

## FEATURES

- 0.2% Output Tolerance
- $0.6\Omega$  Shunt Impedance
- $700\mu\text{A}$  to  $10\text{mA}$  Operating Current
- Pin Compatible with LM136-5
- $20\text{ppm}/^\circ\text{C}$  Max Drift
- Output Voltage Trim does not Affect Drift
- Can be Used as Positive or Negative Reference

## APPLICATIONS

- A-to-D and D-to-A Converters
- Precision Regulators
- Precision Current Sources
- V to F and F to V Converters

## DESCRIPTION

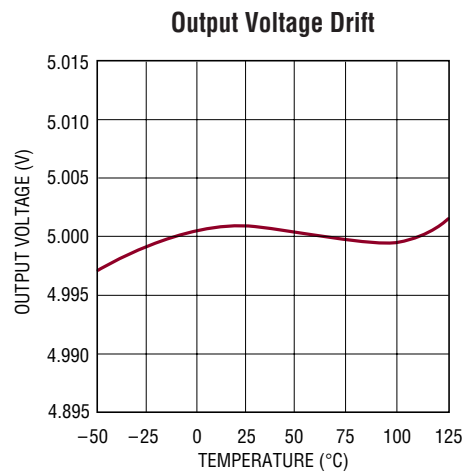
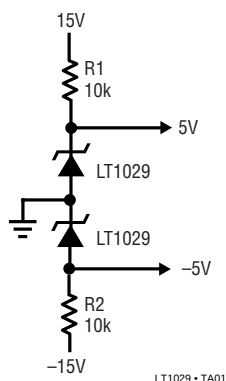
The LT<sup>®</sup>1029 is a 5V bandgap reference intended for use in the shunt or “Zener” mode, allowing it to be used as either a positive or negative reference. The output is pretrimmed to  $\pm 0.2\%$  accuracy with  $20\text{ppm}/^\circ\text{C}$  maximum temperature drift. A trim pin allows additional output adjustment for even more precise output voltage.

Operating current range for the LT1029 is  $700\mu\text{A}$  to  $10\text{mA}$ . Extremely low dynamic impedance allows excellent output regulation even with fluctuating operating current.

The LT1029 will replace an LM136-5 or LM336-5 and simplify circuits using the “minimum temperature coefficient” trim network. The LT1029 does not require this special network to meet its temperature drift specification; these application network components are simply removed. If output trimming is required for initial accuracy, the diodes in the trim network should be replaced with jumpers.

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## TYPICAL APPLICATION

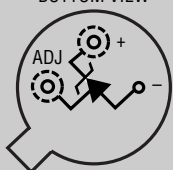
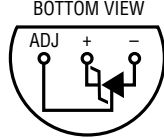


# LT1029/LT1029A

## ABSOLUTE MAXIMUM RATINGS (Note 1)

|                                  |                |                                            |                |
|----------------------------------|----------------|--------------------------------------------|----------------|
| Reverse Current .....            | 15mA           | Storage Temperature .....                  | –65°C to 150°C |
| Forward Current .....            | 10mA           | Lead Temperature (Soldering, 10 sec) ..... | 300°C          |
| Operating Temperature Range      |                |                                            |                |
| LT1029C/LT1029AC .....           | 0°C to 70°C    |                                            |                |
| LT1029M/LT1029AM (OBSOLETE) .... | –55°C to 125°C |                                            |                |

## PACKAGE/ORDER INFORMATION

|                                                                                                                                                                                                                                                                                                                                                                               |                                                |                                                                                                                                                                                                                                            |                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
|  <p>BOTTOM VIEW</p> <p>H PACKAGE<br/>TO-46 METAL CAN<br/><math>T_{JMAX} = 150^{\circ}\text{C}</math>, <math>\theta_{JA} = 440^{\circ}\text{C/W}</math>, <math>\theta_{JC} = 80^{\circ}\text{C/W}</math></p> <p><b>OBSOLETE PACKAGE</b><br/>Consider the Z Package as an Alternate Source</p> | ORDER PART<br>NUMBER                           |  <p>BOTTOM VIEW</p> <p>Z PACKAGE<br/>TO-92 PLASTIC<br/><math>T_{JMAX} = 100^{\circ}\text{C}</math>, <math>\theta_{JA} = 160^{\circ}\text{C/W}</math></p> | ORDER PART<br>NUMBER  |
|                                                                                                                                                                                                                                                                                                                                                                               | LT1029AMH<br>LT1029MH<br>LT1029ACH<br>LT1029CH |                                                                                                                                                                                                                                            | LT1029ACZ<br>LT1029CZ |

Consult LTC Marketing for parts specified with wider operating temperature ranges.

