

### Features

- Low Dropout 1 mV
- High Accuracy 2%
- High Output Current 25 mA
- Low IQ Maximum of 50  $\mu$ A
- Low Temperature Drift: Maximum of 100 ppm/ $^{\circ}$ C
- Package appearance SOT-23

### Applications

- Battery-Powered Equipment
- Data Acquisition Systems
- Precision Audio Components
- Instrumentation
- Process Control

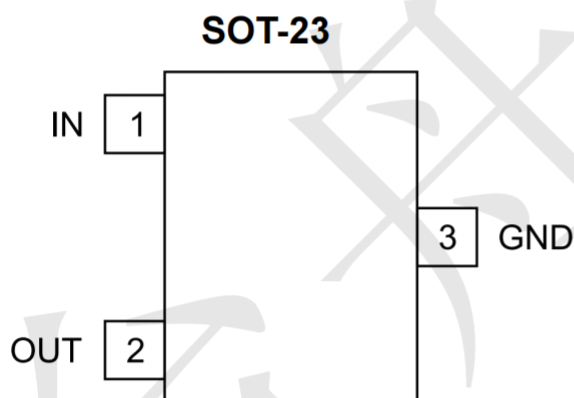
### General Description

The is a precision, low-power, low-voltage dropout voltage reference family available in a tiny 3-pin SOT-23 package.

The small size and low power consumption (50  $\mu$ A maximum) of the make it ideal for portable and battery-powered applications. The does not require a load capacitor, but it is stable with any capacitive load.

Unloaded, the can be operated with supplies within 1 mV of output voltage. All models are specified for the wide temperature range,  $-40^{\circ}$ C to  $125^{\circ}$ C.

### Pin Configuration



### Functions

| NO. | NAME | DESCRIPTION              |
|-----|------|--------------------------|
| 1   | IN   | Input supply voltage     |
| 2   | OUT  | Reference output voltage |
| 3   | GND  | Ground                   |

### Device Comparison Table

| PRODUCT          | VOLTAGE (V) |
|------------------|-------------|
| REF2912AIDBZR-TP | 1.25V       |
| REF2920AIDBZR-TP | 2.048V      |
| REF2925AIDBZR-TP | 2.5V        |
| REF2930AIDBZR-TP | 3.0V        |
| REF2933AIDBZR-TP | 3.3V        |
| REF2940AIDBZR-TP | 4.096V      |

### Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)

|                                       | MIN        | MAX | UNIT |
|---------------------------------------|------------|-----|------|
| Supply voltage, V+ to V–              | --         | 7   | V    |
| Output short circuit <sup>(2)</sup>   | Continuous |     | °C   |
| Lead temperature (soldering, 10 s)    | --         | 300 | °C   |
| Operating temperature                 | -40        | 125 | °C   |
| Junction temperature                  | --         | 150 | °C   |
| Storage temperature, T <sub>stg</sub> | -65        | 150 | °C   |

**Note 1**, Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

**Note 2**, Short-circuit to ground.

### ESD Ratings

|                                            |                            | VALUE | UNIT |
|--------------------------------------------|----------------------------|-------|------|
| V <sub>(ESD)</sub> Electrostatic discharge | Human-body model (HBM)     | ±4000 | V    |
|                                            | Charged-device model (CDM) | ±1500 |      |

### Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

|                   |                                           | MIN   | MAX | UNIT |
|-------------------|-------------------------------------------|-------|-----|------|
| V <sub>IN</sub>   | Input voltage                             | 1.8   | 5.5 | V    |
| I <sub>LOAD</sub> | Load current                              | --    | 25  | mA   |
| T <sub>A</sub>    | Operating temperature                     | -40   | 125 | °C   |
| R <sub>θJA</sub>  | Junction-to-ambient thermal resistance    | 297.3 |     | °C/W |
| R <sub>θJB</sub>  | Junction-to-board thermal resistance      | 91.7  |     | °C/W |
| R <sub>θJC</sub>  | Junction-to-case (top) thermal resistance | 128.5 |     | °C/W |

### Electrical Characteristics

(At  $T_A = 25^\circ\text{C}$ ,  $I_{\text{LOAD}} = 0 \text{ mA}$ ,  $V_{\text{IN}} = 5 \text{ V}$ , unless otherwise noted.)

