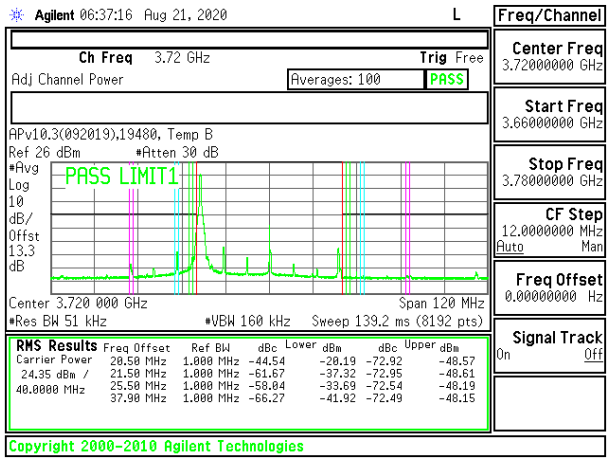

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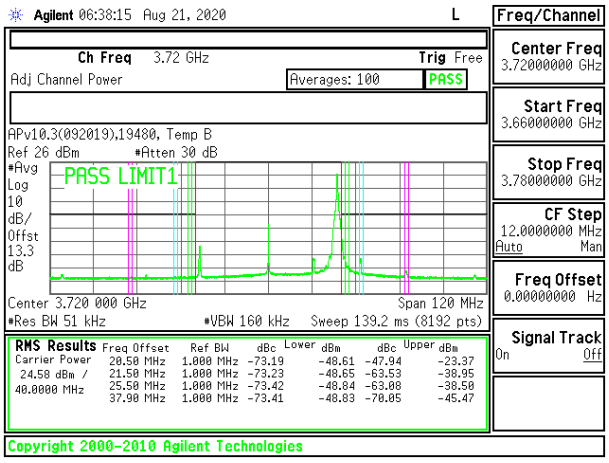

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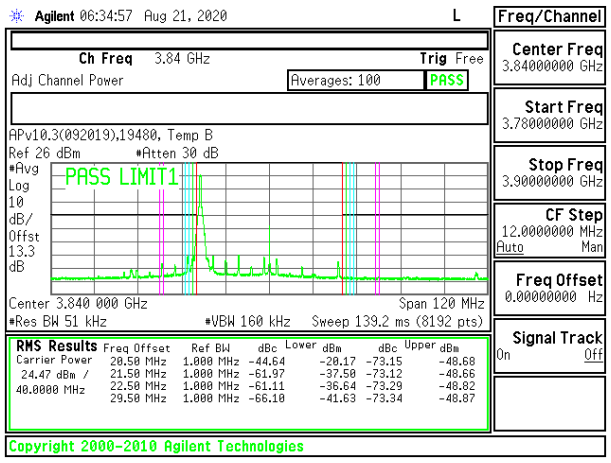

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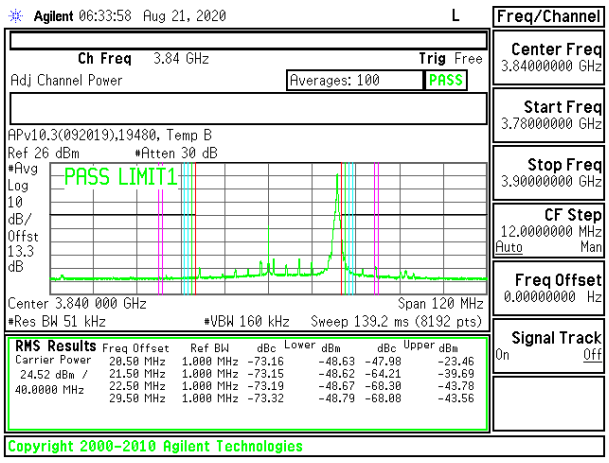

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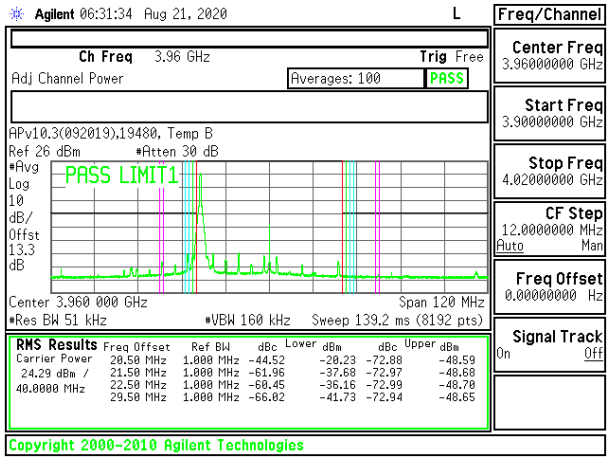

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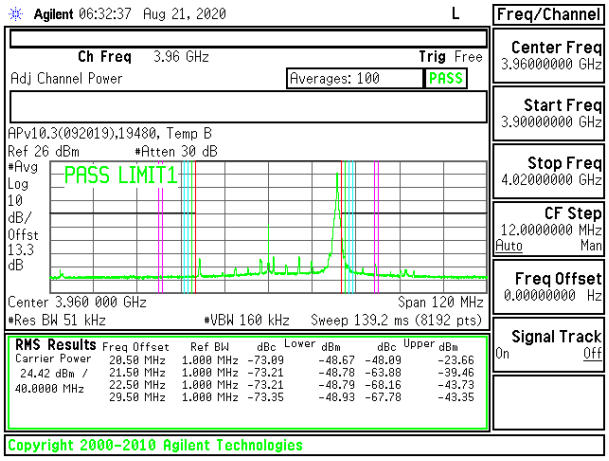

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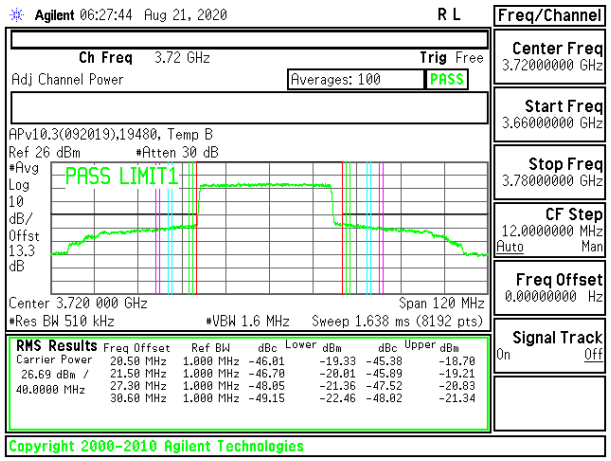

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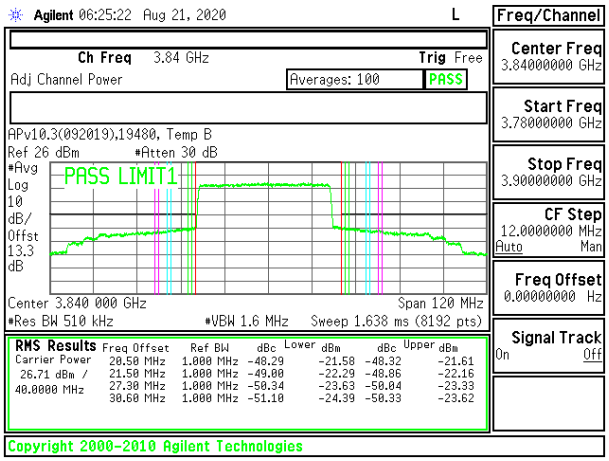

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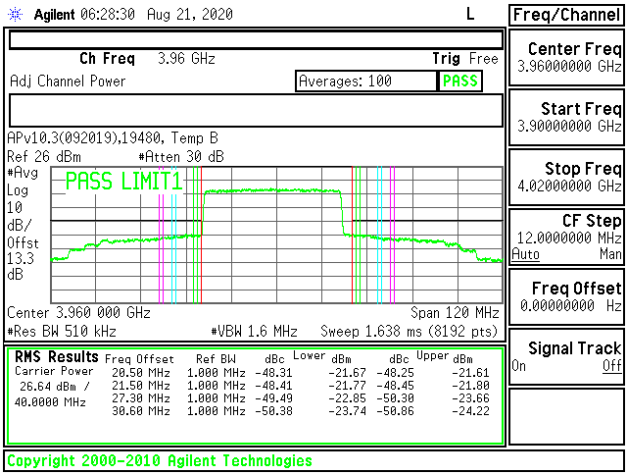

5G NR Bn77 40MHz QPSK High Channel RB100-0

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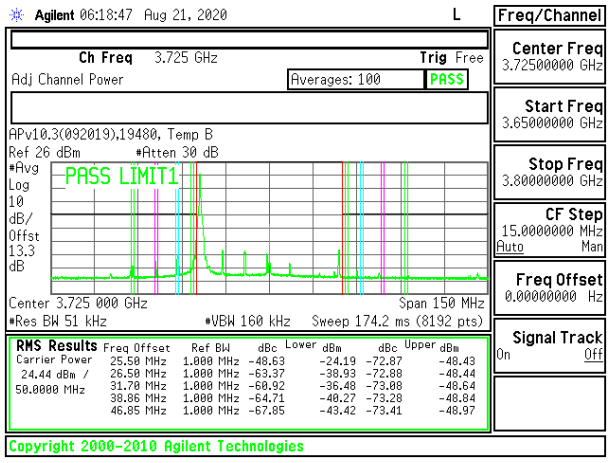
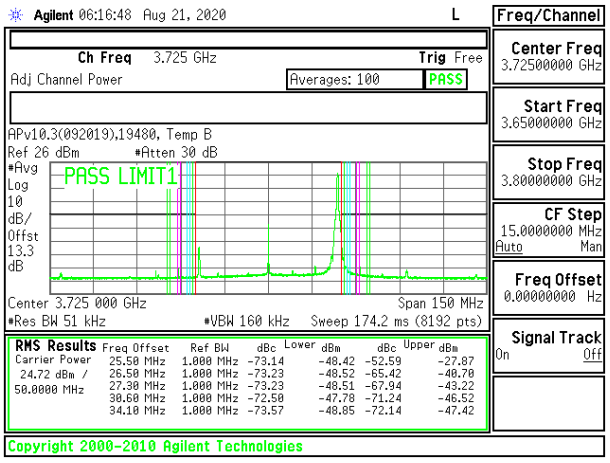


5G NR Bn77 50MHz QPSK Low Channel RB1-0



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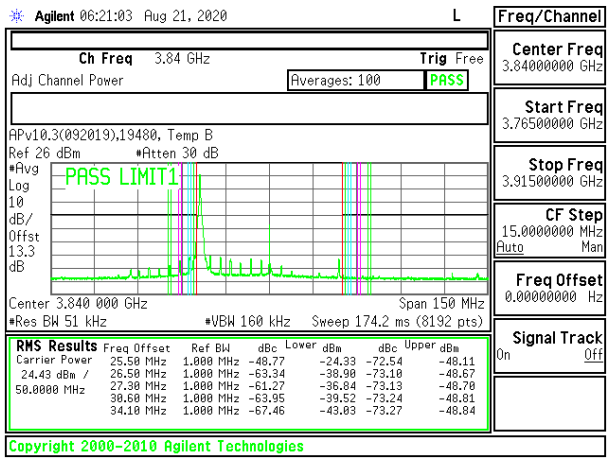

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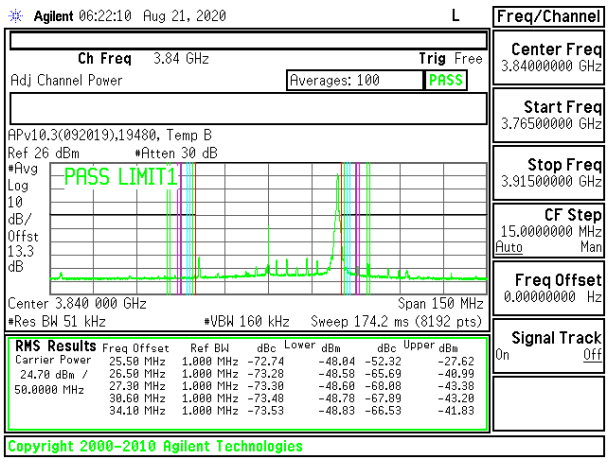
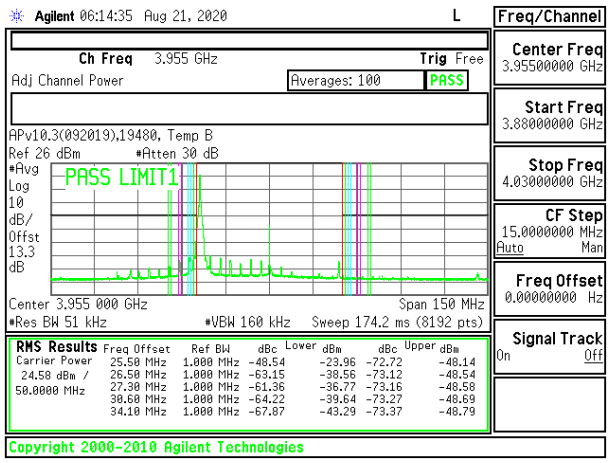


5G NR Bn77 50MHz QPSK Middle Channel RB1-132



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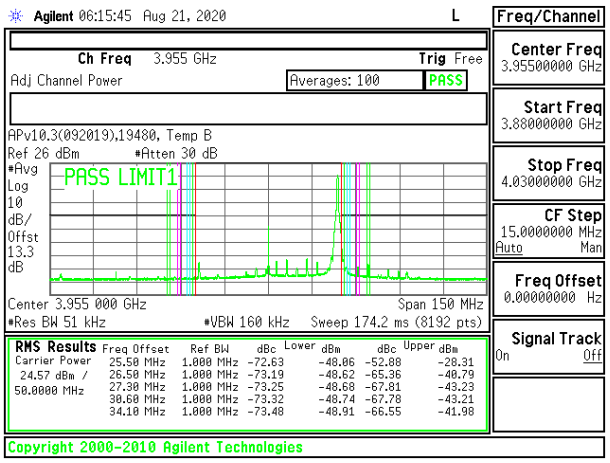

5G NR Bn77 50MHz QPSK High Channel RB1-132

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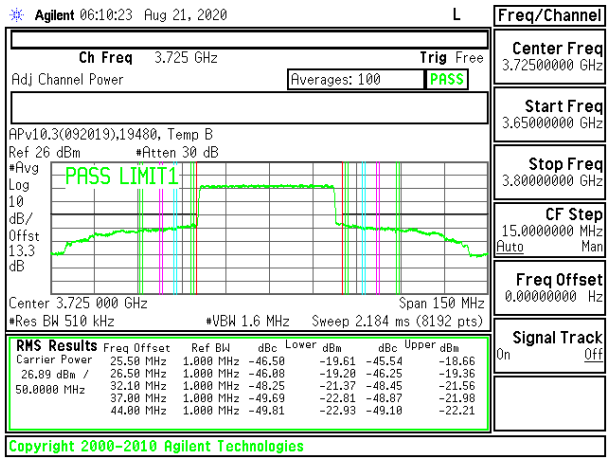

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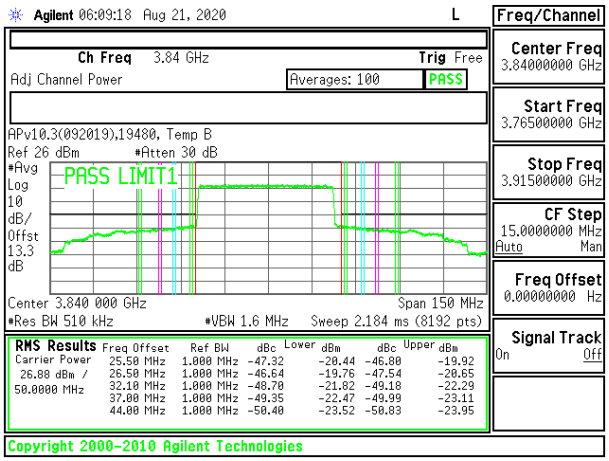

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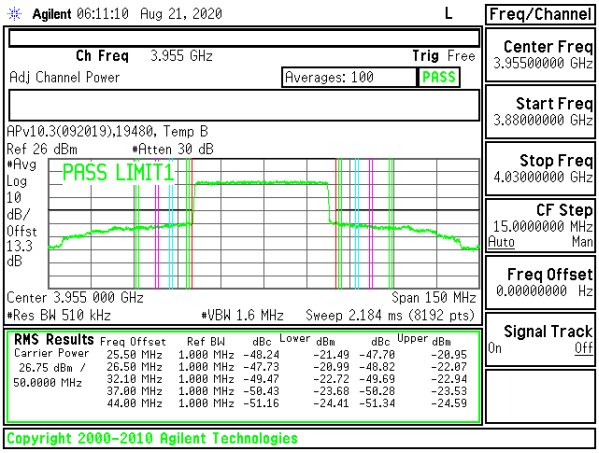

5G NR Bn77 50MHz QPSK High Channel RB128-0

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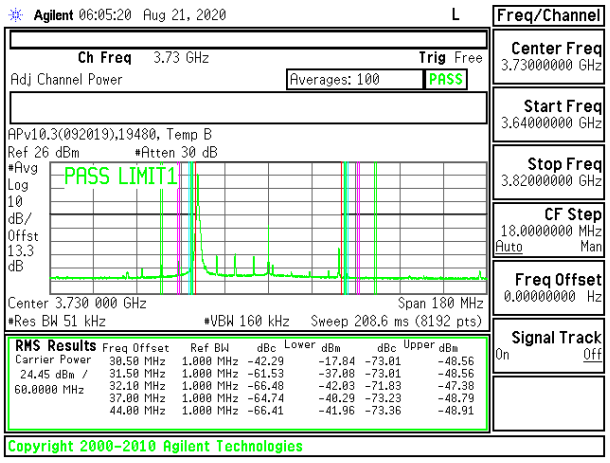
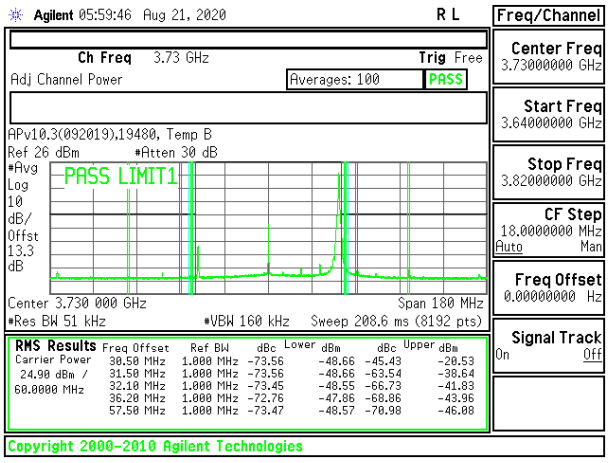


5G NR Bn77 60MHz QPSK Low Channel RB1-0



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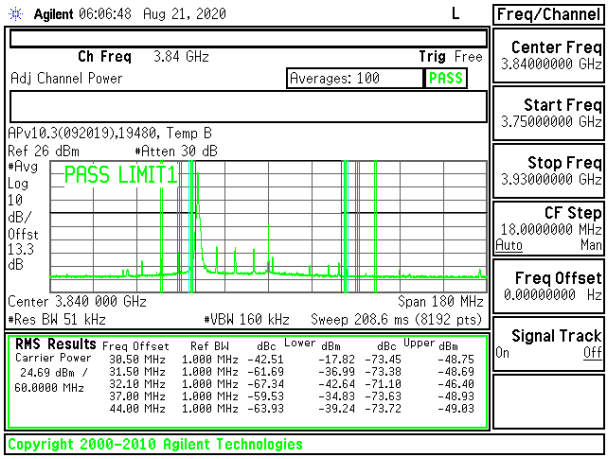
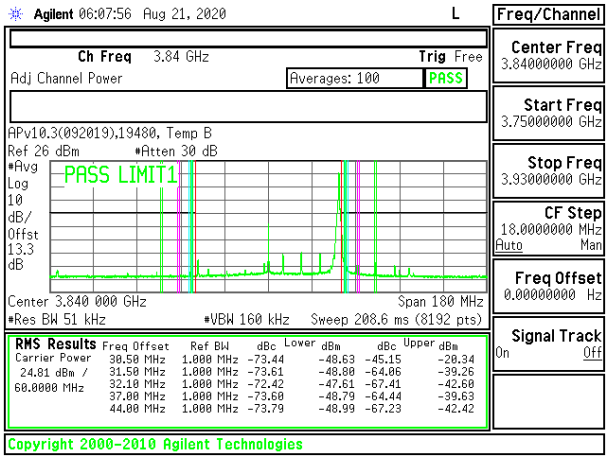
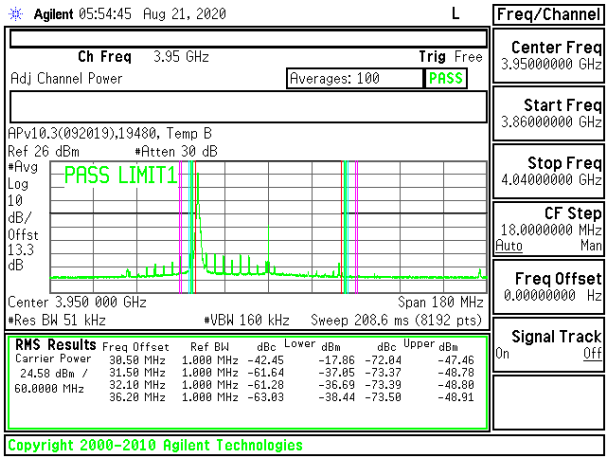


5G NR Bn77 60MHz QPSK Middle Channel RB1-0



5G NR Bn77 60MHz QPSK Middle Channel RB1-161



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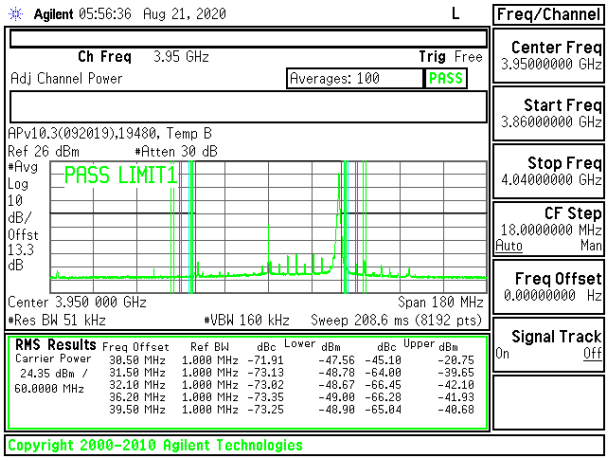

5G NR Bn77 60MHz QPSK High Channel RB1-161

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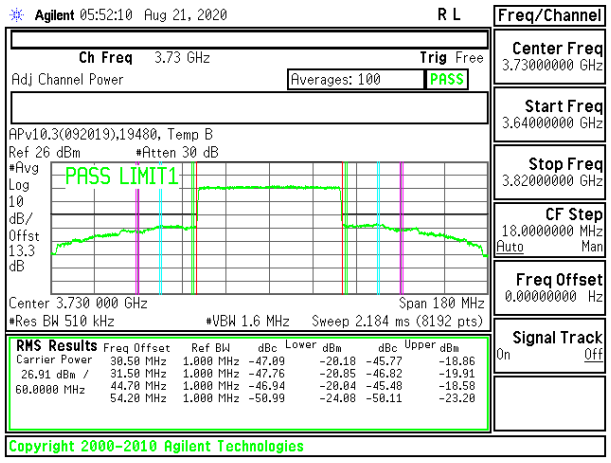

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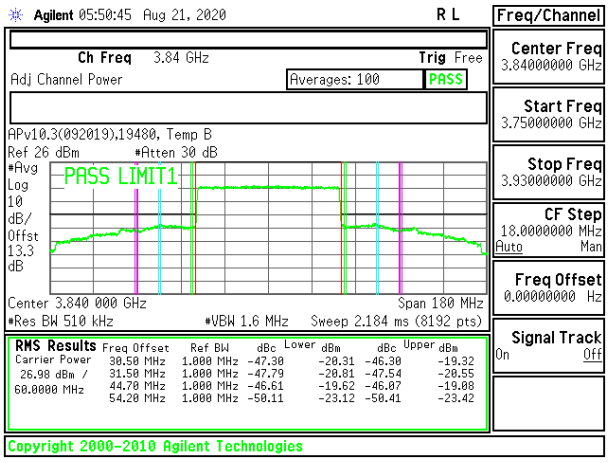

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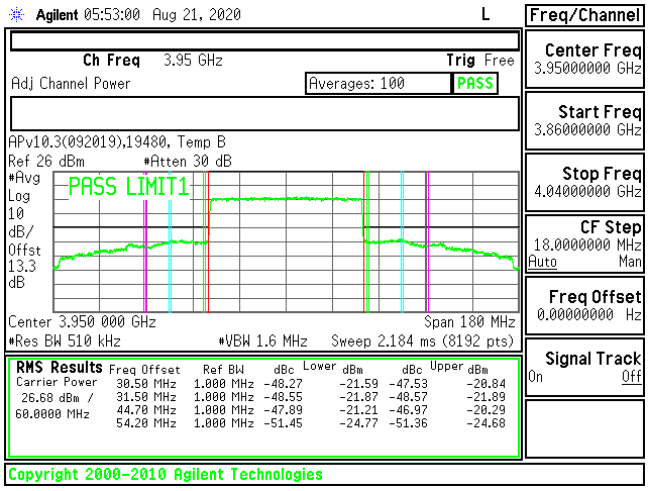

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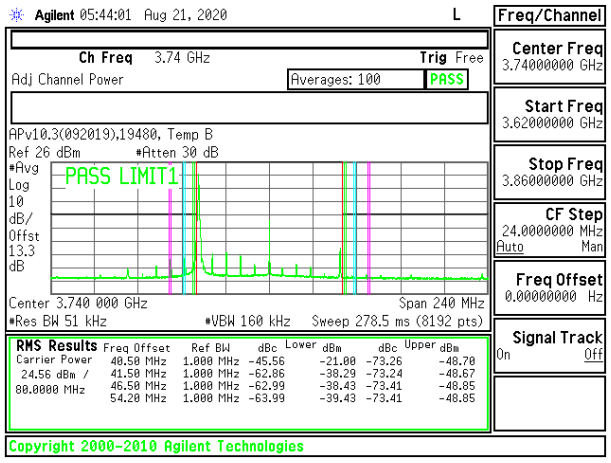
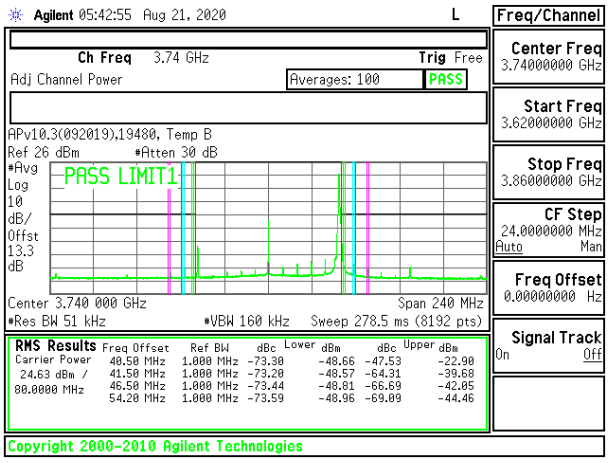


5G NR Bn77 80MHz QPSK Low Channel RB1-0



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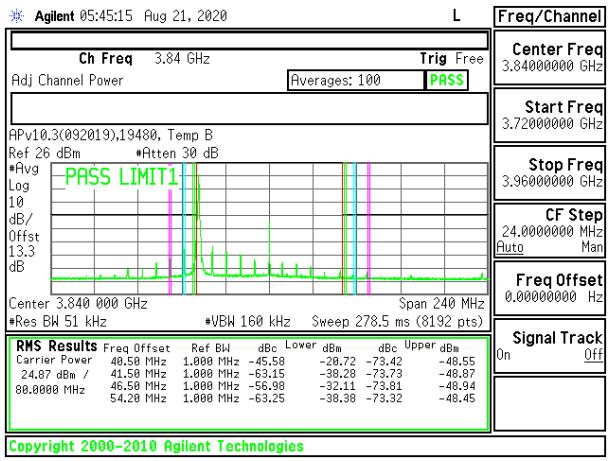
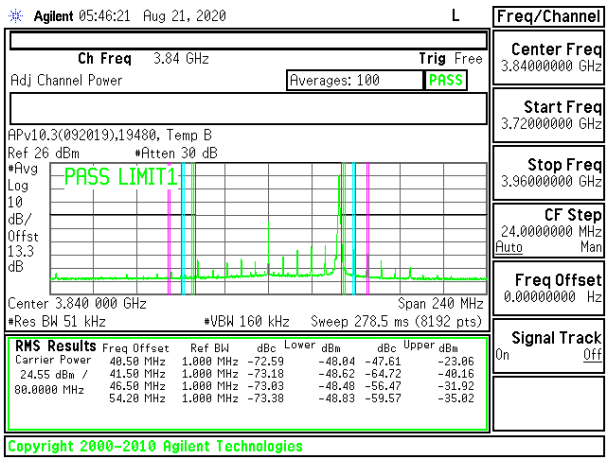


5G NR Bn77 80MHz QPSK Middle Channel RB1-0



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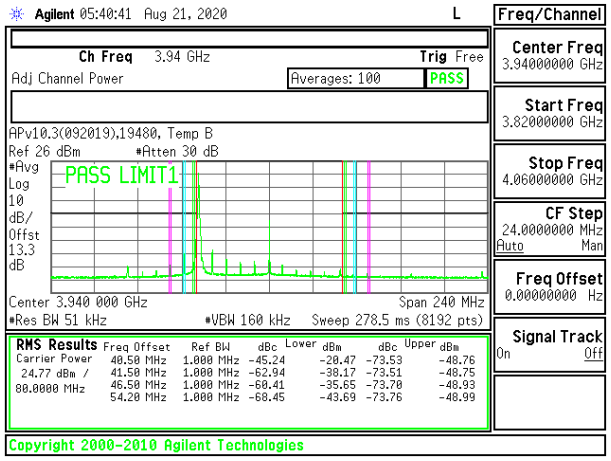

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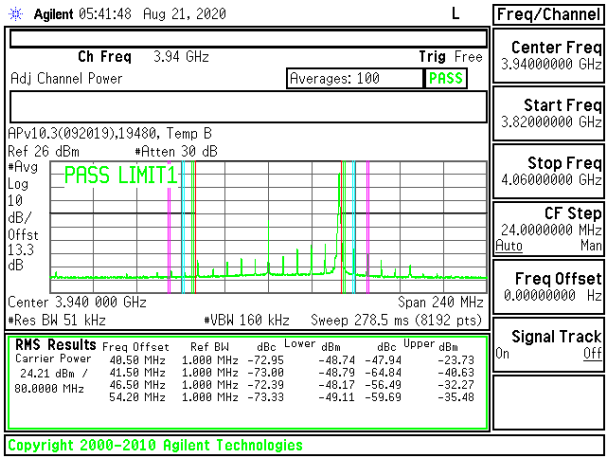

5G NR Bn77 80MHz QPSK High Channel RB1-216

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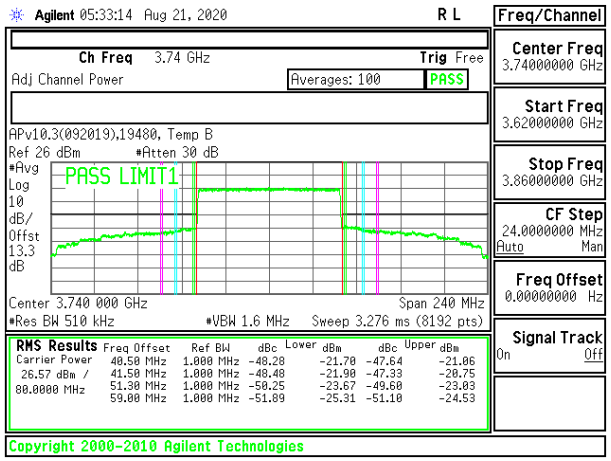

