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HL5810 10 V_{PP} Limiting Amplifier

PRODUCT SUMMARY

HL5810 is a thermally-compensated limiting amplifier designed for broadband pulse amplification and NRZ data transmission up to 20Gbps.

In limiting mode, the HL5810 produces a fixed 10 V_{PP} output amplitude in response to a wide range of input signals from 0.03 V_{PP} to 0.63 V_{PP}.

The exceptional gain compression characteristics of the HL5810 serve to accelerate slow signal transitions and flatten topline aberrations, improving the signal integrity of binary data. HL5810 is NOT recommended for PAM4 applications. See Applications section.

APPLICATIONS

Optical Communications
Satellite Communications
Data Signaling
High-Speed Pulses
Analog Signals
Research & Development

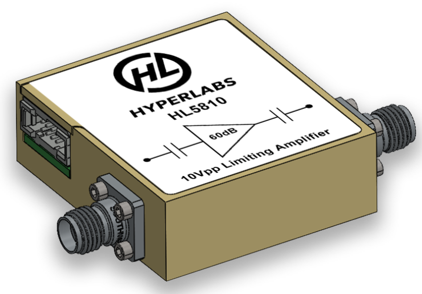
AVAILABLE OPTIONS

The following options and configurations are available for this product:

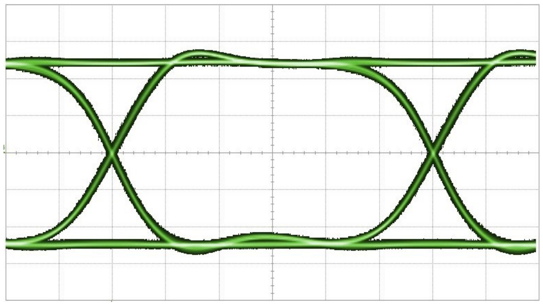
- ***-PP***, plug in & out
- ***-PJ***, plug in, jack out
- ***-JJ***, jack in & out
- ***-JP***, jack in, plug out

Key Features and Technical Specifications

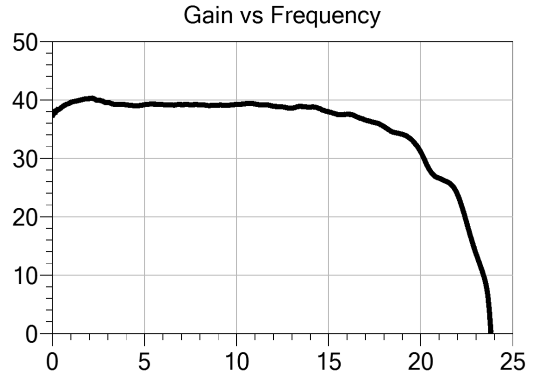
Maximum Data Rate	20 Gbps
Large Signal Bandwidth	15 GHz P_{in} = -10dBm
Small Signal Gain	60 dB
Limiting Output Amplitude	10 V_{PP}
Input P1dB	-38 dBm
Output P1dB	21 dBm
Saturated Output Power	27 dBm
Input Return Loss	20 dB (f < 10 GHz)
Output Return Loss	20 dB (f < 7 GHz)
Group Delay	470 ps
Power Supply	+12V @ 350 mA (typ.) -12V @ 120 mA (typ.)
Dimensions excluding connectors	38.6 x 34.3 x 12.7 mm 1.52” x 1.35” x 0.50”
Weight	31 g (1.09 oz)
Operating Temp.	0° to +70° C, case temp
RoHS Compliant	Yes, assembled with lead-free solder
REACH Compliant	Yes
Warranty	1 year, see website



HL5810 drawing shown



Eye Diagram of HL5810 at 10 Gbps



Large Signal Gain of HL5810 (P_{IN} = -10 dBm)

HL5810 Full Specifications

Parameter	Conditions	Minimum	Typical	Maximum	Comments
Small Signal Gain	f = 2 GHz, P_{IN} ≤ -40 dBm		60 dB		See Figs. 13, 14
Large Signal Gain	f = 2 GHz, -20 dBm ≤ P_{IN} ≤ 0 dBm		27 dBm - P_{IN}		Large signal gain is inversely proportional to input power
Small Signal -3 dB Bandwidth	P_{IN} = -40 dBm		5 GHz		Relative to the gain at 1 GHz. See Figs. 13, 14
Large Signal -3 dB Bandwidth	P_{IN} = -10 dBm		15 GHz		Relative to the gain at 1 GHz. See Figs. 13, 14
Low Frequency -3 dB Cutoff			100 kHz		Relative to the gain at 1 GHz. See Fig. 13
Group Delay	P_{IN} = -10 dBm		470 ps		See Fig. 16
Return Loss, Input	f < 10 GHz P_{IN} = -10 dBm		20 dB		See Fig. 15, 50 Ω nominal
Return Loss, Output	f < 7 GHz P_{IN} = -10 dBm		20 dB		See Fig. 15, 50 Ω nominal
Input Referred Noise Voltage			0.2 mV_{RMS}		Integrated DC to 20 GHz broadband measurement
Noise Figure	f = 1 GHz		15 dB		
Recommended RF Input Voltage		0.03 V_{PP}	0.25 V_{PP}	0.63 V_{PP}	Signals in this range result in 10 V_{PP} output amplitude
Input P1dB	f = 2 GHz		-38 dBm		See Fig. 17
Ouput P1dB	f = 2 GHz		21 dBm		See Fig. 17
Saturated P_{OUT}	f = 2 GHz		27 dBm		See Fig. 17
Output Amplitude Accuracy	2.5 Gbps, PRBS7 V_{IN} = 0.25 V_{PP} T_C = 40° C	9.75 V_{PP}	10.0 V_{PP}	10.25 V_{PP}	See Note 1 and Fig. 18
Eye Crossing (%) Accuracy	2.5 Gbps, PRBS7 V_{IN} = 0.25 V_{PP} T_C = 40° C	48%	50%	52%	See Note 2 and Fig. 18
Added Jitter (RMS)	2.5 Gbps, PRBS7 V_{IN} = 0.25 V_{PP} T_C = 40° C		0.6 ps	1 ps	Deconvolved Tj See Note 3
Eye Risetime (10%-90%)	2.5 Gbps, PRBS7 V_{IN} = 0.25 V_{PP} T_C = 40° C		30 ps	35 ps	See Note 3

