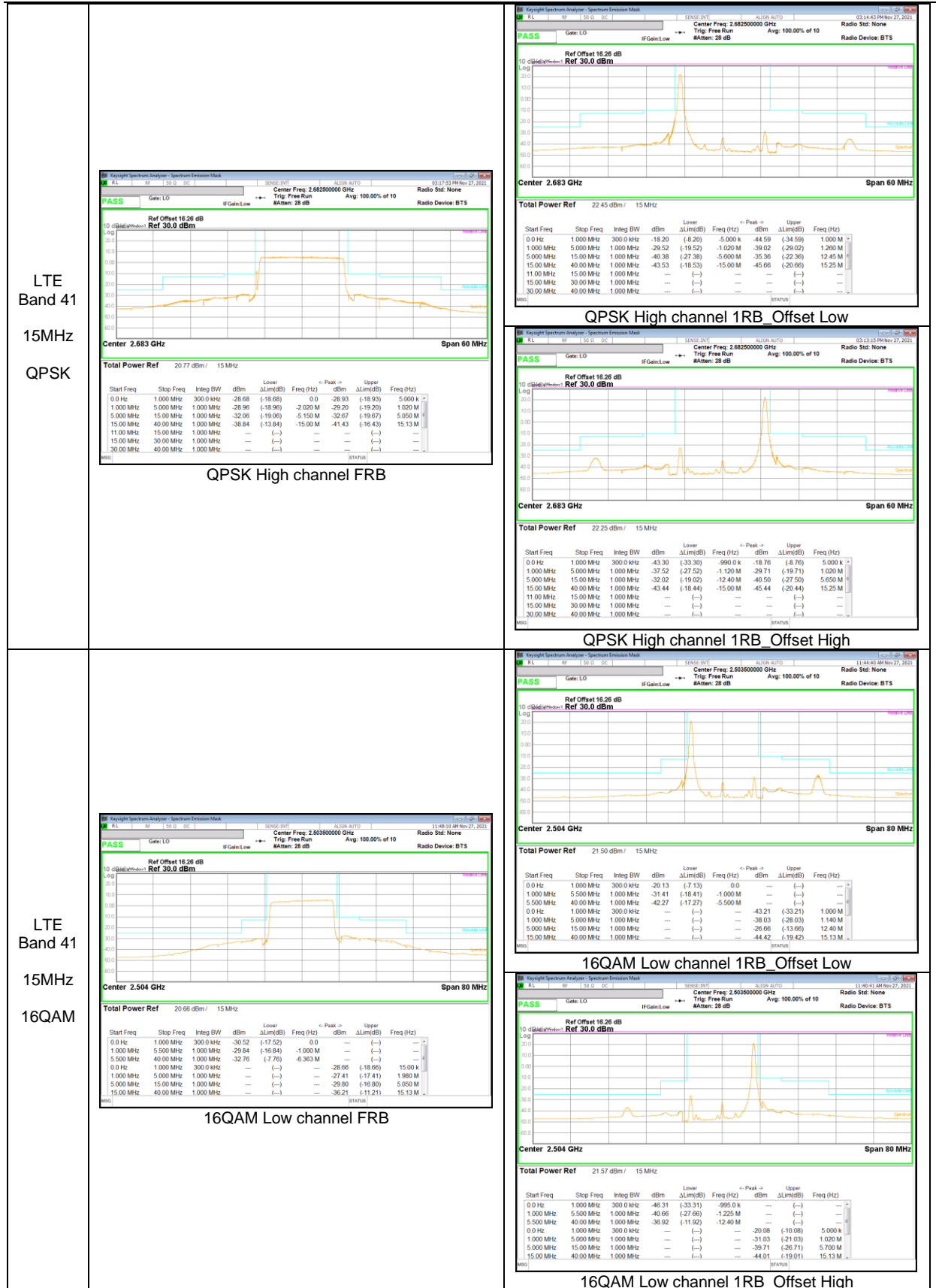
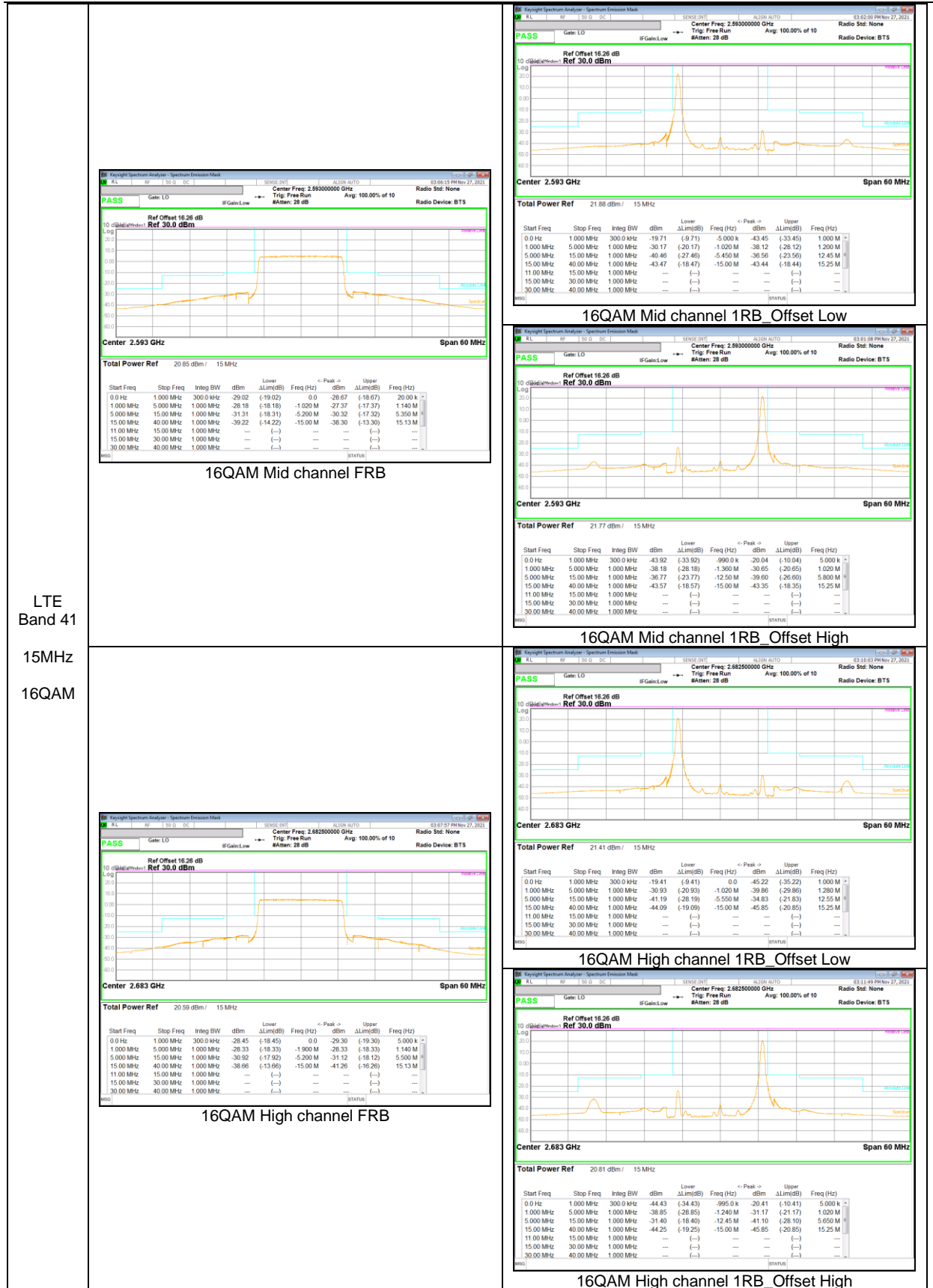
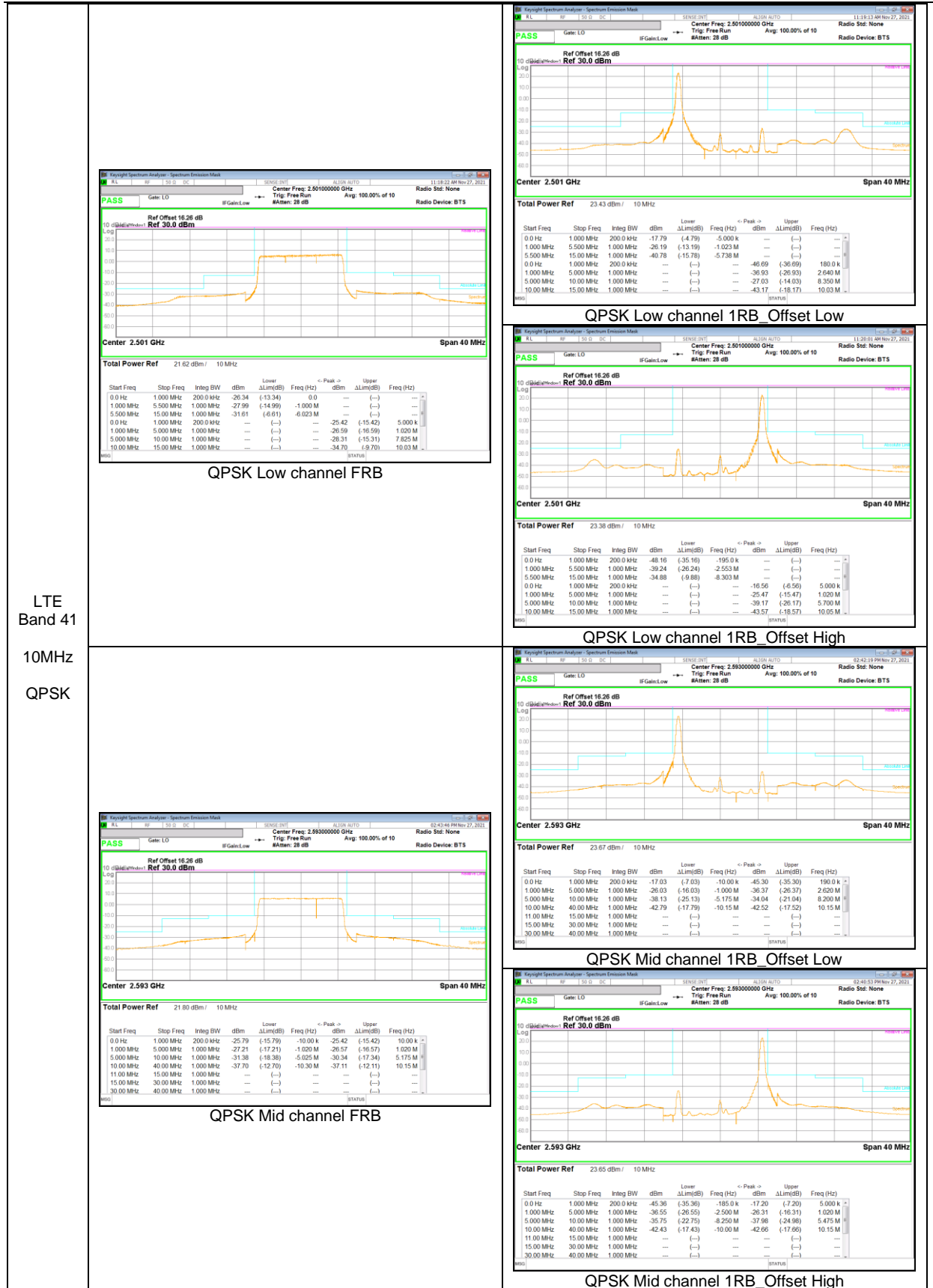


