INITIAL RELEASE
Final Electrical Specifications

# LT1460S3-10 (SOT-23)

# 10V Micropower Series Reference in SOT-23

July 1999

## FEATURES

- **3-Lead SOT-23 Package**
- **Low Drift: 20ppm/°C Max**
- **High Accuracy: 0.2% Max**
- Low Supply Current: 270μA Max
- 20mA Output Current Guaranteed
- No Output Capacitor Required
- Reverse-Battery Protection
- Low PC Board Solder Stress: 0.02% Typ
- Voltage Options: 2.5V, 3V, 3.3V, 5V, 10V

## APPLICATIONS

- Handheld Instruments
- Precision Regulators
- A/D and D/A Converters
- Power Supplies
- Hard Disk Drives

## DESCRIPTION

The LT®1460S3-10 is a SOT-23 micropower series reference that combines high accuracy and low drift with low power dissipation and small package size. This series reference uses curvature compensation to obtain low temperature coefficient, and laser trimmed precision thin-film resistors to achieve high output accuracy. Furthermore, output shift due to PC board soldering stress has been dramatically reduced. The reference will supply up to 20mA, making it ideal for precision regulator applications, yet it is almost totally immune to input voltage variations.

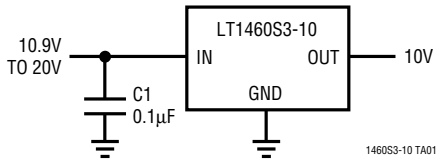
This series reference provides supply current and power dissipation advantages over shunt references that must idle the entire load current to operate. Additionally, the LT1460S3-10 does not require an output compensation capacitor. This feature is important in critical applications where PC board space is a premium or fast settling is demanded. Reverse-battery protection keeps the reference from conducting current and being damaged.

LT1460 SOT-23 available voltage options include: 2.5V, 3V, 3.3V, 5V and 10V. See the individual data sheets for information on the other voltage options.

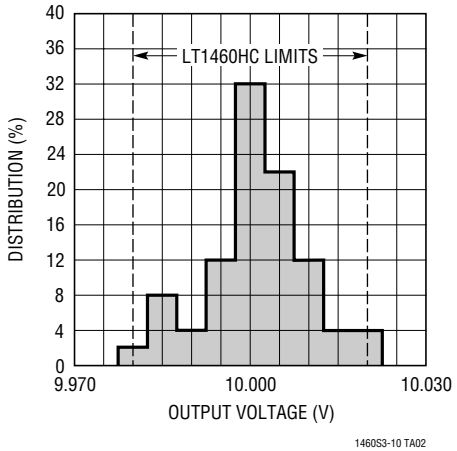


## TYPICAL APPLICATION

**Basic Connection**



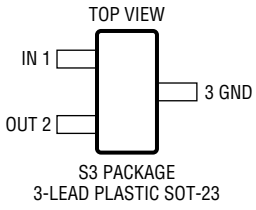

**Typical Distribution of SOT-23 LT1460HC $V_{OUT}$ *After* IR Reflow Solder**



## ABSOLUTE MAXIMUM RATINGS

Input Voltage ..... 30V
Reverse Voltage ..... –15V
Output Short-Circuit Duration, $T_A$ = 25°C
  $V_{IN}$ > 10V ..... 5 sec
  $V_{IN}$ ≤ 10V ..... Indefinite
Specified Temperature Range ..... 0°C to 70°C
Storage Temperature Range (Note 1) ... –65°C to 150°C
Lead Temperature (Soldering, 10 sec) ..... 300°C

## PACKAGE/ORDER INFORMATION




S3 PACKAGE
3-LEAD PLASTIC SOT-23

$T_{JMAX}$ = 125°C, $\theta_{JA}$ = 325°C/W

| ORDER PART NUMBER |
|---|
| LT1460HCS3-10<br>LT1460JCS3-10<br>LT1460KCS3-10 |
| **S3 PART MARKING** |
| LTAU<br>LTAV<br>LTAW |

Consult factory for Industrial and Military grade parts.

## ELECTRICAL CHARACTERISTICS

**The ● denotes specifications which apply over the full specified temperature range, otherwise specifications are at $T_A$ = 25°C. $V_{IN}$ = $V_{OUT}$ + 2.5V, $I_{OUT}$ = 0, unless otherwise specified.**

