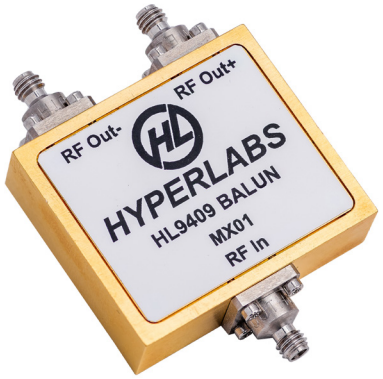
HYPERLABS™
Innovation at Hyperspeed since 1992

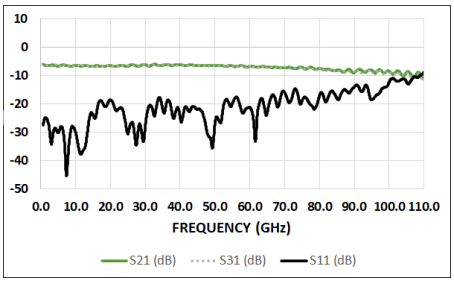
HL9409 Broadband Balun (500 kHz to 100 GHz)

Features and Technical Specifications

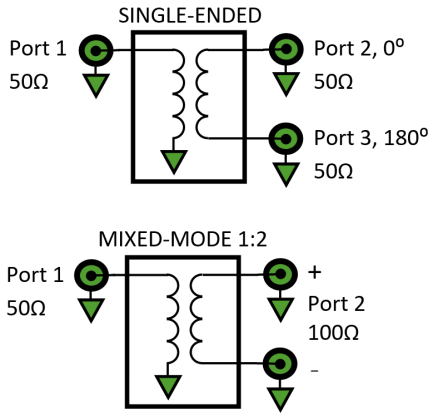
Bandwidth	500 kHz to 100 GHz (3 dB)
Amplitude Match See *Fig. 1*	± 0.2 dB, f ≤ 50 GHz ± 0.5 dB, f > 50 GHz
Phase Match See *Fig. 4*	± 4°, f = 20 GHz ± 5°, f = 40 GHz ±15°, f = 80 GHz
Insertion Loss See *Fig. 1*	6.5 dB, single-ended reference
Return Loss See *Fig. 2*	> 15 dB, unbal. port, f ≤ 60 GHz > 10 dB, unbal. port, 60 GHz < f ≤ 110 GHz > 10 dB, bal. ports, f ≤ 60 GHz > 7.5 dB, bal. ports, 60 GHz < f ≤ 110 GHz
Rise Time	*3.5 ps*
Group Delay See *Fig. 3*	≈ 270 ps
Max Input Power	1 W (+30 dBm)
Impedance	50 Ω
Connectors	1.0 mm, 3x jack/female 1.0 mm plug connectors upon request
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



HL9409, standard configuration shown



Typical HL9409 Single-ended Insertion Loss



HL9409 Schematic and Port Assignments

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

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HL9409 Single-ended Insertion Loss and Return Loss

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 shows the insertion loss and amplitude match of an HL9409 in single-ended mode.

Figure 2 shows the return loss of all ports in single-ended mode.

