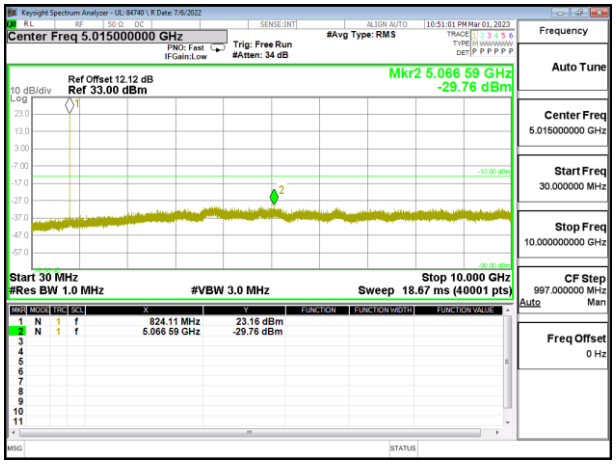
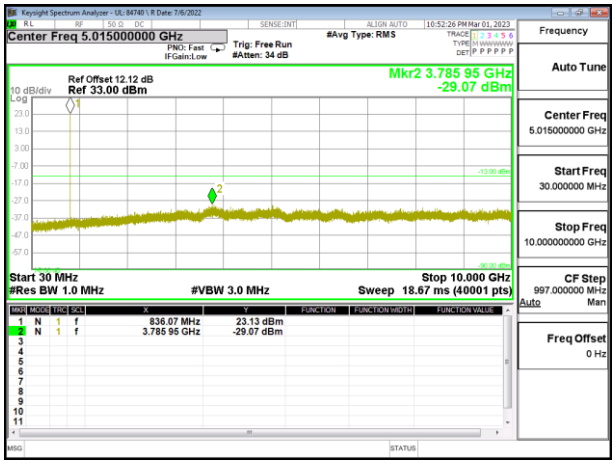
10.3.2. LTE5

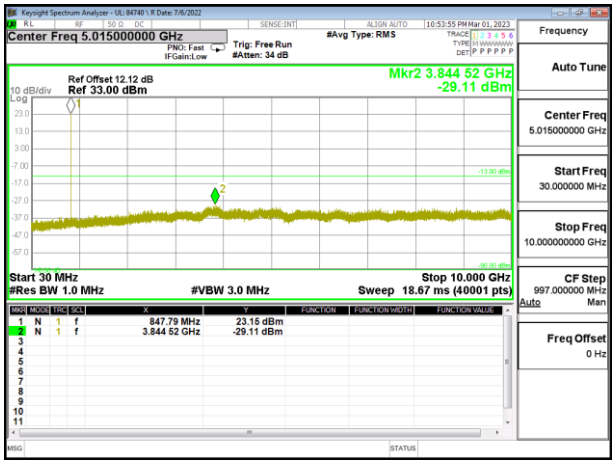
Test Engineer ID:	84740/44389	Test Date:	2023-03-01	Sample Used:	QV7700ADFR



