# 8-Bit Addressable Latch/1-of-8 Decoder CMOS Logic Level Shifter

# with LSTTL-Compatible Inputs

The MC74VHCT259 is an 8-bit Addressable Latch fabricated with silicon gate CMOS technology. It achieves high speed operation similar to equivalent Bipolar Schottky TTL while maintaining CMOS low power dissipation.

The internal circuit is composed of three stages, including a buffer output which provides high noise immunity and stable output.

The VHC259 is designed for general purpose storage applications in digital systems. The device has four modes of operation as shown in the mode selection table. In the addressable latch mode, the signal on Data In is written into the addressed latch. The addressed latch follows the data input with all non–addressed latches remaining in their previous states. In the memory mode, all latches remain in their previous state and are unaffected by the Data or Address inputs. In the one–of–eight decoding or demultiplexing mode, the addressed output follows the state of Data In with all other outputs in the LOW state. In the Reset mode, all outputs are LOW and unaffected by the address and data inputs. When operating the VHCT259 as an addressable latch, changing more than one bit of the address could impose a transient wrong address. Therefore, this should only be done while in the memory mode.

The VHCT inputs are compatible with TTL levels. This device can be used as a level converter for interfacing 3.3 V to 5.0 V because it has full 5.0 V CMOS level output swings.

The VHCT259A input structures provide protection when voltages between 0 V and 5.5 V are applied, regardless of the supply voltage. The output structures also provide protection when  $V_{\rm CC}=0$  V. These input and output structures help prevent device destruction caused by supply voltage–input/output voltage mismatch, battery backup, hot insertion, etc.

#### Features

- High Speed:  $t_{PD} = 7.6 \text{ ns (Typ)}$  at  $V_{CC} = 5.0 \text{ V}$
- Low Power Dissipation:  $I_{CC} = 2 \mu A$  (Max) at  $T_A = 25^{\circ}C$
- TTL-Compatible Inputs:  $V_{IL} = 0.8 \text{ V}$ ;  $V_{IH} = 2.0 \text{ V}$
- Power Down Protection Provided on Inputs and Outputs
- Pin and Function Compatible with Other Standard Logic Families
- Latchup Performance Exceeds 300 mA
- ESD Performance: HBM > 2000 V
- Pb–Free Packages are Available\*



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MARKING DIAGRAMS



SOIC-16 D SUFFIX CASE 751B



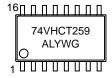


TSSOP-16 DT SUFFIX CASE 948F





SOEIAJ-16 M SUFFIX CASE 966



A = Assembly Location

WL, L = Wafer Lot
Y = Year
WW, W = Work Week
G or ■ = 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 7 of this data sheet.

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

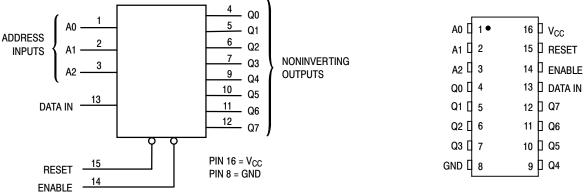


Figure 1. Logic Diagram

BIN/OCT

2

4

ID

ΕN

R

0

1

2

3

4

5

6

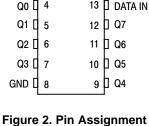
7

10

A0 \_

13

15



DMUX Q0 - Q0 Q1 Q1 Q2 - Q2 2 Q3 Q3 3 Q4 Q4 13 Q5 ID - Q5 5 ΕN Q6 Q6 6 R Q7 Q7 7

Figure 3. IEC Logic Symbol

#### **MODE SELECTION TABLE**

Enable	Enable Reset Mode					
L	Н	Addressable Latch				
Н	Н	Memory				
L	L	8-Line Demultiplexer				
Н	L	Reset				

#### **LATCH SELECTION TABLE**

Addr	ess Ir	nputs	Latch
С	В	Α	Addressed
L	L	L	Q0
L	L	Н	Q1
L	Н	L	Q2
L	Н	Н	Q3
Н	L	L	Q4
н	L	Н	Q5
н	Н	L	Q6
Н	Н	Н	Q7

