

Figure 8.2-41: Conducted spurious emissions above 3.6 GHz, QPSK, 15 MHz, mid channel

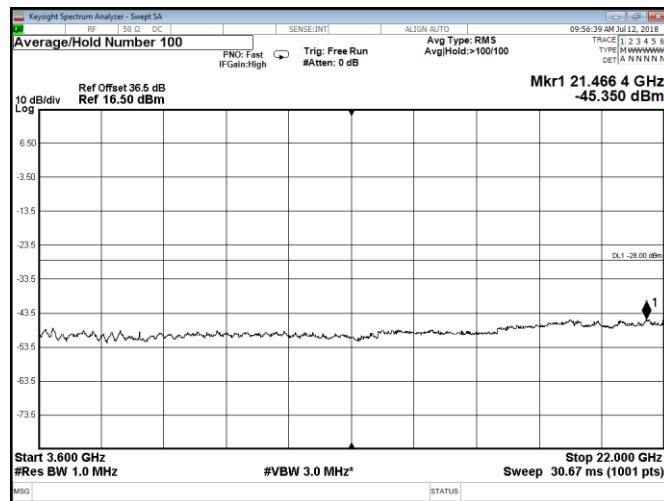


Figure 8.2-42: Conducted spurious emissions above 3.6 GHz, QPSK, 15 MHz, high channel

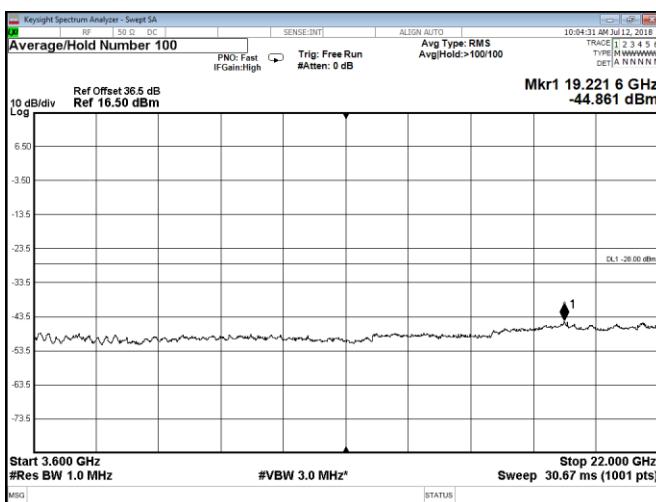


Figure 8.2-43: Conducted spurious emissions above 3.6 GHz, QPSK, 20 MHz, low channel

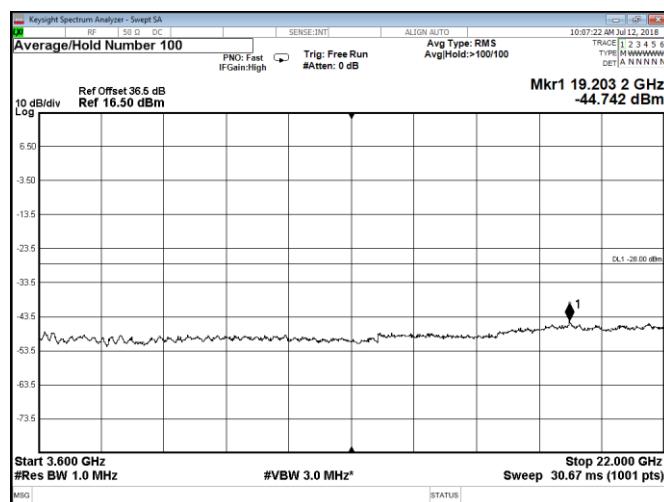


Figure 8.2-44: Conducted spurious emissions above 3.6 GHz, 16QAM, 20 MHz, low channel

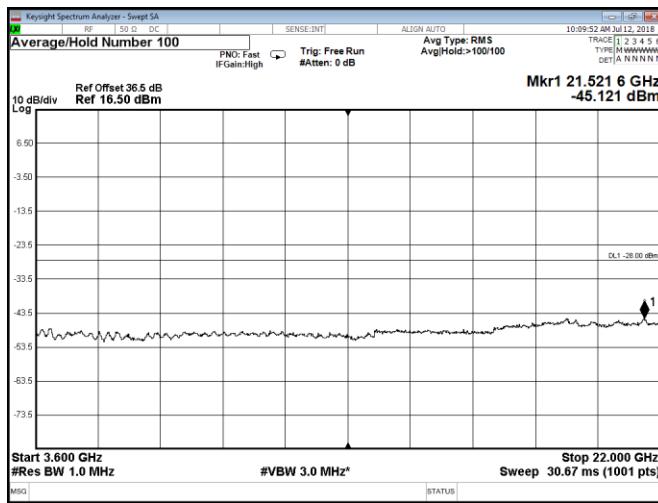


Figure 8.2-45: Conducted spurious emissions above 3.6 GHz, 64QAM, 20 MHz, low channel

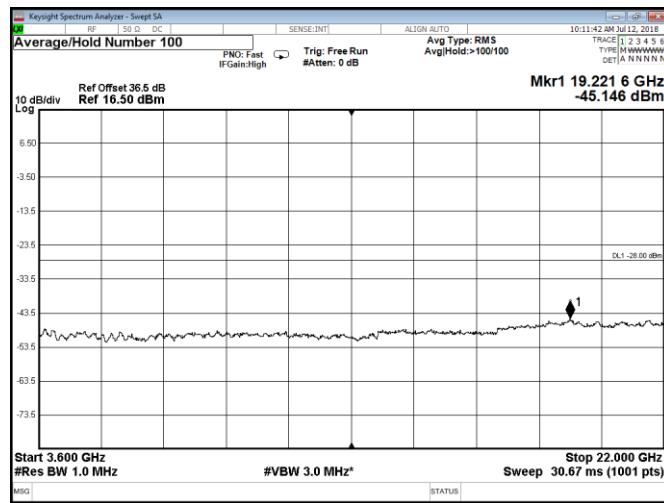


Figure 8.2-46: Conducted spurious emissions above 3.6 GHz, 256QAM, 20 MHz, low channel

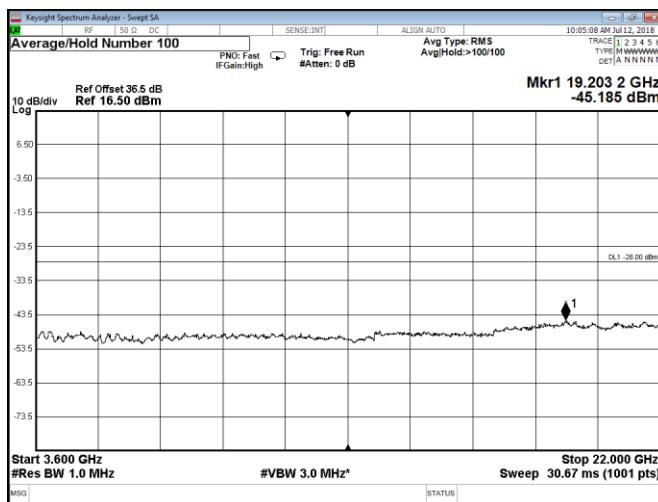


Figure 8.2-47: Conducted spurious emissions above 3.6 GHz, QPSK, 20 MHz, mid channel

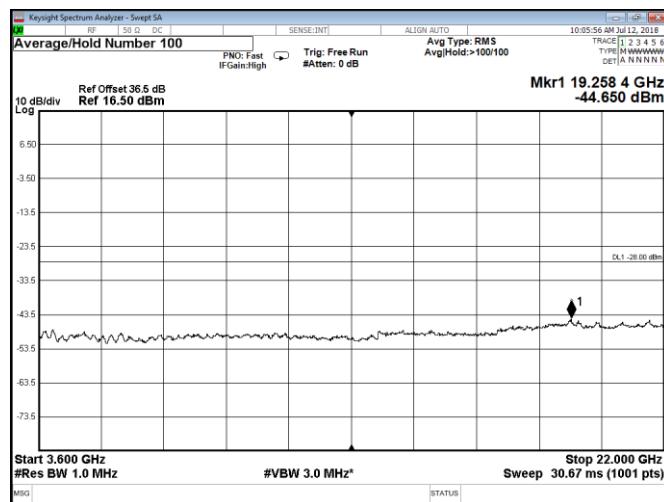


Figure 8.2-48: Conducted spurious emissions above 3.6 GHz, QPSK, 20 MHz, high channel

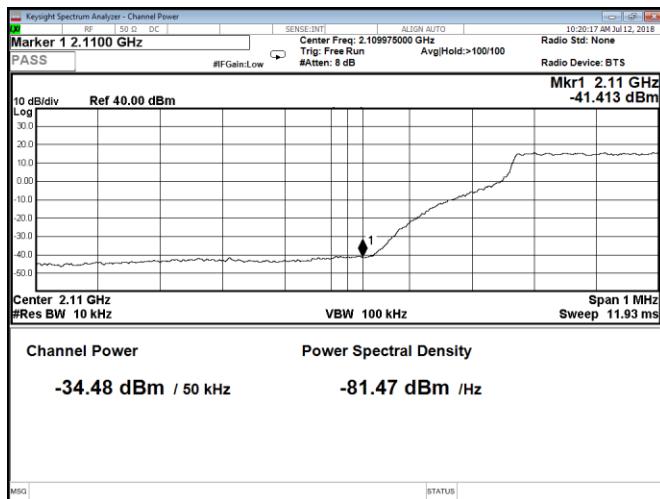


Figure 8.2-49: Conducted band edge emission at 2110 MHz, 5 MHz, QPSK (RBW = 1% of EBW)

