



# QPO-1-EVAL3

## QPO-1 Evaluation Board, Micro Foot Print DC-DC Converters

### Description

The QPO-1-EVAL3 is designed to allow full testing of the QPO-1 and its various performance settings to optimize final system design. The board offers switch settings for the user to select preset values for the Rhr, Rsc, and Rsa resistors. Solder pads are available to mount user-selected values of these components if required. Please refer to the QPO-1 product data sheet, and the following pages for the proper application of this board. The EVAL3 accommodates Vicor's quarter brick DC-DC converters with an input up to 72 Vdc.

The QPO-1 output ripple attenuator SiP uses active filtering to reduce output ripple and noise (PARD) over 20 dB from 50 Hz to 500 kHz. The QPO-1 operates over a voltage range from 3 to 30 Vdc and supports load currents as high as 10A. Output regulation is maintained with remote sense or trim adjustment of the power supply. The closed loop architecture improves transient response and ensures precise point-of-load regulation.

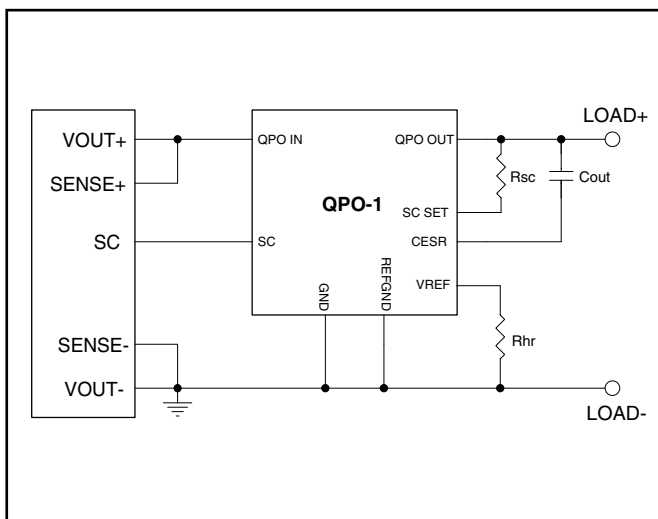
Other eval boards (see part numbering description) allow easy evaluation with other DC-DC converters or power supplies with standard terminations.

### Features of the QPO-1

- >30 dB PARD attenuation, 1 kHz to 500 kHz
- >20 dB PARD attenuation, 50 Hz to 500 Hz <sup>1</sup>
- 10A rating over a 3-30 Vdc operating range
- Supports precise point-of load regulation
- Up to 99% efficiency with power limit protection
- User selectable optimization of attenuation, power dissipation & transient load response
- Peak detector function optimizes for ripple amplitude variation automatically
- 1.0 x 1.0 x 0.2" SiP with BGA or LGA mounting
- Improves transient response of most DC-DC converters and power supplies
- Reduces required number of output capacitors to support dynamic loads.
- Patents Pending

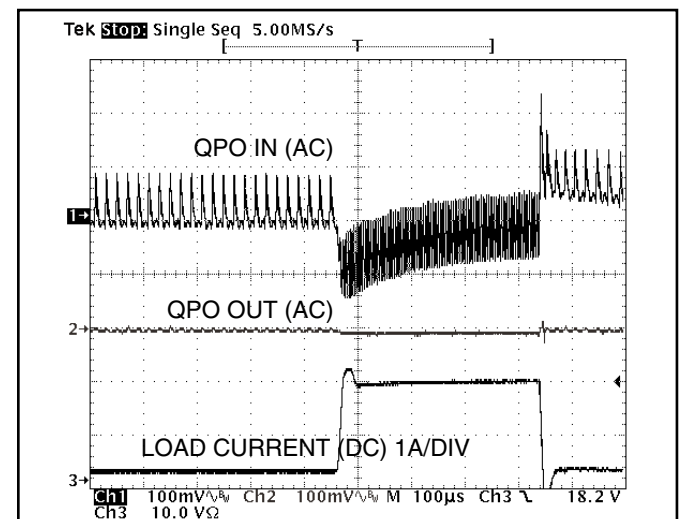
*Note 1: For off-line supplies 20dB attenuation can be achieved down to 50Hz with additional capacitance added from the VREF pin to the REFGND pin.*

