



High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

General Description

The MAX4578/MAX4579 are high-voltage, 8-channel CMOS multiplexers. The MAX4578 and dual 4-channel MAX4579 are ideal for precision ADC calibration and system self-monitoring applications. These calibration multiplexers (cal-muxes) have precision resistor-dividers to generate accurate voltage ratios from an input reference voltage. The reference ratios include 15/4096 and 4081/4096 of the external reference voltage, accurate to 15 bits, and 1/2(V+) and 5/8(V+ - V-), accurate to 8 bits. The external reference voltage as well as ground can also be switched to the output. The MAX4578/MAX4579 have enable inputs and address latching. All digital inputs have 0.8V and 2.4V logic thresholds, ensuring both TTL- and CMOS-logic compatibility when using a single +12V or dual $\pm 15V$ supplies. Protection diodes at all inputs provide >2kV ESD rating.

The MAX4578/MAX4579 operate from a single +4.5V to +36V supply or from dual supplies of $\pm 4.5V$ to $\pm 20V$. On-resistance (350 Ω max) is matched between switches to 15 Ω max. Each switch can handle Rail-to-Rail[®] analog signals. The off-leakage current is 20pA at $T_A = +25^\circ C$ and 1.25nA at $T_A = +85^\circ C$.

The MAX4578/MAX4579 are available in small 20-pin SSOP, SO, and DIP packages.

Applications

Data-Acquisition Systems
Test Equipment
Avionics
Audio Signal Routing
Networking

Rail-to-Rail is a registered trademark of Nippon Motorola, Ltd.

Features

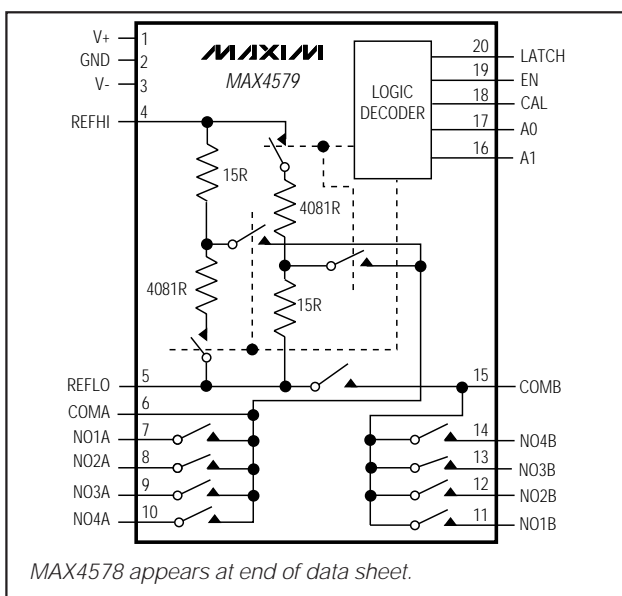
- ♦ On-Chip Gain and Offset Divider Networks Provide 15-Bit Accurate Output Ratios
- ♦ On-Chip V+ to GND and V+ to V- Divider Networks Provide 8-Bit Accurate Output Ratios
- ♦ 350 Ω (max) RON
- ♦ 12 Ω (max) RON Matching Between Channels
- ♦ 10pC (max) Charge Injection
- ♦ Guaranteed 20pA Off-Leakage Current
- ♦ Rail-to-Rail Signal Handling
- ♦ Small 20-Pin SSOP, SO, DIP Packages

Ordering Information

| PART | TEMP. RANGE | PIN-PACKAGE |
|------------|----------------|----------------|
| MAX4578CAP | 0°C to +70°C | 20 SSOP |
| MAX4578CWP | 0°C to +70°C | 20 Wide SO |
| MAX4578CPP | 0°C to +70°C | 20 Plastic DIP |
| MAX4578EAP | -40°C to +85°C | 20 SSOP |
| MAX4578EWP | -40°C to +85°C | 20 Wide SO |
| MAX4578EPP | -40°C to +85°C | 20 Plastic DIP |

Ordering Information continued at end of data sheet.

Pin Configurations/ Functional Diagrams



MAX4578/MAX4579



Maxim Integrated Products 1

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High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

ABSOLUTE MAXIMUM RATINGS

(Voltage Referenced to GND)

| | |
|--|--|
| V+ | -0.3V to +44V |
| V- | -44V to +0.3V |
| V+ to V- | -0.3V to +44V |
| CAL, LATCH, A ₋ , EN, NO ₋ , COM ₋ , REFHI, REFLO (Note 1) | (V ₋ - 0.3V) to (V ₊ + 0.3V) |
| Continuous Current (any terminal) | ±30mA |
| Peak Current, NO ₋ or COM ₋ (pulsed at 1ms, 10% duty cycle max) | ±100mA |

Continuous Power Dissipation (T_A = +70°C)

| | |
|---|-----------------|
| SSOP (derate 8mW/°C above +70°C) | 640mW |
| Wide SO (derate 8mW/°C above +70°C) | 800mW |
| Plastic DIP (derate 10.53mW/°C above +70°C) | 842mW |
| Operating Temperature Ranges | |
| MAX4578C_P/MAX4579C_P | 0°C to +70°C |
| MAX4578E_P/MAX4579E_P | -40°C to +85°C |
| Storage Temperature Range | -65°C to +160°C |
| Lead Temperature (soldering, 10sec) | +300°C |

Note 1: Signals on NO₋, COM₋, EN, LATCH, CAL, A₋ exceeding V₊ or V₋ are clamped by internal diodes. Limit forward current to maximum current ratings.

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—Dual ±15V Supplies

(V₊ = +15V ±10%, V₋ = -15V ±10%, logic levels = 2.4V and 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | | MIN | TYP | MAX | UNITS | |
|--|---|---|---|---|-------|----------------|-------|----|
| SWITCH | | | | | | | | |
| Analog Signal Range | V _{COM₋} , V _{NO₋} | (Note 3) | | V ₋ | | V ₊ | V | |
| On-Resistance | R _{DS(ON)} | I _{COM₋} = 0.2mA, V _{NO₋} = ±10V, V ₊ = 13.5V, V ₋ = -13.5V | T _A = +25°C | 220 | 350 | | Ω | |
| | | | T _A = T _{MIN} to T _{MAX} | | 475 | | | |
| On-Resistance Matching Between Channels (Note 4) | ΔRON | I _{COM₋} = 0.2mA, V _{NO₋} = ±10V, V ₊ = 13.5V, V ₋ = -13.5V | T _A = +25°C | 4 | 12 | | Ω | |
| | | | T _A = T _{MIN} to T _{MAX} | | | 15 | | |
| NO Off-Leakage Current (Note 5) | I _{NO₋(OFF)} | V _{NO₋} = ±14V, V _{COM₋} = ±14V, V ₊ = 16.5V, V ₋ = -16.5V | T _A = +25°C | -0.02 | 0.001 | 0.02 | nA | |
| | | | T _A = T _{MIN} to T _{MAX} | -1.25 | | 1.25 | | |
| COM Off-Leakage Current (Note 5) | I _{COM₋(OFF)} | V _{COM₋} = ±14V, V _{NO₋} = ±14V, V ₊ = 16.5V, V ₋ = -16.5V | MAX4578 | T _A = +25°C | -0.05 | 0.005 | 0.05 | nA |
| | | | MAX4579 | T _A = T _{MIN} to T _{MAX} | -6.5 | | 6.5 | |
| | | | | T _A = +25°C | -0.05 | 0.005 | 0.05 | |
| | | | T _A = T _{MIN} to T _{MAX} | -3.25 | | 3.25 | | |
| COM On-Leakage Current (Note 5) | I _{COM₋(ON)} | V _{COM₋} = ±14V, V _{NO₋} = ±14V, V ₊ = 16.5V, V ₋ = -16.5V | MAX4578 | T _A = +25°C | -0.05 | 0.006 | 0.05 | nA |
| | | | MAX4579 | T _A = T _{MIN} to T _{MAX} | -6.5 | | 6.5 | |
| | | | | T _A = +25°C | -0.05 | 0.008 | 0.05 | |
| | | | T _A = T _{MIN} to T _{MAX} | -3.25 | | 3.25 | | |

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

MAX4578/MAX4579

ELECTRICAL CHARACTERISTICS—Dual ±15V Supplies (continued)

