

Understanding the Differences Between the ADS114S06 and ADS114S08 Standard and Cost-Optimized Versions

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Precision ADCs

ABSTRACT

This document describes the differences between the standard and cost-optimized versions of the ADS114S06 and ADS114S08 (ADS114S0x) devices. Texas Instruments provides cost-optimized, *B-grade* versions of each device for systems that may not require the performance level and feature set offered by the standard devices. [Table 1](#) lists the standard versus B-grade devices.

This application report also describes how the differences apply to the [ADS114S08 evaluation module \(EVM\)](#) because there is no dedicated EVM for the B-grade versions.

Table 1. Standard Versus B-Grade Devices

Standard Device	B-Grade Device
ADS114S06	ADS114S06B
ADS114S08	ADS114S08B

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1 Introduction

The 6-channel ADS114S06 and 12-channel ADS114S08 are 16-bit, 4000 sample-per-second (SPS), delta-sigma, analog-to-digital converters (ADCs). These devices offer an integrated, analog front-end that consists of:

- A fully-flexible input multiplexer
- Dual excitation current sources (IDACs)
- A low-noise programmable gain amplifier (PGA)
- A low-drift 2.5-V voltage reference with buffered reference output
- A temperature sensor
- A precision oscillator
- Multiple monitoring and diagnostic features

The performance and feature set make these ADCs an excellent choice for all types of precision sensor measurements in end equipment such as:

- [Pressure transmitters](#)
- [Thermal controllers](#)
- [Temperature transmitters](#)
- [PLC analog input modules](#)

Figure 1 illustrates the functional block diagram for these two ADCs.

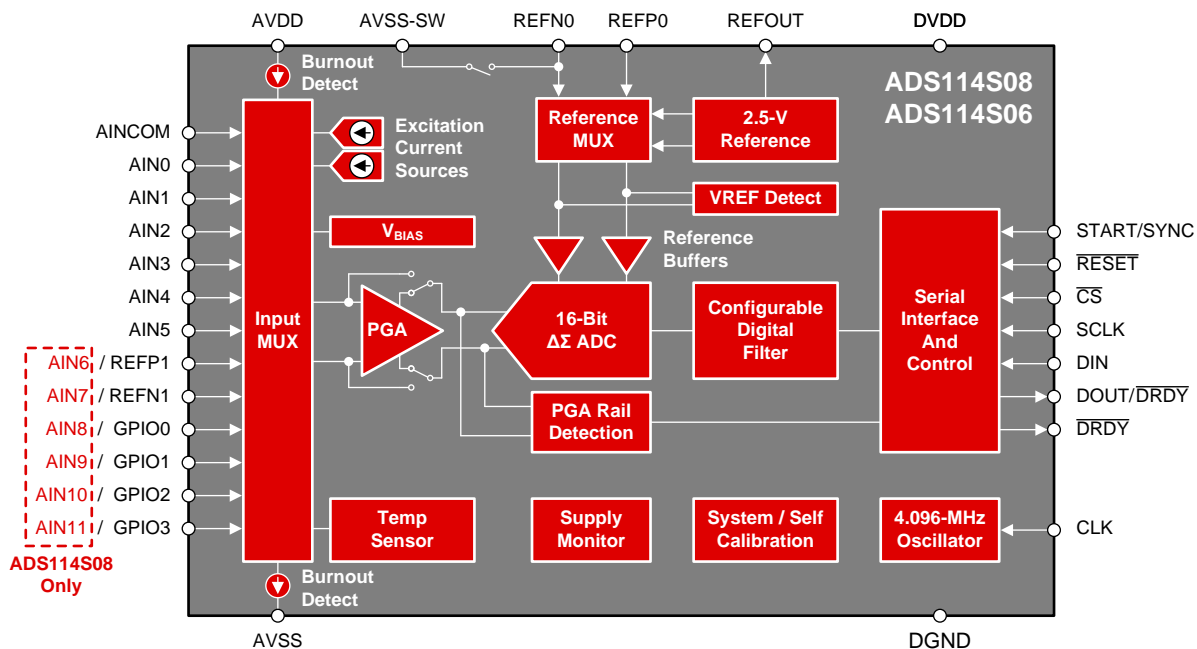


Figure 1. Functional Block Diagram

The differences between the standard and B-grade versions are separated into three different categories:

- [Performance](#)
- [Features](#)
- [Specifications](#)

These categories are discussed in the sections that follow.

2 Performance

For end equipment that does not require the performance of the standard-grade ADCs, some specifications in the ADS114S06B and ADS114S08B are relaxed. [Table 2](#) summarizes these relaxed specifications and compares their values to the standard-grade devices.

