

## 54AC646

### Octal Transceiver/Register with TRI-STATE® Outputs

#### General Description

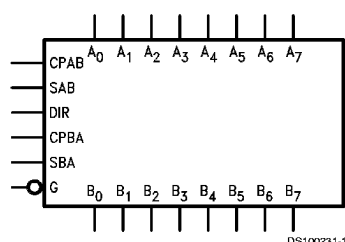
The 'AC646 consist of registered bus transceiver circuits, with outputs, D-type flip-flops and control circuitry providing multiplexed transmission of data directly from the input bus or from the internal storage registers. Data on the A or B bus will be loaded into the respective registers on the LOW-to-HIGH transition of the appropriate clock pin (CPAB or CPBA). The four fundamental data handling functions available are illustrated in *Figures 1, 2, 3, 4*.

- Multiplexed real-time and stored data transfers
- TRI-STATE outputs
- 300 mil slim dual-in-line package
- Outputs source/sink 24 mA
- 'ACT646 has TTL compatible inputs
- Standard Microcircuit Drawing (SMD)
  - 'AC646: 5962-89682

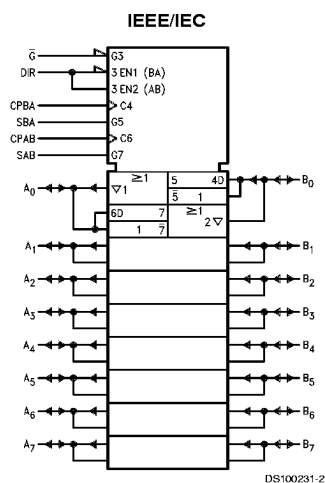
#### Features

- Independent registers for A and B buses

#### Logic Symbols



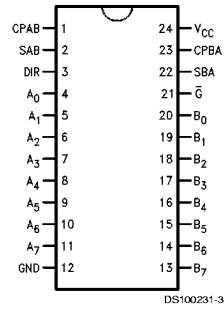
| Pin Names                      | Description                                       |
|--------------------------------|---------------------------------------------------|
| A <sub>0</sub> –A <sub>7</sub> | Data Register A Inputs<br>Data Register A Outputs |
| B <sub>0</sub> –B <sub>7</sub> | Data Register B Inputs<br>Data Register B Outputs |
| CPAB, CPBA                     | Clock Pulse Inputs                                |
| SAB, SBA                       | Transmit/Receive Inputs                           |
| $\overline{G}$                 | Output Enable Input                               |
| DIR                            | Direction Control Input                           |



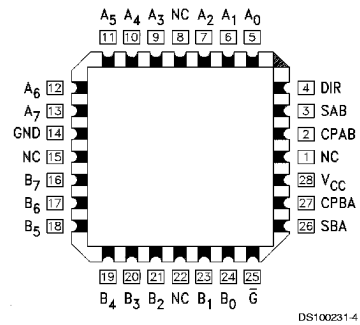
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FACT® is a registered trademark of Fairchild Semiconductor Corporation.

## Connection Diagrams

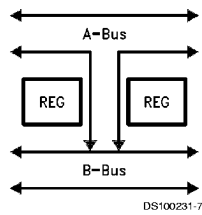
**Pin Assignment  
for DIP and Flatpak**



