AN-1940 LMP8601 Evaluation Board

1 Introduction

The LMP8601 current sense evaluation board is designed to evaluate the LMP8601, 60 V common mode, bidirectional precision current sensing amplifier. This board has a LMP8601 part mounted on the printed circuit board (PCB) together with the required de-coupling capacitor, power supply connections, input and output (I/O) connectors and a 3-pin header for connecting the offset pin to either GND or V_S.

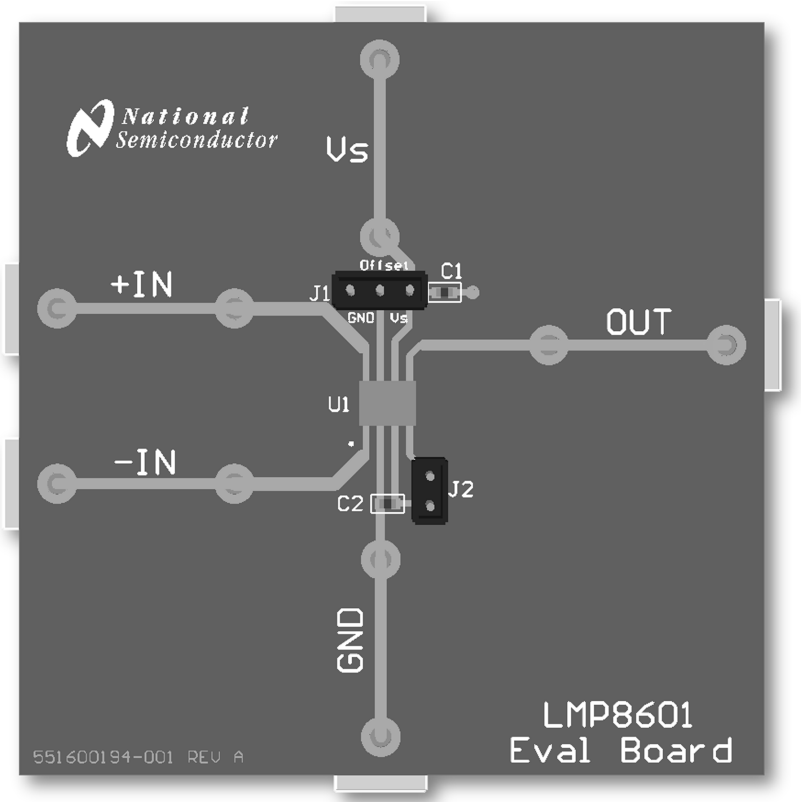


Figure 1. The LMP8601 Evaluation Board

2 General Description

The LMP8601 and LMP8601Q are fixed 20x gain precision amplifiers. The part amplifies and filters small differential signals in the presence of high common mode voltages. The input common mode voltage range is −22 V to +60 V when operating from a single 5 V supply. With 3.3 V supply, the input common mode voltage range is from −4 V to +27 V. The LMP8601 and LMP8601Q are members of the Linear Monolitic Precision (LMP™) family and are ideal parts for unidirectional and bidirectional current sensing applications. All parameter values of the parts that are shown in the tables of the *LMP8601, LMP8601-Q1 60-V Common-Mode Bidirectional Precision Current Sensing Amplifier Data Sheet* (SNOSAR2) are 100% tested and all bold values are also 100% tested over temperature.

The part has a precise gain of 20x, which is adequate in most targeted applications to drive an ADC to its full scale value. The fixed gain is achieved in two separate stages, a pre-amplifier with a gain of 10x and an output stage buffer amplifier with a gain of 2x. The connection between the two stages of the signal path is brought out on two pins to enable the possibility to create an additional filter network around the output buffer amplifier. These pins can also be used for alternative configurations with different gain as described in the *Applications Information* section of the *LMP8601, LMP8601-Q1 60-V Common-Mode Bidirectional Precision Current Sensing Amplifier Data Sheet* (SNOSAR2).

The mid-rail offset adjustment pin enables you to use these devices for bidirectional single supply voltage current sensing. The output signal is bidirectional and mid-rail referenced when this pin is connected to the positive supply rail. With the offset pin connected to ground, the output signal is unidirectional and ground-referenced.