LTE
 Band 41
 15MHz
 QPSK

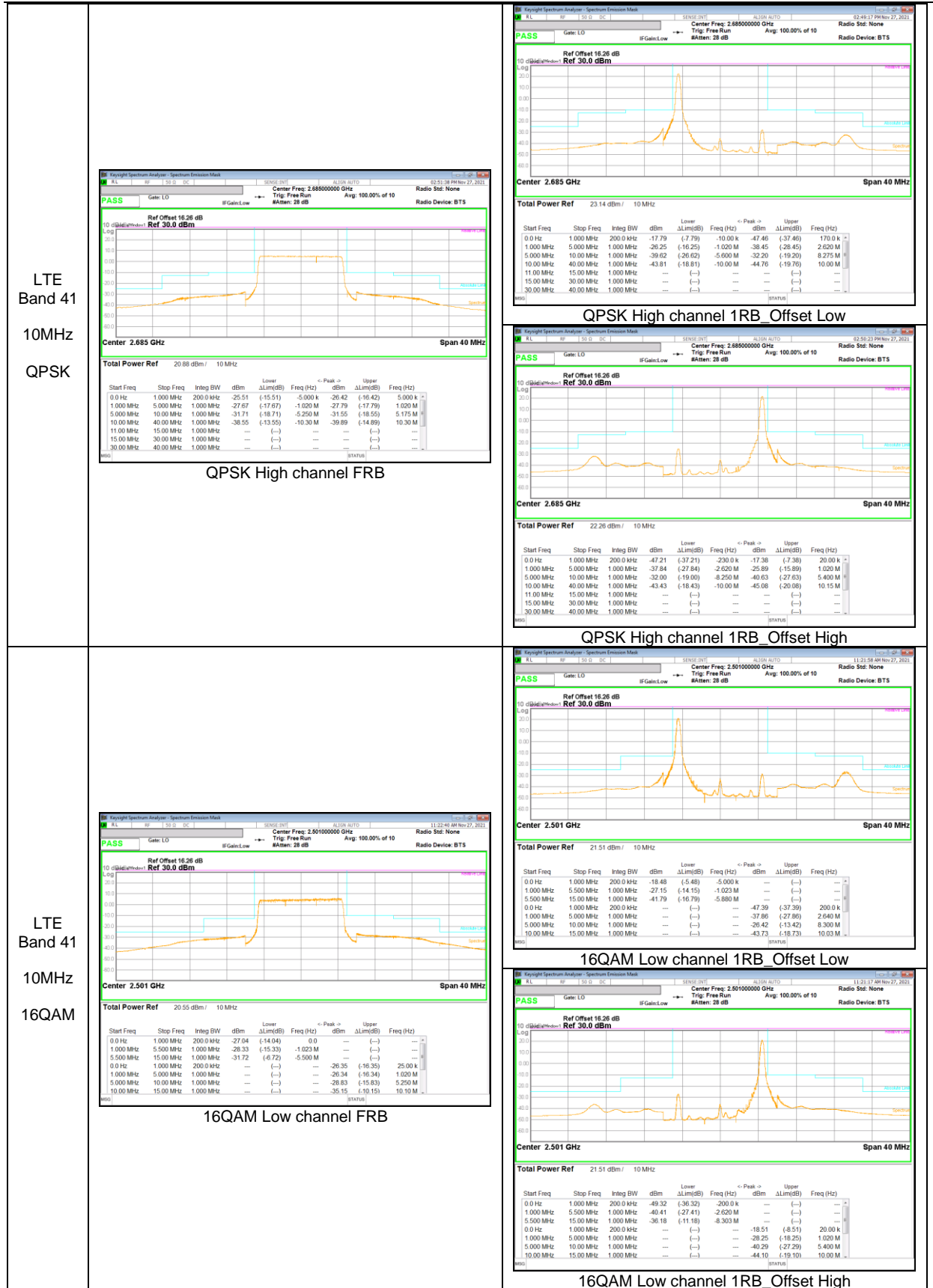


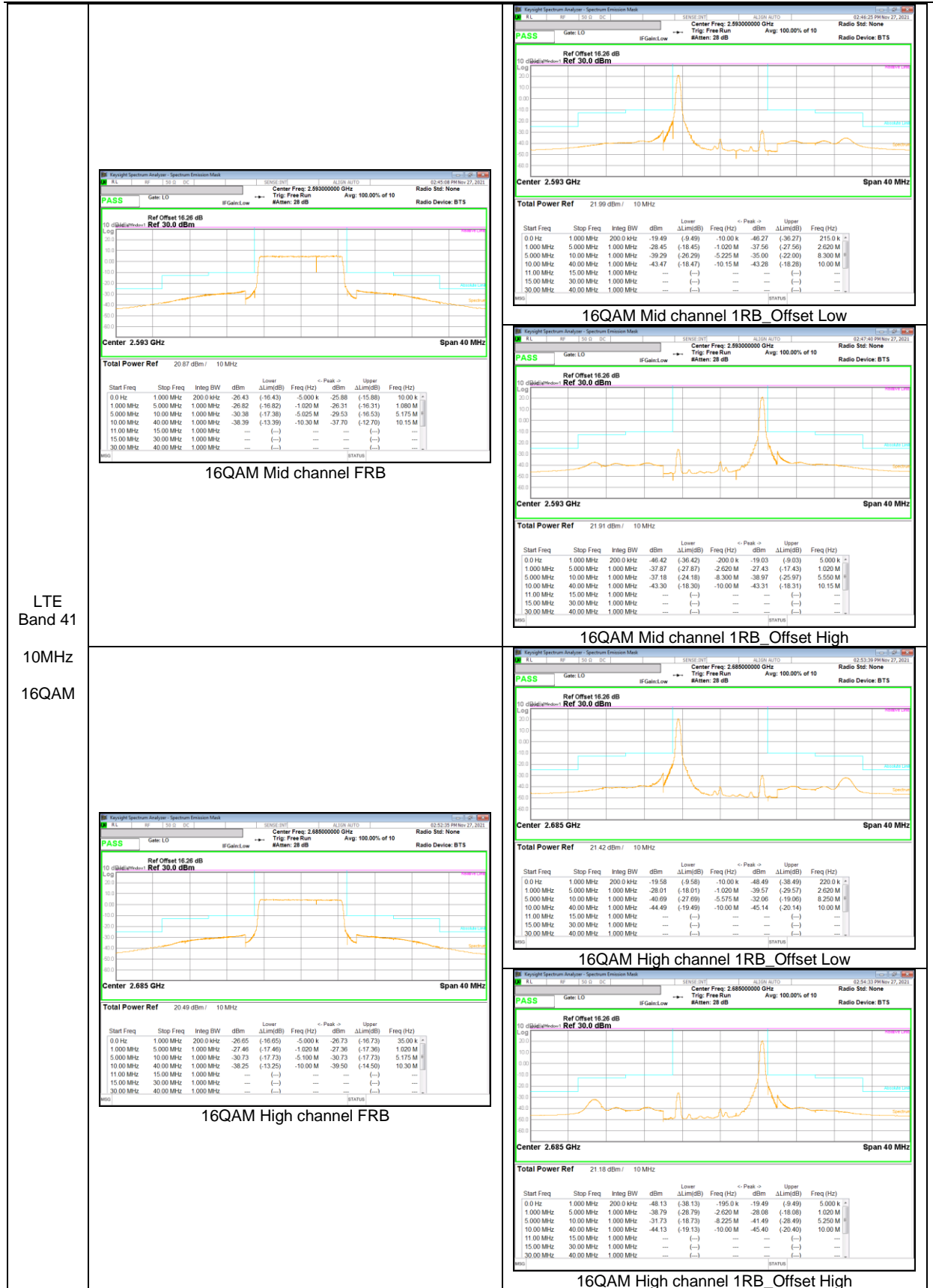


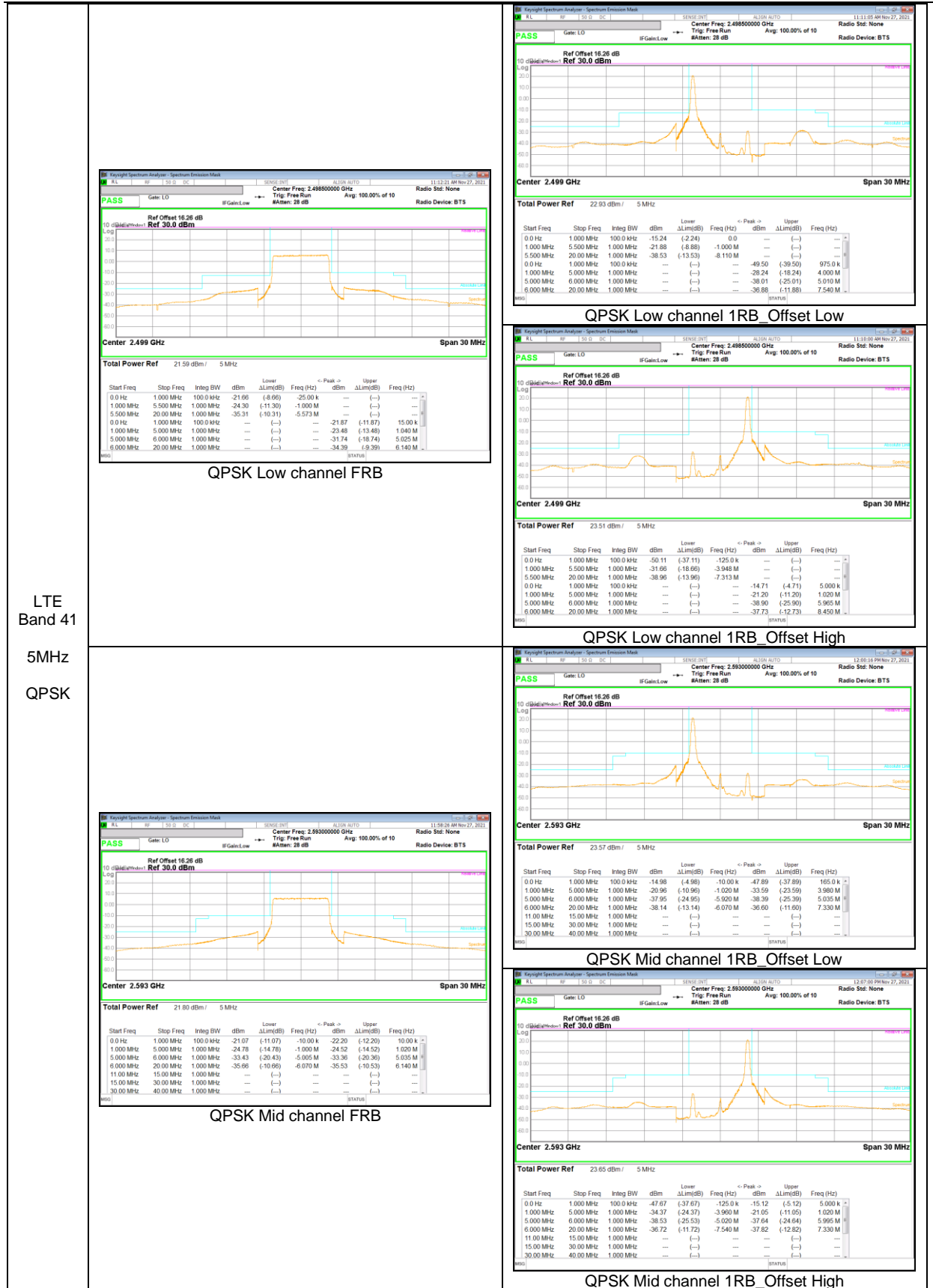
LTE
 Band 41
 15MHz
 16QAM

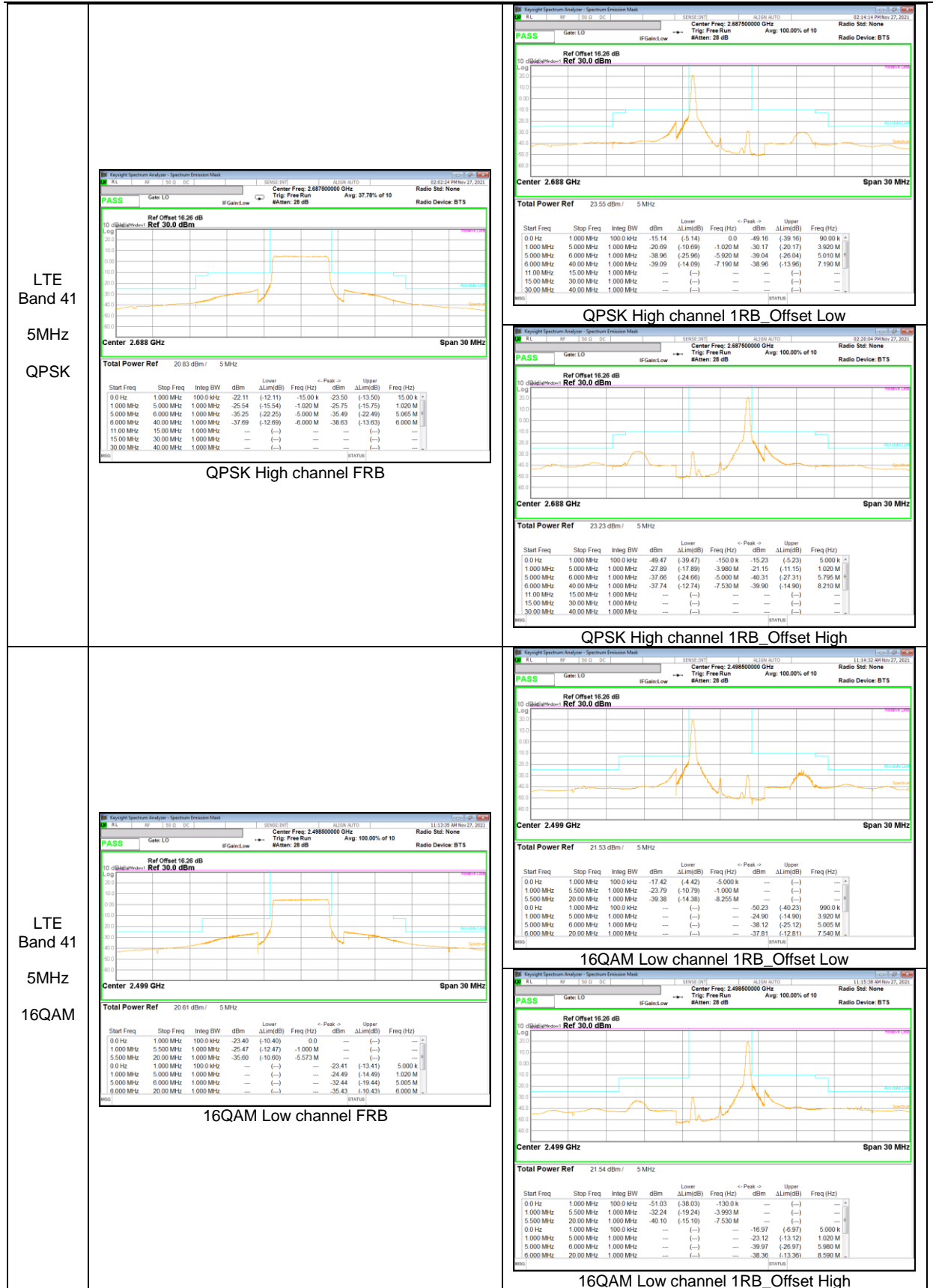


