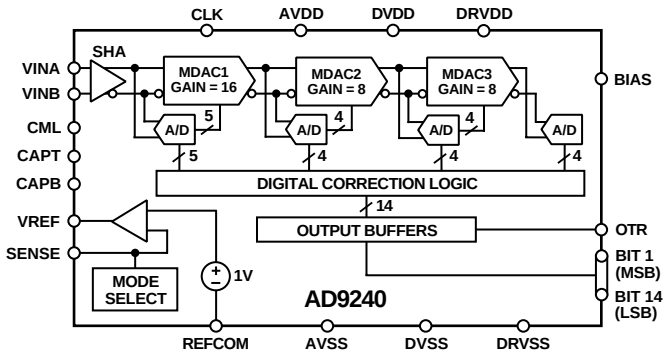
Complete 14-Bit, 10 MSPS Monolithic A/D Converter

AD9240

FEATURES
Monolithic 14-Bit, 10 MSPS A/D Converter
Low Power Dissipation: 285 mW
Single +5 V Supply
Integral Nonlinearity Error: 2.5 LSB
Differential Nonlinearity Error: 0.6 LSB
Input Referred Noise: 0.36 LSB
Complete: On-Chip Sample-and-Hold Amplifier and Voltage Reference
Signal-to-Noise and Distortion Ratio: 77.5 dB
Spurious-Free Dynamic Range: 90 dB
Out-of-Range Indicator
Straight Binary Output Data
44-Lead MQFP

FUNCTIONAL BLOCK DIAGRAM



PRODUCT DESCRIPTION

The AD9240 is a 10 MSPS, single supply, 14-bit analog-to-digital converter (ADC). It combines a low cost, high speed CMOS process and a novel architecture to achieve the resolution and speed of existing hybrid implementations at a fraction of the power consumption and cost. It is a complete, monolithic ADC with an on-chip, high performance, low noise sample-and-hold amplifier and programmable voltage reference. An external reference can also be chosen to suit the dc accuracy and temperature drift requirements of the application. The device uses a multistage differential pipelined architecture with digital output error correction logic to guarantee no missing codes over the full operating temperature range.

The input of the AD9240 is highly flexible, allowing for easy interfacing to imaging, communications, medical and data-acquisition systems. A truly differential input structure allows for both single-ended and differential input interfaces of varying input spans. The sample-and-hold amplifier (SHA) is equally suited for multiplexed systems that switch full-scale voltage levels in successive channels as well as sampling single-channel inputs at frequencies up to and beyond the Nyquist rate. The AD9240 also performs well in communication systems employing Direct-IF Down Conversion, since the SHA in the differential input mode can achieve excellent dynamic performance well beyond its specified Nyquist frequency of 5 MHz.

A single clock input is used to control all internal conversion cycles. The digital output data is presented in straight binary output format. An out-of-range (OTR) signal indicates an overflow condition which can be used with the most significant bit to determine low or high overflow.

PRODUCT HIGHLIGHTS

The AD9240 offers a complete single-chip sampling 14-bit, analog-to-digital conversion function in a 44-lead Metric Quad Flatpack.

Low Power and Single Supply

The AD9240 consumes only 280 mW on a single +5 V power supply.

Excellent DC Performance Over Temperature

The AD9240 provides no missing codes, and excellent temperature drift performance over the full operating temperature range.

Excellent AC Performance and Low Noise

The AD9240 provides nearly 13 ENOB performance and has an input referred noise of 0.36 LSB rms.

Flexible Analog Input Range

The versatile onboard sample-and-hold (SHA) can be configured for either single ended or differential inputs of varying input spans.

Flexible Digital Outputs

The digital outputs can be configured to interface with +3 V and +5 V CMOS logic families.

Excellent Undersampling Performance

The full power bandwidth and dynamic range of the AD9240 make it well suited for Direct-IF Down Conversion extending to 45 MHz.

REV. A

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AD9240–SPECIFICATIONS

DC SPECIFICATIONS (AVDD = +5 V, DVDD = +5 V, DRVDD = +5 V, f_{SAMPLE} = 10 MSPS, R_{BIAS} = 2 kΩ, VREF = 2.5 V, VINB = 2.5 V, T_{MIN} to T_{MAX} unless otherwise noted)

