

## 74AC399 • 74ACT399 Quad 2-Port Register

### General Description

The AC/ACT399 is the logical equivalent of a quad 2-input multiplexer feeding into four edge-triggered flip-flops. A common Select input determines which of the two 4-bit words is accepted. The selected data enters the flip-flop on the rising edge of the clock.

### Features

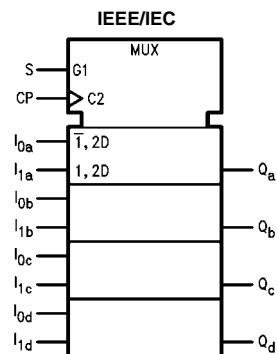
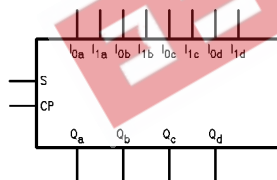
- $I_{CC}$  reduced by 50%
- Select inputs from two data sources
- Fully positive edge-triggered operation
- Outputs source/sink 24 mA
- AC/ACT399 has TTL-compatible inputs

### Ordering Code:

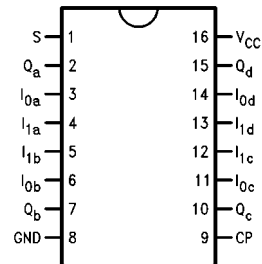
Order Number	Package Number	Package Description
74AC399SC	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow
74AC399PC	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300 Wide
74ACT399SC	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150 Narrow
74ACT399SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74ACT399MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74ACT399PC	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.

### Logic Symbols



### Connection Diagram



### Pin Descriptions

Pin Names	Description
S	Common Select Input
CP	Clock Pulse Input
$I_{0a}$ - $I_{0d}$	Data Inputs from Source 0
$I_{1a}$ - $I_{1d}$	Data Inputs from Source 1
$Q_a$ - $Q_d$	Register True Outputs

## Functional Description

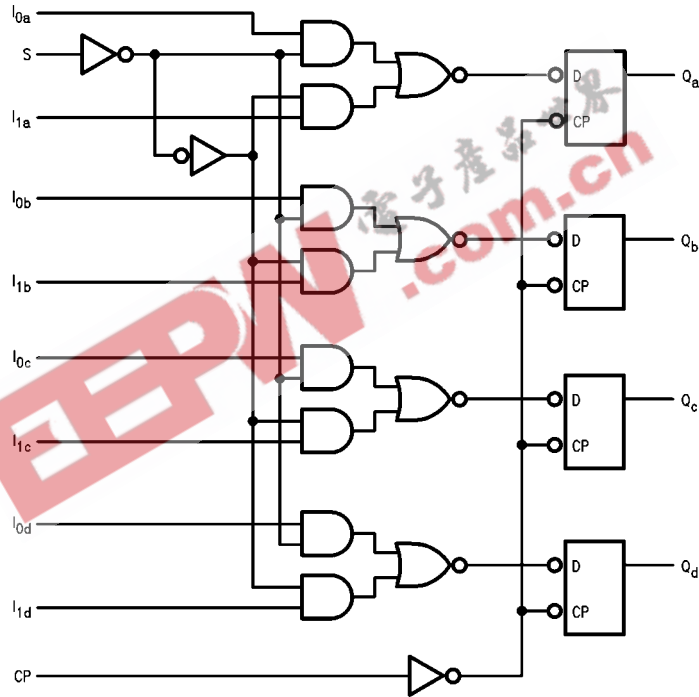
The AC/ACT399 is a high-speed quad 2-port register. It selects four bits of data from either of two sources (Ports) under control of a common Select input (S). The selected data is transferred to a 4-bit output register synchronous with the LOW-to-HIGH transition of the Clock input (CP). The 4-bit D-type output register is fully edge-triggered. The Data inputs ( $I_{0,x}$ ,  $I_{1,x}$ ) and Select input (S) must be stable only a setup time prior to and hold time after the LOW-to-HIGH transition of the Clock input for predictable operation.

