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54FCT/74FCT374A
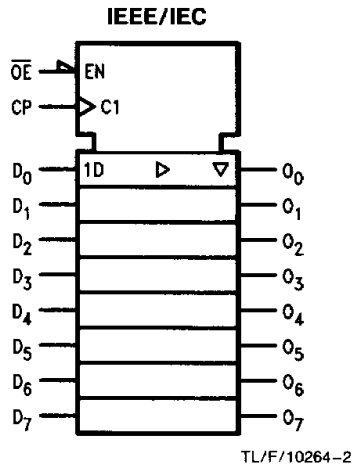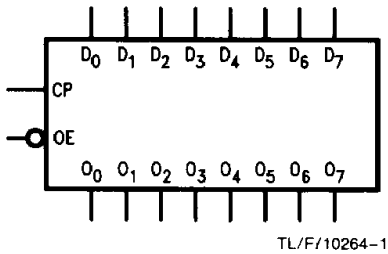# Octal D Flip-Flop with TRI-STATE® Outputs

General Description

The 'FCT374A 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.
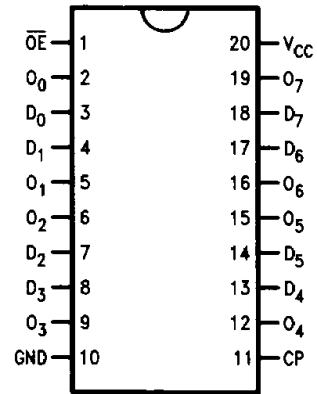
Features

- NSC 54/74FCT374A is pin and functionally equivalent to IDT 54/74FCT374A
- Buffered positive edge triggered clock
- TRI-STATE outputs for bus-oriented applications
- TTL input and output level compatible
- TTL inputs accept CMOS levels
- High current latch up immunity
- I_{OL} = 48 mA (commercial) and 32 mA (military)
- Electrostatic discharge protection ≥ 2 kV
- Inherently radiation tolerant

Logic Symbols

TL/F/10264-1

IEEE/IEC

TL/F/10264-2

Pin Names	Description
D_0-D_7	Data Inputs
CP	Clock Pulse Input
$\overline{OE}$	TRI-STATE Output Enable Input
O_0-O_7	TRI-STATE Outputs

Connection Diagrams

Pin Assignment
for DIP, Flatpak and SOIC

TL/F/10264-3

Pin Assignment
for LCC

TL/F/10264-4
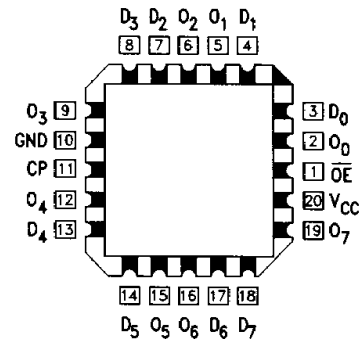
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RRD-B20M120/Printed in U. S. A.

Functional Description

The 'FCT374A consists of eight edge-triggered flip-flops with individual D-type inputs and TRI-STATE 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
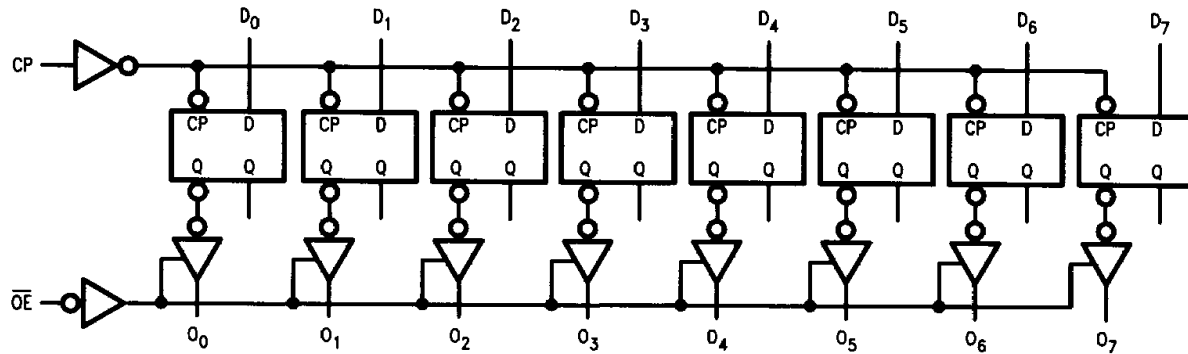
TL/F/10264–5

