ANALOG DEVICES

LC²MOS 8-Bit DAC with Output Amplifier

AD7224

1.1 Scope.

This specification covers the detail requirements for a monolithic CMOS 8-bit, voltage output, digital-to-analog converter with output amplifier and double-buffered interface logic. No external trims are required to achieve full specified performance for the part.

1.2 Part Number.

The complete part numbers per Tables 1 and 2 of this specification are as follows:

Device	Part Number[1]
−1	AD7224T(X)/883B
−2	AD7224U(X)/883B

NOTE
[1]See paragraph 1.2.3 for package identifier.

1.2.3 Case Outline.

See Appendix 1 of General Specification ADI-M-1000: package outline:

(X)	Package	Description
Q	Q-18	18-Pin Cerdip
E	E-20A	20-Contact LCC

1.3 Absolute Maximum Ratings. (T_A = +25°C unless otherwise noted)

V_{DD} to AGND	−0.3V, +17V
V_{DD} to DGND	−0.3V, +17V
V_{SS} to AGND	−7V, V_{DD}
V_{SS} to DGND	−7V, V_{DD}
V_{DD} to V_{SS}	−0.3V, +24V
AGND to DGND	−0.3V, $+V_{DD}$
Digital Input Voltage to DGND	−0.3V, V_{DD}
V_{REF} to AGND	−0.3V, V_{DD}
V_{OUT} to AGND	V_{SS}, V_{DD}
Power Dissipation	
Up to +75°C	450mW
Derates above +75°C	6mW/°C
Operating Temperature Range	−55°C to +125°C
Storage Temperature	−65°C to +150°C
Lead Temperature (Soldering 10sec)	+300°C

1.5 Thermal Characteristics.

Thermal Resistance θ_{JC} = 35°C/W for Q-18 and E-20A
θ_{JA} = 120°C/W for Q-18 and E-20A

AD7224—SPECIFICATIONS

Table 1.

Test	Symbol	Device	Design Limit T_{min}–T_{max}	Sub Group 1	Sub Group 2, 3	Sub Group 4	Test Condition[1]	Units
Resolution	RES	−1, 2	8					Bits
Relative Accuracy	RA	−1	1	1	1		V_{DD} = +14V; V_{SS} = −5V; V_{REF} = +10V	± LSB max
		−2	1/2	1	1/2	1/2		
Total Unadjusted Error	E_T	−1	2	2	2		V_{DD} = +14V; V_{SS} = −5V; V_{REF} = +10V	± LSB max
		−2	1	2	1			
Differential Nonlinearity	DNL	−1, 2	1	1	1		Guaranteed Monotonic to 8-Bits	± LSB max
Full-Scale Error	A_E	−1	3/2	3/2	3/2		V_{DD} = +14V; V_{SS} = −5V; V_{REF} = +10V	± LSB max
		−2	1	3/2	1	1		
Zero Code Error	A_{ZCE}	−1	30	30	30		V_{DD} = 16.5V, 11.4V and 14V; V_{SS} = −5V; V_{REF} = V_{DD} − 4	± mV max
		−2	20	30	20	20		
Full-Scale Temp Coefficient	dA_E/dT	−1, 2	20				V_{DD} = 14V to 16.5V, V_{REF} = +10V	± ppm/°C max
Voltage Output Settling Time[2]	t_{SL}	−1, 2	5				Positive Full-Scale Change	μs max
			7				Negative Full-Scale Change	
Voltage Output Slew Rate	t_{SR}	−1, 2	2.5					V/μs min
Minimum Load Resistance	RL_{MIN}	−1, 2	2				V_{OUT} = +10V; V_{DD} = +14V	kΩ min
Reference Voltage Range	V_{REF}	−1, 2	2 to (V_{DD} − 4)					V min to V max
Reference Input Resistance	R_I	−1, 2	8	8	8		V_{DD} = 14V	kΩ min
Reference Input Capacitance	C_I	−1, 2	100				Occurs When DAC Is Loaded with All 1's	pF min
Digital Input High Voltage	V_{IH}	−1, 2	2.4	2.4	2.4		V_{DD} = 11.4V; V_{REF} = V_{DD} − 4	V min
Digital Input Low Voltage	V_{IL}	−1, 2	0.8	0.8	0.8		V_{DD} = 11.4V; V_{REF} = V_{DD} − 4	V max
Digital Input Leakage Current	I_{IN}	−1, 2	1	1	1		V_{IN} = 0V or V_{DD}; V_{DD} = 11.4V	± μA max
Digital Input Capacitance	C_I	−1, 2	8					pF max
Chip Select/Load DAC Pulse Width	t_{LD}	−1, 2	200					ns min
Write/Reset Pulse Width	t_{WR}	−1, 2	200					ns min
Chip Select/Load DAC to Write Setup Time	t_{CS}	−1, 2	0					ns min
Chip Select/Load DAC to Write Hold Time	t_{CH}	−1, 2	0					ns min
Data Valid to Write Setup Time	t_{DS}	−1, 2	100					ns min
Data Valid to Write Hold Time	t_{DH}	−1, 2	10					ns min
Power Supply Voltage Range	V_{DD}	−1, 2	11.4				For Specified Performance	+ V min
			16.5					+ V max
	V_S	−1, 2	4.5				For Specified Performance	− V min
			5.5					− V max
Power Supply Current	I_{DD}	−1, 2	6	4	6		Output Unloaded: V_{IN} = V_{IL} or V_{IH} V_{DD} = 16.5V; V_{SS} = −5.5V; V_{REF} = 12.5V	mA max
	I_{SS}	−1, 2	5	3	5			

