MAXIM

Quad SPST CMOS Analog Switch

General Description

The Maxim HI-201 monolithic CMOS quad single-pole-single-throw (SPST) analog switch is a plug-in upgrade for the Harris HI-201. Maxim has eliminated the need for a VREF supply, which is normally required for operation with power supplies other than ±15V. And Maxim's part consumes 1/4 the power (4mW typ), making it better suited for portable applications.

Maxim's switch can be continuously operated with power supplies ranging from ±4.5V to ±18V, or single supplies over a range of +5V to +30V. Each switch can be independently selected and features fast switching (t_{on}= 260ns, t_{off} = 100ns typ) and low on resistance (45Ω typ). Maxim guarantees these switches will not latchup if the power supplies are disconnected with switch input signals still present. Logic inputs are both CMOS and TTL compatible without the need for pull-up resistors.

Applications

Disk Drives

Test Equipment

Communication Systems

PBX, PABX

Guidance and Control Systems

Heads-Up Displays

Features

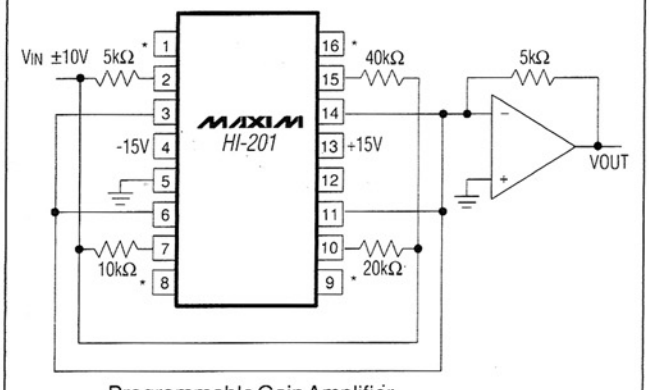
- ♦ **No VREF Supply Required**
- ♦ **Monolithic, Low-Power CMOS Design**
- ♦ **Guaranteed Single-Supply Operation from +5V to +30V**
- ♦ **Guaranteed ±4.5V to ±18V Operation**
- ♦ **Fast Switching Times: t_{on} = 260ns (typ) t_{off} = 100ns (typ)**
- ♦ **45Ω (typ) On Resistance**
- ♦ **Non-Latching with Supplies Turned Off and Input Signals Present**
- ♦ **CMOS and TTL Logic Compatible (0.8V/2.4V)**

Ordering Information

PART	TEMP. RANGE	PIN-PACKAGE
HI3-0201-5	0°C to +70°C	16 Plastic DIP
HI6-0201-5	0°C to +70°C	16 Wide SO
HI1-0201-5	0°C to +70°C	16 CERDIP
HI0-0201-6	0°C to +70°C	Dice
HI3-0201-9	-40°C to +85°C	16 Plastic DIP
HI6-0201-9	-40°C to +85°C	16 Wide SO
HI1-0201-9	-40°C to +85°C	16 CERDIP
HI1-0201-2	-55°C to +125°C	16 CERDIP
HI4-0201-8*	-55°C to +125°C	20 LCC

** Contact Factory for Availability*

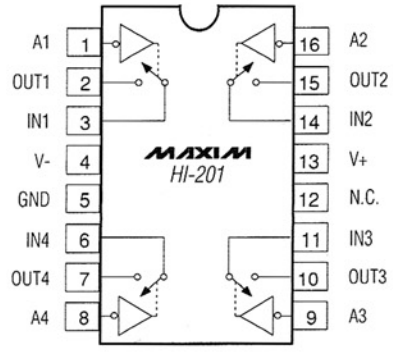
Typical Operating Circuit



Programmable Gain Amplifier

Note: * Pins 1, 8, 9 and 16 are logic control inputs.

Pin Configurations



DIP/SO

Pin configurations continued on page 7.

For pricing, delivery, and ordering information, please contact Maxim/Dallas Direct! at 1-888-629-4642, or visit Maxim's website at www.maxim-ic.com.

