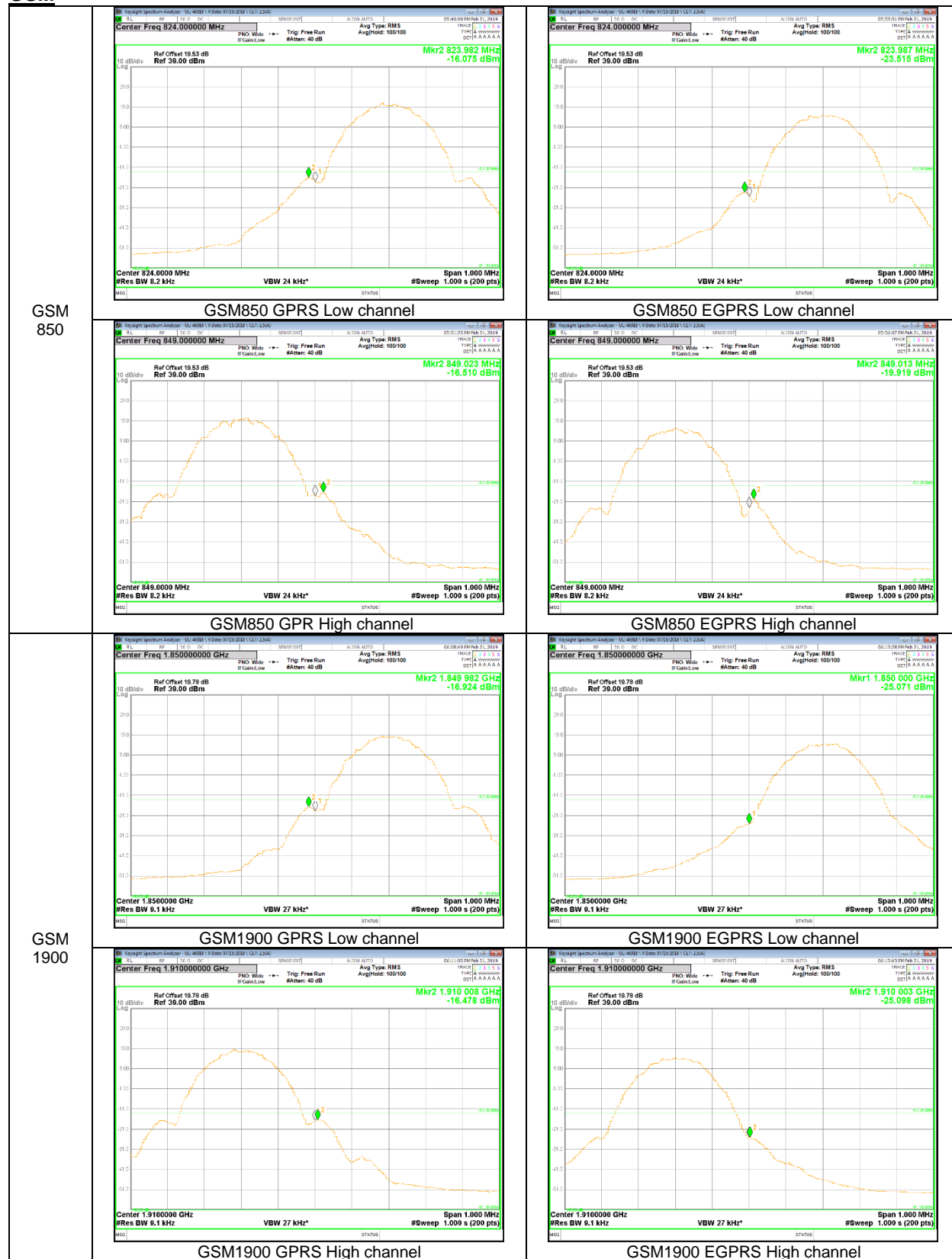


9.2.1. BAND EDGE RESULT

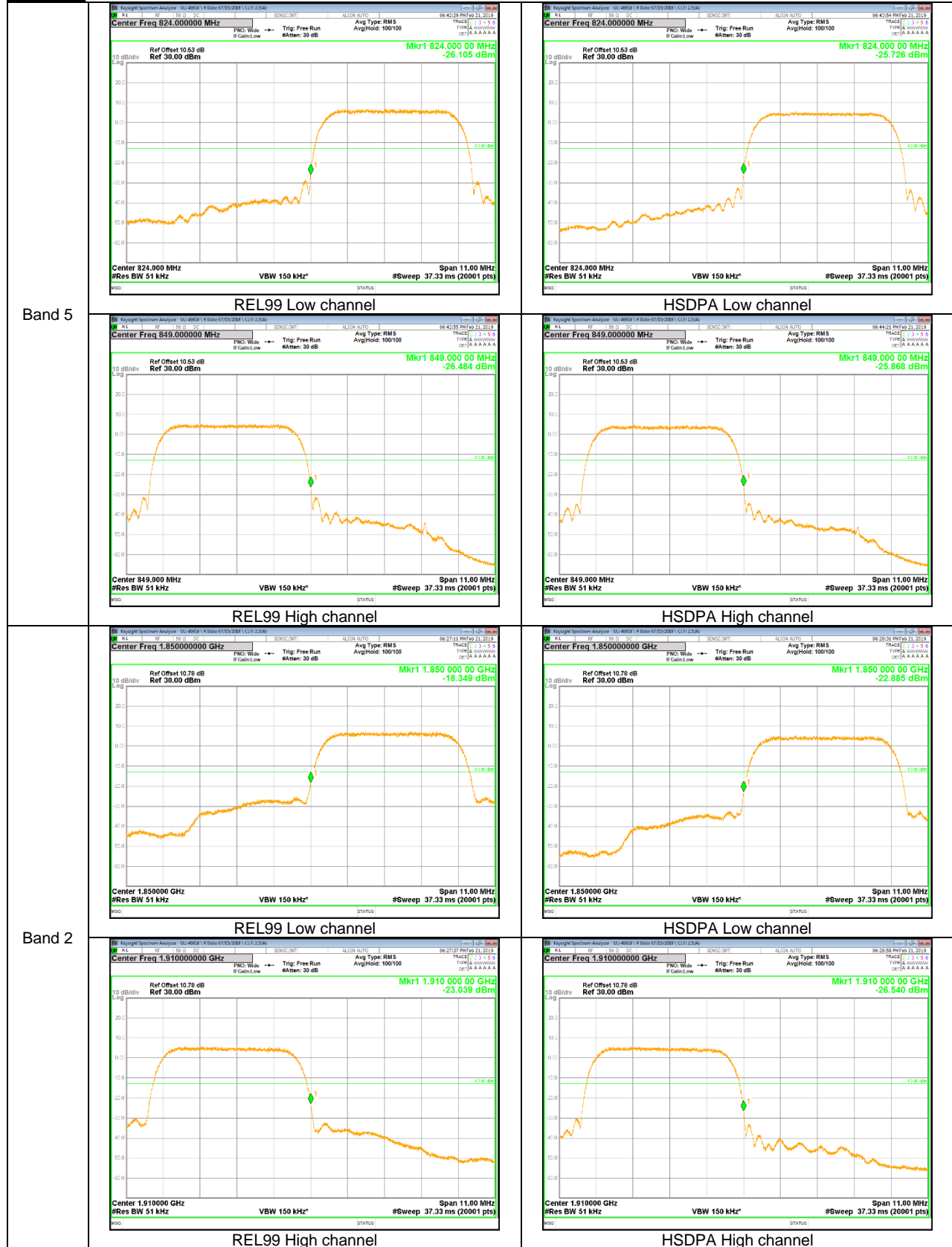
GSM



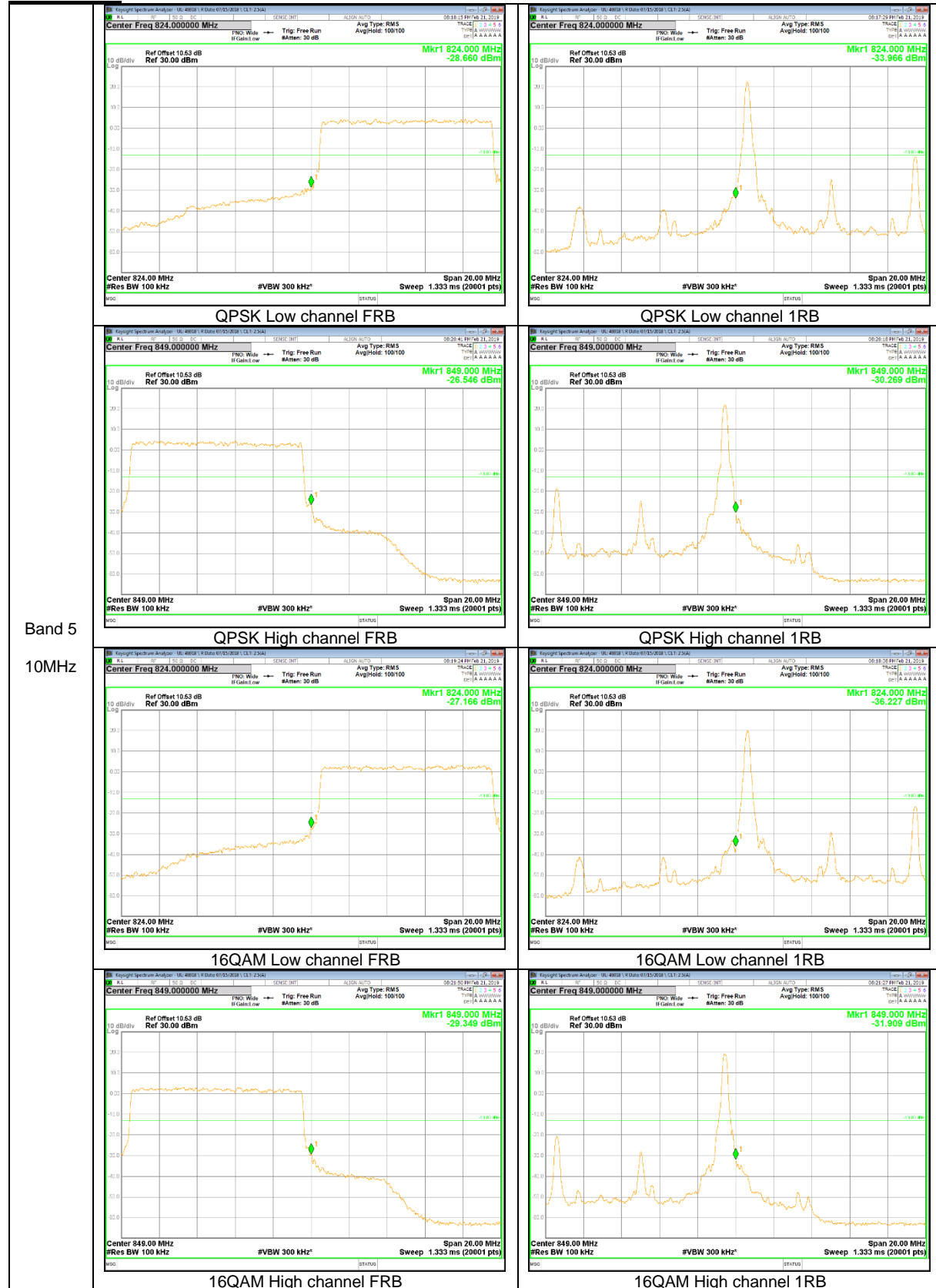
GSM
850

GSM
1900

