# TC1132
# TC1133
## CONSUMER GRADE TEMPERATURE-TO-VOLTAGE CONVERTERS

## FEATURES

- **Linearized Temperature-to-Voltage Converters**
- **Direct Centigrade Output Voltage Scaling (TC1133)**
- **Wide Temperature Measurement Range (TC1132) ..... – 20°C to +125°C**
- **Excellent Temperature Converter Linearity .. 0.8°C Over Temperature**
- **High Temperature Converter Accuracy at 25°C Guaranteed ..... ±3°C**
- **Small Packages ..... TO-92-3 and SOT-23B-3**

## APPLICATIONS

- **Power Supply Thermal Shut-Down**
- **Temperature-Controlled Fans**
- **Temperature Measurement/Instrumentation**
- **Temperature Regulators**
- **Consumer Electronics**

## GENERAL DESCRIPTION

The TC1132/33 temperature sensors furnish a linearized output voltage directly proportional to measured temperature. The TC1133 has a temperature measurement range of – 20°C to +100°C. Its output voltage is directly calibrated in degrees Centigrade (i.e. $V_{OUT}$ = 10mV/°C x Temperature °C). An external pull-down resistor to a negative voltage source is required for temperature measurement below 0°C.

The TC1132 has a temperature measurement range of – 20°C to +125°C, and operates with a single supply. It has the same output voltage slope with temperature as the TC1133 (10mV/°C).

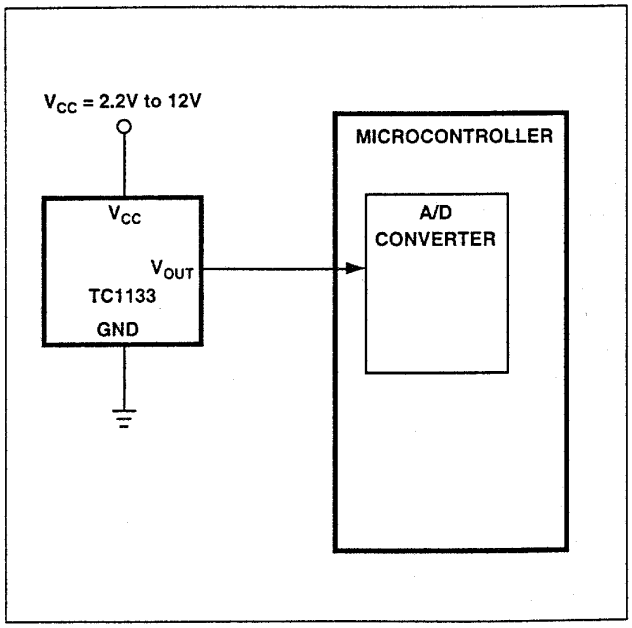
Small size, low cost and low power operation make the TC1132/33 suitable for a wide range of general purpose temperature measurement applications.

## ORDERING INFORMATION

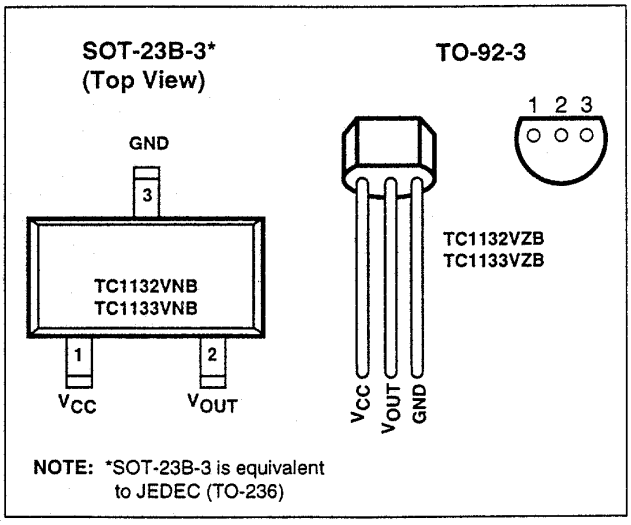
| Part No. | Package | Output Voltage At 25°C | Temp. Range |
|---|---|---|---|
| TC1132VNB | SOT-23B-3 | 750mV | – 20°C to +125°C |
| *TC1132VZB | TO-92 | 750mV | – 20°C to +125°C |
| TC1133VNB | SOT-23B-3 | 250mV | – 20°C to +100°C |
| TC1133VZB | TO-92 | 250mV | – 20°C to +100°C |

* Contact factory for availability.

