ADC0831A, ADC0832A, ADC0831B, ADC0832B A/D PERIPHERALS WITH SERIAL CONTROL

SLAS006 - AUGUST 1985 - REVISED JUNE 1986

- 8-Bit Resolution
- Easy Microprocessor interface or **Stand-Alone Operation**
- **Operates Ratiometrically or With 5-V** Reference
- Single Channel or Multiplexed Twin **Channels With Single-Ended or Differential Input Options**
- Input Range 0 to 5 V With Single 5-V Supply
- Inputs and Outputs Are Compatible With **TTL and MOS**
- Conversion Time of 32 us at CLK = 250 kHz
- Designed to Be interchangeable With **National Semiconductor ADC0831 and** ADC0832

DEVICE	TOTAL UNADJUSTED ERROR					
DEVICE	A-SUFFIX	B-SUFFIX				
ADC0831	±1 LSB	± 1/2 LSB				
ADC0832	±1LSB	± 1/2 LSB				

ADC0831 . . . P PACKAGE (TOP VIEW) ի v_{cc} CS IN+ [2 7 CLK IN-∏3 6 DO GND [REF ADC0832...P PACKAGE (TOP VIEW) CS 8 V_{CC}/REF CH0 2 7 CLK CH1 3 6 DO GND [5 | DI

description

Tom.Cr These devices are 8-bit successive-approximation analog-to-digital converters. The ADC0831A and ADC0831B have single input channels; the ADC0832A and ADC0832B have multiplexed twin input channels. The serial output is configured to interface with standard shift registers or microprocessors. Detailed information on interfacing to most popular microprocessors is readily available from the factory.

The ADC0832 multiplexer is software configured for single-ended or differential inputs. The differential analog voltage input allows for common-mode rejection or offset of the analog zero input voltage value. In addition, the voltage reference input can be adjusted to allow encoding any smaller analog voltage span to the full 8 bits of resolution.

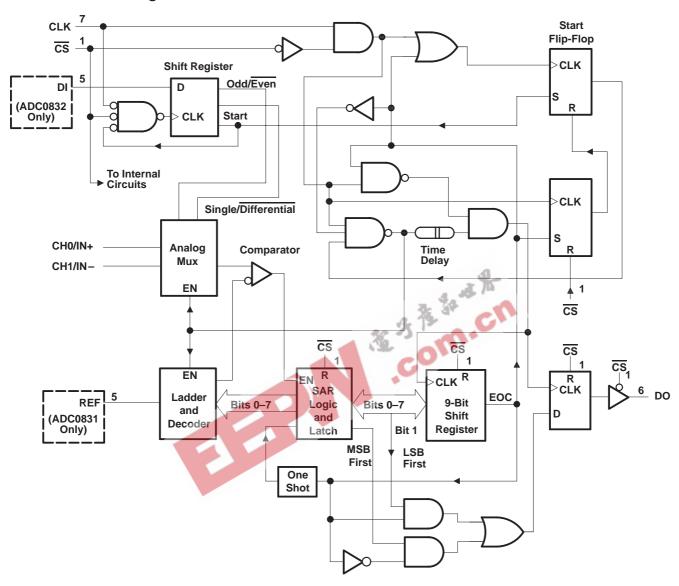
The operation of the ADC0831 and ADC0832 devices is very similar to the more complex ADC0834 and ADC0838 devices. Ratiometric conversion can be attained by setting the REF input equal to the maximum analog input signal value, which gives the highest possible conversion resolution. Typically, REF is set equal to V_{CC} (done internally on the ADC0832). For more detail on the operation of the ADC0831 and ADC0832 devices, refer to the ADC0834/A DC0838 data sheet.

The ADC0831AC, ADC0831BC, ADC0832AC, and ADC0832BC are characterized for operation from 0°C to 70°C. The ADC0831AI, ADC0831BI, ADC0832AI, and ADC0832BI are characterized for operation from -40°C to 85°C.

