



## PRODUCT SUMMARY

The HL9448 and HL9449 are ultra-broadband bias tees with a typical insertion loss of 2.5 dB throughout the specified bandwidth range.

The HL9448/9 blocks any existing DC signal and allows for the insertion of a DC bias current into a circuit with minimal perturbation of the impedance of a 50 ohm transmission line.

These devices can be used for biasing amplifiers, lasers, optical modulators, and other devices.

Applications include 224 Gbps PAM4 communications systems, optical communication systems, high-speed data systems, level shifting, cascading, and interfacing between devices with incompatible DC operating points.

## MODELS & OPTIONS

The following models are available:

**HL9448**, 95 GHz  
**HL9449**, 110 GHz

The following options are available:

**-M**, matched pair  
**-U**, unmatched part(s)

**-11**, 11 V breakdown  
**-30**, 30 V breakdown

## CONNECTORS

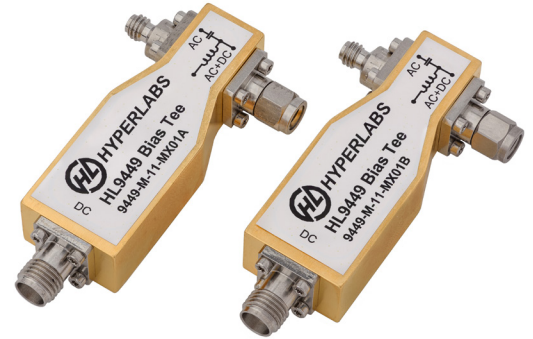
Connectors should be specified according to the configurations listed on Page 2

## HL9448/9 Series Bias Tees (160 kHz to 110 GHz, 175 mA)

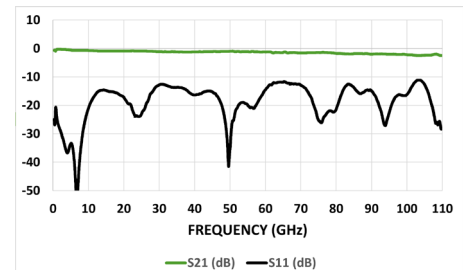
### Features and Technical Specifications<sup>1</sup> (HL9449 shown)

|                                   |  |
|-----------------------------------|--|
| Bandwidth                         | 160 kHz to > 110 GHz (opt. -11)<br>200 kHz to > 110 GHz (opt. -30)   |
| Amplitude Match<br>(opt. -M only) | $\pm 0.1$ dB, $f \leq 110$ GHz, all options<br>See Fig. 1  |
| Phase Match<br>(opt. -M only)     | $\pm 4^\circ$ , $f = 40$ GHz   |
| Insertion Loss                    | < 2.5 dB, 160 kHz to 110 GHz, (opt. -JJ)<br>See Fig. 1   |
| Return Loss                       | 15 dB, $f \leq 50$ GHz, all options<br>10 dB, $50 \text{ GHz} < f \leq 110$ GHz, all options<br>See Fig. 3                     |
| Breakdown Voltage                 | 11 V, max (opt. -11)<br>30 V, max (opt. -30)   |
| Maximum Current                   | 175 mA   |
| Rise Time (10-90%)                | 3.2 ps, all options  |
| Impedance                         | 50 $\Omega$  |
| Dimensions<br>(W x D x H)         | 1.95" x 1.30" x 0.53"<br>49.53 x 33.02 x 13.46 mm  |
| Weight                            | 24 g (0.85 oz.)  |
| Connectors<br>(AC / AC+DC)        | 1.0 mm<br>Standard configuration is jack/plug with either pins or SMA jack for DC bias.<br>See page 2 for other configurations |
| Temperature Limits                | -40° to +70° C, operating  |
| RoHS Compliant                    | Yes, assembled with lead-free solder   |
| REACH Compliant                   | Yes  |
| Warranty                          | 1 year, see website  |

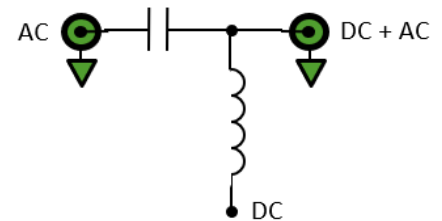
NOTE 1 - Unless otherwise noted, the specifications in this table are typical for Model Number HL9449 using the standard connector configuration (-JP, jack/plug). See page 2 for full specifications.



