

54FCT/74FCT273 Octal D Flip-Flop

General Description

The 54FCT273 has eight edge-triggered D-type flip-flops with individual D inputs and Q outputs. The common buffered Clock (CP) and Master Reset (\overline{MR}) input load and reset (clear) all flip-flops simultaneously.

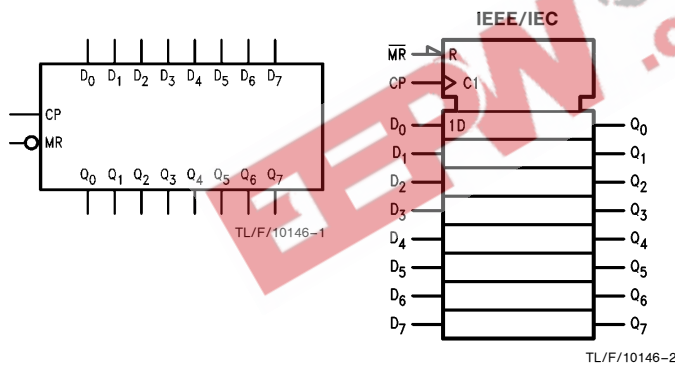
The register is fully edge-triggered. The state of each D input, one setup time before the LOW-to-HIGH clock transition, is transferred to the corresponding flip-flop's Q output.

All outputs will be forced LOW independently of Clock or Data inputs by a LOW voltage level on the \overline{MR} input. The device is useful for applications where the true output only is required and the Clock and Master Reset are common to all storage elements.

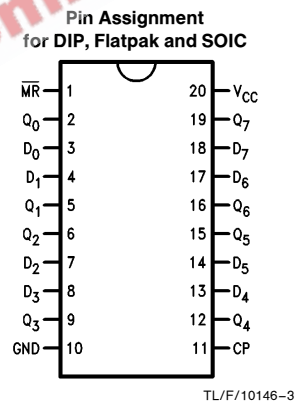
Features

- I_{CC} reduced to 40.0 μ A
- Ideal buffer for MOS microprocessor or memory
- Eight edge-triggered D flip-flops
- Buffered common clock
- Buffered, asynchronous master reset
- TTL input and output level compatible
- TTL levels accept CMOS levels
- $I_{OL} = 48$ mA (Com), 32 mA (Mil)
- NSC 54/74FCT273 is pin and functionally equivalent to IDT 54/74FCT273
- Military product compliant to MIL-STD-883 and Standard Military Drawing #5962-87656

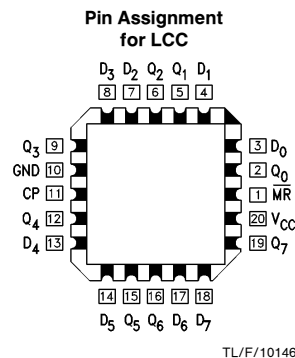
Logic Symbols



Connection Diagrams



| Pin Names | Description |
|-----------------|-------------------|
| D_0 – D_7 | Data Inputs |
| \overline{MR} | Master Reset |
| CP | Clock Pulse Input |
| Q_0 – Q_7 | Data Outputs |

