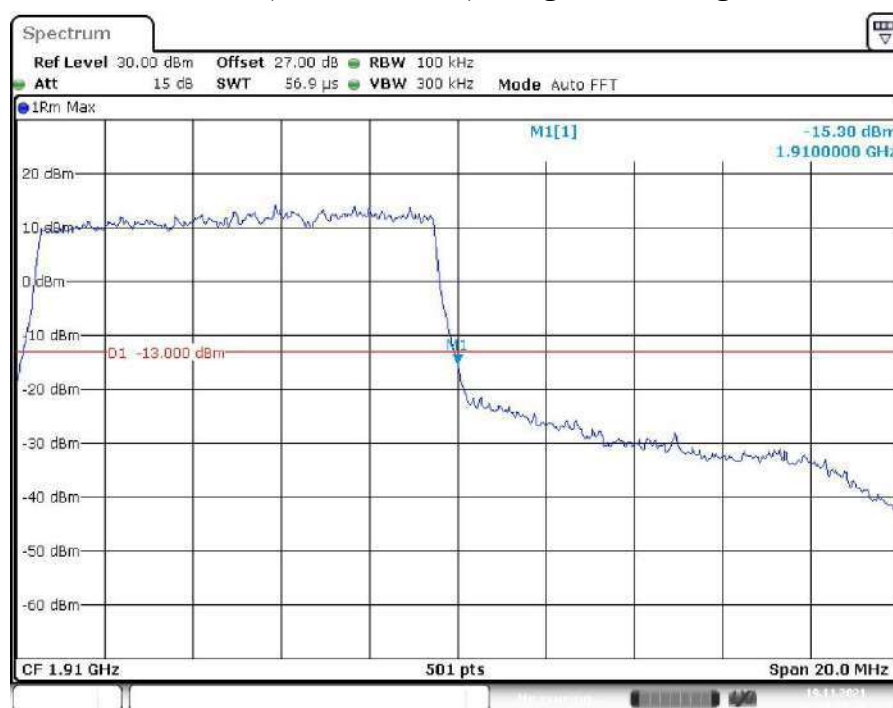
16QAM (5MHz, RB25) – Left Band Edge**16QAM (5MHz, RB25) – Right Band Edge**

