

NECESSARY BANDWIDTH EXHIBIT

Astra Space, Inc.

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Introduction

This document serves as an explanation of how the necessary bandwidth numbers were measured for the telemetry links on Astra Space’s first test launch.

Test Setup

The Quasonix transmitter was connected through 50 dB of attenuators and two lengths of coaxial cable to the spectrum analyzer. Realistic digital data was sent to it and the modulation and RF power were set to the flight settings.

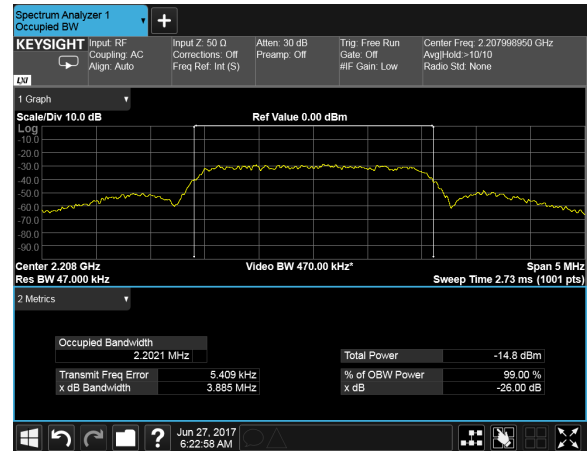
The occupied bandwidth was calculated using two methods: the 99% power method and the 26 dB down method. We used the 26 dB down numbers in the application as those are wider than the 99% power numbers. Both sets are visible on the screen shots from the spectrum analyzer, attached below.

First Stage

The first stage of the launch vehicle contains two Quasonix transmitters. Their outputs are combined together and sent to the same omnidirectional antenna.

First Stage Low Speed Telemetry Link

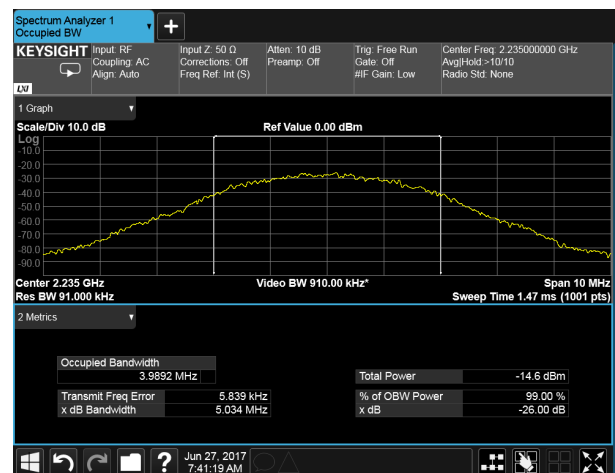
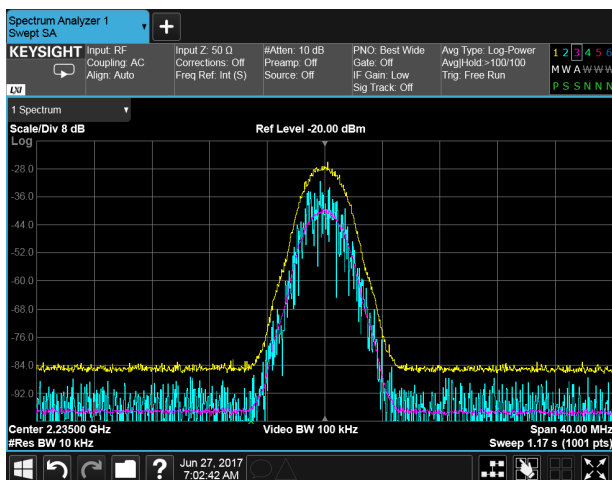
Data rate: 2.1 Mbps. Modulation: PCM/FM IRIG-106. RF output power: 5 W. Center frequency: 2208 MHz. Transmitter Model number: QSX-VAR2-1000-05-N2-01AB C-VP-WV.



The occupied bandwidth was measured using the Occupied BW tool on the spectrum analyzer. It computes bandwidth using two methods: the 99% percent OBW power bandwidth and the 26dB down from peak bandwidth. The occupied bandwidth of the first stage low speed telemetry link using the 26dB down from peak measurement was 3.885 MHz.

