



HL5567 100 Gb/s PAM4 Encoder

Key Features and Technical Specifications¹

PRODUCT SUMMARY

The HL5567 PAM4 Encoder is an impedance-matched broadband resistive summing network designed to combine two equal-amplitude 50 Gb/s NRZ data streams into a single 100 Gb/s PAM4 signal.

When driven with two equal-amplitude NRZ signals, the LSB signal appearing on the PAM4 output is attenuated by 6 dB relative to the MSB signal.

DEPLOYMENT NOTES

For more information see HYPERLABS Application Note AN-2022-005-1.

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.

AVAILABLE OPTIONS

The following options and configurations are available for this product:

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

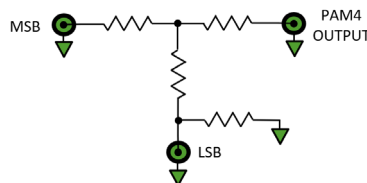
- JJJ, jack (female), all ports
- JPJ, jack (female) MSB and LSB; plug (male) PAM4

Bandwidth (3 dB)	DC to > 67 GHz, MSB path DC to 55 GHz (3 dB), LSB path
Insertion Loss	4.0 ± 0.75 dB, MSB 10.0 ± 1 dB, LSB See Fig. 1
Amplitude Match (opt. -M only)	± 0.25 dB See Figs. 3-4
Phase Match (opt. -M only)	± 2°, f = 10 GHz ± 5°, f = 20 GHz
Return Loss	< 25 dB, f ≤ 25 GHz, MSB < 15 dB, f > 25 GHz, MSB < 15 dB, f ≤ 30 GHz, LSB < 10 dB, f > 30 GHz, LSB See Fig. 5
Group Delay	≈ 115 ps, opt. -JJJ ≈ 125 ps, opt. -JPJ See Fig. 2
Connectors	1.85 mm jack, all ports (opt. -JJJ) 1.85 mm jack, MSB and LSB; 1.85 mm plug, PAM4 (opt. -JPJ)
Unit Dimensions	30.75 x 24.23 x 13.59 mm 1.21" x 0.95" x 0.54"
RoHS Compliant	Yes
REACH Compliant	Yes

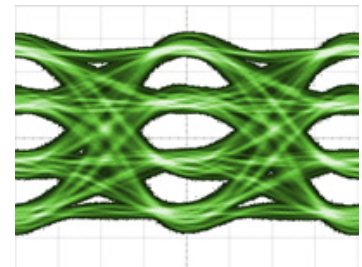
NOTE 1 - The specification in this table are typical. Full specifications are available on Page 2 of this datasheet.

DEVICE PORT ASSIGNMENTS

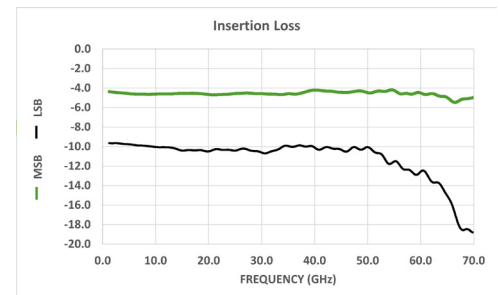
For the purposes of this datasheet, the below port assignments are used.



HL5567, option -U-JPJ shown



100 Gb/s PAM4 Output Eye Diagram



Typical Insertion Loss on MSB and LSB paths of HL5567 (opt. -JPJ); see also Fig. 1



