



# +5V Precision Voltage Reference

**MAX675**

## General Description

The MAX675 is a precision voltage reference that is pretrimmed to within  $\pm 0.15\%$  of 5V. The reference features excellent temperature stability (as low as 12.0ppm/ $^{\circ}\text{C}$  guaranteed), low current drain and low noise. It is supplied in the space-saving narrow SO package, as well as, the standard 8-pin Plastic DIP package.

## Features

- ◆ Pretrimmed to +5V,  $\pm 0.15\%$
- ◆ Excellent Temperature Stability: 12ppm/ $^{\circ}\text{C}$
- ◆ Low Noise: 10 $\mu\text{Vp-p}$
- ◆ Low Supply Current: 1.4mA (max)
- ◆ Short-Circuit Protected
- ◆ Load Regulation 0.001%/mA
- ◆ Pin-for-Pin Compatible with REF02

## Applications

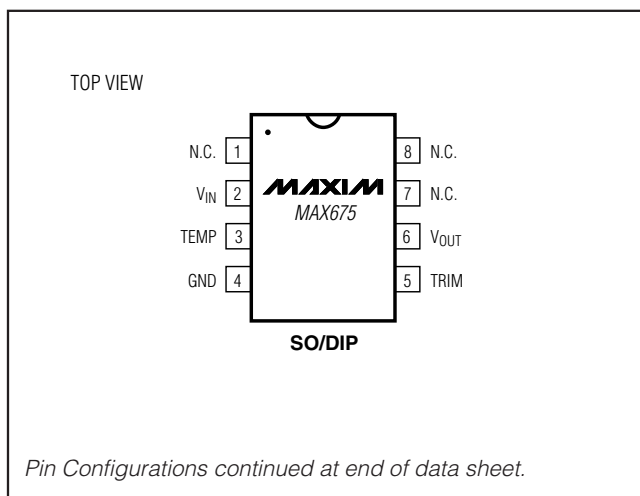
- A/D Converters
- D/A Converters
- Digital Voltmeters
- Voltage Regulators
- Threshold Detectors

## Ordering Information

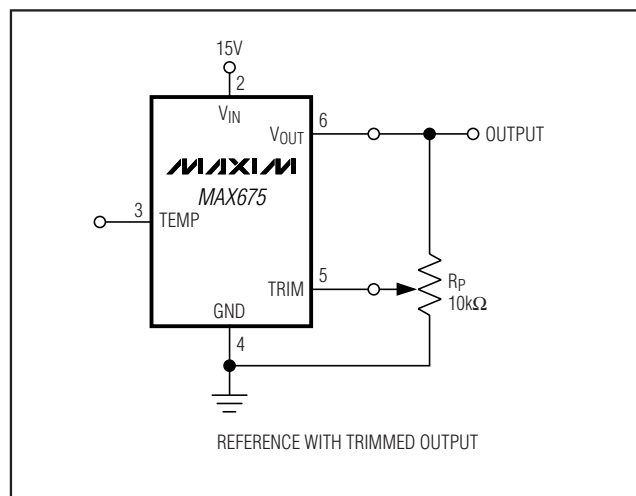
| PART      | TEMP RANGE                                       | PIN-PACKAGE | TEMPCO (ppm/ $^{\circ}\text{C}$ ) | INITIAL ERROR (mV) |
|-----------|--|-------------|-----------------------------------|--------------------|
| MAX675CPA | 0 $^{\circ}\text{C}$ to +70 $^{\circ}\text{C}$   | 8 PDIP      | 12                                | 7                  |
| MAX675CSA | 0 $^{\circ}\text{C}$ to +70 $^{\circ}\text{C}$   | 8 Narrow SO | 12                                | 7                  |
| MAX675EPA | -40 $^{\circ}\text{C}$ to +85 $^{\circ}\text{C}$ | 8 PDIP      | 15                                | 7                  |
| MAX675ESA | -40 $^{\circ}\text{C}$ to +85 $^{\circ}\text{C}$ | 8 Narrow SO | 15                                | 7                  |

Ordering Information continued at end of data sheet.

