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.

Features

- 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
- NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable
- These Devices are Pb−Free and are RoHS Compliant

MAXIMUM RATINGS (Voltages Referenced to V_{SS})

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 1)	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
V_{ESD}	ESD Withstand Voltage Human Body Model Machine Model Charged Device Model	 > 3000 > 300 N/A	V

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

1. Temperature Derating: “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 $V_{SS} \le (V_{in}$ 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.

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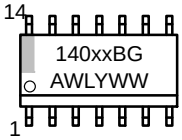


SOIC−14
D SUFFIX
CASE 751A

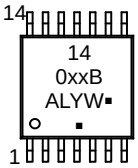


TSSOP−14
DT SUFFIX
CASE 948G

MARKING DIAGRAMS



SOIC−14



TSSOP−14

xx = Specific Device Code
A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week
G or ▪ = Pb−Free Package

(Note: Microdot may be in either location)

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

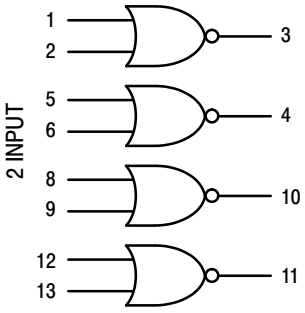
See detailed ordering and shipping information in the package dimensions section on page 8 of this data sheet.

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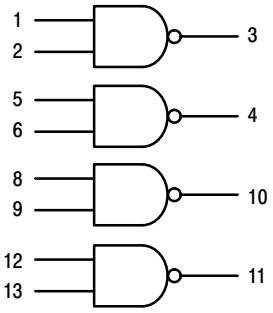
LOGIC DIAGRAMS

NOR | NAND | OR | AND

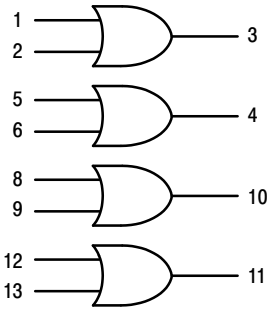
MC14001B
Quad 2−Input NOR Gate



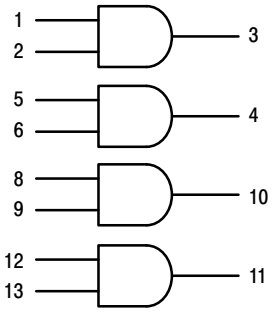
MC14011B
Quad 2−Input NAND Gate



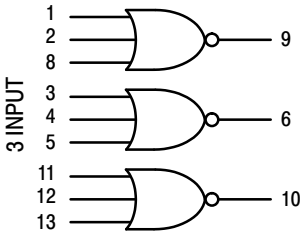
MC14071B
Quad 2−Input OR Gate



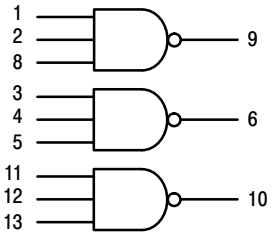
MC14081B
Quad 2−Input AND Gate



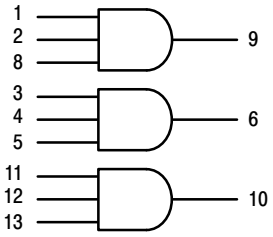
MC14025B
Triple 3−Input NOR Gate



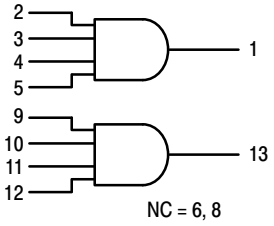
MC14023B
Triple 3−Input NAND Gate



MC14073B
Triple 3−Input AND Gate



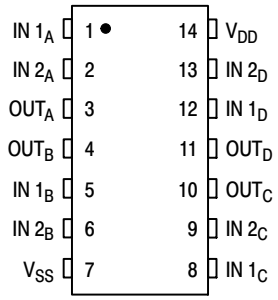
MC14082B
Dual 4−Input AND Gate



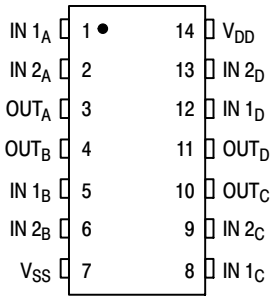
V_{DD} = PIN 14
V_{SS} = PIN 7
FOR ALL DEVICES

