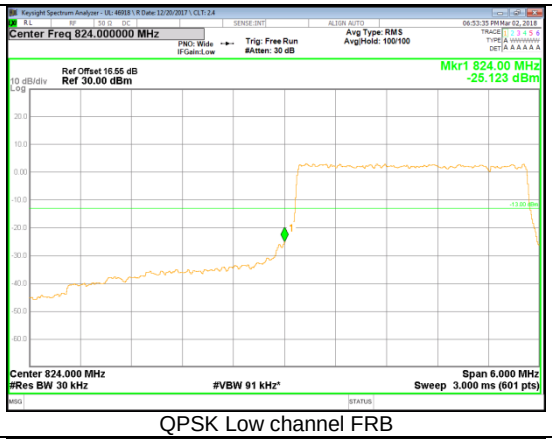
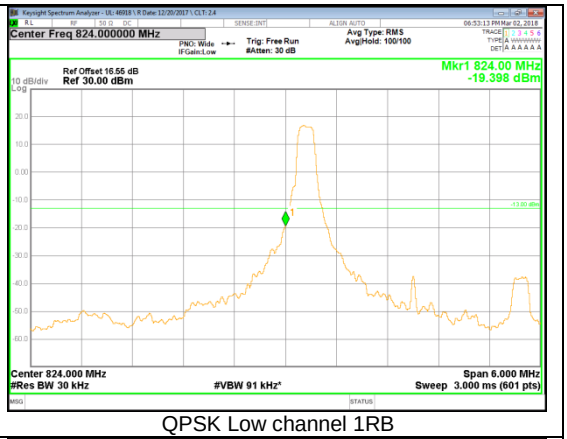
Band 5

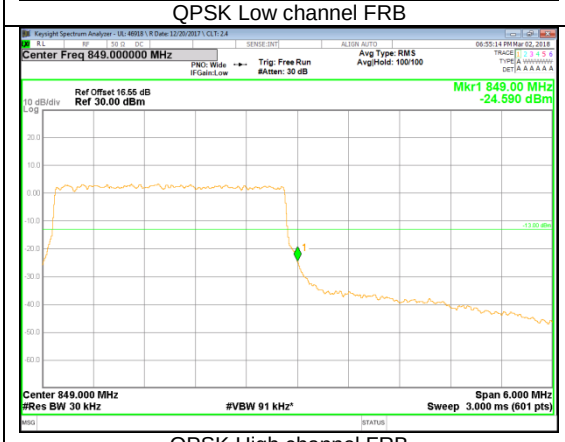
3MHz



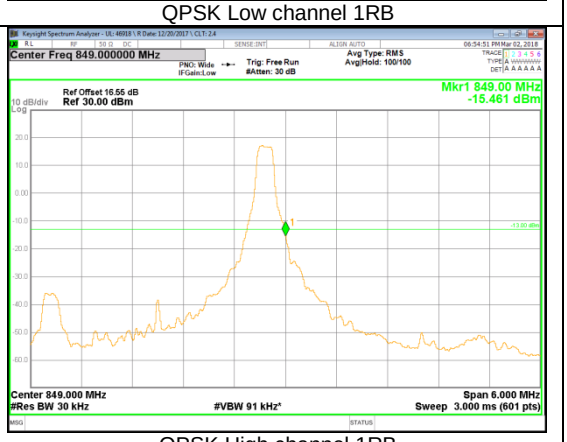
QPSK Low channel FRB



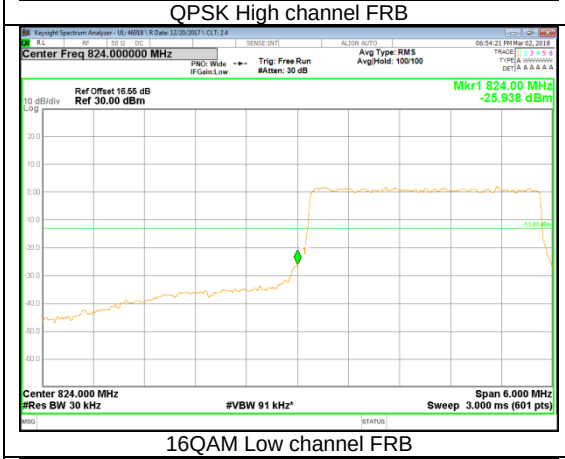
QPSK Low channel 1RB



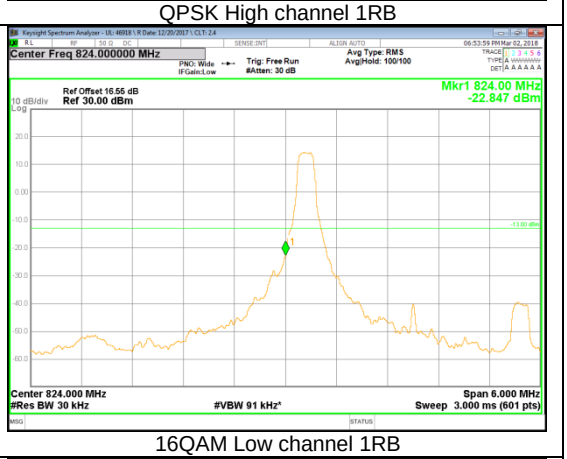
QPSK High channel FRB



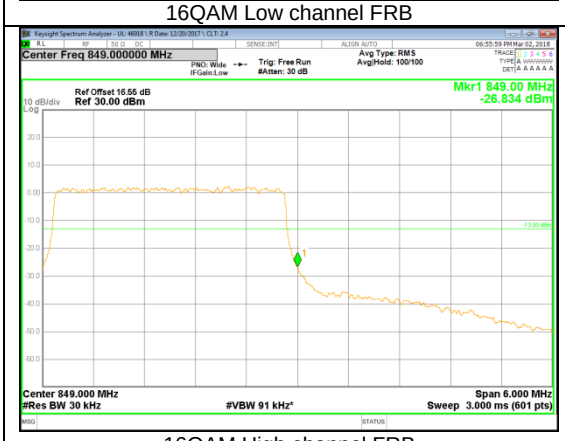
QPSK High channel 1RB



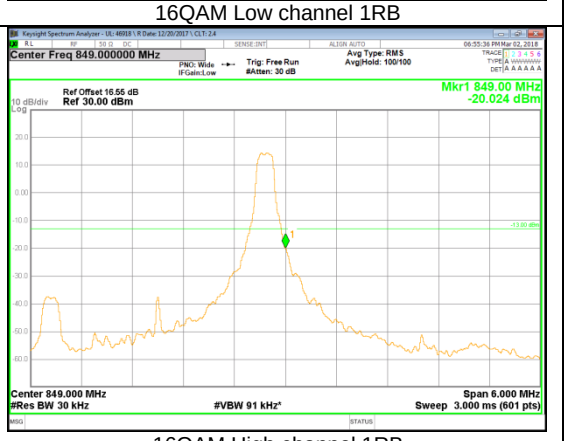
16QAM Low channel FRB



16QAM Low channel 1RB



16QAM High channel FRB



16QAM High channel 1RB

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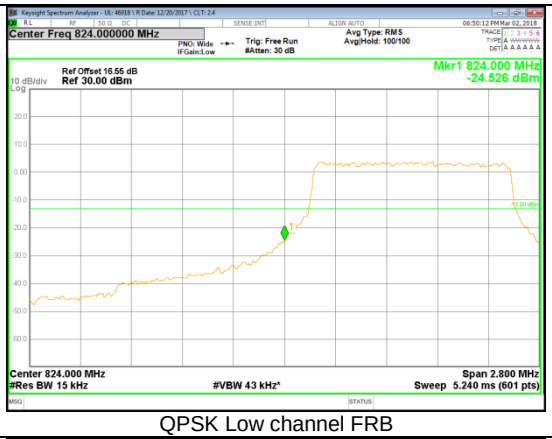
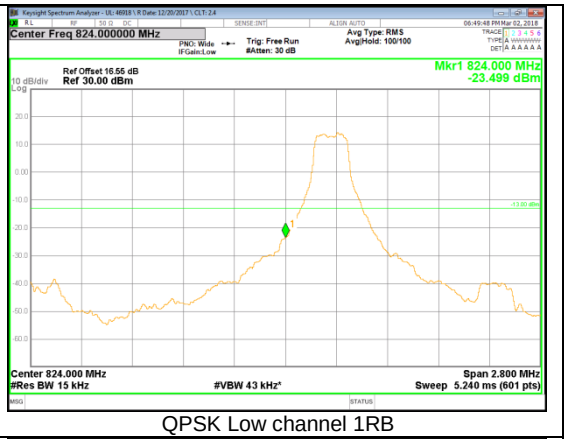
Band 5

