

# FCC LTE Band Test Data

**FCC ID** : 2BHCY-X100

**Company:** : Shenzhen ThreeTigers Trading co..Ltd.

**EUT** : Mobile Phone

**Model Number** : X100

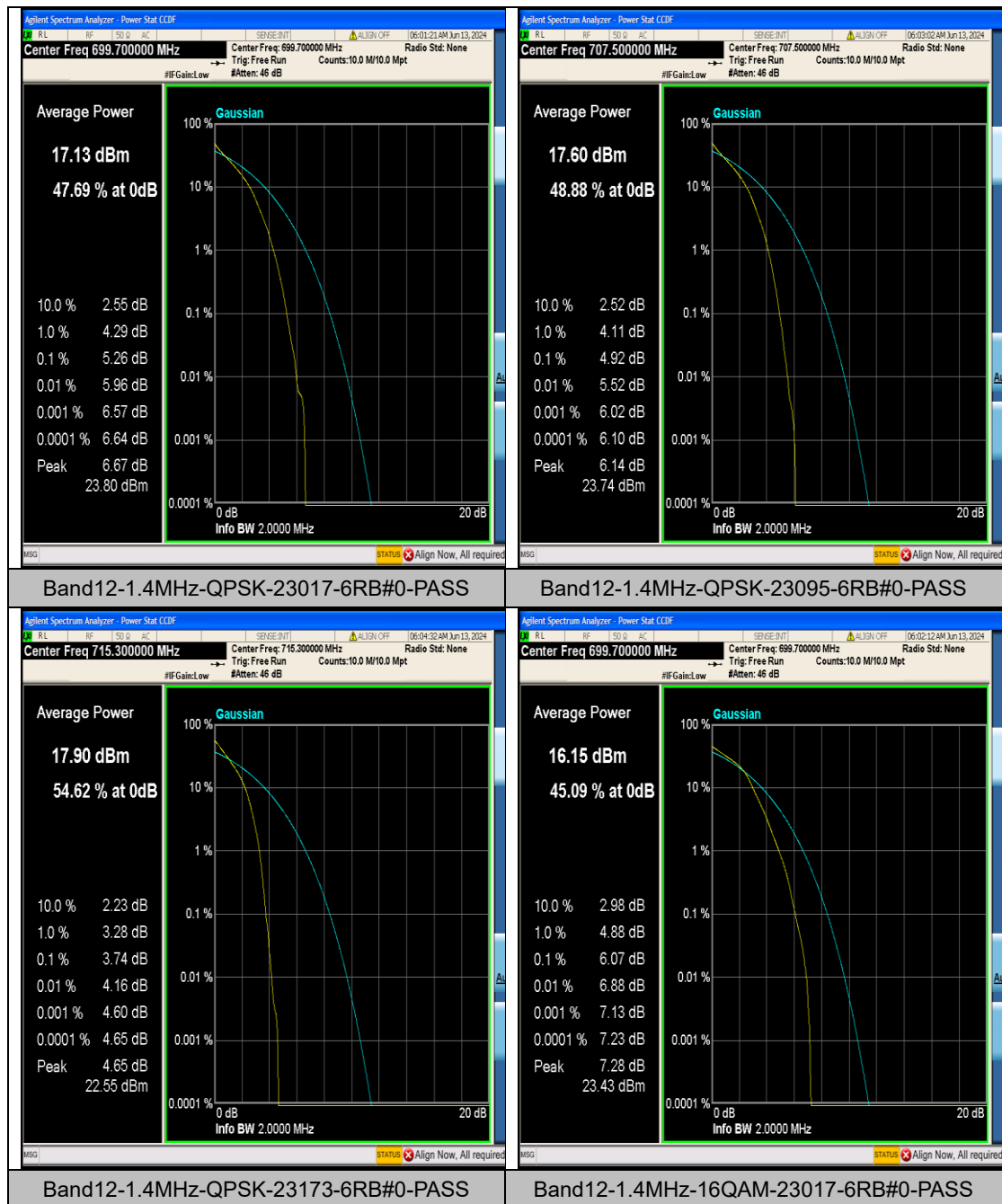
**Reviewed By** : Eric Wang

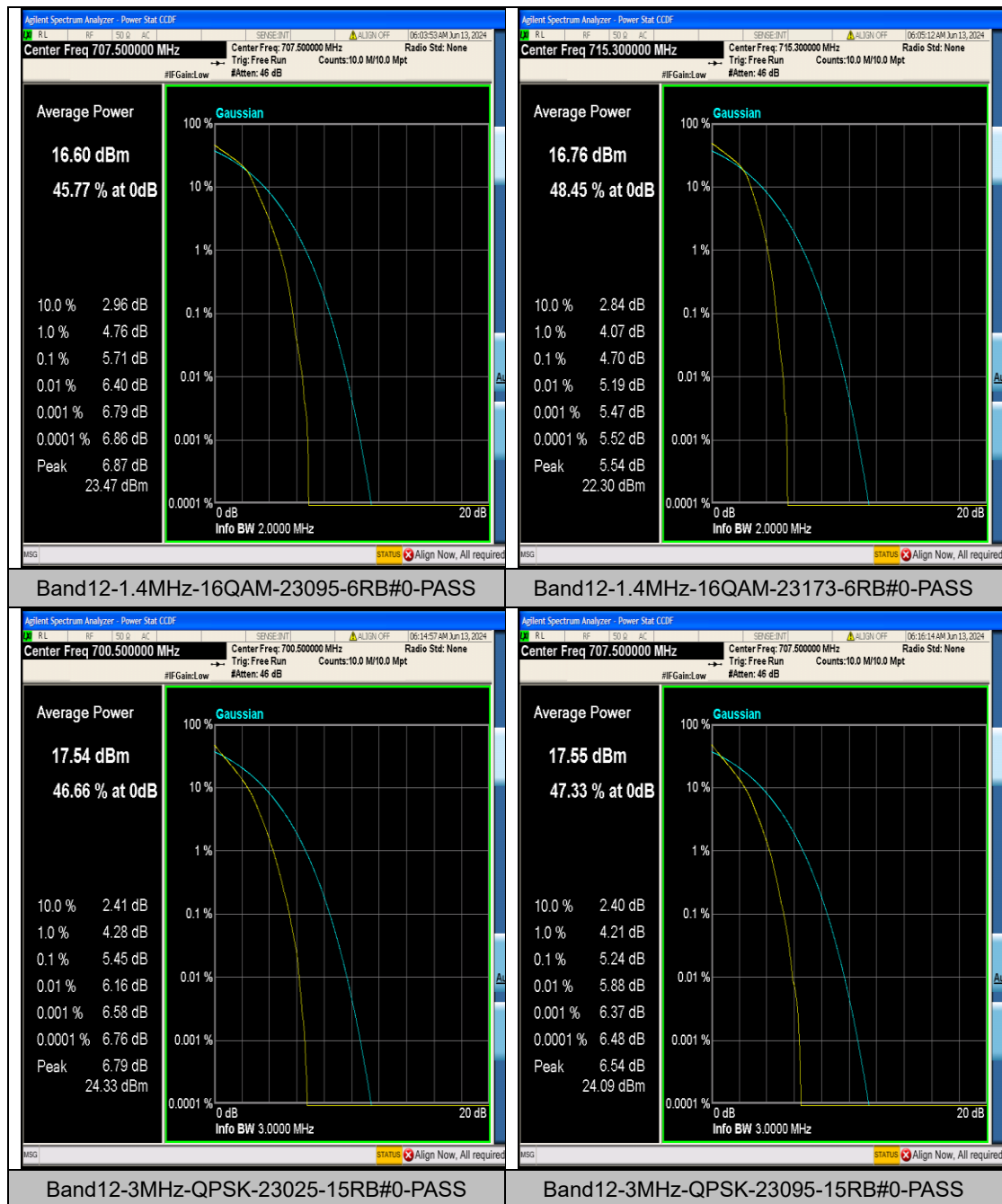
## Appendix B: Peak-to-Average Ratio(CCDF)