PIN ASSIGNMENTS

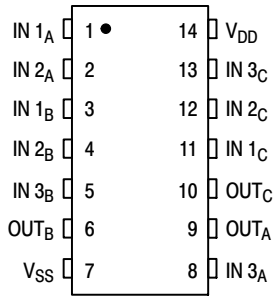
MC14001B
Quad 2−Input NOR Gate



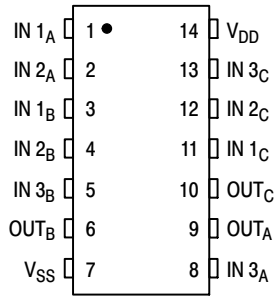
MC14011B
Quad 2−Input NAND Gate



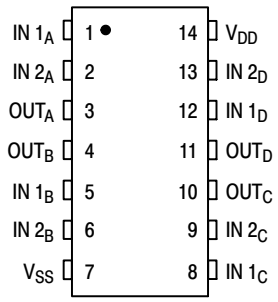
MC14023B
Triple 3−Input NAND Gate



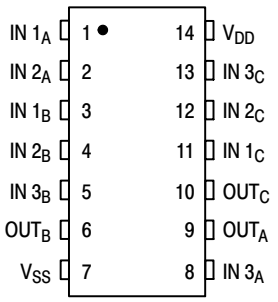
MC14025B
Triple 3−Input NOR Gate



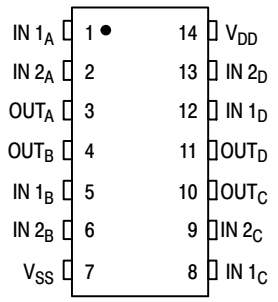
MC14071B
Quad 2−Input OR Gate



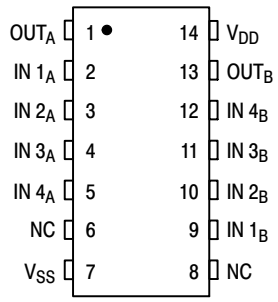
MC14073B
Triple 3−Input AND Gate



MC14081B
Quad 2−Input AND Gate



MC14082B
Dual 4−Input AND Gate



NC = NO CONNECTION

ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic	Symbol	V_{DD} Vdc	− 55°C Min	− 55°C Max	25°C Min	25°C Typ (Note 2)	25°C Max	125°C Min	125°C Max	Unit
Output Voltage “0” Level	V_{OL}	5.0	−	0.05	−	0	0.05	−	0.05	Vdc
V_{in} = V_{DD} or 0		10	−	0.05	−	0	0.05	−	0.05	
		15	−	0.05	−	0	0.05	−	0.05	
“1” Level	V_{OH}	5.0	4.95	−	4.95	5.0	−	4.95	−	Vdc
V_{in} = 0 or V_{DD}		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 = 4.5 or 0.5 Vdc)		5.0	−	1.5	−	2.25	1.5	−	1.5	
(V_O = 9.0 or 1.0 Vdc)		10	−	3.0	−	4.50	3.0	−	3.0	
(V_O = 13.5 or 1.5 Vdc)		15	−	4.0	−	6.75	4.0	−	4.0	
“1” Level	V_{IH}									Vdc
(V_O = 0.5 or 4.5 Vdc)		5.0	3.5	−	3.5	2.75	−	3.5	−	
(V_O = 1.0 or 9.0 Vdc)		10	7.0	−	7.0	5.50	−	7.0	−	
(V_O = 1.5 or 13.5 Vdc)		15	11	−	11	8.25	−	11	−	
Output Drive Current	I_{OH}									mAdc
(V_{OH} = 2.5 Vdc) Source		5.0	–3.0	−	–2.4	–4.2	−	–1.7	−	
(V_{OH} = 4.6 Vdc)		5.0	–0.64	−	–0.51	–0.88	−	–0.36	−	
(V_{OH} = 9.5 Vdc)		10	–1.6	−	–1.3	–2.25	−	–0.9	−	
(V_{OH} = 13.5 Vdc)		15	–4.2	−	–3.4	–8.8	−	–2.4	−	
(V_{OL} = 0.4 Vdc) Sink	I_{OL}	5.0	0.64	−	0.51	0.88	−	0.36	−	mAdc
(V_{OL} = 0.5 Vdc)		10	1.6	−	1.3	2.25	−	0.9	−	
(V_{OL} = 1.5 Vdc)		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 (Notes 3, 4) (Dynamic plus Quiescent, Per Gate, C_L = 50 pF)	I_T	5.0	I_T = (0.3 μA/kHz) f + I_{DD}/N							μAdc
		10	I_T = (0.6 μA/kHz) f + I_{DD}/N							
		15	I_T = (0.9 μA/kHz) f + I_{DD}/N							

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

2. Data labelled “Typ” is not to be used for design purposes but is intended as an indication of the IC’s potential performance.
3. The formulas given are for the typical characteristics only at 25°C.
4. To calculate total supply current at loads other than 50 pF:

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

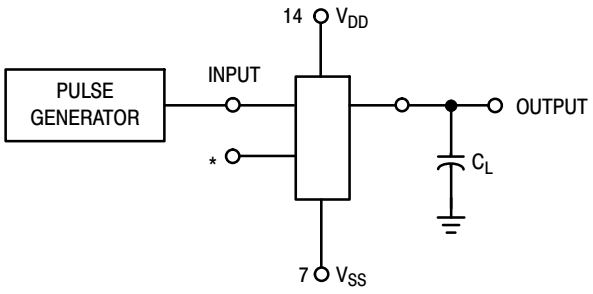
where: I_T is in μA (per package), C_L in pF, V = (V_{DD} − V_{SS}) in volts, f in kHz is input frequency, and k = 0.001 x the number of exercised gates per package.

B−SERIES GATE SWITCHING TIMES

SWITCHING CHARACTERISTICS (Note 5) (C_L = 50 pF, T_A = 25°C)

Characteristic	Symbol	V_{DD} Vdc	Min	Typ (Note 6)	Max	Unit
Output Rise Time, All B−Series Gates	t_{TLH}					ns
t_{TLH} = (1.35 ns/pF) C_L + 33 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 + 20 ns		15	−	40	80	
Output Fall Time, All B−Series Gates	t_{THL}					ns
t_{THL} = (1.35 ns/pF) C_L + 33 ns		5.0	−	100	200	
t_{THL} = (0.60 ns/pF) C_L + 20 ns		10	−	50	100	
t_{THL} = (0.40 ns/pF) C_L + 20 ns		15	−	40	80	
Propagation Delay Time	t_{PLH}, t_{PHL}					ns
MC14001B, MC14011B only						
t_{PLH}, t_{PHL} = (0.90 ns/pF) C_L + 80 ns		5.0	−	125	250	
t_{PLH}, t_{PHL} = (0.36 ns/pF) C_L + 32 ns		10	−	50	100	
t_{PLH}, t_{PHL} = (0.26 ns/pF) C_L + 27 ns		15	−	40	80	
All Other 2, 3, and 4 Input Gates						
t_{PLH}, t_{PHL} = (0.90 ns/pF) C_L + 115 ns		5.0	−	160	300	
t_{PLH}, t_{PHL} = (0.36 ns/pF) C_L + 47 ns		10	−	65	130	
t_{PLH}, t_{PHL} = (0.26 ns/pF) C_L + 37 ns		15	−	50	100	
8−Input Gates (MC14068B, MC14078B)						
t_{PLH}, t_{PHL} = (0.90 ns/pF) C_L + 155 ns		5.0	−	200	350	
t_{PLH}, t_{PHL} = (0.36 ns/pF) C_L + 62 ns		10	−	80	150	
t_{PLH}, t_{PHL} = (0.26 ns/pF) C_L + 47 ns		15	−	60	110	

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

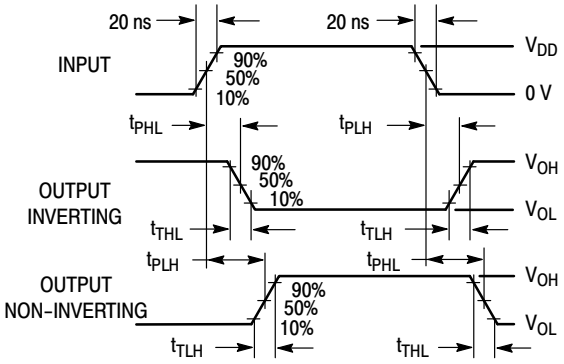
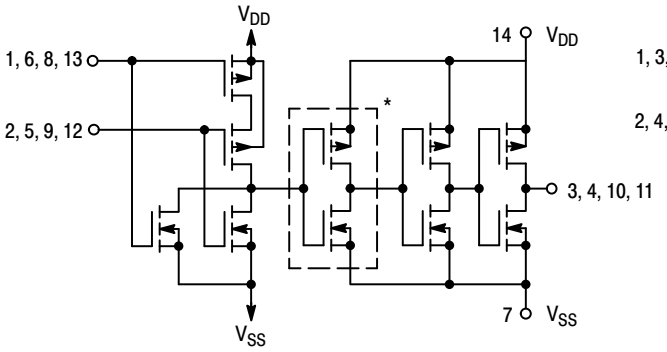


