

Powering a 12V Bus with 24V Batteries in Automotive Applications



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24V systems are common in commercial trucks, including heavy-duty pickup trucks, as well as military vehicles that require extra power.

Converting power from 24V batteries to 12V for low-voltage electronics inside a vehicle cockpit necessitates the use of a DC/DC converter with a wide input-voltage range, fast load transient response and complete system protection, as shown in [Figure 1](#).

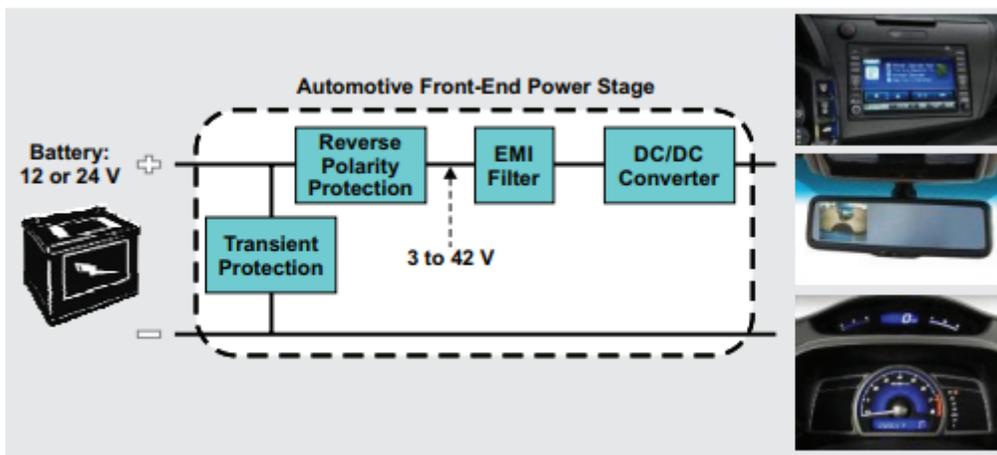


Figure 1. 24V Automotive Battery System

24V systems (just like 12V systems) can experience wide input-voltage variations as a result of cold-crank and load-dump events, as shown in [Figure 2](#). These peak load-dump transients can be as high as 60V.

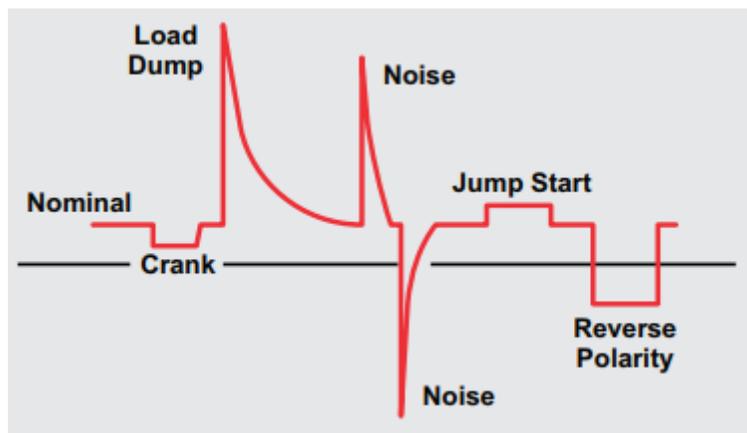


Figure 2. 24V Battery Input-voltage Transient Events

A 24V-to-12V buck DC/DC converter has to be able to handle a wide input-voltage variation (up to 60V), provide tight load regulation and system protection, and have strong drivers to enable high conversion efficiency with external metal-oxide semiconductor field-effect transistors (MOSFETs).

The [280W Automotive Dual-Phase Synchronous Buck Reference Design with 24V_{DC} Input, 12V_{DC} Output](#) showcases a 24V-to-12V automotive battery power-conversion design. The resulting 12V output of the converter is available for various electronics inside the cockpit.

The synchronous buck reference design uses the [LM5119-Q1](#) automotive-qualified two-phase pulse-width modulation (PWM) buck controller and is designed to downconvert 24V to 12V at 20A for a total of 240W of output power. This 240W design is 120mm by 70mm and includes all of the components required for the power supply ([Figure 3](#)).