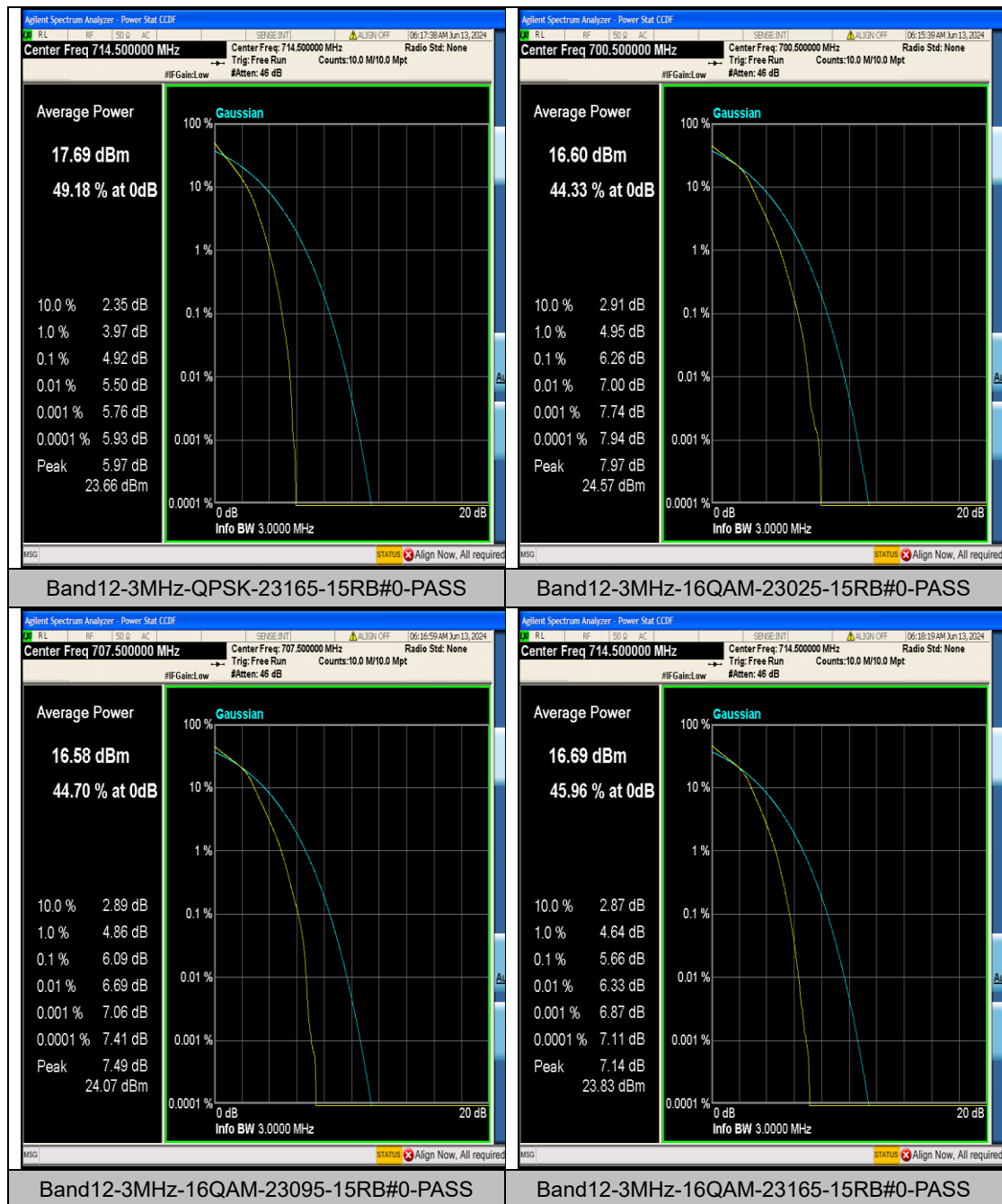
### Test Result

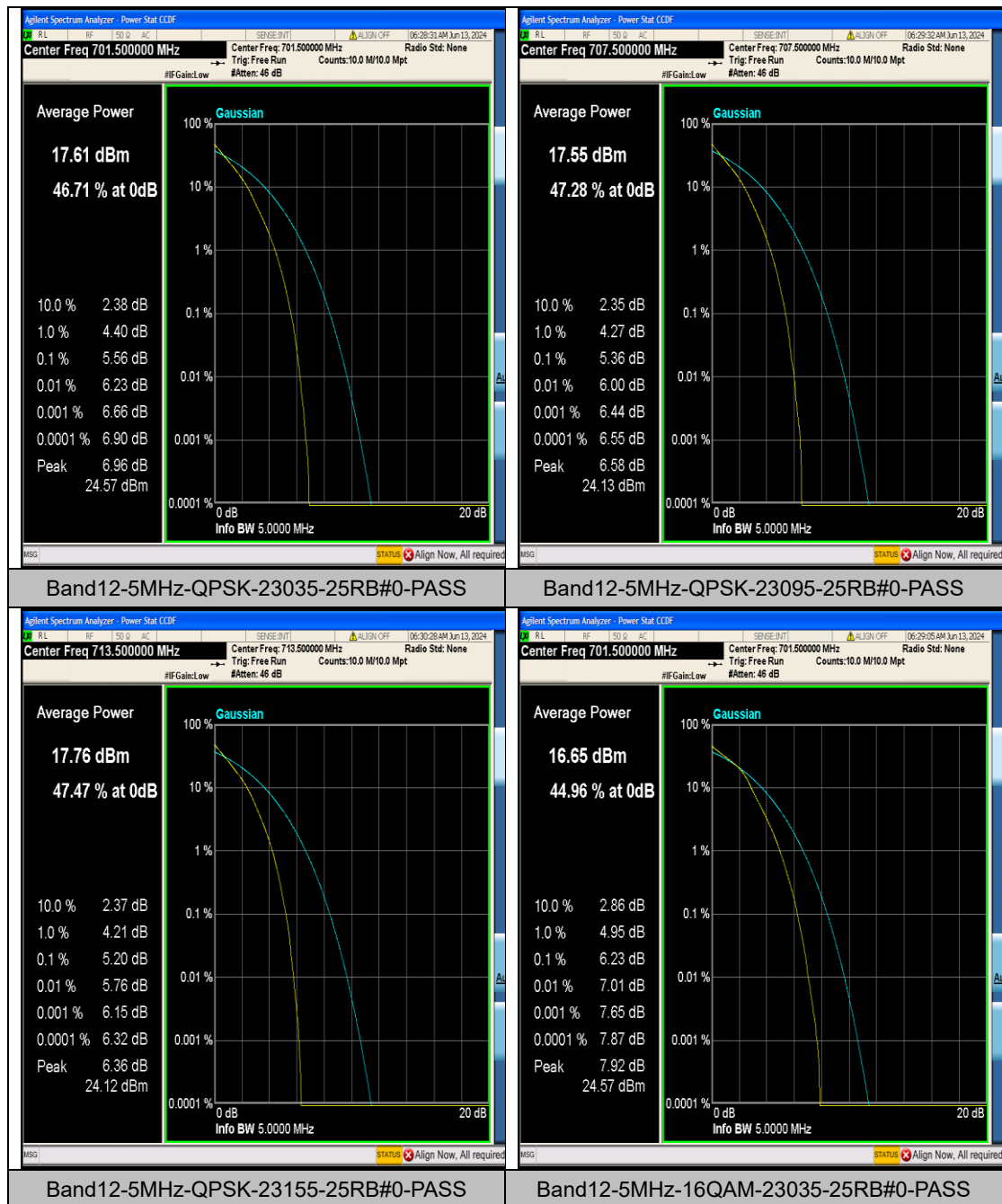
| Band   | Bandwidth | Modulation | Channel | RB Configuration | Result(dB) | Limit(dB) | Verdict |
|--------|-----------|------------|---------|------------------|------------|-----------|---------|
| Band12 | 1.4MHz    | QPSK       | 23017   | 6RB#0            | 5.26       | 13        | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23095   | 6RB#0            | 4.92       | 13        | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23173   | 6RB#0            | 3.74       | 13        | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23017   | 6RB#0            | 6.07       | 13        | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23095   | 6RB#0            | 5.71       | 13        | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23173   | 6RB#0            | 4.70       | 13        | PASS    |
| Band12 | 3MHz      | QPSK       | 23025   | 15RB#0           | 5.45       | 13        | PASS    |
| Band12 | 3MHz      | QPSK       | 23095   | 15RB#0           | 5.24       | 13        | PASS    |
| Band12 | 3MHz      | QPSK       | 23165   | 15RB#0           | 4.92       | 13        | PASS    |
| Band12 | 3MHz      | 16QAM      | 23025   | 15RB#0           | 6.26       | 13        | PASS    |
| Band12 | 3MHz      | 16QAM      | 23095   | 15RB#0           | 6.09       | 13        | PASS    |
| Band12 | 3MHz      | 16QAM      | 23165   | 15RB#0           | 5.66       | 13        | PASS    |
| Band12 | 5MHz      | QPSK       | 23035   | 25RB#0           | 5.56       | 13        | PASS    |
| Band12 | 5MHz      | QPSK       | 23095   | 25RB#0           | 5.36       | 13        | PASS    |
| Band12 | 5MHz      | QPSK       | 23155   | 25RB#0           | 5.20       | 13        | PASS    |
| Band12 | 5MHz      | 16QAM      | 23035   | 25RB#0           | 6.23       | 13        | PASS    |
| Band12 | 5MHz      | 16QAM      | 23095   | 25RB#0           | 6.03       | 13        | PASS    |
| Band12 | 5MHz      | 16QAM      | 23155   | 25RB#0           | 5.89       | 13        | PASS    |
| Band12 | 10MHz     | QPSK       | 23060   | 50RB#0           | 5.52       | 13        | PASS    |
| Band12 | 10MHz     | QPSK       | 23095   | 50RB#0           | 5.40       | 13        | PASS    |
| Band12 | 10MHz     | QPSK       | 23130   | 50RB#0           | 5.19       | 13        | PASS    |
| Band12 | 10MHz     | 16QAM      | 23060   | 50RB#0           | 6.19       | 13        | PASS    |
| Band12 | 10MHz     | 16QAM      | 23095   | 50RB#0           | 6.13       | 13        | PASS    |
| Band12 | 10MHz     | 16QAM      | 23130   | 50RB#0           | 5.96       | 13        | PASS    |