(V+ = +15V ±10%, V- = -15V ±10%, logic levels = 2.4V and 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | |
|---------------------------------------|-----------------------|---|---|-------|-------|-------|----|
| LOGIC INPUTS | | | | | | | |
| Input High Voltage | V _{IH} | | 2.4 | 1.9 | | V | |
| Input Low Voltage | V _{IL} | | | 1.9 | 0.8 | V | |
| Input Current with Input Voltage High | I _{IH} | V _{EN} = V _{A-} = V _{LATCH} = V _{CAL} = V+ | -1 | 0.001 | 1 | μA | |
| Input Current with Input Voltage Low | I _{IL} | V _{EN} = V _{A-} = V _{LATCH} = V _{CAL} = 0 | -1 | 0.001 | 1 | μA | |
| SUPPLY | | | | | | | |
| Power-Supply Range | | | ±4.5 | | ±20 | V | |
| Positive Supply Current | I+ | V _{EN} = V _{A-} = V _{LATCH} = V _{CAL} = 0 or V+, V+ = 16.5V, V- = -16.5V (Note 6) | T _A = +25°C | 50 | 80 | μA | |
| | | | T _A = T _{MIN} to T _{MAX} | | 120 | | |
| Negative Supply Current | I- | V _{EN} = V _{A-} = V _{LATCH} = V _{CAL} = 0 or V+, V+ = 16.5V, V- = -16.5V (Note 6) | T _A = +25°C | -1 | 0.001 | 1 | μA |
| | | | T _A = T _{MIN} to T _{MAX} | -5 | | 5 | |
| GND Supply Current | I _{GND} | V _{EN} = V _{A-} = V _{LATCH} = V _{CAL} = 0 or V+, V+ = 16.5V, V- = -16.5V (Note 6) | T _A = +25°C | 50 | 80 | μA | |
| | | | T _A = T _{MIN} to T _{MAX} | | 120 | | |
| DYNAMIC CHARACTERISTICS | | | | | | | |
| Transition Time | t _{TRANS} | Figure 1 | T _A = +25°C | 320 | 450 | ns | |
| | | | T _A = T _{MIN} to T _{MAX} | | 600 | | |
| Break-Before-Make Interval (Note 3) | t _{OPEN} | Figure 2 | T _A = +25°C | 50 | 180 | ns | |
| Enable Turn-On Time | t _{ON} | Figure 3 | T _A = +25°C | 260 | 400 | ns | |
| | | | T _A = T _{MIN} to T _{MAX} | | 500 | | |
| Enable Turn-Off Time | t _{OFF} | Figure 3 | T _A = +25°C | 130 | 220 | ns | |
| | | | T _A = T _{MIN} to T _{MAX} | | 300 | | |
| Charge Injection (Note 3) | V _{CTE} | C _L = 1nF, V _{NO-} = 0, R _S = 0, Figure 4 | T _A = +25°C | 3.5 | 0 | pC | |
| Off-Isolation | V _{ISO} | V _{EN} = 0, R _L = 50Ω, Figure 5 | T _A = +25°C | -75 | | dB | |
| Crosstalk Between Channels (Note 8) | V _{CT} | V _{EN} = 2.4V, f = 1MHz, V _{GEN} = 1Vp-p, Figure 5 | T _A = +25°C | -70 | | dB | |
| Logic Input Capacitance | C _{IN} | f = 1MHz | T _A = +25°C | 3 | | pF | |
| NO Off-Capacitance | C _{OFF} | f = 1MHz, V _{EN} = 0, Figure 6 | T _A = +25°C | 3 | | pF | |
| COM Off-Capacitance | C _{COM(OFF)} | f = 1MHz, V _{EN} = 0, Figure 6 | T _A = +25°C | 14 | | pF | |
| COM On-Capacitance | C _{COM(ON)} | f = 1MHz, V _{EN} = 2.4V, Figure 6 | T _A = +25°C | 20 | | pF | |

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

ELECTRICAL CHARACTERISTICS—Dual $\pm 15\text{V}$ Supplies (continued)

($V_+ = +15\text{V} \pm 10\%$, $V_- = -15\text{V} \pm 10\%$, logic levels = 2.4V and 0.8V, $T_A = T_{\text{MIN}}$ to T_{MAX} , unless otherwise noted. Typical values are at $T_A = +25^\circ\text{C}$.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | |
|---|-----------|--|--|------------------|----------------|------------------|-----|
| LATCH TIMING (Note 3) | | | | | | | |
| Setup Time | t_s | Figure 7 | $T_A = +25^\circ\text{C}$ | 70 | 200 | ns | |
| | | | $T_A = T_{\text{MIN}}$ to T_{MAX} | | 250 | | |
| Hold Time | t_H | Figure 7 | $T_A = +25^\circ\text{C}$ | -10 | 0 | ns | |
| | | | $T_A = T_{\text{MIN}}$ to T_{MAX} | -10 | | | |
| Enable Setup Time | t_{ES} | Figure 8 | $T_A = +25^\circ\text{C}$ | 22 | 40 | ns | |
| | | | $T_A = T_{\text{MIN}}$ to T_{MAX} | | 60 | | |
| Pulse Width, LATCH Enable | t_{MPW} | Figure 7 | $T_A = +25^\circ\text{C}$ | 120 | 72 | ns | |
| | | | $T_A = T_{\text{MIN}}$ to T_{MAX} | 180 | | | |
| INTERNAL DIVIDERS | | | | | | | |
| Offset Divider Output | | $V_{\text{REFHI}} = 10\text{V}$, $\text{REFLO} = \text{GND}$ | $T_A = +25^\circ\text{C}$ | 14.9 / 4096 | 15 / 4096 | 15.1 / 4096 | LSB |
| | | | $T_A = T_{\text{MIN}}$ to T_{MAX} | 14.9 / 4096 | 15 / 4096 | 15.1 / 4096 | |
| Gain Divider Output | | $V_{\text{REFHI}} = 10\text{V}$, $\text{REFLO} = \text{GND}$ | $T_A = +25^\circ\text{C}$ | 4080.9 / 4096 | 4081 / 4096 | 4081.1 / 4096 | LSB |
| | | | $T_A = T_{\text{MIN}}$ to T_{MAX} | 4080.9 / 4096 | 4081 / 4096 | 4081.1 / 4096 | |
| $(V_+ / 2)$ Divider Output | | Referenced to GND | $T_A = +25^\circ\text{C}$ | 2032 / 4096 | 2048 / 4096 | 2064 / 4096 | LSB |
| | | | $T_A = T_{\text{MIN}}$ to T_{MAX} | 2032 / 4096 | 2048 / 4096 | 2064 / 4096 | |
| $(V_+ - V_-)$ Divider Output | | Referenced to V_- | $T_A = +25^\circ\text{C}$ | 2544 / 4096 | 2560 / 4096 | 2576 / 4096 | LSB |
| | | | $T_A = T_{\text{MIN}}$ to T_{MAX} | 2544 / 4096 | 2560 / 4096 | 2576 / 4096 | |
| Output Resistance Offset Divider | | (Note 3) | $T_A = +25^\circ\text{C}$ | 400 | 800 | Ω | |
| Output Resistance Gain Divider | | (Note 3) | $T_A = +25^\circ\text{C}$ | 400 | 800 | Ω | |
| Output Resistance $(V_+ / 2)$ Divider | | (Note 3) | $T_A = +25^\circ\text{C}$ | 6 | 9 | k Ω | |
| Output Resistance $(V_+ - V_-)$ Divider | | (Note 3) | $T_A = +25^\circ\text{C}$ | 6 | 9 | k Ω | |
| Output Resistance (REFHI, REFLO, GND) | | (Note 3) | $T_A = +25^\circ\text{C}$ | 400 | 800 | Ω | |
| Additional Positive Supply Current (Note 3) | | $(V_+ / 2)$ divider active, $V_{IH} = V_+$, $V_{IL} = 0$ | $T_A = +25^\circ\text{C}$ | $V_+ /$ 24k | $V_+ /$ 13k | mA | |

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

MAX4578/MAX4579

ELECTRICAL CHARACTERISTICS—Dual ±15V Supplies (continued)

(V+ = +15V ±10%, V- = -15V ±10%, logic levels = 2.4V and 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|--------|---|----------|-----------------|-----------------|-------|
| Additional Positive Supply Current (Note 3) | | (V+ - V-) divider active, V _{IH} = V+, V _{IL} = 0 | | (V+ - V-) / 24k | (V+ - V-) / 13k | mA |
| Additional Negative Supply Current (Note 3) | | (V+ - V-) divider active, V _{IH} = V+, V _{IL} = 0 | | (V+ - V-) / 24k | (V+ - V-) / 13k | mA |
| REFHI, REFLO Input Range (Note 3) | | | V- - 0.3 | | V+ + 0.3 | V |
| Input Resistance (REFHI, REFLO) (Note 3) | | Offset divider active, gain divider active | 17 | 32 | | kΩ |

ELECTRICAL CHARACTERISTICS—Dual ±5V Supplies

(V+ = +5V ±10%, V- = -5V ±10%, logic levels = 2.4V and 0.8V, T_A = T_{MIN} to T_{MAX}, unless otherwise noted. Typical values are at T_A = +25°C.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | | |
|--|--------------------------------------|--|---|---|-------|-------|------|----|
| SWITCH | | | | | | | | |
| Analog Signal Range | V _{NO_} , V _{COM_} | (Note 3) | V- | | V+ | V | | |
| On-Resistance | R _{DS(ON)} | I _{COM_} = 0.2mA, V _{NO_} = ±3V, V+ = 4.5V, V- = -4.5V | T _A = +25°C | 660 | 900 | Ω | | |
| | | | T _A = T _{MIN} to T _{MAX} | | 1100 | | | |
| On-Resistance Matching Between Channels (Note 4) | ΔR _{DS(ON)} | I _{COM_} = 0.2mA, V _{NO_} = 3.0V, V+ = 4.5V, V- = -4.5V | T _A = +25°C | 10 | | Ω | | |
| NO Off-Leakage Current (Note 5) | I _{NO(OFF)} | V _{NO_} = ±4.5V, V _{COM_} = ±4.5V, V+ = 5.5V, V- = -5.5V | T _A = +25°C | -0.02 | 0.001 | 0.02 | nA | |
| | | | T _A = T _{MIN} to T _{MAX} | -1.25 | | 1.25 | | |
| COM Off-Leakage Current (Note 5) | I _{COM(OFF)} | V _{COM_} = ±4.5V, 1V; V _{NO_} = ±4.5V, V+ = 5.5V, V- = -5.5V | MAX4578 | T _A = +25°C | -0.05 | 0.005 | 0.05 | nA |
| | | | | T _A = T _{MIN} to T _{MAX} | -6.5 | | 6.5 | |
| | | | MAX4579 | T _A = +25°C | -0.5 | 0.005 | 0.5 | |
| | | | | T _A = T _{MIN} to T _{MAX} | -6.5 | | 6.5 | |
| COM On-Leakage Current (Note 5) | I _{COM(ON)} | V _{COM_} = ±4.5V, V _{NO_} = ±4.5V or floating, V+ = 5.5V, V- = -5.5V | MAX4578 | T _A = +25°C | -0.05 | 0.008 | 0.05 | nA |
| | | | | T _A = T _{MIN} to T _{MAX} | -6.5 | | 6.5 | |
| | | | MAX4579 | T _A = +25°C | -0.05 | | 0.05 | |
| | | | | T _A = T _{MIN} to T _{MAX} | -3.25 | | 3.25 | |

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

ELECTRICAL CHARACTERISTICS—Dual $\pm 5V$ Supplies (continued)

