ADJUSTABLE PRECISION ZENER SHUNT REGULATOR

ISSUE 2 – FEBRUARY 1997

ZHT431

DEVICE DESCRIPTION

The ZHT431 is a three terminal adjustable shunt regulator offering excellent temperature stability and output current handling capability up to 100mA. The device offers extended operating temperature range working from -55 to +125°C. The output voltage may be set to any chosen voltage between 2.5 and 20 volts by selection of two external divider resistors.

The devices can be used as a replacement for zener diodes in many applications requiring an improvement in zener performance.

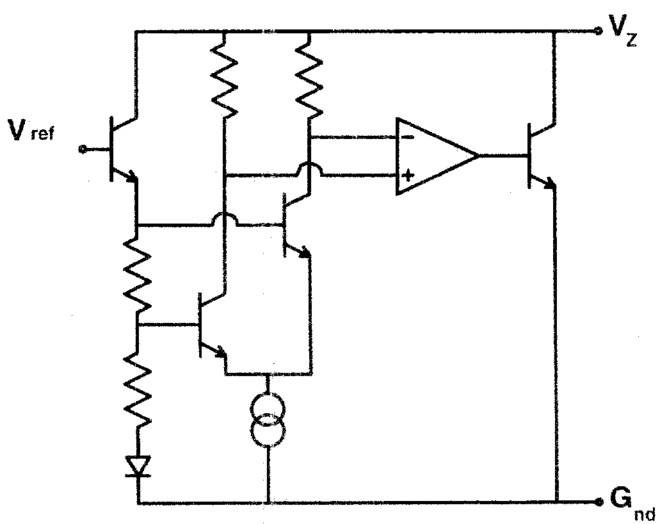
FEATURES

- Surface mount SO8, SOT89, SOT223 and SOT23 packages
- TO92 package
- 2% and 1% tolerance
- Maximum temperature coefficient 67 ppm/°C
- Temperature compensated for operation over the full temperature range
- Programmable output voltage
- 50µA to 100mA current sink capability
- Low output noise
- Wide temperature range -55 to +125°C

APPLICATIONS

- Series and Shunt regulator
- Voltage monitor
- Over voltage/ under voltage protection
- Switch mode power supplies

SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATING

Cathode Voltage (V_Z)	20V
Cathode Current	150mA
Operating Temperature	-55 to 125°C
Storage Temperature	-55 to 150°C

Recommended Operating Conditions

	Min	Max
Cathode Voltage	Vref	20V
Cathode Current	50μA	100mA

Power Dissipation (T_{amb}=25°C)

(T_{jmax} = 150°C)

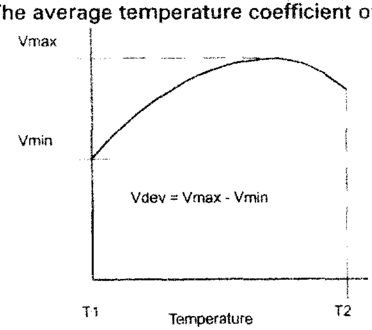
SOT23	330mW
TO92	780mW
SOT223	2W
SO8	780mW
SOT89	1.5W

ELECTRICAL CHARACTERISTICS TEST CONDITIONS (Unless otherwise stated):T_{amb}=25°C

PARAMETER	SYMBOL	VALUE			UNITS	CONDITIONS
		MIN	TYP	MAX		
Reference Voltage 2%	V_{ref}	2.45	2.50	2.55	V	I_L=10mA (Fig1), V_Z=V_{ref}
1%		2.475	2.50	2.525		
Deviation of Reference Input Voltage over Temperature	V_{dev}		10	30	mV	I_L=10mA, V_Z=V_{ref} T_a=full range (Fig1)
Ratio of the change in Reference Voltage to the Change in Cathode Voltage	$\frac{\Delta V_{ref}}{\Delta V_Z}$		-1.85	-2.7	mV/V	V_Z from V_{ref} to 10V I_Z=10mA (Fig2)
			-1.0	-2.0	mV/V	V_Z from 10V to 20V I_Z=10mA (Fig2)
Reference Input Current	I_{ref}		0.12	1.0	μA	R1=10k, R2=O/C, I_L=10mA (Fig2)
Deviation of Reference Input Current over Temperature	ΔI_{ref}		0.04	0.2	μA	R1=10k, R2=O/C, I_L=10mA T_a=full range (Fig2)
Minimum Cathode Current for Regulation	I_{Zmin}		35	50	μA	V_Z=V_{ref} (Fig1)
Off-state Current	I_{Zoff}			0.1	μA	V_Z=20V, V_{ref}=0V(Fig3) †
Dynamic Output Impedance	R_Z			0.75	Ω	V_Z=V_{ref} (Fig1), f=0Hz, I_C=1mA to 100mA

Deviation of reference input voltage, V_{dev}, is defined as the maximum variation of the reference input voltage over the full temperature range.

