

## 54ACTQ/74ACTQ32 Quiet Series Quad 2-Input OR Gate

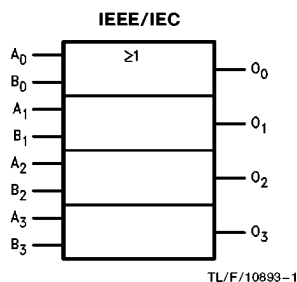
### General Description

The 'ACTQ32 contains four, 2-input OR gates and utilizes NSC Quiet Series technology to guarantee quiet output switching and improved dynamic threshold performance. FACT Quiet Series™ features GTO™ output control and undershoot corrector in addition to a split ground bus for superior AC MOS performance.

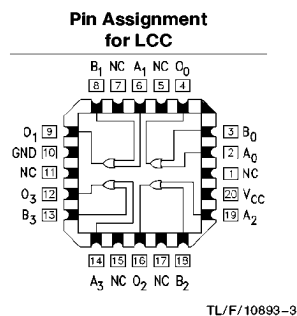
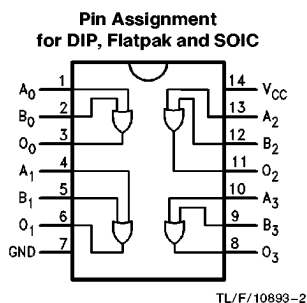
### Features

- $I_{CC}$  reduced by 50%
- Guaranteed simultaneous switching noise level and dynamic threshold performance
- Improved latch-up immunity
- Minimum 4 kV ESD protection
- Outputs source/sink 24 mA
- 'ACTQ32 has TTL-compatible inputs
- Standard Military Drawing (SMD)  
— 'ACTQ32: 5962-89736

### Logic Symbol



### Connection Diagrams



| Pin Names  | Description |
|------------|-------------|
| $A_n, B_n$ | Inputs      |
| $O_n$      | Outputs     |

FACT™, FACT Quiet Series™ and GTO™ are trademarks of National Semiconductor Corporation.

## Absolute Maximum Ratings (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 ( $I_{IK}$ )                                    |                          |
| $V_I = -0.5V$                                                          | −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 ( $I_O$ )                             | ±50 mA                   |
| DC $V_{CC}$ or Ground Current per Output Pin ( $I_{CC}$ or $I_{GND}$ ) | ±50 mA                   |
| Storage Temperature ( $T_{STG}$ )                                      | −65°C to +150°C          |
| DC Latch-up Source or Sink Current                                     | ±300 mA                  |
| 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 (Note 2)

|                                                 |                 |
|-------------------------------------------------|-----------------|
| Supply Voltage ( $V_{CC}$ )                     | 4.5V to 5.5V    |
| 'ACTQ                                           |                 |
| Input Voltage ( $V_I$ )                         | 0V to $V_{CC}$  |
| Output Voltage ( $V_O$ )                        | 0V to $V_{CC}$  |
| Operating Temperature ( $T_A$ )                 |                 |
| 74ACTQ                                          | −40°C to +85°C  |
| 54ACTQ                                          | −55°C to +125°C |
| Minimum Input Edge Rate ( $\Delta V/\Delta t$ ) |                 |
| 'ACTQ Devices                                   | 125 mV/ns       |
| $V_{IN}$ from 0.8V to 2.0V                      |                 |
| $V_{CC}$ @ 4.5V, 5.5V                           |                 |

**Note 2:** All commercial packaging is not recommended for applications requiring greater than 2000 temperature cycles from −40°C to +125°C.

