Test report no.: 1-3977/22-03-12



12.2.5 Block edge compliance

Description:

The spectrum at the band edges must comply with the spurious emissions limits.

Measurement:

Measurement parameters		
Detector:	RMS	
Sweep time:	180s	
Video bandwidth:	100 kHz	
Resolution bandwidth:	20 kHz	
Span:	1 MHz steps	
Trace mode:	Max Hold	
Used equipment:	See chapter 7.4 setup A	
Measurement uncertainty:	See chapter 9	
Measurement procedure:	FCC: § 2.1051	

Limits:

FCC
§ 90.691 (a)(1)

For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 Log10(f/6.1) decibels or 50 + 10 Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

-20 dBm

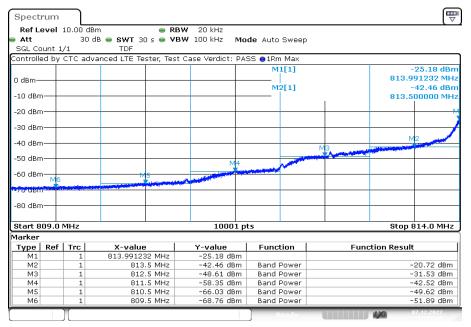
 \Box 10 log (RBW1/RBW2) = X dB; whereas: RBW1 = Y, RBW2 = Z

© CTC advanced GmbH Page 50 of 103



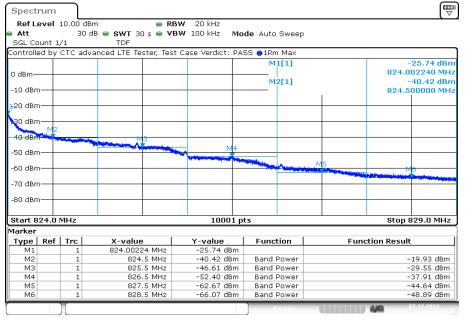
Results:

Plot 1: 1.4 MHz – QPSK - Lowest channel



Date: 7.DEC.2022 17:55:15

Plot 2: 1.4 MHz – QPSK - Highest channel

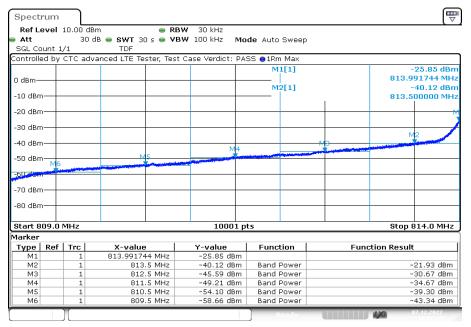


Date: 7.DEC.2022 18:09:24

© CTC advanced GmbH Page 51 of 103

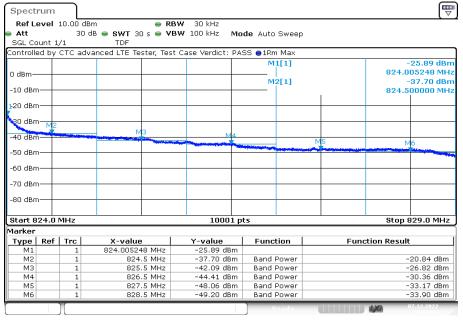


Plot 3: 3 MHz - QPSK - Lowest channel



Date: 7.DEC.2022 18:17:33

Plot 4: 3 MHz – QPSK - Highest channel

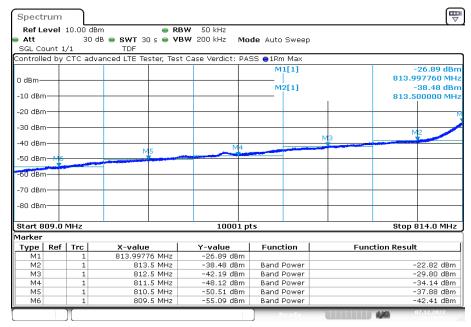


Date: 7.DEC.2022 18:31:44

© CTC advanced GmbH Page 52 of 103

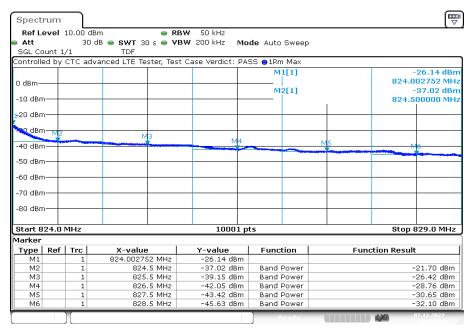


Plot 5: 5 MHz - QPSK - Lowest channel



Date: 7.DEC.2022 18:39:54

Plot 6: 5 MHz – QPSK - Highest channel

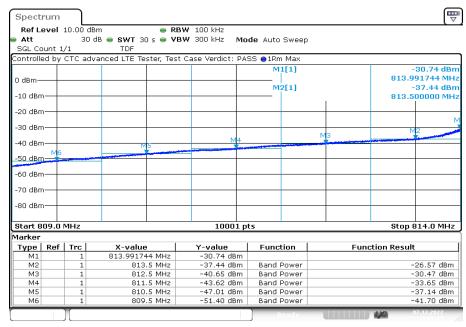


Date: 7.DEC.2022 18:54:04

© CTC advanced GmbH Page 53 of 103

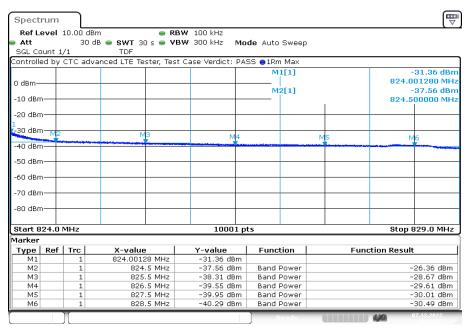


Plot 7: 10 MHz - QPSK - Lowest channel



Date: 7.DEC.2022 19:02:13

Plot 8: 10 MHz - QPSK - Highest channel

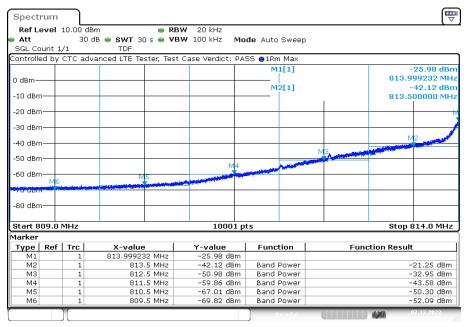


Date: 7.DEC.2022 19:16:25

© CTC advanced GmbH Page 54 of 103

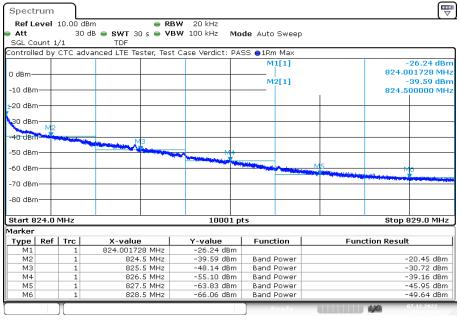


Plot 9: 1.4 MHz – 16-QAM - Lowest channel



Date: 7.DEC.2022 17:57:51

Plot 10: 1.4 MHz - 16-QAM - Highest channel

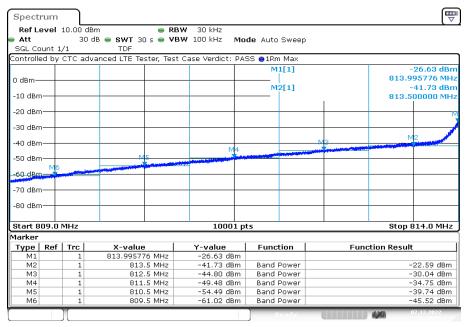


Date: 7.DEC.2022 18:12:01

© CTC advanced GmbH Page 55 of 103

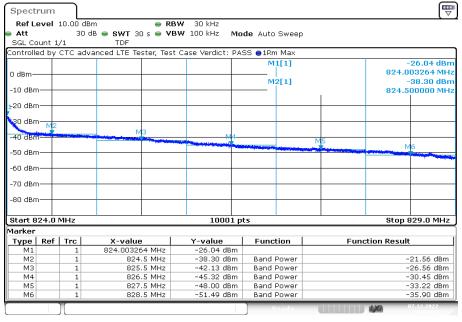


Plot 11: 3 MHz - 16-QAM - Lowest channel



Date: 7.DEC.2022 18:20:09

Plot 12: 3 MHz - 16-QAM - Highest channel

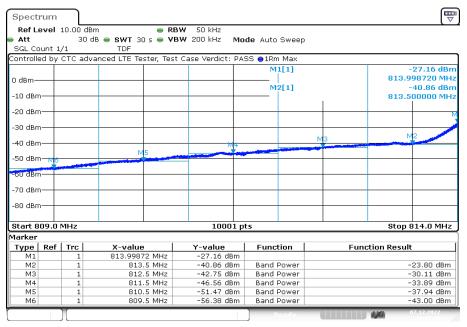


Date: 7.DEC.2022 18:34:27

© CTC advanced GmbH Page 56 of 103

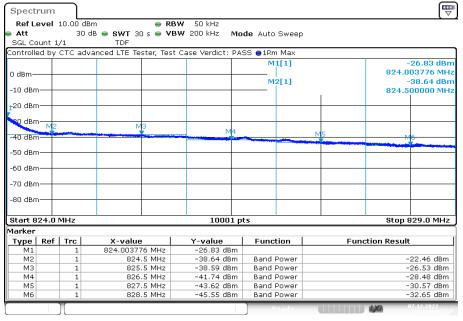


Plot 13: 5 MHz – 16-QAM - Lowest channel



Date: 7.DEC.2022 18:42:30

Plot 14: 5 MHz - 16-QAM - Highest channel

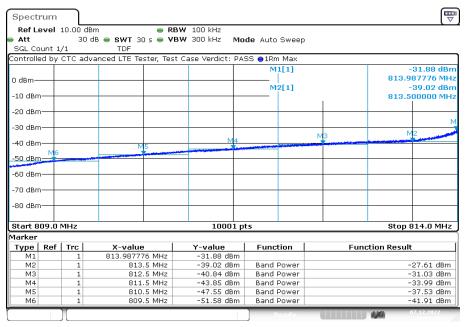


Date: 7.DEC.2022 18:56:47

© CTC advanced GmbH Page 57 of 103

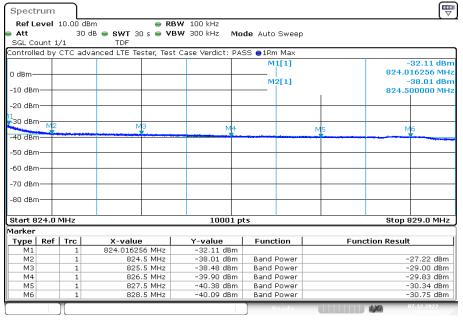


Plot 15: 10 MHz – 16-QAM – Lower Block edge



Date: 7.DEC.2022 19:04:49

Plot 16: 10 MHz – 16-QAM - Upper Block edge

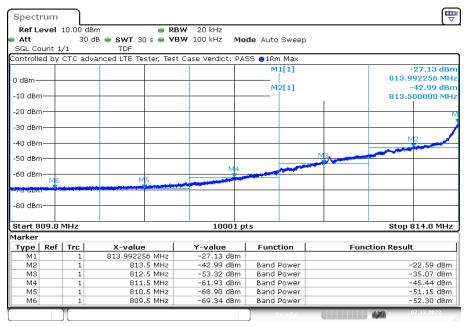


Date: 7.DEC.2022 19:19:09

© CTC advanced GmbH Page 58 of 103

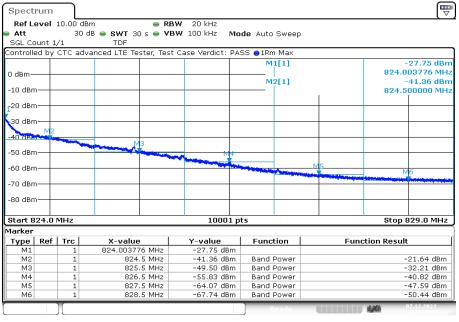


Plot 17: 1.4 MHz - 64-QAM - Lowest channel



Date: 7.DEC.2022 18:00:27

Plot 18: 1.4 MHz - 64-QAM - Highest channel

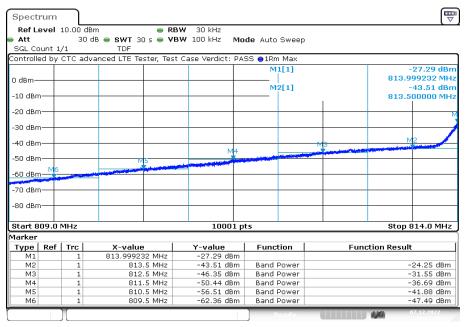


Date: 7.DEC.2022 18:14:44

© CTC advanced GmbH Page 59 of 103

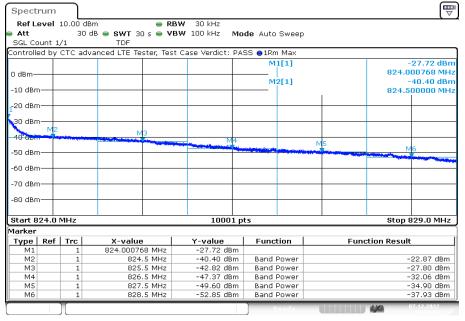


Plot 19: 3 MHz – 64-QAM - Lowest channel



Date: 7.DEC.2022 18:22:45

Plot 20: 3 MHz - 64-QAM - Highest channel

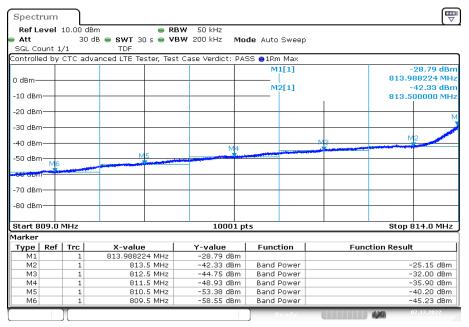


Date: 7.DEC.2022 18:37:04

© CTC advanced GmbH Page 60 of 103

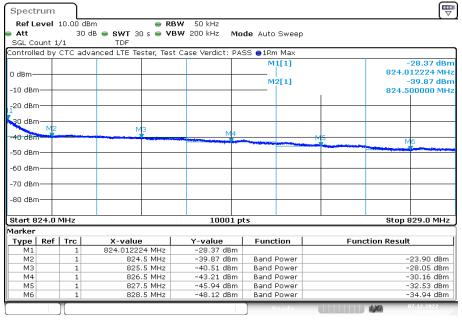


Plot 21: 5 MHz - 64-QAM - Lowest channel



Date: 7.DEC.2022 18:45:13

Plot 22: 5 MHz - 64-QAM - Highest channel

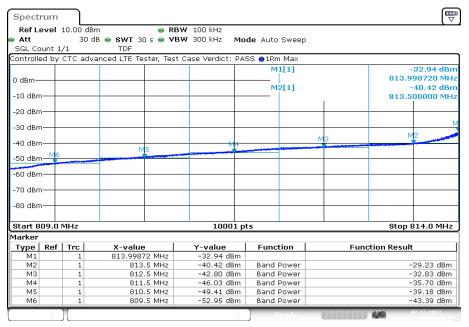


Date: 7.DEC.2022 18:59:23

© CTC advanced GmbH Page 61 of 103

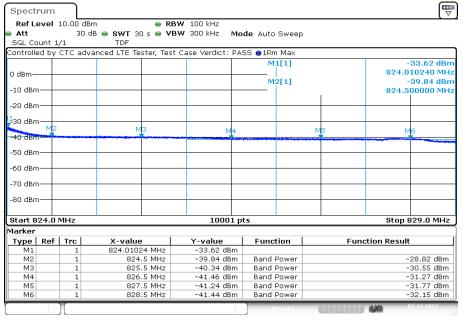


Plot 23: 10 MHz - 64-QAM - Lower Block edge



Date: 7.DEC.2022 19:07:33

Plot 24: 10 MHz - 64-QAM - Upper Block edge



Date: 7.DEC.2022 19:21:45

© CTC advanced GmbH Page 62 of 103

Test report no.: 1-3977/22-03-12



12.2.6 Occupied bandwidth

Description:

Measurement of the occupied bandwidth of the transmitted signal.

Measurement:

Similar to conducted emissions, occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the extreme and middle frequencies of the LTE band 26b. The table below lists the measured 99% power and -26dBc occupied bandwidths. Spectrum analyzer plots are included on the following pages.