The LMP8601Q incorporates enhanced manufacturing and support processes for the automotive market, including defect detection methodologies. Reliability qualification is compliant with the requirements and temperature grades defined in the AEC Q100 standard.

3 LMP8601 Operating Conditions

- Temperature Range −40°C to 125°C
- Power Supply Voltage 3.0 V ≤ V_S ≤ 5.5 V
- CMVR at V_S = 3.3 V −4 V to 27 V
- CMVR at V_S = 5.0 V −22 V to 60 V

4 Description of the LMP8601 Evaluation Board

The LMP8601 evaluation board requires a power supply with a voltage between 3.0 V and 5.5 V, the supply current will be <2 mA in normal operation with high-impedance load on the output of the part. The positive supply voltage is connected to V_S (P5). The negative supply voltage is connected to GND (P6).

The offset voltage on the output of the LMP8601 is determined by the voltage on the offset pin, which is connected to pin2 of J1 and the offset voltage will be V_{Offset}/2. This pin is normally connected with a jumper to GND or V_S, but this pin can also be driven from a low impedance source (<10 Ω).

With a jumper on J1 between 1–2, the offset pin is connected to V_S and the offset voltage is half the value of V_S. In this configuration, the LMP8601 can be used for measuring bidirectional currents.

With a jumper on J1 between 2–3, the offset pin is connected to GND and the output voltage is ground referenced. In this configuration, the LMP8601 is used for measuring unidirectional currents.

The input signal is connected between +IN (P1) and −IN (P2) and the output signal is available at OUT (P3).

On the board there is the possibility to place a capacitor C2 that creates a low-pass filter between the first and second stage. This can be used to reduce the output noise and glitches that might appear from switching large common mode voltages with very fast transients at the input. (For more details about this filter, see the *Application Information* section of the *LMP8601, LMP8601-Q1 60-V Common-Mode Bidirectional Precision Current Sensing Amplifier Data Sheet* (SNOSAR2).

The Header J2 is normally shorted with a jumper and connects the first stage to the second stage. The *Application Information* section of the *LMP8601, LMP8601-Q1 60-V Common-Mode Bidirectional Precision Current Sensing Amplifier Data Sheet* (SNOSAR2) explains more about the alternative configurations that can be made after removing the jumper on J2.

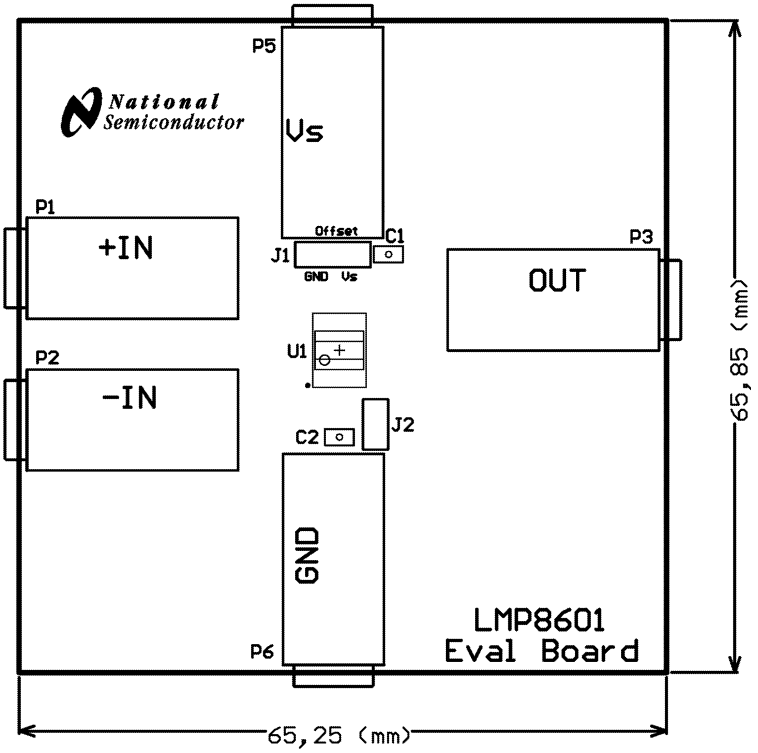


Figure 2. Power Supply Connectors and Headers

5 PCB Layout Guidelines

This section provides general practical guidelines for PCB layouts that use various power and ground traces. Designers should note that these are only "rule-of-thumb" recommendations and the actual results are predicated on the final layout.

