

**FAIRCHILD**  
SEMICONDUCTOR™

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## 74AC139 • 74ACT139 Dual 1-of-4 Decoder/Demultiplexer

### General Description

The AC/ACT139 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 AC/ACT139 can be used as a function generator providing all four minterms of two variables.

### Features

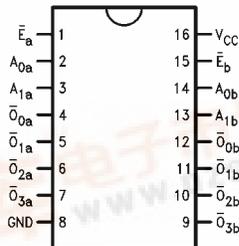
- $I_{CC}$  reduced by 50%
- Multifunction capability
- Two completely independent 1-of-4 decoders
- Active LOW mutually exclusive outputs
- Outputs source/sink 24 mA
- ACT139 has TTL-compatible inputs

### Ordering Code:

Order Number	Package Number	Package Description
74AC139SC	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body
74AC139SJ	M16D	16-Lead Small Outline Package (SOIC), EIAJ Type II, 5.3mm Wide
74AC139MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74AC139PC	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
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74ACT139PC	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide

Device also available in Tape and Reel. Specify by appending suffix letter "X" to the ordering code.

### Connection Diagram



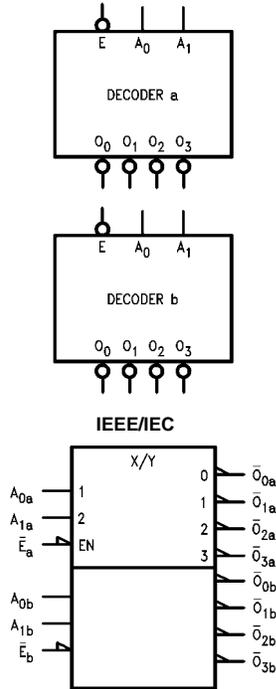
### Pin Descriptions

Pin Names	Description
$A_0, A_1$	Address Inputs
$\bar{E}$	Enable Inputs
$\bar{O}_0 - \bar{O}_3$	Outputs

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### Logic Symbols



### Functional Description

The AC/ACT139 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 ( $\bar{O}_0$ - $\bar{O}_3$ ). Each decoder has an active-LOW enable ( $\bar{E}$ ). When  $\bar{E}$  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 AC/ACT139 generates all four minterms of two variables. These four minterms are useful in some applications, replacing multiple gate functions as shown in Figure 1, and thereby reducing the number of packages required in a logic network.

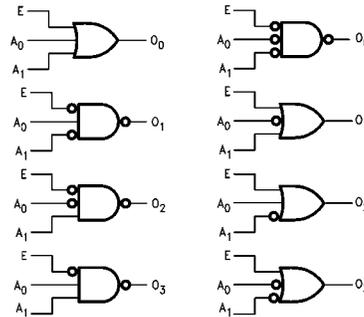


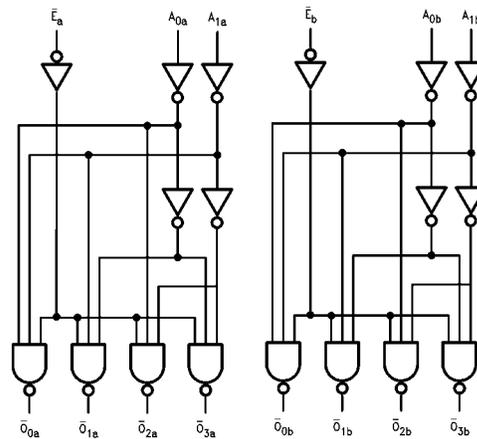
FIGURE 1. Gate Functions (Each Half)

### Truth Table

Inputs			Outputs			
$\bar{E}$	$A_0$	$A_1$	$\bar{O}_0$	$\bar{O}_1$	$\bar{O}_2$	$\bar{O}_3$
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

