

Figure 8.2-113: Conducted band edge emission at 2180 MHz, Port A, 5 MHz channel, QPSK (RBW = 1% of EBW)

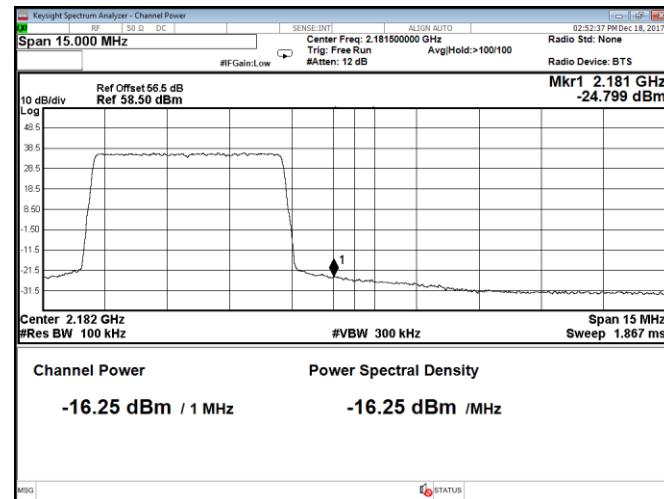


Figure 8.2-114: Conducted band edge emission at 2181 MHz, Port A, 5 MHz channel, QPSK (RBW = 1 MHz)

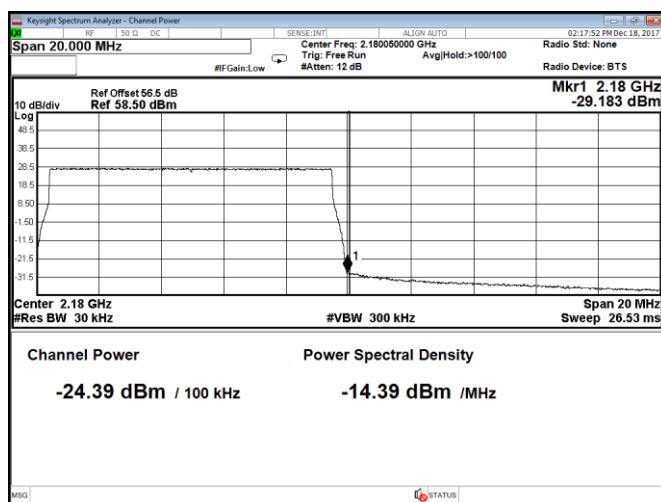


Figure 8.2-115: Conducted band edge emission at 2180 MHz, Port A, 10 MHz channel, QPSK (RBW = 1% of EBW)

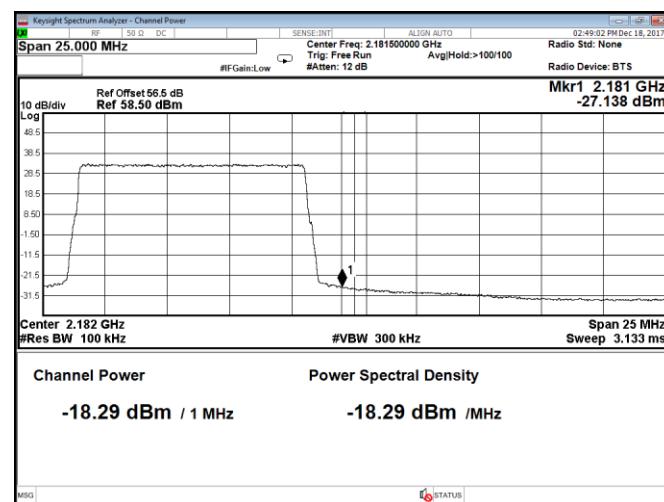


Figure 8.2-116: Conducted band edge emission at 2181 MHz, Port A, 10 MHz channel, QPSK (RBW = 1 MHz)

Note: On the plots above, channel power measurement results must be below -13 dBm/BW

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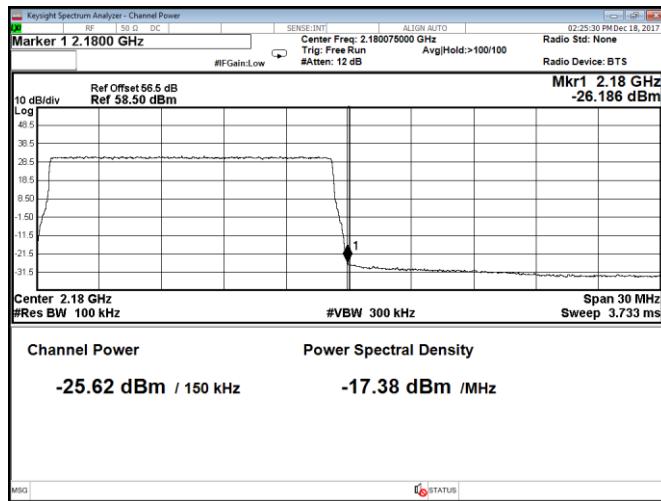


Figure 8.2-117: Conducted band edge emission at 2180 MHz, Port A, 15 MHz channel, QPSK (RBW = 1% of EBW)

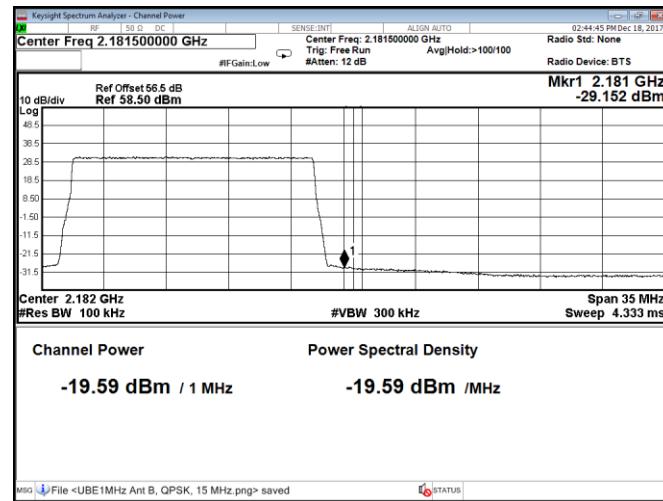


Figure 8.2-118: Conducted band edge emission at 2181 MHz, Port A, 15 MHz channel, QPSK (RBW = 1 MHz)

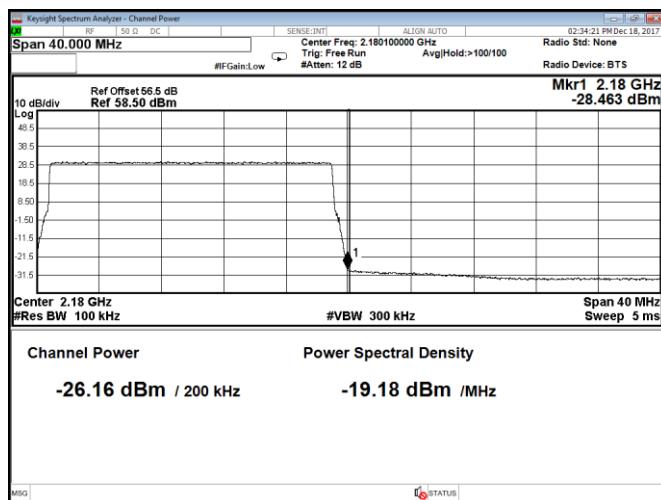


Figure 8.2-119: Conducted band edge emission at 2180 MHz, Port A, 20 MHz channel, QPSK (RBW = 1% of EBW)

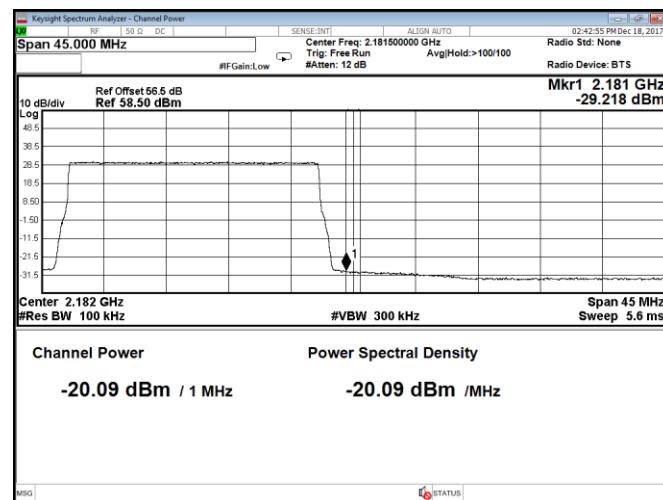
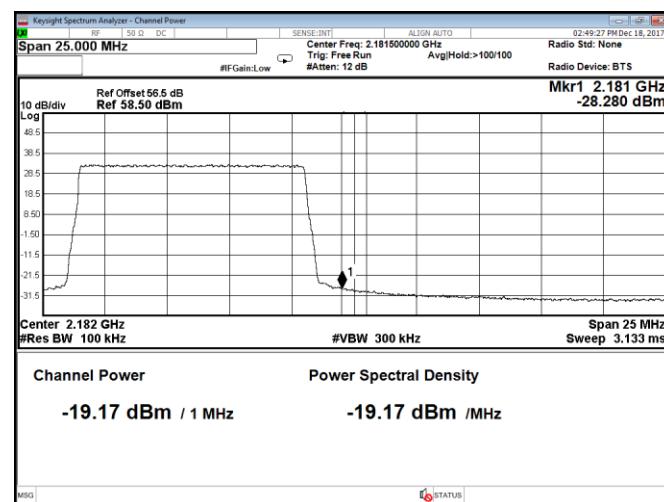
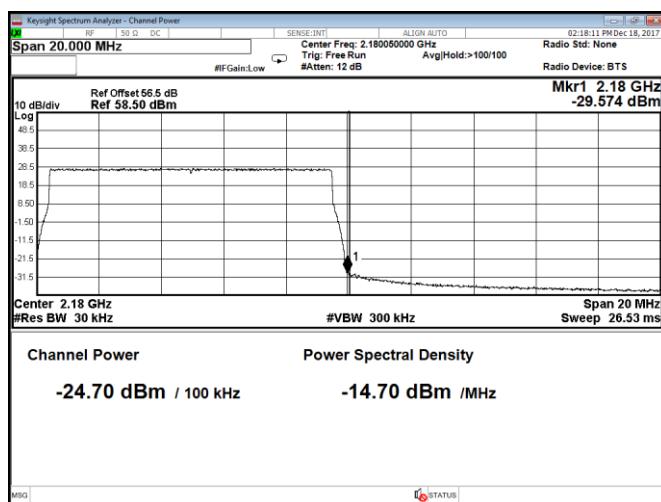
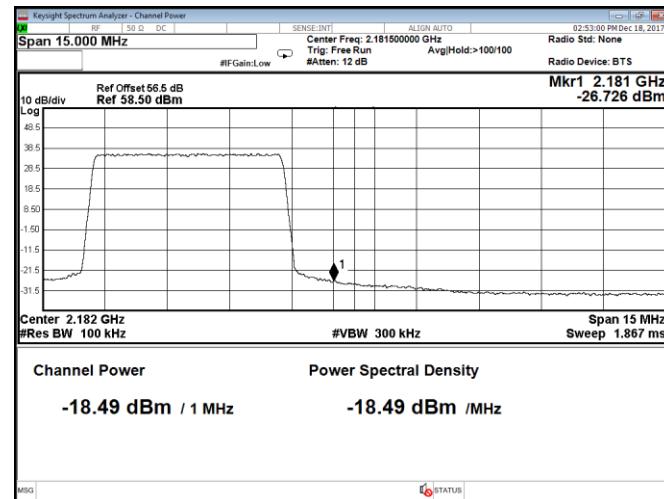
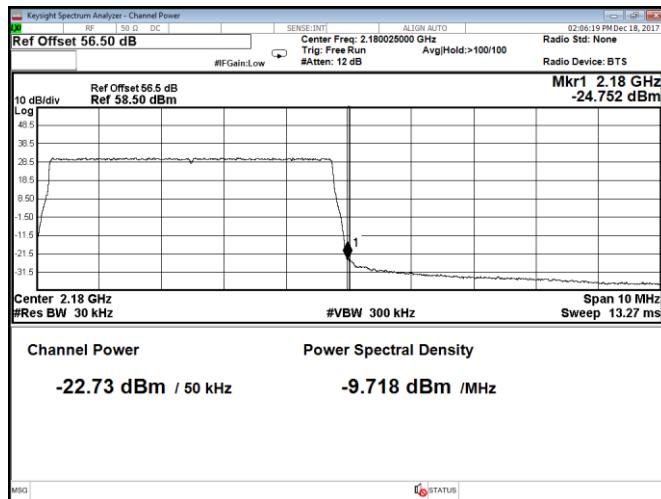


