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AN-5064TC — 滿足便攜設計的低漏電流模擬開關

飛兆半導體已經革新了模擬開關的設計來滿足手機及其他超便攜產品的要求。然而，功能的進一步集成和生產工藝的提高意味著模擬芯片具有不同供電電壓的要求。為了解決這個問題，作為一個主導的模擬開關供應商，飛兆半導體對現有產品進行了革新並推出了新一代模擬開關。這種新一代低功耗模擬開關提供了寬廣的控制電壓輸入範圍並具有切換 0 到 Vcc 信號的能力。該應用筆記討論了設計變換的原因和新的解決方案如何適應這些超便攜式產品的應用需要。另外，本文還討論了特別為便攜設備延長電池壽命而設計的低漏電流（ICCT）模擬開關。

在便攜式產品譬如手機，PDAs，或 MP3 中，模擬開關被廣泛用於 USB 接口的共享和隔離以及音頻信號的切換。不管是何種最終應用，通常考慮了配置和應用的特定要求以後，有幾個關鍵規格是所有超便攜式的設計人員所尋找的。便攜式的產品通常依靠電池作為供電電源。功耗是對一個模擬開關的選擇的主要因素。在大部分的便攜式的系統中，存在著各種高低不同的供電電源。模擬開關供電可能來自手機電池或從被電源管理模塊調節過的電源輸出。根據具體情況，供電電源來自於被調整過的電源（2.7V 到 3.6V）或者來自於電量充足的電池（高達 4.3V）。傳統上，手機上通用輸入輸出口(GPIO)的控制電壓電平與模擬開關的供電電壓是一致的。從而導致開關的功耗很小。在這些情況下，模擬開關標準的功耗小於 1uA。更新的 ASIC 設計逐步走向更小幾何尺寸的工藝從而它們的電壓處理能力被有所限制。因此，系統設計師必須降低能源管理的輸出電壓到一個合理的水平來給 ASIC 供電。在很多情況下，ASIC 設計要求 2.6V 到 2.8V 的供電電壓，這限制了 GPIO 信號的最大輸出電壓。這 GPIO 信號一般用來驅動模擬開關的控制端口。當標準模擬開關直接地由電池供電並且 GPIO 電壓是在 2.6V 到 2.8V 範圍，這將導致過量的功耗。對於某些開關，電流消耗可能高達幾毫安。對於已經運行在很緊的電力預算的便攜式設備，幾毫安的功耗是無法接受的。多數標準模擬開關的產品說明書隻有典型情況的功耗指標，這一典型情況即為開關輸入控制電壓高電平與開關供電電壓一致。這給許多系統設計師造成了混淆，他們會驚奇地發現在低壓 ASIC 設計中模擬開關會有幾毫安漏電流。Fairchild 的低漏電流模擬開關就是專門為這種應用而設計的。圖 1 所描述的應用的不同性來驅使一個設計師去使用新的低漏電流模擬開關。圖 1 還說明了在傳統系統設計使用 FSA4157 和更新的系統設計使用 FSA4157A 的關鍵區別。在第一種情況下（傳統的系統設計）控制管腳的高電平等同於 Vcc 供電電壓，在這種配置裡開關的功耗是典型的小於 1uA。由於被 ASIC 供電電壓所限制，在新的系統設計裡面驅動控制管腳的電壓不再等同於 FSA4157A 的供電電壓。如果傳統模擬開關用於新的系統設計，開關的功耗是通常大於 1mA。

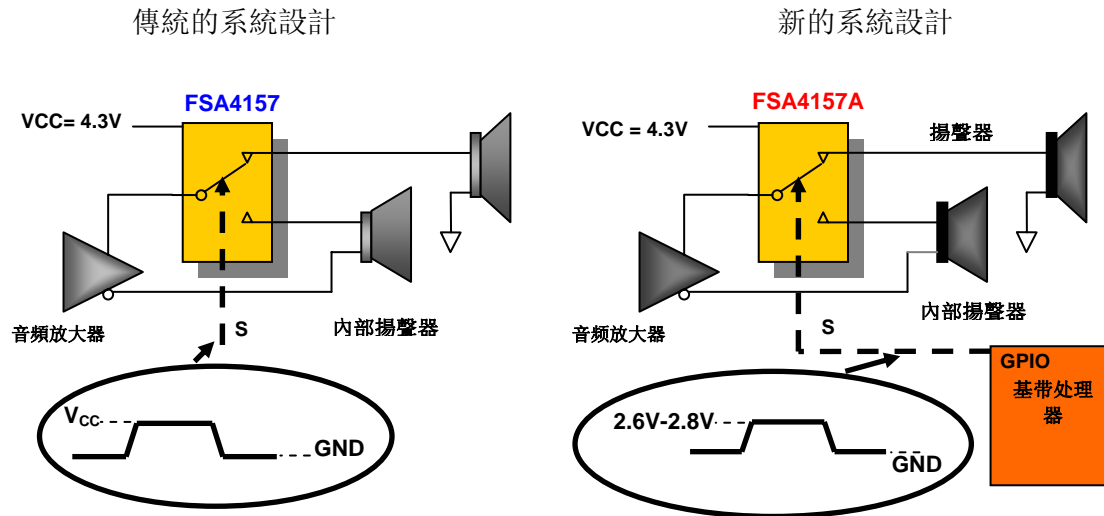


圖 1 音頻開關的應用

當控制輸入電壓在 0V 或 VCC 時，CMOS 控制電路隻有很小的功耗。產品說明書要求隻要控制信號輸入被保持在大於 V_{IH} 最小值和小於 V_{IL} 最大值時，開關將會識別控制信號的高低電平。但傳統產品說明書沒有具體說明當控制輸入電壓不是 0V 或 VCC 時功耗是多少。雖然當控制信號在要求的 V_{IH} 和 V_{IL} 的範圍裡邏輯控制將會選擇正確的輸出狀態，控制電壓離 0 和 VCC 越遠功耗將越大。

