HMC750LP4 / 750LP4E

12.5 Gbps LIMITING AMPLIFIER

Typical Applications

The HMC750LP4(E) is ideal for:

- OC-192 Receivers
- 10 Gbps Ethernet Receivers
- 10 Gbps Fiber Channel Receivers
- Broadband Test & Measurement

Features

Supports Data Rates up to 12.5 Gbps

Differential Gain: 44 dB

2mV p-p input Sensitivity

3 dB Bandwidth: 11 GHz

Integrated DC Offset Correction

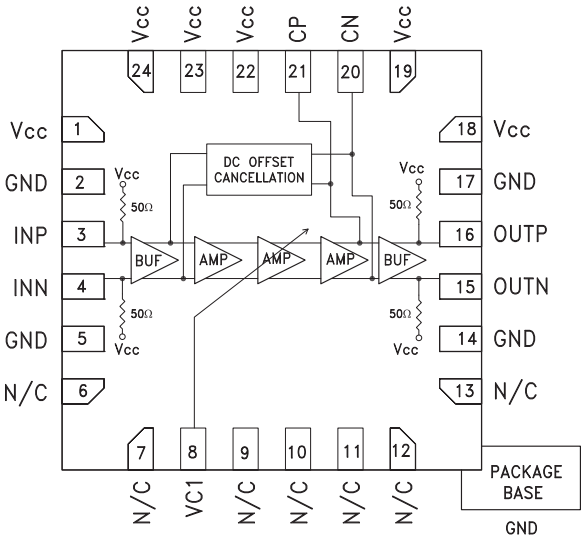
Adjustable Differential Saturated O/P Voltage Swing up to 880 mVp-p

Single +5V Power Supply

Very Low RMS Jitter Degradation

24 Lead Plastic 4x4mm SMT Package: $16mm^2$

Functional Diagram



General Description

HMC750LP4E is a limiting amplifier designed to support data transmission rates up to 12.5 Gbps. The amplifier can operate over a wide range of input voltage levels and provides constant-level differential output swing. HMC750LP4E also features an output level control pin, VC1, which allows for loss compensation or for signal level optimization. Differential output signal swing can be adjustable up to 880 mVp-p. Input signals higher than 3mV p-p can be amplified to saturated 880mV p-p differential signal.

All single-ended input signals to the HMC750LP4E are terminated with 50 ohms to +5V on-chip, and may be either AC or DC coupled. The outputs of the HMC750LP4E may be operated either differentially or single-ended. Outputs can be connected directly to a 50 ohm terminated system referenced to +5V, while DC blocking capacitors may be used if the terminating system is 50 ohms to a non +5V voltage. The HMC750LP4E operates from a single + 5V DC supply and is available in a plastic RoHS compliant 4x4 mm SMT package.

Electrical Specifications, T_A = +25° C, Vcc = +5V, VC1 = +2.5V

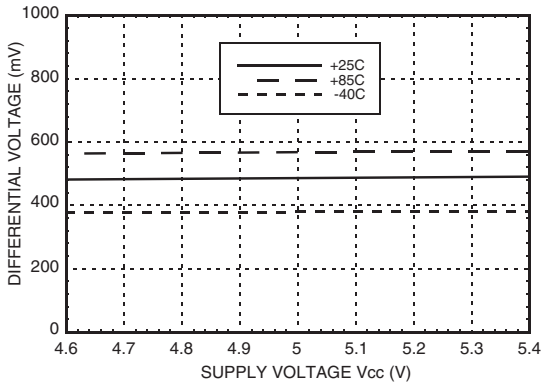
Parameter	Conditions	Min.	Typ.	Max.	Units
Power Supply Voltage		4.6	5	5.4	V
Power Supply Current	VC1 = 2.5V		106	122	mA
Maximum Data Rate			12.5		Gbps
Differential Small Signal Gain	VC1 = 2.5V		44		dB
Small Signal Bandwidth	3-dB Cutoff		11		GHz
Deterministic Jitter [1]	Vin = 20 mV peak to peak		5		ps p-p
Additive Random Jitter [2]	Vin = 200 mV peak to peak			0.2	ps rms

