

## ***Buck-Boost Converter Boasts Low $I_Q$ And Supercapacitor Charging***

[Texas Instruments'](#) TPS61094 bidirectional buck-boost converter features an ultra-low quiescent current ( $I_Q$ ) of 60 nA, which is said to be one-third that of competing boost converters. The integration of a buck mode for supercapacitor charging in combination with the ultra-low  $I_Q$  is notable. According to the vendor this capability enables engineers to extend battery life by as much as 20% when compared to designs using commonly used hybrid-layer capacitors (HLCs).

Supercapacitor charging and discharging helps support peak loads and backup power, which are important for continuous operation in battery-powered industrial applications such as smart meters, smoke detectors and video doorbells, as well as medical applications. Today's lithium thionyl chloride (Li/SOCl<sub>2</sub>) battery-based designs often manage peak loads with HLCs that are expensive, and not optimal for controlling charge current.

The TPS61094's combined low  $I_Q$  and supercapacitor charging and discharging enable engineers to replace HLCs with less-expensive supercapacitors for peak load support and to extend battery life as much as 20% in applications that must run on a single battery for 10 years or more. The TPS61094 also provides backup power in applications that require safe power-down or last-gasp communication during a power outage.

The buck-boost converter has a 2-A inductor current limit in boost operation, which is said to be twice that of competitive boost converters. The additional output current enables the TPS61094 to support radio standards such as narrowband Internet of Things (NB-IoT), LTE-M, Wi-SUN, MIOTY, Bluetooth and wireless M-Bus over a wider input voltage range. As an example, the TPS61094 can support more than 250 mA of output current down to an input voltage of 0.7 V.

Typical industrial applications such as smart meters require several power components for backup power features or peak load support. Integrating a buck charger and a boost converter into a single IC removes the need for a discrete buck charger, inductor and two external capacitors, which can reduce component count by 50% and free up board space. Additionally, the integration of the buck charger and boost converter in the TPS61094 allows design engineers to easily control the handshake between all functions, delivering a more seamless transition between operating modes.

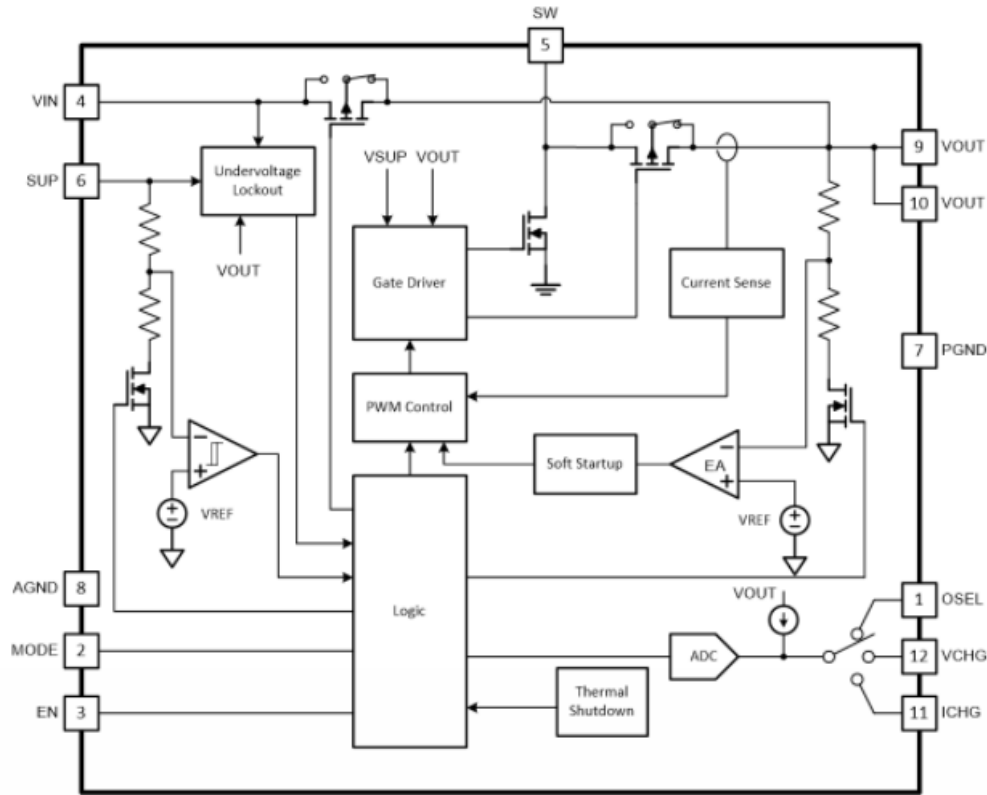
The TPS61094 can operate with a wide input voltage from 0.7 V to 5.5 V and generate output voltage from 2.7 V to 5.4 V. The TPS61094 has four operating modes selected via the EN and MODE pins: auto buck or boost mode, forced buck mode, forced bypass mode, and true shutdown mode.

