

## 54AC/74AC374 • 54ACT/74ACT374 Octal D Flip-Flop with TRI-STATE® Outputs

### General Description

The 'AC/'ACT374 is a high-speed, low-power octal D-type flip-flop featuring separate D-type inputs for each flip-flop and TRI-STATE outputs for bus-oriented applications. A buffered Clock (CP) and Output Enable ( $\overline{OE}$ ) are common to all flip-flops.

### Features

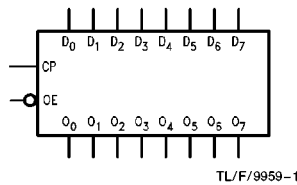
- $I_{CC}$  and  $I_{OZ}$  reduced by 50%
- Buffered positive edge-triggered clock
- TRI-STATE outputs for bus-oriented applications
- Outputs source/sink 24 mA
- See '273 for reset version
- See '377 for clock enable version
- See '373 for transparent latch version
- See '574 for broadside pinout version
- See '564 for broadside pinout version with inverted outputs
- 'ACT374 has TTL-compatible inputs
- Standard Military Drawing (SMD)
  - 'AC374: 5962-87694
  - 'ACT374: 5962-87631

Commercial	Military	Package Number	Package Description
74ACT374PC		N20A	20-Lead Molded Dual-In-Line (0.300" Wide)
74ACT374SC (Note 1)		M20B	20-Lead Molded Small Outline (0.300" Wide), JEDEC
74ACT374SJ (Note 1)		M20D	20-Lead Molded Small Outline, EIAJ Type II
74ACT374MTC (Note 1)		MTC20	20-Lead Molded Thin Shrink Small Outline Package, JEDEC
74ACT374MSA (Note 1)		MSA20	20-Lead Molded Small Shrink Outline Package, (EIAJ SSOP)
	54ACT374DM (Note 2)	J20A	20-Lead Ceramic Dual-In-Line
	54ACT374FM (Note 2)	W20A	20-Lead Cerpak
	54ACT374LM (Note 2)	E20A	20-Lead Ceramic Leadless Chip Carrier, Type C

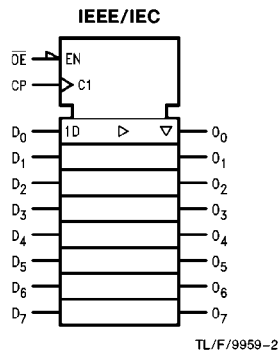
**Note 1:** Devices also available in 13" Tape and Reel. Use suffix SCX, SJX, and MTCX.

**Note 2:** Military grade device with environmental and burn-in processing, use suffix DMQB, FMQB and LMQB.

### Logic Symbols

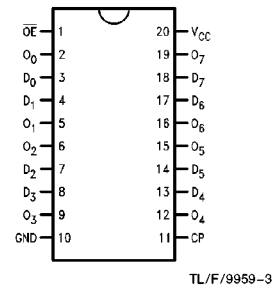


Pin Names	Description
D <sub>0</sub> -D <sub>7</sub>	Data Inputs
CP	Clock Pulse Input
$\overline{OE}$	TRI-STATE Output Enable Input
O <sub>0</sub> -O <sub>7</sub>	TRI-STATE Outputs

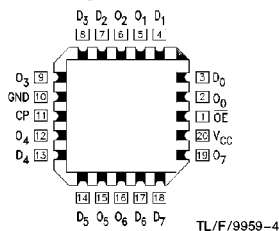


### Connection Diagrams

Pin Assignment for DIP, Flatpak, SSOP, SOIC and TSSOP



Pin Assignment for LCC



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FACT™ is a trademark of National Semiconductor Corporation.

## Functional Description

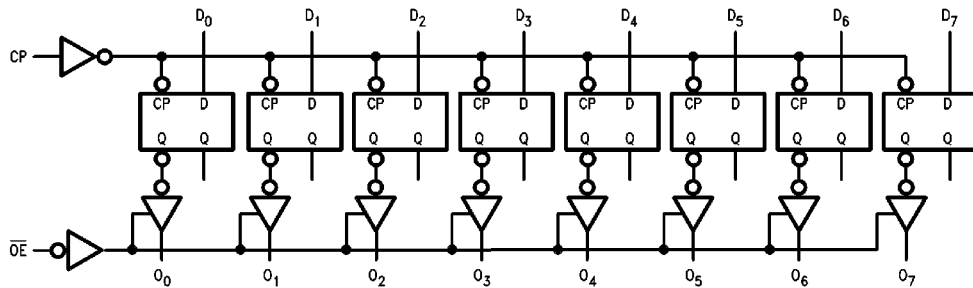
The 'AC/'ACT374 consists of eight edge-triggered flip-flops with individual D-type inputs and TRI-STATE true outputs. The buffered clock and buffered Output Enable are common to all flip-flops. The eight flip-flops will store the state of their individual D inputs that meet the setup and hold time requirements on the LOW-to-HIGH Clock (CP) transition. With the Output Enable ( $\overline{OE}$ ) LOW, the contents of the eight flip-flops are available at the outputs. When the  $\overline{OE}$  is HIGH, the outputs go to the high impedance state. Operation of the  $\overline{OE}$  input does not affect the state of the flip-flops.

