



# General-Purpose CMOS Analog Switches

IH5040-IH5045/IH5047

## 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 ±4.5V to ±18V, 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 ±4.5V to ±18V Operation
- ◆ Input Voltage Range Includes Supplies
- ◆ Latchup-Proof Construction
- ◆ TTL/CMOS Logic Compatible
- ◆ >1µA Quiescent Current
- ◆ Monolithic, Low-Power CMOS Design

## Ordering Information

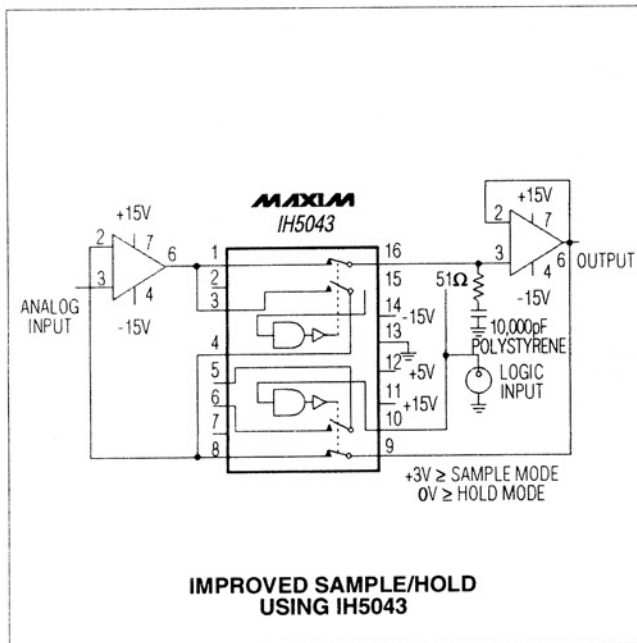
PART	TEMP. RANGE	PIN-PACKAGE
<b>SINGLE POLE, SINGLE THROW (SPST)</b>		
IH5040CPE	0°C to +70°C	16 Plastic DIP
IH5040CWE	0°C to +70°C	16 Wide SO
IH5040 CJE	0°C to +70°C	16 CERDIP
IH5040C/D	0°C to +70°C	Dice*
IH5040MJE	-55°C to +125°C	16 CERDIP**

Ordering Information continued at end of data sheet.

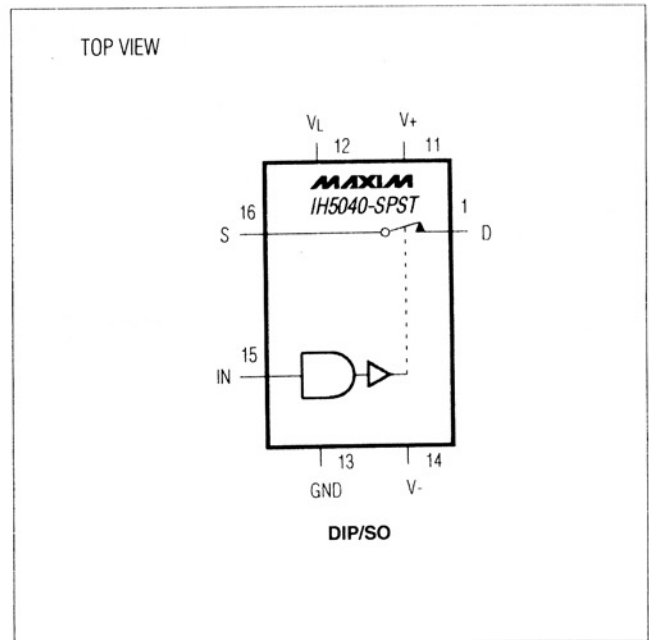
\* Contact factory for dice specifications.

