



# Low-Power, Monolithic, CMOS Analog Multiplexers

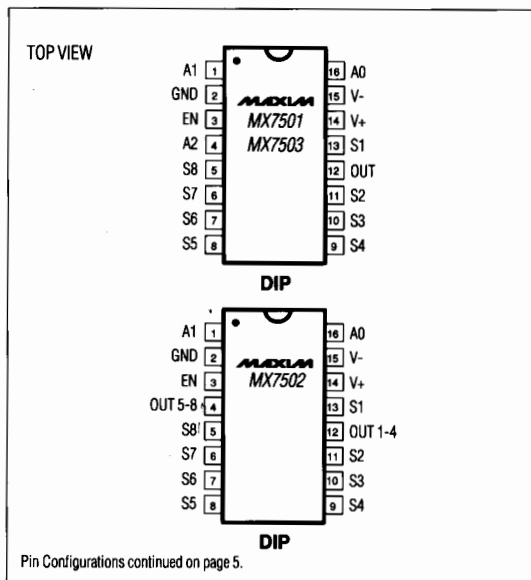
## General Description

Maxim's MX7501/7502/7503 are low-power, monolithic, CMOS analog multiplexers. The MX7501 is a single-ended, 8-channel (1-of-8) multiplexer, while the MX7502 is a differential, 4-channel (2-of-8) multiplexer. The MX7503 is identical to the MX7501, except the enable logic is inverted (channels are on with Enable low). These devices are plug-in upgrades for the industry-standard "7501/7502/7503": the MX7501/7502/7503 consume significantly less power (6mW Max) and offer a wider operating range of power-supply voltages (a single supply of +10V to +30V, or dual supplies of  $\pm 5V$  to  $\pm 18V$ ). The MX7501/7502/7503 also feature Maxim's standard latchup-proof CMOS construction, and they are both TTL and CMOS compatible.

## Applications

- Control Systems
- Data Logging Systems
- Aircraft Heads-Up Displays
- Data Acquisition Systems
- Signal Routing
- Portable Equipment

## Pin Configurations



## Features

- ◆ Drop-In Upgrade for Industry-Standard "7501/7502/7503"
- ◆ Low-Power Consumption: 6mW Max
- ◆ Operable with  $\pm 4.5V$  to  $\pm 18V$  Supplies
- ◆ Latchup-Proof Construction
- ◆ Symmetrical, Bidirectional Operation
- ◆ TTL and CMOS Compatible Logic Inputs
- ◆ Monolithic, Low-Power CMOS Design

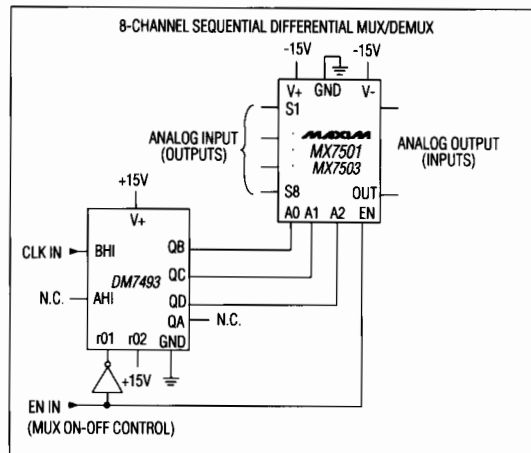
## Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
MX7501JN	0°C to +70°C	16 Plastic DIP
MX7501KN	0°C to +70°C	16 Plastic DIP
MX7501C/D*	0°C to +70°C	Dice
MX7501JQ	-40°C to +85°C	16 CERDIP
MX7501KQ	-40°C to +85°C	16 CERDIP
MX7501SQ	-55°C to +125°C	16 CERDIP
MX7501SE*	-55°C to +125°C	20 LCC

\* For Dice, Plastic Leadless Chip Carrier (PLCC), Ceramic Leadless Chip Carrier (LCC) and Ceramic Sidebrazed (Ceramic SB), contact factory for availability.

Ordering information continued on page 6.