## FUNCTIONAL BLOCK DIAGRAM




## PIN CONFIGURATION




**NOTE:** *SOT-23B-3 is equivalent to JEDEC (TO-236)

## ABSOLUTE MAXIMUM RATINGS *

Supply Voltage ..... 15V
Input Voltage, Any Terminal ..... – 1.0 to ($V_{CC}$ +0.3V)
Operating Temperature (TC1132) ..... – 20°C to +125°C
Operating Temperature (TC1133) ..... – 20°C to +100°C
Storage Temperature ..... – 65°C to +150°C
Lead Temperature (Soldering, 10 sec)
SOT-23B-3 ..... +260°C
TO-92-3 ..... +300°C

* Static-sensitive device. Unused devices must be stored in conductive material. Protect devices from static discharge and static fields. 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 operational sections of the specifications is not implied. Exposure to Absolute Maximum Rating Conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS : $T_A$ = – 20°C to +125°C, $V_{CC}$ = 5V ±5%, unless otherwise specified.

| Symbol | Parameter | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage (TC1132) | | 3.0 | — | 12 | V |
| $V_{CC}$ | Supply Voltage (TC1133) | | 2.2 | — | 12 | V |
| $I_S$ | Supply Current | Note 1 | — | 40 | 80 | µA |
| $I_{SRC}$ | $V_{OUT}$ Output Source Current | | — | — | 1.0 | mA |
| | Accuracy at Room Temperature | $T_A$ = 25°C (Note 2) | – 3 | ± 0.5 | +3 | °C |
| | Accuracy at Minimum Temperature | $T_A$ = – 20°C | — (Note 2) | ± 4 | — | °C |
| | Accuracy at Maximum Temperature | TC1132: $T_A$ = +125°C<br>TC1133: $T_A$ = +100°C<br>(Note 2) | – 4<br>– 4 | —<br>— | +4<br>+4 | °C |
| | Nonlinearity | Note 3 | – 0.8 | — | +0.8 | °C |
| | Line Regulation | | — | 100 | — | µV/V |
| $A_V$ | Average Slope of Output Voltage | | — | 10 | — | mV/°C |
| $V_{OUTMAX}$ | Maximum Output Voltage | TC1132: 3.0V ≤ $V_{CC}$ ≤ 12V<br>TC1133: 2.2V ≤ $V_{CC}$ ≤ 12V<br>(Note 1) | — | — | $V_{CC}$ – 1.2 | V |

**Notes:** 1. $V_{OUT}$ outputs open circuited.
2. Accuracy = Difference between calculated output voltage (10mV/°C x Device case temperature at specified temperature and power supply) and measured output voltage expressed in °C.
3. Nonlinearity = deviation of output voltage versus temperature from the best-fit straight line over the device rated temperature range.
4. Guaranteed by design.

## DETAILED DESCRIPTION

A plot of output voltage versus temperature for both the TC1132 and TC1133 appears in Figure 1. The TC1133 can be used with single power supply to measure temperatures from 0°C to 100°C. A pull-down resistor (R1 in Figure 2) must be added from $V_{OUT}$ to the negative power supply for measuring temperatures less than 0°C. The value of the resistor must be chosen to limit the maximum current pulled from the output to the negative supply to – 50µA (i.e. R1 = $V_{SS}$/50µA).

## OUTPUT STAGE

Both the TC1132 and TC1133 have Class A output stages capable of sourcing 1mA. These devices have a limited ability to drive heavy capacitive loads. Loads of 50pF (to ground) can be driven directly. For heavier loads, a 2kΩ (or greater) resistor should be placed in series with the output for decoupling. If the TC1132/33 is used in a noisy electrical environment, a 0.1µF bypass capacitor from $V_{CC}$ to GND is recommended.

