



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.

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 |

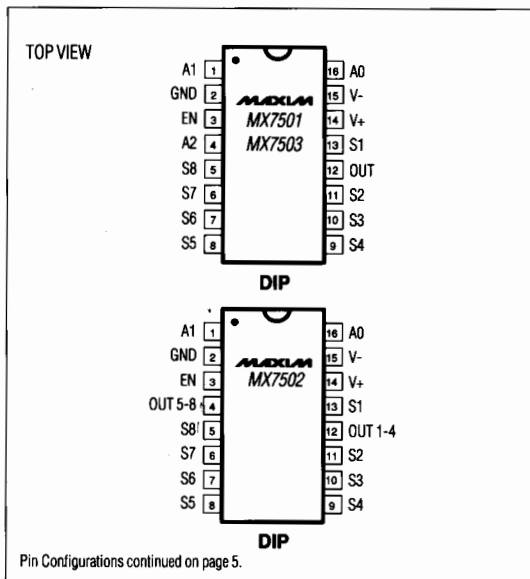
* For Dice, Plastic Leadless Chip Carrier (PLCC), Ceramic Leadless Chip Carrier (LCC) and Ceramic Sidebraze (Ceramic SB), contact factory for availability.

Ordering information continued on page 6.

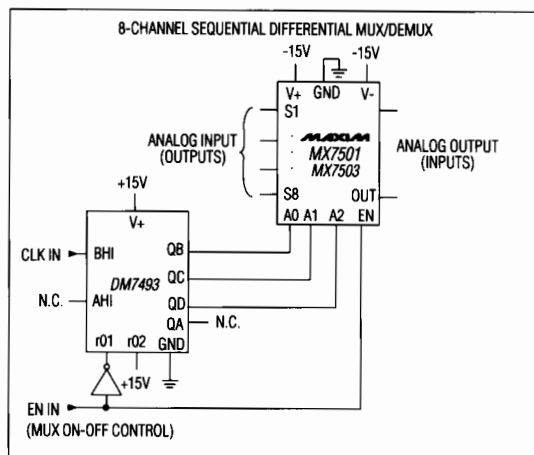
Applications

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

Pin Configurations



Typical Operating Circuit



MX7501/7502/7503



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ABSOLUTE MAXIMUM RATINGS

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

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 | | | UNITS |
|---|---|------------------|------------------|--|-------|------|------|-------|
| | | | | | MIN | TYP | MAX | |
| ANALOG SWITCH | | | | | | | | |
| Drain-Source On Resistance | r _{DS(ON)} | J, K, S | On | V _S = ±10V, I _S = 1mA | 180 | 300 | 450 | Ω |
| | r _{DS(ON)} vs. V _S | All | On | V _S = ±10V, I _S = 1mA | 15 | | | % |
| Tempco of On Resistance | r _{DS(ON)} vs. Temp. | All | On | V _S = 0V, I _S = 1mA | | | 0.5 | %/°C |
| Difference in On Resistance Between Channels | Δr _{DS(ON)} Between Switches | All | On | V _S = 0V, I _S = 1mA | 4 | | | % |
| | Δr _{DS(ON)} vs. Temp. Between Switches | All | On | V _S = 0V, I _S = 1mA | | | 0.05 | %/°C |
| Source-Off Leakage Current | I _{S(OFF)} | J, K | Off | V _S = -10V, V _D = +10V and V _S = +10V, V _D = -10V "Enable Low" | ±0.2 | 2 | ±50 | nA |
| | | S | Off | | | ±0.5 | ±50 | |
| Drain-Off Leakage Current | MX7501 MX7503 | J, K | Off | V _S = -10V, V _D = +10V and V _S = +10V, V _D = -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 _{D(ON)} -I _S (Any Switch On) | MX7501 MX7503 | J, K | On | V _S = 0 | ±12 | | ±300 | nA |
| | | S | On | V _S = 0 | ±5.5 | | ±300 | |
| | MX7502 | J, K | On | V _S = 0 | ±7 | | ±175 | |
| | | S | On | V _S = 0 | ±3.5 | | ±175 | |