### 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 (Note 1)		Recommended Operating Conditions	
Supply Voltage ( $V_{CC}$ )	-0.5V to +7.0V	Supply Voltage ( $V_{CC}$ )	AC 2.0V to 6.0V
DC Input Diode Current ( $I_{IK}$ )		ACT 4.5V to 5.5V	
$V_I = -0.5V$	-20 mA	Input Voltage ( $V_I$ )	0V to $V_{CC}$
$V_I = V_{CC} + 0.5V$	+20 mA	Output Voltage ( $V_O$ )	0V to $V_{CC}$
DC Input Voltage ( $V_I$ )	-0.5V to $V_{CC} + 0.5V$	Operating Temperature ( $T_A$ )	-40°C to +85°C
DC Output Diode Current ( $I_{OK}$ )		Minimum Input Edge Rate ( $\Delta V/\Delta t$ )	
$V_O = -0.5V$	-20 mA	AC Devices	
$V_O = V_{CC} + 0.5V$	+20 mA	$V_{IN}$ from 30% to 70% of $V_{CC}$	
DC Output Voltage ( $V_O$ )	-0.5V to $V_{CC} + 0.5V$	$V_{CC}$ @ 3.3V, 4.5V, 5.5V	125 mV/ns
DC Output Source		Minimum Input Edge Rate ( $\Delta V/\Delta t$ )	
or Sink Current ( $I_O$ )	$\pm 50$ mA	ACT Devices	
DC $V_{CC}$ or Ground Current		$V_{IN}$ from 0.8V to 2.0V	
per Output Pin ( $I_{CC}$ or $I_{GND}$ )	$\pm 50$ mA	$V_{CC}$ @ 4.5V, 5.5V	125 mV/ns
Storage Temperature ( $T_{STG}$ )	-65°C to +150°C	<b>Note 1:</b> Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. Fairchild does not recommend operation of FACT™ circuits outside databook specifications.	
Junction Temperature ( $T_J$ )			
PDIP	140°C		

DC Electrical Characteristics for AC								
Symbol	Parameter	$V_{CC}$ (V)	$T_A = +25^\circ\text{C}$		$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		Units	Conditions
			Typ	Guaranteed Limits	Typ	Guaranteed Limits		
$V_{IH}$	Minimum HIGH Level Input Voltage	3.0	1.5	2.1	2.1	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$	
		4.5	2.25	3.15	3.15			
		5.5	2.75	3.85	3.85			
$V_{IL}$	Maximum LOW Level Input Voltage	3.0	1.5	0.9	0.9	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$	
		4.5	2.25	1.35	1.35			
		5.5	2.75	1.65	1.65			
$V_{OH}$	Minimum HIGH Level Output Voltage	3.0	2.99	2.9	2.9	V	$I_{OUT} = -50 \mu A$	
		4.5	4.49	4.4	4.4			
		5.5	5.49	5.4	5.4			
			3.0		2.56	2.46	V	$V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OH} = -12$ mA $I_{OH} = -24$ mA $I_{OH} = -24$ mA (Note 2)
			4.5		3.86	3.76		
			5.5		4.86	4.76		
$V_{OL}$	Maximum LOW Level Output Voltage	3.0	0.002	0.1	0.1	V	$I_{OUT} = 50 \mu A$	
		4.5	0.001	0.1	0.1			
		5.5	0.001	0.1	0.1			
			3.0		0.36	0.44	V	$V_{IN} = V_{IL}$ or $V_{IH}$ $I_{OL} = 12$ mA $I_{OL} = 24$ mA $I_{OL} = 24$ mA (Note 2)
			4.5		0.36	0.44		
			5.5		0.36	0.44		
$I_{IN}$ (Note 4)	Maximum Input Leakage Current	5.5		$\pm 0.1$	$\pm 1.0$	$\mu A$	$V_I = V_{CC}$ , GND	
$I_{OLD}$	Minimum Dynamic Output Current (Note 3)	5.5			75	mA	$V_{OLD} = 1.65V$ Max	
$I_{OHD}$	Output Current (Note 3)	5.5			-75	mA	$V_{OHD} = 3.85V$ Min	
$I_{CC}$ (Note 4)	Maximum Quiescent Supply Current	5.5		4.0	40.0	$\mu A$	$V_{IN} = V_{CC}$ or GND	

**Note 2:** All outputs loaded; thresholds on input associated with output under test.  
**Note 3:** Maximum test duration 2.0 ms, one output loaded at a time.  
**Note 4:**  $I_{IN}$  and  $I_{CC}$  @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V  $V_{CC}$ .

