19-0907; Rev 1; 7/92

MAXIM

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 ±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

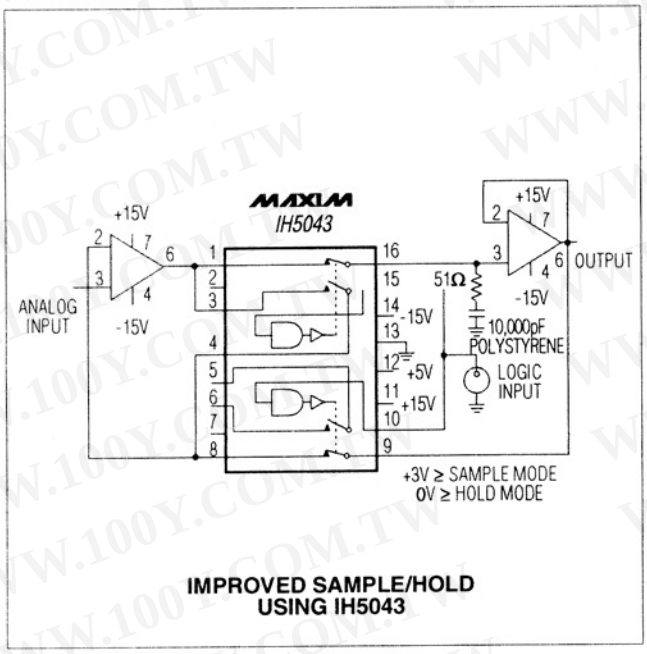
PART	TEMP. RANGE	PIN-PACKAGE
SINGLE POLE, SINGLE THROW (SPST)		
IH5040CPE	0°C to +70°C	16 Plastic DIP
IH5040CWE	0°C to +70°C	16 Wide SO
IH5040 CJE	0°C to +70°C	16 CERDIP
IH5040C/D	0°C to +70°C	Dice*
IH5040MJE	-55°C to +125°C	16 CERDIP**

Ordering Information continued at end of data sheet.

* Contact factory for dice specifications.

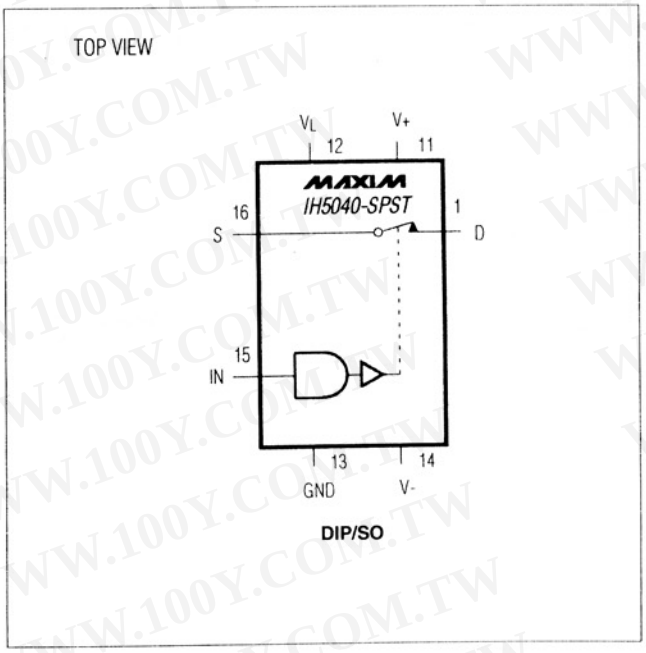
** Contact factory for availability and processing to MIL-STD-883.