HL5567 Full Specifications

Parameter	Minimum	Typical	Maximum	Comments
Bandwidth (3 dB)		DC to > 67 GHz, MSB DC to 55 GHz, LSB		3 dB roll-off point, relative to nominal insertion loss
Insertion Loss		4.0 ± 0.75 dB, MSB 10.0 ± 1 dB, LSB		All options
Amplitude Match		± 0.25 dB		Matched pair (opt. -M) only
Phase Match		± 2.5°, f = 10 GHz ± 5°, f = 20 GHz		Matched pair (opt. -M) only
Return Loss, MSB, PAM4		< 20 dB, f ≤ 25 GHz < 15 dB, f > 25 GHz		
Return Loss, LSB		< 15 dB, f ≤ 30 GHz < 10 dB, f > 30 GHz		
Rise Time		5.2 ps, MSB 7.0 ps, LSB		
Group Delay		≈ 115 ps, opt. -JJJ ≈ 125 ps, opt. -JPJ		
Max Input Power		+30 dBm		
Impedance		50 Ω, all ports		
Connectors		1.85 mm jack/jack/jack (opt. -JJJ) 1.85 mm jack/plug/jack (opt. -JPJ)		MSB / PAM4 / LSB
Dimensions (W x D x H)		30.75 x 24.23 x 13.59 mm 1.21" x 0.95" x 0.54"		Single unit (opt. -U)
Weight		12.5 g 0.44 oz		Single unit (opt. -U)
Operating Temperature	-40° C		+85° C	Case temperature
Storage Temperature	-40° C		125° C	
RoHS Compliant	Yes, assembled with lead-free solder			
REACH Compliant	Yes			
Warranty	1 year, repair or replacement; see website for details			



HL5567 Insertion Loss

Figure 1 shows the typical insertion loss of the HL5567 along the MSB and LSB paths from DC to 70 GHz.

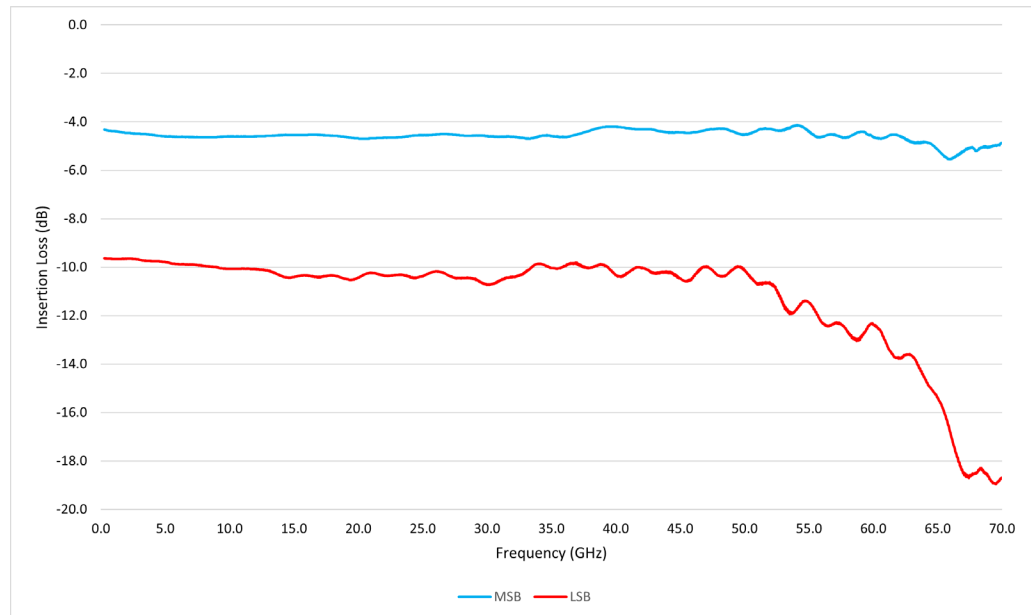


Figure 1: HL5567 Insertion Loss (opt. -JPJ)

HL5567 Group Delay

Figure 2 shows the typical group delay of the HL9467 along the MSB and LSB paths to 70 GHz.