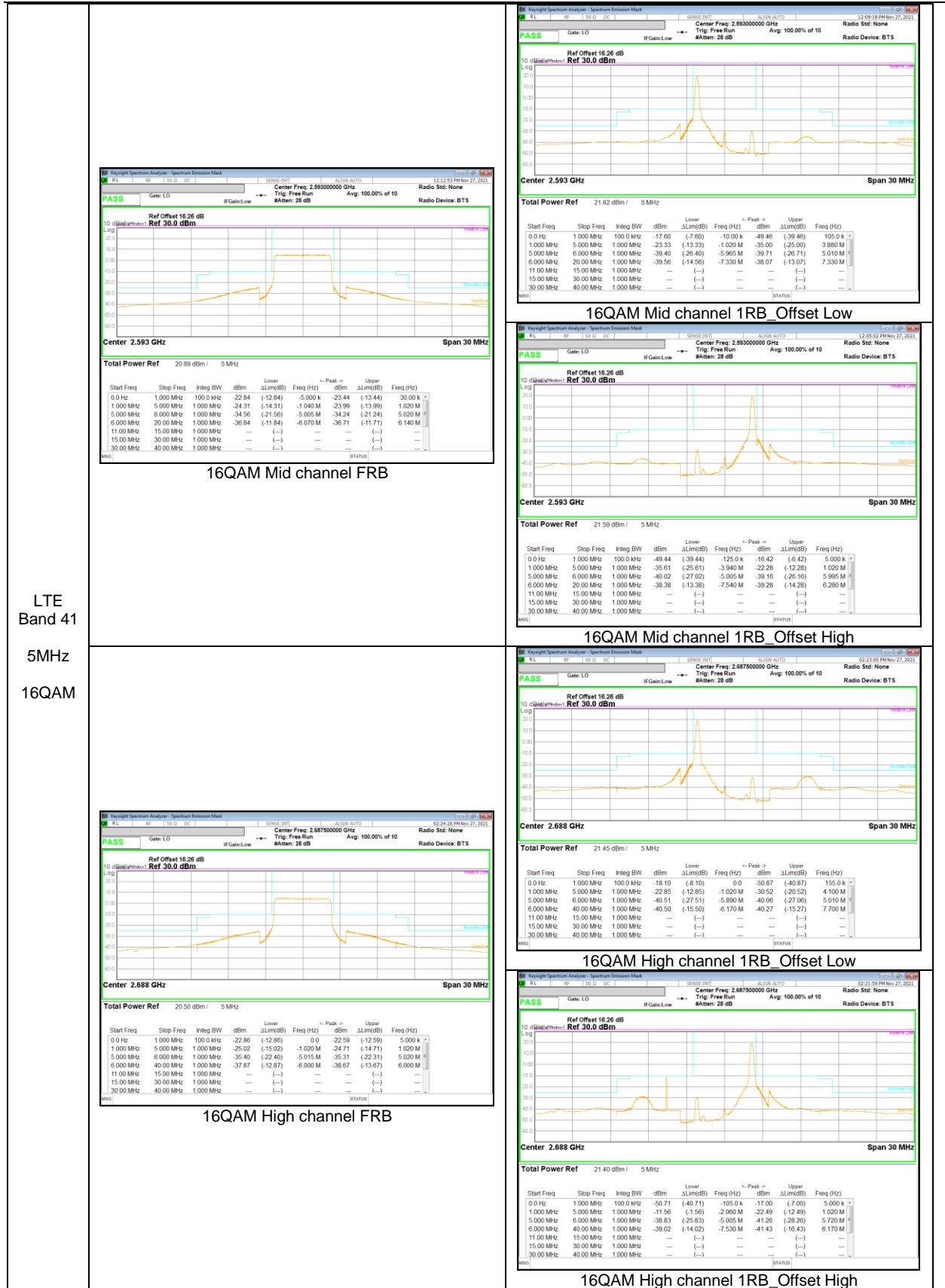
LTE
 Band 41
 10MHz
 QPSK











9.3. OUT OF BAND EMISSIONS

RULE PART(S)

FCC: §2.1051, §22.901, §22.917, §27.53 and 90.691

LIMITS

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.