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

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Absolute Maximum Ratings (Note 1)

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

Terminal Voltage
with Respect to GND (V_{TERM})

54FCTA	−0.5V to 7.0V
74FCTA	−0.5V to 7.0V

Temperature under Bias (T_{BIAS})

74FCTA	−55°C to +125°C
54FCTA	−65°C to +135°C

Storage Temperature (T_{STG})

74FCTA	−55°C to +125°C
54FCTA	−65°C to +150°C

Power Dissipation (P_T)   0.5W

DC Output Current (I_{OUT})   120 mA

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 FCT circuits outside databook specifications.

Recommended Operating Conditions

Supply Voltage (V_{CC})

54FCTA	4.5V to 5.5V
74FCTA	4.75V to 5.25V
Input Voltage	0V to V_{CC}
Output Voltage	0V to V_{CC}

Operating Temperature (T_A)

54FCTA	−55°C to +125°C
74FCTA	0°C to +70°C

Junction Temperature (T_J)

CDIP	175°C
PDIP	140°C

DC Characteristics for 'FCTA Family Devices

Typical values are at V_{CC} = 5.0V, 25°C ambient and maximum loading. For test conditions shown as Max, use the value specified for the appropriate device type: Com: V_{CC} = 5.0V ±5%, T_A = 0°C to +70°C; Mil: V_{CC} = 5.0V ±10%, T_A = −55°C to +125°C, V_{HC} = V_{CC} − 0.2V.

Symbol	Parameter	54FCTA/74FCTA			Units	Conditions	
		Min	Typ	Max			
V_{IH}	Minimum High Level Input Voltage	2.0			V		
V_{IL}	Maximum Low Level Input Voltage			0.8	V		
I_{IH}	Input High Current			5.0 5.0	μA	V_{CC} = Max	$V_I = V_{CC}$ V_I = 2.7V (Note 2)
I_{IL}	Input Low Current			−5.0 −5.0	μA	V_{CC} = Max	V_I = 0.5V (Note 2) V_I = GND
I_{OZ}	Maximum TRI-STATE Current			10.0 10.0 −10.0 −10.0	μA	V_{CC} = Max	$V_O = V_{CC}$ V_O = 2.7V (Note 2) V_O = 0.5V (Note 2) V_O = GND
V_{IK}	Clamp Diode Voltage		−0.7	−1.2	V	V_{CC} = Min; I_N = −18 mA	
I_{OS}	Short Circuit Current	−60		−120	mA	V_{CC} = Max (Note 1); V_O = GND	
V_{OH}	Minimum High Level Output Voltage	2.8 V_{HC} 2.4 2.4	3.0 V_{CC} 4.3 4.3		V	V_{CC} = 3V; V_{IN} = 0.2V or V_{HC}; I_{OH} = −32 μA	
						V_{CC} = Min $V_{IN} = V_{IH}$ or V_{IL}	I_{OH} = −300 μA I_{OH} = −12 mA (Mil) I_{OH} = −15 mA (Com)
V_{OL}	Maximum Low Level Output Voltage		GND GND 0.3 0.3	0.2 0.2 0.50 0.50	V	V_{CC} = 3V; V_{IN} = 0.2V or V_{HC}; I_{OL} = 300 μA	
						V_{CC} = Min $V_{IN} = V_{IH}$ or V_{IL}	I_{OL} = 300 μA I_{OL} = 32 mA (Mil) I_{OL} = 48 mA (Com)
I_{CC}	Maximum Quiescent Supply Current		0.001	1.5	mA	V_{CC} = Max $V_{IN} \geq V_{HC}$, $V_{IN} \leq$ 0.2V f_I = 0	
ΔI_{CC}	Quiescent Supply Current; TTL Inputs HIGH		0.5	2.0	mA	V_{CC} = Max V_{IN} = 3.4V (Note 3)	

