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HL5567 100 Gb/s PAM4 Encoder

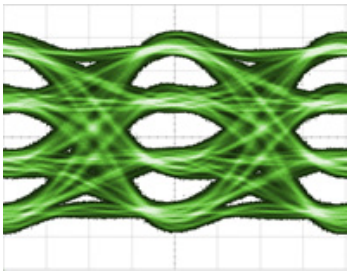
Key Features and Technical Specifications[1]

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

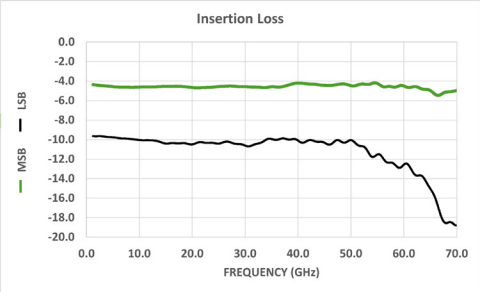
NOTE 1 - The specification in this table are typical. Full specifications are available on Page 2 of this datasheet.



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

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

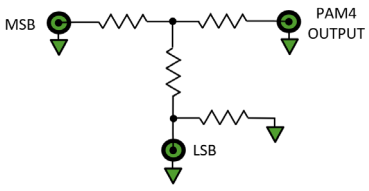
The following options and configurations are available for this product:

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

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

DEVICE PORT ASSIGNMENTS

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



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 replacment; 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.

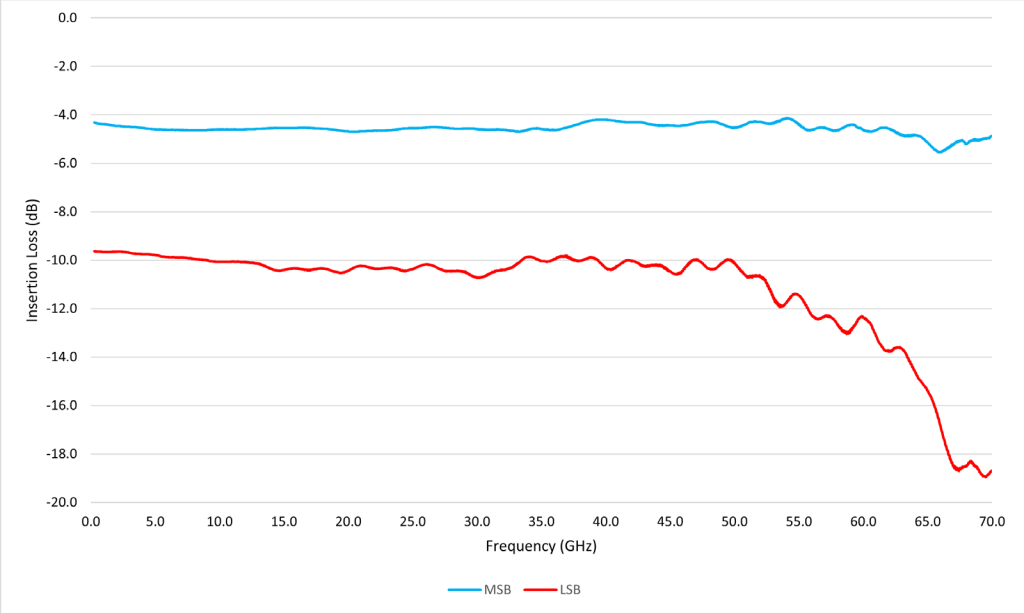


Figure 1: HL5567 Insertion Loss (opt. -JPJ)