($V_+ = +5V \pm 10\%$, $V_- = -5V \pm 10\%$, logic levels = 2.4V and 0.5V, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Typical values are at $T_A = +25^\circ C$.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS |
|---|-------------|--|------------------------------|-------|-----|---------|
| LOGIC INPUTS (Note 3) | | | | | | |
| Input High Voltage | V_{IH} | | 2.4 | 1.4 | | V |
| Input Low Voltage | V_{IL} | | | 1.4 | 0.5 | V |
| Input Current with Input Voltage High | I_{IH} | $V_{EN} = V_{A_-} = V_{LATCH} = V_{CAL} = V_+$ | -1.0 | 0.001 | 1.0 | μA |
| Input Current with Input Voltage Low | I_{IL} | $V_{EN} = V_{A_-} = V_{LATCH} = V_{CAL} = 0$ | -1.0 | 0.001 | 1.0 | μA |
| DYNAMIC CHARACTERISTICS (Note 3) | | | | | | |
| Transition Time | t_{TRANS} | $V_{NO1} = 3V$, $V_{NO8} = 0$, Figure 1 | $T_A = +25^\circ C$ | 1.0 | 1.8 | μs |
| | | | $T_A = T_{MIN}$ to T_{MAX} | | 2.2 | |
| Break-Before-Make Interval | t_{OPEN} | Figure 2 | $T_A = +25^\circ C$ | 200 | 440 | ns |
| Enable Turn-On Time | t_{ON} | $V_{NO1} = 3V$, Figure 3 | $T_A = +25^\circ C$ | 0.675 | 1.2 | μs |
| | | | $T_A = T_{MIN}$ to T_{MAX} | | 1.5 | |
| Enable Turn-Off Time | t_{OFF} | $V_{NO1} = 3V$, Figure 3 | $T_A = +25^\circ C$ | 0.5 | 1.0 | μs |
| | | | $T_A = T_{MIN}$ to T_{MAX} | | 1.3 | |

ELECTRICAL CHARACTERISTICS—Single +12V Supply

($V_+ = +12V$, $V_- = 0$, logic levels = 2.4V and 0.8V, $T_A = T_{MIN}$ to T_{MAX} , unless otherwise noted. Typical values are at $T_A = +25^\circ C$.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | |
|--|-----------------------------|--|------------------------------|-------|-------|----------|----|
| SWITCH | | | | | | | |
| Analog Signal Range | V_{NO_-} , V_{COM_-} | (Note 3) | 0 | | V_+ | V | |
| On-Resistance | $R_{DS(ON)}$ | $I_{COM_-} = 0.2mA$, $V_{NO_-} = 3V$, 10V | $T_A = +25^\circ C$ | 470 | 750 | Ω | |
| | | | $T_A = T_{MIN}$ to T_{MAX} | | 850 | | |
| On-Resistance Matching Between Channels (Note 4) | $\Delta R_{(ON)}$ | $I_{COM_-} = 0.2mA$, $V_{NO_-} = 3V$, 10V | $T_A = +25^\circ C$ | 8 | | Ω | |
| NO Off-Leakage Current (Notes 5, 9) | $I_{NO(OFF)}$ | $V_{COM_-} = 1V$, 11V; $V_{NO_-} = 11V$, 1V | $T_A = +25^\circ C$ | -0.02 | 0.001 | 0.02 | nA |
| | | | $T_A = T_{MIN}$ to T_{MAX} | -1.25 | | 1.25 | |

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

MAX4578/MAX4579

ELECTRICAL CHARACTERISTICS—Single +12V Supply (continued)

(V+ = +12V, V- = 0, logic levels = 2.4V and 0.8V, TA = TMIN to TMAX, unless otherwise noted. Typical values are at TA = +25°C.) (Note 2)

| PARAMETER | SYMBOL | CONDITIONS | MIN | TYP | MAX | UNITS | | |
|---|-----------|--|-------------------|-------------------|-------|-------|------|----|
| SWITCH (continued) | | | | | | | | |
| COM Off-Leakage Current (Notes 5, 9) | ICOM(OFF) | VCOM_ = 11V, 1V; VNO_ = 1V, 11V | MAX4578 | TA = +25°C | -0.05 | 0.005 | 0.05 | nA |
| | | | | TA = TMIN to TMAX | -6.5 | | 6.5 | |
| | | | MAX4579 | TA = +25°C | -0.05 | 0.005 | 0.05 | |
| | | | | TA = TMIN to TMAX | -3.25 | | 3.25 | |
| COM On-Leakage Current (Notes 5, 9) | ICOM(ON) | VCOM_ = 11V, 1V; VNO_ = 11V, 1V, or floating | MAX4578 | TA = +25°C | -0.05 | 0.006 | 0.05 | nA |
| | | | | TA = TMIN to TMAX | -6.5 | | 6.5 | |
| | | | MAX4579 | TA = +25°C | -0.05 | | 0.05 | |
| | | | | TA = TMIN to TMAX | -3.25 | | 3.25 | |
| LOGIC INPUTS | | | | | | | | |
| Input High Voltage | VIH | | 2.4 | 1.8 | | V | | |
| Input Low Voltage | VIL | | | 1.8 | 0.8 | V | | |
| Input Current with Input Voltage High | IiH | VEN = VA_ = VLATCH = VCAL = V+ | -1 | 0.001 | 1 | μA | | |
| Input Current with Input Voltage Low | IiL | VEN = VA_ = VLATCH = VCAL = 0 | -1 | 0.001 | 1 | μA | | |
| DYNAMIC CHARACTERISTICS (Note 3) | | | | | | | | |
| Transition Time | tTRANS | VNO1 = 8V, VNO8 = 0, Figure 1 | TA = +25°C | 600 | 850 | ns | | |
| | | | TA = TMIN to TMAX | | 1100 | | | |
| Break-Before-Make Interval | tOPEN | Figure 2 | TA = +25°C | 120 | 400 | ns | | |
| Enable Turn-On Time | tON | Figure 3 | TA = +25°C | 540 | 800 | ns | | |
| | | | TA = TMIN to TMAX | | 1100 | | | |
| Enable Turn-Off Time | tOFF | Figure 3 | TA = +25°C | 150 | 315 | ns | | |
| | | | TA = TMIN to TMAX | | 450 | | | |

Note 2: The algebraic convention, where the most negative value is a minimum and the most positive value a maximum, is used in this data sheet.

Note 3: Guaranteed by design.

Note 4: $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$.

Note 5: Leakage parameters are 100% tested at maximum-rated hot temperature and guaranteed by correlation at TA = +25°C.

Note 6: If the logic inputs can float during power-on, connect a 1MΩ pull-up from LATCH to V+. See *Applications Information* section.

Note 7: Off-Isolation = $20\log_{10}(V_{COM} / V_{NO})$, VCOM = output, VNO = input to off switch.

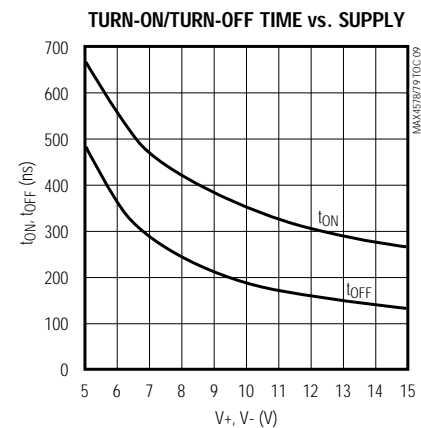
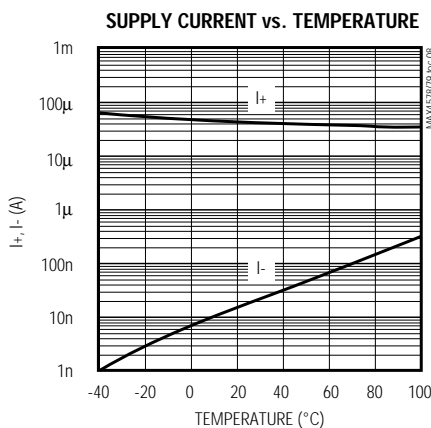
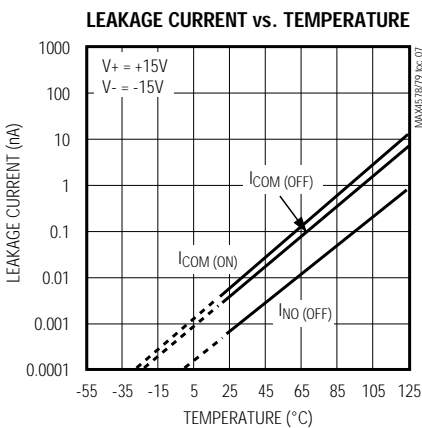
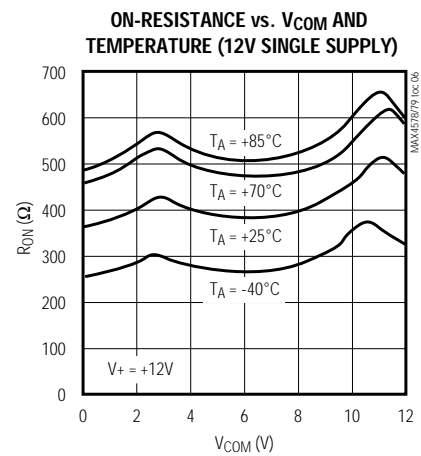
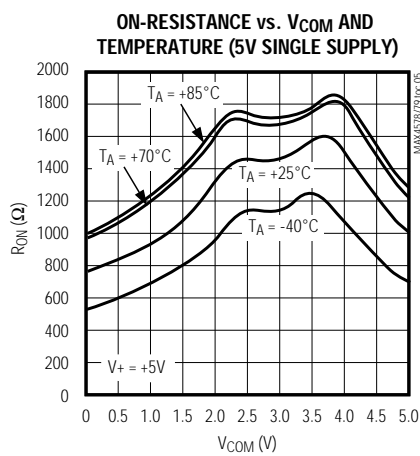
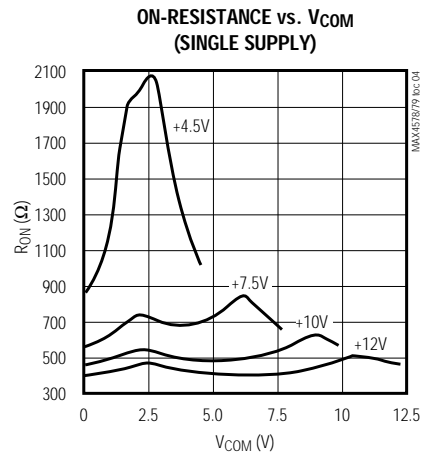
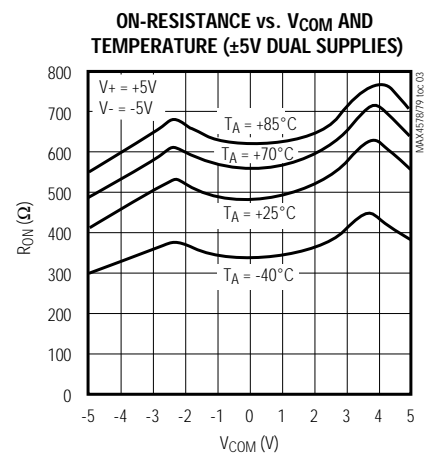
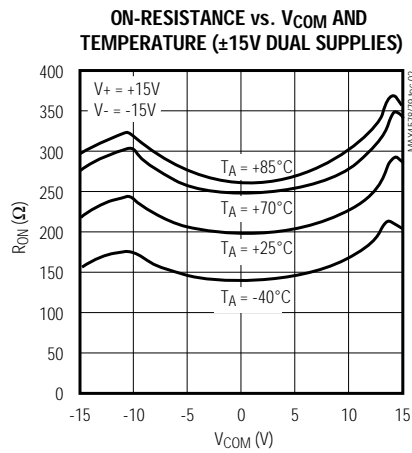
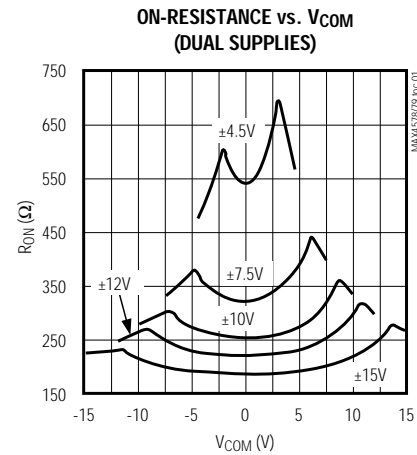
Note 8: Between any two switches.

