

4. Occupied Bandwidth

4.1. Limit

CFR 47, Section FCC §2.1049 and IC RSS-Gen Issue 5 6.7.

4.2. Test Procedure

FCC

The test follows section 5.4.4 of ANSI C63.26-2015.

- a. The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation. products including the emission skirts (typically a span of $1.5 \times \text{OBW}$ is sufficient).
- b. The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1 % to 5 % of the anticipated OBW, and the VBW shall be set $\geq 3 \times \text{RBW}$.
- c. Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.
- d. Set the detection mode to peak, and the trace mode to max-hold.
- e. If the instrument does not have a 99 % OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5 % of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5 % of the total is reached and record that frequency as the upper OBW frequency. The 99 % power OBW can be determined by computing the difference these two frequencies.
- f. The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).

IC

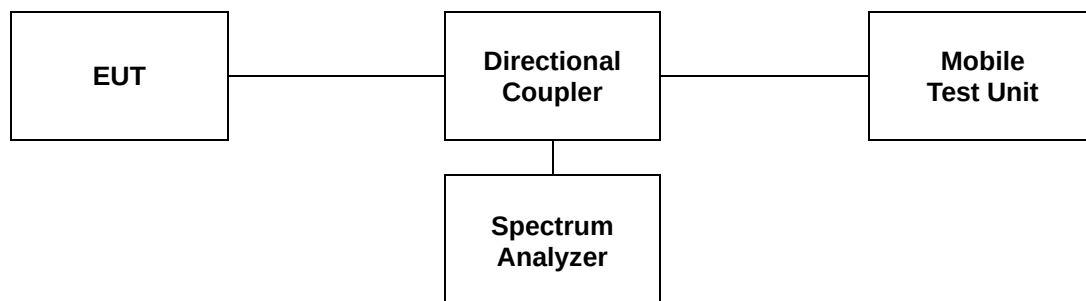
The test follows section 6.7 of RSS-Gen Issue 5.

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to "Sample". However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or "Max Hold") may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1 % to 5 % of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99 % emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99 % emission bandwidth).



4.3 Test Results

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

WCDMA

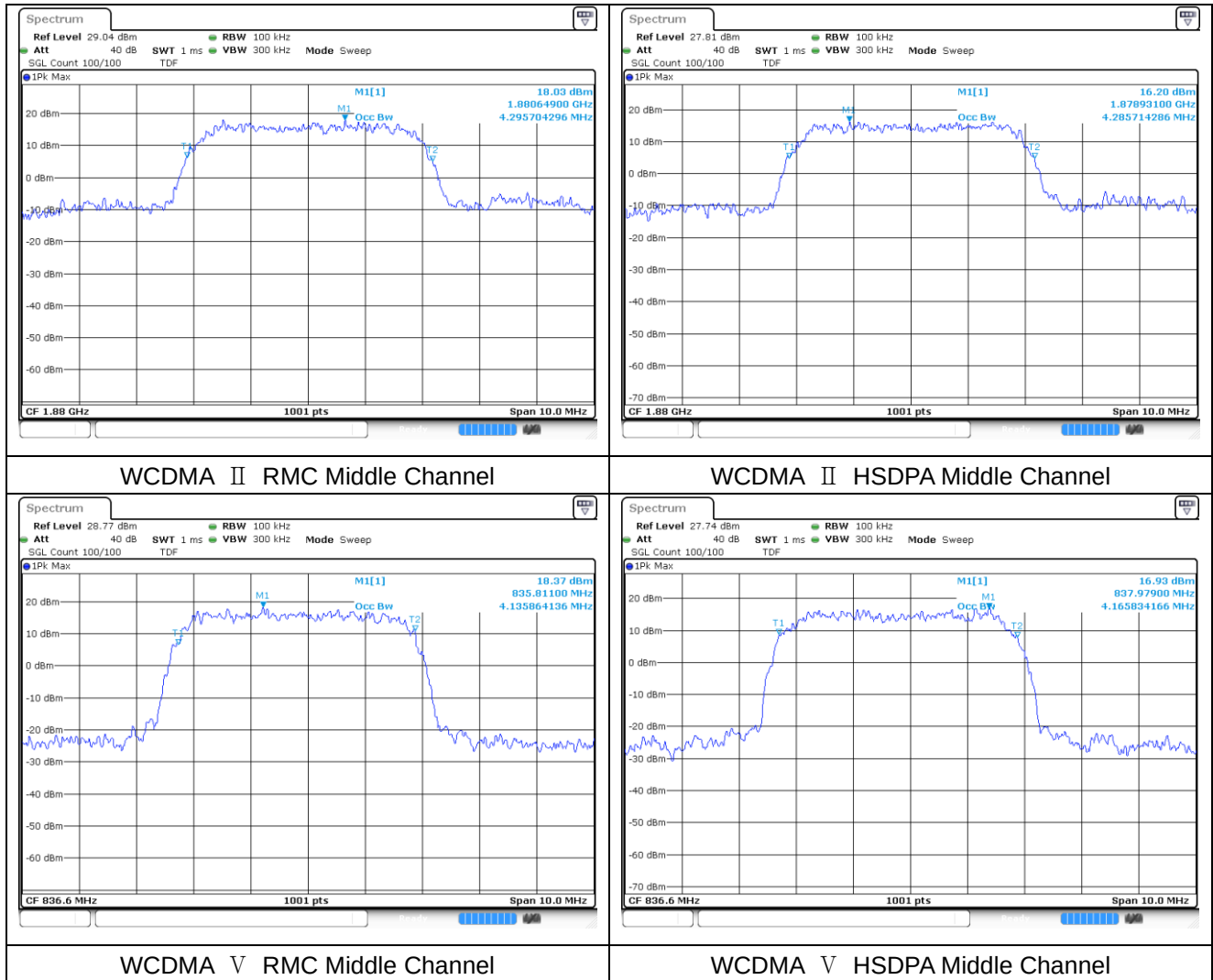
Band	Mode	Frequency (MHz)	Occupied Bandwidth (MHz)
WCDMA II	RMC	1 880.0	4.296
	HSDPA		4.286
WCDMA V	RMC	836.6	4.136
	HSDPA		4.166

LTE

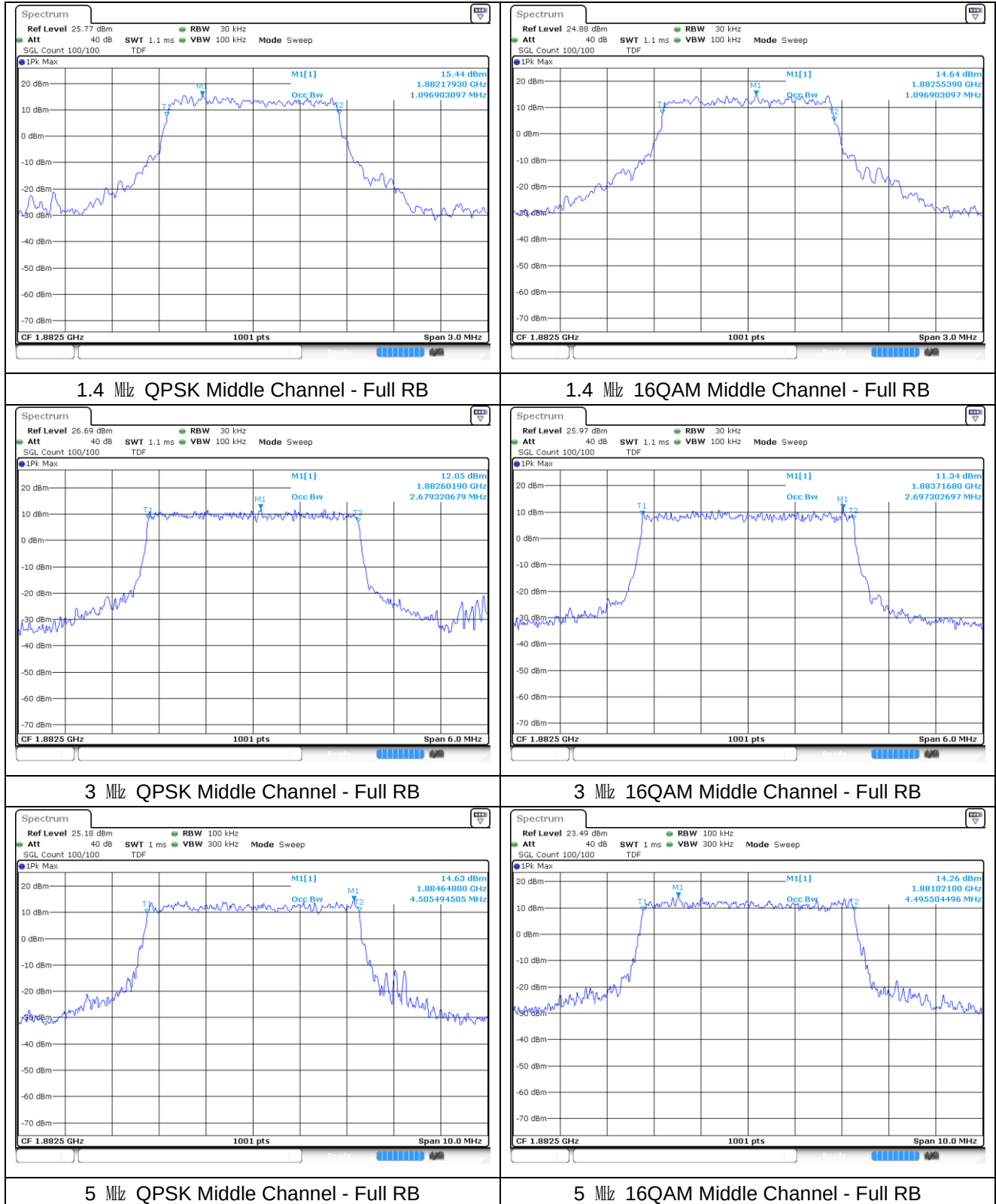
Band	Bandwidth (MHz)	Frequency (MHz)	Occupied Bandwidth (MHz)	
			QPSK	16QAM
25/2	1.4	1 882.5	1.097	1.097
	3		2.679	2.697
	5		4.505	4.496
	10		8.911	8.931
	15		13.457	13.457
	20		17.862	17.902
66/4	1.4	1 745	1.097	1.103
	3		2.679	2.679
	5		4.496	4.476
	10		8.931	8.951
	15		13.457	13.427
	20		17.902	17.982
26/5 Part 22	1.4	836.5	1.091	1.097
	3		2.685	2.679
	5		4.496	4.496
	10		8.951	8.931
	15	831.5	13.457	13.457
7	5	2 535	4.525	4.515
	10		8.951	8.971
	15		13.516	13.516
	20		18.022	17.942
12	1.4	707.5	1.097	1.106
	3		2.685	2.691
12/17	5		4.505	4.515
	10		8.931	8.951
13	5	782	4.476	4.515
	10		8.931	8.971

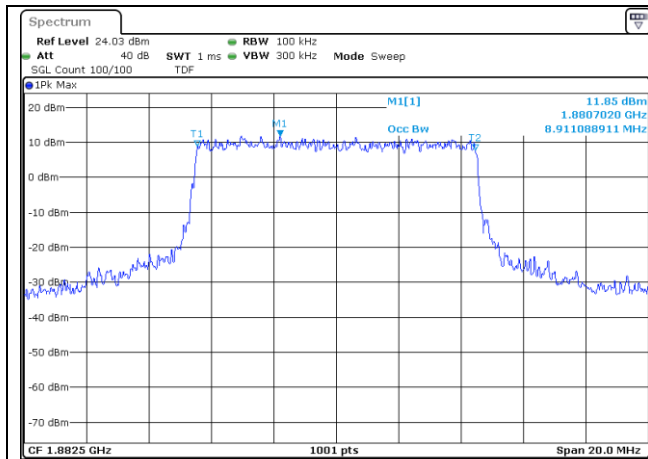
Band	Bandwidth (MHz)	Frequency (MHz)	Occupied Bandwidth (MHz)	
			QPSK	16QAM
26 Part 90	1.4	819	1.103	1.103
	3		2.685	2.697
	5		4.515	4.505
	10		8.951	8.951
	15	821.5	13.487	13.516
71	5	680.5	4.505	4.515
	10		8.931	8.931
	15		13.427	13.487
	20		17.862	17.862

