QPO-1-EVAL1

QuietPower™

QPO Evaluation Board

Description

The QPO-1-EVAL1 kit is designed to allow full testing of the QPO-1 and the various performance options to optimize a final system design. The board offers two terminal options for vertical or horizontal mounting. **The user must select the required values for the Rhr, Rsc and Rsa resistors and solder them in the designated positions before applying power to the EVAL1.** Please refer to the QPO-1 product data sheet, schematics and the following pages for the proper application of this board.

The QPO-1 output ripple attenuator SiP uses active filtering to reduce output ripple and noise (PARD) over 20 dB from 500 Hz to 500 kHz and can be extended down to 50 Hz with additional capacitance added to the VREF pin. 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 quiet point-of-load regulation when used in conjunction with the power supply's control loop or trim node.

Features QPO-1

- **>30 dB PARD attenuation, 1 kHz to 500 kHz**
- **3-30 Vdc operating range**
- **10A rating**
- **Supports precise point-of load regulation**
- **90-99% efficiency**
- User selectable performance optimization for Attenuation, power dissipation, transient response
- 1.0 x 1.0 x 0.2" SiP
- LGA mounting
- Closed control loop improves transient response of most DC-DC converters and power supplies
- Reduces required number of output capacitors to support dynamic loads.
- Evaluation board includes Johnson Jack for low-noise measurement of QPO performance.

Typical Application

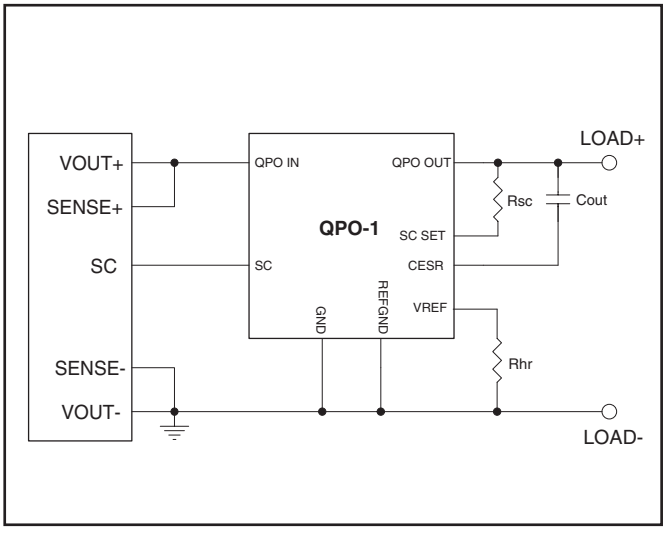


***Figure 1** – SC/Trim supports applications that don't require remote sense.*

QPO-1 Performance

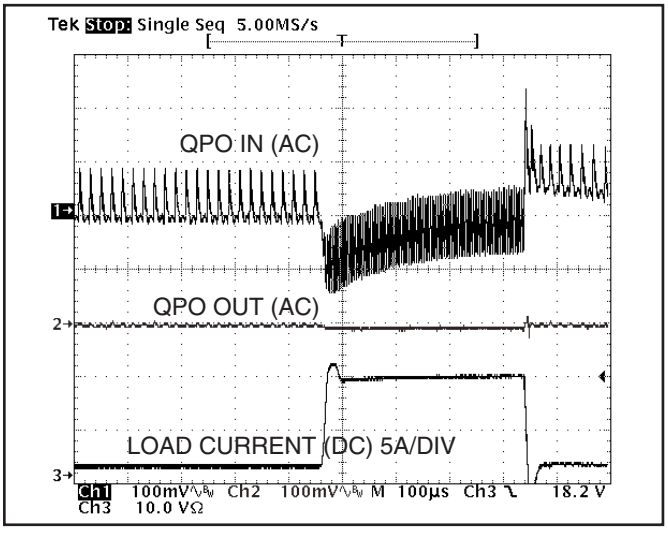
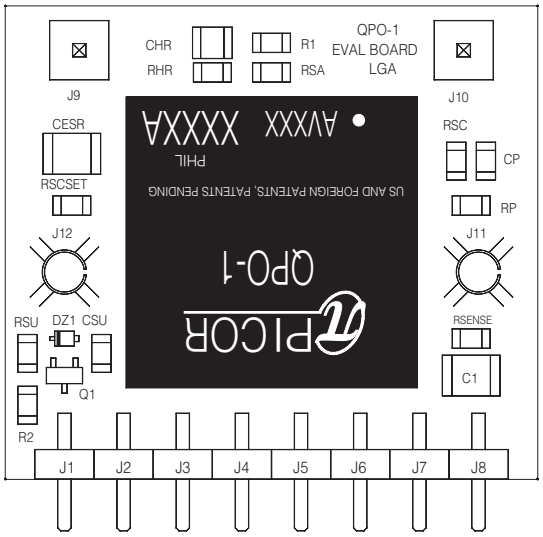


