



Is Now Part of



**ON Semiconductor®**

To learn more about ON Semiconductor, please visit our website at  
[www.onsemi.com](http://www.onsemi.com)

Please note: As part of the Fairchild Semiconductor integration, some of the Fairchild orderable part numbers will need to change in order to meet ON Semiconductor's system requirements. Since the ON Semiconductor product management systems do not have the ability to manage part nomenclature that utilizes an underscore (\_), the underscore (\_) in the Fairchild part numbers will be changed to a dash (-). This document may contain device numbers with an underscore (\_). Please check the ON Semiconductor website to verify the updated device numbers. The most current and up-to-date ordering information can be found at [www.onsemi.com](http://www.onsemi.com). Please email any questions regarding the system integration to [Fairchild\\_questions@onsemi.com](mailto:Fairchild_questions@onsemi.com).

ON Semiconductor and the ON Semiconductor logo are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## 74AC169 4-Stage Synchronous Bidirectional Counter

### General Description

The AC169 is fully synchronous 4-stage up/down counter. The AC169 is a modulo-16 binary counter. It features a preset capability for programmable operation, carry lookahead for easy cascading and a U/D input to control the direction of counting. All state changes, whether in counting or parallel loading, are initiated by the LOW-to-HIGH transition of the Clock.

### Features

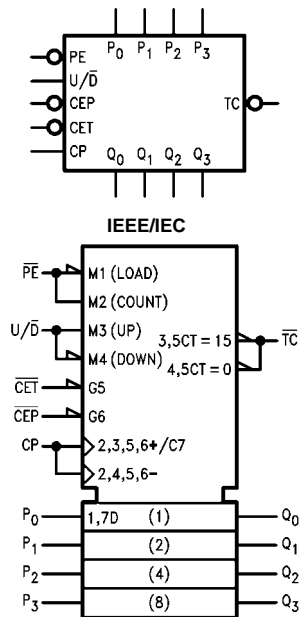
- $I_{CC}$  reduced by 50%
- Synchronous counting and loading
- Built-In lookahead carry capability
- Presetable for programmable operation
- Outputs source/sink 24 mA

### Ordering Code:

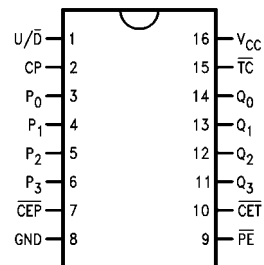
Order Number	Package Number	Package Description
74AC169SC	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body
74AC169SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74AC169MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74AC169PC	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
$\overline{CEP}$	Count Enable Parallel Input
$\overline{CET}$	Count Enable Trickle Input
CP	Clock Pulse Input
$P_0$ - $P_3$	Parallel Data Inputs
$\overline{PE}$	Parallel Enable Input
$U/\overline{D}$	Up-Down Count Control Input
$Q_0$ - $Q_3$	Flip-Flop Outputs
$\overline{TC}$	Terminal Count Output

FACT™ is a trademark of Fairchild Semiconductor Corporation.

### Functional Description

The AC169 uses edge-triggered J-K-type flip-flops and have no constraints on changing the control or data input signals in either state of the Clock. The only requirement is that the various inputs attain the desired state at least a setup time before the rising edge of the clock and remain valid for the recommended hold time thereafter. The parallel load operation takes precedence over the other operations, as indicated in the Mode Select Table. When  $\overline{PE}$  is LOW, the data on the  $P_0$ - $P_3$  inputs enters the flip-flops on the next rising edge of the Clock. In order for counting to occur, both  $\overline{CEP}$  and  $\overline{CET}$  must be LOW and  $\overline{PE}$  must be HIGH; the  $U/\overline{D}$  input then determines the direction of counting. The Terminal Count ( $\overline{TC}$ ) output is normally HIGH and goes LOW, provided that  $\overline{CET}$  is LOW, when a counter reaches zero in the Count Down mode or reaches 15 in the Count Up mode. The  $\overline{TC}$  output state is not a function of the Count Enable Parallel ( $\overline{CEP}$ ) input level. If an illegal state occurs, the AC169 will return to the legitimate sequence within two counts. Since the  $\overline{TC}$  signal is derived by decoding the flip-flop states, there exists the possibility of decoding spikes on  $\overline{TC}$ . For this reason the use of  $\overline{TC}$  as a clock signal is not recommended (see logic equations below).