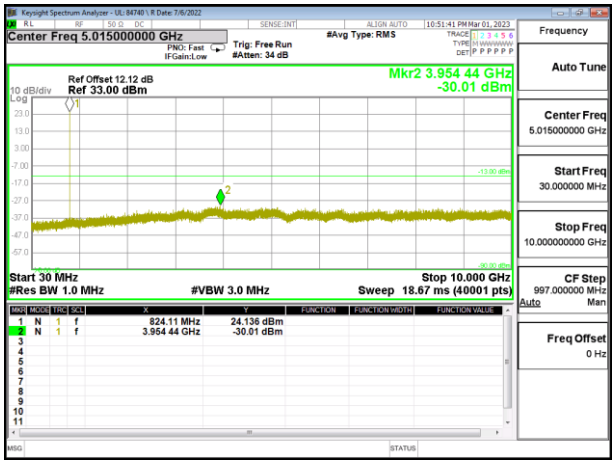
LTE5 1.4MHz QPSK LOW Ch RB1-0



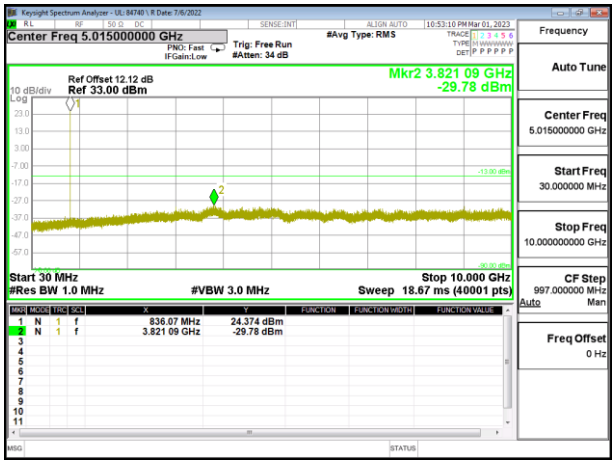
LTE5 1.4MHz QPSK MID Ch RB1-0



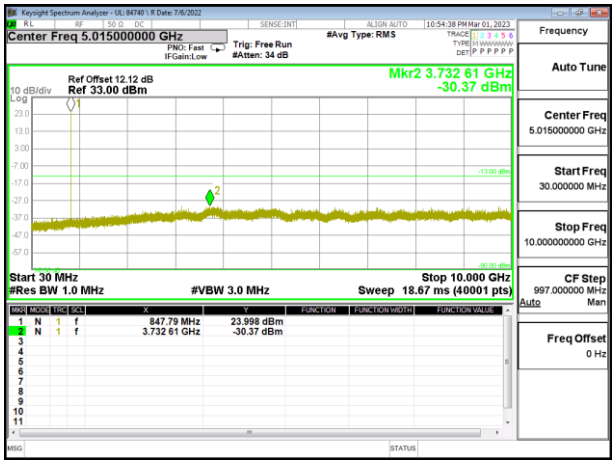
LTE5 1.4MHz QPSK HIGH Ch RB1-0



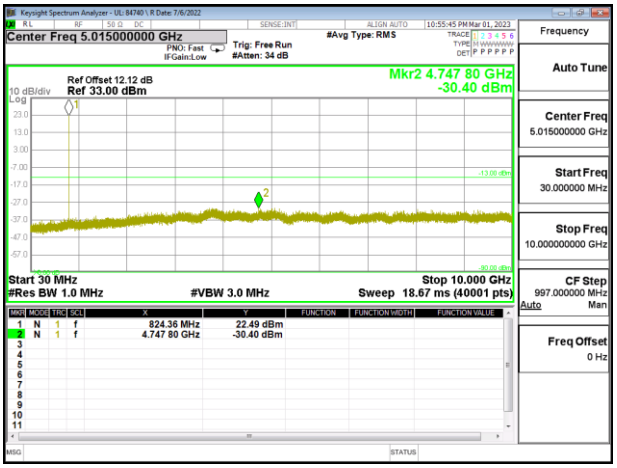
LTE5 1.4MHz 16QAM LOW Ch RB1-0



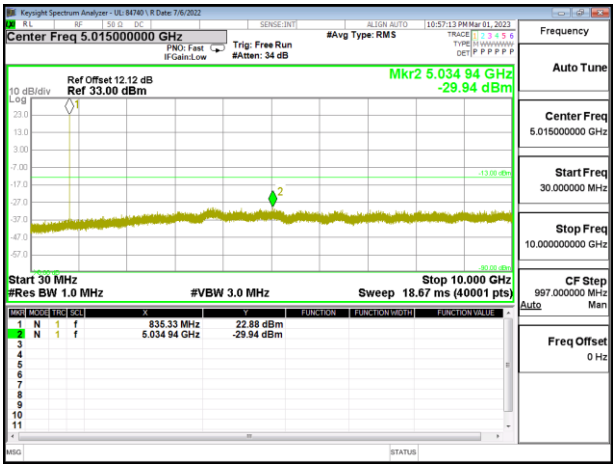
LTE5 1.4MHz 16QAM MID Ch RB1-0



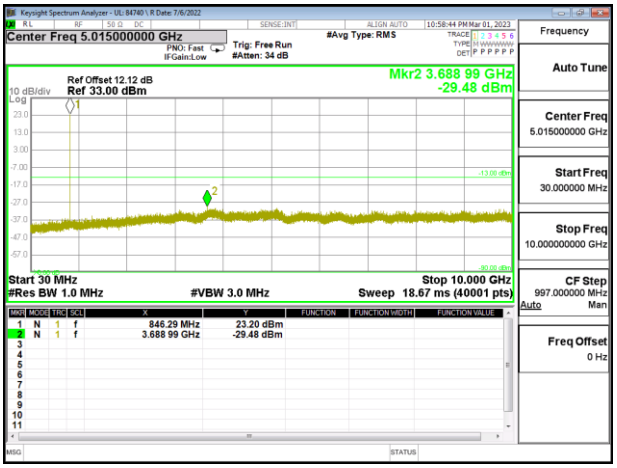
LTE5 1.4MHz 16QAM HIGH Ch RB1-0



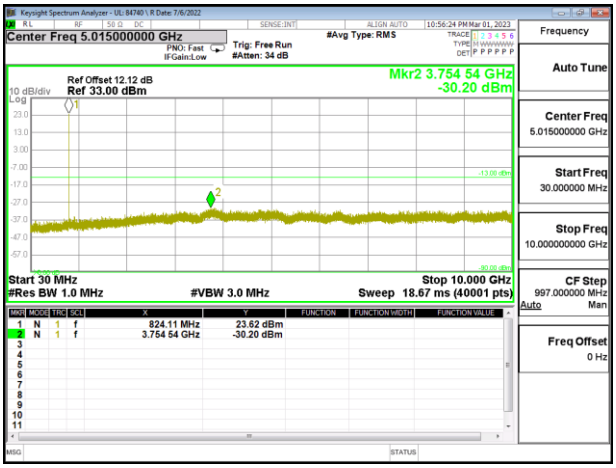
LTE5 3MHz QPSK LOW Ch RB1-0



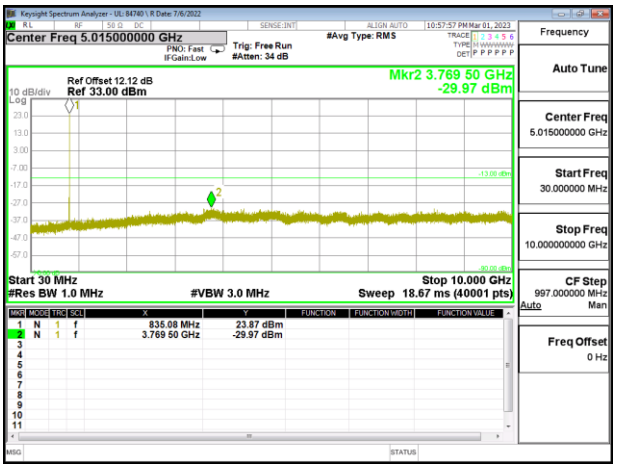
LTE5 MHz QPSK MID Ch RB1-0



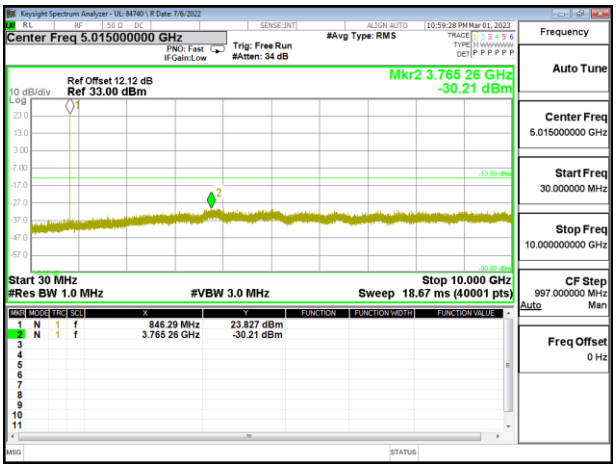
LTE5 3MHz QPSK HIGH Ch RB1-0



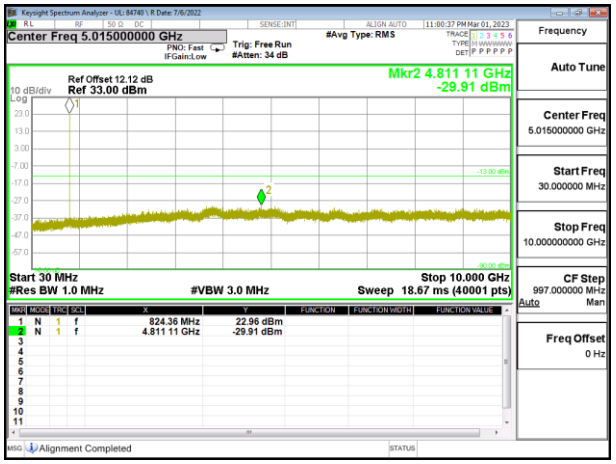
LTE5 3MHz 16QAM LOW Ch RB1-0



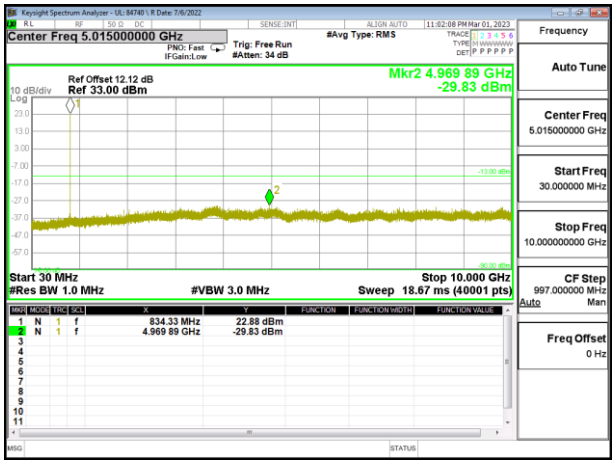
LTE5 3MHz 16QAM MID Ch RB1-0



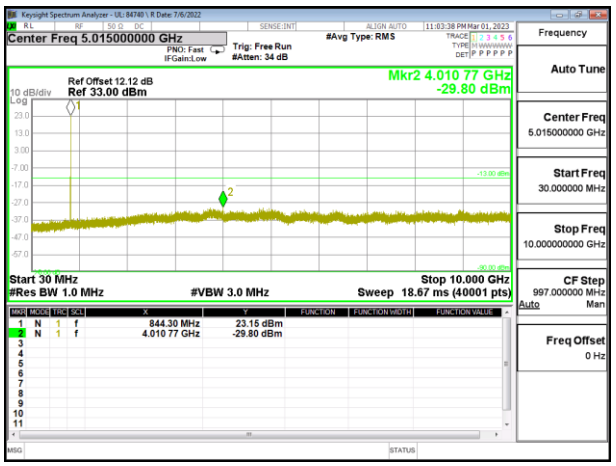
LTE5 3MHz 16QAM HIGH Ch RB1-0



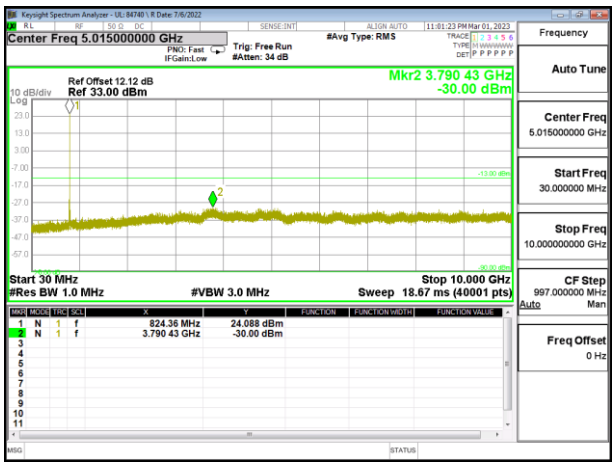
LTE5 5MHz QPSK LOW Ch RB1-0



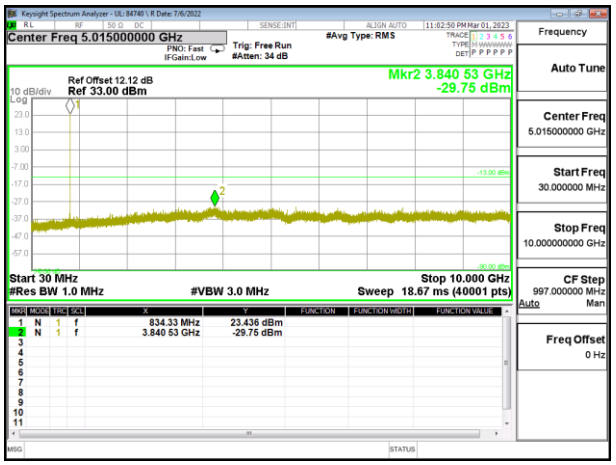
LTE5 5MHz QPSK MID Ch RB1-0



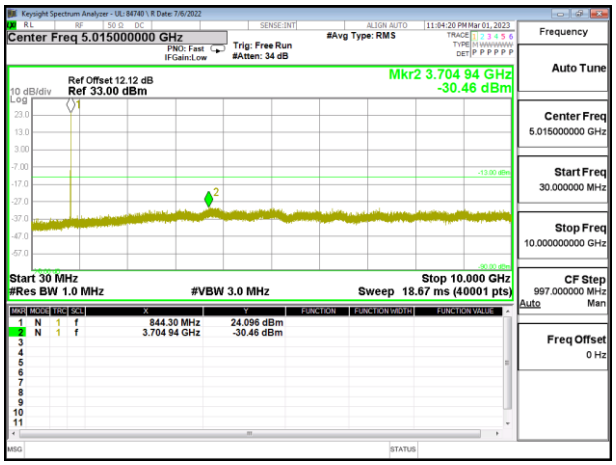
LTE5 5MHz QPSK HIGH Ch RB1-0



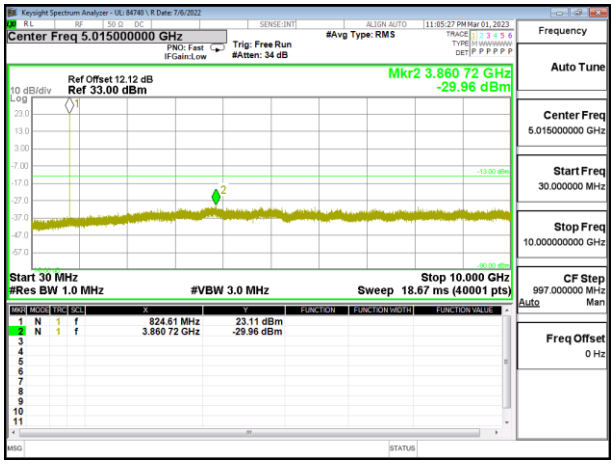
LTE5 5MHz 16QAM LOW Ch RB1-0



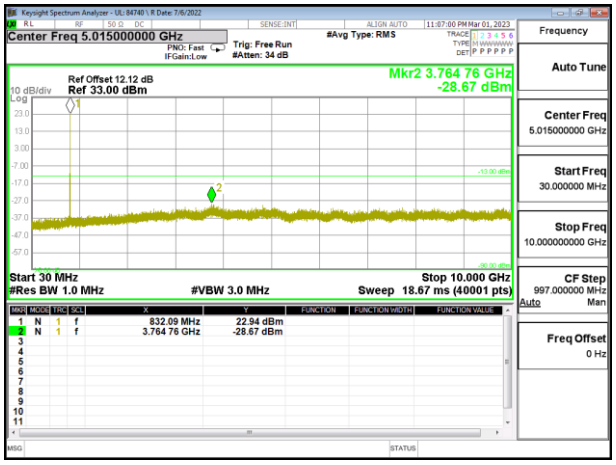
LTE5 5MHz 16QAM MID Ch RB1-0



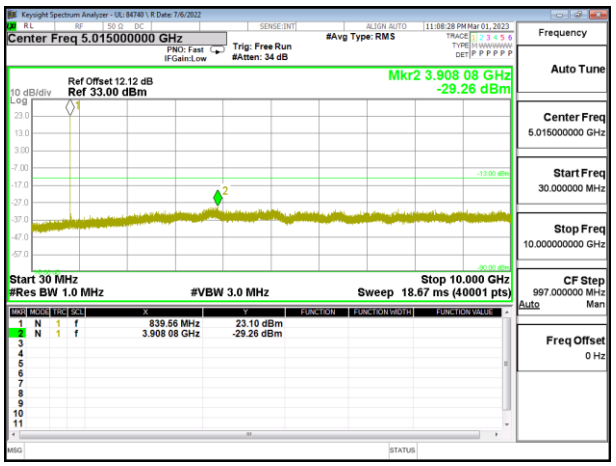
LTE5 5MHz 16QAM HIGH Ch RB1-0



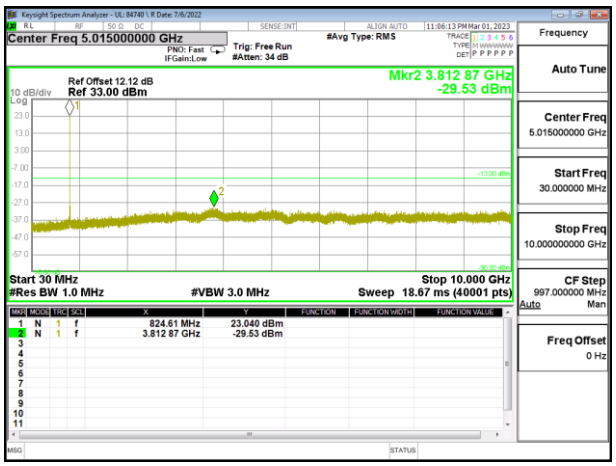
LTE5 10MHz QPSK LOW Ch RB1-0



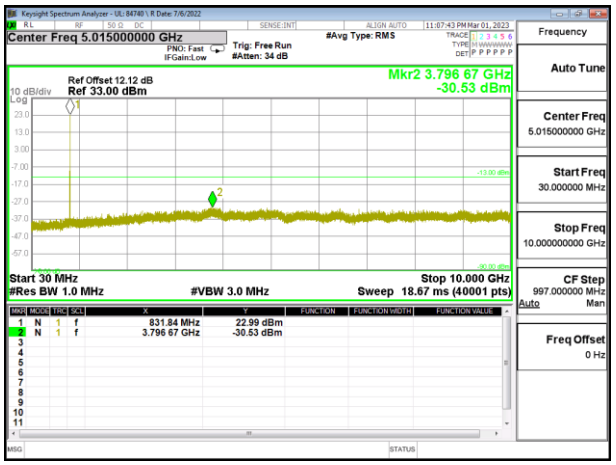
LTE5 10MHz QPSK MID Ch RB1-0



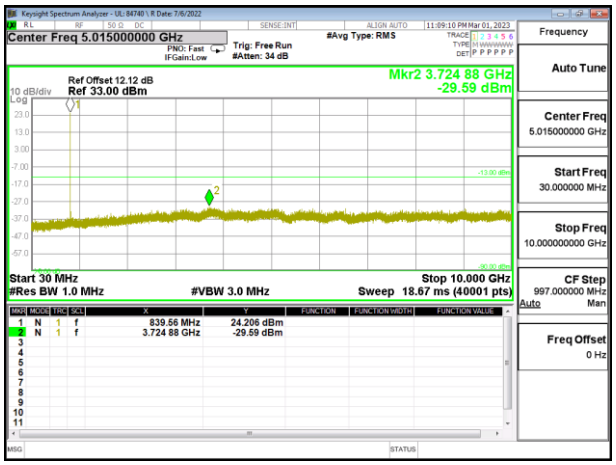
LTE5 10MHz QPSK HIGH Ch RB1-0



LTE5 10MHz 16QAM LOW Ch RB1-0



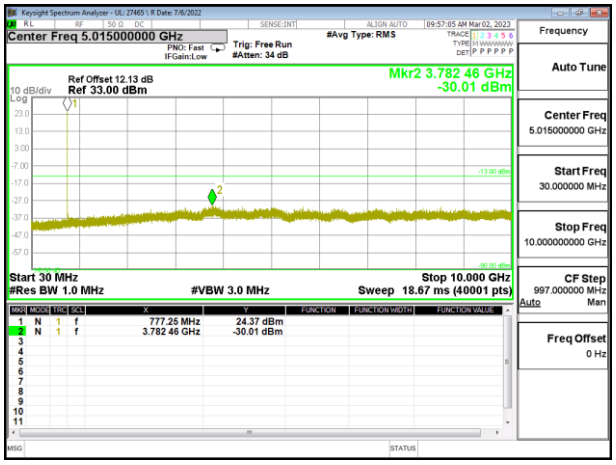
LTE5 10MHz 16QAM MID Ch RB1-0



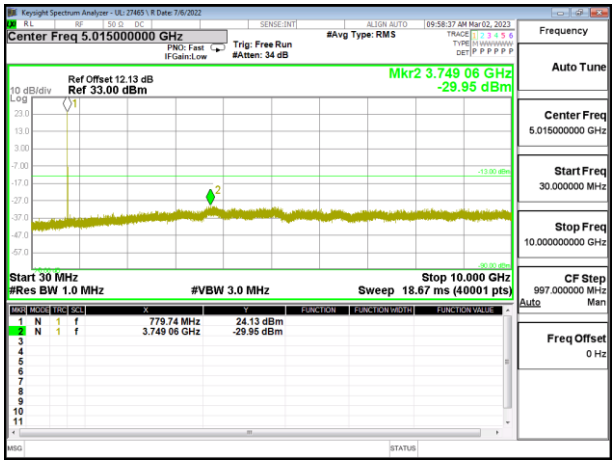
LTE5 10MHz 16QAM HIGH Ch RB1-0

10.3.3. LTE13

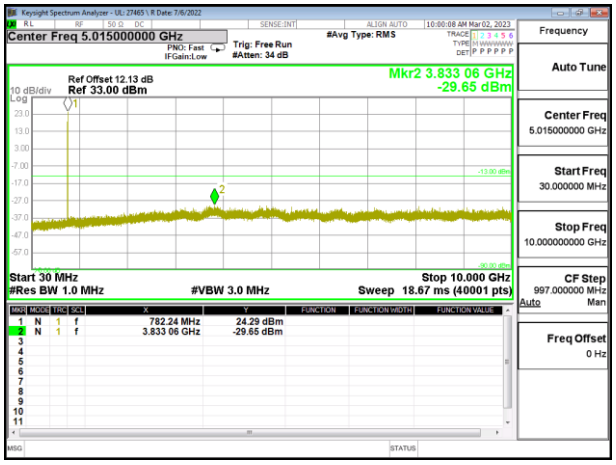
Test Engineer ID:	27465/44389	Test Date:	2023-03-02	Sample Used:	QV7700ADFR