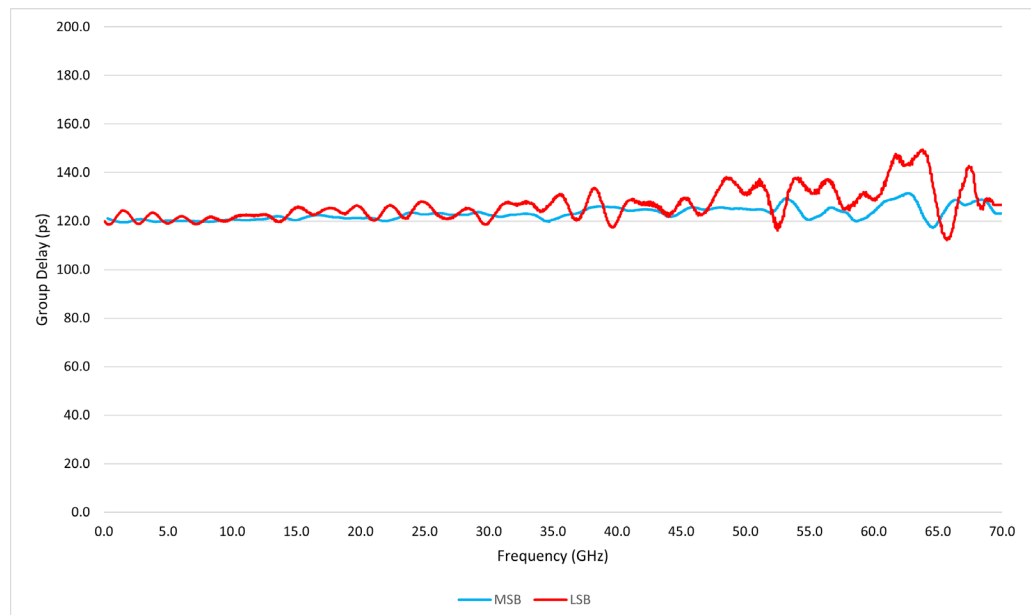


Figure 2: HL5567 Group Delay (opt. -JPJ)



HL5567 Amplitude Match

Figures 3-4 show the amplitude match of two matched HL5567 devices along the MSB and LSB paths, respectively, from DC to 70 GHz.

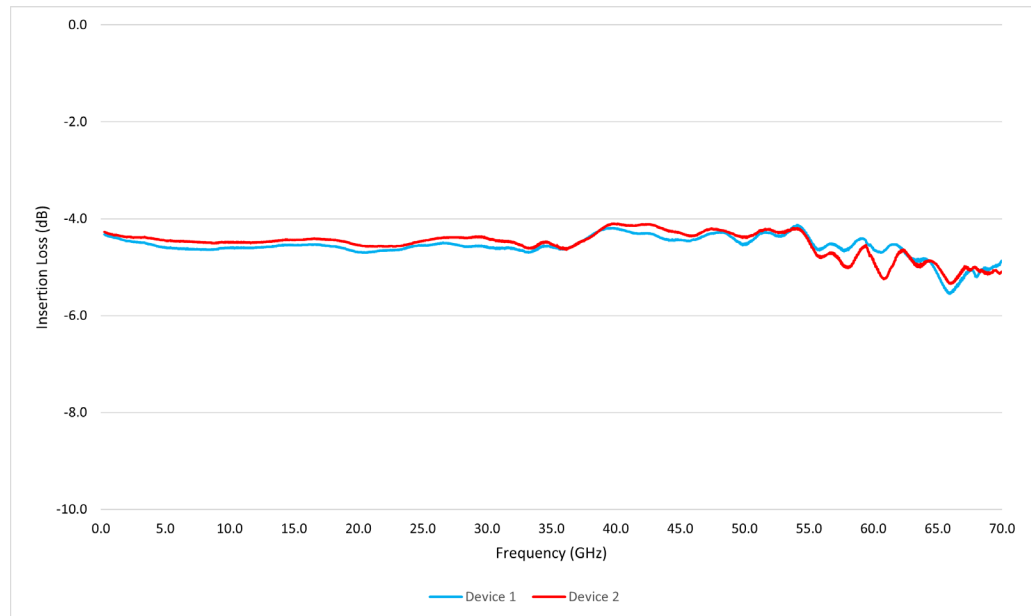


Figure 3: HL5567 MSB Amplitude Match (opt. -M-JPJ)

