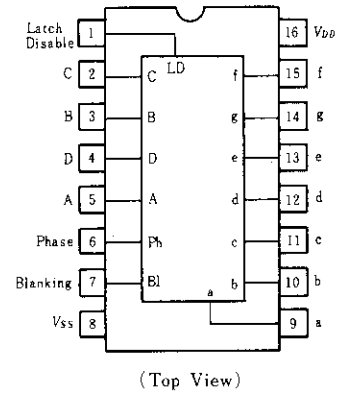


HD14543B

BCD-to-Seven Segment Latch/Decoder/Driver

The HD14543B BCD-to-seven segment latch/decoder/driver is designed for use with liquid crystal readouts. The circuit provides the functions of a 4-bit storage latch and an 8421 BCD-to-seven segment decoder and driver. The device has the capability to invert the logic levels of the output combination. The phase (Ph), blanking (BI), and latch disable (LD) inputs are used to reverse the truth table phase, blank the display, and store a BCD code, respectively. For liquid crystal (LC) readouts, a square wave is applied to the Ph input of the circuit and the electrically common backplane of the display, the outputs of the circuit are connected directly to the segments of the LC readout. For other types of readouts, such as light-emitting diode (LED), incandescent, gas discharge, and fluorescent readouts, connection diagrams are given on this data sheet. Applications include instrument (e.g., counter, DVM etc.) display driver, computer/calculator display driver, cockpit display driver, and various clock, watch, and timer uses.

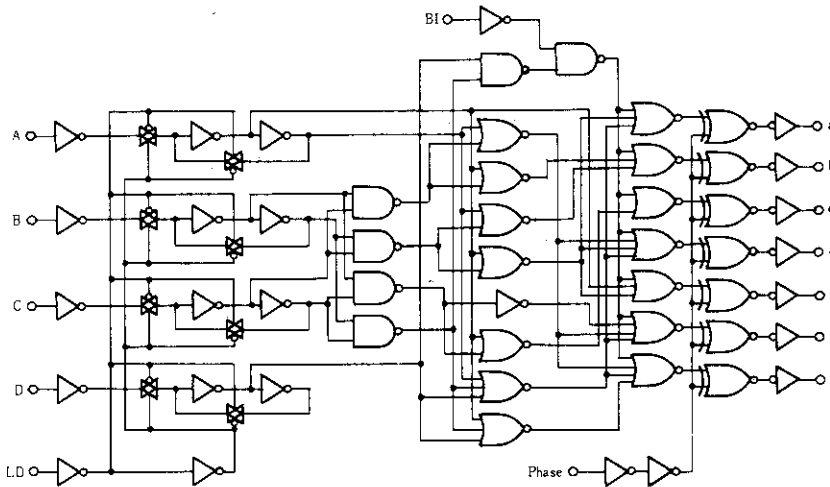
■ PIN ARRANGEMENT



■ FEATURES

- Logic Circuit Quiescent Current = 5nA/pkg typ. @5V
- Latch Storage of Code
- Blanking Input
- Readout Blanking on All Illegal Input Combinations
- Direct LED (Common Anode or Cathode) Driving Capability
- Supply Voltage Range = 3 to 18V
- Capable of Driving One Low-power Schottky TTL Load Over the Rated Temperature Range

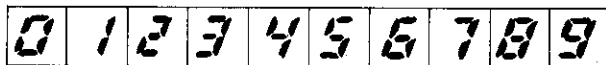
■ LOGIC DIAGRAM



■ MAXIMUM RATINGS (Voltages referenced to V_{SS})

Characteristic	Symbol	Value	Unit
DC Supply Voltage	V_{DD}	-0.5~+18	V
Input/Output Voltage	V_{in}, V_{out}	-0.5~ $V_{DD}+0.5$	V
DC Current Drain per Input Pin	I_{in}	±10	mA
Maximum Output Drive Current	$I_{OH\ max}$ $I_{OL\ max}$	±10	mA
Maximum Continuous Output Power*	$P_{OH\ max}$ $P_{OL\ max}$	70	mW
Power Dissipation	P_D	300	mW
Operating Temperature Range	T_A	-40~+85	°C
Storage Temperature Range	T_{stg}	-65~+150	°C