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DC Electrical Characteristics for ACT								
Symbol	Parameter	V <sub>CC</sub> (V)	T <sub>A</sub> = +25°C		T <sub>A</sub> = -40°C to +85°C		Units	Conditions
			Typ	Guaranteed Limits				
V <sub>IH</sub>	Minimum HIGH Level Input Voltage	4.5	1.5	2.0	2.0	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> - 0.1V	
		5.5	1.5	2.0	2.0			
V <sub>IL</sub>	Maximum LOW Level Input Voltage	4.5	1.5	0.8	0.8	V	V <sub>OUT</sub> = 0.1V or V <sub>CC</sub> - 0.1V	
		5.5	1.5	0.8	0.8			
V <sub>OH</sub>	Minimum HIGH Level Output Voltage	4.5	4.49	4.4	4.4	V	I <sub>OUT</sub> = -50 μA	
		5.5	5.49	5.4	5.4			
		4.5		3.86	3.76	V	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OH</sub> = -24 mA I <sub>OH</sub> = -24 mA (Note 5)	
		5.5		4.86	4.76			
V <sub>OL</sub>	Maximum LOW Level Output Voltage	4.5	0.001	0.1	0.1	V	I <sub>OUT</sub> = 50 μA	
		5.5	0.001	0.1	0.1			
		4.5		0.36	0.44	V	V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub> I <sub>OL</sub> = 24 mA I <sub>OL</sub> = 24 mA (Note 5)	
		5.5		0.36	0.44			
I <sub>IN</sub>	Maximum Input Leakage Current	5.5		±0.1	±1.0	μA	V <sub>I</sub> = V <sub>CC</sub> , GND	
I <sub>CCT</sub>	Maximum I <sub>CC</sub> /Input	5.5	0.6		1.5	mA	V <sub>I</sub> = V <sub>CC</sub> - 2.1V	
I <sub>OLD</sub>	Minimum Dynamic	5.5			75	mA	V <sub>OLD</sub> = 1.65V Max	
I <sub>OHD</sub>	Output Current (Note 6)	5.5			-75	mA	V <sub>OHD</sub> = 3.85V Min	
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5		4.0	40.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND	

**Note 5:** All outputs loaded; thresholds on input associated with output under test.  
**Note 6:** Maximum test duration 2.0 ms, one output loaded at a time.

### AC Electrical Characteristics for AC

Symbol	Parameter	V <sub>CC</sub> (V) (Note 7)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		Units
			Min	Typ	Max	Min	Max	
t <sub>PLH</sub>	Propagation Delay A <sub>n</sub> to $\overline{O}_n$	3.3	4.0	8.0	11.5	3.5	13.0	ns
		5.0	3.0	6.5	8.5	2.5	9.5	
t <sub>PHL</sub>	Propagation Delay A <sub>n</sub> to $\overline{O}_n$	3.3	3.0	7.0	10.0	2.5	11.0	ns
		5.0	2.5	5.5	7.5	2.0	8.5	
t <sub>PLH</sub>	Propagation Delay $\overline{E}_n$ to $\overline{O}_n$	3.3	4.5	9.5	12.0	3.5	13.0	ns
		5.0	3.5	7.0	8.5	3.0	10.0	
t <sub>PHL</sub>	Propagation Delay $\overline{E}_n$ to $\overline{O}_n$	3.3	4.0	8.0	10.0	3.0	11.0	ns
		5.0	2.5	6.0	7.5	2.5	8.5	