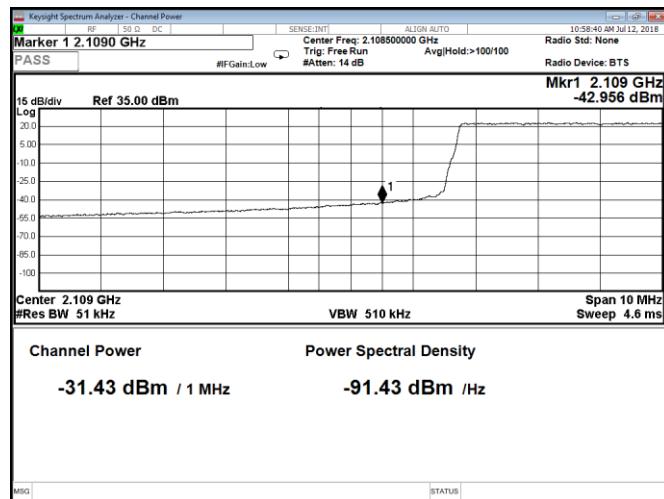


Figure 8.2-50: Conducted band edge emission at 2109 MHz, 5 MHz, QPSK (RBW = 1 MHz)

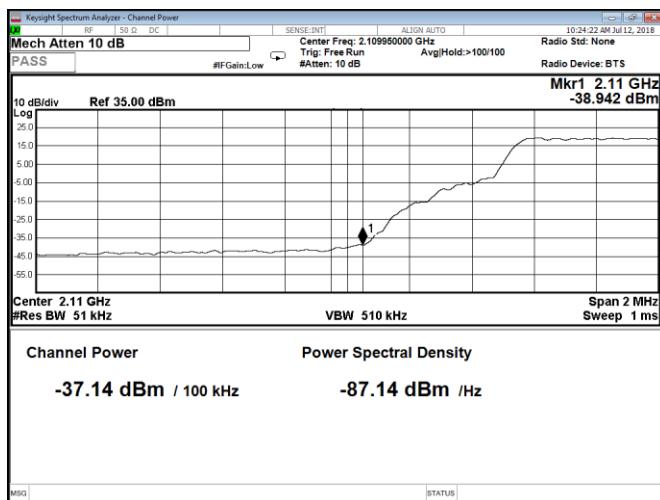


Figure 8.2-51: Conducted band edge emission at 2110 MHz, 10 MHz, QPSK (RBW = 1% of EBW)

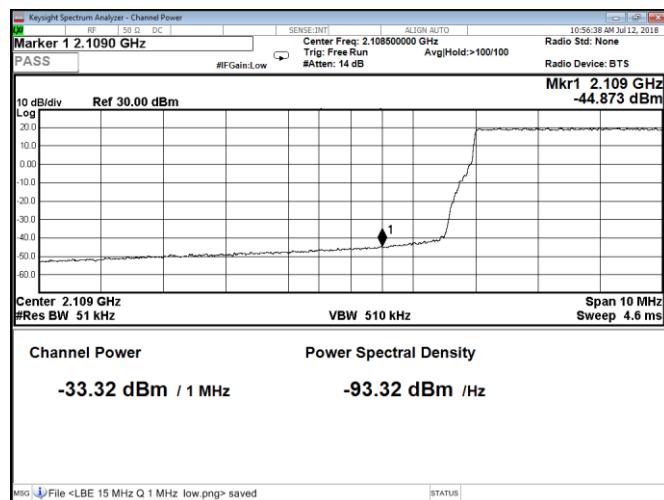
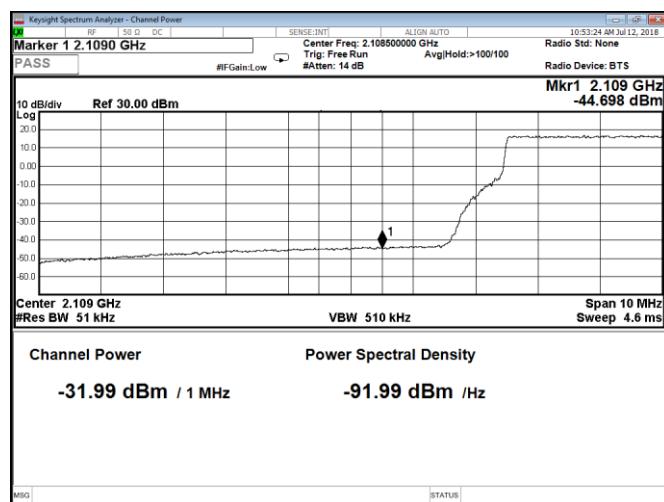
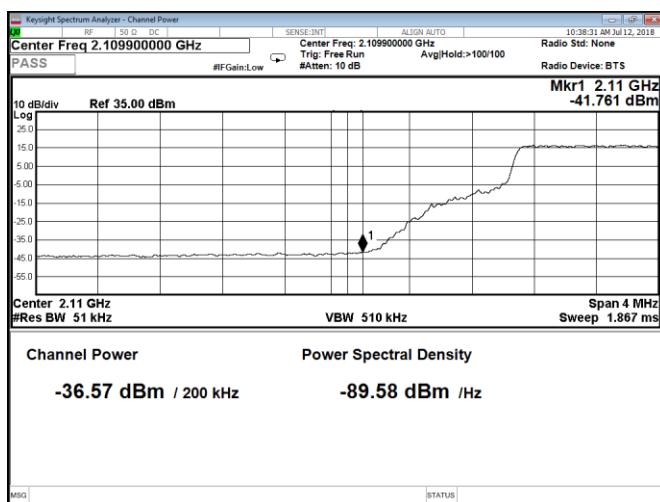
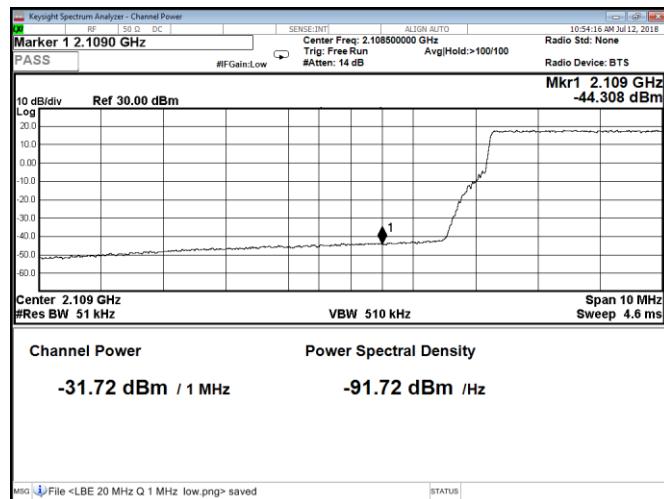
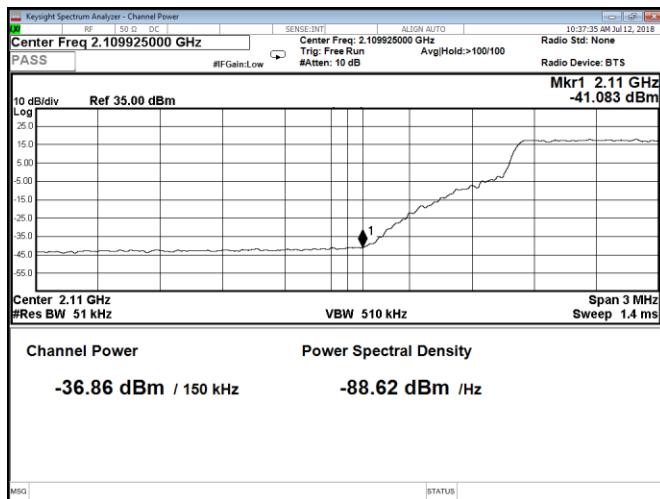


Figure 8.2-52: Conducted band edge emission at 2109 MHz, 10 MHz, QPSK (RBW = 1 MHz)



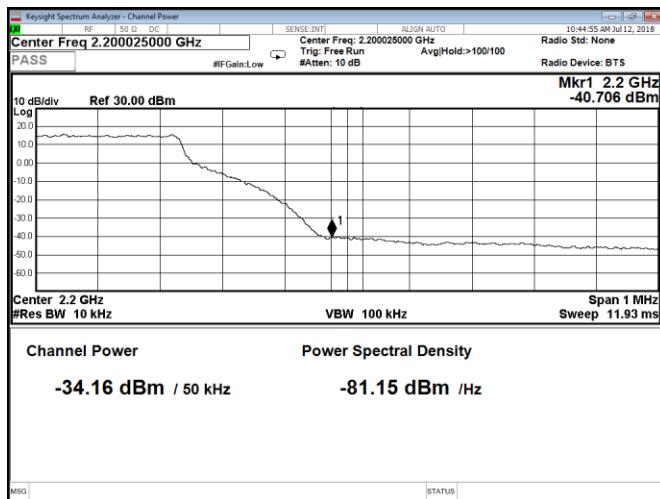


Figure 8.2-57: Conducted band edge emission at 2200 MHz, 5 MHz, QPSK (RBW = 1% of EBW)

