

HL9407 Broadband Balun (67 GHz)

The HL9407 is a signal splitter and combiner that offers industry-leading amplitude and phase match from 5 MHz to 67 GHz at -3 dB.

It is suitable for use in 40+ Gbps communications systems, high-speed analog-to-digital conversion, frequency response testing for differential devices, and many other applications.

Features and Technical Specifications

Bandwidth (-3 dB)	5 MHz to 67 GHz
Amplitude Match (typical)	± 0.1 dB to 30 GHz ± 0.25 dB to 67 GHz See Fig. 3 below
Phase Match (typical)	± 2 - 4° to 20 GHz ± 4 - 8° to 50 GHz See Fig. 4 below
Rise time	10.5 ps (combined)
Insertion Delay	278 ps
Insertion Loss	-6 dB
Return Loss	See Fig. 5 below
VSWR (typical)	See Fig. 6 below
CMRR (typical)	> 70 dB at 10 MHz > 30 dB at 50 GHz See Fig. 7 below
Max Input Power	+30 dBm
Impedance	50 Ω In, 2 x 50 Ω Out
Connectors	1.85 mm; 3x Jack/Female
Dimensions	60.80 x 38.1 x 13.87 mm 2.39" x 1.50" x 0.55"
Weight	45 g (1.6 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



Figure 1: HL9407 Broadband Balun

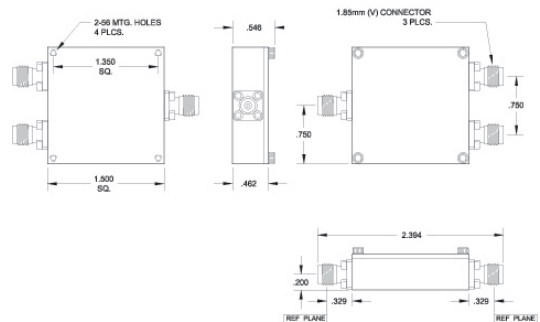


Figure 2: HL9407 Dimensional Drawing

Deployment Notes

Although the HL9407 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 charts on the following pages are available on our website, along with S-parameter files with single-ended (to 67 GHz) and mixed mode (to 50 GHz) data.

HL9407 Bandwidth

Bandwidth is defined as the range of frequencies where insertion loss is within -3 dB of the reference.

The HL9407 reference signal is -6 dB. *Figure 3* below shows better than -9 dB insertion loss up to 67 GHz when the device is used as a signal splitter.

HL9407 Amplitude Match

Amplitude match is a comparison between the signals on the RF Out +/- ports of a balun used as a signal splitter. This specification is derived from the insertion loss (in dB) of the output ports.

Figure 3 below shows typical HL9407 insertion loss from 5 MHz to 67 GHz when the device is used as a signal splitter. Vertical scale is -5.25 to -9.25 dB.

The amplitude balance can be seen by comparing the non-inverting output (blue trace), with the inverting output (red trace).

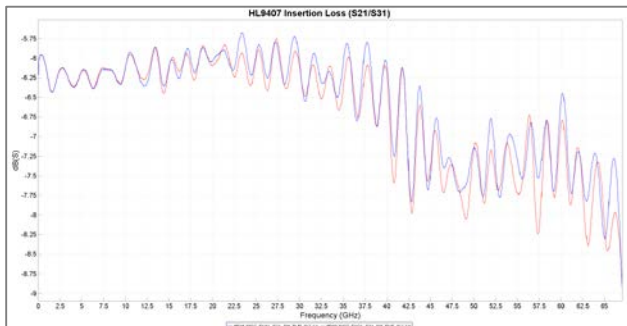


Figure 3: Typical insertion loss of the HL9407 when used as a signal splitter

When the HL9407 is used as a combiner, mixed mode parameters provide additional information on device performance.

For more on the HL9407 performance as a signal combiner, please see the section titled “HL9407 Mixed Mode Data” on the following page.

HL9407 Phase Match

The HL9407 is a 180° balun, so the phase match of the RF Out+ and RF Out- ports is specified to degrees from 180°.