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DC Characteristics for 'FCTA Family Devices (Continued)

Typical values are at $V_{CC} = 5.0V$, 25°C ambient and maximum loading. For test conditions shown as Max, use the value specified for the appropriate device type: Com: $V_{CC} = 5.0V \pm 5\%$, $T_A = 0°C$ to $+70°C$; Mil: $V_{CC} = 5.0V \pm 10\%$, $T_A = -55°C$ to $+125°C$, $V_{HC} = V_{CC} - 0.2V$.

Symbol	Parameter	54FCTA/74FCTA			Units	Conditions	
		Min	Typ	Max			
I_{CCD}	Dynamic Power Supply Current (Note 4)		0.15	0.25	mA/MHz	V_{CC} = Max Outputs Open $\overline{OE}$ = GND One Input Toggling 50% Duty Cycle	$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$
I_C	Total Power Supply Current (Note 6)		1.5	4.0	mA	V_{CC} = Max Outputs Open f_{CP} = 10 MHz $\overline{OE}$ = GND	$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$
			2.0	6.0		f_I = 5.0 MHz One Bit Toggling 50% Duty Cycle	V_{IN} = 3.4V V_{IN} = GND
			3.75	7.8		(Note 5) V_{CC} = Max Outputs Open f_{CP} = 10 MHz $\overline{OE}$ = GND	$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$
			6.0	16.8		f_I = 2.5 MHz Eight Bits Toggling 50% Duty Cycle	V_{IN} = 3.4V V_{IN} = GND
V_H	Input Hysteresis on Clock Only		200		mV		

Note 1: Maximum test duration not to exceed one second, not more than one output shorted at one time.

Note 2: This parameter guaranteed but not tested.

Note 3: Per TTL driven input (V_{IN} = 3.4V); all other inputs at V_{CC} or GND.

Note 4: This parameter is not directly testable, but is derived for use in Total Power Supply calculations.

Note 5: Values for these conditions are examples of the I_{CC} formula. These limits are guaranteed but not tested.

Note 6: $I_C = I_{QUIESCENT} + I_{INPUTS} + I_{DYNAMIC}$

$I_C = I_{CC} + \Delta I_{CC} D_H N_T + I_{CCD} (f_{CP}/2 + f_I N_I)$

I_{CC} = Quiescent Current

ΔI_{CC} = Power Supply Current for a TTL High Input (V_{IN} = 3.4V)

D_H = Duty Cycle for TTL Inputs High

N_T = Number of Inputs at D_H

I_{CCD} = Dynamic Current Caused by an Input Transition Pair (HLH or LHL)

f_{CP} = Clock Frequency for Register Devices (Zero for Non-Register Devices)

f_I = Input Frequency

N_I = Number of Inputs at f_I

All currents are in milliamps and all frequencies are in megahertz.