Electrical Specifications *(Conditions)*

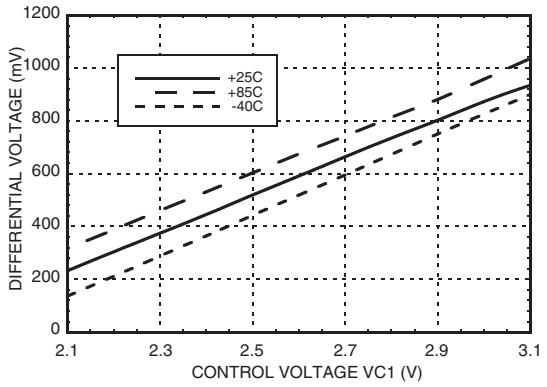
Parameter	Conditions	Min.	Typ.	Max.	Units
Rise Time	20% - 80%		23	27	ps
Fall Time	20% - 80%		21	23	ps
Data Output Swing	Differential Output Swing. VC1 = 3V for maximum output swing.	850	880		mVp-p
Input Return Loss	up to 10 GHz	15			dB
Output Return Loss	up to 10 GHz	8			dB
Input Sensitivity		2			mVp-p
Maximum Input Swing			1200		mVp-p
Output Offset Voltage	VC1 = 3V for maximum output swing		3		mV
VC1		2		3	V
Vout DC		4.5		4.8	V

[1] Deterministic jitter measured at 10 Gbps with PRBS 2^{23}-1 pattern. It is the peak to peak deviation from the ideal time crossing
[2] Random jitter is measured with 10 Gbps 10101… pattern

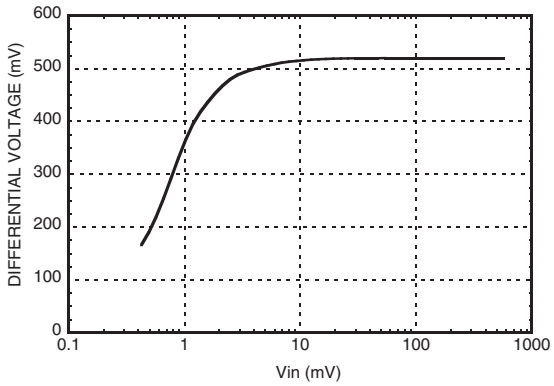
Differential Output vs. Supply Voltage [1]



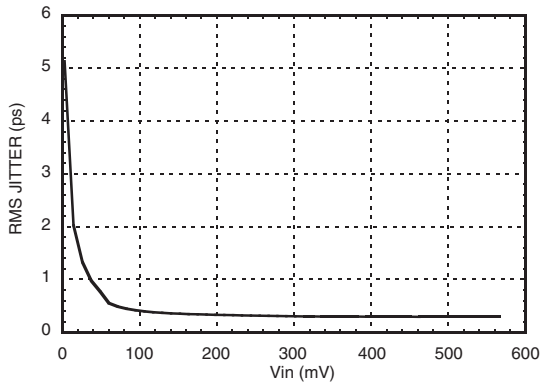
Differential Output vs. Control Voltage [2]



Differential Output vs. Vinput [1][2]

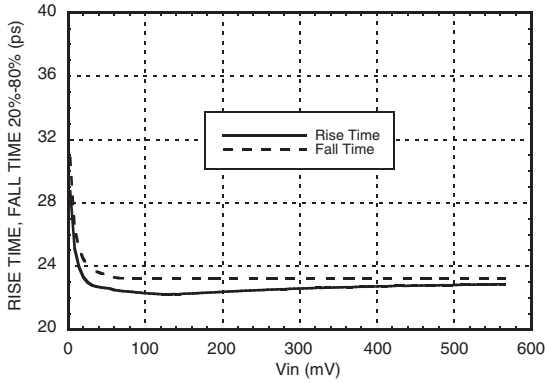


RMS Jitter vs. Vinput [1][2][3]

