



Linear Technology Corporation

LTC3871 - Bidirectional Multi-Phase Synchronous Buck or Boost Controller

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Why did we design this IC?

- The LTC3871 was developed because we wanted a Bidirectional high current controller to step-down or step-up the voltage between the 12V and 48V batteries in **Dual Battery Automotive** applications.

Targeted 48V/12V Dual Battery Applications:

- Automotive Internal Combustion Engines
- Hybrid Electric Vehicles
- Mild Hybrid Electric Vehicles

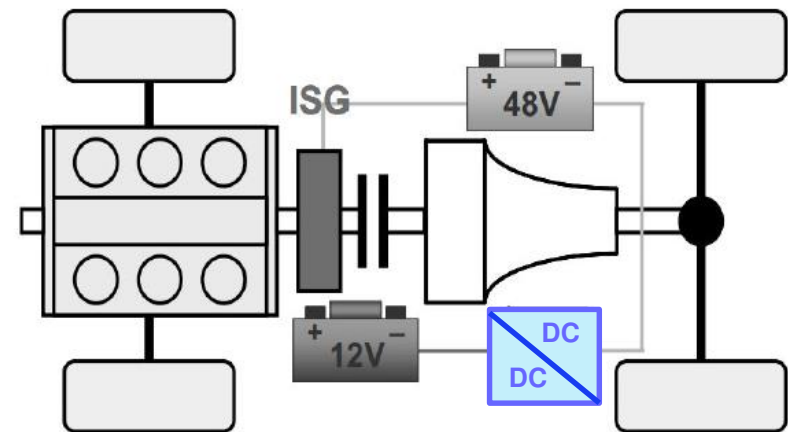
Benefits:

- Increases Available Power from 3kW to 10kW
- Allows for More Electrical Circuits
- Reduces CO2 Emissions



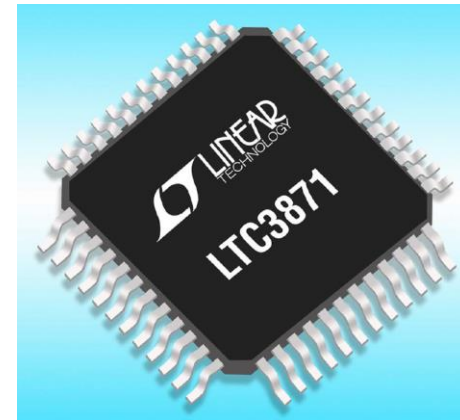
LTC3871 – Features

- Bidirectional 2-Phase Synchronous Buck or Boost
- V_{HIGH} (48V Nominal) Up to 100V
- V_{LOW} (12V Nominal) Up to 30V
- Up to 12 Phase Operation for up to 250A
- Both Batteries can Supply Energy Simultaneously to same Load
- Four Control Loops – Two for Current & Two for Voltage
- On Demand Feature Dynamically regulates Current in either Direction