Parameter	AD9240	Units
RESOLUTION	14	Bits min
MAX CONVERSION RATE	10	MHz min
INPUT REFERRED NOISE		
VREF = 1 V	0.9	LSB rms typ
VREF = 2.5 V	0.36	LSB rms typ
ACCURACY		
Integral Nonlinearity (INL)	±2.5	LSB typ
Differential Nonlinearity (DNL)	±0.6	LSB typ
	±1.0	LSB max
INL[1]	±2.5	LSB typ
DNL[1]	±0.7	LSB typ
No Missing Codes	14	Bits Guaranteed
Zero Error (@ +25°C)	0.3	% FSR max
Gain Error (@ +25°C)[2]	1.5	% FSR max
Gain Error (@ +25°C)[3]	0.75	% FSR max
TEMPERATURE DRIFT		
Zero Error	3.0	ppm/°C typ
Gain Error[2]	20.0	ppm/°C typ
Gain Error[3]	5.0	ppm/°C typ
POWER SUPPLY REJECTION	0.1	% FSR max
ANALOG INPUT		
Input Span (with VREF = 1.0 V)	2	V p-p min
(with VREF = 2.5 V)	5	V p-p max
Input (VINA or VINB) Range	0	V min
	AVDD	V max
Input Capacitance	16	pF typ
INTERNAL VOLTAGE REFERENCE		
Output Voltage (1 V Mode)	1	Volts typ
Output Voltage Tolerance (1 V Mode)	±14	mV max
Output Voltage (2.5 V Mode)	2.5	Volts typ
Output Voltage Tolerance (2.5 V Mode)	±35	mV max
Load Regulation[4]	5.0	mV max
REFERENCE INPUT RESISTANCE	5	kΩ typ
POWER SUPPLIES		
Supply Voltages		
AVDD	+5	V (±5% AVDD Operating)
DVDD	+5	V (±5% DVDD Operating)
DRVDD	+5	V (±5% DRVDD Operating)
Supply Current		
IAVDD	50	mA max (46 mA typ)
IDRVDD	1	mA max (0.1 mA typ)
IDVDD	15	mA max (11 mA typ)
POWER CONSUMPTION	330	mW max (285 mW typ)

NOTES
[1]VREF = 1 V.
[2]Including internal reference.
[3]Excluding internal reference.
[4]Load regulation with 1 mA load current (in addition to that required by the AD9240).

Specification subject to change without notice.

AC SPECIFICATIONS

(AVDD = +5 V, DVDD= +5 V, DRVDD = +5 V, f_{SAMPLE} = 10 MSPS, R_{BIAS} = 2 kΩ, VREF = 2.5 V, A_{IN} = –0.5 dBFS, AC Coupled/Differential Input, T_{MIN} to T_{MAX} unless otherwise noted)

Parameter	AD9240	Units
SIGNAL-TO-NOISE AND DISTORTION RATIO (S/N+D)		
f_{INPUT} = 500 kHz	75.0	dB min
	77.5	dB typ
f_{INPUT} = 1.0 MHz	77.5	dB typ
f_{INPUT} = 5.0 MHz	75.0	dB typ
EFFECTIVE NUMBER OF BITS (ENOB)		
f_{INPUT} = 500 kHz	12.2	Bits min
	12.6	Bits typ
f_{INPUT} = 1.0 MHz	12.6	Bits typ
f_{INPUT} = 5.0 MHz	12.2	Bits typ
SIGNAL-TO-NOISE RATIO (SNR)		
f_{INPUT} = 500 kHz	76.0	dB min
	78.5	dB typ
f_{INPUT} = 1.0 MHz	78.5	dB typ
f_{INPUT} = 5.0 MHz	78.5	dB typ
TOTAL HARMONIC DISTORTION (THD)		
f_{INPUT} = 500 kHz	–78.0	dB max
	–85.0	dB typ
f_{INPUT} = 1.0 MHz	–85.0	dB typ
f_{INPUT} = 5.0 MHz	–77.0	dB typ
SPURIOUS FREE DYNAMIC RANGE		
f_{INPUT} = 500 kHz	90.0	dB typ
f_{INPUT} = 1.0 MHz	90.0	dB typ
f_{INPUT} = 5.0 MHz	80.0	dB typ
DYNAMIC PERFORMANCE		
Full Power Bandwidth	70	MHz typ
Small Signal Bandwidth	70	MHz typ
Aperture Delay	1	ns typ
Aperture Jitter	4	ps rms typ
Acquisition to Full-Scale Step (0.0025%)	45	ns typ
Overvoltage Recovery Time	167	ns typ

Specifications subject to change without notice.