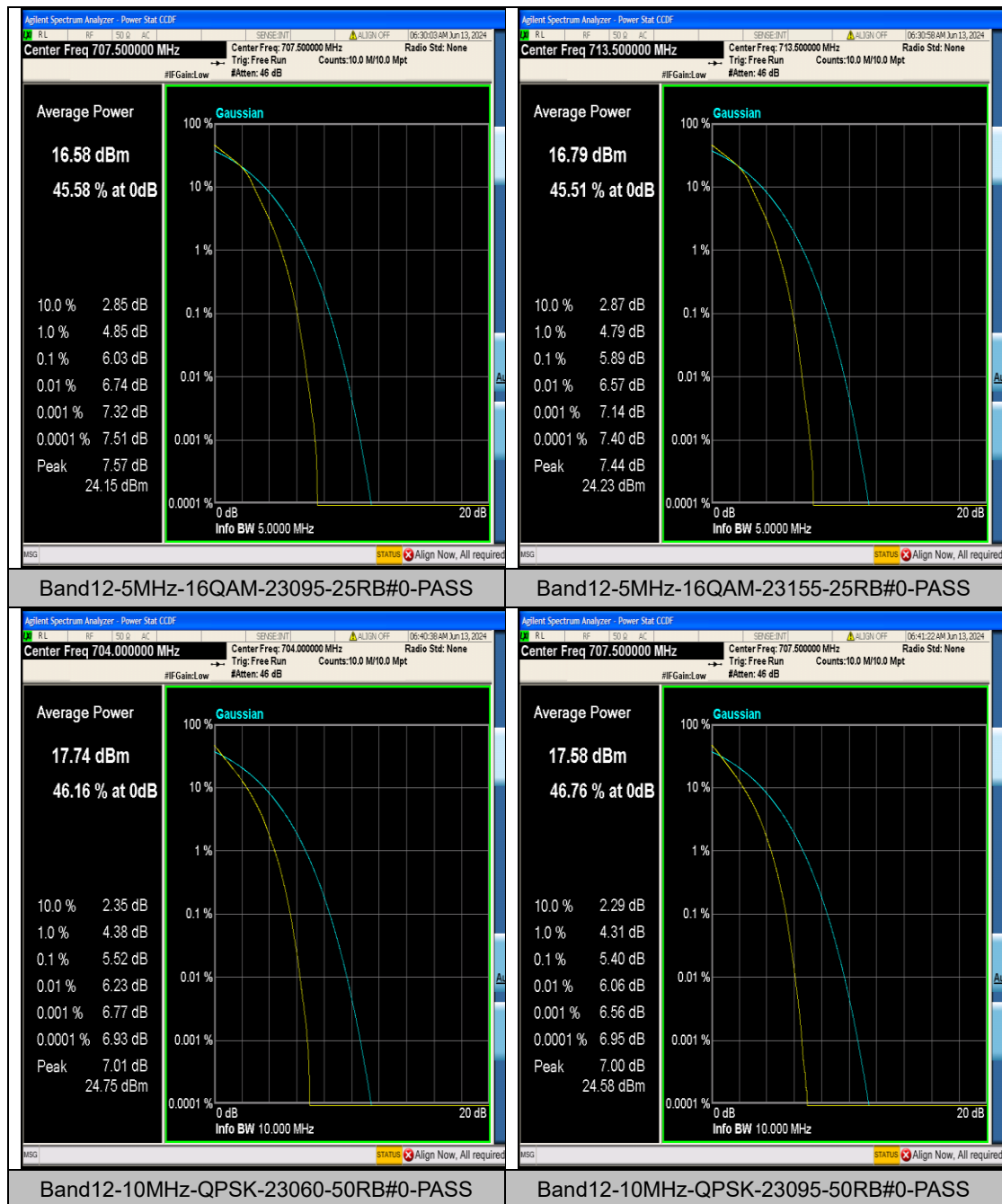
## Test Graphs

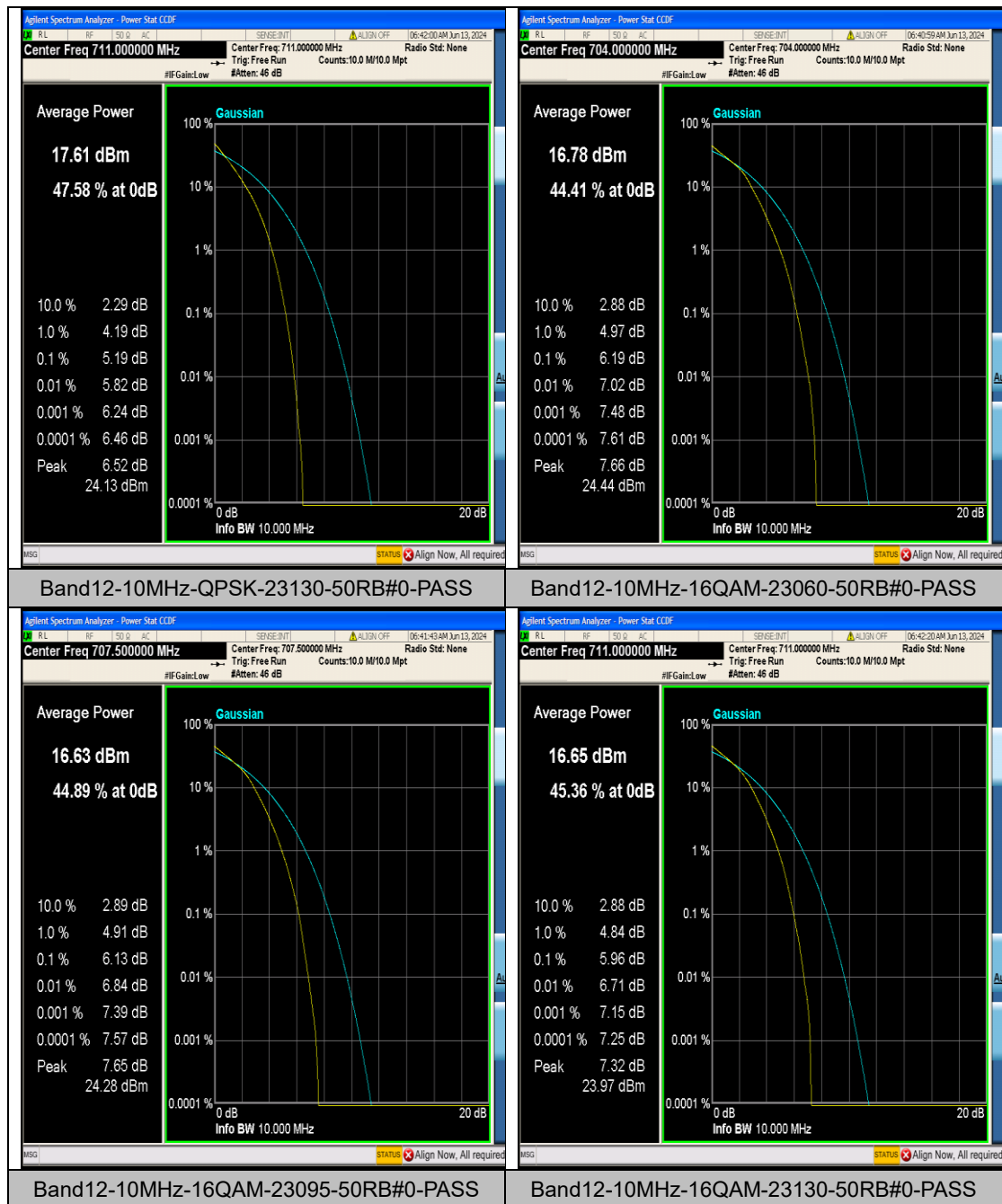










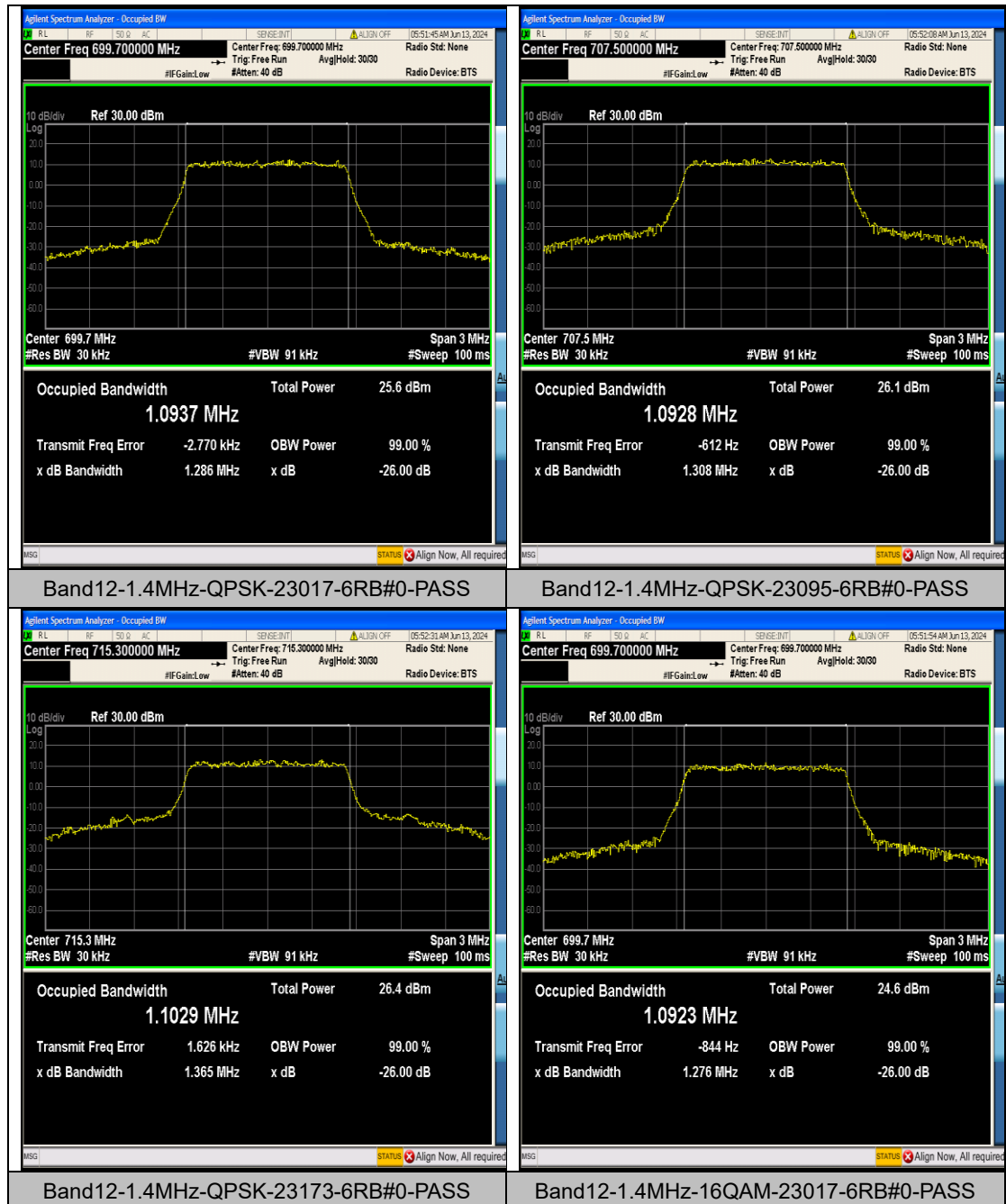


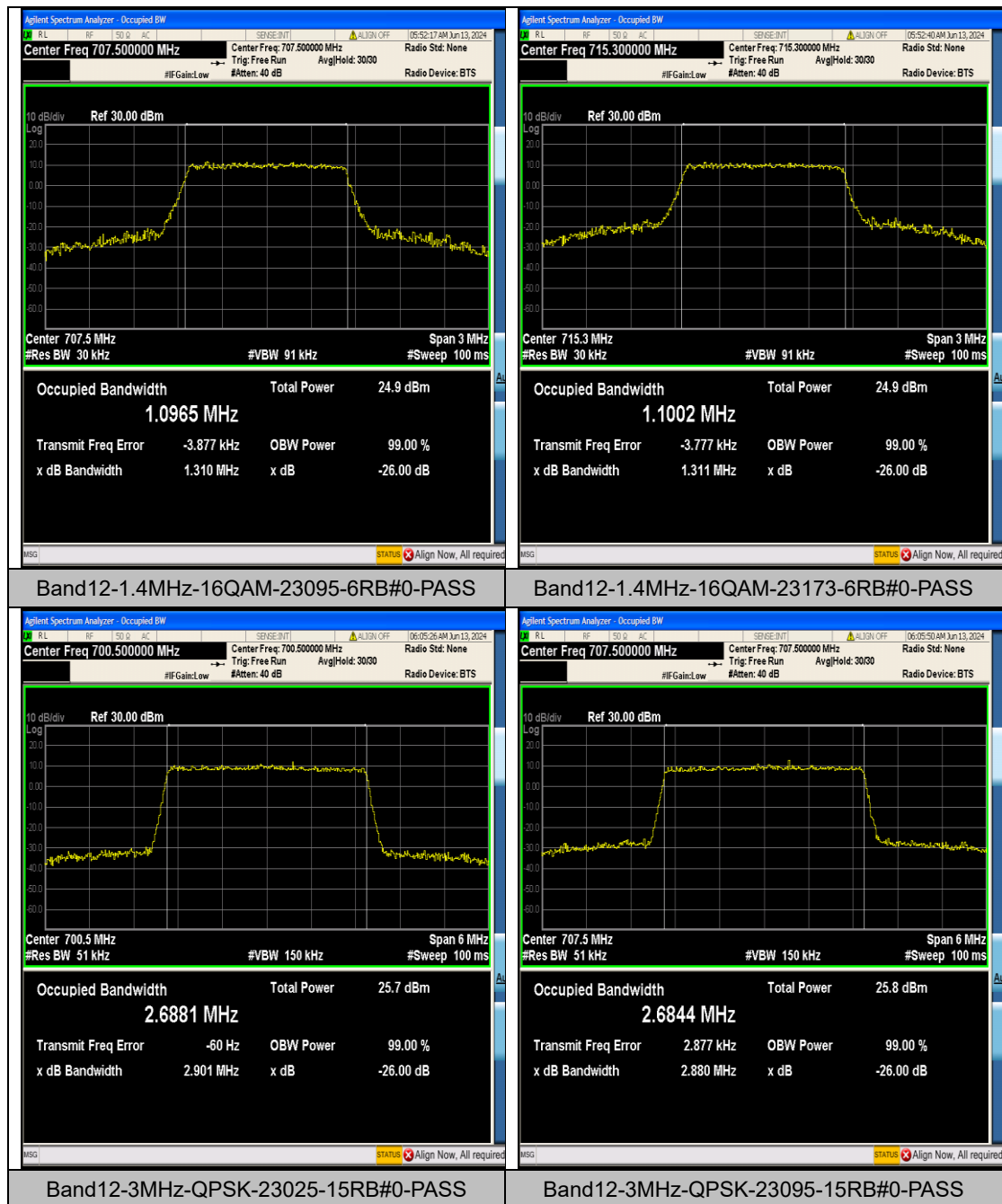
## Appendix C: 26dB Bandwidth and Occupied Bandwidth

