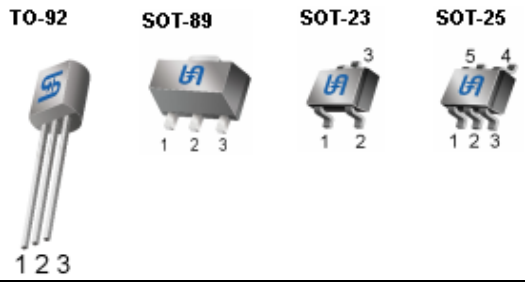
TS432/432A/432B

Adjustable Precision Shunt Regulator



Sink Current Capability up to 100mA

General Description

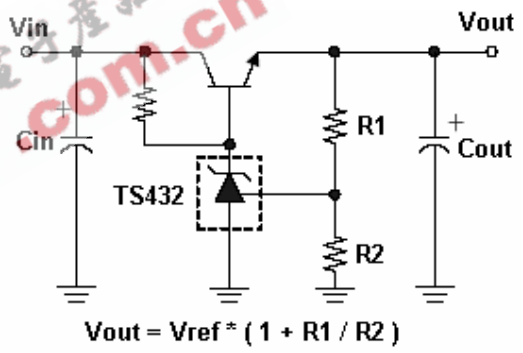
The TS432/432A/432B is a three-terminal adjustable shunt regulator with specified thermal stability. The output voltage may be set to any value between Vref (approximately 1.24V) and 18V with two external resistors. The TS432/432A/432B has a typical output impedance of 0.2Ω. Active output circuitry provides a very sharp turn-on characteristic, making the TS432/432A/432B excellent replacement for zener diode in many applications.

This series is offered in 3-pin TO-92, SOT-89, SOT-23 and 5-pin SOT-25 package.

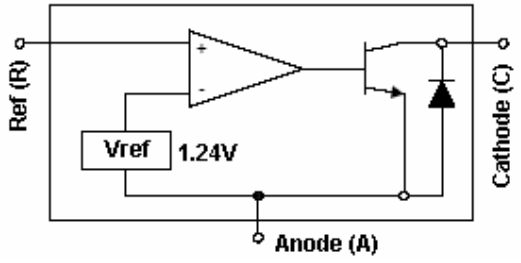
Features

- ✧ Precision Reference Voltage
  - TS432 1.24V±2%
  - TS432A 1.24V±1%
  - TS432B 1.24V±0.5%
- ✧ Minimum Cathode Current for regulation: 150uA(typ)
- ✧ Equivalent Full Range Temp. Coefficient: 50ppm/°C
- ✧ Programmable Output Voltage up to 18V
- ✧ Fast Turn-On Response
- ✧ Sink Current Capability of 1.0 to 100 mA
- ✧ Low Dynamic Output Impedance: 0.2Ω
- ✧ Low Output Noise

Standard Application



Block Diagram



Ordering Information

Part No.	Operating Temp. (Ambient)	Package
TS432xCT	-20 ~ +85 °C	TO-92
TS432xCY		SOT-89
TS432xCX		SOT-23
TS432xCX5		SOT-25

Note: Where **x** denotes voltage tolerance.
Blank: ±2%
A: ±1%
B: ±0.5%

Pin Assignment

Pin No.				Pin Description
TS432/A/BCT	TS432/A/BCY	TS432/A/BCX	TS432/A/BCX5	
1	1	1	4	Reference
2	2	3	5	Anode
3	3	2	3	Cathode
			1, 2	Non connect

Absolute Maximum Rating

Cathode Voltage (Note 1)	Vka	20	V
Continuous Cathode Current Range	Ik	-10 ~ 200	mA
Reference Input Current Range	Iref	10	mA
Power Dissipation (Note 2, 3) TO-92 TO-89 SOT-23 / SOT-25	Pd	0.625 0.5 0.3	W
Operating Junction Temperature Range	Tj	0 ~ +125	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	°C

