19-3987; Rev 0; 11/91

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 (µPs). Data is transferred into the Input register from a 12-bit-wide data bus (MX7245) for 16-bit µPs, or in a right-justified (8+4)-bit format (MX7248) for 8- and 16-bit µPs. All logic signals are level triggered and are TTL and CMOS compatible. The timing specifications ensure compatiblity with common µPs.

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

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 ±5V is available. The output amplifier drives 2kΩ loads to +10V.

See MAX507/MAX508 data sheet for detailed description.

Applications

Minimum Component Count Analog Systems

Digital Offset and Gain Adjustment

Industrial Control

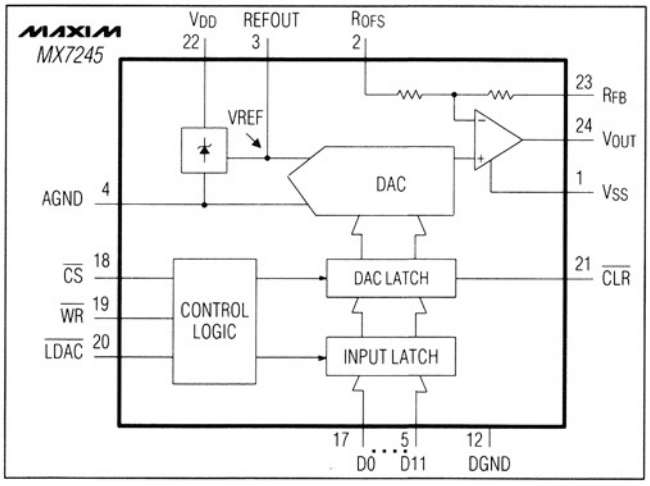
Arbitrary Function Generators

Automatic Test Equipment

Automated Calibration

Machine and Motion Control

Functional Diagram



Features

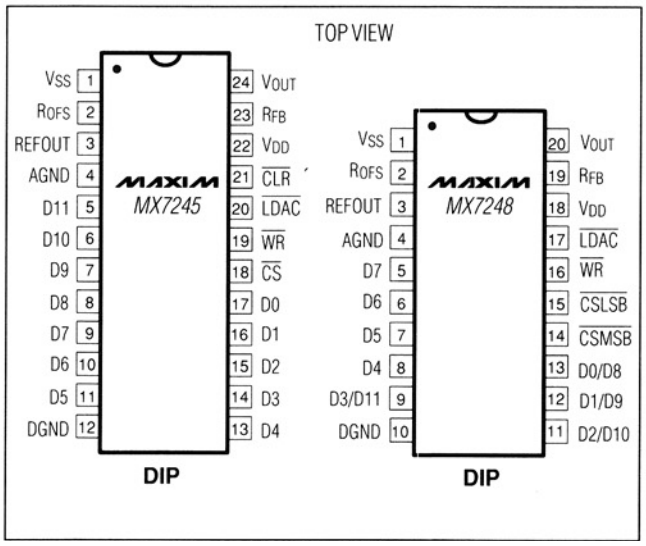
- ♦ 12-Bit Voltage Output
- ♦ Low-Noise, Buried-Zener Voltage Reference
- ♦ Fast Logic Interface (80ns $\overline{WR}$ Pulse)
- ♦ Operate from Single or Dual Supplies
- ♦ 8-/16-Bit Microprocessor-Bus Compatible
- ♦ Available in DIP and PLCC Packages
- ♦ Pin and Electrically Compatible with AD7245/AD7248

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



Complete, 12-Bit Voltage-Output DACs

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	T_A = +25°C			±0.2	% of FSR
			T_A = T_{MIN} to T_{MAX}			±0.6	
ΔFull-Scale Output Voltage Error/ ΔV_{DD}		V_{DD} = 12V or 15V ±5%	T_A = +25°C			±0.12	% of FSR
			T_A = T_{MIN} to T_{MAX}			±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%	T_A = +25°C			2	mV/V
			T_A = T_{MIN} to T_{MAX}			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

ELECTRICAL CHARACTERISTICS (continued)

