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ZHT431

ADJUSTABLE PRECISION ZENER SHUNT REGULATOR

ISSUE 2 – FEBRUARY 1997

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.

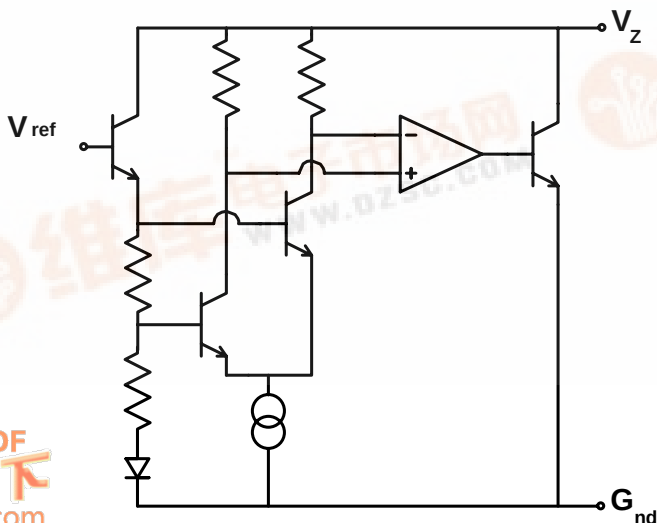
FEATURES

- 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



ZHT431

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	V _{ref}	20V
Cathode Current	50μA	100mA

Power Dissipation (T_{amb}=25°C)

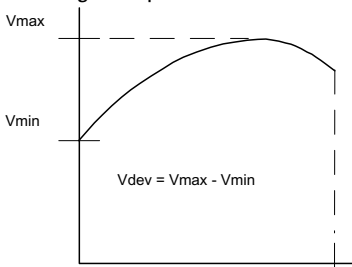
(T _{jmax} = 150°C)	
SOT23	330mW
TO92	780mW
SOT223	2W
SO8	780mW
SOT89	1.5W

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

PARAMETER	SYMBOL	VALUE			UNITS	CONDITIONS
		MIN	TYP	MAX		
Reference Voltage	2% 1% V _{ref}	2.45 2.475	2.50 2.50	2.55 2.525	V	I _L =10mA (Fig1), V _Z =V _{ref}
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:



$$V_{ref} (ppm/^{\circ}C) = \frac{V_{dev} \times 1000000}{V_{ref} (T_1 - T_2)}$$

The dynamic output impedance, R_Z, is defined as:

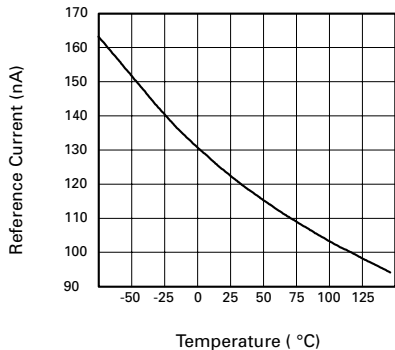
$$R_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

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:

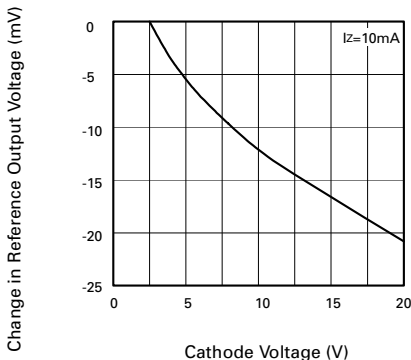
$$R' = R_Z \left(1 + \frac{R_1}{R_2} \right)$$

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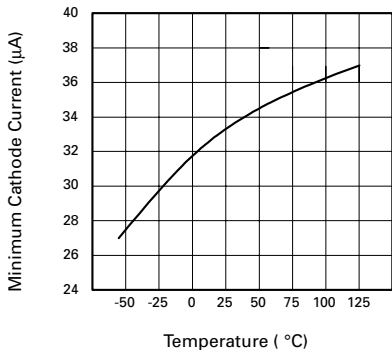
TYPICAL CHARACTERISTICS