Part 27.53:

(c)(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log (P)$ dB.

(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.

(h) The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10} (P)$ dB.

(m) (4) 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.

Part 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 $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ 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.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ 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 37.5 kHz. (NOTE : Use 100kHz reference bandwidth)

(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section.

TEST PROCEDURE

Per KDB 971168 D01 Power Meas License Digital Systems v03r01

The RF output of the transmitter was connected to a spectrum analyzer through a calibrated coaxial cable. Sufficient scans were taken to show the out-of-band Emissions, if any, up to 10th harmonic. Multiple sweeps were recorded in maximum hold mode using a peak detector to ensure that the worst-case emissions were caught.

- a) Set the RBW = 100KHz for emission below 1GHz and 1MHz for emissions above 1GHz (Tests were performed 1MHz [Worst case], to sweep 1 time for all frequency range)
- b) Set VBW $\geq 3 \times$ RBW;
- c) Set span ≥ 1.5 times the OBW;
- d) Sweep time = auto couple;
- e) Detector = rms;
- f) Ensure that the number of measurement points = Max (40001);
- g) Trace mode = average(WCDMA, LTE FDD, NR), Maxhold(GSM, LTE TDD);

NOTE

5G NR: All Waveforms (CP-OFDM vs DFT-s OFDM) and modulations ($\pi/2$ BPSK, QPSK, 16QAM, 64QAM, 256QAM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

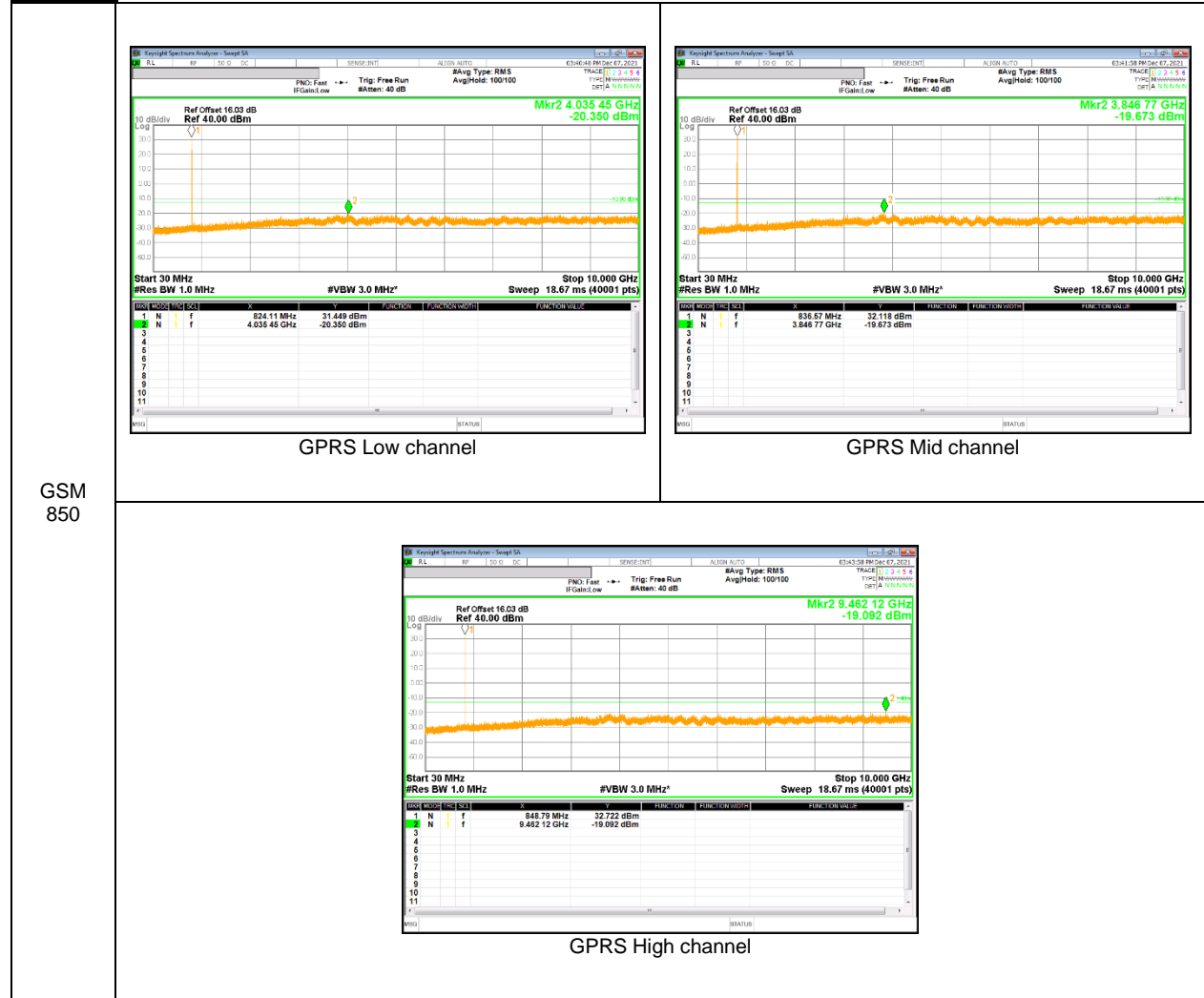
RESULTS

See the following pages.

NOTE : Please refer to section 5.4 for bandwidth and RB setting about LTE,NR bands.

