MC14501UB

Triple Gate
Dual 4–Input “NAND” Gate
2–Input “NOR/OR” Gate
8–Input “AND/NAND” Gate

The MC14501UB is constructed with MOS P–channel and N–channel enhancement mode devices in a single monolithic structure. These complementary MOS logic gates find primary use where low power dissipation and/or high noise immunity is desired. Additional characteristics can be found on the Family Data Sheet.

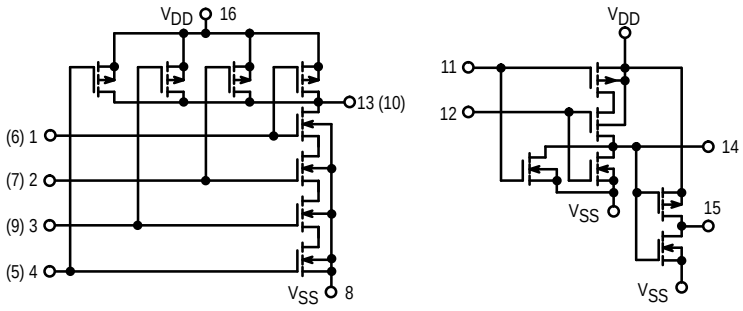
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Logic Swing Independent of Fanout
- Capable of Driving Two Low–Power TTL Loads or One Low–Power Schottky TTL Load Over the Rated Temperature Range

MAXIMUM RATINGS* (Voltages Referenced to V_{SS})

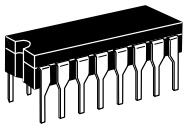
Symbol	Parameter	Value	Unit
V_{DD}	DC Supply Voltage	– 0.5 to + 18.0	V
V_{in}, V_{out}	Input or Output Voltage (DC or Transient)	– 0.5 to V_{DD} + 0.5	V
I_{in}, Iout	Input or Output Current (DC or Transient), per Pin	± 10	mA
P_D	Power Dissipation, per Package†	500	mW
T_{stg}	Storage Temperature	– 65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

* Maximum Ratings are those values beyond which damage to the device may occur.
†Temperature Derating:
Plastic “P and D/DW” Packages: – 7.0 mW/°C From 65°C To 125°C
Ceramic “L” Packages: – 12 mW/°C From 100°C To 125°C

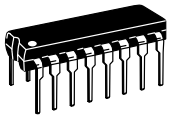
CIRCUIT SCHEMATIC



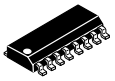
Numbers in parenthesis are for second 4–input gate.



L SUFFIX
CERAMIC
CASE 620



P SUFFIX
PLASTIC
CASE 648



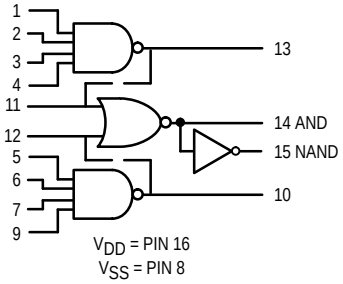
D SUFFIX
SOIC
CASE 751B

ORDERING INFORMATION

MC14XXXBCP	Plastic
MC14XXXBCL	Ceramic
MC14XXXBD	SOIC

T_A = – 55° to 125°C for all packages.

LOGIC DIAGRAM
(POSITIVE LOGIC)



Use Dotted Connection Externally to Obtain 8–Input AND/NAND

NOTE: Pin 14 must not be used as an input to the inverter.

