FAIRCHILD SEMICONDUCTOR™

November 1988
Revised November 1999

74AC175 • 74ACT175
Quad D-Type Flip-Flop

General Description

The AC/ACT175 is a high-speed quad D-type flip-flop. The device is useful for general flip-flop requirements where clock and clear inputs are common. The information on the D-type inputs is stored during the LOW-to-HIGH clock transition. Both true and complemented outputs of each flip-flop are provided. A Master Reset input resets all flip-flops, independent of the Clock or D-type inputs, when LOW.

Features

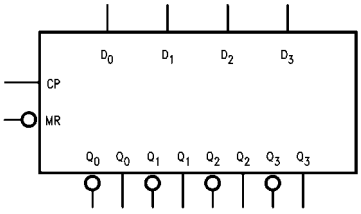
- I_{CC} reduced by 50%
- Edge-triggered D-type inputs
- Buffered positive edge-triggered clock
- Asynchronous common reset
- True and complement output
- Outputs source/sink 24 mA
- ACT175 has TTL-compatible inputs

Ordering Code:

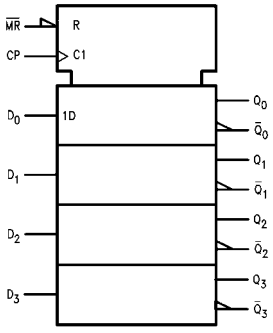
Order Number	Package Number	Package Description
74AC175SC	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body
74AC175SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74AC175MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74AC175PC	N16E	16-Lead Plastic Dual-In-Line Package (PDIP), JEDEC MS-001, 0.300" Wide
74ACT175SC	M16A	16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-012, 0.150" Narrow Body
74ACT175SJ	M16D	16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
74ACT175MTC	MTC16	16-Lead Thin Shrink Small Outline Package (TSSOP), JEDEC MO-153, 4.4mm Wide
74ACT175PC	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.

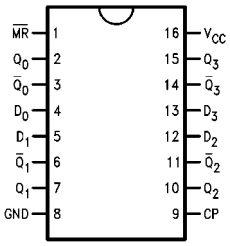
Logic Symbols



IEEE/IEC



Connection Diagram



Pin Descriptions

Pin Names	Description
D_0–D_3	Data Inputs
CP	Clock Pulse Input
$\overline{MR}$	Master Reset Input
Q_0–Q_3	True Outputs
$\overline{Q}_0$–$\overline{Q}_3$	Complement Outputs

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Functional Description

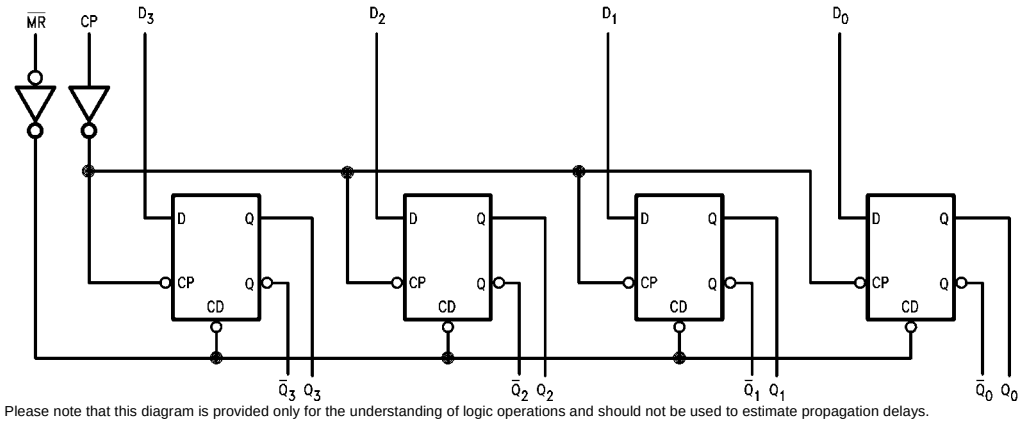
The AC/ACT175 consists of four edge-triggered D-type flip-flops with individual D inputs and Q and $\overline{Q}$ outputs. The Clock and Master Reset are common. The four flip-flops will store the state of their individual D inputs on the LOW-to-HIGH clock (CP) transition, causing individual Q and $\overline{Q}$ outputs to follow. A LOW input on the Master Reset ($\overline{MR}$) will force all Q outputs LOW and $\overline{Q}$ outputs HIGH independent of Clock or Data inputs. The AC/ACT175 is useful for general logic applications where a common Master Reset and Clock are acceptable.