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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 | |
| DIGITAL CONTROL | | | | | | | | | | | |
| Address-Input Threshold (Low) | V _{INL} | All | | | | | | | 0.8 | | V |
| Address-Input Threshold (High) | V _{INH} | J | | (Note 4) | | | | | 3.0 | | V |
| | | K, S | | (Note 4) | | | | | 2.4 | | |
| Input Logic Current | I _{INL} or I _{INH} | All | | | | 0.1 | 10 | | 0.1 | 30 | μA |
| Address-Input Capacitance | C _{IN} | All | | | | 3 | | | 3 | | pF |
| DYNAMIC CHARACTERISTICS (Note 5) | | | | | | | | | | | |
| Switching Time of Multiplexers (Figure 1) | t _{TRANSITION} | All | Off | V _{IN} = 0V to 5V | | 700 | 1000 | | | 1500 | ns |
| Break-Before-Make Interval (Figure 2) | t _{OPEN} | All | Off | V _{IN} = 0V to 5V | | 100 | | | 100 | | ns |
| Enable Turn-On Time (Figure 3) | t _{ON} (EN) | All | On | V _{EN} = 0V to 5V | | 0.8 | 1.5 | | | 2.0 | μs |
| Enable Turn-Off Time (Figure 3) | t _{OFF} (EN) | All | Off | V _{EN} = 0V to 5V | | 0.8 | 1 | | | 1.5 | μs |
| Off Isolation | OIRR | All | Off | V _{EN} = 0, R _L = 200Ω, C _L = 3pF, V _S = 3V _{RMS} , f = 50kHz | | 70 | | | 70 | | dB |
| Source-Off Capacitance | C _{S(OFF)} | All | Off | | | 5 | | | | | pF |
| Drain-Off Capacitance | C _{D(OFF)} | MX7501 MX7503 | Off | | | 40 | | | | | pF |
| | | MX7502 | Off | | | 20 | | | | | |
| Source-to-Drain Capacitance | C _{S-D} | 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.

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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 | |
| POWER SUPPLY | | | | | | | | | | | |
| 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 | VOP | 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.

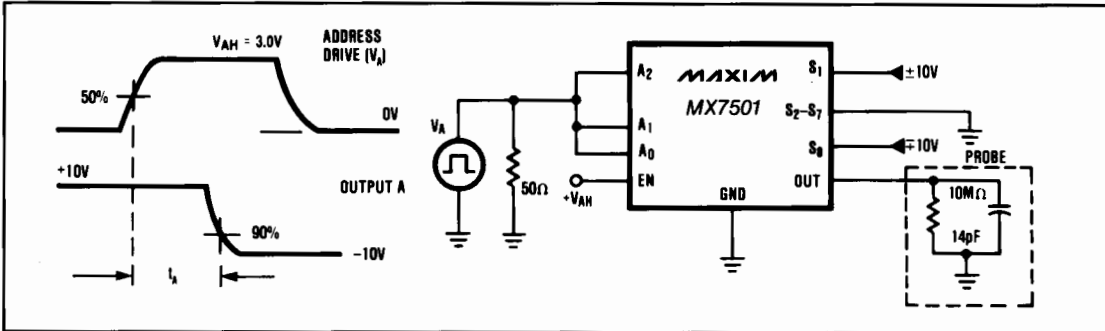


Figure 1. Transition Time vs. Logic Level (High)

