

# 74VHCT138A

## 3-to-8 Decoder/Demultiplexer

### Features

- High Speed:  $t_{PD} = 7.6ns$  (Typ.) at  $V_{CC} = 5V$
- Low power dissipation:  $I_{CC} = 4\mu A$  (Max.) at  $T_A = 25^\circ C$
- Power down protection is provided on all inputs and outputs
- Pin and function compatible with 74HCT138

### General Description

The VHCT138A is an advanced high speed CMOS 3-to-8 DECODER fabricated with silicon gate CMOS technology. It achieves the high speed operation similar to equivalent Bipolar Schottky TTL while maintaining the CMOS low power dissipation.

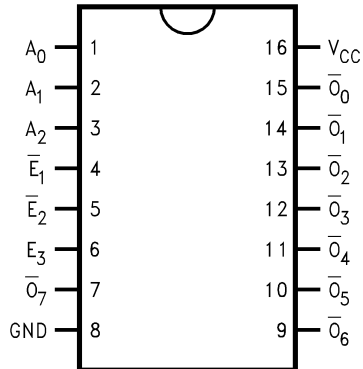
When the device is enabled, 3 Binary Select inputs ( $A_0$ ,  $A_1$  and  $A_2$ ) determine which one of the outputs ( $\overline{O}_0$ – $\overline{O}_7$ ) will go LOW. When enable input  $E_3$  is held LOW or either  $\overline{E}_1$  or  $\overline{E}_2$  is held HIGH, decoding function is inhibited and all outputs go HIGH.  $E_3$ ,  $\overline{E}_1$  and  $\overline{E}_2$  inputs are provided to ease cascade connection and for use as an address decoder for memory systems. Protection circuits ensure that 0V to 7V can be applied to the input pins without regard to the supply voltage and to the output pins with  $V_{CC} = 0V$ . These circuits prevent device destruction due to mismatched supply and input/output voltages. This device can be used to interface 3V to 5V systems and two supply systems such as battery backup.

### Ordering Information

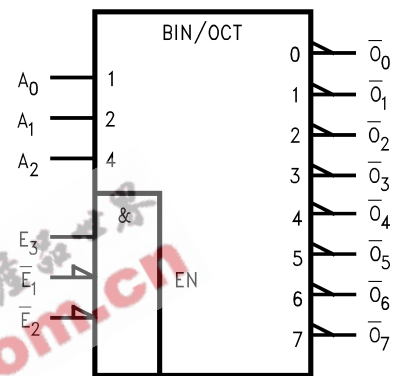
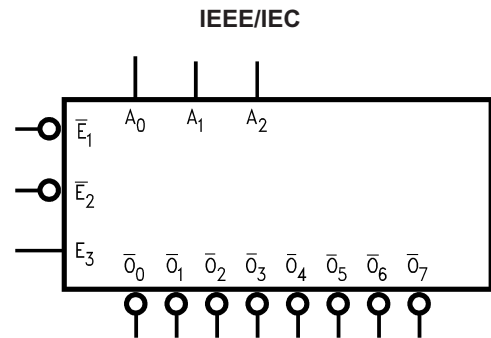
Order Number	Package Number	Package Description
74VHCT138AM	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow
74VHCT138ASJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74VHCT138AMTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide

Surface mount packages are also available on Tape and Reel. Specify by appending the suffix letter "X" to the ordering number.