\*\* 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	Continuous Power Dissipation (T <sub>A</sub> = +70°C)	
V+ to V <sub>D</sub>	30V	Plastic DIP (derate 10.53mW/°C above +70°C)	842mW
V <sub>D</sub> to V-	30V	Wide SO (derate 9.52mW/°C above +70°C)	762mW
V <sub>D</sub> to V <sub>S</sub>	±22V	CERDIP (derate 10.00mW/°C above +70°C)	800mW
V <sub>L</sub> to V-	33V	TO-100 (derate 6.67mW/°C above +70°C)	533mW
V <sub>L</sub> to V <sub>IN</sub>	30V	Operating Temperature Ranges:	
V <sub>L</sub> to GND	20V	IH504_C_	0°C to +70°C
V <sub>IN</sub> to GND	20V	IH504_M_	-55°C to +125°C
Digital Inputs	(V+ + 0.3V) to (V+ - 44V)	Storage Temperature Range	-65°C to +150°C
V <sub>S</sub> or V <sub>D</sub> (Note 1)	-0.3V to (V+ + 0.3V)	Lead Temperature (soldering, 10sec)	+300°C
Current (any terminal)	30mA		

**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<sub>L</sub> = 5V, T<sub>A</sub> = +25°C, unless otherwise noted.)

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

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## ELECTRICAL CHARACTERISTICS (continued)

(V+ = 15V, V- = -15V, VL = 5V, TA = +25°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 ±15V are used.

## Test Circuits

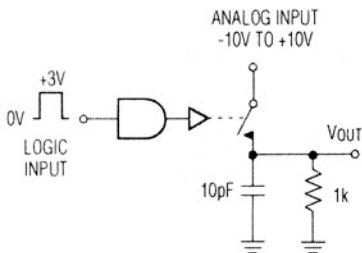


Figure 1. Switching Time

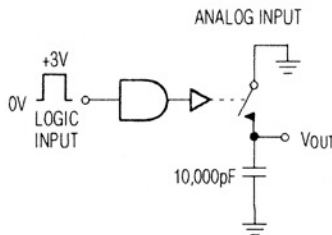


Figure 2. Charge Injection

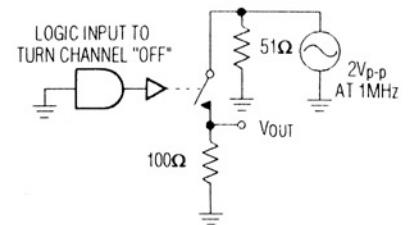
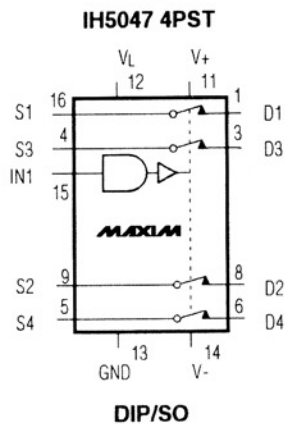
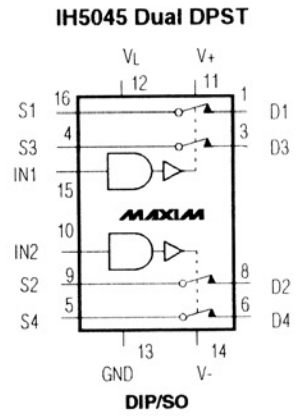
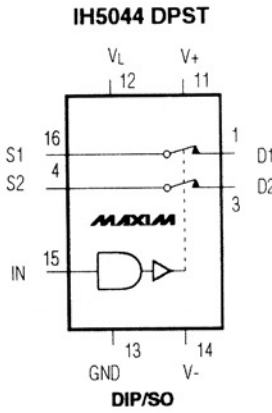
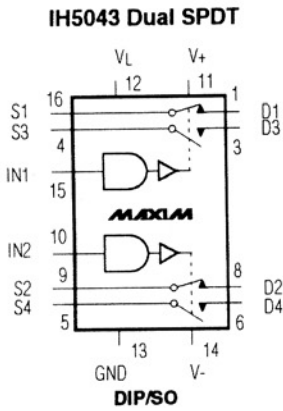
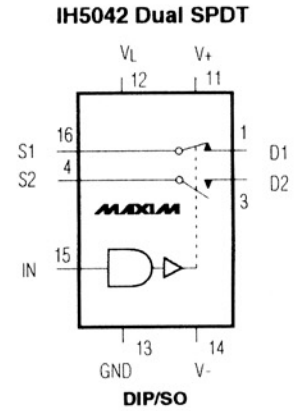
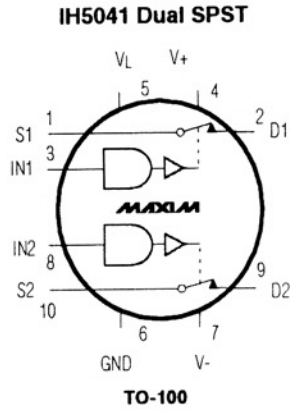
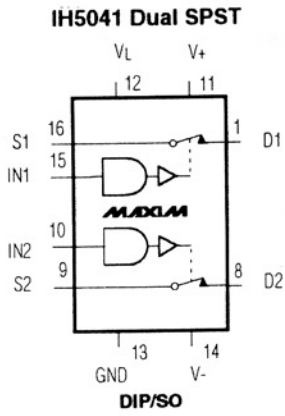


