

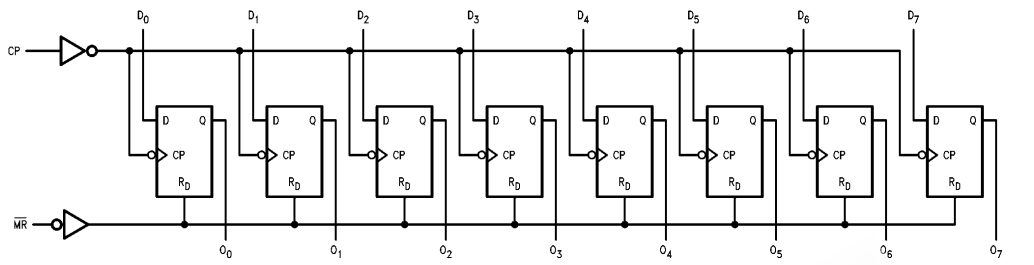


### Mode Select-Function Table

Operating Mode	Inputs			Outputs
	$\overline{MR}$	CP	$D_n$	$Q_n$
Reset (Clear)	L	X	X	L
Load '1'	H	↗	H	H
Load '0'	H	↘	L	L

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

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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

( $V_{TERM}$ )	
54FCT	-0.5 to +7.0V
74FCT	-0.5 to +7.0V

Temperature Under Bias ( $T_{BIAS}$ )

74FCT	-55°C to +125°C
54FCT	-65°C to +135°C

Storage Temperature ( $T_{STG}$ )

74FCT	-55°C to +125°C
54FCT	-65°C to +150°C

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 ( $V_{CC}$ )	4.5V to 5.5V
54FCT	4.75 to 5.25V
74FCT	
Input Voltage	0V to $V_{CC}$
Output Voltage	0V to $V_{CC}$
Operating Temperature ( $T_A$ )	
54FCT	-55°C to +125°C
74FCT	0°C to +70°C
Junction Temperature ( $T_J$ )	
CDIP	175°C
PDIP	140°C

**Note:** All commercial packaging is not recommended for applications requiring greater than 2000 temperature cycles from -40°C to +125°C.

### DC Characteristics for 'FCT 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:  $V_{CC} = 5.0V \pm 5\%$ ,  $T_A = 0^\circ C$  to  $+70^\circ C$ ; Mil:  $V_{CC} = 5.0V \pm 10\%$ ,  $T_A = -55^\circ C$  to  $+125^\circ C$ ,  $V_{HC} = V_{CC} - 0.2V$

Symbol	Parameter	54FCT/74FCT			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	$\mu A$	$V_{CC} = \text{Max}$	$V_I = V_{CC}$ $V_I = 2.7V$ (Note 2)
$I_{IL}$	Input Low Current			-5.0 -5.0	$\mu A$	$V_{CC} = \text{Max}$	$V_I = 0.5V$ (Note 2) $V_I = \text{GND}$
$V_{IK}$	Clamp Diode Voltage		-0.7	-1.2	V	$V_{CC} = \text{Min}$ ; $I_N = -18 \text{ mA}$	
$I_{OS}$	Short Circuit Current	-60	-120		mA	$V_{CC} = \text{Max}$ (Note 1); $V_O = \text{GND}$	
$V_{OH}$	Minimum High Level Output Voltage	2.8	3.0		V	$V_{CC} = 3V$ ; $V_{IN} = 0.2V$ or $V_{HC}$ ; $I_{OL} = -32 \mu A$	
		$V_{HC}$	$V_{CC}$			$V_{CC} = \text{Min}$	$I_{OH} = -300 \mu A$
		2.4	4.3			$V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OH} = -12 \text{ mA}$ (Mil) $I_{OH} = -15 \text{ mA}$ (Com)
		2.4	4.3				

