LMP8640,LMP8645

Application Note 1975 LMP8640 / LMP8645 Evaluation Board User Guide



Literature Number: SNOA546B

LMP8640 / LMP8645 Evaluation Board User Guide

National Semiconductor Application Note 1975 Domenico Granozio July 15, 2010



This evaluation board shows a bidirectional high side current sense made using LMP8640 (LMP8645) and optional differential amplifier in order to have a single output.

Connectors

POWER SUPPLY

There are two banana plugs labeled GND and VCC to power the evaluation board. Moreover a banana plug labeled VCC_Amp is used to power an optional operational amplifier which makes the difference between the outputs of the two LMP8640 (LMP8645).

SIGNAL CONNECTORS

There are five connectors for signals.

Input signals

IN It connects the non inverting input of U1 and

inverting input of U2.

LOAD It connects the non inverting input of U2 and

inverting input of U1.

The device U1 is able to sense the current when it flows in the shunt resistor from LOAD pin to IN pin. The device U2 is able to sense the current when it flows in the shunt resistor from IN pin to LOAD pin.

Output signals

OUT+ Output of device U2, the voltage at this pin is related to the current which flows from IN pin to

LOAD pin.

OUT- Output of device U1, the voltage at this pin is

related to the current which flows from LOAD pin

to IN pin.

OUT Optional Output of the difference amplifier which

makes the difference between OUT+ and OUT-

Hardware Setup

POWER SUPPLY SETUP

High side current sense LMP8640 (LMP8645)
 Connect a supply voltage in the range between 2.7V and 12V to the VCC and GND turrets.

2. Optional difference amplifier

Connect a supply according to the specs of the amplifier to the VCC_Amp and GND turrets.

SOURCE AND LOAD SETUP

First case. Current flows from IN to LOAD plugs.

A voltage supply can be connected between the IN and GND banana plugs, while a load between the LOAD and GND banana plugs. The voltage applied at IN pin has not to exceed the max common mode voltage allowed by the LMP8640/HV (LMP8645/HV). The max allowed common mode voltages are listed in the following table.

Second case. Current flows from LOAD to IN plugs.

In this case the voltage supply is connected between the LOAD and GND banana plugs, while the load between the IN and GND banana plugs. The voltage applied at LOAD pin has not to exceed the max common mode voltage allowed by the LMP8640/HV (LMP8645/HV). The max allowed common mode voltages are listed in the following table.

Max Common Mode Voltage

DEVICE	MAX VCM
LMP8640	42V
LMP8645	42V
LMP8640HV	76V
LMP8645HV	76V

According to the shunt resistor (Rsns), to the gain of LMP8640 (LMP8645) and to the supply voltage different ranges of currents can be sensed with this evaluation board.

COMPONENTS

On the evaluation board there are already the circuit and the footprint of a standard dual op amp (U3) to implement a differential Op amp (U3.B) with reference (U3.A) in order to provide a single ended output of the bidirectional current.

Optional differential circuit

U3 Standard Dual Op Amp 8 pin.

U3.1 OUT A

U3.2 -IN A

U3.3 +IN A

U3.4 V

U3.5 +IN B

U3.6 -IN B

U3.7 OUT B

U3.8 V+

R1, R2, resistors which implement the differential circuit

R3, R4 according to the following equation:

$$\mathsf{OUT} = -\frac{\mathsf{R4}}{\mathsf{R1}} * \mathsf{OUT}^\text{-} + \left(1 + \frac{\mathsf{R4}}{\mathsf{R1}}\right) * \left(\frac{\mathsf{R2}}{\mathsf{R2} + \mathsf{R3}} * \mathsf{Vref} + \frac{\mathsf{R3}}{\mathsf{R2} + \mathsf{R3}} * \mathsf{OUT}^\text{+}\right)$$

R5, R6, components for voltage reference and its filter.