Note 9: Leakage parameters testing at single supply are guaranteed by correlation with dual supplies.

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

Typical Operating Characteristics

($T_A = +25^\circ\text{C}$, unless otherwise noted.)

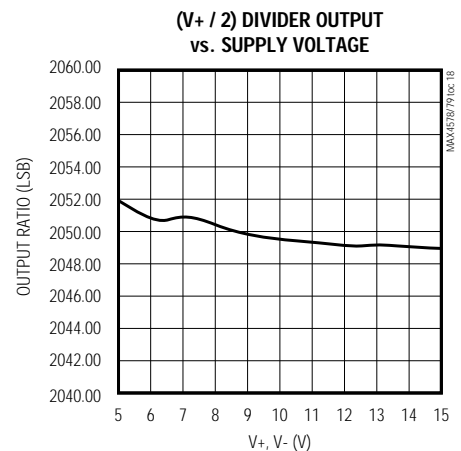
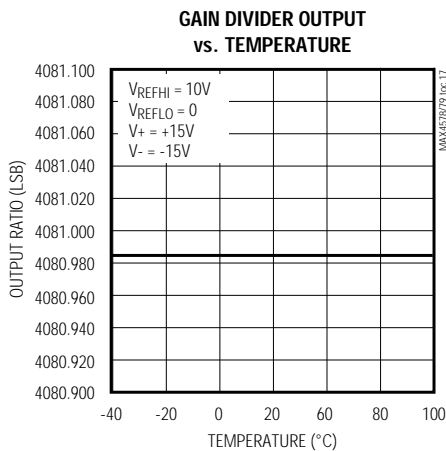
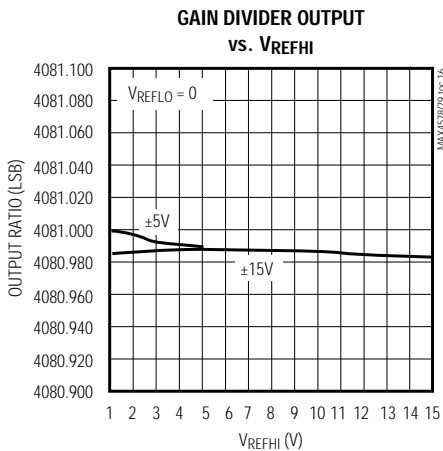
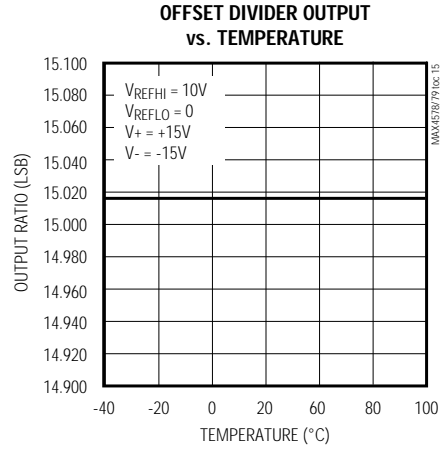
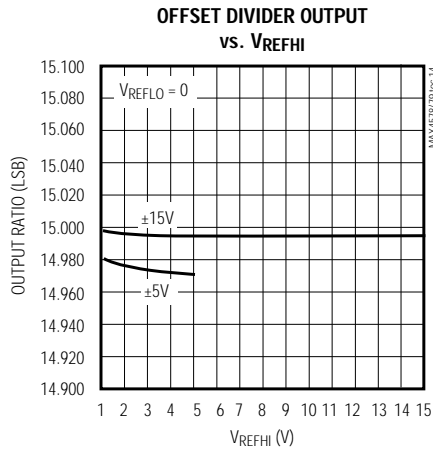
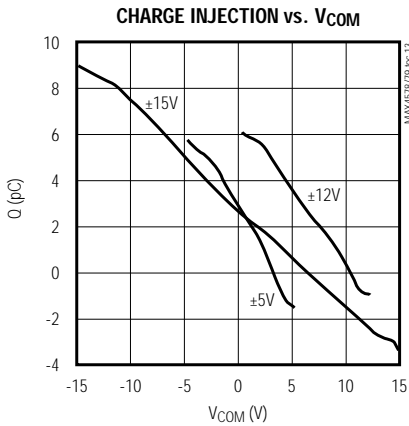
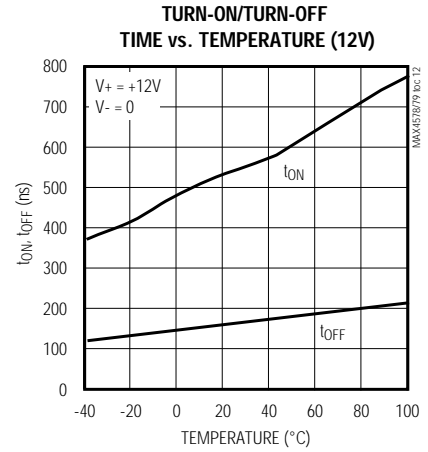
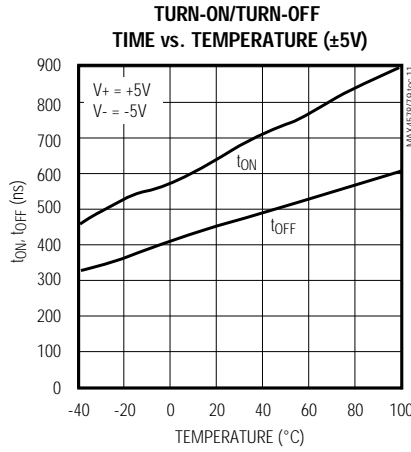
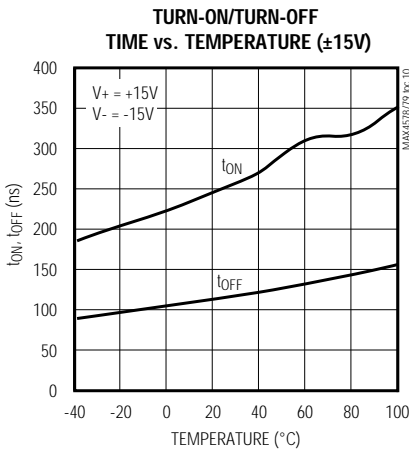


High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

Typical Operating Characteristics (continued)

($T_A = +25^\circ\text{C}$, unless otherwise noted.)