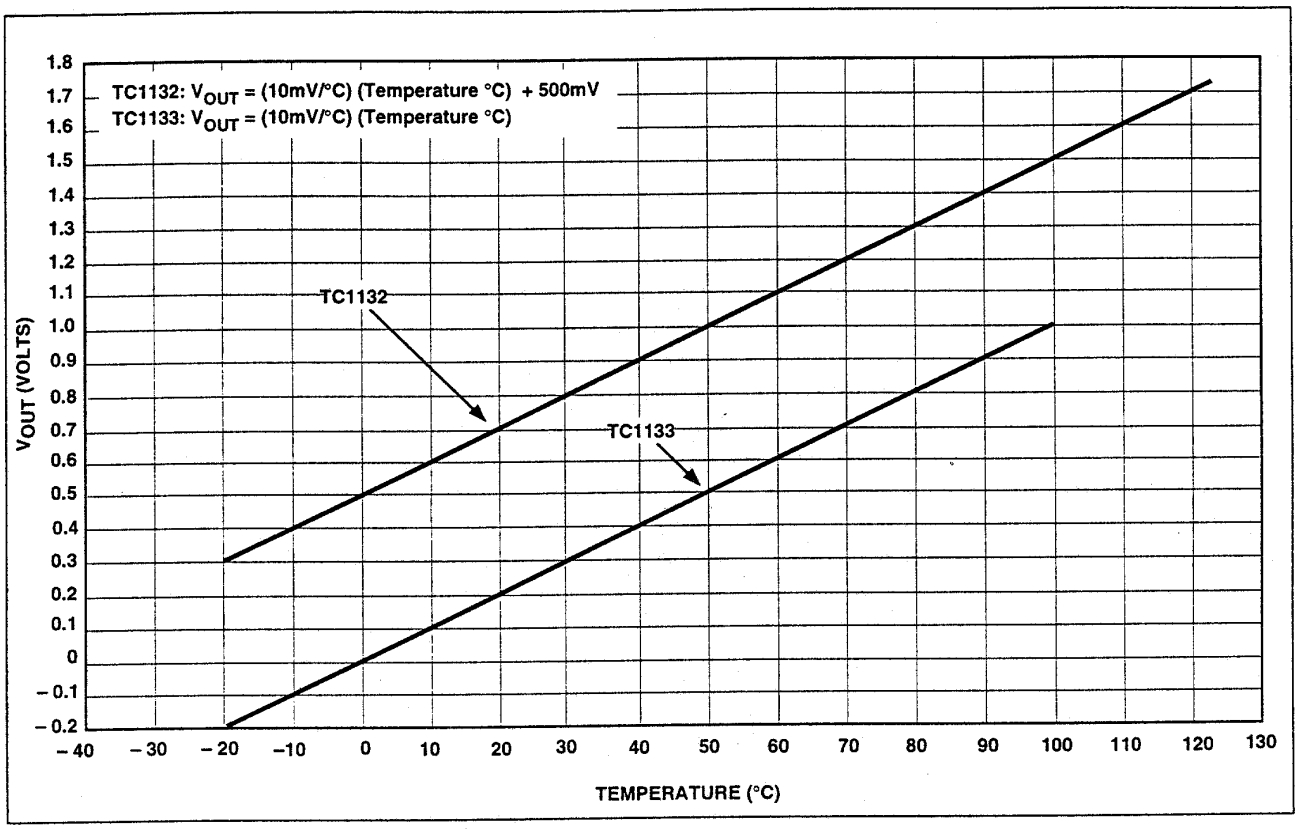



Figure 1. Output Voltage vs. Temperature

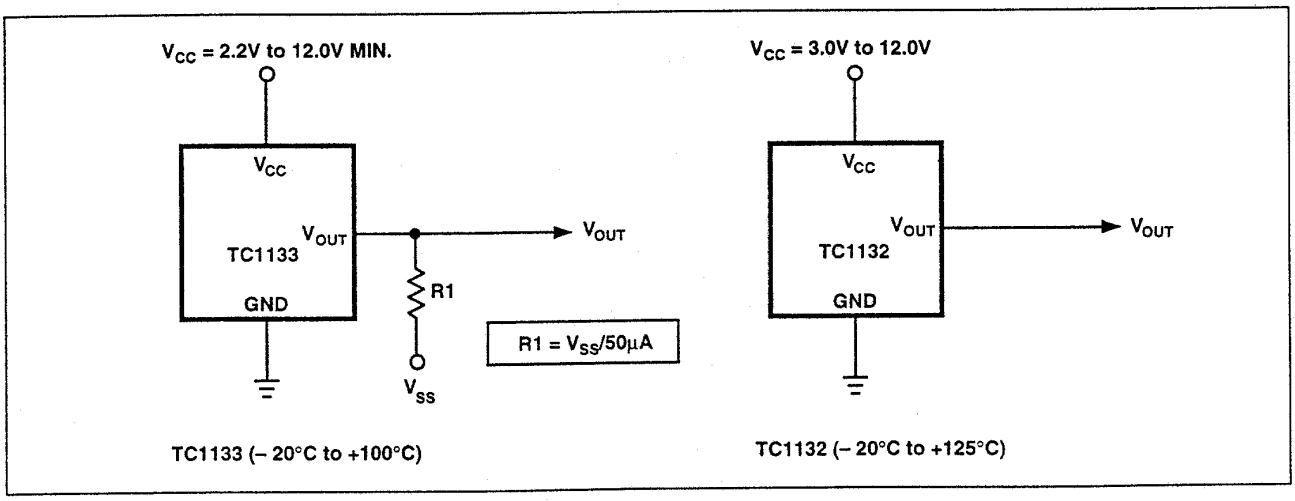
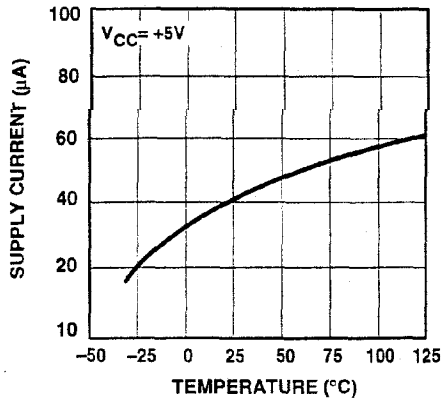


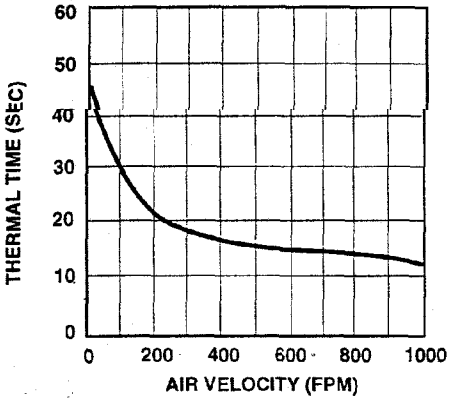

Figure 2. TC1132/33 Power Supply Connections for Full Scale Measurements

