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HL944x Series Bias Tees (35 kHz to 67 GHz, 175 mA)

Features and Technical Specifications[1] (HL9447 shown)

Bandwidth	35 kHz to > 67 GHz (opt. -11) 70 kHz to > 67 GHz (opt. -30)
Amplitude Match (opt. -M only)	± 0.1 dB, f ≤ 67 GHz, all options See *Fig. 5*
Phase Match (opt. -M only)	± 4°, f = 40 GHz
Insertion Loss	1.55 dB, 1 MHz to 67 GHz, (opt. -JJ) See *Fig. 1*
Return Loss	15 dB f ≤ 35 GHz, all options 10 dB f > 35 GHz, all options See *Fig. 3*
Breakdown Voltage	11 V, max (opt. -11) 30 V, max (opt. -30)
Maximum Current	175 mA
Isolation *DC bias port to RF ports*	> 30 dB
Group Delay	≈ 110 ps ± 10 ps ripples, all options See *Fig. 4*
Rise Time (10-90%)	5 ps, all options
Connectors (AC / AC+DC)	1.85 mm Standard configuration is jack/plug with either pins or SMA jack for DC bias. 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

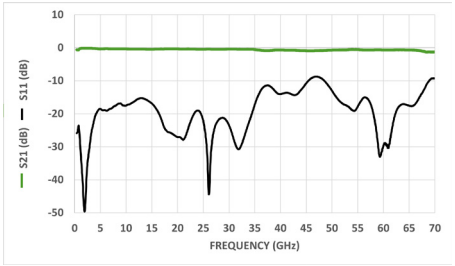
NOTE 1 - Unless otherwise noted, the specifications in this table are typical for Model Number HL9447 using the standard connector configuration (-JP, jack/plug) . Full specifications for this and related models are available on Page 2 of this datasheet.



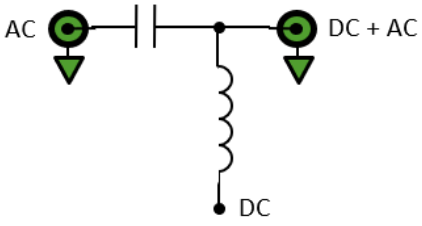
HL9447, Option -M-JPC shown (DC pins)



HL9447, Option -M-JPS shown (SMA DC port)



Typical HL9447 Insertion and Return Loss



HL944x Schematic and Port Assignments

PRODUCT SUMMARY

The HL944x Series are ultra-broadband bias tees with a maximum insertion loss of 1.55 dB throughout the specified bandwidth range.

The HL944x 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:

- ***HL9444***, 40 GHz
- ***HL9445***, 50 GHz
- ***HL9447***, 67 GHz

The following options are available and must be specified:

- ***-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

HL944x Full Specifications

Parameter	HL9444	HL9445	HL9447	Comments
Upper Frequency Limit	> 40 GHz	> 50 GHz	> 67 GHz	3 dB roll-off point, relative to nominal insertion loss
Lower Frequency Limit See *Fig. 2*	35 kHz (opt. -11) 70 kHz (opt. -30)			3 dB roll-off point
Maximum Current	175 mA			
Breakdown Voltage	11 V, max (opt. -11) 30 V, max (opt. -30)			
Amplitude Match See *Fig. 5*	± 0.1 dB, (opt. -M)			Typical, opt. -M
Phase Match	± 4°, f = 40 GHz (opt. -M)			Typical, opt. -M
Insertion Loss See *Fig. 1*	1.55 dB, 1 MHz ≤ f ≤ 40 GHz	1.55 dB, 1 MHz ≤ f ≤ 50 GHz	1.55 dB, 1 MHz ≤ f ≤ 67 GHz	Typical
Return Loss See *Fig. 3*	15 dB, f ≤ 35 GHz 10 dB, f > 35 GHz			Typical, within specified operating frequency
Rise Time	8.75 ps	7 ps	5 ps	Typical
Group Delay See *Fig. 4*	105 ps ± 10 ps ripple	110 ps ± 10 ps ripple	110 ps ± 10 ps ripple	All options
Isolation *DC bias port to RF ports*	> 30 dB			Typical
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 (specify when ordering)	Port 1 (AC): jack (J) or plug (P) Port 2 (AC+DC): jack (J) or plug (P) Port 3 (DC): SMA jack (S) or capacitive feedthru pins (C) *Standard configuration is -JPS or -JPC*			E.g. config -JPS: AC jack, AC+DC plug, DC jack Or, config. -JJC: AC jack, AC+DC jack, DC pins
Dimensions (W x D x H)	1.95” x 1.30” x 0.53” 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			

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

HL9447 Performance Characteristics

Figures 1-5 show the typical performance characteristics of the HL9447 opt. -11 from 10 MHz to 70 GHz, except Fig. 3 which shows low-frequency response to 100 Hz. Other models show similar performance within their specified bandwidth.