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AC Electrical Characteristics

Symbol	Parameter	54FCTA/74FCTA $T_A = +25°C$ $V_{CC} = 5.0V$	74FCTA $T_A, V_{CC} = Com$ $R_L = 500\Omega$ $C_L = 50\,pF$		54FCTA $T_A, V_{CC} = Mil$ $R_L = 500\Omega$ $C_L = 50\,pF$		Units
		Typ	Min (Note 1)	Max	Min (Note 1)	Max	
t_{PLH} t_{PHL}	Propagation Delay C_P to O_n	4.5	2.0	6.5			ns
t_{PZH} t_{PZL}	Output Enable Time	5.5	1.5	6.5			ns
t_{PHZ} t_{PLZ}	Output Disable Time	4.0	1.5	5.5			ns
t_{SU}	Set Up Time High or Low D_n to C_P	1.0	2.0				ns
t_H	Hold Time High or Low D_n to C_P	0.5	1.5				ns
t_w	C_P Pulse Width High or Low	4.0	5.0				ns

Note 1: Minimum limits are guaranteed but not tested on propagation delays.

Capacitance $T_A = +25°C, f = 1.0\,MHz$

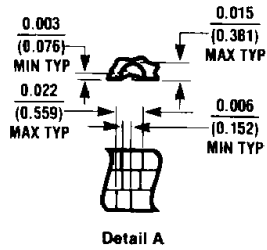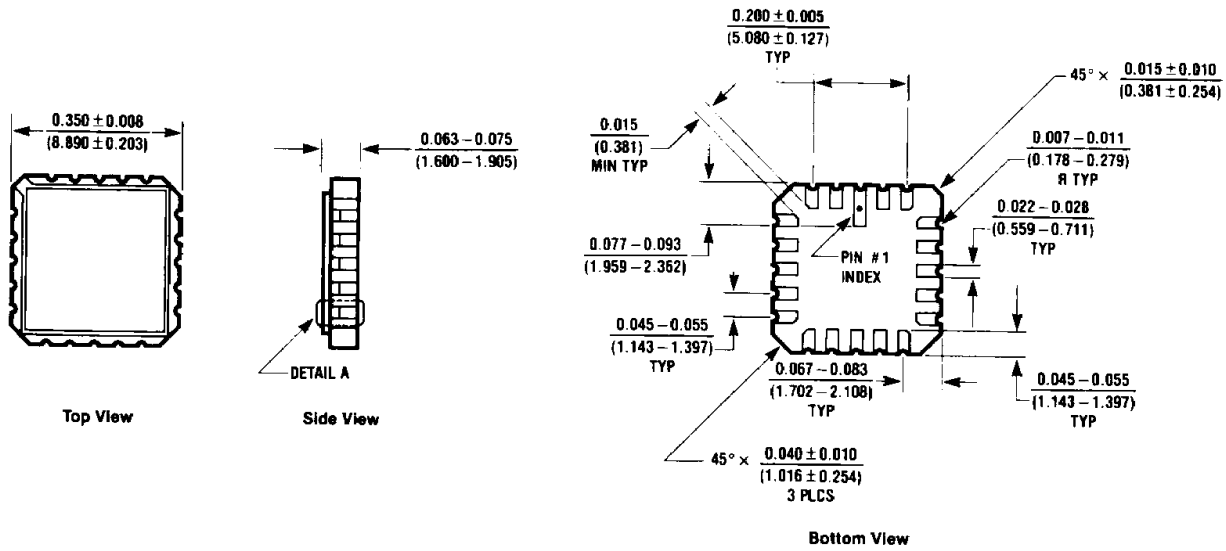| Symbol	Parameter (Note)	Typ	Max	Unit	Condition
C_{IN}	Input Capacitance	6	10	pF	$V_{IN} = 0V$
C_{OUT}	Output Capacitance	8	12	pF	$V_{OUT} = 0V$

Note: This parameter is measured at characterization but not tested.

