

Simplify Robust Hot-swap Design Using Design Calculator Tools



Alex Triano

As the hot swap industry grows and systems require higher power, lower form factor, and lower cost solutions, component selection becomes more critical. Several calculations are involved and designing for worst-case scenarios can quickly become a challenge. Did you account for the timer pin’s minimum/maximum sourcing current, or de-rate the MOSFET’s safe operating area (SOA) curve over temperature? You need to consider these types of questions or else your design may experience startup issues – or even MOSFET or integrated circuit failure.

Design tools such as the [LM25066 design calculator](#) can help address these questions and perform the necessary calculations for you, saving hours of time and avoiding the risk of human error. Whether you are creating a new design or troubleshooting an existing one, consider using a design calculator to reveal areas of concern.

The most dangerous fault that can occur in a hot swap design is a short circuit on the output followed by the application of input power. The MOSFET will begin to turn on while in its saturation region (high V_{DS} voltage), and power dissipation can be quite large. Some hot swap controllers (such as the [TPS24770](#)) may limit the power dissipation of the MOSFET in this condition, while other controllers may not.

In order to check whether the MOSFET is at risk, you’ll need to consider the magnitude and duration of the power that the hot swap controller can limit, and compare it to the magnitude and duration of the power that the MOSFET can handle without failure. A design calculator tool will walk you through this process by gathering all of the necessary inputs (such as maximum load current, ambient temperature, $R_{DS(ON)}$, thermal coefficient, current limit/power limit and SOA curve) and then compute how much margin the design has. If the MOSFET is at risk, the tool will highlight the cell in red (see [Figure 1](#)) and explain how to address the problem.

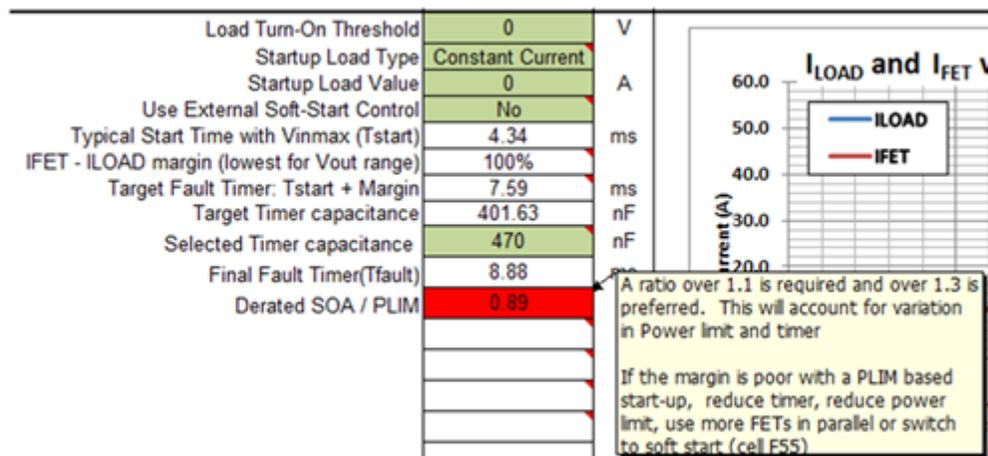


Figure 1. Example of a Hot Swap Design with a Poor MOSFET SOA Margin under Worst-case Conditions (Taken Using Step No. 4 of the LM25066 Design Calculator Tool)

You can avoid many application issues by using a hot swap design calculator tool to help with component selection and to create, review or troubleshoot a hot swap circuit design.

Additional Resources

- Browse TI's [vast collection of hot swap design tools](#), unique to each product family.
- Watch [video tutorials](#) that walk you through each step of the design calculator tool.
- For a discussion of the detailed equations and methodology behind hot swap design, see the application note, "[Robust Hot Swap 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