

GENERAL DESCRIPTION

The L432 is a three-terminal adjustable shunt regulator utilizing an accurate 1.24V band gap reference. The output voltage can be set to any value between 1.24V (V_{REF}) to 18V with two external resistors as shown in the typical application circuit. The device exhibit a wide operating current range of 0.2 to 100 mA with a typical dynamic impedance of 0.25Ω . Active output circuitry provides a very sharp turn-on characteristic, making the L432 excellent replacements for low-voltage zener diodes in many applications, including on-board regulation and adjustable power supplies.

When used with an opto-coupler, the L432 is ideal voltage reference in isolated feedback circuits for 3.3V switching-mode power supplies. The L432 shunt regulator is available in two voltage tolerances (0.5% & 1.0%) and three package options (TO-92, SOT-23-3 and SO-8).

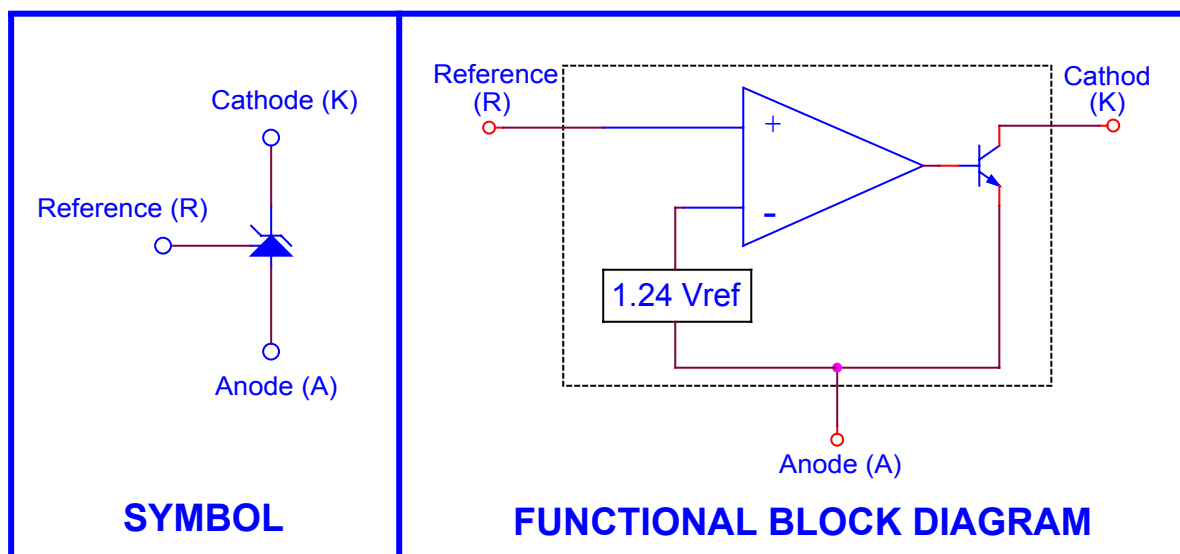
FEATURES

- Internal amplifier with 100 mA capability
- Programmable output voltage to 18V
- 0.25Ω typical output impedance
- Pin to pin compatible with TLV431A, TS431, SC431L & AS432
- Trimmed bandgap design 0.5% & 1.0% with three package options
- Low output noise

APPLICATIONS

- Linear regulator controller
- Precision voltage reference
- Switching power supplies
- Battery operating equipment
- Instrumentation
- PCs, Computer disk drives

SYMBOL & BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

| PARAMETER | VALUE |
|--|----------------|
| Cathode-Anode Reverse Breakdown Voltage - V_{KA} | 20V |
| Anode-Cathode Forward Current - I_{AK} | 1 A |
| Operating Cathode Current - I_{KA} | 100 mA |
| Reference Input Current - I_{REF} | 1 mA |
| Storage Temperature Range - T_{STG} | -65 to +150 °C |
| Junction Temperature - T_J | 150 °C |
| Lead Temperature (Soldering, 10 Seconds) - T_L | 300 °C |
| Continuous Power at 25 °C - P_D | |
| TO-92 | 700 mW |
| SOIC-8 | 650 mW |
| SOT-23 | 200 mW |

