

MC14001B Series

B-Suffix Series CMOS Gates

MC14001B, MC14011B, MC14023B,
MC14025B, MC14071B, MC14073B,
MC14081B, MC14082B

The B Series logic gates are constructed with P and N channel enhancement mode devices in a single monolithic structure (Complementary MOS). Their primary use is where low power dissipation and/or high noise immunity is desired.

- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- All Outputs Buffered
- Capable of Driving Two Low-power TTL Loads or One Low-power Schottky TTL Load Over the Rated Temperature Range.
- Double Diode Protection on All Inputs Except: Triple Diode Protection on MC14011B and MC14081B
- Pin-for-Pin Replacements for Corresponding CD4000 Series B Suffix Devices

MAXIMUM RATINGS (Voltages Referenced to V_{SS}) (Note 1)

Symbol	Parameter	Value	Unit
V_{DD}	DC Supply Voltage Range	- 0.5 to +18.0	V
V_{in} , V_{out}	Input or Output Voltage Range (DC or Transient)	- 0.5 to $V_{DD} + 0.5$	V
I_{in} , I_{out}	Input or Output Current (DC or Transient) per Pin	± 10	mA
P_D	Power Dissipation, per Package (Note 2)	500	mW
T_A	Ambient Temperature Range	- 55 to +125	°C
T_{stg}	Storage Temperature Range	- 65 to +150	°C
T_L	Lead Temperature (8-Second Soldering)	260	°C

1. Maximum Ratings are those values beyond which damage to the device may occur.
2. Temperature Derating:
Plastic "P and D/DW" Packages: - 7.0 mW/°C From 65°C To 125°C

This device contains protection circuitry to guard against damage due to high static voltages or electric fields. However, precautions must be taken to avoid applications of any voltage higher than maximum rated voltages to this high-impedance circuit. For proper operation, V_{in} and V_{out} should be constrained to the range $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$.

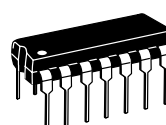
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.



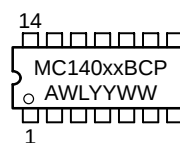
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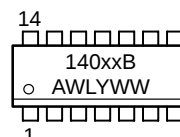
MARKING DIAGRAMS



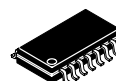
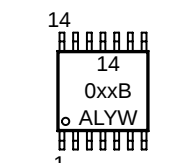
PDIP-14
P SUFFIX
CASE 646



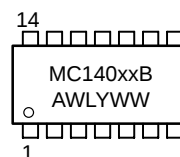
SOIC-14
D SUFFIX
CASE 751A



TSSOP-14
DT SUFFIX
CASE 948G



SOEIAJ-14
F SUFFIX
CASE 965



xx = Specific Device Code
A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week

DEVICE INFORMATION

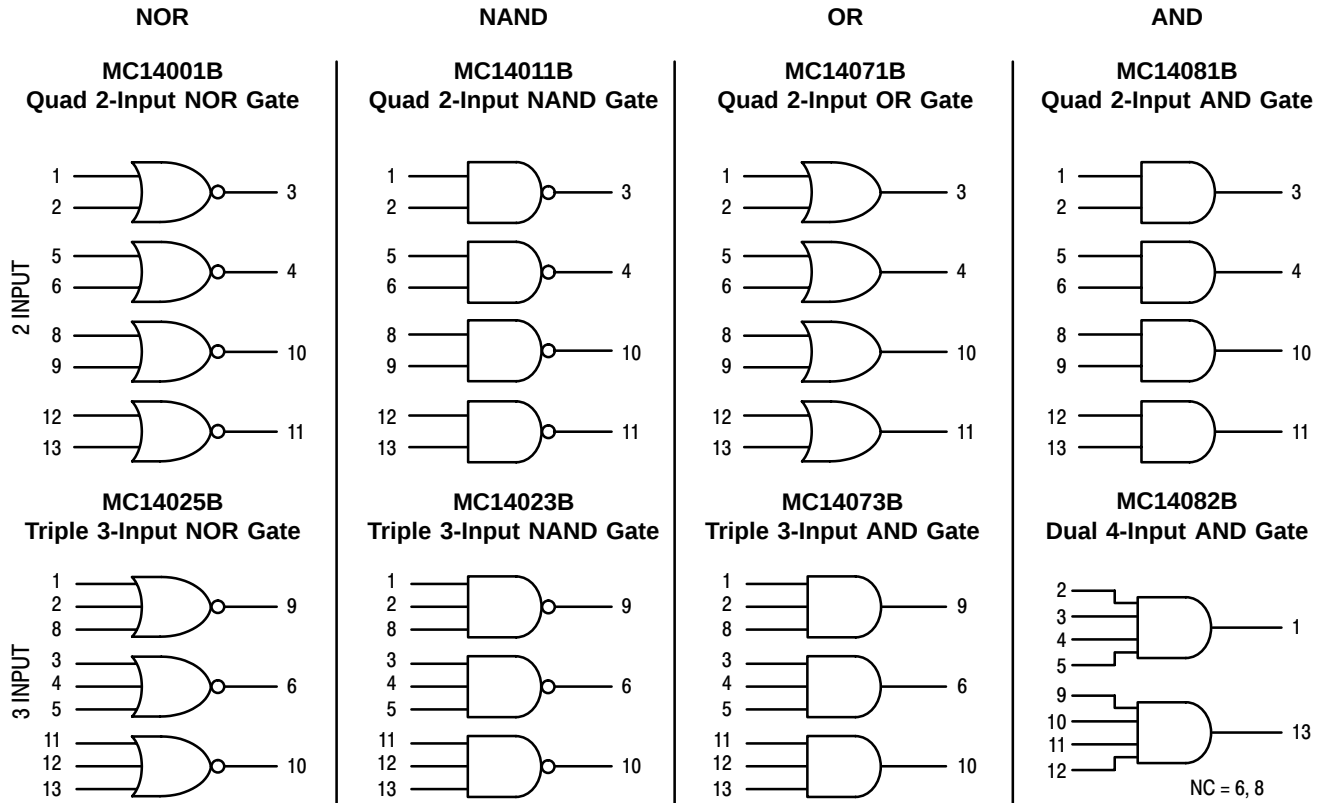
Device	Description
MC14001B	Quad 2-Input NOR Gate
MC14011B	Quad 2-Input NAND Gate
MC14023B	Triple 3-Input NAND Gate
MC14025B	Triple 3-Input NOR Gate
MC14071B	Quad 2-Input OR Gate
MC14073B	Triple 3-Input AND Gate
MC14081B	Quad 2-Input AND Gate
MC14082B	Dual 4-Input AND Gate

