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# 应用指南 AN-5064

## 满足超便携设计的低漏电流 ( $I_{\text{OCT}}$ ) 模拟开关

### 总结

飞兆半导体已革新并增强了模拟开关的设计来满足诸如手机等超便携产品的需求。

然而, 功能的进一步集成和生产工艺的改进意味着控制模拟芯片集和为其供电对供电电压有不同的要求。

为了解决这个问题, 飞兆半导体作为领先的模拟开关供应商, 对现有产品进行了革新并推出了新一代模拟开关。

新一代的模拟开关提供了增大的控制电压输入范围, 同时保持低电流消耗以及轨对轨的信号传输。

该应用指南讨论了设计变换的深层原因和新解决方案如何满足这些超便携式产品的应用需要。

另外, 本文还讨论了特别为延长超便携设备的电池寿命而设计的新型低漏电流 ( $I_{\text{OCT}}$ ) 模拟开关以及为提高混合电压轨上的性能和增强整体系统性能而进行的设计权衡。

超便携式产品, 如手机、PDA 或 MP3 播放器, 模拟开关被广泛用于 USB

接口的共享和隔离, 以及音频信号的切换。

无论何种终端应用, 选择了满足配置和应用特定需求的开关后, 通常有若干关键规格是超便携式产品设计人员所寻求的。

超便携产品依靠电池供电, 使得功耗成为选择模拟开关的主要因素。

在大多数超便携系统中都有多个电源轨可用。设计人员使用电源管理 IC 来检测存在的电源。电源管理 IC 选择直接从电池或稳压电源为模拟开关供电。

具体视情况而定, 如果采用墙装稳压电源供电, 供电电压范围可能在 2.7V 到

3.6V 之间, 完全充电电池供电时电压可能高达 4.3V  $V_{\text{CC}}$ 。

直到近来, 机载通用输入输出端口 (GPIO) 的控制电压电平才符合模拟开关的供电电压。

从而使得开关的功耗很小。

在这些情况下, 模拟开关标准的电流消耗小于 1  $\mu\text{A}$ 。

如果超便携产品是由电池供电, 电流消耗将变得非常重要。在标准配置中 (控制 = 0V 或  $V_{\text{CC}}$ ), 模拟开关完全在标准功率预算之内, 电流消耗小于 1  $\mu\text{A}$ 。

新型 ASIC 设计已转向更小的制作工艺上以限制其

电压处理能力。因此, 系统设计人员必须将电源管理 IC 的输出电压降低 到一个合理的水平来为 ASIC 供电。在很多情况下, ASIC 要求 2.6V 到 2.8V 的供电电压, 这限制了 GPIO 信号的最大输出电压。GPIO 信号一般用于驱动模拟开关的控制引脚。

当标准模拟开关直接由电池供电且 GPIO 电压在 2.6V 到 2.8V 之间时, 这将导致开关的过量电流消耗。过电流可能高达几毫安, 似乎具体开关设计而定。

对于已在紧张的电力预算下运行的便携式设备, 几毫安的功耗是无法接受的。

多数标准模拟开关的产品说明书只有典型情况的 ICC 功耗指标, 即输入控制电压等于供电电压。

这给许多系统设计人员造成困惑, 他们会惊奇地发现在低压 ASIC 设计中模拟开关会有几毫安的漏电流。

低漏电流 ( $I_{\text{OCT}}$ ) 模拟开关专为这类应用而设计。图 1 显示了应用差异, 这使得设计人员使用一个新型低漏电流 ( $I_{\text{OCT}}$ ) 模拟开关。