Truth Table

Inputs	Outputs	
@ t_n, $\overline{MR}$ = H	@ t_{n+1}	
D_n	Q_n	$\overline{Q}_n$
L	L	H
H	H	L

H = HIGH Voltage Level
L = LOW Voltage Level
t_n = Bit Time before Clock Pulse
t_{n+1} = Bit Time after Clock Pulse

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)	± 50 mA
DC V_{CC} or Ground Current	
per Output Pin (I_{CC} or I_{GND})	± 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 (ΔV/Δt)	
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 (ΔV/Δt)	
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. Fairchild does not recommend operation of FACT™ circuits outside databook specifications

DC Electrical Characteristics for AC

Symbol	Parameter	V_{CC} (V)	T_A = +25°C Typ	T_A = −40°C to +85°C Guaranteed Limits		Units	Conditions
V_{IH}	Minimum HIGH Level	3.0	1.5	2.1	2.1		V_{OUT} = 0.1V
	Input Voltage	4.5	2.25	3.15	3.15	V	or V_{CC} − 0.1V
		5.5	2.75	3.85	3.85		
V_{IL}	Maximum LOW Level	3.0	1.5	0.9	0.9		V_{OUT} = 0.1V
	Input Voltage	4.5	2.25	1.35	1.35	V	or V_{CC} − 0.1V
		5.5	2.75	1.65	1.65		
V_{OH}	Minimum HIGH Level	3.0	2.99	2.9	2.9		
	Output Voltage	4.5	4.49	4.4	4.4	V	I_{OUT} = −50 μA
		5.5	5.49	5.4	5.4		
							V_{IN} = V_{IL} or V_{IH}
		3.0		2.56	2.46		I_{OH} = −12 mA
		4.5		3.86	3.76	V	I_{OH} = −24 mA
		5.5		4.86	4.76		I_{OH} = −24 mA (Note 2)
V_{OL}	Maximum LOW Level	3.0	0.002	0.1	0.1		
	Output Voltage	4.5	0.001	0.1	0.1	V	I_{OUT} = 50 μA
		5.5	0.001	0.1	0.1		
							V_{IN} = V_{IL} or V_{IH}
		3.0		0.36	0.44		I_{OL} = 12 mA
		4.5		0.36	0.44	V	I_{OL} = 24 mA
		5.5		0.36	0.44		I_{OL} = 24 mA (Note 2)
I_{IN} (Note 4)	Maximum Input Leakage Current	5.5		±0.1	± 1.0	μA	V_I = V_{CC}, GND
I_{OLD}	Minimum Dynamic	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	μA	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_{CC} (V)	$T_A = +25°C$	$T_A = -40°C$ to $+85°C$		Units	Conditions
			Typ	Guaranteed Limits			
V_{IH}	Minimum HIGH Level	4.5	1.5	2.0	2.0	V	$V_{OUT} = 0.1V$
	Input Voltage	5.5	1.5	2.0	2.0		or $V_{CC} - 0.1V$
V_{IL}	Maximum LOW Level	4.5	1.5	0.8	0.8	V	$V_{OUT} = 0.1V$
	Input Voltage	5.5	1.5	0.8	0.8		or $V_{CC} - 0.1V$