Note 1: Voltage values are with respect to the anode terminal unless otherwise noted.
Note 2: Tj Max = 150 °C
Note 3: Rating apply to ambient temperature at 25 °C

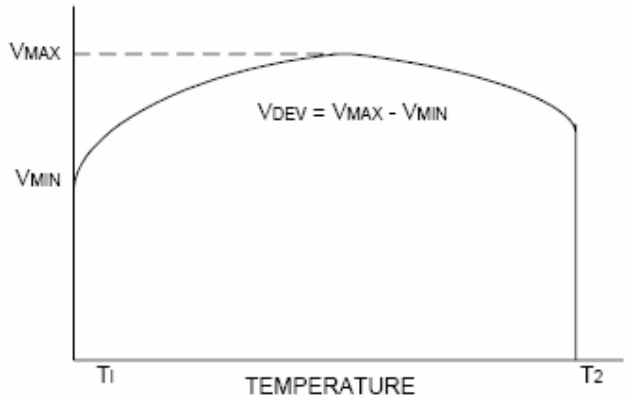
Recommend Operating Condition

Cathode Voltage Range	Vka	Ref ~ 18	V
Cathode Current Range (for regulation)	Ik	1 ~ 100	mA

Electrical Characteristics

(Ta=25 °C, unless otherwise specified.)

Parameter		Symbo	Test Conditions		Min	Typ	Max	Unit
Reference voltage	TS432	Vref	Vka =Vref, Ik=10mA (Figure 1)		1.215	1.240	1.264	V
	TS432A				1.227		1.252	
	TS432B				1.233		1.246	
Deviation of reference input voltage, over temp. (Note 4)		Vref	Ta = full range Vka =Vref, Ik=10mA (Figure 1)		--	5	20	mV
Reference Input current		Iref	R1=10KΩ, R2=∞ , Ika=10mA (Figure 2)		--	0.15	4.0	uA
Radio of change in Vref to change in cathode Voltage		ΔVref / ΔVka	Ika=10mA, Vka = 18V to Vref (Figure 2)		--	-1.0	-2.7	mV/V
Deviation of reference input current, over temp.		Iref(DEV)	Ta= full range R1=10KΩ, R2=∞ , Ika=10mA (Figure 2)		--	0.1	4.0	uA
Minimum operating cathode current		Ika(min)	Vka=Vref (Figure 1)		--	60	200	uA
Off-state Cathode Current		Ioff	Vref=0V (Figure 3)	Vka=18V	--	0.5	2.0	uA
Dynamic Output Impedance		|Zka|	f<1KHz, Vka=Vref Ika=100uA to 15mA (Figure 1)		--	0.2	0.5	Ω



Note 4. Deviation of reference input voltage, VDEV, is defined as the maximum deviation of the reference over the full temperature range.

The average temperature coefficient of the reference input voltage αVref is defined as:

$$| \alpha Vref | = [V_{DEV} / Vref(25)] * 10^6 / T2 - T1 \quad \text{(PPM/ °C)}$$

Where: **T2-T1** = full temperature change.

αVref can be positive or negative depending on whether the slope is positive or negative.

Note 5. The dynamic output impedance, Rz, is defined as:

$$| Zka | = \Delta Vka / \Delta Ika$$

When the device is programmed with two external resistors R1and R2 (see Figure 2). The dynamic output impedance of the overall circuit, is defined as :

$$| Zka | = \Delta v / \Delta i | \approx Zka | * (1 + R1 / R2)$$

Test Circuits

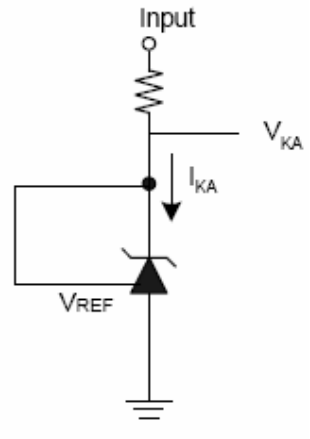
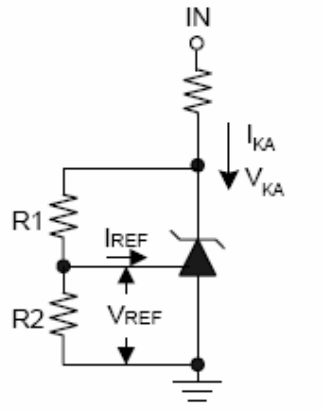


