

MAXIM

Complete, 12-Bit Voltage-Output DACs

General Description

The MX7245/MX7248 are complete, 12-bit digital-to-analog converters (DACs) that include an internal voltage reference and a voltage-output amplifier. The MX7245/MX7248 are pin and electrically compatible with Analog Devices' AD7245/AD7248.

The MX7245/MX7248 have double-buffered logic interfaces that are easily interfaced to microprocessors (μ Ps). Data is transferred into the Input register from a 12-bit-wide data bus (MX7245) for 16-bit μ Ps, or in a right-justified (8+4)-bit format (MX7248) for 8- and 16-bit μ Ps. All logic signals are level triggered and are TTL and CMOS compatible. The timing specifications ensure compatibility with common μ Ps.

The DACs are specified and tested for both dual- and single-supply operation. Usable supplies range from single +12V to dual ± 15 V.

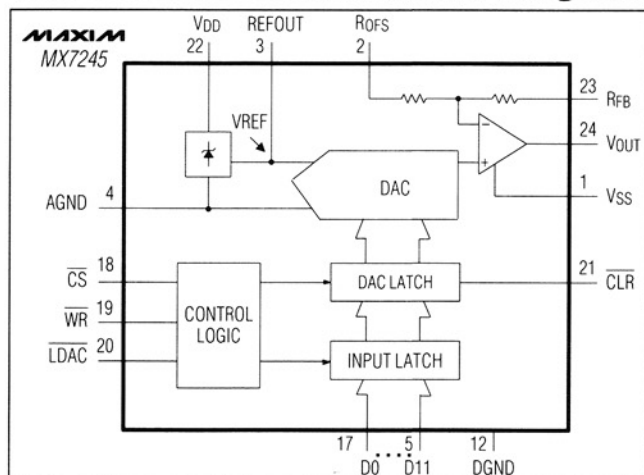
Internal gain-setting resistors allow three output voltage ranges: 0V to +5V and 0V to +10V can be generated using either single or dual supplies. With dual supplies, an additional output range of ± 5 V is available. The output amplifier drives 2k Ω loads to +10V.

See MAX507/MAX508 data sheet for detailed description.

Applications

Minimum Component Count Analog Systems
Digital Offset and Gain Adjustment
Industrial Control
Arbitrary Function Generators
Automatic Test Equipment
Automated Calibration
Machine and Motion Control

Functional Diagram



Features

- ◆ 12-Bit Voltage Output
- ◆ Low-Noise, Buried-Zener Voltage Reference
- ◆ Fast Logic Interface (80ns $\overline{\text{WR}}$ Pulse)
- ◆ Operate from Single or Dual Supplies
- ◆ 8-/16-Bit Microprocessor-Bus Compatible
- ◆ Available in DIP and PLCC Packages
- ◆ Pin and Electrically Compatible with AD7245/AD7248

Ordering Information

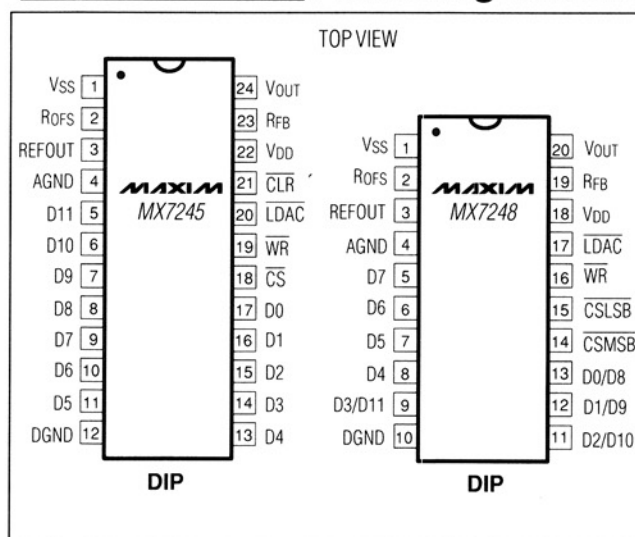
PART	TEMP. RANGE	PIN-PACKAGE
MX7245JN	0°C to +70°C	24 Plastic DIP
MX7245JP	0°C to +70°C	28 PLCC
MX7245J/D	0°C to +70°C	Dice*
MX7245AQ	-40°C to +85°C	24 CERDIP
MX7245SE	-55°C to +125°C	28 LCC**
MX7245SQ	-55°C to +125°C	24 CERDIP**
MX7248JN	0°C to +70°C	20 Plastic DIP
MX7248JP	0°C to +70°C	20 PLCC
MX7248J/D	0°C to +70°C	Dice*
MX7248AE	-40°C to +85°C	20 LCC***
MX7248AQ	-40°C to +85°C	20 CERDIP
MX7248SE	-55°C to +125°C	20 LCC**
MX7248SQ	-55°C to +125°C	20 CERDIP**