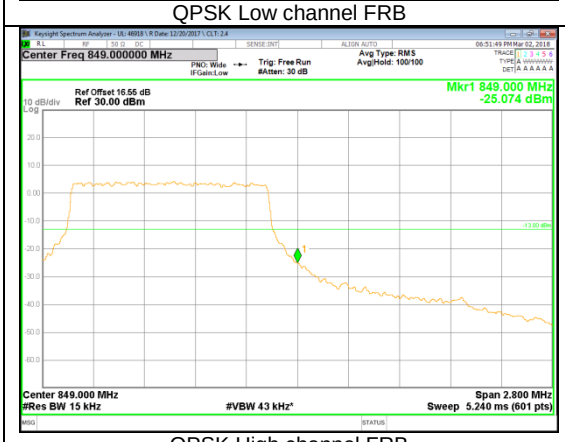
1.4MHz



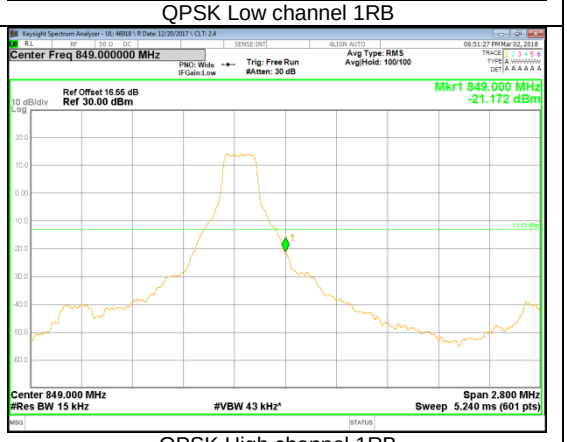
QPSK Low channel FRB



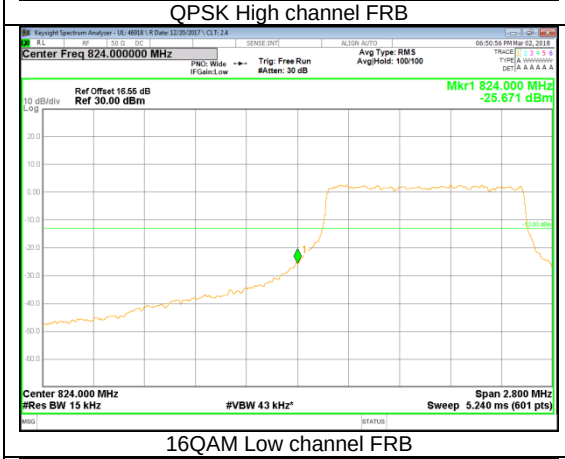
QPSK Low channel 1RB



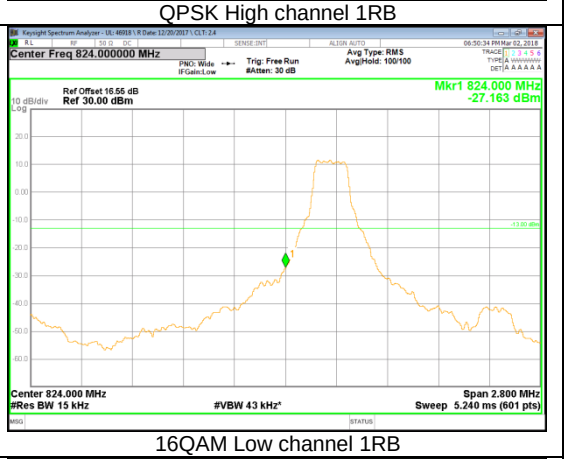
QPSK High channel FRB



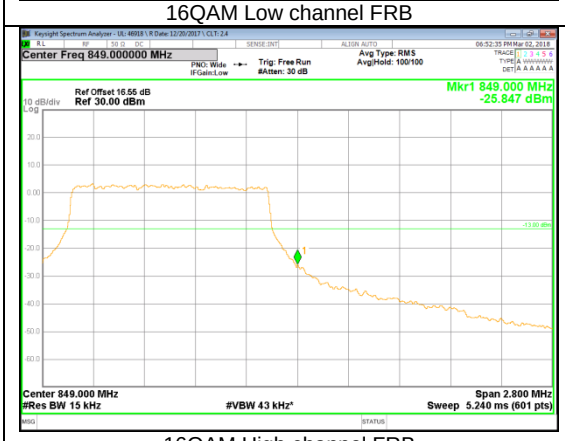
QPSK High channel 1RB



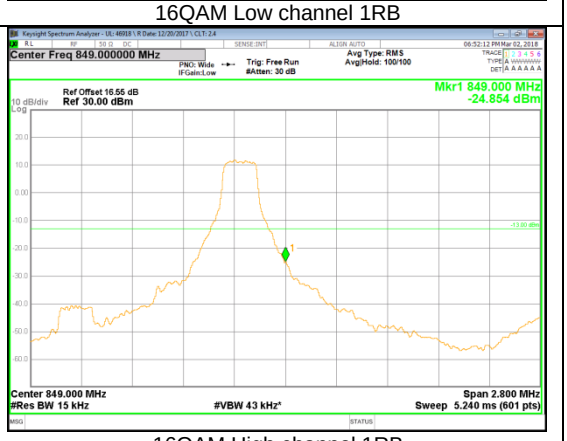
16QAM Low channel FRB



16QAM Low channel 1RB



16QAM High channel FRB



16QAM High channel 1RB

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9.3. OUT OF BAND EMISSIONS

RULE PART(S)

FCC: §2.1051, §22.901, §22.917 and §24.238

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.

TEST PROCEDURE

Per KDB 971168 D01 Power Meas License Digital Systems v03
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 ≥ 3 × RBW;

c) Set span ≥ 1.5 times the OBW;

d) Sweep time = auto couple;

e) Detector = peak(GSM), rms(WCDMA, LTE);

f) Ensure that the number of measurement points = Max (40001);

g) Trace mode = max hold(GSM), average(WCDMA, LTE);

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RESULTS

GSM

Band	Mode	f [MHz]	Spurious [dBm]	Limit [dBm]
GSM850	GPRS	824.2	-23.03	-13.00
		836.6	-22.42	
		848.8	-22.28	
	EGPRS	824.2	-22.47	
		836.6	-21.97	
		848.8	-22.24	
GSM1900	GPRS	1850.2	-21.59	
		1880.0	-22.21	
		1909.8	-21.94	
	EGPRS	1850.2	-21.75	
		1880.0	-21.17	
		1909.8	-22.08	

WCDMA

Band	Mode	f [MHz]	Spurious [dBm]	Limit [dBm]
Band 5	REL99	826.4	-27.870	-13.00
		836.6	-28.862	
		846.6	-27.183	
	HSDPA	826.4	-30.975	
		836.6	-32.682	
		846.6	-30.948	
Band 2	REL99	1852.4	-31.362	
		1880.0	-31.330	
		1907.6	-31.360	
	HSDPA	1852.4	-31.279	
		1880.0	-31.209	
		1907.6	-31.148	

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LTE 5

Bandwidth	Mode	f [MHz]	Spurious [dBm]	5th Harmonic 5MHz Span Spurious [dBm]	Limit [dBm]
10 MHz	QPSK	829.0	-19.224		-13.00
		836.5	-19.610		
		844.0	-17.097	-16.234	
	16QAM	829.0	-23.522		
		836.5	-23.385		
		844.0	-22.593		
5 MHz	QPSK	826.5	-17.987		
		836.5	-19.921		
		846.5	-17.430	-16.079	
	16QAM	826.5	-22.574		
		836.5	-24.424		
		846.5	-22.078		
3 MHz	QPSK	825.5	-19.735		
		836.5	-20.450		
		847.5	-17.310	-16.278	
	16QAM	825.5	-23.277		
		836.5	-23.941		
		847.5	-22.108		
1.4 MHz	QPSK	824.7	-20.377		
		836.5	-20.923		
		848.3	-17.691	-16.528	
	16QAM	824.7	-23.094		
		836.5	-24.347		
		848.3	-21.262		

- NOTE : Highest Ch. and QPSK condition were worst case results for each bandwidth.
  So re-test were performed on the condition of narrow span(5MHz).

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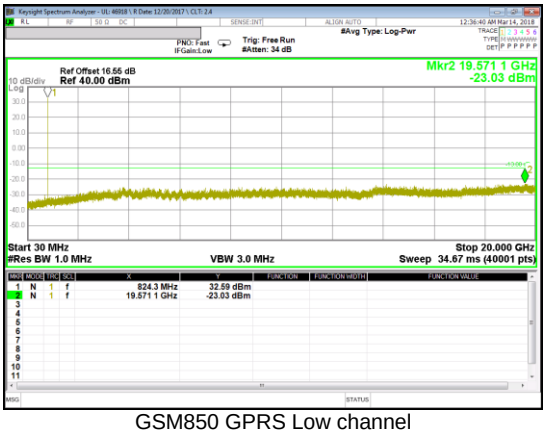
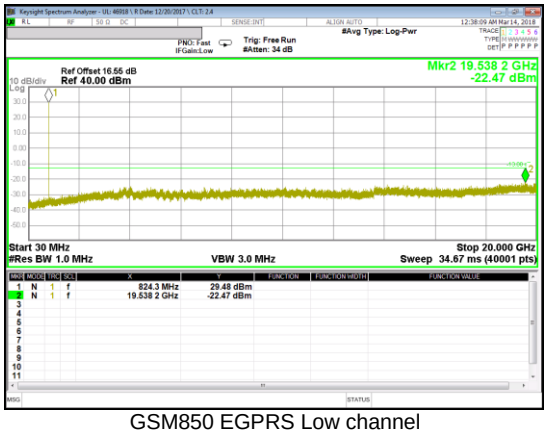
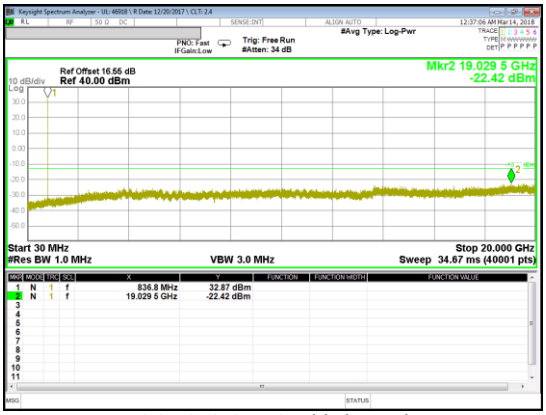
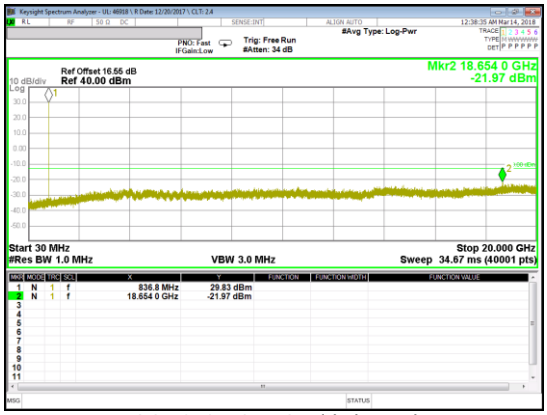
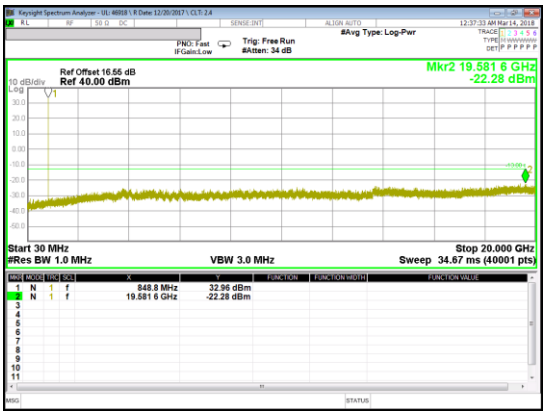
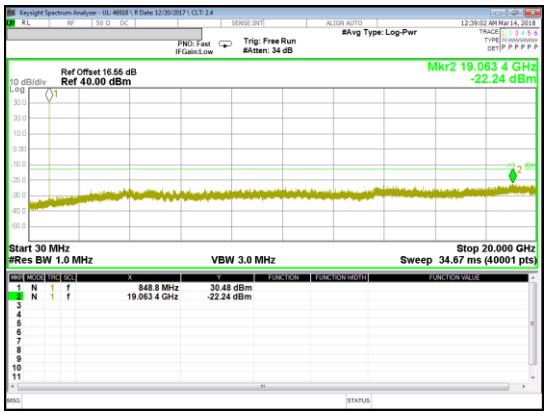
9.3.1. OUT OF BAND EMISSIONS PLOTS

GSM 850	 GSM850 GPRS Low channel	 GSM850 EGPRS Low channel
	 GSM850 GPRS Mid channel	 GSM850 EGPRS Mid channel
	 GSM850 GPRS High channel	 GSM850 EGPRS High channel