DIGITAL SPECIFICATIONS

(AVDD = +5 V, DVDD = +5 V, T_{MIN} to T_{MAX} unless otherwise noted)

Parameters	Symbol	AD9240	Units
CLOCK INPUT			
High Level Input Voltage	V_{IH}	+3.5	V min
Low Level Input Voltage	V_{IL}	+1.0	V max
High Level Input Current (V_{IN} = DVDD)	I_{IH}	±10	μA max
Low Level Input Current (V_{IN} = 0 V)	I_{IL}	±10	μA max
Input Capacitance	C_{IN}	5	pF typ
LOGIC OUTPUTS (with DRVDD = 5 V)			
High Level Output Voltage (I_{OH} = 50 μA)	V_{OH}	+4.5	V min
High Level Output Voltage (I_{OH} = 0.5 mA)	V_{OH}	+2.4	V min
Low Level Output Voltage (I_{OL} = 1.6 mA)	V_{OL}	+0.4	V max
Low Level Output Voltage (I_{OL} = 50 μA)	V_{OL}	+0.1	V max
Output Capacitance	C_{OUT}	5	pF typ
LOGIC OUTPUTS (with DRVDD = 3 V)			
High Level Output Voltage (I_{OH} = 50 μA)	V_{OH}	+2.4	V min
Low Level Output Voltage (I_{OL} = 50 μA)	V_{OL}	+0.7	V max

Specifications subject to change without notice.

SWITCHING SPECIFICATIONS (T_{MIN} to T_{MAX} with AVDD = +5 V, DVDD = +5 V, DRVDD = +5 V, R_{BIAS} = 2 kΩ, C_L = 20 pF)

Parameters	Symbol	AD9240	Units
Clock Period[1]	t_C	100	ns min
CLOCK Pulsewidth High	t_{CH}	45	ns min
CLOCK Pulsewidth Low	t_{CL}	45	ns min
Output Delay	t_{OD}	8	ns min
		13	ns typ
		19	ns max
Pipeline Delay (Latency)		3	Clock Cycles

NOTES
[1]The clock period may be extended to 1 ms without degradation in specified performance @ +25°C.

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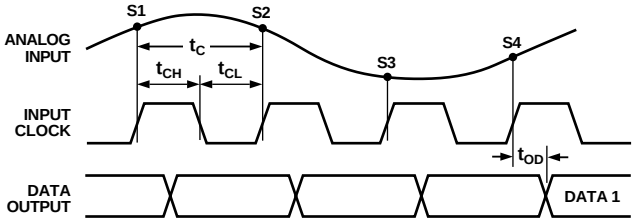


Figure 1. Timing Diagram

ABSOLUTE MAXIMUM RATINGS*

Parameter	With Respect to	Min	Max	Units
AVDD	AVSS	–0.3	+6.5	V
DVDD	DVSS	–0.3	+6.5	V
AVSS	DVSS	–0.3	+0.3	V
AVDD	DVDD	–6.5	+6.5	V
DRVDD	DRVSS	–0.3	+6.5	V
DRVSS	AVSS	–0.3	+0.3	V
REFCOM	AVSS	–0.3	+0.3	V
CLK	AVSS	–0.3	AVDD + 0.3	V
Digital Outputs	DRVSS	–0.3	DRVDD + 0.3	V
VINA, VINB	AVSS	–0.3	AVDD + 0.3	V
VREF	AVSS	–0.3	AVDD + 0.3	V
SENSE	AVSS	–0.3	AVDD + 0.3	V
CAPB, CAPT	AVSS	–0.3	AVDD + 0.3	V
BIAS	AVSS	–0.3	AVDD + 0.3	V
Junction Temperature			+150	°C
Storage Temperature		–65	+150	°C
Lead Temperature (10 sec)			+300	°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.

THERMAL CHARACTERISTICS

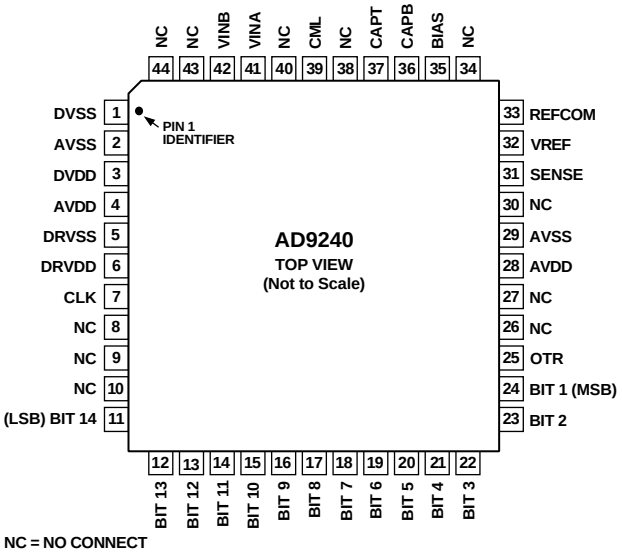
Thermal Resistance
44-Lead MQFP
θ_{JA} = 53.2°C/W
θ_{JC} = 19°C/W

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option*
AD9240AS	–40°C to +85°C	44-Lead MQFP	S-44
AD9240EB		Evaluation Board	

*S = Metric Quad Flatpack.

PIN CONFIGURATION



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 AD9240 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.