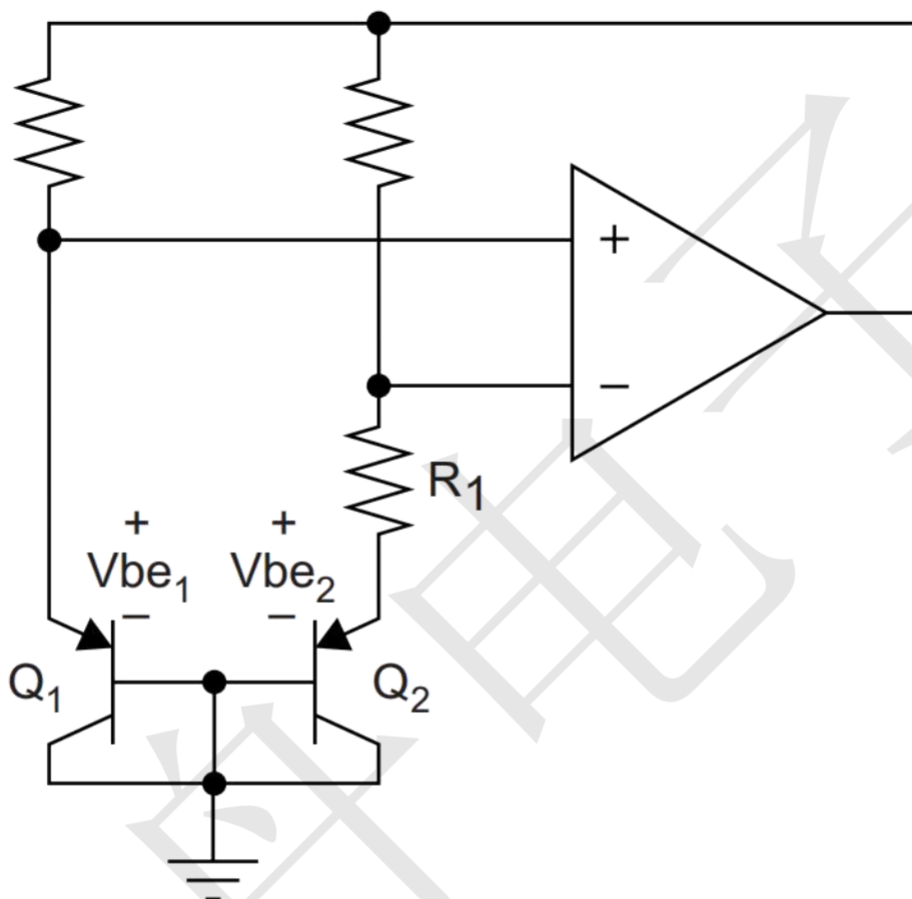
| PARAMETER               |                | TEST CONDITIONS                                                        | MIN   | TYP   | MAX   | UNIT                       |
|-------------------------|----------------|------------------------------------------------------------------------|-------|-------|-------|----------------------------|
| <b>REF2912AIDBZR-TP</b> |                |                                                                        |       |       |       |                            |
| $V_{\text{OUT}}$        | Output voltage |                                                                        | 1.225 | 1.25  | 1.275 | V                          |
| Initial accuracy        |                |                                                                        |       | 2%    |       |                            |
| Output voltage noise    |                | $f = 0.1 \text{ Hz to } 10 \text{ Hz}$ ,                               |       | 14    |       | $\mu\text{V}_{\text{PP}}$  |
| Voltage noise           |                | $f = 10 \text{ Hz to } 10 \text{ kHz}$                                 |       | 42    |       | $\mu\text{V}_{\text{rms}}$ |
| Line regulation         |                | $1.8 \text{ V} \leq V_{\text{IN}} \leq 5.5 \text{ V}$                  | --    | 60    | 190   | $\mu\text{V/V}$            |
| <b>REF2920AIDBZR-TP</b> |                |                                                                        |       |       |       |                            |
| $V_{\text{OUT}}$        | Output voltage |                                                                        | 2.007 | 2.048 | 2.089 | V                          |
| Initial accuracy        |                |                                                                        |       | 2%    |       |                            |
| Output voltage noise    |                | $f = 0.1 \text{ Hz to } 10 \text{ Hz}$ ,                               |       | 23    |       | $\mu\text{V}_{\text{PP}}$  |
| Voltage noise           |                | $f = 10 \text{ Hz to } 10 \text{ kHz}$                                 |       | 65    |       | $\mu\text{V}_{\text{rms}}$ |
| Line regulation         |                | $V_{\text{REF}} + 50 \text{ mV} \leq V_{\text{IN}} \leq 5.5 \text{ V}$ | --    | 110   | 290   | $\mu\text{V/V}$            |
| <b>REF2925AIDBZR-TP</b> |                |                                                                        |       |       |       |                            |
| $V_{\text{OUT}}$        | Output voltage |                                                                        | 2.45  | 2.5   | 2.55  | V                          |
| Initial accuracy        |                |                                                                        |       | 2%    |       |                            |
| Output voltage noise    |                | $f = 0.1 \text{ Hz to } 10 \text{ Hz}$                                 |       | 28    |       | $\mu\text{V}_{\text{PP}}$  |
| Voltage noise           |                | $f = 10 \text{ Hz to } 10 \text{ kHz}$                                 |       | 80    |       | $\mu\text{V}_{\text{rms}}$ |
| Line regulation         |                | $V_{\text{REF}} + 50 \text{ mV} \leq V_{\text{IN}} \leq 5.5 \text{ V}$ | --    | 120   | 325   | $\mu\text{V/V}$            |
| <b>REF2930AIDBZR-TP</b> |                |                                                                        |       |       |       |                            |
| $V_{\text{OUT}}$        | Output voltage |                                                                        | 2.94  | 3     | 3.06  | V                          |
| Initial accuracy        |                |                                                                        |       | 2%    |       |                            |
| Output voltage noise    |                | $f = 0.1 \text{ Hz to } 10 \text{ Hz}$ ,                               |       | 33    |       | $\mu\text{V}_{\text{PP}}$  |
| Voltage noise           |                | $f = 10 \text{ Hz to } 10 \text{ kHz}$                                 |       | 94    |       | $\mu\text{V}_{\text{rms}}$ |
| Line regulation         |                | $V_{\text{REF}} + 50 \text{ mV} \leq V_{\text{IN}} \leq 5.5 \text{ V}$ | --    | 120   | 375   | $\mu\text{V/V}$            |
| <b>REF2933AIDBZR-TP</b> |                |                                                                        |       |       |       |                            |
| $V_{\text{OUT}}$        | Output voltage |                                                                        | 3.234 | 3.3   | 3.366 | V                          |
| Initial accuracy        |                |                                                                        |       | 2%    |       |                            |
| Output voltage noise    |                | $f = 0.1 \text{ Hz to } 10 \text{ Hz}$ ,                               |       | 36    |       | $\mu\text{V}_{\text{PP}}$  |
| Voltage noise           |                | $f = 10 \text{ Hz to } 10 \text{ kHz}$                                 |       | 105   |       | $\mu\text{V}_{\text{rms}}$ |
| Line regulation         |                | $V_{\text{REF}} + 50 \text{ mV} \leq V_{\text{IN}} \leq 5.5 \text{ V}$ | --    | 130   | 400   | $\mu\text{V/V}$            |