HL5810 Full Specifications (continued)

Parameter	Conditions	Minimum	Typical	Maximum	Comments
Polarity	Non-inverting				
Coupling	AC, input and output				
Input DC Voltage		-13 V	0 V	+13 V	
Output DC Voltage		-0.5 V	0 V	+16 V	
Positive Supply Voltage	T_{CASE} < 70° C	+9 V	+12 V	+12.5 V	Operate at low voltage to reduce cooling requirements
Positive Supply Current	V_{IN} = 0.25 V_{PP} T_{CASE} < 70° C		0.35 A	0.38 A	
Negative Supply Voltage	T_{CASE} < 70° C	-12.5 V	-12 V	-10 V	Operate at low voltage to reduce cooling requirements
Negative Supply Current	V_{IN} = 0.25 V_{PP} T_{CASE} < 70° C		0.12 A	0.15 A	
Operating Case Temperature (T_C)		0° C		70° C	DO NOT EXCEED 70° C case temperature
Connectors	SMA				
Dimensions (L x H x D)	38.6 x 34.3 x 12.7 mm 1.52” x 1.35” x 0.50”				Excluding Connectors
Weight	31 g (1.09 oz)				
RoHS Compliant	Yes, assembled with lead-free solder				
REACH Compliant	Yes				
Warranty	1 year, see website				

Notes:

1. Amplitude is calibrated at 2.5 Gbps with a 0.25 Vpp PRBS7 input pattern and 50% mark space density. Amplitude is measured between 45% and 55% unit interval (10% Eye Aperture) using a LeCroy SDA 100G sampling oscilloscope, SE-50 sampler, and Anritsu 41KC-20 attenuator. No cables are inserted between the amplifier output, the attenuator, and the sampler. Amplitude accuracy is guaranteed at 40°C case temperature. See Figure 19 for typical temperature variation.
2. Eye Crossing is calibrated at 2.5 Gbps with a 0.25 Vpp PRBS7 input pattern and 50% mark space density. The eye crossing of the input signal must be 50% +/- 0.1%. Crossing Point is measured using a LeCroy SDA 100G sampling oscilloscope, SE-50 sampler, and Anritsu 41KC-20 attenuator. No cables are inserted between the amplifier output, the attenuator, and the sampler. Eye Crossing accuracy is guaranteed at 40° C case temperature. See Figure 20 for typical temperature variation.
3. Eye Risetime and Total RMS Jitter (Tj) are measured at 2.5 Gbps with a 0.25 Vpp PRBS7 input pattern and 50% mark space density using a LeCroy SDA 100G oscilloscope, SE-50 sampler, and Anritsu 41KC-20 attenuator. Added Jitter (RMS) is calculated by deconvolving the jitter of the test system from the DUT measurement using root-difference-of-squares.

$$Added\ Jitter\ (RMS) = \sqrt{{Tj_{SYSTEM+DUT}}^2 - {Tj_{SYSTEM}}^2}$$

HL5810 Typical Performance Characteristics

The data presented in Figures 1 through 6 were obtained using a MICRAM DAC4 signal source with HL9452-28 transition time converter and a LeCroy SDA 100G Sampling Oscilloscope with 70GHz (SE-70) remote sampling module.

