



## 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 $\Omega$  max) is matched between switches to 15 $\Omega$  max. Each switch can handle Rail-to-Rail<sup>®</sup> 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.



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### Features

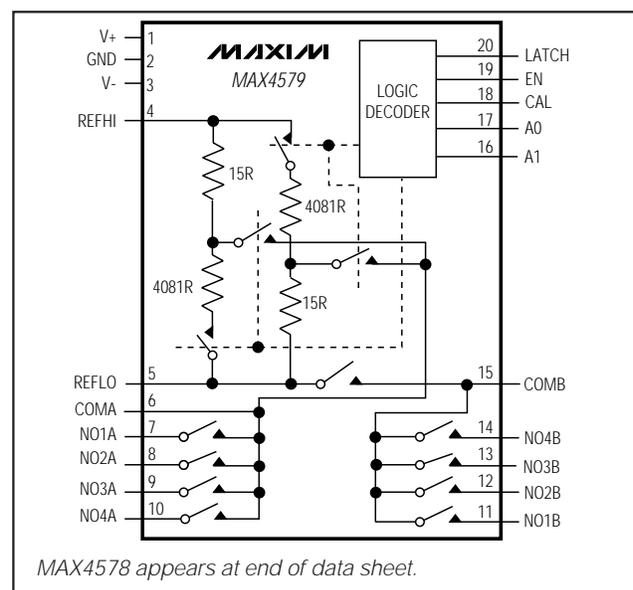
- ♦ On-Chip Gain and Offset Divider Networks Provide 15-Bit Accurate Output Ratios
- ♦ On-Chip V+ to GND and V+ to V- Divider Networks Provide 8-Bit Accurate Output Ratios
- ♦ 350 $\Omega$  (max) RON
- ♦ 12 $\Omega$  (max) RON Matching Between Channels
- ♦ 10pC (max) Charge Injection
- ♦ Guaranteed 20pA 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

# 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 <sub>-</sub> , EN, NO <sub>-</sub> , COM <sub>-</sub> , REFHI, REFLO (Note 1)	(V <sub>-</sub> - 0.3V) to (V <sub>+</sub> + 0.3V)
Continuous Current (any terminal)	±30mA
Peak Current, NO <sub>-</sub> or COM <sub>-</sub> (pulsed at 1ms, 10% duty cycle max)	±100mA

Continuous Power Dissipation (T<sub>A</sub> = +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<sub>-</sub>, COM<sub>-</sub>, EN, LATCH, CAL, A<sub>-</sub> exceeding V<sub>+</sub> or V<sub>-</sub> 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<sub>+</sub> = +15V ±10%, V<sub>-</sub> = -15V ±10%, logic levels = 2.4V and 0.8V, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS	
<b>SWITCH</b>								
Analog Signal Range	V <sub>COM<sub>-</sub></sub> , V <sub>NO<sub>-</sub></sub>	(Note 3)		V <sub>-</sub>		V <sub>+</sub>	V	
On-Resistance	R <sub>DS(ON)</sub>	I <sub>COM<sub>-</sub></sub> = 0.2mA, V <sub>NO<sub>-</sub></sub> = ±10V, V <sub>+</sub> = 13.5V, V <sub>-</sub> = -13.5V	T <sub>A</sub> = +25°C	220	350		Ω	
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		475			
On-Resistance Matching Between Channels (Note 4)	ΔRON	I <sub>COM<sub>-</sub></sub> = 0.2mA, V <sub>NO<sub>-</sub></sub> = ±10V, V <sub>+</sub> = 13.5V, V <sub>-</sub> = -13.5V	T <sub>A</sub> = +25°C	4	12		Ω	
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		15			
NO Off-Leakage Current (Note 5)	I <sub>NO<sub>-</sub>(OFF)</sub>	V <sub>NO<sub>-</sub></sub> = ±14V, V <sub>COM<sub>-</sub></sub> = ±14V, V <sub>+</sub> = 16.5V, V <sub>-</sub> = -16.5V	T <sub>A</sub> = +25°C	-0.02	0.001	0.02	nA	
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-1.25		1.25		
COM Off-Leakage Current (Note 5)	I <sub>COM<sub>-</sub>(OFF)</sub>	V <sub>COM<sub>-</sub></sub> = ±14V, V <sub>NO<sub>-</sub></sub> = ±14V, V <sub>+</sub> = 16.5V, V <sub>-</sub> = -16.5V	MAX4578	T <sub>A</sub> = +25°C	-0.05	0.005	0.05	nA
			MAX4579	T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-6.5		6.5	
				T <sub>A</sub> = +25°C	-0.05	0.005	0.05	
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-3.25		3.25		
COM On-Leakage Current (Note 5)	I <sub>COM<sub>-</sub>(ON)</sub>	V <sub>COM<sub>-</sub></sub> = ±14V, V <sub>NO<sub>-</sub></sub> = ±14V, V <sub>+</sub> = 16.5V, V <sub>-</sub> = -16.5V	MAX4578	T <sub>A</sub> = +25°C	-0.05	0.006	0.05	nA
			MAX4579	T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-6.5		6.5	
				T <sub>A</sub> = +25°C	-0.05	0.008	0.05	
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-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<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

