10-Bit, 60 MSPS A/D Converter

AD9051

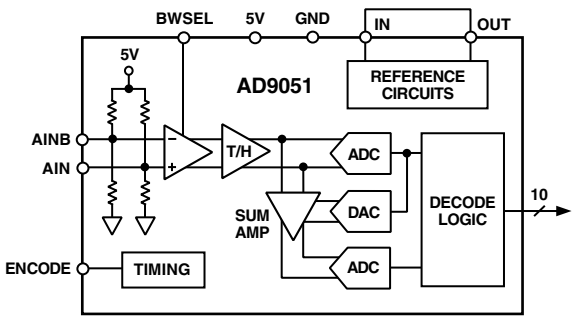
FEATURES

60 MSPS Sampling Rate
9.3 Effective Number of Bits at f_{IN} = 10.3 MHz
250 mW Total Power at 60 MSPS
Selectable Input Bandwidth of 50 MHz or 130 MHz
On-Chip T/H and Voltage Reference
Single 5 V Supply Voltage
5 V or 3 V Logic I/O Compatible
Input Range and Output Coding Options Available

APPLICATIONS

Medical Imaging
Digital Communications
Professional Video
Instrumentation
Set-Top Box

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The AD9051 is a complete 10-bit monolithic sampling analog-to-digital converter (ADC) with an onboard track-and-hold and reference. The unit is designed for low cost, high performance applications and requires only 5 V and an encode clock to achieve 60 MSPS sample rates with 10-bit resolution.

The encode clock is TTL compatible and the digital outputs are CMOS; both can operate with 5 V/3 V logic. The two-step architecture used in the AD9051 is optimized to provide the best dynamic performance available while maintaining low power consumption.

A 2.5 V reference is included onboard, or the user can provide an external reference voltage for gain control or matching of multiple devices. Fabricated on a state-of-the-art BiCMOS process, the AD9051 is packaged in a space saving surface mount package (SSOP) and is specified over the industrial temperature range (–40°C to +85°C).

REV. B

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AD9051–SPECIFICATIONS (V_D = 5 V, V_{DD} = 3 V; external reference = 2.50 V; ENCODE = 60 MSPS unless otherwise noted)

Parameter	Temp	Test Level	AD9051BRS Min	AD9051BRS Typ	AD9051BRS Max	AD9051BRS-2V Min	AD9051BRS-2V Typ	AD9051BRS-2V Max	Unit
RESOLUTION				10			10		Bits
DC ACCURACY									
Differential Nonlinearity	25°C	I		0.75	1.50		0.75	1.50	LSB
	Full	V		0.90			0.90		LSB
Integral Nonlinearity	25°C	I		0.75	1.50		0.75	1.50	LSB
	Full	V		0.90			0.90		LSB
No Missing Codes	25°C	I	GUARANTEED			GUARANTEED			
Gain Error[1]	25°C	I		±0.3	±2.5		±0.3	±3.0	% FS
	Full	VI			±5.0			±5.5	% FS
Gain Tempco[1]	Full	V		±10			±10		ppm/°C
ANALOG INPUT									
Input Voltage Range[2]	25°C	V		1.25			2.0		V p-p
Input Offset Voltage	25°C	I	–14	+5.0	+26	–14	+5.0	+26	LSB
Input Resistance	25°C	I	4.0	6.0		4.0	6.0		kΩ
Input Capacitance	25°C	V		5			5		pF
Analog Bandwidth (BW SEL +V_D/NC)[3]	25°C	V		50/130			50/130		MHz
BANDGAP REFERENCE									
Output Voltage (I_O @ 200 µA)	Full	VI	2.4	2.5	2.6	2.4	2.5	2.6	V
Temperature Coefficient	Full	V		±33			±33		ppm/°C
Power Supply Sensitivity	Full	V		6.2			6.2		mV/V
Reference Input Current (V_{IN} = 2.50 V)	Full	VI		2.0	25		2.0	25	µA
SWITCHING PERFORMANCE									
Maximum Conversion Rate	Full	VI	60			60			MSPS
Minimum Conversion Rate[4]	Full	IV		2.0	5.0		2.0	5.0	MSPS
Aperture Delay (t_A)	25°C	V		2.5			2.5		ns
Aperture Uncertainty (Jitter)	25°C	V		5			5		ps, rms
Output Valid Time (t_V)[5]	Full	VI	4.0			4.0			ns
Output Propagation Delay (t_{PD})[5]	Full	VI		5.5	10		5.5	10	ns
DYNAMIC PERFORMANCE[6]									
Transient Response	25°C	V		10			10		ns
Overvoltage Recovery Time	25°C	V		10			10		ns
ENOBS									
f_{IN} = 1.20 MHz	25°C	V		9.6			9.6		ENOB
f_{IN} = 10.3 MHz	25°C	I	8.93	9.3		8.93	9.3		ENOB
f_{IN} = 29.0 MHz	25°C	V		9.1			9.1		ENOB
Signal-to-Noise Ratio (SINAD)									
f_{IN} = 1.20 MHz	25°C	V		58.5			57.5		dB
f_{IN} = 10.3 MHz	25°C	I	55	57		54	56		dB
f_{IN} = 29.0 MHz	25°C	V		55			54		dB
Signal-to-Noise Ratio (Without Harmonics)									
f_{IN} = 1.20 MHz	25°C	V		59			59		dB
f_{IN} = 10.3 MHz	25°C	I	56	58		56	58		dB
f_{IN} = 29.0 MHz	25°C	V		56.5			56.5		dB
2nd Harmonic Distortion									
f_{IN} = 1.20 MHz	25°C	V		–74			–68		dBc
f_{IN} = 10.3 MHz	25°C	I		–73	–60		–64	–58	dBc
f_{IN} = 29.0 MHz	25°C	V		–67			–60		dBc
3rd Harmonic Distortion									
f_{IN} = 1.20 MHz	25°C	V		–74			–69		dBc
f_{IN} = 10.3 MHz	25°C	I		–70	–60		–65	–60	dBc
f_{IN} = 29.0 MHz	25°C	V		–65			–60		dBc
Two-Tone Intermodulation Distortion (IMD)	25°C	V		–65			–65		dBc
Differential Phase	25°C	V		0.1			0.1		Degrees
Differential Gain	25°C	V		0.5			0.5		%