Figure 8.2-120: Conducted band edge emission at 2181 MHz, Port A, 20 MHz channel, QPSK (RBW = 1 MHz)

Note: On the plots above, channel power measurement results must be below -13 dBm/BW



Note: On the plots above, channel power measurement results must be below -13 dBm/BW

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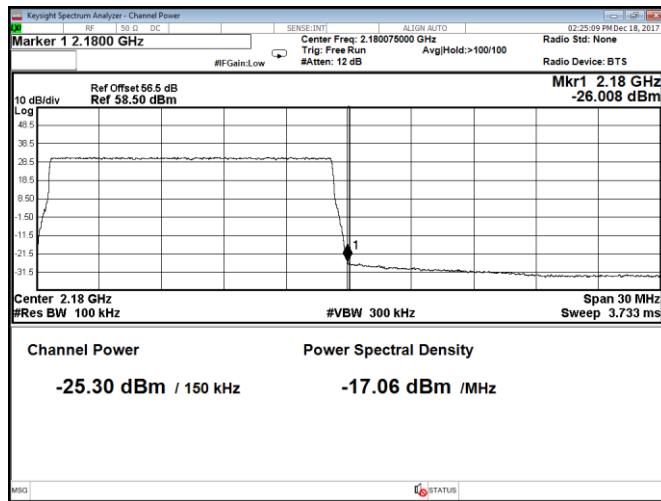


Figure 8.2-125: Conducted band edge emission at 2180 MHz, Port B, 15 MHz channel, QPSK (RBW = 1% of EBW)

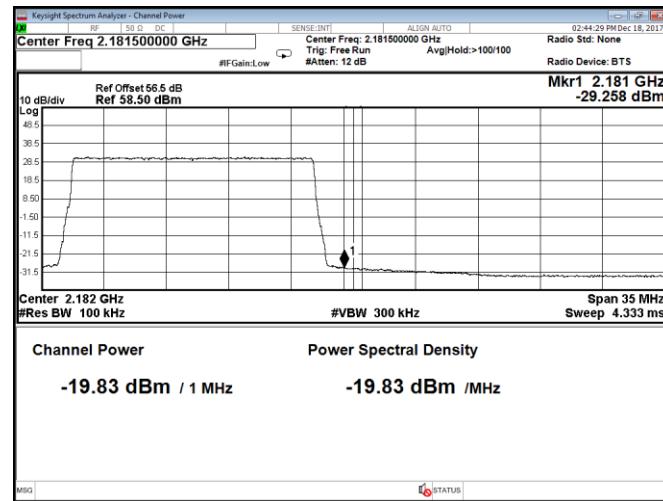


Figure 8.2-126: Conducted band edge emission at 2181 MHz, Port B, 15 MHz channel, QPSK (RBW = 1 MHz)

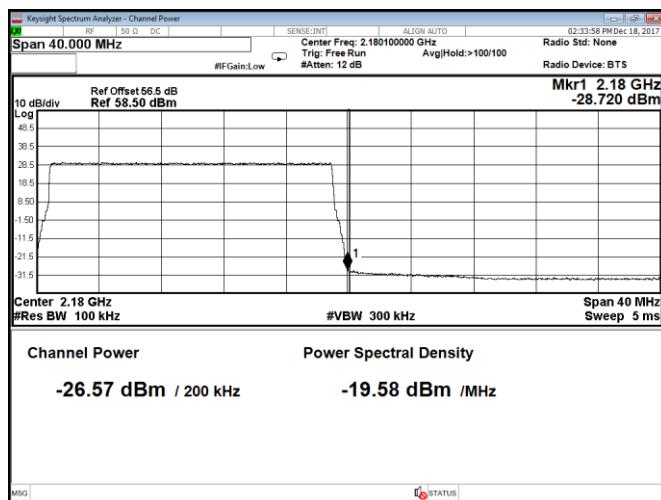


Figure 8.2-127: Conducted band edge emission at 2180 MHz, Port B, 20 MHz channel, QPSK (RBW = 1% of EBW)

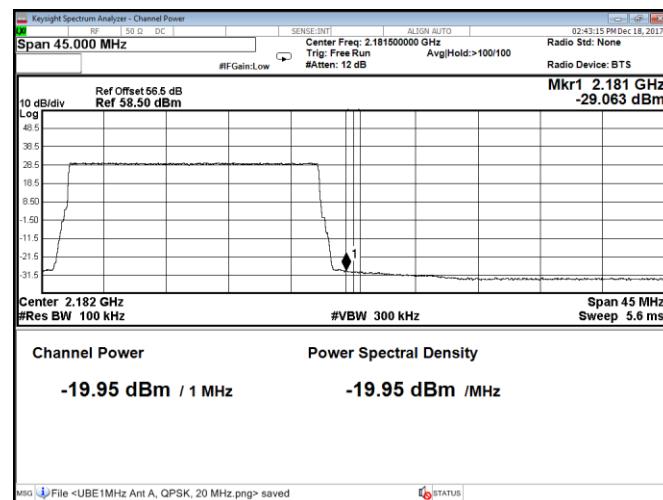
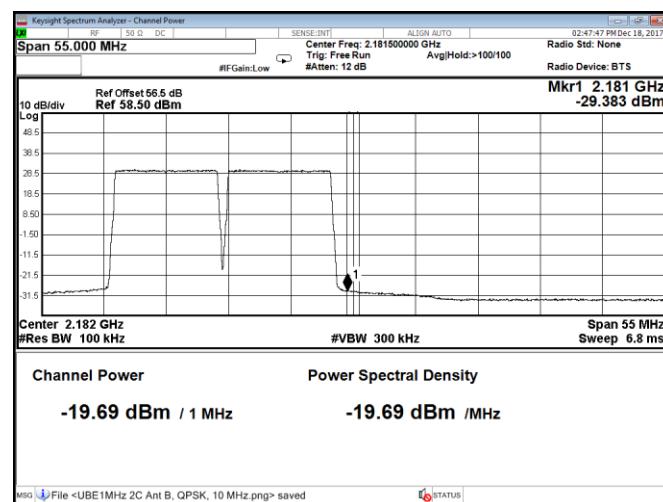
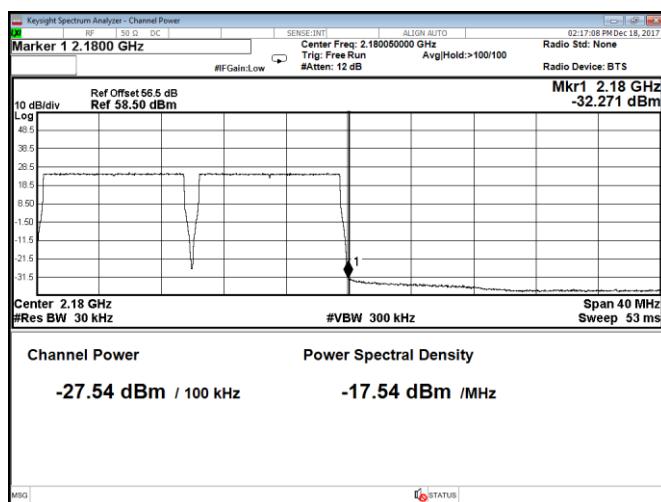
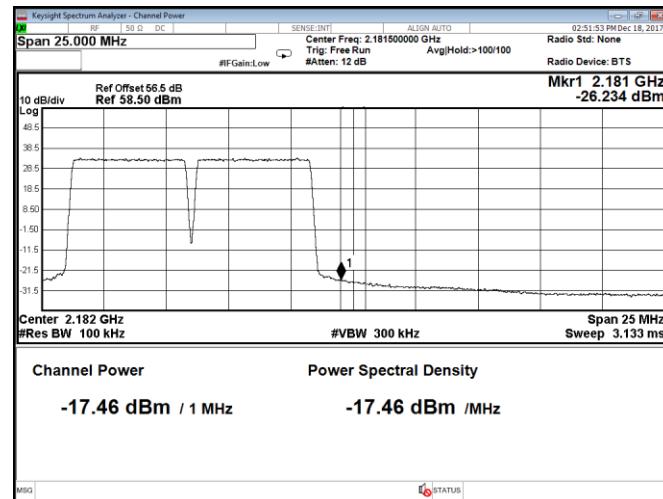


Figure 8.2-128: Conducted band edge emission at 2181 MHz, Port B, 20 MHz channel, QPSK (RBW = 1 MHz)

Note: On the plots above, channel power measurement results must be below -13 dBm/BW



Note: On the plots above, channel power measurement results must be below -13 dBm/BW

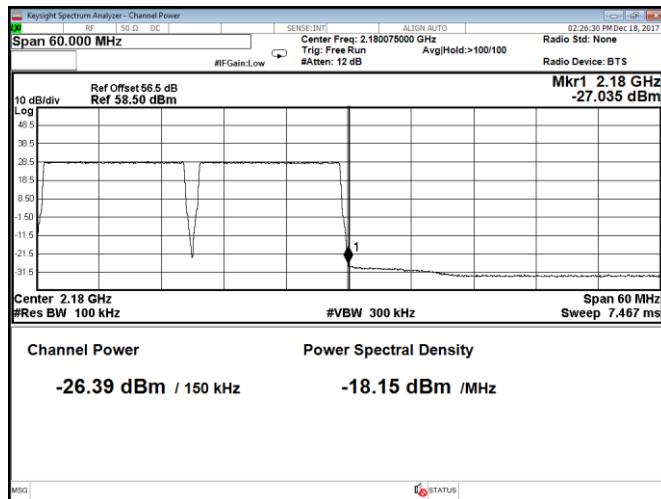


Figure 8.2-133: Conducted band edge emission at 2180 MHz, Port A, 15 MHz channel, 2 carriers, QPSK (RBW = 1% of EBW)

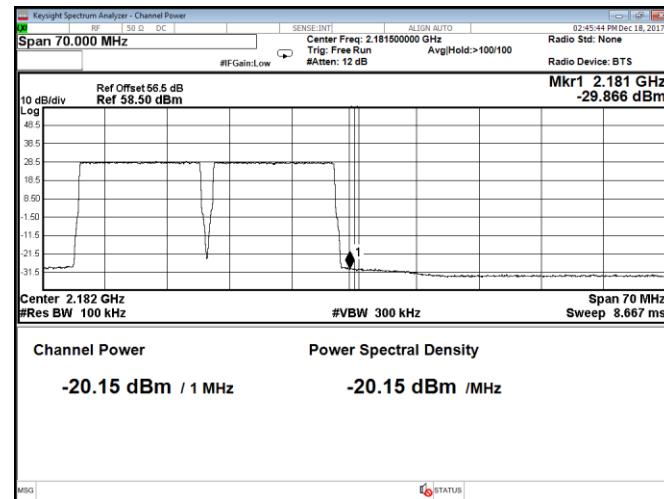


Figure 8.2-134: Conducted band edge emission at 2181 MHz, Port A, 15 MHz channel, 2 carriers, QPSK (RBW = 1 MHz)

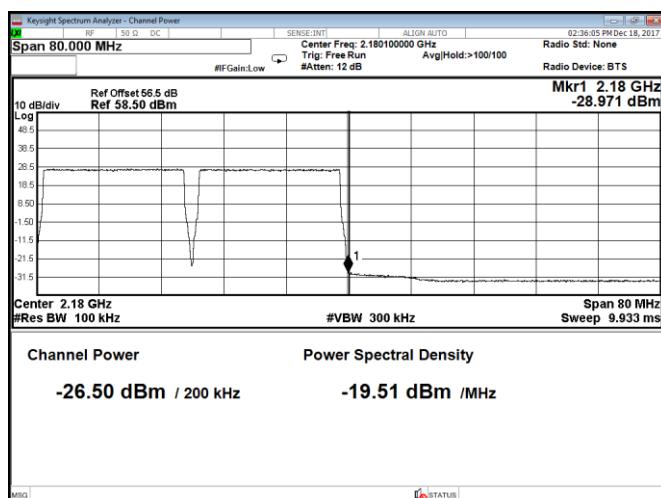


Figure 8.2-135: Conducted band edge emission at 2180 MHz, Port A, 20 MHz channel, 2 carriers, QPSK (RBW = 1% of EBW)