## Typical Operating Circuit



MX7501/7502/7503

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## ABSOLUTE MAXIMUM RATINGS

V+ to GND	+18V	Power Dissipation (Any Package)	Up to +50°C	1000mW
V- to GND	-18V	Up to +50°C	Derate above +50°C by	10mW/°C
V Between Any Switch Terminals (Note 1)	25V	Operating Temperature	MX750_JN/KN/C/D	0°C to +70°C
Digital Input Voltage Range	V+ to GND	MX750_JQ/KQ		-40°C to +85°C
Max Overvoltage at VOUT (Vs)	V-, V+	MX750_SQ/SE		-55°C to +125°C
Switch Current (Is, Continuous 1 Channel)	20mA	Storage Temperature		-65°C to +150°C
Switch Current (Is, Surge 1 Channel, 1ms Duration, 10% Duty Cycle)	35mA			

**Note 1:** Do not apply voltages higher than V+ and V- to any other terminal, especially when V- = V+ = 0V, all other pins should be at 0V.

**Note 2:** The digital control inputs are diode protected; however, permanent damage may occur on unconnected units under high-energy electrostatic fields. Keep unused units in conductive foam at all times.

Stresses listed under "Absolute Maximum Ratings" may be applied (one at a time) to devices without resulting in permanent damage. 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

(V+ = +15V, V- = -15V, GND = 0V, unless otherwise noted.)

PARAMETER	SYMBOL	VERSION (Note 3)	SWITCH CONDITION	TEST CONDITIONS	+25°C			OVER SPECIFIED TEMP. RANGE			UNITS
					MIN	TYP	MAX	MIN	TYP	MAX	
<b>ANALOG SWITCH</b>											
Drain-Source On Resistance	r <sub>DS(ON)</sub>	J, K, S	On	V <sub>S</sub> = ±10V, I <sub>S</sub> = 1mA	180	300		450			Ω
	r <sub>DS(ON)</sub> vs. V <sub>S</sub>	All	On	V <sub>S</sub> = ±10V, I <sub>S</sub> = 1mA	15						%
Tempco of On Resistance	r <sub>DS(ON)</sub> vs. Temp.	All	On	V <sub>S</sub> = 0V, I <sub>S</sub> = 1mA				0.5			%/°C
Difference in On Resistance Between Channels	Δr <sub>DS(ON)</sub> Between Switches	All	On	V <sub>S</sub> = 0V, I <sub>S</sub> = 1mA	4						%
	Δr <sub>DS(ON)</sub> vs. Temp. Between Switches	All	On	V <sub>S</sub> = 0V, I <sub>S</sub> = 1mA				0.05			%/°C
Source-Off Leakage Current	I <sub>S(OFF)</sub>	J, K	Off	V <sub>S</sub> = -10V, V <sub>D</sub> = +10V and V <sub>S</sub> = +10V, V <sub>D</sub> = -10V "Enable Low"	±0.2	2		±50			nA
		S	Off		±0.5			±50			
Drain-Off Leakage Current	MX7501 MX7503	J, K	Off	V <sub>S</sub> = -10V, V <sub>D</sub> = +10V and V <sub>S</sub> = +10V, V <sub>D</sub> = -10V "Enable Low"	±10			±250			nA
		S	Off		±5			±250			
	MX7502	J, K	Off		±5			±125			
		S	Off		±3			±125			
Channel-On Leakage Current I <sub>D(ON)</sub> -I <sub>S</sub> (Any Switch On)	MX7501 MX7503	J, K	On	V <sub>S</sub> = 0	±12			±300			nA
		S	On	V <sub>S</sub> = 0	±5.5			±300			
	MX7502	J, K	On	V <sub>S</sub> = 0	±7			±175			
		S	On	V <sub>S</sub> = 0	±3.5			±175			

# Low-Power, Monolithic, CMOS Analog Multiplexers

**MX7501/7502/7503**
**ELECTRICAL CHARACTERISTICS (continued)**

(V+ = +15V, V- = -15V, GND = 0V, unless otherwise noted.)

