

1 引言

本应用笔记介绍了 LPC55xx 器件上的 DCDC 转换器并提供了硬件设计指南，讲解如何为 DCDC 转换器正确选择外部器件。本文档主要介绍了 DC/DC 外部器件的关键参数以及不正确选择，包括外部器件的 PCB 设计示例。

2 DCDC 转换器的理论和用途

DCDC 转换器用于由电池供电的便携式电子设备中（例如蜂窝电话和膝上型计算机）。这样的电子设备通常包含几个子电路系统，每个子电路具有其自己的电压电平要求，该电压电平要求不同于由电池供电或外部电源供电（有时高于或低于电源电压）。另外，电池电压降低是因为其存储的能量快被消耗完了。开关式 DCDC 转换器提供了一种通过降低部分电池电压来提高电压并节省空间的方法（而不是使用多个电池来实现相同的目标）。大多数 DCDC 转换器电路还可以调节输出的电压。但不包括高效 LED 电源（用于调节流过 LED 的电流的 DCDC 转换器）和简单的电荷泵（将输出电压提高一倍或三倍）。

开关转换器（例如 LPC5500 中的降压转换器）比 DCDC 转换器和线性稳压器（更简单的电路，通过耗散多余的热量作为热量来降低电压）提供的功率效率要高得多，但不会增加输出电流。

3 硬件设计指南

本章总结了内部 DCDC 转换器对于外部元器件的硬件要求，包括推荐合适的外部元器件和 PCB 设计的建议。

LPC55xx 系列内部的电源是由六个内部稳压器（包括 DCDC 转换器）组成，这些稳压器由主外部电源域（VBAT 1.8 V – 3.6 V）供电。正确的 DCDC 功能所需要的外部器件以及它们和 MCU 的连接如图 1 所示。

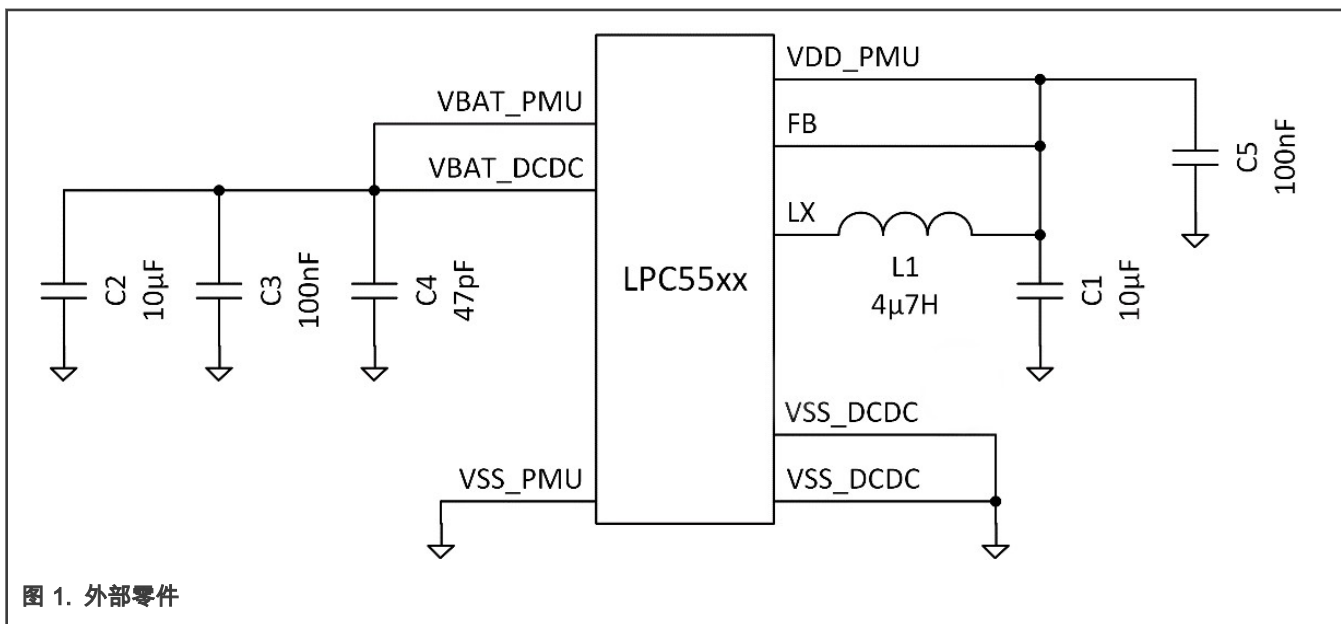


表 1 总结了封装的引脚名称和编号。

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表 1. 内部 DC-DC 转换器的引脚名称和编号列表

引脚名称	引脚编号	
	HLQFP100	VBGA100
VBAT_DCDC	49	45
VBAT_DCDC_CORE	50	45
VBAT_PMU	51	46
VSS_DCDC	47	43
VSS_DCDC_CORE	46	42
VSS_PMU	—	47
LX	48	44
FB_VDD_PMU	45	41

