

# REF01

## +10V Precision VOLTAGE REFERENCE

### FEATURES

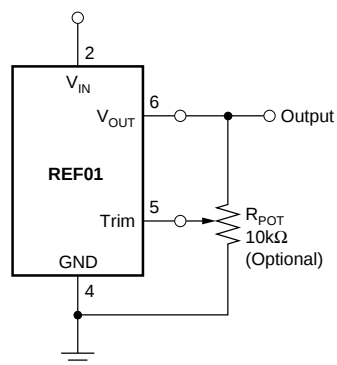
- **OUTPUT VOLTAGE:**  $+10V \pm 0.2\%$  max
- **EXCELLENT TEMPERATURE STABILITY:** 8.5ppm/ $^{\circ}C$  max ( $-40^{\circ}C$  to  $+85^{\circ}C$ )
- **LOW NOISE:** 5 $\mu V$ p-p typ (0.1Hz to 10Hz)
- **EXCELLENT LINE REGULATION:** 0.001%/V max
- **EXCELLENT LOAD REGULATION:** 0.002%/mA max
- **SOURCES 10mA, SINKS 5mA min**
- **LOW SUPPLY CURRENT:** 1.4mA max
- **SHORT-CIRCUIT PROTECTED**
- **WIDE SUPPLY RANGE:** 11.4VDC to 40VDC
- **PACKAGE OPTIONS:** Plastic DIP, SOIC
- **EXTENDED INDUSTRIAL TEMPERATURE RANGE:**  $-40^{\circ}C$  to  $+85^{\circ}C$

### APPLICATIONS

- **PRECISION REGULATORS**
- **CONSTANT CURRENT SOURCE/SINK**
- **DIGITAL VOLTMETERS**
- **A/D AND D/A CONVERTERS**
- **PRECISION CALIBRATION STANDARD**
- **TEST EQUIPMENT**

### DESCRIPTION

The REF01 is a high performance, low price, precision pin compatible second source voltage reference. Output accuracy of  $\pm 0.2\%$  is a 30% improvement over industry standard REF01s. Output noise is 5 $\mu V$ p-p, which is a 75% decrease in noise over all other REF01s. Line regulation is 0.001%/V max and load regulation is 0.002%/mA max, which far exceeds the performance of our competitors. Quiescent current is a low 1.4mA. REF01 provides extended supply range when compared to industry standard devices. Burr-Brown's REF01 is the best choice for applications which requires improved accuracy, low noise, low power consumption, low drift, and the lowest price. Popular package options are available: Plastic DIP, and SOIC. For guaranteed long-term drift see Burr-Brown's model REF10.



# SPECIFICATIONS

## ELECTRICAL

At  $T_A = +25^\circ\text{C}$  and  $V_S = +15\text{V}$  power supply, unless otherwise noted.