## Function Table

Inputs				Outputs	
S	$I_0$	$I_1$	CP	Q	$\bar{Q}$
L	L	X	↗	L	H
L	H	X	↗	H	L
H	X	L	↗	L	H
H	X	H	↗	H	L

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 ↗ = LOW-to-HIGH Clock Transition

## 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)

Supply Voltage ( $V_{CC}$ )	-0.5V to +7.0V
DC Input Diode Current ( $I_{IK}$ )	
$V_I = -0.5V$	-20 mA
$V_I = V_{CC} + 0.5V$	+20 mA
DC Input Voltage ( $V_I$ )	-0.5V to $V_{CC} + 0.5V$
DC Output Diode Current ( $I_{OK}$ )	
$V_O = -0.5V$	-20 mA
$V_O = V_{CC} + 0.5V$	+20 mA
DC Output Voltage ( $V_O$ )	-0.5V to $V_{CC} + 0.5V$
DC Output Source or Sink Current ( $I_O$ )	$\pm 50$ mA
DC $V_{CC}$ or Ground Current per Output Pin ( $I_{CC}$ or $I_{GND}$ )	$\pm 50$ mA
Storage Temperature ( $T_{STG}$ )	-65°C to +150°C
Junction Temperature ( $T_J$ )	
PDIP	+140°C

**Recommended Operating Conditions**

Supply Voltage ( $V_{CC}$ )	
AC	2.0V to 6.0V
ACT	4.5V to 5.5V
Input Voltage ( $V_I$ )	0V to $V_{CC}$
Output Voltage ( $V_O$ )	0V to $V_{CC}$
Operating Temperature ( $T_A$ )	-40°C to +85°C
Minimum Input Edge Rate ( $\Delta V/\Delta t$ )	
AC Devices	
$V_{IN}$ from 30% to 70% of $V_{CC}$	
$V_{CC}$ @ 3.3V, 4.5V, 5.5V	125 mV/ns
Minimum Input Edge Rate ( $\Delta V/\Delta t$ )	
ACT Devices	
$V_{IN}$ from 0.8V to 2.0V	
$V_{CC}$ @ 4.5V, 5.5V	125 mV/ns

**Note 1:** 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. National does not recommend operation of FACT™ circuits outside databook specifications.

**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	$I_{OUT} = -50 \mu\text{A}$	
		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 $V_{IH}$ $I_{OH} = -12 \text{ mA}$ $I_{OH} = -24 \text{ mA}$ $I_{OH} = -24 \text{ mA (Note 2)}$	
		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	$I_{OUT} = 50 \mu\text{A}$	
		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 $V_{IH}$ $I_{OL} = 12 \text{ mA}$ $I_{OL} = 24 \text{ mA}$ $I_{OL} = 24 \text{ mA (Note 2)}$	
		4.5		0.36	0.44			
5.5		0.36	0.44					
$I_{IN}$	Maximum Input Leakage Current	5.5		$\pm 0.1$	$\pm 1.0$	$\mu\text{A}$	$V_I = V_{CC}, \text{ GND}$	
$I_{OZ}$	Maximum 3-STATE Current	5.5		$\pm 0.5$	$\pm 5.0$	$\mu\text{A}$	$V_I (\text{OE}) = V_{IL}, V_{IH}$ $V_I = V_{CC}, \text{ GND}$ $V_O = V_{CC}, \text{ GND}$	
$I_{OLD}$	Minimum Dynamic Output Current (Note 3)	5.5			75	mA	$V_{OLD} = 1.65V \text{ Max}$	
$I_{OHD}$	Output Current (Note 3)	5.5			-75	mA	$V_{OHD} = 3.85V \text{ Min}$	
$I_{CC}$	Maximum Quiescent Supply Current	5.5		4.0	40.0	$\mu\text{A}$	$V_{IN} = V_{CC}$ 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  $V_{CC}$ .