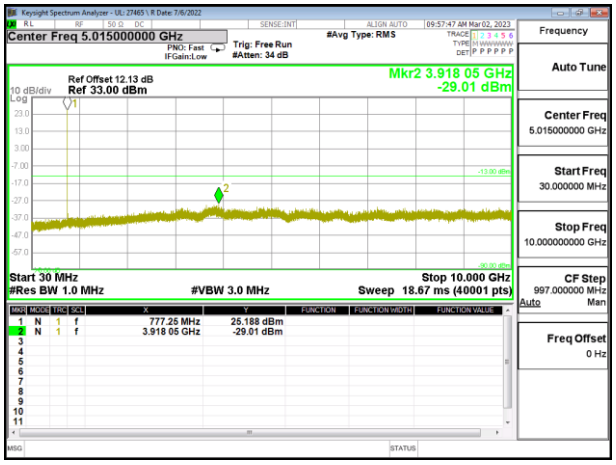
LTE13 5MHz QPSK LOW Ch RB1-0



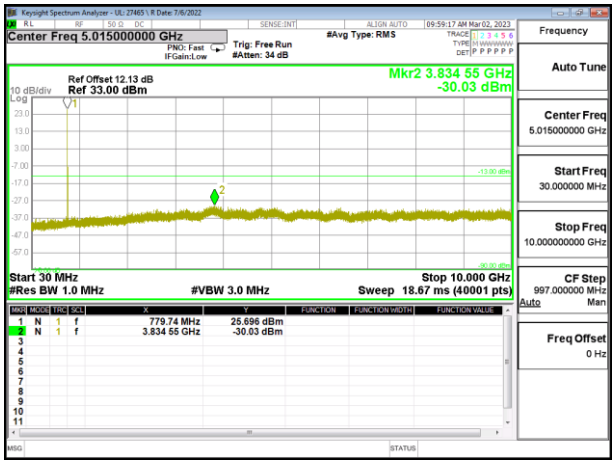
LTE13 5MHz QPSK MID Ch RB1-0



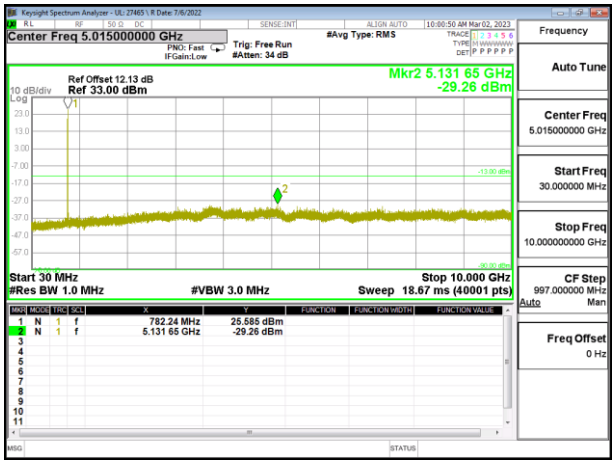
LTE13 5MHz QPSK HIGH Ch RB1-0



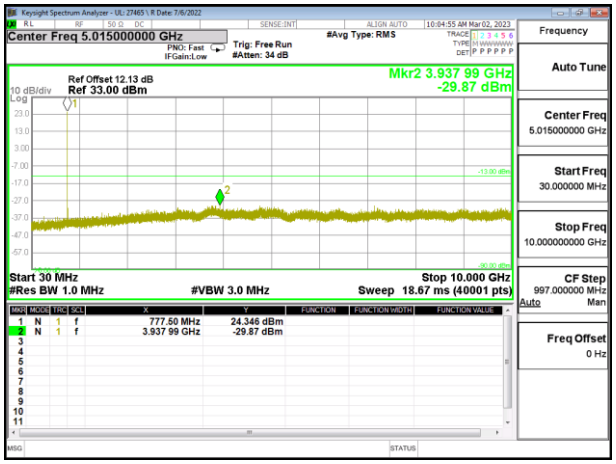
LTE13 5MHz 16QAM LOW Ch RB1-0



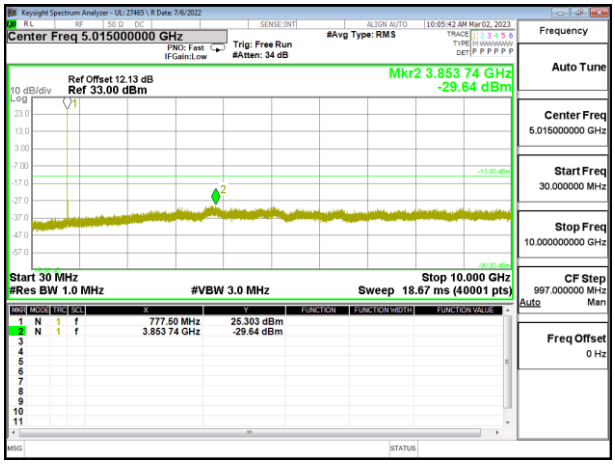
LTE13 5MHz 16QAM MID Ch RB1-0



LTE13 5MHz 16QAM HIGH Ch RB1-0



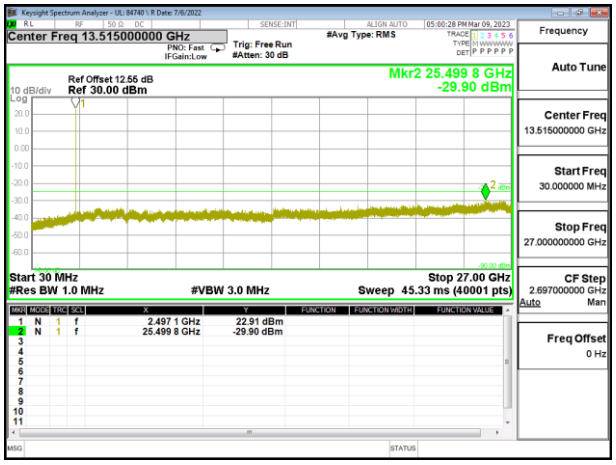
LTE13 10MHz QPSK MID Ch RB1-0



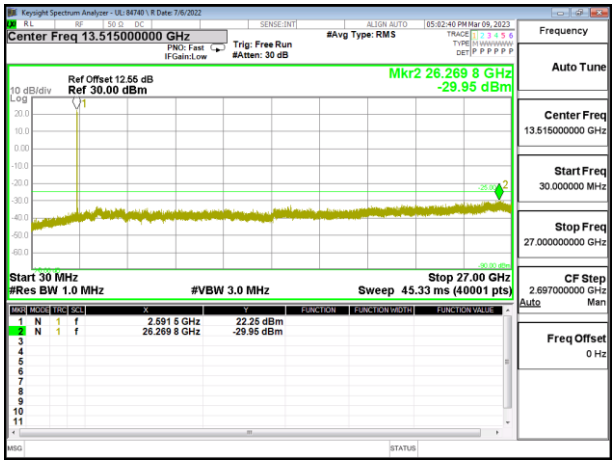
LTE13 10MHz 16QAM MID Ch RB1-0

10.3.4. LTE41

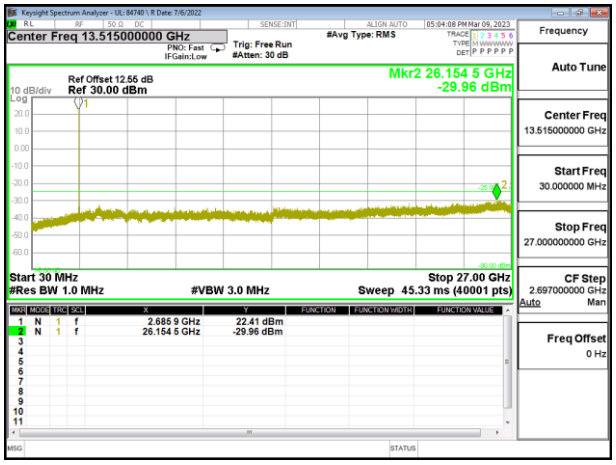
Test Engineer ID:	84740/44389	Test Date:	2023-03-04	Sample Used:	QV7700ADFR



