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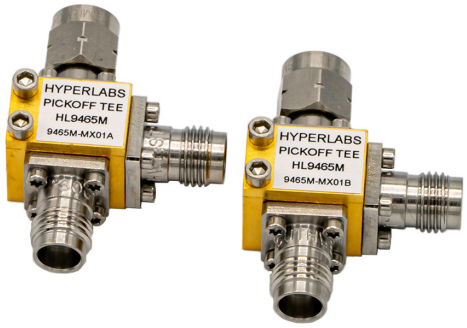
HL946x Broadband Z-matched Pick-off Tee (50 GHz)

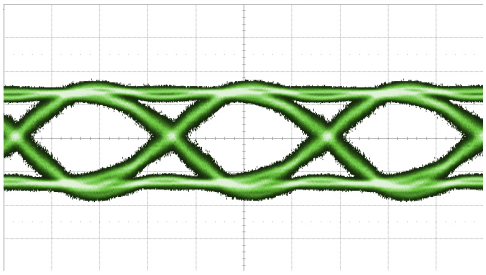
Key Features and Technical Specifications[1] (HL9465 shown)

Bandwidth	DC to 50 GHz, thru line and pick-off
Insertion Loss	3.5 ± 0.5 dB, thru line 10.5 ± 1 dB, pick-off line See *Fig. 1*
Amplitude Match (opt. -M only)	± 0.1 dB See *Figs. 3-4*
Phase Match (opt. -M only)	± 2°, f = 10 GHz ± 5°, f = 20 GHz
Return Loss	< 12.5 dB, f ≤ 35 GHz, thru line < 10 dB, f > 35 GHz, thru line < 20 dB, f ≤ 25 GHz, pick-off line < 15 dB, f > 25 GHz, pick-off line *See Fig. 5*
Group Delay	≈ 125 ps, thru line (opt. -JJJ) ≈ 115 ps, thru line (opt. -JPJ) ≈ 125 ps, pick-off line (all opts.) *See Fig. 2*
Connectors	2.4 mm jack, all ports (opt. -JJJ) 2.4 mm jack, Thru 1 and Pick-off; 2.4 mm plug, Thru 2 (opt. -JPJ)
Unit Dimensions	32.69 x 24.23 x 13.59 mm 1.29” x 0.95” x 0.54”
RoHS Compliant	Yes
REACH Compliant	Yes

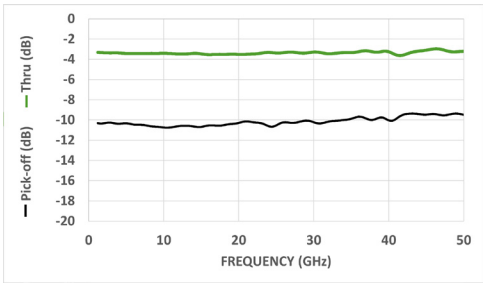
NOTE 1 - The specifications in this table are typical using the standard connector configuration (-JPJ, jack/plug/jack). Full specifications are available on page 2 of this datasheet.



HL9465, option -M-JPJ shown



56 Gbps NRZ pattern on the Thru Out port of HL9465-JPJ; see also Figs. 13-24



Typical Insertion Loss on thru and pick-off lines of HL9465 (opt. -JPJ); see also Fig. 1

PRODUCT SUMMARY

The HL946x series is an impedance-matched pick-off tee with a flat frequency response from DC up to 50 GHz on the thru and pick-off lines.

It is suitable as a trigger source with minimum perturbation of the thru signal path.

Since the pick-off tee is bi-directional, a typical application is to inject noise on the pickoff port into the original signal. This is useful for compliance testing.

Digital oscilloscope applications include pre-scaler triggering, synchronization, and clock/data recovery.

DEPLOYMENT NOTES

Some of the specifications in this datasheet are only applicable to matched pairs of devices and are labeled accordingly.

S-PARAMETERS

S-parameters are available on our website.