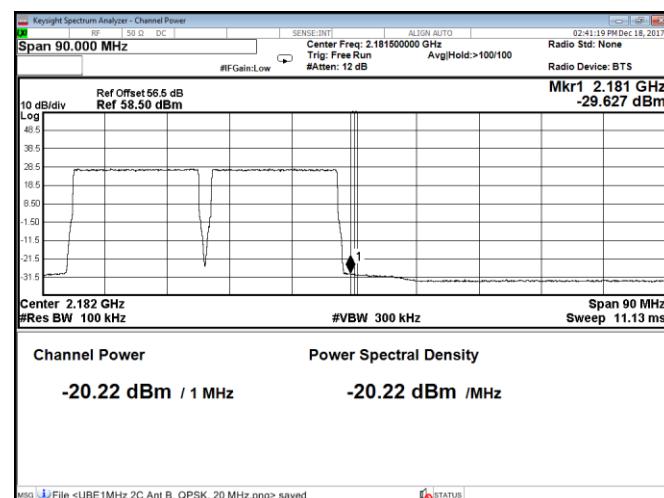


Figure 8.2-136: Conducted band edge emission at 2181 MHz, Port A, 20 MHz channel, 2 carriers, QPSK (RBW = 1 MHz)

Note: On the plots above, channel power measurement results must be below -13 dBm/BW

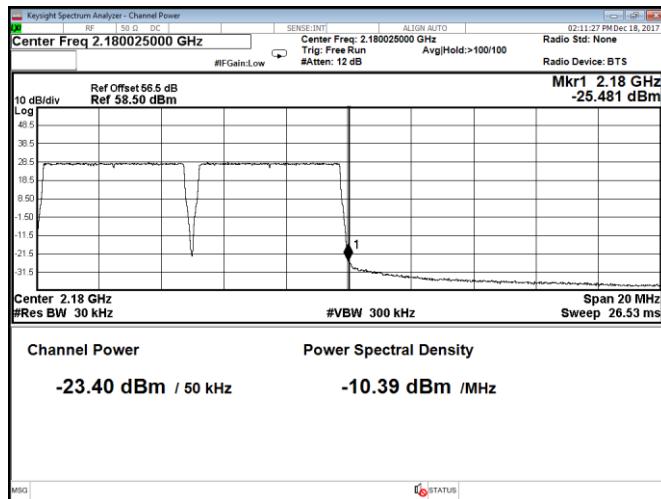


Figure 8.2-137: Conducted band edge emission at 2180 MHz, Port B, 5 MHz channel, 2 carriers, QPSK (RBW = 1% of EBW)

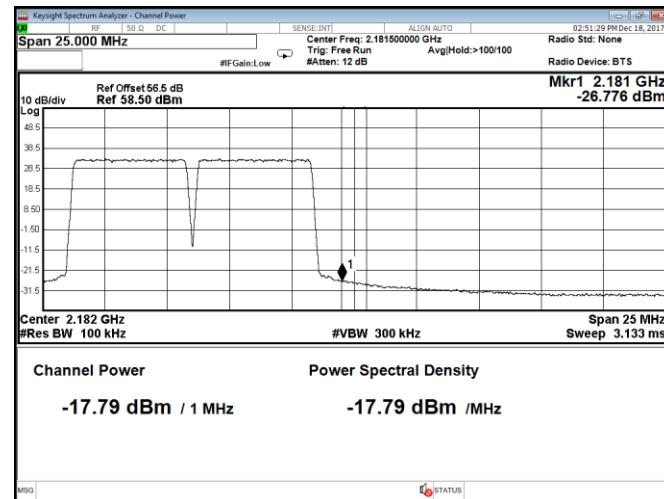


Figure 8.2-138: Conducted band edge emission at 2181 MHz, Port B, 5 MHz channel, 2 carriers, QPSK (RBW = 1 MHz)

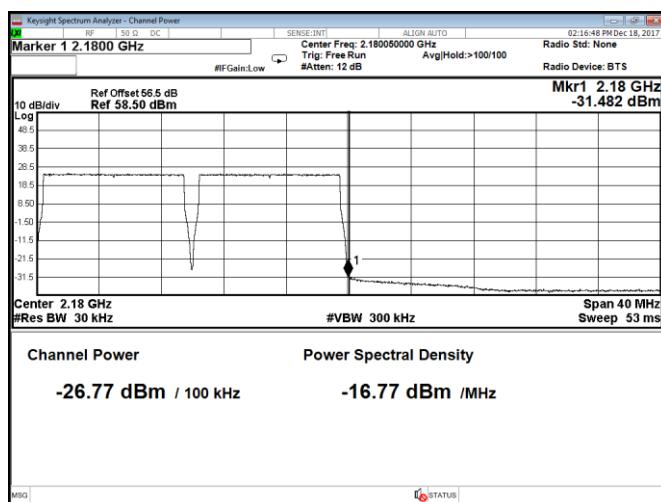


Figure 8.2-139: Conducted band edge emission at 2180 MHz, Port B, 10 MHz channel, 2 carriers, QPSK (RBW = 1% of EBW)

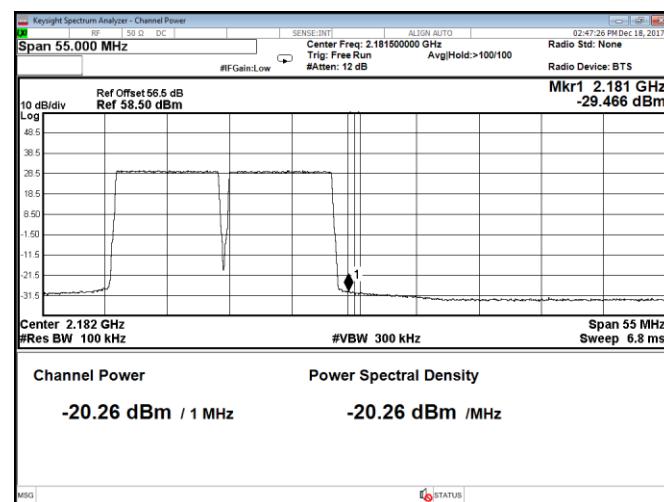


Figure 8.2-140: Conducted band edge emission at 2181 MHz, Port B, 10 MHz channel, 2 carriers, QPSK (RBW = 1 MHz)

Note: On the plots above, channel power measurement results must be below -13 dBm/BW

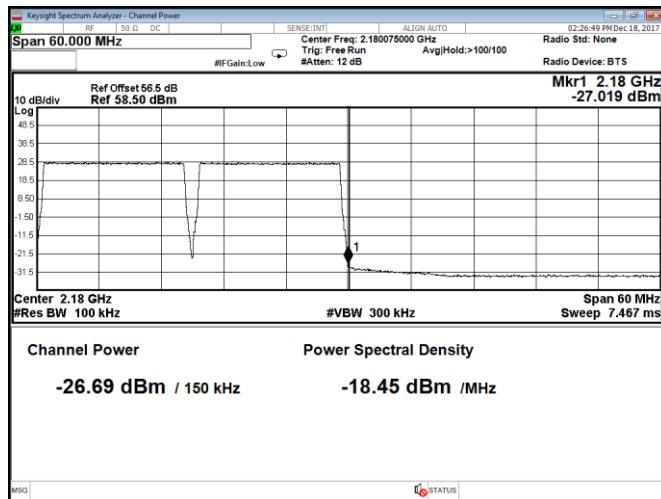


Figure 8.2-141: Conducted band edge emission at 2180 MHz, Port B, 15 MHz channel, 2 carriers, QPSK (RBW = 1% of EBW)

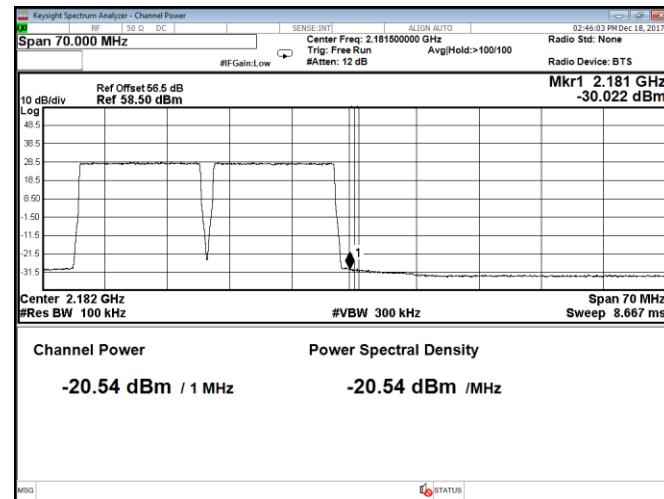


Figure 8.2-142: Conducted band edge emission at 2181 MHz, Port B, 15 MHz channel, 2 carriers, QPSK (RBW = 1 MHz)

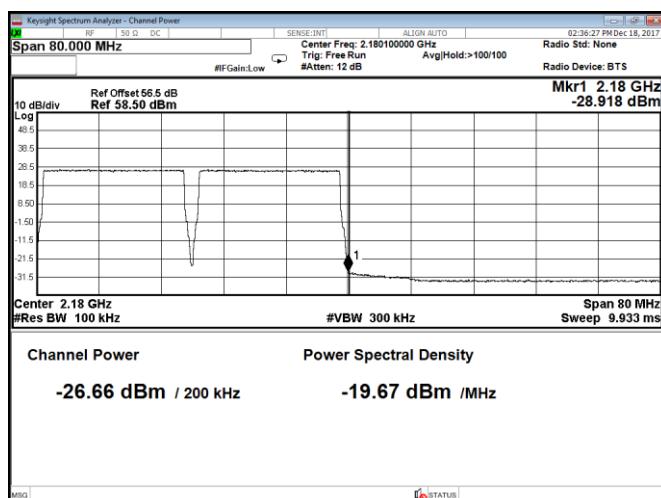


Figure 8.2-143: Conducted band edge emission at 2180 MHz, Port B, 20 MHz channel, 2 carriers, QPSK (RBW = 1% of EBW)

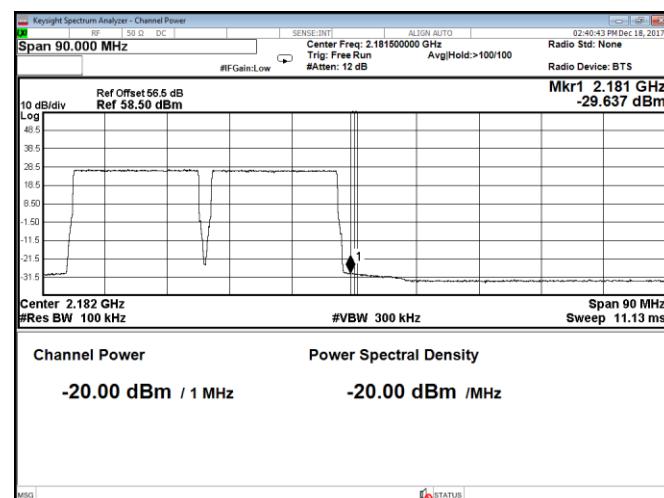


Figure 8.2-144: Conducted band edge emission at 2181 MHz, Port B, 20 MHz channel, 2 carriers, QPSK (RBW = 1 MHz)

Note: On the plots above, channel power measurement results must be below -13 dBm/BW

8.3 FCC 27.53 and RSS-139, 4.2 Radiated spurious emissions

8.3.1 Definitions and limits

FCC:

(h) AWS emission limits

(1) General protection levels. Except as otherwise specified below, for operations in the 1695–1710 MHz, 1710–1755 MHz, 1755–1780 MHz, 1915–1920 MHz, 1995–2000 MHz, 2000–2020 MHz, 2110–2155 MHz, 2155–2180 MHz, and 2180–2200 bands, 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.

(3) Measurement procedure.

(i) Compliance with this provision 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. 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.

(ii) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.

(iii) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

RSS-139, Section 6.6:

i. In the first 1.0 MHz bands immediately outside and adjacent to the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.

ii. After the first 1.0 MHz outside the equipment's smallest operating frequency block, which can contain the equipment's occupied bandwidth, the emission power in any 1 MHz bandwidth shall be attenuated below the transmitter output power P (in dBW) by at least $43 + 10 \log_{10} p$ (watts) dB.

8.3.2 Test summary

Test date	January 4, 2018
Test engineer	David Duchesne
Verdict	Pass

8.3.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.

All measurements were performed using a peak detector.

RBW within 30–1000 MHz was 100 kHz and 1 MHz above 1 GHz. VBW was wider than RBW.

Testing was performed with RF ports terminated with 50 Ohm load.