## DC Characteristics for 'ACTQ Family Devices

| Symbol          | Parameter                         | V <sub>CC</sub><br>(V) | 74ACTQ                 |                   | 54ACTQ                              |  | 74ACTQ                             |  | Units | Conditions                                                                                |
|-----------------|-----------------------------------|------------------------|------------------------|-------------------|-------------------------------------|--|------------------------------------|--|-------|-------------------------------------------------------------------------------------------|
|                 |                                   |                        | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> =<br>−55°C to +125°C |  | T <sub>A</sub> =<br>−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<br>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<br>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                               |  | V     | *V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>−24 mA<br>I <sub>OH</sub> −24 mA |
|                 |                                   | 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                               |  | V     | *V <sub>IN</sub> = V <sub>IL</sub> or V <sub>IH</sub><br>24 mA<br>I <sub>OL</sub> 24 mA   |
|                 |                                   | 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                                                    |

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

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

| Symbol            | Parameter                                    | V <sub>CC</sub><br>(V) | 74ACTQ                 |                   | 54ACTQ                              |  | 74ACTQ                             |  | Units | Conditions                                        |
|-------------------|----------------------------------------------|------------------------|------------------------|-------------------|-------------------------------------|--|------------------------------------|--|-------|---------------------------------------------------|
|                   |                                              |                        | T <sub>A</sub> = +25°C |                   | T <sub>A</sub> =<br>−55°C to +125°C |  | T <sub>A</sub> =<br>−40°C to +85°C |  |       |                                                   |
|                   |                                              |                        | Typ                    | Guaranteed Limits |                                     |  |                                    |  |       |                                                   |
| 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                    |                        | 2.0               | 40.0                                |  | 20.0                               |  | μA    | V <sub>IN</sub> = V <sub>CC</sub> or GND (Note 1) |
| V <sub>OLP</sub>  | Quiet Output Maximum Dynamic V <sub>OL</sub> | 5.0                    | 1.1                    | 1.5               |                                     |  |                                    |  | V     | Figures 2-12, 13 (Notes 2, 3)                     |
| V <sub>OLV</sub>  | Quiet Output Minimum Dynamic V <sub>OL</sub> | 5.0                    | −0.6                   | −1.2              |                                     |  |                                    |  | V     | Figures 2-12, 13 (Notes 2, 3)                     |
| V <sub>IHD</sub>  | Minimum High Level Dynamic Input Voltage     | 5.0                    | 1.9                    | 2.2               |                                     |  |                                    |  | V     | (Notes 2, 4)                                      |
| V <sub>ILD</sub>  | Maximum Low Level Dynamic Input Voltage      | 5.0                    | 1.2                    | 0.8               |                                     |  |                                    |  | V     | (Notes 2, 4)                                      |

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

**Note 1:** I<sub>CC</sub> for 54ACTQ @ 25°C is identical to 74ACTQ @ 25°C.

**Note 2:** Plastic DIP package.

**Note 3:** Max number of outputs defined as (n). Data inputs are 0V to 3V. One output @ GND.

**Note 4:** Max number of data inputs (n) switching. (n−1) inputs switching 0V to 3V ('ACTQ). Input-under-test switching: 3V to threshold (V<sub>ILD</sub>), 0V to threshold (V<sub>IHD</sub>), f = 1 MHz.

## AC Electrical Characteristics

| Symbol                                   | Parameter                           | V <sub>CC</sub> *<br>(V) | 74ACTQ                                           |     |     | 54ACTQ                                                        |     | 74ACTQ                                                       |     | Units |
|------------------------------------------|-------------------------------------|--------------------------|--------------------------------------------------|-----|-----|---------------------------------------------------------------|-----|--------------------------------------------------------------|-----|-------|
|                                          |                                     |                          | T <sub>A</sub> = +25°C<br>C <sub>L</sub> = 50 pF |     |     | T <sub>A</sub> = −55°C<br>to +125°C<br>C <sub>L</sub> = 50 pF |     | T <sub>A</sub> = −40°C<br>to +85°C<br>C <sub>L</sub> = 50 pF |     |       |
|                                          |                                     |                          | Min                                              | Typ | Max | Min                                                           | Max | Min                                                          | Max |       |
| t <sub>PLH</sub>                         | Propagation Delay<br>Data to Output | 5.0                      | 2.5                                              | 6.0 | 6.5 | 1.5                                                           | 7.5 | 2.5                                                          | 7.0 | ns    |
| t <sub>PHL</sub>                         | Propagation Delay<br>Data to Output | 5.0                      | 2.5                                              | 6.0 | 6.5 | 1.5                                                           | 7.5 | 2.5                                                          | 7.0 | ns    |
| t <sub>OSHL</sub> ,<br>t <sub>OSLH</sub> | Output to Output<br>Skew**          | 5.0                      |                                                  | 0.5 | 1.0 |                                                               |     |                                                              | 1.0 | ns    |