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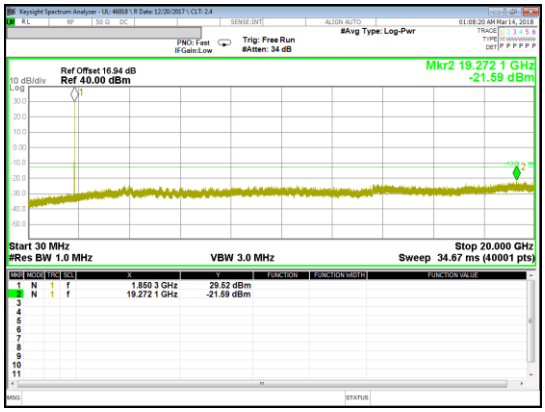
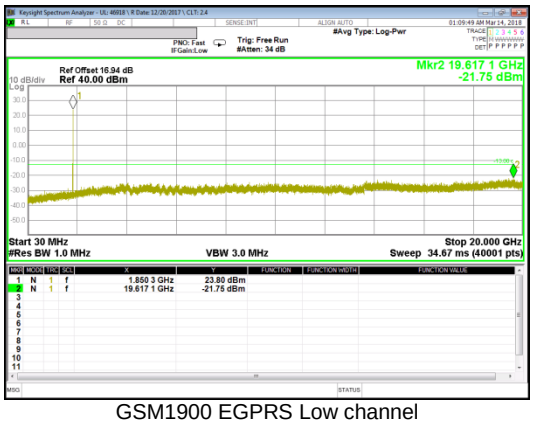
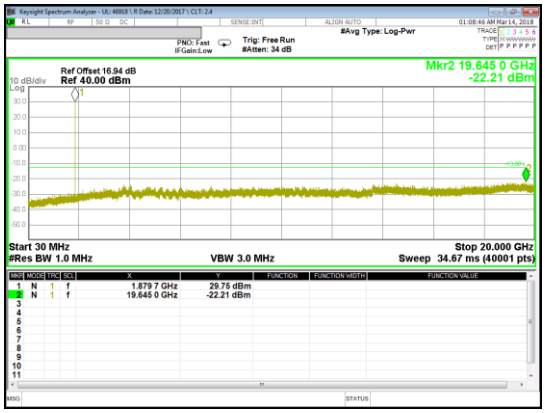
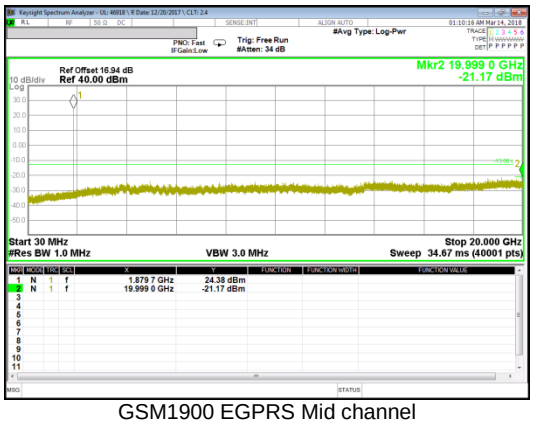
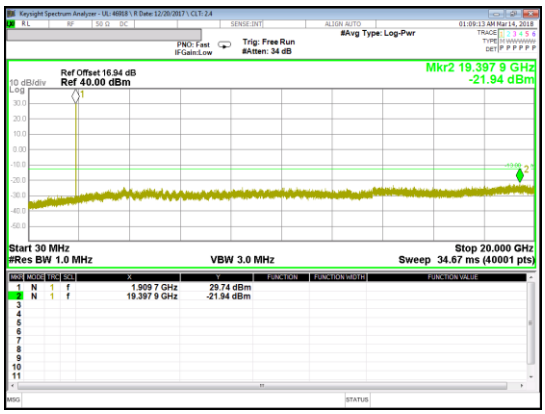
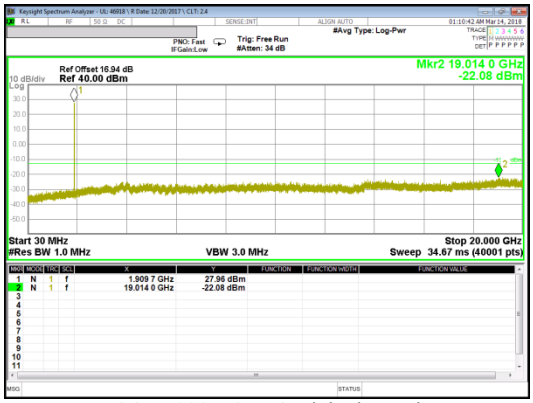
GSM 1900	 GSM1900 GPRS Low channel	 GSM1900 EGPRS Low channel
	 GSM1900 GPRS Mid channel	 GSM1900 EGPRS Mid channel
	 GSM1900 GPRS High channel	 GSM1900 EGPRS High channel

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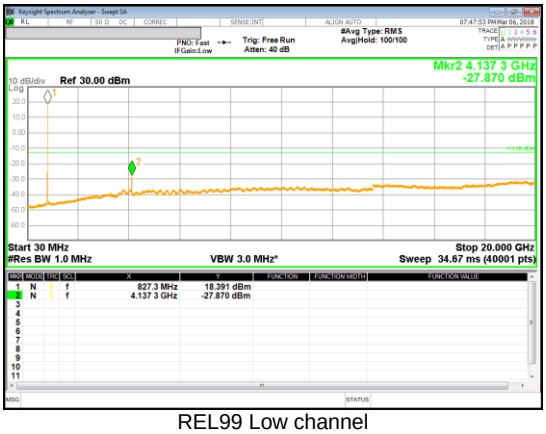
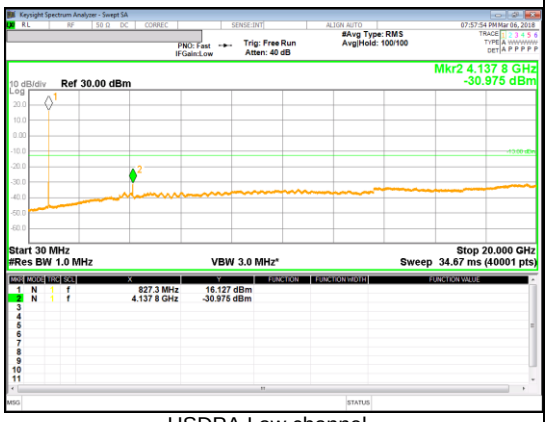
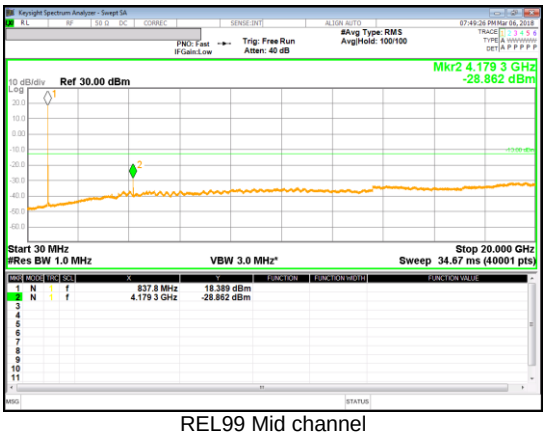
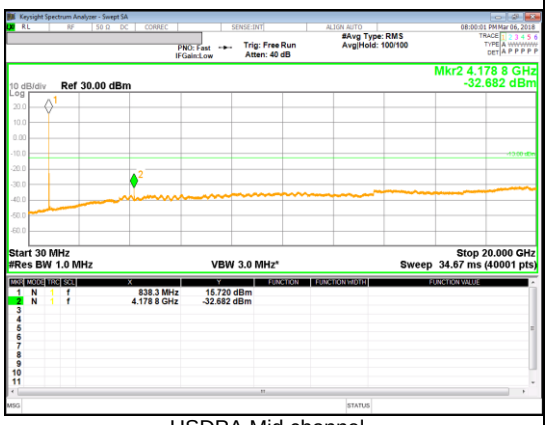
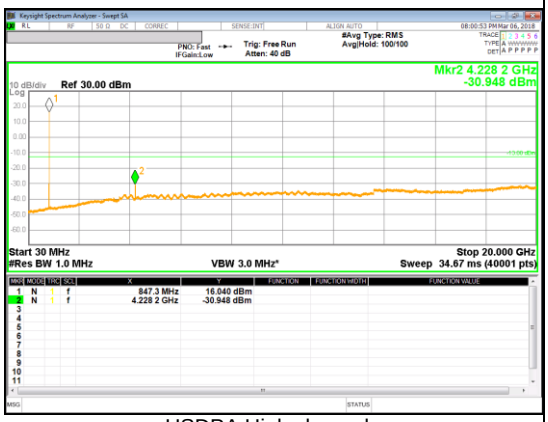
WCDMA Band 5	 REL99 Low channel	 HSDPA Low channel
	 REL99 Mid channel	 HSDPA Mid channel
	 REL99 High channel	 HSDPA High channel

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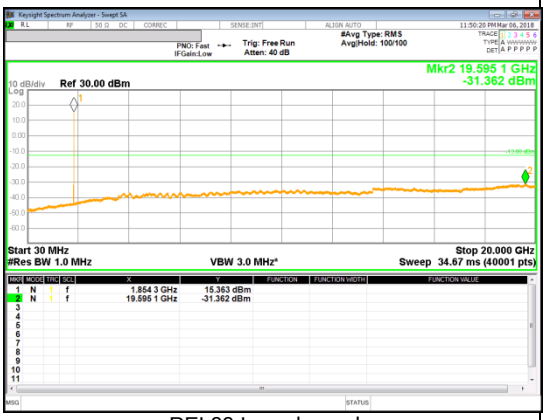
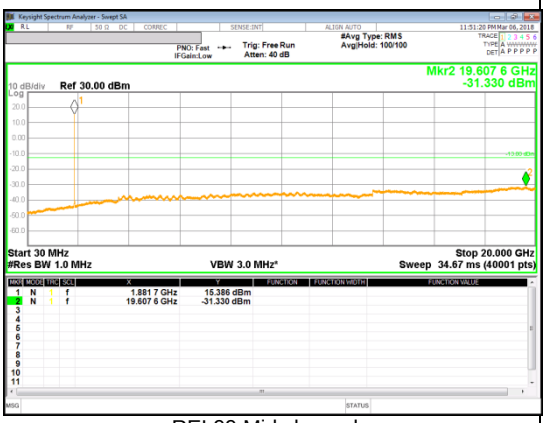
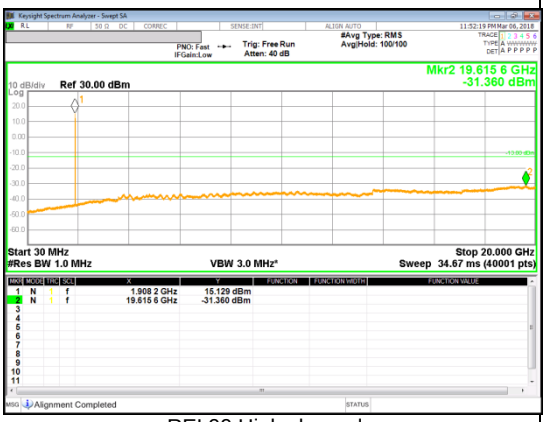
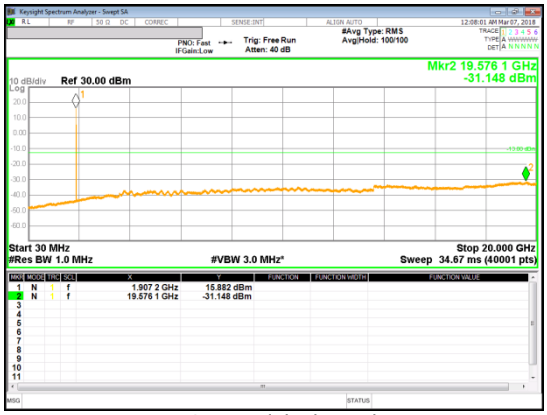
WCDMA Band 2	 REL99 Low channel	 HSDPA Low channel
	 REL99 Mid channel	 HSDPA Mid channel
	 REL99 High channel	 HSDPA High channel

