


MOTOROLA
MC14175B
QUAD TYPE D FLIP-FLOP

The MC14175B quad type D flip-flop is constructed with MOS P-channel and N-channel enhancement mode devices in a single monolithic structure. Each of the four flip-flops is positive-edge triggered by a common clock input (C). An active-low reset input (\bar{R}) asynchronously resets all flip-flops. Each flip-flop has independent Data (D) inputs and complementary outputs (Q and \bar{Q}). These devices may be used as shift register elements or as type T flip-flops for counter and toggle applications.

- Complementary Outputs
- Static Operation
- All Inputs and Outputs Buffered
- Diode Protection on All Inputs
- Supply Voltage Range = 3.0 Vdc to 18 Vdc
- Output Compatible with Two Low-Power TTL Loads or One Low-Power Schottky TTL Load
- Functional Equivalent to TTL 74175

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}, I_{out}	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

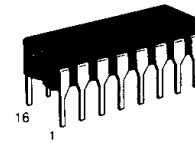
TRUTH TABLE

Clock	INPUTS		OUTPUTS		
	Data	Reset	Q	\bar{Q}	
	0	1	0	1	No Change
	1	1	1	0	
	X	1	Q	\bar{Q}	
X	X	0	0	1	

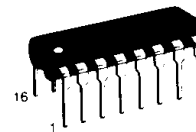
X = Don't Care

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

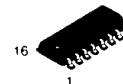
proper operation, V_{in} and V_{out} should be constrained to the range $V_{SS} \leq (V_{in} \text{ or } V_{out}) \leq V_{DD}$. Unused inputs must always be tied to an appropriate logic voltage level (e.g., either V_{SS} or V_{DD}). Unused outputs must be left open.



L SUFFIX
 CERAMIC
 CASE 620



P SUFFIX
 PLASTIC
 CASE 648

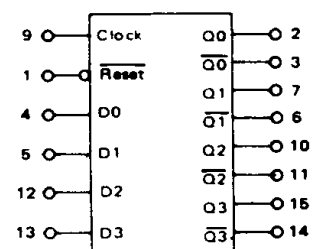


D SUFFIX
 SOIC
 CASE 751B

ORDERING INFORMATION

MC14XXXBCP Plastic
 MC14XXXBCL Ceramic
 MC14XXXBD SOIC

$T_A = -55^\circ$ to 125°C for all packages.

BLOCK DIAGRAM


$V_{DD} = \text{Pin } 16$
 $V_{SS} = \text{Pin } 8$

MC14175B

ELECTRICAL CHARACTERISTICS (Voltages Referenced to V_{SS})

Characteristic	Symbol	V _{DD} V _{Dc}	-55°C		25°C			125°C		Unit
			Min	Max	Min	Typ #	Max	Min	Max	
Output Voltage V _{in} = V _{DD} or 0	V _{OL}	5.0	—	0.05	—	0	0.05	—	0.05	V _{Dc}
		10	—	0.05	—	0	0.05	—	0.05	
V _{in} = 0 or V _{DD}	V _{OH}	5.0	4.95	—	4.95	5.0	—	4.95	—	V _{Dc}
		10	9.95	—	9.95	10	—	9.95	—	
Input Voltage (V _O = 4.5 or 0.5 V _{Dc}) (V _O = 9.0 or 1.0 V _{Dc}) (V _O = 13.5 or 1.5 V _{Dc})	V _{IL}	5.0	—	1.5	—	2.25	1.5	—	1.5	V _{Dc}
		10	—	3.0	—	4.50	3.0	—	3.0	
(V _O = 0.5 or 4.5 V _{Dc}) (V _O = 1.0 or 9.0 V _{Dc}) (V _O = 1.5 or 13.5 V _{Dc})	V _{IH}	5.0	3.5	—	3.5	2.75	—	3.5	—	V _{Dc}
		10	7.0	—	7.0	5.50	—	7.0	—	
Output Drive Current (V _{OH} = 2.5 V _{Dc}) (V _{OH} = 4.6 V _{Dc}) (V _{OH} = 9.5 V _{Dc}) (V _{OH} = 13.5 V _{Dc})	Source I _{OH}	5.0	-3.0	—	-2.4	-4.2	—	-1.7	—	mAdc
		5.0	-0.64	—	-0.51	-0.88	—	-0.36	—	
(V _{OL} = 0.4 V _{Dc}) (V _{OL} = 0.5 V _{Dc}) (V _{OL} = 1.5 V _{Dc})	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	—	5.0	—	0.005	5.0	—	150	μAdc
		10	—	10	—	0.010	10	—	300	
		15	—	20	—	0.015	20	—	600	
Total Supply Current**† (Dynamic plus Quiescent, Per Package) (C _L = 50 pF on all outputs, all buffers switching)	I _T	5.0	I _T = (1.7 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}									