表 2 总结了 DCDC 内部转换器的对外部元件需求的典型值和限制。

表 2. 外部零件

部分	最小值	典型值	最大值	单元
C1	10	22 (X5R or X7R)	47	μF
C2	10	22 (X5R or X7R)	47	μF
C3	80	100 (X5R or X7R)	120	nF
C4	38.7	47 (COG)	56.2	pF
C5	80	100 (X5R or X7R)	120	nF
L1	3.87	4.7	10	μH

3.1 输入去耦电容器

100 nF 和 47 pF 陶瓷电容是 DCDC 转换器的输入去耦电容。10 mF (或者 20 mF) 输入端的陶瓷电容用于去耦内部 DCDC 转换器并为其供电。所有去耦电容必须靠近对应的引脚放置。电容没有 ESR 值限制。

3.2 输出滤波电容

该电容用于优化输出电压的纹波。输出电容的最小选择 10μF，这对于 DCDC 转换器功能的正常工作是必需的。该电容优化了电压纹波值，这点对于 USB 供电的系统来说非常重要。

如果输出电容的值低于 10μF，输出电源的纹波就会变高，不符合内部 LDO 的要求。高于 22μF 的电容会增加相应的电流噪声。

3.3 功率电感

大多数应用的典型电感值范围为 3.7 μH 至 5.6 μH。这些值是根据所需的电流的纹波来选择的。

感值较小的电感器会以较高的输出纹波电压为代价，并且会导致较高的输出电压摆率，从而改善转换器的负载瞬态响应。较大的电感值会降低电流的纹波。

表 3 总结了功率电感的典型值和限制。

表 3. 功率电感器

参数	最小值	典型值	最大值	单元
电感值	3.7	4.7	5.6	μH
饱和电流	350	500	—	mA

3.3.1 饱和电流限制

饱和电流的最小值为 350 mA。建议的饱和电流为 500 mA (或更高)。

3.4 PCB 指导线

为了减小 DCDC 电感器的串联电阻，应使走线尽可能粗和短。电容 C2、C3、C4 的输入端和 DCDC 接地焊盘，以及输出电容 C1 之间的接地必须在同一平面上。不能使用通孔或直接细线连接。图 2 显示了正确的 DCDC 接地连接。

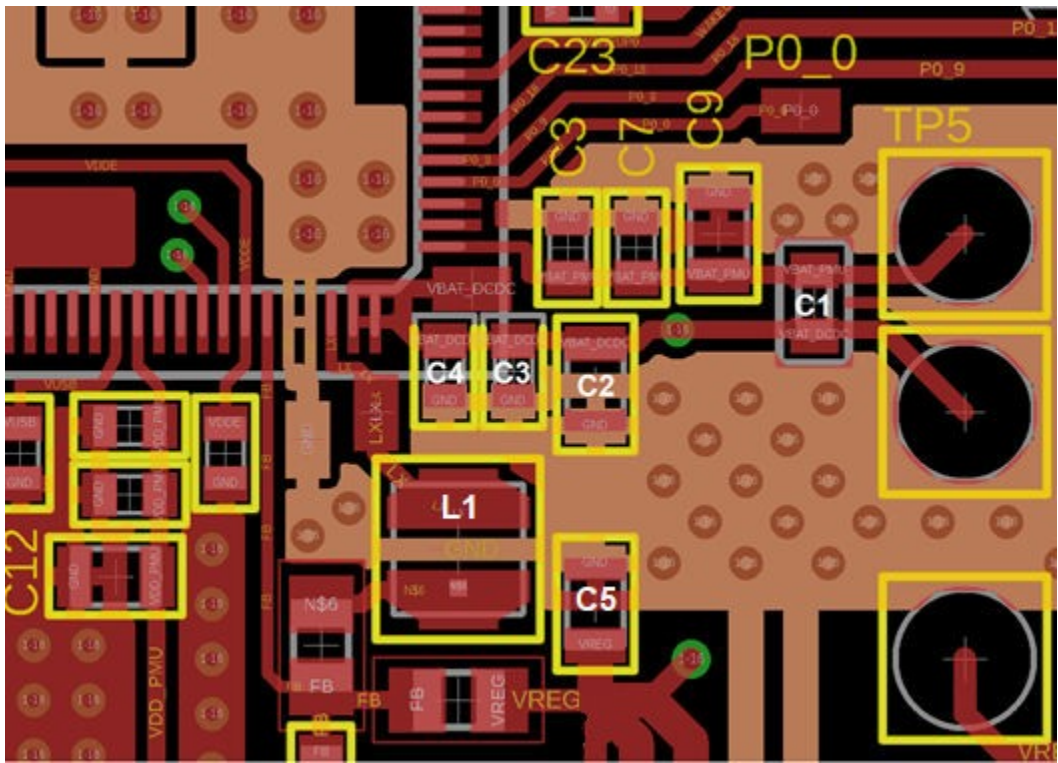


图 2. 接地连接

4 结论

本应用笔记总结了 LPC55xx 中使用的内部 DCDC 转换器的所有外部器件和 PCB 布局建议。要获得正常的功能，请在 LPC55xx 的设计中遵循这些建议。高效率通常是使用 DCDC 转换器的主要目的。使用 DCDC 转换器可提高电池电压从高到低电压时的转换效率。如果使用线性稳压器，则无法达到与开关稳压器相同的效率。

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