HL9402 Broadband Balun (20 GHz)

The HL9402 is a signal splitter and combiner that offers industry-leading amplitude and phase match to 20 GHz (-3 dB).

It is suitable for use in 20 Gbps communications systems, high-speed analog-to-digital conversion, frequency response testing for differential devices, and many other applications.

Figure 1: HL9402 Broadband Balun

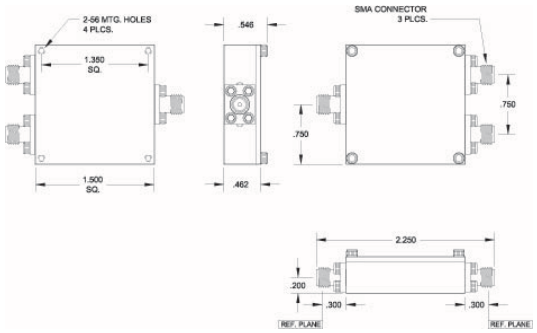

Figure 2: HL9402 Dimensional Drawing

Features and Technical Specifications

Bandwidth (-3 dB)	5 MHz to 20 GHz
Amplitude Balance (typical)	± 0.1 dB to 20 GHz see *Fig. 3* below
Phase Balance (typical)	± 2 degrees at 10 GHz see *Fig. 4* below
Rise Time	17.5 ps
Insertion Delay	308 ps
Insertion Loss	-6 dB
Return Loss	See *Fig. 5* below
VSWR (typical)	See *Fig. 6* below
CMRR	> 70 dB at 10 MHz > 35 dB at 20 GHz See *Fig. 7* below
Max. Input Power	+30 dBm
Impedance	50 Ω In, 2 x 50 Ω Out
Connectors	SMA, 3x Jack/Female
Dimensions	57.3 x 38.1 x 14 mm 2.258″ x 1.50″ x 0.55″
Weight	45.1 g (1.59 oz.)
Temperature Limits	0° to +40° C, operating -40° to +85° C, storage
RoHS Compliance	RoHS compliant; made with lead-free solder
Warranty	1 year, see website

Deployment Notes

Although the HL9402 ports are labeled as RF In/Out, this device is bidirectional and can be used either as a signal splitter or combiner.

If the DC voltage of the input or output is not zero, DC block capacitors are required.

Additional Data

Higher-resolution versions of the frequency domain charts on the following pages are available on our website, along with S-parameter files (.s3p) to 20 GHz for both single-ended and mixed modes.

HL9402 Amplitude Match

In *Figure 3* below, the insertion loss of the RF Outputs of the HL9402 is measured from 5 MHz to 20 GHz. The vertical axis is dB (0 to -10).

The amplitude balance can be seen by comparing the blue trace, Non-inverting (+) Output, with the red trace, Inverting (-) Output.

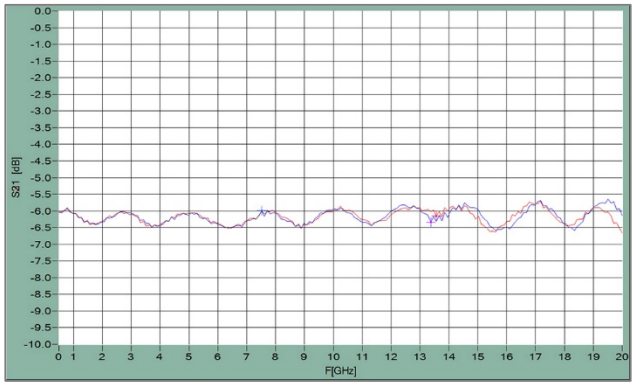

Figure 3: Typical insertion loss (S21/S31) measurements of the HL9402 RF Outputs

HL9402 Phase Match

Our system has a maximum phase uncertainty of 2 degrees, so that is what we specify as typical phase match for the HL9402.

A phase match of 2 degrees at 10 GHz requires the RF Output delays be within ≈ 0.5 ps of each other.