QPSK (10MHz, RB50) – Left Band Edge

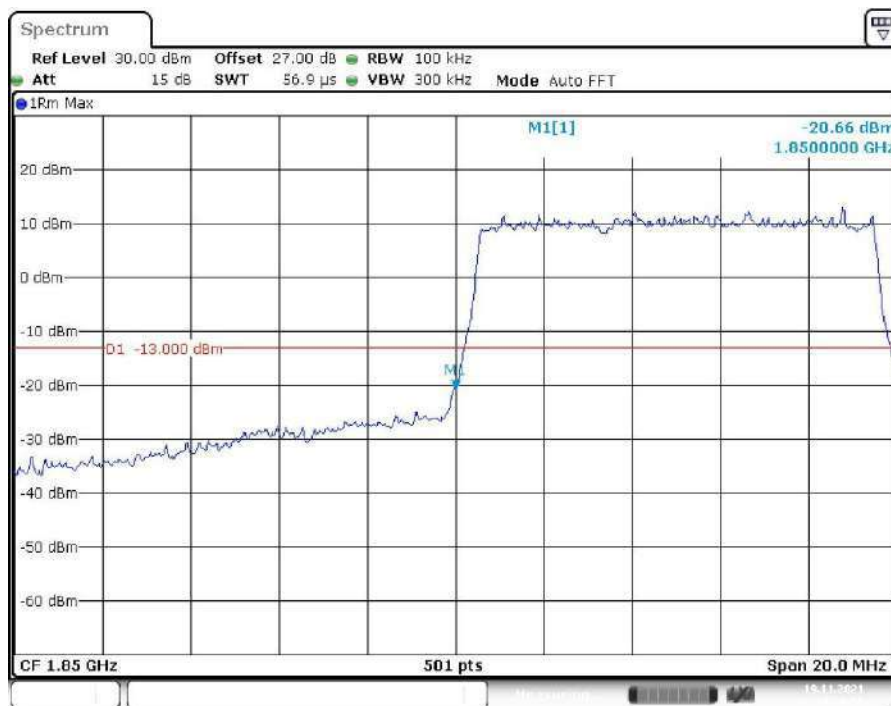


Date: 19.NOV.2021 14:24:28

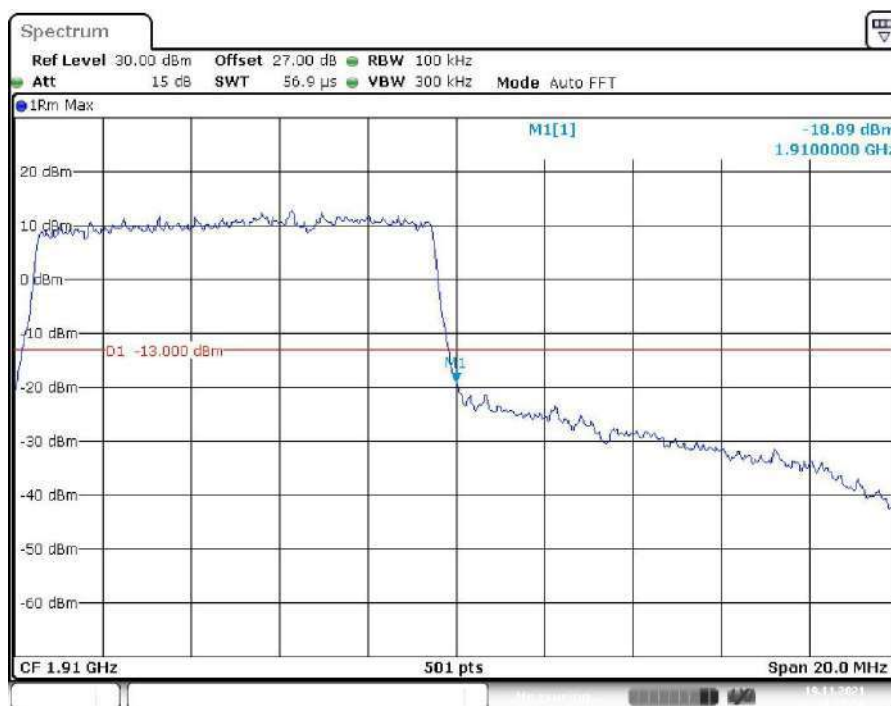
QPSK (10MHz, RB50) – Right Band Edge



Date: 19.NOV.2021 14:25:28

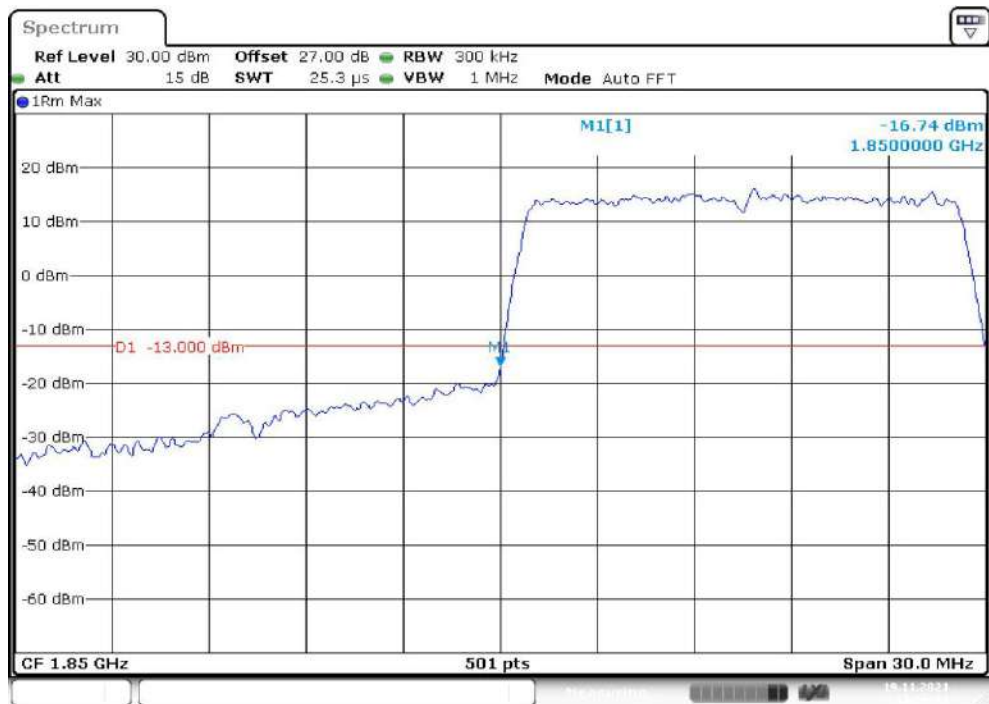
16QAM (10MHz, RB50) – Left Band Edge

Date: 19.NOV.2021 14:24:58

16QAM (10MHz, RB50) – Right Band Edge

Date: 19.NOV.2021 14:25:55

QPSK (15MHz, RB75) – Left Band Edge



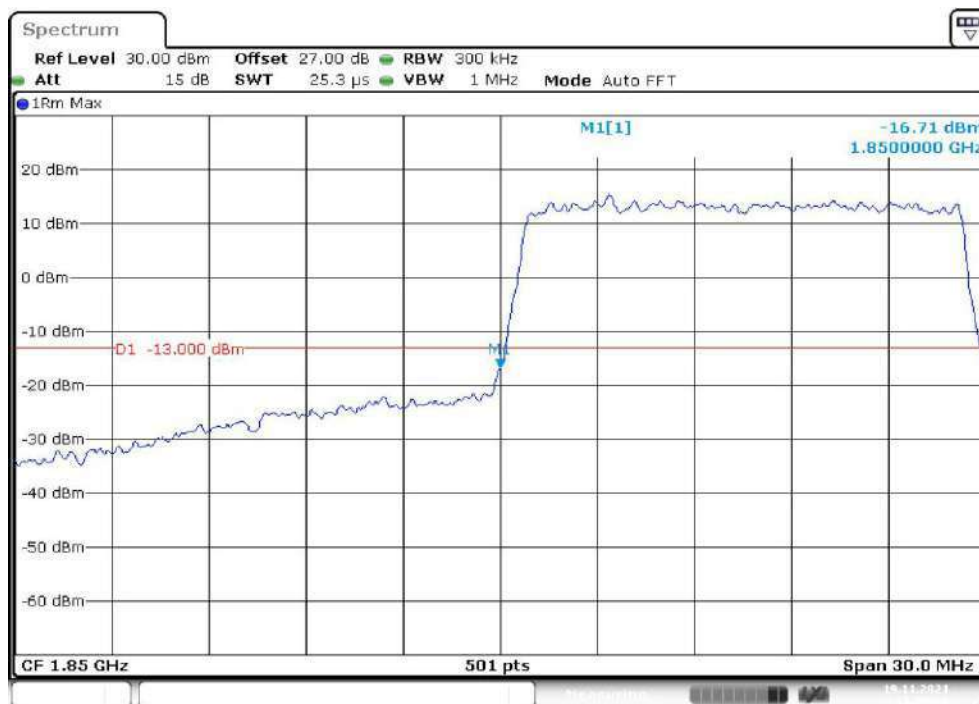
Date: 19.NOV.2021 14:26:31

QPSK (15MHz, RB75) – Right Band Edge



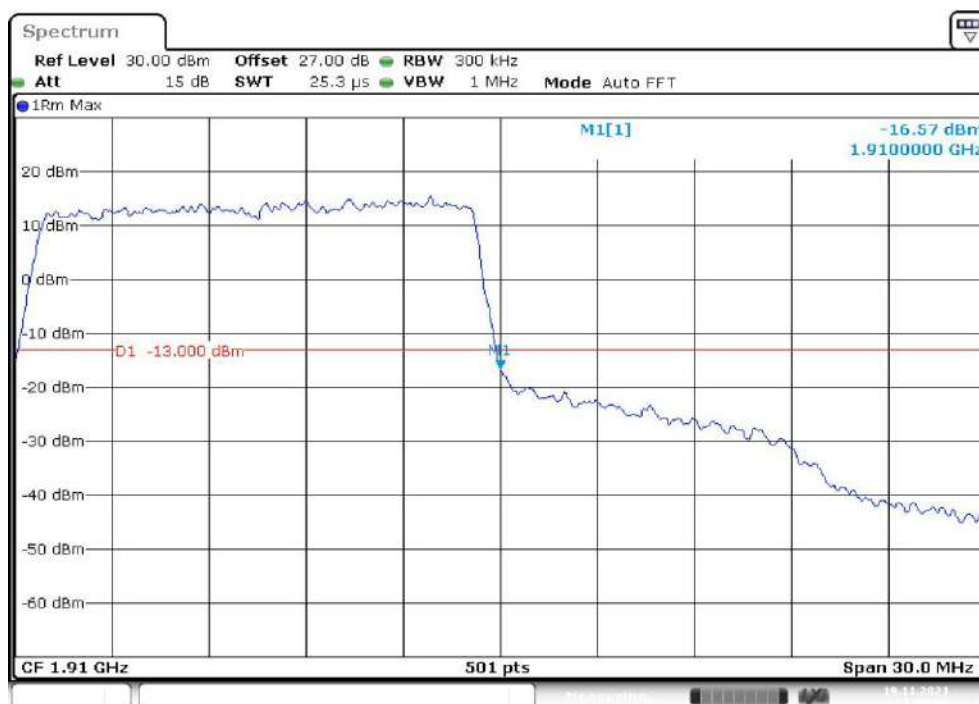
Date: 19.NOV.2021 14:27:25

16QAM (15MHz, RB75) – Left Band Edge



Date: 19.NOV.2021 14:27:01

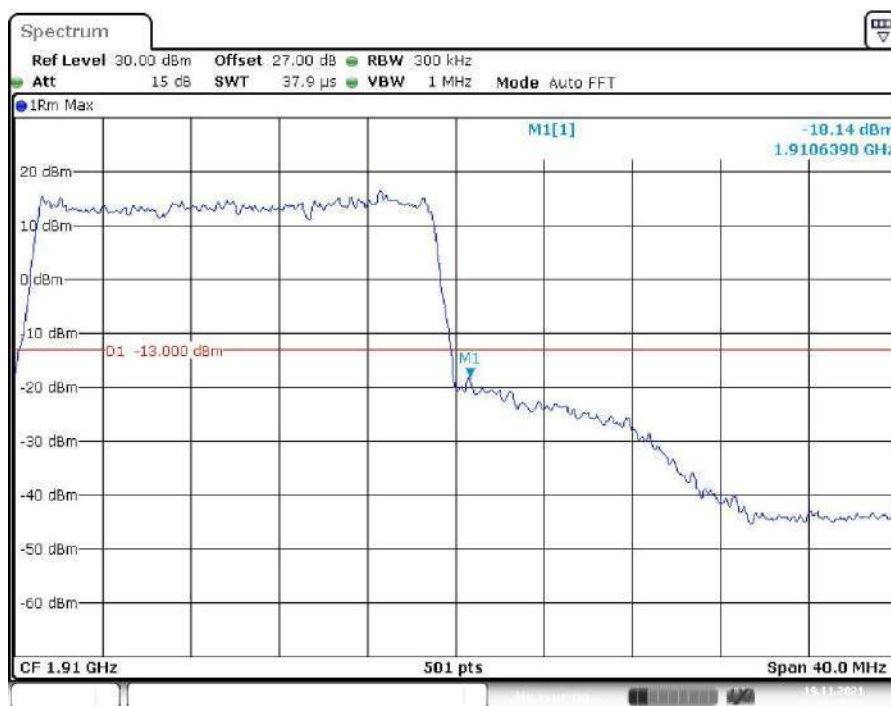
16QAM (15MHz, RB75) – Right Band Edge



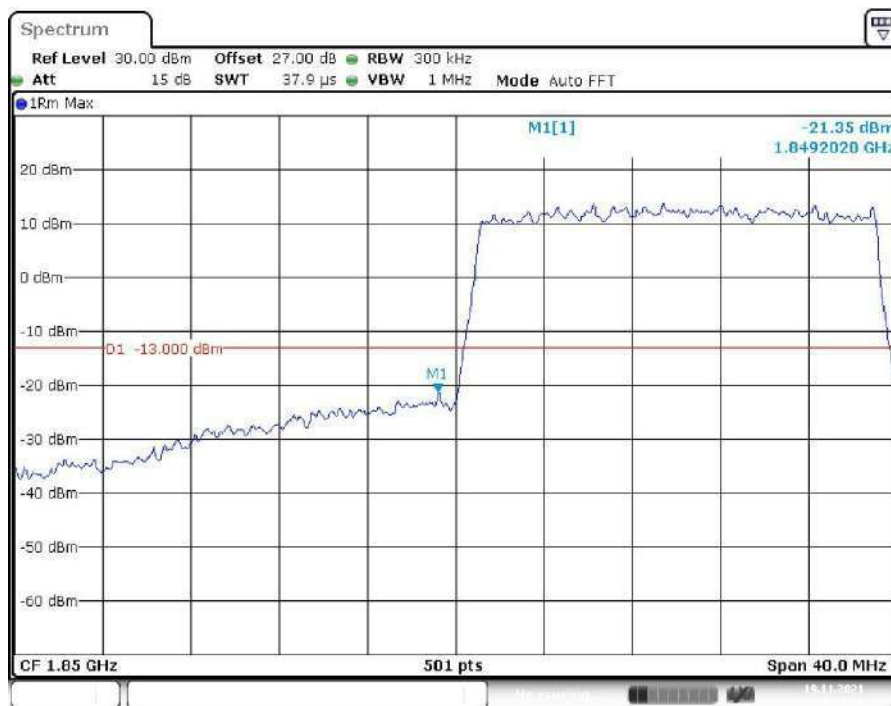
Date: 19.NOV.2021 14:27:45

QPSK (20MHz, RB100) – Left Band Edge

Date: 19.NOV.2021 14:28:16

QPSK (20MHz, RB100) – Right Band Edge

Date: 19.NOV.2021 14:29:22

16QAM (20MHz, RB100) – Left Band Edge

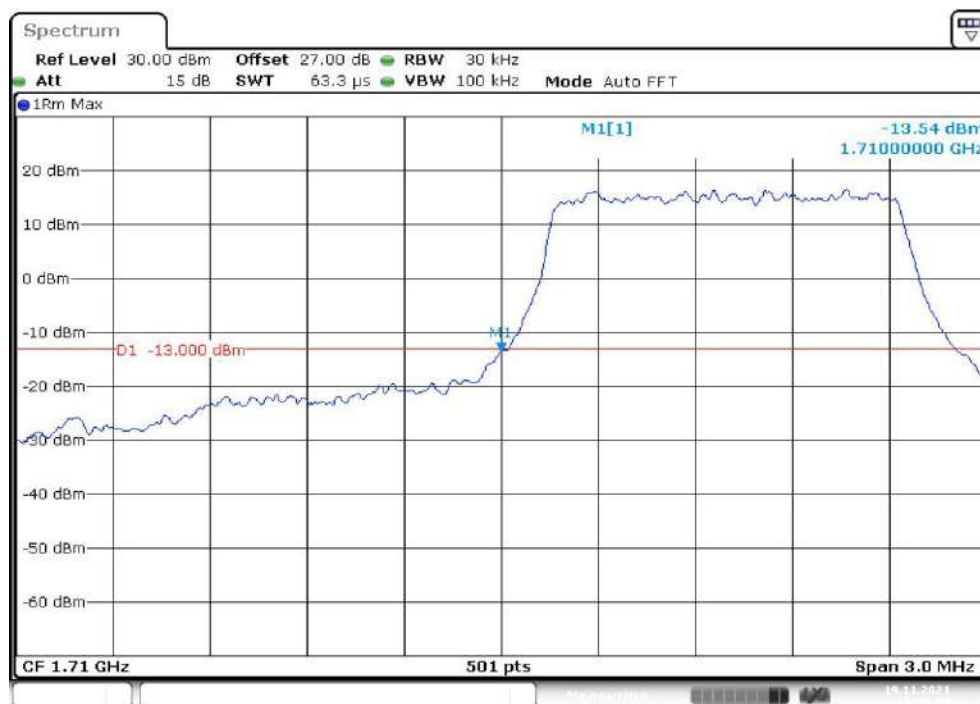
Date: 19.NOV.2021 14:28:46

16QAM (20MHz, RB100) – Right Band Edge

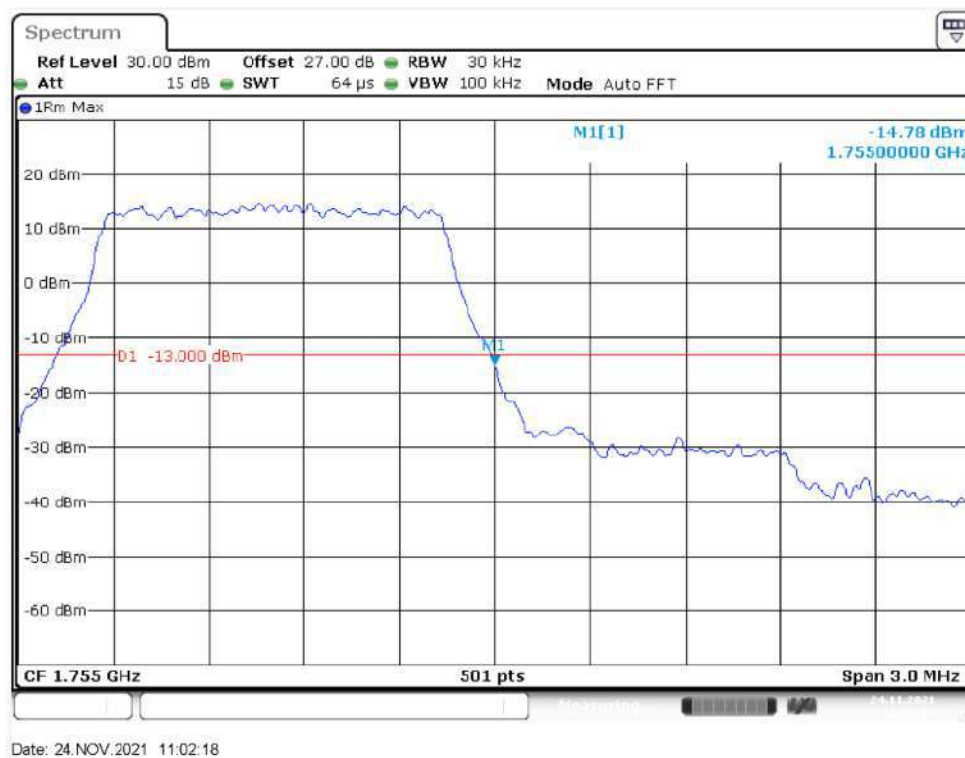
Date: 19.NOV.2021 14:29:55