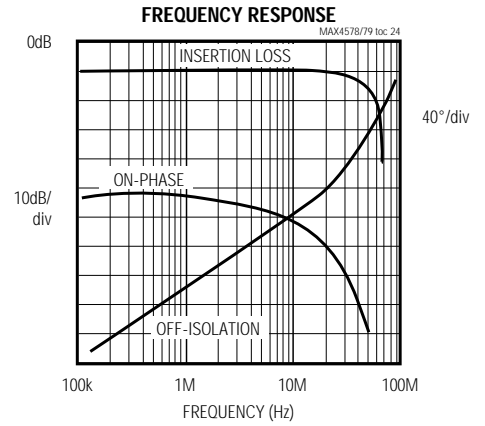
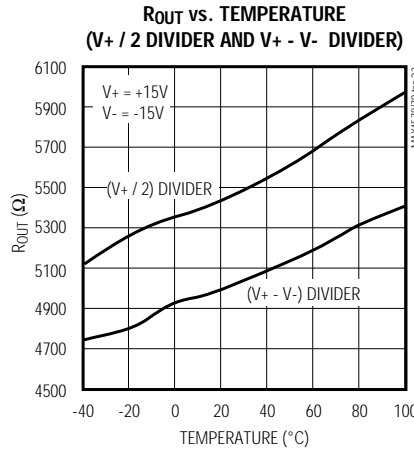
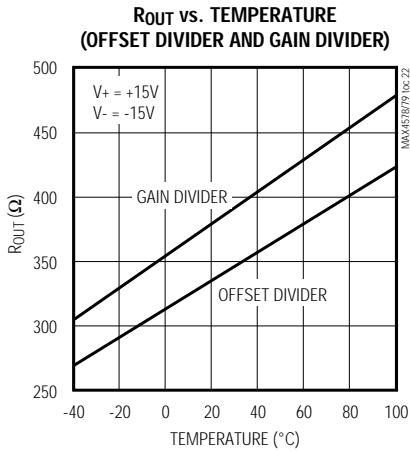
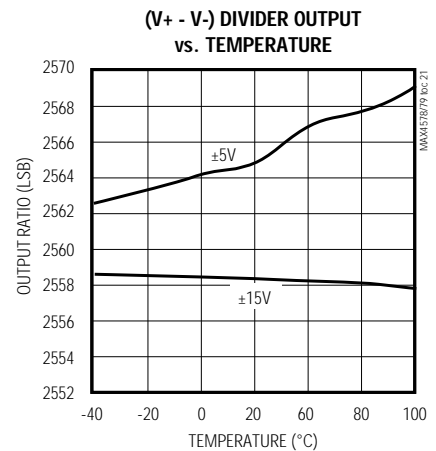
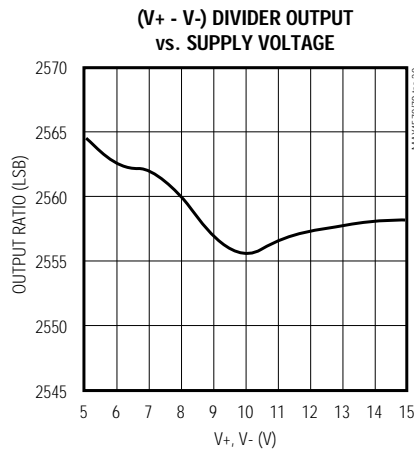
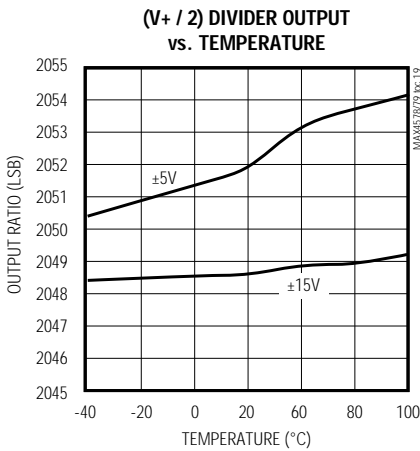
MAX4578/MAX4579



High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

Typical Operating Characteristics (continued)

($T_A = +25^\circ\text{C}$, unless otherwise noted.)



High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

Pin Descriptions

MAX4578 (Single 8-to-1 Cal-Mux)

| PIN | NAME | FUNCTION |
|-----|-------|------------------------------|
| 1 | V+ | Positive Supply Voltage |
| 2 | GND | Ground |
| 3 | V- | Negative Supply Voltage |
| 4 | REFHI | Reference High Voltage Input |
| 5 | REFLO | Reference Low Voltage Input |
| 6 | COM | Output |
| 7 | NO1 | Channel Input 1 |
| 8 | NO2 | Channel Input 2 |
| 9 | NO3 | Channel Input 3 |
| 10 | NO4 | Channel Input 4 |
| 11 | NO5 | Channel Input 5 |
| 12 | NO6 | Channel Input 6 |
| 13 | NO7 | Channel Input 7 |
| 14 | NO8 | Channel Input 8 |
| 15 | A2 | Address Bit 2 |
| 16 | A1 | Address Bit 1 |
| 17 | A0 | Address Bit 0 |
| 18 | CAL | Calibration Control Input |
| 19 | EN | Multiplexer Enable |
| 20 | LATCH | Address Latch Control Input |

MAX4579 (Dual 4-to-1 Cal-Mux)

| PIN | NAME | FUNCTION |
|-----|-------|------------------------------|
| 1 | V+ | Positive Supply Voltage |
| 2 | GND | Ground |
| 3 | V- | Negative Supply Voltage |
| 4 | REFHI | Reference High Voltage Input |
| 5 | REFLO | Reference Low Voltage Input |
| 6 | COMA | Multiplexer Output A |
| 7 | NO1A | Channel Input 1A |
| 8 | NO2A | Channel Input 2A |
| 9 | NO3A | Channel Input 3A |
| 10 | NO4A | Channel Input 4A |
| 11 | NO1B | Channel Input 1B |
| 12 | NO2B | Channel Input 2B |
| 13 | NO3B | Channel Input 3B |
| 14 | NO4B | Channel Input 4B |
| 15 | COMB | Multiplexer Output B |
| 16 | A1 | Address Bit 1 |
| 17 | A0 | Address Bit 0 |
| 18 | CAL | Calibration Control Input |
| 19 | EN | Multiplexer Enable |
| 20 | LATCH | Address Latch Control Input |

MAX4578/MAX4579

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

Truth Tables

MAX4578 (Single 8-to-1 Cal-Mux)

| CAL | A2 | A1 | A0 | EN | LATCH | COM |
|-----|----|----|----|----|-------|--|
| x | x | x | x | 0 | x | All switches and dividers open. COM is high-Z. Latch contents set to all 1s. |
| x | x | x | x | 1 | 1 | State is latched when LATCH is high. |
| 0 | 0 | 0 | 0 | 1 | 0 | NO1 |
| 0 | 0 | 0 | 1 | 1 | 0 | NO2 |
| 0 | 0 | 1 | 0 | 1 | 0 | NO3 |
| 0 | 0 | 1 | 1 | 1 | 0 | NO4 |
| 0 | 1 | 0 | 0 | 1 | 0 | NO5 |
| 0 | 1 | 0 | 1 | 1 | 0 | NO6 |
| 0 | 1 | 1 | 0 | 1 | 0 | NO7 |
| 0 | 1 | 1 | 1 | 1 | 0 | NO8 |
| 1 | 0 | 0 | 0 | 1 | 0 | (V+ / 2) Divider, $V_{COM} = 2048 / 4096 (V+)$ |
| 1 | 0 | 0 | 1 | 1 | 0 | REFHI |
| 1 | 0 | 1 | 0 | 1 | 0 | REFLO |
| 1 | 0 | 1 | 1 | 1 | 0 | (V+ - V-) Divider, $V_{COM} = 2560 / 4096 (V+ - V-)$ |
| 1 | 1 | 0 | 0 | 1 | 0 | GND |
| 1 | 1 | 0 | 1 | 1 | 0 | Gain Divider Mode $V_{COM} = (4081 / 4096) (V_{REFHI} - V_{REFLO})$ |
| 1 | 1 | 1 | 0 | 1 | 0 | Offset Divider Mode $V_{COM} = (15 / 4096) (V_{REFHI} - V_{REFLO})$ |
| 1 | 1 | 1 | 1 | 1 | 0 | All switches and dividers open. COM is high-Z. |

x = Don't Care

MAX4579 (Dual 4-to-1 Cal-Mux)

| CAL | A1 | A0 | EN | LATCH | COMA | COMB |
|-----|----|----|----|-------|---|---|
| x | x | x | 0 | x | All switches and dividers open. COMA is high-Z. | All switches and dividers open. COMB is high-Z. |
| x | x | x | 1 | 1 | State is latched | State is latched |
| 0 | 0 | 0 | 1 | 0 | NO1A | NO1B |
| 0 | 0 | 1 | 1 | 0 | NO2A | NO2B |
| 0 | 1 | 0 | 1 | 0 | NO3A | NO3B |
| 0 | 1 | 1 | 1 | 0 | NO4A | NO4B |
| 1 | 0 | 0 | 1 | 0 | GND | GND |
| 1 | 0 | 1 | 1 | 0 | Gain Divider Mode | REFLO |
| 1 | 1 | 0 | 1 | 0 | Offset Divider Mode | REFLO |
| 1 | 1 | 1 | 1 | 0 | All switches and dividers open. COMA is high-Z. | All switches and dividers open. COMB is high-Z. |

x = Don't Care

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

MAX4578/MAX4579

Detailed Description

The MAX4578/MAX4579 are multiplexers with additional calibration features. Internal resistor-dividers generate accurate voltage ratios from an external voltage reference, allowing zero and full-scale calibration of ADC systems, as well as facilitation of system self-monitoring. To access the resistor-dividers, assert the CAL pin. When CAL and ENABLE are asserted, the three address pins select one of the various resistor-divider or external reference outputs. The MAX4578/ MAX4579 also contain a LATCH input that allows the state of the CAL and address signals to be captured.

Calibration Functions

The gain-divider, offset-divider, REFHI, and REFLO modes allow calibration of offset and gain errors in ADC systems. The gain-divider mode outputs a voltage ratio that is 4081/4096 of $V_{REFHI} - V_{REFLO}$, accurate to 0.1/4096 or better than 15 bits. The offset-divider mode outputs a voltage ratio that is 15/4096 of $V_{REFHI} - V_{REFLO}$, also accurate to 0.1/4096. The REFHI mode allows the voltage on the REFHI pin to be switched to the output. The REFLO mode allows the voltage on the REFLO pin to be switched to the output.

Self-Monitoring Functions

The self-monitoring functions are intended to allow an ADC to measure its own supply voltage. The MAX4578 has an internal divide-by-two resistor string between V+ and GND that is accurate to 8 bits. It also has a 5/8 resistor string between V+ and V- that is accurate to 8 bits. This divider string allows measurement of the negative supply with a unipolar ADC. GND can also be switched to the output, eliminating the need for an additional multiplexer channel.