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:
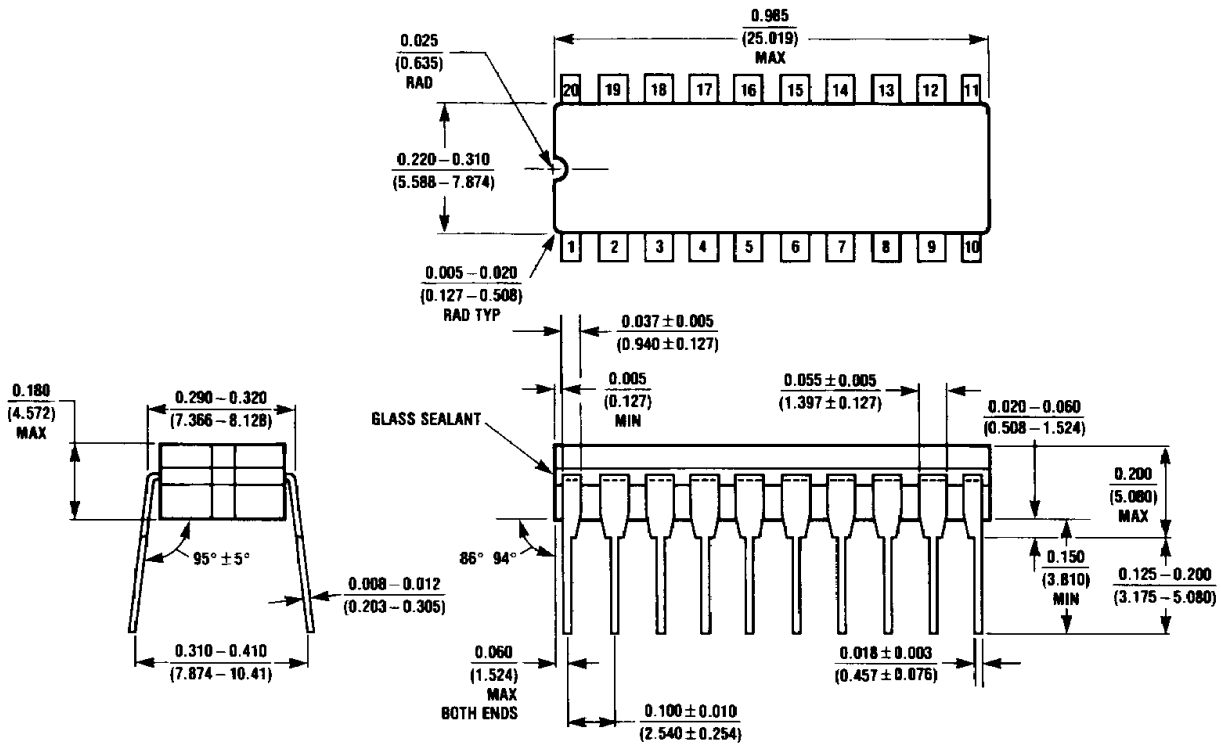
74FCT 374A P C QR

Temperature Range Family —
 74FCT = Commercial TTL-Compatible
 54FCT = Military TTL-Compatible

Device Type —

Package Code —
 P = Plastic DIP
 D = Ceramic DIP
 F = Flatpak
 L = Leadless Ceramic Chip Carrier (LCC)
 S = Small Outline (SOIC)

Special Variations
 X = Devices shipped in 13″ reels
 QR = Commercial grade device with burn-in
 QB = Military grade device with environmental and burn-in processing shipped in tubes

Temperature Range
 C = Commercial (0°C to +70°C)
 M = Military (−55°C to +125°C)

Physical Dimensions inches (millimeters)

Top View   Side View

DETAIL A

Bottom View

PIN #1 INDEX

Detail A

E20A (REV D)

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

GLASS SEALANT

J20A (REV M)