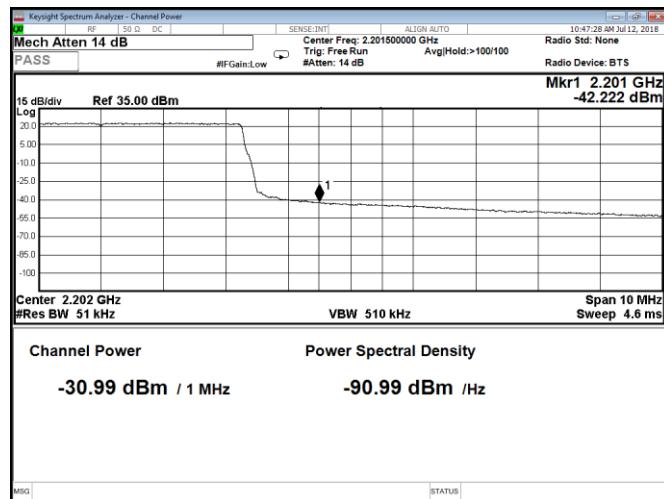


Figure 8.2-58: Conducted band edge emission at 2201 MHz, 5 MHz, QPSK (RBW = 1 MHz)

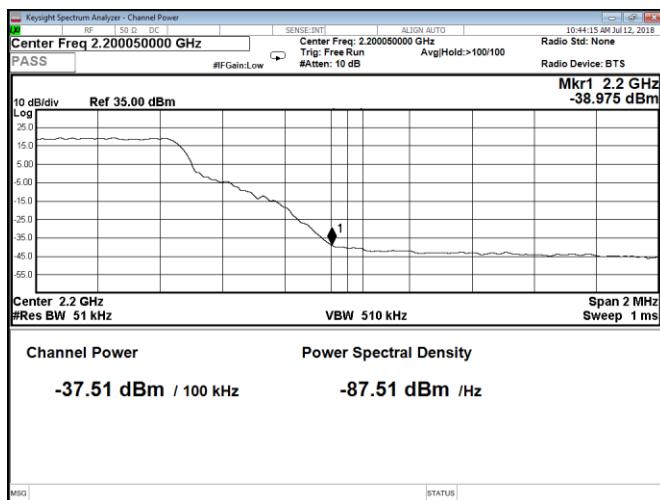


Figure 8.2-59: Conducted band edge emission at 2200 MHz, 10 MHz, QPSK (RBW = 1% of EBW)

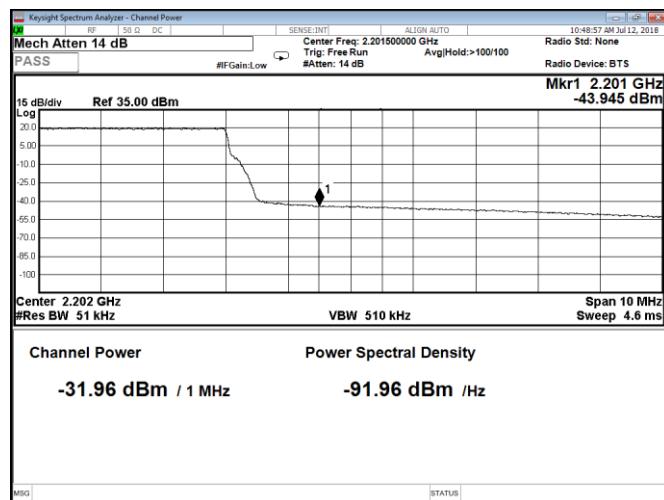


Figure 8.2-60: Conducted band edge emission at 2201 MHz, 10 MHz, QPSK (RBW = 1 MHz)

Section 8
Test name
Specification

Testing data
 Clause 27.53 and RSS-139, 4.2 Spurious emissions at RF antenna connector
 FCC Part 27, RSS-139, Issue 3

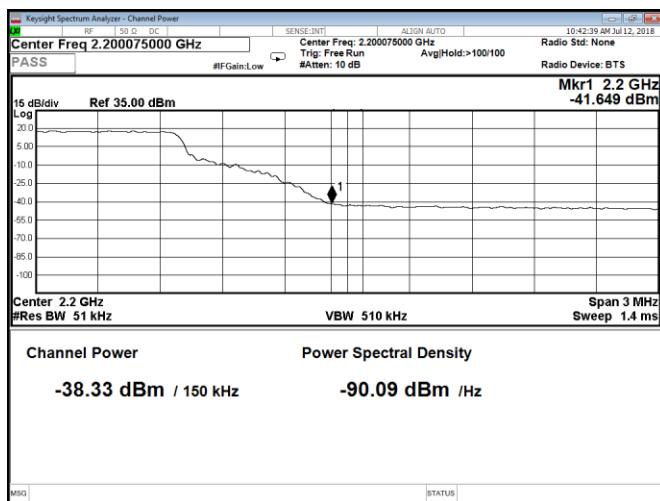


Figure 8.2-61: Conducted band edge emission at 2200 MHz, 15 MHz, QPSK (RBW = 1% of EBW)

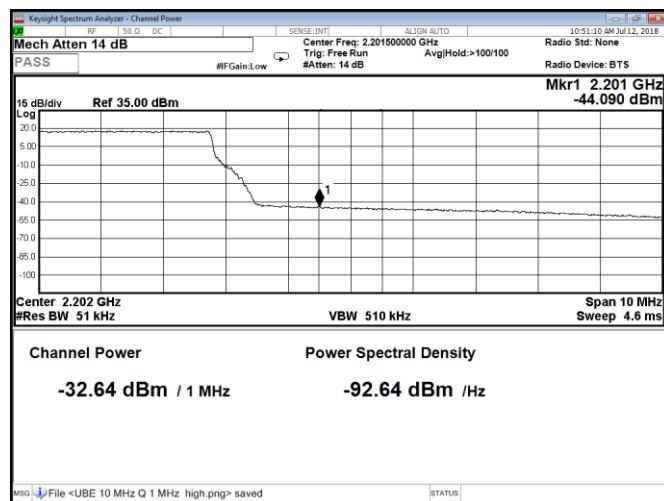


Figure 8.2-62: Conducted band edge emission at 2201 MHz, 15 MHz, QPSK (RBW = 1 MHz)

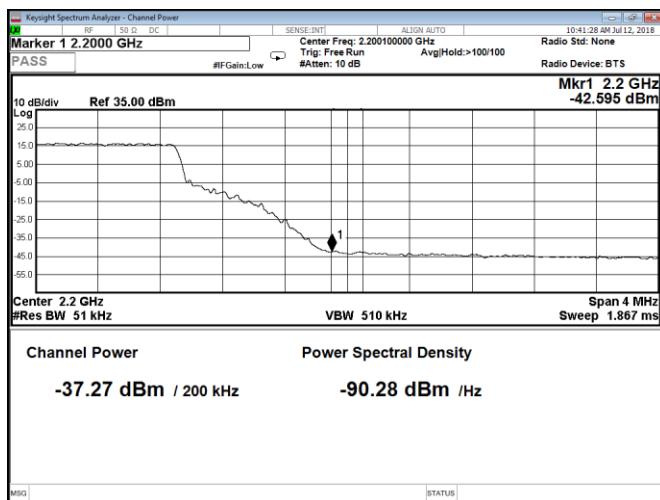


Figure 8.2-63: Conducted band edge emission at 2200 MHz, 20 MHz, QPSK (RBW = 1% of EBW)

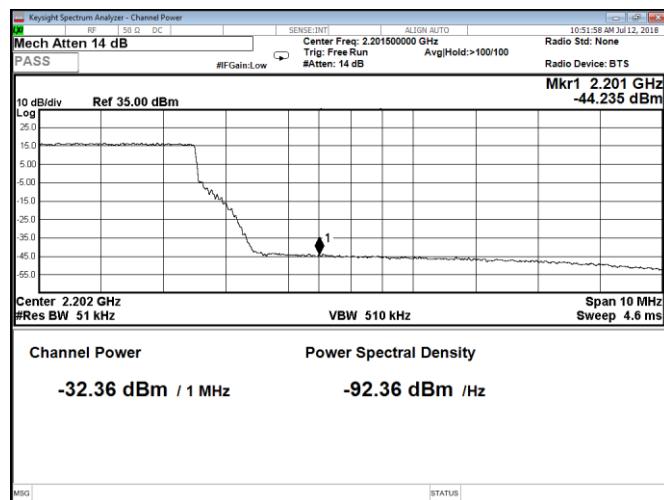


Figure 8.2-64: Conducted band edge emission at 2201 MHz, 20 MHz, QPSK (RBW = 1 MHz)

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 | July 18, 2018 |
| Test engineer | Predrag Golic |

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: Radiated emissions setup photo – below 1 GHz

