# Design Once; Use Twice: Monolithic SEPIC/Boost Regulators with Wide $V_{IN}$ Range Satisfy Requirements of Both Consumer and Commercial Vehicles

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Automobile manufacturers continually add electronic control units (ECUs) to support increasing numbers of performance, comfort and safety features. ECU power either comes from a single lead-acid battery in consumer vehicles, or from two batteries in commercial vehicles. Ideally, an ECU can run off either, enabling a single design for both consumer and commercial vehicles. This requires that ECU power ICs support an input range covering both configurations—namely 3.5V to 60V. Furthermore, the power ICs should feature ultralow quiescent current, preserving the vehicle's battery run time when the engine is off, but always-on systems remain engaged.

The LT8495 and LT8494 are high voltage switching regulators that meet these requirements when configured as SEPIC or boost converters. Both parts operate over 2.5V to 60V input, and have low quiescent current to extend the battery life. The quiescent current of the LT8495 is 9µA, and is 7µA for the LT8494. The parts are available in 20-lead QFN and 20-lead TSSOP packages.

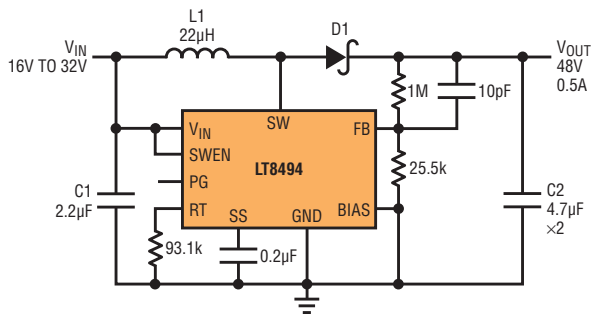
The LT8494 and LT8495 are similar, but the LT8495 adds power-on reset and watchdog timers. It is designed specifically for microcontrolled applications, where reliability and safety are critical. The supply voltage is monitored by power-on reset, and the software/hardware activities are supervised by watchdog timers. These functions are integrated in the LT8495, simplifying designs with enhanced safety and reliability.

## DUAL SUPPLY PINS

The input voltage of the LT8494/LT8495 can be as high as 60V for SEPIC topologies, and 32V for boost circuits with the 60V ride-through voltage. The internal power switch driver must be in the 2.4V~34V (typical) range to enable the LT8494/LT8495, but the minimum operating $V_{IN}$ range can be reduced to 1V. The integrated power switch drivers can operate from either of two supplies: $V_{IN}$ or BIAS. This allows the part to optimize efficiency and reduces the minimum input voltage requirement. The LT8494/LT8495 automatically chooses the lower supply of the two, provided it is in the operation range. This selection is made on-the-fly as $V_{IN}$ or BIAS voltages change. After initial start-up, the part can draw current from BIAS if it is lower than $V_{IN}$.

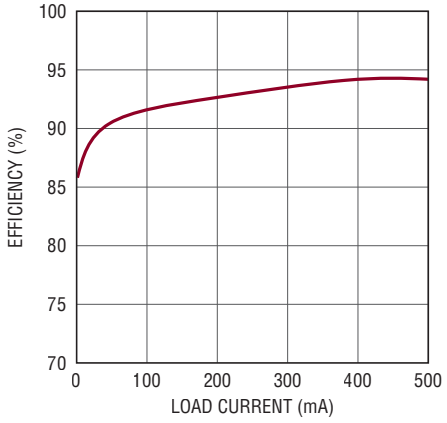
A typical application of a boost converter using the LT8494 is shown in Figure 1. The BIAS pin is connected to ground instead of the output since the input

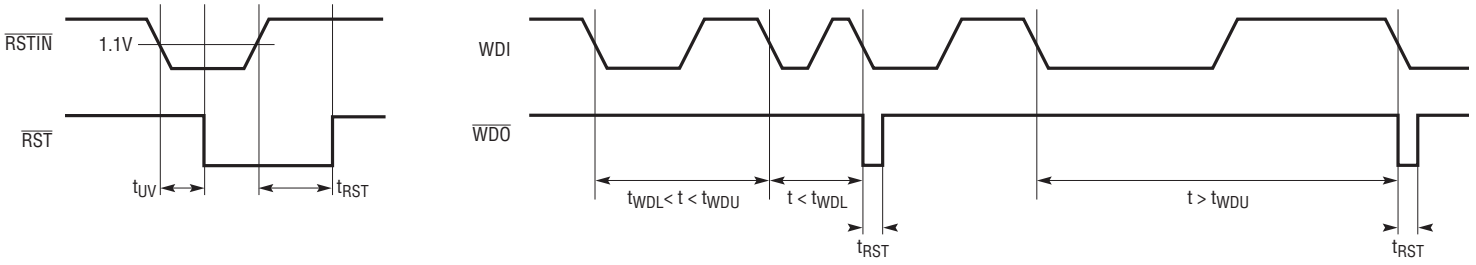
**Figure 1. The LT8494 in a 750kHz, 48V boost converter**




