

4.5 Band Edge Measurement

4.5.1 Limits of Band Edge Measurement

For LTE Band 71:

According to FCC 27.53(g) for operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log(P)$ dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater.

For LTE Band 2:

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. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed.

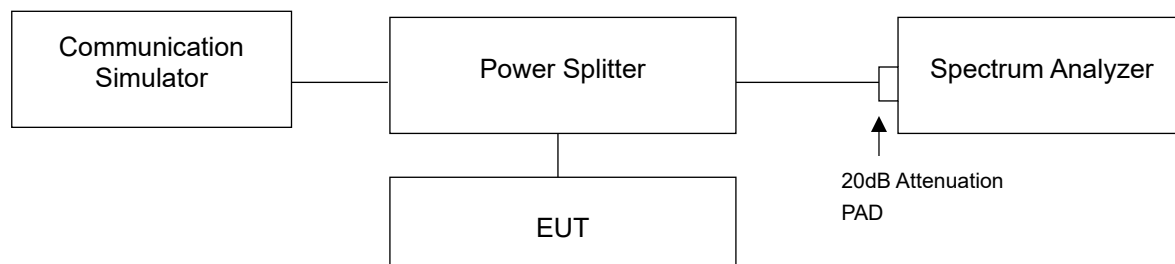
For LTE Band 7:

According to FCC 27.53(m)(4) specified that power of any emission outside of the channel edge must be attenuated below the transmitting power (P) by a 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. In addition, the attenuation factor shall not be less that $43 + 10 \log(P)$ dB on all frequencies between 2490.5MHz and 2496 MHz and $55 + 10 \log(P)$ dB at or below 2490.5MHz. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least two percent may be employed, except when the 1 megahertz band is 2495-2496 MHz, in which case a resolution bandwidth of at least one percent may be employed.

For LTE Band 66:

According to FCC 27.53(h) for operations in the 1695-1710MHz, 1710-1755MHz, 1755-1780 MHz, 1915-1920MHz, 1995-2000 MHz, 2000-2020MHz, 2110-2155MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log(P)$ dB.

4.5.2 Test Setup



4.5.3 Test Procedures

For 5G NR Band:

- a. The center frequency of spectrum is the band edge frequency and span is 2MHz. RB of the spectrum is 51kHz and VB of the spectrum is 160kHz (Channel Bandwidth 5MHz).
- b. The center frequency of spectrum is the band edge frequency and span is 2MHz. RB of the spectrum is 100kHz and VB of the spectrum is 300kHz (Channel Bandwidth 10MHz).
- c. The center frequency of spectrum is the band edge frequency and span is 2MHz. RB of the spectrum is 150kHz and VB of the spectrum is 470kHz (Channel Bandwidth 15MHz).
- d. The center frequency of spectrum is the band edge frequency and span is 2MHz. RB of the spectrum is 200kHz and VB of the spectrum is 620kHz (Channel Bandwidth 20MHz).
- e. Record the max trace plot into the test report.

For LTE Band:

- a. All measurements were done at low and high operational frequency range.
- b. The center frequency of spectrum is the band edge frequency and span is 1MHz. RB of the spectrum is 15kHz and VB of the spectrum is 51kHz (Channel Bandwidth 1.4MHz).
- c. The center frequency of spectrum is the band edge frequency and span is 1MHz. RB of the spectrum is 30kHz and VB of the spectrum is 100kHz (Channel Bandwidth 3MHz).
- d. The center frequency of spectrum is the band edge frequency and span is 1MHz. RB of the spectrum is 51kHz and VB of the spectrum is 160kHz (Channel Bandwidth 5MHz).
- e. The center frequency of spectrum is the band edge frequency and span is 1MHz. RB of the spectrum is 100kHz and VB of the spectrum is 300kHz (Channel Bandwidth 10MHz).
- f. The center frequency of spectrum is the band edge frequency and span is 1MHz. RB of the spectrum is 150kHz and VB of the spectrum is 470kHz (Channel Bandwidth 15MHz).
- g. The center frequency of spectrum is the band edge frequency and span is 1MHz. RB of the spectrum is 200kHz and VB of the spectrum is 1MHz (Channel Bandwidth 20MHz).
- h. Record the max trace plot into the test report.

4.5.4 Test Results

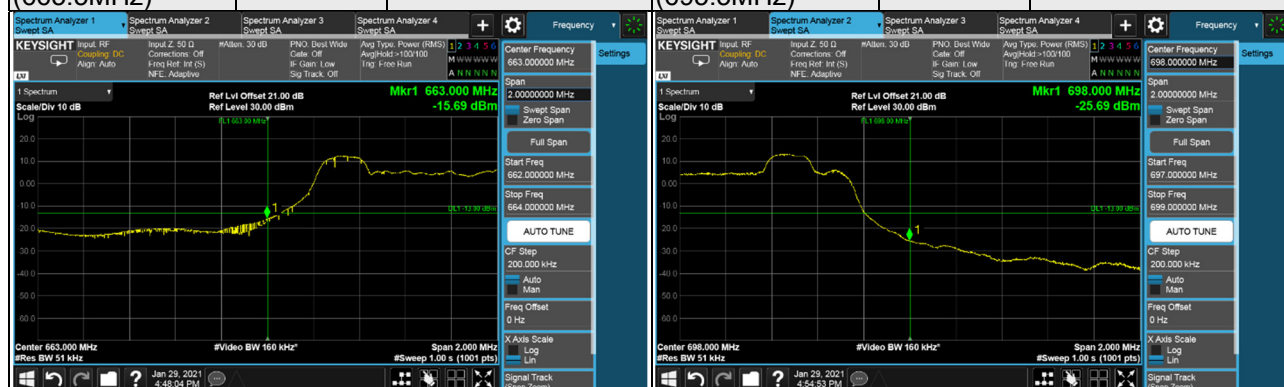
Band Edge

n71, Channel Bandwidth 5MHz

Channel 133100 (665.5MHz)	$\pi/2$ BPSK	1 RB / 0 RB Offset	Channel 139100 (695.5MHz)	$\pi/2$ BPSK	1 RB / 24 RB Offset
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Channel 133100 (665.5MHz)	$\pi/2$ BPSK	25 RB / 0 RB Offset	Channel 139100 (695.5MHz)	$\pi/2$ BPSK	25 RB / 0 RB Offset
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n71, Channel Bandwidth 10MHz

Channel 133600
(668.0MHz)

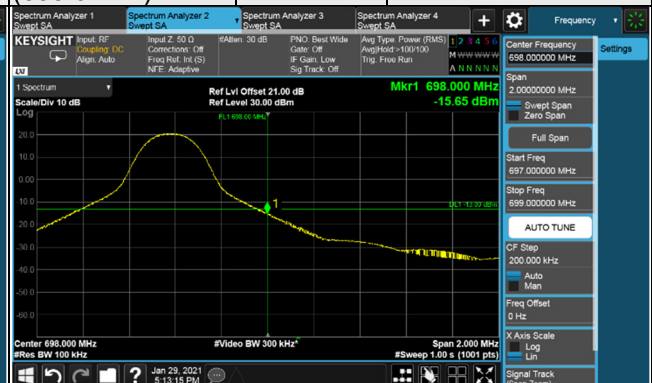
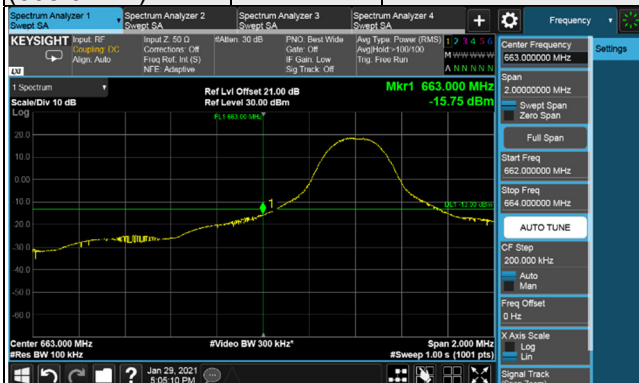
$\pi/2$ BPSK

1 RB / 1 RB Offset

Channel 138600
(693.0MHz)

$\pi/2$ BPSK

1 RB / 50 RB Offset



Channel 133600
(668.0MHz)

$\pi/2$ BPSK

50 RB / 0 RB Offset

Channel 138600
(693.0MHz)

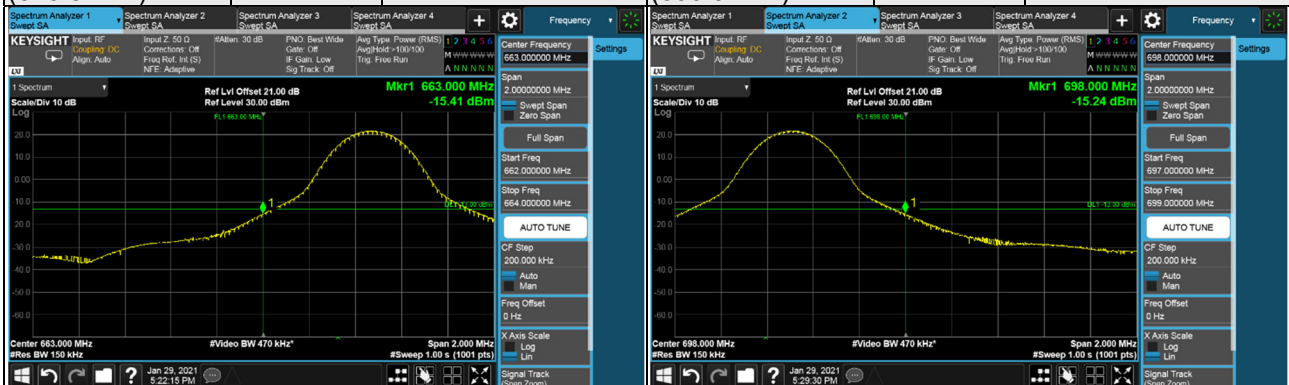
$\pi/2$ BPSK

50 RB / 0 RB Offset



n71, Channel Bandwidth 15MHz

Channel 134100 (670.5MHz)	$\pi/2$ BPSK	1 RB / 1 RB Offset	Channel 138100 (690.5MHz)	$\pi/2$ BPSK	1 RB / 77 RB Offset
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Channel 134100 (670.5MHz)	$\pi/2$ BPSK	75 RB / 0 RB Offset	Channel 138100 (690.5MHz)	$\pi/2$ BPSK	75 RB / 0 RB Offset
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n71, Channel Bandwidth 20MHz

Channel 134600
(673.0MHz)

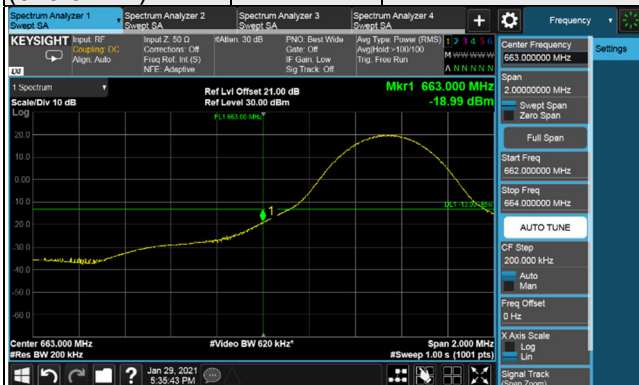
$\pi/2$ BPSK

1 RB / 1 RB Offset

Channel 137600
(688.0MHz)

$\pi/2$ BPSK

1 RB / 104 RB Offset



Channel 134600
(673.0MHz)

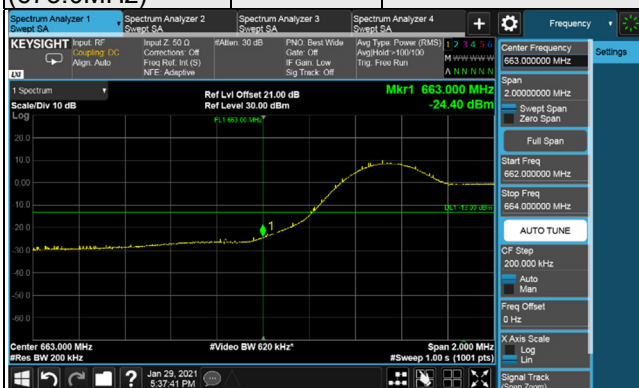
$\pi/2$ BPSK

100 RB / 0 RB Offset

Channel 137600
(688.0MHz)

