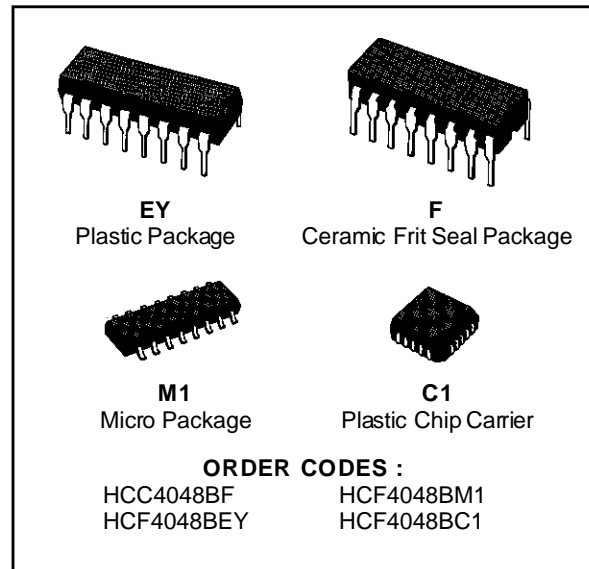


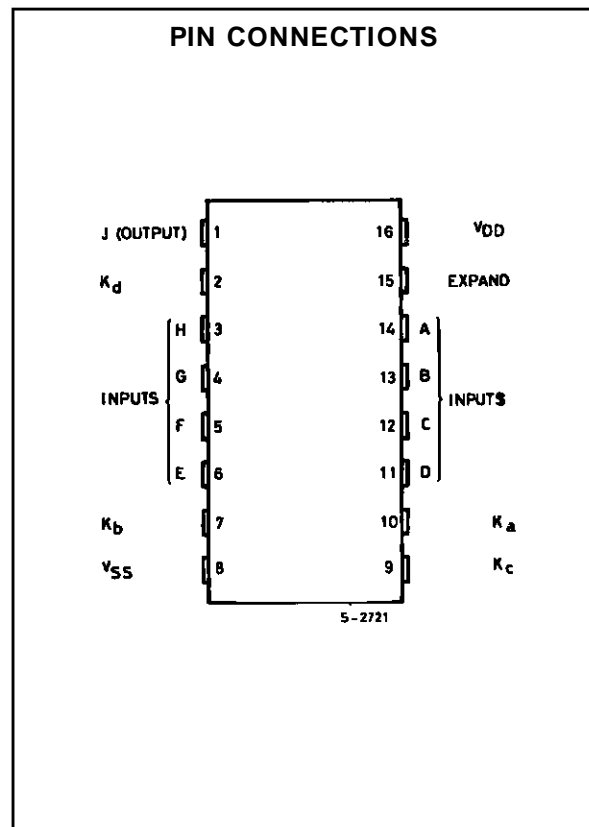
**MULTIFUNCTION EXPANDABLE 8-INPUT GATE**

- THREE-STATE OUTPUT
- MANY LOGIC FUNCTIONS AVAILABLE IN ONE PACKAGE
- QUIESCENT CURRENT SPECIFIED TO 20V FOR HCC DEVICE
- STANDARDIZED SYMMETRICAL OUTPUT CHARACTERISTICS
- 5V, 10V, AND 15V PARAMETRIC RATINGS
- INPUT CURRENT OF 100nA AT 18V AND 25°C FOR HCC DEVICE
- 100% TESTED FOR QUIESCENT CURRENT
- MEETS ALL REQUIREMENTS OF JEDEC TENTATIVE STANDARD N°. 13A, "STANDARD SPECIFICATIONS FOR DESCRIPTION OF "B" SERIES CMOS DEVICES"