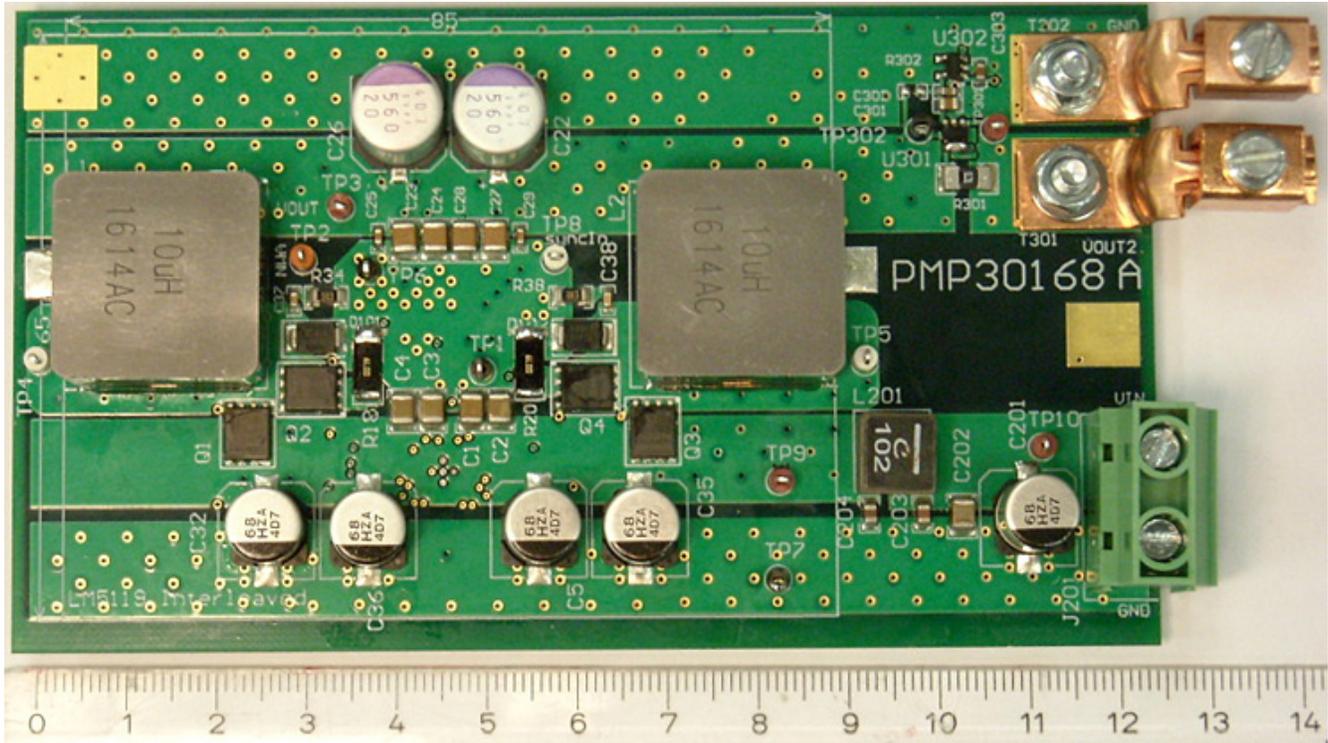


Figure 3. Synchronous Buck Reference Design 24V to 12V Buck Converter for Automotive Batteries

The reference design will support cranking down to 18V and load-dump transients (input voltage overshoot) to 58V.

Efficiency is >97% from 6A to 20A with a power loss less than 9W, as shown in [Figure 4](#).