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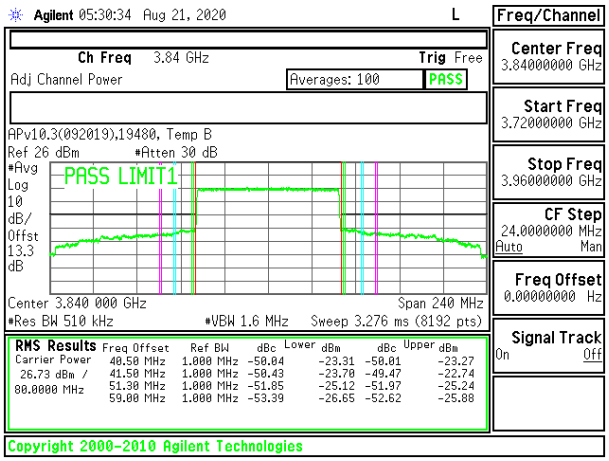

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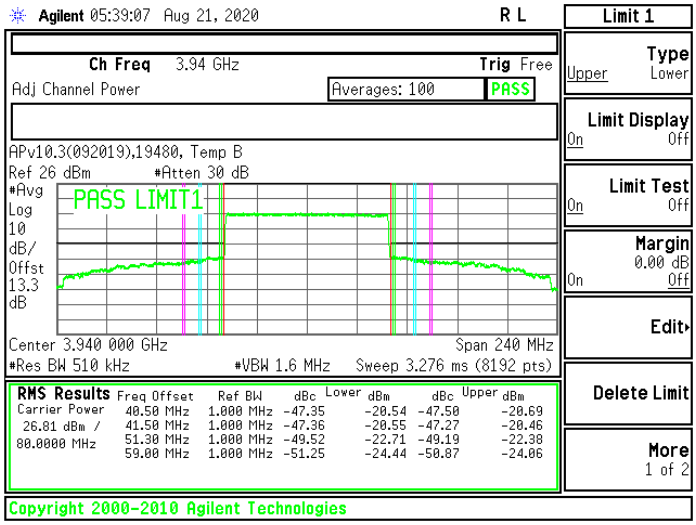

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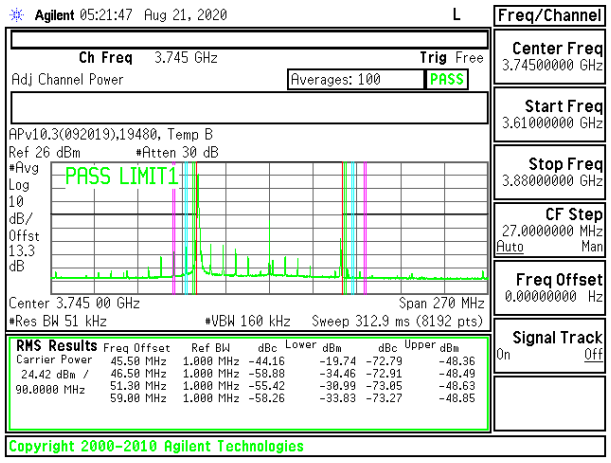
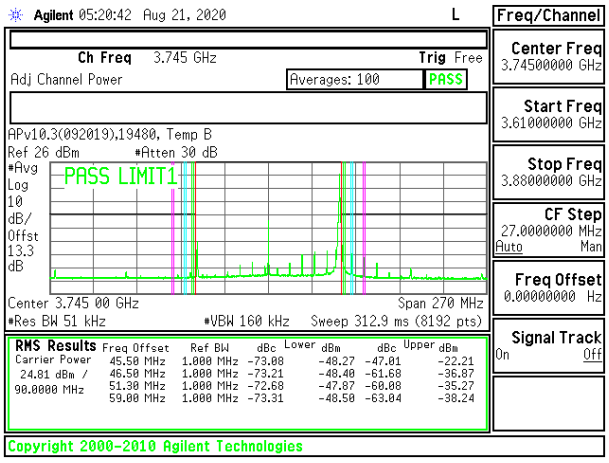


5G NR Bn77 90MHz QPSK Low Channel RB1-0



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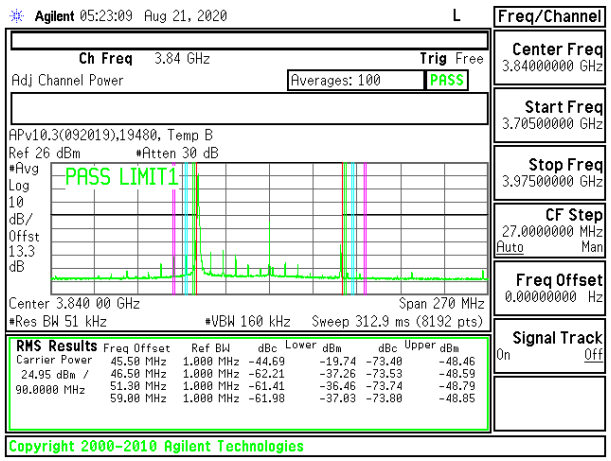
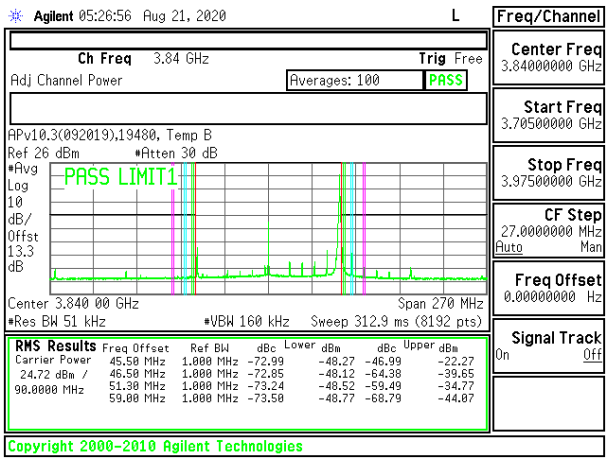


5G NR Bn77 90MHz QPSK Middle Channel RB1-0



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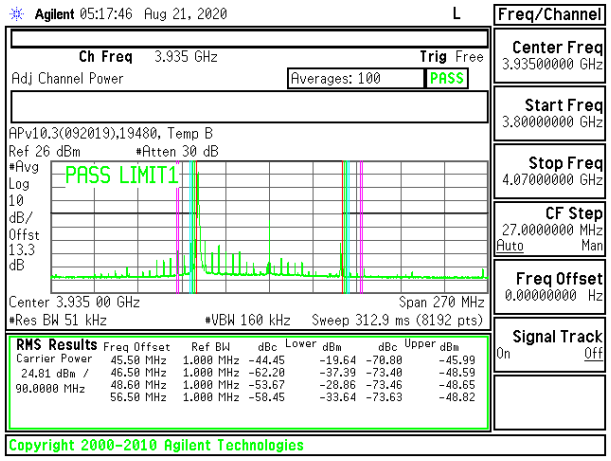

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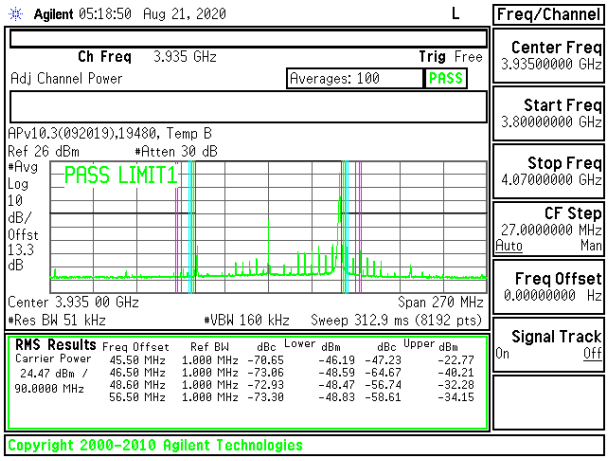

5G NR Bn77 90MHz QPSK High Channel RB1-244

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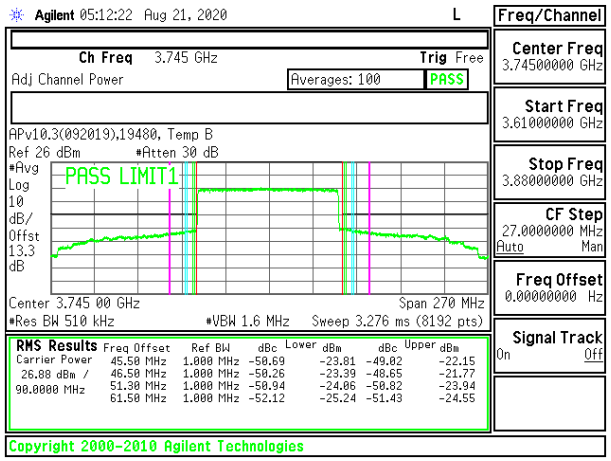
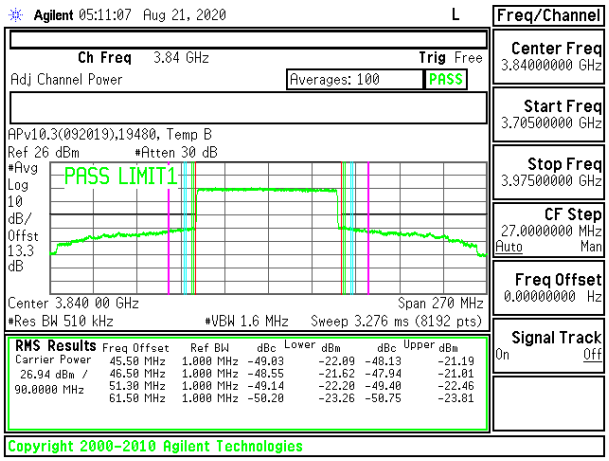
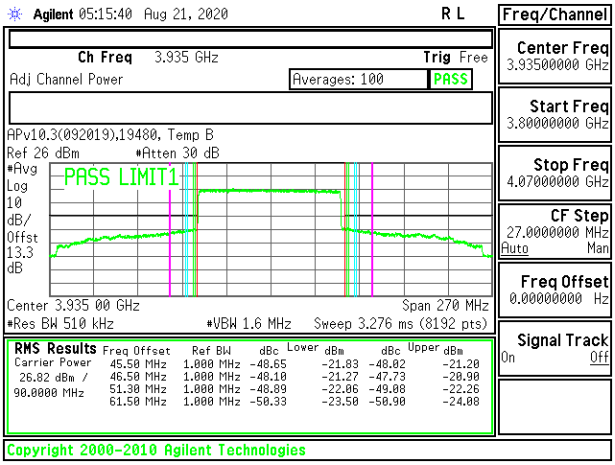


5G NR Bn77 90MHz QPSK Low Channel RB240-0



5G NR Bn77 90MHz QPSK Middle Channel RB240-0



5G NR Bn77 90MHz QPSK High Channel RB240-0

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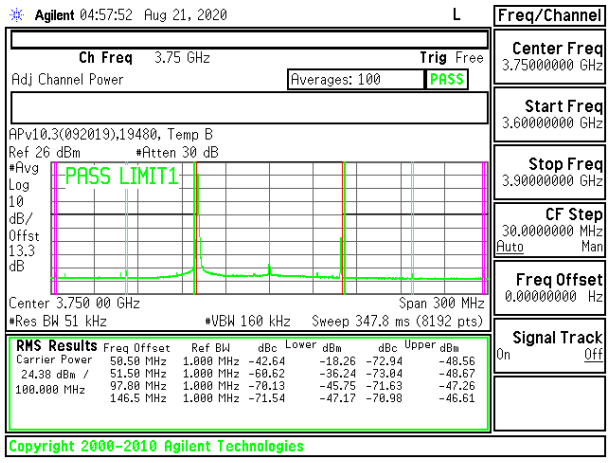
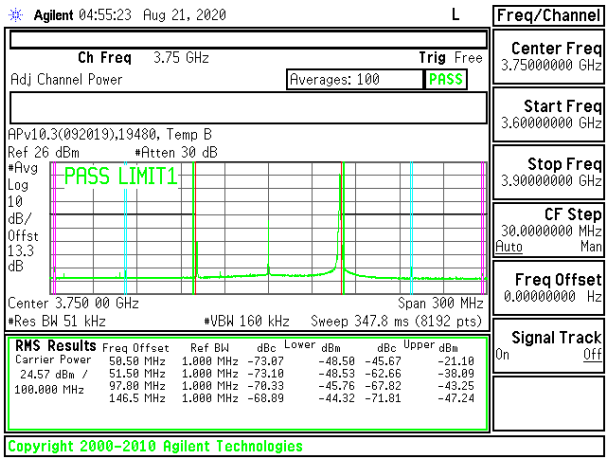
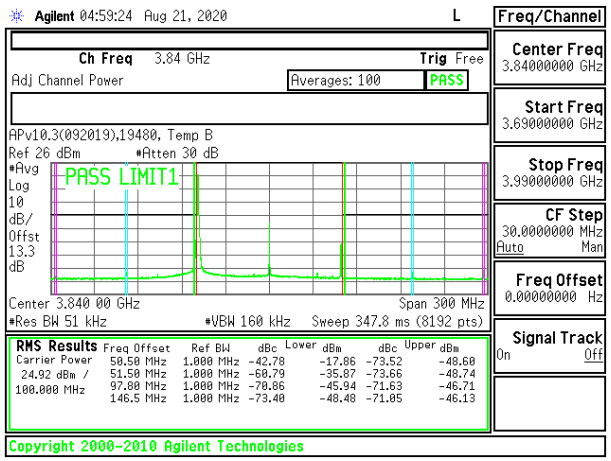


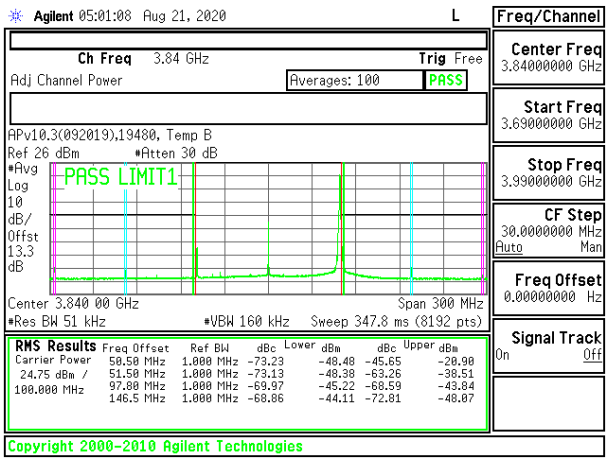
5G NR Bn77 100MHz QPSK Low Channel RB1-0



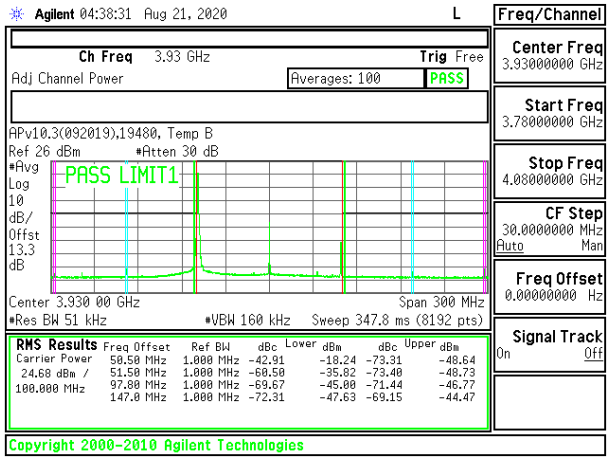
5G NR Bn77 100MHz QPSK Low Channel RB1-272



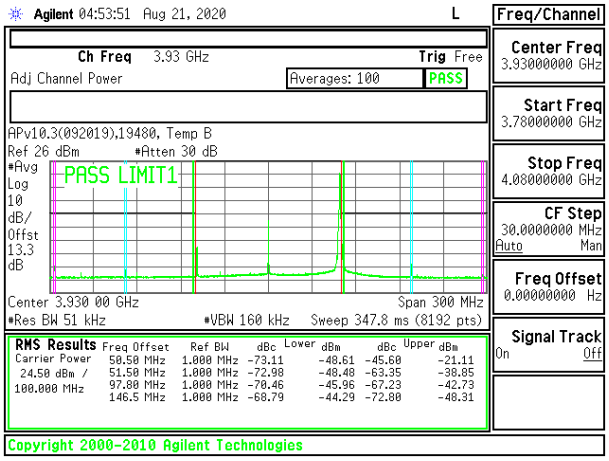
5G NR Bn77 100MHz QPSK Middle Channel RB1-0



5G NR Bn77 100MHz QPSK Middle Channel RB1-272



5G NR Bn77 100MHz QPSK High Channel RB1-0



5G NR Bn77 100MHz QPSK High Channel RB1-270

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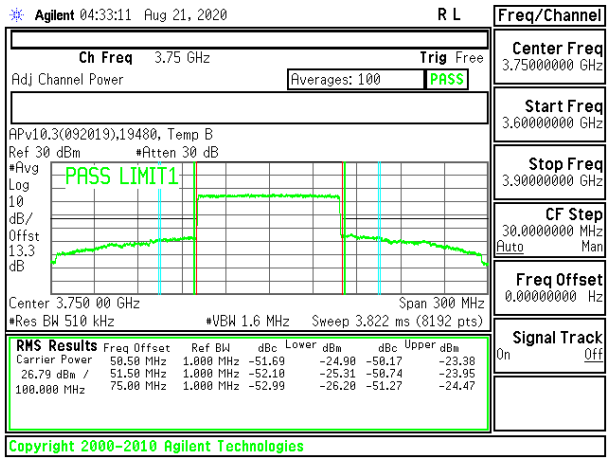
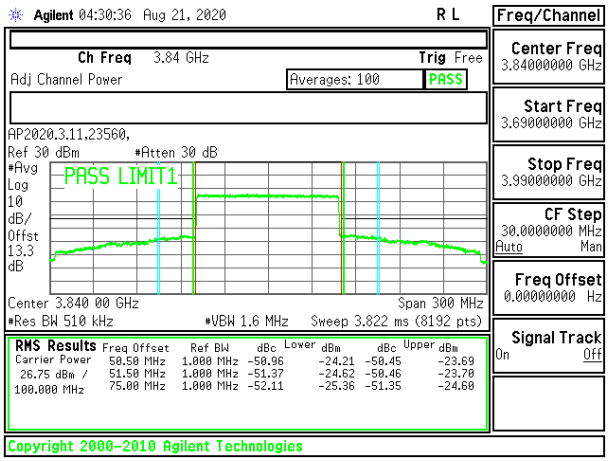
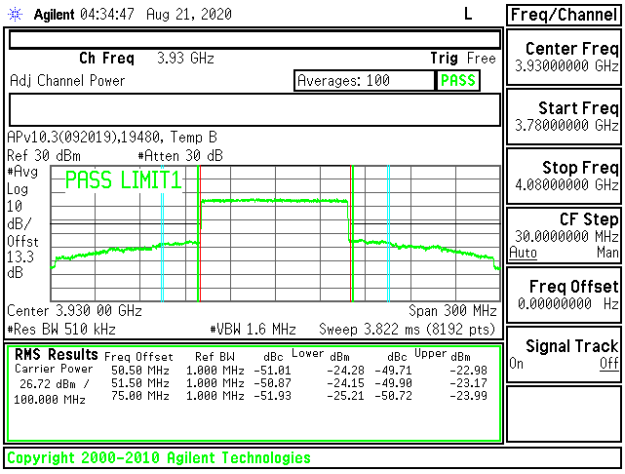


5G NR Bn77 100MHz QPSK Low Channel RB270-0



5G NR Bn77 100MHz QPSK Middle Channel RB270-0



5G NR Bn77 100MHz QPSK High Channel RB270-0

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8.3. OUT OF BAND EMISSIONS

TEST PROCEDURE

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.

For each out of band emissions measurement:

- Set display line at -13 dBm, -25dBm and -40dBm according to the band Limit
- Set RBW & VBW to 100 kHz for the measurement below 1 GHz, and 1 MHz for the measurement above 1 GHz. (NOTE: Worst case set RBW/VBW to 1MHz/3MHz)

RESULTS

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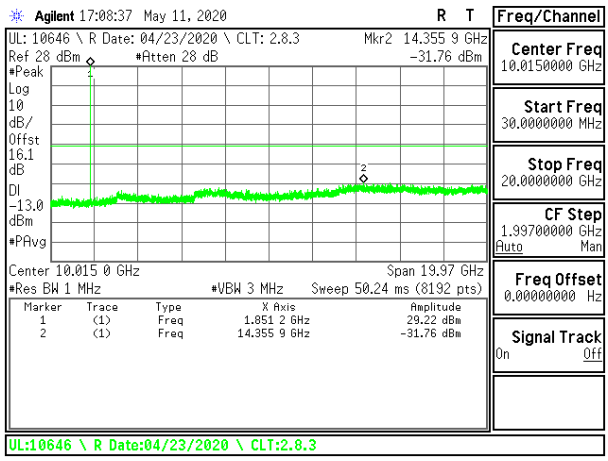
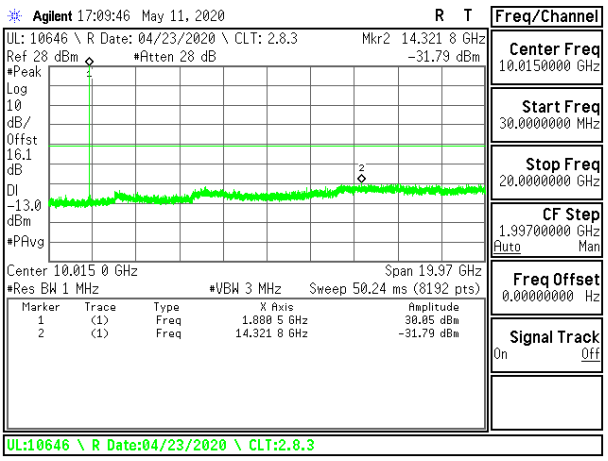
8.3.1. LTE BAND 2

LIMITS

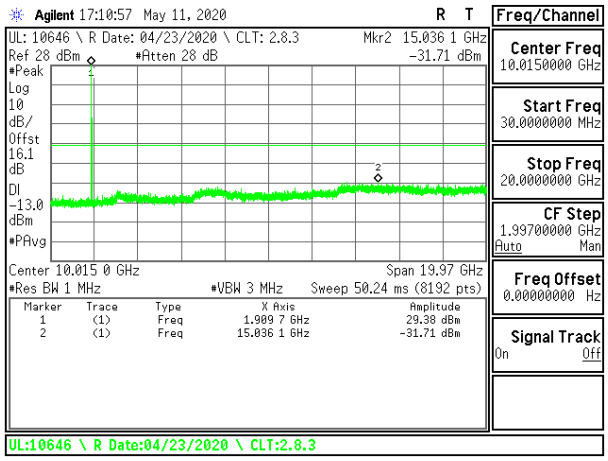
FCC: §24.238
The minimum permissible attenuation level of any spurious emissions is 43 + 10 log (P) dB where transmitting power (P) in Watts.



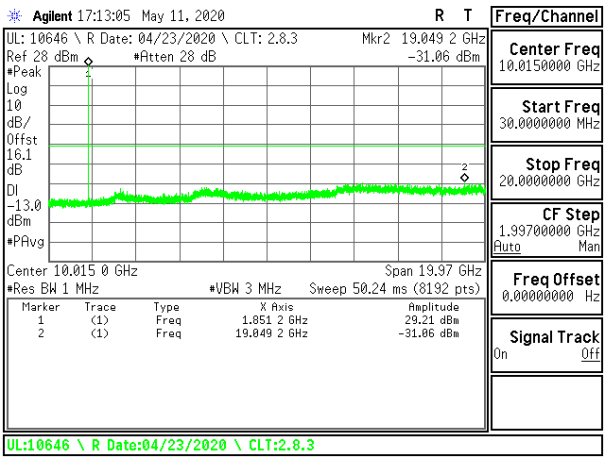
LTE B2 1.4MHz QPSK Low Channel RB1-0



LTE B2 1.4MHz QPSK Middle Channel RB1-0



LTE B2 1.4MHz QPSK High Channel RB1-0



LTE B2 3MHz QPSK Low Channel RB1-0

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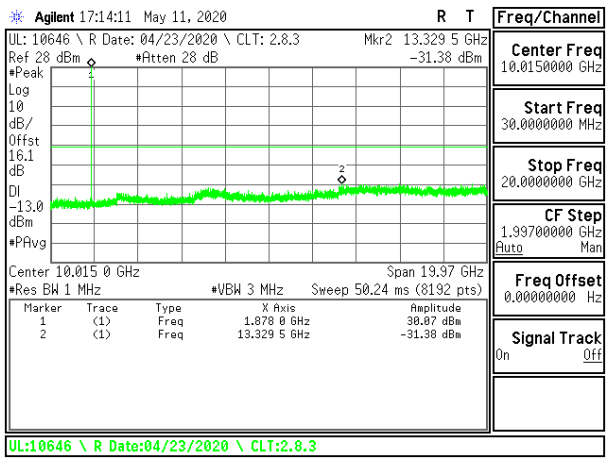
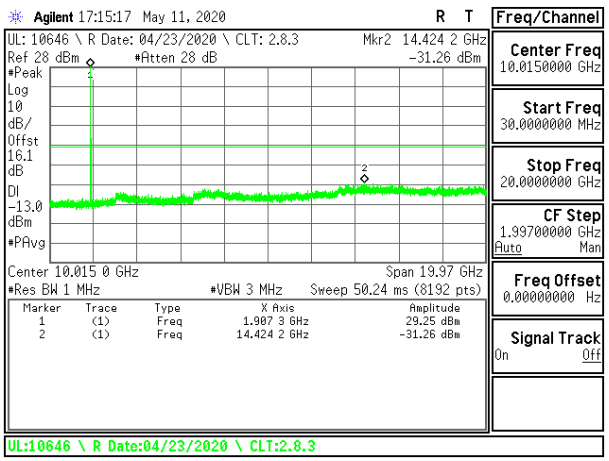
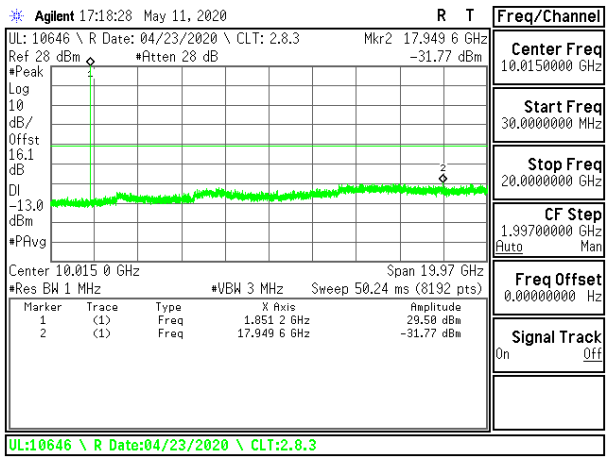


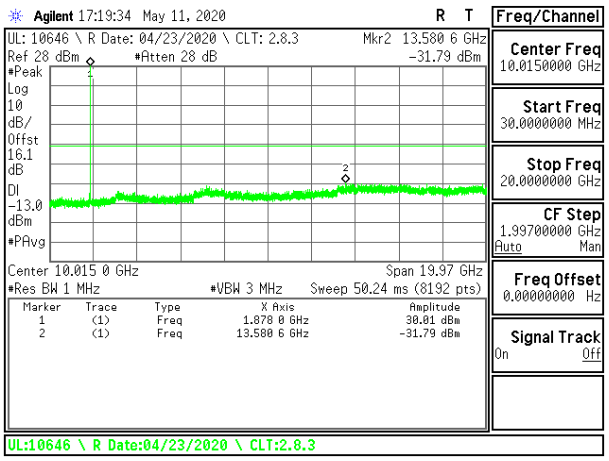
LTE B2 3MHz QPSK Middle Channel RB1-0



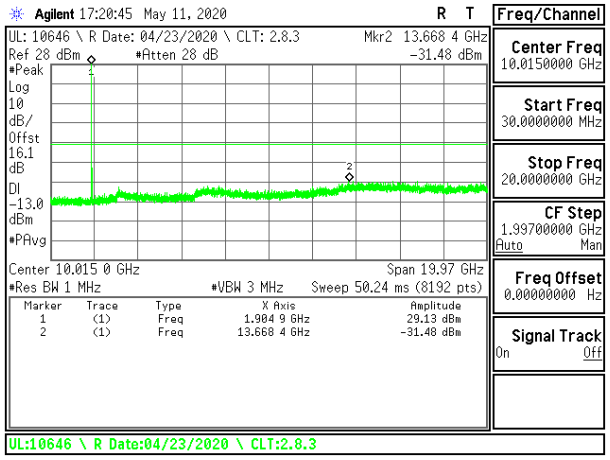
LTE B2 3MHz QPSK High Channel RB1-0



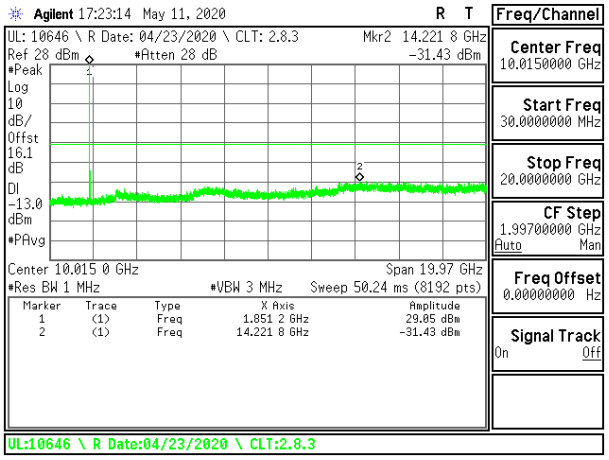
LTE B2 5MHz QPSK Low Channel RB1-0



LTE B2 5MHz QPSK Middle Channel RB1-0



LTE B2 5MHz QPSK High Channel RB1-0



LTE B2 10MHz QPSK Low Channel RB1-0

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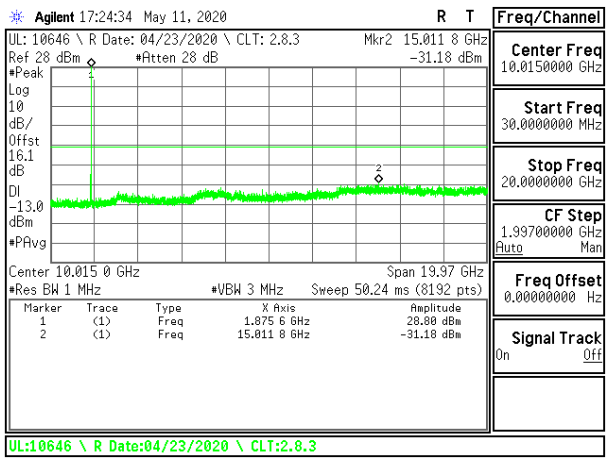
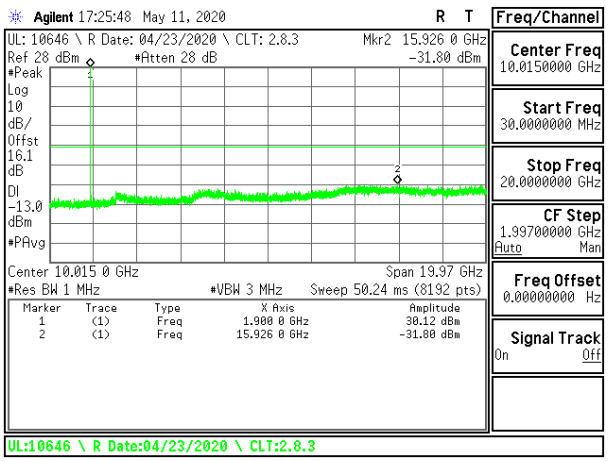
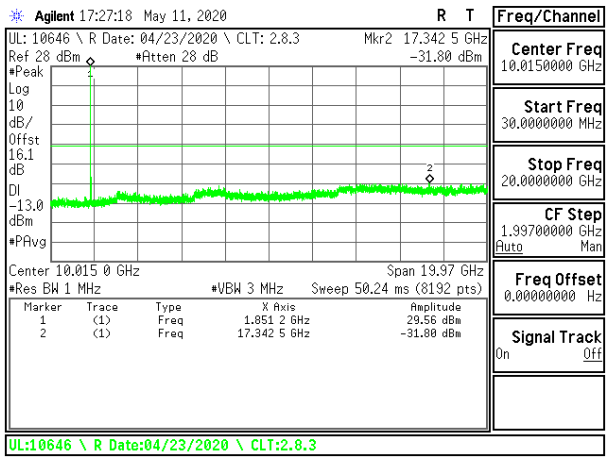


