

MC74HC174A

Hex D Flip-Flop with Common Clock and Reset

High-Performance Silicon-Gate CMOS

The MC74HC174A is identical in pinout to the LS174. The device inputs are compatible with standard CMOS outputs; with pullup resistors, they are compatible with LSTTL outputs.

This device consists of six D flip-flops with common Clock and Reset inputs. Each flip-flop is loaded with a low-to-high transition of the Clock input. Reset is asynchronous and active-low.

Features

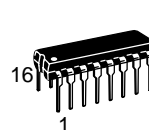
- Output Drive Capability: 10 LSTTL Loads
- Outputs Directly Interface to CMOS, NMOS, and TTL
- Operating Voltage Range: 2.0 to 6.0 V
- Low Input Current: 1.0 μ A
- In Compliance with the Requirements Defined by JEDEC Standard No. 7A
- Chip Complexity: 162 FETs or 40.5 Equivalent Gates
- Pb-Free Packages are Available*



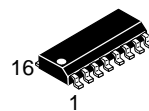
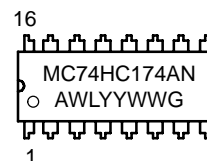
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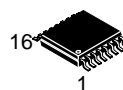
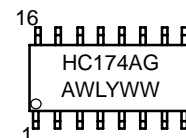
MARKING DIAGRAMS



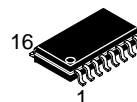
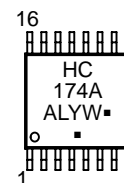
PDIP-16
N SUFFIX
CASE 648



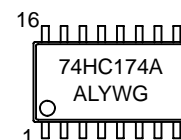
SOIC-16
D SUFFIX
CASE 751B



TSSOP-16
DT SUFFIX
CASE 948F



SOEIAJ-16
F SUFFIX
CASE 966



A = Assembly Location
L, WL = Wafer Lot
Y, YY = Year
W, WW = Work Week
G = Pb-Free Package
▪ = Pb-Free Package
(Note: Microdot may be in either location)

ORDERING INFORMATION

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

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

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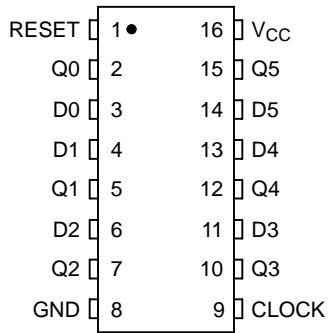


Figure 1. Pin Assignment

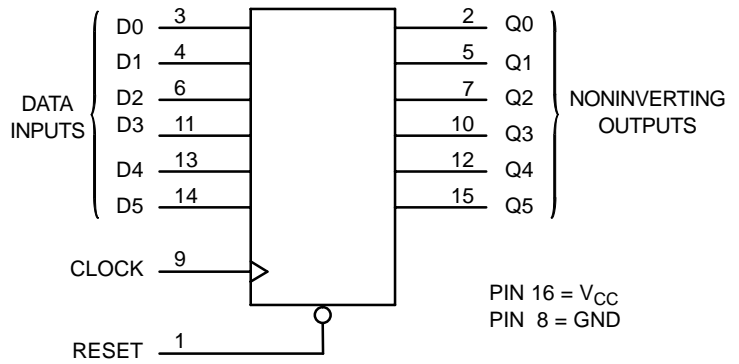


Figure 2. Logic Diagram

FUNCTION TABLE

Inputs			Output
Reset	Clock	D	Q
L	X	X	L
H	↗	H	H
H	↘	L	L
H	L	X	No Change
H	↖	X	No Change

DESIGN/VALUE TABLE

Design Criteria	Value	Units
Internal Gate Count*	40.5	ea.
Internal Gate Propagation Delay	1.5	ns
Internal Gate Power Dissipation	5.0	μW
Speed Power Product	0.0075	μJ

*Equivalent to a two-input NAND gate.