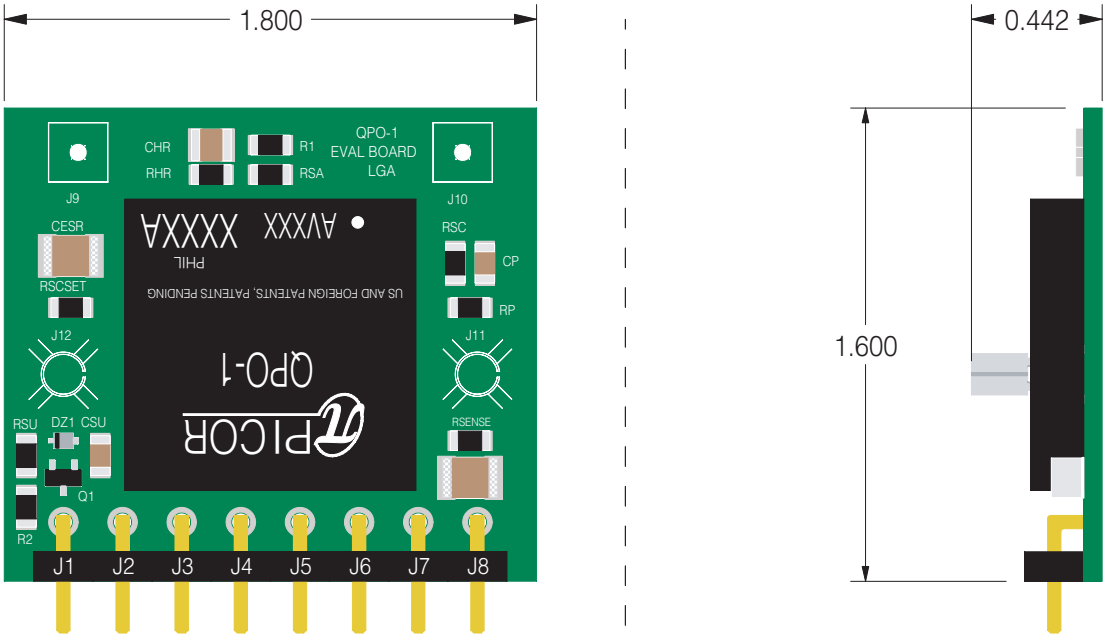
***Figure 2** – Typical performance with a 3.3 Volt converter, showing 1 to 10 A load step.*

