



# TC7106/A/TC7107/A

## 3-1/2 Digit Analog-to-Digital Converters

### Features

- Internal Reference with Low Temperature Drift
  - TC7106/7: 80ppm/°C Typical
  - TC7106A/7A: 20ppm/°C Typical
- Drives LCD (TC7106) or LED (TC7107) Display Directly
- Zero Reading with Zero Input
- Low Noise for Stable Display
- Auto-Zero Cycle Eliminates Need for Zero Adjustment
- True Polarity Indication for Precision Null Applications
- Convenient 9V Battery Operation (TC7106A)
- High Impedance CMOS Differential Inputs:  $10^{12}\Omega$
- Differential Reference Inputs Simplify Ratiometric Measurements
- Low Power Operation: 10mW

### Applications

- Thermometry
- Bridge Readouts: Strain Gauges, Load Cells, Null Detectors
- Digital Meters: Voltage/Current/Ohms/Power, pH
- Digital Scales, Process Monitors
- Portable Instrumentation

### Device Selection Table

| Package Code | Package       | Pin Layout   | Temperature Range |
|--------------|---------------|--------------|-------------------|
| CPI          | 40-Pin PDIP   | Normal       | 0°C to +70°C      |
| IPL          | 40-Pin PDIP   | Normal       | -25°C to +85°C    |
| IJL          | 40-Pin CERDIP | Normal       | -25°C to +85°C    |
| CKW          | 44-Pin PQFP   | Formed Leads | 0°C to +70°C      |
| CLW          | 44-Pin PLCC   | —            | 0°C to +70°C      |

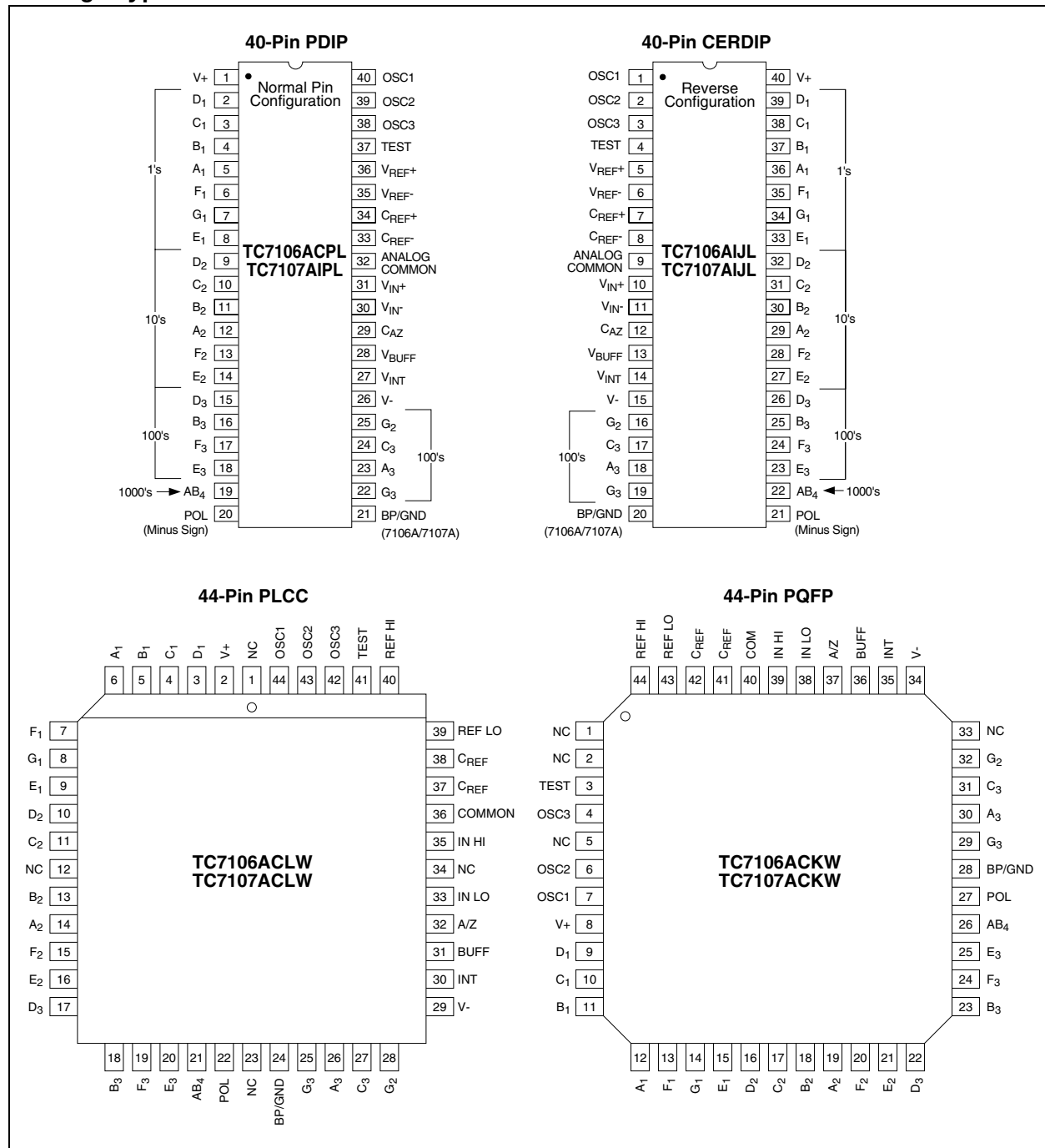
### General Description

The TC7106A and TC7107A 3-1/2 digit direct display drive analog-to-digital converters allow existing 7106/7107 based systems to be upgraded. Each device has a precision reference with a 20ppm/°C max temperature coefficient. This represents a 4 to 7 times improvement over similar 3-1/2 digit converters. Existing 7106 and 7107 based systems may be upgraded without changing external passive component values. The TC7107A drives common anode light emitting diode (LED) displays directly with 8mA per segment. A low cost, high resolution indicating meter requires only a display, four resistors, and four capacitors. The TC7106A low power drain and 9V battery operation make it suitable for portable applications.

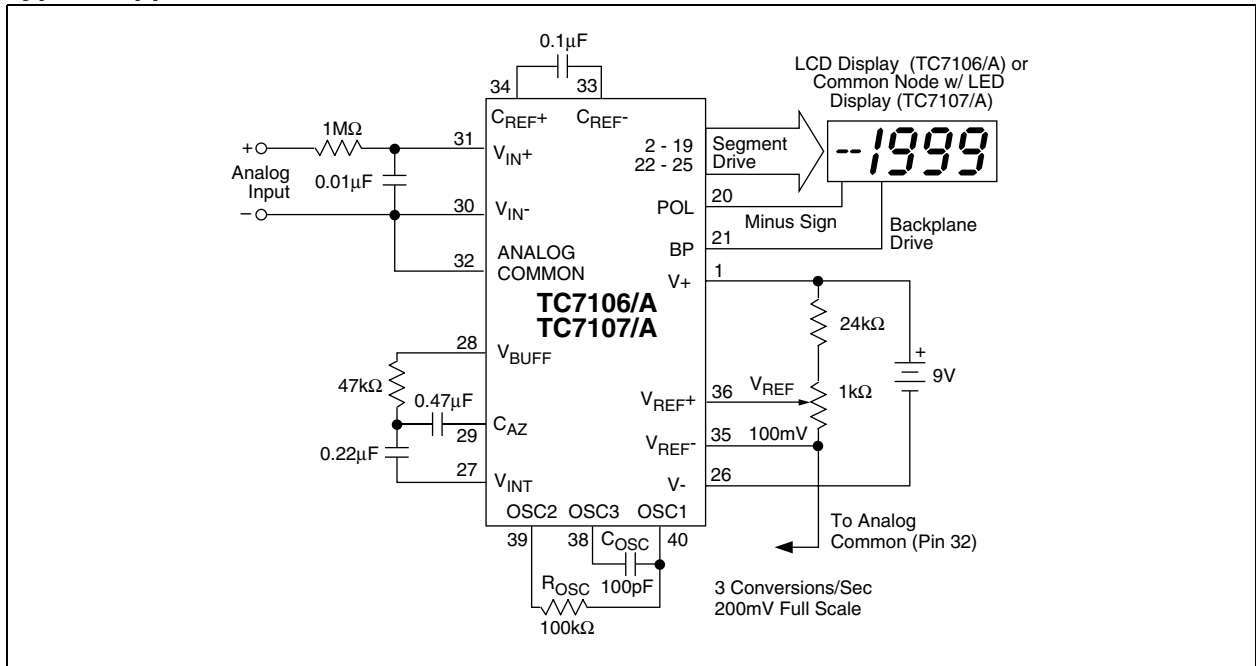
The TC7106A/TC7107A reduces linearity error to less than 1 count. Rollover error – the difference in readings for equal magnitude, but opposite polarity input signals, is below  $\pm 1$  count. High impedance differential inputs offer 1pA leakage current and a  $10^{12}\Omega$  input impedance. The differential reference input allows ratiometric measurements for ohms or bridge transducer measurements. The  $15\mu V_{P-P}$  noise performance ensures a “rock solid” reading. The auto-zero cycle ensures a zero display reading with a zero volts input.

# TC7106/A/TC7107/A

## Package Type



## Typical Application



# TC7106/A/TC7107/A

## 1.0 ELECTRICAL CHARACTERISTICS

### Absolute Maximum Ratings\*

#### TC7106A

Supply Voltage (V+ to V-) ..... 15V  
Analog Input Voltage (either Input) (**Note 1**) ... V+ to V-  
Reference Input Voltage (either Input) ..... V+ to V-  
Clock Input ..... Test to V+  
Package Power Dissipation ( $T_A \leq 70^\circ\text{C}$ ) (**Note 2**):  
40-Pin Cerdip ..... 2.29W  
40-Pin PDIP ..... 1.23W  
44-Pin PLCC ..... 1.23W  
44-Pin PQFP ..... 1.00W

Operating Temperature Range:

C (Commercial) Devices .....  $0^\circ\text{C}$  to  $+70^\circ\text{C}$   
I (Industrial) Devices .....  $-25^\circ\text{C}$  to  $+85^\circ\text{C}$

Storage Temperature Range .....  $-65^\circ\text{C}$  to  $+150^\circ\text{C}$

#### TC7107A

Supply Voltage (V+) ..... +6V  
Supply Voltage (V-) ..... -9V  
Analog Input Voltage (either Input) (**Note 1**) ... V+ to V-  
Reference Input Voltage (either Input) ..... V+ to V-  
Clock Input ..... GND to V+  
Package Power Dissipation ( $T_A \leq 70^\circ\text{C}$ ) (**Note 2**):  
40-Pin Cerdip ..... 2.29W  
40-Pin PDIP ..... 1.23W  
44-Pin PLCC ..... 1.23W  
44-Pin PQFP ..... 1.00W

Operating Temperature Range:

C (Commercial) Devices .....  $0^\circ\text{C}$  to  $+70^\circ\text{C}$   
I (Industrial) Devices .....  $-25^\circ\text{C}$  to  $+85^\circ\text{C}$

Storage Temperature Range .....  $-65^\circ\text{C}$  to  $+150^\circ\text{C}$

\*Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these or any other conditions above those indicated in the operation sections of the specifications is not implied. Exposure to Absolute Maximum Rating conditions for extended periods may affect device reliability.