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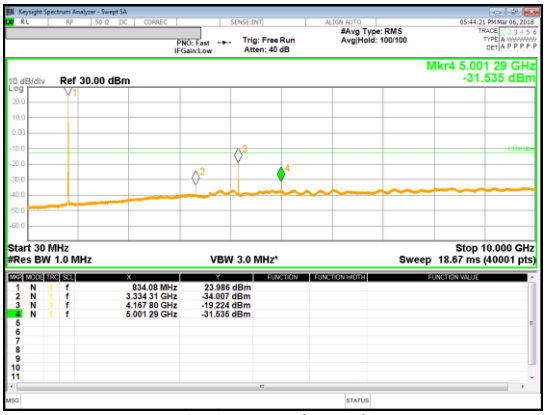
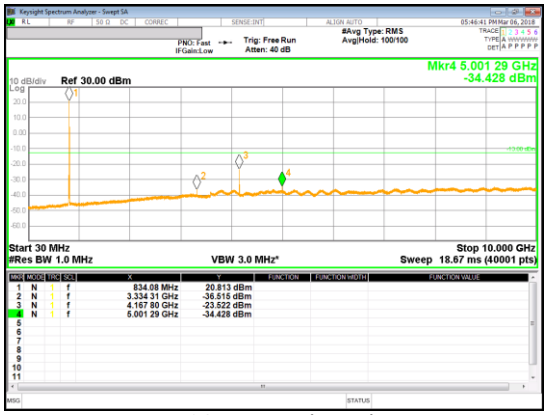
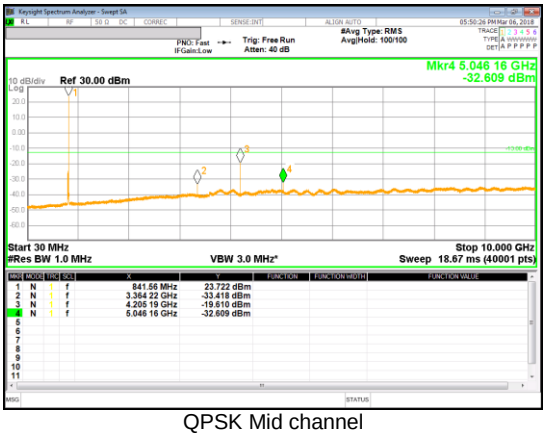
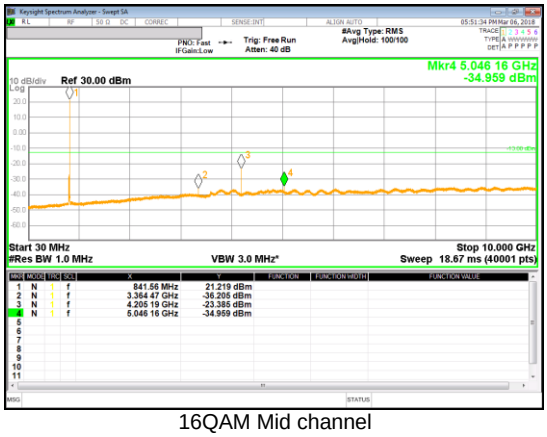
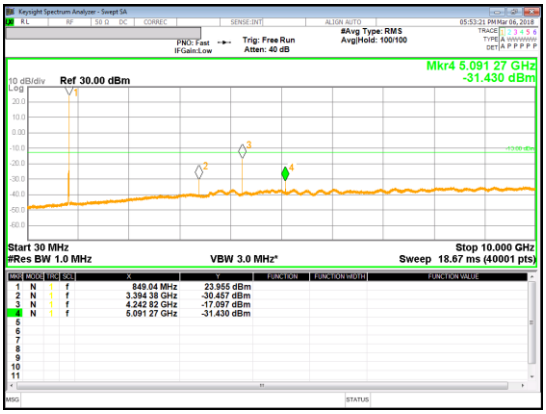
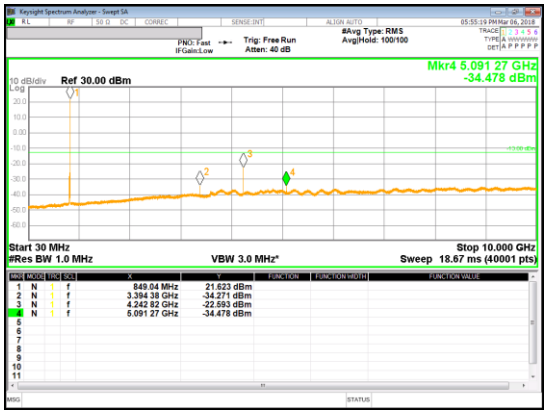
LTE Band 5

LTE Band 5 10MHz	 QPSK Low channel	 16QAM Low channel
	 QPSK Mid channel	 16QAM Mid channel
	 QPSK High channel	 16QAM High channel

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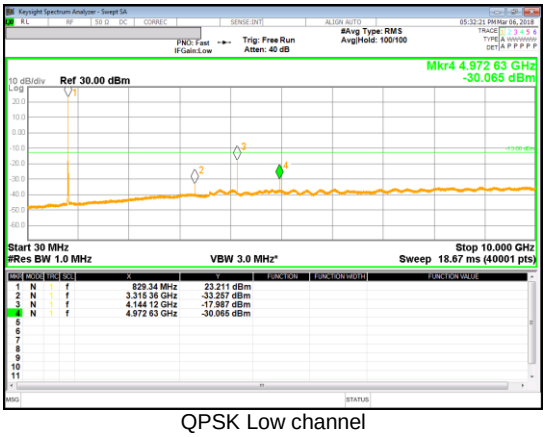
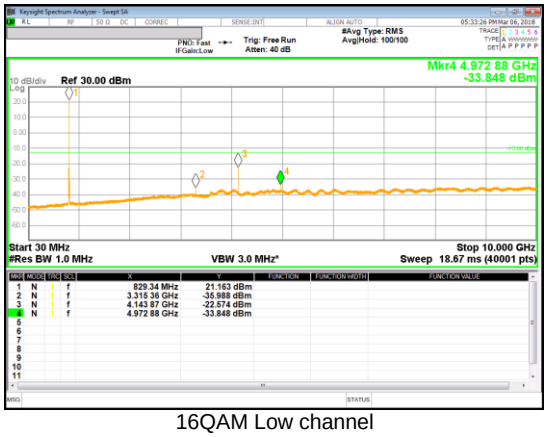
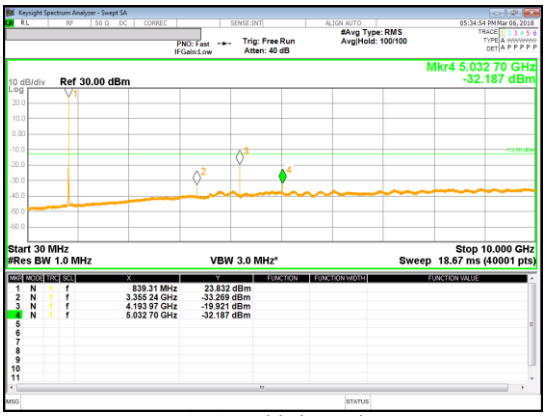
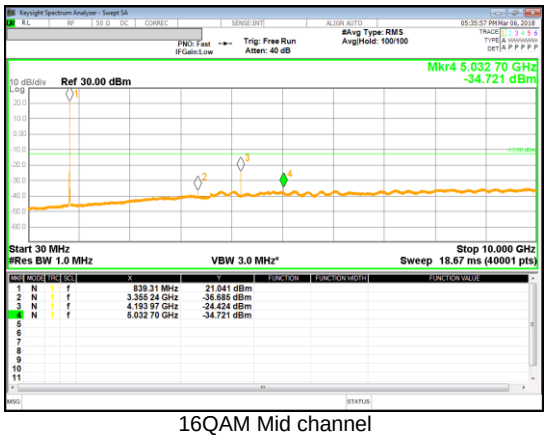
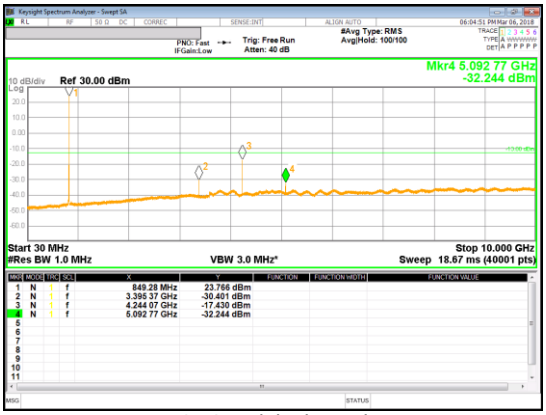
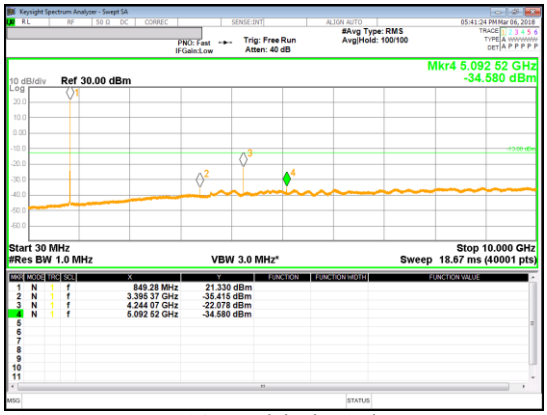
LTE Band 5 5MHz	 QPSK Low channel	 16QAM Low channel
	 QPSK Mid channel	 16QAM Mid channel
	 QPSK High channel	 16QAM High channel

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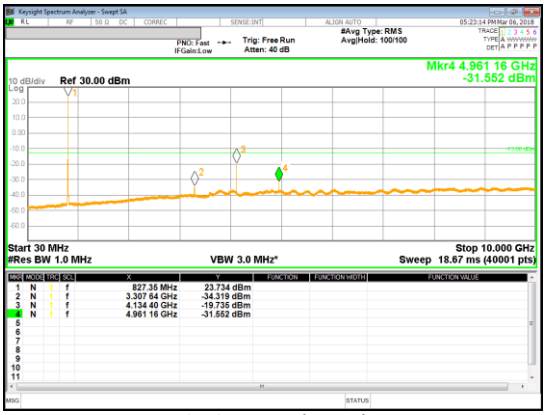
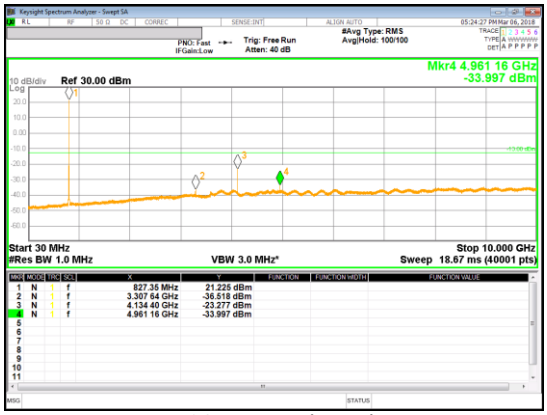
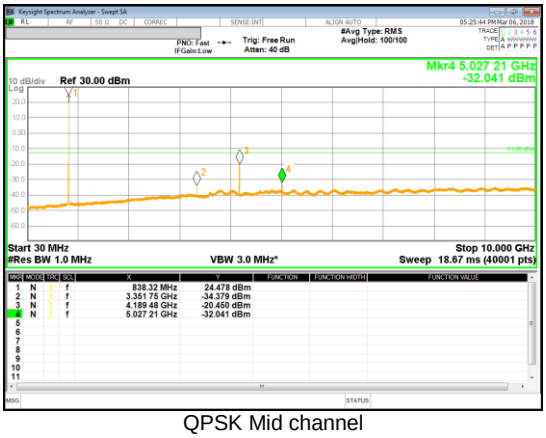
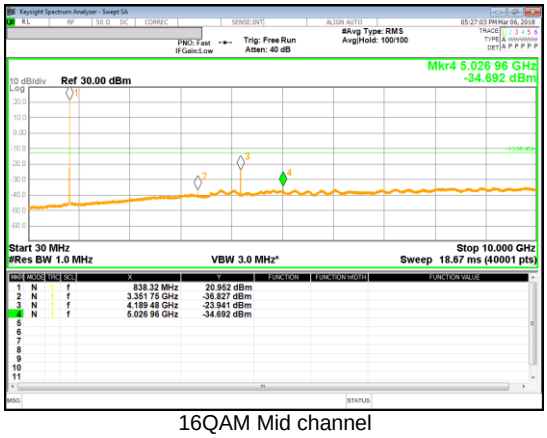
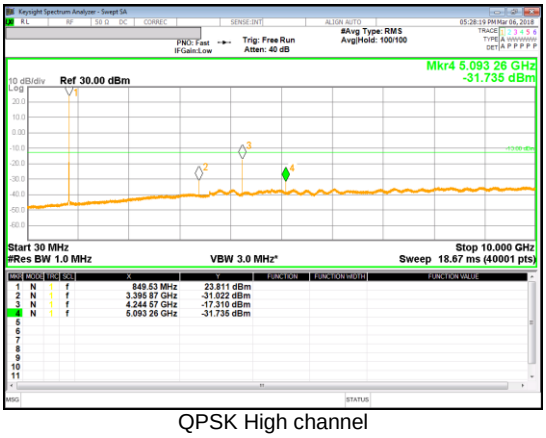
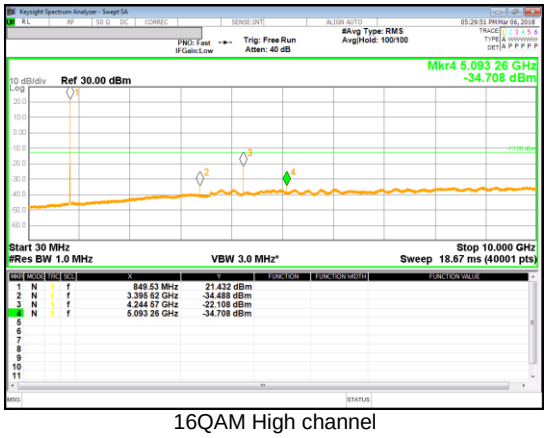
LTE Band 5 3MHz	 QPSK Low channel	 16QAM Low channel
	 QPSK Mid channel	 16QAM Mid channel
	 QPSK High channel	 16QAM High channel

