

## PRODUCT SUMMARY

The HL9409 is an ultra-broadband 180° signal splitter and combiner that offers excellent amplitude and phase match over an industry-best bandwidth of 500 kHz to 100 GHz.

It is suitable for use in 224 Gbps PAM4 communications systems, high-speed analog-to-digital conversion, frequency response testing for differential devices, and many other applications.

## DEPLOYMENT NOTES

When the device is used as a signal combiner using differential signals with unmatched source impedance, attenuators (3-6 dB) may be required to improve isolation.

If the DC voltage of the balanced or unbalanced ports is non-zero, DC blocks are required. The balanced ports (2 and 3) are DC shorted.

## MODELS

The following model is available:

**HL9409**, 100 GHz

The following connector option is available:

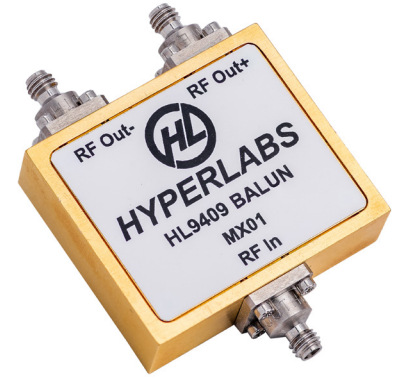
**-JJJ**, jack/jack/jack

## HL9409 Broadband Balun (500 kHz to 100 GHz)

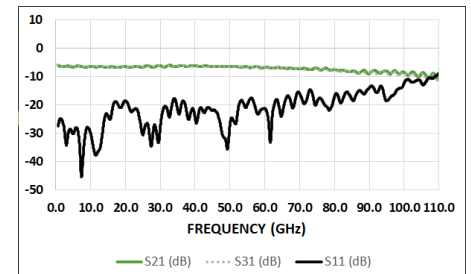
### Features and Technical Specifications<sup>1</sup>

Bandwidth	500 kHz to 100 GHz (3 dB)
Amplitude Match See Fig. 1	$\pm 0.2$ dB, $f \leq 50$ GHz $\pm 0.5$ dB, $f > 50$ GHz
Phase Match See Fig. 4	$\pm 4^\circ$ , $f = 20$ GHz $\pm 5^\circ$ , $f = 40$ GHz $\pm 15^\circ$ , $f = 80$ GHz
Insertion Loss See Fig. 1	6.5 dB, single-ended reference
Return Loss See Fig. 2	$> 15$ dB, unbal. port, $f \leq 60$ GHz $> 10$ dB, unbal. port, $60 \text{ GHz} < f \leq 110$ GHz $> 10$ dB, bal. ports, $f \leq 60$ GHz $> 7.5$ dB, bal. ports, $60 \text{ GHz} < f \leq 110$ GHz
Rise Time	3.5 ps
Group Delay See Fig. 3	$\approx 270$ ps
Max Input Power	1 W (+30 dBm)
Impedance	50 $\Omega$
Connectors	1.0 mm, 3 x jack/female (standard config)
Dimensions (W x D x H)	1.967" x 1.40" x 0.40" 50.0 x 35.6 x 10.2 mm
Weight	45.3 g (1.6 oz.)
Temperature Limits	-40° to +100° C, operating
RoHS Compliant	Yes, assembled with lead-free solder
REACH Compliant	Yes
Warranty	1 year, see website

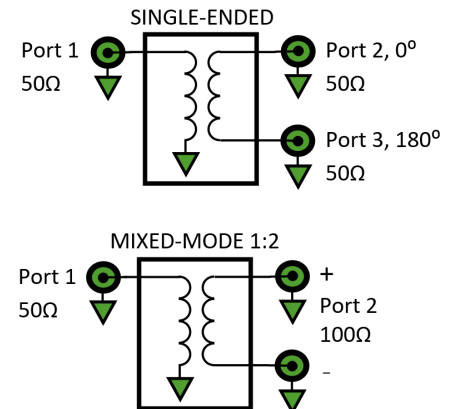
Note 1 - All specifications based on test results using standard connector configuration (3 x jack).