MODELS & OPTIONS

The following models are available:

- ***HL9462***, 26.5 GHz
- ***HL9464***, 40 GHz
- ***HL9465***, 50 GHz

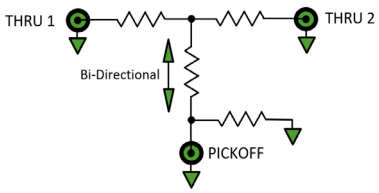
The following options and configurations are available for this product:

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

- ***-JJJ***, jack (female), all ports
- ***-JPJ***, jack (female) thru in and pick-off; plug (male) thru out

DEVICE PORT ASSIGNMENTS

For the purposes of this datasheet, the below port assignments are used.



HL946x Full Specifications

Parameter	HL9462	HL9464	HL9465	Comments
Bandwidth	DC to 26.5 GHz, thru and pick-off	DC to 40 GHz, thru and pick-off	DC to 50 GHz, thru and pick-off	3 dB roll-off point, relative to nominal insertion loss
Amplitude Match See *Figs. 2-3, 8-9*	± 0.1 dB	± 0.1 dB	± 0.1 dB	Matched pair (opt. -M) only
Phase Match	± 2.5°, f = 10 GHz ± 5°, f = 20 GHz			Matched pair (opt. -M) only
Insertion Loss See Figs. 1, 7	3.5 ± 0.5 dB, thru 10.5 ± 1 dB, pick-off	3.5 ± 0.5 dB, thru 10.5 ± 1 dB, pick-off	3.5 ± 0.5 dB, thru 10.5 ± 1 dB, pick-off	All options
Return Loss, Thru See *Figs. 4, 10*	< 15 dB, thru	< 15 dB, f ≤ 30 GHz < 10 dB, f > 30 GHz	< 12.5 dB, f ≤ 35 GHz < 10 dB, f > 35 GHz	
Return Loss, Pick-off See *Figs. 4, 10*	< 20 dB, pick-off	< 20 dB, f ≤ 20 GHz < 15 dB, f > 20 GHz	< 20 dB, f ≤ 25 GHz < 15 dB, f > 25 GHz	
Rise Time	17.5 ps	9.0 ps	7 ps	
Group Delay *See Figs. 6, 12*	130 ps, thru (opt.-JJJ) 110 ps, thru (opt-JPJ) 140 ps, pick-off	110 ps, thru (opt.-JJJ) 90 ps, thru (opt. -JPJ) 120 ps, pick-off	125 ps, thru (opt.-JJJ) 115 ps, thru (opt-JPJ) 125 ps, pick-off	
Max Input Power	+30 dBm (1 W)			
Impedance	50 Ω			All ports
Connectors	SMA, 3x jack SMA, jack/plug/jack	2.92 mm, 3x jack 2.92 mm, jack/plug/jack	2.4 mm, 3x jack 2.4 mm, jack/plug/jack	opt. -JJJ opt. -JPJ
Dimensions (W x D x H)	1.23” x 0.90” x 0.54” 31.24 x 22.86 x 13.59 mm	1.10” x 0.90” x 0.54” 26.41 x 22.86 x 13.59 mm	1.29” x 0.95” x 0.54” 32.69 x 24.23 x 13.59 mm	Package including connectors
Weight	15 g (0.53 oz.)	12.5 g (0.44 oz.)	13.5 g (0.48 oz.)	
Operating Temperature	-40° to +85° 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 (-JPJ). Specifications may vary slightly for other configurations.

HL9465 Plot Diagrams

Figures 1-6 show the typical insertion loss, return loss, VSWR, amplitude matching, and group delay plots for an HL9465. The plots for the HL9462 and HL9464 will be similar through their respective frequency bandwidths.