HL9449, Option -M-U-JPS shown



Typical HL9449 Insertion and Return Loss



HL9449 Schematic and Port Assignments

## HL9448 and HL9449 Full Specifications

| Parameter  | HL9448  | HL9449  | Comments   |
|--|---|---|--|
| Upper Frequency Limit                            | > 95 GHz  | > 110 GHz   | 3 dB roll-off point, relative to nominal insertion loss  |
| Lower Frequency Limit<br>See Fig. 2              | 160 kHz (opt. -11)<br>200 kHz (opt. -30)  |   | 3 dB roll-off point  |
| Maximum Current                                  | 175 mA  |   |  |
| Breakdown Voltage                                | 11 V, max (opt. -11)<br>30 V, max (opt. -30)  |   |  |
| Amplitude Match<br>See Fig. 5                    | $\pm 0.1$ dB, $f \leq 110$ GHz, all options   |   | Typical, opt. -M   |
| Phase Match                                      | $\pm 4^\circ$ , $f = 40$ GHz (opt. -M)  |   | Typical, opt. -M   |
| Insertion Loss<br>See Fig. 1                     | 2.5 dB<br>$160 \text{ kHz} \leq f \leq 95 \text{ GHz}$  | 2.5 dB<br>$160 \text{ kHz} \leq f \leq 110 \text{ GHz}$ | Typical  |
| Return Loss<br>See Fig. 3                        | 15 dB, $f \leq 50$ GHz<br>10 dB, $50 \text{ GHz} < f \leq 110 \text{ GHz}$  |   | Typical, within specified operating frequency  |
| Rise Time  | 3.7 ps  | 3.2 ps  | Typical  |
| Group Delay<br>See Fig. 4                        | 103 ps  | 105 ps  | All options  |
| Impedance  | 50 $\Omega$   |   | Input and Output   |
| DC Resistance                                    | 2 $\Omega$  |   | DC to AC+DC  |
| Connector Type                                   | 1.0 mm  |   | AC and AC+DC ports   |
| Connector Configurations (specify when ordering) | Port 1 (AC): jack (J) or plug (P)<br>Port 2 (AC+DC): jack (J) or plug (P)<br>Port 3 (DC): SMA jack (S) or capacitive feedthru pins (C)<br><i>Standard configuration is -JPS or -JPC</i> |   | E.g. config -JPS: AC jack, AC+DC plug, DC jack<br>Or, config. -JJC: AC jack, AC+DC jack, DC pins |
| Dimensions (W x D x H)                           | 1.95" x 1.30" x 0.53"<br>49.53 x 33.02 x 13.46 mm   |   | Package including connectors   |
| Weight   | 24 g (0.85 oz.)   |   |  |
| Operating Temperature                            | -40° to +70° C  |   | Case temperature   |
| RoHS Compliant                                   | Yes, assembled with lead-free solder  |   |  |
| REACH Compliant                                  | Yes   |   |  |
| Warranty   | 1 year, repair or replacement; see website for details  |   |  |

NOTE - All specifications are based on test results using the standard connector configuration (-JP, jack/plug). Specifications may vary slightly for other configurations.

## HL9449 Performance Characteristics

Figures 1-5 show the typical performance characteristics of the HL9449 opt. -11 from 10 MHz to 110 GHz, except Fig. 3 which shows low-frequency response to 100 KHz. Other models show similar performance within their specified bandwidth.