* Contact factory for dice specifications.

** Contact factory for availability and processing to MIL-STD-883.

***Contact factory for availability.

Pin Configurations



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ABSOLUTE MAXIMUM RATINGS

V _{DD} to AGND	-0.3V, +17V
V _{DD} to DGND	-0.3V, +17V
V _{DD} to V _{SS}	-0.3V, +34V
AGND to DGND	-0.3V, V _{DD}
Digital Input Voltage to GND	-0.3V, V _{DD} + 0.3V
V _{OUT} to AGND (Note 1)	V _{SS} , V _{DD}
REFOUT to AGND (Note 1)	-0.3V, V _{DD} + 0.3V
Continuous Power Dissipation (any package)	
to +75°C	.450mW
derate above +75°C by	6mW/°C

Operating Temperature Ranges:

MX724_J_	0°C to +70°C
MX724_A_	-40°C to +85°C
MX724_S_	-55°C to +125°C
Storage Temperature Range	-65°C to +160°C
Lead Temperature (soldering, 10 sec)	+300°C

Note 1: The output can be shorted to either supply rail if the package power dissipation is not exceeded. Typical short-circuit current to AGND is 25mA.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

Single Supply (V_{DD} = +11.4V to +15.75V, V_{SS} = AGND = DGND = 0V, R_L = 2kΩ, C_L = 100pF, REFOUT unloaded, all grades, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
STATIC PERFORMANCE						
Resolution	N		12			Bits
Relative Accuracy	INL				±1	LSB
Differential Nonlinearity	DNL				±1	LSB
Unipolar Offset Error	UOE	T _A = +25°C			±3	LSB
		T _A = T _{MIN} to T _{MAX}			±5	
DAC Gain Error					±2	LSB
Full-Scale Output Voltage Error	FSE	V _{DD} = 12V or 15V			±0.2	% of FSR
					±0.6	
ΔFull-Scale Output Voltage Error/ ΔV _{DD}		V _{DD} = 12V or 15V ±5%			±0.12	% of FSR
					±0.2	
Full-Scale Tempco		MX724_J_/A_			±30	ppm of FSR/°C
		MX724_S_			±40	
ΔOffset/ΔV _{DD}		V _{DD} = 12V or 15V ±5%			±1	mV
REFERENCE						
Reference Output		V _{DD} = 12V or 15V, T _A = +25°C	4.99		5.01	V
ΔReference/ΔV _{DD}		V _{DD} = 12V or 15V ±5%			2	mV/V
					6	
Reference Temperature Coefficient	TCV _O	MX724_J_/A_			±30	ppm/°C
		MX724_S_			±40	
Reference Load Sensitivity		I _{LOAD} = 0μA to 100μA			±1	mV
ANALOG OUTPUT						
Output Range Resistors			15		30	kΩ
Ranges		(Note 2)			0 to 5 or 10	V
DC Output Impedance				0.5		Ω
Short-Circuit Current				25		mA