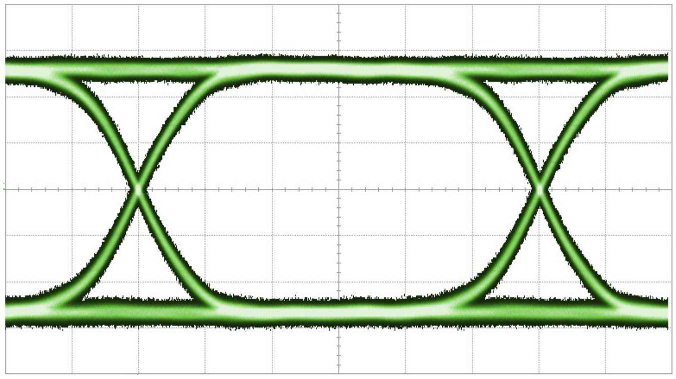


Fig. 1: 10 Gbps PRBS7 RF Input eye. 50 mV/div

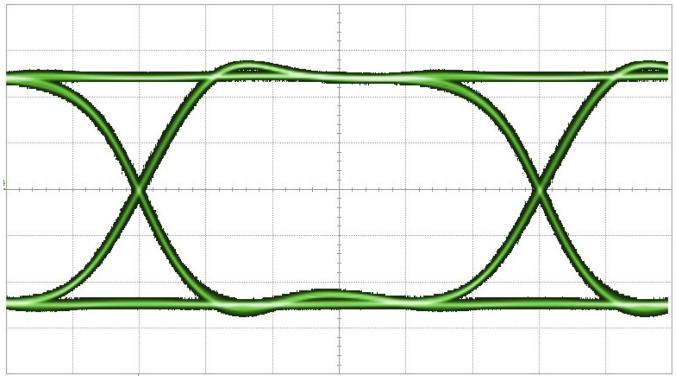


Fig. 2: 10 Gbps PRBS7 RF Output eye. 2 V/div

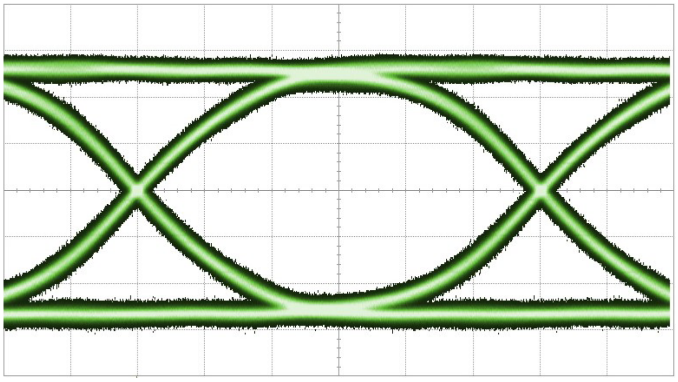


Fig. 3: 20 Gbps PRBS7 RF Input eye. 50 mV/div

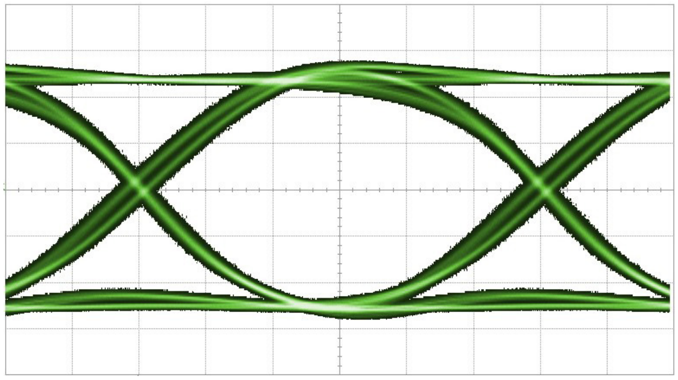


Fig. 4: 20 Gbps PRBS7 RF Output eye. 2 V/div

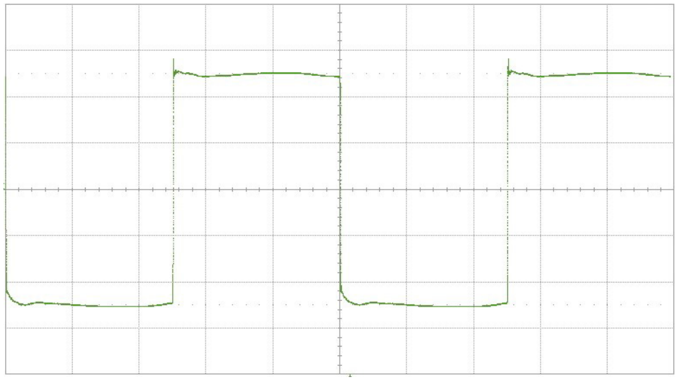


Fig. 5: 40 MHz RF Output Square Wave. 2 V/div

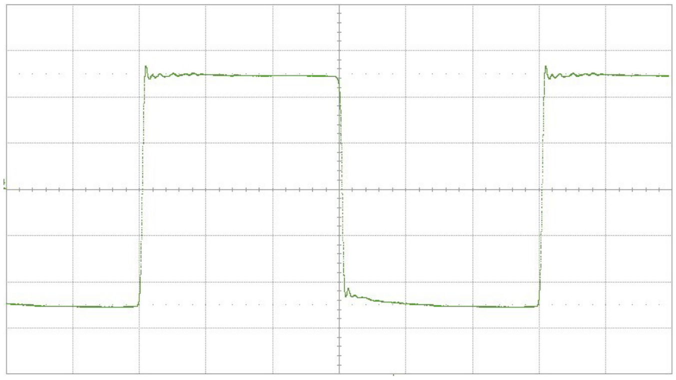


Fig. 6: 333 MHz RF Output Square Wave. 2 V/div

HL5810 Typical Performance Characteristics

The data presented in Figures 7 through 12 were obtained using an Anritsu 69369A signal generator and a LeCroy SDA 100G Sampling Oscilloscope with 70GHz (SE-70) remote sampling module.