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

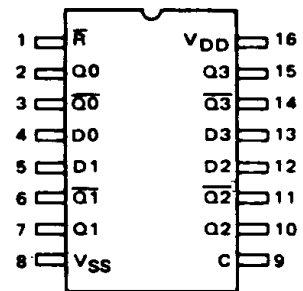
**The formulas given are for the typical characteristics only at 25°C.

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

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

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.

PIN ASSIGNMENT



MC14175B

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

Characteristic	Symbol	V _{DD} Vdc	All Types			Unit
			Min	Typ #	Max	
Output Rise and Fall Time $t_{TLH}, t_{THL} = (1.35 \text{ ns/pF}) C_L + 32 \text{ ns}$ $t_{TLH}, t_{THL} = (0.6 \text{ ns/pF}) C_L + 20 \text{ ns}$ $t_{TLH}, t_{THL} = (0.4 \text{ ns/pF}) C_L + 20 \text{ ns}$	t_{TLH}, t_{THL}	5.0 10 15	— — —	100 50 40	200 100 80	ns
Propagation Delay Time — Clock to Q, \bar{Q} $t_{PLH}, t_{PHL} = (0.9 \text{ ns/pF}) C_L + 175 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.36 \text{ ns/pF}) C_L + 72 \text{ ns}$ $t_{PLH}, t_{PHL} = (0.26 \text{ ns/pF}) C_L + 57 \text{ ns}$	t_{PLH}, t_{PHL}	5.0 10 15	— — —	220 90 70	400 160 120	ns
Propagation Delay Time — Reset to Q, \bar{Q} $t_{PHL} = (0.9 \text{ ns/pF}) C_L + 280 \text{ ns}$ $t_{PHL} = (0.36 \text{ ns/pF}) C_L + 112 \text{ ns}$ $t_{PHL} = (0.26 \text{ ns/pF}) C_L + 87 \text{ ns}$	t_{PHL}, t_{PLH}	5.0 10 15	— — —	325 130 100	500 200 150	ns
Clock Pulse Width	t_{WH}	5.0 10 15	250 100 75	110 45 35	— — —	ns
Reset Pulse Width	t_{WL}	5.0 10 15	200 80 60	100 40 30	— — —	ns
Clock Pulse Frequency	f_{cl}	5.0 10 15	— — —	4.5 11 14	2.0 5.0 6.5	MHz
Clock Pulse Rise and Fall Time	t_{TLH}, t_{THL}	5.0 10 15	— — —	— — —	15 5 4	μs
Data Setup Time	t_{su}	5.0 10 15	120 50 40	60 25 20	— — —	ns
Data Hold Time	t_h	5.0 10 15	80 40 30	40 20 15	— — —	ns
Reset Removal Time	t_{rem}	5.0 10 15	250 100 80	125 50 40	— — —	ns

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

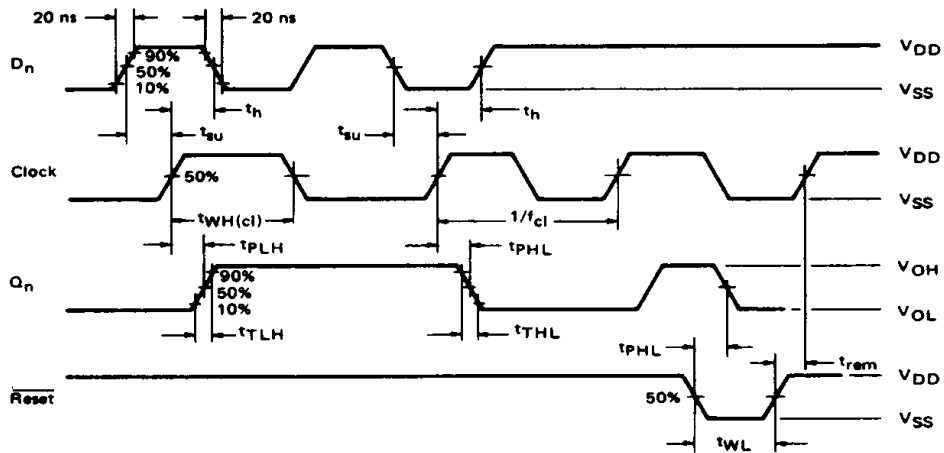
#Data labelled "Typ" is not to be used for design purposes but is intended as an indication of the IC's potential performance.