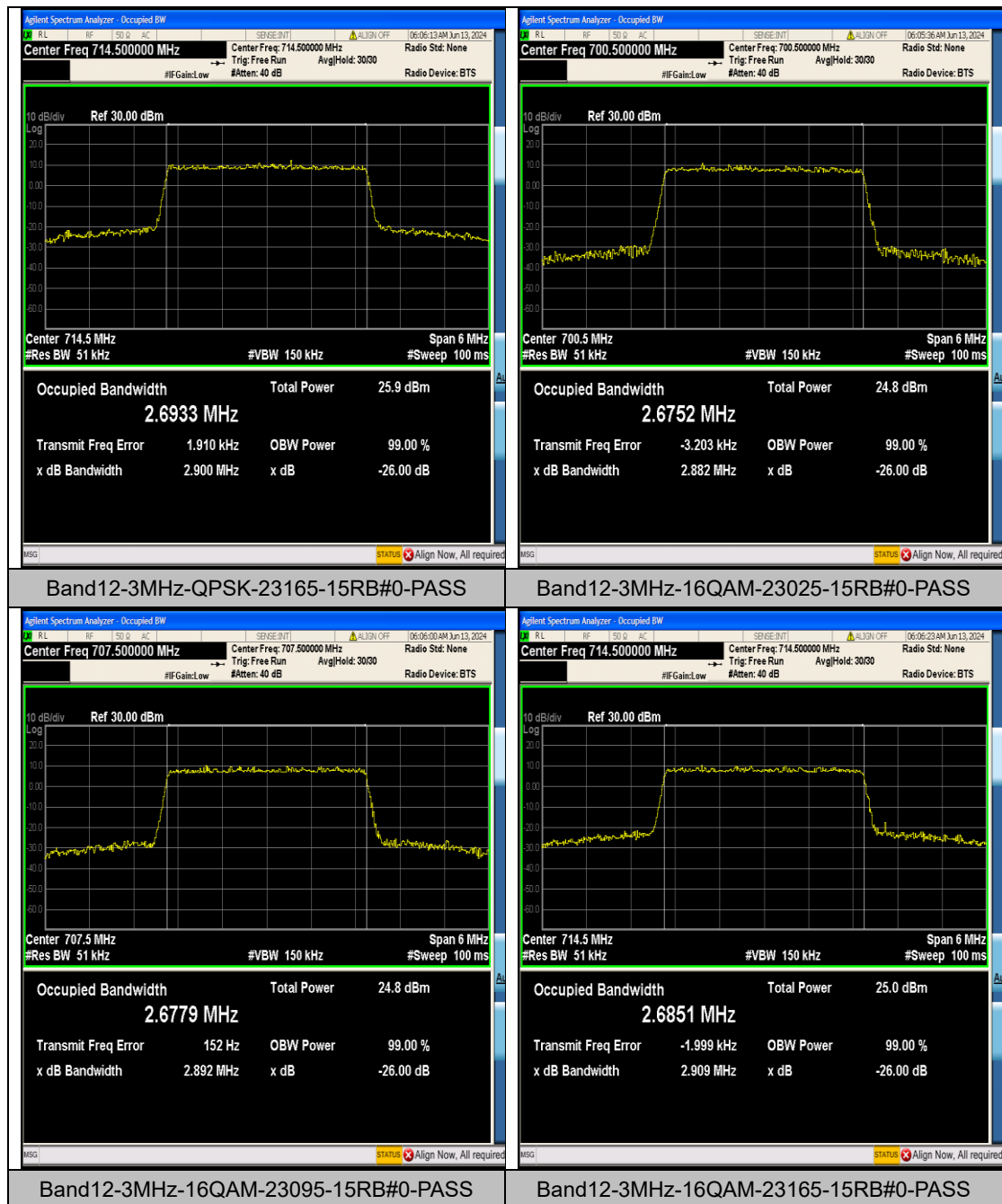
### Test Result

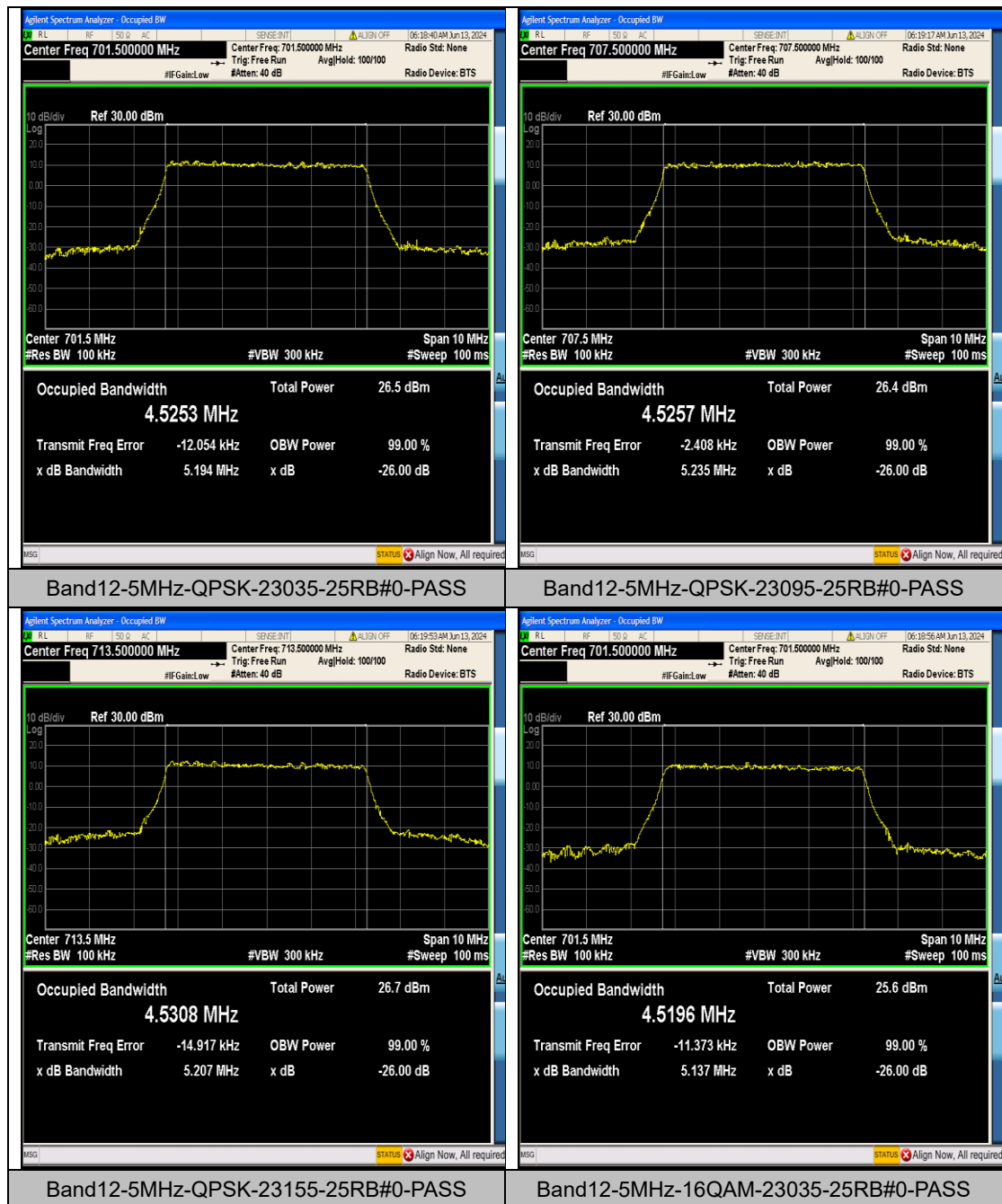
| Band   | Bandwidth | Modulation | Channel | RB Configuration | Occupied Bandwidth (MHz) | 26dB Bandwidth (MHz) | Verdict |
|--------|-----------|------------|---------|------------------|--------------------------|----------------------|---------|
| Band12 | 1.4MHz    | QPSK       | 23017   | 6RB#0            | 1.0937                   | 1.286                | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23095   | 6RB#0            | 1.0928                   | 1.308                | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23173   | 6RB#0            | 1.1029                   | 1.365                | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23017   | 6RB#0            | 1.0923                   | 1.276                | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23095   | 6RB#0            | 1.0965                   | 1.310                | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23173   | 6RB#0            | 1.1002                   | 1.311                | PASS    |
| Band12 | 3MHz      | QPSK       | 23025   | 15RB#0           | 2.6881                   | 2.901                | PASS    |
| Band12 | 3MHz      | QPSK       | 23095   | 15RB#0           | 2.6844                   | 2.880                | PASS    |
| Band12 | 3MHz      | QPSK       | 23165   | 15RB#0           | 2.6933                   | 2.900                | PASS    |
| Band12 | 3MHz      | 16QAM      | 23025   | 15RB#0           | 2.6752                   | 2.882                | PASS    |
| Band12 | 3MHz      | 16QAM      | 23095   | 15RB#0           | 2.6779                   | 2.892                | PASS    |
| Band12 | 3MHz      | 16QAM      | 23165   | 15RB#0           | 2.6851                   | 2.909                | PASS    |
| Band12 | 5MHz      | QPSK       | 23035   | 25RB#0           | 4.5253                   | 5.194                | PASS    |
| Band12 | 5MHz      | QPSK       | 23095   | 25RB#0           | 4.5257                   | 5.235                | PASS    |
| Band12 | 5MHz      | QPSK       | 23155   | 25RB#0           | 4.5308                   | 5.207                | PASS    |
| Band12 | 5MHz      | 16QAM      | 23035   | 25RB#0           | 4.5196                   | 5.137                | PASS    |
| Band12 | 5MHz      | 16QAM      | 23095   | 25RB#0           | 4.5185                   | 5.161                | PASS    |
| Band12 | 5MHz      | 16QAM      | 23155   | 25RB#0           | 4.5283                   | 5.159                | PASS    |
| Band12 | 10MHz     | QPSK       | 23060   | 50RB#0           | 9.0341                   | 10.15                | PASS    |
| Band12 | 10MHz     | QPSK       | 23095   | 50RB#0           | 8.9985                   | 10.03                | PASS    |
| Band12 | 10MHz     | QPSK       | 23130   | 50RB#0           | 9.0022                   | 10.10                | PASS    |
| Band12 | 10MHz     | 16QAM      | 23060   | 50RB#0           | 9.0285                   | 10.10                | PASS    |
| Band12 | 10MHz     | 16QAM      | 23095   | 50RB#0           | 8.9942                   | 10.12                | PASS    |
| Band12 | 10MHz     | 16QAM      | 23130   | 50RB#0           | 8.9993                   | 9.979                | PASS    |