- Test plots

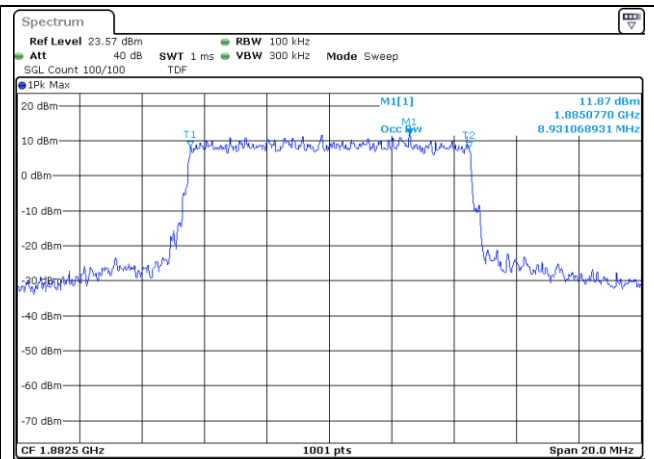


LTE band 25/2

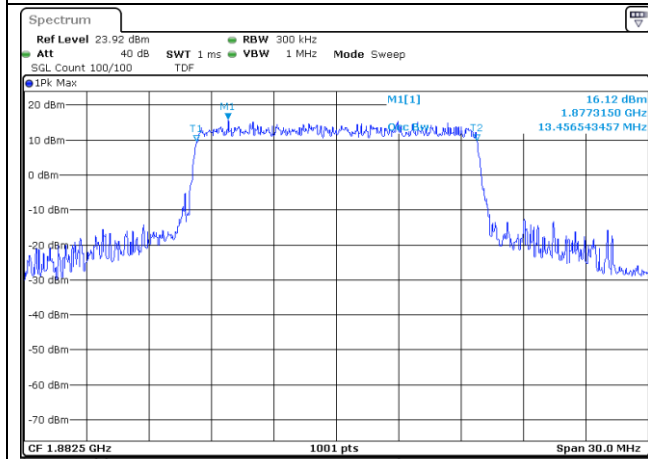




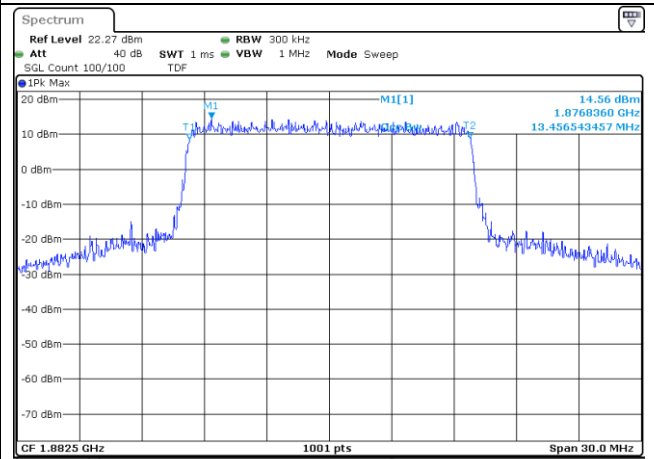
10 MHz QPSK Middle Channel - Full RB



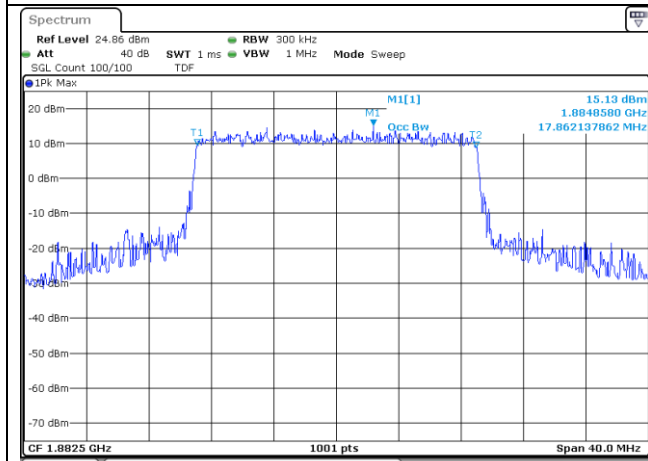
10 MHz 16QAM Middle Channel - Full RB



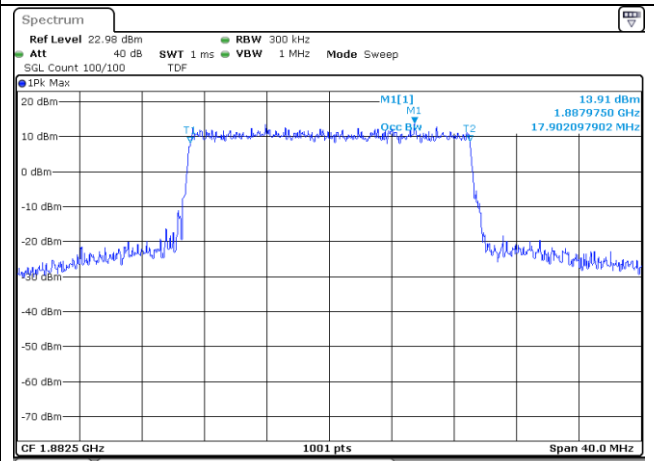
15 MHz QPSK Middle Channel - Full RB



15 MHz 16QAM Middle Channel - Full RB

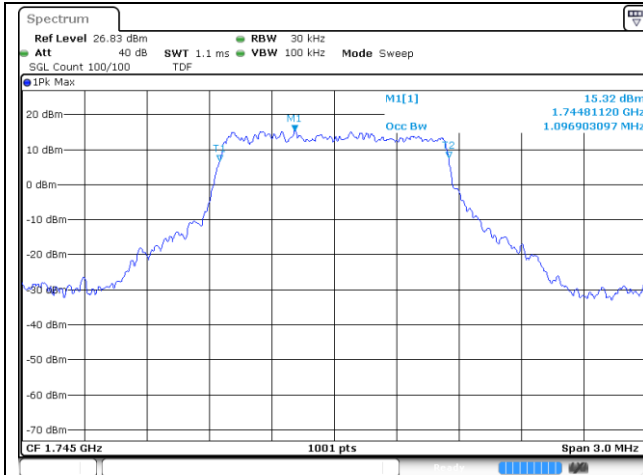


20 MHz QPSK Middle Channel - Full RB

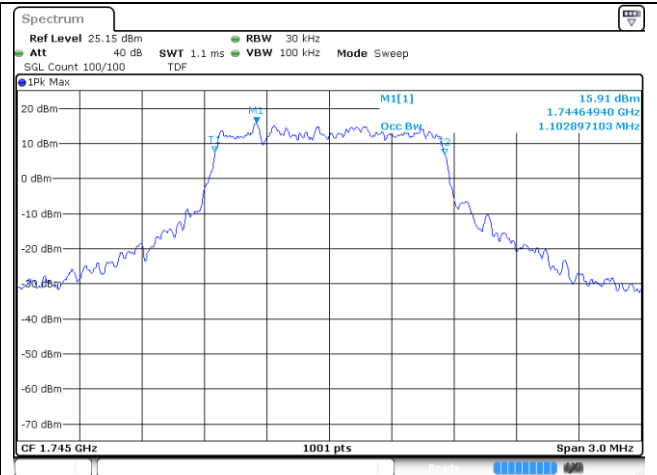


20 MHz 16QAM Middle Channel - Full RB

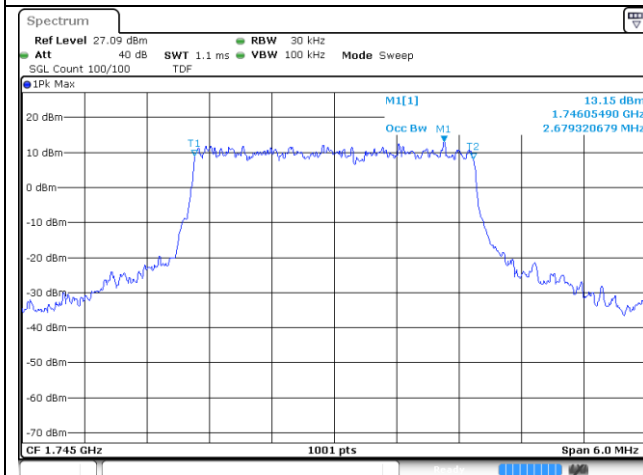