| PARAMETER                                                                                         | CONDITIONS                                                                               | REF01A |                         |                         | REF01B |                         |                         | REF01C |                         |                         | UNITS   |
|---------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|--------|-------------------------|-------------------------|--------|-------------------------|-------------------------|--------|-------------------------|-------------------------|---------|
|                                                                                                   |                                                                                          | MIN    | TYP                     | MAX                     | MIN    | TYP                     | MAX                     | MIN    | TYP                     | MAX                     |         |
| OUTPUT VOLTAGE ( $\Delta V_{OT}$ )<br>Change with Temperature <sup>(1, 2)</sup><br>–40°C to +85°C | $I_L = 0\text{mA}$                                                                       | 9.970  | 10.0                    | 10.030                  | 9.975  | 10.0                    | 10.025                  | 9.980  | 10.0                    | 10.020                  | V       |
| OUTPUT VOLTAGE DRIFT <sup>(3)</sup><br>–40°C to +85°C ( $TCV_O$ )                                 |                                                                                          |        | 0.11                    | 0.18                    |        | 0.06                    | 0.11                    |        | 0.04                    | 0.07                    | %       |
| OUTPUT VOLTAGE DRIFT <sup>(3)</sup><br>–40°C to +85°C ( $TCV_O$ )                                 |                                                                                          |        | 10                      | 25                      |        | 8                       | 15                      |        | 3                       | 8.5                     | ±ppm/°C |
| OUTPUT ADJUSTMENT RANGE                                                                           | $R_{POT} = 10\text{k}\Omega$ <sup>(6)</sup>                                              | ±3     |                         |                         | ±3     |                         |                         | ±3     |                         |                         | %       |
| CHANGE IN $V_O$ TEMP COEFFICIENT WITH OUTPUT ADJUSTMENT<br>(–55°C to +125°C)                      | $R_{POT} = 10\text{k}\Omega$                                                             |        | 0.5                     |                         |        | 0.5                     |                         |        | 0.5                     |                         | ppm/%   |
| OUTPUT VOLTAGE NOISE                                                                              | 0.1Hz to 10Hz <sup>(5)</sup>                                                             |        | 5                       |                         |        | 5                       |                         |        | 5                       |                         | µVp-p   |
| LINE REGULATION <sup>(4)</sup><br>–40°C to +85°C                                                  | $V_{IN} = 11.4\text{V}$ to 36V                                                           |        | 0.001<br>0.002          | 0.003<br>0.006          |        | 0.0007<br>0.001         | 0.002<br>0.004          |        | 0.0003<br>0.001         | 0.001<br>0.002          | %/V     |
| LOAD REGULATION <sup>(4)</sup><br>–40°C to +85°C                                                  | $I_L = 0\text{mA}$ to +10mA<br>$I_L = 0\text{mA}$ to –5mA<br>$I_L = 0\text{mA}$ to +10mA |        | 0.001<br>0.003<br>0.005 | 0.004<br>0.008<br>0.016 |        | 0.001<br>0.002<br>0.004 | 0.003<br>0.006<br>0.012 |        | 0.001<br>0.001<br>0.003 | 0.002<br>0.004<br>0.008 | %/mA    |
| TURN-ON SETTLING TIME                                                                             | $T_o \pm 0.1\%$<br>of Final Value                                                        |        | 5                       |                         |        | 5                       |                         |        | 5                       |                         | µs      |
| QUIESCENT CURRENT                                                                                 | No Load                                                                                  |        | 1.2                     | 1.4                     |        | 1.2                     | 1.4                     |        | 1.2                     | 1.4                     | mA      |
| LOAD CURRENT                                                                                      |                                                                                          | 10     | 21                      |                         | 10     | 21                      |                         | 10     | 21                      |                         | mA      |
| SINK CURRENT                                                                                      |                                                                                          | –5     | –10                     |                         | *      | *                       |                         | *      | *                       |                         | mA      |
| SHORT-CIRCUIT CURRENT                                                                             | $V_O = 0$                                                                                |        | 30                      |                         |        | 30                      |                         |        | 30                      |                         | mA      |
| POWER DISSIPATION                                                                                 |                                                                                          |        | 18                      |                         |        | 18                      |                         |        | 18                      |                         | mW      |
| TEMPERATURE RANGE<br>Specification<br>REF01A, B, C                                                |                                                                                          | –40    |                         | +85                     | *      |                         | *                       | *      |                         | *                       | °C      |

NOTES: (1)  $\Delta V_{OT}$  is defined as the absolute difference between the maximum output and the minimum output voltage over the specified temperature range expressed as a percentage of 10V:  $\Delta V_O = \frac{|V_{MAX} - V_{MIN}|}{10V} \times 100\%$  (2)  $\Delta V_{OT}$  specification applies trimmed to +10.000V or untrimmed. (3)  $TCV_O$  is defined as  $\Delta V_{OT}$  divided

by the temperature range. (4) Line and load regulation specifications include the effect of self heating. (5) Sample tested. (6) 10kΩ potentiometer connected between  $V_O$  and ground with wiper connected to trim pin. See Figure 3.

## ORDERING INFORMATION

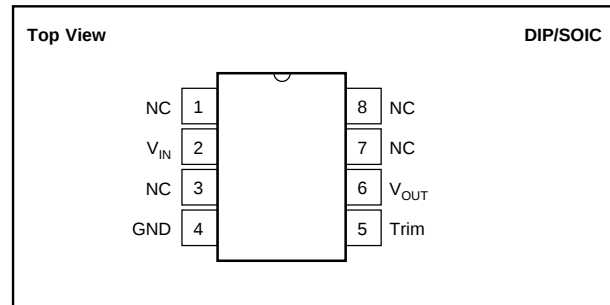
| PRODUCT | $V_{OUT}$ AT 25°C | MAX DRIFT (ppm/°C) | TEMPERATURE    | PACKAGE           |
|---------|-------------------|--------------------|----------------|-------------------|
| REF01AU | 10V±30mV          | ±25                | –40°C to +85°C | 8-Pin SOIC        |
| REF01BU | 10V±25mV          | ±15                | –40°C to +85°C | 8-Pin SOIC        |
| REF01AP | 10V±30mV          | ±25                | –40°C to +85°C | 8-Pin Plastic DIP |
| REF01BG | 10V±25mV          | ±15                | –40°C to +85°C | 8-Pin Ceramic DIP |
| REF01BP | 10V±25mV          | ±15                | –40°C to +85°C | 8-Pin Plastic DIP |