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

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS	
<b>LATCH TIMING</b> (Note 3)							
Setup Time	$t_s$	Figure 7	$T_A = +25^\circ\text{C}$	70	200	ns	
			$T_A = T_{\text{MIN}}$ to $T_{\text{MAX}}$		250		
Hold Time	$t_H$	Figure 7	$T_A = +25^\circ\text{C}$	-10	0	ns	
			$T_A = T_{\text{MIN}}$ to $T_{\text{MAX}}$	-10			
Enable Setup Time	$t_{\text{ES}}$	Figure 8	$T_A = +25^\circ\text{C}$	22	40	ns	
			$T_A = T_{\text{MIN}}$ to $T_{\text{MAX}}$		60		
Pulse Width, LATCH Enable	$t_{\text{MPW}}$	Figure 7	$T_A = +25^\circ\text{C}$	120	72	ns	
			$T_A = T_{\text{MIN}}$ to $T_{\text{MAX}}$	180			
<b>INTERNAL DIVIDERS</b>							
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 $T_{\text{MAX}}$	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 $T_{\text{MAX}}$	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 $T_{\text{MAX}}$	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 $T_{\text{MAX}}$	2544 / 4096	2560 / 4096	2576 / 4096	
Output Resistance Offset Divider		(Note 3)	$T_A = +25^\circ\text{C}$	400	800	$\Omega$	
Output Resistance Gain Divider		(Note 3)	$T_A = +25^\circ\text{C}$	400	800	$\Omega$	
Output Resistance $(V_+ / 2)$ Divider		(Note 3)	$T_A = +25^\circ\text{C}$	6	9	k $\Omega$	
Output Resistance $(V_+ - V_-)$ Divider		(Note 3)	$T_A = +25^\circ\text{C}$	6	9	k $\Omega$	
Output Resistance (REFHI, REFLO, GND)		(Note 3)	$T_A = +25^\circ\text{C}$	400	800	$\Omega$	
Additional Positive Supply Current (Note 3)		$(V_+ / 2)$ divider active, $V_{\text{IH}} = V_+$ , $V_{\text{IL}} = 0$	$T_A = +25^\circ\text{C}$	$V_+ / 24\text{k}$	$V_+ / 13\text{k}$	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, TA = TMIN to TMAX, unless otherwise noted. Typical values are at TA = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Additional Positive Supply Current (Note 3)		(V+ - V-) divider active, VIH = V+, VIL = 0	TA = +25°C	(V+ - V-) / 24k	(V+ - V-) / 13k	mA
Additional Negative Supply Current (Note 3)		(V+ - V-) divider active, VIH = V+, VIL = 0	TA = +25°C	(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	TA = +25°C	17	32	kΩ

## ELECTRICAL CHARACTERISTICS—Dual ±5V Supplies

(V+ = +5V ±10%, V- = -5V ±10%, 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		
<b>SWITCH</b>								
Analog Signal Range	VNO_, VCOM_	(Note 3)	V-		V+	V		
On-Resistance	RDS(ON)	ICOM_ = 0.2mA, VNO_ = ±3V, V+ = 4.5V, V- = -4.5V	TA = +25°C	660	900	Ω		
			TA = TMIN to TMAX		1100			
On-Resistance Matching Between Channels (Note 4)	ΔRDS(ON)	ICOM_ = 0.2mA, VNO_ = 3.0V, V+ = 4.5V, V- = -4.5V	TA = +25°C	10		Ω		
NO Off-Leakage Current (Note 5)	INO(OFF)	VNO_ = ±4.5V, VCOM_ = ±4.5V, V+ = 5.5V, V- = -5.5V	TA = +25°C	-0.02	0.001	0.02	nA	
			TA = TMIN to TMAX	-1.25		1.25		
COM Off-Leakage Current (Note 5)	ICOM(OFF)	VCOM_ = ±4.5V, 1V; VNO_ = ±4.5V, V+ = 5.5V, V- = -5.5V	MAX4578	TA = +25°C	-0.05	0.005	0.05	nA
			MAX4579	TA = TMIN to TMAX	-6.5		6.5	
				TA = +25°C	-0.5	0.005	0.5	
				TA = TMIN to TMAX	-6.5		6.5	
COM On-Leakage Current (Note 5)	ICOM(ON)	VCOM_ = ±4.5V, VNO_ = ±4.5V or floating, V+ = 5.5V, V- = -5.5V	MAX4578	TA = +25°C	-0.05	0.008	0.05	nA
			MAX4579	TA = TMIN to TMAX	-6.5		6.5	
				TA = +25°C	-0.05		0.05	
				TA = TMIN to TMAX	-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
<b>LOGIC INPUTS</b> (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	$\mu A$
Input Current with Input Voltage Low	$I_{IL}$	$V_{EN} = V_{A_-} = V_{LATCH} = V_{CAL} = 0$	-1.0	0.001	1.0	$\mu A$
<b>DYNAMIC CHARACTERISTICS</b> (Note 3)						
Transition Time	$t_{TRANS}$	$V_{NO1} = 3V$ , $V_{NO8} = 0$ , Figure 1	$T_A = +25^\circ C$	1.0	1.8	$\mu s$
			$T_A = T_{MIN}$ 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	$\mu s$
			$T_A = T_{MIN}$ 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	$\mu s$
			$T_A = T_{MIN}$ 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	
<b>SWITCH</b>							
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	$\Omega$	
			$T_A = T_{MIN}$ 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		$\Omega$	
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, T<sub>A</sub> = T<sub>MIN</sub> to T<sub>MAX</sub>, unless otherwise noted. Typical values are at T<sub>A</sub> = +25°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS		
<b>SWITCH (continued)</b>								
COM Off-Leakage Current (Notes 5, 9)	I <sub>COM(OFF)</sub>	V <sub>COM_</sub> = 11V, 1V; V <sub>NO_</sub> = 1V, 11V	MAX4578	T <sub>A</sub> = +25°C	-0.05	0.005	0.05	nA
				T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-6.5		6.5	
			MAX4579	T <sub>A</sub> = +25°C	-0.05	0.005	0.05	
				T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-3.25		3.25	
COM On-Leakage Current (Notes 5, 9)	I <sub>COM(ON)</sub>	V <sub>COM_</sub> = 11V, 1V; V <sub>NO_</sub> = 11V, 1V, or floating	MAX4578	T <sub>A</sub> = +25°C	-0.05	0.006	0.05	nA
				T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-6.5		6.5	
			MAX4579	T <sub>A</sub> = +25°C	-0.05		0.05	
				T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>	-3.25		3.25	
<b>LOGIC INPUTS</b>								
Input High Voltage	V <sub>IH</sub>		2.4	1.8		V		
Input Low Voltage	V <sub>IL</sub>			1.8	0.8	V		
Input Current with Input Voltage High	I <sub>IH</sub>	V <sub>EN</sub> = V <sub>A_</sub> = V <sub>LATCH</sub> = V <sub>CAL</sub> = V+	-1	0.001	1	μA		
Input Current with Input Voltage Low	I <sub>IL</sub>	V <sub>EN</sub> = V <sub>A_</sub> = V <sub>LATCH</sub> = V <sub>CAL</sub> = 0	-1	0.001	1	μA		
<b>DYNAMIC CHARACTERISTICS (Note 3)</b>								
Transition Time	t <sub>TRANS</sub>	V <sub>NO1</sub> = 8V, V <sub>NO8</sub> = 0, Figure 1	T <sub>A</sub> = +25°C	600	850	ns		
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		1100			
Break-Before-Make Interval	t <sub>OPEN</sub>	Figure 2	T <sub>A</sub> = +25°C	120	400	ns		
Enable Turn-On Time	t <sub>ON</sub>	Figure 3	T <sub>A</sub> = +25°C	540	800	ns		
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		1100			
Enable Turn-Off Time	t <sub>OFF</sub>	Figure 3	T <sub>A</sub> = +25°C	150	315	ns		
			T <sub>A</sub> = T <sub>MIN</sub> to T <sub>MAX</sub>		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:** ΔRON = RON(MAX) - RON(MIN).