## Pin Configurations



## Typical Operating Circuit



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## ABSOLUTE MAXIMUM RATINGS

|  |                 |   |                 |
|--|-----------------|---|-----------------|
| Input Voltage .....                                    | 40V             | Operating Temperature Range                       |                 |
| Power Dissipation                                      |                 | MAX675C .....                                     | 0°C to +70°C    |
| TO-99 (TV) (derate at 7.1mW/ C above +80°C).....       | 500mW           | MAX675E .....                                     | -40°C to +85°C  |
| CERDIP (J) (derate at 6.7mW/ C above +75°C).....       | 500mW           | MAX675M .....                                     | -55°C to +125°C |
| Plastic DIP (P) (derate at 5.6mW/ C above +36°C) ..... | 500mW           | Dice Junction Temperature (T <sub>J</sub> ) ..... | -65°C to +150°C |
| Narrow SO (S) (derate at 5.0mW/ C above +55°C) .....   | 300mW           | Output Short-Circuit Duration                     |                 |
| Storage Temperature Range .....                        | -65°C to +150°C | (to Ground or V <sub>IN</sub> ).....              | Indefinite      |
|  |                 | Lead Temperature (soldering, 60s) .....           | +300°C          |

Stresses beyond 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 beyond 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

(V<sub>IN</sub> = +15V, T<sub>A</sub> = +25°C, unless otherwise noted.)

| PARAMETER                                       | SYMBOL              | CONDITIONS                   | MIN  | TYP   | MAX   | UNITS  |
|---|---------------------|------------------------------|------|-------|-------|--------|
| Output Voltage Tolerance                        |                     | I <sub>L</sub> = 0mA         |      |       | ±7    | mV     |
| Output Voltage Temperature Coefficient (Note 1) | TCV <sub>O</sub>    | MAX675CTV/CPA/CSA            |      |       | 12    | ppm/°C |
|   |                     | MAX675ETV/EJA/EPA/ESA        |      |       | 15    |        |
|   |                     | MAX675MTV/MJA                |      |       | 20    |        |
| Output Adjustment Range                         | V <sub>TRIM</sub>   | R <sub>p</sub> = 10          | ±150 | ±300  |       | mV     |
| Line Regulation (Note 2)                        |                     | V <sub>IN</sub> = 18V to 33V |      | 0.006 | 0.01  | %/V    |
| Load Regulation (Note 2)                        |                     | I <sub>L</sub> = 0 to 10mA   |      | 0.001 | 0.002 | %/mA   |
| Turn-On Settling Time                           | t <sub>ON</sub>     | To ±0.1% of final value      |      | 5     |       | µs     |
| Quiescent Supply Current                        | I <sub>Q</sub>      | No load                      |      | 750   | 1400  | µA     |
| Noise (Note 3)                                  | e <sub>N(P-P)</sub> | 0.1Hz to 10Hz                |      | 10    | 15    | µVP-P  |
| Sink Current                                    | I <sub>S</sub>      |                              | 0.3  | 0.5   |       | mA     |
| Short-Circuit Current                           | I <sub>SC</sub>     | V <sub>OUT</sub> = 0V        |      | 30    |       | mA     |
| Current Temperature Voltage Output              | V <sub>T</sub>      | (Note 4)                     |      | 630   |       | mV     |

**Note 1:** Temperature Coefficient is measured by the "box" method, i.e., the maximum  $\Delta V_{OUT}$  is divided by  $\Delta T$ .

**Note 2:** Line and Load Regulation specifications include the effect of self-heating.

**Note 3:** Guaranteed by design for MAX675CPA, MAX675CSA, MAX675EPA, MAX675ESA; sample tested for all other grades and packages.

**Note 4:** Limit current in or out of pin 3 to 50nA and capacitance on pin 3 to 30pF.

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## Output Adjustment

The MAX675 trim terminal can be used to adjust the output voltage over a  $5V \pm 150mV$  range. This feature allows system errors to be trimmed by setting the reference to a voltage other than 5V such as 5.120V for binary applications (see *Typical Operating Circuit*). The trim terminal may, of course, be left open if no adjustment is needed.

Adjustment of the output does not significantly affect the temperature performance of the device. The temperature coefficient change is approximately  $0.7ppm/^{\circ}C$  for each 100mV of output adjustment from its initial value.