Quad SPST CMOS Analog Switch

ABSOLUTE MAXIMUM RATINGS

Supply Voltage Between Pins 4 and 13 ..... 44V (±22)
VREF to Ground ..... +20V, -5V
Digital Input Voltage ..... $+V_{SUPPLY}$ +4V
$-V_{SUPPLY}$ -4V
Analog Input Voltage (One Switch) ..... $+V_{SUPPLY}$ +2.0V
$-V_{SUPPLY}$ -2.0V
Analog Current - Continuous, Peak 30mA, 80mA
Power Dissipation (any package) 750mW
Derate Above +75°C ..... 8mW/°C

Operating Temperature
HI_-0201-5,6 ..... 0°C to +70°C
HI_-0201-9 ..... -40°C to +85°C
HI_-0201-2,8 ..... -55°C to +125°C
Storage Temperature ..... -65°C to +150°C
Power Dissipation (Note 1)
16-Pin CERDIP (Note 2) 900mW
16-Pin Plastic DIP (Note 3) 470mW
16-Pin Wide SO (Note 4) 400mW

Note 1: Device mounted with all pins soldered to PC board.
Note 2: Derate 12mW/°C above +75°C.
Note 3: Derate 6.5mW/°C above +25°C.
Note 4: Derate 7mW/°C above +25°C.

Stresses listed under "Absolute Maximum Ratings" may be applied (one at a time) to devices without resulting in permanent damage. These are stress ratings only, and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum ratings conditions for extended periods may affect device reliability.

ELECTRICAL CHARACTERISTICS

($V+ = +15V$, $V- = -15V$, GND = 0V, $T_A = +25°C$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		LIMITS						UNITS
				HI_-0201-2/8			HI_-0201-5/6/9			
				MIN (Note 5)	TYP (Note 6)	MAX	MIN (Note 5)	TYP (Note 6)	MAX	
SWITCH										
Analog-Signal Range	V_{ANALOG}			-15		15	-15		15	V
Drain-Source On Resistance (Note 7)	$r_{DS\ (on)}$	$V_D = \pm10V$, $V_{IN} = 0.8V$, $I_S = 1mA$			45	70		45	80	Ω
Source-Off Leakage Current	$I_{S\ (off)}$	$V_{IN} = 2.4V$	$V_S = 14V$, $V_D = -14V$	-5	±0.01	5	-10	±0.01	10	nA
			$V_S = -14V$, $V_D = 14V$	-5	±0.02	5	-10	±0.02	10	
Drain-Off Leakage Current	$I_{D\ (off)}$	$V_{IN} = 2.4V$	$V_D = 14V$, $V_S = -14V$	-5	±0.01	5	-10	±0.01	10	nA
			$V_D = -14V$, $V_S = 14V$	-5	±0.02	5	-10	±0.02	10	
Drain-On Leakage Current (Note 8)	$I_{D\ (on)}$	$V_S = -14V$, $V_{IN} = 0.8V$		-5	±0.1	5	-10	±0.1	10	nA
		$V_D = 14V$, $V_{IN} = 0.8V$		-5	±0.15	5	-10	±0.15	10	
LOGIC INPUT										
Input Current with Input Voltage High	I_{INH}	VIN = 2.4V		-1	±0.0004	1	-1	±0.0004	1	µA
		$V_{IN} = 15V$		-1	0.003	1	-1	0.003	1	
Input Current with Input Voltage Low	I_{INL}	$V_{IN} = 0V$		-1	±0.0004	1	-1	±0.0004	1	µA

ELECTRICAL CHARACTERISTICS (continued)