Typical Operating Circuit



IMPROVED SAMPLE/HOLD USING IH5043

Pin Configurations & Switching-State Diagrams



General-Purpose CMOS Analog Switches

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	$\Delta r_{DS(ON)}$				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	

ELECTRICAL CHARACTERISTICS (continued)

(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	
Switch-On Leakage Current	$I_{D(ON)}$	V_D = V_S = -10V to 10V	T_A = +25°C	-2		2	-10		10	nA
			T_A = T_{MAX}	-200		200	-100		100	
Switch-On Time	t_{ON}	Figure 1				400			400	ns
Switch-Off Time	t_{OFF}	Figure 1				200			200	ns
Charge Injection	$Q_{(INJ)}$	Figure 2 (Note 2)			15			20		mV
Minimum Off-Isolation Rejection Ratio	OIRR	Figure 3, C_L < 5pF			54			50		dB
V+ Quiescent Current	I+Q	V_{IN} = 0V and 5V	T_A = +25°C			1			10	µA
			T_A = T_{MAX}			10			100	
V- Quiescent Current	I-Q	V_{IN} = 0V and 5V	T_A = +25°C	-1			-10			µA
			T_A = T_{MAX}	-10			-100			
V_L Quiescent Current	I_{LQ}	V_{IN} = 0V and 5V	T_A = +25°C			1			10	µA
			T_A = T_{MAX}			10			100	
Ground Quiescent Current	I_{GND}	V_{IN} = 0V and 5V	T_A = +25°C	-1			-10			µA
			T_A = T_{MAX}	-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	V_{OP}	(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

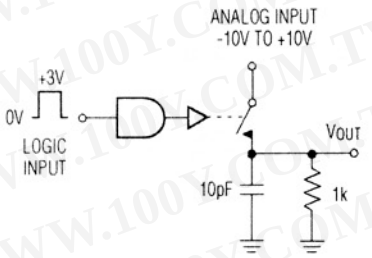


Figure 1. Switching Time

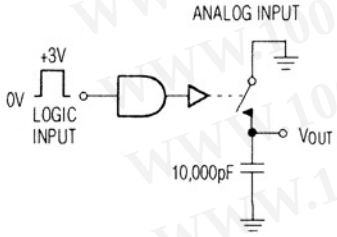


Figure 2. Charge Injection

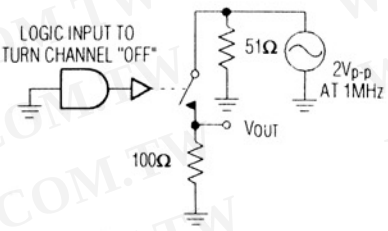
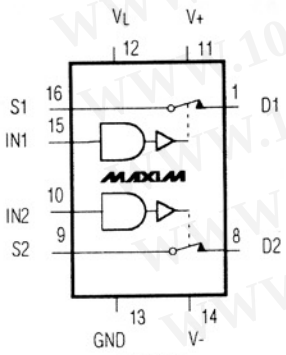


Figure 3. Off-Isolation Rejection Ratio

General-Purpose CMOS Analog Switches

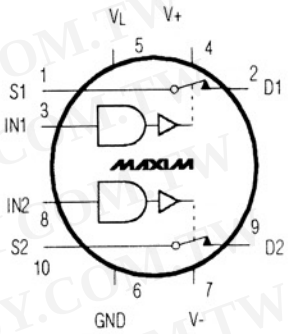
Pin Configurations & Switching-State Diagrams (continued)

