

Application Brief

75-nA I_Q Buck-Boost Converter in Parallel for Increased Output Current ($\geq 2\text{ A}$)



The TPS63900 buck-boost DC/DC converter delivers $> 400\text{-mA}$ output current for $V_I = 1.8\text{ V}$ and $V_O = 3.3\text{ V}$ and even $> 900\text{ mA}$ for $V_I = 3.3\text{ V}$ and $V_O = 3.3\text{ V}$. The high output power is combined with ultra-low quiescent current (75 nA typ) and very high efficiency at light load ($> 90\%$ at $10\text{-}\mu\text{A}$ load). The high output current capability supports most commonly-used RF standards like sub-1GHz, BLE, LoRa, wM-Bus, NB-IoT, and LTE Cat M1. The TPS63900 offers excellent line and load transient performance compared to other existing ultra-low I_Q DC/DC converter.

Some systems may require higher currents for short periods of time while very low currents are required the majority of the time. In this case, two or more TPS63900 devices can be used in parallel. The output voltage of all devices need to be programmed to the same setting.

Wireless Security Cameras

One such application is a remote wireless security camera. This type of camera is battery supplied and operates only on demand, for example if a sensor detects a motion inside a house when the owner is not present. In that case the camera takes pictures or videos and transmits the data over Wi-Fi® to a cell phone. In the more desirable case, that nothing happens, the camera operates in sleep mode where only a motion detector (PIR sensor) and a low-power micro controller (μC) are active.

During active video operation a high supply current of more than 1.5 A is necessary, while during sleep mode only less than $50\text{ }\mu\text{A}$ is needed. In this application two parallel TPS63900 devices can deliver the high-output current and help to increase battery life time with the ultra-low quiescent current.

One option to implement the power tree is to use TPS63900 for the always-on part to have excellent efficiency during sleep mode. The high power subsystems use a single TPS63802 buck-boost converter. In sleep mode, TPS63802 would be shutdown to keep the system efficiency high. The drawback of this solution is that two different converters need to be introduced.

Figure 1 shows a more elegant solution, where two TPS63900 devices in parallel supply the combined 3.3-V rail. This eliminates the drawback of the previous solution. Both TPS63900 devices are used up to the full output current capability while keeping the efficiency high.

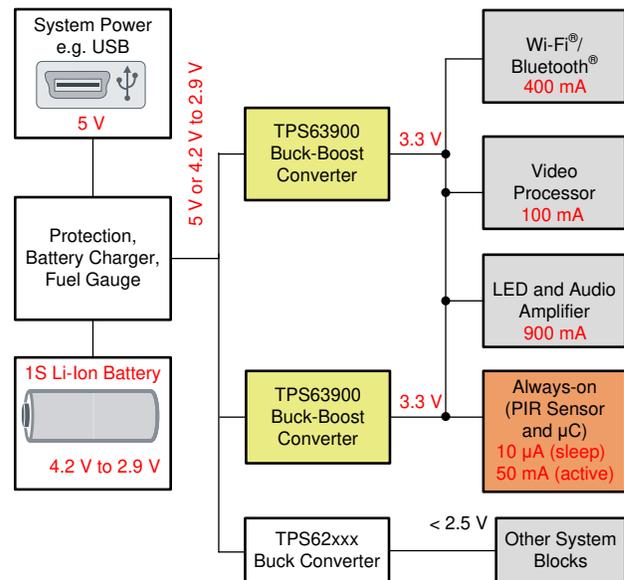


Figure 1. Implementation of a Wireless Network Camera With two TPS63900 Devices

Table 1-1 compares both solutions.

Table 1. Comparison Between Power Options

	2 × TPS63900	TPS63900 + TPS63802
Solution Size	42 mm ²	39 mm ²
I_Q (sleep mode)	2 × 75 nA	75 nA + 11 μA
Max output current	2 A	$> 2\text{ A}$
When to use?	Long low current periods	Long or many high current periods

Theory and Measurements

The TPS63900 uses a comparator to monitor the output voltage. If the voltage drops below a certain value, the comparator sends a signal to the control logic to request a new switching cycle. If the output voltage is higher than the target, then the converter

does not switch and does not transfer energy to the output. This operation principle helps to synchronize the output voltage regulation, when two or more devices are in parallel. Important for this operation is that the device does not allow reverse current and does not have an active output discharge. There is no limit on how many devices can be placed in parallel.