8.3.4 Test data

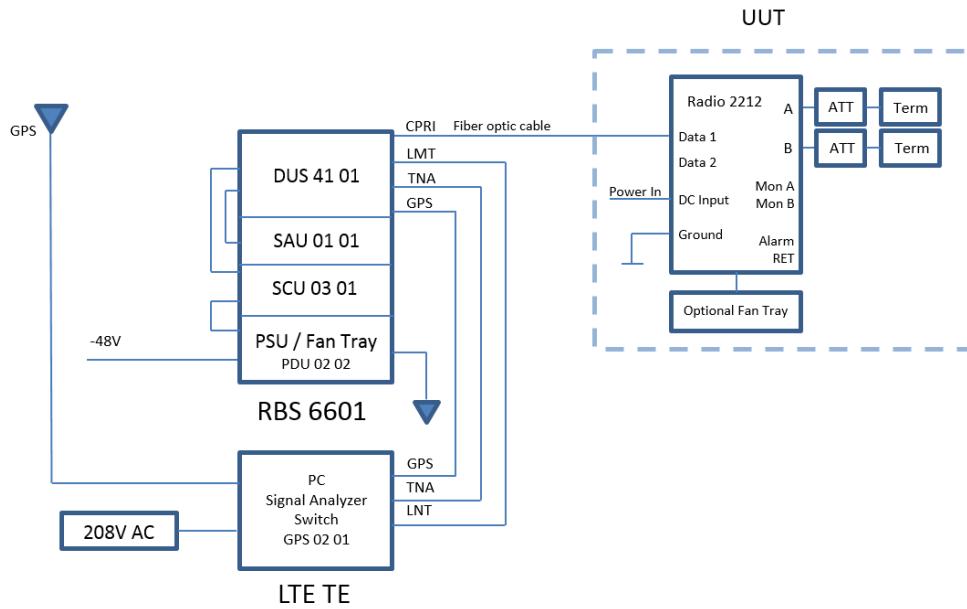


Figure 8.3-1: Set-up Diagram Radiated Spurious Emission



Figure 8.3-2: EUT Set -up for Radiated Compliance Testing – below 1 GHz



Figure 8.3-3: EUT Set -up for Radiated Compliance Testing – above 1 GHz

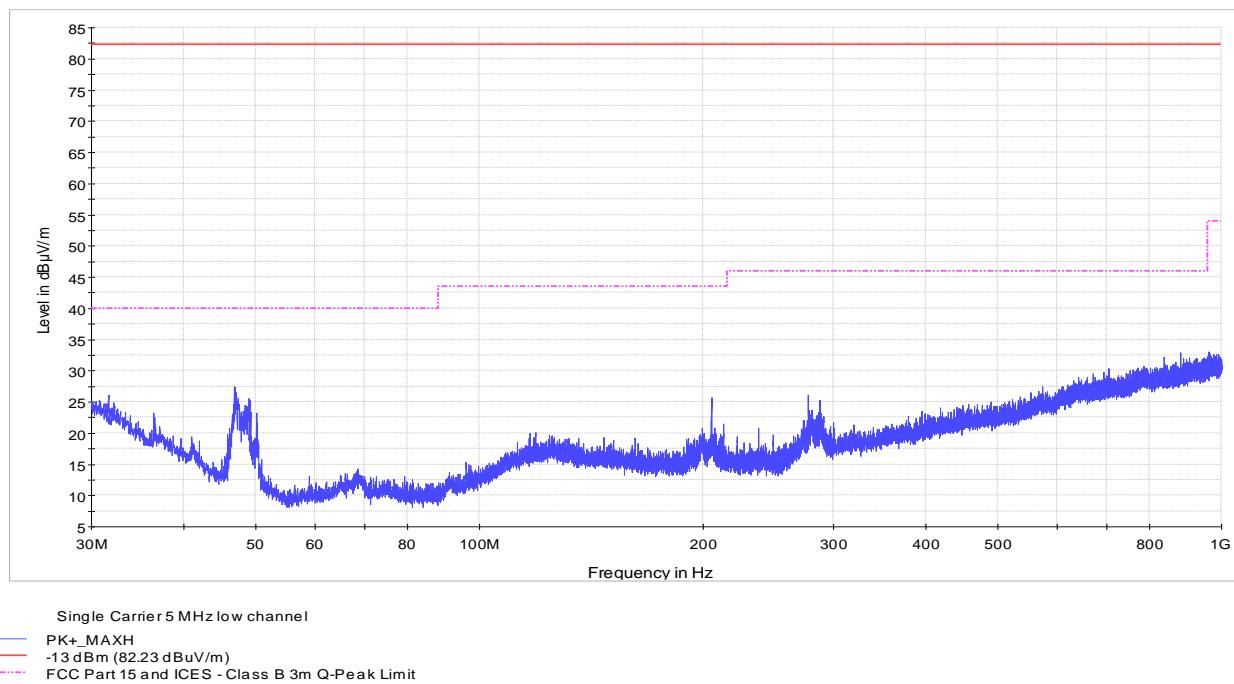


Figure 8.3-4: Radiated spurious emission below 1 GHz for single carrier operation

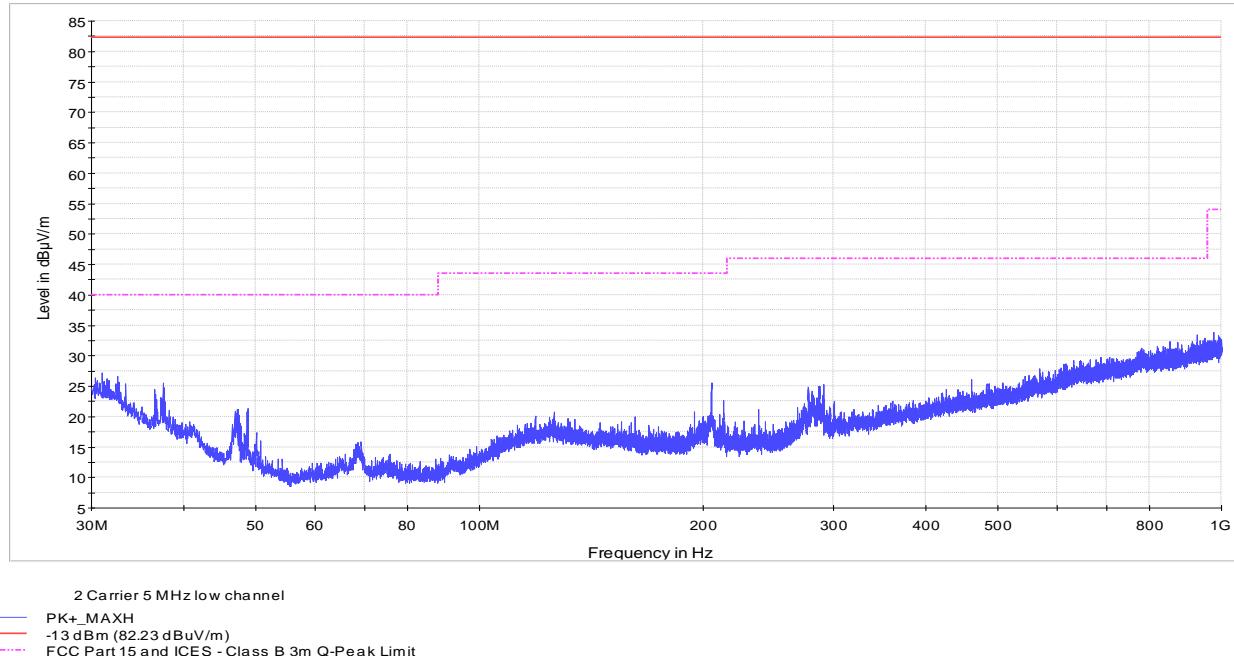
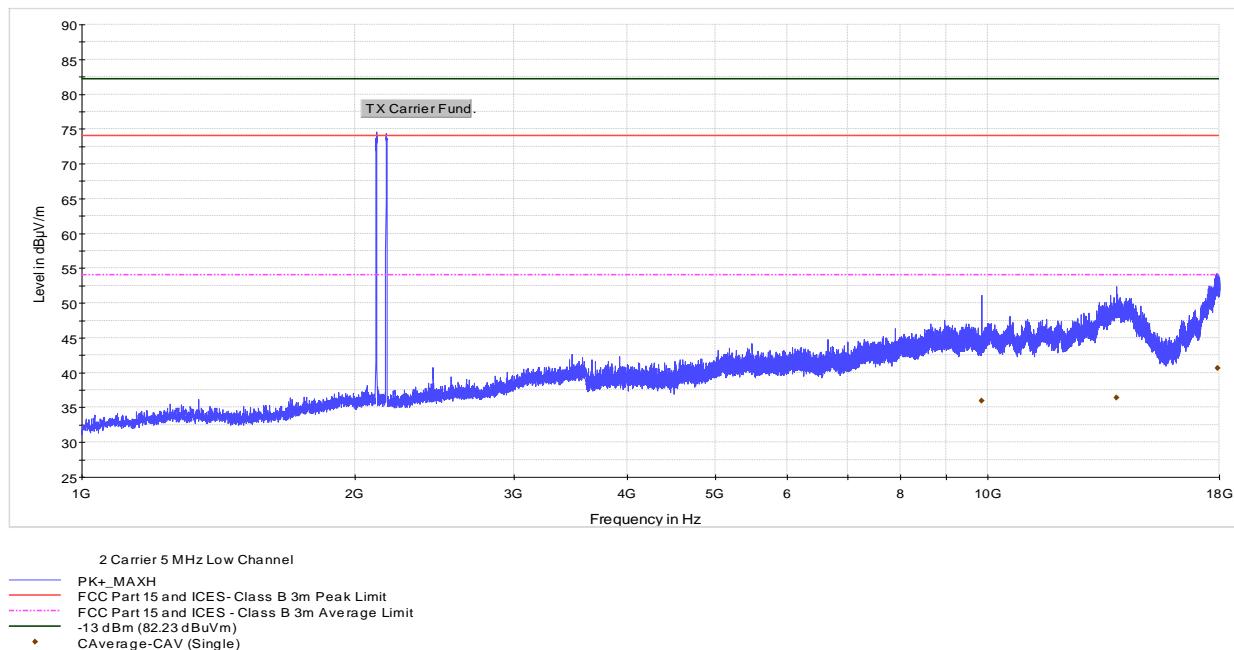
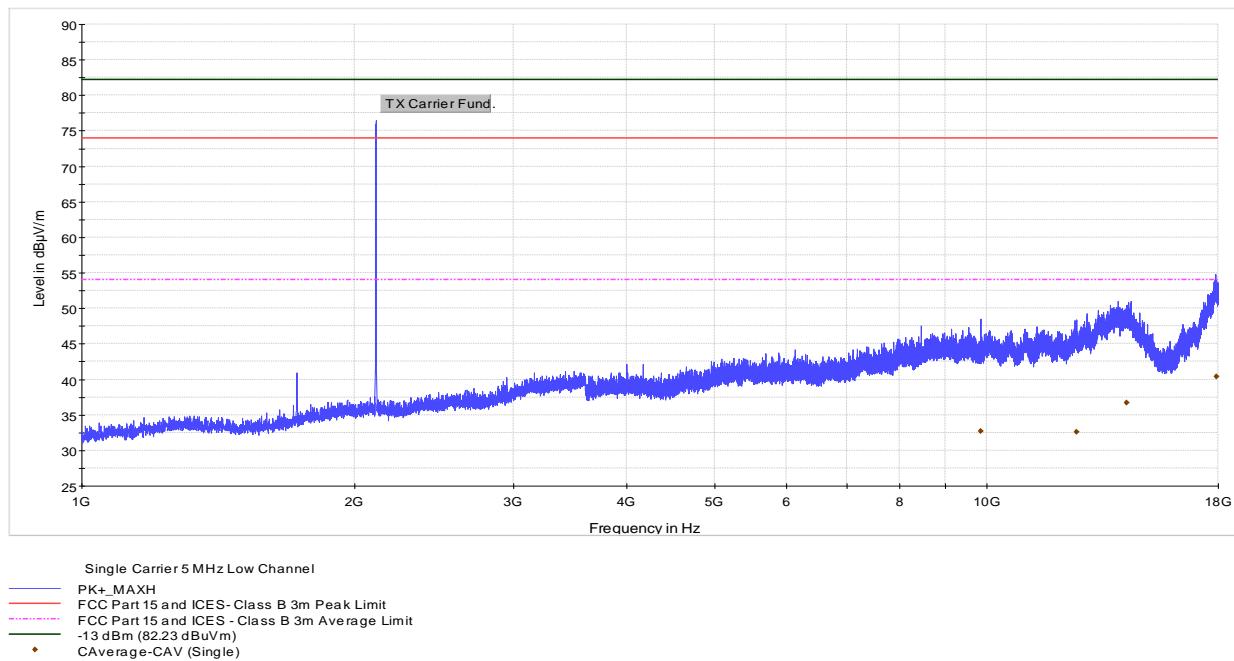


