MC74AC139, MC74ACT139

Dual 1-of-4 Decoder/Demultiplexer

The MC74AC139/74ACT139 is a high−speed, dual 1−of−4 decoder/demultiplexer. The device has two independent decoders, each accepting two inputs and providing four mutually−exclusive active−LOW outputs. Each decoder has an active−LOW Enable input which can be used as a data input for a 4−output demultiplexer. Each half of the MC74AC139/74ACT139 can be used as a function generator providing four minterms of two variables.

ON Semiconductor®

Features

- Multifunctional Capability
- Two Completely Independent 1−of−4 Decoders
- Active LOW Mutually Exclusive Outputs
- Outputs Source/Sink 24 mA
- ′ACT139 Has TTL Compatible Inputs
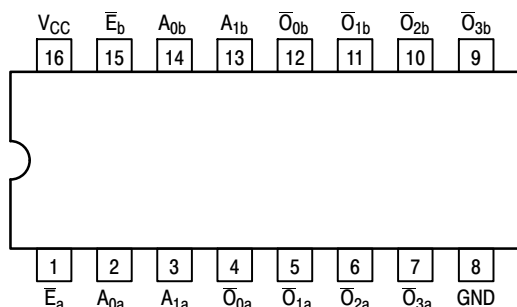- These are Pb−Free Devices

MARKING DIAGRAMS

SOIC−16 D SUFFIX CASE 751B	xxx139G AWLYWW
TSSOP−16 DT SUFFIX CASE 948F	xxx 139 ALYW■

xxx	= AC or ACT
A	= Assembly Location
WL or L	= Wafer Lot
Y	= Year
WW or W	= Work Week
G or ■	= Pb−Free Package

(Note: Microdot may be in either location)

16	15	14	13	12	11	10	9
V_{CC}	$\overline{E}_b$	A_{0b}	A_{1b}	$\overline{O}_{0b}$	$\overline{O}_{1b}$	$\overline{O}_{2b}$	$\overline{O}_{3b}$

1	2	3	4	5	6	7	8
$\overline{E}_a$	A_{0a}	A_{1a}	$\overline{O}_{0a}$	$\overline{O}_{1a}$	$\overline{O}_{2a}$	$\overline{O}_{3a}$	GND

Figure 1. Pinout: 16−Lead Packages Conductors
(Top View)

ORDERING INFORMATION

See detailed ordering and shipping information in the package dimensions section on page 6 of this data sheet.

PIN ASSIGNMENT

PIN	FUNCTION
A_0, A_1	Address Inputs
$\overline{E}$	Enable Inputs
$\overline{O}_0$−$\overline{O}_3$	Outputs

TRUTH TABLE

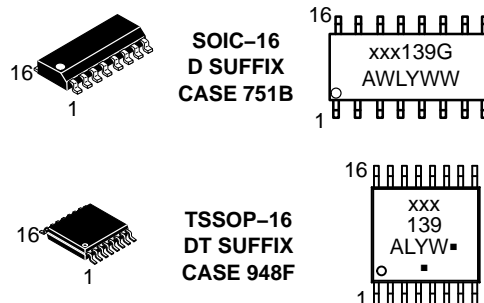| Inputs			Outputs			
$\overline{E}$	A_0	A_1	$\overline{O}_0$	$\overline{O}_1$	$\overline{O}_2$	$\overline{O}_3$
H	X	X	H	H	H	H
L	L	L	L	H	H	H
L	H	L	H	L	H	H
L	L	H	H	H	L	H
L	H	H	H	H	H	L