### Connection Diagram



### Logic Symbols



### Pin Description

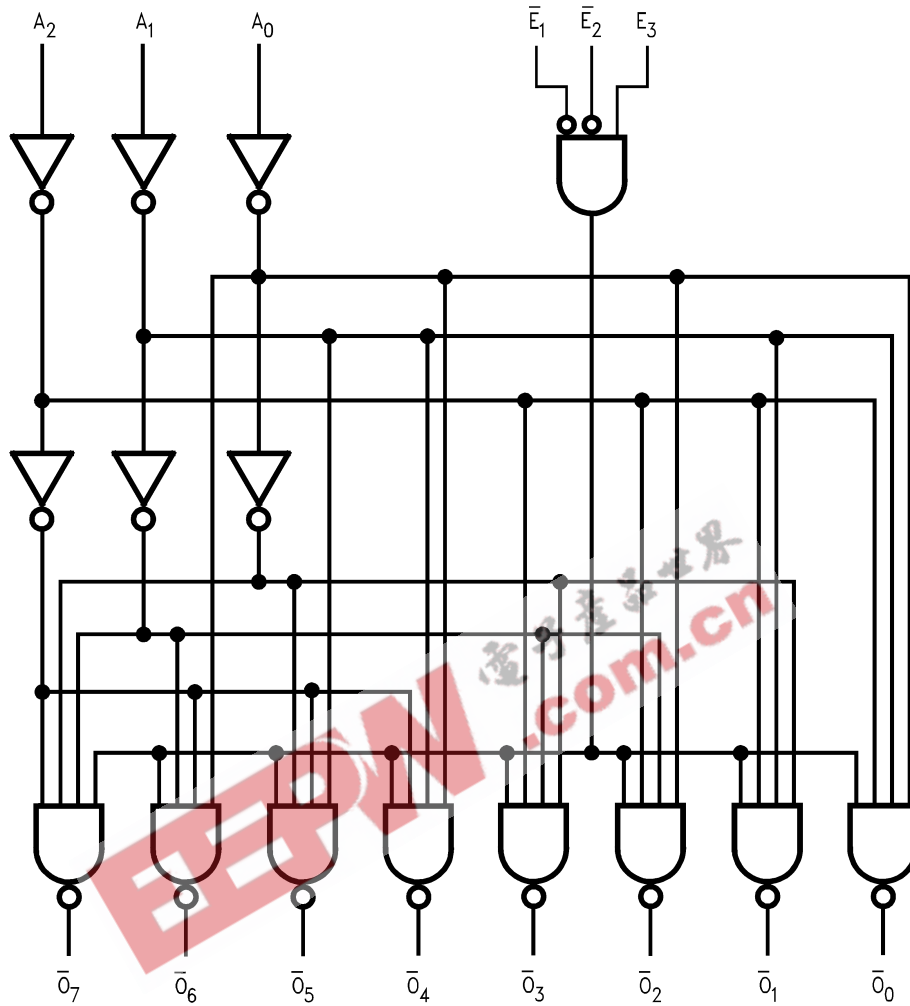
Pin Names	Description
A <sub>0</sub> –A <sub>2</sub>	Address Inputs
$\bar{E}_1$ – $\bar{E}_2$	Enable Inputs
E <sub>3</sub>	Enable Input
$\bar{O}_0$ – $\bar{O}_7$	Outputs

### Truth Table

Inputs						Outputs							
$\bar{E}_1$	$\bar{E}_2$	E <sub>3</sub>	A <sub>0</sub>	A <sub>1</sub>	A <sub>2</sub>	$\bar{O}_0$	$\bar{O}_1$	$\bar{O}_2$	$\bar{O}_3$	$\bar{O}_4$	$\bar{O}_5$	$\bar{O}_6$	$\bar{O}_7$
H	X	X	X	X	X	H	H	H	H	H	H	H	H
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	L	X	X	X	H	H	H	H	H	H	H	H
L	L	H	L	L	L	L	H	H	H	H	H	H	H
L	L	H	H	L	L	H	L	H	H	H	H	H	H
L	L	H	L	H	L	H	H	L	H	H	H	H	H
L	L	H	H	H	L	H	H	H	L	H	H	H	H
L	L	H	L	L	H	H	H	H	H	L	H	H	H
L	L	H	H	L	H	H	H	H	H	H	L	H	H
L	L	H	L	H	H	H	H	H	H	H	H	L	H
L	L	H	H	H	H	H	H	H	H	H	H	H	L

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

## Logic Diagram



Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

## Absolute Maximum Ratings

Stresses exceeding the absolute maximum ratings may damage the device. The device may not function or be operable above the recommended operating conditions and stressing the parts to these levels is not recommended. In addition, extended exposure to stresses above the recommended operating conditions may affect device reliability. The absolute maximum ratings are stress ratings only.