REV 3
1/94

ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic	Symbol	V_{DD} Vdc	– 55°C		25°C			125°C		Unit
			Min	Max	Min	Typ #	Max	Min	Max	
Output Voltage “0” Level 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	
“1” Level V_{in} = 0 or V_{DD}	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 “0” Level	V_{IL}									Vdc
(V_O = 3.6 or 1.4 Vdc)		5.0	—	1.5	—	2.25	1.5	—	1.4	
(V_O = 7.2 or 2.8 Vdc)		10	—	3.0	—	4.50	3.0	—	2.9	
(V_O = 11.5 or 3.5 Vdc)		15	—	3.75	—	6.75	3.75	—	3.6	
(V_O = 1.4 or 3.6 Vdc) “1” Level	V_{IH}	5.0	3.6	—	3.5	2.75	—	3.5	—	Vdc
(V_O = 2.8 or 7.2 Vdc)		10	7.1	—	7.0	5.50	—	7.0	—	
(V_O = 3.5 or 11.5 Vdc)		15	11.4	—	11.25	8.25	—	11	—	
Output Drive Current	I_{OH}									mAdc
(V_{OH} = 2.5 Vdc) Source		5.0	– 1.2	—	– 1.0	– 1.7	—	– 0.7	—	
(V_{OH} = 4.6 Vdc)		5.0	– 0.25	—	– 0.2	– 0.36	—	– 0.14	—	
(V_{OH} = 9.5 Vdc) NAND*		10	– 0.62	—	– 0.5	– 0.9	—	– 0.35	—	
(V_{OH} = 13.5 Vdc)		15	– 1.8	—	– 1.5	– 3.5	—	– 1.1	—	
(V_{OH} = 2.5 Vdc) NOR		5.0	– 2.1	—	– 1.75	– 3.0	—	– 1.22	—	mAdc
(V_{OH} = 4.6 Vdc)		5.0	– 0.42	—	– 0.35	– 0.63	—	– 0.24	—	
(V_{OH} = 9.5 Vdc		10	– 1.06	—	– 0.88	– 1.58	—	– 0.62	—	
(V_{OH} = 13.5 Vdc)		15	– 3.1	—	– 2.63	– 6.12	—	– 1.84	—	
(V_{OH} = 2.5 Vdc) NOR–		5.0	– 3.6	—	– 3.0	– 5.1	—	– 2.1	—	mAdc
(V_{OH} = 4.6 Vdc)		5.0	– 0.72	—	– 0.6	– 1.08	—	– 0.42	—	
(V_{OH} = 9.5 Vdc) Inverter		10	– 1.8	—	– 1.5	– 2.7	—	– 1.05	—	
(V_{OH} = 13.5 Vdc)		15	– 5.4	—	– 4.5	– 10.5	—	– 3.15	—	
(V_{OL} = 0.4 Vdc) Sink	I_{OL}	5.0	0.64	—	0.51	0.88	—	0.36	—	mAdc
(V_{OL} = 0.5 Vdc) NAND*		10	1.6	—	1.3	2.25	—	0.9	—	
(V_{OL} = 1.5 Vdc)		15	4.2	—	3.4	8.8	—	2.4	—	
(V_{OL} = 0.4 Vdc) NOR		5.0	0.92	—	0.77	1.32	—	0.54	—	mAdc
(V_{OL} = 0.5 Vdc)		10	2.34	—	1.95	3.37	—	1.36	—	
(V_{OL} = 1.5 Vdc)		15	6.12	—	5.1	13.2	—	3.57	—	
(V_{OL} = 0.4 Vdc) NOR–		5.0	1.54	—	1.28	2.2	—	0.90	—	mAdc
(V_{OL} = 0.5 Vdc) Inverter		10	3.90	—	3.25	5.63	—	2.27	—	
(V_{OL} = 1.5 Vdc)		15	10.2	—	8.5	22	—	5.95	—	
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**† (Dynamic plus Quiescent, Per Package) (C_L = 50 pF on all outputs, all buffers switching)	I_T	5.0	I_T = (1.2 µA/kHz) f + I_{DD}							µAdc
		10	I_T = (2.4 µA/kHz) f + I_{DD}							
		15	I_T = (3.6 µA/kHz) f + I_{DD}							

#Data labelled “Typ” is not to be used for design purposes but is intended as an indication of the IC’s potential performance.

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

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

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

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 = 0.004.

