19-1396; Rev 0; 10/98

MAXIM

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 ±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 ±4.5V to ±20V. On-resistance (350Ω max) is matched between switches to 15Ω max. Each switch can handle Rail-to-Rail® analog signals. The off-leakage current is 20pA at T_A = +25°C and 1.25nA at T_A = +85°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

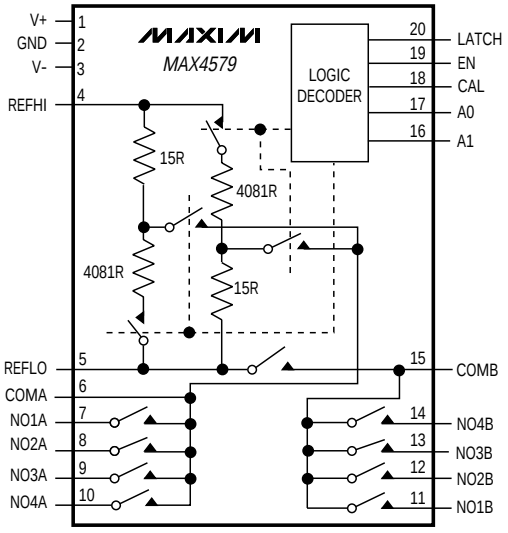
- ♦ **On-Chip Gain and Offset Divider Networks Provide 15-Bit Accurate Output Ratios**
- ♦ **On-Chip V+ to GND and V+ to V- Divider Networks Provide 8-Bit Accurate Output Ratios**
- ♦ **350Ω (max) R_{ON}**
- ♦ **12Ω (max) R_{ON} Matching Between Channels**
- ♦ **10pC (max) Charge Injection**
- ♦ **Guaranteed 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 appears at end of data sheet.

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)	ΔR_{ON}	$I_{COM\_}$ = 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
				T_A = T_{MIN} to T_{MAX}	-6.5		6.5	
			MAX4579	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
				T_A = T_{MIN} to T_{MAX}	-6.5		6.5	
			MAX4579	T_A = +25°C	-0.05	0.008	0.05	
				T_A = T_{MIN} to T_{MAX}	-3.25		3.25	

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

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

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	T_A = +25°C		(V+ - V-) / 24k	(V+ - V-) / 13k	mA
Additional Negative Supply Current (Note 3)		(V+ - V-) divider active, V_{IH} = V+, V_{IL} = 0	T_A = +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	T_A = +25°C	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)	$\Delta R_{DS(ON)}$	$I_{COM\_}$ = 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 ±5V Supplies (continued)

(V+ = +5V ±10%, V- = -5V ±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°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°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°C	200	440		ns
Enable Turn-On Time	t_{ON}	V_{NO1} = 3V, Figure 3	T_A = +25°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°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°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°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°C		8		Ω
NO Off-Leakage Current (Notes 5, 9)	$I_{NO(OFF)}$	$V_{COM\_}$ = 1V, 11V; $V_{NO\_}$ = 11V, 1V	T_A = +25°C	-0.02	0.001	0.02	nA
			$T_A = T_{MIN}$ to T_{MAX}	-1.25		1.25	

ELECTRICAL CHARACTERISTICS—Single +12V Supply (continued)

(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°C.) (Note 2)

PARAMETER	SYMBOL	CONDITIONS			MIN	TYP	MAX	UNITS
SWITCH (continued)								
COM Off-Leakage Current (Notes 5, 9)	$I_{COM\_(OFF)}$	$V_{COM\_}$ = 11V, 1V; $V_{NO\_}$ = 1V, 11V	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	-0.05	0.005	0.05	
				$T_A = T_{MIN}$ to T_{MAX}	-3.25		3.25	
COM On-Leakage Current (Notes 5, 9)	$I_{COM\_(ON)}$	$V_{COM\_}$ = 11V, 1V; $V_{NO\_}$ = 11V, 1V, or floating	MAX4578	T_A = +25°C	-0.05	0.006	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	
LOGIC INPUTS								
Input High Voltage	V_{IH}				2.4	1.8		V
Input Low Voltage	V_{IL}					1.8	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
DYNAMIC CHARACTERISTICS (Note 3)								
Transition Time	t_{TRANS}	V_{NO1} = 8V, V_{NO8} = 0, Figure 1		T_A = +25°C		600	850	ns
				$T_A = T_{MIN}$ to T_{MAX}			1100	
Break-Before-Make Interval	t_{OPEN}	Figure 2		T_A = +25°C	120	400		ns
Enable Turn-On Time	t_{ON}	Figure 3		T_A = +25°C		540	800	ns
				$T_A = T_{MIN}$ to T_{MAX}			1100	
Enable Turn-Off Time	t_{OFF}	Figure 3		T_A = +25°C		150	315	ns
				$T_A = T_{MIN}$ to T_{MAX}			450	

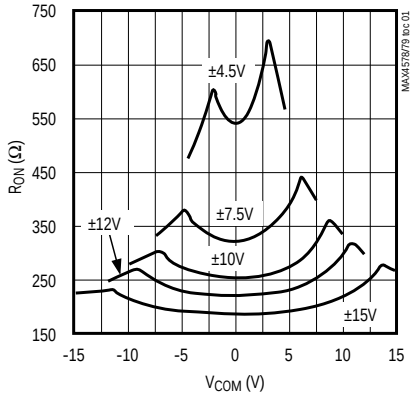
Note 2: The algebraic convention, where the most negative value is a minimum and the most positive value a maximum, is used in this data sheet.
Note 3: Guaranteed by design.
Note 4: $\Delta R_{ON} = R_{ON(MAX)} - R_{ON(MIN)}$.
Note 5: Leakage parameters are 100% tested at maximum-rated hot temperature and guaranteed by correlation at T_A = +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 = $20\log_{10}(V_{COM} / V_{NO})$, V_{COM} = output, V_{NO} = 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

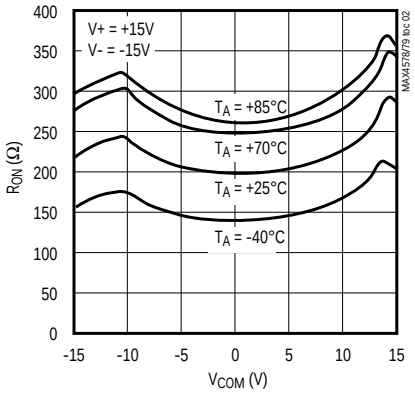
Typical Operating Characteristics

(T_A = +25°C, unless otherwise noted.)

