

# Micropower Precision Shunt Voltage Reference

## FEATURES

- Initial Voltage Accuracy: 0.05%
- Low Operating Current: 10 $\mu$ A
- Low Drift: 10ppm/ $^{\circ}$ C Max
- Less Than 1 $\Omega$  Dynamic Impedance
- Both Commercial and Industrial Temperature Range Parts Are Available
- Available in 1.25V, 2.5V, 4.096V and 5V in SO-8 and TO-92 Packages
- 1.25V and 2.5V Available in MSOP Package

## APPLICATIONS

- Portable Meters
- Precision Regulators
- A/D and D/A Converters
- Calibrators

## DESCRIPTION

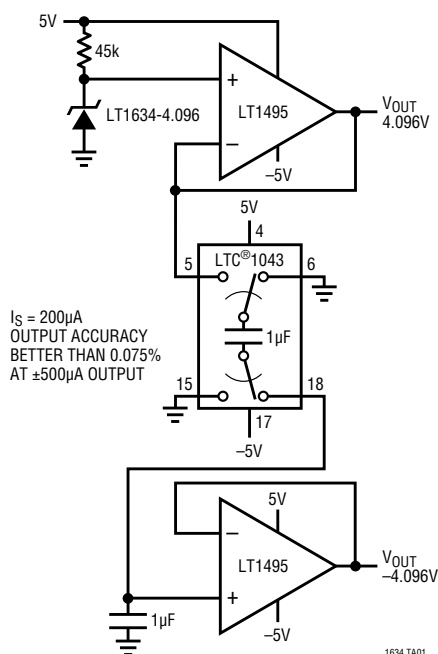
The LT<sup>®</sup>1634 is a micropower, precision, shunt voltage reference. The bandgap reference uses trimmed precision thin film resistors to achieve 0.05% initial voltage accuracy. Improved curvature correction technique guarantees 10ppm/ $^{\circ}$ C maximum temperature drift. Advances in design, processing and packaging techniques guarantee 10 $\mu$ A operation and low temperature cycling hysteresis. The LT1634 does not require an output compensation capacitor, but is stable with capacitive loads. Low dynamic impedance makes the LT1634 reference easy to use from unregulated supplies.

The LT1634 reference can be used as a high performance upgrade to the LM185/LM385, LT1004 and LT1034 where lower power and guaranteed temperature drift is required.

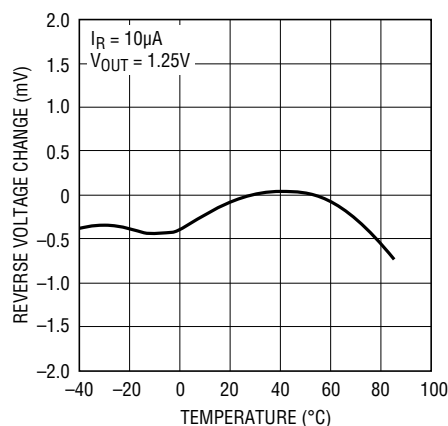
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## TYPICAL APPLICATION

Super Accurate  $\pm 4.096$ V Output References



Temperature Drift



# LT1634

## ABSOLUTE MAXIMUM RATINGS (Note 1)

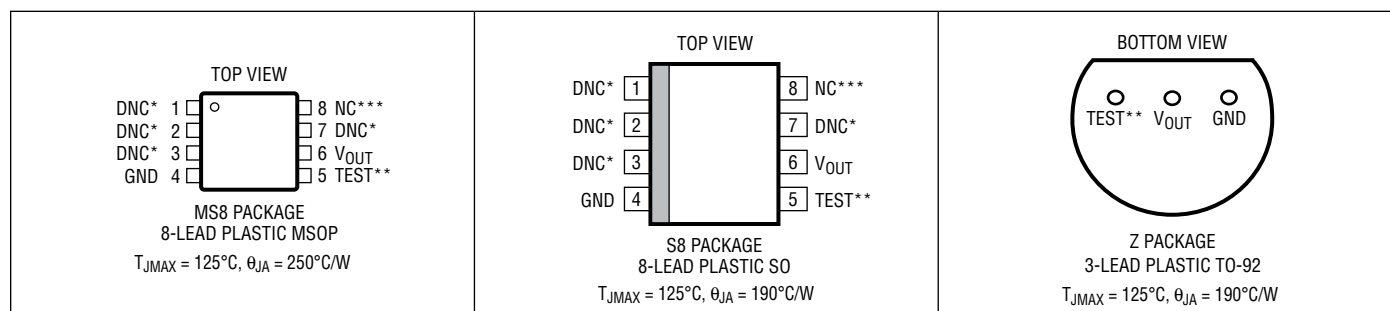
### Current Operating

|                      |       |
|----------------------|-------|
| 1.25V .....          | 100mA |
| 2.5V .....           | 50mA  |
| 4.096V, 5V .....     | 30mA  |
| Forward Current..... | 20mA  |

### Operating Temperature Range

|                                           |                |
|-------------------------------------------|----------------|
| Commercial .....                          | 0°C to 70°C    |
| Industrial .....                          | –40°C to 85°C  |
| Storage Temperature Range (Note 1).....   | –65°C to 150°C |
| Lead Temperature (Soldering, 10 sec)..... | 300°C          |

## PIN CONFIGURATION



\*Connected internally. Do Not Connect external circuitry to these pins.

\*\*The TEST pin can be left unconnected or connected to the GND pin (GND pin on Z package, Pin4 on MS8 and S8 packages)

\*\*\* Not connected internally.

## ORDER INFORMATION

| LEAD FREE FINISH     | TAPE AND REEL          | PART MARKING | PACKAGE DESCRIPTION  | SPECIFIED TEMPERATURE RANGE |
|----------------------|------------------------|--------------|----------------------|-----------------------------|
| LT1634BCMS8-1.25#PBF | LT1634BCMS8-1.25#TRPBF | LTCV         | 8-Lead Plastic MSOP  | 0°C to 70°C                 |
| LT1634BCMS8-2.5#PBF  | LT1634BCMS8-2.5#TRPBF  | LTDF         | 8-Lead Plastic MSOP  | 0°C to 70°C                 |
| LT1634ACS8-1.25#PBF  | LT1634ACS8-1.25#TRPBF  | 1634A1       | 8-Lead Plastic SO    | 0°C to 70°C                 |
| LT1634ACS8-2.5#PBF   | LT1634ACS8-2.5#TRPBF   | 1634A2       | 8-Lead Plastic SO    | 0°C to 70°C                 |
| LT1634ACS8-4.096#PBF | LT1634ACS8-4.096#TRPBF | 1634A4       | 8-Lead Plastic SO    | 0°C to 70°C                 |
| LT1634ACS8-5#PBF     | LT1634ACS8-5#TRPBF     | 1634A5       | 8-Lead Plastic SO    | 0°C to 70°C                 |
| LT1634AIS8-1.25#PBF  | LT1634AIS8-1.25#TRPBF  | 634AI1       | 8-Lead Plastic SO    | –40°C to 85°C               |
| LT1634AIS8-2.5#PBF   | LT1634AIS8-2.5#TRPBF   | 634AI2       | 8-Lead Plastic SO    | –40°C to 85°C               |
| LT1634AIS8-4.096#PBF | LT1634AIS8-4.096#TRPBF | 634AI4       | 8-Lead Plastic SO    | –40°C to 85°C               |
| LT1634AIS8-5#PBF     | LT1634AIS8-5#TRPBF     | 634AI5       | 8-Lead Plastic SO    | –40°C to 85°C               |
| LT1634BCS8-1.25#PBF  | LT1634BCS8-1.25#TRPBF  | 1634B1       | 8-Lead Plastic SO    | 0°C to 70°C                 |
| LT1634BCS8-2.5#PBF   | LT1634BCS8-2.5#TRPBF   | 1634B2       | 8-Lead Plastic SO    | 0°C to 70°C                 |
| LT1634BCS8-4.096#PBF | LT1634BCS8-4.096#TRPBF | 1634B4       | 8-Lead Plastic SO    | 0°C to 70°C                 |
| LT1634BCS8-5#PBF     | LT1634BCS8-5#TRPBF     | 1634B5       | 8-Lead Plastic SO    | 0°C to 70°C                 |
| LT1634BIS8-1.25#PBF  | LT1634BIS8-1.25#TRPBF  | 634BI1       | 8-Lead Plastic SO    | –40°C to 85°C               |
| LT1634BIS8-2.5#PBF   | LT1634BIS8-2.5#TRPBF   | 634BI2       | 8-Lead Plastic SO    | –40°C to 85°C               |
| LT1634BIS8-4.096#PBF | LT1634BIS8-4.096#TRPBF | 634BI4       | 8-Lead Plastic SO    | –40°C to 85°C               |
| LT1634BIS8-5#PBF     | LT1634BIS8-5#TRPBF     | 634BI5       | 8-Lead Plastic SO    | –40°C to 85°C               |
| LT1634CCZ-1.25#PBF   | LT1634CCZ-1.25#TRPBF   |              | 3-Lead Plastic TO-92 | 0°C to 70°C                 |
| LT1634CCZ-2.5#PBF    | LT1634CCZ-2.5#TRPBF    |              | 3-Lead Plastic TO-92 | 0°C to 70°C                 |
| LT1634CCZ-4.096#PBF  | LT1634CCZ-4.096#TRPBF  |              | 3-Lead Plastic TO-92 | 0°C to 70°C                 |
| LT1634CCZ-5#PBF      | LT1634CCZ-5#TRPBF      |              | 3-Lead Plastic TO-92 | 0°C to 70°C                 |