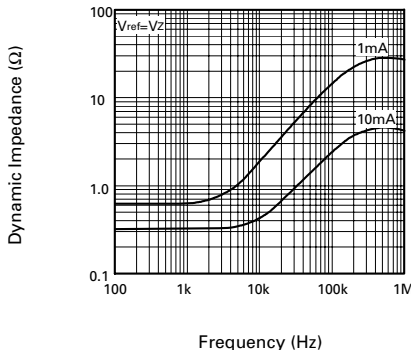
I_{ref} vs. Temperature



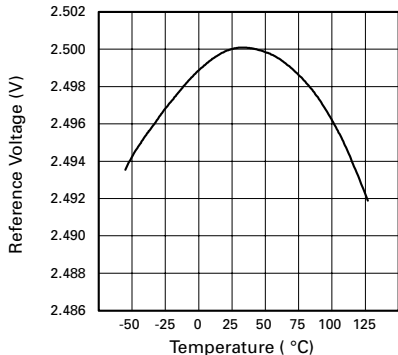
Change in V_{ref} v Cathode Voltage



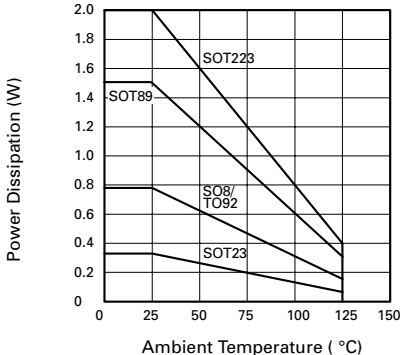
I_{Zmin} vs. Temperature



Dynamic Impedance v Frequency



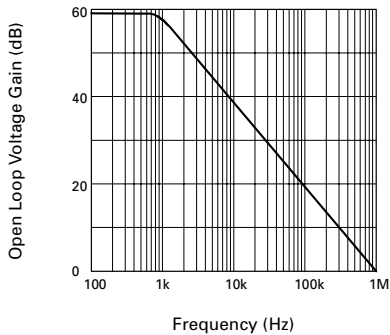
V_{ref} vs. Temperature



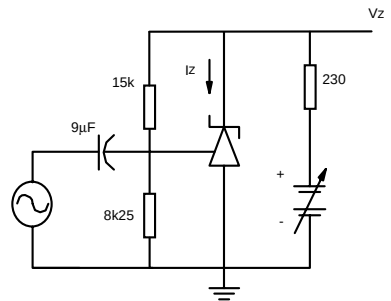
Power Dissipation vs. Ambient Temperature

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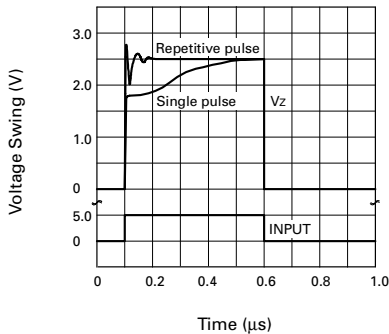
TYPICAL CHARACTERISTICS



