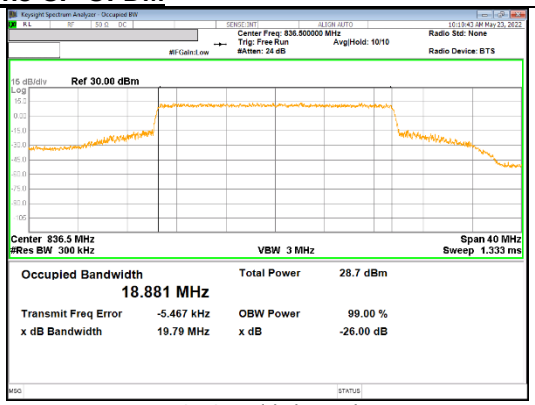
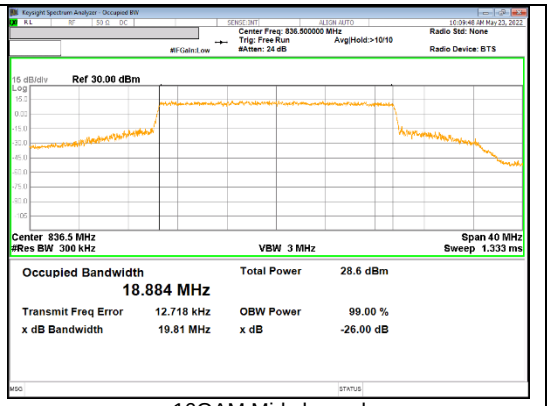
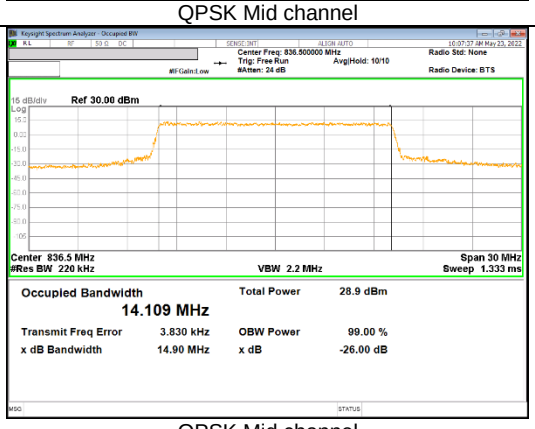
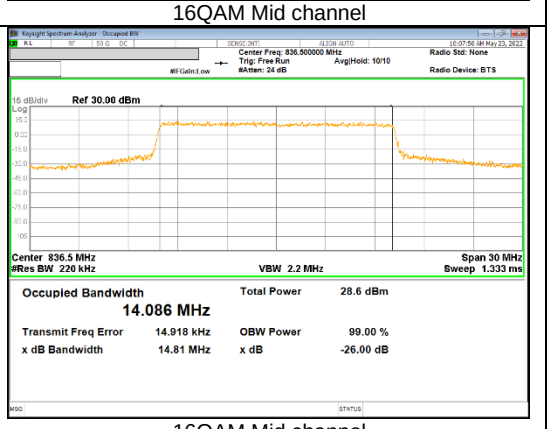
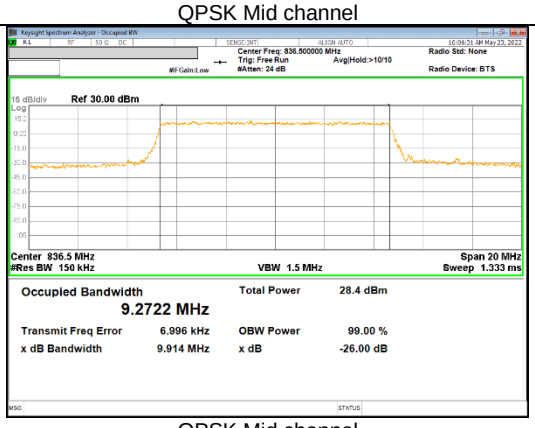
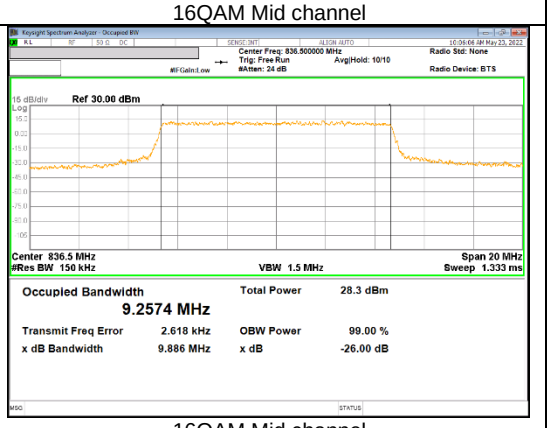
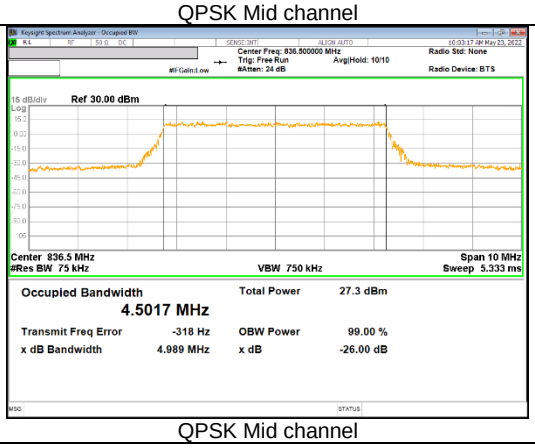
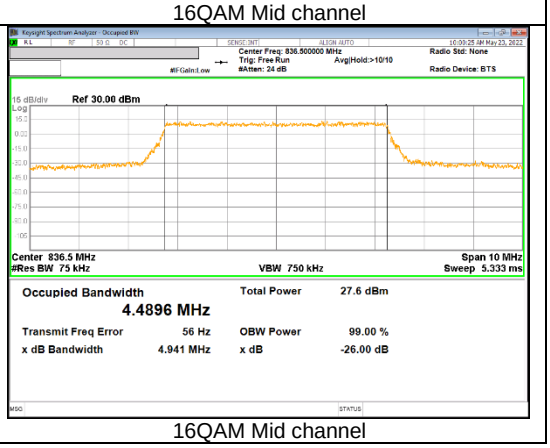
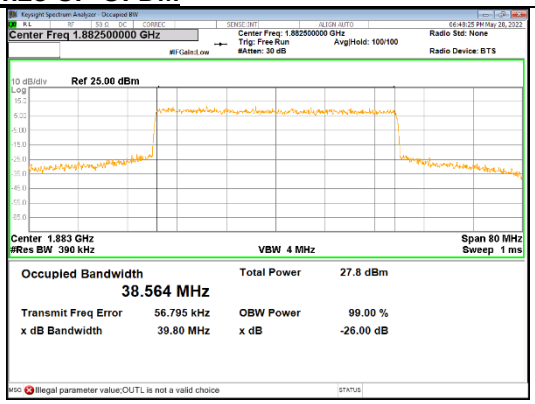
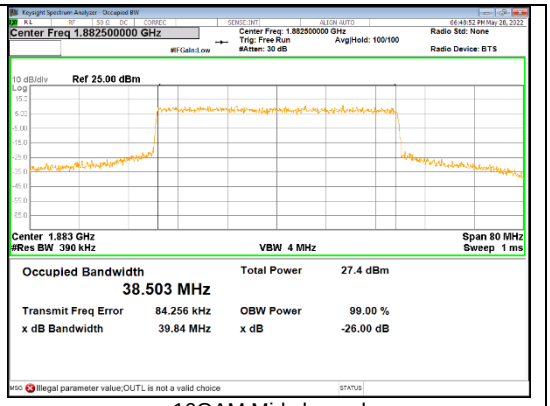
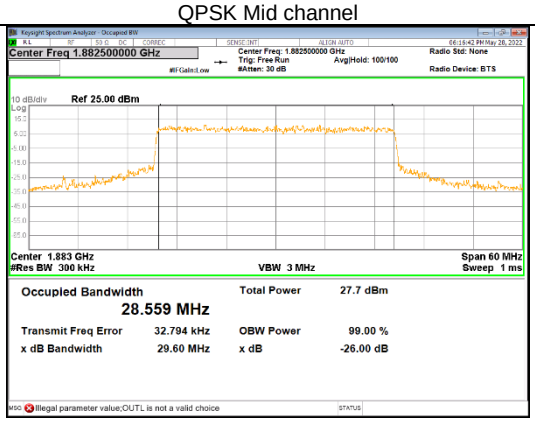
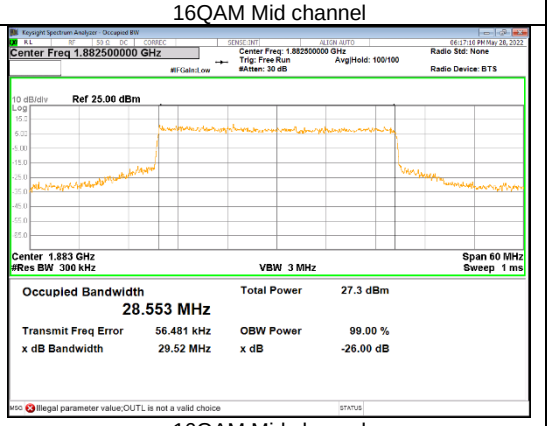
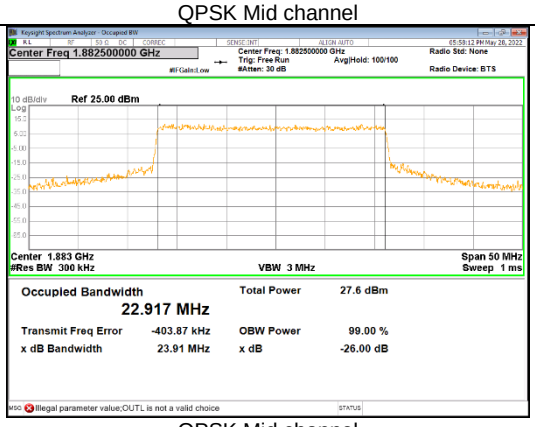
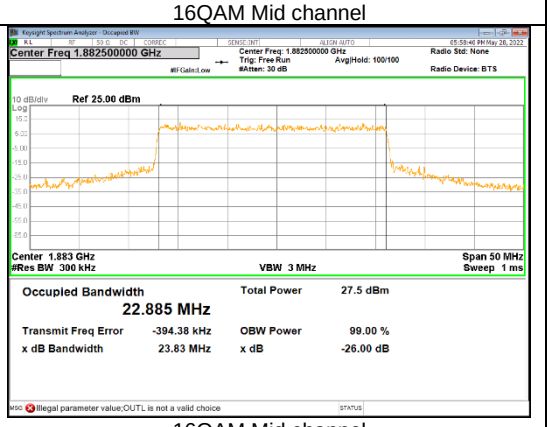
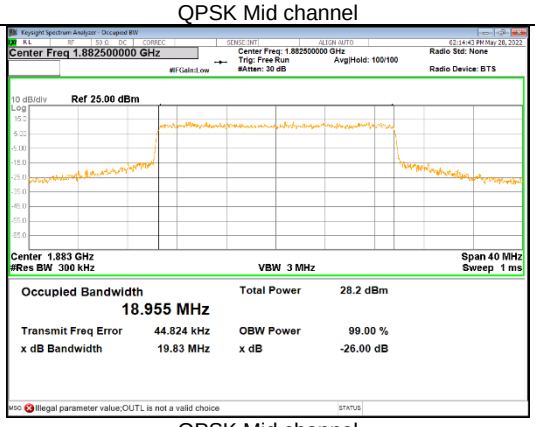
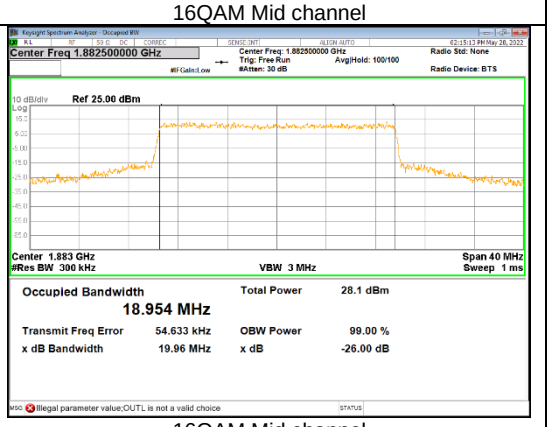
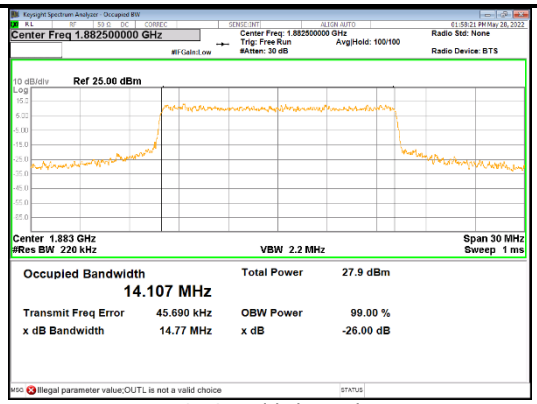
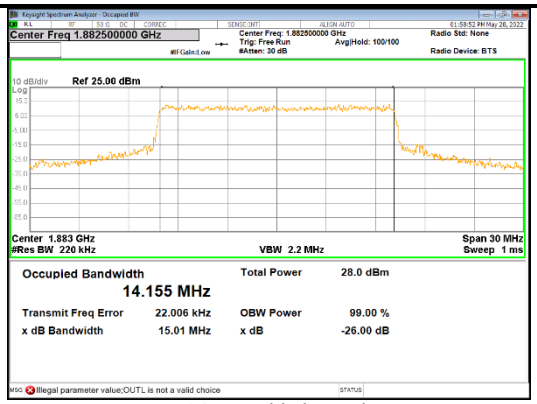
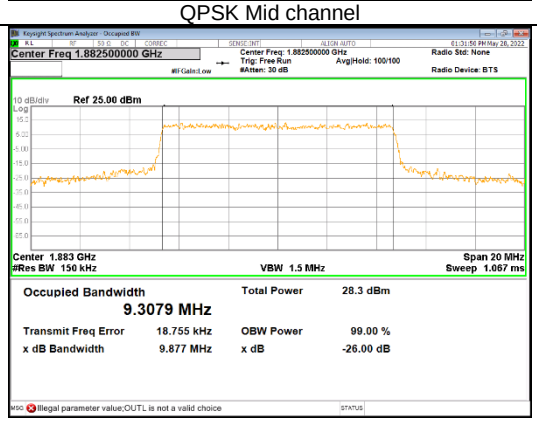
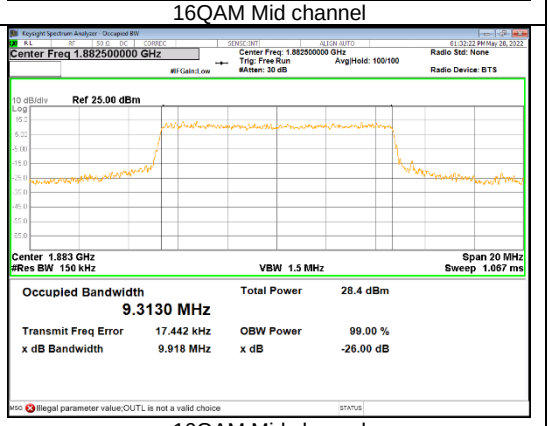
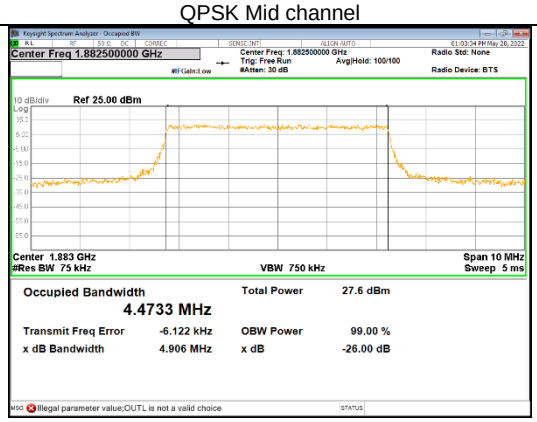
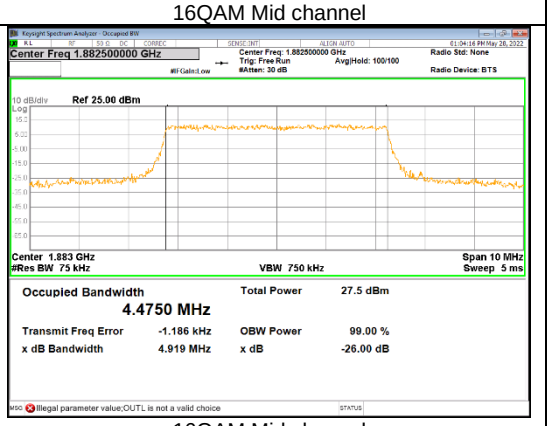
NR Band n5 CP-OFDM