ORDERING INFORMATION

Device	Package	Shipping†
MC74HC174AN	PDIP-16	500 Units / Rail
MC74HC174ANG	PDIP-16 (Pb-Free)	500 Units / Rail
MC74HC174AD	SOIC-16	48 Units / Rail
MC74HC174ADG	SOIC-16 (Pb-Free)	48 Units / Rail
MC74HC174ADR2	SOIC-16	2500 Units / Reel
MC74HC174ADR2G	SOIC-16 (Pb-Free)	2500 Units / Reel
MC74HC174ADTR2	TSSOP-16*	2500 Units / Reel
MC74HC174ADTR2G	TSSOP-16*	2500 Units / Reel
MC74HC174AFEL	SOEIAJ-16	2000 Units / Reel
MC74HC174AFELG	SOEIAJ-16 (Pb-Free)	2000 Units / 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.

*This package is inherently Pb-Free.

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MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)	- 0.5 to + 7.0	V
V_{IN}	DC Input Voltage (Referenced to GND)	- 1.5 to $V_{CC} + 1.5$	V
V_{OUT}	DC Output Voltage (Referenced to GND) (Note 1)	- 0.5 to $V_{CC} + 0.5$	V
I_{IN}	DC Input Current, per Pin	± 20	mA
I_{OUT}	DC Output Current, per Pin	± 25	mA
I_{CC}	DC Supply Current, V_{CC} and GND Pins	± 50	mA
T_{STG}	Storage Temperature Range	- 65 to + 150	$^{\circ}C$
T_L	Lead Temperature, 1 mm from Case for 10 Seconds PDIP, SOIC, TSSOP	260	$^{\circ}C$
T_J	Junction Temperature Under Bias	+ 150	$^{\circ}C$
θ_{JA}	Thermal Resistance PDIP SOIC TSSOP	78 112 148	$^{\circ}C/W$
P_D	Power Dissipation in Still Air at 85 $^{\circ}C$ PDIP SOIC TSSOP	750 500 450	mW
MSL	Moisture Sensitivity	Level 1	
F_R	Flammability Rating Oxygen Index: 30% – 35%	UL 94 V-0 @ 0.125 in.	
V_{ESD}	ESD Withstand Voltage Human Body Model (Note 2) Machine Model (Note 3) Charged Device Model (Note 4)	> 2000 > 100 > 500	V
$I_{LATCHUP}$	Latchup Performance Above V_{CC} and Below GND at 85 $^{\circ}C$ (Note 5)	± 300	mA

Maximum ratings are those values beyond which device damage can occur. Maximum ratings applied to the device are individual stress limit values (not normal operating conditions) and are not valid simultaneously. If these limits are exceeded, device functional operation is not implied, damage may occur and reliability may be affected.

1. I_O absolute maximum rating must be observed.
2. Tested to EIA/JESD22-A114-A.
3. Tested to EIA/JESD22-A115-A.
4. Tested to JESD22-C101-A.
5. Tested to EIA/JESD78.
6. For high frequency or heavy load considerations, see the ON Semiconductor High-Speed CMOS Data Book (DL129/D).

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V_{CC}	DC Supply Voltage (Referenced to GND)	2.0	6.0	V
V_{IN}, V_{OUT}	DC Input Voltage, Output Voltage (Referenced to GND) (Note 7)	0	V_{CC}	V
T_A	Operating Temperature, All Package Types	- 55	+ 125	$^{\circ}C$
t_r, t_f	Input Rise and Fall Time (Figure 4) $V_{CC} = 2.0 V$ $V_{CC} = 4.5 V$ $V_{CC} = 6.0 V$	0 0 0	1000 500 400	ns

7. Unused inputs may not be left open. All inputs must be tied to a high- or low-logic input voltage level.

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DC ELECTRICAL CHARACTERISTICS (Voltages Referenced to GND)