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

Consult LTC Marketing for information on lead based finish parts.

For more information on lead free part marking, go to: <http://www.linear.com/leadfree/>

For more information on tape and reel specifications, go to: <http://www.linear.com/tapeandree/>

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## AVAILABLE OPTIONS

| TEMPERATURE   | ACCURACY (%) | TEMPERATURE COEFFICIENT<br>(ppm/°C) | PACKAGE TYPE                        |                                                                       |                                                                   |
|---------------|--------------|-------------------------------------|-------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------------|
|               |              |                                     | MS8                                 | S8                                                                    | Z                                                                 |
| 0°C to 70°C   | 0.05         | 10                                  |                                     | LT1634ACS8-1.25<br>LT1634ACS8-2.5<br>LT1634ACS8-4.096<br>LT1634ACS8-5 |                                                                   |
| -40°C to 85°C | 0.05         | 10                                  |                                     | LT1634AIS8-1.25<br>LT1634AIS8-2.5<br>LT1634AIS8-4.096<br>LT1634AIS8-5 |                                                                   |
| 0°C to 70°C   | 0.05         | 25                                  | LT1634BCMS8-1.25<br>LT1634BCMS8-2.5 | LT1634BCS8-1.25<br>LT1634BCS8-2.5<br>LT1634BCS8-4.096<br>LT1634BCS8-5 |                                                                   |
| -40°C to 85°C | 0.05         | 25                                  |                                     | LT1634BIS8-1.25<br>LT1634BIS8-2.5<br>LT1634BIS8-4.096<br>LT1634BIS8-5 |                                                                   |
| 0°C to 70°C   | 0.20         | 25                                  |                                     |                                                                       | LT1634CCZ-1.25<br>LT1634CCZ-2.5<br>LT1634CCZ-4.096<br>LT1634CCZ-5 |

## 1.25V ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ . (Note 3)

| PARAMETER                                         | CONDITIONS                                                                            | MIN               | TYP            | MAX              | UNITS                |
|---------------------------------------------------|---------------------------------------------------------------------------------------|-------------------|----------------|------------------|----------------------|
| Reverse Breakdown Voltage                         | LT1634ACS8/LT1634BCMS8/LT1634BCS8/<br>LT1634AIS8/LT1634BIS8 ( $I_R = 10\mu\text{A}$ ) | 1.24937<br>-0.05  | 1.250          | 1.25062<br>0.05  | V<br>%               |
|                                                   | LT1634CCZ ( $I_R = 10\mu\text{A}$ )                                                   | 1.24750<br>-0.20  | 1.250          | 1.25250<br>0.20  | V<br>%               |
|                                                   | LT1634ACS8 ( $I_R = 10\mu\text{A}$ ) ●                                                | 1.24849<br>-0.12  | 1.250          | 1.25149<br>0.12  | V<br>%               |
|                                                   | LT1634AIS8 ( $I_R = 10\mu\text{A}$ ) ●                                                | 1.24781<br>-0.175 | 1.250          | 1.25218<br>0.175 | V<br>%               |
|                                                   | LT1634BCS8/LT1634BCMS8 ( $I_R = 10\mu\text{A}$ ) ●                                    | 1.24718<br>-0.225 | 1.250          | 1.25281<br>0.225 | V<br>%               |
|                                                   | LT1634BIS8 ( $I_R = 10\mu\text{A}$ ) ●                                                | 1.24547<br>-0.362 | 1.250          | 1.25453<br>0.362 | V<br>%               |
|                                                   | LT1634CCZ ( $I_R = 10\mu\text{A}$ ) ●                                                 | 1.24531<br>-0.375 | 1.250          | 1.25469<br>0.375 | V<br>%               |
| Reverse Breakdown Change<br>with Current (Note 4) | $10\mu\text{A} \leq I_R \leq 2\text{mA}$                                              | ●                 | 0.25<br>0.30   | 1<br>2           | mV<br>mV             |
|                                                   | $2\text{mA} \leq I_R \leq 20\text{mA}$                                                | ●                 | 2<br>2         | 8<br>10          | mV<br>mV             |
|                                                   |                                                                                       | ●                 |                | 7                | $\mu\text{A}$        |
| Minimum Operating Current                         |                                                                                       | ●                 |                | 7                | $\mu\text{A}$        |
| Temperature Coefficient (Note 8)                  | LT1634A, $I_R = 10\mu\text{A}$                                                        | ●                 | 4              | 10               | ppm/°C               |
|                                                   | LT1634B/LT1634C, $I_R = 10\mu\text{A}$                                                | ●                 | 10             | 25               | ppm/°C               |
| Reverse Dynamic Impedance (Note 5)                | $10\mu\text{A} \leq I_R \leq 2\text{mA}$                                              | ●                 | 0.125<br>0.150 | 0.5<br>1.0       | $\Omega$<br>$\Omega$ |
| Low Frequency Noise (Note 6)                      | $I_R = 10\mu\text{A}$ , $0.1\text{Hz} \leq f \leq 10\text{Hz}$                        |                   | 10             |                  | $\mu\text{V}_{P-P}$  |
| Hysteresis (Note 7)                               | $\Delta T = -40^\circ\text{C}$ to $85^\circ\text{C}$                                  |                   | 160            |                  | ppm                  |
|                                                   | $\Delta T = 0^\circ\text{C}$ to $70^\circ\text{C}$                                    |                   | 40             |                  | ppm                  |