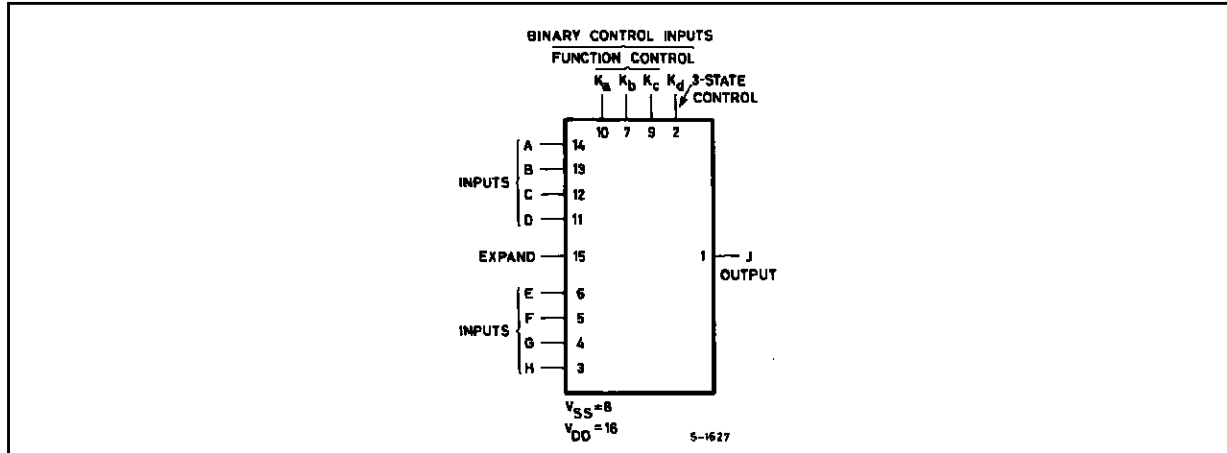
**DESCRIPTION**

The **HCC4048B** (extended temperature range) and **HCF4048B** (intermediate temperature range) are monolithic integrated circuit, available in 16-lead dual in-line plastic or ceramic package and plastic micro package. The **HCC/HCF4048B** is an 8-input gate having four control inputs. Three binary control inputs - Ka, Kb, and Kc - provide the implementation of eight different logic functions. These functions are OR, NOR, AND, NAND, OR/AND, OR/NAND, AND/OR and AND/NOR. A fourth control input-Kd provides the user with a 3-state output. When control input Kd is high the output is either a logic 1 or a logic 0 depending on the inner states. When control input Kd is low, the output is an open circuit. This feature enables the user to connect this device to a common bus line. In addition to the eight input lines, an EXPAND input is provided that permits the user to increase the number of inputs to one **HCC/HCF4048B**. For example, two **HCC/HCF4048B**'s can be cascaded to provide a 16-input multifunction gate. When the EXPAND input is not used, it should be connected to Vss.



# HCC/HCF4048B

## FUNCTIONAL DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
$V_{DD}^*$	Supply Voltage : <b>HCC</b> Types <b>HCF</b> 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)	200	mW
	Dissipation per Output Transistor for $T_{op} =$ Full Package-temperature Range	100	mW
$T_{op}$	Operating Temperature : <b>HCC</b> Types <b>HCF</b> Types	- 55 to + 125	$^{\circ}$ C
		- 40 to + 85	$^{\circ}$ C
$T_{stg}$	Storage Temperature	- 65 to + 150	$^{\circ}$ C