Figure 1. Vka = Vref



Vka Vref(1+R1/R2)+Iref * R1

Figure 2. Vka > Vref

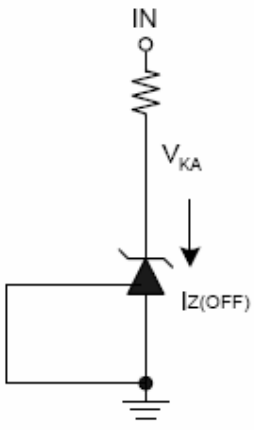
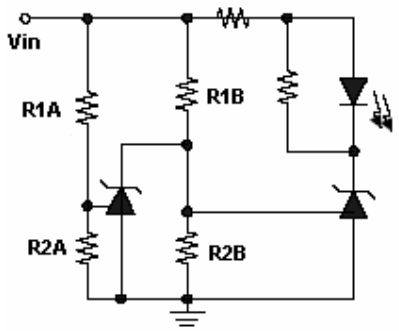


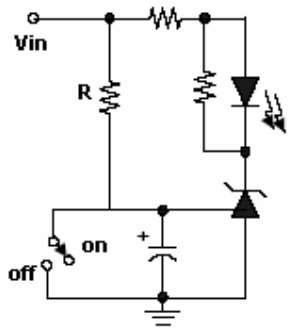
Figure 3. Off-state Current

Application Examples



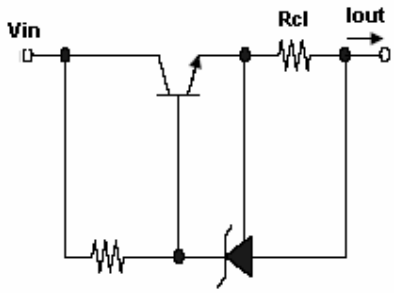
LED on when low limit<Vin<high limit
low limit= Vref (1 + R1B / R2B)
high limit= Vref (1 + R1A / R2A)

Figure 4. Voltage Monitor



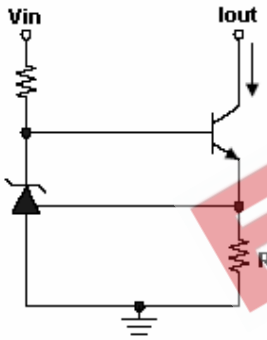
Delay= RC * ln (Vin / Vin - Vref)