**Note 5:** Leakage parameters are 100% tested at maximum-rated hot temperature and guaranteed by correlation at T<sub>A</sub> = +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 = 20log<sub>10</sub>(V<sub>COM</sub> / V<sub>NO</sub>), V<sub>COM</sub> = output, V<sub>NO</sub> = input to off switch.

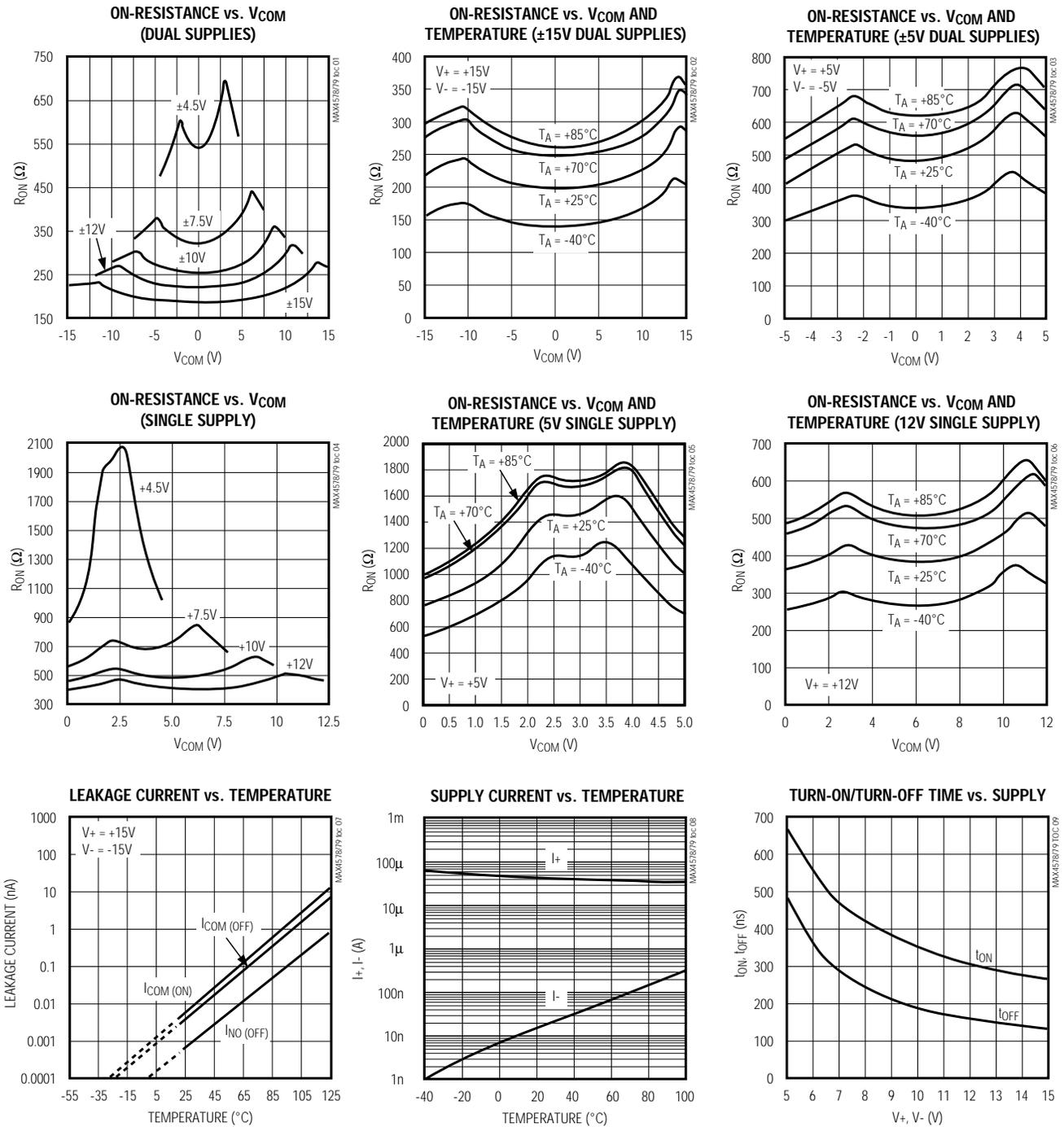
**Note 8:** Between any two switches.