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 11 of this data sheet.

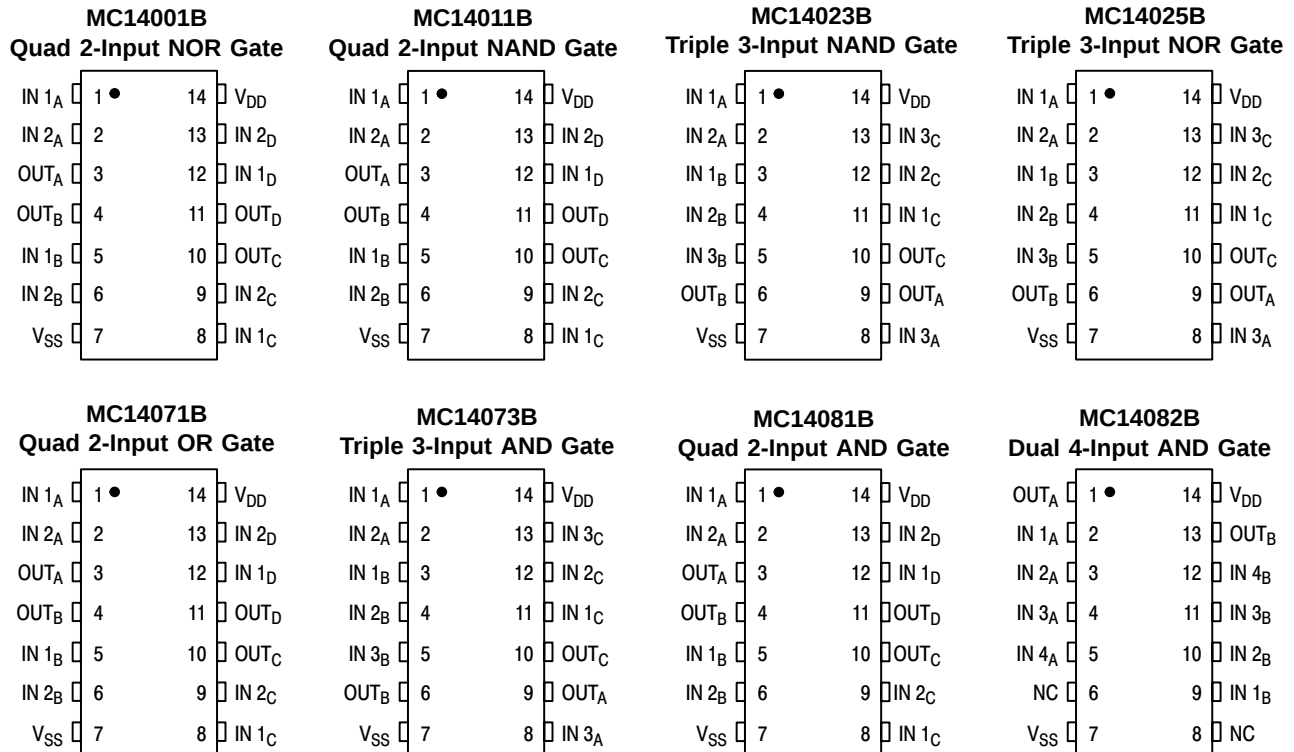
MC14001B Series

LOGIC DIAGRAMS



V_{DD} = PIN 14
 V_{SS} = PIN 7
 FOR ALL DEVICES

PIN ASSIGNMENTS



NC = NO CONNECTION

MC14001B Series

ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic	Symbol	V _{DD} Vdc	- 55°C		25°C			125°C		Unit
			Min	Max	Min	Typ ⁽³⁾	Max	Min	Max	
Output Voltage V _{in} = V _{DD} or 0	V _{OL}	5.0	—	0.05	—	0	0.05	—	0.05	Vdc
		10	—	0.05	—	0	0.05	—	0.05	
		15	—	0.05	—	0	0.05	—	0.05	
	V _{OH}	5.0	4.95	—	4.95	5.0	—	4.95	—	Vdc
		10	9.95	—	9.95	10	—	9.95	—	
		15	14.95	—	14.95	15	—	14.95	—	
Input Voltage (V _O = 4.5 or 0.5 Vdc) (V _O = 9.0 or 1.0 Vdc) (V _O = 13.5 or 1.5 Vdc)	V _{IL}	5.0	—	1.5	—	2.25	1.5	—	1.5	Vdc
		10	—	3.0	—	4.50	3.0	—	3.0	
		15	—	4.0	—	6.75	4.0	—	4.0	
	V _{IH}	5.0	3.5	—	3.5	2.75	—	3.5	—	Vdc
		10	7.0	—	7.0	5.50	—	7.0	—	
		15	11	—	11	8.25	—	11	—	
Output Drive Current (V _{OH} = 2.5 Vdc) (V _{OH} = 4.6 Vdc) (V _{OH} = 9.5 Vdc) (V _{OH} = 13.5 Vdc)	Source I _{OH}	5.0	- 3.0	—	- 2.4	- 4.2	—	- 1.7	—	mAdc
		5.0	- 0.64	—	- 0.51	- 0.88	—	- 0.36	—	
		10	- 1.6	—	- 1.3	- 2.25	—	- 0.9	—	
		15	- 4.2	—	- 3.4	- 8.8	—	- 2.4	—	
	Sink I _{OL}	5.0	0.64	—	0.51	0.88	—	0.36	—	mAdc
		10	1.6	—	1.3	2.25	—	0.9	—	
		15	4.2	—	3.4	8.8	—	2.4	—	
Input Current	I _{in}	15	—	± 0.1	—	± 0.00001	± 0.1	—	± 1.0	µAdc
Input Capacitance (V _{in} = 0)	C _{in}	—	—	—	—	5.0	7.5	—	—	pF
Quiescent Current (Per Package)	I _{DD}	5.0	—	0.25	—	0.0005	0.25	—	7.5	µAdc
		10	—	0.5	—	0.0010	0.5	—	15	
		15	—	1.0	—	0.0015	1.0	—	30	
Total Supply Current ^{(4) (5)} (Dynamic plus Quiescent, Per Gate, C _L = 50 pF)	I _T	5.0	I _T = (0.3 µA/kHz) f + I _{DD} /N I _T = (0.6 µA/kHz) f + I _{DD} /N I _T = (0.9 µA/kHz) f + I _{DD} /N							µAdc

3. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

4. The formulas given are for the typical characteristics only at 25°C.