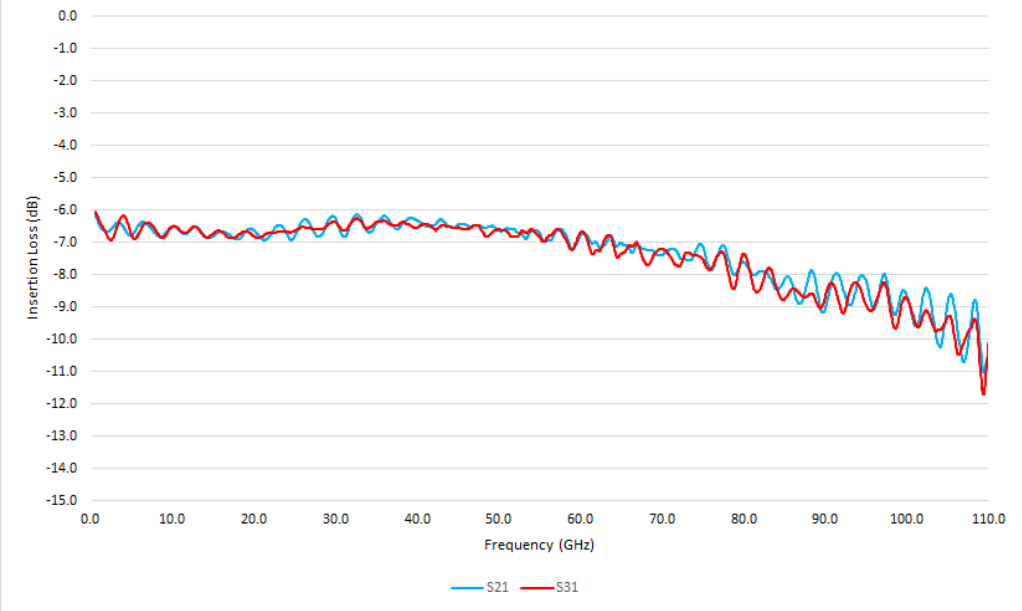

Figure 1: HL9409 Single-ended Insertion Loss

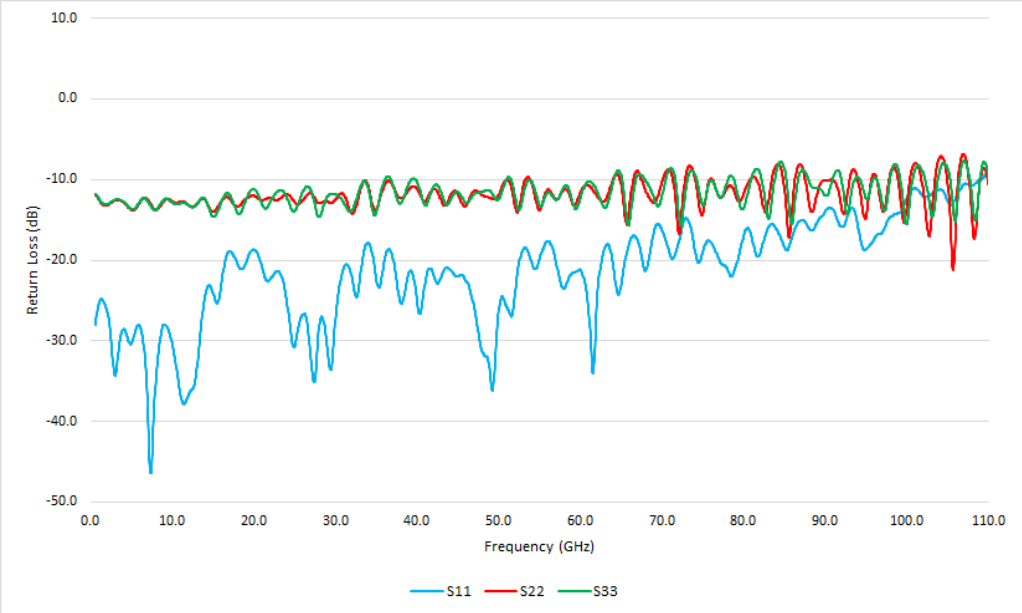

Figure 2: HL9409 Single-ended Return Loss

HL9409 Group Delay and Phase Match

Figure 3 shows the typical group delay of an HL9409 used as a signal splitter. The average slope of the phase mismatch, shown in *Figure 4*, is equal to the group delay mismatch.