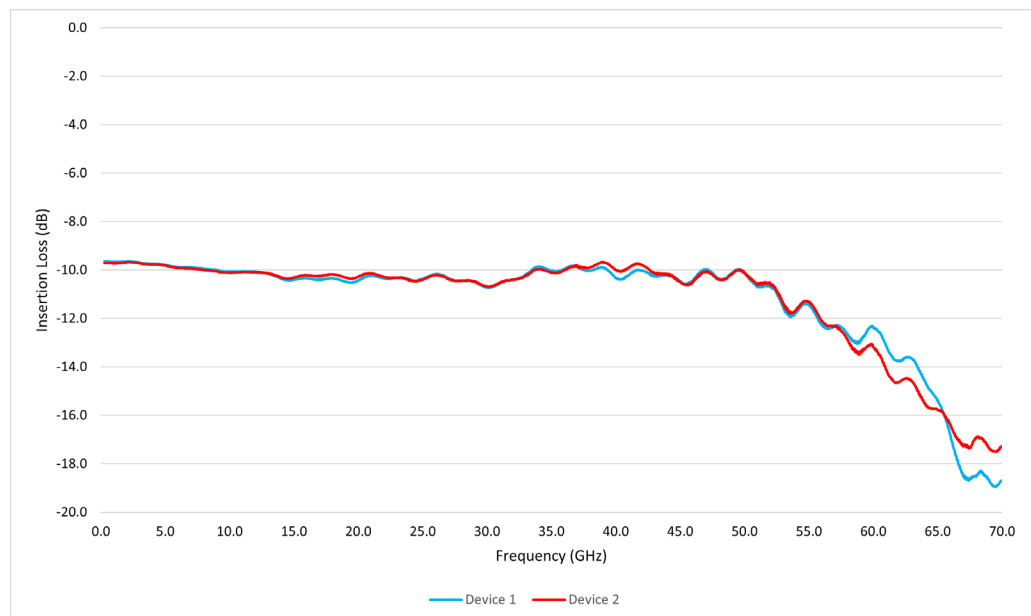


Figure 4: HL5567 LSB Amplitude Match (opt. -M-JPJ)



HL5567 Return Loss and VSWR

Figure 5 shows typical return loss on all ports of an HL5567 from DC to 70 GHz. Figure 6 shows the corresponding Voltage Standing Wave Ratio (VSWR).

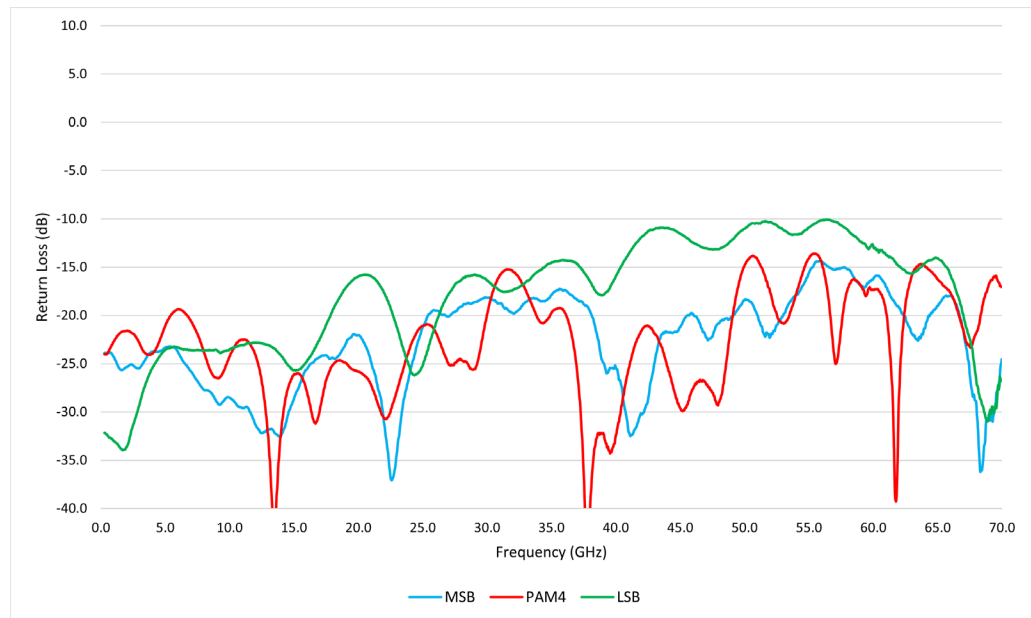


Figure 5: HL5567 Return Loss (opt. -JPJ)