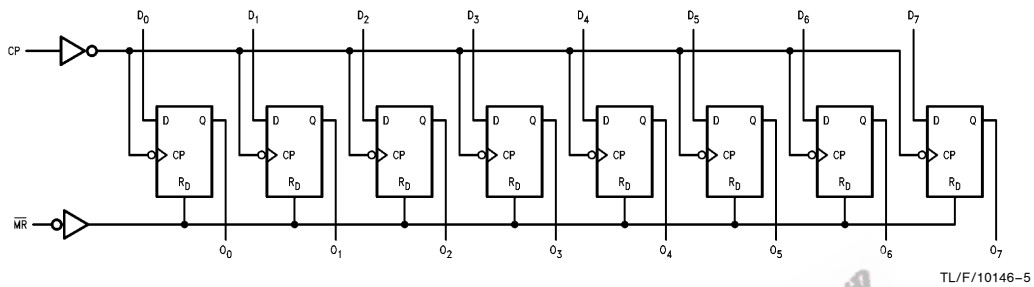


Mode Select-Function Table

| 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 | μA | $V_{CC} = \text{Max}$ | $V_I = V_{CC}$ $V_I = 2.7V$ (Note 2) |
| I_{IL} | Input Low Current | | | -5.0 -5.0 | μA | $V_{CC} = \text{Max}$ | $V_I = 0.5V$ (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 | | μA | $V_{CC} = \text{Max}$ $V_{IN} \geq V_{HC}$, $V_{IN} \leq 0.2V$ $f_I = 0$ | |
| ΔI_{CC} | Quiescent Supply Current; TTL Inputs HIGH | 0.5 | 2.0 | | mA | $V_{CC} = \text{Max}$ $V_{IN} = 3.4V$ (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

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.

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.

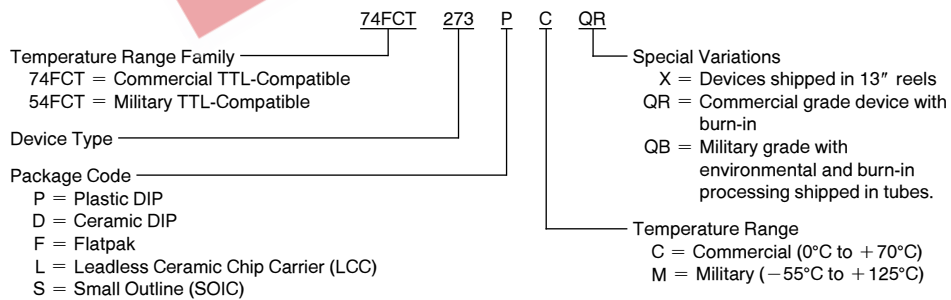
Capacitance $T_A = 25^\circ\text{C}, f = 1.0\text{MHz}$

| 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 |

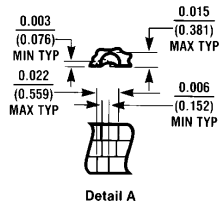
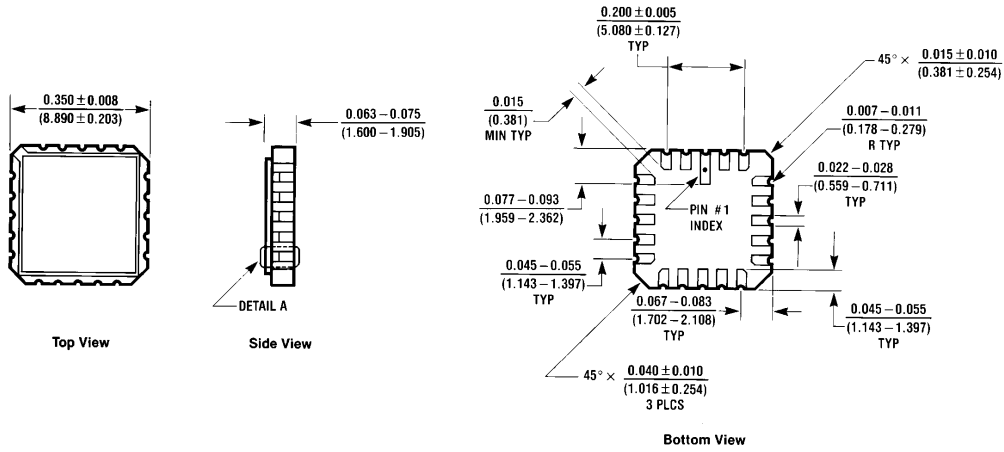
Note: This parameter is guaranteed by characterization data and not tested.

