基于热性能的 NIS(V)3071 PCB 设计考虑因素

AND90246/D

介绍

单片电子保险丝 (eFuse) NIS(V)3071能够提供高达10 A 连续电流。在设计它的PCB时热性能是重要的考量因素，在设计PCB热特性时，需要考虑 eFuse 的两种工作模式: 软开关开通阶段和稳定工作状态。在软开关开通阶段，eFuse的短期功率耗散可达几十瓦，而稳定工作状态时则可能为几瓦。本文将通过比较四层和两层PCB，说明使用多层PCB为器件散热带来的性能优势。图 1 显示的是两层PCB，图 2 显示的是面积同样为 2000 平方毫米的四层PCB。

以下对两种PCB在相同条件下的热参数进行比较。FAULT引脚上ESD结构的线性温度曲线用于测量结温。该器件在输入电压Vin = 12 V且无负载的情况下驱动芯片，在此电压下，以 1 mA的电流对两个测试板上的ESD结构进行温度特性分析，并使用 Temptronic X–Stream 4300对温度进行扫描。此温度特性分析的电路原理图如图 3所示: 温度特性测试配置。

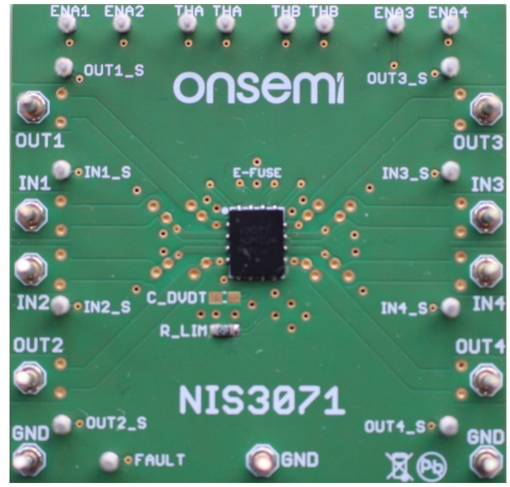

图 1. 双层PCB

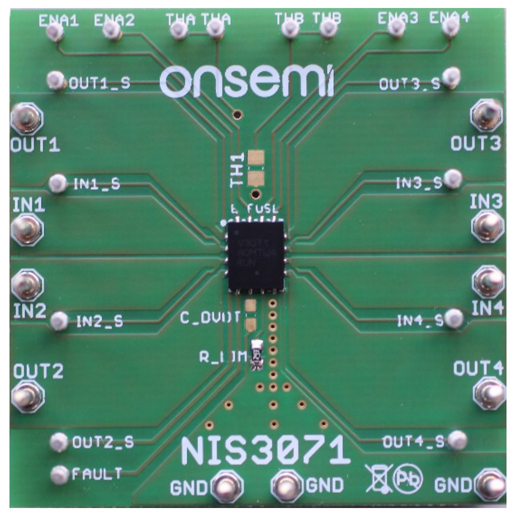

图 2. 四层PCB

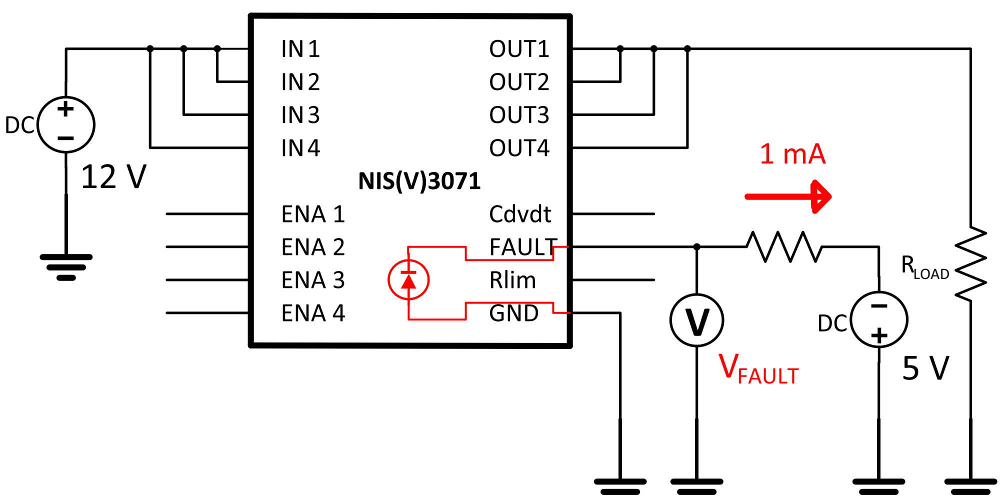

图 3. 温度特性测试配置

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在 30°C 至 150°C 的温度范围内，ESD 结构的两块测试板上的电压如图 4 所示: 热性能分析。

