

General-Purpose CMOS Analog Switches

General Description

The IH5040 family consists of seven CMOS analog switches that are intended for general-purpose applications. These switches are latch-up proof, break-before-make single, dual, and quad versions of the popular switch formats SPST, SPDT, DPST, and 4PST. Key features of the family include a low, 1nA leakage current and a quiescent current of less than 1μA.

Maxim's IH5040 family has faster switching times than the original manufacturer's devices. All devices are bidirectional and maintain almost constant on resistance throughout their operating range. These switches are guaranteed to operate from $\pm 4.5\text{V}$ to $\pm 18\text{V}$, and will switch input signals that include the supplies.

Applications

PBX, PABX
Guidance and Control Systems
Test Equipment
Sample-and-Holds
Military Radios

Features

- ◆ Improved Second Source
- ◆ Guaranteed $\pm 4.5\text{V}$ to $\pm 18\text{V}$ Operation
- ◆ Input Voltage Range Includes Supplies
- ◆ Latchup-Proof Construction
- ◆ TTL/CMOS Logic Compatible
- ◆ $>1\mu\text{A}$ Quiescent Current
- ◆ Monolithic, Low-Power CMOS Design

Ordering Information

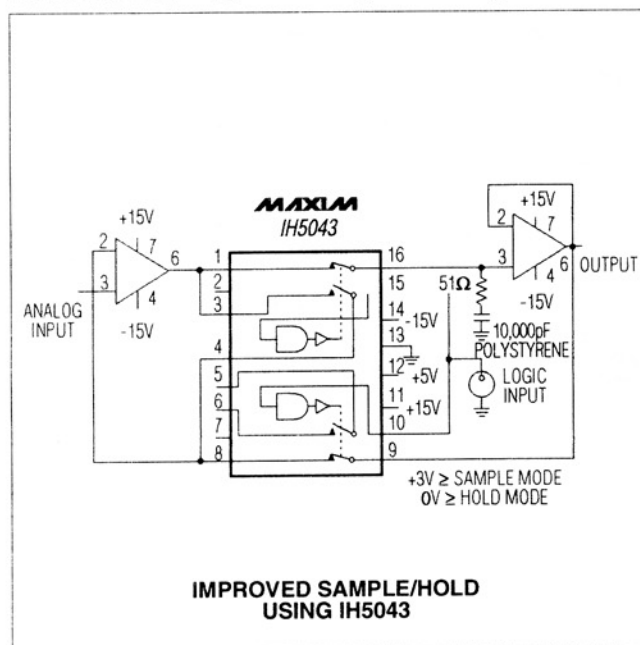
PART	TEMP. RANGE	PIN-PACKAGE
SINGLE POLE, SINGLE THROW (SPST)		
IH5040CPE	0°C to +70°C	16 Plastic DIP
IH5040CWE	0°C to +70°C	16 Wide SO
IH5040 CJE	0°C to +70°C	16 Cerdip
IH5040C/D	0°C to +70°C	Dice*
IH5040MJE	-55°C to +125°C	16 Cerdip**

Ordering Information continued at end of data sheet.

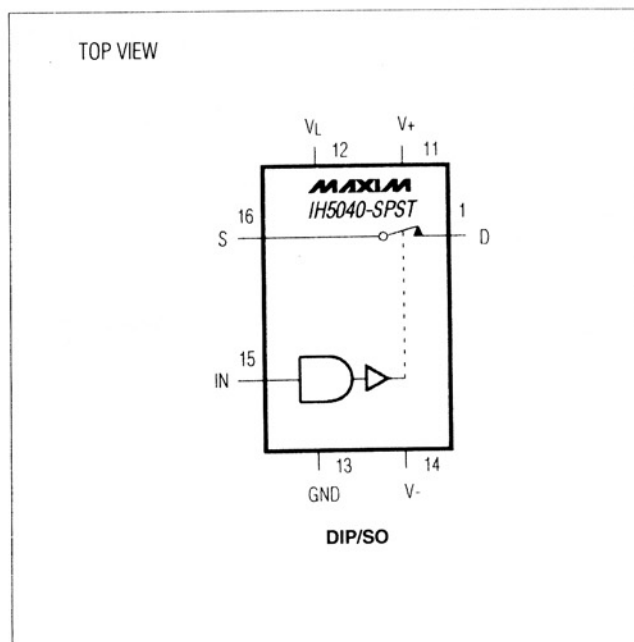
* Contact factory for dice specifications.