First Stage Video Link

Data rate: 5 Mbps. Modulation: SOQPSK. RF output power: 5 W. Center Frequency: 2235 MHz. Transmitter Model number: QSX-VAR2-1000-05-N2-01AB C-VP-WV.



The occupied bandwidth was measured using the Occupied BW tool on the spectrum analyzer. It computes bandwidth using two methods: the 99% percent OBW power bandwidth and the 26dB

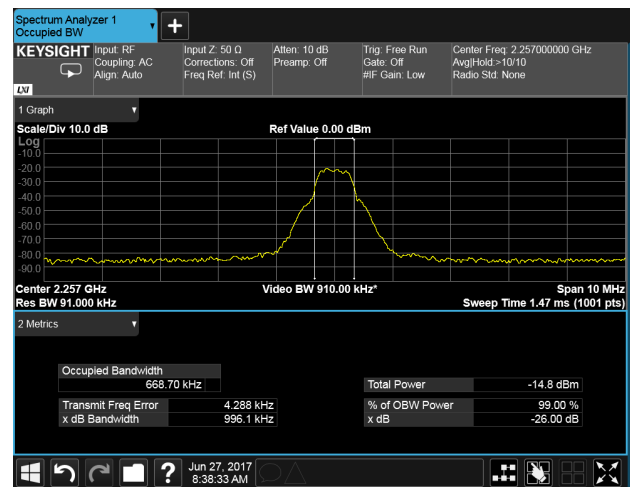
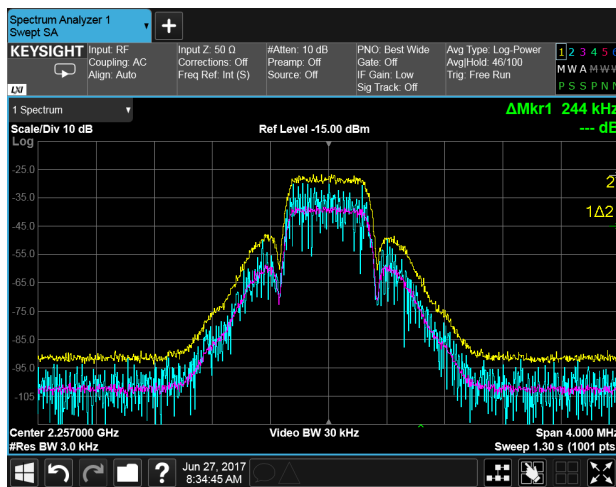
down from peak bandwidth. The occupied bandwidth of the first stage high speed telemetry link using the 26dB down from peak measurement was 5.034 MHz.

Second Stage

The second stage of the launch vehicle contains two Quasonix transmitters. Their outputs are combined together and sent to the same omnidirectional antenna.

Second Stage Low Speed Telemetry Link

Data rate: 500 kbps. Modulation: PCM/FM IRIG-106. RF output power: 5 W. Center frequency: 2257 MHz . Transmitter Model number: QSX-VAR2-1000-05-N2-01AB C-VP-WV.



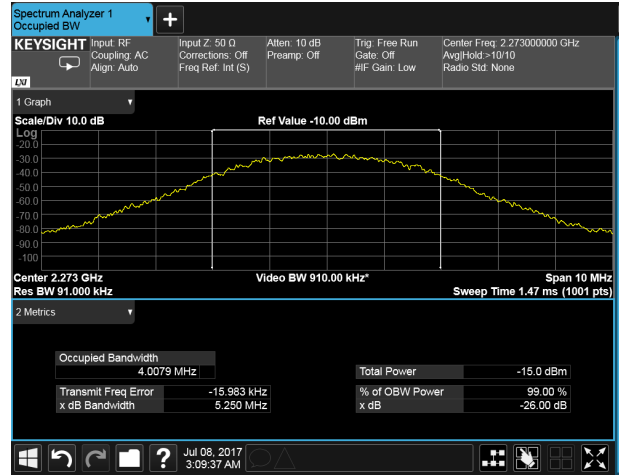
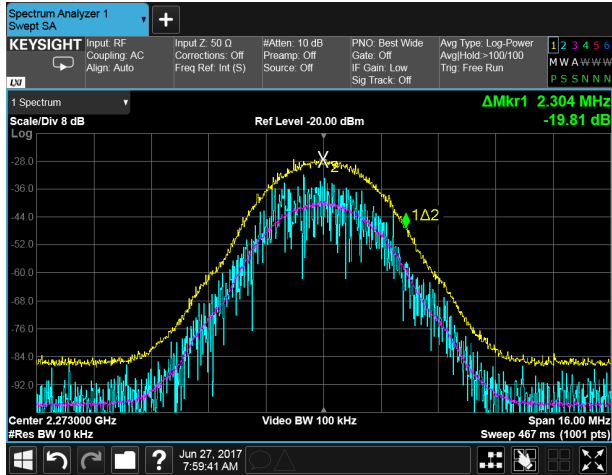
The occupied bandwidth was measured using the Occupied BW tool on the spectrum analyzer. It computes bandwidth using two methods: the 99% percent OBW power bandwidth and the 26dB down from peak bandwidth. The occupied bandwidth of the second stage low speed telemetry link using the 26dB down from peak measurement was 0.9961 MHz.