IH5041 Dual SPST



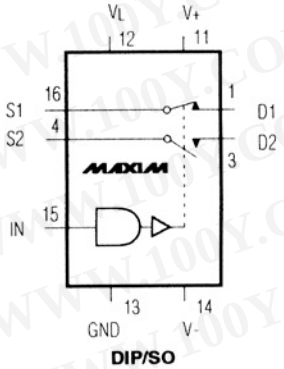
DIP/SO

IH5041 Dual SPST



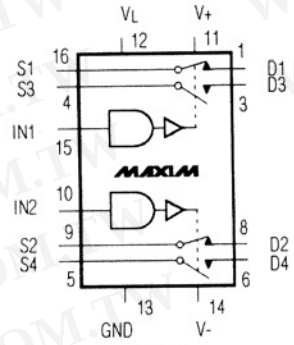
TO-100

IH5042 Dual SPDT



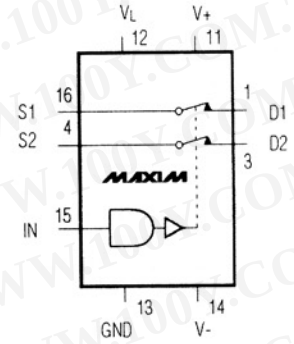
DIP/SO

IH5043 Dual SPDT



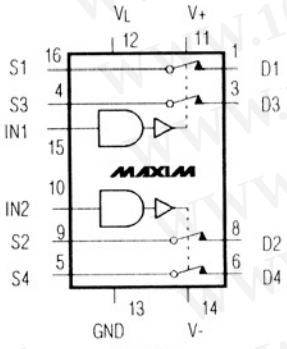
DIP/SO

IH5044 DPST



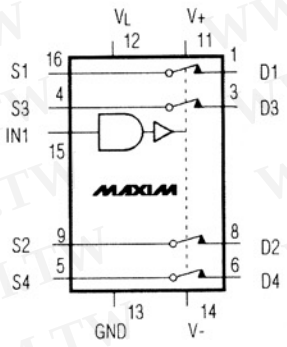
DIP/SO

IH5045 Dual DPST



DIP/SO

IH5047 4PST



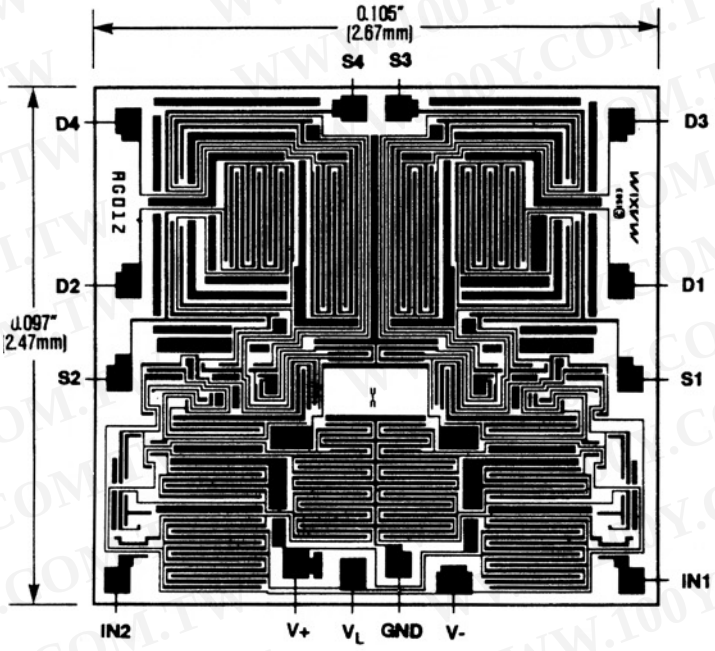
DIP/SO

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)

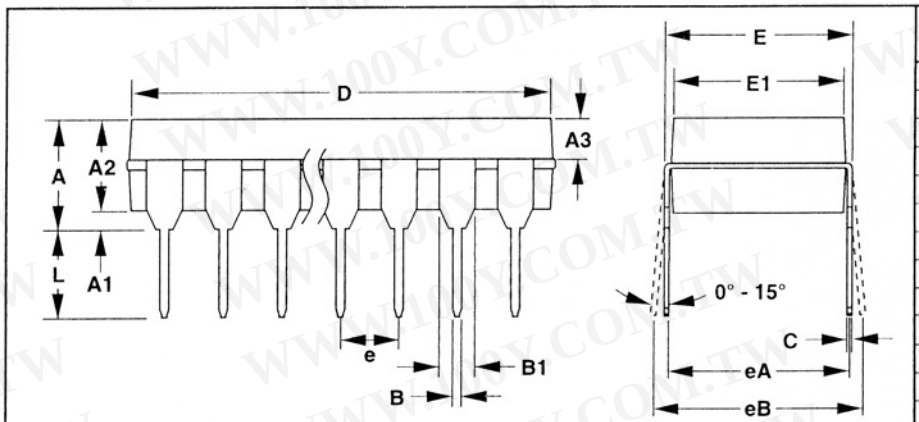
PART	TEMP. RANGE	PIN-PACKAGE
DUAL, SINGLE POLE, SINGLE THROW (DUAL SPST)		
IH5041CPE	0°C to +70°C	16 Plastic DIP
IH5041CWE	0°C to +70°C	16 Wide SO
IH5041CJE	0°C to +70°C	16 CERDIP
IH5041CTW	0°C to +70°C	16 TO-100†
IH5041C/D	0°C to +70°C	Dice*
IH5041MJE	-55°C to +125°C	16 CERDIP**
IH5041MTW	-55°C to +125°C	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.*

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**.)