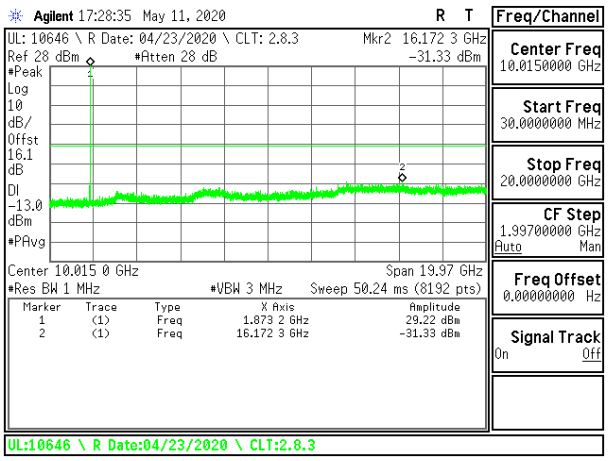
LTE B2 10MHz QPSK Middle Channel RB1-0



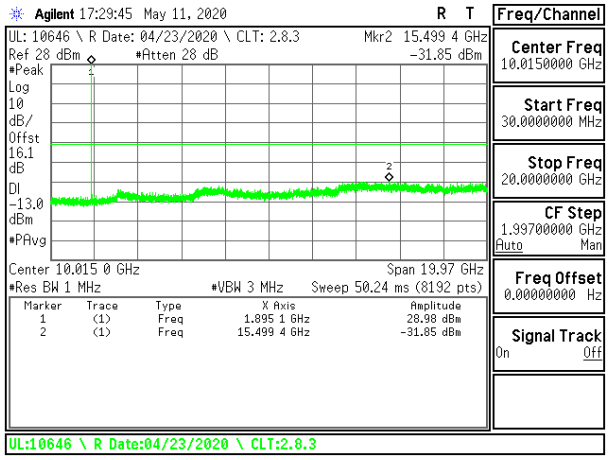
LTE B2 10MHz QPSK High Channel RB1-0



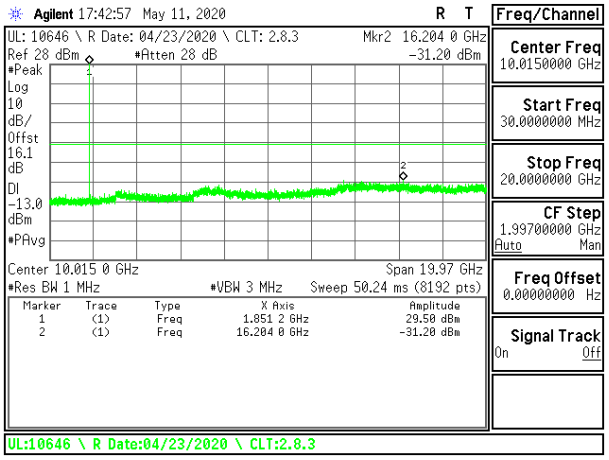
LTE B2 15MHz QPSK Low Channel RB1-0



LTE B2 15MHz QPSK Middle Channel RB1-0



LTE B2 15MHz QPSK High Channel RB1-0



LTE B2 20MHz QPSK Low Channel RB1-0

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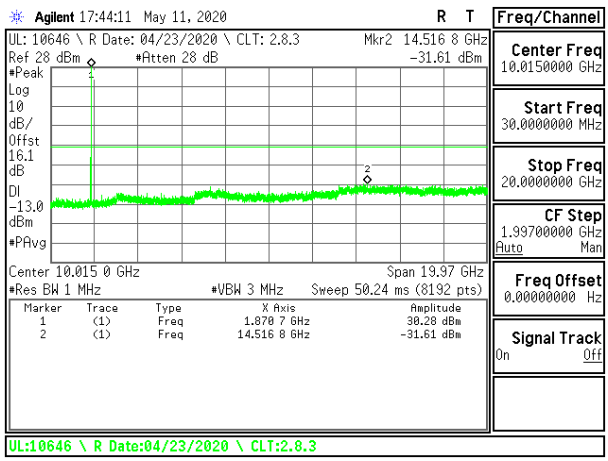
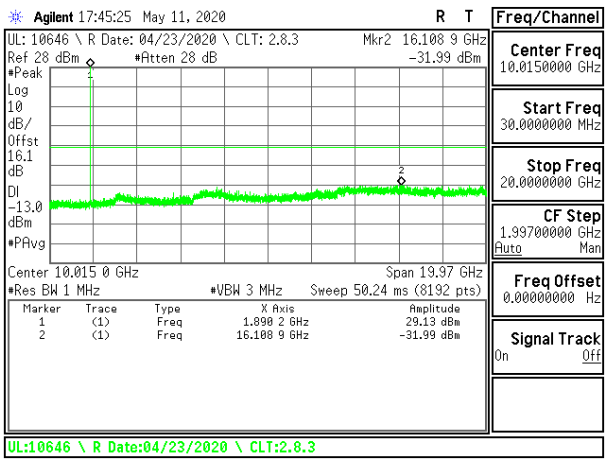


LTE B2 20MHz QPSK Middle Channel RB1-0



LTE B2 20MHz QPSK High Channel RB1-0

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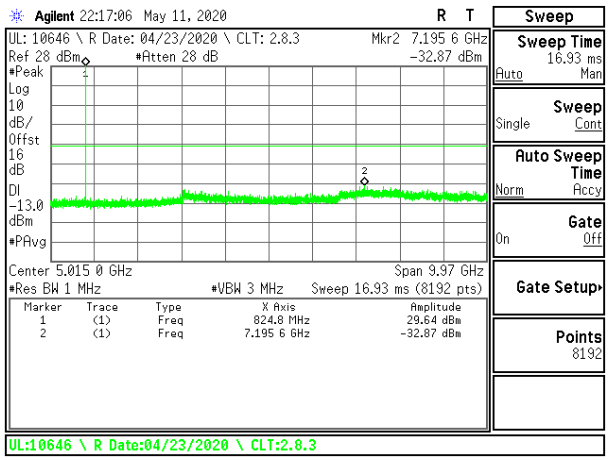
8.3.2. LTE BAND 5 AND 5G NR BAND n5

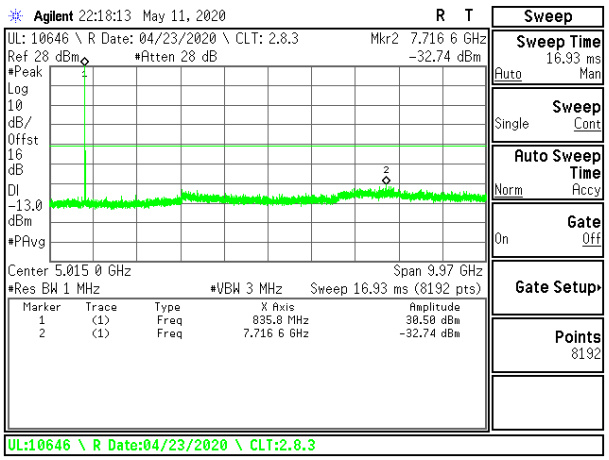
LIMITS

FCC: §22.917
The minimum permissible attenuation level of any spurious emissions is 43 + 10 log (P) dB where transmitting power (P) in Watts.

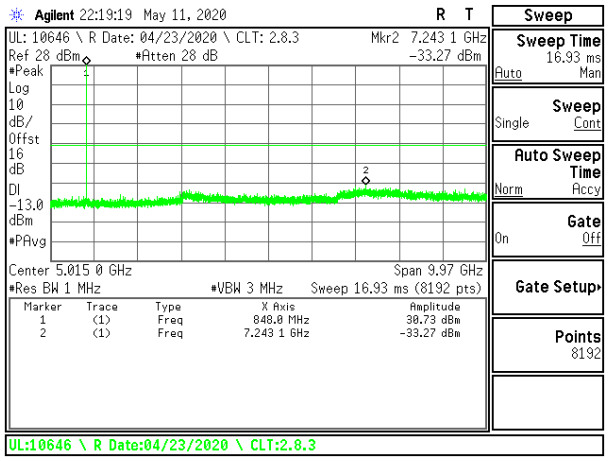
LTE BAND 5



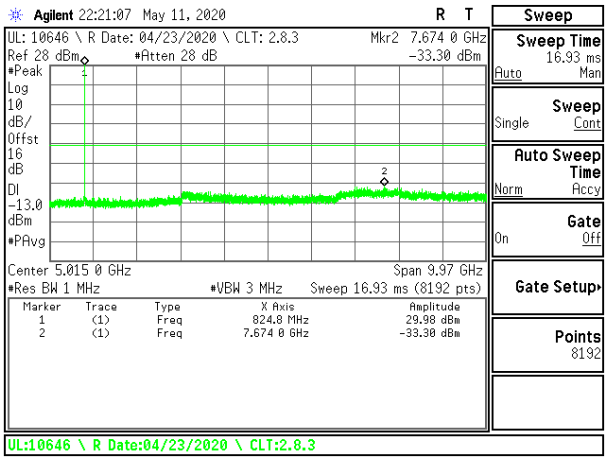
LTE B5 1.4MHz QPSK Low Channel RB1-0



LTE B5 1.4MHz QPSK Middle Channel RB1-0



LTE B5 1.4MHz QPSK High Channel RB1-0



LTE B5 3MHz QPSK Low Channel RB1-0

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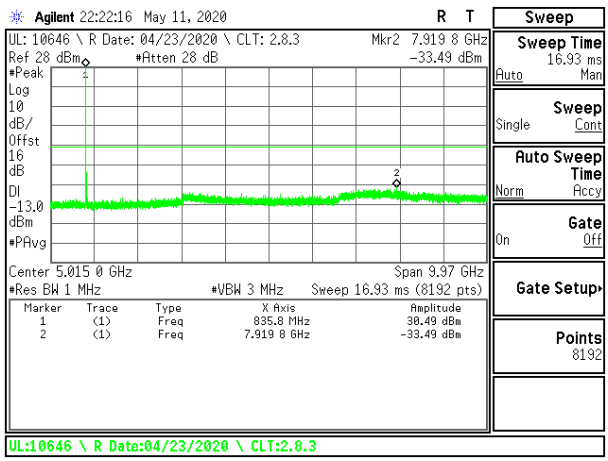
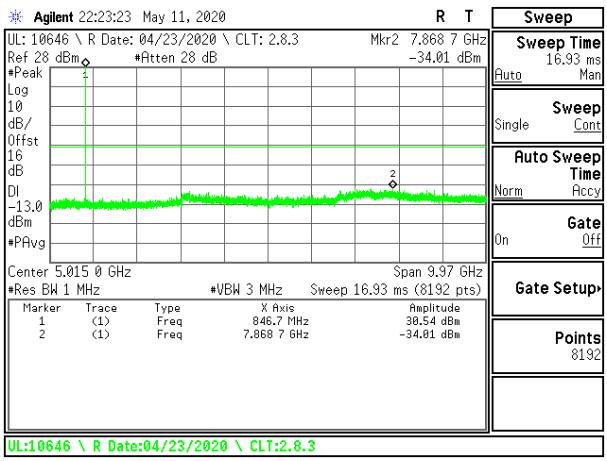
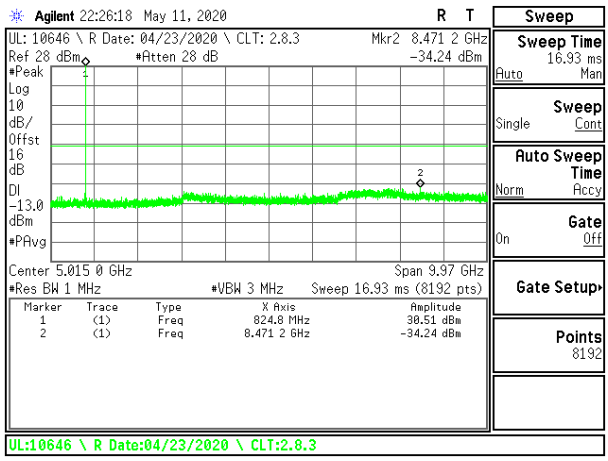


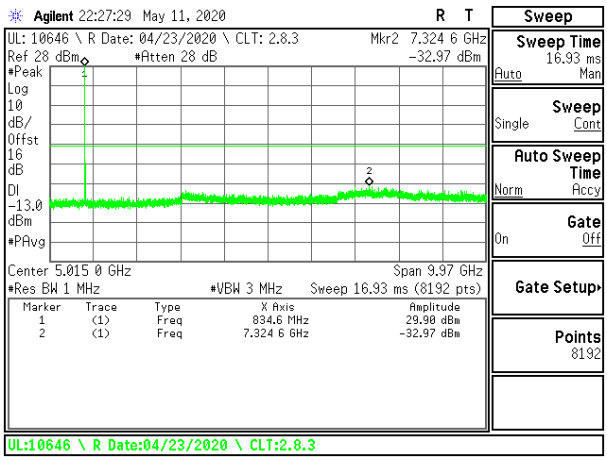
LTE B5 3MHz QPSK Middle Channel RB1-0



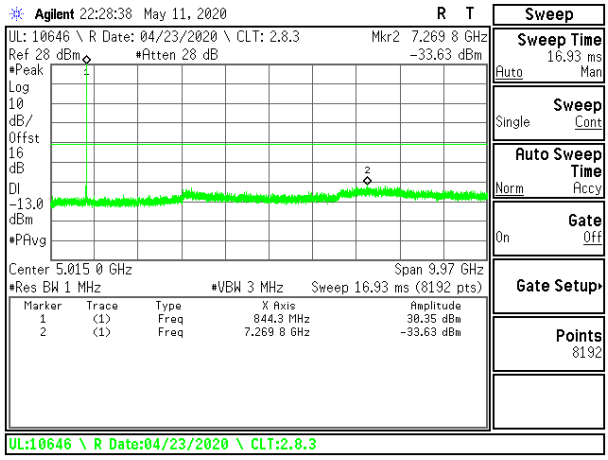
LTE B5 3MHz QPSK High Channel RB1-0



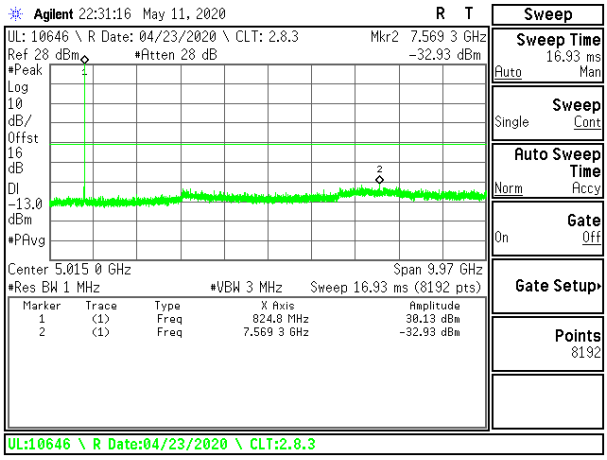
LTE B5 5MHz QPSK Low Channel RB1-0



LTE B5 5MHz QPSK Middle Channel RB1-0



LTE B5 5MHz QPSK High Channel RB1-0



LTE B5 10MHz QPSK Low Channel RB1-0

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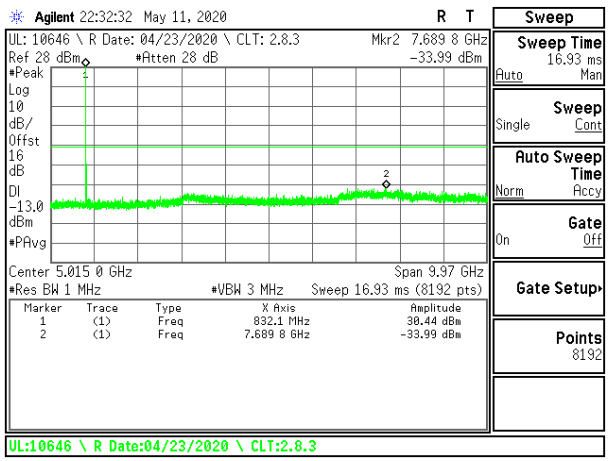
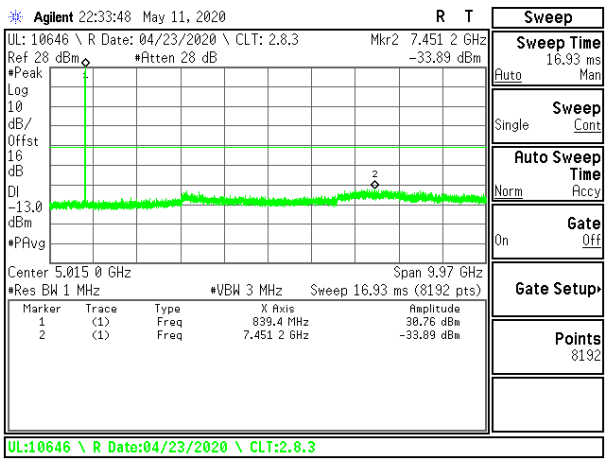


LTE B5 10MHz QPSK Middle Channel RB1-0



LTE B5 10MHz QPSK High Channel RB1-0

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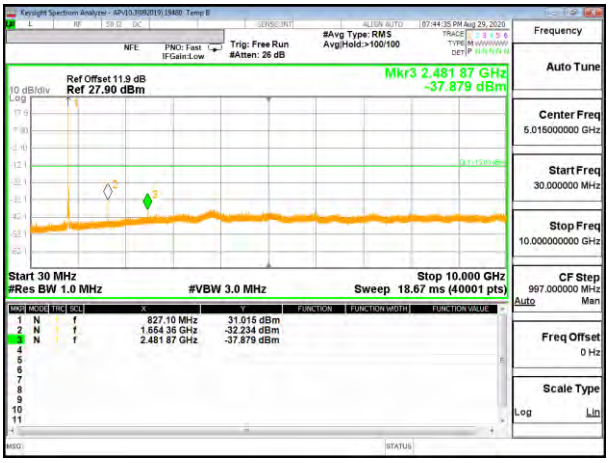
5G NR BAND n5

5G NR Bn5 20MHz QPSK Low Channel RB1-0



5G NR Bn5 20MHz QPSK Middle Channel RB1-0

5G NR Bn5 20MHz QPSK High Channel RB1-0

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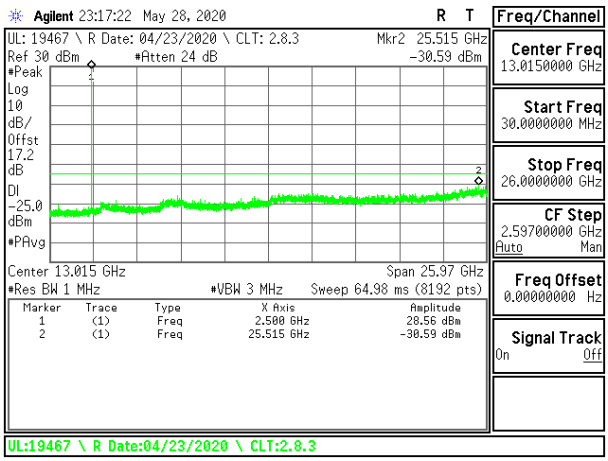
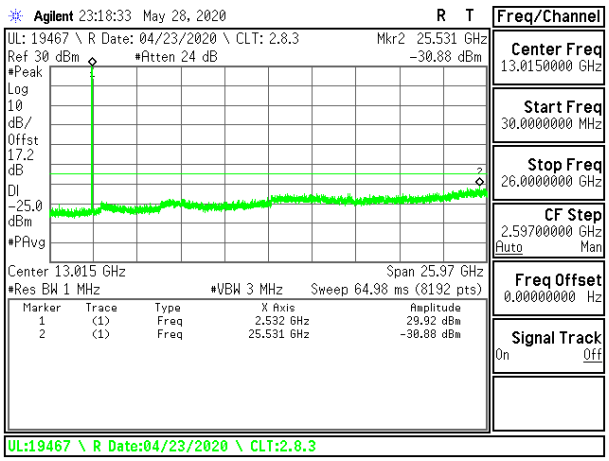
8.3.3. LTE BAND 7

LIMITS

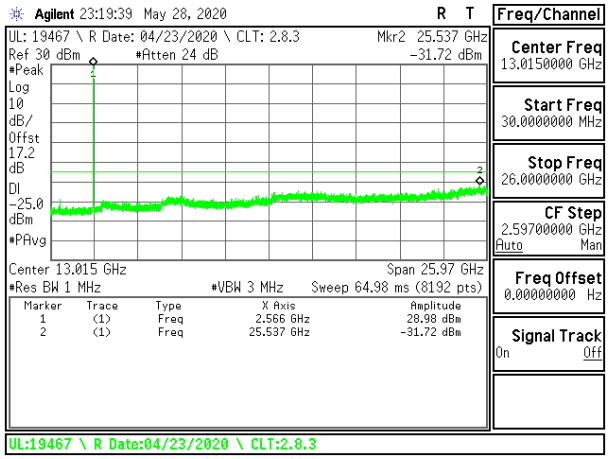
FCC: §27.53 (m)
The minimum permissible attenuation level of any spurious emissions is 55 + 10 log (P) dB where transmitting power (P) in Watts.



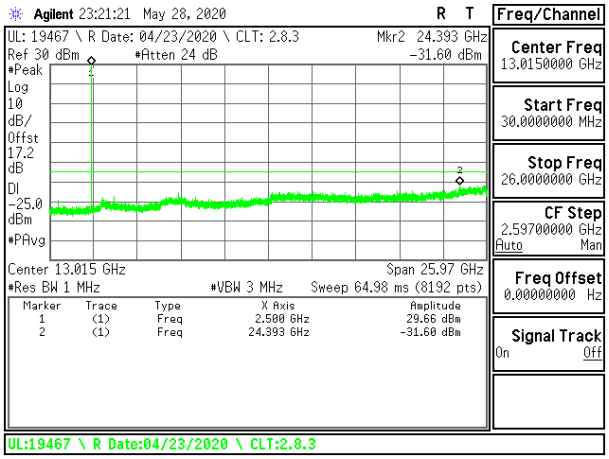
LTE B7 5MHz QPSK Low Channel RB1-0



LTE B7 5MHz QPSK Middle Channel RB1-0



LTE B7 5MHz QPSK High Channel RB1-0



LTE B7 10MHz QPSK Low Channel RB1-0

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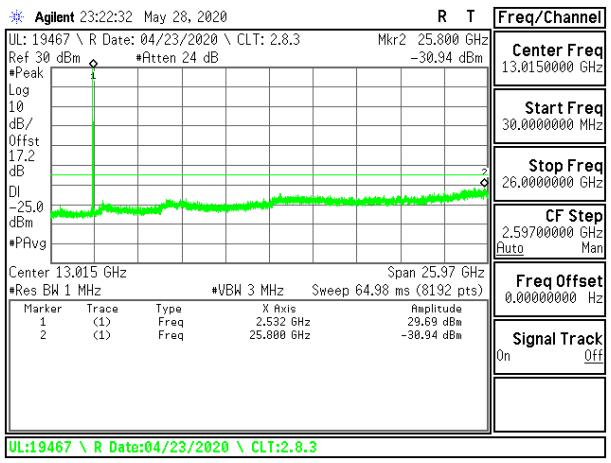
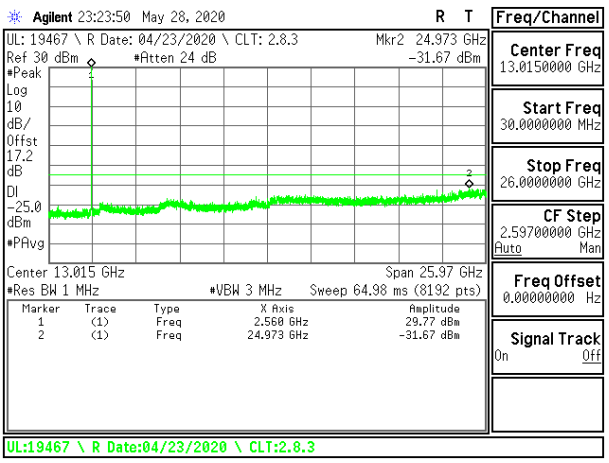
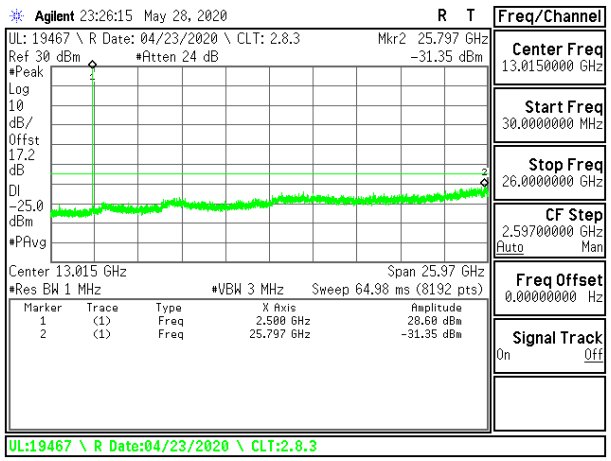


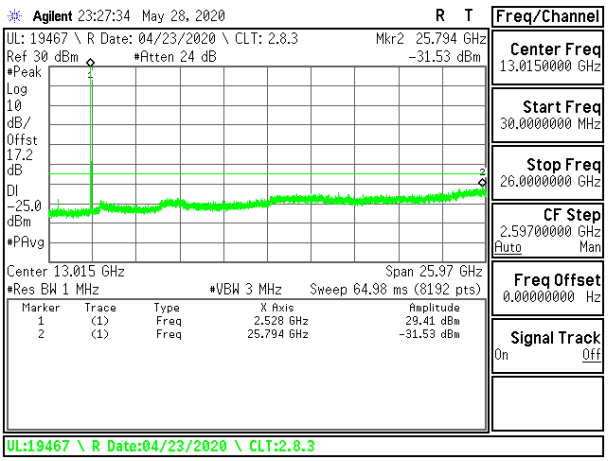
LTE B7 10MHz QPSK Middle Channel RB1-0



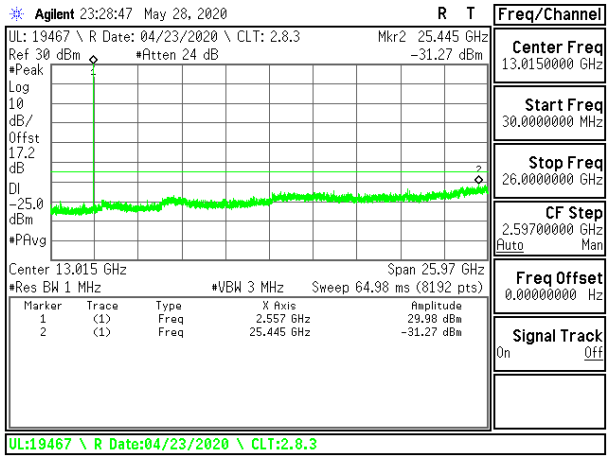
LTE B7 10MHz QPSK High Channel RB1-0



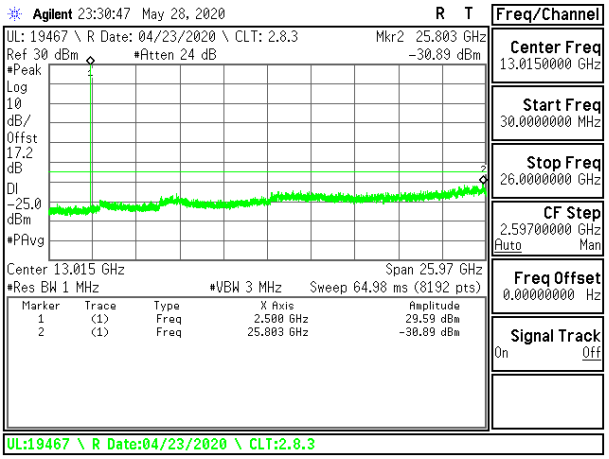
LTE B7 15MHz QPSK Low Channel RB1-0



LTE B7 15MHz QPSK Middle Channel RB1-0



LTE B7 15MHz QPSK High Channel RB1-0



LTE B7 20MHz QPSK Low Channel RB1-0

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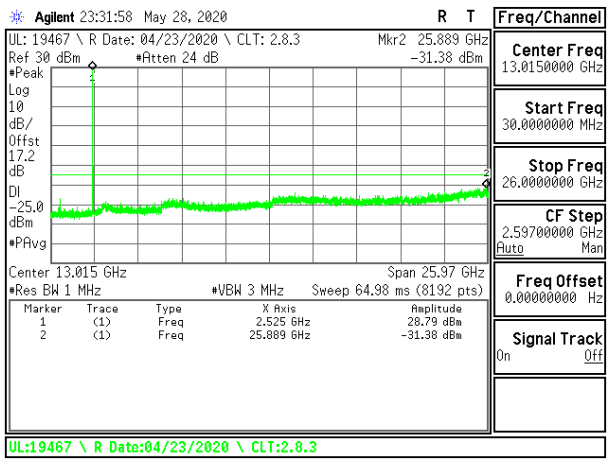
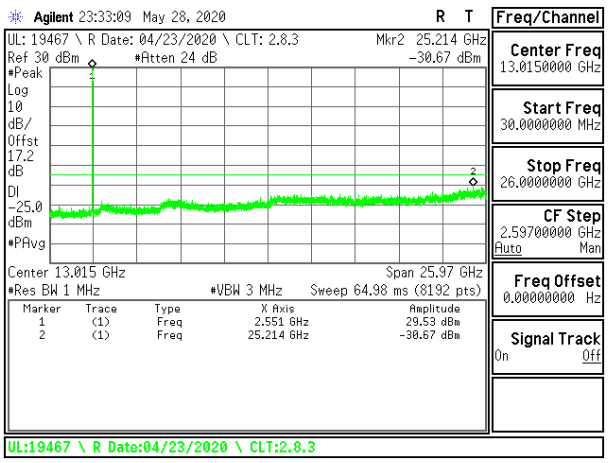


LTE B7 20MHz QPSK Middle Channel RB1-0



LTE B7 20MHz QPSK High Channel RB1-0

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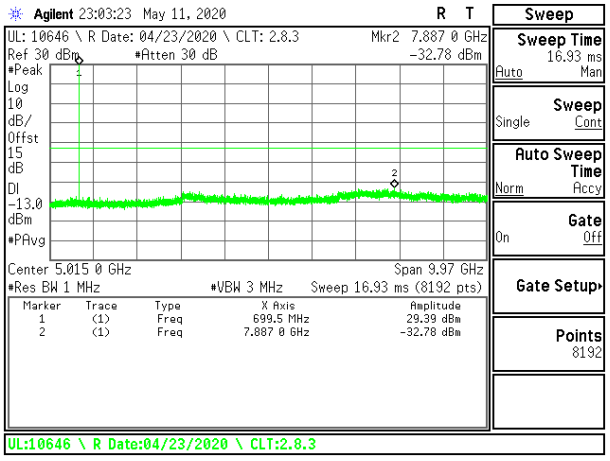
8.3.4. LTE BAND 12 AND 5G NR BAND n12

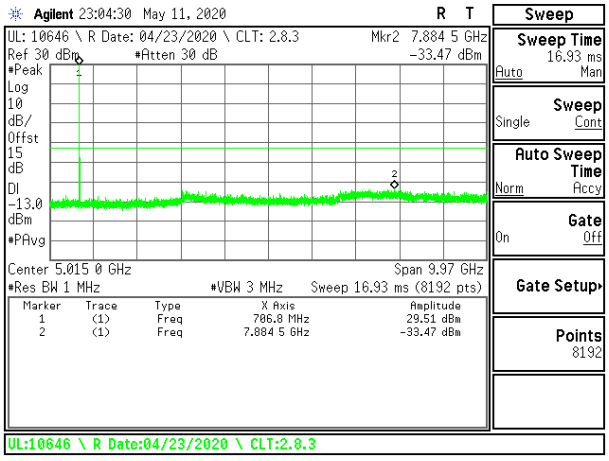
LIMITS

FCC: §27.53 (g)
The minimum permissible attenuation level of any spurious emissions is 43 + 10 log (P) dB where transmitting power (P) in Watts.