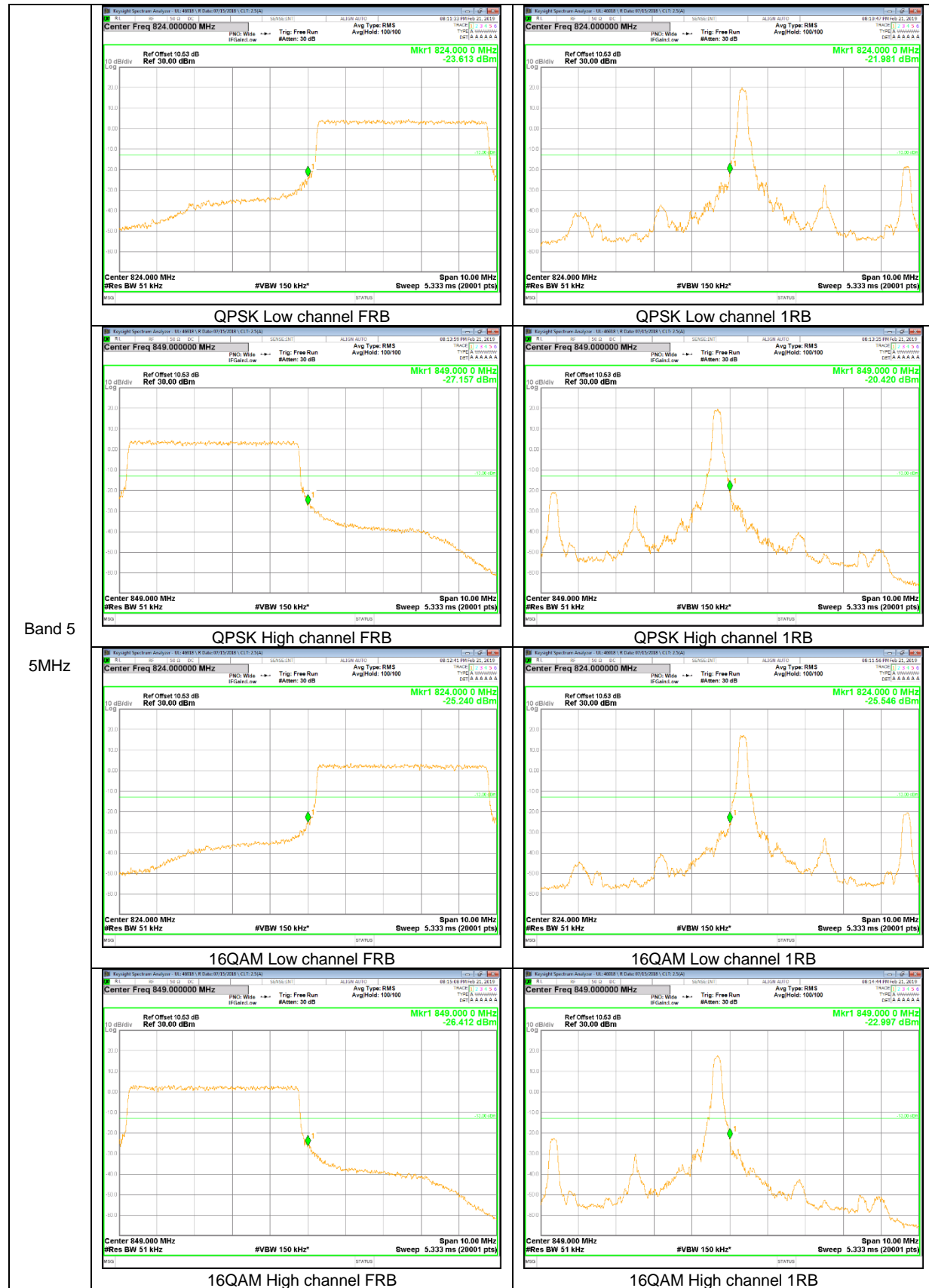
WCDMA

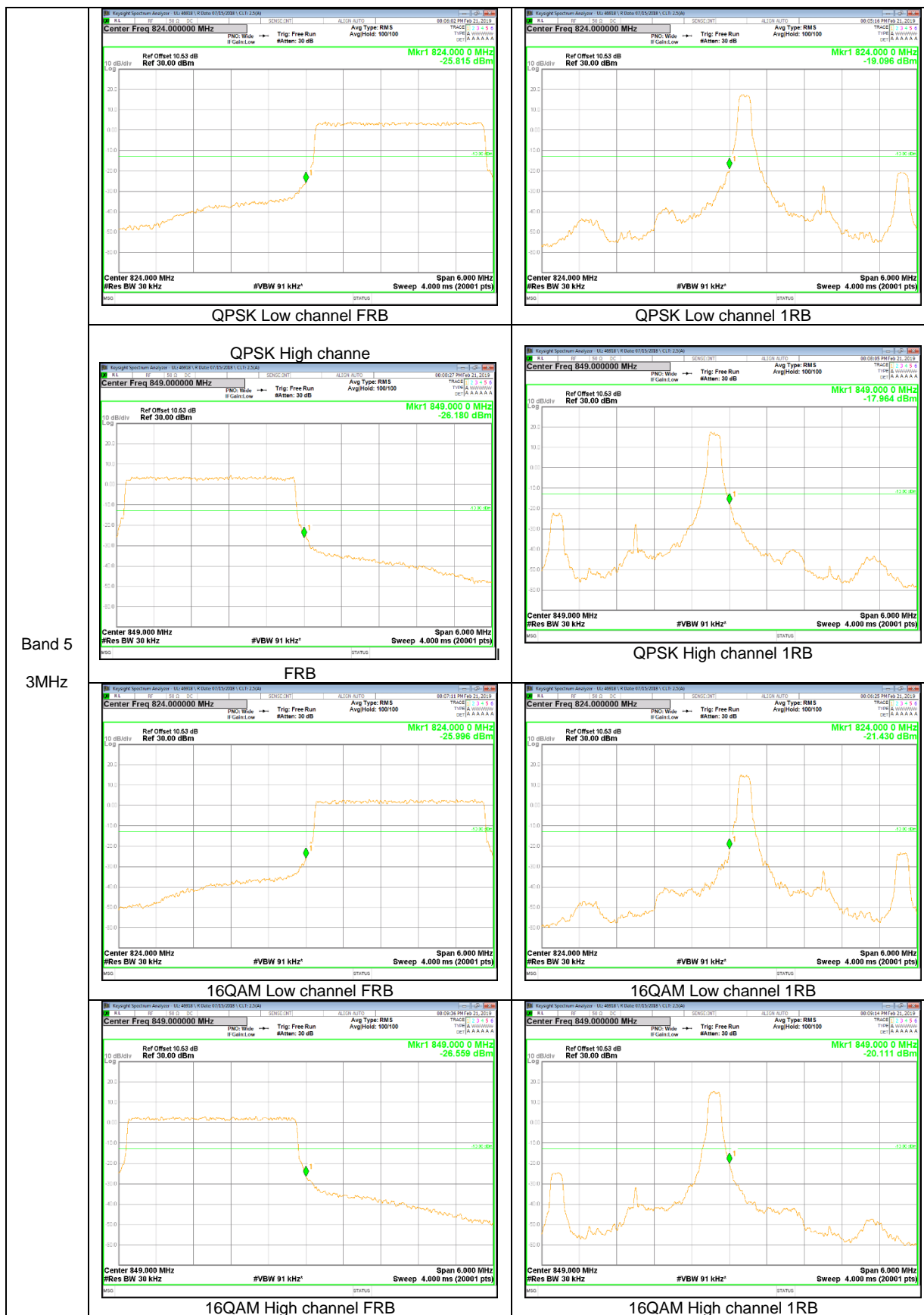


LTE Band 5

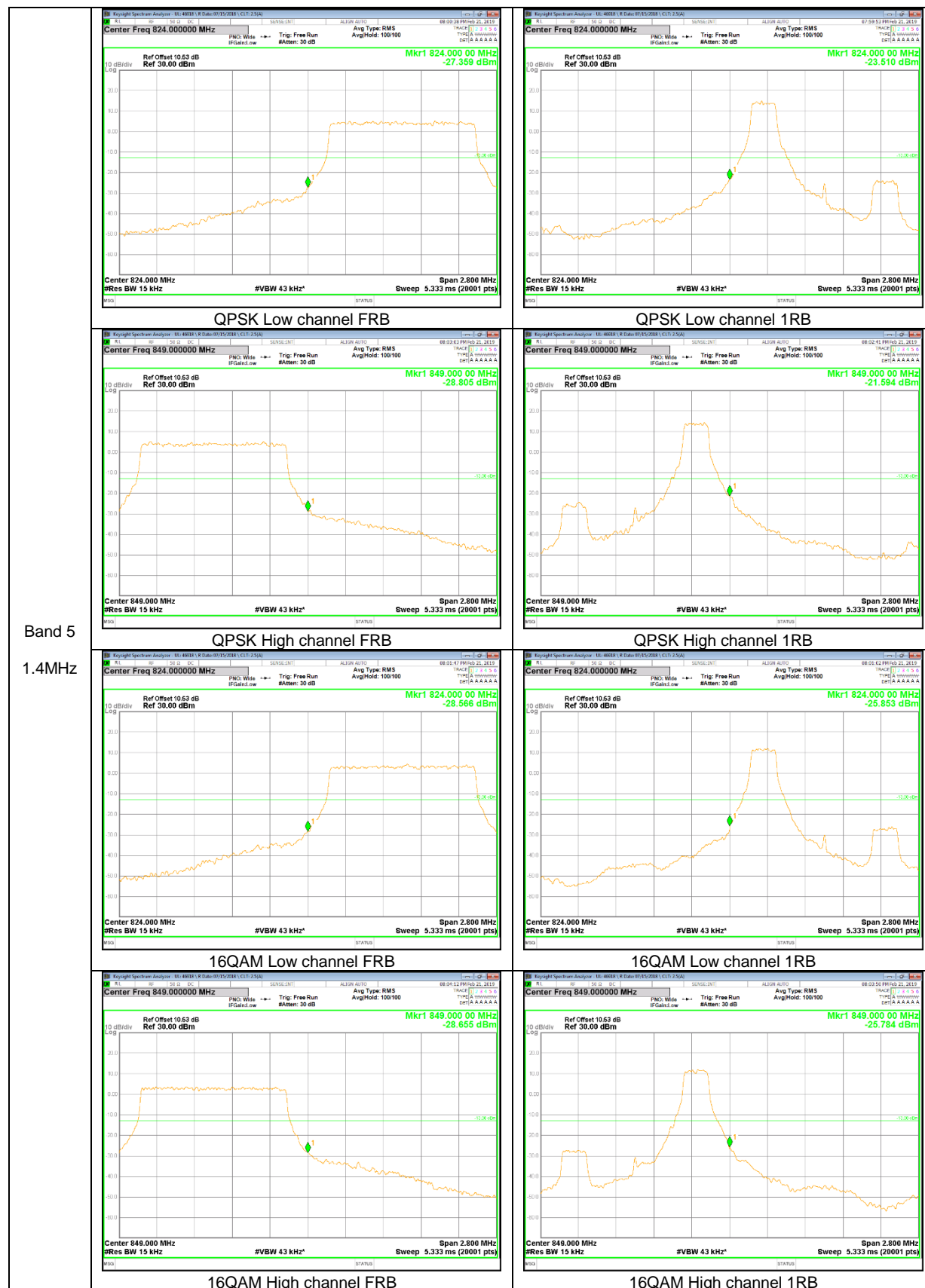


Band 5
10MHz





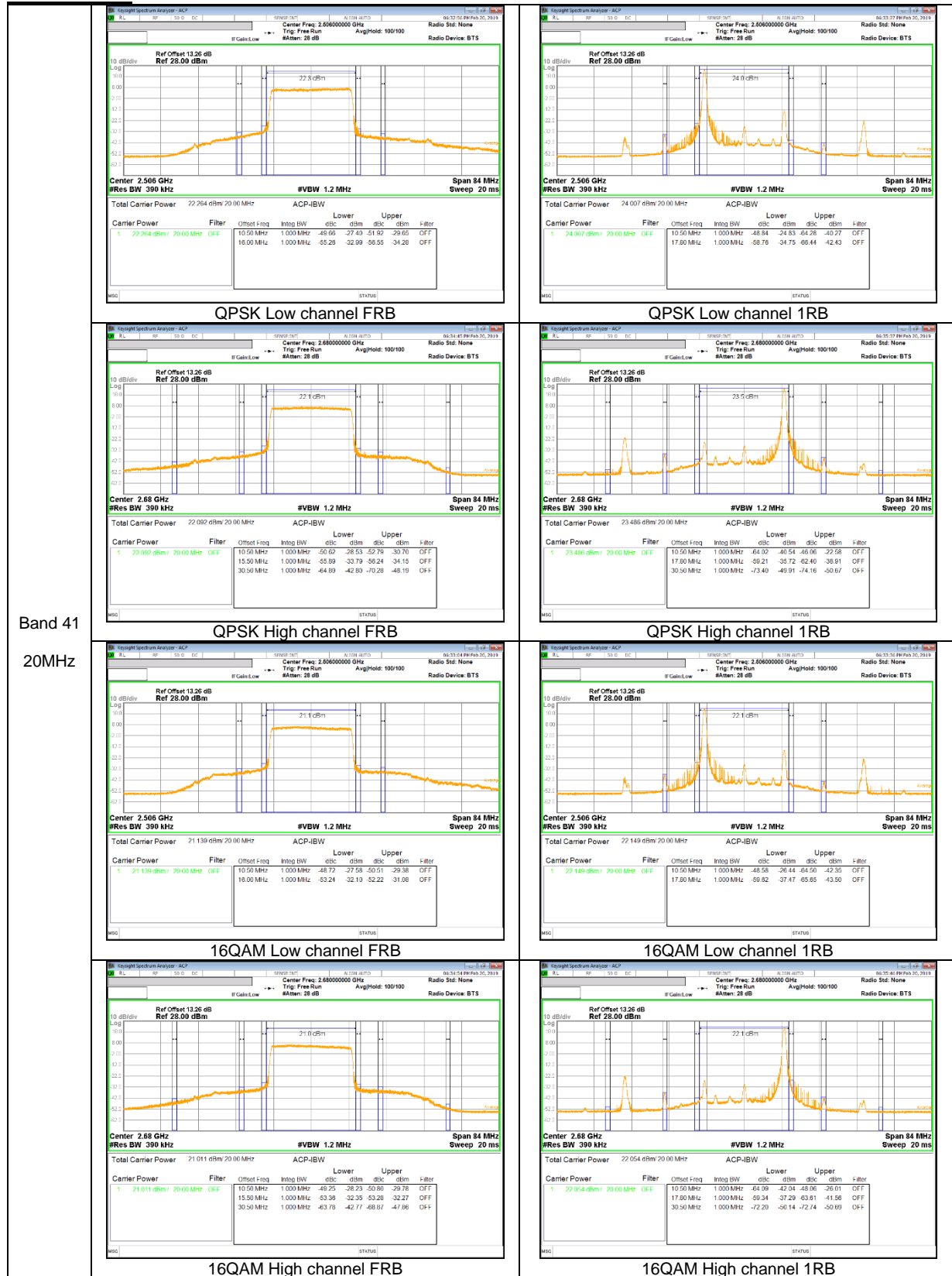