Figure 1. Switching Time Test Circuit and Waveforms

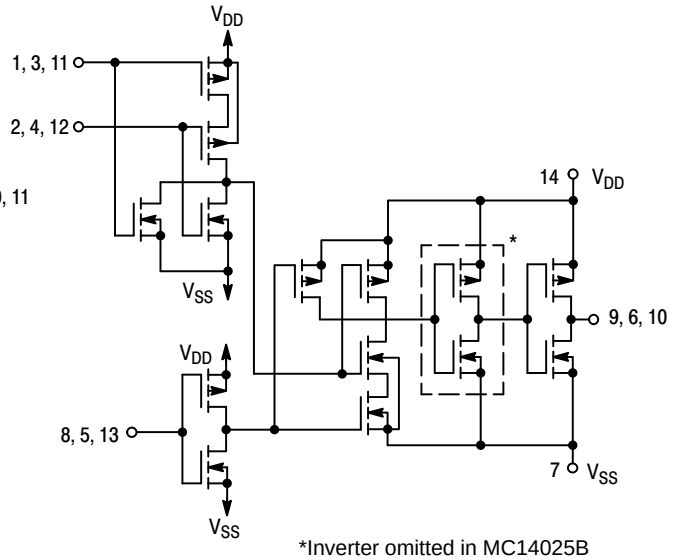
CIRCUIT SCHEMATIC
NOR, OR GATES

MC14001B, MC14071B
One of Four Gates Shown



*Inverter omitted in MC14001B

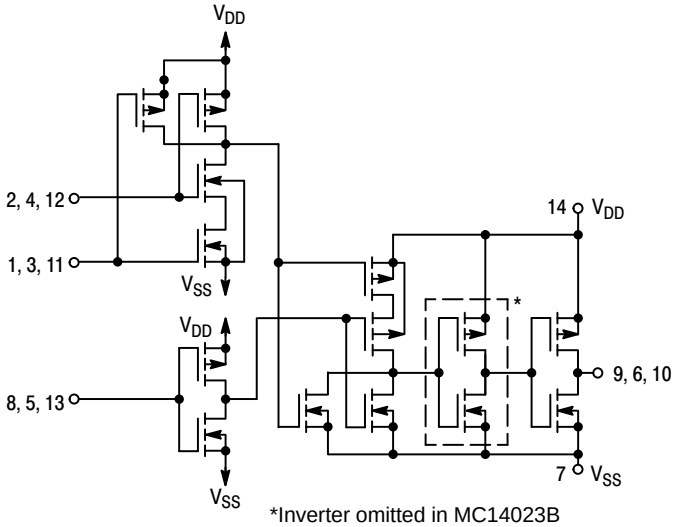
MC14025B
One of Three Gates Shown



*Inverter omitted in MC14025B

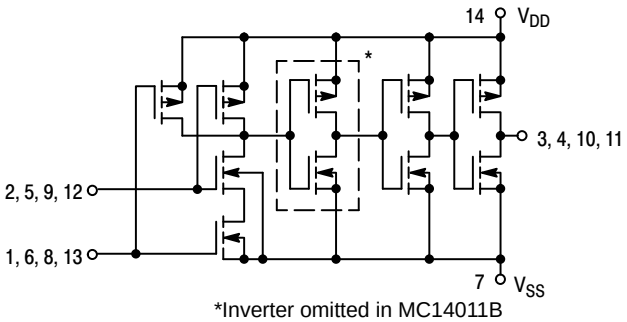
CIRCUIT SCHEMATIC
NAND, AND GATES

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)

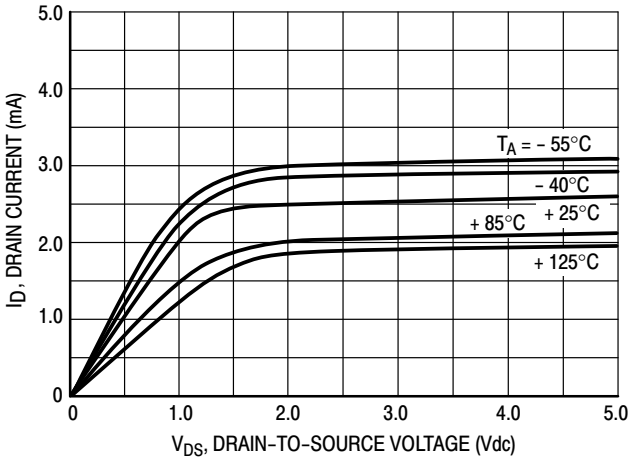


Figure 2. V_{GS} = 5.0 Vdc

P−CHANNEL DRAIN CURRENT (SOURCE)