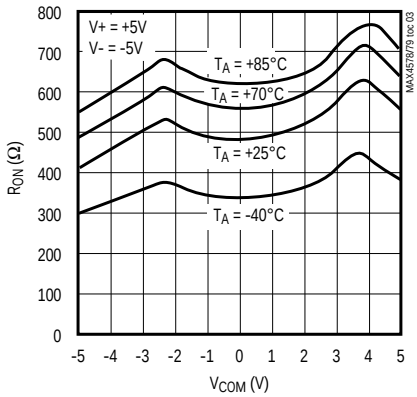
ON-RESISTANCE vs. V_{COM} (DUAL SUPPLIES)



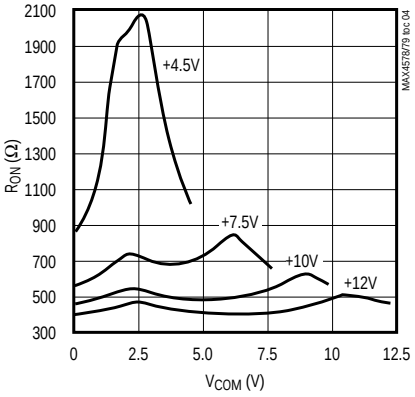
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (±15V DUAL SUPPLIES)



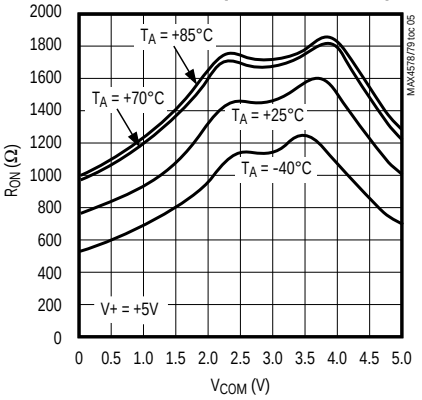
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (±5V DUAL SUPPLIES)



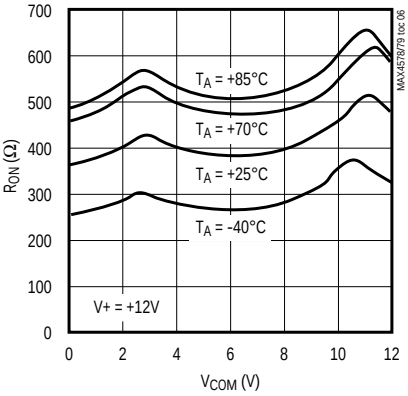
ON-RESISTANCE vs. V_{COM} (SINGLE SUPPLY)



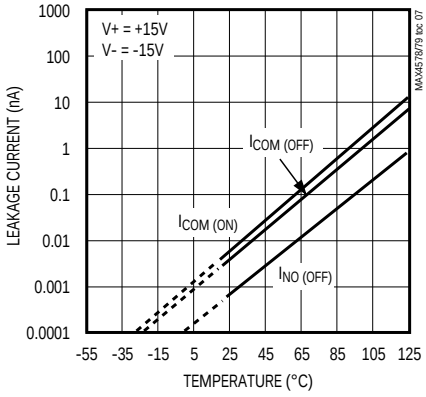
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (5V SINGLE SUPPLY)



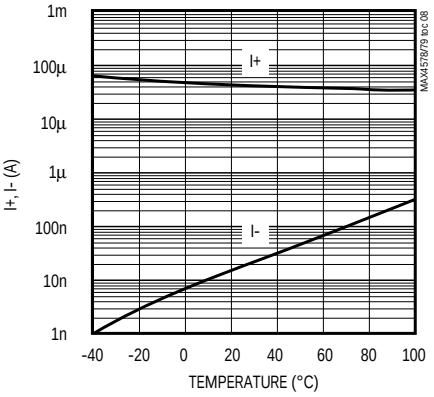
ON-RESISTANCE vs. V_{COM} AND TEMPERATURE (12V SINGLE SUPPLY)



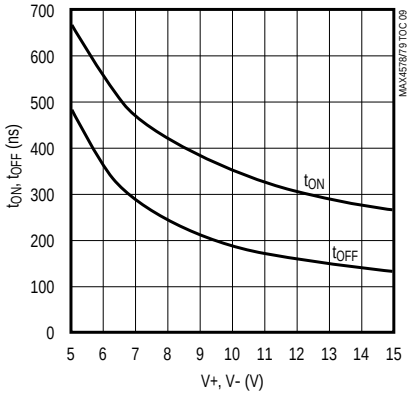
LEAKAGE CURRENT vs. TEMPERATURE



SUPPLY CURRENT vs. TEMPERATURE



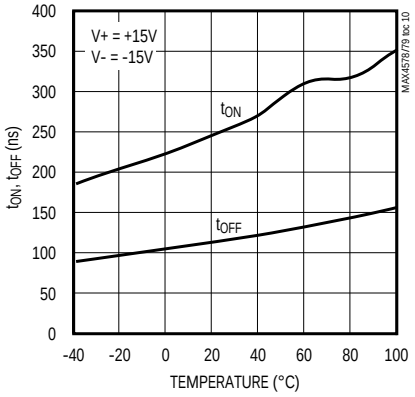
TURN-ON/TURN-OFF TIME vs. SUPPLY



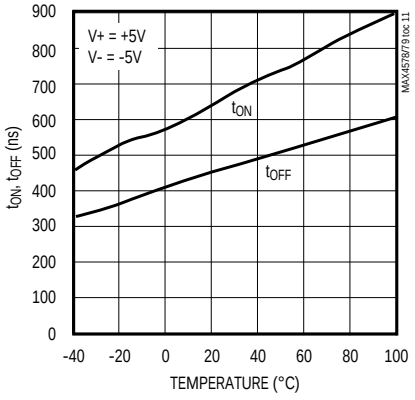
Typical Operating Characteristics (continued)

(T_A = +25°C, unless otherwise noted.)

