HL9402 Broadband Amplitude- and Phase-matched RF Balun

The HL9402 is the world's first broadband RF and microwave balun with ± 0.1 dB amplitude matching and ± 0.5 degree phase matching from 5 MHz to 20 GHz.

This component is optimized for use in:

- Signal integrity testing
- Serial data link measurement
- Analog to digital conversion
- Signal inversion
- High-linearity down-converter sampling modules

The compact and accurate HL9402 is available with SMA, K, or V connectors, in any combination of jacks and plugs.

Figure 1: HL9402 Broadband Amplitude- and Phase-matched Balun

HL9402 Technical Specifications

Parameter	Performance
Amplitude Balance	+/- 0.1 dB
Phase Balance	+/- 0.5 degrees
Risetime	17.5 ps
Bandwidth	5 MHz to 20 GHz
Impedance	50 ohms
Insertion Delay	308 ps
Insertion Loss	See Figures 2-3 on following page
Return Loss	See Figures 4-6 on following pages
Dimensions	38.1 x 38.1 x 14.0 mm (1.5 x 1.5 x 0.55 in), without connectors 57.3 x 38.1 x 14.0 mm (2.258 x 1.50 x 0.55 in), with SMA connectors
Weight	35.1 g (1.23 oz)
Connectors	SMA with three jacks; any combination of plugs and jacks available upon request; K or V connectors available upon request
Operating Temperature	0° C to +40° C
Storage Temperature	-40° C to +85° C
Warranty	1 year, repair or replacement at the discretion of HYPERLABS, Inc.

Frequency Domain Measurements of the HL9402

Figures 2-3 highlight the exceptional symmetry, even at high frequencies, of the HL9402 when used in balun mode to convert a single-ended signal to a differential signal.

These measurements were taken by sending a signal from the Input and measuring the insertion loss (S21) on both the Non-inverting (+) and Inverting (-) Outputs. In both images, the horizontal axis is frequency (0 to 20 GHz), while the vertical axis is dB (0 to -60).

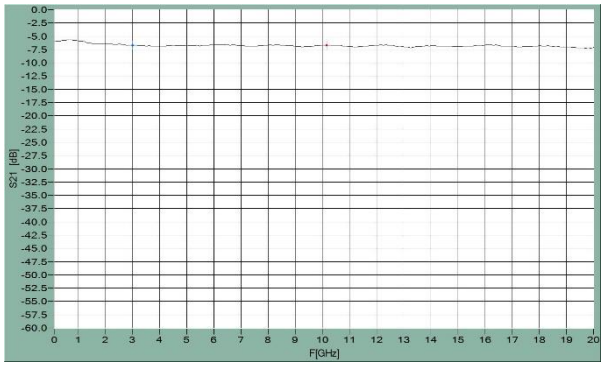

Figure 2: Insertion Loss (S21) on the Non-inverting Output of the HL9402 used as a balun

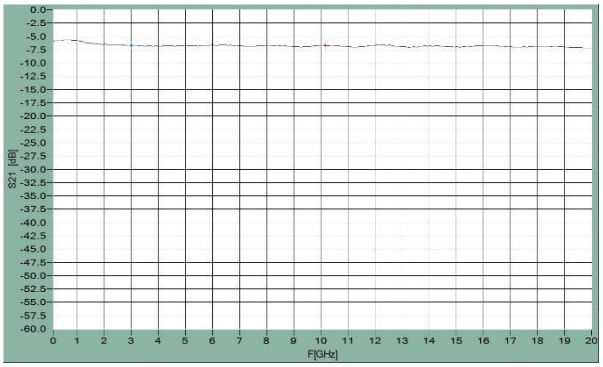

Figure 3: Insertion Loss (S21) on the Inverting Output of the HL9402 used as a balun

In ***Figures 4-5***, the HL9402 was set up in combiner (or reverse balun) mode, in which a differential signal is converted into a single-ended signal. These measurements show the return loss (S11) on each of the two output connectors. The axes and scale are the same as above.

Once again, the symmetry between the two measurements indicates the quality of the signal conversion.