HL5567 Group Delay

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

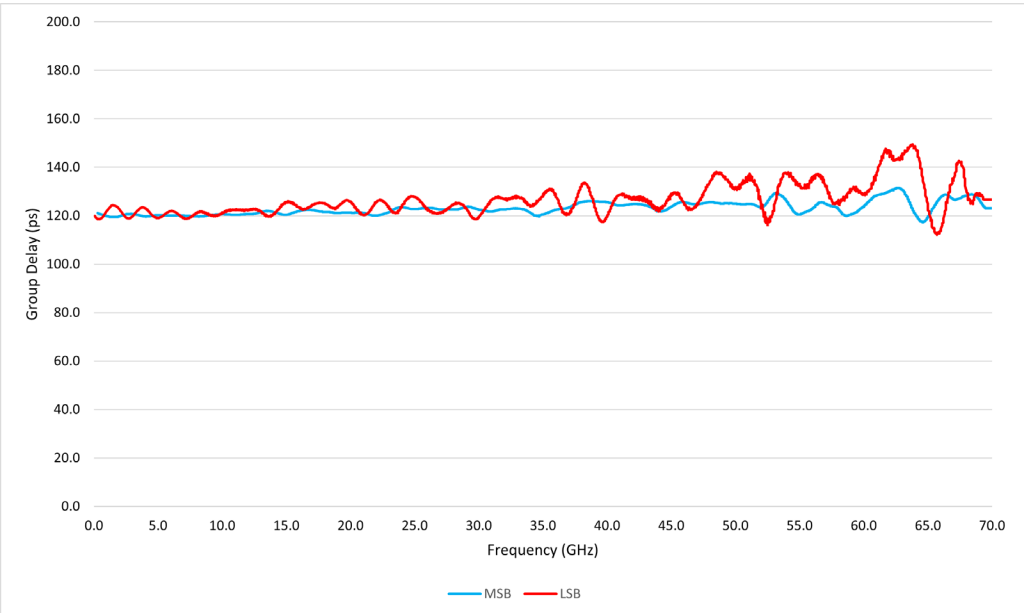


Figure 2: HL5567 Group Delay (opt. -JPJ)

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.

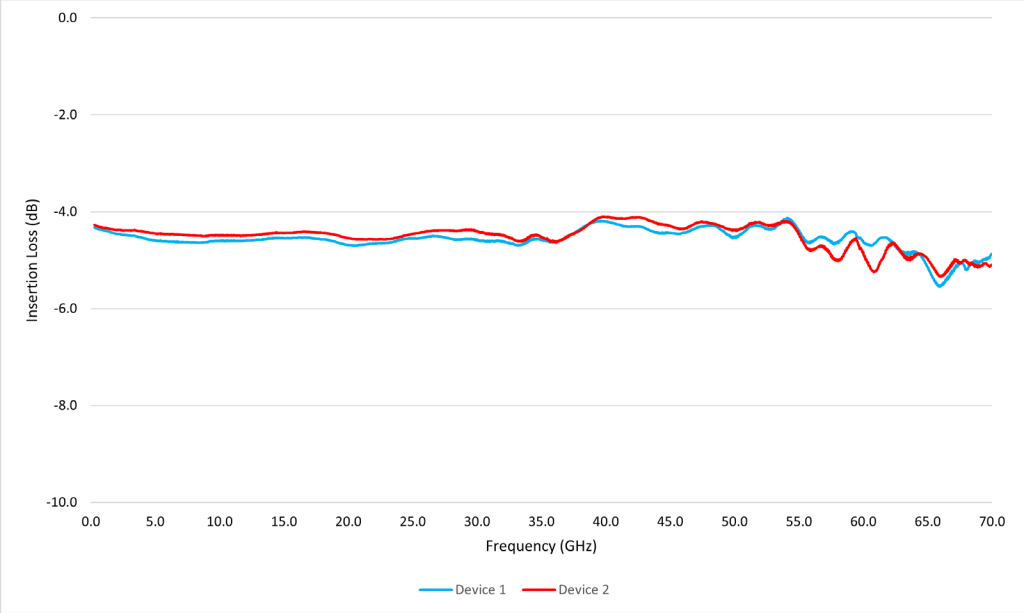


Figure 3: HL5567 MSB Amplitude Match (opt. -M-JPJ)