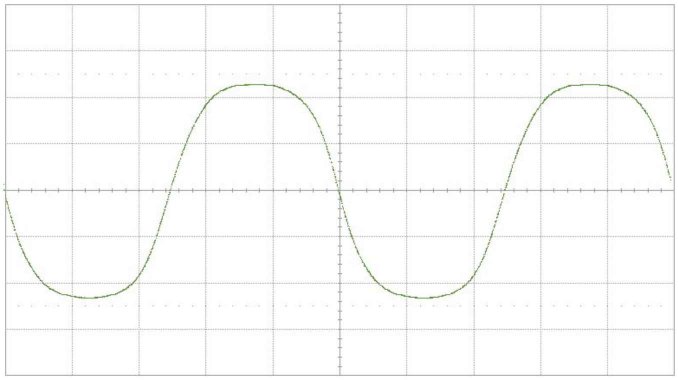


Fig. 7: 2 GHz RF Output @ P_{IN} = -32 dBm (sinewave) 2 V/div

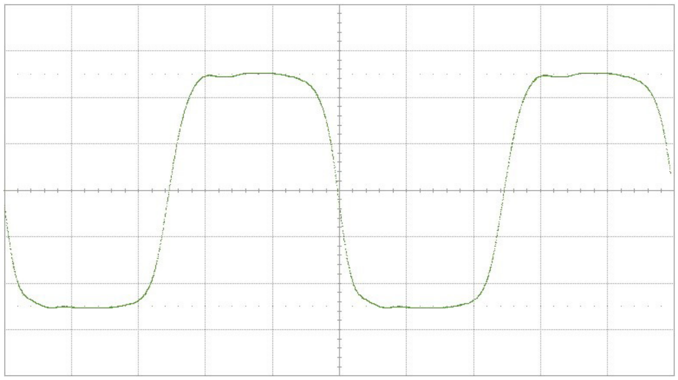


Fig. 8: 2 GHz RF Output @ P_{IN} = -26 dBm (sinewave) 2 V/div

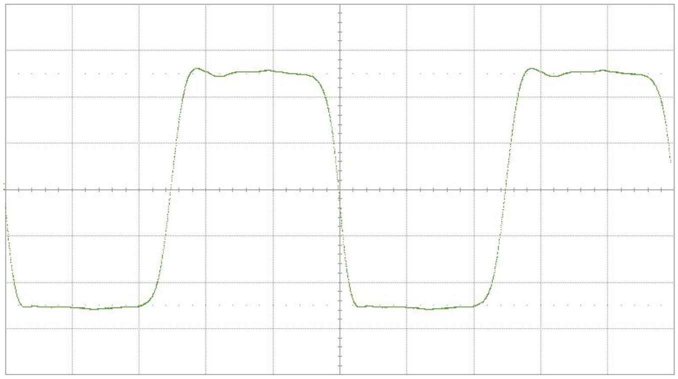


Fig. 9: 2 GHz RF Output @ P_{IN} = -20 dBm (sinewave) 2 V/div

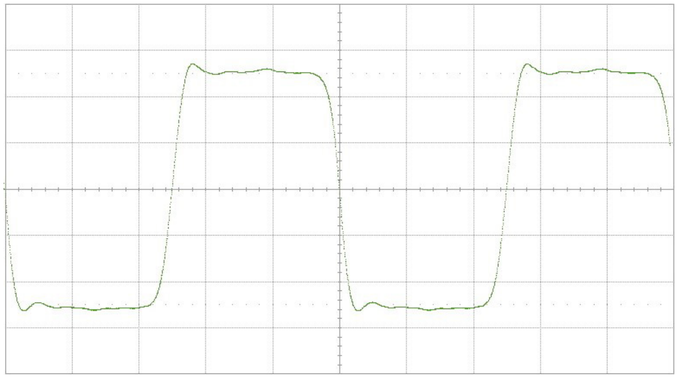


Fig. 10: 2 GHz RF Output @ P_{IN} = -14 dBm (sinewave) 2 V/div

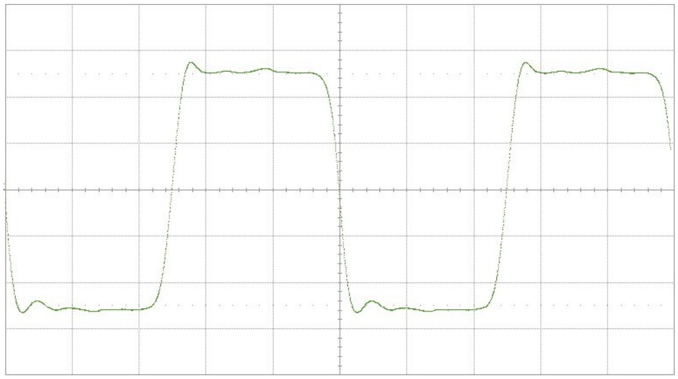


Fig. 11: 2 GHz RF Output @ P_{IN} = -8 dBm (sinewave) 2 V/div

Fig. 12: 2 GHz RF Output @ P_{IN} = -2 dBm (sinewave) 2 V/div

HL5810 Typical Performance Characteristics

The data presented in Figures 13 through 16 were obtained using an Anritsu MS4647B Vector Network Analyzer. The data presented in Figure 17 were obtained using an Anritsu 69369A signal generator and Agilent 8565EC Spectrum Analyzer.