5. To calculate total supply current at loads other than 50 pF:

$$I_T(C_L) = I_T(50 \text{ pF}) + (C_L - 50) \text{ Vfk}$$

where: I_T is in µA (per package), C_L in pF, V = (V_{DD} - V_{SS}) in volts, f in kHz is input frequency, and k = 0.001 x the number of exercised gates per package.

MC14001B Series

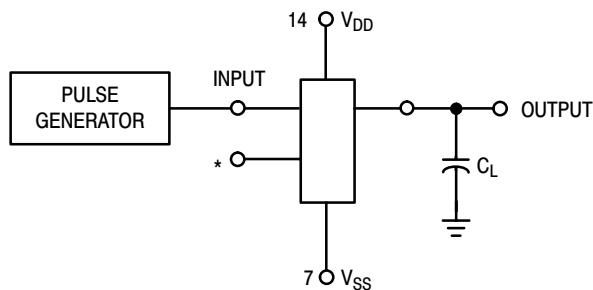
B-SERIES GATE SWITCHING TIMES

SWITCHING CHARACTERISTICS ⁽⁶⁾ ($C_L = 50 \text{ pF}$, $T_A = 25^\circ\text{C}$)

Characteristic	Symbol	V_{DD} Vdc	Min	Typ ⁽⁷⁾	Max	Unit
Output Rise Time, All B-Series Gates $t_{TLH} = (1.35 \text{ ns/pF}) C_L + 33 \text{ ns}$ $t_{TLH} = (0.60 \text{ ns/pF}) C_L + 20 \text{ ns}$ $t_{TLH} = (0.40 \text{ ns/pF}) C_L + 20 \text{ ns}$	t_{TLH}	5.0 10 15	— — —	100 50 40	200 100 80	ns
Output Fall Time, All B-Series Gates $t_{THL} = (1.35 \text{ ns/pF}) C_L + 33 \text{ ns}$ $t_{THL} = (0.60 \text{ ns/pF}) C_L + 20 \text{ ns}$ $t_{THL} = (0.40 \text{ ns/pF}) C_L + 20 \text{ ns}$	t_{THL}	5.0 10 15	— — —	100 50 40	200 100 80	ns
Propagation Delay Time MC14001B, MC14011B only $t_{PLH}, t_{PHL} = (0.90 \text{ ns/pF}) C_L + 80 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.36 \text{ ns/pF}) C_L + 32 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.26 \text{ ns/pF}) C_L + 27 \text{ ns}$ All Other 2, 3, and 4 Input Gates $t_{PLH}, t_{PHL} = (0.90 \text{ ns/pF}) C_L + 115 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.36 \text{ ns/pF}) C_L + 47 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.26 \text{ ns/pF}) C_L + 37 \text{ ns}$ 8-Input Gates (MC14068B, MC14078B) $t_{PLH}, t_{PHL} = (0.90 \text{ ns/pF}) C_L + 155 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.36 \text{ ns/pF}) C_L + 62 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.26 \text{ ns/pF}) C_L + 47 \text{ ns}$	t_{PLH}, t_{PHL}	5.0 10 15 5.0 10 15 5.0 10 15	— — — — — — — — —	125 50 40 160 65 50 200 80 60	250 100 80 300 130 100 350 150 110	ns

