Make Your ADAS High-Resolution Remote Camera Design Smaller and Flexible

High-resolution remote cameras in a modern automobile (Figure 1) require increasingly higher power while confined within a small space. The camera power management electronics in turn must be small and highly efficient to minimize generation of heat that would quickly raise the temperature inside the small camera enclosure, potentially compromising its reliability. Power management integrated circuits (PMICs) can effectively help size reduction but often at a cost of reduced flexibility. This design solution reviews the shortcomings of a typical solution and presents a highly integrated solution that is highly efficient and reduces PCB space while preserving the design flexibility for ease of reuse.

Figure 1. Assisted Parking in Action

Remote Camera Power

Figure 2 shows a high-level remote camera system. The remote camera is powered through a coaxial cable with 8V. This POC (power-over-coax) rail is subsequently bucked down to the three voltage rails necessary to power the imager and the serializer.

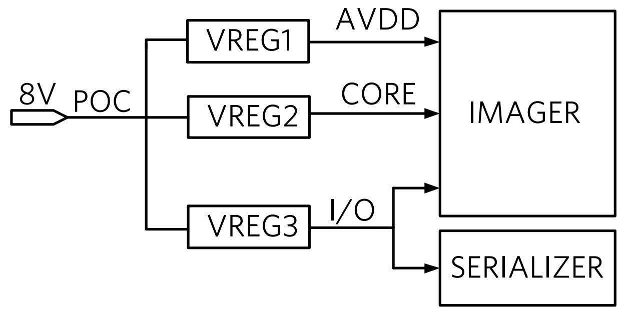

Figure 2. Remote Camera Power

Typical Solution Size

The typical solution shown in Figure 3 uses three ICs and a dozen passives to implement the power function of Figure 2. The result is a PCB size of about 69mm^2.

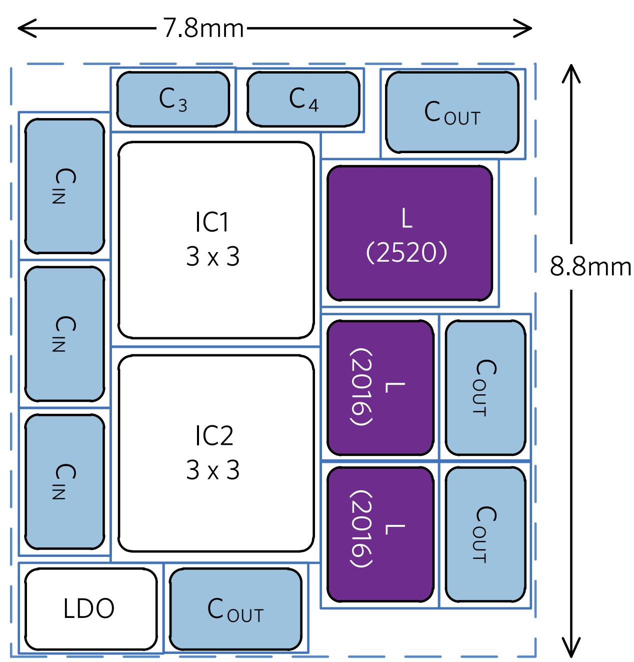

Figure 3. Typical Solution PCB Size (68.7mm^2)

Highly Integrated Solution

Figure 4 shows a highly integrated solution in which the three rails (AVDD, I/O, CORE) come from a single PMIC.

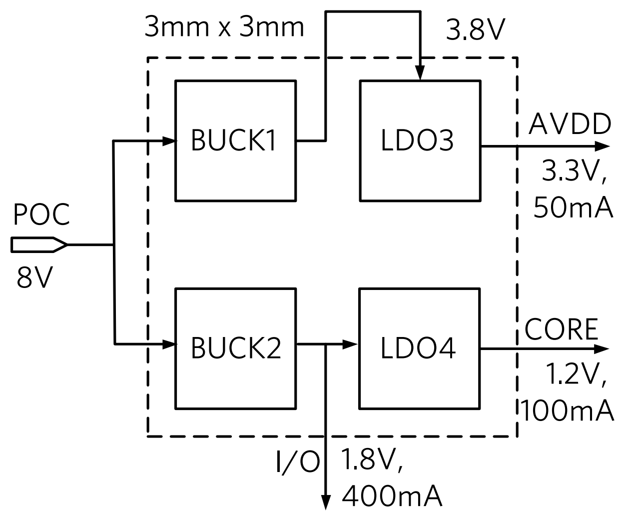

Figure 4. Flexible PMIC Architecture

The above architecture is implemented in the MAX20049, a flexible, mini dual, 500mA buck converter with two LDOs. Spread spectrum and a 2.2MHz switching frequency lower EMI, meeting CISPR low-noise specifications. The stand-alone LDO3 has excellent PSRR, up to 90dB at 1kHz. The PMIC integrates four regulators in a small 3mm × 3mm side-wettable (SW) TQFN-16 package.

Thanks to a high clock frequency, the external components are small. This, together with the small TDFN-12 package, yields a PCB size of only about 38mm^2 as shown in Figure 5. This is 45% smaller than the typical solution in Figure 3.