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## ABSOLUTE MAXIMUM RATINGS

|                                                              |                |
|--------------------------------------------------------------|----------------|
| Input Voltage .....                                          | +40V           |
| Operating Temperature<br>P, U .....                          | -40°C to +85°C |
| Storage Temperature Range<br>P, U .....                      | -65°C to +125° |
| Output Short Circuit Duration (to Ground or $V_{IN}$ ) ..... | Indefinite     |
| Junction Temperature .....                                   | -65°C to +150° |
| $\theta_{JA}$ P .....                                        | 120°C/W        |
| U .....                                                      | 80°C/W         |
| Lead Temperature (soldering, 60s) .....                      | +300°C         |

## PIN CONFIGURATIONS

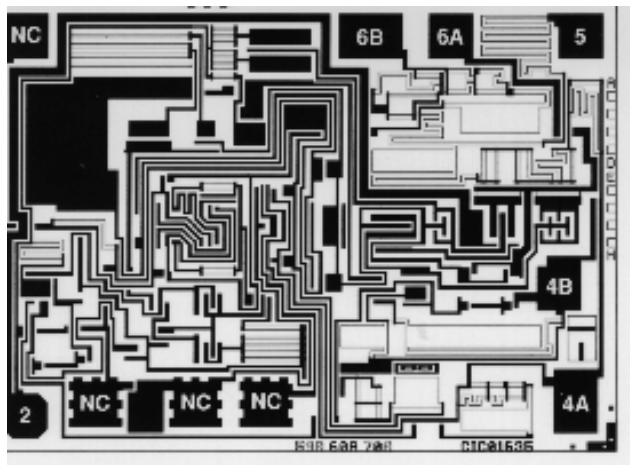


## PACKAGE INFORMATION

| PRODUCT | PACKAGE           | PACKAGE DRAWING NUMBER <sup>(1)</sup> |
|---------|-------------------|---------------------------------------|
| REF01AU | 8-Pin SOIC        | 182                                   |
| REF01BU | 8-Pin SOIC        | 182                                   |
| REF01AP | 8-Pin Plastic DIP | 006                                   |
| REF01BP | 8-Pin Plastic DIP | 006                                   |

NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book.

## DICE INFORMATION



REF01 DIE TOPOGRAPHY

| PAD | FUNCTION | PAD | FUNCTION          |
|-----|----------|-----|-------------------|
| 2   | $V_{IN}$ | 4B  | GND               |
| 3A  | NC       | 5   | Trim              |
| 3B  | NC       | 6A  | $V_{OUT}$         |
| 3C  | NC       | 6B  | $V_{OUT}$ (Sense) |
| 4A  | GND      |     |                   |

Substrate Bias: Common, pad 4B.

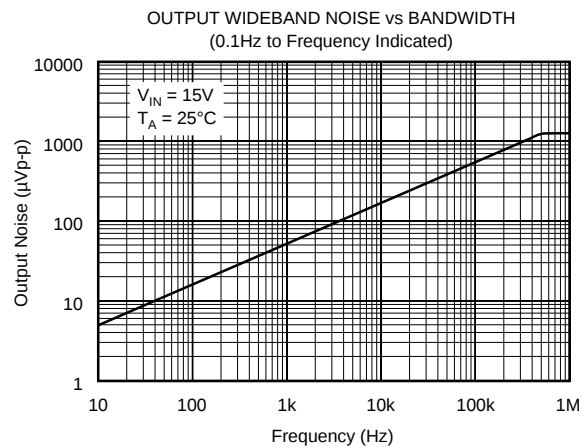
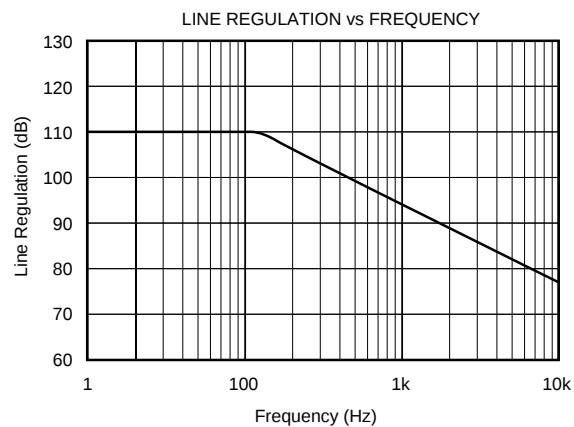
NOTE: Both common pads must be connected and both  $V_{OUT}$  pads must be tied together.