Figure 5. Delay Timer



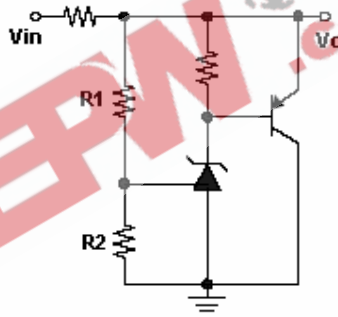
Iout= Vref / Rcl

Figure 6. Current limiter or Current Source



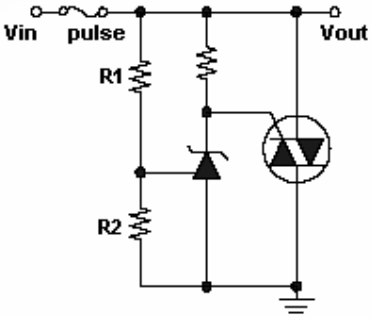
Iout= Vref / Rs

Figure 7. Constant Current Sink



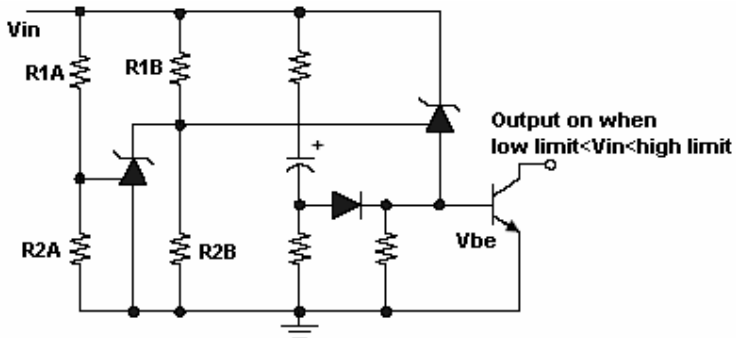
Vout= Vref * (1 + R1 / R2)

Figure 8. Higher Current Shunt



Limit= Vref * (1 + R1 / R2)

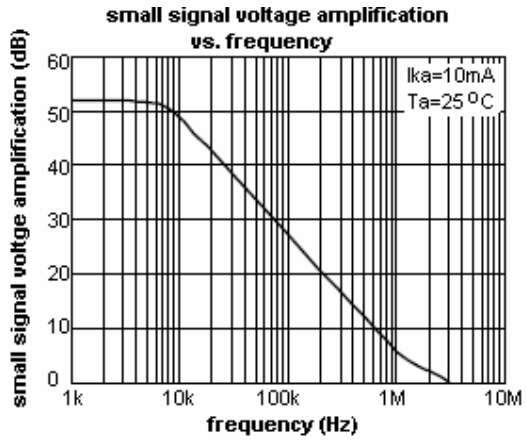
Figure 9. Crow Bar

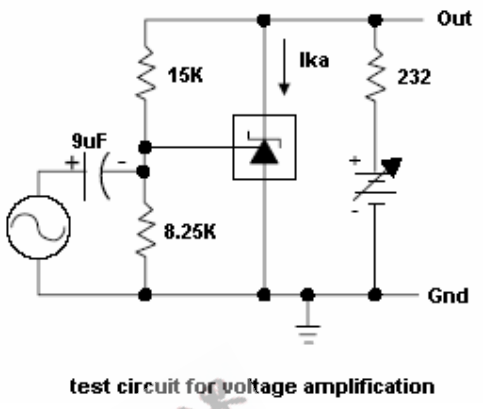


low limit= Vref (1 + R1B / R2B) +Vbe
high limit= Vref (1 + R1A / R2A)

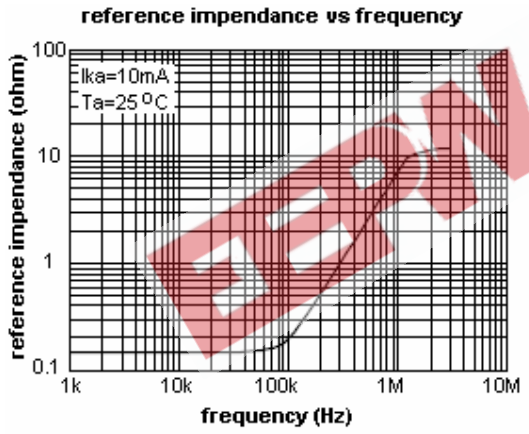
Figure 10. Under voltage protection & Over voltage circuit