**Note 7:** Voltage Range 3.3 is 3.3V ± 0.3V.  
Voltage Range 5.0 is 5.0V ± 0.5V

AC Electrical Characteristics for ACT								
Symbol	Parameter	V <sub>CC</sub> (V) (Note 8)	T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		Units
			Min	Typ	Max	Min	Max	
t <sub>PLH</sub>	Propagation Delay A <sub>n</sub> to $\overline{O}_n$	5.0	1.5	6.0	8.5	1.5	9.5	ns
t <sub>PHL</sub>	Propagation Delay A <sub>n</sub> to $\overline{O}_n$	5.0	1.5	6.0	9.5	1.5	10.5	ns
t <sub>PLH</sub>	Propagation Delay $\overline{E}_n$ to $\overline{O}_n$	5.0	2.5	7.0	10.0	2.0	11.0	ns
t <sub>PHL</sub>	Propagation Delay $\overline{E}_n$ to $\overline{O}_n$	5.0	2.0	7.0	9.5	1.5	10.5	ns

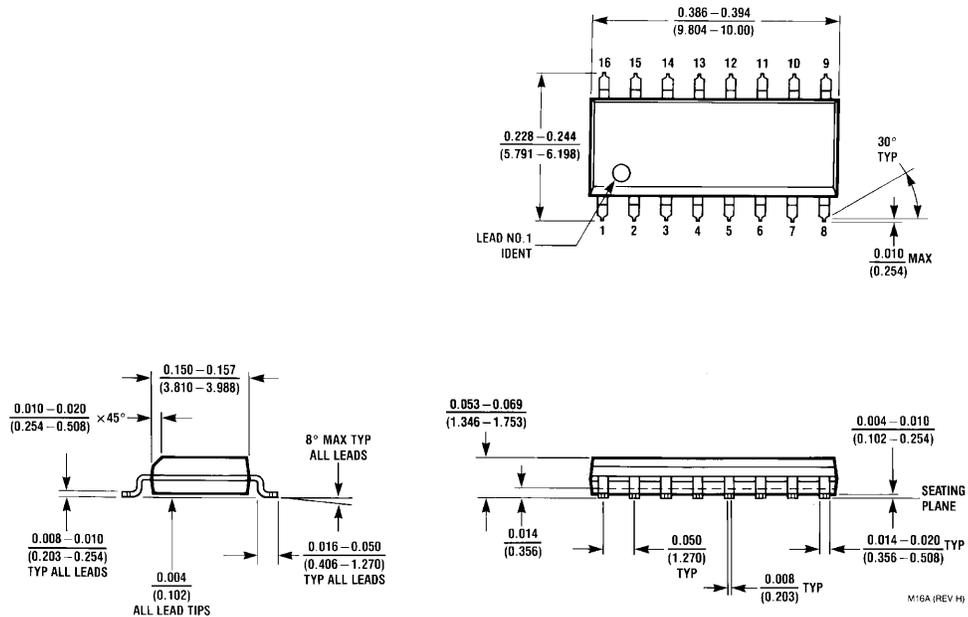
**Note 8:** Voltage Range 5.0 is 5.0V ± 0.5V