Band 5
 3MHz



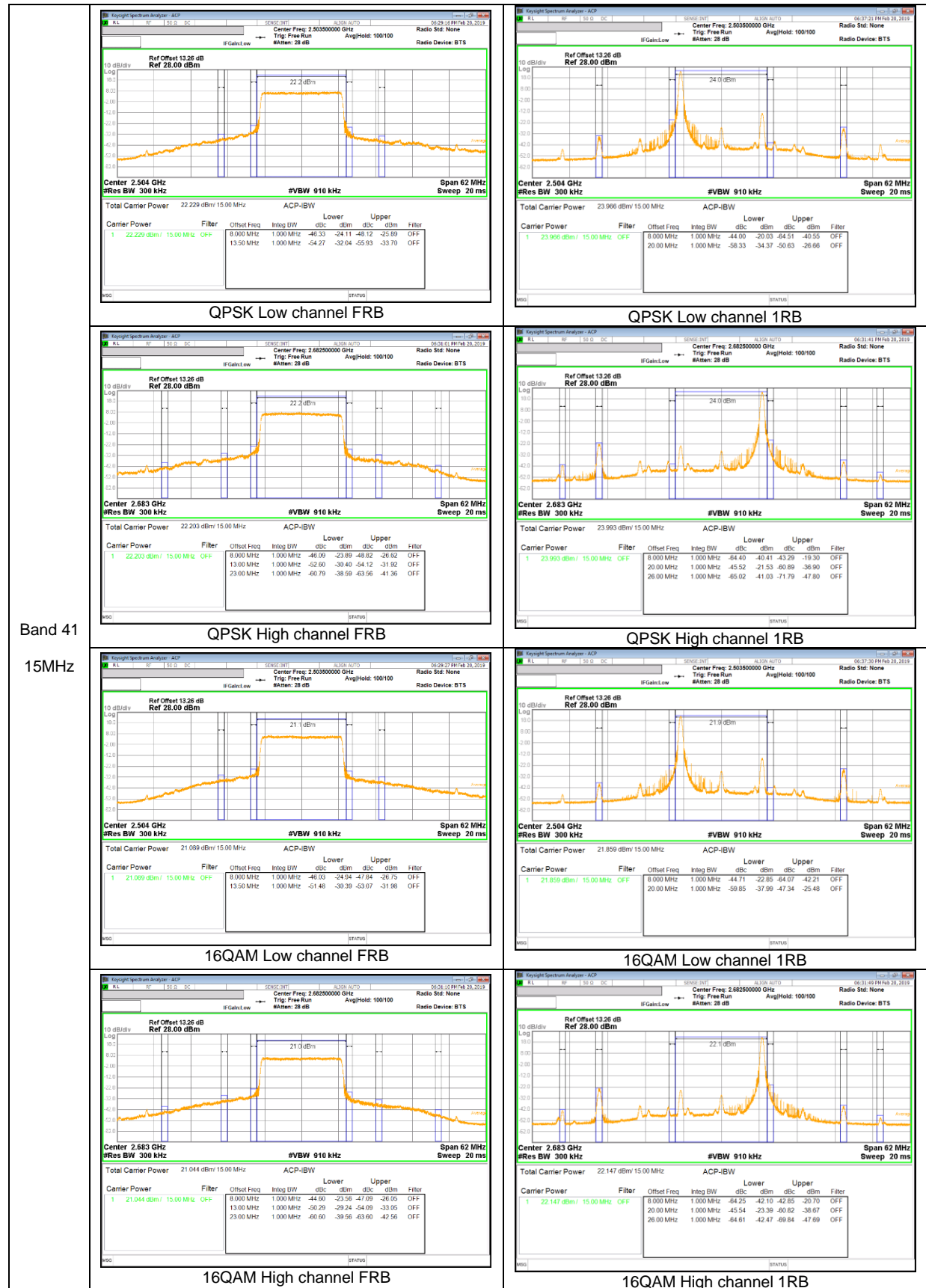
Band 5
1.4MHz

9.2. EMISSION MASK RESULT

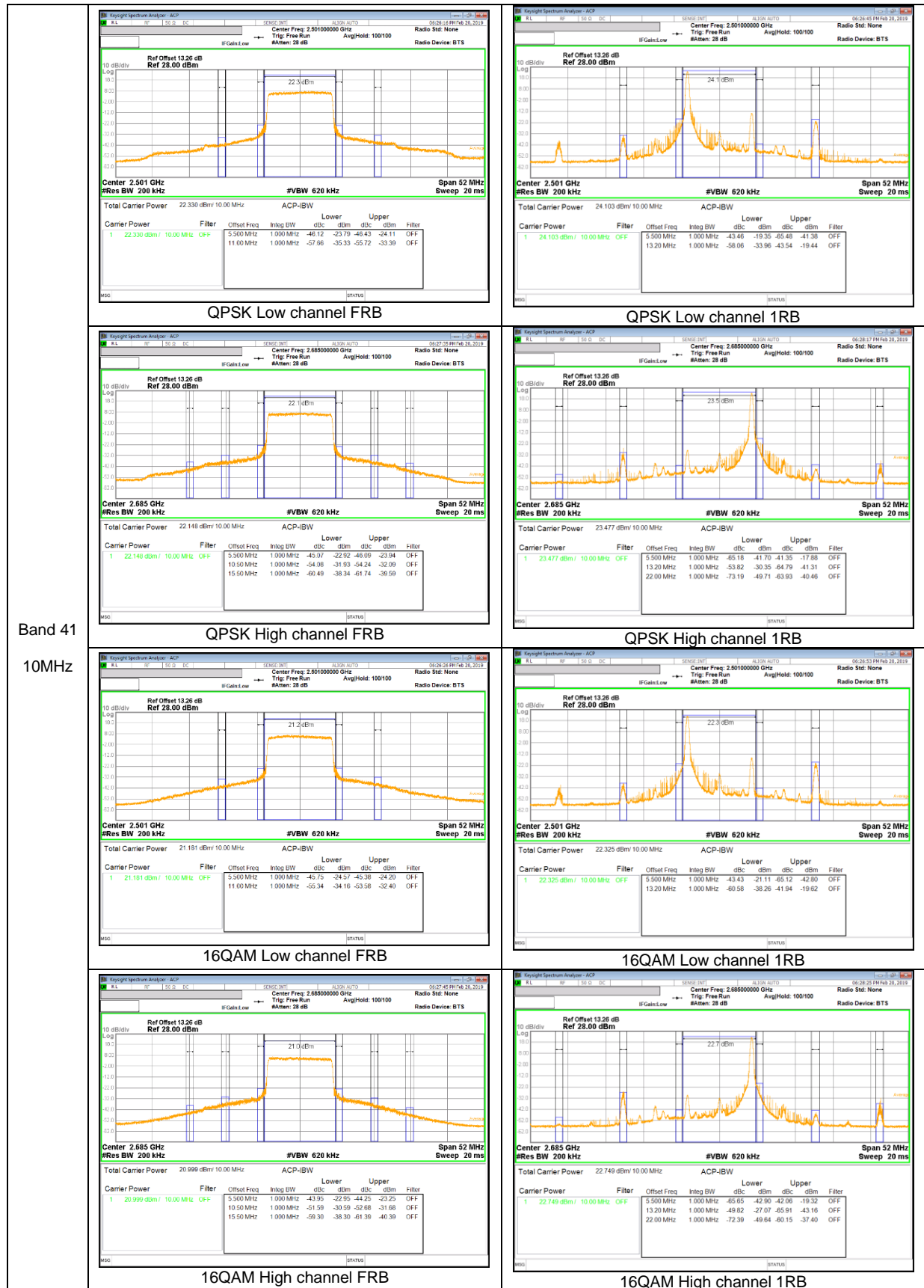
LTE Band 41

