MC14008B

4-Bit Full Adder

The MC14008B 4−bit full adder is constructed with MOS P−Channel and N−Channel enhancement mode devices in a single monolithic structure. This device consists of four full adders with fast internal look−ahead carry output. It is useful in binary addition and other arithmetic applications. The fast parallel carry output bit allows high−speed operation when used with other adders in a system.

Features

- Look−Ahead Carry Output
- Diode Protection on All Inputs
- All Outputs Buffered
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Capable of Driving Two Low−Power TTL Loads or One Low−Power Schottky TTL Load Over the Rated Temperature Range
- Pin−for−Pin Replacement for CD4008B
- This Device is Pb−Free and is 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

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

1. Temperature Derating: “D/DW” Package: –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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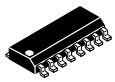
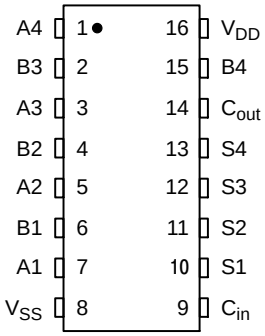
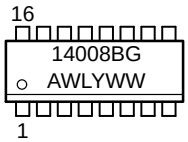


SOIC−16
D SUFFIX
CASE 751B

PIN ASSIGNMENT



MARKING DIAGRAM



A = Assembly Location
WL, L = Wafer Lot
YY, Y = Year
WW, W = Work Week
G = Pb−Free Indicator

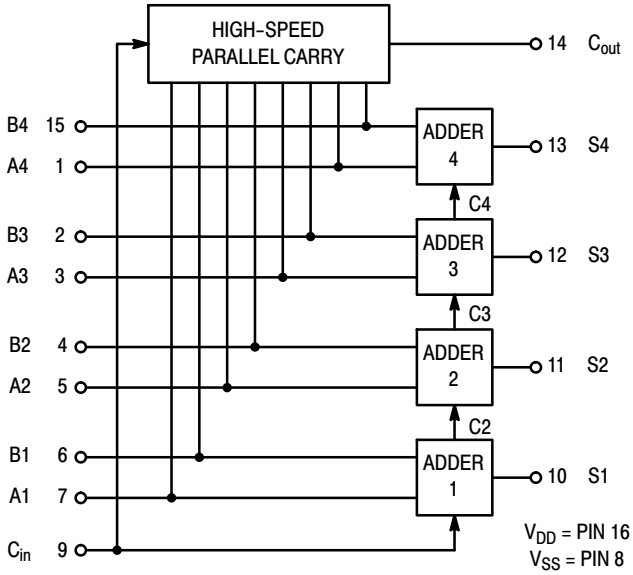
ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

TRUTH TABLE
(One Stage)

C_{in}	B	A	C_{out}	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

BLOCK DIAGRAM



ORDERING INFORMATION

Device	Package	Shipping†
MC14008BDR2G	SOIC−16 (Pb−Free)	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.

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	
V_{in} = 0 or V_{DD} “1” Level	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 = 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	
(V_O = 0.5 or 4.5 Vdc) “1” Level	V_{IH}	5.0	3.5	−	3.5	2.75	−	3.5	−	Vdc
(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	−	5.0	−	0.005	5.0	−	150	μAdc
		10	−	10	−	0.010	10	−	300	
		15	−	20	−	0.015	20	−	600	
Total Supply Current (Notes 3 & 4) (Dynamic plus Quiescent, Per Package) (C_L = 50 pF on all outputs, all buffers switching)	I_T	5.0	I_T = (1.7 μA/kHz) f + I_{DD}							μAdc
		10	I_T = (3.4 μA/kHz) f + I_{DD}							
		15	I_T = (5.0 μA/kHz) f + I_{DD}							

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 = 0.005.

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 and Fall Time	t_{TLH},					ns
t_{TLH}, t_{THL} = (1.5 ns/pF) C_L + 25 ns	t_{THL}	5.0	–	100	200	
t_{TLH}, t_{THL} = (0.75 ns/pF) C_L + 12.5 ns		10	–	50	100	
t_{TLH}, t_{THL} = (0.55 ns/pF) C_L + 9.5 ns		15	–	40	80	
Propagation Delay Time	t_{PLH}, t_{PHL}					ns
Sum in to Sum Out						
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 315 ns		5.0	–	400	800	
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 127 ns		10	–	160	320	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 90 ns		15	–	115	230	
Sum In to Carry Out						
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 220 ns		5.0	–	305	610	
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 112 ns		10	–	145	290	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 85 ns		15	–	110	220	
Carry In to Sum Out						
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 290 ns		5.0	–	375	750	
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 122 ns		10	–	155	310	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 90 ns		15	–	115	230	
Carry In to Carry Out						
t_{PLH}, t_{PHL} = (1.7 ns/pF) C_L + 85 ns		5.0	–	170	340	
t_{PLH}, t_{PHL} = (0.66 ns/pF) C_L + 42 ns		10	–	75	150	
t_{PLH}, t_{PHL} = (0.5 ns/pF) C_L + 30 ns		15	–	55	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.

