

## Micromonitor

### Features

- Halts and restarts an out-of-control microprocessor
- Holds microprocessor in check during power transients
- Automatic restart after power failure
- Monitors pushbutton for external reset
- Monitors microprocessor power supply to be within 5% or 10% of 5 V
- No discrete components needed
- 8-pin Mini-DIP or 16-pin SOIC
- Pin compatible with DS1232

### General Description

The CS1232 is a monitor for microprocessors which checks program execution, power source quality, and external reset status.

The power status ( $V_{CC}$ ) is monitored by a comparator and a precision temperature-compensated reference. Reset is forced active by an internal signal when  $V_{CC}$  goes out-of-tolerance. Reset signals stay active for a minimum for 250 ms after  $V_{CC}$  returns to an in-tolerance condition. This allows both power supply and processor to stabilize.

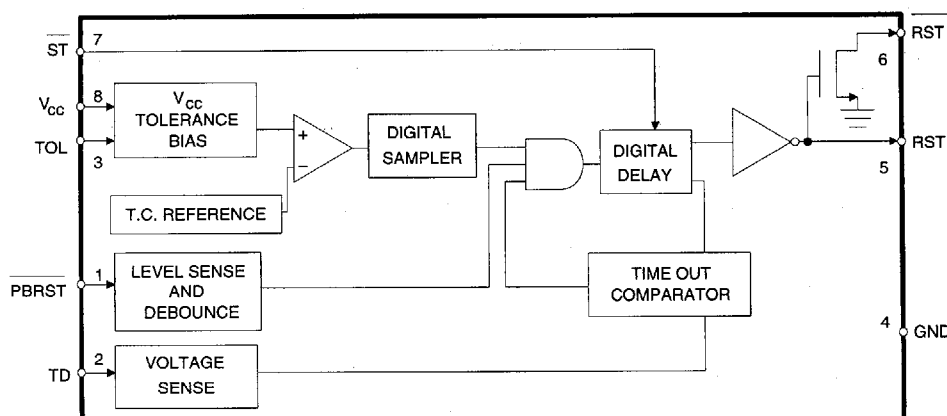
The pushbutton reset control input is debounced and the active reset minimum pulse width of 250 ms is guaranteed.

The internal watchdog timer forces the reset signals active if the strobe input is not driven low prior to time out. The CS1232 timer can be set to operate at time out settings of approximately 150ms, 600ms, and 1.2 seconds.

A surface mount 16-pin SOIC is available, as well as an 8-pin Plastic DIP.

### ORDERING INFORMATION:

| Model            | Temp. Range      | Package           |
|------------------|------------------|-------------------|
| CS1232-CP        | 0 °C to 70 °C    | 8-pin Plastic DIP |
| CS1232-IP        | -40 °C to +85 °C | 8-pin Plastic DIP |
| CS1232-CS        | 0 °C to 70 °C    | 16-pin SOIC       |
| CS1232-IS        | -40 °C to +85 °C | 16-pin SOIC       |
| <b>Die Only:</b> |                  |                   |
| CS1232-YU        |                  | Unpackaged Die    |



**ANALOG CHARACTERISTICS** ( $T_{MIN}$  to  $T_{MAX}$ ,  $V_{CC} = 4.5$  to  $5.5V$ )

| Parameter                  |          | Symbol                          | Min          | Typ          | Max          | Units  |
|----------------------------|----------|---------------------------------|--------------|--------------|--------------|--------|
| V <sub>CC</sub> Trip Point | (Note 1) | TOL = GND<br>V <sub>CC</sub> TP | 4.50<br>4.25 | 4.62<br>4.37 | 4.74<br>4.49 | V<br>V |
| Operating Current          | (Note 2) | I <sub>CC</sub>                 | -            | 0.4          | 2.0          | mA     |

Notes: 1. All voltages referenced to ground.  
2. Measured with outputs open.

**RECOMMENDED OPERATING CONDITIONS**

| Parameter             |                    | Symbol          | Min      | Typ    | Max        | Units    |
|-----------------------|--------------------|-----------------|----------|--------|------------|----------|
| Operating Temperature | CS1232<br>CS1232-I |                 | 0<br>-40 | -<br>- | +70<br>+85 | °C<br>°C |
| Supply voltage        | (Note 1)           | V <sub>CC</sub> | 4.5      | 5.0    | 5.5        | V        |

