

Common Mode Rejection of the HYPERLABS' HL940X Series Baluns

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OVERVIEW

In these measurements we will focus on differential to single-ended conversion versus single-ended measurements. We will show that using a balun with a high Common Mode Rejection Ratio (CMRR) will be beneficial to the designer only if common mode signals are present on the differential signal.

DIFFERENTIAL MEASUREMENTS

The setup for our initial experiments is shown in Figure 1, a high speed MICRAM DAC4 is used to produce a 32 Gbps NRZ eye diagram. The differential signal is sent through a pair of phase-matched HYPERLABS 40GHz Pick-Off Tees (POTs) (HL9464). We will use these POTs to insert Common Mode signaling on top of the 32 Gbps NRZ pattern. We will then send the combined signaling through the 40 GHz Balun (HL9404) and finally the 40 GHz Linear Amplifier (HL5887). We will measure the outputs with a 50 GHz Lecroy Sampling Scope.

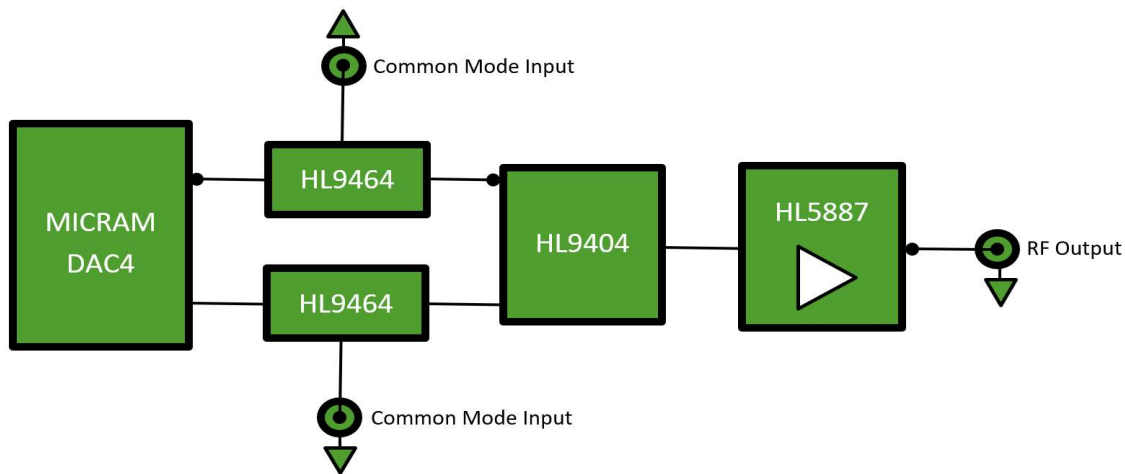


Figure 1: Differential Measurement Setup.

In Figure 2 we have our clean signal 32 Gbps NRZ signal with common signaling turned off and on. We will show that the HL9404 Balun's high CMRR will eliminate the Common Mode Noise. We will also show if the system does not have any Common Mode signaling, the system will perform equally single-ended.

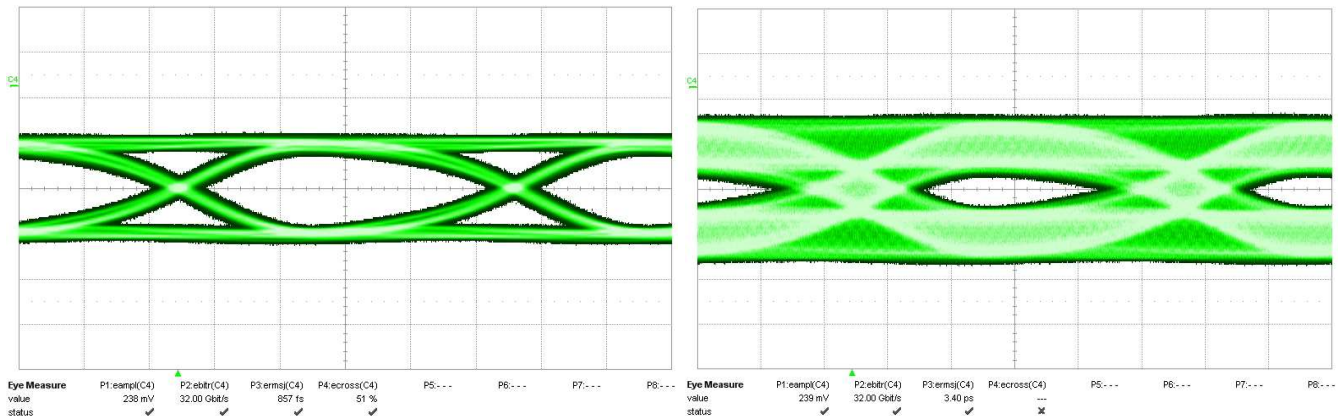


Figure 2: Input Signal (Left) and Input Signal with Common Mode (Right)

Figure 3 (LEFT) shows the output of the Balun performing the differential to single-ended conversion. The Common Mode Signaling is turned on and eliminated by the Balun. The figure on the right is the Balun output run through a HL5887 Amplifier with a gain of 14.7dB.