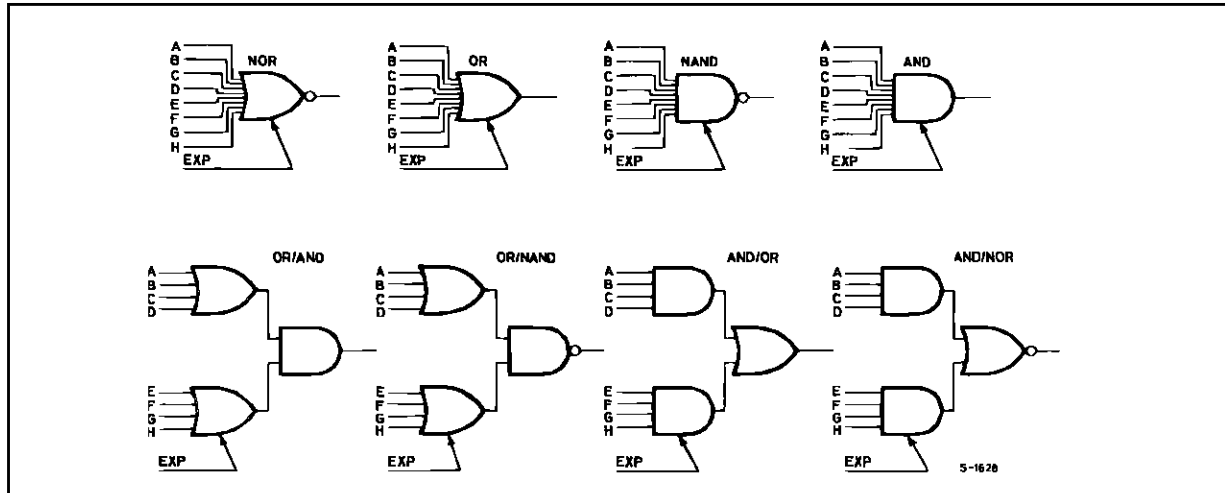
Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for external periods may affect device reliability.

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

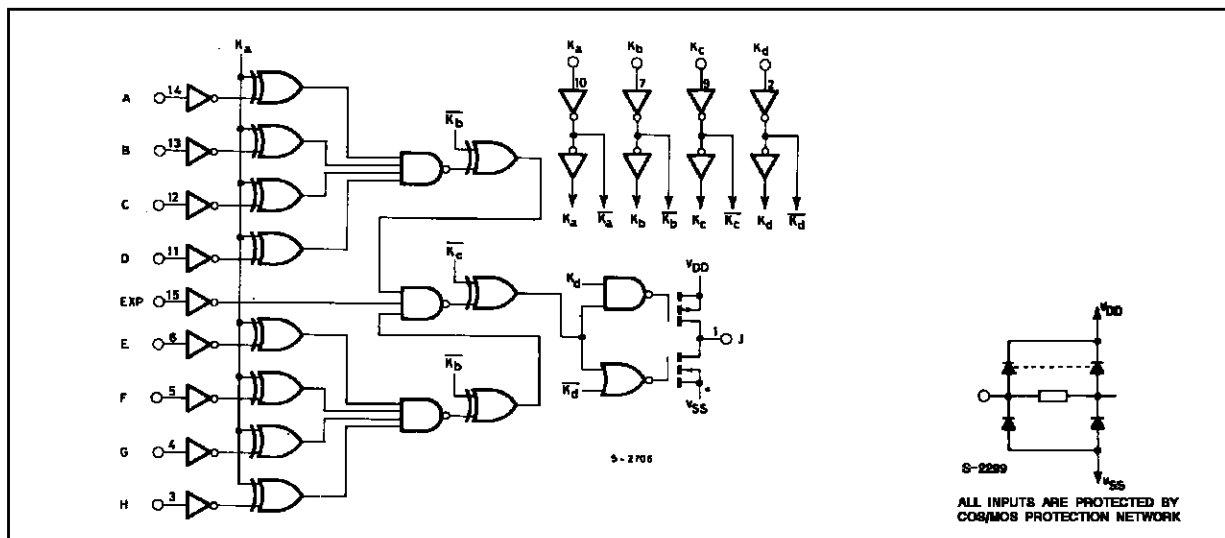
## RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
$V_{DD}$	Supply Voltage : <b>HCC</b> Types <b>HCF</b> Types	3 to 18	V
		3 to 15	V
$V_i$	Input Voltage	0 to $V_{DD}$	V
$T_{op}$	Operating Temperature : <b>HCC</b> Types <b>HCF</b> Types	- 55 to + 125	$^{\circ}$ C
		- 40 to + 85	$^{\circ}$ C