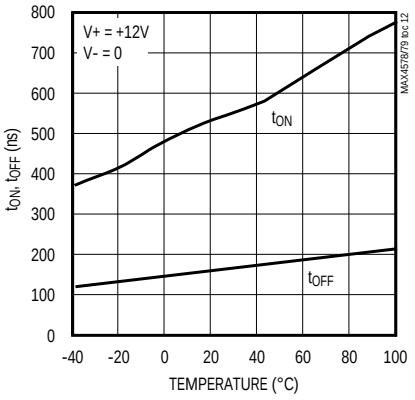
TURN-ON/TURN-OFF TIME vs. TEMPERATURE (±15V)



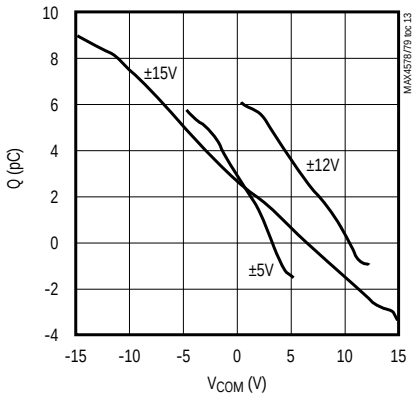
TURN-ON/TURN-OFF TIME vs. TEMPERATURE (±5V)



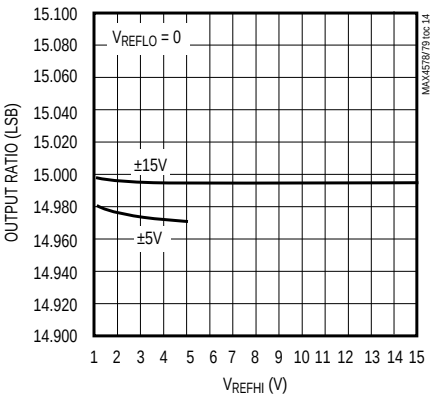
TURN-ON/TURN-OFF TIME vs. TEMPERATURE (12V)



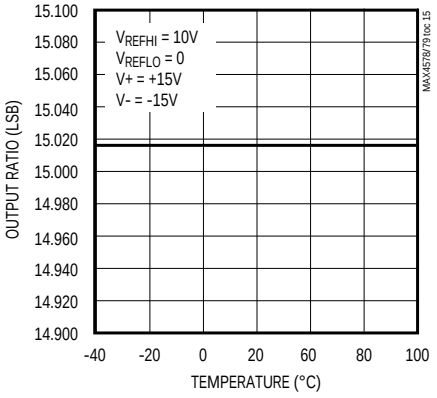
CHARGE INJECTION vs. V_{COM}



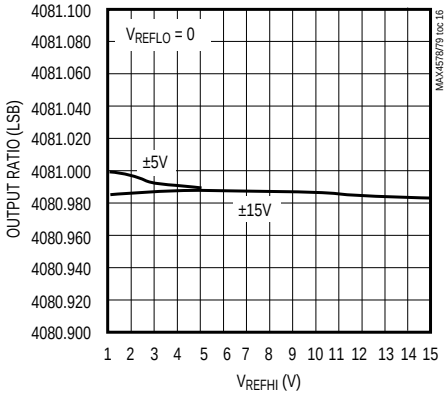
OFFSET DIVIDER OUTPUT vs. V_{REFHI}



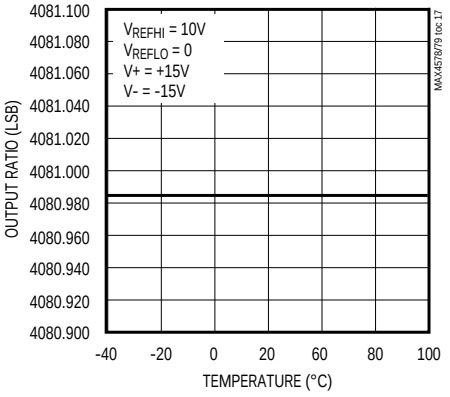
OFFSET DIVIDER OUTPUT vs. TEMPERATURE



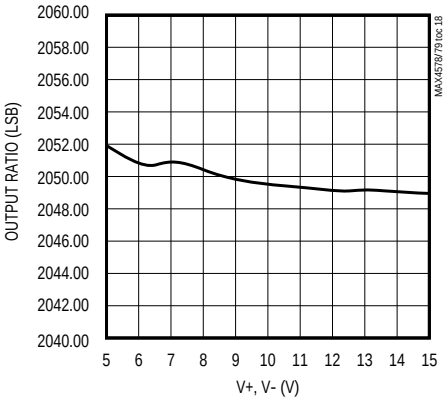
GAIN DIVIDER OUTPUT vs. V_{REFHI}



GAIN DIVIDER OUTPUT vs. TEMPERATURE



(V+ / 2) DIVIDER OUTPUT vs. SUPPLY VOLTAGE

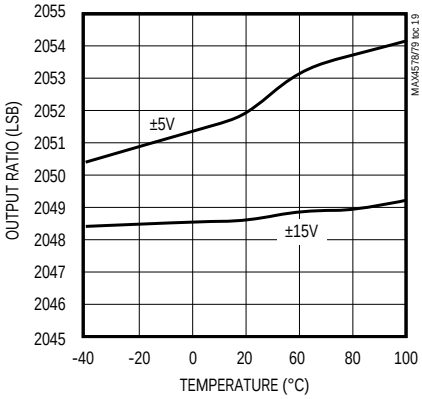


High-Voltage, Single 8-to-1/ Dual 4-to-1 Cal-Multiplexers

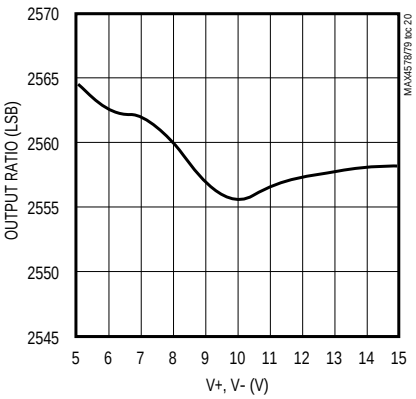
Typical Operating Characteristics (continued)

(T_A = +25°C, unless otherwise noted.)