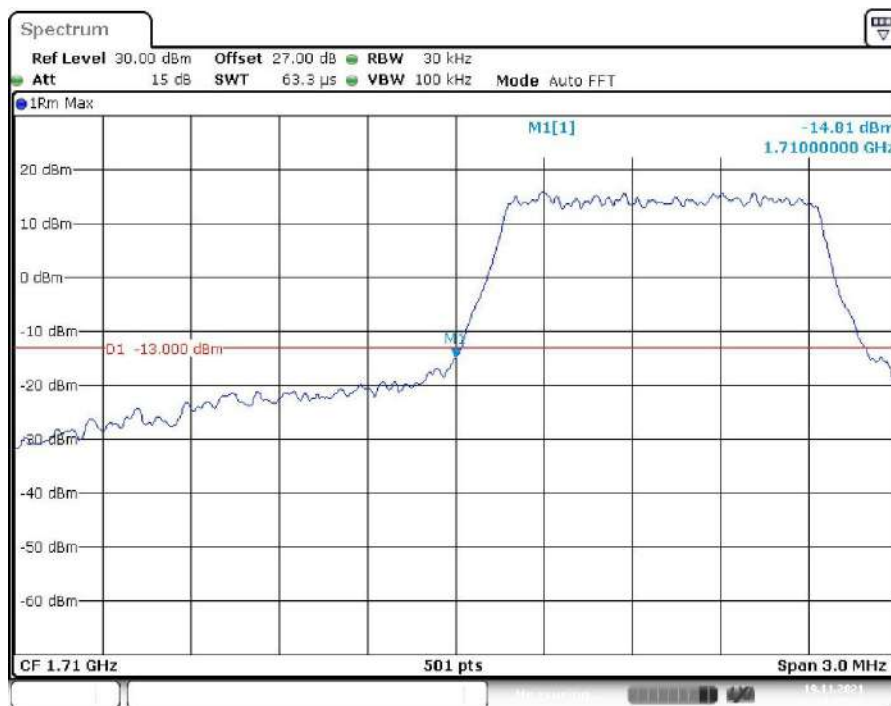
LTE Band 4

QPSK (1.4MHz, RB6) – Left Band Edge

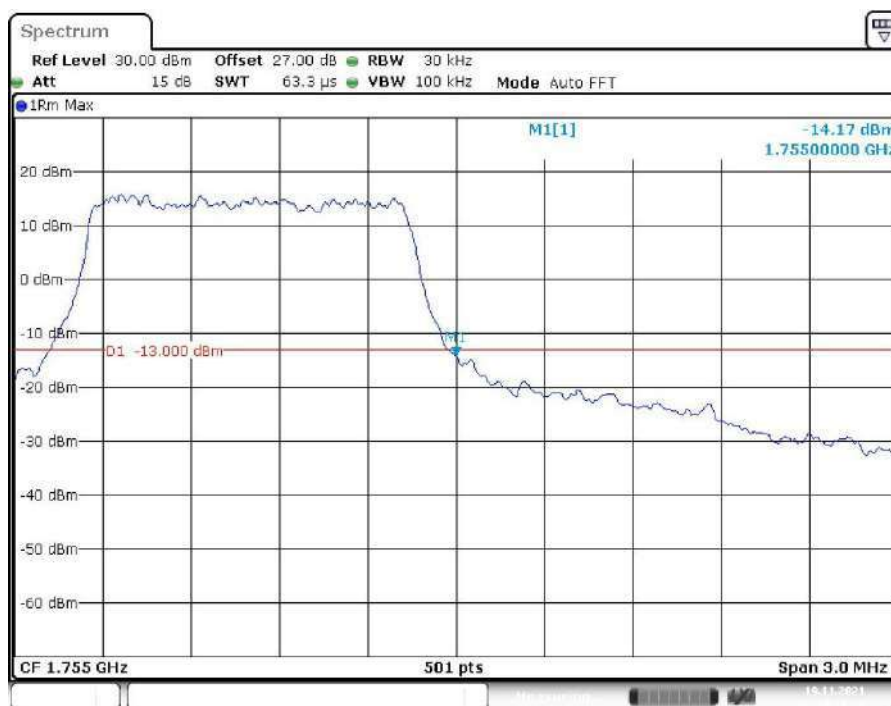


QPSK (1.4MHz, RB6) – Right Band Edge

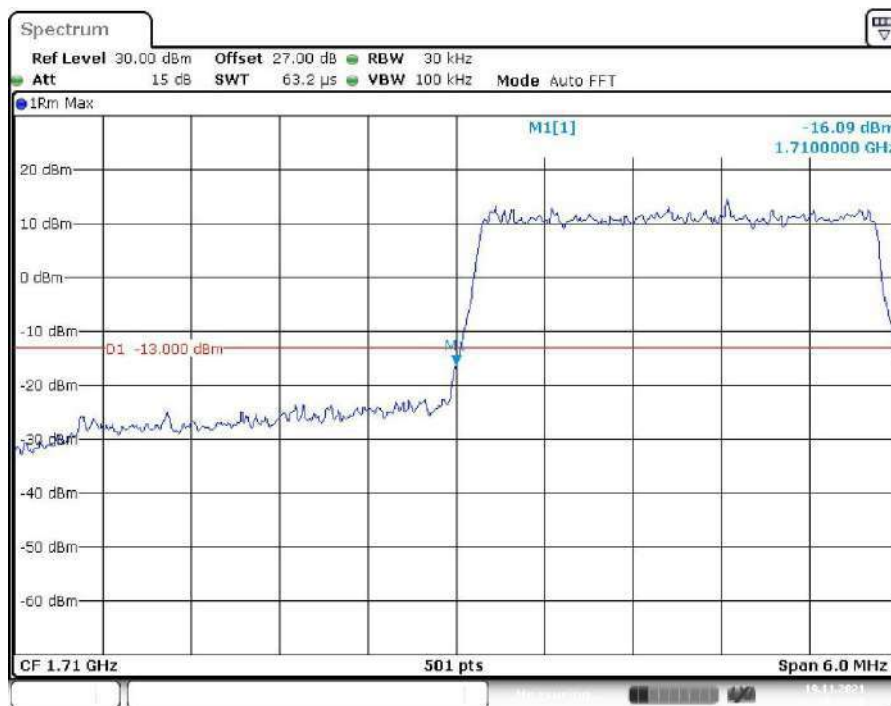


16QAM (1.4MHz, RB5) – Left Band Edge

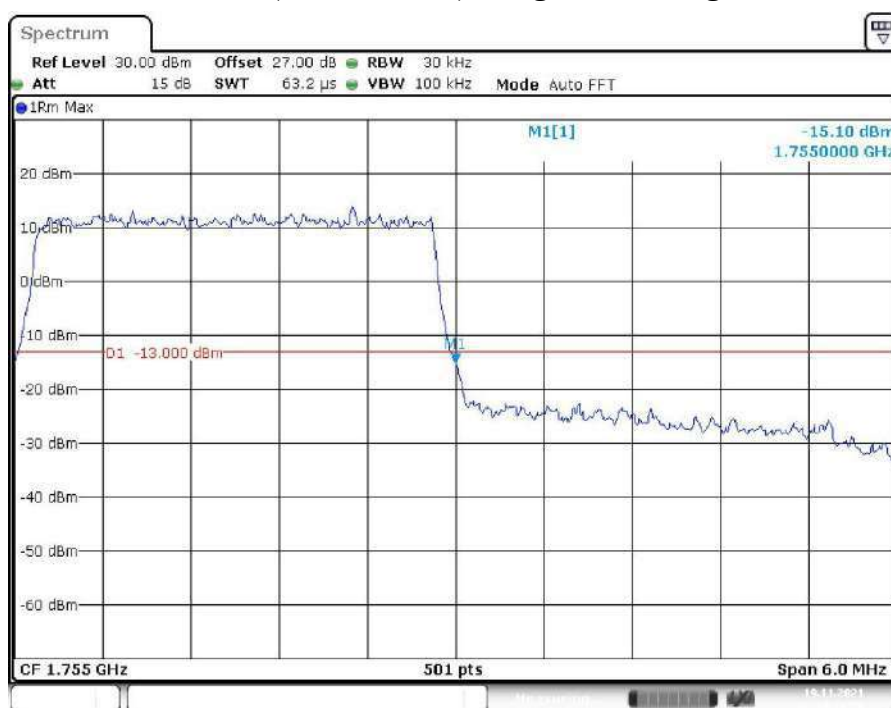
Date: 19.NOV.2021 14:30:38

16QAM (1.4MHz, RB5) – Right Band Edge

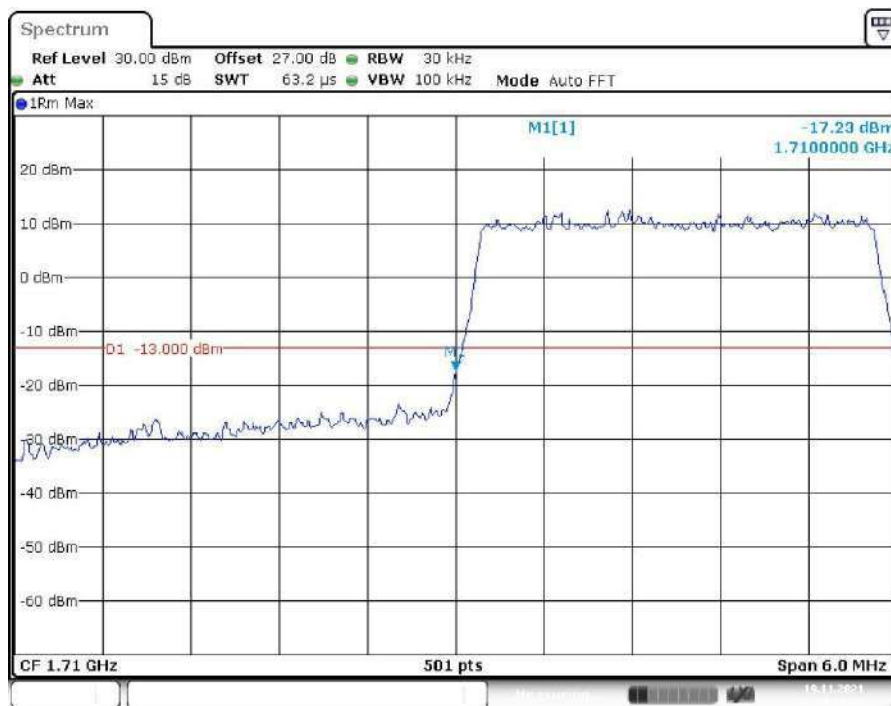
Date: 19.NOV.2021 14:31:12

QPSK (3MHz, RB15) – Left Band Edge

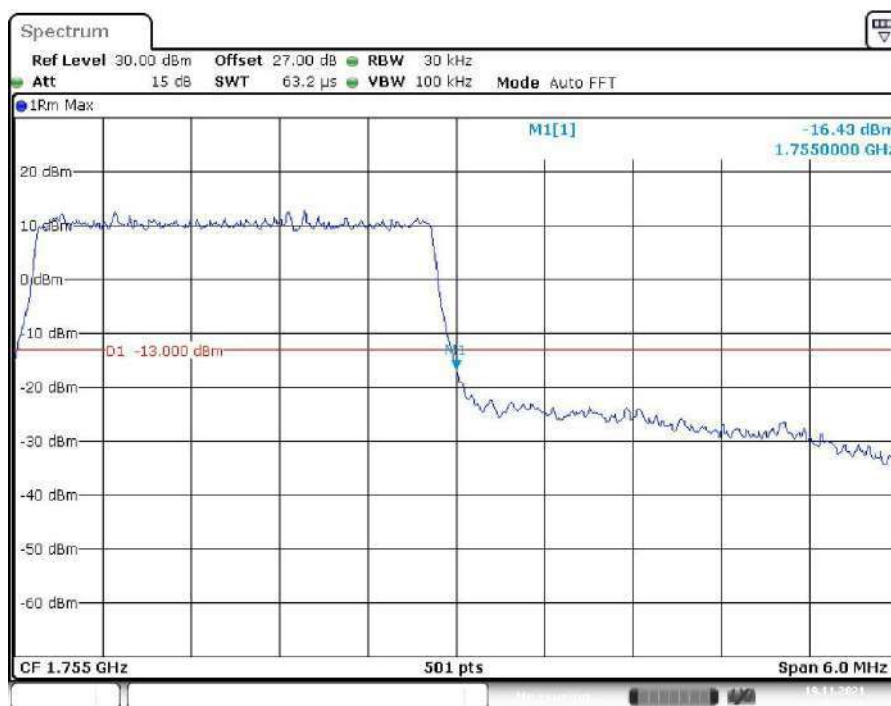
Date: 19.NOV.2021 14:31:30

QPSK (3MHz, RB15) – Right Band Edge

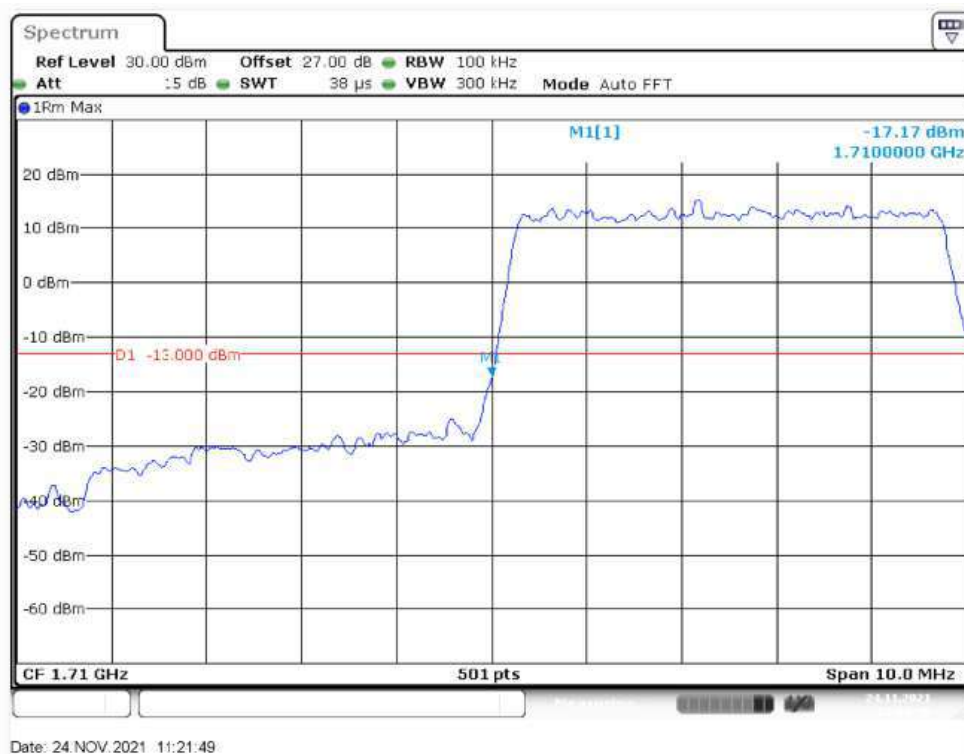
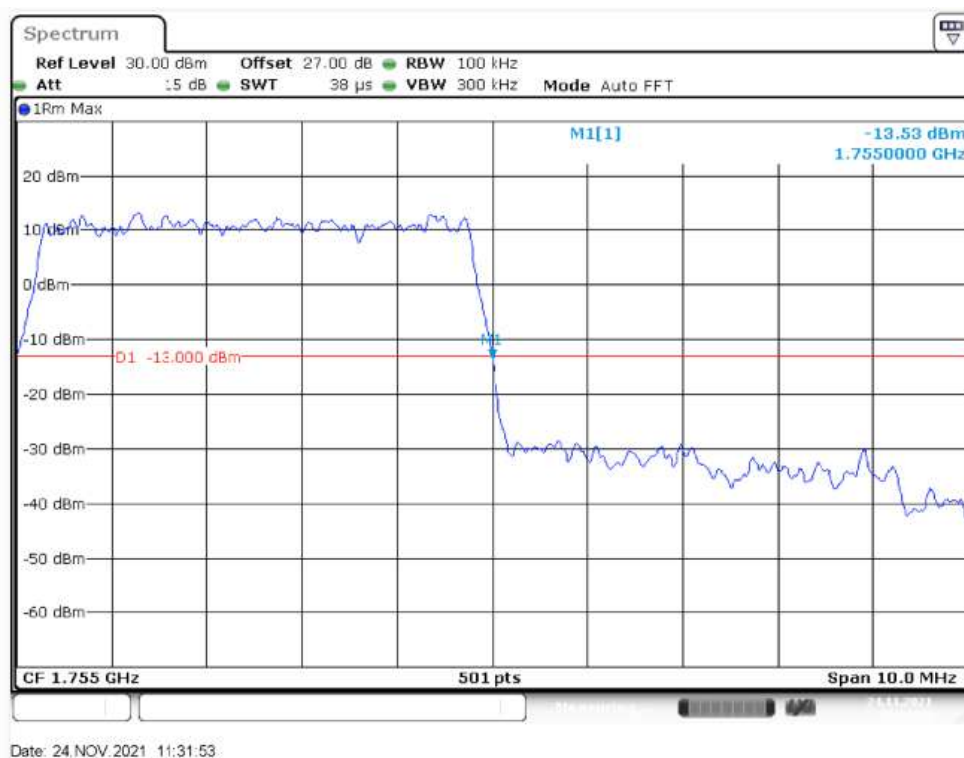
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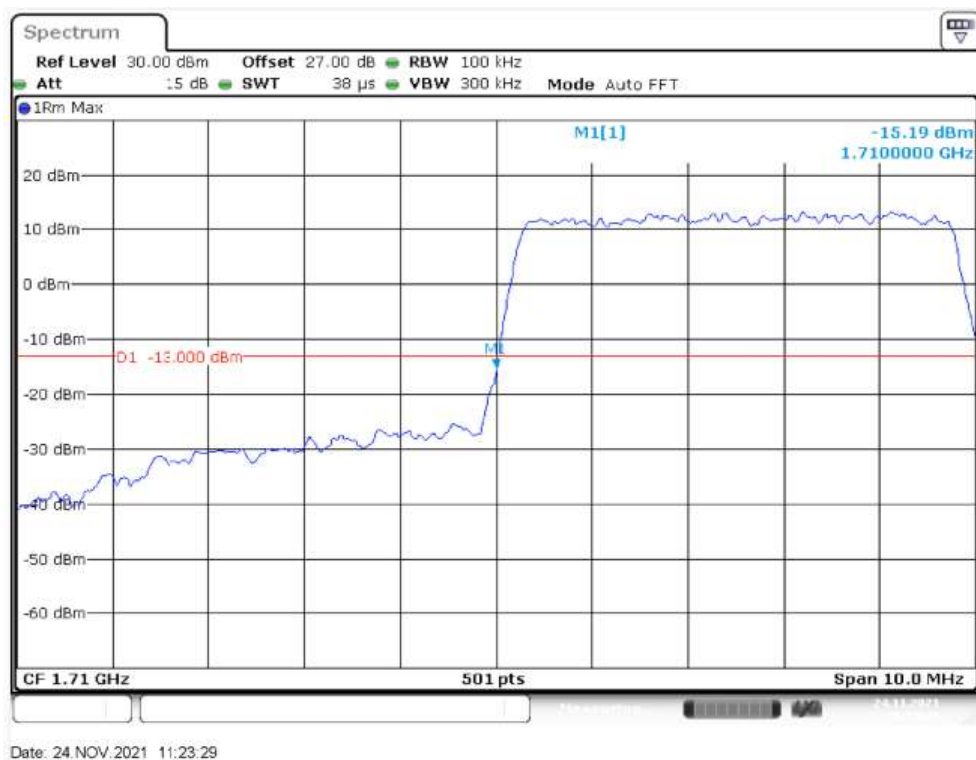
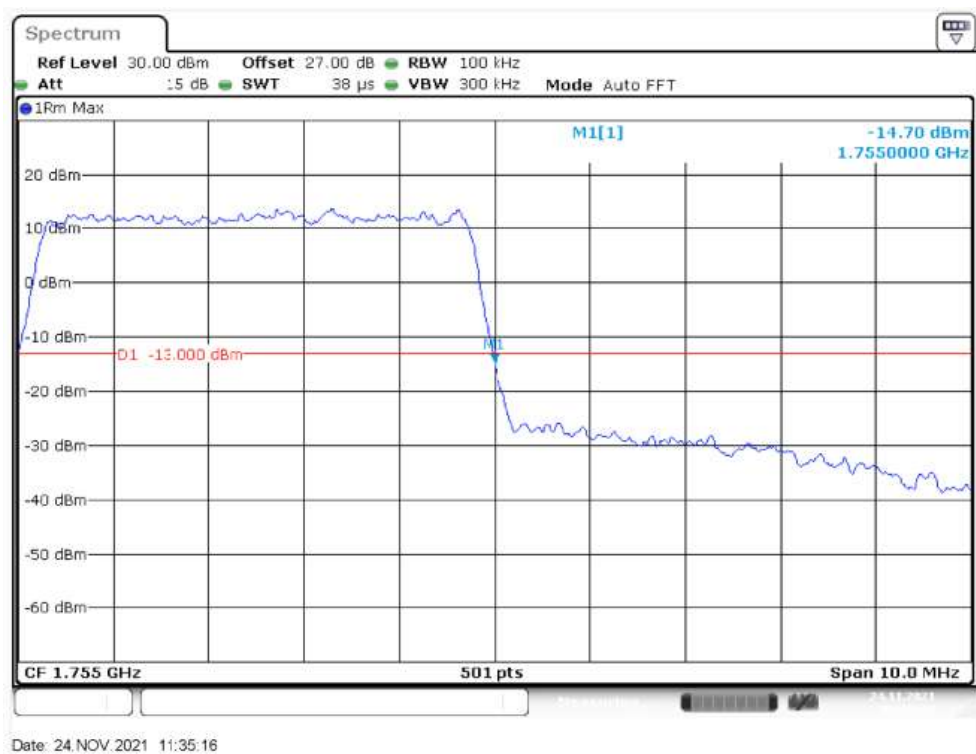
16QAM (3MHz, RB15) – Left Band Edge

Date: 19.NOV.2021 14:31:44

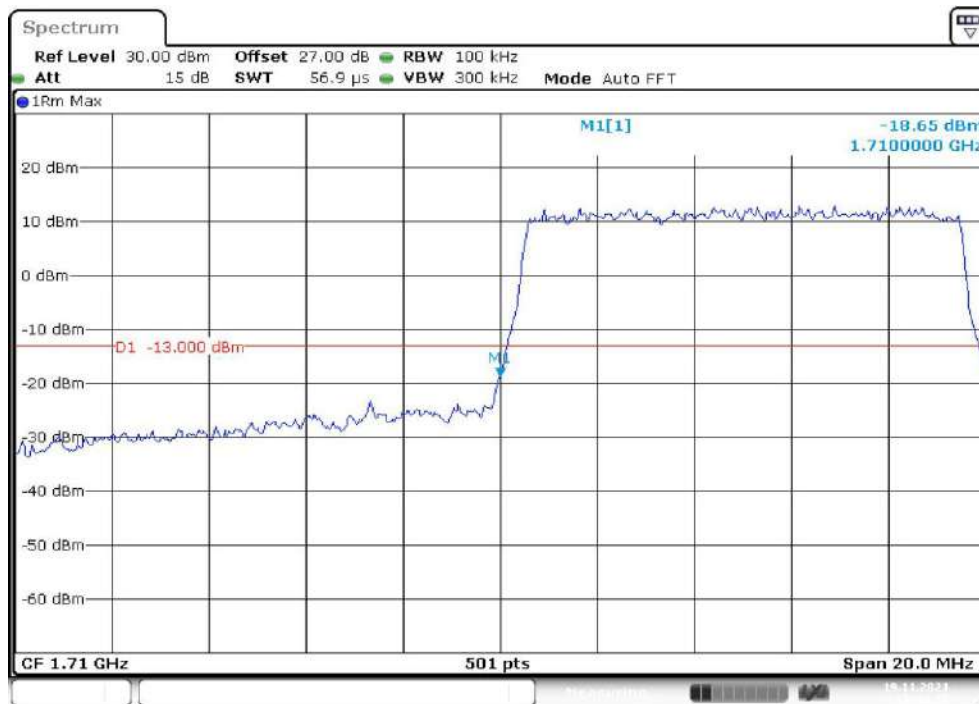
16QAM (3MHz, RB15) – Right Band Edge

Date: 19.NOV.2021 14:32:18

QPSK (5MHz, RB25) – Left Band Edge**QPSK (5MHz, RB25) – Right Band Edge**

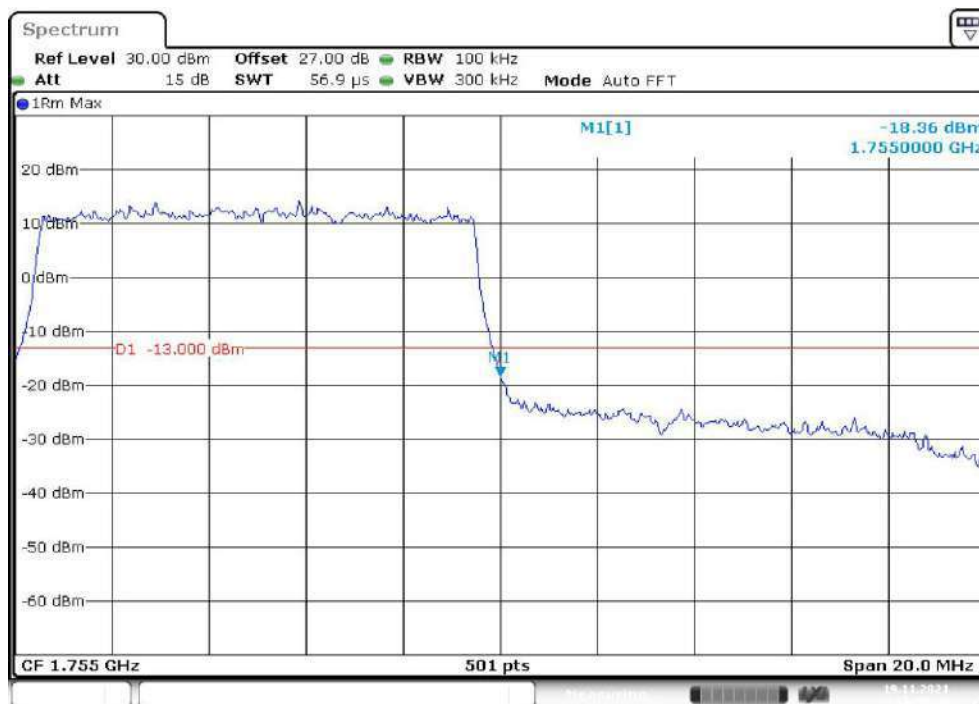
16QAM (5MHz, RB25) – Left Band Edge**16QAM (5MHz, RB25) – Right Band Edge**