Match is dependent on the delay of the output ports. For example, 2 degree mismatch at 10 GHz requires the delays be within ≈ 0.5 ps of each other. Phase mismatch increases with frequency.

Figure 4 below shows phase mismatch between the RF Outputs from 5 MHz to 67 GHz. The vertical range is 0-12°.

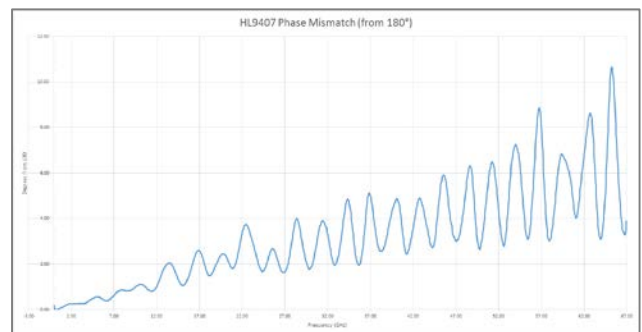


Figure 4: HL9407 phase match, represented as degrees from 180°

HL9407 Return Loss Measurements

In *Figure 5*, return loss on the HL9407 RF Input is shown from 5 MHz to 67 GHz. The vertical axis is dB (-7.5 to -45).



Figure 5: Typical return loss on RF In port of the HL9407

Mixed mode S-parameters are informative when the HL9407 is used as a combiner. Please see “HL9407 Mixed Mode Data” section on the following page.

HL9407 VSWR

The typical Voltage Standing Wave Ratio (VSWR) of the HL9407 is shown in *Figure 8* below.

The blue and orange traces show typical VSWR on the RF In and RF Out+ ports, respectively.

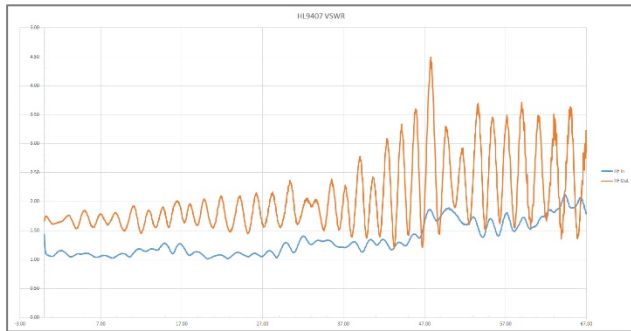


Figure 6: Typical VSWR of HL9407 RF Input and RF Out+

HL9407 CMRR

The exceptional Common Mode Rejection Ratio (CMRR) of the HL9407 allows it to be used as a signal combiner as well as a splitter.

Figure 7 shows the CMRR of the HL9407 when used to combine a differential signal from a 50 GHz VNA source.

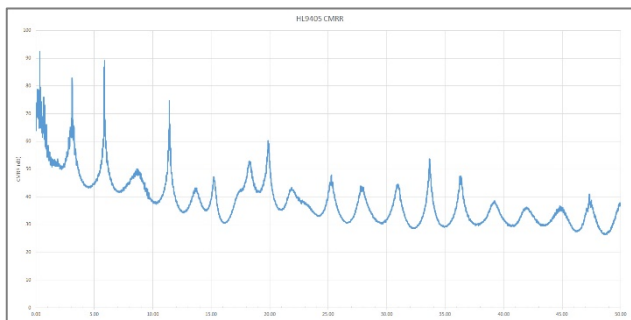


Figure 7: HL9407 CMRR (to 50 GHz)

HL9407 Mixed Mode Data

The unique design of HYPERLABS baluns allows the HL9407 to be used as a signal combiner as well as a signal splitter.

In combiner mode, the balun converts a differential source signal into a single-ended output, minimizing common mode noise and harmonic distortion.

For this reason, HL9407 combiner performance is best characterized from mixed mode S-parameters using a 4-port VNA as a differential source.

Full mixed mode data for the HL9407 (to 50 GHz) is found in the S-parameters file available on the HYPERLABS website.