TL430
ADJUSTABLE SHUNT REGULATORS
SLVS050D – JUNE 1976 – REVISED JANUARY 2005

- Temperature Compensated
- Programmable Output Voltage
- Low Output Resistance
- Low Output Noise
- Sink Capability up to 100 mA

description/ordering information

The TL430 is a 3-terminal adjustable shunt regulator, featuring excellent temperature stability, wide operating current range, and low output noise. The output voltage can be set by two external resistors to any desired value between 3 V and 30 V. The TL430 can replace Zener diodes in many applications, providing improved performance.

The TL430C is characterized for operation from 0°C to 70°C.

ORDERING INFORMATION

<table>
<thead>
<tr>
<th>T_A</th>
<th>PACKAGE†</th>
<th>ORDERABLE PART NUMBER</th>
<th>TOP-SIDE MARKING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C to 70°C</td>
<td>TO-226 / TO-92 (LP)</td>
<td>Bulk of 1000 TL430CLP</td>
<td>TL430C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reel of 2000 TL430CLPR</td>
<td></td>
</tr>
</tbody>
</table>

†Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.

symbol

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**TL430**

**ADJUSTABLE SHUNT REGULATORS**

SLVS050D – JUNE 1976 – REVISED JANUARY 2005

**Absolute Maximum Ratings**

Over operating free-air temperature range (unless otherwise noted) †

- **Regulator voltage**: 30 V
- **Continuous regulator current**: 150 mA
- **Package thermal impedance, \( \theta_{JA} \)** (see Notes 2 and 3): 140°C/W
- **Operating virtual junction temperature, \( T_J \)**: 150°C
- **Lead temperature 1.6 mm (1/16 inch) from case for 10 seconds**: 260°C
- **Storage temperature range, \( T_{stg} \)**: −65°C to 150°C

† Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

**Notes:**

1. All voltage values are with respect to the anode terminal.
2. Maximum power dissipation is a function of \( T_J(\text{max}) \), \( \theta_{JA} \), and \( T_A \). The maximum allowable power dissipation at any allowable ambient temperature is \( P_D = (T_J(\text{max}) − T_A)/\theta_{JA} \). Operating at the absolute maximum \( T_J \) of 150°C can impact reliability.
3. The package thermal impedance is calculated in accordance with JESD 51-7.

**Recommended Operating Conditions**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MIN</th>
<th>MAX</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_Z )</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulator voltage</td>
<td>( V_{\text{ref}} )</td>
<td>30</td>
<td>V</td>
</tr>
<tr>
<td>( I_Z )</td>
<td>2</td>
<td>100</td>
<td>mA</td>
</tr>
<tr>
<td>( T_A )</td>
<td>TL430C</td>
<td>0</td>
<td>70</td>
</tr>
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</table>

**Electrical Characteristics**

Over recommended operating conditions, \( T_A = 25°C \) (unless otherwise noted)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Figure</th>
<th>Test Conditions</th>
<th>TL430C</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_I(\text{ref}) )</td>
<td>1</td>
<td>( V_Z = V_I(\text{ref}), I_Z = 10 \text{ mA} )</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>( \alpha_V(\text{ref}) )</td>
<td>1</td>
<td>( V_Z = V_I(\text{ref}), T_A = 0°C \text{ to } 70°C, I_Z = 10 \text{ mA} )</td>
<td>120</td>
<td>ppm/°C</td>
</tr>
<tr>
<td>( I_{I(\text{ref})} )</td>
<td>2</td>
<td>( I_Z = 10 \text{ mA}, R_1 = 10 \text{ kΩ}, R_2 = \infty )</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>( I_{ZK} )</td>
<td>1</td>
<td>( V_Z = V_I(\text{ref}) )</td>
<td>0.5</td>
<td>2</td>
</tr>
<tr>
<td>( I_{ZK} )</td>
<td>1</td>
<td>( V_Z = V_I(\text{ref}) )</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>( r_z )</td>
<td>1</td>
<td>( V_Z = V_I(\text{ref}) ), ( \Delta I_Z = (52 - 2) \text{ mA} )</td>
<td>1.5</td>
<td>3</td>
</tr>
<tr>
<td>( V_n )</td>
<td>2</td>
<td>( f = 0.1 \text{ Hz to } 10 \text{ Hz} )</td>
<td>50, 120, 650</td>
<td>μV</td>
</tr>
</tbody>
</table>

