

MC14028B

BCD-To-Decimal Decoder Binary-To-Octal Decoder

The MC14028B decoder is constructed so that an 8421 BCD code on the four inputs provides a decimal (one-of-ten) decoded output, while a 3-bit binary input provides a decoded octal (one-of-eight) code output with D forced to a logic “0”. Expanded decoding such as binary-to-hexadecimal (one-of-sixteen), etc., can be achieved by using other MC14028B devices. The part is useful for code conversion, address decoding, memory selection control, demultiplexing, or readout decoding.

Features

- Diode Protection on All Inputs
- 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
- Positive Logic Design
- Low Outputs on All Illegal Input Combinations
- Similar to CD4028B
- These Devices are Pb-Free and are RoHS Compliant

MAXIMUM RATINGS (Voltages Referenced to V_{SS})

Parameter	Symbol	Value	Unit
DC Supply Voltage Range	V_{DD}	-0.5 to +18.0	V
Input or Output Voltage Range (DC or Transient)	V_{in}, V_{out}	-0.5 to $V_{DD} + 0.5$	V
Input or Output Current (DC or Transient) per Pin	I_{in}, I_{out}	± 10	mA
Power Dissipation per Package (Note 1)	P_D	500	mW
Ambient Temperature Range	T_A	-55 to +125	°C
Storage Temperature Range	T_{stg}	-65 to +150	°C
Lead Temperature (8-Second Soldering)	T_L	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: 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 $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$.

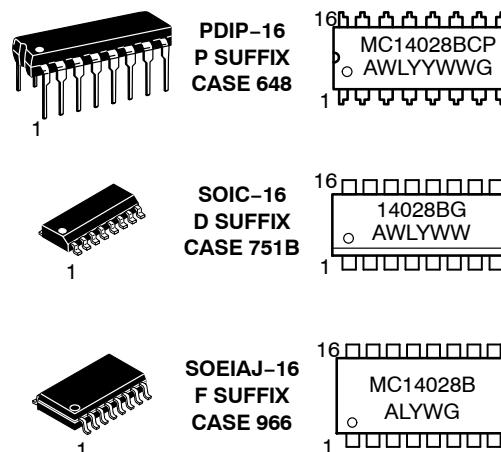
Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.



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MARKING DIAGRAMS



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

ORDERING INFORMATION

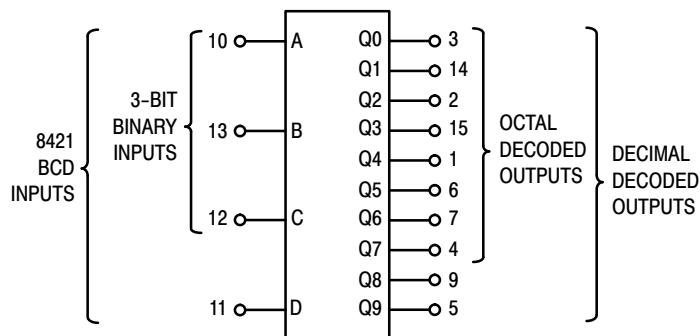
See detailed ordering and shipping information in the package dimensions section on page 2 of this data sheet.

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PIN ASSIGNMENT

Q4	1 •	16	V _{DD}
Q2	2	15	Q3
Q0	3	14	Q1
Q7	4	13	B
Q9	5	12	C
Q5	6	11	D
Q6	7	10	A
V _{SS}	8	9	Q8

BLOCK DIAGRAM



V_{DD} = PIN 16

V_{SS} = PIN 8

TRUTH TABLE

D	C	B	A	Q9	Q8	Q7	Q6	Q5	Q4	Q3	Q2	Q1	Q0
0	0	0	0	0	0	0	0	0	0	0	0	0	1
0	0	0	1	0	0	0	0	0	0	0	0	1	0
0	0	1	0	0	0	0	0	0	0	0	1	0	0
0	0	1	1	0	0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0	1	0	0	0	0
0	1	0	1	0	0	0	0	1	0	0	0	0	0
0	1	1	0	0	0	0	1	0	0	0	0	0	0
0	1	1	1	0	0	0	1	0	0	0	0	0	0
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1	0	1	0	0	0	0	0	0	0	0	0	0	0
1	0	1	1	0	0	0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0	0	0	0
1	1	0	1	0	0	0	0	0	0	0	0	0	0
1	1	1	0	0	0	0	0	0	0	0	0	0	0
1	1	1	1	0	0	0	0	0	0	0	0	0	0