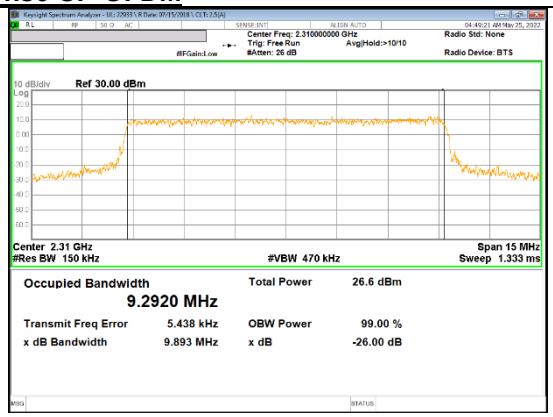
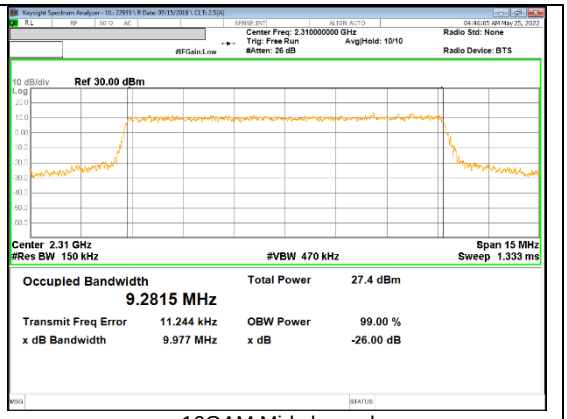
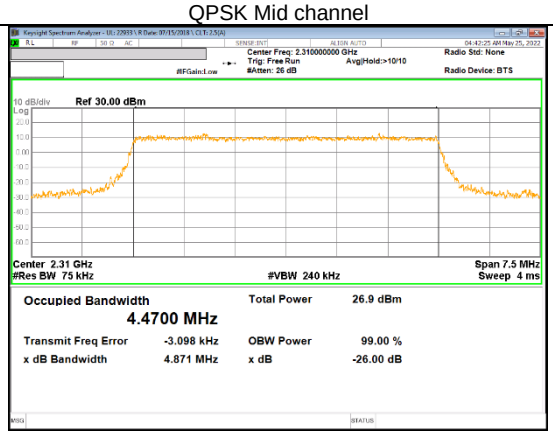
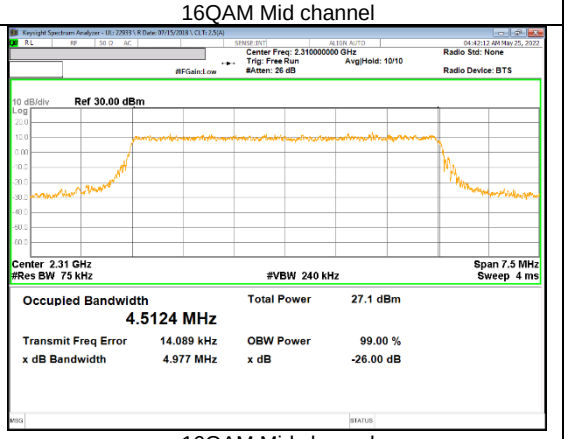
20MHz	 QPSK Mid channel	 16QAM Mid channel
15MHz	 QPSK Mid channel	 16QAM Mid channel
10MHz	 QPSK Mid channel	 16QAM Mid channel
5MHz	 QPSK Mid channel	 16QAM Mid channel