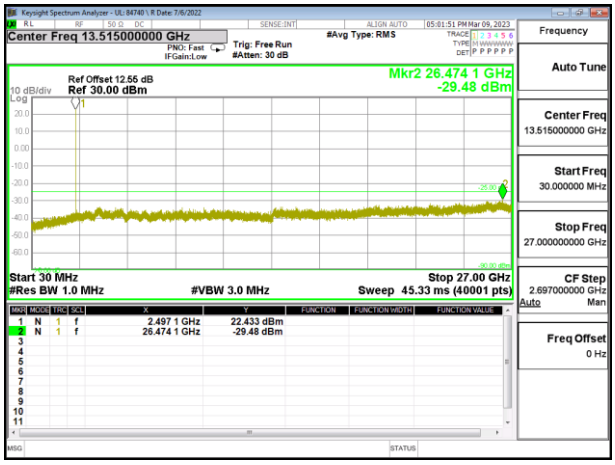
LTE41 5MHz QPSK LOW Ch RB1-0



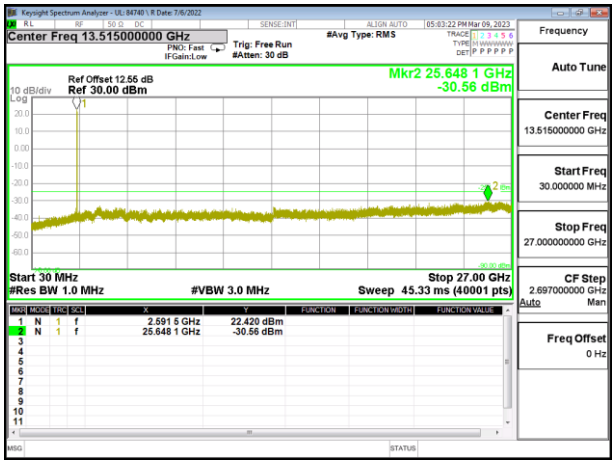
LTE41 5MHz QPSK MID Ch RB1-0



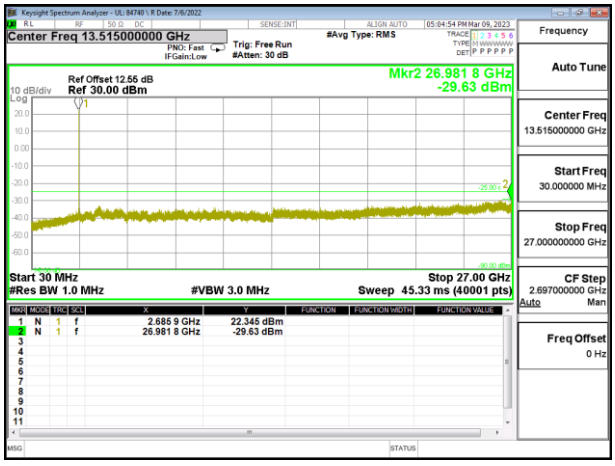
LTE41 5MHz QPSK HIGH Ch RB1-0



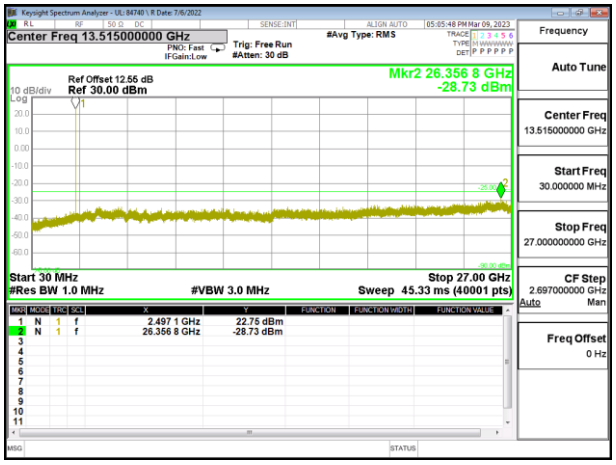
LTE41 5MHz 16QAM LOW Ch RB1-0



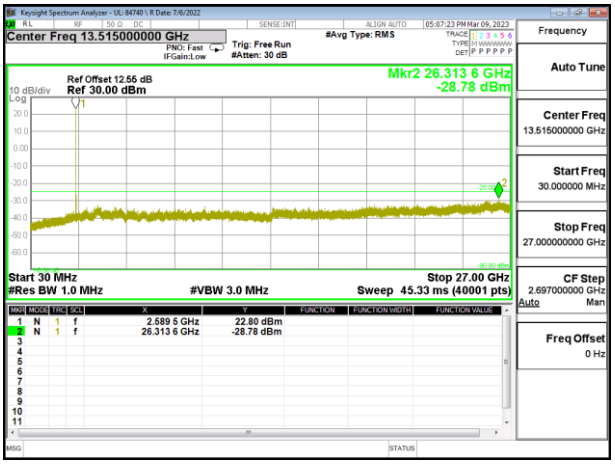
LTE41 5MHz 16QAM MID Ch RB1-0



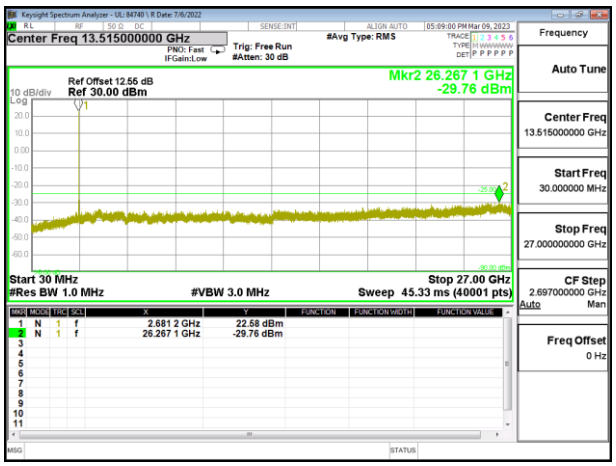
LTE41 5MHz 16QAM HIGH Ch RB1-0



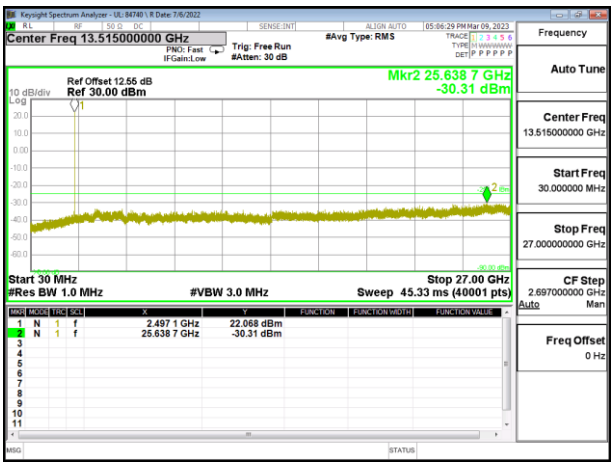
LTE41 10MHz QPSK LOW Ch RB1-0



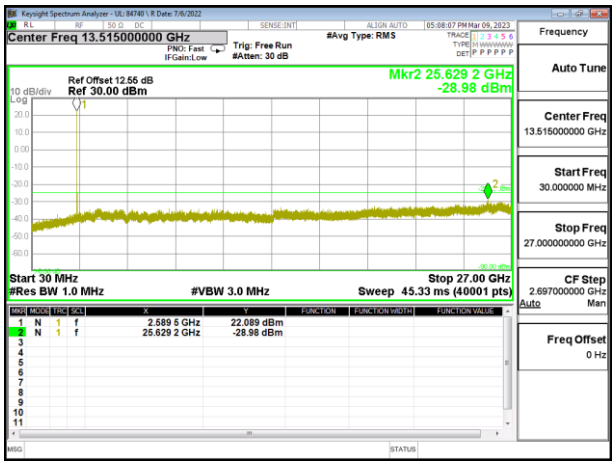
LTE41 10MHz QPSK MID Ch RB1-0



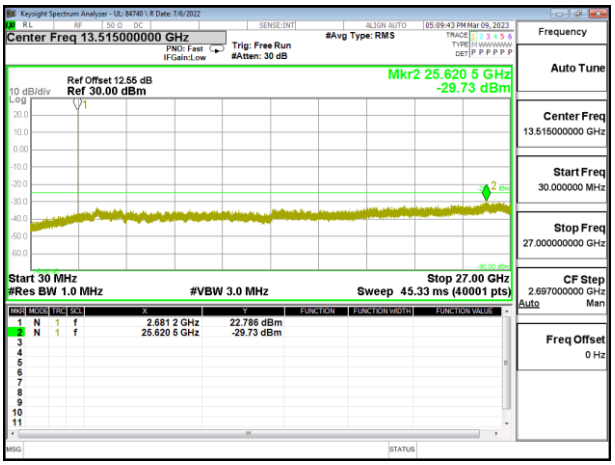
LTE41 10MHz QPSK HIGH Ch RB1-0



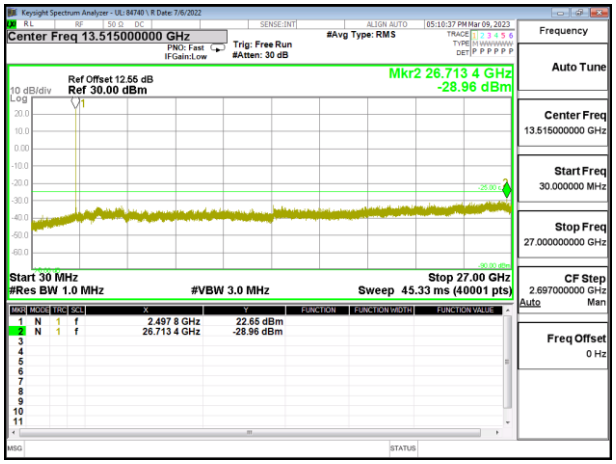
LTE41 10MHz 16QAM LOW Ch RB1-0



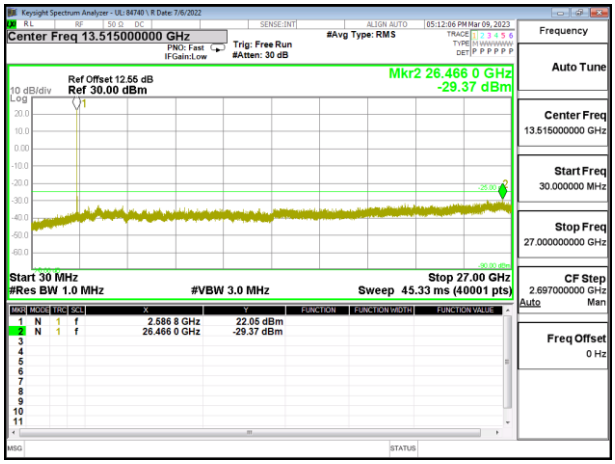
LTE41 10MHz 16QAM MID Ch RB1-0



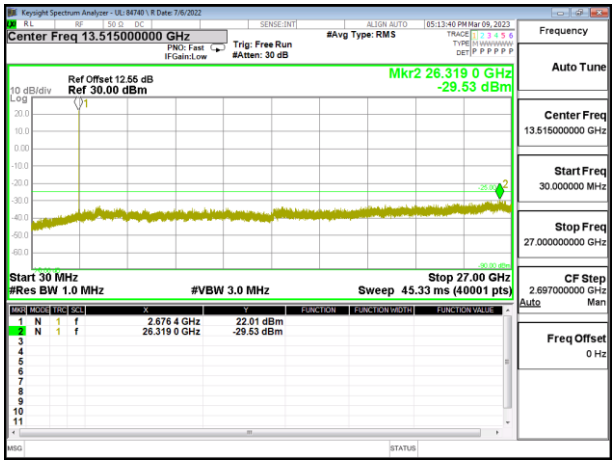
LTE41 10MHz 16QAM HIGH Ch RB1-0



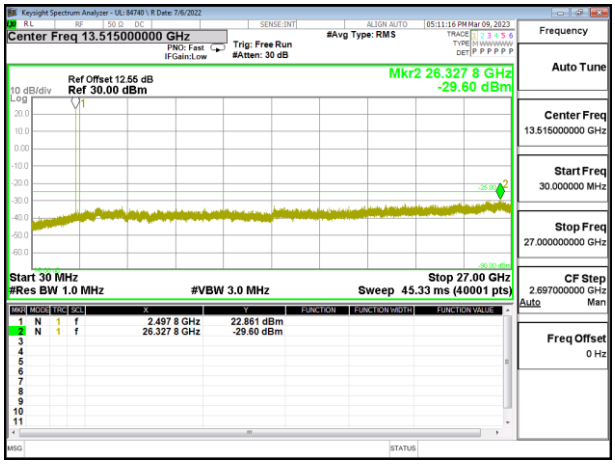
LTE41 15MHz QPSK LOW Ch RB1-0



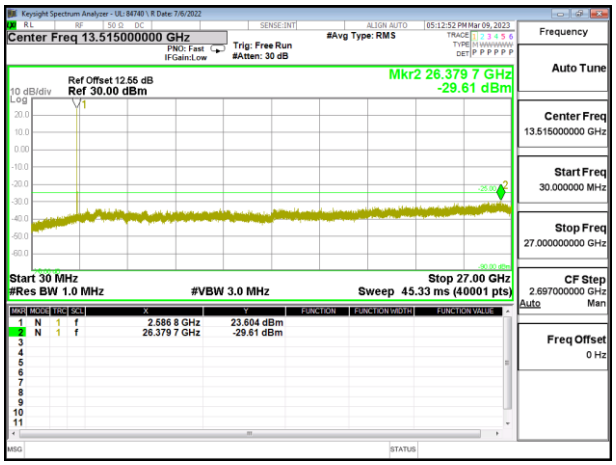
LTE41 15MHz QPSK MID Ch RB1-0



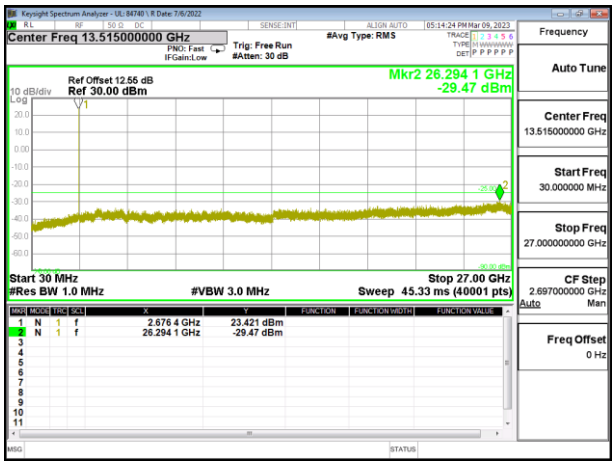
LTE41 15MHz QPSK HIGH Ch RB1-0



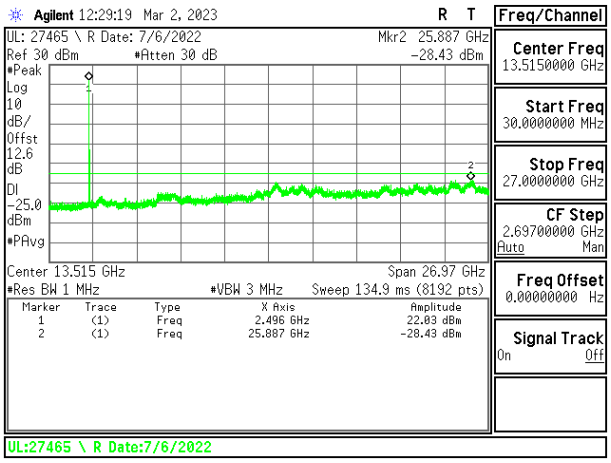
LTE41 15MHz 16QAM LOW Ch RB1-0



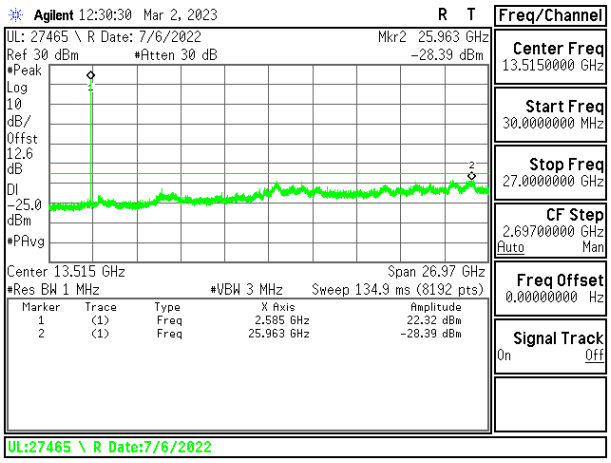
LTE41 15MHz 16QAM MID Ch RB1-0



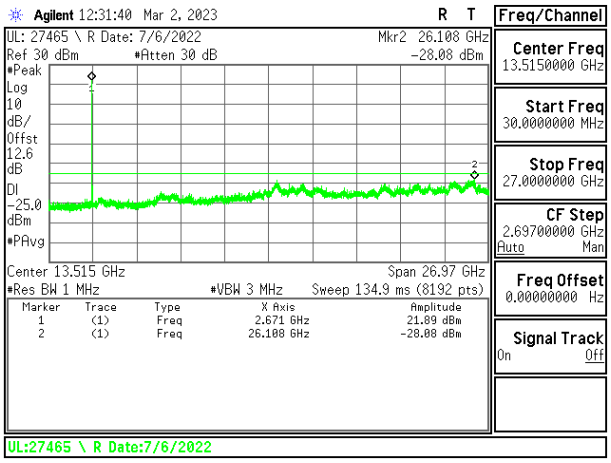
LTE41 15MHz 16QAM HIGH Ch RB1-0



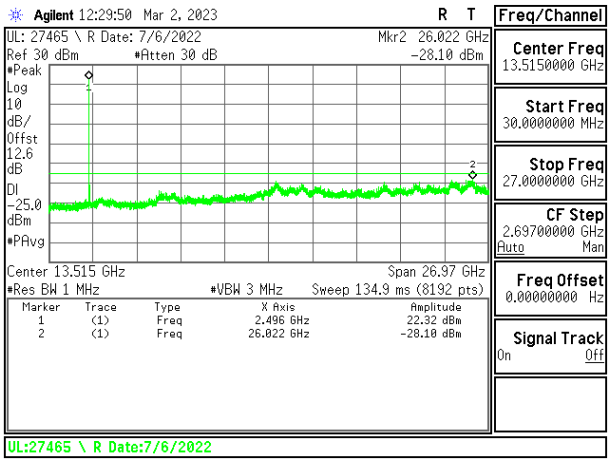
LTE41 20MHz QPSK LOW Ch RB1-0



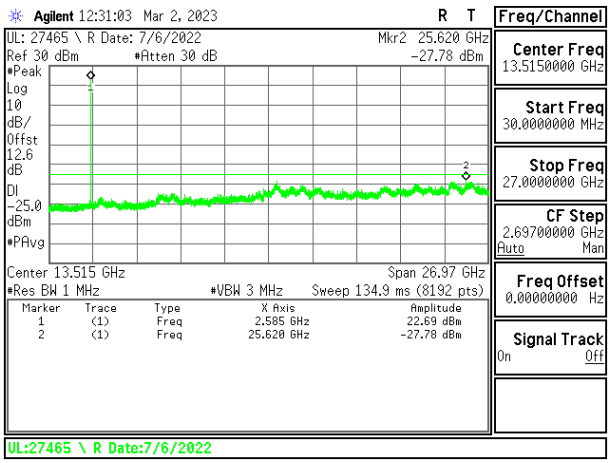
LTE41 20MHz QPSK MID Ch RB1-0



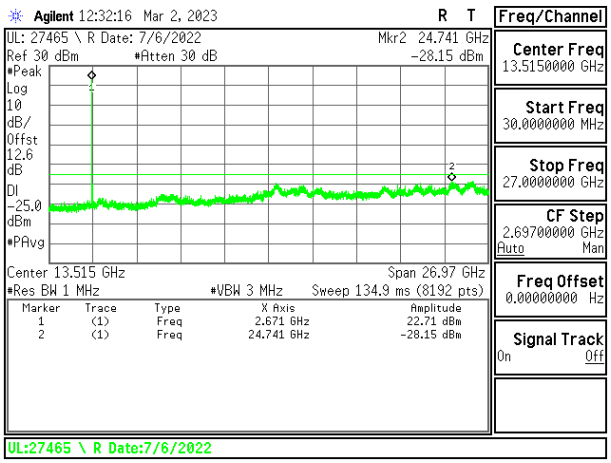
LTE41 20MHz QPSK HIGH Ch RB1-0



LTE41 20MHz 16QAM LOW Ch RB1-0



LTE41 20MHz 16QAM MID Ch RB1-0



LTE41 20MHz 16QAM HIGH Ch RB1-0

10.4. FREQUENCY STABILITY

LIMITS

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

FCC: §27.54
The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

TEST PROCEDURE

Use CMW 500 with Frequency Error measurement capability.