**DIGITAL CHARACTERISTICS** ( $T_{MIN}$  to  $T_{MAX}$ ,  $V_{CC} = 4.5V$  to  $5.5V$ )

| Parameter                                               |                       | Symbol           | Min                  | Typ                  | Max                  | Units   |
|---------------------------------------------------------|-----------------------|------------------|----------------------|----------------------|----------------------|---------|
| $\overline{ST}$ and $\overline{PBRST}$ Input High Level | (Note 1)              | V <sub>IH</sub>  | 2.0                  | -                    | V <sub>CC</sub> +0.3 | V       |
| $\overline{ST}$ and $\overline{PBRST}$ Input Low Level  | (Note 1)              | V <sub>IL</sub>  | -0.3                 | -                    | +0.8                 | V       |
| Output High Current at 2.4 V RST only                   |                       | I <sub>OH</sub>  | -8.0                 | -10.0                | -                    | mA      |
| Output High Voltage at -500 $\mu$ A RST only            | (Note 3)              | V <sub>OH</sub>  | V <sub>CC</sub> -0.5 | V <sub>CC</sub> -0.1 | -                    | V       |
| Output Low Current at 0.4 V RST, $\overline{RST}$       |                       | I <sub>OL</sub>  | 8.0                  | 10.0                 | -                    | mA      |
| Input Leakage                                           | (Note 4)              | I <sub>IL</sub>  | -1.0                 | -                    | +1.0                 | $\mu$ A |
| Input Capacitance                                       | T <sub>A</sub> = 25°C | C <sub>IN</sub>  | -                    | -                    | 5                    | pF      |
| Output Capacitance                                      | T <sub>A</sub> = 25°C | C <sub>OUT</sub> | -                    | -                    | 7                    | pF      |

Notes: 3. On power-down, RST typically remains within 0.5V of V<sub>CC</sub> (and  $\overline{RST}$  typically remains within 0.5V of GND) until V<sub>CC</sub> falls below 2.0V.  
4.  $\overline{PBRST}$  is internally pulled up to V<sub>CC</sub> with a 100 k $\Omega$  resistor. TD is internally pulled up to V<sub>CC</sub> with a 100 k $\Omega$  resistor and pulled down to ground with a 100 k $\Omega$  resistor.

Specifications are subject to change without notice.

# **ABSOLUTE MAXIMUM RATINGS**

| Parameter                             | Min               | Typ | Max  | Units |
|---------------------------------------|-------------------|-----|------|-------|
| Voltage on Any Pin Relative to Ground | -1.0              | -   | +7.0 | V     |
| Input Current                         | -                 | -   | ±10  | mA    |
| Storage Temperature                   | -55               | -   | +125 | °C    |
| Soldering Temperature                 | 260 °C for 10 sec |     |      |       |

**WARNING:** Operation at or beyond these limits may result in permanent damage to the device.  
Normal operation is not guaranteed at these extremes.

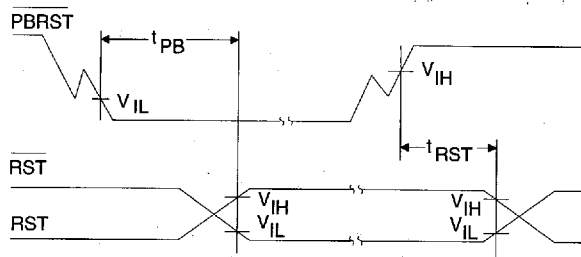
# **SWITCHING CHARACTERISTICS** (T<sub>MIN</sub> to T<sub>MAX</sub>, V<sub>CC</sub> = 5V ± 10%)

| Parameter                                      | Symbol                              | Min             | Typ  | Max  | Units |    |
|------------------------------------------------|-------------------------------------|-----------------|------|------|-------|----|
| PBRST = V <sub>IL</sub>                        | t <sub>PB</sub>                     | -               | 20   | -    | ms    |    |
| RESET Active Time                              | t <sub>RST</sub>                    | 250             | 610  | 1000 | ms    |    |
| ST Pulse Width                                 | t <sub>ST</sub>                     | 20              | -    | -    | ns    |    |
| V <sub>CC</sub> Detect to RST and RST          | t <sub>RPD</sub>                    | -               | -    | 100  | ns    |    |
| V <sub>CC</sub> Slew Rate from 4.75V - 4.25V   | t <sub>F</sub>                      | 300             | -    | -    | μs    |    |
| V <sub>CC</sub> Detect to RST and RST (Note 5) | t <sub>RPU</sub>                    | 250             | 610  | 1000 | ms    |    |
| V <sub>CC</sub> Slew Rate from 4.25V - 4.75V   | t <sub>R</sub>                      | 0               | -    | -    | ns    |    |
| ST Pulse Period (Note 6)                       | TD pin at Ground                    | t <sub>TD</sub> | 50.0 | 150  | 250   | ms |
|                                                | TD pin floating                     | t <sub>TD</sub> | 250  | 600  | 1000  | ms |
|                                                | TD pin connected to V <sub>CC</sub> | t <sub>TD</sub> | 400  | 1200 | 2000  | ms |

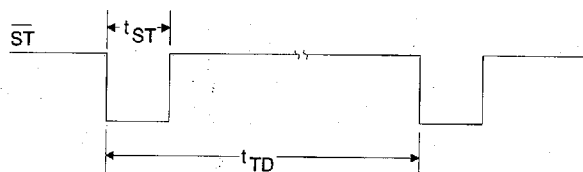
Note: 5. t<sub>R</sub> = 5 µs

6. t<sub>TD</sub> is the maximum elapsed time between ST pulses which will keep the watchdog timer from forcing RST and RST to the active state for a time of t<sub>RST</sub>.