ORDERING INFORMATION

Device	Package	Shipping [†]
MC14028BCPG	PDIP-16 (Pb-Free)	25 Units / Rail
MC14028BDG	SOIC-16 (Pb-Free)	48 Units / Rail
MC14028BDR2G	SOIC-16 (Pb-Free)	2500 / Tape & Reel
MC14028BFELG	SOEIAJ-16 (Pb-Free)	2000 / 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.

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ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic	Symbol	V _{DD} Vdc	- 55°C		25°C			125°C		Unit
			Min	Max	Min	Typ (Note 2)	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	Vdc
		15	—	0.05	—	0	0.05	—	0.05	Vdc
	V _{OH}	5.0	4.95	—	4.95	5.0	—	4.95	—	Vdc
		10	9.95	—	9.95	10	—	9.95	—	Vdc
		15	14.95	—	14.95	15	—	14.95	—	Vdc
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	Vdc
		15	—	4.0	—	6.75	4.0	—	4.0	Vdc
	V _{IH}	5.0	3.5	—	3.5	2.75	—	3.5	—	Vdc
		10	7.0	—	7.0	5.50	—	7.0	—	Vdc
		15	11	—	11	8.25	—	11	—	Vdc
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
		I _{OH}	5.0	-0.64	—	-0.51	-0.88	—	-0.36	mAdc
		I _{OH}	10	-1.6	—	-1.3	-2.25	—	-0.9	mAdc
		I _{OH}	15	-4.2	—	-3.4	-8.8	—	-2.4	mAdc
	Sink	I _{OL}	5.0	0.64	—	0.51	0.88	—	0.36	mAdc
		I _{OL}	10	1.6	—	1.3	2.25	—	0.9	mAdc
		I _{OL}	15	4.2	—	3.4	8.8	—	2.4	mAdc
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
5.0	—	10	—	10	—	0.010	10	—	300	μAdc
5.0	—	15	—	20	—	0.015	20	—	600	μAdc
Total Supply Current (Note 3, 4) (Dynamic plus Quiescent, Per Package) (C _L = 50 pF on all outputs, all buffers switching)	I _T	5.0	I _T = (0.3 μA/kHz) f + I _{DD} I _T = (0.6 μA/kHz) f + I _{DD} I _T = (0.9 μA/kHz) f + I _{DD}						—	μAdc

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.

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

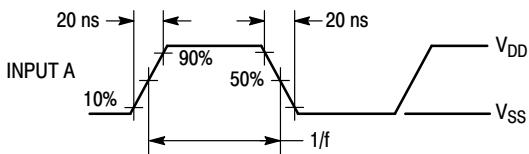
Characteristic	Symbol	V _{DD}	Min	Typ (Note 6)	Max	Unit
Output Rise and Fall Time t _{TLH} , t _{THL} = (1.5 ns/pF) C _L + 25 ns t _{TLH} , t _{THL} = (0.75 ns/pF) C _L + 12.5 ns t _{TLH} , t _{THL} = (0.55 ns/pF) C _L + 9.5 ns	t _{TLH} , t _{THL}	5.0 10 15	— — —	100 50 40	200 100 80	ns
Propagation Delay Time t _{PLH} , t _{PHL} = (1.7 ns/pF) C _L + 215 ns t _{PLH} , t _{PHL} = (0.66 ns/pF) C _L + 97 ns t _{PLH} , t _{PHL} = (0.5 ns/pF) C _L + 65 ns	t _{PLH} , t _{PHL}	5.0 10 15	— — —	300 130 90	600 260 180	ns

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.

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Inputs B, C, and D switching in respect to a BCD code.



All outputs connected to respective C_L loads. f in respect to a system clock.

Inputs A, B, and D low.