## TC7106/A AND TC7107/A ELECTRICAL SPECIFICATIONS

| Electrical Characteristics: Unless otherwise noted, specifications apply to both the TC7106/A and TC7107/A at $T_A = 25^\circ\text{C}$ , $f_{\text{CLOCK}} = 48\text{kHz}$ . Parts are tested in the circuit of the Typical Operating Circuit. |                                                                                                |        |             |        |                 |                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|--------|-------------|--------|-----------------|---------------------------------------------------------------------|
| Symbol                                                                                                                                                                                                                                         | Parameter                                                                                      | Min    | Typ         | Max    | Unit            | Test Conditions                                                     |
| $Z_{\text{IR}}$                                                                                                                                                                                                                                | Zero Input Reading                                                                             | -000.0 | $\pm 000.0$ | +000.0 | Digital Reading | $V_{\text{IN}} = 0.0\text{V}$<br>Full Scale = 200.0mV               |
|                                                                                                                                                                                                                                                | Ratiometric Reading                                                                            | 999    | 999/1000    | 1000   | Digital Reading | $V_{\text{IN}} = V_{\text{REF}}$<br>$V_{\text{REF}} = 100\text{mV}$ |
| R/O                                                                                                                                                                                                                                            | Rollover Error (Difference in Reading for Equal Positive and Negative Reading Near Full Scale) | -1     | $\pm 0.2$   | +1     | Counts          | $V_{\text{IN}} = +V_{\text{IN}} \pm 200\text{mV}$                   |
|                                                                                                                                                                                                                                                | Linearity (Max. Deviation from Best Straight Line Fit)                                         | -1     | $\pm 0.2$   | +1     | Counts          | Full Scale = 200mV or<br>Full Scale = 2.000V                        |

- Note 1:** Input voltages may exceed the supply voltages, provided the input current is limited to  $\pm 100\mu\text{A}$ .  
**Note 2:** Dissipation rating assumes device is mounted with all leads soldered to printed circuit board.  
**Note 3:** Refer to "Differential Input" discussion.  
**Note 4:** Backplane drive is in phase with segment drive for "OFF" segment,  $180^\circ$  out of phase for "ON" segment. Frequency is 20 times conversion rate. Average DC component is less than 50mV.

# TC7106/A/TC7107/A

## TC7106/A AND TC7107/A ELECTRICAL SPECIFICATIONS (CONTINUED)

| <b>Electrical Characteristics:</b> Unless otherwise noted, specifications apply to both the TC7106/A and TC7107/A at $T_A = 25^\circ\text{C}$ , $f_{\text{CLOCK}} = 48\text{kHz}$ . Parts are tested in the circuit of the Typical Operating Circuit. |                                                                            |                    |          |         |                                                |                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------|--------------------|----------|---------|------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| Symbol                                                                                                                                                                                                                                                | Parameter                                                                  | Min                | Typ      | Max     | Unit                                           | Test Conditions                                                                                                                     |
| CMRR                                                                                                                                                                                                                                                  | Common Mode Rejection Ratio ( <b>Note 3</b> )                              | —                  | 50       | —       | $\mu\text{V/V}$                                | $V_{\text{CM}} = \pm 1\text{V}$ , $V_{\text{IN}} = 0\text{V}$ , Full Scale = 200.0mV                                                |
| $e_N$                                                                                                                                                                                                                                                 | Noise (Peak to Peak Value not Exceeded 95% of Time)                        | —                  | 15       | —       | $\mu\text{V}$                                  | $V_{\text{IN}} = 0\text{V}$<br>Full Scale - 200.0mV                                                                                 |
| $I_L$                                                                                                                                                                                                                                                 | Leakage Current at Input                                                   | —                  | 1        | 10      | pA                                             | $V_{\text{IN}} = 0\text{V}$                                                                                                         |
|                                                                                                                                                                                                                                                       | Zero Reading Drift                                                         | —                  | 0.2      | 1       | $\mu\text{V}/^\circ\text{C}$                   | $V_{\text{IN}} = 0\text{V}$<br>"C" Device = $0^\circ\text{C}$ to $+70^\circ\text{C}$                                                |
|                                                                                                                                                                                                                                                       |                                                                            | —                  | 1.0      | 2       | $\mu\text{V}/^\circ\text{C}$                   | $V_{\text{IN}} = 0\text{V}$<br>"I" Device = $-25^\circ\text{C}$ to $+85^\circ\text{C}$                                              |
| TC <sub>SF</sub>                                                                                                                                                                                                                                      | Scale Factor Temperature Coefficient                                       | —                  | 1        | 5       | ppm/ $^\circ\text{C}$                          | $V_{\text{IN}} = 199.0\text{mV}$ ,<br>"C" Device = $0^\circ\text{C}$ to $+70^\circ\text{C}$<br>(Ext. Ref = 0ppm/ $^\circ\text{C}$ ) |
|                                                                                                                                                                                                                                                       |                                                                            | —                  | —        | 20      | ppm/ $^\circ\text{C}$                          | $V_{\text{IN}} = 199.0\text{mV}$<br>"I" Device = $-25^\circ\text{C}$ to $+85^\circ\text{C}$                                         |
| $I_{\text{DD}}$                                                                                                                                                                                                                                       | Supply Current (Does not include LED Current For TC7107/A)                 | —                  | 0.8      | 1.8     | mA                                             | $V_{\text{IN}} = 0.8$                                                                                                               |
| $V_C$                                                                                                                                                                                                                                                 | Analog Common Voltage (with Respect to Positive Supply)                    | 2.7                | 3.05     | 3.35    | V                                              | 25k $\Omega$ Between Common and Positive Supply                                                                                     |
| $V_{\text{CTC}}$                                                                                                                                                                                                                                      | Temperature Coefficient of Analog Common (with Respect to Positive Supply) | —                  | —        | —       | —                                              | 25k $\Omega$ Between Common and Positive Supply                                                                                     |
|                                                                                                                                                                                                                                                       |                                                                            | 7106/7/A<br>7106/7 | 20<br>80 | 50<br>— | ppm/ $^\circ\text{C}$<br>ppm/ $^\circ\text{C}$ | $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$<br>("C" Commercial Temperature Range Devices)                                     |
| $V_{\text{CTC}}$                                                                                                                                                                                                                                      | Temperature Coefficient of Analog Common (with Respect to Positive Supply) | —                  | —        | 75      | ppm/ $^\circ\text{C}$                          | $0^\circ\text{C} \leq T_A \leq +70^\circ\text{C}$<br>("I" Industrial Temperature Range Devices)                                     |
| $V_{\text{SD}}$                                                                                                                                                                                                                                       | TC7106A ONLY Peak to Peak Segment Drive Voltage                            | 4                  | 5        | 6       | V                                              | $V_+$ to $V_- = 9\text{V}$<br>( <b>Note 4</b> )                                                                                     |
| $V_{\text{BD}}$                                                                                                                                                                                                                                       | TC7106A ONLY Peak to Peak Backplane Drive Voltage                          | 4                  | 5        | 6       | V                                              | $V_+$ to $V_- = 9\text{V}$<br>( <b>Note 4</b> )                                                                                     |
|                                                                                                                                                                                                                                                       | TC7107A ONLY Segment Sinking Current (Except Pin 19)                       | 5                  | 8.0      | —       | mA                                             | $V_+ = 5.0\text{V}$<br>Segment Voltage = 3V                                                                                         |
|                                                                                                                                                                                                                                                       | TC7107A ONLY Segment Sinking Current (Pin 19)                              | 10                 | 16       | —       | mA                                             | $V_+ = 5.0\text{V}$<br>Segment Voltage = 3V                                                                                         |

- Note 1:** Input voltages may exceed the supply voltages, provided the input current is limited to  $\pm 100\mu\text{A}$ .
- Note 2:** Dissipation rating assumes device is mounted with all leads soldered to printed circuit board.
- Note 3:** Refer to "Differential Input" discussion.
- Note 4:** Backplane drive is in phase with segment drive for "OFF" segment,  $180^\circ$  out of phase for "ON" segment. Frequency is 20 times conversion rate. Average DC component is less than 50mV.

# TC7106/A/TC7107/A

## 2.0 PIN DESCRIPTIONS

The descriptions of the pins are listed in Table 2-1.

TABLE 2-1: PIN FUNCTION TABLE

| Pin Number<br>(40-Pin PDIP)<br>Normal | Pin No.<br>(40-Pin PDIP)<br>(Reversed) | Symbol            | Description                                                                                                                                                                                                                                                     |
|---------------------------------------|----------------------------------------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                                     | (40)                                   | V+                | Positive supply voltage.                                                                                                                                                                                                                                        |
| 2                                     | (39)                                   | D <sub>1</sub>    | Activates the D section of the units display.                                                                                                                                                                                                                   |
| 3                                     | (38)                                   | C <sub>1</sub>    | Activates the C section of the units display.                                                                                                                                                                                                                   |
| 4                                     | (37)                                   | B <sub>1</sub>    | Activates the B section of the units display.                                                                                                                                                                                                                   |
| 5                                     | (36)                                   | A <sub>1</sub>    | Activates the A section of the units display.                                                                                                                                                                                                                   |
| 6                                     | (35)                                   | F <sub>1</sub>    | Activates the F section of the units display.                                                                                                                                                                                                                   |
| 7                                     | (34)                                   | G <sub>1</sub>    | Activates the G section of the units display.                                                                                                                                                                                                                   |
| 8                                     | (33)                                   | E <sub>1</sub>    | Activates the E section of the units display.                                                                                                                                                                                                                   |
| 9                                     | (32)                                   | D <sub>2</sub>    | Activates the D section of the tens display.                                                                                                                                                                                                                    |
| 10                                    | (31)                                   | C <sub>2</sub>    | Activates the C section of the tens display.                                                                                                                                                                                                                    |
| 11                                    | (30)                                   | B <sub>2</sub>    | Activates the B section of the tens display.                                                                                                                                                                                                                    |
| 12                                    | (29)                                   | A <sub>2</sub>    | Activates the A section of the tens display.                                                                                                                                                                                                                    |
| 13                                    | (28)                                   | F <sub>2</sub>    | Activates the F section of the tens display.                                                                                                                                                                                                                    |
| 14                                    | (27)                                   | E <sub>2</sub>    | Activates the E section of the tens display.                                                                                                                                                                                                                    |
| 15                                    | (26)                                   | D <sub>3</sub>    | Activates the D section of the hundreds display.                                                                                                                                                                                                                |
| 16                                    | (25)                                   | B <sub>3</sub>    | Activates the B section of the hundreds display.                                                                                                                                                                                                                |
| 17                                    | (24)                                   | F <sub>3</sub>    | Activates the F section of the hundreds display.                                                                                                                                                                                                                |
| 18                                    | (23)                                   | E <sub>3</sub>    | Activates the E section of the hundreds display.                                                                                                                                                                                                                |
| 19                                    | (22)                                   | AB <sub>4</sub>   | Activates both halves of the 1 in the thousands display.                                                                                                                                                                                                        |
| 20                                    | (21)                                   | POL               | Activates the negative polarity display.                                                                                                                                                                                                                        |
| 21                                    | (20)                                   | BP/GND            | LCD Backplane drive output (TC7106A). Digital Ground (TC7107A).                                                                                                                                                                                                 |
| 22                                    | (19)                                   | G <sub>3</sub>    | Activates the G section of the hundreds display.                                                                                                                                                                                                                |
| 23                                    | (18)                                   | A <sub>3</sub>    | Activates the A section of the hundreds display.                                                                                                                                                                                                                |
| 24                                    | (17)                                   | C <sub>3</sub>    | Activates the C section of the hundreds display.                                                                                                                                                                                                                |
| 25                                    | (16)                                   | G <sub>2</sub>    | Activates the G section of the tens display.                                                                                                                                                                                                                    |
| 26                                    | (15)                                   | V-                | Negative power supply voltage.                                                                                                                                                                                                                                  |
| 27                                    | (14)                                   | V <sub>INT</sub>  | Integrator output. Connection point for integration capacitor. See INTEGRATING CAPACITOR section for more details.                                                                                                                                              |
| 28                                    | (13)                                   | V <sub>BUFF</sub> | Integration resistor connection. Use a 47kΩ resistor for a 200mV full scale range and a 47kΩ resistor for 2V full scale range.                                                                                                                                  |
| 29                                    | (12)                                   | C <sub>AZ</sub>   | The size of the auto-zero capacitor influences system noise. Use a 0.47μF capacitor for 200mV full scale, and a 0.047μF capacitor for 2V full scale. See Section 7.1 on Auto-Zero Capacitor for more details.                                                   |
| 30                                    | (11)                                   | V <sub>IN-</sub>  | The analog LOW input is connected to this pin.                                                                                                                                                                                                                  |
| 31                                    | (10)                                   | V <sub>IN+</sub>  | The analog HIGH input signal is connected to this pin.                                                                                                                                                                                                          |
| 32                                    | (9)                                    | ANALOG COMMON     | This pin is primarily used to set the Analog Common mode voltage for battery operation or in systems where the input signal is referenced to the power supply. It also acts as a reference voltage source. See Section 8.3 on ANALOG COMMON for more details.   |
| 33                                    | (8)                                    | C <sub>REF-</sub> | See Pin 34.                                                                                                                                                                                                                                                     |
| 34                                    | (7)                                    | C <sub>REF+</sub> | A 0.1μF capacitor is used in most applications. If a large Common mode voltage exists (for example, the V <sub>IN-</sub> pin is not at analog common), and a 200mV scale is used, a 1μF capacitor is recommended and will hold the rollover error to 0.5 count. |
| 35                                    | (6)                                    | V <sub>REF-</sub> | See Pin 36.                                                                                                                                                                                                                                                     |