(vii) Temp. = −30°C to +50°C
(viii) Voltage = (85% - 115%)
Low voltage, 3.23VDC, Normal, 3.8VDC and High voltage, 4.37VDC.
End Voltage, 3.2VDC.

Frequency Stability vs Temperature:
The EUT is place inside a temperature chamber. The temperature is set to 20ºC and allowed to stabilize. After sufficient soak time, the transmitting frequency error is measured. The temperature is increased by 10 degrees, allowed to stabilize and soak, and then the measurement is repeated. This is repeated until +50ºC is reached.

Frequency Stability vs Voltage:
The peak frequency error is recorded (worst-case).

RESULTS

10.4.1. WCDMA

Test Engineer ID:	85502/44389	Test Date:	2023-03-01	Sample Used:	QV770090FR

Band	5	Frequency Range		Frequency Error Reading (Hz)	Limit	
Condition		824	849		2.5	
Temperature	Voltage	Freq Reading @ Low End (MHz)	Freq Reading @ High End (MHz)		Frequency Stability (ppm)	Within Authorized Frequency Block (Hz)
Normal (20°C)	Normal	826.4000	846.6000			
Extreme (50°C)		826.4000	846.6000	-6.5	-0.008	Yes
Extreme (40°C)		826.4000	846.6000	-6.64	-0.008	Yes
Extreme (30°C)		826.4000	846.6000	-4.96	-0.006	Yes
Extreme (10°C)		826.4000	846.6000	2.24	0.003	Yes
Extreme (0°C)		826.4000	846.6000	3.33	0.004	Yes
Extreme (-10°C)		826.4000	846.6000	4.34	0.005	Yes
Extreme (-20°C)		826.4000	846.6000	4.13	0.005	Yes
Extreme (-30°C)		826.4000	846.6000	3.24	0.004	Yes
20°C	End Point Voltage	826.4000	846.6000	-2.78	-0.003	Yes

10.4.2. LTE5

Test Engineer ID:	85502/44389	Test Date:	2023-03-01	Sample Used:	QV770090FR

QPSK (10MHz)

Band	5	Frequency Range		Frequency Error Reading (Hz)	Limit	
Condition		824	849		2.5	
Temperature	Voltage	Freq Reading @ Low End (MHz)	Freq Reading @ High End (MHz)		Frequency Stability (ppm)	Within Authorized Frequency Block (Hz)
Normal (20°C)	Normal	829.0000	844.0000			
Extreme (50°C)		829.0000	844.0000	3.85	0.005	Yes
Extreme (40°C)		829.0000	844.0000	3.42	0.004	Yes
Extreme (30°C)		829.0000	844.0000	-4.19	-0.005	Yes
Extreme (10°C)		829.0000	844.0000	4.75	0.006	Yes
Extreme (0°C)		829.0000	844.0000	4.6	0.005	Yes
Extreme (-10°C)		829.0000	844.0000	4.86	0.006	Yes
Extreme (-20°C)		829.0000	844.0000	5.62	0.007	Yes
Extreme (-30°C)		829.0000	844.0000	4.28	0.005	Yes
20°C	End Point Voltage	829.0000	844.0000	3.49	0.004	Yes

10.4.3. LTE13

Test Engineer ID:	85502/44389	Test Date:	2023-03-01	Sample Used:	QV770090FR

QPSK (10MHz)

Band	13	Frequency Range		Frequency Error Reading (Hz)	Limit	
Condition		777	787		2.5	
Temperature	Voltage	Freq Reading @ Low End (MHz)	Freq Reading @ High End (MHz)		Frequency Stability (ppm)	Within Authorized Frequency Block (Hz)
Normal (20°C)	Normal		782.0000			
Extreme (50°C)		0.0000	782.0000	4.10	0.005	Yes
Extreme (40°C)		0.0000	782.0000	3.68	0.005	Yes
Extreme (30°C)		0.0000	782.0000	4.89	0.006	Yes
Extreme (10°C)		0.0000	782.0000	4.77	0.006	Yes
Extreme (0°C)		0.0000	782.0000	5.72	0.007	Yes
Extreme (-10°C)		0.0000	782.0000	4.20	0.005	Yes
Extreme (-20°C)		0.0000	782.0000	3.70	0.005	Yes
Extreme (-30°C)		0.0000	782.0000	4.22	0.005	Yes
20°C	End Point Voltage	0.0000	782.0000	3.51	0.004	Yes

10.4.4. LTE41

Test Engineer ID:	85502/44389	Test Date:	2023-03-01	Sample Used:	QV770090FR

QPSK (20MHz)

Band	41	Frequency Range		Frequency Error Reading (Hz)	Limit	
Condition		2500	2690		2.5	
Temperature	Voltage	Freq Reading @ Low End (MHz)	Freq Reading @ High End (MHz)		Frequency Stability (ppm)	Within Authorized Frequency Block (Hz)
Normal (20°C)	Normal	2506.0000	2680.0000			
Extreme (50°C)		2506.0000	2680.0000	-11.75	-0.005	Yes
Extreme (40°C)		2506.0000	2680.0000	-9.60	-0.004	Yes
Extreme (30°C)		2506.0000	2680.0000	-10.18	-0.004	Yes
Extreme (10°C)		2506.0000	2680.0000	-10.00	-0.004	Yes
Extreme (0°C)		2506.0000	2680.0000	-10.04	-0.004	Yes
Extreme (-10°C)		2506.0000	2680.0000	-11.20	-0.004	Yes
Extreme (-20°C)		2506.0000	2680.0000	-11.16	-0.004	Yes
Extreme (-30°C)		2506.0000	2680.0000	-9.83	-0.004	Yes
20°C	End Point Voltage	2506.0000	2680.0000	-9.82	-0.004	Yes

10.5. PEAK TO AVERAGE RATIO

LIMIT

FCC: §22.913

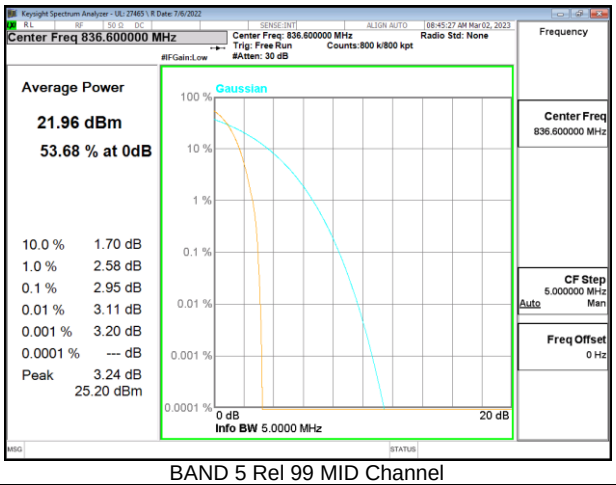
In addition, the peak to average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

RESULTS

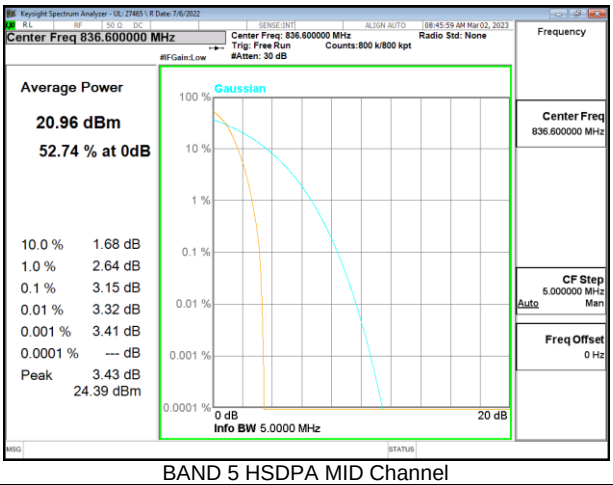
Antenna 1 was used to measure as the worst case; full resource block (FRB) for each bandwidth was used to measure as the worst case. The results from all CCDF measurements are passed with 13dB peak-to-average power ratio criteria.

10.5.1. WCDMA

Test Engineer ID:	27465/44389	Test Date:	2023-03-02	Sample Used:	QV770090FR



BAND 5 Rel 99 MID Channel



BAND 5 HSDPA MID Channel

10.5.2. LTE5

Test Engineer ID:	27465/44389	Test Date:	2023-03-02	Sample Used:	QV770090FR

Band	Bandwidth (MHz)	Frequency (MHz)	RB Allocation	RB OffSet	Modulation	Conducted Power (dBm)		Peak-to-Average Power Ratio (dB)
						Peak	Average	
LTE Band 5	1.4MHz	836.5	6	0	QPSK	24.21	21.14	3.07
					16QAM	25.15	21.22	3.93
	3MHz		15	0	QPSK	24.33	21.18	3.15
					16QAM	25.49	21.24	4.25
	5MHz		25	0	QPSK	24.57	21.21	3.36
					16QAM	24.71	21.19	3.52
	10MHz		50	0	QPSK	24.73	21.25	3.48
					16QAM	25.74	21.23	4.51
Duty Cycle Correction Factor (dB) =			0.00					
Peak-to-Average Power Ratio= Peak Reading - Average Reading - Duty Cycle Correction Factor								

11. RADIATED TEST RESULTS

Radiated measurement using the Field Strength Method

Using the test configuration shown in Figure 6 below, We measure the radiated emissions directly from the EUT and convert the measured field strength or received power to ERP or EIRP, as required, for comparison to the applicable limits. As stated in 5.5.1 of ANSI C63.26-2015, the field strength measurement method using a test site validated to the requirements of ANSI C63.4 is an alternative to the substitution measurement method.

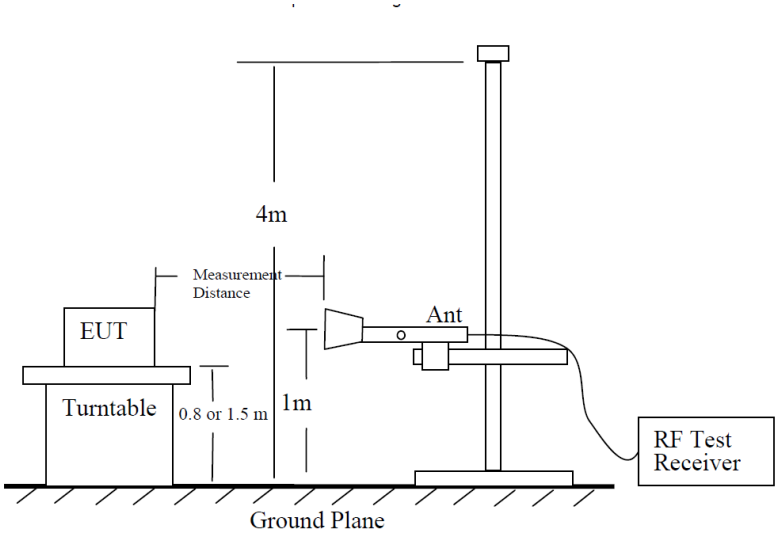


Figure 6—Test site-up for radiated ERP and/or EIRP measurements

Radiated Power Measurement Calculation According to ANSI C63.26-2015

a) E (dBμV/m) = Measured amplitude level (dBμV) + Cable Loss (dB) + Antenna Factor (dB/m).
b) E (dBμV/m) = Measured amplitude level (dBm) + 107 + Cable Loss (dB) + Antenna Factor (dB/m).
c) E (dBμV/m) = EIRP (dBm) − 20log(D) + 104.8; where D is the measurement distance (in the far field region) in m.
d) EIRP (dBm) = E (dBμV/m) + 20log(D) − 104.8; where D is the measurement distance (in the far field region) in m.

So, from d)
The measuring distance is usually at 3m, then 20*Log(3)=9.5424

Then, EIRP (dBm) = E (dBμV/m) + 9.5424 − 104.8 = E (dBμV/m) – 95.2576
Note: Confidence check of each chamber is performed daily to see if any degradation from expected/normal reading reference data. Ambient check of each chamber is performed monthly.

11.1. FIELD STRENGTH OF SPURIOUS RADIATION ABOVE 1GHz

LIMITS

FCC: §22.917(a), §24.238(a), §27.53(h), (g)
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.

FCC: §27.53
(c) 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.
(f) Emissions in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth.

FCC: §27.53 (m)
At least 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.