| PARAMETER | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Output Voltage (Note 2) | LT1460HCS3 | | 9.980<br>–0.2 | 10 | 10.02<br>0.2 | V<br>% |
| | LT1460JCS3 | | 9.960<br>–0.4 | 10 | 10.04<br>0.4 | V<br>% |
| | LT1460KCS3 | | 9.950<br>–0.5 | 10 | 10.05<br>0.5 | V<br>% |
| Output Voltage Temperature Coefficient (Note 3) | $T_{MIN} \le T_J \le T_{MAX}$<br>LT1460HCS3<br>LT1460JCS3<br>LT1460KCS3 | <br>●<br>●<br>● | | <br>10<br>10<br>25 | <br>20<br>20<br>50 | <br>ppm/°C<br>ppm/°C<br>ppm/°C |
| Line Regulation | 10.9V ≤ $V_{IN}$ ≤ 12.5V | <br>● | | 150 | 800<br>1000 | ppm/V<br>ppm/V |
| | 12.5V ≤ $V_{IN}$ ≤ 20V | <br>● | | 50 | 100<br>130 | ppm/V<br>ppm/V |
| Load Regulation Sourcing (Note 4) | $I_{OUT}$ = 100µA | <br>● | | 1000 | 3000<br>4000 | ppm/mA<br>ppm/mA |
| | $I_{OUT}$ = 10mA | <br>● | | 50 | 200<br>300 | ppm/mA<br>ppm/mA |
| | $I_{OUT}$ = 20mA<br>0°C ≤ $T_A$ ≤ 70°C | <br>● | | 20 | 70<br>100 | ppm/mA<br>ppm/mA |
| Thermal Regulation (Note 5) | ΔP = 200mW | | | 2.5 | 10 | ppm/mW |
| Dropout Voltage (Note 6) | $V_{IN}$ – $V_{OUT}$, $\Delta V_{OUT}$ ≤ 0.2%, $I_{OUT}$ = 0 | ● | | | 0.9 | V |
| | $V_{IN}$ – $V_{OUT}$, $\Delta V_{OUT}$ ≤ 0.2%, $I_{OUT}$ = 10mA | <br>● | | | 1.3<br>1.4 | V<br>V |
| Output Current | Short $V_{OUT}$ to GND | | | 40 | | mA |
| Reverse Leakage | $V_{IN}$ = –15V | ● | | 0.5 | 10 | µA |

## ELECTRICAL CHARACTERISTICS

**The ● denotes specifications which apply over the full specified temperature range, otherwise specifications are at $T_A$ = 25°C. $V_{IN}$ = $V_{OUT}$ + 2.5V, $I_{OUT}$ = 0, unless otherwise specified.**

| PARAMETER | CONDITIONS | | MIN | TYP | MAX | UNITS |
|---|---|---|---|---|---|---|
| Supply Current | | | | 215 | 270 | µA |
| | | ● | | | 350 | µA |
| Output Voltage Noise (Note 7) | 0.1Hz ≤ f ≤ 10Hz | | | 40 | | $\mu V_{P-P}$ |
| | 10Hz ≤ f ≤ 1kHz | | | 40 | | $\mu V_{RMS}$ |
| Long-Term Stability of Output Voltage (Note 8) | | | | 70 | | ppm/$\sqrt{kHr}$ |
| Hysteresis (Note 9) | ΔT = 0°C to 70°C | | | 100 | | ppm |

**Note 1:** If the part is stored outside of the specified temperature range, the output may shift due to hysteresis.

**Note 2:** ESD (Electrostatic Discharge) sensitive device. Extensive use of ESD protection devices are used internal to the LT1460S3-10, however, high electrostatic discharge can damage or degrade the device. Use proper ESD handling precautions.

**Note 3:** Temperature coefficient is measured by dividing the change in output voltage by the specified temperature range. Incremental slope is also measured at 25°C.

**Note 4:** Load regulation is measured on a pulse basis from no load to the specified load current. Output changes due to die temperature change must be taken into account separately.

**Note 5:** Thermal regulation is caused by die temperature gradients created by load current or input voltage changes. This effect must be added to normal line or load regulation. This parameter is not 100% tested.

**Note 6:** Excludes load regulation errors.

**Note 7:** Peak-to-peak noise is measured with a single-pole highpass filter at 0.1Hz and 2-pole lowpass filter at 10Hz. The unit is enclosed in a still-air environment to eliminate thermocouple effects on the leads. The test time is 10 sec. RMS noise is measured with a single-pole highpass filter at 10Hz and a 2-pole lowpass filter at 1kHz. The resulting output is full wave rectified and then integrated for a fixed period, making the final reading an average as opposed to RMS. A correction factor of 1.1 is used to convert from average to RMS and a second correction of 0.88 is used to correct for the nonideal bandpass of the filters.