## Truth Table

Inputs			Outputs
$D_n$	CP	$\overline{OE}$	$O_n$
H	↗	L	H
L	↗	L	L
X	X	H	Z

H = HIGH Voltage Level  
 L = LOW Voltage Level  
 X = Immaterial  
 Z = High Impedance  
 ↗ = LOW-to-HIGH Transition

## Logic Diagram



TL/F/9959-5

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 Rating (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

Supply Voltage ( $V_{CC}$ )	-0.5V to +7.0V
DC Input Diode Current ( $I_{IK}$ )	-20 mA
$V_I = -0.5V$	+20 mA
$V_I = V_{CC} + 0.5V$	
DC Input Voltage ( $V_I$ )	-0.5V to $V_{CC} + 0.5V$
DC Output Diode Current ( $I_{OK}$ )	-20 mA
$V_O = -0.5V$	+20 mA
$V_O = V_{CC} + 0.5V$	
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 ( $T_J$ )	
CDIP	175°C
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. National does not recommend operation of FACT™ circuits outside databook specifications.

## Recommended Operating Conditions

Supply Voltage ( $V_{CC}$ )	2.0V to 6.0V
'AC	4.5V to 5.5V
'ACT	
Input Voltage ( $V_I$ )	0V to $V_{CC}$
Output Voltage ( $V_O$ )	0V to $V_{CC}$
Operating Temperature ( $T_A$ )	
74AC/ACT	-40°C to +85°C
54AC/ACT	-55°C to +125°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

## DC Characteristics for 'AC Family Devices

Symbol	Parameter	$V_{CC}$ (V)	74AC		54AC	74AC	Units	Conditions
			$T_A = +25^\circ\text{C}$		$T_A = -55^\circ\text{C to } +125^\circ\text{C}$	$T_A = -40^\circ\text{C to } +85^\circ\text{C}$		
			Typ	Guaranteed Limits				
$V_{IH}$	Minimum High Level Input Voltage	3.0	1.5	2.1	2.1	2.1	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		4.5	2.25	3.15	3.15	3.15		
		5.5	2.75	3.85	3.85	3.85		
$V_{IL}$	Maximum Low Level Input Voltage	3.0	1.5	0.9	0.9	0.9	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		4.5	2.25	1.35	1.35	1.35		
		5.5	2.75	1.65	1.65	1.65		
$V_{OH}$	Minimum High Level Output Voltage	3.0	2.99	2.9	2.9	2.9	V	$I_{OUT} = -50 \mu A$
		4.5	4.49	4.4	4.4	4.4		
		5.5	5.49	5.4	5.4	5.4		
		3.0		2.56	2.4	2.46	V	* $V_{IN} = V_{IL}$ or $V_{IH}$ -12 mA $I_{OH}$ -24 mA -24 mA
		4.5		3.86	3.7	3.76		
		5.5		4.86	4.7	4.76		
$V_{OL}$	Maximum Low Level Output Voltage	3.0	0.002	0.1	0.1	0.1	V	$I_{OUT} = 50 \mu A$
		4.5	0.001	0.1	0.1	0.1		
		5.5	0.001	0.1	0.1	0.1		
		3.0		0.36	0.50	0.44	V	* $V_{IN} = V_{IL}$ or $V_{IH}$ 12 mA $I_{OL}$ 24 mA 24 mA
		4.5		0.36	0.50	0.44		
		5.5		0.36	0.50	0.44		
$I_{IN}$	Maximum Input Leakage Current	5.5		$\pm 0.1$	$\pm 1.0$	$\pm 1.0$	$\mu A$	$V_I = V_{CC}, GND$

\*All outputs loaded; thresholds on input associated with output under test.

## DC Characteristics for 'AC Family Devices (Continued)

Symbol	Parameter	V <sub>CC</sub> (V)	74AC		54AC	74AC		Units	Conditions
			T <sub>A</sub> = +25°C		T <sub>A</sub> = -55°C to +125°C	T <sub>A</sub> = -40°C to +85°C			
			Typ	Guaranteed Limits					
I <sub>OZ</sub>	Maximum TRI-STATE® Current	5.5		±0.25	±5.0		±2.5	μA	V <sub>I</sub> (OE) = V <sub>IL</sub> , V <sub>IH</sub> V <sub>I</sub> = V <sub>CC</sub> , GND V <sub>O</sub> = V <sub>CC</sub> , GND
I <sub>OLD</sub>	†Minimum Dynamic Output Current	5.5			50		75	mA	V <sub>OLD</sub> = 1.65V Max
I <sub>OHD</sub>		5.5			-50		-75	mA	V <sub>OHD</sub> = 3.85V Min
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5		4.0	80.0		40.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND

†Maximum test duration 2.0 ms, one output loaded at a time.