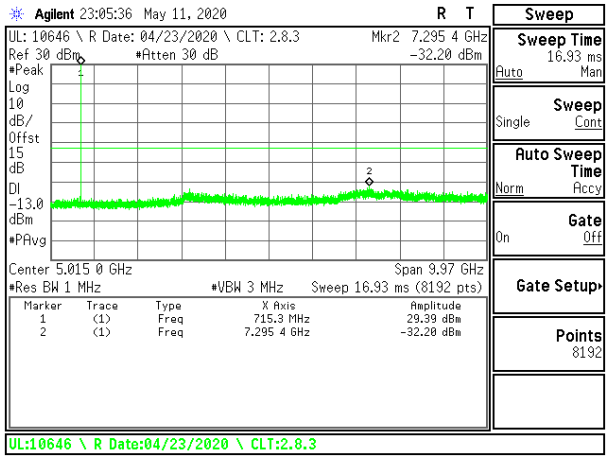
LTE BAND 12



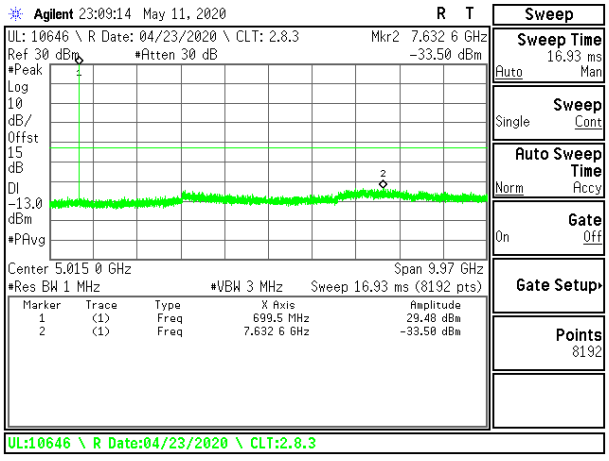
LTE B12 1.4MHz QPSK Low Channel RB1-0



LTE B12 1.4MHz QPSK Middle Channel RB1-0



LTE B12 1.4MHz QPSK High Channel RB1-0



LTE B12 3MHz QPSK Low Channel RB1-0

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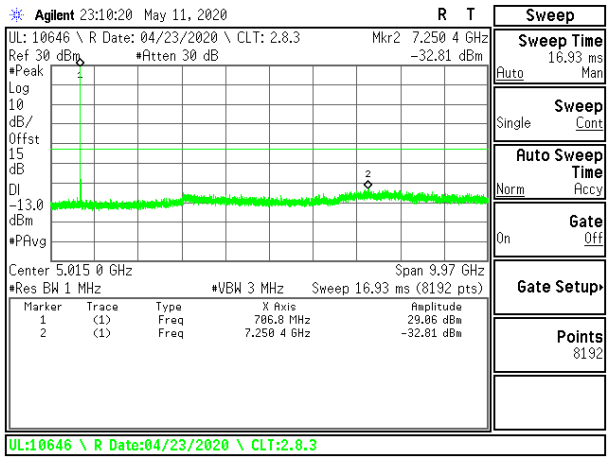
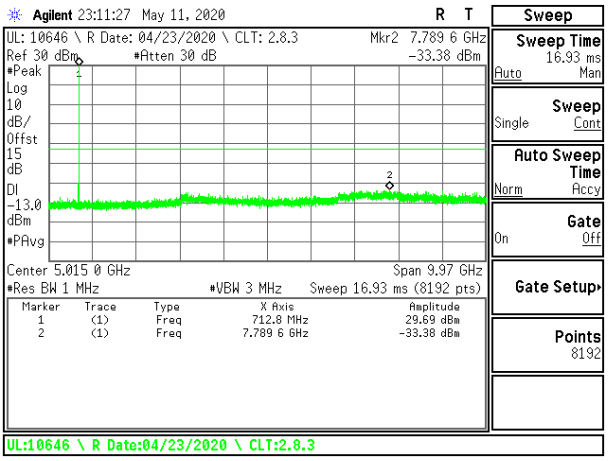
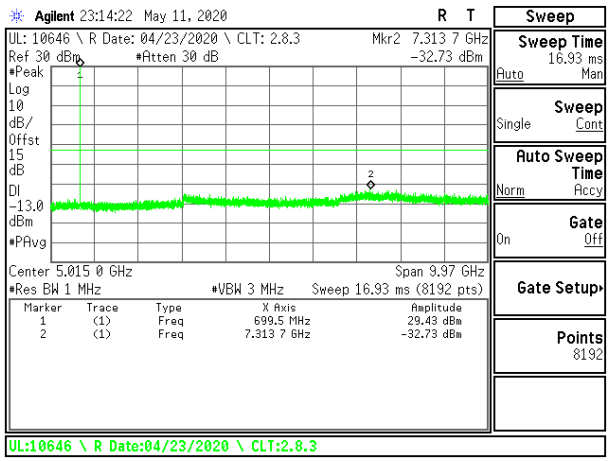


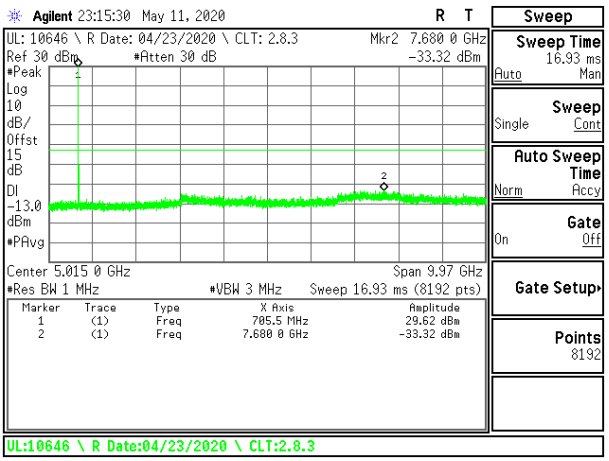
LTE B12 3MHz QPSK Middle Channel RB1-0



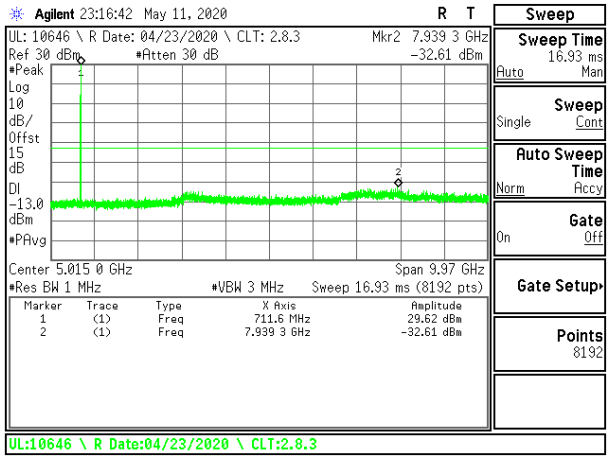
LTE B12 3MHz QPSK High Channel RB1-0



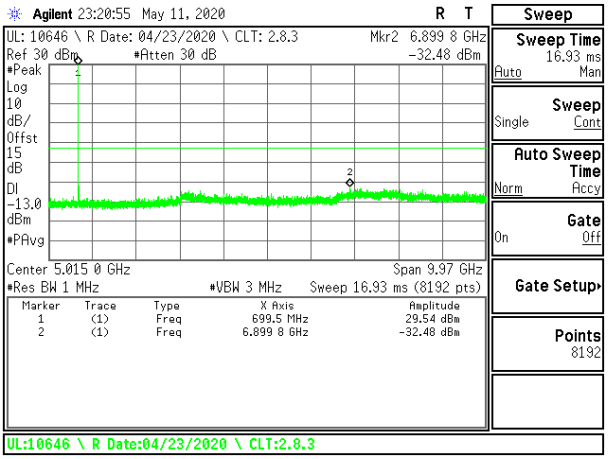
LTE B12 5MHz QPSK Low Channel RB1-0



LTE B12 5MHz QPSK Middle Channel RB1-0



LTE B12 5MHz QPSK High Channel RB1-0



LTE B12 10MHz QPSK Low Channel RB1-0

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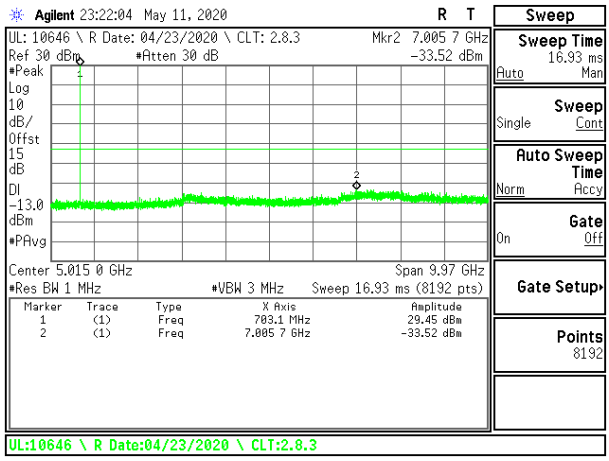
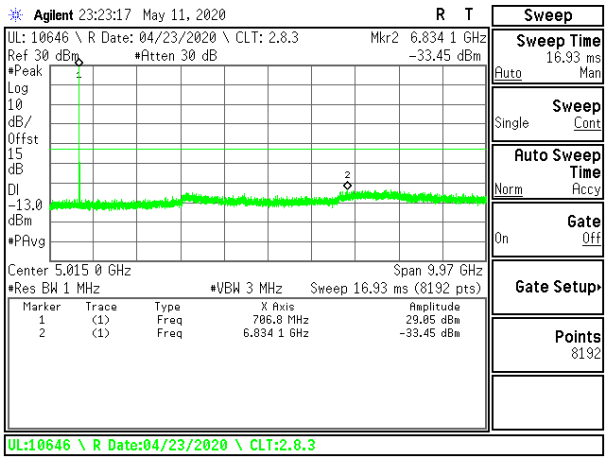


LTE B12 10MHz QPSK Middle Channel RB1-0



LTE B12 10MHz QPSK High Channel RB1-0

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5G NR BAND n12

5G NR Bn12 15MHz QPSK Low Channel RB1-0

5G NR Bn12 15MHz QPSK Middle Channel RB1-0

5G NR Bn12 15MHz QPSK High Channel RB1-0

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8.3.5. LTE BAND 13

LIMITS

FCC: §27.53 (c), (f)
The minimum permissible attenuation level of any spurious emissions is 43 + 10 log (P) dB where transmitting power (P) in Watts. 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.
Note: Radiated data in section 9.1.6 confirms a compliance for the emissions in GPS 1559-1610 MHz band were wideband emissions therefore the -40dBm/MHz limit was used.

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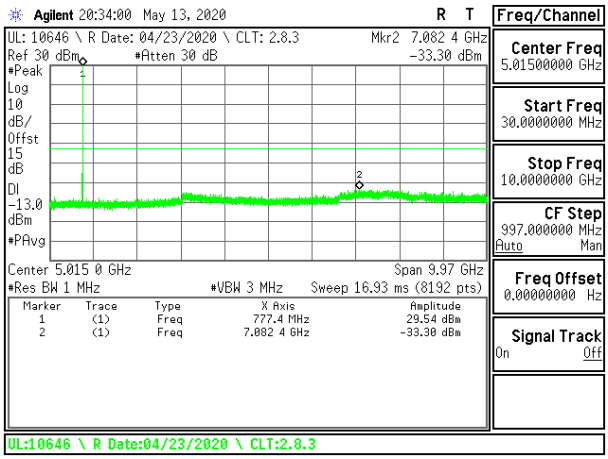
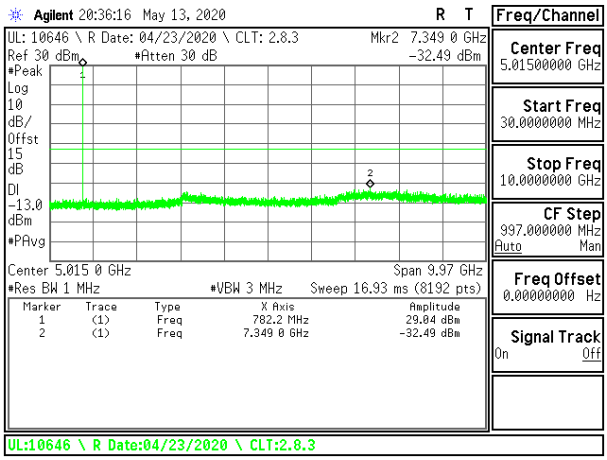
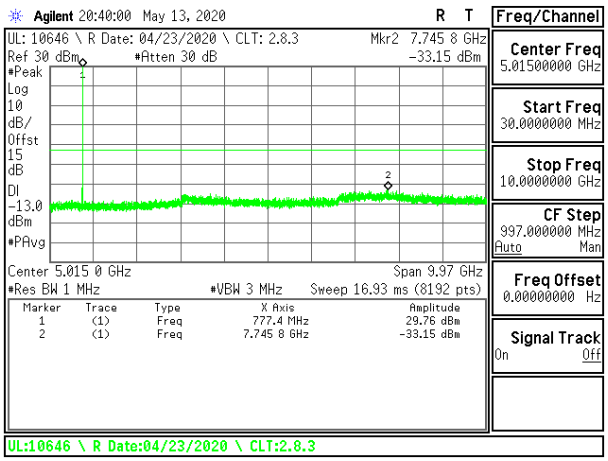


LTE B13 5MHz QPSK Low Channel RB1-0



LTE B13 5MHz QPSK High Channel RB1-0



LTE B13 10MHz QPSK Middle Channel RB1-0

Note: Radiated data in section 9.1.6 confirms a compliance with narrowband limits for GPS1559-1610 MHz band.

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8.3.6. LTE BAND 14

LIMITS

FCC: §90.543 (e), (f)
The minimum permissible attenuation level of any spurious emissions is 43 + 10 log (P) dB where transmitting power (P) in Watts. 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.
Note: Radiated data in section 9.1.7 confirms a compliance for the emissions in GPS 1559-1610 MHz band were wideband emissions therefore the -40dBm/MHz limit was used.

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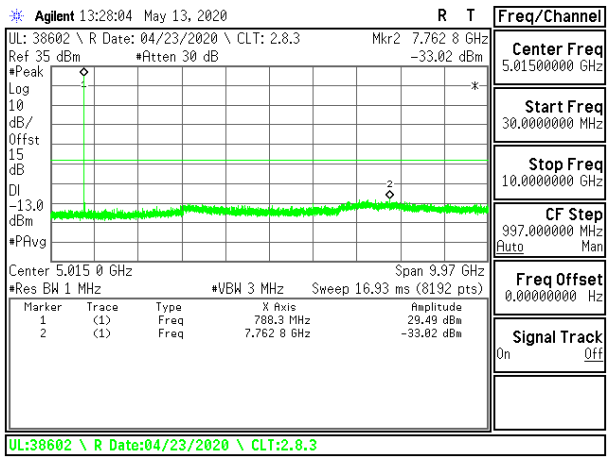
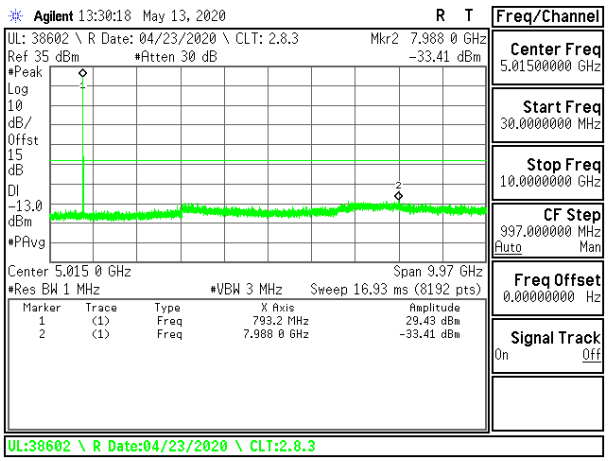
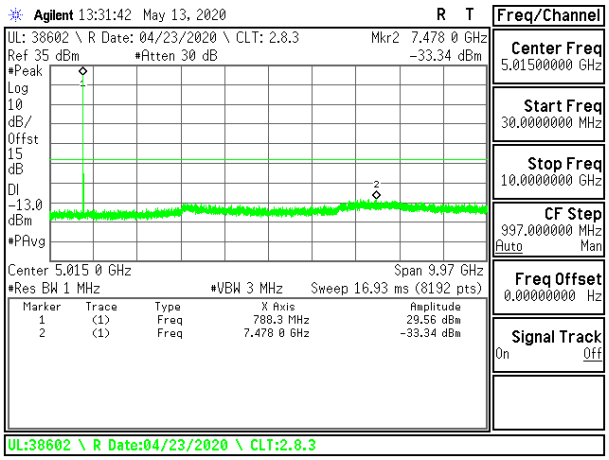


LTE B14 5MHz QPSK Low Channel RB1-0



LTE B14 5MHz QPSK High Channel RB1-0



LTE B14 10MHz QPSK Middle Channel RB1-0

Note: Radiated data in section 9.1.7 confirms a compliance with narrowband limits for GPS1559-1610 MHz band.

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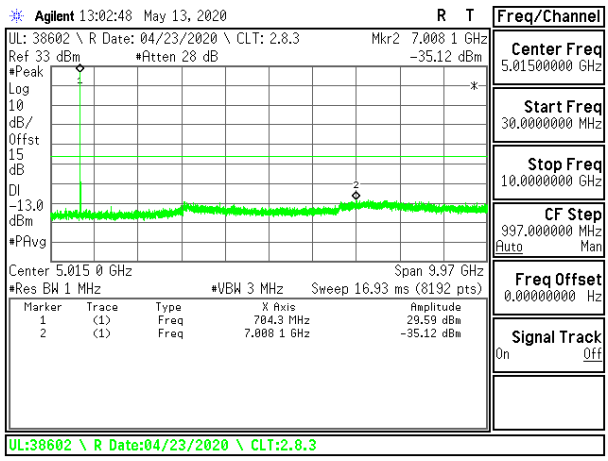
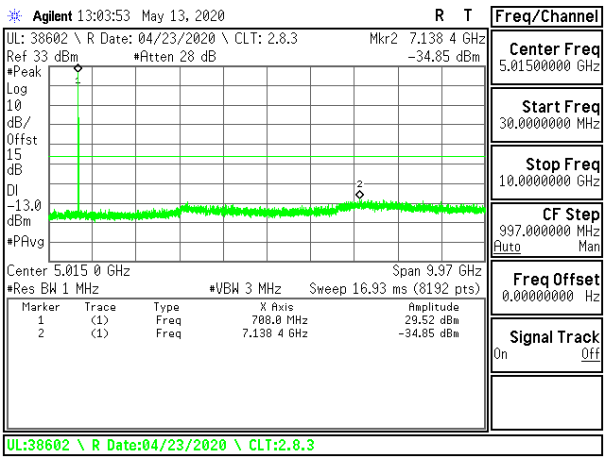
8.3.7. LTE BAND 17

LIMITS

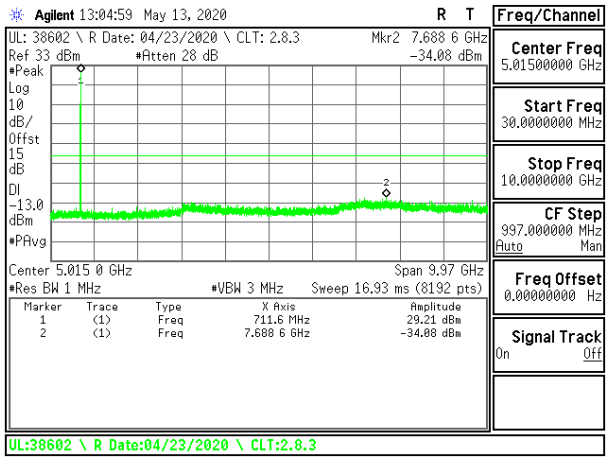
FCC: §27.53 (g)
The minimum permissible attenuation level of any spurious emissions is 43 + 10 log (P) dB where transmitting power (P) in Watts.



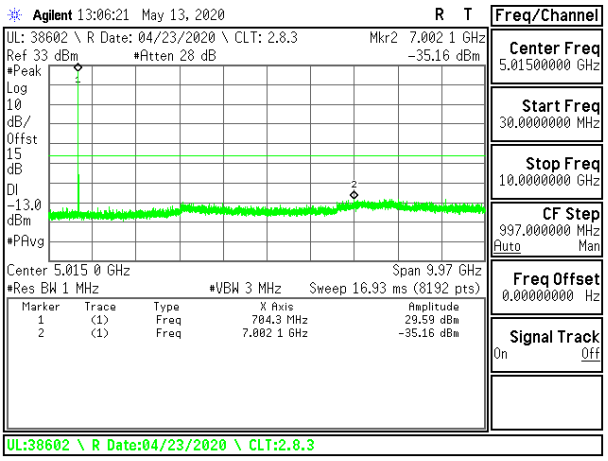
LTE B17 5MHz QPSK Low Channel RB1-0



LTE B17 5MHz QPSK Middle Channel RB1-0



LTE B17 5MHz QPSK High Channel RB1-0



LTE B17 10MHz QPSK Low Channel RB1-0

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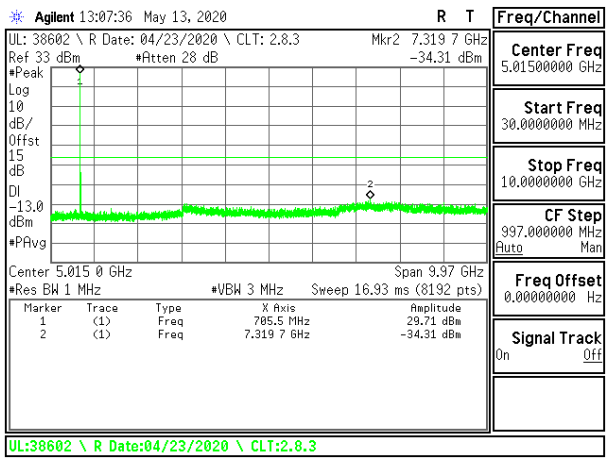
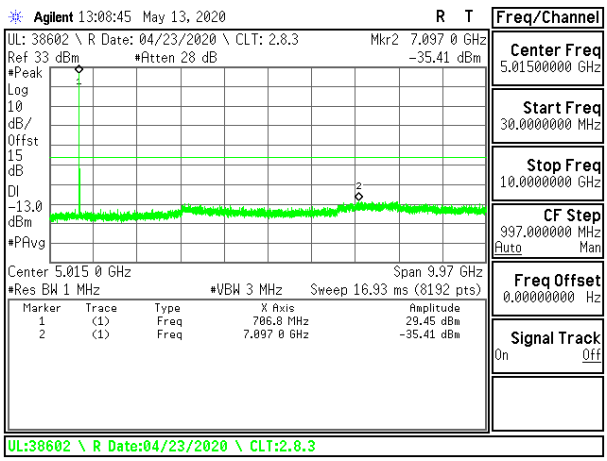


LTE B17 10MHz QPSK Middle Channel RB1-0



LTE B17 10MHz QPSK High Channel RB1-0

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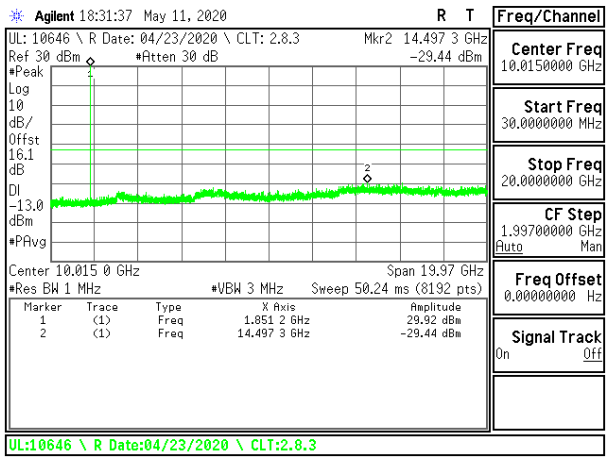
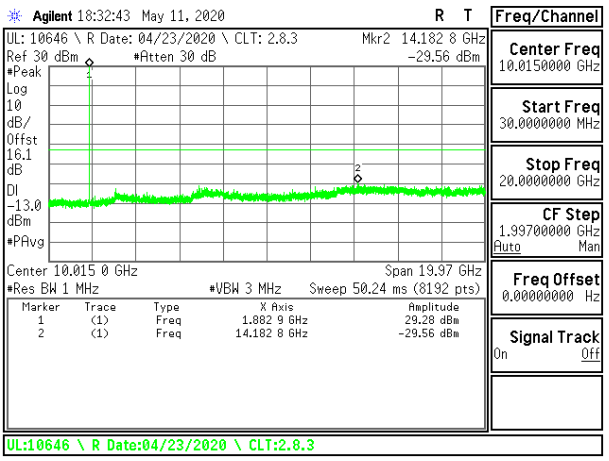
8.3.8. LTE BAND 25

LIMITS

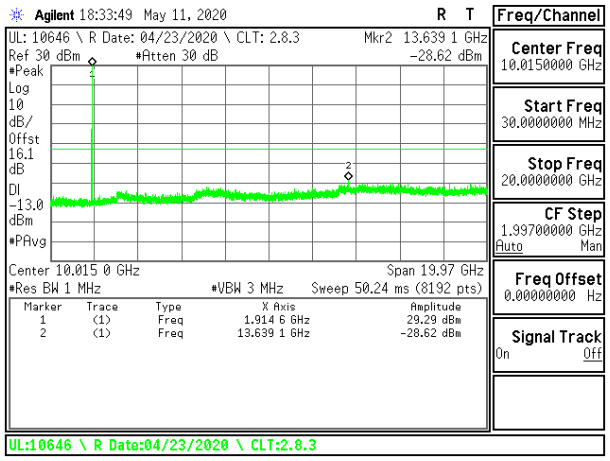
FCC: §24.238
The minimum permissible attenuation level of any spurious emissions is 43 + 10 log (P) dB where transmitting power (P) in Watts.