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

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

Symbol	Parameter	54FCT/74FCT			Units	Conditions	
		Min	Typ	Max			
$V_{OL}$	Maximum Low Level Output Voltage	GND	0.2		V	$V_{CC} = 3V$ ; $V_{IN} = 0.2V$ or $V_{HC}$ ; $I_{OL} = 300 \mu A$	
		GND 0.3 0.3	0.2 0.5 0.5			$V_{CC} = \text{Min}$ $V_{IN} = V_{IH}$ or $V_{IL}$	$I_{OL} = 300 \mu A$ $I_{OL} = 48 \text{ mA (Mil)}$ $I_{OL} = 32 \text{ mA (Com)}$
$I_{CC}$	Maximum Quiescent Supply Current	1.0	40.0		$\mu A$	$V_{CC} = \text{Max}$ $V_{IN} \geq V_{HC}$ , $V_{IN} \leq 0.2V$ $f_I = 0$	
$\Delta I_{CC}$	Quiescent Supply Current; TTL Inputs HIGH	0.5	2.0		mA	$V_{CC} = \text{Max}$ $V_{IN} = 3.4V$ (Note 3)	
$I_{CCD}$	Dynamic Power Supply Current (Note 4)	0.25	0.40		mA/MHz	$V_{CC} = \text{Max}$ Outputs Open $\overline{MR} = V_{CC}$ One Input Toggling 50% Duty Cycle	$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$
$V_H$	Input Hysteresis on Clock Only	200			mV		
$I_C$	Total Power Supply Current (Note 6)	1.5	4.0		mA	$V_{CC} = \text{Max}$ Outputs Open $\overline{MR} = V_{CC}$	$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$
		1.8	6.0			$f_I = 10 \text{ MHz}$ One Bit Toggling 50% Duty Cycle	$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$
		3.0	7.8			(Note 5) $V_{CC} = \text{Max}$ Outputs Open $\overline{MR} = V_{CC}$	$V_{IN} \geq V_{HC}$ $V_{IN} \leq 0.2V$
		5.0	16.8			$f_I = 2.5 \text{ MHz}$ Eight Bits Toggling 50% Duty Cycle	$V_{IN} = 3.4V$ $V_{IN} = \text{GND}$
$V_H$	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

$\Delta I_{CC}$  = 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.

## AC Electrical Characteristics

Symbol	Parameter	54FCT/74FCT	74FCT		54FCT		Units
		$T_A = +25^\circ\text{C}$ $V_{CC} = 5.0\text{V}$	$T_A, V_{CC} = \text{Com}$ $R_L = 500\Omega$ $C_L = 50\text{pF}$		$T_A, V_{CC} = \text{Mil}$ $R_L = 500\Omega$ $C_L = 50\text{pF}$		
		Typ	Min	Max	Min	Max	
$t_{PHL}$ $t_{PLH}$	Propagation Delay Clock to Output	7.0	2.0	13.0	1.5	9.5	ns
$t_{PLH}$ $t_{PHL}$	Propagation Delay MR to Output	8.0	2.0	13.0	1.5	10.5	ns
$t_{SU}$	Setup Time HIGH or LOW Data to CP	1.5	3.0		3.5		ns
$t_h$	Hold Time HIGH or LOW Data to CP	1.0	2.0		2.0		ns
$t_w$	Clock Pulse Width HIGH or LOW	4.0	7.0		5.0		ns
$t_w$	MR Pulse Width HIGH or LOW	4.0	7.0		5.0		ns
$t_{rec}$	Recovery Time MR to CP	3.0	4.0		4.0		ns
$f_{max}$	Maximum Clock Frequency				90		MHz

Note 1: Minimum limits are guaranteed but not tested on Propagation Delays.

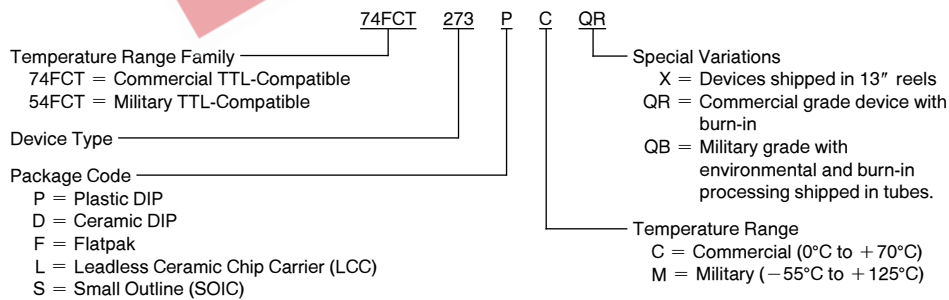
### Capacitance $T_A = 25^\circ\text{C}, f = 1.0\text{MHz}$