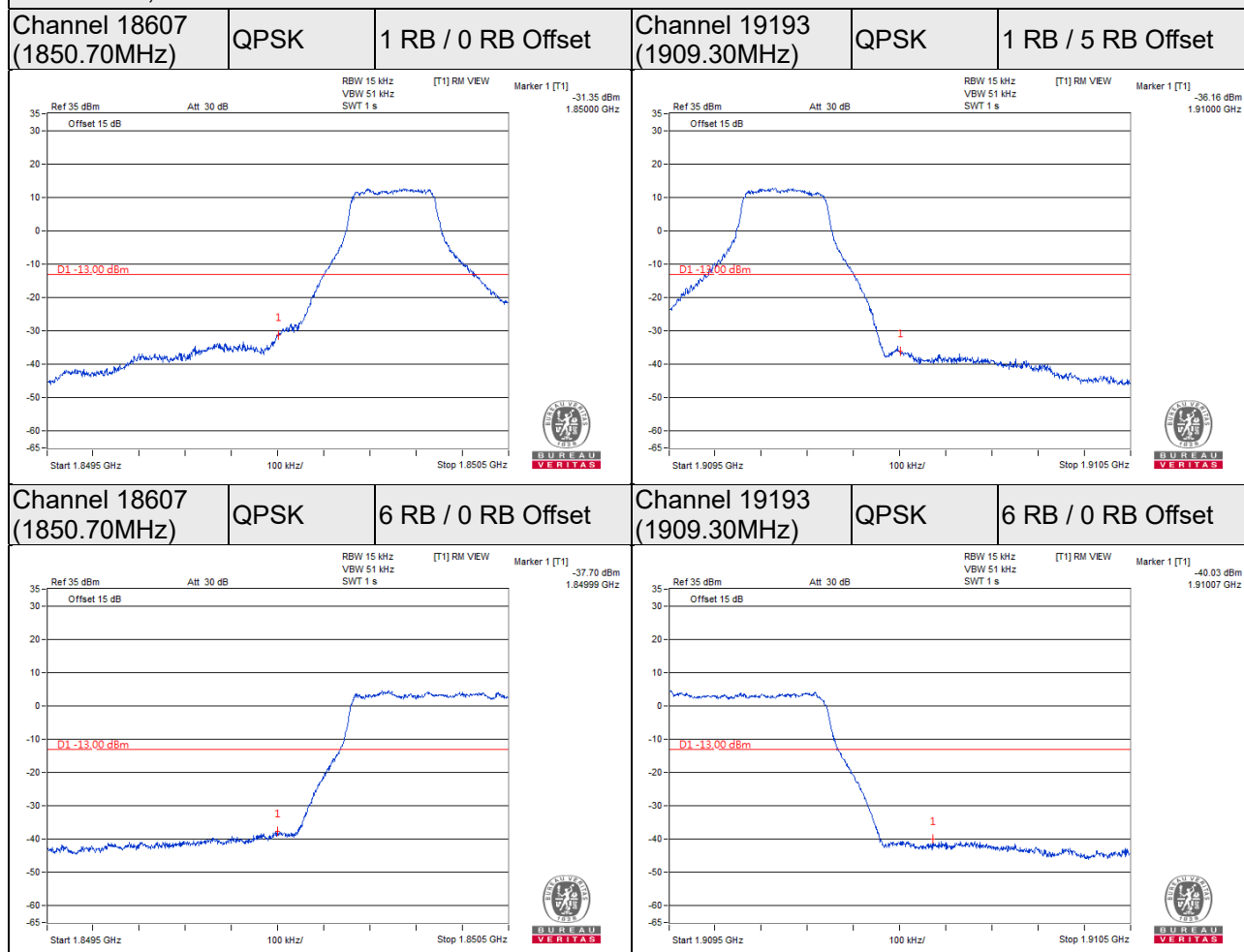
$\pi/2$ BPSK

100 RB / 0 RB Offset



Band Edge

LTE Band 2, Channel Bandwidth 1.4MHz



LTE Band 2, Channel Bandwidth 3MHz

Channel 18615
(1851.50MHz)

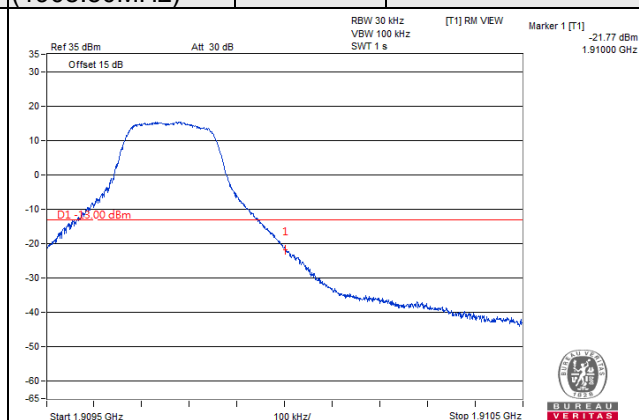
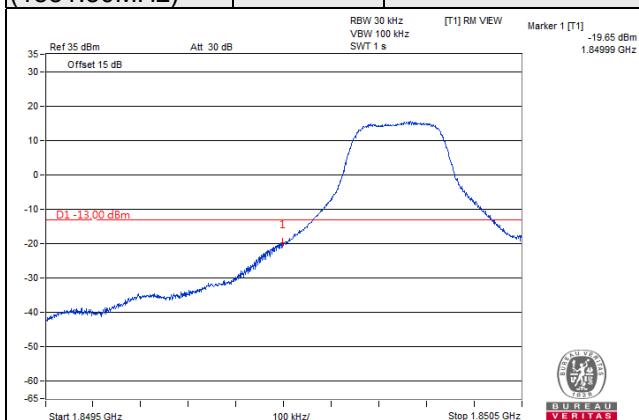
QPSK

1 RB / 0 RB Offset

Channel 19185
(1908.50MHz)

QPSK

1 RB / 14 RB Offset



Channel 18615
(1851.50MHz)

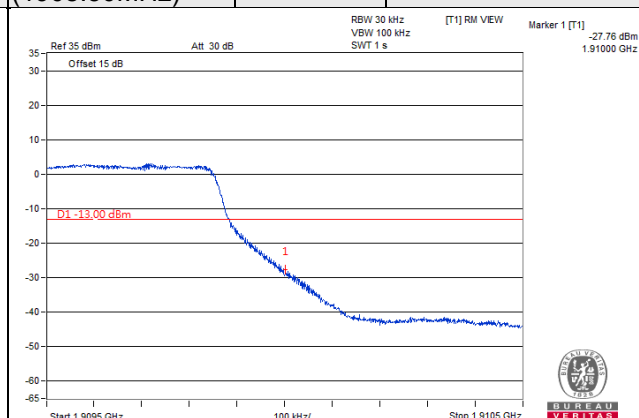
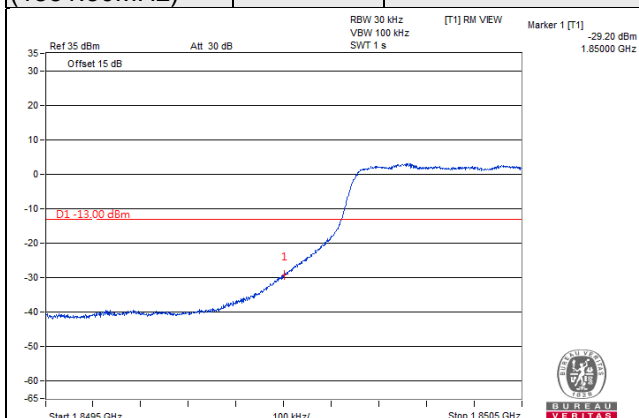
QPSK

15 RB / 0 RB Offset

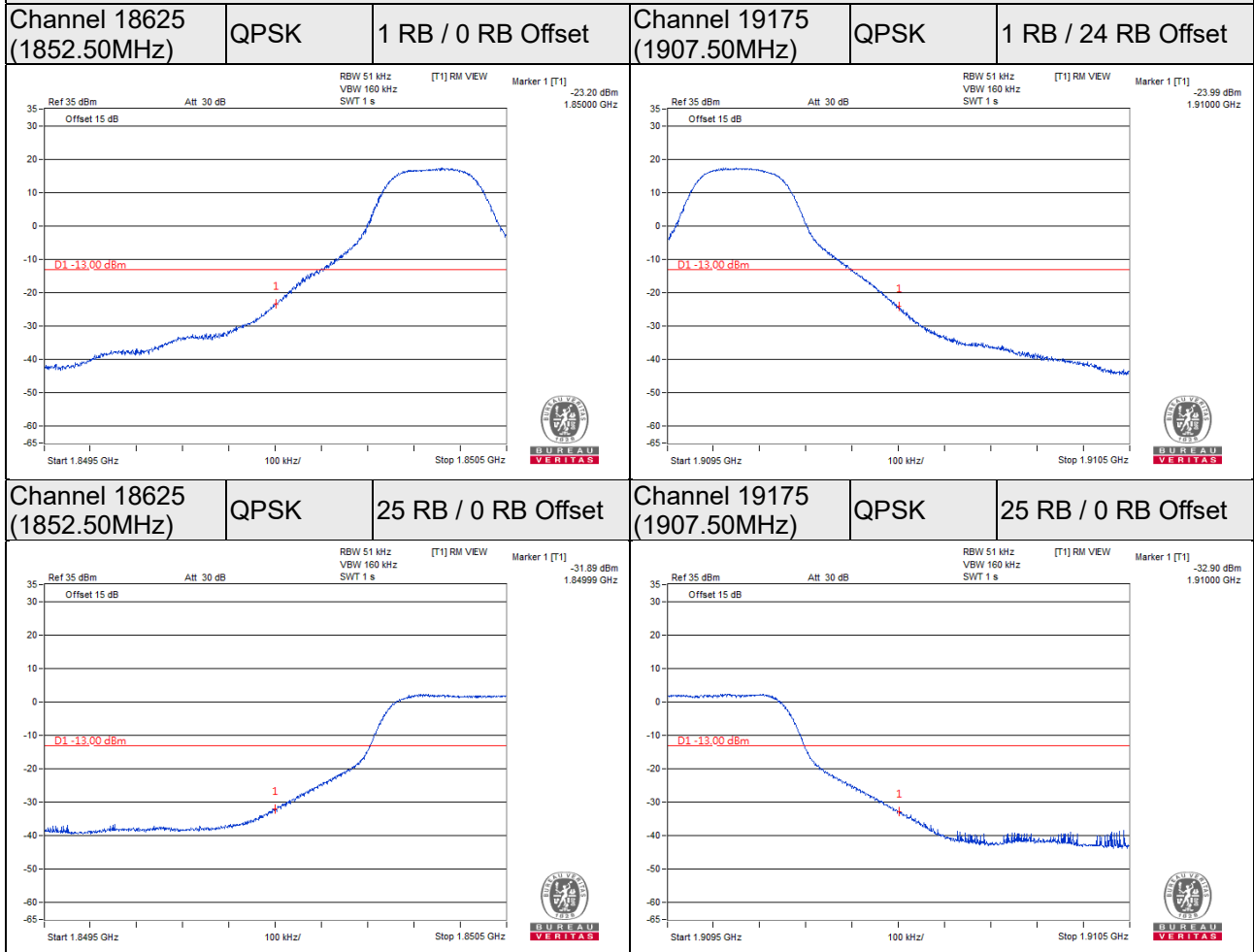
Channel 19185
(1908.50MHz)

QPSK

15 RB / 0 RB Offset



LTE Band 2, Channel Bandwidth 5MHz



LTE Band 2, Channel Bandwidth 10MHz

Channel 18650
(1855.00MHz)

