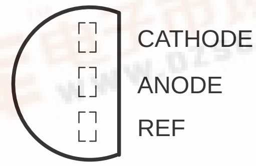
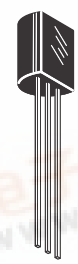
ADJUSTABLE SHUNT REGULATORS

SLVS050B – JUNE 1976 – REVISED JULY 1999

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

LP PACKAGE
(TOP VIEW)



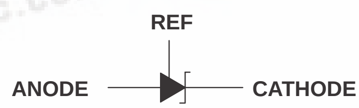


description

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.

symbol



AVAILABLE OPTIONS

T_A	PACKAGED DEVICES PLASTIC (LP)	CHIP FORM (Y)
0°C to 70°C	TL430CLP	TL430Y

The LP package is available taped and reeled. Add R suffix to device type (e.g., TL430CLPR). Chip forms are tested at 25°C.

Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)†

Regulator voltage (see Note 1) . . . . 30 V
Continuous regulator current . . . . 150 mA
Package thermal impedance, θ_{JA} (see Notes 2 and 3): . . . . 156°C/W
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(max), θ_{JA}, and T_A. The maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_J(max) – T_A)/\theta_{JA}$. 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, except for through-hole packages, which use a trace length of zero.

recommended operating conditions

		MIN	MAX	UNIT
Regulator voltage, V_Z		V_{ref}	30	V
Regulator current, I_Z		2	100	mA
Operating free-air temperature range, T_A	TL430C	0	70	°C

electrical characteristics over recommended operating conditions, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST FIGURE	TEST CONDITIONS		TL430C MIN	TL430C TYP	TL430C MAX	UNIT
$V_{I(ref)}$	Reference input voltage	1	$V_Z = V_{I(ref)}$,	I_Z = 10 mA	2.5	2.75	3	V
$\alpha V_{I(ref)}$	Temperature coefficient of reference input voltage	1	$V_Z = V_{I(ref)}$, T_A = 0°C to 70°C	I_Z = 10 mA,		120		ppm/°C
$I_{I(ref)}$	Reference input current	2	I_Z = 10 mA, R2 = ∞	R1 = 10 kΩ,		3	10	µA
I_{ZK}	Regulator current near lower knee of regulation range	1	$V_Z = V_{I(ref)}$			0.5	2	mA
I_{ZK}	Regulator current at maximum limit of regulation range	1	$V_Z = V_{I(ref)}$		50			mA
		2	V_Z = 5 V to 30 V,	See Note 4	100			
r_z	Differential regulator resistance (see Note 5)	1	$V_Z = V_{I(ref)}$, ΔI_Z = (52 – 2) mA			1.5	3	W
V_n	Noise voltage	2	f = 0.1 Hz to 10 Hz	V_Z = 3 V		50		µV
				V_Z = 12 V		200		
				V_Z = 30 V		650		

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

$$r_z' = r_z \left(1 + \frac{R1}{R2}\right)$$

electrical characteristics over recommended operating conditions, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST FIGURE	TEST CONDITIONS		TL430Y MIN	TL430Y TYP	TL430Y MAX	UNIT
$V_{I(ref)}$	Reference input voltage	1	$V_Z = V_{I(ref)}$,	I_Z = 10 mA	2.5	2.75	3	V
$I_{I(ref)}$	Reference input current	2	I_Z = 10 mA, R2 = ∞	R1 = 10 kΩ,		3	10	μA
I_{ZK}	Regulator current near lower knee of regulation range	1	$V_Z = V_{I(ref)}$			0.5	2	mA
I_{ZK}	Regulator current at maximum limit of regulation range	1	$V_Z = V_{I(ref)}$		50			mA
		2	V_Z = 5 V to 30 V,	See Note 4	100			
r_z	Differential regulator resistance (see Note 5)	1	$V_Z = V_{I(ref)}$, . . . ΔI_Z = (52 – 2) mA			1.5	3	W
V_n	Noise voltage	2	f = 0.1 Hz to 10 Hz	V_Z = 3 V		50		μV
				V_Z = 12 V		200		
				V_Z = 30 V		650		