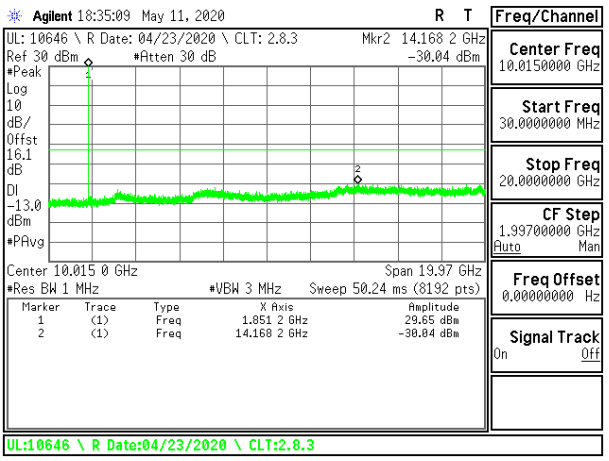
LTE B25 1.4MHz QPSK Low Channel RB1-0



LTE B25 1.4MHz QPSK Middle Channel RB1-0



LTE B25 1.4MHz QPSK High Channel RB1-0



LTE B25 3MHz QPSK Low Channel RB1-0

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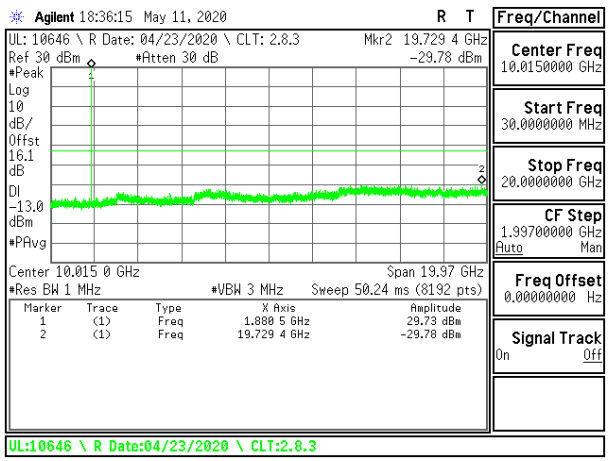
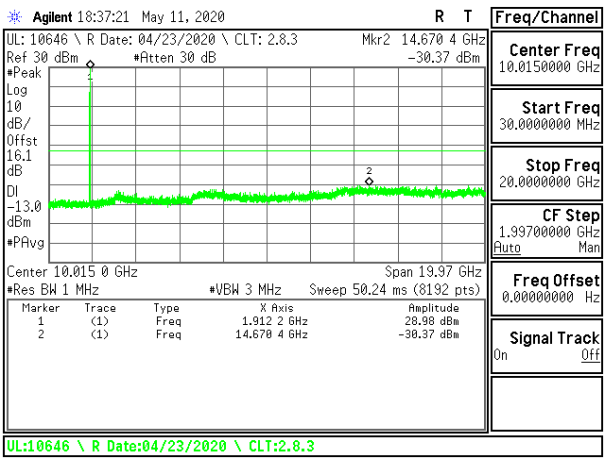
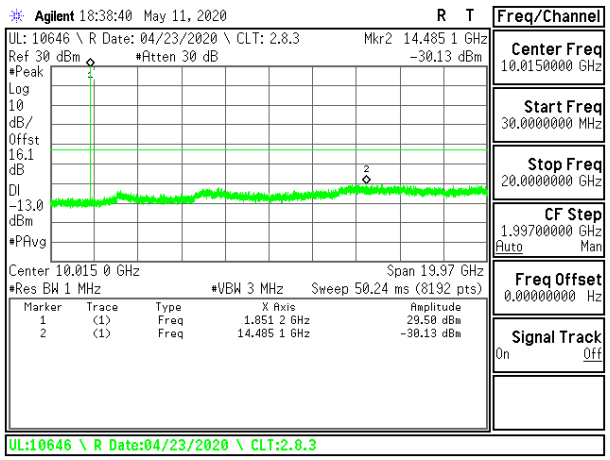


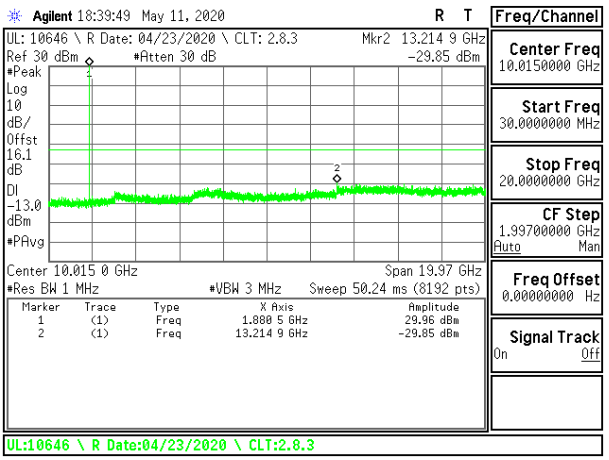
LTE B25 3MHz QPSK Middle Channel RB1-0



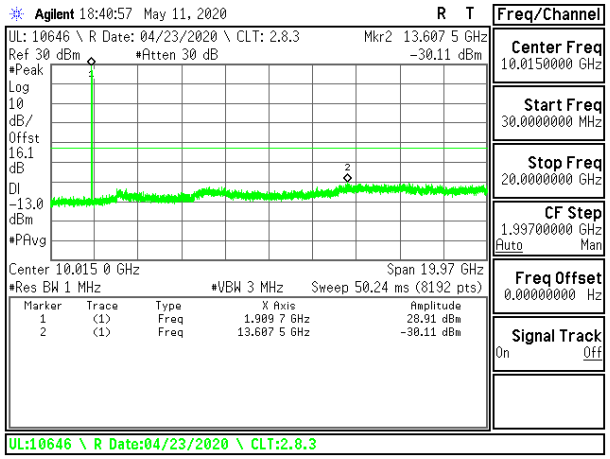
LTE B25 3MHz QPSK High Channel RB1-0



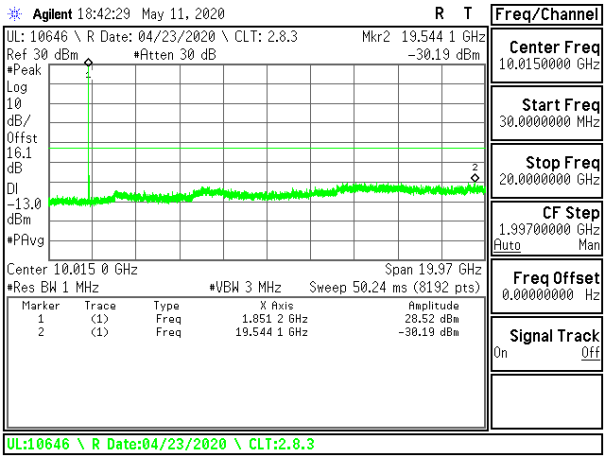
LTE B25 5MHz QPSK Low Channel RB1-0



LTE B25 5MHz QPSK Middle Channel RB1-0



LTE B25 5MHz QPSK High Channel RB1-0



LTE B25 10MHz QPSK Low Channel RB1-0

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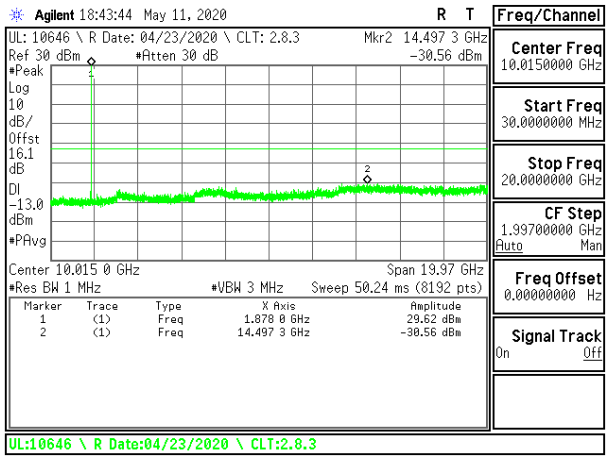
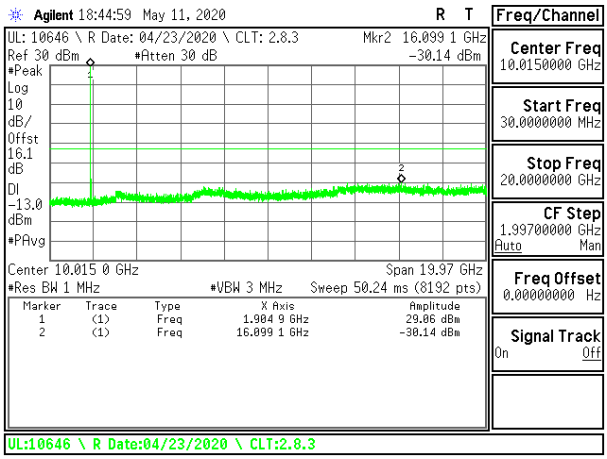
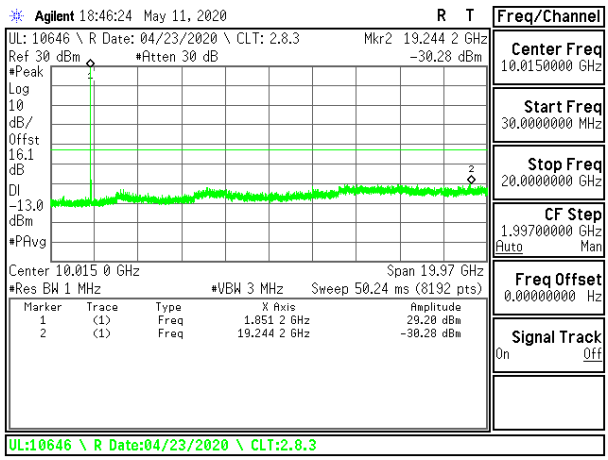


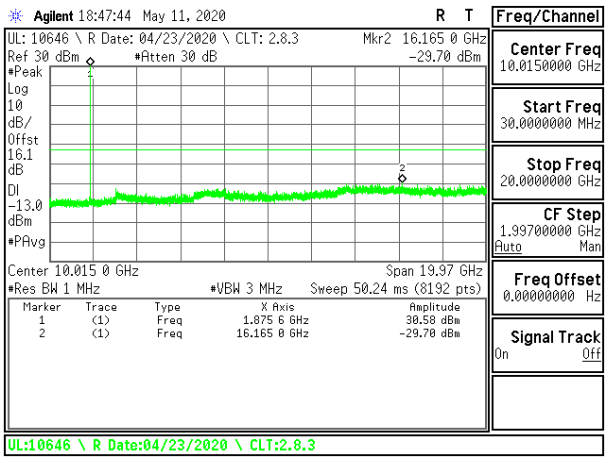
LTE B25 10MHz QPSK Middle Channel RB1-0



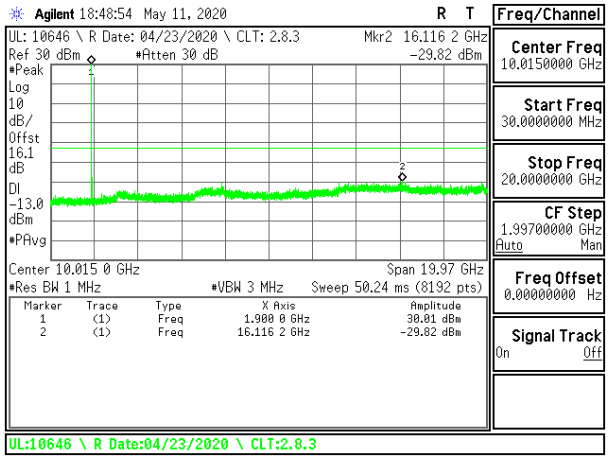
LTE B25 10MHz QPSK High Channel RB1-0



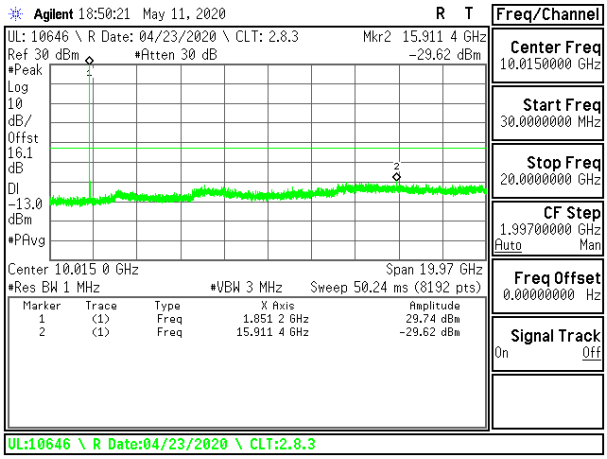
LTE B25 15MHz QPSK Low Channel RB1-0



LTE B25 15MHz QPSK Middle Channel RB1-0



LTE B25 15MHz QPSK High Channel RB1-0



LTE B25 20MHz QPSK Low Channel RB1-0

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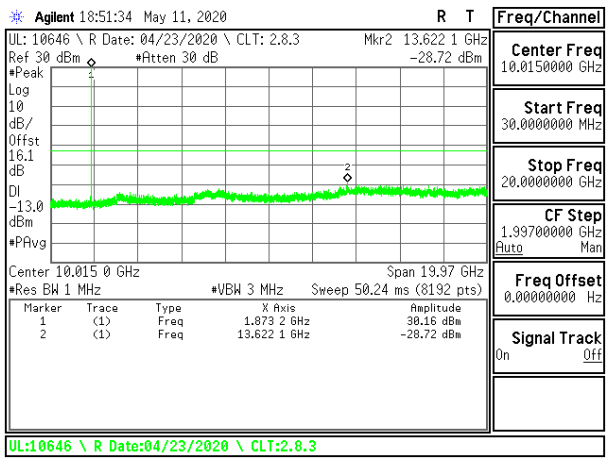
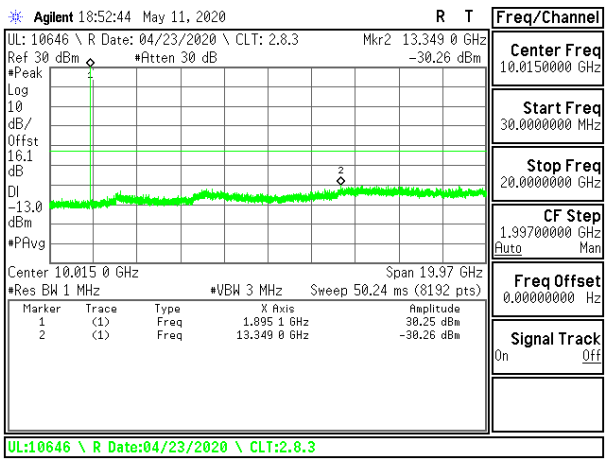


LTE B25 20MHz QPSK Middle Channel RB1-0



LTE B25 20MHz QPSK High Channel RB1-0

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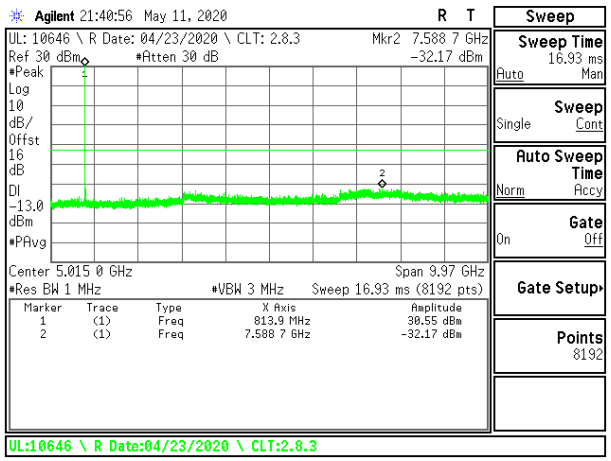
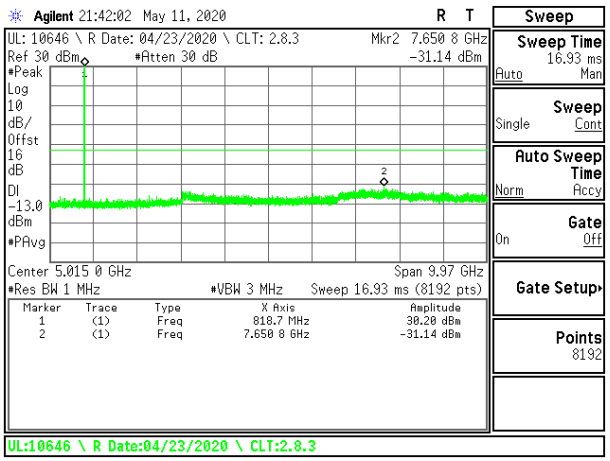
8.3.9. LTE BAND 26 (FCC PART 90S)

LIMITS

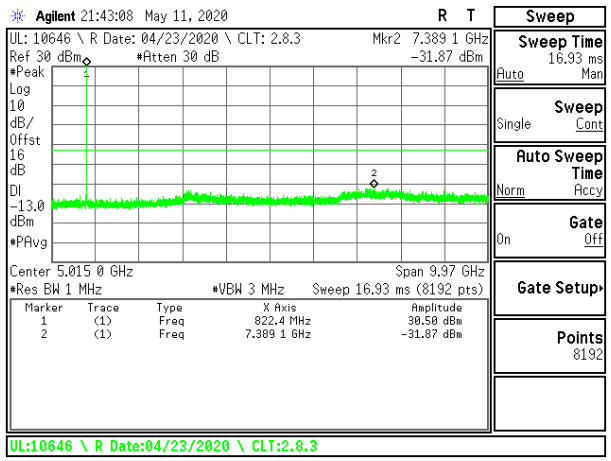
FCC: §90.691
The minimum permissible attenuation level of any spurious emissions is 43 + 10 log (P) dB where transmitting power (P) in Watts.



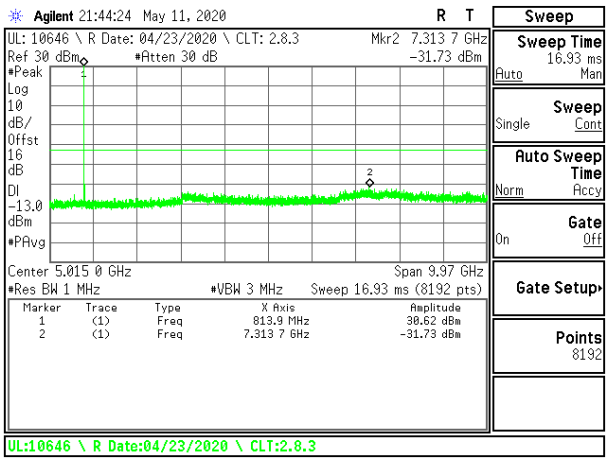
LTE B26 1.4MHz QPSK Low Channel RB1-0



LTE B26 1.4MHz QPSK Middle Channel RB1-0



LTE B26 1.4MHz QPSK High Channel RB1-0



LTE B26 3MHz QPSK Low Channel RB1-0

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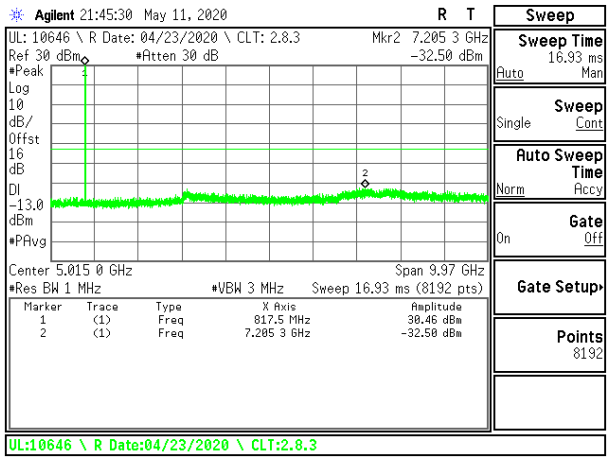
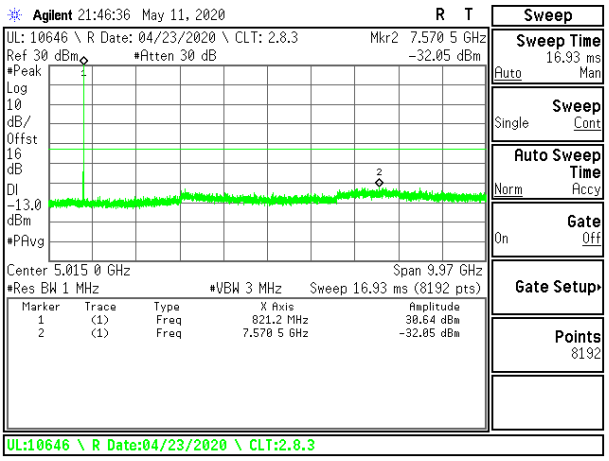
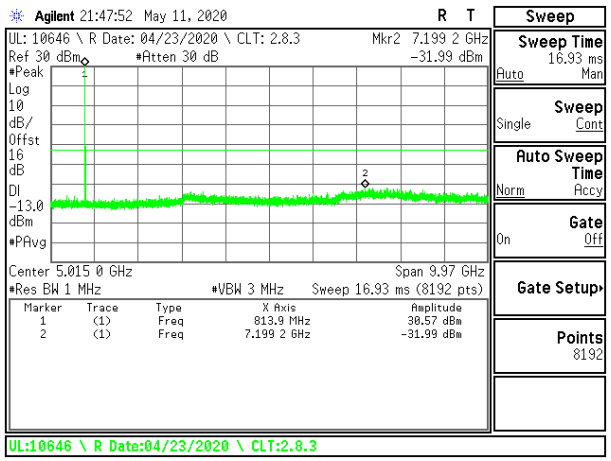


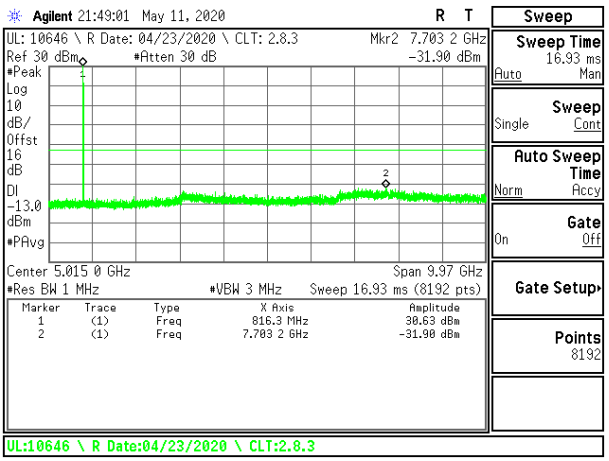
LTE B26 3MHz QPSK Middle Channel RB1-0



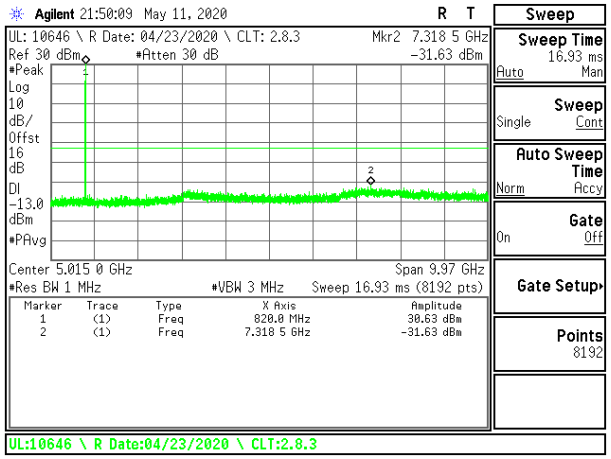
LTE B26 3MHz QPSK High Channel RB1-0



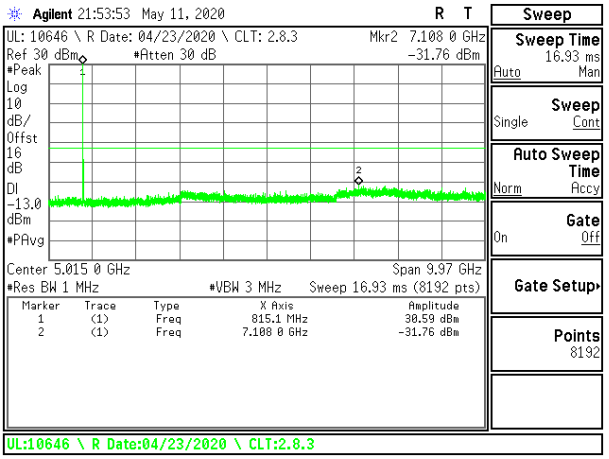
LTE B26 5MHz QPSK Low Channel RB1-0



LTE B26 5MHz QPSK Middle Channel RB1-0



LTE B26 5MHz QPSK High Channel RB1-0



LTE B26 10MHz QPSK Middle Channel RB1-0

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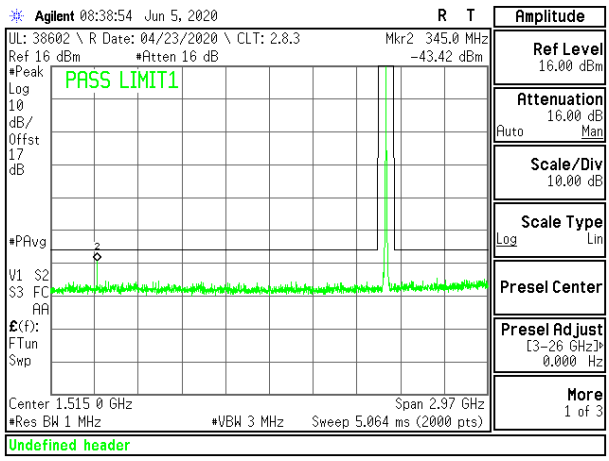
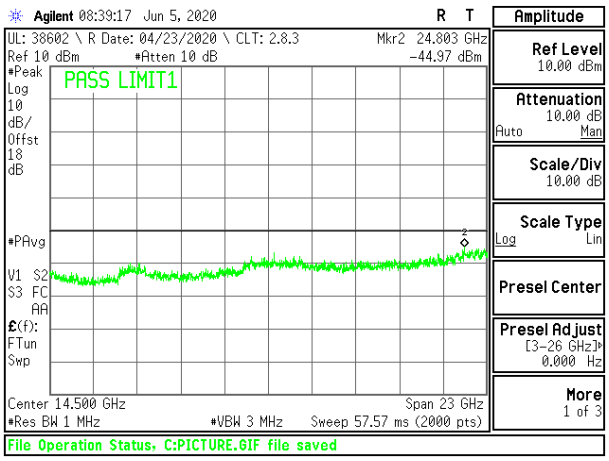
8.3.10. LTE BAND 30

LIMITS

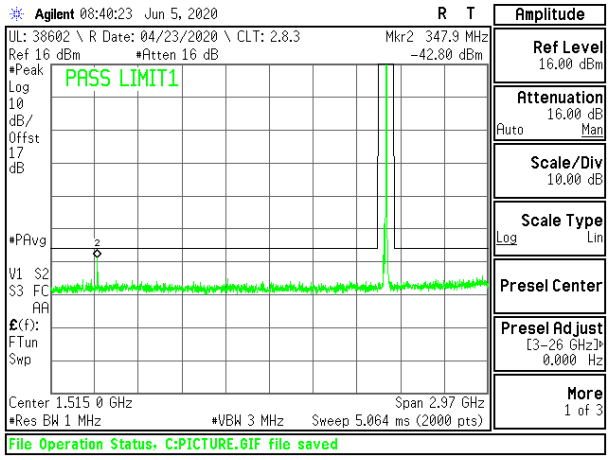
FCC: §27.53 (a)
The minimum permissible attenuation level of any spurious emissions is 70 + 10 log (P) dB where transmitting power (P) in Watts.



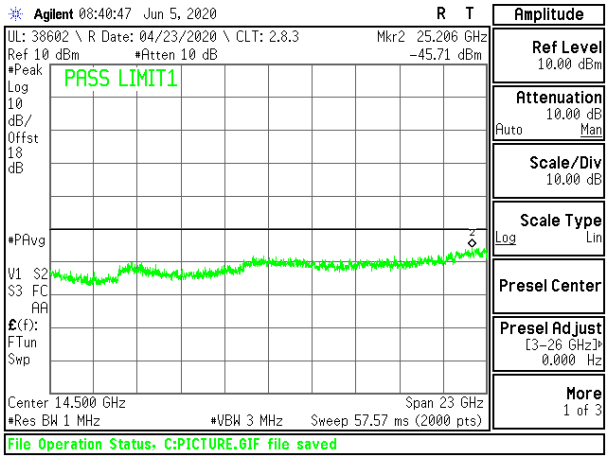
LTE B30 5MHz QPSK Low Channel RB1-0 (30MHz to 3GHz)



LTE B30 5MHz QPSK Low Channel RB1-0 (3G to 26G)



LTE B30 5MHz QPSK Mid Channel RB1-0 (30MHz to 3GHz)



LTE B30 5MHz QPSK Middle Channel RB1-0 (3G to 26G)

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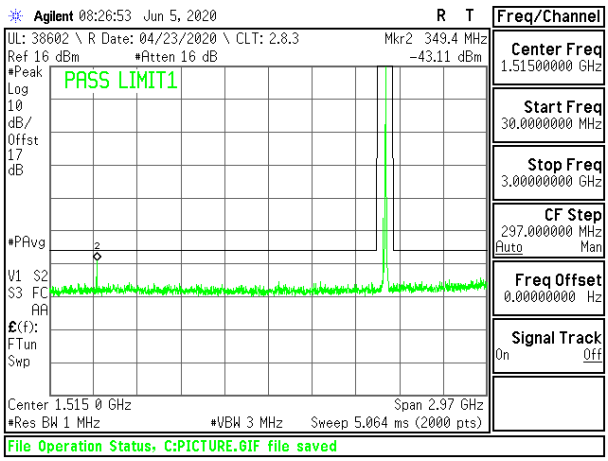
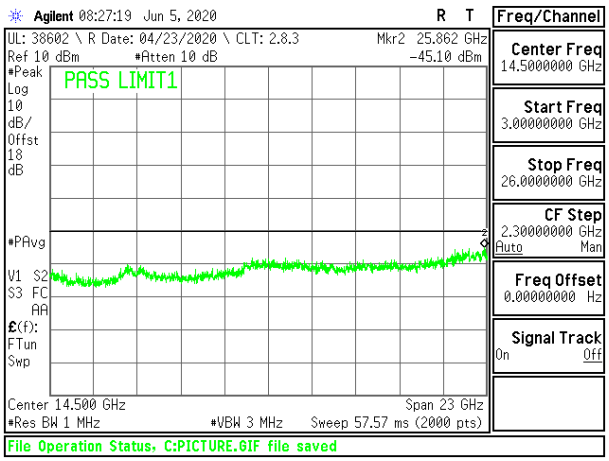
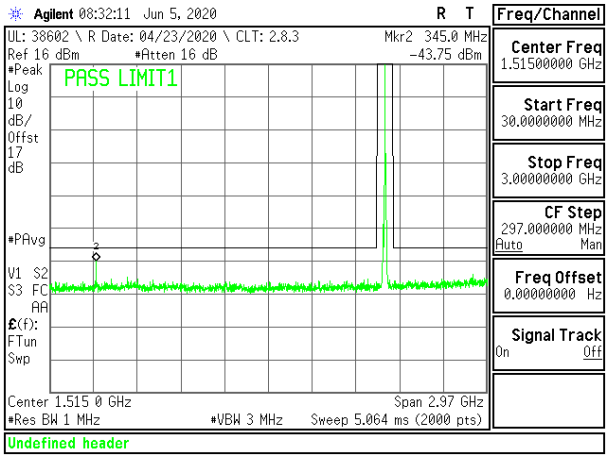


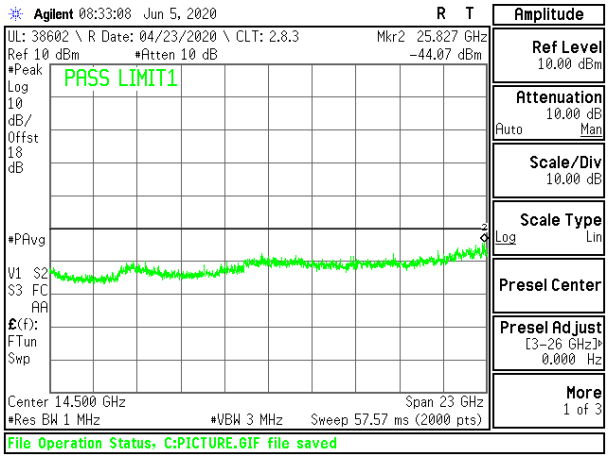
LTE B30 5MHz QPSK High Channel RB1-0 (30MHz to 3GHz)



LTE B30 5MHz QPSK High Channel RB1-0 (3G to 26G)



LTE B30 10MHz QPSK Mid Channel RB1-0 (30MHz to 3GHz)



LTE B30 10MHz QPSK Middle Channel RB1-0 (3G to 26G)

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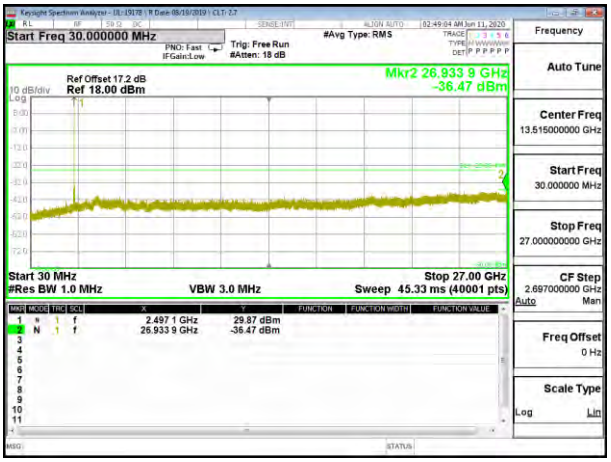
8.3.11. LTE BAND 41 AND 5G NR BAND n41

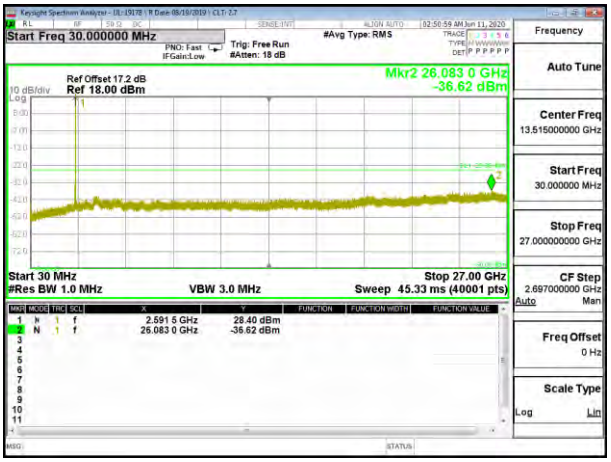
LIMITS

FCC: §27.53 (m)
The minimum permissible attenuation level of any spurious emissions is 55 + 10 log (P) dB where transmitting power (P) in Watts.