Measurement parameters		
Detector:	Peak	
Sweep time:	180s	
Resolution bandwidth:	30 kHz	
Video bandwidth:	100 kHz	
Span:	2 x nominal BW	
Trace mode:	Max Hold	
Used equipment:	See chapter 7.4 setup A	
Measurement uncertainty:	See chapter 9	
Measurement procedure:	FCC: § 2.1049	

Limits:

FCC
§ 2.1049
Reporting only

© CTC advanced GmbH Page 63 of 103



Results:

Occupied Bandwidth – QPSK			
Bandwidth	Channel	99% OBW (MHz)	-26 dBc BW (MHz)
	low	1.10	1.39
1.4	mid	1.10	1.38
	high	1.10	1.36
	low	2.74	3.14
3.0	mid	2.75	3.16
	high	2.74	3.16
	low	4.51	5.19
5.0	mid	4.52	5.21
	high	4.52	5.17
	low	9.07	10.28
10.0	mid	9.07	10.36
	high	9.07	10.31

Occupied Bandwidth — 16-QAM			
Bandwidth	Channel	99% OBW (MHz)	-26 dBc BW (MHz)
	low	1.10	1.38
1.4	mid	1.11	1.39
	high	1.10	1.39
	low	2.74	3.16
3.0	mid	2.74	3.14
	high	2.75	3.16
5.0	low	4.51	5.20
	mid	4.53	5.24
	high	4.52	5.18
10.0	low	9.06	10.22
	mid	9.07	10.27
	high	9.06	10.30

© CTC advanced GmbH Page 64 of 103

Test report no.: 1-3977/22-03-12



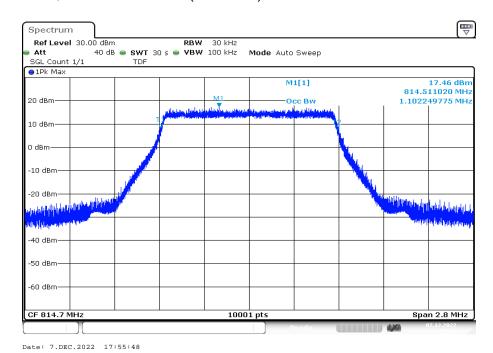
Occupied Bandwidth - 64-QAM			
Bandwidth	Channel	99% OBW (MHz)	-26 dBc BW (MHz)
	low	1.10	1.38
1.4	mid	1.11	1.37
	high	1.10	1.38
	low	2.74	3.15
3.0	mid	2.74	3.14
	high	2.74	3.15
5.0	low	4.51	5.21
	mid	4.52	5.19
	high	4.52	5.20
	low	9.06	10.31
	mid	9.06	10.31
	high	9.06	10.31

© CTC advanced GmbH Page 65 of 103

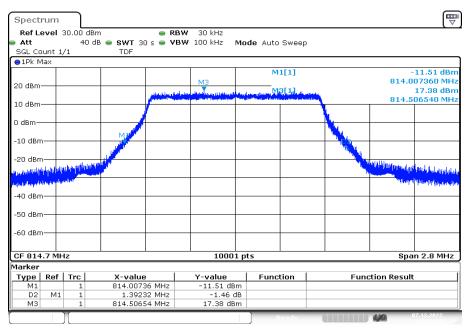


Plots:

Plot 1: 1.4 MHz – QPSK - lowest channel (99% - OBW)



Plot 2: 1.4 MHz – QPSK - lowest channel (-26 dBc BW)

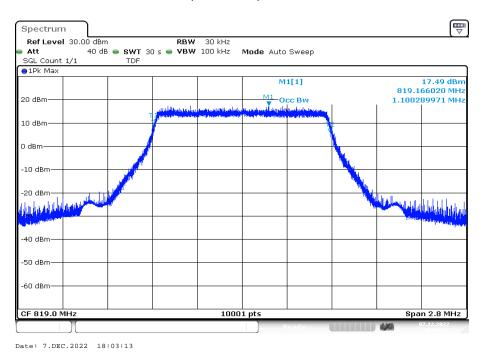


Date: 7.DEC.2022 17:56:20

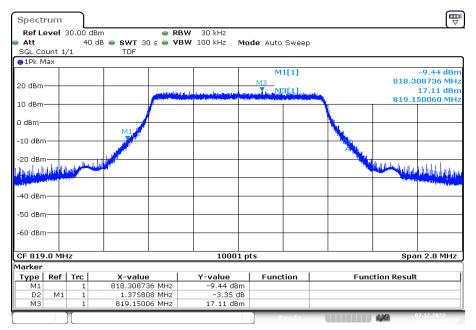
© CTC advanced GmbH Page 66 of 103



Plot 3: 1.4 MHz - QPSK - middle channel (99% - OBW)



Plot 4: 1.4 MHz – QPSK – middle channel (-26 dBc BW)

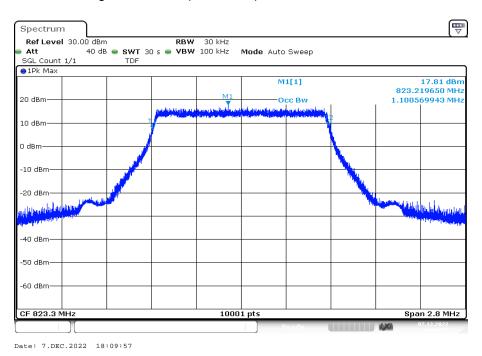


Date: 7.DEC.2022 18:03:45

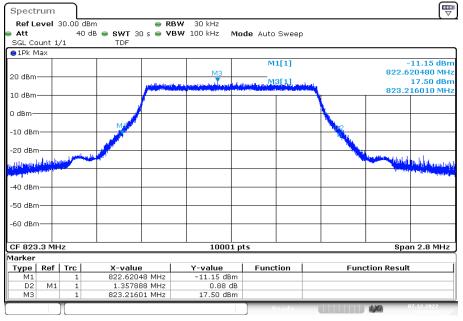
© CTC advanced GmbH Page 67 of 103



Plot 5: 1.4 MHz – QPSK - highest channel (99% - OBW)



Plot 6: 1.4 MHz – QPSK - highest channel (-26 dBc BW)

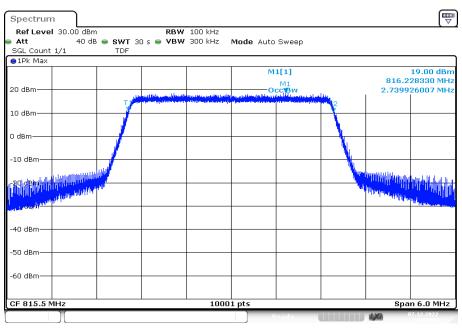


Date: 7.DEC.2022 18:10:30

© CTC advanced GmbH Page 68 of 103

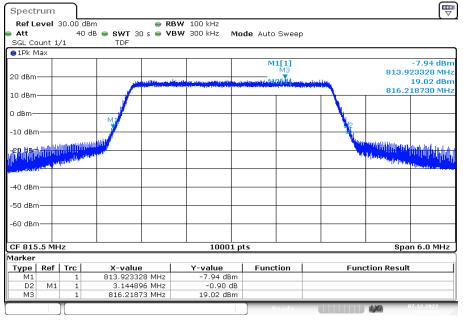


Plot 7: 3 MHz – QPSK - lowest channel (99% - OBW)



Date: 7.DEC.2022 18:18:06

Plot 8: 3 MHz – QPSK - lowest channel (-26 dBc BW)

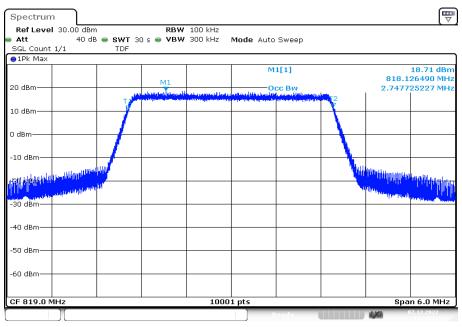


Date: 7.DEC.2022 18:18:38

© CTC advanced GmbH Page 69 of 103

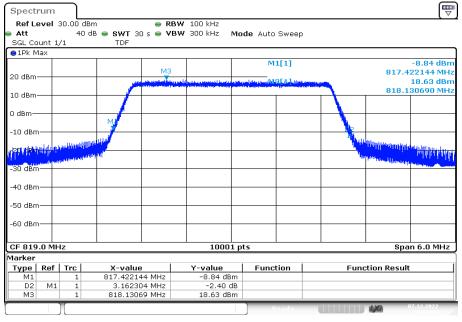


Plot 9: 3 MHz – QPSK - middle channel (99% - OBW)



Date: 7.DEC.2022 18:25:31

Plot 10: 3 MHz - QPSK - middle channel (-26 dBc BW)

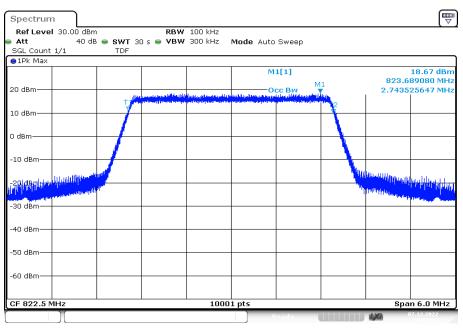


Date: 7.DEC.2022 18:26:04

© CTC advanced GmbH Page 70 of 103

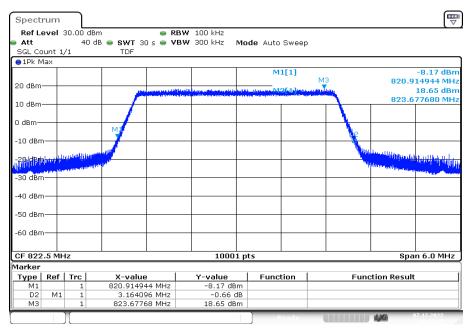


Plot 11: 3 MHz - QPSK - highest channel (99% - OBW)



Date: 7.DEC.2022 18:32:17

Plot 12: 3 MHz - QPSK - highest channel (-26 dBc BW)