** Contact factory for availability and processing to MIL-STD-883.

Typical Operating Circuit



Pin Configurations & Switching-State Diagrams



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ABSOLUTE MAXIMUM RATINGS

V+ to V-	44V
V+ to V _D	30V
V _D to V-	30V
V _D to V _S	±22V
V _L to V-	33V
V _L to V _{IN}	30V
V _L to GND	20V
V _{IN} to GND	20V
Digital Inputs (V+ + 0.3V) to (V+ - 44V)	
V _S or V _D (Note 1)	-0.3V to (V+ + 0.3V)
Current (any terminal)	30mA

Continuous Power Dissipation (T _A = +70°C)	
Plastic DIP (derate 10.53mW/°C above +70°C)	842mW
Wide SO (derate 9.52mW/°C above +70°C)	762mW
CERDIP (derate 10.00mW/°C above +70°C)	800mW
TO-100 (derate 6.67mW/°C above +70°C)	533mW
Operating Temperature Ranges:	
IH504_C	0°C to +70°C
IH504_M	-55°C to +125°C
Storage Temperature Range	-65°C to +150°C
Lead Temperature (soldering, 10sec)	+300°C

Note 1: Signals on S, D, and digital inputs that exceed V- or V+ will be clamped by internal diodes. Limit forward diode current to 30mA maximum.

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

(V+ = 15V, V- = -15V, V_L = 5V, T_A = +25°C, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		IH504_M			IH504_C			UNITS
				MIN	TYP	MAX	MIN	TYP	MAX	
Input Logic Current	I _{IN(ON)}	V _{IN} = 2.4V	T _A = +25°C	-1		1	-1		1	μA
			T _A = T _{MAX}	-10		10	-10		10	
	I _{IN(OFF)}	V _{IN} = 0.8V	T _A = +25°C	-1		1	-1		1	
			T _A = T _{MAX}	-10		10	-10		10	
Input Logic Low	V _{IL}	T _A = T _{MIN} to T _{MAX}		0.8			0.8			V
Input Logic High	V _{IH}	T _A = T _{MIN} to T _{MAX}		2.4			2.4			V
Drain-Source On Resistance	r _{DS(ON)}	I _S = 10mA, V _{ANALOG} = -10V to 10V	T _A = +25°C	75			80			Ω
			T _A = T _{MAX}	150			130			
Channel-to-Channel r _{DS(ON)} Match	Δr _{DS(ON)}			3			5			Ω
Minimum Analog-Signal Handling Capability	V _{ANALOG}			-15 15			-15 15			V
Switch-Off Leakage Current	I _D /I _{S(OFF)}	V _{ANALOG} = -10V to 10V	T _A = +25°C	-1 1			-5 5			nA
			T _A = T _{MAX}	-100 100			-100 100			

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ELECTRICAL CHARACTERISTICS (continued)

($V_+ = 15V$, $V_- = -15V$, $V_L = 5V$, $T_A = +25^\circ C$, unless otherwise noted.)