\*Voltage Range 5.0 is 5.0V ±0.5V

\*\*Skew is defined as the absolute value of the difference between the actual propagation delay for any two separate outputs of the same device. The specification applies to any outputs switching in the same direction, either HIGH to LOW (t<sub>OSHL</sub>) or LOW to HIGH (t<sub>OSLH</sub>). Parameter guaranteed by design.

## 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 | 68  | pF    | V <sub>CC</sub> = 5.0V |

## FACT Noise Characteristics

The setup of a noise characteristics measurement is critical to the accuracy and repeatability of the tests. The following is a brief description of the setup used to measure the noise characteristics of FACT.

### Equipment:

Hewlett Packard Model 8180A Word Generator  
PC-163A Test Fixture  
Tektronics Model 7854 Oscilloscope

### Procedure:

1. Verify Test Fixture Loading: Standard Load 50 pF, 500Ω.
2. Deskew the word generator so that no two channels have greater than 150 ps skew between them. This requires that the oscilloscope be deskewed first. Swap out the channels that have more than 150 ps of skew until all channels being used are within 150 ps. It is important to deskew the word generator channels before testing. This will ensure that the outputs switch simultaneously.
3. Terminate all inputs and outputs to ensure proper loading of the outputs and that the input levels are at the correct voltage.
4. Set  $V_{CC}$  to 5.0V.
5. Set the word generator to toggle all but one output at a frequency of 1 MHz. Greater frequencies will increase DUT heating and affect the results of the measurement.

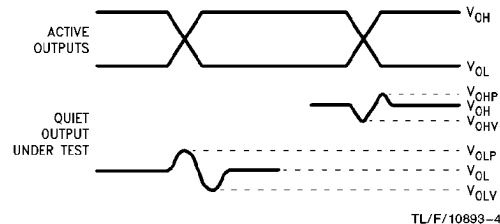


FIGURE 1. Quiet Output Noise Voltage Waveforms

**Note A.**  $V_{OHP}$  and  $V_{OLP}$  are measured with respect to ground reference.

**Note B.** Input pulses have the following characteristics:  $f = 1$  MHz,  $t_r = 3$  ns,  $t_f = 3$  ns, skew  $< 150$  ps.

6. Set the word generator input levels at 0V LOW and 3V HIGH for ACT devices and 0V LOW and 5V HIGH for AC devices. Verify levels with a digital volt meter.

### $V_{OLP}/V_{OLV}$ and $V_{OHP}/V_{OHV}$ :

- Determine the quiet output pin that demonstrates the greatest noise levels. The worst case pin will usually be the furthest from the ground pin. Monitor the output voltages using a 50Ω coaxial cable plugged into a standard SMB type connector on the test fixture. Do not use an active FET probe.
- Measure  $V_{OLP}$  and  $V_{OLV}$  on the quiet output during the HL transition. Measure  $V_{OHP}$  and  $V_{OHV}$  on the quiet output during the LH transition.
- Verify that the GND reference recorded on the oscilloscope has not drifted to ensure the accuracy and repeatability of the measurements.