Symbol	Parameter	Rating
$V_{CC}$	Supply Voltage	-0.5V to +7.0V
$V_{IN}$	DC Input Voltage	-0.5V to +7.0V
$V_{OUT}$	DC Output Voltage Note 1 Note 2	-0.5V to 7.0V -0.5V to $V_{CC} + 0.5V$
$I_{IK}$	Input Diode Current	-20mA
$I_{OK}$	Output Diode Current <sup>(3)</sup>	±20mA
$I_{OUT}$	DC Output Current	±25mA
$I_{CC}$	DC $V_{CC}$ / GND Current	±75mA
$T_{STG}$	Storage Temperature	-65°C to +150°C
$T_L$	Lead Temperature (Soldering, 10 seconds)	260°C

## Recommended Operating Conditions<sup>(4)</sup>

The Recommended Operating Conditions table defines the conditions for actual device operation. Recommended operating conditions are specified to ensure optimal performance to the datasheet specifications. Fairchild does not recommend exceeding them or designing to absolute maximum ratings.

Symbol	Parameter	Rating
$V_{CC}$	Supply Voltage	4.5V to +5.5V
$V_{IN}$	Input Voltage	0V to +5.5V
$V_{OUT}$	Output Voltage Note 1 Note 2	0V to 5.5V 0V to $V_{CC}$
$T_{OPR}$	Operating Temperature	-40°C to +85°C
$t_r, t_f$	Input Rise and Fall Time, $V_{CC} = 5.0V \pm 0.5V$	0 ~ 20ns/V

### Notes:

- $V_{CC} = 0V$ .
- HIGH or LOW state.  $I_{OUT}$  absolute maximum rating must be observed.
- $V_{OUT} < GND$ ,  $V_{OUT} > V_{CC}$  (Outputs Active).
- Unused inputs must be held HIGH or LOW. They may not float.

## DC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Units
				Min.	Typ.	Max.	Min.	Max.	
V <sub>IH</sub>	HIGH Level Input Voltage	4.5 – 5.5		2.0			2.0		V
V <sub>IL</sub>	LOW Level Input Voltage	4.5 – 5.5				0.8		0.8	V
V <sub>OH</sub>	HIGH Level Output Voltage	4.5	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OH</sub> = -50μA	4.4	4.5	4.4		V
				I <sub>OH</sub> = -8mA	3.94		3.80		
V <sub>OL</sub>	LOW Level Output Voltage	4.5	V <sub>IN</sub> = V <sub>IH</sub> or V <sub>IL</sub>	I <sub>OL</sub> = 50μA		0.0	0.1	0.1	V
				I <sub>OL</sub> = 8mA			0.36	0.44	
I <sub>IN</sub>	Input Leakage Current	0 – 5.5	V <sub>IN</sub> = 5.5V or GND			±0.1		±1.0	μA
I <sub>CC</sub>	Quiescent Supply Current	5.5	V <sub>IN</sub> = V <sub>CC</sub> or GND			4.0		20.0	μA
I <sub>CCT</sub>	Maximum I <sub>CC</sub> /Input	5.5	V <sub>IN</sub> = 3.4V, All other inputs = V <sub>CC</sub> or GND			1.35		1.50	mA
I <sub>OFF</sub>	Output Leakage Current	0	V <sub>OUT</sub> = 5.5V			0.5		5.0	μA

## AC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> (V)	Conditions	T <sub>A</sub> = 25°C			T <sub>A</sub> = -40°C to +85°C		Units
				Min.	Typ.	Max.	Min.	Max.	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, A <sub>n</sub> to $\bar{O}_n$	5.0 ± 0.5	C <sub>L</sub> = 15pF		7.6	10.4	1.0	12.0	ns
				C <sub>L</sub> = 50pF		8.1	11.4	1.0	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, E <sub>3</sub> to $\bar{O}_n$	5.0 ± 0.5	C <sub>L</sub> = 15pF		6.6	9.1	1.0	10.5	ns
				C <sub>L</sub> = 50pF		7.1	10.1	1.0	
t <sub>PLH</sub> , t <sub>PHL</sub>	Propagation Delay, $\bar{E}_1$ or $\bar{E}_2$ to $\bar{O}_n$	5.0 ± 0.5	C <sub>L</sub> = 15pF		7.0	9.6	1.0	11.0	ns
				C <sub>L</sub> = 50pF		7.5	10.6	1.0	
C <sub>IN</sub>	Input Capacitance		V <sub>CC</sub> = Open		4	10		10	pF
C <sub>PD</sub>	Power Dissipation Capacitance		(5)		49				pF