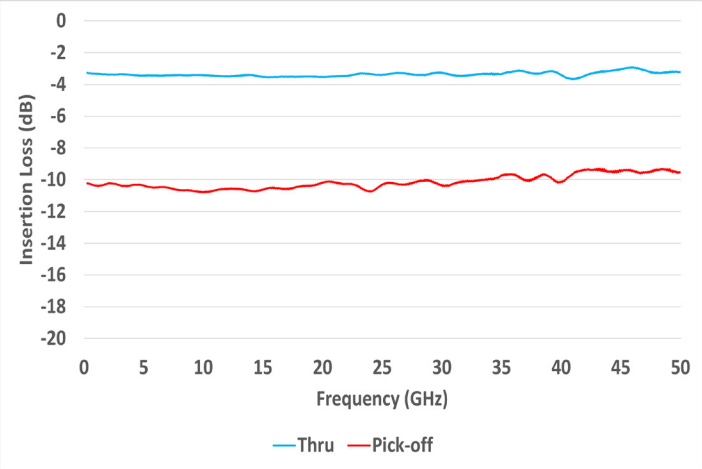


Figure 1: HL9465 Insertion Loss (-JPJ)

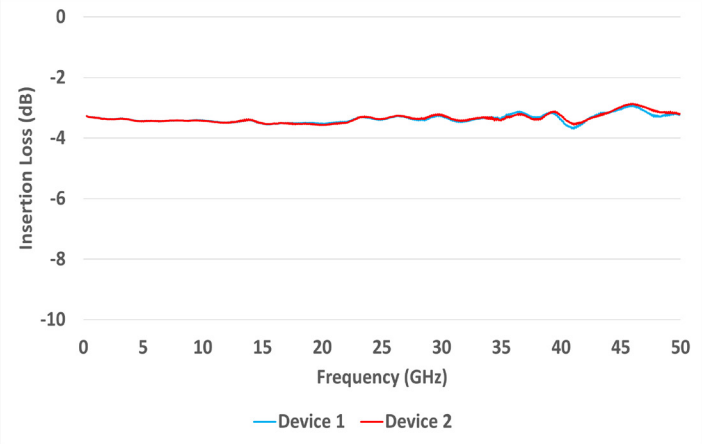


Figure 2: HL9465 Thru Amplitude Match (-JPJ)

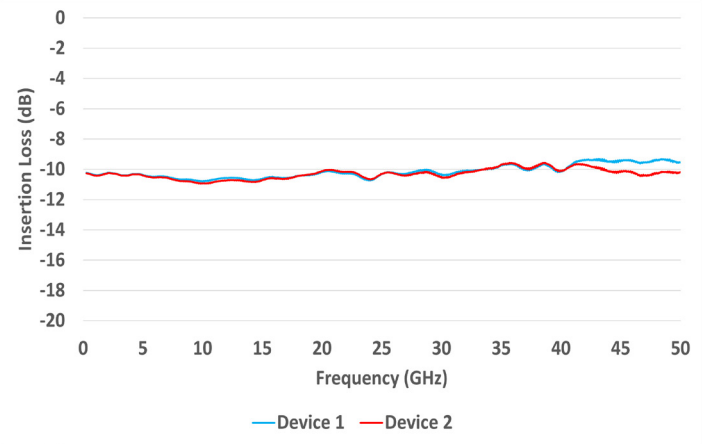


Figure 3: HL9465 Pick-off Amplitude Match (-JPJ)

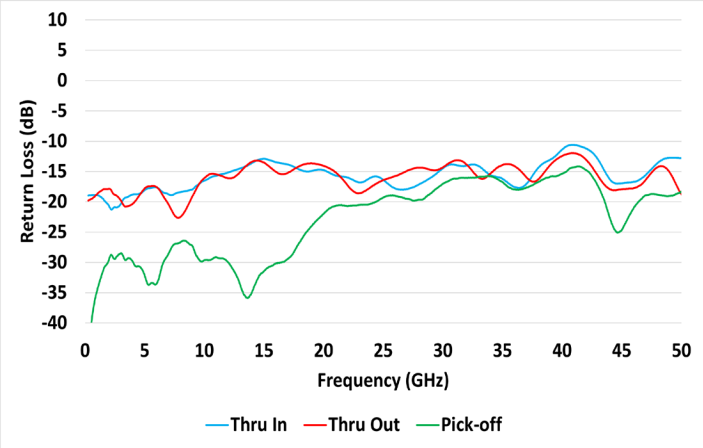


Figure 4: HL9465 Return Loss (-JPJ)