RECOMMENDED CONDITIONS

| Parameter | Rating |
|------------------------------|------------------|
| Cathode Voltage (V_{KA}) | V_{REF} to 18V |
| Cathode Current (I_K) | 10 mA |

TYPICAL THERMAL RESISTANCES

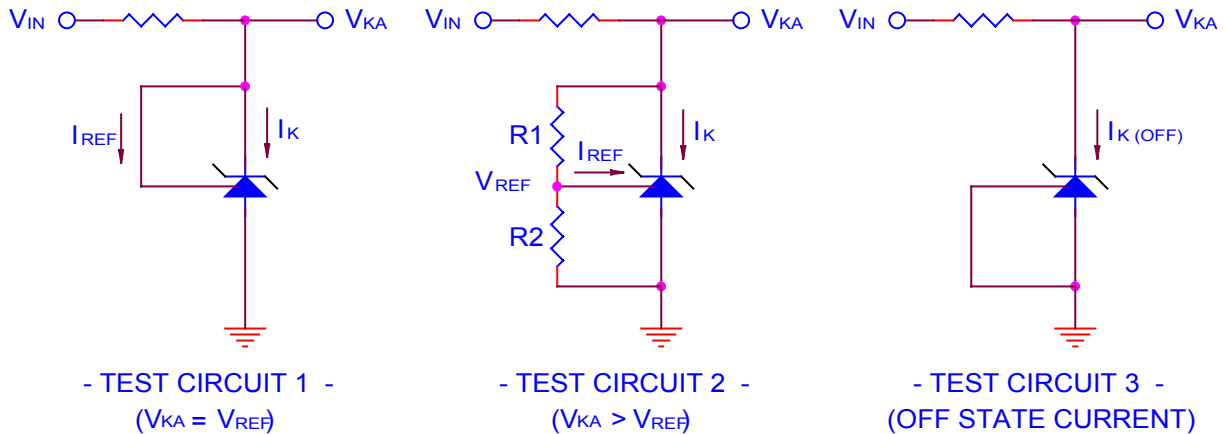
| Package | θ_{JA} | θ_{JC} | Typ. De-rating |
|---------|---------------|---------------|----------------|
| TO-92 | 160 °C/W | 80 °C/W | 6.3 mW/°C |
| SOIC-8 | 175 °C/W | 45 °C/W | 5.7 mW/°C |
| SOT-23 | 575 °C/W | 150 °C/W | 1.7 mW/°C |

ELECTRICAL SPECIFICATIONS

(Ambient temperature must be derated base on power dissipation and package thermal characteristics. The conditions are: $V_{KA} = V_{REF}$ and $I_K = 10$ mA unless otherwise stated)

| PARAMETER | TEST CONDITIONS | MIN | TYP | MAX | UNITS | TEST CIRCUIT |
|--|--|-------|-------|-------|-------|--------------|
| Output Voltage - V_{REF} | $T_A = 25$ °C, L432 (0.5%) | 1.234 | 1.240 | 1.246 | V | 1 |
| | $T_A = 25$ °C, L432 (1%) | 1.228 | 1.240 | 1.252 | | |
| Line Regulation - ΔV_{REF} | $V_{KA} = V_{REF}$ to 15V | | 28 | 50 | mV | 2 |
| Load Regulation - ΔV_{REF} | $I_K = 1$ to 100 mA | | 3.9 | 6 | mV | 1 |
| Temperature Deviation - ΔV_{REF} | $0 < T_J < 105$ °C | | 5 | 12 | mV | 1 |
| Reference Input Current - I_{REF} | | | 2.3 | 6 | μA | 1 |
| Reference Input Current Temperature Coefficient - ΔI_{REF} | $0 < T_J < 105$ °C | | 0.14 | 0.6 | μA | 1 |
| Minimum Cathode Current for Regulation - $I_{K(MIN)}$ | | | 0.2 | 1 | mA | 1 |
| Off State Leakage - $I_{K(MIN)}$ | $V_{REF} = 0V, V_{KA} = 15V$ | | 40 | 500 | nA | 3 |
| Dynamic impedance | $V_{KA} = V_{ref}, f \leq 1$ kHz $I_K = 0.1$ mA to 100 mA | | 0.25 | 0.4 | Ω | 1 |