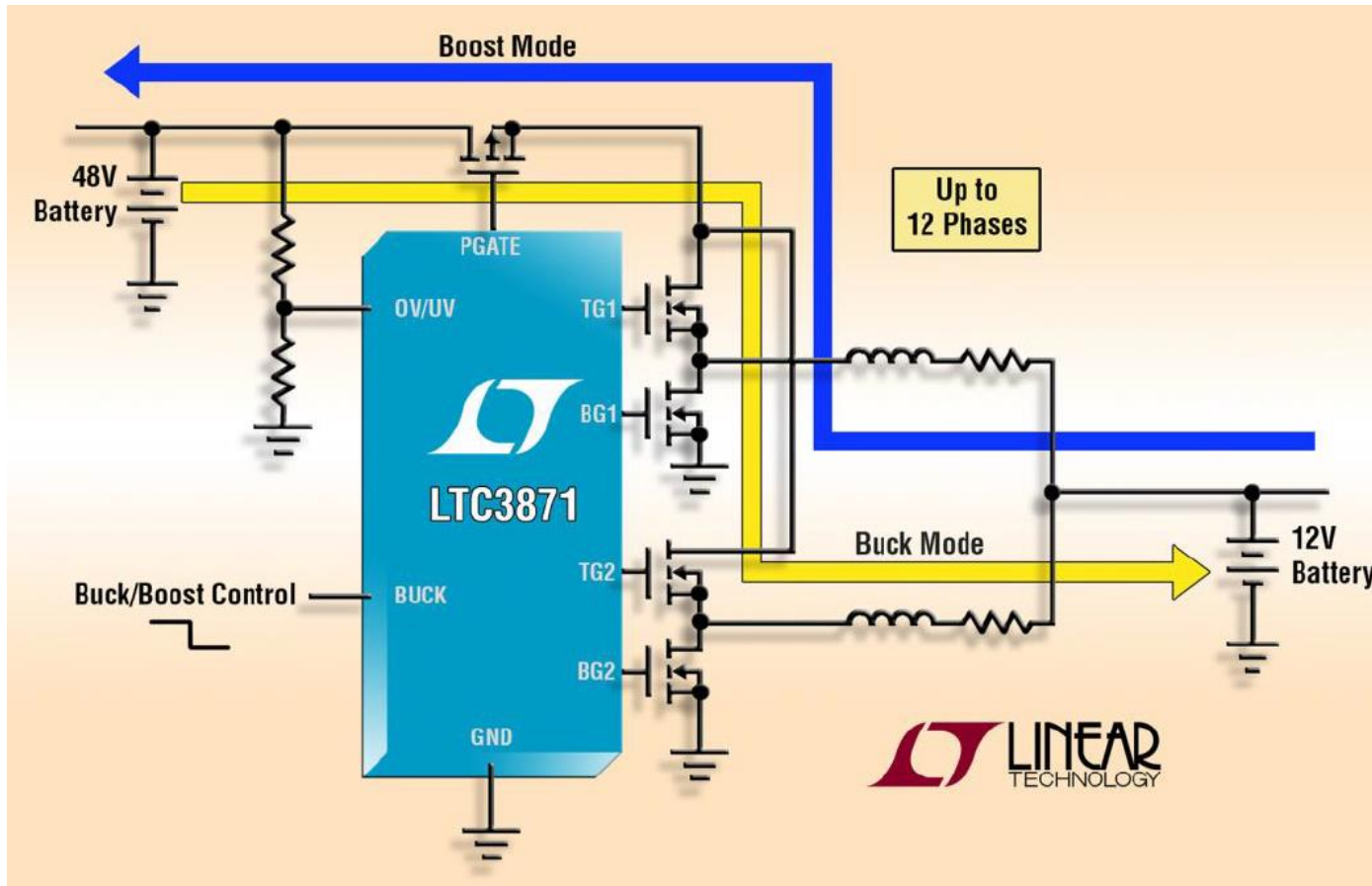


LTC3871 - Features (cont.)

