GL432

1.24V ADJUSTABLE PRECISION SHUNT REGULATORS

Description

The GL432's are low-voltage three-terminal adjustable precision shunt regulators with specified thermal stability over their full temperature range. Output voltage can be set to any value from V_{ref} (1.24V) to 16V by using two external resistors. Their active output circuitry provides a very unique turn-on characteristic, making them excellent replacements for zener diodes in many applications such as onboard regulation and adjustable power supplies. In a wide range of home applications, these versatile darlings are ideal voltage references for 3.0V to 3.3V switching power suppies. With operational cathode current as low as 80μA, batteries keep on going. Whatever your application is, the GL432's offer the optimum combination of performance, reliability, and economy.

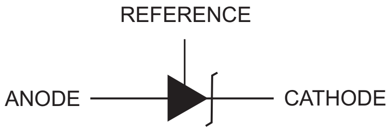
Features

- Low-voltage operation, down to 1.24V
- 0.5% or 1% reference voltage tolerance
- Adjustable output voltage, $V_O = V_{ref}$ to 16V
- Sink Current Capability 80μA to 100mA
- Low dynamic output impedance, 0.05Ω typical
- Wide temperature range, 0° to +70°C
- Pin-to-pin replacement for TLV431, SC431L
- Available in SOT-23, TO-92

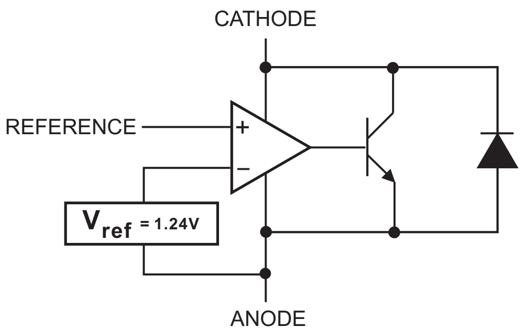
Application

Switching power supplies	Battery-operated computers,
Linear regulators	PDA's portable devices
Adjustable supplies	Monitors, TV's, camcorders
Instrumentation	Computer disk drives

LOGIC SYMBOL

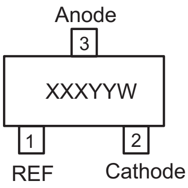


BLOCK DIAGRAM (POSITIVE LOGIC)

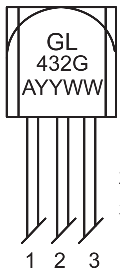


MARKING INFORMATION & PIN CONFIGURATIONS (TOP VIEW)

SOT-23



TO-92



1. REF
2. Anode
3. Cathode

XXX = Marking Code
G** = Grade
A = Assembly Location
YY = Year
WW, W= Weekly

ORDERING INFORMATION (Green Package Products are available now!)

Ordering Number	Precision	Device code	Grade	Package	Shipping
GL432AT92B	0.5%		A	TO-92	1,000 Units/ ESD Bag
GL432AT92RL	0.5%		A	TO-92	2,000 Units/ Ammo Pack(Tape)
GL432AST23R	0.5%	MAA		SOT-23	3,000 Units/Tape &Reel
GL432BT92B	1%		B	TO-92	1,000 Units/ ESD Bag
GL432BT92RL	1%		B	TO-92	2,000 Units/ Ammo Pack(Tape)
GL432BST23R	1%	MAB		SOT-23	3,000 Units/Tape &Reel

* For detail ordering number identification, please see last page.
** Grade A: indicates Precision of 0.5%, B: indicates Precision of 1%

ABSOLUTE MAXIMUM RATINGS (over free-air temperature range except as noted)

PARAMETER	SYMBOL	VALUE	UNIT
Cathode Voltage (1)	V_{KA}	20	V
Continuous cathode current	I_K	100	mA
Reference input current range	I_{ref}	3	mA
Power dissipation at T_A = 25°C SOT-23 TO-92	P_D	0.37 0.95	W
Package thermal impedance (2, 3) SOT-23 TO-92	θ_{JA}	336 132	°C/W
Operating ambient temperature range	T_A	0 to + 70	°C
Lead temperature (soldering) 10 seconds	T_{LEAD}	260	°C

These are stress ratings only. Functional operation of the device at these or any conditions beyond the "recommended operating conditions" is not implied. Exposure to absolute maximum rated conditions may affect device reliability.