Symbol	Parameter	Conditions	Typ	Max	Unit
$C_{IN}$	Input Capacitance	$V_{IN} = 0\text{V}$	6	10	pF
$C_{OUT}$	Output Capacitance	$V_{OUT} = 0\text{V}$	8	12	pF

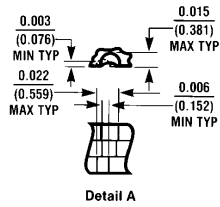
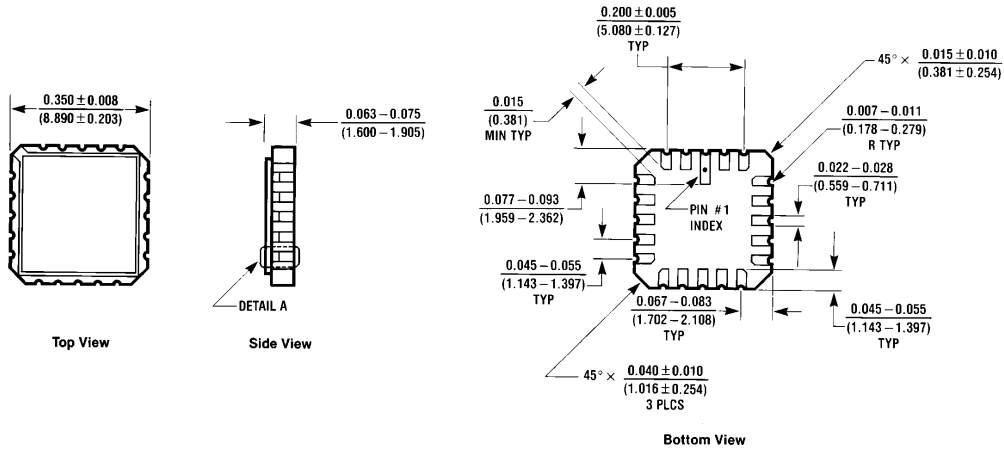
Note: This parameter is guaranteed by characterization data and not tested.