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
DYNAMIC PERFORMANCE (Note 3)							
Output Voltage Settling Time	t_S	Settling time to ±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} = 0V to +10V (Note 2)		2			kΩ
POWER SUPPLIES							
V_{DD} Range		For specified performance		11.40		15.75	V
I_{DD}		Outputs unloaded	T_A = +25°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 = 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
Bipolar Zero Offset Error	BZOE	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} = 15V or -15V	T_A = +25°C			±0.2	% of FSR
			T_A = T_{MIN} to T_{MAX}			±0.6	
		V_{DD} = 12V or -12V	T_A = +25°C			±0.2	
			T_A = T_{MIN} to T_{MAX}			±0.6	
ΔFull-Scale Output Voltage Error/ ΔV_{DD}		V_{DD} = 12V or 15V ±5%	T_A = +25°C			±0.12	% of FSR
			T_A = T_{MIN} to T_{MAX}			±0.2	
ΔFull-Scale Output Voltage Error/ ΔV_{SS}		V_{SS} = 12V or 15V ±5%				±1	mV
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%	T_A = +25°C			2	mV/V
			T_A = T_{MIN} to T_{MAX}			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

Complete, 12-Bit Voltage-Output DACs

ELECTRICAL CHARACTERISTICS (continued)

Dual Supply (V_{DD} = +11.4V to +15.75V, V_{SS} = -11.4V to -15.75V, DGND = AGND = 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
ANALOG OUTPUT							
Output Range Resistors				15		30	kΩ
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 ±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			kΩ
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°C			9	mA
			T_A = T_{MIN} to T_{MAX}			12	
I_{SS}		Outputs unloaded	T_A = +25°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 = 2kΩ, C_L = 100pF, REFOUT unloaded, all grades, T_A = T_{MIN} to T_{MAX}, unless otherwise noted.)

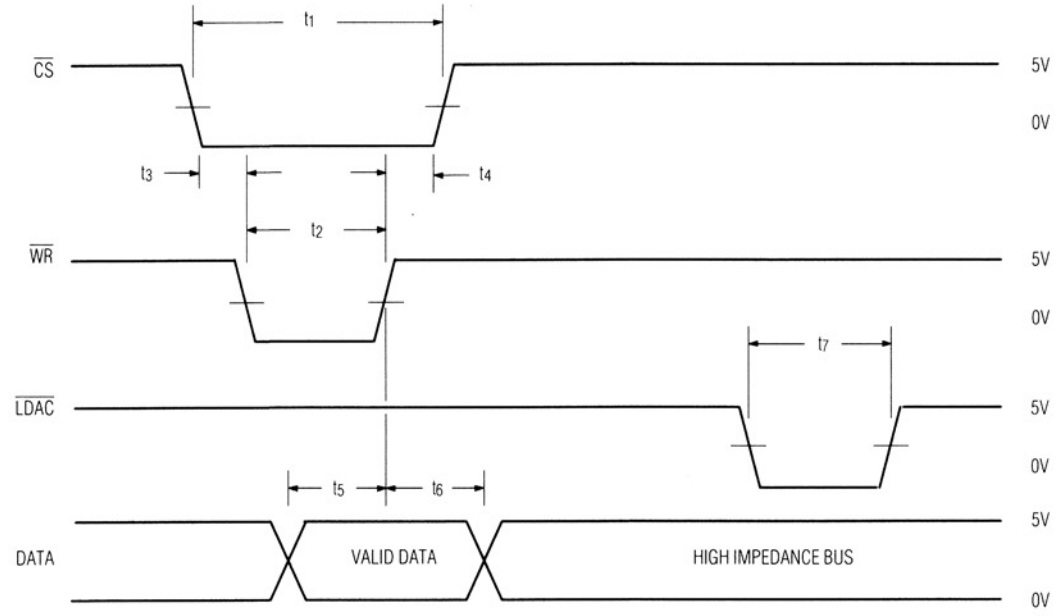
PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
DIGITAL INPUTS							
Input High Voltage	V_{INH}			2.4			V
Input Low Voltage	V_{INL}					0.8	V
Input Current	I_N	D0-D11	T_A = +25°C			±1	µA
			T_A = T_{MIN} to T_{MAX}			±10	
	I_{INH}	$\overline{CS}$, $\overline{WR}$, $\overline{LDAC}$, $\overline{CLR}$, $\overline{CSMB}$, $\overline{CSLSB}$	T_A = +25°C			±1	
			T_A = T_{MIN} to T_{MAX}			±10	
	I_{INL}	$\overline{CS}$, $\overline{WR}$, $\overline{LDAC}$, $\overline{CLR}$, $\overline{CSMB}$, $\overline{CSLSB}$	T_A = +25°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°C, but not production tested.