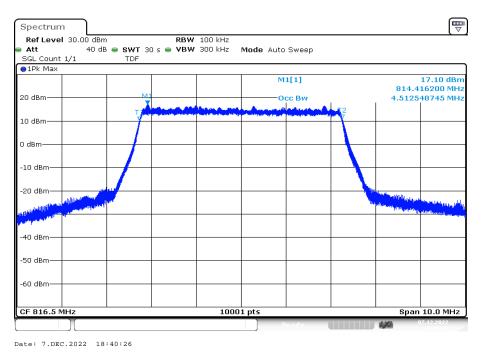


Date: 7.DEC.2022 18:32:49

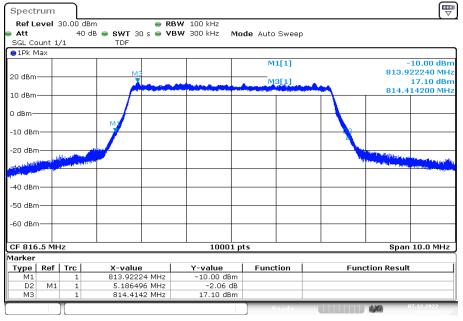
© CTC advanced GmbH Page 71 of 103



Plot 13: 5 MHz – QPSK - lowest channel (99% - OBW)



Plot 14: 5 MHz - QPSK - lowest channel (-26 dBc BW)

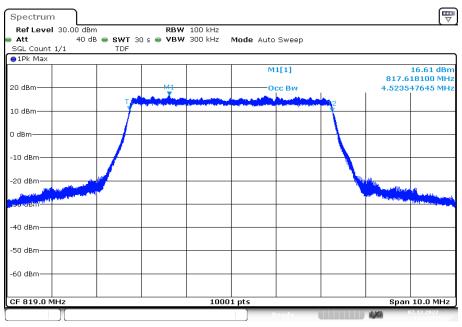


Date: 7.DEC.2022 18:40:59

© CTC advanced GmbH Page 72 of 103

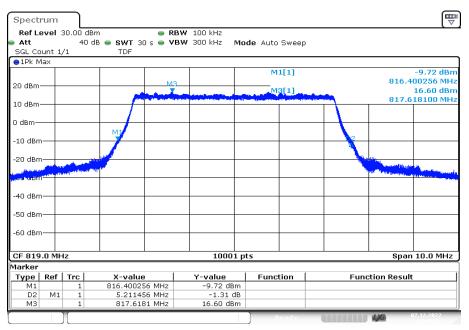


Plot 15: 5 MHz - QPSK - middle channel (99% - OBW)



Date: 7.DEC.2022 18:47:51

Plot 16: 5 MHz - QPSK - middle channel (-26 dBc BW)

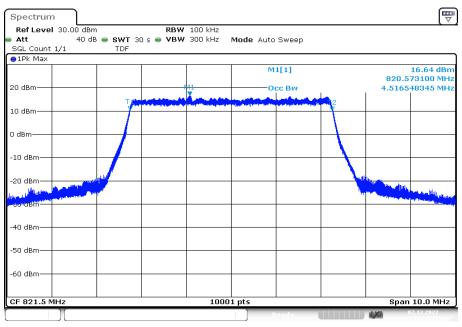


Date: 7.DEC.2022 18:48:24

© CTC advanced GmbH Page 73 of 103

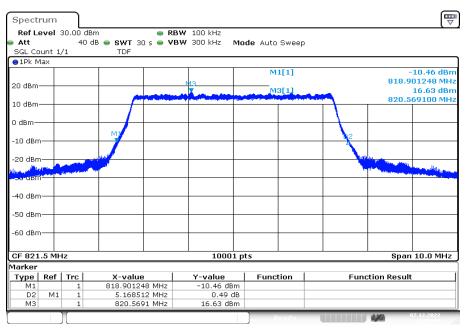


Plot 17: 5 MHz – QPSK - highest channel (99% - OBW)



Date: 7.DEC.2022 18:54:37

Plot 18: 5 MHz - QPSK - highest channel (-26 dBc BW)

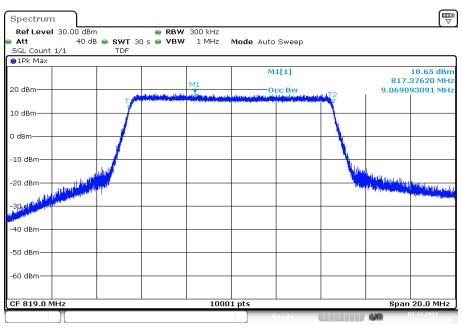


Date: 7.DEC.2022 18:55:09

© CTC advanced GmbH Page 74 of 103

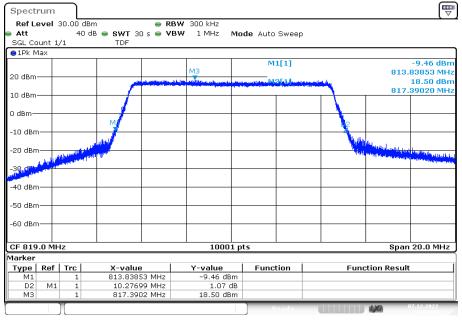


Plot 19: 10 MHz - QPSK - lowest channel (99% - OBW)



Date: 7.DEC.2022 19:02:45

Plot 20: 10 MHz - QPSK - lowest channel (-26 dBc BW)

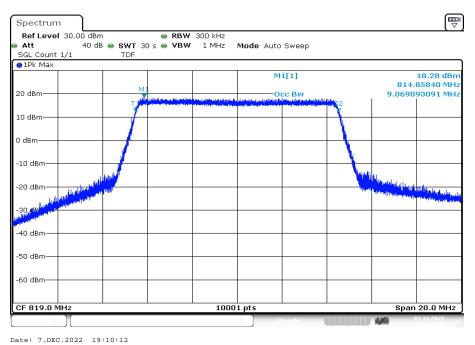


Date: 7.DEC.2022 19:03:19

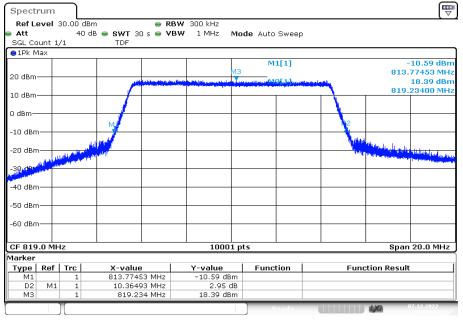
© CTC advanced GmbH Page 75 of 103



Plot 21: 10 MHz - QPSK - middle channel (99% - OBW)



Plot 22: 10 MHz – QPSK - middle channel (-26 dBc BW)

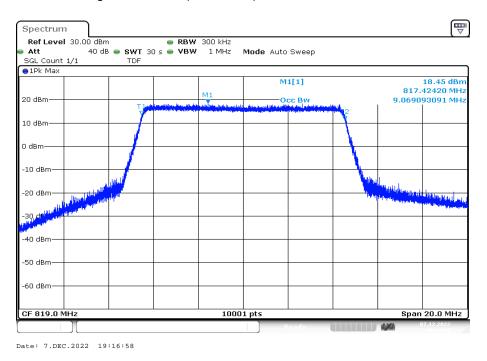


Date: 7.DEC.2022 19:10:44

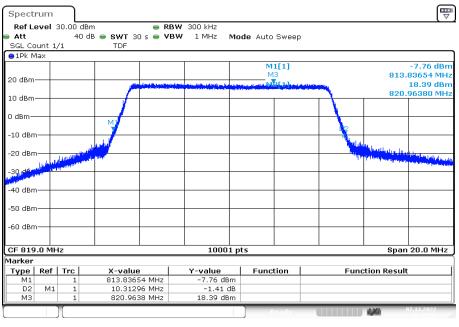
© CTC advanced GmbH Page 76 of 103



Plot 23: 10 MHz - QPSK - highest channel (99% - OBW)



Plot 24: 10 MHz - QPSK - highest channel (-26 dBc BW)

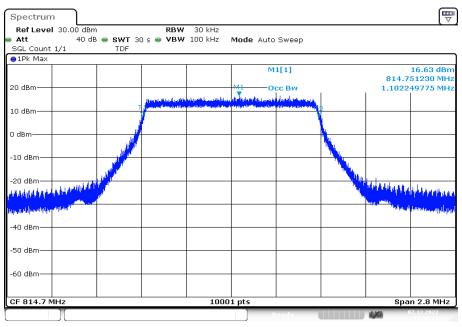


Date: 7.DEC.2022 19:17:38

© CTC advanced GmbH Page 77 of 103

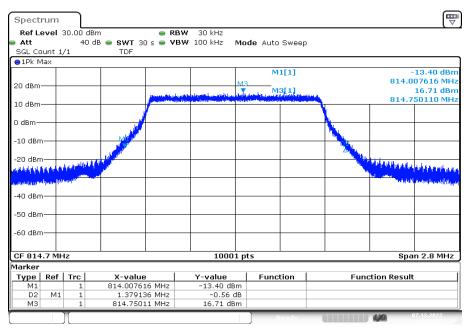


Plot 25: 1.4 MHz – 16-QAM - lowest channel (99% - OBW)