PARAMETER	SYMBOL	CONDITIONS		IH504_M			IH504_C			UNITS	
				MIN	TYP	MAX	MIN	TYP	MAX		
Switch-On Leakage Current	ID(ON)	VD = VS = -10V to 10V	TA = +25°C	-2		2	-10		10	nA	
			TA = TMAX	-200		200	-100		100		
Switch-On Time	ton	Figure 1				400			400	ns	
Switch-Off Time	toff	Figure 1				200			200	ns	
Charge Injection	Q(INJ)	Figure 2 (Note 2)				15			20	mV	
Minimum Off-Isolation Rejection Ratio	OIRR	Figure 3, CL < 5pF				54			50	dB	
V+ Quiescent Current	I+Q	VIN = 0V and 5V	TA = +25°C			1			10	μA	
			TA = TMAX			10			100		
V- Quiescent Current	I-Q	VIN = 0V and 5V	TA = +25°C	-1			-10			μA	
			TA = TMAX	-10			-100				
VL Quiescent Current	ILQ	VIN = 0V and 5V	TA = +25°C			1			10	μA	
			TA = TMAX			10			100		
Ground Quiescent Current	IGND	VIN = 0V and 5V	TA = +25°C	-1			-10			μA	
			TA = TMAX	-10			-100				
Minimum Channel-to-Channel Cross-Coupling Rejection Ratio	CCRR	One channel off (Note 2)				54			50	dB	
Power-Supply Range for Continuous Operation	VOP	(Notes 2, 3)			±4.5		±18		±4.5	±18	V

Note 2: Not production tested.

Note 3: Electrical characteristics, such as on resistance, will change when power supplies other than $\pm 15V$ are used.

Test Circuits

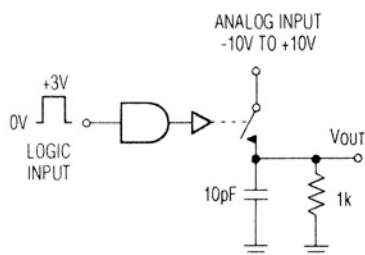


Figure 1. Switching Time

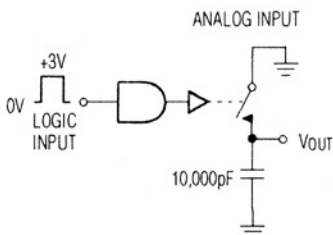


Figure 2. Charge Injection

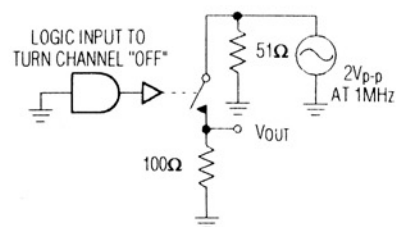
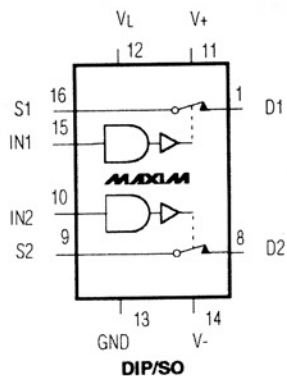


Figure 3. Off-Isolation Rejection Ratio

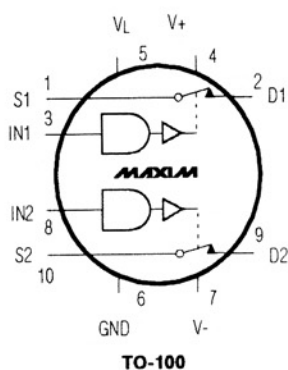
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Pin Configurations & Switching-State Diagrams (continued)