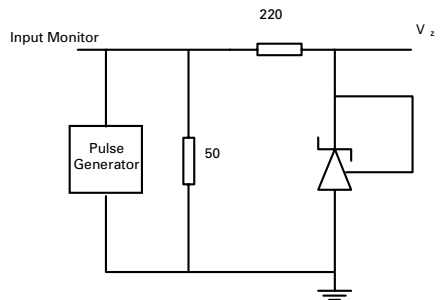
Gain v Frequency



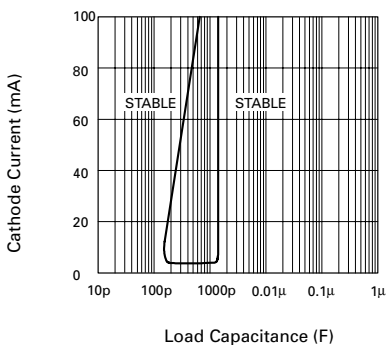
Test Circuit for Open Loop Voltage Gain



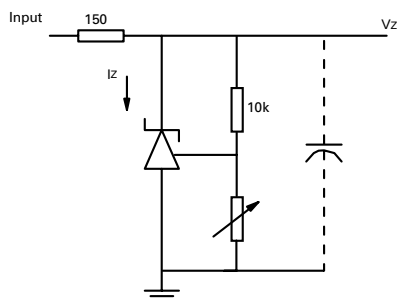
Pulse Response



Test Circuit for Pulse Response



Stability Boundary Conditions



Test Circuit for Stability Boundary Conditions

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DC TEST CIRCUITS

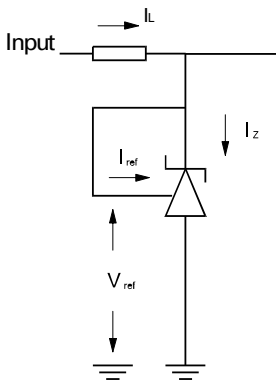


Fig 1 – Test Circuit for $V_z = V_{ref}$

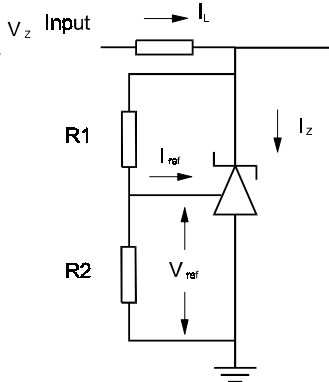


Fig 2 – Test Circuit for $V_z > V_{ref}$

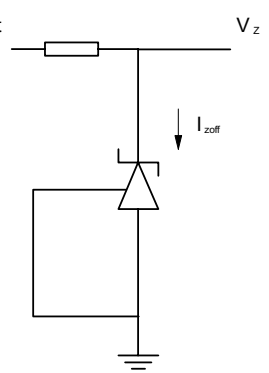


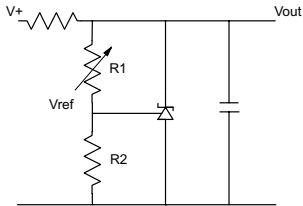
Fig 3 – Test Circuit for Off State current I_{zoff}

NOTE

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

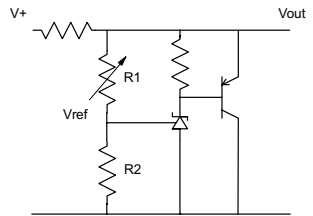
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APPLICATION CIRCUITS



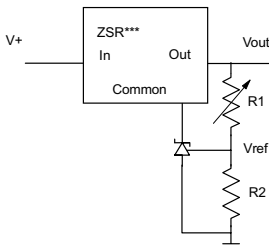
$$V_{out} = \left(1 + \frac{R1}{R2} \right) V_{ref}$$

SHUNT REGULATOR



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

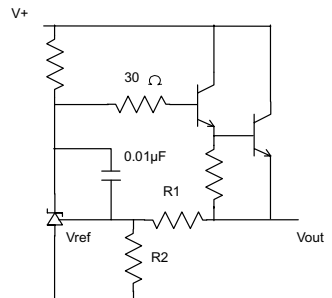
HIGHER CURRENT SHUNT REGULATOR



$$V_{out_MIN} = V_{ref} + V_{reg}$$

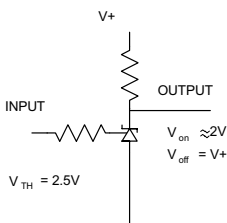
$$V_{out} = \left(1 + \frac{R1}{R2} \right) V_{ref}$$

OUTPUT CONTROL OF A THREE TERMINAL FIXED REGULATOR

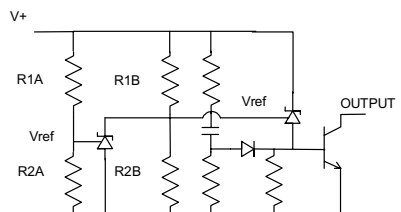


$$V_{out} = \left(1 + \frac{R1}{R2} \right) V_{ref}$$

SERIES REGULATOR



SINGLE SUPPLY COMPARATOR
WITH TEMPERATURE
COMPENSATED THRESHOLD



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

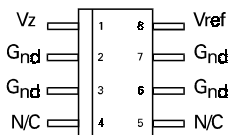
$$\text{High limit} = \left(1 + \frac{R1A}{R2A} \right) V_{ref}$$

OVER VOLTAGE / UNDER VOLTAGE

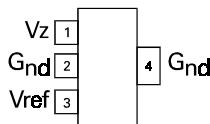
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CONNECTION DIAGRAMS

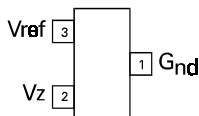
SO8 Package Suffix – N8



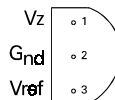
SOT223 Package Suffix – G



SOT23 Package Suffix – F



TO92 Package Suffix – C



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

