Automotive remote camera power management, although challenging, can deliver high levels of efficiency at a fraction of the PCB space.

The market for advanced driver assistance systems (ADAS) is one of the fastest growing for automotive electronics. Remote camera modules, which include on-board power management systems, are a key element of the ADAS sensors’ toolset (Figure 1). Cameras are installed in selected locations around the vehicle exterior, and an increasing number are used to deliver a ‘surround view’ experience, giving drivers new, and previously unobtainable, exterior views.

Meanwhile, advanced cruise control and situation-aware collision-avoidance systems are on the horizon.

The nature of automotive design means that these remote camera modules, with their on-board power management systems, must be small, efficient, and cost-effective.

Powering the remote camera
The remote camera module is typically powered by a power-over-coax (PoC) 8V rail and consumes ≥1W (up to 125mA). This rail is bucked down to power the on-board electronic loads, including the imager and the serialiser (Figure 2).

The camera operates in an on-off fashion; either on at full operation or completely off. For this reason, it is more cost-effective to select streamlined buck converter ICs designed for high efficiency at full load without extra silicon (or costs) devoted to enhancing light-load operation.

Typically, a dedicated, 8V-powered, discrete buck converter is implemented on each rail. The four converters are usually designed around identical ICs for economies of scale and ease of design. However, since the buck converter loads are quite different, the overall design is inherently inefficient.

For brevity, we will discuss only two of the four rails, (buck 1 and buck 4) in detail, as buck 2 and buck 3 mirror buck 1 and buck 4 (Figure 3, page 22).

The efficiency of buck 1 with a 30mA load is sub-optimal (78%) as it operates under a light load. The efficiency of buck 4 is also sub-optimal (82%) since it operates at a low duty cycle (1.8V/8V = 0.225V). The net result is a system draw of 71mA from the 8V rail (568mW).

Balancing cost and footprint
This discrete solution is costly and space-consuming, requiring one IC for each rail and the related passive components. As shown in Figure 4 (page 22), the PCB space required by two of the four buck converters, including passives, is 160.4mm².

By covering the four rails with two dual-buck converter ICs, additional space is saved and efficiency preserved. Figure 5 (page 22) shows the dual-buck solution for two of the four rails using the MAX20019. It shows two integrated buck converters optimised for cascaded operation, both working at or near full load and high duty cycle for the highest efficiency.

The 1.8V buck converter, with only 3.3V at its input (as opposed
Figure 6 (page 22) illustrates the PCB footprint with the dual buck IC. This integrated option occupies a PCB area of only 125.1 mm² which represents a reduction of 22% for the PCB area. A second IC can be used for the other two rails depicted in Figure 2 (buck 2 and buck 3). The entire remote camera PoC is efficiently provided with only two ICs and their related passives.

Low noise
An additional advantage of the IC is the internally fixed frequency at 3.2 MHz, which allows for small external components, reduced output ripple, and operation above the AM band to reduce radio frequency interference. The device operates at constant frequency in forced PWM mode (FPWM) and offers optional spread-spectrum frequency modulation to minimise EMI-radiated emissions due to the modulation frequency.

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Size restrictions
Many enhancements contribute to the dual-buck option’s size advantage. First, the integration of two buck converters into a single chip helps to reduce the PCB footprint by eliminating one IC package.

Second, the high clock frequency (3.2 MHz) and fast transient response reduce the PCB footprint further by minimising the sizes of the output inductors and capacitors.

Third, out-of-phase clocks between the two converters smooth out the input current, reducing the size of the input capacitors.
About the authors

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