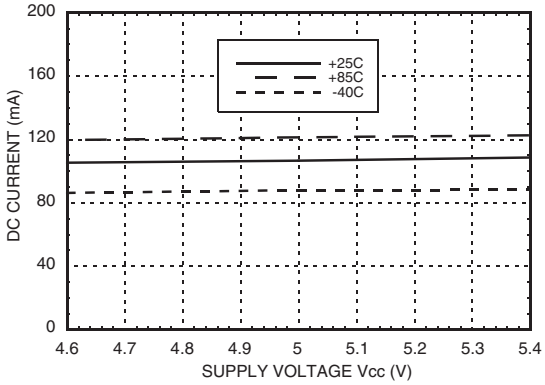


[1] VC1 = 2.5V [2] Vcc = 5V [3] Input Data Rate = 10 Gbps

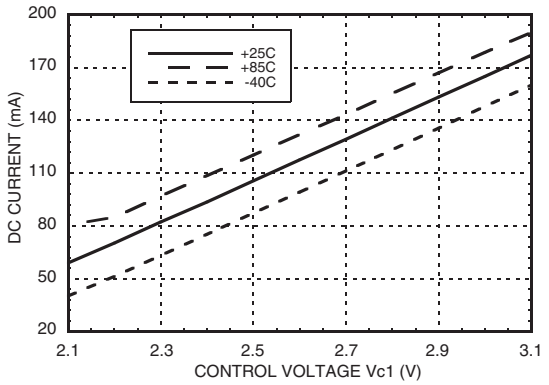
Rise & Fall Time vs. Vinput [1] [2] [3]



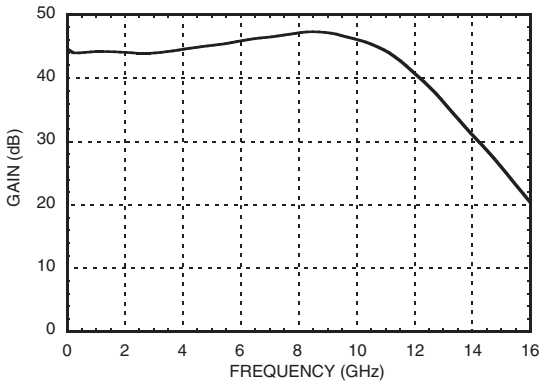
DC Current vs. Supply Voltage [1] [3]



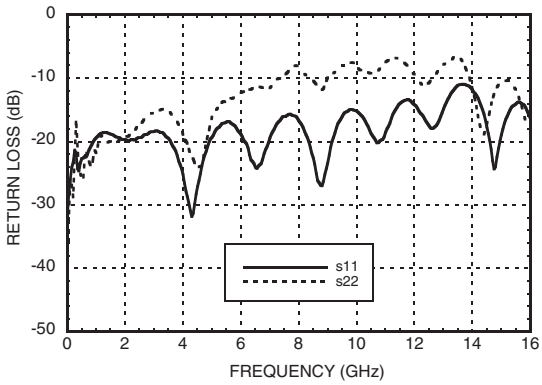
DC Current vs. Control Voltage [2] [3]



Differential Gain vs. Frequency [1] [2]