TEST CIRCUITS



Applications Information – Stability

Selection of load capacitance when using L432 as a shunt regulator

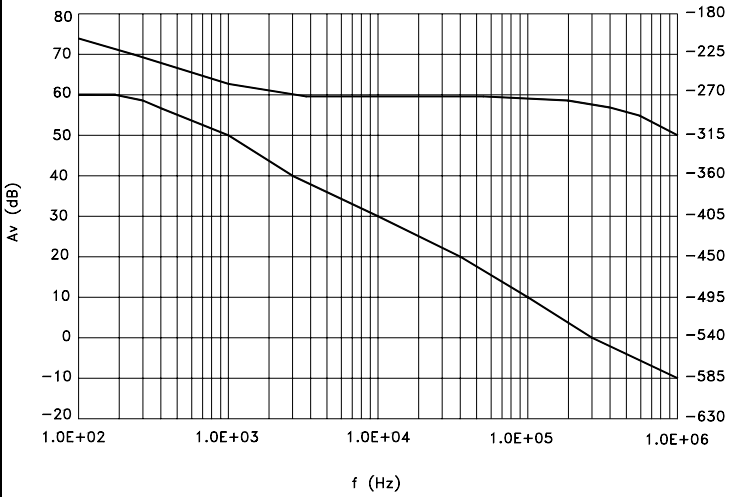
When the L432 is used as a shunt regulator, two options for selection of CL are recommended for optimal stability:

1. No load capacitance across the device, decouple at the load.
2. Large capacitance across the device, optional decoupling at the load.

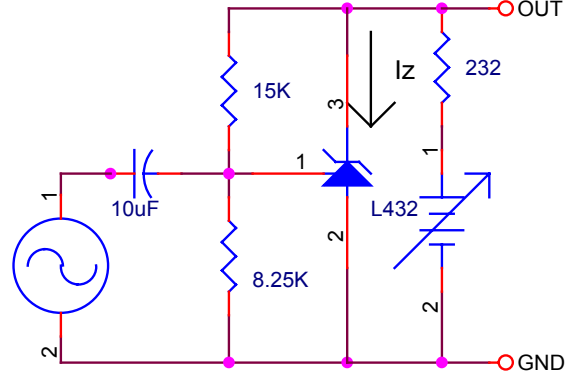
The reason for this is that L432 exhibits instability with capacitances in the range of 1nF to 1uF (approx.) at light cathode currents (up to 3mA typical). The device is less stable the lower the cathode voltage has been set for. Therefore while the device will be perfectly stable operating at a cathode current of 10mA with a 0.1uF capacitor across it, it will oscillate transiently during start-up as the cathode current passes through the instability region. Selecting a very low

(or preferably, no)capacitance, or alternatively a high capacitance (such as 10uF) will avoid this issue altogether. Since the user will probably wish to have local decoupling at the load anyway, the most cost effective method is to use no capacitance at all directly across the device. PCB trace/via resistance and inductance prevent the local load decoupling from causing the oscillation during the transient start-up phase. Note : if the L432 is located right at the load, so the load decoupling capacitor is directly across it, then this capacitor will have to be $\leq 100\text{pF}$ or $\geq 1\mu\text{F}$.

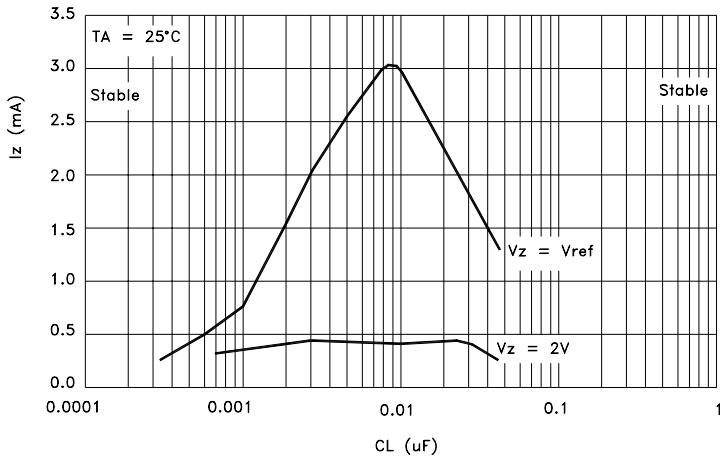
Small-Signal Gain and Phase Shift VS. Frequency