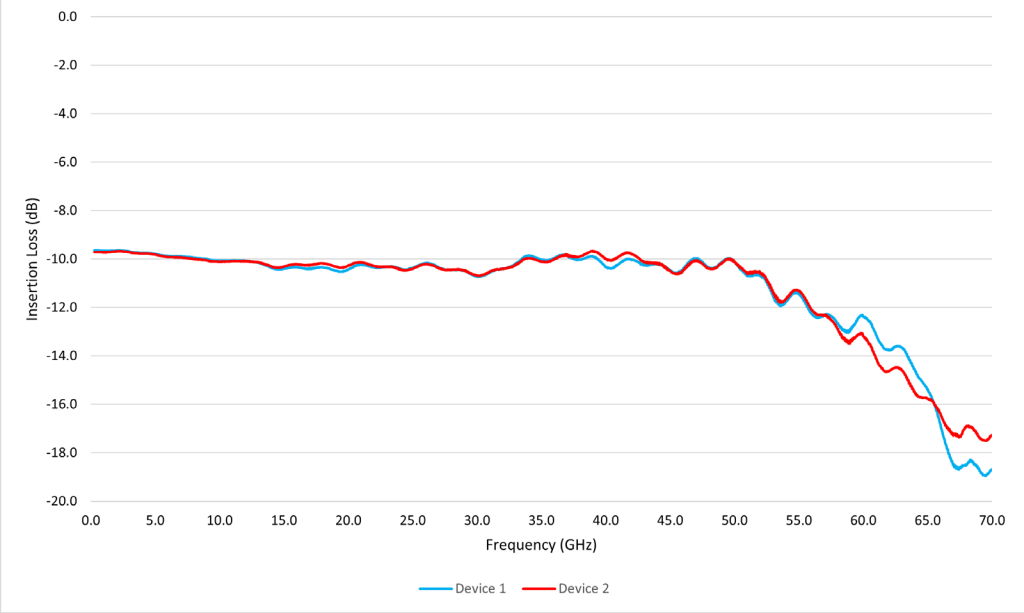


Figure 4: HL5567 LSB Amplitude Match (opt. -M-JPJ)

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).

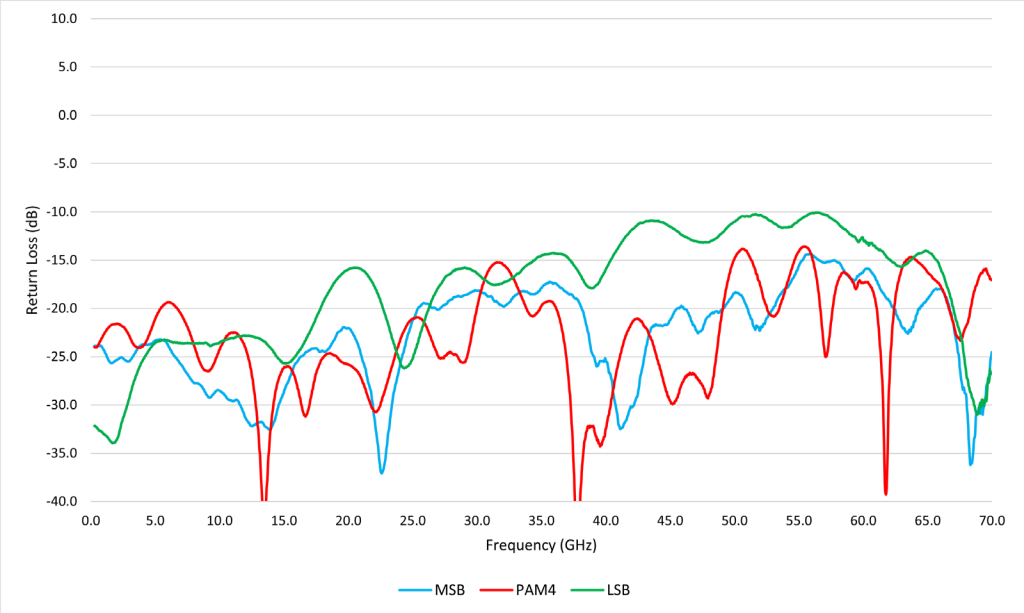


Figure 5: HL5567 Return Loss (opt. -JPJ)