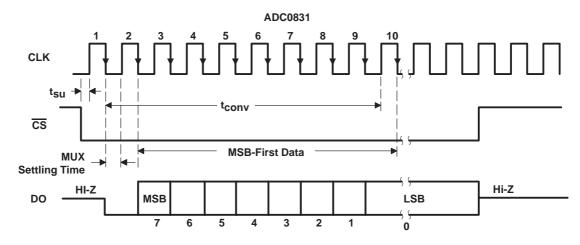
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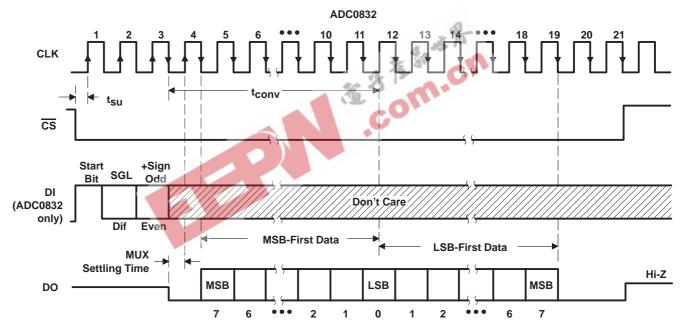
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functional block diagram



sequence of operation





ADC0832 MUX ADDRESS CONTROL LOGIC TABLE

MUX AI	DDRESS	CHANNEL NUMBER			
SGL/DIF	ODD/EVEN	0	1		
L	L	+	_		
L	Н	_	+		
H	L	+			
Н	Н		+		

H = high level, L = low level,

- or + = polarity of selected input pin



ADC0831A, ADC0832A, ADC0831B, ADC0832B A/D PERIPHERALS WITH SERIAL CONTROL

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absolute maximum ratings over recommended operating free-air temperature range (unless otherwise noted)

Supply voltage, V _{CC} (see Note 1)	6.5 V
Input voltage range: Logic	
Analog	$-0.3 \text{ V to V}_{CC} + 0.3$
Input current	±5 mA
Total input current for package	±20 mA
Operating free-air temperature range: C-suffix	0°C to 70°C
I-suffix	–40°C to 85°C
Storage temperature range	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds	260°C

NOTE 1: All voltage values, except differential voltages, are with respect to the network ground terminal.

recommended operating conditions

		MIN	NOM	MAX	UNIT
VCC	Supply voltage	4.5	5	6.3	V
V_{IH}	High-level input voltage	2			V
V_{IL}	Low-level input voltage			0.8	V
fclock	Clock frequency	10		400	kHz
	Clock duty cycle (see Note 2)	40		60	%
twH(C S)	Pulse duration, CS high	220			ns
t _{su}	Setup time, CS low or ADC0832 data valid before CLK↑	350	-		ns
t _h	Hold time, ADC0832 data valid after CLK	90			ns
Τ.	Operating free pir temporature C-suffix	0		70	°C
TA	Operating free-air temperature I-suffix	-40		85	C

NOTE 2: The clock duty cycle range ensures proper operation at all clock frequencies. If a clock frequency is used outside the recommended duty cycle range, the minimum pulse duration (high or low) is 1 µs.

electrical characteristics over recommended range of operating free-air temperature, $V_{CC} = 5 \text{ V}$, $f_{clock} = 250 \text{ kHz}$ (unless otherwise noted)

digital section

PARAMETER		TEST COL	TEST CONDITIONS†		SUFFIX		I SUFFIX			UNIT
		TEST CON			TYP [‡]	MAX	MIN	TYP [‡]	MAX	UNII
VOH High-level output voltage	I Park I and a standard and a second	$V_{CC} = 4.75 \text{ V},$	I _{OH} = -360 μA	2.8			2.4			V
	$V_{CC} = 4.75 \text{ V},$	I _{OH} = -10 μA	4.6			4.5			V	
VOL	Low-levl output voltage	$V_{CC} = 4.75 \text{ V},$	I _{OL} = 1.6 mA	0.34			0.4			V
ΙΗ	High-level input current	V _{IH} = 5 V			0.005	1		0.005	1	μΑ
I _{IL}	Low-level input current	V _{IL} = 0			-0.005	-1		-0.005	-1	μΑ
loн	High-level output (source) current	$V_{OH} = V_{O}$	T _A = 25°C	-6.5	-14		-6.5	-14		mA
loL	Low-level output (sink) current	$V_{OL} = V_{CC}$	T _A = 25°C	8	16		8	16		mA
	High-impedance-state output	V _O = 5 V,	T _A = 25°C		0.01	3		0.01	3	μА
loz	current (DO)	$V_{O} = 0,$	T _A = 25°C		-0.01	-3		-0.01	-3	μΑ
Ci	Input capacitance				5			5		pF
Co	Output capacitance				5			5		pF

[†] All parameters are measured under open-loop conditions with zero common-mode input voltage.

[‡] All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^{\circ}\text{C}$.