* $P_{OH\ max}=I_{OH}(V_{OH}-V_{DD})$, $P_{OL\ max}=I_{OL}(V_{OL}-V_{SS})$



■ TRUTH TABLE

LD	BI	Inputs					Outputs					Disply		
		Ph*	D	C	B	A	a	b	c	d	e		f	g
x	1	0	x	x	x	0	0	0	0	0	0	0	0	Blank
1	0	0	0	0	0	1	1	1	1	1	1	1	0	0
1	0	0	0	0	0	1	0	1	1	0	0	0	0	1
1	0	0	0	0	1	0	1	1	0	1	1	0	1	2
1	0	0	0	0	1	1	1	1	1	1	0	0	1	3
1	0	0	0	1	0	0	0	1	1	0	0	1	1	4
1	0	0	0	1	0	1	1	0	1	1	0	1	1	5
1	0	0	0	1	1	0	1	0	1	1	1	1	1	6
1	0	0	0	1	1	1	1	1	1	0	0	0	0	7
1	0	0	1	0	0	0	1	1	1	1	1	1	1	8
1	0	0	1	0	0	1	1	1	1	1	0	1	1	9
1	0	0	1	0	1	0	0	0	0	0	0	0	0	Blank
1	0	0	1	0	1	1	0	0	0	0	0	0	0	Blank
1	0	0	1	1	0	0	0	0	0	0	0	0	0	Blank
1	0	0	1	1	0	1	0	0	0	0	0	0	0	Blank
1	0	0	1	1	1	0	0	0	0	0	0	0	0	Blank
1	0	0	1	1	1	1	0	0	0	0	0	0	0	Blank
0	0	0	x	x	x	x				**				*

x : Don't Care

* : For liquid crystal readouts, apply a square wave to Ph. For common cathode LED readouts, select Ph=0. For common anode LED readouts, select Ph=1

** : Depends upon the BCD coder previously applied when LD=1

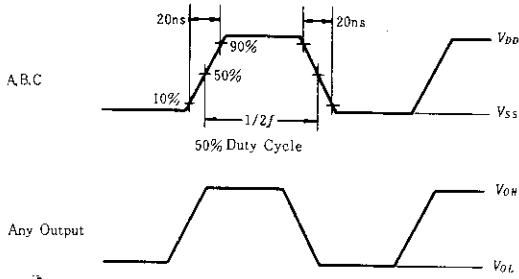
■ ELECTRICAL CHARACTERISTICS

Characteristic	Symbol	Test Conditions	-40°C		25°C		85°C		Unit	
			min	max	min	typ	max	min		max
Output Voltage	V_{OL}	$V_{in} = V_{DD}$ or 0	5.0	—	0.05	—	0	0.05	—	0.05
			10	—	0.05	—	0	0.05	—	0.05
			15	—	0.05	—	0	0.05	—	0.05
	V_{OH}	$V_{in} = 0$ or V_{DD}	5.0	4.95	—	4.95	5.0	—	4.95	—
			10	9.95	—	9.95	10	—	9.95	—
			15	14.95	—	14.95	15	—	14.95	—
Input Voltage	V_{IL}	5.0	—	1.5	—	2.25	1.5	—	1.5	
		10	—	3.0	—	4.50	3.0	—	3.0	
		15	—	4.0	—	6.75	4.0	—	4.0	
	V_{IH}	5.0	3.5	—	3.5	2.75	—	3.5	—	
		10	7.0	—	7.0	5.50	—	7.0	—	
		15	11.0	—	11.0	8.25	—	11.0	—	
Output Drive Current	I_{OH}	5.0	-1.0	—	-0.8	-1.7	—	-0.6	—	
		5.0	-0.2	—	-0.16	-0.36	—	-0.12	—	
		10	—	—	—	-8.7	—	—	—	
		10	-0.5	—	-0.4	-0.9	—	-0.3	—	
	15	-1.4	—	-1.2	-3.5	—	-1.0	—		
	I_{OL}	5.0	0.52	—	0.44	0.88	—	0.36	—	
		10	1.3	—	1.1	2.25	—	0.9	—	
		10	—	—	—	10.1	—	—	—	
15		3.6	—	3.0	8.8	—	2.4	—		
Input Current	I_{in}	15	—	±0.3	—	±0.0001	±0.3	—	±1.0	
Input Capacitance	C_{in}		—	—	—	5.0	7.5	—	—	
Quiescent Current	I_{DD}	5.0	—	20	—	0.005	20	—	150	
		10	—	40	—	0.010	40	—	300	
		15	—	80	—	0.015	80	—	600	
Total Supply Current*	I_T	5.0	—	—	—	1.6	—	—	—	
		10	—	—	—	3.1	—	—	—	
		15	—	—	—	4.7	—	—	—	

* To calculate total supply current at frequency other than 1kHz.