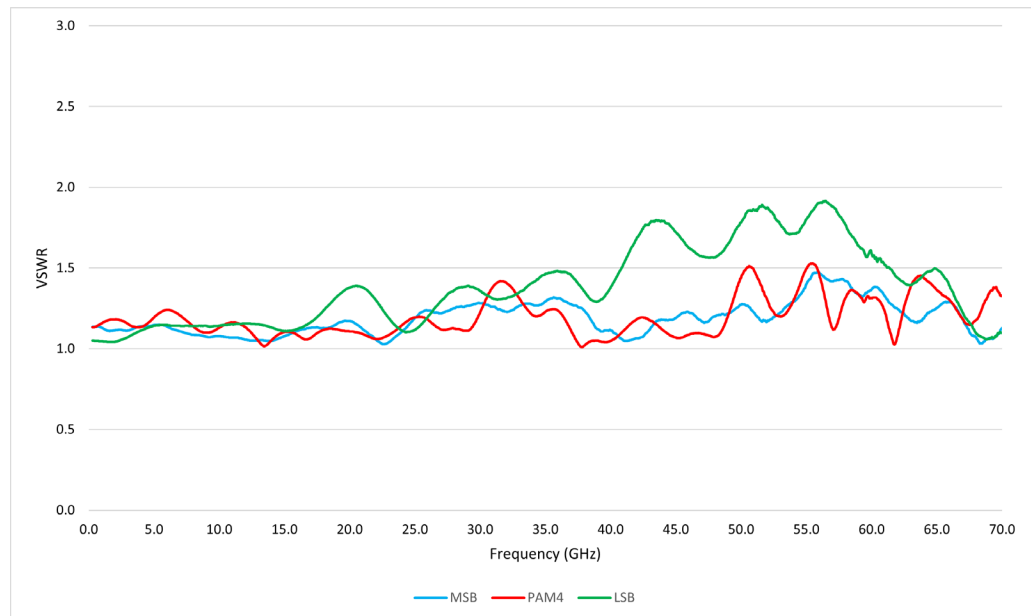


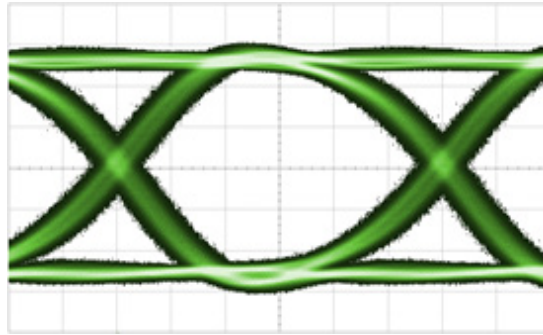
Figure 6: HL5567 VSWR (opt. -JPJ)



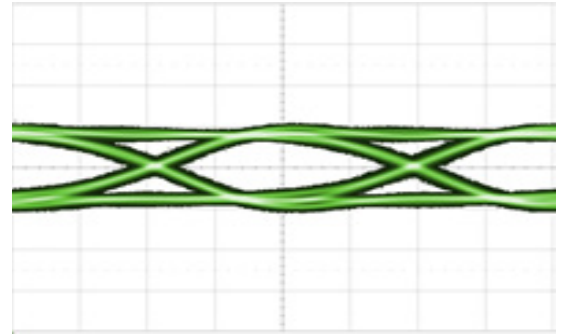
HL5567 Eye Diagrams

The eye diagrams in Figures 7 and 8 show the LSB and MSB input signals respectively at 50Gb/s. Figures 9 and 10 show the output eye diagrams that result when the inputs are driven one at a time with the opposite input terminated into 50Ω.

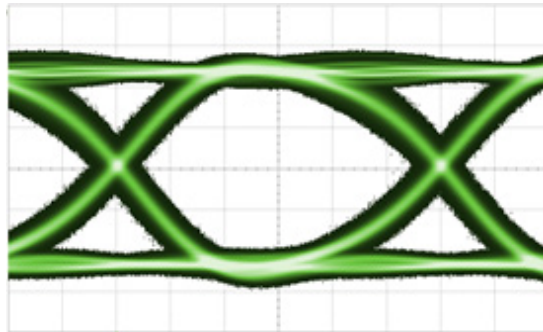
Figure 11 shows the combined PAM4 output that results when both inputs are driven simultaneously.