6. The formulas given are for the typical characteristics only at 25°C .

7. Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.



*All unused inputs of AND, NAND gates must be connected to V_{DD} .
 All unused inputs of OR, NOR gates must be connected to V_{SS} .

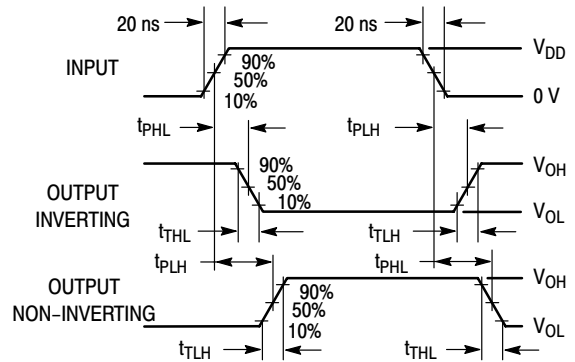
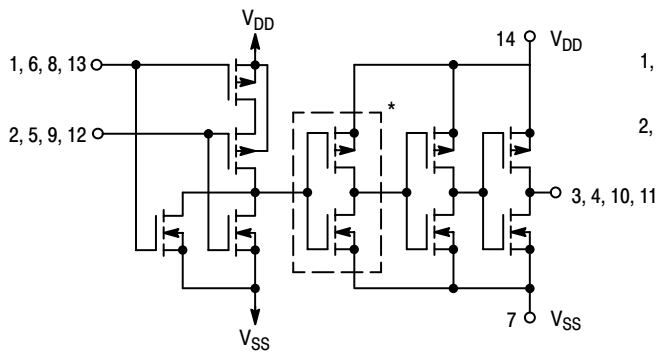