(V+ = +15V, V- = -15V, GND = 0V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		LIMITS						UNITS
				HI_-0201-2/8			HI_-0201-5/6/9			
				MIN (Note 5)	TYP (Note 6)	MAX	MIN (Note 5)	TYP (Note 6)	MAX	
DYNAMIC										
Turn-On Time	t_{on}	See Switching-Time Test Circuit			260	400		260	500	ns
Turn-Off Time	t_{off}	See Switching-Time Test Circuit			100	300		100	350	ns
Charge Injection	Q	C_L = 1000pF, V_{GEN} = 0V, R_{GEN} = 0Ω			20			20		pC
Source-Off Capacitance	$C_{S\,(off)}$	V_S = 0V, V_{IN} = 5V	f = 140kHz		5			5		pF
Drain-Off Capacitance	$C_{D\,(off)}$	V_S = 0V, V_{IN} = 5V	f = 140kHz		5			5		pF
Channel-On Capacitance	$C_{D\,(on)}$ + $C_{S\,(on)}$	V_D = V_S = 0V, V_{IN} = 0V	f = 140kHz		16			16		pF
Off Isolation		V_{IN} = 5V, Z_L = 75Ω			70			70		dB
Crosstalk (Channel-to-Channel)		V_S = 2.0V, f = 100kHz			90			90		dB
SUPPLY										
Positive Supply Current	I+	All Channels On or Off			0.2	0.3		0.2	0.3	mA
Negative Supply Current	I-			-0.1	-0.01		-0.1	-0.01		mA
Power-Supply Range for Continuous Operation	V_{OP}	(Note 7)		±4.5		±18	±4.5		±18	V

Note 5: The algebraic convention where the most negative value is a minimum and the most positive a maximum is used in this data sheet.
Note 6: Typical values are for DESIGN AID ONLY, not guaranteed or subject to production testing.
Note 7: Electrical characteristics, such as on resistance, will change when power supplies other than ±15V are used.
Note 8: $I_{D(on)}$ is leakage from driver into on switch.

ELECTRICAL CHARACTERISTICS

(V+ = +15V, V- = -15V, GND = 0V, $T_A = T_{MIN}$ to T_{MAX})

PARAMETER	SYMBOL	CONDITIONS		LIMITS						UNITS
				HI_-201-2/7/8			HI_-201-5/6/9			
				MIN (Note 5)	TYP (Note 6)	MAX	MIN (Note 5)	TYP (Note 6)	MAX	
SWITCH										
Analog-Signal Range	V_{ANALOG}			-15		15	-15		15	V
Drain-Source On Resistance (Note 9)	$r_{DS\ (on)}$	V_D = ±10V, V_{IN} = 0.8V, I_S = 1mA			100			100		Ω
Source-Off Leakage Current	$I_{S\ (off)}$	V_{IN} = 2.4V	V_S = 14V, V_D = -14V		500			250		nA
			V_S = -14V, V_D = 14V	-500			-250			
Drain-Off Leakage Current	$I_{D\ (off)}$	V_{IN} = 2.4V	V_D = 14V, V_S = -14V		500			250		nA
			V_D = -14V, V_S = 14V	-500			-250			
Drain-On Leakge Current (Note 10)	$I_{D\ (on)}$	V_S = -14V, V_{IN} = 0.8V			500			250		nA
		V_D = 14V, V_{IN} = 0.8V		-500			-250			
LOGIC INPUT										
Input Current with Input Voltage High	I_{INH}	V_{IN} = 2.4V		-1.0			-1.0			µA
		V_{IN} = 15V			1.0			1.0		
Input Current with Input Voltage Low	I_{INL}	VIN = 0V		-1.0			-1.0			µA
DYNAMIC										
Turn-On Time	t_{on}	See Switching-Time Test Circuit			500			600		ns
Turn-Off Time	t_{off}	See Switching-Time Test Circuit			400			450		ns
SUPPLY										
Positive Supply Current	I+	All Channels On or Off			0.4			0.4		mA
Negative Supply Current	I-	All Channels On or Off		-0.1			-0.1			mA

Note 9: Electrical characteristics, such as on resistance, will change when power supplies other than ±15V are used.
Note 10: $I_{D(on)}$ is leakage from driver into on switch.