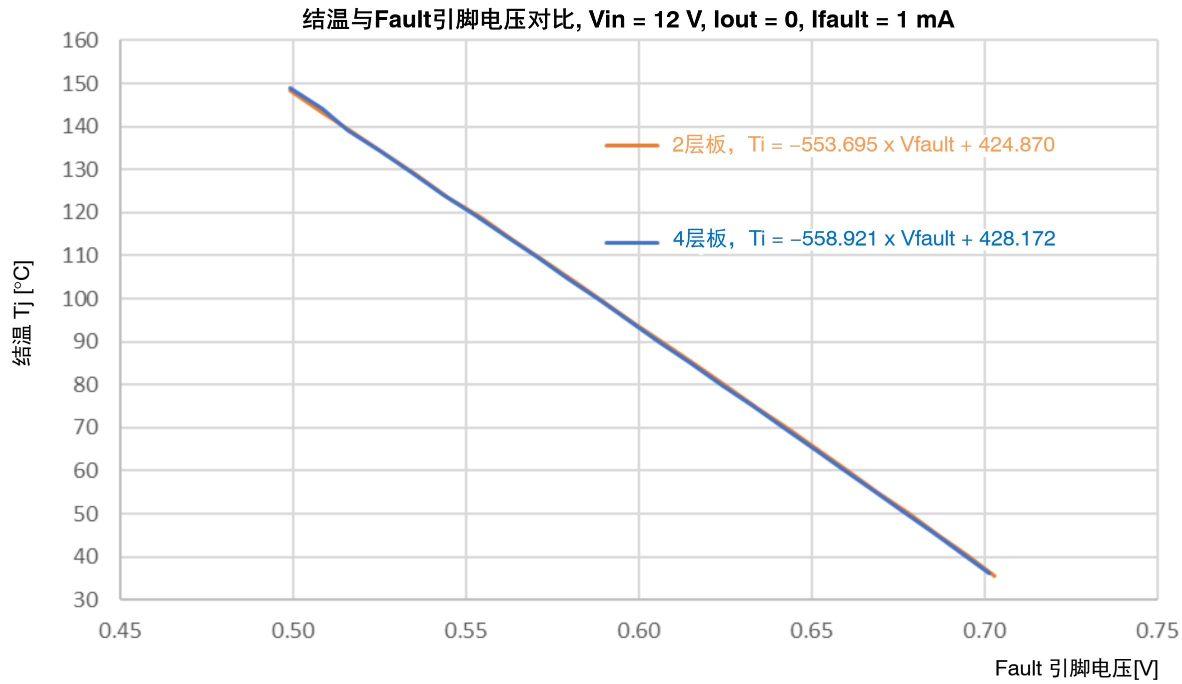


图 4. 温度特性测试配置

在供电电压 Vin = 12 V 的情况下，设定所有四个并联通道的输出电流，使两块测试 eFuse PCB上的功耗都正好为 1 W。

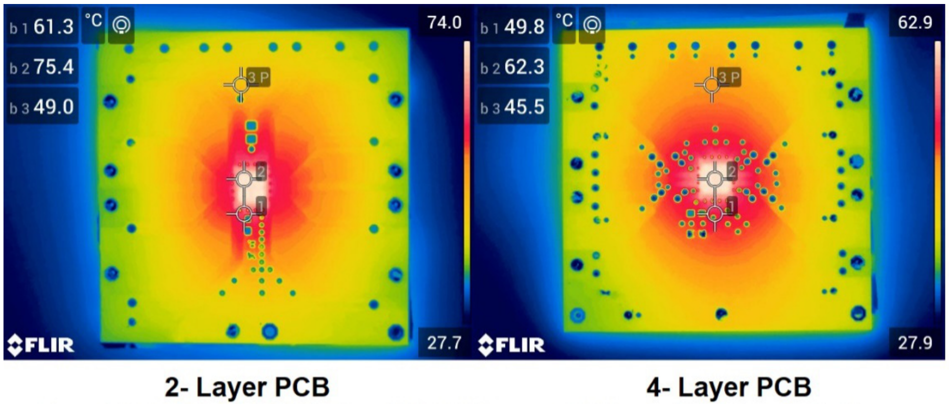
表 1 显示了在相同电流 (1 mA)下，两块被测PCB上 FAULT 引脚基于 ESD 结构的电压。根据这些电压，按照图 4 所示公式可计算出每块电路板上的结温。测量是在环境温度为 Ta = 23°C 的自然空气对流条件下进行的。两层和四层PCB的结至环境热阻 (Rthja) 值由下式给出。

Rthja = (Tj − Ta)/Pd [°C/W]

表 1.