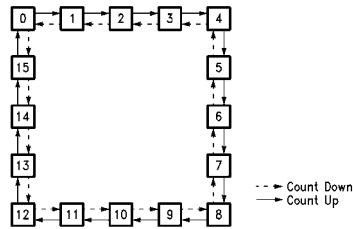
1. Count Enable =  $\overline{CEP} \cdot \overline{CET} \cdot \overline{PE}$
2. Up:  $\overline{TC} = Q_0 \cdot Q_1 \cdot Q_2 \cdot Q_3 \cdot (Up) \cdot \overline{CET}$
3. Down:  $\overline{TC} = \overline{Q_0} \cdot \overline{Q_1} \cdot \overline{Q_2} \cdot \overline{Q_3} \cdot (Down) \cdot \overline{CET}$

### Mode Select Table

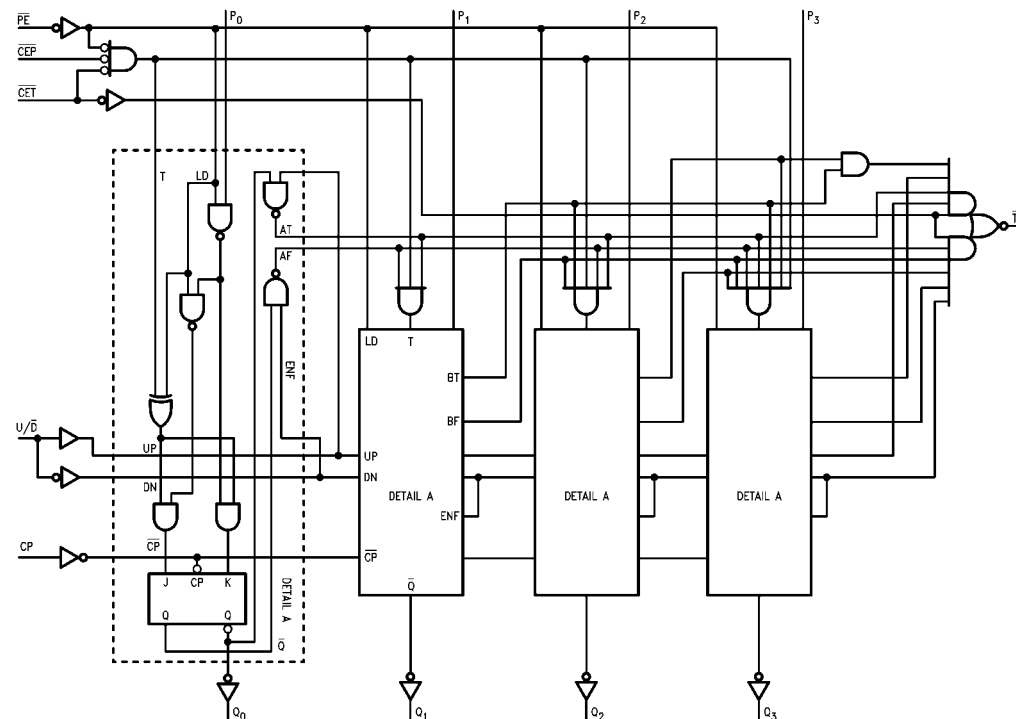
$\overline{PE}$	$\overline{CEP}$	$\overline{CET}$	$U/\overline{D}$	Action on Rising Clock Edge
L	X	X	X	Load ( $P_n$ to $Q_n$ )
H	L	L	H	Count Up (Increment)
H	L	L	L	Count Down (Decrement)
H	H	X	X	No Change (Hold)
H	X	H	X	No Change (Hold)