Table 2. Performance Differences Between the ADS114S0x and ADS114S0xB

PARAMETER	TEST CONDITIONS	ADS114S06 ADS114S08			ADS114S06B ADS114S08B			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
Operating ambient temperature		-50		125	-40		125	°C
Absolute input current	PGA enabled, all gains		0.1	±2		0.1	±10	nA
INL (best fit)	PGA bypassed, $V_{CM} = AVDD / 2$		1	10		1		ppm _{FSR}
	PGA enabled, gain = 1 to 8, $V_{CM} = AVDD / 2$		2	15		2	25	
	PGA enabled, gain = 16 to 128, $V_{CM} = AVDD / 2$		3	15		2	25	
Gain error	$T_A = 25^\circ\text{C}$, PGA bypassed		0.004%	0.012%		0.01%	0.1%	
	$T_A = 25^\circ\text{C}$, PGA enabled, gain = 1 to 32		0.004%	0.012%		0.025%	0.2%	
	$T_A = 25^\circ\text{C}$, PGA enabled, gain = 64 and 128		0.004%	0.02%		0.025%	0.2%	
V_{REF} accuracy	$T_A = 25^\circ\text{C}$, TQFP package	-0.05%	±0.01%	0.05%	-0.2%	±0.01%	0.2%	
	$T_A = 25^\circ\text{C}$, QFN package	-0.1%	±0.01%	0.1%	-0.2%	±0.01%	0.2%	
V_{REF} temperature drift	$T_A = -40^\circ\text{C}$ to $+85^\circ\text{C}$		2.5	8		8	40	ppm/°C
	$T_A = -50^\circ\text{C}$ to $+125^\circ\text{C}$		3	10		N/A		
IDAC accuracy (each IDAC)	$T_A = 25^\circ\text{C}$, 10 μA to 100 μA	-5%	±0.7%	5%	-6%	±1%	6%	
	$T_A = 25^\circ\text{C}$, 250 μA to 2 mA	-3%	±0.5%	3%	-6%	±1%	6%	
IDAC current mismatch	$T_A = 25^\circ\text{C}$, 10 μA to 100 μA		0.15%	0.8%		0.20%		
	$T_A = 25^\circ\text{C}$, 250 μA to 750 μA		0.1%	0.6%		0.20%		
	$T_A = 25^\circ\text{C}$, 1 mA to 2 mA		0.07%	0.4%		0.20%		
IDAC temperature drift	10 μA to 750 μA		20	120		100		ppm/°C
	1 mA to 2 mA		10	80		100		
IDAC temperature drift matching	10 μA to 100 μA		3	25		10		ppm/°C
	250 μA to 2 mA		2	15		10		
Oscillator accuracy		-1.5%		1.5%	-2%		2%	
Device cost			ADS114S06		ADS114S06B			USD (\$)
			ADS114S08		ADS114S08B			

3 Features

Several features that are available in the standard-grade devices are removed from the B-grade devices. [Table 3](#) summarizes these features, as well as their intended purpose in the standard-grade devices.

Table 3. Features Available Only in Standard-Grade Devices

Feature	Purpose
SINC3 Filter	Reduces ADC noise compared to low-latency filter, while increasing settling time
Low-Side Power Switch	Power-down path for resistive bridges to reduce power consumption between conversions
Global Chop	Averages two readings to reduce offset, offset drift, and noise
PGA Rail Detection	Detects if the PGA is operating outside the linear region of operation
Reference Detection	Detects if the differential reference voltage drops below 0.3 V or $[1/3 \times (AVDD - AVSS)]$
Cyclic Redundancy Check (CRC)	Detects single-bit or multibit data-transmission errors
Programmable Conversion Delay	User-defined programmable delay time to compensate for external analog circuitry settling time when multiplexing through channels

4 Specifications

In addition to removed features, the ADS114S06B and ADS114S08B have several specifications that are also removed. These specifications are generally unnecessary in more cost-sensitive applications that require a balance between performance and value. [Table 4](#) summarizes the specifications removed from the B-grade devices.

Table 4. Specifications Removed From B-Grade Devices

Change	Specification
Minimum and maximum values removed	Differential input current
	Input offset voltage
	Offset drift
	VREF absolute input current
Minimum values removed	CMRR
	PSRR
Maximum values removed	Gain drift
	Analog supply current
	Digital supply current
Values not specified	Absolute input current drift
	Differential input current drift

5 EVM Differences

While there is no B-grade-specific EVM for the ADS114S06B or ADS114S08B, the behavior of these devices can be mimicked using the standard-grade ADS114S08EVM. [Table 5](#) identifies the bit values within each field and register that must be fixed when using the ADS114S08EVM, so that the EVM operates like the B-grade devices. Although this fix allows the EVM to function like the B-grade device, the EVM performance is relaxed per [Table 2](#) and [Table 4](#).

Table 5. Register Settings to Mimic ADS114S0xB Behavior on the ADS114S08EVM

Address	Register	Field	Bit No.	Bit Value
03h	PGA	DELAY[2:0]	7	0
			6	0
			5	0
04h	DATARATE	G_CHOP	7	0
		FILTER	4	1
05h	REF	FL_REF_EN[1:0]	7	0
			6	0
06h	IDACMAG	FL_RAIL_EN	7	0
		PSW	6	0
08h	VBIAS	VB_LEVEL	7	0
09h	SYS	CRC	1	0
		SENDSTAT	0	0

6 Alternative Device Recommendations

In addition to the 16-bit ADS114S06 and ADS114S08, Texas Instruments also offers the pin-to-pin compatible, 24-bit devices shown in [Table 6](#). These ADCs offer the same feature set and performance as their 16-bit counterparts, but with 24-bit resolution.

Table 6. Pin-Compatible, 24-Bit Versions of the ADS114S06 and ADS114S08

Device	Description
ADS124S06	24-bit, pin-to-pin compatible with the ADS114S06
ADS124S08	24-bit, pin-to-pin compatible with the ADS114S08

7 Conclusion

Many types of sensor measurement end equipment often require the high-performance and extensive feature set of the 16-bit, 6-channel ADS114S06 and 12-channel ADS114S08. However, for more cost-sensitive end equipment or applications, Texas Instruments offers pin-compatible, B-grade versions of these devices (the ADS114S06B and ADS114S08B) that offer an excellent combination of performance and cost.

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