**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.)

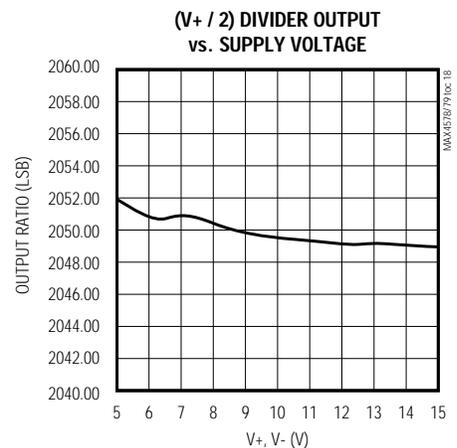
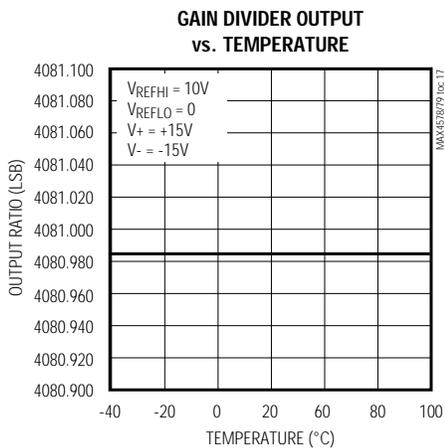
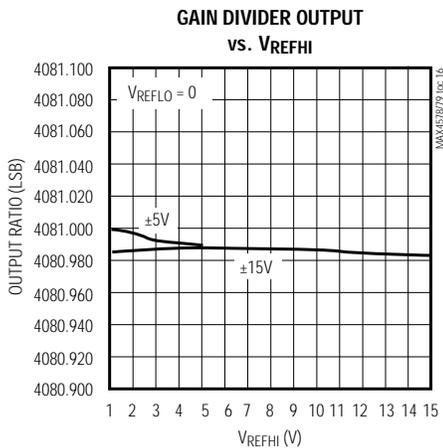
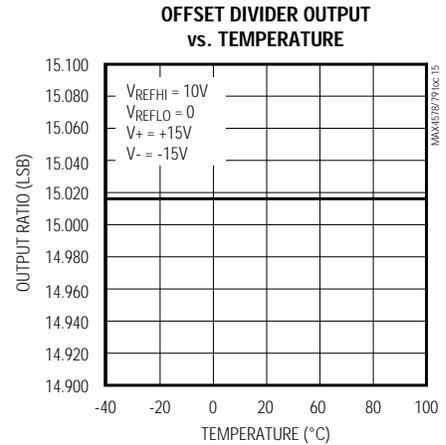
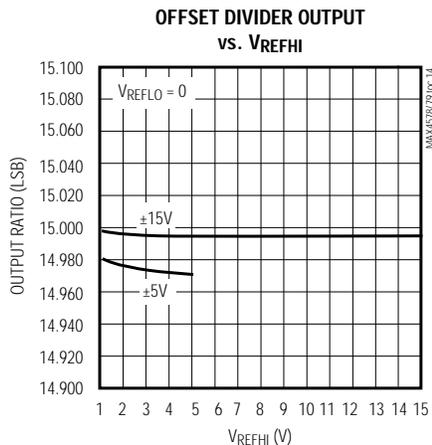
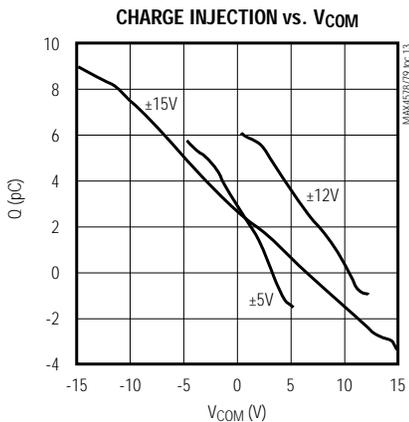
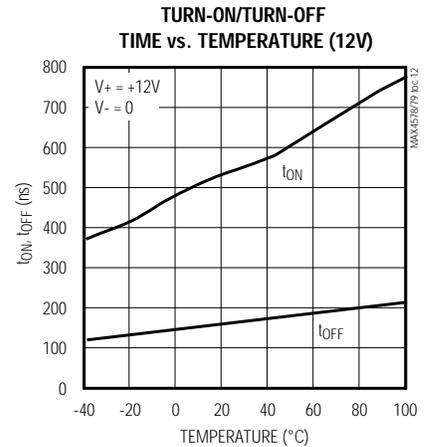
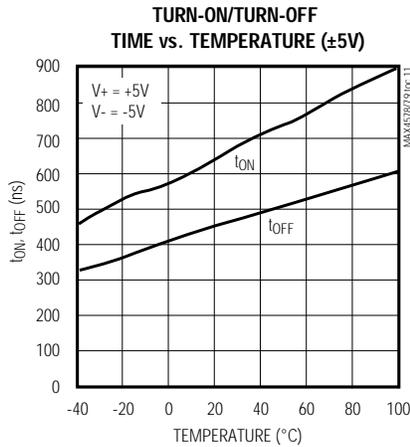
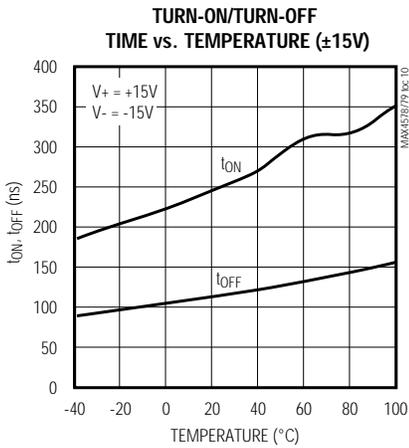