Figure 1. Switching Time Test Circuit and Waveforms

MC14001B Series

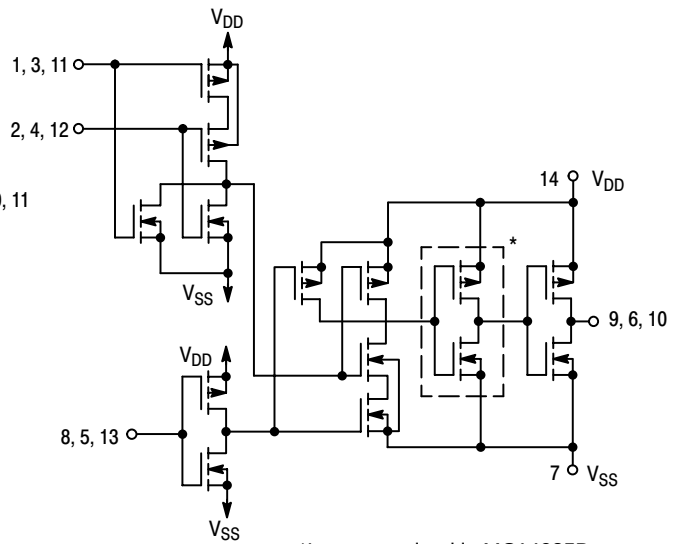
CIRCUIT SCHEMATIC NOR, OR GATES

MC14001B, MC14071B
One of Four Gates Shown



*Inverter omitted in MC14001B

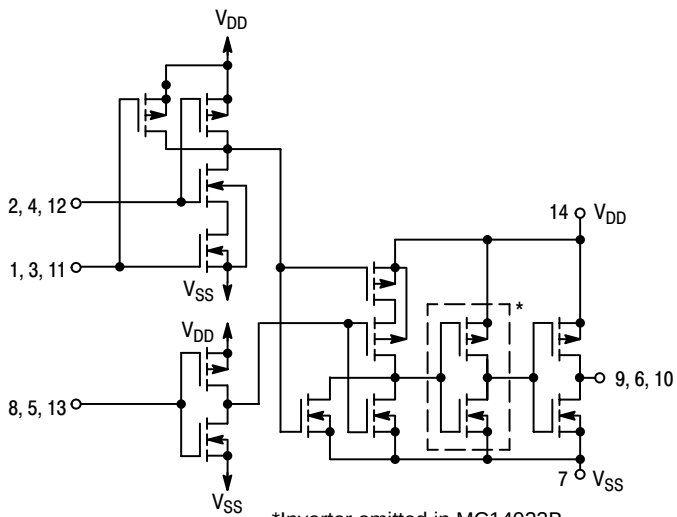
MC14025B
One of Three Gates Shown



*Inverter omitted in MC14025B

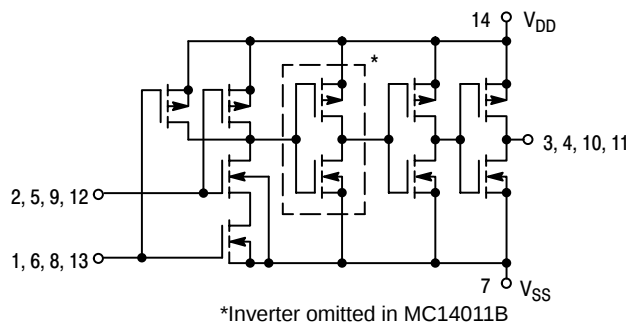
CIRCUIT SCHEMATIC NAND, AND GATES

MC14023B, MC14073B
One of Three Gates Shown



*Inverter omitted in MC14023B

MC14011B, MC14081B
One of Four Gates Shown



*Inverter omitted in MC14011B

TYPICAL B-SERIES GATE CHARACTERISTICS

N-CHANNEL DRAIN CURRENT (SINK)

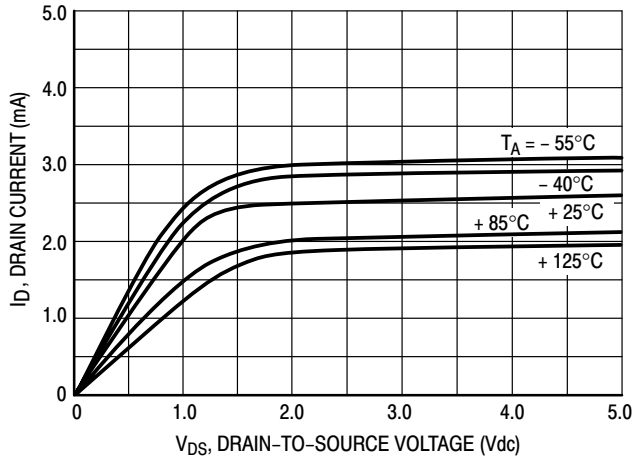


Figure 2. $V_{GS} = 5.0$ Vdc

P-CHANNEL DRAIN CURRENT (SOURCE)