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:

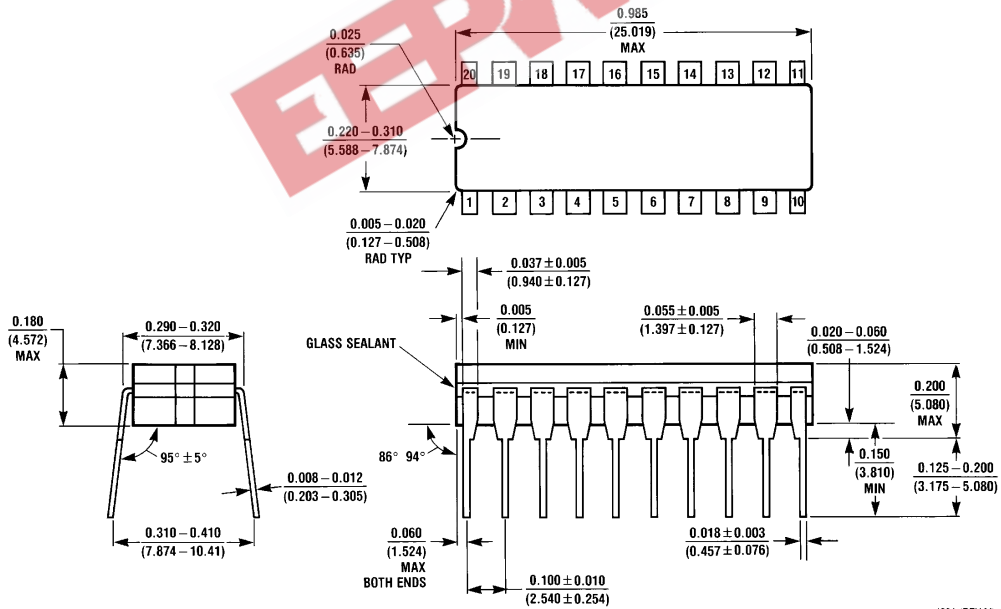


Physical Dimensions inches (millimeters)



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

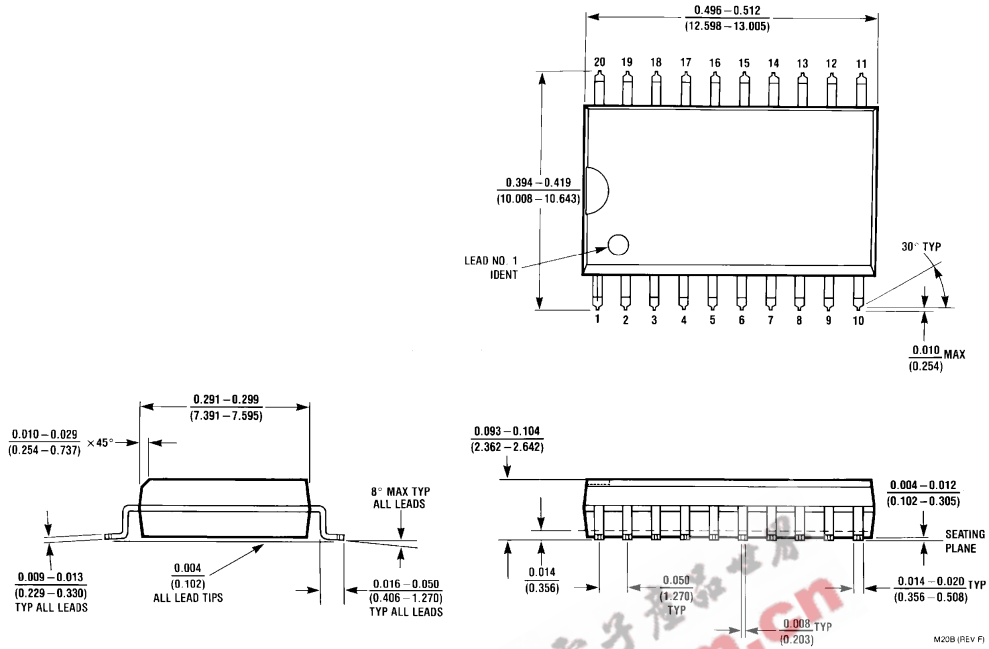
E20A (REV D)