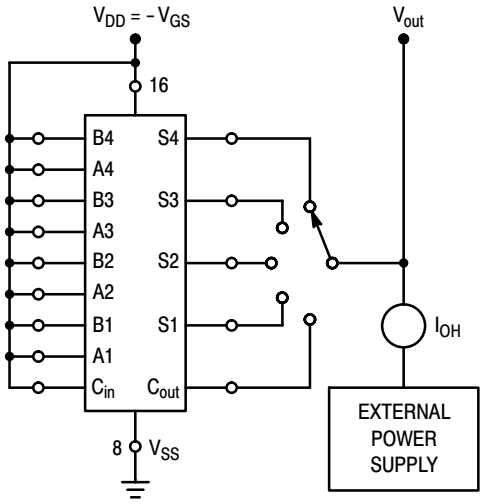


Figure 1. Typical Source Current Characteristics Test Circuit

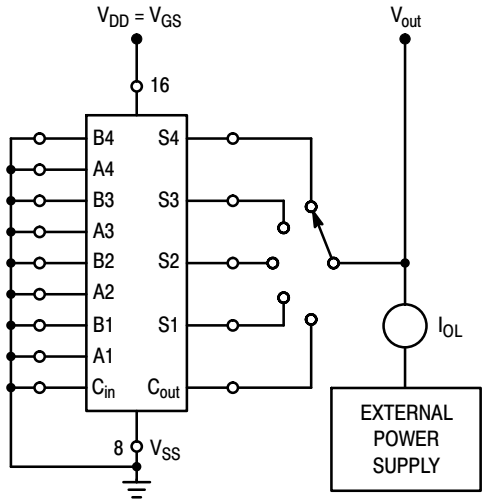


Figure 2. Typical Sink Current Characteristics Test Circuit

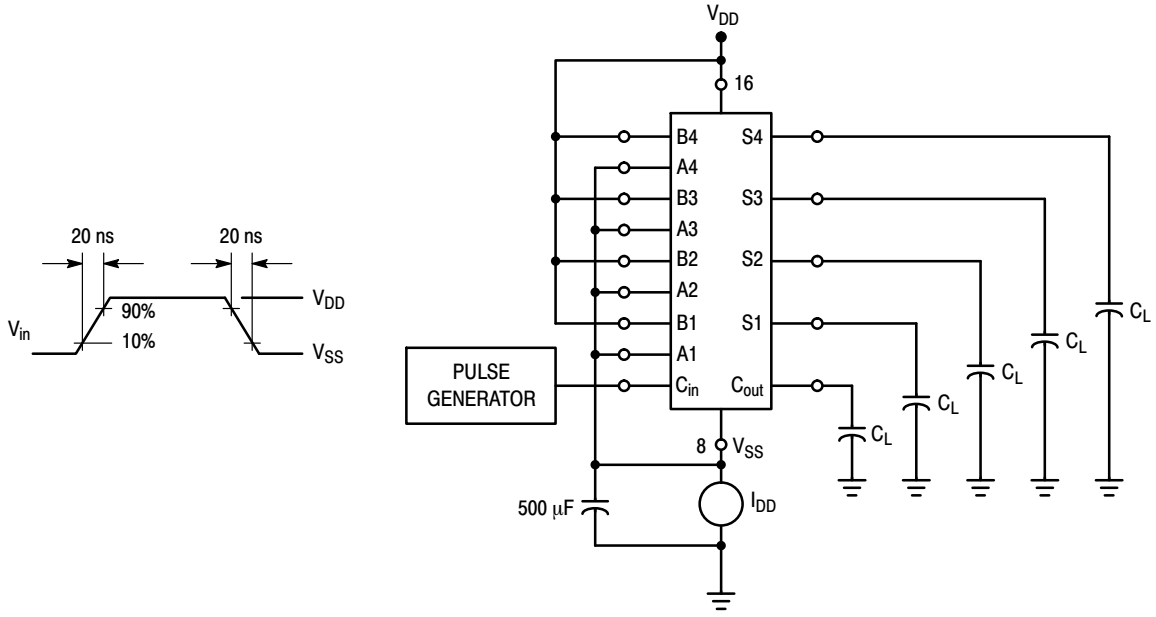


Figure 3. Dynamic Power Dissipation Test Circuit and Waveform