NOTES:
1. Voltage values are with respect to the anode except as noted.
2. Maximum power dissipation is a function of $T_{J(max)}$, θ_{JA} and T_A. Maximum allowable power dissipation at any allowable ambient temperature is $P_D = (T_{J(max)} - T_A)/\theta_{JA}$.
3. Package thermal impedance is calculated per JESD 51.

RECOMMENDED OPERATING CONDITIONS

PARAMETER	SYMBOL	MINIMUM	MAXIMUM	UNIT
Cathode Voltage	V_{KA}	V_{ref}	16	V
Cathode Current	I_K	80μA	100	mA

ELECTRICAL CHARACTERISTICS (T_A = 25°C unless otherwise noted)

GL432A (0.5%)

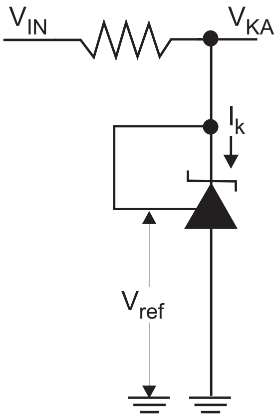
PARAMETER		CONDITION	MIN	TYP	MAX	UNIT
Reference input Voltage	V_{ref}	$V_{KA} = V_{ref}$, I_K = 10 mA, T_A = 25°C (1) $V_{KA}=V_{ref}$, I_K=10 mA, T_A= 0 to +70°C(1)	1.234 1.222	1.240	1.246 1.258	V
V_{ref} temp deviation	V_{dev}	$V_{KA} = V_{ref}$, I_K = 10 mA (1)		10	25	mV
Ratio of change in V_{ref} to change in V_{KA}	$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	I_K = 10mA, ΔV_{KA} = 16V to V_{ref}	- 2.7	-1.0		mV/V
Reference input current	I_{ref}	I_K = 10mA, R1 = 10KΩ, R2 =∞ (2)		0.15	0.5	μA
Deviation of reference input voltage over full temperature range	$I_{ref(dev)}$	I_K = 10mA, R1 = 10KΩ, R2 =∞ (2) **T_A = full range**		0.1	0.4	μA
Minimum operating current	$I_{K(min)}$	$V_{KA} = V_{ref}$ (1)		20	80	μA
Off-state cathode current	$I_{K(off)}$	V_{KA} = 6V, V_{ref} = 0V (3) V_{KA} = 16V, V_{ref} = 0V (3)		0.125 0.135	0.150 0.150	μA
Dynamic impedance	$\lvert Z_{KA} \rvert$	f≤1kHz, $V_{KA}=V_{ref}$, I_K=100μA to 100mA (1)		0.05	0.15	Ω

GL432B (1.0%)