Date: 7.DEC.2022 17:58:24

Plot 26: 1.4 MHz – 16-QAM - lowest channel (-26 dBc BW)

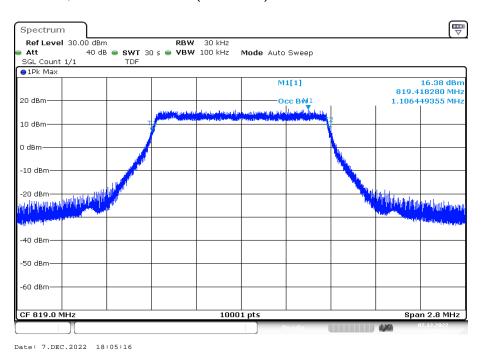


Date: 7.DEC.2022 17:58:57

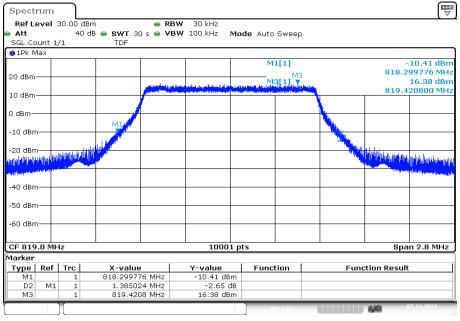
© CTC advanced GmbH Page 78 of 103



Plot 27: 1.4 MHz – 16-QAM - middle channel (99% - OBW)



Plot 28: 1.4 MHz – 16-QAM - middle channel (-26 dBc BW)

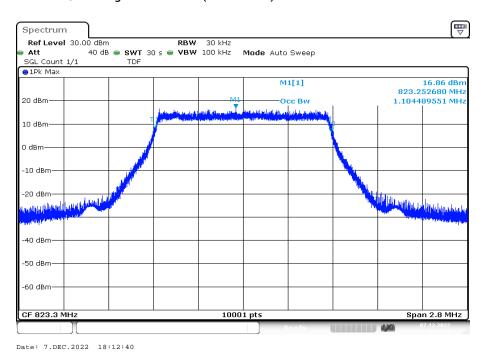


Date: 7.DEC.2022 18:05:48

© CTC advanced GmbH Page 79 of 103

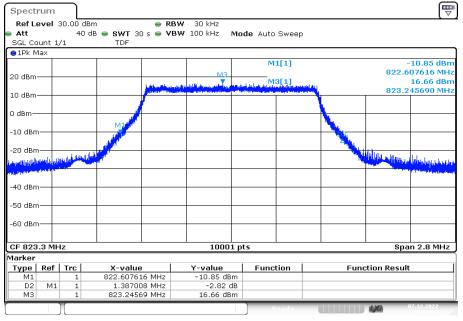


Plot 29: 1.4 MHz – 16-QAM - highest channel (99% - OBW)



1.4 MHz - 16-QAM - highest channel (-26 dBc BW)

Plot 30:

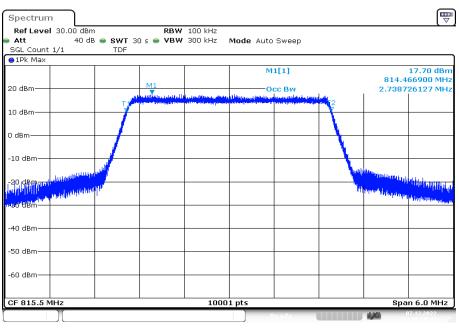


Date: 7.DEC.2022 18:13:13

© CTC advanced GmbH Page 80 of 103

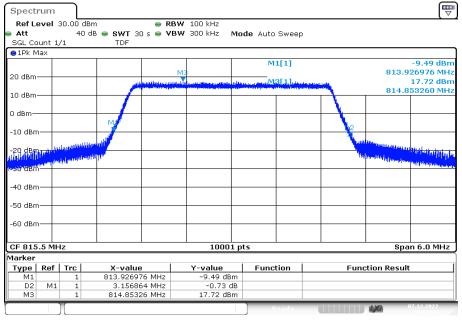


Plot 31: 3 MHz – 16-QAM - lowest channel (99% - OBW)



Date: 7.DEC.2022 18:20:42

Plot 32: 3 MHz – 16-QAM - lowest channel (-26 dBc BW)

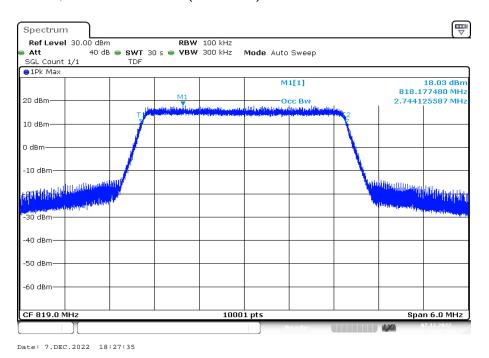


Date: 7.DEC.2022 18:21:15

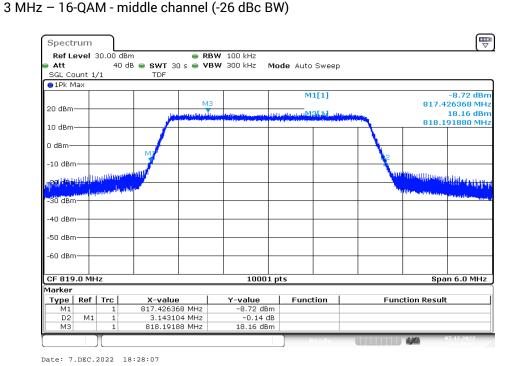
© CTC advanced GmbH Page 81 of 103



Plot 33: 3 MHz – 16-QAM - middle channel (99% - OBW)



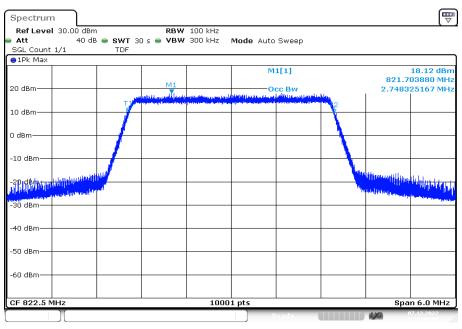
Plot 34:



© CTC advanced GmbH Page 82 of 103

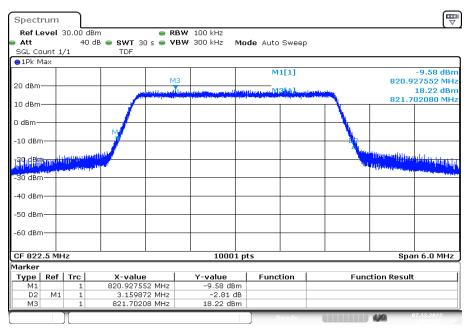


Plot 35: 3 MHz – 16-QAM - highest channel (99% - OBW)



Date: 7.DEC.2022 18:35:00

Plot 36: 3 MHz - 16-QAM - highest channel (-26 dBc BW)

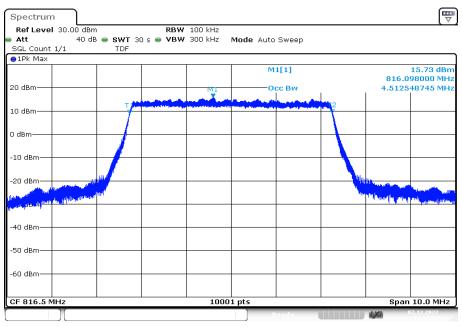


Date: 7.DEC.2022 18:35:33

© CTC advanced GmbH Page 83 of 103

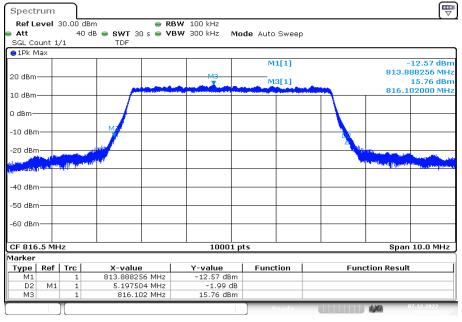


Plot 37: 5 MHz – 16-QAM - lowest channel (99% - OBW)



Date: 7.DEC.2022 18:43:03

Plot 38: 5 MHz – 16-QAM - lowest channel (-26 dBc BW)