Figure 8.3-5: Radiated spurious emission below 1 GHz for two carriers operation



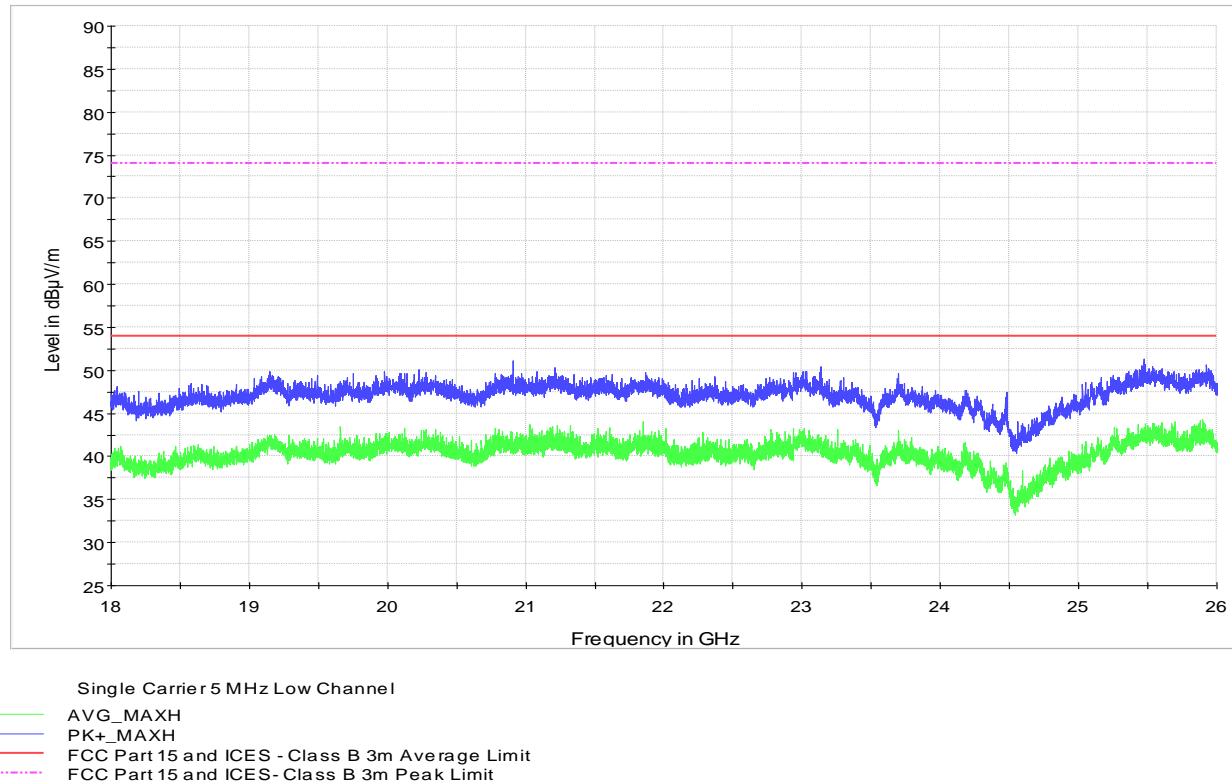


Figure 8.3-8: Radiated spurious emission within 18–26 GHz, for single carrier operation

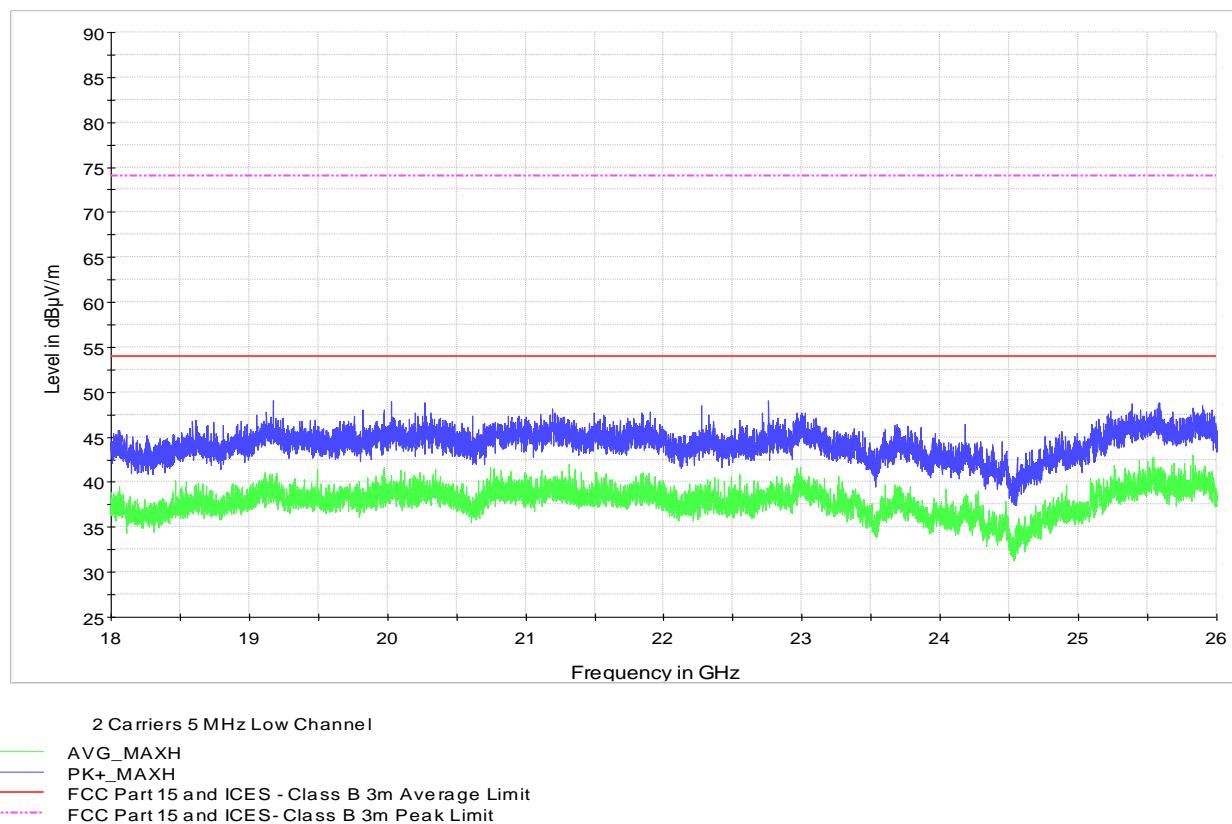


Figure 8.3-9: Radiated spurious emission within 18–26 GHz, for two carriers operation

8.4 FCC 27.54 and RSS-139, Section 6.4 Frequency stability

8.4.1 Definitions and limits

FCC:

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

RSS-139, Section 6.4:

The frequency stability shall be sufficient to ensure that the occupied bandwidth stays within the operating frequency block when tested to the temperature and supply voltage variations specified in RSS-Gen.

8.4.2 Test summary

Test date	December 19, 2017
Test engineer	Andrey Adelberg
Verdict	Pass

8.4.3 Observations, settings and special notes

26 dBc points including frequency tolerance were assessed to remain within assigned band.

Spectrum analyzer was used to demodulate the signal from the EUT and to provide measurement information of the frequency drift.

8.4.4 Test data

Table 8.4-1: Frequency error results

Temperature, °C	Voltage, V _{DC}	Frequency error, Hz
+50	48.0	+3.08
+40	48.0	+2.66
+30	48.0	+3.71
+20	55.2*	+3.41
+20	48.0	+3.19
+20	40.8*	+4.47
+10	48.0	+3.26
0	48.0	+3.41
-10	48.0	+3.52
-20	48.0	+3.54
-30	48.0	+3.47

Max negative drift: 0 Hz, Max positive drift: +4.47 Hz

* Extreme voltages were calculated as follows: $48 V_{DC_nom} \pm 15\% = 40.8 - 55.2 V_{DC}$.

26 dB bandwidth of the emissions is contained within the allocated authorized band and is situated few hundreds of kilohertz away from the closest band edges. Maximum temperature inflicted frequency drift of a fundamental was less than 4.5 Hz.

8.5 FCC Part 2.1049 and RSS-Gen, 6.6 Occupied bandwidth

8.5.1 Definitions and limits

FCC:

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.

RSS-Gen, 6.6

The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated \times dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3 \times the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.

The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3 \times RBW.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

8.5.2 Test summary

Test date	December 19, 2017
Test engineer	Andrey Adelberg
Verdict	Pass

8.5.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	$\geq 1\%$ of span
Video bandwidth	RBW $\times 3$
Trace mode	Max Hold

8.5.4 Test data

Table 8.5-1: Occupied bandwidth results

Remarks	Frequency, MHz	99% OBW, MHz	26 dB BW, MHz
5 MHz, QPSK, Port A, QPSK	2112.5	4.477	4.728
5 MHz, QPSK, Port A, QPSK	2145.0	4.476	4.726
5 MHz, QPSK, Port A, QPSK	2177.5	4.481	4.739
5 MHz, QPSK, Port B, QPSK	2112.5	4.477	4.730
5 MHz, QPSK, Port B, QPSK	2145.0	4.479	4.736
5 MHz, QPSK, Port B, QPSK	2177.5	4.479	4.738
5 MHz, QPSK, Port A, 16QAM	2112.5	4.461	4.718
5 MHz, QPSK, Port B, 16QAM	2112.5	4.464	4.712
5 MHz, QPSK, Port A, 64QAM	2112.5	4.479	4.712
5 MHz, QPSK, Port B, 64QAM	2112.5	4.473	4.729
5 MHz, QPSK, Port A, 256QAM	2112.5	4.480	4.729
5 MHz, QPSK, Port B, 256QAM	2112.5	4.476	4.749
10 MHz, QPSK, Port A, QPSK	2115.0	8.929	9.347
10 MHz, QPSK, Port A, QPSK	2145.0	8.931	9.379
10 MHz, QPSK, Port A, QPSK	2175.0	8.934	9.384
10 MHz, QPSK, Port B, QPSK	2115.0	8.929	9.333
10 MHz, QPSK, Port B, QPSK	2145.0	8.932	9.338
10 MHz, QPSK, Port B, QPSK	2175.0	8.930	9.355
15 MHz, QPSK, Port A, QPSK	2117.5	13.384	13.880
15 MHz, QPSK, Port A, QPSK	2145.0	13.379	13.900
15 MHz, QPSK, Port A, QPSK	2172.5	13.379	13.860
15 MHz, QPSK, Port B, QPSK	2117.5	13.384	13.880
15 MHz, QPSK, Port B, QPSK	2145.0	13.380	13.860
15 MHz, QPSK, Port B, QPSK	2172.5	13.384	13.880
20 MHz, QPSK, Port A, QPSK	2120.0	17.835	18.420
20 MHz, QPSK, Port A, QPSK	2145.0	17.831	18.430
20 MHz, QPSK, Port A, QPSK	2170.0	17.843	18.470
20 MHz, QPSK, Port B, QPSK	2120.0	17.846	18.440
20 MHz, QPSK, Port B, QPSK	2145.0	17.838	18.510
20 MHz, QPSK, Port B, QPSK	2170.0	17.845	18.480

