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连接/参考器件

AD5426/AD5432/AD5443	8/10/12 位乘法 DAC
AD8065	高性能 FastFET™ 放大器
ADR01	低噪声精密基准电压源

利用 8-12 位 DAC AD5426/AD5432/AD5443 实现单极性、精密直流数模转换

电路功能与优势

此电路为一种高性能、单极性、精密直流 DAC 配置，采用 AD5426/AD5432/AD5443 系列精密乘法 DAC、低噪声运算放大器 AD8065 以及精密基准电压源 ADR01。运算放大器可决定电路的整体精度或速度性能，因此高精度、低噪声运算放大器 AD8065 非常适合注重性能的应用。该电路还采用高精度、高稳定性、10 V 精密基准电压源 ADR01。基准电压源的温度系数和长期漂移性能均为要求高精度转换应用的主要考虑因素，因此该器件是理想选择。

电路描述

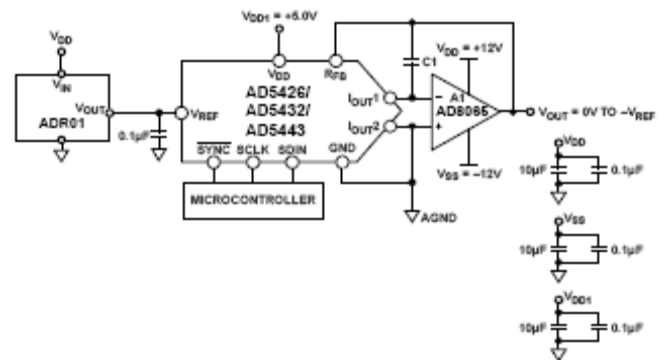
该电路采用 CMOS、电流输出 DAC AD5426/AD5432/AD5443，可分别提供 8 位、10 位和 12 位操作。由于这是一款电流输出 DAC，因此需要一个运算放大器在 DAC 的输出端进行电流电压 (I-V) 转换。运算放大器的偏置电流和失调电压均为选择精密电流输出 DAC 的重要标准，所以该电路采用具有超低失调电压（典型值为 0.4 mV）和偏置电流（典型值为 2 pA）的 AD8065 运算放大器。AD8065 与 AD5426/AD5432/AD5443 可以通过配置，轻松提供二象限乘法操作或单极性输出电压摆幅，如图 1 所示。

当输出放大器以单极性模式连接时，输出电压可由下式得出：

$$V_{OUT} = -V_{REF} \times (D/2^N)$$

其中 D 为载入 DAC 的数字字，而 N 为位数：D = 0 至 255（8 位 AD5426）；D = 0 至 1023（10 位 AD5432）；D = 0 至 4095（12 位 AD5443）。

运算放大器的输入失调电压也会和电路的可变噪声增益（由于存在 DAC 的代码相关输出电阻）相乘。由于放大器的输入电压失调，两个相邻数字码之间的噪声增益变化会使输出电压产生步进变化。此输出电压变化与两个代码间所需的输出变化相叠加，引起差分线性误差；如果该误差足够大，可能会导致 DAC 非单调。一般而言，为了确保沿各代码步进时保持单调性，输入失调电压应为 LSB 的一小部分。对于 12 位 AD5443，LSB 大小为 $10 \text{ V}/2^{12} = 2.44 \text{ mV}$ ，而 AD8065 的输入失调电压仅为 0.4 mV。



NOTES
1. C1 PHASE COMPENSATION (1pF TO 5pF) MAY BE REQUIRED IF A1 IS A HIGH SPEED AMPLIFIER.

图 1. 单极性输出、精密直流配置（原理示意图）

常见变化

OP1177 是另一款适合该电流电压转换电路的优秀运算放大器，它同样具有低失调电压（典型值为 15 μV）和超低偏置电流（典型值为 0.5 nA）特性。

Rev.A

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10.0 V [ADR01](#)基准电压源可以用[ADR02](#)或[ADR03](#)代替，二者均为低噪声基准电压源，与ADR01 同属一个基准电压源系列，分别提供 5.0 V和 2.5 V输出。超低噪声基准电压源[ADR445](#)和[ADR441](#)也是合适的替代器件，分别提供 5.0 V和 2.5 V输出。请注意，基准输入电压的大小受所选运算放大器的轨到轨电压限制。

进一步阅读

[ADIsimPower Design Tool](#). Analog Devices.

Kester, Walt. 2005. *The Data Conversion Handbook*. Analog Devices. Chapters 3 and 7.

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-033 Tutorial, *Voltage Feedback Op Amp Gain and Bandwidth*. Analog Devices.

MT-035 Tutorial, *Op Amp Inputs, Outputs, Single-Supply, and Rail-to-Rail Issues*. Analog Devices.

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

Voltage Reference Wizard Design Tool. Analog Devices.

数据手册和评估板

[AD5426 Data Sheet](#).

[AD5432 Data Sheet](#).

[AD5443 Data Sheet](#).

[AD8065 Data Sheet](#).

[ADR01 Data Sheet](#).

[ADR02 Data Sheet](#).

[ADR03 Data Sheet](#).

[ADR441 Data Sheet](#).

[ADR445 Data Sheet](#).

[OP1177 Data Sheet](#).

修订历史

7/09—Rev. 0 to Rev. A

Updated Format Universal

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