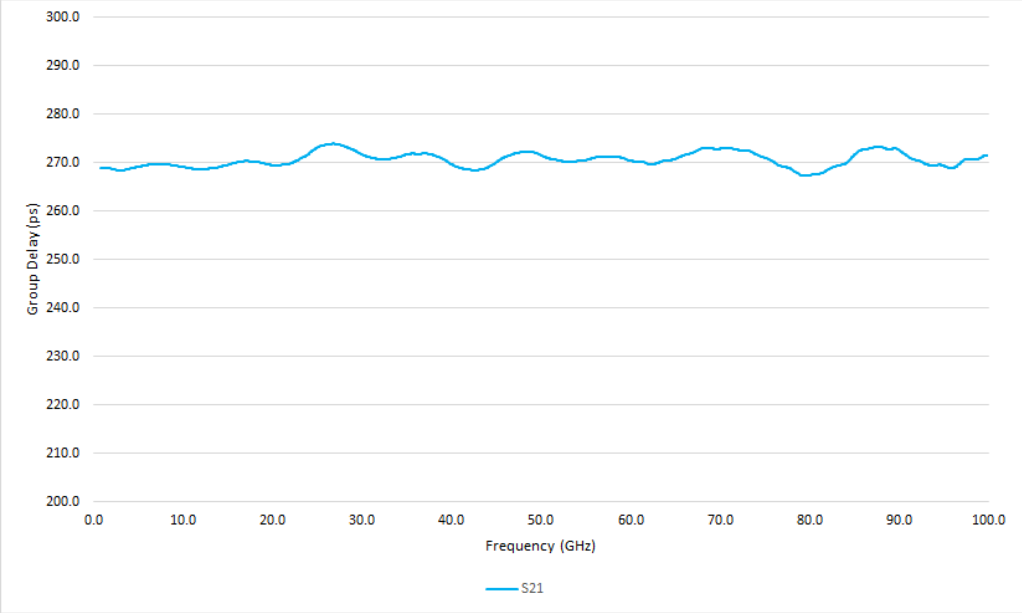

Figure 3: HL9409 Single-ended Group Delay

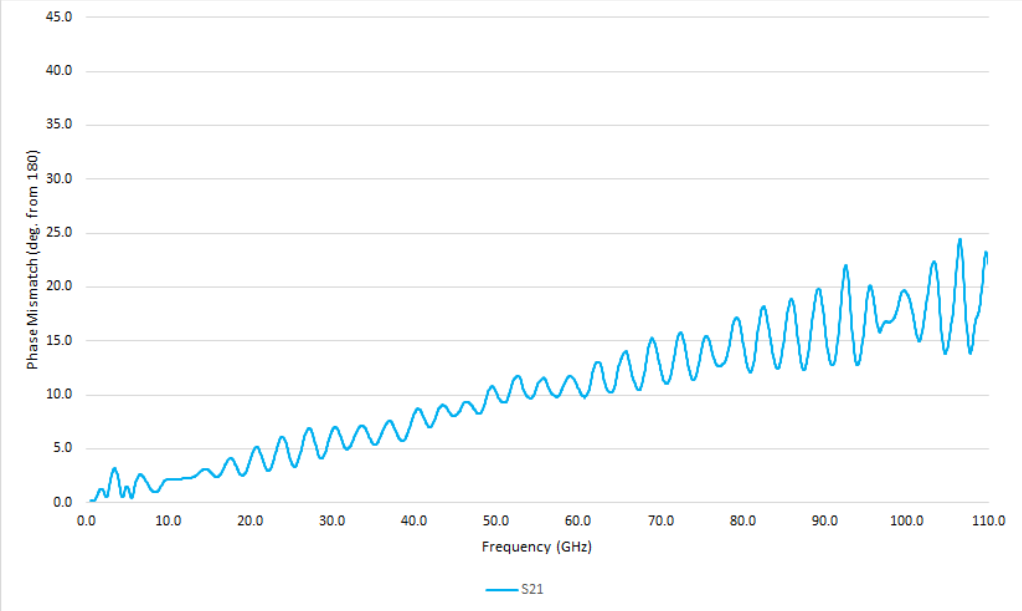

Figure 4: HL9409 Phase Mismatch

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.