Figure 3. Off-Isolation Rejection Ratio

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## Pin Configurations & Switching-State Diagrams (continued)

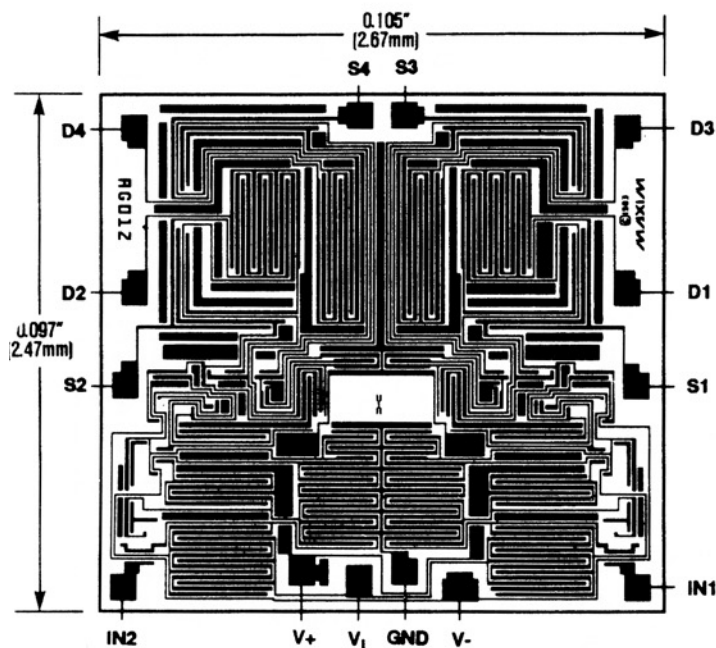


**Table 1. Using the IH5040 Family with Only Two Supplies**

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

# General-Purpose CMOS Analog Switches

## Chip Topography



## Ordering Information (continued)

PART	TEMP. RANGE	PIN-PACKAGE
<b>DUAL, SINGLE POLE, SINGLE THROW (DUAL SPST)</b>		
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†
<b>SINGLE POLE, DOUBLE THROW (SPDT)</b>		
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**
<b>DUAL, SINGLE POLE, DOUBLE THROW (DUAL SPDT)</b>		
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**
<b>DOUBLE POLE, SINGLE THROW (DPST)</b>		
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**
<b>DUAL, DOUBLE POLE, SINGLE THROW (DUAL DPST)</b>		
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**
<b>QUAD POLE, SINGLE THROW (4PST)</b>		
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

# General-Purpose CMOS Analog Switches

## 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](http://www.maxim-ic.com/packages).)

**Plastic DIP  
PLASTIC  
DUAL-IN-LINE  
PACKAGE  
(0.300 in.)**

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	—	0.200	—	5.08
A1	0.015	—	0.38	—
A2	0.125	0.175	3.18	4.45
A3	0.055	0.080	1.40	2.03
B	0.016	0.022	0.41	0.56
B1	0.045	0.065	1.14	1.65
C	0.008	0.012	0.20	0.30
D1	0.005	0.080	0.13	2.03
E	0.300	0.325	7.62	8.26
E1	0.240	0.310	6.10	7.87
e	0.100	—	2.54	—
eA	0.300	—	7.62	—
eB	—	0.400	—	10.16
L	0.115	0.150	2.92	3.81

PKG.	DIM	PINS	INCHES		MILLIMETERS	
			MIN	MAX	MIN	MAX
P	D	8	0.348	0.390	8.84	9.91
P	D	14	0.735	0.765	18.67	19.43
P	D	16	0.745	0.765	18.92	19.43
P	D	18	0.885	0.915	22.48	23.24
P	D	20	1.015	1.045	25.78	26.54
N	D	24	1.14	1.265	28.96	32.13