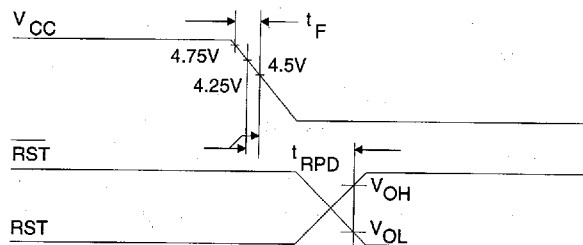
7. RST is an N-channel open drain output.



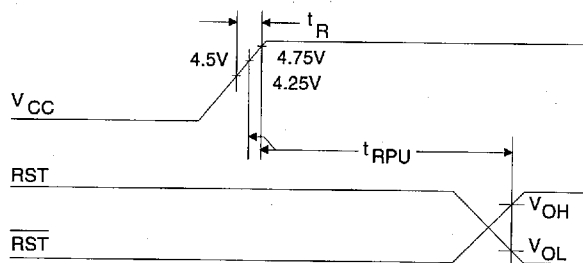
**Timing Diagram—Pushbutton Reset**



**Timing Diagram—Strobe Input**



**Timing Diagram—Power Down**



**Timing Diagram—Power Up**

### POWER SUPPLY MONITOR

The CS1232 will detect out-of-tolerance power supplies for processor-based systems as well as warn of an impending power failure. The TOL digital input pin defines the threshold level for VCC; when the VCC level drops below the TOL defined level, the CS1232 asserts the signals RST and  $\overline{\text{RST}}$ . The threshold level is set to typically 4.37 V if TOL is connected to VCC, and is set to typically 4.62 V if TOL is connected to GND. The processor is allowed to continue until the last possible moment that VCC is valid. Upon return of power, RST and  $\overline{\text{RST}}$  are active for 250 ms (minimum) to allow stabilization.

### PUSHBUTTON RESET CONTROL

$\overline{\text{PBRST}}$  is normally connected to a reset push-button (see Figure 1). This active low signal is debounced and timed to generate signals of 250 ms (minimum) for RST and  $\overline{\text{RST}}$ . The delay begins when  $\overline{\text{PBRST}}$  is released from the low state.  $\overline{\text{PBRST}}$  has an internal 100 k $\Omega$  pull-up resistor.

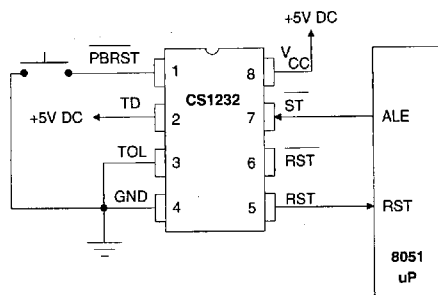


Figure 1. Pushbutton Reset

### WATCHDOG TIMER

When RST and  $\overline{\text{RST}}$  become inactive (normal CPU operation), the watchdog timer starts timing out, using the time set by TD. RST and  $\overline{\text{RST}}$  are forced active when  $\overline{\text{ST}}$  is not stimulated for this predetermined time. TD sets the time to be: 150 ms if TD is connected to ground, 600 ms if TD is not connected, or 1.2 seconds with TD connected to VCC. RST and  $\overline{\text{RST}}$  are driven active for 250 ms (minimum) if no high-to-low transition occurs on the  $\overline{\text{ST}}$  input pin before time out. Microprocessor address signals, data signals, control signals, and output port bits can be used for the  $\overline{\text{ST}}$  input pin. These signals cause the watchdog timer to be reset prior to time out indicating normal function of the microprocessor (see Figure 2).

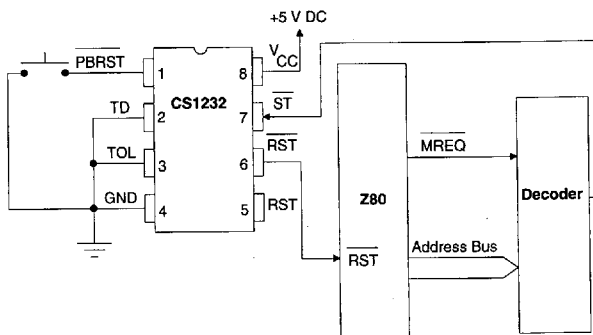


Figure 2. Watchdog Timer

### Schematic & Layout Review Service

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|                          |              |   |   |            |                                       |
|--------------------------|--------------|---|---|------------|---------------------------------------|
| PUSH BUTTON RESET INPUT  | <b>PBRST</b> | 1 | 8 | <b>Vcc</b> | +5 VOLT POWER                         |
| TIME DELAY SET           | <b>TD</b>    | 2 | 7 | <b>ST</b>  | STROBE INPUT                          |
| SELECTS Vcc DETECT LEVEL | <b>TOL</b>   | 3 | 6 | <b>RST</b> | RESET OUTPUT (Active Low, Open Drain) |
| GROUND                   | <b>GND</b>   | 4 | 5 | <b>RST</b> | RESET OUTPUT (Active High)            |

