

How to Choose the Right Kind of DC/DC Conversion for Your Appliance Design



TI Kevin

Appliances need DC/DC conversion to transform a rail (usually a 12V rail) into a 5V or 3.3V rail in order to power low-voltage components. You can achieve DC/DC conversion in multiple ways, but one popular way is to use a low-dropout regulator (LDO) or a switch-mode power supply.

Designers choose LDOs because they are usually low cost and small in size, but there are more reasons why you would want to use an LDO as a point of load. An LDO's lack of switching noise makes it a perfect power supply for noise-sensitive subsystems. Another key feature of LDOs are their low quiescent current, making them a good fit for applications that do not require continuous operation while minimizing power consumption during idle mode. An LDO is also fairly easy to design with given its low external component count.

Here is a selection of some LDOs for your appliance design:

- [TPS7A16](#), 60V, 5- μ A I_q, 100-mA with Enable and Power Good
- [TPS709](#), 30-V, 150-mA, Ultra-Low IQ with Reverse Current Protection
- [TPS7A39](#), Dual-Output, 2-A/1-A with Power Good
- [TLV760](#), 150mA With Foldback Current Limit
- [TLV703](#), 300mA Low-IQ, high PSRR

The losses in an LDO are the product of the current and the voltage drop, meaning that efficiency and power dissipation will limit their use if the voltage difference between the input and output is too wide or if the output current requirements are too high. These situations can cause temperature increases at the LDO. You can resolve this heat exchange problem by selecting an LDO package like transistor outline (TO)-220 with a large metal tab, or a surface-mount device (SMD) package with an exposed thermal pad and a large-enough metal area acting as a heat sink. LDOs in an SMD package with a large-enough pad can achieve very good thermal dissipation, directly reducing the increase in temperature.

To improve the efficiency of this step-down stage, you can use a switch-mode converter, which will enable you to have more output current available while consuming less power at the input. Your two options are a step-down converter or a power module.

Converters are controllers with integrated field-effect transistors (FETs), allowing some flexibility. The [5V, 1A, Cost-Effective Dual-Layer TO-220 LDO Replacement Reference Design with 92.5% Efficiency](#) uses a step-down converter to replace an LDO. The increased efficiency in this reference design also enables a smaller footprint, because you no longer need a heat sink or pad and the switch-mode converter requires a very small area. This works within any existing appliance designs or as an improved subsystem in next-generation designs.

Power modules facilitate a decreased time to market by integrating most external components (although you may still need input and output capacitors). Like step-down converters, power modules are also really easy to design with. I recommend these power modules for appliances: the [TPSM84205](#) and [TPS82150](#).

LDOs, switch-mode converters and power modules have many advantages that would make each of them fitting different requirements. For point of load in appliances, have a look at TI's LDOs, switch-mode converters and power modules, as well as our reference designs.

Additional Resources

- Learn more about TI's [solutions for your appliance design](#)

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2023, Texas Instruments Incorporated