H = HIGH Voltage Level
L = LOW Voltage Level
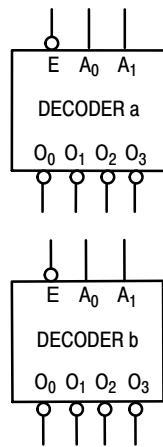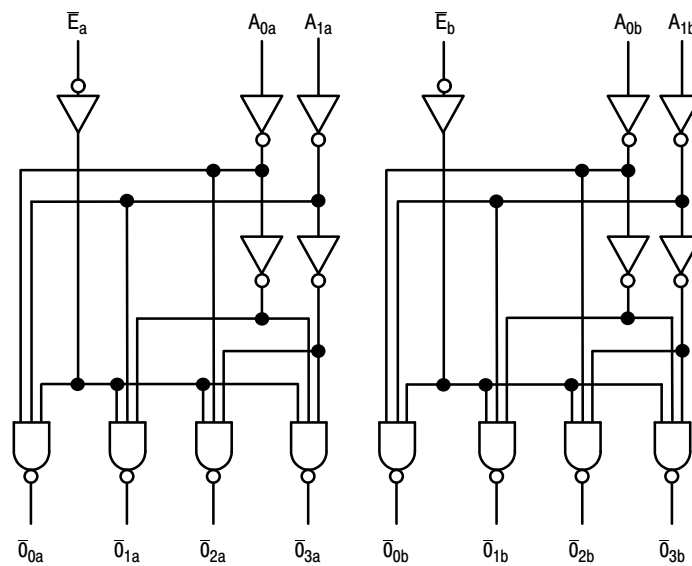X = Immaterial

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Figure 2. Logic Symbol

NOTE: This diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Figure 3. Logic Diagram

FUNCTIONAL DESCRIPTION

The MC74AC139/74ACT139 is a high–speed dual 1–of–4 decoder/demultiplexer. The device has two independent decoders, each of which accepts two binary weighted inputs (A_0–A_1) and provides four mutually exclusive active–LOW outputs ($\overline{O}_0$–$\overline{O}_3$). Each decoder has an active–LOW enable ($\overline{E}$). When $\overline{E}$ is HIGH all outputs are forced HIGH. The enable can be used as the data input for a 4–output demultiplexer application. Each half of the MC74AC139/74ACT139 generates all four minterms of two variables. These four minterms are useful in some applications, replacing multiple gate functions as shown in Figure 4, and thereby reducing the number of packages required in a logic network.
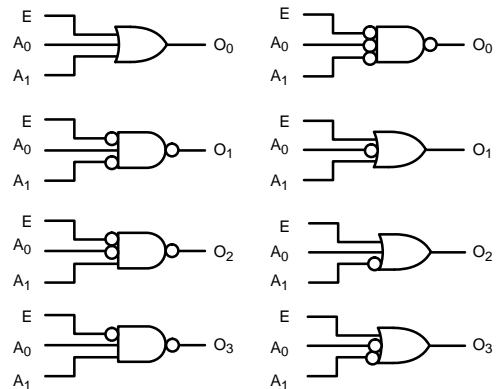

Figure 4. Gate Functions (Each Half)

MAXIMUM RATINGS

Symbol	Parameter		Value	Unit
V_{CC}	DC Supply Voltage		-0.5 to $+7.0$	V
V_I	DC Input Voltage		$-0.5 \leq V_I \leq V_{CC} + 0.5$	V
V_O	DC Output Voltage	(Note 1)	$-0.5 \leq V_O \leq V_{CC} + 0.5$	V
I_{IK}	DC Input Diode Current		± 20	mA
I_{OK}	DC Output Diode Current		± 50	mA
I_O	DC Output Sink/Source Current		± 50	mA
I_{CC}	DC Supply Current per Output Pin		± 50	mA
I_{GND}	DC Ground Current per Output Pin		± 50	mA
T_{STG}	Storage Temperature Range		-65 to $+150$	°C
T_L	Lead temperature, 1 mm from Case for 10 Seconds		260	°C
T_J	Junction temperature under Bias		$+150$	°C
θ_{JA}	Thermal Resistance (Note 2)	SOIC TSSOP	69.1 103.8	°C/W
P_D	Power Dissipation in Still Air at 65°C (Note 3)	SOIC TSSOP	500 500	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 4) Machine Model (Note 5) Charged Device Model (Note 6)	> 2000 > 200 > 1000	V
$I_{Latch-Up}$	Latch–Up Performance Above V_{CC} and Below GND at 85°C (Note 7)		± 100	mA

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. I_O absolute maximum rating must be observed.
2. The package thermal impedance is calculated in accordance with JESD51–7.
3. 500 mW at 65°C; derate to 300 mW by 10 mW/ from 65°C to 85°C.
4. Tested to EIA/JESD22–A114–A.
5. Tested to EIA/JESD22–A115–A.
6. Tested to JESD22–C101–A.
7. Tested to EIA/JESD78.

