

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

### GENERAL DESCRIPTION

The MMC 4511 is a monolithic integrated circuit available in 16-lead dual in-line plastic or ceramic package

The MMC 4511 type is a BCD-to-7-segment latch decoder driver constructed with COS/MOS logic and n-p-n bipolar transistor output devices on a single monolithic structure. This device combines the low quiescent power dissipation and high noise immunity features of COS/MOS with n-p-n bipolar output capable of sourcing up to 25 mA. This capability allows the MMC 4511 type to drive LED's and other displays directly. Lamp Test (LT), Blanking (BL) and Latch Enable or Strobe inputs are provided to test the display, shut off or intensity-modulate it, and store or strobe a BCD code, respectively. Several different signals may be multiplexed and displayed when external multiplexing circuitry is used.

### FEATURES

- High-output-sourcing capability (up to 25mA)
- Input latches for BCD code storage
- Lamp test and blanking capability
- 7-segment outputs blanked for BCD input codes > 1001

### APPLICATION

- Interfacing with various displays
- Driving common-cathode 7-segment LED displays
- Driving low-voltage fluorescent displays
- Driving incandescent displays.

### ABSOLUTE MAXIMUM RATINGS

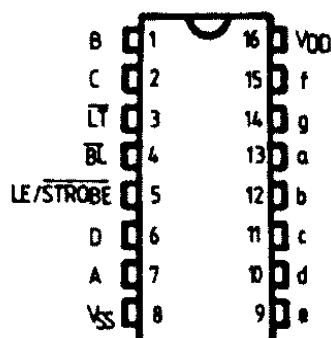
$V_{DD}^*$	Supply voltage: G and H types E and F types	-0.5 to -0.5 to	20 18	V V
$V_i$	Input voltage	-0.5 to	$V_{DD}+0.5$	V
$I_{IL}$	DC input current (any one input)		$\pm 10$	mA
$P_{tot}$	Total power dissipation (per package) Dissipation per output transistor for $T_A$ = full package-temperature range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