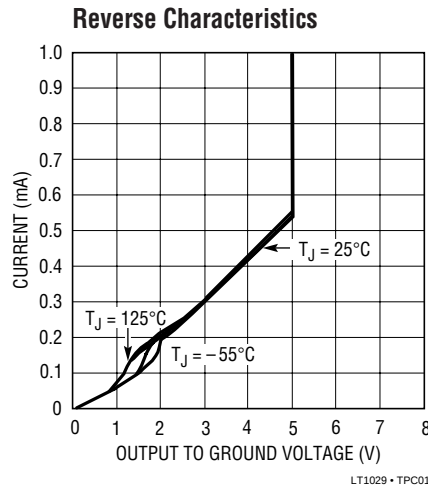
## ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are  $T_A = 25^{\circ}\text{C}$ .

| PARAMETER                             | CONDITIONS                                                    |                  | MIN          | TYP               | MAX                 | UNITS                                                                         |
|---------------------------------------|---------------------------------------------------------------|------------------|--------------|-------------------|---------------------|-------------------------------------------------------------------------------|
| Reverse Breakdown Voltage             | $I_R = 1\text{mA}$ LT1029AM/LT1029AC<br>LT1029M/LT1029C       |                  | 4.99<br>4.95 | 5.00<br>5.00      | 5.01<br>5.05        | V<br>V                                                                        |
| Reverse Breakdown Change with Current | $700\mu\text{A} \leq I_R \leq 10\text{mA}$                    | ●                |              | 2<br>3            | 5<br>8              | mV<br>mV                                                                      |
| Reverse Dynamic Impedance             | $I_R = 1\text{mA}$                                            | ●                |              | 0.2<br>0.3        | 0.6<br>1.0          | $\Omega$<br>$\Omega$                                                          |
| Temperature Stability                 | $I_R = 1\text{mA}$ LT1029AC<br>LT1029C<br>LT1029AM<br>LT1029M | ●<br>●<br>●<br>● |              | 3<br>5<br>7<br>10 | 7<br>12<br>18<br>36 | mV<br>mV<br>mV<br>mV                                                          |
| Equivalent Temperature Drift          | LT1029AM/LT1029AC<br>LT1029C<br>LT1029M                       | ●<br>●<br>●      |              | 8<br>12<br>15     | 20<br>34<br>40      | ppm/ $^{\circ}\text{C}$<br>ppm/ $^{\circ}\text{C}$<br>ppm/ $^{\circ}\text{C}$ |
| Long Term Stability                   |                                                               |                  |              | 20                |                     | ppm/kHr                                                                       |
| Trim Range                            |                                                               |                  | $\pm 3$      | +5, –13           |                     | %                                                                             |

**Note 1:** Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

## TYPICAL PERFORMANCE CHARACTERISTICS



## APPLICATIONS INFORMATION

### Output Trimming

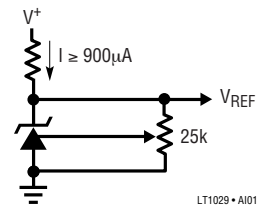
Output voltage trimming on the LT1029 is nominally accomplished with a potentiometer connected from output to ground with the wiper tied to the trim pin. The LT1029 was made compatible with existing references, so the trim range is large; 5%, –13%. This large trim range makes precision trimming rather difficult. One solution is to insert resistors in series with both ends of the potentiometer. This has the disadvantage of potentially poor tracking between the fixed resistors and the potentiometer. A second method of reducing trim range is to insert a resistor in series with the wiper of the potentiometer. This works well only for a very small trim range because of the mismatch in TCs between the series resistor and the internal thin film resistors. These film resistors can have a TC as high as 500ppm/°C. That same TC is then transferred to the change in output voltage; a 1% shift in output voltage causes a (500ppm) (1%) = 5ppm/°C change in output voltage drift. The worst case error in initial output voltage for the LT1029A is 0.2% and the LT1029 is 1%, so a series resistor is satisfactory if the output is simply trimmed to nominal value. 1ppm/°C TC shift would be the maximum expected for the LT1029A and 5ppm/°C for the LT1029.

### Shunt Capacitance

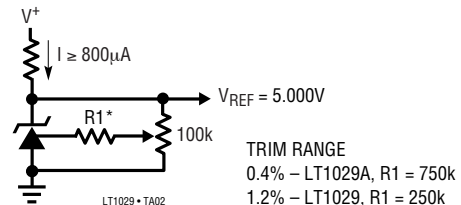
The LT1029 is stable with all values of shunt capacitance, but values between 300pF and 0.01μF are not recommended because they cause longer settling following a

transient in operating current. A 1μF solid tantalum capacitor is suggested for most situations where bypassing is desirable.