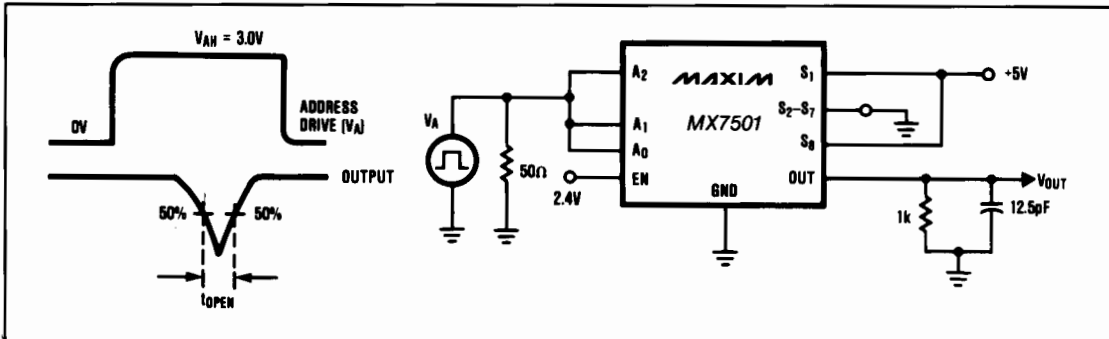


Figure 2. Break-Before-Make Interval (t_{OPEN})

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MX7501/7502/7503

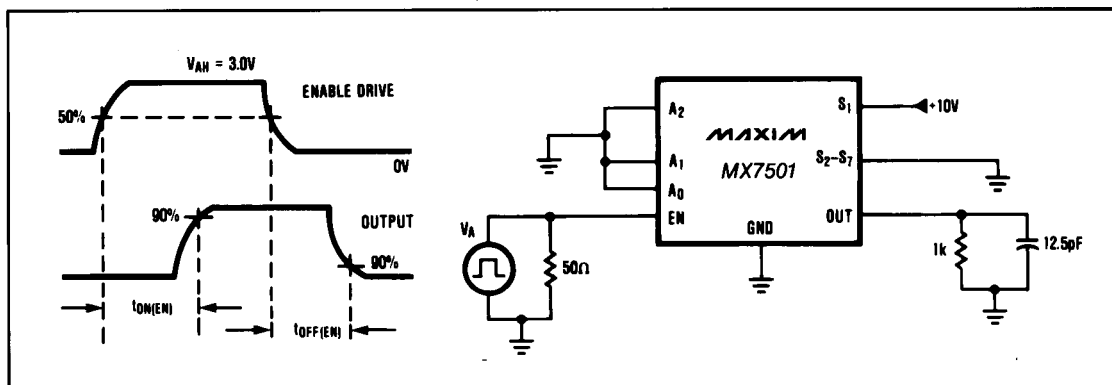


Figure 3. Enable Turn-On/Turn-Off Time

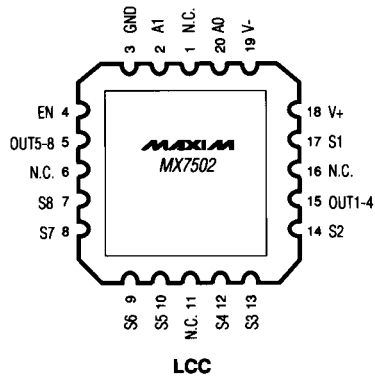
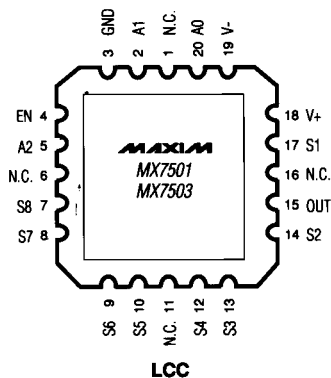
TRUTH TABLES

| 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 |

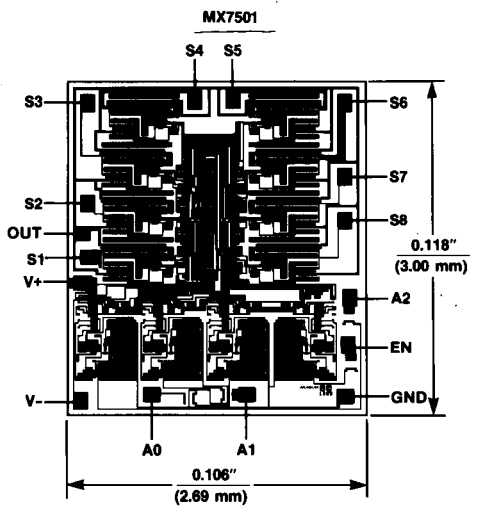
Pin Configurations (continued)