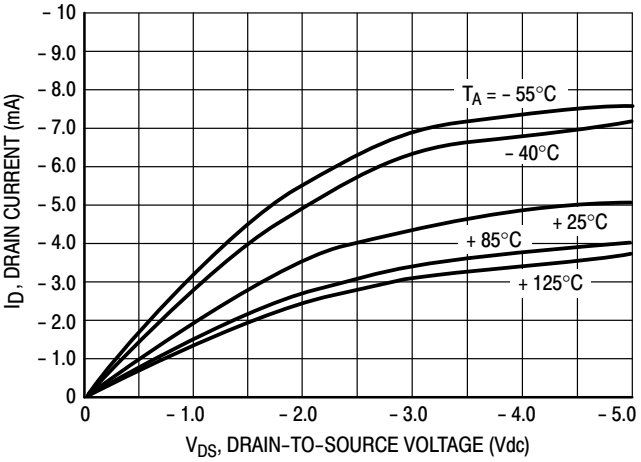


Figure 3. V_{GS} = − 5.0 Vdc

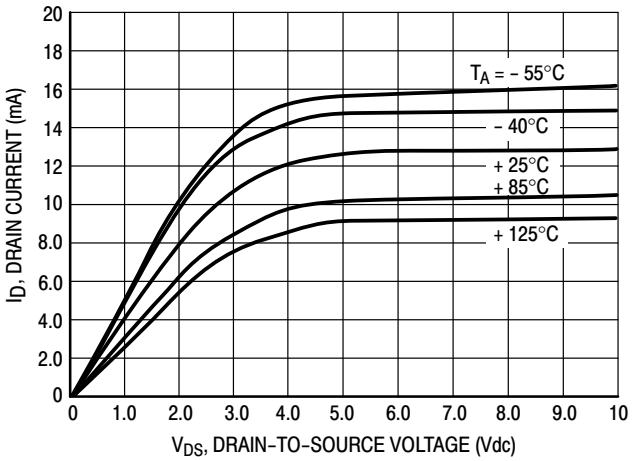


Figure 4. V_{GS} = 10 Vdc

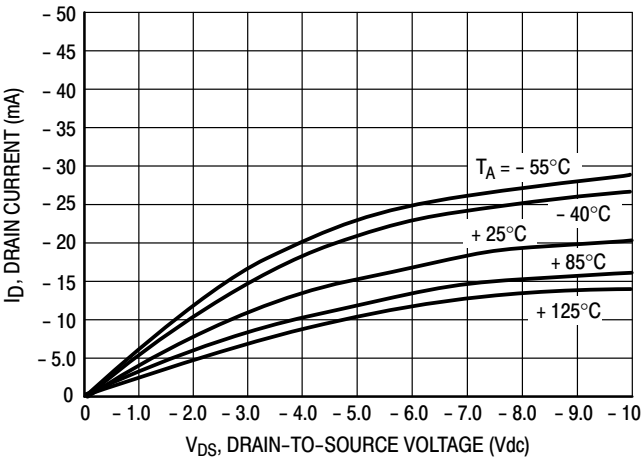


Figure 5. V_{GS} = − 10 Vdc

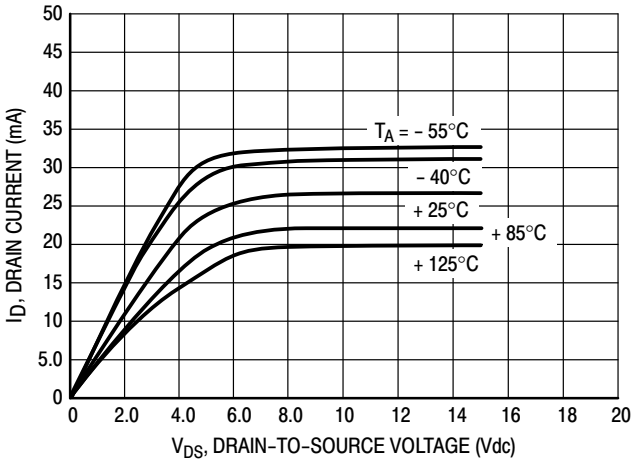


Figure 6. V_{GS} = 15 Vdc

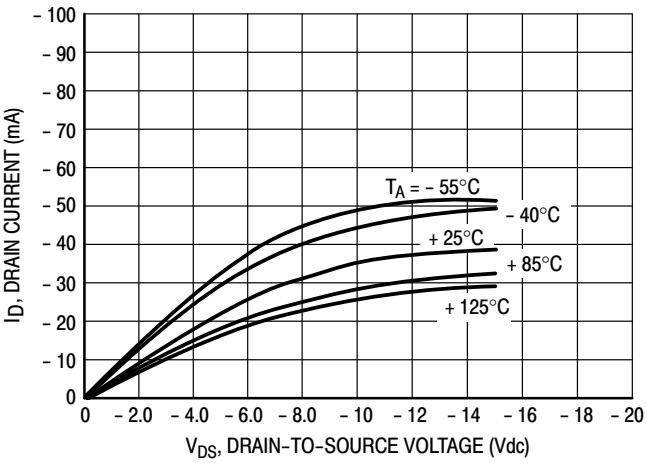


Figure 7. V_{GS} = − 15 Vdc

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

TYPICAL B−SERIES GATE CHARACTERISTICS (cont'd)