NR Band n25 CP-OFDM

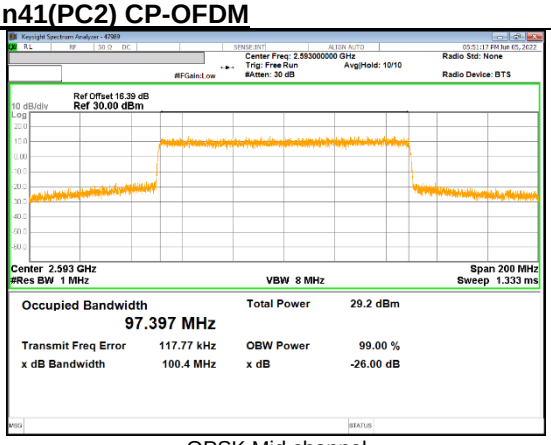
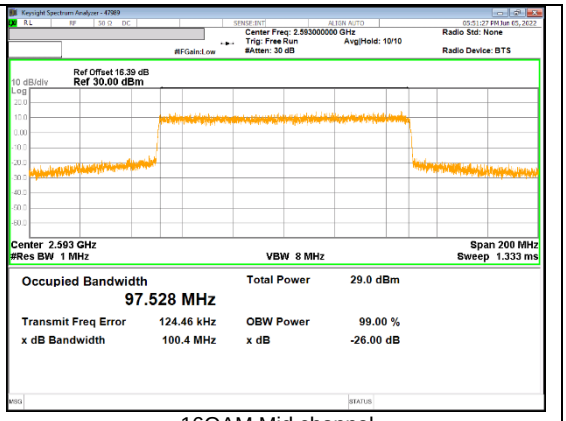
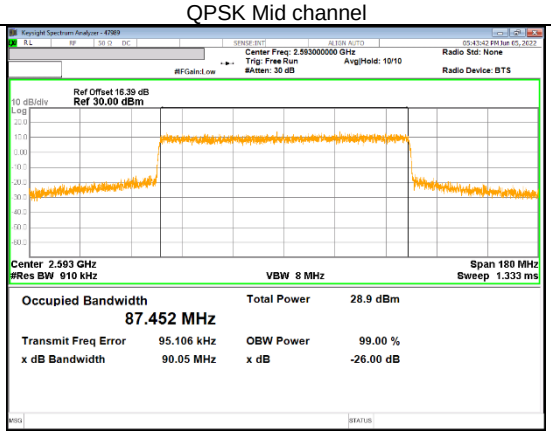
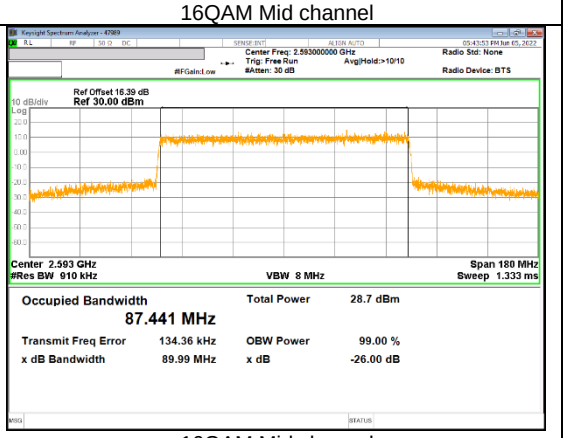
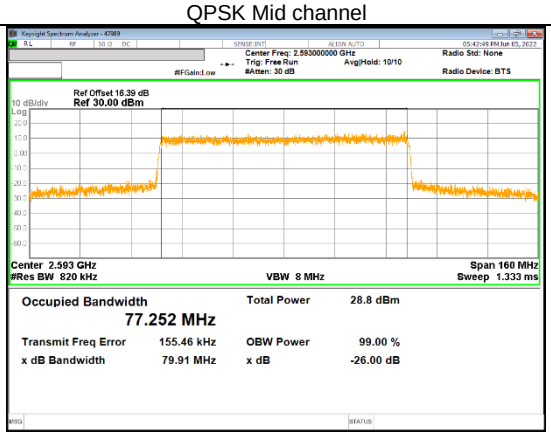
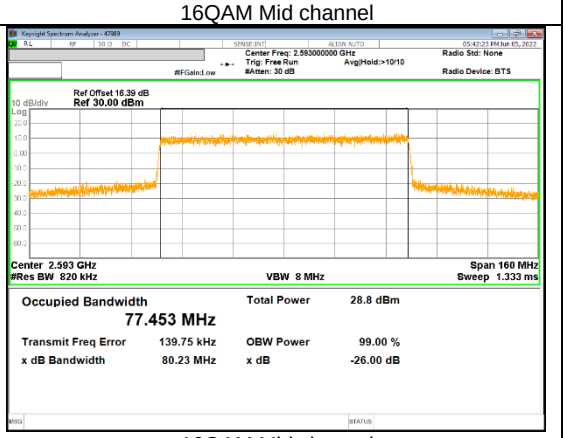
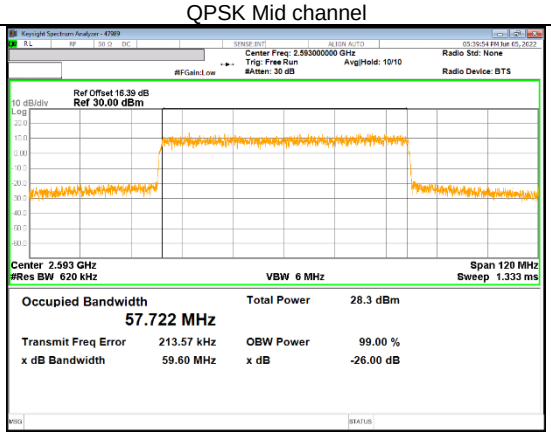
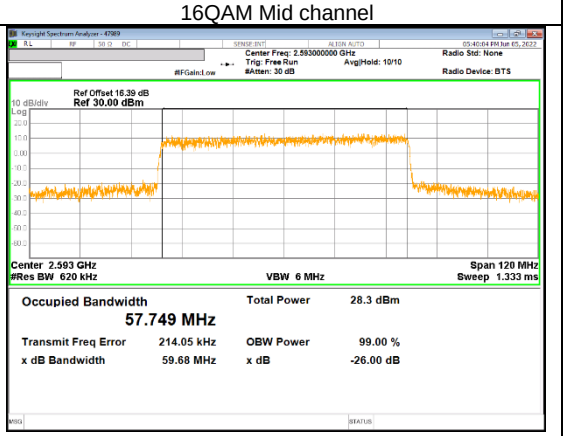
40MHz	 QPSK Mid channel	 16QAM Mid channel
30MHz	 QPSK Mid channel	 16QAM Mid channel
25MHz	 QPSK Mid channel	 16QAM Mid channel
20MHz	 QPSK Mid channel	 16QAM Mid channel

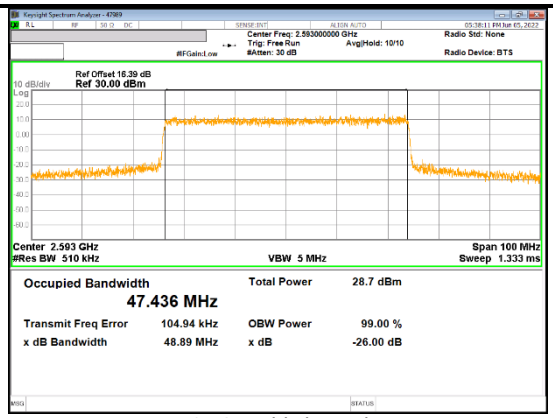
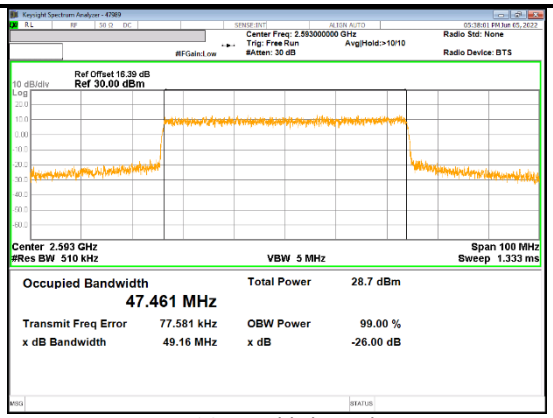
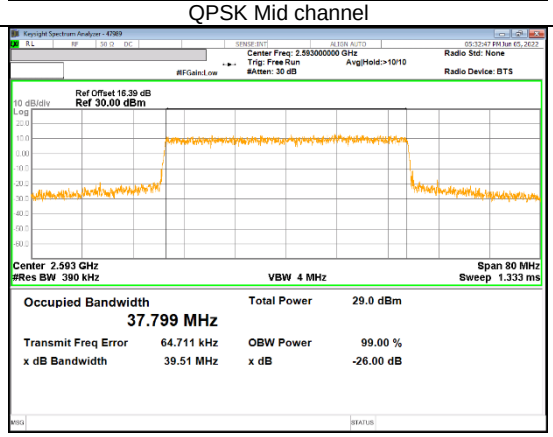
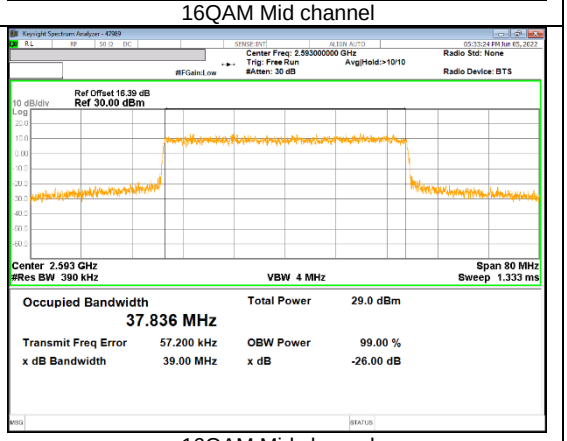
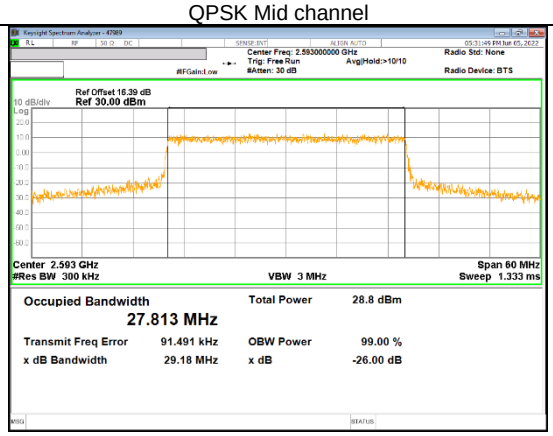
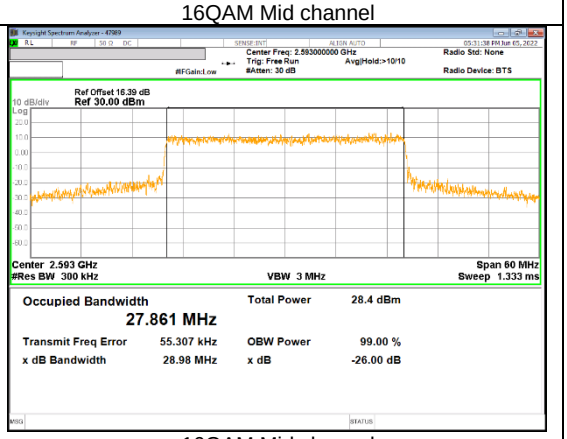
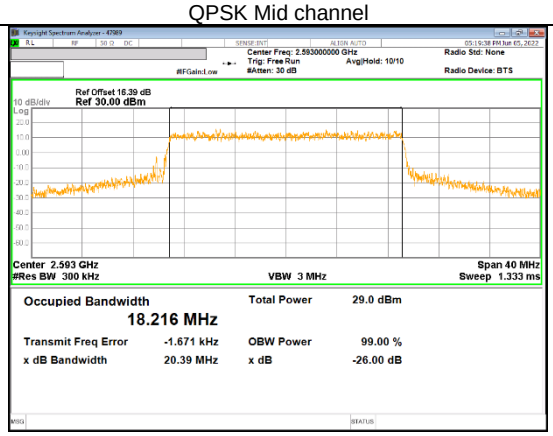
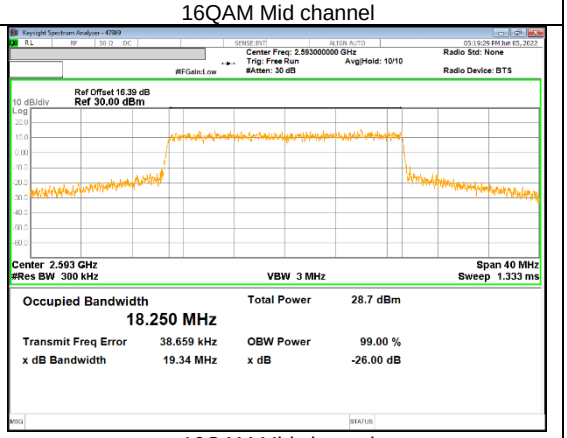
15MHz	 QPSK Mid channel	 16QAM Mid channel
10MHz	 QPSK Mid channel	 16QAM Mid channel
5MHz	 QPSK Mid channel	 16QAM Mid channel

