

### 连接/参考器件

ADuM4160	全速/低速 USB 隔离器
ADP3339	高精度、1.5 A LDO (5V 选项)
ADP3330	高精度、200 mA LDO (3.3V 选项)

## 通用串行总线(USB)集线器隔离器电路

### 电路功能与优势

通用串行总线(USB)正迅速成为大部分 PC 外设的标准接口。由于它具有出色的速度、灵活性, 并且支持设备热插拔, 因而正在取代 RS-232 和并行打印机端口。工业和医疗设备制造商也非常希望使用这种总线, 但苦于没有很好的方式来为控制危险电压的机器连接或者医疗应用中的低泄漏防去颤连接提供必要的隔离, 导致应用推广相当缓慢。

ADuM4160 主要设计用作 USB 外设的隔离元件。但在某些情况下, 它也可以用于隔离主机。为此, 必须先解决几个问题。ADuM4160 上游和下游的缓冲器完全相同, 均能驱动 USB 电缆, 但下游缓冲器还必须能够根据与之相连的全速或低速外设调整速度。

在构建专用外设接口的应用中, 速度是已知的并且不会改变, 而主机应用则不同, 必须随机应变。ADuM4160 通过引脚以硬连线方式确定单一速度。因此, 当插入下游侧的外设速度正确时, 它正常工作; 当所连外设的速度不正确时, 它无法工作。解决这一问题的最佳办法是将 ADuM4160 与一个集线器控制器相结合使用。

可以将集线器控制器的上游侧看作是一个标准的固定速度外设端口, 利用 ADuM4160 可以很容易对其进行隔离, 而下游端口的速度则由集线器控制器处理。集线器控制器转换不同速度的外设, 以便与上游端口速度相匹配。图 1 电路显示在某个设计中如何使用一个双端口集线器芯片来隔离两个下游主机端口, 这种处理可以使设计完全符合 USB 规范。

ADuM4160 提供了一种经济简单的方式来实现工业和医疗外设隔离缓冲器。利用该器件的挑战在于必须将其与集线器芯片配对, 以构建完全兼容的主机端口。与任何外设隔离一样, ADuM4160 和集线器提供如下功能特性:

1. 在上游直接隔离集线器芯片的 USB D+ 和 D- 线路, 使集线器能够管理下游主机端口活动。
2. 针对不需要外部控制线路的控制数据流实施自动控制方案。
3. 提供医用级隔离。
4. 允许创建一个或多个符合 USB-IF 认证标准的主机端口。
5. 支持全速信号速率。
6. 支持灵活的电源配置。

本应用电路的目标是像全速外设一样对集线器进行隔离。集线器或主机功能要求为各下游端口提供 2.5 W 功率。隔离器下游侧的电源以及集线器和端口的电源是作为解决方案的一部分而提供。本应用电路是许多医疗和工业应用的典型电路。

### 电路描述

上游 USB 连接器所用的电源从 USB 电缆提供的 5 V VBUS 电压获得。集线器芯片必须提供未使用 ADuM4160 时所需要的所有信号和上拉/下拉电阻。所选的集线器芯片为 **SMSC USB2512** 双端口 USB 集线器控制器, 它具有低成本和小尺寸的特点。此外, 还可以使用相同尺寸的 4 通道版本。本设计为全功能型, 通过 **MIC2026** 配电开关支持各通道的限流功能,