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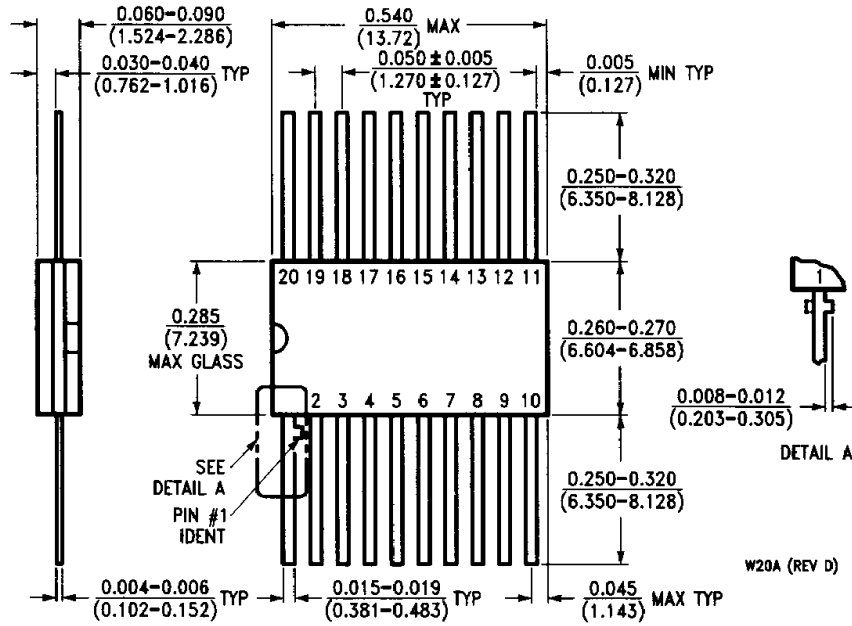**NS Package Number J20A**

6
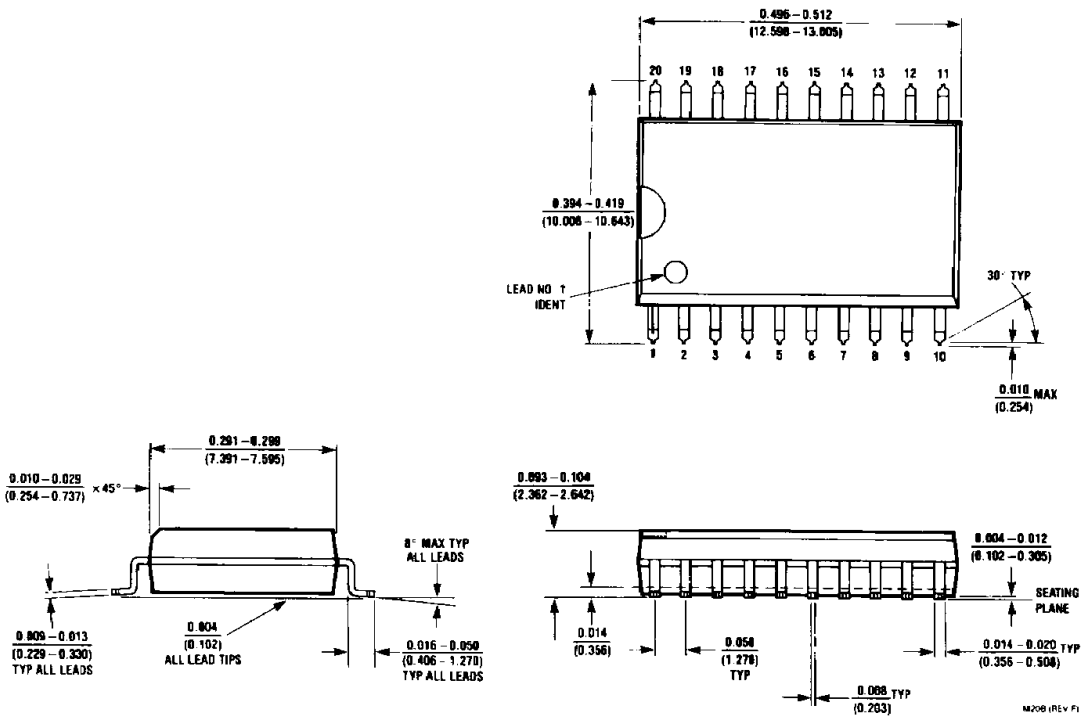
20-Lead Small Outline Integrated Circuit (S)
NS Package Number M20B
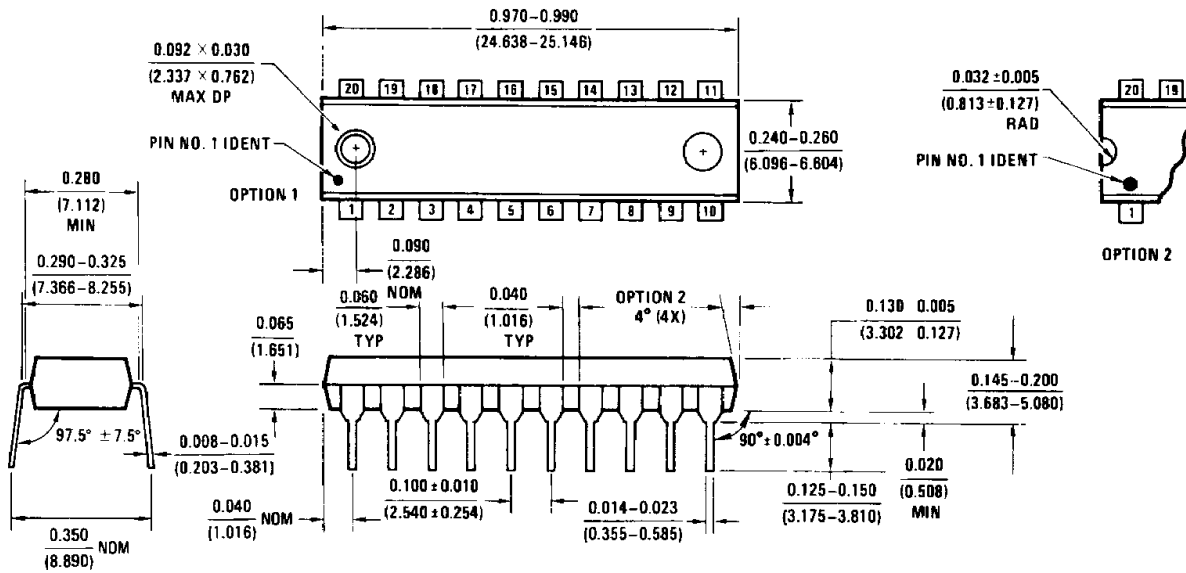
20-Lead Plastic Dual-In-Line Package (P)
NS Package Number N20B