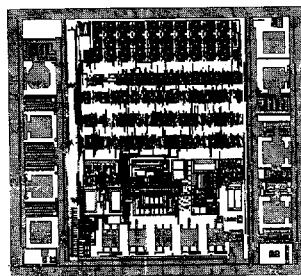
|                          |              |   |    |            |                                       |
|--------------------------|--------------|---|----|------------|---------------------------------------|
| NO CONNECTION            | <b>NC</b>    | 1 | 16 | <b>NC</b>  | NO CONNECT                            |
| PUSH BUTTON RESET INPUT  | <b>PBRST</b> | 2 | 15 | <b>Vcc</b> | +5 VOLT POWER                         |
| NO CONNECT               | <b>NC</b>    | 3 | 14 | <b>NC</b>  | NO CONNECTION                         |
| TIME DELAY SET           | <b>TD</b>    | 4 | 13 | <b>ST</b>  | STROBE INPUT                          |
| NO CONNECT               | <b>NC</b>    | 5 | 12 | <b>NC</b>  | NO CONNECT                            |
| SELECTS Vcc DETECT LEVEL | <b>TOL</b>   | 6 | 11 | <b>RST</b> | RESET OUTPUT (Active Low, Open Drain) |
| NO CONNECT               | <b>NC</b>    | 7 | 10 | <b>NC</b>  | NO CONNECT                            |
| GROUND                   | <b>GND</b>   | 8 | 9  | <b>RST</b> | RESET OUTPUT (Active High)            |

### DIE INFORMATION

Crystal Semiconductor Procedure 42AA00007 outlines the General Requirements for Die Sales. The document includes information on wafer fabrication, manufacturing flow, screening/inspection procedures, packing, shipping, and change notification.

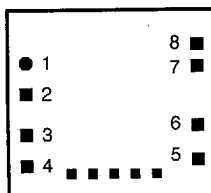
### Assembly Information

1. Die size: 0.061" by 0.069" ( $\pm 0.002$ ").
2. The die is suited for die attach through either eutectic or adhesive means. When eutectic die attach is used, Crystal Semiconductor recommends either a 99.9% Au or 98% Au/2% Si preform of the appropriate size. The backside of the die should be electrically connected to  $V_{CC}$ .
3. Die thickness shall be 0.0175"  $\pm 0.0035$ ". If tighter tolerances are required, contact the factory.
4. The maximum number of die per waffle pack carrier is 100.
5. The cavity dimensions for each die within the waffle pack are 0.080" by 0.080" (Waffle Pack Type H20-080).



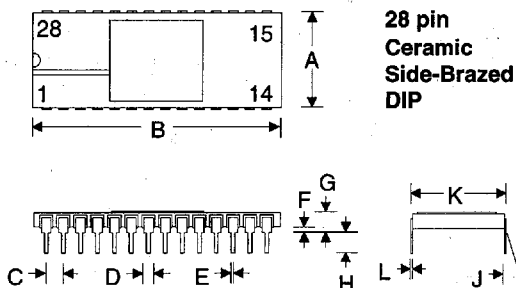
6. The CS1232-YU requires no particular bonding sequence.
7. Each pin of the CS1232 has ESD and latch-up protection circuitry.
8. Technical constraints limit the viability of accurate performance measurements of precision analog IC's at wafer probe. Although high yield to the limits listed in the specification tables is anticipated, no guarantee is given for unpackaged die product.

CS1232-YU Bonding Diagram

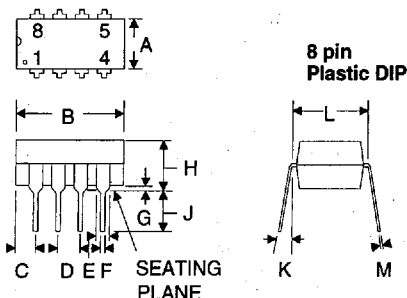


|                        |                      |
|------------------------|----------------------|
| 1 - $\overline{PBRST}$ | 5 - $\overline{RST}$ |
| 2 - TD                 | 6 - $\overline{RST}$ |
| 3 - TOL                | 7 - ST               |
| 4 - GND                | 8 - VCC              |

### MECHANICAL DATA



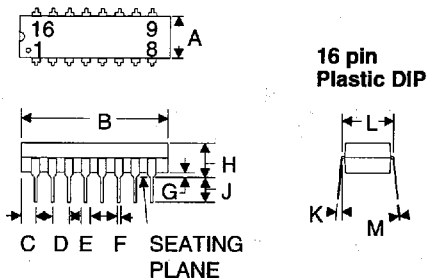
| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 14.73       | 15.34 | 0.580  | 0.604 |
| B   | 35.20       | 35.92 | 1.386  | 1.414 |
| C   | 2.54        | BSC   | 0.100  | BSC   |
| D   | 0.76        | 1.40  | 0.030  | 0.055 |
| E   | 0.38        | 0.53  | 0.015  | 0.021 |
| F   | 1.02        | 1.52  | 0.040  | 0.060 |
| G   | 2.79        | 4.32  | 0.110  | 0.170 |
| H   | 2.54        | 4.57  | 0.100  | 0.180 |
| J   | -           | 10°   | -      | 10°   |
| K   | 14.99       | 15.49 | 0.590  | 0.610 |
| L   | 0.20        | 0.30  | 0.008  | 0.012 |