ADC0831A, ADC0832A, ADC0831B, ADC0832B A/D PERIPHERALS WITH SERIAL CONTROL

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electrical characteristics over recommended range of operating free-air temperature, V_{CC} = 5 V, f_{clock} = 250 kHz (unless otherwise noted)

analog and converter section

	PARAMETER		TEST CONDITIONS†	MIN	TYP‡	MAX	UNIT
VICR	Common-mode input voltage range		See Note 3	-0.05 to V _{CC} +0.05			V
I _I (stdby) Standby input current (see Note 4)		On-channel	V _I = 5 V			1	
	Cton dhu innut sument (one Note 4)	Off-channel	V _I = 0			-1	
	Standby input current (see Note 4)	On-channel	V _I = 0			-1	μΑ
		Off-channel	V _I = 5 V			1	
ri(REF)	Input resistance to reference ladder	·		1.3	2.4	5.9	kΩ

total device

	PARAMETER	_	TEST CONDITIONS†	MIN	TYP‡	MAX	UNIT
laa	Supply ourrent	ADC0831			1	2.5	m ^
Icc	Supply current	ADC0832	۵		3	5.2	mA

[†] All parameters are measured under open-loop conditions with zero common-mode input voltage.

NOTES: 3. If channel IN– is more positive than channel IN+, the digital output code will be 0000 0000. Connected to each analog input are two on-chip diodes that conduct forward current for analog input voltages one diode drop above V_{CC}. Care must be taken during testing at low V_{CC} levels (4.5 V) because high-level analog input voltage (5 V) can, especially at high temperatures, cause this input diode to conduct and cause errors for analog inputs that are near full-scale. As long as the analog voltage does not exceed the supply voltage by more than 50 mV, the output code will be correct. To achieve an absolute 0 V to 5 V input voltage range requires a minimum V_{CC} of 4.95 V for all variations of temperature and load.

4. Standby input currents are currents going into or out of the on or off channels when the A/D converter is not performing conversion and the clock is in a high or low steady-state condition.

operating characteristics V_{CC} = REF = 5 V, f_{clock} = 250 kHz, t_r = t_f = 20 ns, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS§	AI, AC SUFFIX			BI, BC SUFFIX			UNIT	
	FARAIVIETER		LEST COMPLITIONS	MIN	TYP	MAX	MIN	TYP	MAX	UNIT
	Supply-voltage variation error		V _{CC} = 4.75 V to 5.25 V		±1/16	±1/4		±1/16	±1/4	LSB
Intal linadilisted error (see Note 5)		$V_{ref} = 5 V$, $T_A = MIN \text{ to MAX}$			±1			±1/2	LSB	
	Common-mode error		Differential mode		±1/16	±1/4		±1/16	±1/4	LSB
	Propagation delay time, ouput data after CLK↑ (see Note 6)	MSB-first data	C _I = 100 pF		650	1500		650	1500	ns
^t pd		LSB-first data	С_ = 100 рі		250	600		250	600	113
.	Output disable time,		$C_L = 10 \text{ pF}, R_L = 10 \text{ k}\Omega$		125	250		125	250	no
^t dis	DO after CS↑		$C_L = 100 \text{ pF}, R_L = 2 \text{ k}\Omega$			500			500	ns
tconv	Conversion time (multiplexer a time not included)	ddressing				8			8	clock periods

[§] All parameters are measured under open-loop conditions with zero common-mode input voltage. For conditions shown as MIN or MAX, use the appropriate value specified under recommended operating conditions.

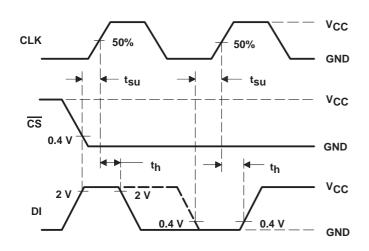


[‡] All typical values are at $V_{CC} = 5 \text{ V}$, $T_A = 25^{\circ}\text{C}$.

NOTES:5. Total unadjusted error includes offset, full-scale, linearity, and multiplexer errors.

^{6.} The most significant-bit-first data is output directly from the comparator and therefore requires additional delay to allow for comparator response time. Least-significant-bit-first data applies only to ADC0832.