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	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		4.85	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>CC1</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 (Note 6)	5.5			75	mA	V <sub>OLD</sub> = 1.65V Max
		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 Ground

**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 V <sub>CC</sub> = +5.0V C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C V <sub>CC</sub> = 5.0V C <sub>L</sub> = 50 pF		Units
			Min	Typ	Max	Min	Max	
			f <sub>MAX</sub>	Input Clock Frequency	3.3 5.0	140 170	160 190	
t <sub>PLH</sub>	Propagation Delay CP to Q	3.3	4.0	7.5	10.0	3.5	11.0	ns
		5.0	2.0	5.0	8.0	1.5	8.5	
t <sub>PHL</sub>	Propagation Delay CP to Q	3.3	3.5	7.0	9.5	3.0	10.5	ns
		5.0	2.0	5.0	7.5	1.5	8.0	

**Note 7:** Voltage Range 5.0 is 5.0V ± 0.5V

AC Operating Requirements for AC							
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
			Typ	Guaranteed Minimum			
t <sub>S</sub>	Setup Time, HIGH or LOW	3.3	2.0	4.0	4.0		ns
	I <sub>n</sub> to CP	5.0	1.5	3.0	3.0		
t <sub>H</sub>	Hold Time, HIGH or LOW	3.3	0.5	1.0	1.0		ns
	I <sub>n</sub> to CP	5.0	0.5	1.0	1.0		
t <sub>S</sub>	Setup Time, HIGH or LOW	3.3	3.5	5.5	5.5		ns
	S to CP	5.0	2.0	4.0	4.0		
t <sub>H</sub>	Hold Time, HIGH or LOW	3.3	0.5	1.0	1.0		ns
	S to CP	5.0	0.5	1.0	1.0		
t <sub>W</sub>	CP Pulse Width,	3.3	3.0	4.5	4.5		ns
	HIGH or LOW	5.0	2.0	3.5	3.5		

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

AC Electrical Characteristics for ACT								
Symbol	Parameter	V <sub>CC</sub> (V) (Note 9)	T <sub>A</sub> = +25°C V <sub>CC</sub> = +5.0V C <sub>L</sub> = 50 pF			T <sub>A</sub> = -40°C to +85°C V <sub>CC</sub> = 5.0V C <sub>L</sub> = 50 pF		Units
			Min	Typ	Max	Min	Max	
f <sub>MAX</sub>	Input Clock Frequency	5.0	165	180		160		MHz
t <sub>PLH</sub>	Propagation Delay CP to Q	5.0	1.5	7.0	8.0	1.5	8.5	ns
t <sub>PHL</sub>	Propagation Delay CP to Q	5.0	2.0	6.0	9.0	2.0	9.5	ns

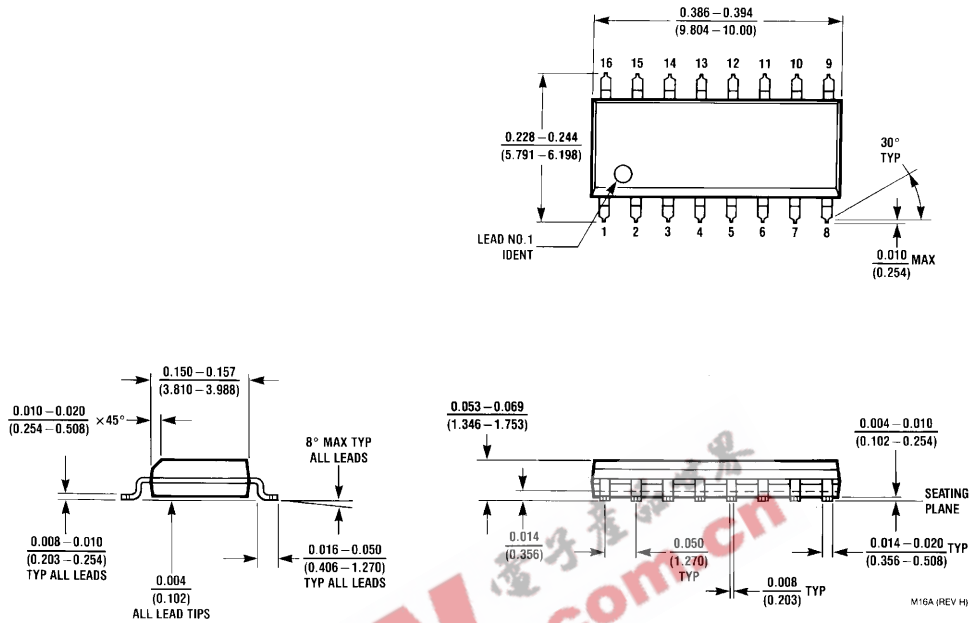
**Note 9:** Voltage Range 5.0 is 5.0V ± 0.5V

