

ADS16xx Reference Options

Tom Hendrick

Precision Analog – Delta Sigma Converters

ABSTRACT

This application note presents methods for applying the internal reference or external reference options for use with the 16-bit ADS1602 and ADS1605 and the 18-bit ADS1625 and ADS1626.

1 Introduction

The ADS1605/06 and ADS1626/26 can operate from an internal or external voltage reference. In either case, the reference voltage VREF is set by the differential voltage between VREFN and VREFP: $VREF = (VREFP - VREFN)$. VREFP and VREFN each use two pins, which should be shorted together. VMID equals approximately 2.5 V and is used by the modulator. VCAP connects to an internal node and must also be bypassed with an external capacitor. For the best analog performance, it is recommended that an external reference voltage (VREF) of 3 V be used.

2 Internal Reference

To use the internal reference, set the REFEN pin low. This activates the internal circuitry that generates the reference voltages. The internal reference voltages are applied to the pins. Good bypassing of the reference pins is critical to achieve optimum performance and is done by placing the bypass capacitors as close to the pins as possible. [Figure 1](#) shows the recommended bypass capacitor values. Use high quality ceramic capacitors for the smaller values. Avoid loading the internal reference with external circuitry. If the ADS1605/6 or ADS1625/26 internal reference is to be used by other circuitry, buffer the reference voltages to prevent directly loading the reference pins.

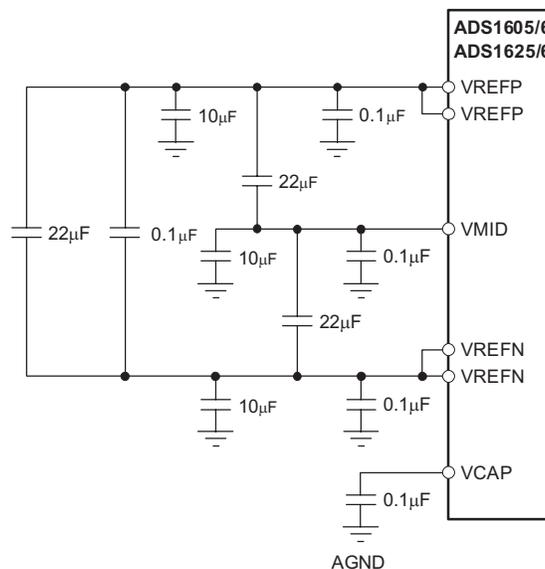


Figure 1. Internal Reference Bypassing

2.1 Internal Reference Startup

The internal bandgap reference has two startup mechanisms. The first is a static mechanism that ensures some current is present in the output stage of the bandgap. The second is a transient mechanism which ensures the proper output voltage. This dual startup approach provides coverage across silicon process variations and is triggered at power-up of the DVDD supply or by toggling the power down (PD) pin.

When not in use, the ADS1605/06 and ADS1625/26 can be powered down by taking the PD pin low. All circuitry will be shutdown, including the voltage reference. There is an internal pull-up resistor of 170 kΩ on the $\overline{\text{PD}}$ pin, but it is recommended that this pin be connected to a general purpose I/O pin to help ensure proper startup of the reference when power cycling the device at cold temperatures.

When power cycling the ADS1605/06 and ADS1625/26 below -20°C, it is recommended to allow the voltage present on the VCAP pin (pin 59) to drain completely to 0 V before the application of the analog supply voltage (AVDD) and the digital supply voltage (DVDD). If the reference voltage does not recover at power-up, toggling the /PD pin will allow the reference to recover.

3 External Reference

To use an external reference, set the REFEN pin high. This deactivates the internal generators for VREFP, VREFN and VMID, and saves approximately 25 mA of current on the analog supply (AVDD). The voltages applied to these pins must be within the values specified in the Electrical Characteristics table. Typically VREFP = 4 V, VMID = 2.5 V and VREFN = 1 V. The external circuitry must be capable of providing both a dc and a transient current.

Figure 2 shows the recommended circuitry for driving these reference inputs. Keep the resistances used in the buffer circuits low to prevent excessive thermal noise from degrading performance. Layout of these circuits is critical, make sure to follow good high-speed layout practices. Place the buffers and especially the bypass capacitors as close to the pins as possible. VCAP is unaffected by the setting on REFEN and must be bypassed when using the internal or an external reference.

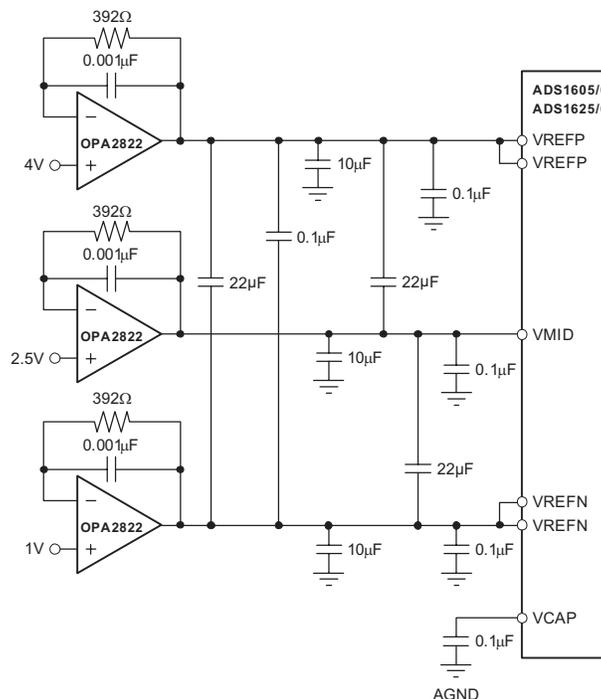


Figure 2. Recommended External Reference Buffer Circuit

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com