Protecting Against Fault Conditions

Fault conditions occur when power supplies are turned off and input signals are still present, or overvoltages occur at the inputs during normal operation. In either case, source-to-body diodes can be forward biased and conduct current from the signal source. If this current is required to be kept to low (µA) levels, the addition of external protection diodes is recommended (Figure 1).

To provide protection for overvoltages up to 20V above the supplies, a 1N4001 or 1N914 type diode should be placed in series with the positive and negative supplies, as shown in Figure 1. The addition of these diodes will reduce the analog-signal range to 1V below the positive supply and 1V above the negative supply.

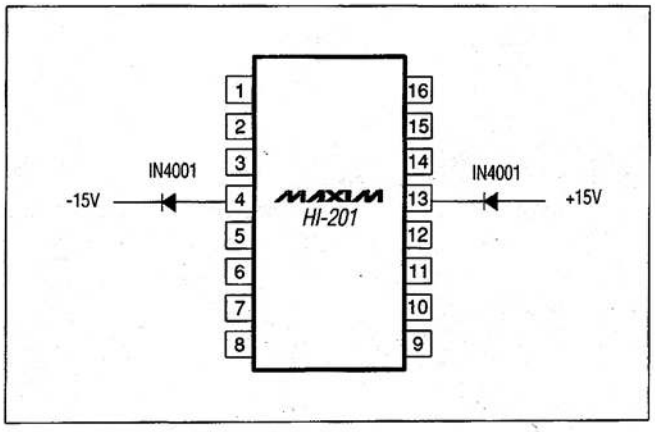


Figure 1. Protection Against Fault Conditions

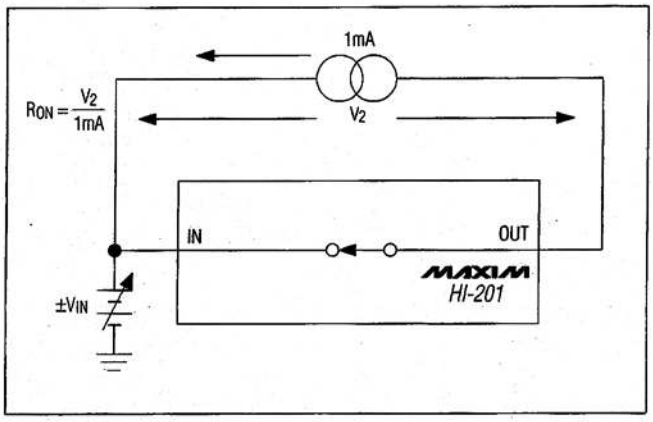


Figure 2. On Resistance vs. Analog-Signal Level Supply Voltage

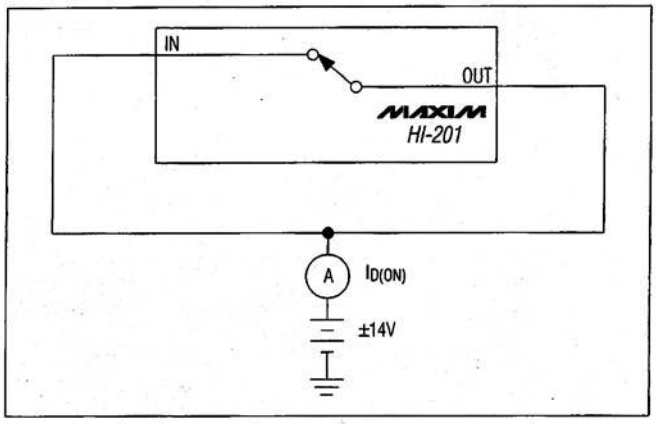


Figure 3. On Leakage Current

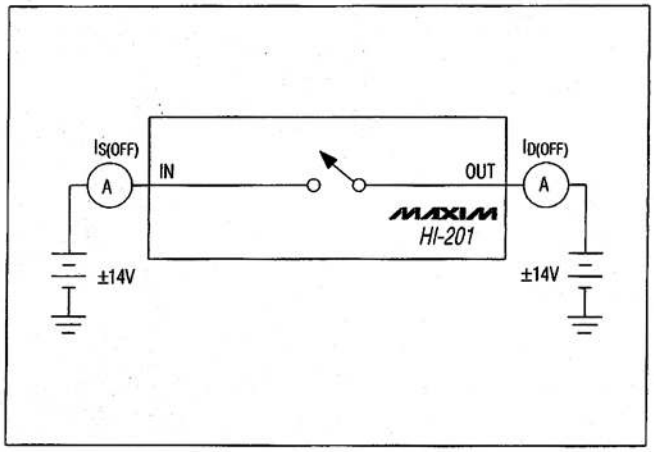


Figure 4. Off Leakage Current

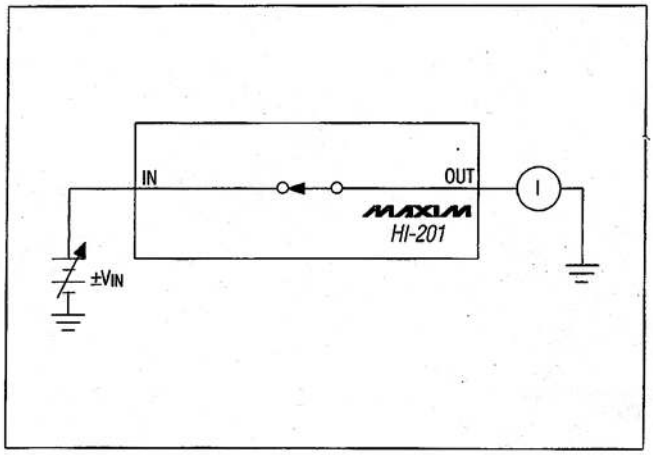
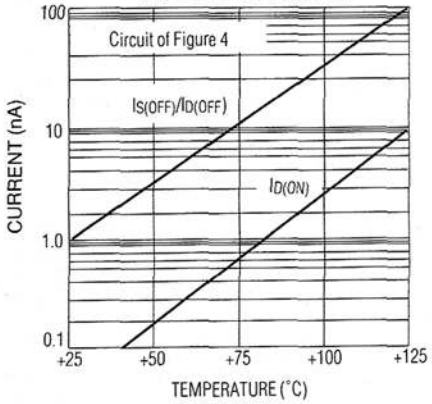


