CRYOGENIC, LOW NOISE, 0.5-11 GHZ ACTIVE BALUN MMIC

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Background

Recent development in ultra wideband log-periodic antenna feeds [1, 2] for radio astronomy applications calls for a wideband balun. Common for these feeds is that they all have a balanced output. The balanced signal from the feed can be transformed to an unbalanced signal using a passive balun and then amplified with a conventional single-ended amplifier. Alternatively, an amplifier with differential input can be connected directly to the feed, and if the output is also differential, it would be followed by a passive balun. We have developed an amplifier with a balanced input and an unbalanced output that covers the frequency range of 0.5-11 GHz. This active balun replaces both the passive balun and the single-ended LNA in a receiver.

Circuit design

The active balun MMIC uses a differential pair input stage, very similar to those used in operational amplifiers. The output stage is a regular common source stage. The design and theoretical values for gain and noise is discussed and compared to regular single-ended amplifiers. The external input matching network allows the differential input impedance to be chosen between approximately 100 and 300 ohms, which makes it ideal for integration with wideband antenna feeds whose impedance usually falls within this range. A suggested way of integrating the active balun with such a feed is presented.

Measurements

The amplifier can be used as a regular single-ended LNA with two separate inputs referenced to ground and with a single output. Measurement result in this single-ended mode using co-planar waveguide probes is presented and discussed. To be able to measure the amplifier's differential mode performance, a new measurement system had to be developed. The system is a 200 ohm Differential Variable Temperature Load (DVTL), which allows us to measure the gain and noise of the active balun at different ambient temperatures. The design of the DVTL is discussed in detail and measurement result is presented at 300, 77 and 12 Kelvin ambient temperature.

[1] G.Engargiola, Non-planar log-periodic antenna feed for integration with a cryogenic microwave amplifier, IEEE Antennas and propagation society international symposium and USNC/URSI national science meetings, page 140-143, 2002

[2] Olsson R, Kildal P-S, Weinreb S, A novel low-profile log-periodic ultra wideband feed for the dual-reflector antenna of us-ska, Antennas and Propagation Society Symposium, 2004. IEEE , Volume: 3, Pages:3035 3038