The green plot below shows a typical measured phase uncertainty from 100 MHz to 20 GHz. The vertical axis ranges from -2° to 2.5°. The red line is a trend of phase mismatch values.

Figure 4: Typical Phase Mismatch of the HL9402

HL9402 Return Loss Measurements

In *Figure 5*, return loss (S11) is measured on the RF Input of the HL9402 from 5 MHz to 20 GHz. The vertical axis is dB (0 to -40).

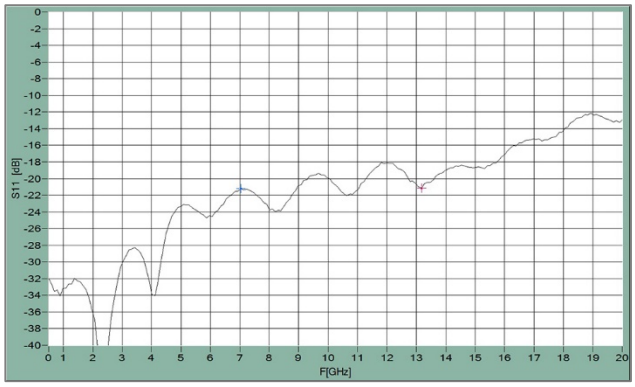

Figure 5: Typical return loss (S11) measurement of the HL9402 RF Input

In *Figure 6*, the HL9402 is used in signal combiner (reverse balun) mode. Return loss of the RF Outputs of the HL9402 is shown from 5 MHz to 20 GHz. The vertical axis is dB (0 to -40).

The blue trace is the Non-inverting (+) Output. The red trace shows the Inverting (-) Output.

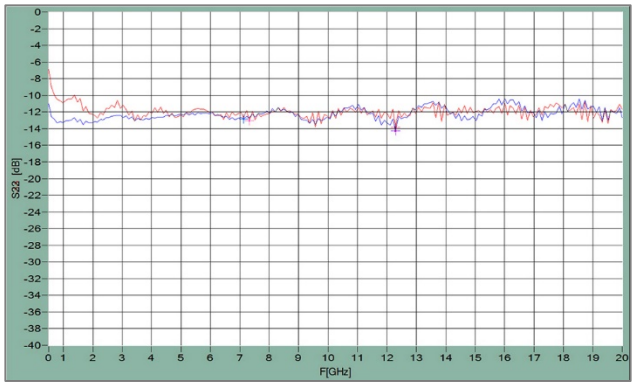

Figure 6: Typical return loss (S22/S33) measurements of the HL9402 RF Outputs

HL9402 Time Domain Measurements

In *Figure 7*, the positive going input signal is shown with a rise time of 32.19 ps and a time window delay of 39.86 ns.

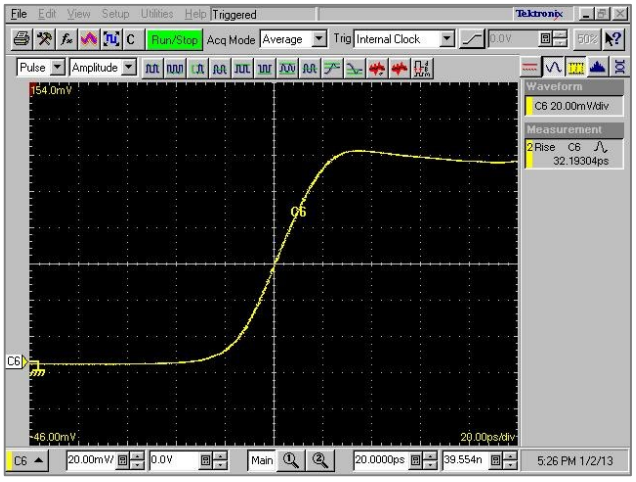

Figure 7: Positive going input signal of the HL9402 measured in the time domain

Figure 8 shows that the Non-inverting Output signal (yellow C6 trace) has a rise time of 34.33 ps, while the Inverting Output (green C5 trace) has a fall time of 34.38 ps. The time window delay is 39.862 ns.