象前面所提到，理想的低功耗模擬開關應該允許寬廣的控制電壓範圍同時能夠切換 0 到 VCC 的輸入信號。為了滿足這一需要。飛兆半導體開發了一系列新的低漏電流 (ICCT) 開關。這些新產品是為在圖 1 所描述的新的系統設計而開發的。這種低功耗特征被包含在所有為便攜產品應用設計的模擬開關新品中。所有 A 版本的模擬開關也都有此低功耗特征。這些元件仍然可以直接用 4.3V 的電池供電，但是它沒有必要要求控制電壓等於 VCC 來保持低功耗。設計人員可以免除使用電平轉換(Translator) 模塊從而降低了成本。

圖 2 是新一代模擬開關與傳統開關的傳輸曲線比較圖。雖然電流的尖峰依然存在但是向左移動並且它的峰值已經減小。在這些新的低漏電流模擬開關中，當開關供電電壓等於 4.3V 和控制信號等於 2.6V 時，總功耗遠小於 10uA。這對於傳統模擬開關來講是巨大的提高。在供電電源與控制信號電平不匹配的便攜式產品應用中，這類開關是市場上僅有的低功耗信號切換解決方案。

由於這種被提高了的性能而伴隨出一些折衷的關係。第一，新的開關的控制輸入電壓 (V_{IH}) 的最大值變小。這能夠在圖 2 的電流尖峰位置的移動中看到。而且，這些 A 版本的產品在 t_{ON} 和 t_{OFF} 以及 VCC 的最小供電範圍上面略有增大。好的消息是這種折衷關係在應用中並不影響系統的性能。典型的低漏電流產品的最小供電電壓將從 1.65V 增加到 2.3V。有幾條理由可以說明這不是問題。幾乎沒有便攜產品設計需要用 1.65V 電壓來給模擬開關供電。此外，因為模擬開關不消耗很多功耗(大約 1uA)，設計人員更喜歡用較高的供電電壓(大於 2.3V)來達到更低的導通電阻。對於典型的音頻開關或 USB 應用，低

的導通電阻是非常重要的。同時對於大多數的應用，新型模擬開關較長的開關時間仍然遠小於系統的要求，所以 t_{ON} 和 t_{OFF} 時間的增加是無關緊要的。

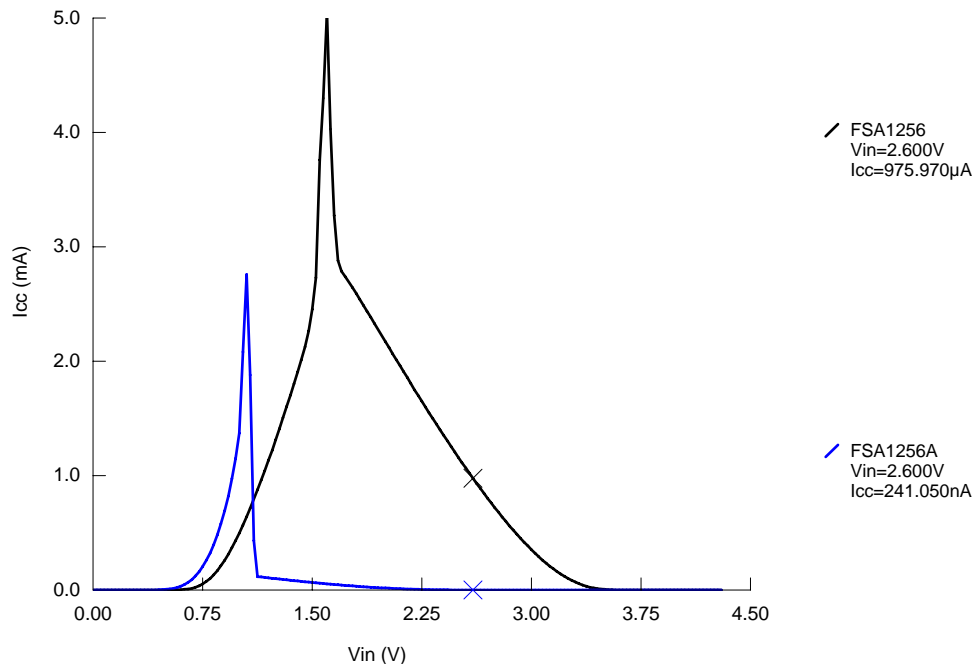


圖 2 開關功耗對應於控制信號輸入電壓的傳輸曲線（傳統模擬開關與新型模擬開關的比較）

總而言之，使用新的低漏電流（ICCT）模擬開關的優越性是重大的。這些產品可以幫助設計人員保持他們的產品功耗預算並確保電池的使用時間。

欲了解所有飛兆半導體 (Fairchild Semiconductor) 模擬開關的完全目錄，請參見

www.fairchildsemi.com/analogswitch.

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