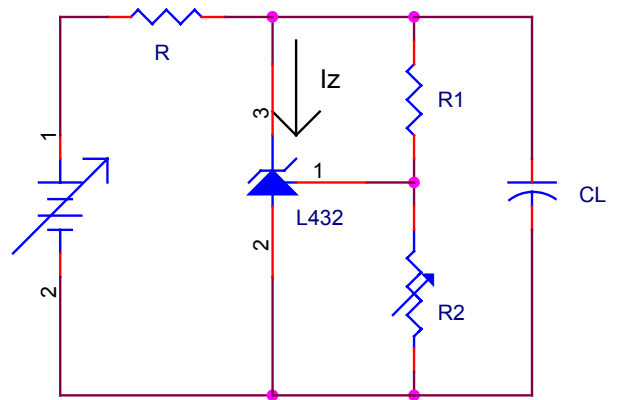
Test Circuit for Small Signal Gain and Phase



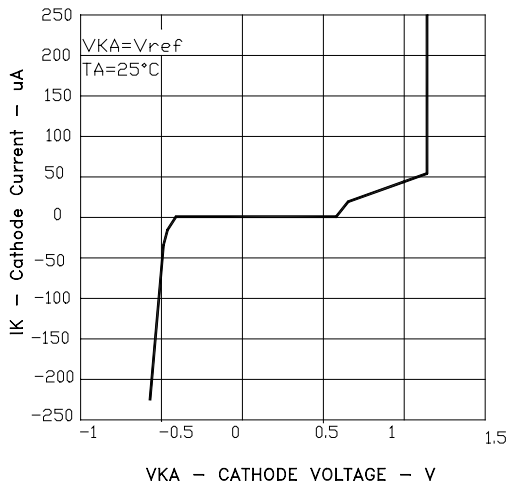
Stability Boundary Condition For Shunt Regulation VS. Cathode Current and Load Capacitance