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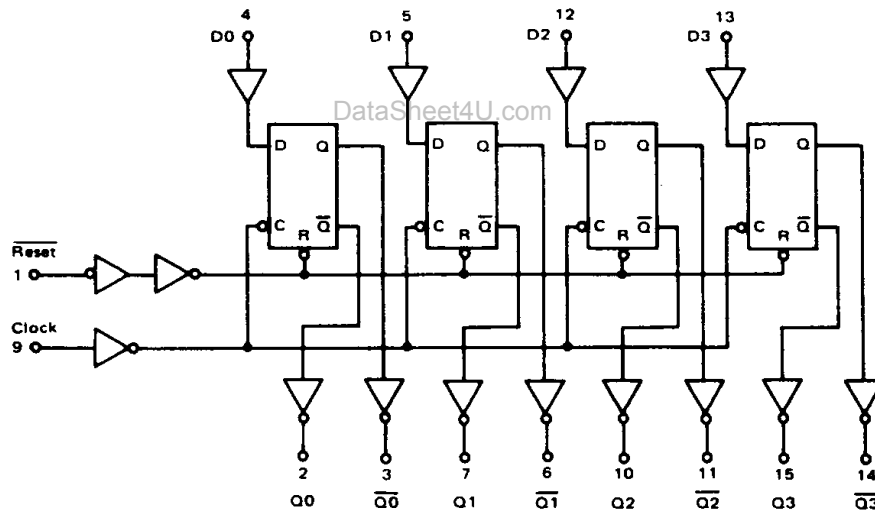
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MC14175B

TIMING DIAGRAM



FUNCTIONAL BLOCK DIAGRAM



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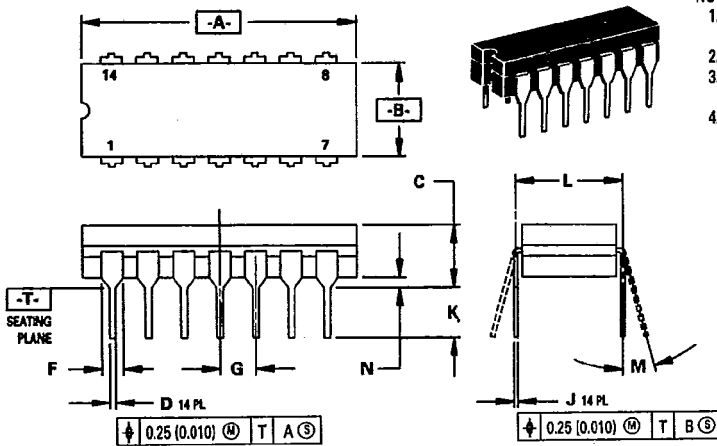
PACKAGE DIMENSIONS

T-90-20

The standard package availability for each device is indicated on the front page of the individual data sheets. Dimensions for the packages are given in this chapter. Surface mount packages may be special ordered by specifying the following suffixes: "D" (narrow SOIC), "DW" (wide SOIC), or "FN" (PLCC). For example, to order a quad NOR gate, use MC14001BD.

14-PIN PACKAGE

CERAMIC PACKAGE
CASE 632-08

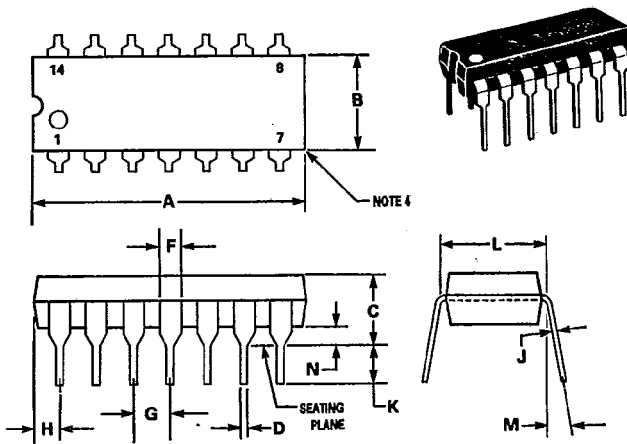


NOTES:

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

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	19.05	19.94	0.750	0.785
B	6.23	7.11	0.245	0.280
C	3.94	5.08	0.155	0.200
D	0.39	0.50	0.015	0.020
F	1.40	1.65	0.055	0.065
G	2.54 BSC		0.100 BSC	
J	0.21	0.38	0.008	0.015
K	3.18	4.31	0.125	0.170
L	7.62 BSC		0.300 BSC	
M	0°	15°	0°	15°
N	0.51	1.01	0.020	0.040

PLASTIC PACKAGE
CASE 646-06



NOTES:

1. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
2. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION "B" DOES NOT INCLUDE MOLD FLASH.
4. ROUNDED CORNERS OPTIONAL.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	18.16	19.56	0.715	0.770
B	6.10	6.60	0.240	0.260
C	3.69	4.69	0.145	0.165
D	0.38	0.53	0.015	0.021
F	1.02	1.78	0.040	0.070
G	2.54 BSC		0.100 BSC	
H	1.32	2.41	0.052	0.095
J	0.20	0.38	0.008	0.015
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	0°	10°	0°	10°
N	0.39	1.01	0.015	0.039

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9-2

PACKAGE DIMENSIONS (Continued)

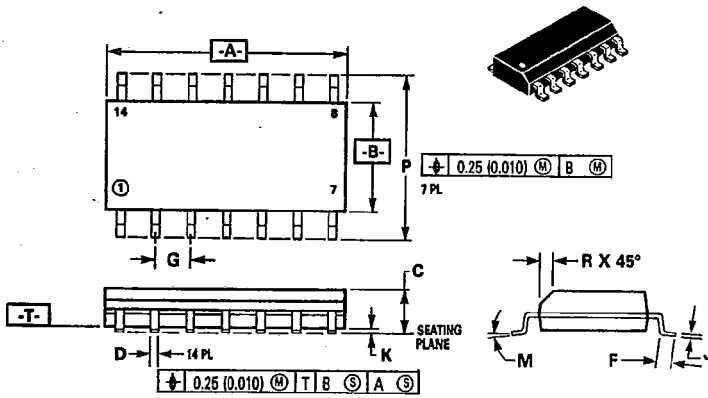
14-PIN PACKAGE

SOIC PACKAGE
CASE 751A-02
D SUFFIX

NOTES:

1. DIMENSIONS A AND B ARE DATUMS AND T IS A DATUM SURFACE.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
3. CONTROLLING DIMENSION: MILLIMETER.
4. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
5. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.

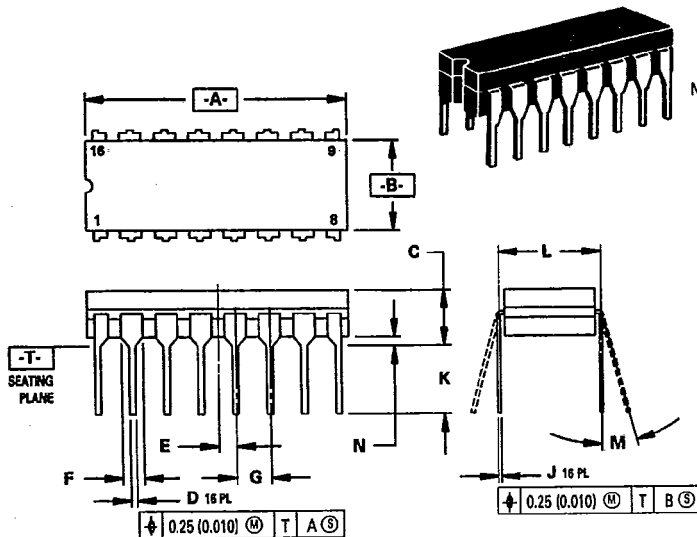
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	8.55	8.75	0.337	0.344
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27 BSC		0.050 BSC	
J	0.19	0.25	0.008	0.009
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019



PACKAGE DIMENSIONS (Continued)

