

## HL954x Series Bias Tees (50 kHz to 67 GHz, 400 mA)

### Features and Technical Specifications<sup>1</sup> (HL9547 shown)

#### PRODUCT SUMMARY

The HL954x Series are ultra-broadband bias tees with a maximum insertion loss of 1.8 dB throughout the specified bandwidth range.

The HL954x 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 112 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:

- HL9544**, 40 GHz
- HL9545**, 50 GHz
- HL9547**, 67 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

|                                |  |
|--------------------------------|--|
| Bandwidth                      | 50 kHz to > 67 GHz (opt. -11)<br>75 kHz to > 67 GHz (opt. -30)   |
| Insertion Loss                 | 1.8 dB max, 1 MHz to 67 GHz, (opt. -JJ)<br>See Fig. 1  |
| Return Loss                    | 15 dB $f \leq 35$ GHz, all options<br>10 dB $f > 35$ GHz, all options<br>See Fig. 3  |
| Amplitude Match (opt. -M only) | $\pm 0.1$ dB, $f \leq 67$ GHz, all options<br>See Fig. 5   |
| Phase Match (opt. -M only)     | $\pm 4^\circ$ , $f = 40$ GHz   |
| Breakdown Voltage              | 11 V, max (opt. -11)<br>30 V, max (opt. -30)   |
| Maximum Current                | 400 mA   |
| Group Delay                    | $\approx 110$ ps $\pm 10$ ps ripples, all options<br>See Fig. 4  |
| Rise Time (10-90%)             | 5 ps, all options  |
| Connectors (AC / AC+DC)        | 1.85 mm, jack/jack (opt. -JJ)<br>1.85 mm, jack/plug (opt. -JP)<br>1.85 mm, plug/jack (opt. -PJ)<br>1.85 mm, plug/plug (opt. -PP) |
| Temperature Limits             | $-40^\circ$ to $+70^\circ$ C, operating  |
| RoHS Compliant                 | Yes, assembled with lead-free solder   |
| REACH Compliant                | Yes  |
| Warranty                       | 1 year, see website  |

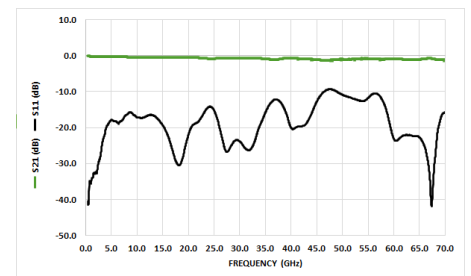
NOTE 1 - Unless otherwise noted, the specifications in this table are typical for Model Number HL9547. Full specifications for this and related models are available on Page 2 of this datasheet.



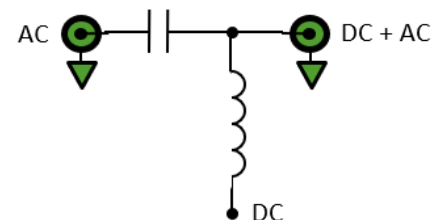
HL9547, Option -M-JPC shown (DC pins)



HL9547, Option -M-JPS shown (SMA DC port)



Typical HL9547 Insertion and Return Loss



HL954x Schematic and Port Assignments

## HL944x Full Specifications

| Parameter   | HL9544   | HL9545   | HL9547                            | Comments   |
|---|--|--|-----------------------------------|--|
| Upper Frequency Limit                               | > 40 GHz   | > 50 GHz   | > 67 GHz                          | 3 dB roll-off point, relative to nominal insertion loss  |
| Lower Frequency Limit<br>See Fig. 2                 |  | 50 kHz (opt. -11)<br>75 kHz (opt. -30)   |                                   | 3 dB roll-off point  |
| Maximum Current                                     |  | 400 mA   |                                   |  |
| Breakdown Voltage                                   |  | 11 V, max (opt. -11)<br>30 V, max (opt. -30)   |                                   |  |
| Insertion Loss<br>See Fig. 1                        | 1.5 dB max,<br>1 MHz ≤ f ≤ 40 GHz                      | 1.5 dB max,<br>1 MHz ≤ f ≤ 50 GHz  | 1.8 dB max,<br>1 MHz ≤ f ≤ 67 GHz |  |
| Return Loss<br>See Fig. 3                           |  | 15 dB, f ≤ 35 GHz<br>10 dB, f > 35 GHz   |                                   | Typical, within specified operating frequency  |
| Amplitude Match<br>See Fig. 5                       |  | ± 0.1 dB, (opt. -M)  |                                   | Typical, opt. -M   |
| Phase Match   |  | ± 4°, f = 40 GHz (opt. -M)   |                                   | Typical, opt. -M   |
| Rise Time   | 8.75 ps  | 7 ps   | 5 ps                              | Typical  |
| Group Delay<br>See Fig. 4                           | 107 ps ± 10 ps ripple                                  | 107 ps ± 10 ps ripple  | 110 ps ± 10 ps ripple             | All options  |
| Impedance   |  | 50 Ω   |                                   | Input and Output   |
| DC Resistance                                       |  | 2 Ω  |                                   | DC to AC+DC  |
| Connector Type                                      | 2.92 mm  | 2.4 mm   | 1.85 mm                           | AC and AC+DC ports   |
| Connector Configurations<br>(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) |                                   | 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 |  |                                   |  |