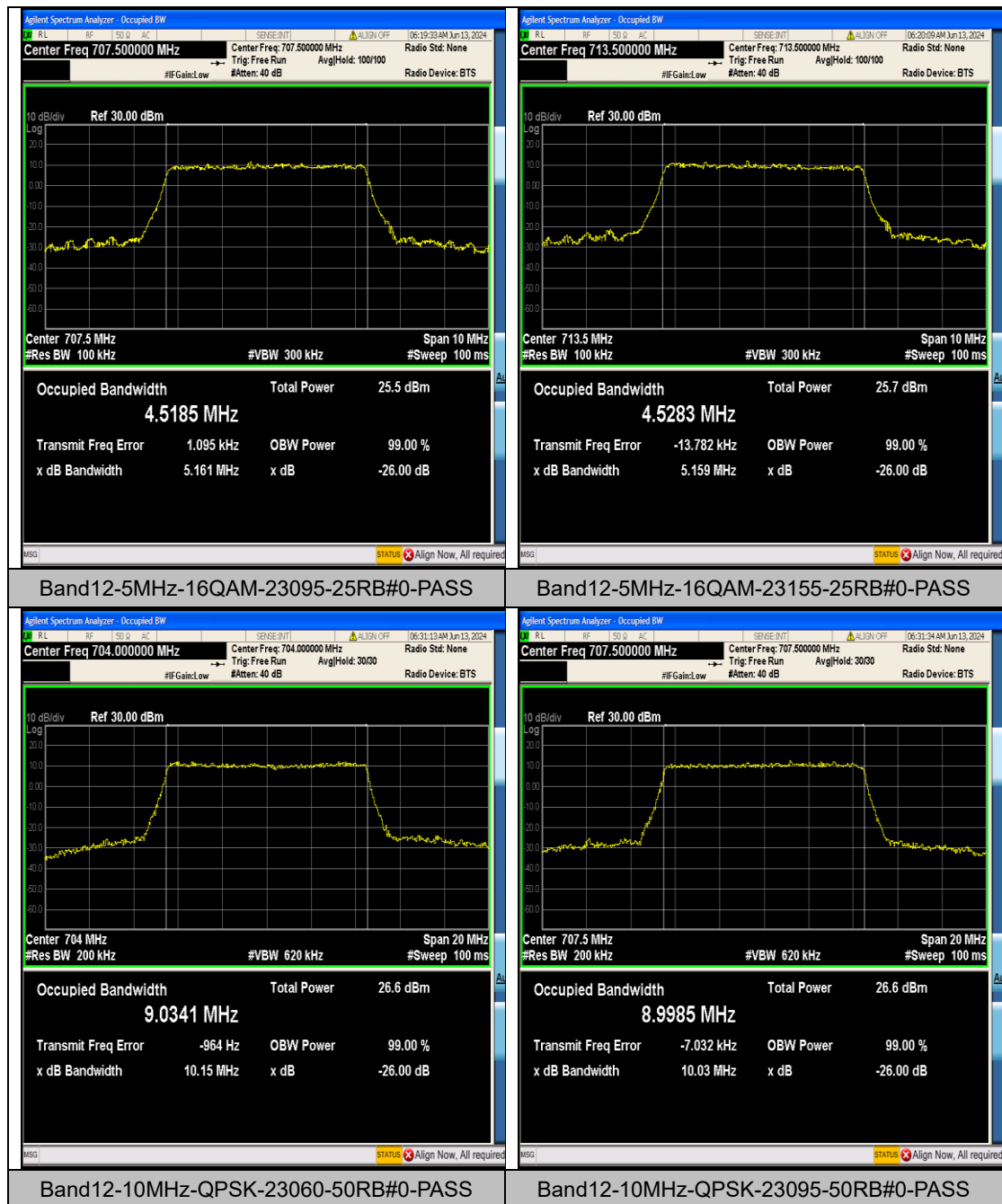
## Test Graphs

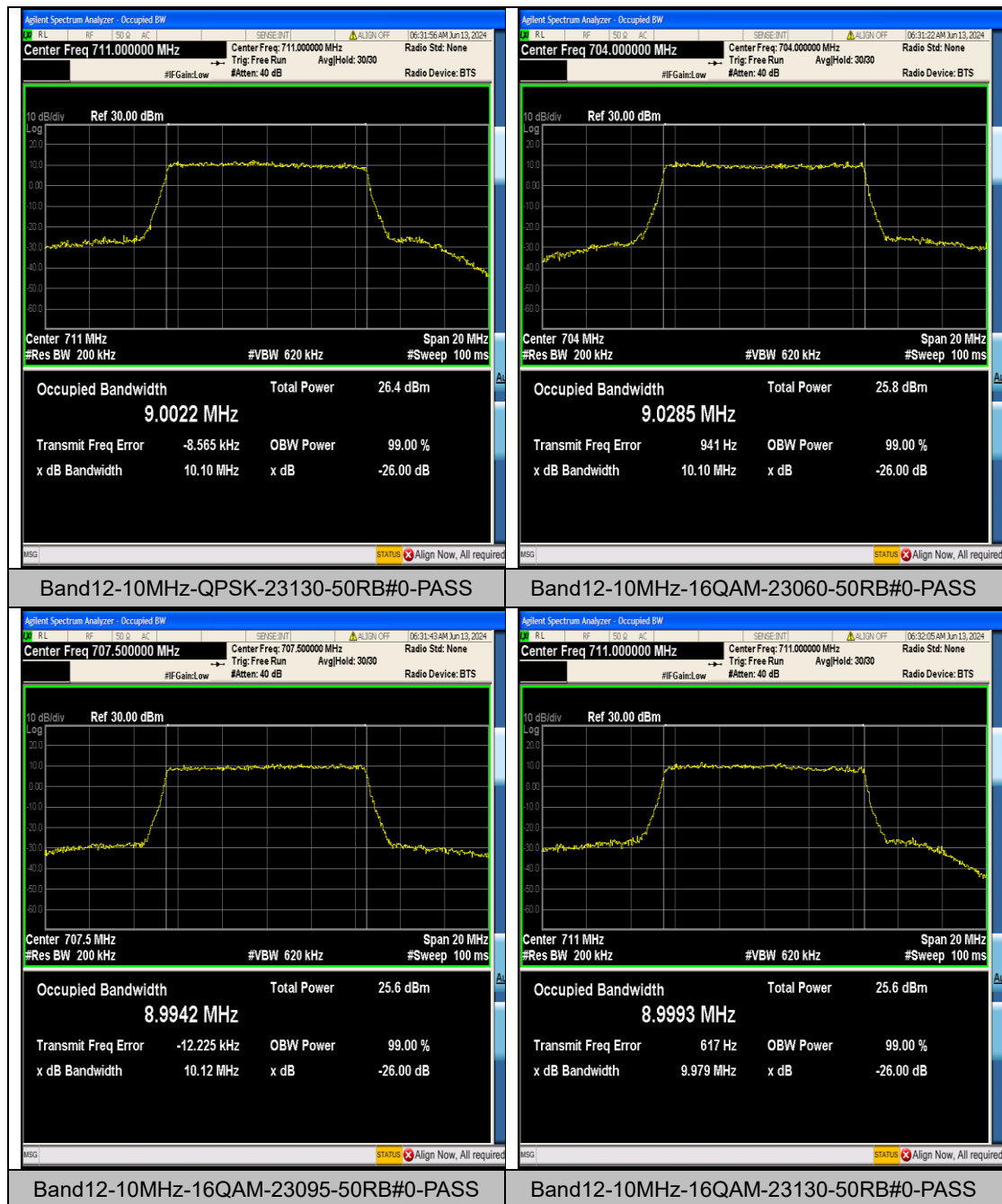










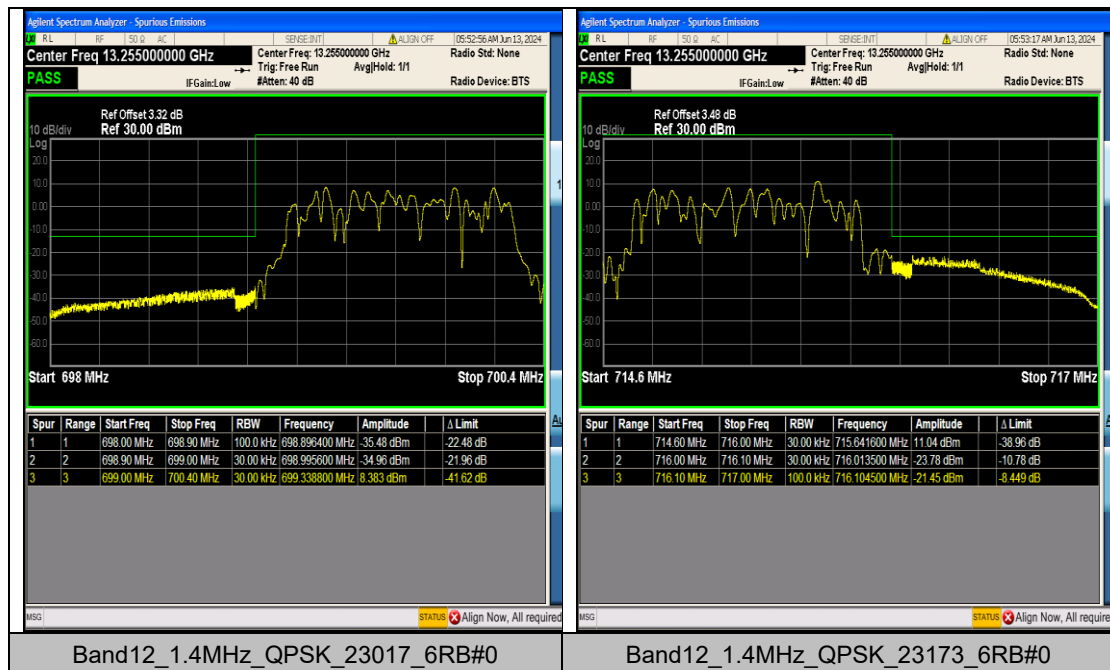


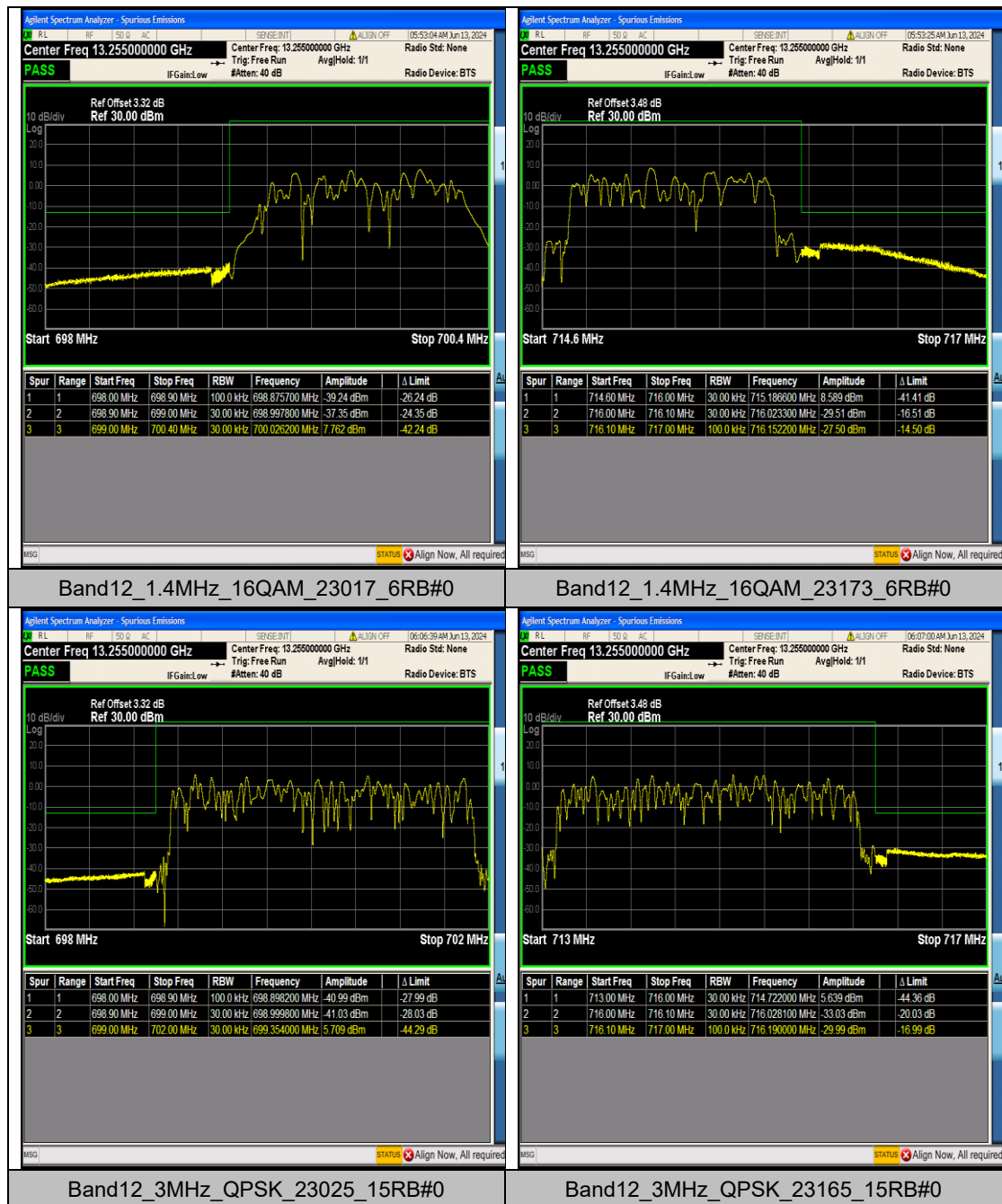
## Appendix D: Band Edge

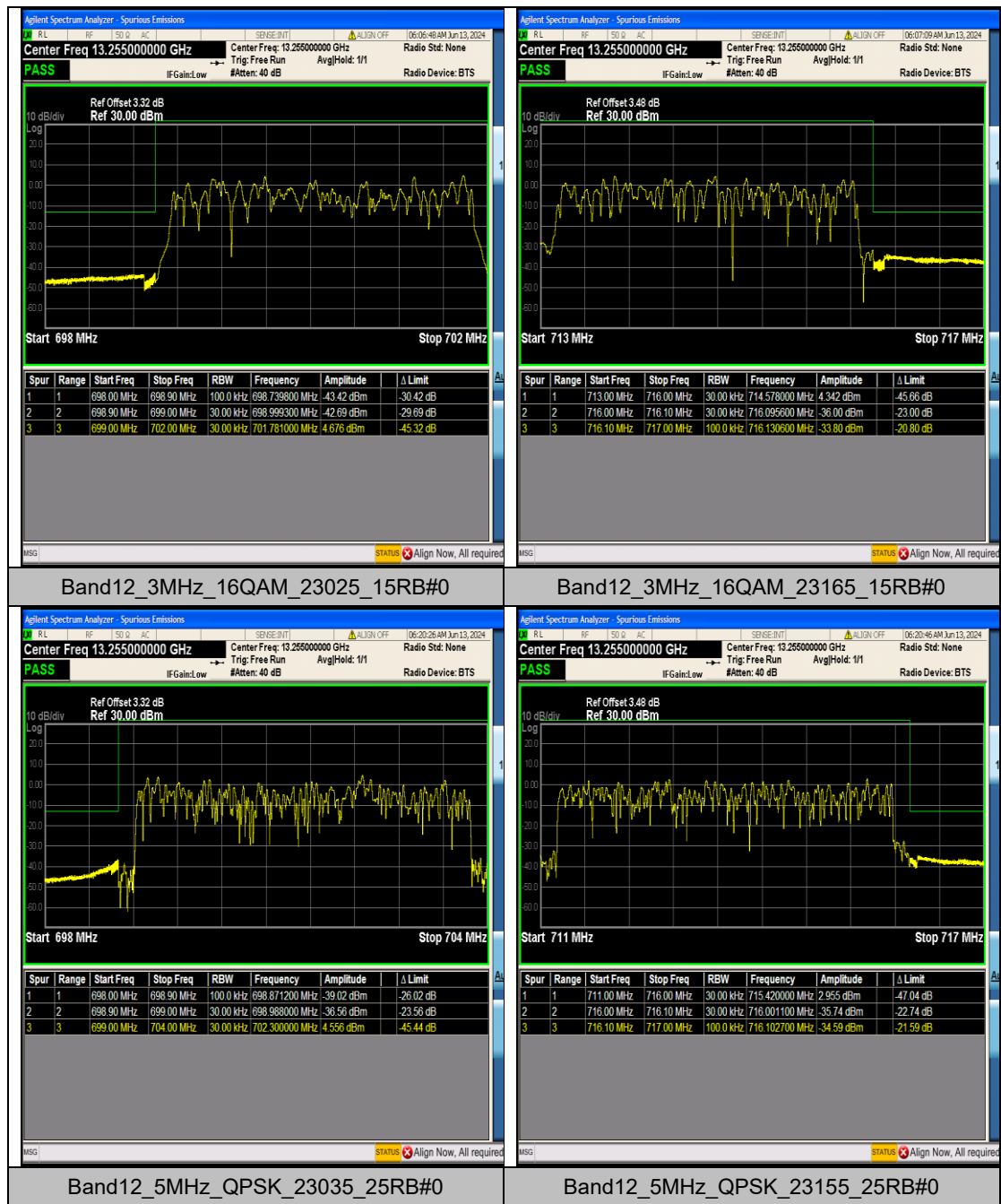
### Test Result

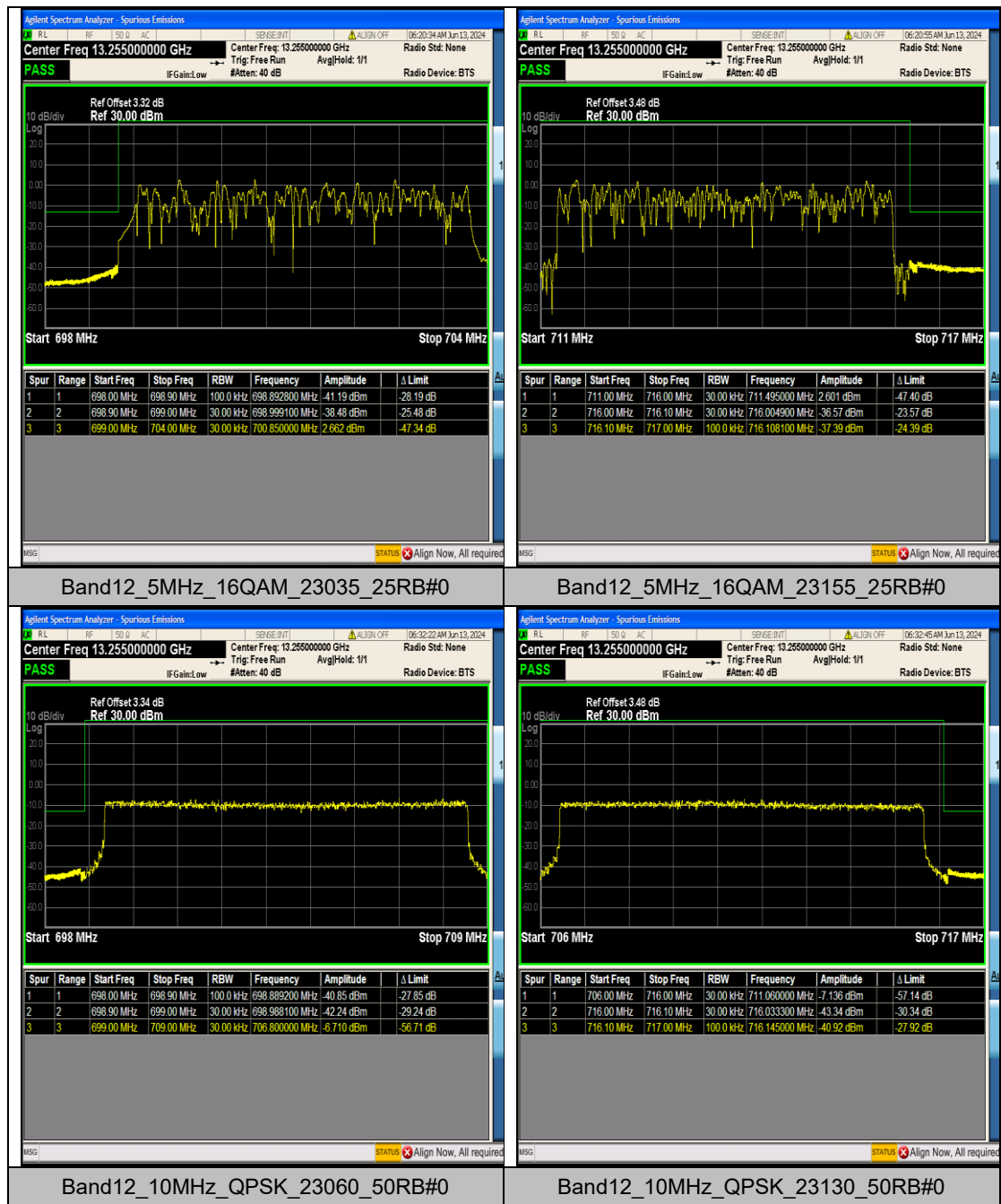
| Band   | Bandwidth | Modulation | Channel | RB Configuration | Result(dBm) | Verdict |
|--------|-----------|------------|---------|------------------|-------------|---------|
| Band12 | 1.4MHz    | QPSK       | 23017   | 6RB#0            | -34.96      | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23173   | 6RB#0            | -21.45      | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23017   | 6RB#0            | -37.35      | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23173   | 6RB#0            | -27.50      | PASS    |
| Band12 | 3MHz      | QPSK       | 23025   | 15RB#0           | -40.99      | PASS    |
| Band12 | 3MHz      | QPSK       | 23165   | 15RB#0           | -29.99      | PASS    |
| Band12 | 3MHz      | 16QAM      | 23025   | 15RB#0           | -42.69      | PASS    |
| Band12 | 3MHz      | 16QAM      | 23165   | 15RB#0           | -33.80      | PASS    |
| Band12 | 5MHz      | QPSK       | 23035   | 25RB#0           | -36.56      | PASS    |
| Band12 | 5MHz      | QPSK       | 23155   | 25RB#0           | -34.59      | PASS    |
| Band12 | 5MHz      | 16QAM      | 23035   | 25RB#0           | -38.48      | PASS    |
| Band12 | 5MHz      | 16QAM      | 23155   | 25RB#0           | -36.57      | PASS    |
| Band12 | 10MHz     | QPSK       | 23060   | 50RB#0           | -40.85      | PASS    |
| Band12 | 10MHz     | QPSK       | 23130   | 50RB#0           | -40.92      | PASS    |
| Band12 | 10MHz     | 16QAM      | 23060   | 50RB#0           | -43.14      | PASS    |
| Band12 | 10MHz     | 16QAM      | 23130   | 50RB#0           | -43.92      | PASS    |

### Test Graphs











## Appendix E: Conducted Spurious Emission

### Test Result

| Band   | Bandwidth | Modulation | Channel | RB Configuration | Frequency Range | Result (dBm) | Verdict |