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54FCT/74FCT374A Octal D Flip-Flop with TRI-STATE Outputs

$$\frac{0.060-0.090}{(1.524-2.286)}$$

$$\frac{0.030-0.040}{(0.762-1.016)} \text{ TYP}$$

$$\frac{0.540}{(13.72)} \text{ MAX}$$

$$\frac{0.050 \pm 0.005}{(1.270 \pm 0.127)} \text{ TYP}$$

$$\frac{0.005}{(0.127)} \text{ MIN TYP}$$

$$\frac{0.250-0.320}{(6.350-8.128)}$$

20 19 18 17 16 15 14 13 12 11

$$\frac{0.285}{(7.239)} \text{ MAX GLASS}$$

$$\frac{0.260-0.270}{(6.604-6.858)}$$

2 3 4 5 6 7 8 9 10

SEE DETAIL A

PIN #1 IDENT

$$\frac{0.250-0.320}{(6.350-8.128)}$$

$$\frac{0.008-0.012}{(0.203-0.305)}$$

DETAIL A

W20A (REV D)

$$\frac{0.004-0.006}{(0.102-0.152)} \text{ TYP}$$

$$\frac{0.015-0.019}{(0.381-0.483)} \text{ TYP}$$

$$\frac{0.045}{(1.143)} \text{ MAX TYP}$$

20-Lead Ceramic Flatpak (F)
NS Package Number W20A

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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.