LTE band 66/4



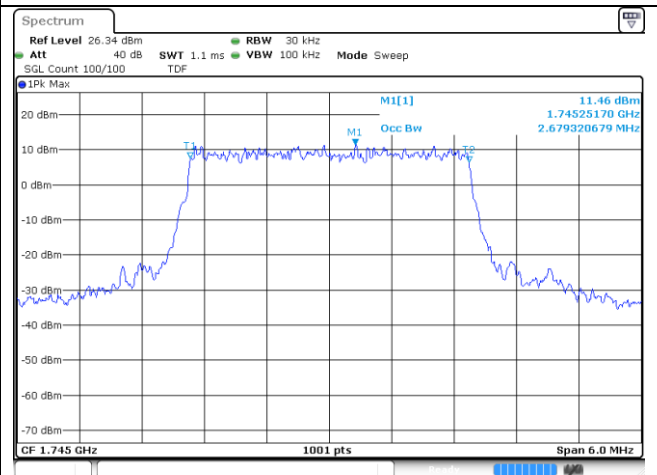
1.4 MHz QPSK Middle Channel - Full RB



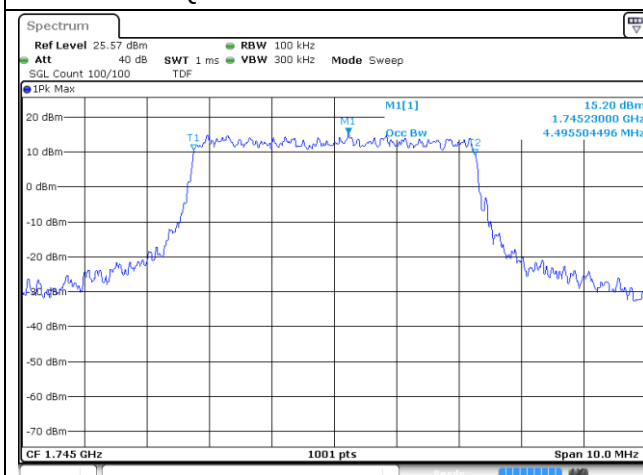
1.4 MHz 16QAM Middle Channel - Full RB



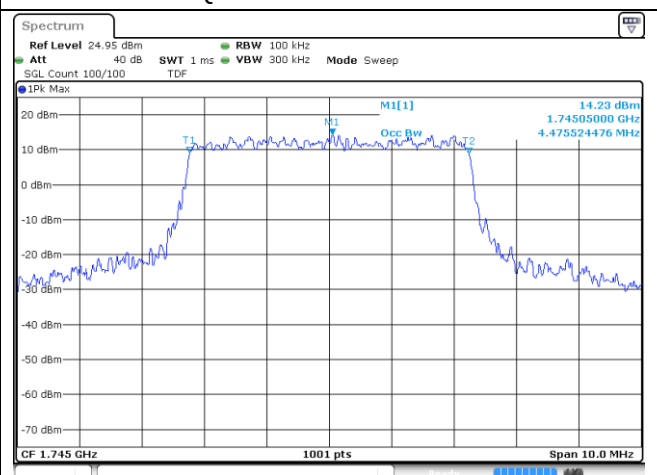
3 MHz QPSK Middle Channel - Full RB



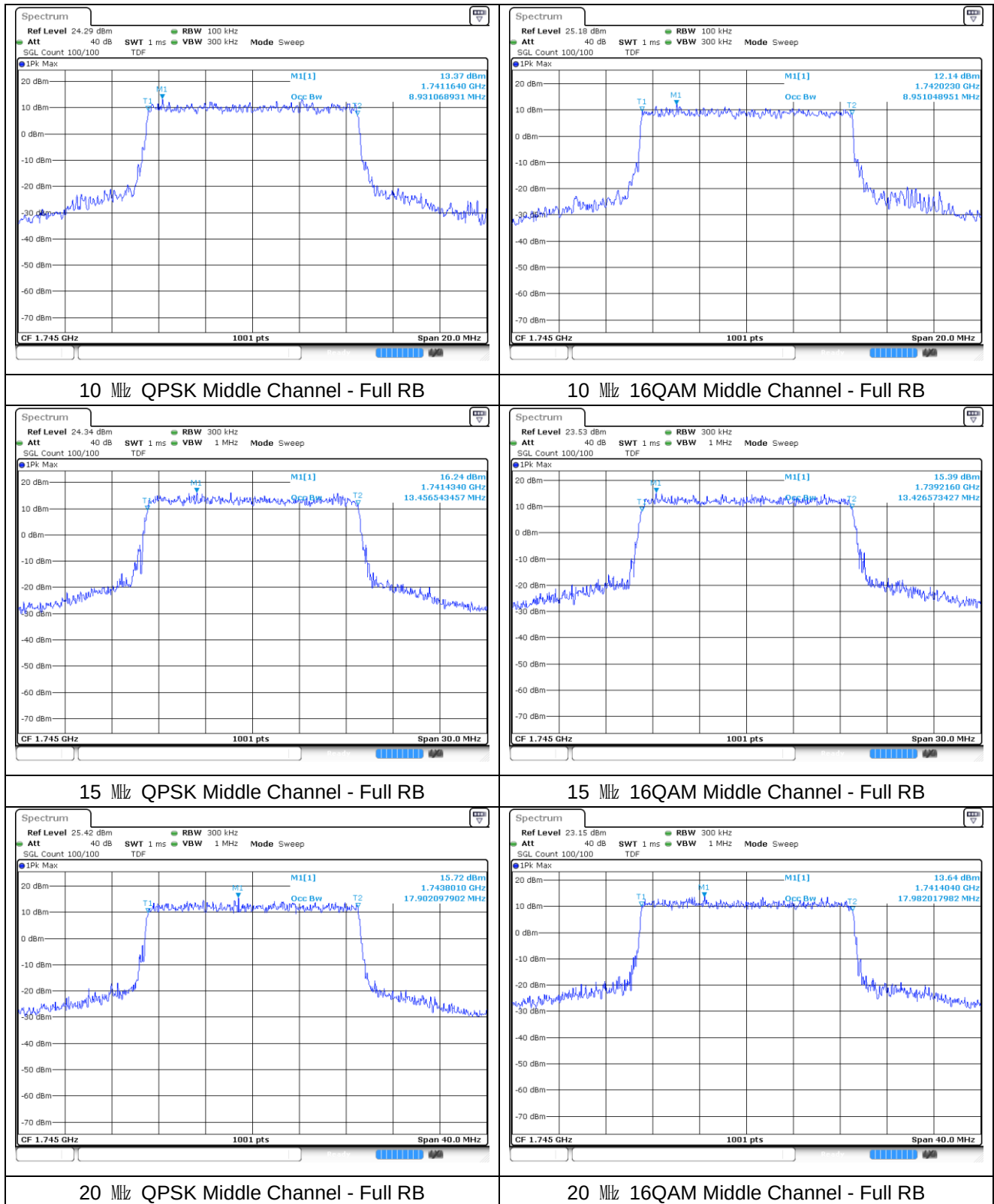
3 MHz 16QAM Middle Channel - Full RB



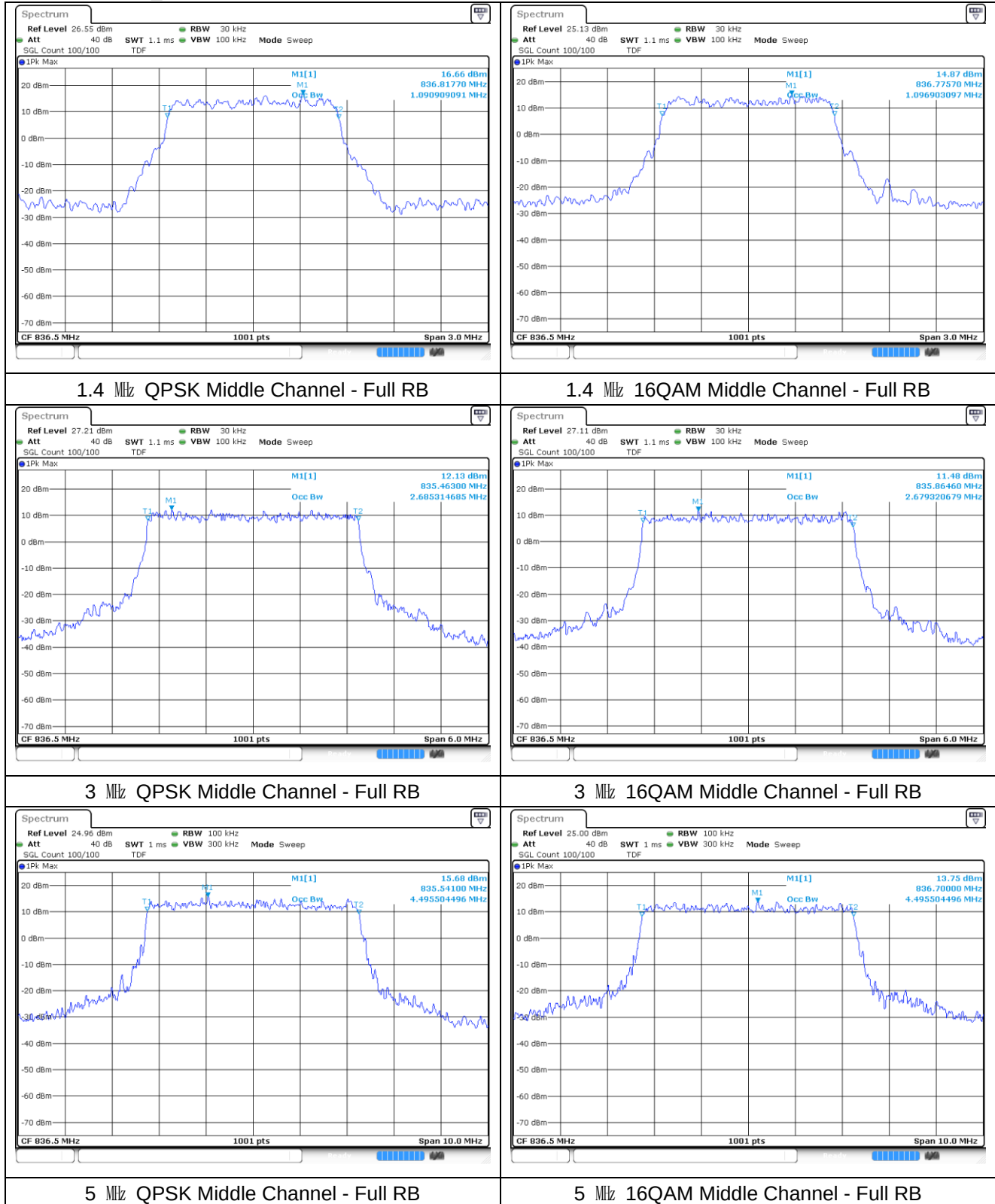
5 MHz QPSK Middle Channel - Full RB

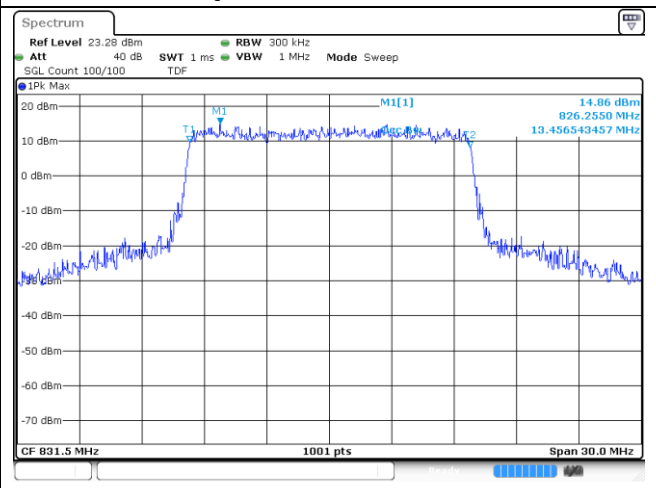
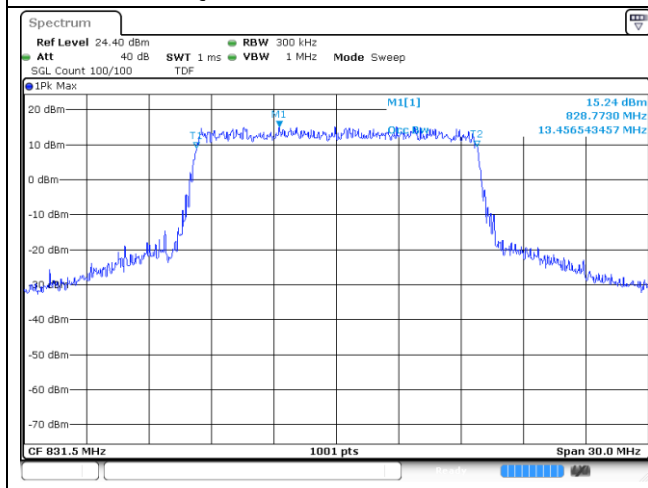
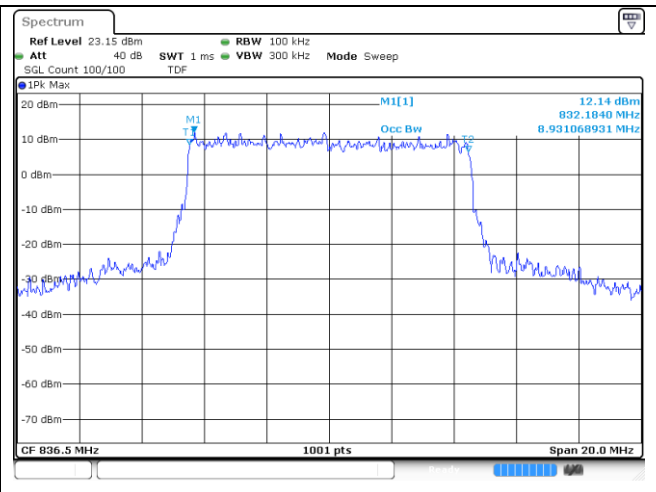
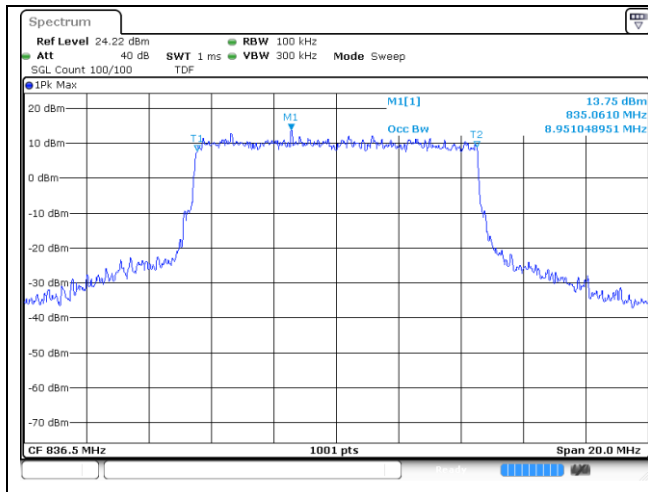