### $V_{ILD}$ and $V_{IHD}$ :

- Monitor one of the switching outputs using a 50Ω coaxial cable plugged into a standard SMB type connector on the test fixture. Do not use an active FET probe.
- First increase the input LOW voltage level,  $V_{IL}$ , until the output begins to oscillate. Oscillation is defined as noise on the output LOW level that exceeds  $V_{IL}$  limits, or on output HIGH levels that exceed  $V_{IH}$  limits. The input LOW voltage level at which oscillation occurs is defined as  $V_{ILD}$ .
- Next increase the input HIGH voltage level on the word generator,  $V_{IH}$  until the output begins to oscillate. Oscillation is defined as noise on the output LOW level that exceeds  $V_{IL}$  limits, or on output HIGH levels that exceed  $V_{IH}$  limits. The input HIGH voltage level at which oscillation occurs is defined as  $V_{IHD}$ .
- Verify that the GND reference recorded on the oscilloscope has not drifted to ensure the accuracy and repeatability of the measurements.

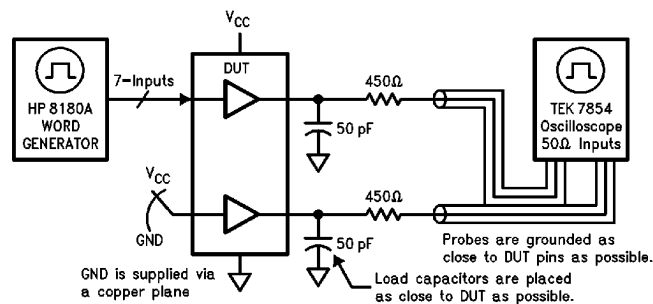


FIGURE 2. Simultaneous Switching Test Circuit

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

74ACTQ    32    P    C    QR

Temperature Range Family  
 74ACTQ = Commercial TTL-Compatible  
 54ACTQ = 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 (–40°C to +85°C)  
 M = Military (–55°C to +125°C)

**Top View**

Overall width:  $0.350 \pm 0.008$  (8.890 ± 0.203)

**Side View**

Overall height:  $0.063 - 0.075$  (1.600 - 1.905)

**Bottom View**

Overall width:  $0.200 \pm 0.005$  (5.080 ± 0.127) TYP

Overall height:  $0.015 \pm 0.010$  (0.381 ± 0.254) 45° ×

Pin #1 INDEX

Pin pitch:  $0.007 - 0.011$  (0.178 - 0.279) R TYP

Pin width:  $0.022 - 0.028$  (0.559 - 0.711) TYP

Pin height:  $0.045 - 0.055$  (1.143 - 1.397) TYP

Pin length:  $0.067 - 0.083$  (1.702 - 2.108) TYP

Pin spacing:  $0.045 - 0.055$  (1.143 - 1.397) TYP

Pin angle:  $0.040 \pm 0.010$  (1.016 ± 0.254) 3 PLCS

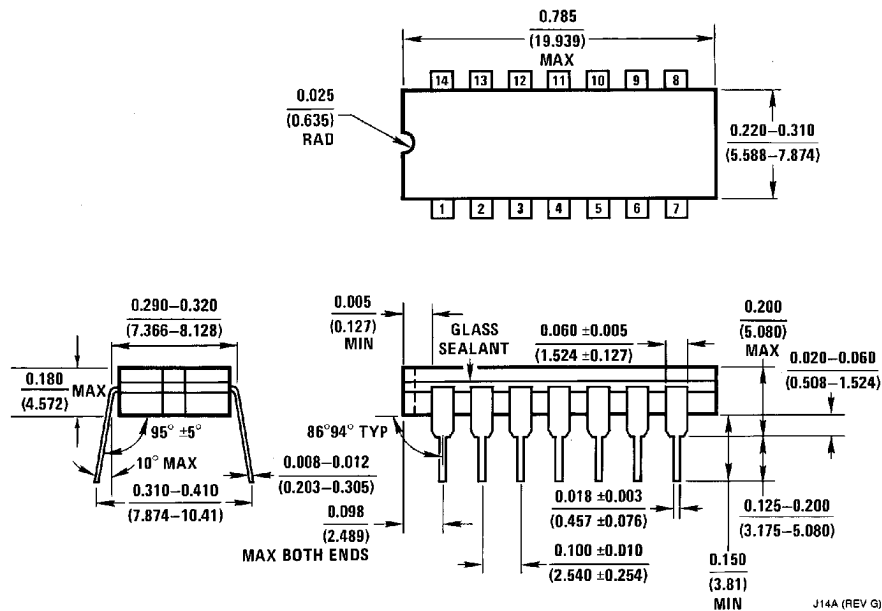
**Detail A**

Detail A shows a close-up of the pin and its mounting structure.