# High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

## Typical Operating Characteristics (continued)

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

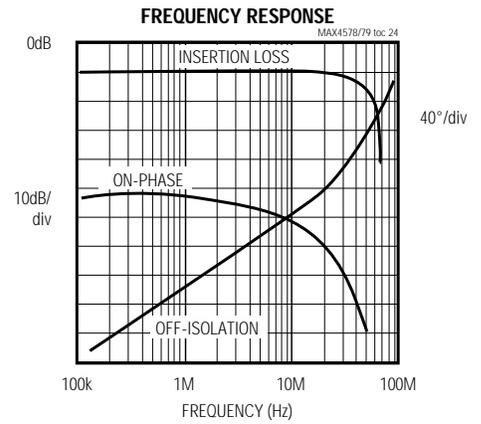
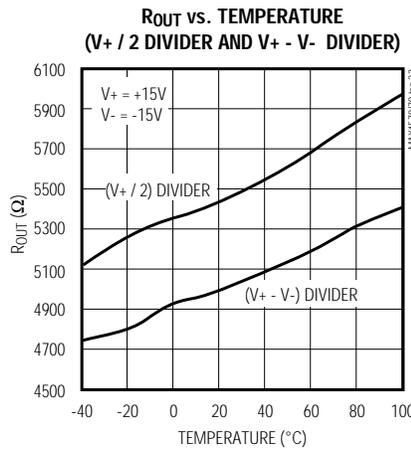
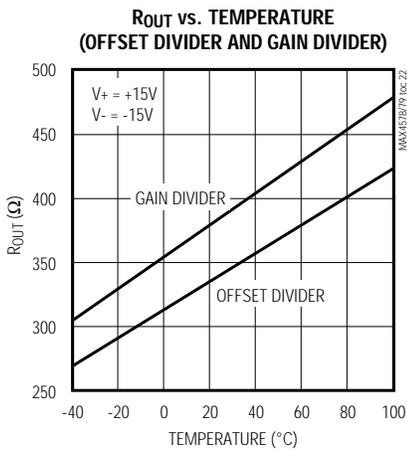
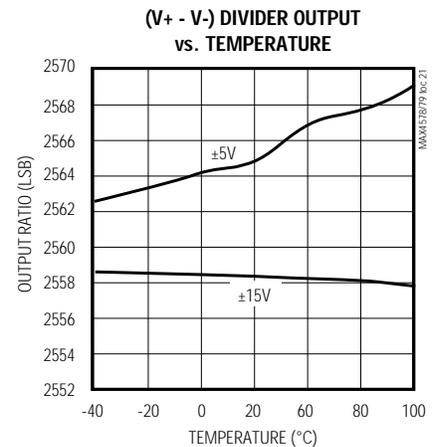
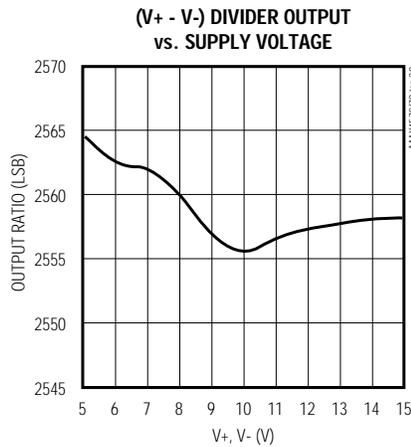
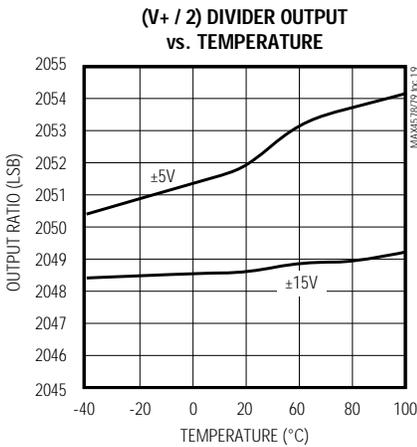
MAX4578/MAX4579



# 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/MAX4579

### 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

# 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

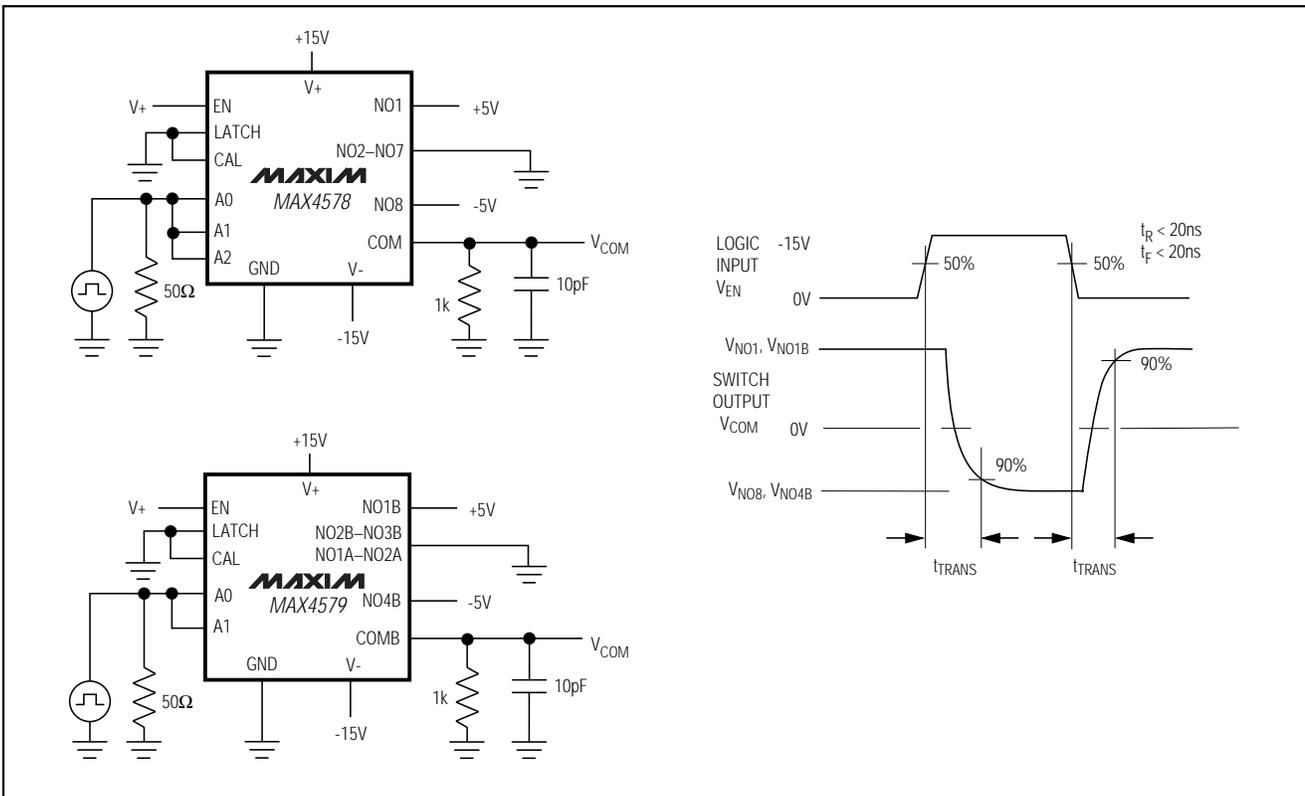


Figure 1. Transition Time

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

Test Circuits/Timing Diagrams (continued)