**Pin Assignment  
for LCC**

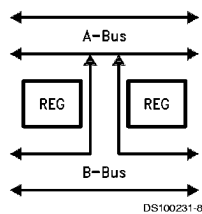


**Real Time Transfer  
A-Bus to B-Bus**



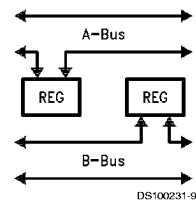
**FIGURE 1.**

**Real Time Transfer  
B-Bus to A-Bus**



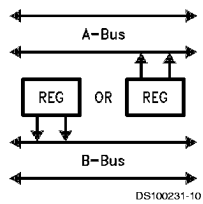
**FIGURE 2.**

**Storage from  
Bus to Register**



**FIGURE 3.**

**Transfer from  
Register to Bus**



**FIGURE 4.**

## Function Table

| Inputs         |     |        |        |     |     | Data I/O (Note 1)              |                                | Function                                                               |
|----------------|-----|--------|--------|-----|-----|--------------------------------|--------------------------------|------------------------------------------------------------------------|
| $\overline{G}$ | DIR | CPAB   | CPBA   | SAB | SBA | A <sub>0</sub> –A <sub>7</sub> | B <sub>0</sub> –B <sub>7</sub> |                                                                        |
| H              | X   | H or L | H or L | X   | X   | Input                          | Input                          | Isolation                                                              |
| H              | X   | ↗      | X      | X   | X   |                                |                                | Clock A <sub>n</sub> Data into A Register                              |
| H              | X   | X      | ↗      | X   | X   |                                |                                | Clock B <sub>n</sub> Data into B Register                              |
| L              | H   | X      | X      | L   | X   | Input                          | Output                         | A <sub>n</sub> to B <sub>n</sub> — Real Time (Transparent Mode)        |
| L              | H   | ↗      | X      | L   | X   |                                |                                | Clock A <sub>n</sub> Data into A Register                              |
| L              | H   | H or L | X      | H   | X   |                                |                                | A Register to B <sub>n</sub> (Stored Mode)                             |
| L              | H   | ↗      | X      | H   | X   |                                |                                | Clock A <sub>n</sub> Data into A Register and Output to B <sub>n</sub> |
| L              | L   | X      | X      | X   | L   | Output                         | Input                          | B <sub>n</sub> to A <sub>n</sub> — Real Time (Transparent Mode)        |
| L              | L   | X      | ↗      | X   | L   |                                |                                | Clock B <sub>n</sub> Data into B Register                              |
| L              | L   | X      | H or L | X   | H   |                                |                                | B Register to A <sub>n</sub> (Stored Mode)                             |
| L              | L   | X      | ↗      | X   | H   |                                |                                | Clock B <sub>n</sub> Data into B Register and Output to A <sub>n</sub> |

H = HIGH Voltage Level

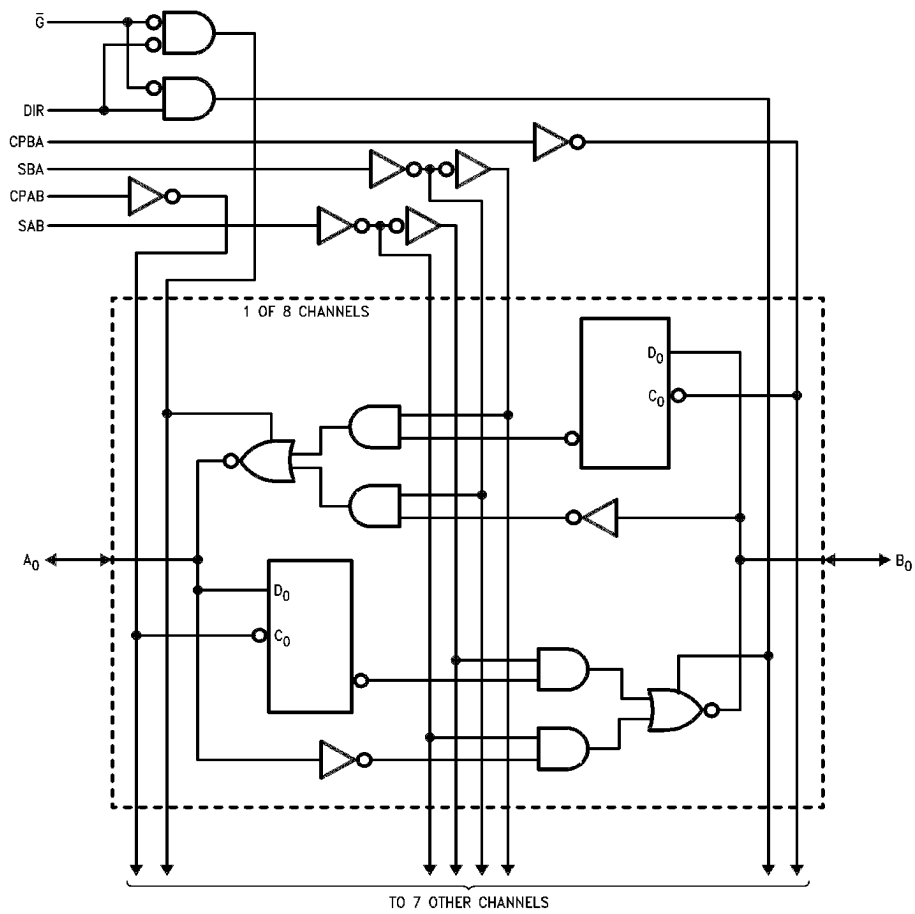
L = LOW Voltage Level

X = Immaterial

↗ = LOW-to-HIGH Transition

**Note 1:** The data output functions may be enabled or disabled by various signals at the  $\overline{G}$  and DIR inputs. Data input functions are always enabled; i.e., data at the bus pins will be stored on every LOW-to-HIGH transition of the appropriate clock inputs.