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

$$r_z' = r_z \left(1 + \frac{R1}{R2}\right)$$

PARAMETER MEASUREMENT INFORMATION

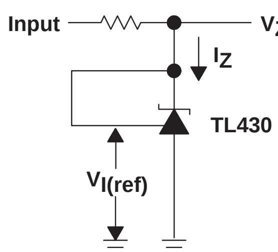
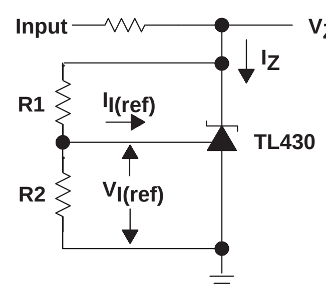


Figure 1. Test Circuit for $V_Z = V_{I(ref)}$



$$V_Z = V_{I(ref)} \left(1 + \frac{R1}{R2}\right) + I_{I(ref)} \times R1$$

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

TYPICAL CHARACTERISTICS

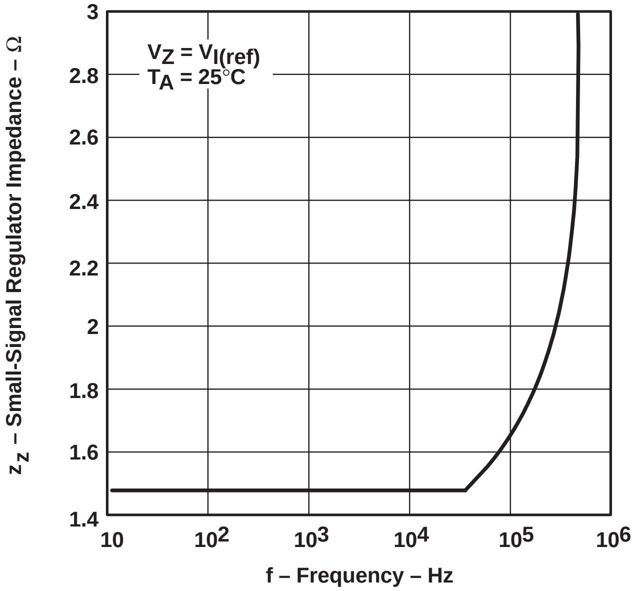


Figure 3

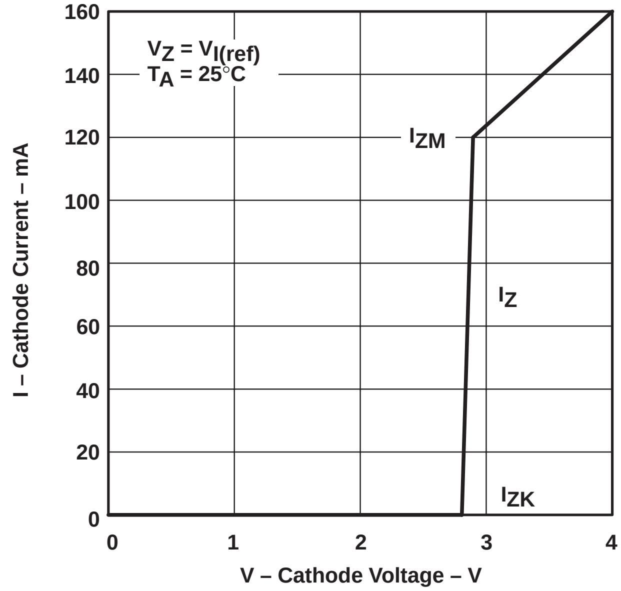
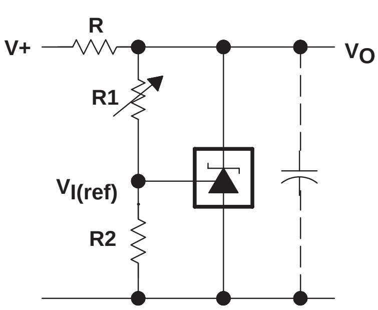