#### Rev.0

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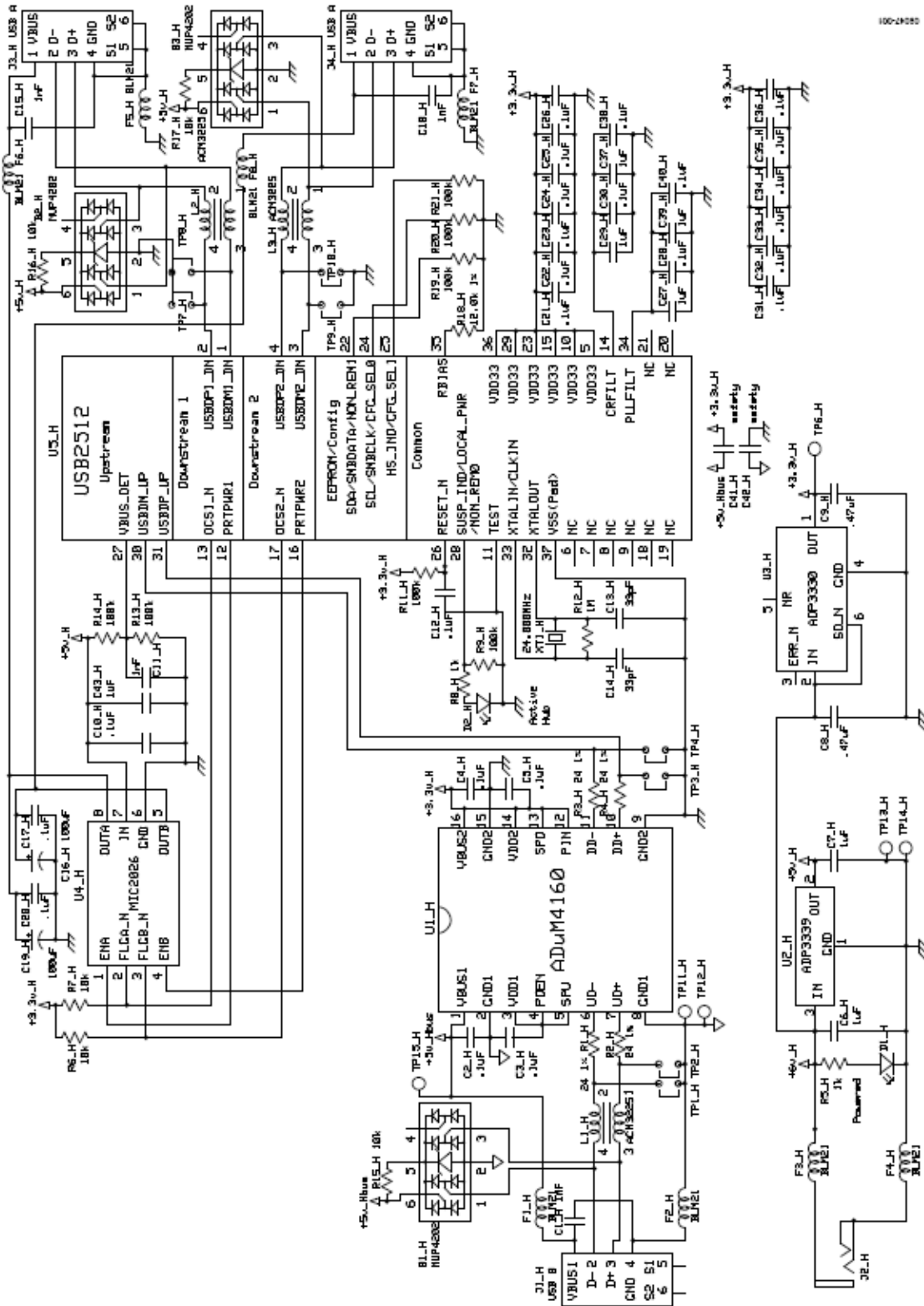


图1. 隔离USB集线器电路



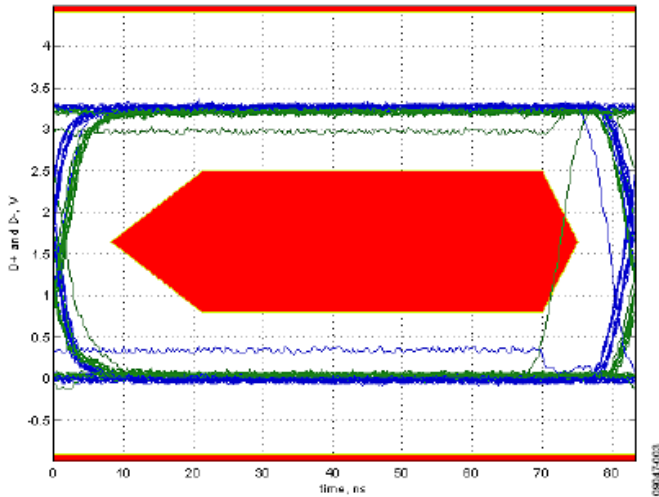


图 3. 显示禁入区域的全速眼图

图 3 为全速眼图，显示 ADuM4160 能够提供充分张开的眼图，并远离禁入区域。但有一个转换是例外，它侵入了禁入区。对于这种测试认证来说这是可以接受的。针对低速评估也获得了类似的数据。评估板的照片如图 4 所示。欲了解布局文件，请访问：[www.analog.com/CN0158\\_Board\\_Layout](http://www.analog.com/CN0158_Board_Layout)。

### 常见变化

根据系统要求，可以使用其它线性调节器代替。详细信息请参考 ADIsimPower™ 设计工具。

### 进一步阅读

ADIsimPower™ Design Tool, Analog Devices.