Parameter	Temp	Test Level	AD9051BRS Min	AD9051BRS Typ	AD9051BRS Max	AD9051BRS-2V Min	AD9051BRS-2V Typ	AD9051BRS-2V Max	Unit
ENCODE INPUT									
Logic "1" Voltage	Full	VI	2.0			2.0			V
Logic "0" Voltage	Full	VI			0.8			0.8	V
Logic "1" Current	Full	VI			1			1	µA
Logic "0" Current	Full	VI			1			1	µA
Input Capacitance	25°C	V		7.5			7.5		pF
Encode Pulsewidth High (t_{EH})	25°C	IV	7.5			7.5			ns
Encode Pulsewidth Low (t_{EL})	25°C	IV	7.5			7.5			ns
DIGITAL OUTPUTS									
Logic "1" Voltage (5.0 V_{DD})	Full	VI	4.95			4.95			V
Logic "0" Voltage (5.0 V_{DD})	Full	VI			0.05			0.05	V
Logic "1" Voltage (3.0 V_{DD})	Full	VI	2.95			2.95			V
Logic "0" Voltage (3.0 V_{DD})	Full	VI			0.05			0.05	V
Output Coding[7]				Offset Binary			Offset Binary		
POWER SUPPLY									
V_D, V_{DD} Supply Current	Full	VI		50	63		50	63	mA
Power Dissipation[8]	Full	VI		250	315		250	315	mW
Power Supply Rejection Ratio (PSRR)[9]	25°C	I		±2	±10		±7	±15	mV/V

NOTES

[1]Gain error and gain temperature coefficient are based on the ADC only (with a fixed 2.5 V external reference).

[2]Contact factory or authorized sales agent for information concerning the availability of expanded input voltage range devices.

[3]3 dB bandwidth with full-power input signal.

[4]Minimum conversion rate at which all data sheet specifications remain stable.

[5]t_V and t_{PD} are measured from the threshold crossing of the ENCODE input to valid TTL levels 0.5 V and 2.4 V of the digital outputs with V_{DD} = 3.0 V. The output ac load during test is 5 pF.

[6]SNR/harmonics tested with an analog input voltage of –0.5 dBFS. All tests performed at 60 MSPS.

[7]Contact factory or authorized sales agent for information concerning the availability of alternative output coding and input range devices.

[8]Power dissipation is measured under the following conditions: analog input = –FS at 60 MSPS ENCODE.

[9]A change in input offset voltage with respect to a change in V_D.

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS*

V_D, V_{DD} . . . . . 7 V
Analog Inputs . . . . . –0.5 V to V_D + 0.5 V
Digital Inputs . . . . . –0.5 V to V_D
VREF Input . . . . . –0.5 V to V_D
Digital Output Current . . . . . 20 mA
Operating Temperature . . . . . –55°C to +125°C
Storage Temperature . . . . . –65°C to +150°C
Maximum Junction Temperature . . . . . 150°C
Maximum Case Temperature . . . . . 150°C

*Stresses above those listed under Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only; functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum ratings for extended periods may effect device reliability.

EXPLANATION OF TEST LEVELS

Test Level

I. 100% production tested.

II. 100% production tested at 25°C and sample tested at specified temperatures.

III. Sample tested only.

IV. Parameter is guaranteed by design and characterization testing.

V. Parameter is a typical value only.

VI. 100% production tested at 25°C; guaranteed by design and characterization testing for industrial temperature range.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Options
AD9051BRS	–40°C to +85°C	28-Lead Shrink Small Outline Package (SSOP)	RS-28
AD9051BRS-2V	–40°C to +85°C	28-Lead Shrink Small Outline Package (SSOP)	RS-28
AD9051/PCB	25°C		Evaluation Board
AD9051-2V/PCB	25°C		Evaluation Board

Table I. Digital Coding (Single-Ended Input with AIN, AINB Bypassed to GND)

Analog Input	Voltage Level	OR (Out of Range)	Digital Output MSB . . . LSB
3.126 (3.50)*	Positive Full Scale + 1 LSB	1	1111111111
2.5	Midscale	0	0111111111
1.874 (1.50)*	Negative Full Scale – 1 LSB	1	0000000000

*(BRS-2V Version)

CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the AD9051 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high-energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.