V_{OH}	Minimum HIGH Level	4.5	4.49	4.4	4.4	V	$I_{OUT} = -50\ \mu A$
	Output Voltage	5.5	5.49	5.4	5.4		
							$V_{IN} = V_{IL}$ or V_{IH}
		4.5		3.86	3.76	V	$I_{OH} = -24$ mA
		5.5		4.86	4.76		$I_{OH} = -24$ mA (Note 5)
V_{OL}	Maximum LOW Level	4.5	0.001	0.1	0.1	V	$I_{OUT} = 50\ \mu A$
	Output Voltage	5.5	0.001	0.1	0.1		
							$V_{IN} = V_{IL}$ or V_{IH}
		4.5		0.36	0.44	V	$I_{OL} = 24$ mA
		5.5		0.36	0.44		$I_{OL} = 24$ mA (Note 5)
I_{IN}	Maximum Input Leakage Current	5.5		±0.1	± 1.0	μA	$V_I = V_{CC}$, GND
I_{CCT}	Maximum I_{CC}/Input	5.5	0.6		1.5	mA	$V_I = V_{CC} - 2.1V$
I_{OLD}	Minimum Dynamic	5.5			75	mA	$V_{OLD} = 1.65V$ Max
I_{OHD}	Output Current(Note 6)	5.5			−75	mA	$V_{OHD} = 3.85V$ Min
I_{CC}	Maximum Quiescent	5.5		4.0	40.0	μA	$V_{IN} = V_{CC}$
	Supply Current						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_{CC} (V)	$T_A = +25°C$, $C_L = 50$ pF			$T_A = -40°C$ to $+85°C$, $C_L = 50$ pF		Units
		(Note 7)	Min	Typ	Max	Min	Max	
f_{MAX}	Maximum Clock	3.3	149	214		139		MHz
	Frequency	5.0	187	244		187		
t_{PLH}	Propagation Delay	3.3	2.0	9.5	12.0	2.0	13.5	ns
	CP to Q_n or $\overline{Q}_n$	5.0	1.5	7.0	9.0	1.0	9.5	
t_{PHL}	Propagation Delay	3.3	2.5	8.5	13.0	2.0	14.5	ns
	CP to Q_n or $\overline{Q}_n$	5.0	1.5	6.0	9.5	1.5	10.5	
t_{PLH}	Propagation Delay	3.3	3.0	7.5	12.5	2.5	13.5	ns
	$\overline{MR}$ to $\overline{Q}_n$	5.0	2.0	5.5	9.0	1.5	10.0	
t_{PHL}	Propagation Delay	3.3	3.0	8.5	11.0	2.5	12.5	ns
	$\overline{MR}$ to Q_n	5.0	2.0	6.0	8.5	1.5	9.0	

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

AC Operating Requirements for AC

Symbol	Parameter	V_{CC} (V) (Note 8)	$T_A = +25°C$, $C_L = 50$ pF	$T_A = -40°C$ to $+85°C$, $C_L = 50$ pF		Units
			Typ	Guaranteed Minimum		
t_S	Setup Time, HIGH or LOW	3.3	2.0	4.5	4.5	ns
	D_n to CP	5.0	1.0	3.0	3.0	
t_H	Hold Time, HIGH or LOW	3.3	1.0	1.0	1.0	ns
	D_n to CP	5.0	1.0	1.0	1.0	
t_W	CP Pulse Width	3.3	2.5	4.5	4.5	ns
	HIGH or LOW	5.0	2.0	3.5	3.5	
t_W	$\overline{MR}$ Pulse Width, LOW	3.3	2.5	4.5	5.0	ns
		5.0	2.0	3.5	3.5	
t_{REC}	Recovery Time	3.3	−2.0	0	0	ns
	$\overline{MR}$ to CP	5.0	−1.0	0	0	