### Typical Application



**Figure 1** – SC/Trim supports applications that don't require remote sense.

### QPO-1 Performance



**Figure 2** – Typical performance with a 3.3 Volt converter.

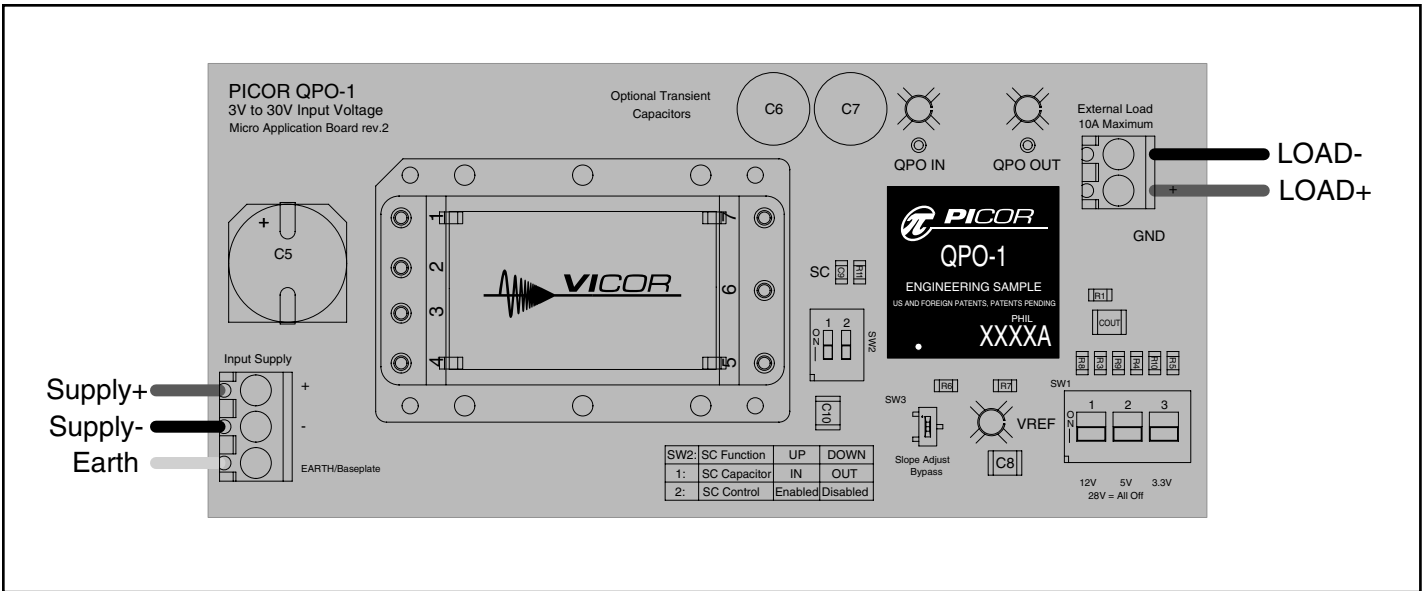


Figure 3 - EVAL3 Board layout and measurement locations.