NOTE: DUAL SUPPLY OPERATION

[1] V_{DD} = +11.4V to 16.5V; V_{SS} = −5V ± 10%; AGND = DGND = 0V; V_{REF} = +2V to (V_{DD} − 4V) unless otherwise stated.

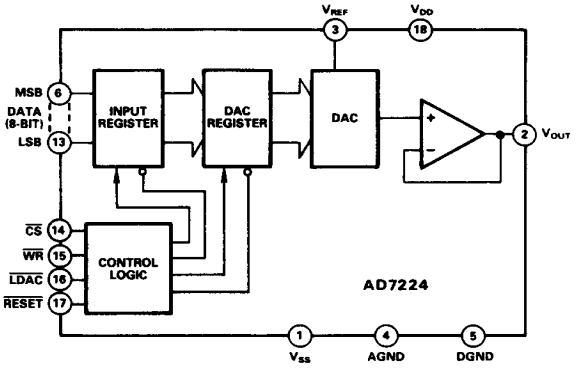
[2] V_{REF} = +10V; settling time to ± 1/2LSB.

Table 2.

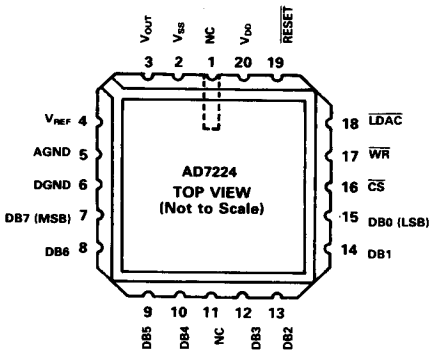
Test	Symbol	Device	Design Limit T_{min}–T_{max}	Sub Group 1	Sub Group 2, 3	Sub Group 4	Test Condition[1]	Units
Resolution	RES	–1, 2	8					Bits
Total Unadjusted Error	E_T	–1, 2	2	2	2		V_{DD} = +14V	± LSB max
Differential Nonlinearity	DNL	–1, 2	1	1	1		V_{DD} = +14V; Guaranteed Monotonic to 8-Bits	± LSB max
Voltage Output Settling Time[2]	t_{SL}	–1, 2	5				Positive Full-Scale Change	µs max
			20				Negative Full-Scale Change	
Voltage Output Slew Rate	t_{SR}	–1, 2	2					V/µs min
Minimum Load Resistance	RL_{MIN}	–1, 2	2	2	2		V_{OUT} = +10V; V_{DD} = +15V	kΩ min
Reference Input Resistance	R_I	–1, 2	8				V_{DD} = 14.25V	kΩ min
Reference Input Capacitance	C_I	–1, 2	100				Occurs When DAC Is Loaded with All 1's	pF max
Digital Input High Voltage	V_{IH}	–1, 2	2.4	2.4	2.4		V_{DD} = 14.25V	V min
Digital Input Low Voltage	V_{IL}	–1, 2	0.8	0.8	0.8		V_{DD} = 14.25V	V max
Digital Input Leakage Current	I_{IN}	–1, 2	1				V_{IN} = 0V or V_{DD}; V_{DD} = 14.25V	± µA max
Digital Input Capacitance	C_I	–1, 2	8					pF max
Chip Select/Load DAC Pulse Width	t_{LD}	–1, 2	200					ns min
Write/Reset Pulse Width	t_{WR}	–1, 2	200					ns min
Chip Select/Load DAC to Write Setup Time	t_{CS}	–1, 2	0					ns min
Chip Select/Load DAC to Write Hold Time	t_{CH}	–1, 2	0					ns min
Data Valid to Write Setup Time	t_{DS}	–1, 2	100					ns min
Data Valid to Write Hold Time	t_{DH}	–1, 2	10					ns min
Power Supply Voltage Range	V_{DD}	–1, 2	14.25				For Specified Performance	+ V min
			15.75					+ V max
Power Supply Current	I_{DD}	–1, 2	6				Outputs Unloaded; V_{IN} = V_{IL} or V_{IH} V_{DD} = 15.75V	mA max

