

## BCD-TO-SEVEN SEGMENT LATCH/ DECODER/DRIVER

### GENERAL DESCRIPTION

The MMC 4543 BCD-to-7 Segment Latch/Decoder/Driver is designed for use with liquid crystal readouts and is constructed with complementary MOS (CMOS) enhancement-mode devices. The circuit provides the functions of a 4-bit storage latch and a 8421 BCD-to-7 segment decoder and driver. The device has the capability to invert the logic levels of the output combinations. The Phase (Ph), Blanking (Bl), 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 readouts, a square wave is applied to the Ph input of the circuit and the electrically common back plane of the display. The outputs of the circuit are connected directly to the segments of the readout. For other types of readouts, such as light-emitting diode (LED), incandescent, gas discharge, and fluorescent readouts connections diagrams are given on this data sheet.

### FEATURES

- Phase input signal reproduced on outputs for liquid crystal display
- Latched storage of input code
- Blanking input for display intensity modulation
- Readout blanking for illegal input combinations
- Balanced output drive current specifications

### APPLICATIONS

Applications include instrument (e.g. counter, DVM, etc.) display driver, computer/calculator display driver, cockpit display driver, and various clock, watch, and timer uses.

### ABSOLUTE MAXIMUM RATINGS

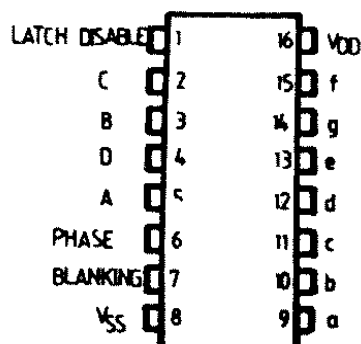
$V_{DD}^*$	Supply voltage: G and H types E and F types	-0.5 to -0.5 to	20 18	V V
$V_i$	Input voltage	-0.5 to	$V_{DD} + 0.5$	V
$I_i$	DC input current (any one input)		$\pm 10$	mA
$P_{tot}$	Total power dissipation (per package) Dissipation per output transistor for $T_A =$ full package-temperature range		200 100	mW mW
$T_A$	Operating temperature: G and H types E and F types	-55 to -40 to	125 85	$^{\circ}C$ $^{\circ}C$
$T_{stg}$	Storage temperature	-65 to	150	$^{\circ}C$

\* All voltage values are referred to  $V_{SS}$  pin voltage

### RECOMMENDED OPERATING CONDITIONS

$V_{DD}^*$	Supply voltage: G and H types E and F types	3 to 3 to	18 15	V V
$V_i$	Input voltage	0 to	$V_{DD}$	V
$T_A$	Operating temperature: G and H types E and F types	-55 to -40 to	125 85	$^{\circ}C$ $^{\circ}C$

### CONNECTION DIAGRAM



**STATIC ELECTRICAL CHARACTERISTICS**

(over recommended operating conditions)

PARAMETER		TEST CONDITIONS				VALUES						UNIT	
		V <sub>i</sub> (V)	V <sub>o</sub> (V)	I <sub>o</sub>   ( $\mu$ A)	V <sub>DD</sub> (V)	T <sub>LOW</sub>		25°C			T <sub>HIGH</sub>		
						min.	max.	min.	typ	max.	min.		max.
Quiescent current	G, H types	0/ 5			5		5		0.04	5		150	$\mu$ A
		0/10			10		10		0.04	10		300	
		0/15			15		20		0.04	20		600	
		0/20			20		100		0.08	100		3000	
	E, F types	0/ 5			5		20		0.04	20		150	
		0/10 0/15			10 15		40 80		0.04 0.04	40 80		300 600	
V <sub>OH</sub>	Output high voltage	0/ 5 0/10 0/15		< 1 < 1 < 1	5 10 15	4.95 9.95 14.95		4.95 9.95 14.95			4.95 9.95 14.95		V
V <sub>OL</sub>	Output low voltage	5 /0 10/0 15/0		< 1 < 1 < 1	5 10 15		0.05 0.05 0.05				0.05 0.05 0.05		V
V <sub>IH</sub>	Input high voltage		0.5/4.5 1/9 1.5/13.5	< 1 < 1 < 1	5 10 15	3.5 7 11		3.5 7 11			3.5 7 11		V
V <sub>IL</sub>	Input low voltage		4.5/0.5 9/1 13.5/1.5	< 1 < 1 < 1	5 10 15		1.5 3 4				1.5 3 4		V
I <sub>OH</sub>	Output drive current	G, H types	0/ 5	2.5		5	-2		-1.6	-3.2		-1.15	mA
			0/ 5	4.6		5	-0.64		-0.51	-1		-0.36	
			0/10	9.5		10	-1.6		-1.3	-2.6		-0.9	
			0/15	13.5		15	-4.2		-3.4	-6.8		-2.4	
	E, F types	0/ 5	2.5		5	-1.53		-1.36	-3.2		-1.1		
		0/ 5 0/10 0/15	4.6 9.5 13.5		5 10 15	-0.52 -1.3 -3.6		-0.44 -1.1 -3.0	-1 -2.6 -6.8		-0.36 -0.9 -2.4		
I <sub>OL</sub>	Output sink current	G, H types	0/ 5	0.4		5	0.64		0.51	1		0.36	mA
			0/10	0.5		10	1.6		1.3	2.6		0.9	
			0/15	1.5		15	4.2		3.4	6.8		2.4	
	E, F types	0/ 5	0.4		5	0.52		0.44	1		0.36		
		0/10	0.5		10	1.3		1.1	2.6		0.9		
		0/15	1.5		15	3.6		3.0	6.8		2.4		
I <sub>IH</sub> / I <sub>IL</sub>	Input leakage current	G, H types	0/18	Any input		18		$\pm 0.1$		$\pm 10^{-5}$	$\pm 0.1$		$\pm 1$
		E, F types	0/15		15		$\pm 0.3$		$\pm 10^{-5}$	$\pm 0.3$		$\pm 1$	
C <sub>i</sub>	Input capacitance		Any input						5	7.5			pF

\* T<sub>LOW</sub> = -55°C for G, H devices; -40°C for E, F devices.\* T<sub>HIGH</sub> = +125°C for G, H devices; +85°C for E, F devices.

