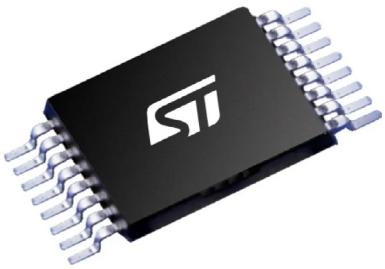


STMicroelectronics L7987L Asynchronous Switching Regulator User Guide

Contents

STMicroelectronics L7987L Asynchronous Switching

DC-DC switching regulators are by far the most efficient way to convert one DC voltage to another. Even if more complex and expensive than linear regulators, the added flexibility and superior efficiency have contributed to the popularity of switching regulators. This guide provides developers with an overview of our most commonly used switching regulators and will help identify the most appropriate solution for each type of application.

WHY SWITCHING REGULATORS ?

Efficiency

While linear regulators remain popular thanks to their low noise factor, simplicity, and small size, the primary reason for implementing a switching regulator is to increase the application's efficiency. While the power lost in a linear regulation is lost directly to excess power being dissipated as heat, the power losses in switching regulators are only caused by small biasing currents and losses in non-ideal components. In a well-made design, the efficiency can be more than 95% over a wide range of working conditions.

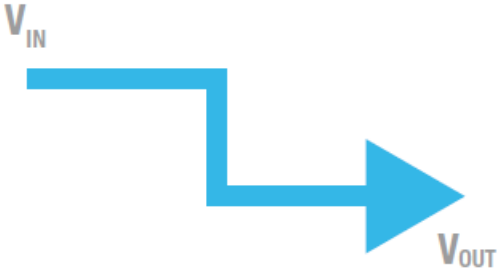
Flexibility

The primary application for DC-DC regulators is to step down a higher input voltage to a lower output voltage, but owing to their mode of operation many regulators can also be configured to work with outputs that can be higher than their input, or even convert input voltages that are both higher and lower than the output voltage.

These three main topologies are referred to as Buck, Boost, and Buck-Boost.

Buck

- The most common topology
- Used when the input is higher than the output
- As most existing regulators are made for this purpose, solutions are plenty, easy and well-developed



Buck-boost

- Buck-boost topology is applied when the input voltage is expected to be both higher and lower than the output voltage during operation

- This, for example, occurs in battery-operated circuits, where the voltage of a fully charged battery may be higher than needed, while the voltage gradually becomes too low as the battery discharges

Boost

- Boost (step-up) topology converts a low input voltage to a higher output voltage
- This is often seen in handheld and wearable devices where the output voltage is consistently expected to be higher than the input voltage, and using multiple batteries in series is considered too bulky

HOW DO I PICK THE RIGHT DC-DC SWITCHING REGULATOR FOR AN APPLICATION ?

While some applications may require more attention to specific characteristics, a generalized approach to selecting a DC-DC switching regulator is to match criteria in the following order:

- Galvanic isolated DC to DC regulation
- Input voltage range and output voltage (fixed or adjustable)
- Current requirement of the load
- Efficiency and quiescence
- Rectification architecture
- Switching frequency
- Compensation
- Output accuracy
- Extra features (Enable, Soft-start, Power Good, etc.)

It is important that the regulator can work with the desired input and output voltages; some devices have fixed output voltages, while many are adjustable. Depending on the input/output voltage relation, different topologies will be used,
such as the Buck/Boost/Buck-Boost topologies.

Maximum output current

The regulator needs to be able to supply the load appropriately. An overhead margin is recommended in order to achieve optimal product performance.

Efficiency and quiescence

The main selling point of the switching regulator is its efficiency. While an ideal regulator can convert power without losses, a real regulator will have some losses caused by factors such as internal references, operation of the switches, and dissipation caused by resistive parasitics in traces and components. The quiescent current is the current required to operate the regulator.

Rectification architecture

Switching regulators are either asynchronous or synchronous, meaning that they, respectively, have an external catch diode or an internal second pass element. Typically the synchronous option improves efficiency while also

reducing the area needed on the PCB. On the other hand, the asynchronous architecture is less expensive, and the external diode allows for heat dissipation over a larger area.

Switching frequency

The switching frequency and efficiency are directly related, and also affect the noise, size and cost of the regulator.

A higher switching frequency means that smaller inductors and other passives can be used, but it will also incur higher power consumption and increase EM radiation. While some regulators have fixed frequencies, so that the designer can tailor

the regulator to the application.