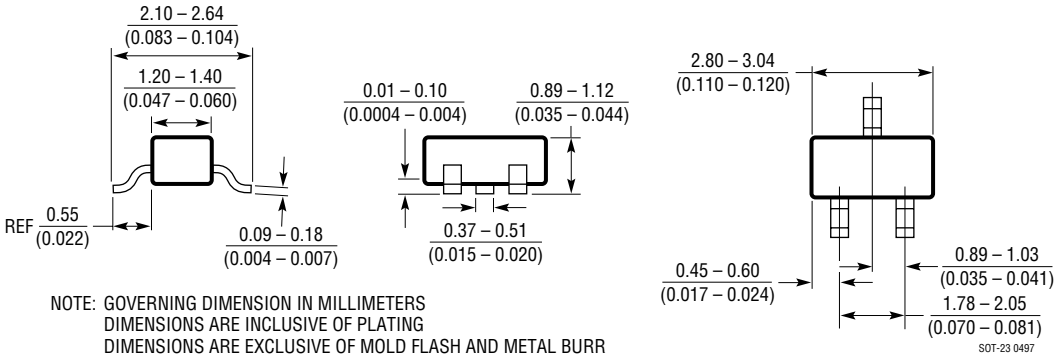
**Note 8:** Long-term stability typically has a logarithmic characteristic and therefore, changes after 1000 hours tend to be much smaller than before that time. Total drift in the second thousand hours is normally less than one third that of the first thousand hours with a continuing trend toward reduced drift with time. Long-term stability will also be affected by differential stresses between the IC and the board material created during board assembly.

**Note 9:** Hysteresis in output voltage is created by package stress that differs depending on whether the IC was previously at a higher or lower temperature. Output voltage is always measured at 25°C, but the IC is cycled to 70°C or 0°C before successive measurements. Hysteresis is roughly proportional to the square of the temperature change. Hysteresis is not normally a problem for operational temperature excursions where the instrument might be stored at high or low temperature.

## PACKAGE DESCRIPTION

**Dimensions in millimeters (inches) unless otherwise noted.**

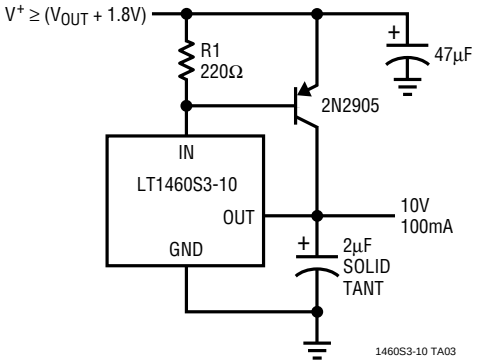
**S3 Package**
**3-Lead Plastic SOT-23**
(LTC DWG # 05-08-1631)



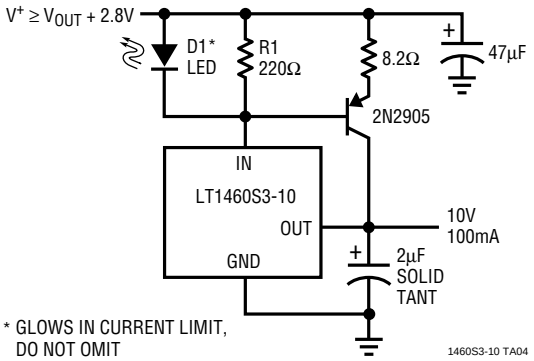

NOTE: GOVERNING DIMENSION IN MILLIMETERS
DIMENSIONS ARE INCLUSIVE OF PLATING
DIMENSIONS ARE EXCLUSIVE OF MOLD FLASH AND METAL BURR
MOLD FLASH SHALL NOT EXCEED 0.254mm

## TYPICAL APPLICATIONS

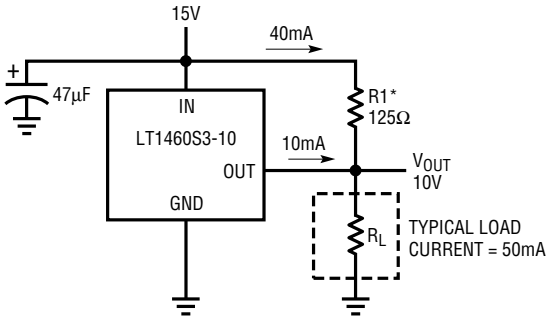
**Boosted Output Current with No Current Limit**




**Boosted Output Current with Current Limit**




**Handling Higher Load Currents**




*SELECT R1 TO DELIVER 80% OF TYPICAL LOAD CURRENT. LT1460 WILL THEN SOURCE AS NECESSARY TO MAINTAIN PROPER OUTPUT. DO NOT REMOVE LOAD AS OUTPUT WILL BE DRIVEN UNREGULATED HIGH. LINE REGULATION IS DEGRADED IN THIS APPLICATION

1460S3-10 TA05

## RELATED PARTS

| PART NUMBER | DESCRIPTION | COMMENTS |
|---|---|---|
| LT1019 | Precision Bandgap Reference | 0.05% Max, 5ppm/°C Max |
| LT1027 | Precision 5V Reference | 0.02%, 2ppm/°C Max |
| LT1236 | Precision Low Noise Reference | 0.05% Max, 5ppm/°C Max, SO Package |
| LTC®1258 | Micropower Low Dropout Reference | 0.15% Max, 6.5µA Supply Current |
| LT1634 | Micropower Precision Shunt Reference 1.25V, 2.5V Output | 0.05%, 25ppm/°C Max |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