**Note:** I<sub>IN</sub> and I<sub>CC</sub> @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V<sub>CC</sub>.

I<sub>CC</sub> for 54AC @ 25°C is identical to 74AC @ 25°C.

## DC Characteristics for 'ACT Family Devices

Symbol	Parameter	V <sub>CC</sub> (V)	74ACT		54ACT	74ACT		Units	Conditions
			T <sub>A</sub> = +25°C		T <sub>A</sub> = -55°C to +125°C	T <sub>A</sub> = -40°C to +85°C			
			Typ	Guaranteed Limits					
V <sub>IH</sub>	Minimum High Level Input Voltage	4.5	1.5	2.0	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		2.0		
V <sub>IL</sub>	Maximum Low Level Input Voltage	4.5	1.5	0.8	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		0.8		
V <sub>OH</sub>	Minimum High Level Output Voltage	4.5	4.49	4.4	4.4		4.4	V	I <sub>OUT</sub> = -50 μA
		5.5	5.49	5.4	5.4		5.4		
		4.5		3.86	3.70		3.76		
5.5		4.86	4.70		4.76				
V <sub>OL</sub>	Maximum Low Level Output Voltage	4.5	0.001	0.1	0.1		0.1	V	I <sub>OUT</sub> = 50 μA
		5.5	0.001	0.1	0.1		0.1		
		4.5		0.36	0.50		0.44		
5.5		0.36	0.50		0.44				
I <sub>IN</sub>	Maximum Input Leakage Current	5.5		±0.1	±1.0		±1.0	μA	V <sub>I</sub> = V <sub>CC</sub> , GND
I <sub>OZ</sub>	Maximum TRI-STATE® Current	5.5		±0.25	±5.0		±2.5	μA	V <sub>I</sub> = V <sub>IL</sub> , V <sub>IH</sub> V <sub>O</sub> = V <sub>CC</sub> , GND
I <sub>CC</sub> T	Maximum I <sub>CC</sub> /Input	5.5	0.6		1.6		1.5	mA	V <sub>I</sub> = V <sub>CC</sub> - 2.1V
I <sub>OLD</sub>	†Minimum Dynamic Output Current	5.5			50		75	mA	V <sub>OLD</sub> = 1.65V Max
I <sub>OHD</sub>		5.5			-50		-75	mA	V <sub>OHD</sub> = 3.85V Min
I <sub>CC</sub>	Maximum Quiescent Supply Current	5.5		4.0	80.0		40.0	μA	V <sub>IN</sub> = V <sub>CC</sub> or GND

\*All outputs loaded; thresholds on input associated with output under test.

†Maximum test duration 2.0 ms, one output loaded at a time.

**Note:** I<sub>CC</sub> for 54ACT @ 25°C is identical to 74ACT @ 25°C.

## AC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> * (V)	74AC			54AC		74AC		Units
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		
			Min	Typ	Max	Min	Max	Min	Max	
f <sub>max</sub>	Maximum Clock Frequency	3.3 5.0	60 100	110 155		60 95		60 100	MHz	
t <sub>PLH</sub>	Propagation Delay CP to O <sub>n</sub>	3.3 5.0	3.0 2.5	11.0 8.0	13.5 9.5	3.0 3.0	16.5 12.0	1.5 1.5	15.5 10.5	ns
t <sub>PHL</sub>	Propagation Delay CP to O <sub>n</sub>	3.3 5.0	2.5 2.0	10.0 7.0	12.5 9.0	3.0 3.0	15.0 11.0	2.0 1.5	14.0 10.0	ns
t <sub>PZH</sub>	Output Enable Time	3.3 5.0	3.0 2.0	9.5 7.0	11.5 8.5	1.0 1.5	14.0 10.5	1.5 1.0	13.0 9.5	ns
t <sub>PZL</sub>	Output Enable Time	3.3 5.0	2.5 2.0	9.0 6.5	11.5 8.5	1.0 1.5	14.0 10.5	1.5 1.0	13.0 9.5	ns
t <sub>PHZ</sub>	Output Disable Time	3.3 5.0	3.0 2.0	10.5 8.0	12.5 11.0	1.0 1.5	16.0 12.5	2.0 2.0	14.5 12.5	ns
t <sub>PLZ</sub>	Output Disable Time	3.3 5.0	2.0 1.5	8.0 6.5	11.5 8.5	1.0 1.5	13.0 10.5	1.0 1.0	12.5 10.0	ns