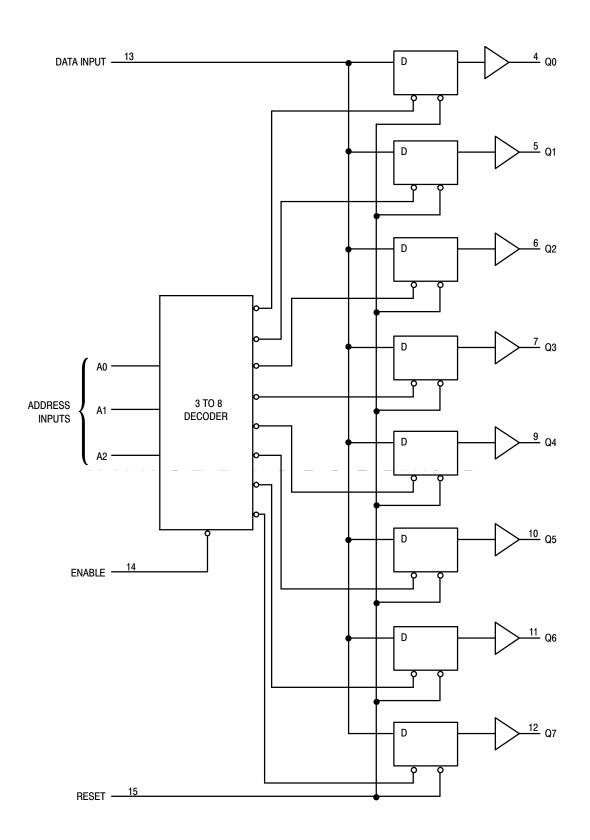


Figure 4. Expanded Logic Diagram

#### **MAXIMUM RATINGS**

Symbol	F	Parameter	Value	Unit
V <sub>CC</sub>	Positive DC Supply Voltage		-0.5 to +7.0	V
V <sub>IN</sub>	Digital Input Voltage		-0.5 to +7.0	V
V <sub>OUT</sub>	DC Output Voltage	Output in 3–State High or Low State	-0.5 to +7.0 -0.5 to V <sub>CC</sub> +0.5	V
I <sub>IK</sub>	Input Diode Current		-20	mA
I <sub>OK</sub>	Output Diode Current		± 20	mA
I <sub>OUT</sub>	DC Output Current, per Pin		± 25	mA
I <sub>CC</sub>	DC Supply Current, V <sub>CC</sub> and GND Pir	ns	± 75	mA
$P_{D}$	Power Dissipation in Still Air	SOIC Package TSSOP	200 180	mW
T <sub>STG</sub>	Storage Temperature Range		-65 to +150	°C
V <sub>ESD</sub>	ESD Withstand Voltage	Human Body Model (Note 1) Machine Model (Note 2) Charged Device Model (Note 3)	>2000 >200 >200	V
I <sub>LATCHUP</sub>	Latchup Performance	Above V <sub>CC</sub> and Below GND at 125°C (Note 4)	±300	mA
$\theta_{\sf JA}$	Thermal Resistance, Junction-to-Am	bient SOIC Package TSSOP	143 164	°C/W

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. Tested to EIA/JESD22–A114–A

- 2. Tested to EIA/JESD22-A115-A
- 3. Tested to JESD22-C101-A
- 4. Tested to EIA/JESD78

#### **RECOMMENDED OPERATING CONDITIONS**

Symbol	Characteristics	Min	Max	Unit
V <sub>CC</sub>	DC Supply Voltage	4 <u>.5</u>	5.5	V
V <sub>IN</sub>	DC Input Voltage	0	5.5	V
V <sub>OUT</sub>		output in 3–State 0 igh or Low State 0	5.5 V <sub>CC</sub>	V
T <sub>A</sub>	Operating Temperature Range, all Package Types	-55	125	°C
t <sub>r</sub> , t <sub>f</sub>	Input Rise or Fall Time V <sub>CC</sub>	; = 5.0 V <u>+</u> 0.5 V 0	20	ns/V