C5 The voltage reference is calculating according the following equation:

$$Vref = \frac{R5}{R5 + R6} \times VCC_Amp$$

Using the Evaluation Board

INPUT AND OUTPUT SIGNALS

The evaluation board allow to measure a bidirectional current, so the IN and LOAD banana connectors can act either as Source or LOAD pin. If the current flows from the IN pin to the LOAD pin, a simply way to test the performance of the LMP8640 (LMP8645) is showed in *Figure 1*

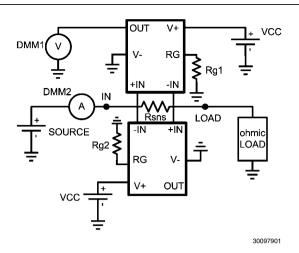


FIGURE 1. LMP8640 (LMP8645) measurement setup

The DMM1 is configured as a Voltmeter it measures the output of the LMP8640 (LMP8645), while the DMM2 is configured as an Ammeter; it measures the current which flows in the LOAD. The source is a voltage supply; make sure to set a voltage in the range of -2Vto +46V for LMP8640 (LMP8645) or -2V to +76V for LMP8640HV (LMP8645HV).

GAIN SELECTION OF LMP8645

The evaluation board is provided with a shunt resistor Rsns $(10m\Omega, @1\%, 1W)$. While two gain resistors Rg1 and Rg2

 $(10k\Omega,\ @\ 1\%)$ ensure a gain of 2V/V for each current sense. The Gain is evaluated according to the following formula:

$$Gain = \frac{Rg}{5k\Omega}V/V$$

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The gain resistor must be chosen such that the max output voltage does not exceed the LMP8645 max output voltage rating for a given common mode voltage (further details in the Datasheet).

SINGLE OUTPUT

In the applications where a single measurement of a bidirectional current sense is needed is possible to populate the evaluation board with two amplifiers and some resistors (see section COMPONENTS).

For instance in the following configuration:

 $R1 = R2 = R3 = R4 = 10k\Omega$,

 $R5 = R6 = 10k\Omega$

OUT = Vref +(OUT+ -OUT-)

Vref = 0.5*Vcc_Amp.

The Vref level represents the zero level; the voltages greater than Vref are related to a current which flows from IN pin to LOAD pin while the voltages less than Vref are related to a current which flows from LOAD pin to IN pin. To ensure good results in the measurements the resistors R4 and R3 and the resistors R1 and R2 need to be well matched.

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Schematic

This schematic shows the evaluation board with a LMP8645 mounted on the PCB. For the version of the PCB stuffed with LMP8640 the only difference will be the gain resistors RG1, RG2. The LMP8640 is a current sense with fixed gain, so it doesn't require any external gain resistor.