|--------|-----------|------------|---------|------------------|-----------------|--------------|---------|
| Band12 | 1.4MHz    | QPSK       | 23017   | 6RB#0            | 0.009~0.15      | -44.35       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23017   | 6RB#0            | 0.15~30         | -59.49       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23017   | 6RB#0            | 30~1000         | -57.04       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23017   | 6RB#0            | 1000~3000       | -52.27       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23017   | 6RB#0            | 3000~10000      | -49.20       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23095   | 6RB#0            | 0.009~0.15      | -47.17       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23095   | 6RB#0            | 0.15~30         | -60.91       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23095   | 6RB#0            | 30~1000         | -55.32       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23095   | 6RB#0            | 1000~3000       | -52.68       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23095   | 6RB#0            | 3000~10000      | -47.43       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23173   | 6RB#0            | 0.009~0.15      | -48.06       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23173   | 6RB#0            | 0.15~30         | -58.14       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23173   | 6RB#0            | 30~1000         | -54.49       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23173   | 6RB#0            | 1000~3000       | -51.77       | PASS    |
| Band12 | 1.4MHz    | QPSK       | 23173   | 6RB#0            | 3000~10000      | -43.35       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23017   | 6RB#0            | 0.009~0.15      | -50.57       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23017   | 6RB#0            | 0.15~30         | -57.55       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23017   | 6RB#0            | 30~1000         | -58.72       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23017   | 6RB#0            | 1000~3000       | -52.27       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23017   | 6RB#0            | 3000~10000      | -49.05       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23095   | 6RB#0            | 0.009~0.15      | -48.86       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23095   | 6RB#0            | 0.15~30         | -58.42       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23095   | 6RB#0            | 30~1000         | -56.41       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23095   | 6RB#0            | 1000~3000       | -52.69       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23095   | 6RB#0            | 3000~10000      | -48.14       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23173   | 6RB#0            | 0.009~0.15      | -45.47       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23173   | 6RB#0            | 0.15~30         | -56.87       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23173   | 6RB#0            | 30~1000         | -55.60       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23173   | 6RB#0            | 1000~3000       | -52.30       | PASS    |
| Band12 | 1.4MHz    | 16QAM      | 23173   | 6RB#0            | 3000~10000      | -45.21       | PASS    |
| Band12 | 3MHz      | QPSK       | 23025   | 15RB#0           | 0.009~0.15      | -47.48       | PASS    |
| Band12 | 3MHz      | QPSK       | 23025   | 15RB#0           | 0.15~30         | -56.61       | PASS    |
| Band12 | 3MHz      | QPSK       | 23025   | 15RB#0           | 30~1000         | -56.21       | PASS    |
| Band12 | 3MHz      | QPSK       | 23025   | 15RB#0           | 1000~3000       | -52.53       | PASS    |
| Band12 | 3MHz      | QPSK       | 23025   | 15RB#0           | 3000~10000      | -49.71       | PASS    |
| Band12 | 3MHz      | QPSK       | 23095   | 15RB#0           | 0.009~0.15      | -48.72       | PASS    |