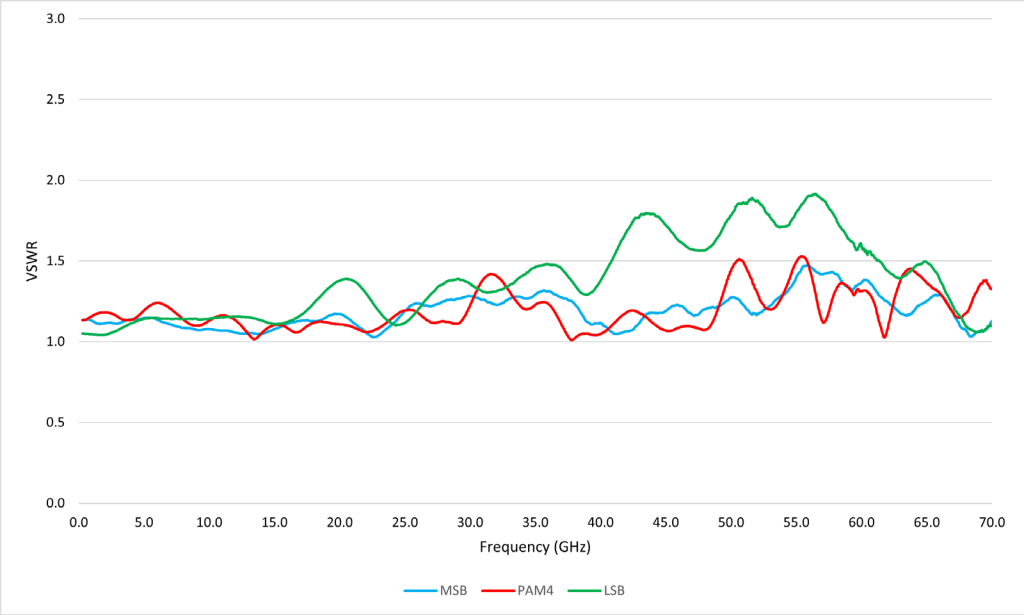


Figure 6: HL5567 VSWR (opt. -JPJ)

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.

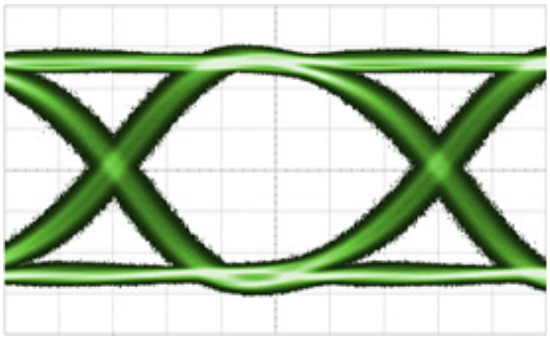


Figure 7: LSB Input Eye Diagram, 50 Gb/s, PRBS7. 75mV/div & 3.35ps/div

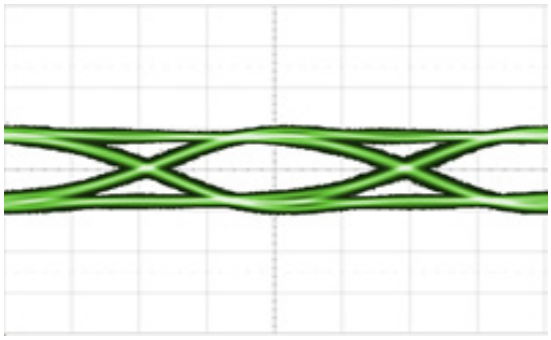


Figure 9: 50 Gb/s Output Eye Diagram. LSB port driven, MSB port terminated into 50Ω. 71mV/div & 5ps/div

