

### 连接/参考器件

AD5452	12 位乘法 DAC
AD8655	低噪声精密 CMOS 放大器
ADR127	低噪声 1.25 V 精密 LDO

## 在反向模式下利用电流输出 DAC 构建单电源、低噪声 LED 电流源驱动器

### 电路功能与优势

本电路提供一种用于 LED 的低噪声、单电源电流驱动器。所选的每个器件均采用 3.0 V 单电源供电，同时保持极低的峰峰值噪声。该信号链针对低功耗、低噪声光通信和医疗应用进行了优化。

在典型的脉搏血氧仪应用中，LED 接收到脉冲信号后，从高电流电平（如 3/4 量程）变为低电流电平（如 1/4 量程）。这些脉冲的“导通”时间通常只有数百微秒。“导通”期间叠加于 LED 亮度水平上的峰峰值  $1/f$  噪声，会影响整体测量的精度。电流输出 DAC 的 R-2R 本身具有 0.1 Hz 至 10 Hz 低噪声，即梯形电阻的阻性噪声。电流输出 DAC AD5452 用在“反向”模式下，以便支持单电源应用。将 1.25 V 电压施加于 IOUT 引脚时，满量程码对应的 VREF 引脚上的电压为  $1.25\text{ V} - 1\text{ LSB}$ ，而零电平码对应的 VREF 引脚上的电压为 0 V。

在这个信号链中，保持低噪声的关键在于基准电压源 ADR127，其 0.1 Hz 至 10 Hz 噪声仅为  $9\text{ }\mu\text{V}$  峰峰值。此外，AD8655 是低噪声的精密 CMOS 放大器（ $1.23\text{ }\mu\text{V}$  峰峰值）。因此，整个电路的 0.1 Hz 至 10 Hz 典型噪声仅为  $14.7\text{ }\mu\text{V}$  峰峰值。

### 电路描述

图 1 中的信号链显示，电流输出 DAC AD5452 在反向（电压切换）模式下工作，用于控制 LED 的亮度。关于反向模式的描述详见 AD5452 数据手册。在反向模式下，该器件可以接受 1.25 V 低噪声正基准电压输入，并提供  $1.25\text{ V} - 1\text{ LSB}$  正满量程输出。必须注意，采用此配置时，DAC 梯形电阻中的开关没有相同的源极至漏极驱动电压，因此该电流输出 DAC 只能接受低输入电压 ( $<1.5\text{ V}$ )。这就导致各开关的导通电阻不同，从而降低 DAC 的积分线性。ADR127 是一款低噪声、1.25 V 输出精密 LDO，可提供此低电压，其高输出电流和低静态电流特性特别适合手持式医疗设备应用。

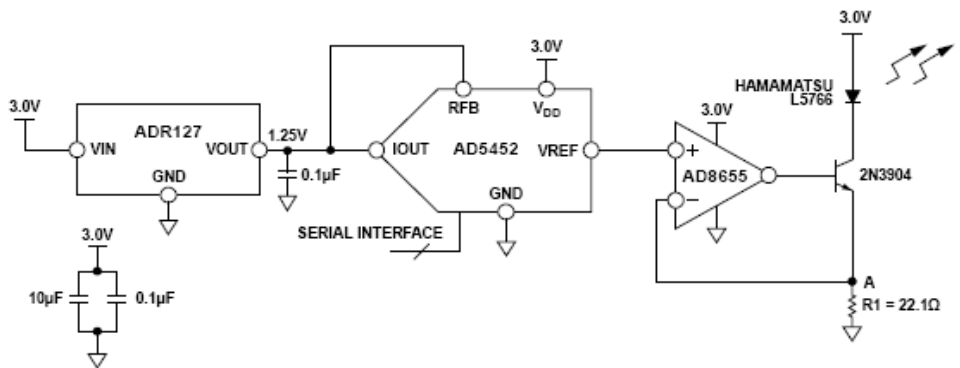


图 1. 低噪声 LED 驱动器（原理示意图：未显示所有连接）

Rev.0

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12 位AD5452 DAC产生的电压驱动运算放大器的同相输入端。此电压也出现在电阻R1 上（它应是一个高精度电阻），并产生双极性晶体管的集电极所需的电流。对于图 1所示电路，满量程时二极管标称电流为 56.6 mA。低噪声AD8655用来检测流经R1 的电流。

AD5452 采用R-2R结构，DAC内核噪声非常低。信号链中的主要噪声源是基准电压源ADR127，其额定 1/f噪声典型值为 9  $\mu$ V峰峰值。图 2显示AD8655 负端的 0.1 Hz至 10 Hz电压噪声，其中不包括LED（本例中为Hamamatsu L5766）所增加的噪声。本电路使用标准 2N3904 NPN双极性晶体管驱动LED。

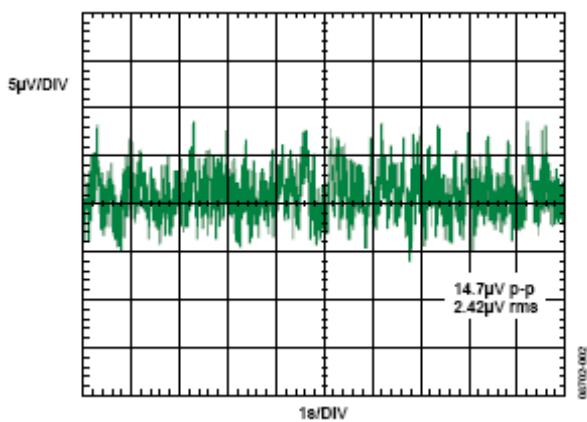


图2. A 点测得的0.1 Hz 至 10 Hz 噪声

## 常见变化

其它合适的DAC有 16 位单通道AD5543或 14 位AD5446。双通道DAC同样适用，例如AD5447（12 位）和AD5545（16 位）。AD8656是AD8655 的双通道版本。

其它低噪声精密运算放大器也适用，例如ADA4841-1和ADA4841-2。

## 进一步阅读

Kester, Walt. *The Data Conversion Handbook*. Chapter 3, 7.

Analog Devices. 2005.

MT-015 Tutorial, *Basic DAC Architectures II: Binary DACs*. Analog Devices.

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

MT-101 Tutorial, *Decoupling Techniques*. Analog Devices.

Voltage Reference Wizard Design Tool. Analog Devices

## 数据手册和评估板

[AD5452 Data Sheet](#)

[AD5452 Evaluation Board](#)

[AD8655 Data Sheet](#)

[ADR127 Data Sheet](#)

## 修订历史

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