### Electrical Characteristics (continued)

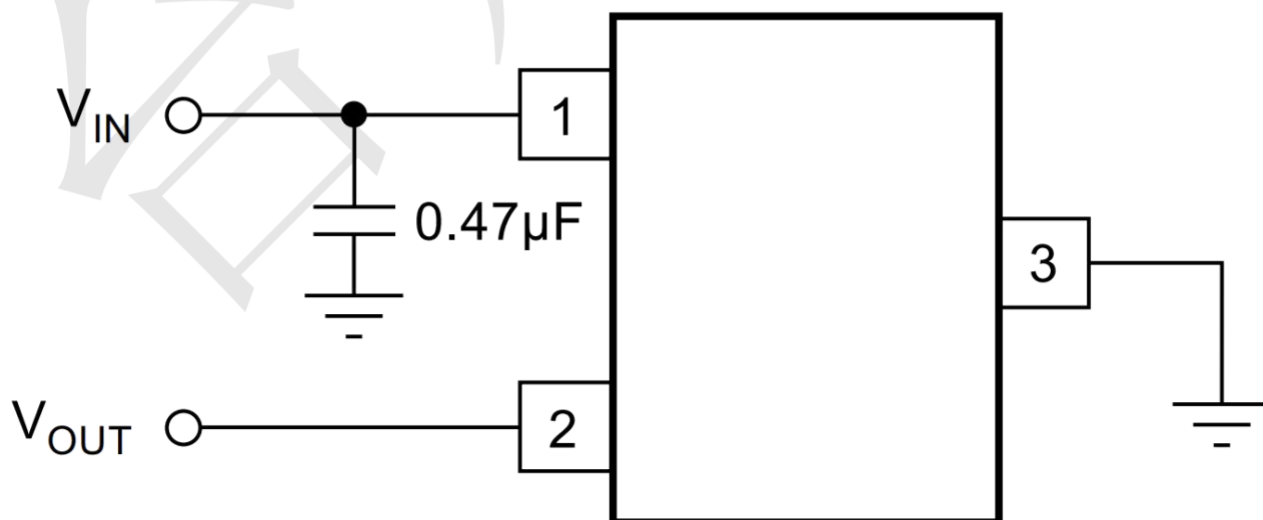
(At  $T_A = 25^\circ\text{C}$ ,  $I_{\text{LOAD}} = 0\text{ mA}$ ,  $V_{\text{IN}} = 5\text{ V}$ , unless otherwise noted.)