Figure 5. Switch Current vs. Voltage

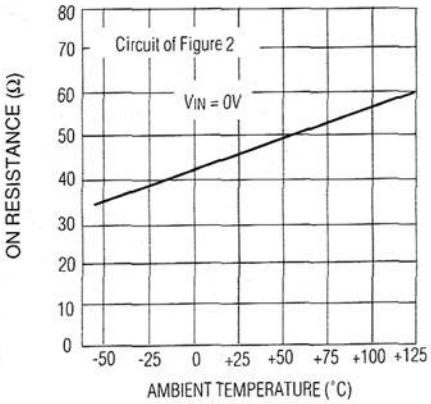
Quad SPST CMOS Analog Switch

Typical Operating Characteristics

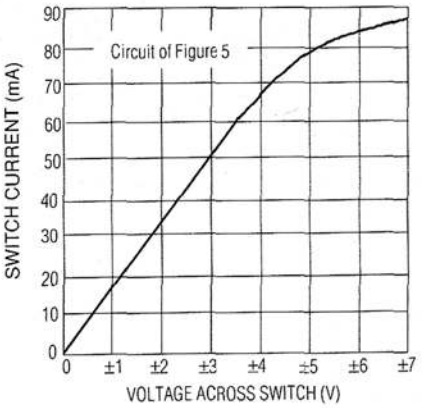
SWITCH LEAKAGE CURRENT vs. TEMPERATURE



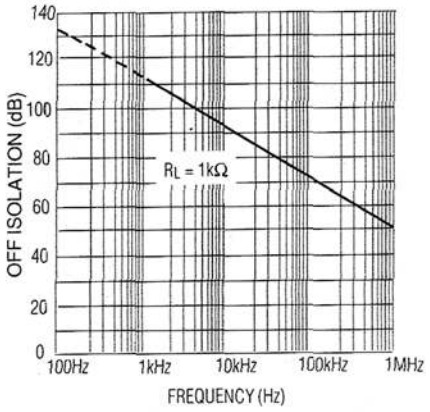
ON RESISTANCE vs. TEMPERATURE



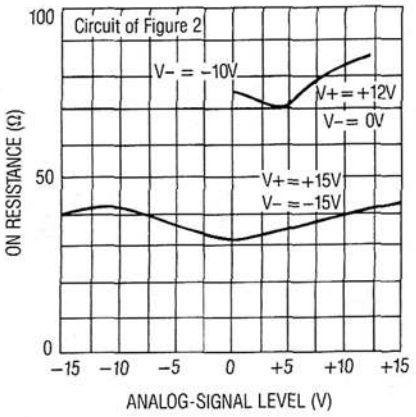
SWITCH CURRENT vs. VOLTAGE



OFF ISOLATION vs. FREQUENCY



ON RESISTANCE vs. ANALOG-SIGNAL LEVEL AND POWER SUPPLY VOLTAGE



Pin Configurations (continued)

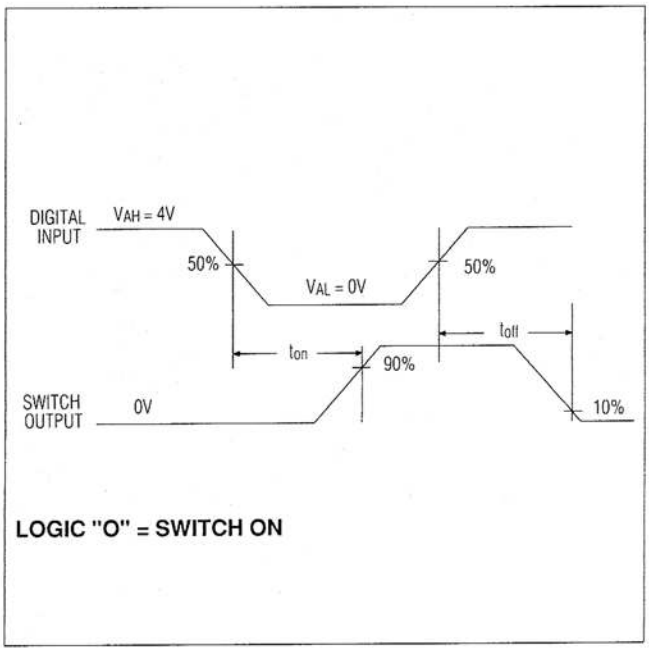
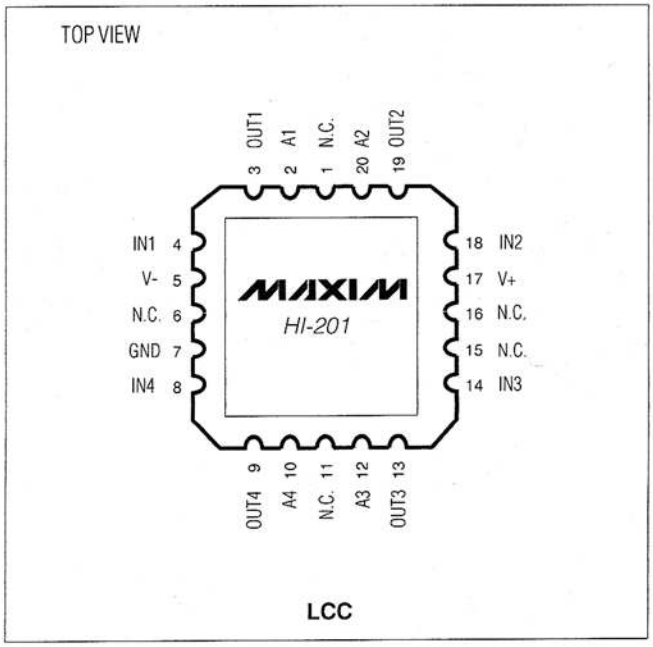