## HL954x Bandwidth and Insertion Loss

Figure 1 shows the insertion loss and bandwidth of the HL9547 from 10 MHz to 67 GHz.

Figure 2 shows the low-frequency response of this same configuration to 100 Hz.

Other models show similar performance within their respective specified bandwidths.

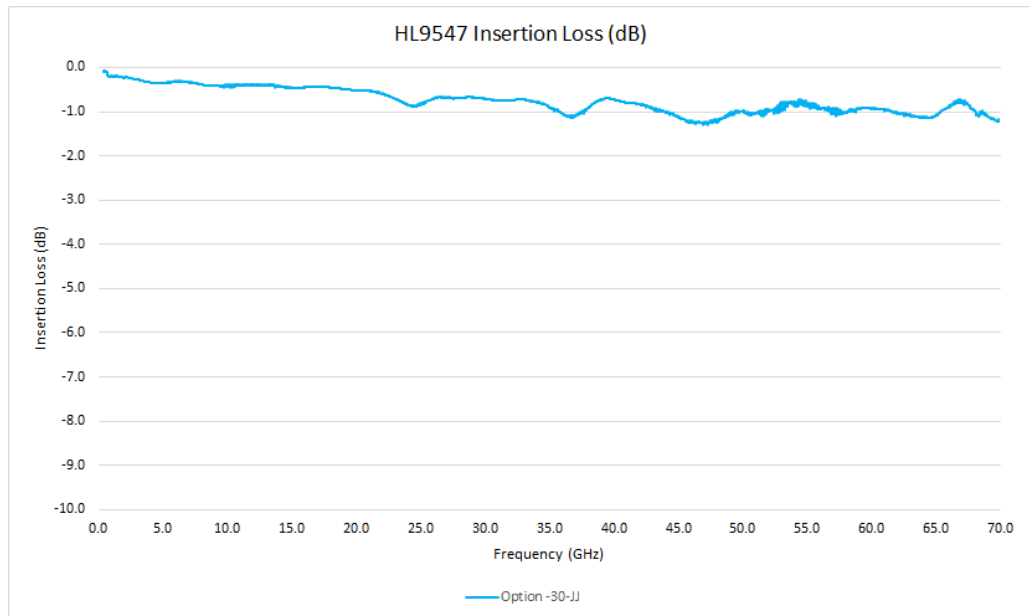


Figure 1: Typical HL9547 Bandwidth and Insertion Loss

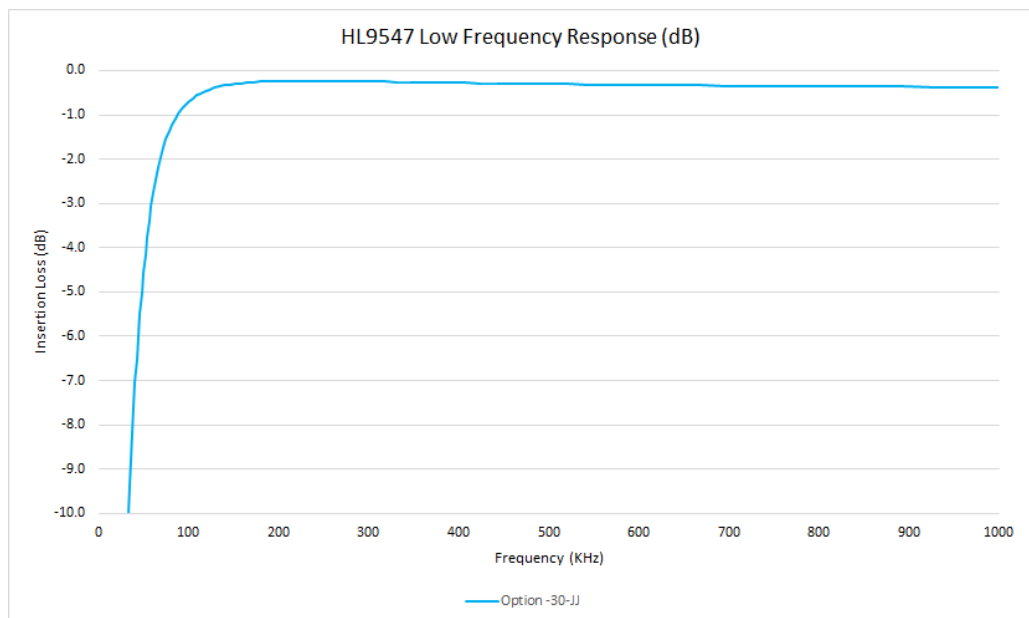


Figure 2: Typical HL9547 Low-frequency Performance (opt. -30)

## HL954x Return Loss and Group Delay

Figure 3 shows Return Loss and Figure 4 shows the Group Delay on a typical HL9547 from 10 MHz to 67 GHz.

Other models show similar performance within their respective specified bandwidths.

