



**MMC 4000 MMC 4001  
MMC 4002 MMC 4025**

# NOR GATES: 4000 DUAL 3 INPUT PLUS INVERTER 4001 QUAD 2 INPUT 4002 DUAL 4 INPUT 4025 TRIPLE 3 INPUT

## GENERAL DESCRIPTION

## FEATURES

These NOR gates are monolithic complementary MOS (CMOS) integrated circuits. The N and P channel enhancement mode transistors provide a symmetrical circuit with output swings essentially equal to the supply voltage. This results in high noise immunity over a wide supply voltage range. No DC power other than that caused by leakage current is consumed during static conditions. All inputs are protected against static discharge and latching conditions. The MMC 4000, MMC 4001, MMC 4002 and MMC 4025E/F/G/H

- Propagation delay time = 60 ns (typ) at  $C_L = 50$  pF  $V_{DD} = 10$  V
- Buffered inputs and outputs
- Standardized symmetrical output characteristics
- 100% tested for maximum quiescent current
- 5 V, 10 V and 15 V parametric ratings
- High noise immunity: 0.45  $V_{DD}$  (typical)

NOR gates provide the system designer with direct implementation of the NOR function.

The MMC 4000, MMC 4001, MMC 4002 and MMC 4025E/F/G/H types are supplied in 14-lead hermetic dual-in-line ceramic or plastic packages

## ABSOLUTE MAXIMUM RATINGS

$V_{DD}^*$	Supply voltage: G and H types E and F types	-0.5 to 20 -0.5 to 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	mW
$T_A$	Operating temperature : G and H types E and F types	-55 to 125 -40 to 85	$^{\circ}C$ $^{\circ}C$
$T_{stg}$	Storage temperature	-65 to 150	$^{\circ}C$

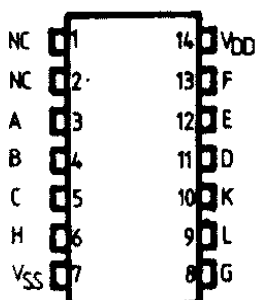
\* All voltage values are referred to  $V_{SS}$  pin voltage

## RECOMMENDED OPERATING CONDITIONS

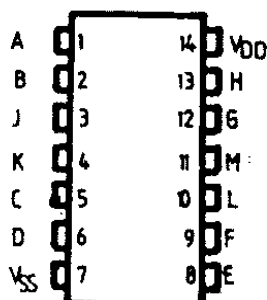
$V_{DD}^*$	Supply voltage: G and H types E and F types	3 to 18 3 to 15	V V
$V_i$	Input voltage	0 to $V_{DD}$	V
$T_A$	Operating temperature : G and H types E and F types	-55 to 125 -40 to 85	$^{\circ}C$ $^{\circ}C$

## CONNECTION DIAGRAMS

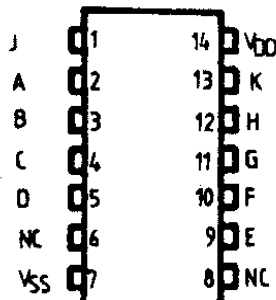
**MMC 4000**



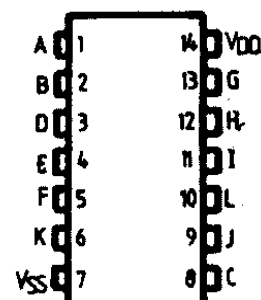
**MMC 4001**



**MMC 4002**



**MMC 4025**



## 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		0.25		0.01	0.25		7.5	$\mu$ A
		0/10			10		0.5		0.01	0.5		15	
		0/15			15		1		0.01	1		30	
		0/20			20		5		0.02	5		150	
	E, F types	0/5			5		1		0.01	1		7.5	
		0/10 0/15			10 15		2 4		0.01 0.01	2 4		15 30	
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		-0.38		
		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 <sup>-5</sup>	$\pm$ 0.1		$\pm$ 1	$\mu$ A
	E, F types	0/15			15		$\pm$ 0.3		$\pm$ 10 <sup>-5</sup>	$\pm$ 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 V