PARAMETER MEASUREMENT INFORMATION



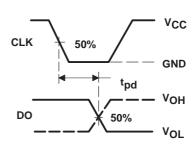
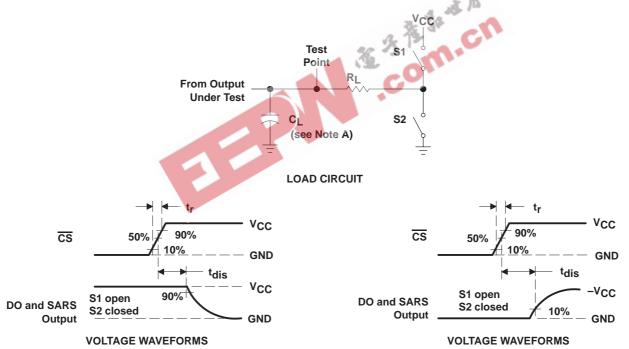


Figure 1. ADC0832 Data Input Timing

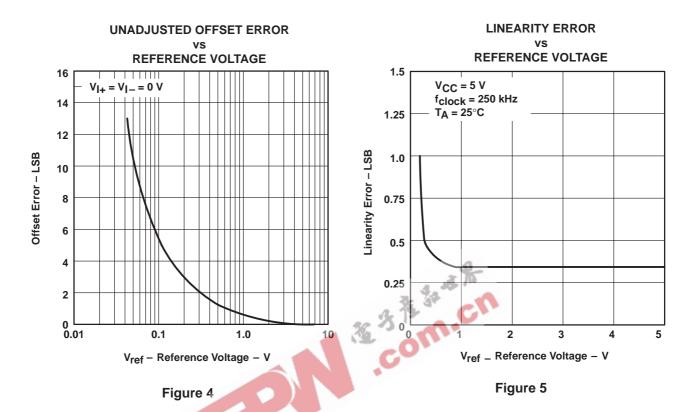
Figure 2. Data Output Timing

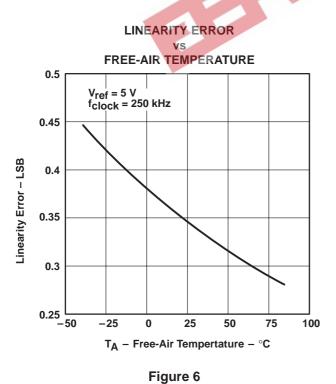


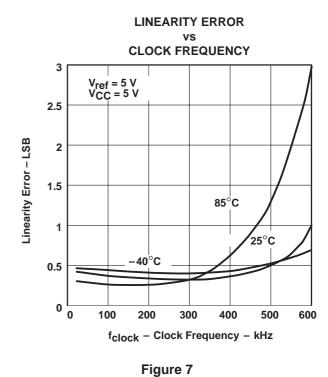
NOTE A: C_L includes probe and jig capacitance.

Figure 3. Output Disable Time Test Circuit and Voltage Waveforms

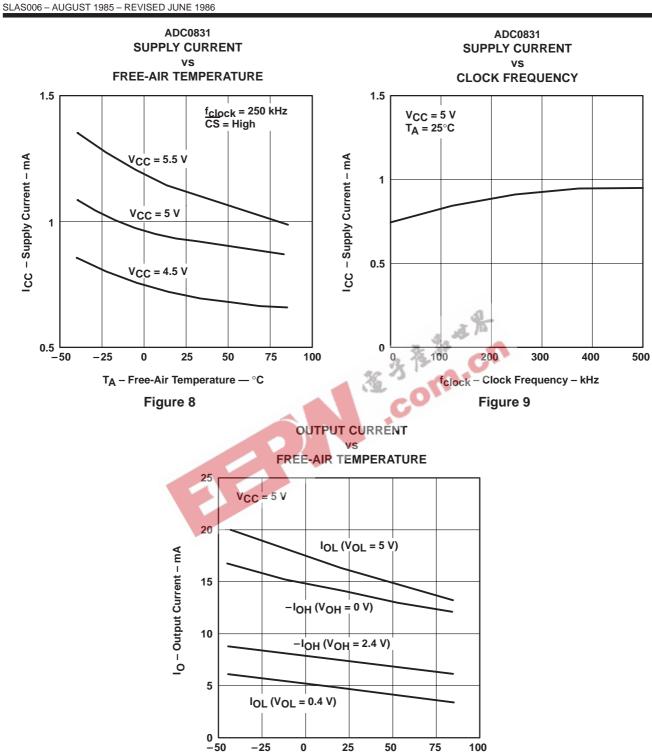
TYPICAL CHARACTERISTICS







ADC0831A, ADC0832A, ADC0831B, ADC0832B A/D PERIPHERALS WITH SERIAL CONTROL





25

 T_A – Free-Air Temperature – $^{\circ}$ C Figure 10

75

100

-25

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