| PARAMETER                                                                                                   |                                    | TEST CONDITIONS                                                                              | MIN                      | TYP   | MAX   | UNIT              |
|-------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------------------------------------------------------------------------|--------------------------|-------|-------|-------------------|
| REF2940AIDBZR-TP                                                                                            |                                    |                                                                                              |                          |       |       |                   |
| V <sub>OUT</sub>                                                                                            | Output voltage                     |                                                                                              | 4.014                    | 4.096 | 4.178 | V                 |
| Initial accuracy                                                                                            |                                    |                                                                                              | 2%                       |       |       |                   |
| Output voltage noise                                                                                        |                                    | f = 0.1 Hz to 10 Hz,                                                                         | 45                       |       |       | μV <sub>PP</sub>  |
| Voltage noise                                                                                               |                                    | f = 10 Hz to 10 kHz                                                                          | 128                      |       |       | μV <sub>rms</sub> |
| Line regulation                                                                                             |                                    | V <sub>REF</sub> + 50 mV ≤ V <sub>IN</sub> ≤ 5.5 V                                           | --                       | 160   | 410   | μV/V              |
| REF2912AIDBZR-TP, REF2920AIDBZR-TP, REF2925AIDBZR-TP, REF2930AIDBZR-TP, TREF2933AIDBZR-TP, REF2940AIDBZR-TP |                                    |                                                                                              |                          |       |       |                   |
| dV <sub>OUT</sub> /dT                                                                                       | Output voltage temperature drift   | -40°C ≤ T <sub>A</sub> ≤ 125°C                                                               | --                       | 35    | 100   | ppm/°C            |
| I <sub>LOAD</sub>                                                                                           | Output current                     |                                                                                              | 25                       |       |       | mA                |
| Long-term stability                                                                                         |                                    | 0 to 1000H                                                                                   | 24                       |       |       | ppm               |
|                                                                                                             |                                    | 1000 to 2000H                                                                                | 15                       |       |       | ppm               |
| dV <sub>OUT</sub> /dI <sub>LOAD</sub> Load regulation                                                       |                                    | 0 mA < I <sub>LOAD</sub> < 25 mA, V <sub>IN</sub> = V <sub>REF</sub> + 500 mV <sup>(3)</sup> | --                       | 3     | 100   | μV/mA             |
| dT                                                                                                          | Thermal Hysteresis                 |                                                                                              | --                       | 25    | 100   | ppm               |
| V <sub>IN</sub> – V <sub>OUT</sub>                                                                          | Dropout voltage                    |                                                                                              | --                       | 1     | 50    | mV                |
| I <sub>SC</sub>                                                                                             | Short-circuit current              |                                                                                              | 45                       |       |       | mA                |
| Turnon settling time                                                                                        |                                    | to 0.1% at V <sub>IN</sub> = 5 V with C <sub>L</sub> = 0                                     | 120                      |       |       | μs                |
| POWER SUPPLY                                                                                                |                                    |                                                                                              |                          |       |       |                   |
| V <sub>S</sub>                                                                                              | Voltage                            | I <sub>L</sub> = 0                                                                           | V <sub>REF</sub> + 0.001 | --    | 5.5   | V                 |
|                                                                                                             | Voltage over temperature           | -40°C ≤ T <sub>A</sub> ≤ 125°C                                                               | V <sub>REF</sub> + 0.05  | --    | 5.5   |                   |
| I <sub>Q</sub>                                                                                              | Quiescent current                  |                                                                                              | --                       | 42    | 50    | μA                |
|                                                                                                             | Quiescent current over temperature | -40°C ≤ T <sub>A</sub> ≤ 125°C                                                               | 59                       |       |       |                   |
| TEMPERATURE RANGE                                                                                           |                                    |                                                                                              |                          |       |       |                   |
| Specified range                                                                                             |                                    |                                                                                              | -40                      | --    | 125   | °C                |
| Operating range                                                                                             |                                    |                                                                                              | -40                      | --    | 125   | °C                |
| Storage range                                                                                               |                                    |                                                                                              | -65                      | --    | 150   | °C                |

## Functional Block Diagram



## Typical Connections for Operating



### Typical Operating Characteristics

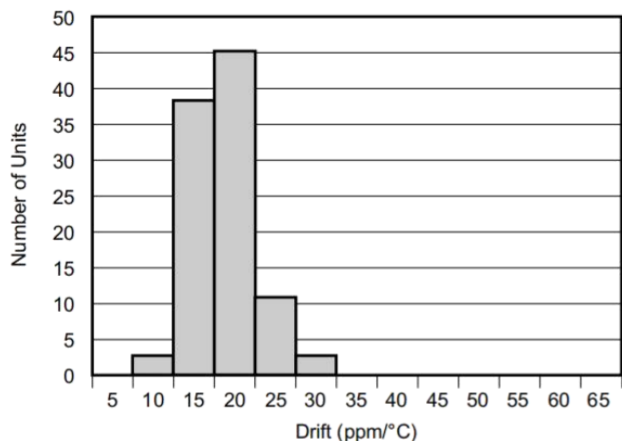


Figure 1. Temperature Drift (0°C to 70°C)