NR Band n30 CP-OFDM

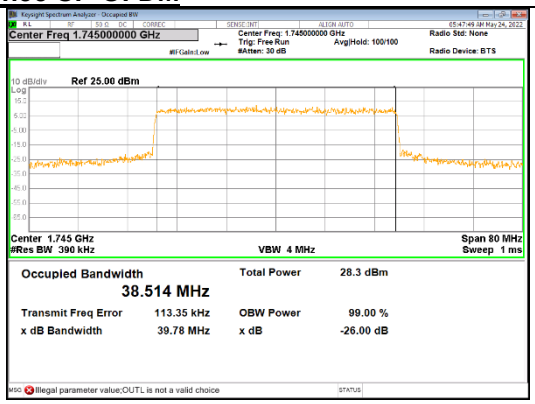
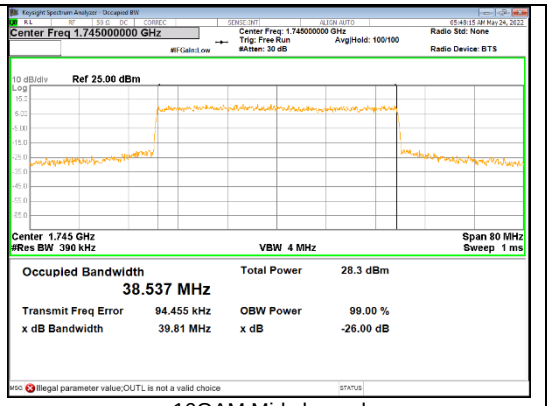
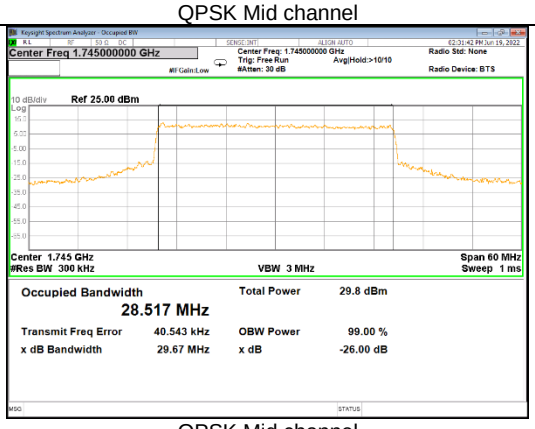
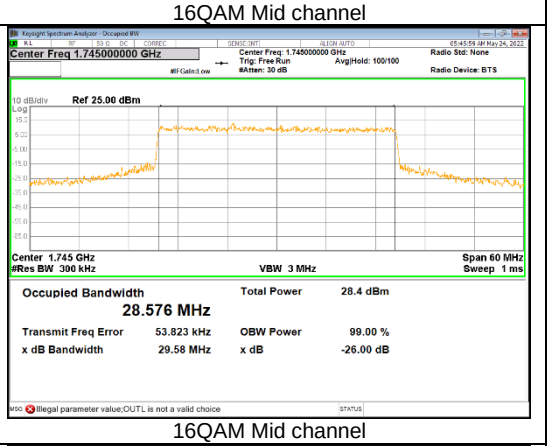
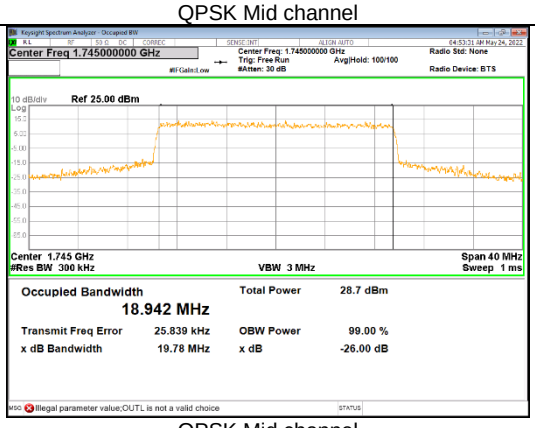
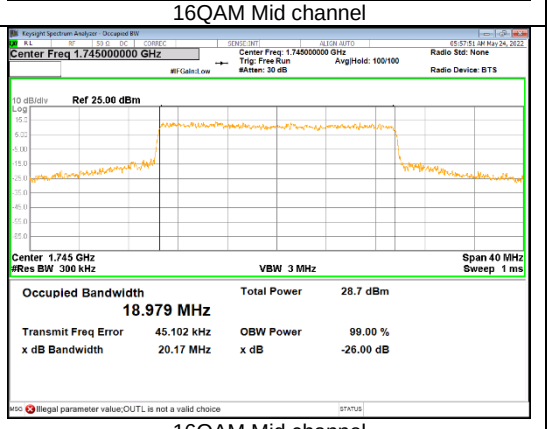
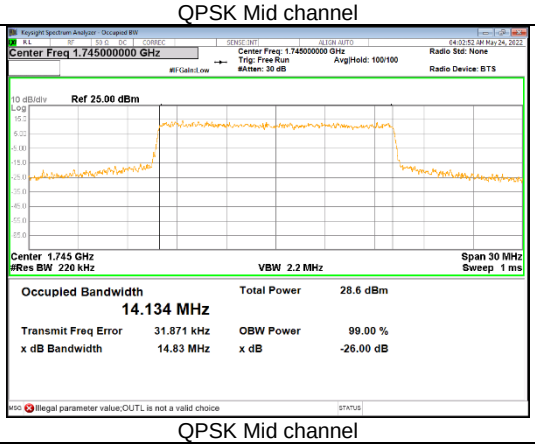
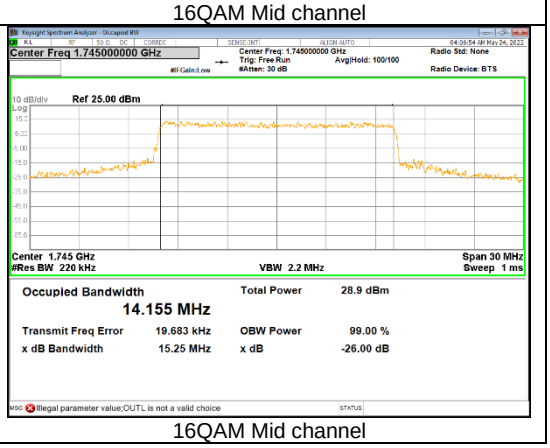
10MHz	 QPSK Mid channel	 16QAM Mid channel
5MHz	 QPSK Mid channel	 16QAM Mid channel

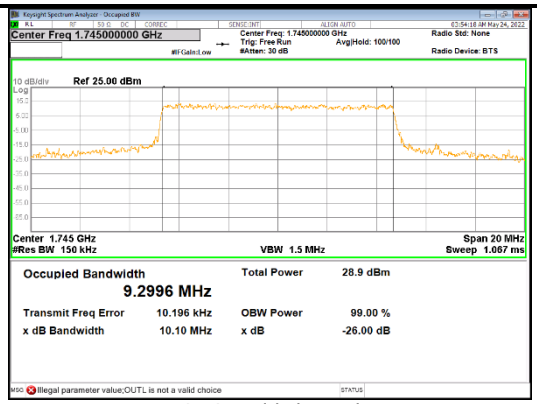
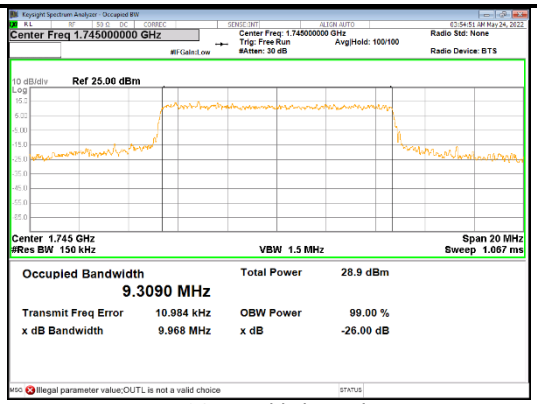
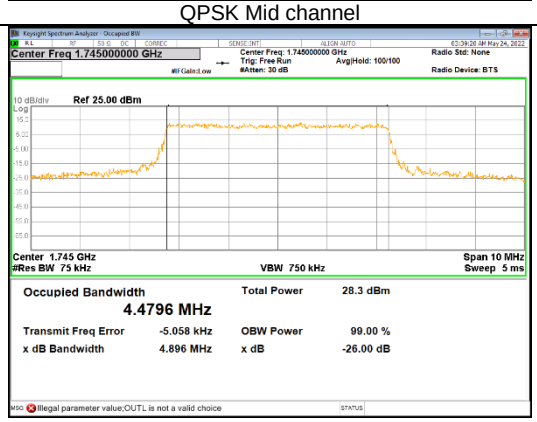
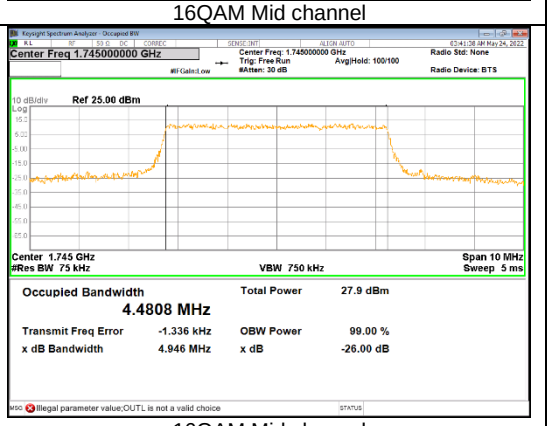
NR Band n41(PC2) CP-OFDM

100 MHz	 QPSK Mid channel	 16QAM Mid channel
90 MHz	 QPSK Mid channel	 16QAM Mid channel
80 MHz	 QPSK Mid channel	 16QAM Mid channel
60 MHz	 QPSK Mid channel	 16QAM Mid channel

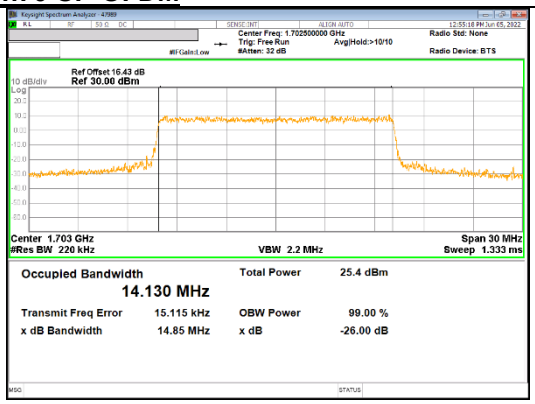
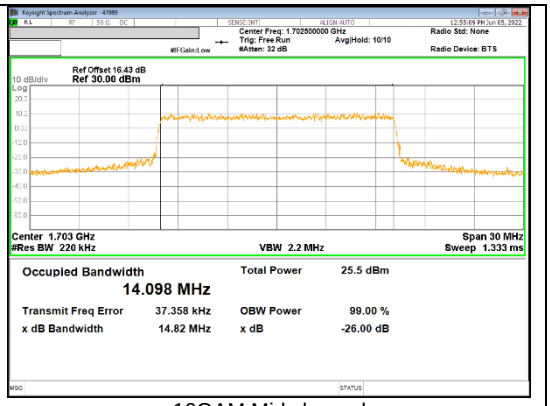
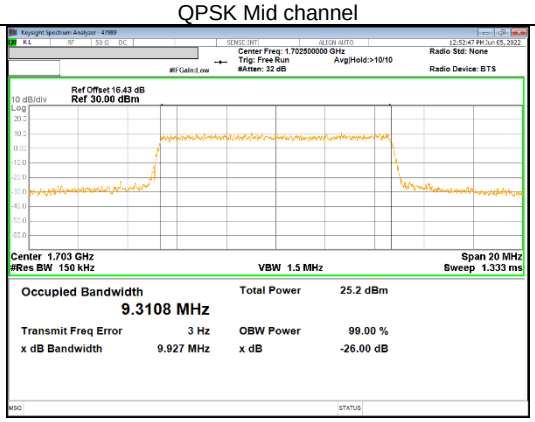
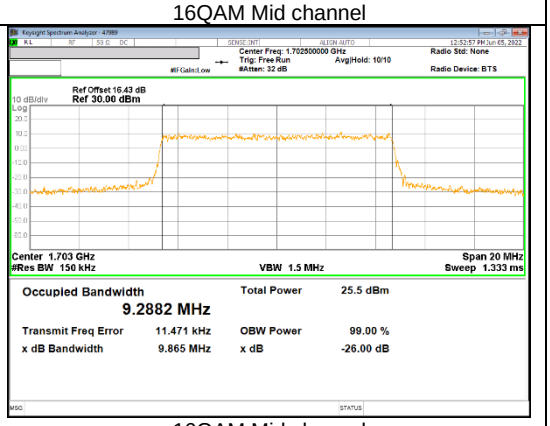
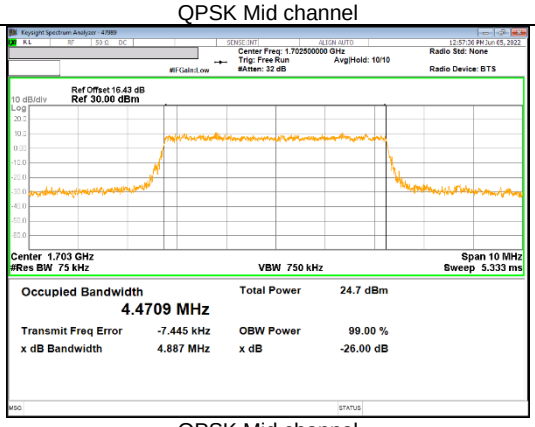
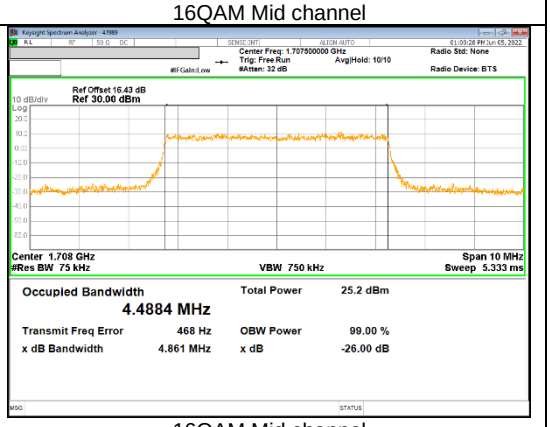
50 MHz	 QPSK Mid channel	 16QAM Mid channel
40 MHz	 QPSK Mid channel	 16QAM Mid channel
30 MHz	 QPSK Mid channel	 16QAM Mid channel
20 MHz	 QPSK Mid channel	 16QAM Mid channel