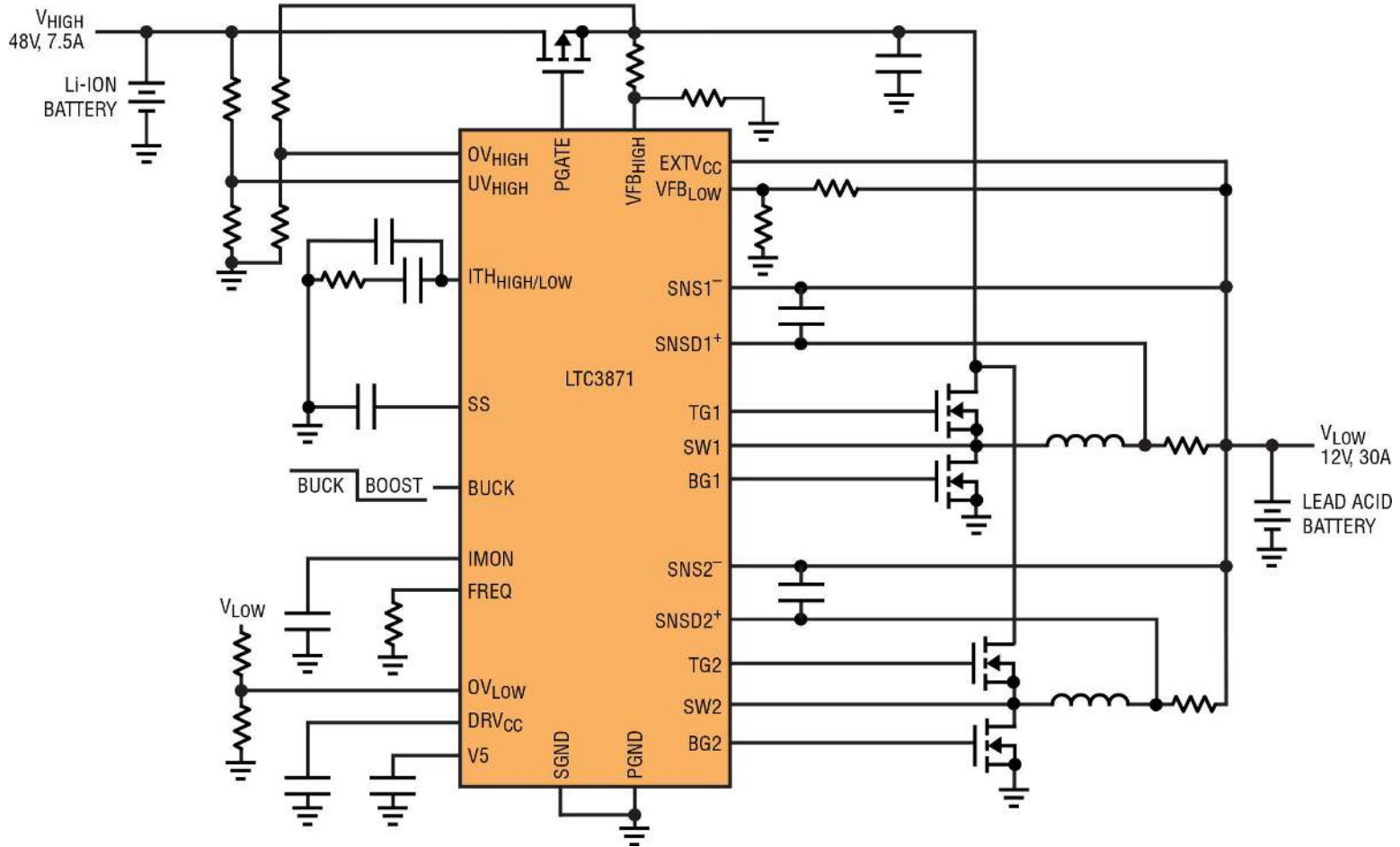
- Phase-Lockable Frequency: 60kHz to 475kHz
- Overload and Short Circuit protection
- Selectable CCM/DCM Modes
- Independent Buck or Boost Loop Compensation
- $EXTV_{CC}$ for Reduced Power Dissipation
- $\pm 1\%$ Regulation Voltage Accuracy Over Temp
- Programmable UV and OV Thresholds
- AEC-Q100/ISO-26262
- 7mm \times 7mm Leaded Package