**BASIC LOGIC CONFIGURATIONS**



**LOGIC DIAGRAM**



**FUNCTION TRUTH TABLE**

Output Function	Boolean Expression	K <sub>a</sub>	K <sub>b</sub>	K <sub>c</sub>	Unused Input
NOR	$J = \overline{A+B+C+D+E+F+G+H}$	0	0	0	V <sub>SS</sub>
OR	$J = A + B + C + D + E + F + G + H$	0	0	1	V <sub>SS</sub>
OR/AND	$J = (A + B + C + D) \cdot (E + F + G + H)$	0	1	0	V <sub>SS</sub>
OR/NAND	$J = \overline{(A+B+C+D)} \cdot (E+F+G+H)$	0	1	1	V <sub>SS</sub>
AND	$J = ABCDEFGH$	1	0	0	V <sub>DD</sub>
NAND	$J = \overline{ABCDEFGH}$	1	0	1	V <sub>DD</sub>
AND/NOR	$J = \overline{ABCD} + EFGH$	1	1	0	V <sub>DD</sub>
AND/OR	$J = ABCD + EFGH$	1	1	1	V <sub>DD</sub>

K<sub>d</sub> = 1 Normal Inverter Action  
 K<sub>d</sub> = 0 High Impedance Output

EXPAND Input = 0

**STATIC ELECTRICAL CHARACTERISTICS** (over recommended operating conditions)

Symbol	Parameter		Test Conditions				Value						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	HCC Types	0/ 5			5		0.25		0.01	0.25		7.5	
			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	
		HCF Types	0/ 5			5		1		0.01	1		7.5	
			0/10			10		2		0.01	2		15	
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	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		
I <sub>OH</sub>	Output Drive Current	HCC 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		
		HCF 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		
I <sub>OL</sub>	Output Sink Current	HCC 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		
		HCF 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	HCC Types	0/18	Any Input		18		$\pm 0.1$		$\pm 10^{-5}$	$\pm 0.01$		$\pm 1$	
		HCF Types	0/15			15		$\pm 0.3$		$\pm 10^{-5}$	$\pm 0.3$		$\pm 1$	
I <sub>OH</sub>	3-state Output Current	HCC Types	0/18	0/18		18		$\pm 0.4$		$\pm 10^{-4}$	$\pm 0.4$		$\pm 12$	
		HCF Types	0/15	0/15		15		$\pm 1.0$		$\pm 10^{-4}$	$\pm 1.0$		$\pm 7.5$	
C <sub>I</sub>	Input Capacitance		Any Input						5	7.5		pF		

\* T<sub>Low</sub> = - 55°C for **HCC** device : - 40°C for **HCF** device.

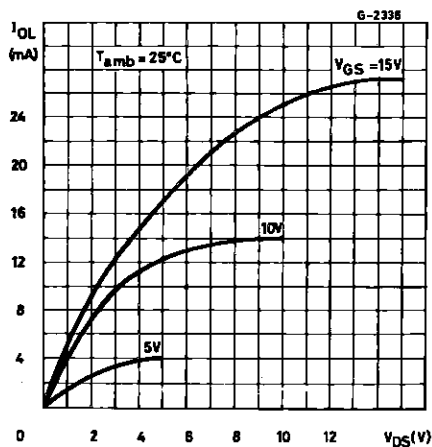
\* T<sub>High</sub> = - 125°C for **HCC** device : - 85°C for **HCF** device.

The Noise Margin for both "1" and "0" level is : 1V min. with V<sub>DD</sub> = 5V, 2V min. with V<sub>DD</sub> = 10V, 2.5V min. with V<sub>DD</sub> = 15V,

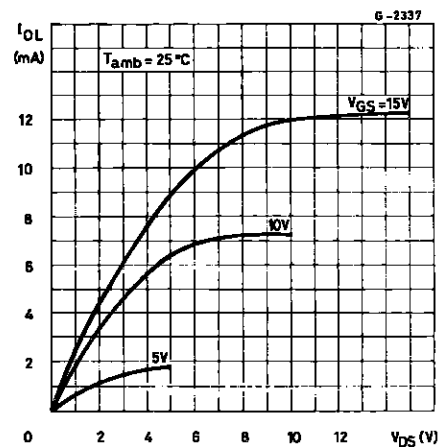
**DYNAMIC ELECTRICAL CHARACTERISTICS** ( $T_{amb} = 25^{\circ}\text{C}$ ,  $C_L = 50\text{pF}$ ,  $R_L = 200\text{k}\Omega$ , typical temperature coefficient for all  $V_{DD} = 0.3\%/^{\circ}\text{C}$  values, all input rise and fall time = 20ns)