**TABLE 2-1: PIN FUNCTION TABLE (CONTINUED)**

| Pin Number<br>(40-Pin PDIP)<br>Normal | Pin No.<br>(40-Pin PDIP)<br>(Reversed) | Symbol     | Description                                                                                                                                                                                                                                                           |
|---------------------------------------|----------------------------------------|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 36                                    | (5)                                    | $V_{REF+}$ | The analog input required to generate a full scale output (1999 counts). Place 100mV between Pins 35 and 36 for 199.9mV full scale. Place 1V between Pins 35 and 36 for 2V full scale. See paragraph on Reference Voltage.                                            |
| 37                                    | (4)                                    | TEST       | Lamp test. When pulled HIGH (to V+) all segments will be turned on and the display should read -1888. It may also be used as a negative supply for externally generated decimal points. See paragraph under TEST for additional information.                          |
| 38                                    | (3)                                    | OSC3       | See Pin 40.                                                                                                                                                                                                                                                           |
| 39                                    | (2)                                    | OSC2       | See Pin 40.                                                                                                                                                                                                                                                           |
| 40                                    | (1)                                    | OSC1       | Pins 40, 39, 38 make up the oscillator section. For a 48kHz clock (3 readings per section), connect Pin 40 to the junction of a 100k $\Omega$ resistor and a 100pF capacitor. The 100k $\Omega$ resistor is tied to Pin 39 and the 100pF capacitor is tied to Pin 38. |





## 4.0 ANALOG SECTION

In addition to the basic signal integrate and de-integrate cycles discussed, the circuit incorporates an auto-zero cycle. This cycle removes buffer amplifier, integrator, and comparator offset voltage error terms from the conversion. A true digital zero reading results without adjusting external potentiometers. A complete conversion consists of three cycles: an auto-zero, signal integrate and reference integrate cycle.

### 4.1 Auto-Zero Cycle

During the auto-zero cycle, the differential input signal is disconnected from the circuit by opening internal analog gates. The internal nodes are shorted to analog common (ground) to establish a zero input condition. Additional analog gates close a feedback loop around the integrator and comparator. This loop permits comparator offset voltage error compensation. The voltage level established on  $C_{AZ}$  compensates for device offset voltages. The offset error referred to the input is less than  $10\mu V$ .

The auto-zero cycle length is 1000 to 3000 counts.

### 4.2 Signal Integrate Cycle

The auto-zero loop is entered and the internal differential inputs connect to  $V_{IN+}$  and  $V_{IN-}$ . The differential input signal is integrated for a fixed time period. The TC7136/A signal integration period is 1000 clock periods or counts. The externally set clock frequency is divided by four before clocking the internal counters.

The integration time period is:

#### EQUATION 4-1:

$$T_{SI} = \frac{4}{F_{OSC}} \times 1000$$

Where:  $F_{OSC}$  = external clock frequency.

The differential input voltage must be within the device Common mode range when the converter and measured system share the same power supply common (ground). If the converter and measured system do not share the same power supply common,  $V_{IN-}$  should be tied to analog common.

Polarity is determined at the end of signal integrate phase. The sign bit is a true polarity indication, in that signals less than 1LSB are correctly determined. This allows precision null detection limited only by device noise and auto-zero residual offsets.

### 4.3 Reference Integrate Phase

The third phase is reference integrate or de-integrate.  $V_{IN-}$  is internally connected to analog common and  $V_{IN+}$  is connected across the previously charged reference capacitor. Circuitry within the chip ensures that the capacitor will be connected with the correct polarity to cause the integrator output to return to zero.

The time required for the output to return to zero is proportional to the input signal and is between 0 and 2000 counts.

The digital reading displayed is:

#### EQUATION 4-2:

$$1000 = \frac{V_{IN}}{V_{REF}}$$

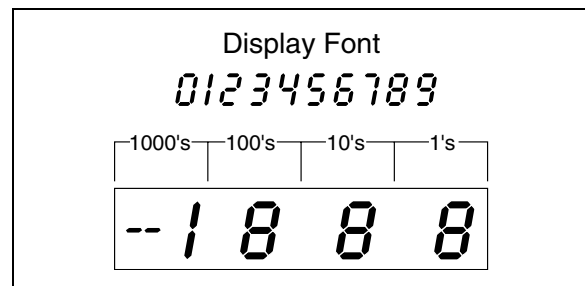
## 5.0 DIGITAL SECTION (TC7106A)

The TC7106A (Figure 5-2) contains all the segment drivers necessary to directly drive a 3-1/2 digit liquid crystal display (LCD). An LCD backplane driver is included. The backplane frequency is the external clock frequency divided by 800. For three conversions/second, the backplane frequency is 60Hz with a 5V nominal amplitude. When a segment driver is in phase with the backplane signal, the segment is "OFF." An out of phase segment drive signal causes the segment to be "ON" or visible. This AC drive configuration results in negligible DC voltage across each LCD segment. This insures long LCD display life. The polarity segment driver is "ON" for negative analog inputs. If  $V_{IN+}$  and  $V_{IN-}$  are reversed, this indicator will reverse.

When the TEST pin on the TC7106A is pulled to  $V+$ , all segments are turned "ON." The display reads -1888. During this mode, the LCD segments have a constant DC voltage impressed. DO NOT LEAVE THE DISPLAY IN THIS MODE FOR MORE THAN SEVERAL MINUTES! LCD displays may be destroyed if operated with DC levels for extended periods.

The display font and the segment drive assignment are shown in Figure 5-1.

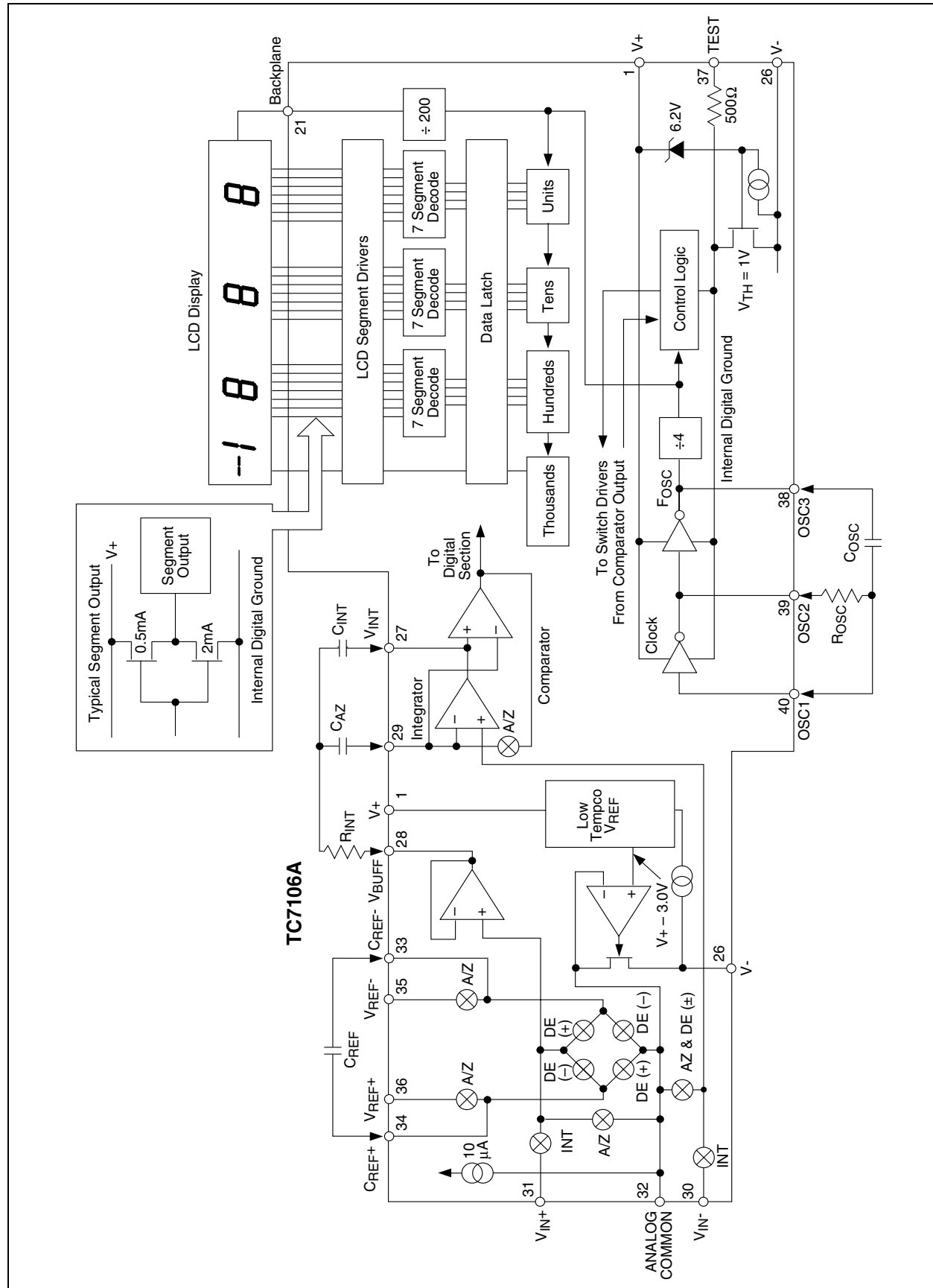
**FIGURE 5-1: DISPLAY FONT AND SEGMENT ASSIGNMENT**



In the TC7106A, an internal digital ground is generated from a 6-volt zener diode and a large P channel source follower. This supply is made stiff to absorb the large capacitive currents when the backplane voltage is switched.

# TC7106/A/TC7107/A

FIGURE 5-2: TC7106A BLOCK DIAGRAM



## 6.0 DIGITAL SECTION (TC7107A)

Figure 6-2 shows a TC7107A block diagram. It is designed to drive common anode LEDs. It is identical to the TC7106A, except that the regulated supply and backplane drive have been eliminated and the segment drive is typically 8mA. The 1000's output (Pin 19) sinks current from two LED segments, and has a 16mA drive capability.

In both devices, the polarity indication is "ON" for negative analog inputs. If  $V_{IN-}$  and  $V_{IN+}$  are reversed, this indication can be reversed also, if desired.

The display font is the same as the TC7106A.

## 6.1 System Timing

The oscillator frequency is divided by 4 prior to clocking the internal decade counters. The four-phase measurement cycle takes a total of 4000 counts, or 16,000 clock pulses. The 4000-count cycle is independent of input signal magnitude.