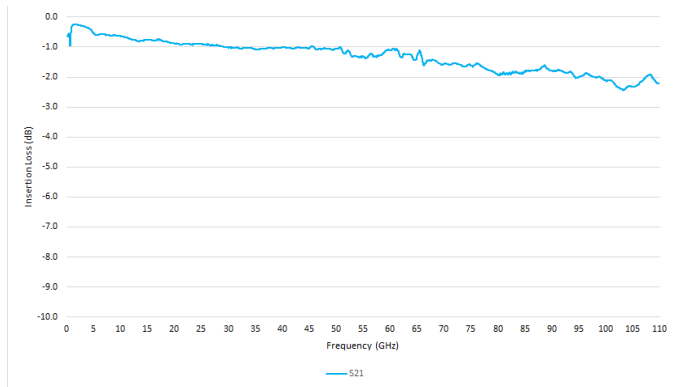


Fig. 1: Typical HL9449 Bandwidth and Insertion Loss

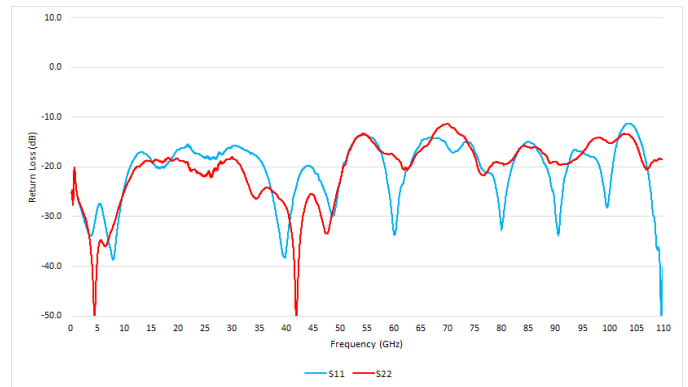


Fig. 2: Typical HL9449 Return Loss

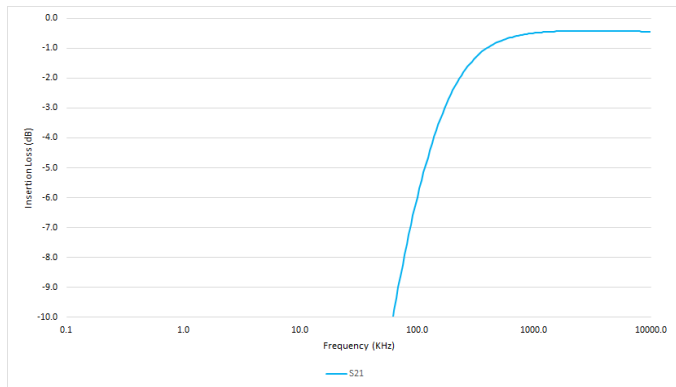


Fig. 3: Typical HL9449 Low Frequency Performance (opt. -30)

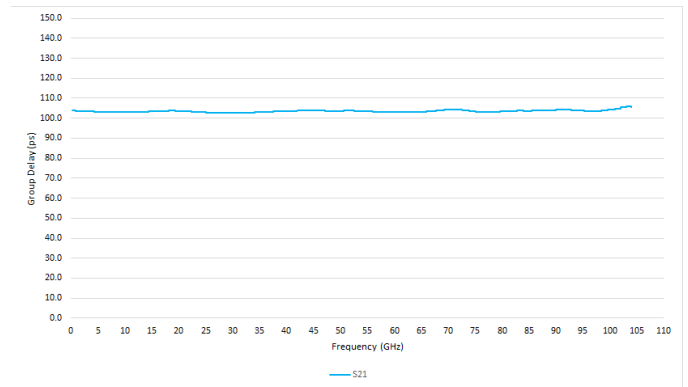


Fig. 4: Typical HL9449 Group Delay

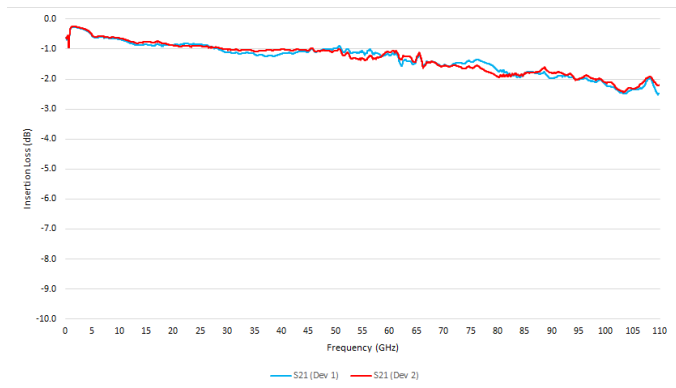


Fig. 5: Typical HL9449 Amplitude Matching (opt. -M)

## HL9449 Dimensional Drawing

Figure 6 shows a mechanical drawing of an HL9449 (opt. -JJC) with pins for DC bias. Figure 7 shows the HL9449 (opt. -JJS) with an SMA DC port. Unless otherwise noted, all units are in inches. See page 2 for full dimensions.