## Temperature Voltage Output

The MAX675 provides a temperature-dependent output voltage on the TEMP pin. This voltage is proportional to the absolute temperature, and has a scale factor of approximately  $2.1mV/^{\circ}C$  (Figure 2).

$$\text{Output Voltage} = 2.1(T + 273)mV$$

where T = Temperature in  $^{\circ}C$

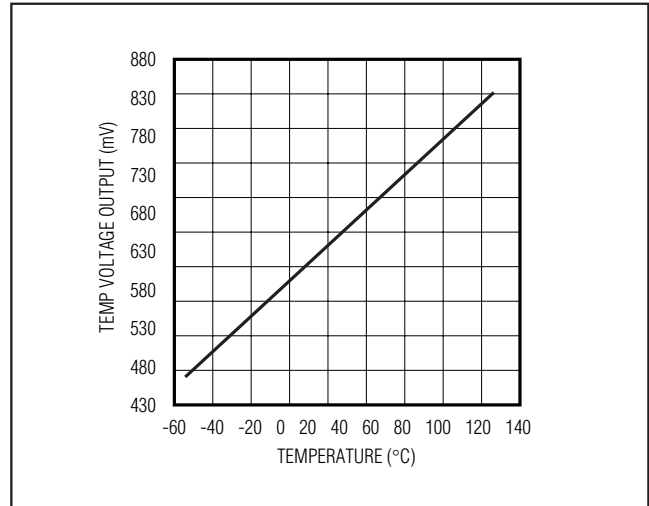
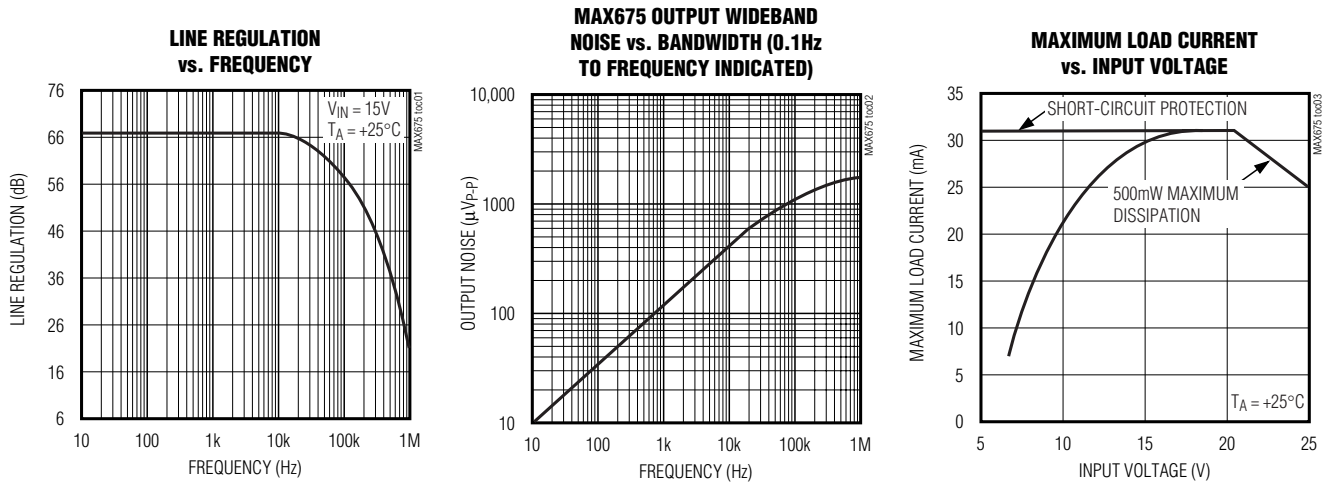