5 MHz 16QAM Middle Channel - Full RB

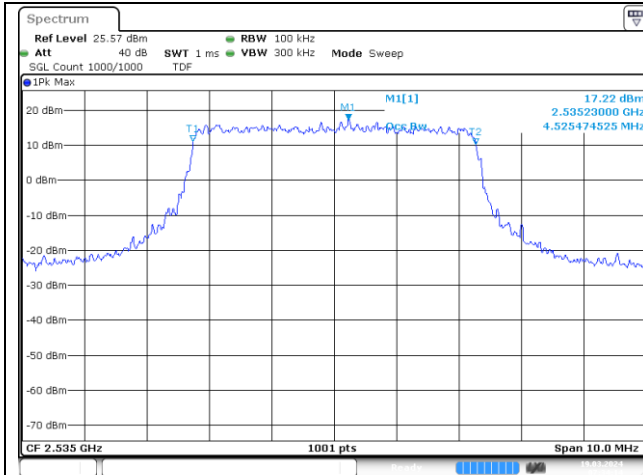


LTE band 26/5 Part 22

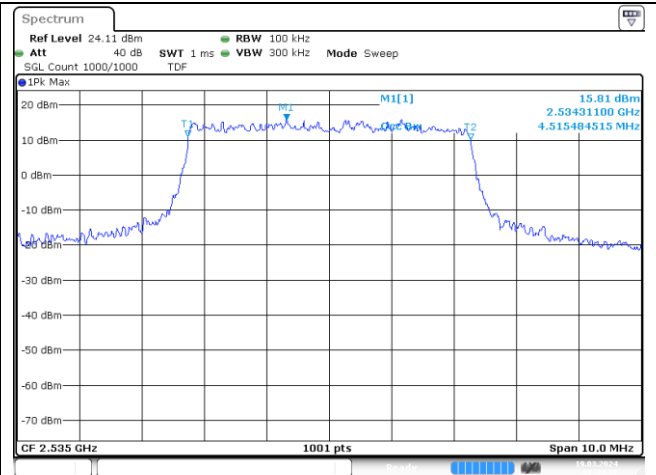




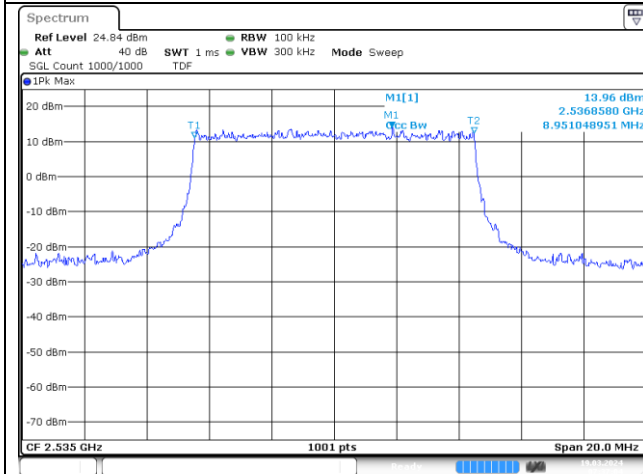
LTE band 7



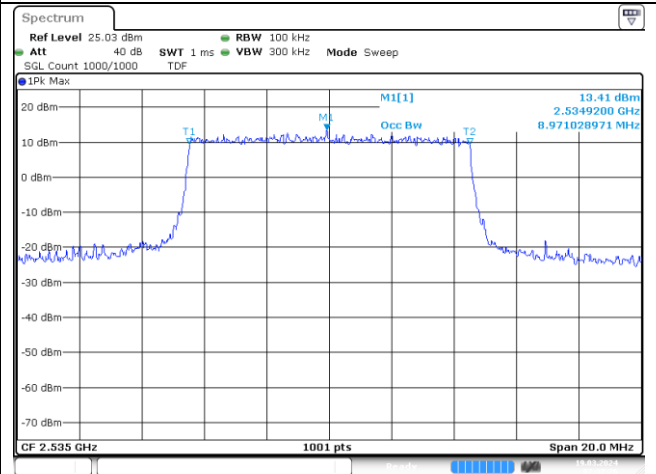
5 MHz QPSK Middle Channel - Full RB



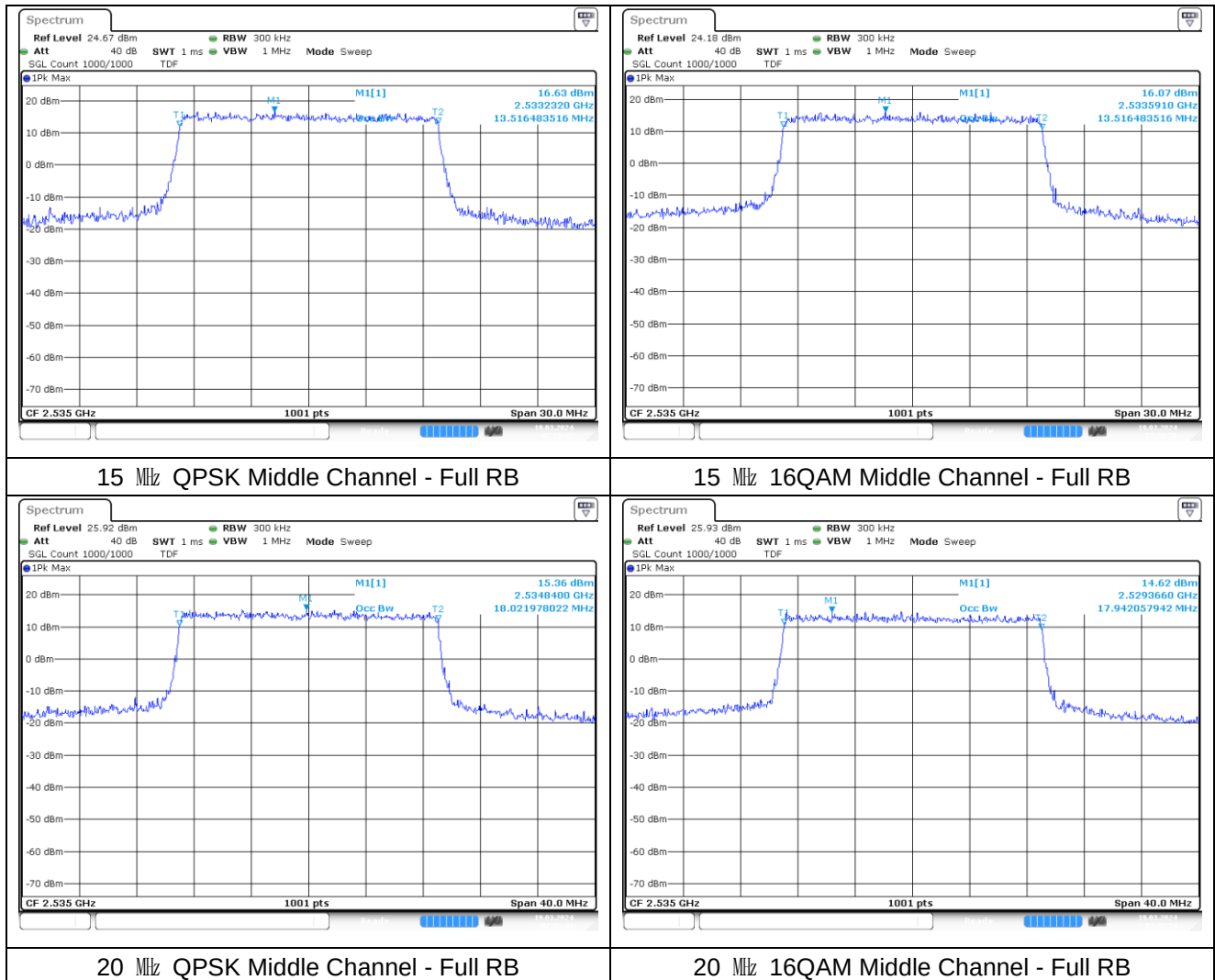
5 MHz 16QAM Middle Channel - Full RB



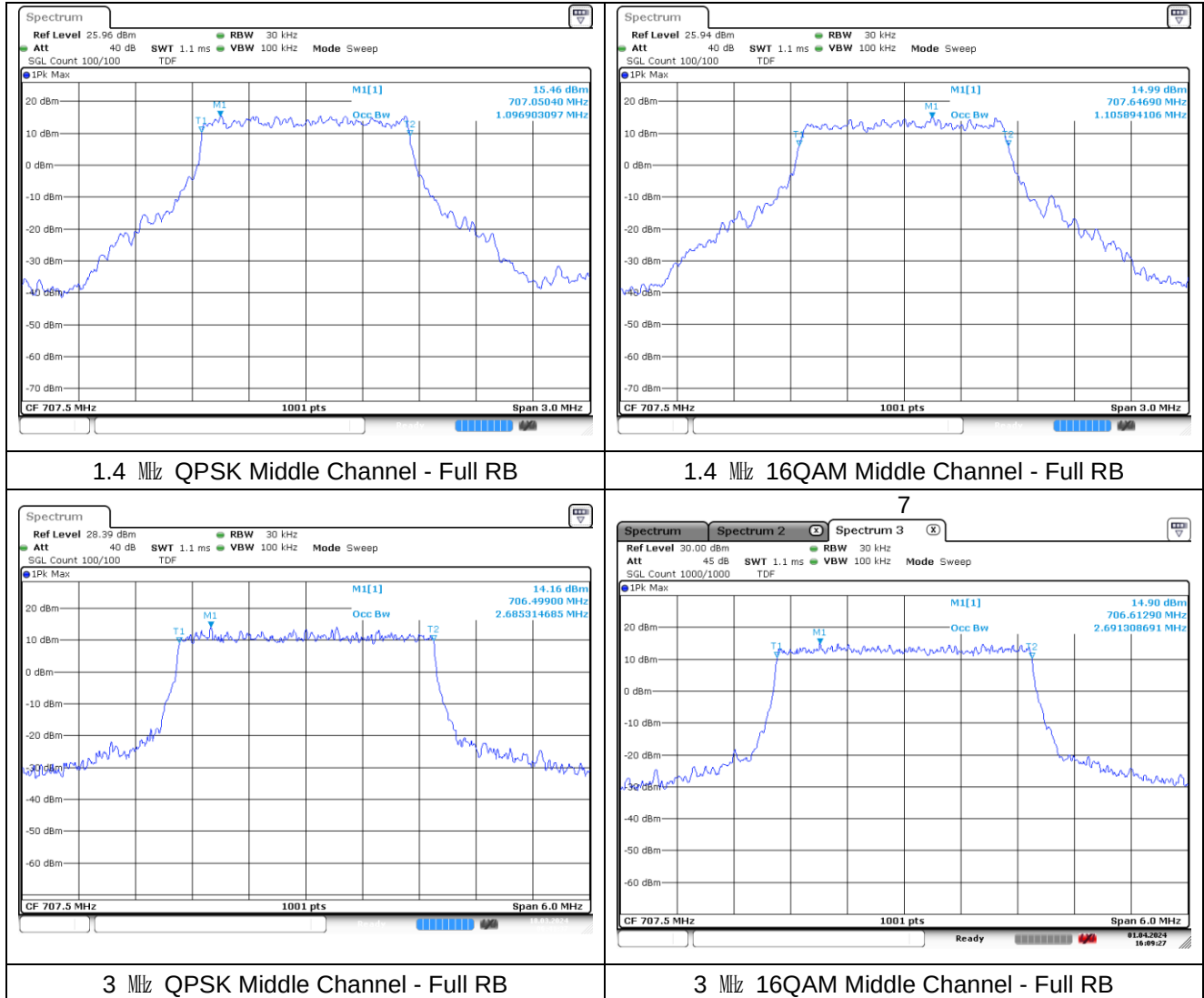
10 MHz QPSK Middle Channel - Full RB



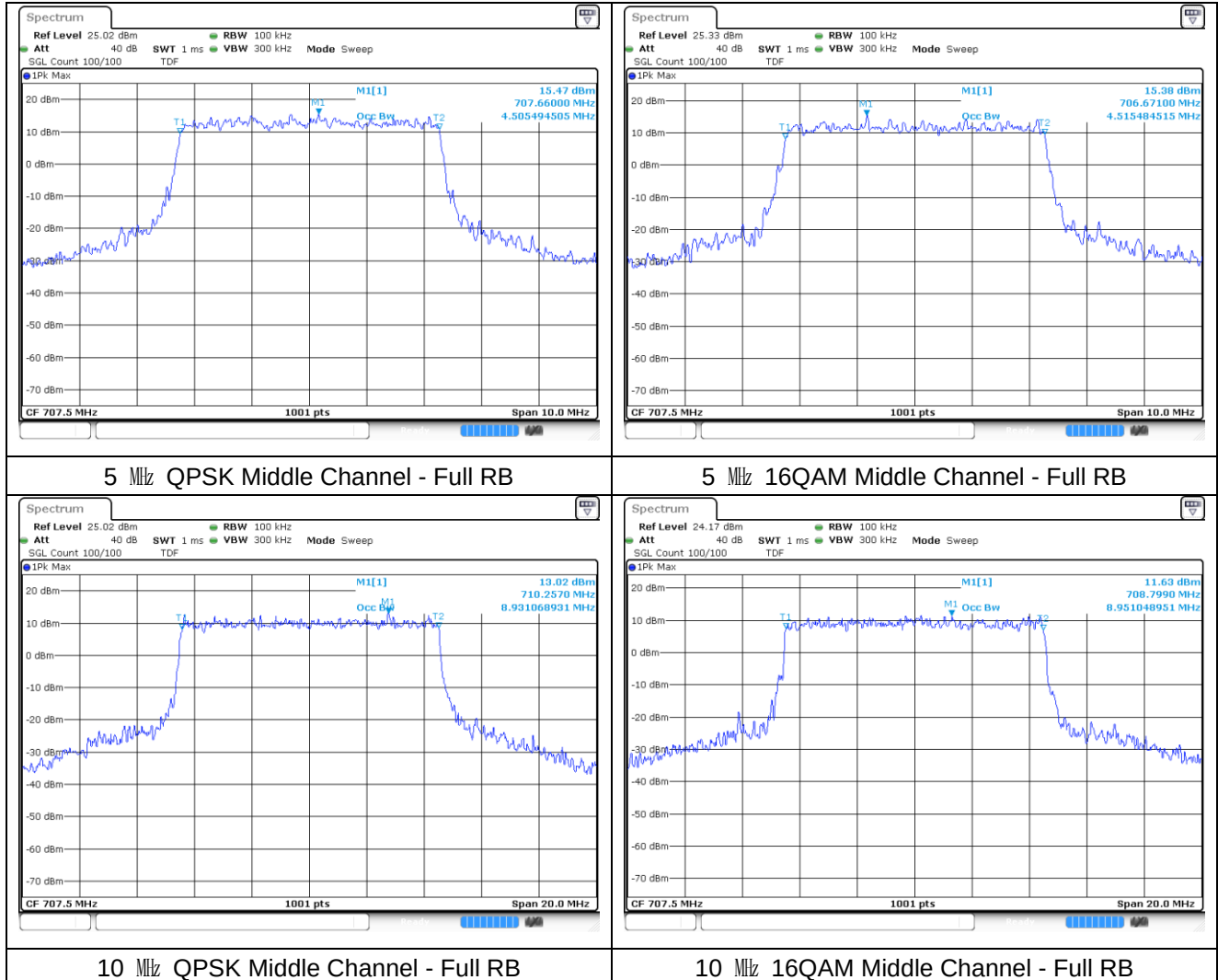
10 MHz 16QAM Middle Channel - Full RB



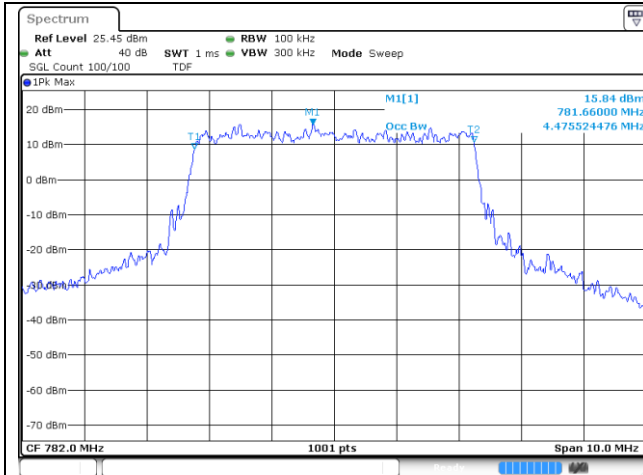
LTE band 12



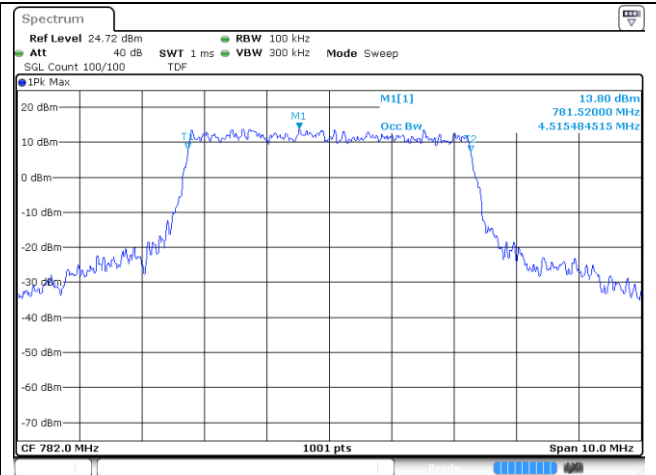
LTE band 12/17



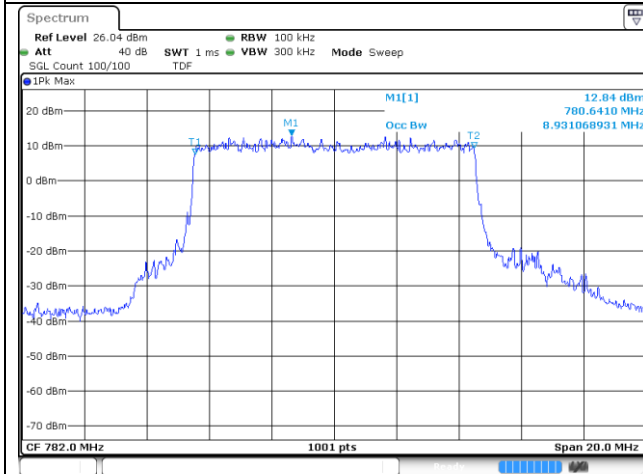
LTE band 13



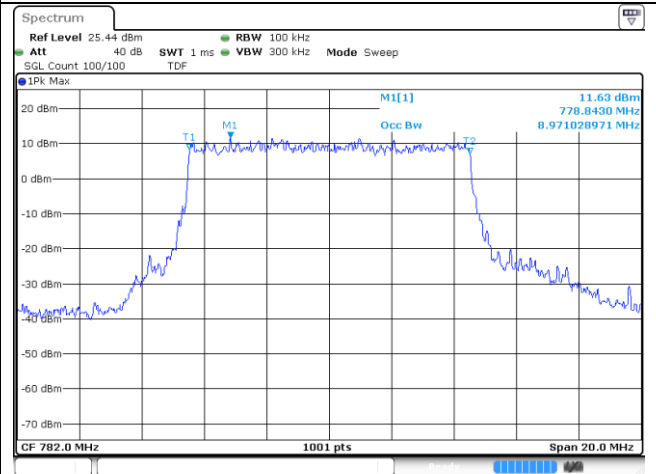
5 MHz QPSK Middle Channel - Full RB



5 MHz 16QAM Middle Channel - Full RB

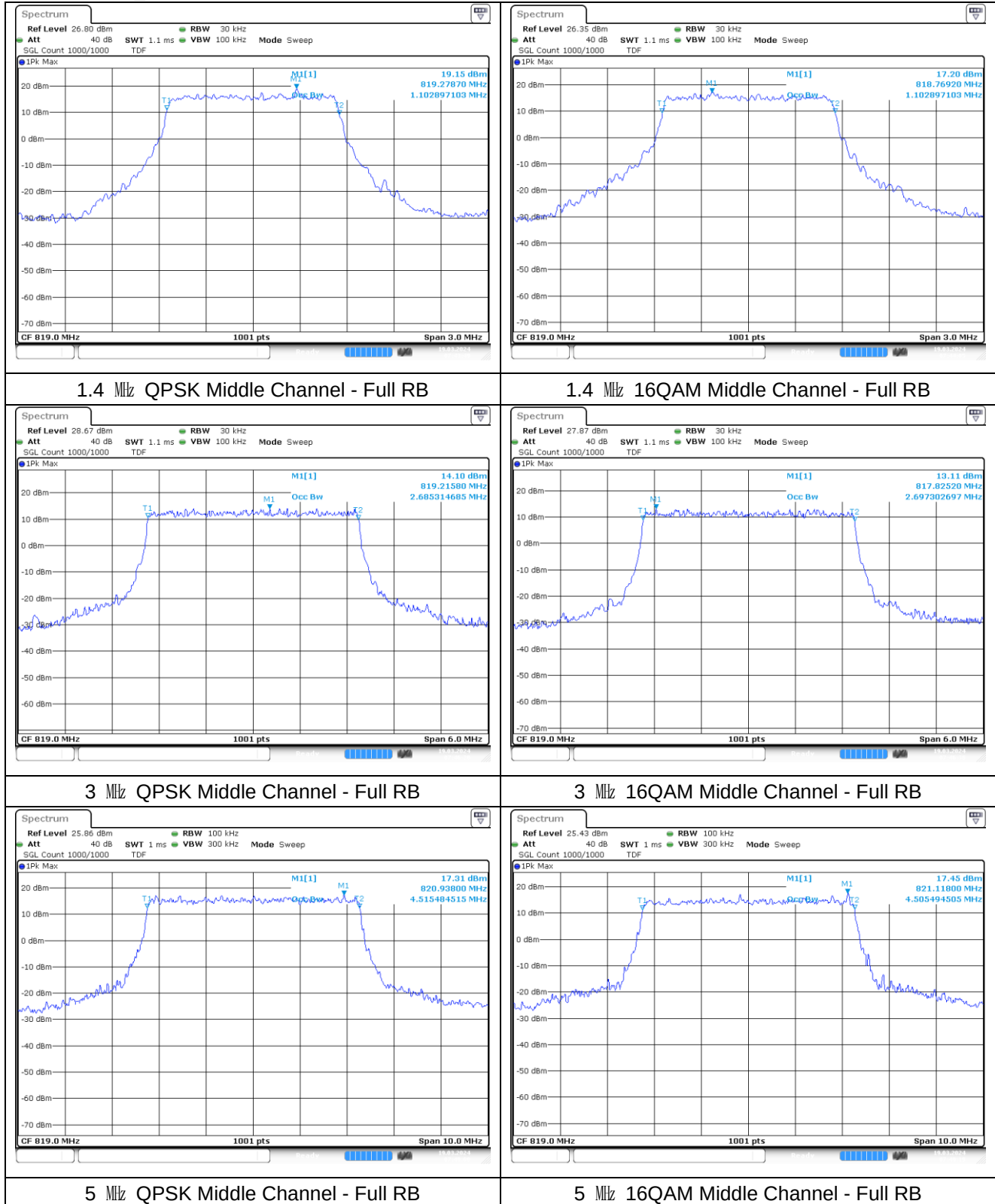


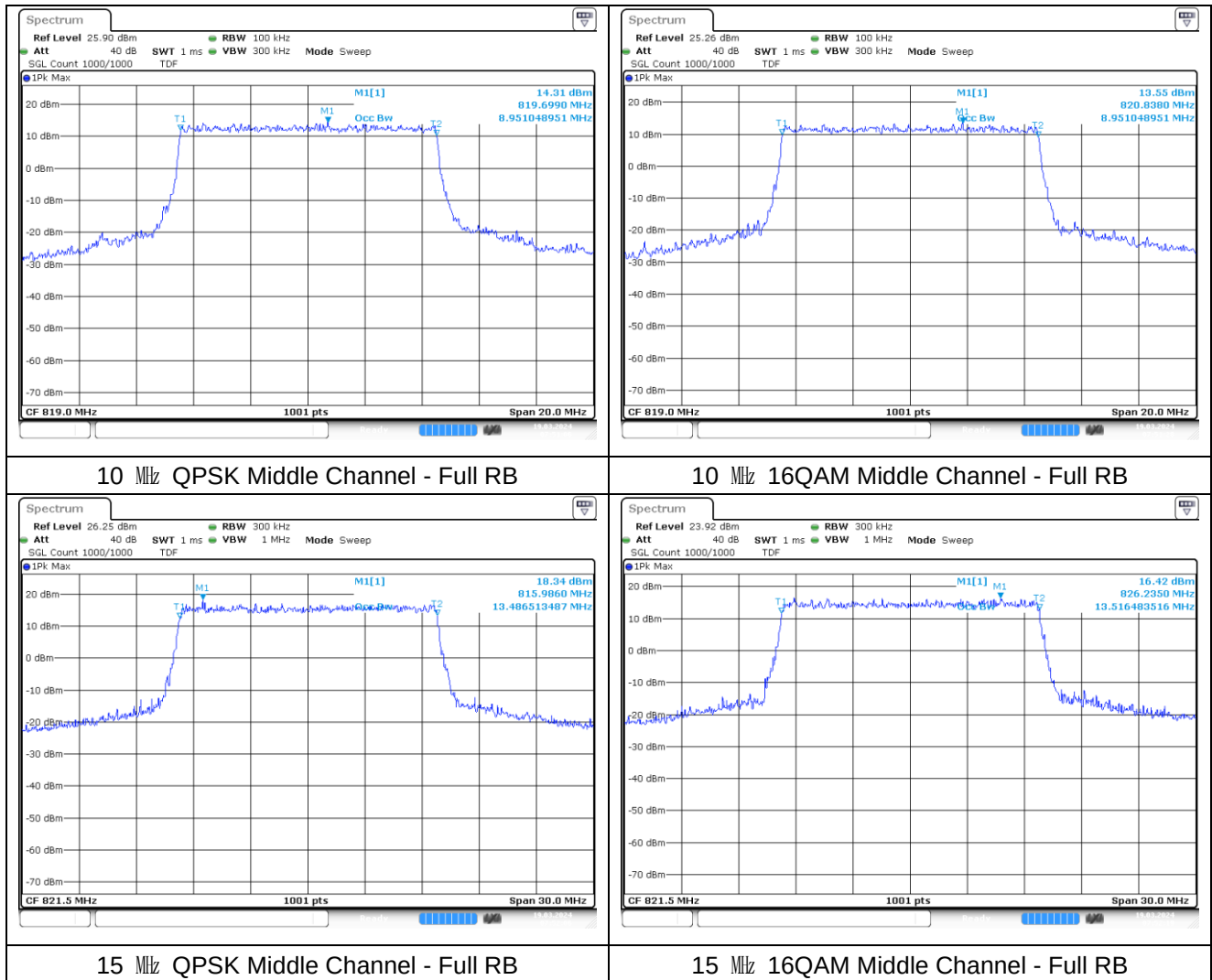