## 2.5V ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ . (Note 3)

| PARAMETER                                         | CONDITIONS                                                                            | MIN                 | TYP          | MAX              | UNITS                      |
|---------------------------------------------------|---------------------------------------------------------------------------------------|---------------------|--------------|------------------|----------------------------|
| Reverse Breakdown Voltage                         | LT1634ACS8/LT1634BCMS8/LT1634BCS8/<br>LT1634AIS8/LT1634BIS8 ( $I_R = 10\mu\text{A}$ ) | 2.49875<br>-0.05    | 2.500        | 2.50125<br>0.05  | V<br>%                     |
|                                                   | LT1634CCZ ( $I_R = 10\mu\text{A}$ )                                                   | 2.49500<br>-0.20    | 2.500        | 2.50500<br>0.20  | V<br>%                     |
|                                                   | LT1634ACS8 ( $I_R = 10\mu\text{A}$ )                                                  | ● 2.49700<br>-0.12  | 2.500        | 2.50300<br>0.12  | V<br>%                     |
|                                                   | LT1634AIS8 ( $I_R = 10\mu\text{A}$ )                                                  | ● 2.49562<br>-0.175 | 2.500        | 2.50437<br>0.175 | V<br>%                     |
|                                                   | LT1634BCMS8/LT1634BCS8 ( $I_R = 10\mu\text{A}$ )                                      | ● 2.49437<br>-0.225 | 2.500        | 2.50562<br>0.225 | V<br>%                     |
|                                                   | LT1634BIS8 ( $I_R = 10\mu\text{A}$ )                                                  | ● 2.49094<br>-0.362 | 2.500        | 2.50906<br>0.362 | V<br>%                     |
|                                                   | LT1634CCZ ( $I_R = 10\mu\text{A}$ )                                                   | ● 2.49062<br>-0.375 | 2.500        | 2.50937<br>0.375 | V<br>%                     |
| Reverse Breakdown Change<br>with Current (Note 4) | $10\mu\text{A} \leq I_R \leq 2\text{mA}$                                              | ●                   | 0.30<br>0.40 | 1.5<br>3.0       | mV<br>mV                   |
|                                                   | $2\text{mA} \leq I_R \leq 20\text{mA}$                                                | ●                   | 2<br>2       | 8<br>10          | mV<br>mV                   |
|                                                   |                                                                                       | ●                   |              | 8                | $\mu\text{A}$              |
| Minimum Operating Current                         |                                                                                       | ●                   |              | 8                | $\mu\text{A}$              |
|                                                   |                                                                                       | ●                   |              | 8                | $\mu\text{A}$              |
| Temperature Coefficient (Note 8)                  | LT1634A, $I_R = 10\mu\text{A}$                                                        | ●                   | 4            | 10               | ppm/ $^\circ\text{C}$      |
|                                                   | LT1634B/LT1634C, $I_R = 10\mu\text{A}$                                                | ●                   | 10           | 25               | ppm/ $^\circ\text{C}$      |
| Reverse Dynamic Impedance (Note 5)                | $10\mu\text{A} \leq I_R \leq 2\text{mA}$                                              | ●                   | 0.15<br>0.20 | 0.75<br>1.50     | $\Omega$<br>$\Omega$       |
|                                                   |                                                                                       | ●                   |              |                  |                            |
| Low Frequency Noise (Note 6)                      | $I_R = 10\mu\text{A}$ , $0.1\text{Hz} \leq f \leq 10\text{Hz}$                        |                     | 15           |                  | $\mu\text{V}_{\text{P-P}}$ |
| Hysteresis (Note 7)                               | $\Delta T = -40^\circ\text{C}$ to $85^\circ\text{C}$                                  |                     | 160          |                  | ppm                        |
|                                                   | $\Delta T = 0^\circ\text{C}$ to $70^\circ\text{C}$                                    |                     | 40           |                  | ppm                        |

## 4.096 ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ . (Note 3)

| PARAMETER                                         | CONDITIONS                                                                | MIN                 | TYP          | MAX              | UNITS         |
|---------------------------------------------------|---------------------------------------------------------------------------|---------------------|--------------|------------------|---------------|
| Reverse Breakdown Voltage                         | LT1634ACS8/LT1634BCS8/<br>LT1634AIS8/LT1634BIS8 ( $I_R = 20\mu\text{A}$ ) | 4.09395<br>-0.05    | 4.096        | 4.09805<br>0.05  | V<br>%        |
|                                                   | LT1634CCZ ( $I_R = 20\mu\text{A}$ )                                       | 4.08780<br>-0.20    | 4.096        | 4.10419<br>0.20  | V<br>%        |
|                                                   | LT1634ACS8 ( $I_R = 20\mu\text{A}$ )                                      | ● 4.09108<br>-0.12  | 4.096        | 4.10091<br>0.12  | V<br>%        |
|                                                   | LT1634AIS8 ( $I_R = 20\mu\text{A}$ )                                      | ● 4.08883<br>-0.175 | 4.096        | 4.10317<br>0.175 | V<br>%        |
|                                                   | LT1634BCS8 ( $I_R = 20\mu\text{A}$ )                                      | ● 4.08678<br>-0.225 | 4.096        | 4.10522<br>0.225 | V<br>%        |
|                                                   | LT1634BIS8 ( $I_R = 20\mu\text{A}$ )                                      | ● 4.08115<br>-0.362 | 4.096        | 4.11085<br>0.362 | V<br>%        |
|                                                   | LT1634CCZ ( $I_R = 20\mu\text{A}$ )                                       | ● 4.08064<br>-0.375 | 4.096        | 4.11137<br>0.375 | V<br>%        |
| Reverse Breakdown Change<br>with Current (Note 4) | $20\mu\text{A} \leq I_R \leq 2\text{mA}$                                  | ●                   | 0.30<br>0.40 | 1.5<br>3.0       | mV<br>mV      |
|                                                   | $2\text{mA} \leq I_R \leq 20\text{mA}$                                    | ●                   | 6<br>6       | 15<br>20         | mV<br>mV      |
|                                                   |                                                                           | ●                   |              | 15               | $\mu\text{A}$ |
| Minimum Operating Current                         |                                                                           | ●                   |              | 15               | $\mu\text{A}$ |

## 4.096V ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ . (Note 3)

| PARAMETER                          | CONDITIONS                                                                                                 | MIN | TYP          | MAX          | UNITS                                          |
|------------------------------------|------------------------------------------------------------------------------------------------------------|-----|--------------|--------------|------------------------------------------------|
| Temperature Coefficient (Note 8)   | LT1634A, $I_R = 20\mu\text{A}$<br>LT1634B/LT1634C, $I_R = 20\mu\text{A}$                                   | ●   | 4<br>10      | 10<br>25     | ppm/ $^\circ\text{C}$<br>ppm/ $^\circ\text{C}$ |
| Reverse Dynamic Impedance (Note 5) | $20\mu\text{A} \leq I_R \leq 2\text{mA}$                                                                   | ●   | 0.15<br>0.20 | 0.75<br>1.50 | $\Omega$<br>$\Omega$                           |
| Low Frequency Noise (Note 6)       | $I_R = 20\mu\text{A}$ , $0.1\text{Hz} \leq f \leq 10\text{Hz}$                                             |     | 30           |              | $\mu\text{V}_{\text{P-P}}$                     |
| Hysteresis (Note 7)                | $\Delta T = -40^\circ\text{C}$ to $85^\circ\text{C}$<br>$\Delta T = 0^\circ\text{C}$ to $70^\circ\text{C}$ |     | 160<br>40    |              | ppm<br>ppm                                     |