SWITCHING CHARACTERISTICS** (C_L = 50 pF, T_A = 25°C)

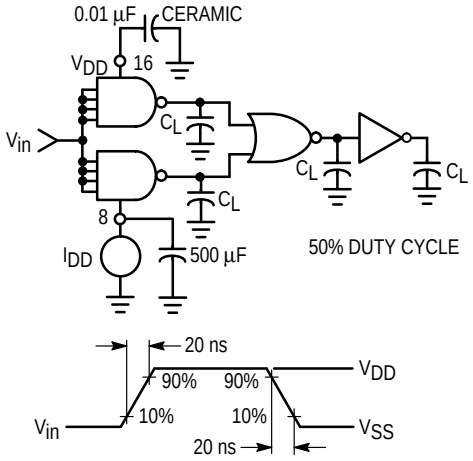
Characteristic		Figure	Symbol	V_{DD}	Typ #	Max	Unit
Output Rise Time	NAND, NOR	2, 3	t_{TLH}				ns
t_{TLH} = (3.0 ns/pF) C_L + 30 ns				5.0	180	360	
t_{TLH} = (1.5 ns/pF) C_L + 15 ns				10	90	180	
t_{TLH} = (1.1 ns/pF) C_L + 10 ns				15	65	130	
Output Fall Time	NAND, NOR	2, 3	t_{THL}				ns
t_{THL} = (1.5 ns/pF) C_L + 25 ns				5.0	100	200	
t_{THL} = (0.75 ns/pF) C_L + 12.5 ns				10	50	100	
t_{THL} = (0.55 ns/pF) C_L + 9.5 ns				15	40	80	
Output Rise Time	NOR–Inverter	3	t_{TLH}				ns
t_{TLH} = (1.35 ns/pF) C_L + 32.5 ns				5.0	100	200	
t_{TLH} = (0.60 ns/pF) C_L + 20 ns				10	50	100	
t_{TLH} = (0.40 ns/pF) C_L + 17 ns				15	40	80	
Output Fall Time	NOR–Inverter	3	t_{THL}				ns
t_{THL} = (0.67 ns/pF) C_L + 26.5 ns				5.0	60	120	
t_{THL} = (0.45 ns/pF) C_L + 17.5 ns				10	40	80	
t_{THL} = (0.37 ns/pF) C_L + 11.5 ns				15	30	60	
Propagation Delay Time	NAND	2	t_{PLH},				ns
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 45 ns			t_{PHL}	50	130	260	
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 37 ns				10	70	140	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 25 ns				15	50	100	
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 30 ns	NOR	3	t_{PLH}	5.0	115	230	ns
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 32 ns			t_{PHL}	10	65	130	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 20 ns				15	45	90	
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 45 ns	NOR–Inverter	3	t_{PLH},	5.0	130	260	ns
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 37 ns			t_{PHL}	10	70	140	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 25 ns				15	50	100	

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

#Data labelled “Typ” is not to be used for design purposes but is intended as an indication of the IC’s potential performance.

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 $V_{SS} \le (V_{in}$ or $V_{out}) \le V_{DD}$.

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.



PIN ASSIGNMENT

IN 1_A	1	16	V_{DD}
IN 2_A	2	15	OUT_B
IN 3_A	3	14	OUT_B
IN 4_A	4	13	OUT_A
IN 1_C	5	12	IN 2_B
IN 2_C	6	11	IN 1_B
IN 3_C	7	10	OUT_C
V_{SS}	8	9	IN 4_C