@ $V_{DD}=5.0V$ $I_T=(1.6\mu A/kHz)f+I_{DD}$, @ $V_{DD}=10V$ $I_T=(3.1\mu A/kHz)f+I_{DD}$, @ $V_{DD}=15V$ $I_T=(4.7\mu A/kHz)f+I_{DD}$

● Dynamic Power Dissipation Signal Waveforms



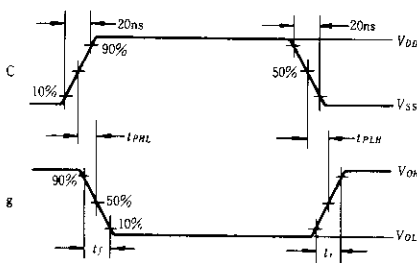
Note) 1. Input BI and Ph low, and Inputs D and LD high.
 2. f in respect to a system clock.
 3. All outputs connected to respective C_L loads.

■ SWITCHING CHARACTERISTICS ($C_L = 50\text{pF}$, $T_a = 25^\circ\text{C}$)

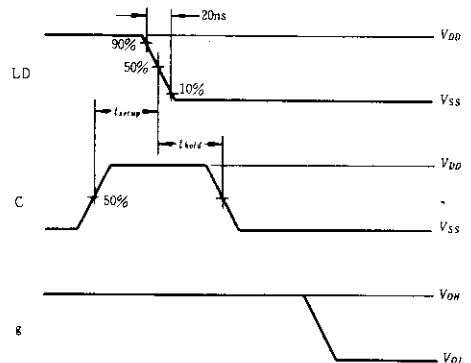
Characteristic	Symbol	V_{DD} (V)	min	typ	max	Unit
Output Rise Time	t_r	5.0	—	180	400	ns
		10	—	90	200	
		15	—	65	160	
Output Fall Time	t_f	5.0	—	120	250	ns
		10	—	60	125	
		15	—	40	100	
Propagation Delay Time	t_{PLH}	5.0	—	605	1650	ns
		10	—	250	660	
		15	—	185	495	
	t_{PHL}	5.0	—	505	1650	ns
		10	—	205	660	
		15	—	155	495	
Setup Time	t_{setup}	5.0	80	-40	—	ns
		10	30	-15	—	
		15	20	-10	—	
Hold Time	t_{hold}	5.0	120	40	—	ns
		10	45	15	—	
		15	30	10	—	
Latch Disable Pulse Width (Strobing Data)	PW_{LD}	5.0	375	125	—	ns
		10	150	50	—	
		15	120	40	—	

● DYNAMIC SIGNAL WAVEFORMS

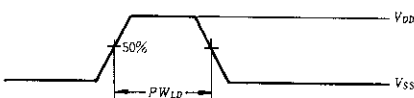
a) Inputs D, Ph, and BI low, and Inputs A, B, and LD high



b) Inputs D, Ph, and BI low, and Inputs A and B high.

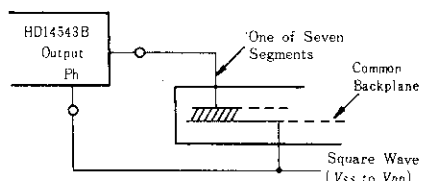


c) Data DCBA strobed into latches

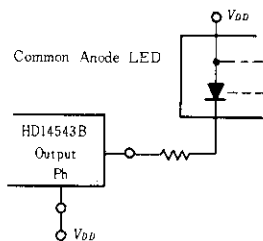
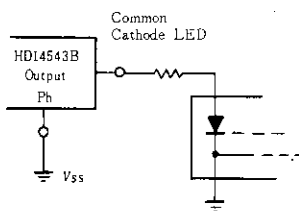