| DIM | MILLIMETERS |      | INCHES |       |
|-----|-------------|------|--------|-------|
|     | MIN         | MAX  | MIN    | MAX   |
| A   | 6.10        | 6.60 | 0.240  | 0.260 |
| B   | 9.14        | 10.2 | 0.360  | 0.400 |
| C   | 0.38        | 1.52 | 0.015  | 0.060 |
| D   | 2.54        | BSC  | 0.100  | BSC   |
| E   | 1.02        | 1.78 | 0.040  | 0.070 |
| F   | 0.38        | 0.53 | 0.015  | 0.021 |
| G   | 0.51        | 1.02 | 0.020  | 0.040 |
| H   | 3.81        | 5.08 | 0.150  | 0.200 |
| J   | 2.92        | 3.43 | 0.115  | 0.135 |
| K   | 0°          | 10°  | 0°     | 10°   |
| L   | 7.62        | BSC  | 0.300  | BSC   |
| M   | 0.20        | 0.38 | 0.008  | 0.015 |

#### NOTES:

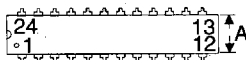
1. POSITIONAL TOLERANCE OF LEADS SHALL BE WITHIN 0.13MM (0.005") AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH.



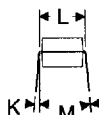
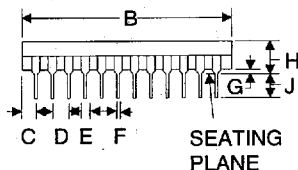
| DIM | MILLIMETERS |       | INCHES |       |
|-----|-------------|-------|--------|-------|
|     | MIN         | MAX   | MIN    | MAX   |
| A   | 6.10        | 6.60  | 0.240  | 0.260 |
| B   | 18.80       | 19.30 | 0.740  | 0.760 |
| C   | 1.32        | 2.89  | 0.015  | 0.035 |
| D   | 2.54        | BSC   | 0.100  | BSC   |
| E   | 1.02        | 1.78  | 0.040  | 0.070 |
| F   | 0.38        | 0.53  | 0.015  | 0.021 |
| G   | 0.51        | 1.02  | 0.020  | 0.040 |
| H   | 3.81        | 5.08  | 0.150  | 0.200 |
| J   | 2.92        | 3.43  | 0.115  | 0.135 |
| K   | 0°          | 10°   | 0°     | 10°   |
| L   | 7.62        | BSC   | 0.300  | BSC   |
| M   | 0.20        | 0.38  | 0.008  | 0.015 |

#### NOTES:

1. POSITIONAL TOLERANCE OF LEADS SHALL BE WITHIN 0.13MM (0.005") AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH.



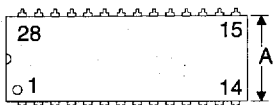
24 pin  
Plastic  
Skinny DIP



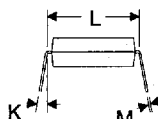
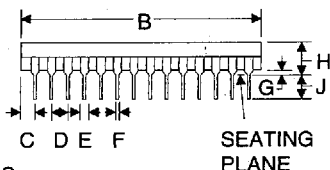
NOTES:

1. POSITIONAL TOLERANCE OF LEADS SHALL BE WITHIN 0.25MM (0.010") AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 6.10        | 6.60  | 0.240     | 0.260 |
| B   | 31.37       | 32.13 | 1.235     | 1.265 |
| C   | 1.65        | 2.16  | 0.065     | 0.085 |
| D   | 2.54 BSC    |       | 0.100 BSC |       |
| E   | 1.02        | 1.52  | 0.040     | 0.060 |
| F   | 0.36        | 0.56  | 0.014     | 0.022 |
| G   | 0.51        | 1.02  | 0.020     | 0.040 |
| H   | 3.94        | 4.57  | 0.155     | 0.180 |
| J   | 2.92        | 3.43  | 0.115     | 0.135 |
| K   | 0°          | 15°   | 0°        | 15°   |
| L   | 7.62 BSC    |       | 0.300 BSC |       |
| M   | 0.20        | 0.38  | 0.008     | 0.015 |



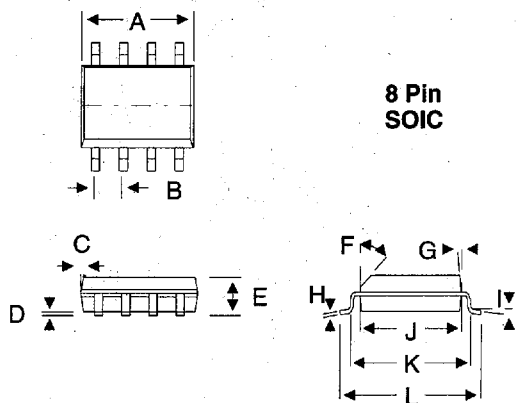
28 pin  
Plastic DIP



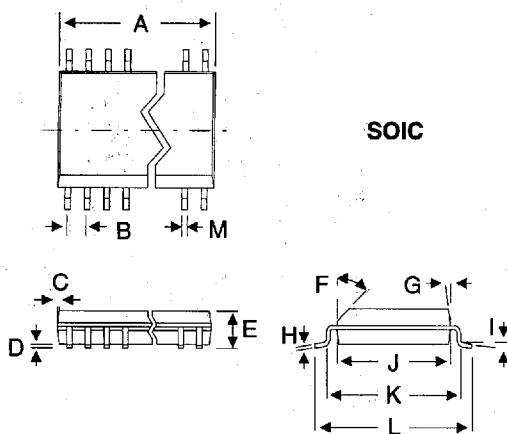
NOTES:

1. POSITIONAL TOLERANCE OF LEADS SHALL BE WITHIN 0.25MM (0.010") AT MAXIMUM MATERIAL CONDITION, IN RELATION TO SEATING PLANE AND EACH OTHER.
2. DIMENSION L TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSION A DOES NOT INCLUDE MOLD FLASH.