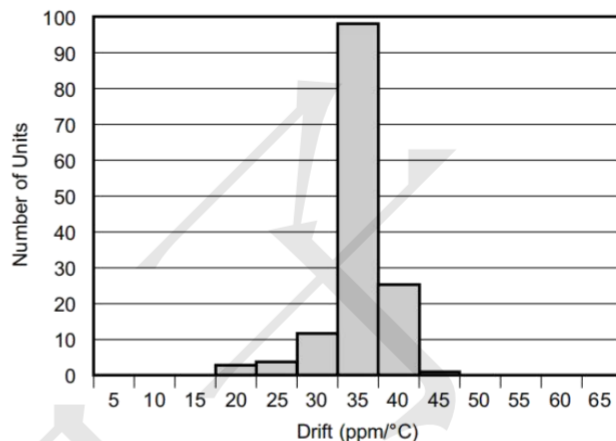


Figure 2. Temperature Drift (-40°C to 125°C)

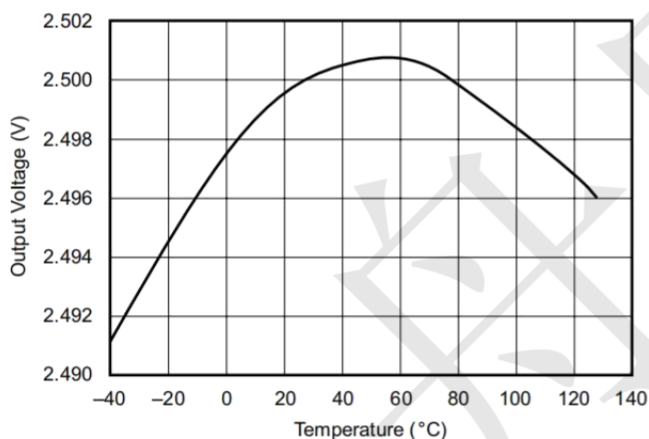


Figure 3. Output Voltage vs Temperature

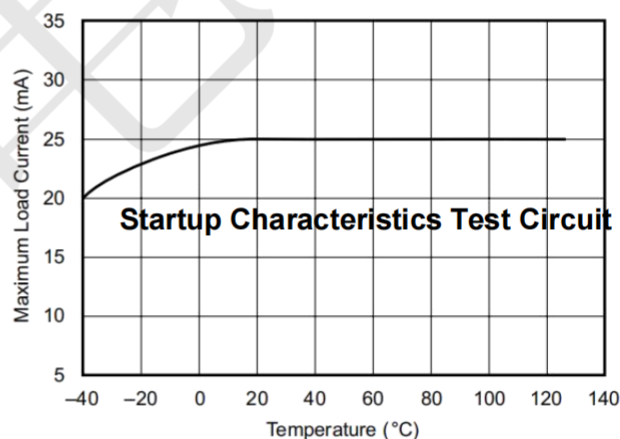


Figure 4. Maximum Load Current vs Temperature

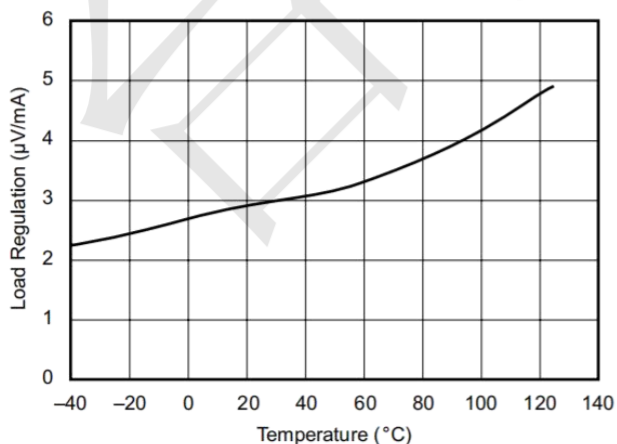


Figure 5. Load Regulation vs Temperature

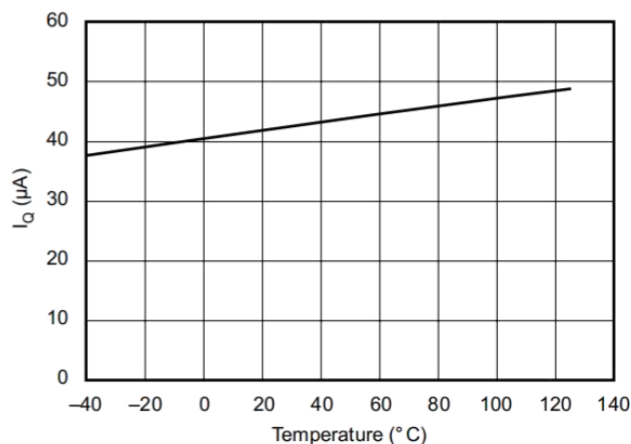


Figure 6. Quiescent Current vs Temperature

### Typical Operating Characteristics

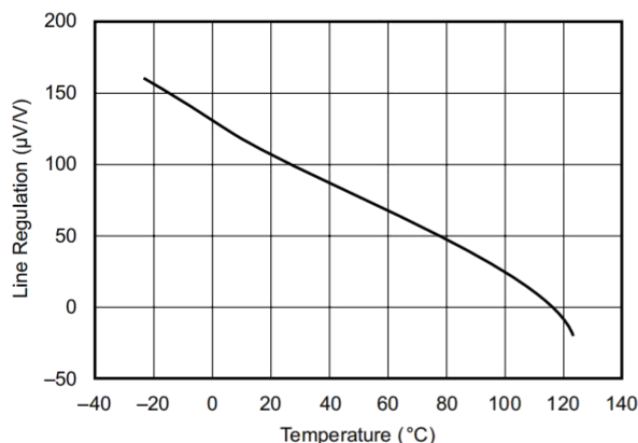