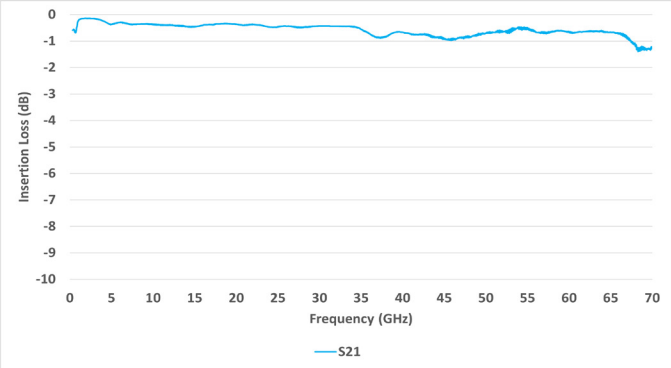


Fig. 1: Typical HL9447 Bandwidth and Insertion Loss

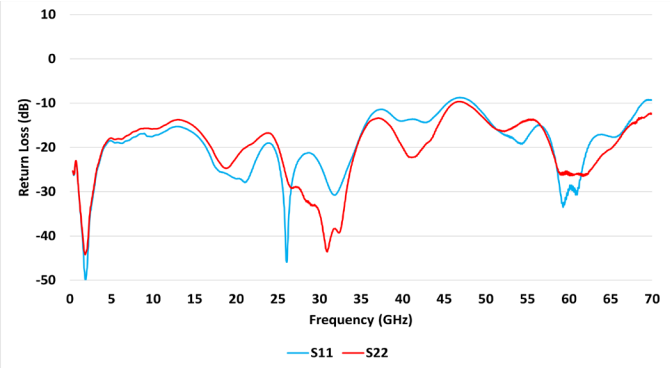


Fig. 2: Typical HL9447 Return Loss

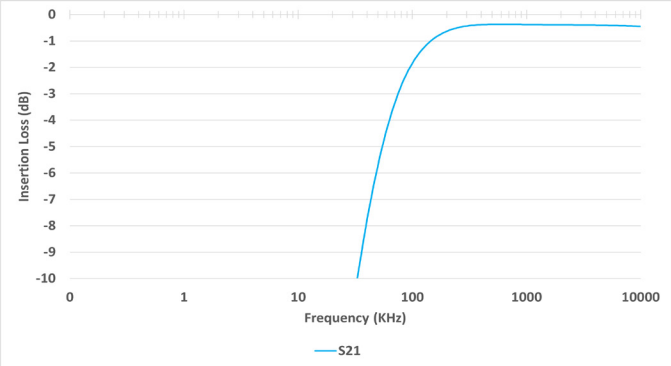


Fig. 3: Typical HL9447 Low Frequency Performance (opt. -30)