## Logic Diagram



DS100231-5

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 Ratings (Note 2)

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 ( $I_{IK}$ )      |                          |
| $V_I = -0.5V$                            | –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 ( $I_O$ )                | $\pm 50$ 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

## Recommended Operating Conditions

|                                                 |                 |
|-------------------------------------------------|-----------------|
| Supply Voltage ( $V_{CC}$ )                     |                 |
| 'AC                                             | 2.0V to 6.0V    |
| Input Voltage ( $V_I$ )                         | 0V to $V_{CC}$  |
| Output Voltage ( $V_O$ )                        | 0V to $V_{CC}$  |
| Operating Temperature ( $T_A$ )                 |                 |
| 54AC                                            | –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       |

**Note 2:** 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.

## DC Characteristics for 'AC Family Devices

| Symbol    | Parameter                                     | $V_{CC}$<br>(V) | 54AC                       | Units   | Conditions                                                                                               |
|-----------|-----------------------------------------------|-----------------|----------------------------|---------|----------------------------------------------------------------------------------------------------------|
|           |                                               |                 | $T_A =$<br>–55°C to +125°C |         |                                                                                                          |
|           |                                               |                 | Guaranteed<br>Limits       |         |                                                                                                          |
| $V_{IH}$  | Minimum High Level<br>Input Voltage           | 3.0             | 2.1                        | V       | $V_{OUT} = 0.1V$<br>or $V_{CC} - 0.1V$                                                                   |
|           |                                               | 4.5             | 3.15                       |         |                                                                                                          |
|           |                                               | 5.5             | 3.85                       |         |                                                                                                          |
| $V_{IL}$  | Maximum Low Level<br>Input Voltage            | 3.0             | 0.9                        | V       | $V_{OUT} = 0.1V$<br>or $V_{CC} - 0.1V$                                                                   |
|           |                                               | 4.5             | 1.35                       |         |                                                                                                          |
|           |                                               | 5.5             | 1.65                       |         |                                                                                                          |
| $V_{OH}$  | Minimum High Level<br>Output Voltage          | 3.0             | 2.9                        | V       | $I_{OUT} = -50 \mu A$                                                                                    |
|           |                                               | 4.5             | 4.4                        |         |                                                                                                          |
|           |                                               | 5.5             | 5.4                        |         |                                                                                                          |
|           |                                               | 3.0             | 2.4                        | V       | (Note 3)<br>$V_{IN} = V_{IL}$ or $V_{IH}$<br>$I_{OH} = -12$ mA<br>$I_{OH} = -24$ mA<br>$I_{OH} = -24$ mA |
|           |                                               | 4.5             | 3.7                        |         |                                                                                                          |
|           |                                               | 5.5             | 4.7                        |         |                                                                                                          |
| $V_{OL}$  | Maximum Low Level<br>Output Voltage           | 3.0             | 0.1                        | V       | $I_{OUT} = 50 \mu A$                                                                                     |
|           |                                               | 4.5             | 0.1                        |         |                                                                                                          |
|           |                                               | 5.5             | 0.1                        |         |                                                                                                          |
|           |                                               | 3.0             | 0.50                       | V       | (Note 3)<br>$V_{IN} = V_{IL}$ or $V_{IH}$<br>$I_{OH} = 12$ mA<br>$I_{OL} = 24$ mA<br>$I_{OH} = 24$ mA    |
|           |                                               | 4.5             | 0.50                       |         |                                                                                                          |
|           |                                               | 5.5             | 0.50                       |         |                                                                                                          |
| $I_{IN}$  | Maximum Input<br>Leakage Current              | 5.5             | $\pm 1.0$                  | $\mu A$ | $V_I = V_{CC}, GND$                                                                                      |
| $I_{OLD}$ | Minimum Dynamic<br>Output Current<br>(Note 4) | 5.5             | 50                         | mA      | $V_{OLD} = 1.65V$ Max                                                                                    |
| $I_{OHD}$ |                                               | 5.5             | –50                        | mA      | $V_{OHD} = 3.85V$ Min                                                                                    |