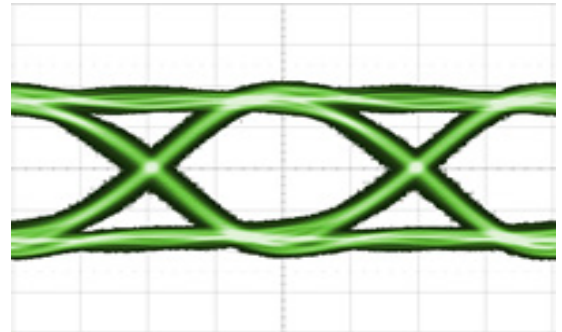
*Figure 7: LSB Input Eye Diagram, 50 Gb/s, PRBS7.
75mV/div & 3.35ps/div*



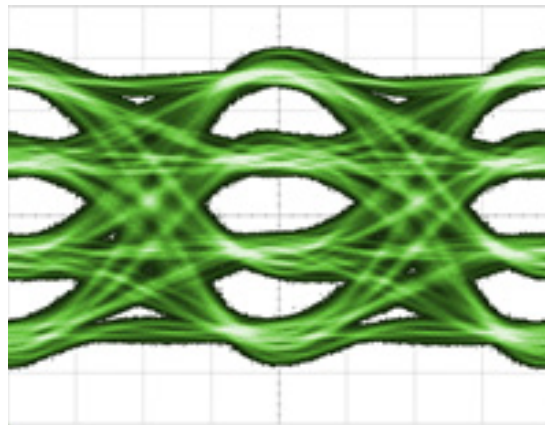
*Figure 9: 50 Gb/s Output Eye Diagram. LSB port driven,
MSB port terminated into 50Ω. 71mV/div & 5ps/div*



*Figure 8: MSB Input Eye Diagram, 50 Gb/s, PRBS7.
75mV/div & 3.35ps/div*



*Figure 10: 50 Gb/s Output Eye Diagram. MSB port driven,
LSB port terminated into 50Ω. 71 mV/div & 5 ps/div*



*Figure 11: 100 Gb/s PAM4 Output Eye Diagram. LSB
and MSB ports driven. 71mV/div & 5ps/div*



HL5567 Dimensional Drawing

Figure 13 shows a mechanical drawing of an HL5567, option -JPJ. Unless otherwise noted, all units are in inches.

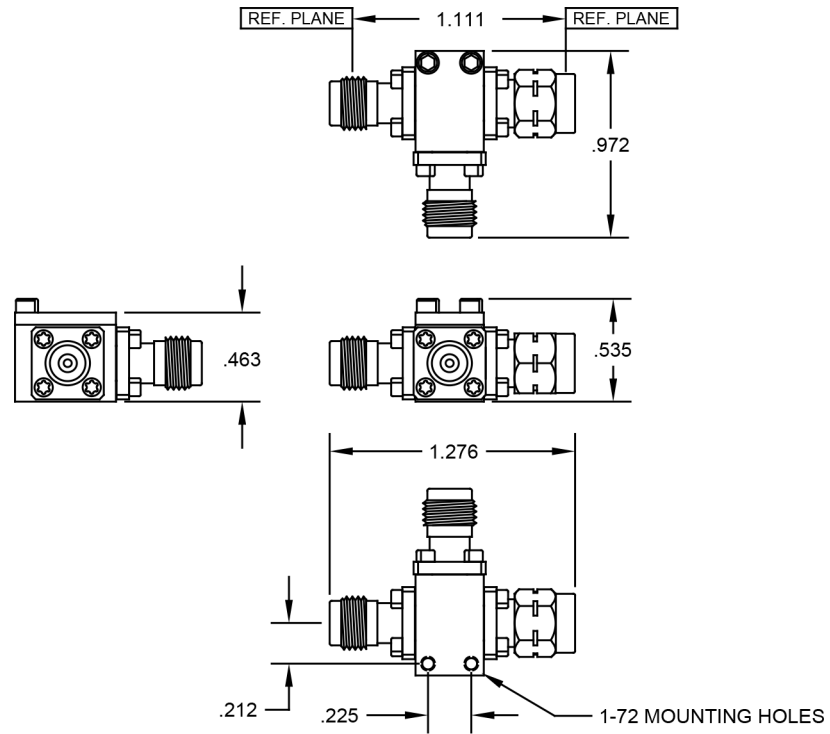


Figure 13: HL5567 mechanical drawing (opt. -JPJ)