TPS61040 Inverter Design

Jeff Falin *HPA Portable Power*

ABSTRACT

Although designed to be a positive voltage boost converter, the TPS61040 can be configured as an inverting converter using an OPA348 operational amplifier or equivalent to invert the feedback signal.

Although designed to be a positive voltage boost converter, the TPS61040 can be configured as an inverting converter. The application section of the TPS61040 data sheet (Figure 19) shows an implementation using a discrete charge pump to produce a positive voltage rail and an auxiliary negative rail with the same magnitude as the positive rail. However, the negative rail produced by the charge pump is outside of the control loop, so its load regulation is dependent on the positive rail's regulation. This type of tracking regulation is acceptable when dual rail ICs require approximately the same amount of current into/out of each rail. Using an OPA348 operational amplifier or equivalent, this configuration is modified to provide a negative rail and an optional auxiliary positive rail, as shown in Figure 1. Depending on the operational amplifier's operating voltage, the auxiliary positive rail could be used to power the operational amplifier. The operational amplifier inverts the feedback signal so that it can be tied to the FB pin of the TPS61040. Resistors R3 and R1 are sized to give the operational amplifier an inverting gain that converts the negative rail voltage to 1.233 V. Capacitor C2 is required to stabilize the operational amplifier. Resistor R2 is used to prevent a large current spike through the IC's switch when D3 turns on.

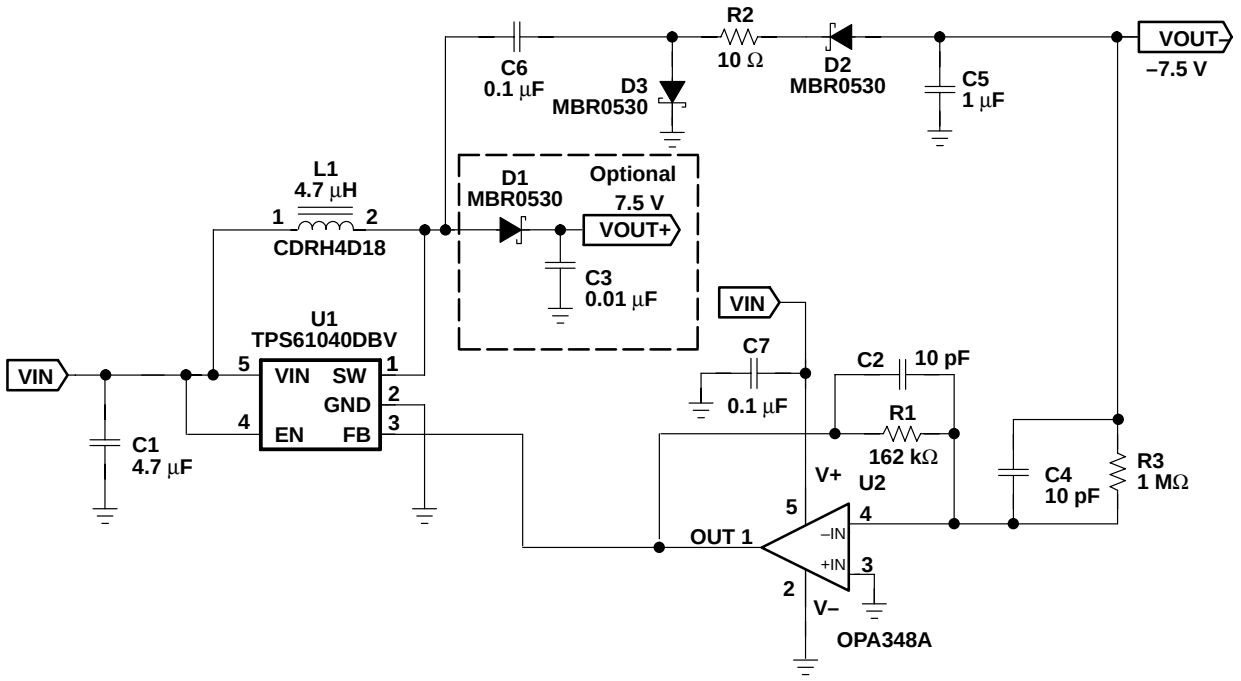

Figure 1. Charge Pump Inverter

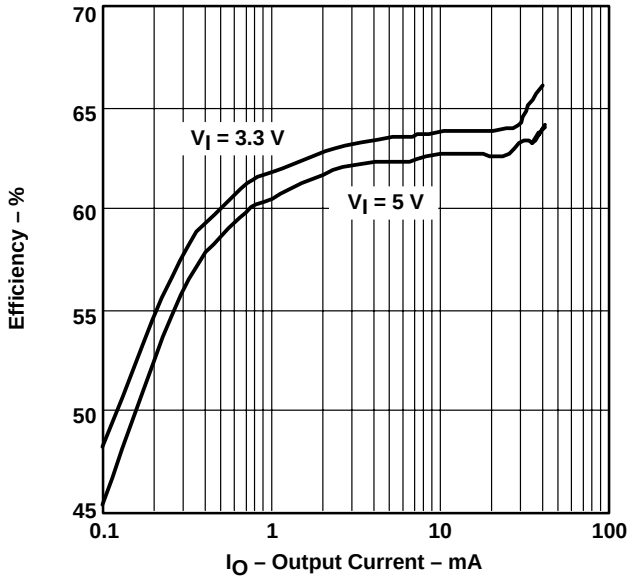

Figure 2. Efficiency for TPS61040 Charge Pump Inverter Using CDRH4D18-4R7

Assuming 65% efficiency for the charge pump design, the TPS61040 data sheet equation for computing maximum load (shown below) predicts maximum load currents of 54 mA and 81 mA for V_{IN} = 3.3 V and V_{IN} = 5.0 V, respectively. The measured load currents at the point where the design enters continuous conduction mode are 50 mA and 75 mA.

$$I_{LMAX} = \eta \times \frac{V_{INmin} \times I_P}{2 \times \left(V_O + V_{DIODE}\right)}$$

where η is the estimated efficiency.

Load transient results with V_{IN} = 5.0 V and I_{OUT} transitioning from 1 mA to 25 mA are shown in Figure 3.

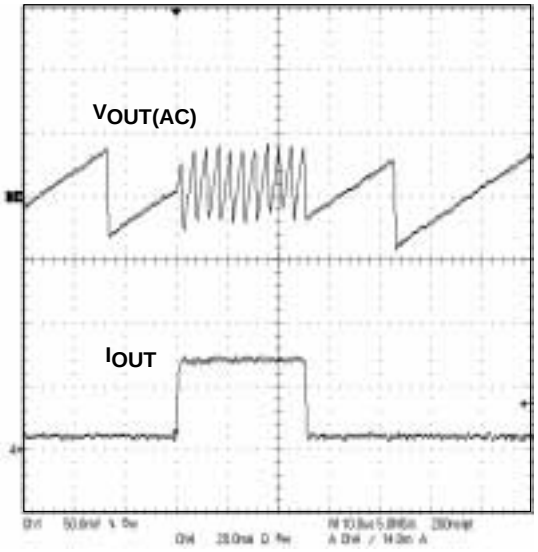

Figure 3. Load Transient Response of the TPS61040 Charge Pump Inverter

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265