QPSK (10MHz, RB50) – Left Band Edge

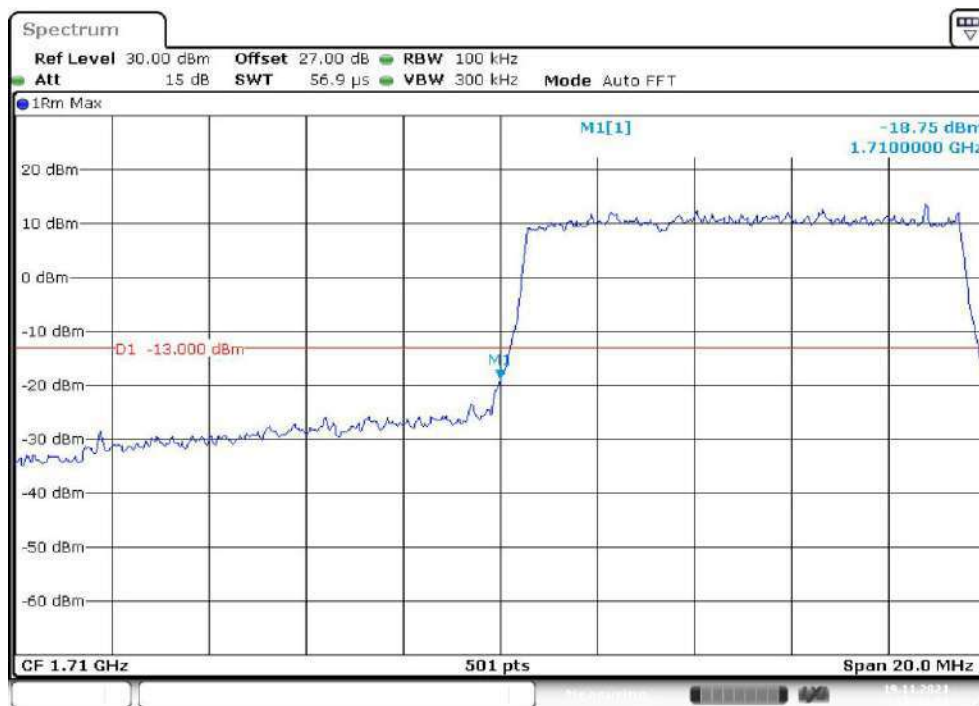


Date: 19.NOV.2021 14:34:18

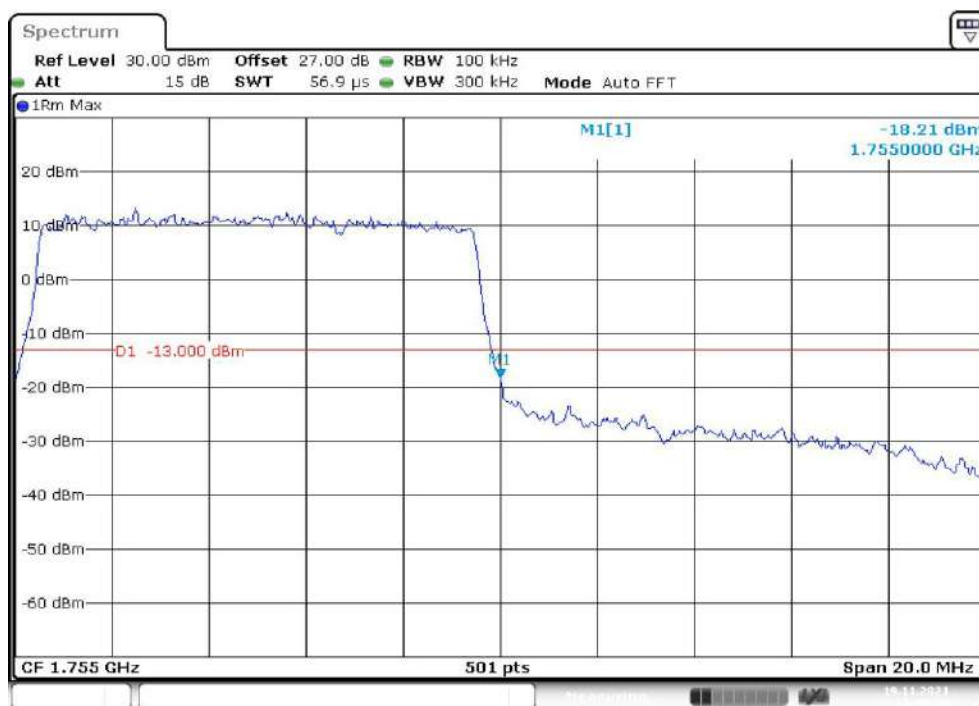
QPSK (10MHz, RB50) – Right Band Edge



Date: 19.NOV.2021 14:35:26

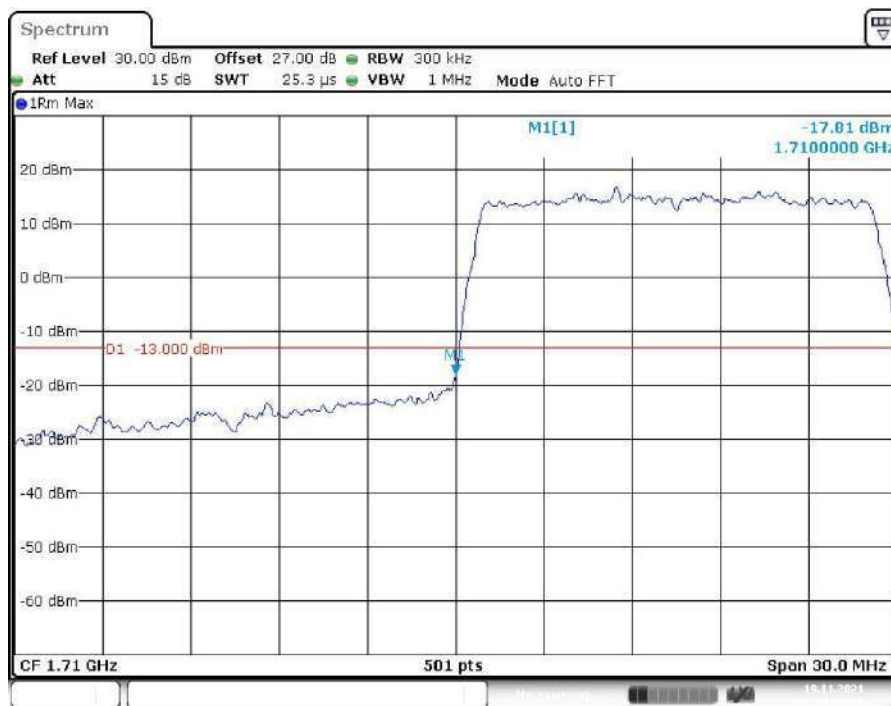
16QAM (10MHz, RB50) – Left Band Edge

Date: 19.NOV.2021 14:34:51

16QAM (10MHz, RB50) – Right Band Edge

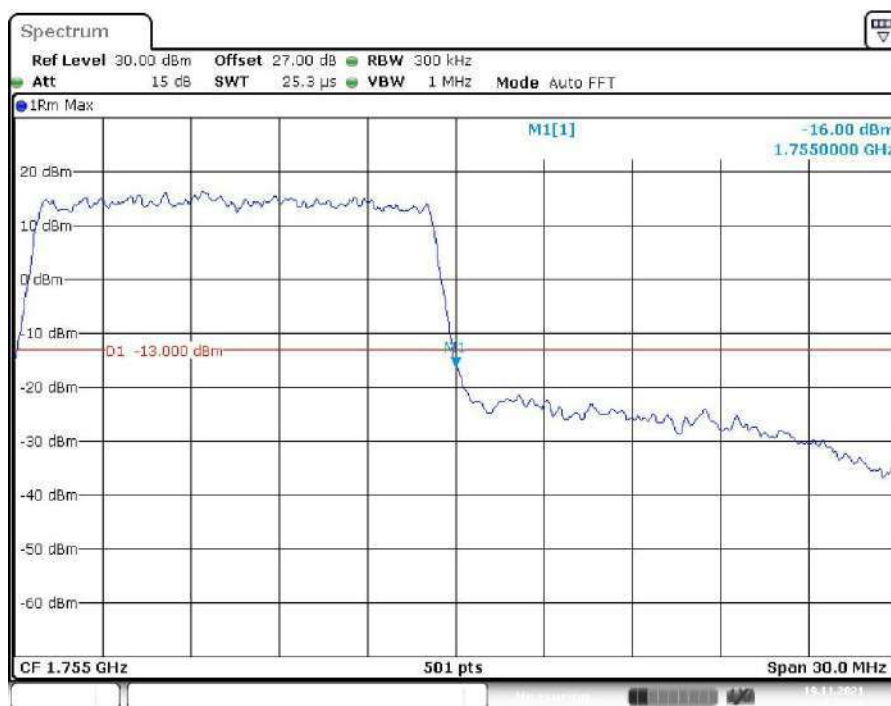
Date: 19.NOV.2021 14:35:53

QPSK (15MHz, RB75) – Left Band Edge

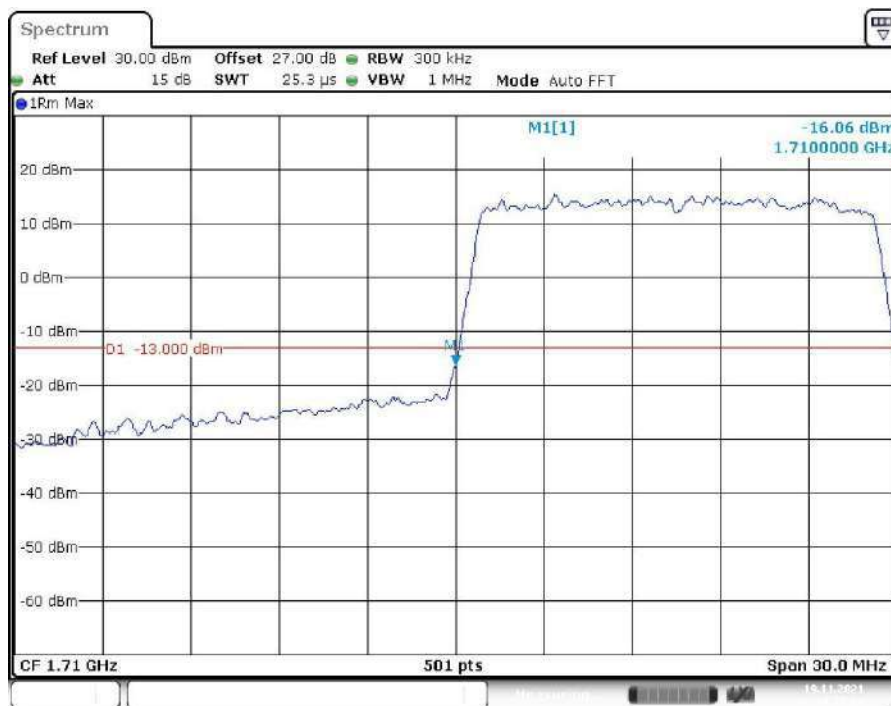


Date: 19.NOV.2021 14:36:38

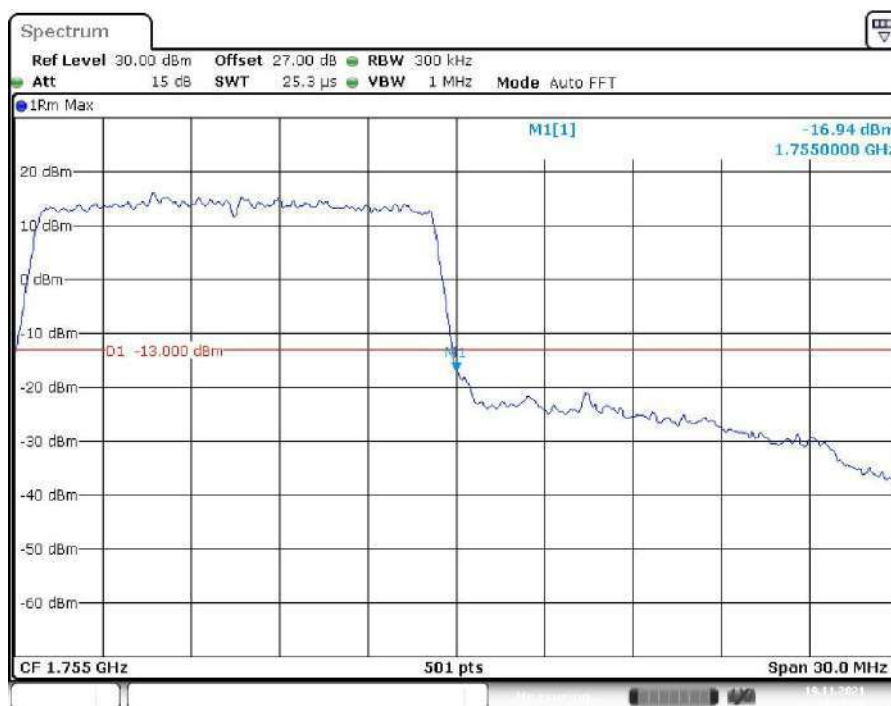
QPSK (15MHz, RB75) – Right Band Edge



Date: 19.NOV.2021 14:37:55

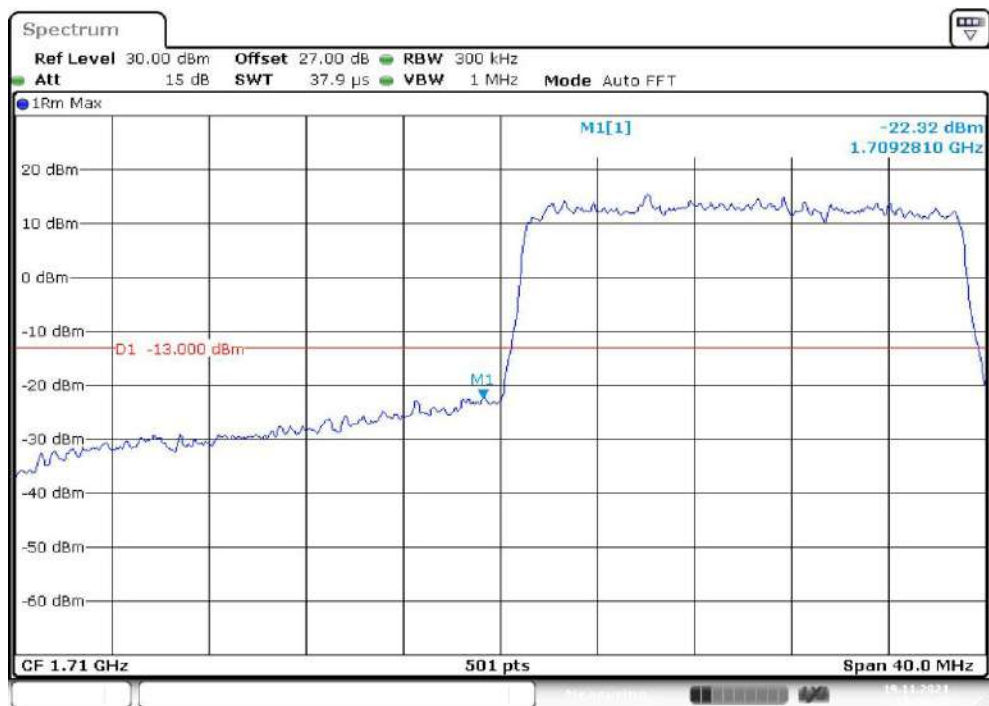
16QAM (15MHz, RB75) – Left Band Edge

Date: 19.NOV.2021 14:37:34

16QAM (15MHz, RB75) – Right Band Edge

Date: 19.NOV.2021 14:38:34

QPSK (20MHz, RB100) – Left Band Edge

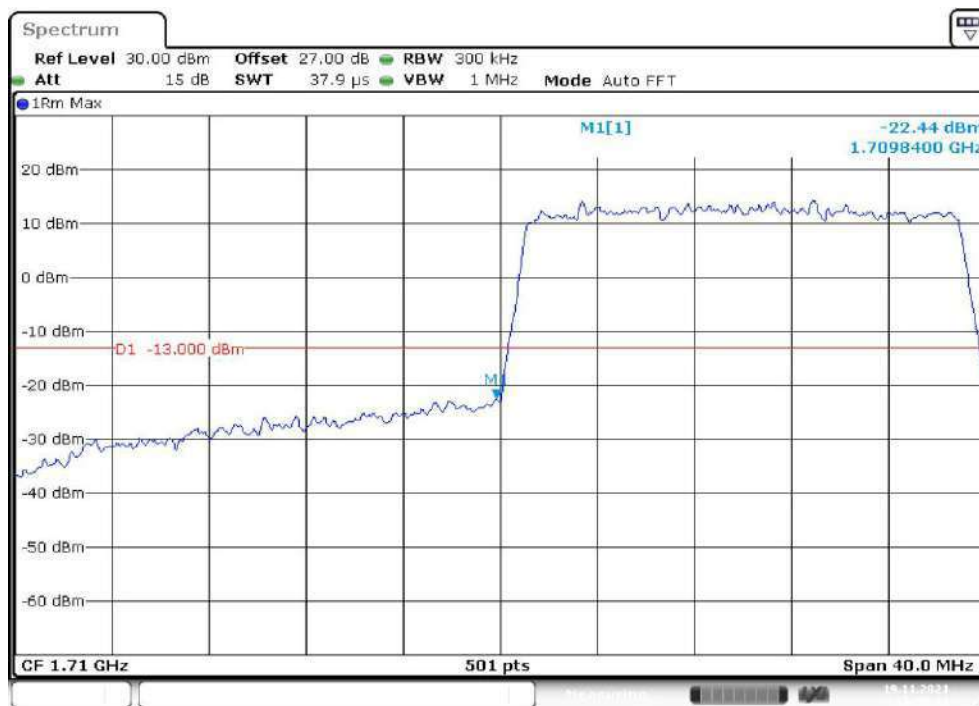


Date: 19.NOV.2021 14:38:58

QPSK (20MHz, RB100) – Right Band Edge