9.3.1. OUT OF BAND EMISSIONS RESULT

GSM 850



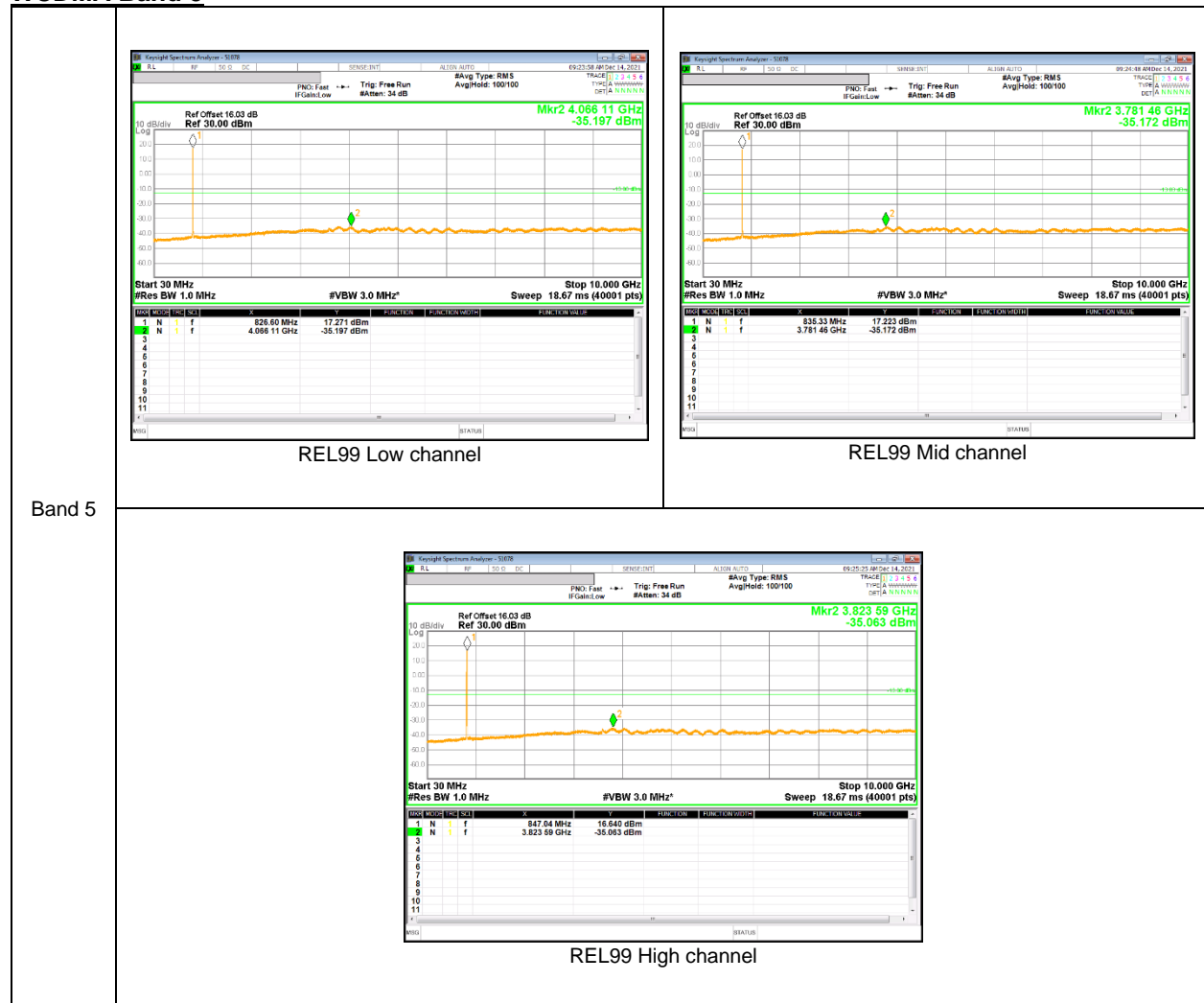
GSM
850

GSM 1900



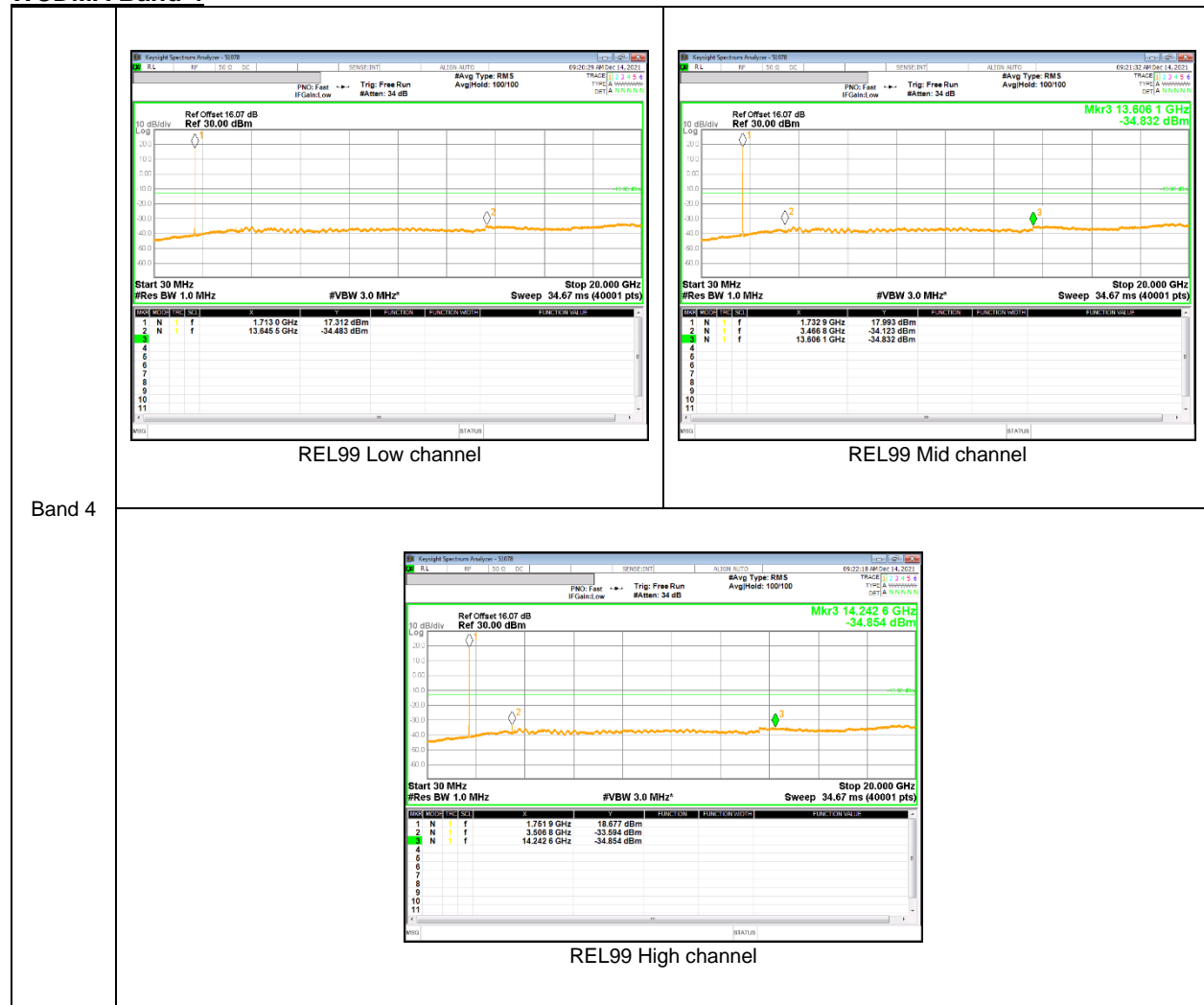
GSM
1900

WCDMA Band 5



Band 5

WCDMA Band 4



WCDMA Band 2

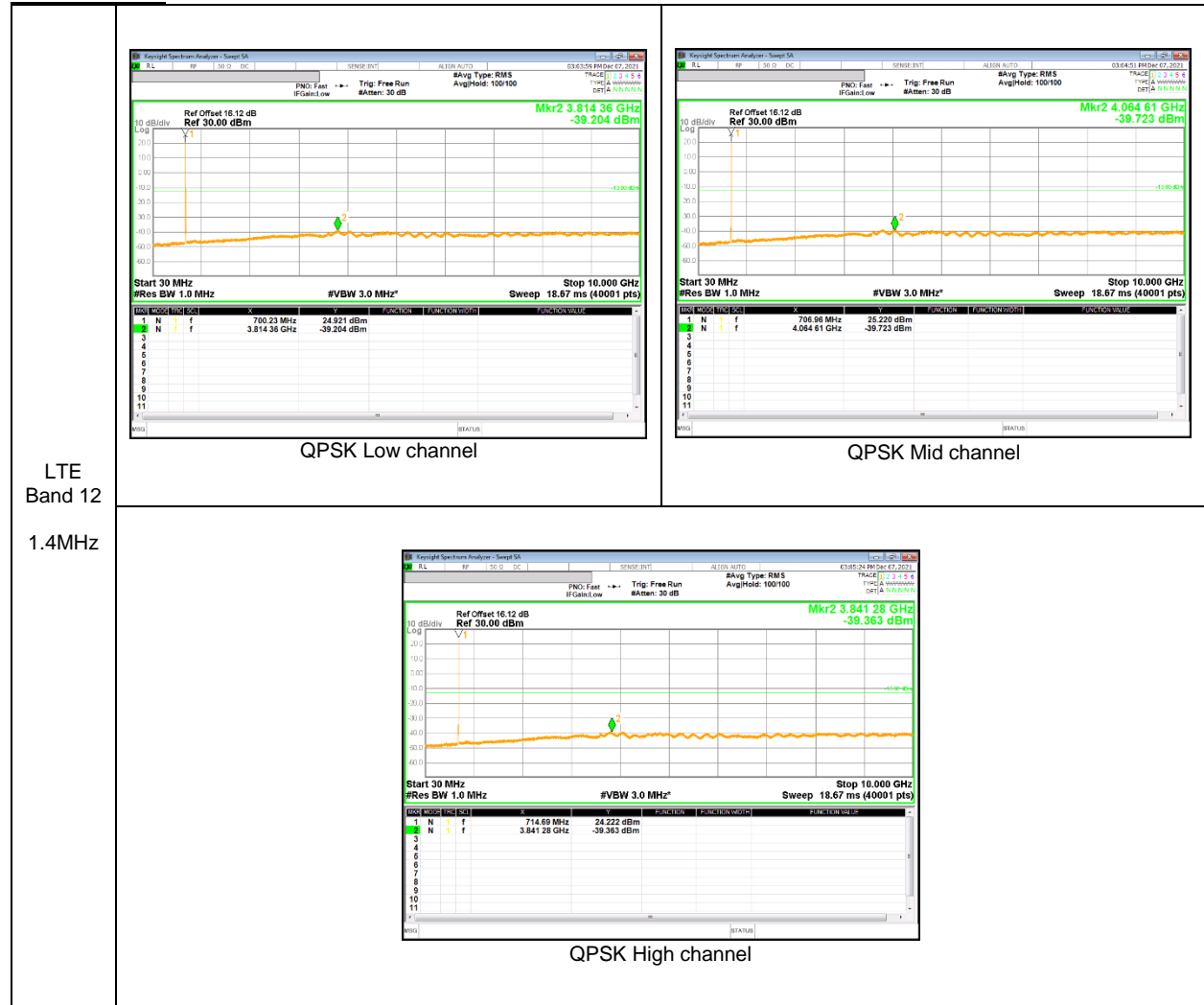