10 MHz QPSK Middle Channel - Full RB



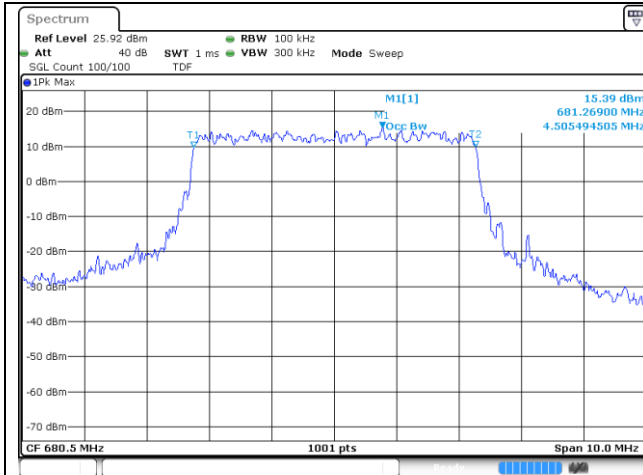
10 MHz 16QAM Middle Channel - Full RB

LTE band 26 Part 90

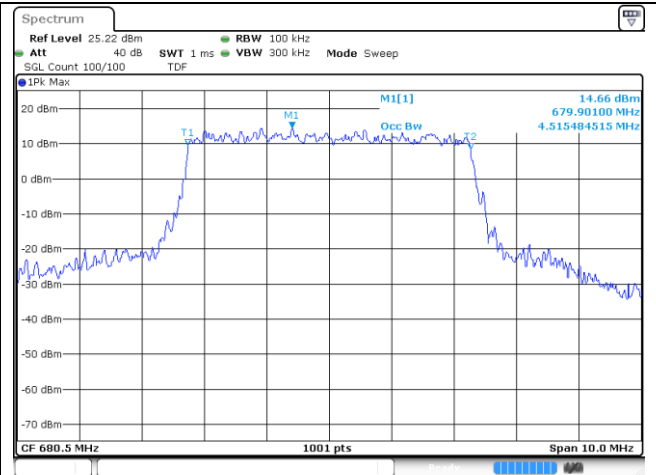




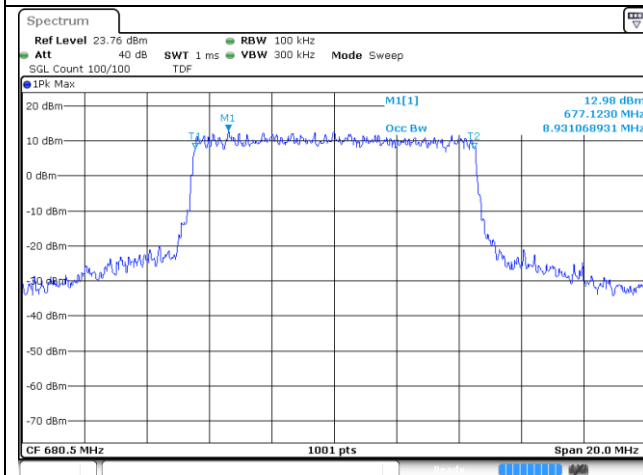
LTE band 71



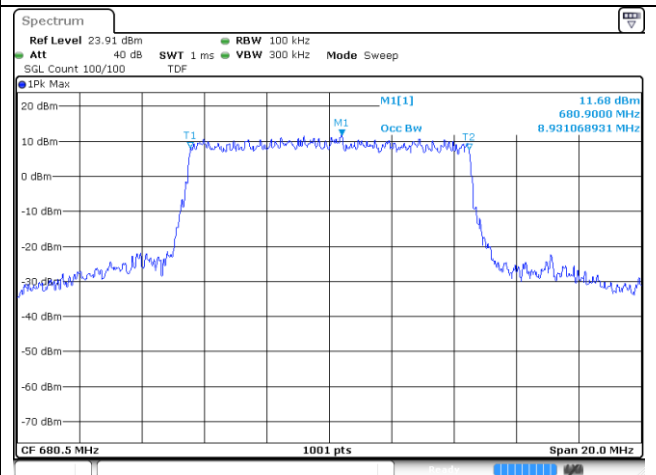
5 MHz QPSK Middle Channel - Full RB



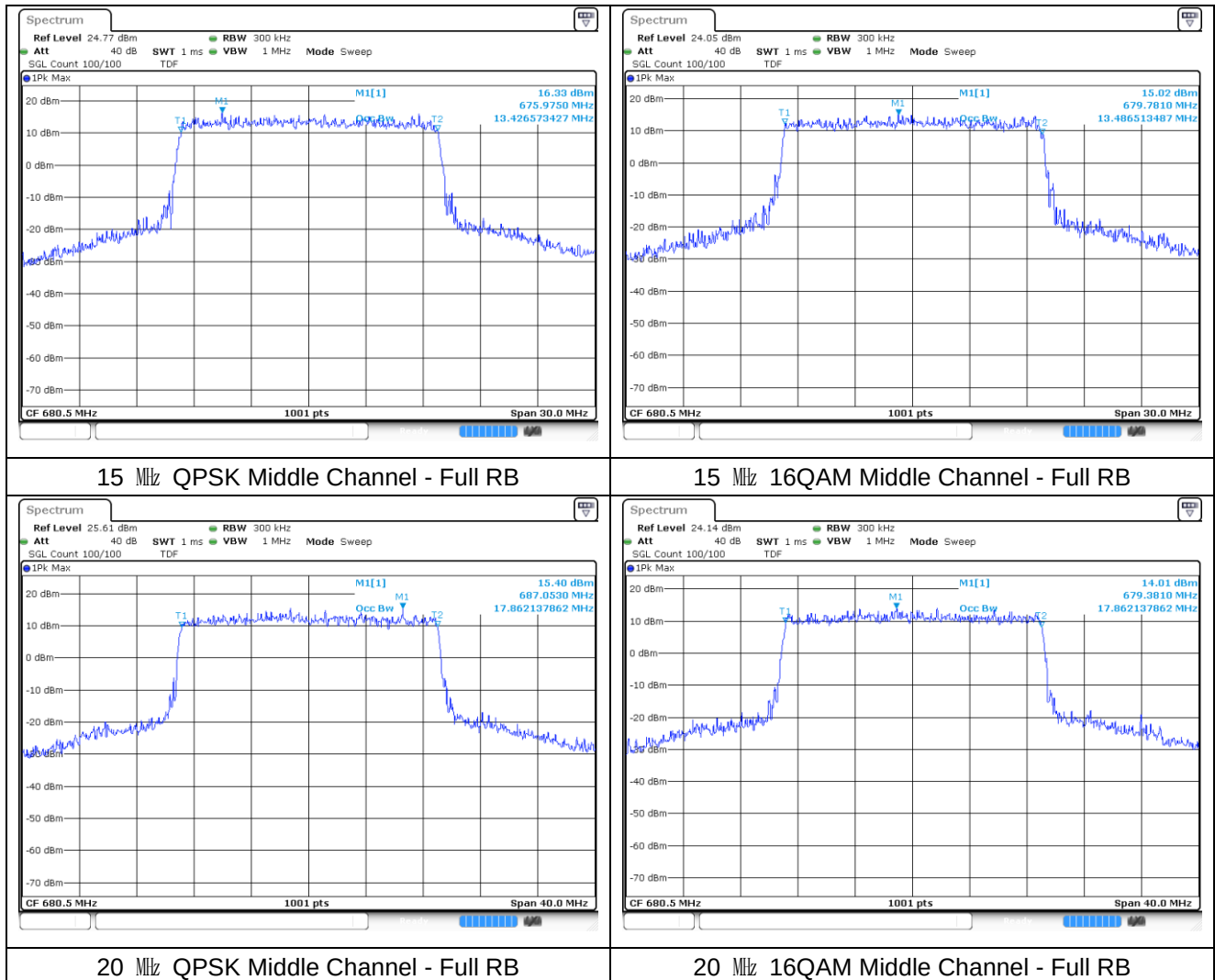
5 MHz 16QAM Middle Channel - Full RB



10 MHz QPSK Middle Channel - Full RB



10 MHz 16QAM Middle Channel - Full RB



5. Peak-Average Ratio

5.1. Limit

FCC

- §22.913(d) Measurement of the ERP of Cellular base transmitters and repeaters must be made using an average power measurement technique. The peak-to-average ratio (PAR) of the transmission must not exceed 13 dB.

- §24.232(d), power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. 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.

- §27.50(d)(5), power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. 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.

IC

- RSS-130 Issue 2

4.6.1, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1 % of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

- RSS-132 Issue 4

5.4, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1 % of the time using a signal corresponding to the highest PAPR during periods of continuous transmission.

- RSS-133 Issue 7

5.5, the peak-to-average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1% of the time, using a signal corresponding to the highest PAPR during periods of continuous transmission.

- RSS-139 Issue 4

5.5, the peak to average power ratio (PAPR) of the equipment shall not exceed 13 dB for more than 0.1 % of the time, using a signal that corresponds to the highest PAPR during periods of continuous transmission.