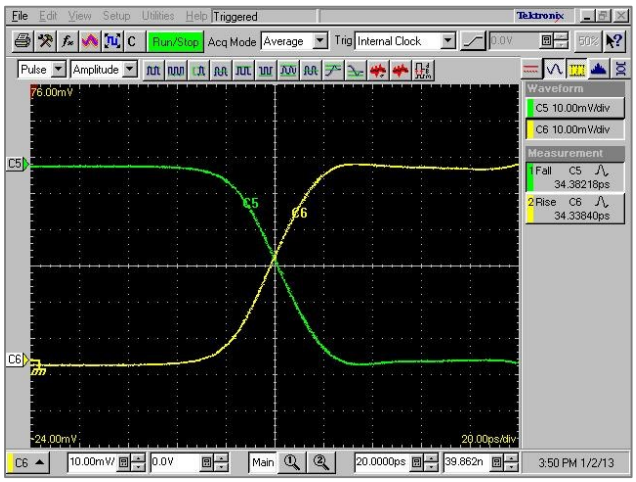

Figure 8: Non-inverting and inverting outputs of the HL9402 measured in the time domain

These measurements show a rise time of 11.93 ps (derived from the root of the difference of squares) and an insertion delay of 308 ps.

HL9402 Eye Diagrammer Measurements

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.

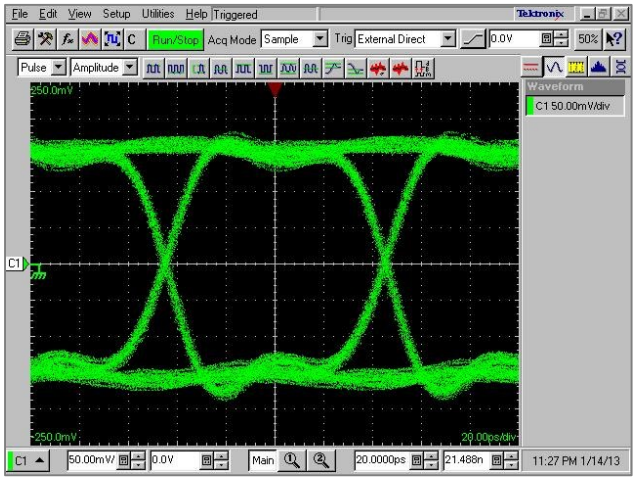

Figure 9: Eye Diagram of the HL9402 Interfaced with a 10 Gbit/s PRBS

In *Figure 10*, the green C5 trace shows the Inverting (-) RF Output, while the yellow C6 trace shows the Non-inverting (+) Output. The same 10 Gbit/s PRBS was used here.

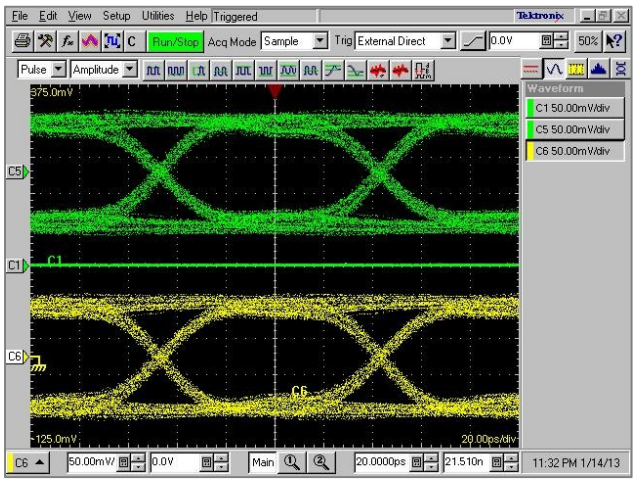

Figure 10: Eye diagram of the HL9402 interfaced with a 10 Gbit/s PRBS