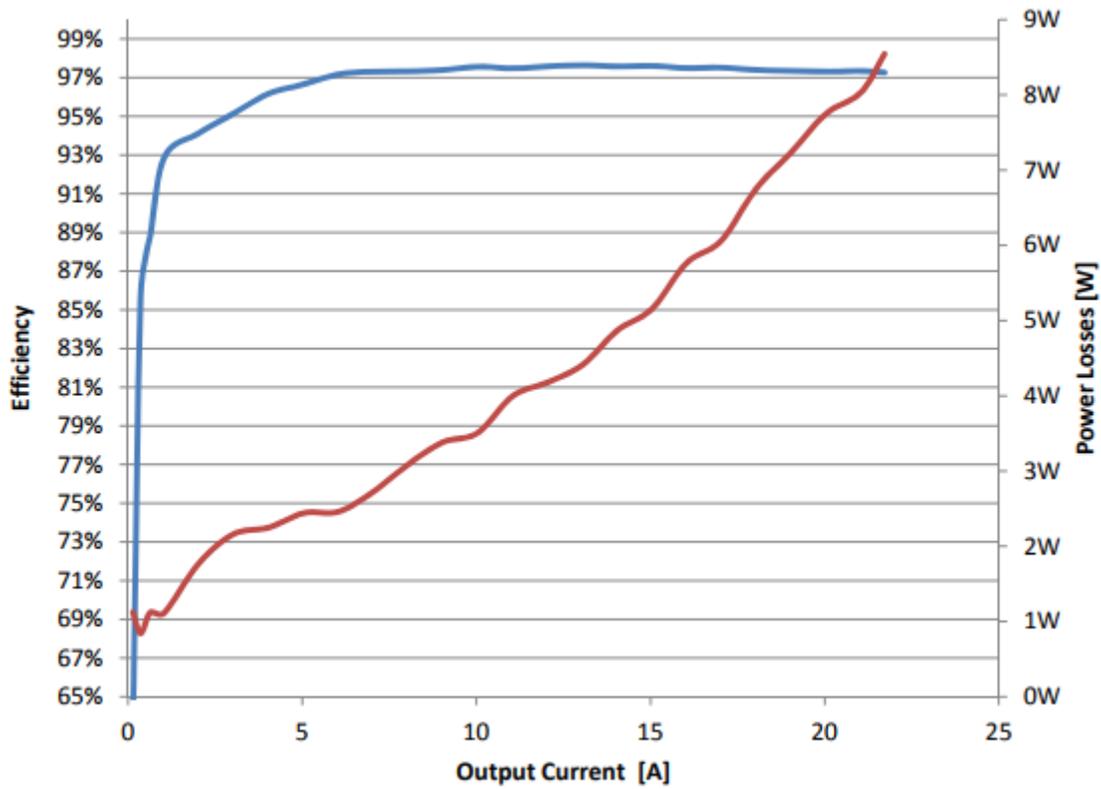


Figure 4. Synchronous Buck Reference Design 24V-to-12V Buck Converter Efficiency and Power Loss

As shown in Figure 5, the load regulation has only 2mV of deviation over the load current range.