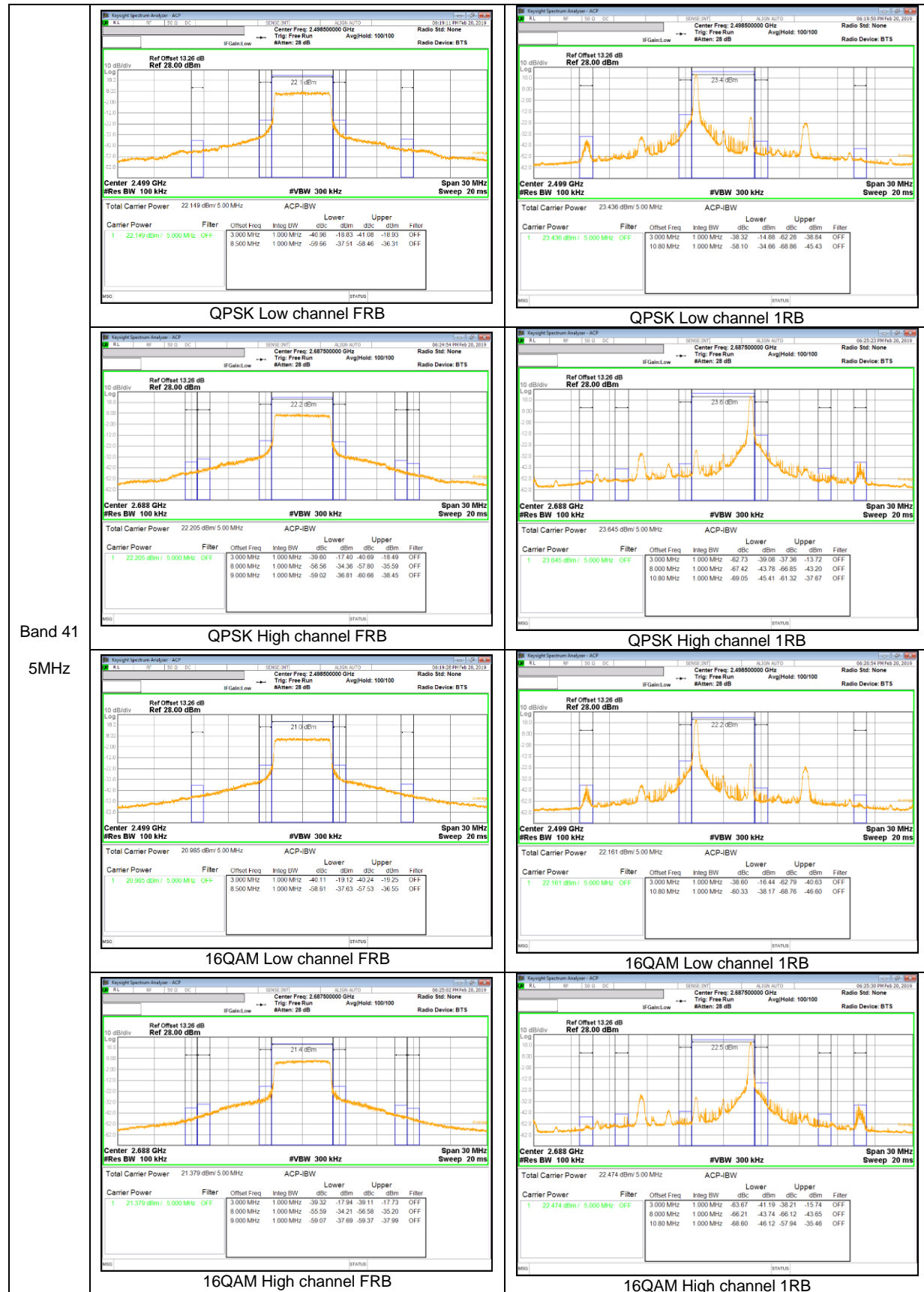


Band 41
20MHz



Band 41
15MHz





Band 41
5MHz

9.3. OUT OF BAND EMISSIONS

RULE PART(S)

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

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:

(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.

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), Maxhold(GSM, LTE Band41);