HL9409, standard configuration shown



Typical HL9409 Single-ended Insertion Loss



HL9409 Schematic and Port Assignments

## HL9409 Plot Diagrams

Figures 1-4 show the typical S-parameter characteristics in single-ended mode. Unless otherwise noted, bandwidth for all HYPERLABS baluns is defined as the range of frequencies where insertion loss is within 3 dB of the nominal level (6.5 dB) in single-ended mode.

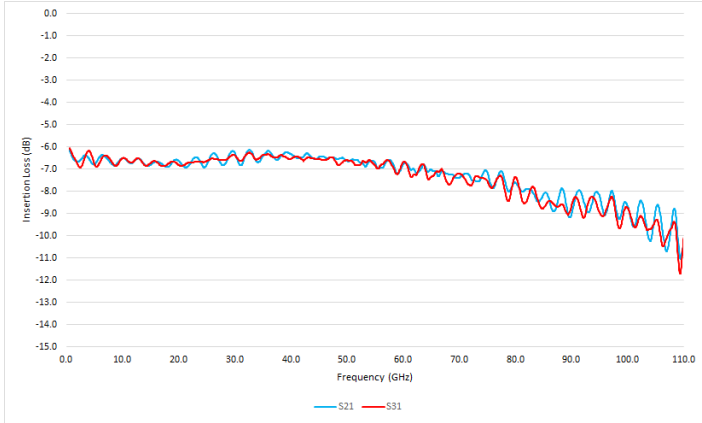


Figure 1: HL9409 Single-ended Insertion Loss and Amplitude Match



Figure 2: HL9409 Single-ended Return Loss

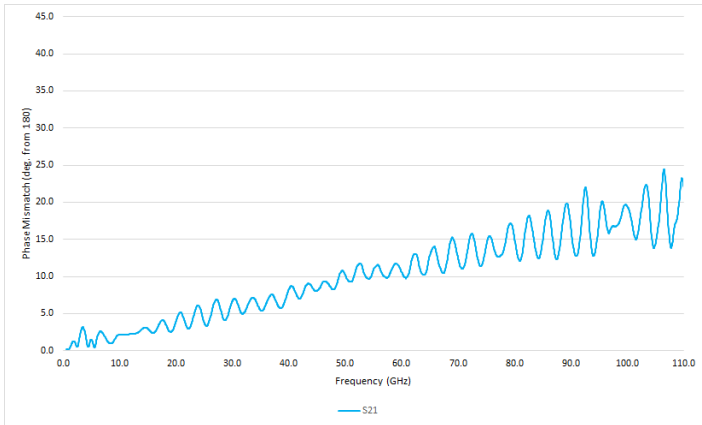


Figure 3: HL9409 Phase Mismatch

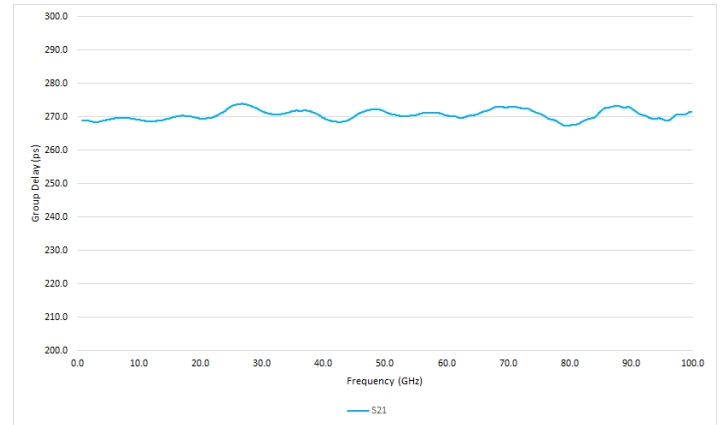


Figure 4: HL9409 Group Delay

## HL9409 Dimensional Drawing

Figure 5 shows a mechanical drawing of an HL9409. Unless otherwise noted, all units are in inches. See page 1 for full dimensions.