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter		Min	Typ	Max	Unit
V_{CC}	Supply Voltage	'AC	2.0	5.0	6.0	V
		'ACT	4.5	5.0	5.5	
V_{IN}, V_{OUT}	DC Input Voltage, Output Voltage (Ref. to GND)		0	–	V_{CC}	V
t_r, t_f	Input Rise and Fall Time (Note 1) 'AC Devices except Schmitt Inputs	V_{CC} @ 3.0 V	–	150	–	ns/V
		V_{CC} @ 4.5 V	–	40	–	
		V_{CC} @ 5.5 V	–	25	–	
t_r, t_f	Input Rise and Fall Time (Note 2) 'ACT Devices except Schmitt Inputs	V_{CC} @ 4.5 V	–	10	–	ns/V
		V_{CC} @ 5.5 V	–	8.0	–	
T_J	Junction Temperature (PDIP)		–	–	140	°C
T_A	Operating Ambient Temperature Range		–40	25	85	°C
I_{OH}	Output Current – High		–	–	–24	mA
I_{OL}	Output Current – Low		–	–	24	mA

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.
1. V_{IN} from 30% to 70% V_{CC}; see individual Data Sheets for devices that differ from the typical input rise and fall times.
2. V_{IN} from 0.8 V to 2.0 V; see individual Data Sheets for devices that differ from the typical input rise and fall times.

DC CHARACTERISTICS

Symbol	Parameter	V_CC (V)	74AC T_A = +25°C Typ	74AC T_A = +25°C Guaranteed Limits	74AC T_A = −40°C to +85°C	Unit	Conditions
V_{IH}	Minimum High Level Input Voltage	3.0 4.5 5.5	1.5 2.25 2.75	2.1 3.15 3.85	2.1 3.15 3.85	V	V_{OUT} = 0.1 V or V_{CC} − 0.1 V
V_{IL}	Maximum Low Level Input Voltage	3.0 4.5 5.5	1.5 2.25 2.75	0.9 1.35 1.65	0.9 1.35 1.65	V	V_{OUT} = 0.1 V or V_{CC} − 0.1 V
V_{OH}	Minimum High Level Output Voltage	3.0 4.5 5.5	2.99 4.49 5.49	2.9 4.4 5.4	2.9 4.4 5.4	V	I_{OUT} = −50 μA
		3.0 4.5 5.5	− − −	2.56 3.86 4.86	2.46 3.76 4.76	V	*V_{IN} = V_{IL} or V_{IH} −12 mA I_{OH} −24 mA −24 mA
V_{OL}	Maximum Low Level Output Voltage	3.0 4.5 5.5	0.002 0.001 0.001	0.1 0.1 0.1	0.1 0.1 0.1	V	I_{OUT} = 50 μA
		3.0 4.5 5.5	− − −	0.36 0.36 0.36	0.44 0.44 0.44	V	*V_{IN} = V_{IL} or V_{IH} 12 mA I_{OL} 24 mA 24 mA
I_{IN}	Maximum Input Leakage Current	5.5	−	±0.1	±1.0	μA	V_I = V_{CC}, GND
I_{OLD}	†Minimum Dynamic Output Current	5.5	−	−	75	mA	V_{OLD} = 1.65 V Max
I_{OHD}		5.5	−	−	−75	mA	V_{OHD} = 3.85 V Min
I_{CC}	Maximum Quiescent Supply Current	5.5	−	8.0	80	μA	V_{IN} = V_{CC} or GND

*All outputs loaded; thresholds on input associated with output under test.
†Maximum test duration 2.0 ms, one output loaded at a time.

NOTE: I_{IN} and I_{CC} @ 3.0 V are guaranteed to be less than or equal to the respective limit @ 5.5 V V_{CC}.