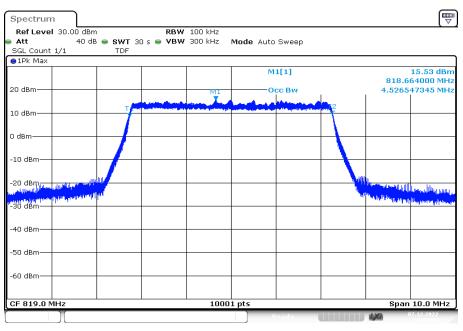


Date: 7.DEC.2022 18:43:35

© CTC advanced GmbH Page 84 of 103

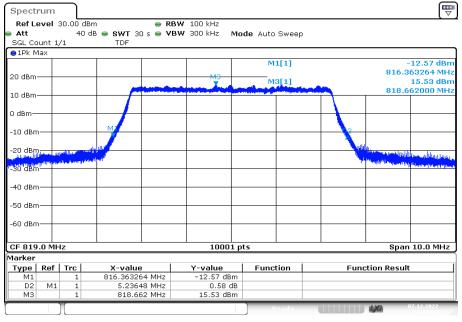


Plot 39: 5 MHz – 16-QAM - middle channel (99% - OBW)



Date: 7.DEC.2022 18:49:55

Plot 40: 5 MHz – 16-QAM - middle channel (-26 dBc BW)

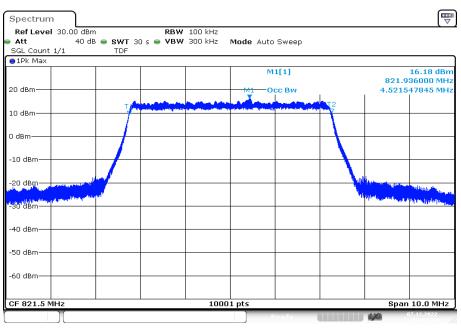


Date: 7.DEC.2022 18:50:27

© CTC advanced GmbH Page 85 of 103

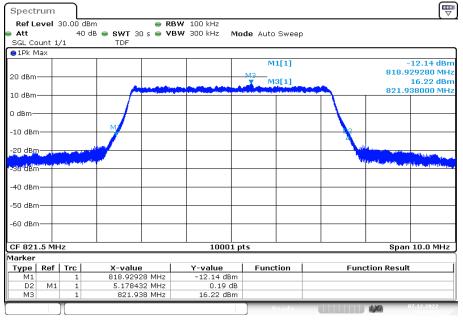


Plot 41: 5 MHz - 16-QAM - highest channel (99% - OBW)



Date: 7.DEC.2022 18:57:20

Plot 42: 5 MHz - 16-QAM - highest channel (-26 dBc BW)

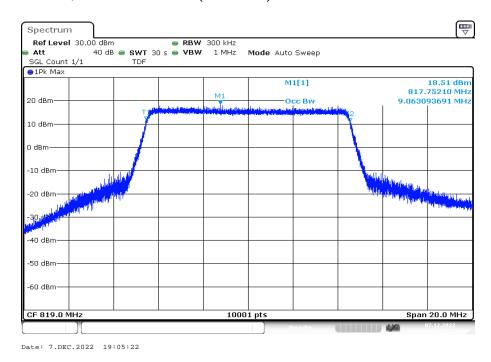


Date: 7.DEC.2022 18:57:53

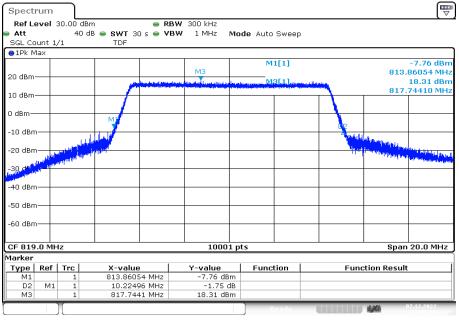
© CTC advanced GmbH Page 86 of 103



Plot 43: 10 MHz – 16-QAM - lowest channel (99% - OBW)



Plot 44: 10 MHz – 16-QAM - lowest channel (-26 dBc BW)

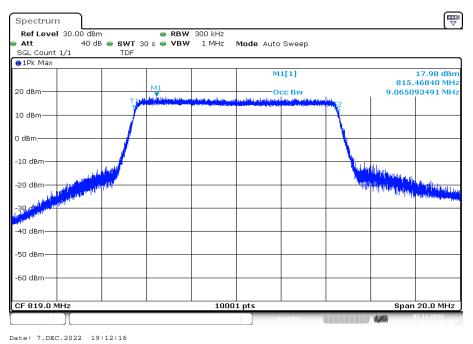


Date: 7.DEC.2022 19:05:55

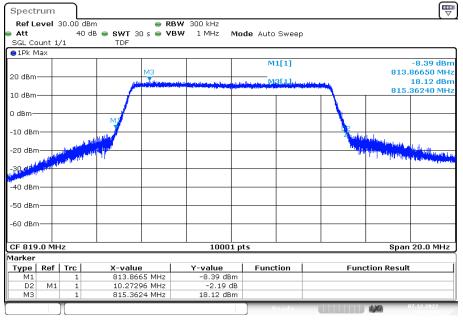
© CTC advanced GmbH Page 87 of 103



Plot 45: 10 MHz – 16-QAM - middle channel (99% - OBW)



Plot 46: 10 MHz – 16-QAM - middle channel (-26 dBc BW)

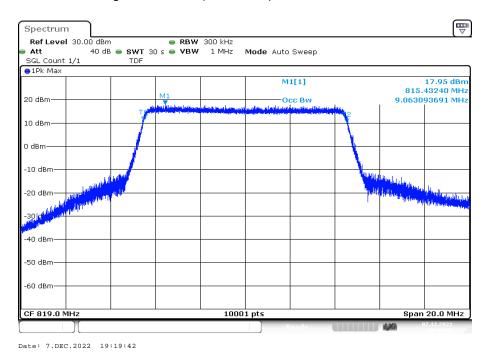


Date: 7.DEC.2022 19:12:48

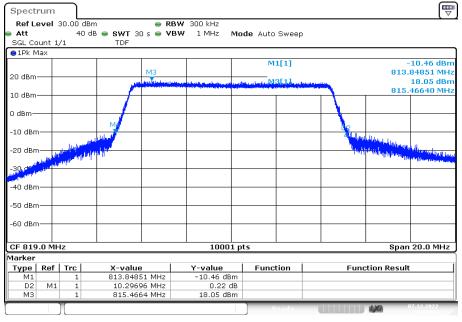
© CTC advanced GmbH Page 88 of 103



Plot 47: 10 MHz – 16-QAM - highest channel (99% - OBW)



Plot 48: 10 MHz – 16-QAM - highest channel (-26 dBc BW)

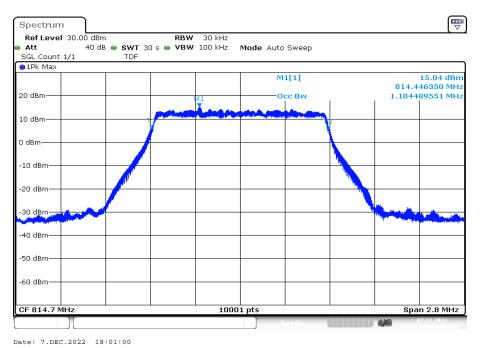


Date: 7.DEC.2022 19:20:14

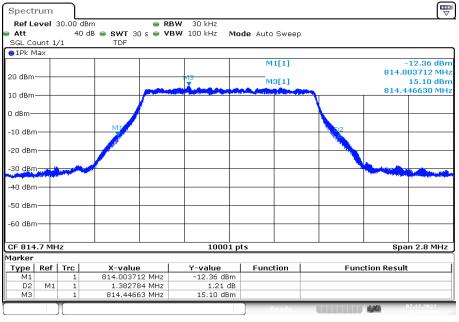
© CTC advanced GmbH Page 89 of 103



Plot 49: 1.4 MHz - 64-QAM - lowest channel (99% - OBW)



Plot 50: 1.4 MHz - 64-QAM - lowest channel (-26 dBc BW)

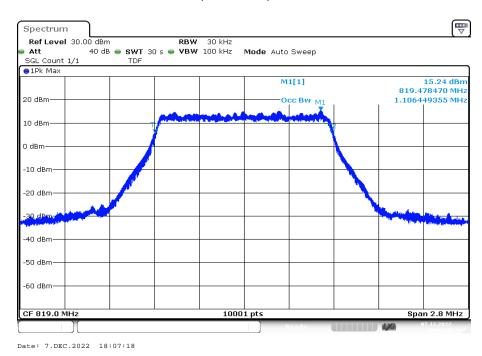


Date: 7.DEC.2022 18:01:40

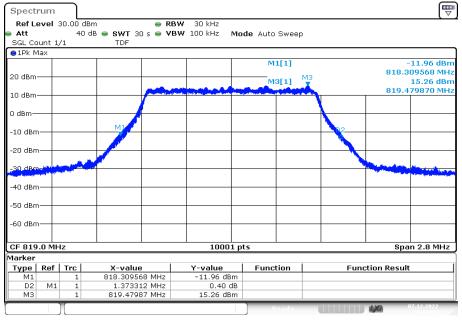
© CTC advanced GmbH Page 90 of 103



Plot 51: 1.4 MHz – 64-QAM - middle channel (99% - OBW)



Plot 52: 1.4 MHz - 64-QAM - middle channel (-26 dBc BW)