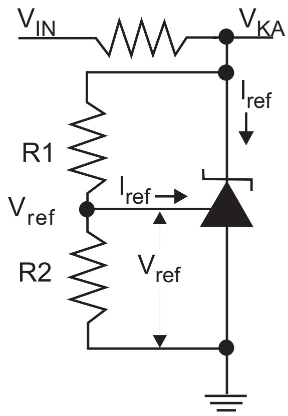
PARAMETER		CONDITION	MIN	TYP	MAX	UNIT
Reference input Voltage	V_{ref}	$V_{KA} = V_{ref}$, I_K = 10 mA, T_A = 25°C (1) $V_{KA}=V_{ref}$, I_K=10 mA, T_A= 0 to +70°C(1)	1.228 1.215	1.240	1.252 1.258	V
V_{ref} temp deviation	V_{dev}	$V_{KA} = V_{ref}$, I_K = 10 mA (1)		10	25	mV
Ratio of change in V_{ref} to change in V_{KA}	$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	I_K = 10mA, ΔV_{KA} = 16V to V_{ref}	- 2.7	-1.0		mV/V
Reference input current	I_{ref}	I_K = 10mA, R1 = 10KΩ, R2 =∞ (2)		0.15	0.5	μA
Deviation of reference input voltage over full temperature range	$I_{ref(dev)}$	I_K = 10mA, R1 = 10KΩ, R2 =∞ (2) **T_A = full range**		0.1	0.4	μA
Minimum operating current	$I_{K(min)}$	$V_{KA} = V_{ref}$ (1)		20	80	μA
Off-state cathode current	$I_{K(off)}$	V_{KA} = 6V, V_{ref} = 0V (3) V_{KA} = 16V, V_{ref} = 0V (3)		0.125 0.135	0.150 0.150	μA
Dynamic impedance	$\lvert Z_{KA} \rvert$	f≤1kHz, $V_{KA}=V_{ref}$, I_K=100μA to 100mA (1)		0.05	0.15	Ω

NOTES:
(1) See test circuit 1 on page 5.
(2) See test circuit 2 on page 5.
(3) See test circuit 3 on page 5.

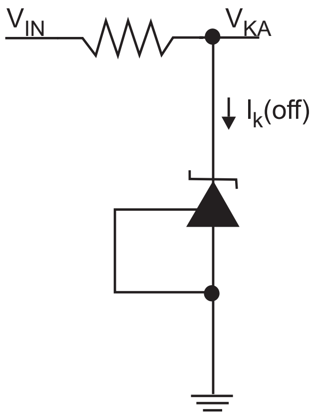
◆ TEST CIRCUITS



Test Circuit 1
$V_{KA} = V_{ref}$

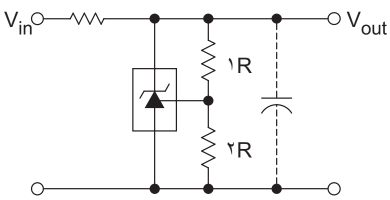


Test Circuit 2
$V_{KA} > V_{ref}$



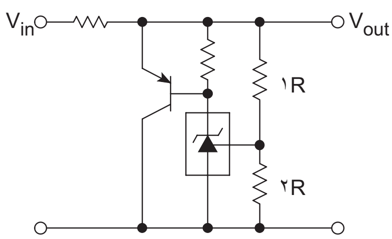
Test Circuit 3
Off-State

◆ TYPICAL APPLICATIONS (GL432A, GL432B)