AC CHARACTERISTICS

Symbol	Parameter	V_CC* (V)	74AC T_A = +25°C C_L = 50 pF Min	Typ	Max	74AC T_A = −40°C to +85°C C_L = 50 pF Min	Max	Unit	Fig. No.
t_{PLH}	Propagation Delay A_n to $\overline{O}_n$	3.3 5.0	4.0 3.0	8.0 6.5	11.5 8.5	3.5 2.5	13 9.5	ns	3–6
t_{PHL}	Propagation Delay A_n to $\overline{O}_n$	3.3 5.0	3.0 2.5	7.0 5.5	10 7.5	2.5 2.0	11 8.5	ns	3–6
t_{PLH}	Propagation Delay $\overline{E}_n$ to $\overline{O}_n$	3.3 5.0	4.5 3.5	9.5 7.0	12 8.5	3.5 3.0	13 10	ns	3–6
t_{PHL}	Propagation Delay $\overline{E}_n$ to $\overline{O}_n$	3.3 5.0	4.0 2.5	8.0 6.0	10 7.5	3.0 2.5	11 8.5	ns	3–6

*Voltage Range 3.3 V is 3.3 V ±0.3 V.
*Voltage Range 5.0 V is 5.0 V ±0.5 V.

DC CHARACTERISTICS

Symbol	Parameter	V_{CC} (V)	74ACT $T_A = +25°C$	74ACT $T_A = -40°C$ to $+85°C$	Unit	Conditions
			Typ	Guaranteed Limits		
V_{IH}	Minimum High Level Input Voltage	4.5 5.5	1.5 1.5	2.0 2.0	2.0 2.0	V	$V_{OUT} = 0.1$ V or $V_{CC} - 0.1$ V
V_{IL}	Maximum Low Level Input Voltage	4.5 5.5	1.5 1.5	0.8 0.8	0.8 0.8	V	$V_{OUT} = 0.1$ V or $V_{CC} - 0.1$ V
V_{OH}	Minimum High Level Output Voltage	4.5 5.5	4.49 5.49	4.4 5.4	4.4 5.4	V	$I_{OUT} = -50$ μA
		4.5 5.5	– –	3.86 4.86	3.76 4.76	V	*$V_{IN} = V_{IL}$ or V_{IH} I_{OH} -24 mA -24 mA
V_{OL}	Maximum Low Level Output Voltage	4.5 5.5	0.001 0.001	0.1 0.1	0.1 0.1	V	$I_{OUT} = 50$ μA
		4.5 5.5	– –	0.36 0.36	0.44 0.44	V	*$V_{IN} = V_{IL}$ or V_{IH} I_{OL} 24 mA 24 mA
I_{IN}	Maximum Input Leakage Current	5.5	–	±0.1	±1.0	μA	$V_I = V_{CC}$, GND
ΔI_{CCT}	Additional Max. I_{CC}/Input	5.5	0.6	–	1.5	mA	$V_I = V_{CC} - 2.1$ V
I_{OLD}	†Minimum Dynamic Output Current	5.5	–	–	75	mA	$V_{OLD} = 1.65$ V Max
I_{OHD}		5.5	–	–	–75	mA	$V_{OHD} = 3.85$ V Min
I_{CC}	Maximum Quiescent Supply Current	5.5	–	8.0	80	μA	$V_{IN} = V_{CC}$ or GND

*All outputs loaded; thresholds on input associated with output under test.
†Maximum test duration 2.0 ms, one output loaded at a time.

AC CHARACTERISTICS

Symbol	Parameter	V_{CC}* (V)	74ACT $T_A = +25°C$ $C_L = 50$ pF			74ACT $T_A = -40°C$ to $+85°C$ $C_L = 50$ pF		Unit	Fig. No.
			Min	Typ	Max	Min	Max		
t_{PLH}	Propagation Delay A_n to $\overline{O}_n$	5.0	1.5	6.0	8.5	1.5	9.5	ns	3–6
t_{PHL}	Propagation Delay A_n to $\overline{O}_n$	5.0	1.5	6.0	9.5	1.5	10.5	ns	3–6
t_{PLH}	Propagation Delay $\overline{E}_n$ to $\overline{O}_n$	5.0	2.5	7.0	10.0	2.0	11.0	ns	3–6
t_{PHL}	Propagation Delay $\overline{E}_n$ to $\overline{O}_n$	5.0	2.0	7.0	9.5	1.5	10.5	ns	3–6

*Voltage Range 5.0 V is 5.0 V ±0.5 V.