VOLTAGE TRANSFER CHARACTERISTICS

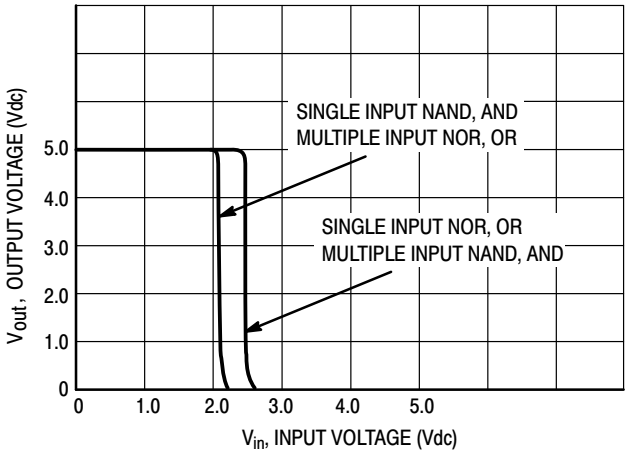


Figure 8. V_{DD} = 5.0 Vdc

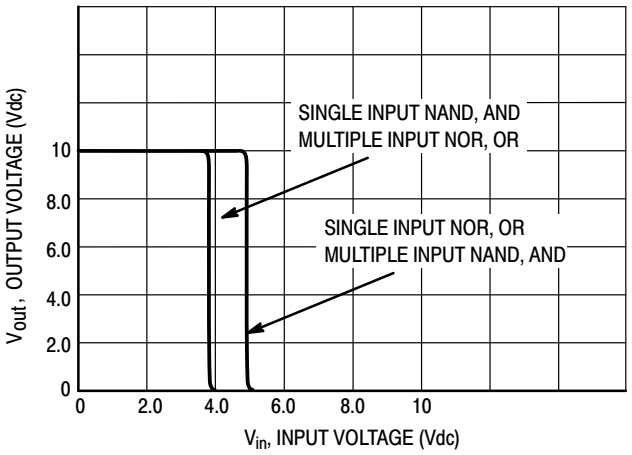


Figure 9. V_{DD} = 10 Vdc

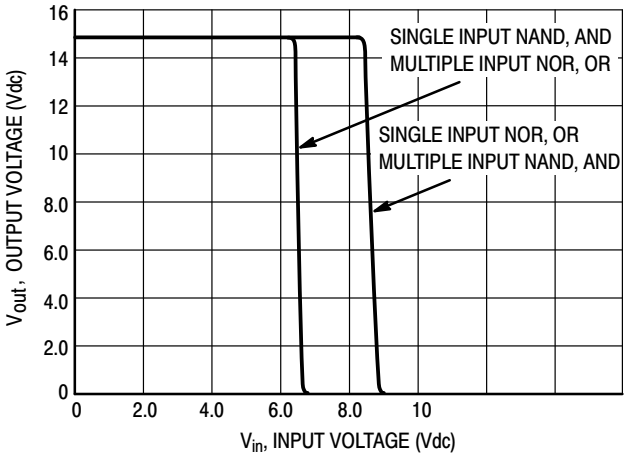


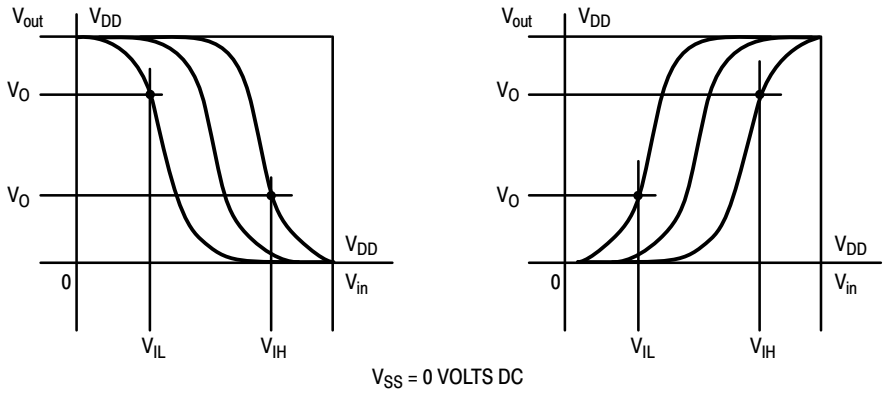
Figure 10. V_{DD} = 15 Vdc

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**

Figure 11. DC Noise Immunity

ORDERING INFORMATION

Device	Package	Shipping†
MC14001BDG	SOIC−14 (Pb−Free)	55 Units / Rail
NLV14001BDG*		
MC14001BDR2G	SOIC−14 (Pb−Free)	2500 Units / Tape & Reel
NLV14001BDR2G*		
MC14001BDTR2G	TSSOP−14 (Pb−Free)	
NLV14001BDTR2G*		
MC14001BFELG	SOEIAJ−14 (Pb−Free)	2000 Units / Tape & Reel
MC14011BDG	SOIC−14 (Pb−Free)	55 Units / Rail
NLV14011BDG*		
MC14011BDR2G	SOIC−14 (Pb−Free)	2500 Units / Tape & Reel
NLV14011BDR2G*		
MC14011BDTR2G	TSSOP−14 (Pb−Free)	
NLV14011BDTR2G*		
MC14011BFG	SOEIAJ−14 (Pb−Free)	50 Units / Rail
MC14011BFELG		2000 Units / Tape & Reel
MC14023BDG	SOIC−14 (Pb−Free)	55 Units / Rail
MC14023BDR2G	SOIC−14 (Pb−Free)	2500 Units / Tape & Reel
NLV14023BDR2G*		
MC14023BFELG	SOEIAJ−14 (Pb−Free)	2000 Units / Tape & Reel
MC14025BDG	SOIC−14 (Pb−Free)	55 Units / Rail