21-0043A

**Wide SO  
SMALL-OUTLINE  
PACKAGE  
(0.300 in.)**

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.093	0.104	2.35	2.65
A1	0.004	0.012	0.10	0.30
B	0.014	0.019	0.35	0.49
C	0.009	0.013	0.23	0.32
E	0.291	0.299	7.40	7.60
e	0.050		1.27	
H	0.394	0.419	10.00	10.65
L	0.016	0.050	0.40	1.27

DIM	PINS	INCHES		MILLIMETERS	
		MIN	MAX	MIN	MAX
D	16	0.398	0.413	10.10	10.50
D	18	0.447	0.463	11.35	11.75
D	20	0.496	0.512	12.60	13.00
D	24	0.598	0.614	15.20	15.60
D	28	0.697	0.713	17.70	18.10

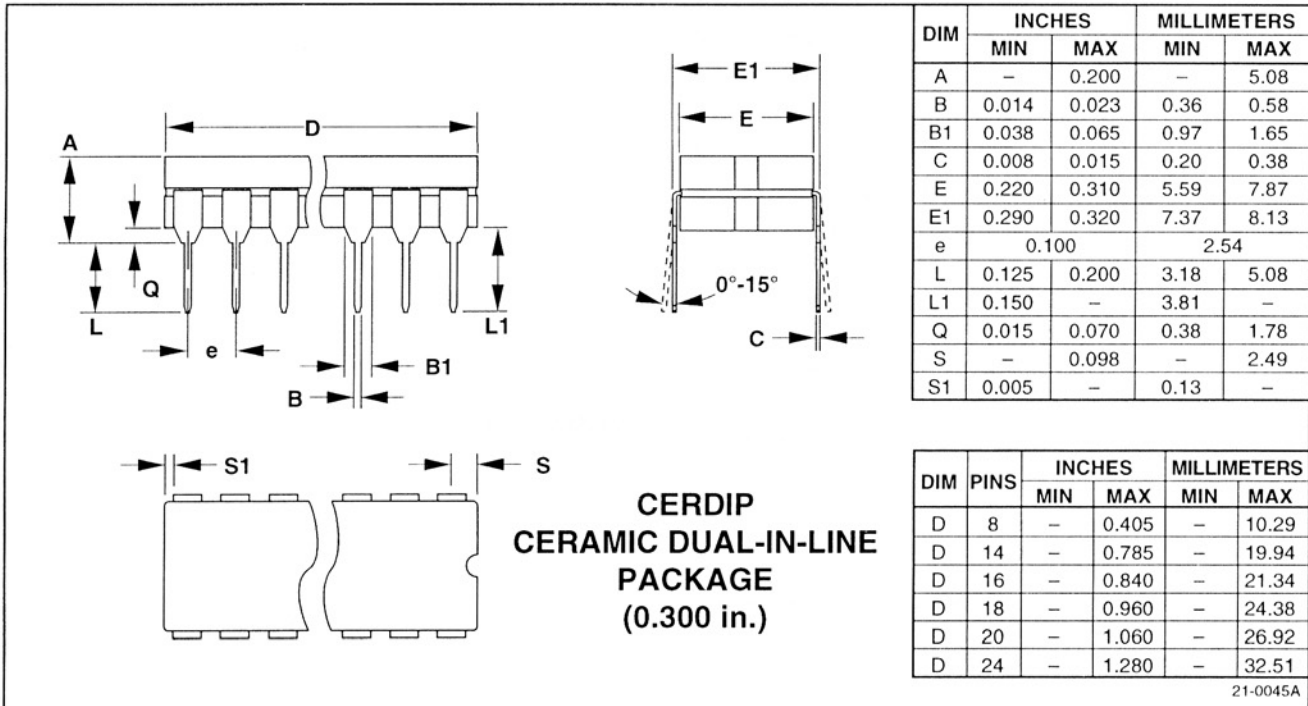
21-0042A

# General-Purpose CMOS Analog Switches

## Package Information (continued)

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IH5040-IH5045/IH5047



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**IH5040-IH5045/IH5047**

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