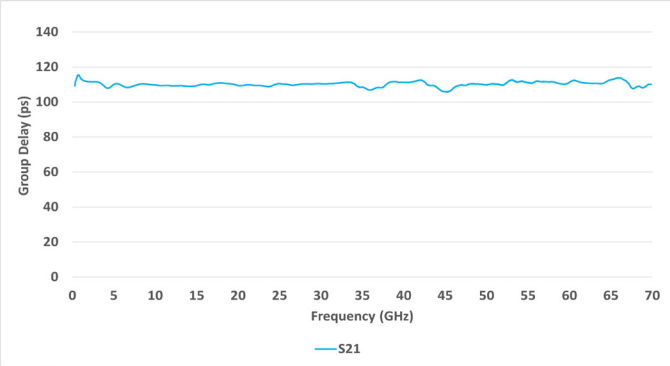


Fig. 4: Typical HL9447 Group Delay

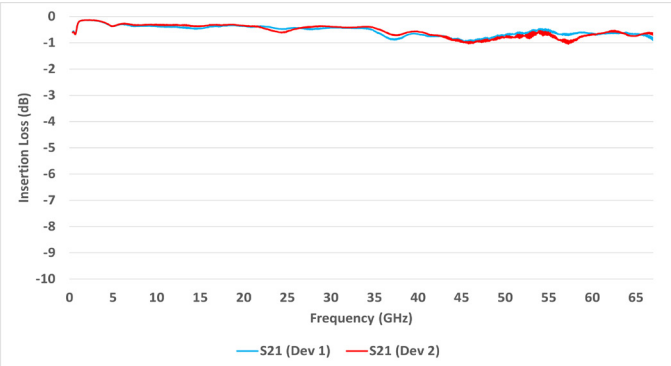


Fig. 5: Typical HL9447 Amplitude Matching (opt. -M)

HL944x Eye Diagrams

The eye diagrams in *Figures 6-7* show a 56 Gbps PRBS11 pattern passed through an HL9447 (opt. -30).

Figures 8-9 show a 112 Gbps PAM4 signal passed through the HL9447 (opt. -30).

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

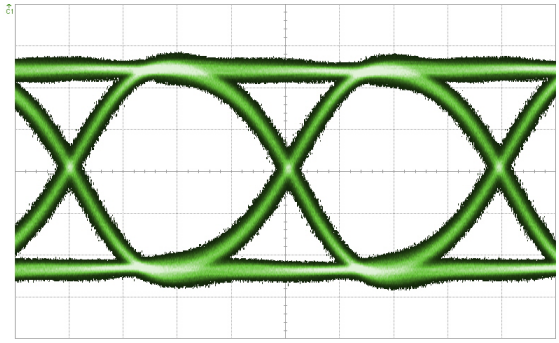


Figure 6: HL9447 56 Gpbs PRBS 11, RF Input

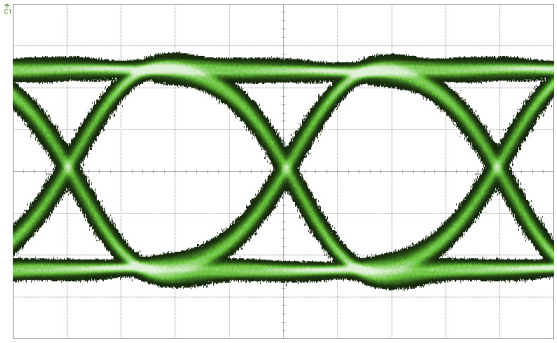


Figure 7: HL9447 56 Gpbs PRBS 11, RF Output

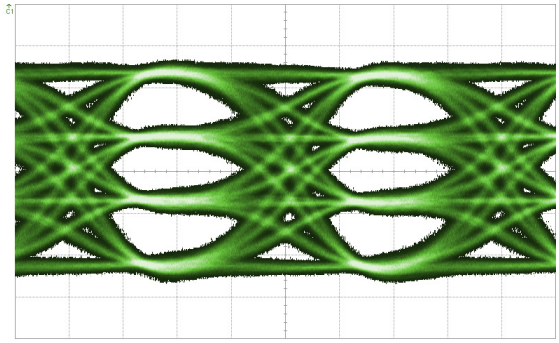


Figure 8: HL9447 112 Gbps PAM4, RF Input

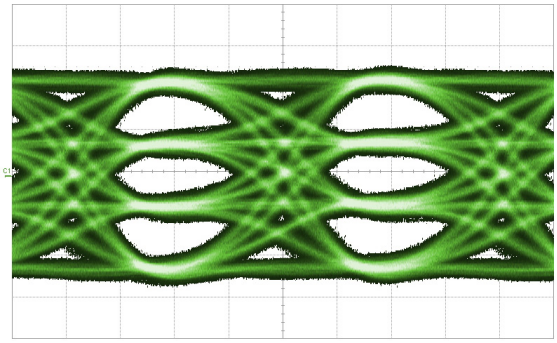


Figure 9: HL9447 112 Gbps PAM4, RF Output

HL944x Dimensional Drawing

Figure 10 shows a mechanical drawing of an HL9447 (opt. -JPC) with pins for DC bias. *Figure 11* shows the HL9447 (opt. -JJS) with an SMA DC port. Unless otherwise noted, all units are in inches. See page 2 for full dimensions.