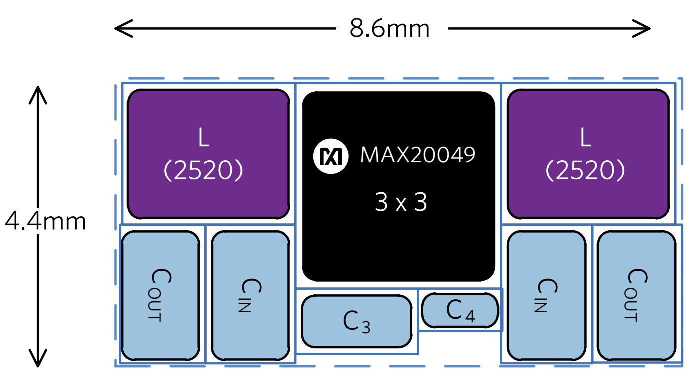

Figure 5. Smaller PCB Size with MAX20049 (37.8mm^2)

Higher Efficiency

The efficiency curves of Figure 6 are measured under the following conditions:

BUCK1 = 3.8V

I/O = 1.8V, I_{BUCK2} 100mA to 600mA

AVDD = 3.3V, I_{LDO3} = 50mA

CORE = 1.2V, I_{LDO4} = 100mA

Under these conditions, the system efficiency (power outputted by the 3 rails over input power) is an outstanding 73% at full load vs. the competitor at 67%.

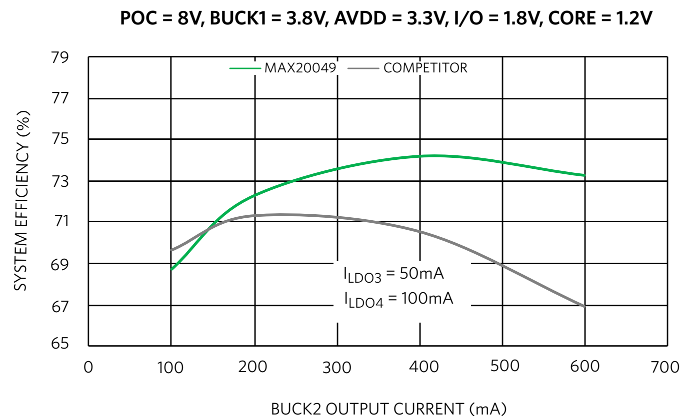

Figure 6. Higher Efficiency Reduces Heat

High Flexibility

Three of the four regulators (BUCK1, BUCK2, LDO3) are virtually stand-alone with their inputs and outputs fully accessible. They confer the PMIC with great architectural flexibility, supporting multiple configurations with different image sensors. The fourth regulator (LDO4) is internally tied to BUCK2 to save a pin and fit the entire solution in the smallest possible package.

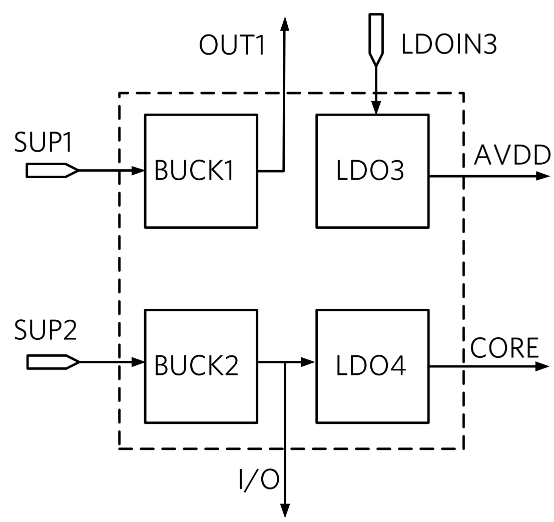

Figure 7. Highly Flexible PMIC Supports Different Image Sensors

High Safety and Reliability

The PMIC passes the stress test qualification for packaged integrated circuits according to AEC-Q100. The IC has fault protection designed to protect against abnormal conditions. If either buck output is shorted, the respective converter implements a cycle-by-cycle current limit. If LDOs are cascaded, the respective LDO output tracks the buck output. The IC provides voltage monitoring on all four output rails. Once an overvoltage or undervoltage is detected, power-good goes high impedance.

Soft-Start, Sequencing and Monitoring

The IC features an internal soft-start timer. Referring to Figure 4, the BUCK1 converter starts first, with a ramp rate of 3.3V/ms. LDO3 starts at the same time as BUCK1 with a 500µs soft-start time. BUCK2 soft-starts with a ramp rate of 3.3V/ms after the BUCK1 output has reached regulation. LDO4 begins soft-start once the output of BUCK2 has reached regulation. The IC provides overvoltage and undervoltage monitoring on all four output rails. Once an overvoltage or undervoltage is detected, power-good goes high impedance.

Conclusion

High-resolution remote cameras in a modern automobile are rapidly evolving, requiring increasingly higher power while confined within a small space. This creates challenges in terms of flexibility, electronics miniaturization, and heat dissipation. We reviewed the shortcomings of currently available solutions and presented the MAX20049, a highly integrated PMIC that reduces PCB space while enhancing efficiency and preserving the design flexibility for ease of reuse with different image sensors.

Learn more:

MAX20049 Flexible Mini Dual 2.2MHz, 500mA Buck Converter with LDOs for Automotive Camera Supplies

How to Minimize Your Automotive Remote Camera

Design Solutions No. 139

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