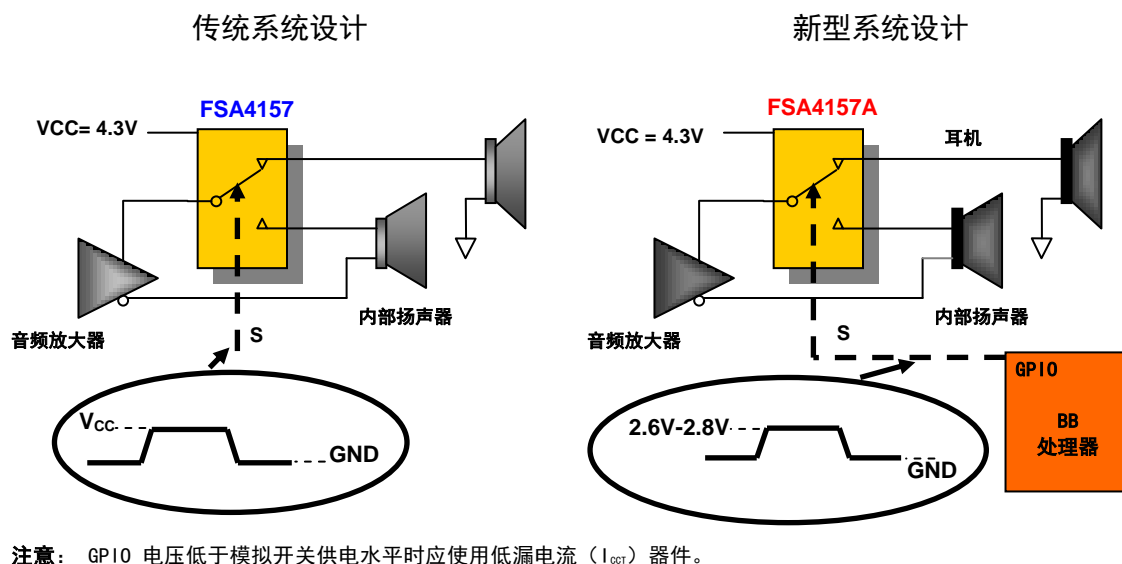


图 1 音频开关应用

图 1 阐明了使用 FSA4157 的传统系统设计和使用 FSA4157A 的新型系统设计之间的关键差异。可以看出，在第一种情况下选择的引脚高电平状态是由为 FSA4157 供电的同一个  $V_{CC}$  电轨所驱动的。在该配置中，电流消耗通常小于  $1\mu A$ 。在新的系统设计中，选择的引脚不再由 FSA4157A  $V_{CC}$  电轨驱动，但是受到 ASIC 电源轨的限制。在该配置中，标准模拟开关电流消耗通常大于  $1mA$ 。

当控制输入电压为  $0V$  或  $V_{CC}$  时，CMOS 控制电路输入缓冲器只有很小的电流消耗。数据表指出，只要控制信号输入保持大于  $V_{IH}$  最小值且小于  $V_{IL}$  最大值时，开关将会识别控制信号的高低电平，但没有具体说明当控制输入电压不是  $0V$  或  $V_{CC}$  时电流消耗是多少。虽然当控制信号在要求的  $V_{IH}$  和  $V_{IL}$  的范围之内时控制逻辑将会选择正确的输出状态，

但控制电压离电轨更远，而且电源消耗也更大。

模拟开关应保持轨对轨信号传输的低功耗，同时支持增大的输入控制范围。

为了满足这一需要，飞兆半导体开发了一系列低漏电流 ( $I_{OCT}$ ) 开关。

这些部件专为用于混合电压轨环境而设计。

不仅在专为超便携应用而设计的新开关中实现了此低电流消耗，而且在为超便携式应用设计的新型模拟开关产品中亦如此。模拟开关团队发布的

"A" 版本在类似应用中选择使用现有模拟开关。

这些部件仍然可以直接通过

4.3V 的电池供电，但是不再要求控制电压等于  $V_{CC}$  来保持低功耗。即使对于那些电池供电始终下调至 3.6V 的应用，当选择低于开关电源轨且需要低漏电流 ( $I_{OCT}$ ) 版本时，标准模拟开关的电流消耗也会过大。