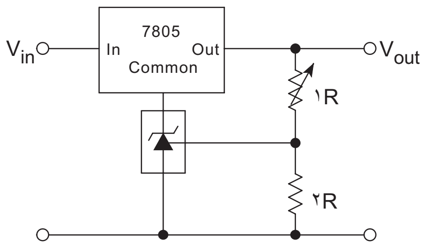
$V_{out}=(١+\frac{١R}{٢R})V_{ref}$

Figure 1. Shunt Regulator



$V_{out}=(١+\frac{١R}{٢R})V_{ref}$

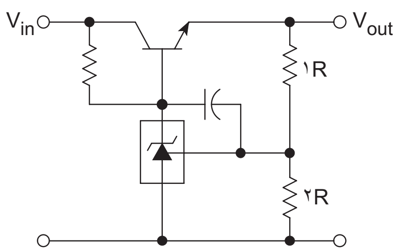
Figure 2. High Current Shunt Regulator



$V_{out}=(١+\frac{١R}{٢R})V_{ref}$

$V_{out(min)} = V_{ref} + 5.0V$

Figure 3. Output Control for a Three Terminal Fixed Regulator

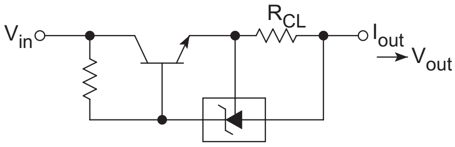


$V_{out}=(١+\frac{١R}{٢R})V_{ref}$

$V_{out(min)} = V_{ref} + V_{be} \approx 2.0V$

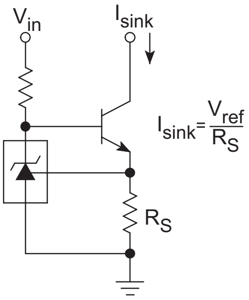
Figure 4. Series Pass Regulator

◆ TYPICAL APPLICATIONS (GL432A, GL432B)



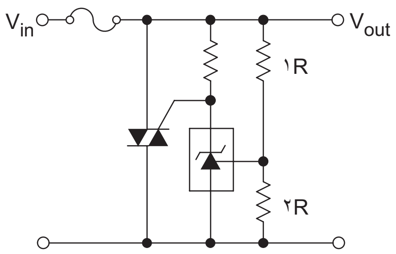
$I_{out}=\frac{V_{ref}}{R_{CL}}$

Figure 5. Constant Current Source



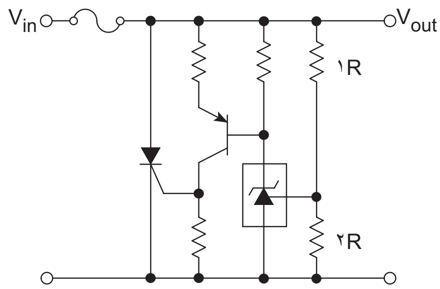
$I_{sink}=\frac{V_{ref}}{R_S}$

Figure 6. Constant Current Sink



$V_{out(trip)}$=(١ + ١R/٢R) V_{ref}

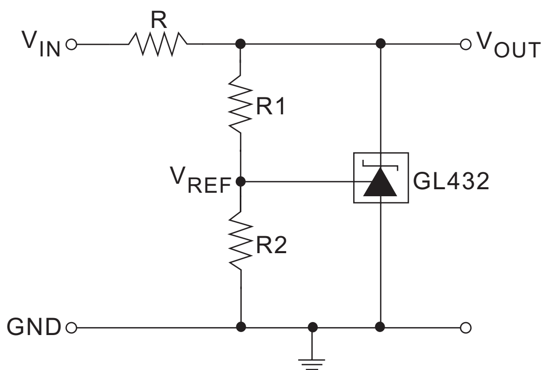
Figure 7. TRIAC Crowbar



$V_{out(trip)}$=(١ + ١R/٢R) V_{ref}

Figure 8. SRC Crowbar

◆ TYPICAL APPLICATION CIRCUIT



Notes:

1. Set V_{OUT} according to the following equation:

$$V_{OUT} = V_{REF}\left(1+\frac{R1}{R2}\right)+I_{REF}\,R1$$

2. Choose the value for R as follows:

◆ The maximum limit for R should be such that the cathode current, I_K, is greater than the minimum operating current (80μA) at $V_{IN(MIN)}$*

◆ The minimum limit for R should be such that the cathode current, I_K, does not exceed 100mA under all load conditions, and the instantaneous turn-on value for I_K does not exceed 150 mA. Both of the following conditions must be met:

$$Rmin \geq \frac{V_{IN(max)}}{150mA} \quad \text{(to limit instantaneous turn-on } I_K\text{)}$$

$$Rmin \geq \frac{V_{IN(max)}-V_{OUT}}{I_{OUT(min)}+100mA} \quad \text{(to limit } I_K \text{ under normal operating conditions)}$$