### 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:

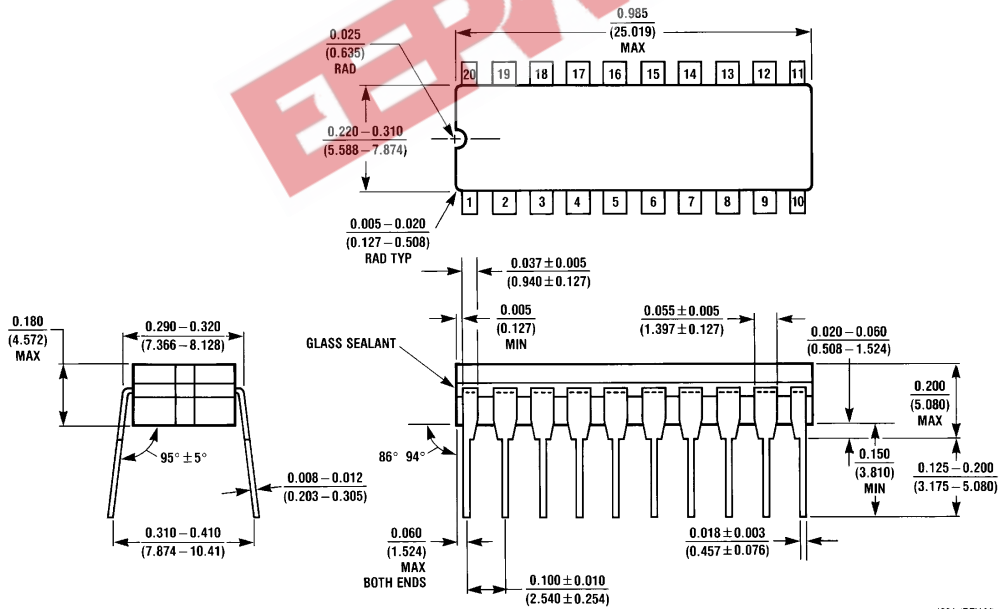


**Physical Dimensions** inches (millimeters)



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

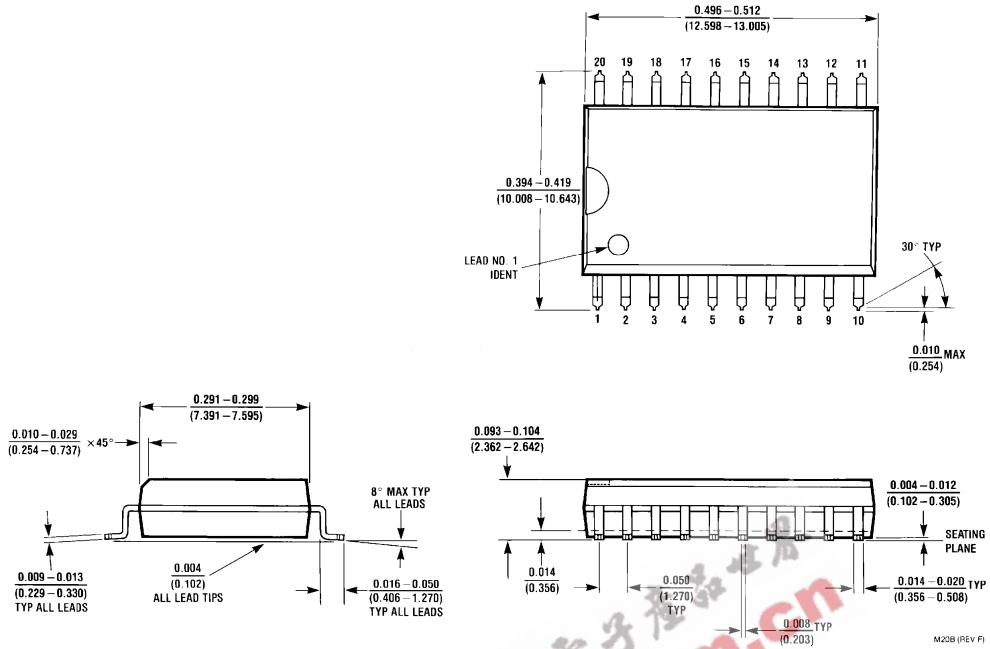
E20A (REV D)



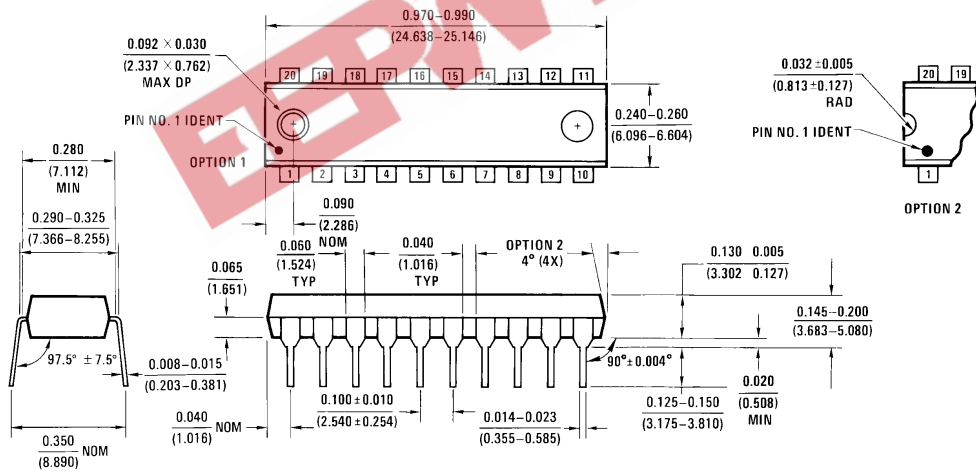
**20-Lead Ceramic Dual-In-Line Package (D)  
 NS Package Number J20A**

J20A (REV M)

**Physical Dimensions** inches (millimeters) (Continued)



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



**20-Lead Plastic Dual-In-Line Package (P)**  
NS Package Number N20B