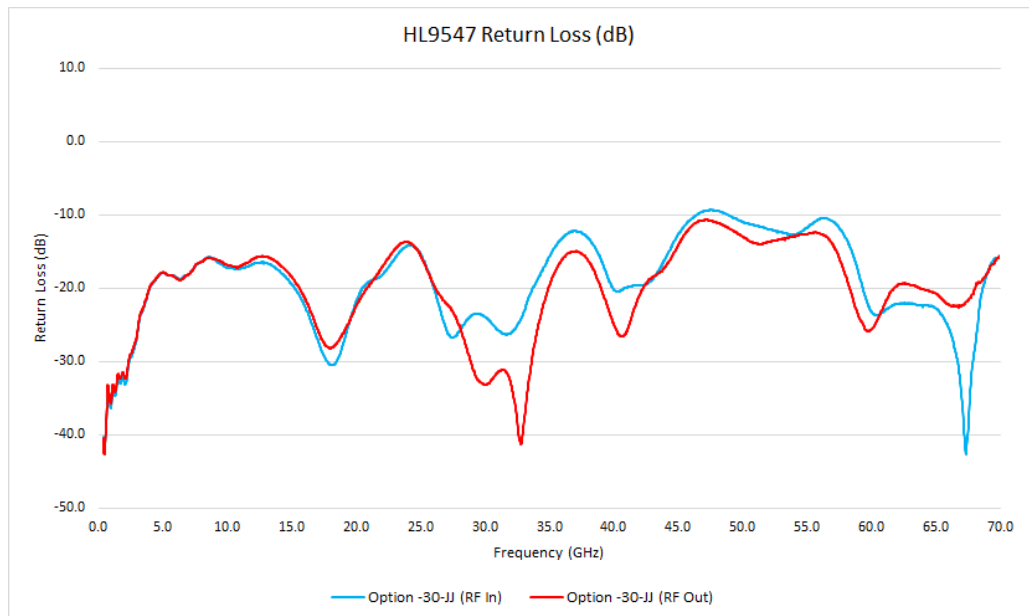


Figure 3: Typical HL9547 Return Loss

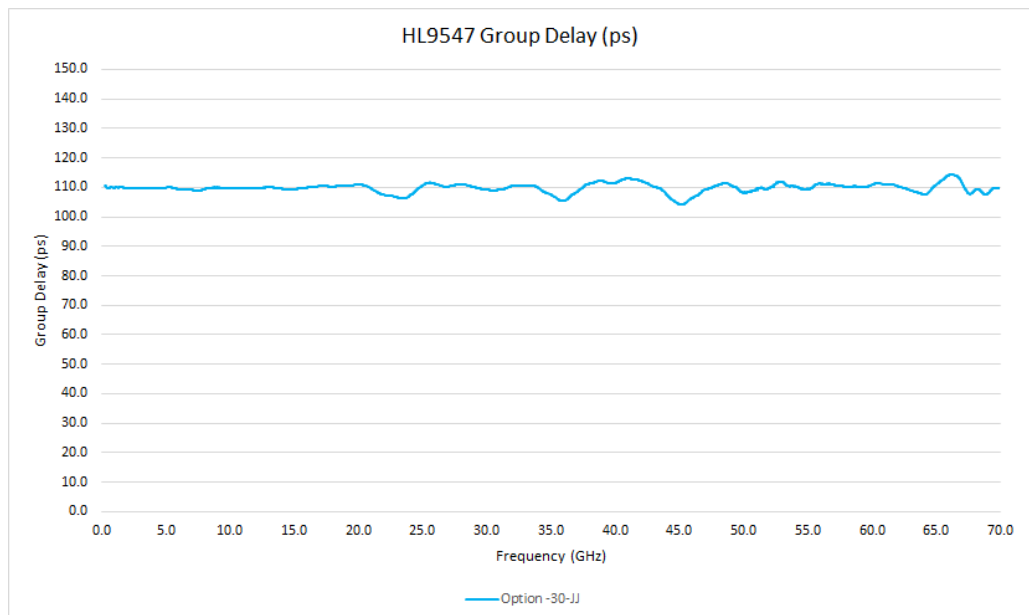


Figure 4: Typical HL9547 Group Delay

## HL954x Matching

Figure 5 shows the typical amplitude match between a matched pair of HL9547 devices from 10 MHz to 67 GHz.

Other models show similar performance within their respective specified bandwidths.

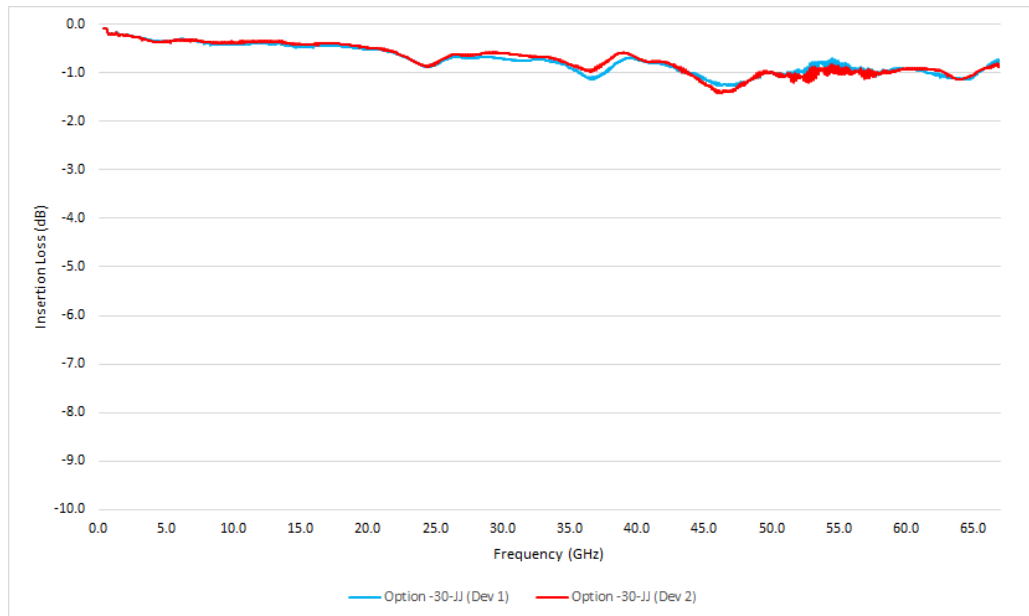


Figure 5: Typical HL9547 Amplitude Matching (opt. -M)

## HL957x Eye Diagrams

The eye diagrams in Figures 6-7 show a 32 Gbps PRBS31 pattern passed through an HL9547 (opt. -11).