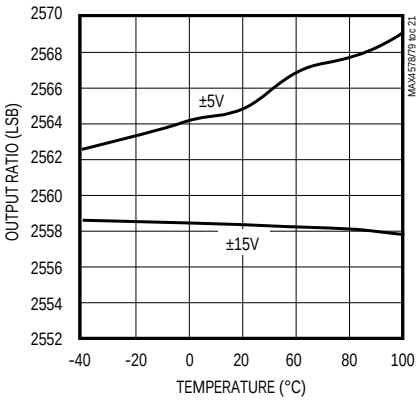
(V+ / 2) DIVIDER OUTPUT vs. TEMPERATURE



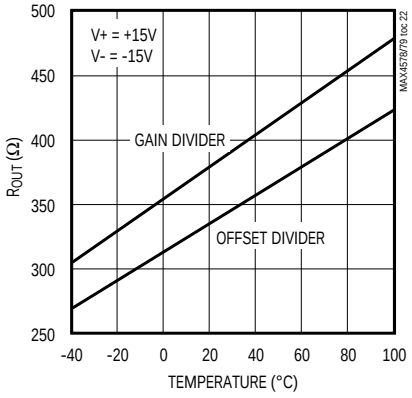
(V+ - V-) DIVIDER OUTPUT vs. SUPPLY VOLTAGE



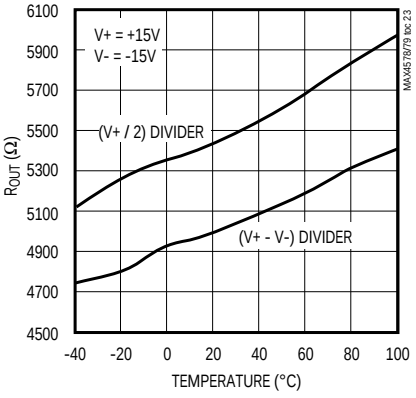
(V+ - V-) DIVIDER OUTPUT vs. TEMPERATURE



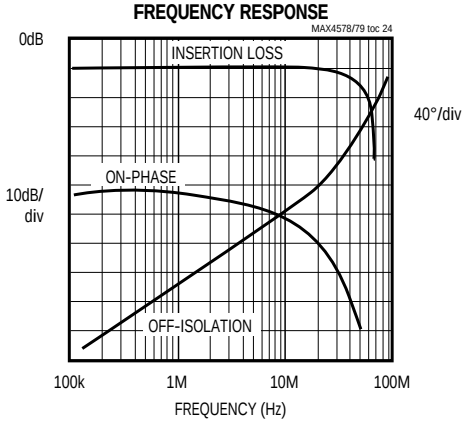
R_{OUT} vs. TEMPERATURE (OFFSET DIVIDER AND GAIN DIVIDER)



R_{OUT} vs. TEMPERATURE (V+ / 2 DIVIDER AND V+ - V- DIVIDER)



FREQUENCY RESPONSE



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

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

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 ±4.5V and ±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 ±15V operation, and most AC and DC characteristics are degraded significantly when departing from ±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 ±0.3V. Voltages beyond ±0.3V cause the internal ESD-protection diodes to conduct, and the parts can be damaged if excessive current flows.

Test Circuits/Timing Diagrams

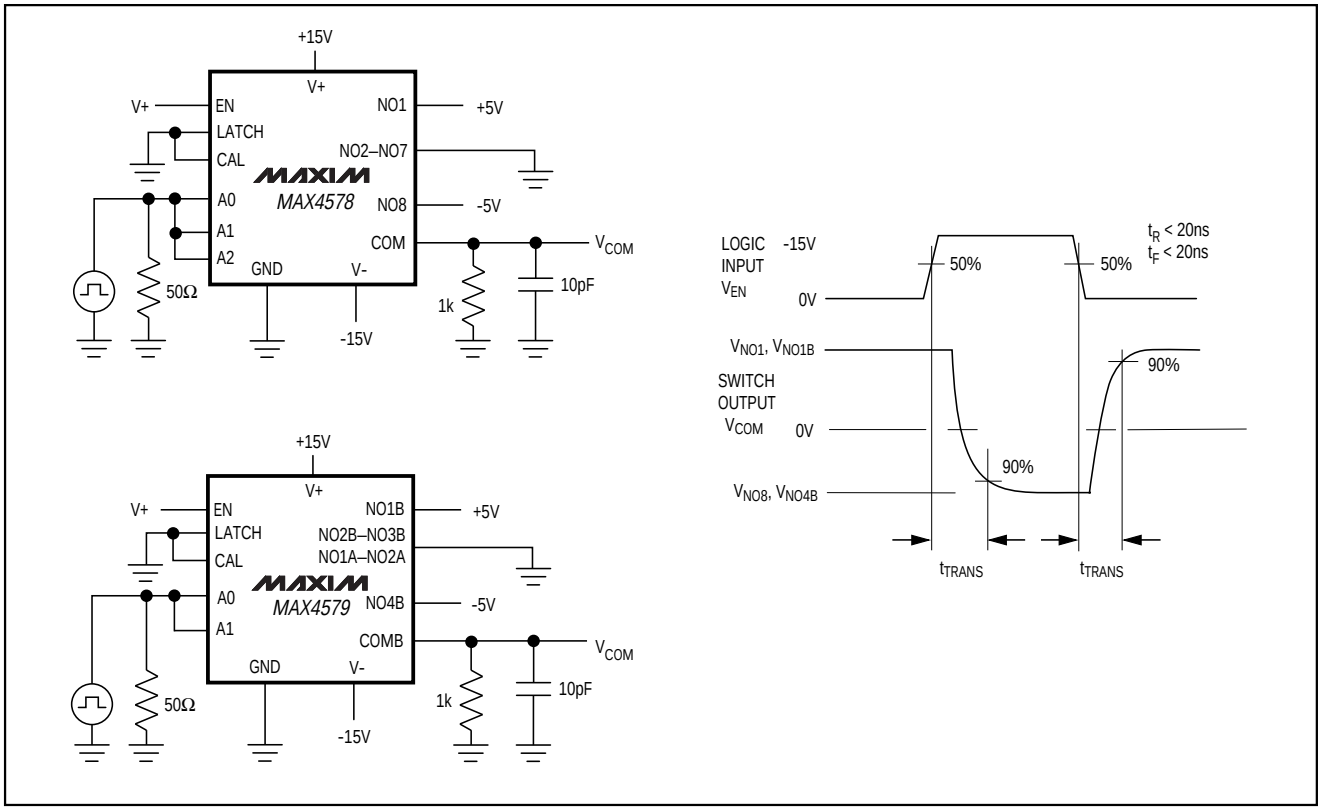


Figure 1. Transition Time

Test Circuits/Timing Diagrams (continued)

