

# HEX INVERTER

## GENERAL DESCRIPTION

The MMC 4069 is a monolithic integrated circuit processed in standard Al-gate CMOS technology. The MMC 4069 consists of six CMOS inverter circuits. This device is intended for all general-purpose inverter applications where the medium-power TTL-drive and logic-level-conversion capabilities of circuits such as MMC 4049 Hex Inverter/Buffer are not required.

## FEATURES

- Medium-speed operation  
 $t_{PHL}, t_{PLH} = 30 \text{ ns (typ.) at } 10 \text{ V}$
- Quiescent current specified to 20 V
- 5 V, 10 V, 15 V parametric ratings

## ABSOLUTE MAXIMUM RATINGS

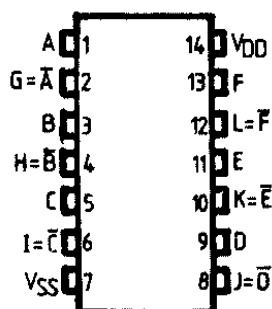
$V_{DD}^*$	Supply voltage: G and H types	-0.5 to	20	V
	E and F types	-0.5 to	18	V
$V_i$	Input voltage	-0.5 to	$V_{DD}+0.5$	V
$I_i$	DC input current (any one input)		$\pm 10$	mA
$P_{tot}$	Total power dissipation (per package)		200	mW
	Dissipation per output transistor for $T_A =$ full package-temperature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

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

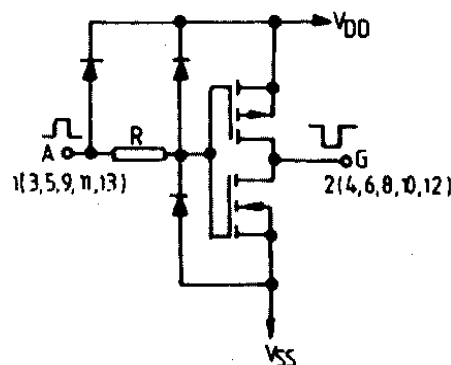
## RECOMMENDED OPERATING CONDITIONS

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

## CONNECTION DIAGRAM



## SCHEMATIC 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.
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			10		2		0.01	2		15		
			0/15			15		4		0.01	4		30	
V <sub>OH</sub>	Output high voltage		0/5		< 1	5	4.95		4.95			4.95	V	
			0/10		< 1	10	9.95		9.95			9.95		
			0/15		< 1	15	14.95		14.95			14.95		
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	4		4				V	
				1/9	< 1	10	8		8			8		
				1.5/13.5	< 1	15	12.5		12.5			12.5		
V <sub>IL</sub>	Input low voltage			4.5/0.5	< 1	5		1			1	1	V	
				9/1	< 1	10		2			2	2		
				13.5/1.5	< 1	15		2.5			2.5	2.5		
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	4.6		5	-0.52		-0.44	1		-0.36		
		0/10	9.5		10	-1.3		-1.1	2.6		-0.9			
		0/15	13.5		15	-3.6		-3.0	6.8		-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>IN</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

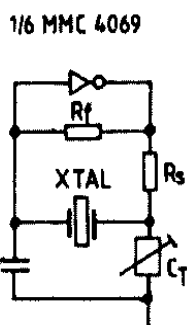
**DYNAMIC ELECTRICAL CHARACTERISTICS**

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

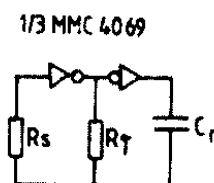
PARAMETER	TEST CONDITIONS	VALUES			UNIT
		$V_{DD}$ (V)	min.	typ.	
$t_{PLH}$ Propagation delay time $t_{PHL}$	5		55	110	ns
	10		30	60	
	15		25	50	
$t_{TLH}$ Transition time $t_{THL}$	5		100	200	ns
	10		50	100	
	15		40	80	

**APPLICATIONS**

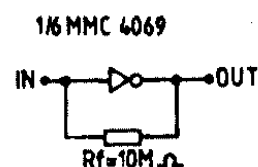
Typical crystal oscillator circuit



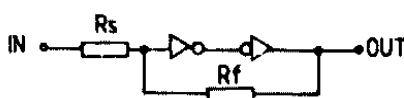
Typical RC oscillator circuit



High-input impedance amplifier



Input pulse shaping circuit (Schmitt trigger)



UPPER SWITCHING POINT

$$V_P = \frac{R_f + R_s}{R_f} \cdot \frac{V_{DD}}{2}$$

LOWER SWITCHING POINT

$$V_N = \frac{R_f - R_s}{R_f} \cdot \frac{V_{DD}}{2}$$

$$R_f > R_s$$