\*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)	74AC		54AC	74AC		Units
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF	T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		
			Typ	Guaranteed Minimum				
t <sub>s</sub>	Setup Time, HIGH or LOW D <sub>n</sub> to CP	3.3 5.0	2.0 1.0	5.5 4.0	6.5 5.0	6.0 4.5		ns
t <sub>h</sub>	Hold Time, HIGH or LOW D <sub>n</sub> to CP	3.3 5.0	-1.0 0	1.0 1.5	1.0 1.5	1.0 1.5		ns
t <sub>w</sub>	CP Pulse Width, HIGH or LOW	3.3 5.0	4.0 2.5	5.5 4.0	6.5 5.0	6.0 4.5		ns

\*Voltage Range 3.3 is 3.3V ±0.3V  
Voltage Range 5.0 is 5.0V ±0.5V

## AC Electrical Characteristics

Symbol	Parameter	V <sub>CC</sub> * (V)	74ACT			54ACT		74ACT		Units
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF			T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		
			Min	Typ	Max	Min	Max	Min	Max	
f <sub>max</sub>	Maximum Clock Frequency	5.0	100	160		70		90	MHz	
t <sub>PLH</sub>	Propagation Delay CP to O <sub>n</sub>	5.0	2.0	8.5	10.0	1.5	12.0	2.0	11.5	ns
t <sub>PHL</sub>	Propagation Delay CP to O <sub>n</sub>	5.0	2.0	8.0	9.5	1.5	11.5	1.5	11.0	ns
t <sub>PZH</sub>	Output Enable Time	5.0	2.0	8.0	9.5	1.5	11.5	1.5	10.5	ns
t <sub>PZL</sub>	Output Enable Time	5.0	1.5	8.0	9.0	1.5	11.5	1.5	10.5	ns
t <sub>PHZ</sub>	Output Disable Time	5.0	1.5	8.5	11.5	1.5	13.0	1.0	12.5	ns
t <sub>PLZ</sub>	Output Disable Time	5.0	1.5	7.0	8.5	1.5	11.0	1.0	10.0	ns