Figure 2. MAX675 Temperature Voltage Output vs. Temperature

## Typical Operating Characteristics

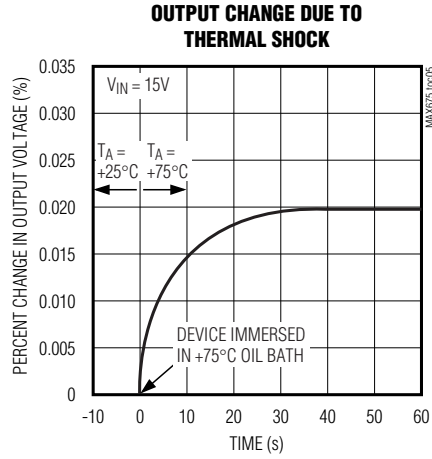
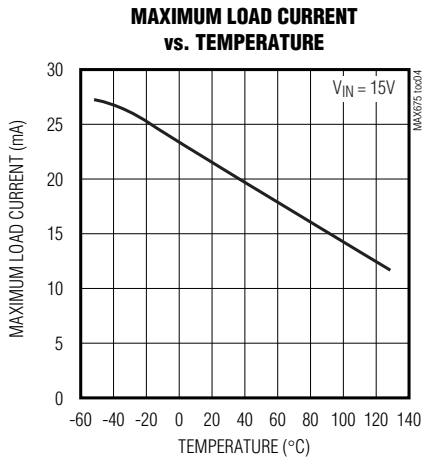
( $T_A = +25^{\circ}C$ , unless otherwise noted.)



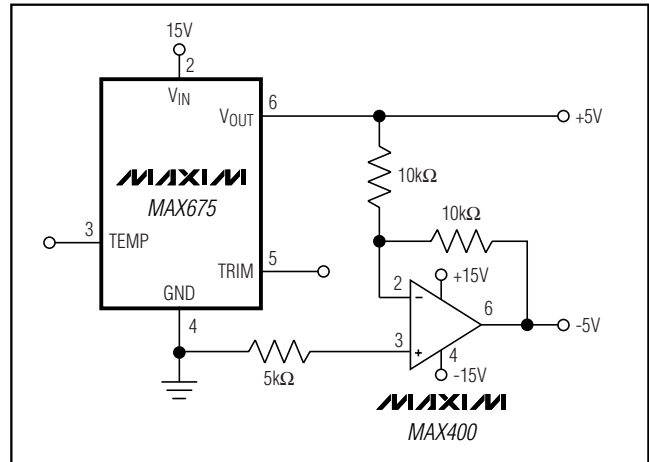
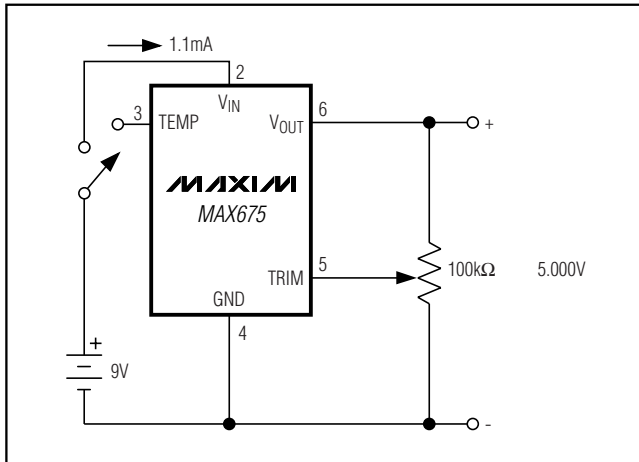
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## Typical Operating Characteristics (continued)

( $T_A = +25^\circ\text{C}$ , unless otherwise noted.)



## Typical Applications



# +5V Precision Voltage Reference

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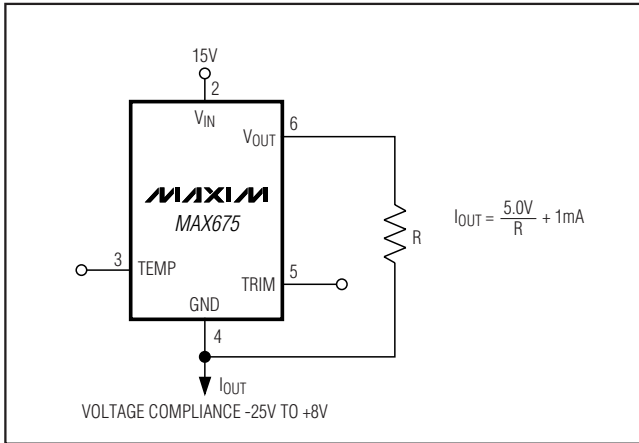