## MECHANICAL INFORMATION

|               | MILS (0.001") | MILLIMETERS     |
|---------------|---------------|-----------------|
| Die Size      | 55 x 75       | 1.40 x 1.91 ±13 |
| Die Thickness | 20 ±3         | 0.51 ±0.08      |
| Min. Pad Size | 5 x 5         | 0.10 x 0.10     |
| Backing       | Gold          |                 |

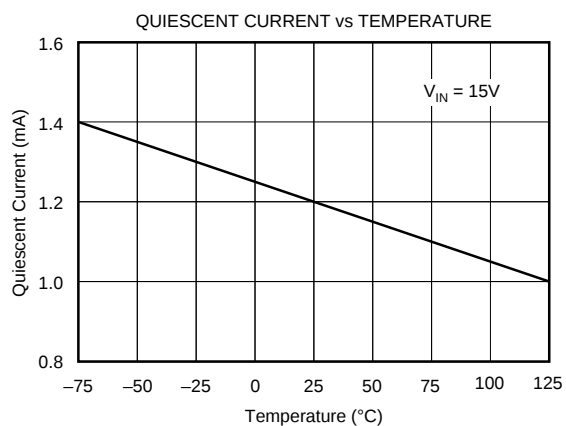
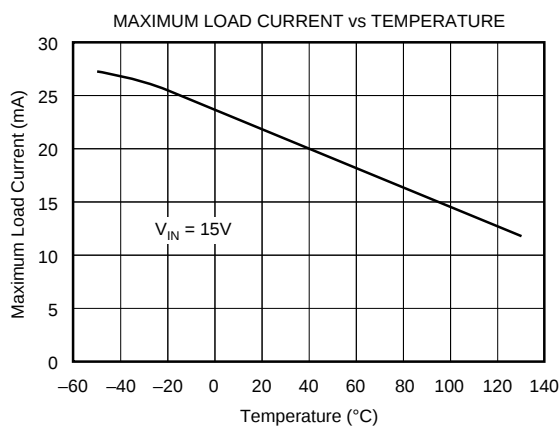
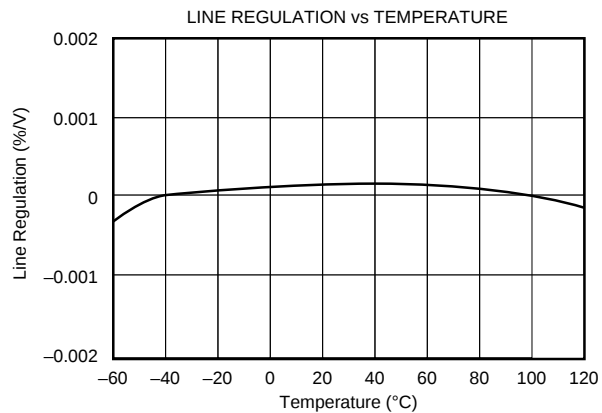
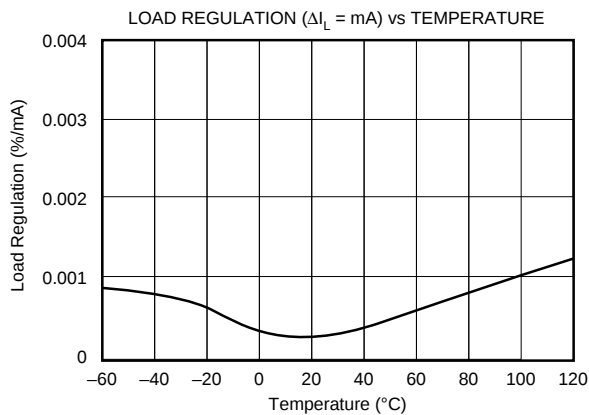
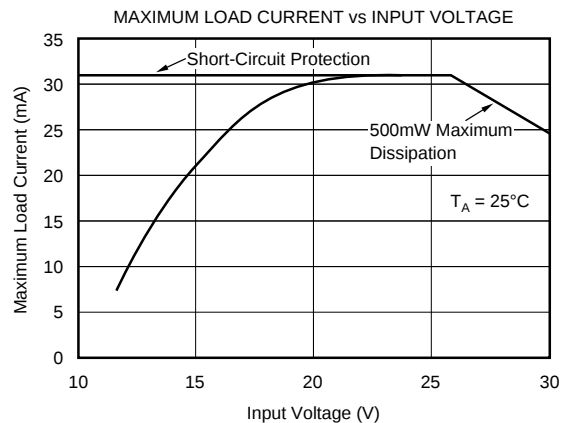
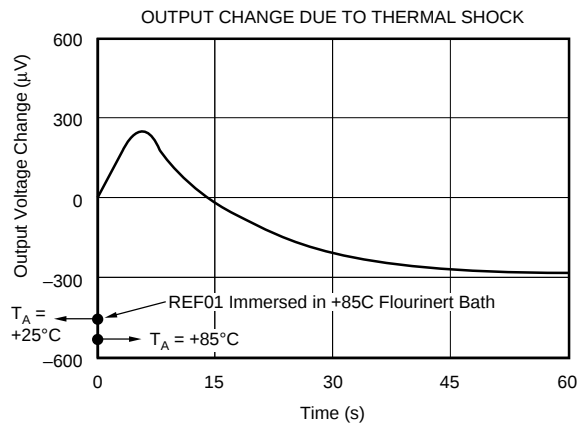
## TYPICAL PERFORMANCE CURVES