PC Board Layout Diagram

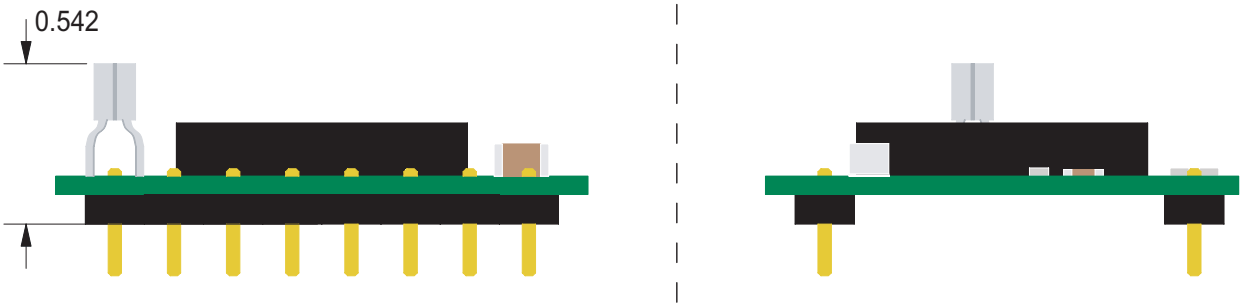


Mounting Options

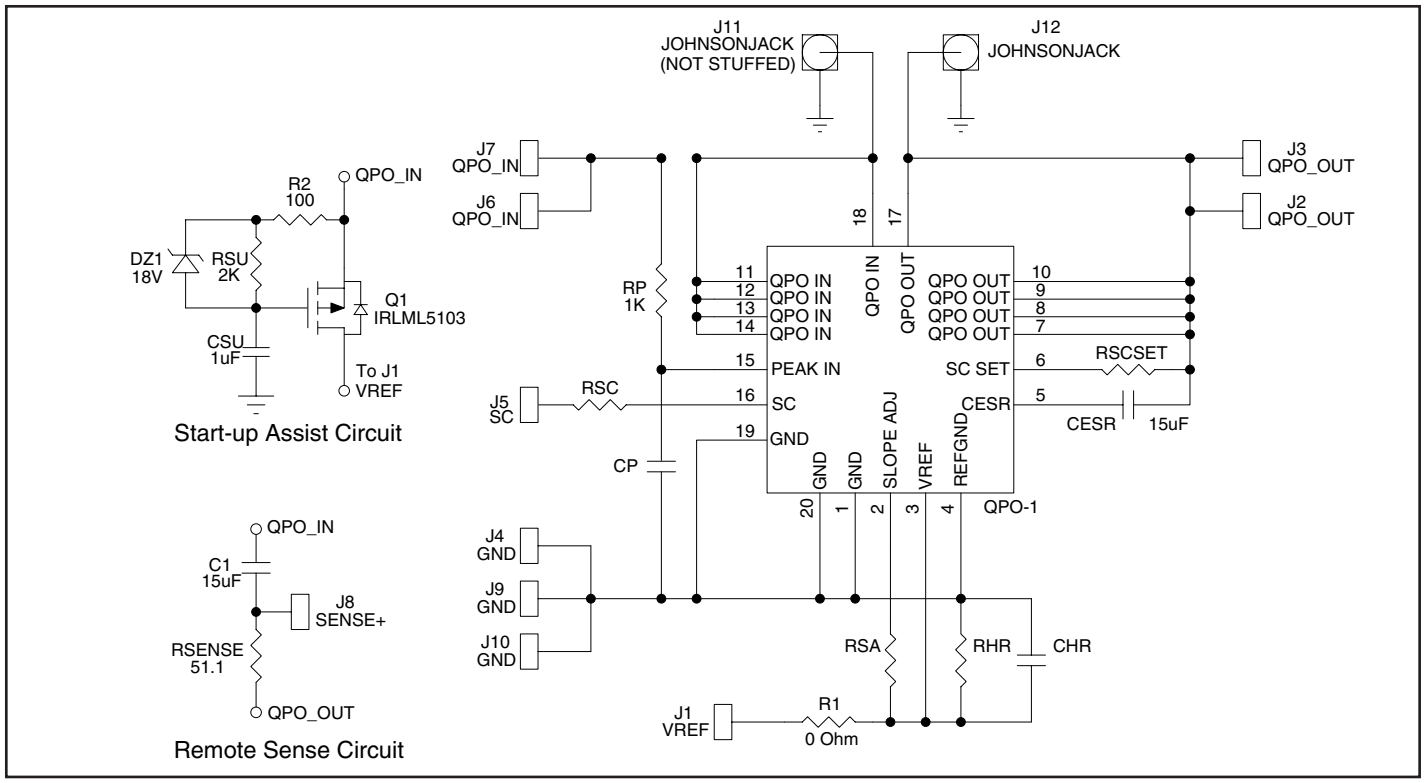
Vertical Mount



Horizontal Mount



Board Circuit Schematic



Instructions for Use

The EVAL1 board has the following components, QPO-1, Cesr=15uF and Rp=1k Ohm already soldered to the PCB as well as the zero-headroom start-up assist circuit shown in the schematic above. The remaining pads are spaced for 1206 chip size components. If these are not available to the user, once values are determined axial component leads can be formed to line up with the pads and hand soldered to the proper pads. Refer to the schematic and mechanical drawing above for the pad locations to connect these components.

Component values can be determined using the formulas below. Refer to the QPO-1 product data sheet for a complete explanation of the features and the parameters set by these component values. First determine the headroom resistor value.

$$Rhr = \frac{QPOout}{Vhr} * 2.5k\Omega$$

where; Rhr = headroom setting resistor value,

QPOout = the expected voltage on the QPO's output,

Vhr = the target headroom voltage determined from the product data sheet.

The RSC 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; RSC is the SC SET resistor value,

RIN is the resistance of the SC or TRIM input of the converter,

VOUT is the desired QPO output voltage,

VRPT is the pre-trimmed reference of the SC or TRIM.

IMPORTANT NOTE: When connecting the Rsc resistor into the EVAL1 board note the pad landing for the Rsc resistor that is adjacent to the VIA hole that also connects to CESR's lower pad. The resistor must be connected/soldered to that VIA hole point to make proper connection to the circuit and not just to the resistor pad landing.