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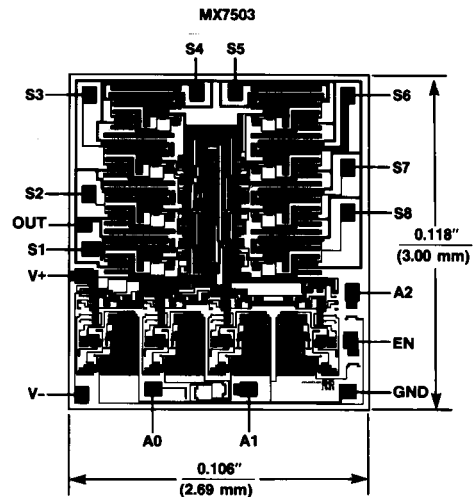
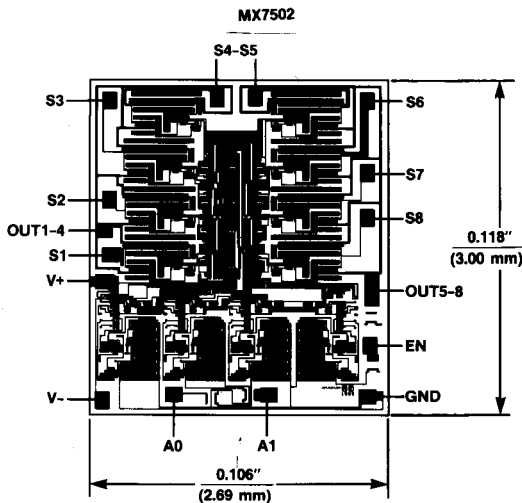
Chip Topographies

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 |

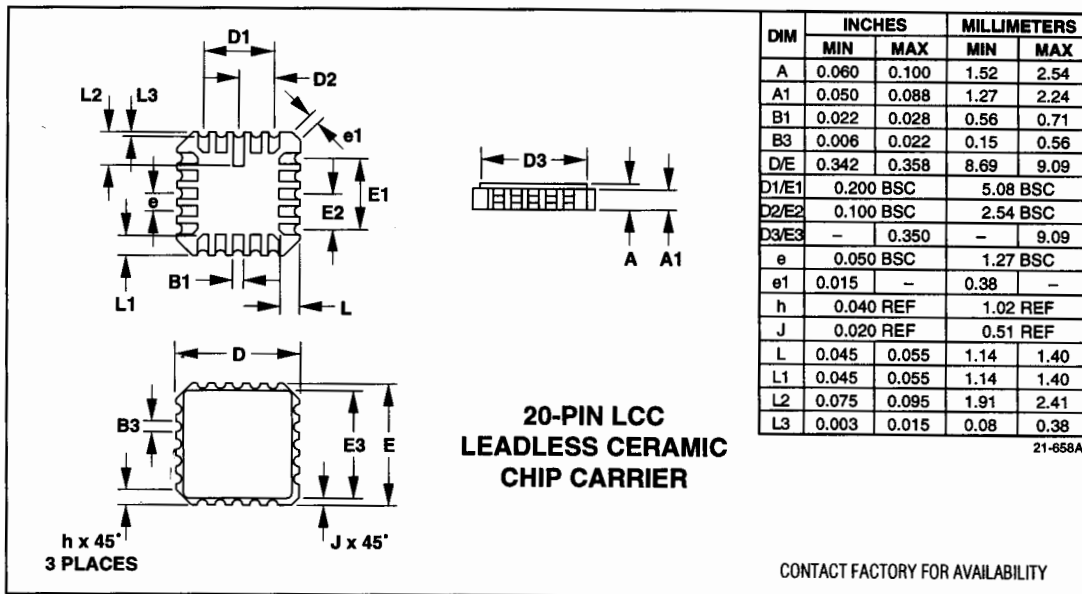
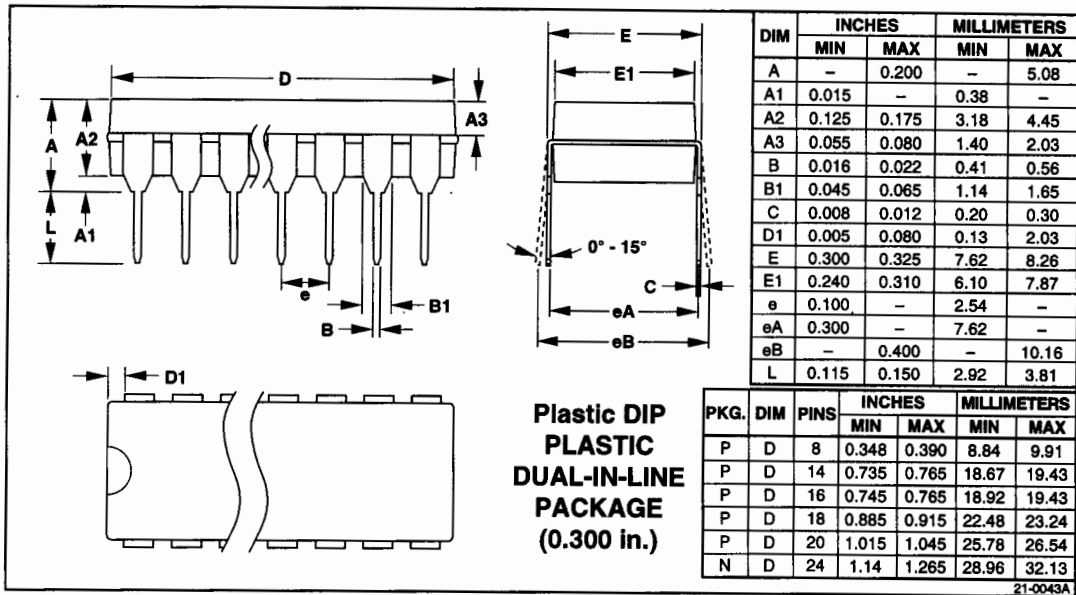
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Package Information