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

E2C4 (REV D)

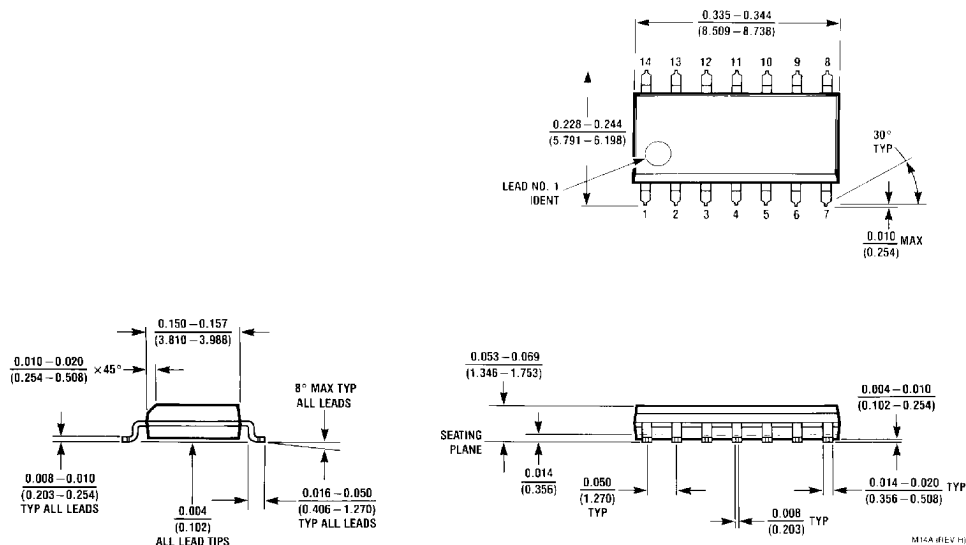
Physical Dimensions inches (millimeters) (Continued)



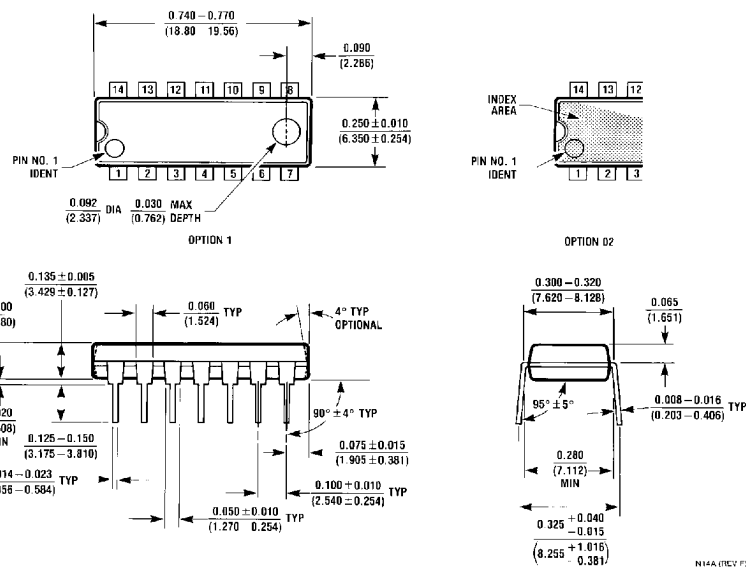
14-Lead Ceramic Dual-In-Line Package (D)  
NS Package Number J14A

J14A (REV G)