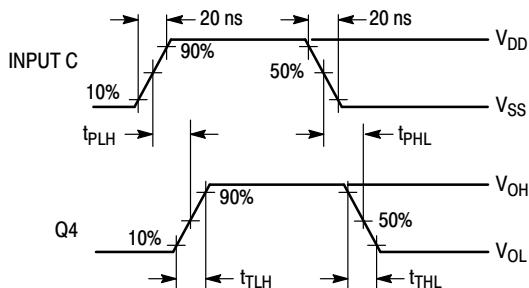
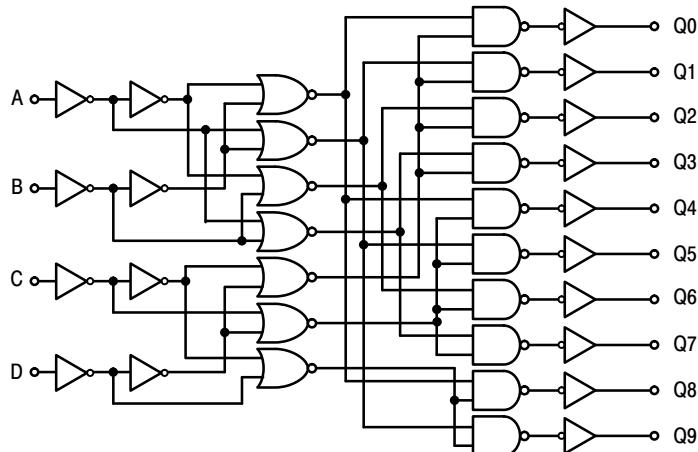


Figure 1. Dynamic Signal Waveforms



LOGIC DIAGRAM

APPLICATIONS INFORMATION

Expanded decoding can be performed by using the MC14028B and other CMOS Integrated Circuits. The circuit in Figure 2 converts any 4-bit code to a decimal or hexadecimal code. The accompanying table shows the input binary combinations, the associated “output numbers” that go “high” when selected, and the “redefined output numbers” needed for the proper code. For example: For the combination DCBA = 0111 the output number 7 is redefined for the 4-bit binary, 4-bit gray, excess-3, or excess-3 gray codes as 7, 5, 4, or 2, respectively. Figure 3 shows a 6-bit binary 1-of-64 decoder using nine MC14028B circuits and two MC14069UB inverters.

The MC14028B can be used in decimal digit displays, such as, neon readouts or incandescent projection indicators as shown in Figure 4.

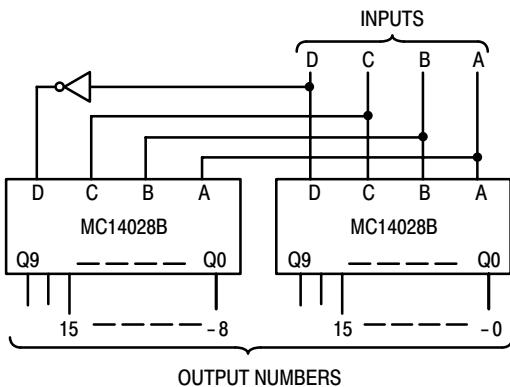


Figure 2. Code Conversion Circuit and Truth Table

MC14028B

Inputs		Output Numbers																	Code and Redefined Output Numbers					
																			Hexadecimal					
D	C	B	A	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	4-Bit Binary	4-Bit Gray	Excess-3 Gray	Alken	4221
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	3	2	2	2
0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3	2	3	3	2
0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	7	1	4	4
0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	6	2	4	3
0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	4	3	1	4
0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	5	4	2	2
1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	8	15	5		
1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	9	14	6		5
1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	10	12	7	9	6
1	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	11	13	8		5
1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	12	8	9	5	6
1	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	13	9	6	7	7
1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	14	11	8	8	8
1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	10	7	9	9