Date: 19.NOV.2021 14:39:58

16QAM (20MHz, RB100) – Left Band Edge

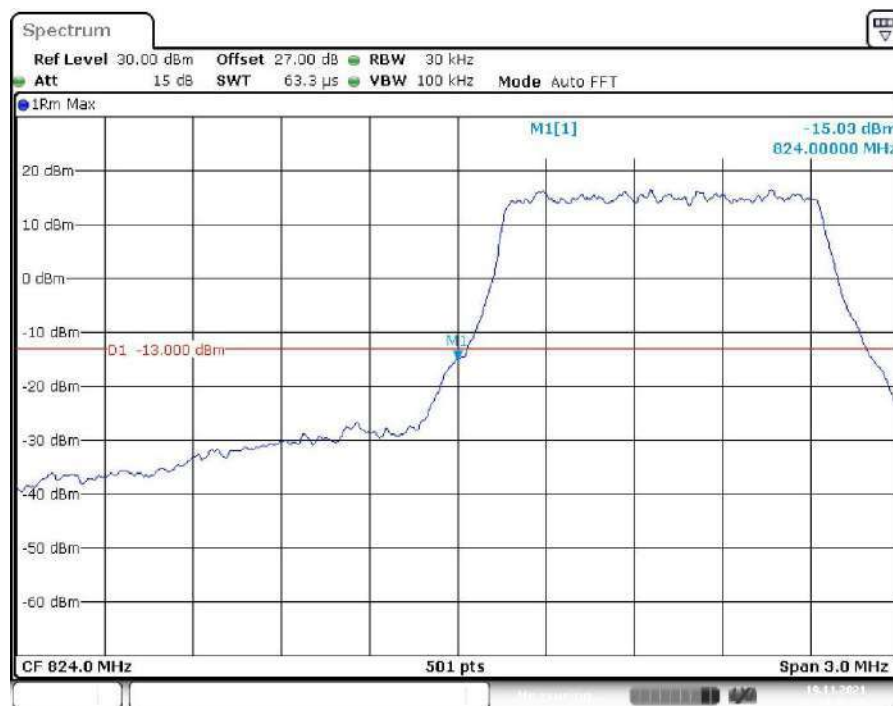
Date: 19.NOV.2021 14:39:31

16QAM (20MHz, RB100) – Right Band Edge

Date: 19.NOV.2021 14:40:25

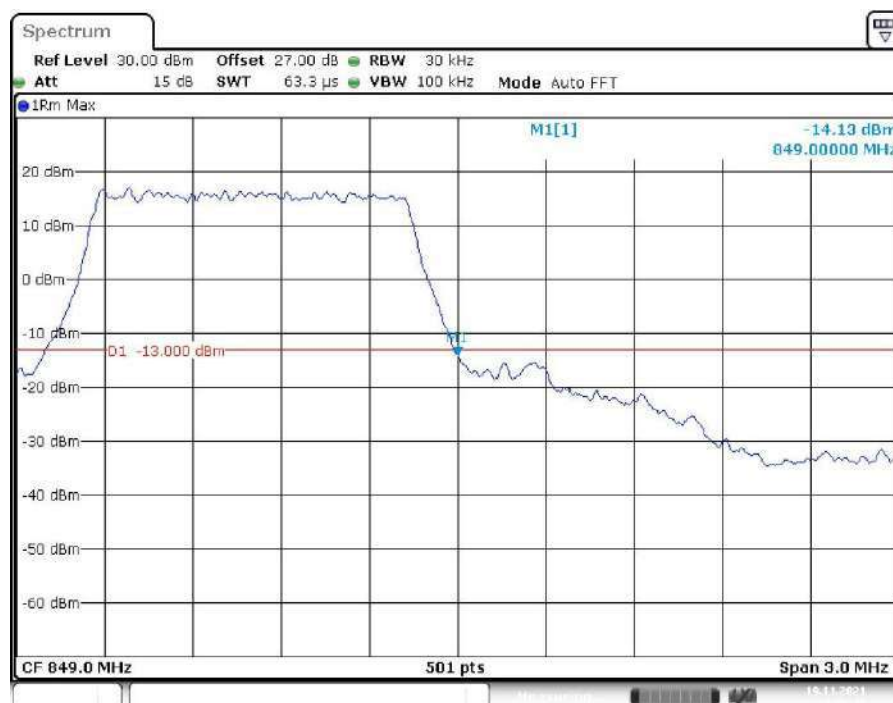
LTE Band 5

QPSK (1.4MHz, RB6) – Left Band Edge



Date: 19.NOV.2021 14:40:48

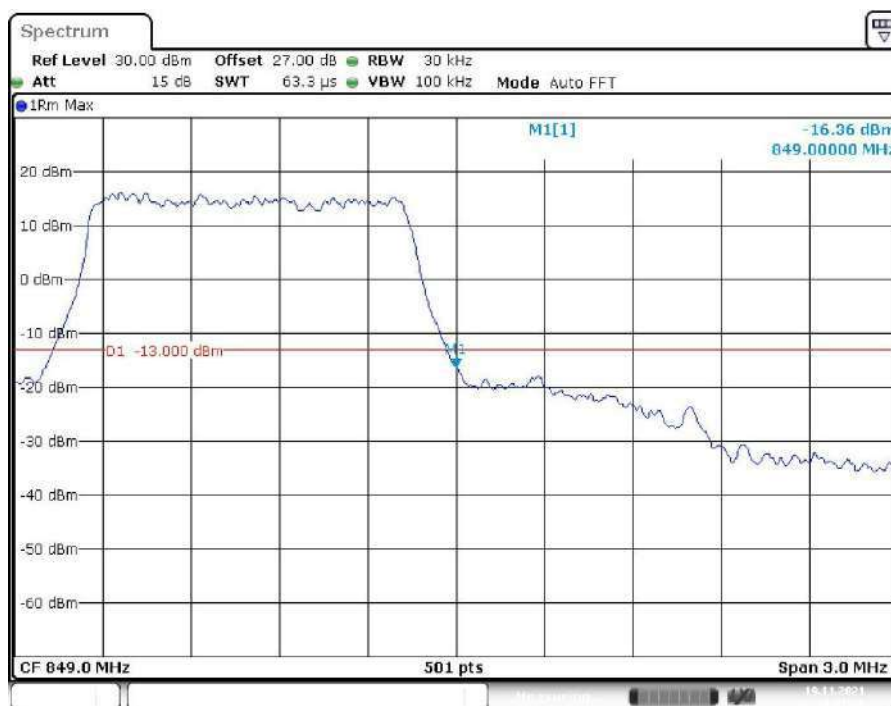
QPSK (1.4MHz, RB6) – Right Band Edge



Date: 19.NOV.2021 14:41:18

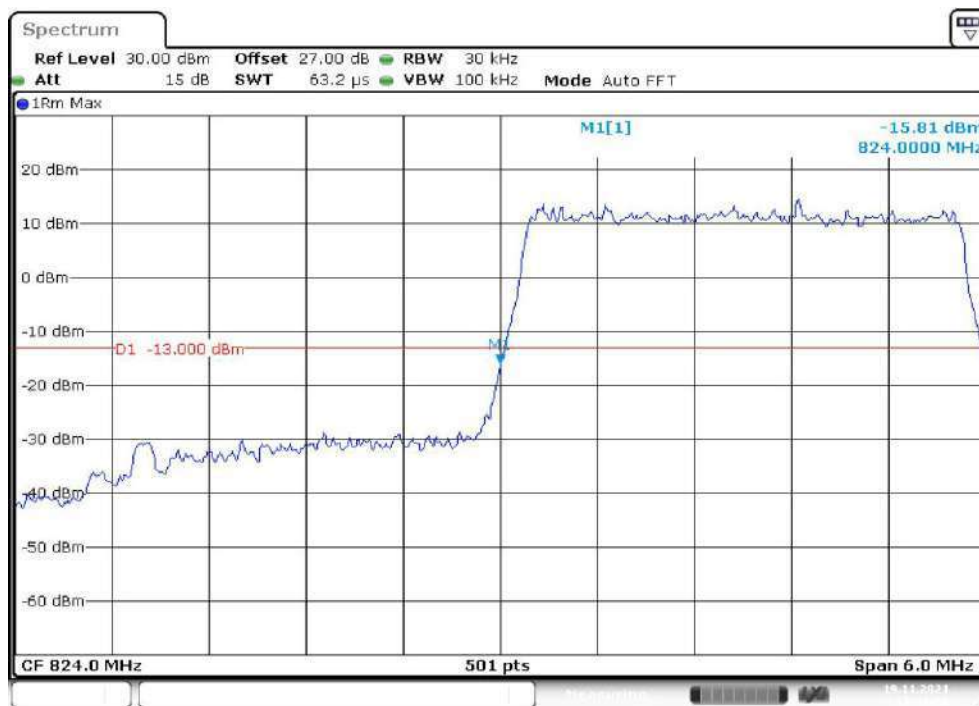
16QAM (1.4MHz, RB6) – Left Band Edge

Date: 19.NOV.2021 14:41:03

16QAM (1.4MHz, RB6) – Right Band Edge

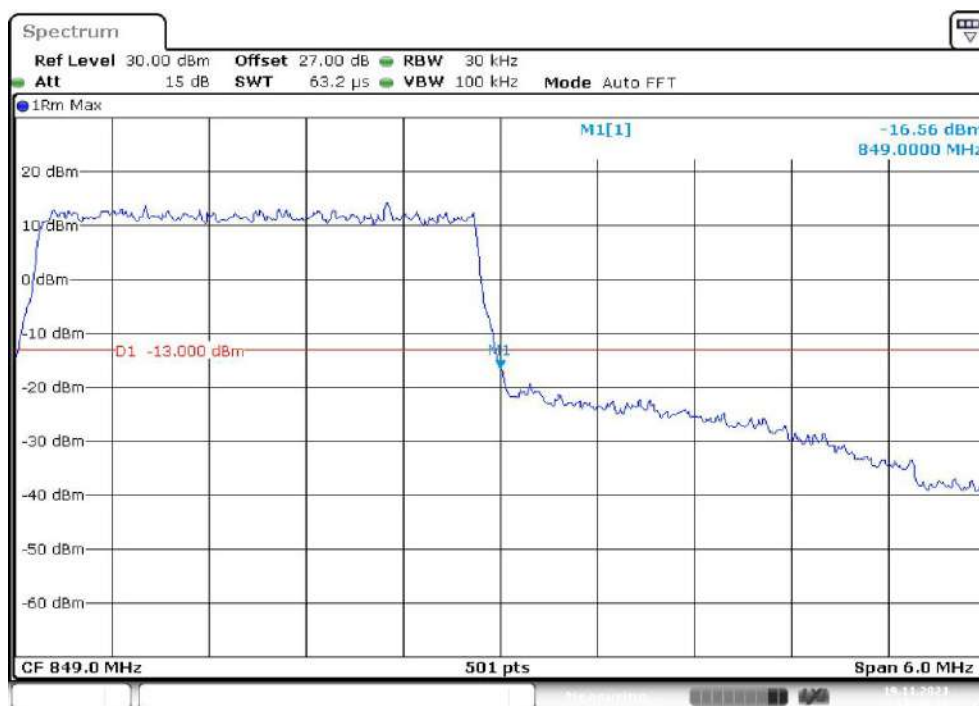
Date: 19.NOV.2021 14:41:28

QPSK (3MHz, RB15) – Left Band Edge

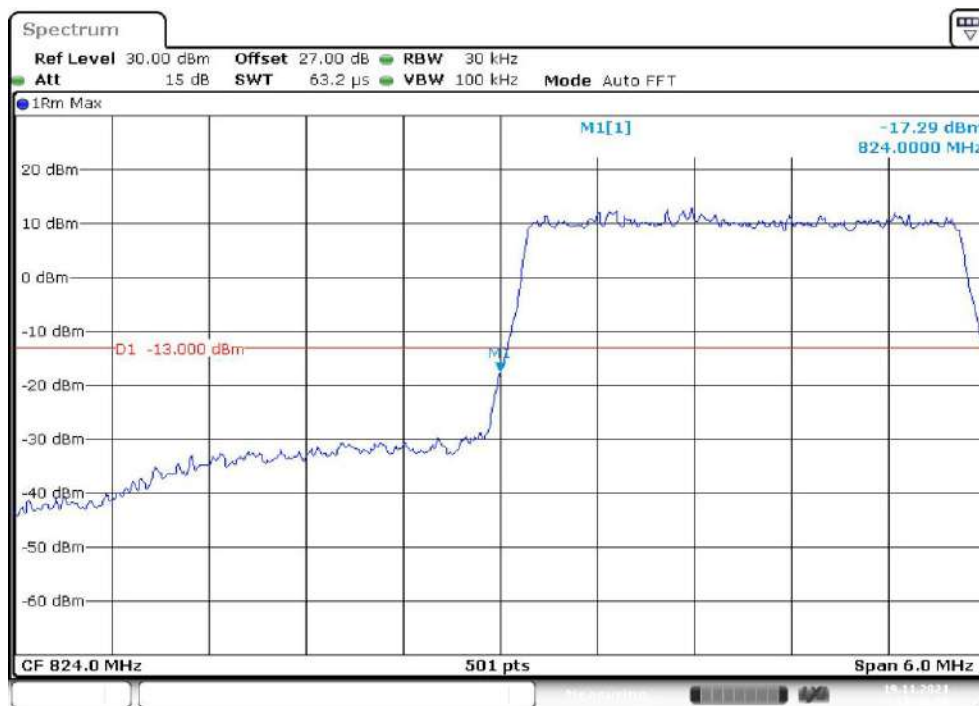


Date: 19.NOV.2021 14:41:50

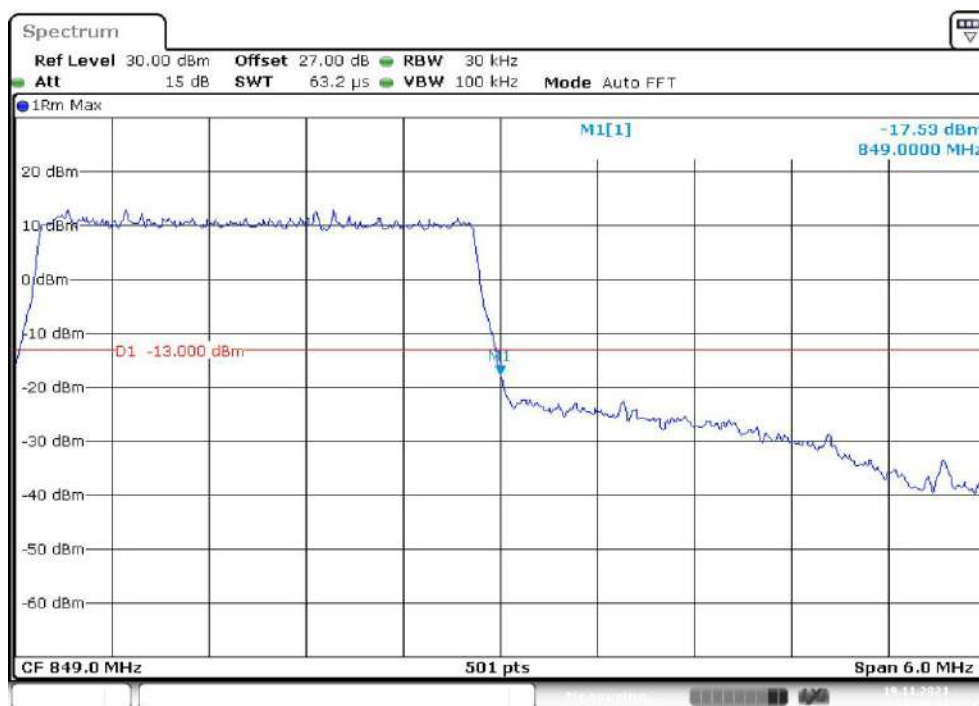
QPSK (3MHz, RB15) – Right Band Edge



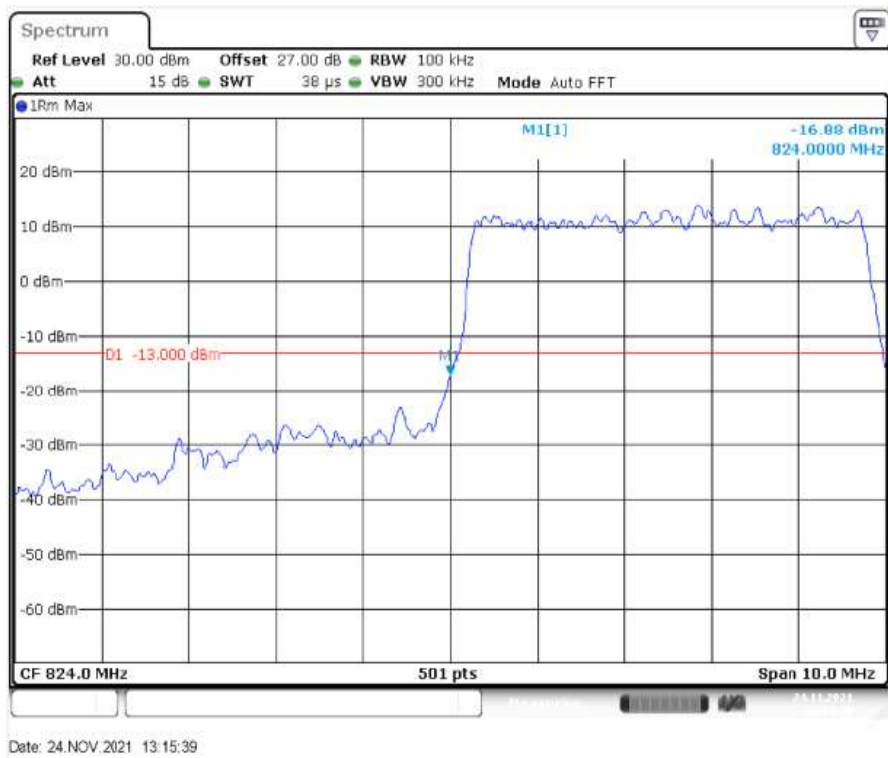
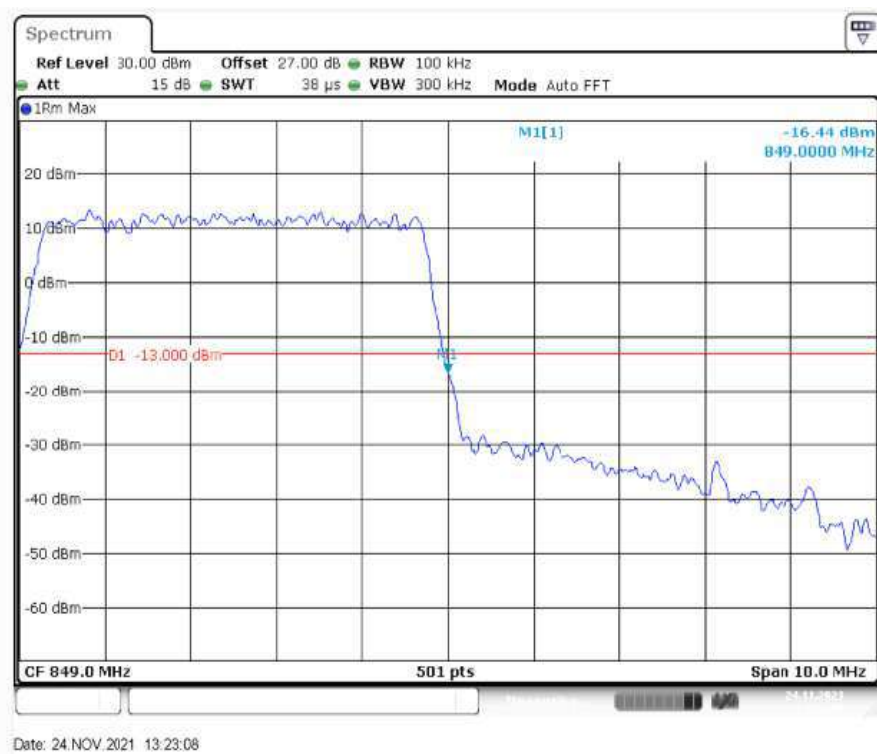
Date: 19.NOV.2021 14:42:18