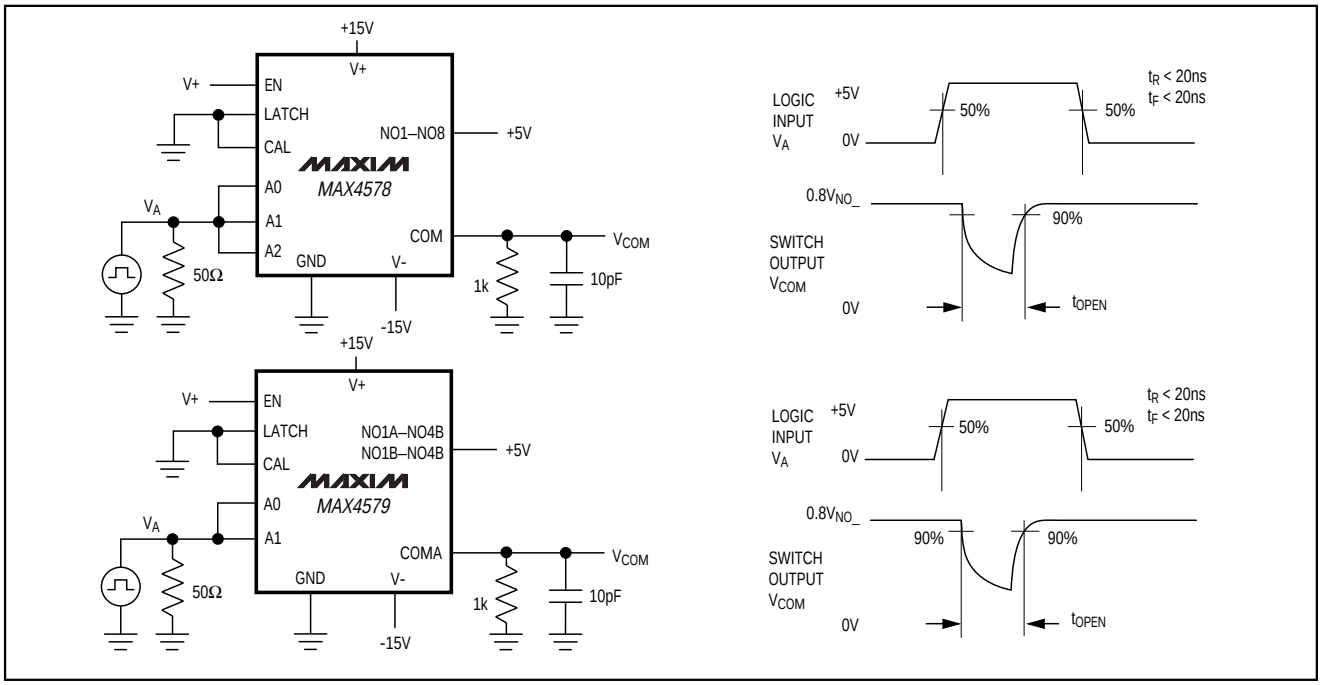


Figure 2. Break-Before-Make Interval

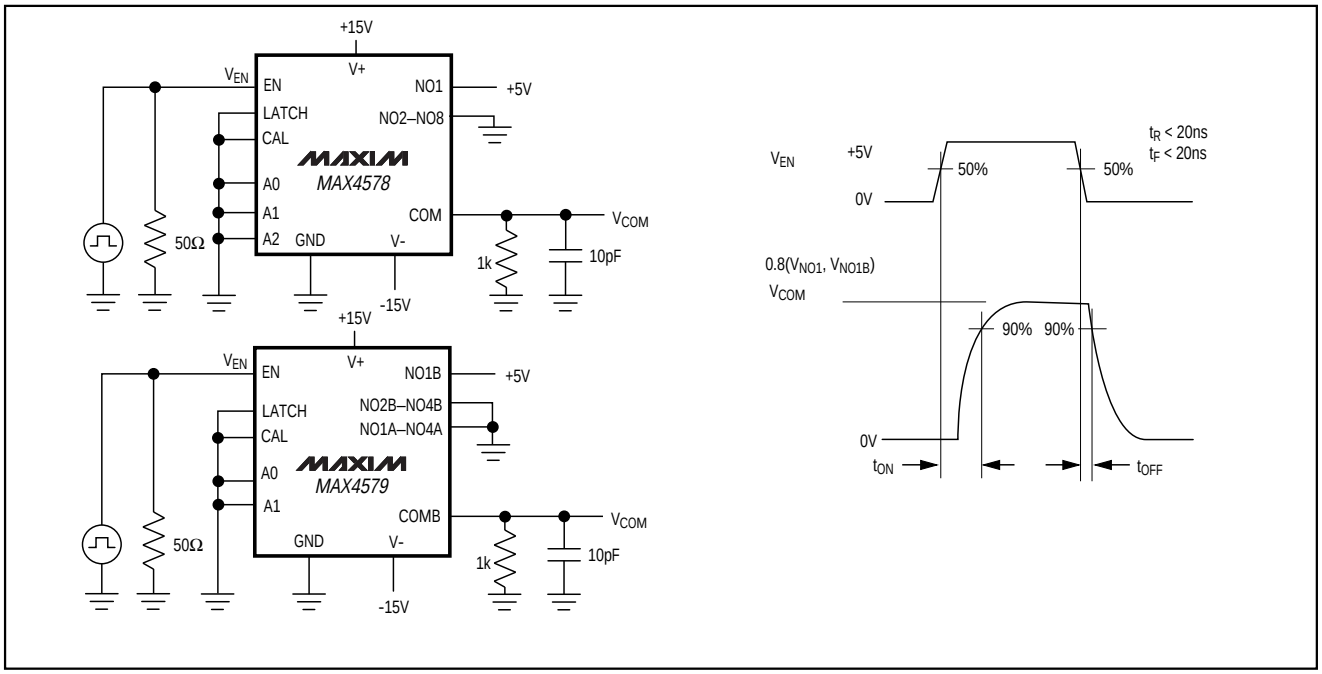


Figure 3. Enable Switching Time

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

Test Circuits/Timing Diagrams (continued)