Applications Information

The MAX4578/MAX4579's construction is typical of most CMOS analog switches. There are three supply pins: V+, V-, and GND. The positive and negative power supplies provide drive to the internal CMOS switches and set the limits of the analog voltage on any switch. Reverse-biased ESD protection diodes are internally connected between each analog signal pin and both V+ and V-. If the voltage on any pin exceeds V+ or V-, one of these diodes will conduct. During normal operation, these reverse-biased ESD diodes leak, forming the only current drawn from V-.

Virtually all the analog leakage current is through the ESD diodes. Although the ESD diodes on a given signal pin are identical, and therefore fairly well balanced,

they are reverse-biased differently. Each is biased by either V+ or V- and the analog signal. This means their leakage varies as the signal varies. The difference in the two-diode leakage from the signal path to the V+ and V- pins constitutes the analog signal-path leakage current. All analog-leakage current flows to the supply terminals, not to the other switch terminal, which explains how both sides of a given switch can show leakage currents of either the same or opposite polarity.

There is no connection between the analog-signal paths and GND. The analog-signal paths consist of an N-channel and P-channel MOSFET with their sources and drains paralleled and their gates driven out of phase with V+ and V- by the logic-level translators.

V+ and GND power the internal logic and logic-level translators and set the input-logic thresholds. The logic-level translators convert the logic levels to switched V+ and V- signals to drive the gates of the analog switches. This drive signal is the only connection between the logic supplies and the analog supplies. All pins have ESD protection to V+ and to V-.

Increasing V- has no effect on the logic-level thresholds, but it does increase the drive to the P-channel switches, which reduces their on-resistance. V- also sets the negative limit of the analog-signal voltage.

The logic-level thresholds are CMOS- and TTL-compatible when V+ is greater than +4.5V.

Bipolar-Supply Operation

The MAX4578/MAX4579 operate with bipolar supplies between $\pm 4.5V$ and $\pm 20V$. The V+ and V- supplies need not be symmetrical, but their sum cannot exceed the absolute maximum rating of 44V. **Note: Do not connect the MAX4578/MAX4579 V+ pin to +3V AND connect logic-level input pins to TTL logic-level signals. TTL logic-level outputs can exceed the absolute maximum ratings, which will cause damage to the part and/or external circuits.**

Single-Supply Operation

The MAX4578/MAX4579 operate from a single supply between +4.5V and +36V when V- is connected to GND. All of the bipolar precautions must be observed (see *Bipolar Supply Operation* section). However these parts are optimized for $\pm 15V$ operation, and most AC and DC characteristics are degraded significantly when departing from $\pm 15V$. As the overall supply voltage (V+ to V-) is lowered, switching speed, on-resistance, off-isolation, and distortion will degrade, and supply current will decrease (see the *Typical Operating Characteristics* section).

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

Single-supply operation also limits signal levels and interferes with ground referenced signals. When $V_- = 0$, AC signals are limited to $-0.3V$. Voltages below $-0.3V$ can be clipped by the internal ESD-protection diodes, and the parts can be damaged if excessive current flows.

Power Up

During power up, on-chip latches will strobe whatever addresses are present if EN goes high before LATCH reaches a logic high. When this condition occurs, one of the internal dividers connected between the supplies may immediately turn on, causing higher supply current (1.4mA) when the enable input is toggled. Avoid this condition by ensuring that EN stays low until the remaining logic inputs are valid. To accomplish this, connect a resistor from EN to ground or apply a low voltage to EN before the other logic inputs go high.

Power Off

When power to the MAX4578/MAX4579 is off (i.e., $V_+ = V_- = 0$), the Absolute Maximum Ratings still apply. This means that neither logic-level inputs on NO_ nor signals on COM_ can exceed $\pm 0.3V$. Voltages beyond $\pm 0.3V$ cause the internal ESD-protection diodes to conduct, and the parts can be damaged if excessive current flows.

Test Circuits/Timing Diagrams

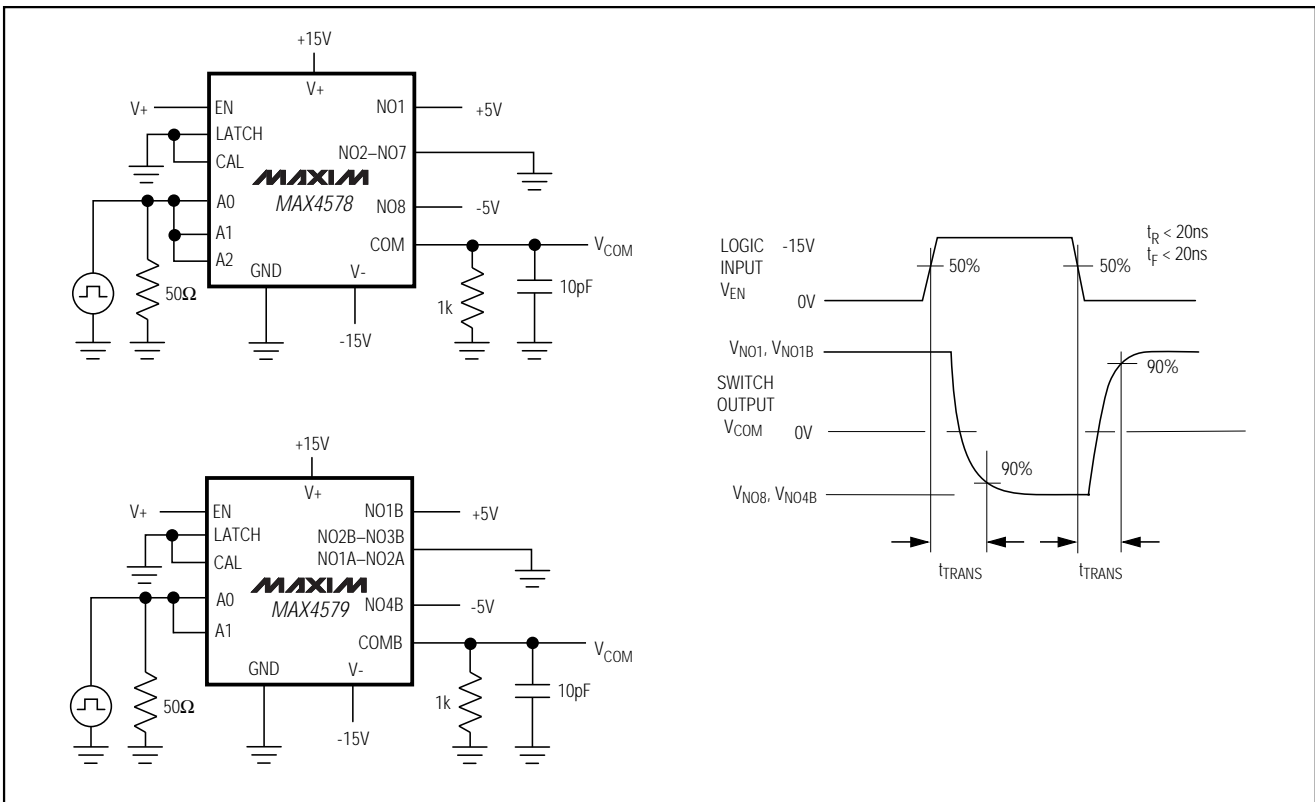


Figure 1. Transition Time

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

Test Circuits/Timing Diagrams (continued)