## 5V ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at  $T_A = 25^\circ\text{C}$ . (Note 3)

| PARAMETER                                      | CONDITIONS                                                                                                 | MIN                 | TYP          | MAX              | UNITS                                          |
|------------------------------------------------|------------------------------------------------------------------------------------------------------------|---------------------|--------------|------------------|------------------------------------------------|
| Reverse Breakdown Voltage                      | LT1634ACS8/LT1634BCS8/<br>LT1634AIS8/LT1634BIS8 ( $I_R = 20\mu\text{A}$ )                                  | 4.99750<br>-0.05    | 5.000        | 5.00250<br>0.05  | V<br>%                                         |
|                                                | LT1634CCZ ( $I_R = 20\mu\text{A}$ )                                                                        | 4.99000<br>-0.20    | 5.000        | 5.01000<br>0.20  | V<br>%                                         |
|                                                | LT1634ACS8 ( $I_R = 20\mu\text{A}$ )                                                                       | ● 4.99400<br>-0.12  | 5.000        | 5.00600<br>0.12  | V<br>%                                         |
|                                                | LT1634AIS8 ( $I_R = 20\mu\text{A}$ )                                                                       | ● 4.99125<br>-0.175 | 5.000        | 5.00875<br>0.175 | V<br>%                                         |
|                                                | LT1634BCS8 ( $I_R = 20\mu\text{A}$ )                                                                       | ● 4.98875<br>-0.225 | 5.000        | 5.01125<br>0.225 | V<br>%                                         |
|                                                | LT1634BIS8 ( $I_R = 20\mu\text{A}$ )                                                                       | ● 4.98188<br>-0.362 | 5.000        | 5.01813<br>0.362 | V<br>%                                         |
|                                                | LT1634CCZ ( $I_R = 20\mu\text{A}$ )                                                                        | ● 4.98126<br>-0.375 | 5.000        | 5.01876<br>0.375 | V<br>%                                         |
| Reverse Breakdown Change with Current (Note 4) | $20\mu\text{A} \leq I_R \leq 2\text{mA}$                                                                   | ●                   | 0.30<br>0.40 | 1.5<br>3.0       | mV<br>mV                                       |
|                                                | $2\text{mA} \leq I_R \leq 20\text{mA}$                                                                     | ●                   | 6<br>6       | 15<br>20         | mV<br>mV                                       |
| Minimum Operating Current                      |                                                                                                            | ●                   |              | 15               | $\mu\text{A}$                                  |
| Temperature Coefficient (Note 8)               | LT1634A, $I_R = 20\mu\text{A}$<br>LT1634B/LT1634C, $I_R = 20\mu\text{A}$                                   | ●                   | 4<br>10      | 10<br>25         | ppm/ $^\circ\text{C}$<br>ppm/ $^\circ\text{C}$ |
| Reverse Dynamic Impedance (Note 5)             | $20\mu\text{A} \leq I_R \leq 2\text{mA}$                                                                   | ●                   | 0.15<br>0.20 | 0.75<br>1.50     | $\Omega$<br>$\Omega$                           |
| Low Frequency Noise (Note 6)                   | $I_R = 20\mu\text{A}$ , $0.1\text{Hz} \leq f \leq 10\text{Hz}$                                             |                     | 35           |                  | $\mu\text{V}_{\text{P-P}}$                     |
| Hysteresis (Note 7)                            | $\Delta T = -40^\circ\text{C}$ to $85^\circ\text{C}$<br>$\Delta T = 0^\circ\text{C}$ to $70^\circ\text{C}$ |                     | 160<br>40    |                  | ppm<br>ppm                                     |

**Note 1:** Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

**Note 2:** If the part is stored outside of the specific operating temperature range, the output may shift due to hysteresis.

**Note 3:** ESD (Electrostatic Discharge) sensitive device. Use proper ESD handling precautions.

**Note 4:** Output requires  $0.1\mu\text{F}$  for operating current greater than  $1\text{mA}$ .

**Note 5:** This parameter is guaranteed by “reverse breakdown change with current” test.

**Note 6:** Peak-to-peak noise is measured with a single highpass filter at  $0.1\text{Hz}$  and 2-pole lowpass filter at  $10\text{Hz}$ .

**Note 7:** 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  $25^\circ\text{C}$  but the IC is cycled to  $85^\circ\text{C}$  or  $-40^\circ\text{C}$  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.

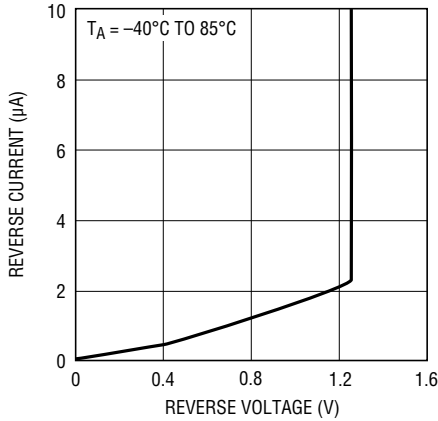
**Note 8:** Temperature coefficient is calculated from the minimum and maximum output voltage measured at  $T_{\text{MIN}}$ , Room and  $T_{\text{MAX}}$  as follows:

$$\text{TC} = (V_{\text{OMAX}} - V_{\text{OMIN}}) / (T_{\text{MAX}} - T_{\text{MIN}})$$

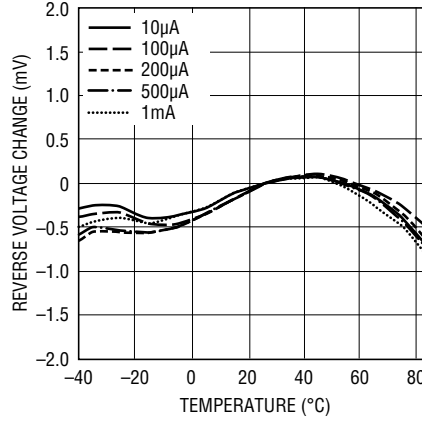
Incremental slope is also measured at  $25^\circ\text{C}$ .