C1: 2.2µF, 50V, X5R, 1206
C2: 4.7µF, 100V, X7R, 1210
D1: ONSEMI MBRA2H100
L1: WÜRTH LHMI 74437349220

**Figure 2. Efficiency of the circuit in Figure 1**






$t_{UV}$ = TIME REQUIRED TO ASSERT $\overline{RST}$ LOW AFTER $\overline{RSTIN}$ GOES BELOW ITS THRESHOLD, APPROXIMATELY 23µs
$t_{RST}$ = PROGRAMMED RESET PERIOD

(a)

$t_{WDU}$ = WATCHDOG UPPER BOUNDARY PERIOD, APPROXIMATELY 31 RAMPING CYCLES ON CWDT PIN
$t_{WDL}$ = WATCHDOG LOWER BOUNDARY PERIOD, APPROXIMATELY 1 RAMPING CYCLE ON CWDT PIN

(b)

**Figure 3. POR (a) and watchdog (b) timing**

voltage is always lower than the output. The efficiency is given in Figure 2. At very light load, the efficiency of the LT8494 is slightly higher than that of the LT8495 because the LT8494 is not supporting a watchdog function.

## WATCHDOG TIMER AND POR FUNCTIONS

The LT8495 is similar to the LT8494, but it adds integrated power-on reset (POR) and watchdog timer functions to enhance system safety in automotive applications. The POR monitors the supply voltages, while the watchdog timer monitors the software and hardware functions.

The LT8495 monitors the output via the $\overline{RSTIN}$ pin voltage. During normal operation, if the voltage of the $\overline{RSTIN}$ is below its threshold, the $\overline{RST}$ pin is asserted low. Once the $\overline{RSTIN}$ rises above its threshold, the $\overline{RST}$ pin is released after the reset delay time. The reset delay time, $t_{RST}$, is programmable through the cap on the CPOR pin.

The LT8495's watchdog timer includes an independent enable pin (WDE), and can operate without the $V_{IN}$ supply. If the time between the negative edges on the WDI is too long or too short, the WDO pin is pulled low for the reset delay time, $t_{RST}$, before it is released. The window time of WDI can be programmed through the cap on CWDT pin. The timing diagrams of the POR and watchdog timer are shown in Figure 3.

Figure 4 shows the LT8495 configured as a SEPIC converter with a 3V–60V input voltage and 5V output. The max load current increases with the input voltage until reaching the full load current of 1A at 12V input. The output voltage is monitored by the $\overline{RSTIN}$ pin, and the watchdog timer supervises the microcontroller.

## CONCLUSION

The LT8494 and LT8495 are monolithic boost/SEPIC switching regulators with input voltage ranges of 1V to 60V after start-up. Both parts can automatically select the lower supply pins, $V_{IN}$ or BIAS, to improve efficiency. The LT8495 features an integrated power-on reset and a watchdog timer to monitor the microcontroller's activity. Their wide input voltage ranges, high efficiency, low quiescent current and programmable timing make them ideal for industrial and automotive applications. ■

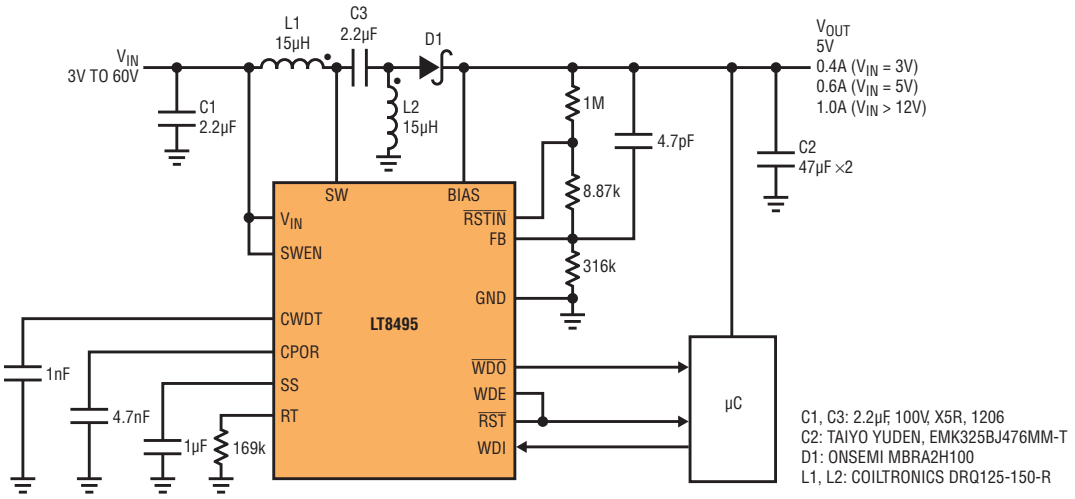



**Figure 4. The LT8495 in a 450kHz, 5V output SEPIC converter with POR and watchdog timer**