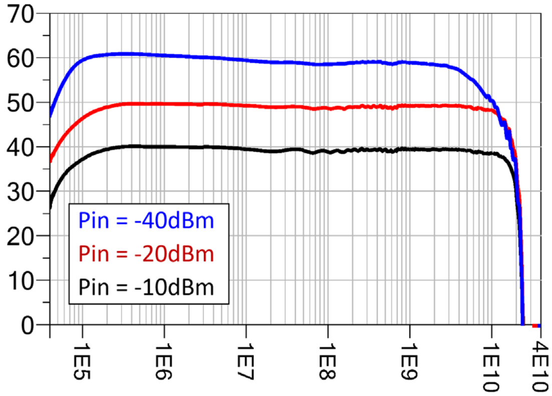


Fig. 13: Gain (dB) vs Log Freq (GHz) at Various Power Levels

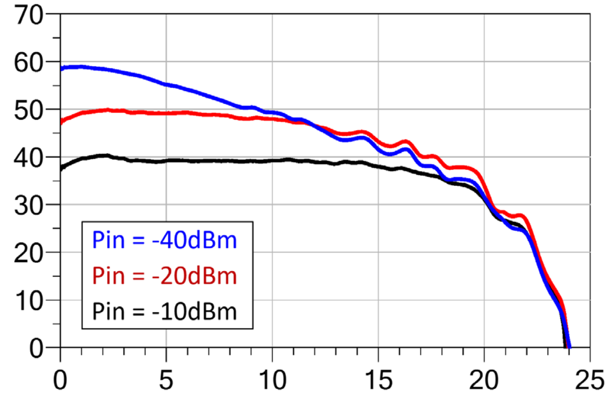


Fig. 14: Gain (dB) vs Linear Freq (GHz) at Various Power Levels

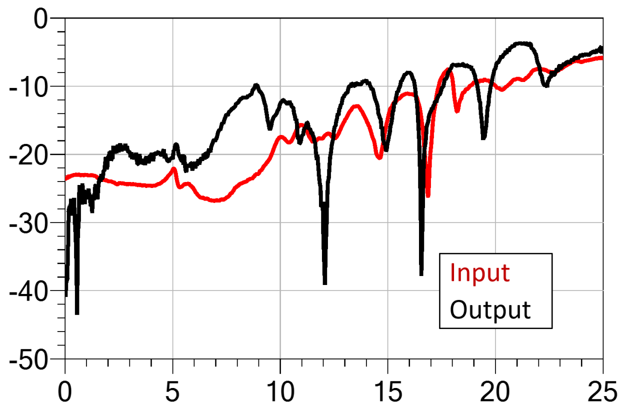


Fig. 15: Return Loss (dB) vs Freq (GHz) at -10 dBm

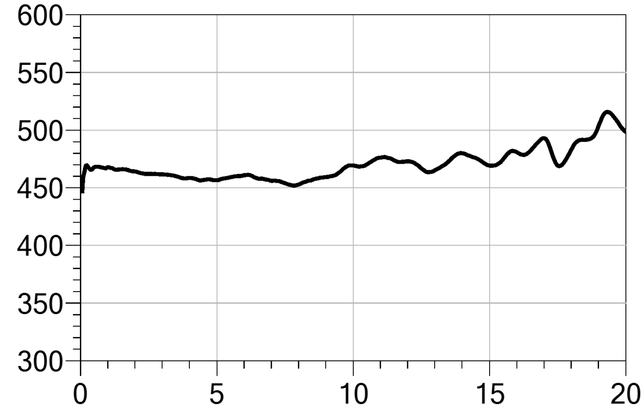


Fig. 16: Group Delay (ps) vs Freq (GHz) at P_{IN} = -10 dBm

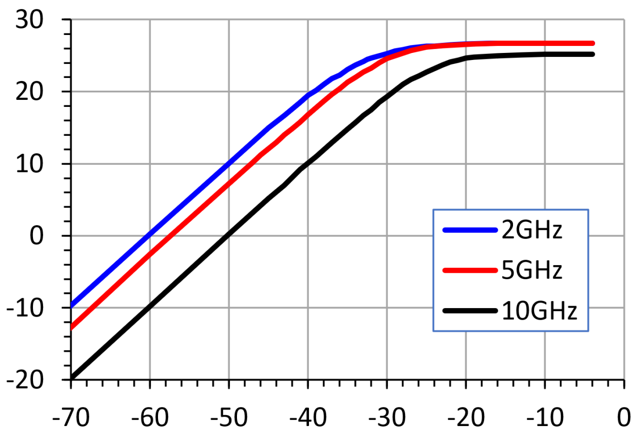


Fig. 17: P_{OUT} (dBm) vs P_{IN} (dBm) at Various Frequencies

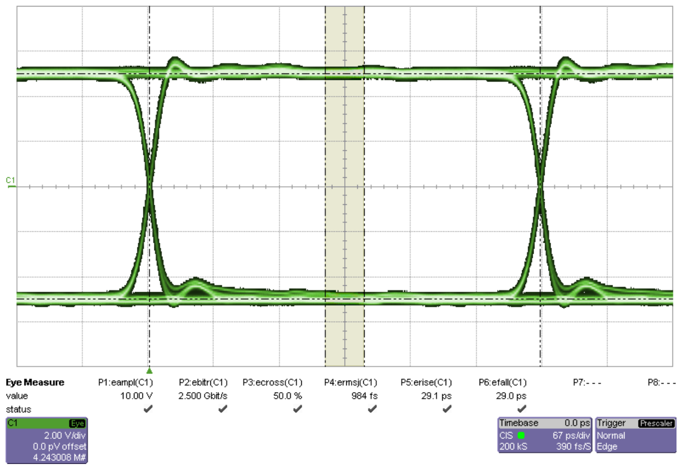


Fig. 18: Amplitude and Crossing Calibration Eye Diagram

HL5810 Typical Performance Characteristics

The data presented in Figures 19 and 20 were obtained using a LeCroy SDA 100G Sampling Oscilloscope with 50 GHz (SE-50) remote sampling module. The data presented in Figures 21 and 22 were obtained using a Fluke 87 Multimeter.