Second Stage Video Link

The Second stage video link can support two different emissions designators – a low speed version and a high speed version. The nominal operation for the first test launch uses the high speed version of this link.

Second Stage High Speed Video Link

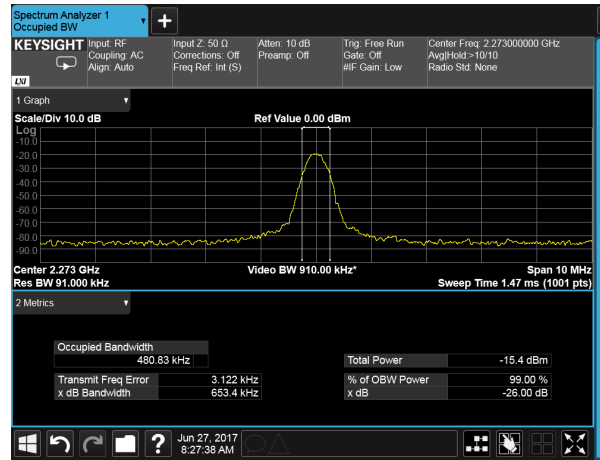
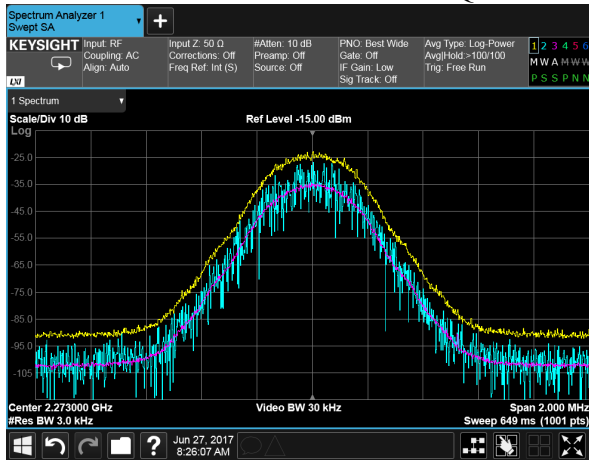
Data rate: 5 Mbps. Modulation: SOQPSK. RF output power: 5 W. Center Frequency: 2273 MHz. Transmitter Model number: QSX-VAR2-1000-05-N2-01AB C-VP-WV.



The occupied bandwidth was measured using the Occupied BW tool on the spectrum analyzer. It computes bandwidth using two methods: the 99% percent OBW power bandwidth and the 26dB down from peak bandwidth. The occupied bandwidth of the second stage low speed telemetry link using the 26dB down from peak measurement was 5.25 MHz.

Second Stage Low Speed Video Link

Data rate: 500 kbps. Modulation: SOQPSK. RF output power: 5 W. Center Frequency: 2273 MHz. Transmitter Model number: QSX-VAR2-1000-05-N2-01AB C-VP-WV.



The occupied bandwidth was measured using the Occupied BW tool on the spectrum analyzer. It computes bandwidth using two methods: the 99% percent OBW power bandwidth and the 26dB down from peak bandwidth. The occupied bandwidth of the second stage low speed telemetry link using the 26dB down from peak measurement was 653 kHz.