Figure 5. Current Source

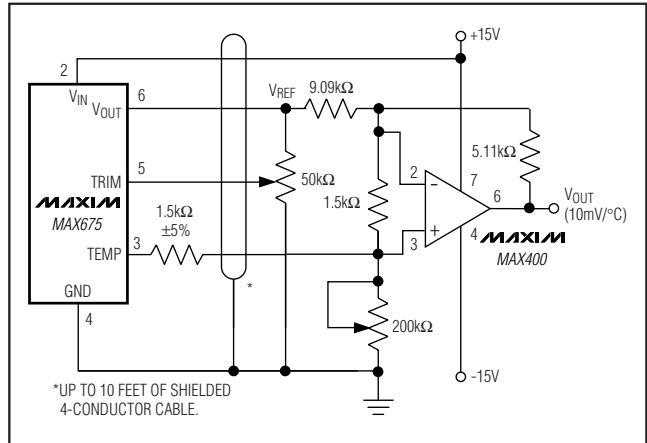
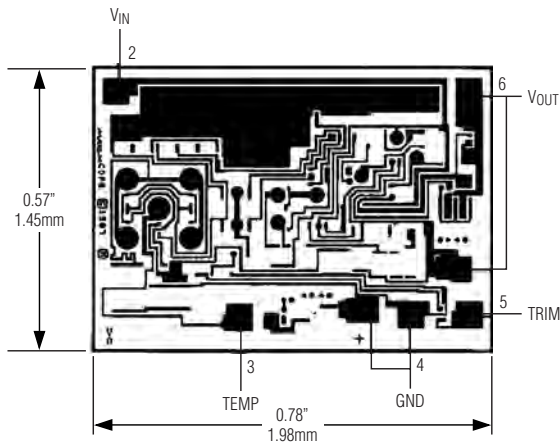
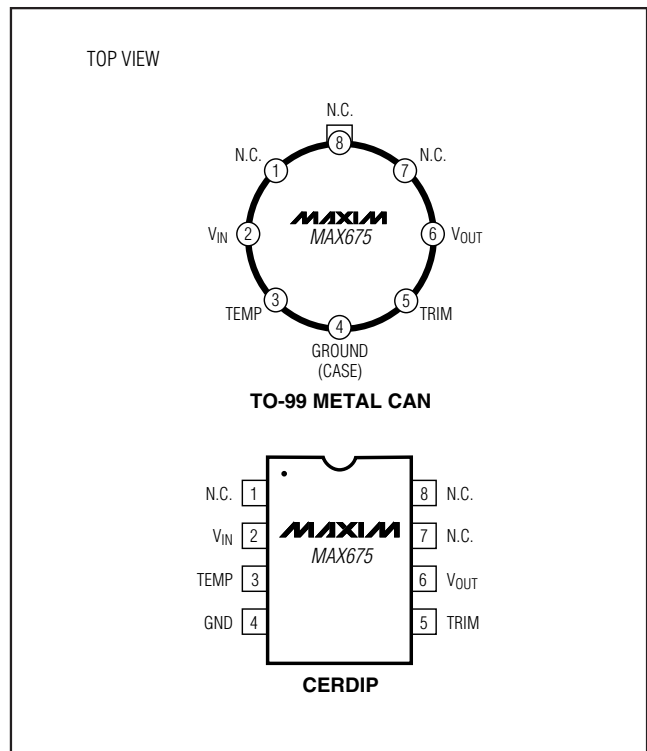


Figure 6. Precision Temperature Transducer with Remote Sensor

## Chip Topography



## Pin Configurations (continued)



## Ordering Information

| PART       | TEMP RANGE      | PIN-PACKAGE | TEMPCO (ppm/°C) | INITIAL ERROR (mV) |
|------------|-----------------|-------------|-----------------|--------------------|
| MAX675CTV* | 0°C to +70°C    | 8 TO-99     | 12              | 7                  |
| MAX675ETV* | -40°C to +85°C  | 8 TO-99     | 15              | 7                  |
| MAX675EJA* | -40°C to +85°C  | 8 CERDIP    | 15              | 7                  |
| MAX675MTV* | -55°C to +125°C | 8 TO-99     | 20              | 7                  |
| MAX675MJA* | -55°C to +125°C | 8 CERDIP    | 20              | 7                  |

\*Contact factory for availability. Not recommended for new designs.

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