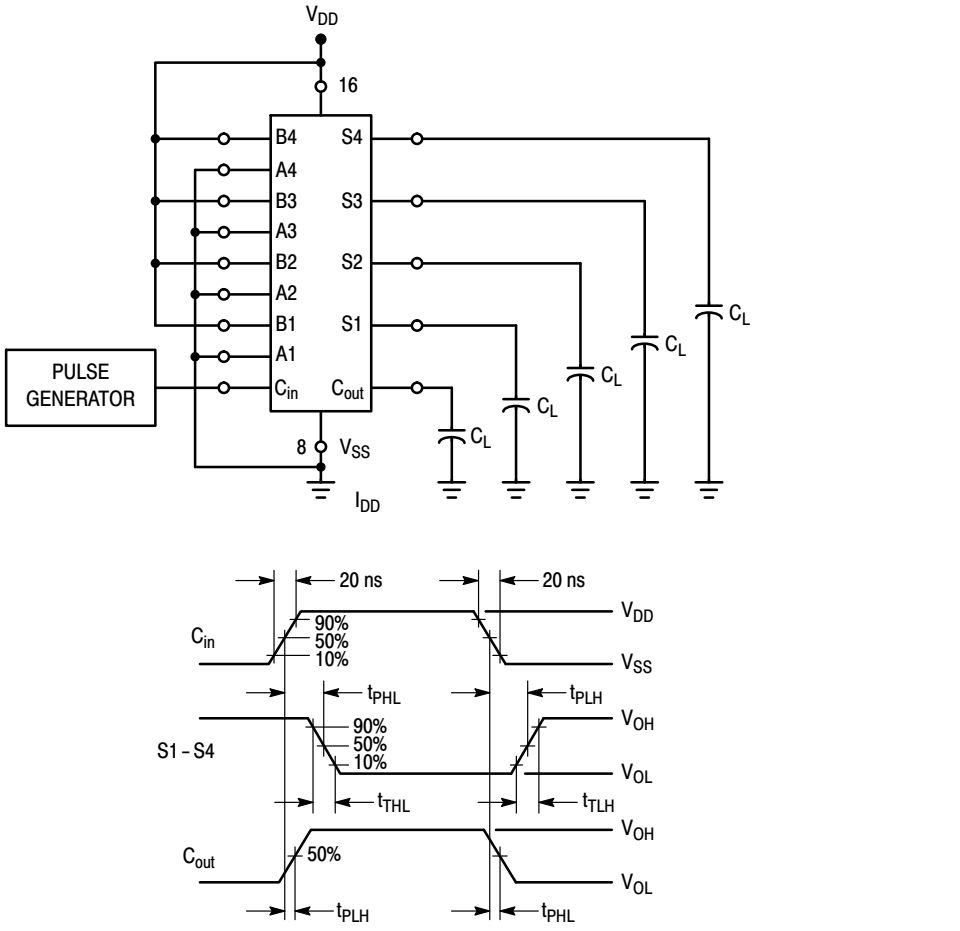


Figure 4. Switching Time Test Circuit and Waveforms

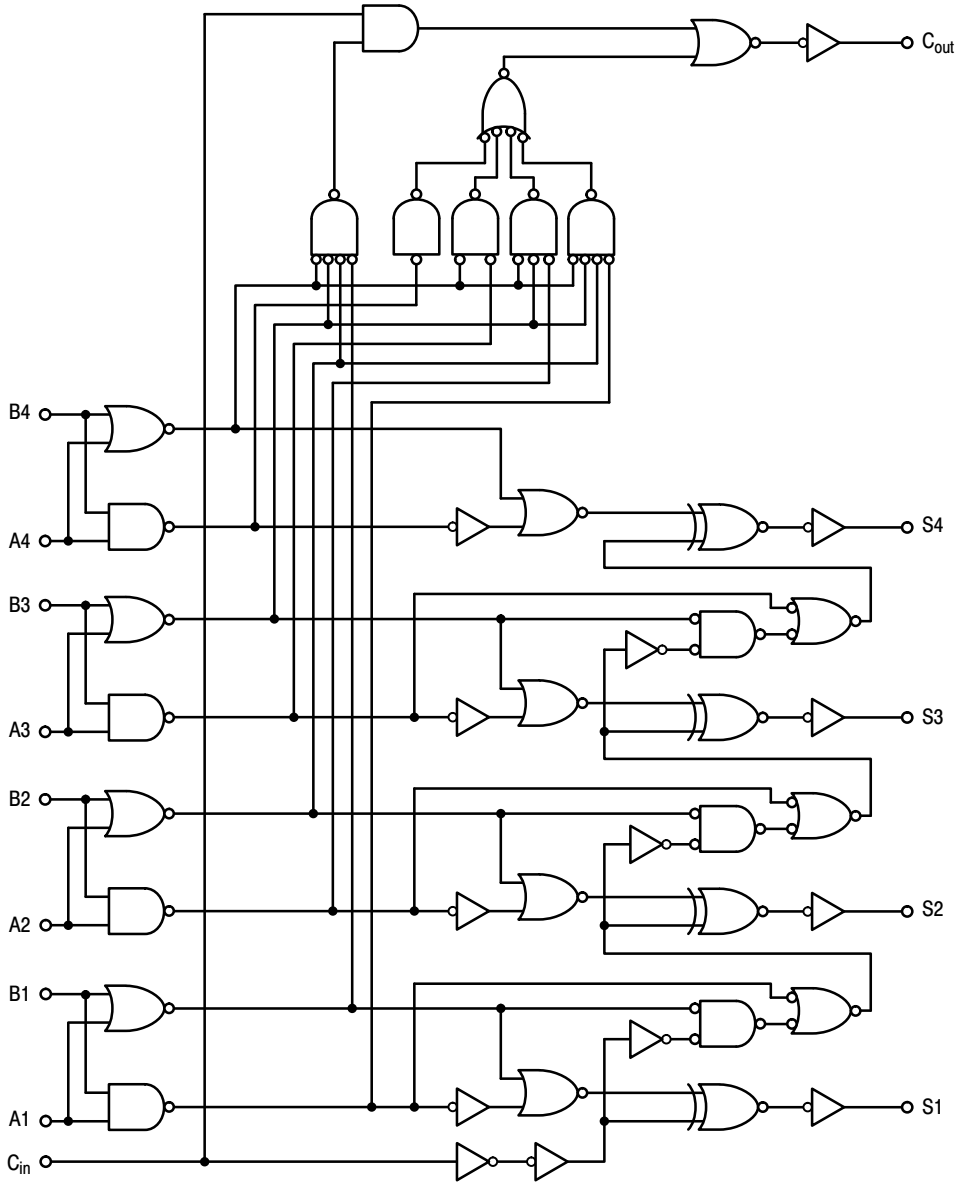
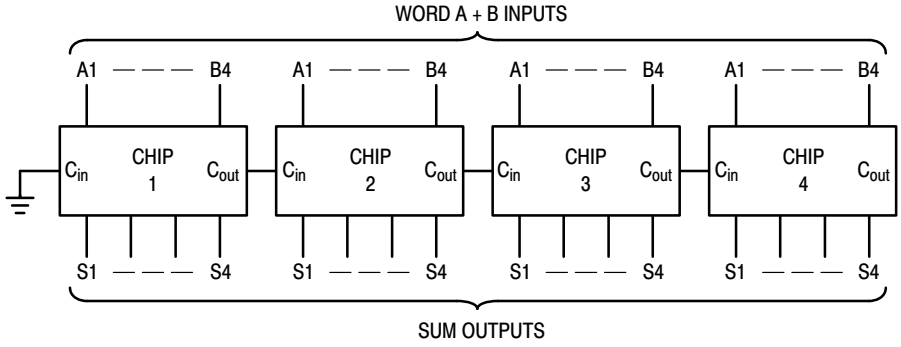


Figure 5. Logic Diagram

TYPICAL APPLICATION



Calculation of 16−bit adder speed:

t_P total = t_P (Sum to Carry) + t_P (Carry to Sum) + 2 t_P (Carry to Carry)

The guaranteed 16−bit adder speed at 10 V, 25°C, C_L = 50 pF is:

t_p total = 290 + 310 + 300 = 900 ns

Figure 6. Using the MC14008B in a 16−Bit Adder Configuration

MECHANICAL CASE OUTLINE
PACKAGE DIMENSIONS

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SOIC−16
CASE 751B−05
ISSUE K