All plots have an input signal amplitude of 395 mV and are shown at 89 mV/div.

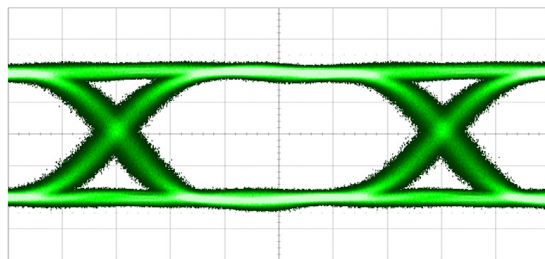


Figure 6: HL9547 32 Gbps PRBS 31, RF Input

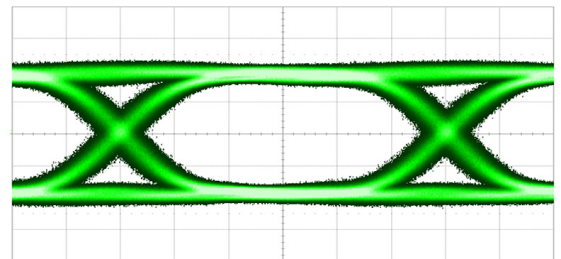


Figure 7: HL9547 32 Gbps PRBS 31, RF Output

## HL954x Dimensional Drawing

Figure 10 shows a mechanical drawing of an HL9547 (opt. -JPC) with pins for DC bias. Figure 11 shows the HL9547 (opt. -JJS) with an SMA DC port. Unless otherwise noted, all units are in inches. See page 2 for full dimensions.