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

| Symbol           | Parameter                           | V <sub>CC</sub><br>(V) | 54AC                                | Units | Conditions                                                                                                                                  |
|------------------|-------------------------------------|------------------------|-------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------|
|                  |                                     |                        | T <sub>A</sub> =<br>–55°C to +125°C |       |                                                                                                                                             |
|                  |                                     |                        | Guaranteed<br>Limits                |       |                                                                                                                                             |
| I <sub>CC</sub>  | Maximum Quiescent<br>Supply Current | 5.5                    | 160.0                               | μA    | V <sub>IN</sub> = V <sub>CC</sub><br>or GND                                                                                                 |
| I <sub>OZT</sub> | Maximum I/O<br>Leakage Current      | 5.5                    | ±10.0                               | μA    | V <sub>I</sub> (OE) = V <sub>IL</sub> , V <sub>IH</sub><br>V <sub>I</sub> = V <sub>CC</sub> , GND<br>V <sub>O</sub> = V <sub>CC</sub> , GND |

**Note 3:** All outputs loaded; thresholds on input associated with output under test.

**Note 4:** Maximum test duration 2.0 ms, one output loaded at a time.

**Note 5:** 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.

## AC Electrical Characteristics

| Symbol           | Parameter                                                                                                                | V <sub>CC</sub><br>(V)<br>(Note 6)                                                                                       | 54AC                                                          |              | Units | Fig.<br>No. |
|------------------|--------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|--------------|-------|-------------|
|                  |                                                                                                                          |                                                                                                                          | T <sub>A</sub> = –55°C<br>to +125°C<br>C <sub>L</sub> = 50 pF |              |       |             |
|                  |                                                                                                                          |                                                                                                                          | Min                                                           | Max          |       |             |
| t <sub>PLH</sub> | Propagation Delay<br>Clock to Bus                                                                                        | 3.3<br>5.0                                                                                                               | 1.0<br>1.5                                                    | 20.0<br>14.0 | ns    |             |
|                  | t <sub>PHL</sub>                                                                                                         | Propagation Delay<br>Clock to Bus                                                                                        | 3.3<br>5.0                                                    | 1.0<br>1.5   |       |             |
| t <sub>PLH</sub> | Propagation Delay<br>Bus to Bus                                                                                          | 3.3<br>5.0                                                                                                               | 1.0<br>1.5                                                    | 15.0<br>10.0 | ns    |             |
|                  | t <sub>PHL</sub>                                                                                                         | Propagation Delay<br>Bus to Bus                                                                                          | 3.3<br>5.0                                                    | 1.0<br>1.5   |       |             |
| t <sub>PLH</sub> | Propagation Delay<br>SBA or SAB to A <sub>n</sub> or B <sub>n</sub><br>(w/ A <sub>n</sub> or B <sub>n</sub> HIGH or LOW) | 3.3<br>5.0                                                                                                               | 1.0<br>1.5                                                    | 17.0<br>12.0 | ns    |             |
|                  | t <sub>PHL</sub>                                                                                                         | Propagation Delay<br>SBA or SAB to A <sub>n</sub> or B <sub>n</sub><br>(w/ A <sub>n</sub> or B <sub>n</sub> HIGH or LOW) | 3.3<br>5.0                                                    | 1.0<br>1.5   |       |             |
| t <sub>PZH</sub> | Enable Time<br>G̅ to A <sub>n</sub> or B <sub>n</sub>                                                                    | 3.3<br>5.0                                                                                                               | 1.0<br>1.5                                                    | 13.0<br>9.5  | ns    |             |
|                  | t <sub>PZL</sub>                                                                                                         | Enable Time<br>G̅ to A <sub>n</sub> or B <sub>n</sub>                                                                    | 3.3<br>5.0                                                    | 1.0<br>1.5   |       |             |
| t <sub>PHZ</sub> | Disable Time<br>G̅ to A <sub>n</sub> or B <sub>n</sub>                                                                   | 3.3<br>5.0                                                                                                               | 1.0<br>1.5                                                    | 14.0<br>11.0 | ns    |             |
|                  | t <sub>PLZ</sub>                                                                                                         | Disable Time<br>G̅ to A <sub>n</sub> or B <sub>n</sub>                                                                   | 3.3<br>5.0                                                    | 1.0<br>1.5   |       |             |
| t <sub>PZH</sub> | Enable Time<br>DIR to A <sub>n</sub> or B <sub>n</sub>                                                                   | 3.3<br>5.0                                                                                                               | 1.0<br>1.5                                                    | 14.5<br>10.5 | ns    |             |
|                  | t <sub>PZL</sub>                                                                                                         | Enable Time<br>DIR to A <sub>n</sub> or B <sub>n</sub>                                                                   | 3.3<br>5.0                                                    | 1.0<br>1.5   |       |             |
| t <sub>PHZ</sub> | Disable Time<br>DIR to A <sub>n</sub> or B <sub>n</sub>                                                                  | 3.3<br>5.0                                                                                                               | 1.0<br>1.5                                                    | 14.5<br>12.0 | ns    |             |