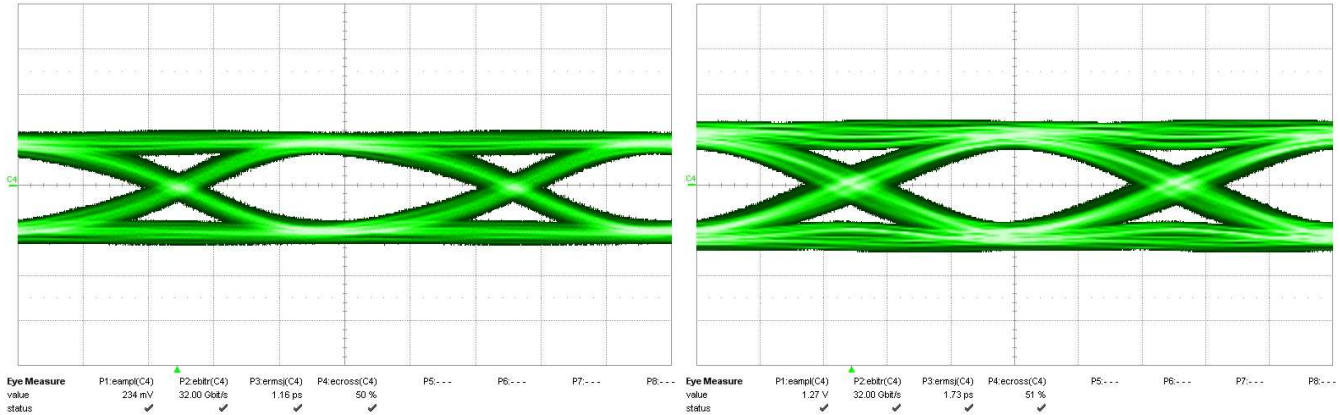


Figure 3: Balun Output Showing CM Removed (Left) and Amplified Balun Output (Right)

SINGLE-ENDED MEASUREMENTS

The single-ended setup shown in Figure 4 is an easier implementation but will only function properly if there is no Common Mode (CM) present on the differential drive signal. We will show the output signal of the amplifier with and without the CM turned on and also that the CM is simply amplified with the signal.

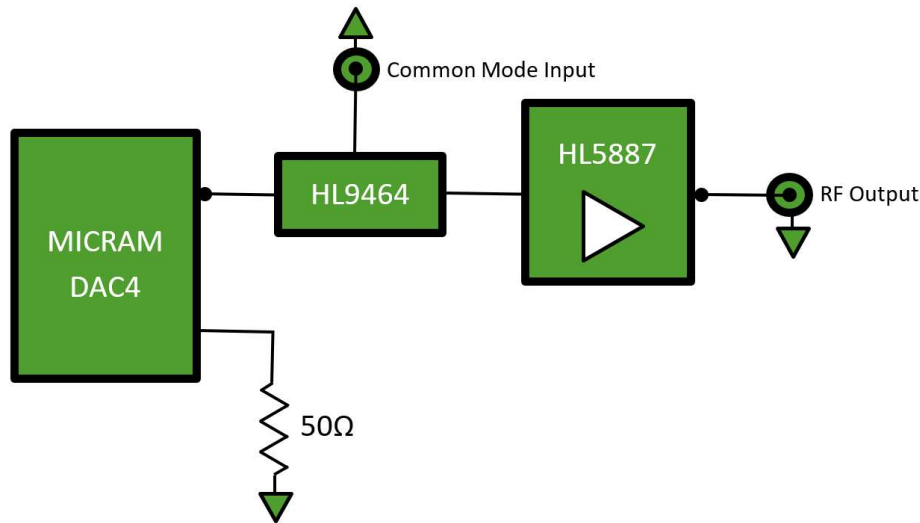


Figure 4: Single-Ended Measurement Setup.

Figure 5 shows the two outputs mentioned above. The CM, when turned on is just amplified along with the NRZ signaling and is shown on the LEFT. The output shown on the RIGHT is the amplification of the signal with no CM present. You can see the output amplitudes shown in Figures 3 and 5 are roughly the same amplitude. The amplitude of the differential drive is offset by the loss in the Balun. It is our opinion that if no CM is present, then the need for a Balun is eliminated. If CM is present, then the setup in Figure 1 will be most beneficial.

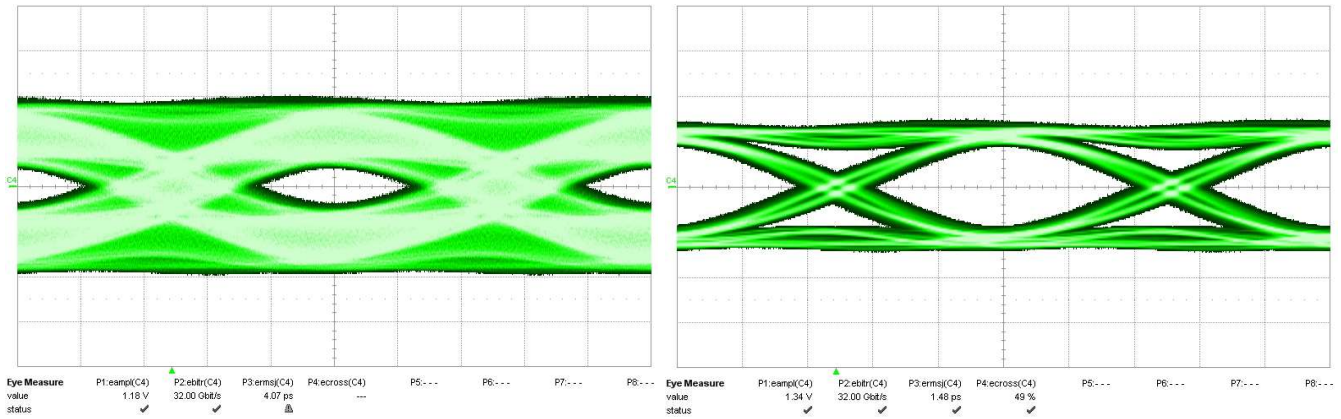


Figure 5: Amplified Signal with CM (Left) and Amplified Signal without CM (Right)