NR Band n66 CP-OFDM

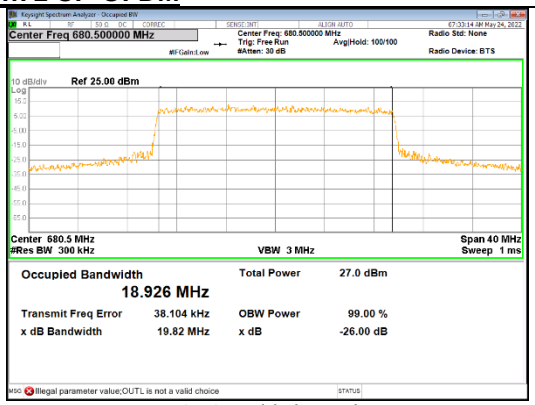
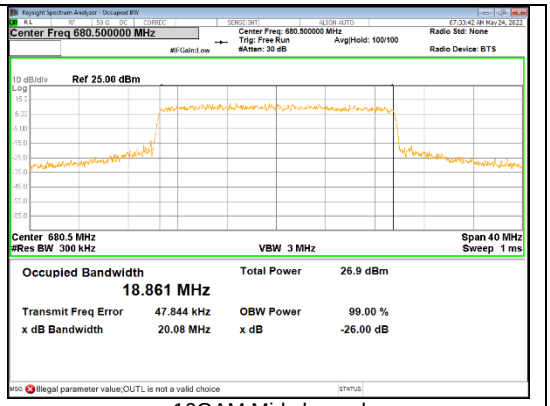
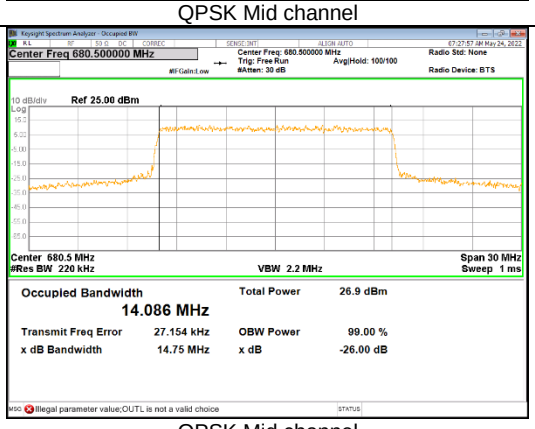
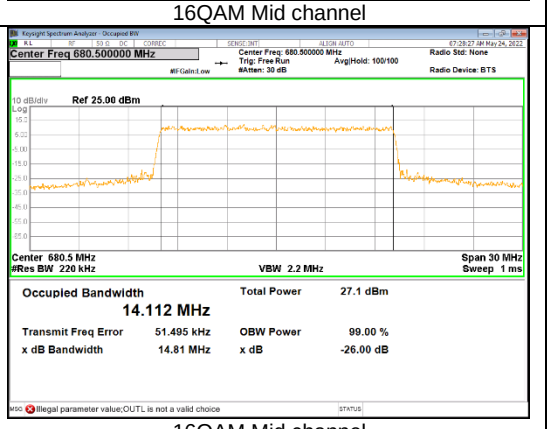
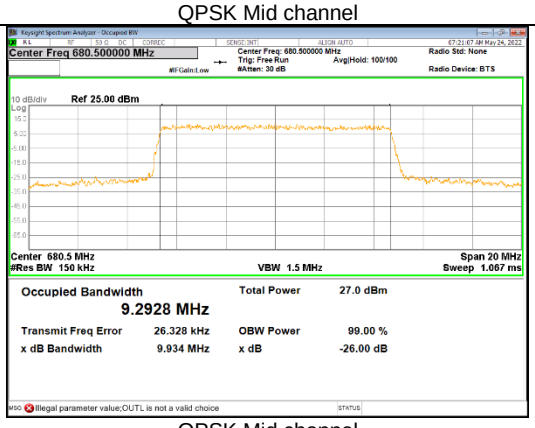
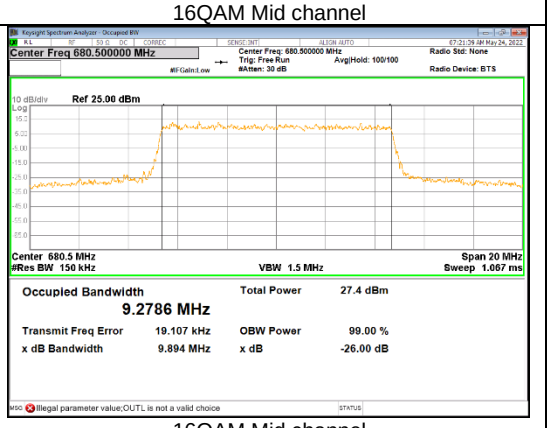
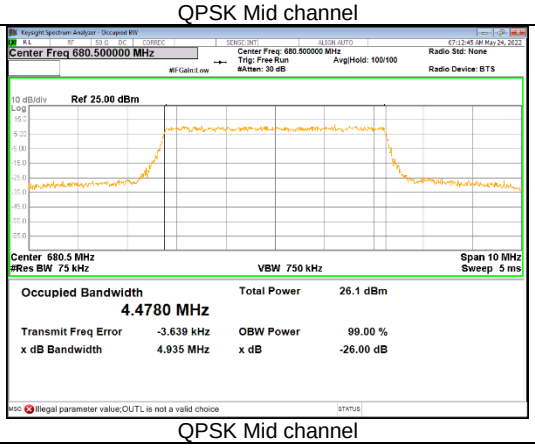
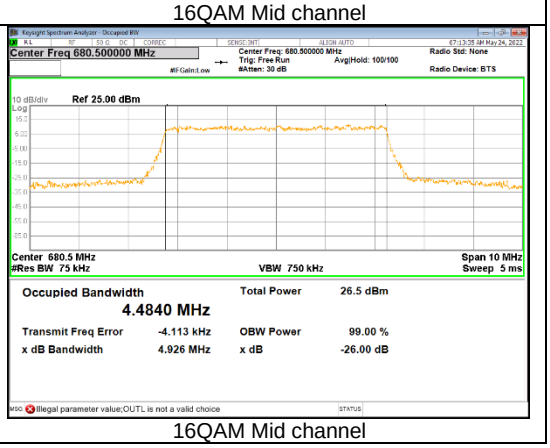
40MHz	 QPSK Mid channel	 16QAM Mid channel
30MHz	 QPSK Mid channel	 16QAM Mid channel
20MHz	 QPSK Mid channel	 16QAM Mid channel
15MHz	 QPSK Mid channel	 16QAM Mid channel

10MHz	 QPSK Mid channel	 16QAM Mid channel
5MHz	 QPSK Mid channel	 16QAM Mid channel