MAX4578/MAX4579

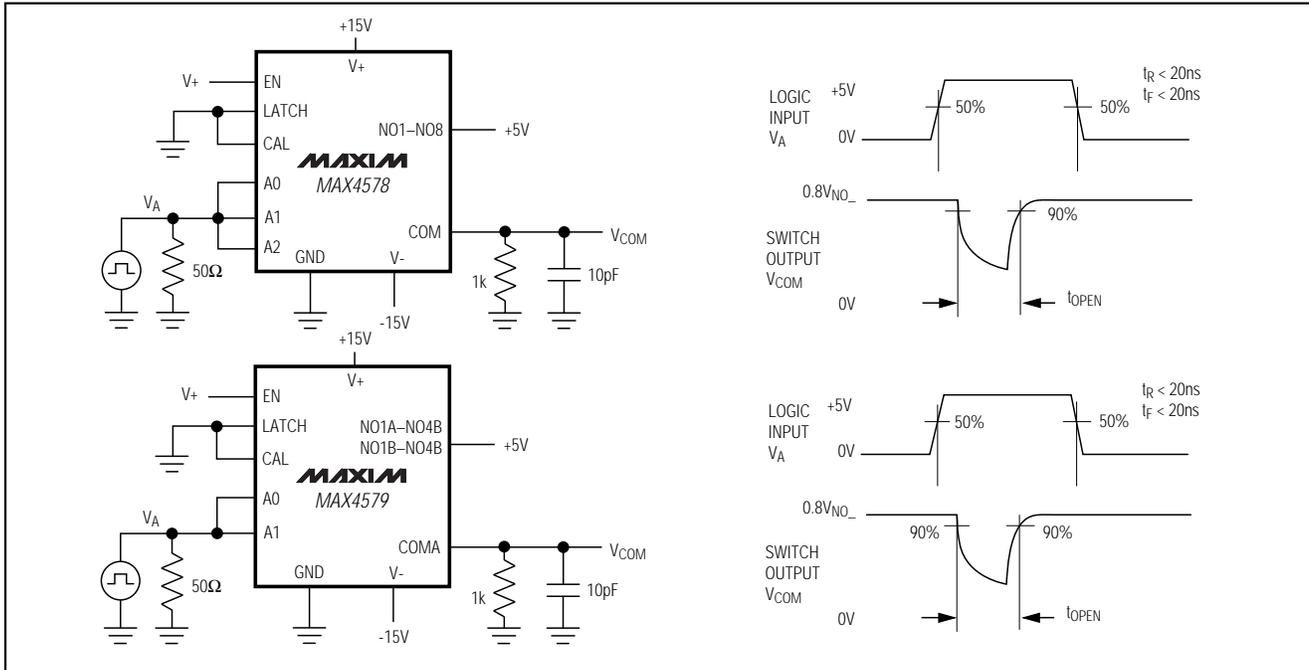


Figure 2. Break-Before-Make Interval

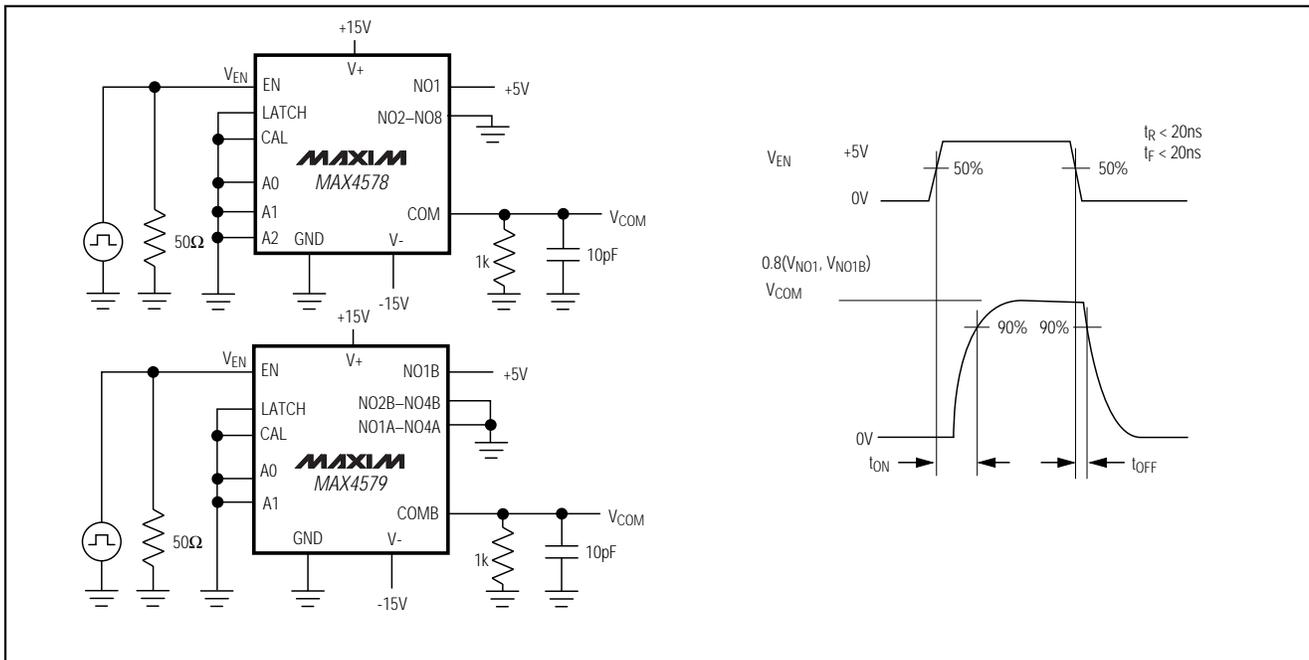


Figure 3. Enable Switching Time

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

Test Circuits/Timing Diagrams (continued)