5.1 Differential Signals

The two input pins of the LMP8601 form a differential pair that must be handled following the rules given below.

- Keep both signals coupled by routing them closely together and keeping them of equal length.
- Do not allow any other signal in between these two signals of the differential pair.
- Keep all impedances in both traces of the signal equal.

5.2 Power, Ground and De-Coupling

Keep the power supply de-coupling capacitor close to the power supply pin (V_S of the part.)

Make sure all return currents of the signals can flow next to the originating signals

6 Description of Headers and Connectors of the LMP8601 Evaluation Board

The LMP8601 evaluation board provides the following headers and connectors for connecting test equipment and supplying the LMP8601 part.

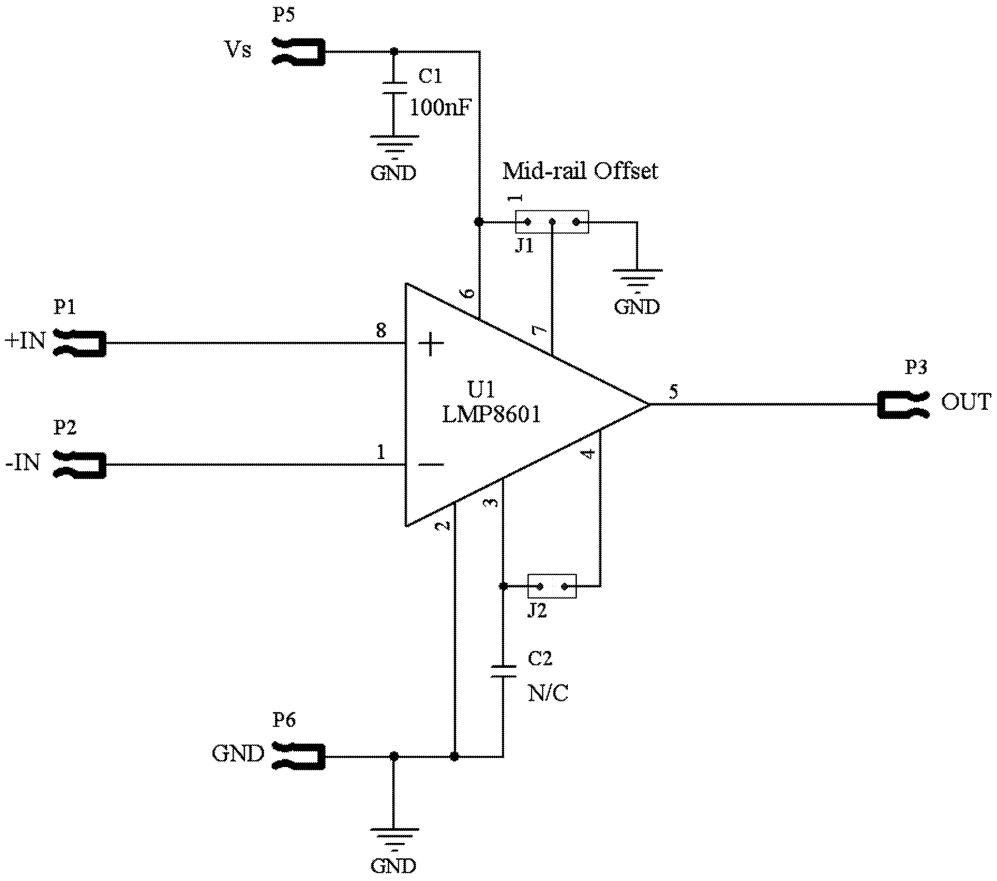
7 Connector and Header Functions

Designator	Function or Use	Comment
J1	Offset selection	1–2 Mid rail offset (Bi-directional)2–3 Ground Referenced (unidirectional)
J2 the second stage	Short to connect first stager output to output amplifier input	Normally shorted
P1	Positive Input	
P2	Negative Input	
P3	Output	
P5	supply V_S	
P6	ground connection (GND)	