## TYPICAL CHARACTERISTICS

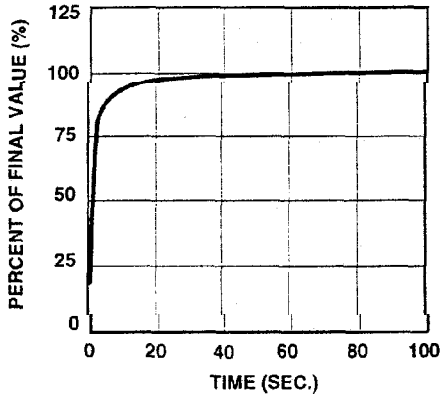
Supply Current vs. Temperature



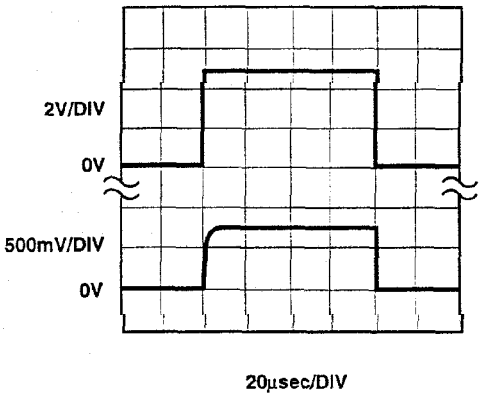

Thermal Time Constant (Sec) vs. Air Velocity




Thermal Response in Still Air vs.Time

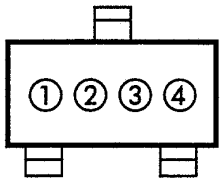



$V_{OUT}$ (From Power Initially Applied) vs. Time (Turn-on Response)