\*Voltage Range 5.0 is 5.0V ± 0.5V

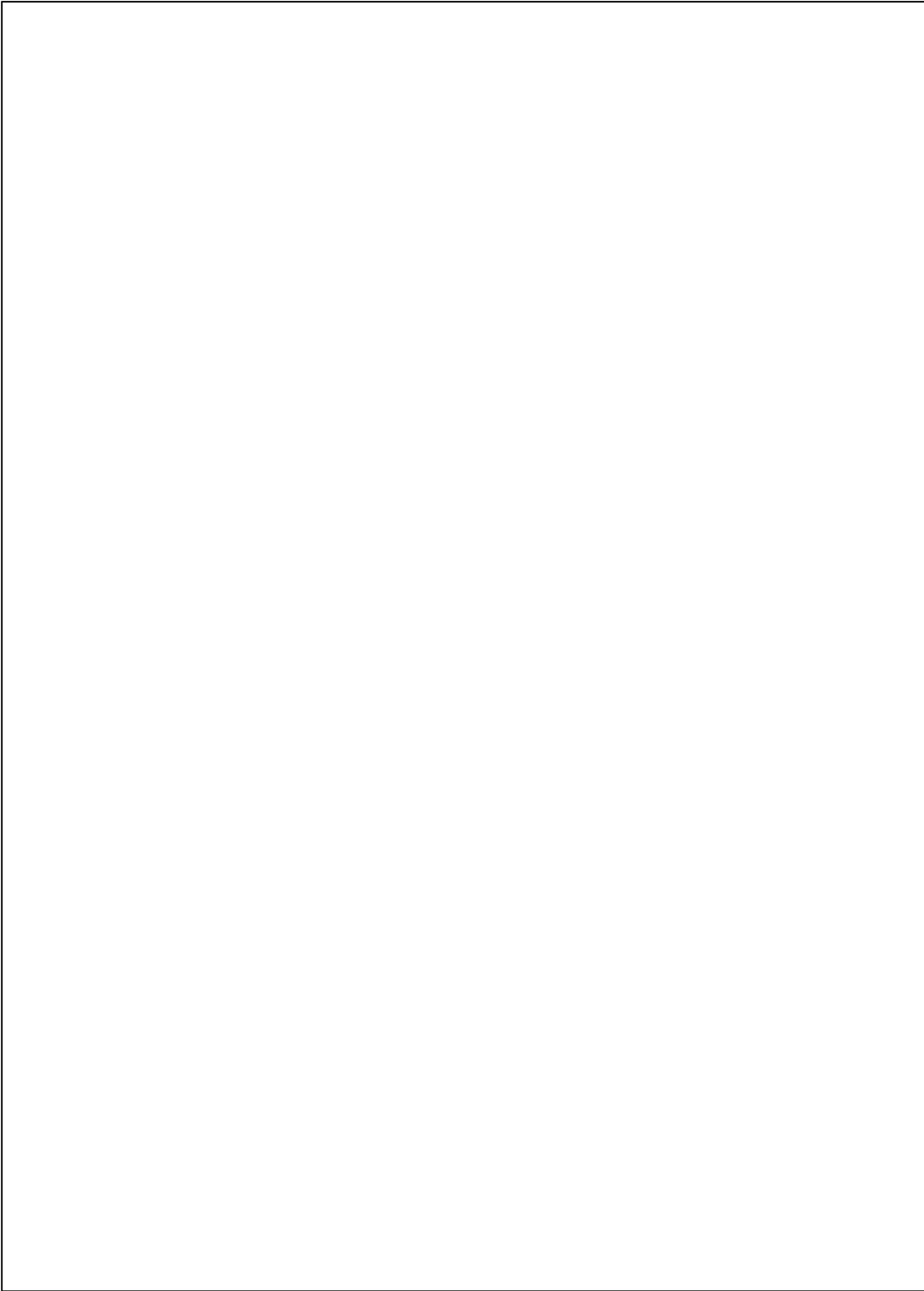
## AC Operating Requirements

Symbol	Parameter	V <sub>CC</sub> * (V)	74ACT		54ACT	74ACT		Units
			T <sub>A</sub> = +25°C C <sub>L</sub> = 50 pF		T <sub>A</sub> = -55°C to +125°C C <sub>L</sub> = 50 pF	T <sub>A</sub> = -40°C to +85°C C <sub>L</sub> = 50 pF		
			Typ		Guaranteed Minimum			
t <sub>s</sub>	Setup Time, HIGH or LOW D <sub>n</sub> to CP	5.0	1.0	5.5	5.5	5.5	5.5	ns
t <sub>h</sub>	Hold Time, HIGH or LOW D <sub>n</sub> to CP	5.0	0	1.5	1.5	1.5	1.5	ns
t <sub>w</sub>	CP Pulse Width, HIGH or LOW	5.0	2.5	5.0	5.0	5.0	5.0	ns

\*Voltage Range 5.0 is 5.0V ± 0.5V

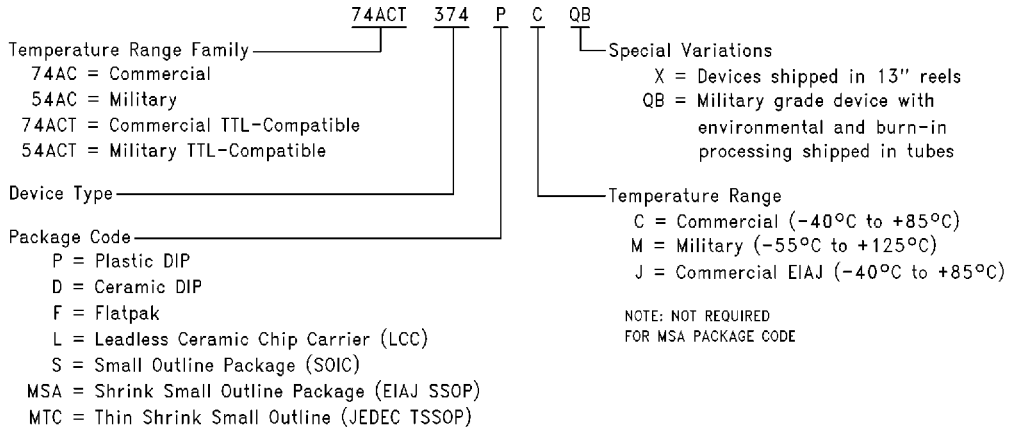
## Capacitance

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	pF	V <sub>CC</sub> = 5.0V



## Ordering Information

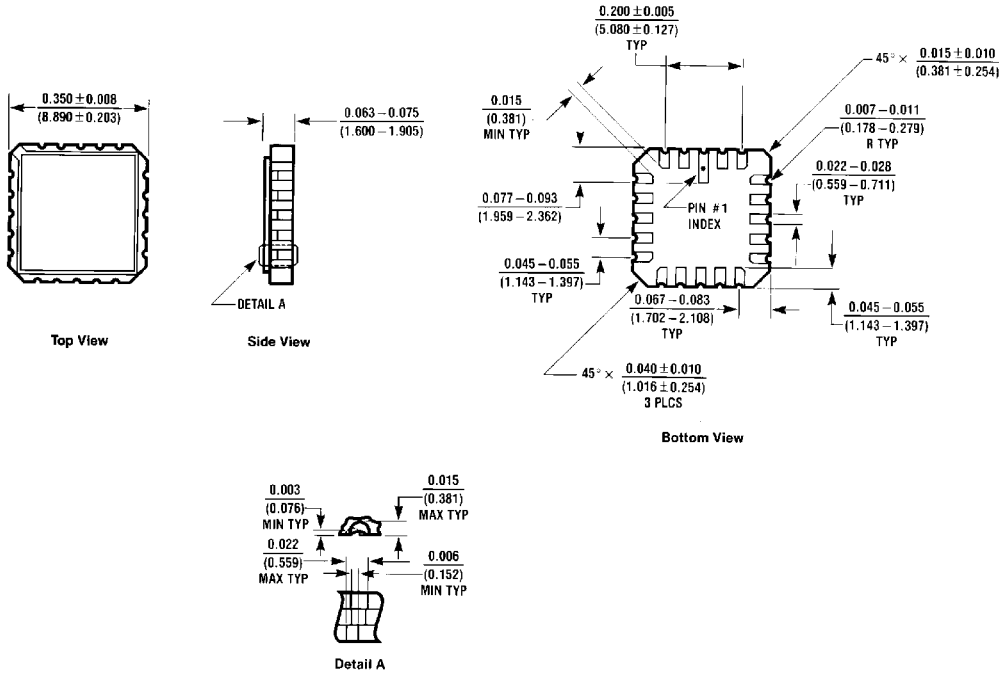
The device number is used to form part of a simplified purchasing code where the package type and temperature range are defined as follows:



NOTE: NOT REQUIRED FOR MSA PACKAGE CODE

TL/F/9959-7

## Physical Dimensions inches (millimeters) unless otherwise noted

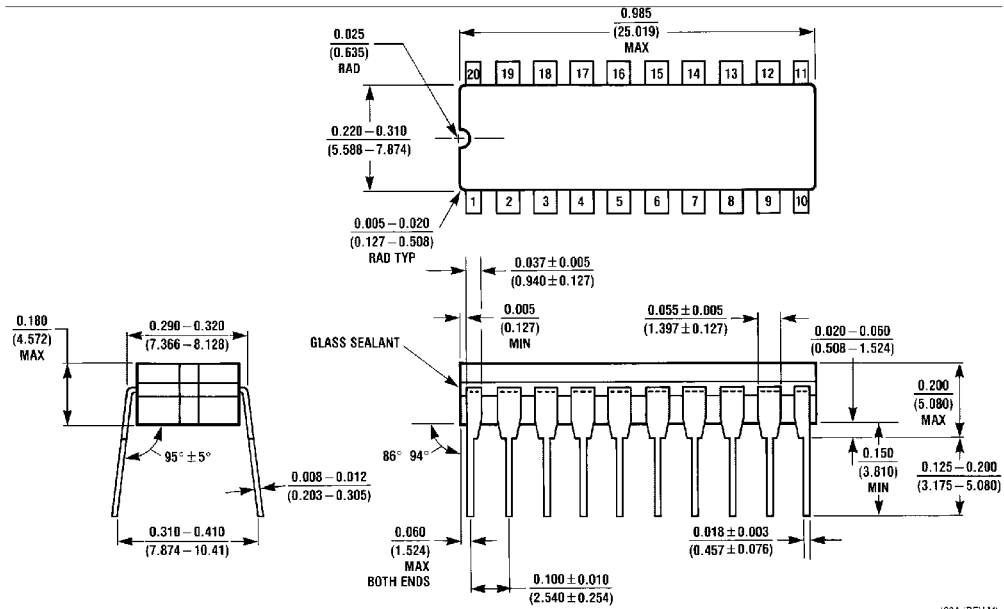


20 Terminal Ceramic Leadless Chip Carrier (L)  
NS Package Number E20A

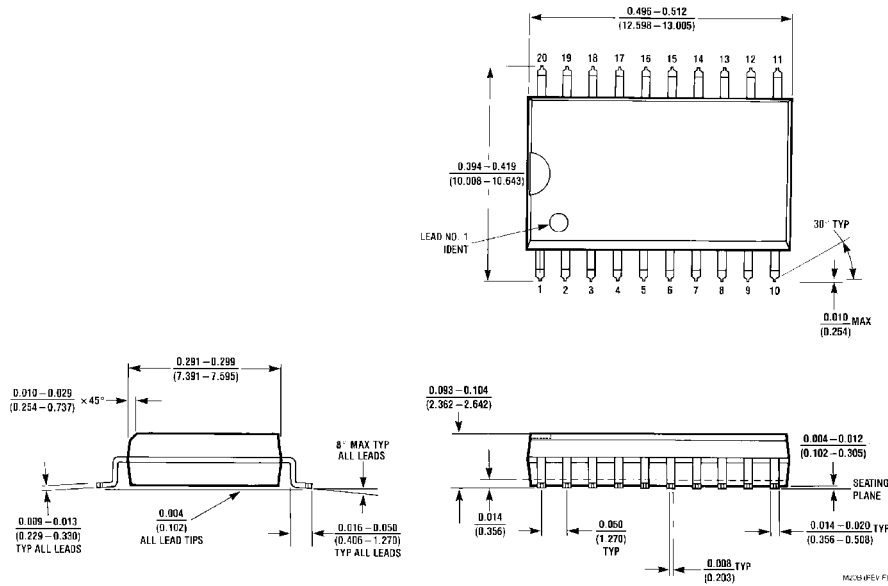
E20A (REV D)