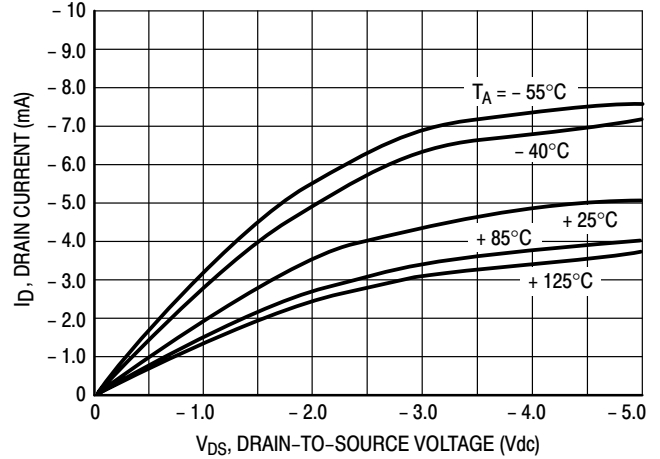


Figure 3. $V_{GS} = -5.0$ Vdc

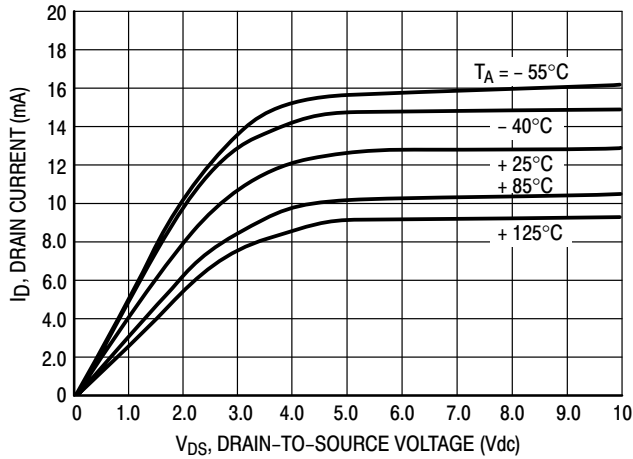


Figure 4. $V_{GS} = 10$ Vdc

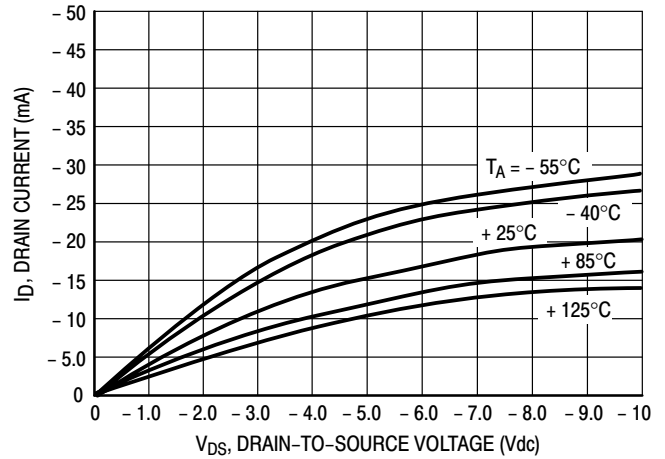


Figure 5. $V_{GS} = -10$ Vdc

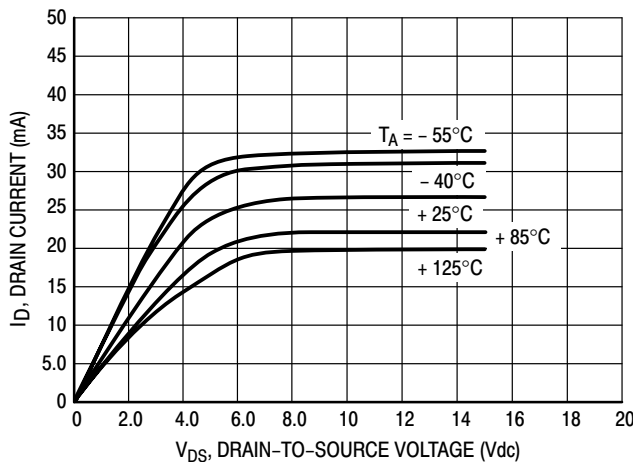


Figure 6. $V_{GS} = 15$ Vdc

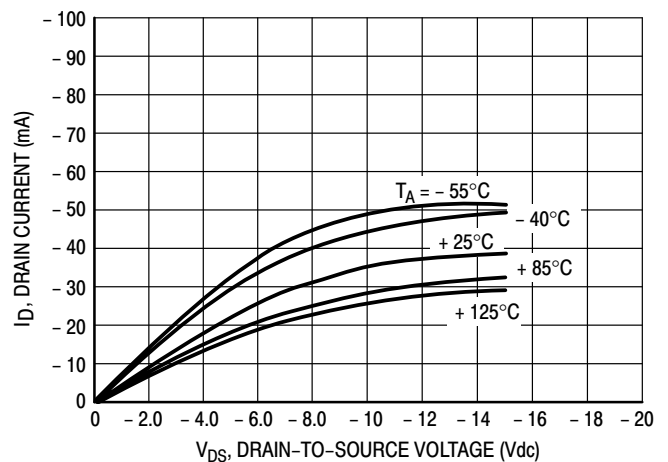


Figure 7. $V_{GS} = -15$ Vdc

These typical curves are not guarantees, but are design aids.
Caution: The maximum rating for output current is 10 mA per pin.

MC14001B Series

TYPICAL B-SERIES GATE CHARACTERISTICS (cont'd)