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ELECTRICAL CHARACTERISTICS (continued)

Single Supply ($V_{DD} = +11.4V$ to $+15.75V$, $V_{SS} = AGND = DGND = 0V$, $R_L = 2k\Omega$, $C_L = 100pF$, $REFOUT$ unloaded, all grades, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DYNAMIC PERFORMANCE (Note 3)						
Output Voltage Settling Time	t_s	Settling time to $\pm 1/2LSB$			5	μs
Output Voltage Slew Rate			2			$V/\mu s$
Digital Feedthrough				10		$nV-s$
Digital-to-Analog Glitch Impulse	Q	Major carry transition		30		$nV-s$
Output Load Resistance		$V_{OUT} = 0V$ to $+10V$ (Note 2)	2			$k\Omega$
POWER SUPPLIES						
V_{DD} Range		For specified performance	11.40		15.75	V
I_{DD}		Outputs unloaded	$T_A = +25^\circ C$		9	mA
			$T_A = T_{MIN}$ to T_{MAX}		12	

ELECTRICAL CHARACTERISTICS

Dual Supply ($V_{DD} = +11.4V$ to $+15.75V$, $V_{SS} = -11.4V$ to $-15.75V$, $DGND = AGND = 0V$, $R_L = 2k\Omega$, $C_L = 100pF$, $REFOUT$ unloaded, all grades, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
STATIC PERFORMANCE						
Resolution	N		12			Bits
Relative Accuracy	INL				± 1	LSB
Differential Nonlinearity	DNL				± 1	LSB
Bipolar Zero Offset Error	BZOE	$T_A = +25^\circ C$			± 3	LSB
		$T_A = T_{MIN}$ to T_{MAX}			± 5	
DAC Gain Error					± 2	LSB
Full-Scale Output Voltage Error	FSE	$V_{DD} = 15V$ or $-15V$	$T_A = +25^\circ C$		± 0.2	% of FSR
			$T_A = T_{MIN}$ to T_{MAX}		± 0.6	
		$V_{DD} = 12V$ or $-12V$	$T_A = +25^\circ C$		± 0.2	
			$T_A = T_{MIN}$ to T_{MAX}		± 0.6	
Δ Full-Scale Output Voltage Error/ ΔV_{DD}		$V_{DD} = 12V$ or $15V \pm 5\%$	$T_A = +25^\circ C$		± 0.12	% of FSR
			$T_A = T_{MIN}$ to T_{MAX}		± 0.2	
Δ Full-Scale Output Voltage Error/ ΔV_{SS}		$V_{SS} = 12V$ or $15V \pm 5\%$			± 1	mV
Full-Scale Tempco		MX724_J_/A_			± 30	ppm of FSR/ $^\circ C$
		MX724_S_			± 40	
Δ Offset/ ΔV_{DD}		$V_{DD} = 12V$ or $15V \pm 5\%$			± 1	mV
REFERENCE						
Reference Output		$V_{DD} = 12V$ or $15V$, $T_A = +25^\circ C$	4.99		5.01	V
Δ Reference/ ΔV_{DD}		$V_{DD} = 12V$ or $15V \pm 5\%$	$T_A = +25^\circ C$		2	mV/V
			$T_A = T_{MIN}$ to T_{MAX}		6	
Reference Temperature Coefficient	TCVO	MX724_J_/A_		± 30		ppm/ $^\circ C$
		MX724_S_		± 40		
Reference Load Sensitivity		$I_{LOAD} = 0\mu A$ to $100\mu A$			± 1	mV

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ELECTRICAL CHARACTERISTICS (continued)