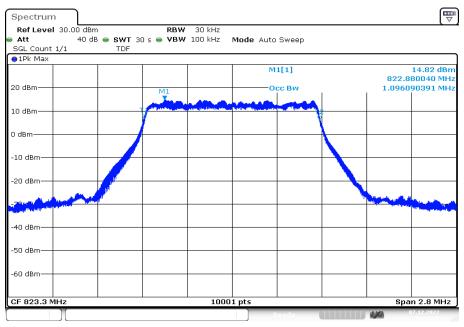


Date: 7.DEC.2022 18:07:51

© CTC advanced GmbH Page 91 of 103

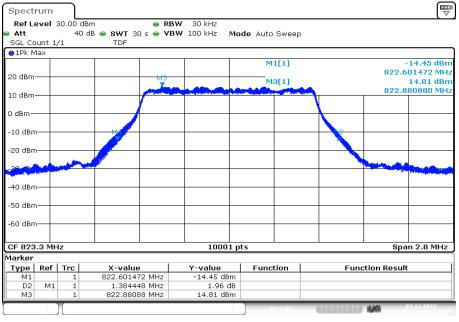


Plot 53: 1.4 MHz – 64-QAM - highest channel (99% - OBW)



Date: 7.DEC.2022 18:15:17

Plot 54: 1.4 MHz - 64-QAM - highest channel (-26 dBc BW)

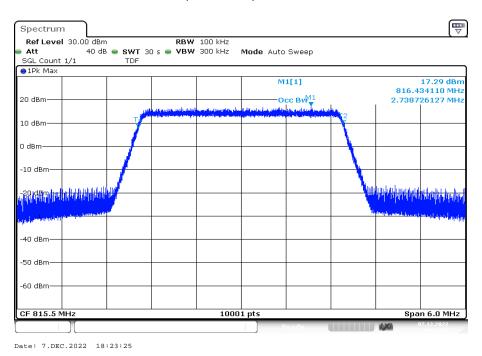


Date: 7.DEC.2022 18:15:49

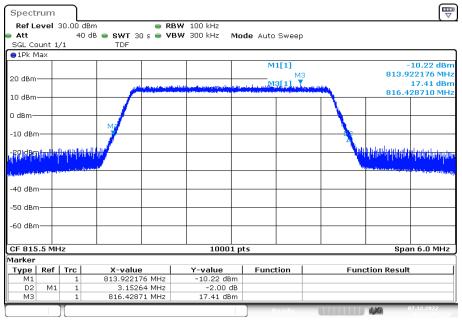
© CTC advanced GmbH Page 92 of 103



Plot 55: 3 MHz – 64-QAM - lowest channel (99% - OBW)



Plot 56: 3 MHz – 64-QAM - lowest channel (-26 dBc BW)

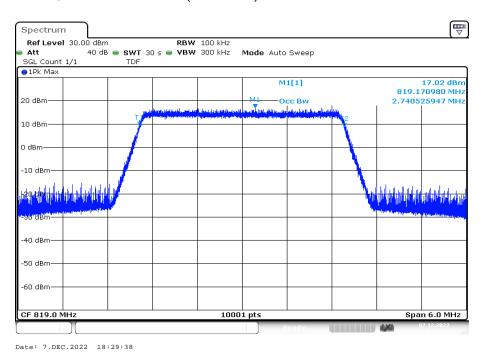


Date: 7.DEC.2022 18:23:58

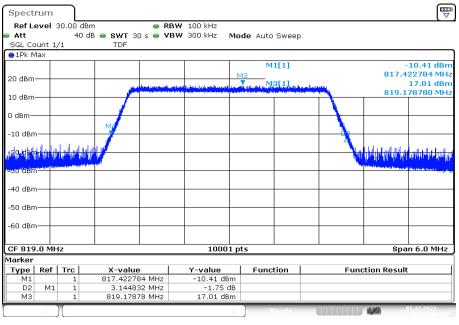
© CTC advanced GmbH Page 93 of 103



Plot 57: 3 MHz - 64-QAM - middle channel (99% - OBW)



Plot 58: 3 MHz – 64-QAM - middle channel (-26 dBc BW)

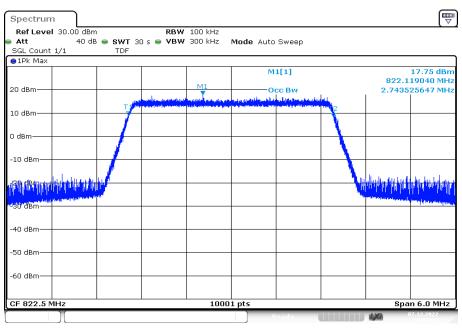


Date: 7.DEC.2022 18:30:10

© CTC advanced GmbH Page 94 of 103

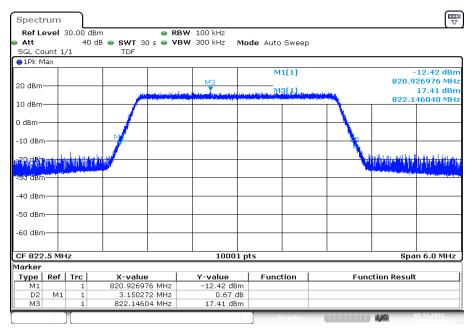


Plot 59: 3 MHz - 64-QAM - highest channel (99% - OBW)



Date: 7.DEC.2022 18:37:37

Plot 60: 3 MHz - 64-QAM - highest channel (-26 dBc BW)

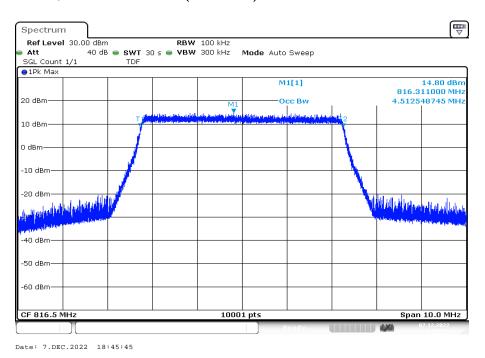


Date: 7.DEC.2022 18:38:10

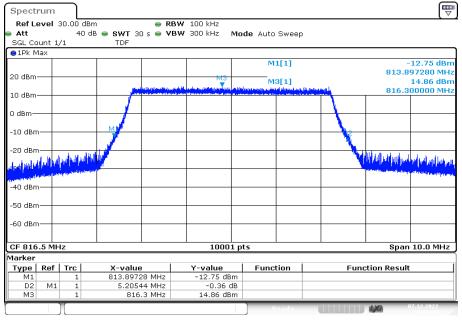
© CTC advanced GmbH Page 95 of 103



Plot 61: 5 MHz - 64-QAM - lowest channel (99% - OBW)



Plot 62: 5 MHz - 64-QAM - lowest channel (-26 dBc BW)

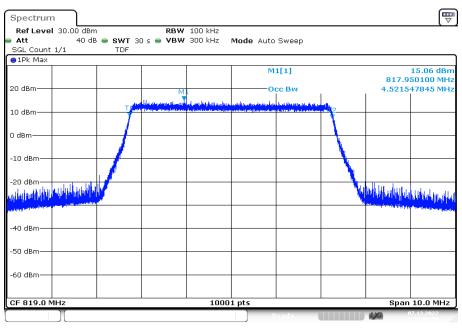


Date: 7.DEC.2022 18:46:18

© CTC advanced GmbH Page 96 of 103

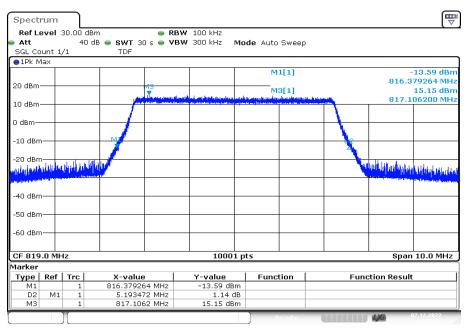


Plot 63: 5 MHz - 64-QAM - middle channel (99% - OBW)



Date: 7.DEC.2022 18:51:58

Plot 64: 5 MHz – 64-QAM - middle channel (-26 dBc BW)

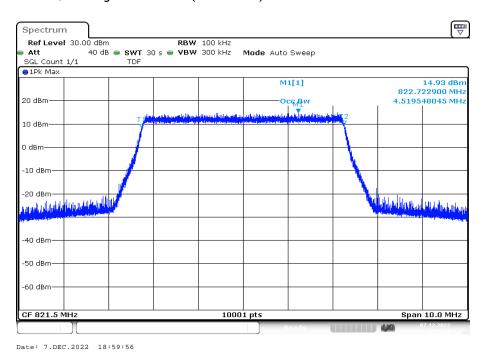


Date: 7.DEC.2022 18:52:31

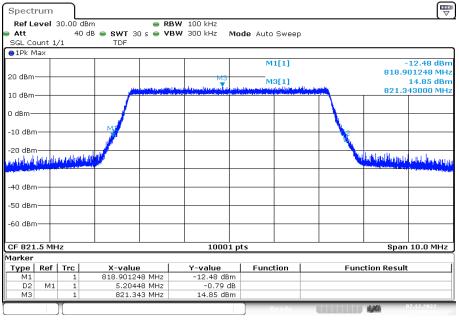
© CTC advanced GmbH Page 97 of 103



Plot 65: 5 MHz - 64-QAM - highest channel (99% - OBW)