Board	Vin [V]	Iout [A]	Vin−Vout [mV]	Rdson [mΩ]	Pd [W]	− Vfault [mV]	Tj [°C]	Ta [°C]	Rthja [°C/W]
4−Layer	12.00	6.84	149.22	21.82	1.02	636.16	72.61	23.04	48.57
2−Layer	12.00	6.09	165.11	27.09	1.01	615.16	84.26	23.18	60.71

图 5. 热像仪显示了作为对比的两个PCB的温度分布。相比于相同面积的两层PCB，四层PCB具有低12°C/W的热阻。结温Tj也可以通过Rdson的变化来计算，但在大约6 A的输出电流下，自热效应使得这种相关性的表征变得复杂，并且Rdson随温度以及输出电流的变化并非线性。



Ta = 23°C, Vin = 12 V, Pd = 1 W PCB面积为 2000 mm2，自然空气流通

图 5. 热像仪

附录中是上述两种PCB的完整说明和堆叠图。

焊接指南

焊接 NIV3071 器件时，我们建议遵循 IPC−7527 标准和焊接指南。在某些需要刚性多层PCB的应用中，建议使用高可靠性焊膏。高可靠性焊膏将有助于确保焊点在板级可靠性温度循环测试期间的机械完整性。

附录

双层PCB设计

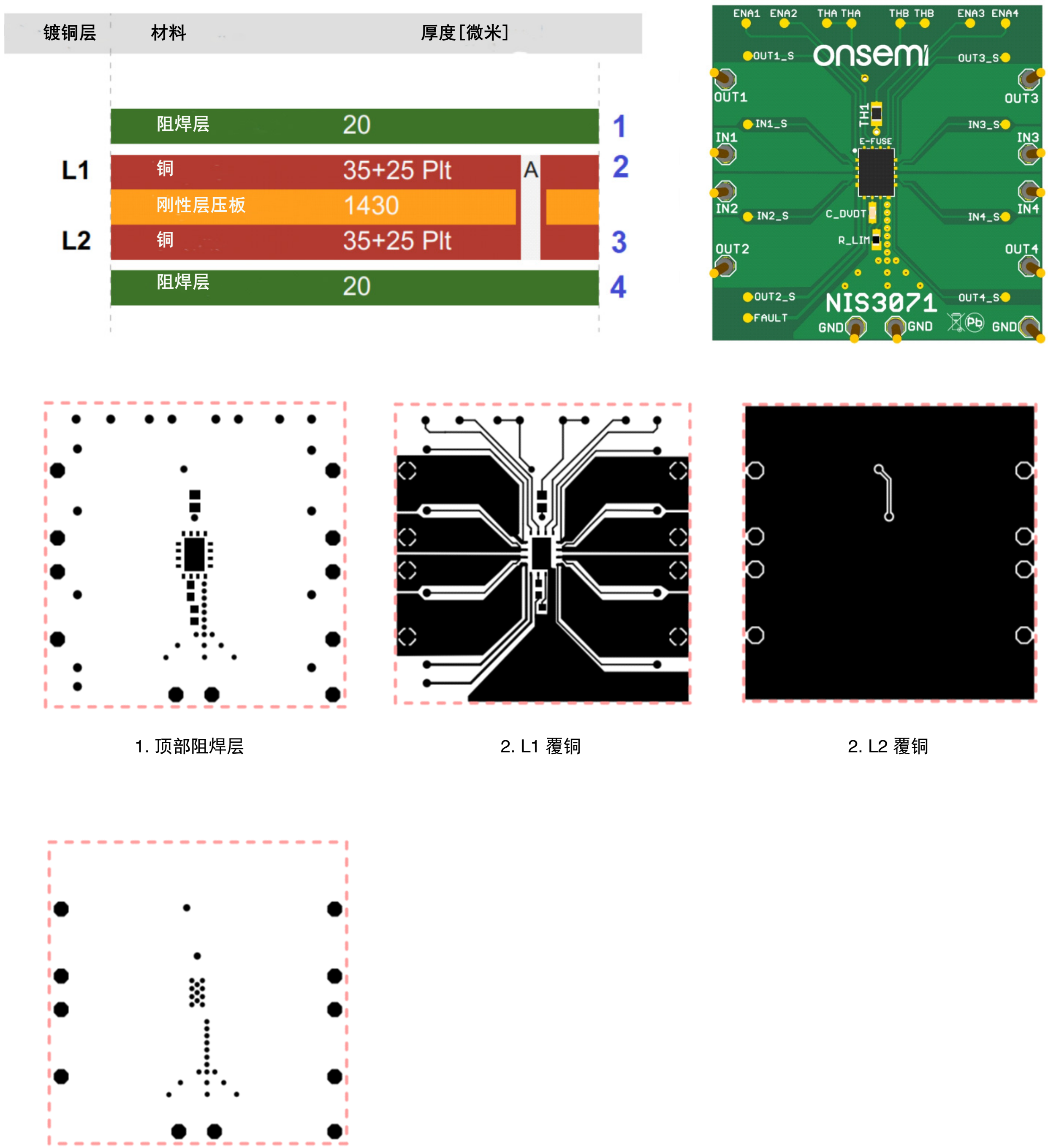


图 6. 双层PCB设计

四层PCB设计

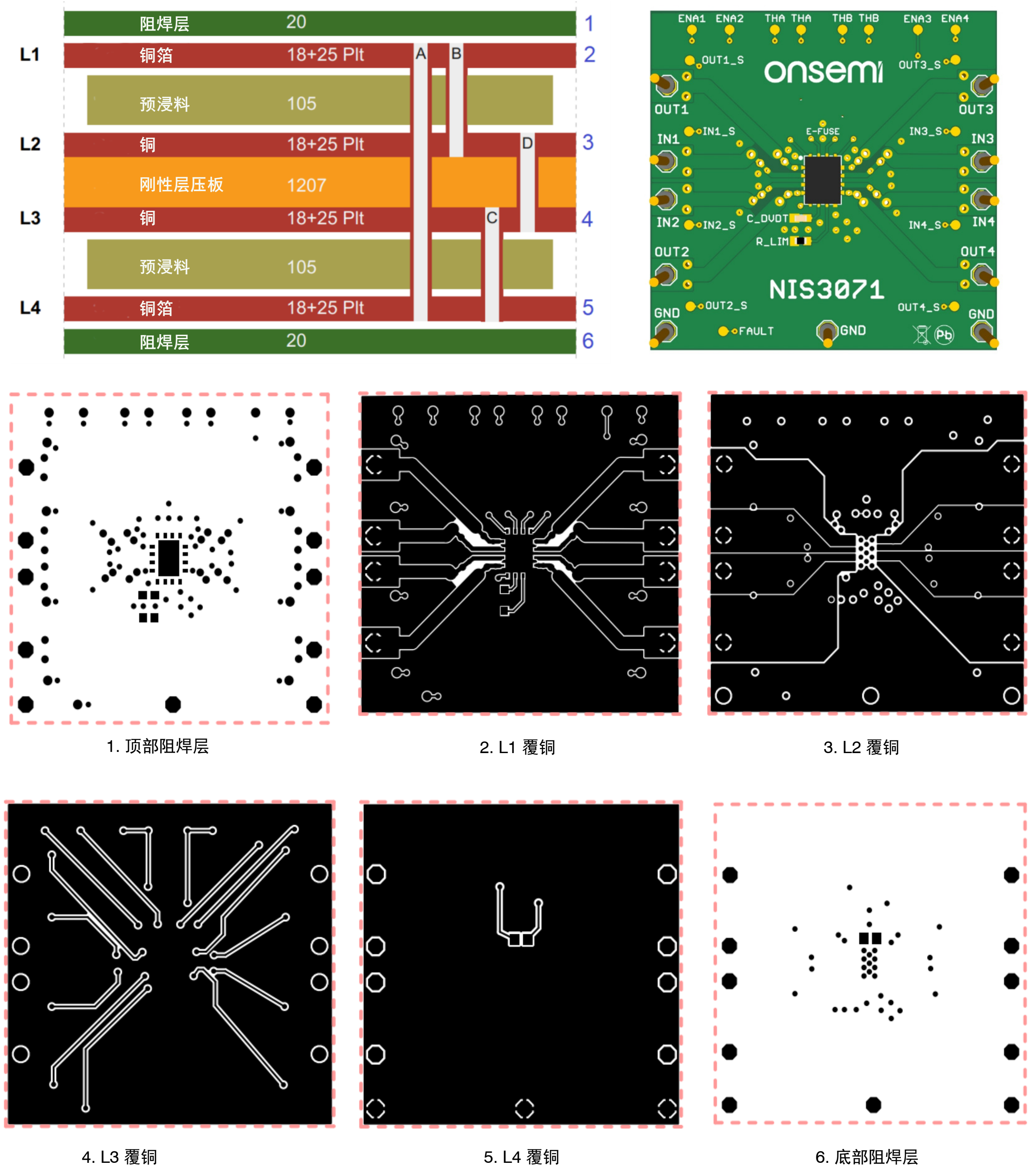


图 7. 四层PCB设计

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