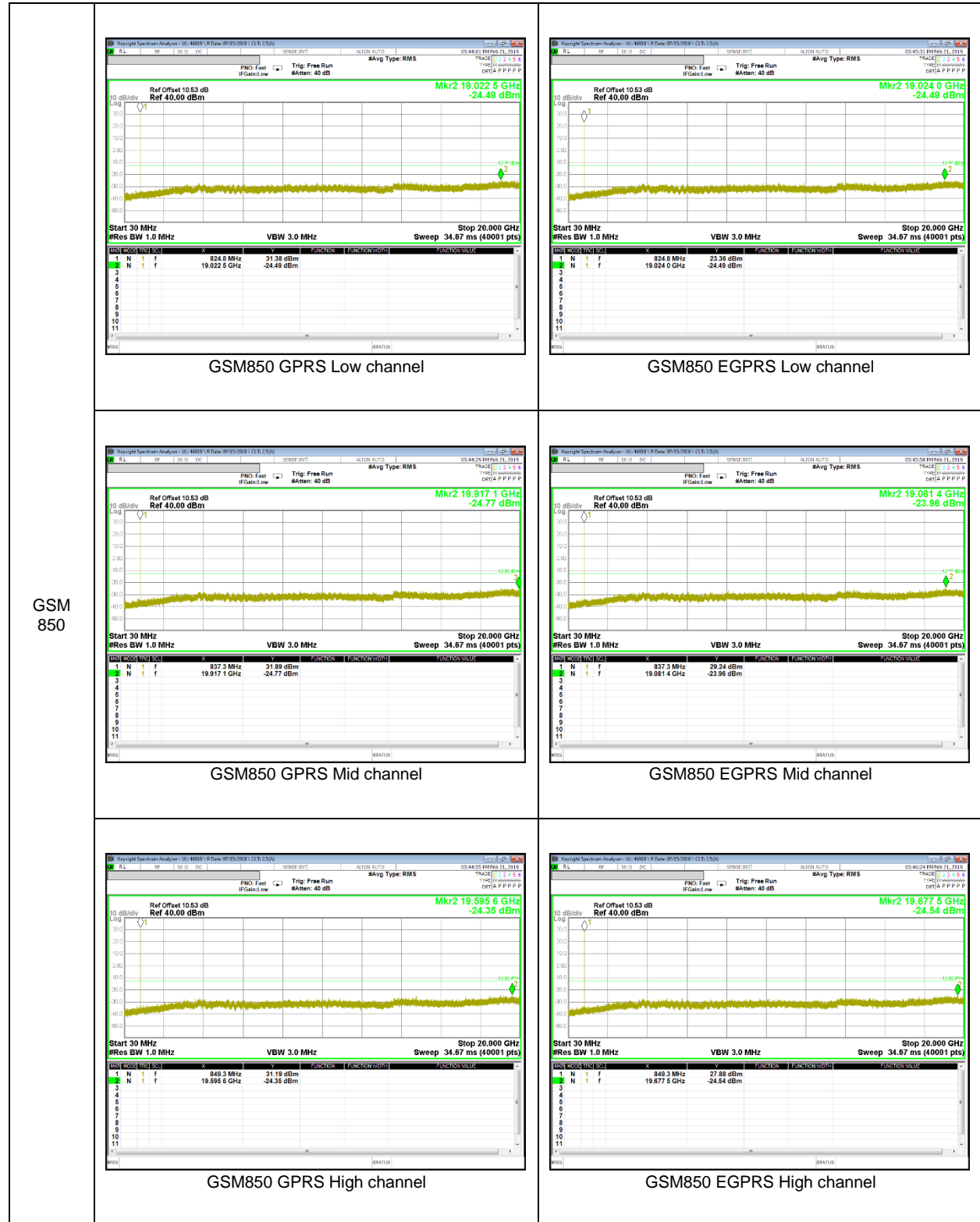
RESULTS

See the following pages.

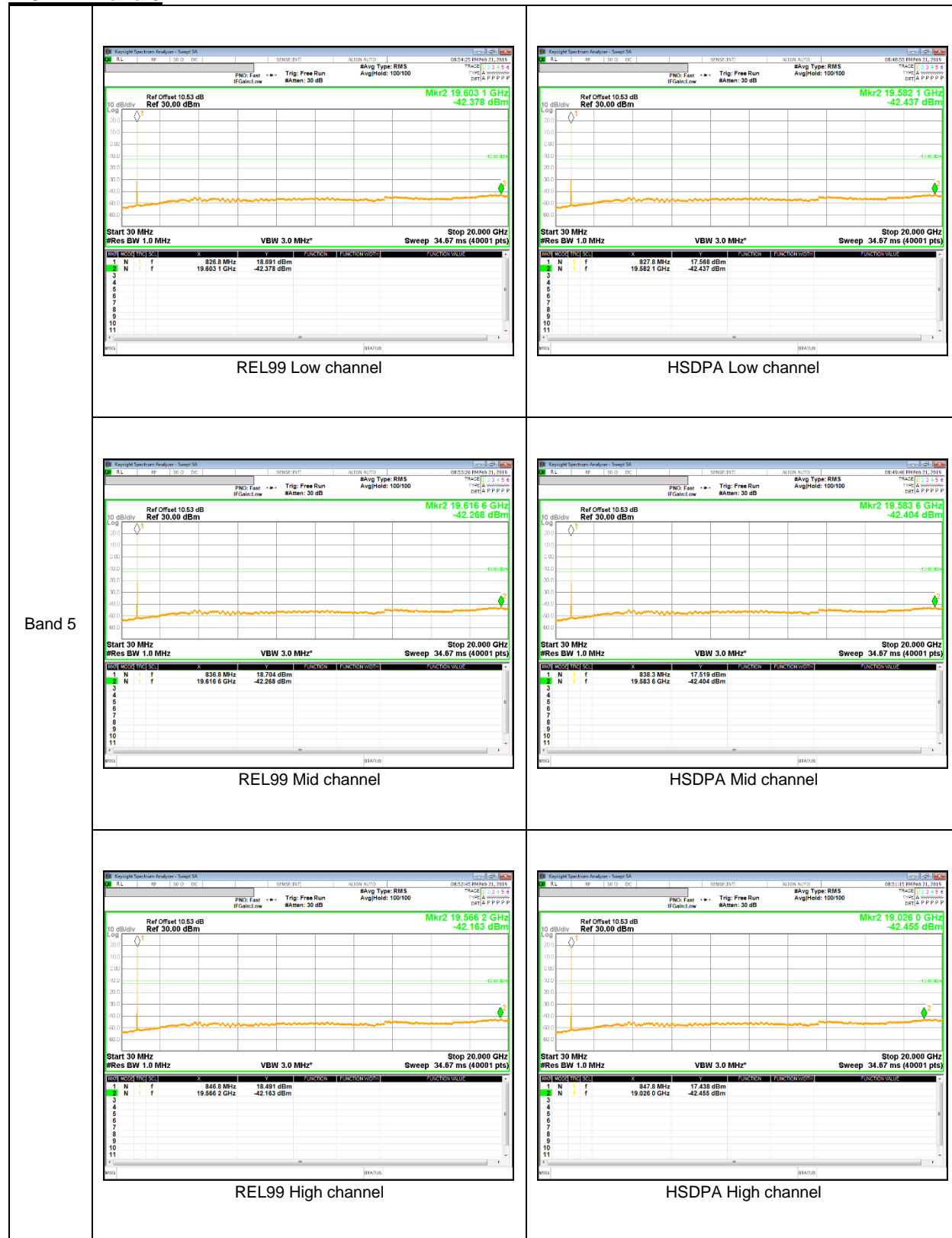
NOTE : Please refer to section 5.4 for bandwidth and RB setting about LTE bands.