Symbol	Parameter	Test Conditions		Value			Unit
			$V_{DD}$ (V)	Min.	Typ.	Max.	
$t_{PHL}$ , $t_{PLH}$	Propagation Delay Time Inputs to Output and Ka to Output		5		300	600	ns
			10		150	300	
			15		120	240	
	Kb to Output		5		225	450	
			10		85	170	
			15		55	110	
	Kc to Output		5		140	280	
			10		50	100	
			15		40	80	
	Expand Input to Output		5		190	380	
			10		90	180	
			15		65	130	
$t_{PHZ}$ , $t_{PLZ}$ $t_{PZH}$ , $t_{PZL}$	3-state Propagation Delay Time Kd to Output	$R_L = 1\text{k}\Omega$	5		80	160	
			10		35	70	
			15		25	50	
$t_{THL}$ , $t_{TLH}$	Transition Time		5		100	200	
			10		50	100	
			15		40	80	
3-state Output Capacitance					5	10	pF

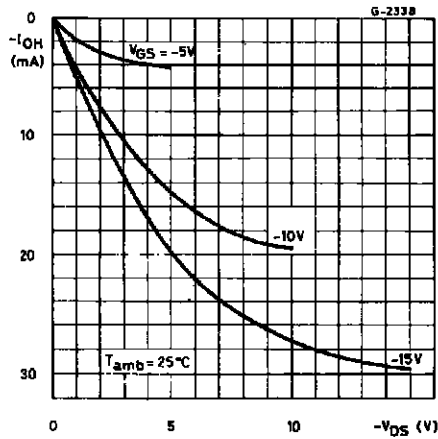
Typical Output Low (sink) Current Characteristics.



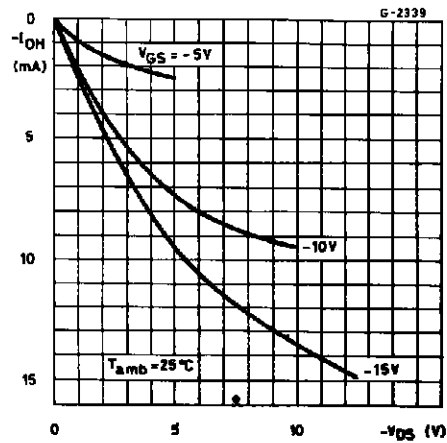
Minimum Output Low (sink) Current Characteristics.



Typical Output High (source) Current Characteristics.

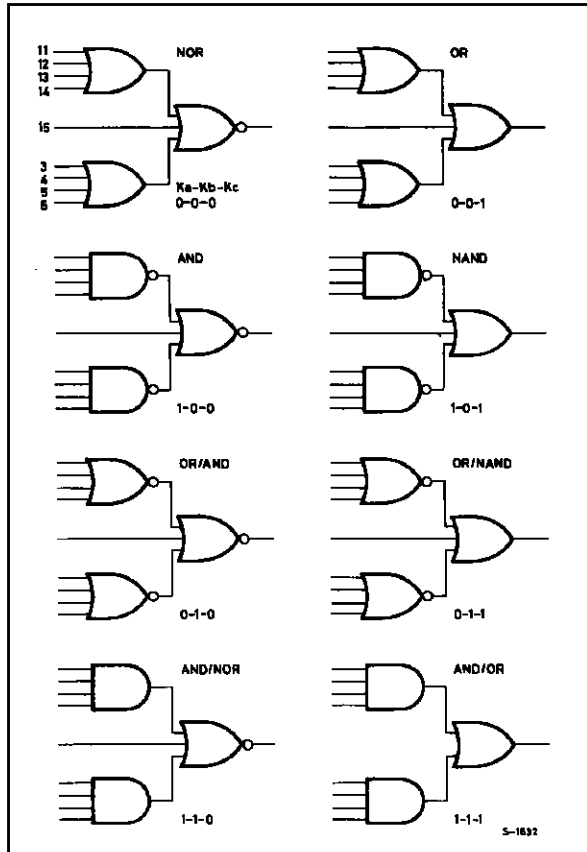


Minimum Output high (source) Current Characteristics.