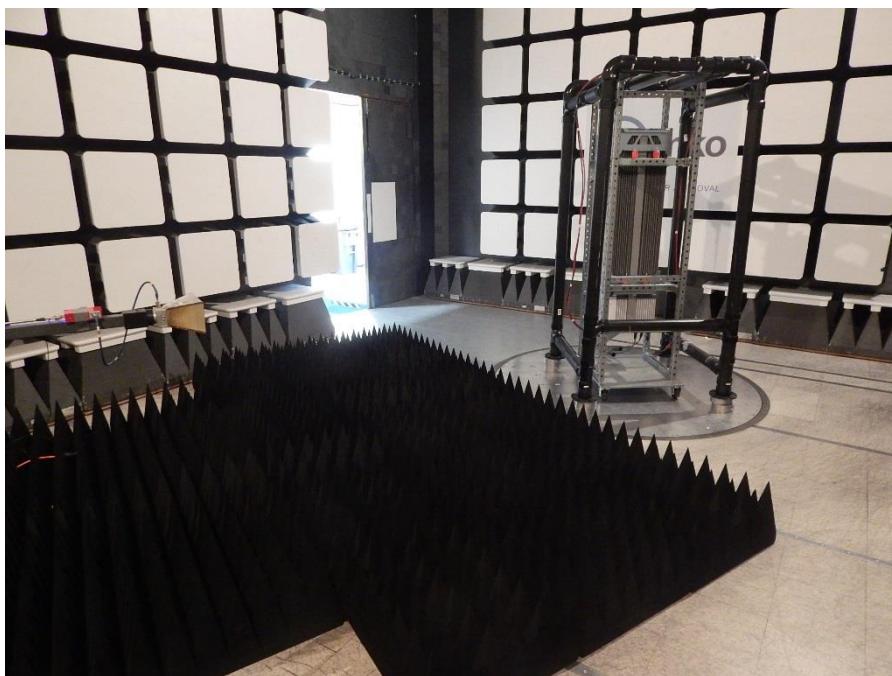


Figure 8.3-2: Radiated emissions setup photo – above 1 GHz

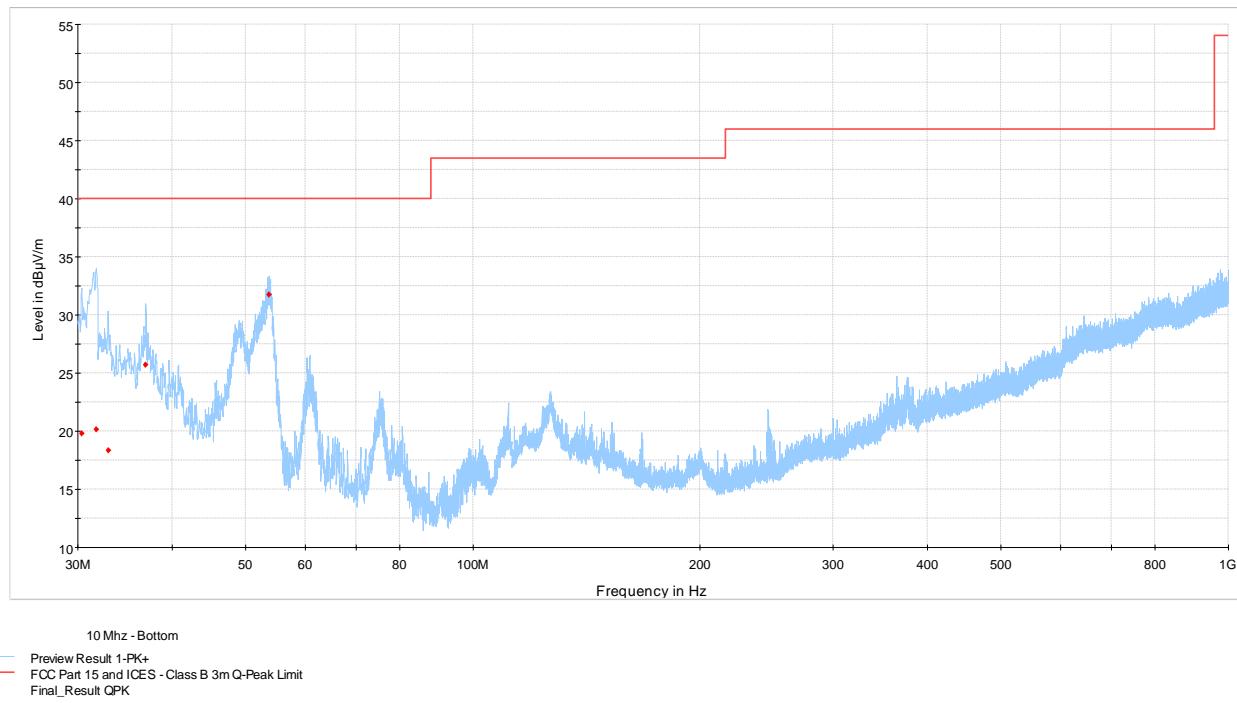


Figure 8.3-1: Radiated spurious emission below 1 GHz for single carrier operation, low channel

Table 8.3-1: Radiated emissions (Quasi-Peak) results

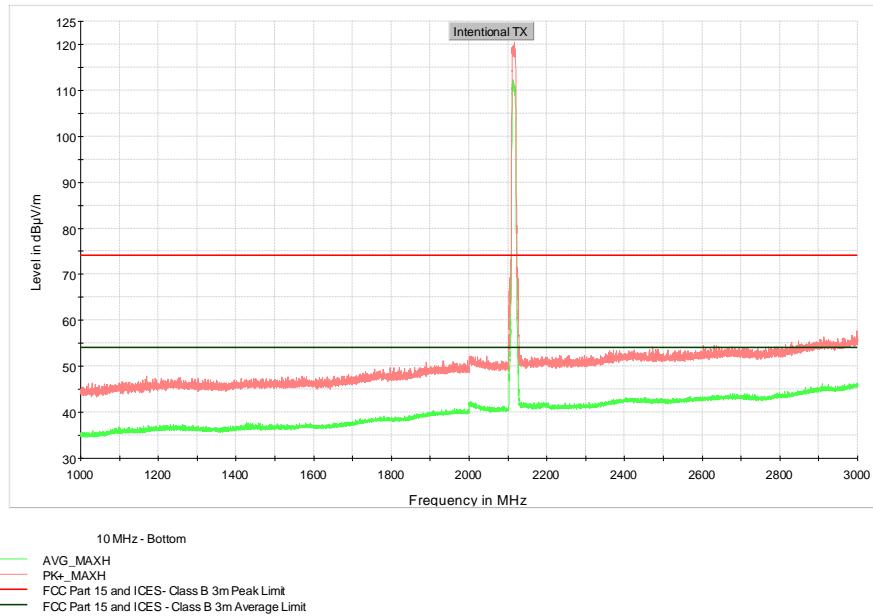
| Frequency (MHz) | Quasi-Peak field strength ¹ (dBµV/m) | 3 m Quasi-Peak limit ³ (dBµV/m) | Margin (dB) | Measurement time (ms) | Bandwidth (kHz) | Antenna height (cm) | Pol. (V/H) | Turn table position (°) | Correction factor ² (dB) |
|-----------------|---|--|-------------|-----------------------|-----------------|---------------------|------------|-------------------------|-------------------------------------|
| 53.70 | 31.7 | 40.0 | 8.3 | 100 | 120 | 256 | H | 129 | 9.0 |

Notes: ¹ Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)

² Correction factor = antenna factor ACF (dB) + cable loss (dB)

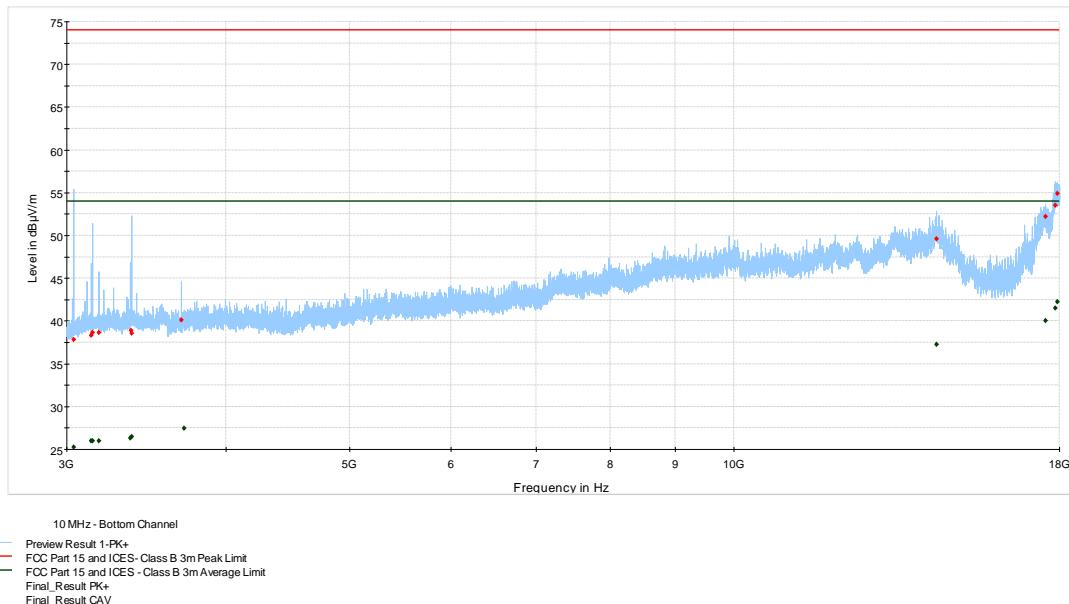
³ Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Sample calculation: 31.7 dBµV/m (field strength) = 22.7 dBµV (receiver reading) + 9.0 dB (Correction factor)