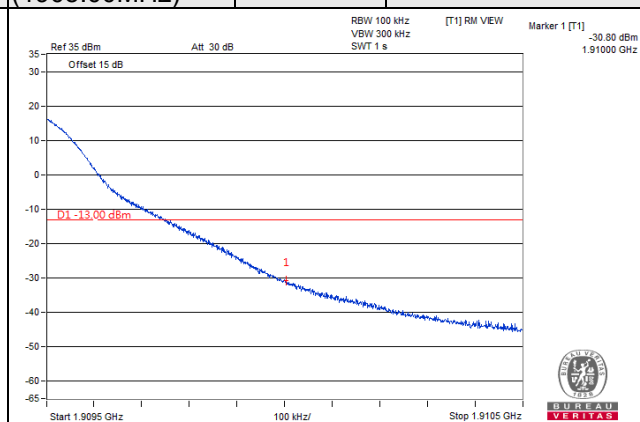
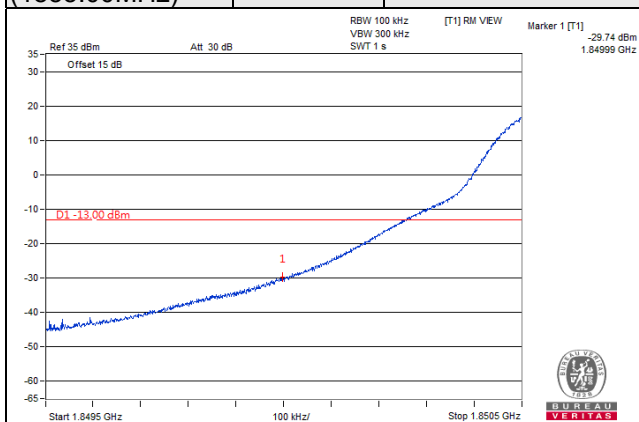
QPSK

1 RB / 0 RB Offset

Channel 19150
(1905.00MHz)

QPSK

1 RB / 49 RB Offset



Channel 18650
(1855.00MHz)

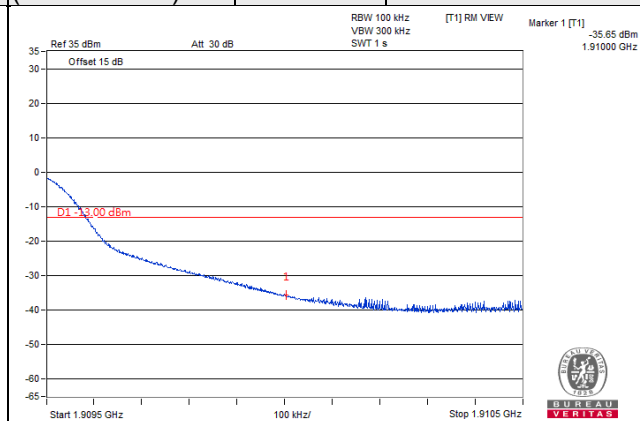
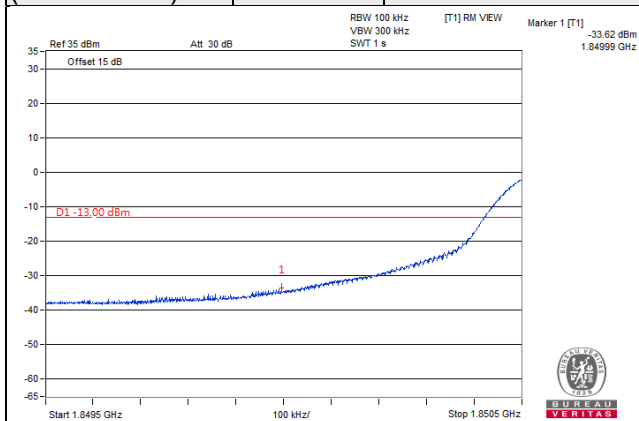
QPSK

50 RB / 0 RB Offset

Channel 19150
(1905.00MHz)

QPSK

50 RB / 0 RB Offset



LTE Band 2, Channel Bandwidth 15MHz

Channel 18675
(1857.50MHz)

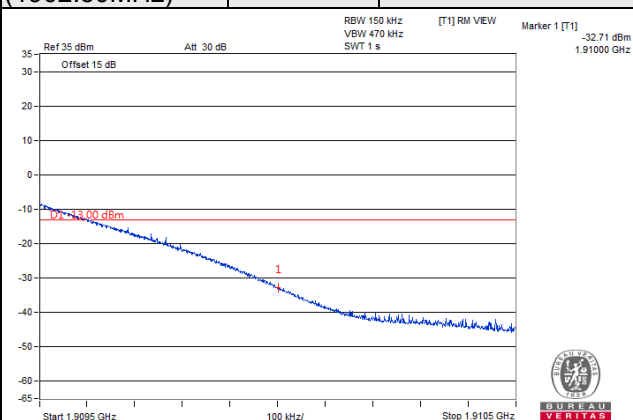
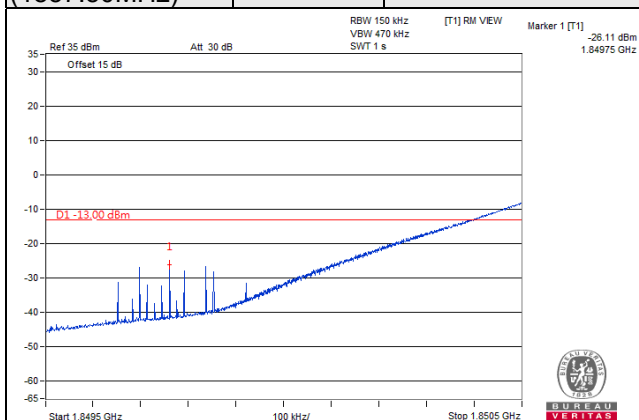
QPSK

1 RB / 0 RB Offset

Channel 19125
(1902.50MHz)

QPSK

1 RB / 74 RB Offset



Channel 18675
(1857.50MHz)

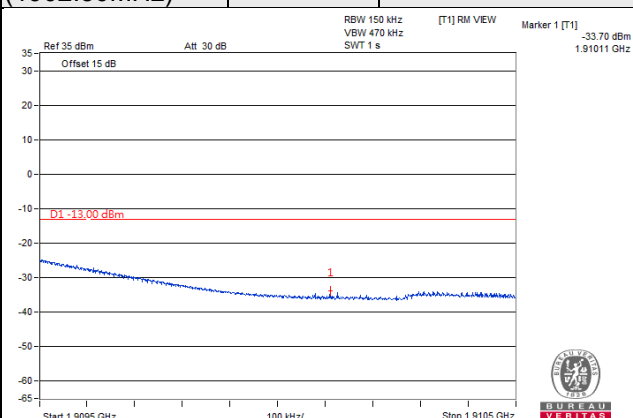
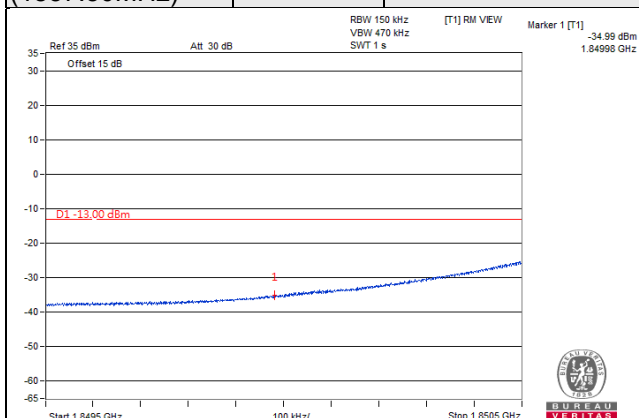
QPSK

75 RB / 0 RB Offset

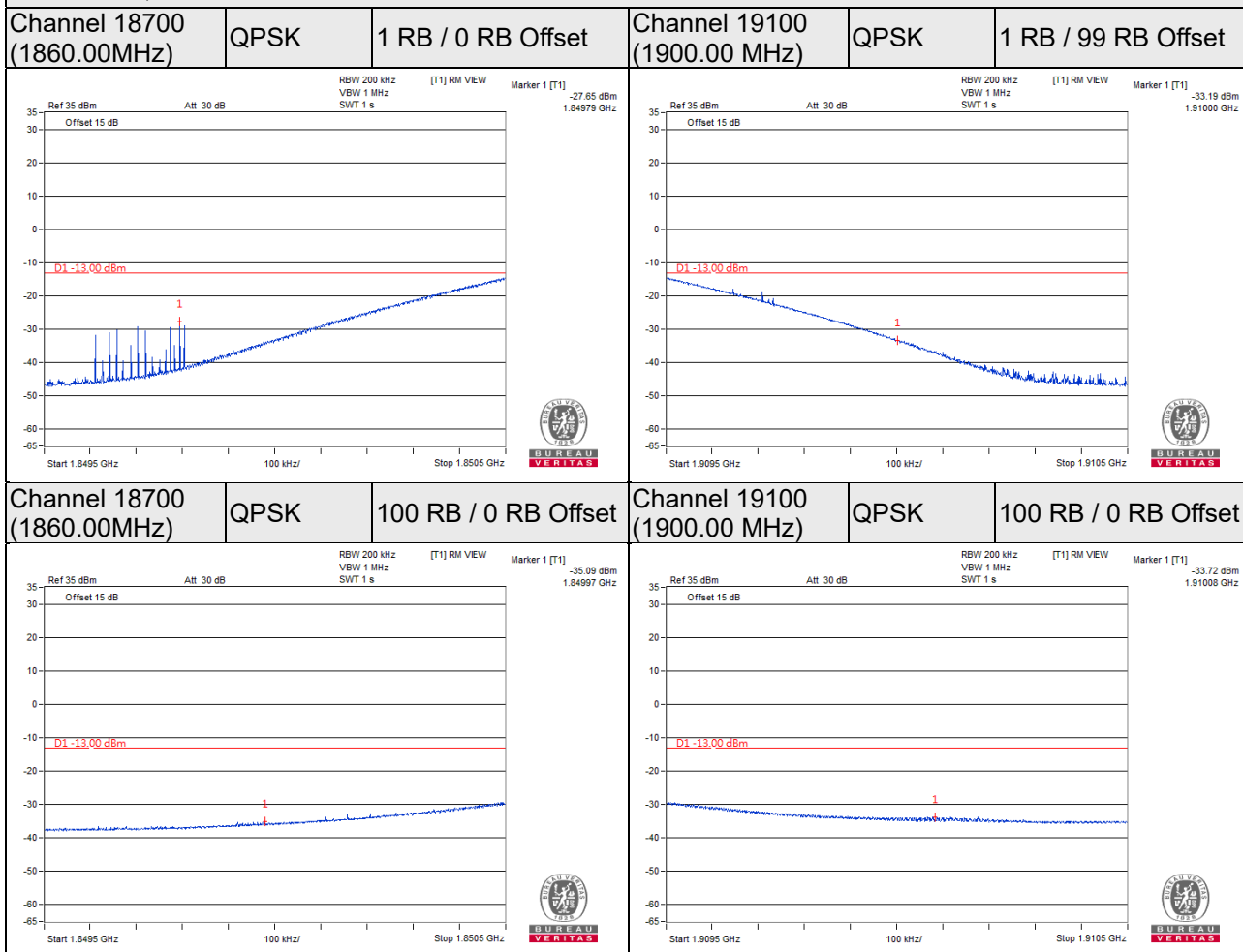
Channel 19125
(1902.50MHz)