Dual Supply ($V_{DD} = +11.4V$ to $+15.75V$, $V_{SS} = -11.4V$ to $-15.75V$, $DGND = AGND = 0V$, $R_L = 2k\Omega$, $C_L = 100pF$, REF_{OUT} unloaded, all grades, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
ANALOG OUTPUT						
Output Range Resistors			15		30	$k\Omega$
Ranges		(Note 2)		0 to 5 or 10 -5 to 5		V
DC Output Impedance				0.5		Ω
Short-Circuit Current				25		mA
DYNAMIC PERFORMANCE (Note 3)						
Output Voltage Settling Time	t_S	Settling time to $\pm 1/2LSB$			5	μs
Output Voltage Slew Rate			2			V/ μs
Digital Feedthrough				10		nV-s
Digital-to-Analog Glitch Impulse	Q	Major carry transition		30		nV-s
Output Load Resistance		$V_{OUT} = -5V$ to $+10V$	2			$k\Omega$
POWER SUPPLIES						
V_{DD} Range		For specified performance	11.40		15.75	V
V_{SS} Range		For specified performance	-11.40		-15.75	V
I_{DD}		Outputs unloaded	$T_A = +25^\circ C$		9	mA
			$T_A = T_{MIN}$ to T_{MAX}		12	
I_{SS}		Outputs unloaded	$T_A = +25^\circ C$		3	mA
			$T_A = T_{MIN}$ to T_{MAX}		5	

ELECTRICAL CHARACTERISTICS

Single or Dual Supply ($V_{DD} = +11.4V$ to $+15.75V$, $V_{SS} = 0V$ to $-15.75V$, $DGND = AGND = 0V$, $R_L = 2k\Omega$, $C_L = 100pF$, REF_{OUT} unloaded, all grades, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
DIGITAL INPUTS						
Input High Voltage	V_{INH}		2.4			V
Input Low Voltage	V_{INL}				0.8	V
Input Current	I_{IN}	D0-D11	$T_A = +25^\circ C$		± 1	μA
			$T_A = T_{MIN}$ to T_{MAX}		± 10	
	I_{INH}	$\overline{CS}$, WR , $LDAC$, CLR , $CSMB$, $CSLSB$	$T_A = +25^\circ C$		± 1	
			$T_A = T_{MIN}$ to T_{MAX}		± 10	
	I_{INL}	$\overline{CS}$, WR , $LDAC$, CLR , $CSMB$, $CSLSB$	$T_A = +25^\circ C$		150	
			$T_A = T_{MIN}$ to T_{MAX}		200	
Digital Input Capacitance	C_{IN}	MX7245			8	pF
		MX7248			16	

Note 2: V_{OUT} must be less than $(V_{DD} - 2.5V)$.

Note 3: Guaranteed at $T_A = +25^\circ C$, but not production tested.

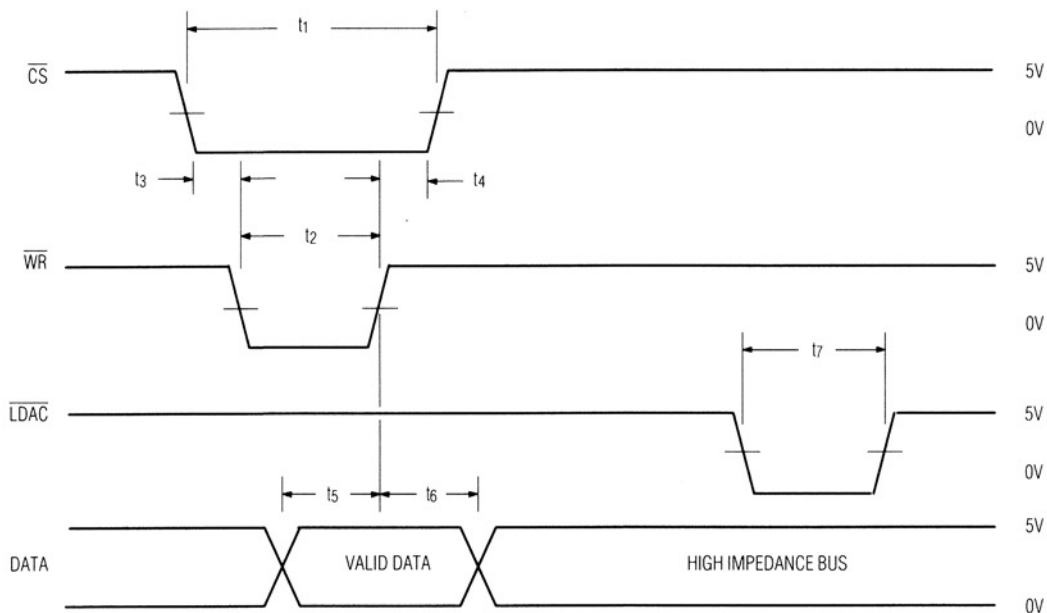
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SWITCHING CHARACTERISTICS