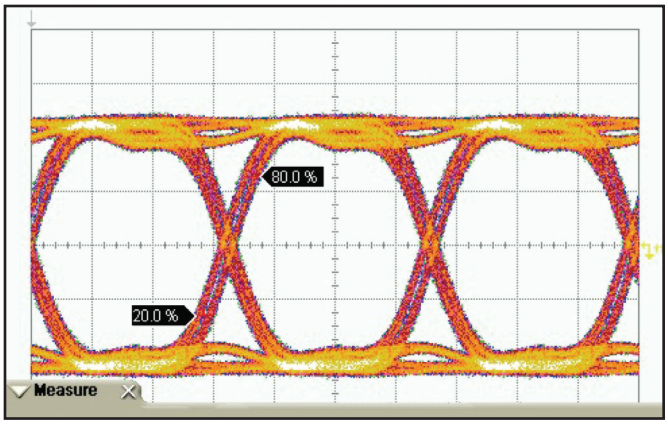


Return Loss [1] [2]



[1] VC1 = 2.5V [2] Vcc = 5V [3] Input Data Rate = 10 Gbps

Output Eye Diagram



Test Conditions

Eye diagram data presented on an Infinium DCA 86100A

Rate = 10 Gb/s

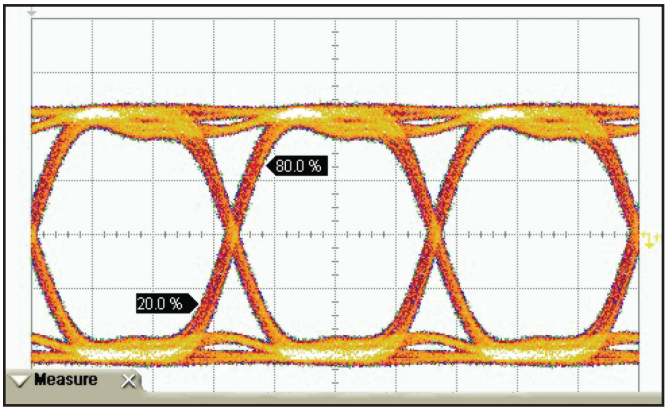
Pseudo Random Code = 2^{23} -1

Vin = 100 mVpp differential, VC1 = 3V

	Current	Minimum	Maximum	Total Meas
Rise Time (f1)	23.33 ps	23.33 ps	23.33 ps	32
Fall Time (f1)	24.67 ps	24.00 ps	25.33 ps	32
Differential Eye Amplitude (f1)	860 mV	858 mV	860 mV	32
Eye S/N (f1)	15.35	15.28	15.50	32

Vertical Scale	100 mV / div
Horizontal Scale	30.0 ps / div

Output Eye Diagram



Test Conditions

Eye diagram data presented on an Infinium DCA 86100A

Rate = 10 Gb/s

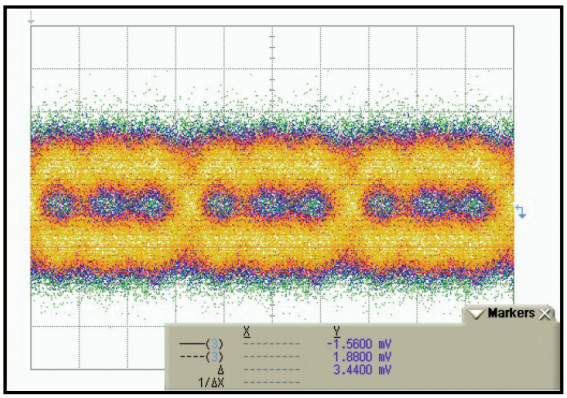
Pseudo Random Code = 2^{23} -1

Vin = 500 mVpp differential, VC1 = 3V

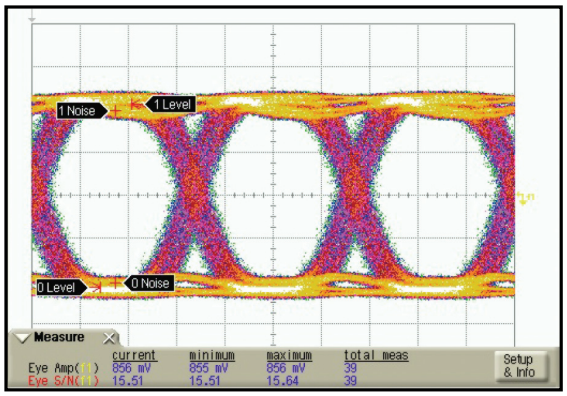
	Current	Minimum	Maximum	Total Meas
Rise Time (f1)	23.33 ps	22.67 ps	23.33 ps	30
Fall Time (f1)	24.67 ps	24.67 ps	26.00 ps	30
Differential Eye Amplitude (f1)	862 mV	861 mV	862 mV	30
Eye S/N (f1)	15.27	15.19	15.35	30