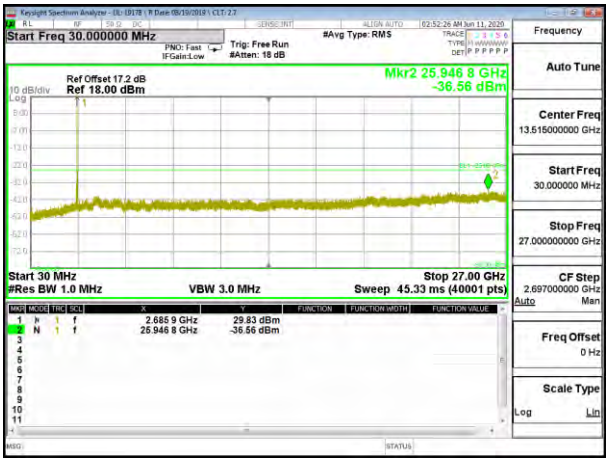
LTE BAND 41



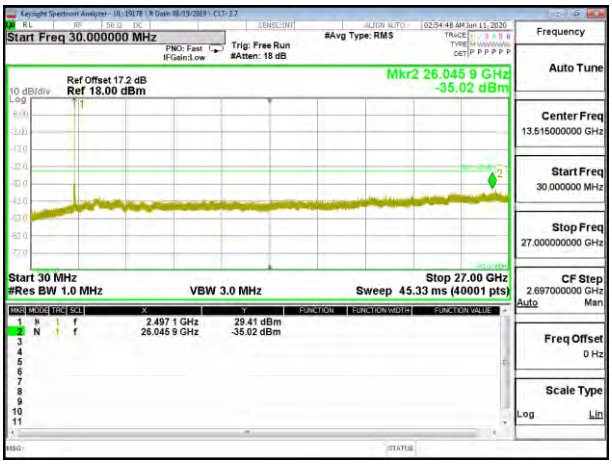
LTE B41 5MHz QPSK Low Channel RB1-0



LTE B41 5MHz QPSK Middle Channel RB1-0



LTE B41 5MHz QPSK High Channel RB1-0



LTE B41 10MHz QPSK Low Channel RB1-0

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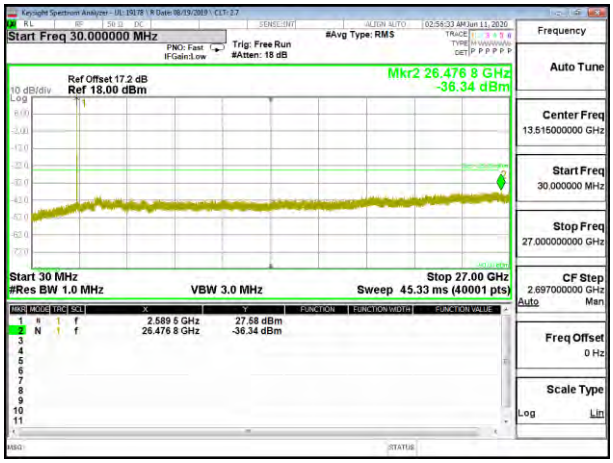
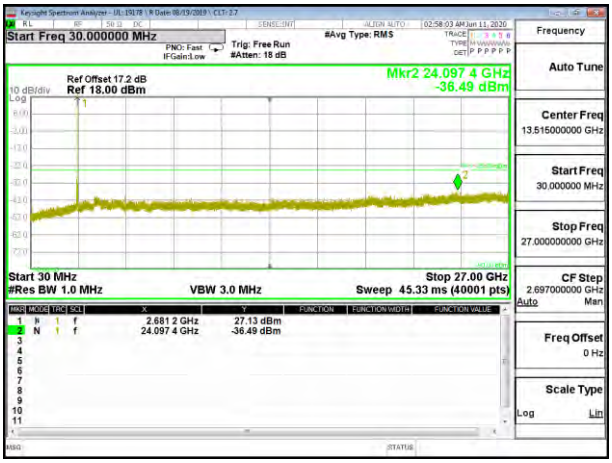
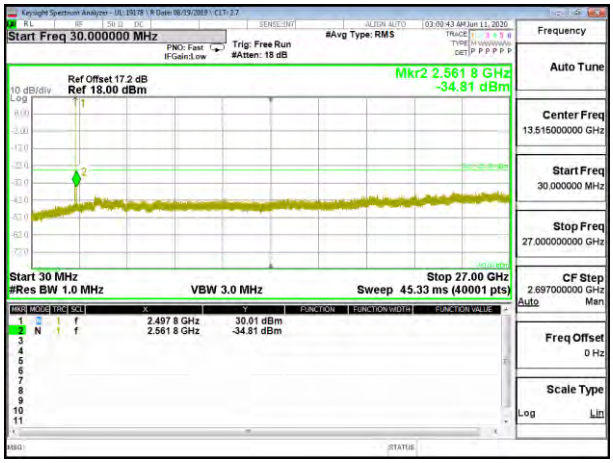


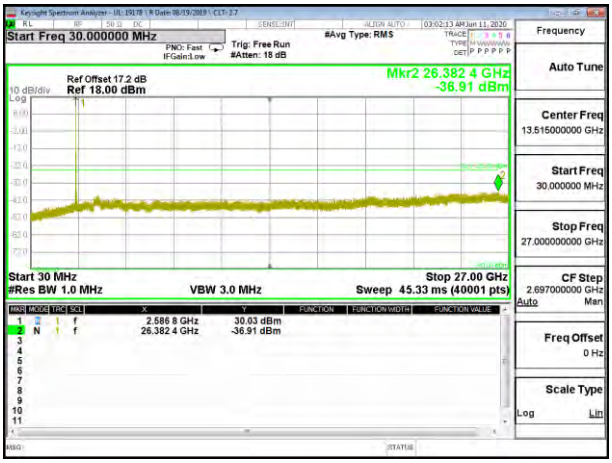
LTE B41 10MHz QPSK Middle Channel RB1-0



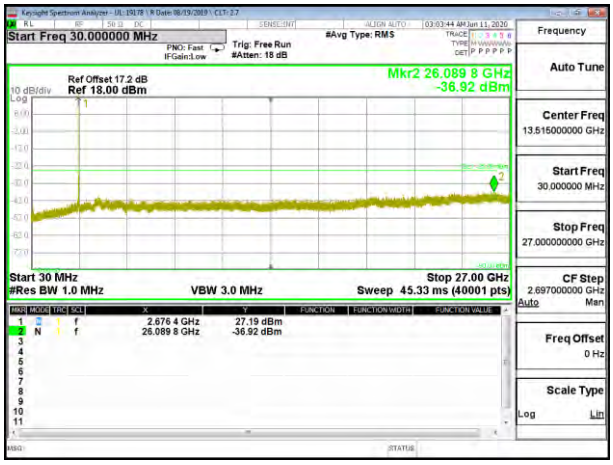
LTE B41 10MHz QPSK High Channel RB1-0



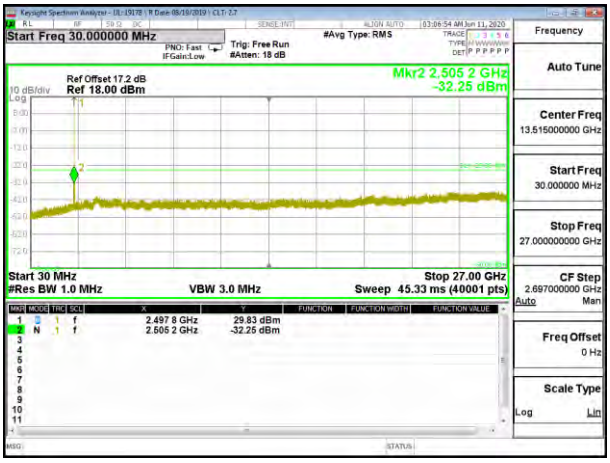
LTE B41 15MHz QPSK Low Channel RB1-0



LTE B41 15MHz QPSK Middle Channel RB1-0



LTE B41 15MHz QPSK High Channel RB1-0



LTE B41 20MHz QPSK Low Channel RB1-0

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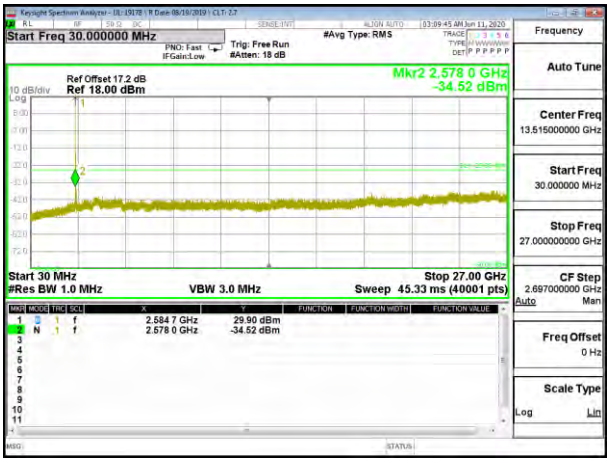
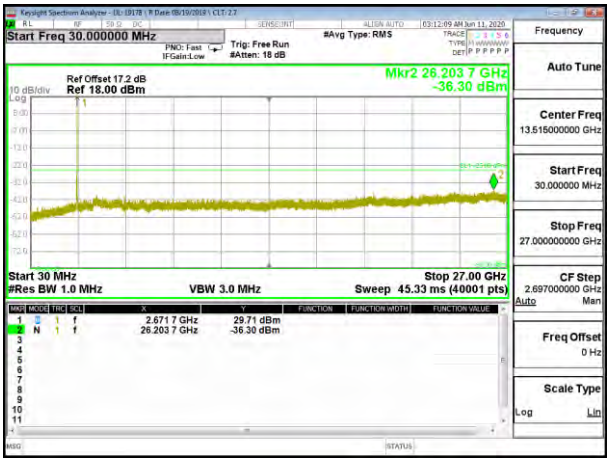


LTE B41 20MHz QPSK Middle Channel RB1-0



LTE B41 20MHz QPSK High Channel RB1-0

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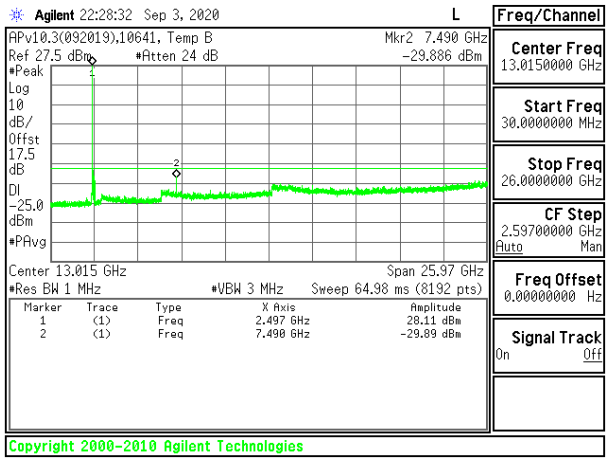
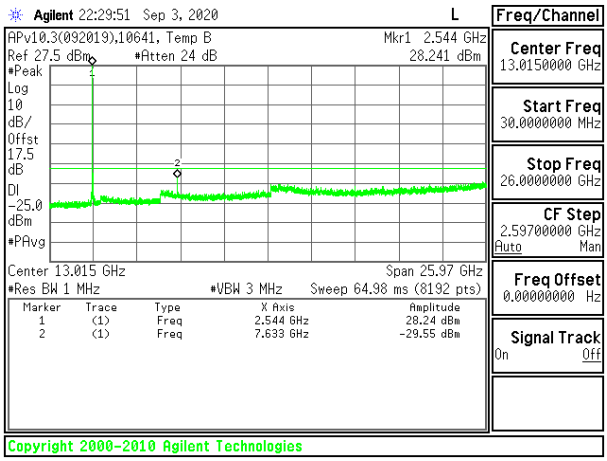
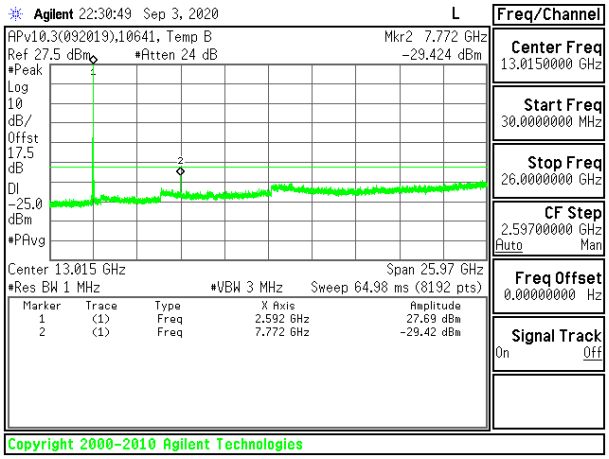
5G NR BAND n41



5G NR Bn41 100MHz QPSK Low Channel RB1-0



5G NR Bn41 100MHz QPSK Middle Channel RB1-0



5G NR Bn41 100MHz QPSK High Channel RB1-

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8.3.12. LTE BAND 48

LIMITS

FCC: §96.41
(e) 3.5 GHz Emissions and Interference Limits—
(2) Additional protection levels. Notwithstanding paragraph (e)(1) of this section, for CBSDs and End User Devices, the conducted power of emissions below 3540 MHz or above 3710 MHz shall not exceed −25 dBm/MHz, and the conducted power of emissions below 3530 MHz or above 3720 MHz shall not exceed −40dBm/MHz.

Test Engineer ID:	52275	Test Date:	9/9/2020

LTE B48 5MHz QPSK Low Channel RB1-0 (30MHz to 4GHz)

LTE B48 5MHz QPSK Low Channel RB1-0 (4G to 40G)

LTE B48 5MHz QPSK Mid Channel RB1-0 (30MHz to 4GHz)

LTE B48 5MHz QPSK Middle Channel RB1-0 (4G to 40G)

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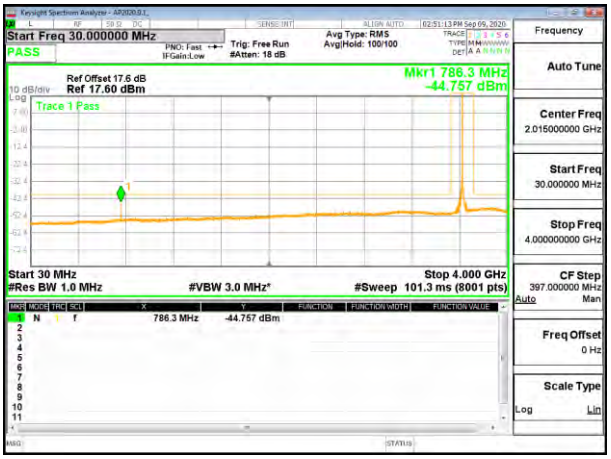
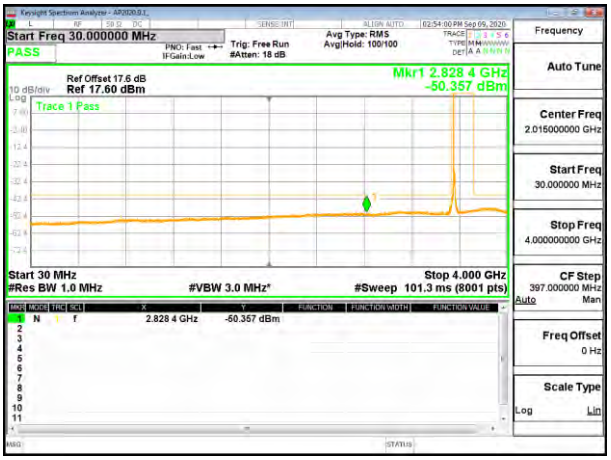


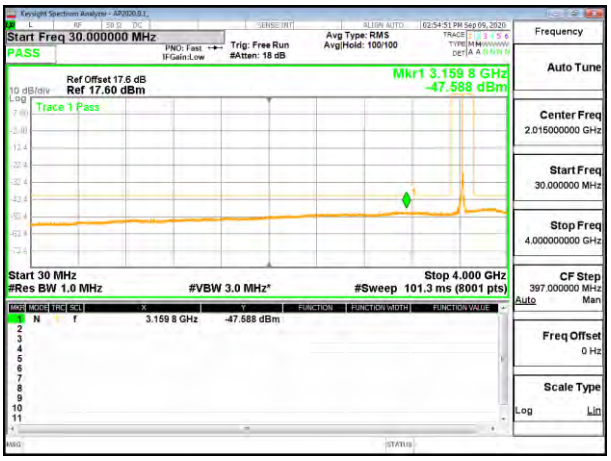
LTE B48 5MHz QPSK High Channel RB1-0 (30MHz to 4GHz)

LTE B48 5MHz QPSK High Channel RB1-0 (4G to 40G)



LTE B48 10MHz QPSK Low Channel RB1-0 (30MHz to 4GHz)

LTE B48 10MHz QPSK Low Channel RB1-0 (4G to 40G)



LTE B48 10MHz QPSK Mid Channel RB1-0 (30MHz to 4GHz)

LTE B48 10MHz QPSK Middle Channel RB1-0 (4G to 40G)

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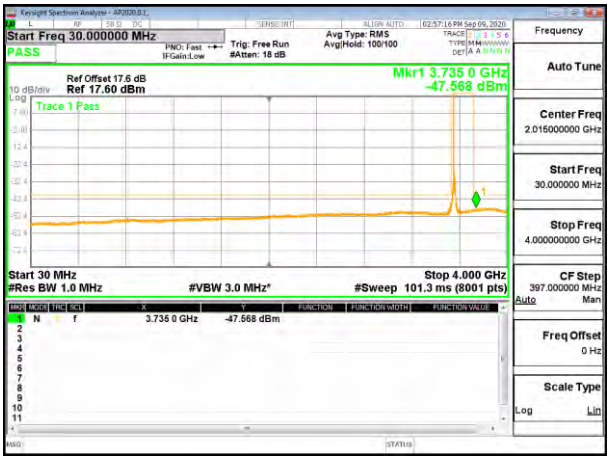
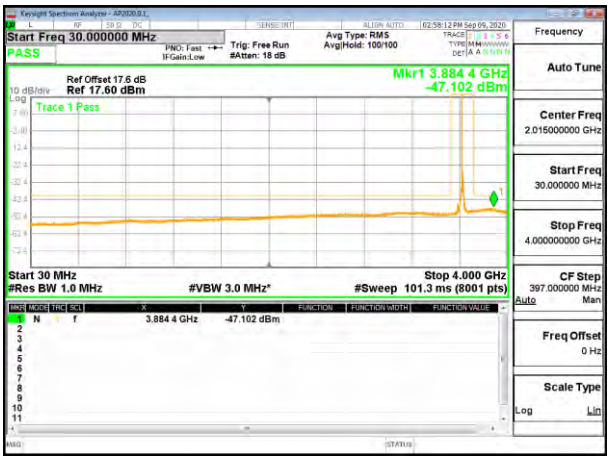
LTE B48 10MHz QPSK High Channel RB1-0 (30MHz to 4GHz)

LTE B48 10MHz QPSK High Channel RB1-0 (4G to 40G)



LTE B48 15MHz QPSK Low Channel RB1-0 (30MHz to 4GHz)

LTE B48 15MHz QPSK Low Channel RB1-0 (4G to 40G)



LTE B48 15MHz QPSK Mid Channel RB1-0 (30MHz to 4GHz)

LTE B48 15MHz QPSK Middle Channel RB1-0 (4G to 40G)

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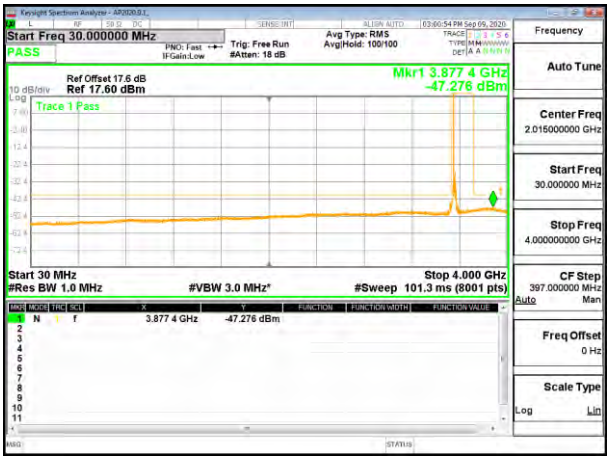
LTE B48 15MHz QPSK High Channel RB1-0 (30MHz to 4GHz)

LTE B48 15MHz QPSK High Channel RB1-0 (4G to 40G)



LTE B48 20MHz QPSK Low Channel RB1-0 (30MHz to 4GHz)

LTE B48 20MHz QPSK Low Channel RB1-0 (4G to 40G)

LTE B48 20MHz QPSK Mid Channel RB1-0 (30MHz to 4GHz)

LTE B48 20MHz QPSK Middle Channel RB1-0 (4G to 40G)

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LTE B48 20MHz QPSK High Channel RB1-0 (30MHz to 4GHz)

LTE B48 20MHz QPSK High Channel RB1-0 (4G to 40G)

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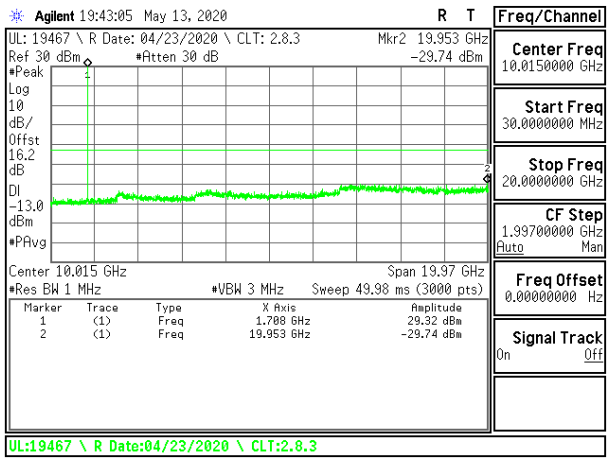
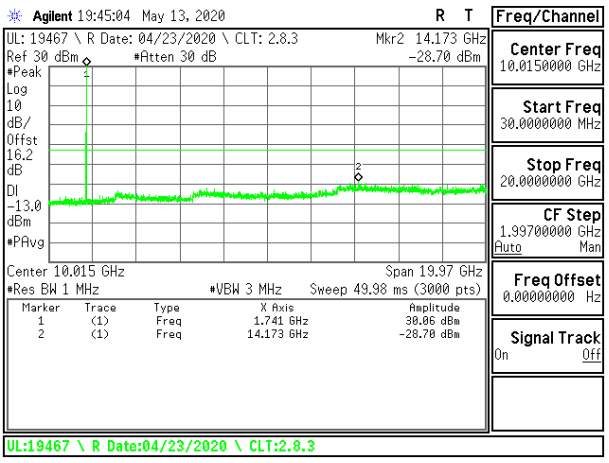
8.3.13. LTE BAND 66

LIMITS

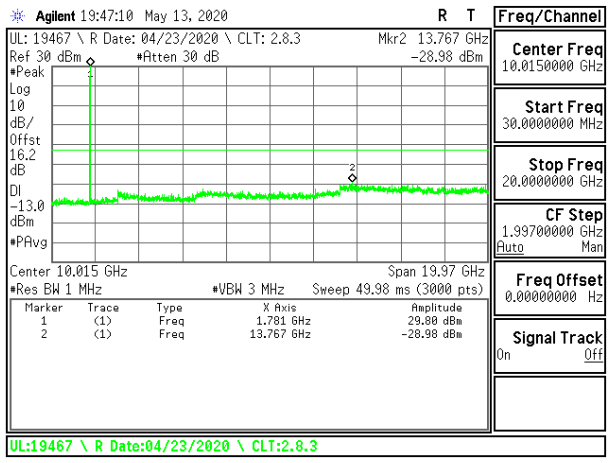
FCC: §27.53 (h)
The minimum permissible attenuation level of any spurious emissions is 43 + 10 log (P) dB where transmitting power (P) in Watts.



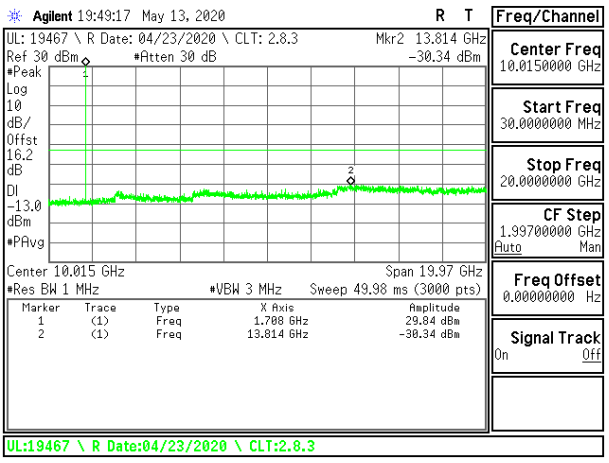
LTE B66 1.4MHz QPSK Low Channel RB1-0



LTE B66 1.4MHz QPSK Middle Channel RB1-0



LTE B66 1.4MHz QPSK High Channel RB1-0



LTE B66 3MHz QPSK Low Channel RB1-0

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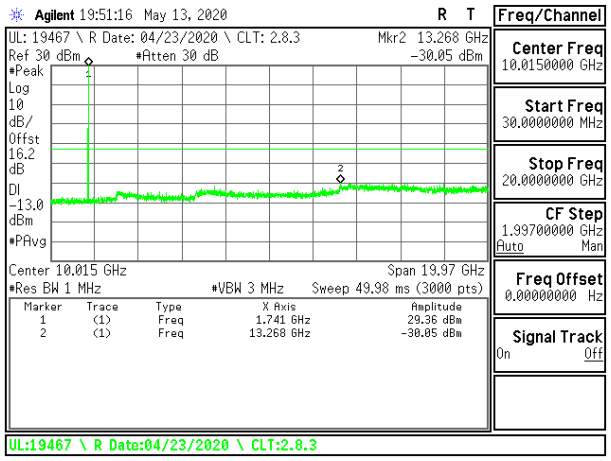
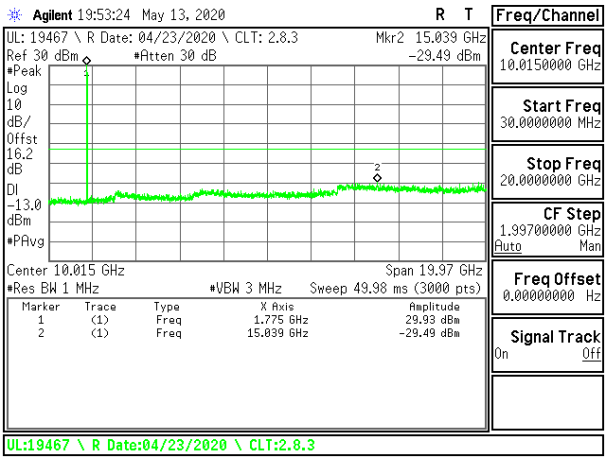
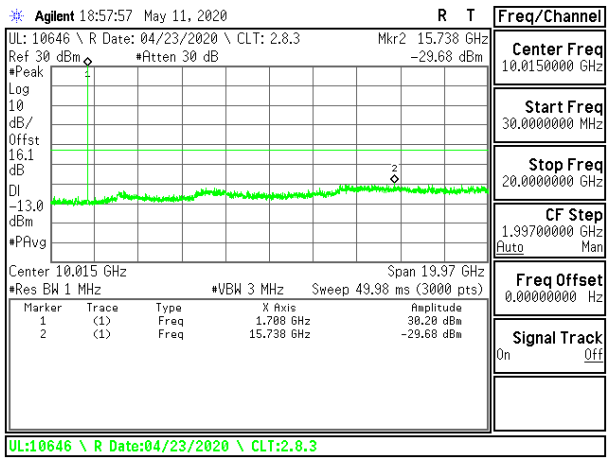


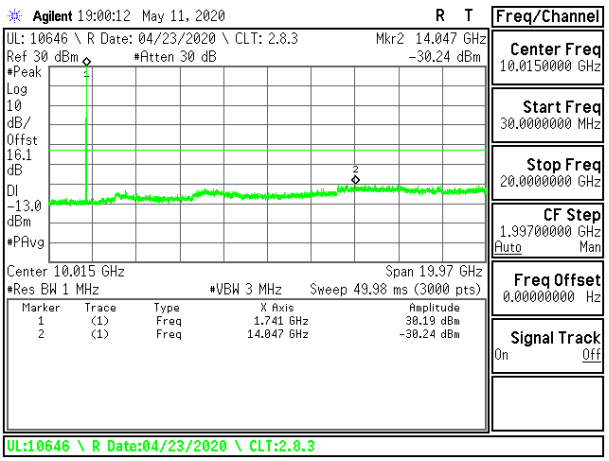
LTE B66 3MHz QPSK Middle Channel RB1-0



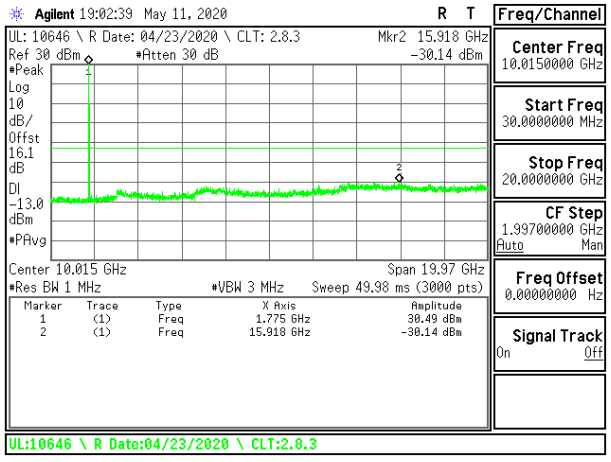
LTE B66 3MHz QPSK High Channel RB1-0



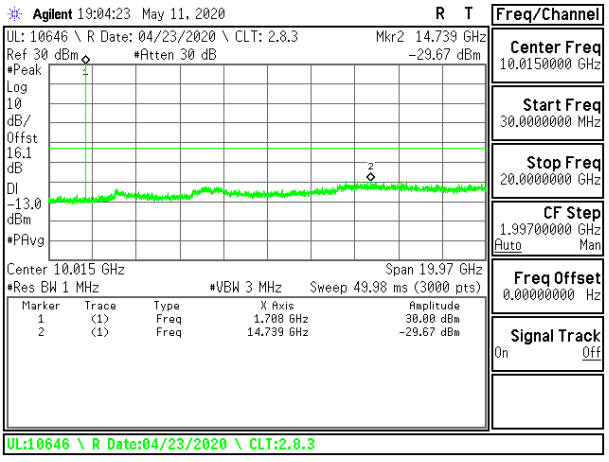
LTE B66 5MHz QPSK Low Channel RB1-0



LTE B66 5MHz QPSK Middle Channel RB1-0



LTE B66 5MHz QPSK High Channel RB1-0



LTE B66 10MHz QPSK Low Channel RB1-0

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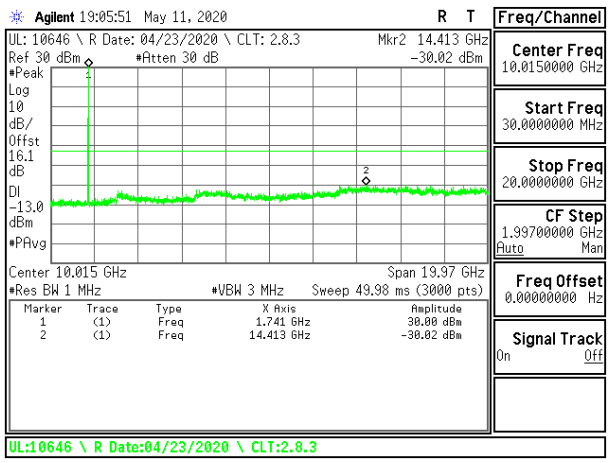
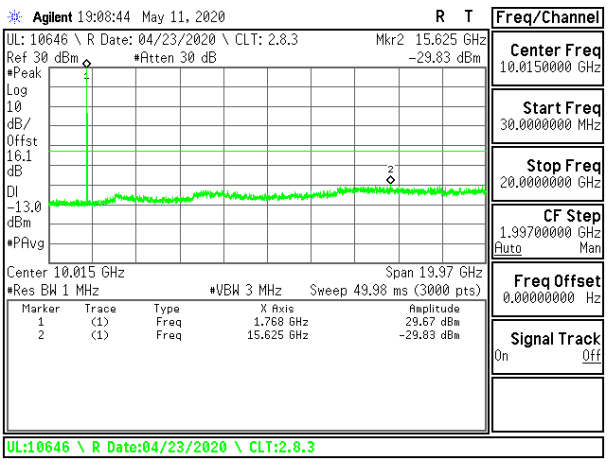
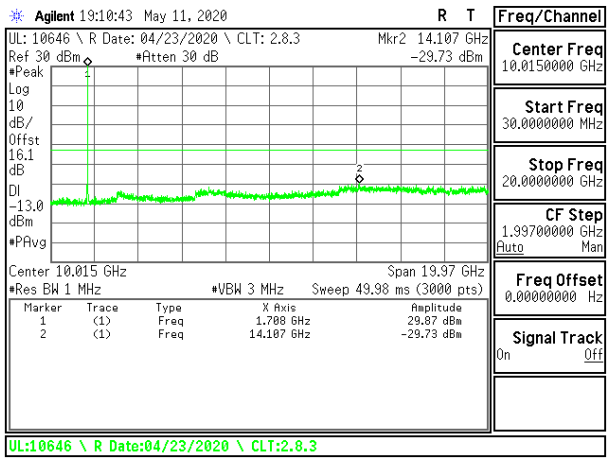