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

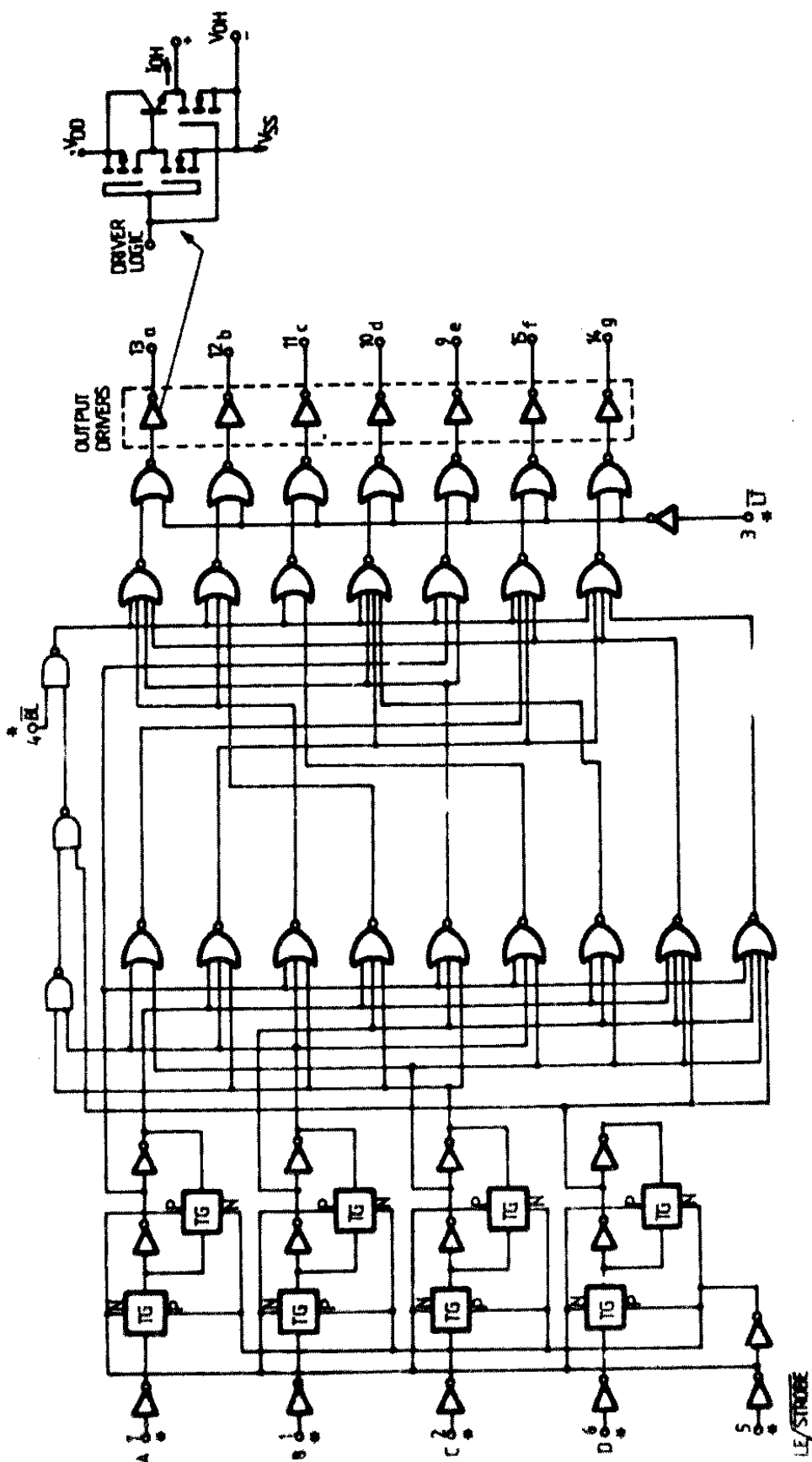
### RECOMMENDED OPERATING CONDITIONS

$V_{DD}^*$	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	°C °C

### CONNECTION DIAGRAM



LOGIC DIAGRAM



**TRUTH TABLE**

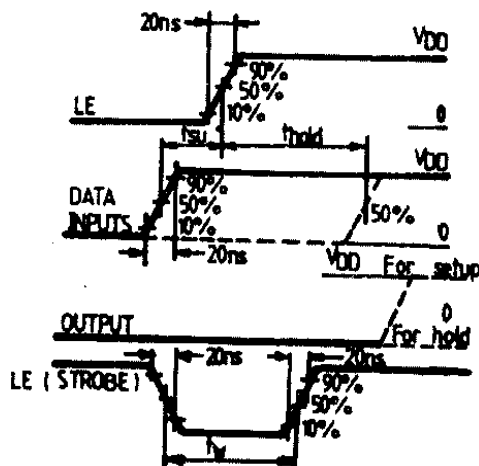
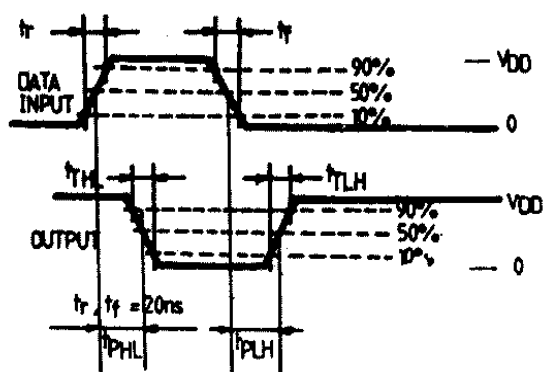
LE	BI	LT	D	C	B	A	a	b	c	d	e	f	g	Display
X	X	0	X	X	X	X	1	1	1	1	1	1	1	<b>8</b>
X	0	1	X	X	X	X	0	0	0	0	0	0	0	Blank
0	1	1	0	0	0	0	1	1	1	1	1	1	0	<b>0</b>
0	1	1	0	0	0	1	0	1	1	0	0	0	0	<b>1</b>
0	1	1	0	0	1	0	1	1	0	1	1	0	1	<b>2</b>
0	1	1	0	0	1	1	1	1	1	1	0	0	1	<b>3</b>
0	1	1	0	1	0	0	0	1	1	0	0	1	1	<b>4</b>
0	1	1	0	1	0	1	1	0	1	1	0	1	1	<b>5</b>
0	1	1	0	1	1	0	0	0	1	1	1	1	1	<b>6</b>
0	1	1	0	1	1	1	1	1	1	0	0	0	0	<b>7</b>
0	1	1	1	0	0	0	1	1	1	1	1	1	1	<b>8</b>
0	1	1	1	0	0	1	1	1	1	0	0	1	1	<b>9</b>
0	1	1	1	0	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	0	1	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	0	1	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	0	0	0	0	0	0	0	0	Blank
0	1	1	1	1	1	1	0	0	0	0	0	0	0	Blank
1	1	1	X	X	X	X				*				*

X = Don't care

\* = Depends on BCD code previously applied when LE = 0

Note : Display is blank for all illegal input codes (BCD > 1001)