Vertical Scale	100 mV / div
Horizontal Scale	30.0 ps / div

Input Signal



Output Signal

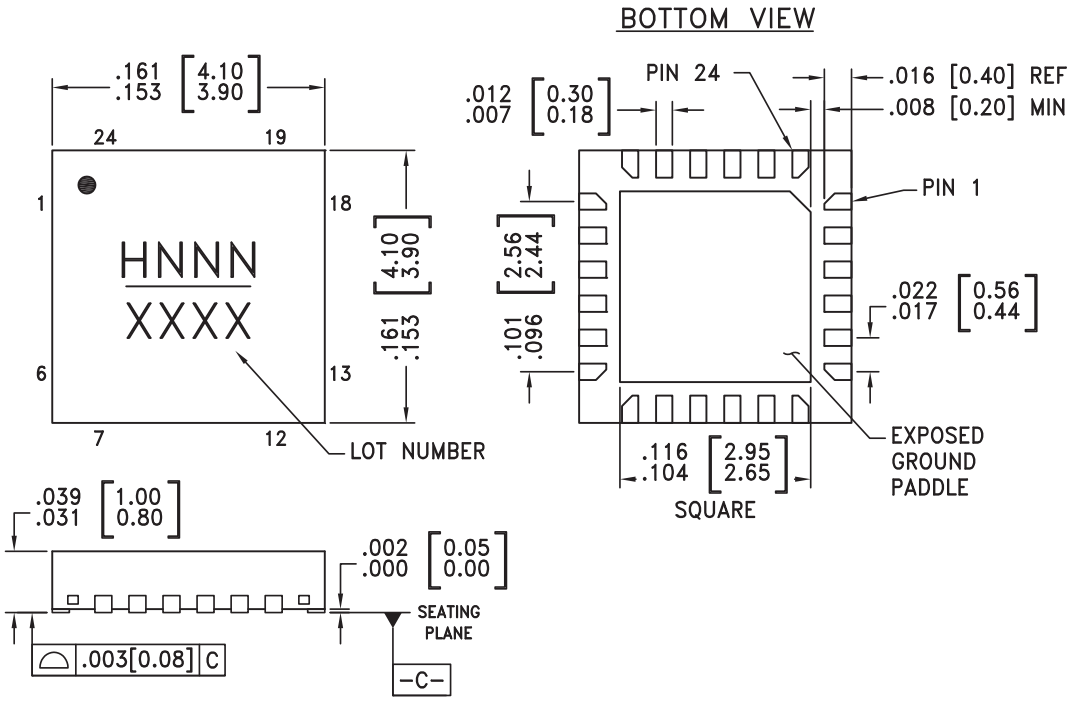


Input and output signal for 10 Gbps, PRBS 2^{23} -1, 3.5mV p-p differential, VC1 = 3V.

Absolute Maximum Ratings

Supply Voltage	5.6V
Input Signals	4V to 5.5V
RF Input Power	10 dBm
Junction Temperature	125 °C
Continuous Pdiss (T = 85°C) (Derate 24 mW/°C above 85°C)	0.95 Watts
Thermal Resistance (R_{th}) (junction to ground paddle)	42 °C/W
Storage Temperature	-65 to 150 °C
Operating Temperature	-40 to +85 °C

Outline Drawing



NOTES:

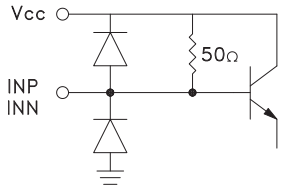
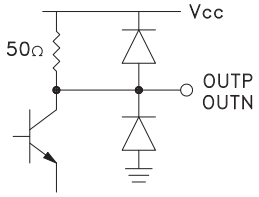
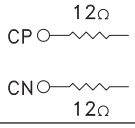
1. LEADFRAME MATERIAL: COPPER ALLOY
2. DIMENSIONS ARE IN INCHES [MILLIMETERS].
3. LEAD SPACING TOLERANCE IS NON-CUMULATIVE
4. PAD BURR LENGTH SHALL BE 0.15mm MAXIMUM. PAD BURR HEIGHT SHALL BE 0.05mm MAXIMUM.
5. PACKAGE WARP SHALL NOT EXCEED 0.05mm.
6. ALL GROUND LEADS AND GROUND PADDLE MUST BE SOLDERED TO PCB RF GROUND.
7. REFER TO HMC APPLICATION NOTE FOR SUGGESTED PCB LAND PATTERN.

Package Information

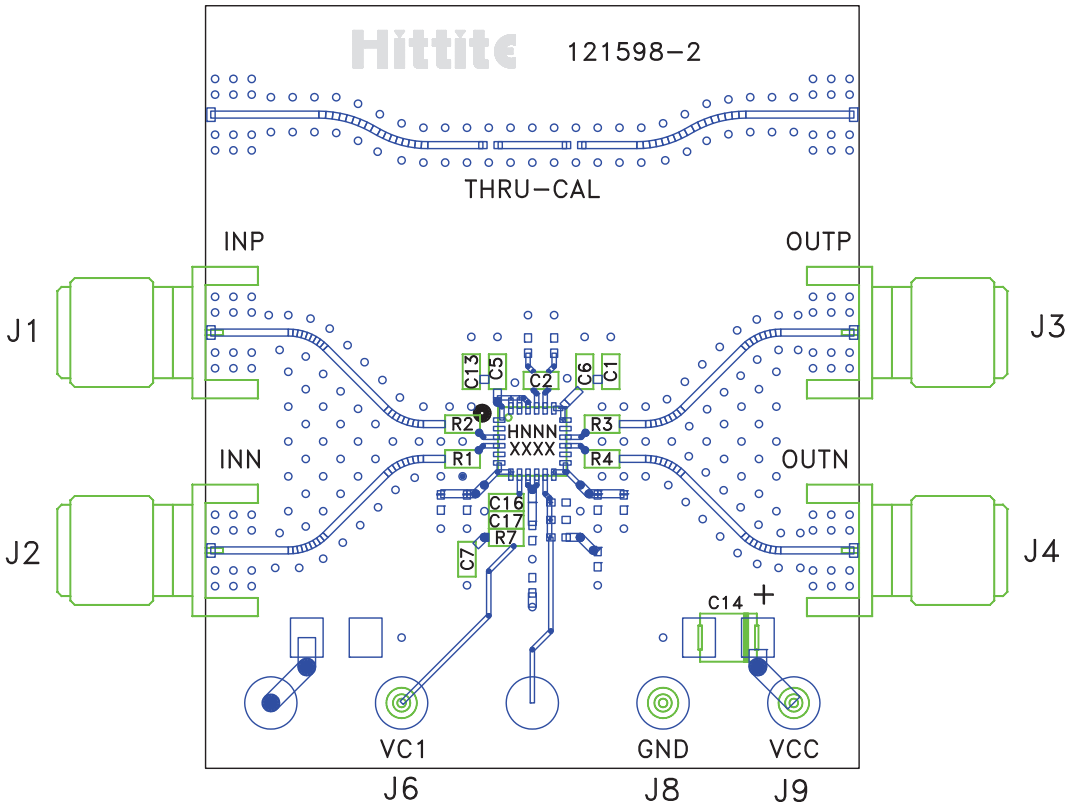
Part Number	Package Body Material	Lead Finish	MSL Rating	Package Marking [3]
HMC750LP4	Low Stress Injection Molded Plastic	Sn/Pb Solder	MSL1 [1]	H750 XXXX
HMC750LP4E	RoHS-compliant Low Stress Injection Molded Plastic	100% matte Sn	MSL1 [2]	H750 XXXX

