High Efficiency, High Density 3-Phase Supply Delivers 60A with Power Saving Stage Shedding, Active Voltage Positioning and Nonlinear Control for Superior Load Step Response

Design Note 489
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Introduction
The LTC®3829 is a feature-rich single output 3-phase synchronous buck controller that meets the power density demands of modern high speed, high capacity data processing systems, telecom systems, industrial equipment and DC power distribution systems. The LTC3829's features include:

- 4.5V to 38V input range and 0.6V to 5V output range
- 3-phase operation for low input current ripple and output voltage ripple with Stage Shedding™ mode to yield high light load efficiency
- On-chip drivers in a 38-pin 5mm × 7mm QFN (or 38-pin FE) package to satisfy demanding space requirements
• Remote output voltage sensing and inductor DCR
temperature compensation for accurate regulation
• Active voltage positioning (AVP) and nonlinear control
  ensure impressive load transient performance

1.5V/60A, 3-Phase Power Supply

Figure 1 shows a 7V to 14V input, 1.5V/60A output
application. The LTC3829’s three channels run 120°
out-of-phase, which reduces input RMS current ripple
and output voltage ripple compared to single-channel
solutions. Each phase uses one top MOSFET and two
bottom MOSFETs to provide up to 20A of output current.

The LTC3829 includes unique features that maximize effi-
ciency, including strong gate drivers, short dead times and
a programmable Stage Shedding mode, where two of the
three phases shut down at light load. Onset of Stage Shed-
ding mode can be programmed from no load to 30% load.
Figure 2 shows the efficiency of this regulator at over 86.5%
with a 12V input and a 1.5V/60A output with Stage Shedding
mode, dramatically increasing light load efficiency.

The current mode control architecture of the LTC3829
ensures that DC load current is evenly distributed among
the three channels, as shown in Figure 3. Dynamic, cycle-
by-cycle current sharing performance is similarly tight
in the face of load transients.

A fast and controlled transient response is another
important requirement for modern power supplies. The
LTC3829 includes two features that reduce the peak-
to-peak output voltage excursion during a load step:
programmable nonlinear control or programmable active
voltage positioning (AVP). Figure 4 shows the transient
response without these features enabled. Figure 5 shows
that nonlinear control improves peak-to-peak response
by 17%. Figure 6 shows that AVP can achieve a 50%
reduction in the amplitude of voltage spikes.

Conclusion

The LTC3829’s tiny 5mm × 7mm 38-pin QFN package
belie its expansive feature set. It produces high efficiency
with a combination of strong integrated drivers and Stage
Shedding/Burst Mode® operation. It supports tempera-
ture compensated DCR sensing for high reliability. AVP
and nonlinear control improve transient response with
minimum output capacitance. Voltage tracking, multichip
operation and external sync capability fill out its menu of
features. The LTC3829 is ideal for high current applica-
tions such as telecom and datacom systems, industrial
and computer systems.