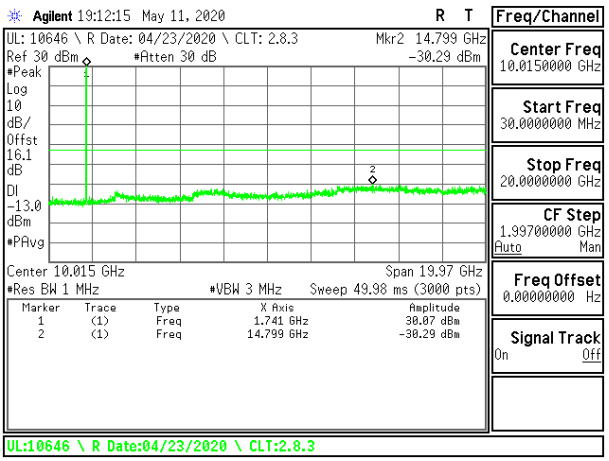
LTE B66 10MHz QPSK Middle Channel RB1-0



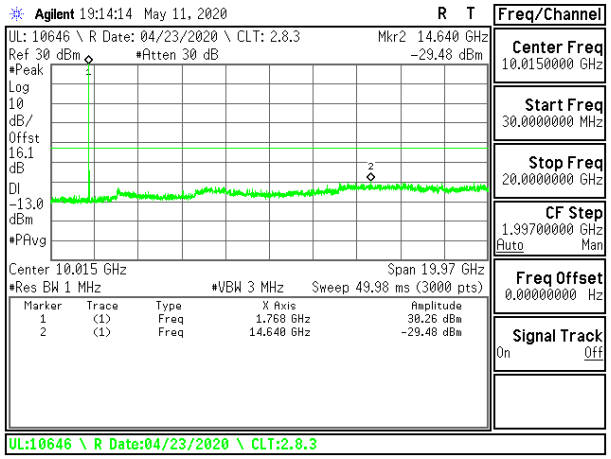
LTE B66 10MHz QPSK High Channel RB1-0



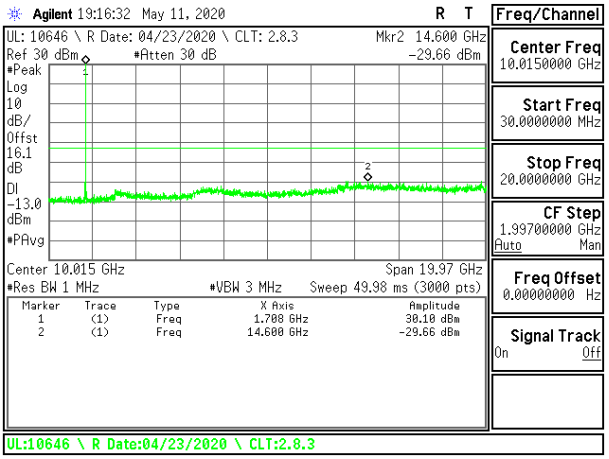
LTE B66 15MHz QPSK Low Channel RB1-0



LTE B66 15MHz QPSK Middle Channel RB1-0



LTE B66 15MHz QPSK High Channel RB1-0



LTE B66 20MHz QPSK Low Channel RB1-0

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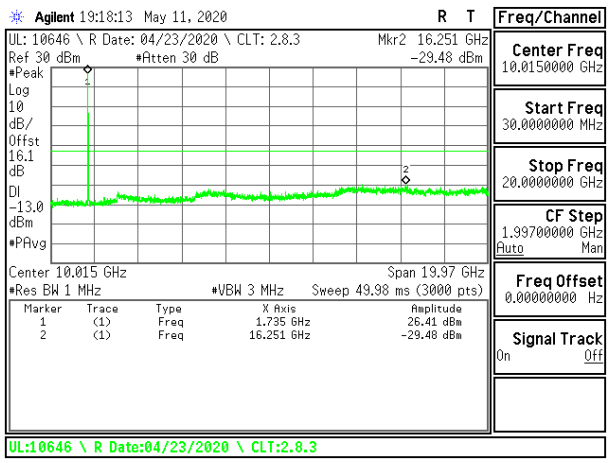
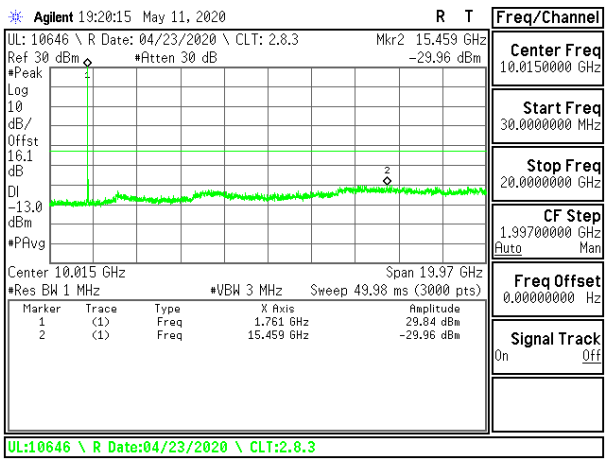


LTE B66 20MHz QPSK Middle Channel RB1-0



LTE B66 20MHz QPSK High Channel RB1-0

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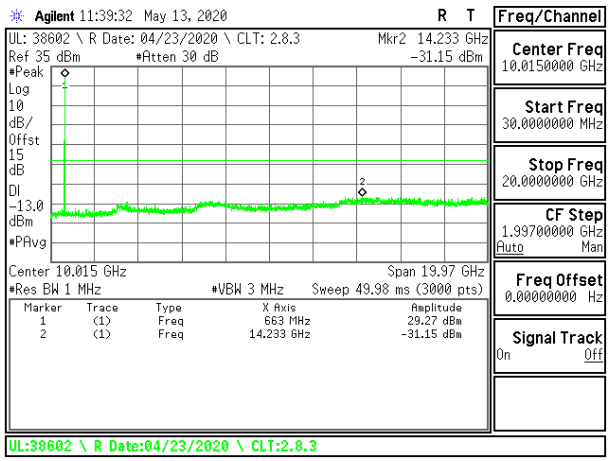
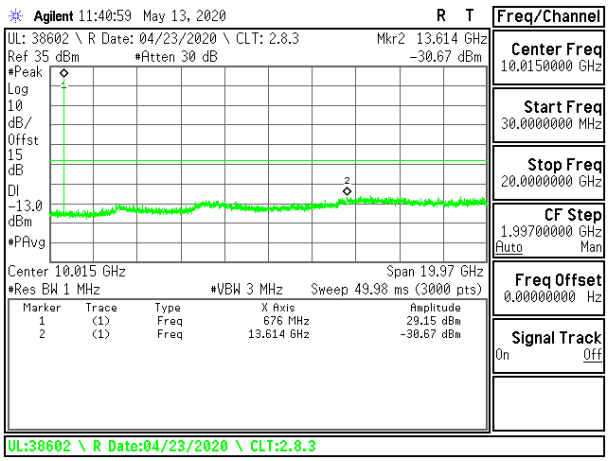
8.3.14. LTE BAND 71

LIMITS

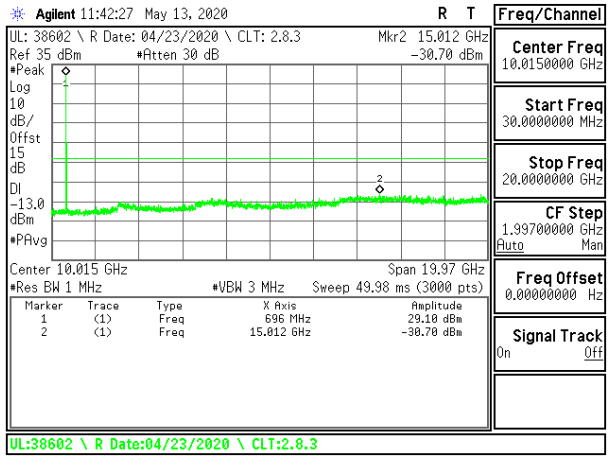
FCC: §27.53 (g)
The minimum permissible attenuation level of any spurious emissions is 43 + 10 log (P) dB where transmitting power (P) in Watts.



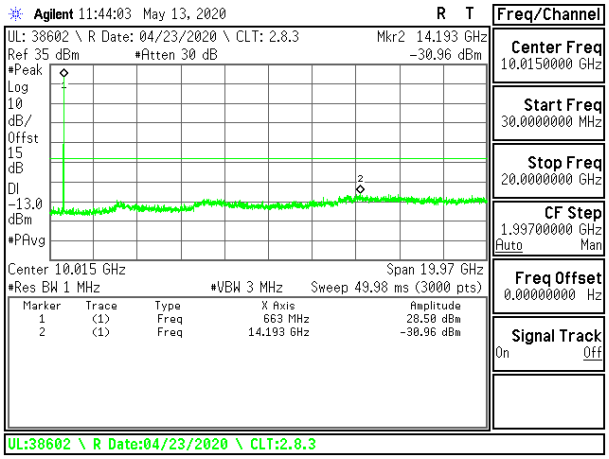
LTE B71 5MHz QPSK Low Channel RB1-0



LTE B71 5MHz QPSK Middle Channel RB1-0



LTE B71 5MHz QPSK High Channel RB1-0



LTE B71 10MHz QPSK Low Channel RB1-0

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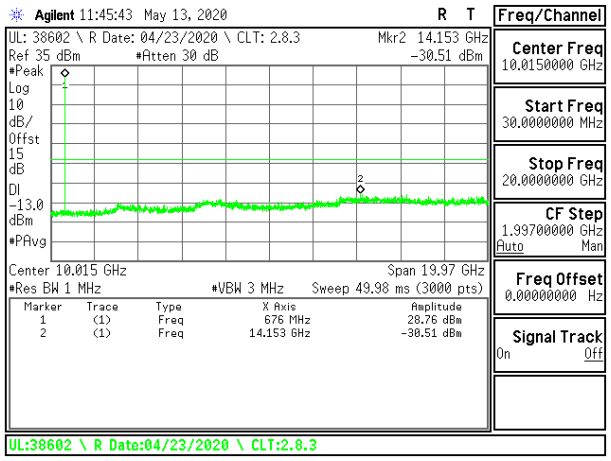
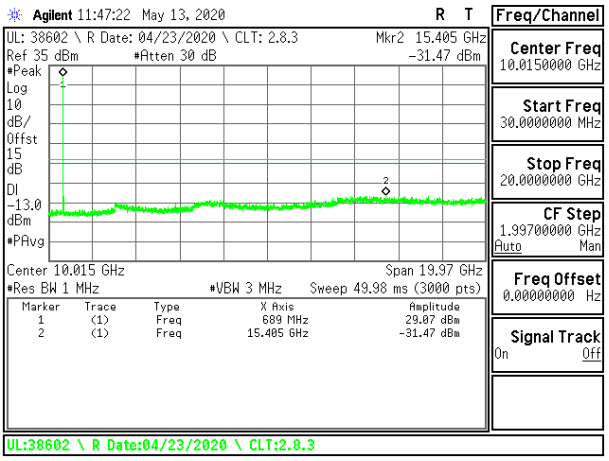
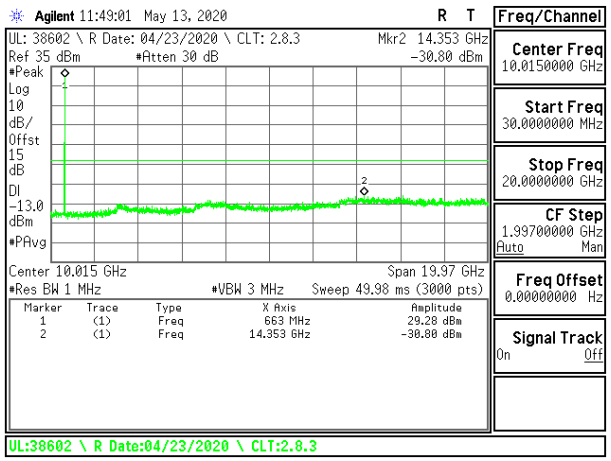


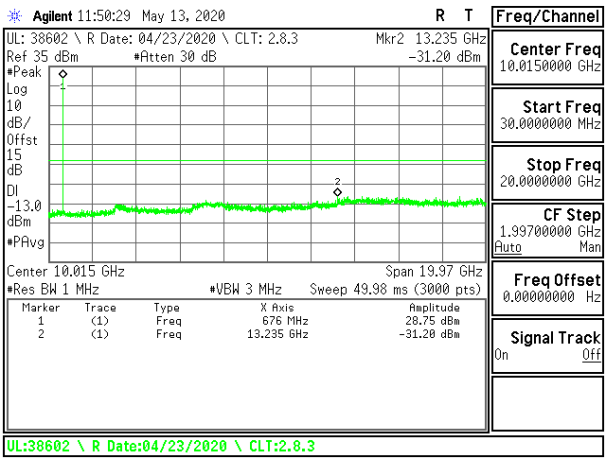
LTE B71 10MHz QPSK Middle Channel RB1-0



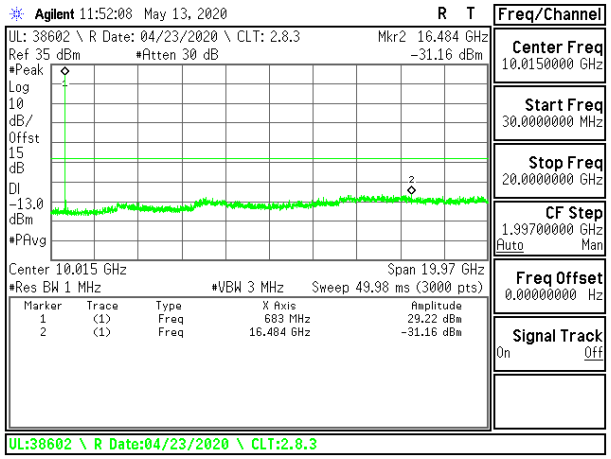
LTE 71 10MHz QPSK High Channel RB1-0



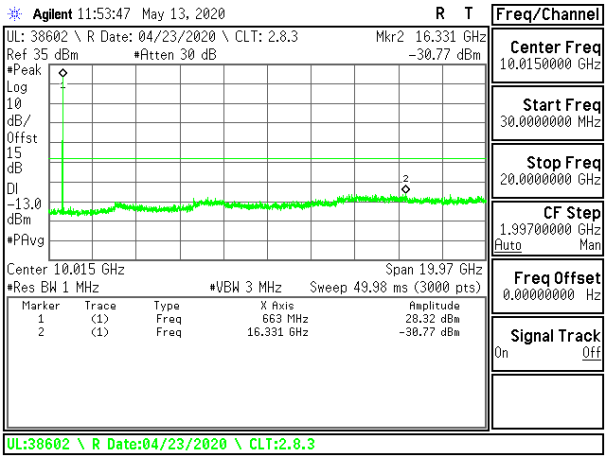
LTE B71 15MHz QPSK Low Channel RB1-0



LTE B71 15MHz QPSK Middle Channel RB1-0



LTE B71 15MHz QPSK High Channel RB1-0



LTE B71 20MHz QPSK Low Channel RB1-0

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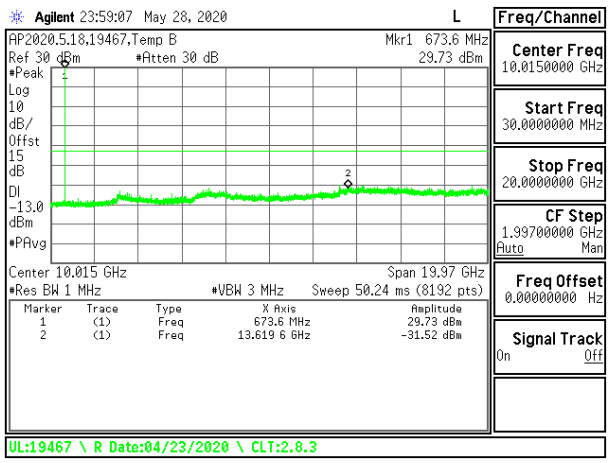
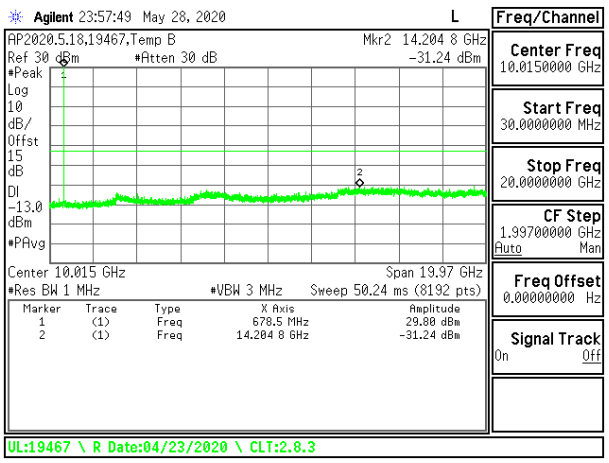


LTE B71 20MHz QPSK Middle Channel RB1-0



LTE B71 20MHz QPSK High Channel RB1-0

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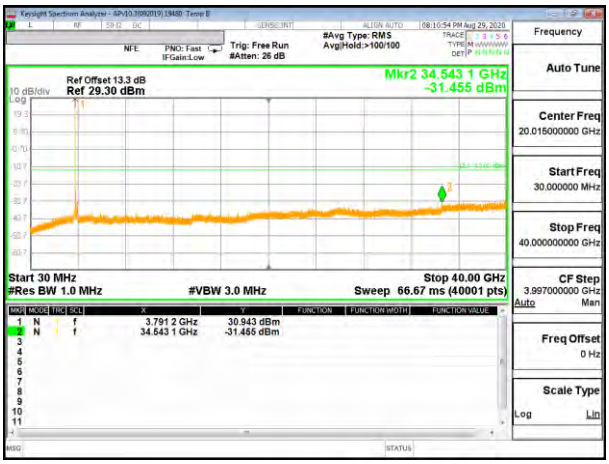
8.3.15. 5G NR BAND n77

LIMITS

FCC: §27.53
Emission limits
(I) 3.7 GHz Service. The following emission limits apply to stations transmitting in the 3700-3980 MHz band:
(2) For mobile operations in the 3700-3980 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed −13 dBm/MHz.

5G NR Bn77 100MHz QPSK Low Channel RB1-0



5G NR Bn77 100MHz QPSK Mid Channel RB1-0

5G NR Bn77 100MHz QPSK High Channel RB1-0

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8.4. FREQUENCY STABILITY

TEST PROCEDURE

Use CMW 500 with Frequency Error measurement capability.

- Temp. = −30°C to +50°C
- 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

See the following pages.

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8.4.1. LTE BAND 2

LIMITS

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

Test Engineer ID:	19177	Test Date:	6/30/2020

QPSK (20MHz BANDWIDTH)

Limit		1850	1910	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	1850.9881	1909.0383		
Extreme (50C)		1850.9881	1909.0383	-12.3	-0.007
Extreme (40C)		1850.9881	1909.0383	-11.5	-0.006
Extreme (30C)		1850.9881	1909.0383	-13.8	-0.007
Extreme (10C)		1850.9881	1909.0383	-13.7	-0.007
Extreme (0C)		1850.9881	1909.0383	11.9	0.006
Extreme (-10C)		1850.9881	1909.0383	11.9	0.006
Extreme (-20C)		1850.9881	1909.0383	-10.7	-0.006
Extreme (-30C)		1850.9881	1909.0383	8.9	0.005
20C	15%	1850.9881	1909.0383	-12.2	-0.006
	-15%	1850.9881	1909.0383	-12.7	-0.007
	End Point	1850.9881	1909.0383	-12.1	-0.006

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8.4.2. LTE BAND 5 AND 5G NR BAND n5

LIMITS

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

Test Engineer ID:	19178	Test Date:	6/20/2020

LTE BAND 5 QPSK (10MHz BANDWIDTH)

Limit		824	849	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	824.4917	848.5578		
Extreme (50C)		824.4917	848.5578	-6.1	-0.007
Extreme (40C)		824.4917	848.5578	-5.6	-0.007
Extreme (30C)		824.4917	848.5578	4.0	0.005
Extreme (10C)		824.4917	848.5578	-5.5	-0.007
Extreme (0C)		824.4917	848.5578	5.8	0.007
Extreme (-10C)		824.4917	848.5578	-5.7	-0.007
Extreme (-20C)		824.4917	848.5578	-3.5	-0.004
Extreme (-30C)		824.4917	848.5578	5.1	0.006
20C	15%	824.4917	848.5578	-7.5	-0.009
	-15%	824.4917	848.5578	-7.2	-0.009
	End Point	824.4917	848.5578	5.9	0.007

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5G NR BAND n5 QPSK (20MHz BANDWIDTH)

Limit		824	849	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm	F high @ -13dBm		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	824.4688	847.4390		
Extreme (50C)		824.4688	847.4390	-17.1	-0.020
Extreme (40C)		824.4688	847.4390	-11.5	-0.014
Extreme (30C)		824.4688	847.4390	-13.5	-0.016
Extreme (10C)		824.4688	847.4390	-13.5	-0.016
Extreme (0C)		824.4688	847.4390	-11.8	-0.014
Extreme (-10C)		824.4688	847.4390	-10.7	-0.013
Extreme (-20C)		824.4688	847.4390	-11.7	-0.014
Extreme (-30C)		824.4688	847.4390	-10.7	-0.013
20C	15%	824.4688	847.4390	-10.0	-0.012
	-15%	824.4688	847.4390	-11.0	-0.013
	End Point	824.4688	847.4390	-14.1	-0.017

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8.4.3. LTE BAND 7

LIMITS

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

Test Engineer ID:	19177	Test Date:	6/30/2020

QPSK (20MHz BANDWIDTH)

Limit		2500	2570	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	2500.3192	2569.6289		
Extreme (50C)		2500.3192	2569.6289	-12.1	-0.005
Extreme (40C)		2500.3192	2569.6289	16.3	0.006
Extreme (30C)		2500.3192	2569.6289	-13.2	-0.005
Extreme (10C)		2500.3192	2569.6289	-15.4	-0.006
Extreme (0C)		2500.3192	2569.6289	-13.5	-0.005
Extreme (-10C)		2500.3192	2569.6289	-13.9	-0.005
Extreme (-20C)		2500.3192	2569.6289	14.2	0.006
Extreme (-30C)		2500.3192	2569.6289	-14.9	-0.006
20C	15%	2500.3192	2569.6289	-13.7	-0.005
	-15%	2500.3192	2569.6289	-14.0	-0.006
	End Point	2500.3192	2569.6289	-15.1	-0.006

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8.4.4. LTE BAND 12 AND 5G NR BAND n12

LIMITS

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

Test Engineer ID:	19177	Test Date:	6/30/2020

QPSK (10MHz BANDWIDTH)

Limit		699	716	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm	F high @ -13dBm		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	699.4827	715.5095		
Extreme (50C)		699.4827	715.5095	-7.0	-0.010
Extreme (40C)		699.4827	715.5095	-6.7	-0.009
Extreme (30C)		699.4827	715.5095	-8.4	-0.012
Extreme (10C)		699.4827	715.5095	5.6	0.008
Extreme (0C)		699.4827	715.5095	5.9	0.008
Extreme (-10C)		699.4827	715.5095	-7.4	-0.010
Extreme (-20C)		699.4827	715.5095	-7.7	-0.011
Extreme (-30C)		699.4827	715.5095	8.0	0.011
20C	15%	699.4827	715.5095	-8.3	-0.012
	-15%	699.4827	715.5095	-9.1	-0.013
	End Point	699.4827	715.5095	-8.3	-0.012

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5G NR BAND n12 QPSK (15MHz BANDWIDTH)

Limit		699	716	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm	F high @ -13dBm		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	699.3861	714.8681		
Extreme (50C)		699.3861	714.8681	14.4	0.020
Extreme (40C)		699.3861	714.8681	-13.5	-0.019
Extreme (30C)		699.3861	714.8681	-13.3	-0.019
Extreme (10C)		699.3861	714.8681	-13.5	-0.019
Extreme (0C)		699.3861	714.8681	-14.3	-0.020
Extreme (-10C)		699.3861	714.8681	-14.1	-0.020
Extreme (-20C)		699.3861	714.8681	-14.7	-0.021
Extreme (-30C)		699.3861	714.8681	-12.4	-0.018
20C	15%	699.3861	714.8681	-13.8	-0.019
	-15%	699.3861	714.8681	-13.9	-0.020
	End Point	699.3861	714.8681	-12.9	-0.018

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8.4.5. LTE BAND 13

LIMITS

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

Test Engineer ID:	19177	Test Date:	6/30/2020

QPSK (10MHz BANDWIDTH)

Limit		777	787	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	777.4821	786.5223		
Extreme (50C)		777.4821	786.5223	-5.6	-0.007
Extreme (40C)		777.4821	786.5223	-8.3	-0.011
Extreme (30C)		777.4821	786.5223	-6.8	-0.009
Extreme (10C)		777.4821	786.5223	-6.2	-0.008
Extreme (0C)		777.4821	786.5223	7.2	0.009
Extreme (-10C)		777.4821	786.5223	6.0	0.008
Extreme (-20C)		777.4821	786.5223	-2.4	-0.003
Extreme (-30C)		777.4821	786.5223	4.6	0.006
20C	15%	777.4821	786.5223	5.0	0.006
	-15%	777.4821	786.5223	6.9	0.009
	End Point	777.4821	786.5223	-6.1	-0.008

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8.4.6. LTE BAND 14

LIMITS

FCC: §90.539
(e) The frequency stability of mobile, portable and control transmitters operating in the wideband segment must be 1.25 ppm or better when AFC is locked to a base station, and 5 ppm or better when AFC is not locked.

Test Engineer ID:	19178	Test Date:	6/19/2020

QPSK (10MHz BANDWIDTH)

Limit		788	798	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm	F high @ -13dBm		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	788.2415	797.7962		
Extreme (50C)		788.2415	797.7962	-6.2	-0.008
Extreme (40C)		788.2415	797.7962	-4.7	-0.006
Extreme (30C)		788.2415	797.7962	-4.0	-0.005
Extreme (10C)		788.2415	797.7962	-3.6	-0.005
Extreme (0C)		788.2415	797.7962	3.7	0.005
Extreme (-10C)		788.2415	797.7962	-3.5	-0.004
Extreme (-20C)		788.2415	797.7962	-4.4	-0.006
Extreme (-30C)		788.2415	797.7962	-4.5	-0.006
20C	15%	788.2415	797.7962	-3.3	-0.004
	-15%	788.2415	797.7962	4.2	0.005
	End Point	788.2415	797.7962	-4.1	-0.005

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8.4.7. LTE BAND 17

LIMITS

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

Test Engineer ID:	19177	Test Date:	6/30/2020

QPSK (10MHz BANDWIDTH)

Limit		704	716	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	704.4843	715.5021		
Extreme (50C)		704.4843	715.5021	-7.3	-0.010
Extreme (40C)		704.4843	715.5021	-7.3	-0.010
Extreme (30C)		704.4843	715.5021	-8.0	-0.011
Extreme (10C)		704.4843	715.5021	-8.6	-0.012
Extreme (0C)		704.4843	715.5021	7.8	0.011
Extreme (-10C)		704.4843	715.5021	6.9	0.010
Extreme (-20C)		704.4843	715.5021	-10.4	-0.015
Extreme (-30C)		704.4843	715.5021	4.5	0.006
20C	15%	704.4843	715.5021	-7.6	-0.011
	-15%	704.4843	715.5021	-9.2	-0.013
	End Point	704.4843	715.5021	-9.0	-0.013

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8.4.8. LTE BAND 25

LIMITS

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

Test Engineer ID:	19177	Test Date:	6/30/2020

QPSK (20MHz BANDWIDTH)

Limit		1850	1915	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm	F high @ -13dBm		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	1850.9779	1914.0159		
Extreme (50C)		1850.9779	1914.0159	-13.7	-0.007
Extreme (40C)		1850.9779	1914.0159	-14.4	-0.008
Extreme (30C)		1850.9779	1914.0159	-15.4	-0.008
Extreme (10C)		1850.9779	1914.0159	-13.9	-0.007
Extreme (0C)		1850.9779	1914.0159	-12.9	-0.007
Extreme (-10C)		1850.9779	1914.0159	-13.6	-0.007
Extreme (-20C)		1850.9779	1914.0159	-13.6	-0.007
Extreme (-30C)		1850.9779	1914.0159	-11.7	-0.006
20C	15%	1850.9779	1914.0159	-16.2	-0.009
	-15%	1850.9779	1914.0159	-15.8	-0.008
	End Point	1850.9779	1914.0159	-14.4	-0.008

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8.4.9. LTE BAND 26 (PART 90S)

LIMITS

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

Test Engineer ID:	19177	Test Date:	6/30/2020

QPSK (10MHz BANDWIDTH)

Limit		814	824	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	814.4918	823.5327		
Extreme (50C)		814.4918	823.5327	-8.9	-0.011
Extreme (40C)		814.4918	823.5327	-9.5	-0.012
Extreme (30C)		814.4918	823.5327	-4.0	-0.005
Extreme (10C)		814.4918	823.5327	-10.0	-0.012
Extreme (0C)		814.4918	823.5327	-7.5	-0.009
Extreme (-10C)		814.4918	823.5327	-8.0	-0.010
Extreme (-20C)		814.4918	823.5327	-8.6	-0.010
Extreme (-30C)		814.4918	823.5327	-8.4	-0.010
20C	15%	814.4918	823.5327	-11.0	-0.013
	-15%	814.4918	823.5327	-10.0	-0.012
	End Point	814.4918	823.5327	-10.3	-0.013

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8.4.10. LTE BAND 30

LIMITS

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

Test Engineer ID:	19177	Test Date:	6/30/2020

QPSK (10MHz BANDWIDTH)

Limit		2305	2315	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm	F high @ -13dBm		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	2305.4526	2314.5362		
Extreme (50C)		2305.4526	2314.5362	-14.0	-0.006
Extreme (40C)		2305.4526	2314.5362	-13.3	-0.006
Extreme (30C)		2305.4526	2314.5362	-17.9	-0.008
Extreme (10C)		2305.4526	2314.5362	-13.1	-0.006
Extreme (0C)		2305.4526	2314.5362	14.2	0.006
Extreme (-10C)		2305.4526	2314.5362	-13.3	-0.006
Extreme (-20C)		2305.4526	2314.5362	13.2	0.006
Extreme (-30C)		2305.4526	2314.5362	16.3	0.007
20C	15%	2305.4526	2314.5362	-14.1	-0.006
	-15%	2305.4526	2314.5362	-12.9	-0.006
	End Point	2305.4526	2314.5362	-13.5	-0.006

