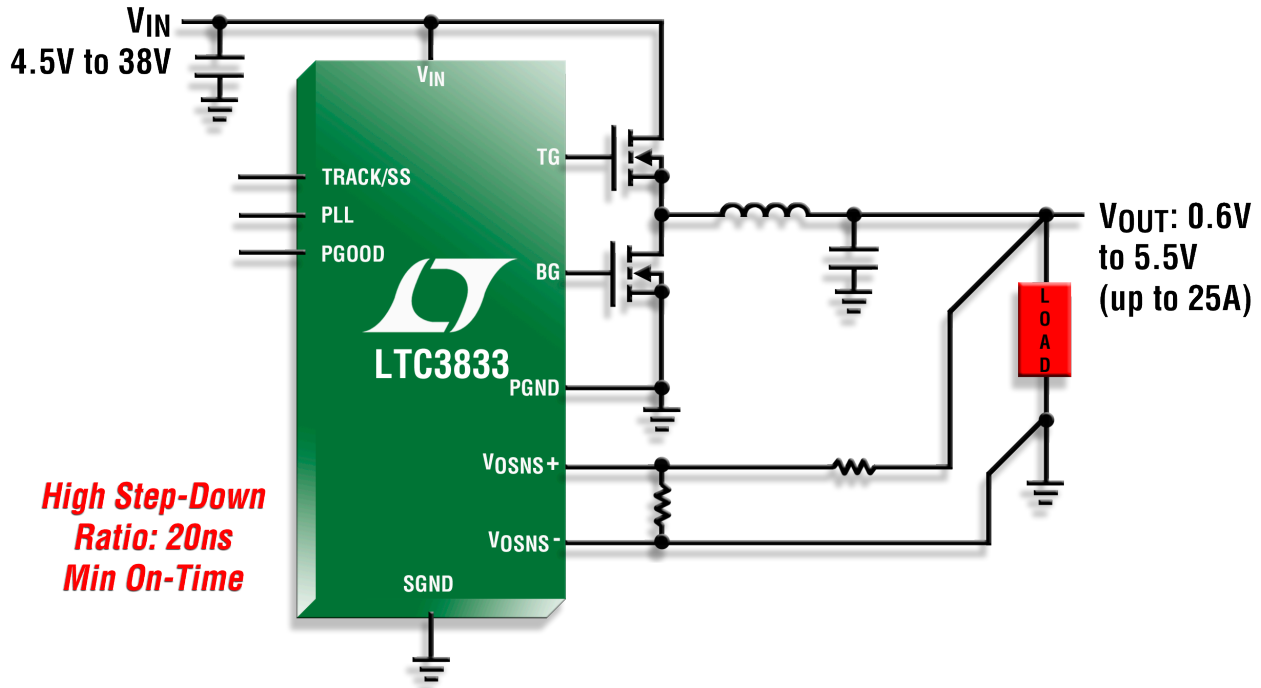


# Constant On-Time High Step-Down Controllers

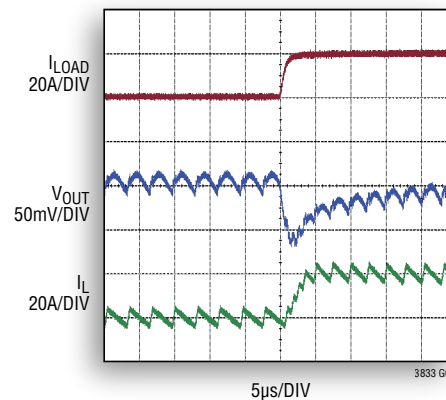


Constant on-time DC/DC buck topology controllers provide the highest step-down ratio power supplies. These controllers allow for tight frequency control, making them suitable for many fixed frequency applications. The LTC®3833 can operate up to 2MHz and still supply a tightly regulated output. High frequency operation is desired to mitigate noise interference, reduce solution size and provide excellent efficiency. A typical example is found in automotive applications when stepping down from a nominal battery voltage of 12V to 3.3V power rail at a high switching frequency to prevent interference to noise sensitive circuitry by operating above the 1.8MHz AM radio band.

## Features

- V<sub>IN</sub> Range: 4.5V to 38V
- V<sub>OUT</sub> Range: 0.6V to 5.5V
- 20ns Min On-Time for High Step-Down Ratios
- Controlled On-Time Valley Current Mode Control
- Synchronizable 200kHz to 2MHz Frequency
- Powerful Onboard N-Channel Gate Drive
- Diff Amp for V<sub>OUT</sub> Sensing
- R<sub>SENSE</sub> or DCR Current Sense
- Output Tracking or Adjustable Soft Start
- Very Fast Transient Response
- Output Accuracy: ±0.25% at 25°C and ±0.67% over Temperature

## Transient Response



LOAD STEP = 0A TO 20A  
V<sub>IN</sub> = 12V, V<sub>OUT</sub> = 1.5V  
L<sub>OUT</sub> = 0.47µH,  
C<sub>OUT</sub> = 660µF + 200µF