PARAMETER	SYMBOL	VERSION (Note 3)	SWITCH CONDITION	TEST CONDITIONS	+25°C			OVER SPECIFIED TEMP. RANGE			UNITS
					MIN	TYP	MAX	MIN	TYP	MAX	
<b>DIGITAL CONTROL</b>											
Address-Input Threshold (Low)	V <sub>INL</sub>	All							0.8		V
Address-Input Threshold (High)	V <sub>INH</sub>	J		(Note 4)					3.0		V
		K, S		(Note 4)					2.4		
Input Logic Current	I <sub>INL</sub> or I <sub>INH</sub>	All			0.1	10		0.1	30		μA
Address-Input Capacitance	C <sub>IN</sub>	All			3			3			pF
<b>DYNAMIC CHARACTERISTICS (Note 5)</b>											
Switching Time of Multiplexers (Figure 1)	t <sub>TRANSITION</sub>	All	Off	V <sub>IN</sub> = 0V to 5V	700	1000			1500		ns
Break-Before-Make Interval (Figure 2)	t <sub>OPEN</sub>	All	Off	V <sub>IN</sub> = 0V to 5V	100			100			ns
Enable Turn-On Time (Figure 3)	t <sub>ON (EN)</sub>	All	On	V <sub>EN</sub> = 0V to 5V	0.8	1.5			2.0		μs
Enable Turn-Off Time (Figure 3)	t <sub>OFF (EN)</sub>	All	Off	V <sub>EN</sub> = 0V to 5V	0.8	1			1.5		μs
Off Isolation	OIRR	All	Off	V <sub>EN</sub> = 0, R <sub>L</sub> = 200Ω, C <sub>L</sub> = 3pF, V <sub>S</sub> = 3V <sub>RMS</sub> , f = 50kHz	70				70		dB
Source-Off Capacitance	C <sub>S(OFF)</sub>	All	Off		5						pF
Drain-Off Capacitance	C <sub>D(OFF)</sub>	MX7501 MX7503	Off		40						pF
		MX7502	Off		20						
Source-to-Drain Capacitance	C <sub>S-D</sub>	All	Off		0.5						pF

**Note 3:** JN/KN versions specified for 0°C to +70°C; JQ/KQ versions for -40°C to +85°C; SQ/SE versions for -55°C to +125°C.

**Note 4:** A pull-up resistor, typically 1-2kΩ is required to make the J version compatible with TTL/DTL. The maximum value is determined by the output leakage current of the driver gate when in the high state.

**Note 5:** AC parameters are sample tested to ensure conformance to specifications.

# Low-Power, Monolithic, CMOS Analog Multiplexers

## ELECTRICAL CHARACTERISTICS (continued)

(V+ = +15V, V- = -15V, GND = 0V, unless otherwise noted.)

PARAMETER	SYMBOL	VERSION (Note 3)	SWITCH CONDITION	TEST CONDITIONS	+25°C			OVER SPECIFIED TEMP. RANGE			UNITS
					MIN	TYP	MAX	MIN	TYP	MAX	
<b>POWER SUPPLY</b>											
Positive Supply Current	I+	All	Off	Digital Inputs = 0V	0.05	0.1		0.2			mA
Negative Supply Current	I-	All	Off	Digital Inputs = 0V	0.05	0.1		0.2			mA
Positive Supply Current	I+	All	On	Digital Inputs = 5V	0.15	0.3		0.5			mA
Negative Supply Current	I-	All	On	Digital Inputs = 5V	0.05	0.1		0.2			mA
Power-Supply Range for Continuous Operation	V <sub>OP</sub>	All		(Note 6)	±4.5			±18			V

**Note 3:** JN/KN versions specified for 0°C to +70°C; JQ/KQ versions for -40°C to +85°C; SQ/SE versions for -55°C to +125°C.  
**Note 4:** A pull-up resistor, typically 1-2kΩ is required to make the J version compatible with TTL/DTL. The maximum value is determined by the output leakage current of the driver gate when in the high state.  
**Note 5:** AC parameters are sample tested to ensure conformance to specifications.  
**Note 6:** Guaranteed, but not tested. Electrical Characteristics will change when power supplies other than ±15V are used.