- RSS-199 Issue 4

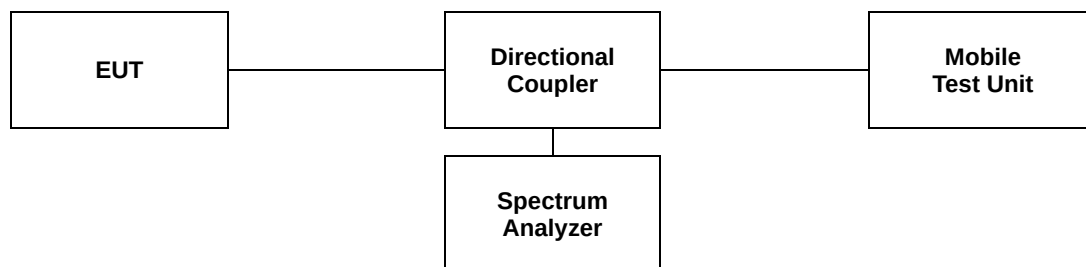
5.5, the peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

5.2. Test Procedure

The test follows section 5.2.3.4 of ANSI C63.26-2015.

See instrumentation-specific application literature for further guidance regarding use of the CCDF capability. The following guidelines are offered for performing a CCDF measurement.

- a. Set resolution/measurement bandwidth $\geq$ OBW or specified reference bandwidth.
- b. Set the number of counts to a value that stabilizes the measured CCDF curve.
- c. Set the measurement interval as follows:
 - 1) For continuous transmissions, set to greater of $[10 \times (\text{number of points in sweep}) \times (\text{transmission symbol period})]$ or 1 ms.
 - 2) For burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize. Set the measurement interval to a time that is less than or equal to the burst duration.
 - 3) If there are several carriers in a single antenna port, the peak power shall be determined for each individual carrier (by disabling the other carriers while measuring the required carrier) and the total peak power calculated from the sum of the individual carrier peak powers.
- d. Record the maximum PAPR level associated with a probability of 0.1 %.
- e. The peak power level is calculated from the sum of the PAPR value from step d) to the measured average power.



5.3 Test Results

Ambient temperature : (23 ± 1) °C
 Relative humidity : 47 % R.H.

WCDMA

Band	Mode	Frequency (MHz)	PAR (dB)
WCDMA II	RMC	1 852.4	2.70
		1 880.0	2.35
		1 907.6	2.41
	HSDPA	1 852.4	2.55
		1 880.0	2.70
		1 907.6	2.52
WCDMA V	RMC	826.4	3.04
		836.6	3.33
		846.6	2.99
	HSDPA	826.4	3.33
		836.6	3.25
		846.6	3.28

LTE

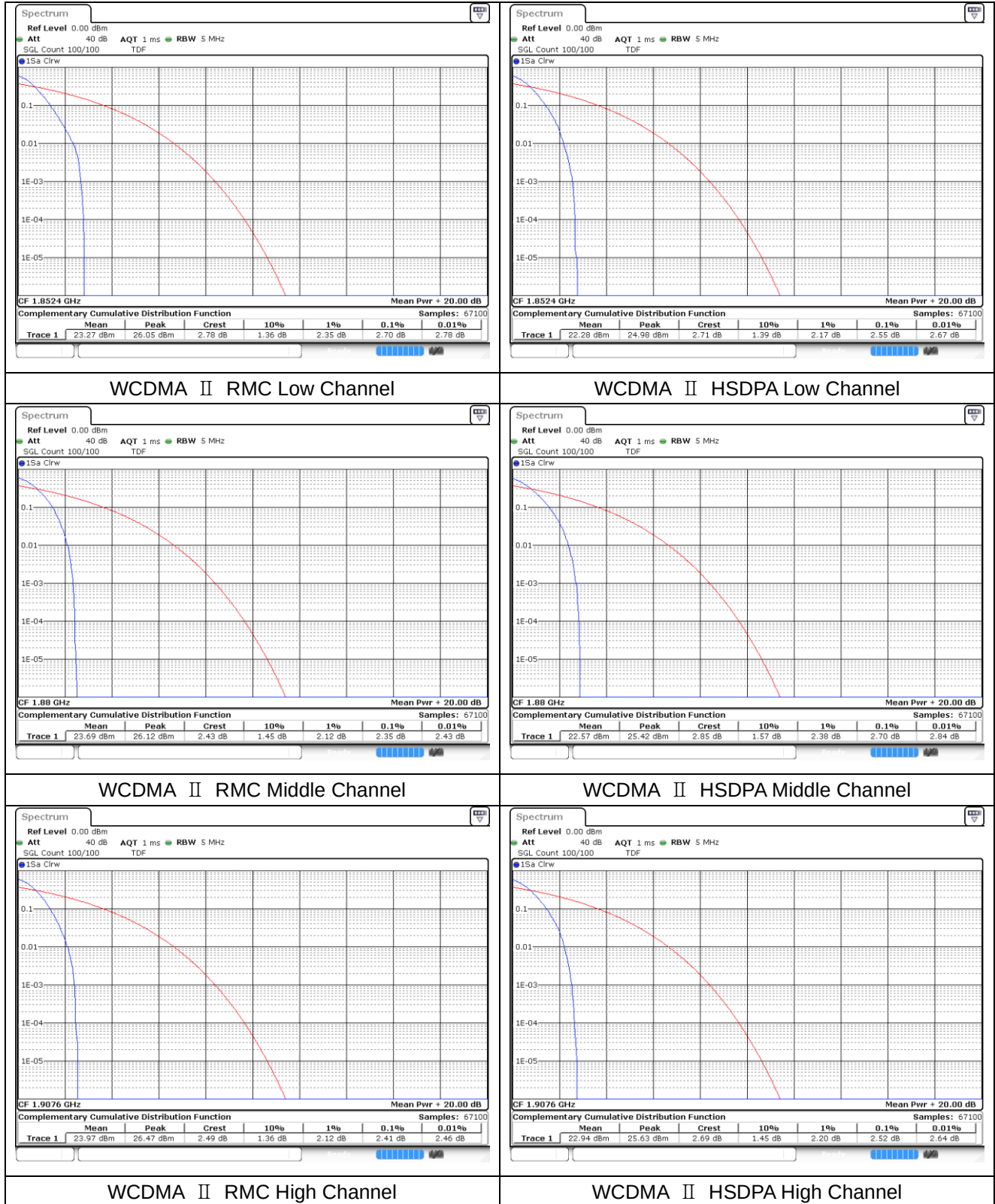
Band	Bandwidth (MHz)	Mode	Frequency (MHz)	PAR (dB)
25/2	1.4	256QAM	1 850.7	6.96
			1 882.5	6.43
			1 914.3	6.70
	3		1 851.5	6.70
			1 882.5	6.81
			1 913.5	6.41
	5		1 852.5	6.29
			1 882.5	6.70
			1 912.5	6.41
	10		1 855.0	6.35
			1 882.5	6.43
			1 910.0	6.35
	15		1 857.5	6.49
			1 882.5	6.72
			1 907.5	6.67
	20		1 860.0	6.29
1 882.5		6.43		
1 905.0		6.43		
66/4	1.4	256QAM	1 710.7	6.61
			1 745.0	6.38
			1 779.3	6.64
	3		1 711.5	6.61
			1 745.0	6.81
			1 778.5	6.81
	5		1 712.5	6.90
			1 745.0	6.93
			1 777.5	6.93
	10		1 715.0	6.81
			1 745.0	6.61
			1 775.0	6.81
	15		1 717.5	6.81
			1 745.0	6.61
			1 772.5	6.55
	20		1 720.0	6.72
1 745.0		6.70		
1 770.0		6.32		

Band	Bandwidth (MHz)	Mode	Frequency (MHz)	PAR (dB)	
26/5 Part 22	1.4	256QAM	824.7	6.75	
			836.5	6.55	
			848.3	6.64	
	3		825.5	6.78	
			836.5	6.43	
			847.5	6.35	
	5		826.5	6.49	
			836.5	6.43	
			846.5	6.52	
	10		829.0	6.55	
			836.5	6.55	
			844.0	6.58	
	15		831.5	6.58	
			841.5	6.46	
7	5	2 502.5	5.22		
		2 535.0	5.28		
		2 567.5	5.28		
	10	2 505.0	5.33		
		2 535.0	5.28		
		2 565.0	5.51		
	15	2 507.5	5.30		
		2 535.0	5.30		
		2 562.5	5.42		
	20	2 510.0	5.54		
		2 535.0	5.36		
		2 560.0	6.43		
12	1.4	256QAM	699.7	6.75	
			707.5	6.75	
			715.3	6.46	
	3		700.5	6.58	
			707.5	6.41	
			714.5	6.49	
12/17	5		701.5	6.78	
			707.5	6.46	
			713.5	6.32	
	10		704.0	6.46	
			707.5	6.49	
			711.0	6.49	
13	5		256QAM	779.5	6.55
				782.0	6.49
	10	784.5		6.49	
		782.0		6.46	

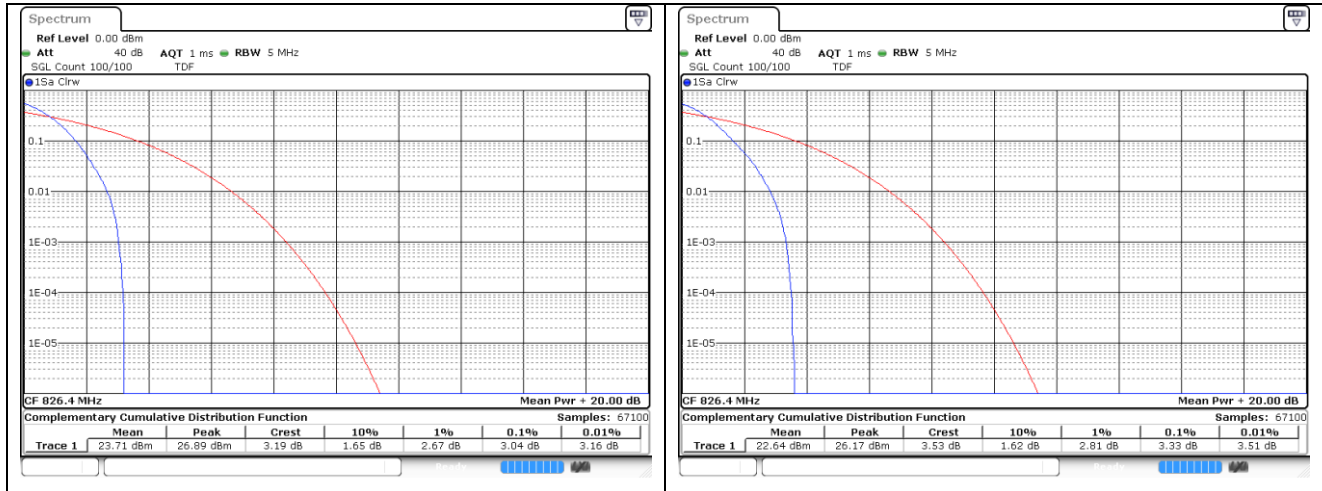
Band	Bandwidth (MHz)	Mode	Frequency (MHz)	PAR (dB)
26 Part 90	1.4	256QAM	814.7	6.70
			819.0	6.55
			823.3	6.58
	3		815.5	6.81
			819.0	6.46
			822.5	6.29
	5		816.5	6.43
			819.0	6.38
			821.5	6.70
	10		819.0	6.52
15	821.5	6.55		
71	5	256QAM	665.5	6.81
			680.5	6.26
			695.5	6.46
	10		668.0	6.58
			680.5	6.35
			693.0	6.46
	15		670.5	6.64
			680.5	6.52
			690.5	6.38
	20		673.0	6.49
			680.5	6.43
			688.0	6.52