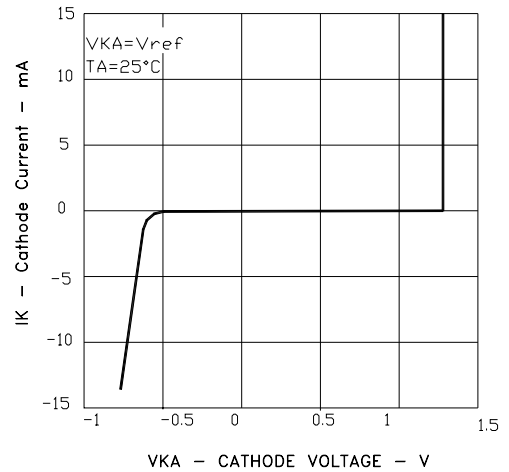
Test Circuit for Stability



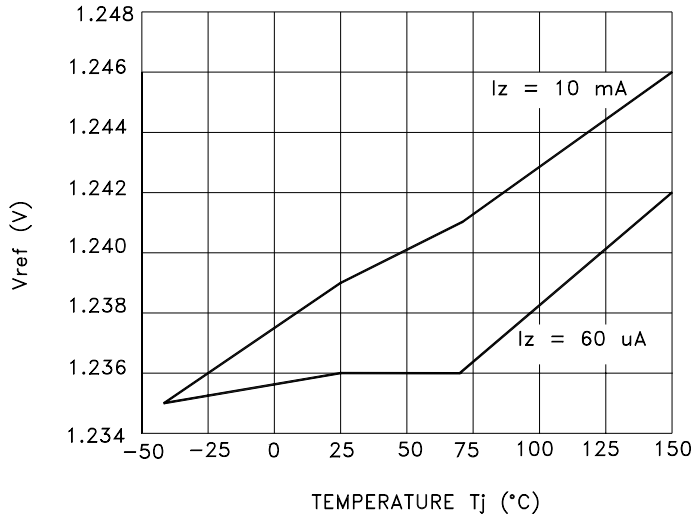
Cathode Current VS. Cathode Voltage



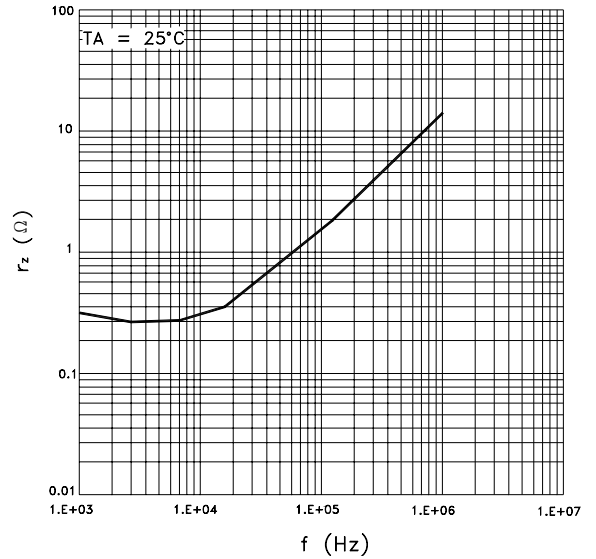
Cathode Current VS. Cathode Voltage



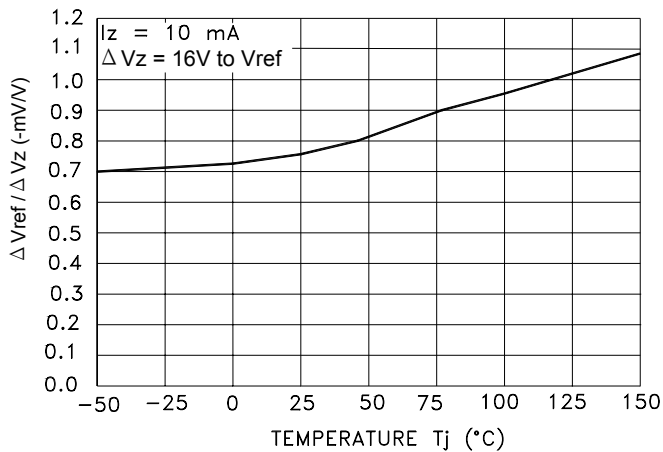
Reference Voltage
VS. Junction Temperature



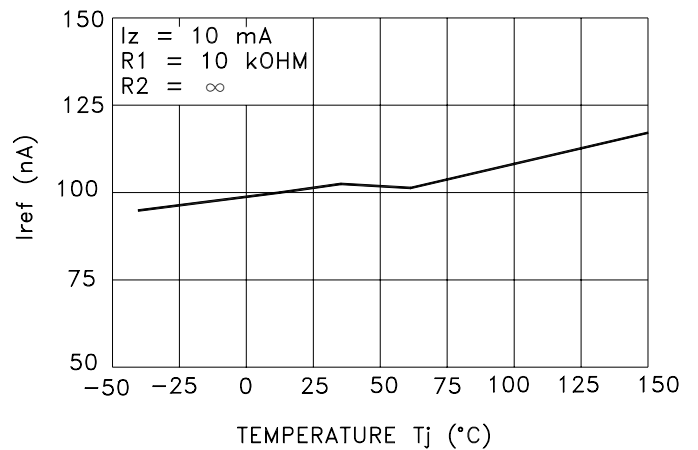
Reference Impedance
VS. Frequency



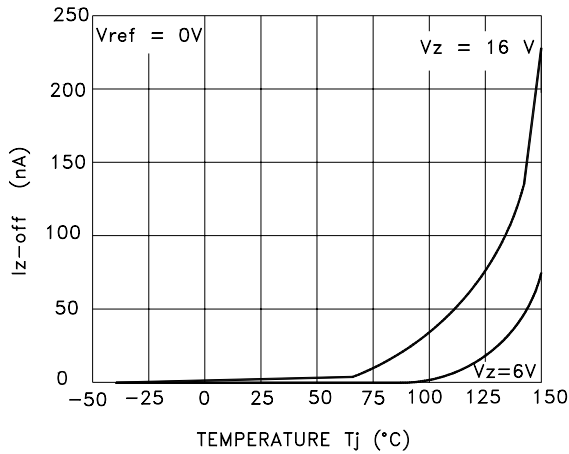
Ratio of Delta Reference Voltage to Delta Cathode Voltage
VS. Junction Temperature