In auto buck or boost mode, the TPS61094 can automatically transition between buck charging mode and boost mode based on the input voltage. When the input voltage is lower than the setting boost regulation voltage, the TPS61094 generates a regulation voltage from the low input voltage of a supercap or a battery. When the input voltage is 0.1 V higher than the setting boost regulation voltage, the output voltage of the TPS61094 equals the input voltage. Meanwhile, the TPS61094 charges the backup supercap by buck mode.

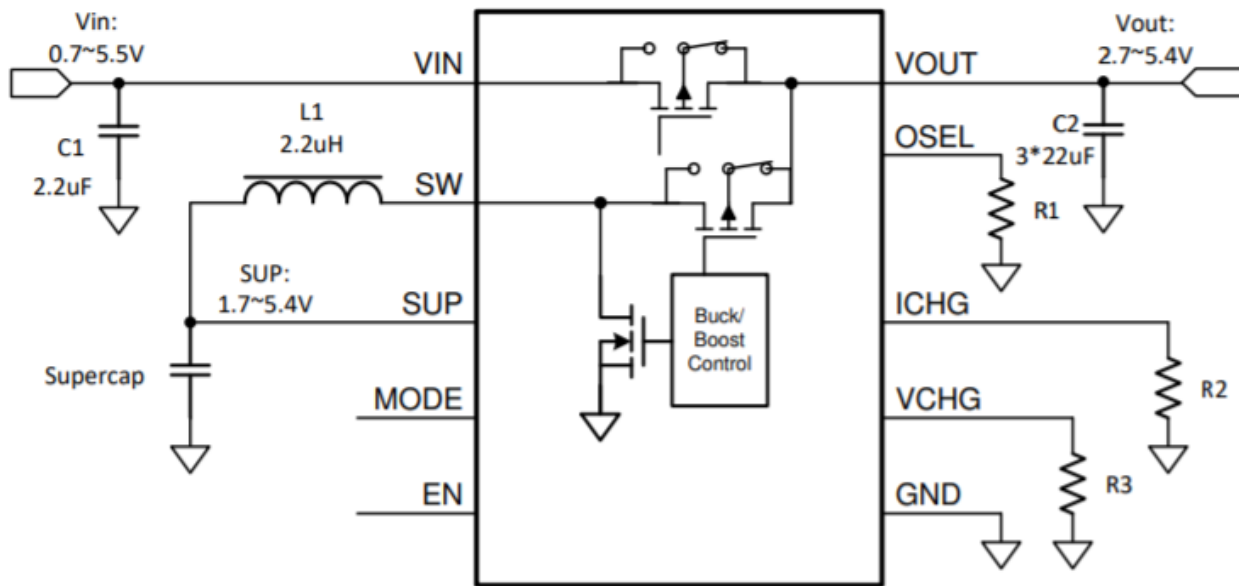
When the TPS61094 works in forced buck mode, the TPS61094 connects the output of the device directly to the input while the buck converter outputs a setting constant current charging a backup supercap. When the supercap is charged to a pre-set termination voltage, the buck converter stops charging. When the supercap voltage drops 75 mV below the setting voltage, the buck converter starts charging the supercap again.

In forced bypass mode, the TPS61094 turns on the bypass MOSFET, thus the output voltage equals to input voltage. The TPS61094 has approximately 4-nA  $I_Q$  in this mode. In true shutdown mode, the TPS61094 can disconnect the load from the input and SUP pin.

The TPS61094 is now available through TI and authorized distributors in a 2.0-mm-by-3.0-mm, 12-pin WSON package and is priced at \$1.20 in 1,000-unit quantities. The TPS61094EVM-066 evaluation module is available on TI.com for \$99. For more information see the TPS61094 [page](#) and the TPS61094EVM-066 [page](#).



(a)



(b)

Figure. The TPS61094 is a synchronous bidirectional buck-boost converter with bypass switch. The device provides a power supply solution for smart meter and supercapacitor backup power applications. Its 60-nA quiescent current at 150°C (in boost mode or buck charging mode) is said to be one third of competing boost converters. An internal block diagram (a) and application diagram (b) are shown here.