Symbol	Parameter	Test Conditions	V _{CC} V	Guaranteed Limit			Unit
				-55°C to 25°C	≤85°C	≤125°C	
V _{IH}	Minimum High-Level Input Voltage	V _{OUT} = 0.1 V or V _{CC} - 0.1 V I _{OUT} ≤ 20 μA	2.0	1.5	1.5	1.5	V
			4.5	3.15	3.15	3.15	
			6.0	4.2	4.2	4.2	
V _{IL}	Maximum Low-Level Input Voltage	V _{OUT} = 0.1 V or V _{CC} - 0.1 V I _{OUT} ≤ 20 μA	2.0	0.5	0.5	0.5	V
			4.5	1.35	1.35	1.35	
			6.0	1.8	1.8	1.8	
V _{OH}	Minimum High-Level Output Voltage	V _{IN} = V _{IH} or V _{IL} I _{OUT} ≤ 20 μA	2.0	1.9	1.9	1.9	V
			4.5	4.4	4.4	4.4	
		6.0	5.9	5.9	5.9		
		V _{IN} = V _{IH} or V _{IL} I _{OUT} ≤ 4.0 mA I _{OUT} ≤ 5.2 mA	4.5	3.98	3.84	3.7	
6.0	5.48	5.34	5.2				
V _{OL}	Maximum Low-Level Output Voltage	V _{IN} = V _{IH} or V _{IL} I _{OUT} ≤ 20 μA	2.0	0.1	0.1	0.1	V
			4.5	0.1	0.1	0.1	
		6.0	0.1	0.1	0.1		
		V _{IN} = V _{IH} or V _{IL} I _{OUT} ≤ 4.0 mA I _{OUT} ≤ 5.2 mA	4.5	0.26	0.33	0.4	
6.0	0.26	0.33	0.4				
I _{IN}	Maximum Input Leakage Current	V _{IN} = V _{CC} or GND	6.0	±0.1	±1.0	±1.0	μA
I _{CC}	Maximum Quiescent Supply Current (per Package)	V _{IN} = V _{CC} or GND I _{OUT} = 0 μA	6.0	4.0	40	160	μA

8. Information on typical parametric values, along with high frequency or heavy load considerations, can be found in the ON Semiconductor High-Speed CMOS Data Book (DL129/D).

AC ELECTRICAL CHARACTERISTICS (C_L = 50 pF, Input t_r = t_f = 6.0 ns)

Symbol	Parameter	V _{CC} V	Guaranteed Limit			Unit
			-55°C to 25°C	≤85°C	≤125°C	
f _{max}	Maximum Clock Frequency (50% Duty Cycle) (Figures 4 and 7)	2.0	6.0	4.8	4.0	MHz
		4.5	30	24	20	
		6.0	35	28	24	
t _{PLH} t _{PHL}	Maximum Propagation Delay, Clock to Q (Figures 5 and 7)	2.0	110	140	165	ns
		4.5	22	28	33	
		6.0	19	24	28	
t _{PLH} t _{PHL}	Maximum Propagation Delay, Reset to Q (Figures 2 and 7)	2.0	110	140	160	ns
		4.5	21	28	32	
		6.0	19	24	27	
t _{TLH} t _{THL}	Maximum Output Transition Time, Any Output (Figures 4 and 7)	2.0	75	95	110	ns
		4.5	15	19	22	
		6.0	13	16	19	
C _{in}	Maximum Input Capacitance		10	10	10	pF

9. For propagation delays with loads other than 50 pF, and information on typical parametric values, see the ON Semiconductor High-Speed CMOS Data Book (DL129/D).

C _{PD}	Power Dissipation Capacitance, per Enabled Output (Note 10)	Typical @ 25°C, V _{CC} = 5.0 V		pF
		62		

10. Used to determine the no-load dynamic power consumption: P_D = C_{PD} V_{CC}²f + I_{CC} V_{CC}. For load considerations, see the ON Semiconductor High-Speed CMOS Data Book (DL129/D).

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TIMING REQUIREMENTS ($C_L = 50 \text{ pF}$, Input $t_r = t_f = 6.0 \text{ ns}$)

Symbol	Parameter	Figure	V_{CC} V	Guaranteed Limit						Unit
				-55°C to 25°C		≤ 85°C		≤ 125°C		
				Min	Max	Min	Max	Min	Max	
t_{su}	Minimum Setup Time, Data to Clock	6	2.0 4.5 6.0	50 10 9.0		65 13 11		75 15 13		ns
t_h	Minimum Hold Time, Clock to Data	6	2.0 4.5 6.0	5.0 5.0 5.0		5.0 5.0 5.0		5.0 5.0 5.0		ns
t_{rec}	Minimum Recovery Time, Reset Inactive to Clock	5	2.0 4.5 6.0	5.0 5.0 5.0		5.0 5.0 5.0		5.0 5.0 5.0		ns
t_w	Minimum Pulse Width, Clock	4	2.0 4.5 6.0	75 15 13		95 19 16		110 22 19		ns
t_w	Minimum Pulse Width, Reset	5	2.0 4.5 6.0	75 15 13		95 19 16		110 22 19		ns
t_r, t_f	Maximum Input Rise and Fall Times	4	2.0 4.5 6.0		1000 500 400		1000 500 400		1000 500 400	ns