## MARKING

**SOT-23B-3**



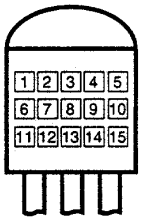

① & ② = part number code and temperature range
TC1132 = AC – 20°C to 125°C
TC1133 = AD – 20°C to 100°C

ex: 1132 = ⒶⒸ○○
ex: 1133 = ⒶⒹ○○

③ = year and quarter

④ = lot ID

**TO-92**




① & ② = TC (fixed)

③, ④ & ⑤ = blank

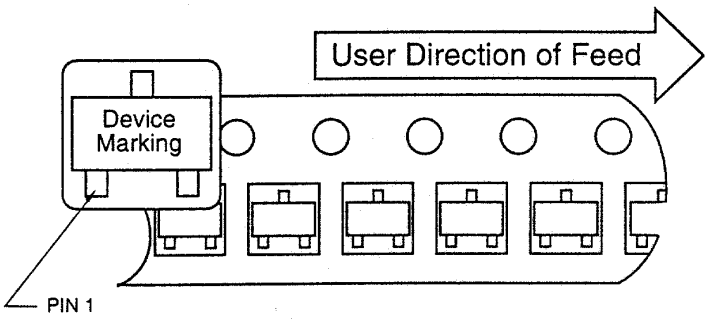
⑥, ⑦, ⑧ & ⑨ = part number

⑩ = temperature range
C = – 20°C to +125°C
D = – 20°C to +100°C

⑪, ⑫, ⑬, ⑭ & ⑮ = traceability code

## TAPING FORMS

**Component Taping Orientation for 3L SOT-23B**



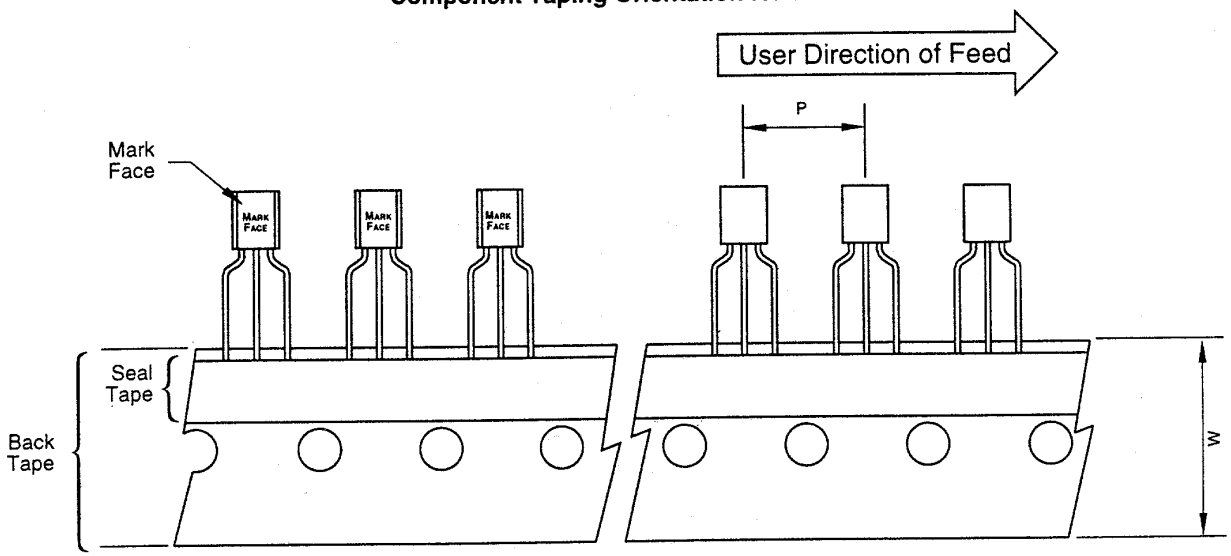

Standard Reel Component Orientation
for 713 or TR Suffix Device
(Mark Right Side Up)