The Noise Margin for both "1" and "0" level is:

1 V min. with V<sub>DD</sub> = 5 V2 V min. with V<sub>DD</sub> = 10 V2.5 V min. with V<sub>DD</sub> = 15 V

**DYNAMIC ELECTRICAL CHARACTERISTICS** $C_L = 5 \text{ pF}$ ,  $T_A = 25^\circ\text{C}$ 

PARAMETER	$V_{DD}$ (Vdc)	VALUES			UNIT
		min.	typ.	max.	
$t_{PHL}$ , $t_{PLH}$ Propagation delay time	5 10 15		550 210 160	1100 420 320	ns
$t_{TLH}$ , $t_{THL}$ Output transition time	5 10 15		100 50 40	200 100 80	ns
$t_{setup}$ Minimum data input setup time	5 10 15		-40 -15 -10	0 0 0	ns
$t_{hold}$ Minimum data input hold time	5 10 15		40 15 10	80 30 20	ns
$PW_{LD}$ Minimum LD pulse width	5 10 15		125 50 40	250 100 80	ns

**TRUTH TABLE**

INPUTS							OUTPUTS							Display
LD	BI	Ph*	D	C	B	A	a	b	c	d	e	f	g	
X	1	0	X	X	X	X	0	0	0	0	0	0	0	Blank
1	0	0	0	0	0	0	1	1	1	1	1	1	0	0
1	0	0	0	0	0	1	0	1	1	0	1	1	0	1
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								.
†	†	1				†	Inverse of output combinations above							Display as above

X = Don't care

† = Above combinations

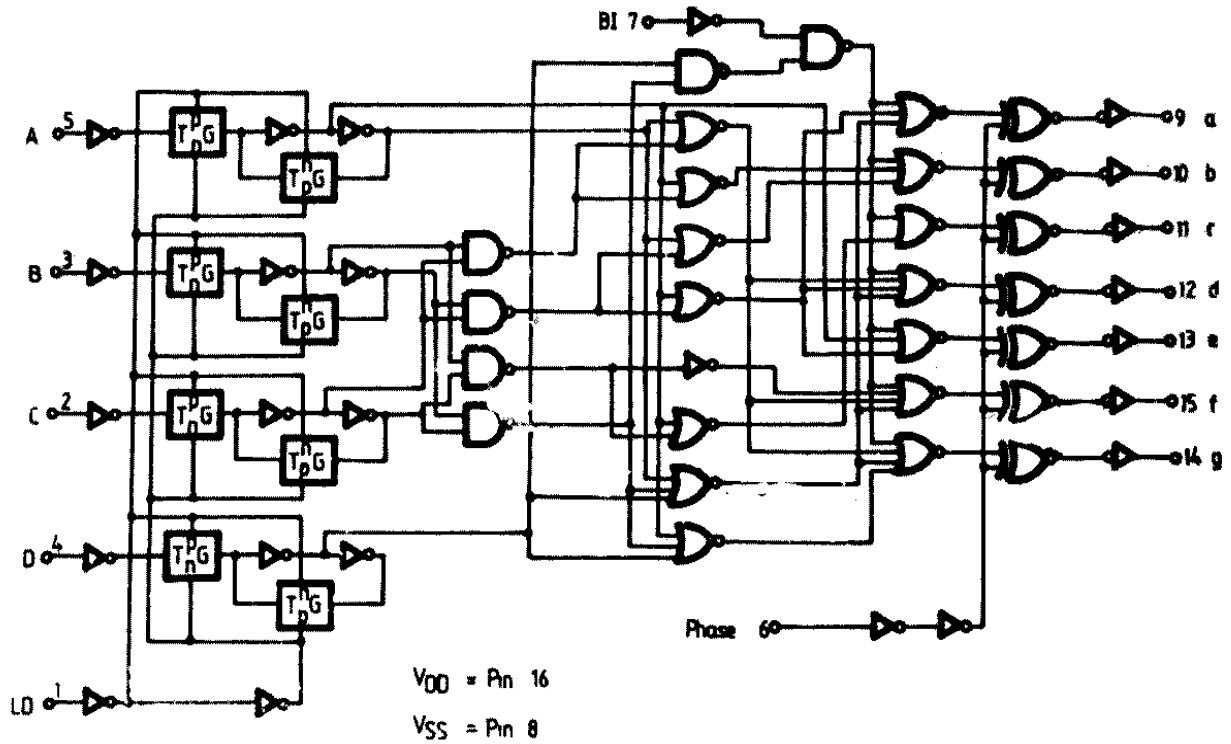
\* = For liquid crystal readouts, apply a square wave to Ph

For common cathode LED readouts, select Ph = 0

For common anode LED readouts, select Ph = 1

\*\* = Depends upon the BCD code previously applied when LD = 1

**LOGIC DIAGRAM**



**TYPICAL APPLICATIONS**