AC Operating Requirements for ACT							
Symbol	Parameter	V <sub>CC</sub> (V) (Note 10)	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
			Typ	Guaranteed Minimum			
t <sub>S</sub>	Setup Time, HIGH or LOW	5.0	0.8	2.5	2.5		ns
	I <sub>n</sub> to CP						
t <sub>H</sub>	Hold Time, HIGH or LOW	5.0	0	1.0	1.0		ns
	I <sub>n</sub> to CP						
t <sub>S</sub>	Setup Time, HIGH or LOW	5.0	0.8	4.0	4.0		ns
	S to CP						
t <sub>H</sub>	Hold Time, HIGH or LOW	5.0	-1.0	0.5	0.5		ns
	S to CP						
t <sub>W</sub>	CP Pulse Width,	5.0	1.7	3.5	3.5		ns
	HIGH or LOW						

**Note 10:** Voltage Range 5.0 is 5.0V ± 0.5V

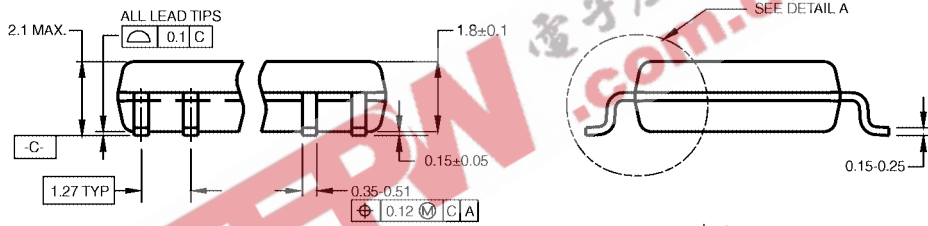
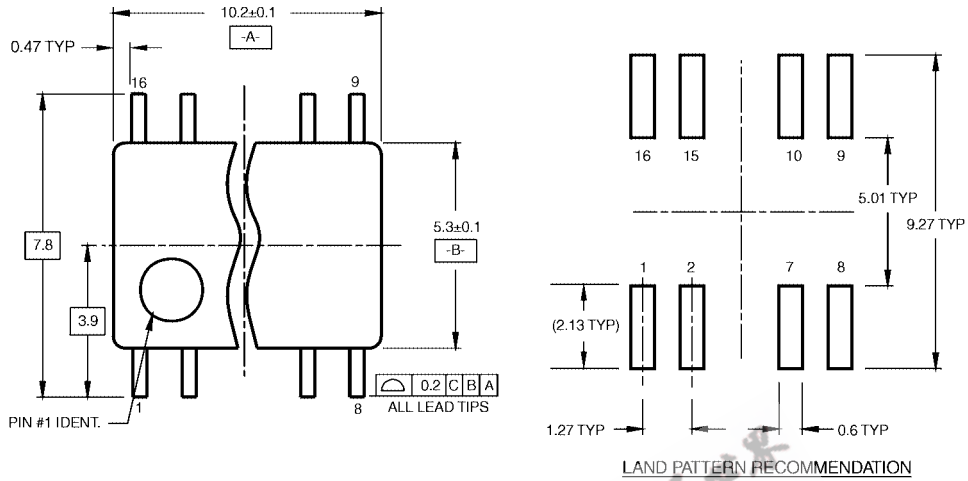
Capacitance				
Symbol	Parameter	Typ	Units	Conditions
C <sub>IN</sub>	Input Capacitance	4.5	pF	V <sub>CC</sub> = OPEN
C <sub>PD</sub>	Power Dissipation Capacitance	30	pF	V <sub>CC</sub> = 5.0V