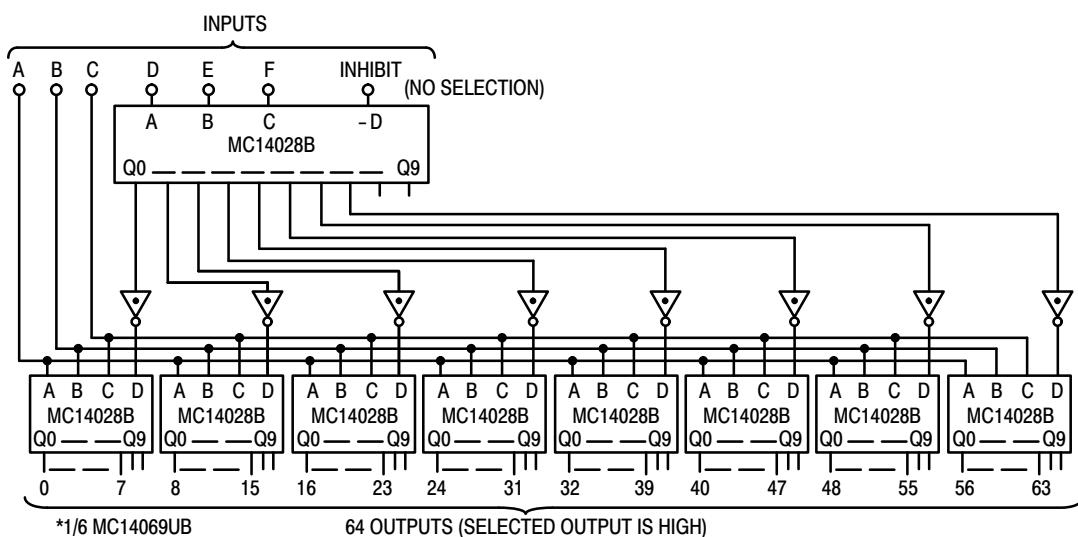


Figure 3. Six-Bit Binary 1-of-64 Decoder

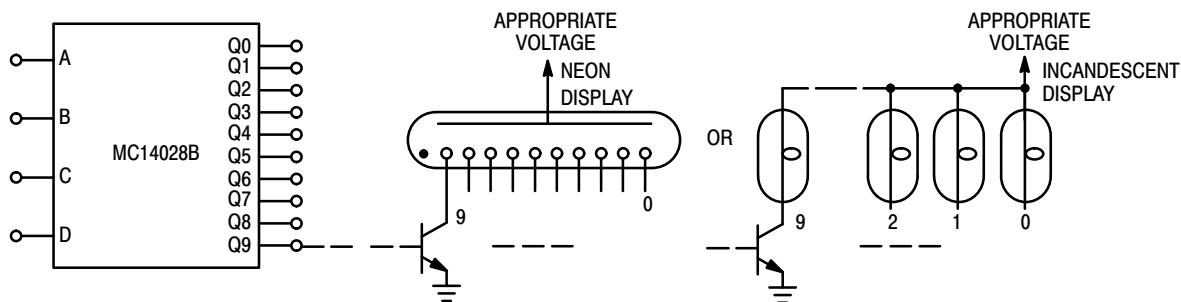
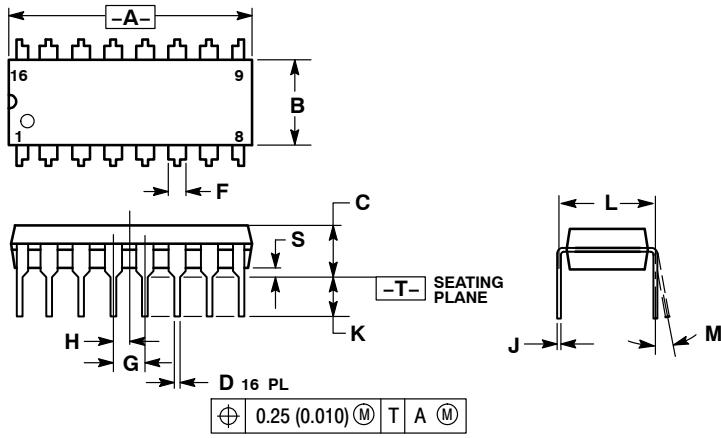