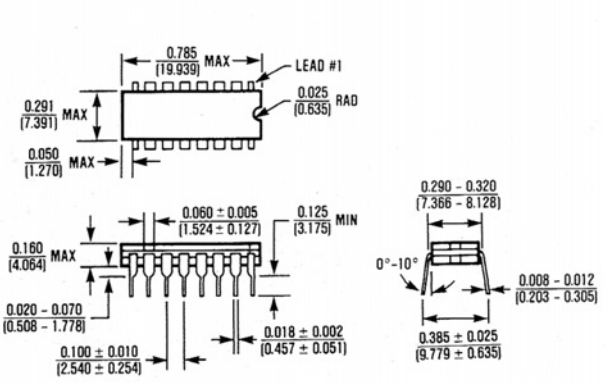
Figure 6. HI-201 Switch Timing



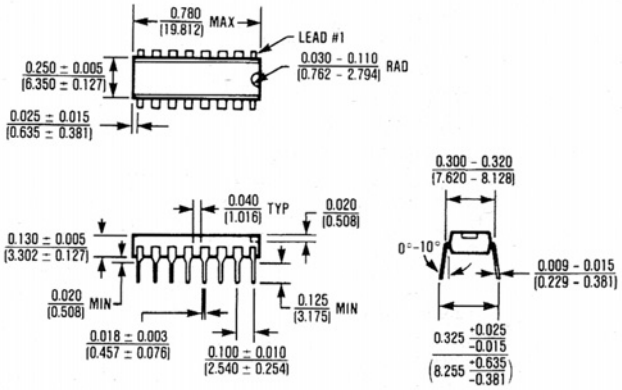
Quad SPST CMOS Analog Switch

Package Information

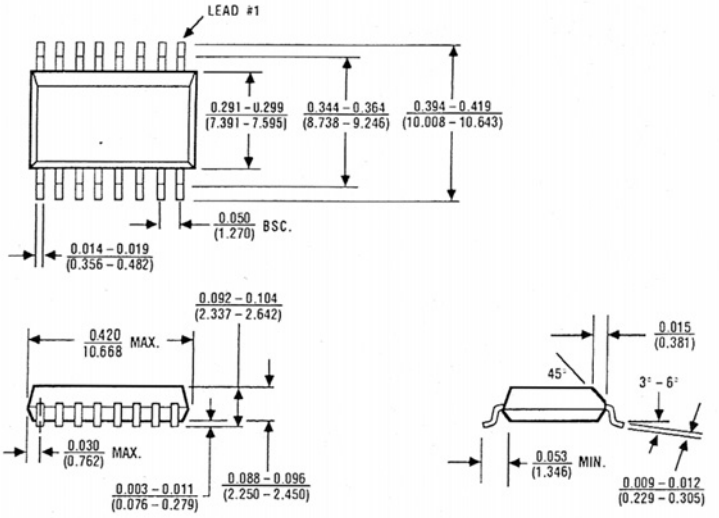
(The package drawing(s) in this data sheet may not reflect the most current specifications. For the latest package outline information go to **www.maxim-ic.com/packages**.)



16 Lead CERDIP (HI1)
θ_{JA} = 100°C/W
θ_{JC} = 50°C/W



16 Lead Plastic DIP (HI3)
θ_{JA} = 135°C/W
θ_{JC} = 65°C/W



16 Lead Small Outline, Wide (WI6)
θ_{JA} = 105°C/W
θ_{JC} = 60° C/W

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