- Test plots

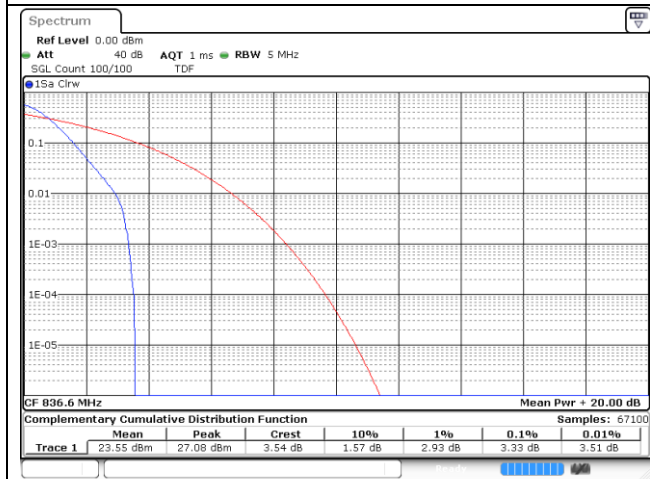
WCDMA II



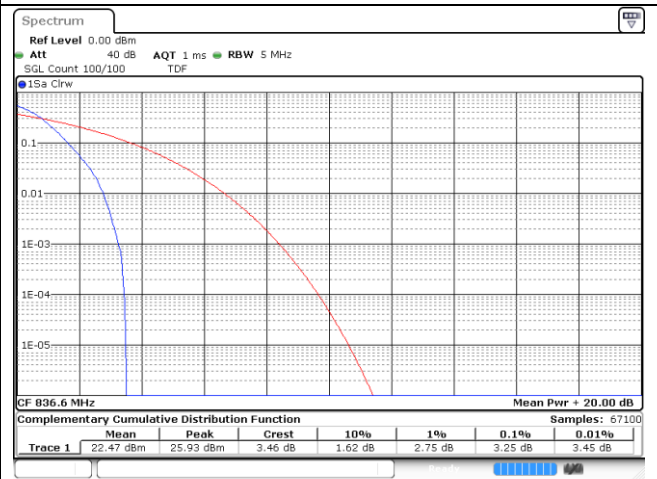
WCDMA V



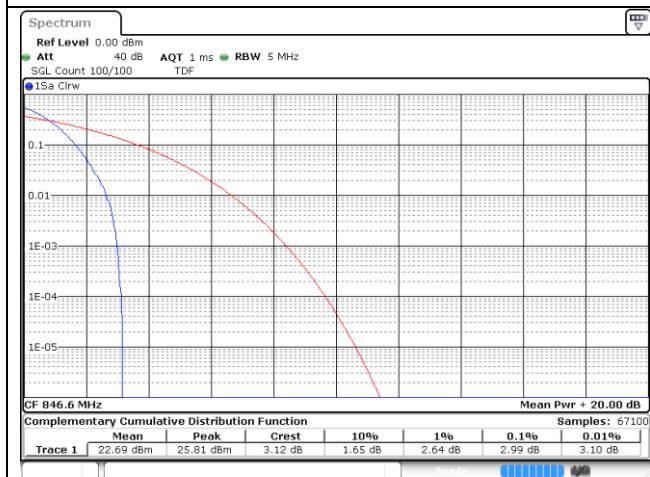
WCDMA V RMC Low Channel



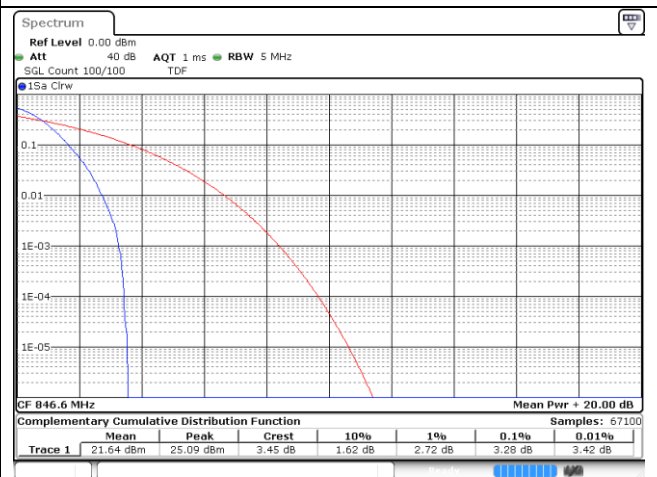
WCDMA V HSDPA Low Channel



WCDMA V RMC Middle Channel



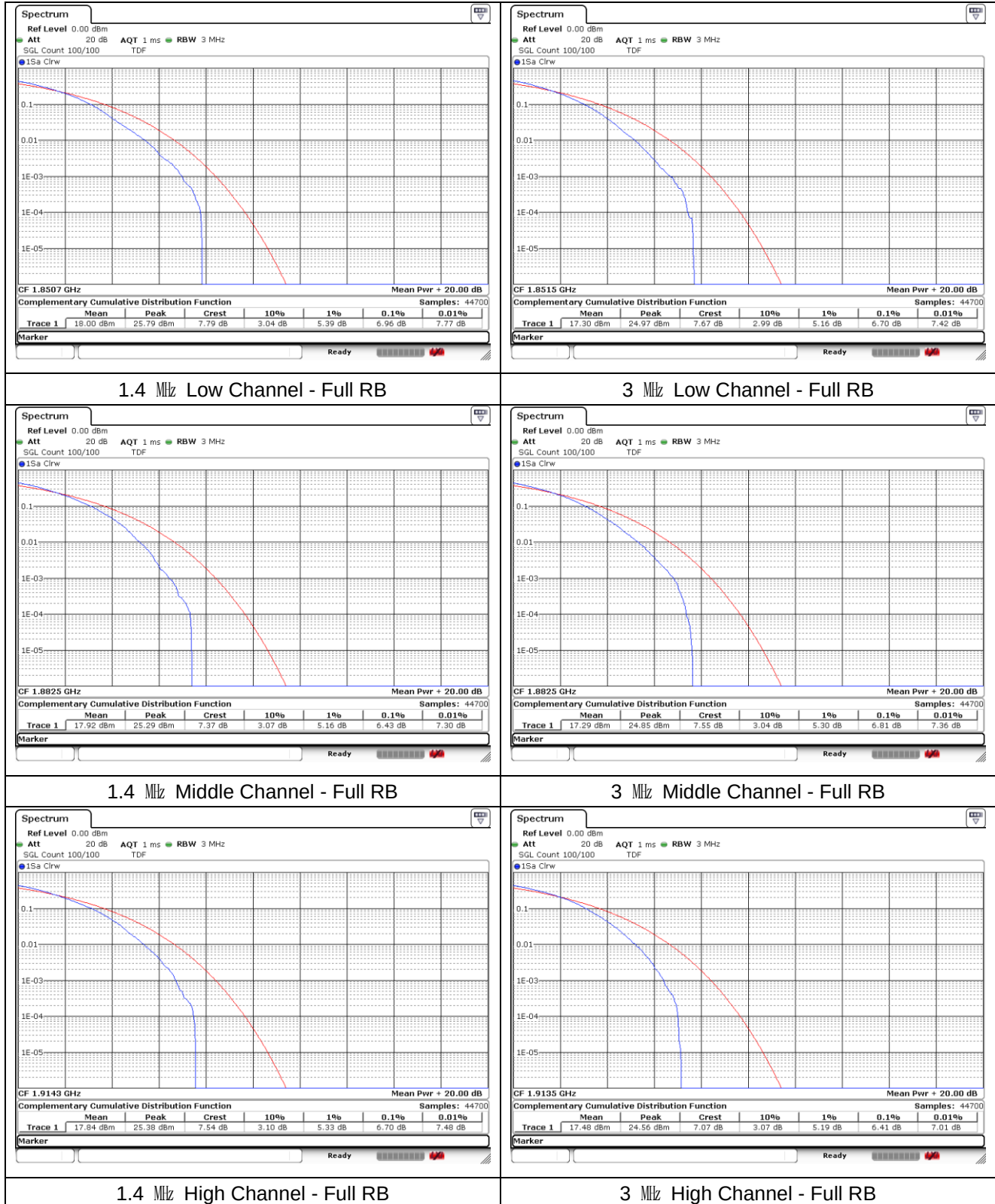
WCDMA V HSDPA Middle Channel



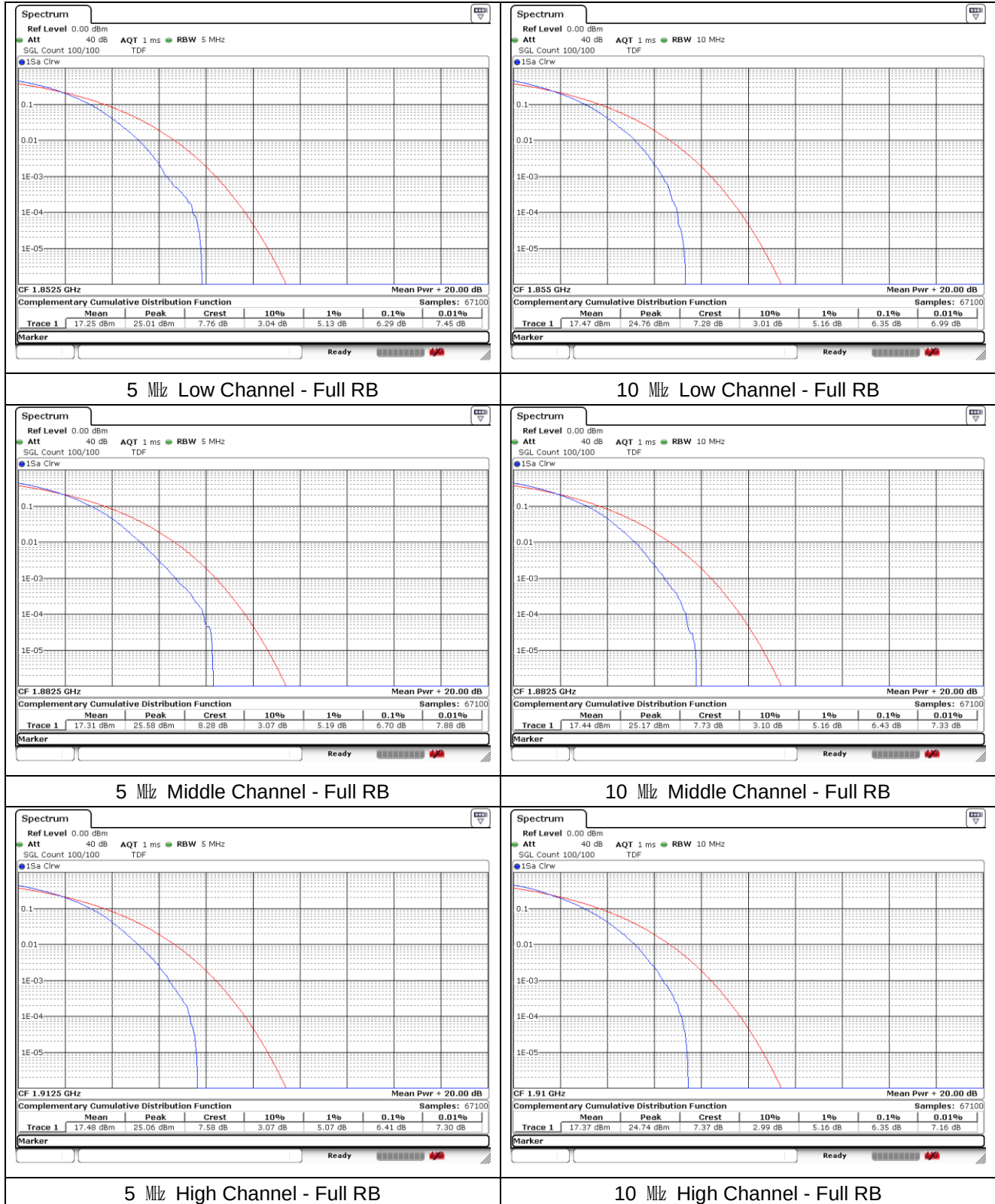
WCDMA V RMC High Channel

WCDMA V HSDPA High Channel

LTE band 25/2



LTE band 25/2



LTE band 25/2