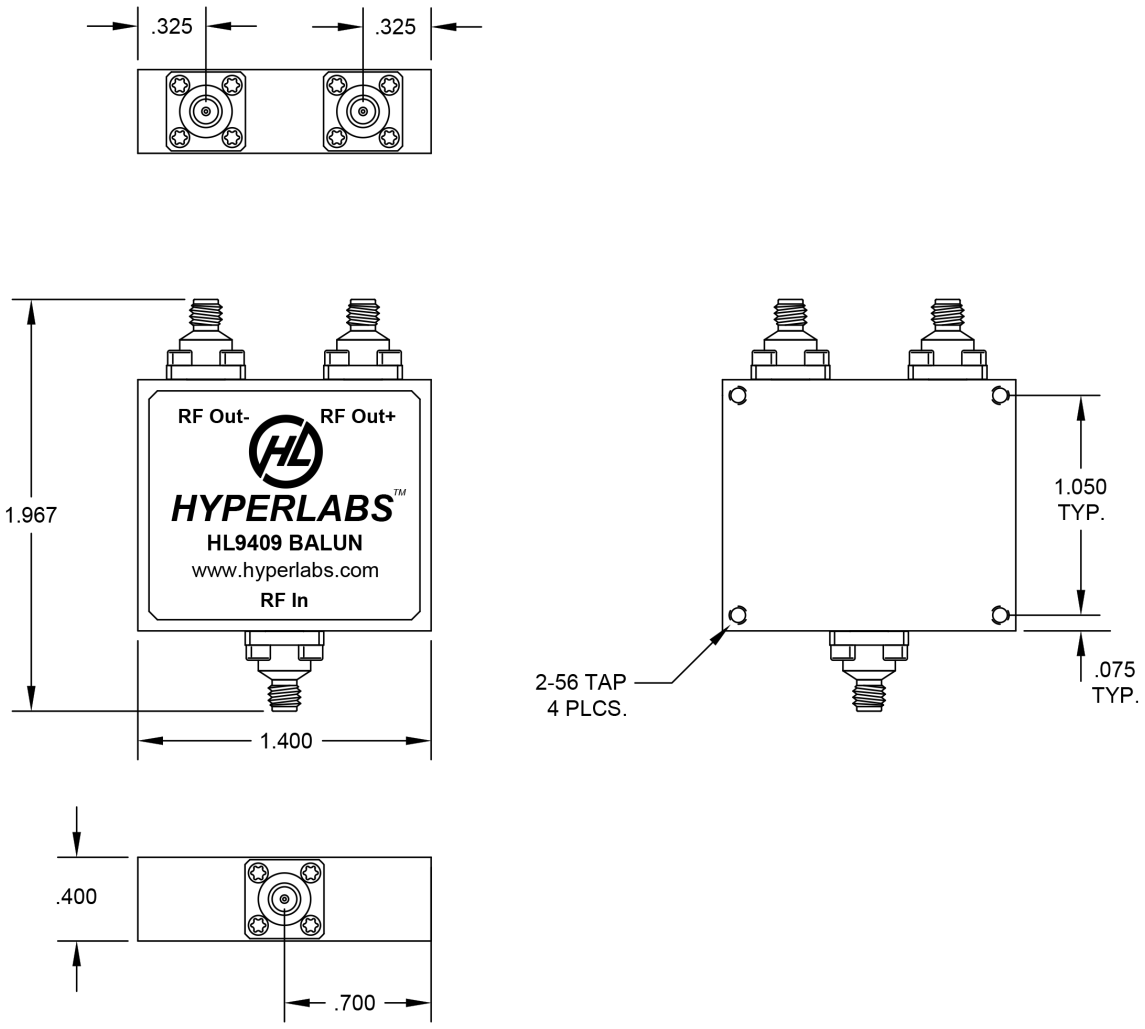

Fig. 5: HL9409 Mechanical Drawing