# Physical Dimensions inches (millimeters) (Continued)

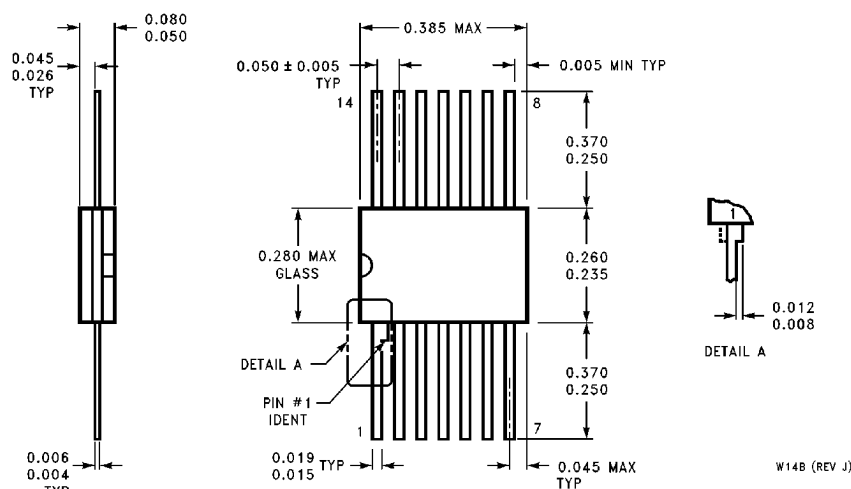


**14-Lead Small Outline Integrated Circuit (S)  
NS Package Number M14A**



**14-Lead Plastic Dual-In-Line Package (P)  
NS Package Number N14A**

# Physical Dimensions inches (millimeters) (Continued)



**14-Lead Ceramic Flatpak (F)  
NS Package Number W14B**

## LIFE SUPPORT POLICY

NATIONAL'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN APPROVAL OF THE PRESIDENT OF NATIONAL SEMICONDUCTOR CORPORATION. As used herein:

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user.
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.

|                                                                                                                                                                                                                                                         |                                                                                                                                                              |                                                                                                                                                                                                             |                                                                                                                                                                                                |                                                                                                                                                                                                             |                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  <b>National Semiconductor Corporation</b><br>2900 Semiconductor Drive<br>P.O. Box 58090<br>Santa Clara, CA 95052-8090<br>Tel: (800) 272-9959<br>TWX: (910) 339-9240 | <b>National Semiconductor GmbH</b><br>Livry-Gargan-Str. 10<br>D-82256 Fürstenfeldbruck<br>Germany<br>Tel: (81-41) 35-0<br>Telex: 527640<br>Fax: (81-41) 35-1 | <b>National Semiconductor Japan Ltd.</b><br>Sumitomo Chemical Engineering Center<br>Bldg. 7F<br>1-7-1, Nakase, Mihama-Ku<br>Chiba-City<br>Ciba Prefecture 261<br>Tel: (043) 299-2300<br>Fax: (043) 299-2500 | <b>National Semiconductor Hong Kong Ltd.</b><br>13th Floor, Straight Block,<br>Ocean Centre, 5 Canton Rd.<br>Tsimshatsui, Kowloon<br>Hong Kong<br>Tel: (852) 2737-1600<br>Fax: (852) 2736-9960 | <b>National Semiconductores Do Brazil Ltda.</b><br>Rue Deputado Lacorda Franco<br>120-3A<br>Sao Paulo-SP<br>Brazil 05418-000<br>Tel: (55-11) 212-5066<br>Telex: 391-113191 NSBR BR<br>Fax: (55-11) 212-1181 | <b>National Semiconductor (Australia) Pty. Ltd.</b><br>Building 16<br>Business Park Drive<br>Monash Business Park<br>Nottingham, Melbourne<br>Victoria 3168 Australia<br>Tel: (3) 558-9999<br>Fax: (3) 558-9998 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

National does not assume any responsibility for use of any circuitry described, no circuit patent licenses are implied and National reserves the right at any time without notice to change said circuitry and specifications.