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

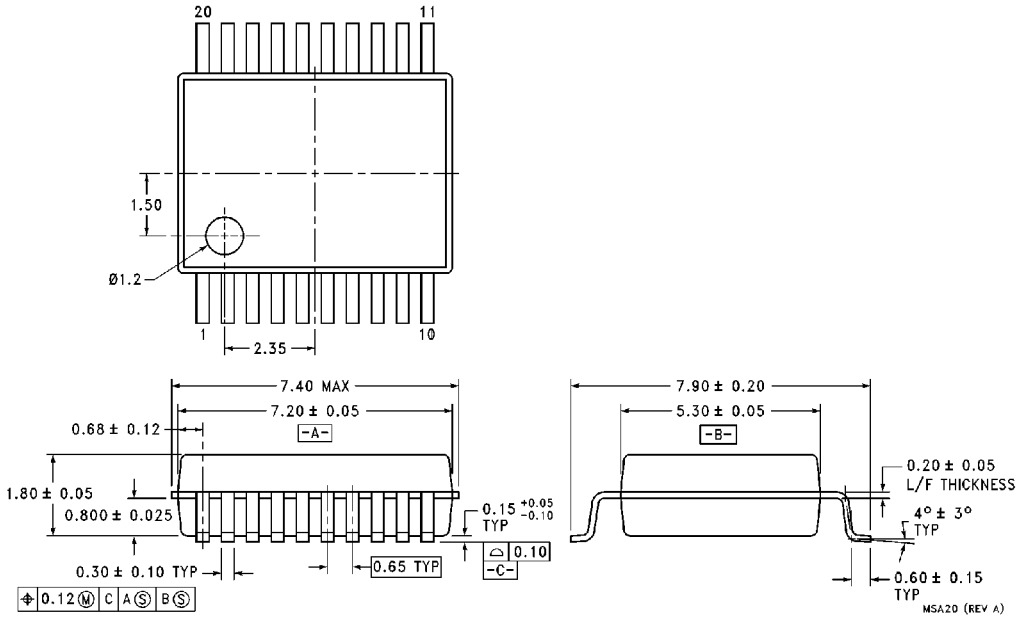


**20 Lead Ceramic Dual-In-Line Package (D)**  
NS Package Number J20A



**20 Lead Small Outline Integrated Circuit (S)**  
NS Package Number M20B

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

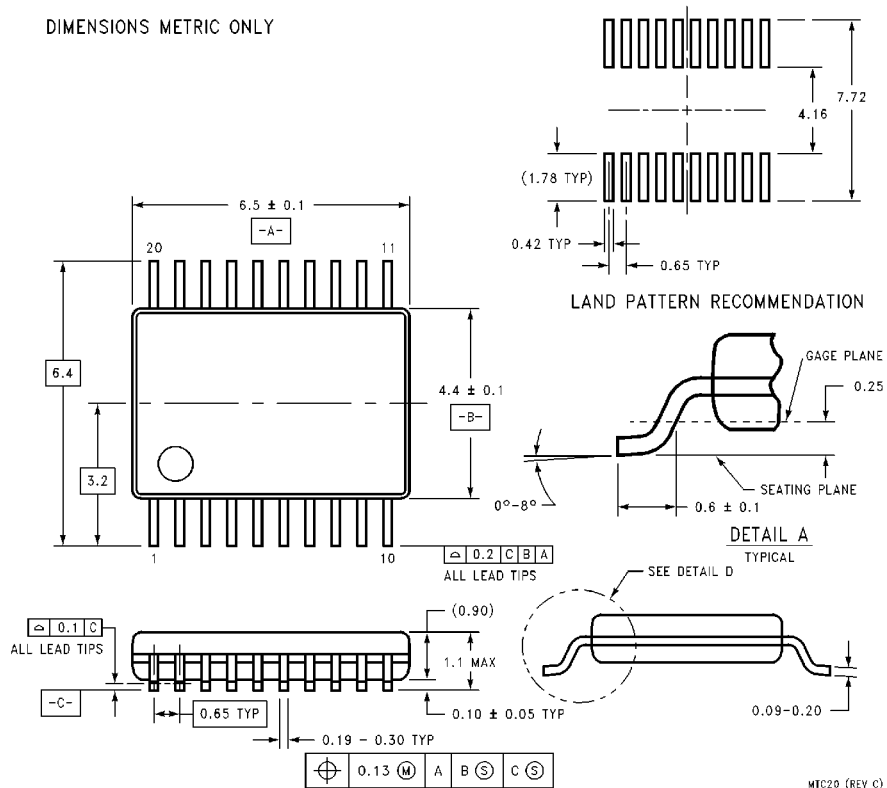


**20 Lead Plastic EIAJ SSOP (MSA)**  
**NS Package Number MSA20**

MSA20 (REV A)