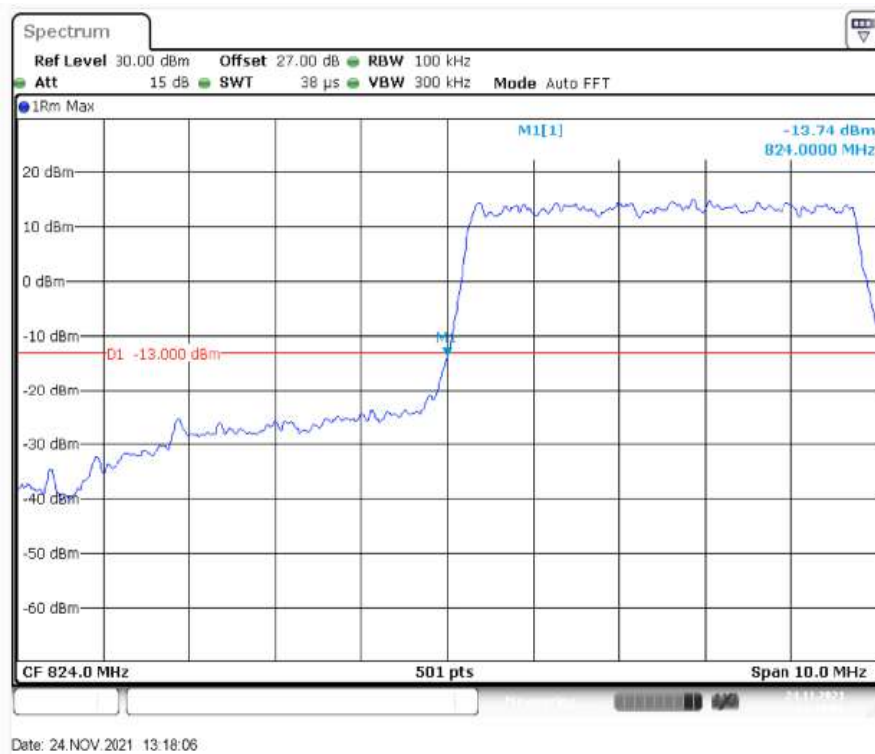
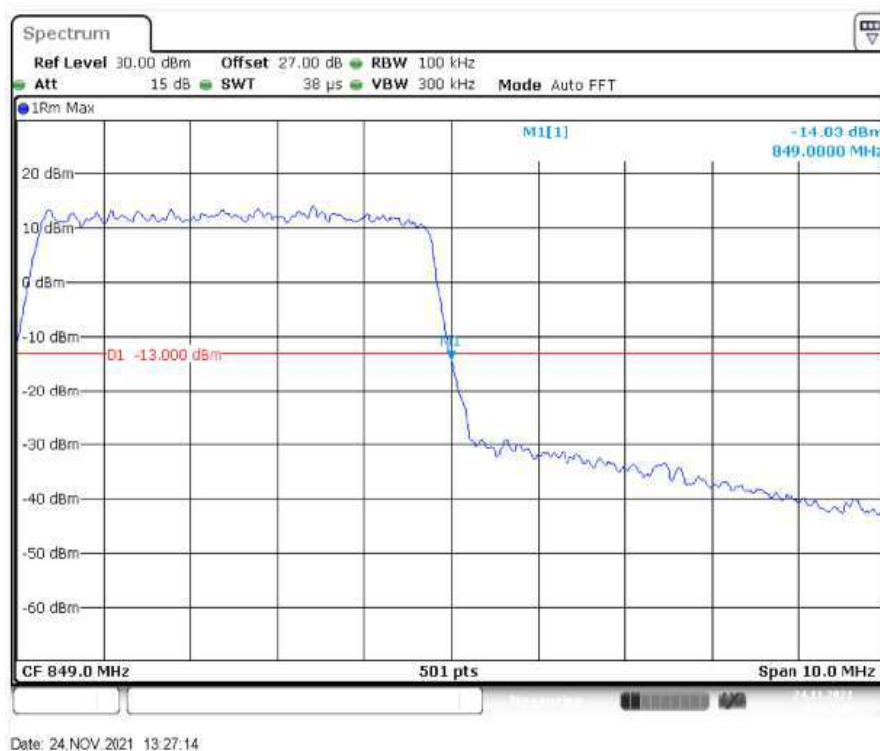
16QAM (3MHz, RB15) – Left Band Edge

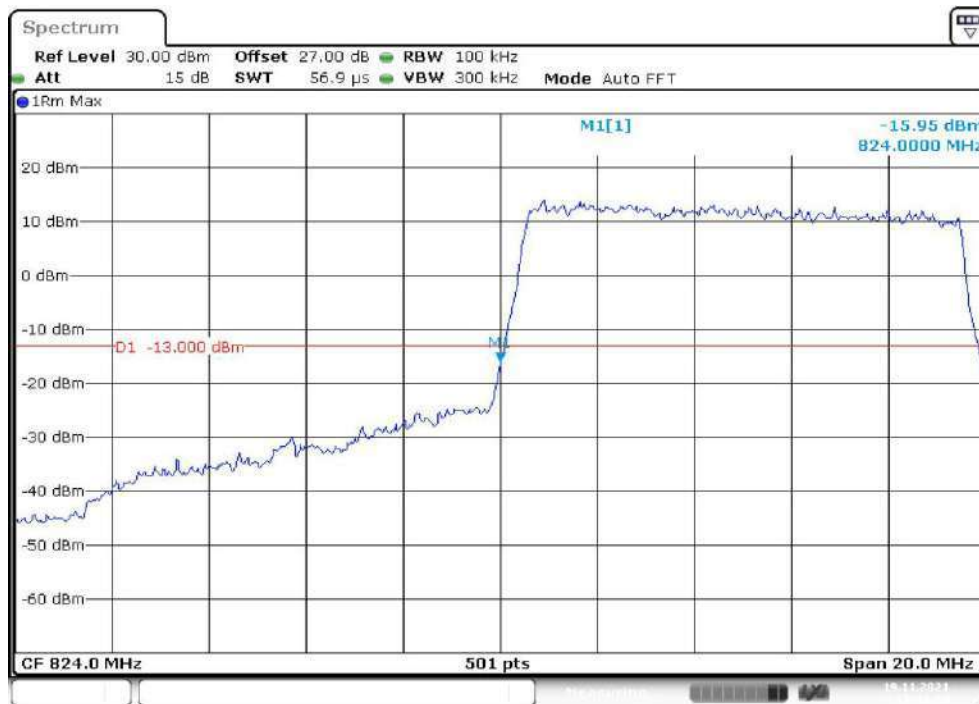
Date: 19.NOV.2021 14:42:00

16QAM (3MHz, RB15) – Right Band Edge

Date: 19.NOV.2021 14:42:32

QPSK (5MHz, RB25) – Left Band Edge**QPSK (5MHz, RB25) – Right Band Edge**

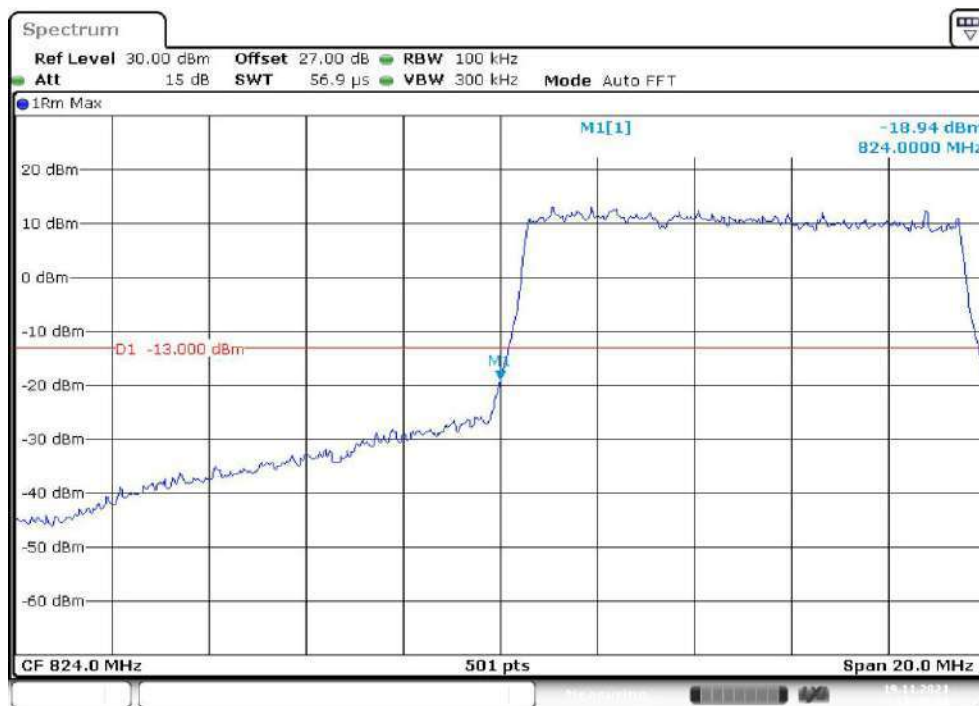
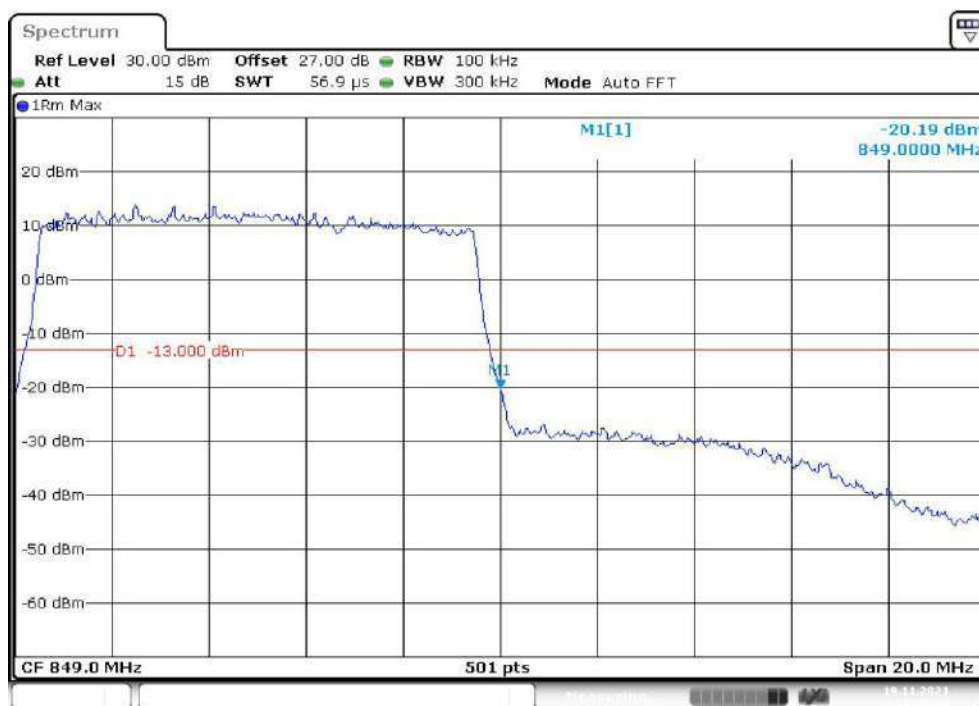
16QAM (5MHz, RB25) – Left Band Edge**16QAM (5MHz, RB25) – Right Band Edge**