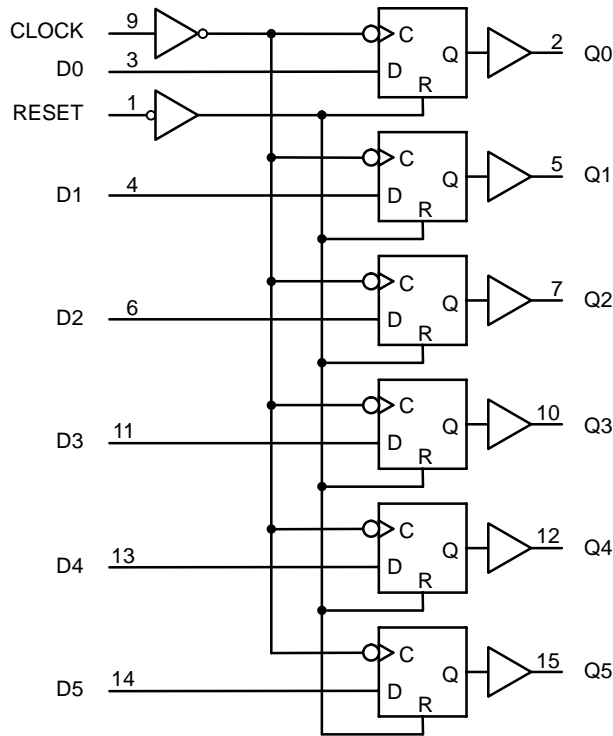


Figure 3. Expanded Logic Diagram

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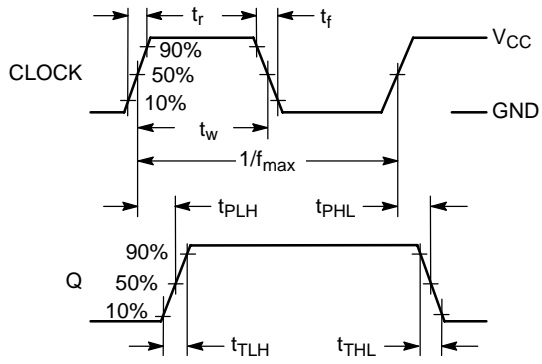


Figure 4. Switching Waveform

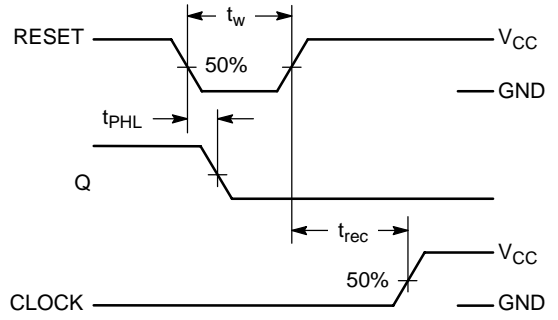


Figure 5. Switching Waveform

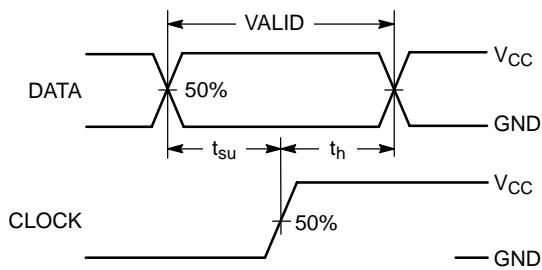
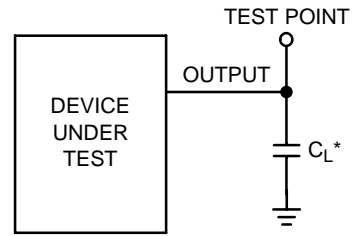