Each phase of the measurement cycle has the following length:

1. Auto-zero phase: 1000 to 3000 counts (4000 to 12000 clock pulses).

For signals less than full scale, the auto-zero phase is assigned the unused reference integrate time period:

2. Signal integrate: 1000 counts (4000 clock pulses).

This time period is fixed. The integration period is:

### EQUATION 6-1:

$$T_{SI} = 4000 \left( \frac{1}{F_{OSC}} \right)$$

Where:  $F_{OSC}$  is the externally set clock frequency.

3. Reference Integrate: 0 to 2000 counts (0 to 8000 clock pulses).

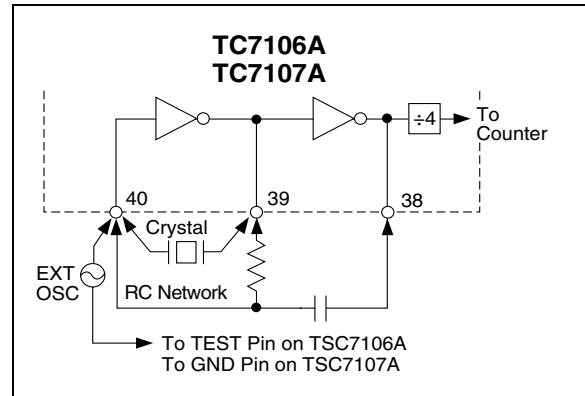
The TC7106A/7107A are drop-in replacements for the 7106/7107 parts. External component value changes are not required to benefit from the low drift internal reference.

## 6.2 Clock Circuit

Three clocking methods may be used (see Figure 6-1):

1. An external oscillator connected to Pin 40.
2. A crystal between Pins 39 and 40.
3. An RC oscillator using all three pins.

FIGURE 6-1: CLOCK CIRCUITS



\_\_\_\_\_

---



## 7.0 COMPONENT VALUE SELECTION

### 7.1 Auto-Zero Capacitor ( $C_{AZ}$ )

The  $C_{AZ}$  capacitor size has some influence on system noise. A  $0.47\mu\text{F}$  capacitor is recommended for 200mV full scale applications where 1LSB is  $100\mu\text{V}$ . A  $0.047\mu\text{F}$  capacitor is adequate for 2.0V full scale applications. A mylar type dielectric capacitor is adequate.

### 7.2 Reference Voltage Capacitor ( $C_{REF}$ )

The reference voltage used to ramp the integrator output voltage back to zero during the reference integrate cycle is stored on  $C_{REF}$ . A  $0.1\mu\text{F}$  capacitor is acceptable when  $V_{IN-}$  is tied to analog common. If a large Common mode voltage exists ( $V_{REF-}$  – analog common) and the application requires 200mV full scale, increase  $C_{REF}$  to  $1.0\mu\text{F}$ . Rollover error will be held to less than 1/2 count. A mylar dielectric capacitor is adequate.

### 7.3 Integrating Capacitor ( $C_{INT}$ )

$C_{INT}$  should be selected to maximize the integrator output voltage swing without causing output saturation. Due to the TC7106A/7107A superior temperature coefficient specification, analog common will normally supply the differential voltage reference. For this case, a  $\pm 2\text{V}$  full scale integrator output swing is satisfactory. For 3 readings/second ( $F_{OSC} = 48\text{kHz}$ ), a  $0.22\mu\text{F}$  value is suggested. If a different oscillator frequency is used,  $C_{INT}$  must be changed in inverse proportion to maintain the nominal  $\pm 2\text{V}$  integrator swing.

An exact expression for  $C_{INT}$  is:

#### EQUATION 7-1:

$$C_{INT} = \frac{(4000) \left( \frac{1}{F_{OSC}} \right) \left( \frac{V_{FS}}{R_{INT}} \right)}{V_{INT}}$$

Where:

- $F_{OSC}$  = Clock Frequency at Pin 38
- $V_{FS}$  = Full Scale Input Voltage
- $R_{INT}$  = Integrating Resistor
- $V_{INT}$  = Desired Full Scale Integrator Output Swing

$C_{INT}$  must have low dielectric absorption to minimize rollover error. A polypropylene capacitor is recommended.

### 7.4 Integrating Resistor ( $R_{INT}$ )

The input buffer amplifier and integrator are designed with class A output stages. The output stage idling current is  $100\mu\text{A}$ . The integrator and buffer can supply  $20\mu\text{A}$  drive currents with negligible linearity errors.  $R_{INT}$  is chosen to remain in the output stage linear drive region, but not so large that printed circuit board leakage currents induce errors. For a 200mV full scale,  $R_{INT}$  is  $47\text{k}\Omega$ . 2.0V full scale requires  $470\text{k}\Omega$ .

| Component Value | Nominal Full Scale Voltage |                     |
|-----------------|----------------------------|---------------------|
|                 | 200.0mV                    | 2.000V              |
| $C_{AZ}$        | $0.47\mu\text{F}$          | $0.047\mu\text{F}$  |
| $R_{INT}$       | $47\text{k}\Omega$         | $470\text{k}\Omega$ |
| $C_{INT}$       | $0.22\mu\text{F}$          | $0.22\mu\text{F}$   |

**Note:**  $F_{OSC} = 48\text{kHz}$  (3 readings per sec).

### 7.5 Oscillator Components

$R_{OSC}$  (Pin 40 to Pin 39) should be  $100\text{k}\Omega$ .  $C_{OSC}$  is selected using the equation:

#### EQUATION 7-2:

$$F_{OSC} = \frac{0.45}{RC}$$

For  $F_{OSC}$  of  $48\text{kHz}$ ,  $C_{OSC}$  is  $100\text{pF}$  nominally.

Note that  $F_{OSC}$  is divided by four to generate the TC7106A internal control clock. The backplane drive signal is derived by dividing  $F_{OSC}$  by 800.

To achieve maximum rejection of 60Hz noise pickup, the signal integrate period should be a multiple of 60Hz. Oscillator frequencies of  $240\text{kHz}$ ,  $120\text{kHz}$ ,  $80\text{kHz}$ ,  $60\text{kHz}$ ,  $48\text{kHz}$ ,  $40\text{kHz}$ , etc. should be selected. For 50Hz rejection, oscillator frequencies of  $200\text{kHz}$ ,  $100\text{kHz}$ ,  $66\text{-}2/3\text{kHz}$ ,  $50\text{kHz}$ ,  $40\text{kHz}$ , etc. would be suitable. Note that  $40\text{kHz}$  (2.5 readings/second) will reject both 50Hz and 60Hz.

### 7.6 Reference Voltage Selection

A full scale reading (2000 counts) requires the input signal be twice the reference voltage.

| Required Full Scale Voltage* | $V_{REF}$ |
|------------------------------|-----------|
| 200.0mV                      | 100.0mV   |
| 2.000V                       | 1.000V    |

\*  $V_{FS} = 2V_{REF}$ .

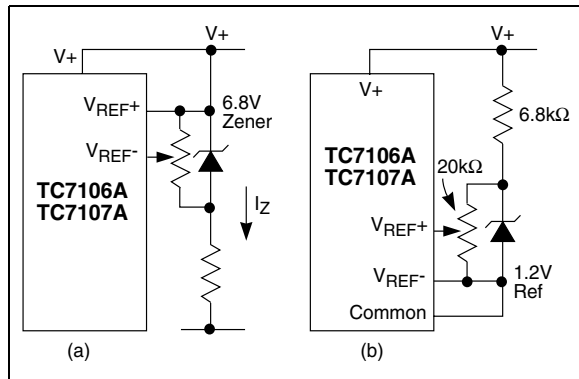
In some applications, a scale factor other than unity may exist between a transducer output voltage and the required digital reading. Assume, for example, a pressure transducer output is  $400\text{mV}$  for  $2000\text{ lb/in}^2$ . Rather than dividing the input voltage by two, the reference voltage should be set to  $200\text{mV}$ . This permits the transducer input to be used directly.

# TC7106A/TC7107A

The differential reference can also be used when a digital zero reading is required when  $V_{IN}$  is not equal to zero. This is common in temperature measuring instrumentation. A compensating offset voltage can be applied between analog common and  $V_{IN-}$ . The transducer output is connected between  $V_{IN+}$  and analog common.

The internal voltage reference potential available at analog common will normally be used to supply the converter's reference. This potential is stable whenever the supply potential is greater than approximately 7V. In applications where an externally generated reference voltage is desired, refer to Figure 7-1.

**FIGURE 7-1: EXTERNAL REFERENCE**



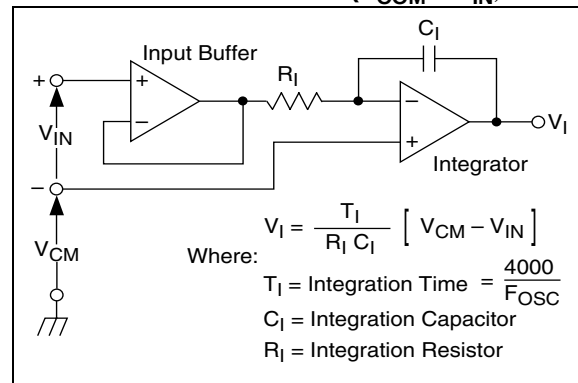
## 8.0 DEVICE PIN FUNCTIONAL DESCRIPTION

### 8.1 Differential Signal Inputs $V_{IN+}$ (Pin 31), $V_{IN-}$ (Pin 30)

The TC7106A/7017A is designed with true differential inputs and accepts input signals within the input stage common mode voltage range ( $V_{CM}$ ). The typical range is  $V+ - 1.0$  to  $V+ + 1V$ . Common mode voltages are removed from the system when the TC7106A/TC7107A operates from a battery or floating power source (isolated from measured system) and  $V_{IN-}$  is connected to analog common ( $V_{COM}$ ) (see Figure 8-2).

In systems where Common mode voltages exist, the 86dB Common mode rejection ratio minimizes error. Common mode voltages do, however, affect the integrator output level. Integrator output saturation must be prevented. A worst case condition exists if a large positive  $V_{CM}$  exists in conjunction with a full scale negative differential signal. The negative signal drives the integrator output positive along with  $V_{CM}$  (see Figure 8-1). For such applications the integrator output swing can be reduced below the recommended 2.0V full scale swing. The integrator output will swing within 0.3V of  $V+$  or  $V-$  without increasing linearity errors.

**FIGURE 8-1: COMMON MODE VOLTAGE REDUCES AVAILABLE INTEGRATOR SWING ( $V_{COM} \neq V_{IN}$ )**



### 8.2 Differential Reference $V_{REF+}$ (Pin 36), $V_{REF-}$ (Pin 35)

The reference voltage can be generated anywhere within the  $V+$  to  $V-$  power supply range.

To prevent rollover type errors being induced by large Common mode voltages,  $C_{REF}$  should be large compared to stray node capacitance.

The TC7106A/TC7107A circuits have a significantly lower analog common temperature coefficient. This gives a very stable voltage suitable for use as a reference. The temperature coefficient of analog common is 20ppm/°C typically.