Figure 7. Line Regulation vs Temperature

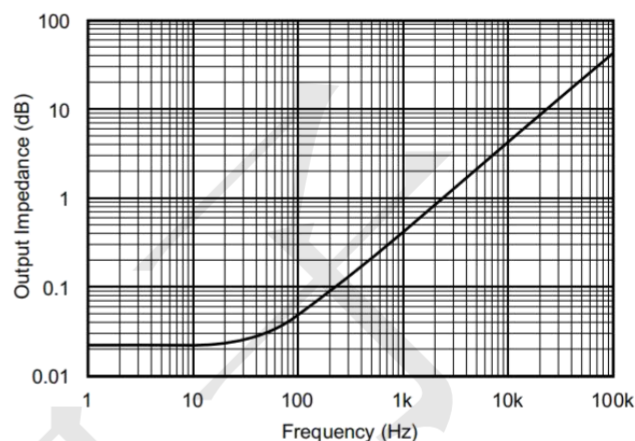


Figure 8. Output Impedance vs Frequency

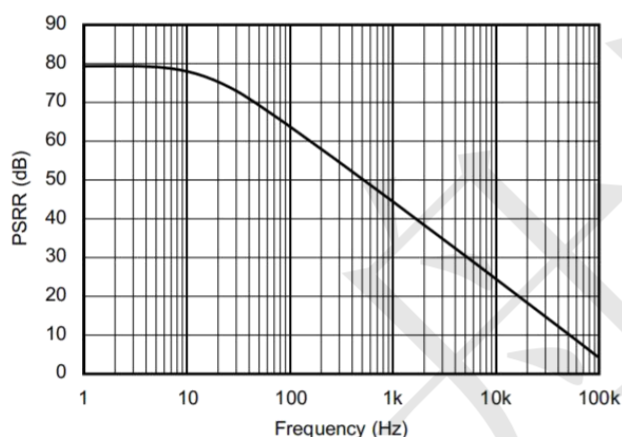


Figure 9. Power-Supply Rejection Ratio vs Frequency

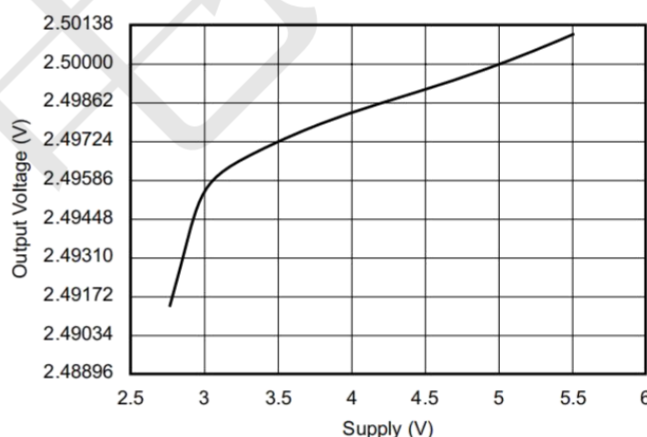


Figure 10. Output Voltage vs Supply Voltage (No Load)

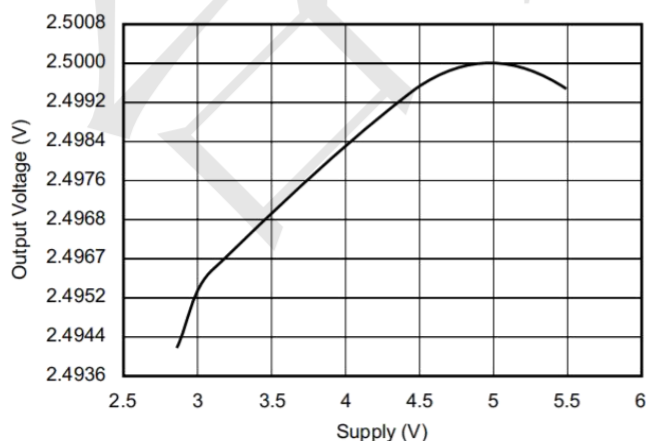


Figure 11. Output Voltage vs Supply Voltage ( $I_{LOAD} = 25\text{ mA}$ )