Figure 1. Power Dissipation Test Circuit and Waveform

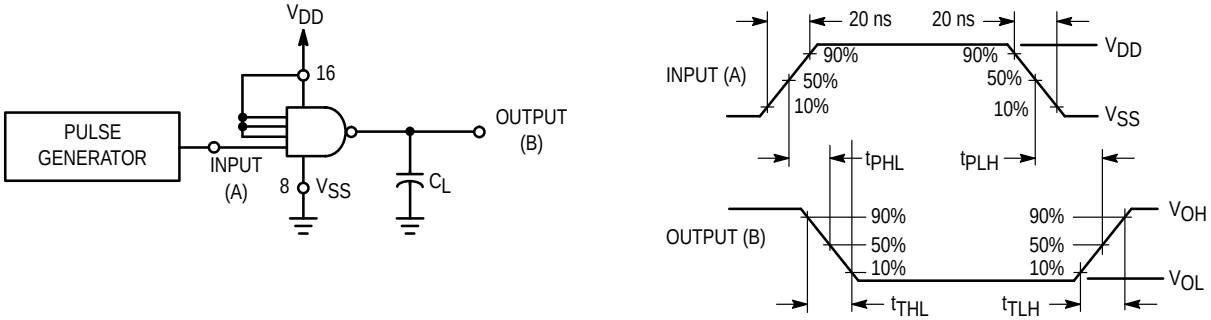
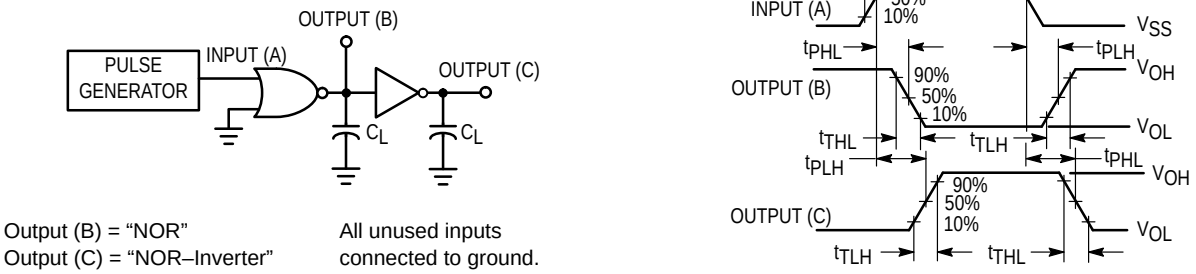


Figure 2. Input “NAND” Gate Switching Time Test Circuit and Waveforms



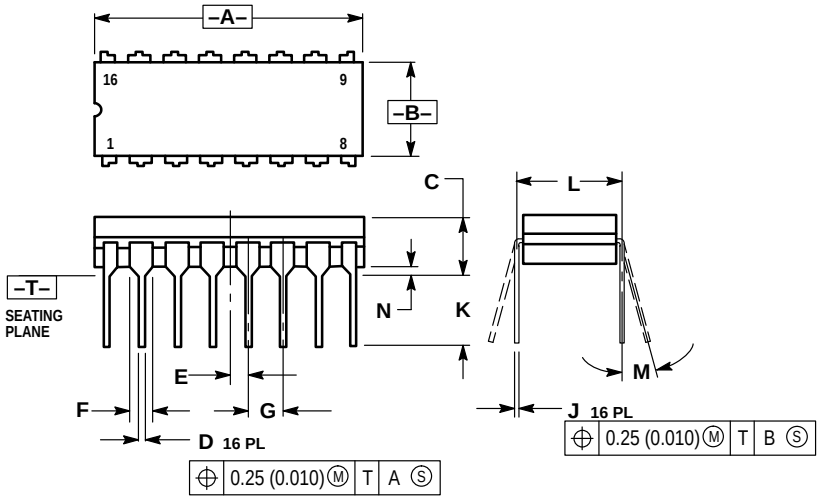
Output (B) = “NOR”
Output (C) = “NOR–Inverter”

All unused inputs connected to ground.

Figure 3. “NOR” Gate and “NOR–Inverter” Switching Time Test Circuit and Waveforms