## AC Electrical Characteristics (Continued)

| Symbol           | Parameter                                               | V <sub>CC</sub><br>(V)<br>(Note 6) | 54AC                                                          |              | Units | Fig.<br>No. |
|------------------|---------------------------------------------------------|------------------------------------|---------------------------------------------------------------|--------------|-------|-------------|
|                  |                                                         |                                    | T <sub>A</sub> = −55°C<br>to +125°C<br>C <sub>L</sub> = 50 pF |              |       |             |
|                  |                                                         |                                    | Min                                                           | Max          |       |             |
| t <sub>PLZ</sub> | Disable Time<br>DIR to A <sub>n</sub> or B <sub>n</sub> | 3.3<br>5.0                         | 1.0<br>1.5                                                    | 16.5<br>12.0 | ns    |             |

**Note 6:** 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><br>(V)<br>(Note 7) | 54AC                                                            | Units | Fig.<br>No. |
|----------------|-----------------------------------------|------------------------------------|-----------------------------------------------------------------|-------|-------------|
|                |                                         |                                    | T <sub>A</sub> = -55° C<br>to +125° C<br>C <sub>L</sub> = 50 pF |       |             |
|                |                                         |                                    | Guaranteed<br>Minimum                                           |       |             |
| t <sub>s</sub> | Setup Time, HIGH or LOW<br>Bus to Clock | 3.3                                | 6.0                                                             | ns    |             |
|                |                                         | 5.0                                | 4.5                                                             |       |             |
| t <sub>h</sub> | Hold Time, HIGH or LOW<br>Bus to Clock  | 3.3                                | 1.5                                                             | ns    |             |
|                |                                         | 5.0                                | 2.0                                                             |       |             |
| t <sub>w</sub> | Clock Pulse Width<br>HIGH or LOW        | 3.3                                | 5.0                                                             | ns    |             |
|                |                                         | 5.0                                | 5.0                                                             |       |             |