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



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

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



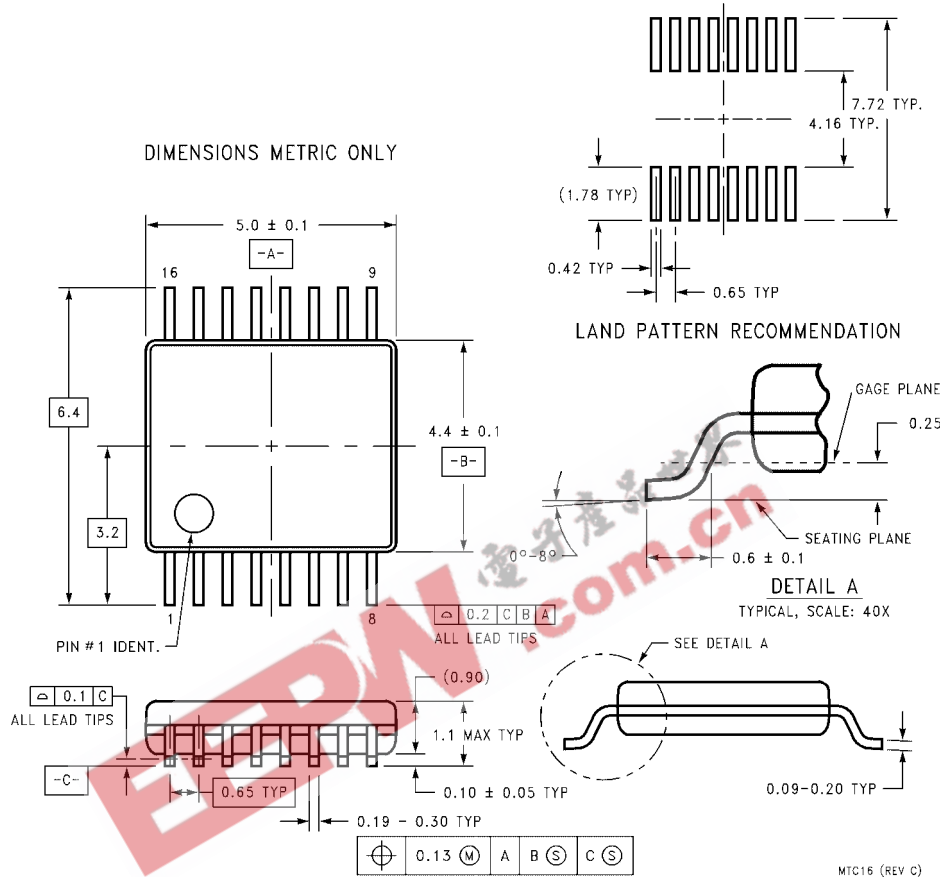
DIMENSIONS ARE IN MILLIMETERS

- 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.

M16DRevB1

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

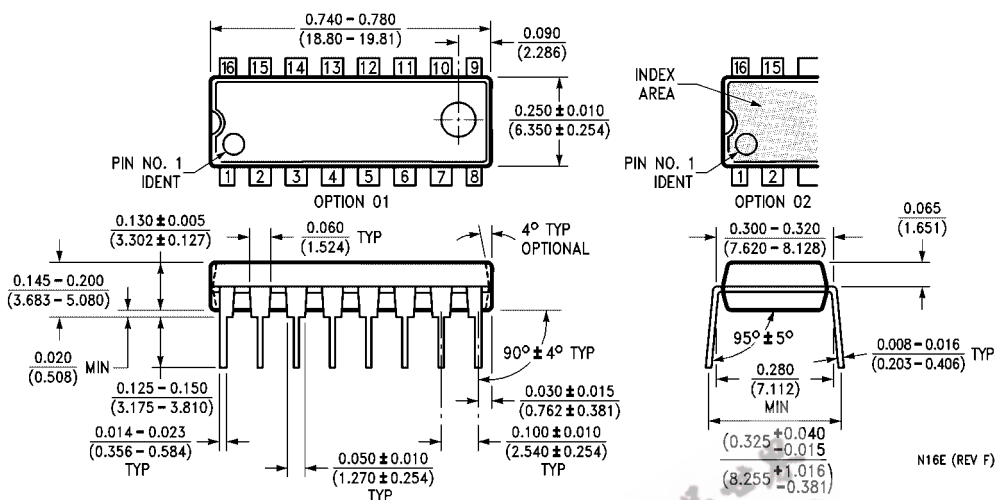
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



**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

N16E (REV F)

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