NLV14025BDG*		
MC14025BDR2G	SOIC−14 (Pb−Free)	2500 Units / Tape & Reel
NLV14025BDR2G*		
MC14071BDG	SOIC−14 (Pb−Free)	55 Units / Rail
NLV14071BDG*		
MC14071BDR2G	SOIC−14 (Pb−Free)	2500 Units / Tape & Reel
NLV14071BDR2G*		
MC14071BDTG	TSSOP−14 (Pb−Free)	96 Units per Rail
MC14071BDTR2G		2500 Units / Tape & Reel
NLV14071BDTR2G*		
MC14073BDG	SOIC−14 (Pb−Free)	55 Units / Rail
MC14073BDR2G	SOIC−14 (Pb−Free)	2500 Units / Tape & Reel

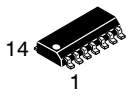
ORDERING INFORMATION (continued)

Device	Package	Shipping†
MC14081BDG	SOIC−14 (Pb−Free)	55 Units / Rail
NLV14081BDG*		
MC14081BDR2G	SOIC−14 (Pb−Free)	2500 Units / Tape & Reel
NLV14081BDR2G*		
MC14081BDTR2G	TSSOP−14 (Pb−Free)	
NLV14081BDTR2G*		
MC14082BDG	SOIC−14 (Pb−Free)	55 Units / Rail
NLV14082BDG*		
MC14082BDR2G		2500 Units / Tape & Reel

†For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D.

*NLV Prefix for Automotive and Other Applications Requiring Unique Site and Control Change Requirements; AEC−Q100 Qualified and PPAP Capable.

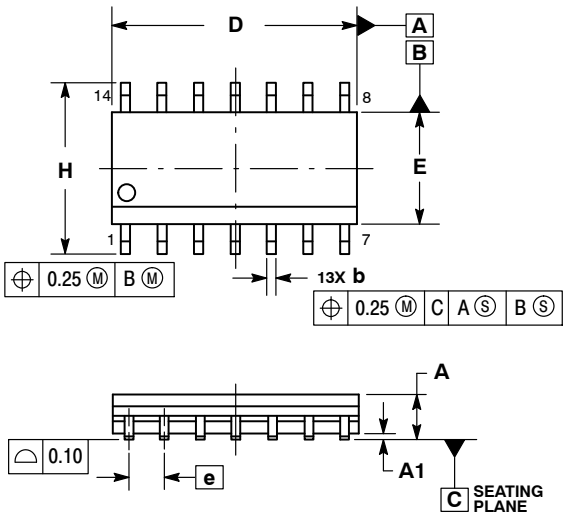
MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