■ CONNECTIONS TO VARIOUS DISPLAY READOUTS

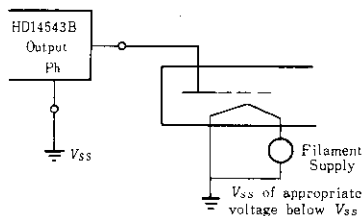
● LCD



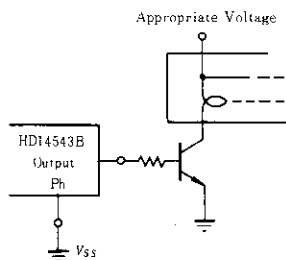
● LED



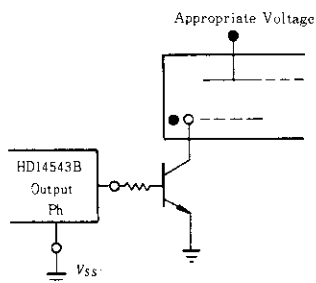
● Fluorescent Readout



● Incandescent Readout



● Gas Discharge Readout





Hitachi Code	DP-16
JEDEC	Conforms
EIAJ	Conforms
Weight (reference value)	1.07 g

Cautions

1. Hitachi neither warrants nor grants licenses of any rights of Hitachi's or any third party's patent, copyright, trademark, or other intellectual property rights for information contained in this document. Hitachi bears no responsibility for problems that may arise with third party's rights, including intellectual property rights, in connection with use of the information contained in this document.
2. Products and product specifications may be subject to change without notice. Confirm that you have received the latest product standards or specifications before final design, purchase or use.
3. Hitachi makes every attempt to ensure that its products are of high quality and reliability. However, contact Hitachi's sales office before using the product in an application that demands especially high quality and reliability or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support.
4. Design your application so that the product is used within the ranges guaranteed by Hitachi particularly for maximum rating, operating supply voltage range, heat radiation characteristics, installation conditions and other characteristics. Hitachi bears no responsibility for failure or damage when used beyond the guaranteed ranges. Even within the guaranteed ranges, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail-safes, so that the equipment incorporating Hitachi product does not cause bodily injury, fire or other consequential damage due to operation of the Hitachi product.
5. This product is not designed to be radiation resistant.
6. No one is permitted to reproduce or duplicate, in any form, the whole or part of this document without written approval from Hitachi.
7. Contact Hitachi's sales office for any questions regarding this document or Hitachi semiconductor products.

HITACHI

Hitachi, Ltd.

Semiconductor & Integrated Circuits.
Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan
Tel: Tokyo (03) 3270-2111 Fax: (03) 3270-5109

URL North America : <http://semiconductor.hitachi.com/>
 Europe : <http://www.hitachi-eu.com/hel/ecg>
 Asia (Singapore) : <http://www.has.hitachi.com.sg/grp3/sicd/index.htm>
 Asia (Taiwan) : http://www.hitachi.com.tw/E/Product/SICD_Frame.htm
 Asia (HongKong) : <http://www.hitachi.com.hk/eng/bo/grp3/index.htm>
 Japan : <http://www.hitachi.co.jp/Sicd/indx.htm>

For further information write to:

Hitachi Semiconductor
(America) Inc.
179 East Tasman Drive,
San Jose, CA 95134
Tel: <1> (408) 433-1990
Fax: <1> (408) 433-0223

Hitachi Europe GmbH
Electronic components Group
Dornacher Straße 3
D-85622 Feldkirchen, Munich
Germany
Tel: <49> (89) 9 9180-0
Fax: <49> (89) 9 29 30 00

Hitachi Europe Ltd.
Electronic Components Group.
Whitebrook Park
Lower Cookham Road
Maidenhead
Berkshire SL6 8YA, United Kingdom
Tel: <44> (1628) 585000
Fax: <44> (1628) 778322

Hitachi Asia Pte. Ltd.
16 Collyer Quay #20-00
Hitachi Tower
Singapore 049318
Tel: 535-2100
Fax: 535-1533

Hitachi Asia Ltd.
Taipei Branch Office
3F, Hung Kuo Building, No.167,
Tun-Hwa North Road, Taipei (105)
Tel: <886> (2) 2718-3666
Fax: <886> (2) 2718-8180

Hitachi Asia (Hong Kong) Ltd.
Group III (Electronic Components)
7/F., North Tower, World Finance Centre,
Harbour City, Canton Road, Tsim Sha Tsui,
Kowloon, Hong Kong
Tel: <852> (2) 735 9218
Fax: <852> (2) 730 0281
Telex: 40815 HITEC HX

Copyright ' Hitachi, Ltd., 1999. All rights reserved. Printed in Japan.

HITACHI