NOTE: SINGLE SUPPLY OPERATION
[1]V_{DD} = +15V ± 5%; V_{SS} = AGND = DGND = 0V; V_{REF} = +10V unless otherwise stated.
[2]Settling time to ± 1/2LSB.

3.2.1 Functional Block Diagram and Terminal Assignments.



E Package (LCC)

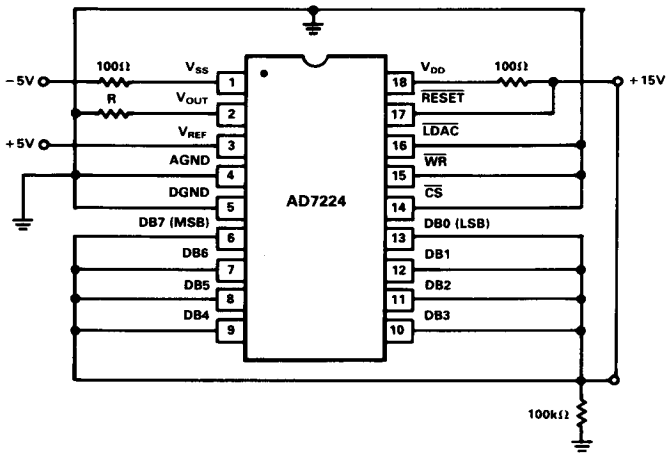


3.2.4 Microcircuit Technology Group.

This microcircuit is covered by technology group (80).

4.2.1 Life Test/Burn-In Circuit.

Steady state life test is per MIL-STD-883 Method 1005. Burn-in is per MIL-STD-883 Method 1015 test condition (B).



NOTE:
V_{DD} IS TURNED ON FIRST, THEN V_{SS} FOLLOWED BY V_{REF}.

Table 3. AD7224 Truth Table

$\overline{RESET}$	$\overline{LDAC}$	$\overline{WR}$	$\overline{CS}$	Function
H	L	L	L	Both Registers are Transparent
H	X	H	X	Both Registers are Latched
H	H	X	H	Both Registers are Latched
H	H	L	L	Input Register Transparent
H	H	↓	L	Input Register Latched
H	L	L	H	DAC Register Transparent
H	L	↓	H	DAC Register Latched
L	X	X	X	Both Registers Loaded With All Zeros
↓	H	H	H	Both Register Latched With All Zeros and Output Remains at Zero
↓	L	L	L	Both Registers are Transparent and Output Follows Input Data

H = High State, L = Low State, X = Don't Care

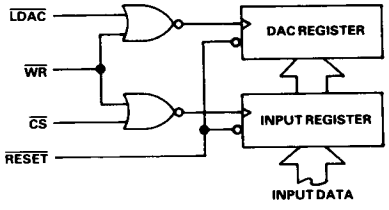


Figure 1. Input Control Logic

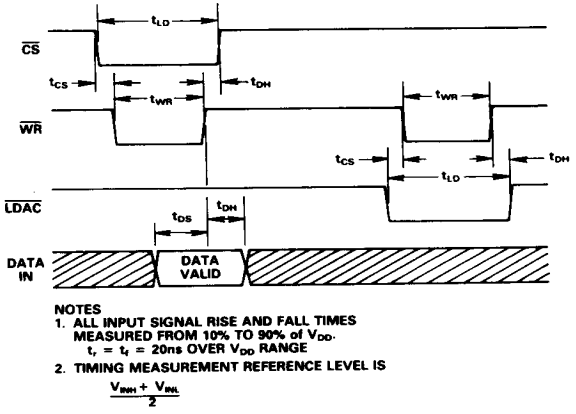


Figure 2. Write Cycle Timing Diagram