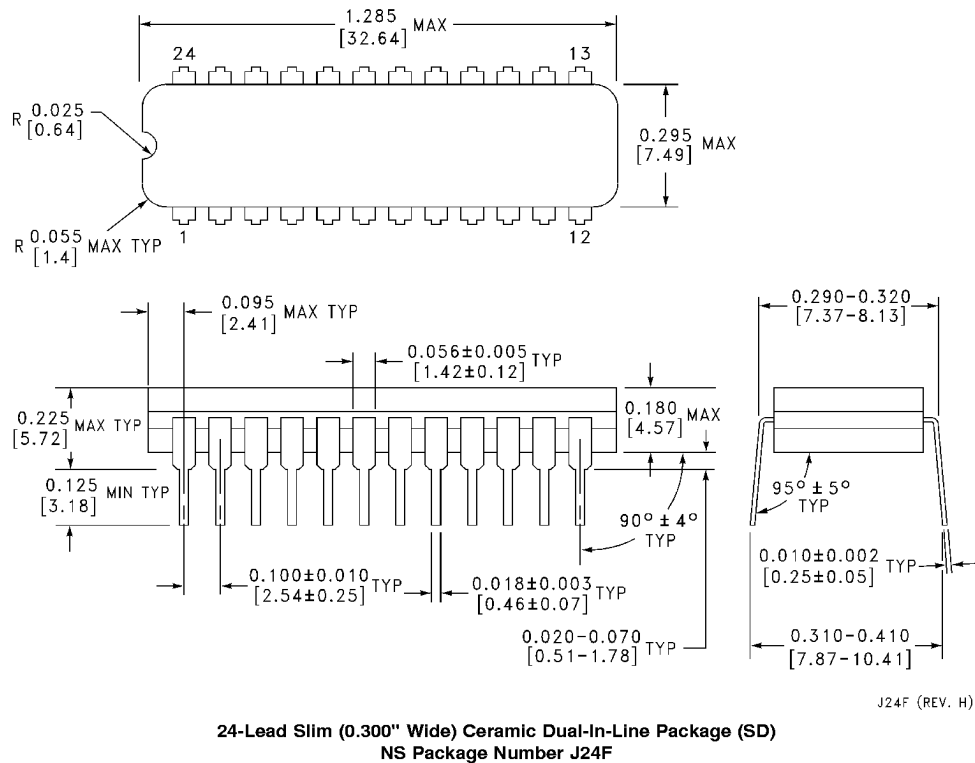
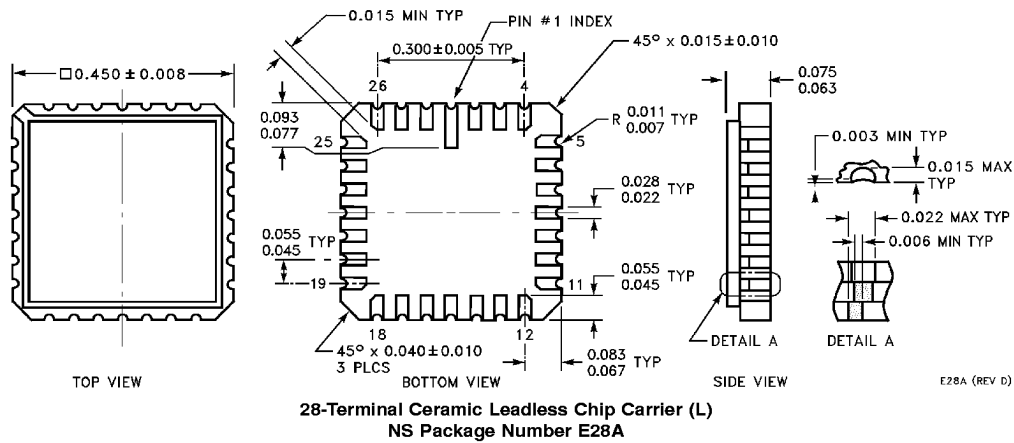
**Note 7:** Voltage Range 3.3 is 3.3V ±0.3V  
Voltage Range 5.0 is 5.0V ±0.5V

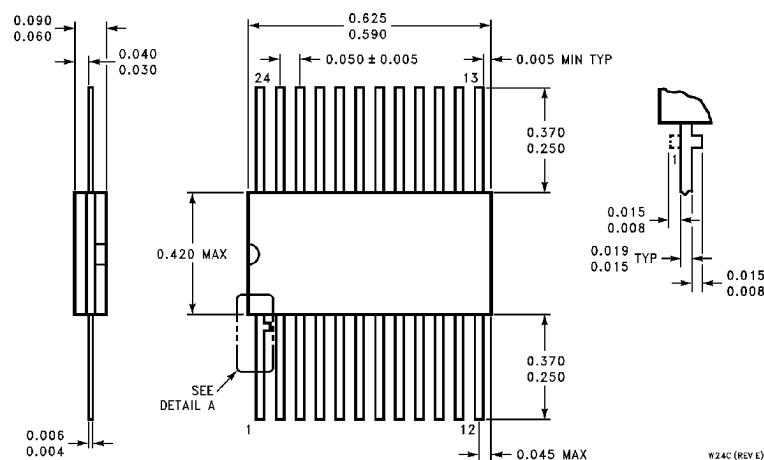
## Capacitance

| Symbol           | Parameter                        | Typ  | Units | Conditions             |
|------------------|----------------------------------|------|-------|------------------------|
| C <sub>IN</sub>  | Input Capacitance                | 4.5  | pF    | V <sub>CC</sub> = OPEN |
| C <sub>I/O</sub> | Input/Output Capacitance         | 15.0 | pF    | V <sub>CC</sub> = 5.0V |
| C <sub>PD</sub>  | Power Dissipation<br>Capacitance | 60.0 | pF    | V <sub>CC</sub> = 5.0V |



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



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

**24-Lead Ceramic Flatpak (F)**  
**NS Package Number W24C**

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