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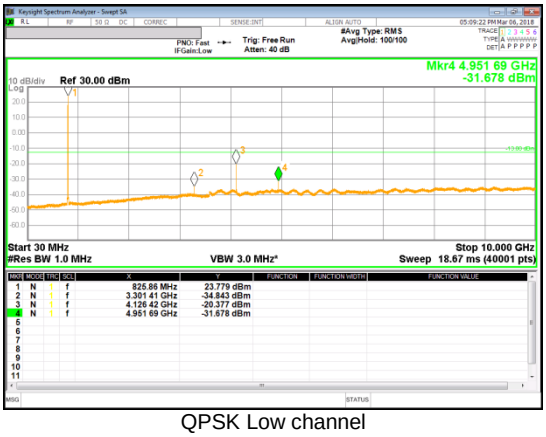
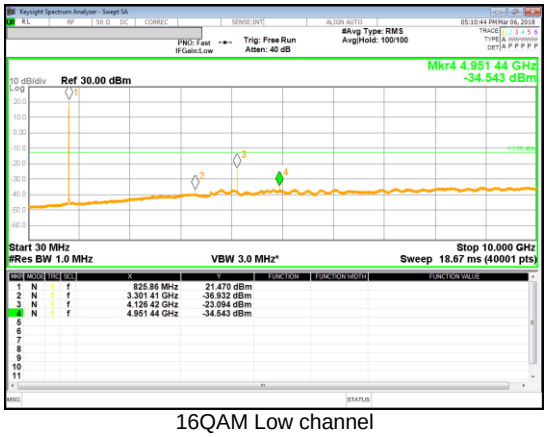
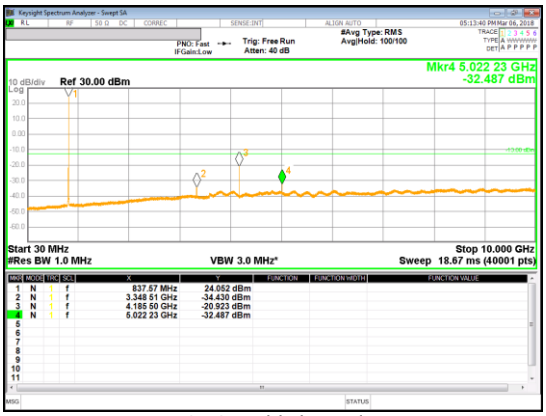
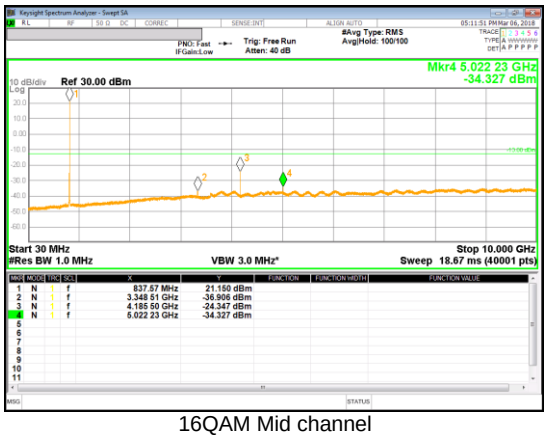
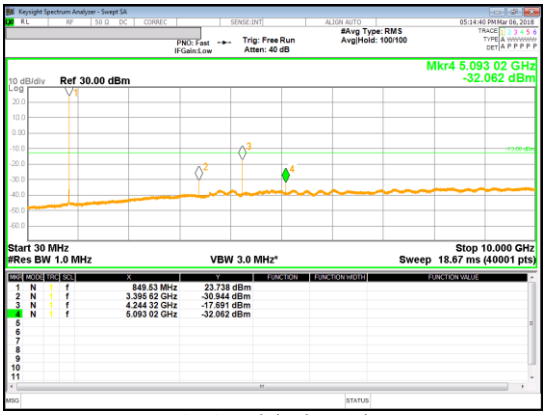
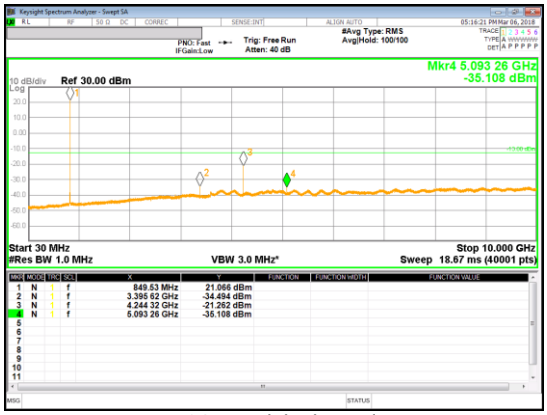
LTE Band 5 1.4MHz	 QPSK Low channel	 16QAM Low channel
	 QPSK Mid channel	 16QAM Mid channel
	 QPSK High channel	 16QAM High channel

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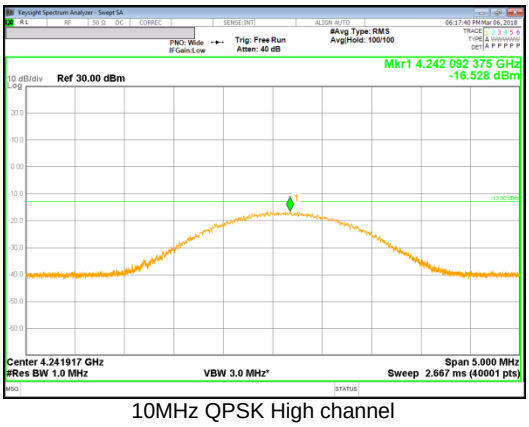
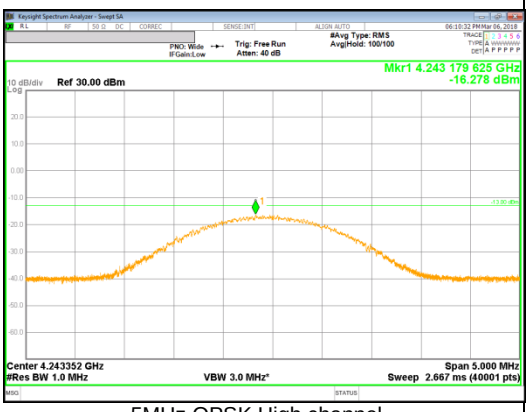
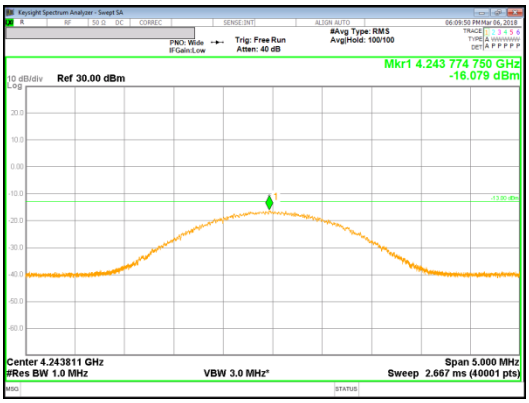
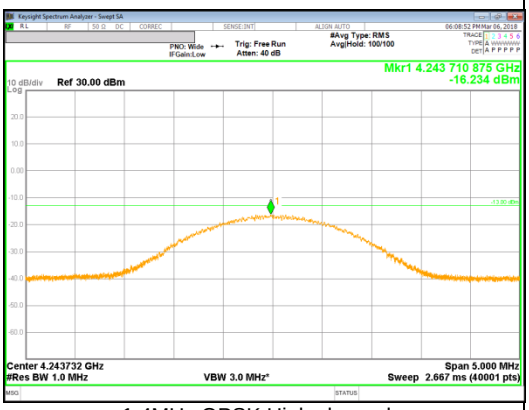
LTE Band5 5th Harmonic Span 5MHz	 10MHz QPSK High channel	 5MHz QPSK High channel
	 3MHz QPSK High channel	 1.4MHz QPSK High channel

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9.4. FREQUENCY STABILITY

RULE PART(S)

FCC: §2.1055, §22.355 and §24.235

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.

TEST PROCEDURE

Per KDB 971168 D01 Power Meas License Digital Systems v03

RESULTS

See the following pages.