Figure 6. Switching Waveform



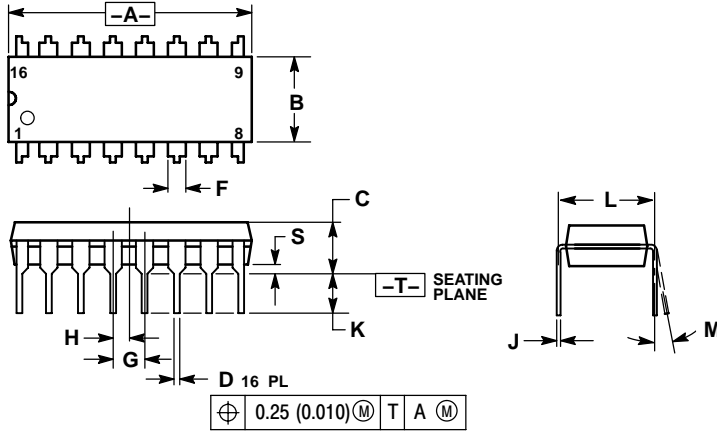
*Includes all probe and jig capacitance

Figure 7. Test Circuit

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PACKAGE DIMENSIONS

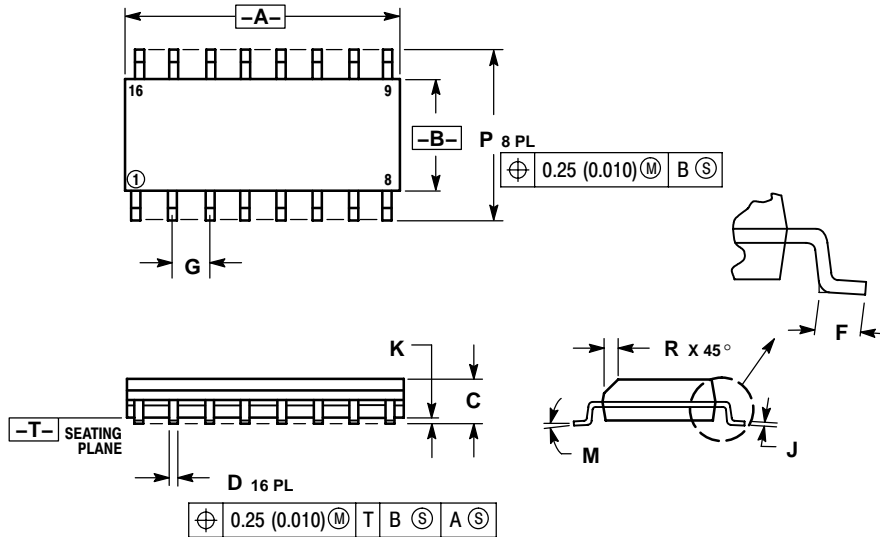
PDIP-16
N SUFFIX
CASE 648-08
ISSUE T



- 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.