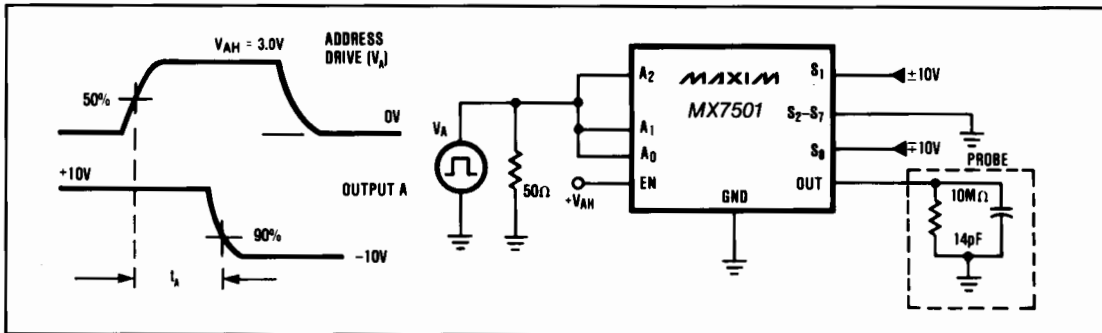


Figure 1. Transition Time vs. Logic Level (High)

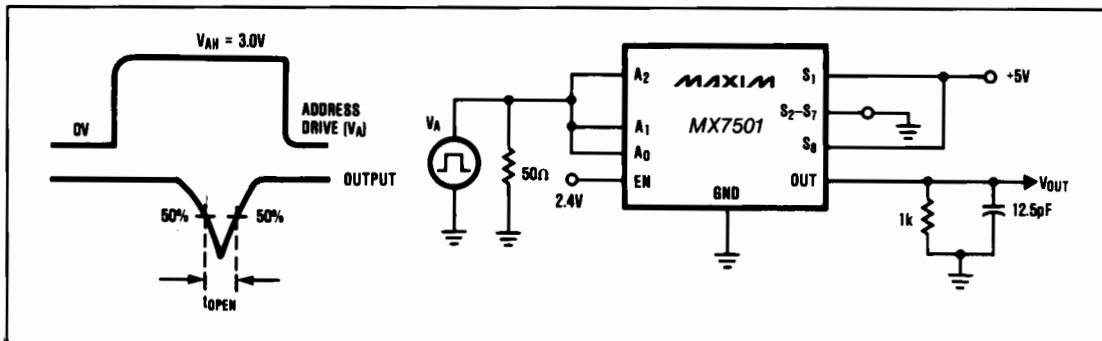


Figure 2. Break-Before-Make Interval ( $t_{OPEN}$ )