# 1.25V TYPICAL PERFORMANCE CHARACTERISTICS

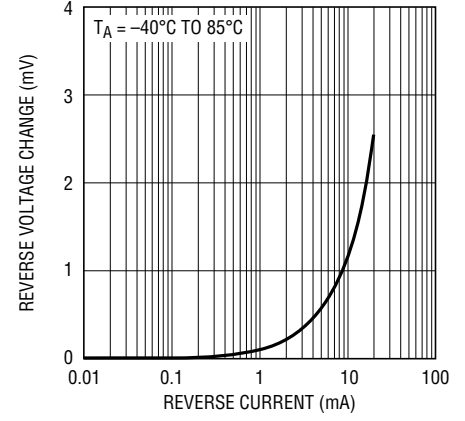
Reverse Characteristics



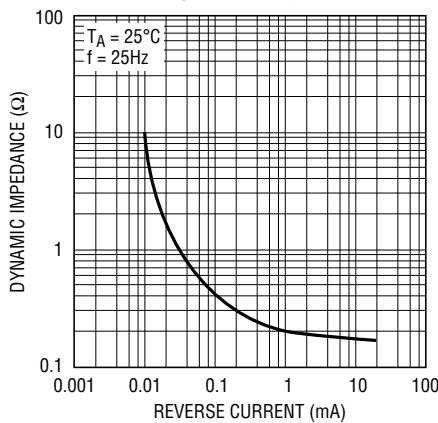
Temperature Drift



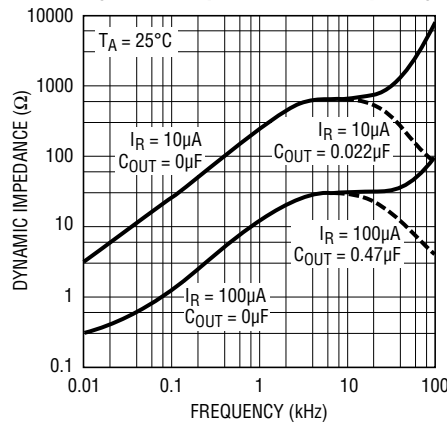
Reverse Voltage Change vs Current



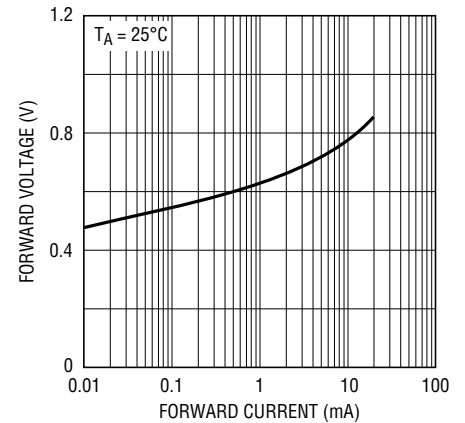
Reverse Dynamic Impedance



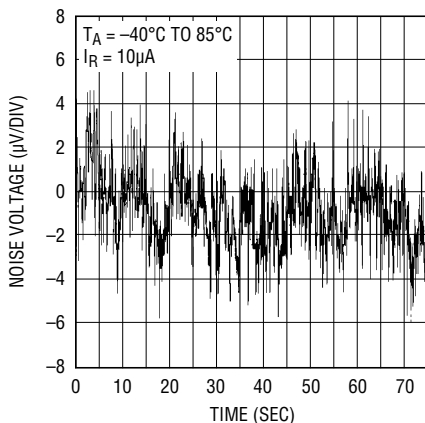
Dynamic Impedance vs Frequency



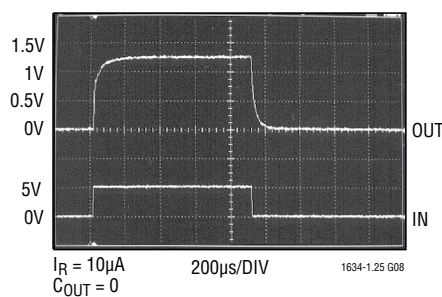
Forward Characteristics



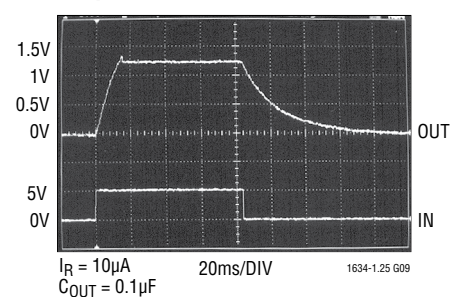
0.1Hz to 10Hz Noise



Response Time

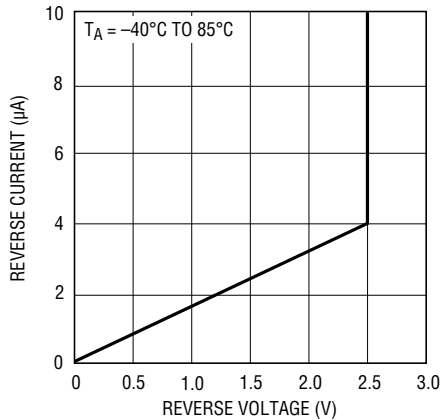


Response Time



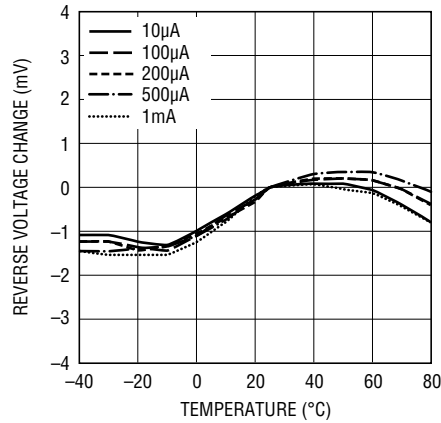
# 2.5V TYPICAL PERFORMANCE CHARACTERISTICS