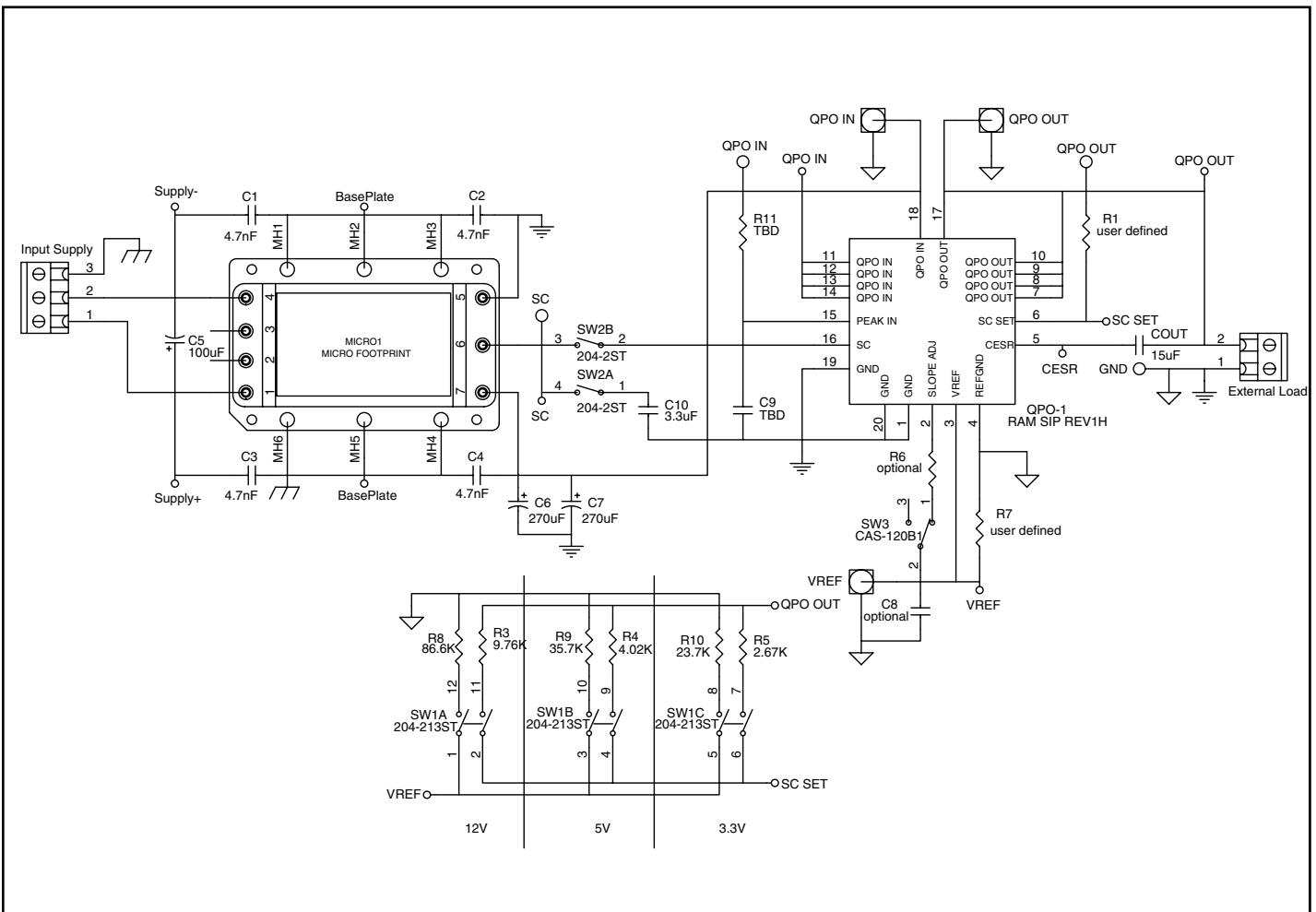


Figure 4 - Schematic of EVAL3

## Switch Tables

The **QPO-EVAL3** board has been designed to accommodate a wide range of output voltages from a micro footprint DC-DC converter.

Switch 1 (SW1 in the lower-right corner of the pc board) is used to set the appropriate headroom voltage and SC current for converters with 12V, 5V or 3.3 Vdc outputs. Optimal headroom and SC current settings are pre-defined and the appropriate components are populated on the board.