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9.4.1. FREQUENCY STABILITY RESULTS

GSM 850, Channel 190, Frequency 836.6 MHz

Reference Frequency : GSM850 Mid Channel 836.6 MHz @ 20ºC Limit: +- 2.5 ppm = 2091.500 Hz				
Power Supply	Environment	Frequency Deviation Measureed with Time Elapse		
[Vdc]	Temperature [*C]	[MHz]	Delta [ppm]	Limit [ppm]
3.85	50	836.59997155	0.006	2.5
3.85	40	836.59997074	0.007	2.5
3.85	30	836.59996728	0.011	2.5
3.85	***20***	836.59997627	***0***	***2.5***
3.85	10	836.59997590	0.000	2.5
3.85	0	836.59997183	0.005	2.5
3.85	-10	836.59997352	0.003	2.5
3.85	-20	836.59997610	0.000	2.5
3.85	-30	836.59997317	0.004	2.5

Reference Frequency : GSM850 Mid Channel 836.6 MHz @ 20ºC Limit: +- 2.5 ppm = 2091.500 Hz				
Power Supply	Environment	Frequency Deviation Measureed with Time Elapse		
[Vdc]	Temperature [*C]	[MHz]	Delta [ppm]	Limit [ppm]
3.85	***20***	**836.59997627**	***0***	***2.5***
4.40	20	836.59997237	0.005	2.5
3.60	20	836.59997656	0.000	2.5

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GSM 1900, Channel 661, Frequency 1880.0 MHz

Reference Frequency: GSM1900 Mid Channel 1880.0 MHz @ 20ºC Limit: +- 2.5 ppm = 4700.000 Hz				
Power Supply	Environment	Frequency Deviation Measureed with Time Elapse		
[Vdc]	Temperature [*C]	[MHz]	Delta [ppm]	Limit [ppm]
3.85	50	1880.00001950	0.000	2.5
3.85	40	1880.00002383	-0.002	2.5
3.85	30	1880.00001980	0.000	2.5
3.85	***20***	1880.00001918	***0***	***2.5***
3.85	10	1880.00002108	-0.001	2.5
3.85	0	1880.00002592	-0.004	2.5
3.85	-10	1880.00002138	-0.001	2.5
3.85	-20	1880.00002693	-0.004	2.5
3.85	-30	1880.00001935	0.000	2.5

Reference Frequency: GSM1900 Mid Channel 1880.0 MHz @ 20ºC Limit: +- 2.5 ppm = 4700.000 Hz				
Power Supply	Environment	Frequency Deviation Measureed with Time Elapse		
[Vdc]	Temperature [*C]	[MHz]	Delta [ppm]	Limit [ppm]
3.85	***20***	**1880.00001918**	***0***	***2.5***
4.40	20	1880.00001703	0.001	2.5
3.60	20	1880.00002713	-0.004	2.5

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WCDMA Band 5 , Channel 4183, Frequency 836.6 MHz

Reference Frequency: WCDMA Band 5 Mid Channel 836.6 MHz @ 20ºC Limit: +- 2.5 ppm = 2091.500 Hz				
Power Supply	Environment	Frequency Deviation Measureed with Time Elapse		
[Vdc]	Temperature [*C]	[MHz]	Delta [ppm]	Limit [ppm]
3.85	50	836.59997477	-0.008	2.5
3.85	40	836.59997384	-0.007	2.5
3.85	30	836.59997158	-0.004	2.5
3.85	***20***	836.59996784	***0***	***2.5***
3.85	10	836.59997148	-0.004	2.5
3.85	0	836.59997488	-0.008	2.5
3.85	-10	836.59997745	-0.011	2.5
3.85	-20	836.59997381	-0.007	2.5
3.85	-30	836.59997322	-0.006	2.5

Reference Frequency: WCDMA Band 5 Mid Channel 836.6 MHz @ 20ºC Limit: +- 2.5 ppm = 2091.500 Hz				
Power Supply	Environment	Frequency Deviation Measureed with Time Elapse		
[Vdc]	Temperature [*C]	[MHz]	Delta [ppm]	Limit [ppm]
3.85	***20***	**836.59996784**	***0***	***2.5***
4.40	20	836.59997374	-0.007	2.5
3.60	20	836.59997102	-0.004	2.5

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WCDMA Band 2 , Channel 9400, Frequency 1880.0 MHz

Reference Frequency: WCDMA Band 2 Mid Channel 1880.0 MHz @ 20ºC Limit: +- 2.5 ppm = 4700.000 Hz				
Power Supply	Environment	Frequency Deviation Measureed with Time Elapse		
[Vdc]	Temperature [*C]	[MHz]	Delta [ppm]	Limit [ppm]
3.85	50	1880.00002183	0.003	2.5
3.85	40	1880.00002373	0.002	2.5
3.85	30	1880.00002629	0.000	2.5
3.85	***20***	1880.00002692	***0***	***2.5***
3.85	10	1880.00002788	-0.001	2.5
3.85	0	1880.00002848	-0.001	2.5
3.85	-10	1880.00002280	0.002	2.5
3.85	-20	1880.00001979	0.004	2.5
3.85	-30	1880.00001926	0.004	2.5

Reference Frequency: WCDMA Band 2 Mid Channel 1880.0 MHz @ 20ºC Limit: +- 2.5 ppm = 4700.000 Hz				
Power Supply	Environment	Frequency Deviation Measureed with Time Elapse		
[Vdc]	Temperature [*C]	[MHz]	Delta [ppm]	Limit [ppm]
3.85	***20***	**1880.00002692**	***0***	***2.5***
4.40	20	1880.00002621	0.000	2.5
3.60	20	1880.00002885	-0.001	2.5

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LTE Band 5 , Channel 20524, Frequency 836.5 MHz

Reference Frequency: LTE Band 5 Mid Channel 836.5 MHz @ 20ºC Limit: +- 2.5 ppm = 2091.250 Hz				
Power Supply	Environment	Frequency Deviation Measureed with Time Elapse		
[Vdc]	Temperature [*C]	[MHz]	Delta [ppm]	Limit [ppm]
3.85	50	836.50001642	0.007	2.5
3.85	40	836.50002343	-0.002	2.5
3.85	30	836.50002051	0.002	2.5
3.85	***20***	836.50002198	***0***	***2.5***
3.85	10	836.50001627	0.007	2.5
3.85	0	836.50001772	0.005	2.5
3.85	-10	836.50002133	0.001	2.5
3.85	-20	836.50002177	0.000	2.5
3.85	-30	836.50002254	-0.001	2.5

Reference Frequency: LTE Band 5 Mid Channel 836.5 MHz @ 20ºC Limit: +- 2.5 ppm = 2091.250 Hz				
Power Supply	Environment	Frequency Deviation Measureed with Time Elapse		
[Vdc]	Temperature [*C]	[MHz]	Delta [ppm]	Limit [ppm]
3.85	***20***	**836.50002198**	***0***	***2.5***
4.40	20	836.50001931	0.003	2.5
3.60	20	836.50001630	0.007	2.5

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10. RADIATED TEST RESULTS

10.1. RADIATED POWER (ERP & EIRP)

RULE PART(S)

FCC: §2.1046, §22.913 and §24.232

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.

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 v03

For peak power measurement with a ESU40:

a) Set the RBW ≥ OBW; b) Set VBW ≥ 3 × RBW; c) Set span ≥ 2 x RBW; d) Sweep time = auto couple; e) Detector = peak; f) Ensure that the number of measurement points ≥ span/RBW; g) Trace mode = max hold;

For average power measurement with a ESU40:

a) Set span to at least 1.5 times the OBW; b) Set RBW = 1-5% of the OBW, not to exceed 1 MHz; c) Set VBW ≥ 3 x RBW; d) Set number of points in sweep ≥ 2 × span / RBW; e) Sweep time = auto-couple; f) Detector = RMS (power averaging); g) Use free run trigger If burst duty cycle ≥ 98; h) Use trigger to capture bursts If burst duty cycle < 98; i) Trace average at least 100 traces in power averaging (*i.e.*, RMS) mode. j) Compute the power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function. (RBW/VBW are automatically set for LTE B41)

TEST RESULTS

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10.1.1. ERP/EIRP Results

GSM

Band	Mode	Channel	f [MHz]	ERP / EIRP	
				[dBm]	[mW]
GSM850	GPRS	512	824.2	27.80	602.56
		661	836.6	26.61	458.14
		810	848.8	25.59	362.24
	EGPRS	512	824.2	22.75	188.36
		661	836.6	21.09	128.53
		810	848.8	19.51	89.33
GSM1900	GPRS	512	1850.2	27.25	530.88
		661	1880.0	27.41	550.81
		810	1909.8	27.89	615.18
	EGPRS	512	1850.2	24.26	266.69
		661	1880.0	24.10	257.04
		810	1909.8	24.79	301.30

WCDMA

Band	Mode	Channel	f [MHz]	ERP / EIRP	
				[dBm]	[mW]
Band 5	REL99	4132	826.4	17.37	54.58
		4183	836.6	17.31	53.83
		4233	846.6	16.91	49.09
	HSDPA	4132	826.4	15.55	35.89
		4183	836.6	14.83	30.41
		4233	846.6	14.49	28.12
Band 2	REL99	9262	1852.4	19.07	80.72
		9400	1880.0	19.16	82.41
		9538	1907.6	18.26	66.99
	HSDPA	9262	1852.4	18.77	75.34
		9400	1880.0	18.64	73.11
		9538	1907.6	18.28	67.30

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LTE Band 5

Band	BW [MHz]	Mode	RB/RB Size	f [MHz]	ERP	
			Full RB		[dBm]	[mW]
Band 5	10	QPSK	50/0	829.0	14.72	29.65
			50/0	836.5	14.54	28.44
			50/0	844.0	14.20	26.30
		16QAM	50/0	829.0	13.63	23.07
			50/0	836.5	13.48	22.28
			50/0	844.0	13.11	20.46
	5	QPSK	25/0	826.5	14.96	31.33
			25/0	836.5	14.10	25.70
			25/0	846.5	13.99	25.06
		16QAM	25/0	826.5	13.80	23.99
			25/0	836.5	13.03	20.09
			25/0	846.5	12.83	19.19
	3	QPSK	15/0	825.5	14.55	28.51
			15/0	836.5	13.71	23.50
			15/0	847.5	13.87	24.38
		16QAM	15/0	825.5	13.42	21.98
			15/0	836.5	12.62	18.28
			15/0	847.5	12.73	18.75
	1.4	QPSK	6/0	824.7	11.91	15.52
			6/0	836.5	11.59	14.42
			6/0	848.3	11.78	15.07
		16QAM	6/0	824.7	10.81	12.05
			6/0	836.5	10.43	11.04
			6/0	848.3	10.66	11.64

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10.1.2.ERP/EIRP DATA

GSM 850

GSM

GSM850
GPRS

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-03-13
Test Engineer: 47989
Configuration: EUT / X-Position
Location: Chamber 2
Mode: GPRS 850 MHz Fundamentals

Test Equipment:
Receiving: VULB9163-749, and Chamber 2 SMA Cables
Substitution: Dipole 3121_DB4, 3m N-type Cable

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	23.92	V	1.0	-1.5	21.49	38.5	-17.0	
824.20	30.23	H	1.0	-1.5	27.80	38.5	-10.7	
Mid Ch								
836.60	22.88	V	1.0	-1.4	20.50	38.5	-18.0	
836.60	28.99	H	1.0	-1.4	26.61	38.5	-11.9	
High Ch								
848.80	22.62	V	1.0	-1.4	20.27	38.5	-18.2	
848.80	27.94	H	1.0	-1.4	25.59	38.5	-12.9	

GSM

GSM850
EGPRS

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-03-13
Test Engineer: 47989
Configuration: EUT / X-Position
Location: Chamber 2
Mode: EGPRS 850 MHz Fundamentals

Test Equipment:
Receiving: VULB9163-749, and Chamber 2 SMA Cables
Substitution: Dipole 3121_DB4, 3m N-type Cable

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	18.89	V	1.0	-1.5	16.46	38.5	-22.0	
824.20	25.18	H	1.0	-1.5	22.75	38.5	-15.7	
Mid Ch								
836.60	17.53	V	1.0	-1.4	15.15	38.5	-23.3	
836.60	23.47	H	1.0	-1.4	21.09	38.5	-17.4	
High Ch								
848.80	16.77	V	1.0	-1.4	14.42	38.5	-24.1	
848.80	21.86	H	1.0	-1.4	19.51	38.5	-19.0	

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GSM 1900

GSM

GSM1900
GPRS

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-03-12
Test Engineer: 47989
Configuration: EUT / Y-Position
Location: Chamber 2
Mode: GPRS 1900 MHz Fundamentals