◆ Typical Performance Characteristics

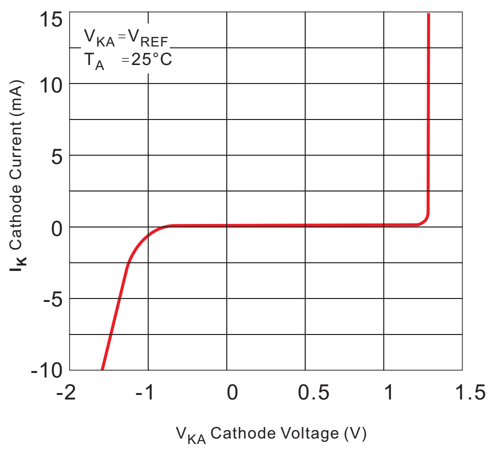


Figure 9. Cathode Current vs. Cathode Voltage

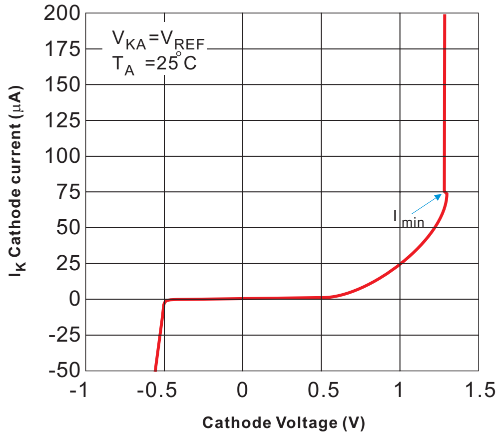


Figure 10. Cathode Current vs. Cathode Voltage

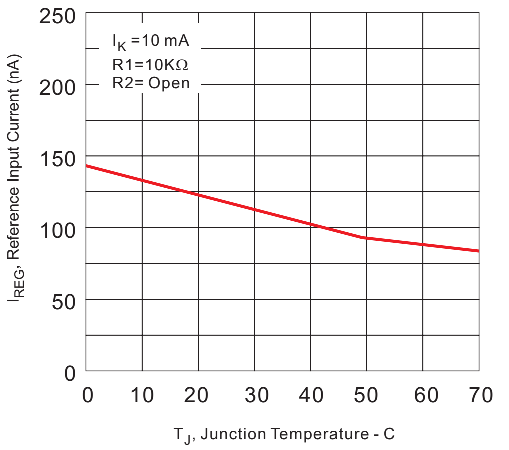


Figure 11. Ref. Voltage vs. Junction Temperature

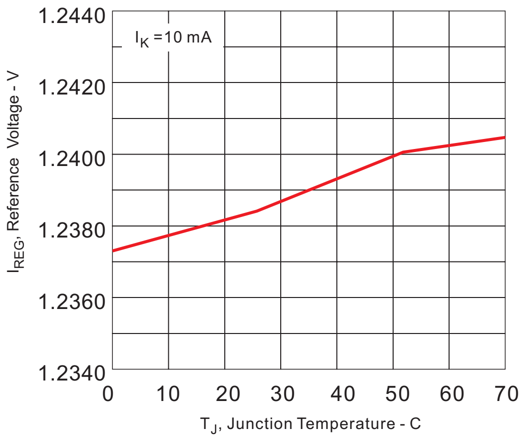
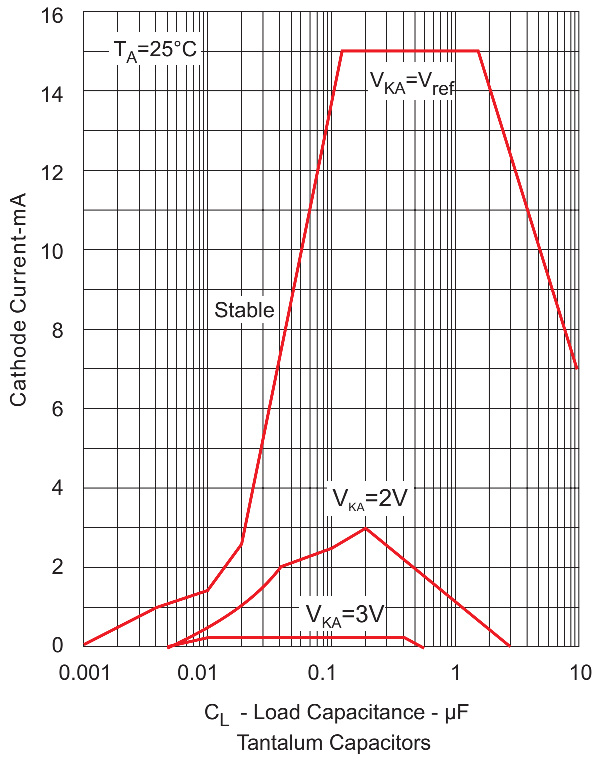