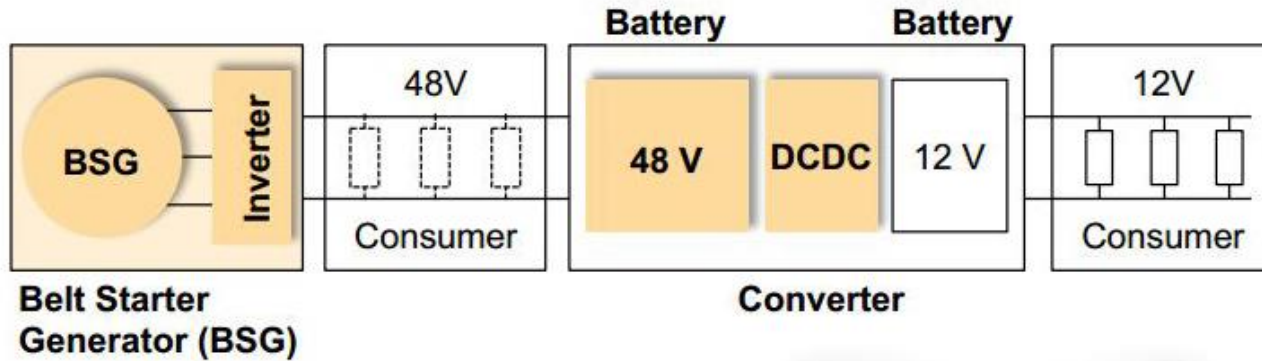
LTC3871 – PR Photo



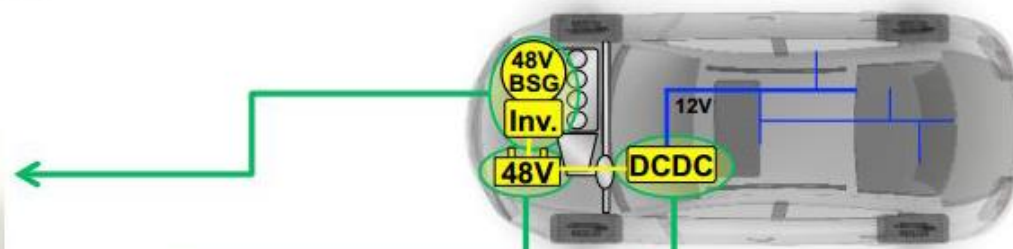
LTC3871 Simplified Schematic



48V/12V Dual Battery Block Diagram



BSG
 14 kW peak
 8 kW cont.
 50 Nm
 Inverter
 integrated

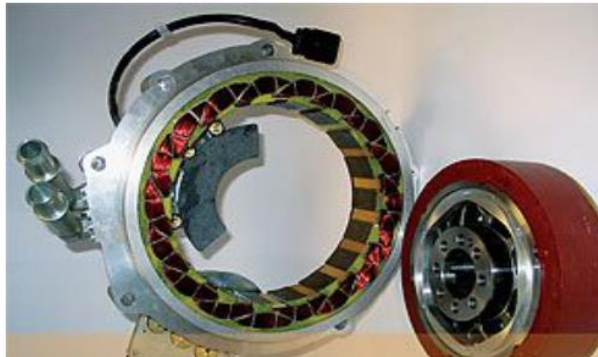
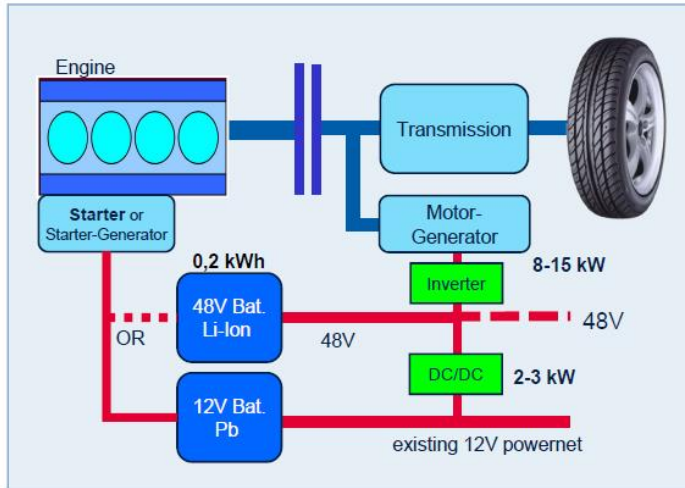