QPSK

75 RB / 0 RB Offset

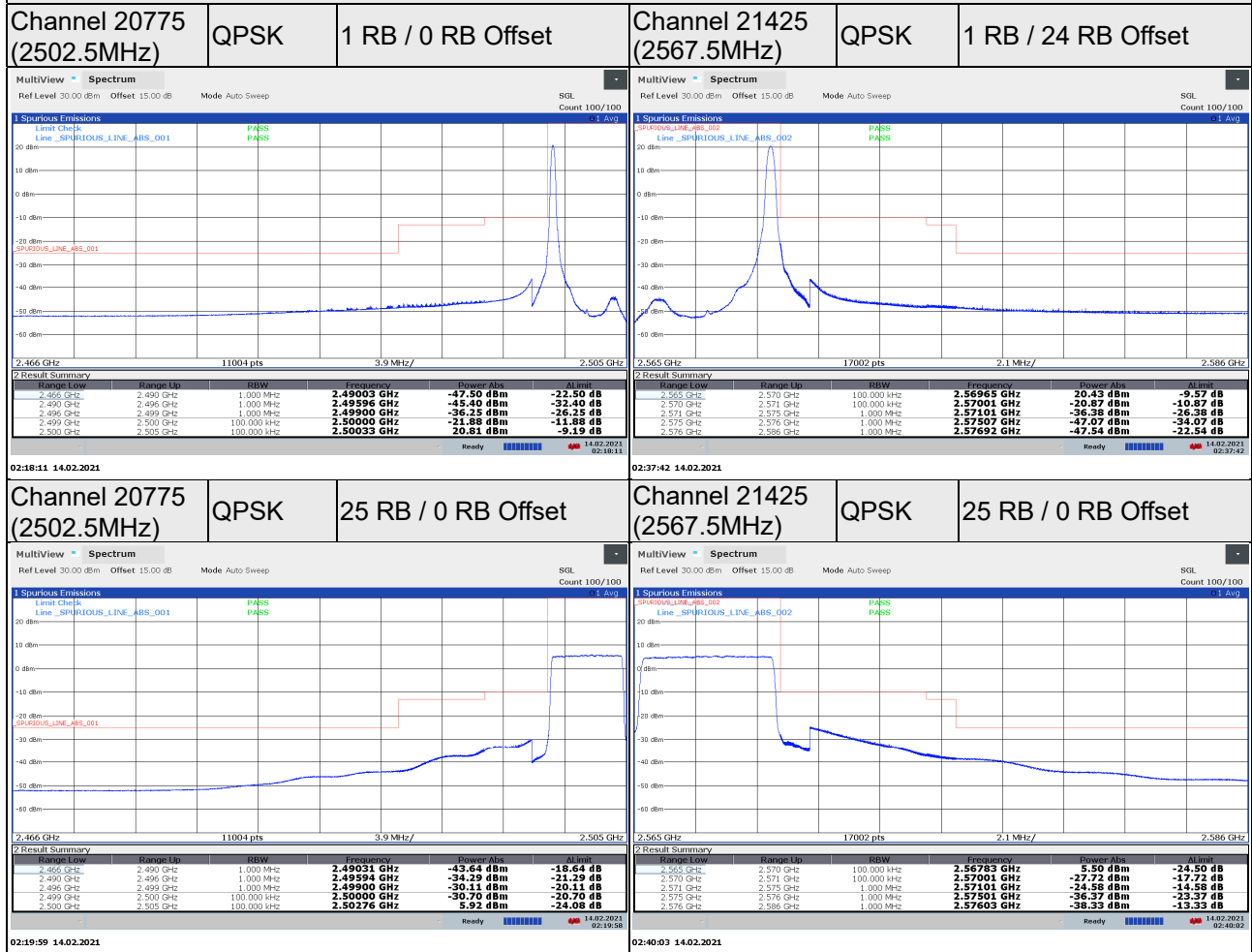


LTE Band 2, Channel Bandwidth 20MHz



Out-of-Band Emission

LTE Band 7, Channel Bandwidth 5MHz



LTE Band 7, Channel Bandwidth 10MHz

Channel 20800
(2505.0MHz)

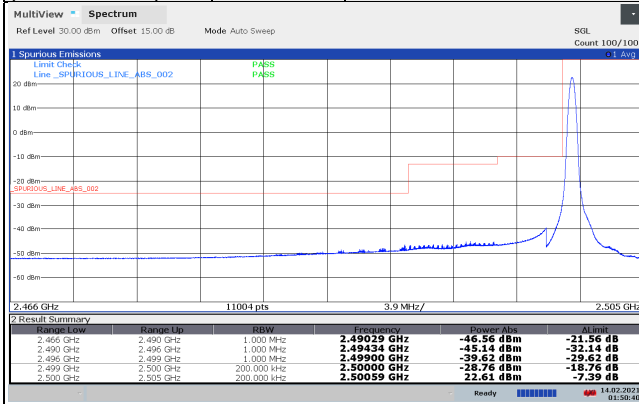
QPSK

1 RB / 0 RB Offset

Channel 21400
(2565.0MHz)

QPSK

1 RB / 49 RB Offset



01:50:40 14.02.2021

Channel 20800
(2505.0MHz)

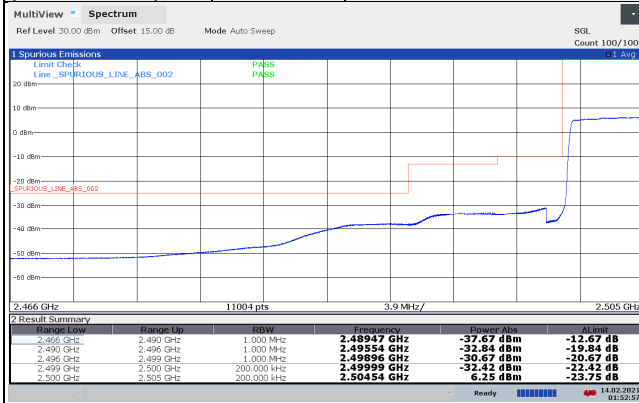
QPSK

50 RB / 0 RB Offset

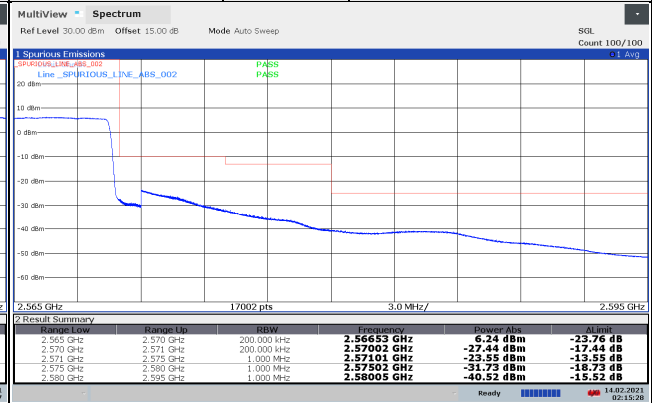
Channel 21400
(2565.0MHz)

QPSK

50 RB / 0 RB Offset



01:52:58 14.02.2021



02:13:45 14.02.2021

LTE Band 7, Channel Bandwidth 15MHz

Channel 20825
(2507.5MHz)

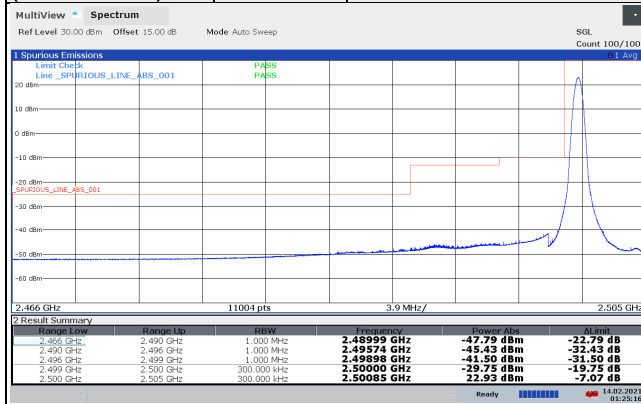
QPSK

1 RB / 0 RB Offset

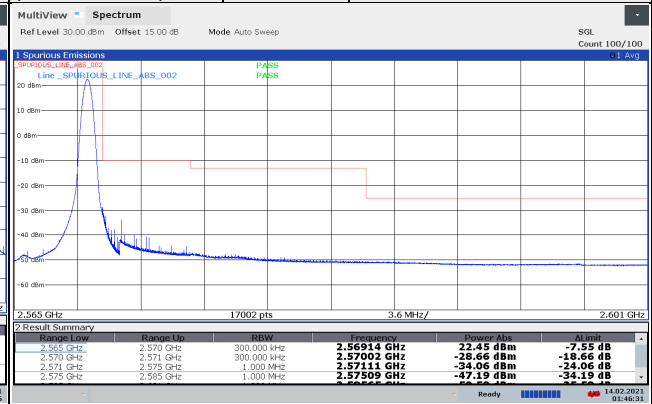
Channel 21375
(2562.5MHz)

QPSK

1 RB / 74 RB Offset



01:25:16 14.02.2021



01:46:32 14.02.2021

Channel 20825
(2507.5MHz)

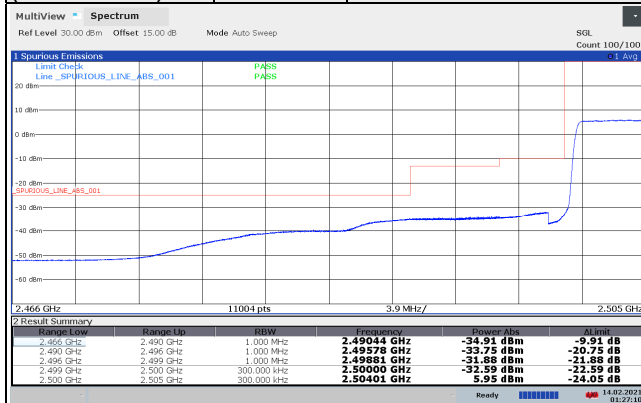
QPSK

75 RB / 0 RB Offset

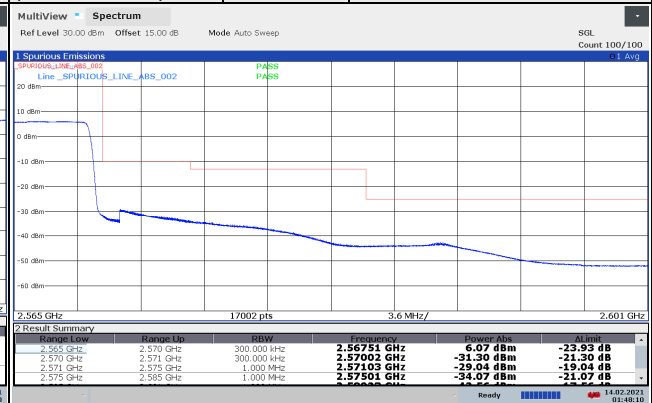
Channel 21375
(2562.5MHz)

QPSK

75 RB / 0 RB Offset



01:27:11 14.02.2021



01:48:10 14.02.2021

LTE Band 7, Channel Bandwidth 20MHz

Channel 20850
(2510.0MHz)

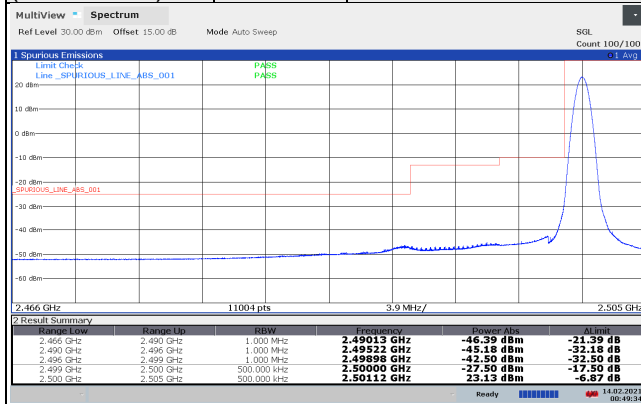
QPSK

1 RB / 0 RB Offset

Channel 21350
(2560.0MHz)

QPSK

1 RB / 99 RB Offset



00:49:35 14.02.2021

Channel 20850
(2510.0MHz)

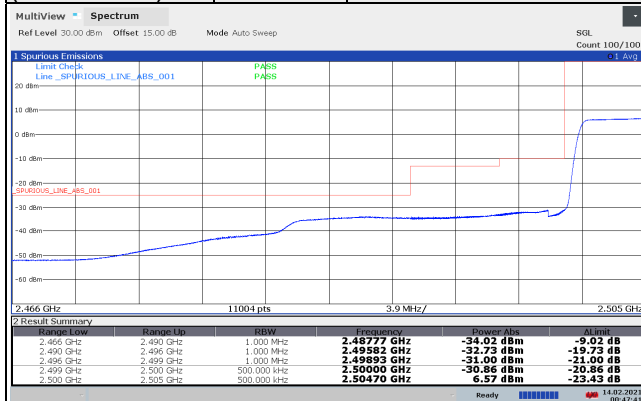
QPSK

100 RB / 0 RB Offset

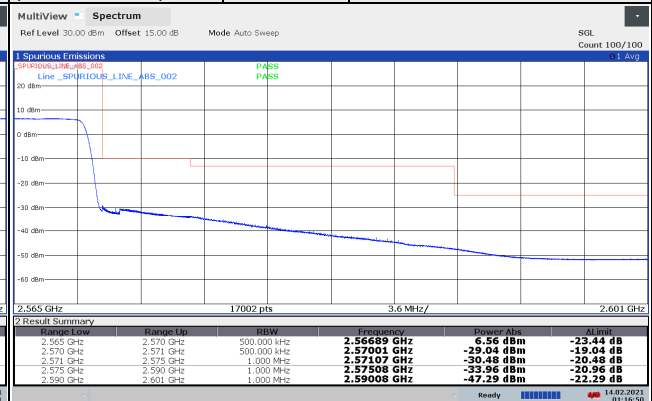
Channel 21350
(2560.0MHz)