9.3.1. OUT OF BAND EMISSIONS RESULT

GSM 850

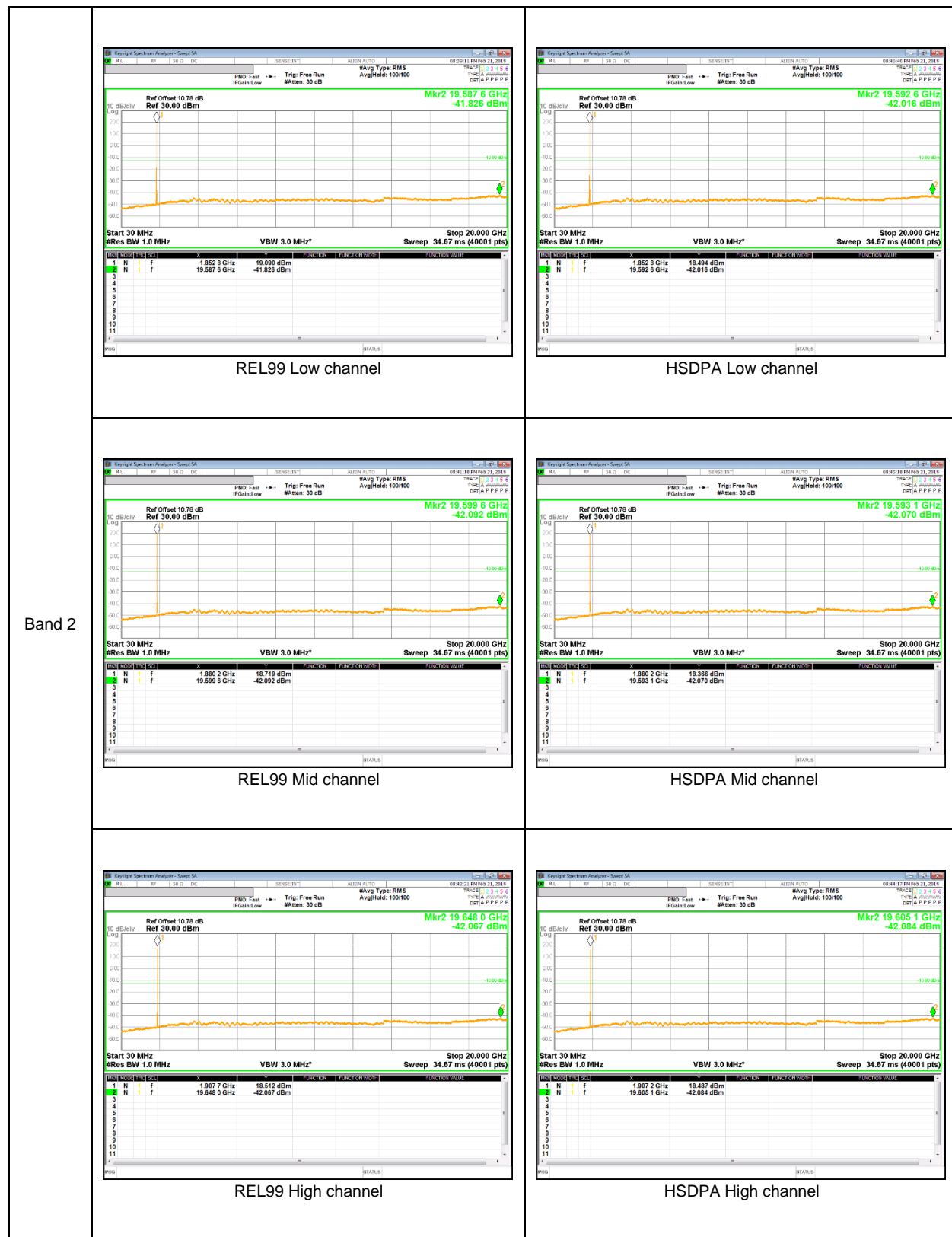


WCDMA Band 5



Band 5

WCDMA Band 2



LTE Band 5



LTE Band 41



9.4. FREQUENCY STABILITY

RULE PART(S)

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

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.

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]		
3.85	50	824.19998928	-0.010	848.79998459	-0.003	2.5	
3.85	40	824.19998511	-0.005	848.79998951	-0.009	2.5	
3.85	30	824.19998054	0.001	848.79998927	-0.009	2.5	
3.85	20	824.19998114	0.000	848.79998162	0.000	2.5	
3.85	10	824.19998204	-0.001	848.79998560	-0.005	2.5	
3.85	0	824.19998005	0.001	848.79998213	-0.001	2.5	
3.85	-10	824.19999058	-0.011	848.79998707	-0.006	2.5	
3.85	-20	824.19998325	-0.003	848.79998608	-0.005	2.5	
3.85	-30	824.19999004	-0.011	848.79998266	-0.001	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]		
3.85	20	824.19998114	0	848.79998162	0	2.5	
4.40	20	824.19998021	0.001	848.79998423	-0.003	2.5	
3.40	20	824.19998197	-0.001	848.79998477	-0.004	2.5	

GSM 1900, Channel 512/810, Frequency 1850.0/1910.0 MHz

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	1850.0752	1909.9237		
Extreme (50C)		1850.0752	1909.9236	-21.9	-0.012
Extreme (40C)		1850.0752	1909.9236	-19.7	-0.010
Extreme (30C)		1850.0752	1909.9236	-25.5	-0.014
Extreme (10C)		1850.0752	1909.9236	-27.7	-0.015
Extreme (0C)		1850.0752	1909.9236	-24.4	-0.013
Extreme (-10C)		1850.0752	1909.9236	-20.7	-0.011
Extreme (-20C)		1850.0752	1909.9236	-24.2	-0.013
Extreme (-30C)		1850.0752	1909.9236	-26.0	-0.014
20C	15%	1850.0752	1909.9236	-20.9	-0.011
	-15%	1850.0752	1909.9236	-20.7	-0.011
	End Point	1850.0752	1909.9236	-20.4	-0.011

WCDMA Band 5 (HSDPA)

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]		
3.85	50	826.39998126	-0.003	846.59997787	0.008	2.5	
3.85	40	826.39998061	-0.002	846.59998496	0.000	2.5	
3.85	30	826.39997986	-0.001	846.59997850	0.007	2.5	
3.85	20	826.39997871	0.000	846.59998472	0.000	2.5	
3.85	10	826.39998596	-0.009	846.59998495	0.000	2.5	
3.85	0	826.39998057	-0.002	846.59998371	0.001	2.5	
3.85	-10	826.39998400	-0.006	846.59998237	0.003	2.5	
3.85	-20	826.39998238	-0.004	846.59998229	0.003	2.5	
3.85	-30	826.39998577	-0.009	846.59997519	0.011	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]		
3.85	20	826.39997871	0	846.59998472	0	2.5	
4.40	20	826.39998232	-0.004	846.59997876	0.007	2.5	
3.40	20	826.39997696	0.002	846.59998468	0.000	2.5	

WCDMA Band 2 (Rel. 99)

Limit		1850	1910	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	1852.3979	1907.6021		
Extreme (50C)		1852.3979	1907.6021	-23.0	-0.012
Extreme (40C)		1852.3979	1907.6021	-22.7	-0.012
Extreme (30C)		1852.3979	1907.6021	-21.3	-0.011
Extreme (10C)		1852.3979	1907.6021	-21.9	-0.012
Extreme (0C)		1852.3979	1907.6020	-28.6	-0.015
Extreme (-10C)		1852.3979	1907.6021	-20.5	-0.011
Extreme (-20C)		1852.3979	1907.6021	-22.5	-0.012
Extreme (-30C)		1852.3979	1907.6020	-27.4	-0.015
20C	15%	1852.3979	1907.6020	-27.3	-0.015
	-15%	1852.3979	1907.6020	-28.0	-0.015
	End Point	1852.3979	1907.6020	-28.6	-0.015

LTE Band 5 (QPSK)

Reference Frequency : LTE 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	824.69998507	-0.003	848.29997591	0.003	2.5	
3.85	40	824.69998162	0.001	848.29997954	-0.001	2.5	
3.85	30	824.69997608	0.008	848.29998348	-0.006	2.5	
3.85	20	824.69998285	0.000	848.29997870	0.000	2.5	
3.85	10	824.69997935	0.004	848.29998397	-0.006	2.5	
3.85	0	824.69998441	-0.002	848.29998516	-0.008	2.5	
3.85	-10	824.69998001	0.003	848.29997676	0.002	2.5	
3.85	-20	824.69998187	0.001	848.29998532	-0.008	2.5	
3.85	-30	824.69998274	0.000	848.29998338	-0.006	2.5	

Reference Frequency : LTE 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	20	824.69998285	0	848.29997870	0	2.5	
4.40	20	824.69997994	0.004	848.29997838	0.000	2.5	
3.40	20	824.69998282	0.000	848.29997805	0.001	2.5	

LTE Band 41 (QPSK)

Limit		2496	2690	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	2498.4978	2687.5023		
Extreme (50C)		2498.4977	2687.5022	-26.4	-0.010
Extreme (40C)		2498.4977	2687.5022	-29.9	-0.012
Extreme (30C)		2498.4977	2687.5022	-32.5	-0.013
Extreme (10C)		2498.4977	2687.5022	-32.0	-0.012
Extreme (0C)		2498.4977	2687.5022	-33.2	-0.013
Extreme (-10C)		2498.4977	2687.5022	-28.5	-0.011
Extreme (-20C)		2498.4977	2687.5022	-24.3	-0.009
Extreme (-30C)		2498.4977	2687.5022	-31.5	-0.012
20C		15%	2498.4977	2687.5022	-30.7
	-15%	2498.4977	2687.5022	-29.1	-0.011
	End Point	2498.4977	2687.5022	-24.4	-0.009

10. RADIATED TEST RESULTS

10.1. RADIATED POWER (ERP & EIRP)

RULE PART(S)

FCC: §2.1046, §22.913, §24.232 and §27.50

LIMITS

22.913(a) - The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 Watts.

24.232(c) - Mobile/portable stations are limited to 2 watts e.i.r.p. peak power and the equipment must employ means to limit the power to the minimum necessary for successful communications.