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Table 1. LTC3833 Efficiency vs Switching Frequency for Various Input Voltages. Power Loss is Also Shown.

|              | LTC3833 $V_{OUT} = 1.8V$ LOAD = 10A |                  |                  |                  |                  |                  |                  |                  |
|--------------|-------------------------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|              | L = 2.00 $\mu$ H                    | L = 0.82 $\mu$ H | L = 0.47 $\mu$ H | L = 0.20 $\mu$ H | L = 2.00 $\mu$ H | L = 0.82 $\mu$ H | L = 0.47 $\mu$ H | L = 0.20 $\mu$ H |
| FREQ         | 200KHz                              | 500KHz           | 1MHz             | 2MHz             | 200KHz           | 500KHz           | 1MHz             | 2MHz             |
| $V_{IN}$ (V) | Efficiency (%)                      |                  |                  |                  | Power Loss (W)   |                  |                  |                  |
| 6            | 91.50                               | 92.50            | 91.10            | 87.50            | 1.68             | 1.47             | 1.76             | 2.58             |
| 9            | 92.00                               | 92.20            | 90.20            | 86.00            | 1.56             | 1.52             | 1.95             | 2.93             |
| 12           | 92.10                               | 91.70            | 88.90            | 83.60            | 1.55             | 1.63             | 2.24             | 3.54             |
| 15           | 91.80                               | 90.90            | 87.40            | 80.80            | 1.6              | 1.79             | 2.59             | 4.28             |
| 18           | 91.60                               | 90.10            | 85.90            | 78.00            | 1.65             | 1.99             | 2.96             | 5.07             |
| 21           | 91.30                               | 89.20            | 84.30            | 75.30            | 1.71             | 2.18             | 3.36             | 5.9              |
| 24           | 90.90                               | 88.30            | 82.70            | 72.80            | 1.79             | 2.39             | 3.77             | 6.73             |
| 27           | 90.50                               | 87.40            | 81.10            | 70.40            | 1.88             | 2.6              | 4.19             | 7.57             |
| 30           | 90.10                               | 86.40            | 79.60            | 69.80            | 1.97             | 2.82             | 4.62             | 7.77             |

Table 2. Detail of Output Voltage Capability Based on Input Voltage and Switching Frequency

| $V_{IN}$   | LTC3833 $t_{ON}$ Min = 20ns |      |      | LTC3878/LTC3879 $t_{ON}$ Min = 43ns |     |      | LTC3851A $t_{ON}$ Min = 90ns |     |     |
|------------|-----------------------------|------|------|-------------------------------------|-----|------|------------------------------|-----|-----|
|            | 38V                         | 24V  | 12V  | 38V                                 | 24V | 12V  | 38V                          | 24V | 12V |
| FREQ (kHz) | LTC3833 $V_{OUT}$ Min (V)   |      |      | LTC3879 $V_{OUT}$ Min (V)           |     |      | LTC3851A $V_{OUT}$ Min (V)   |     |     |
| 250        | 0.6                         | 0.6  | 0.6  | 0.6                                 | 0.6 | 0.6  | 0.95                         | 0.6 | 0.6 |
| 500        | 0.6                         | 0.6  | 0.6  | 0.95                                | 0.6 | 0.6  | 1.9                          | 1.2 | 0.6 |
| 750        | 0.86                        | 0.6  | 0.6  | 1.43                                | 0.9 | 0.6  | 2.85                         | 1.8 | 0.9 |
| 1000       | 1.14                        | 0.72 | 0.6  | 1.9                                 | 1.2 | 0.6  | NA                           | NA  | NA  |
| 1250       | 1.43                        | 0.9  | 0.6  | 2.38                                | 1.5 | 0.75 | NA                           | NA  | NA  |
| 1500       | 1.71                        | 1.08 | 0.6  | 2.85                                | 1.8 | 0.9  | NA                           | NA  | NA  |
| 1750       | 2                           | 1.26 | 0.63 | 3.33                                | 2.1 | 1.05 | NA                           | NA  | NA  |
| 2000       | 2.28                        | 1.44 | 0.72 | 3.8                                 | 2.4 | 1.2  | NA                           | NA  | NA  |

Other Related Controlled/Constant On-Time Controllers

| Part Number | $V_{IN}$ Range (V) | $V_{OUT}$ Range      | Number of Outputs | Min On-Time | Clock Synchronization | Diff Amp (Remote Sensing) |
|-------------|--------------------|----------------------|-------------------|-------------|-----------------------|---------------------------|
| LTC3833     | 4.5V to 38V        | 0.6V to 5.5V         | 1                 | 20ns        | √                     | √                         |
| LTC3878     | 4V to 38V          | 0.8V to 0.9 $V_{IN}$ | 1                 | 43ns        |                       |                           |
| LTC3879     | 4V to 38V          | 0.6V to 0.9 $V_{IN}$ | 1                 | 43ns        |                       |                           |
| LTC3838     | 4.5V to 38V        | 0.6V to 5.5V         | 2                 | 30ns        | √                     | √                         |