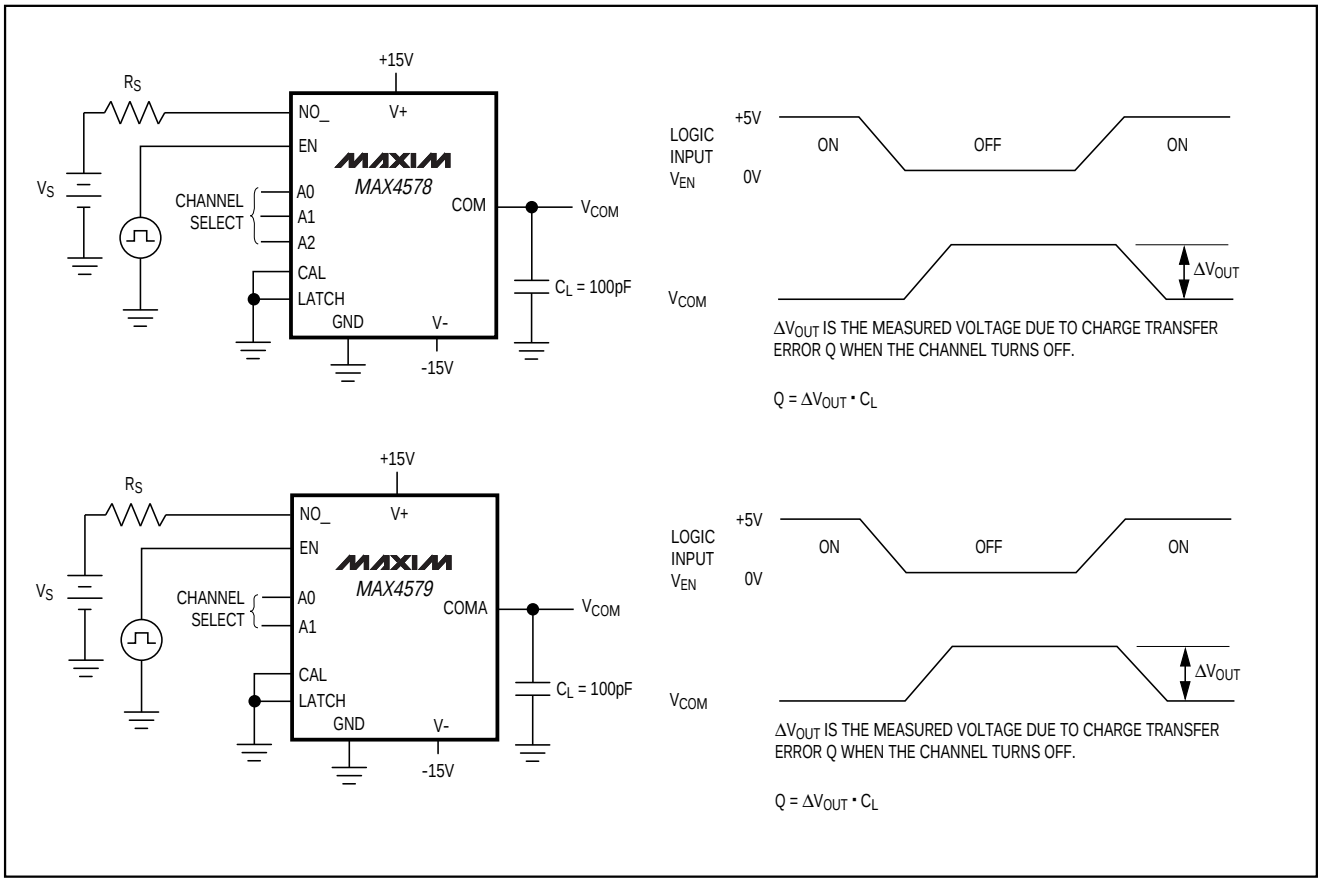


Figure 4. Charge Injection

Test Circuits/Timing Diagrams (continued)