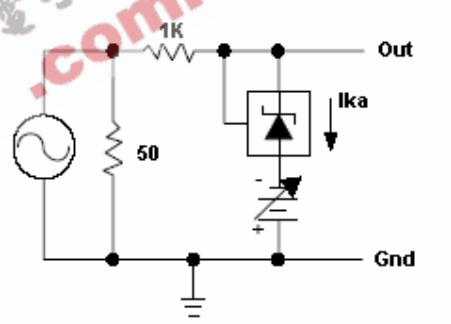
Typical Performance Characteristics



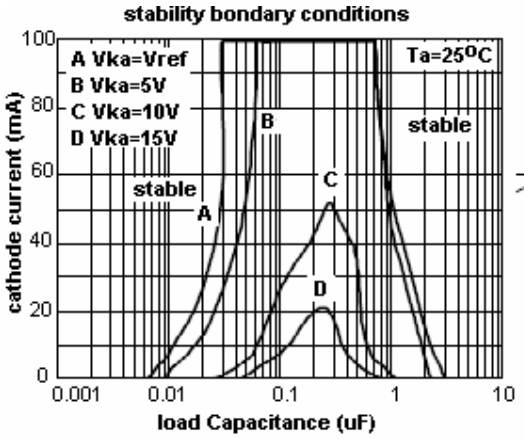


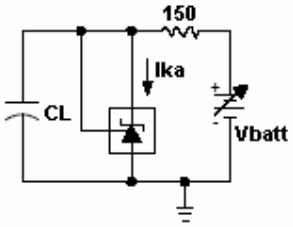
test circuit for voltage amplification



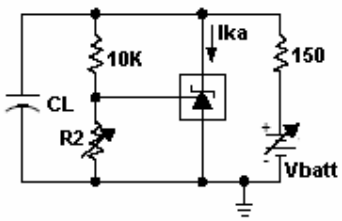


test circuit for reference impendance





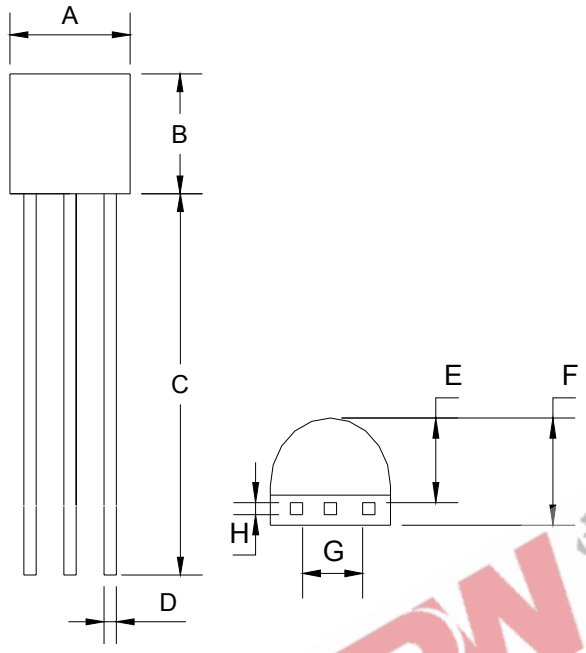
test circuit for curve A



test circuit for curve B, C, D

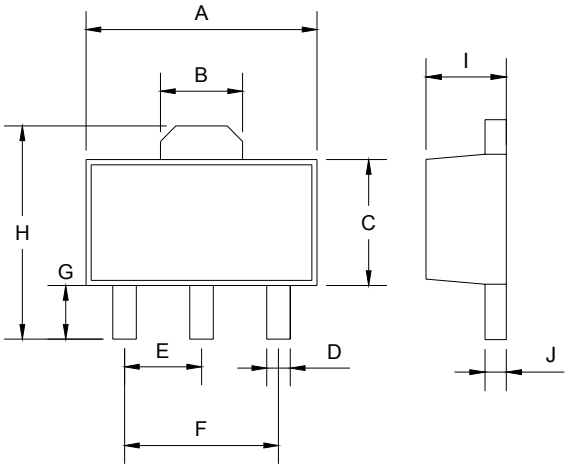
the area under the curves represent conditions that may cause the device to oscillate. for curves B, C and D, R2 and V+ were adjusted to establish the initial Vka and Ika conditions with CL=0. Vbatt and CL were then adjusted to determine the ranges of stability.