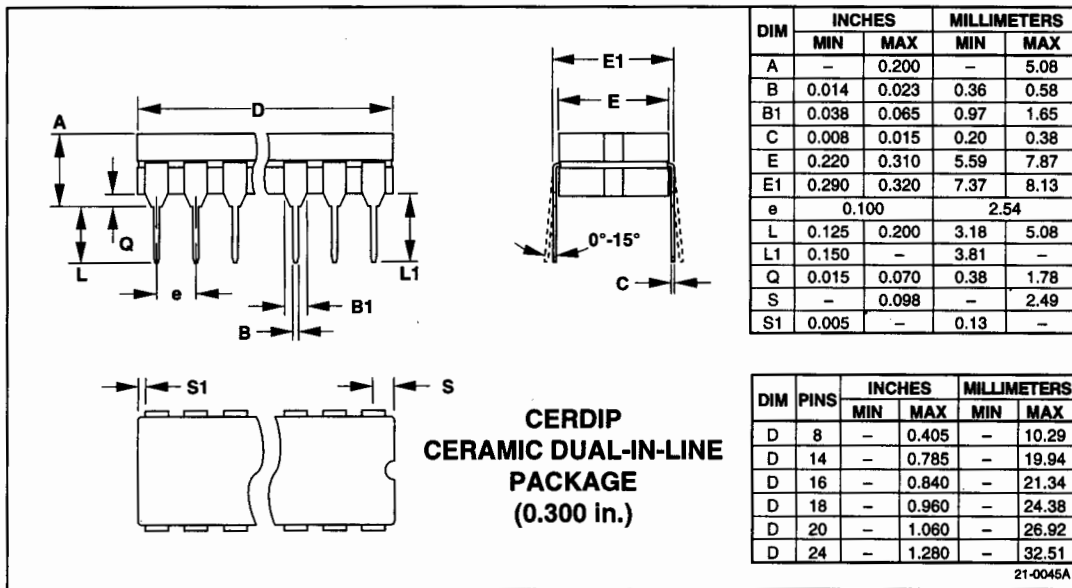
MX7501/7502/7503



MX7501/7502/7503

Low-Power, Monolithic, CMOS Analog Multiplexers

Package Information (continued)



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