2 V min. with V<sub>DD</sub> = 10 V

2.5 V min. with V<sub>DD</sub> = 15 V

**MMC 4000 MMC 4001 MMC 4002 MMC 4025**

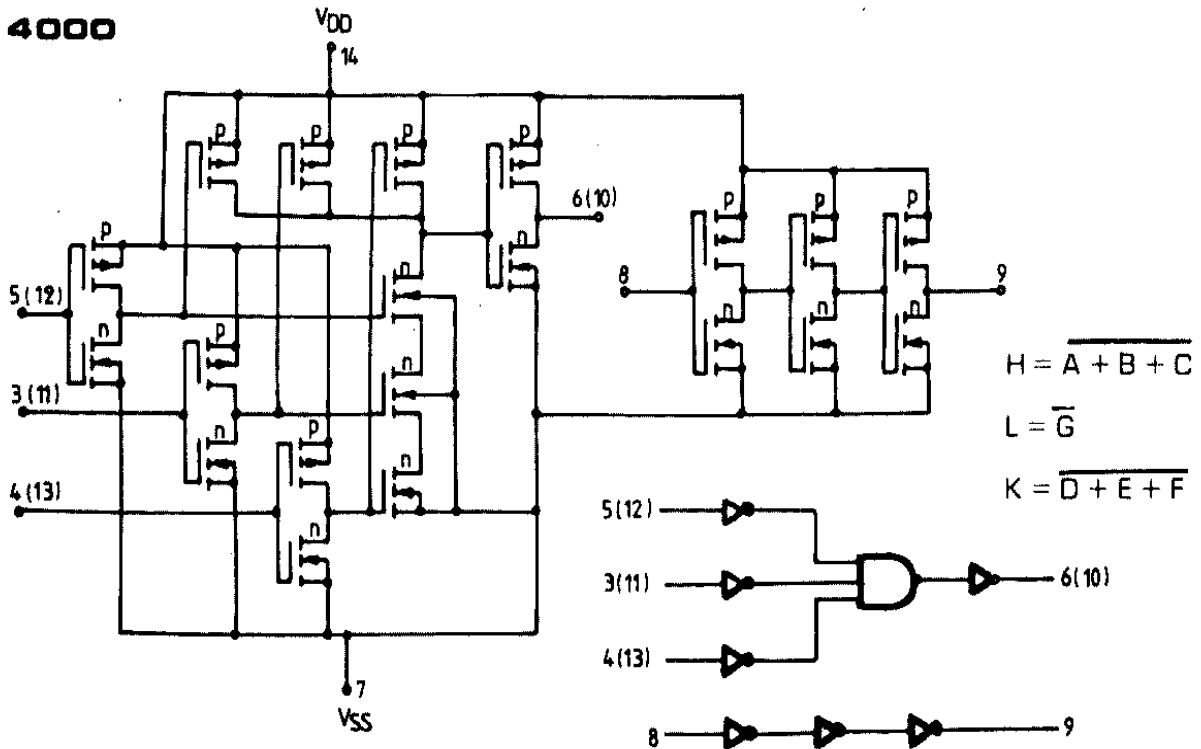
**DYNAMIC ELECTRICAL CHARACTERISTICS**

( $T_A = 25^\circ\text{C}$ ,  $C_L = 50\text{ pF}$ ,  $R_L = 200\text{ k}$ , typical temperature coefficient for all  $V_{DD}$  values is  $0.3\%/^\circ\text{C}$ , all input rise and fall times =  $20\text{ ns}$ )