#### **DEVICE JUNCTION TEMPERATURE VERSUS TIME TO** 0.1% BOND FAILURES

Junction Temperature °C	Time, Hours	Time, Years
80	1,032,200	117.8
90	419,300	47.9
100	178,700	20.4
110	79,600	9.4
120	37,000	4.2
130	17,800	2.0
140	8,900	1.0

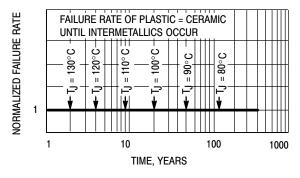


Figure 5. Failure Rate vs. Time Junction Temperature

#### DC CHARACTERISTICS (Voltages Referenced to GND)

			V <sub>CC</sub>	Т	A = 25°	С	T <sub>A</sub> ≤	85°C	-55°C ≤ T	A ≤ 125°C	
Symbol	Parameter	Condition	(V)	Min	Тур	Max	Min	Max	Min	Max	Unit
V <sub>IH</sub>	Minimum High-Level Input Voltage		4.5 to 5.5	2			2		2		V
V <sub>IL</sub>	Maximum Low-Level Input Voltage		4.5 to 5.5			0.8		0.8		0.8	V
V <sub>OH</sub>	Maximum High-Level Output Voltage	$V_{IN} = V_{IH} \text{ or } V_{IL}$ $I_{OH} = -50 \mu\text{A}$	4.5	4.4	4.5		4.4		4.4		V
		$V_{IN} = V_{IH} \text{ or } V_{IL}$ $I_{OH} = -8 \text{ mA}$	4.5	3.94			3.8		3.66		
V <sub>OL</sub>	Maximum Low-Level Output Voltage	$V_{IN} = V_{IH}$ or $V_{IL}$ $I_{OL} = 50 \mu A$	4.5		0	0.1		0.1		0.1	V
		$V_{IN} = V_{IH} \text{ or } V_{IL}$ $I_{OH} = 8 \text{ mA}$	4.5			0.36		0.44		0.52	
I <sub>IN</sub>	Input Leakage Current	$V_{IN} = 5.5 \text{ V or GND}$	0 to 5.5			±0.1		±1.0		±1.0	μΑ
I <sub>CC</sub>	Maximum Quiescent Supply Current	$V_{IN} = V_{CC}$ or GND	5.5			4.0		40.0		40.0	μΑ
Ісст	Additional Quiescent Supply Current (per Pin)	Any one input: $V_{IN} = 3.4 \text{ V}$ All other inputs: $V_{IN} = V_{CC}$ or GND	5.5			1.35		1.5		1.5	μΑ
I <sub>OPD</sub>	Output Leakage Current	V <sub>OUT</sub> = 5.5 V	0			0.5		5		5	μΑ