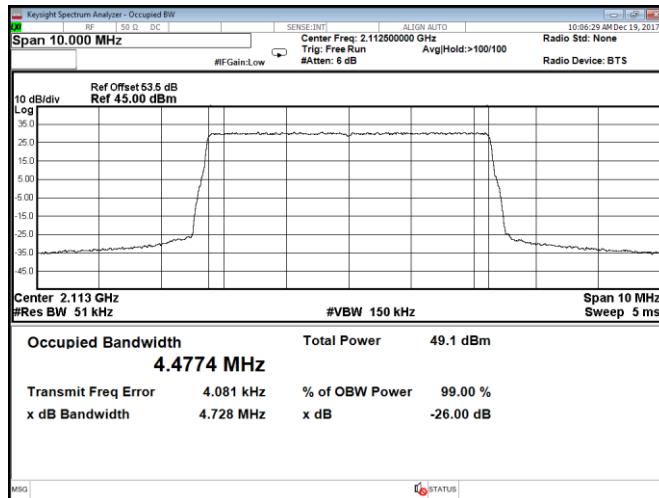


Figure 8.5-1: Occupied bandwidth, QPSK, 5 MHz, Port A, Low channel

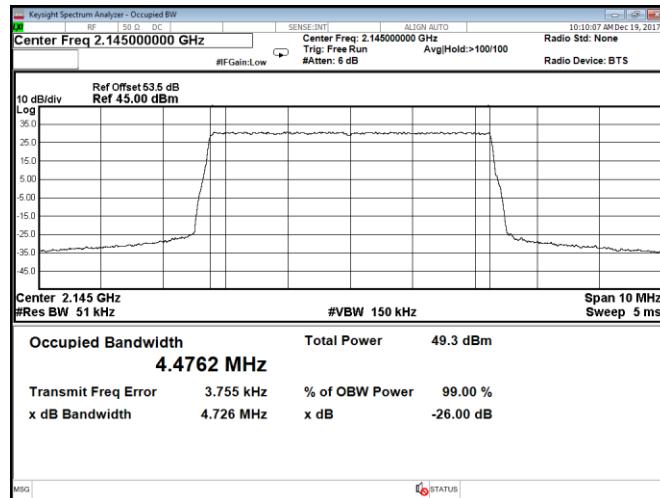


Figure 8.5-2: Occupied bandwidth, QPSK, 5 MHz, Port A, Mid channel

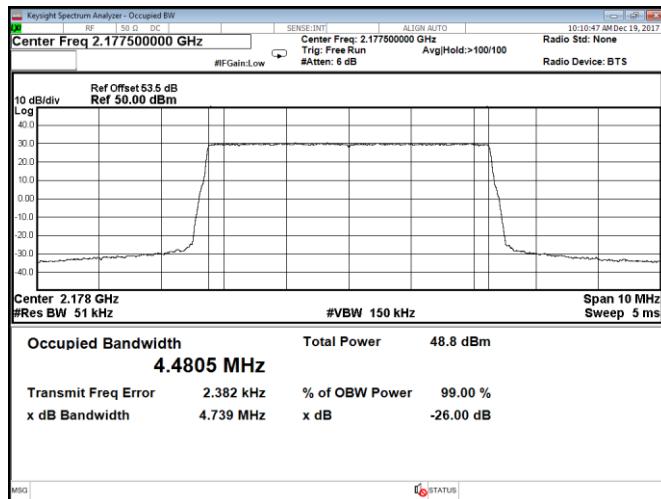


Figure 8.5-3: Occupied bandwidth, QPSK, 5 MHz, Port A, High channel

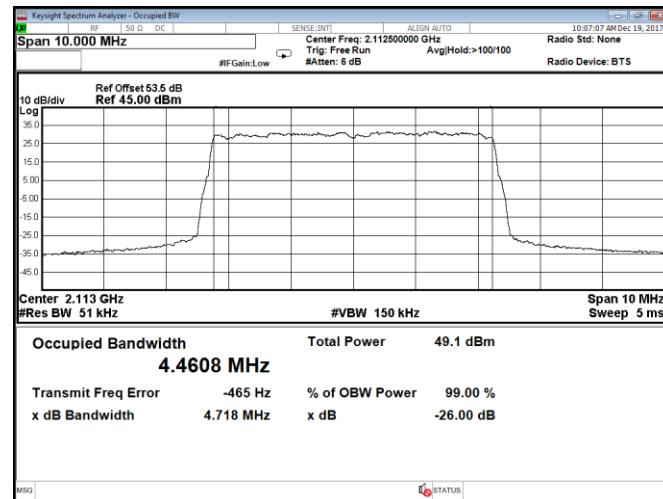


Figure 8.5-4: Occupied bandwidth, 16QAM, 5 MHz, Port A, Low channel

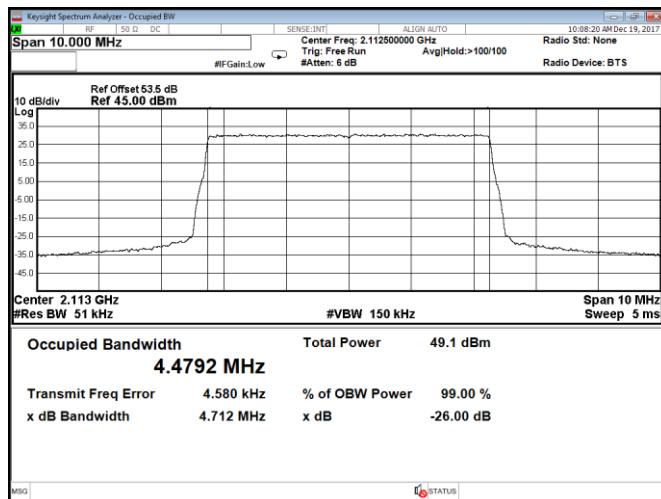


Figure 8.5-5: Occupied bandwidth, 64QAM, 5 MHz, Port A, Low channel

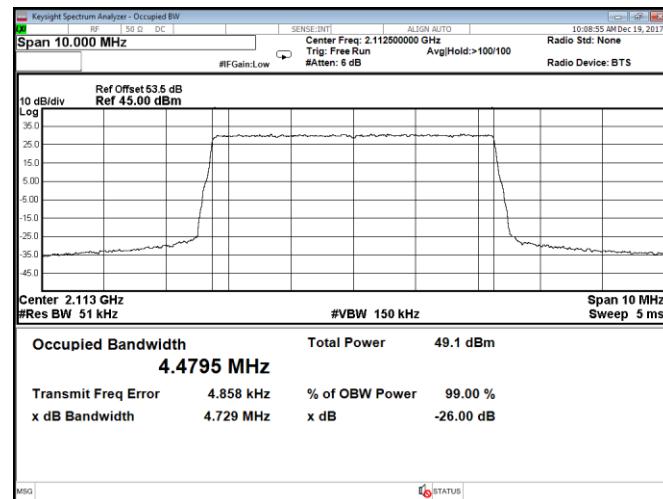


Figure 8.5-6: Occupied bandwidth, 256QAM, 5 MHz, Port A, Low channel

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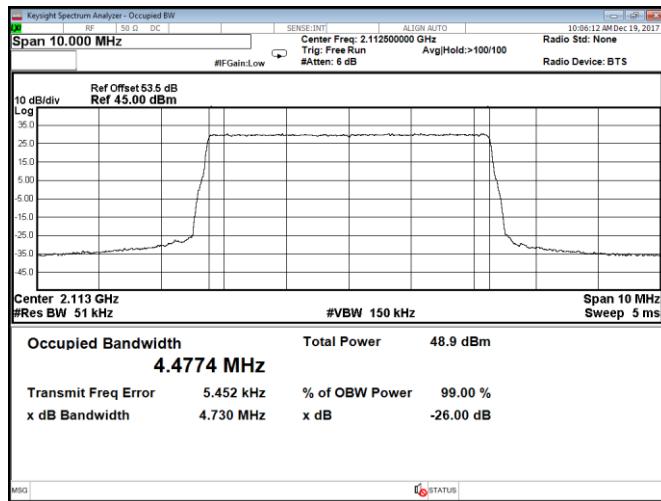


Figure 8.5-7: Occupied bandwidth, QPSK, 5 MHz, Port B, Low channel

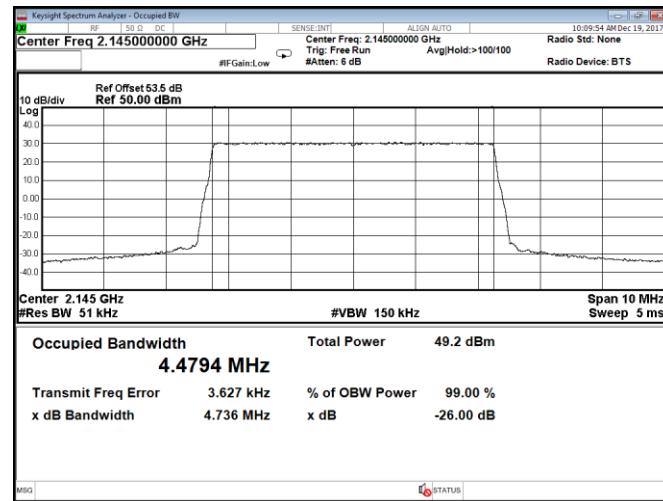


Figure 8.5-8: Occupied bandwidth, QPSK, 5 MHz, Port B, Mid channel

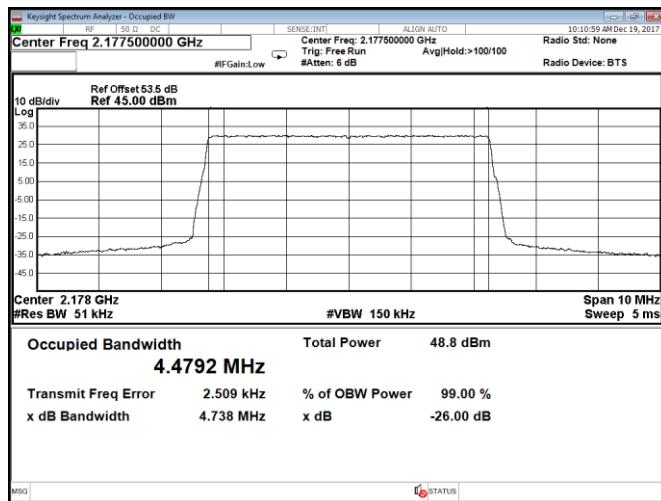


Figure 8.5-9: Occupied bandwidth, QPSK, 5 MHz, Port B, High channel

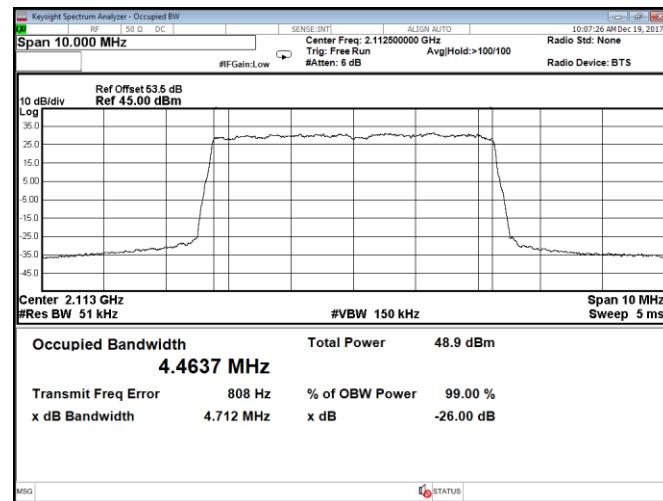


Figure 8.5-10: Occupied bandwidth, 16QAM, 5 MHz, Port B, Low channel

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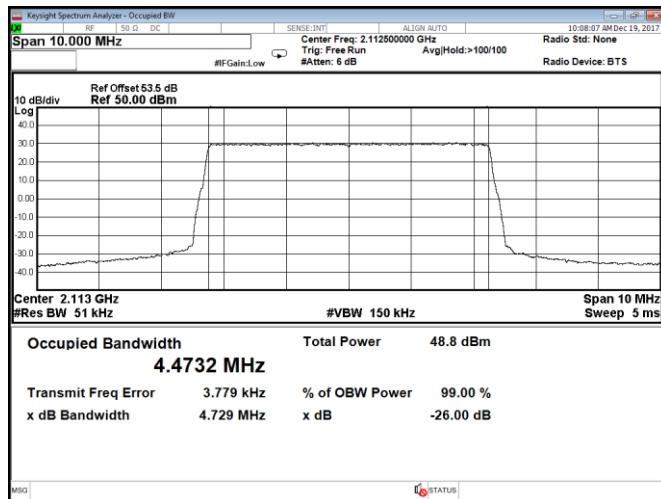