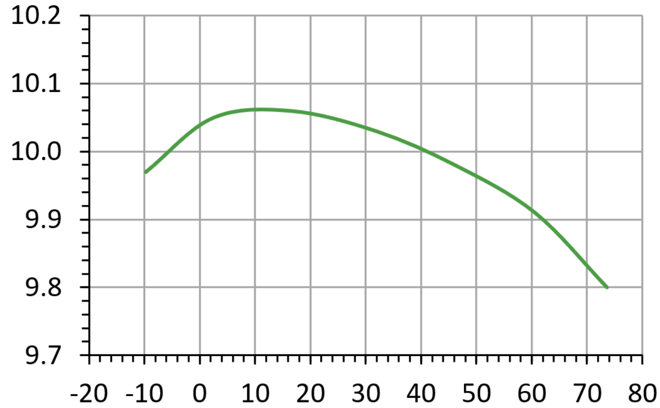


Fig. 19: Output Amplitude (Vpp) vs Temp (°C) at 2.5Gb/s

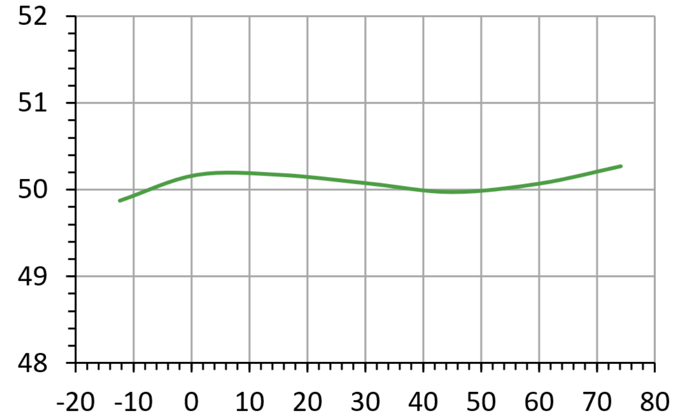


Fig. 20: Eye Crossing (%) vs Temp (°C) at 2.5Gb/s

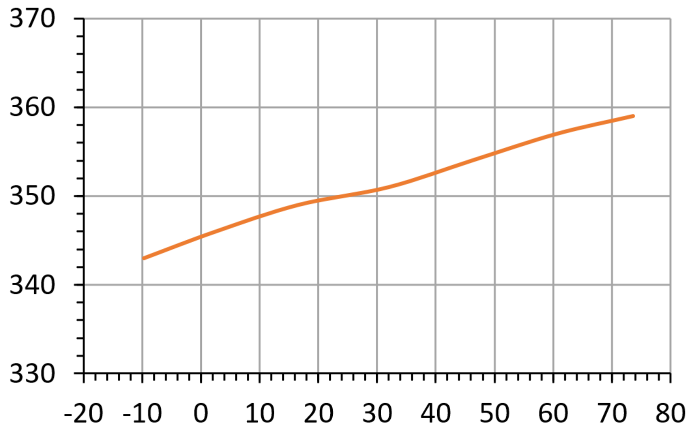


Fig. 21: Positive Supply Current (mA) vs Temp (°C); Vin = 0.25Vpp

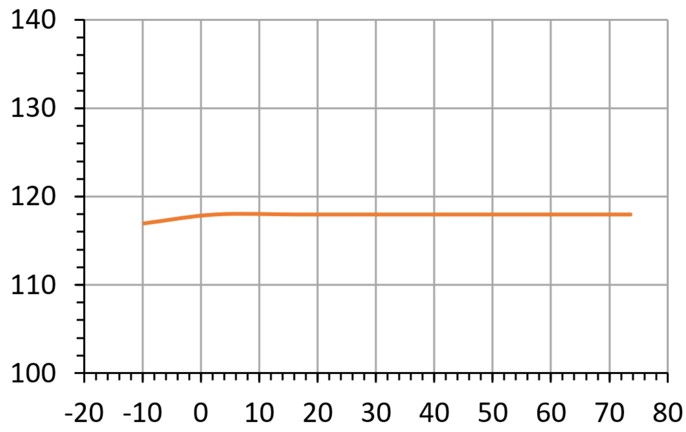


Fig. 22: Negative Supply Current (mA) vs Temp (°C); Vin = 0.25Vpp

HL5810 Applications

HL5810 produces a calibrated output amplitude of 10Vpp over the full operating temperature range and in response to input signals ranging from 0.03Vpp to 0.63Vpp. Due to the effects of gain compression, HL5810 accelerates slow signal transitions and flattens topline aberrations while preserving the jitter characteristics and amplifying the noise of the input signal. HL5810 can significantly improve signal integrity in binary signaling applications. HL5810 is NOT recommended for PAM4 applications. The signal processing characteristics of HL5810 are demonstrated below.