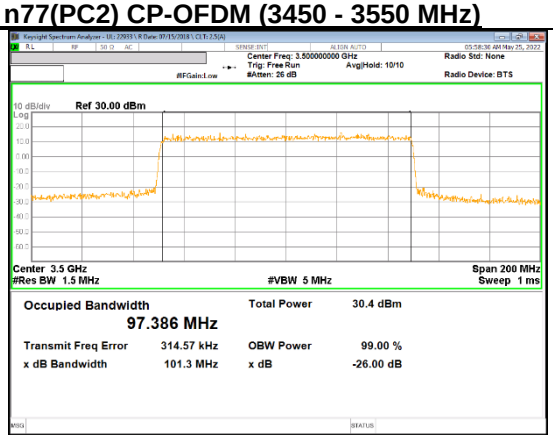
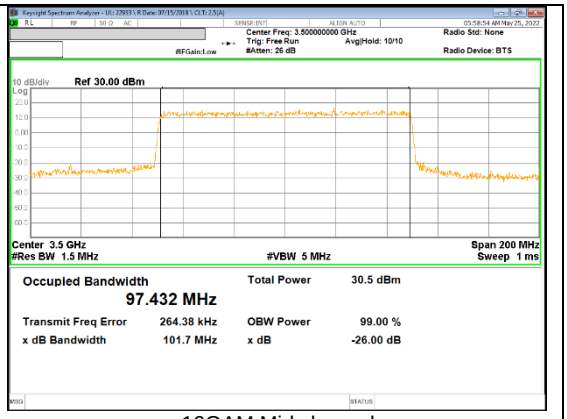
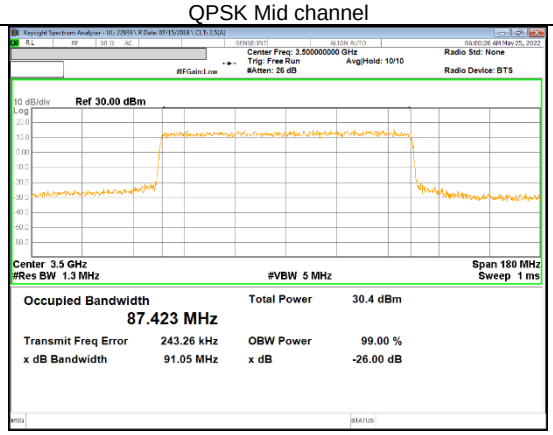
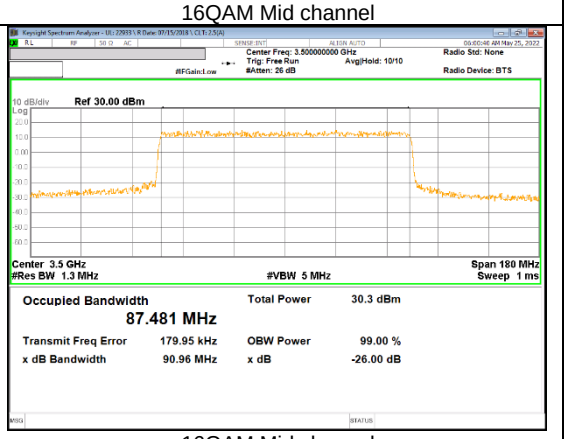
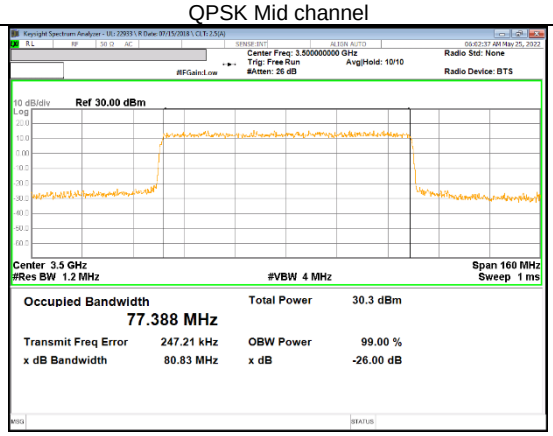
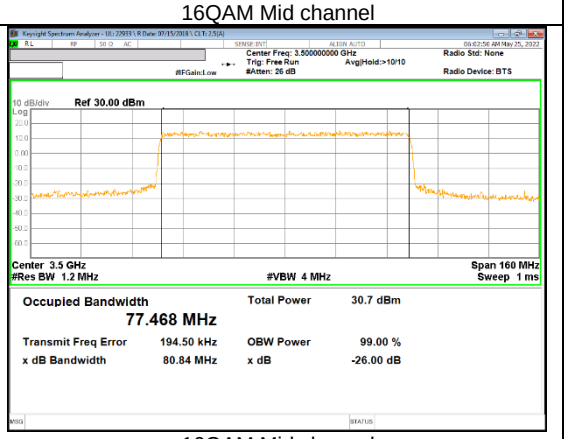
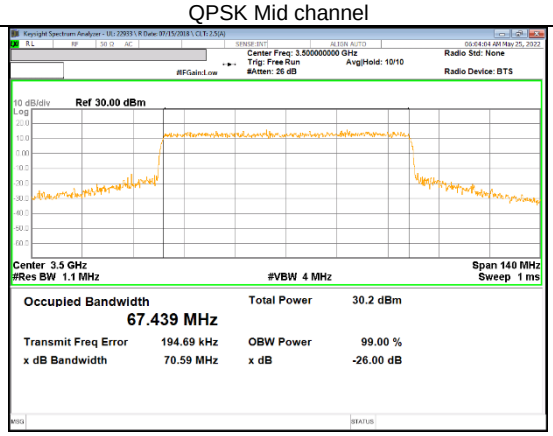
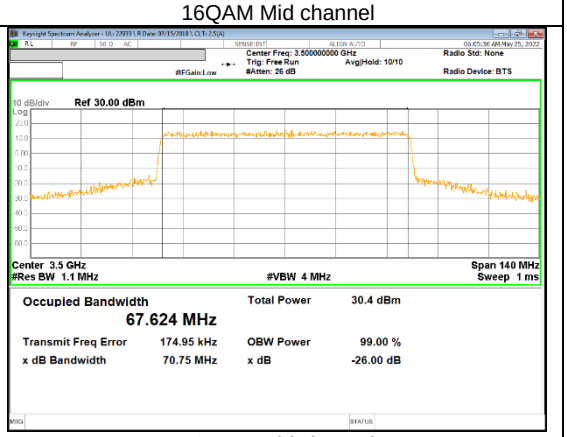
NR Band n70 CP-OFDM

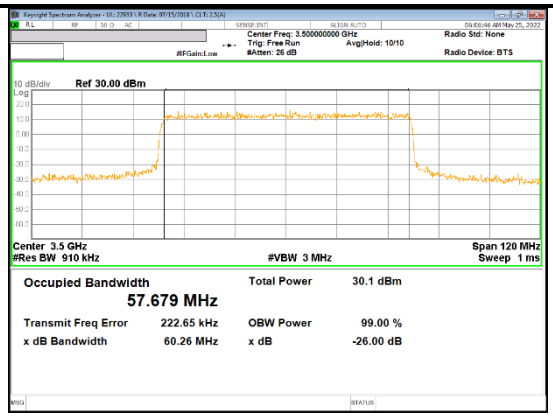
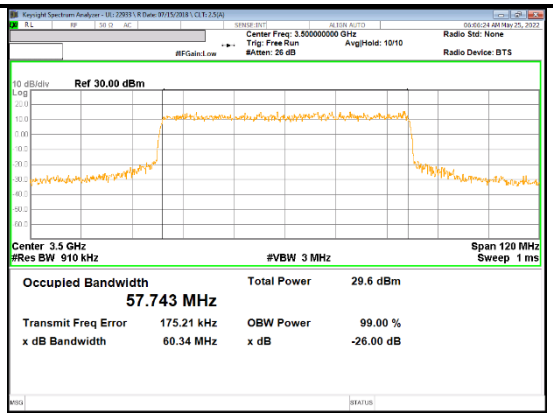
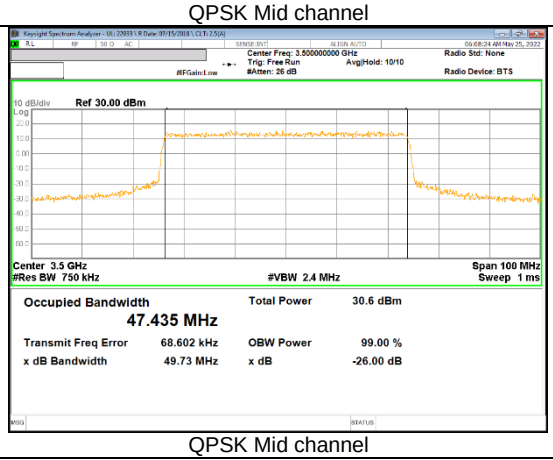
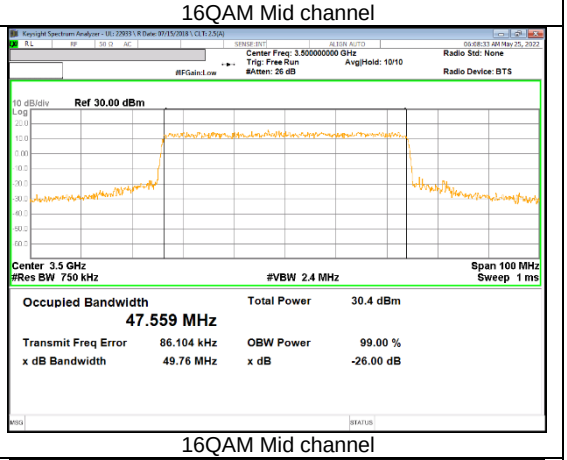
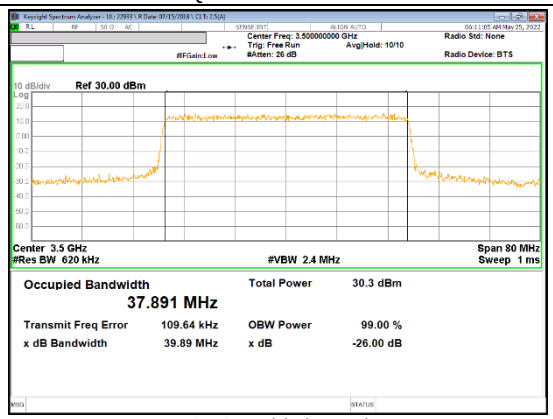
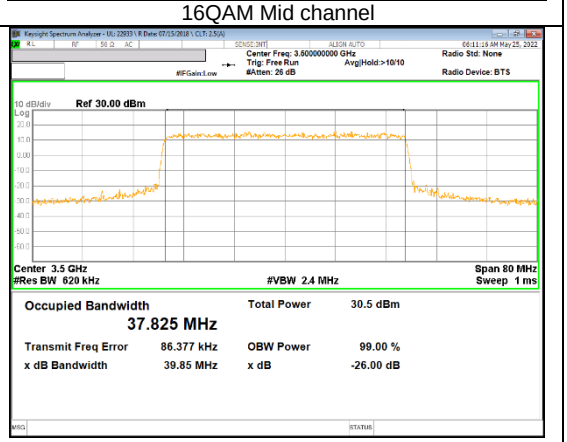
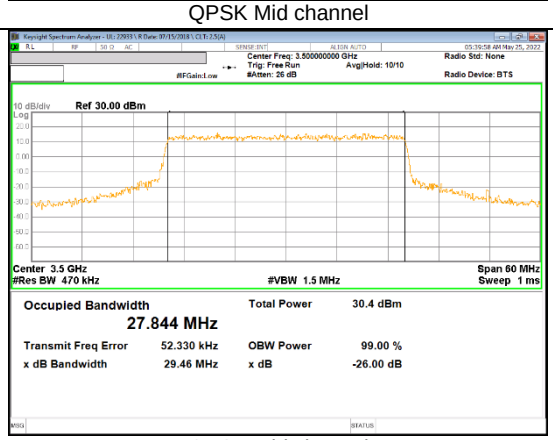
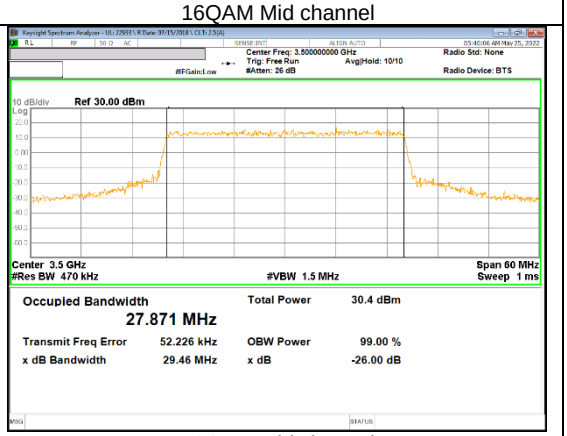
15MHz	 QPSK Mid channel	 16QAM Mid channel
10MHz	 QPSK Mid channel	 16QAM Mid channel
5MHz	 QPSK Mid channel	 16QAM Mid channel

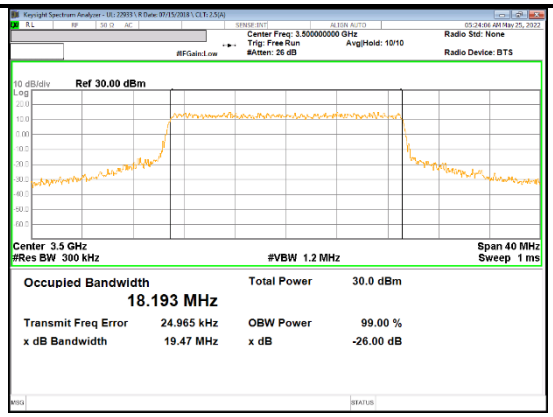
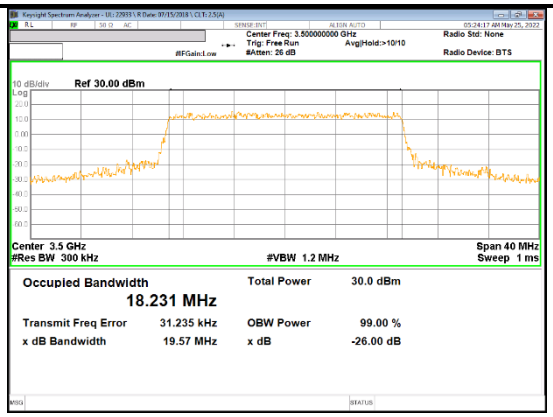
NR Band n71 CP-OFDM