At  $T_A = +25^\circ\text{C}$  and  $V_S = +15\text{V}$  power supply, unless otherwise noted.



# TYPICAL PERFORMANCE CURVES (CONT)

At  $T_A = +25^\circ\text{C}$  and  $V_S = +15\text{V}$  power supply, unless otherwise noted.



## OUTPUT ADJUSTMENT

The REF01 trim terminal can be used to adjust the voltage over a  $10V \pm 300mV$  range. This feature allows the system designer to trim system errors by setting the reference to a voltage other than 10V, including 10.240V for binary applications (see circuit on the first page).

Adjustment of the output does not significantly affect the temperature performance of the device. The temperature coefficient change is approximately  $0.5ppm/^{\circ}C$  for 100mV of output adjustment.

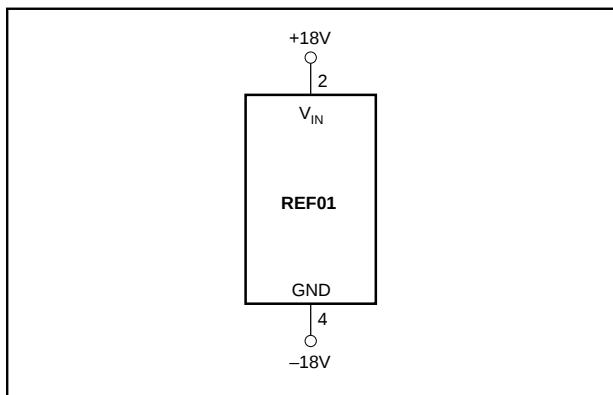


FIGURE 1. Burn-In Circuit.

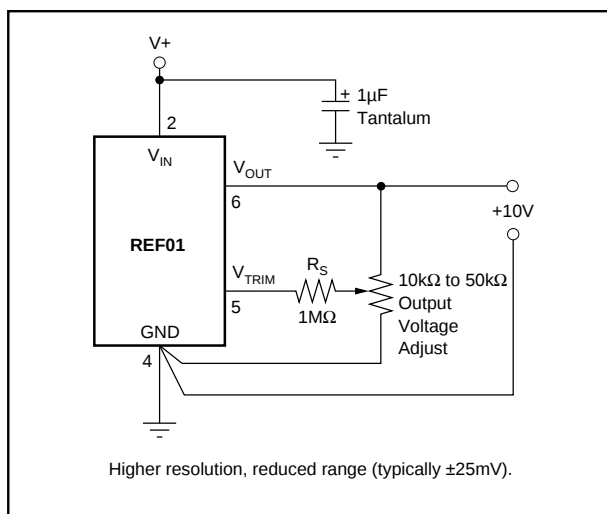


FIGURE 2. High Resolution Output Adjustment.