($T_A = T_{MIN} = T_{MAX}$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS	J GRADE		A GRADE		S GRADE		UNITS
			MIN	MAX	MIN	MAX	MIN	MAX	
$\overline{CS}$ Pulse Width	t_1	$T_A = +25^\circ\text{C}$	80		80		105		ns
		$T_A = T_{MIN} \text{ to } T_{MAX}$	100		100		135		
$\overline{WR}$ Pulse Width	t_2	$T_A = +25^\circ\text{C}$	80		80		105		ns
		$T_A = T_{MIN} \text{ to } T_{MAX}$	100		100		135		
$\overline{CS}$ to $\overline{WR}$ Setup Time	t_3		0		0		0		ns
$\overline{CS}$ to $\overline{WR}$ Hold Time	t_4		0		0		0		ns
Data to $\overline{WR}$ Setup Time	t_5 (MX7245 only)	$T_A = +25^\circ\text{C}$	100		100		155		ns
		$T_A = T_{MIN} \text{ to } T_{MAX}$	110		130		250		
	t_5 (MX7248 only)	$T_A = +25^\circ\text{C}$	110		110		180		
		$T_A = T_{MIN} \text{ to } T_{MAX}$	130		130		270		
Data to $\overline{WR}$ Hold Time	t_6 (MX7245 only)		10		10		10		ns
$\overline{LDAC}$ Pulse Width	t_7	$T_A = +25^\circ\text{C}$	80		80		90		ns
		$T_A = T_{MIN} \text{ to } T_{MAX}$	100		100		120		
$\overline{CLR}$ Pulse Width	t_8 (MX7245 only)	$T_A = +25^\circ\text{C}$	80		80		140		ns
		$T_A = T_{MIN} \text{ to } T_{MAX}$	100		100		200		



NOTES:

1. SEE TIMING SPECIFICATIONS.
2. ALL INPUT RISE AND FALL TIMES MEASURED FROM 10% TO 90% OF +5V, $t_r = t_f = 5\text{ns}$.
3. TIMING MEASUREMENT REFERENCE LEVEL IS $\frac{V_{INH} + V_{INL}}{2}$.
4. IF $\overline{LDAC}$ IS ACTIVATED WHILE $\overline{WR}$ IS LOW THEN $\overline{LDAC}$ MUST STAY LOW FOR t_7 OR LONGER AFTER $\overline{WR}$ GOES HIGH.