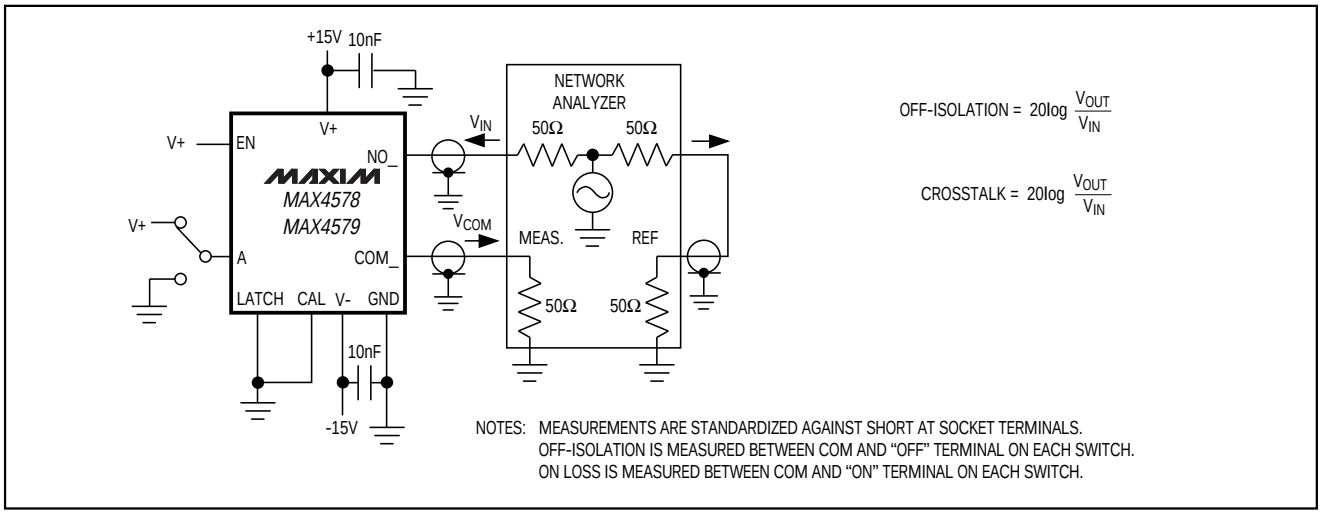


Figure 5. Off-Isolation/Crosstalk

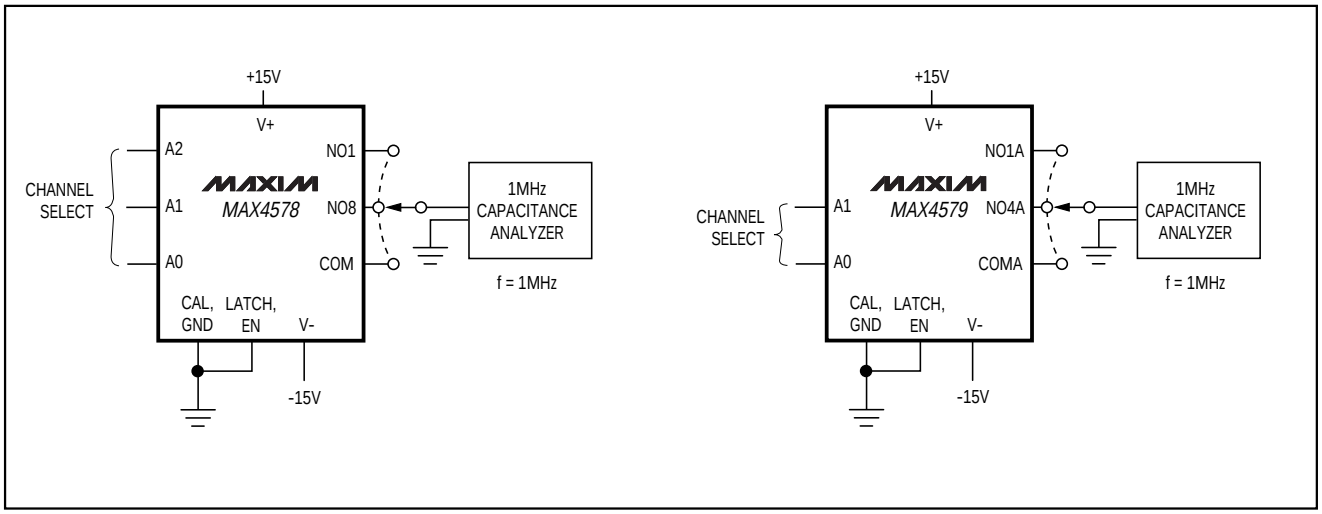


Figure 6. NO_/COM_ Capacitance

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

Test Circuits/Timing Diagrams (continued)