TEST PROCEDURE

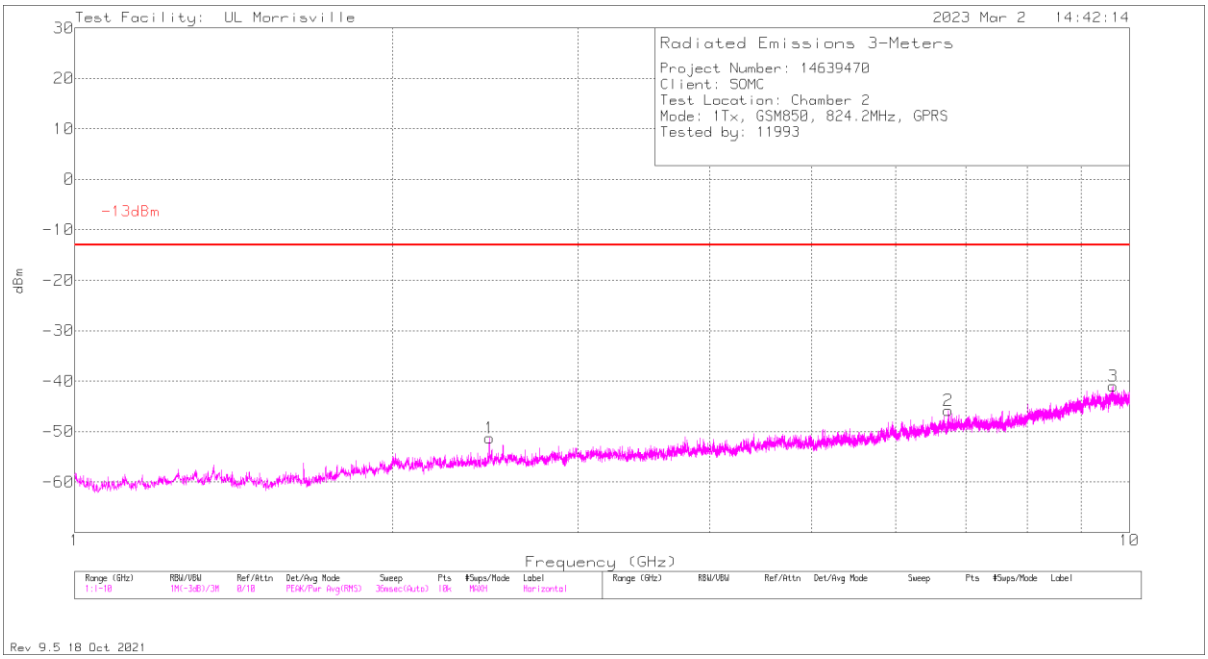
KDB 971168 D01 v03r01/D02 v02/r01
All tests above 1GHz were done with a Resolution Bandwidth of 1MHz, and a Video Bandwidth of 3MHz.

RESULTS

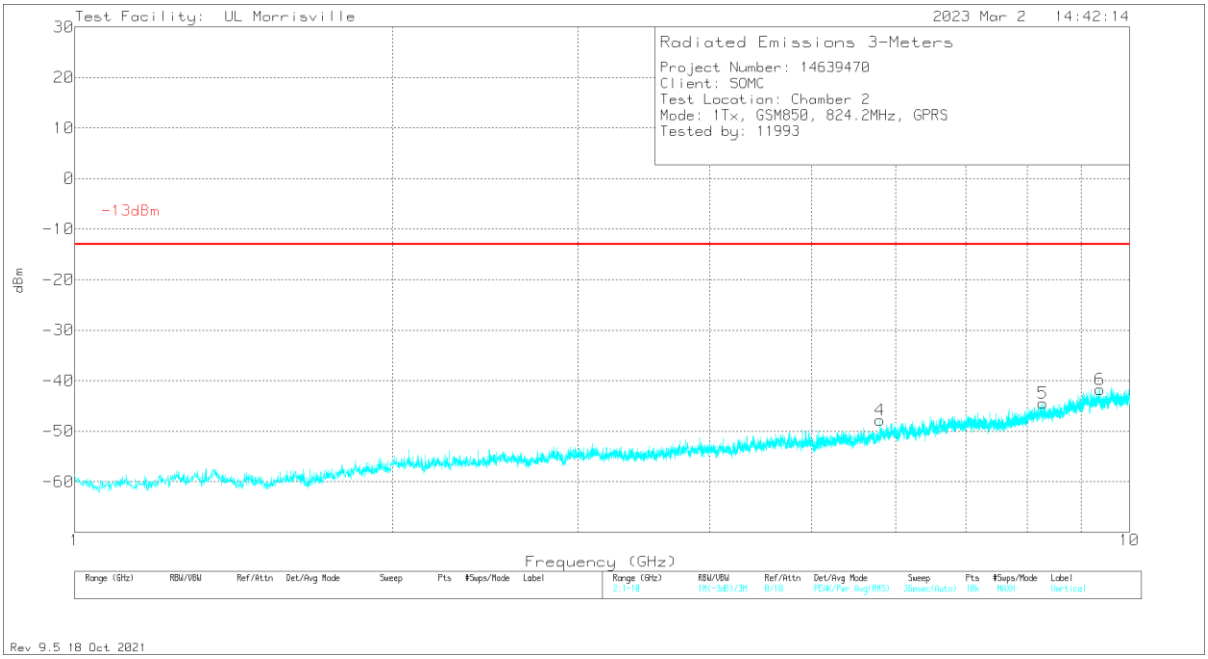
11.1.1. GSM850

Test Engineer ID:	11993	Test Date:	2023-03-02	Sample Used:	QV77003JFR

GPRS LOW CHANNEL



HORIZONTAL



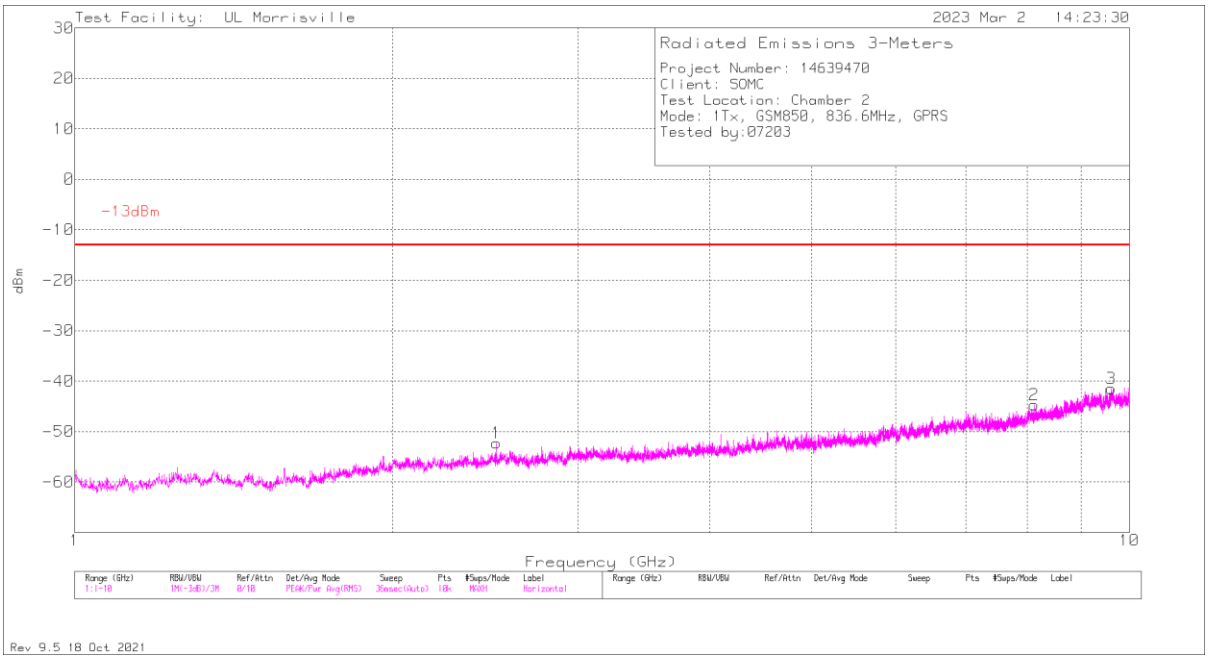
VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBm)	Det	206211 (dB/m)	Gain/Loss (dB)	Filter (dB)	CF (dB)	Corrected Reading dBm	-13dBm	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.4724	-61.44	Pk	32.3	-34.3	.3	11.8	-51.34	-13	-38.34	0-360	199	H
4	5.8006	-64.61	Pk	34.7	-30.4	.7	11.8	-47.81	-13	-34.81	0-360	101	V
2	6.7366	-64.74	Pk	35.6	-29	.5	11.8	-45.84	-13	-32.84	0-360	199	H
5	8.2801	-65.26	Pk	35.8	-27.3	.5	11.8	-44.46	-13	-31.46	0-360	300	V
6	9.3718	-65.42	Pk	36.5	-25.8	1.2	11.8	-41.72	-13	-28.72	0-360	300	V
3	9.6553	-64.79	Pk	36.7	-25.6	.9	11.8	-40.99	-13	-27.99	0-360	199	H

Pk - Peak detector

GPRS MID CHANNEL



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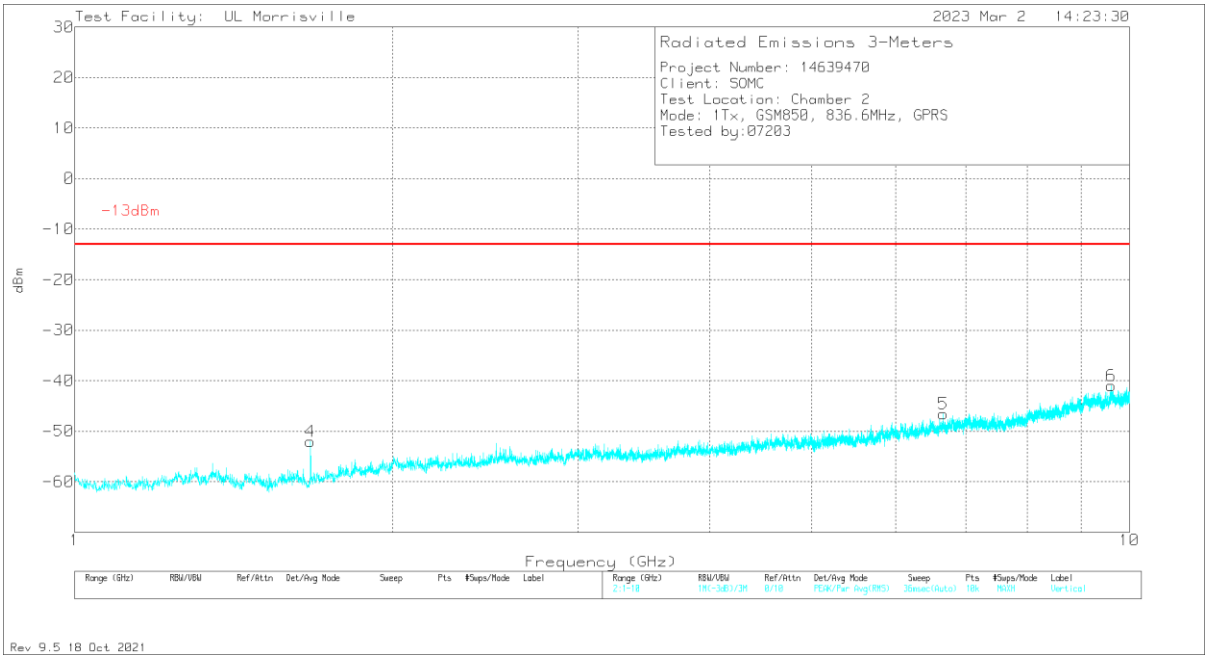


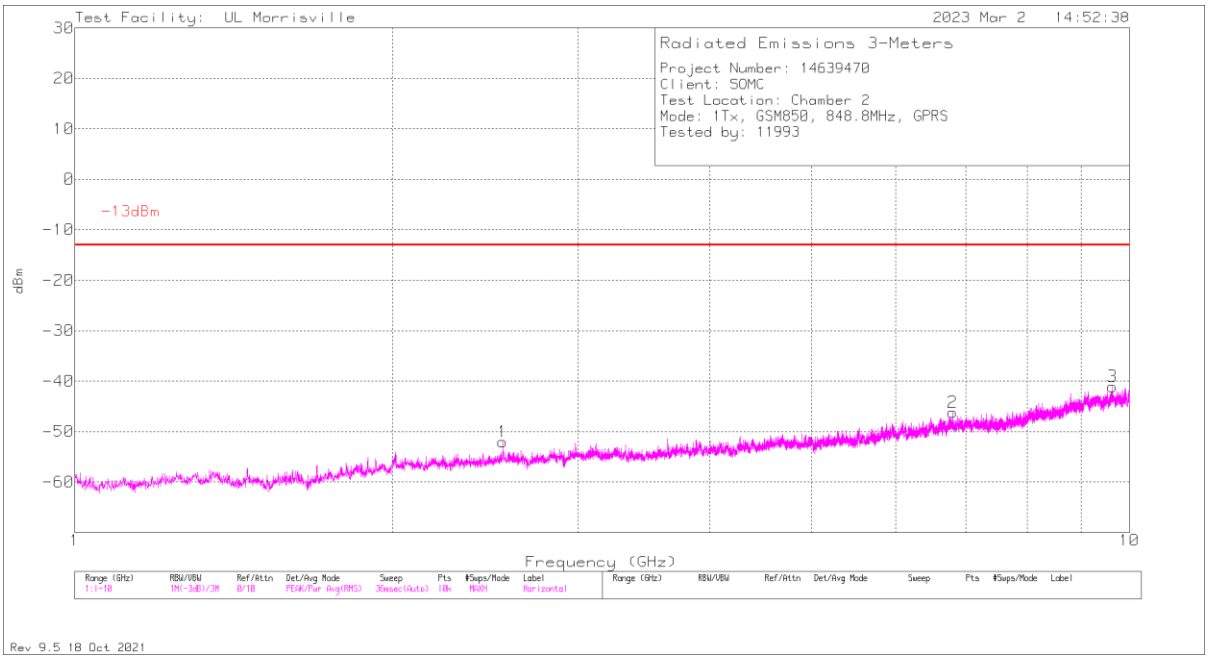
VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBm)	Det	206211 (dB/m)	Gain/Loss (dB)	Filter (dB)	CF (dB)	Corrected Reading dBm	-13dBm	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	1.6723	-58.17	Pk	28.5	-34.7	.5	11.8	-52.07	-13	-39.07	0-360	300	V
1	2.5102	-63.09	Pk	32.4	-33.8	.4	11.8	-52.29	-13	-39.29	0-360	100	H
5	6.6637	-65.98	Pk	35.6	-28.6	.6	11.8	-46.58	-13	-33.58	0-360	300	V
2	8.1199	-65.14	Pk	35.7	-27.6	.5	11.8	-44.74	-13	-31.74	0-360	299	H
6	9.6049	-65.11	Pk	36.7	-25.6	1.2	11.8	-41.01	-13	-28.01	0-360	300	V
3	9.6121	-65.66	Pk	36.7	-25.5	1.2	11.8	-41.46	-13	-28.46	0-360	299	H