Figure 1. MX7245 Write-Cycle Timing Diagram

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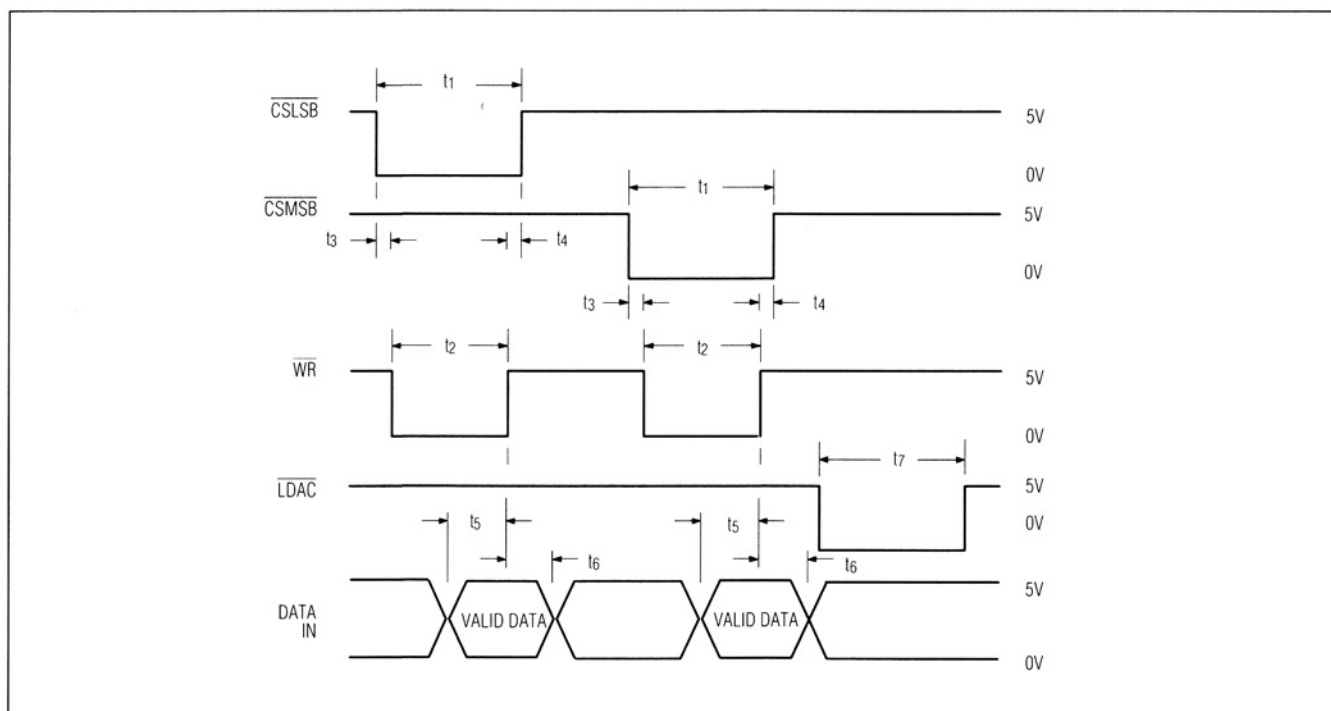


Figure 2. MX7248 Write-Cycle Timing Diagram

MX7245 PIN	MX7248 PIN	NAME	FUNCTION	MX7245 PIN	MX7248 PIN	NAME	FUNCTION
1	1	V _{SS}	Negative Supply Voltage	13-17		D4-D0	Data Bits 4-0
2	2	R _{OFFS}	Bipolar Offset Resistor	18		CS	Chip-Select Input - active low
3	3	REFOUT	Reference Output		14	C̄SMSB	Chip-Select Input for the MSB nibble – active low
4	4	AGND	Analog Ground		15	C̄LSLB	Chip-Select Input for the LSB byte – active low
	5-8	D7-D4	Data Bits 7-4	19	16	W̄R	Write Input - active low
	9	D3/D11	Data Bits 3 and 11	20	17	L̄DAC	Load DAC Input - active low
5-11		D11-D5	Data Bits 11-5	21		CL̄R	Clear Input - active low
12	10	DGND	Digital Ground	22	18	V _{DD}	Positive Supply Voltage
	11	D2/D10	Data Bits 2 and 10	23	19	R _{FB}	Feedback Resistor
	12	D1/D9	Data Bits 1 and 9	24	20	V _{OUT}	Output Voltage
	13	D0-D8	Data Bits 0 and 8				

See MAX507/MAX508 data sheet for applications information.

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