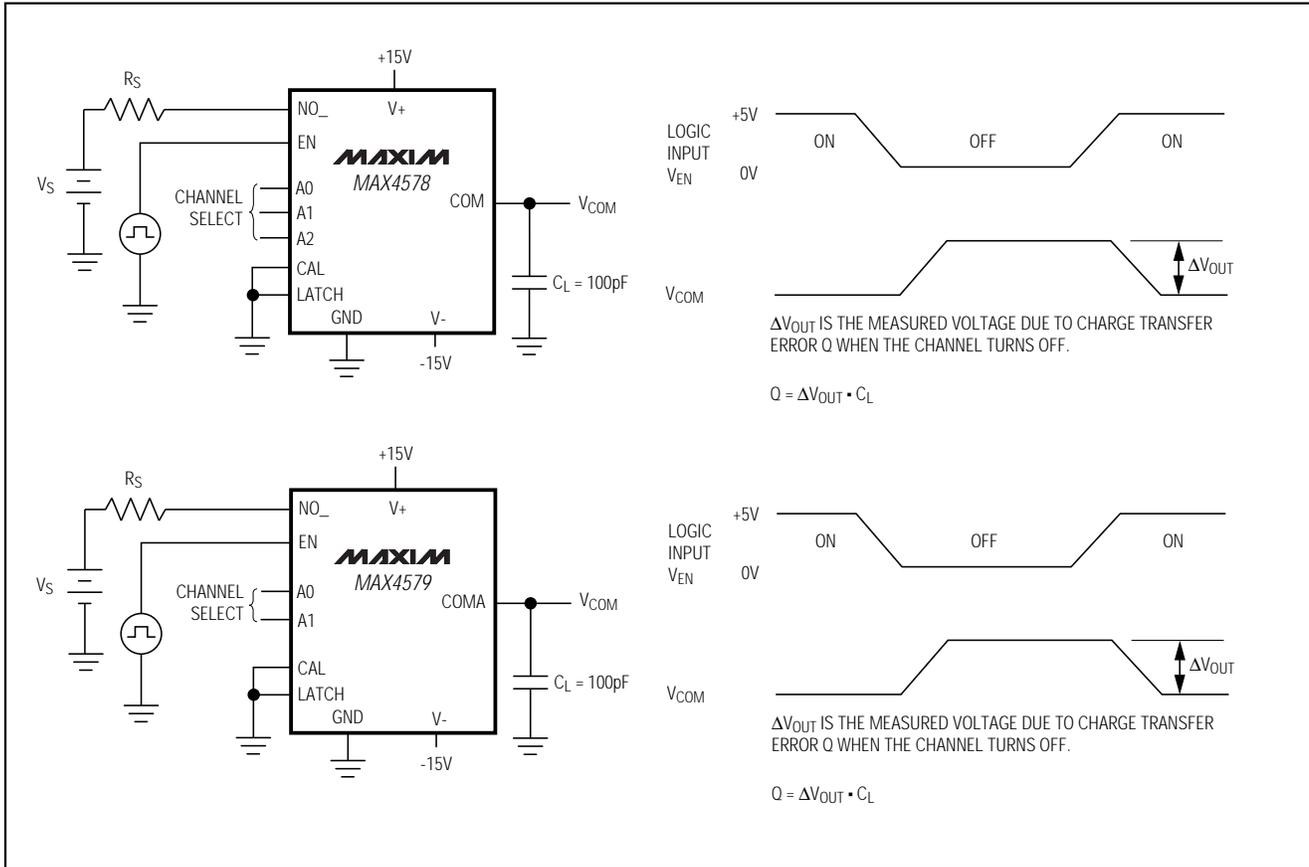


Figure 4. Charge Injection

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

Test Circuits/Timing Diagrams (continued)

MAX4578/MAX4579

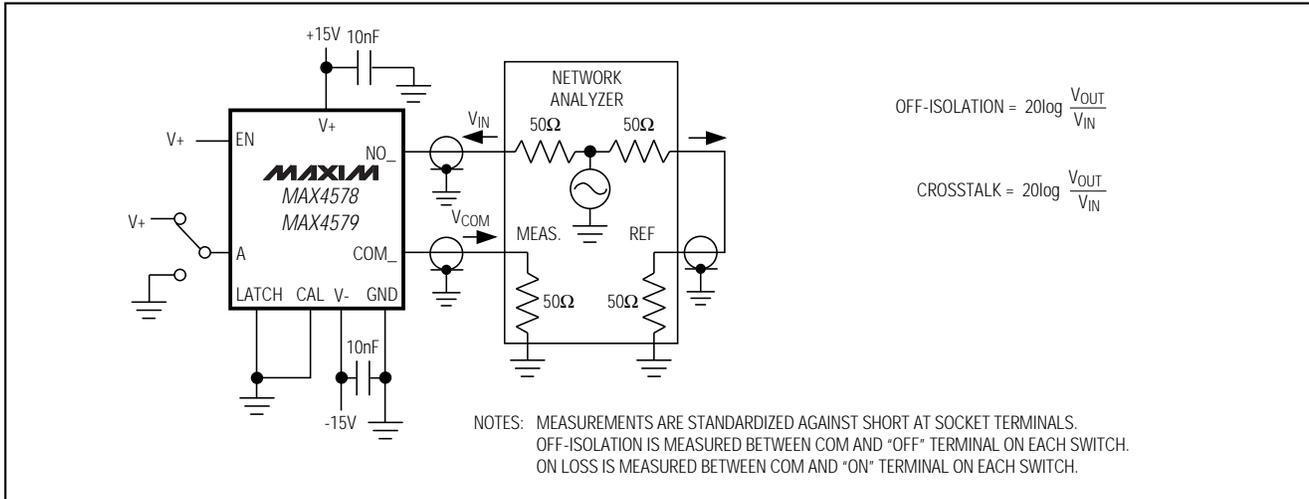


Figure 5. Off-Isolation/Crosstalk

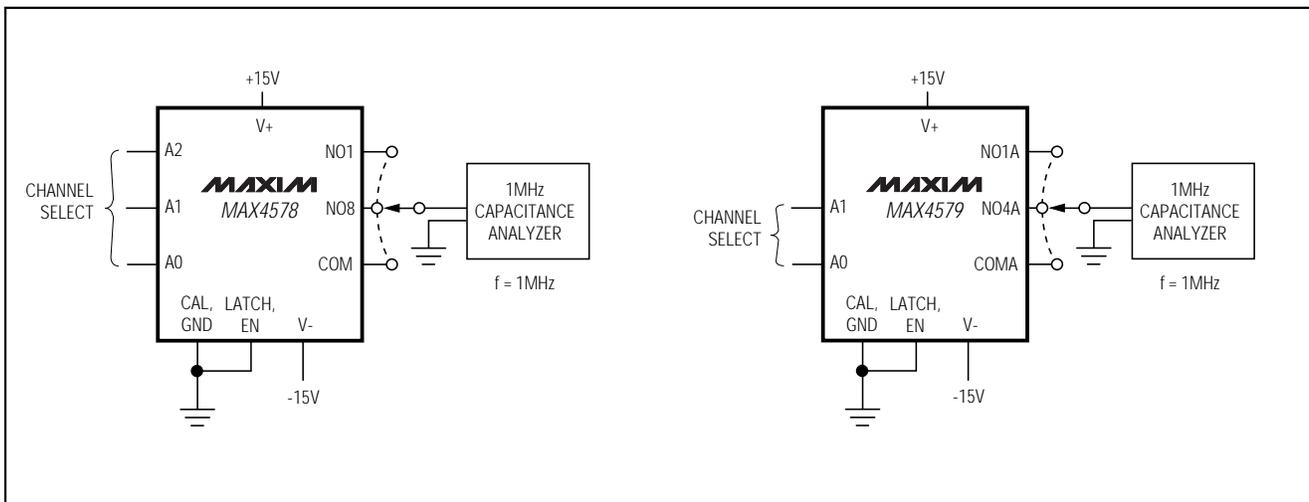


Figure 6. NO\_/COM\_ Capacitance

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

Test Circuits/Timing Diagrams (continued)