Reverse Characteristics



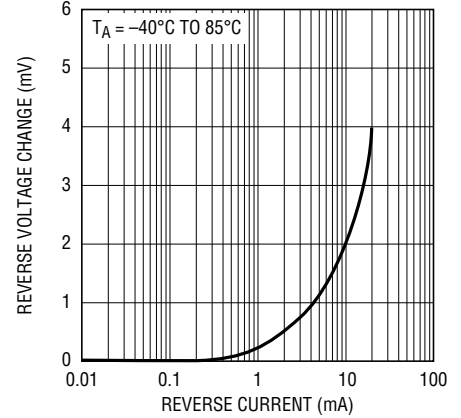
1634-2.5 G01

Temperature Drift



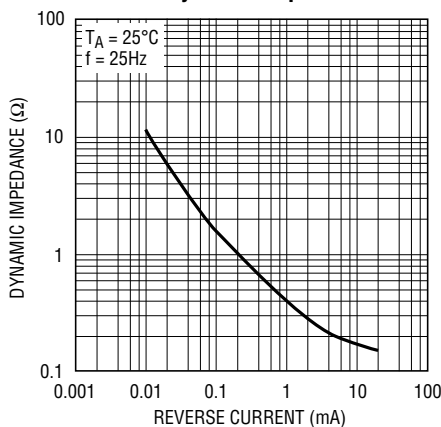
1634-2.5 G02

Reverse Voltage Change vs Current



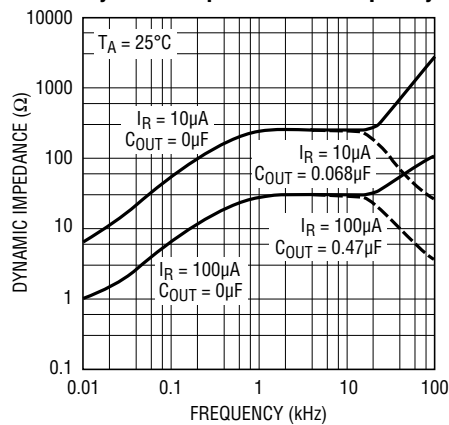
1634-2.5 G03

Reverse Dynamic Impedance



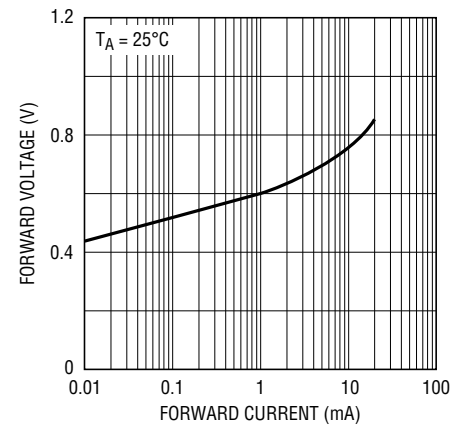
1635-2.5 G04

Dynamic Impedance vs Frequency



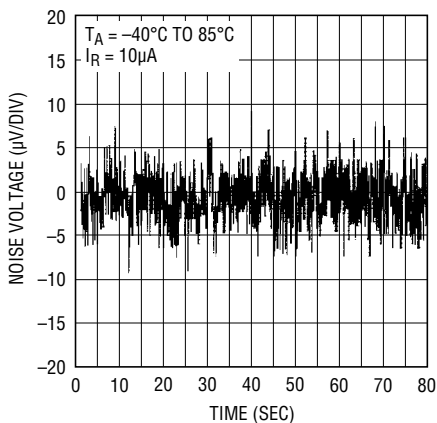
1634-2.5 G05

Forward Characteristics



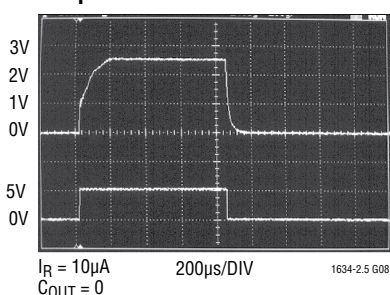
1634-2.5 G06

0.1Hz to 10Hz Noise



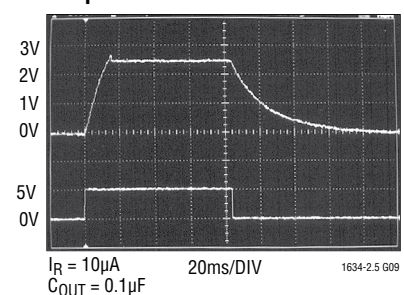
1634-2.5 G07

Response Time



1634-2.5 G08

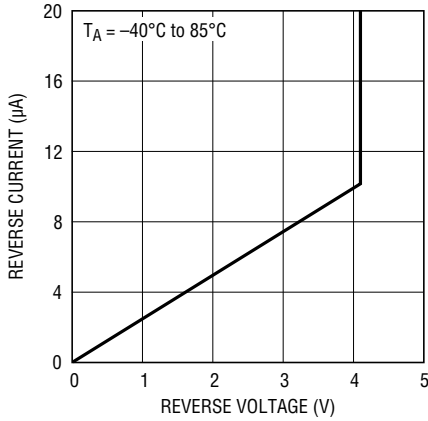
Response Time



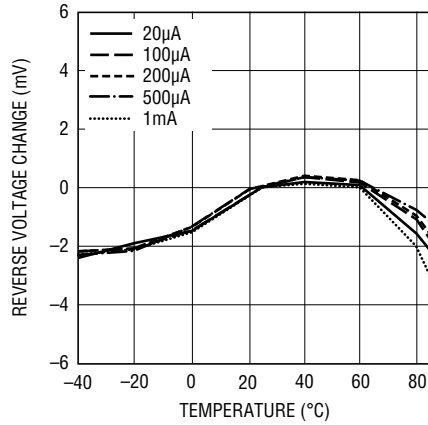
1634-2.5 G09

# 4.096V TYPICAL PERFORMANCE CHARACTERISTICS

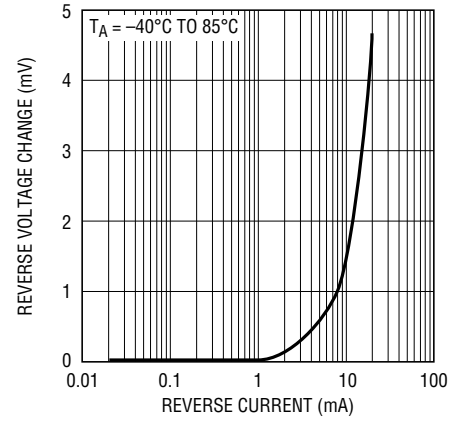
Reverse Characteristics



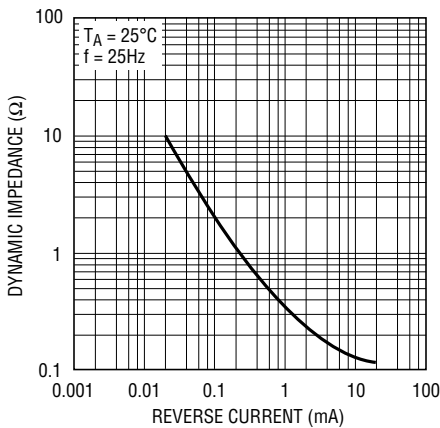
Temperature Drift



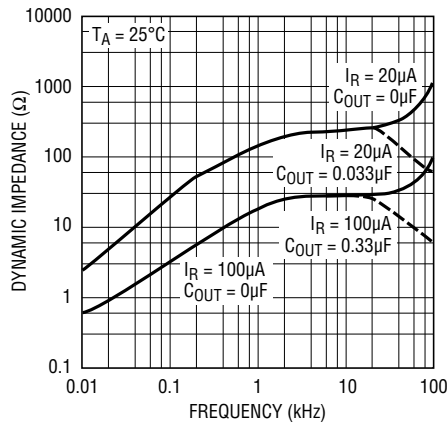
Reverse Voltage Change vs Current



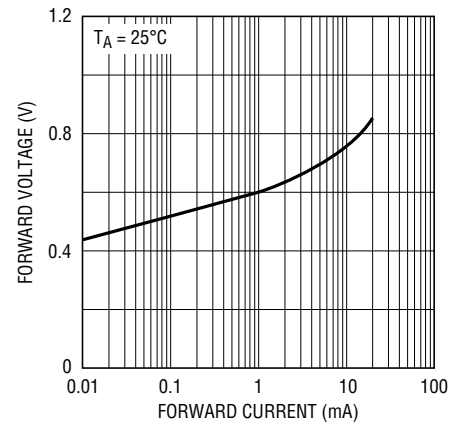
Reverse Dynamic Impedance



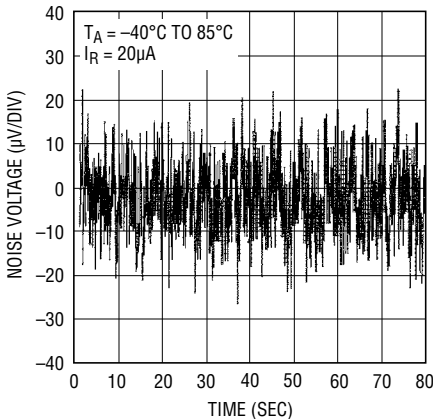
Dynamic Impedance vs Frequency



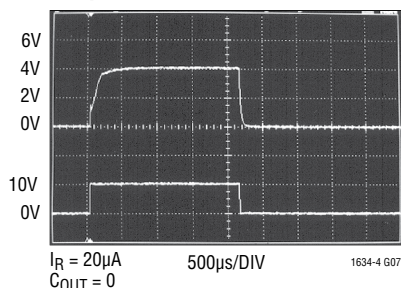
Forward Characteristics



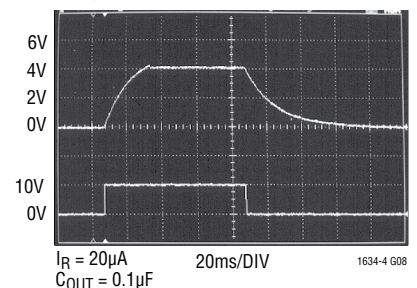
0.1Hz to 10Hz Noise



Response Time

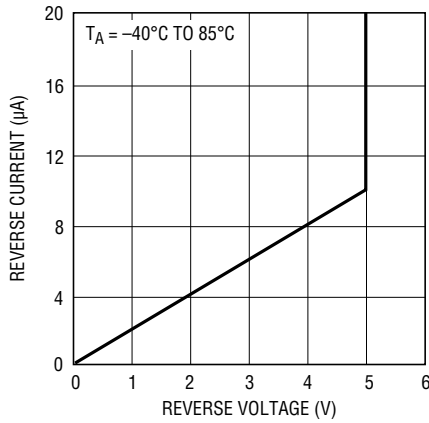


Response Time

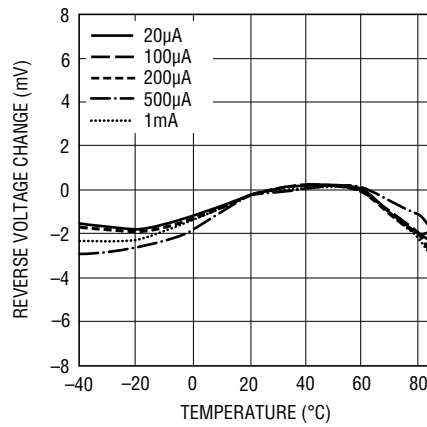


# 5V TYPICAL PERFORMANCE CHARACTERISTICS

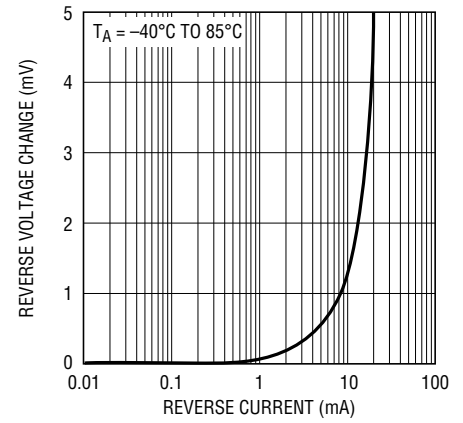
Reverse Characteristics



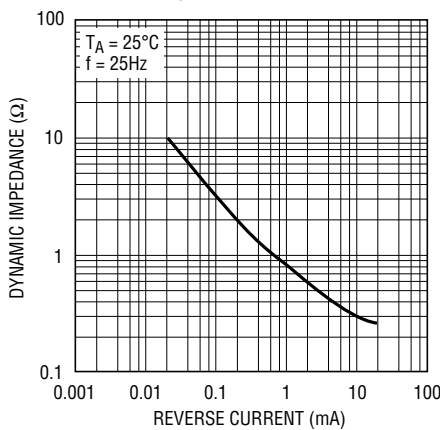
Temperature Drift



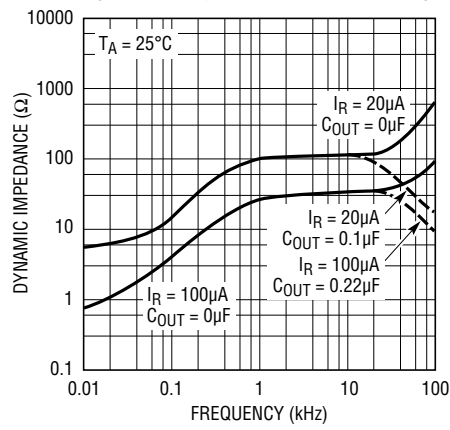
Reverse Voltage Change vs Current



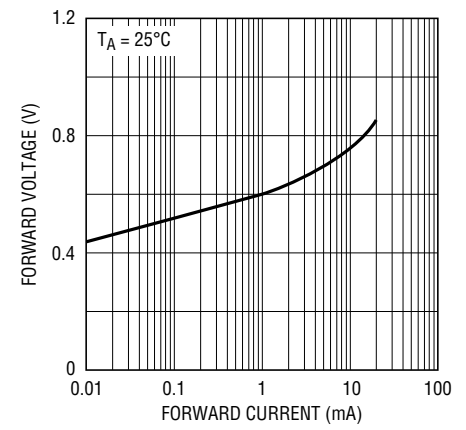
Reverse Dynamic Impedance