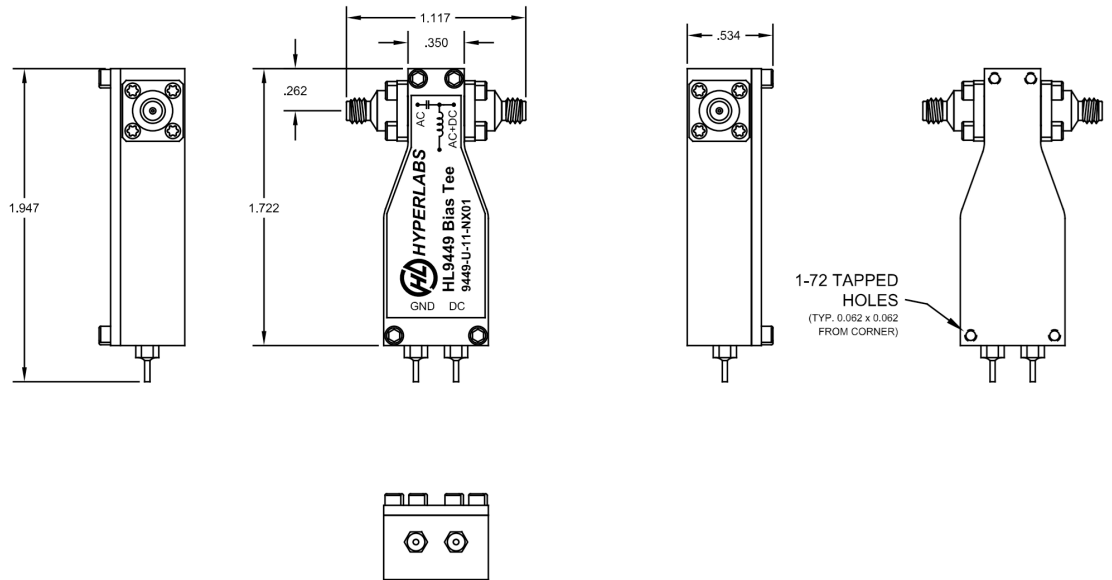


Fig 6: HL9449 with DC bias pins Mechanical Drawing

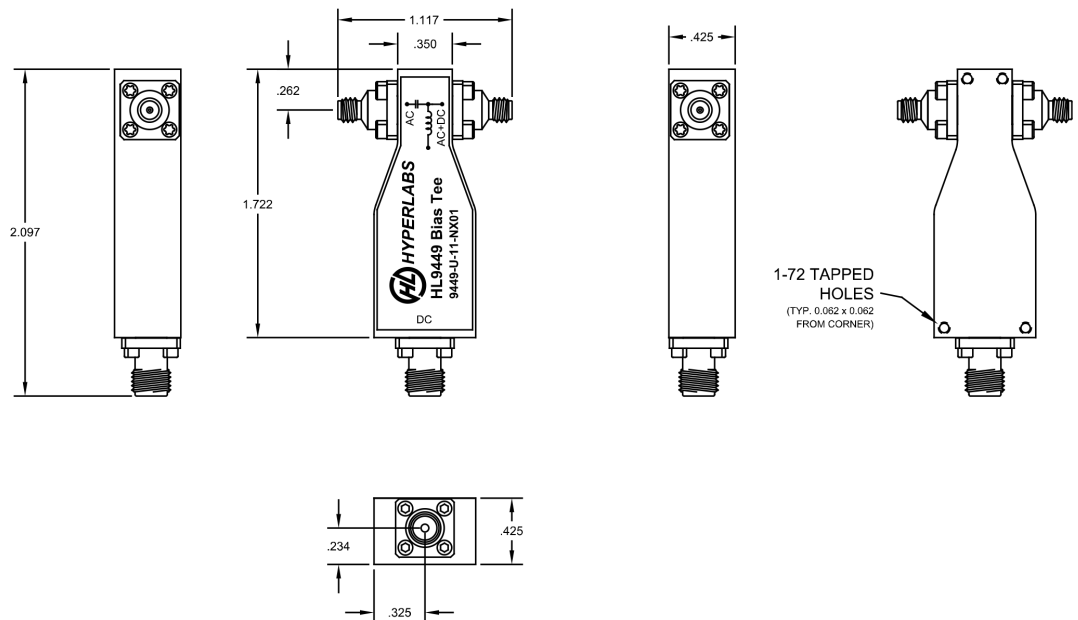


Fig 7: HL9449 with SMA DC bias port Mechanical Drawing