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 13.72       | 14.22 | 0.540     | 0.560 |
| B   | 36.45       | 37.21 | 1.435     | 1.465 |
| C   | 1.65        | 2.16  | 0.065     | 0.085 |
| D   | 2.54 BSC    |       | 0.100 BSC |       |
| E   | 1.02        | 1.52  | 0.040     | 0.060 |
| F   | 0.36        | 0.56  | 0.014     | 0.022 |
| G   | 0.51        | 1.02  | 0.020     | 0.040 |
| H   | 3.94        | 5.08  | 0.155     | 0.200 |
| J   | 2.92        | 3.43  | 0.115     | 0.135 |
| K   | 0°          | 15°   | 0°        | 15°   |
| L   | 15.24 BSC   |       | 0.600 BSC |       |
| M   | 0.20        | 0.38  | 0.008     | 0.015 |



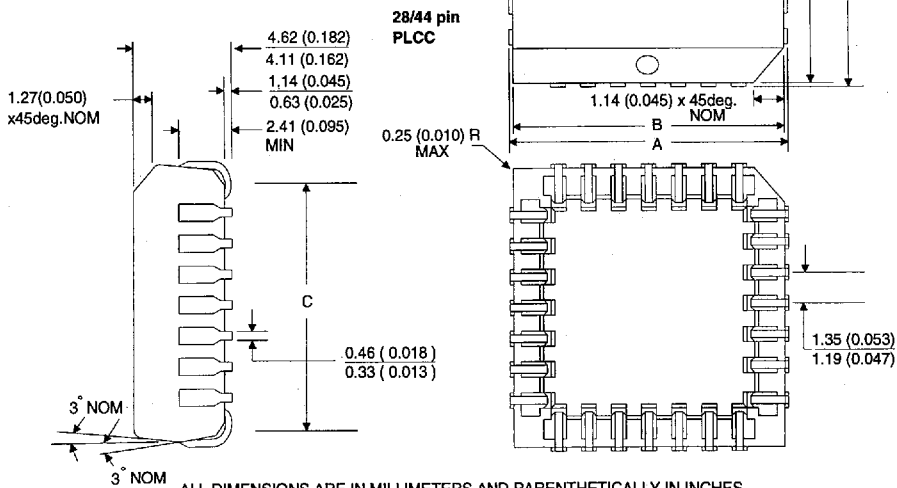
| DIM | MILLIMETERS |       | INCHES    |        |
|-----|-------------|-------|-----------|--------|
|     | MIN         | MAX   | MIN       | MAX    |
| A   | 5.25        | 5.30  | 0.207     | 0.209  |
| B   | 1.27 TYP    |       | 0.050 TYP |        |
| C   | 7° NOM      |       | 7° NOM    |        |
| D   | 0.120       | 0.180 | 0.005     | 0.007  |
| E   | 1.80        | 1.86  | 0.071     | 0.073  |
| F   | 45° NOM     |       | 45° NOM   |        |
| G   | 7° NOM      |       | 7° NOM    |        |
| H   | 0.195       | 0.205 | 0.0078    | 0.0082 |
| I   | 2°          | 4°    | 2°        | 4°     |
| J   | -           | -     | -         | -      |
| K   | 6.57        | 6.63  | 0.259     | 0.261  |
| L   | 7.85        | 7.95  | 0.308     | 0.312  |



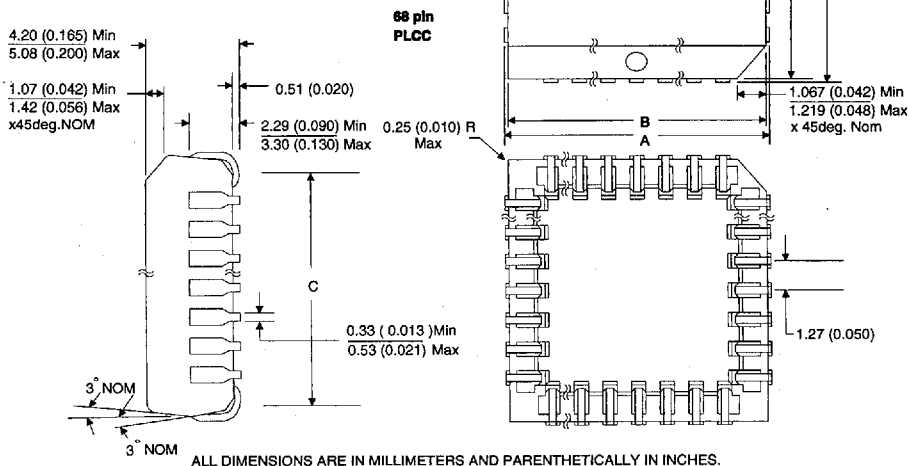
| pins | MILLIMETERS |       | INCHES |       |
|------|-------------|-------|--------|-------|
|      | MIN         | MAX   | MIN    | MAX   |
| 16   | 9.91        | 10.41 | 0.390  | 0.410 |
| 20   | 12.45       | 12.95 | 0.490  | 0.510 |
| 24   | 14.99       | 15.50 | 0.590  | 0.610 |
| 28   | 17.53       | 18.03 | 0.690  | 0.710 |