Battery
 11 kW peak
 10 Ah cells



DCDC
 3kW

Integrated Motor-Generator Application

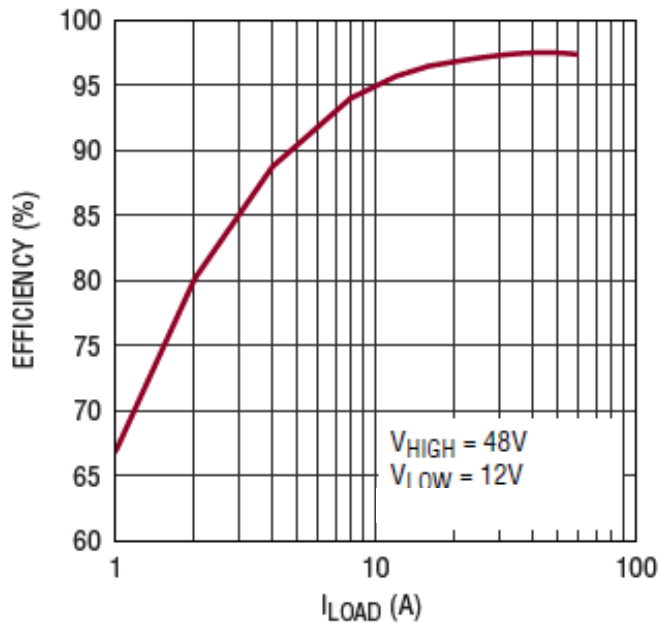


Integrated Motor-Generator

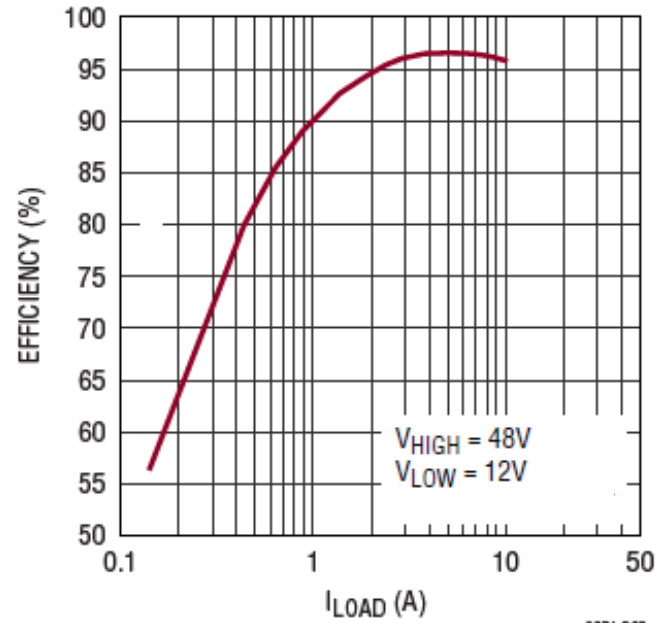
- 48V powernet architecture provides some challenges in the system:
 - Separation of 48V and 12 V
 - Higher voltage generator
 - DC/DC-configuration and safety
 - Fulfillment of LV148 of OEMs (specification of OEMs)
- Functions to be provided:
 - Start-Stop, <20km/h or higher
 - Regenerative braking ($\approx 10\text{kW}$)
 - Electricity without fuel burning
 - Car Coasting, Gliding, Sailing
 - Torque Boost ($\approx 10\text{kW}$)
 - Motor Propulsion (crawl $\approx 10\text{kW}$ or constant speed)

Demo Board (DC23498A) Efficiency Curves

Buck: 48V→12V
Efficiency vs Load Current



Boost: 12V→48V
Efficiency vs Load Current



3871 G08

Thermals of DC2348A in Buck Mode

48V→12V @ 60A, $T_{\text{Ambient}} = 25^{\circ}\text{C}$, Free Air