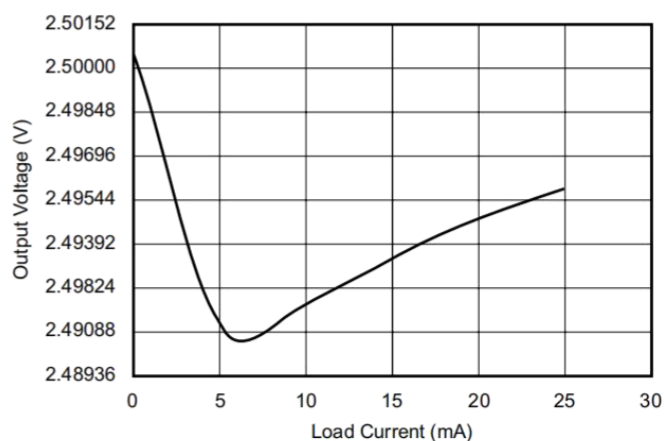


Figure 12. Output Voltage vs Load Current

### Typical Operating Characteristics

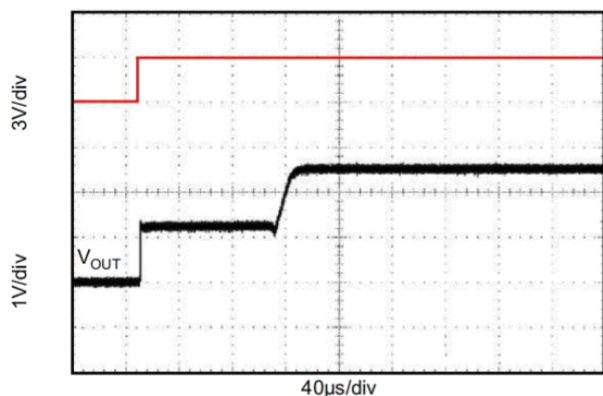


Figure 13. Step Response,  $C_L = 0$ , 3-V Start-Up

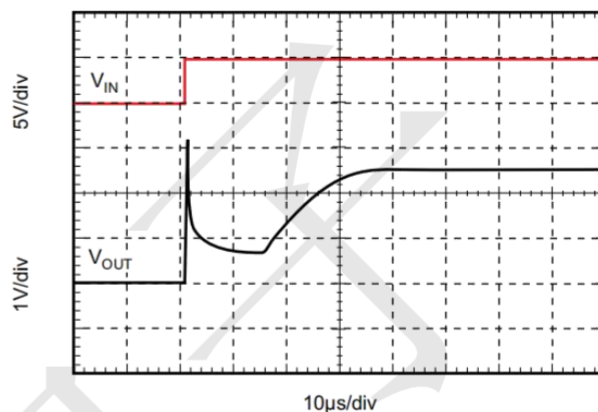


Figure 14. Step Response,  $C_L = 0$ , 5-V Start-Up

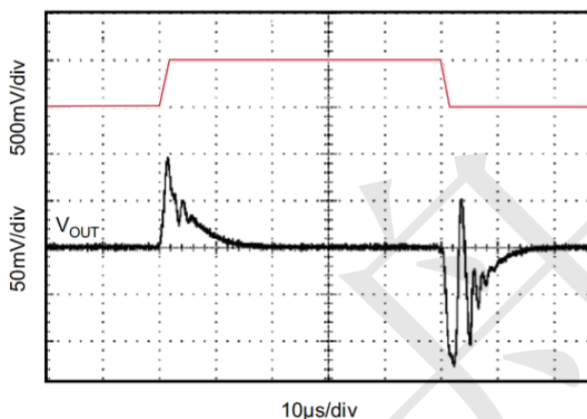


Figure 15. Line Transient Response

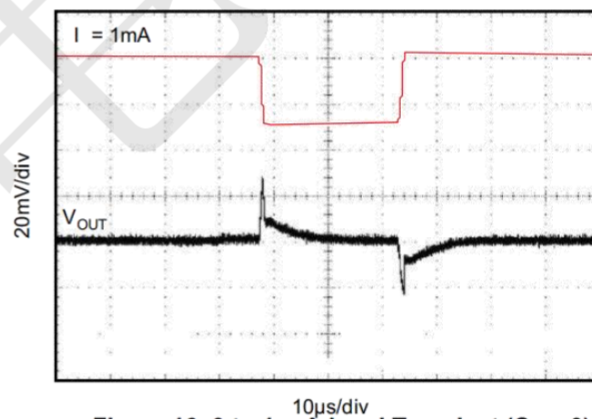


Figure 16. 0 to 1-mA Load Transient ( $C_L = 0$ )