MAX4578/MAX4579

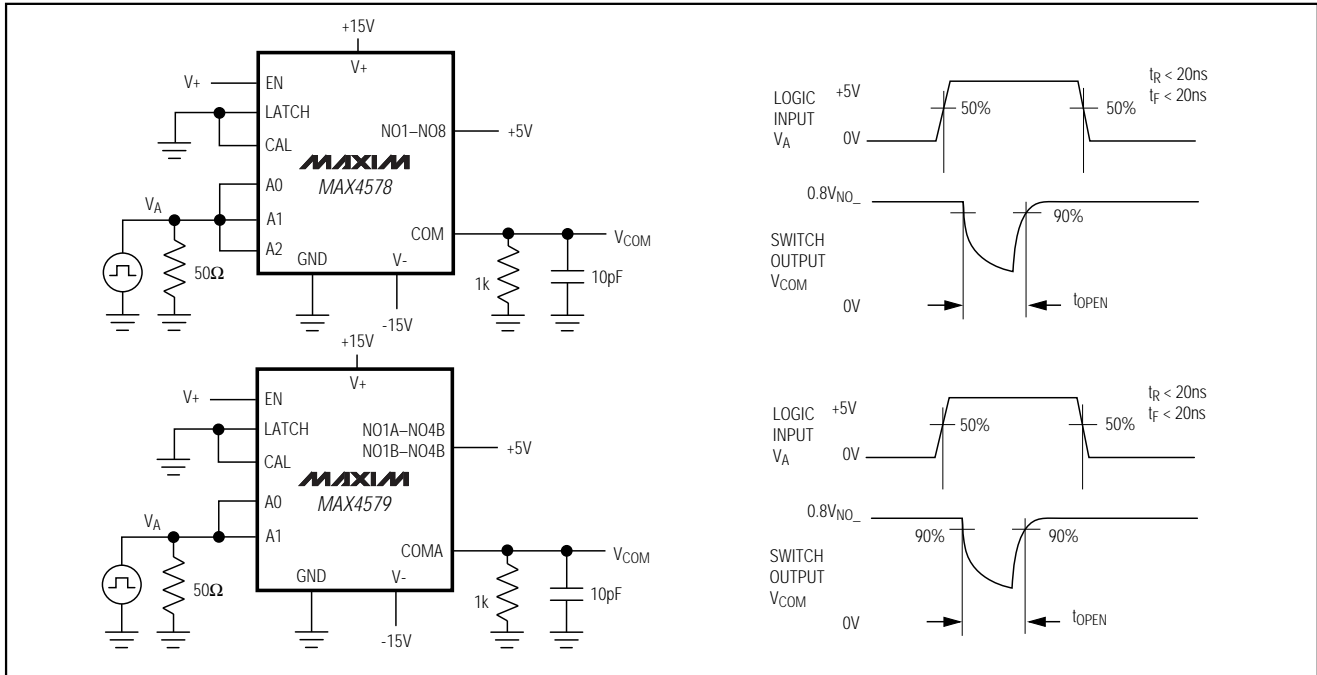


Figure 2. Break-Before-Make Interval

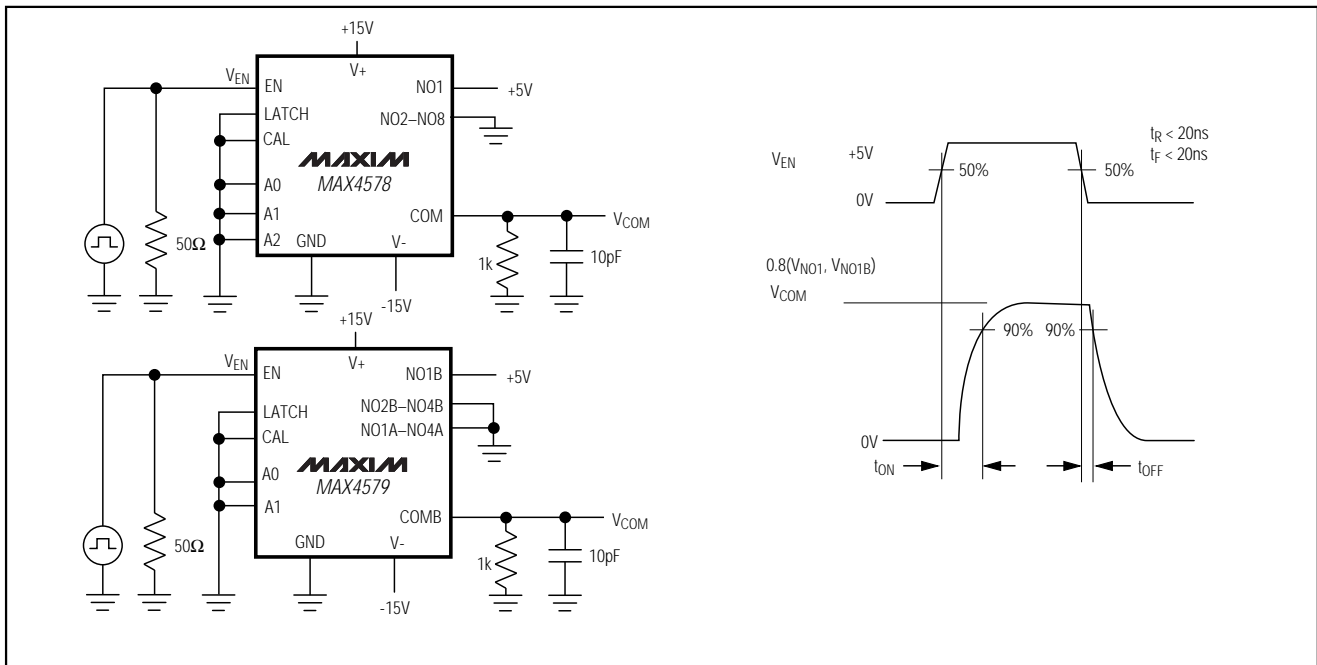


Figure 3. Enable Switching Time

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

Test Circuits/Timing Diagrams (continued)

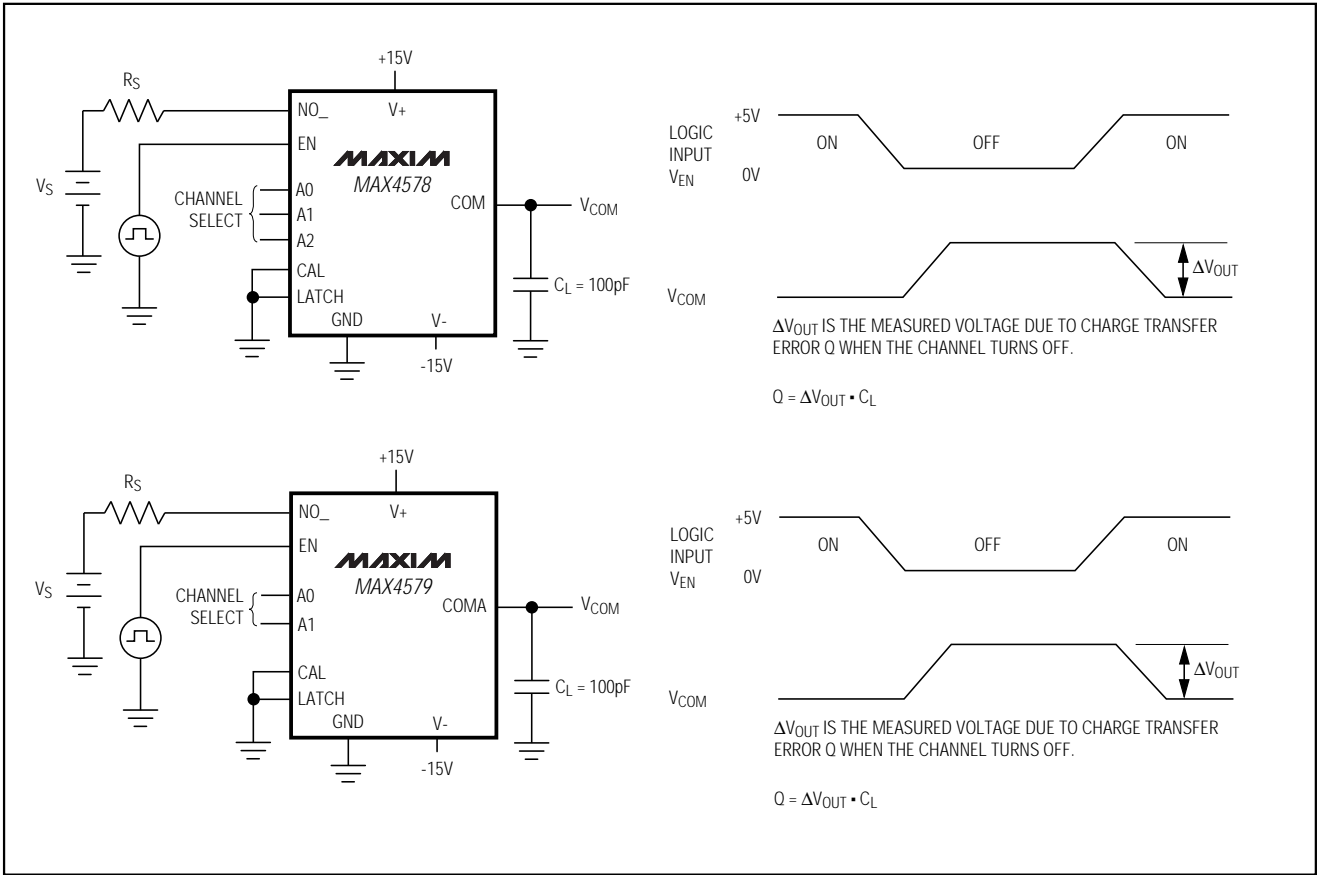


Figure 4. Charge Injection

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

Test Circuits/Timing Diagrams (continued)