The average temperature coefficient of the reference input voltage, V_{ref} is defined as:



$$V_{ref}(ppm/^{\circ}C) = \frac{V_{dev} \times 1000000}{V_{ref}(T1-T2)}$$

The dynamic output impedance, Rz, is defined as:

$$R_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

When the device is programmed with two external resistors, R1 and R2, (fig 2) , the dynamic output impedance of the overall circuit, R', is defined as:

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

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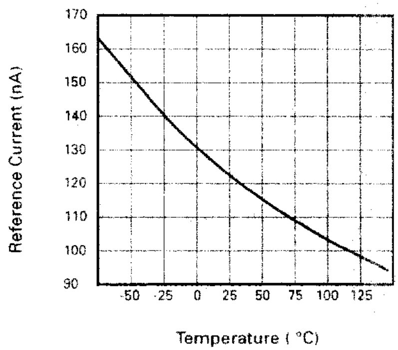
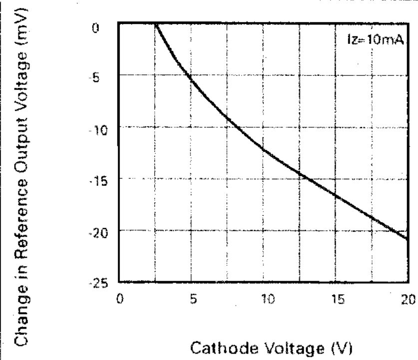
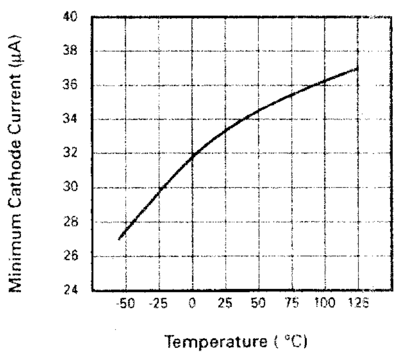
TYPICAL CHARACTERISTICS