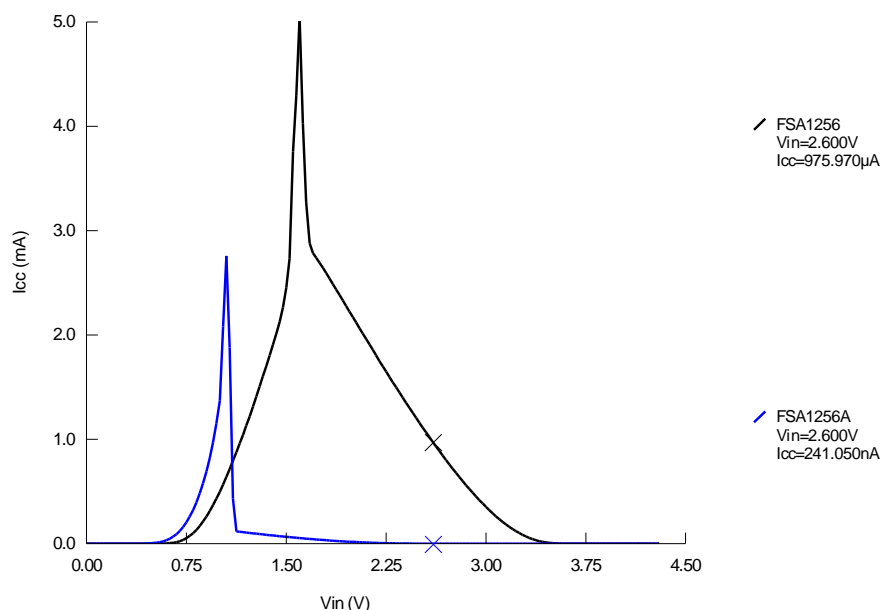


图 2  $I_{cc}$  与  $V_{IN}$ , 低漏电流开关 ( $I_{OCT}$ ) 与传统模拟开关, FSA1256 与 FSA1256A

图2 是新一代模拟开关与传统开关的传输曲线比较图。可以看出, 虽然电流峰值依然存在, 但是向左移动且其峰值已经减小。

在这些新的低漏电流 ( $I_{OCT}$ ) 开关中, 当  $V_{CC} = 4.3V$  且控制 = 2.6V 时, 总功耗电流消耗远小于 10μA。

这对于传统模拟开关而言是巨大的增强。

对于使用混合电压轨以及受限

GPIO 驱动能力的便携式应用,

这些开关提供了一个低功耗解决方案。

为了提高性能需要作出一些取舍。

首先, 新开关上的控制输入开关阈值下移了。

电流峰值的位置移动在图 2 中可以看出。

而且, 这些新 "A" 型产品导通 ( $t_{ON}$ ) 和关断 ( $t_{OFF}$ )

时间略有增加且  $V_{CC}$  最小电源电压范围也有所提高。

这种折衷关系在应用中并不影响系统的性能。

典型的低漏电流 ( $I_{OCT}$ ) 产品最小供电电压将从 1.65V

增加到2.3V。

这通常不是问题, 因为很少有超便携式设计会以低于 2.3V 的电源来为模拟开关供电。

此外, 由于模拟开关不会消耗太多功率 (大约 1μA), 所以设计人员更喜欢使用高功率电轨 (大于 2.3V) 来实现更低导通电阻。对于典型音频开关或 USB 应用, 低的  $R_{ON}$  是非常重要的。

在大多数的应用中, 开关时间的增加仍然远小于系统的要求, 所以  $t_{ON}$  和  $t_{OFF}$  时间的增加是无关紧要的。

总而言之, 使用新低漏电流 ( $I_{OCT}$ ) 模拟开关获益巨大。

对于新型电池供电超便携式设计, 新一代模拟开关是超便携式设计人员不可或缺的工具包。

这些产品可以帮助设计人员控制其产品功耗预算并确保较长的电池使用寿命。

要查看所有飞兆半导体模拟开关的完整目录, 请参阅模拟开关页面:

[www.fairchildsemi.com/analogswitch](http://www.fairchildsemi.com/analogswitch)。

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