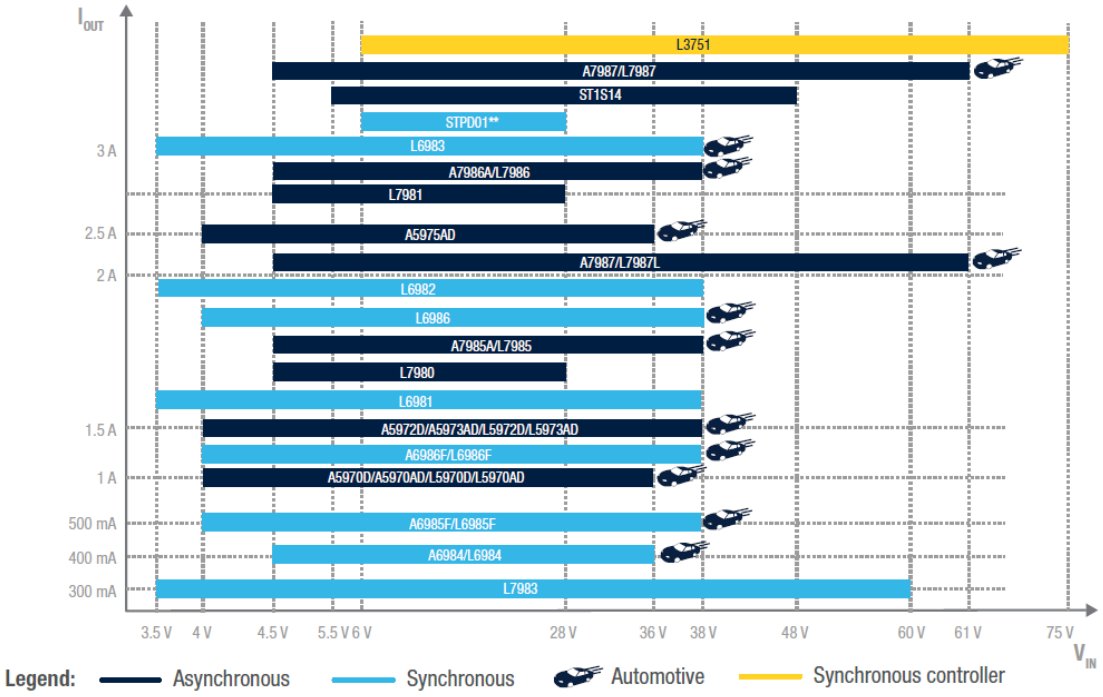
Compensation

Compensation refers to the feedback and compensation networks that keep the regulator stable. For some regulators, these are external and allow for customization and flexible designs; while other regulators have embedded compensation networks that contribute to easier and more compact designs.

Accuracy

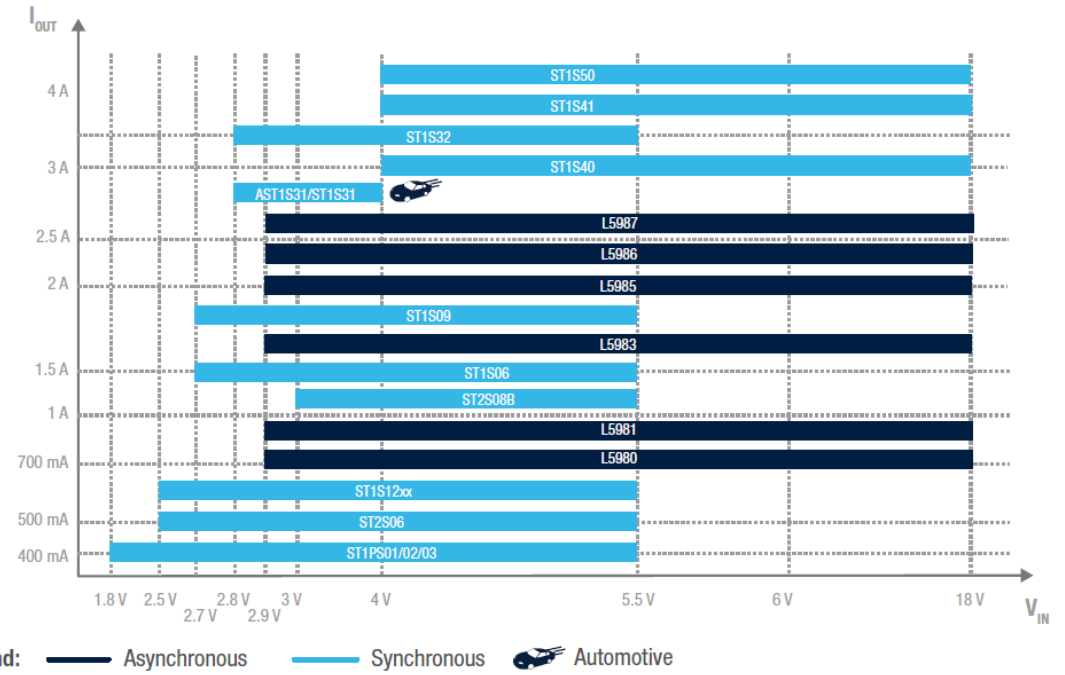
Accuracy is the variance in output voltage with respect to the desired target voltage. The overall output accuracy also includes variance caused by line and load changes.

Pre-regulation (>24 V)



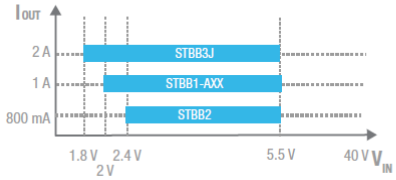
Note: * under development, ** for USB PD, up to 60 W output power (20 V, 3 A)

Post-Regulation (<24 V)

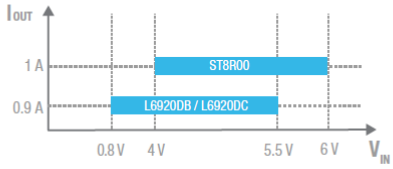


Note: * under development

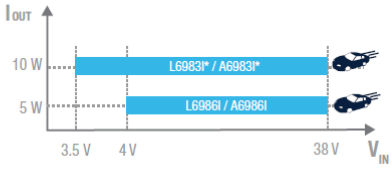
Buck-Boost



Boost



IsoBuck



Note: * under development

Documents / Resources

	STMicroelectronics L7987L Asynchronous Switching Regulator [pdf] User Guide BR2209DCDCQR, L7987L, L7987L Asynchronous Switching Regulator, Asynchronous Switching Regulator, Switching Regulator, Regulator

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