QPSK (10MHz, RB50) – Left Band Edge

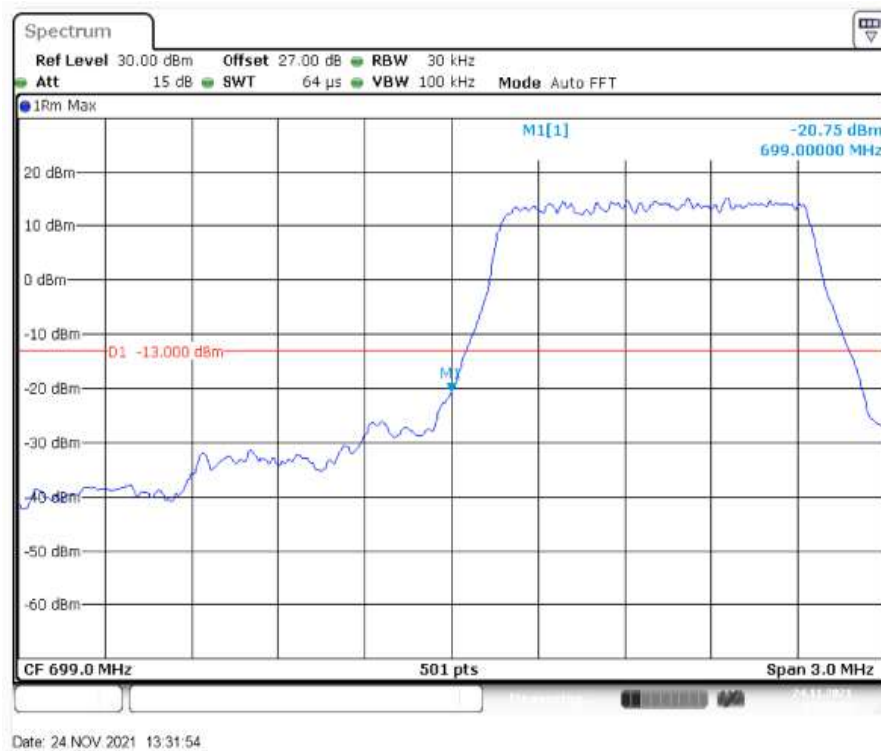
Date: 19.NOV.2021 14:44:35

QPSK (10MHz, RB50) – Right Band Edge

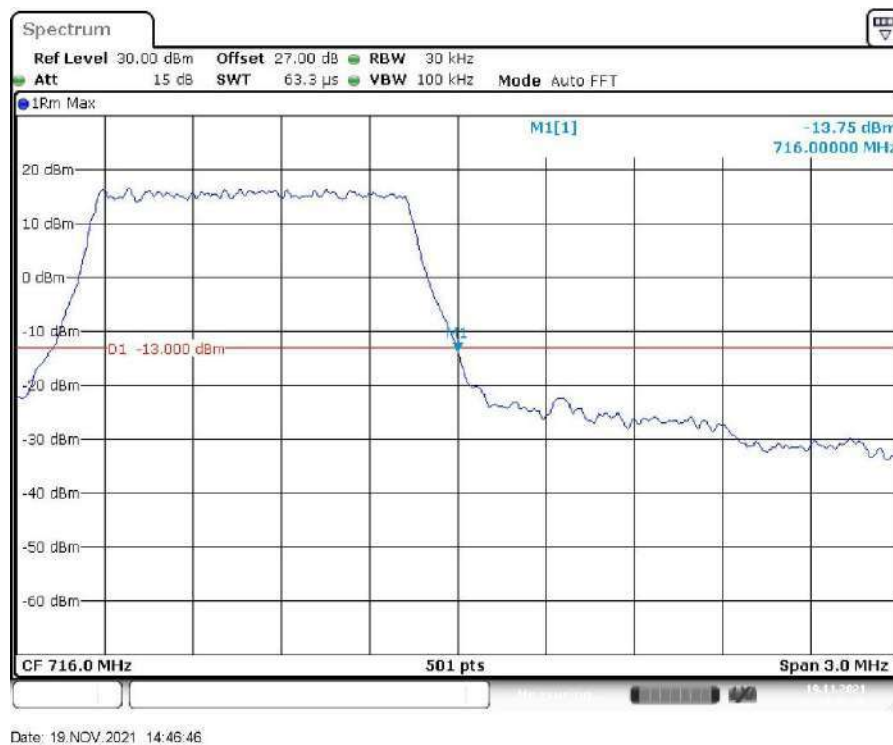
Date: 19.NOV.2021 14:45:30

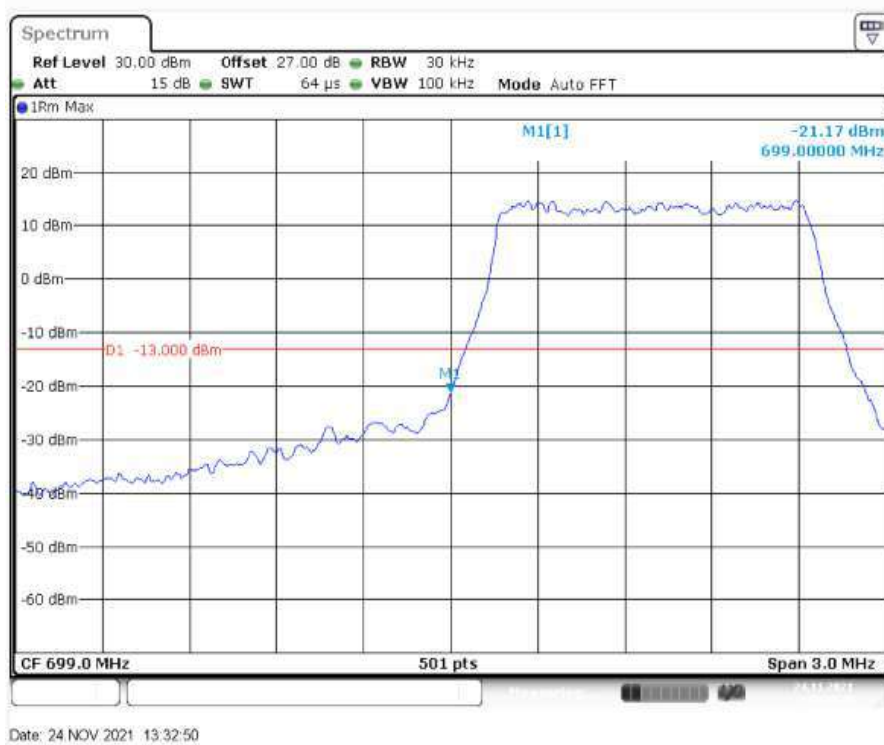
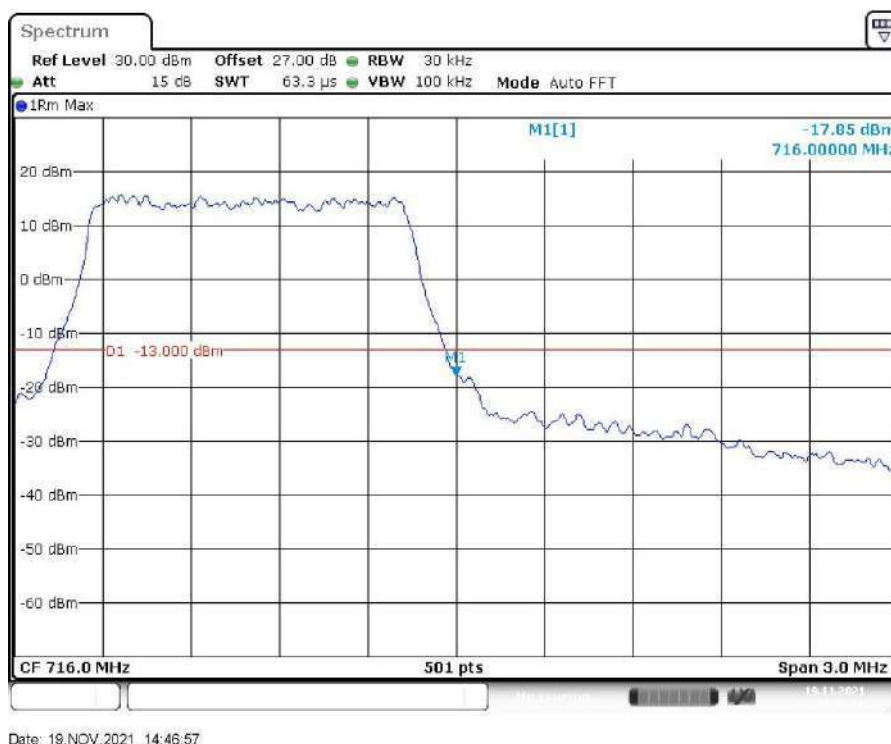
16QAM (10MHz, RB50) – Left Band Edge**16QAM (10MHz, RB50) – Right Band Edge**

LTE Band 12
QPSK (1.4MHz, RB6) – Left Band Edge

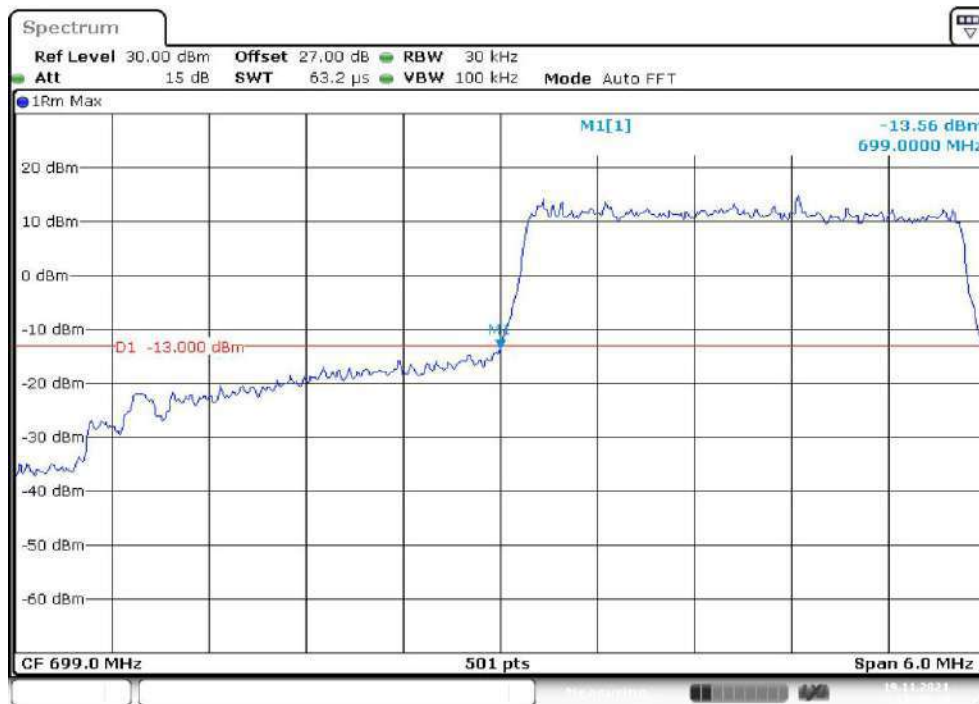


QPSK (1.4MHz, RB6) – Right Band Edge



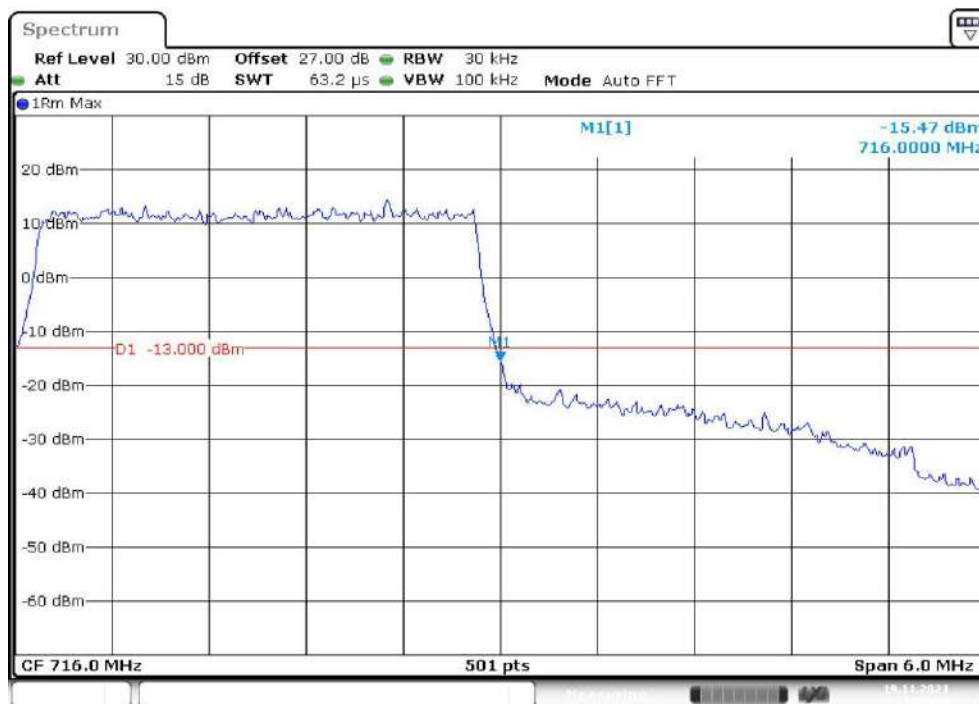
16QAM (1.4MHz, RB6) – Left Band Edge**16QAM (1.4MHz, RB6) – Right Band Edge**