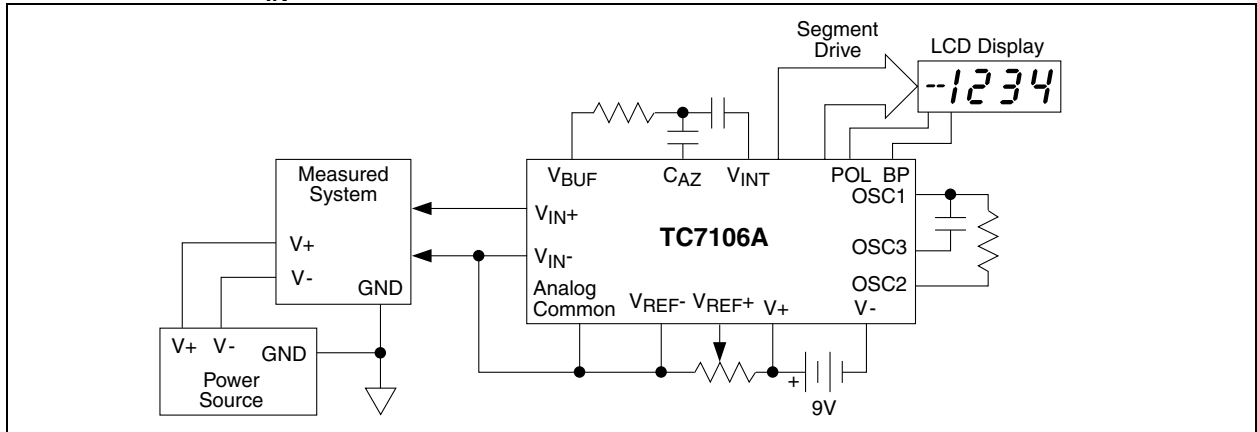
### 8.3 Analog Common (Pin 32)

The analog common pin is set at a voltage potential approximately 3.0V below  $V+$ . The potential is between 2.7V and 3.35V below  $V+$ . Analog common is tied internally to the N channel FET capable of sinking 20mA. This FET will hold the common line at 3.0V should an external load attempt to pull the common line toward  $V+$ . Analog common source current is limited to 10μA. Analog common is, therefore, easily pulled to a more negative voltage (i.e., below  $V+ - 3.0V$ ).

The TC7106A connects the internal  $V_{IN+}$  and  $V_{IN-}$  inputs to analog common during the auto-zero cycle. During the reference integrate phase,  $V_{IN-}$  is connected to analog common. If  $V_{IN-}$  is not externally connected to analog common, a Common mode voltage exists. This is rejected by the converter's 86dB Common mode rejection ratio. In battery operation, analog common and  $V_{IN-}$  are usually connected, removing Common mode voltage concerns. In systems where  $V-$  is connected to the power supply ground, or to a given voltage, analog common should be connected to  $V_{IN-}$ .

**TC7106/A/TC7107/A**

**FIGURE 8-2: COMMON MODE VOLTAGE REMOVED IN BATTERY OPERATION WITH  $V_{IN-}$  = ANALOG COMMON**



The analog common pin serves to set the analog section reference or common point. The TC7106A is specifically designed to operate from a battery, or in any measurement system where input signals are not referenced (float), with respect to the TC7106A power source. The analog common potential of  $V+ - 3.0V$  gives a 6V end of battery life voltage. The common potential has a 0.001% voltage coefficient and a  $15\Omega$  output impedance.

With sufficiently high total supply voltage ( $V_+ - V_- > 7.0V$ ), analog common is a very stable potential with excellent temperature stability, typically 20ppm/°C. This potential can be used to generate the reference voltage. An external voltage reference will be unnecessary in most cases because of the 50ppm/°C maximum temperature coefficient. See Internal Voltage Reference discussion.

## 8.4 TEST (Pin 37)

The TEST pin potential is 5V less than V+. TEST may be used as the negative power supply connection for external CMOS logic. The TEST pin is tied to the internally generated negative logic supply (Internal Logic Ground) through a 500Ω resistor in the TC7106A. The TEST pin load should be no more than 1mA.

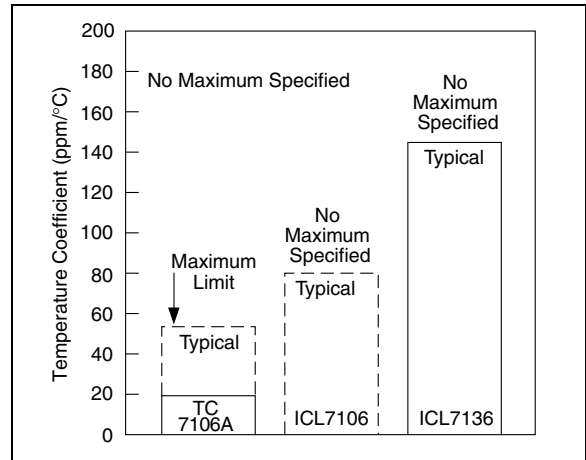
If TEST is pulled to V+ all segments plus the minus sign will be activated. Do not operate in this mode for more than several minutes with the TC7106A. With TEST = V+, the LCD segments are impressed with a DC voltage which will destroy the LCD.

The TEST pin will sink about 10mA when pulled to V+.

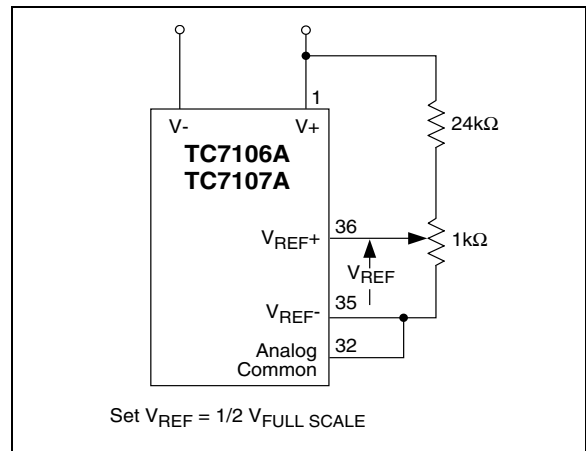
## 8.5 Internal Voltage Reference

The analog common voltage temperature stability has been significantly improved (Figure 8-3). The “A” version of the industry standard circuits allow users to upgrade old systems and design new systems without external voltage references. External R and C values do not need to be changed. Figure 8-4 shows analog common supplying the necessary voltage reference for the TC7106A/TC7107A.

**FIGURE 8-3: ANALOG COMMON TEMPERATURE COEFFICIENT**



**FIGURE 8-4: INTERNAL VOLTAGE REFERENCE CONNECTION**



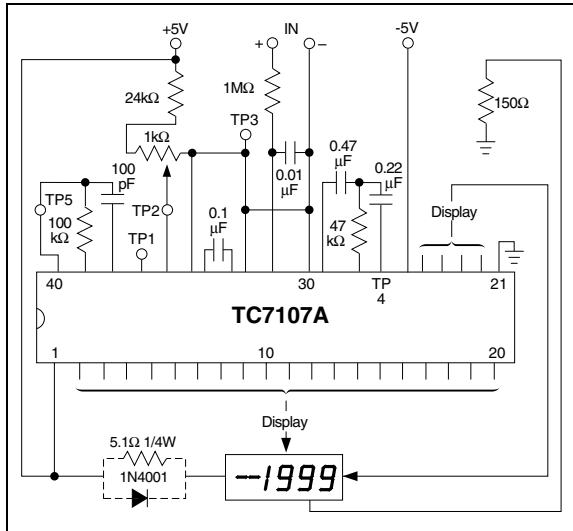




ments (a “111” display) to worst case (a “1888” display), the resistor will change about 230mW, while a circuit without the resistor will change about 470mW. Therefore, the resistor will reduce the effect of display dissipation on reference voltage drift by about 50%.

The change in LED brightness caused by the resistor is almost unnoticeable as more segments turn off. If display brightness remaining steady is very important to the designer, a diode may be used instead of the resistor.

**FIGURE 9-4: DIODE OR RESISTOR LIMITS PACKAGE POWER DISSIPATION**



## 10.0 TYPICAL APPLICATIONS

### 10.1 Liquid Crystal Display Sources

Several manufacturers supply standard LCDs to interface with the TC7106A 3-1/2 digit analog-to-digital converter.

| Manufacturer           | Address/Phone                                             | Representative Part Numbers*              |
|------------------------|-----------------------------------------------------------|-------------------------------------------|
| Crystaloid Electronics | 5282 Hudson Dr.<br>Hudson, OH 44236<br>216-655-2429       | C5335, H5535,<br>T5135, SX440             |
| AND                    | 720 Palomar Ave.<br>Sunnyvale, CA 94086<br>408-523-8200   | FE 0201, 0701<br>FE 0203, 0701<br>FE 0501 |
| Epson                  | 3415 Kashikawa st.<br>Torrance, CA 90505<br>213-534-0360  | LD-B709BZ<br>LD-H7992AZ                   |
| Hamlin, Inc.           | 612 E. Lake St.<br>Lake Mills, WI 53551<br>414-648-236100 | 3902, 3933, 3903                          |

**Note:** Contact LCD manufacturer for full product listing and specifications.

### 10.2 Light Emitting Diode Display Sources

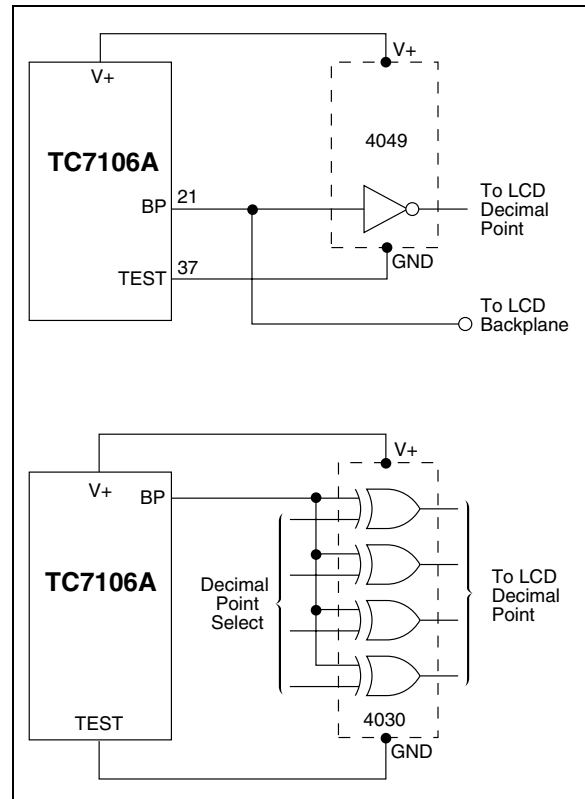
Several LED manufacturers supply seven segment digits with and without decimal point annunciators for the TC7107A.

| Manufacturer               | Address/Phone                                           | Display |
|----------------------------|---------------------------------------------------------|---------|
| Hewlett-Packard Components | 640 Page Mill Rd.<br>Palo Alto, CA 94304                | LED     |
| AND                        | 720 Palomar Ave.<br>Sunnyvale, CA 94086<br>408-523-8200 | LED     |

### 10.3 Decimal Point and Annunciator Drive

The TEST pin is connected to the internally generated digital logic supply ground through a 500Ω resistor. The TEST pin may be used as the negative supply for external CMOS gate segment drivers. LCD display annunciators for decimal points, low battery indication, or function indication may be added without adding an additional supply. No more than 1mA should be supplied by the TEST pin; its potential is approximately 5V below V+ (see Figure 10-1).

**FIGURE 10-1: DECIMAL POINT DRIVE USING TEST AS LOGIC GROUND**



# TC7106/A/TC7107/A

## 10.4 Ratiometric Resistance Measurements

The true differential input and differential reference make ratiometric reading possible. Typically in a ratiometric operation, an unknown resistance is measured, with respect to a known standard resistance. No accurately defined reference voltage is needed.

The unknown resistance is put in series with a known standard and a current passed through the pair. The voltage developed across the unknown is applied to the input and the voltage across the known resistor is applied to the reference input. If the unknown equals the standard, the display will read 1000.