Figure 8.5-11: Occupied bandwidth, 64QAM, 5 MHz, Port B, Low channel

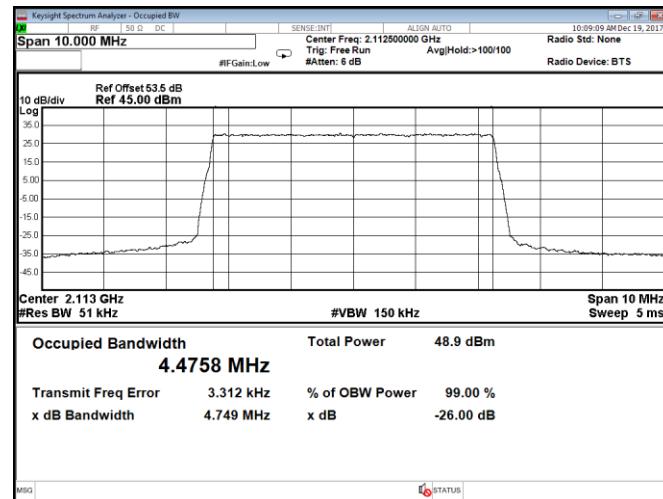


Figure 8.5-12: Occupied bandwidth, 256QAM, 5 MHz, Port B, Low channel

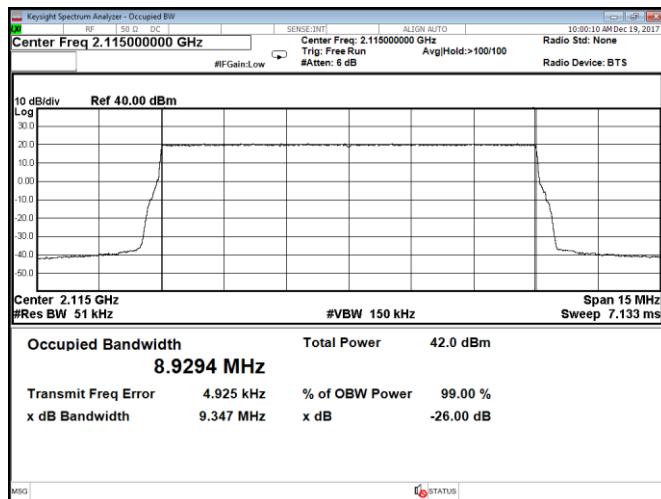


Figure 8.5-13: Occupied bandwidth, QPSK, 10 MHz, Port A, Low channel

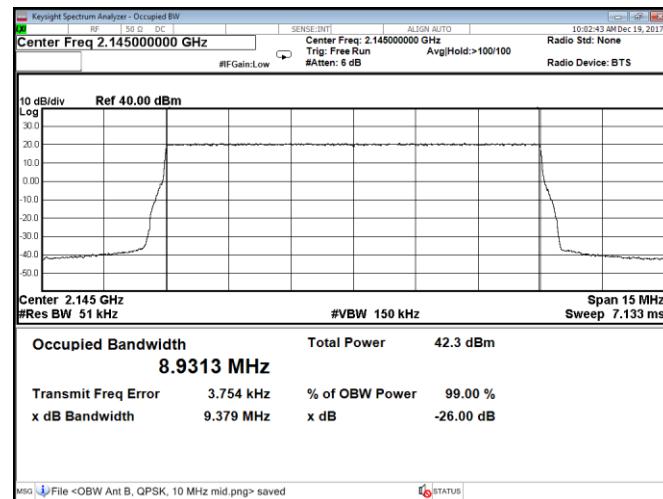


Figure 8.5-14: Occupied bandwidth, QPSK, 10 MHz, Port A, Mid channel

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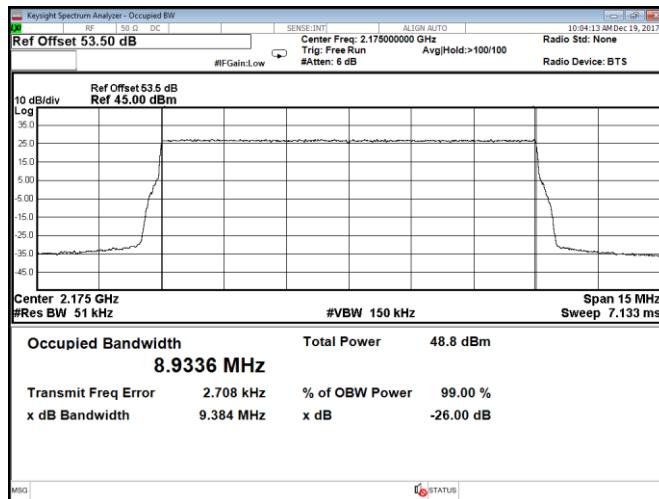


Figure 8.5-15: Occupied bandwidth, QPSK, 10 MHz, Port A, High channel

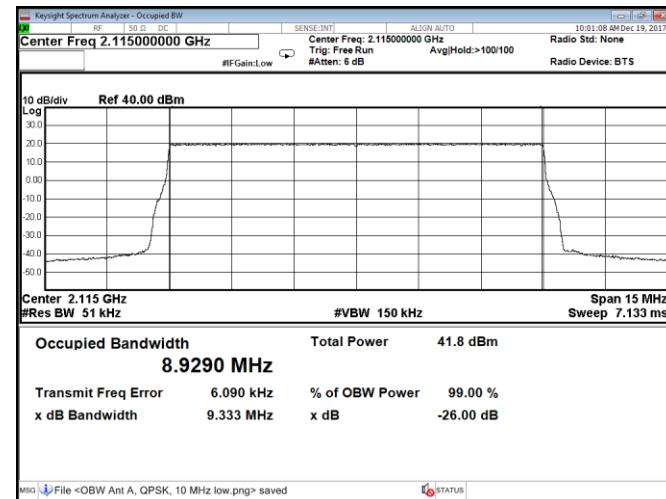


Figure 8.5-16: Occupied bandwidth, QPSK, 10 MHz, Port B, Low channel

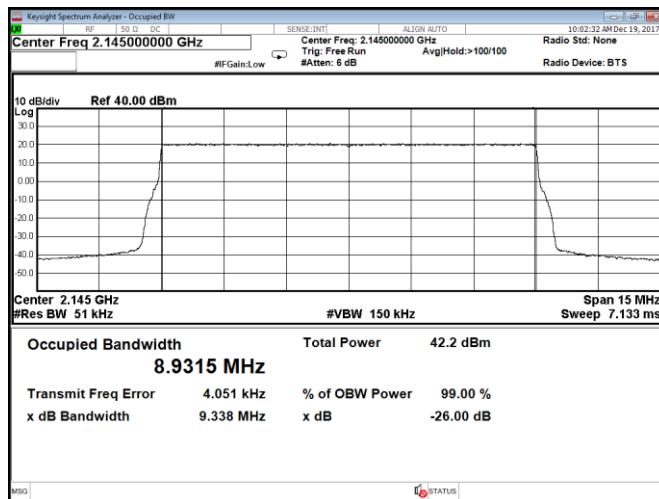


Figure 8.5-17: Occupied bandwidth, QPSK, 510 MHz, Port B, Mid channel

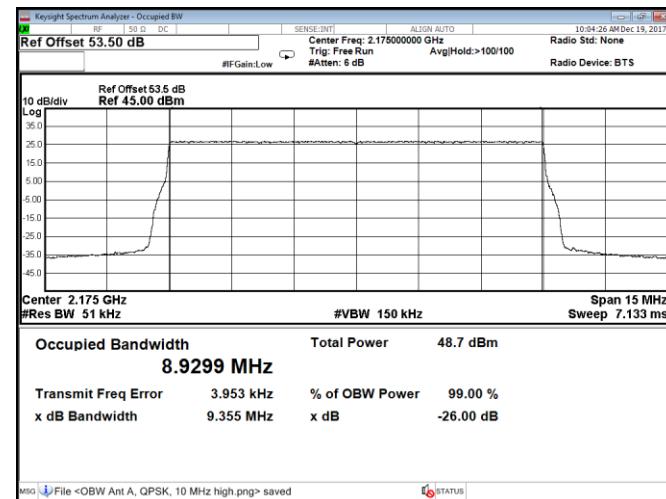


Figure 8.5-18: Occupied bandwidth, QPSK, 10 MHz, Port B, High channel

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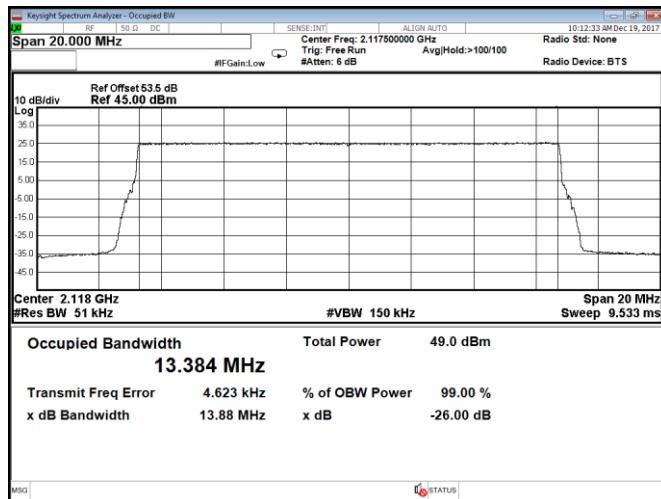


Figure 8.5-19: Occupied bandwidth, QPSK, 15 MHz, Port A, Low channel

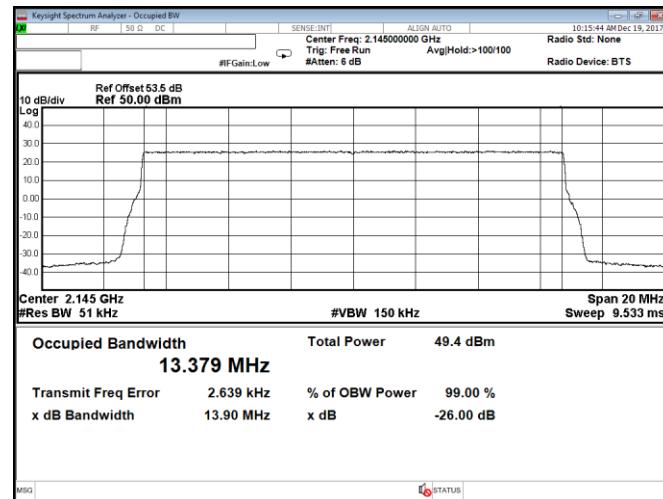


Figure 8.5-20: Occupied bandwidth, QPSK, 15 MHz, Port A, Mid channel

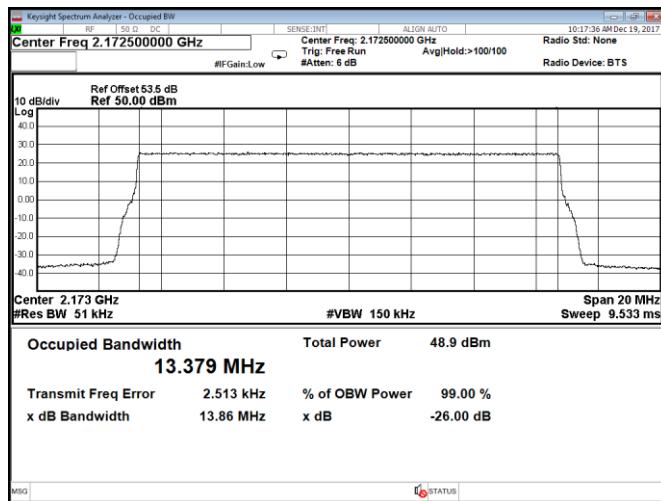


Figure 8.5-21: Occupied bandwidth, QPSK, 15 MHz, Port A, High channel

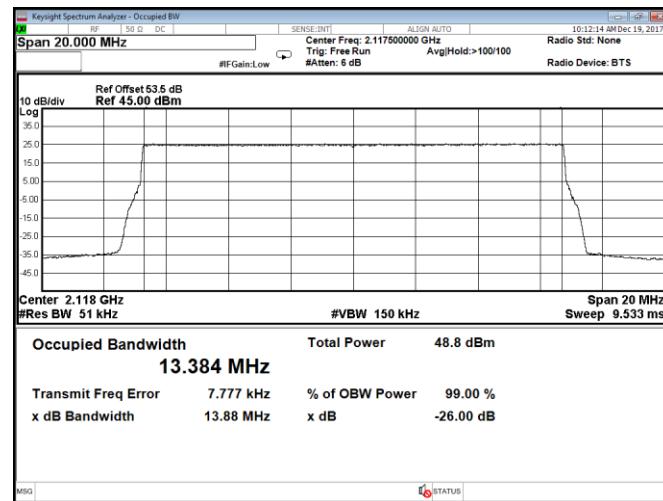


Figure 8.5-22: Occupied bandwidth, QPSK, 15 MHz, Port B, Low channel

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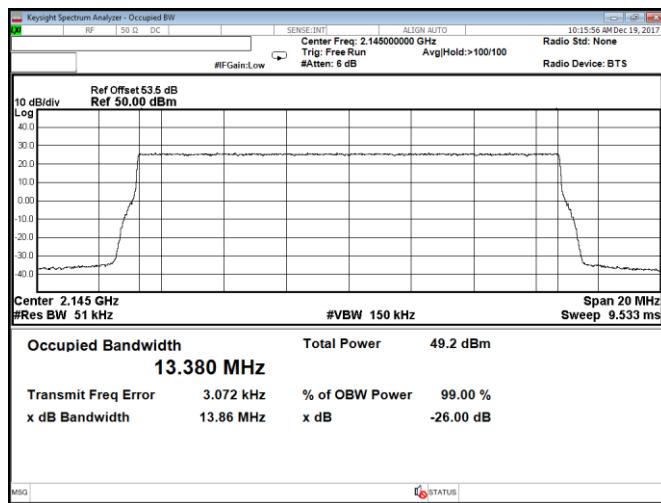