Plot 66: 5 MHz - 64-QAM - highest channel (-26 dBc BW)

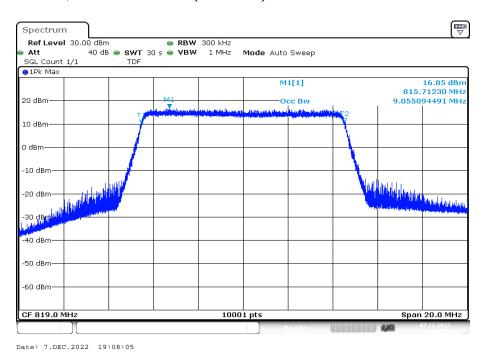


Date: 7.DEC.2022 19:00:29

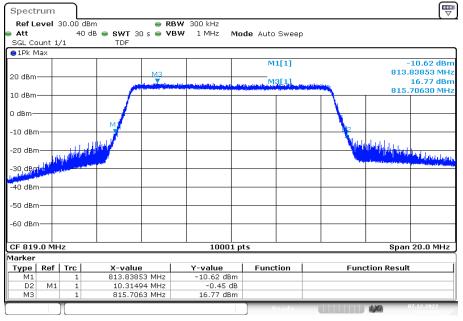
© CTC advanced GmbH Page 98 of 103



Plot 67: 10 MHz - 64-QAM - lowest channel (99% - OBW)



Plot 68: 10 MHz - 64-QAM - lowest channel (-26 dBc BW)

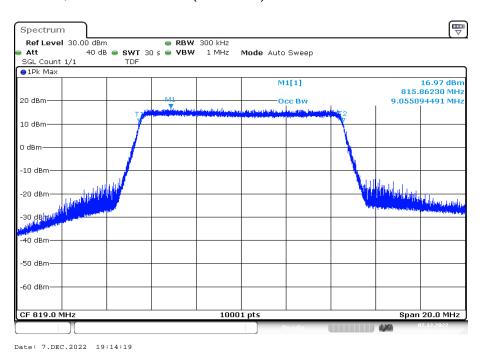


Date: 7.DEC.2022 19:08:38

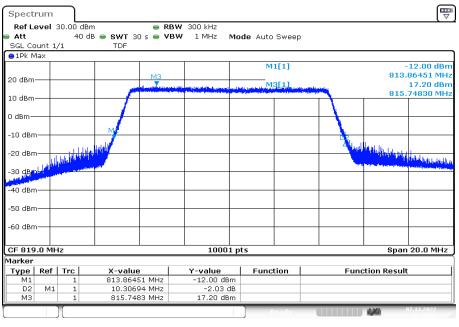
© CTC advanced GmbH Page 99 of 103



Plot 69: 10 MHz – 64-QAM - middle channel (99% - OBW)



Plot 70: 10 MHz - 64-QAM - middle channel (-26 dBc BW)

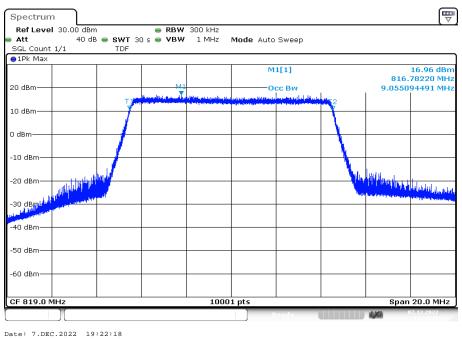


Date: 7.DEC.2022 19:14:52

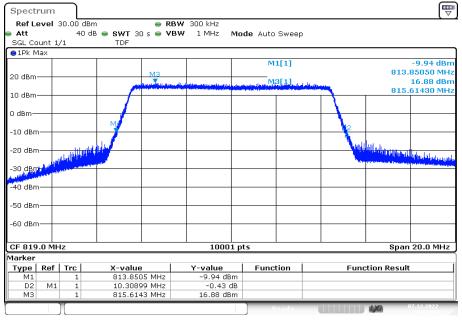
© CTC advanced GmbH Page 100 of 103



Plot 71: 10 MHz - 64-QAM - highest channel (99% - OBW)



Plot 72: 10 MHz - 64-QAM - highest channel (-26 dBc BW)



Date: 7.DEC.2022 19:22:51

© CTC advanced GmbH Page 101 of 103 Test report no.: 1-3977/22-03-12



13 Glossary

EUT	Equipment under test		
DUT	Device under test		
UUT	Unit under test		
GUE	GNSS User Equipment		
ETSI	European Telecommunications Standards Institute		
EN	European Standard		
FCC	Federal Communications Commission		
FCC ID	Company Identifier at FCC		
IC	Industry Canada		
PMN	Product marketing name		
HMN	Host marketing name		
HVIN	Hardware version identification number		
FVIN	Firmware version identification number		
EMC	Electromagnetic Compatibility		
HW	Hardware		
SW	Software		
Inv. No.	Inventory number		
S/N or SN	Serial number		
С	Compliant		
NC	Not compliant		
NA	Not applicable		
NP	Not performed		
PP	Positive peak		
QP	Quasi peak		
AVG	Average		
ОС	Operating channel		
ocw	Operating channel bandwidth		
OBW	Occupied bandwidth		
ООВ	Out of band		
DFS	Dynamic frequency selection		
CAC	Channel availability check		
OP	Occupancy period		
NOP	Non occupancy period		
DC	Duty cycle		
PER	Packet error rate		
CW	Clean wave		
MC	Modulated carrier		
WLAN	Wireless local area network		
RLAN	Radio local area network		
DSSS	Dynamic sequence spread spectrum		
OFDM	Orthogonal frequency division multiplexing		
FHSS	Frequency hopping spread spectrum		
GNSS	Global Navigation Satellite System		
C/N₀	Carrier to noise-density ratio, expressed in dB-Hz		

© CTC advanced GmbH Page 102 of 103



14 Document history

Version	Applied changes	Date of release
-/-	Initial release	2023-01-17

15 Accreditation Certificate - D-PL-12076-01-05

first page	last page
Deutsche Akkreditierungsstelle Deutsche Akkreditierungsstelle GmbH Entrusted according to Section 8 subsection 1 AkkStelleG in connection with Section 1 subsection 1 AkkStelleGBV Signatory to the Multilateral Agreements of EA, ILAC and IAF for Mutual Recognition Accreditation The Deutsche Akkreditierungsstelle GmbH attests that the testing laboratory CTC advanced GmbH Untertürkheimer Straße 6-10, 66117 Saarbrücken Is competent under the terms of DIN EN ISO/IEC 17025-2018 to carry out tests in the following fields: Telecommunication (FCC Requirements)	Deutsche Akkreditierungsstelle GmbH Office Berlin Office Frankfurt am Main Spittelmarkt 10 10117 Berlin G0327 Frankfurt am Main The publication of extracts of the accreditation certificate is subject to the prior written approval by Deutsche Akkreditierungsstelle GmbH (DA&AS). Exempted is the unchanged form of separate
The accreditation certificate shall only apply in connection with the notice of accreditation of 09.06.2020 with the accreditation number D-PL-12076-01. It comprises the cover sheet, the reverse side of the cover sheet and the following annex with a total of 05 pages. Registration number of the certificate: D-PL-12076-01-05 Frankfurt am Main, 09.06.2020 by order following in the following pages. The certificate is the state of t	disseminations of the cover sheet by the conformity assessment body mentioned overleaf. No impression shall be made that the accreditation also extends to fields beyond the scope of accreditation matseted by DAMS. The accreditation was granted pursuant to the Act on the Accreditation Body (AMSStelleS) of 31 July 2008 (Federal Law Gazette 1s. 2625) and the Regulation (EC) No 785/2008 of the Surpopen Parliament and of federal Law Gazette 1s. 2625) and the Regulation (EC) No 785/2008 of the Surpopen Parliament and of the Composition of the Surpopen Parliament and of the Composition of the Surpopen Parliament and of the Surpopen Composition (1s. 158 of 9 July 2008, p. 30). DAMS is a signatory to the Multilateral Agreements for Mutual Recognition of the European co-operation for Accreditation (EA), International Accreditation Formul (AF) and international Laboratory Accreditation Cooperation (ILAC). The signatories to these agreements recognise each other's accreditations. The up-4to-date state of membership can be retrieved from the following websites: EA: www.lac.org ILAC: www.lac.org ILAC: www.lac.org

Note: The current certificate annex is published on the websites (link see below).

https://www.dakks.de/files/data/as/pdf/D-PL-12076-01-05e.pdf

or

https://ctcadvanced.com/app/uploads/2020/06/D-PL-12076-01-05_TCB_USA.pdf

© CTC advanced GmbH Page 103 of 103