# Low-Power, Monolithic, CMOS Analog Multiplexers

MX7501/7502/7503

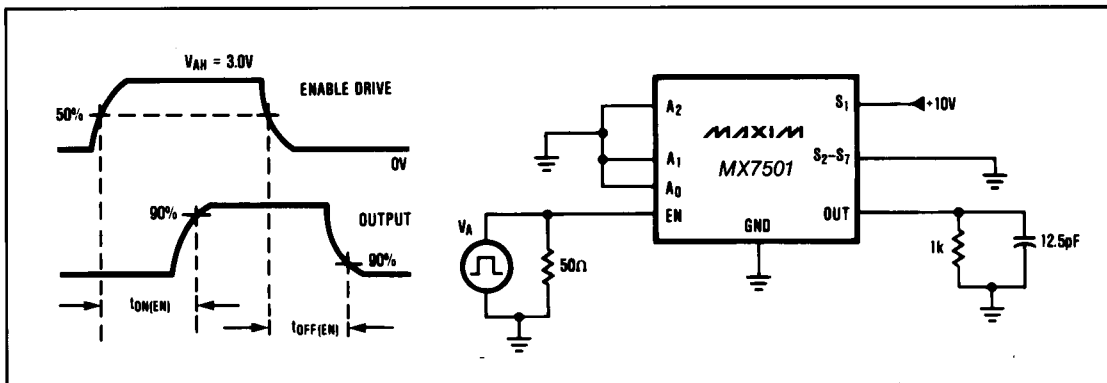


Figure 3. Enable Turn-On/Turn-Off Time

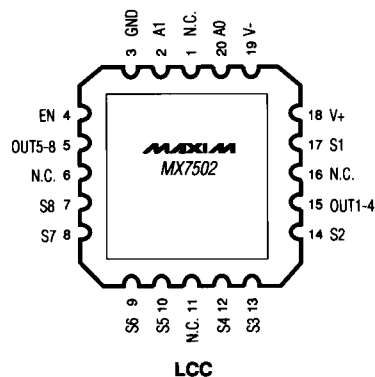
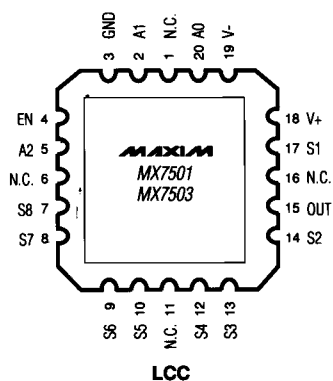
## TRUTH TABLES

MX7501				
A2	A1	A0	EN	"ON"
0	0	0	1	1
0	0	1	1	2
0	1	0	1	3
0	1	1	1	4
1	0	0	1	5
1	0	1	1	6
1	1	0	1	7
1	1	1	1	8
X	X	X	0	None

MX7502			
A1	A0	EN	"ON"
0	0	1	1 & 5
0	1	1	2 & 6
1	0	1	3 & 7
1	1	1	4 & 8
X	X	0	None

MX7503				
A2	A1	A0	EN	"ON"
0	0	0	0	1
0	0	1	0	2
0	1	0	0	3
0	1	1	0	4
1	0	0	0	5
1	0	1	0	6
1	1	0	0	7
1	1	1	0	8
X	X	X	1	None

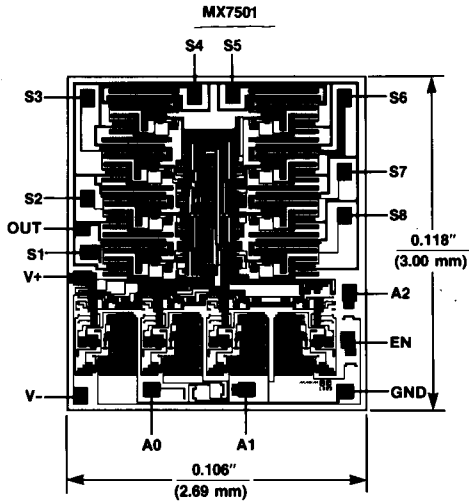
## Pin Configurations (continued)



# Low-Power, Monolithic, CMOS Analog Multiplexers

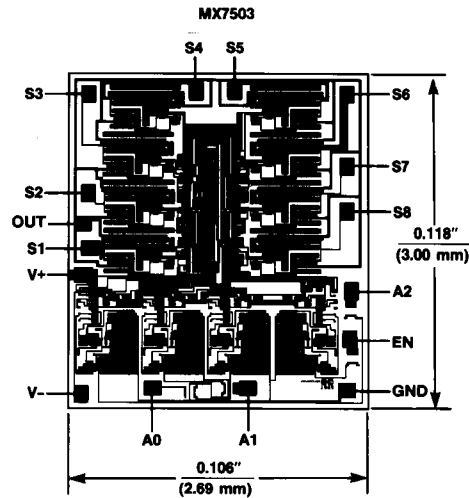
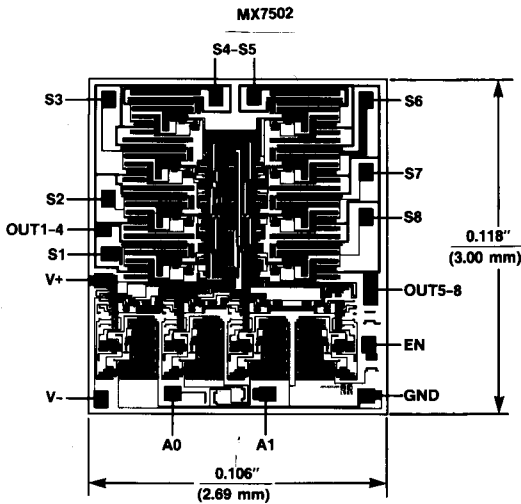
## Chip Topographies