| DIM | MILLIMETERS     |       | INCHES  |       |
|-----|-----------------|-------|---------|-------|
|     | MIN             | MAX   | MIN     | MAX   |
| A   | see table above |       |         |       |
| B   | 1.27            | BSC   | 0.050   | BSC   |
| C   | 7° NOM          |       | 7° NOM  |       |
| D   | 0.127           | 0.330 | 0.005   | 0.013 |
| E   | 2.41            | 2.67  | 0.095   | 0.105 |
| F   | 45° NOM         |       | 45° NOM |       |
| G   | 7° NOM          |       | 7° NOM  |       |
| H   | 0.203           | 0.381 | 0.008   | 0.015 |
| I   | 2°              | 8°    | 2°      | 8°    |
| J   | 7.42            | 7.59  | 0.292   | 0.298 |
| K   | 8.76            | 9.02  | 0.345   | 0.355 |
| L   | 10.16           | 10.67 | 0.400   | 0.420 |
| M   | 0.33            | 0.51  | 0.013   | 0.020 |

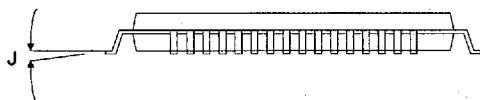
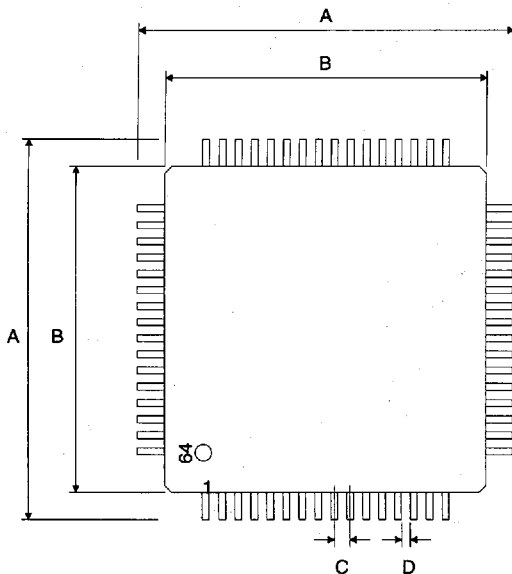
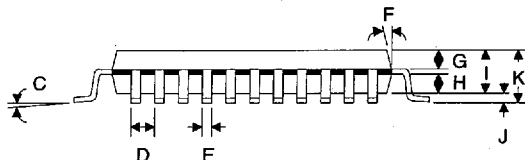
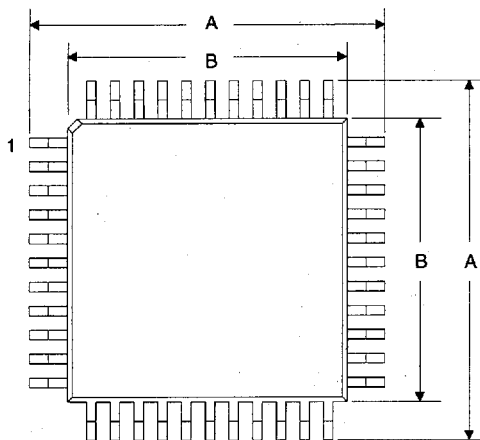
| NO. OF<br>TERMINAL | A                |                  | B                |                  | C                |                  |
|--------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|                    | MIN              | MAX              | MIN              | MAX              | MIN              | MAX              |
| 28                 | 12.32<br>(0.485) | 12.57<br>(0.495) | 11.43<br>(0.450) | 11.58<br>(0.456) | 9.91<br>(0.390)  | 10.92<br>(0.430) |
| 44                 | 17.40<br>(0.685) | 17.65<br>(0.695) | 16.51<br>(0.650) | 16.66<br>(0.656) | 14.98<br>(0.590) | 16.00<br>(0.630) |



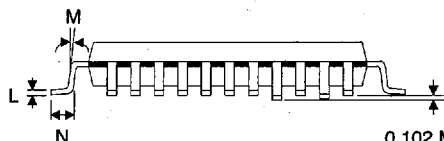
|    | A                |                  | B                |                  | C                |                  |
|----|------------------|------------------|------------------|------------------|------------------|------------------|
|    | MIN              | MAX              | MIN              | MAX              | MIN              | MAX              |
| 68 | 25.02<br>(0.985) | 25.27<br>(0.995) | 24.13<br>(0.950) | 24.33<br>(0.958) | 22.61<br>(0.890) | 23.62<br>(0.930) |