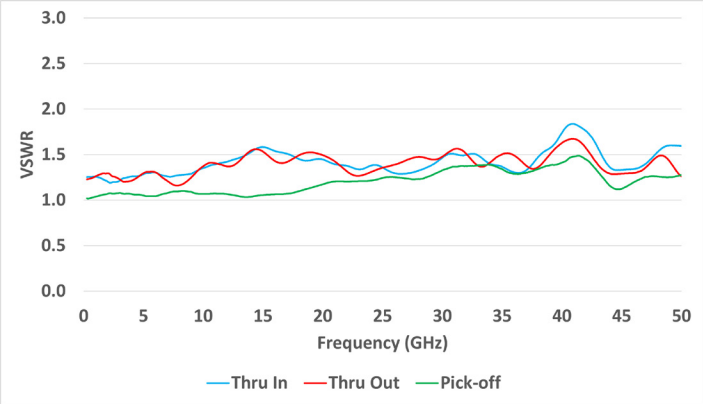


Figure 5: HL9465 VSWR (-JPJ)

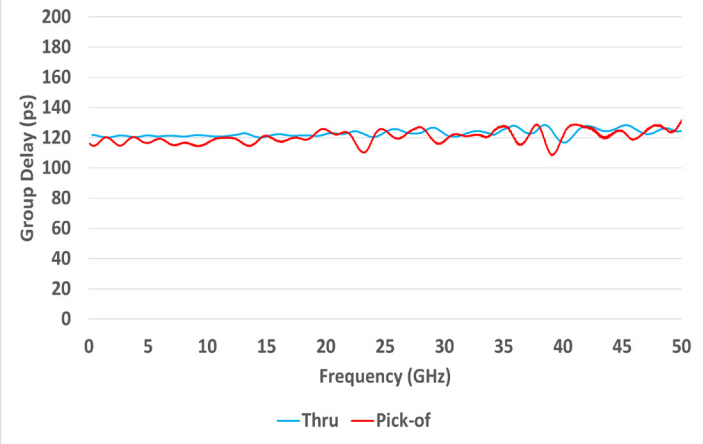


Figure 6: HL9465 Group Delay (-JPJ)

HL9465 Eye Diagrams

The eye diagrams in *Figures 7-9* show a PRBS31 pattern at 28 Gpbs. The input signal has a 1.53 V amplitude and is shown at 450 mV/div. The thru and pick-off outputs are shown at 275 mV/div.

Figures 10-12 were generated by a PRBS31 pattern at 12.5 Gbps. The input signal has amplitude of 1.49 V and is shown at 450 mV/div. The thru and pick-off outputs are shown at 275 mV/div.