Test Equpment:
Receiving: Horn 3117[00168724], and Chamber 2 SMA Cables
Substitution: Horn 3115[00161451], 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
1850.20	22.24	V	4.5	9.5	27.25	33.0	-5.7	
1850.20	18.30	H	4.5	9.5	23.31	33.0	-9.7	
Mid Ch								
1880.00	22.73	V	4.5	9.2	27.41	33.0	-5.6	
1880.00	17.06	H	4.5	9.2	21.74	33.0	-11.3	
High Ch								
1909.80	23.58	V	4.6	8.9	27.89	33.0	-5.1	
1909.80	17.11	H	4.6	8.9	21.42	33.0	-11.6	

GSM

GSM1900
EGPRS

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-03-12
Test Engineer: 47989
Configuration: EUT / Y-Position
Location: Chamber 2
Mode: EGPRS 1900 MHz Fundamentals

Test Equpment:
Receiving: Horn 3117[00168724], and Chamber 2 SMA Cables
Substitution: Horn 3115[00161451], 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
1850.20	19.25	V	4.5	9.5	24.26	33.0	-8.7	
1850.20	15.56	H	4.5	9.5	20.57	33.0	-12.4	
Mid Ch								
1880.00	19.42	V	4.5	9.2	24.10	33.0	-8.9	
1880.00	15.19	H	4.5	9.2	19.87	33.0	-13.1	
High Ch								
1909.80	20.48	V	4.6	8.9	24.79	33.0	-8.2	
1909.80	15.38	H	4.6	8.9	19.69	33.0	-13.3	

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WCDMA Band 5

WCDMA

Band 5
REL99

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-02-22
Test Engineer: 47989
Configuration: EUT / X-Position
Location: Chamber 2
Mode: Rel99 Band 5 Fundamentals

Test Equipment:
Receiving: VULB9163-749, and Chamber 2 SMA Cables
Substitution: Dipole 3121_DB4, 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
826.40	11.81	V	1.0	-1.5	9.39	38.5	-29.1	
826.40	19.79	H	1.0	-1.5	17.37	38.5	-21.1	
Mid Ch								
836.60	11.20	V	1.0	-1.4	8.82	38.5	-29.7	
836.60	19.69	H	1.0	-1.4	17.31	38.5	-21.2	
High Ch								
846.60	10.69	V	1.0	-1.4	8.34	38.5	-30.2	
846.60	19.26	H	1.0	-1.4	16.91	38.5	-21.6	

WCDMA

Band 5
HSDPA

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-02-22
Test Engineer: 47989
Configuration: EUT / X-Position
Location: Chamber 2
Mode: HSDPA Band 5 Fundamentals

Test Equipment:
Receiving: VULB9163-749, and Chamber 2 SMA Cables
Substitution: Dipole 3121_DB4, 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
826.40	9.49	V	1.0	-1.5	7.07	38.5	-31.4	
826.40	17.97	H	1.0	-1.5	15.55	38.5	-23.0	
Mid Ch								
836.60	8.30	V	1.0	-1.4	5.92	38.5	-32.6	
836.60	17.21	H	1.0	-1.4	14.83	38.5	-23.7	
High Ch								
846.60	7.94	V	1.0	-1.4	5.59	38.5	-32.9	
846.60	16.84	H	1.0	-1.4	14.49	38.5	-24.0	

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WCDMA Band 2

WCDMA

Band 2
REL99

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-03-01
Test Engineer: 47989
Configuration: EUT / Y-Position
Location: Chamber 1
Mode: Rel99 Band 2 Fundamentals

Test Equpment:
Receiving: Horn 3117[00168717], and Chamber 1 SMA Cables
Substitution: Horn 3115[00161451], 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
1852.40	14.08	V	4.5	9.5	19.07	33.0	-13.9	
1852.40	9.44	H	4.5	9.5	14.43	33.0	-18.6	
Mid Ch								
1880.00	14.48	V	4.5	9.2	19.16	33.0	-13.8	
1880.00	9.56	H	4.5	9.2	14.24	33.0	-18.8	
High Ch								
1907.60	13.92	V	4.6	8.9	18.26	33.0	-14.7	
1907.60	10.32	H	4.6	8.9	14.66	33.0	-18.3	

WCDMA

Band 2
HSDPA

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-03-01
Test Engineer: 47989
Configuration: EUT / Y-Position
Location: Chamber 1
Mode: HSDPA Band 2 Fundamentals

Test Equpment:
Receiving: Horn 3117[00168717], and Chamber 1 SMA Cables
Substitution: Horn 3115[00161451], 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
1852.40	13.78	V	4.5	9.5	18.77	33.0	-14.2	
1852.40	8.63	H	4.5	9.5	13.62	33.0	-19.4	
Mid Ch								
1880.00	13.96	V	4.5	9.2	18.64	33.0	-14.4	
1880.00	9.19	H	4.5	9.2	13.87	33.0	-19.1	
High Ch								
1907.60	13.94	V	4.6	8.9	18.28	33.0	-14.7	
1907.60	9.87	H	4.6	8.9	14.21	33.0	-18.8	

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LTE Band 5

LTE Band 5 10MHz QPSK

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-02-22
Test Engineer: 47989
Configuration: EUT / X-Position
Location: Chamber 2
Mode: LTE_QPSK Band 5 Fundamentals, 10MHz Bandwidth

Test Equipment:
Receiving: VULB9163-749, and Chamber 2 SMA Cables
Substitution: Dipole 3121_DB4, 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
829.00	9.35	V	1.0	-1.5	6.94	38.5	-31.6	
829.00	17.13	H	1.0	-1.5	14.72	38.5	-23.8	
Mid Ch								
836.50	8.77	V	1.0	-1.4	6.39	38.5	-32.1	
836.50	16.92	H	1.0	-1.4	14.54	38.5	-24.0	
High Ch								
844.00	8.27	V	1.0	-1.4	5.92	38.5	-32.6	
844.00	16.56	H	1.0	-1.4	14.20	38.5	-24.3	

LTE Band 5 10MHz 16QAM

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-02-22
Test Engineer: 47989
Configuration: EUT / X-Position
Location: Chamber 2
Mode: LTE_16QAM Band 5 Fundamentals, 10MHz Bandwidth

Test Equipment:
Receiving: VULB9163-749, and Chamber 2 SMA Cables
Substitution: Dipole 3121_DB4, 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
829.00	8.30	V	1.0	-1.5	5.89	38.5	-32.6	
829.00	16.04	H	1.0	-1.5	13.63	38.5	-24.9	
Mid Ch								
836.50	7.66	V	1.0	-1.4	5.28	38.5	-33.2	
836.50	15.86	H	1.0	-1.4	13.48	38.5	-25.0	
High Ch								
844.00	7.17	V	1.0	-1.4	4.82	38.5	-33.7	
844.00	15.47	H	1.0	-1.4	13.11	38.5	-25.4	

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LTE
Band 5
5MHz
QPSK

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-02-22
Test Engineer: 47989
Configuration: EUT / X-Position
Location: Chamber 2
Mode: LTE_QPSK Band 5 Fundamentals, 5MHz Bandwidth

Test Equipment:
Receiving: VULB9163-749, and Chamber 2 SMA Cables
Substitution: Dipole 3121_DB4, 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
826.50	9.23	V	1.0	-1.5	6.81	38.5	-31.7	
826.50	17.38	H	1.0	-1.5	14.96	38.5	-23.5	
Mid Ch								
836.50	8.15	V	1.0	-1.4	5.77	38.5	-32.7	
836.50	16.48	H	1.0	-1.4	14.10	38.5	-24.4	
High Ch								
846.50	7.70	V	1.0	-1.4	5.35	38.5	-33.1	
846.50	16.34	H	1.0	-1.4	13.99	38.5	-24.5	

LTE
Band 5
5MHz
16QAM

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-02-22
Test Engineer: 47989
Configuration: EUT / X-Position
Location: Chamber 2
Mode: LTE_16QAM Band 5 Fundamentals, 5MHz Bandwidth

Test Equipment:
Receiving: VULB9163-749, and Chamber 2 SMA Cables
Substitution: Dipole 3121_DB4, 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
826.50	8.14	V	1.0	-1.5	5.72	38.5	-32.8	
826.50	16.22	H	1.0	-1.5	13.80	38.5	-24.7	
Mid Ch								
836.50	7.06	V	1.0	-1.4	4.68	38.5	-33.8	
836.50	15.41	H	1.0	-1.4	13.03	38.5	-25.5	
High Ch								
846.50	6.62	V	1.0	-1.4	4.27	38.5	-34.2	
846.50	15.18	H	1.0	-1.4	12.83	38.5	-25.7	

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LTE
Band 5
3MHz
QPSK

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-02-22
Test Engineer: 47989
Configuration: EUT / X-Position
Location: Chamber 2
Mode: LTE_QPSK Band 5 Fundamentals, 3MHz Bandwidth

Test Equipment:
Receiving: VULB9163-749, and Chamber 2 SMA Cables
Substitution: Dipole 3121_DB4, 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
825.50	9.02	V	1.0	-1.5	6.60	38.5	-31.9	
825.50	16.97	H	1.0	-1.5	14.55	38.5	-24.0	
Mid Ch								
836.50	8.07	V	1.0	-1.4	5.69	38.5	-32.8	
836.50	16.09	H	1.0	-1.4	13.71	38.5	-24.8	
High Ch								
847.50	7.35	V	1.0	-1.4	5.01	38.5	-33.5	
847.50	16.22	H	1.0	-1.4	13.87	38.5	-24.6	

LTE
Band 5
3MHz
16QAM

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-02-22
Test Engineer: 47989
Configuration: EUT / X-Position
Location: Chamber 2
Mode: LTE_16QAM Band 5 Fundamentals, 3MHz Bandwidth

Test Equipment:
Receiving: VULB9163-749, and Chamber 2 SMA Cables
Substitution: Dipole 3121_DB4, 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
825.50	7.88	V	1.0	-1.5	5.46	38.5	-33.0	
825.50	15.84	H	1.0	-1.5	13.42	38.5	-25.1	
Mid Ch								
836.50	6.86	V	1.0	-1.4	4.48	38.5	-34.0	
836.50	15.00	H	1.0	-1.4	12.62	38.5	-25.9	
High Ch								
847.50	6.23	V	1.0	-1.4	3.89	38.5	-34.6	
847.50	15.08	H	1.0	-1.4	12.73	38.5	-25.8	

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LTE
Band 5
1.4MHz
QPSK

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-02-22
Test Engineer: 47989
Configuration: EUT / X-Position
Location: Chamber 2
Mode: LTE_QPSK Band 5 Fundamentals, 1.4MHz Bandwidth

Test Equipment:
Receiving: VULB9163-749, and Chamber 2 SMA Cables
Substitution: Dipole 3121_DB4, 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
824.70	5.42	V	1.0	-1.5	2.99	38.5	-35.5	
824.70	14.34	H	1.0	-1.5	11.91	38.5	-26.6	
Mid Ch								
836.50	5.37	V	1.0	-1.4	2.99	38.5	-35.5	
836.50	13.97	H	1.0	-1.4	11.59	38.5	-26.9	
High Ch								
848.30	5.10	V	1.0	-1.4	2.75	38.5	-35.7	
848.30	14.13	H	1.0	-1.4	11.78	38.5	-26.7	

LTE
Band 5
1.4MHz
16QAM

UL Verification Services, Inc.
High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-02-22
Test Engineer: 47989
Configuration: EUT / X-Position
Location: Chamber 2
Mode: LTE_16QAM Band 5 Fundamentals, 1.4MHz Bandwidth

Test Equipment:
Receiving: VULB9163-749, and Chamber 2 SMA Cables
Substitution: Dipole 3121_DB4, 3m N-type Cable

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Cable Loss (dB)	Antenna Gain (dBd)	ERP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch								
824.70	4.42	V	1.0	-1.5	1.99	38.5	-36.5	
824.70	13.24	H	1.0	-1.5	10.81	38.5	-27.7	
Mid Ch								
836.50	4.28	V	1.0	-1.4	1.90	38.5	-36.6	
836.50	12.81	H	1.0	-1.4	10.43	38.5	-28.1	
High Ch								
848.30	3.96	V	1.0	-1.4	1.61	38.5	-36.9	
848.30	13.01	H	1.0	-1.4	10.66	38.5	-27.8	

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10.2. FIELD STRENGTH OF SPURIOUS RADIATION

RULE PART(S)

FCC: §2.1053, §22.917and §24.238

LIMIT

Part 22.917(a) & Part 24.238(a) 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.