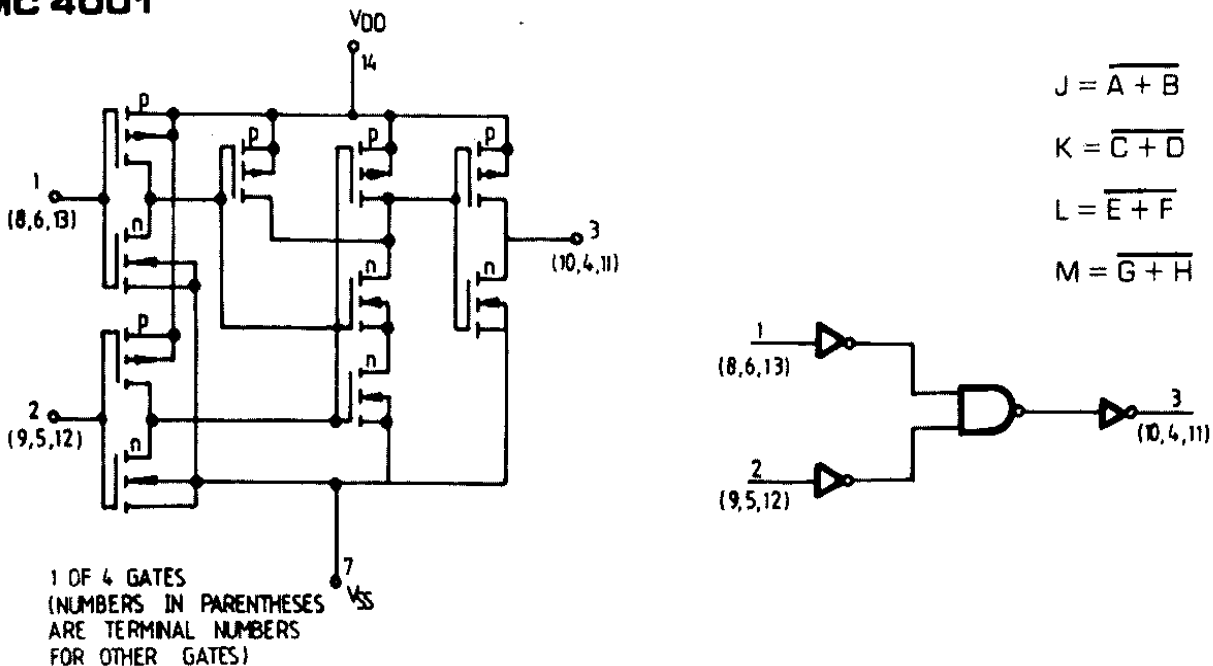
PARAMETER	TEST CONDITIONS	VALUES			UNIT
		$V_{DD}$ (V)	min	typ	
$t_{PLH}$ $t_{PHL}$ Propagation delay time	5		125	250	ns
	10		60	120	
	15		45	90	
$t_{THL}$ $t_{TLH}$ Transition time	5		100	200	ns <sup>†</sup>
	10		50	100	
	15		40	80	