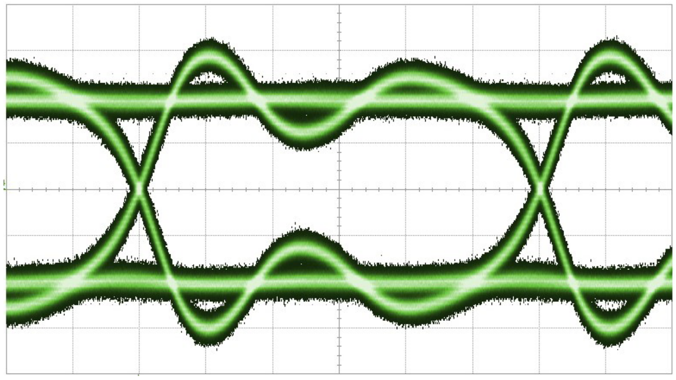


Fig. 23: Input signal exhibiting "Brick Wall" response 26.5mV/div

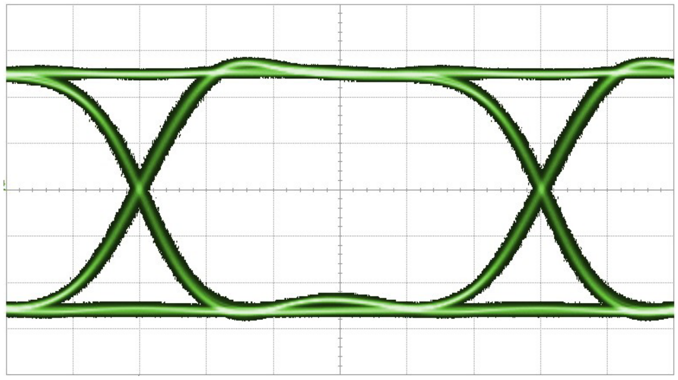


Fig. 24: RF Output Eye resulting from Fig. 23 stimulus. 2V/div

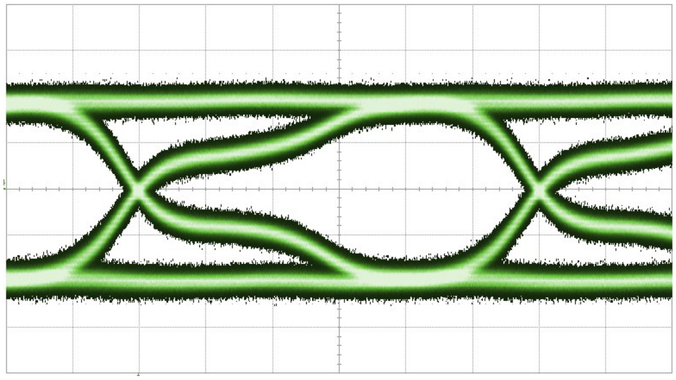


Fig. 25: Input signal exhibiting "Lazy Eye" response 26.5 mV/div

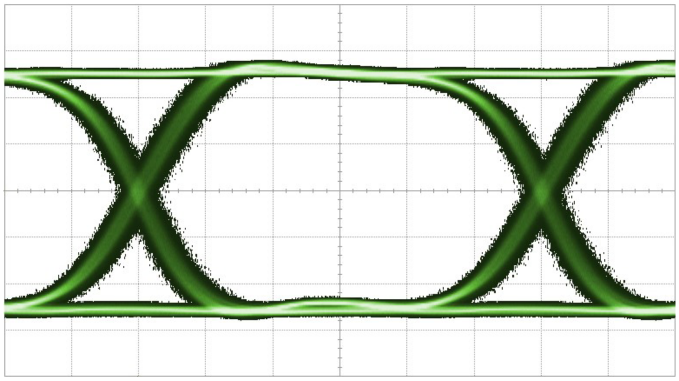


Fig. 26: RF Output Eye resulting from Fig. 25 stimulus 2 V/div

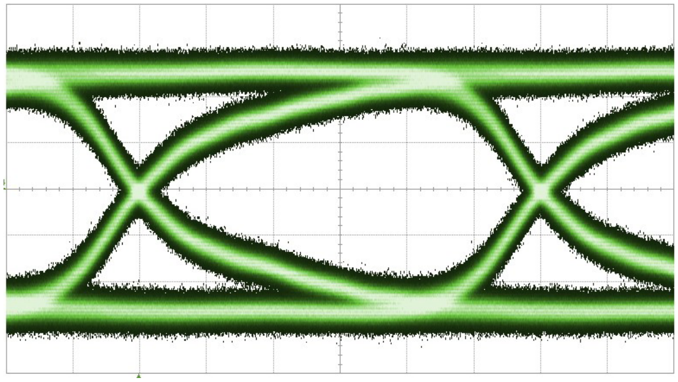


Fig. 27: Input signal exhibiting "Lazy Eye" response 20 mV/div

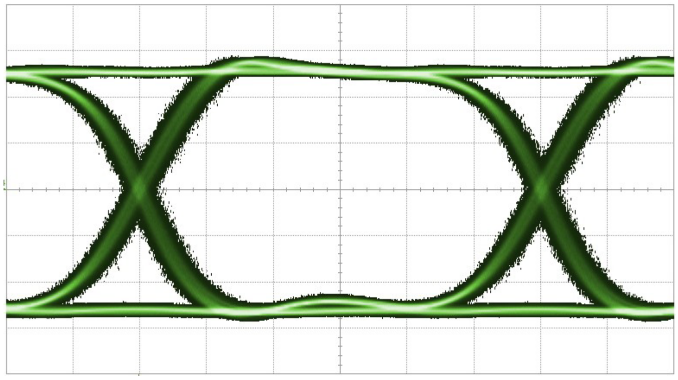


Fig. 28: RF Output Eye resulting from Fig. 27 stimulus 2 V/div

HL5810 Applications

Due to the effects of gain compression, HL5810 accelerates slow signal transitions and flattens topline aberrations while preserving the jitter characteristics and amplifying the noise of the input signal. HL5810 can significantly improve signal integrity in binary signaling applications. HL5810 is NOT recommended for PAM4 applications. The signal processing characteristics of HL5810 are demonstrated below.