Cantrell, Mark. Application Note AN-0971, *Recommendations for Control of Radiated Emissions with isoPower Devices*. Analog Devices.

Chen, Baoxing, John Wynne, and Ronn Kliger. *High Speed Digital Isolators Using Microscale On-Chip Transformers*, Analog Devices, 2003.

Chen, Baoxing. *iCoupler® Products with isoPower™ Technology: Signal and Power Transfer Across Isolation Barrier Using Microtransformers*, Analog Devices, 2006

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Krakauer, David. “Digital Isolation Offers Compact, Low-Cost Solutions to Challenging Design Problems.” *Analog Dialogue*. Volume 40, December 2006.

MT-031 Tutorial, *Grounding Data Converters and Solving the Mystery of “AGND” and “DGND”*. Analog Devices.

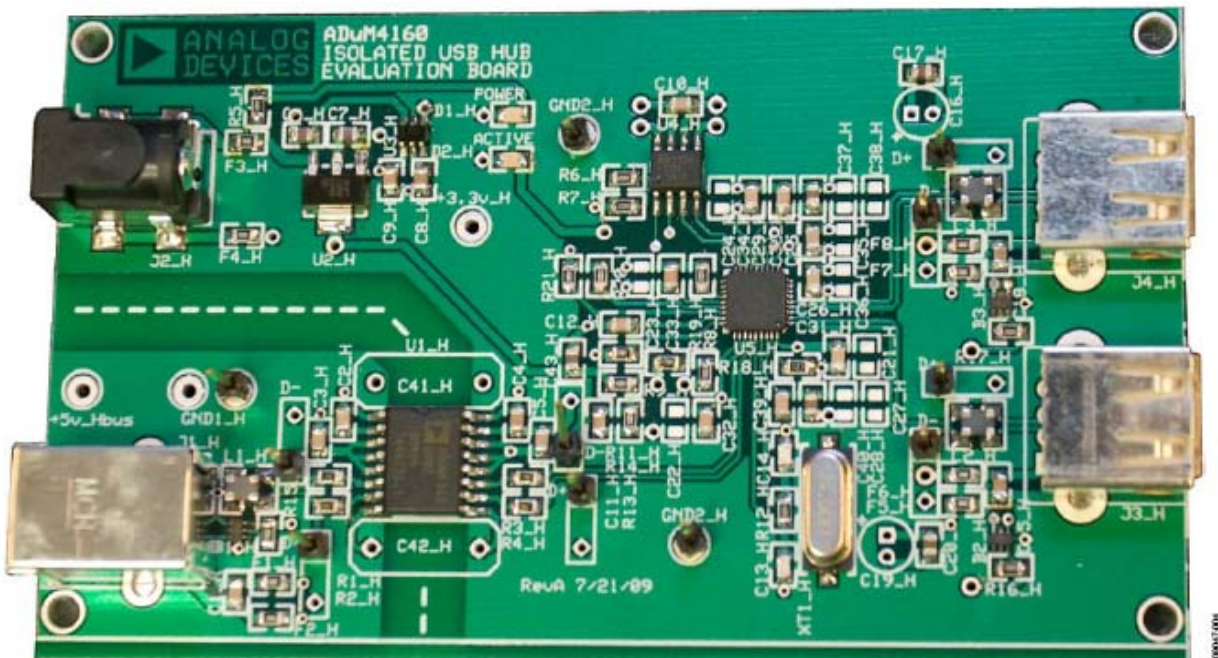


图 4. ADuM4160 隔离 USB 集线器评估板

MT-101 Tutorial, *Decoupling Techniques*, Analog Devices.  
USB 2.0 Specifications, USB Implementers Forum, Inc.  
Wayne, Scott. "iCoupler<sup>®</sup> Digital Isolators Protect RS-232,  
RS-485, and CAN Buses in Industrial, Instrumentation, and  
Computer Applications." *Analog Dialogue*. Volume 39, October  
2005.

#### 数据手册和评估板

[ADuM4160 Data Sheet](#)

[ADP3339 Data Sheet](#)

[ADP3330 Data Sheet](#)

[ADuM4160 Evaluation Board](#)

[ADuM4160 Isolated USB Hub Evaluation Board Layout Files](#)

#### 修订历史

**7/10—Revision 0: Initial Version**

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