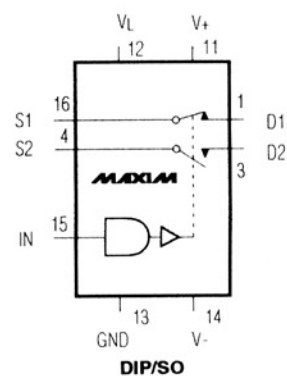
IH5041 Dual SPST



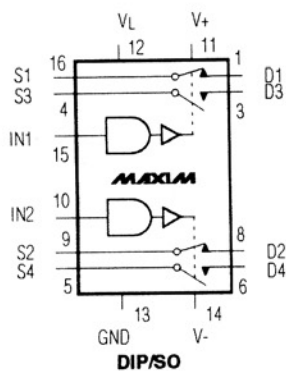
IH5041 Dual SPST



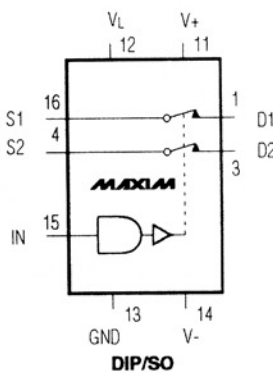
IH5042 Dual SPDT



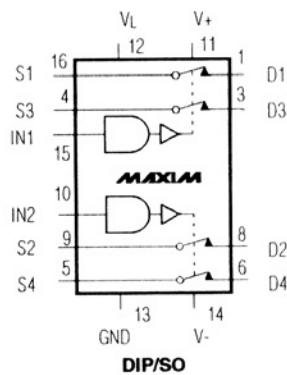
IH5043 Dual SPDT



IH5044 DPST



IH5045 Dual DPST



IH5047 4PST

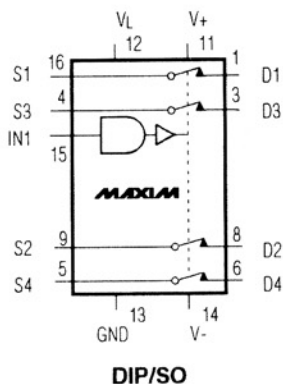


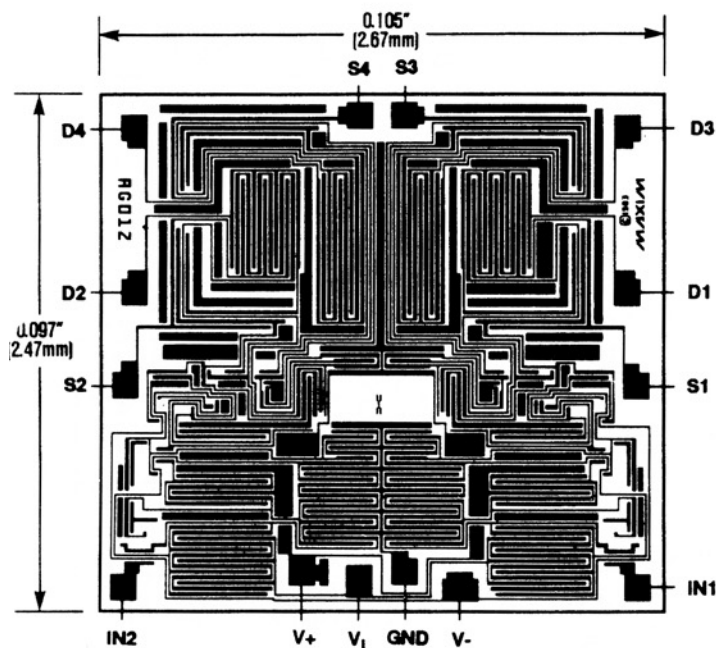
Table 1. Using the IH5040 Family with Only Two Supplies

SUPPLY VOLTAGES (V)	MINIMUM LOGIC I/P FOR "1" STATE (V)
±15	12.6
±12	9.6
±10	7.6
±5	2.6

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Chip Topography

Ordering Information (continued)