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

### State Diagram



### 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 <sup>(Note 1)</sup>			Recommended Operating Conditions		
Supply Voltage ( $V_{CC}$ )		-0.5V to +7.0V	Supply Voltage ( $V_{CC}$ )		2.0V to 6.0V
DC Input Diode Current ( $I_{IK}$ )			Input Voltage ( $V_I$ )		0V to $V_{CC}$
$V_I = -0.5V$		-20 mA	Output Voltage ( $V_O$ )		0V to $V_{CC}$
$V_I = V_{CC} + 0.5V$		+20 mA	Operating Temperature ( $T_A$ )		-40°C to +85°C
DC Input Voltage ( $V_I$ )		-0.5V to $V_{CC} + 0.5V$	Minimum Input Edge Rate ( $\Delta V/\Delta t$ )		
DC Output Diode Current ( $I_{OK}$ )			$V_{IN}$ from 30% to 70% of $V_{CC}$		
$V_O = -0.5V$		-20 mA	$V_{CC}$ @ 3.3V, 4.5V, 5.5V		125 mV/ns
$V_O = V_{CC} + 0.5V$		+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			

**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. Fairchild does not recommend operation of FACT™ circuits outside databook specifications.

### DC Electrical Characteristics

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			
$V_{IH}$	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  $V_{CC}$ .

AC Electrical Characteristics								
Symbol	Parameter	V <sub>CC</sub> (V) (Note 5)	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	
f <sub>MAX</sub>	Maximum Clock Frequency	3.3	75	118		65		MHz
		5.0	100	154		90		
t <sub>PLH</sub>	Propagation Delay CP to Q <sub>n</sub> (P <sub>E</sub> HIGH or LOW)	3.3	2.5	9.5	13.0	2.0	14.5	ns
		5.0	1.5	7.0	10.0	1.5	11.0	
t <sub>PHL</sub>	Propagation Delay CP to Q <sub>n</sub> (P <sub>E</sub> HIGH or LOW)	3.3	2.5	10.5	14.5	2.0	16.0	ns
		5.0	1.5	7.5	11.0	1.5	12.0	
t <sub>PLH</sub>	Propagation Delay CP to $\overline{TC}$	3.3	4.5	13.5	18.0	3.5	22.0	ns
		5.0	3.0	9.5	13.0	2.0	14.0	
t <sub>PHL</sub>	Propagation Delay CP to $\overline{TC}$	3.3	3.5	13.5	18.0	3.0	20.5	ns
		5.0	2.5	9.5	13.0	2.0	14.5	
t <sub>PLH</sub>	Propagation Delay $\overline{CET}$ to $\overline{TC}$	3.3	3.5	11.0	15.0	3.0	16.5	ns
		5.0	3.0	8.0	10.5	2.5	12.0	
t <sub>PHL</sub>	Propagation Delay $\overline{CET}$ to $\overline{TC}$	3.3	3.0	9.5	12.5	2.5	14.5	ns
		5.0	2.0	7.0	9.0	1.5	10.0	
t <sub>PLH</sub>	Propagation Delay U/ $\overline{D}$ to $\overline{TC}$	3.3	3.5	11.0	15.0	3.0	17.0	ns
		5.0	2.5	8.0	10.5	2.0	12.0	
t <sub>PHL</sub>	Propagation Delay U/ $\overline{D}$ to $\overline{TC}$	3.3	2.5	10.0	13.5	2.0	15.5	ns
		5.0	1.5	7.0	9.5	1.5	10.5	