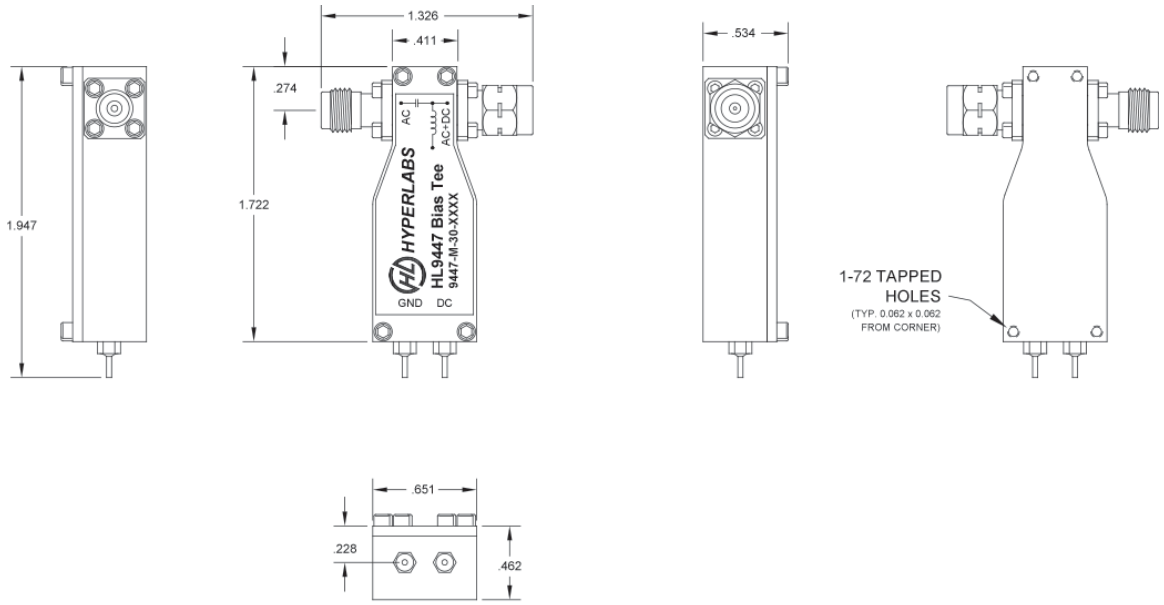


Fig 10: HL9447 with DC bias pins Mechanical Drawing

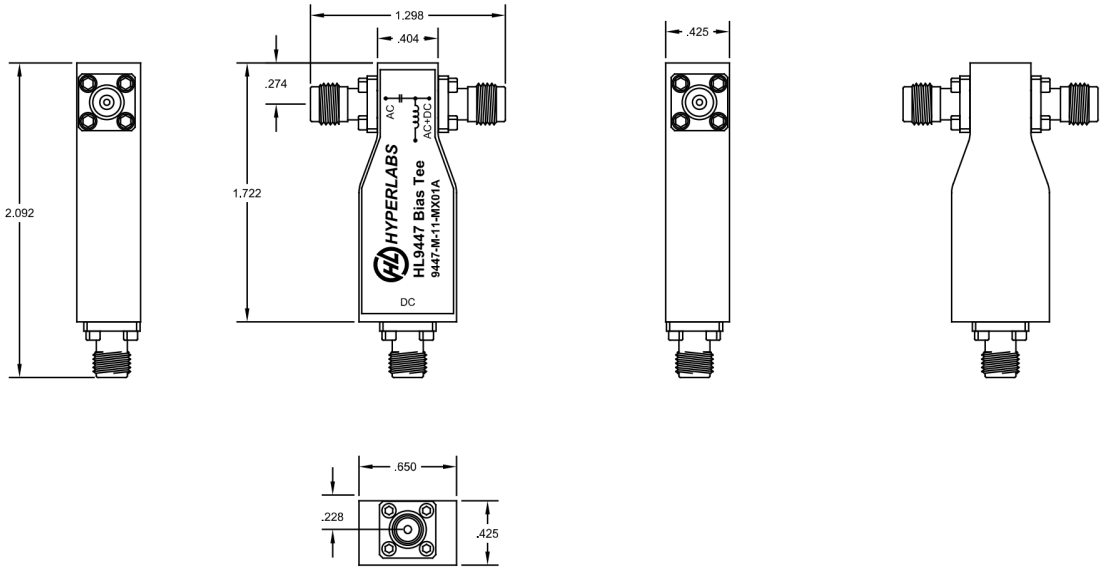


Fig 11: HL9447 with SMA DC bias port Mechanical Drawing