Band 2

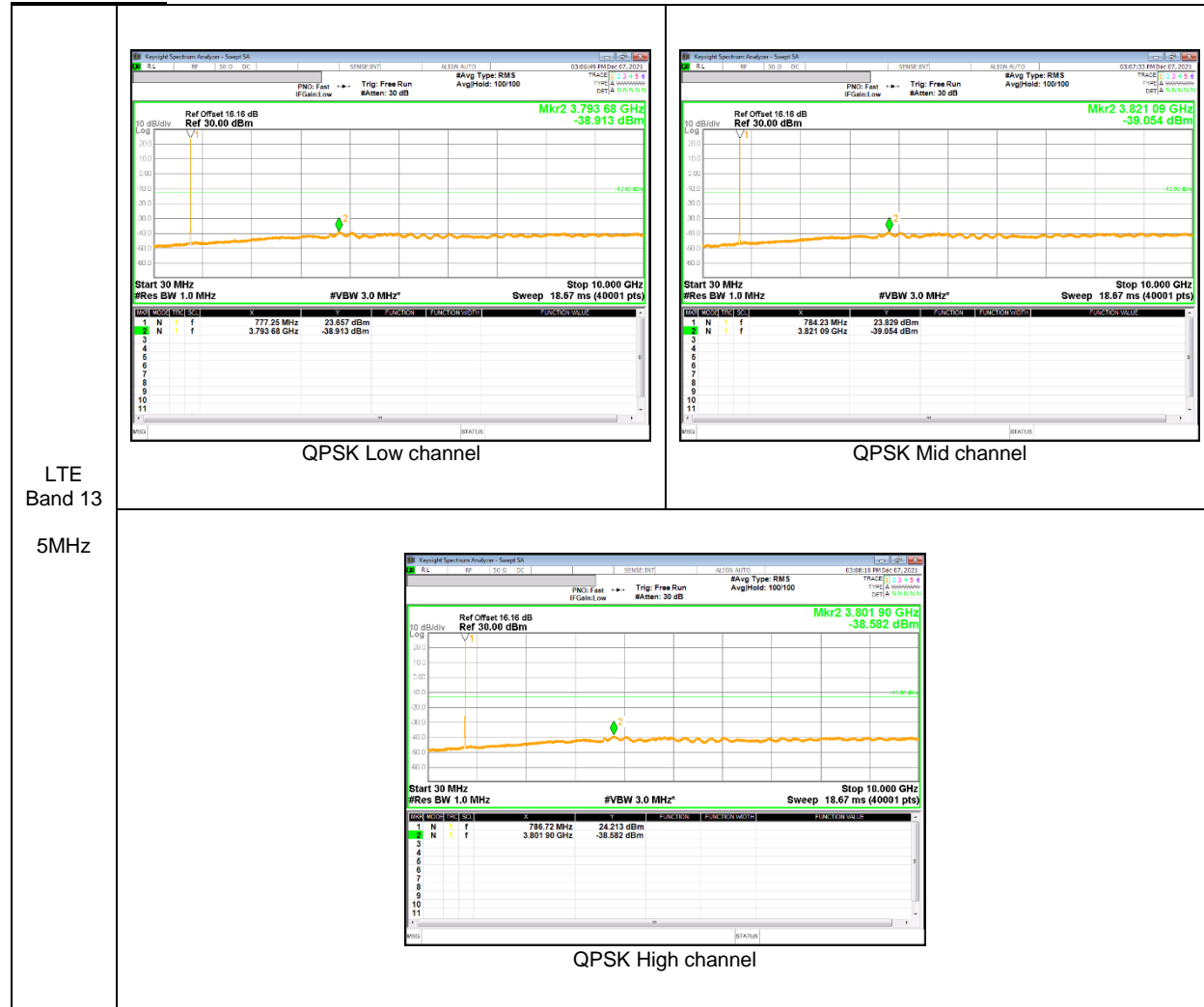
LTE Band 2



LTE Band 12



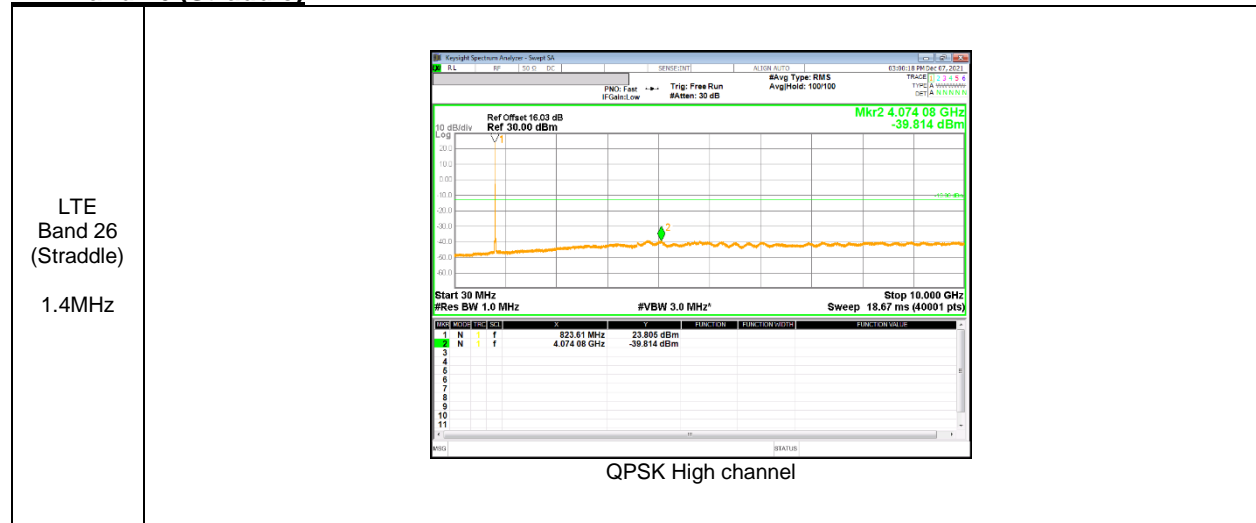
LTE Band 13



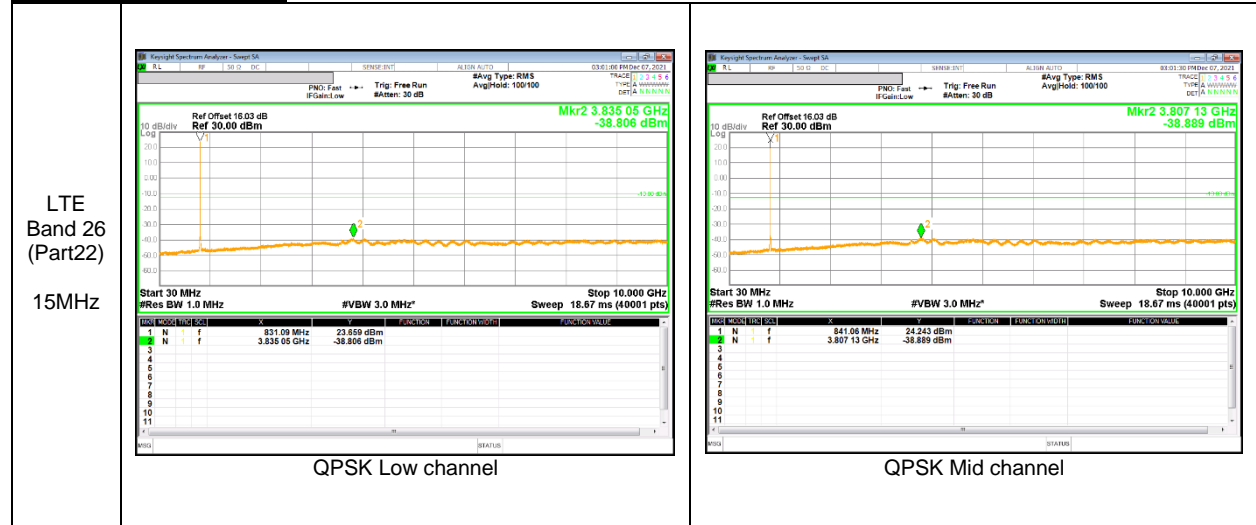
LTE Band 26(Part 90)



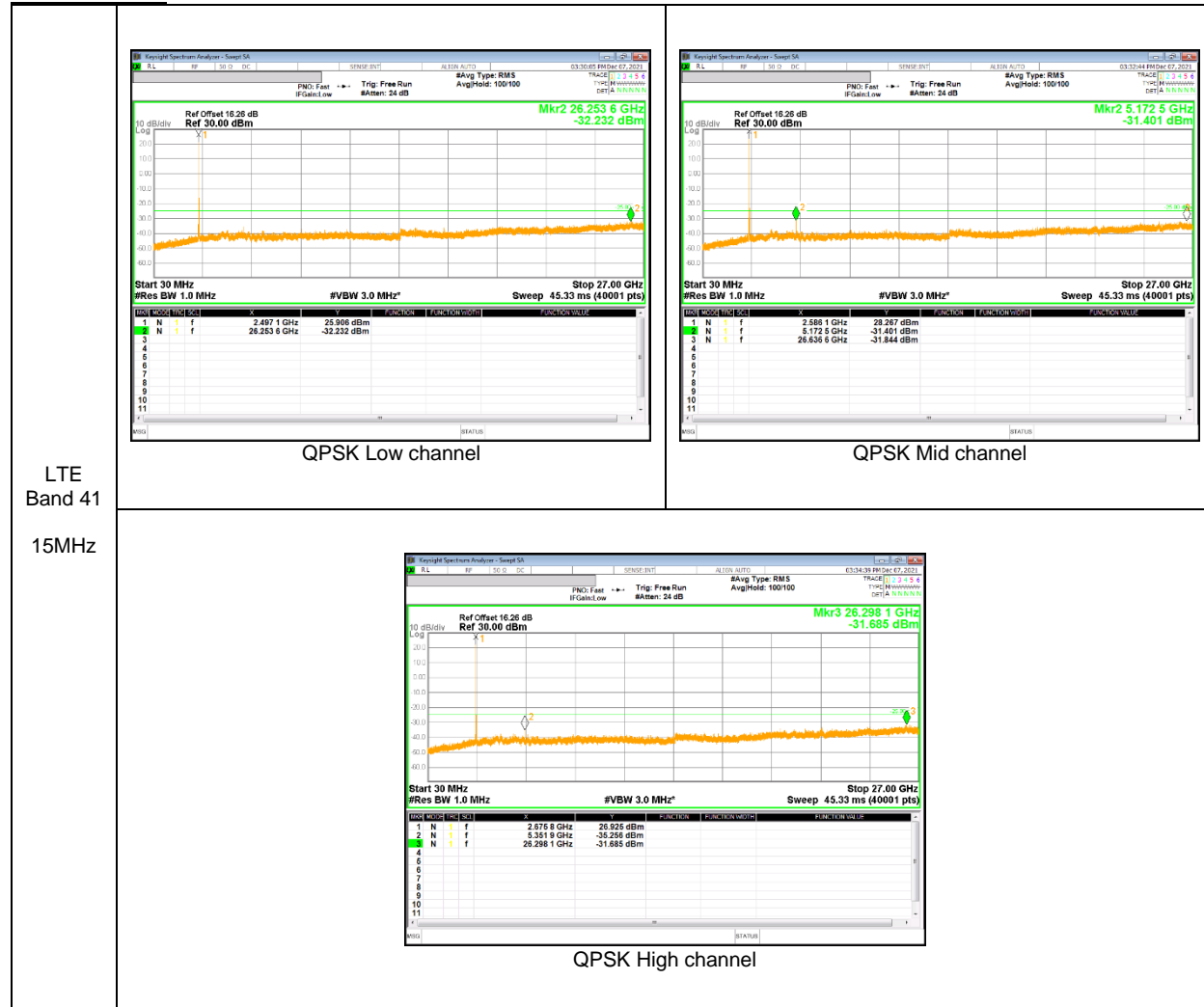
LTE Band 26 (Straddle)