[1] Max peak reflow temperature of 235 °C
[2] Max peak reflow temperature of 260 °C
[3] 4-Digit lot number XXXX

Pin Descriptions

Pin Number	Function	Description	Interface Schematic
1, 18, 19, 22 - 24	Vcc	Positive supply.	
2, 5, 14, 17, Ground Paddle	GND	Signal and supply ground. Package base must be connected to DC ground.	
3, 4	INP, INN	Data inputs	
6, 7, 9 - 13	N/C	No connection. These pins are not connected internally, but should be connected to ground externally.	
8	VC1	Gain, output level control.	
15, 16	OUTN, OUTP	Data outputs	
20, 21	CN, CP	Filter capacitor for offset correction. Connect 100nF capacitor between CP and CN.	

Evaluation PCB



List of Materials for Evaluation PCB 121600 [1]

Item	Description
J1 - J4	PCB Mount SMA Connector
J6, J8, J9	DC Pin
C1, C2, C13	0.1 µF Capacitor, 0402 Pkg.
C5 - C7	1 nF Capacitor, 0402 Pkg.
C14	4.7 µF Capacitor, 0402 Pkg.
C16	100 pF Capacitor, 0402 Pkg.
C17	10 nF Capacitor, 0402 Pkg.
R1 -R4	0 Ohm Resistor, 0402 Pkg.
R7	620 Ohm Resistor, 0402 Pkg.
U1	HMC750LP4(E) Limiting Amplifier
PCB [2]	121598 Evaluation PCB

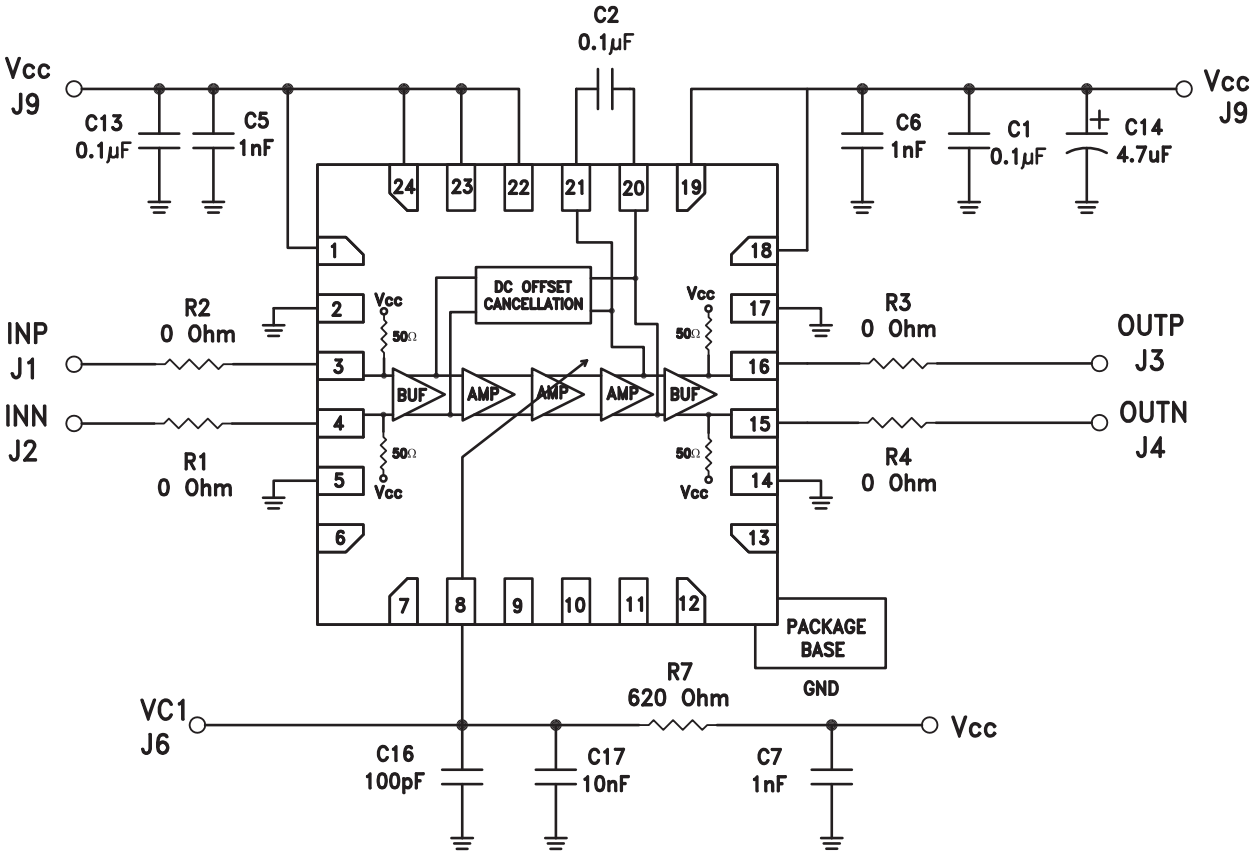
[1] Reference this number when ordering complete evaluation PCB