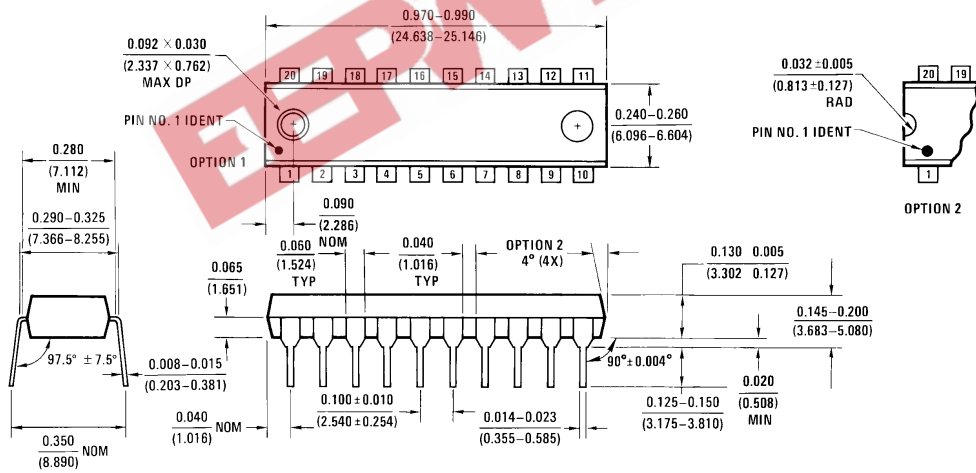
**20-Lead Ceramic Dual-In-Line Package (D)
 NS Package Number J20A**

J20A (REV M)

Physical Dimensions inches (millimeters) (Continued)



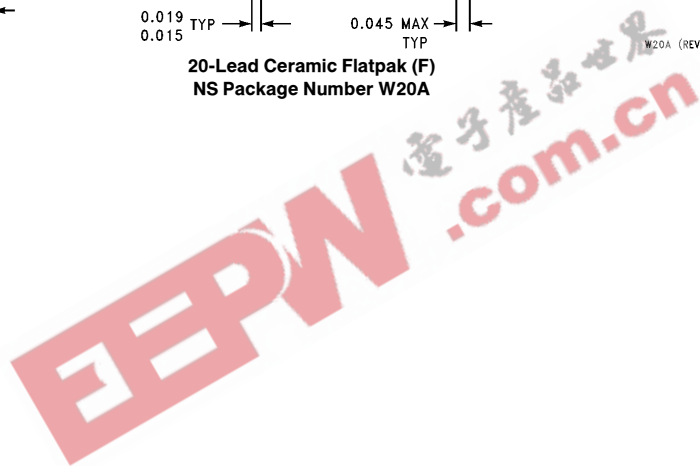
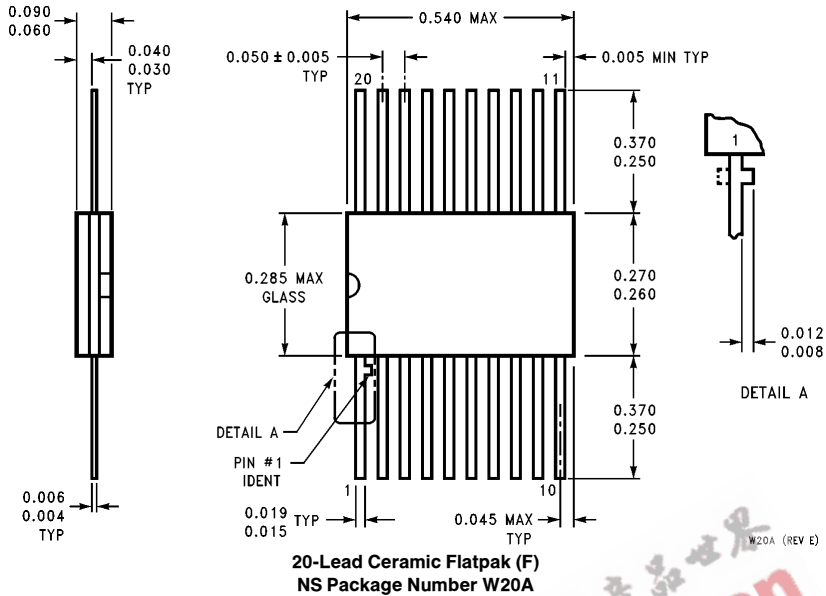
20-Lead Small Outline Integrated Circuit (S)
NS Package Number M20B



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

Physical Dimensions inches (millimeters) (Continued)

Lit. # 114706



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