PART	TEMP. RANGE	PIN-PACKAGE
DUAL, SINGLE POLE, SINGLE THROW (DUAL SPST)		
IH5041CPE	0°C to +70°C	16 Plastic DIP
IH5041CWE	0°C to +70°C	16 Wide SO
IH5041CJE	0°C to +70°C	16 Cerdip
IH5041CTW	0°C to +70°C	16 TO-100 [†]
IH5041C/D	0°C to +70°C	Dice*
IH5041MJE	-55°C to +125°C	16 Cerdip**
IH5041MTW	-55°C to +125°C	16 TO-100 [†]
SINGLE POLE, DOUBLE THROW (SPDT)		
IH5042CPE	0°C to +70°C	16 Plastic DIP
IH5042CWE	0°C to +70°C	16 Wide SO
IH5042CJE	0°C to +70°C	16 Cerdip
IH5042C/D	0°C to +70°C	Dice*
IH5042MJE	-55°C to +125°C	16 Cerdip**
DUAL, SINGLE POLE, DOUBLE THROW (DUAL SPDT)		
IH5043CPE	0°C to +70°C	16 Plastic DIP
IH5043CWE	0°C to +70°C	16 Wide SO
IH5043CJE	0°C to +70°C	16 Cerdip
IH5043C/D	0°C to +70°C	Dice*
IH5043MJE	-55°C to +125°C	16 Cerdip**
DOUBLE POLE, SINGLE THROW (DPST)		
IH5044CPE	0°C to +70°C	16 Plastic DIP
IH5044CWE	0°C to +70°C	16 Wide SO
IH5044CJE	0°C to +70°C	16 Cerdip
IH5044C/D	0°C to +70°C	Dice*
IH5044MJE	-55°C to +125°C	16 Cerdip**
DUAL, DOUBLE POLE, SINGLE THROW (DUAL DPST)		
IH5045CPE	0°C to +70°C	16 Plastic DIP
IH5045CWE	0°C to +70°C	16 Wide SO
IH5045CJE	0°C to +70°C	16 Cerdip
IH5045C/D	0°C to +70°C	Dice*
IH5045MJE	-55°C to +125°C	16 Cerdip**
QUAD POLE, SINGLE THROW (4PST)		
IH5047CPE	0°C to +70°C	16 Plastic DIP
IH5047CWE	0°C to +70°C	16 Wide SO
IH5047CJE	0°C to +70°C	16 Cerdip
IH5047C/D	0°C to +70°C	Dice*
IH5047MJE	-55°C to +125°C	16 Cerdip**

* Contact factory for dice specifications.