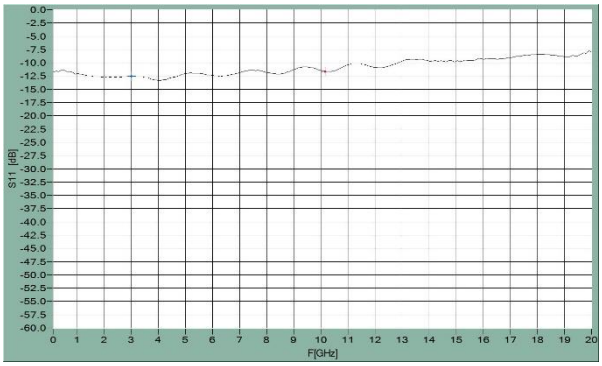

Figure 4: Return Loss (S11) on the Non-inverting Output of the HL9402 used as a combiner

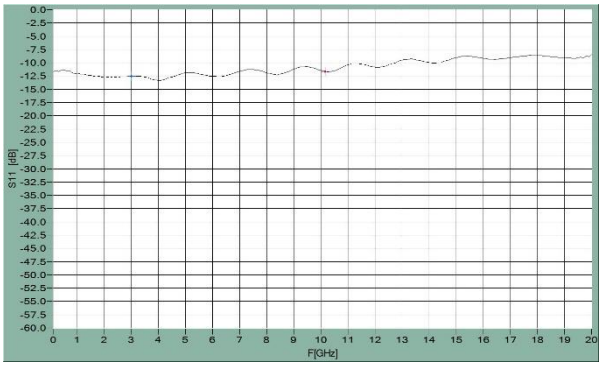

Figure 5: Return Loss (S11) on the Inverting Output of the HL9402 used as a combiner

Frequency Domain Measurements of the HL9402 (cont.)

Figure 6 shows the return loss (S11) measurement on the RF Input of the HL9402 when used as a balun to convert a single-ended signal to a differential signal.

The horizontal axis is frequency (5 MHz to 20 GHz) and the vertical axis is dB (0 to -60).

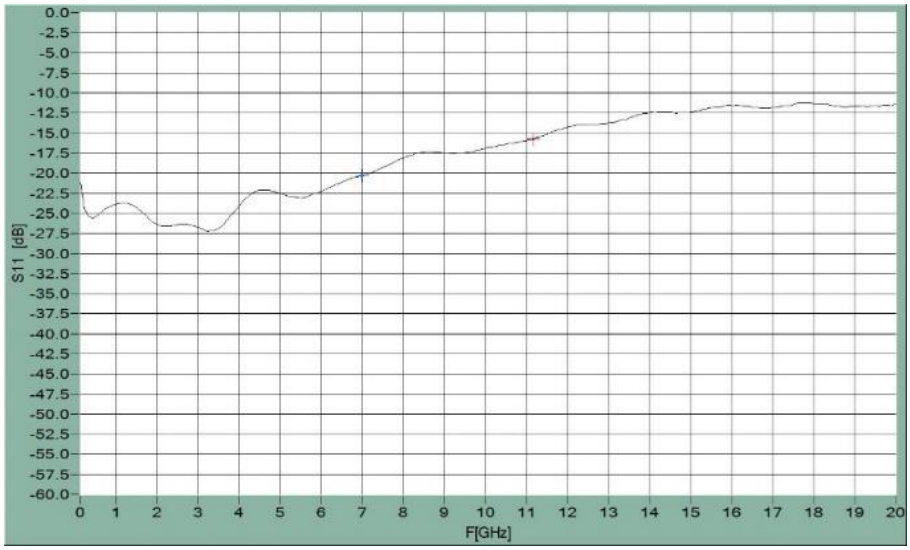

Figure 6: Return Loss (S11) on the RF Input of the HL9402

Time Domain Measurements of the HL9402

Figure 7 shows the positive going input signal, with a risetime of 32.19 ps and a time window delay of 39.86 ns. In ***Figure 8***, the C6 trace (non-inverting output signal) has a risetime of 34.33 ps and the C5 trace (inverting output signal) has a falltime of 34.38 ps. The time window delay is 39.862.

These measurements show that the HL9402 has a risetime of 11.93 ps (derived from the root of the difference of squares) and an insertion delay of 308 ps.