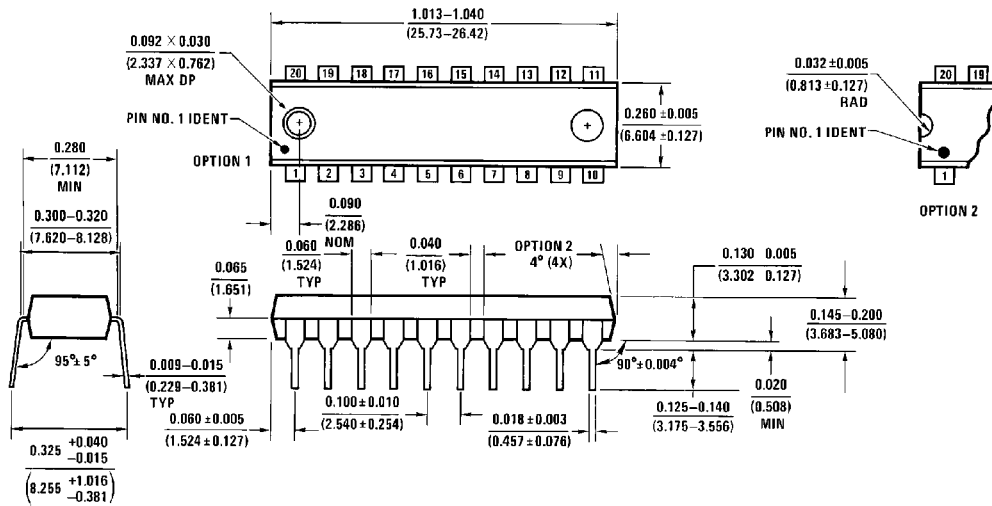
**Physical Dimensions** inches (millimeters) unless otherwise noted (Continued)

DIMENSIONS METRIC ONLY



**20-Lead Molded Thin Shrink Small Outline Package, JEDEC  
NS Package Number MTC20**

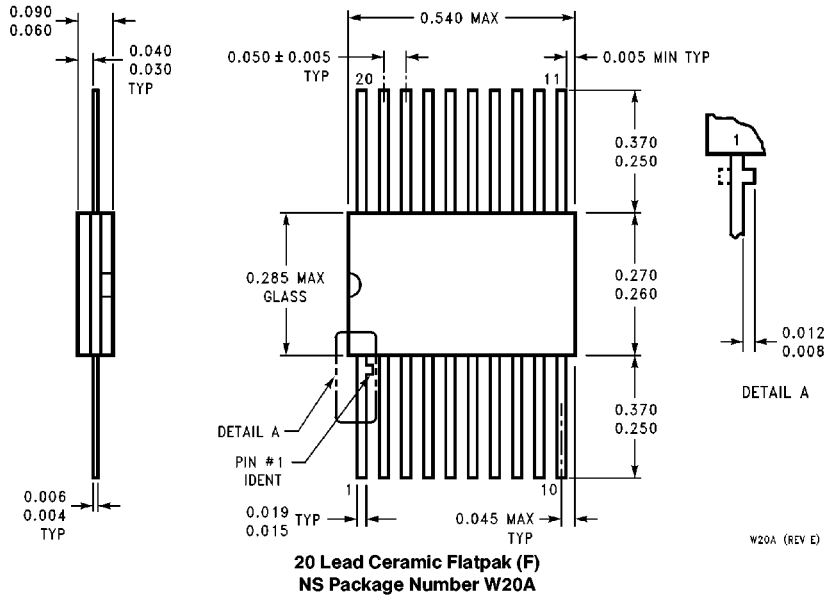
MTC20 (REV C)



**20-Lead Plastic Dual-In-Line Package (P)  
NS Package Number N20A**

N20A (REV G)

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



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2. A critical component is 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.



**National Semiconductor Corporation**  
1111 West Bardin Road  
Arlington, TX 76017  
Tel: 1(800) 272-9959  
Fax: 1(800) 737-7018

<http://www.national.com>

**National Semiconductor Europe**  
Fax: +49 (0) 180-530 85 86  
Email: [europe.support@nsc.com](mailto:europe.support@nsc.com)  
Deutsch Tel: +49 (0) 180-530 85 85  
English Tel: +49 (0) 180-532 78 32  
Français Tel: +49 (0) 180-532 93 58  
Italiano Tel: +49 (0) 180-534 16 80

**National Semiconductor Hong Kong Ltd.**  
13th Floor, Straight Block,  
Ocean Centre, 5 Canton Rd.  
Tsimshatsui, Kowloon  
Hong Kong  
Tel: (852) 2737-1600  
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Tel: 81-043-299-2308  
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