**Tape & Reel Specifications Table**

| Package | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|---|---|---|---|---|
| 3L SOT-23B | 8 mm | 4 mm | 3000 | 7 |

**TAPING FORMS** (Cont.)

**Component Taping Orientation for TO-92**

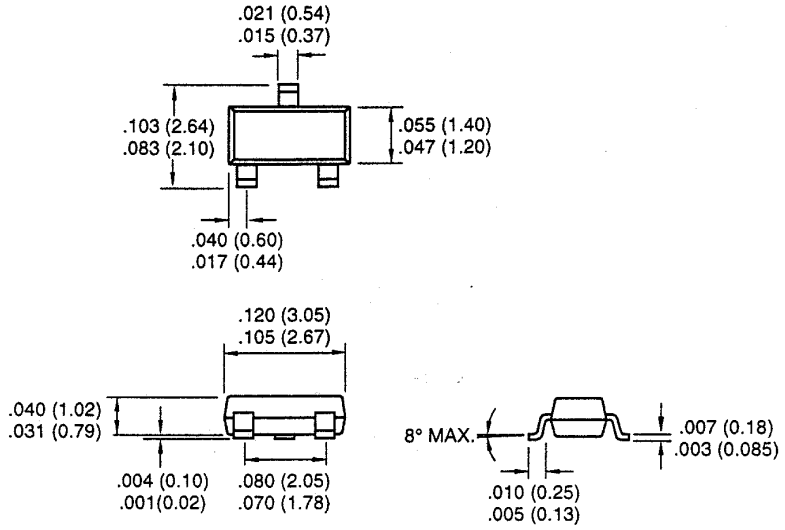



**Tape & Reel Specifications Table**

| Package | Carrier Width (W) | Pitch (P) | Part Per Full Reel | Reel Size |
|---|---|---|---|---|
| TO-92-3 | 18 mm | 12.7 mm | 2000 | 13 |

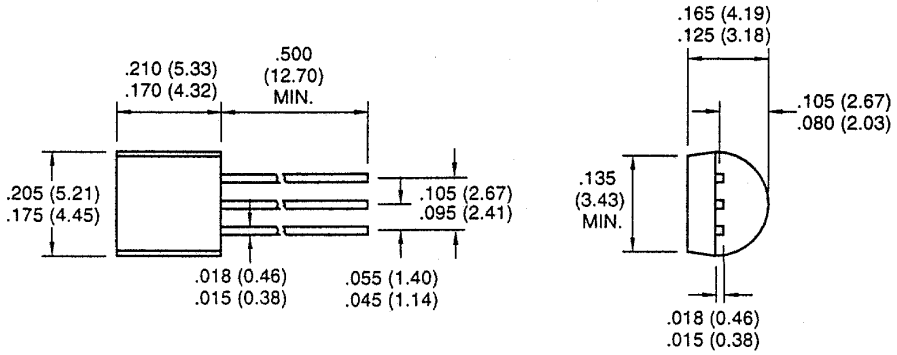
## PACKAGE DIMENSIONS

### SOT-23B-3*




***NOTE:** SOT-23B-3 is equivalent to JEDEC (TO-236)

### TO-92-3




Dimensions: inches (mm)

## LIFE SUPPORT USAGE POLICY:

GMT's products are not authorized for use as critical components in life support devices or systems without the express written approval of the CEO of GMT. As used herein:

(a) Life support devices or systems are devices or systems which (1) are intended for surgical implant into the body; or (2) support or sustain life, and whose failure to perform when properly used in accordance with instructions for use provided in the labeling, can be reasonably expected to result in a significant injury to the user; and

(b) A critical component in any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system.

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