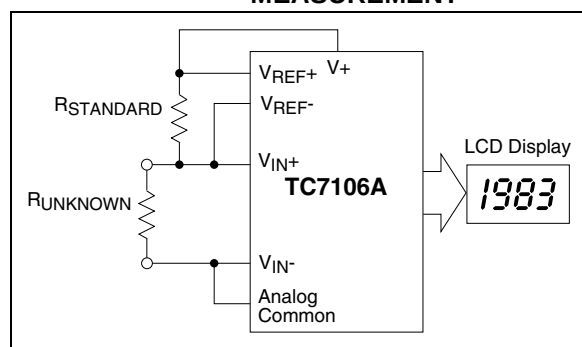
The displayed reading can be determined from the following expression:

$$\text{Displayed(Reading)} = \frac{R_{\text{Unknown}}}{R_{\text{Standard}}} \times 1000$$

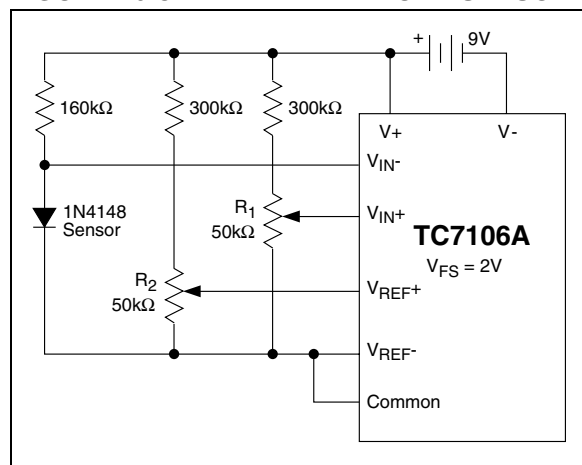
The display will over range for:

$$R_{\text{UNKNOWN}} \geq 2 \times R_{\text{STANDARD}}$$

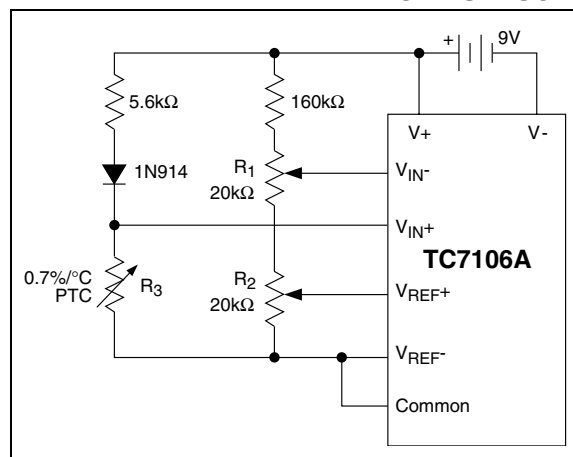
**FIGURE 10-2: LOW PARTS COUNT RATIOMETRIC RESISTANCE MEASUREMENT**



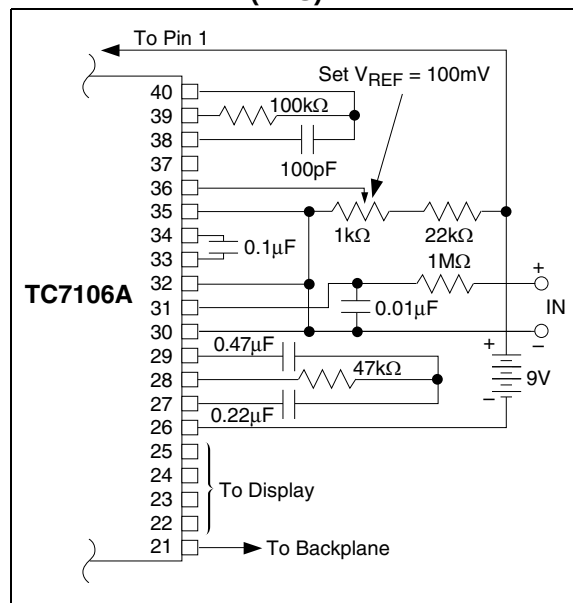
**FIGURE 10-3: TEMPERATURE SENSOR**



**FIGURE 10-4: POSITIVE TEMPERATURE COEFFICIENT RESISTOR TEMPERATURE SENSOR**

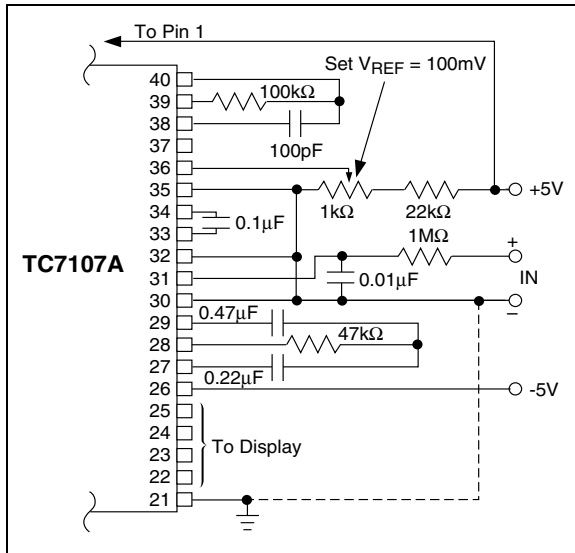


**FIGURE 10-5: TC7106A, USING THE INTERNAL REFERENCE: 200mV FULL SCALE, 3 READINGS-PER-SECOND (RPS)**

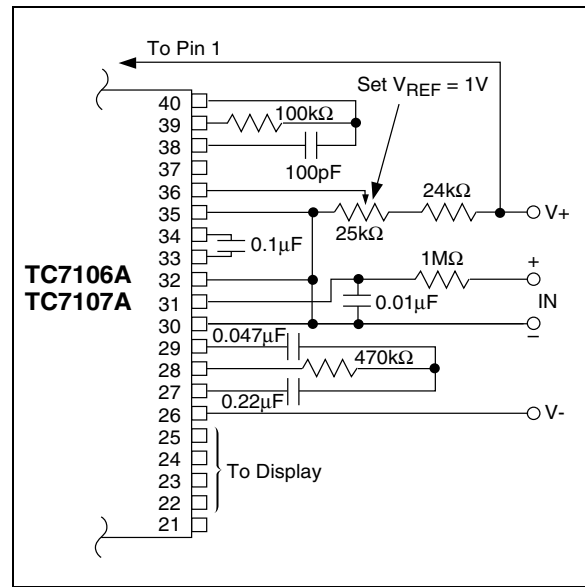


# TC7106/A/TC7107/A

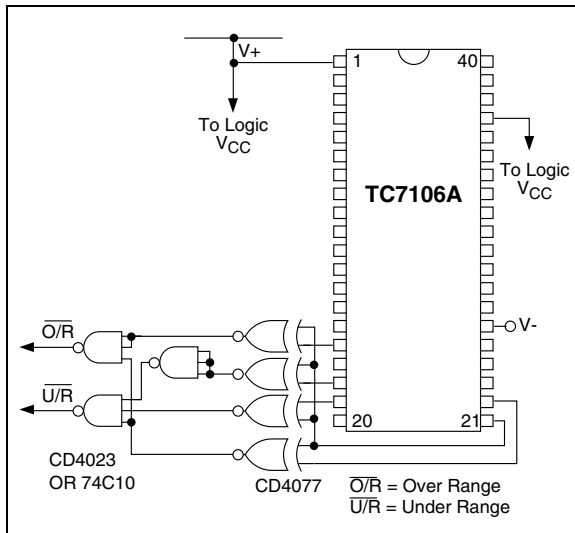
**FIGURE 10-6: TC7107 INTERNAL REFERENCE: 200mV FULL SCALE, 3RPS,  $V_{IN-}$  TIED TO GND FOR SINGLE ENDED INPUTS**



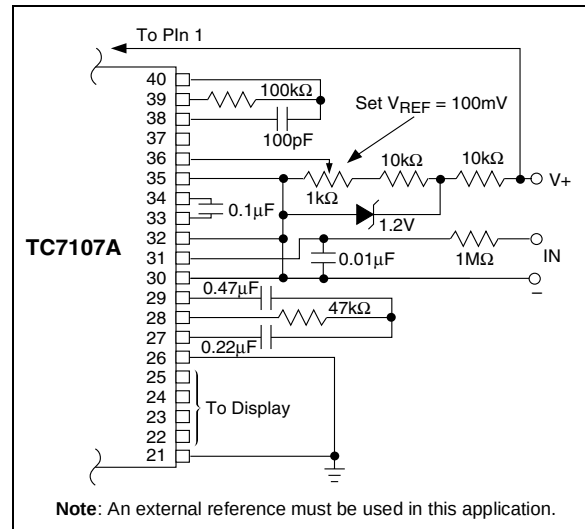
**FIGURE 10-8: TC7106/TC7107: RECOMMENDED COMPONENT VALUES FOR 2.00V FULL SCALE**



**FIGURE 10-7: CIRCUIT FOR DEVELOPING UNDER RANGE AND OVER RANGE SIGNALS FROM TC7106A OUTPUTS**



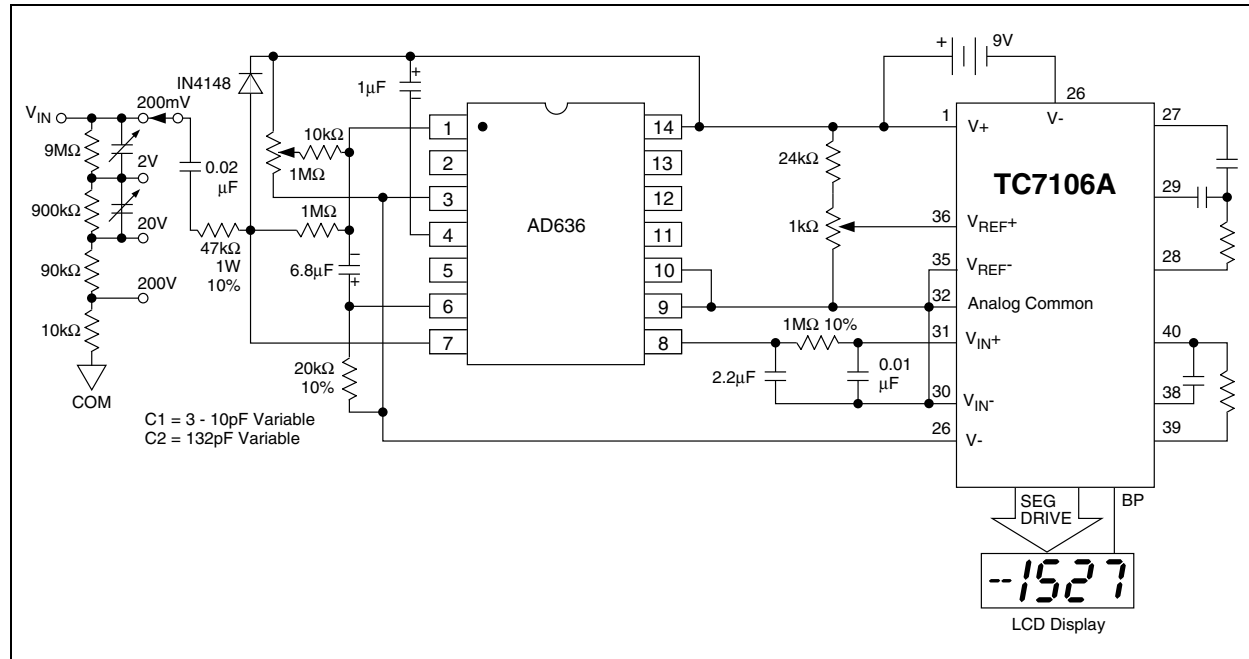
**FIGURE 10-9: TC7107 OPERATED FROM SINGLE +5V SUPPLY**



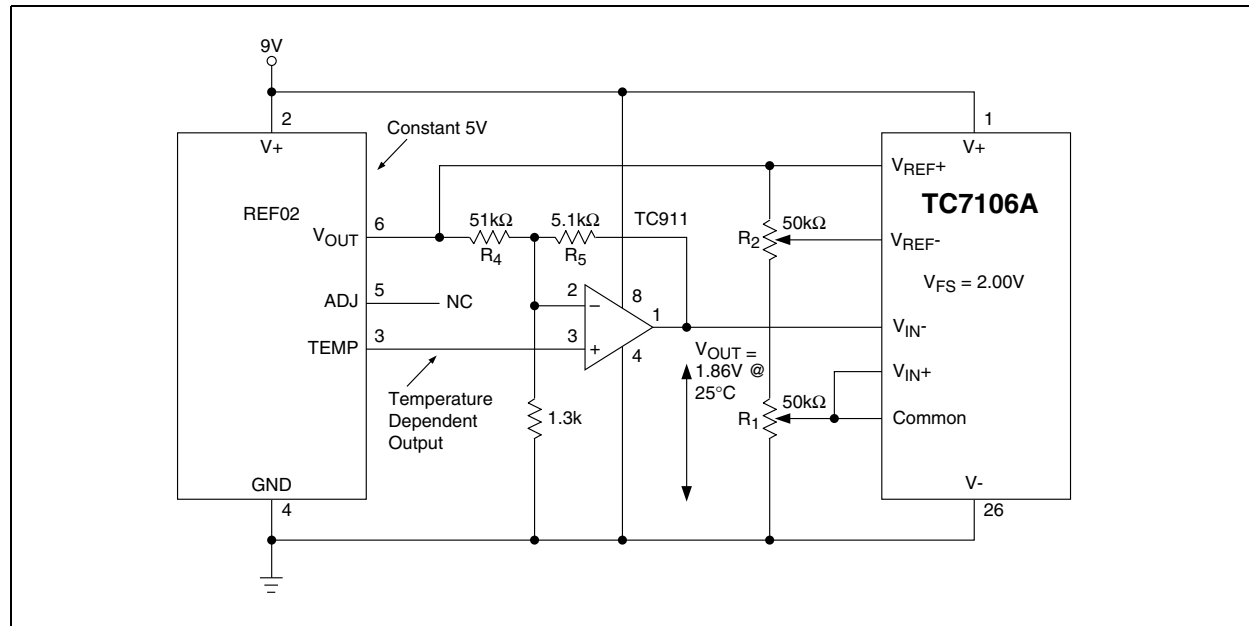
Note: An external reference must be used in this application.