Note 5: Voltage Range 3.3 is 3.3V ± 0.3V Voltage Range 5.0 is 5.0V ± 0.5V

AC Operating Requirements							
Symbol	Parameter	V <sub>CC</sub> (V) (Note 6)	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 P <sub>n</sub> to CP	3.3	3.0	4.5	5.0		ns
		5.0	1.5	2.5	2.5		
t <sub>H</sub>	Hold Time, HIGH or LOW P <sub>n</sub> to CP	3.3	-1.5	0.5	0.5		ns
		5.0	-0.5	1.5	1.5		
t <sub>S</sub>	Setup Time, HIGH or LOW $\overline{CEP}$ to CP	3.3	7.5	10.5	12.5		ns
		5.0	4.5	7.0	8.0		
t <sub>H</sub>	Hold Time, HIGH or LOW $\overline{CEP}$ to CP	3.3	-4.5	0	0		ns
		5.0	-2.0	0.5	1.0		
t <sub>S</sub>	Setup Time, HIGH or LOW $\overline{CET}$ to CP	3.3	7.0	10.0	12.0		ns
		5.0	4.0	6.5	8.0		
t <sub>H</sub>	Hold Time, HIGH or LOW $\overline{CET}$ to CP	3.3	-6.0	0	0		ns
		5.0	-4.0	0.5	1.0		
t <sub>S</sub>	Setup Time, HIGH or LOW $\overline{PE}$ to CP	3.3	3.5	5.5	6.5		ns
		5.0	2.0	3.5	4.0		
t <sub>H</sub>	Hold Time, HIGH or LOW $\overline{PE}$ to CP	3.3	-3.5	0	0		ns
		5.0	-1.5	0.5	0.5		
t <sub>S</sub>	Setup Time, HIGH or LOW U/ $\overline{D}$ to CP	3.3	7.0	10.0	11.5		ns
		5.0	4.5	6.5	7.5		
t <sub>H</sub>	Hold Time, HIGH or LOW U/ $\overline{D}$ to CP	3.3	-7.0	0	0		ns
		5.0	-4.0	0.5	0.5		
t <sub>W</sub>	CP Pulse Width, HIGH or LOW	3.3	2.0	3.0	4.0		ns
		5.0	2.0	3.0	3.0		

Note 6: Voltage Range 3.3 is 3.3V ± 0.3V Voltage Range 5.0 is 5.0V ± 0.5V

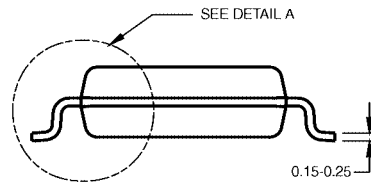
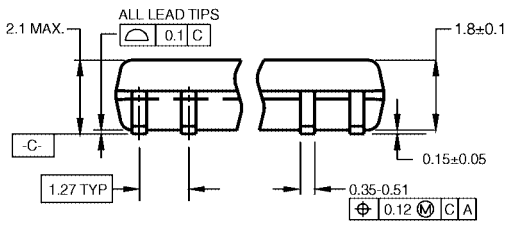
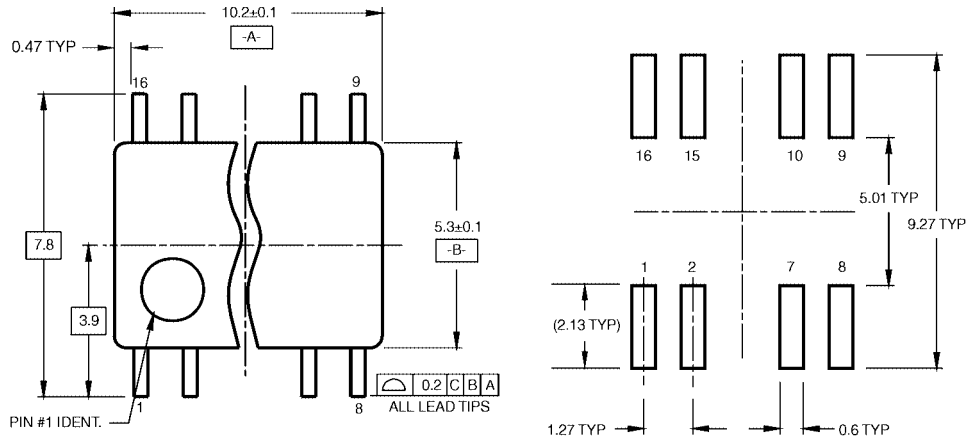
Capacitance				
Symbol	Parameter	Typ	Units	Conditions
C <sub>IN</sub>	Input Capacitance	4.5	pF	V <sub>CC</sub> = OPEN
C <sub>PD</sub>	Power Dissipation Capacitance	60.0	pF	V <sub>CC</sub> = 5.0V