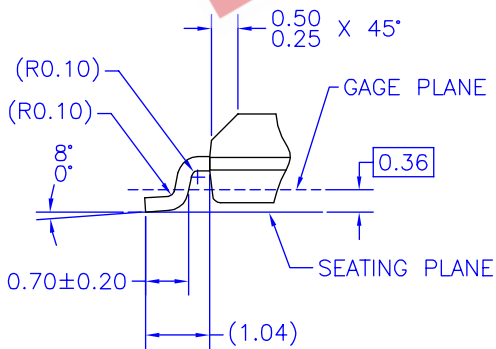
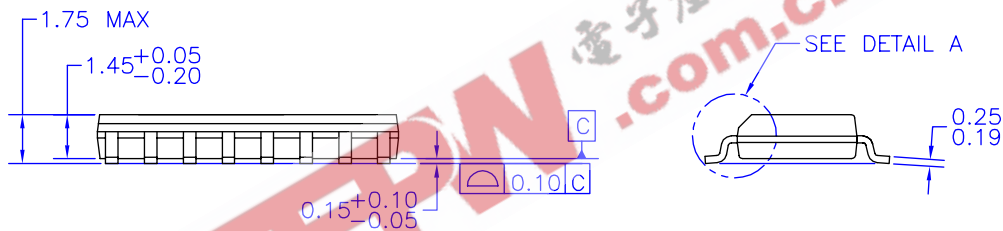
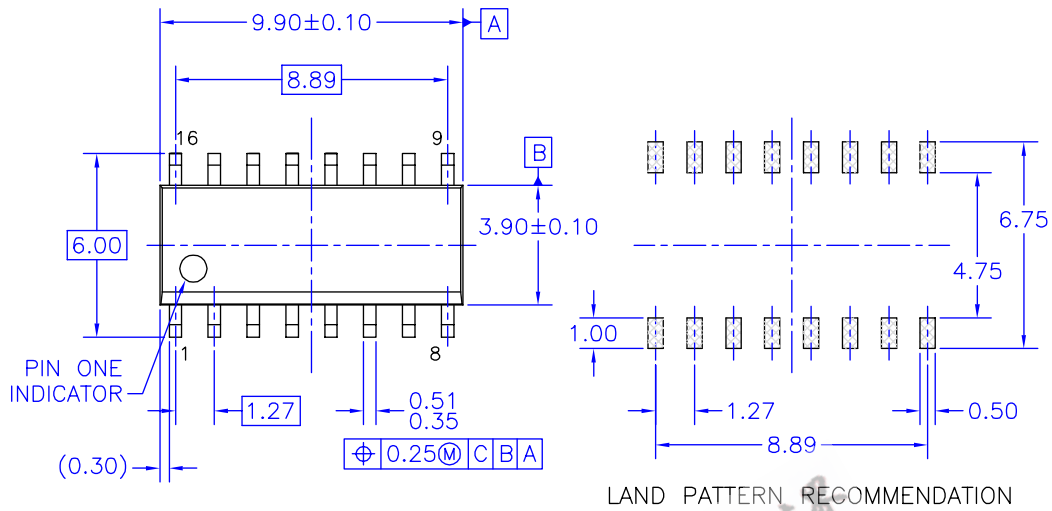
## Note:

5. 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:

$$I_{CC} (\text{Opr.}) = C_{PD} \cdot V_{CC} \cdot f_{IN} + I_{CC}$$

### Physical Dimensions

Dimensions are in millimeters unless otherwise noted.