8 Bill of Materials (BOM)

Designator	Component	Value	Tolerance	Comment	Package Type
C1	Capacitor	100 nF			0603
C2	Capacitor	N/A			0603
J1	Header 2 pin			Mid-rail Offset	
J2	Header 2 pin				
P1	Banana plug	YELLOW		+IN	Banana_COLOR
P2	Banana plug	WHITE		−IN	Banana_COLOR
P3	Banana plug	BLUE		OUT	Banana_COLOR
P5	Banana plug	RED		V_S	Banana_COLOR
P7	Banana plug	BLACK		GND	Banana_COLOR
U1	LMP8601	LMP8601			SOIC

Appendix A Schematic



Appendix B Layout

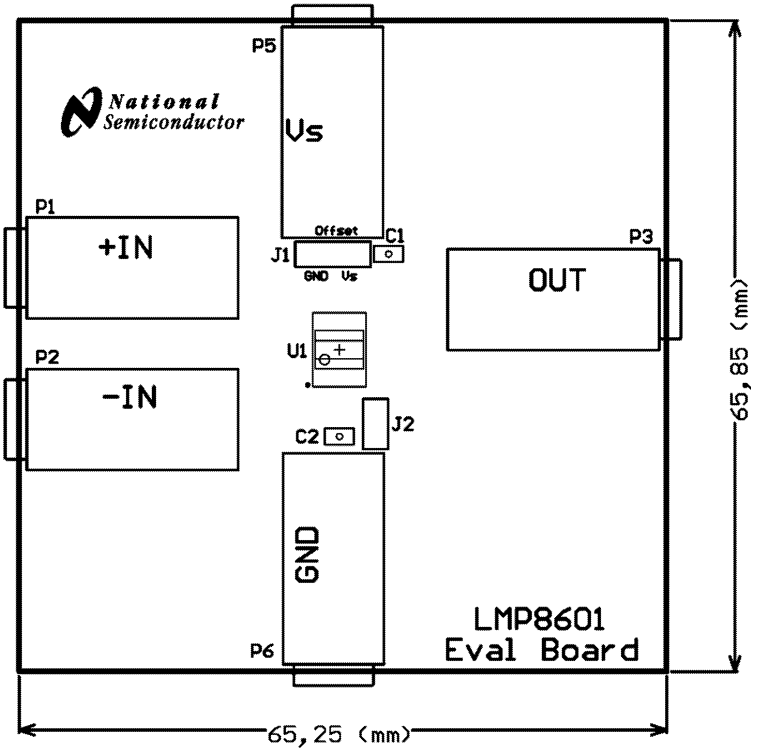


Figure 3. Layout, Silk Screen

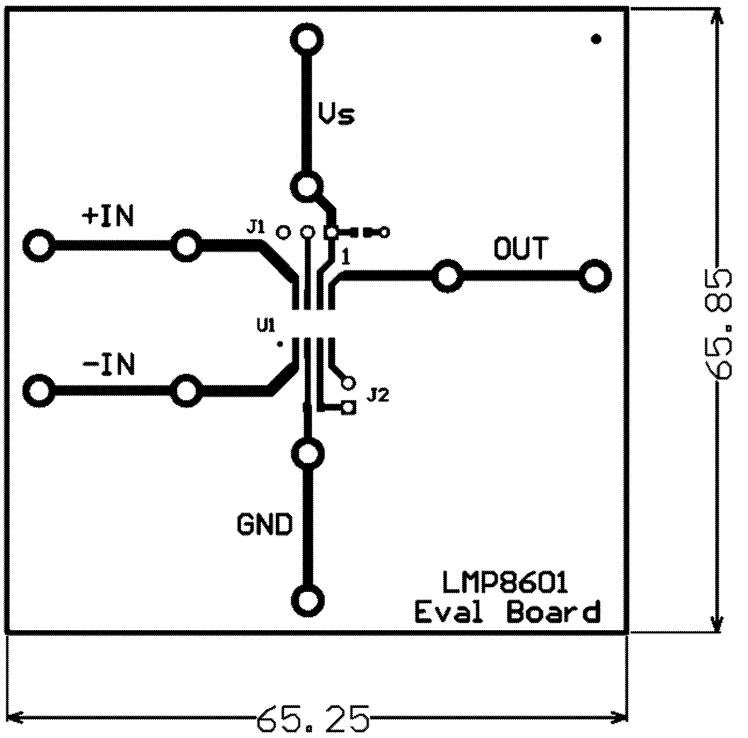


Figure 4. Layout, Top Layer

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