Abstract: A setup is presented for measuring ATSC 8-VSB receiver blocker performance that overcomes out-of-band noise limitations of the Rohde & Schwarz SFQ TV Test Transmitter. The setup involves close-in filtering with a SAW filter at 44MHz, mixing up to a fixed, desired RF frequency, and filtering further-out noise with a cavity bandpass filter. Blocker requirements in the ATSC A/74 standard are discussed. The SFQ out-of-band noise is shown before and after the two filter stages.

Introduction

Measurement of receiver blocker performance for A/74 ATSC 8-VSB signals using the Rohde & Schwarz SFQ TV Test Transmitter requires special considerations due to noise limitations of the SFQ signal. Out-of-band noise from the SFQ's undesired signal significantly raises the noise floor in the desired channel. To avoid this measurement system limitation, the undesired signal is filtered to remove this noise. First, a SAW bandpass filter removes the close-in noise; then, a cavity bandpass filter removes the further-out noise.

Blocker Measurement System

Figure 1 shows the 8-VSB blocker measurement system. The undesired signal is combined with the desired signal before passing through a 50Ω-to-75Ω minimum-loss pad (MLP) into the tuner. Before combining, the undesired signal is filtered twice. The SFQ signal is filtered by a readily available ATSC 44MHz SAW filter to remove the close-in (N±1 and N±2) noise. Next, the signal is mixed up to a fixed RF frequency by the General Instruments C6M-II modulator, which has low-noise and high linearity. Then the signal is filtered by a three-cavity bandpass filter to remove further-out (N±2 to N±15) noise. In this measurement system, the undesired frequency is fixed, while the desired frequency is moved to measure the various adjacent offsets required by the A/74 standard.
Figure 1. ATSC blocker measurement system for 8-VSB interference into an 8-VSB desired channel.

Figure 2 shows the blocker performance or desired-to-undesired ratio (D/U) required by the A/74 standard for 8-VSB interference into an 8-VSB desired channel. Displayed here is the weak desired (-68dBm) scenario, which is typically the limiting case. The receiver must tolerate a N±1 undesired signal that is at least 33dB stronger than the desired signal, while still meeting the threshold of visibility (TOV) requirement of 3x10^-6 bit-error rate (BER). Similarly, an undesired signal that is at least 57dB stronger than the desired must be tolerated at N±6.
**Figure 2.** ATSC blocker mask for 8-VSB interference into 8-VSB.

**Figure 3** shows the SFQ spectral output for an 8-VSB signal. The noise bump in the lower adjacent channel limits the measurement when this SFQ signal is used as an N+1 undesired signal. The channel power, including the noise bump, is only -46dBc relative to the desired signal; however, a minimum of -58.5dBc is required (-33dBc D/U minus 15.5dB SNR minus 10dB noise floor margin). Less dramatic limitations are also observed when this SFQ signal is used for the N-1 undesired or the N±2 undesired signal.
Figure 3. Close-in 8-VSB spectrum from a SFQ TV Test Transmitter.

Figure 4 shows that the SAW filter reduces the SFQ noise in the worst-case (upper) first adjacent to -60.5dBc, which is adequate. Note that the spectrum is now inverted because of the high-side LO injection in the C6M-II modulator. The spectrum inversion is not a problem, as this is the undesired signal.
Figure 4. SAW filter noise reduction of the close-in SFQ 8-VSB spectrum.

A wider span of the SFQ output after SAW filtering is shown in Figure 5. In a similar way, further-out noise from the SFQ limits D/U measurements for further-out adjacents. The noise at N-6 is only -66dBc, though -82.5dB is required (-57dBc D/U minus 15.5dB SNR minus 10dB noise floor margin). All of the adjacents on the lower side need noise reduction, as well as some of the adjacents on the upper side.

Note that the spectrum over the N±1 and N±2 frequencies in Figure 5 should be neglected. These are artifacts from slightly overdriving the spectrum analyzer when its attenuator is set to 0dB. The 0dB attenuator setting is required to reduce the spectrum analyzer noise floor at further-out offsets.
Figure 5. Further-out 8-VSB spectrum from an SFQ.

Figure 6 shows that the cavity filter reduces the further-out SFQ noise at least to the noise floor of the spectrum analyzer at -84dBc, which is adequate. Again, the spectrums over the N±1 and N±2 frequencies in Figure 6 should be neglected. These are also artifacts from slightly overdriving the spectrum analyzer due to the 0dB attenuator setting.
Conclusion

An 8-VSB blocker measurement setup is presented that overcomes the noise limitations of the Rohde & Schwarz SFQ by filtering both close-in and further-out noise.

Appendix—Filter List

- Communications & Energy Corp. 4001BPU (3) Bandpass filter for UHF Channel 42D.
- Epcos B39440-X6965-N201 44MHz SAW filter with 6MHz bandwidth. Figure 7 shows the circuit schematic used to match this filter into 50Ω.
Figure 7. Schematic for 44MHz SAW filter matched into 50Ω connectors.

Related Parts

MAX3540 Complete Single-Conversion Television Tuner

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