27.50:(h) The following power limits shall apply in the BRS and EBS:

(2) Mobile stations are limited to 2.0 watts EIRP. All user stations are limited to 2.0 watts transmitter output power.

In addition, when the transmitter power is measured in terms of average value, the peak-to-average ratio of the power shall not exceed 13dB.

TEST PROCEDURE

ANSI / TIA / EIA 603 E Clause 2.2.17; ESU40 setting reference to 971168 D01 v03r01

For radiated output power measurement with a ESU40:

a) Set the RBW \geq OBW; b) Set VBW $\geq 3 \times$ RBW; c) Set span $\geq 2 \times$ RBW; d) Sweep time = auto couple; e) Detector = rms; f) Ensure that the number of measurement points \geq span/RBW; g) Trace mode = max hold(GSM, WCDMA), average(LTE);

TEST RESULTS

10.1.1. ERP/EIRP Results

GSM

Band	Mode	Channel	f [MHz]	ERP / EIRP	
				[dBm]	[mW]
GSM850	GPRS	512	824.2	24.8	302.00
		661	836.6	24.71	295.80
		810	848.8	24.54	284.45
	EGPRS	512	824.2	20.47	111.43
		661	836.6	20.12	102.80
		810	848.8	19.19	82.99
GSM1900	GPRS	512	1850.2	23.28	212.81
		661	1880	23.94	247.74
		810	1909.8	22.94	196.79
	EGPRS	512	1850.2	20.19	104.47
		661	1880	21.11	129.12
		810	1909.8	20.37	108.89

WCDMA

Band	Mode	Channel	f [MHz]	ERP / EIRP	
				[dBm]	[mW]
Band 5	REL99	4132	826.4	15.83	38.28
		4183	836.6	16.99	50.00
		4233	846.6	17.64	58.08
	HSDPA	4132	826.4	15.83	38.28
		4183	836.6	16.56	45.29
		4233	846.6	16.46	44.26
Band 2	REL99	9262	1852.4	18.31	67.76
		9400	1880.0	18.42	69.50
		9538	1907.6	16.52	44.87
	HSDPA	9262	1852.4	17.94	62.23
		9400	1880.0	18.08	64.27
		9538	1907.6	16.06	40.36

LTE Band 5

Band	BW	Mode	RB Size/	f [MHz]	ERP / EIRP	
	[MHz]		RB Offset		[dBm]	[mW]
Band 5	10	QPSK	1 / 0	829.0	17.79	60.12
			1 / 0	836.5	18.21	66.22
			1 / 0	844.0	18.26	66.99
		16QAM	1 / 0	829.0	15.48	35.32
			1 / 0	836.5	15.78	37.84
			1 / 0	844.0	15.90	38.90
	5	QPSK	1 / 0	826.5	17.55	56.89
			1 / 0	836.5	17.87	61.24
			1 / 0	846.5	18.11	64.71
		16QAM	1 / 0	826.5	15.41	34.75
			1 / 0	836.5	15.92	39.08
			1 / 0	846.5	15.85	38.46
	3	QPSK	1 / 0	825.5	17.54	56.75
			1 / 14	836.5	18.27	67.14
			1 / 8	847.5	18.02	63.39
		16QAM	1 / 0	825.5	14.55	28.51
			1 / 8	836.5	15.42	34.83
			1 / 8	847.5	15.69	37.07
	1.4	QPSK	1 / 5	824.7	17.22	52.72
			1 / 0	836.5	18.49	70.63
			1 / 0	848.3	18.38	68.87
		16QAM	1 / 5	824.7	15.26	33.57
			1 / 0	836.5	16.24	42.07
			1 / 0	848.3	16.21	41.78

LTE Band 41

Band	BW	Mode	RB Size/	f [MHz]	ERP / EIRP	
	[MHz]		RB Offset		[dBm]	[mW]
Band 41	20	QPSK	1 / 99	2506.0	22.46	176.20
			1 / 49	2593.0	20.23	105.44
			1 / 99	2680.0	17.04	50.58
		16QAM	1 / 49	2506.0	21.14	130.02
			1 / 0	2593.0	19.08	80.91
			1 / 99	2680.0	15.25	33.50
	15	QPSK	1 / 37	2503.5	22.50	177.83
			1 / 37	2593.0	20.03	100.69
			1 / 74	2682.5	16.72	46.99
		16QAM	1 / 37	2503.5	21.23	132.74
			1 / 74	2593.0	19.17	82.60
			1 / 74	2682.5	16.13	41.02
	10	QPSK	1 / 25	2501.0	22.88	194.09
			1 / 49	2593.0	19.66	92.47
			1 / 49	2685.0	17.05	50.70
		16QAM	1 / 49	2501.0	20.23	105.44
			1 / 49	2593.0	19.28	84.72
			1 / 49	2685.0	16.76	47.42
	5	QPSK	1 / 12	2498.5	22.68	185.35
			1 / 12	2593.0	19.81	95.72
			1 / 24	2687.5	17.18	52.24
		16QAM	1 / 12	2498.5	21.26	133.66
			1 / 12	2593.0	18.51	70.96
			1 / 24	2687.5	15.31	33.96

10.1.2. ERP/EIRP DATA

GSM850

GSM850 GPRS	<p style="text-align: center;">UL Verification Services, Inc. High Frequency Substitution Measurement</p> <p>Company: Samsung Project #: 4788874100 Date: 2019-02-18 Test Engineer: 45585 Configuration: EUT / X-Position Location: Chamber 2 Mode: GPRS 850 MHz Fundamentals</p> <p><u>Test Equipment:</u> Receiving: VULB9163-749, and Chamber 2 SMA Cables Substitution: Dipole 3121_DB4, 8.5m SMA-type Cable</p> <table border="1"> <thead> <tr> <th>f MHz</th> <th>SG reading (dBm)</th> <th>Ant. Pol. (H/V)</th> <th>Cable Loss (dB)</th> <th>Antenna Gain (dBd)</th> <th>ERP (dBm)</th> <th>Limit (dBm)</th> <th>Delta (dB)</th> <th>Notes</th> </tr> </thead> <tbody> <tr> <td colspan="9">Low Ch</td> </tr> <tr> <td>824.20</td> <td>21.73</td> <td>V</td> <td>3.0</td> <td>-1.5</td> <td>17.24</td> <td>38.5</td> <td>-21.3</td> <td></td> </tr> <tr> <td>824.20</td> <td>29.29</td> <td>H</td> <td>3.0</td> <td>-1.5</td> <td>24.80</td> <td>38.5</td> <td>-13.7</td> <td></td> </tr> <tr> <td colspan="9">Mid Ch</td> </tr> <tr> <td>836.60</td> <td>22.91</td> <td>V</td> <td>3.0</td> <td>-1.4</td> <td>18.45</td> <td>38.5</td> <td>-20.0</td> <td></td> </tr> <tr> <td>836.60</td> <td>29.17</td> <td>H</td> <td>3.0</td> <td>-1.4</td> <td>24.71</td> <td>38.5</td> <td>-13.8</td> <td></td> </tr> <tr> <td colspan="9">High Ch</td> </tr> <tr> <td>848.80</td> <td>22.51</td> <td>V</td> <td>3.1</td> <td>-1.4</td> <td>18.07</td> <td>38.5</td> <td>-20.4</td> <td></td> </tr> <tr> <td>848.80</td> <td>28.98</td> <td>H</td> <td>3.1</td> <td>-1.4</td> <td>24.54</td> <td>38.5</td> <td>-14.0</td> <td></td> </tr> </tbody> </table>								f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes	Low Ch									824.20	21.73	V	3.0	-1.5	17.24	38.5	-21.3		824.20	29.29	H	3.0	-1.5	24.80	38.5	-13.7		Mid Ch									836.60	22.91	V	3.0	-1.4	18.45	38.5	-20.0		836.60	29.17	H	3.0	-1.4	24.71	38.5	-13.8		High Ch									848.80	22.51	V	3.1	-1.4	18.07	38.5	-20.4		848.80	28.98	H	3.1	-1.4	24.54	38.5	-14.0	
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