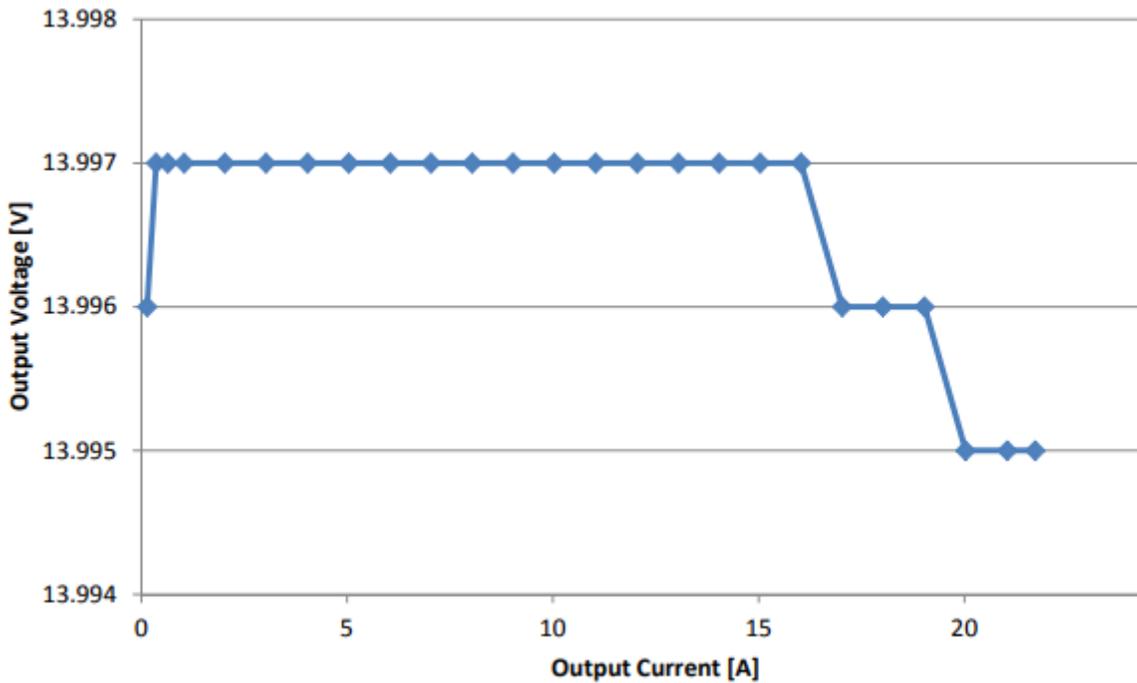


Figure 5. Synchronous Buck Reference Design Load Regulation

Output ripple voltage is less than 10mVpp, with noise at 20mVpp (Figure 6).

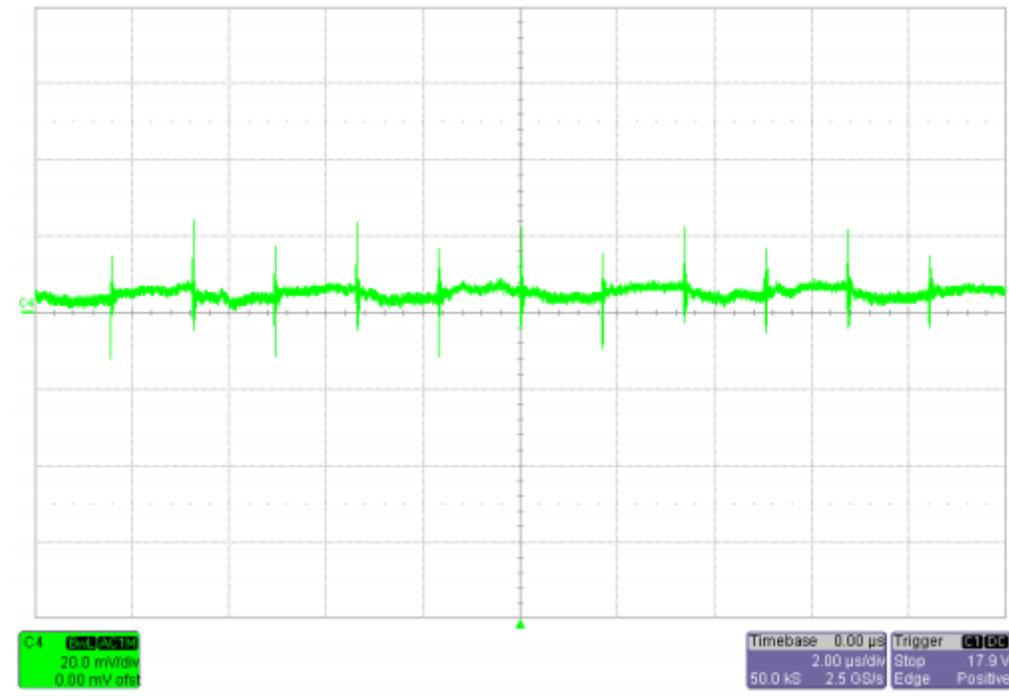


Figure 6. Synchronous Buck Reference Design Output Voltage Ripple

If you are designing an automotive battery 24V-to-12V buck DC/DC converter, consider this reference design for your toolkit. It comes with all of the technical documents and files to enable a quick implementation so that you and your customers can start steering the wheel.

Additional Resources:

- Read the Analog Applications Journal article, [“Designing the front-end DC/DC conversion stage to withstand automotive transients.”](#)
- Check out the [automotive applications portal](#).

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