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8.4.11. LTE BAND 41 AND 5G NR BAND n41

LIMITS

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

Test Engineer ID:	19177	Test Date:	6/30/2020

LTE BAND 41 QPSK (20MHz BANDWIDTH)

Limit		2496	2690	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	2496.8999	2689.1023		
Extreme (50C)		2496.8999	2689.1023	-22.0	-0.008
Extreme (40C)		2496.8999	2689.1023	-22.9	-0.009
Extreme (30C)		2496.8999	2689.1023	-20.9	-0.008
Extreme (10C)		2496.8999	2689.1023	-26.1	-0.010
Extreme (0C)		2496.8999	2689.1023	-11.4	-0.004
Extreme (-10C)		2496.8999	2689.1023	-24.8	-0.010
Extreme (-20C)		2496.8999	2689.1023	-22.7	-0.009
Extreme (-30C)		2496.8999	2689.1023	-21.4	-0.008
20C	15%	2496.8999	2689.1023	-23.1	-0.009
	-15%	2496.8999	2689.1023	-20.0	-0.008
	End Point	2496.8999	2689.1023	-21.3	-0.008

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5G NR BAND n41 QPSK (100MHz BANDWIDTH)

Limit		2496	2690	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm	F high @ -13dBm		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	2497.0086	2687.9440		
Extreme (50C)		2497.0086	2687.9440	-34.0	-0.013
Extreme (40C)		2497.0086	2687.9440	32.2	0.012
Extreme (30C)		2497.0086	2687.9440	-30.5	-0.012
Extreme (10C)		2497.0086	2687.9440	-39.9	-0.015
Extreme (0C)		2497.0086	2687.9440	38.6	0.015
Extreme (-10C)		2497.0086	2687.9440	-27.9	-0.011
Extreme (-20C)		2497.0086	2687.9440	-28.6	-0.011
Extreme (-30C)		2497.0086	2687.9440	-30.0	-0.012
20C	15%	2497.0086	2687.9440	-36.5	-0.014
	-15%	2497.0086	2687.9440	-34.9	-0.013
	End Point	2497.0086	2687.9440	-40.0	-0.015

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8.4.12. LTE BAND 48

Test Engineer ID:	19177	Test Date:	6/30/2020

QPSK (20MHz BANDWIDTH)

Limit		3550	3700	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	3550.7904	3699.0067		
Extreme (50C)		3550.7904	3699.0067	11.3	0.003
Extreme (40C)		3550.7904	3699.0067	8.5	0.002
Extreme (30C)		3550.7904	3699.0067	9.1	0.003
Extreme (10C)		3550.7904	3699.0067	9.4	0.003
Extreme (0C)		3550.7904	3699.0067	8.6	0.002
Extreme (-10C)		3550.7904	3699.0067	10.7	0.003
Extreme (-20C)		3550.7904	3699.0067	9.4	0.003
Extreme (-30C)		3550.7904	3699.0067	10.8	0.003
20C	15%	3550.7904	3699.0067	11.2	0.003
	-15%	3550.7904	3699.0067	8.9	0.002
	End Point	3550.7904	3699.0067	10.5	0.003

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8.4.13. LTE BAND 66

LIMITS

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

Test Engineer ID:	19177	Test Date:	6/30/2020

QPSK (20MHz BANDWIDTH)

Limit		1710	1780	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	1710.9674	1779.0774		
Extreme (50C)		1710.9674	1779.0774	11.7	0.007
Extreme (40C)		1710.9674	1779.0774	-13.7	-0.008
Extreme (30C)		1710.9674	1779.0774	-11.9	-0.007
Extreme (10C)		1710.9674	1779.0774	-11.4	-0.007
Extreme (0C)		1710.9674	1779.0774	11.5	0.007
Extreme (-10C)		1710.9674	1779.0774	-10.4	-0.006
Extreme (-20C)		1710.9674	1779.0774	13.3	0.008
Extreme (-30C)		1710.9674	1779.0774	-11.9	-0.007
20C	15%	1710.9674	1779.0774	-12.4	-0.007
	-15%	1710.9674	1779.0774	-11.7	-0.007
	End Point	1710.9674	1779.0774	-13.8	-0.008

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8.4.14. LTE BAND 71

LIMITS

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

Test Engineer ID:	19177	Test Date:	6/30/2020

QPSK (20MHz BANDWIDTH)

Limit		663	698	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm	F high @ -13dBm		
Temperature	Voltage	(MHz)	(MHz)		
Normal (20C)	Normal	664.0057	696.9919		
Extreme (50C)		664.0057	696.9919	3.3	0.005
Extreme (40C)		664.0057	696.9919	-4.8	-0.007
Extreme (30C)		664.0057	696.9919	-3.6	-0.005
Extreme (10C)		664.0057	696.9919	-5.1	-0.007
Extreme (0C)		664.0057	696.9919	3.9	0.006
Extreme (-10C)		664.0057	696.9919	5.3	0.008
Extreme (-20C)		664.0057	696.9919	4.6	0.007
Extreme (-30C)		664.0057	696.9919	-5.5	-0.008
20C	15%	664.0057	696.9919	5.4	0.008
	-15%	664.0057	696.9919	5.4	0.008
	End Point	664.0057	696.9919	6.2	0.009

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8.4.15. 5G NR BAND n77

LIMITS

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

Test Engineer ID:	19480	Test Date:	8/4/2020

5G NR BAND n77 QPSK (100MHz BANDWIDTH)

Limit		3700	3980	Delta (Hz)	Frequency Stability (ppm)
Condition		F low @ -13dBm (MHz)	F high @ -13dBm (MHz)		
Temperature	Voltage				
Normal (20C)	Normal	3700.9198	3977.9617		
Extreme (50C)		3700.9197	3977.9616	-53.3	-0.014
Extreme (40C)		3700.9198	3977.9617	-33.2	-0.009
Extreme (30C)		3700.9198	3977.9617	34.7	0.009
Extreme (10C)		3700.9198	3977.9617	27.5	0.007
Extreme (0C)		3700.9198	3977.9617	-32.7	-0.009
Extreme (-10C)		3700.9198	3977.9617	-34.4	-0.009
Extreme (-20C)		3700.9198	3977.9617	-41.3	-0.011
Extreme (-30C)		3700.9198	3977.9617	-44.9	-0.012
20C	15%	3700.9198	3977.9617	-30.0	-0.008
	-15%	3700.9198	3977.9617	-31.6	-0.008
	End Point	3700.9198	3977.9617	-30.2	-0.008

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8.5. PEAK-TO-AVERAGE POWER RATIO

LIMIT

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.

RESULT

The highest output power antenna port 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.

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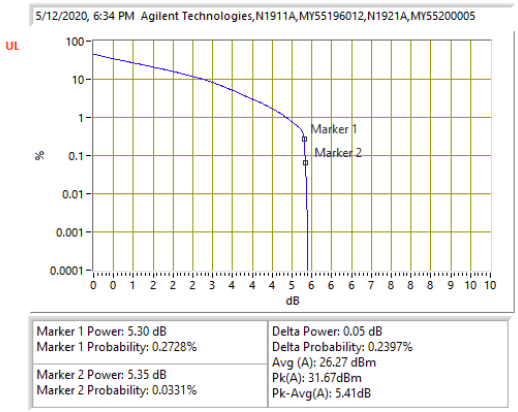
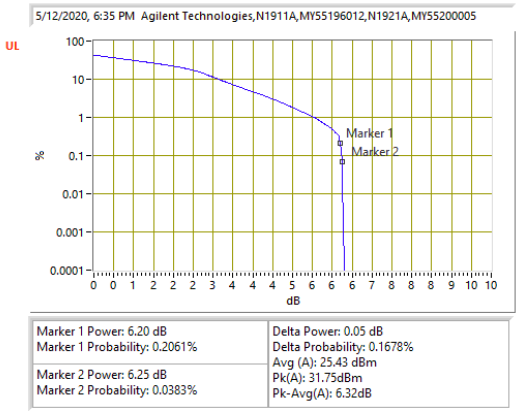
8.5.1. LTE BAND 2

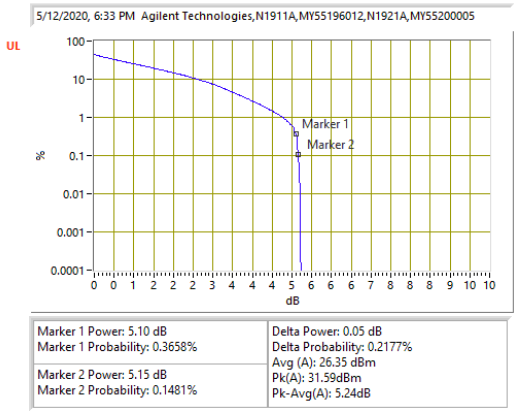
Test Engineer ID:	10646	Test Date:	5/12/2020



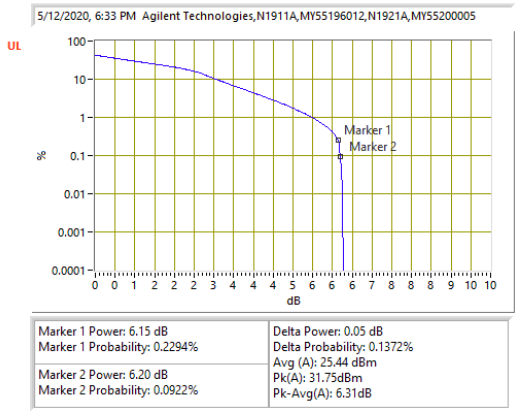
LTE B2 1.4MHz QPSK Middle Channel



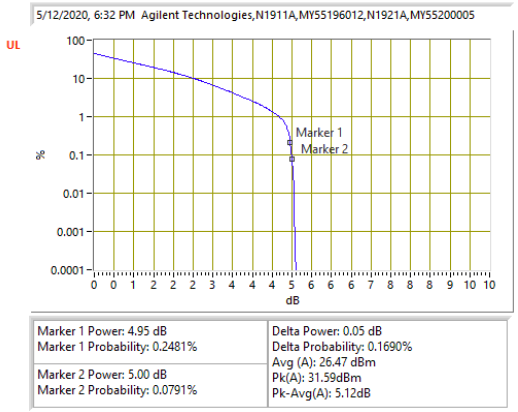
LTE B2 1.4MHz 16QAM Middle Channel



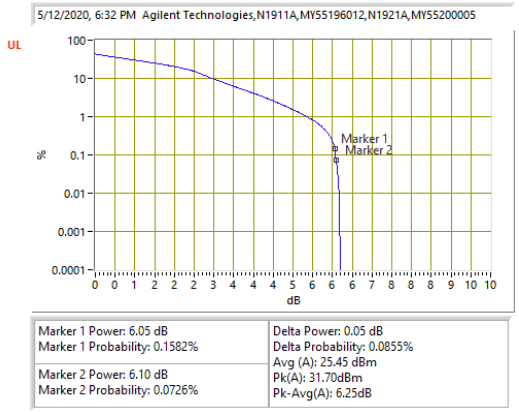
LTE B2 3MHz QPSK Middle Channel



LTE B2 3MHz 16QAM Middle Channel



LTE B2 5MHz QPSK Middle Channel



LTE B2 5MHz 16QAM Middle Channel

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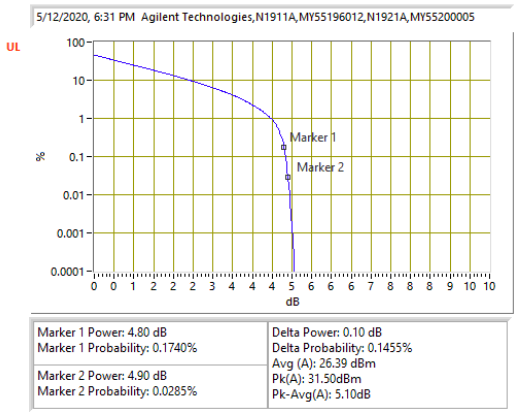
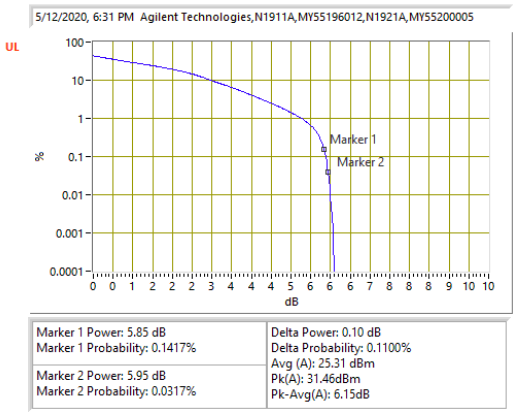
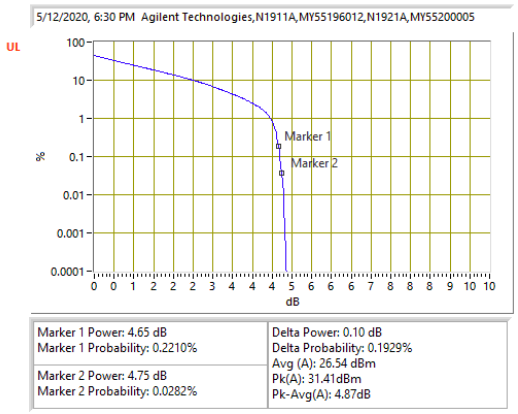


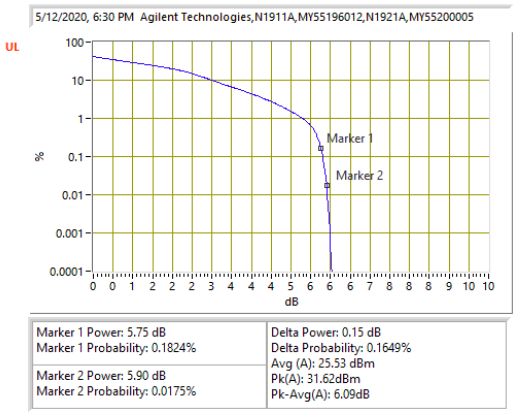
LTE B2 10MHz QPSK Middle Channel



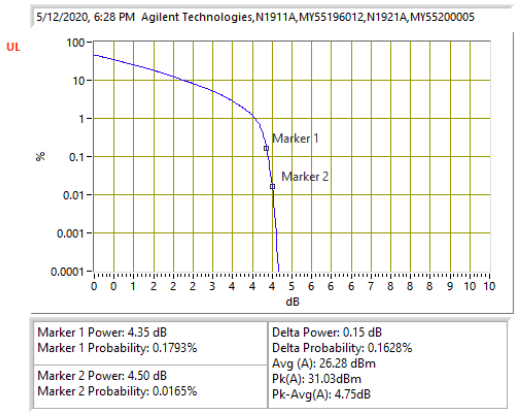
LTE B2 10MHz 16QAM Middle Channel



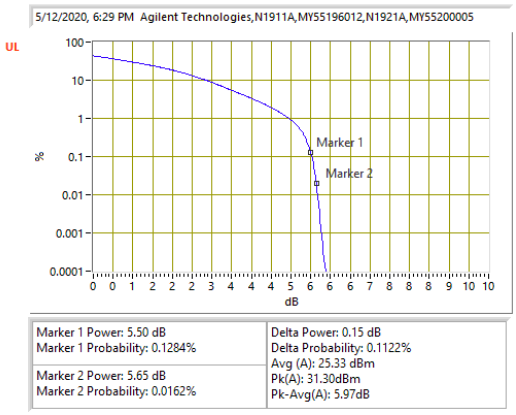
LTE B2 15MHz QPSK Middle Channel



LTE B2 15MHz 16QAM Middle Channel



LTE B2 20MHz QPSK Middle Channel



LTE B2 20MHz 16QAM Middle Channel

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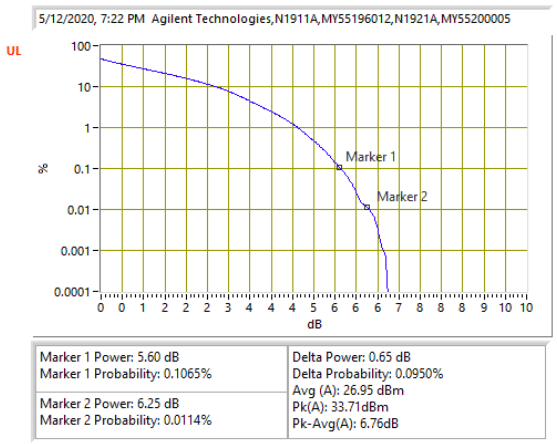
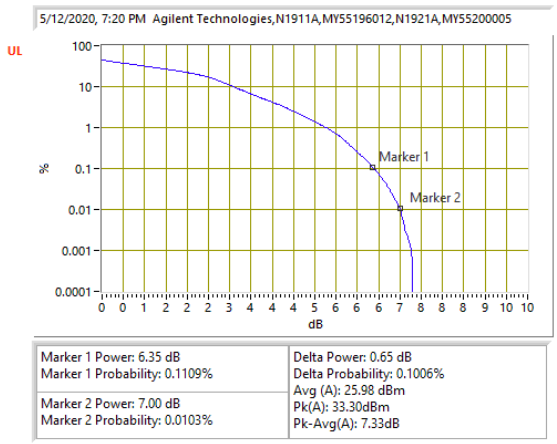
8.5.2. LTE BAND 5 AND 5G NR BAND n5

LTE BAND 5

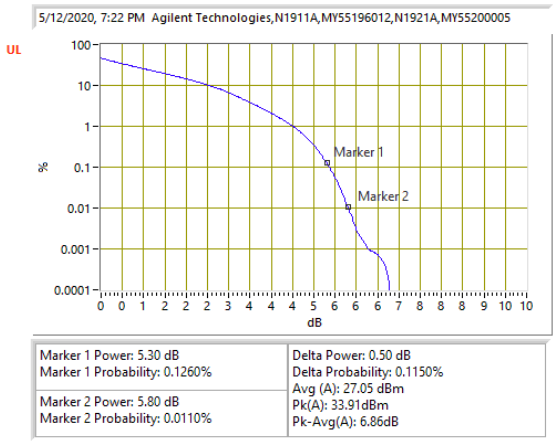
Test Engineer ID:	10646	Test Date:	5/12/2020



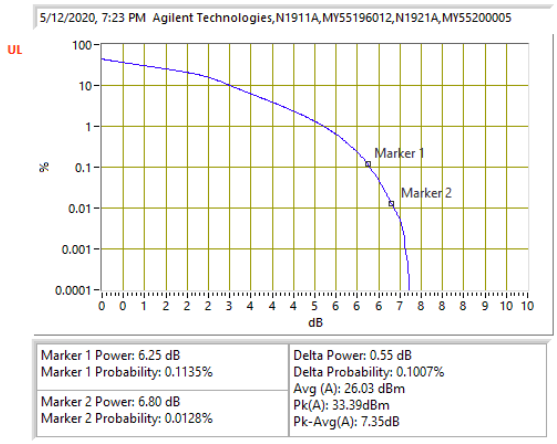
LTE B5 1.4MHz QPSK Middle Channel



LTE B5 1.4MHz 16QAM Middle Channel



LTE B5 3MHz QPSK Middle Channel



LTE B5 3MHz 16QAM Middle Channel

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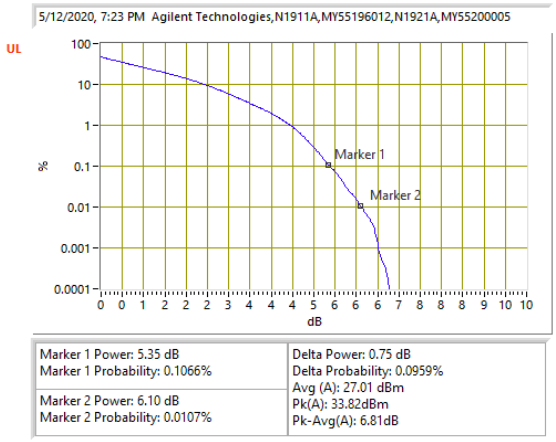
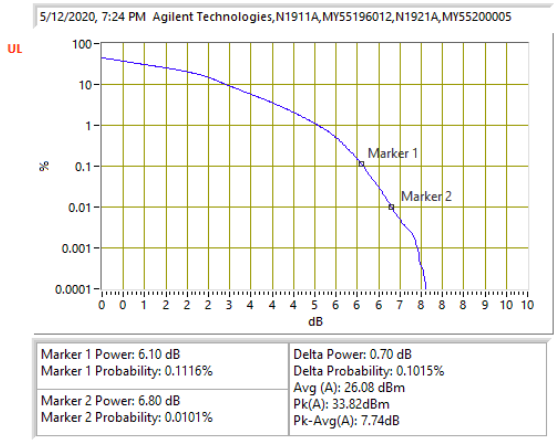
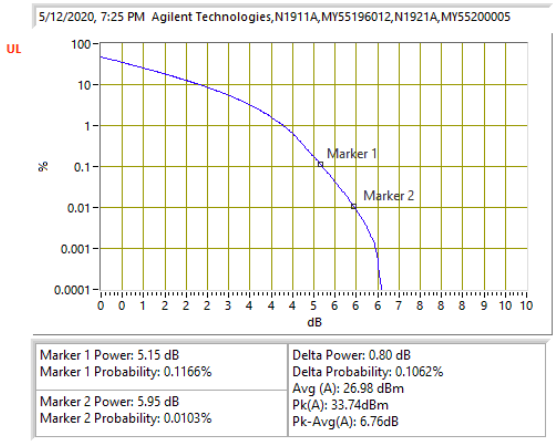


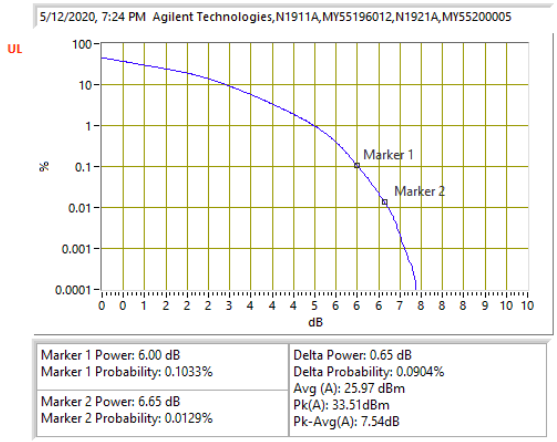
LTE B5 5MHz QPSK Middle Channel



LTE B5 5MHz 16QAM Middle Channel



LTE B5 10MHz QPSK Middle Channel



LTE B5 10MHz 16QAM Middle Channel

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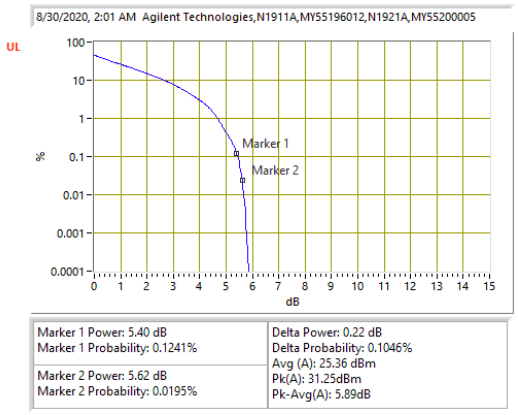
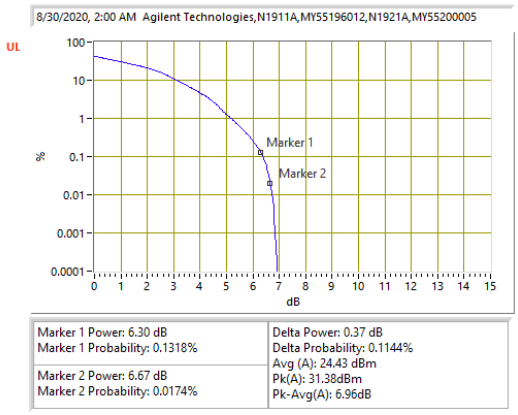
5G NR BAND n5

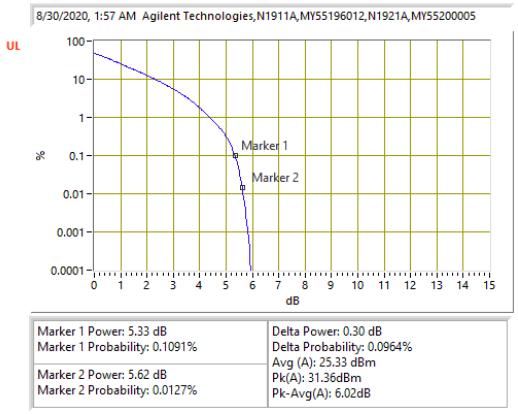
Test Engineer ID:	10646	Test Date:	8/30/2020



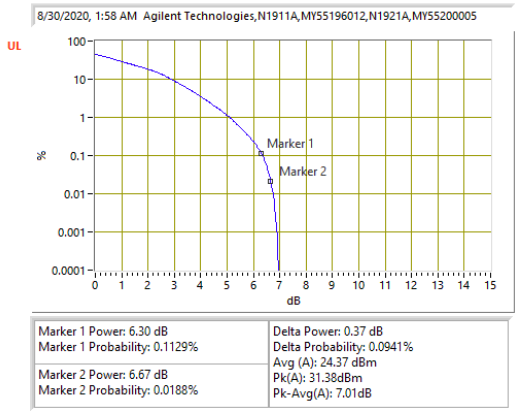
5G NR Bn5 15MHz QPSK Middle Channel



5G NR Bn5 15MHz 16QAM Middle Channel



5G NR Bn5 20MHz QPSK Middle Channel



5G NR Bn5 20MHz 16QAM Middle Channel

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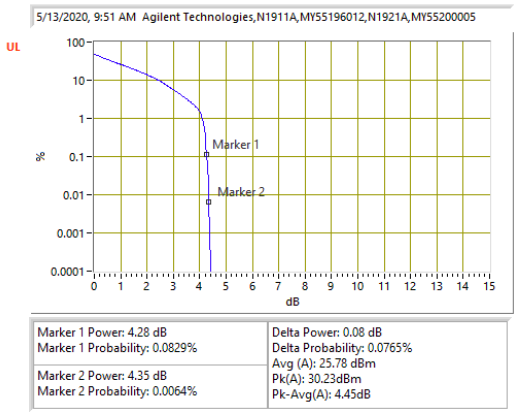
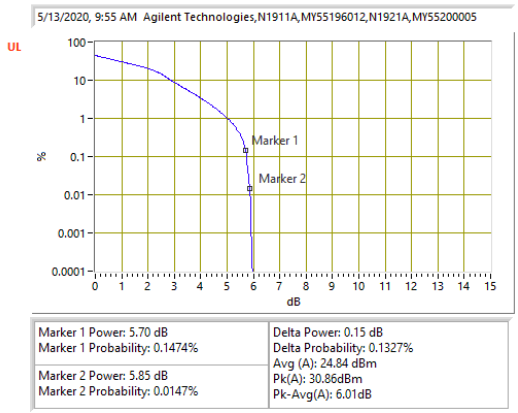
8.5.3. LTE BAND 7

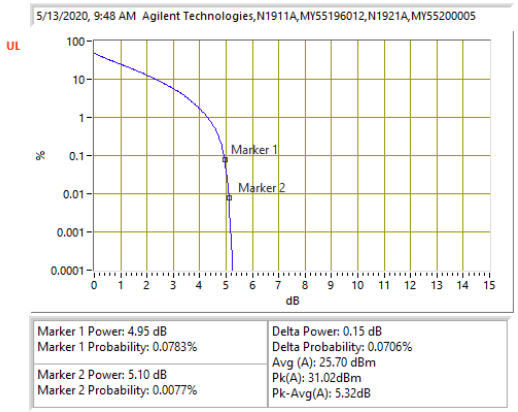
Test Engineer ID:	39004	Test Date:	5/13/2020



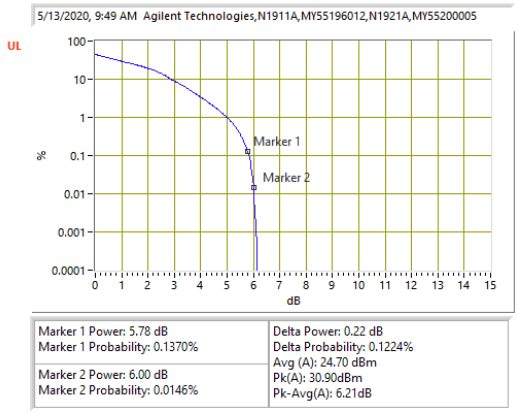
LTE B7 5MHz QPSK Middle Channel



LTE B7 5MHz 16QAM Middle Channel



LTE B7 10MHz QPSK Middle Channel



LTE B7 10MHz 16QAM Middle Channel

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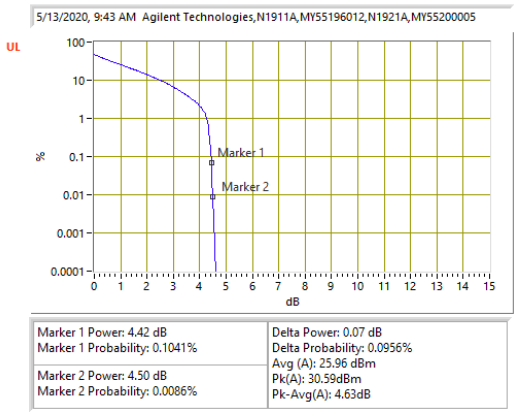
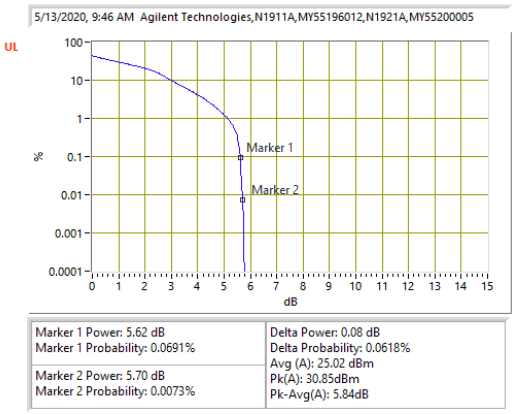
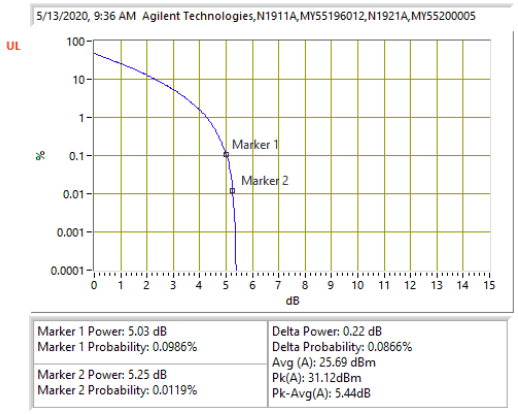


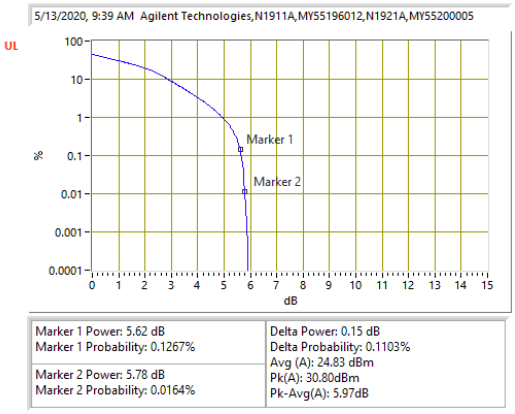
LTE B7 15MHz QPSK Middle Channel



LTE B7 15MHz 16QAM Middle Channel



LTE B7 20MHz QPSK Middle Channel



LTE B7 20MHz 16QAM Middle Channel

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