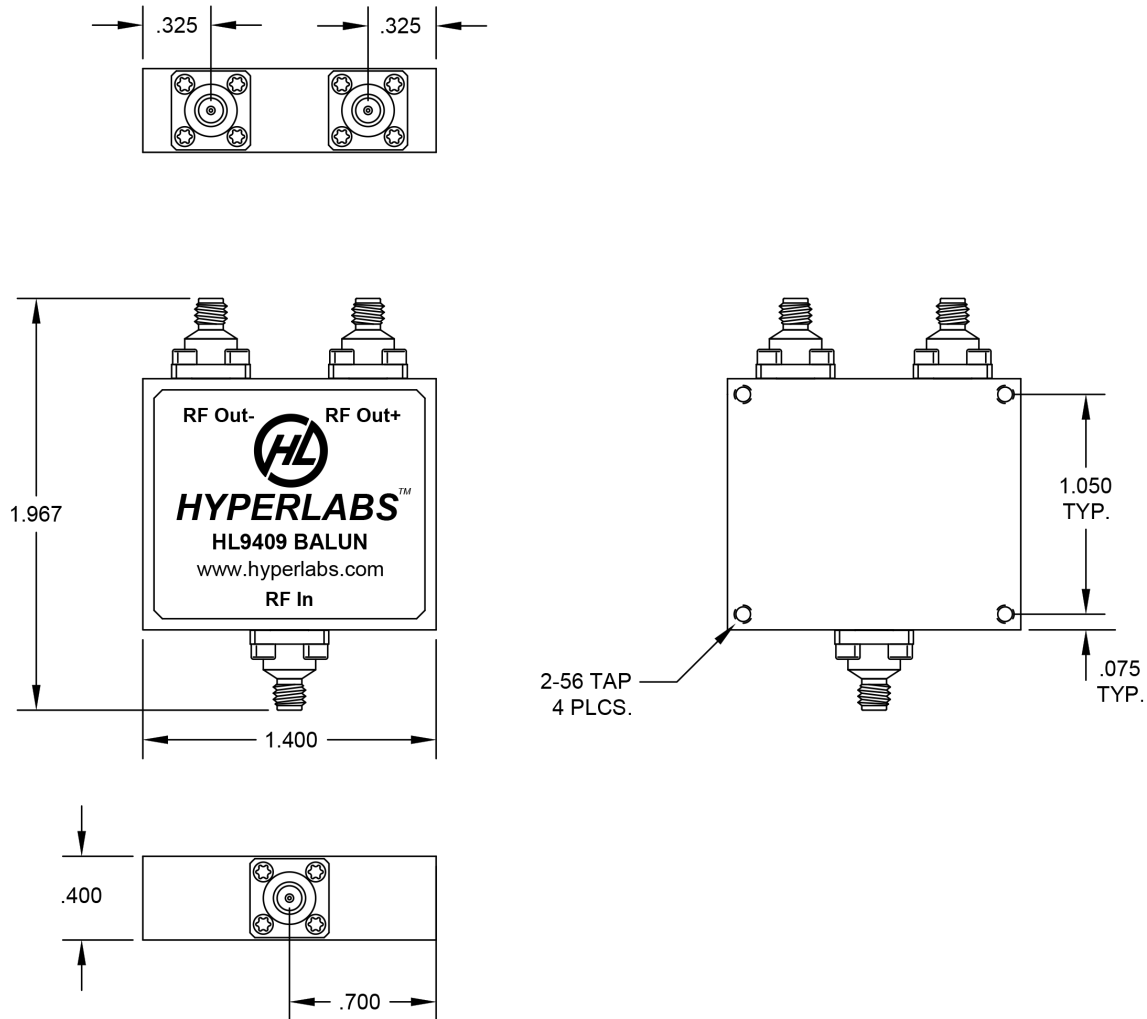


Fig. 5: HL9409 Mechanical Drawing