### Capacitance

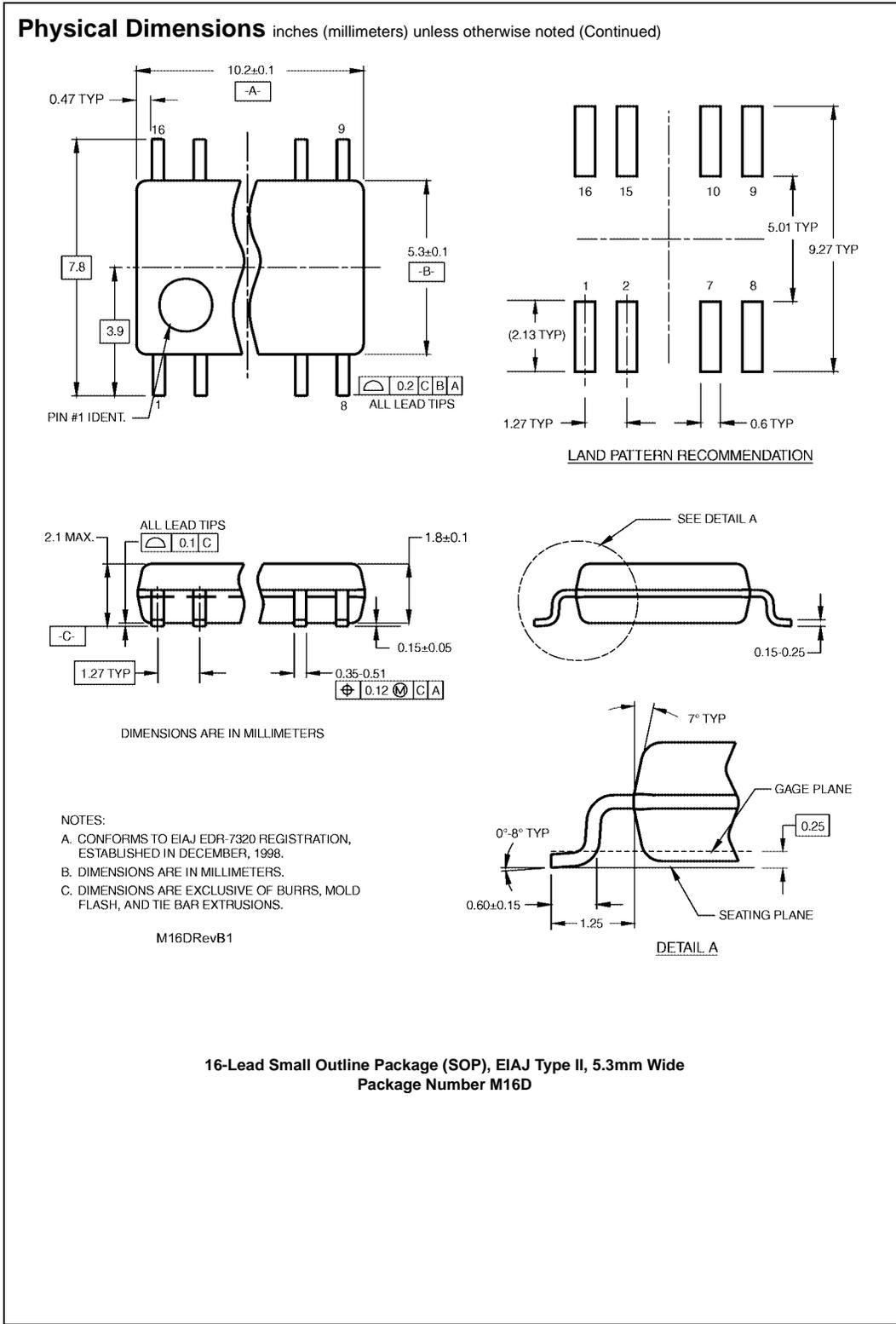
Symbol	Parameter	Typ	Units	Conditions
C <sub>IN</sub>	Input Capacitance	4.5	pF	V <sub>CC</sub> = OPEN
C <sub>PD</sub>	Power Dissipation Capacitance	40.0	pF	V <sub>CC</sub> = 5.0V

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**Physical Dimensions** inches (millimeters) unless otherwise noted

