

## ***Buck-Boost Controllers Deliver True Bidirectional Power Conversion For Industrial Battery-Powered Applications***

[Renesas Electronics'](#) ISL81601 and ISL81401 are members of a new family of bidirectional four-switch synchronous buck-boost controllers. The ISL81601 and ISL81401 are said to be the industry's only true bidirectional controllers that sense peak current at both ends and provide cycle-by-cycle current limit in both directions while in buck or boost mode. The controllers generate point-of-load (POL) and voltage rail conversions with peak efficiency up to 99% (see Fig 1).

The ISL81601 has a wide input range of 4.5 V to 60 V and produces a 0.8-V to 60-V output to support most industrial batteries including 12 V, 24 V, 36 V and 48 V. The ISL81401 is a version with narrower input and output ranges—4.5-V to 40-V input and 0.8-V to 40-V output version. This device also has a unidirectional counterpart, the ISL81401A. The new controllers are well suited for dc power backup and battery-powered medical, industrial and telecommunication systems.

The ISL81601 and ISL81401's bidirectional peak current sensing capability eliminates complex external circuitry required for charging and discharging a battery to supply power to the loads. Their proprietary algorithm provides smooth mode transitions between buck, boost and buck-boost, while reducing low frequency ripple at Vout, ensuring minimal disturbances during line or load transients. The algorithm also ensures predictable ripple voltage under all conditions.

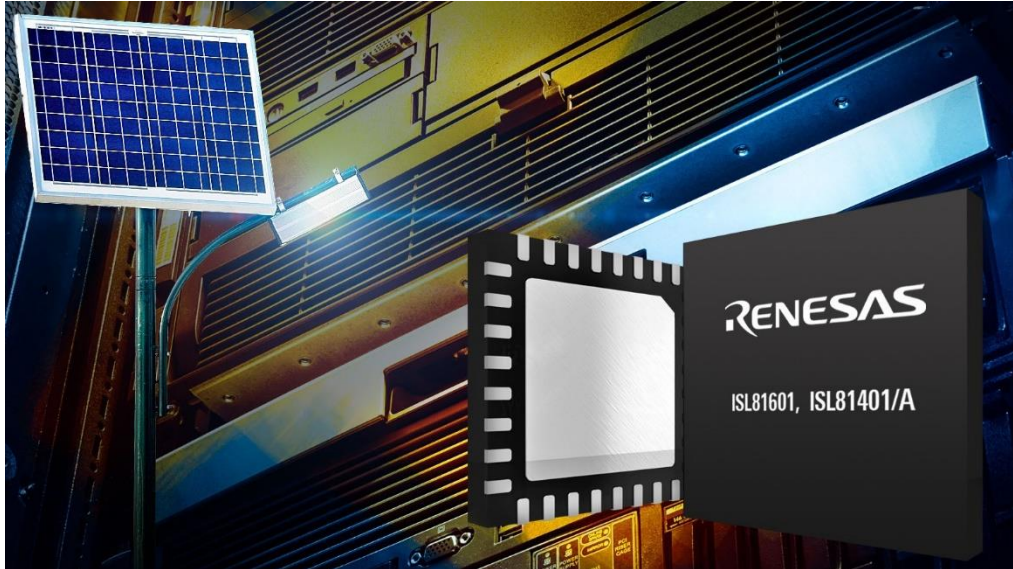
The addition of multilayer overcurrent protection and a precision control algorithm delivers constant current down to 0.1 V at Vout for reliable operation. Designers can easily expand system power by paralleling an unlimited number of controllers. The ISL81601 and ISL81401 operate two switches at a time to minimize power loss and achieve higher efficiency. For more features, see the table.

"Our new bidirectional buck-boost controllers eliminate extra sensing circuitry and offer customers a robust feature-set that maintains battery health and superior power utilization," said Philip Chesley, vice president of Renesas' Industrial Analog and Power Business Division (see Fig. 2). "Leveraging Renesas' proprietary modulation scheme and algorithms allows the highly integrated ISL81601, ISL81401 and ISL81401A to achieve the high reliability performance required for battery-powered equipment."

The ISL81601 and ISL81401/A can be combined with a Renesas RL78 microcontroller (MCU), or other MCUs, to program the voltages, battery charge/discharge function, and on-the-fly bidirectional power flow. Designers can also use the PowerCompass tool to help them quickly identify other power supply parts that match their specific system requirements. Multiple power rails can be set up and designers can perform high-level system analysis and generate custom reference design files in minutes.

All three controllers and evaluation boards are available now from Renesas Electronics' worldwide distributors. The ISL81601 bidirectional 60-V synchronous buck-boost controller is available in a 38-lead HTSSOP package priced at \$3.99, and a 32-lead QFN package priced at \$3.69, both in 1000-piece quantities. For more information, visit the ISL81601 [product page](#).

The ISL81401 bidirectional and ISL81401A unidirectional synchronous 40-V buck-boost controllers are available in 32-lead QFN packages. The ISL81401 is priced at \$2.79, and the ISL81401A is priced at \$2.29, both in 1000-piece quantities. For more information, visit the ISL81401 [product page](#) and the ISL81401A [product page](#).