#### AC ELECTRICAL CHARACTERISTICS (Input $t_f = t_f = 3.0 \text{ns}$ )

				Т	$T_A = 25^{\circ}C$ $T_A = \leq 85^{\circ}C$		$-55$ °C ≤ $T_A$ ≤ 125°C				
Symbol	Parameter	Test Condi	tions	Min	Тур	Max	Min	Max	Min	Max	Unit
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Data to Output	$V_{CC} = 3.3 \pm 0.3 V$	$C_L = 15pF$ $C_L = 50pF$		8.5 8.5	11.0 16.0	1.0 1.0	13.0 18.0	1.0 1.0	13.0 18.0	ns
	(Figures 6 and 11)	$\overline{V}_{CC} = 5.0 \pm 0.5 \overline{V}$	$C_L = 1\overline{5}pF$ $C_L = 50pF$		6.0 6.0	8.0 10.0	1.0 1.0	9.5 11.5	1.0 1.0	9.5 11.5	
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Address Select	$V_{CC} = 3.3 \pm 0.3 V$	$C_L = 15pF$ $C_L = 50pF$		8.5 8.5	11.0 16.0	1.0 1.0	13.0 18.0	1.0 1.0	13.0 18.0	ns
	to Output (Figures 7 and 11)	$V_{CC} = 5.0 \pm 0.5 V$	$C_L = 15pF$ $C_L = 50pF$		6.0 8.5	8.0 10.0	1.0 1.0	9.5 11.5	1.0 1.0	9.5 11.5	
t <sub>PLH</sub> , t <sub>PHL</sub>	Maximum Propagation Delay, Enable to Output	$V_{CC} = 3.3 \pm 0.3 V$	$C_L = 15pF$ $C_L = 50pF$		8.5 8.5	11.0 16.0	1.0 1.0	13.0 18.0	1.0 1.0	13.0 18.0	ns
	(Figures 8 and 11)	$V_{CC} = 5.0 \pm 0.5 V$	$C_L = 15pF$ $C_L = 50pF$		6.0 8.5	8.0 10.0	1.0 1.0	9.5 11.5	1.0 1.0	9.5 11.5	
t <sub>PHL</sub>	Maximum Propagation Delay, Reset to Output	$V_{CC} = 3.3 \pm 0.3 V$	$C_L = 15pF$ $C_L = 50pF$		8.5 8.5	11.0 16.0	1.0 1.0	13.0 18.0	1.0 1.0	13.0 18.0	ns
	(Figures 9 and 11)	$V_{CC} = 5.0 \pm 0.5 V$	$C_L = 15pF$ $C_L = 50pF$		6.0 8.5	8.0 10.0	1.0 1.0	9.5 11.5	1.0 1.0	9.5 11.5	
C <sub>IN</sub>	Maximum Input Capacitance				6	10		10		10	pF

			Typical @ 25°C, V <sub>CC</sub> = 5.0V	
(	$C_{PD}$	Power Dissipation Capacitance (Note 5)	30	pF

<sup>5.</sup> C<sub>PD</sub> is defined as the value of the internal equivalent capacitance which is calculated from the operating current consumption without load. Average operating current can be obtained by the equation: I<sub>CC(OPR)</sub> = C<sub>PD</sub> • V<sub>CC</sub> • f<sub>in</sub> + I<sub>CC</sub>. C<sub>PD</sub> is used to determine the no–load dynamic power consumption; P<sub>D</sub> = C<sub>PD</sub> • V<sub>CC</sub><sup>2</sup> • f<sub>in</sub> + I<sub>CC</sub> • V<sub>CC</sub>.

#### **TIMING REQUIREMENTS** (Input $t_f = t_f = 3.0 \text{ns}$ )

			T <sub>A</sub> = 25°C		$T_A = \le 85^{\circ}C$		<b>T</b> <sub>A</sub> = ≤ 125°C			
Symbol	Parameter	Test Conditions	Min	Тур	Max	Min	Max	Min	Max	Unit
t <sub>w</sub>	Minimum Pulse Width, Reset or Enable	$V_{CC} = 3.3 \pm 0.3 V$	5.0			5.5		5.5		ns
	(Figure 10)	$V_{CC} = 5.0 \pm 0.5 V$	5.0			5.5		5.5		
t <sub>su</sub>	Minimum Setup Time, Address or Data to Enable	$V_{CC} = 3.3 \pm 0.3 V$	4.5			4.5		4.5		ns
	(Figure 10)	$V_{CC} = 5.0 \pm 0.5 V$	3.0			3.0		3.0		
t <sub>h</sub>	Minimum Hold Time, Enable to Address or Data	$V_{CC} = 3.3 \pm 0.3 V$	2.0			2.0		2.0		ns
	(Figure 8 or 9)	$V_{CC} = 5.0 \pm 0.5 V$	2.0			2.0		2.0		
t <sub>r,</sub> t <sub>f</sub>	Maximum Input, Rise and Fall Times	$V_{CC} = 3.3 \pm 0.3 V$			400		300		300	ns
	(Figure 6)	$V_{CC} = 5.0 \pm 0.5 V$			200		100		100	