Note 8: 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_{CC} (V) (Note 9)	$T_A = +25°C$, $C_L = 50$ pF			$T_A = -40°C$ to $+85°C$, $C_L = 50$ pF		Units
			Min	Typ	Max	Min	Max	
f_{MAX}	Maximum Clock Frequency	5.0	175	236		145		MHz
t_{PLH}	Propagation Delay CP to Q_n or $\overline{Q}_n$	5.0	2.0	6.0	10.0	1.5	11.0	ns
t_{PHL}	Propagation Delay CP to Q_n or $\overline{Q}_n$	5.0	2.0	7.0	11.0	1.5	12.0	ns
t_{PLH}	Propagation Delay $\overline{MR}$ to $\overline{Q}_n$	5.0	2.0	6.0	9.5	1.5	10.5	ns
t_{PHL}	Propagation Delay $\overline{MR}$ to Q_n	5.0	2.0	5.5	9.5	1.5	10.5	ns

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

AC Operating Requirements for ACT

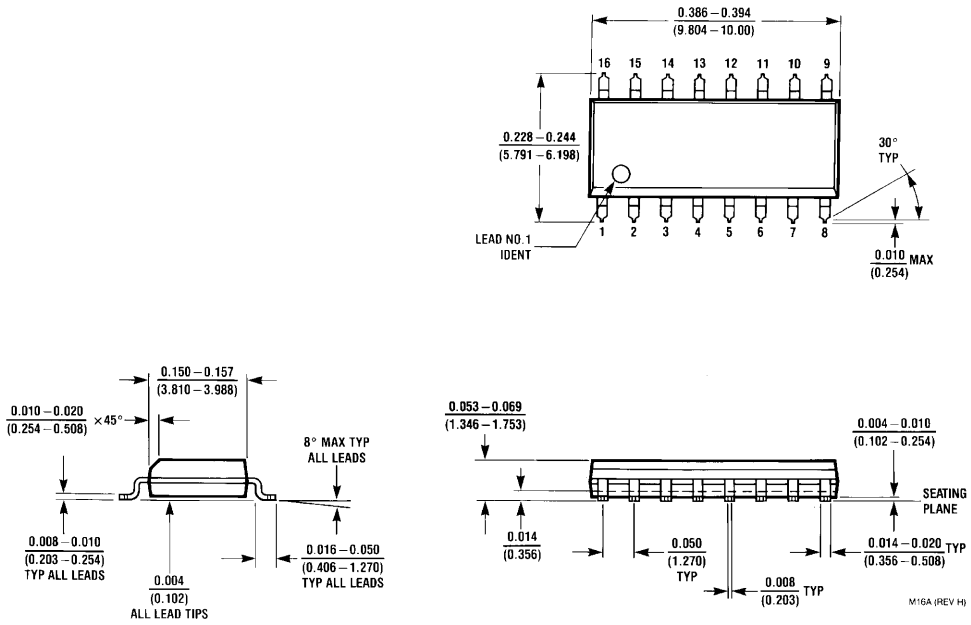
Symbol	Parameter	V_{CC} (V) (Note 10)	$T_A = +25°C$, $C_L = 50$ pF	$T_A = -40°C$ to $+85°C$, $C_L = 50$ pF		Units
			Typ	Guaranteed Minimum		
t_S (H)	Setup Time	5.0	3.0	2.0	2.0	ns
t_S (L)	D_n to CP		3.0	2.5	2.5	
t_H	Hold Time, HIGH or LOW D_n to CP	5.0	0	1.0	1.0	ns
t_W	CP Pulse Width HIGH or LOW	5.0	4.0	3.0	3.5	ns
t_W	$\overline{MR}$ Pulse Width, LOW	5.0	4.0	3.0	4.0	ns
t_{rec}	Recovery Time, $\overline{MR}$ to CP	5.0	0	0	0	ns