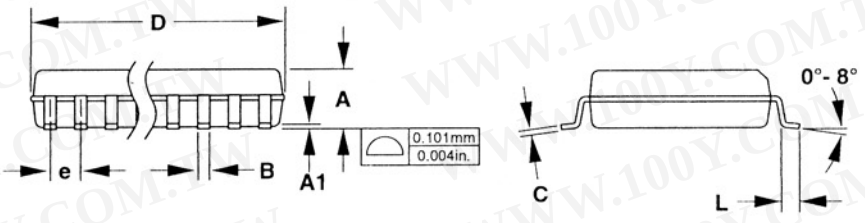


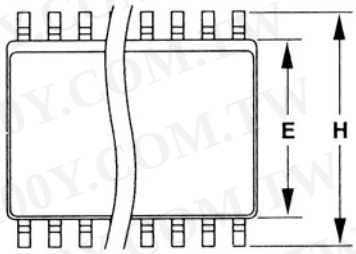
Plastic DIP
PLASTIC
DUAL-IN-LINE
PACKAGE
(0.300 in.)

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.)

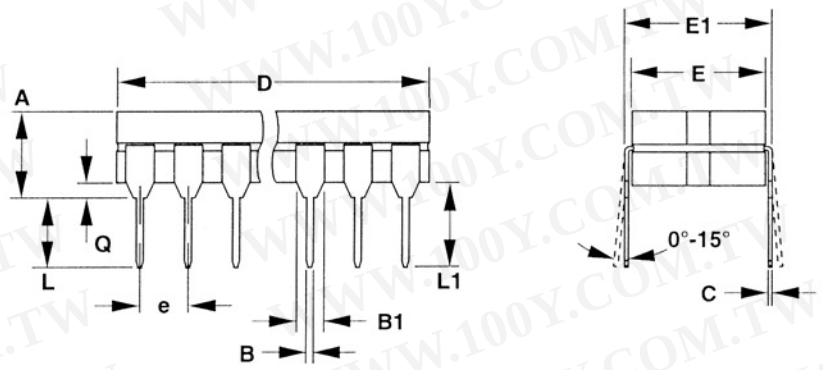
DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.093	0.104	2.35	2.65
A1	0.004	0.012	0.10	0.30
B	0.014	0.019	0.35	0.49
C	0.009	0.013	0.23	0.32
E	0.291	0.299	7.40	7.60
e	0.050		1.27	
H	0.394	0.419	10.00	10.65
L	0.016	0.050	0.40	1.27

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

Package Information (continued)

(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**.)



CERDIP
CERAMIC DUAL-IN-LINE
PACKAGE
(0.300 in.)

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	–	0.200	–	5.08
B	0.014	0.023	0.36	0.58
B1	0.038	0.065	0.97	1.65
C	0.008	0.015	0.20	0.38
E	0.220	0.310	5.59	7.87
E1	0.290	0.320	7.37	8.13
e	0.100		2.54	
L	0.125	0.200	3.18	5.08
L1	0.150	–	3.81	–
Q	0.015	0.070	0.38	1.78
S	–	0.098	–	2.49
S1	0.005	–	0.13	–

DIM	PINS	INCHES		MILLIMETERS	
		MIN	MAX	MIN	MAX
D	8	–	0.405	–	10.29
D	14	–	0.785	–	19.94
D	16	–	0.840	–	21.34
D	18	–	0.960	–	24.38
D	20	–	1.060	–	26.92
D	24	–	1.280	–	32.51

21-0045A

General-Purpose CMOS Analog Switches