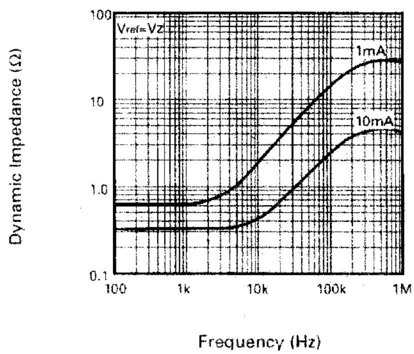
Iref vs. Temperature



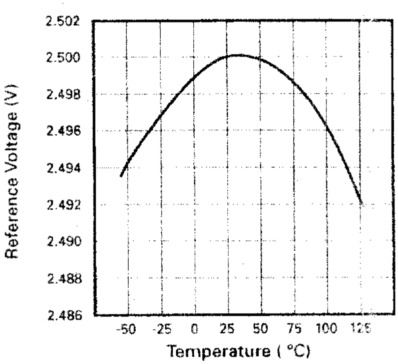
Change in Vref v Cathode Voltage



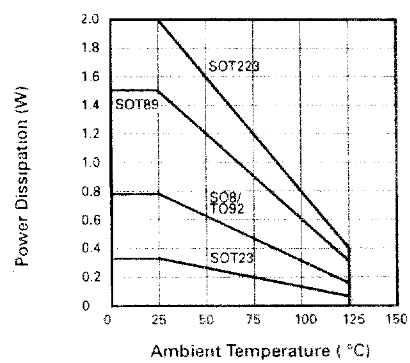
Izmin vs. Temperature



Dynamic Impedance v Frequency

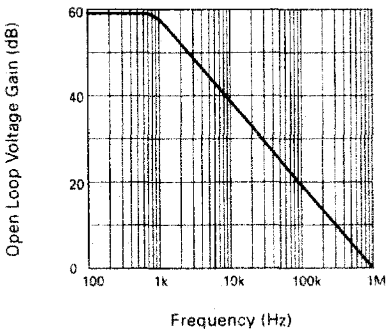


Vref vs. Temperature

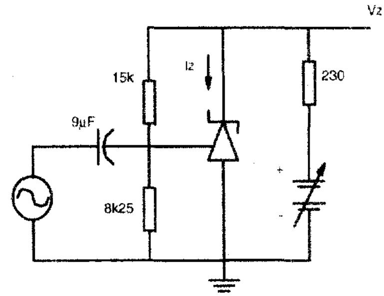


Power Dissipation Derating

TYPICAL CHARACTERISTICS

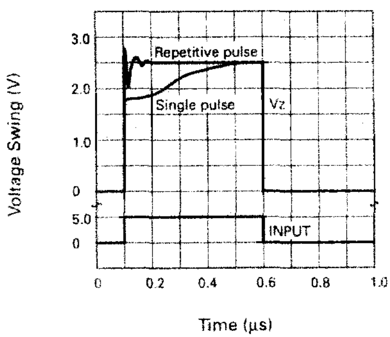


Gain v Frequency

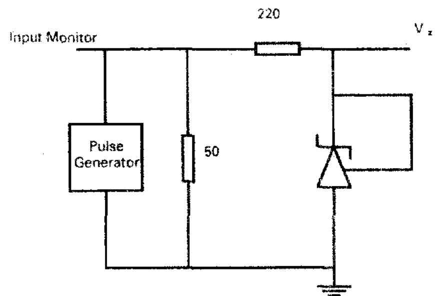


Iz = 10mA, TA = 25°C

Test Circuit for Open Loop Voltage Gain

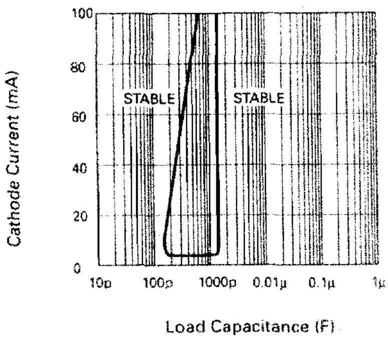


Pulse Response

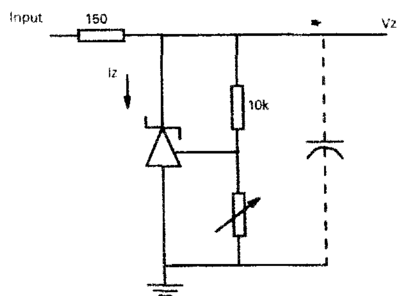


TA = 25°C

Test Circuit for Pulse Response



Stability Boundary Conditions



Vref < Vz < 20, Iz = 10mA, TA = 25°C

Test Circuit for Stability Boundary Conditions

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DC TEST CIRCUITS

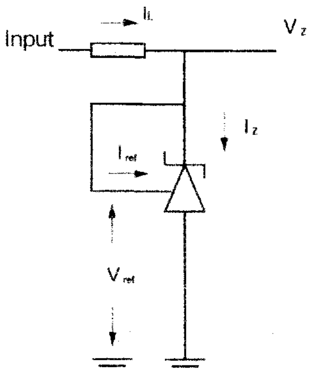


Fig 1 – Test Circuit for V_z=V_{ref}

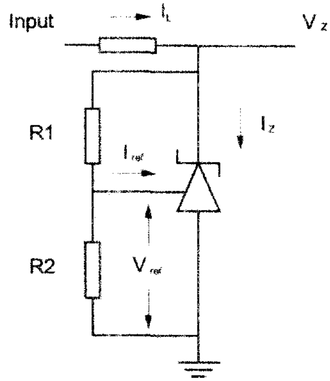


Fig 2 – Test Circuit for V_z>V_{ref}

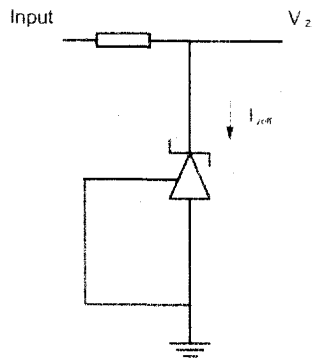
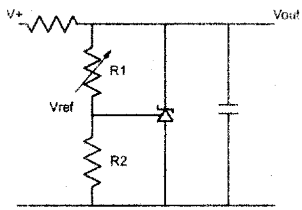