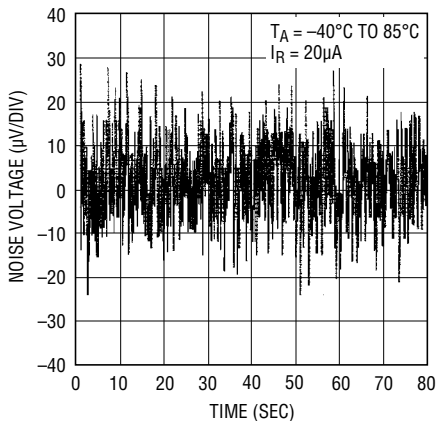
Dynamic Impedance vs Frequency



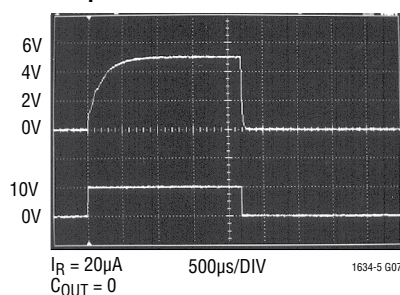
Forward Characteristics



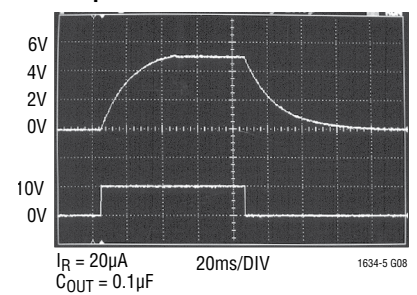
0.1Hz to 10Hz Noise



Response Time



Response Time



## APPLICATIONS INFORMATION

The reverse characteristics of the LT1634 behave like a resistor in parallel with a Zener diode. This simple, well behaved characteristic is important to the proper operation of circuits like Figure 1. The adjustable output voltage reference depends upon positive feedback from the LT1495's output to start-up and regulate the bias current for the LT1634.

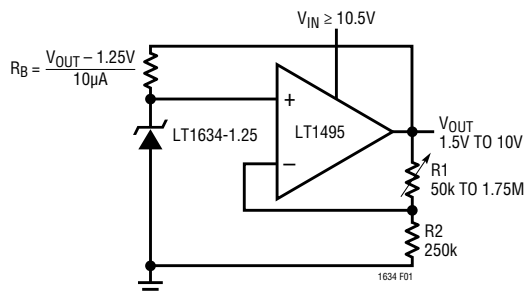
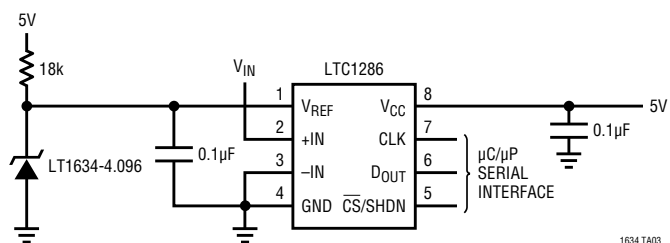


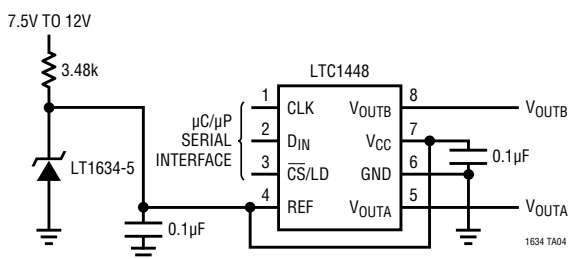
Figure 1. Adjustable Output Voltage Reference

## TYPICAL APPLICATIONS

### Reference for Micropower A/D Converter



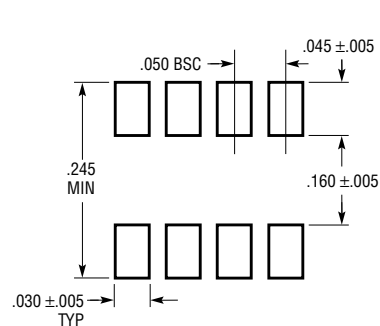
### The LT1634-5 Generates the LTC1448 Dual 12-Bit DAC's Reference and Supply Voltage



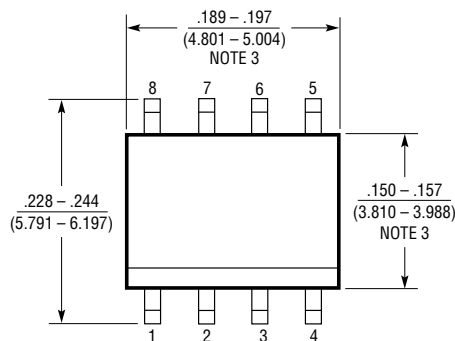
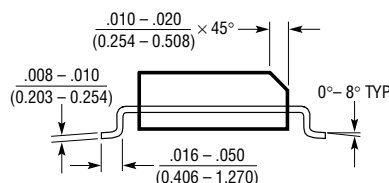
# PACKAGE DESCRIPTION

Please refer to <http://www.linear.com/designtools/packaging/> for the most recent package drawings.

## S8 Package 8-Lead Plastic Small Outline (Narrow .150 Inch) (Reference LTC DWG # 05-08-1610 Rev G)



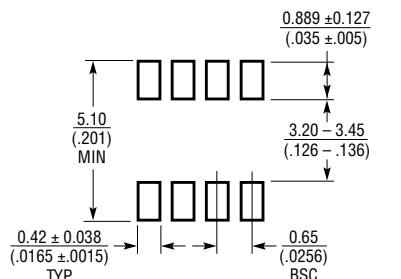
RECOMMENDED SOLDER PAD LAYOUT



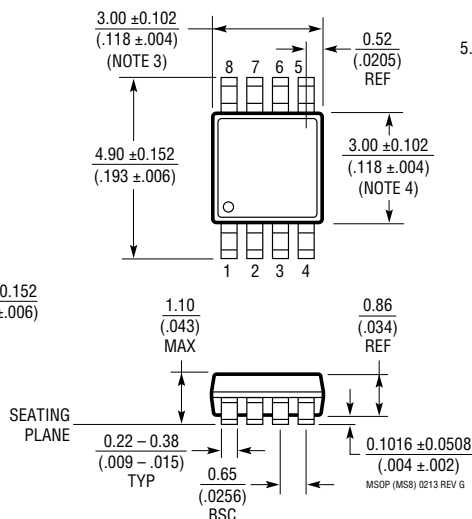
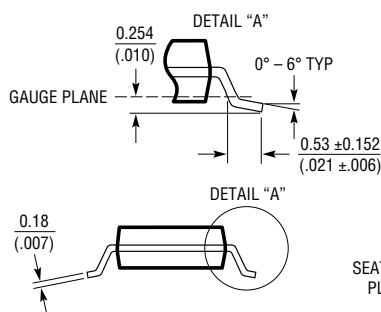
- NOTE:
1. DIMENSIONS IN INCHES (MILLIMETERS)
  2. DRAWING NOT TO SCALE
  3. THESE DIMENSIONS DO NOT INCLUDE MOLD FLASH OR PROTRUSIONS. MOLD FLASH OR PROTRUSIONS SHALL NOT EXCEED .006" (0.15mm)
  4. PIN 1 CAN BE BEVEL EDGE OR A DIMPLE