DETAIL A  
SCALE: 2:1

NOTES: UNLESS OTHERWISE SPECIFIED

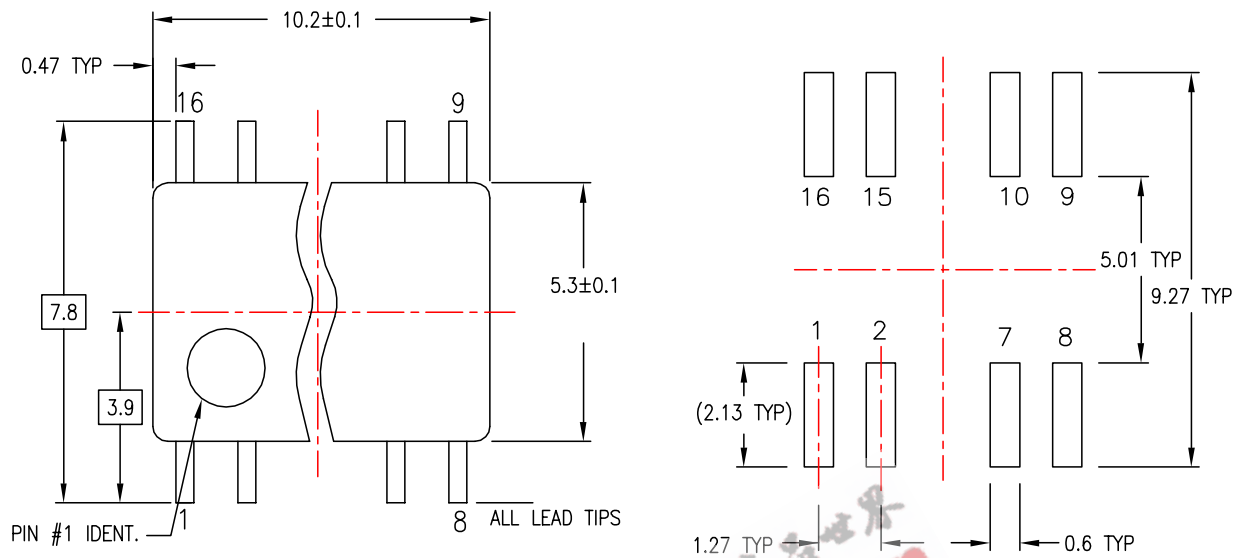
- A) THIS PACKAGE CONFORMS TO JEDEC MS-012, VARIATION AC, ISSUE C, DATED MAY 1990.
- B) ALL DIMENSIONS ARE IN MILLIMETERS.
- C) DIMENSIONS DO NOT INCLUDE MOLD FLASH OR BURRS.
- D) STANDARD LEAD FINISH:  
200 MICRONS / 5.08 MICRONS MIN.  
LEAD/TIN (SOLDER) ON COPPER.

M16AREVK

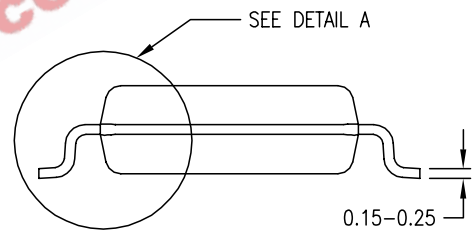
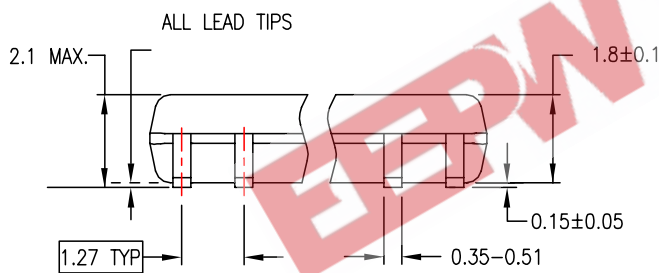
Figure 1. 16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Package Number M16A

**Physical Dimensions (Continued)**

Dimensions are in millimeters unless otherwise noted.



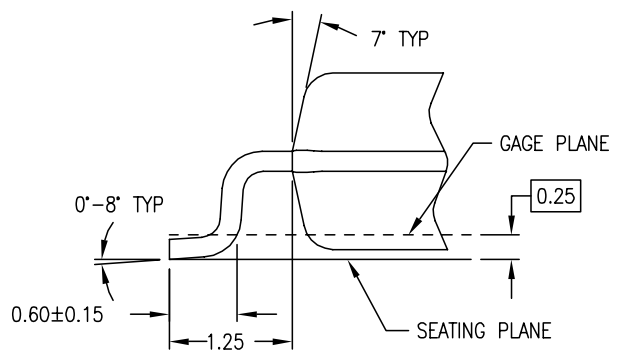
LAND PATTERN RECOMMENDATION



DIMENSIONS ARE IN MILLIMETERS

NOTES:

- A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.
- B. DIMENSIONS ARE IN MILLIMETERS.
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.