TEST PROCEDURE

ANSI / TIA / EIA 603 E Clause 2.2.12; ESU40 setting reference to 971168 D01 v03

For peak power measurement with a ESU40:

a) Set the RBW = 100 KHz for emission below 1GHz and 1MHz for emissions above 1GHz

b) Set VBW ≥ 3 × RBW;

c) Set span ≥ 1.5 times the OBW;

d) Sweep time = auto couple;

e) Detector = peak;

f) Ensure that the number of measurement points ≥ span/RBW;

g) Trace mode = max hold;

NOTE : Radiated spurious emissions were investigated 30MHz – 1GHz and above 1GHz. There were no emissions found on 30MHz – 1GHz.

RESULTS

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10.2.1. SPURIOUS RADIATION PLOTS

GSM 850

GSM

GSM850
GPRS

UL Verification Services, Inc.
Above 1GHz High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-03-13
Test Engineer: 47989
Configuration: EUT / AC Adapter / Earphone, X-Position
Location: Chamber 2
Mode: GPRS 850 MHz Harmonics

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, 824.2MHz									
1648.40	-10.0	V	3.0	38.2	1.0	-47.2	-13.0	-34.2	
2472.60	8.8	V	3.0	38.8	1.0	-29.0	-13.0	-16.0	
3296.80	-15.0	V	3.0	39.4	1.0	-53.5	-13.0	-40.5	
4121.00	1.1	V	3.0	39.8	1.0	-37.7	-13.0	-24.7	
1648.40	-10.6	H	3.0	38.2	1.0	-47.8	-13.0	-34.8	
2472.60	9.8	H	3.0	38.8	1.0	-28.0	-13.0	-15.0	
3296.80	-15.2	H	3.0	39.4	1.0	-53.6	-13.0	-40.6	
4121.00	3.5	H	3.0	39.8	1.0	-35.3	-13.0	-22.3	
Mid Ch, 836.6MHz									
1673.20	-10.2	V	3.0	38.2	1.0	-47.4	-13.0	-34.4	
2509.80	7.3	V	3.0	38.8	1.0	-30.6	-13.0	-17.6	
3346.40	-14.7	V	3.0	39.5	1.0	-53.2	-13.0	-40.2	
4183.00	3.6	V	3.0	39.8	1.0	-35.2	-13.0	-22.2	
1673.20	-9.2	H	3.0	38.2	1.0	-46.5	-13.0	-33.5	
2509.80	9.2	H	3.0	38.8	1.0	-28.7	-13.0	-15.7	
3346.40	-14.2	H	3.0	39.5	1.0	-52.7	-13.0	-39.7	
4183.00	4.6	H	3.0	39.8	1.0	-34.2	-13.0	-21.2	
High Ch, 848.8MHz									
1697.60	-8.7	V	3.0	38.2	1.0	-45.9	-13.0	-32.9	
2546.40	7.4	V	3.0	38.9	1.0	-30.5	-13.0	-17.5	
3395.20	-14.8	V	3.0	39.5	1.0	-53.3	-13.0	-40.3	
4244.00	4.0	V	3.0	39.8	1.0	-34.8	-13.0	-21.8	
1697.60	-4.3	H	3.0	38.2	1.0	-41.6	-13.0	-28.6	
2546.40	11.6	H	3.0	38.9	1.0	-26.3	-13.0	-13.3	
3395.20	-14.3	H	3.0	39.5	1.0	-52.8	-13.0	-39.8	
4244.00	2.2	H	3.0	39.8	1.0	-36.6	-13.0	-23.6	

GSM

GSM850
EGPRS

UL Verification Services, Inc.
Above 1GHz High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-03-13
Test Engineer: 47989
Configuration: EUT / AC Adapter / Earphone, X-Position
Location: Chamber 2
Mode: EGPRS 850 MHz Harmonics

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, 824.2MHz									
1648.40	-17.5	V	3.0	38.2	1.0	-54.7	-13.0	-41.7	
2472.60	-4.2	V	3.0	38.8	1.0	-42.0	-13.0	-29.0	
3296.80	-15.5	V	3.0	39.4	1.0	-53.9	-13.0	-40.9	
4121.00	-10.6	V	3.0	39.8	1.0	-49.4	-13.0	-36.4	
1648.40	-15.2	H	3.0	38.2	1.0	-52.4	-13.0	-39.4	
2472.60	-3.7	H	3.0	38.8	1.0	-41.5	-13.0	-28.5	
3296.80	-15.4	H	3.0	39.4	1.0	-53.8	-13.0	-40.8	
4121.00	-9.0	H	3.0	39.8	1.0	-47.8	-13.0	-34.8	
Mid Ch, 836.6MHz									
1673.20	-17.1	V	3.0	38.2	1.0	-54.3	-13.0	-41.3	
2509.80	-5.7	V	3.0	38.8	1.0	-43.5	-13.0	-30.5	
3346.40	-14.5	V	3.0	39.5	1.0	-52.9	-13.0	-39.9	
4183.00	-9.7	V	3.0	39.8	1.0	-48.6	-13.0	-35.6	
1673.20	-14.7	H	3.0	38.2	1.0	-51.9	-13.0	-38.9	
2509.80	-2.7	H	3.0	38.8	1.0	-40.6	-13.0	-27.6	
3346.40	-14.5	H	3.0	39.5	1.0	-53.0	-13.0	-40.0	
4183.00	-7.8	H	3.0	39.8	1.0	-46.6	-13.0	-33.6	
High Ch, 848.8MHz									
1697.60	-11.2	V	3.0	38.2	1.0	-48.5	-13.0	-35.5	
2546.40	-2.2	V	3.0	38.9	1.0	-40.0	-13.0	-27.0	
3395.20	-14.2	V	3.0	39.5	1.0	-52.7	-13.0	-39.7	
4244.00	-9.1	V	3.0	39.8	1.0	-47.9	-13.0	-34.9	
1697.60	-8.7	H	3.0	38.2	1.0	-46.0	-13.0	-33.0	
2546.40	2.0	H	3.0	38.9	1.0	-35.9	-13.0	-22.9	
3395.20	-14.2	H	3.0	39.5	1.0	-52.6	-13.0	-39.6	
4244.00	-8.5	H	3.0	39.8	1.0	-47.3	-13.0	-34.3	

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GSM 1900

GSM

GSM1900
GPRS

UL Verification Services, Inc.
Above 1GHz High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-03-12
Test Engineer: 47989
Configuration: EUT / AC Adapter / Earphone, Y-Position
Location: Chamber 2
Mode: GPRS 1900 MHz Harmonics

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, 1850.2MHz									
3700.40	-9.0	V	3.0	39.7	1.0	-47.6	-13.0	-34.6	
5550.60	-8.8	V	3.0	39.9	1.0	-47.7	-13.0	-34.7	
7400.80	-11.6	V	3.0	39.4	1.0	-50.0	-13.0	-37.0	
3700.40	-10.3	H	3.0	39.7	1.0	-48.9	-13.0	-35.9	
5550.60	-10.0	H	3.0	39.9	1.0	-48.9	-13.0	-35.9	
7400.80	-11.1	H	3.0	39.4	1.0	-49.5	-13.0	-36.5	
Mid Ch, 1880MHz									
3760.00	-9.0	V	3.0	39.7	1.0	-47.7	-13.0	-34.7	
5640.00	-10.3	V	3.0	40.0	1.0	-49.3	-13.0	-36.3	
7520.00	-10.7	V	3.0	39.4	1.0	-49.1	-13.0	-36.1	
3760.00	-10.1	H	3.0	39.7	1.0	-48.8	-13.0	-35.8	
5640.00	-11.6	H	3.0	40.0	1.0	-50.6	-13.0	-37.6	
7520.00	-10.8	H	3.0	39.4	1.0	-49.2	-13.0	-36.2	
High Ch, 1909.8MHz									
3819.60	-9.8	V	3.0	39.7	1.0	-48.5	-13.0	-35.5	
5729.40	-11.1	V	3.0	40.0	1.0	-50.1	-13.0	-37.1	
7639.20	-10.7	V	3.0	39.3	1.0	-49.1	-13.0	-36.1	
3819.60	-11.1	H	3.0	39.7	1.0	-49.8	-13.0	-36.8	
5729.40	-9.8	H	3.0	40.0	1.0	-48.7	-13.0	-35.7	
7639.20	-10.3	H	3.0	39.3	1.0	-48.7	-13.0	-35.7	

GSM

GSM1900
EGPRS

UL Verification Services, Inc.
Above 1GHz High Frequency Substitution Measurement

Company: Samsung
Project #: 4788371662
Date: 2018-03-12
Test Engineer: 47989
Configuration: EUT / AC Adapter / Earphone, Y-Position
Location: Chamber 2
Mode: EGPRS 1900 MHz Harmonics

f MHz	SG reading (dBm)	Ant. Pol. (H/V)	Distance (m)	Preamp (dB)	Filter (dB)	EIRP (dBm)	Limit (dBm)	Delta (dB)	Notes
Low Ch, 1850.2MHz									
3700.40	-10.9	V	3.0	39.7	1.0	-49.5	-13.0	-36.5	
5550.60	-11.0	V	3.0	39.9	1.0	-49.9	-13.0	-36.9	
7400.80	-11.9	V	3.0	39.4	1.0	-50.4	-13.0	-37.4	
3700.40	-13.1	H	3.0	39.7	1.0	-51.8	-13.0	-38.8	
5550.60	-12.1	H	3.0	39.9	1.0	-51.0	-13.0	-38.0	
7400.80	-11.2	H	3.0	39.4	1.0	-49.6	-13.0	-36.6	
Mid Ch, 1880MHz									
3760.00	-11.9	V	3.0	39.7	1.0	-50.6	-13.0	-37.6	
5640.00	-12.3	V	3.0	40.0	1.0	-51.2	-13.0	-38.2	
7520.00	-10.9	V	3.0	39.4	1.0	-49.3	-13.0	-36.3	
3760.00	-12.4	H	3.0	39.7	1.0	-51.1	-13.0	-38.1	
5640.00	-12.3	H	3.0	40.0	1.0	-51.2	-13.0	-38.2	
7520.00	-10.9	H	3.0	39.4	1.0	-49.2	-13.0	-36.2	
High Ch, 1909.8MHz									
3819.60	-12.0	V	3.0	39.7	1.0	-50.7	-13.0	-37.7	
5729.40	-11.5	V	3.0	40.0	1.0	-50.5	-13.0	-37.5	
7639.20	-11.0	V	3.0	39.3	1.0	-49.3	-13.0	-36.3	
3819.60	-12.9	H	3.0	39.7	1.0	-51.6	-13.0	-38.6	
5729.40	-12.1	H	3.0	40.0	1.0	-51.1	-13.0	-38.1	
7639.20	-11.0	H	3.0	39.3	1.0	-49.3	-13.0	-36.3	

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