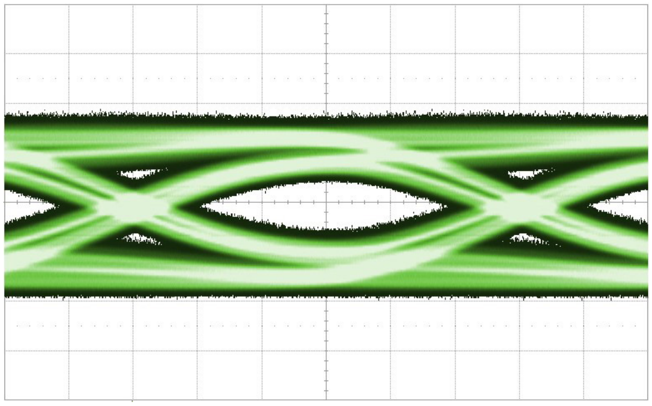


Fig. 29: Input signal degraded by 3 m of cables 50 mV/div

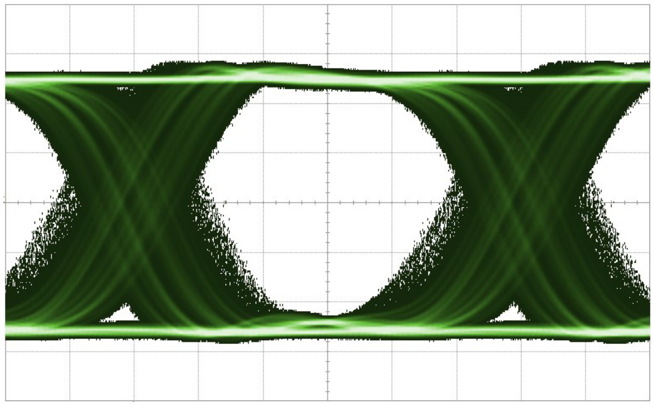


Fig. 30: RF Output Eye resulting from Fig. 29 stimulus 2 V/div

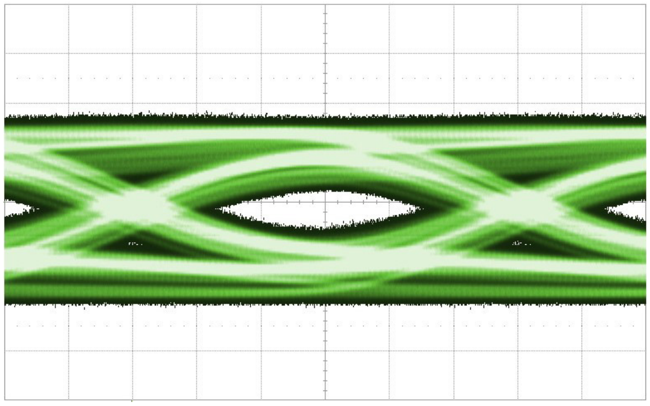


Fig. 31: Input signal degraded by reflections and cables 50 mV/div

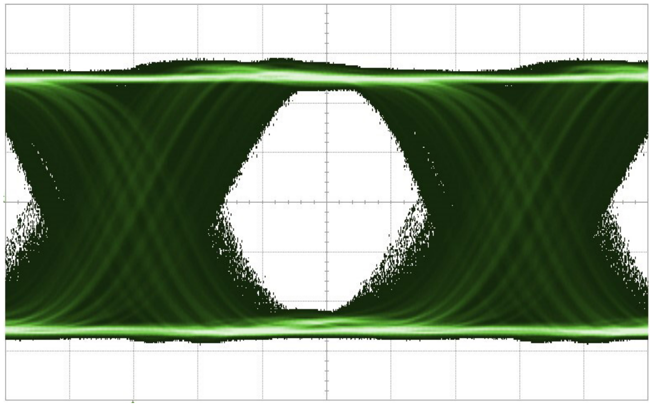


Fig. 32: RF Output Eye resulting from Fig. 31 stimulus 2 V/div

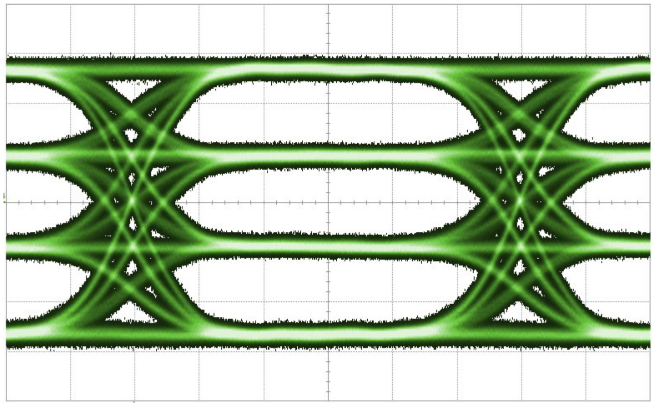


Fig. 33: 20 Gbps PAM4 RF Input Eye 50 mV/div

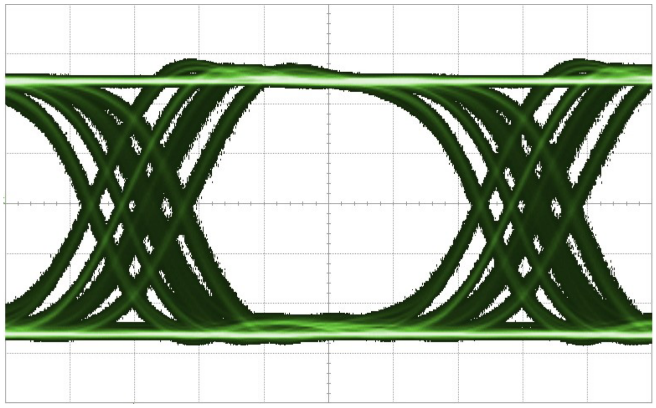
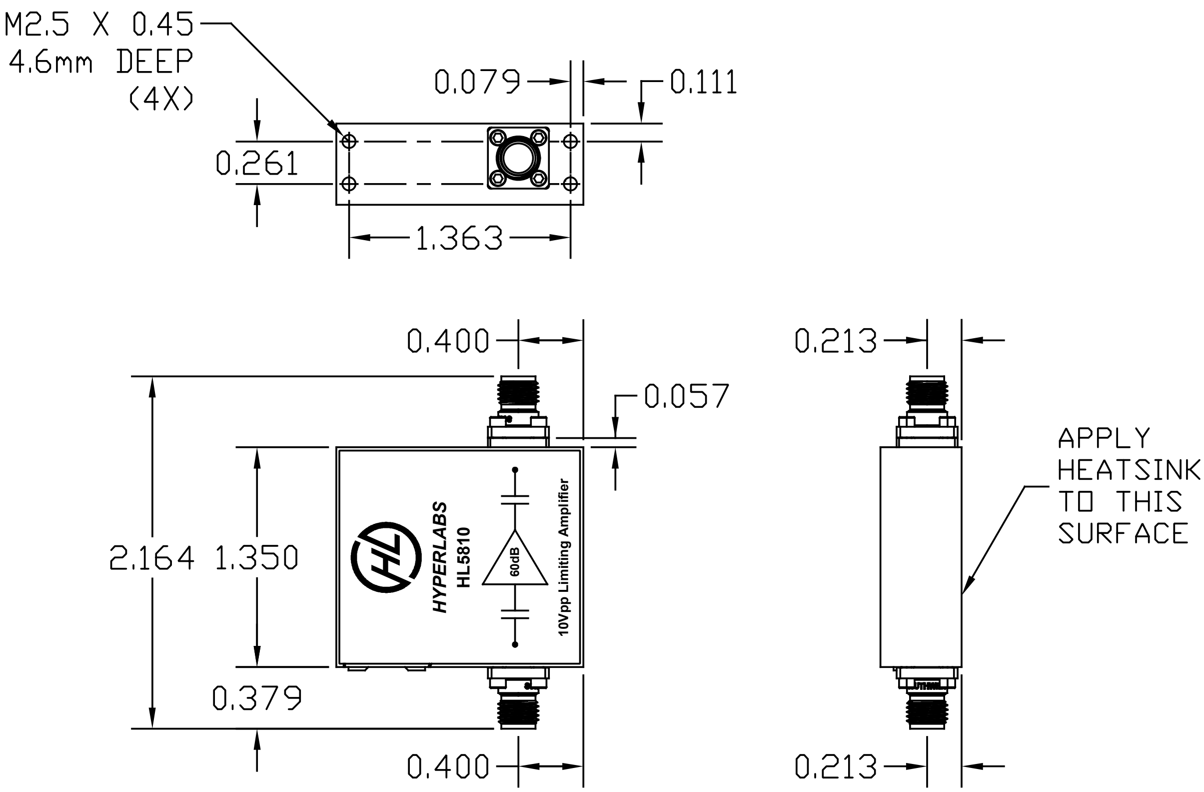
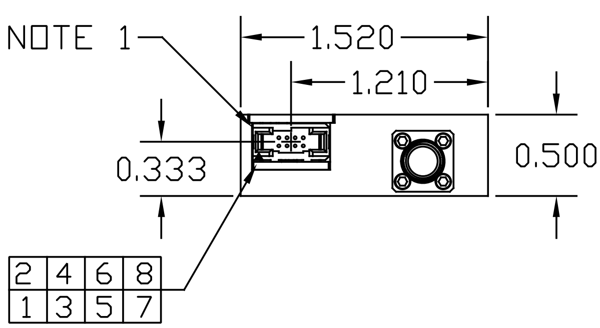


Fig. 34: RF Output Eye resulting from Fig. 33 stimulus 2 V/div

HL5810 Dimensional Drawing

Figure 35 shows a mechanical drawing of an HL5810. Unless otherwise noted, all units are in inches.





PIN	NET	WIRE COLOR
1	GND	BROWN
2	+12V	RED
3	DNC*	
4	+12V	YELLOW
5	DNC*	
6	DNC*	
7	DNC*	
8	-12V	WHITE
*DO NOT CONNECT		

NOTES:
1. POWER CONNECTOR: SAMTEC TFM-104-02-L-DH-FR
2. POWER CABLE: SAMTEC SFSD-04-28C-24.00-SR
3. ALL DIMENSIONS ARE IN INCHES EXCEPT THREADED HOLES.

Figure 35: HL5810 mechnical drawing