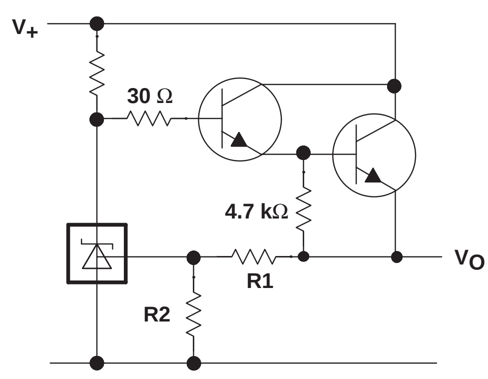
Figure 4

APPLICATION INFORMATION



$$V_O \approx \left(1 + \frac{R1}{R2}\right) V_{I(ref)}$$

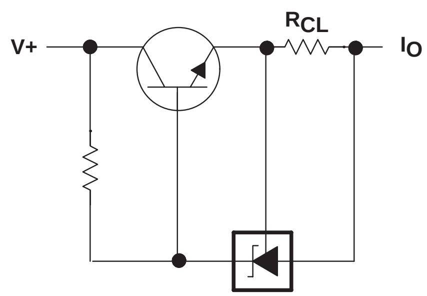
Figure 5. Shunt Regulator



$$V_O \approx \left(1 + \frac{R1}{R2}\right) V_{I(ref)}$$

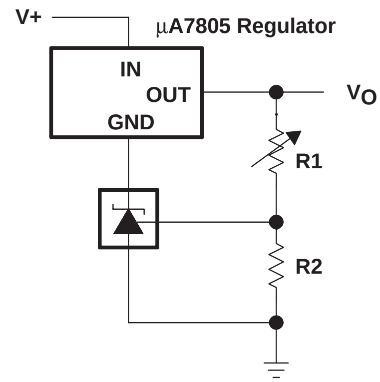
Figure 6. Series Regulator

APPLICATION INFORMATION



$$I_O \approx \frac{V_{I(ref)}}{R_{CL}}$$

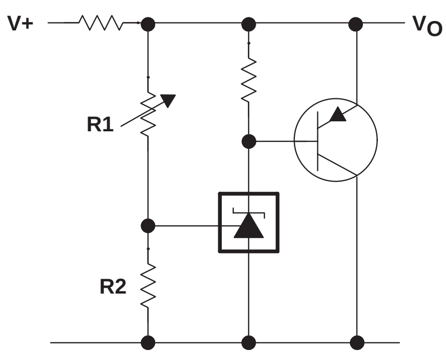
Figure 7. Current Limiter



$$V_O = \left(1 + \frac{R1}{R2}\right) V_{I(ref)}$$

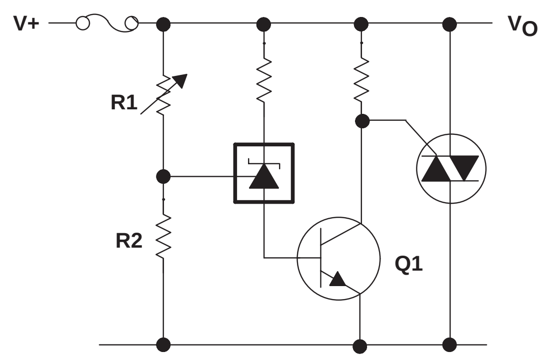
$$\text{Min } V_O = V_{I(ref)} + 5\,V$$

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



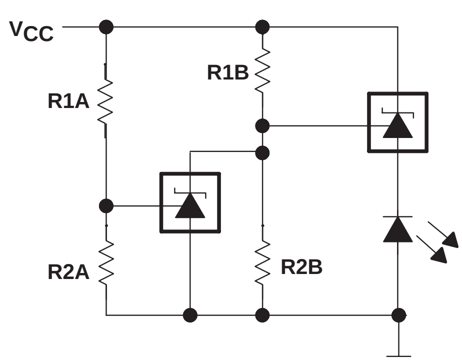
$$V_O \approx \left(1 + \frac{R1}{R2}\right) V_{I(ref)}$$

Figure 9. Higher-Current Applications



$$V_{limit} \approx \left(1 + \frac{R1}{R2}\right)\left(V_{I(ref)} + V_{BE(Q1)}\right)$$

Figure 10. Crowbar



$$\text{Low limit} \approx V_{I(ref)}\left(1 + \frac{R1B}{R2B}\right) + V_D$$

$$\text{High limit} \approx V_{I(ref)}\left(1 + \frac{R1A}{R2A}\right)$$

Figure 11. V_{CC} Monitor

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