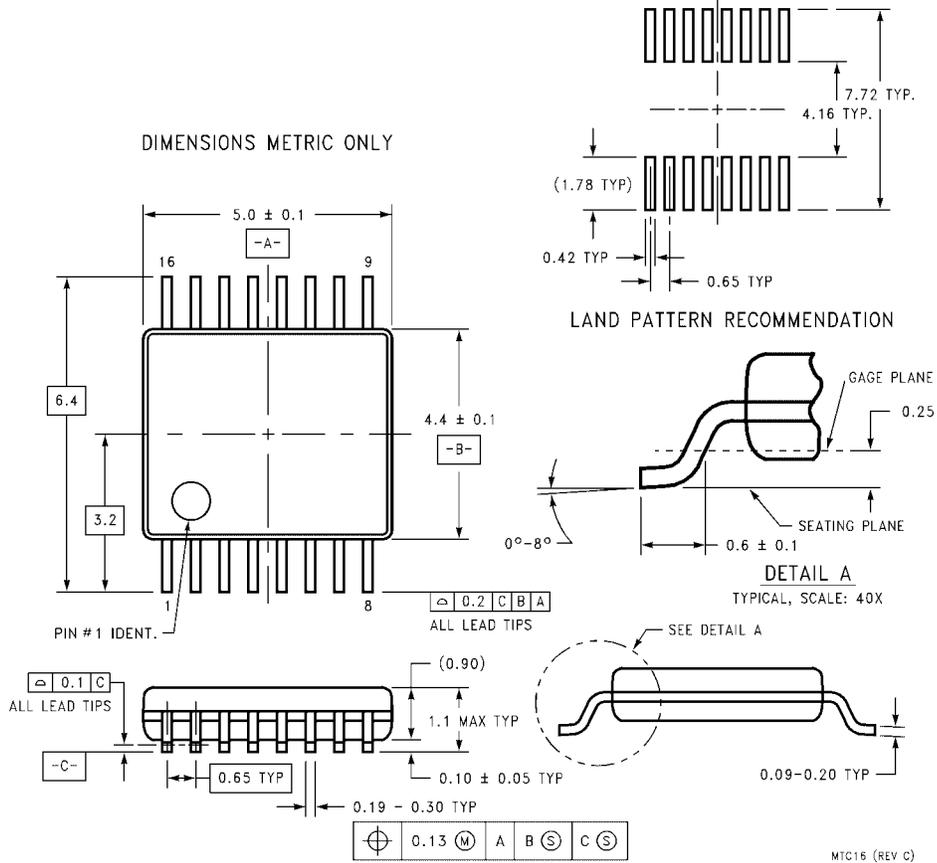


**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body  
Package Number M16A**



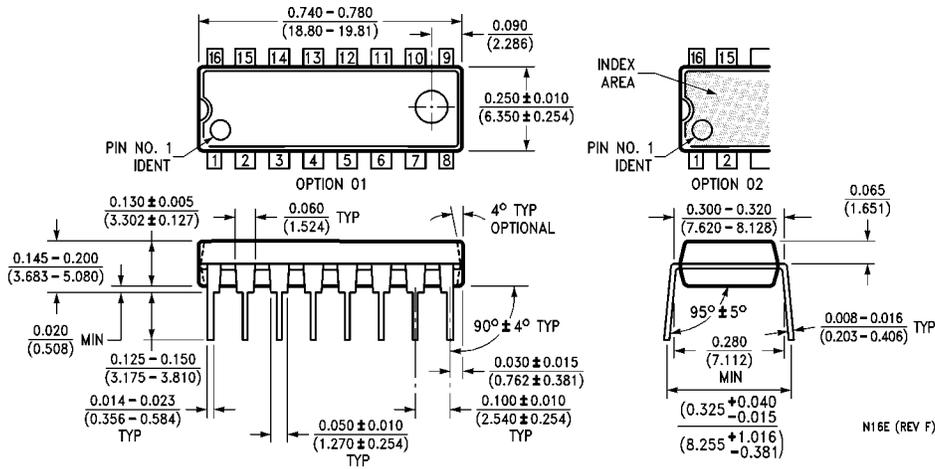
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**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



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

**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide Package Number N16E**

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