Figure 8.5-23: Occupied bandwidth, QPSK, 15 MHz, Port B, Mid channel

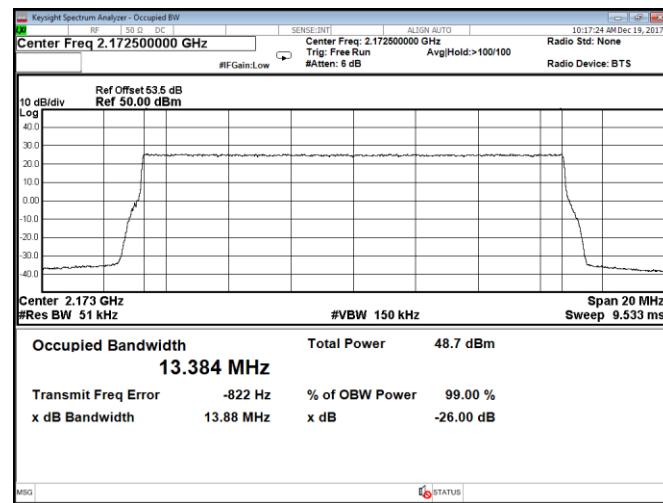


Figure 8.5-24: Occupied bandwidth, QPSK, 15 MHz, Port B, High channel

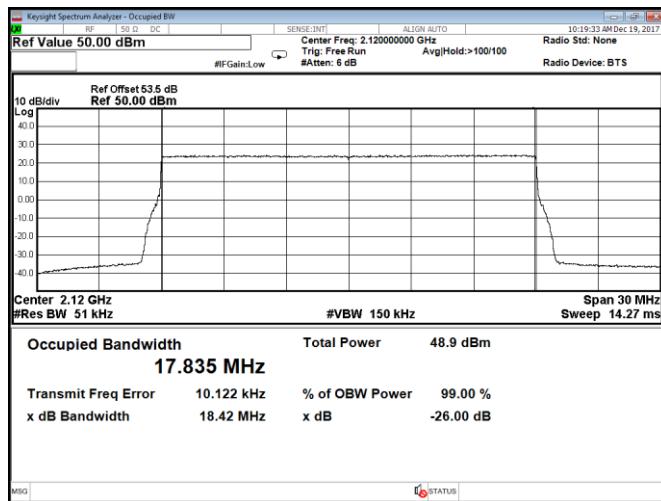


Figure 8.5-25: Occupied bandwidth, QPSK, 20 MHz, Port A, Low channel

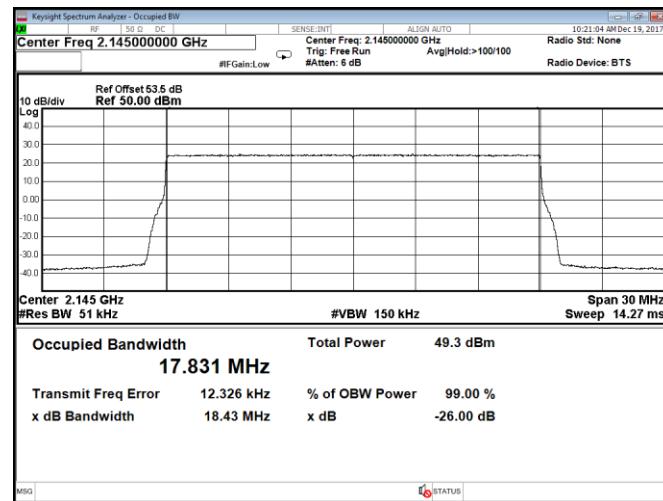


Figure 8.5-26: Occupied bandwidth, QPSK, 20 MHz, Port A, Mid channel

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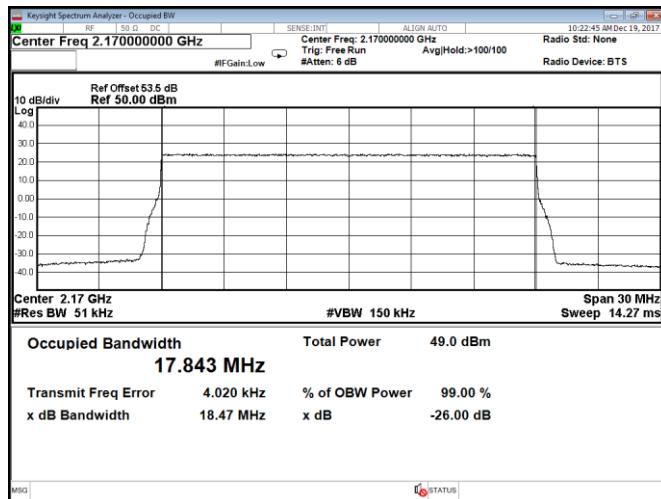


Figure 8.5-27: Occupied bandwidth, QPSK, 20 MHz, Port A, High channel

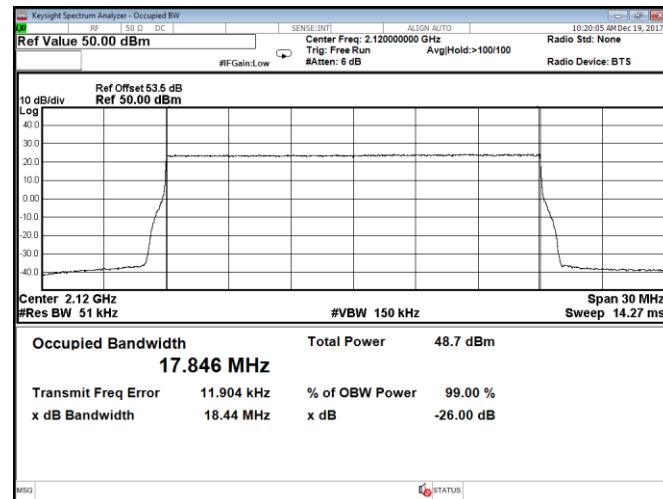


Figure 8.5-28: Occupied bandwidth, QPSK, 20 MHz, Port B, Low channel

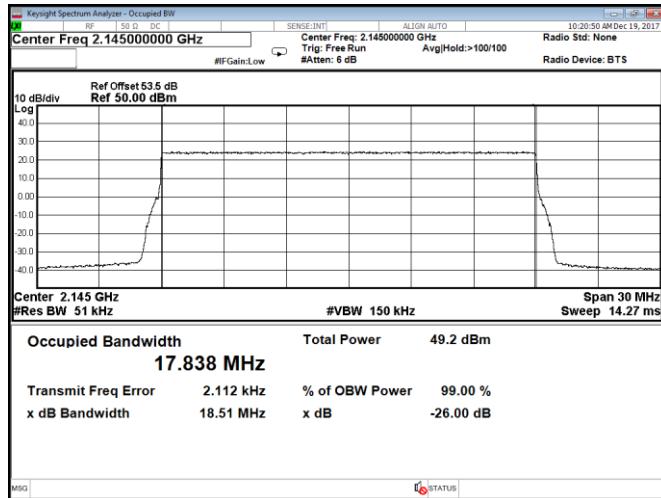


Figure 8.5-29: Occupied bandwidth, QPSK, 20 MHz, Port B, Mid channel

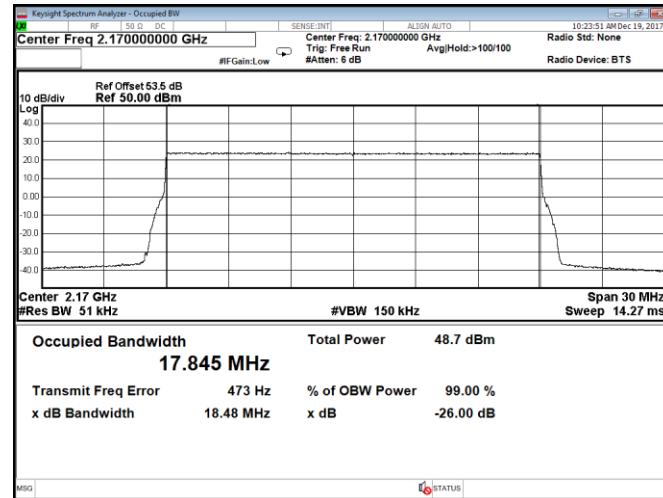
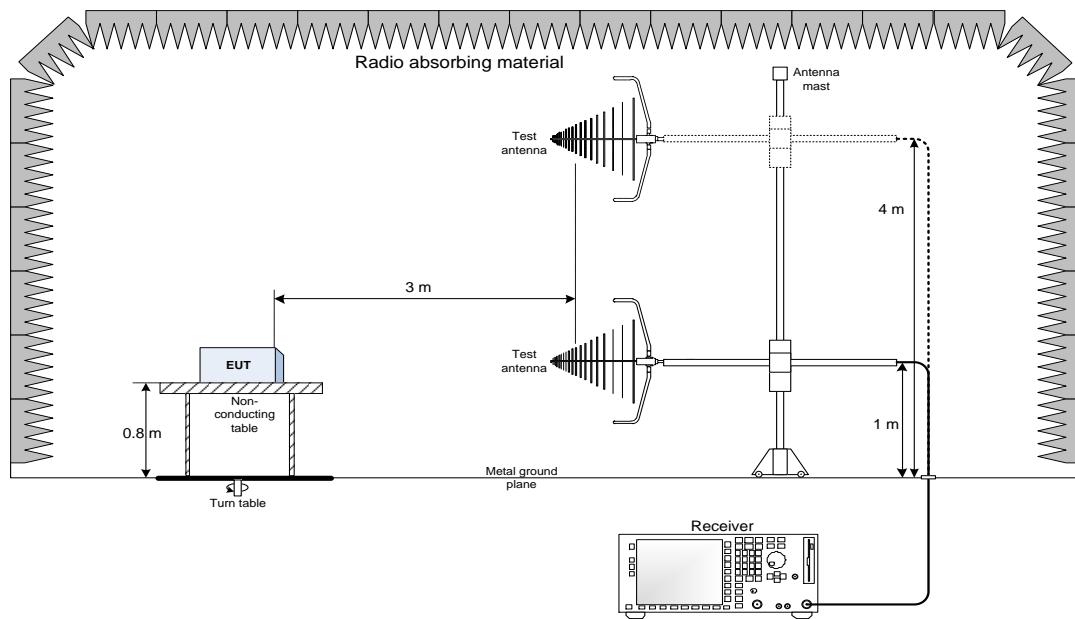


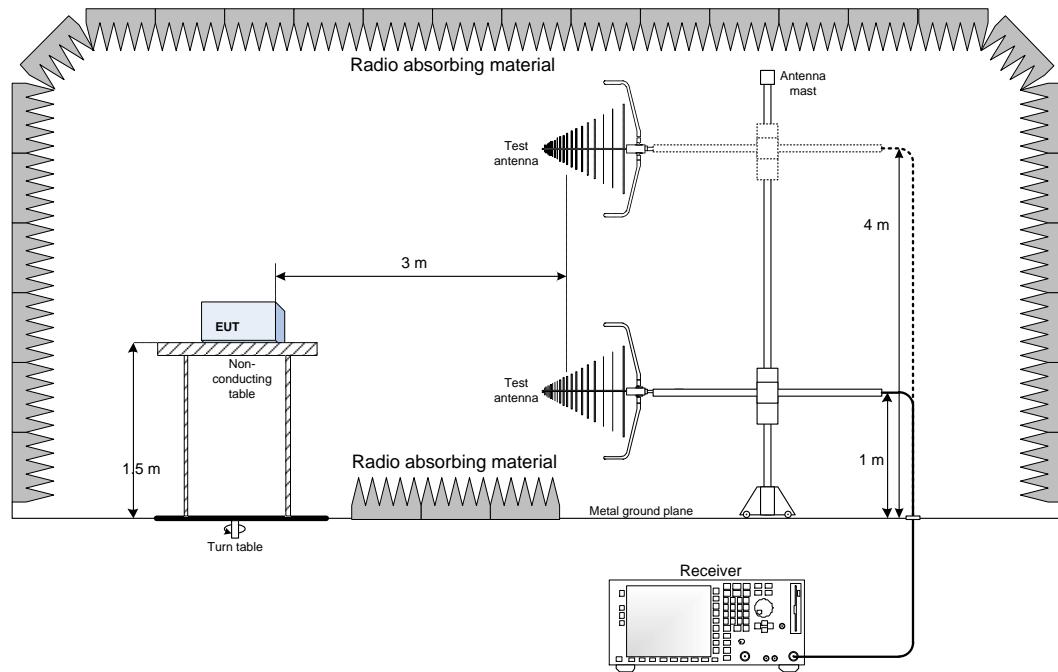
Figure 8.5-30: Occupied bandwidth, QPSK, 20 MHz, Port B, High channel

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up