APPLICATIONS OF EXPAND INPUT

ACTUAL-CIRCUIT LOGIC CONFIGURATIONS



EXPANSION LOGIC AND TRUTH TABLE

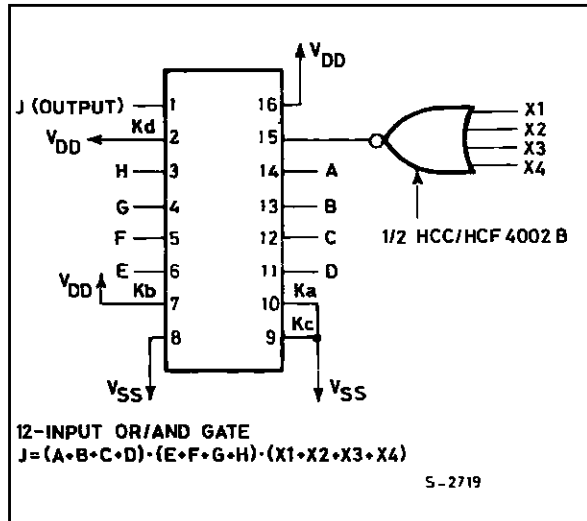
IMPLEMENTATION OF EXPAND INPUT FOR 9 OR MORE INPUTS

OUTPUT FUNCTION	FUNCTION NEEDED AT EXPAND INPUT	OUTPUT BOOLEAN EXPRESSION
NOR	OR	$J = \overline{(A+B+C+D+E+F+G+H) + (EXP)}$
OR	OR	$J = (A+B+C+D+E+F+G+H) + (EXP)$
AND	NAND	$J = (ABCDEFHG) \cdot (EXP)$
NAND	NAND	$J = \overline{(ABCDEFHG) \cdot (EXP)}$
OR/AND	NOR	$J = (A+B+C+D) \cdot (E+F+G+H) \cdot (EXP)$
OR/NAND	NOR	$J = \overline{(A+B+C+D) \cdot (E+F+G+H) \cdot (EXP)}$
AND/NOR	AND	$J = \overline{(ABCD) + (EFGH) + (EXP)}$
AND/OR	AND	$J = (ABCD) + (EFGH) + (EXP)$

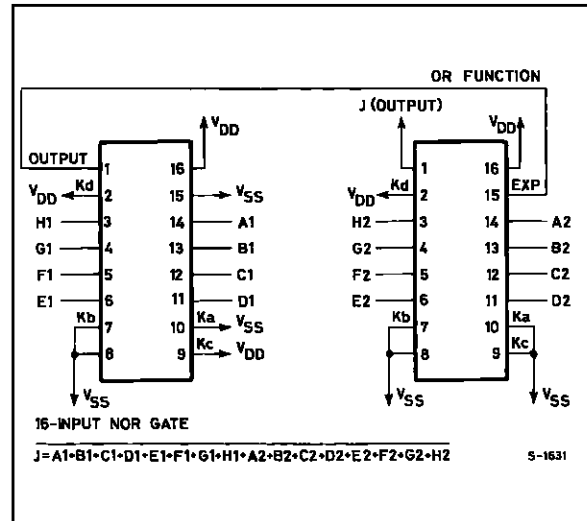
Note : (EXP) designates the EXPAND function (i.e.,  $X_1 + X_2 + \dots + X_N$ ).

APPLICATIONS OF EXPAND INPUT (continued)

12-Input or/and Gate.