QPSK

100 RB / 0 RB Offset



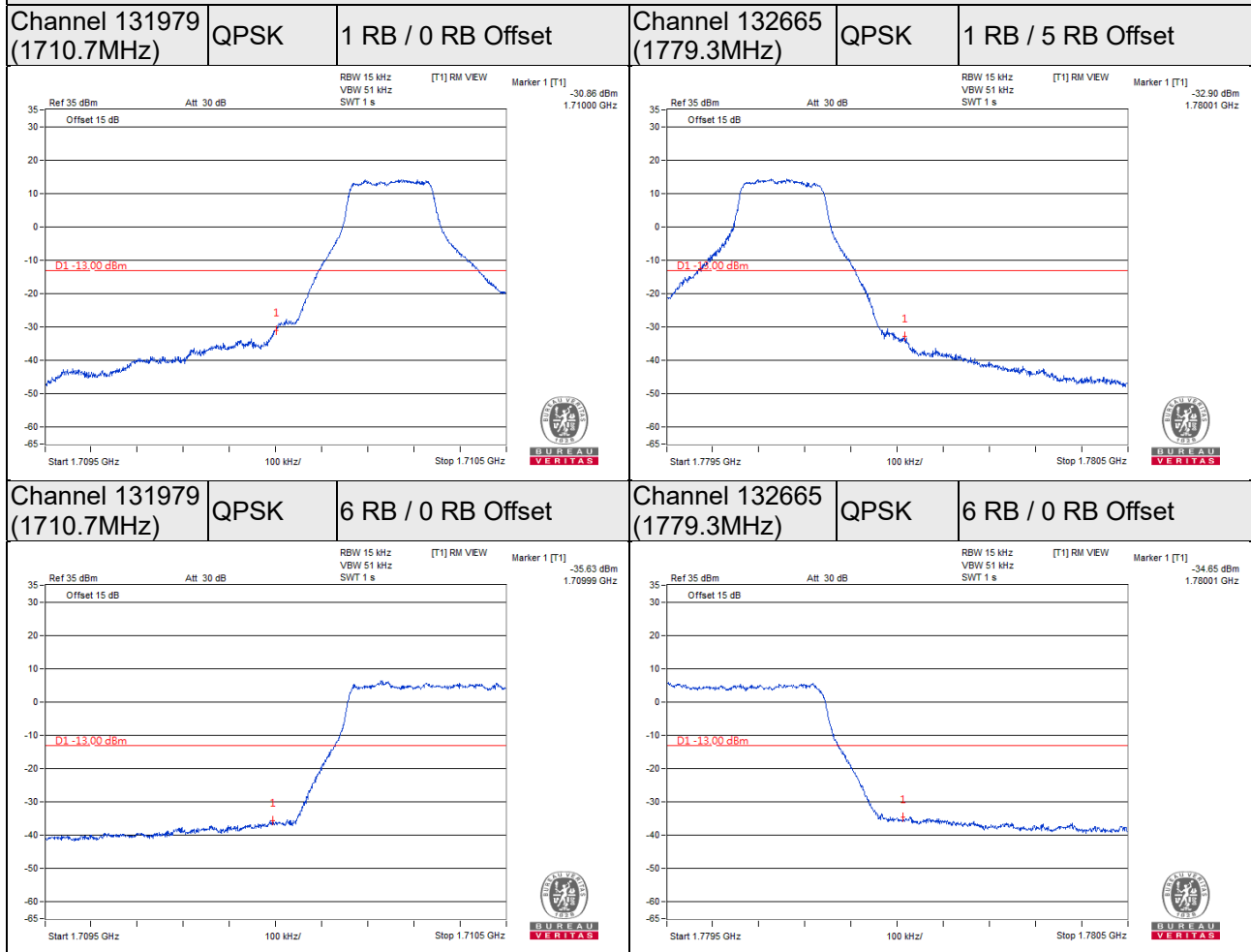
00:47:41 14.02.2021



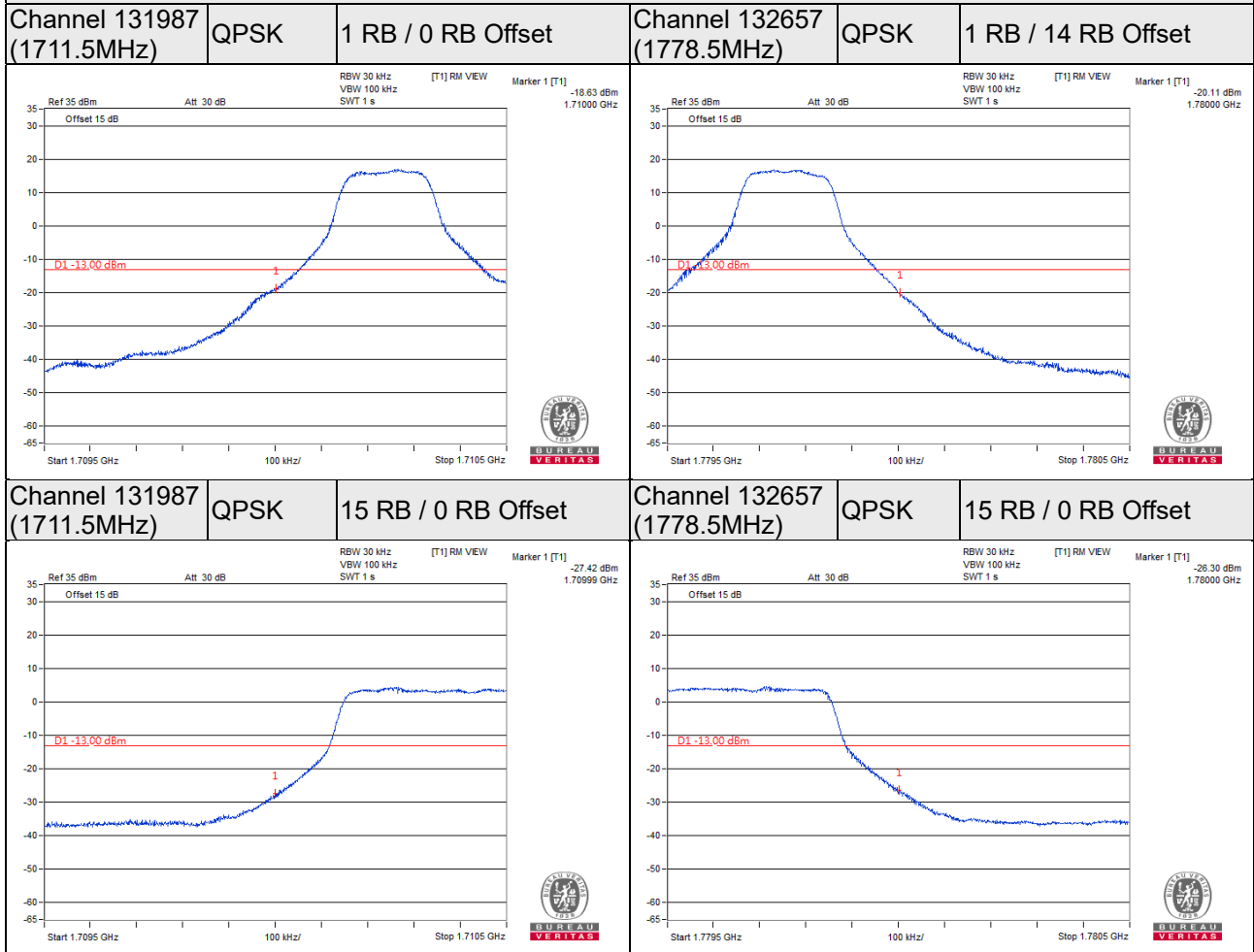
01:16:50 14.02.2021

Band Edge

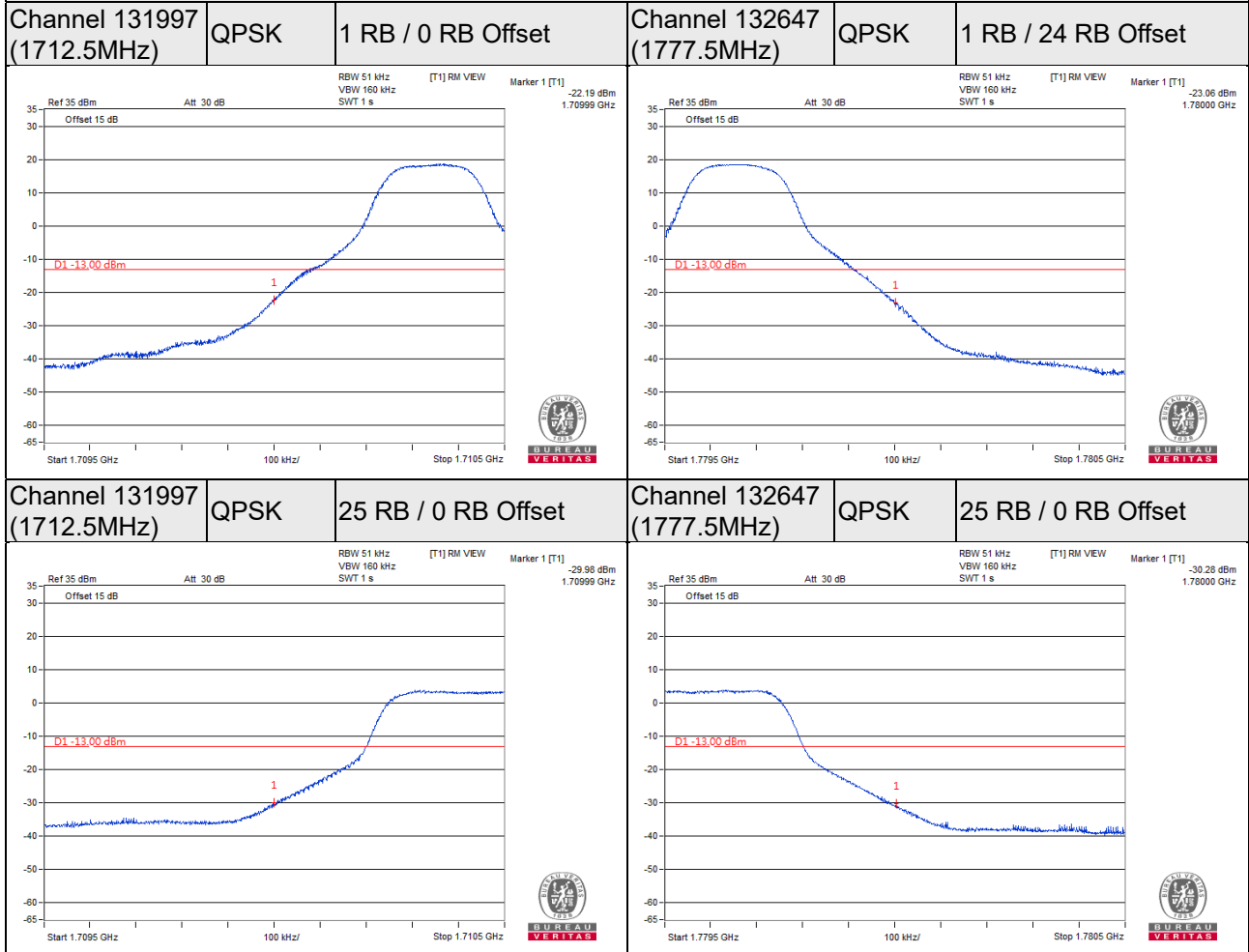
LTE Band 66, Channel Bandwidth 1.4MHz



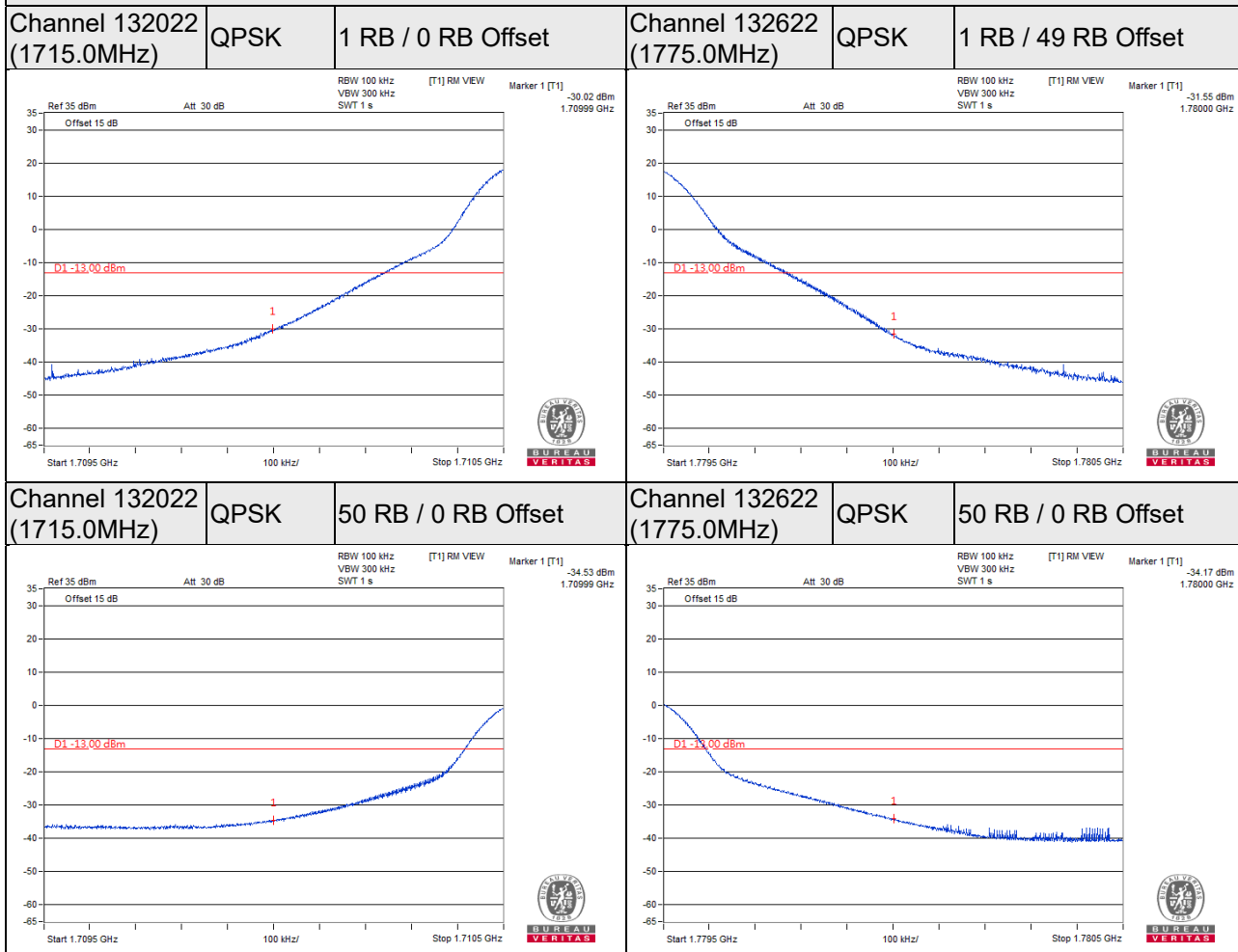
LTE Band 66, Channel Bandwidth 3MHz



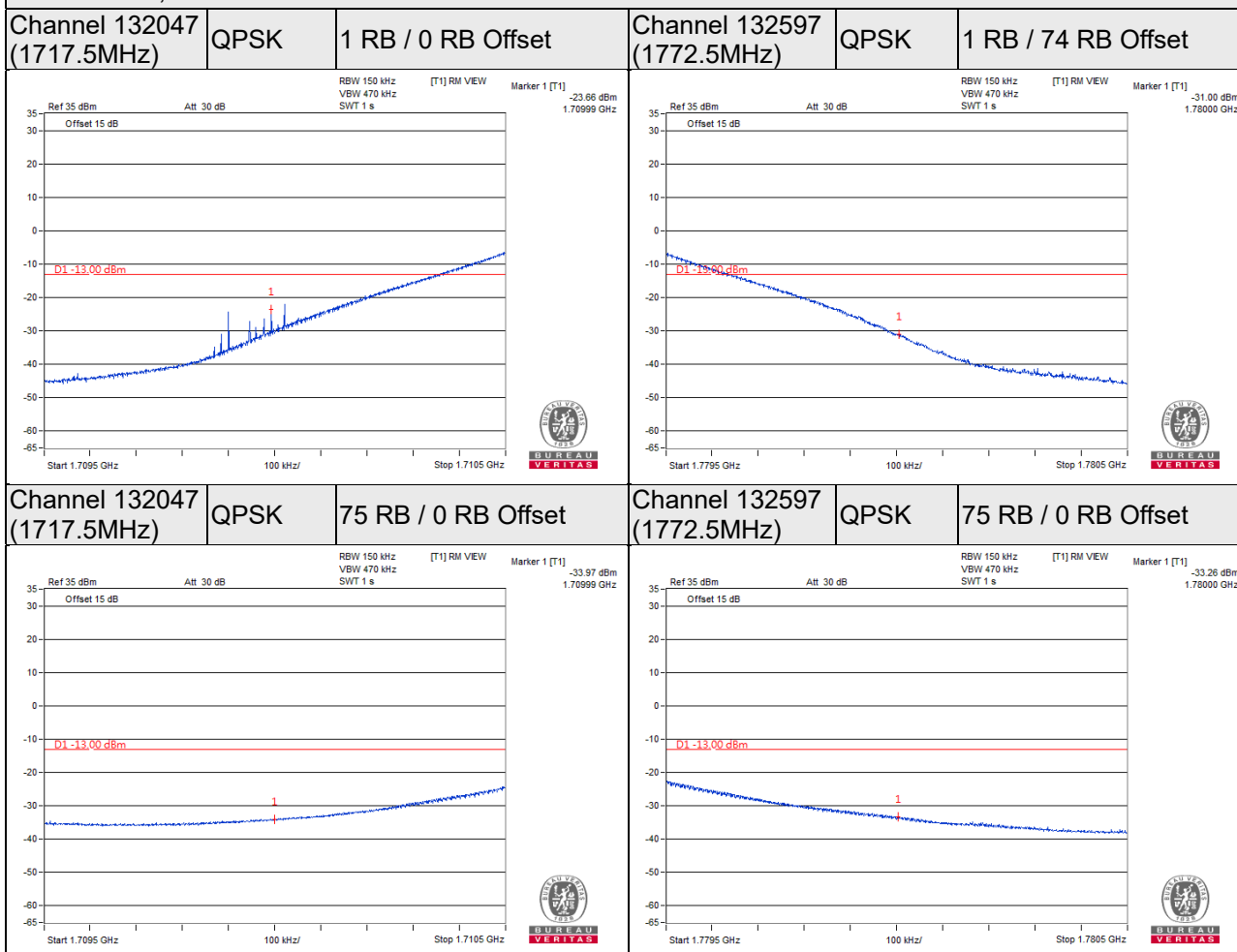
LTE Band 66, Channel Bandwidth 5MHz



LTE Band 66, Channel Bandwidth 10MHz

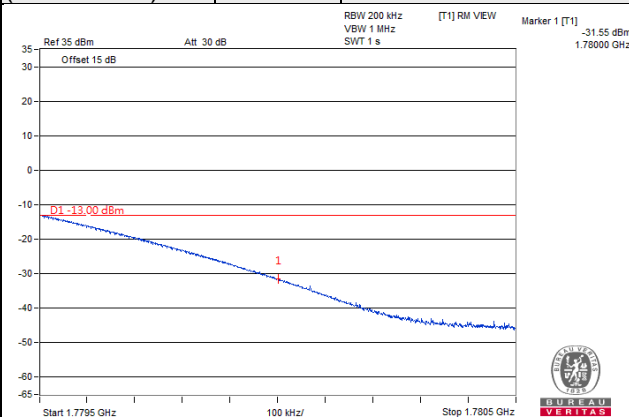
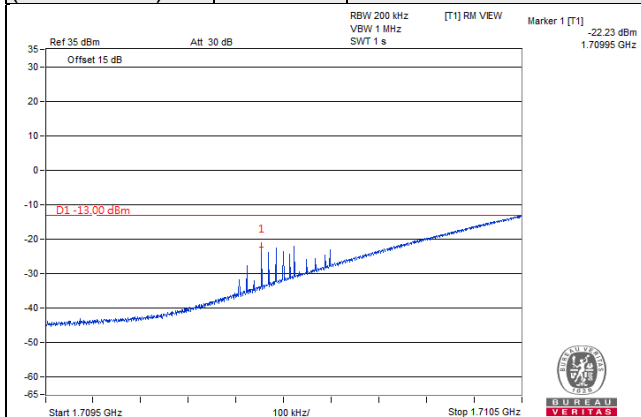


LTE Band 66, Channel Bandwidth 15MHz

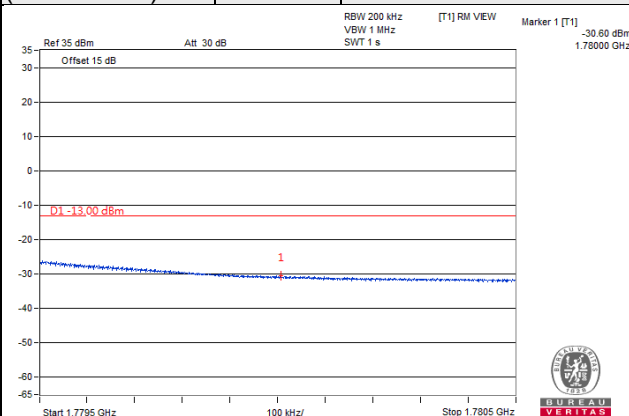
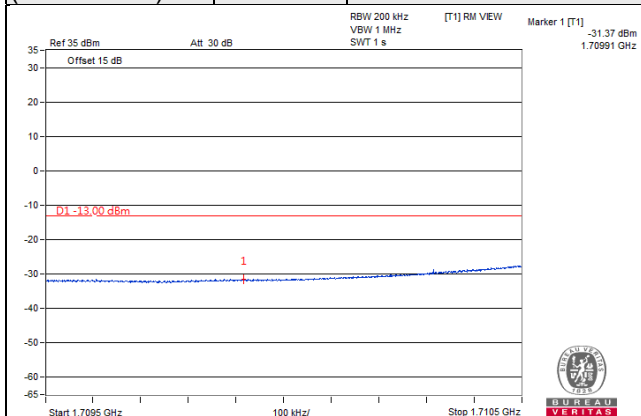


LTE Band 66, Channel Bandwidth 20MHz

Channel 132072 (1720.0MHz)	QPSK	1 RB / 0 RB Offset	Channel 132572 (1770.0MHz)	QPSK	1 RB / 99 RB Offset