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



**16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 1.150" Narrow Body  
Package Number M16A**

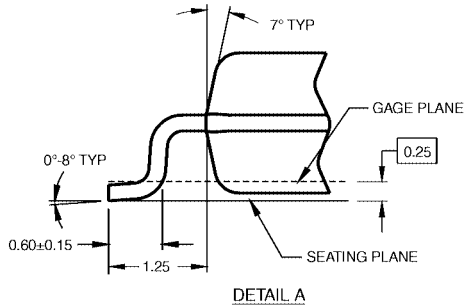
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)



DIMENSIONS ARE IN MILLIMETERS

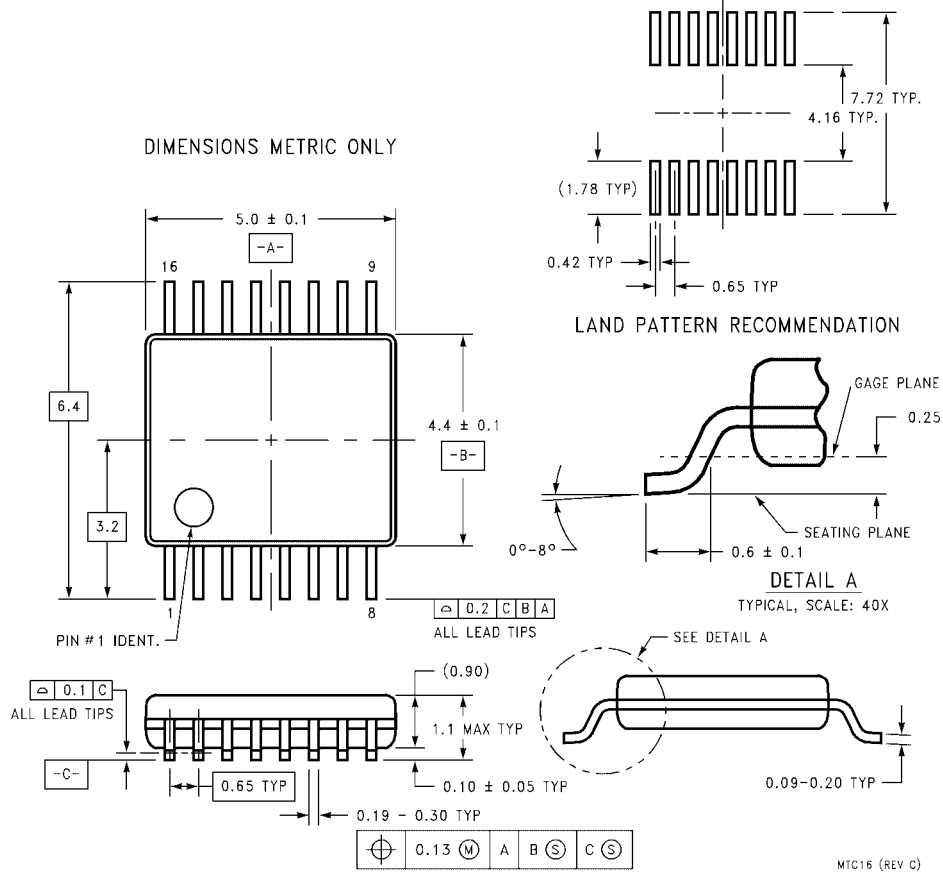
- NOTES:  
 A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.  
 B. DIMENSIONS ARE IN MILLIMETERS.  
 C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M16DRRevB1