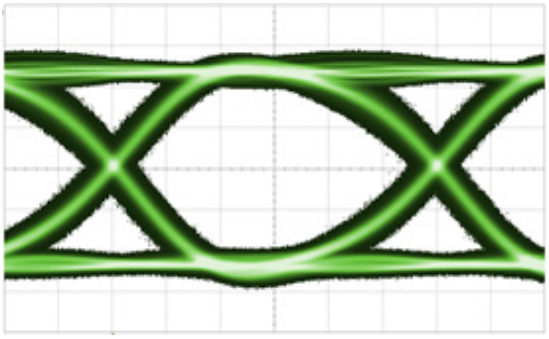


Figure 8: MSB Input Eye Diagram, 50 Gb/s, PRBS7. 75mV/div & 3.35ps/div

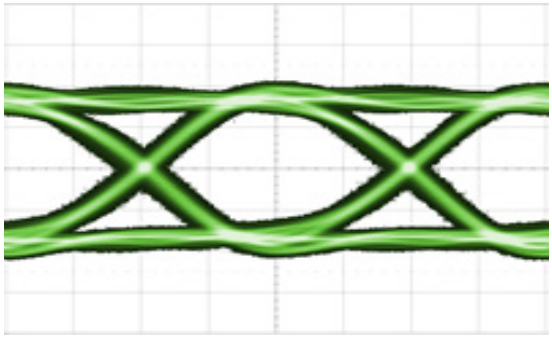


Figure 10: 50 Gb/s Output Eye Diagram. MSB port driven, LSB port terminated into 50Ω. 71 mV/div & 5 ps/div

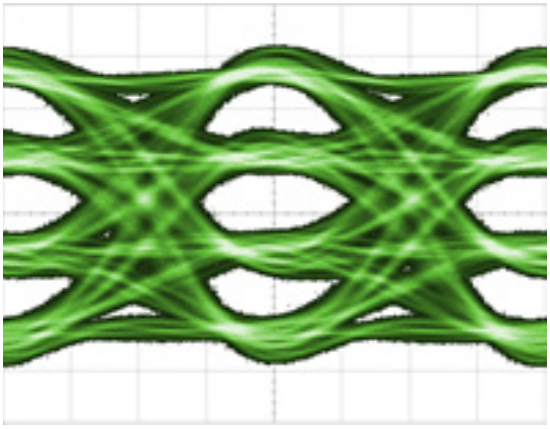


Figure 11: 100 Gb/s PAM4 Output Eye Diagram. LSB and MSB ports driven. 71mV/div & 5ps/div

HL5567 Dimensional Drawing

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

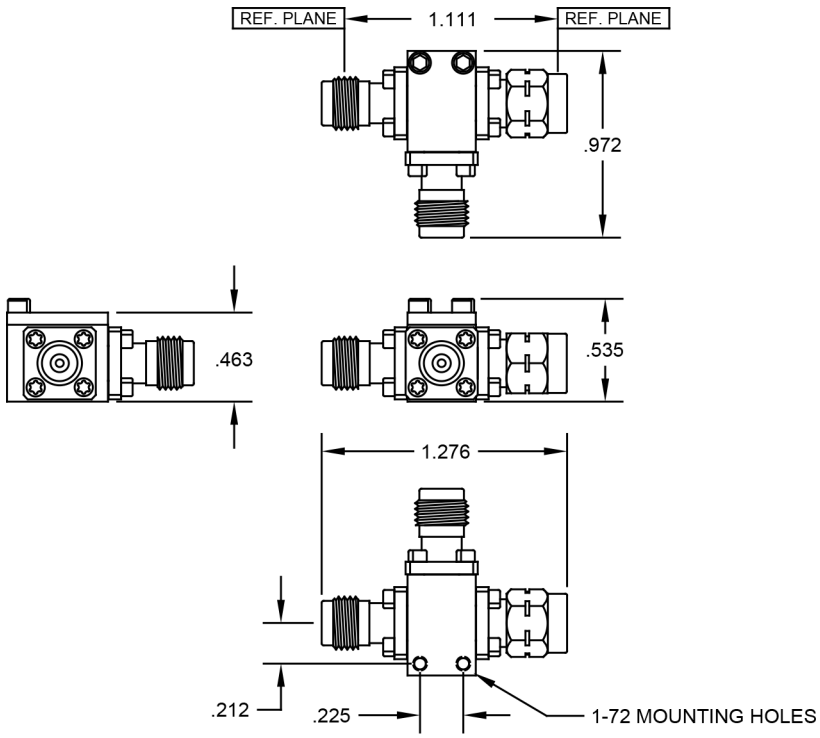


Figure 13: HL5567 mechnical drawing (opt. -JPJ)