# AD592: Current Output – Precision IC Temperature Transducer

## Product Description

The AD592 is a two terminal monolithic integrated circuit temperature transducer that provides an output current proportional to absolute temperature. For a wide range of supply voltages the transducer acts as a high impedance temperature dependent current source of 1 µA/K. Improved design and laser wafer trimming of the IC's thin film resistors allows the AD592 to achieve absolute accuracy levels and nonlinearity errors previously unattainable at a comparable price.

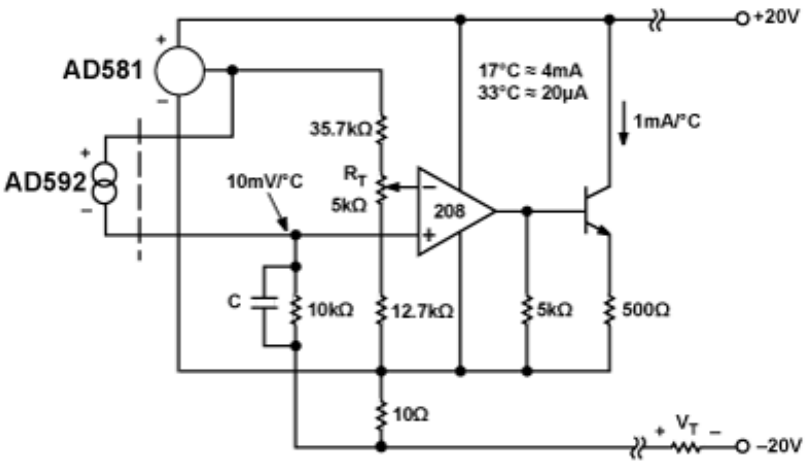
The AD592 can be employed in applications between -25°C and +105°C where conventional temperature sensors (i.e., thermistor, RTD, thermocouple, diode) are currently being used. The inherent low cost of a monolithic integrated circuit in a plastic package, combined with a low total parts count in any given application, make the AD592 the most cost effective temperature transducer currently available. Expensive linearization circuitry, precision voltage references, bridge components, resistance measuring circuitry and cold junction compensation are not required with the AD592.

Typical application areas include: appliance temperature sensing, automotive temperature measurement and control, HVAC (heating/ventilating/air conditioning) system monitoring, industrial temperature control, thermocouple cold junction compensation, board-level electronics temperature diagnostics, temperature readout options in instrumentation, and temperature correction circuitry for precision electronics. Particularly useful in remote sensing applications, the AD592 is immune to voltage drops and voltage noise over long lines due to its high impedance current output. AD592s can easily be multiplexed; the signal current can be switched by a CMOS multiplexer or the supply voltage can be enabled with a tri-state logic gate.

The AD592 is available in three performance grades: the AD592AN, AD592BN and AD592CN. All devices are packaged in a plastic TO-92 case rated from -45°C to +125°C. Performance is specified from -25°C to +105°C. AD592 chips are also available, contact the factory for details.

### Features

- High Precalibrated Accuracy:
  0.5°C max @ +25°C
- Excellent Linearity: 0.15°C max (0°C to +70°C)
- Wide Operating Temperature Range:
  -25°C to +105°C
- Single Supply Operation: +4 V to +30 V
- Excellent Repeatability and Stability
- High Level Output: 1 µA/K
- Two Terminal Monolithic IC:
  Temperature In/Current Out
- Minimal Self-Heating Errors




**Typical Application Circuit for AD592**

## Specifications

| | |
|---|---|
| **Output Type** | **Analog** |
| **Sensor Output** | **+1 µA/°K** |
| **Temp Res(°C/LSB)** | **n/a** |
| **Supply Voltage Range** | **+4V to +30V** |
| **Temp Range(s)** | **-25 to +105** |

| Model | Package | Pins | ROHS Compilant |
|---|---|---|---|
| AD592ANZ | T092 | 3 | Y Material Declaration |
| AD592BNZ | T092 | 3 | Y Material Declaration |
| AD592CNZ | T092 | 3 | Y Material Declaration |

# Low Cost, Precision IC Temperature Transducer

# AD592*

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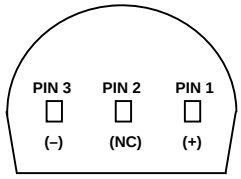
**CONNECTION DIAGRAM**




* PIN 2 CAN BE EITHER ATTACHED OR UNCONNECTED
BOTTOM VIEW

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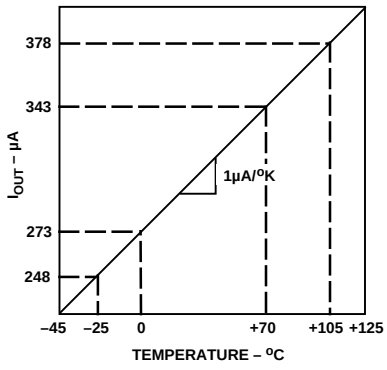
## PRODUCT HIGHLIGHTS