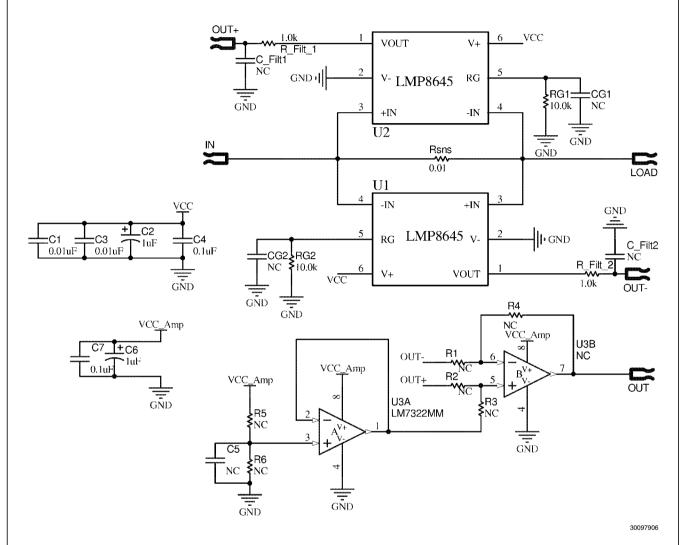


FIGURE 2. Schematic Diagram

Layout

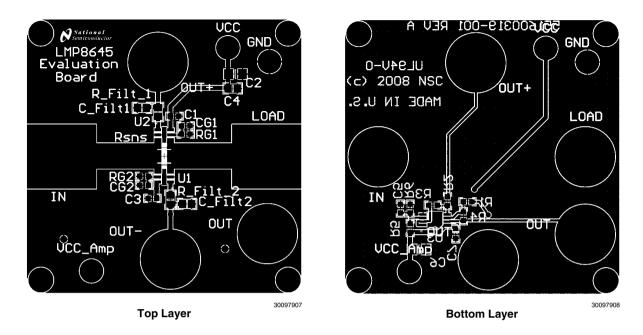


FIGURE 3. PCB Layout

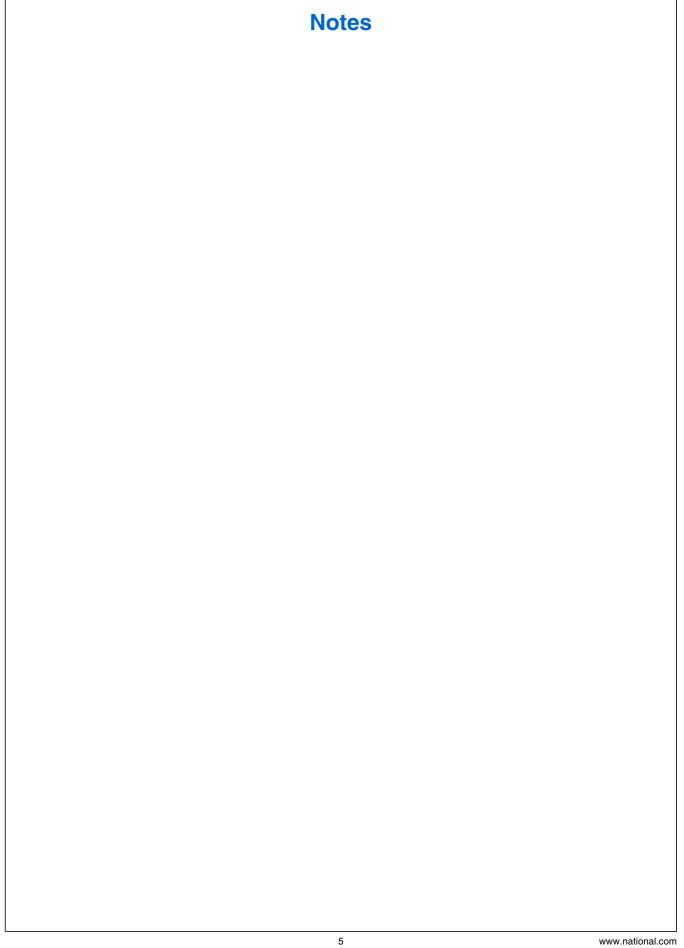
Bill Of Material

Components marked with (*) are not soldered on the board.

Components marked with (**) are soldered only on LMP8645 board.

Designator	Component	Value	Tolerance	Package type
C1, C3	Capacitor	0.01µF	5%	0603
C2, C6*	Capacitor	1µF	10%	3216–18
C4	Capacitor	0.1µF	10%	0805
C5*, C7	Capacitor	0.1µF	10%	0603
C_Filt1*, C_Filt2*	Capacitor			0805
CG1*, CG2*	Capacitor			0805
R1*, R2*, R3*, R4*, R5*, R6*	Resistor	min 10kΩ	1%	0603
RG1**, RG2**	Resistor	10.0kΩ	1%	0603
Rsns**	Resistor	0.01Ω	1%, 1W	2010
Rsns	Resistor	0.01Ω	0.1%, 1W	2512
R_Filt_1, R_Filt2	Resistor		5%	0805
U3*	Dual Op Amp			MSOP-8

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