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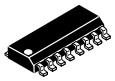
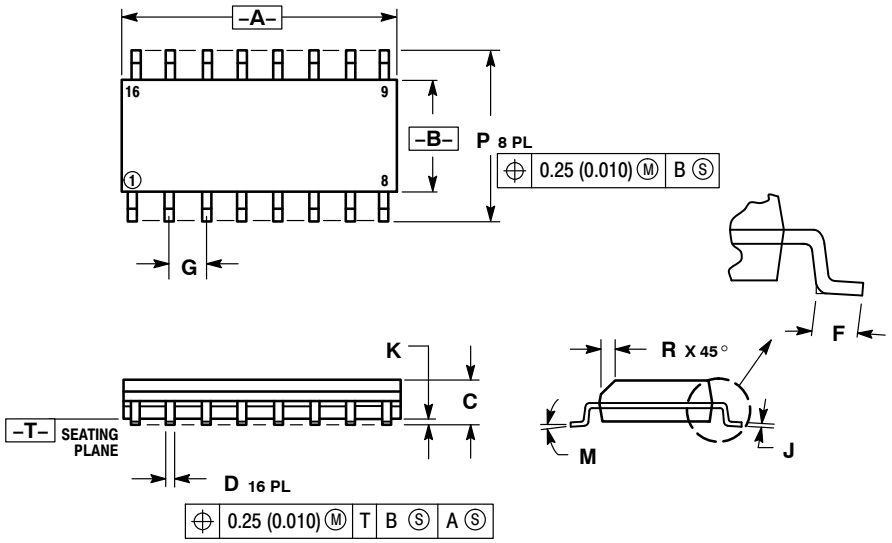


SCALE 1:1



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

STYLE 1:
PIN 1. COLLECTOR
2. BASE
3. EMITTER
4. NO CONNECTION
5. EMITTER
6. BASE
7. COLLECTOR
8. COLLECTOR
9. BASE
10. EMITTER
11. NO CONNECTION
12. EMITTER
13. BASE
14. COLLECTOR
15. EMITTER
16. COLLECTOR

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

STYLE 3:
PIN 1. COLLECTOR, DYE #1
2. BASE, #1
3. EMITTER, #1
4. COLLECTOR, #1
5. COLLECTOR, #2
6. BASE, #2
7. EMITTER, #2
8. COLLECTOR, #2
9. COLLECTOR, #3
10. BASE, #3
11. EMITTER, #3
12. COLLECTOR, #3
13. COLLECTOR, #4
14. BASE, #4
15. EMITTER, #4
16. COLLECTOR, #4

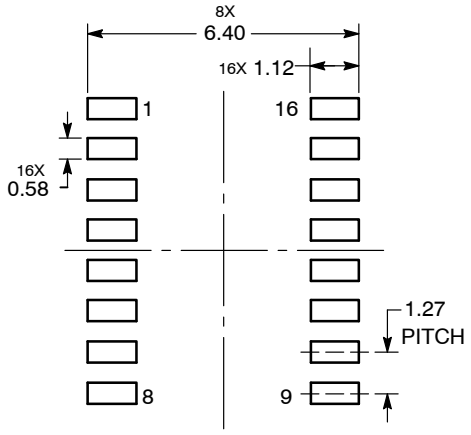
STYLE 4:
PIN 1. COLLECTOR, DYE #1
2. COLLECTOR, #1
3. COLLECTOR, #2
4. COLLECTOR, #2
5. COLLECTOR, #3
6. COLLECTOR, #3
7. COLLECTOR, #4
8. COLLECTOR, #4
9. BASE, #4
10. EMITTER, #4
11. BASE, #3
12. EMITTER, #3
13. BASE, #2
14. EMITTER, #2
15. BASE, #1
16. EMITTER, #1

STYLE 5:
PIN 1. DRAIN, DYE #1
2. DRAIN, #1
3. DRAIN, #2
4. DRAIN, #2
5. DRAIN, #3
6. DRAIN, #3
7. DRAIN, #4
8. DRAIN, #4
9. GATE, #4
10. SOURCE, #4
11. GATE, #3
12. SOURCE, #3
13. GATE, #2
14. SOURCE, #2
15. GATE, #1
16. SOURCE, #1

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

STYLE 7:
PIN 1. SOURCE N-CH
2. COMMON DRAIN (OUTPUT)
3. COMMON DRAIN (OUTPUT)
4. GATE P-CH
5. COMMON DRAIN (OUTPUT)
6. COMMON DRAIN (OUTPUT)
7. COMMON DRAIN (OUTPUT)
8. SOURCE P-CH
9. SOURCE P-CH
10. COMMON DRAIN (OUTPUT)
11. COMMON DRAIN (OUTPUT)
12. COMMON DRAIN (OUTPUT)
13. GATE N-CH
14. COMMON DRAIN (OUTPUT)
15. COMMON DRAIN (OUTPUT)
16. SOURCE N-CH

SOLDERING FOOTPRINT



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