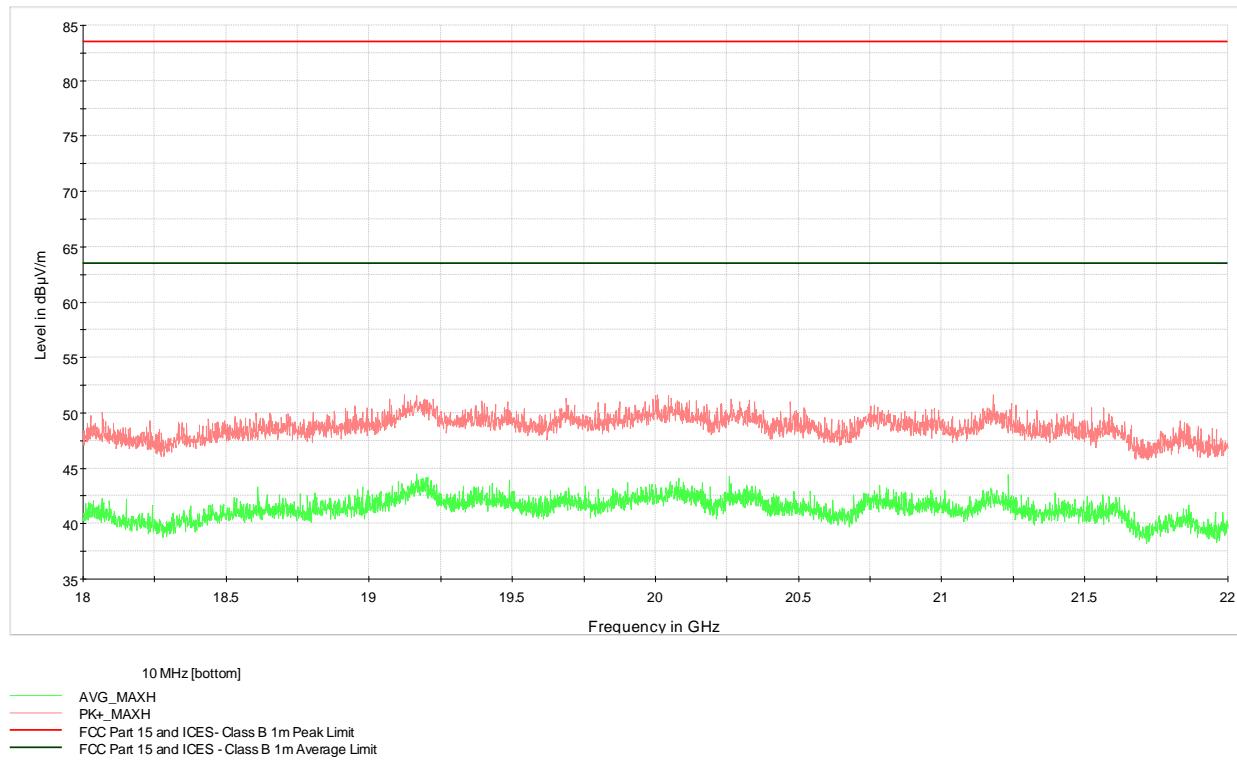
The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 8.3-3: Radiated emissions spectral plot (1 to 3 GHz)



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators).

Figure 8.3-4: Radiated emissions spectral plot (3 to 18 GHz)



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators.

Figure 8.3-5: Radiated emissions spectral plot (18 to 22 GHz)

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 | July 12, 2018 |
| Test engineer | Andrey Adelberg |

8.4.3 Observations, settings and special notes

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

8.4.4 Test data

Table 8.4-1: Frequency error results

| Temperature, °C | Voltage, V _{dc} | Frequency error, Hz |
|-----------------|--------------------------|---------------------|
| +50 | 48.0 | -2.44 |
| +40 | 48.0 | 2.80 |
| +30 | 48.0 | 3.44 |
| +20 | 55.2 | -2.78 |
| +20 | 48.0 | -2.69 |
| +20 | 40.8 | 2.59 |
| +10 | 48.0 | -2.12 |
| 0 | 48.0 | 2.07 |
| -10 | 48.0 | -2.88 |
| -20 | 48.0 | -2.82 |
| -30 | 48.0 | -2.93 |
| -40 | 48.0 | -2.74 |

Max negative drift: -2.88 Hz, Max positive drift: +3.44 Hz.

26 dB is located no closer than 134 kHz from the band edges.

8.5 FCC Part 2.1049 and RSS-Gen, 6.7 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, 6.7

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

8.5.2 Test summary

| | |
|---------------|-----------------|
| Test date | July 5, 2018 |
| Test engineer | Andrey Adelberg |

8.5.3 Observations, settings and special notes

Spectrum analyzer settings:

| | |
|----------------------|--------------|
| Detector mode | Peak |
| Resolution bandwidth | ≥1 % of span |
| Video bandwidth | RBW × 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, low channel | 2112.5 | 4.7118 | 5.019 |
| 5 MHz, 16QAM, low channel | 2112.5 | 4.5000 | 4.852 |
| 5 MHz, 64QAM, low channel | 2112.5 | 4.5091 | 4.875 |
| 5 MHz, 256QAM, low channel | 2112.5 | 4.4986 | 4.868 |
| 5 MHz, QPSK, mid channel | 2155.0 | 4.7077 | 5.018 |
| 5 MHz, QPSK, high channel | 2197.5 | 4.7095 | 5.012 |
| 10 MHz, QPSK, low channel | 2115.0 | 8.9987 | 9.371 |
| 10 MHz, 16QAM, low channel | 2115.0 | 9.0011 | 9.688 |
| 10 MHz, 64QAM, low channel | 2115.0 | 9.0149 | 9.737 |
| 10 MHz, 256QAM, low channel | 2115.0 | 9.0392 | 9.735 |
| 10 MHz, QPSK, mid channel | 2155.0 | 9.0192 | 9.760 |
| 10 MHz, QPSK, high channel | 2195.0 | 9.0110 | 9.731 |
| 15 MHz, QPSK, low channel | 2117.5 | 13.493 | 14.57 |
| 15 MHz, 16QAM, low channel | 2117.5 | 13.536 | 14.49 |
| 15 MHz, 64QAM, low channel | 2117.5 | 13.479 | 14.51 |
| 15 MHz, 256QAM, low channel | 2117.5 | 13.538 | 14.55 |
| 15 MHz, QPSK, mid channel | 2155.0 | 13.508 | 14.59 |
| 15 MHz, QPSK, high channel | 2192.5 | 13.515 | 14.59 |
| 20 MHz, QPSK, low channel | 2120.0 | 18.031 | 19.61 |
| 20 MHz, 16QAM, low channel | 2120.0 | 18.105 | 19.49 |
| 20 MHz, 64QAM, low channel | 2120.0 | 18.047 | 19.61 |
| 20 MHz, 256QAM, low channel | 2120.0 | 18.040 | 19.59 |
| 20 MHz, QPSK, mid channel | 2155.0 | 17.997 | 19.54 |
| 20 MHz, QPSK, high channel | 2190.0 | 18.036 | 19.51 |

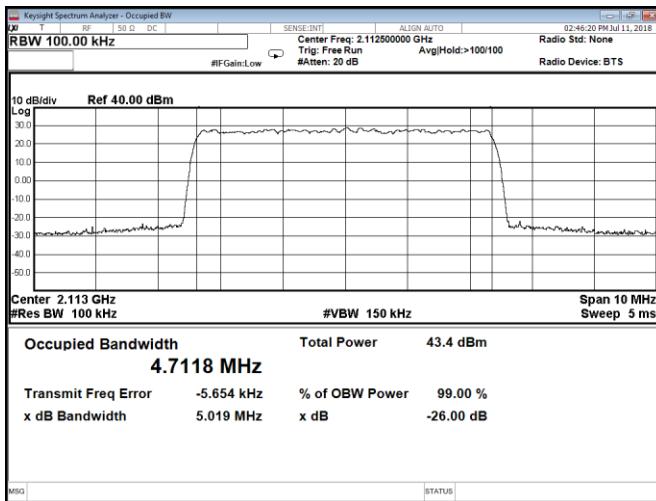


Figure 8.5-1: Occupied bandwidth, QPSK, 5 MHz, Low channel

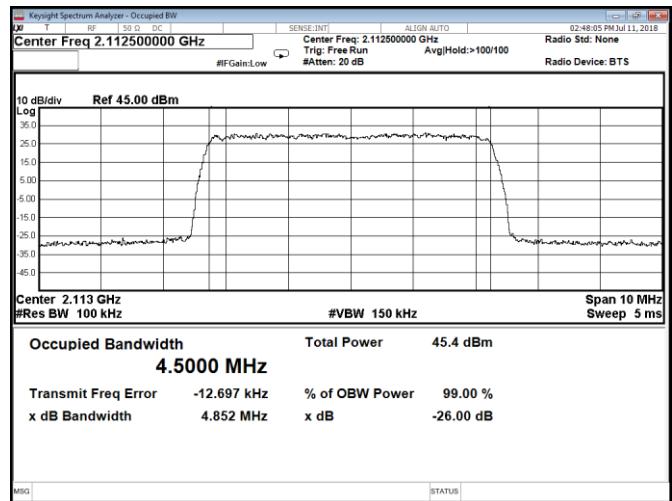


Figure 8.5-2: Occupied bandwidth, 16QAM, 5 MHz, low channel

Section 8
Test name
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Testing data
 FCC Part 2.1049 and RSS-Gen, 6.7 Occupied bandwidth
 FCC Part 2, RSS-Gen, Issue 5