The board EVAL3 will also accommodate user defined output voltages. With all SW1 switches in the "down" position (open circuit), the switch settings allow access to the open pads for R1 and R7. The user must calculate a value for headroom voltage setting resistor (R7) and the SC current setting resistor (R1) and populate the pads with the selected components. Originally, this position was designed to be used with a 28V converter, hence the reference to "28V - ALL OFF" on the pc board.

With the first switch of **SW1** in the "up" position, and the rest in the "down" position, the headroom voltage and SC current setting is adjusted to work with a 12V converter. With the second switch of **SW1** in the "up" position, the rest "down", the converter is set to work with a 5V converter. With the third switch "up", the rest "down", the board is set to work with a 3.3V converter. This switching network will parallel the switched in resistors with R7 and R1. If a predefined voltage is to be used, R7 and R1 should not be populated. At no time should more than one switch be in the "up" position to get accurate results.

**SW2** is used to engage the SC control function and to add an additional bypass capacitor to the SC pin of the converter. With the first switch of SW2 in the "up" position, a 3.3uF capacitor (C10) is added to the SC pin of the converter. With the second switch of SW2 in the "up" position, the SC control circuit of the QPO is connected to the converter. When the switches are in the "down" position, the capacitor and SC connection are opened and out of the circuit.

**SW3** is used to engage the optional Slope Adjust resistor when in the "up" position.

## Instructions For Use

The terminal block in the lower left-hand corner of the pc board (labeled "Input Supply") is used to provide the input voltage to the DC-DC converter. The output load should be connected to the terminal block on the right, labeled "External Load" and should not exceed 10 Amps.

The QPO application board has Johnson Jacks mounted on three key measurement points. These jacks greatly reduce the amount of radiated noise that gets picked up by the ground clip leads of the scope probes. **QPO IN** is the input to the QPO from the DC-DC converter. **QPO OUT** is the output of the QPO where effects of the various settings can be analyzed. **VREF** is the reference voltage that the QPO uses to maintain a desired output voltage. A resistor from this pin to ground will determine the QPO's operating headroom voltage (the voltage drop between **QPO IN** and **QPO OUT**) according to the following equation:

$$R_{hr} = \frac{QPO_{out}}{V_{hr}} * 2.5k\Omega$$

where;

$R_{hr}$  is headroom resistor value,  
 $QPO_{out}$  is the voltage seen on the QPO's output,  
 $V_{hr}$  is the target headroom voltage.

The  $R_{sc}$  resistor is tied between QPOOUT and SC SET pin and sets the correction current used to trim up the converter to maintain a constant output voltage on the QPO's output. The value for the SC SET resistor is calculated by the following equation:

$$R_{sc} = \frac{R_{in} * V_{out}}{V_{rpt}}$$

where;

$R_{sc}$  is SC SET resistor value,  
 $R_{in}$  is the input resistance of the SC or TRIM,  
 $V_{out}$  is the source output voltage,  
 $V_{rpt}$  is the pre-trimmed reference of the SC or TRIM.

On the application board there are two spots for additional capacitors (C6 and C7) to be added to the QPO's input. These might be required if higher transient steps are needed from higher output voltage converters. These converters typically have lower output capacitance than lower output voltage converters do.

R11 and C9 are used for filtering the input to the QPO's peak detector input. The QPO's peak detector circuit will increase the headroom of the QPO by roughly half of the peak-to-peak ripple on the QPO's input. At low input voltage, the added headroom might cause the SC circuit to trim up a converter to a point where it shuts down due to an over-voltage fault.

There is a spot for adding an addition capacitor to VREF (C8) if greater attenuation is needed at lower frequencies.

## Ordering Information

Part Number	Description
QPO-1-EVAL3	Evaluation board for QPO-1 for Micro footprint DC-DC Converters

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