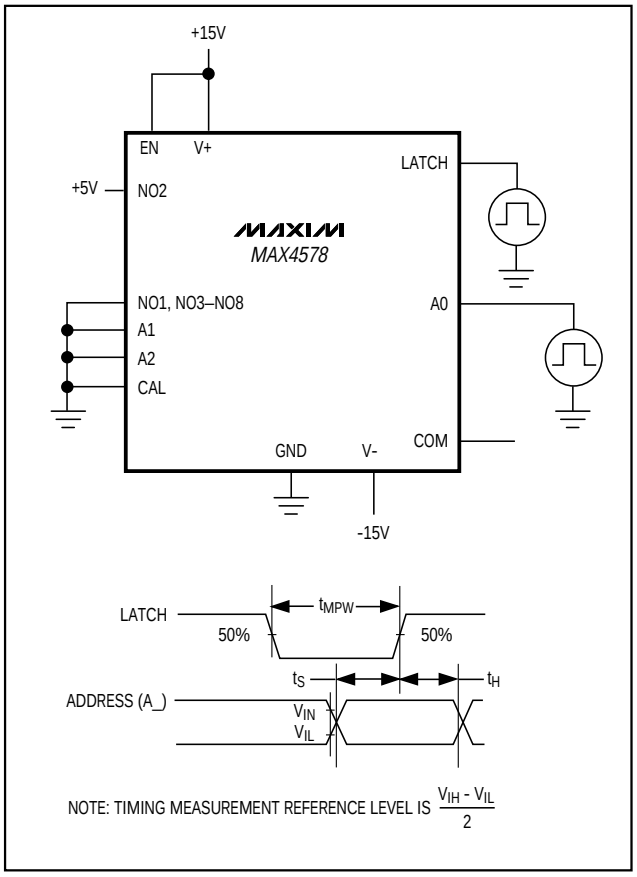


Figure 7. Setup Time, Hold Time, Latch Pulse Width

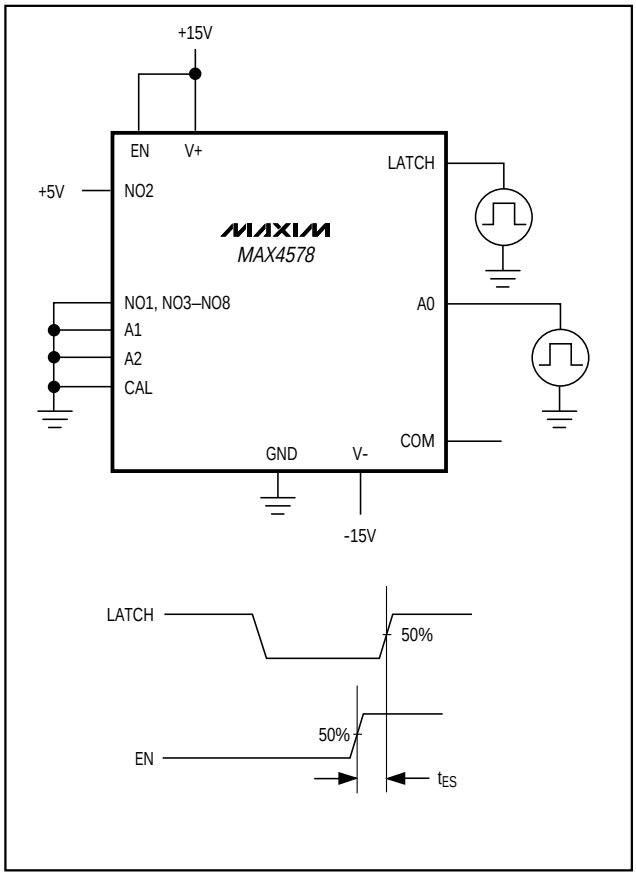
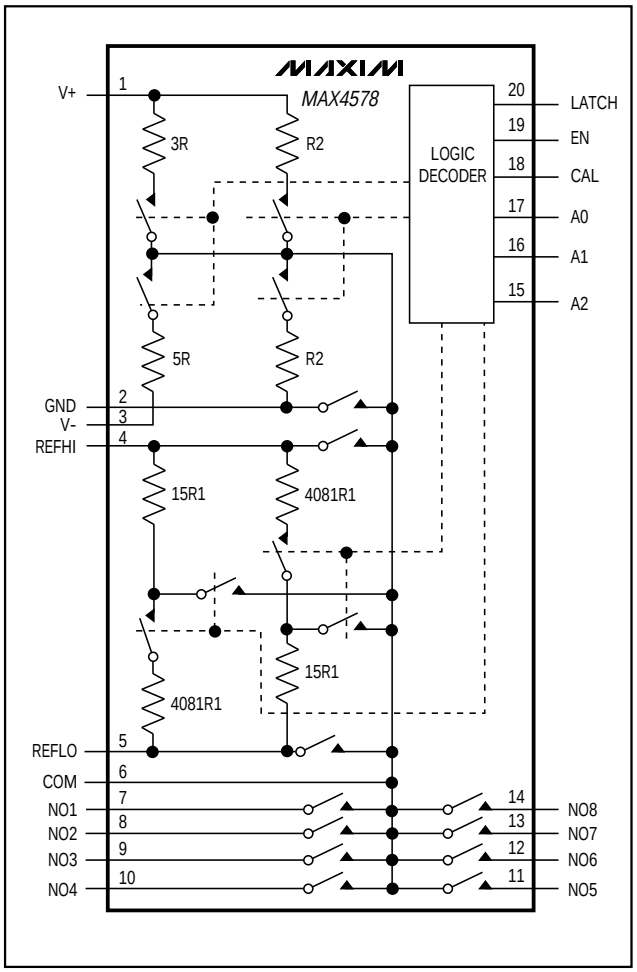


Figure 8. Enable Setup Time

Pin Configurations/ Functional Diagrams (continued)



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

Ordering Information (continued)

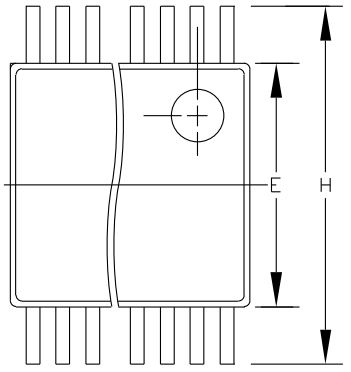
PART	TEMP. RANGE	PIN-PACKAGE
MAX4579CAP	0°C to +70°C	20 SSOP
MAX4579CWP	0°C to +70°C	20 SO Wide
MAX4579CPP	0°C to +70°C	20 Plastic DIP
MAX4579EAP	-40°C to +85°C	20 SSOP
MAX4579EWP	-40°C to +85°C	20 SO Wide
MAX4579EPP	-40°C to +85°C	20 Plastic DIP

Chip Information

TRANSISTOR COUNT: 520

Package Information

SSOP.EPS



DIM	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS 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°

	INCHES MIN	INCHES MAX	MILLIMETERS MIN	MILLIMETERS 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. 21-0056 | REV A | 1/1

MAX4578

Part Number Table

Notes:

1. See the MAX4578 QuickView Data Sheet for further information on this product family or download the MAX4578 full data sheet (PDF, 192kB).
2. Other options and links for purchasing parts are listed at: http://www.maxim-ic.com/sales.
3. Didn't Find What You Need? Ask our applications engineers. Expert assistance in finding parts, usually within one business day.
4. Part number suffixes: T or T&R = tape and reel; + = RoHS/lead-free; # = RoHS/lead-exempt. More: See full data sheet or Part Naming Conventions.
5. * Some packages have variations, listed on the drawing. "PkgCode/Variation" tells which variation the product uses.

Part Number	Free Sample	Buy Direct	Package: TYPE PINS SIZE DRAWING CODE/VAR *	Temp	RoHS/Lead-Free? Materials Analysis
MAX4578C/D					RoHS/Lead-Free: No
MAX4578CPP			PDIP;20 pin;.300" Dwg: 21-0043D (PDF) Use pkgcode/variation: P20-2*	0C to +70C	RoHS/Lead-Free: No Materials Analysis
MAX4578EPP			PDIP;20 pin;.300" Dwg: 21-0043D (PDF) Use pkgcode/variation: P20-2*	-40C to +85C	RoHS/Lead-Free: No Materials Analysis
MAX4578CWP-T			SOIC;20 pin;.300" Dwg: 21-0042B (PDF) Use pkgcode/variation: W20-4*	0C to +70C	RoHS/Lead-Free: No Materials Analysis
MAX4578CWP			SOIC;20 pin;.300" Dwg: 21-0042B (PDF) Use pkgcode/variation: W20-4*	0C to +70C	RoHS/Lead-Free: No Materials Analysis
MAX4578EWP			SOIC;20 pin;.300" Dwg: 21-0042B (PDF) Use pkgcode/variation: W20-4*	-40C to +85C	RoHS/Lead-Free: No Materials Analysis
MAX4578EWP-T			SOIC;20 pin;.300" Dwg: 21-0042B (PDF) Use pkgcode/variation: W20-4*	-40C to +85C	RoHS/Lead-Free: No Materials Analysis

MAX4578CAP-T			SSOP;20 pin;.209" Dwg: 21-0056C (PDF) Use pkgcode/variation: A20-2*	0C to +70C	RoHS/Lead-Free: No Materials Analysis
MAX4578CAP			SSOP;20 pin;.209" Dwg: 21-0056C (PDF) Use pkgcode/variation: A20-2*	0C to +70C	RoHS/Lead-Free: No Materials Analysis
MAX4578EAP			SSOP;20 pin;.209" Dwg: 21-0056C (PDF) Use pkgcode/variation: A20-2*	-40C to +85C	RoHS/Lead-Free: No Materials Analysis
MAX4578EAP-T			SSOP;20 pin;.209" Dwg: 21-0056C (PDF) Use pkgcode/variation: A20-2*	-40C to +85C	RoHS/Lead-Free: No Materials Analysis

Didn't Find What You Need?

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