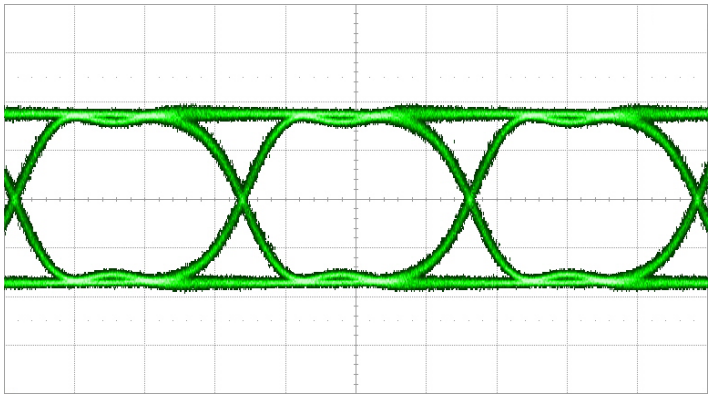


Figure 7: 28 Gbps PRBS31 pattern on RF In

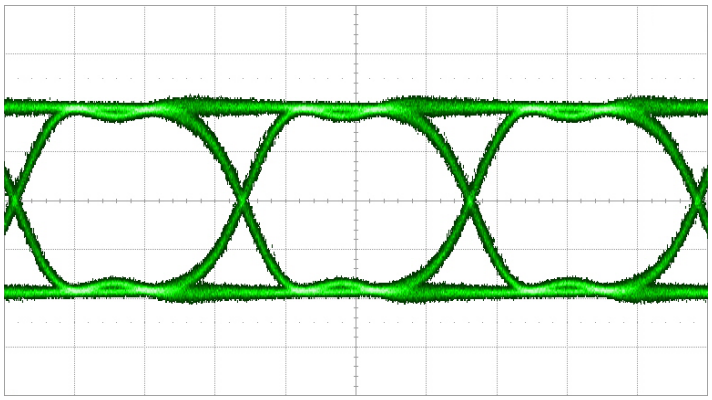


Figure 8: 28 Gbps PRBS31 pattern on Thru Out

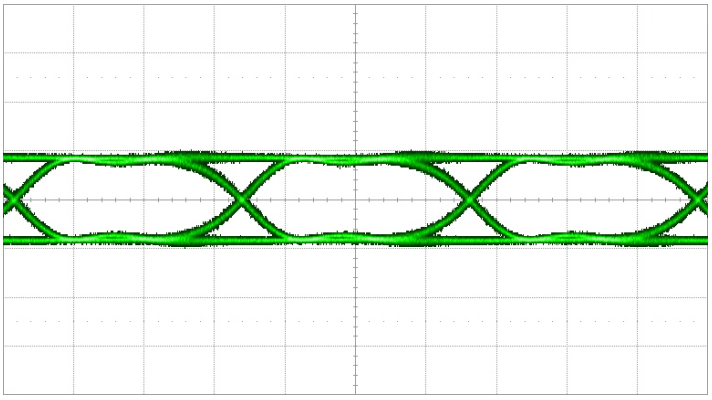


Figure 9: 28 Gbps PRBS31 pattern on Pick-off

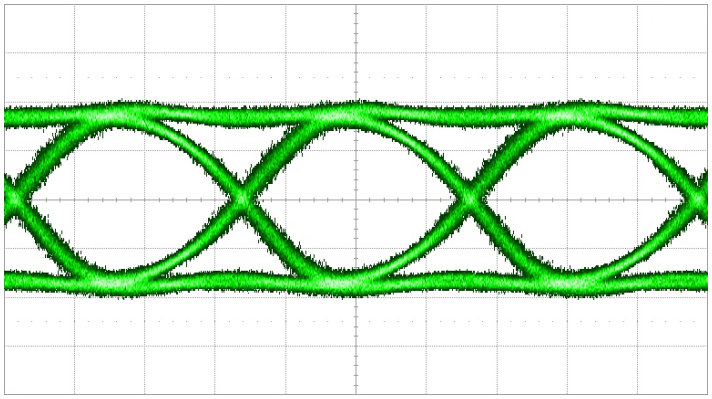


Figure 10: 12.5 Gbps PRBS31 pattern on RF In

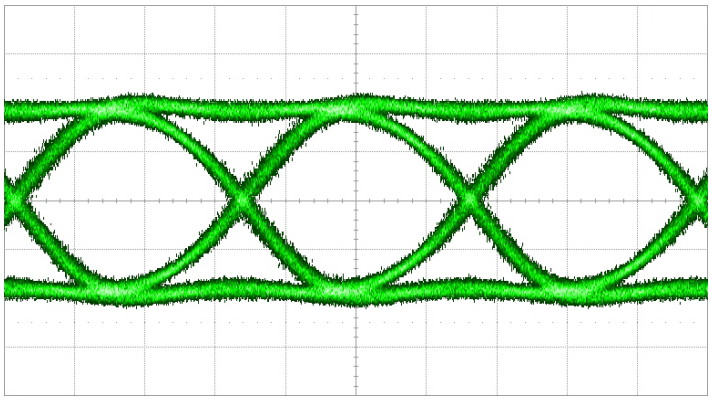