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Channel 132072 (1720.0MHz)	QPSK	100 RB / 0 RB Offset	Channel 132572 (1770.0MHz)	QPSK	100 RB / 0 RB Offset
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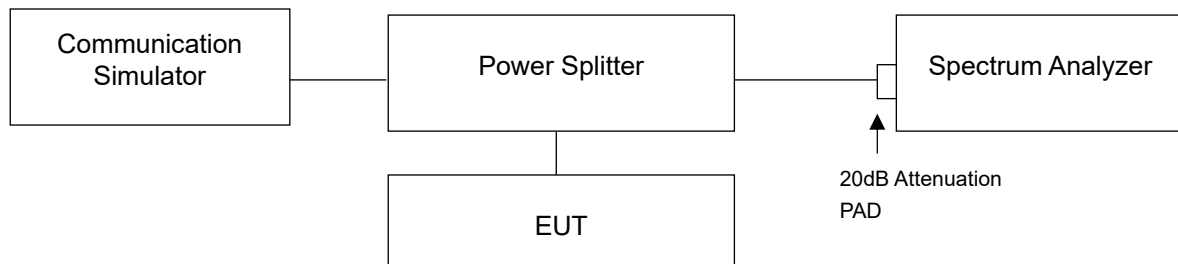


4.6 Peak to Average Ratio

4.6.1 Limits of Peak to Average Ratio Measurement

In measuring transmissions in this band using an average power technique, the peak to-average ratio (PAR) of the transmission may not exceed 13 dB

4.6.2 Test Setup



4.6.3 Test Procedures

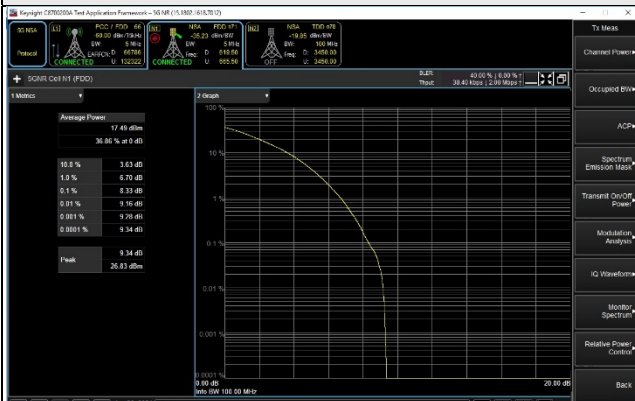
- Set resolution/measurement bandwidth $\geq$ signal's occupied bandwidth;
- Set the number of counts to a value that stabilizes the measured CCDF curve;
- Record the maximum PAPR level associated with a probability of 0.1%.