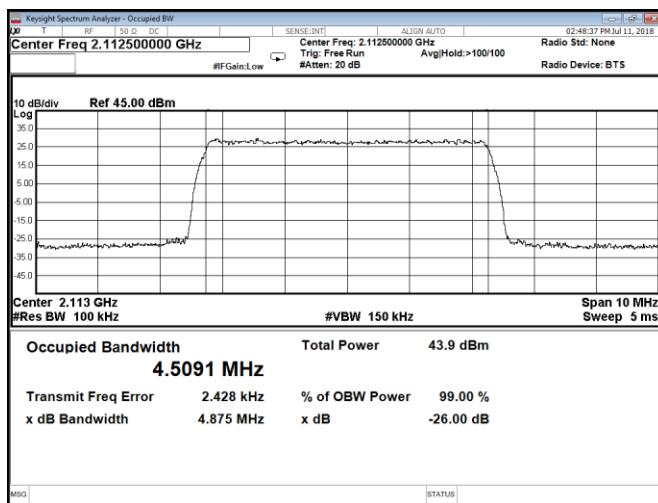


Figure 8.5-3: Occupied bandwidth, 64QAM, 5 MHz, low channel

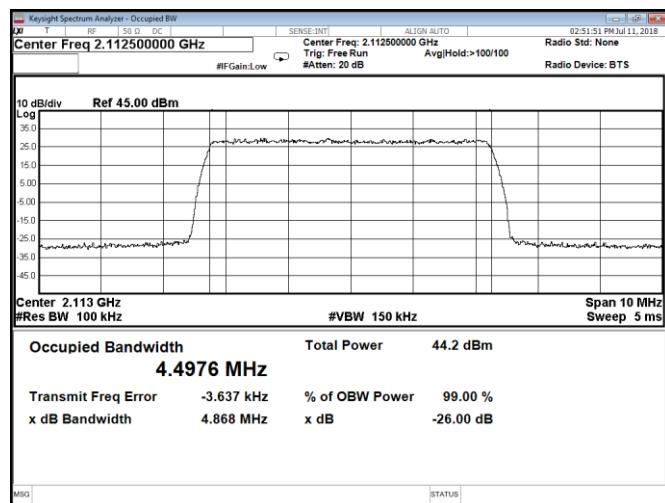


Figure 8.5-4: Occupied bandwidth, 256QAM, 5 MHz, low channel

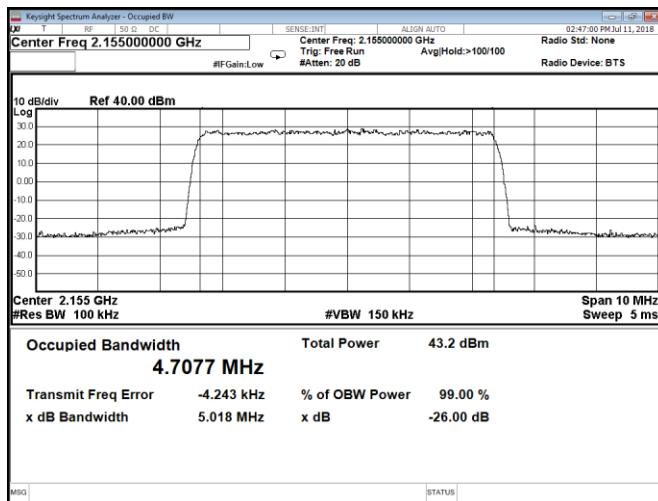


Figure 8.5-5: Occupied bandwidth, QPSK, 5 MHz, Mid channel

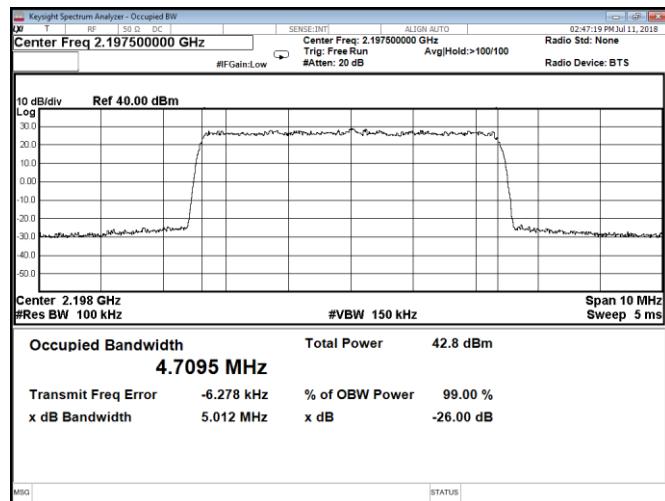
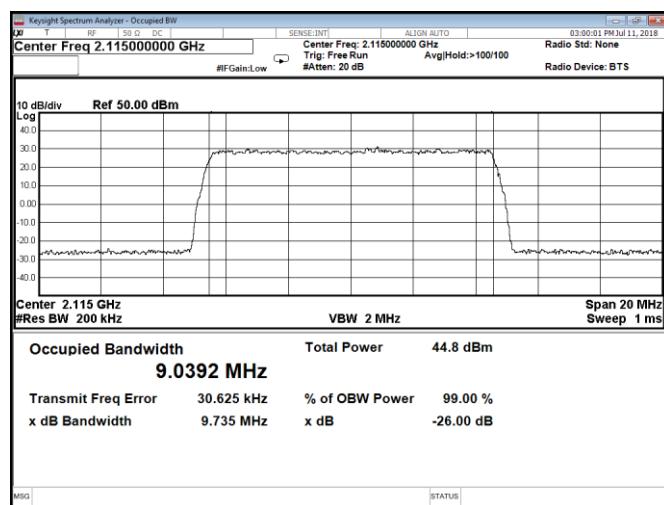
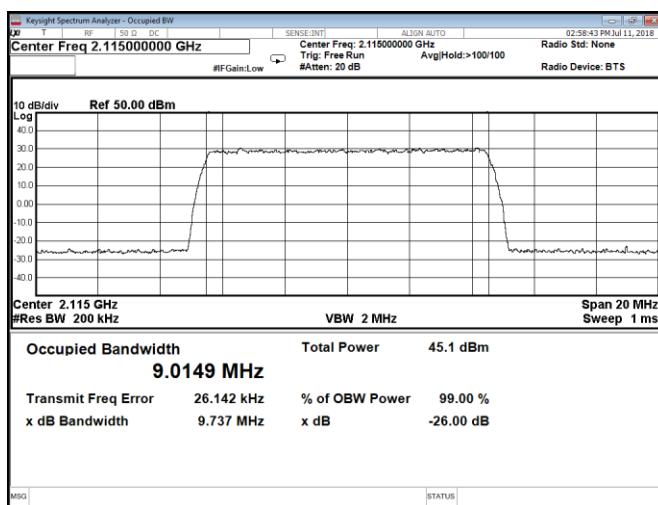
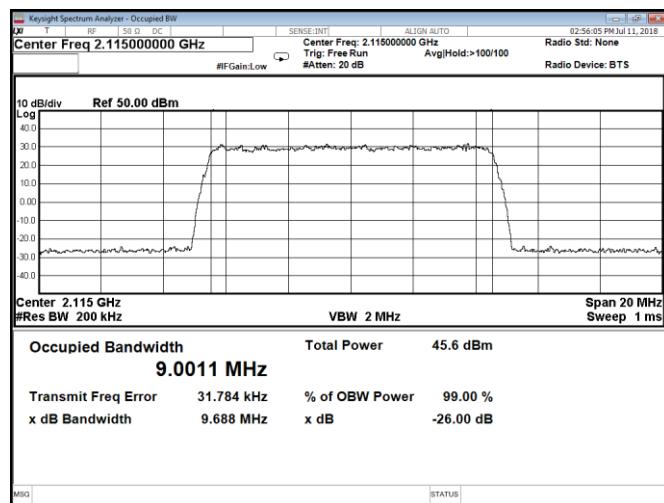
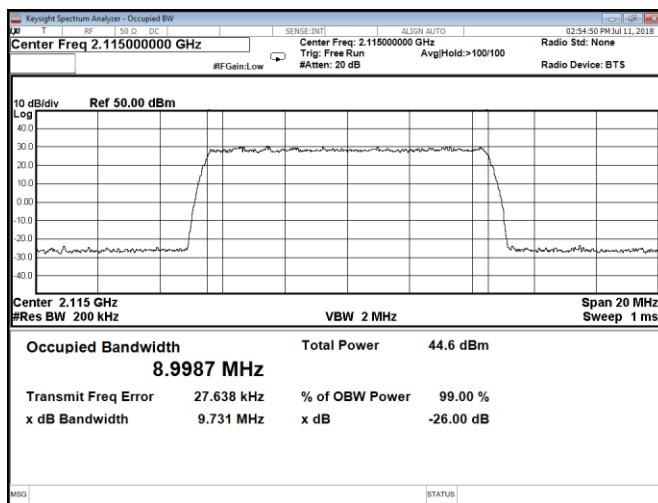