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

Capacitance

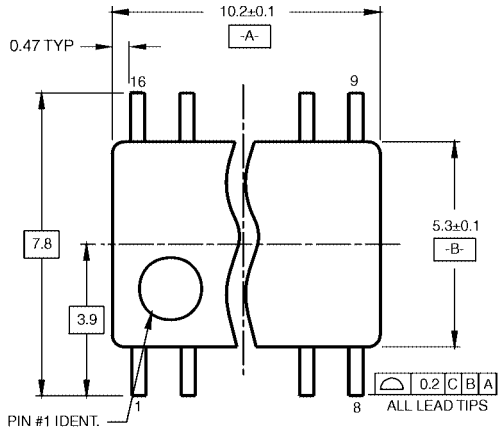
Symbol	Parameter	Typ	Units	Conditions
C_{IN}	Input Capacitance	4.5	pF	V_{CC} = OPEN
C_{PD}	Power Dissipation Capacitance	45.0	pF	V_{CC} = 5.0V

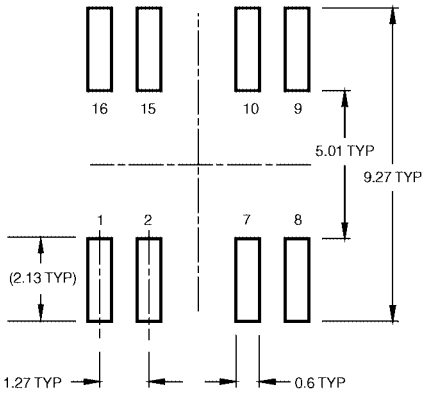
Physical Dimensions inches (millimeters) unless otherwise noted



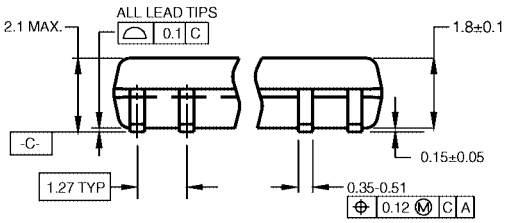
16-Lead Small Outline Integrated Circuit (SOIC), JEDEC MS-120, 0.150” Narrow Body
Package Number M16A

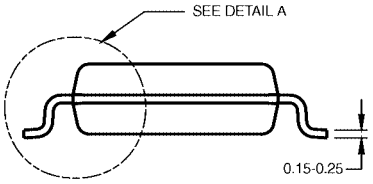
Physical Dimensions inches (millimeters) unless otherwise noted (Continued)



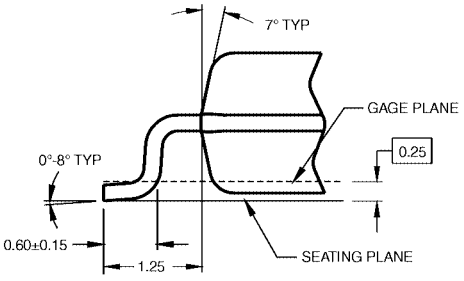


LAND PATTERN RECOMMENDATION





DIMENSIONS ARE IN MILLIMETERS



DETAIL A

NOTES:

A. CONFORMS TO EIAJ EDR-7320 REGISTRATION, ESTABLISHED IN DECEMBER, 1998.

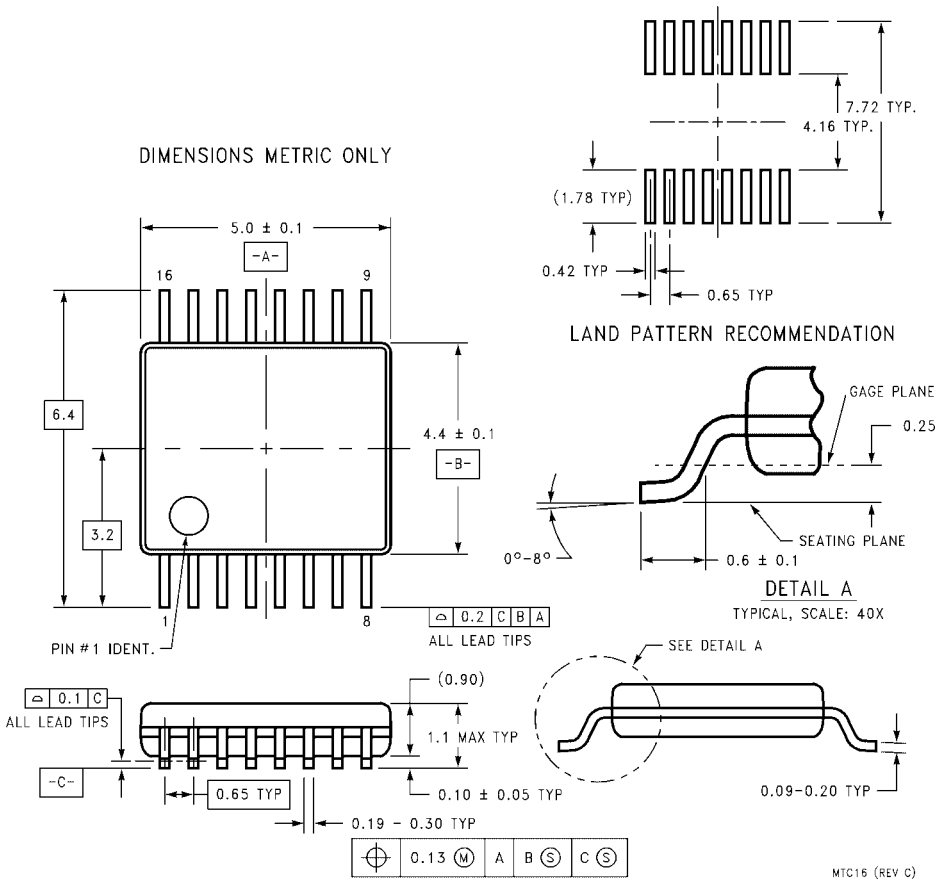
B. DIMENSIONS ARE IN MILLIMETERS.

C. DIMENSIONS ARE EXCLUSIVE OF BURRS, MOLD FLASH, AND TIE BAR EXTRUSIONS.

M16DRevB1

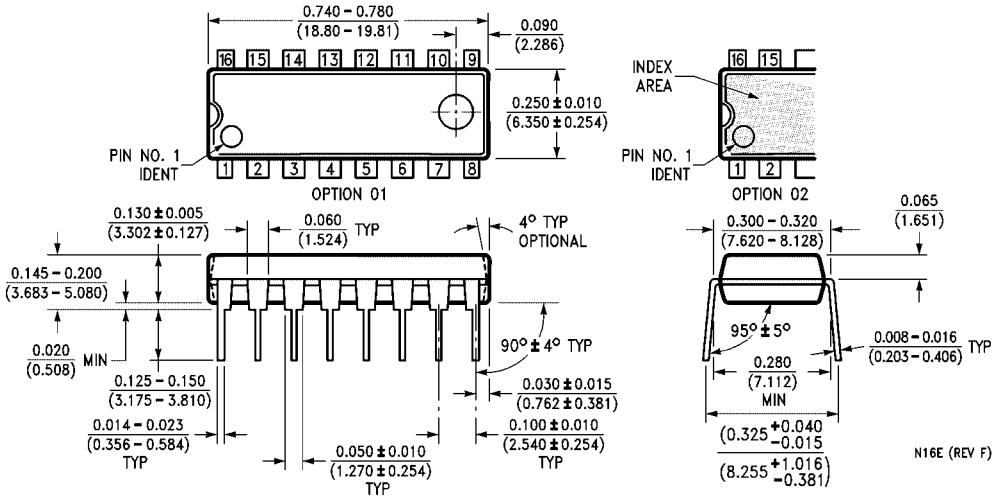
16-Lead Small Outline Package (SOP), EIAJ TYPE II, 5.3mm Wide
Package Number M16D

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

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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.

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