*Fig. 1. The ISL81601 and ISL81401 are described as the industry's only true bidirectional controllers that sense peak current at both ends and provide cycle-by-cycle current limit in both directions while in buck or boost mode. Leveraging the company's modulation scheme and algorithms, these controllers achieve the high reliability needed for dc power backup and battery-powered medical, industrial and telecommunication systems.*

Table. Key features of the ISL81601, ISL81401 and ISL81401A synchronous buck-boost controllers.

<ul style="list-style-type: none"> <li>● Single-inductor four-switch buck-boost controllers</li> </ul>
<ul style="list-style-type: none"> <li>● Bidirectional operation (ISL81601 &amp; ISL81401) with four feedback control loops                             <ul style="list-style-type: none"> <li>○ Independent voltage and current feedback loop control</li> <li>○ Constant current/constant voltage profile for input and output</li> <li>○ Support of on-the-fly changes in parametric settings using a microcontroller</li> </ul> </li> </ul>
<ul style="list-style-type: none"> <li>● MOSFET drivers with adaptive shoot-through protection</li> </ul>
<ul style="list-style-type: none"> <li>● Programmable frequency: 100 kHz to 600 kHz</li> </ul>
<ul style="list-style-type: none"> <li>● 8-V drive (ISL81601) and 5-V drive (ISL81401/A) for optimized efficiency</li> </ul>
<ul style="list-style-type: none"> <li>● Light-load-efficiency mode and 2.7-<math>\mu</math>A shutdown current extends battery life.</li> </ul>
<ul style="list-style-type: none"> <li>● Frequency dithering for lower EMI (ISL81601 &amp; ISL81401)</li> </ul>
<ul style="list-style-type: none"> <li>● Extensive multilayer protection for overvoltage, undervoltage, overcurrent, overtemperature, and short circuit</li> </ul>

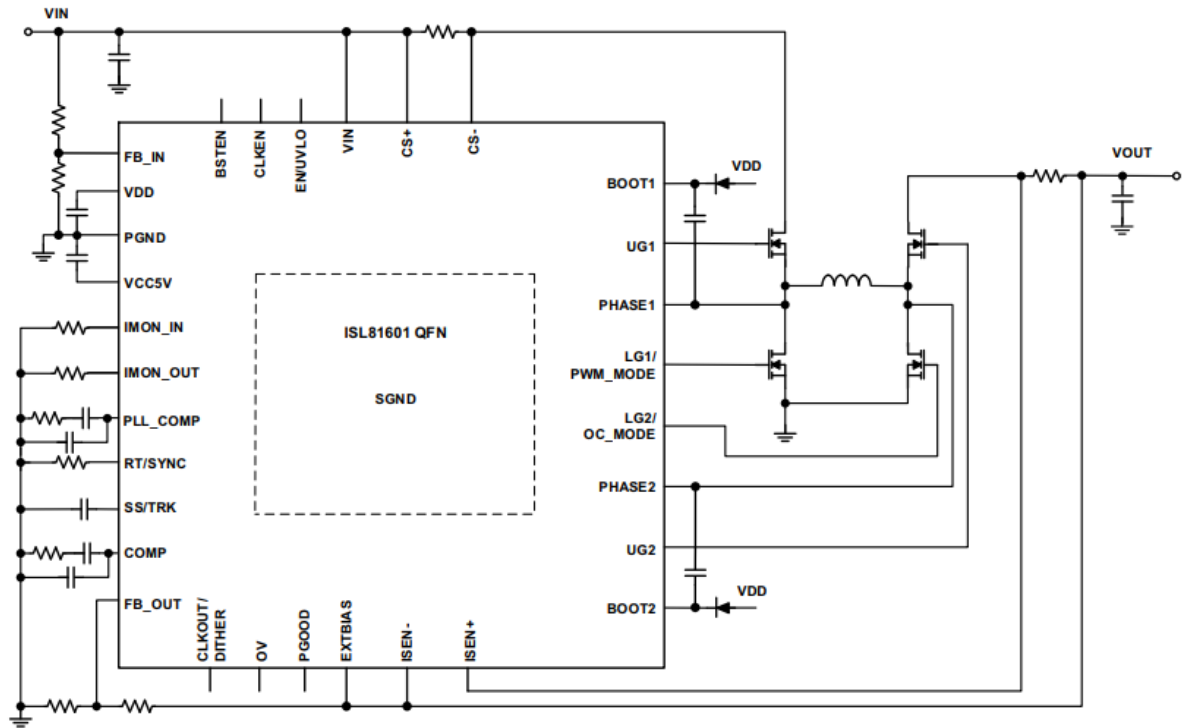


Fig. 2. Typical application diagram for the ISL81601. Bidirectional peak current sensing capability eliminates the complex external circuitry required for charging and discharging a battery to supply power to the loads. A proprietary algorithm provides smooth mode transitions between buck, boost and buck-boost, while reducing low-frequency ripple at Vout, ensuring minimal disturbances during line or load transients.