**Notes:**

4. The average power dissipation, \( V_Z \cdot I_Z \) duty cycle, must not exceed the maximum continuous rating in any 10-ms interval.
5. The regulator resistance for \( V_Z > V_I(\text{ref}) \), \( r_z \), is given by:

\[
 r_z' = r_z \left( 1 + \frac{R_1}{R_2} \right)
\]
PARAMETER MEASUREMENT INFORMATION

Figure 1. Test Circuit for $V_Z = V_{I(\text{ref})}$

$V_Z = V_{I(\text{ref})} \left( 1 + \frac{R_1}{R_2} \right) + I_{I(\text{ref})} \times R_1$

Figure 2. Test Circuit for $V_Z > V_{I(\text{ref})}$
TYPICAL CHARACTERISTICS

SMALL-SIGNAL REGULATOR IMPEDANCE

\[ Z_Z = V_I(\text{ref}) \]

\[ T_A = 25^\circ C \]

![Small-Signal Regulator Impedance](image)

CATHODE CURRENT

\[ I = V_I(\text{ref}) \]

\[ T_A = 25^\circ C \]

![Cathode Current](image)

APPLICATION INFORMATION

\[ V_O = \left( 1 + \frac{R1}{R2} \right) V_I(\text{ref}) \]

Figure 3

![Small-Signal Regulator Impedance](image)

Figure 4

![Cathode Current](image)

Figure 5. Shunt Regulator

\[ V_O = \left( 1 + \frac{R1}{R2} \right) V_I(\text{ref}) \]

Figure 6. Series Regulator

\[ V_O = 30 \Omega \]

\[ 4.7 \, k\Omega \]

\[ R2 \]

\[ R1 \]
APPLICATION INFORMATION

Figure 7. Current Limiter

\[ I_O = \frac{V_{I\text{(ref)}}}{R_{CL}} \]

Figure 8. Output Control of a 3-Terminal Fixed Regulator

\[ V_O = \left( 1 + \frac{R_1}{R_2} \right) V_{I\text{(ref)}} \]

\[ \text{Min } V_O = V_{I\text{(ref)}} + 5\text{V} \]

Figure 9. Higher-Current Applications

\[ V_O = \left( 1 + \frac{R_1}{R_2} \right) V_{I\text{(ref)}} \]

Figure 10. Crowbar

\[ V_{\text{limit}} = \left( 1 + \frac{R_1}{R_2} \right) \left( V_{I\text{(ref)}} + V_{BE(Q1)} \right) \]

Figure 11. \( V_{CC} \) Monitor

\[ \text{Low limit} = V_{I\text{(ref)}} \left( 1 + \frac{R_{1B}}{R_{2B}} \right) + V_D \]

\[ \text{High limit} = V_{I\text{(ref)}} \left( 1 + \frac{R_{1A}}{R_{2A}} \right) \]
### PACKAGING INFORMATION

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Status (1)</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>Package Qty</th>
<th>Eco Plan (2)</th>
<th>Lead/Ball Finish</th>
<th>MSL Peak Temp (3)</th>
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<td>TO-92</td>
<td>LP</td>
<td>3</td>
<td>1000</td>
<td>Pb-Free (RoHS)</td>
<td>CU SN</td>
<td>N/A for Pkg Type</td>
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<td>3</td>
<td>1000</td>
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<td>CU SN</td>
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<td>TL430CLPRE3</td>
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<td>TO-92</td>
<td>LP</td>
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<td>TL430ILP</td>
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<td>TO-92</td>
<td>LP</td>
<td>3</td>
<td>TBD</td>
<td>Call TI</td>
<td>Call TI</td>
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</tr>
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(1) The marketing status values are defined as follows:
- **ACTIVE:** Product device recommended for new designs.
- **LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.
- **NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.
- **PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.
- **OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check [http://www.ti.com/productcontent](http://www.ti.com/productcontent) for the latest availability information and additional product content details.
- **TBD:** The Pb-Free/Green conversion plan has not been defined.
- **Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
- **Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
- **Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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D. Falls within JEDEC TO-226 Variation AA (TO-226 replaces TO-92) 
E. Shipping Method:  
  Straight lead option available in bulk pack only.  
  Formed lead option available in tape & reel or ammo pack.
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