|        |      |       |       |        |            |        |      |
|--------|------|-------|-------|--------|------------|--------|------|
| Band12 | 3MHz | QPSK  | 23095 | 15RB#0 | 0.15~30    | -58.84 | PASS |
| Band12 | 3MHz | QPSK  | 23095 | 15RB#0 | 30~1000    | -56.97 | PASS |
| Band12 | 3MHz | QPSK  | 23095 | 15RB#0 | 1000~3000  | -52.52 | PASS |
| Band12 | 3MHz | QPSK  | 23095 | 15RB#0 | 3000~10000 | -49.59 | PASS |
| Band12 | 3MHz | QPSK  | 23165 | 15RB#0 | 0.009~0.15 | -49.67 | PASS |
| Band12 | 3MHz | QPSK  | 23165 | 15RB#0 | 0.15~30    | -58.21 | PASS |
| Band12 | 3MHz | QPSK  | 23165 | 15RB#0 | 30~1000    | -56.37 | PASS |
| Band12 | 3MHz | QPSK  | 23165 | 15RB#0 | 1000~3000  | -52.76 | PASS |
| Band12 | 3MHz | QPSK  | 23165 | 15RB#0 | 3000~10000 | -47.64 | PASS |
| Band12 | 3MHz | 16QAM | 23025 | 15RB#0 | 0.009~0.15 | -46.81 | PASS |
| Band12 | 3MHz | 16QAM | 23025 | 15RB#0 | 0.15~30    | -58.28 | PASS |
| Band12 | 3MHz | 16QAM | 23025 | 15RB#0 | 30~1000    | -57.33 | PASS |
| Band12 | 3MHz | 16QAM | 23025 | 15RB#0 | 1000~3000  | -52.68 | PASS |
| Band12 | 3MHz | 16QAM | 23025 | 15RB#0 | 3000~10000 | -49.74 | PASS |
| Band12 | 3MHz | 16QAM | 23095 | 15RB#0 | 0.009~0.15 | -47.87 | PASS |
| Band12 | 3MHz | 16QAM | 23095 | 15RB#0 | 0.15~30    | -58.37 | PASS |
| Band12 | 3MHz | 16QAM | 23095 | 15RB#0 | 30~1000    | -58.77 | PASS |
| Band12 | 3MHz | 16QAM | 23095 | 15RB#0 | 1000~3000  | -52.70 | PASS |
| Band12 | 3MHz | 16QAM | 23095 | 15RB#0 | 3000~10000 | -49.92 | PASS |
| Band12 | 3MHz | 16QAM | 23165 | 15RB#0 | 0.009~0.15 | -46.83 | PASS |
| Band12 | 3MHz | 16QAM | 23165 | 15RB#0 | 0.15~30    | -59.62 | PASS |
| Band12 | 3MHz | 16QAM | 23165 | 15RB#0 | 30~1000    | -57.28 | PASS |
| Band12 | 3MHz | 16QAM | 23165 | 15RB#0 | 1000~3000  | -52.78 | PASS |
| Band12 | 3MHz | 16QAM | 23165 | 15RB#0 | 3000~10000 | -48.86 | PASS |
| Band12 | 5MHz | QPSK  | 23035 | 25RB#0 | 0.009~0.15 | -46.94 | PASS |
| Band12 | 5MHz | QPSK  | 23035 | 25RB#0 | 0.15~30    | -58.50 | PASS |
| Band12 | 5MHz | QPSK  | 23035 | 25RB#0 | 30~1000    | -59.29 | PASS |
| Band12 | 5MHz | QPSK  | 23035 | 25RB#0 | 1000~3000  | -52.79 | PASS |
| Band12 | 5MHz | QPSK  | 23035 | 25RB#0 | 3000~10000 | -49.33 | PASS |
| Band12 | 5MHz | QPSK  | 23095 | 25RB#0 | 0.009~0.15 | -48.94 | PASS |
| Band12 | 5MHz | QPSK  | 23095 | 25RB#0 | 0.15~30    | -59.69 | PASS |
| Band12 | 5MHz | QPSK  | 23095 | 25RB#0 | 30~1000    | -61.67 | PASS |
| Band12 | 5MHz | QPSK  | 23095 | 25RB#0 | 1000~3000  | -52.51 | PASS |
| Band12 | 5MHz | QPSK  | 23095 | 25RB#0 | 3000~10000 | -50.07 | PASS |
| Band12 | 5MHz | QPSK  | 23155 | 25RB#0 | 0.009~0.15 | -45.41 | PASS |
| Band12 | 5MHz | QPSK  | 23155 | 25RB#0 | 0.15~30    | -58.28 | PASS |
| Band12 | 5MHz | QPSK  | 23155 | 25RB#0 | 30~1000    | -58.39 | PASS |
| Band12 | 5MHz | QPSK  | 23155 | 25RB#0 | 1000~3000  | -52.21 | PASS |
| Band12 | 5MHz | QPSK  | 23155 | 25RB#0 | 3000~10000 | -48.06 | PASS |
| Band12 | 5MHz | 16QAM | 23035 | 25RB#0 | 0.009~0.15 | -48.59 | PASS |
| Band12 | 5MHz | 16QAM | 23035 | 25RB#0 | 0.15~30    | -59.95 | PASS |
| Band12 | 5MHz | 16QAM | 23035 | 25RB#0 | 30~1000    | -60.54 | PASS |
| Band12 | 5MHz | 16QAM | 23035 | 25RB#0 | 1000~3000  | -52.23 | PASS |

|        |       |       |       |        |            |        |      |
|--------|-------|-------|-------|--------|------------|--------|------|
| Band12 | 5MHz  | 16QAM | 23035 | 25RB#0 | 3000~10000 | -49.75 | PASS |
| Band12 | 5MHz  | 16QAM | 23095 | 25RB#0 | 0.009~0.15 | -45.92 | PASS |
| Band12 | 5MHz  | 16QAM | 23095 | 25RB#0 | 0.15~30    | -58.93 | PASS |
| Band12 | 5MHz  | 16QAM | 23095 | 25RB#0 | 30~1000    | -63.82 | PASS |
| Band12 | 5MHz  | 16QAM | 23095 | 25RB#0 | 1000~3000  | -52.63 | PASS |
| Band12 | 5MHz  | 16QAM | 23095 | 25RB#0 | 3000~10000 | -49.85 | PASS |
| Band12 | 5MHz  | 16QAM | 23155 | 25RB#0 | 0.009~0.15 | -48.82 | PASS |
| Band12 | 5MHz  | 16QAM | 23155 | 25RB#0 | 0.15~30    | -57.59 | PASS |
| Band12 | 5MHz  | 16QAM | 23155 | 25RB#0 | 30~1000    | -59.74 | PASS |
| Band12 | 5MHz  | 16QAM | 23155 | 25RB#0 | 1000~3000  | -52.38 | PASS |
| Band12 | 5MHz  | 16QAM | 23155 | 25RB#0 | 3000~10000 | -49.85 | PASS |
| Band12 | 10MHz | QPSK  | 23060 | 50RB#0 | 0.009~0.15 | -45.58 | PASS |
| Band12 | 10MHz | QPSK  | 23060 | 50RB#0 | 0.15~30    | -57.73 | PASS |
| Band12 | 10MHz | QPSK  | 23060 | 50RB#0 | 30~1000    | -66.73 | PASS |
| Band12 | 10MHz | QPSK  | 23060 | 50RB#0 | 1000~3000  | -52.22 | PASS |
| Band12 | 10MHz | QPSK  | 23060 | 50RB#0 | 3000~10000 | -49.70 | PASS |
| Band12 | 10MHz | QPSK  | 23095 | 50RB#0 | 0.009~0.15 | -46.67 | PASS |
| Band12 | 10MHz | QPSK  | 23095 | 50RB#0 | 0.15~30    | -57.92 | PASS |
| Band12 | 10MHz | QPSK  | 23095 | 50RB#0 | 30~1000    | -66.67 | PASS |
| Band12 | 10MHz | QPSK  | 23095 | 50RB#0 | 1000~3000  | -52.56 | PASS |
| Band12 | 10MHz | QPSK  | 23095 | 50RB#0 | 3000~10000 | -49.48 | PASS |
| Band12 | 10MHz | QPSK  | 23130 | 50RB#0 | 0.009~0.15 | -49.50 | PASS |
| Band12 | 10MHz | QPSK  | 23130 | 50RB#0 | 0.15~30    | -59.75 | PASS |
| Band12 | 10MHz | QPSK  | 23130 | 50RB#0 | 30~1000    | -66.65 | PASS |
| Band12 | 10MHz | QPSK  | 23130 | 50RB#0 | 1000~3000  | -52.44 | PASS |
| Band12 | 10MHz | QPSK  | 23130 | 50RB#0 | 3000~10000 | -49.91 | PASS |
| Band12 | 10MHz | 16QAM | 23060 | 50RB#0 | 0.009~0.15 | -48.08 | PASS |
| Band12 | 10MHz | 16QAM | 23060 | 50RB#0 | 0.15~30    | -57.53 | PASS |
| Band12 | 10MHz | 16QAM | 23060 | 50RB#0 | 30~1000    | -66.39 | PASS |
| Band12 | 10MHz | 16QAM | 23060 | 50RB#0 | 1000~3000  | -52.41 | PASS |
| Band12 | 10MHz | 16QAM | 23060 | 50RB#0 | 3000~10000 | -50.02 | PASS |
| Band12 | 10MHz | 16QAM | 23095 | 50RB#0 | 0.009~0.15 | -46.63 | PASS |
| Band12 | 10MHz | 16QAM | 23095 | 50RB#0 | 0.15~30    | -57.42 | PASS |
| Band12 | 10MHz | 16QAM | 23095 | 50RB#0 | 30~1000    | -66.55 | PASS |
| Band12 | 10MHz | 16QAM | 23095 | 50RB#0 | 1000~3000  | -52.32 | PASS |
| Band12 | 10MHz | 16QAM | 23095 | 50RB#0 | 3000~10000 | -50.04 | PASS |
| Band12 | 10MHz | 16QAM | 23130 | 50RB#0 | 0.009~0.15 | -46.59 | PASS |
| Band12 | 10MHz | 16QAM | 23130 | 50RB#0 | 0.15~30    | -60.39 | PASS |
| Band12 | 10MHz | 16QAM | 23130 | 50RB#0 | 30~1000    | -66.52 | PASS |
| Band12 | 10MHz | 16QAM | 23130 | 50RB#0 | 1000~3000  | -52.50 | PASS |
| Band12 | 10MHz | 16QAM | 23130 | 50RB#0 | 3000~10000 | -49.36 | PASS |

## Test Graphs