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°C	80		80		105		ns
		T_A = T_{MIN} to T_{MAX}	100		100		135		
$\overline{WR}$ Pulse Width	t_2	T_A = +25°C	80		80		105		ns
		T_A = T_{MIN} 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°C	100		100		155		ns
		T_A = T_{MIN} to T_{MAX}	110		130		250		
	t_5 (MX7248 only)	T_A = +25°C	110		110		180		
		T_A = T_{MIN} 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°C	80		80		90		ns
		T_A = T_{MIN} to T_{MAX}	100		100		120		
$\overline{CLR}$ Pulse Width	t_8 (MX7245 only)	T_A = +25°C	80		80		140		ns
		T_A = T_{MIN} 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 = 5ns.
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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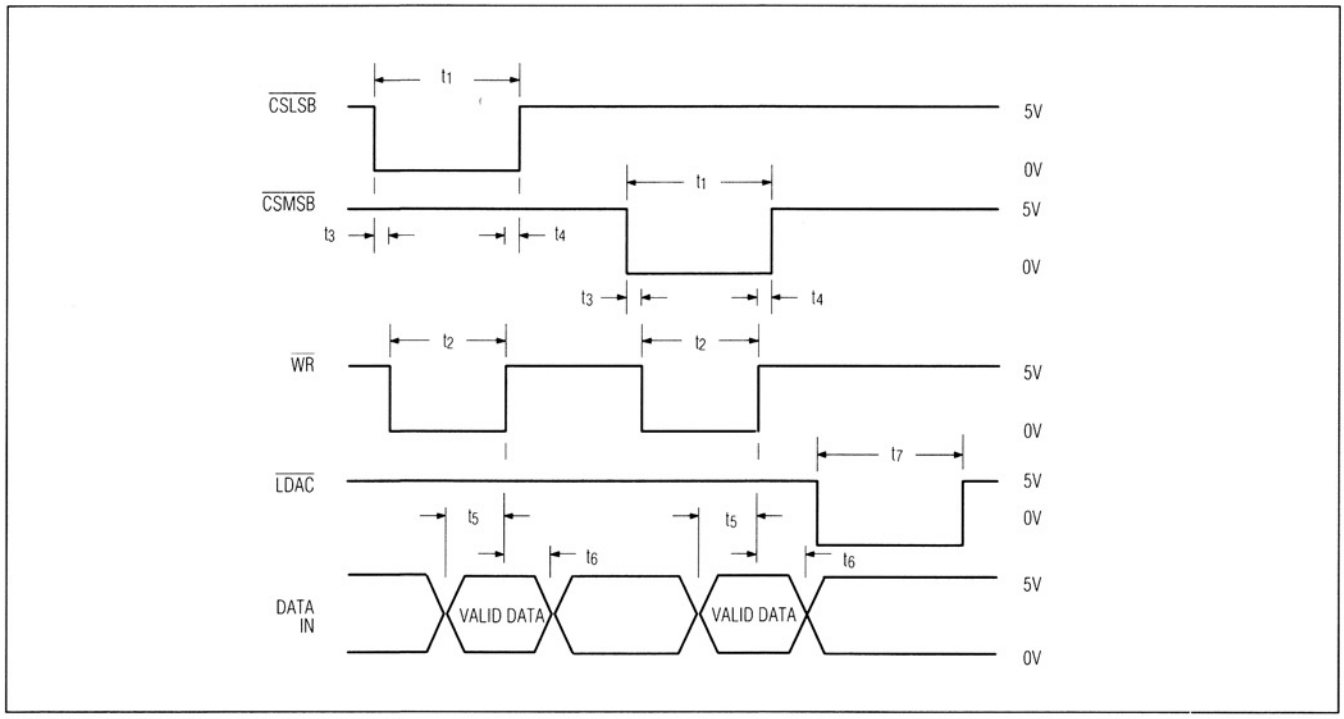

Figure 2. MX7248 Write-Cycle Timing Diagram

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_{OFS}	Bipolar Offset Resistor	18		$\overline{CS}$	Chip-Select Input - active low
3	3	REFOUT	Reference Output		14	$\overline{CSMSB}$	Chip-Select Input for the MSB nibble – active low
4	4	AGND	Analog Ground		15	$\overline{CSLSB}$	Chip-Select Input for the LSB byte – active low
	5-8	D7-D4	Data Bits 7-4	19	16	$\overline{WR}$	Write Input - active low
	9	D3/D11	Data Bits 3 and 11	20	17	$\overline{LDAC}$	Load DAC Input - active low
5-11		D11-D5	Data Bits 11-5	21		$\overline{CLR}$	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.