# TC7106/A/TC7107/A

**FIGURE 10-10: 3-1/2 DIGIT TRUE RMS AC DMM**



**FIGURE 10-11: INTEGRATED CIRCUIT TEMPERATURE SENSOR**



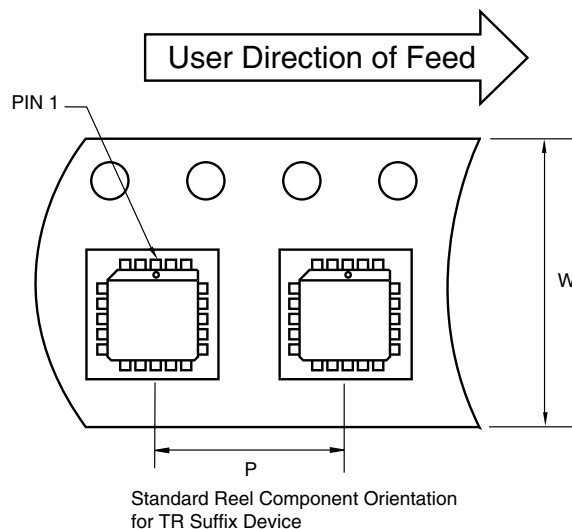
## 11.0 PACKAGING INFORMATION

### 11.1 Package Marking Information

Package marking data not available at this time.

### 11.2 Taping Form

#### Component Taping Orientation for 44-Pin PLCC Devices

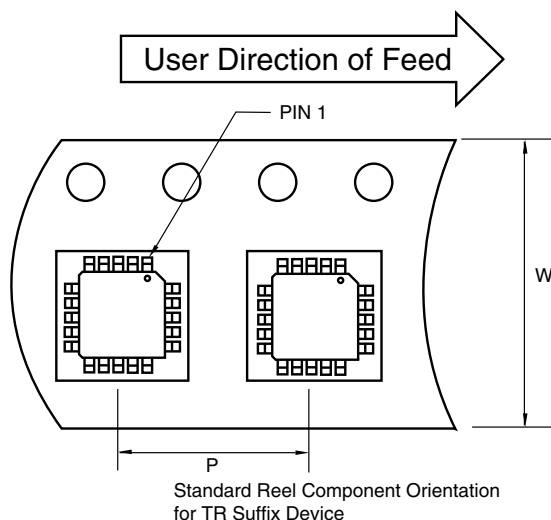


#### Carrier Tape, Number of Components Per Reel and Reel Size

| Package     | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|-------------|-------------------|-----------|--------------------|-----------|
| 44-Pin PLCC | 32 mm             | 24 mm     | 500                | 13 in     |

**Note:** Drawing does not represent total number of pins.

#### Component Taping Orientation for 44-Pin PQFP Devices



#### Carrier Tape, Number of Components Per Reel and Reel Size

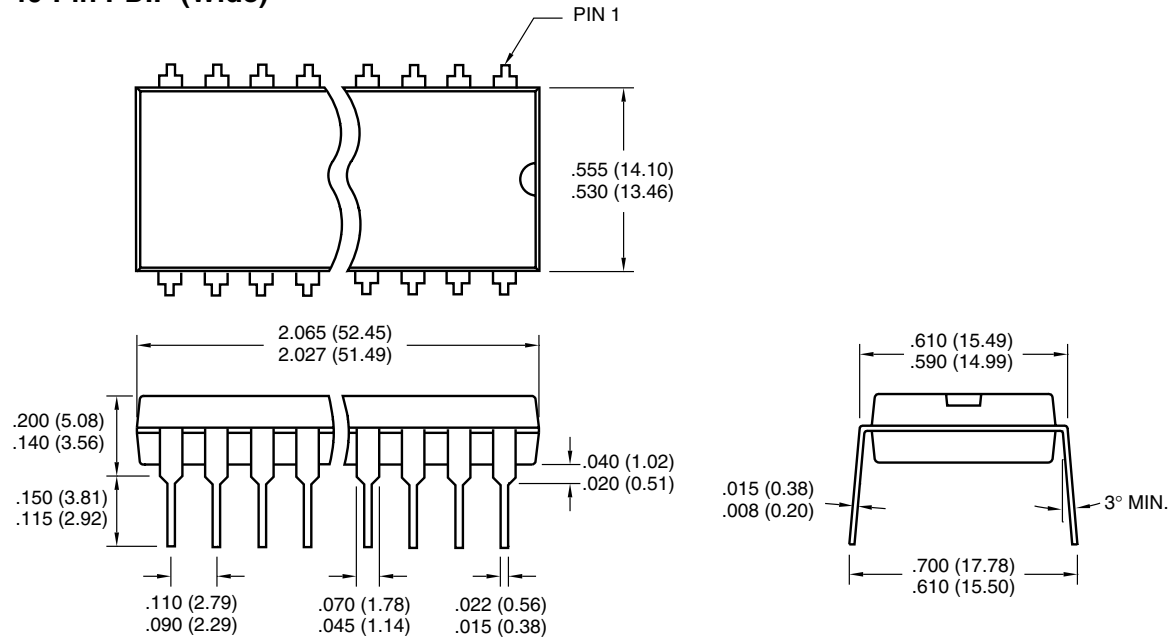
| Package     | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|-------------|-------------------|-----------|--------------------|-----------|
| 44-Pin PQFP | 24 mm             | 16 mm     | 500                | 13 in     |

**Note:** Drawing does not represent total number of pins.

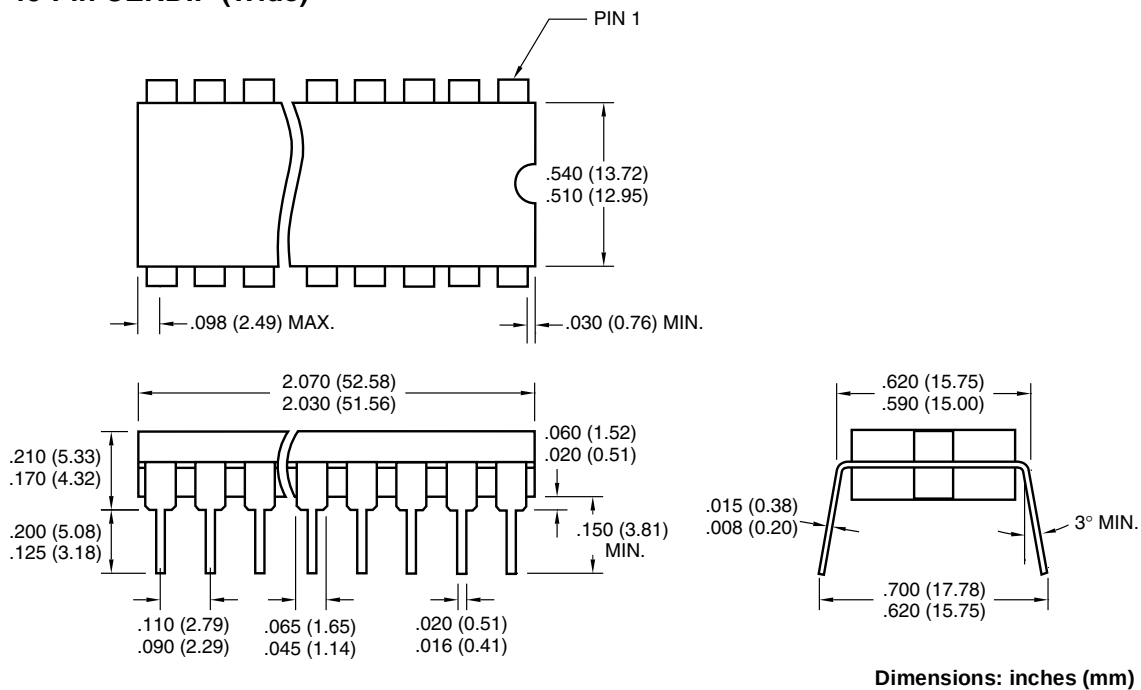
# TC7106/A/TC7107/A

## 11.3 Package Dimensions

### 40-Pin PDIP (Wide)

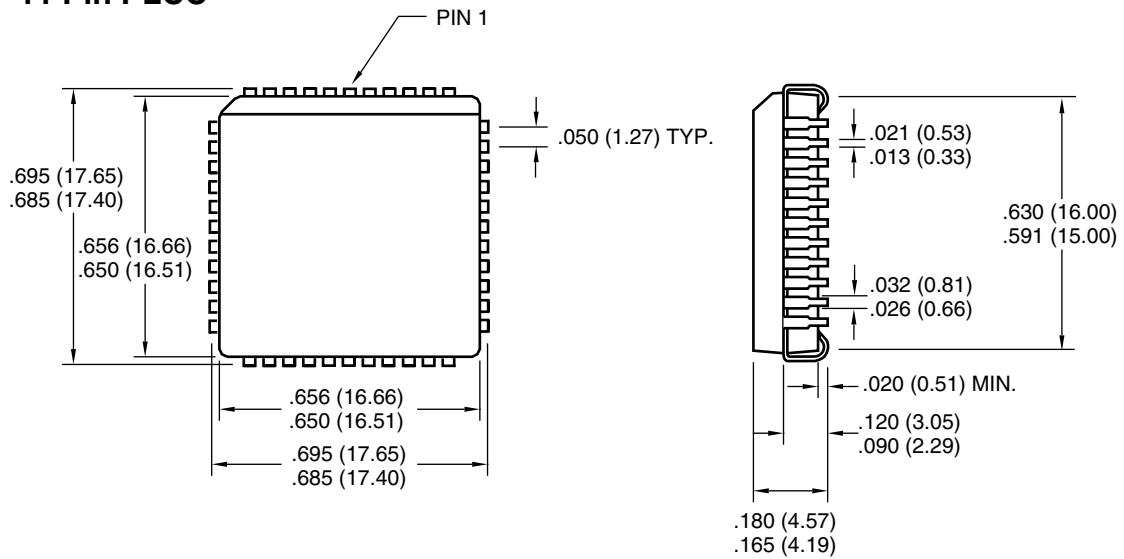


### 40-Pin Cerdip (Wide)



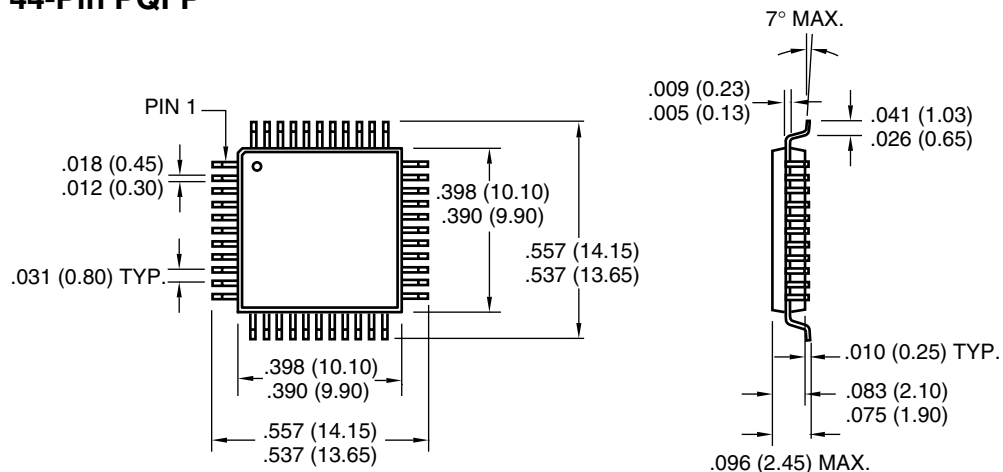
## 11.3 Package Dimensions (Continued)