** Contact factory for availability and processing to MIL-STD-883.

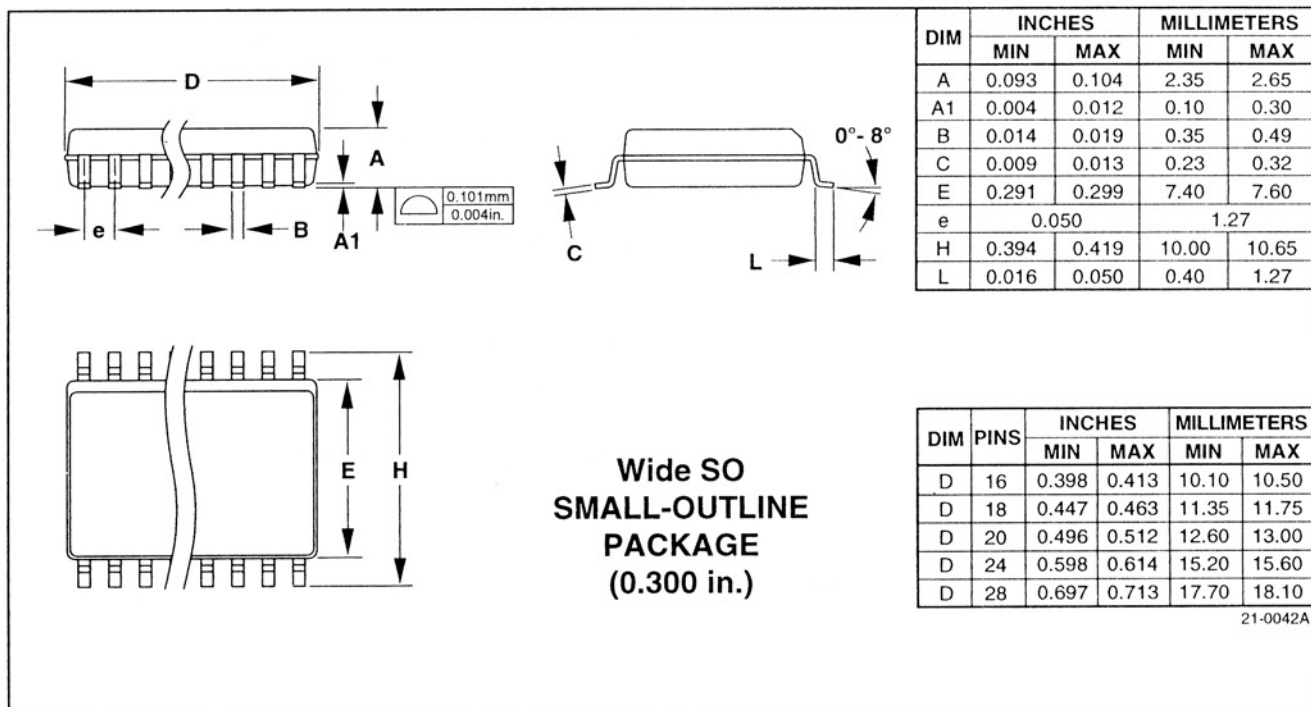
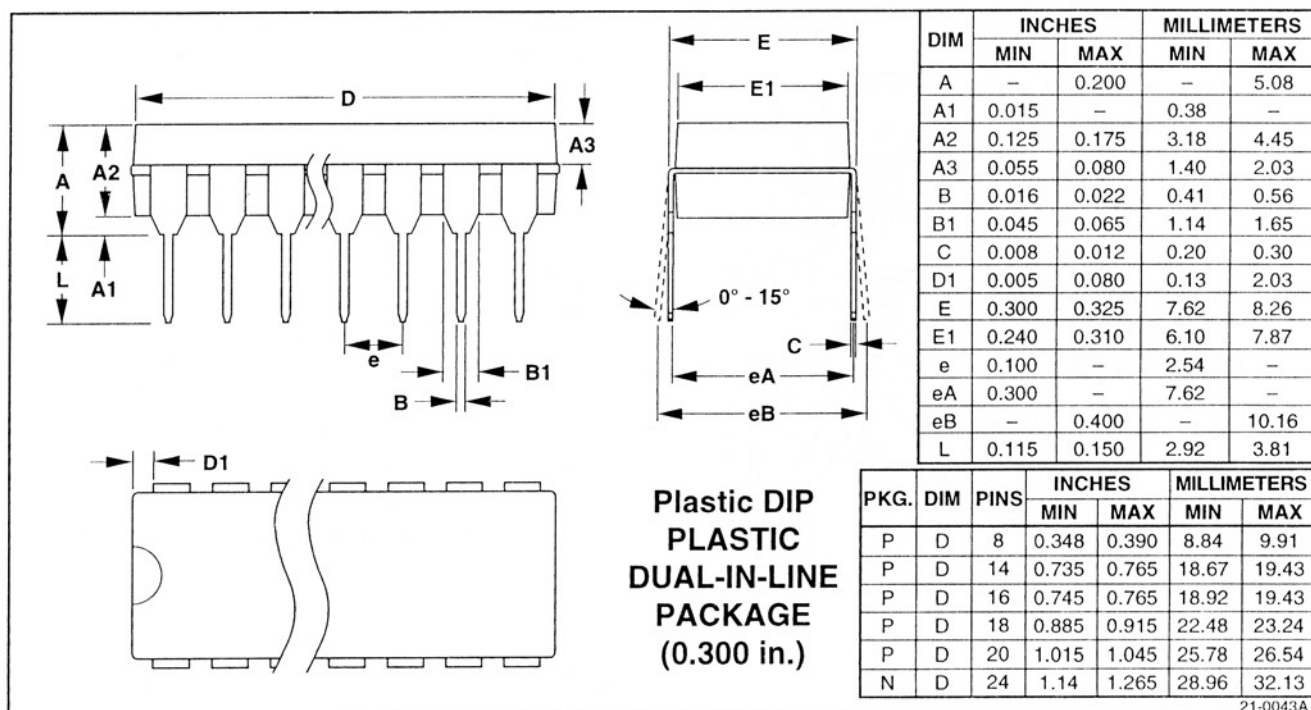
[†] Contact factory for availability.