## Ordering Information (continued)



PART	TEMP. RANGE	PIN-PACKAGE
MX7502JN	0°C to +70°C	16 Plastic DIP
MX7502KN	0°C to +70°C	16 Plastic DIP
MX7502C/D*	0°C to +70°C	Dice
MX7502JQ	-40°C to +85°C	16 CERDIP
MX7502KQ	-40°C to +85°C	16 CERDIP
MX7502SQ	-55°C to +125°C	16 CERDIP
MX7502SE*	-55°C to +125°C	20 LCC
MX7503JN	0°C to +70°C	16 Plastic DIP
MX7503KN	0°C to +70°C	16 Plastic DIP
MX7503C/D*	0°C to +70°C	Dice
MX7503JQ	-40°C to +85°C	16 CERDIP
MX7503KQ	-40°C to +85°C	16 CERDIP
MX7503SQ	-55°C to +125°C	16 CERDIP
MX7503SE*	-55°C to +125°C	20 LCC

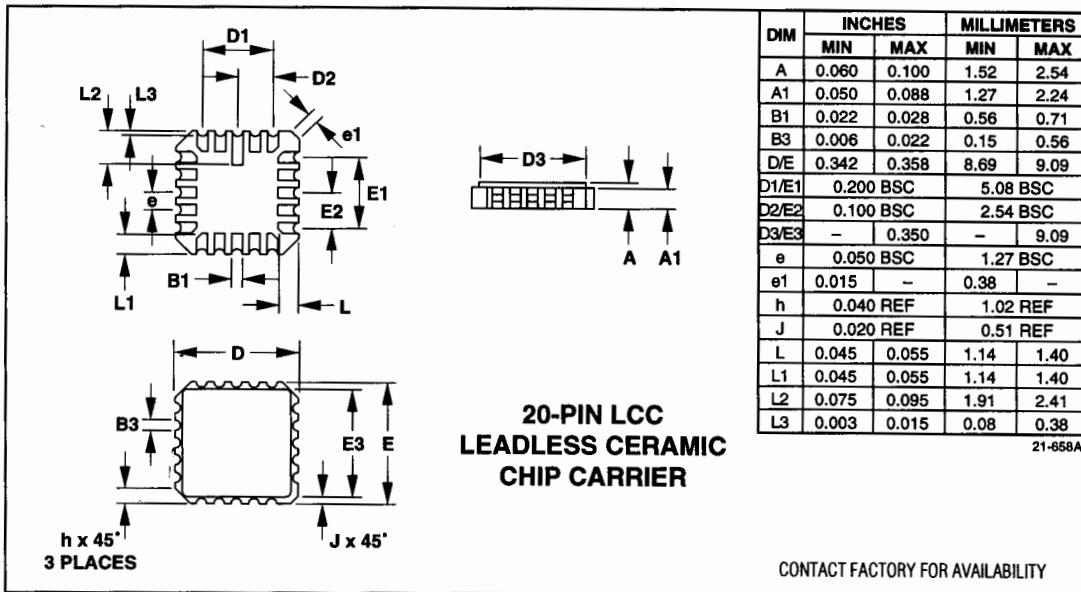
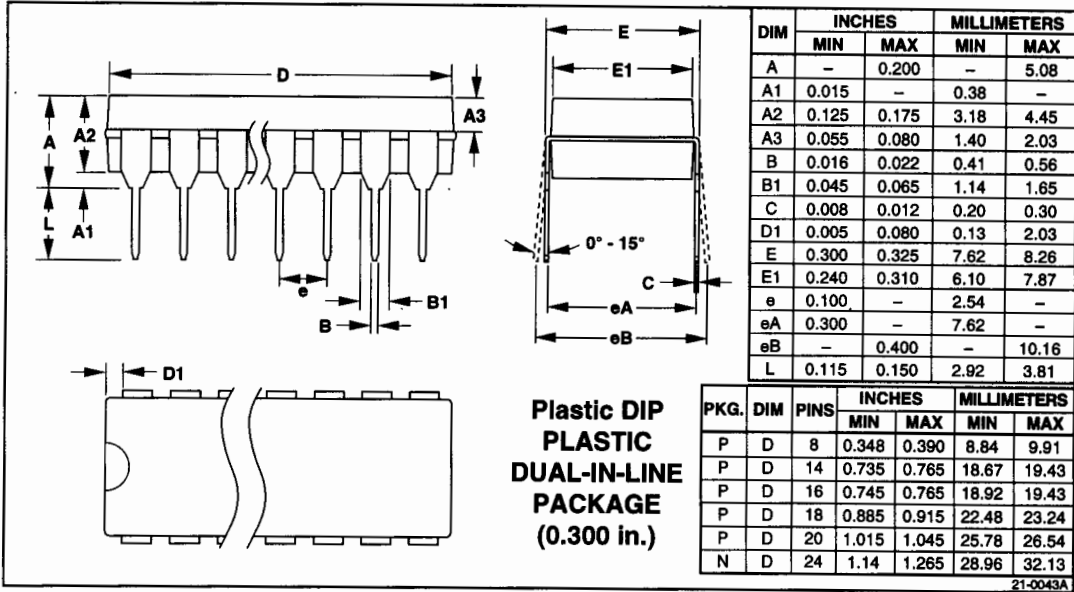
\* For Dice, Plastic Leadless Chip Carrier (PLCC), Ceramic Leadless Chip Carrier (LCC) and Ceramic Sidebrazed (Ceramic SB), contact factory for availability.