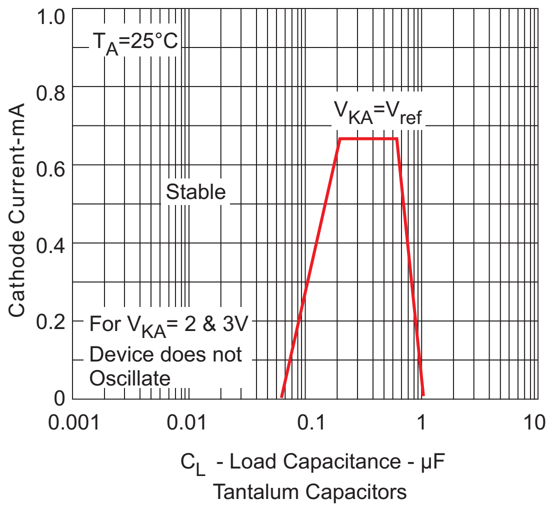
Figure 12. Ref. Input Current vs. Junction Temperature

◆ Stability Boundary Conditions

(1)



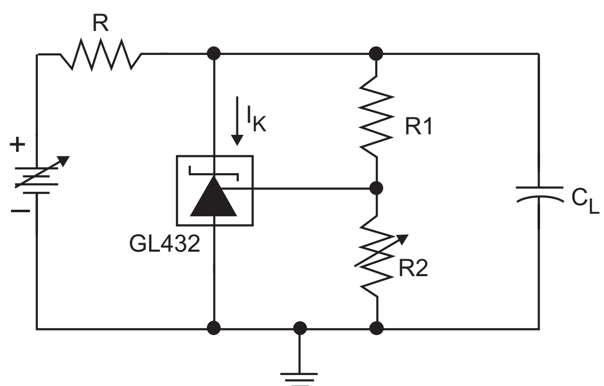
(2)



* Stability boundary condition test shows that tantalum capacitors are recommended to minimize the conditions that may cause the device to oscillate.

A Note About Stability

When using the GL432 as a shunt regulator, you can optimize stability by setting C_L either (1) no load ca-pacitance across the GL432, decouple at the load; or (2) large capacitance across the GL432, op-tional de-coupling at the load. The GL432 can be-come unsta-ble with capacitances of approximately 10nF to 1μF when cathode currents are less than 3mA or so, with instability increasing as cathode cur-rent is reduced. So, while the GL432 is happily stable at, for example, cathode current of 10mA with a 0.1μF capacitor across it, it can oscillate transiently as the cathode current rises through the region of in-stability. To avoid this problem completely, simply elim-inate the capacitor or select a very low or very high (e.g. 10μF) capacitor C_L. Since you will probably want local decoupling at the load, the best idea is to use no capacitance across the device. Just the resis-tance and capaci-tance of the PCB traces and vias will prevent local load decoupling from causing tran-sient oscillation dur-ing start-up. If you place the GL432 right next to the load, with the load decoupling capacitor directly across it, you must use a capacitor of nF or ≤ 10μF. ≤