MAX4578/MAX4579

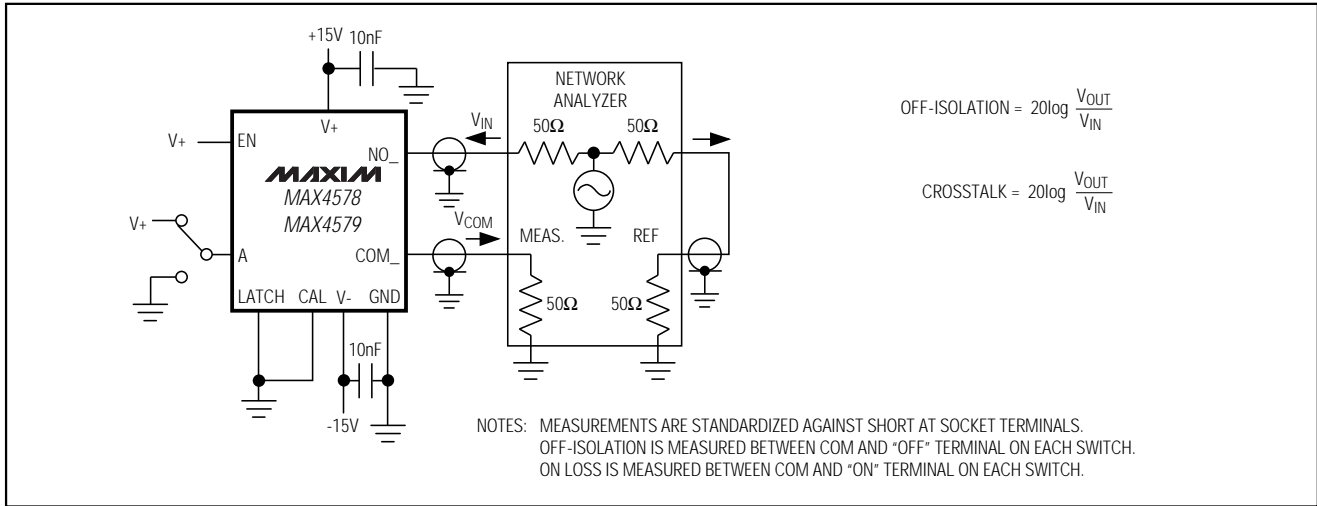


Figure 5. Off-Isolation/Crosstalk

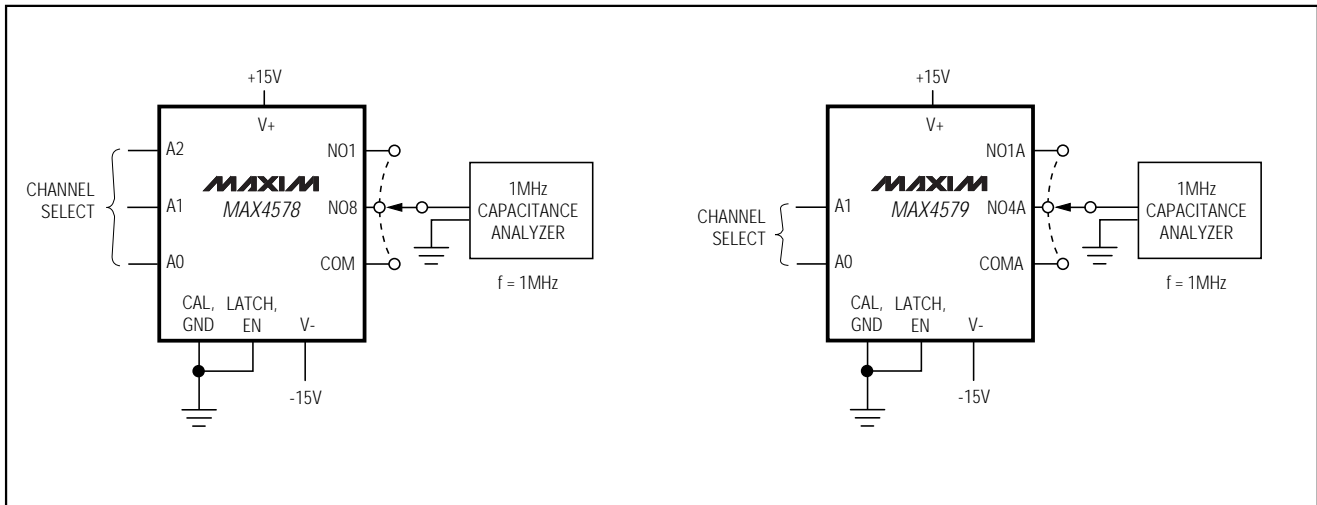


Figure 6. NO_/COM_ Capacitance

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

Test Circuits/Timing Diagrams (continued)

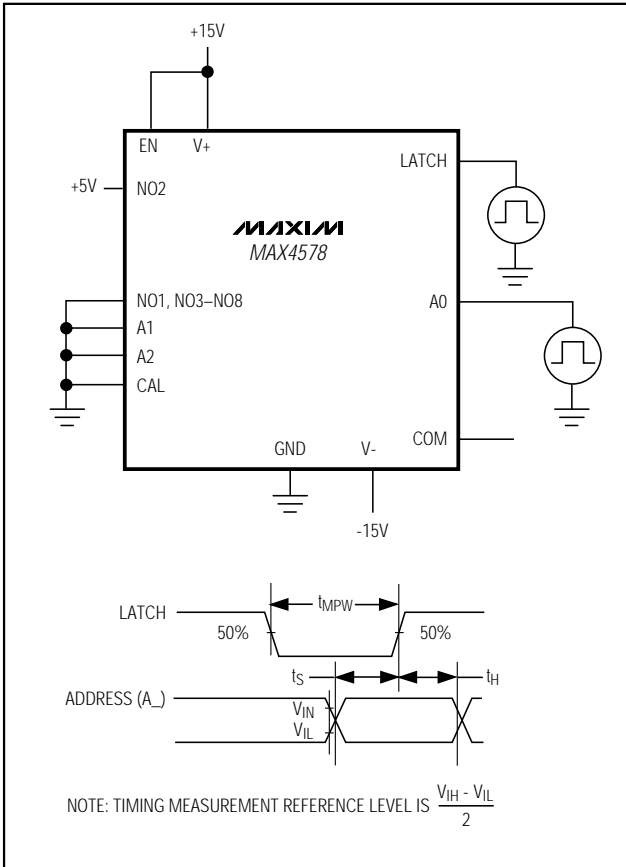


Figure 7. Setup Time, Hold Time, Latch Pulse Width

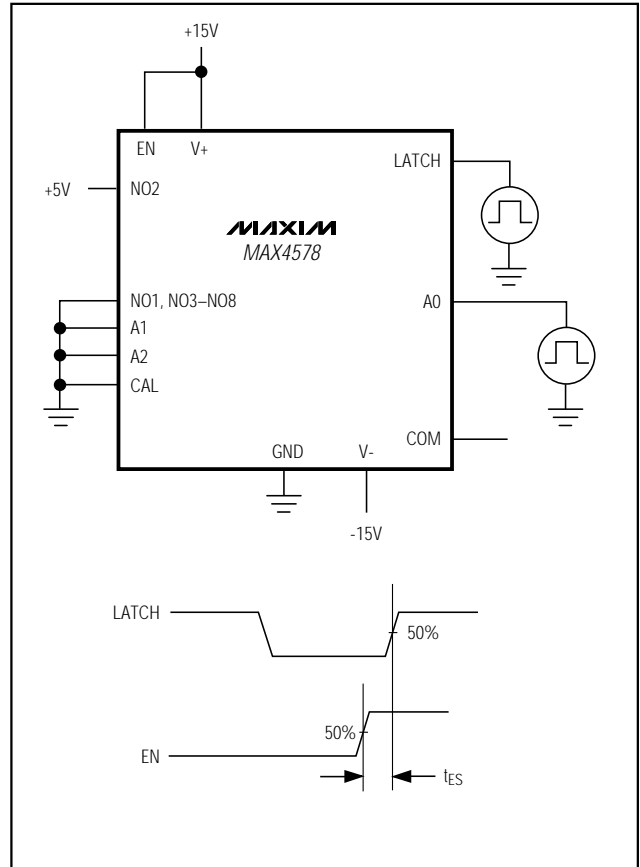
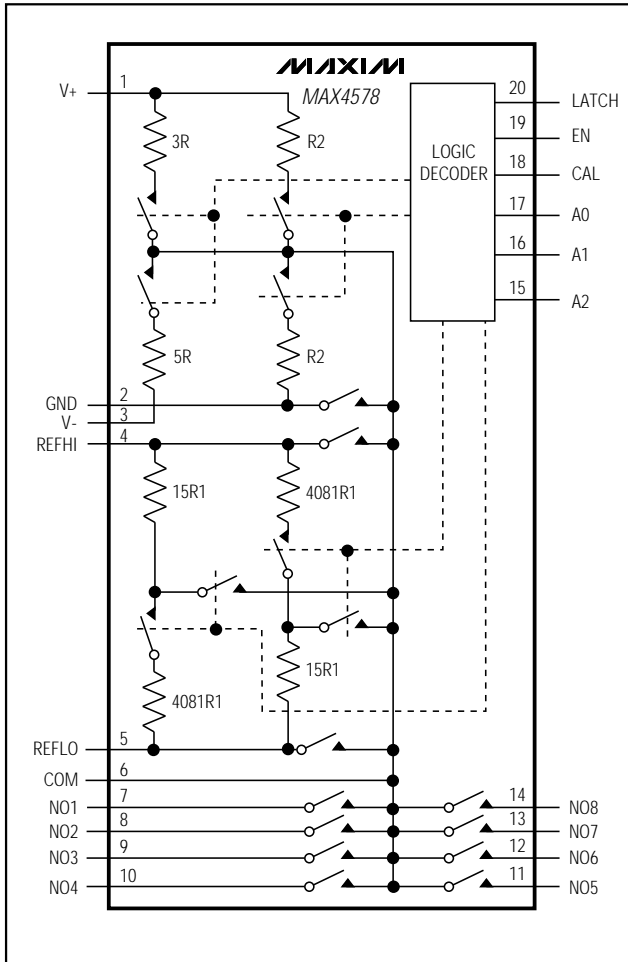


Figure 8. Enable Setup Time

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

Pin Configurations/
_Functional Diagrams (continued)



MAX4578/MAX4579

High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

Ordering Information (continued)

| PART | TEMP. RANGE | PIN-PACKAGE |
|------------|----------------|----------------|
| MAX4579CAP | 0°C to +70°C | 20 SSOP |
| MAX4579CWP | 0°C to +70°C | 20 SO Wide |
| MAX4579CPP | 0°C to +70°C | 20 Plastic DIP |
| MAX4579EAP | -40°C to +85°C | 20 SSOP |
| MAX4579EWP | -40°C to +85°C | 20 SO Wide |
| MAX4579EPP | -40°C to +85°C | 20 Plastic DIP |

Chip Information

TRANSISTOR COUNT: 520

Package Information

| DIM | INCHES | | MILLIMETERS | |
|-----|----------------|-------|-------------|------|
| | MIN | MAX | MIN | MAX |
| A | 0.068 | 0.078 | 1.73 | 1.99 |
| A1 | 0.002 | 0.008 | 0.05 | 0.21 |
| B | 0.010 | 0.015 | 0.25 | 0.38 |
| C | 0.004 | 0.008 | 0.09 | 0.20 |
| D | SEE VARIATIONS | | | |
| E | 0.205 | 0.209 | 5.20 | 5.38 |
| e | 0.0256 | BSC | 0.65 | BSC |
| H | 0.301 | 0.311 | 7.65 | 7.90 |
| L | 0.025 | 0.037 | 0.63 | 0.95 |
| α | 0° | 8° | 0° | 8° |

| D | INCHES | | MILLIMETERS | | |
|---|--------|-------|-------------|-------|-----|
| | MIN | MAX | MIN | MAX | |
| D | 0.239 | 0.249 | 6.07 | 6.33 | 14L |
| D | 0.239 | 0.249 | 6.07 | 6.33 | 16L |
| D | 0.278 | 0.289 | 7.07 | 7.33 | 20L |
| D | 0.317 | 0.328 | 8.07 | 8.33 | 24L |
| D | 0.397 | 0.407 | 10.07 | 10.33 | 28L |

NOTES:
 1. D&E DO NOT INCLUDE MOLD FLASH.
 2. MOLD FLASH OR PROTRUSIONS NOT TO EXCEED .15mm (.006")
 3. CONTROLLING DIMENSION: MILLIMETER

| | | |
|----------------------------------|----------------------|-------|
| MAXIM | | |
| PROPRIETARY INFORMATION | | |
| TITLE: | | |
| PACKAGE OUTLINE, SSOP, 5.3X.65mm | | |
| APPROVAL | DOCUMENT CONTROL NO. | REV |
| | 21-0056 | A 1/1 |

SSOPERS

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