1. With a single supply (4 V to 30 V) the AD592 offers 0.5°C temperature measurement accuracy.
2. A wide operating temperature range (–25°C to +105°C) and highly linear output make the AD592 an ideal substitute for older, more limited sensor technologies (i.e., thermistors, RTDs, diodes, thermocouples).
3. The AD592 is electrically rugged; supply irregularities and variations or reverse voltages up to 20 V will not damage the device.
4. Because the AD592 is a temperature dependent current source, it is immune to voltage noise pickup and IR drops in the signal leads when used remotely.
5. The high output impedance of the AD592 provides greater than 0.5°C/V rejection of supply voltage drift and ripple.
6. Laser wafer trimming and temperature testing insures that AD592 units are easily interchangeable.
7. Initial system accuracy will not degrade significantly over time. The AD592 has proven long term performance and repeatability advantages inherent in integrated circuit design and construction.

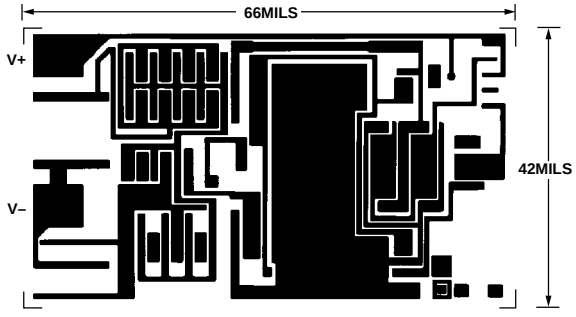


# AD592–SPECIFICATIONS (typical @ $T_A$ = +25°C, $V_S$ = +5 V, unless otherwise noted)

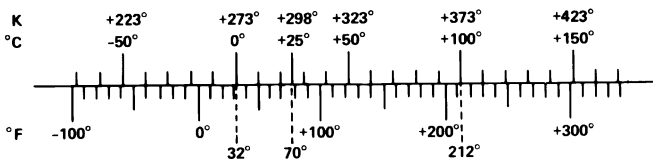
| Model | AD592AN Min | AD592AN Typ | AD592AN Max | AD592BN Min | AD592BN Typ | AD592BN Max | AD592CN Min | AD592CN Typ | AD592CN Max | Units |
|---|---|---|---|---|---|---|---|---|---|---|
| ACCURACY | | | | | | | | | | |
| Calibration Error @ +25°C[1] | | 1.5 | **2.5** | | 0.7 | **1.0** | | 0.3 | **0.5** | °C |
| $T_A$ = 0°C to +70°C | | | | | | | | | | |
| Error over Temperature | | 1.8 | 3.0 | | 0.8 | 1.5 | | 0.4 | 0.8 | °C |
| Nonlinearity[2] | | 0.15 | 0.35 | | 0.1 | 0.25 | | 0.05 | 0.15 | °C |
| $T_A$ = –25°C to +105°C | | | | | | | | | | |
| Error over Temperature[3] | | 2.0 | **3.5** | | 0.9 | **2.0** | | 0.5 | **1.0** | °C |
| Nonlinearity[2] | | 0.25 | 0.5 | | 0.2 | 0.4 | | 0.1 | 0.35 | °C |
| OUTPUT CHARACTERISTICS | | | | | | | | | | |
| Nominal Current Output @ +25°C (298.2K) | | 298.2 | | | 298.2 | | | 298.2 | | µA |
| Temperature Coefficient | | 1 | | | 1 | | | 1 | | µA/°C |
| Repeatability[4] | | | 0.1 | | | 0.1 | | | 0.1 | °C |
| Long Term Stability[5] | | | 0.1 | | | 0.1 | | | 0.1 | °C/month |
| ABSOLUTE MAXIMUM RATINGS | | | | | | | | | | |
| Operating Temperature | –25 | | +105 | –25 | | +105 | –25 | | +105 | °C |
| Package Temperature[6] | –45 | | +125 | –45 | | +125 | –45 | | +125 | °C |
| Forward Voltage (+ to –) | | | **44** | | | **44** | | | **44** | V |
| Reverse Voltage (– to +) | | | **20** | | | **20** | | | **20** | V |
| Lead Temperature (Soldering 10 sec) | | | 300 | | | 300 | | | 300 | °C |
| POWER SUPPLY | | | | | | | | | | |
| Operating Voltage Range | 4 | | 30 | 4 | | 30 | 4 | | 30 | V |
| Power Supply Rejection | | | | | | | | | | |
| +4 V < $V_S$ < +5 V | | | **0.5** | | | **0.5** | | | **0.5** | °C/V |
| +5 V < $V_S$ < +15 V | | | **0.2** | | | **0.2** | | | **0.2** | °C/V |
| +15 V < $V_S$ < +30 V | | | **0.1** | | | **0.1** | | | **0.1** | °C/V |