4.6.4 Test Results

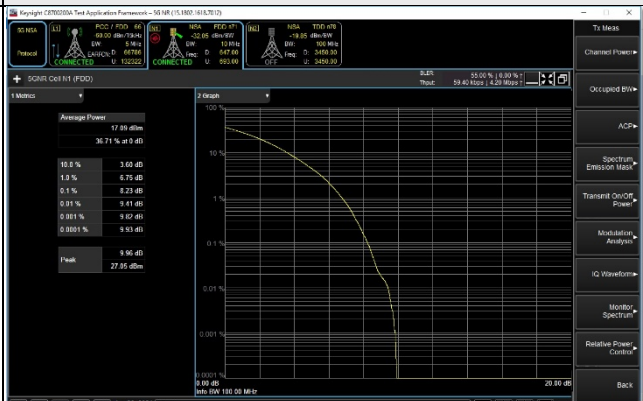
n71, Channel Bandwidth 5MHz						
Channel	Frequency (MHz)	Peak To Average Ratio (dB)				
		$\pi/2$ BPSK	QPSK	16QAM	64QAM	256QAM
133100	665.5	3.95	6.53	6.73	7.04	8.33
136100	680.5	3.98	6.53	6.67	7.00	8.18
139100	695.5	3.98	6.52	6.63	7.01	8.25
n71, Channel Bandwidth 10MHz						
Channel	Frequency (MHz)	Peak To Average Ratio (dB)				
		$\pi/2$ BPSK	QPSK	16QAM	64QAM	256QAM
133600	668.0	3.97	6.58	6.46	6.99	8.12
136100	680.5	4.04	6.53	6.35	6.93	8.17
138600	693.0	3.94	6.53	6.33	6.86	8.23
n71, Channel Bandwidth 15MHz						
Channel	Frequency (MHz)	Peak To Average Ratio (dB)				
		$\pi/2$ BPSK	QPSK	16QAM	64QAM	256QAM
134100	670.5	4.23	6.91	6.88	7.27	8.42
136100	680.5	3.75	6.71	6.70	7.08	8.74
138100	690.5	6.04	6.67	6.63	7.75	8.59
n71, Channel Bandwidth 20MHz						
Channel	Frequency (MHz)	Peak To Average Ratio (dB)				
		$\pi/2$ BPSK	QPSK	16QAM	64QAM	256QAM
134600	673.0	5.59	6.86	6.82	7.20	8.34
136100	680.5	3.51	6.72	6.70	7.13	8.58
137600	688.0	3.92	6.58	6.63	7.01	8.43

Spectrum Plot of Worst Value

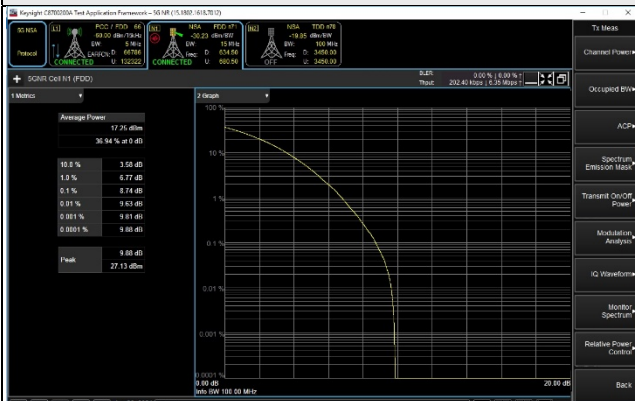
5MHz / 256QAM



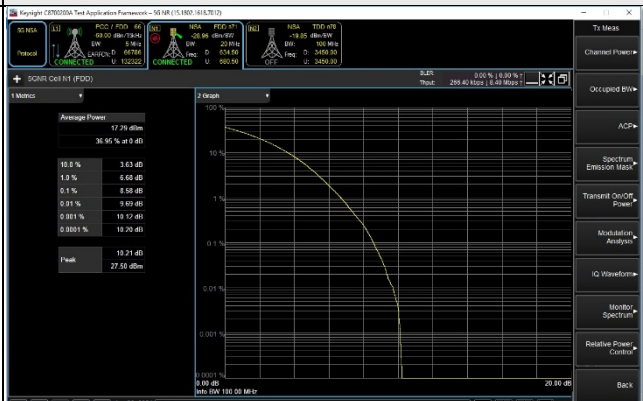
10MHz / 256QAM



15MHz / 256QAM



20MHz / 256QAM

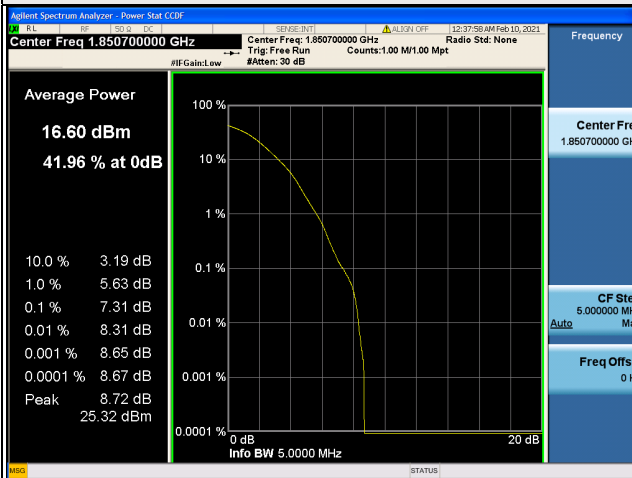


LTE Band 2, Channel Bandwidth 1.4MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
18607	1850.7	4.03	5.37	7.26	7.31
18900	1880.0	3.67	5.90	6.96	6.75
19193	1909.3	3.89	5.61	6.97	6.98
LTE Band 2, Channel Bandwidth 3MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
18615	1851.5	3.79	5.24	6.41	7.32
18900	1880.0	3.49	5.85	7.24	7.76
19185	1908.5	3.64	5.45	7.02	7.27
LTE Band 2, Channel Bandwidth 5MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
18625	1852.5	3.82	5.22	6.38	7.74
18900	1880.0	3.45	5.79	7.41	7.60
19175	1907.5	3.67	5.46	6.98	7.03
LTE Band 2, Channel Bandwidth 10MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
18650	1855.0	3.94	5.08	7.87	7.81
18900	1880.0	3.95	5.87	7.65	7.74
19150	1905.0	3.46	4.22	6.98	7.46
LTE Band 2, Channel Bandwidth 15MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
18675	1857.5	3.81	5.18	6.47	7.68
18900	1880.0	3.50	4.45	6.97	7.68
19125	1902.5	3.55	4.46	7.33	7.45

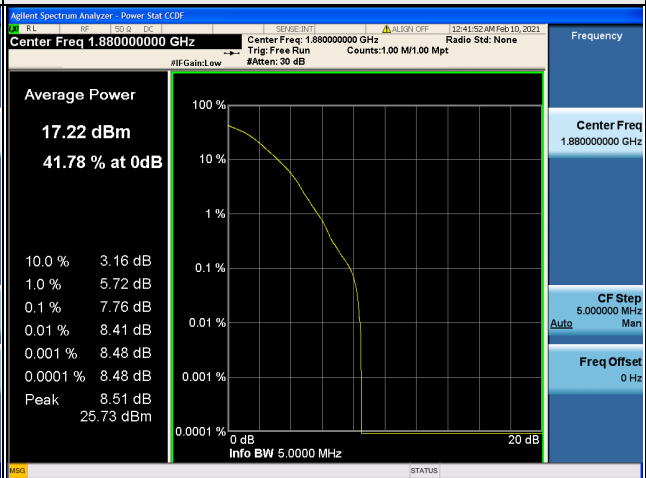
LTE Band 2, Channel Bandwidth 20MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
18700	1860.0	3.70	5.28	6.42	7.92
18900	1880.0	3.58	4.48	6.97	7.83
19100	1900.0	3.61	4.60	6.87	7.83