**SCHEMATIC AND LOGIC DIAGRAMS**

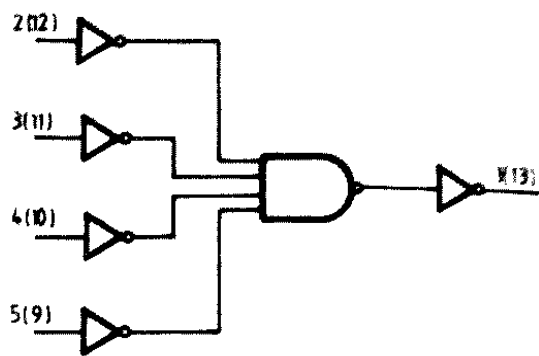
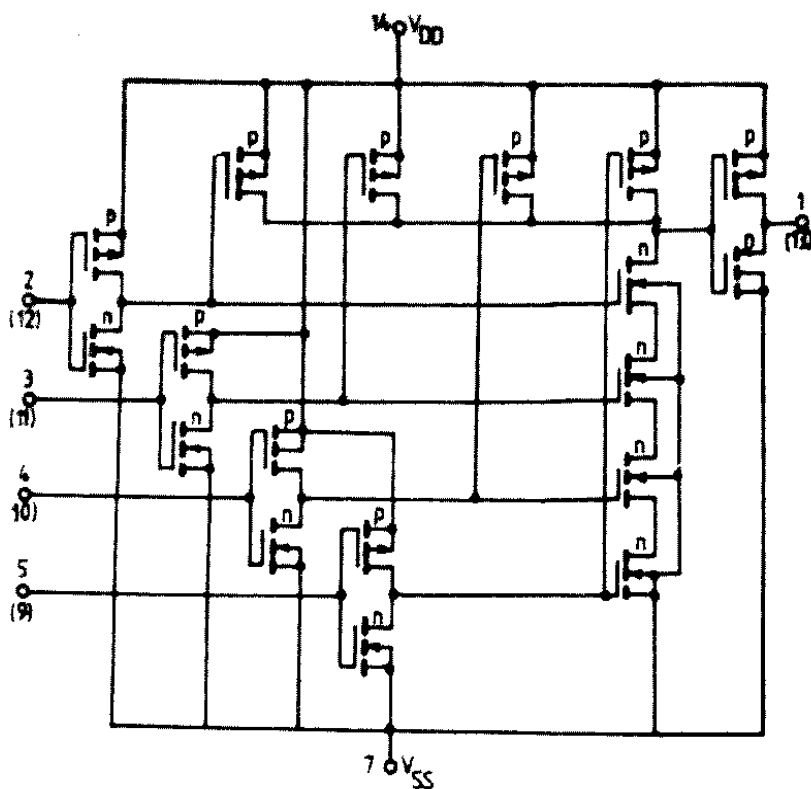
**MMC 4000**



**MMC 4001**



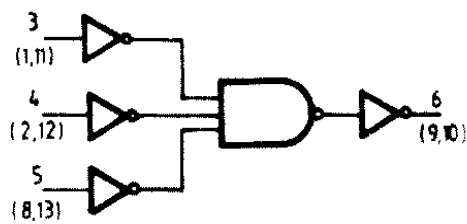
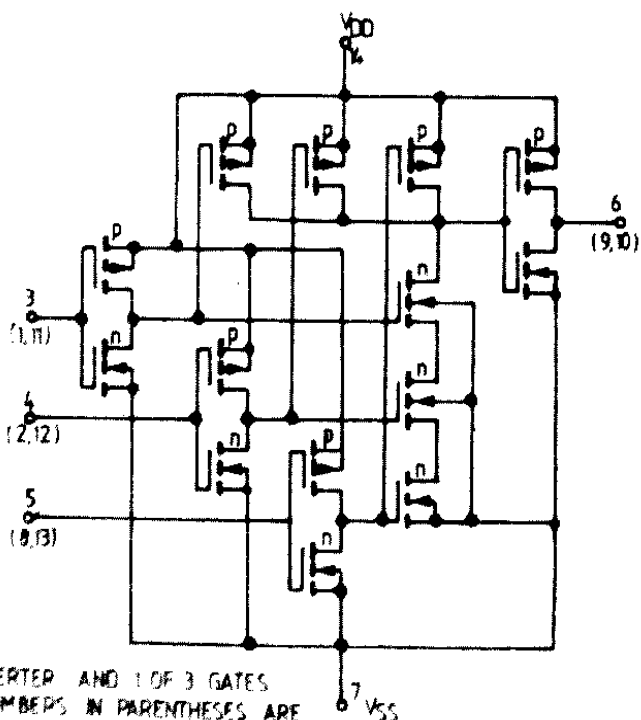
**MMC 4002**



$$J = \overline{A + B + C + D}$$

$$K = \overline{E + F + G + H}$$

**MMC 4025**



$$J = \overline{A + B + C}$$

$$K = \overline{D + E + F}$$

$$L = \overline{G + H + I}$$

INVERTER AND 1 OF 3 GATES  
(NUMBERS IN PARENTHESES ARE  
TERMINAL NUMBERS FOR SECOND GATE)