Pk - Peak detector

GPRS HIGH CHANNEL



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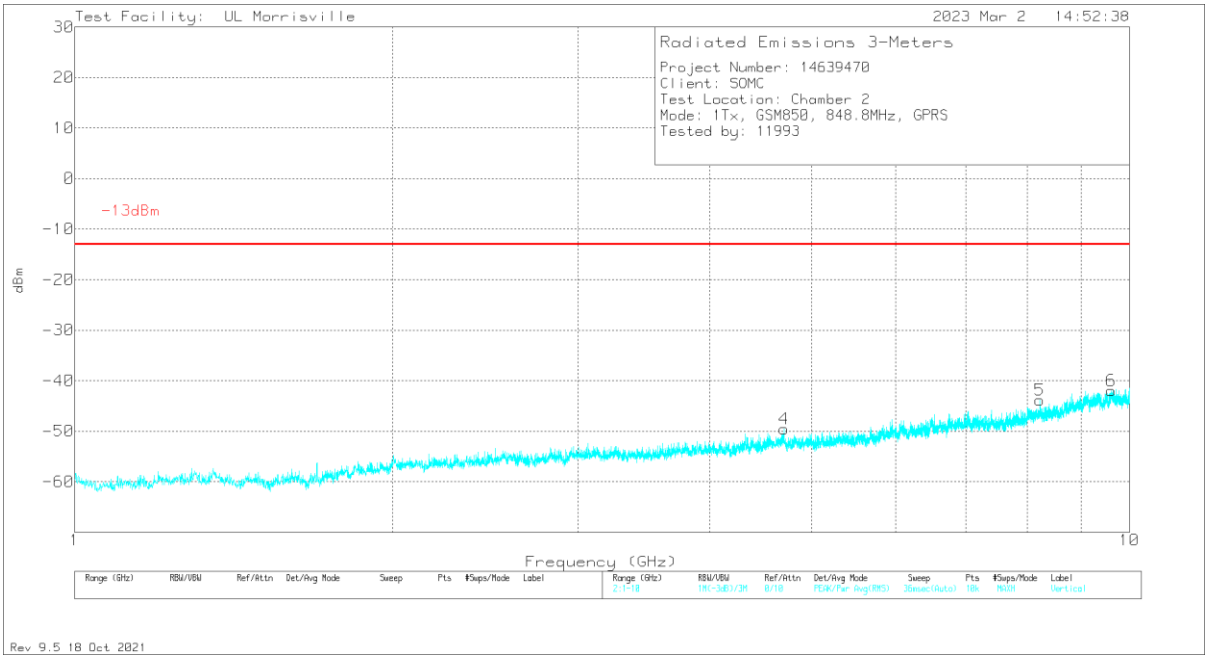


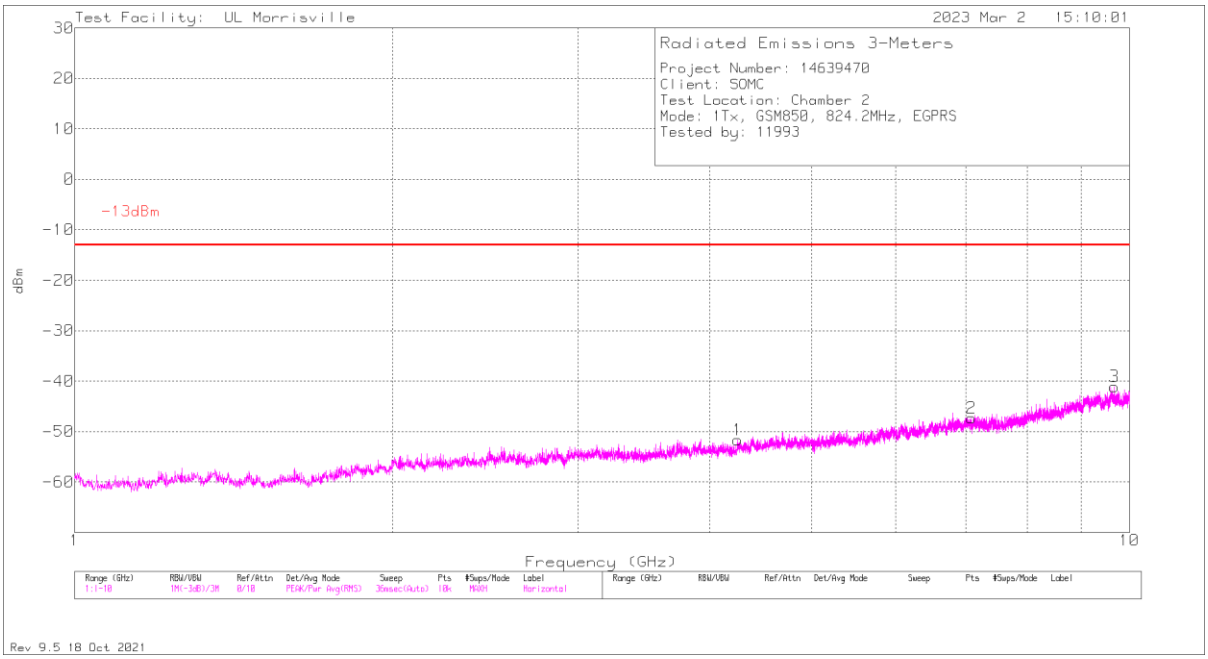
VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBm)	Det	206211 (dB/m)	Gain/Loss (dB)	Filter (dB)	CF (dB)	Corrected Reading dBm	-13dBm	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.5462	-63.2	Pk	32.5	-33.6	.5	11.8	-52	-13	-39	0-360	200	H
4	4.7026	-64.81	Pk	34.1	-31	.4	11.8	-49.51	-13	-36.51	0-360	101	V
2	6.7951	-66.22	Pk	35.6	-28	.6	11.8	-46.22	-13	-33.22	0-360	200	H
5	8.2279	-64.89	Pk	35.7	-27	.5	11.8	-43.89	-13	-30.89	0-360	299	V
6	9.6058	-66.19	Pk	36.7	-25.5	1.2	11.8	-41.99	-13	-28.99	0-360	200	V
3	9.6337	-64.75	Pk	36.7	-26	1.2	11.8	-41.05	-13	-28.05	0-360	299	H

Pk - Peak detector

EGPRS LOW CHANNEL



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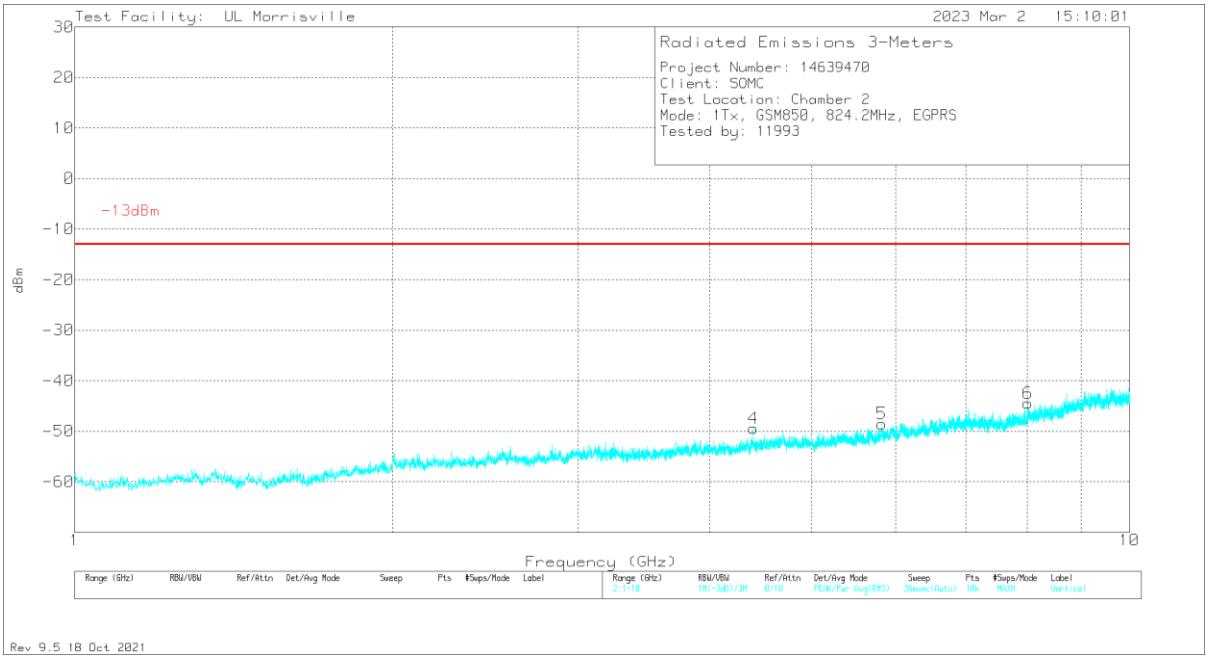


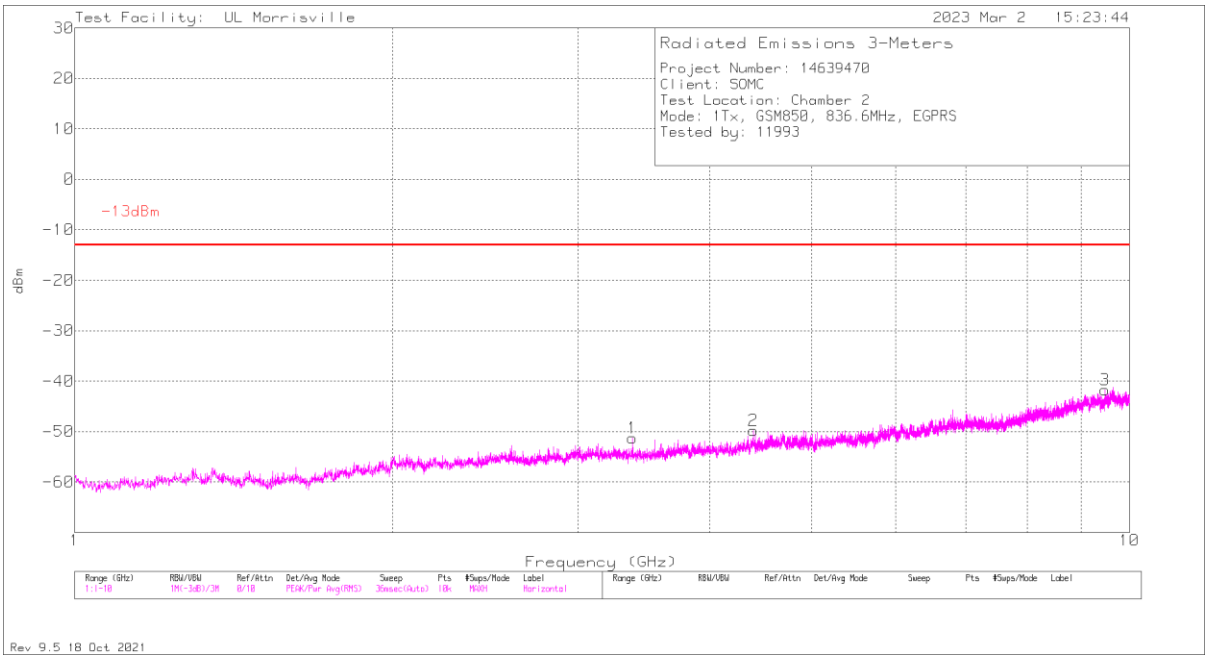
VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBm)	Det	206211 (dB/m)	Gain/Loss (dB)	Filter (dB)	CF (dB)	Corrected Reading dBm	-13dBm	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	4.2544	-65.99	Pk	33.3	-31.2	.4	11.8	-51.69	-13	-38.69	0-360	199	H
4	4.402	-64.1	Pk	33.7	-31.2	.4	11.8	-49.4	-13	-36.4	0-360	200	V
5	5.8267	-66.1	Pk	34.8	-29.6	.6	11.8	-48.5	-13	-35.5	0-360	300	V
2	7.0867	-66.89	Pk	35.6	-28.5	.7	11.8	-47.29	-13	-34.29	0-360	199	H
6	8.0074	-65.41	Pk	35.8	-27.2	.5	11.8	-44.51	-13	-31.51	0-360	300	V
3	9.6733	-64.75	Pk	36.7	-25.5	.7	11.8	-41.05	-13	-28.05	0-360	101	H

Pk - Peak detector

EGPRS MID CHANNEL



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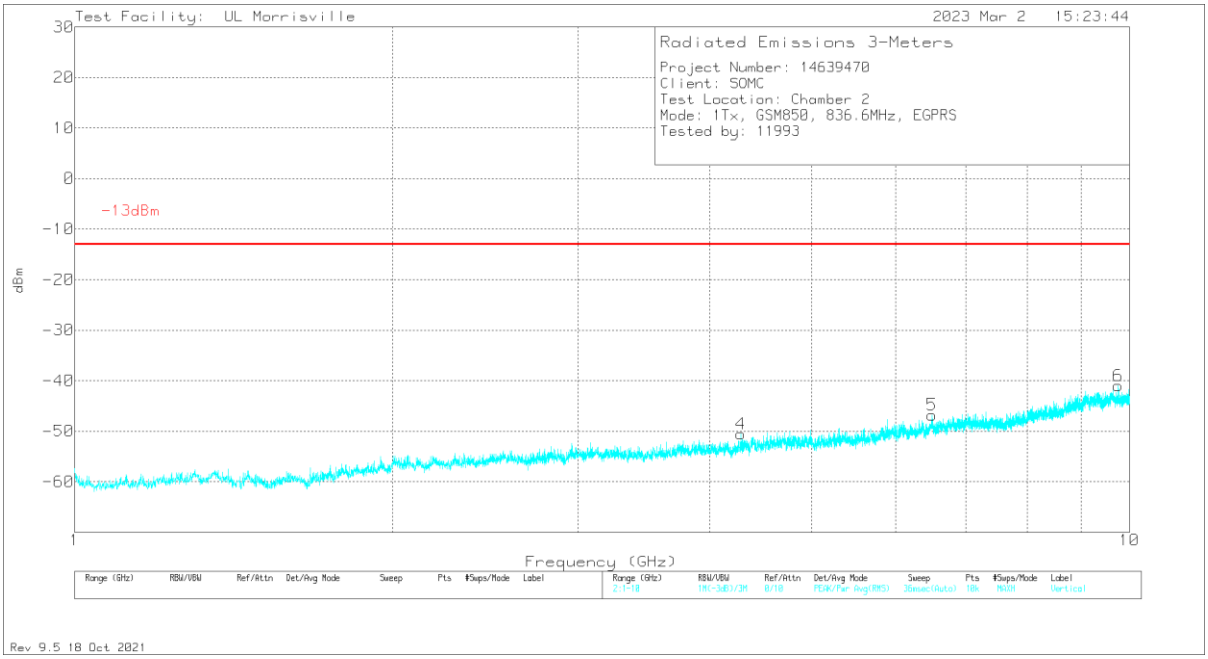