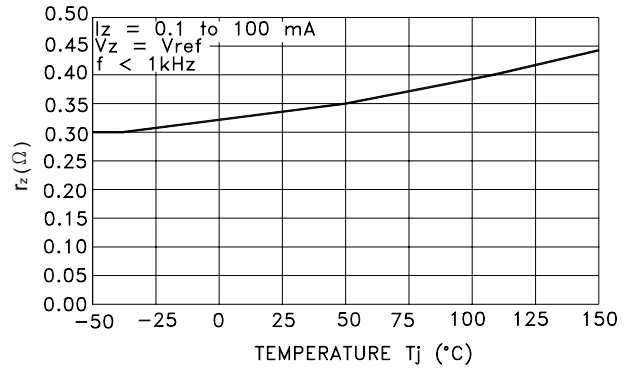
Reference Input Current
VS. Junction Temperature



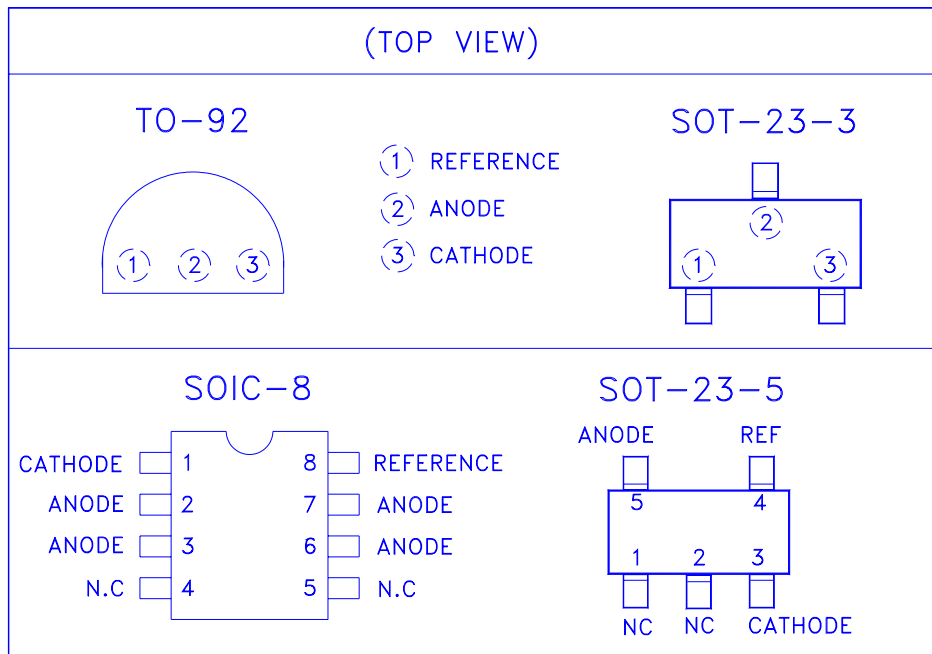
Off-State Cathode Current
VS. Junction Temperature