CAPACITANCE

| Symbol	Parameter	Value Typ	Unit	Test Conditions
C_{IN}	Input Capacitance	4.5	pF	$V_{CC} = 5.0$ V
C_{PD}	Power Dissipation Capacitance	40	pF	$V_{CC} = 5.0$ V

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ORDERING INFORMATION

Device Order Number	Package	Shipping†
MC74AC139DG	SOIC−16 (Pb−Free)	48 Units / Rail
MC74AC139DR2G	SOIC−16 (Pb−Free)	2500 Tape & Reel
MC74AC139DTR2G	TSSOP−16 (Pb−Free)	2500 Tape & Reel
MC74ACT139DG	SOIC−16 (Pb−Free)	48 Units / Rail
MC74ACT139DR2G	SOIC−16 (Pb−Free)	2500 Tape & Reel
MC74ACT139DTR2G	TSSOP−16 (Pb−Free)	2500 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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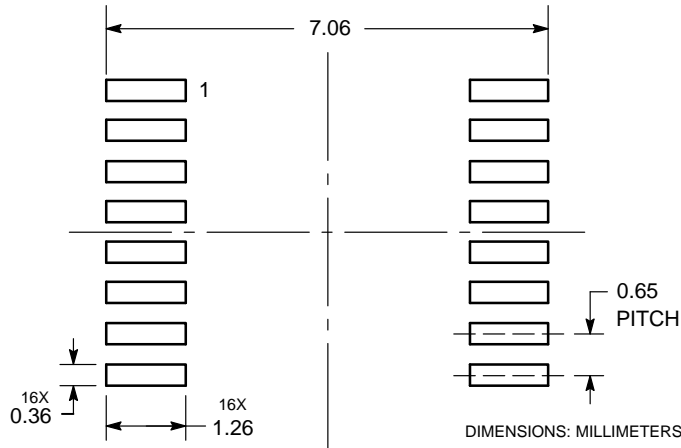## PACKAGE DIMENSIONS

SOIC−16
D SUFFIX
CASE 751B−05
ISSUE K
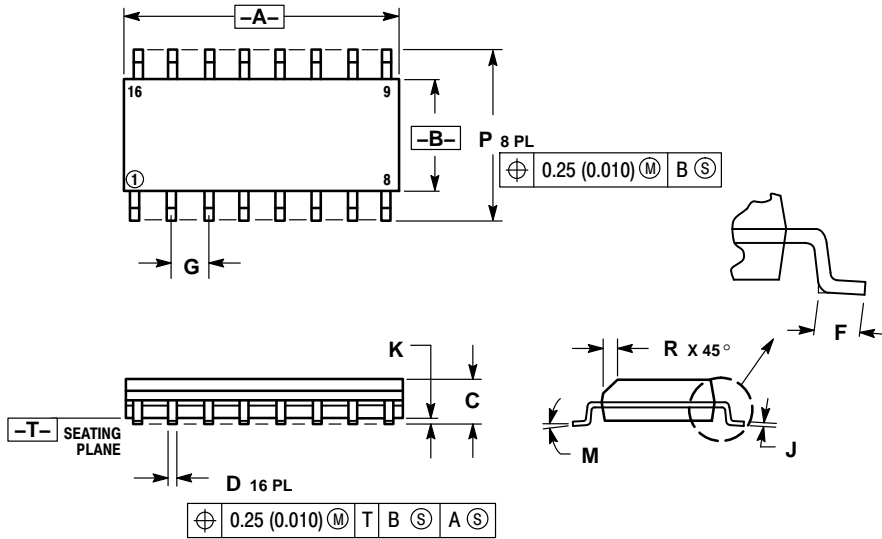
NOTES:
1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
2. CONTROLLING DIMENSION: MILLIMETER.
3. DIMENSIONS A AND B DO NOT INCLUDE MOLD PROTRUSION.
4. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.
5. DIMENSION D DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE DAMBAR PROTRUSION SHALL BE 0.127 (0.005) TOTAL IN EXCESS OF THE D DIMENSION AT MAXIMUM MATERIAL CONDITION.