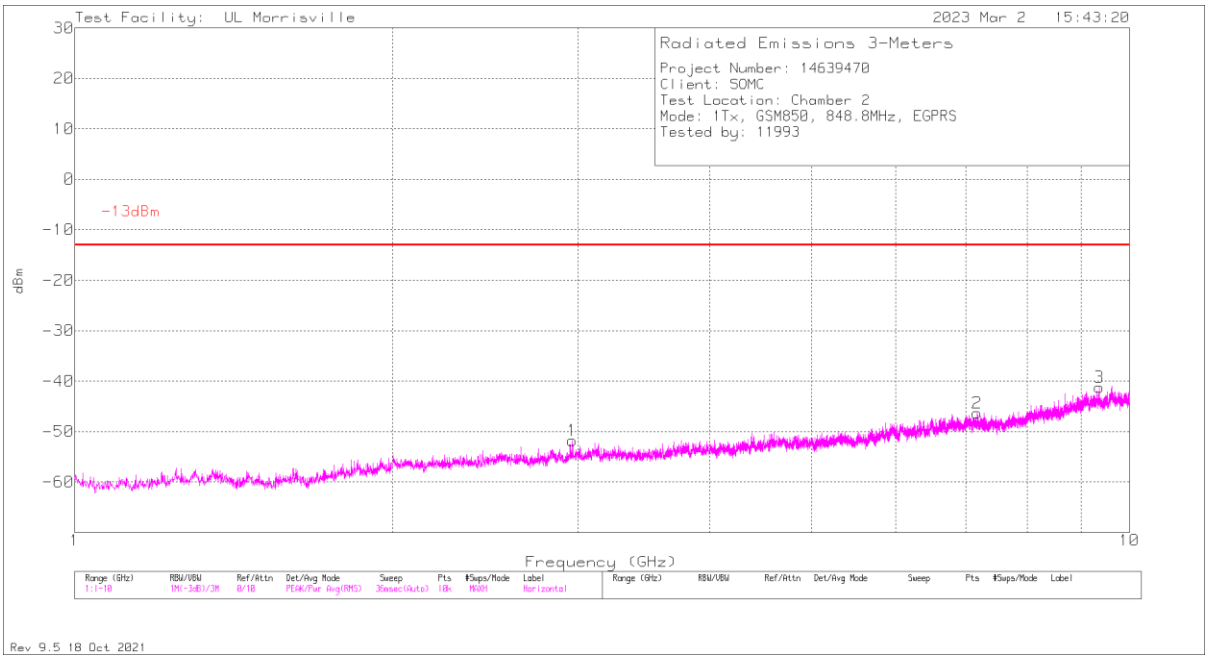
VERTICAL

RADIATED EMISSIONS

Marker	Frequency (GHz)	Meter Reading (dBm)	Det	206211 (dB/m)	Gain/Loss (dB)	Filter (dB)	CF (dB)	Corrected Reading dBm	-13dBm	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	3.3778	-63.08	Pk	32.5	-32.9	.4	11.8	-51.28	-13	-38.28	0-360	101	H
4	4.2805	-64.47	Pk	33.4	-31.7	.4	11.8	-50.57	-13	-37.57	0-360	200	V
2	4.3975	-64.58	Pk	33.7	-31.1	.4	11.8	-49.78	-13	-36.78	0-360	200	H
5	6.4972	-66.46	Pk	35.6	-28.3	.6	11.8	-46.76	-13	-33.76	0-360	200	V
3	9.4861	-65.58	Pk	36.6	-25.8	1.3	11.8	-41.68	-13	-28.68	0-360	101	H
6	9.7624	-65.07	Pk	36.8	-25.6	1.1	11.8	-40.97	-13	-27.97	0-360	200	V

Pk - Peak detector

EGPRS HIGH CHANNEL



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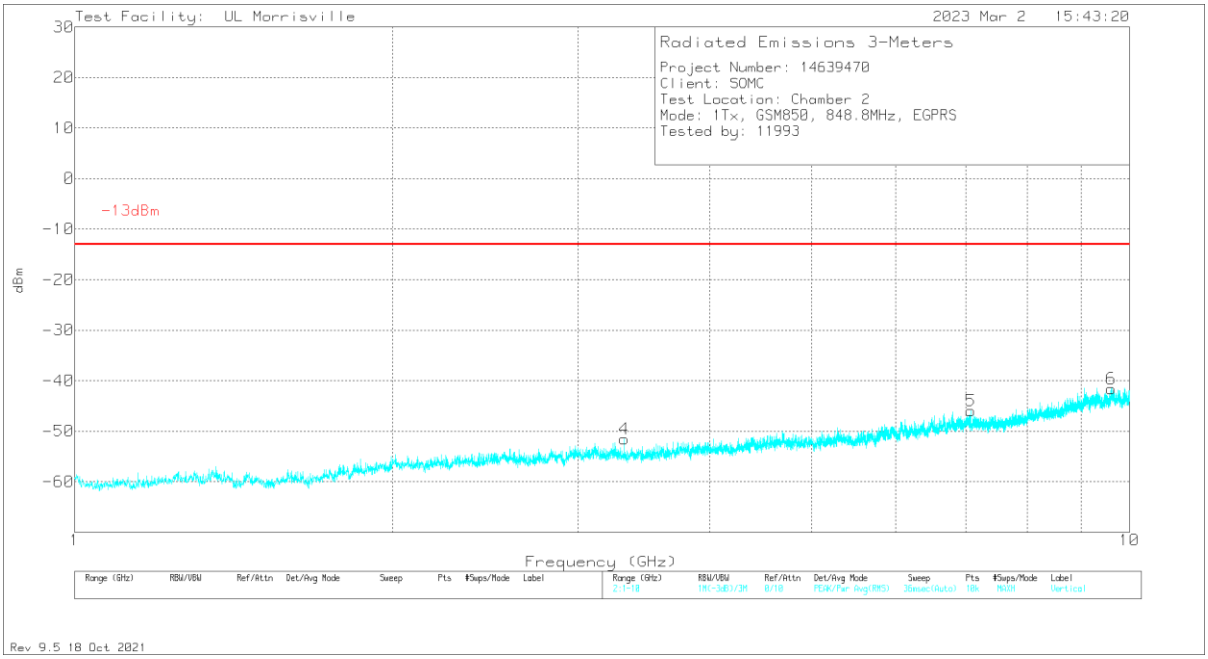


VERTICAL

RADIATED EMISSIONS

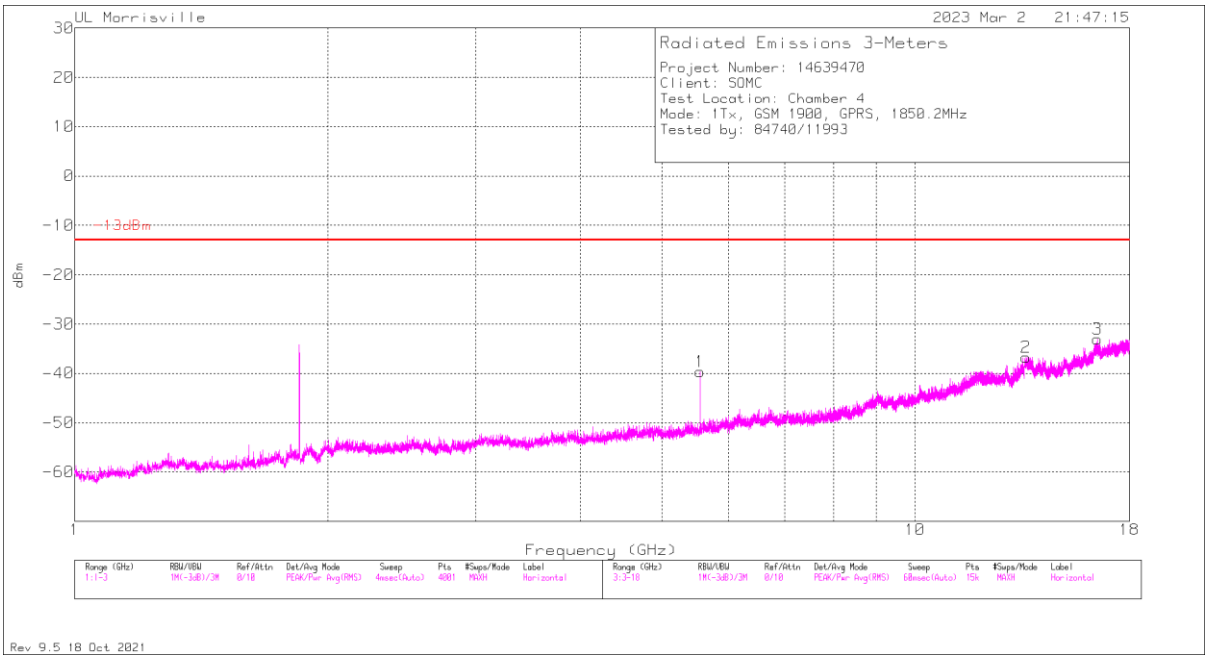
Marker	Frequency (GHz)	Meter Reading (dBm)	Det	206211 (dB/m)	Gain/Loss (dB)	Filter (dB)	CF (dB)	Corrected Reading dBm	-13dBm	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.9647	-63.42	Pk	32.6	-33.4	.6	11.8	-51.82	-13	-38.82	0-360	199	H
4	3.3202	-63.72	Pk	32.7	-33	.7	11.8	-51.52	-13	-38.52	0-360	300	V
5	7.0714	-65.62	Pk	35.6	-28.4	.7	11.8	-45.92	-13	-32.92	0-360	300	V
2	7.1758	-66.38	Pk	35.6	-28	.7	11.8	-46.28	-13	-33.28	0-360	101	H
3	9.3655	-64.93	Pk	36.5	-25.8	1.2	11.8	-41.23	-13	-28.23	0-360	300	H
6	9.6166	-65.71	Pk	36.7	-25.6	1.2	11.8	-41.61	-13	-28.61	0-360	300	V

Pk - Peak detector

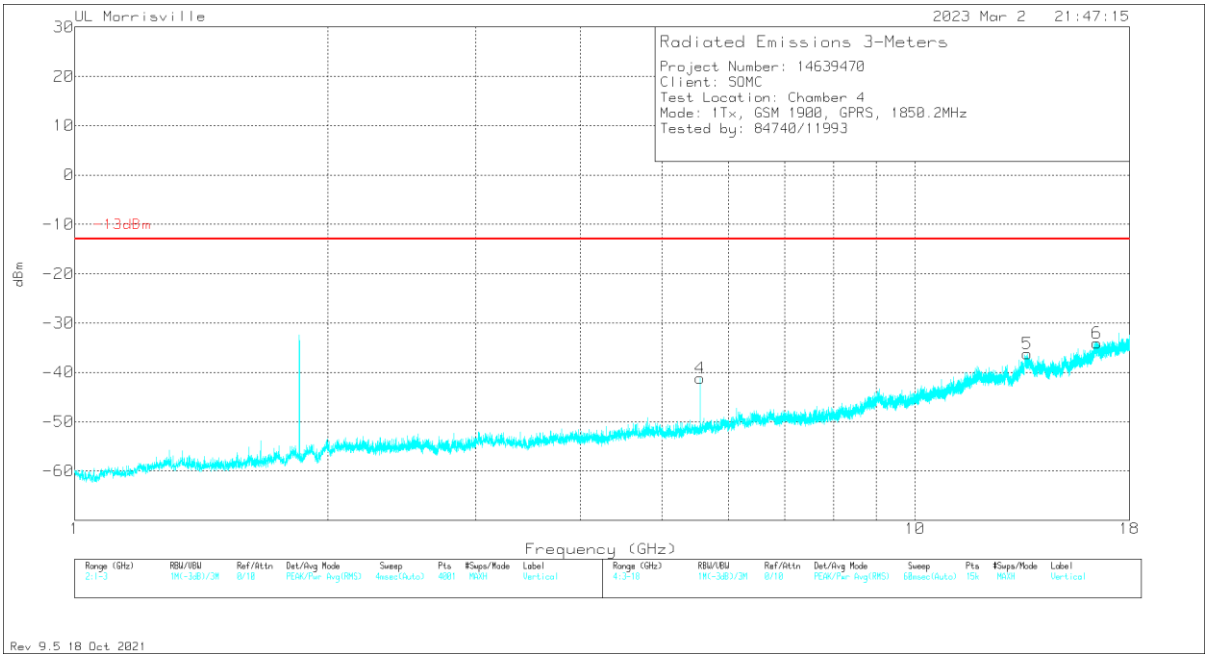
11.1.2. GSM1900

Test Engineer ID:	84740/11993	Test Date:	2023-03-02	Sample Used:	QV7700HTFR

GPRS LOW CHANNEL



HORIZONTAL



VERTICAL