Figure 2 and Figure 3 show the efficiency of a single device in comparison to two and three in parallel. For low-output currents, the efficiency is lowered due to the additional quiescent current. In the high-current range, the additional output current capability boosts the efficiency.

Figure 4 shows the output current capability for up to three devices in parallel. The output voltage is set to 3.3 V.

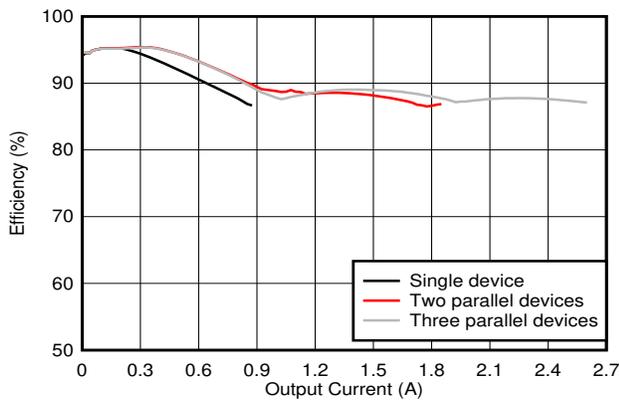


Figure 2. Efficiency Comparison, High-Current Range

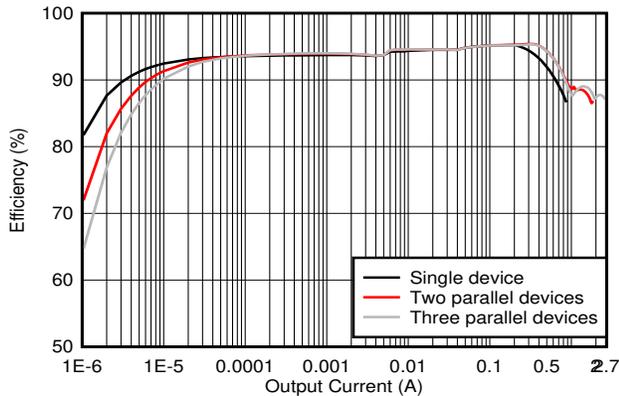


Figure 3. Efficiency Comparison, Low-Current Range

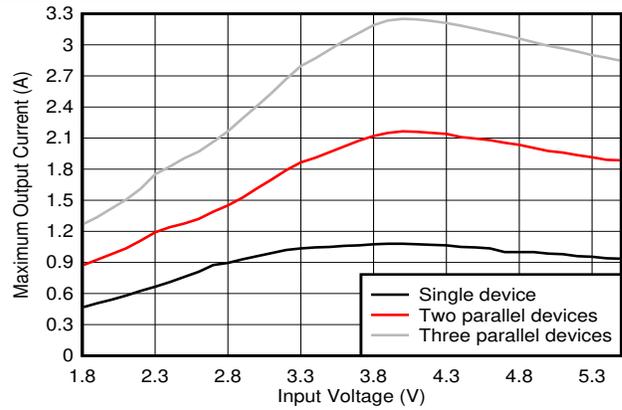


Figure 4. Typical Output Current Capability Over Input Voltage

Figure 5 shows the load transient performance of two boards in parallel. The output current changes from 0 A to 1.8 A in 10 μ s. An output voltage drop of lower than 150 mV is measured.

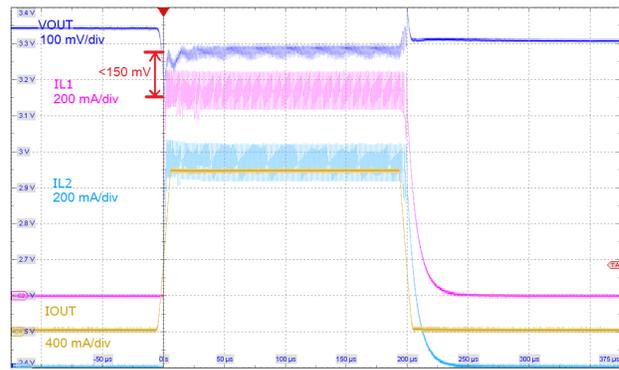


Figure 5. Load Transient, $V_I = V_O = 3.3$ V, $I_O = 0.01$ A to 1.8 A, $t_r/t_f = 10$ μ s

The TPS63900 is an ultra-low quiescent current device with an excellent transient performance. It is also easy to scale the output current to higher levels by placing multiple devices in parallel. This allows to build systems that need low quiescent current for long time periods and at the same time support high-output current phases.

References

[TPS63900 Data Sheet](#)

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