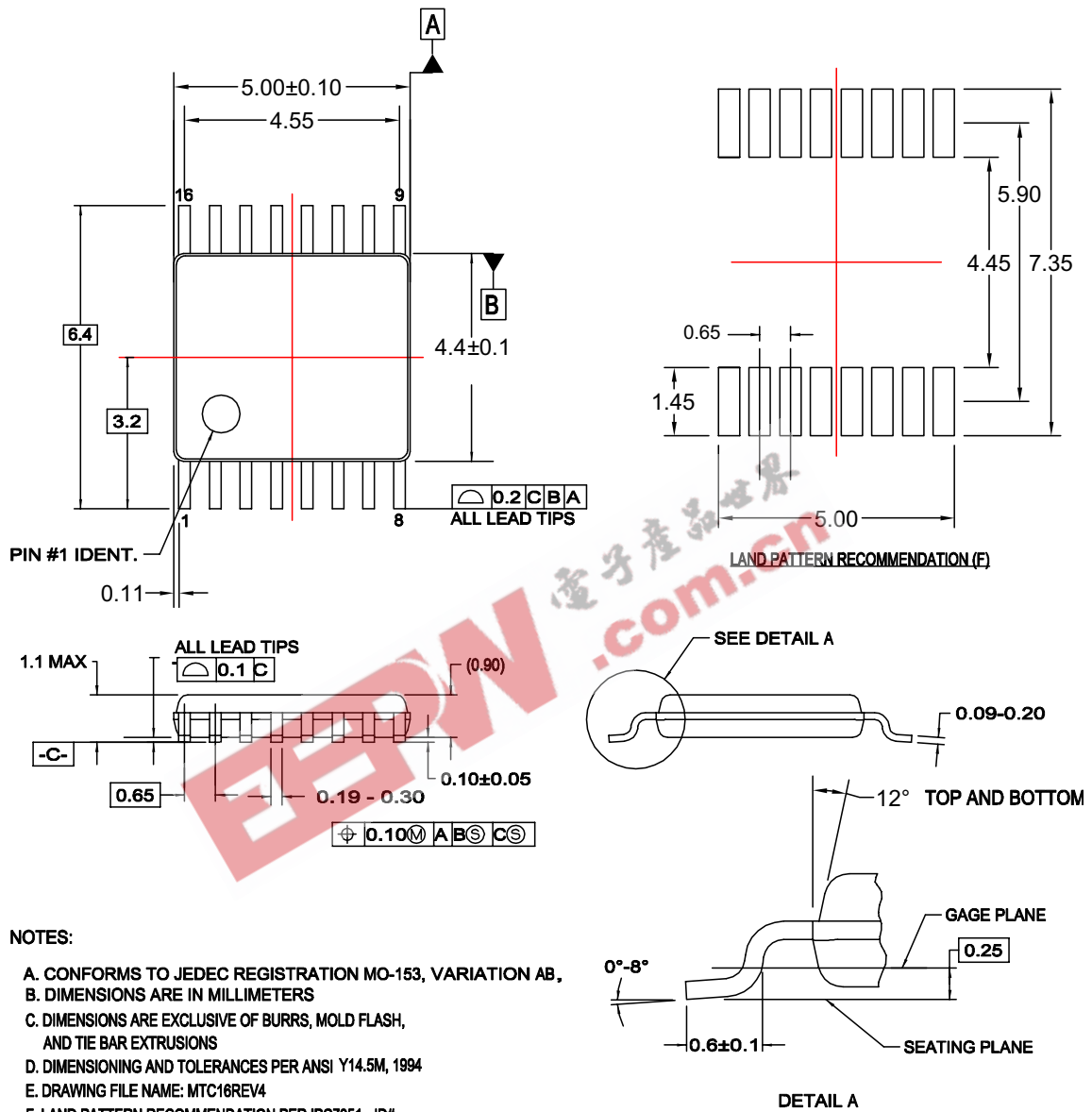
DETAIL A

M16DREVC

**Figure 2. 16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide Package Number M16D**

**Physical Dimensions** (Continued)

Dimensions are in millimeters unless otherwise noted.



**NOTES:**

- A. CONFORMS TO JEDEC REGISTRATION MO-153, VARIATION AB,
- B. DIMENSIONS ARE IN MILLIMETERS
- C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS
- D. DIMENSIONING AND TOLERANCES PER ANSI Y14.5M, 1994
- E. DRAWING FILE NAME: MTC16REV4
- F. LAND PATTERN RECOMMENDATION PER IPC7351 - ID# TSOP65P640X110-16N

MTC16rev4

**Figure 3. 16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide Package Number MTC16**





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