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

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

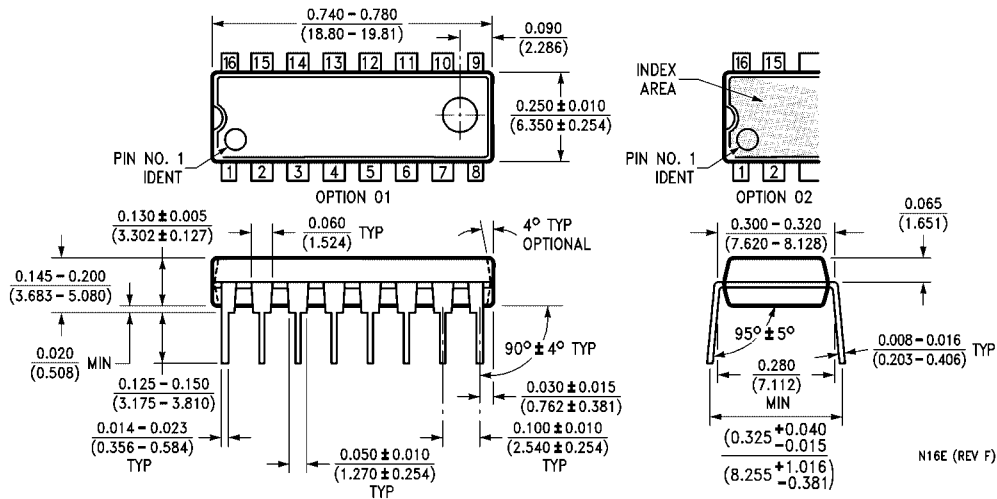


**16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide  
Package Number MTC16**

MTC16 (REV C)



### 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)

Fairchild does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and Fairchild reserves the right at any time without notice to change said circuitry and specifications.

#### LIFE SUPPORT POLICY

FAIRCHILD'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF FAIRCHILD SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and (c) whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
2. A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

[www.fairchildsemi.com](http://www.fairchildsemi.com)

ON Semiconductor and  are trademarks of Semiconductor Components Industries, LLC dba ON Semiconductor or its subsidiaries in the United States and/or other countries. ON Semiconductor owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of ON Semiconductor's product/patent coverage may be accessed at [www.onsemi.com/site/pdf/Patent-Marking.pdf](http://www.onsemi.com/site/pdf/Patent-Marking.pdf). ON Semiconductor reserves the right to make changes without further notice to any products herein. ON Semiconductor makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does ON Semiconductor assume any liability arising out of the application or use of any product or circuit, and specifically disclaims any and all liability, including without limitation special, consequential or incidental damages. Buyer is responsible for its products and applications using ON Semiconductor products, including compliance with all laws, regulations and safety requirements or standards, regardless of any support or applications information provided by ON Semiconductor. "Typical" parameters which may be provided in ON Semiconductor data sheets and/or specifications can and do vary in different applications and actual performance may vary over time. All operating parameters, including "Typicals" must be validated for each customer application by customer's technical experts. ON Semiconductor does not convey any license under its patent rights nor the rights of others. ON Semiconductor products are not designed, intended, or authorized for use as a critical component in life support systems or any FDA Class 3 medical devices or medical devices with a same or similar classification in a foreign jurisdiction or any devices intended for implantation in the human body. Should Buyer purchase or use ON Semiconductor products for any such unintended or unauthorized application, Buyer shall indemnify and hold ON Semiconductor and its officers, employees, subsidiaries, affiliates, and distributors harmless against all claims, costs, damages, and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if such claim alleges that ON Semiconductor was negligent regarding the design or manufacture of the part. ON Semiconductor is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

## PUBLICATION ORDERING INFORMATION

### LITERATURE FULFILLMENT:

Literature Distribution Center for ON Semiconductor  
19521 E. 32nd Pkwy, Aurora, Colorado 80011 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](mailto: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](http://www.onsemi.com)  
**Order Literature:** <http://www.onsemi.com/orderlit>  
For additional information, please contact your local  
Sales Representative