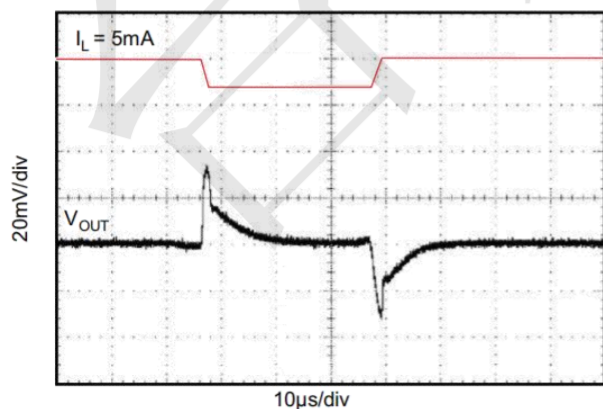


Figure 17. 0 to 5-mA Load Transient ( $C_L = 0$ )

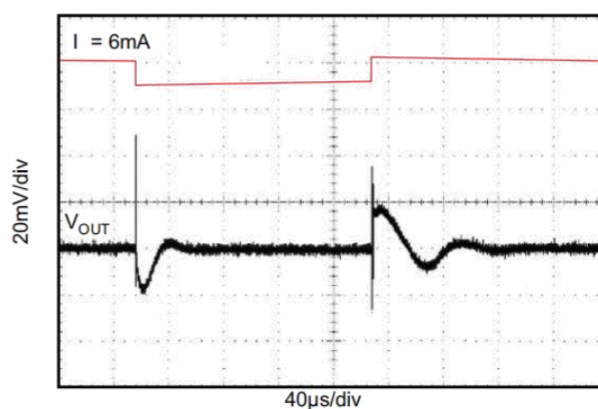
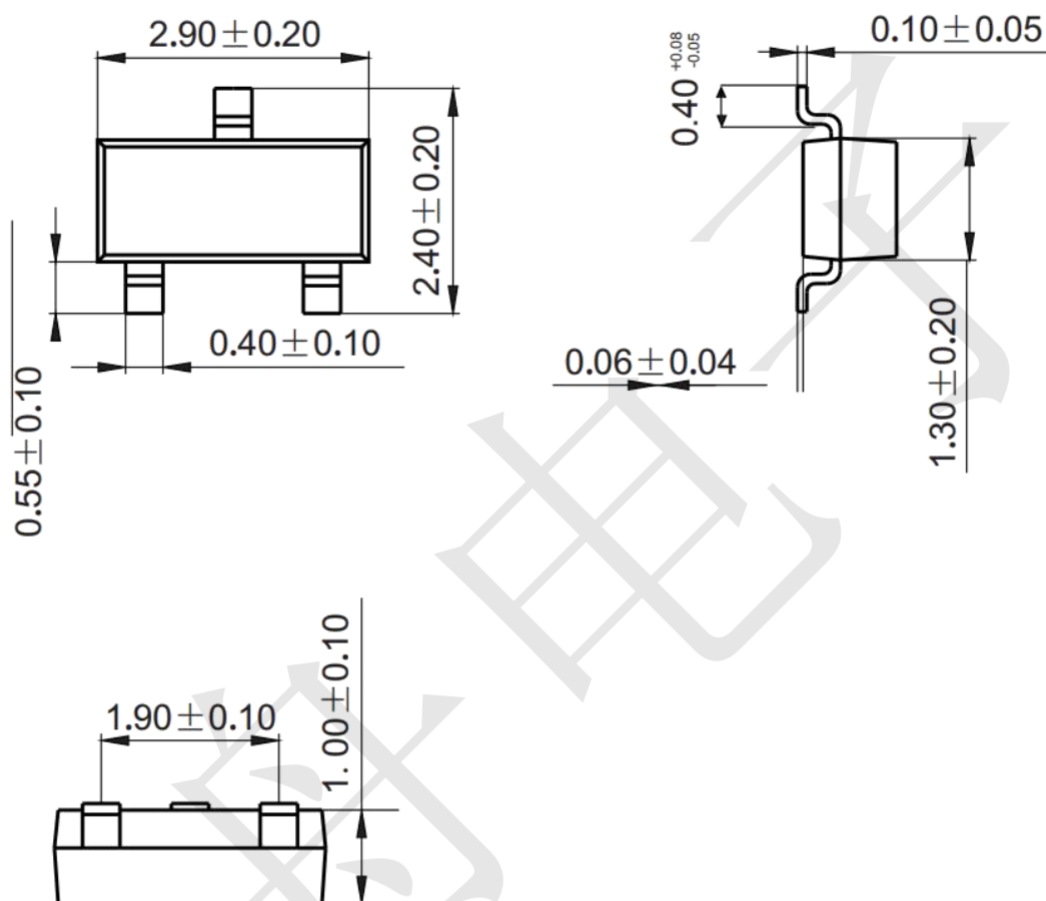


Figure 18. 1 to 6-mA Load Transient ( $C_L = 1 \mu F$ )

## Package Outline Dimensions (unit: mm)

### SOT-23



## Mounting Pad Layout (unit: mm)