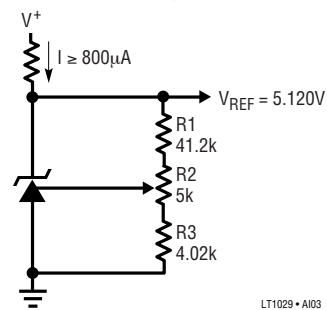
### Wide Trim Range (5%, –13%)



### Narrow Trim Range



### Trimming Output to 5.120V



The diagram shows a precision current source circuit. It features an LT1029 current source connected to a resistor network. The network consists of three resistors: R1 (25k, 0.1%), R2 (25k, 0.1%), and R3 (1k, 5%). The output of the current source is connected to R1, which is in series with R2. The junction between R1 and R2 is connected to the non-inverting input of an LT1001 op-amp. The op-amp is configured as a voltage follower, with its output connected to its inverting input. The op-amp is powered by a 5V supply and a -5V reference. The output of the op-amp is connected to R3, which is connected to the -5V reference. The output of the current source is also connected to the 5V supply. The output of the op-amp is connected to the 2.5V output terminal. The output of the current source is also connected to the 2.5V output terminal. The output of the op-amp is connected to the -2.5V output terminal. The output of the current source is also connected to the -2.5V output terminal.

## PACKAGE DESCRIPTION

The image contains two mechanical drawings of a 3-lead package. The left drawing is a side view showing the package profile with dimensions: .209 - .219 (5.309 - 5.537) for the top width, .178 - .195 (4.521 - 4.953) for the body width, .085 - .105 (2.159 - 2.667) for the lead height, .500 (12.700) MIN for the body height, .025 (0.635) MAX for the lead thickness, and .016 - .019\*\* (0.406 - 0.483) DIA for the lead diameter. A 'REFERENCE PLANE' is indicated at the base of the body, and a 'SEATING\* PLANE' is indicated at the base of the leads. The right drawing is a top view showing a circular body with a dashed circle for the lead diameter. Dimensions include .050 (1.270) TYP for the lead pitch, .100 (2.540) TYP for the body diameter, .050 (1.270) TYP for the lead diameter, .036 - .046 (0.914 - 1.168) for the lead width, .028 - .048 (0.711 - 1.219) for the lead thickness, and a 45° angle for the lead lead-in. A 'PIN 1' indicator is shown. The text 'FOR 3-LEAD PACKAGE ONLY' is present. A note at the bottom states: '\* LEAD DIAMETER IS UNCONTROLLED BETWEEN THE REFERENCE PLANE AND .050" BELOW THE REFERENCE PLANE' and '\*\*FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS .016 - .024 (0.406 - 0.610)'. A reference number 'H02/03(TO-46) 0801' is at the bottom right.

Top View Dimensions:

- Lead Pitch: .050 (1.270) TYP
- Body Diameter: .100 (2.540) TYP
- Lead Diameter: .050 (1.270) TYP
- Lead Width: .036 - .046 (0.914 - 1.168)
- Lead Thickness: .028 - .048 (0.711 - 1.219)
- Lead Lead-in Angle: 45°
- PIN 1 Indicator

Side View Dimensions:

- Top Width: .209 - .219 (5.309 - 5.537)
- Body Width: .178 - .195 (4.521 - 4.953)
- Lead Height: .085 - .105 (2.159 - 2.667)
- Body Height: .500 (12.700) MIN
- Lead Thickness: .025 (0.635) MAX
- Lead Diameter: .016 - .019\*\* (0.406 - 0.483) DIA

Reference Planes:

- REFERENCE PLANE
- SEATING\* PLANE

Notes:

- \* LEAD DIAMETER IS UNCONTROLLED BETWEEN THE REFERENCE PLANE AND .050" BELOW THE REFERENCE PLANE
- \*\*FOR SOLDER DIP LEAD FINISH, LEAD DIAMETER IS .016 - .024 (0.406 - 0.610)

Reference Number: H02/03(TO-46) 0801

## OBSOLETE PACKAGE

The mechanical drawing illustrates the LTC6908 package from three perspectives: top, side, and end view.

- Top View:** Shows a square body with a central circular feature. Dimensions include a width of  $.180 \pm .005$  (4.572 ± 0.127), a diameter of  $.060 \pm .005$  (1.524 ± 0.127) DIA, a height of  $.180 \pm .005$  (4.572 ± 0.127), a thickness of  $.050$  (12.70) MIN, and a lead width of  $.050$  (1.27) BSC. A note indicates "UNCONTROLLED LEAD DIMENSION MAX" for the leads.
- Side View:** Shows the profile of the package with a maximum height of  $.090$  (2.286) NOM and a lead angle of  $5^\circ$  NOM.
- End View:** Shows the bottom of the package with a width of  $.060 \pm .010$  (1.524 ± 0.254), a distance between leads of  $.140 \pm .010$  (3.556 ± 0.127), and a lead angle of  $10^\circ$  NOM.

Additional dimensions shown include a lead length of  $.016 \pm .003$  (0.406 ± 0.076), a lead thickness of  $.008 + .016 / -.04$  (2.5 + 0.4 / -0.1) 2 PL CS, and a reference to the TO-92 TAPE AND REEL section of the LTC DATA BOOK FOR ADDITIONAL INFORMATION.



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