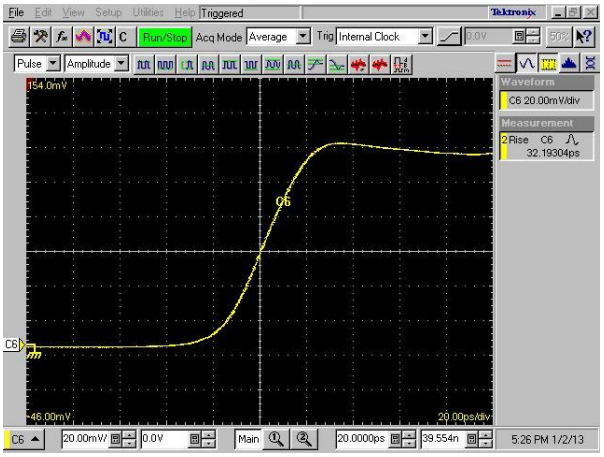

Figure 7: Positive Going Input Signal of the HL9402 Measured in the Time Domain

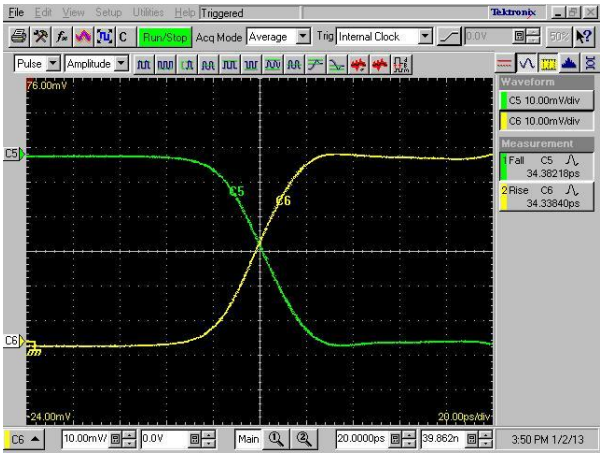

Figure 8: Non-inverting and Inverting Output Signals of the HL9402 Measured in the Time Domain

Eye Diagrammer Measurements of the HL9402

Figure 9 shows an eye diagram of a 10 Gbit/s Pseudo-Random Bit Sequence (PRBS) used as the input signal for testing the HL9402 balun. In ***Figure 10***, the CH5 trace shows the Inverting RF Output (-), while the CH6 trace shows the Non-inverting (+) RF Output.

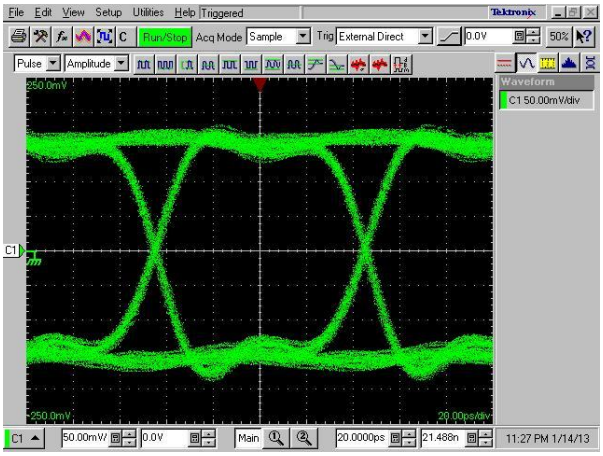

Figure 9: Eye Diagram Measurement of the HL9402 with a 10 Gbit/s PRBS Generator Used as the Input Signal

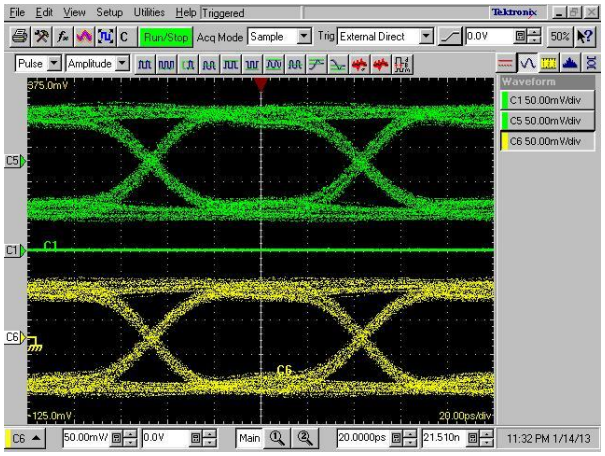

Figure 10: Eye Diagram Measurement of the Inverting and Non-inverting RF Outputs of the HL9402