OUTLINE DIMENSIONS

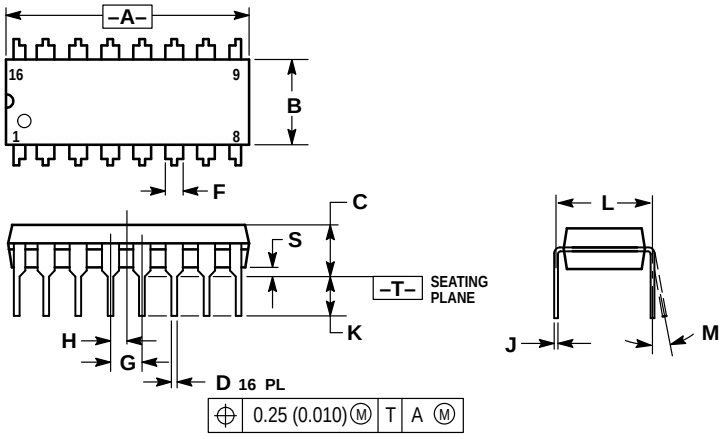
L SUFFIX
CERAMIC DIP PACKAGE
CASE 620–10
ISSUE V



NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
4. DIMENSION F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.750	0.785	19.05	19.93
B	0.240	0.295	6.10	7.49
C	—	0.200	—	5.08
D	0.015	0.020	0.39	0.50
E	0.050 BSC		1.27 BSC	
F	0.055	0.065	1.40	1.65
G	0.100 BSC		2.54 BSC	
H	0.008	0.015	0.21	0.38
K	0.125	0.170	3.18	4.31
L	0.300 BSC		7.62 BSC	
M	0 °	15 °	0 °	15 °
N	0.020	0.040	0.51	1.01

P SUFFIX
PLASTIC DIP PACKAGE
CASE 648–08
ISSUE R

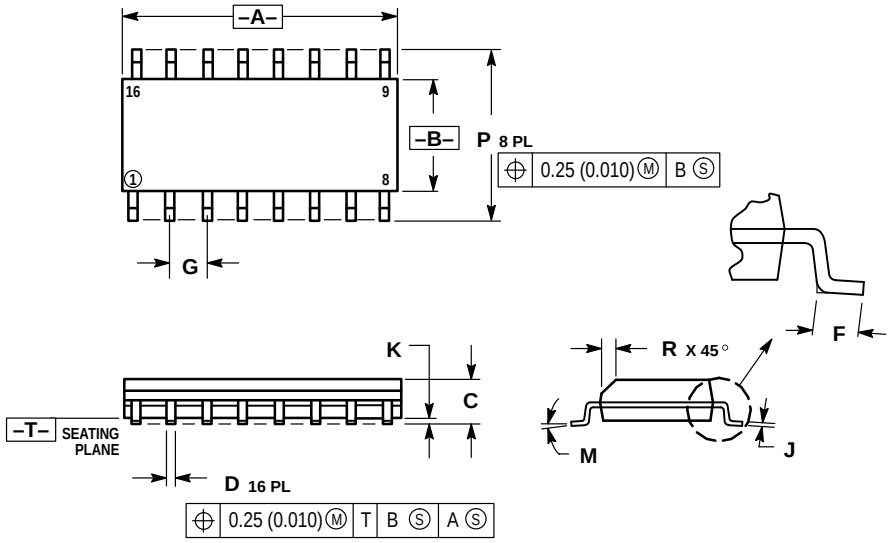


NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: INCH.
3. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
4. DIMENSION B DOES NOT INCLUDE MOLD FLASH.
5. ROUNDED CORNERS OPTIONAL.

	INCHES		MILLIMETERS	
DIM	MIN	MAX	MIN	MAX
A	0.740	0.770	18.80	19.55
B	0.250	0.270	6.35	6.85
C	0.145	0.175	3.69	4.44
D	0.015	0.021	0.39	0.53
F	0.040	0.70	1.02	1.77
G	0.100 BSC		2.54 BSC	
H	0.050 BSC		1.27 BSC	
J	0.008	0.015	0.21	0.38
K	0.110	0.130	2.80	3.30
L	0.295	0.305	7.50	7.74
M	0 °	10 °	0 °	10 °
S	0.020	0.040	0.51	1.01

OUTLINE DIMENSIONS

D SUFFIX
PLASTIC SOIC PACKAGE
CASE 751B–05
ISSUE J



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.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	9.80	10.00	0.386	0.393
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	0.229	0.244
R	0.25	0.50	0.010	0.019

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