16-PIN PACKAGE

CERAMIC PACKAGE CASE 620-09

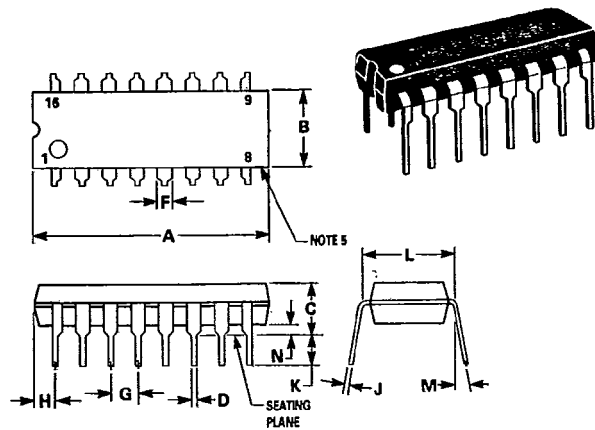


- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: INCH.
 3. DIMENSION L TO CENTER OF LEAD WHEN FORMED PARALLEL.
 4. DIM F MAY NARROW TO 0.76 (0.030) WHERE THE LEAD ENTERS THE CERAMIC BODY.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	19.05	19.55	0.750	0.770
B	6.10	7.36	0.240	0.290
C	—	4.19	—	0.165
D	0.39	0.53	0.015	0.021
E	1.27 BSC	—	0.050 BSC	—
F	1.40	1.77	0.055	0.070
G	2.54 BSC	—	0.100 BSC	—
J	0.23	0.27	0.009	0.011
K	—	5.08	—	0.200
L	7.62 BSC	—	0.300 BSC	—
M	0°	15°	0°	15°
N	0.39	0.88	0.015	0.035

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PLASTIC PACKAGE CASE 648-06



- NOTES:
1. LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION.
 2. DIMENSION "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
 3. DIMENSION "B" DOES NOT INCLUDE MOLD FLASH.
 4. "F" DIMENSION IS FOR FULL LEADS.
 5. ROUNDED CORNERS OPTIONAL.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	18.80	21.34	0.740	0.840
B	6.10	6.60	0.240	0.260
C	3.69	4.69	0.145	0.185
D	0.38	0.53	0.015	0.021
F	1.02	1.78	0.040	0.070
G	2.54 BSC	—	0.100 BSC	—
H	0.38	2.41	0.015	0.095
J	0.20	0.38	0.008	0.015
K	2.92	3.43	0.115	0.135
L	7.62 BSC	—	0.300 BSC	—
M	0°	10°	0°	10°
N	0.39	1.01	0.015	0.040

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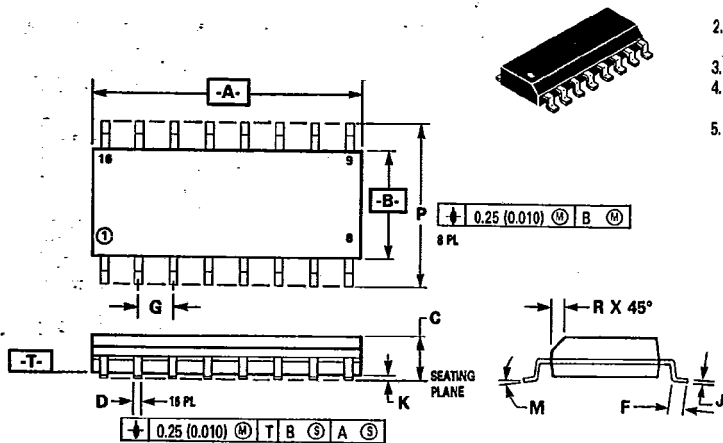
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PACKAGE DIMENSIONS (Continued)

16-PIN PACKAGE

SOIC PACKAGE
CASE 751B-03
D SUFFIX

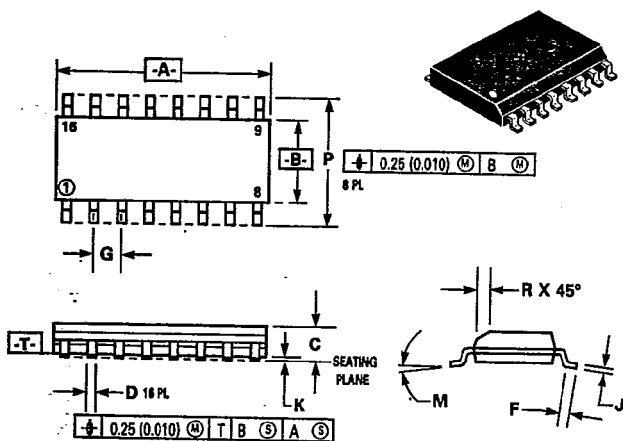


NOTES:

1. DIMENSIONS A AND B ARE DATUMS AND T IS A DATUM SURFACE.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
3. CONTROLLING DIMENSION: MILLIMETER.
4. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
5. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.

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

SOIC PACKAGE
CASE 751G-01
DW SUFFIX



NOTES:

1. DIMENSIONS A AND B ARE DATUMS AND T IS A DATUM SURFACE.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
3. CONTROLLING DIMENSION: MILLIMETER.
4. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
5. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	10.15	10.45	0.400	0.411
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.50	0.90	0.020	0.035
G	1.27 BSC		0.050 BSC	
J	0.25	0.32	0.010	0.012
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

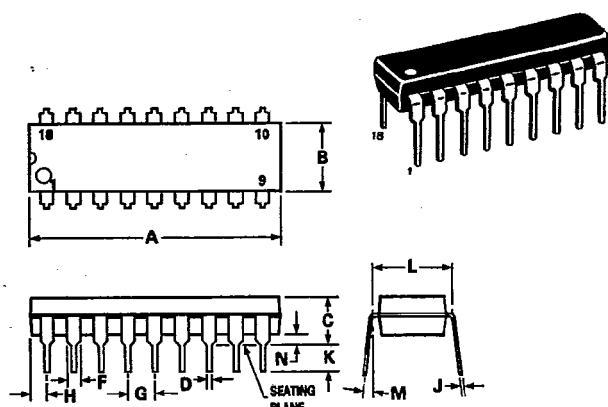
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PACKAGE DIMENSIONS (Continued)

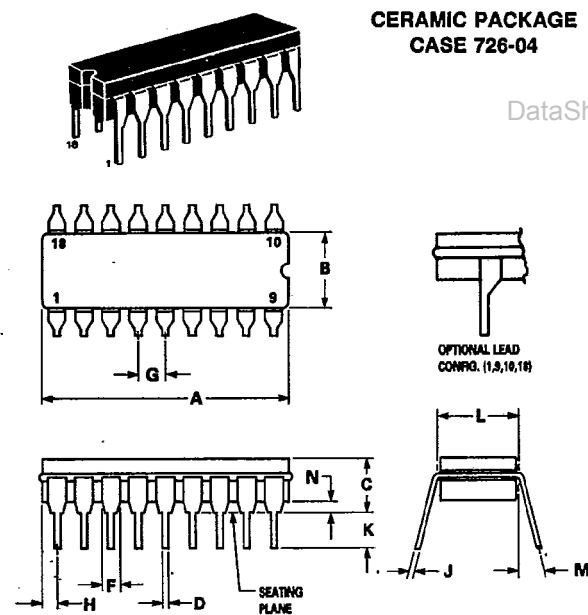
18-PIN PACKAGE

PLASTIC PACKAGE
CASE 707-02

NOTES:

1. POSITIONAL TOLERANCE OF LEADS (D), SHALL BE WITHIN 0.25mm(0.010) AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION B DOES NOT INCLUDE MOLD FLASH.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	22.22	23.24	0.875	0.915
B	6.10	6.60	0.240	0.260
C	3.56	4.57	0.140	0.180
D	0.36	0.56	0.014	0.022
F	1.27	1.78	0.050	0.070
G	2.54 BSC		0.100 BSC	
H	1.02	1.52	0.040	0.060
J	0.20	0.30	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62 BSC		0.300 BSC	
M	0°	15°	0°	15°
N	0.51	1.02	0.020	0.040

CERAMIC PACKAGE
CASE 726-04

NOTES:

1. LEADS, TRUE POSITIONED WITHIN 0.25 mm (0.010) DIA. AT SEATING PLANE, AT MAXIMUM MATERIAL CONDITION.
2. DIM "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIM "A" & "B" INCLUDES MENISCUS.
4. "F" DIMENSION IS FOR FULL LEADS. "HALF" LEADS ARE OPTIONAL AT LEAD POSITIONS 1, 9, 10, AND 18.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	22.35	23.11	0.880	0.910
B	6.10	7.49	0.240	0.295
C	—	5.08	—	0.200
D	0.38	0.53	0.015	0.021
F	1.40	1.78	0.055	0.070
G	2.54 BSC		0.100 BSC	
H	0.51	1.14	0.020	0.045
J	0.20	0.30	0.008	0.012
K	3.18	4.32	0.125	0.170
L	7.62 BSC		0.300 BSC	
M	0°	15°	0°	15°
N	0.51	1.02	0.020	0.040

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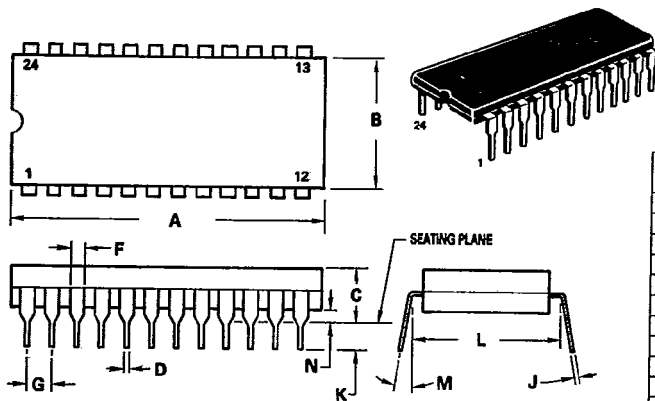
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PACKAGE DIMENSIONS (Continued)

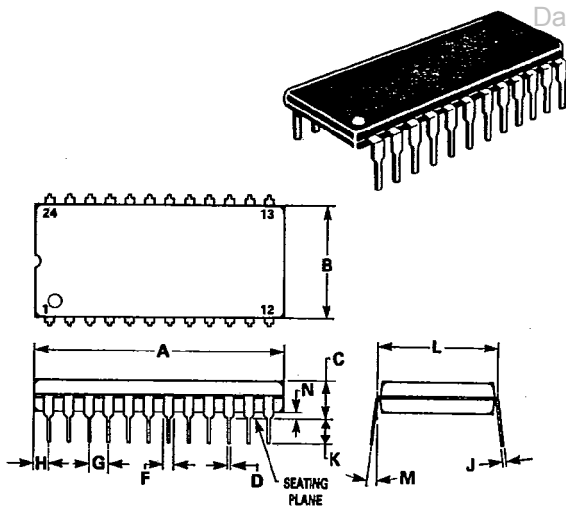
24-PIN PACKAGE

CERAMIC PACKAGE
CASE 623-05

NOTES:

- DIM "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
- LEADS WITHIN 0.13 mm (0.005) RADIUS OF TRUE POSITION AT SEATING PLANE AT MAXIMUM MATERIAL CONDITION. (WHEN FORMED PARALLEL).

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	31.24	32.77	1.230	1.290
B	12.70	15.49	0.500	0.610
C	4.06	5.59	0.160	0.220
D	0.41	0.51	0.016	0.020
F	1.27	1.52	0.050	0.060
G	2.54 BSC		0.100 BSC	
J	0.20	0.30	0.008	0.012
K	3.18	4.06	0.125	0.160
L	15.24 BSC		0.600 BSC	
M	0°	15°	0°	15°
N	0.51	1.27	0.020	0.050

PLASTIC PACKAGE
CASE 709-02

NOTES:

- POSITIONAL TOLERANCE OF LEADS (D), SHALL BE WITHIN 0.25 mm (0.010) AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
- DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
- DIMENSION B DOES NOT INCLUDE MOLD FLASH.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	31.37	32.13	1.235	1.265
B	13.72	14.22	0.540	0.560
C	3.94	5.08	0.155	0.200
D	0.36	0.56	0.014	0.022
F	1.02	1.52	0.040	0.060
G	2.54 BSC		0.100 BSC	
H	1.65	2.03	0.065	0.080
J	0.20	0.38	0.008	0.015
K	2.92	3.43	0.115	0.135
L	15.24 BSC		0.600 BSC	
M	0°	15°	0°	15°
N	0.51	1.02	0.020	0.040

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F-03

9-7

9