Figure 8.5-6: Occupied bandwidth, QPSK, 5 MHz, High channel

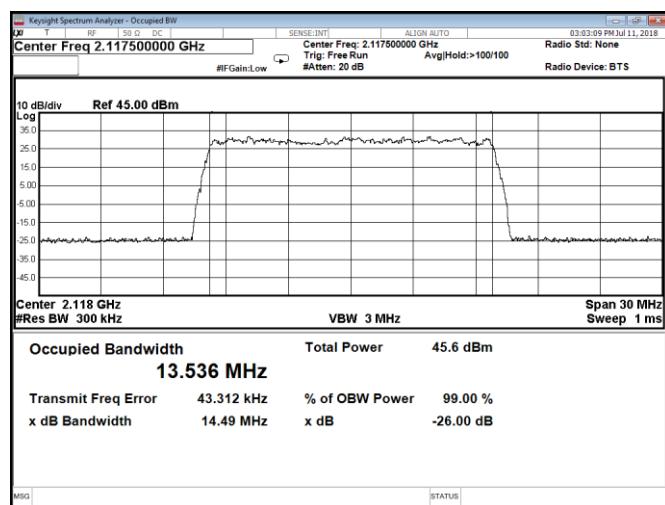
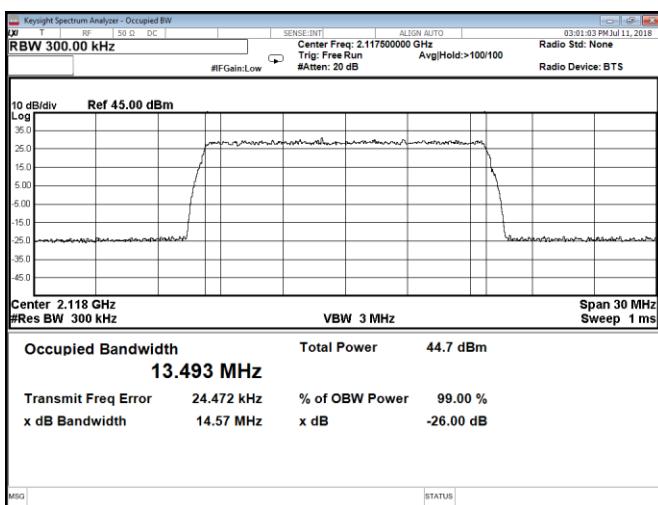
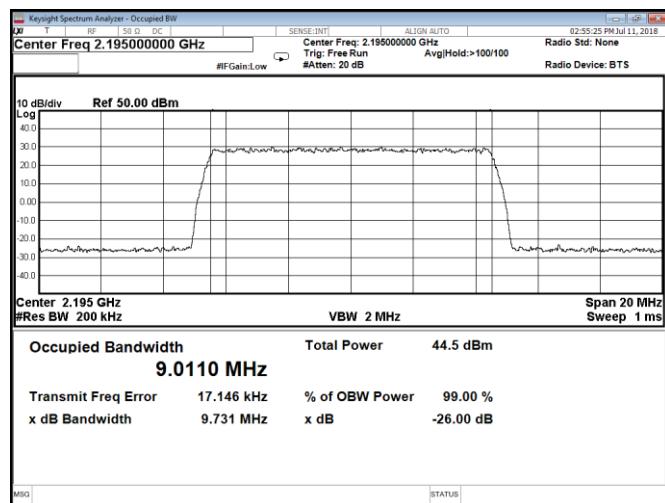
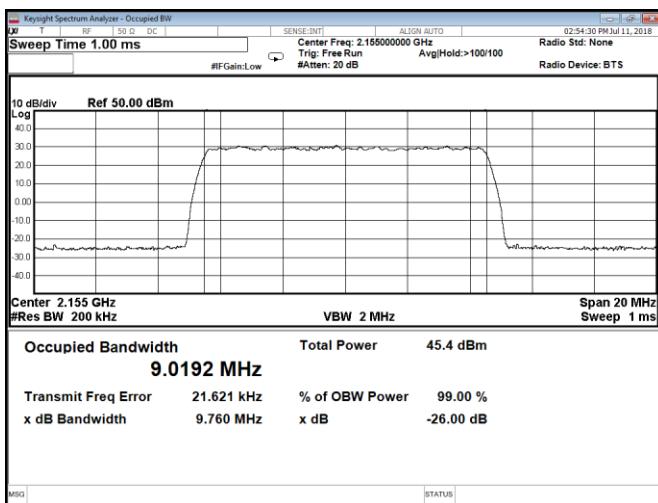
Section 8
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Testing data
 FCC Part 2.1049 and RSS-Gen, 6.7 Occupied bandwidth
 FCC Part 2, RSS-Gen, Issue 5



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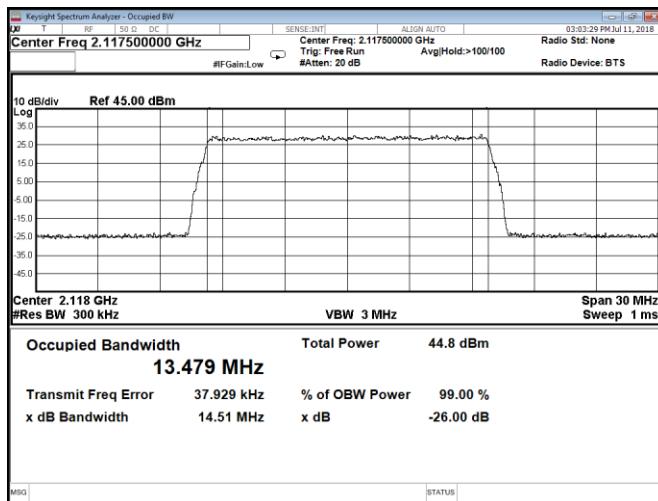


Figure 8.5-15: Occupied bandwidth, 64QAM, 15 MHz, low channel

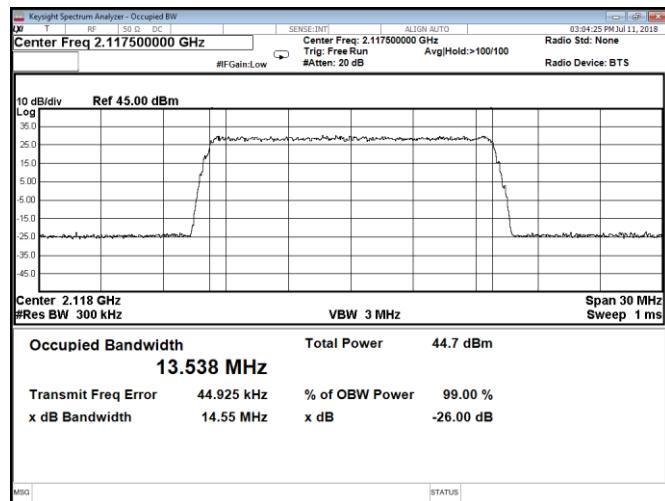


Figure 8.5-16: Occupied bandwidth, 256QAM, 15 MHz, low channel

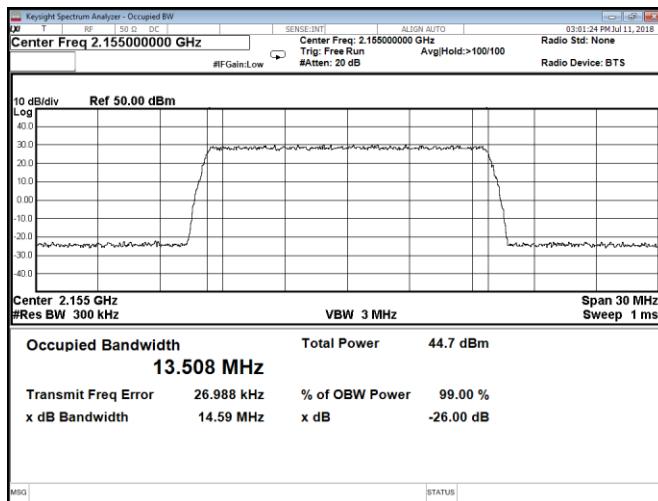


Figure 8.5-17: Occupied bandwidth, QPSK, 15 MHz, Mid channel

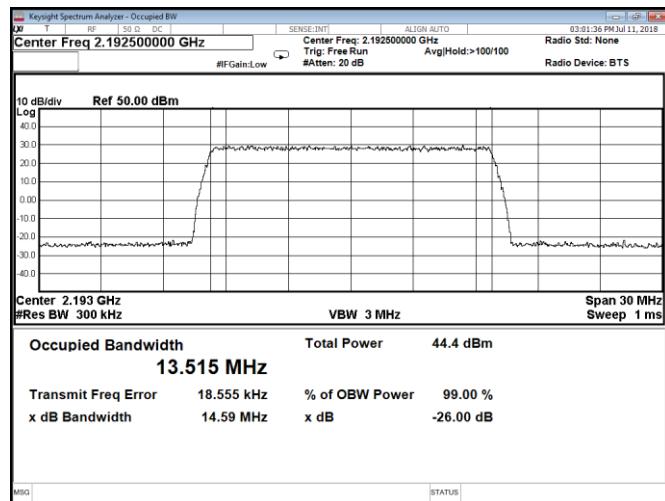


Figure 8.5-18: Occupied bandwidth, QPSK, 15 MHz, High channel

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Test name
Specification

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 FCC Part 2.1049 and RSS-Gen, 6.7 Occupied bandwidth
 FCC Part 2, RSS-Gen, Issue 5