IH5040-IH5045/IH5047

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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.)

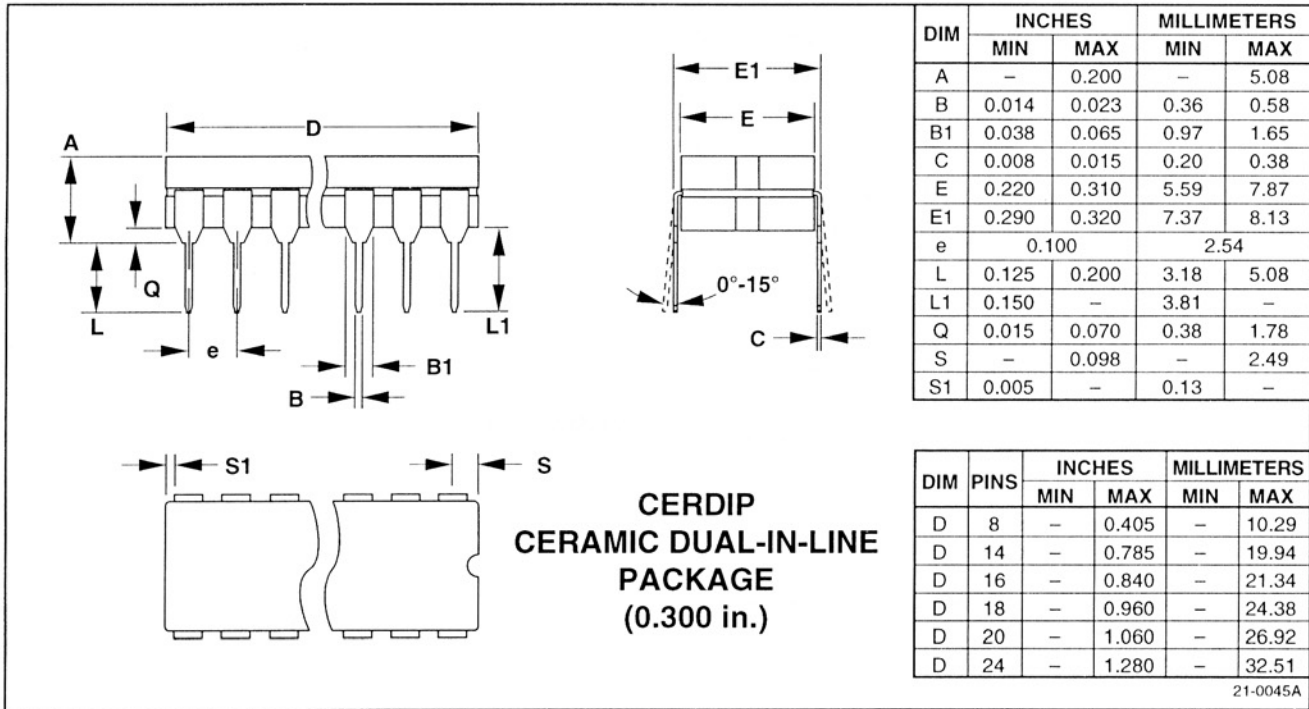


General-Purpose CMOS Analog Switches

Package Information (continued)

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IH5040-IH5045/IH5047



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8 _____ **Maxim Integrated Products, 120 San Gabriel Drive, Sunnyvale, CA 94086 (408) 737-7600**