20MHz	 QPSK Mid channel	 16QAM Mid channel
15MHz	 QPSK Mid channel	 16QAM Mid channel
10MHz	 QPSK Mid channel	 16QAM Mid channel
5MHz	 QPSK Mid channel	 16QAM Mid channel

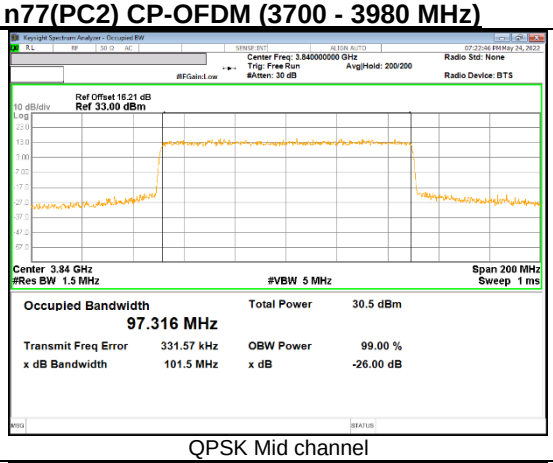
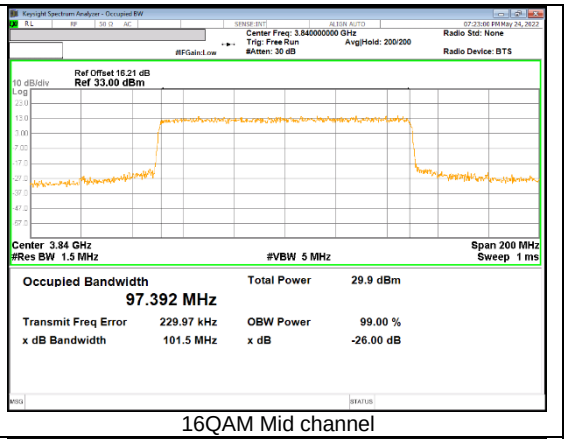
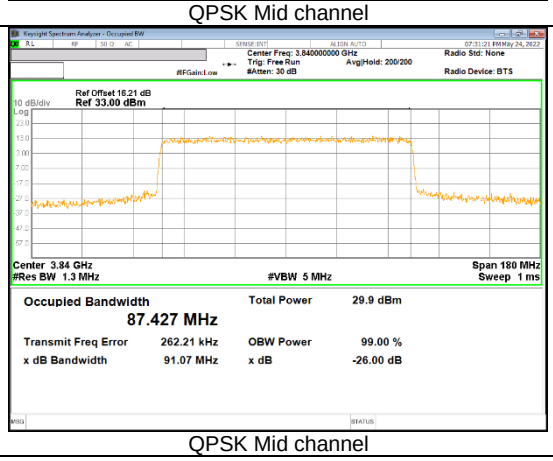
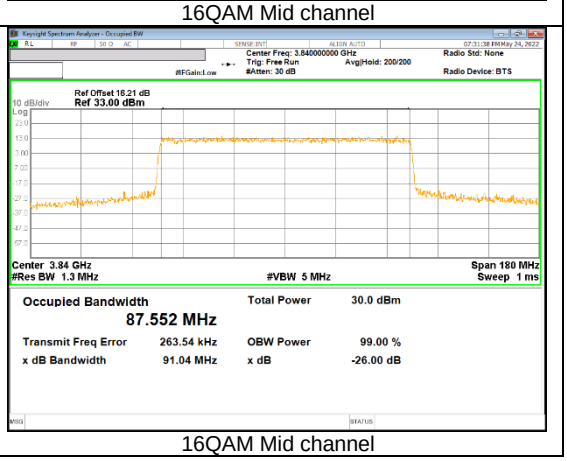
NR Band n77(PC2) CP-OFDM (3450 - 3550 MHz)

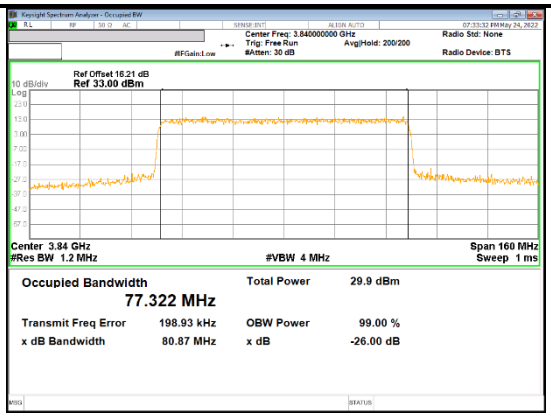
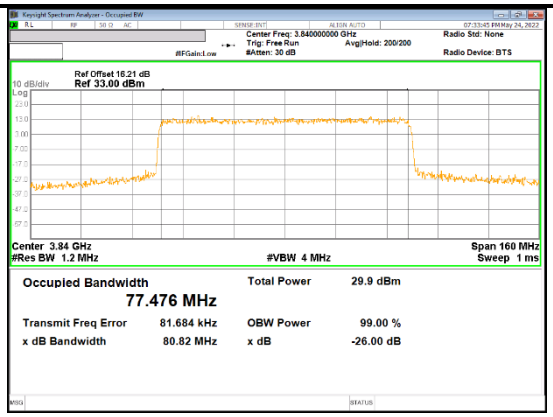
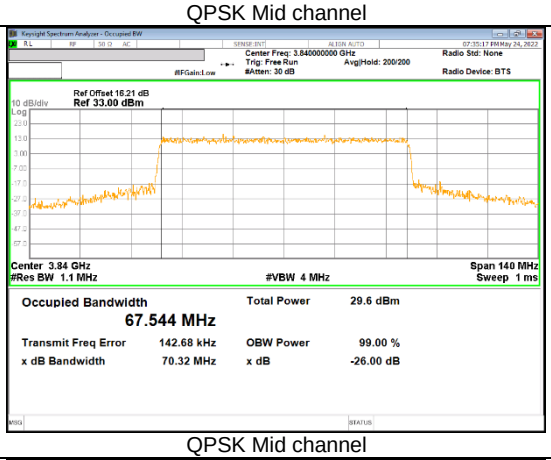
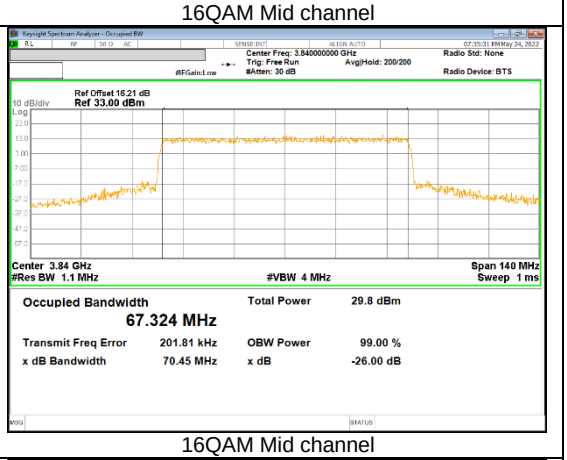
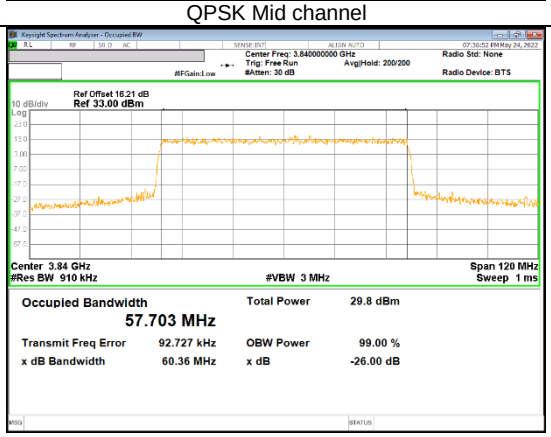
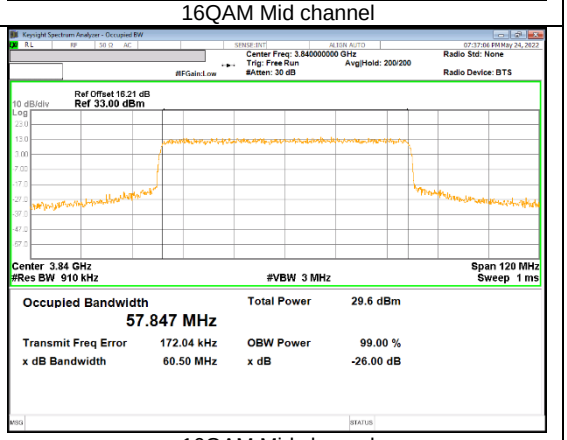
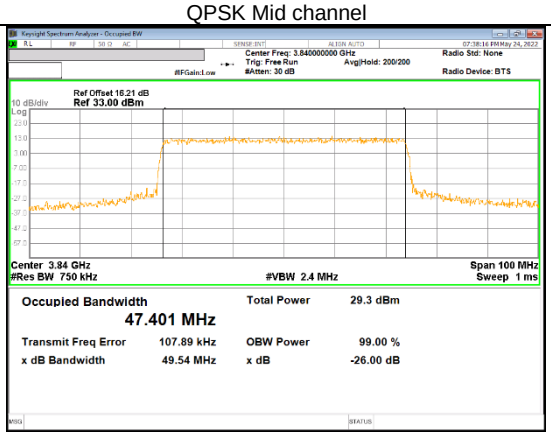
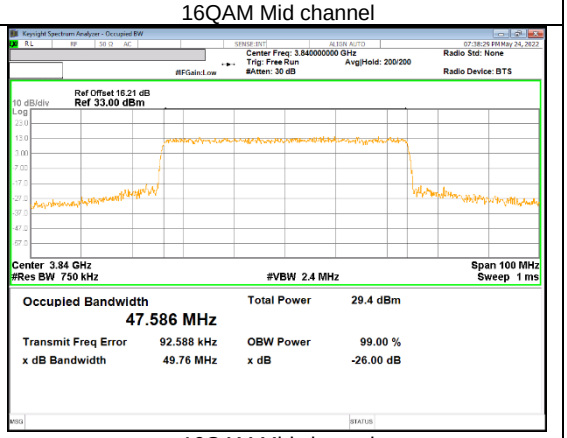
100 MHz	 QPSK Mid channel	 16QAM Mid channel
90 MHz	 QPSK Mid channel	 16QAM Mid channel
80 MHz	 QPSK Mid channel	 16QAM Mid channel
70 MHz	 QPSK Mid channel	 16QAM Mid channel