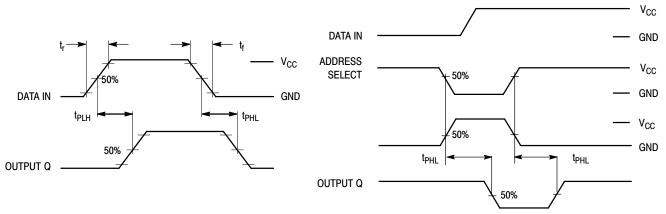


Figure 6. Switching Waveform

Figure 7. Switching Waveform

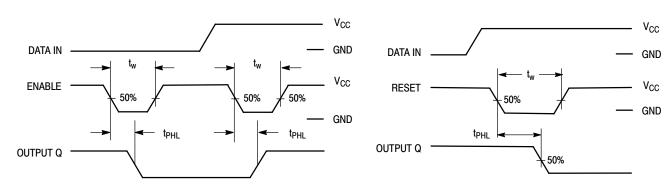


Figure 8. Switching Waveform

Figure 9. Switching Waveform

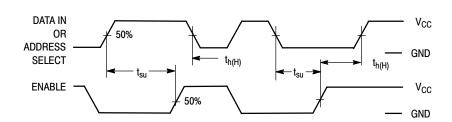
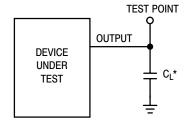


Figure 10. Switching Waveform



\*Includes all probe and jig capacitance

Figure 11. Test Circuit

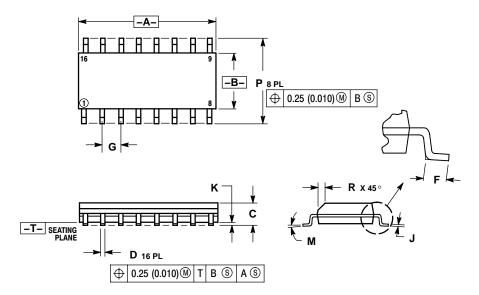
#### **ORDERING INFORMATION**

Device	Package	Shipping <sup>†</sup>
MC74VHCT259AD	SOIC-16	48 Units / Rail
MC74VHCT259ADG	SOIC-16 (Pb-Free)	48 Units / Rail
MC74VHCT259ADR2	SOIC-16	2500 Tape & Reel
MC74VHCT259ADR2G	SOIC-16 (Pb-Free)	2500 Tape & Reel
MC74VHCT259ADT	TSSOP-16*	96 Units / Rail
MC74VHCT259ADTG	TSSOP-16*	96 Units / Rail
MC74VHCT259ADTR2	TSSOP-16*	2500 Tape & Reel
MC74VHCT259ADTRG	TSSOP-16*	2500 Tape & Reel
MC74VHCT259AM	SOEIAJ-16	50 Units / Rail
MC74VHCT259AMG	SOEIAJ-16 (Pb-Free)	50 Units / Rail
MC74VHCT259AMEL	SOEIAJ-16	2000 Tape & Reel
MC74VHCT259AMELG	SOEIAJ-16 (Pb-Free)	2000 Tape & Reel

<sup>†</sup>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.

#### PACKAGE DIMENSIONS

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

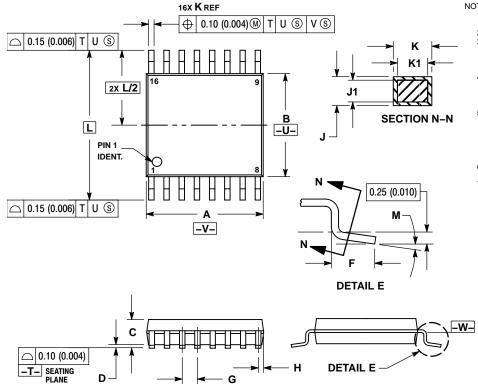


#### NOTES:

- DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
- 2. CONTROLLING DIMENSION: MILLIMETER.
  3. DIMENSIONS A AND B DO NOT INCLUDE
- MOLD PROTRUSION.
  MAXIMUM MOLD PROTRUSION 0.15 (0.006)
- MAXIMUM MOLD PHOLIUSION 0.15 (0.006)
  PER SIDE.
  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.