LTE Band 26 (Part 22)



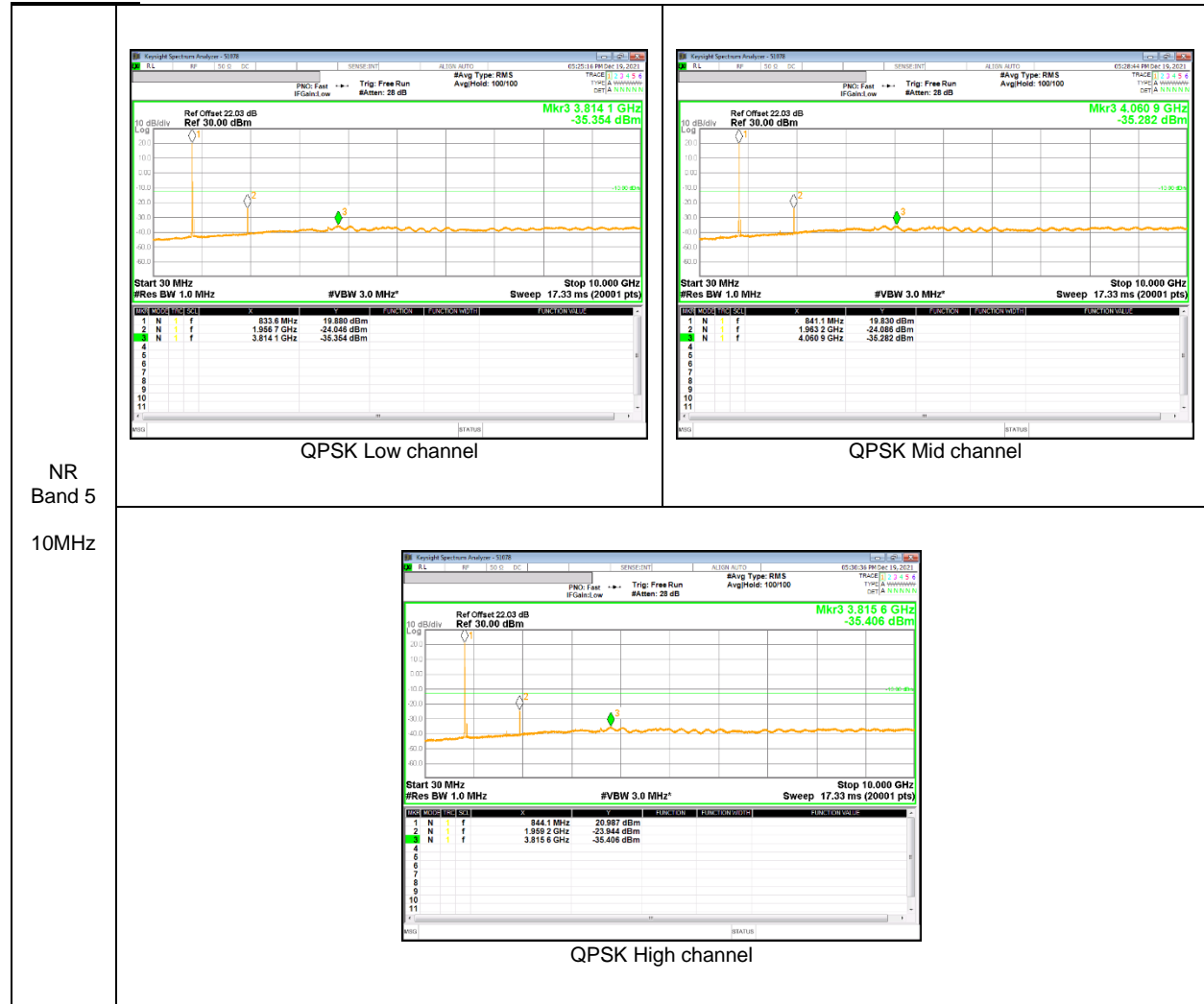
LTE Band 41



LTE Band 66



NR Band 5



NR Band 66



9.4. FREQUENCY STABILITY

RULE PART(S)

FCC: §2.1055, §22.355, §24.235, §27.54 and §90.213

LIMITS

§22.355 - The carrier frequency shall not depart from the reference frequency in excess of ± 2.5 ppm for mobile stations.

§24.235 - The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

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

§90.213 - The carrier frequency shall not depart from the reference frequency in excess of ± 2.5 ppm for mobile stations.

TEST PROCEDURE

Per KDB 971168 D01 Power Meas License Digital Systems v03r01

RESULTS

See the following pages.

NOTE : Test were performed each lowest or highest frequency on the modulation condition of more wide bandwidth. (Please refer to section 9.1.1 OBW results)

9.4.1. FREQUENCY STABILITY RESULTS

GSM 850, Channel 128/251, Frequency 824.2/848.8 MHz

Reference Frequency : GSM850 Low Channel 824.2 MHz / High Channel 848.8 MHz @ 20°C							
Limit: +- 2.5 ppm =		Low Channel	2060.500	Hz	High Channel	2122.000	Hz
Power Supply [Vdc]	Environment Temperature [°C]	Frequency Deviation Measured with Time Elapse				Limit [ppm]	
		Low Channel		High Channel			
		[MHz]	Delta [ppm]	[MHz]	Delta [ppm]		
4.20	50	824.20001050	-0.005	848.80001261	-0.002	2.5	
4.20	40	824.20001160	-0.007	848.80001284	-0.002	2.5	
4.20	30	824.20000639	0.000	848.80001137	-0.001	2.5	
4.20	20	824.20000605	0.000	848.80001080	0.000	2.5	
4.20	10	824.20000660	-0.001	848.80001273	-0.002	2.5	
4.20	0	824.20000664	-0.001	848.80001143	-0.001	2.5	
4.20	-10	824.20000866	-0.003	848.80001007	0.001	2.5	
4.20	-20	824.20000895	-0.004	848.80001180	-0.001	2.5	
4.20	-30	824.20000913	-0.004	848.80001258	-0.002	2.5	

Reference Frequency : GSM850 Low Channel 824.2 MHz / High Channel 848.8 MHz @ 20°C							
Limit: +- 2.5 ppm =		Low Channel	2060.500	Hz	High Channel	2122.000	Hz
Power Supply [Vdc]	Environment Temperature [°C]	Frequency Deviation Measured with Time Elapse				Limit [ppm]	
		Low Channel		High Channel			
		[MHz]	Delta [ppm]	[MHz]	Delta [ppm]		
4.20	20	824.20000605	0	848.80001080	0	2.5	
4.40	20	824.20001757	-0.014	848.80001421	-0.004	2.5	
3.80	20	824.20001247	-0.008	848.80001580	-0.006	2.5	

GSM 1900, Channel 512/810, Frequency 1850.0/1910.0 MHz (Lowest Frequency:GPRS / Highest Frequency: EGPRS)

Limit		1850	1910	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ End of OBW	F high @ End of OBW		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	1850.0740	1909.9230		
Extreme (50C)		1850.0741	1909.9230	22.8	0.012
Extreme (40C)		1850.0741	1909.9230	23.5	0.013
Extreme (30C)		1850.0741	1909.9230	24.2	0.013
Extreme (10C)		1850.0741	1909.9230	15.8	0.008
Extreme (0C)		1850.0741	1909.9230	22.3	0.012
Extreme (-10C)		1850.0741	1909.9230	29.2	0.016
Extreme (-20C)		1850.0741	1909.9230	25.9	0.014
Extreme (-30C)		1850.0741	1909.9230	24.9	0.013
20C		15%	1850.0741	1909.9230	34.1
	-15%	1850.0741	1909.9230	31.8	0.017
	End Point	1850.0741	1909.9230	15.0	0.008

WCDMA Band 5

Reference Frequency : WCDMA Band 5 Low Channel 826.4 MHz / High Channel 846.6 MHz @ 20°C							
Limit: +/- 2.5 ppm =		Low Channel	2066.000	Hz	High Channel	2116.500	Hz
Power Supply [Vdc]	Environment Temperature [°C]	Frequency Deviation Measured with Time Elapse				Limit [ppm]	
		Low Channel		High Channel			
		[MHz]	Delta [ppm]	[MHz]	Delta [ppm]		
4.20	50	826.40000413	0.000	846.60000468	-0.001	2.5	
4.20	40	826.40000428	0.000	846.60000471	-0.001	2.5	
4.20	30	826.40000495	-0.001	846.60000458	0.000	2.5	
4.20	20	826.40000403	0.000	846.60000421	0.000	2.5	
4.20	10	826.40000418	0.000	846.60000416	0.000	2.5	
4.20	0	826.40000436	0.000	846.60000492	-0.001	2.5	
4.20	-10	826.40000425	0.000	846.60000463	0.000	2.5	
4.20	-20	826.40000413	0.000	846.60000406	0.000	2.5	
4.20	-30	826.40000408	0.000	846.60000385	0.000	2.5	

Reference Frequency : WCDMA Band 5 Low Channel 826.4 MHz / High Channel 846.6 MHz @ 20°C							
Limit: +/- 2.5 ppm =		Low Channel	2066.000	Hz	High Channel	2116.500	Hz
Power Supply [Vdc]	Environment Temperature [°C]	Frequency Deviation Measured with Time Elapse				Limit [ppm]	
		Low Channel		High Channel			
		[MHz]	Delta [ppm]	[MHz]	Delta [ppm]		
4.20	20	826.40000403	0	846.60000421	0	2.5	
4.40	20	826.40000297	0.001	846.60000288	0.002	2.5	
3.80	20	826.40000348	0.001	846.60000316	0.001	2.5	

WCDMA Band 4 (Lowest Frequency: Rel99 / Highest Frequency: HSDPA)