VOLTAGE TRANSFER CHARACTERISTICS

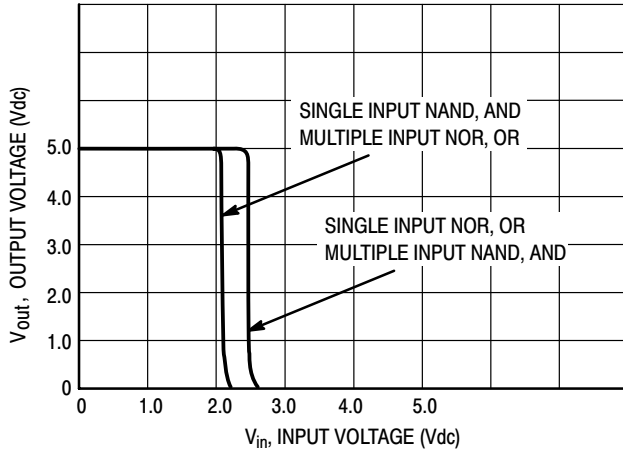


Figure 8. $V_{DD} = 5.0$ Vdc

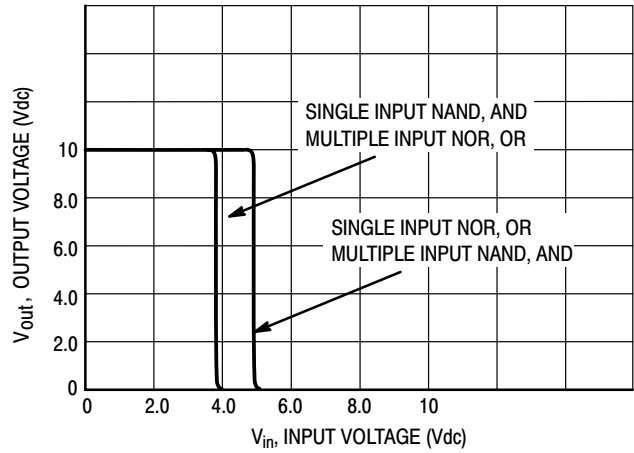


Figure 9. $V_{DD} = 10$ Vdc

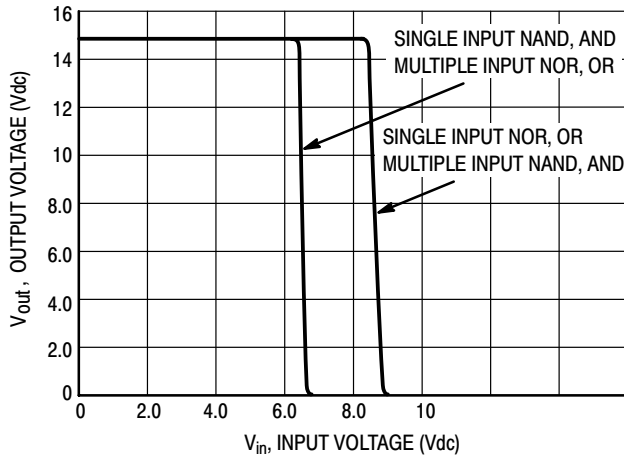


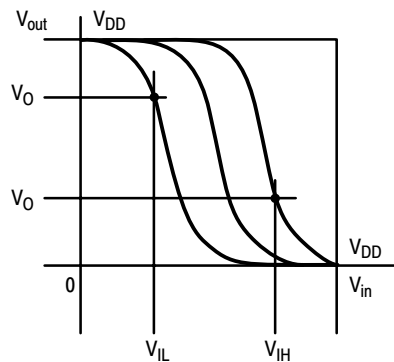
Figure 10. $V_{DD} = 15$ Vdc

DC NOISE MARGIN

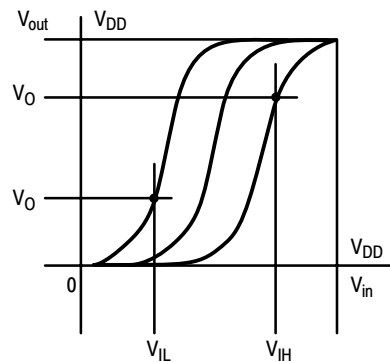
The DC noise margin is defined as the input voltage range from an ideal "1" or "0" input level which does not produce output state change(s). The typical and guaranteed limit values of the input values V_{IL} and V_{IH} for the output(s) to be at a fixed voltage V_O are given in the Electrical Characteristics table. V_{IL} and V_{IH} are presented graphically in Figure 11.

Guaranteed minimum noise margins for both the "1" and "0" levels =

- 1.0 V with a 5.0 V supply
- 2.0 V with a 10.0 V supply
- 2.5 V with a 15.0 V supply



(a) Inverting Function



(b) Non-Inverting Function

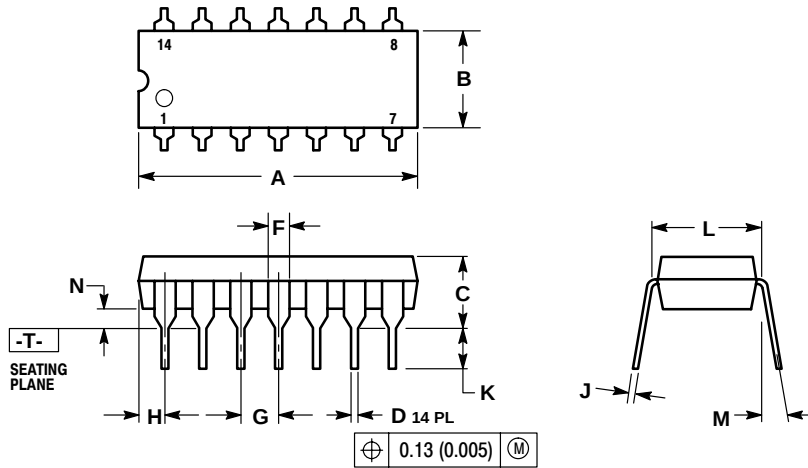
$V_{SS} = 0$ VOLTS DC

Figure 11. DC Noise Immunity

MC14001B Series

PACKAGE DIMENSIONS

P SUFFIX PLASTIC DIP PACKAGE CASE 646-06 ISSUE M

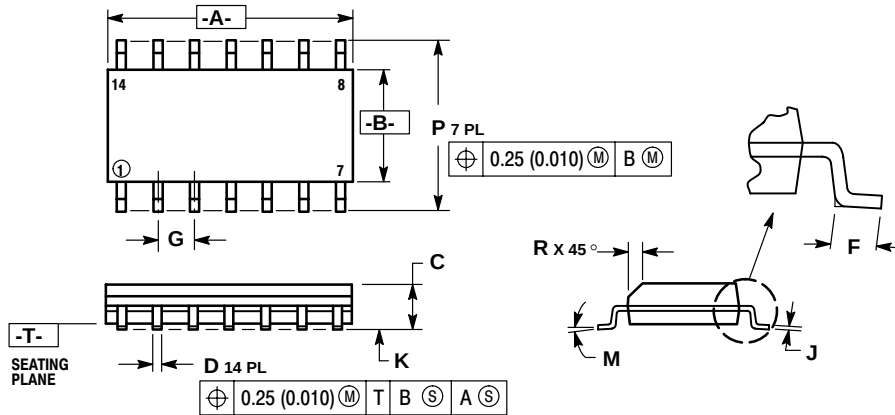


NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.715	0.770	18.16	18.80
B	0.240	0.260	6.10	6.60
C	0.145	0.185	3.69	4.69
D	0.015	0.021	0.38	0.53
F	0.040	0.070	1.02	1.78
G	0.100 BSC		2.54 BSC	
H	0.052	0.095	1.32	2.41
J	0.008	0.015	0.20	0.38
K	0.115	0.135	2.92	3.43
L	0.290	0.310	7.37	7.87
M	---	10°	---	10°
N	0.015	0.039	0.38	1.01