TO-92 Mechanical Drawing



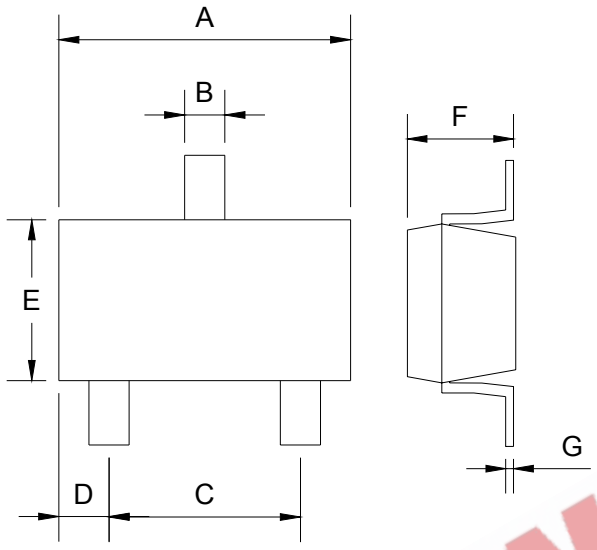
TO-92 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.30	4.70	0.169	0.185
B	4.30	4.70	0.169	0.185
C	14.30(typ)		0.563(typ)	
D	0.43	0.49	0.017	0.019
E	2.19	2.81	0.086	0.111
F	3.30	3.70	0.130	0.146
G	2.42	2.66	0.095	0.105
H	0.37	0.43	0.015	0.017

SOT-89 Mechanical Drawing



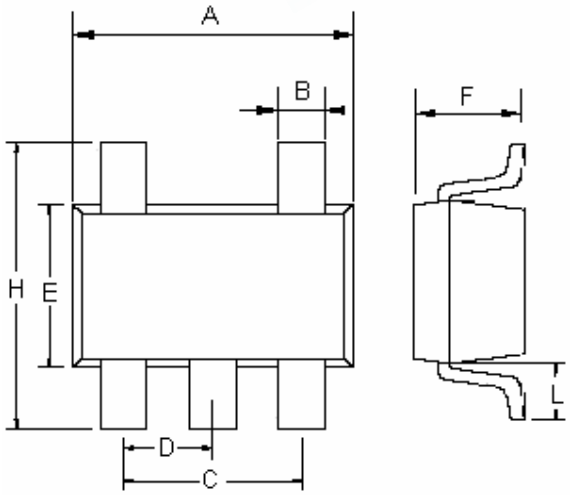
SOT-89 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	4.40	4.60	0.173	0.181
B	1.50	1.7	0.059	0.070
C	2.30	2.60	0.090	0.102
D	0.40	0.52	0.016	0.020
E	1.50	1.50	0.059	0.059
F	3.00	3.00	0.118	0.118
G	0.89	1.20	0.035	0.047
H	4.05	4.25	0.159	0.167
I	1.4	1.6	0.055	0.068
J	0.35	0.44	0.014	0.017

SOT-23 Mechanical Drawing



SOT-23 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.88	2.91	0.113	0.115
B	0.39	0.42	0.015	0.017
C	1.78	2.03	0.070	0.080
D	0.51	0.61	0.020	0.024
E	1.59	1.66	0.063	0.065
F	1.04	1.08	0.041	0.043
G	0.07	0.09	0.003	0.004

SOT-25 Mechanical Drawing



SOT-23 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	2.70	3.00	0.106	0.118
B	0.25	0.50	0.010	0.020
C	1.90(typ)		0.075(typ)	
D	0.95(typ)		0.037(typ)	
E	1.50	1.70	0.059	0.067
F	1.05	1.35	0.041	0.053
H	2.60	3.00	0.102	0.118
L	0.60(typ)		0.024(typ)	