**WAVEFORMS**



**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.		
I <sub>L</sub>	Quiescent current	G, H types	0/ 5			5		5		0.04	5		150		
			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			10		40		0.04	40		300		
			0/15			15		80		0.04	80		600		
V <sub>OH</sub>	Output high voltage		0/ 5			5	4		4.1	4.55		4.2		V	
			0/10			10	9		9.1	9.55		9.2			
			0/15			15	14		14.1	14.55		14.2			
V <sub>OL</sub>	Output low voltage		5 /0		< 1	5		0.05			0.05		0.05	V	
			10/0		< 1	10		0.05			0.05		0.05		
			15/0		< 1	15		0.05			0.05		0.05		
V <sub>IH</sub>	Input high voltage			0.5/4.5	< 1	5	3.5		3.5			3.5		V	
				1/9	< 1	10	7		7			7			
				1.5/13.5	< 1	15	11		11			11			
V <sub>IL</sub>	Input low voltage			4.5/0.5	< 1	5		1.5			1.5		1.5	V	
				9/1	< 1	10		3			3		3		
				13.5/1.5	< 1	15		4			4		4		
V <sub>OH</sub>	Output drive voltage	G, H types			0		4.1		4.1	4.55		4.2			
					5				4.25						
					10	5	3.8		3.9	4.10		3.9			
					15					3.95					
					20			3.55	3.4	3.75					
					25			3.4	3.1	3.55					
						0		9		9.1	9.55		9.2		
						5				9.25					
						10	10	8.85		9	9.15				
						15				9.05					
						20		8.7		8.6	8.9		8.4		
						25		8.6		8.3	8.75				
				0		14		14.1	14.55		14.2				
				5				14.3							
				10	15	13.9		14	14.2		14.0				
				15				14.1							
				20		13.75		13.7	13.95		13.5				
				25		13.65		13.5	13.8		13.1				
		E, F types			0		4.1		4.1	4.57		4.1		V	
				5				4.24							
				10	5	3.6		3.6	4.12		3.3				
				15				3.94							
				20		2.8		2.8	3.75		2.5				
				25				3.54							
				0		9.1		9.1	9.58		9.1				
				5				9.26							
				10	10	8.75		8.75	9.17		8.45				
				15				9.04							
				20		8.1		8.1	8.9		7.8				
				25				8.75							

**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.	
	E, F types			0 5 10 15 20 25	15	14.1		14.1	14.59 14.27 14.18 14.07 13.95 13.8		14.1		V	
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		$\pm 0.1$		$\pm 10^{-5}$	$\pm 0.1$		$\pm 1$	$\mu$ A
		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**(T<sub>A</sub> = 25°C, C<sub>L</sub> = 50 pF, R<sub>L</sub> = 200 k $\Omega$ , typical temperature coefficient for all V<sub>DD</sub> values is 0.3%/°C, all input rise and fall times = 20 ns)

PARAMETER		TEST CONDITIONS	VALUES			UNIT
		V <sub>DD</sub> (V)	min.	typ.	max.	
t <sub>PHL</sub>	Propagation delay time (Data)	5		520	1040	ns
		10		210	420	
		15		150	300	
t <sub>PLH</sub>	Propagation delay time (Data)	5		660	1320	ns
		10		260	520	
		15		180	360	
t <sub>PHL</sub>	Propagation delay time ( $\overline{BL}$ )	5		350	700	ns
		10		175	350	
		15		150	300	
t <sub>PLH</sub>	Propagation delay time ( $\overline{BL}$ )	5		400	800	ns
		10		175	350	
		15		150	300	
t <sub>PHL</sub>	Propagation delay time ( $\overline{LT}$ )	5		250	500	ns
		10		125	250	
		15		85	170	
t <sub>PLH</sub>	Propagation delay time ( $\overline{LT}$ )	5		150	300	ns
		10		75	150	
		15		50	100	

PARAMETER	TEST CONDITIONS	VALUES			UNIT
		VDD(V)	min.	typ.	
$t_{TLH}$ Transition time	5		40	80	ns
	10		30	60	
	15		20	50	
$t_{THL}$ Transition time	5		125	310	ns
	10		75	185	
	15		65	160	
$t_{setup}$ Setup time	5	150	75		ns
	10	70	35		
	15	40	20		
$t_{hold}$ Hold time	5	0	-75		ns
	10	0	-35		
	15	0	-20		
$t_w$ Strobe pulse width	5	400	200		ns
	10	160	80		
	15	100	50		

## APPLICATION

Driving common-cathode 7-segment LED displays