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°	
S	0.020	0.040	0.51	1.01

SOIC-16
D SUFFIX
CASE 751B-05
ISSUE J



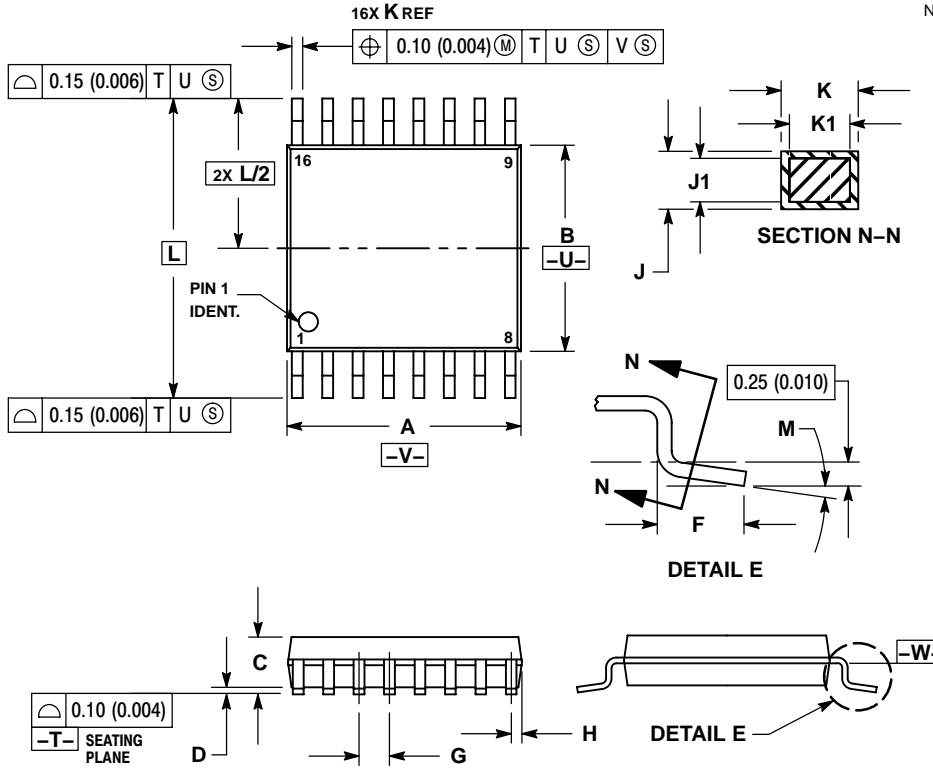
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.
 3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
 4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
 5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

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°	
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

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PACKAGE DIMENSIONS

TSSOP-16
DT SUFFIX
CASE 948F-01
ISSUE A



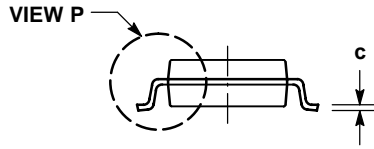
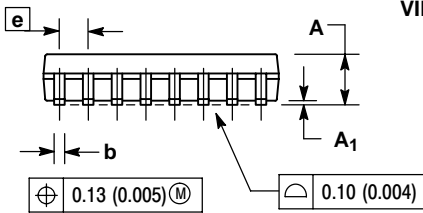
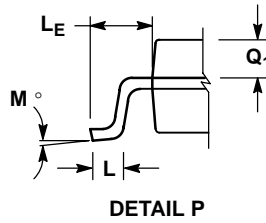
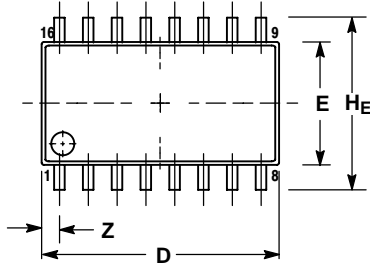
- NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
 2. CONTROLLING DIMENSION: MILLIMETER.
 3. DIMENSION A DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
 4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25 (0.010) PER SIDE.
 5. DIMENSION K DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE K DIMENSION AT MAXIMUM MATERIAL CONDITION.
 6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
 7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE -W-.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.90	5.10	0.193	0.200
B	4.30	4.50	0.169	0.177
C	---	1.20	---	0.047
D	0.05	0.15	0.002	0.006
F	0.50	0.75	0.020	0.030
G	0.65 BSC		0.026 BSC	
H	0.18	0.28	0.007	0.011
J	0.09	0.20	0.004	0.008
J1	0.09	0.16	0.004	0.006
K	0.19	0.30	0.007	0.012
K1	0.19	0.25	0.007	0.010
L	6.40 BSC		0.252 BSC	
M	0°	8°	0°	8°

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PACKAGE DIMENSIONS

SOEIAJ-16
F SUFFIX
CASE 966-01
ISSUE O



NOTES:

1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS AND ARE MEASURED AT THE PARTING LINE. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.15 (0.006) PER SIDE.
4. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
5. THE LEAD WIDTH DIMENSION (b) DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.08 (0.003) TOTAL IN EXCESS OF THE LEAD WIDTH DIMENSION AT MAXIMUM MATERIAL CONDITION. DAMBAR CANNOT BE LOCATED ON THE LOWER RADIUS OR THE FOOT. MINIMUM SPACE BETWEEN PROTRUSIONS AND ADJACENT LEAD TO BE 0.46 (0.018).

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	0.18	0.27	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

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