S08 REV G 0212

## MS8 Package 8-Lead Plastic MSOP (Reference LTC DWG # 05-08-1660 Rev G)



RECOMMENDED SOLDER PAD LAYOUT



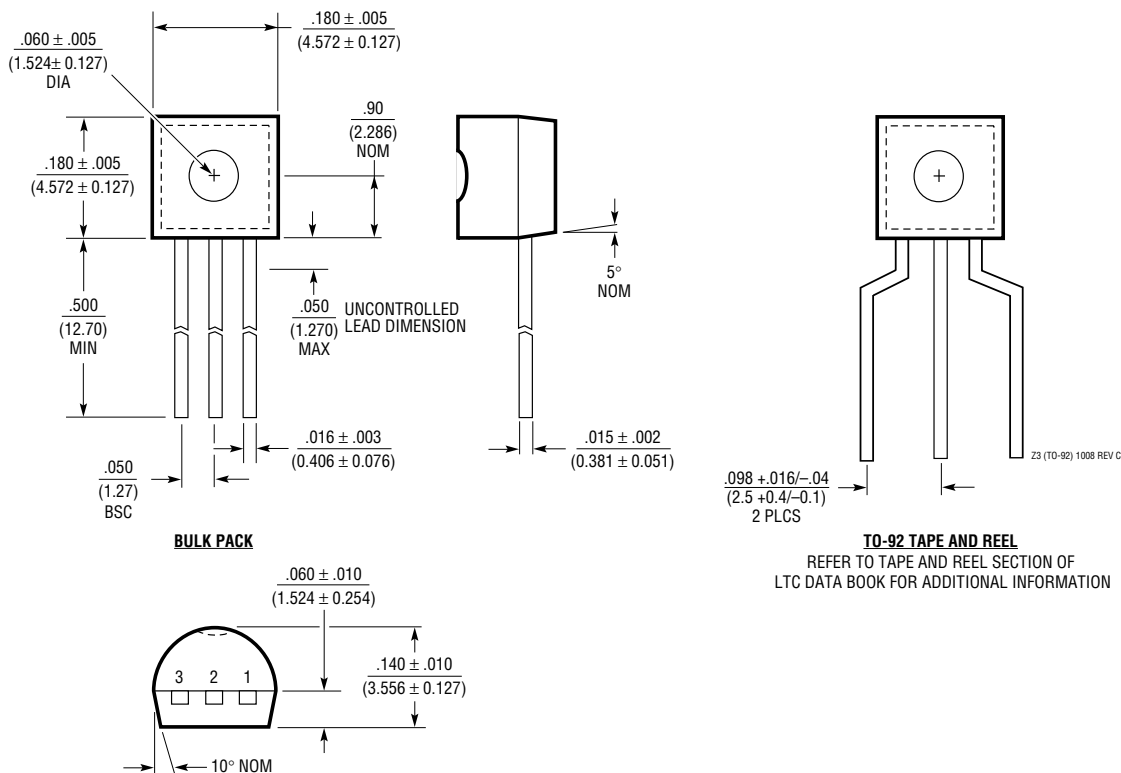
- NOTE:
1. DIMENSIONS IN MILLIMETER/(INCH)
  2. DRAWING NOT TO SCALE
  3. DIMENSION DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.152mm (.006") PER SIDE
  4. DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS. INTERLEAD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.152mm (.006") PER SIDE
  5. LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.102mm (.004") MAX

1634ff

## PACKAGE DESCRIPTION

Please refer to <http://www.linear.com/designtools/packaging/> for the most recent package drawings.

### Z Package 3-Lead Plastic T0-92 (Similar to T0-226) (Reference LTC DWG # 05-08-1410 Rev C)

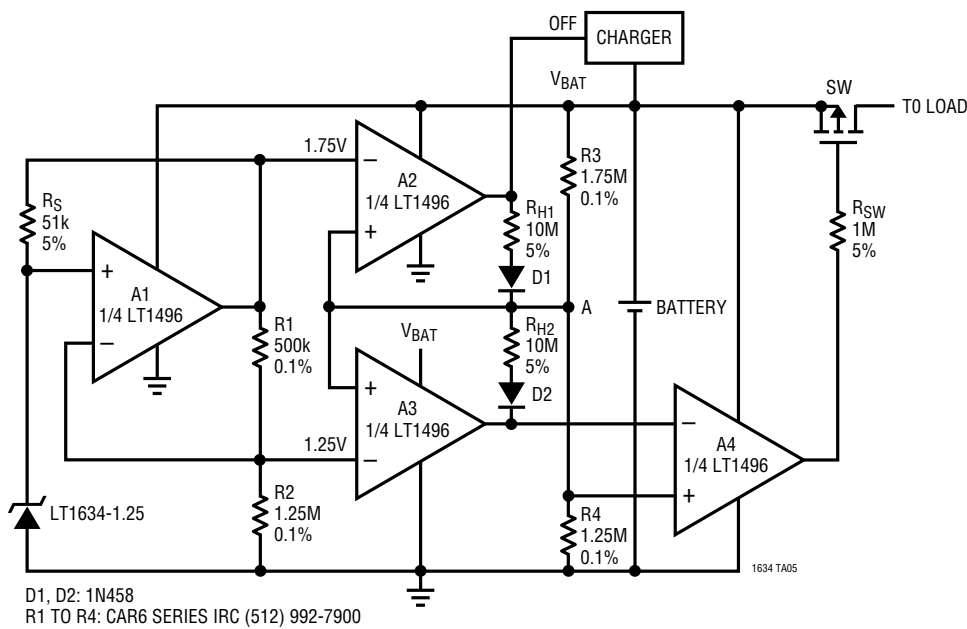


**REVISION HISTORY** (Revision history begins at Rev F)

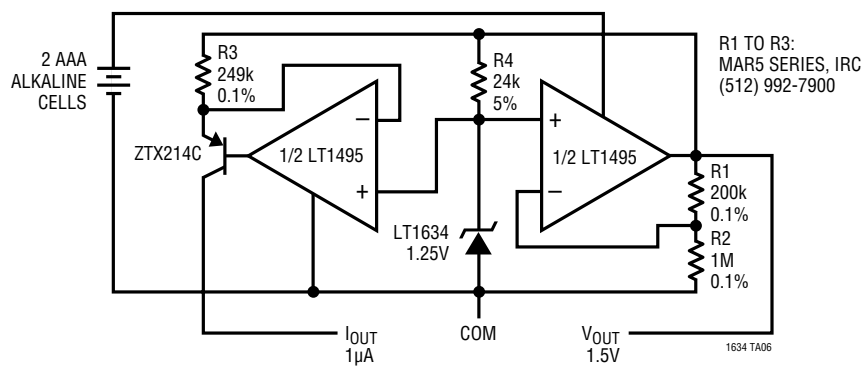
| REV | DATE  | DESCRIPTION                                                                           | PAGE NUMBER    |
|-----|-------|---------------------------------------------------------------------------------------|----------------|
| F   | 10/14 | Web Links Added<br>NC Pins Identified on MS8 and S8 Package<br>Revision History Added | All<br>2<br>13 |

TYPICAL APPLICATIONS

Single Cell Li-Ion Battery Supervisory Circuit (I<sub>Q</sub> = 20μA)



Micropower Voltage and Current Reference



RELATED PARTS

| PART NUMBER             | DESCRIPTION                              | COMMENTS                                                                                               |
|-------------------------|------------------------------------------|--------------------------------------------------------------------------------------------------------|
| <a href="#">LTC1440</a> | Micropower Comparator with Reference     | 3.7μA Max Supply Current, 1% 1.182V Reference, MSOP, PDIP and SO-8 Packages                            |
| <a href="#">LT1460</a>  | Micropower Series Reference              | 0.075% Max, 10ppm/°C Max Drift, 2.5V, 5V and 10V Versions, MSOP, PDIP, SO-8, SOT-23 and TO-92 Packages |
| <a href="#">LT1495</a>  | 1.5μA Precision Rail-to-Rail Dual Op Amp | 1.5μA Max Supply Current, 100pA Max IOS                                                                |
| <a href="#">LTC1540</a> | Nanopower Comparator with Reference      | 600nA Max Supply Current, 2% 1.182V Reference, MSOP and SO-8 Packages                                  |