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## Package Information

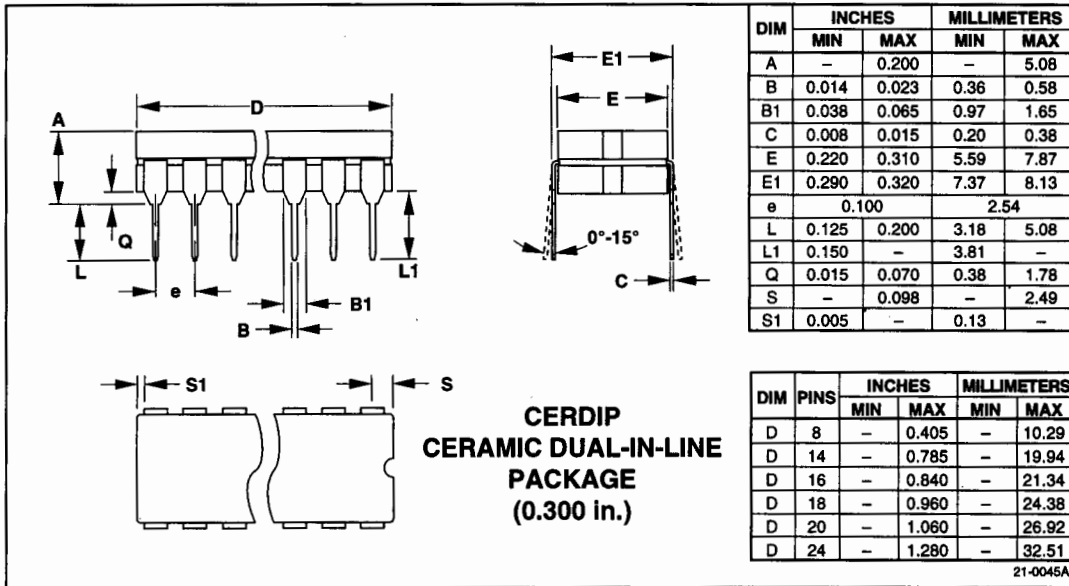
MX7501/7502/7503



MX7501/7502/7503

# Low-Power, Monolithic, CMOS Analog Multiplexers

## Package Information (continued)



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