Figure 11: 12.5 Gbps PRBS31 pattern on Thru Out

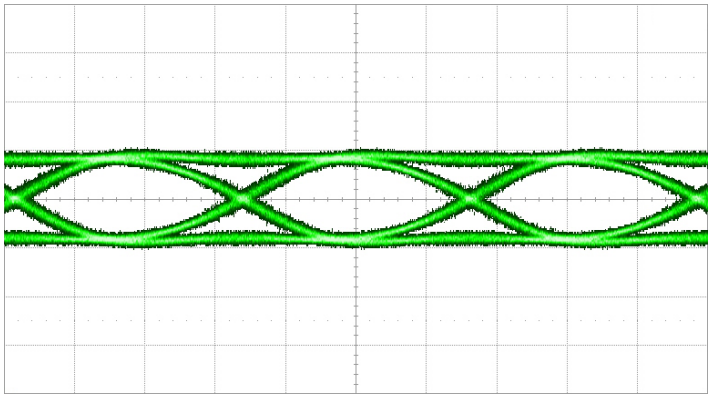


Figure 12: 12.5 Gbps PRBS31 pattern on Pick-off

HL9465 Dimensional Drawing

Figure 13 shows a mechanical drawing of an HL9465, option -JPJ. Unless otherwise noted, all units are in inches.

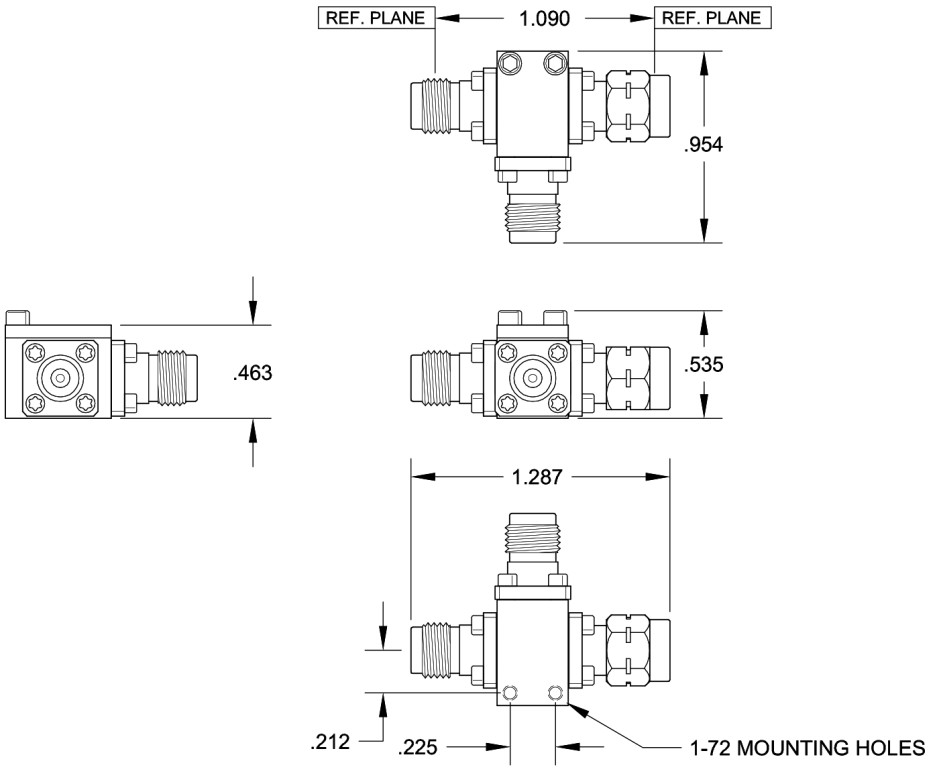


Figure 13: HL9465 mechnical drawing (opt. -JPJ)