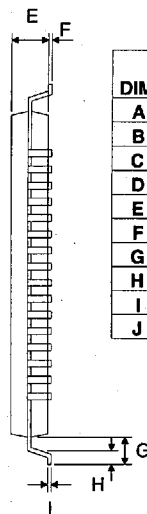
### 44 PIN QUAD FLATPACK



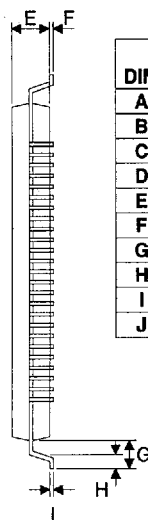
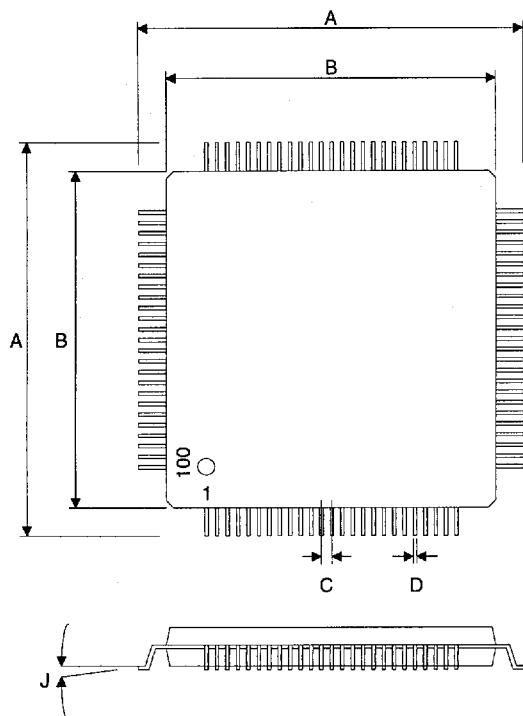
| 44 Pin TQFP              |             |       |           |       |
|--------------------------|-------------|-------|-----------|-------|
| 1.4 mm Package Thickness |             |       |           |       |
| DIM                      | MILLIMETERS |       | INCHES    |       |
|                          | MIN         | MAX   | MIN       | MAX   |
| A                        | 11.75       | 12.25 | 0.463     | 0.482 |
| B                        | 9.90        | 10.10 | 0.390     | 0.398 |
| C                        | 0°          | 7°    | 0°        | 7°    |
| D                        | 0.80 BSC    |       | 0.031 BSC |       |
| E                        | 0.35 BSC    |       | 0.014 BSC |       |
| F                        | 120         |       | 120       |       |
| G                        | 0.54        | 0.74  | 0.021     | 0.029 |
| H                        | 0.54        | 0.74  | 0.021     | 0.029 |
| I                        | 1.35        | 1.50  | 0.053     | 0.059 |
| J                        | 0.05        |       | 0.002     |       |
| K                        |             | 1.60  |           | 0.063 |
| L                        |             | 0.17  |           | 0.007 |
| M                        | 2°          | 10°   | 2°        | 10°   |
| N                        | 0.35        | 0.65  | 0.014     | 0.026 |



0.102 MAX  
Lead Coplanarity



| 64 Pin TQFP |             |      |           |       |
|-------------|-------------|------|-----------|-------|
| DIM         | MILLIMETERS |      | INCHES    |       |
|             | MIN         | MAX  | MIN       | MAX   |
| A           | 12.00 BSC   |      | 0.472 BSC |       |
| B           | 10.00 BSC   |      | 0.393 BSC |       |
| C           | 0.50 BSC    |      | 0.020 BSC |       |
| D           | 0.14        | 0.30 | 0.005     | 0.012 |
| E           | 0.95        | 1.12 | 0.037     | 0.044 |
| F           | 0.05        | 0.15 | 0.002     | 0.006 |
| G           | 1.00 BSC    |      | 0.039 BSC |       |
| H           | 0.45        | 0.75 | 0.018     | 0.030 |
| I           | 0.09        | 0.18 | 0.003     | 0.007 |
| J           | 0°          | 7°   | 0°        | 7°    |



100-pin TQFP

| DIM | MILLIMETERS |       | INCHES    |       |
|-----|-------------|-------|-----------|-------|
|     | MIN         | MAX   | MIN       | MAX   |
| A   | 15.75       | 16.25 | 0.620     | 0.640 |
| B   | 13.90       | 14.10 | 0.547     | 0.555 |
| C   | 0.50 BSC    |       | 0.020 BSC |       |
| D   | 0.10        | 0.20  | 0.004     | 0.012 |
| E   | 1.25        | 1.55  | 0.049     | 0.061 |
| F   | 0.00        | 0.20  | 0.000     | 0.008 |
| G   | 1.00 BSC    |       | 0.039 BSC |       |
| H   | 0.35        | 0.65  | 0.014     | 0.026 |
| I   | 0.077       | 0.177 | 0.003     | 0.007 |
| J   | 0°          | 10°   | 0°        | 10°   |