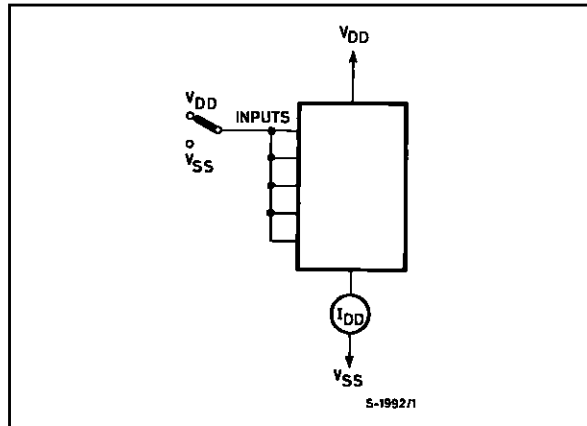


16-Input Nor Gate.

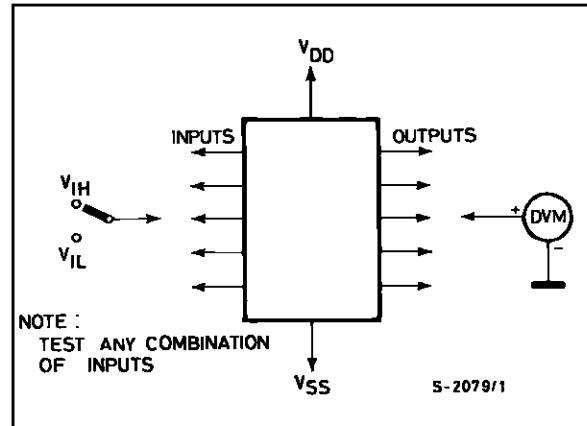


TEST CIRCUITS

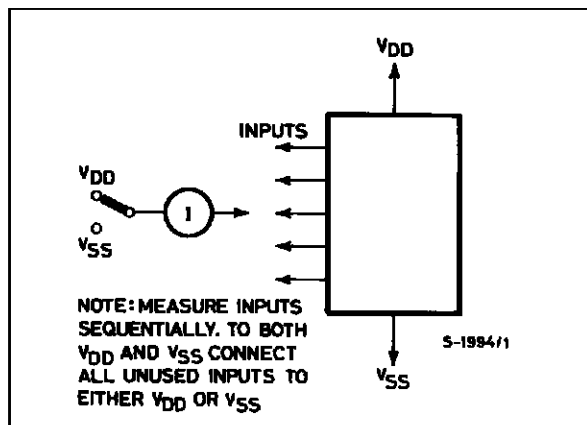
Quiescent Device Current.



Input Voltage.



Input Current.



**Plastic DIP16 (0.25) MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
I			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050



P001C



## Ceramic DIP16/1 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			20			0.787
B			7			0.276
D		3.3			0.130	
E	0.38			0.015		
e3		17.78			0.700	
F	2.29		2.79	0.090		0.110
G	0.4		0.55	0.016		0.022
H	1.17		1.52	0.046		0.060
L	0.22		0.31	0.009		0.012
M	0.51		1.27	0.020		0.050
N			10.3			0.406
P	7.8		8.05	0.307		0.317
Q			5.08			0.200



**SO16 (Narrow) MECHANICAL DATA**

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A			1.75			0.068
a1	0.1		0.2	0.004		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	9.8		10	0.385		0.393
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		8.89			0.350	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.62			0.024
S	8° (max.)					



P013H

## PLCC20 MECHANICAL DATA

DIM.	mm			inch		
	MIN.	TYP.	MAX.	MIN.	TYP.	MAX.
A	9.78		10.03	0.385		0.395
B	8.89		9.04	0.350		0.356
D	4.2		4.57	0.165		0.180
d1		2.54			0.100	
d2		0.56			0.022	
E	7.37		8.38	0.290		0.330
e		1.27			0.050	
e3		5.08			0.200	
F		0.38			0.015	
G			0.101			0.004
M		1.27			0.050	
M1		1.14			0.045	



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