### 44-Pin PLCC



Dimensions: inches (mm)

### 44-Pin PQFP



Dimensions: inches (mm)

# TC7106/A/TC7107/A

---

## PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

|                                                 |              |          |          |          |            |
|-------------------------------------------------|--------------|----------|----------|----------|------------|
| <b>PART CODE</b>                                | <b>TC711</b> | <b>X</b> | <b>X</b> | <b>X</b> | <b>XXX</b> |
| 6 = LCD } _____                                 | _____        | _____    | _____    | _____    | _____      |
| 7 = LED } _____                                 | _____        | _____    | _____    | _____    | _____      |
| A or blank* _____                               | _____        | _____    | _____    | _____    | _____      |
| R (reversed pins) or blank (CPL pkg only) _____ | _____        | _____    | _____    | _____    | _____      |
| * "A" parts have an improved reference TC       |              |          |          |          |            |
| Package Code (see below): _____                 | _____        | _____    | _____    | _____    | _____      |

## SALES AND SUPPORT

### Data Sheets

Products supported by a preliminary Data Sheet may have an errata sheet describing minor operational differences and recommended workarounds. To determine if an errata sheet exists for a particular device, please contact one of the following:

1. Your local Microchip sales office
2. The Microchip Corporate Literature Center U.S. FAX: (480) 792-7277
3. The Microchip Worldwide Site ([www.microchip.com](http://www.microchip.com))

Please specify which device, revision of silicon and Data Sheet (include Literature #) you are using.

### New Customer Notification System

Register on our web site ([www.microchip.com/cn](http://www.microchip.com/cn)) to receive the most current information on our products.



Information contained in this publication regarding device applications and the like is intended through suggestion only and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. No representation or warranty is given and no liability is assumed by Microchip Technology Incorporated with respect to the accuracy or use of such information, or infringement of patents or other intellectual property rights arising from such use or otherwise. Use of Microchip's products as critical components in life support systems is not authorized except with express written approval by Microchip. No licenses are conveyed, implicitly or otherwise, under any intellectual property rights.

## Trademarks

The Microchip name and logo, the Microchip logo, FilterLab, KEELOQ, microID, MPLAB, PIC, PICmicro, PICMASTER, PICSTART, PRO MATE, SEEVAL and The Embedded Control Solutions Company are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

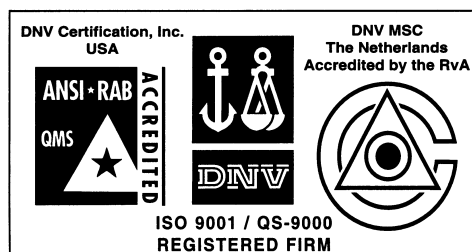
dsPIC, ECONOMONITOR, FanSense, FlexROM, fuzzyLAB, In-Circuit Serial Programming, ICSP, ICEPIC, microPort, Migratable Memory, MPASM, MPLIB, MPLINK, MPSIM, MXDEV, PICC, PICDEM, PICDEM.net, rfPIC, Select Mode and Total Endurance are trademarks of Microchip Technology Incorporated in the U.S.A.

Serialized Quick Turn Programming (SQTP) is a service mark of Microchip Technology Incorporated in the U.S.A.

All other trademarks mentioned herein are property of their respective companies.

© 2002, Microchip Technology Incorporated, Printed in the U.S.A., All Rights Reserved.

 Printed on recycled paper.



*Microchip received QS-9000 quality system certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona in July 1999 and Mountain View, California in March 2002. The Company's quality system processes and procedures are QS-9000 compliant for its PICmicro® 8-bit MCUs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, non-volatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001 certified.*



## WORLDWIDE SALES AND SERVICE

### AMERICAS

#### Corporate Office

2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7200 Fax: 480-792-7277  
Technical Support: 480-792-7627  
Web Address: <http://www.microchip.com>

#### Rocky Mountain

2355 West Chandler Blvd.  
Chandler, AZ 85224-6199  
Tel: 480-792-7966 Fax: 480-792-7456

#### Atlanta

500 Sugar Mill Road, Suite 200B  
Atlanta, GA 30350  
Tel: 770-640-0034 Fax: 770-640-0307

#### Boston

2 Lan Drive, Suite 120  
Westford, MA 01886  
Tel: 978-692-3848 Fax: 978-692-3821

#### Chicago

333 Pierce Road, Suite 180  
Itasca, IL 60143  
Tel: 630-285-0071 Fax: 630-285-0075

#### Dallas

4570 Westgrove Drive, Suite 160  
Addison, TX 75001  
Tel: 972-818-7423 Fax: 972-818-2924

#### Detroit

Tri-Atria Office Building  
32255 Northwestern Highway, Suite 190  
Farmington Hills, MI 48334  
Tel: 248-538-2250 Fax: 248-538-2260

#### Kokomo

2767 S. Albright Road  
Kokomo, Indiana 46902  
Tel: 765-864-8360 Fax: 765-864-8387

#### Los Angeles

18201 Von Karman, Suite 1090  
Irvine, CA 92612  
Tel: 949-263-1888 Fax: 949-263-1338

#### New York

150 Motor Parkway, Suite 202  
Hauppauge, NY 11788  
Tel: 631-273-5305 Fax: 631-273-5335

#### San Jose

Microchip Technology Inc.  
2107 North First Street, Suite 590  
San Jose, CA 95131  
Tel: 408-436-7950 Fax: 408-436-7955

#### Toronto

6285 Northam Drive, Suite 108  
Mississauga, Ontario L4V 1X5, Canada  
Tel: 905-673-0699 Fax: 905-673-6509

### ASIA/PACIFIC

#### Australia

Microchip Technology Australia Pty Ltd  
Suite 22, 41 Rawson Street  
Epping 2121, NSW  
Australia  
Tel: 61-2-9868-6733 Fax: 61-2-9868-6755

#### China - Beijing

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Beijing Liaison Office  
Unit 915  
Bei Hai Wan Tai Bldg.  
No. 6 Chaoyangmen Beidajie  
Beijing, 100027, No. China  
Tel: 86-10-85282100 Fax: 86-10-85282104

#### China - Chengdu

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Chengdu Liaison Office  
Rm. 2401, 24th Floor,  
Ming Xing Financial Tower  
No. 88 TIDU Street  
Chengdu 610016, China  
Tel: 86-28-6766200 Fax: 86-28-6766599

#### China - Fuzhou

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Fuzhou Liaison Office  
Unit 28F, World Trade Plaza  
No. 71 Wusi Road  
Fuzhou 350001, China  
Tel: 86-591-7503506 Fax: 86-591-7503521

#### China - Shanghai

Microchip Technology Consulting (Shanghai)  
Co., Ltd.  
Room 701, Bldg. B  
Far East International Plaza  
No. 317 Xian Xia Road  
Shanghai, 200051  
Tel: 86-21-6275-5700 Fax: 86-21-6275-5060

#### China - Shenzhen

Microchip Technology Consulting (Shanghai)  
Co., Ltd., Shenzhen Liaison Office  
Rm. 1315, 13/F, Shenzhen Kerry Centre,  
Renminnan Lu  
Shenzhen 518001, China  
Tel: 86-755-2350361 Fax: 86-755-2366086

#### Hong Kong

Microchip Technology Hongkong Ltd.  
Unit 901-6, Tower 2, Metroplaza  
223 Hing Fong Road  
Kwai Fong, N.T., Hong Kong  
Tel: 852-2401-1200 Fax: 852-2401-3431

#### India

Microchip Technology Inc.  
India Liaison Office  
Divyasree Chambers  
1 Floor, Wing A (A3/A4)  
No. 11, O'Shaugnessey Road  
Bangalore, 560 025, India  
Tel: 91-80-2290061 Fax: 91-80-2290062

### Japan

Microchip Technology Japan K.K.  
Benex S-1 6F  
3-18-20, Shinyokohama  
Kohoku-Ku, Yokohama-shi  
Kanagawa, 222-0033, Japan  
Tel: 81-45-471- 6166 Fax: 81-45-471-6122

### Korea

Microchip Technology Korea  
168-1, Youngbo Bldg. 3 Floor  
Samsung-Dong, Kangnam-Ku  
Seoul, Korea 135-882  
Tel: 82-2-554-7200 Fax: 82-2-558-5934

### Singapore

Microchip Technology Singapore Pte Ltd.  
200 Middle Road  
#07-02 Prime Centre  
Singapore, 188980  
Tel: 65-6334-8870 Fax: 65-6334-8850

### Taiwan

Microchip Technology Taiwan  
11F-3, No. 207  
Tung Hua North Road  
Taipei, 105, Taiwan  
Tel: 886-2-2717-7175 Fax: 886-2-2545-0139

### EUROPE

#### Denmark

Microchip Technology Nordic ApS  
Regus Business Centre  
Lautrup høj 1-3  
Ballerup DK-2750 Denmark  
Tel: 45 4420 9895 Fax: 45 4420 9910

#### France

Microchip Technology SARL  
Parc d'Activite du Moulin de Massy  
43 Rue du Saule Trapu  
Batiment A - 1er Etage  
91300 Massy, France  
Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79

#### Germany

Microchip Technology GmbH  
Gustav-Heinemann Ring 125  
D-81739 Munich, Germany  
Tel: 49-89-627-144 0 Fax: 49-89-627-144-44

#### Italy

Microchip Technology SRL  
Centro Direzionale Colleoni  
Palazzo Taurus 1 V. Le Colleoni 1  
20041 Agrate Brianza  
Milan, Italy  
Tel: 39-039-65791-1 Fax: 39-039-6899883

#### United Kingdom

Arizona Microchip Technology Ltd.  
505 Eskdale Road  
Winnersh Triangle  
Wokingham  
Berkshire, England RG41 5TU  
Tel: 44 118 921 5869 Fax: 44-118 921-5820

03/01/02



# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

## Microchip:

[TC7106CKW713](#) [TC7107CKW713](#) [TC7107ACPL](#) [TC7107ACKW](#) [TC7107ACLW](#) [TC7107CKW](#) [TC7107CLW](#)  
[TC7107CPL](#) [TC7106RCPL](#) [TC7107ARCPL](#) [TC7107AIPL](#) [TC7107IPL](#) [TC7106ARCPL](#) [TC7106ACKW713](#)  
[TC7107ACKW713](#) [TC7106ACPL](#) [TC7106ACLW](#) [TC7106CPL](#) [TC7106IPL](#) [TC7106ACKW](#) [TC7106CKW](#) [TC7106IKW](#)