Figure 4. Decimal Digit Display Application

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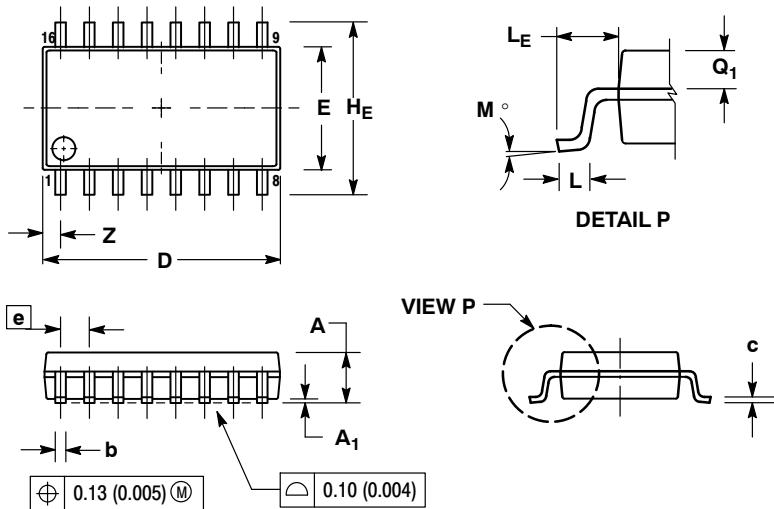
PACKAGE DIMENSIONS

PDIP-16
P SUFFIX
CASE 648-08
ISSUE T



DIM	INCHES		MILLIMETERS	
	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

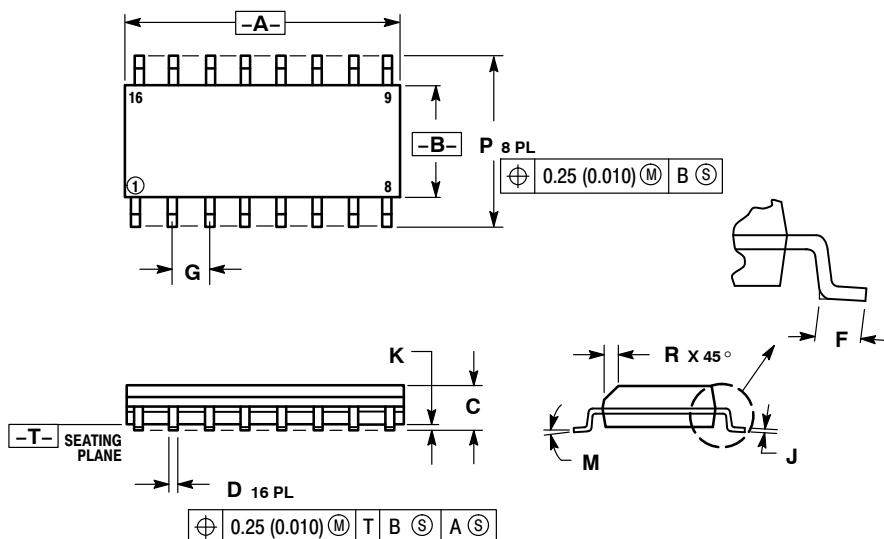
SOEIAJ-16
F SUFFIX
CASE 966-01
ISSUE A



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	0.10	0.20	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	
H _E	7.40	8.20	0.291	0.323
L	0.50	0.85	0.020	0.033
L _E	1.10	1.50	0.043	0.059
M	0°	10°	0°	10°
Q ₁	0.70	0.90	0.028	0.035
Z	---	0.78	---	0.031

PACKAGE DIMENSIONS

**SOIC-16
D SUFFIX
CASE 751B-05
ISSUE K**

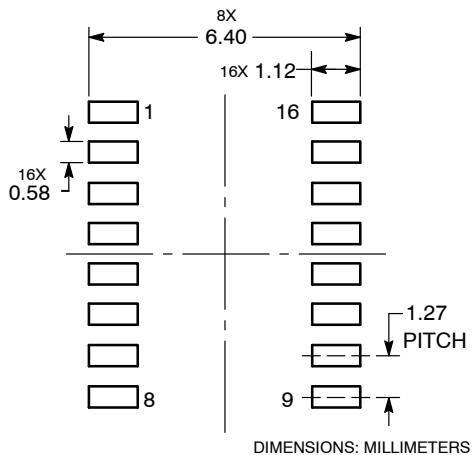


NOTES:

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	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

SOLDERING FOOTPRINT



DIMENSIONS: MILLIMETERS

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«FORSTAR» (основан в 1998 г.)

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(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).



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