MX7245

Part Number Table

Notes:

1. See the MX7245 QuickView Data Sheet for further information on this product family or download the MX7245 full data sheet (PDF, 2MB).
2. Other options and links for purchasing parts are listed at: http://www.maxim-ic.com/sales.
3. Didn't Find What You Need? Ask our applications engineers. Expert assistance in finding parts, usually within one business day.
4. Part number suffixes: T or T&R = tape and reel; + = RoHS/lead-free; # = RoHS/lead-exempt. More: See full data sheet or Part Naming Conventions.
5. * Some packages have variations, listed on the drawing. "PkgCode/Variation" tells which variation the product uses.

Part Number	Free Sample	Buy Direct	Package: TYPE PINS SIZE DRAWING CODE/VAR *	Temp	RoHS/Lead-Free? Materials Analysis
MX7245JENG+	Sample	Buy		-40°C to +85°C	RoHS/Lead-Free: Yes
MX7245SE+	Sample	Buy		-55°C to +125°C	RoHS/Lead-Free: Yes
MX7245AQ		Buy		-40°C to +85°C	RoHS/Lead-Free: No
MX7245SQ		Buy		-55°C to +125°C	RoHS/Lead-Free: No
MX7245J/D		Buy			RoHS/Lead-Free: No
MX7245JN	Sample	Buy	PDIP;24 pin;.300" Dwg: 21-0043D (PDF)	0°C to +70°C	RoHS/Lead-Free: No Materials Analysis

			Use pkgcode/variation: N24-3*		
MX7245JN+	Sample	Buy	PDIP;24 pin;.300" Dwg: 21-0043D (PDF) Use pkgcode/variation: N24+3*	0°C to +70°C	RoHS/Lead-Free: Yes Materials Analysis
MX7245JP+	Sample	Buy	PLCC;28 pin;.453" SQ Dwg: 21-0049D (PDF) Use pkgcode/variation: Q28+2*	0°C to +70°C	RoHS/Lead-Free: Yes Materials Analysis
MX7245JP	Sample	Buy	PLCC;28 pin;.453" sq. Dwg: 21-0049D (PDF) Use pkgcode/variation: Q28-2*	0°C to +70°C	RoHS/Lead-Free: No Materials Analysis
MX7245JP-T		Buy	PLCC;28 pin;.453" sq. Dwg: 21-0049D (PDF) Use pkgcode/variation: Q28-2*	0°C to +70°C	RoHS/Lead-Free: No Materials Analysis
MX7245JP+T		Buy		0°C to +70°C	RoHS/Lead-Free: Yes
MX7245JENG		Buy	SOIC;24 pin;.300" Dwg: 21-0042B (PDF) Use pkgcode/variation: W24-2*	-40°C to +85°C	RoHS/Lead-Free: No Materials Analysis
MX7245JENG+T		Buy		-40°C to +85°C	RoHS/Lead-Free: Yes
MX7245JEQI-T		Buy		-40°C to +85°C	RoHS/Lead-Free: No
MX7245JENG-T		Buy		-40°C to +85°C	RoHS/Lead-Free: No
MX7245JEQI	Sample	Buy	SOIC;24 pin;.300" Dwg: 21-0042B (PDF) Use pkgcode/variation: W24-2*	-40°C to +85°C	RoHS/Lead-Free: No Materials Analysis
MX7245SE-T		Buy		-55°C to +125°C	RoHS/Lead-Free: No
MX7245SE		Buy	SOIC;24 pin;.300" Dwg: 21-0042B (PDF) Use pkgcode/variation: W24-2*	-55°C to +125°C	RoHS/Lead-Free: No Materials Analysis
MX7245SE+T		Buy		-55°C to +125°C	RoHS/Lead-Free: Yes

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