[2] Circuit Board Material: Arlon 25FR

The circuit board used in the application should use RF circuit design techniques. Signal lines should have 50 ohm impedance while the package ground leads and exposed paddle should be connected directly to the ground plane similar to that shown. A sufficient number of via holes should be used to connect the top and bottom ground planes. The evaluation circuit board shown is available from Hittite upon request.

RoHS✓ EARTH FRIENDLY

Application Circuit

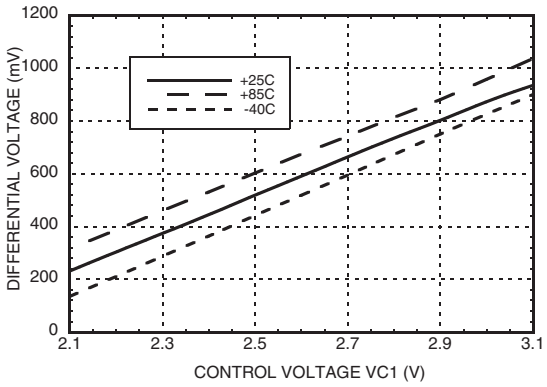


Application Information

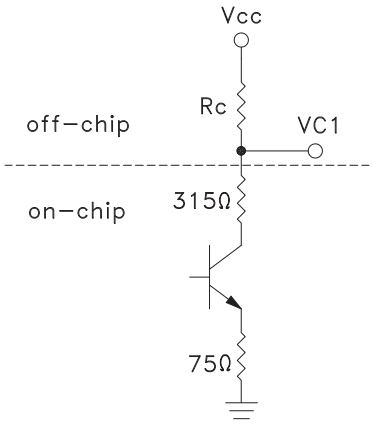
Setting the output swing using external resistor Rc

The HMC750LP4E features output swing level adjustment by using VC1 pin. Output swing can be adjusted to the desired level by applying a DC voltage to VC1 pin. Differential output swing vs. control voltage relationship is given in the plot below.

Differential Output vs. Control Voltage



In order to adjust the DC voltage on VC1 pin a resistor, Rc (R7 in application circuit), should be connected between VC1 pin and VCC as shown in the figure below.



The value of the resistor can be chosen using the following equation as a function of VC1. VC1 DC voltage value can be chosen by using the plot given above.

$$Rc = \frac{390(Vcc - VC1)}{Vc1 - 1.73}$$