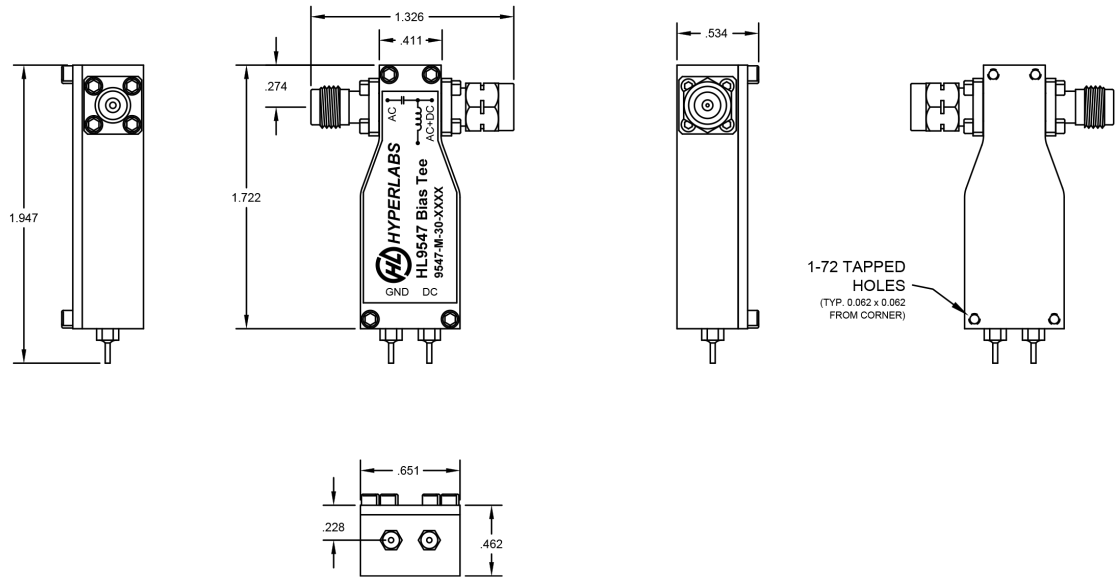


Fig 10: HL9547 with DC bias pins Mechanical Drawing

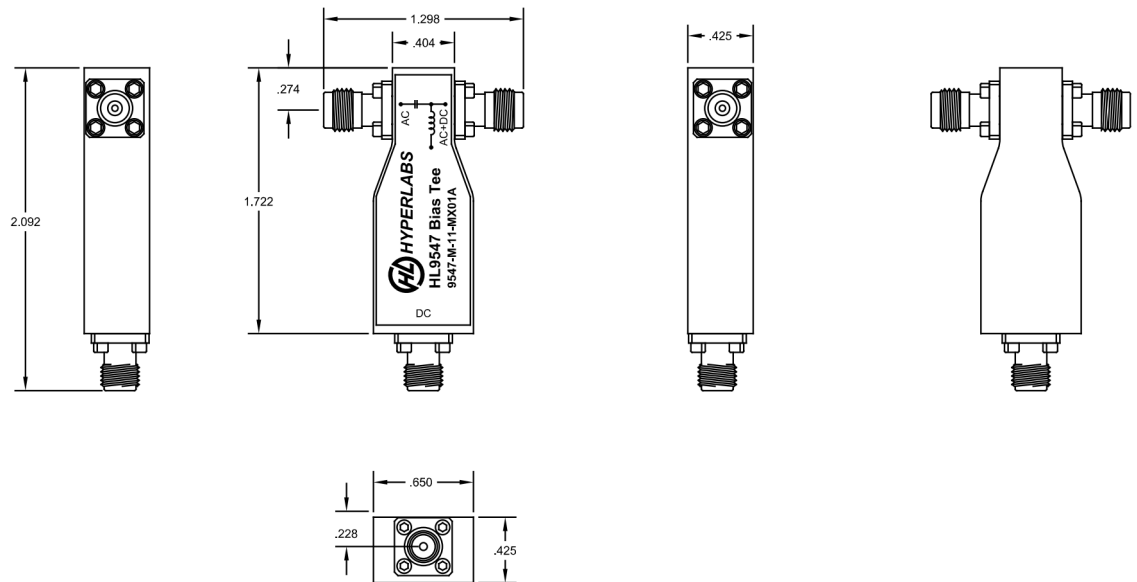


Fig 11: HL9547 with SMA DC bias port Mechanical Drawing