Spectrum Plot of Worst Value

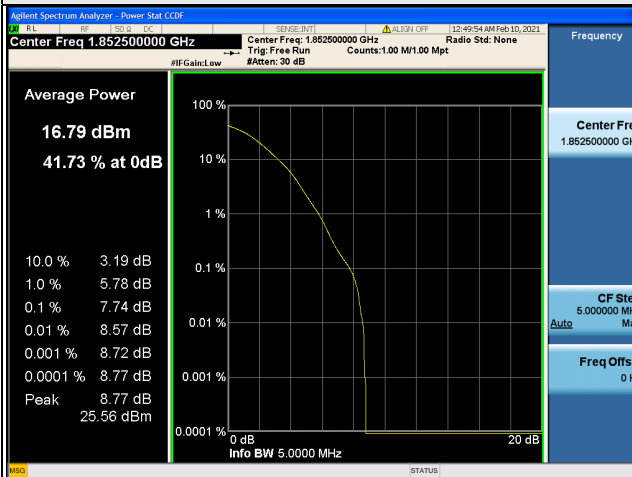
1.4MHz / 256QAM



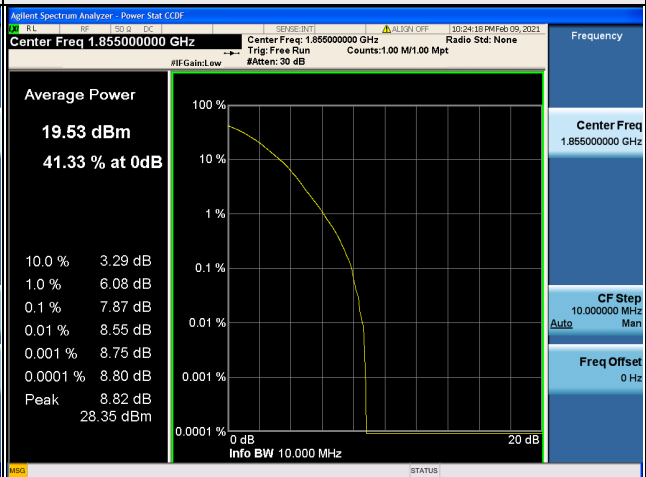
3MHz / 256QAM



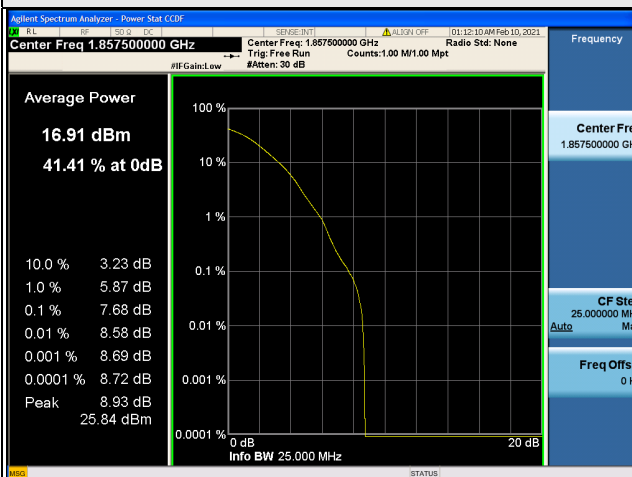
5MHz / 256QAM



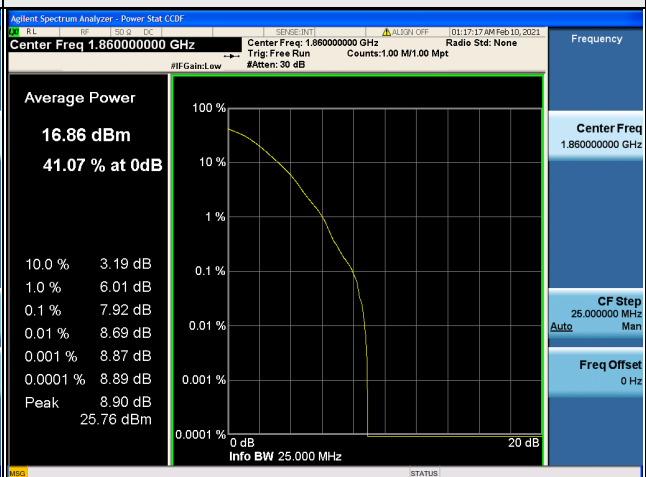
10MHz / 64QAM



15MHz / 256QAM



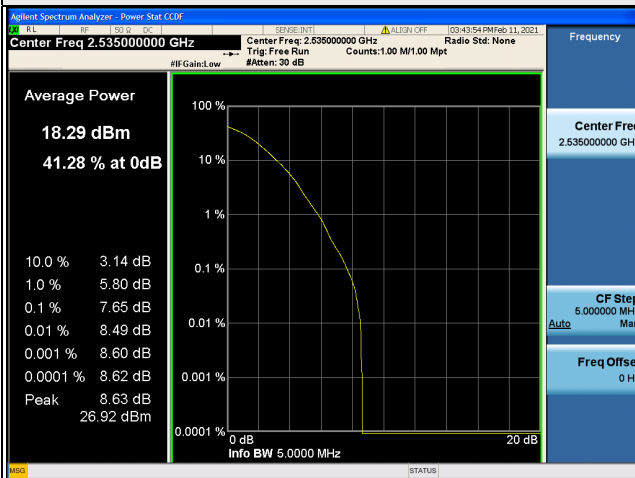
20MHz / 256QAM



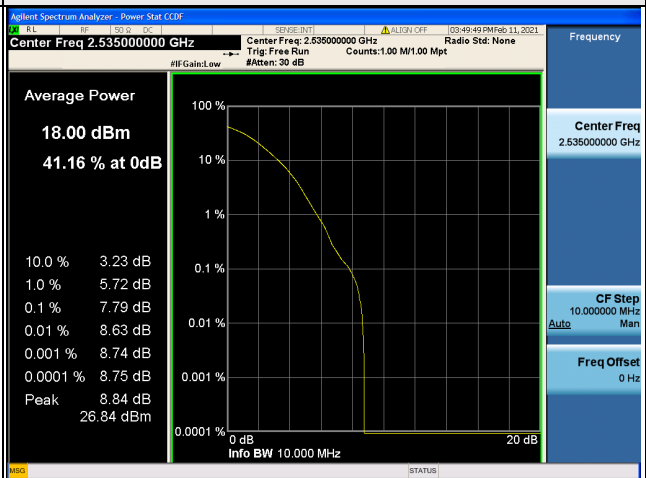
LTE Band 7, Channel Bandwidth 5MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
20775	2502.5	3.59	5.27	6.35	7.04
21100	2535.0	3.62	5.32	7.03	7.65
21425	2567.5	3.65	5.44	6.57	6.83
LTE Band 7, Channel Bandwidth 10MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
20800	2505.0	3.70	5.22	6.36	7.48
21100	2535.0	3.61	5.33	6.98	7.79
21400	2565.0	3.71	5.23	6.44	7.53
LTE Band 7, Channel Bandwidth 15MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
20825	2507.5	3.61	5.29	6.33	7.20
21100	2535.0	3.51	5.15	6.82	7.23
21375	2562.5	3.54	5.01	6.13	7.18
LTE Band 7, Channel Bandwidth 20MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
20850	2510.0	3.54	5.29	6.41	7.34
21100	2535.0	3.51	5.28	6.73	9.88
21350	2560.0	3.53	5.10	6.22	7.46

Spectrum Plot of Worst Value

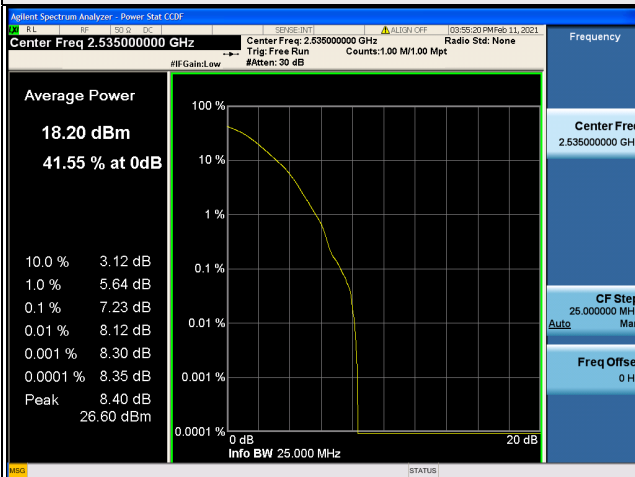
5MHz / 256QAM



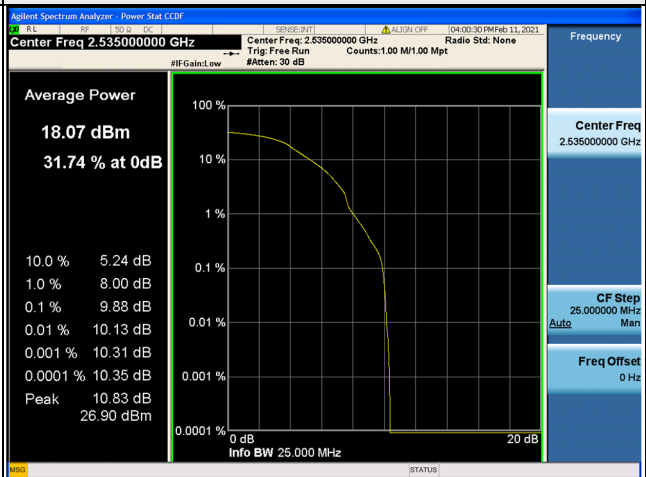
10MHz / 256QAM



15MHz / 256QAM



20MHz / 256QAM

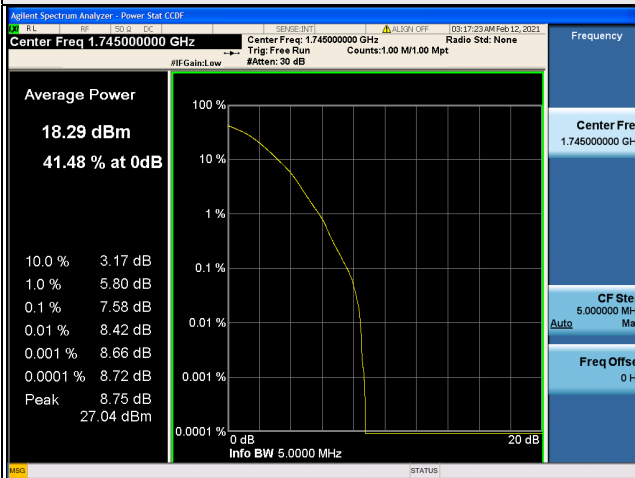


LTE Band 66, Channel Bandwidth 1.4MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
131979	1710.7	3.93	5.12	6.30	7.44
132322	1745.0	4.11	5.82	7.11	7.58
132665	1779.3	3.90	5.54	6.80	6.93
LTE Band 66, Channel Bandwidth 3MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
131987	1711.5	3.69	5.21	6.28	7.24
132322	1745.0	3.69	5.63	7.15	7.12
132657	1778.5	3.64	5.39	6.90	7.40
LTE Band 66, Channel Bandwidth 5MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
131997	1712.5	3.69	5.06	6.20	7.62
132322	1745.0	3.81	5.68	7.17	7.50
132647	1777.5	3.77	5.54	6.89	7.61
LTE Band 66, Channel Bandwidth 10MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
132022	1715.0	3.71	4.96	6.25	7.72
132322	1745.0	3.86	5.39	6.68	7.49
132622	1775.0	3.86	5.37	6.44	7.34
LTE Band 66, Channel Bandwidth 15MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
132047	1717.5	3.57	5.25	6.63	7.50
132322	1745.0	3.73	5.47	6.89	7.86
132597	1772.5	3.60	5.31	6.42	7.16

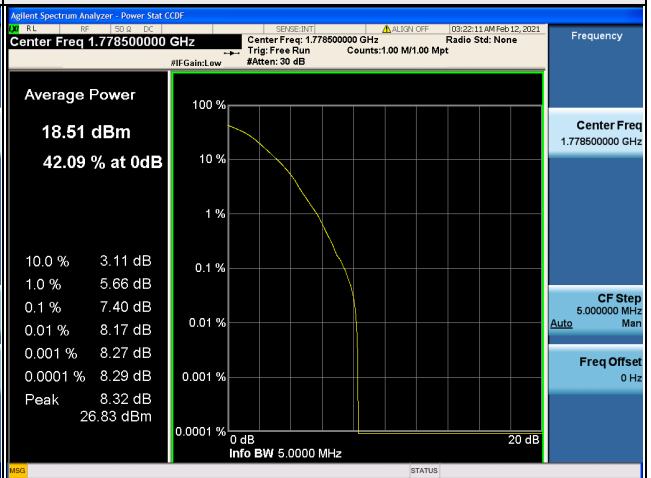
LTE Band 66, Channel Bandwidth 20MHz					
Channel	Frequency (MHz)	Peak To Average Ratio (dB)			
		QPSK	16QAM	64QAM	256QAM
132072	1720.0	3.70	5.20	6.32	7.81
132322	1745.0	3.82	5.29	6.50	7.08
132572	1770.0	3.45	5.14	6.59	7.46

Spectrum Plot of Worst Value

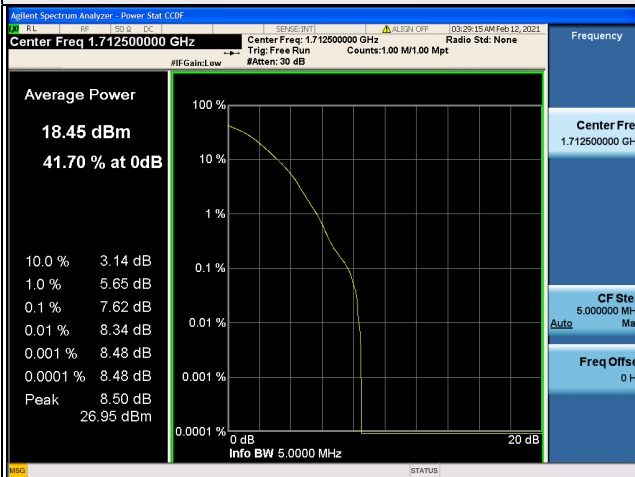
1.4MHz / 256QAM



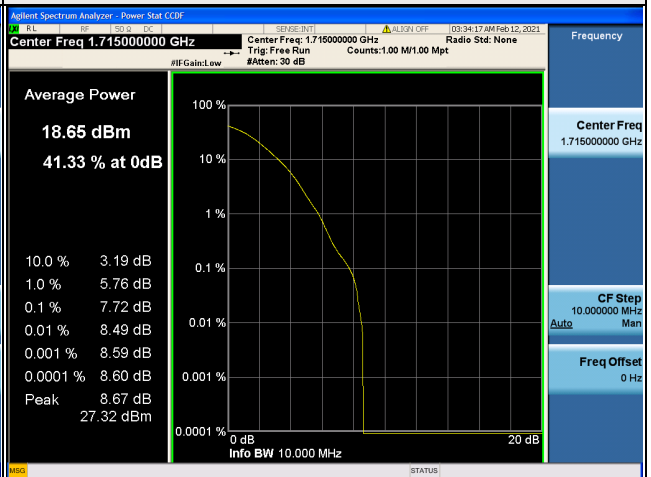
3MHz / 256QAM



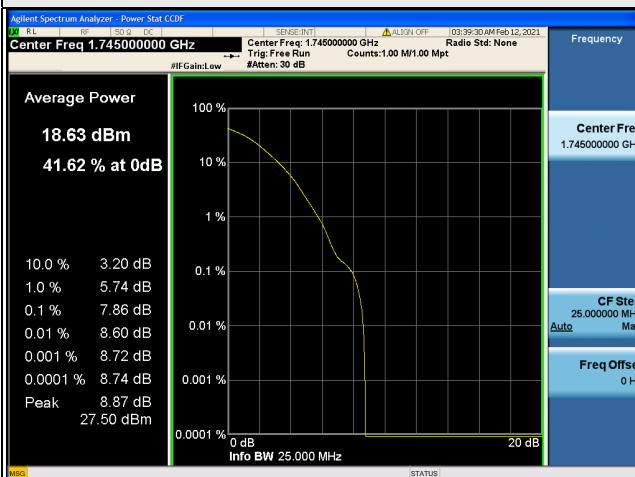
5MHz / 256QAM



10MHz / 256QAM



15MHz / 256QAM



20MHz / 256QAM