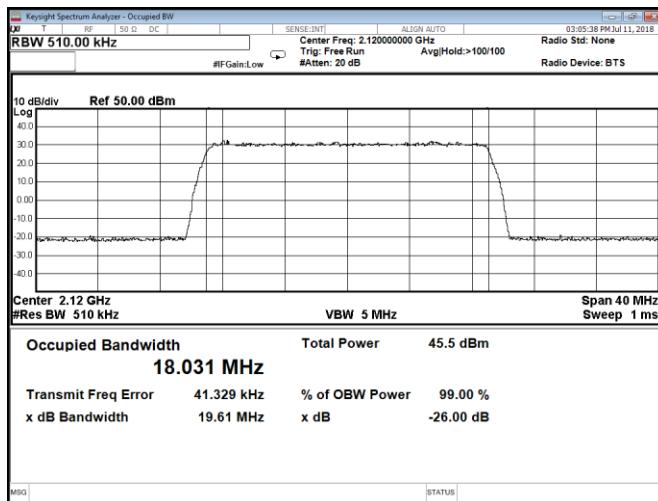


Figure 8.5-19: Occupied bandwidth, QPSK, 20 MHz, Low channel

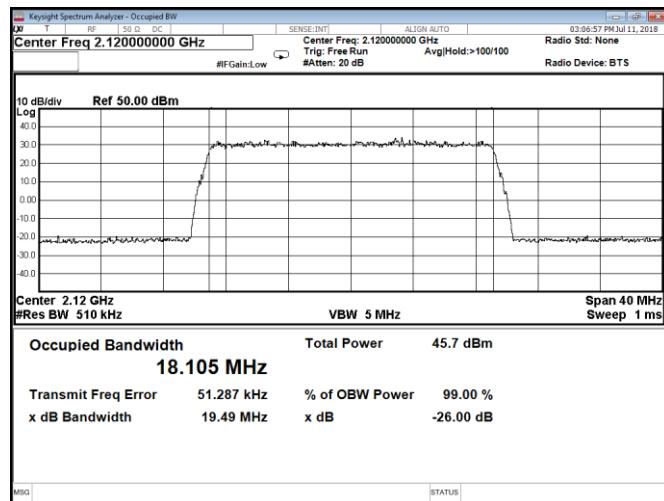


Figure 8.5-20: Occupied bandwidth, 16QAM, 20 MHz, low channel

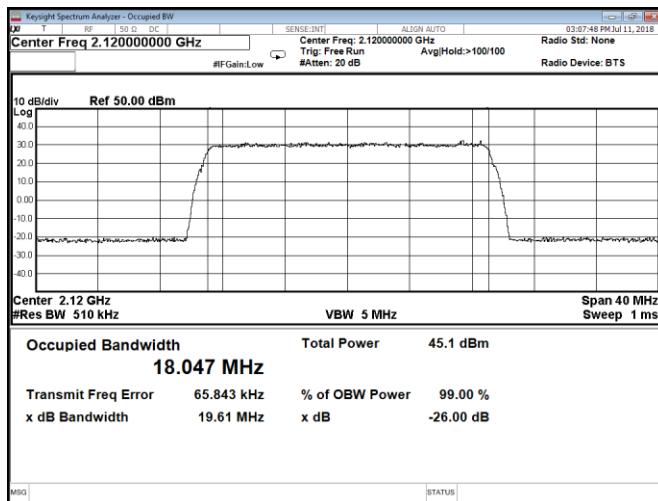


Figure 8.5-21: Occupied bandwidth, 64QAM, 20 MHz, low channel

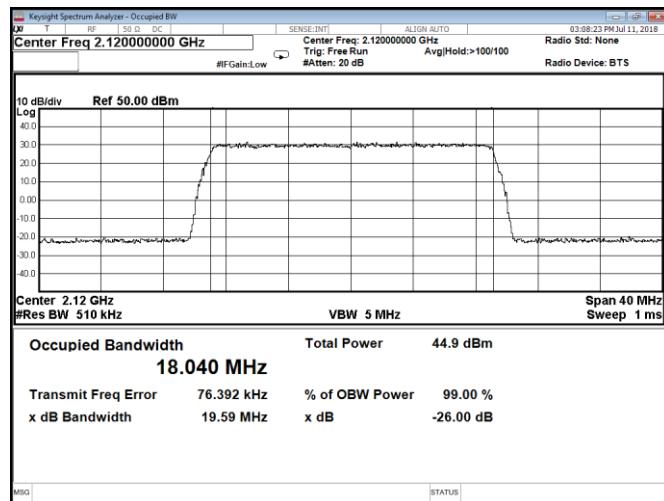


Figure 8.5-22: Occupied bandwidth, 256QAM, 20 MHz, low channel

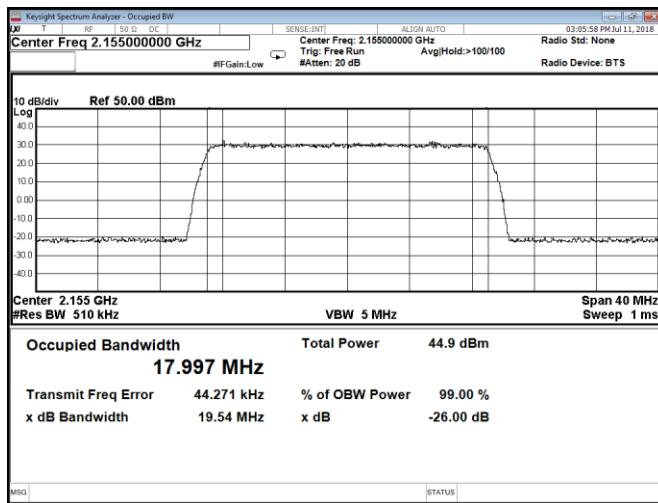


Figure 8.5-23: Occupied bandwidth, QPSK, 20 MHz, Mid channel

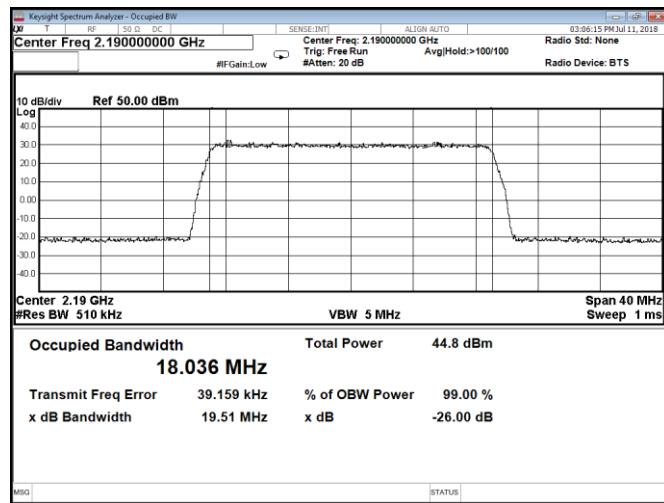
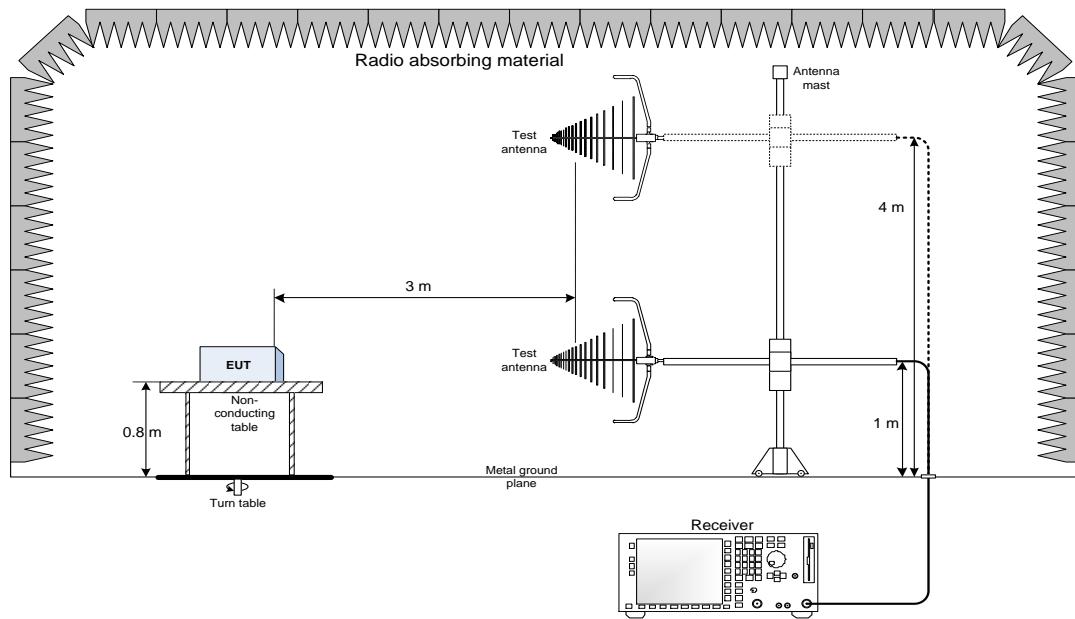


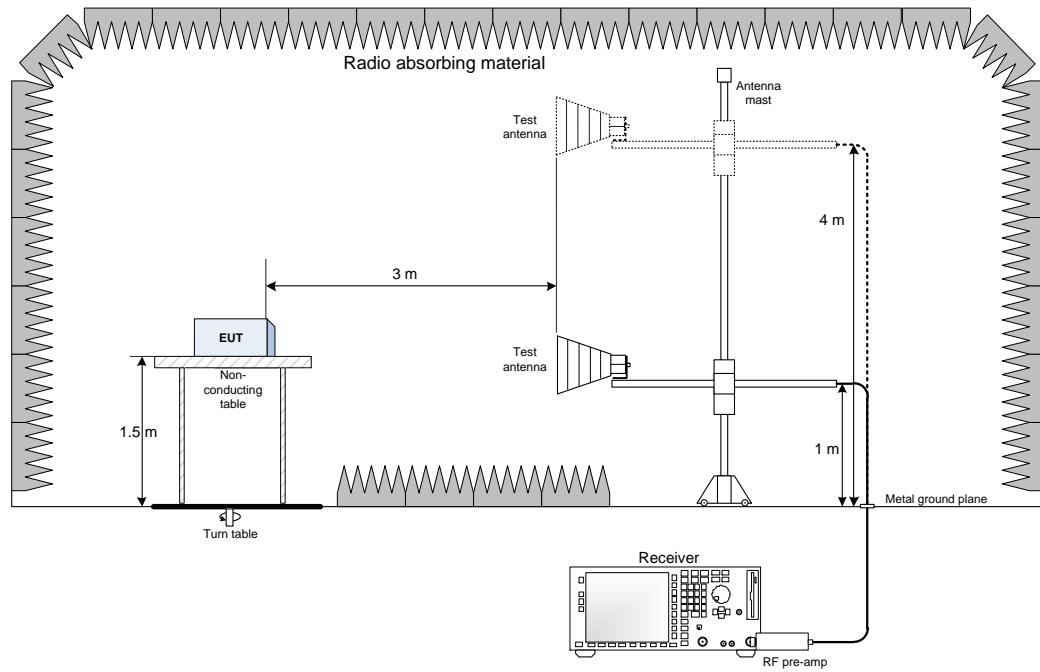
Figure 8.5-24: Occupied bandwidth, QPSK, 20 MHz, High channel

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