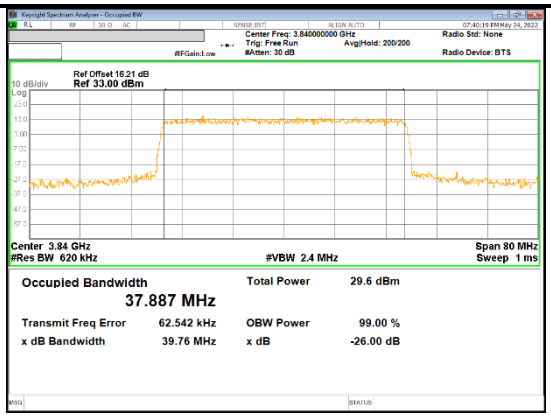
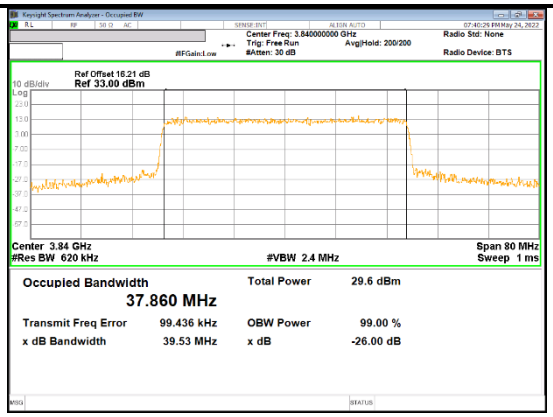
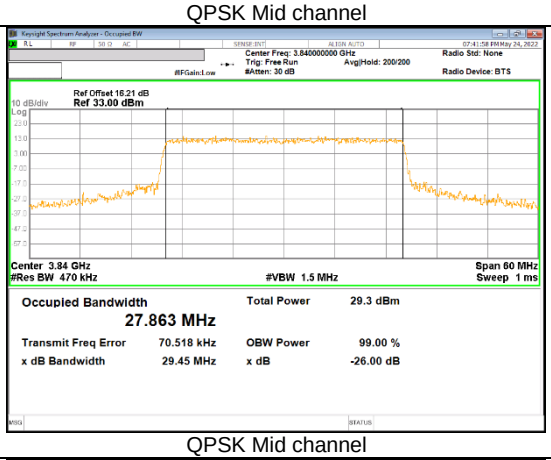
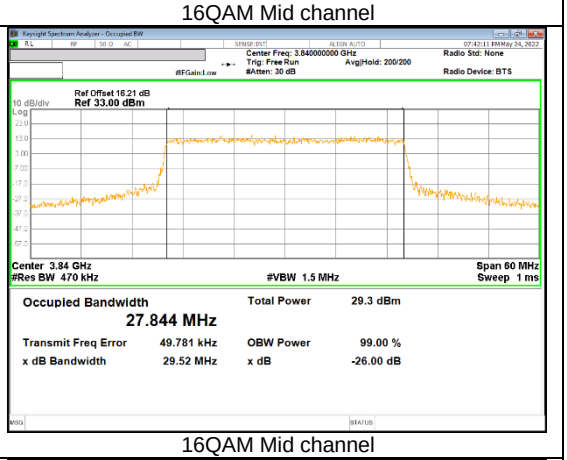
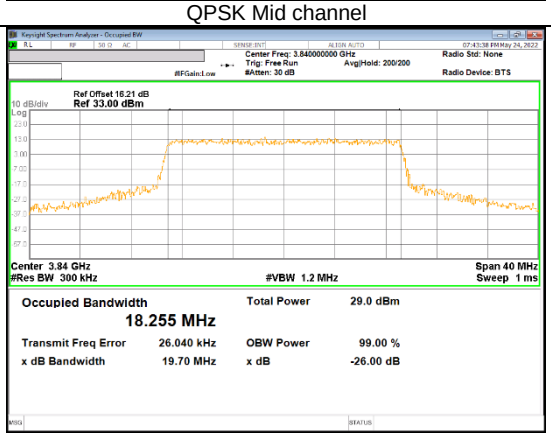
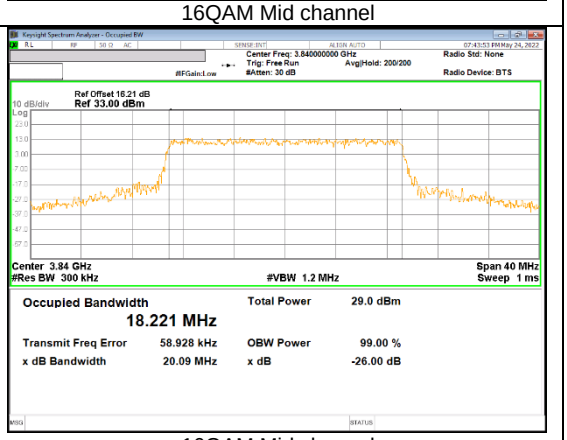
60 MHz	 QPSK Mid channel	 16QAM Mid channel
50 MHz	 QPSK Mid channel	 16QAM Mid channel
40 MHz	 QPSK Mid channel	 16QAM Mid channel
30 MHz	 QPSK Mid channel	 16QAM Mid channel

20 MHz	 QPSK Mid channel	 16QAM Mid channel

NR Band n77(PC2) CP-OFDM (3700 - 3980 MHz)

100 MHz	 QPSK Mid channel	 16QAM Mid channel
90 MHz	 QPSK Mid channel	 16QAM Mid channel

80 MHz	 QPSK Mid channel	 16QAM Mid channel
70 MHz	 QPSK Mid channel	 16QAM Mid channel
60 MHz	 QPSK Mid channel	 16QAM Mid channel
50 MHz	 QPSK Mid channel	 16QAM Mid channel

40 MHz	 QPSK Mid channel	 16QAM Mid channel
30 MHz	 QPSK Mid channel	 16QAM Mid channel
20 MHz	 QPSK Mid channel	 16QAM Mid channel

9.2. BAND EDGE EMISSIONS

RULE PART(S)

FCC: §22.359, §22.917, §24.238, §27. 53, §90. 543 and 90.691

LIMITS

The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

Part 27.53:
(a) (4) For mobile and portable stations operating in the 2305-2315 MHz and 2350-2360 MHz bands:
(i) By a factor of not less than: 43 + 10 log (P) dB on all frequencies between 2305 and 2320 MHz and on all frequencies between 2345 and 2360 MHz that are outside the licensed band(s) of operation, not less than 55 + 10 log (P) dB on all frequencies between 2320 and 2324 MHz and on all frequencies between 2341(PC2) and 2345 MHz, not less than 61 + 10 log (P) dB on all frequencies between 2324 and 2328 MHz and on all frequencies between 2337 and 2341(PC2) MHz, and not less than 67 + 10 log (P) dB on all frequencies between 2328 and 2337 MHz;
(ii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2300 and 2305 MHz, 55 + 10 log (P) dB on all frequencies between 2296 and 2300 MHz, 61 + 10 log (P) dB on all frequencies between 2292 and 2296 MHz, 67 + 10 log (P) dB on all frequencies between 2288 and 2292 MHz, and 70 + 10 log (P) dB below 2288 MHz;
(iii) By a factor of not less than 43 + 10 log (P) dB on all frequencies between 2360 and 2365 MHz, and not less than 70 + 10 log (P) dB above 2365 MHz.

(c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:
(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;
(4) On all frequencies between 763-775 MHz and 793-806 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations;

(g) For operations in the 600 MHz band and the 698-746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB.

(h) The power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}$ (P) dB.

(m) (4) For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less that 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz. Mobile Satellite Service licensees operating on frequencies below 2495 MHz may also submit a documented interference complaint against BRS licensees operating on channel BRS Channel 1 on the same terms and conditions as adjacent channel BRS or EBS licensees.

(l)(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. Compliance with this paragraph (l)(2) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, the minimum resolution bandwidth for the measurement shall be either one percent of the emission bandwidth of the fundamental emission of the transmitter or 350 kHz. In the bands between 1 and 5 MHz removed from the licensee's frequency block, the minimum resolution bandwidth for the measurement shall be 500 kHz. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(n)(2) For mobile operations in the 3450-3550 MHz band, the conducted power of any emission outside the licensee's authorized bandwidth shall not exceed −13 dBm/MHz. Compliance with this paragraph (n)(2) is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed, but limited to a maximum of 200 kHz. In the bands between 1 and 5 MHz removed from the licensee's frequency block, the minimum resolution bandwidth for the measurement shall be 500 kHz. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Part 90.543:
(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 76 + 10 log (P) dB in a 6.25 kHz band segment, for base and fixed stations.
(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.
(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.
(4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.

Part 90.691:
(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:

(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 Log10(f/6.1) decibels or 50 + 10 Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.

(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10(P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

TEST PROCEDURE

Per KDB 971168 D01 Power Meas License Digital Systems v03r01
The transmitter output was connected to a CMW500 Test Set and configured to operate at maximum power. The band edge emissions were measured at the required operating frequencies in each band on the Spectrum Analyzer.

GSM

a) Set the RBW = 1 - 5% of OBW(GSM850 – 8.2KHz, GSM1900 – 9.1KHz)
b) Set VBW ≥ 3 × RBW;
c) Set span ≥ 1.5 times the OBW;
d) Sweep time = 1S ;
e) Detector = RMS;
f) Ensure that the number of measurement points ≥ 2*Span/RBW;
g) Trace mode = Average(100);
h) Add duty cycle correction factor (9dB)

WCDMA/LTE/5G NR

a) Set the RBW = 1 - 1.5 % of OBW(Typically limited to a minimum RBW of 1% of the OBW)
b) Set VBW ≥ 3 × RBW;
c) Set span ≥ 1.5 times the OBW;
d) Sweep time = Auto;
e) Detector = RMS;
f) Ensure that the number of measurement points ≥ 2*Span/RBW;
g) Trace mode = Average (100);

NOTE1

For frequency range of 763-775 MHz and 793-806 MHz, 769-775 MHz and 799-805 MHz.(LTE Band 13, 14)

a) Set the RBW = 6.2kHz
b) Set VBW ≥ 3 × RBW;
c) Sweep time = 1 second ;
d) Detector = RMS;
e) Ensure that the number of measurement points ≥ 2*Span/RBW;
f) Trace mode = Average;

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NOTE2

Note that the spurious emissions outside of the channel include narrowband signals. These signals are all below the -13dBm / -25dBm limits. Although the measurement bandwidth is less than the reference bandwidth of 1MHz no addental correction is applied as ANSI C63.26 section 4.2.3 only requires the correction to be applied when the OBW of the emission being measured is wider than the measurement bandwidth (Where the OBW of the signal under measurement is less than the RBW of the measuring instrument, no bandwidth correction or integration will be required.) Plots for low and high channels show the level of the emission measured with the reduced bandwidth and the level of the same emission measured using the integration method over the 1MHz reference bandwidth are very close, indicating the emissions are narrowband.

NOTE3

For Band-Edge extended:

CH BW (MHz)	RB Used (kHz)	CF for emissions more than 100kHz	CF for emissions more than 1MHz
1.4	15	+8.2 dB	+18.2 dB
3	30	+5.2 dB	+15.2 dB
5	51	+2.9 dB	+12.9 dB
10	100	N/A	+10.0 dB
15	150	N/A	+8.2 dB
20	200	N/A	+7.0 dB

For the band edge value measured in [RB Used], even if [CF for emissions reference bandwidth 100kHz/1MHz] is applied, it is below -13dBm.

NOTE4

For 5G NR n41 Emission Mask (Gate trigger off):
RF Path Loss: 16.39 dB & DCF 7 dB: 10log(1/5)
Measure offset: 16.39 dB+7 dB = 23.39 dB

NOTE5

LTE Band 41(PC2) A-MPR is implemented in this EUT when operating on HPUE per the A-MPR specification in 3GPP TS 36.101 (Table 6.2.4-4a). Conducted output power verification data are shown Appendix A. Also only Emission mask test item were performd A-MPR condition (Especially low channel side).

LTE Band 41C(PC2) A-MPR is implemented in this EUT when operating on HPUE per the A-MPR specification in 3GPP TS 36.101 (Table 6.2.4A,10-1, Table 6.2.4A,10-2). Conducted output power verification data are shown Appendix A. Also only Emission mask test item were performd A-MPR condition (Especially low channel side).

NOTE6

5G NR: All Waveforms (CP-OFDM vs DFT-s_OFDM) and modulations (π/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM) were investigated to determine the worst case configuration. All modes of operation were investigated and the worst case configuration results are reported in this section.

RESULTS

See the following pages.