	MILLIN	IETERS	INC	HES
DIM	MIN	MAX	MIN	MAX
Α	9.80	10.00	0.386	0.393
В	3.80	4.00	0.150	0.157
С	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

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



- NOTES:

  1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.

  2. CONTROLLING DIMENSION: MILLIMETER.

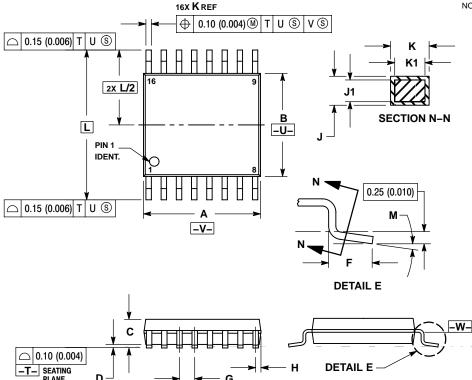
  3. DIMENSION A DOES NOT INCLUDE MOLD IN A DOES NOT INCLUDE MOLD IN A DOES NOT INCLUDE MOLD. 3. DIMENSION A DOES NOT INCLUDE MOLD FLASH. PROTRUSIONS OR GATE BURRS. MOLD FLASH OR GATE BURRS SHALL NOT
  - EXCEED 0.15 (0.006) PER SIDE.
    4. DIMENSION B DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION. INTERLEAD 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

  - 6. TERMINAL NUMBERS ARE SHOWN FOR REFERENCE ONLY.
    7. DIMENSION A AND B ARE TO BE DETERMINED AT DATUM PLANE –W–.

	MILLIN	IETERS	INC	HES	
DIM	MIN	MAX	MIN	MAX	
Α	4.90	5.10	0.193	0.200	
В	4.30	4.50	0.169	0.177	
С		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	
Н	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		0.252 BSC		
М	0°	8°	0°	8 °	

#### PACKAGE DIMENSIONS

SOEIAJ-16 **M SUFFIX** CASE 966-01 **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.
- 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.

  5. TERMINAL NUMBERS ARE SHOWN FOR
- REFERENCE ONLY.

  7. DIMENSION A AND B ARE TO BE
- DETERMINED AT DATUM PLANE -W-

MILLIMETERS		INCHES	
MIN	MAX	MIN	MAX
4.90	5.10	0.193	0.200
4.30	4.50	0.169	0.177
	1.20		0.047
0.05	0.15	0.002	0.006
0.50	0.75	0.020	0.030
0.65 BSC		0.026 BSC	
0.18	0.28	0.007	0.011
0.09	0.20	0.004	0.008
0.09	0.16	0.004	0.006
0.19	0.30	0.007	0.012
0.19	0.25	0.007	0.010
6.40 BSC		0.252 BSC	
_ 0 °	8°	0°	8 °
	MIN 4.90 4.30  0.05 0.50 0.65 0.18 0.09 0.09 0.19 0.19 6.40	MIN         MAX           4.90         5.10           4.30         4.50            1.20           0.05         0.15           0.50         0.75           0.65         BSC           0.09         0.20           0.09         0.16           0.19         0.30           0.19         0.25           6.40         BSC	MIN         MAX         MIN           4.90         5.10         0.193           4.30         4.50         0.169            1.20            0.05         0.15         0.002           0.50         0.75         0.020           0.65         BSC         0.026           0.18         0.28         0.007           0.09         0.20         0.004           0.09         0.16         0.004           0.19         0.30         0.007           0.19         0.25         0.007           6.40         BSC         0.252

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