The peak detector function is enabled on the evaluation board. Connecting a 0.1uF capacitor to the CP pads disables the peak detector if not desired for the application. 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. Excessive ripple with low voltage converters could create enough additional headroom to cause the converter's output to increase to the point where an over-voltage fault is created and the converter will shut down. Check the converter's OVP set point and select component values to keep the QPO headroom adjustment from reaching the OVP trip point.

The slope adjust feature can be set to zero providing relatively constant headroom versus load using an Rsa of 100kΩ. To improve efficiency of the filter the slope adjust feature can provide a specific reduction in headroom (slope adjust) over a desired current range. The user can optimize performance based on the expected variation in load current and the desired power dissipation range. The formula below should be used to calculate the Rsa value for the desired headroom slope versus current. If the peak detector is enabled, the peak of the ripple will be added back to the headroom at a given load condition.

$$R_{SA} = 0.05(V/A) * \frac{\Delta Iout}{\Delta Vhr} * 2.5k\Omega$$

where:

ΔIout = Maximum load current change

ΔVhr= Change in headroom desired over the load range

Rsa= Slope adjust resistor value

Typical standard 1% values for the Rhr and Rsc resistors and the listed voltages

QPOout Voltage	Headroom Voltage	Rhr Value	Rsc Value[1]
3.3V	375mV	22k	2.67k
5.0V	375mV	33.2k	4.02k
12.0V	375mV	80.6k	9.76k
15.0V	375mV	100k	12.1k
24.0V	375mV	160k	19.6k
28.0V	375mV	187k	22.6k

Note1: These Rsc values are for a converter with a 1.23 Volt pre-trimmed reference and 1k Ohm input resistance on the SC/Trim.

Typical Value For Rsa Resistor and Typical Voltages

QPOout Voltage	Headroom Voltage Change (Slope=ΔV)	Rsa Value	Load Current Change
3.3V	150mV	8.25k	10 A
5.0V	150mV	8.25k	10 A
12.0V	150mV	8.25k	10 A
15.0V	150mV	8.25k	10 A
24.0V	150mV	8.25k	10 A
28.0V	150mV	8.25k	10 A

Ordering Information

Part Number	Description
QPO-1 EVAL1	Evaluation board for QPO-1

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