DIM	MILLIMETERS MIN	MILLIMETERS MAX	INCHES MIN	INCHES 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*
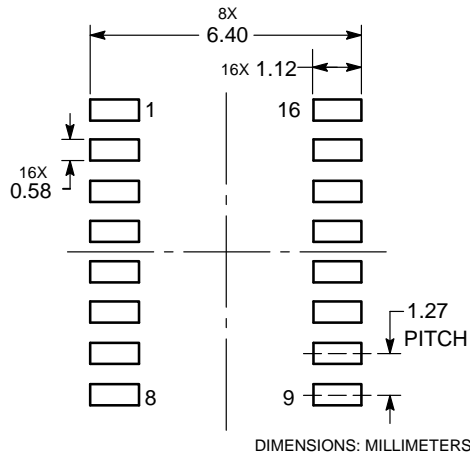
DIMENSIONS: MILLIMETERS

*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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PACKAGE DIMENSIONS

TSSOP–16
DT SUFFIX
CASE 948F
ISSUE B
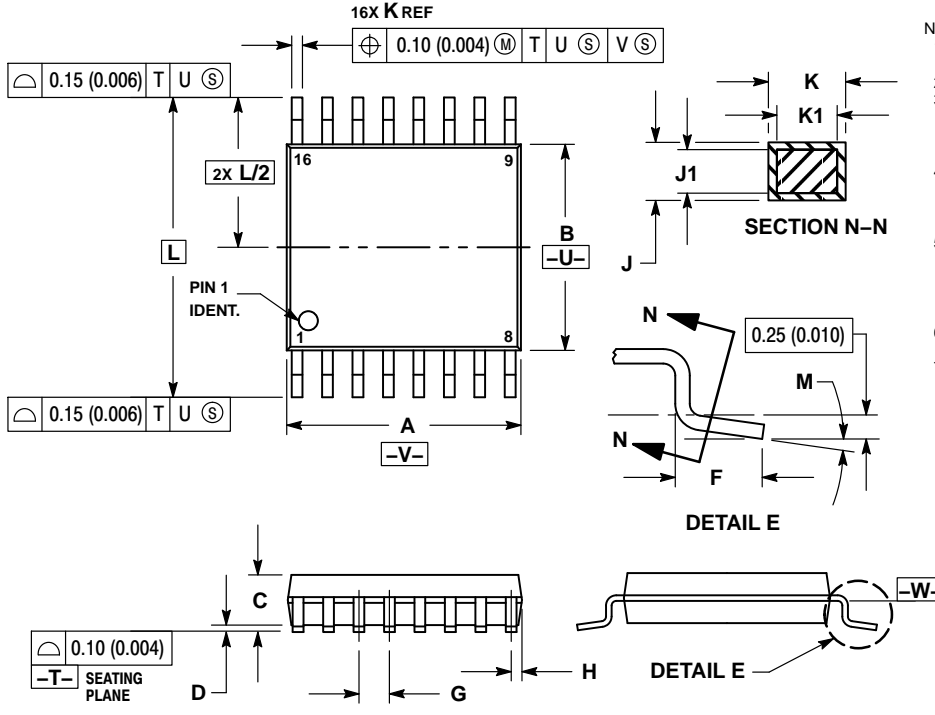
16X **K** REF

⊕ 0.10 (0.004) Ⓜ T U Ⓢ V Ⓢ

◠ 0.15 (0.006) T U Ⓢ

2X **L/2**

16

9

L

PIN 1
IDENT.

1

8

B
–U–

A
–V–

◠ 0.15 (0.006) T U Ⓢ

K
K1

J1

SECTION N–N

J

N

0.25 (0.010)

N

M

F

DETAIL E

C

◠ 0.10 (0.004)

–T– SEATING
PLANE

D

G

H

DETAIL E

–W–

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 °

SOLDERING FOOTPRINT*

7.06

1

0.65
PITCH

16X
0.36

16X
1.26

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.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
P.O. Box 5163, Denver, Colorado 80217 USA
Phone: 303–675–2175 or 800–344–3860 Toll Free USA/Canada
Fax: 303–675–2176 or 800–344–3867 Toll Free USA/Canada
Email: orderlit@onsemi.com

N. American Technical Support: 800–282–9855 Toll Free USA/Canada
Europe, Middle East and Africa Technical Support:
 Phone: 421 33 790 2910
Japan Customer Focus Center
 Phone: 81–3–5817–1050

ON Semiconductor Website: **www.onsemi.com**

Order Literature: http://www.onsemi.com/orderlit

For additional information, please contact your local Sales Representative

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