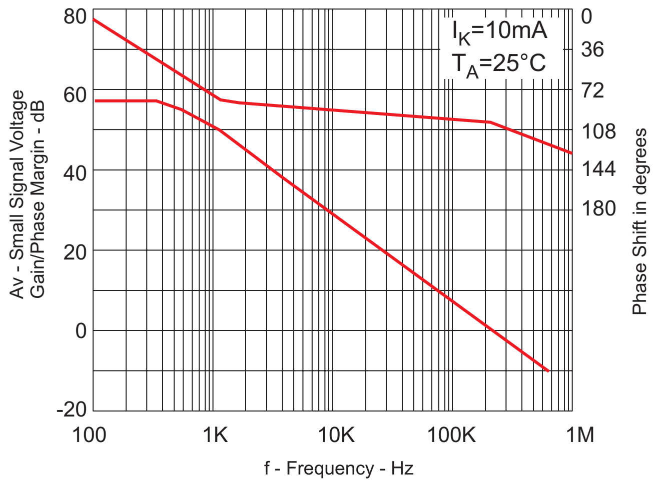


Figure 13. Small Signal Voltage Gain/ Phase Margin vs. Frequency

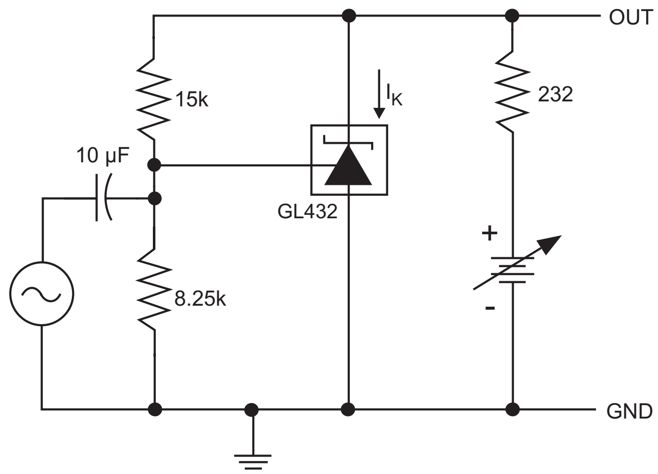
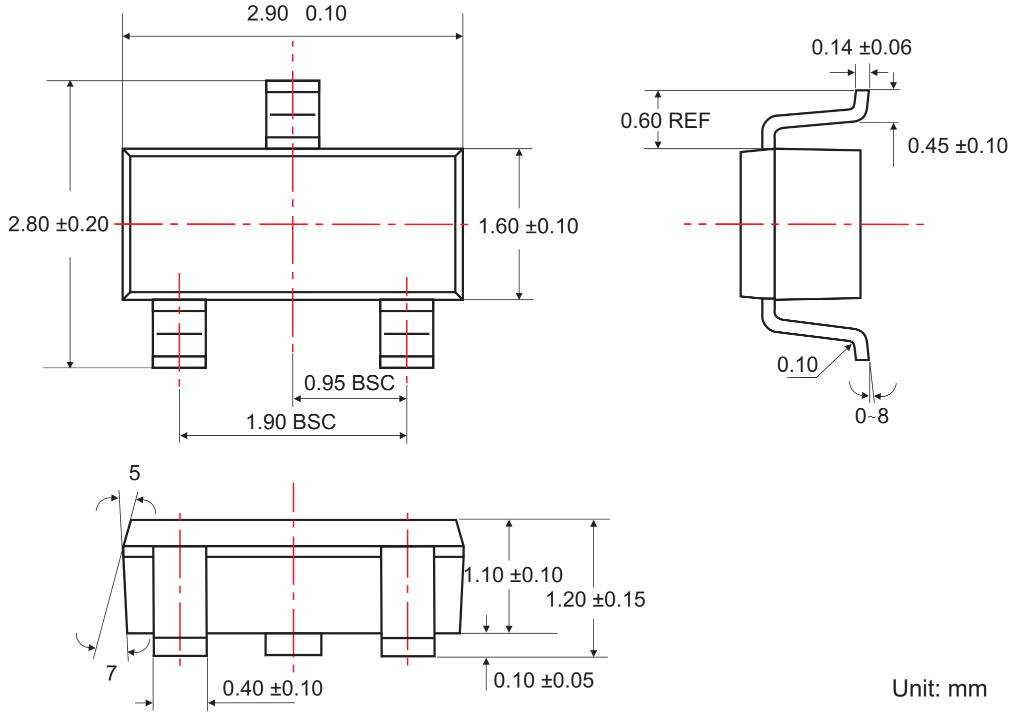
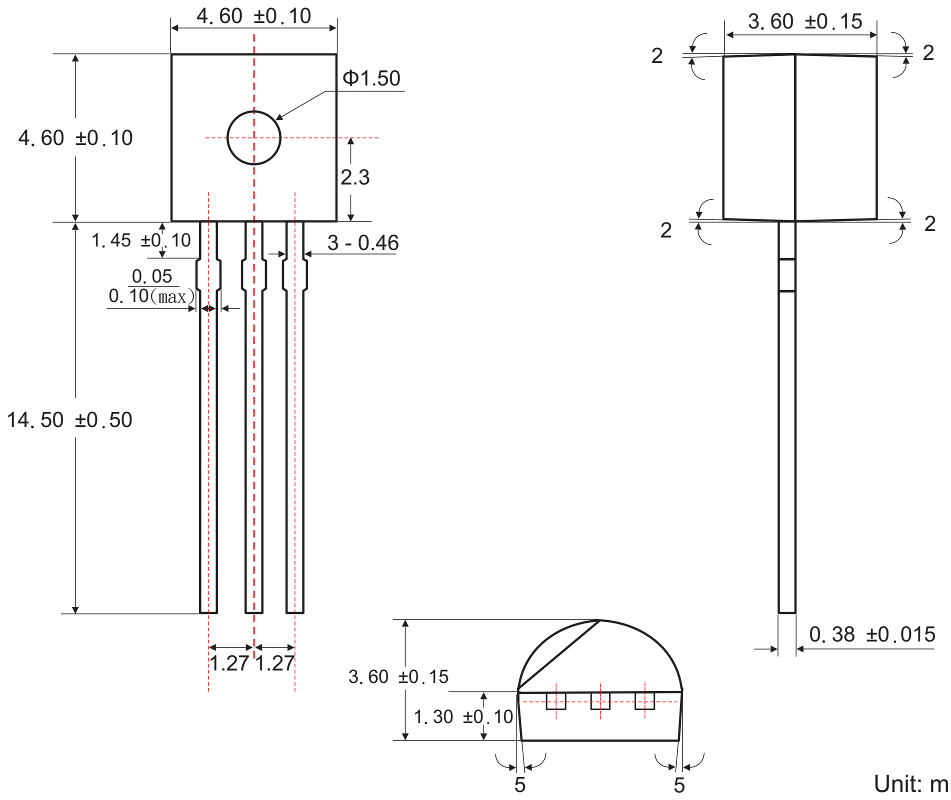


Figure 14. Test Circuit - Small - Signal Gain and Phase

SOT-23 PACKAGE OUTLINE DIMENSIONS



TO-92 PACKAGE OUTLINE DIMENSIONS



Unit: mm

ORDERING NUMBER

GL432 A T92 B

- GL432 → Circuit Type
- A → Voltage Tolerance
  - A: 0.5%
  - B: 1.0%
- T92 → Package
  - T92: TO-92
  - ST23: SOT-23
- B → Shipping
  - B : ESD Bag
  - RL: Ammo Pack (Tape)
  - R: Tape & Ree
  - T: Tube l