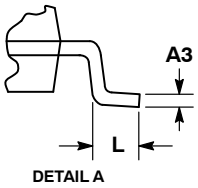


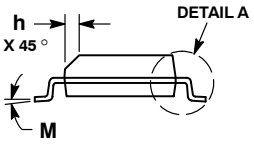
SCALE 1:1

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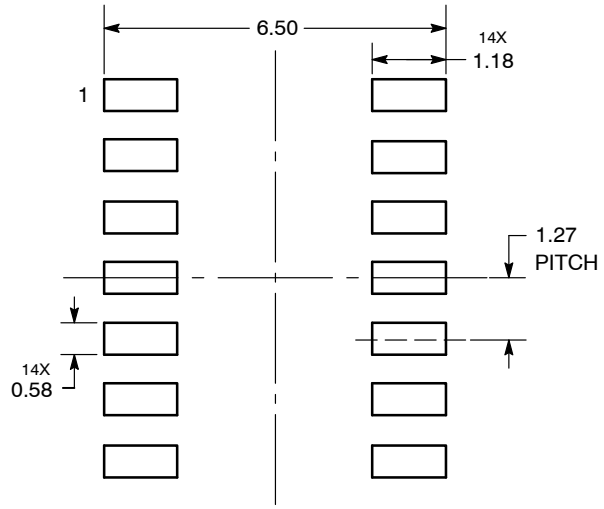




NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
2. CONTROLLING DIMENSION: MILLIMETERS.
3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.13 TOTAL IN EXCESS OF AT MAXIMUM MATERIAL CONDITION.
4. DIMENSIONS D AND E DO NOT INCLUDE MOLD PROTRUSIONS.
5. MAXIMUM MOLD PROTRUSION 0.15 PER SIDE.

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	1.35	1.75	0.054	0.068
A1	0.10	0.25	0.004	0.010
A3	0.19	0.25	0.008	0.010
b	0.35	0.49	0.014	0.019
D	8.55	8.75	0.337	0.344
E	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
H	5.80	6.20	0.228	0.244
h	0.25	0.50	0.010	0.019
L	0.40	1.25	0.016	0.049
M	0 °	7 °	0 °	7 °

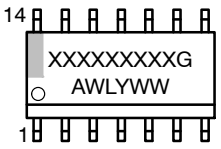
SOLDERING FOOTPRINT*



DIMENSIONS: MILLIMETERS

*For additional information on our Pb−Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

GENERIC MARKING DIAGRAM*



XXXXX = Specific Device Code
A = Assembly Location
WL = Wafer Lot
Y = Year
WW = Work Week
G = Pb−Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb−Free indicator, “G” or microdot “▪”, may or may not be present. Some products may not follow the Generic Marking.

STYLES ON PAGE 2

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SOIC−14
CASE 751A−03
ISSUE L

DATE 03 FEB 2016

STYLE 1:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. NO CONNECTION
5. ANODE/CATHODE
6. NO CONNECTION
7. ANODE/CATHODE
8. ANODE/CATHODE
9. ANODE/CATHODE
10. NO CONNECTION
11. ANODE/CATHODE
12. ANODE/CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 2:
CANCELLED

STYLE 3:
PIN 1. NO CONNECTION
2. ANODE
3. ANODE
4. NO CONNECTION
5. ANODE
6. NO CONNECTION
7. ANODE
8. ANODE
9. ANODE
10. NO CONNECTION
11. ANODE
12. ANODE
13. NO CONNECTION
14. COMMON CATHODE

STYLE 4:
PIN 1. NO CONNECTION
2. CATHODE
3. CATHODE
4. NO CONNECTION
5. CATHODE
6. NO CONNECTION
7. CATHODE
8. CATHODE
9. CATHODE
10. NO CONNECTION
11. CATHODE
12. CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 5:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. ANODE/CATHODE
5. ANODE/CATHODE
6. NO CONNECTION
7. COMMON ANODE
8. COMMON CATHODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. ANODE/CATHODE
12. ANODE/CATHODE
13. NO CONNECTION
14. COMMON ANODE

STYLE 6:
PIN 1. CATHODE
2. CATHODE
3. CATHODE
4. CATHODE
5. CATHODE
6. CATHODE
7. CATHODE
8. ANODE
9. ANODE
10. ANODE
11. ANODE
12. ANODE
13. ANODE
14. ANODE

STYLE 7:
PIN 1. ANODE/CATHODE
2. COMMON ANODE
3. COMMON CATHODE
4. ANODE/CATHODE
5. ANODE/CATHODE
6. ANODE/CATHODE
7. ANODE/CATHODE
8. ANODE/CATHODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. COMMON CATHODE
12. COMMON ANODE
13. ANODE/CATHODE
14. ANODE/CATHODE

STYLE 8:
PIN 1. COMMON CATHODE
2. ANODE/CATHODE
3. ANODE/CATHODE
4. NO CONNECTION
5. ANODE/CATHODE
6. ANODE/CATHODE
7. COMMON ANODE
8. COMMON ANODE
9. ANODE/CATHODE
10. ANODE/CATHODE
11. NO CONNECTION
12. ANODE/CATHODE
13. ANODE/CATHODE
14. COMMON CATHODE

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