QPSK (3MHz, RB15) – Left Band Edge

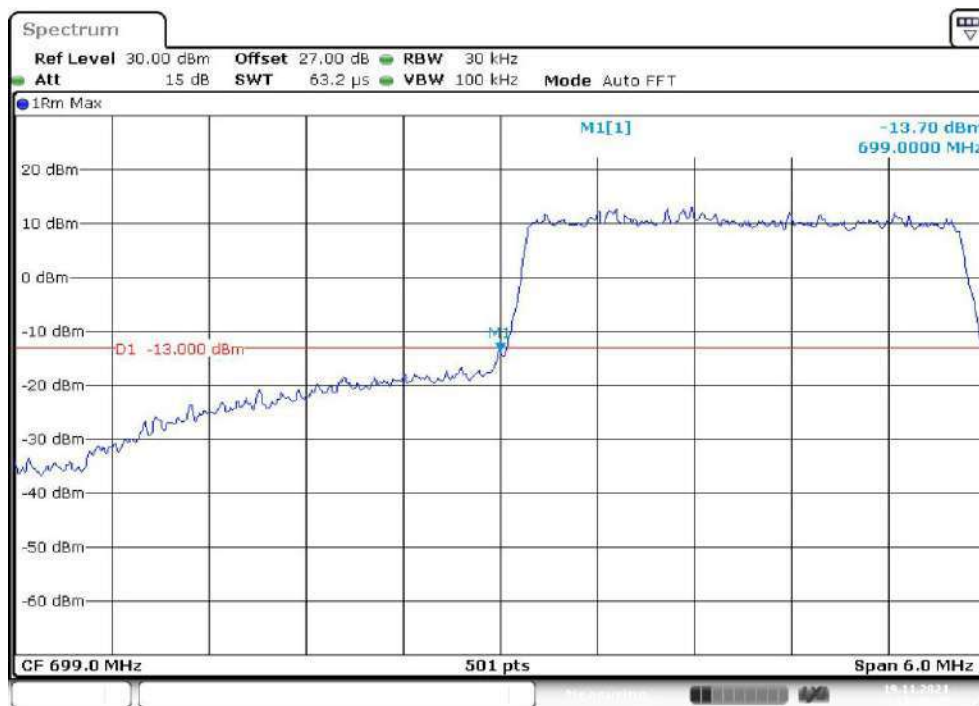


Date: 19.NOV.2021 14:47:14

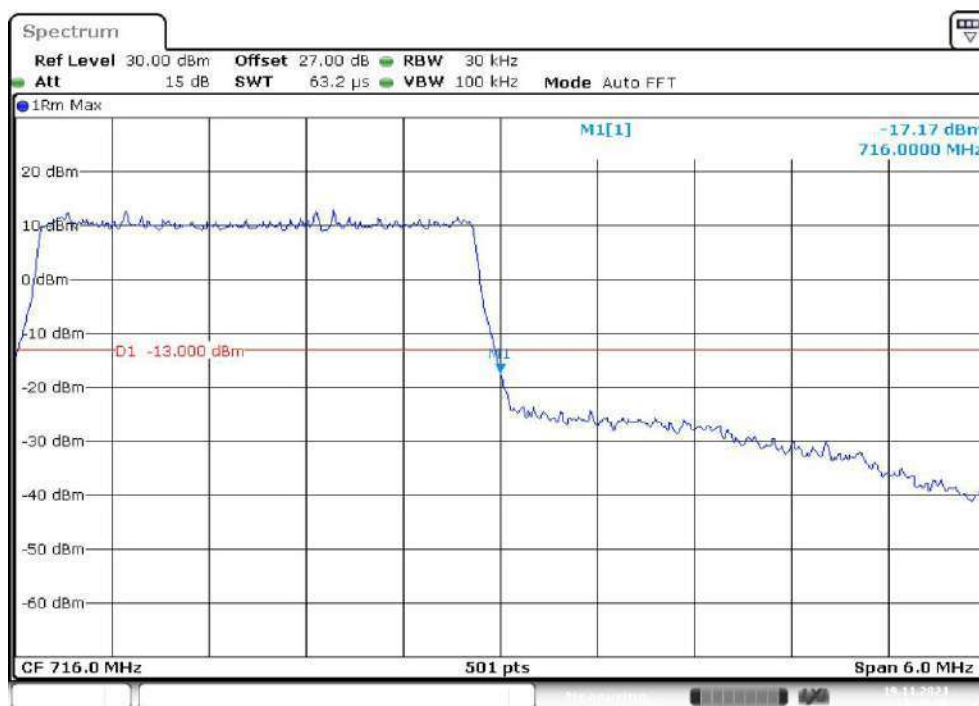
QPSK (3MHz, RB15) – Right Band Edge



Date: 19.NOV.2021 14:47:43

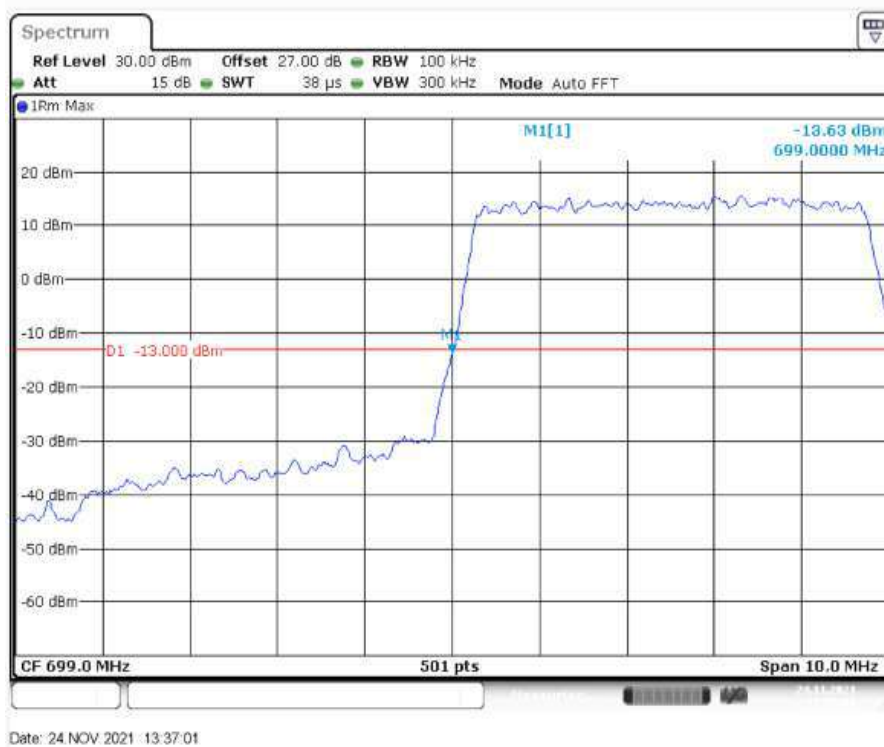
16QAM (3MHz, RB15) – Left Band Edge

Date: 19.NOV.2021 14:47:28

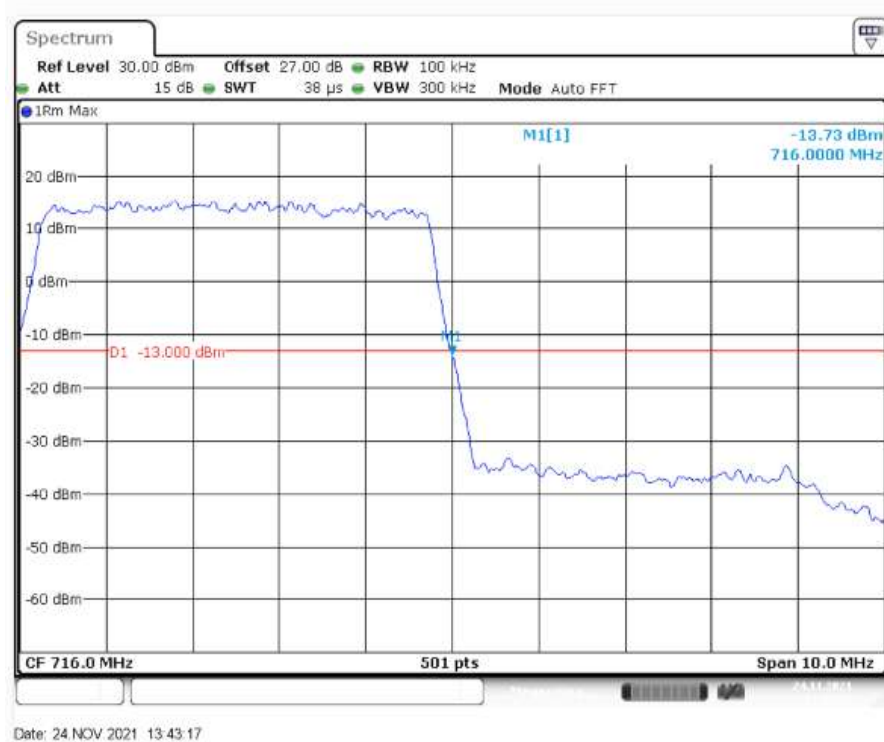
16QAM (3MHz, RB15) – Right Band Edge

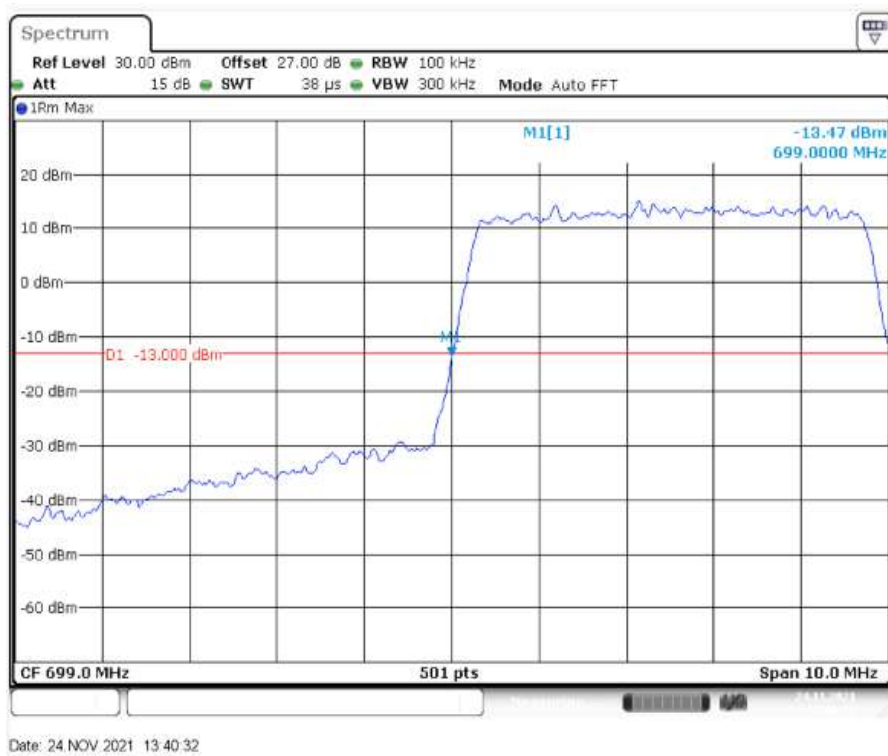
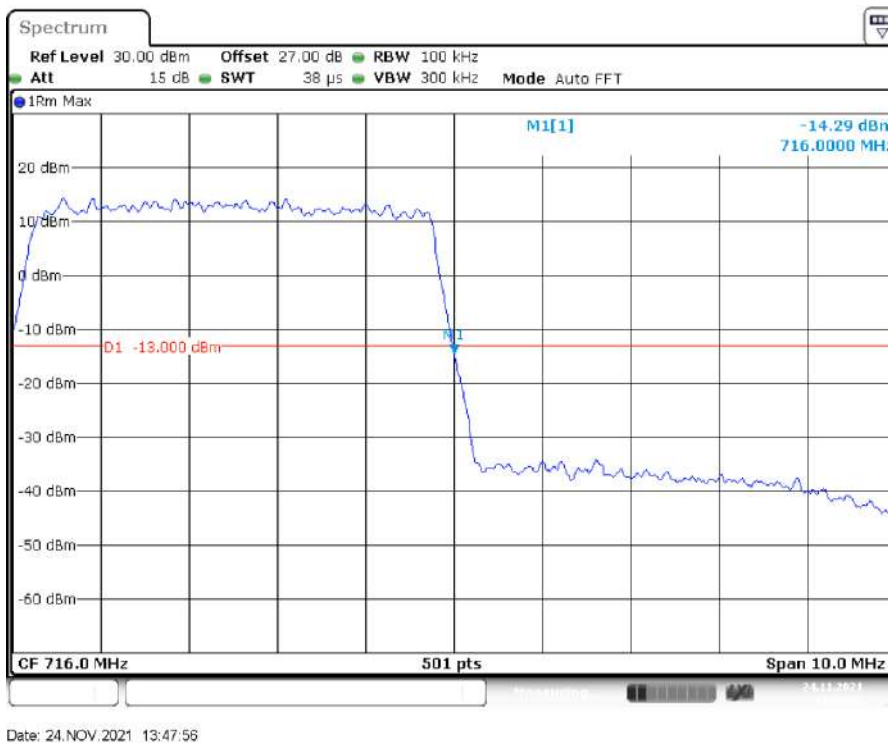
Date: 19.NOV.2021 14:47:56

QPSK (5MHz, RB25) – Left Band Edge

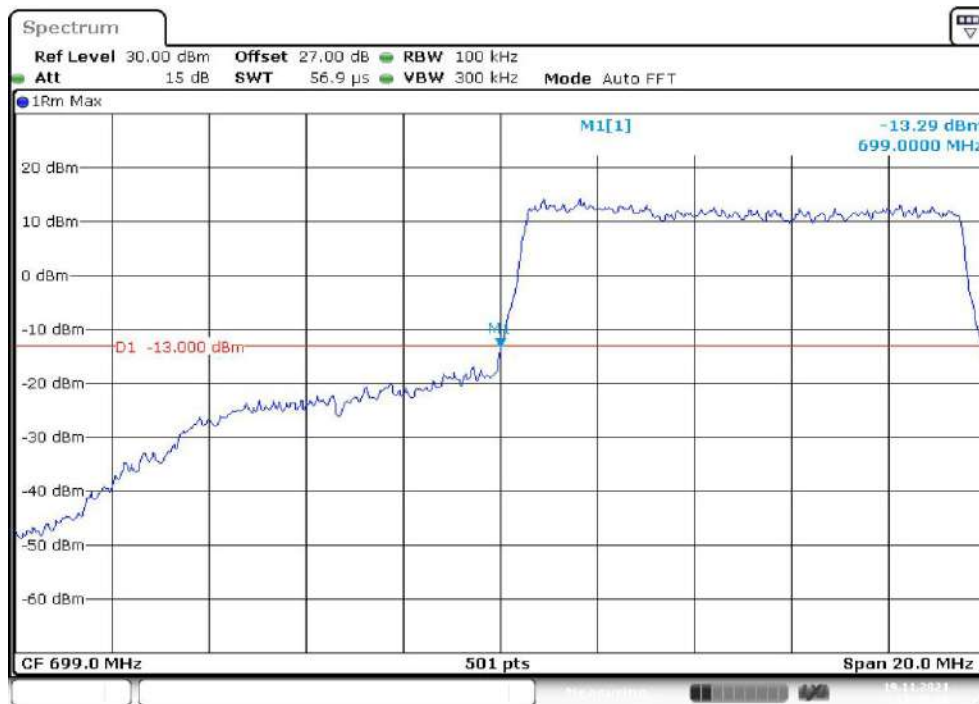


QPSK (5MHz, RB25) – Right Band Edge



16QAM (5MHz, RB25) – Left Band Edge**16QAM (5MHz, RB25) – Right Band Edge**

QPSK (10MHz, RB50) – Left Band Edge

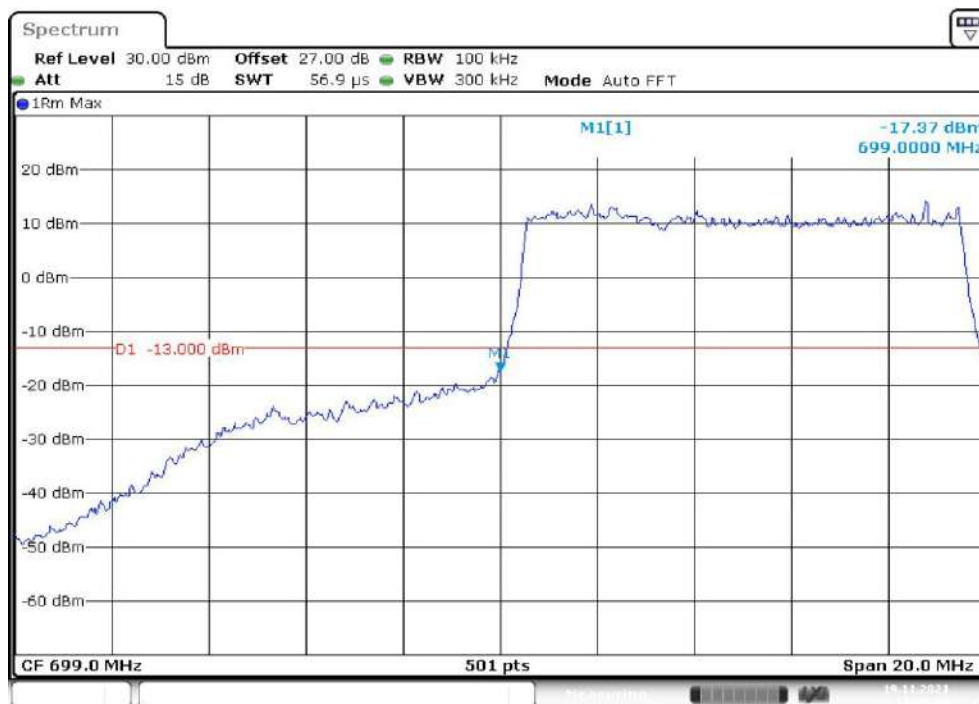


Date: 19.NOV.2021 14:49:59

QPSK (10MHz, RB50) – Right Band Edge



Date: 19.NOV.2021 14:50:54

16QAM (10MHz, RB50) – Left Band Edge

Date: 19.NOV.2021 14:50:23

16QAM (10MHz, RB50) – Right Band Edge

Date: 19.NOV.2021 14:51:15

FCC §2.1055, §22.355 & §24.235 & §27.54 – FREQUENCY STABILITY

Applicable Standard

FCC § 2.1055 (a)(d), §22.355, §24.235 · §27.54

According to FCC §2.1055, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

According to §22.355, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within the tolerances given in Table below:

Frequency Tolerance for Transmitters in the Public Mobile Services

Frequency Range (MHz)	Base, fixed (ppm)	Mobile > 3 watts (ppm)	Mobile ≤ 3 watts (ppm)
25 to 50	20.0	20.0	50.0
50 to 450	5.0	5.0	50.0
450 to 512	2.5	5.0	5.0
821 to 896	1.5	2.5	2.5
928 to 929	5.0	N/A	N/A
929 to 960	1.5	N/A	N/A
2110 to 2220	10.0	N/A	N/A

According to §24.235, the frequency stability shall be sufficient to ensure that the fundamental emissions stays within the authorized frequency block.

According to §27.54, the frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external DC power supply and the RF output was connected to communication test set via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the communication test set.

Frequency Stability vs. Voltage: For hand carried, battery powered equipment; reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

Test Results**LTE Band 2**

10.0 MHz Middle Channel, fo =1880 MHz_QPSK				
Temperature (°C)	Voltage Supplied (V_{DC})	Frequency Error (Hz)	Frequency Error (ppm)	Result
-30	12	-7.14	-0.0038	PASS
-20		5.02	0.0027	PASS
-10		-8.46	-0.0045	PASS
0		8.94	0.0048	PASS
10		8.27	0.0044	PASS
20		6.18	0.0033	PASS
30		6.54	0.0035	PASS
40		-6.76	-0.0036	PASS
50		-7.53	-0.004	PASS
20	V min.= 10.2	8.49	0.0045	PASS
20	V max.= 36	5.37	0.0029	PASS

10.0 MHz Middle Channel, fo =1880 MHz_16QAM				
Temperature (°C)	Voltage Supplied (V_{DC})	Frequency Error (Hz)	Frequency Error (ppm)	Result
-30	12	-6.58	-0.0035	PASS
-20		-8.19	-0.0044	PASS
-10		-7.73	-0.0041	PASS
0		-7.19	-0.0038	PASS
10		-5.63	-0.003	PASS
20		-6.43	-0.0034	PASS
30		-5.20	-0.0028	PASS
40		-5.39	-0.0029	PASS
50		-5.62	-0.003	PASS
20	V min.= 10.2	6.45	0.0034	PASS
20	V max.= 36	-5.34	-0.0028	PASS

LTE Band 4

Low Channel & High Channel (QPSK)					
Temperature (°C)	Voltage Supplied (V _{DC})	F _L (MHz)	F _H (MHz)	F _L Limit (MHz)	F _H Limit (MHz)
-30	12	1710.53	1754.47	1710	1755
-20		1710.53	1754.43	1710	1755
-10		1710.53	1754.43	1710	1755
0		1710.57	1754.51	1710	1755
10		1710.57	1754.51	1710	1755
20		1710.53	1754.51	1710	1755
30		1710.53	1754.47	1710	1755
40		1710.53	1754.43	1710	1755
50		1710.49	1754.47	1710	1755
20	V min.= 10.2	1710.49	1754.47	1710	1755
20	V max.= 36	1710.49	1754.47	1710	1755

Low Channel & High Channel (16-QAM)					
Temperature (°C)	Voltage Supplied (V _{DC})	F _L (MHz)	F _H (MHz)	F _L Limit (MHz)	F _H Limit (MHz)
-30	12	1710.53	1754.47	1710	1755
-20		1710.49	1754.43	1710	1755
-10		1710.49	1754.47	1710	1755
0		1710.57	1754.47	1710	1755
10		1710.53	1754.43	1710	1755
20		1710.53	1754.47	1710	1755
30		1710.57	1754.43	1710	1755
40		1710.49	1754.47	1710	1755
50		1710.49	1754.43	1710	1755
20	V min.= 10.2	1710.53	1754.43	1710	1755
20	V max.= 36	1710.57	1754.47	1710	1755

LTE Band 5

10.0 MHz Middle Channel, fo =836.5 MHz_QPSK				
Temperature (°C)	Voltage Supplied (V _{DC})	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
-30	12	-0.47	-0.0006	±2.5
-20		-8.66	-0.0104	±2.5
-10		7.52	0.009	±2.5
0		-7.62	-0.0091	±2.5
10		5.26	0.0063	±2.5
20		-8.69	-0.0104	±2.5
30		8.00	0.0096	±2.5
40		-7.64	-0.0091	±2.5
50		-8.77	-0.0105	±2.5
20	V min.= 10.2	-6.41	-0.0077	±2.5
20	V max.= 36	5.55	0.0066	±2.5

10.0 MHz Middle Channel, fo =836.5 MHz_16QAM				
Temperature (°C)	Voltage Supplied (V _{DC})	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)
-30	12	0.13	0.0002	±2.5
-20		8.82	0.0105	±2.5
-10		6.54	0.0078	±2.5
0		9.01	0.0108	±2.5
10		-9.99	-0.0119	±2.5
20		5.92	0.0071	±2.5
30		-6.98	-0.0083	±2.5
40		-9.99	-0.0119	±2.5
50		6.45	0.0077	±2.5
20	V min.= 10.2	-5.07	-0.0061	±2.5
20	V max.= 36	-7.60	-0.0091	±2.5

LTE Band 12

Low Channel & High Channel (QPSK)					
Temperature (°C)	Voltage Supplied (V _{DC})	F _L (MHz)	F _H (MHz)	F _L Limit (MHz)	F _H Limit (MHz)
-30	12	699.55	715.41	699	716
-20		699.51	715.45	699	716
-10		699.55	715.49	699	716
0		699.51	715.41	699	716
10		699.55	715.49	699	716
20		699.47	715.45	699	716
30		699.51	715.49	699	716
40		699.51	715.41	699	716
50		699.51	715.49	699	716
20	V min.= 10.2	699.55	715.41	699	716
20	V max.= 36	699.51	715.49	699	716

Low Channel & High Channel (16-QAM)					
Temperature (°C)	Voltage Supplied (V _{DC})	F _L (MHz)	F _H (MHz)	F _L Limit (MHz)	F _H Limit (MHz)
-30	12	699.55	715.45	699	716
-20		699.47	715.49	699	716
-10		699.55	715.41	699	716
0		699.51	715.45	699	716
10		699.55	715.41	699	716
20		699.51	715.49	699	716
30		699.55	715.45	699	716
40		699.47	715.49	699	716
50		699.47	715.45	699	716
20	V min.= 10.2	699.47	715.45	699	716
20	V max.= 36	699.51	715.41	699	716

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