NOTES
[1]An external calibration trim can be used to zero the error @ +25°C.
[2]Defined as the maximum deviation from a mathematically best fit line.
[3]Parameter tested on all production units at +105°C only. C grade at –25°C also.
[4]Maximum deviation between +25°C readings after a temperature cycle between –45°C and +125°C. Errors of this type are noncumulative.
[5]Operation @ +125°C, error over time is noncumulative.
[6]Although performance is not specified beyond the operating temperature range, temperature excursions within the package temperature range will not damage the device.
Specifications subject to change without notice.
Specifications shown in boldface are tested on all production units at final electrical test. Results from those tests are used to calculate outgoing quality levels. All min and max specifications are guaranteed, although only those shown in boldface are tested on all production units.

## METALIZATION DIAGRAM




## TEMPERATURE SCALE CONVERSION EQUATIONS




$$°C = \frac{5}{9}(°F - 32) \qquad K = °C + 273.15$$

$$°F = \frac{9}{5}°C + 32 \qquad °R = °F + 459.7$$

## ORDERING GUIDE

| Model | Max Cal Error @ +25°C | Max Error –25°C to +105°C | Max Nonlinearity –25°C to +105°C | Package Option |
|---|---|---|---|---|
| AD592CN | 0.5°C | 1.0°C | 0.35°C | TO-92 |
| AD592BN | 1.0°C | 2.0°C | 0.4°C | TO-92 |
| AD592AN | 2.5°C | 3.5°C | 0.5°C | TO-92 |

To minimize the number of MUXs required when a large number of AD592s are being used, the circuit can be configured in a matrix. That is, a decoder can be used to switch the supply voltage to a column of AD592s while a MUX is used to control which row of sensors are being measured. The maximum number of AD592s which can be used is the product of the number of channels of the decoder and MUX.

An example circuit controlling 80 AD592s is shown in Figure 16. A 7-bit digital word is all that is required to select one of the sensors. The enable input of the multiplexer turns all the sensors off for minimum dissipation while idling.

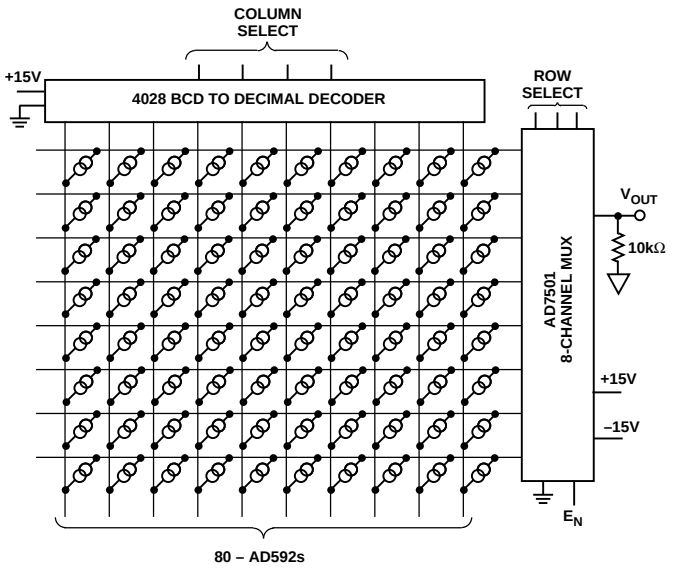



*Figure 16. Matrix Multiplexer*

To convert the AD592 output to °C or °F a single inexpensive reference and op amp can be used as shown in Figure 17. Although this circuit is similar to the two temperature trim circuit shown in Figure 6, two important differences exist. First, the gain resistor is fixed alleviating the need for an elevated temperature trim. Acceptable accuracy can be achieved by choosing an inexpensive resistor with the correct tolerance. Second, the AD592 calibration error can be trimmed out at a known convenient temperature (i.e., room temperature) with a single pot adjustment. This step is independent of the gain selection.

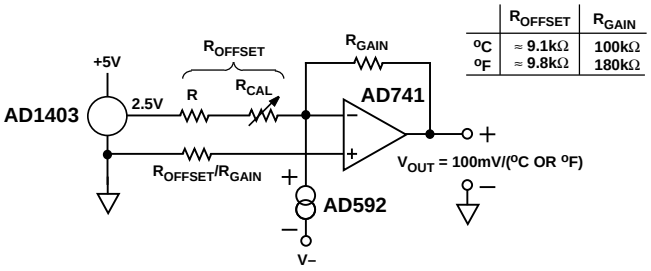



*Figure 17. Celsius or Fahrenheit Thermometer*

## OUTLINE DIMENSIONS

Dimensions shown in inches and (mm).