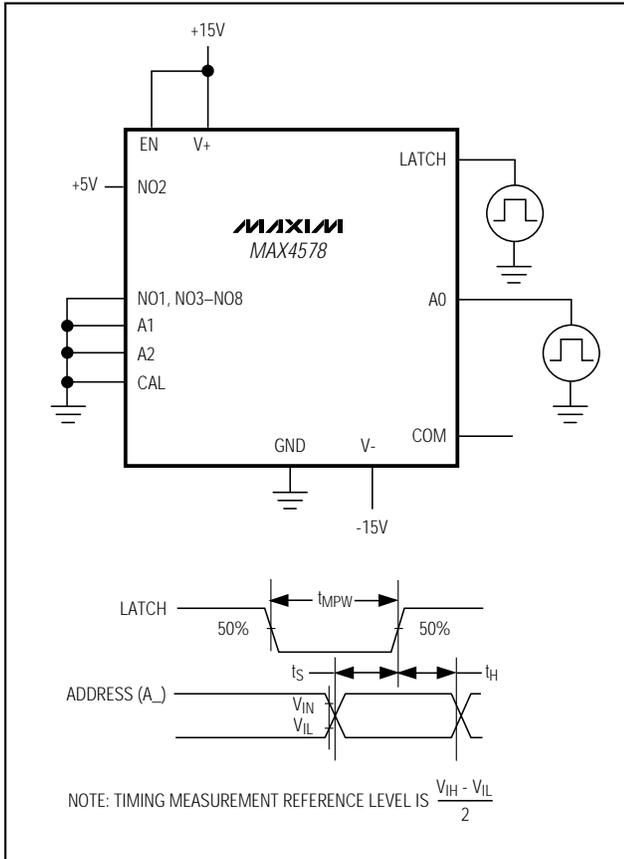


Figure 7. Setup Time, Hold Time, Latch Pulse Width

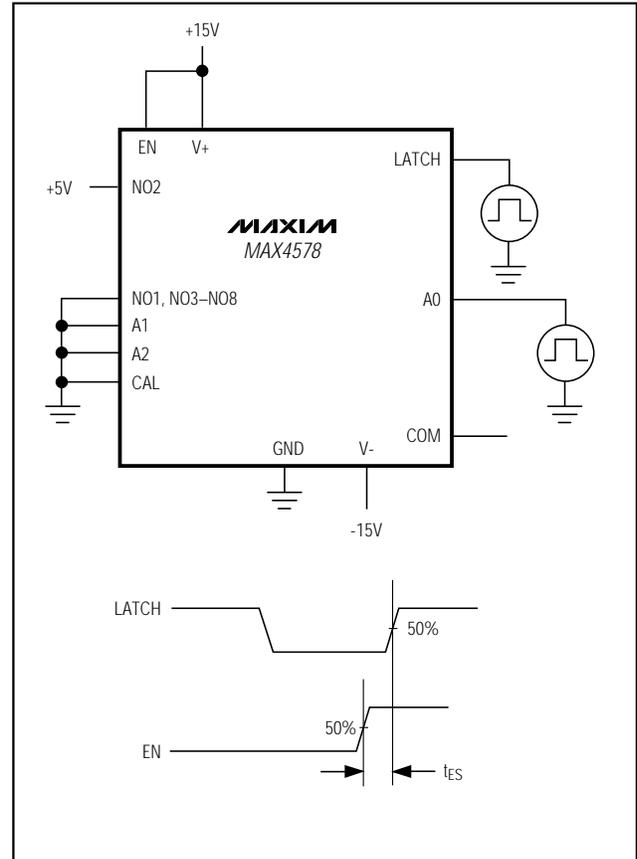
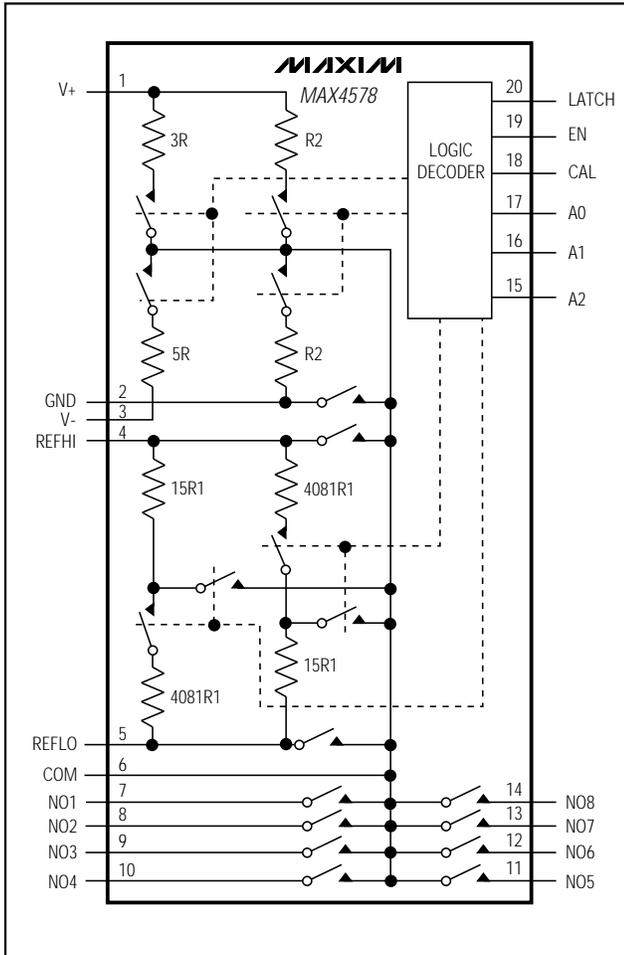


Figure 8. Enable Setup Time

# 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

SSOPERS

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

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