Fig 3 – Test Circuit for Off State current †

NOTE

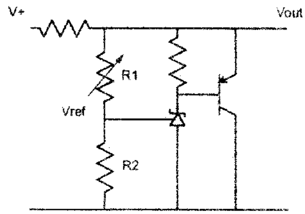
† Since the "Off State" disables all internal circuitry including leakage control, operating in this mode at high temperature is not recommended.

APPLICATION CIRCUITS



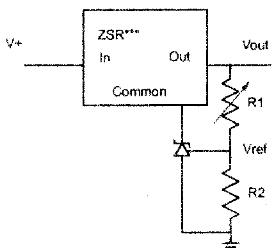
$$Vout = \left(1 + \frac{R1}{R2}\right) Vref$$

SHUNT REGULATOR



$$Vout = \left(1 + \frac{R1}{R2}\right) Vref$$

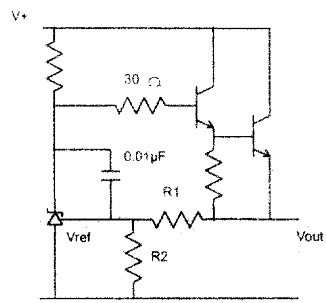
HIGHER CURRENT SHUNT REGULATOR



$$Vout_{MIN} = Vref + Vreg$$

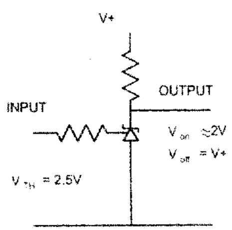
$$Vout = \left(1 + \frac{R1}{R2}\right) Vref$$

OUTPUT CONTROL OF A
THREE TERMINAL FIXED REGULATOR

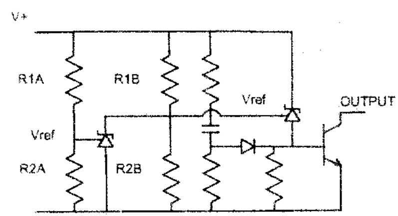


$$Vout = \left(1 + \frac{R1}{R2}\right) Vref$$

SERIES REGULATOR



SINGLE SUPPLY COMPARATOR
WITH TEMPERATURE
COMPENSATED THRESHOLD



$$\text{Low limit} = \left(1 + \frac{R1B}{R2B}\right) Vref$$

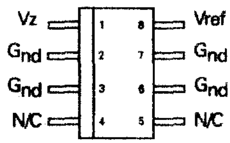
$$\text{High limit} = \left(1 + \frac{R1A}{R2A}\right) Vref$$

OVER VOLTAGE / UNDER VOLTAGE
PROTECTION CIRCUIT

ZHT431

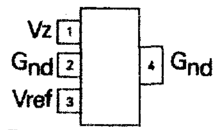
CONNECTION DIAGRAMS

SO8 Package Suffix – N8



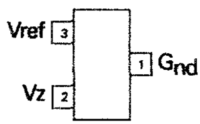
Top View

SOT223 Package Suffix – G



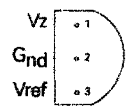
Top View –
Pin 4 floating or connected to pin 2

SOT23 Package Suffix – F



Top View

TO92 Package Suffix – C

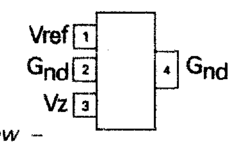


Bottom View

ORDERING INFORMATION

PART No	TOL %	PACKAGE	PARTMARK
ZHT431N802	2	SO8	ZHT43102
ZHT431N801	1	SO8	ZHT43101
ZHT431G02	2	SOT223	ZHT43102
ZHT431G01	1	SOT223	ZHT43101
ZHT431F02	2	SOT23	43D
ZHT431F01	1	SOT23	43C
ZHT431C02	2	TO92	ZHT43102
ZHT431C01	1	TO92	ZHT43101
ZHT431Z02	2	SOT89	43F
ZHT431Z01	1	SOT89	43E

SOT89 Package Suffix – Z



Top View –
Pin 4 floating or connected to pin 2