D SUFFIX PLASTIC SOIC PACKAGE CASE 751A-03 ISSUE F



NOTES:

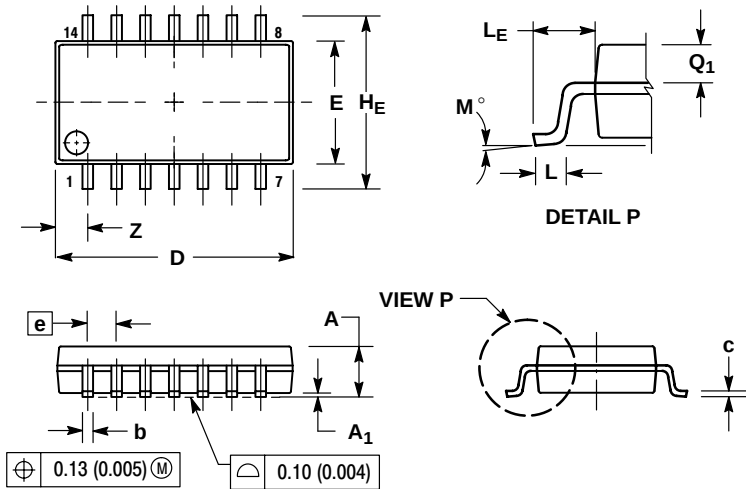
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.228	0.244
R	0.25	0.50	0.010	0.019

MC14001B Series

PACKAGE DIMENSIONS

F SUFFIX PLASTIC EIAJ SOIC PACKAGE CASE 965-01 ISSUE O



NOTES:

- 1 DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- 2 CONTROLLING DIMENSION: MILLIMETER.
- 3 DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
- 4 TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
- 5 THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	---	2.05	---	0.081
A ₁	0.05	0.20	0.002	0.008
b	0.35	0.50	0.014	0.020
c	0.18	0.27	0.007	0.011
D	9.90	10.50	0.390	0.413
E	5.10	5.45	0.201	0.215
e	1.27 BSC		0.050 BSC	
HE	7.40	8.20	0.291	0.323
0.50	0.50	0.85	0.020	0.033
LE	1.10	1.50	0.043	0.059
M	0°	10°	0°	10°
Q ₁	0.70	0.90	0.028	0.035
Z	---	1.42	---	0.056

MC14001B Series

ORDERING & SHIPPING INFORMATION:

Device	Package	Shipping
MC14001BCP	PDIP-14	2000 Units per Box
MC14001BD	SOIC-14	2750 Units per Box
MC14001BDR2	SOIC-14	2500 Units / Tape & Reel
MC14001BDT	TSSOP-14	96 Units per Rail
MC14001BDTR2	TSSOP-14	2500 Units / Tape & Reel
MC14011BCP	PDIP-14	2000 Units per Box
MC14011BD	SOIC-14	2750 Units per Box
MC14011BDR2	SOIC-14	2500 Units / Tape & Reel
MC14011BDT	TSSOP-14	96 Units per Rail
MC14011BDTEL	TSSOP-14	2000 Units / Tape & Reel
MC14011BDTR2	TSSOP-14	2500 Units / Tape & Reel
MC14023BCP	PDIP-14	2000 Units per Box
MC14023BD	SOIC-14	2750 Units per Box
MC14023BDR2	SOIC-14	2500 Units / Tape & Reel
MC14025BCP	PDIP-14	2000 Units per Box
MC14025BD	SOIC-14	2750 Units per Box
MC14025BDR2	SOIC-14	2500 Units / Tape & Reel

ORDERING & SHIPPING INFORMATION:

Device	Package	Shipping
MC14071BCP	PDIP-14	2000 Units per Box
MC14071BD	SOIC-14	55 Units per Rail
MC14071BDR2	SOIC-14	2500 Units / Tape & Reel
MC14071BDT	TSSOP-14	96 Units per Rail
MC14071BDTR2	TSSOP-14	2500 Units / Tape & Reel
MC14073BCP	PDIP-14	2000 Units per Box
MC14073BD	SOIC-14	55 Units per Rail
MC14073BDR2	SOIC-14	2500 Units / Tape & Reel
MC14081BCP	PDIP-14	2000 Units per Box
MC14081BD	SOIC-14	55 Units per Rail
MC14081BDR2	SOIC-14	2500 Units / Tape & Reel
MC14081BDT	TSSOP-14	96 Units per Rail
MC14081BDTR2	TSSOP-14	2500 Units / Tape & Reel
MC14082BCP	PDIP-14	2000 Units per Box
MC14082BD	SOIC-14	55 Units per Rail
MC14082BDR2	SOIC-14	2500 Units / Tape & Reel

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MC14001B Series

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