Limit		1710	1755	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ End of OBW	F high @ End of OBW		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	1710.3102	1754.6869		
Extreme (50C)		1710.3102	1754.6869	5.2	0.003
Extreme (40C)		1710.3102	1754.6869	6.4	0.004
Extreme (30C)		1710.3102	1754.6869	6.8	0.004
Extreme (10C)		1710.3102	1754.6869	6.3	0.004
Extreme (0C)		1710.3102	1754.6869	6.5	0.004
Extreme (-10C)		1710.3102	1754.6869	5.7	0.003
Extreme (-20C)		1710.3102	1754.6869	6.1	0.004
Extreme (-30C)		1710.3102	1754.6869	5.8	0.003
20C	15%	1710.3102	1754.6869	6.3	0.004
	-15%	1710.3102	1754.6869	6.1	0.004
	End Point	1710.3102	1754.6869	5.8	0.003

WCDMA Band 2 (Lowest Frequency: Rel99 / Highest Frequency: Rel99)

Limit		1850	1910	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ End of OBW	F high @ End of OBW		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	1850.3146	1909.6855		
Extreme (50C)		1850.3146	1909.6855	7.5	0.004
Extreme (40C)		1850.3146	1909.6855	6.9	0.004
Extreme (30C)		1850.3146	1909.6855	5.8	0.003
Extreme (10C)		1850.3146	1909.6855	6.2	0.003
Extreme (0C)		1850.3146	1909.6855	5.9	0.003
Extreme (-10C)		1850.3146	1909.6855	5.9	0.003
Extreme (-20C)		1850.3146	1909.6855	5.7	0.003
Extreme (-30C)		1850.3146	1909.6855	6.1	0.003
20C		15%	1850.3146	1909.6855	6.7
	-15%	1850.3146	1909.6855	8.7	0.005
	End Point	1850.3146	1909.6855	8.2	0.004

LTE Band 2 (Lowest Frequency: 16QAM / Highest Frequency: QPSK)

Limit		1850	1910	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ End of OBW	F high @ End of OBW		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	1850.1543	1909.8444		
Extreme (50C)		1850.1543	1909.8444	8.4	0.004
Extreme (40C)		1850.1543	1909.8444	8.9	0.005
Extreme (30C)		1850.1543	1909.8444	6.3	0.003
Extreme (10C)		1850.1543	1909.8444	6.1	0.003
Extreme (0C)		1850.1543	1909.8444	7.6	0.004
Extreme (-10C)		1850.1543	1909.8444	7.7	0.004
Extreme (-20C)		1850.1543	1909.8444	7.7	0.004
Extreme (-30C)		1850.1543	1909.8444	8.7	0.005
20C		15%	1850.1543	1909.8444	8.3
	-15%	1850.1543	1909.8444	7.6	0.004
	End Point	1850.1543	1909.8444	7.6	0.004

LTE Band 12 (Lowest Frequency: 16QAM / Highest Frequency: 16QAM)

Limit		699	716	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ End of OBW	F high @ End of OBW		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	699.1555	715.8435	5.3	0.007
Extreme (50C)		699.1555	715.8435		
Extreme (40C)		699.1555	715.8435		
Extreme (30C)		699.1555	715.8435		
Extreme (10C)		699.1555	715.8435		
Extreme (0C)		699.1555	715.8435		
Extreme (-10C)		699.1555	715.8435		
Extreme (-20C)		699.1555	715.8435		
Extreme (-30C)		699.1555	715.8435		
20C		15%	699.1555		
	-15%	699.1555	715.8435	4.6	0.007
	End Point	699.1555	715.8435	4.7	0.007

LTE Band 13 (Lowest Frequency: 16QAM / Highest Frequency: QPSK)

Limit		777	787	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ End of OBW	F high @ End of OBW		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	777.2471	786.7494	5.7	0.007
Extreme (50C)		777.2471	786.7494		
Extreme (40C)		777.2471	786.7494		
Extreme (30C)		777.2471	786.7494		
Extreme (10C)		777.2471	786.7494		
Extreme (0C)		777.2471	786.7494		
Extreme (-10C)		777.2471	786.7494		
Extreme (-20C)		777.2471	786.7494		
Extreme (-30C)		777.2471	786.7494		
20C		15%	777.2471		
	-15%	777.2471	786.7494	4.6	0.006
	End Point	777.2471	786.7494	4.5	0.006

LTE Band 26

Reference Frequency : LTE Band 26 Low Channel 814.7 MHz / High Channel 848.3 MHz @ 20°C							
Limit: +- 2.5 ppm =		Low Channel	2036.750	Hz	High Channel	2120.750	Hz
Power Supply [Vdc]	Environment Temperature [°C]	Frequency Deviation Measured with Time Elapse					Limit [ppm]
		Low Channel		High Channel			
		[MHz]	Delta [ppm]	[MHz]	Delta [ppm]		
3.85	50	814.70000508	-0.001	848.30000503	-0.001	2.5	
3.85	40	814.70000513	-0.001	848.30000426	0.000	2.5	
3.85	30	814.70000482	0.000	848.30000413	0.000	2.5	
3.85	20	814.70000461	0.000	848.30000398	0.000	2.5	
3.85	10	814.70000463	0.000	848.30000462	-0.001	2.5	
3.85	0	814.70000404	0.001	848.30000443	-0.001	2.5	
3.85	-10	814.70000329	0.002	848.30000373	0.000	2.5	
3.85	-20	814.70000443	0.000	848.30000457	-0.001	2.5	
3.85	-30	814.70000438	0.000	848.30000523	-0.001	2.5	

Reference Frequency : LTE Band 26 Low Channel 814.7 MHz / High Channel 848.3 MHz @ 20°C							
Limit: +- 2.5 ppm =		Low Channel	2036.750	Hz	High Channel	2120.750	Hz
Power Supply [Vdc]	Environment Temperature [°C]	Frequency Deviation Measured with Time Elapse					Limit [ppm]
		Low Channel		High Channel			
		[MHz]	Delta [ppm]	[MHz]	Delta [ppm]		
4.20	20	814.70000461	0	848.30000398	0	2.5	
4.40	20	814.70000614	-0.002	848.30000617	-0.003	2.5	
3.80	20	814.70000593	-0.002	848.30000608	-0.002	2.5	

LTE Band 41 (Lowest Frequency:16QAM / Highest Frequency: QPSK)

Limit		2496	2690	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ End of OBW	F high @ End of OBW		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	2496.2529	2689.7425		
Extreme (50C)		2496.2529	2689.7425	12.1	0.005
Extreme (40C)		2496.2529	2689.7425	13.2	0.005
Extreme (30C)		2496.2529	2689.7425	12.6	0.005
Extreme (10C)		2496.2529	2689.7425	12.1	0.005
Extreme (0C)		2496.2529	2689.7425	13.0	0.005
Extreme (-10C)		2496.2529	2689.7425	12.3	0.005
Extreme (-20C)		2496.2529	2689.7425	12.4	0.005
Extreme (-30C)		2496.2529	2689.7425	12.1	0.005
20C	15%	2496.2529	2689.7425	9.4	0.004
	-15%	2496.2529	2689.7425	10.5	0.004
	End Point	2496.2529	2689.7425	10.6	0.004

LTE Band 66 (Lowest Frequency: QPSK / Highest Frequency: QPSK)

Limit		1710	1780	Delta (Hz)	Frequency Stability (ppm)		
Condition		F low @ End of OBW (MHz)	F high @ End of OBW (MHz)				
Temperature	Voltage	(MHz)	(MHz)				
Normal (20C)	Normal	1710.1554	1779.8457	7.3	0.004		
Extreme (50C)		1710.1554	1779.8457			6.9	0.004
Extreme (40C)		1710.1554	1779.8457			7.1	0.004
Extreme (30C)		1710.1554	1779.8457			6.8	0.004
Extreme (10C)		1710.1554	1779.8457			6.2	0.004
Extreme (0C)		1710.1554	1779.8457			6.5	0.004
Extreme (-10C)		1710.1554	1779.8457			7.6	0.004
Extreme (-20C)		1710.1554	1779.8457				
Extreme (-30C)		1710.1554	1779.8457				
20C		15%	1710.1554			1779.8457	7.3
	-15%	1710.1554	1779.8457	6.2	0.004		
	End Point	1710.1554	1779.8457	7.8	0.004		

NR Band 5

Reference Frequency : NR Band 5 Low Channel 824.7 MHz / High Channel 848.3 MHz @ 20°C							
Limit: +- 2.5 ppm =		Low Channel	2061.750	Hz	High Channel	2120.750	Hz
Power Supply [Vdc]	Environment Temperature [°C]	Frequency Deviation Measured with Time Elapse				Limit [ppm]	
		Low Channel		High Channel			
		[MHz]	Delta [ppm]	[MHz]	Delta [ppm]		
3.85	50	824.70000565	-0.001	848.30000518	0.000	2.5	
3.85	40	824.70000514	0.000	848.30000504	0.000	2.5	
3.85	30	824.70000482	0.000	848.30000496	0.000	2.5	
3.85	20	824.70000506	0.000	848.30000513	0.000	2.5	
3.85	10	824.70000604	-0.001	848.30000608	-0.001	2.5	
3.85	0	824.70000592	-0.001	848.30000506	0.000	2.5	
3.85	-10	824.70000448	0.001	848.30000405	0.001	2.5	
3.85	-20	824.70000518	0.000	848.30000504	0.000	2.5	
3.85	-30	824.70000596	-0.001	848.30000608	-0.001	2.5	

Reference Frequency : NR Band 5 Low Channel 824.7 MHz / High Channel 848.3 MHz @ 20°C							
Limit: +- 2.5 ppm =		Low Channel	2061.750	Hz	High Channel	2120.750	Hz
Power Supply [Vdc]	Environment Temperature [°C]	Frequency Deviation Measured with Time Elapse				Limit [ppm]	
		Low Channel		High Channel			
		[MHz]	Delta [ppm]	[MHz]	Delta [ppm]		
4.20	20	824.70000506	0	848.30000513	0	2.5	
4.40	20	824.70000624	-0.001	848.30000640	-0.001	2.5	
3.80	20	824.70000629	-0.001	848.30000538	0.000	2.5	