Reference Impedance
VS. Junction Temperature



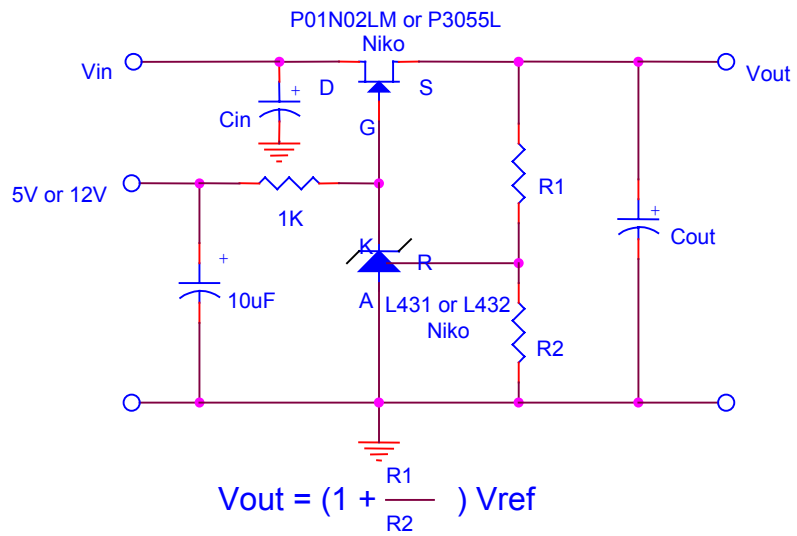
PIN CONFIGURATIONS



DEVICE SELECTION GUIDE

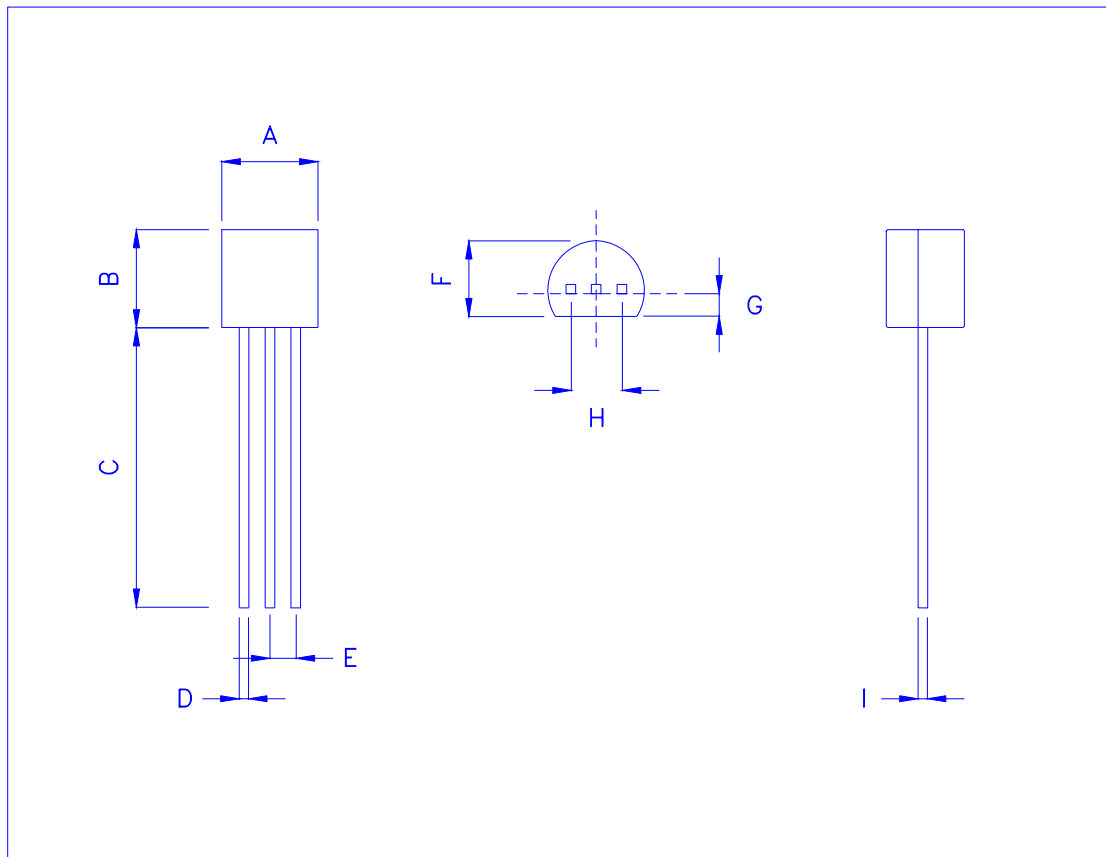
| | | | | |
|------------------|--------|----------|--------|----------|
| Device | L432NB | L432M3B | L432VB | L432M5B |
| Package | TO-92 | SOT-23-3 | SOIC-8 | SOT-23-5 |
| Marking | L432NA | 2M3A | L432V | 2M5A |
| Tolerance | 1% | 1% | 1% | 1% |

APPLICATION CIRCUIT



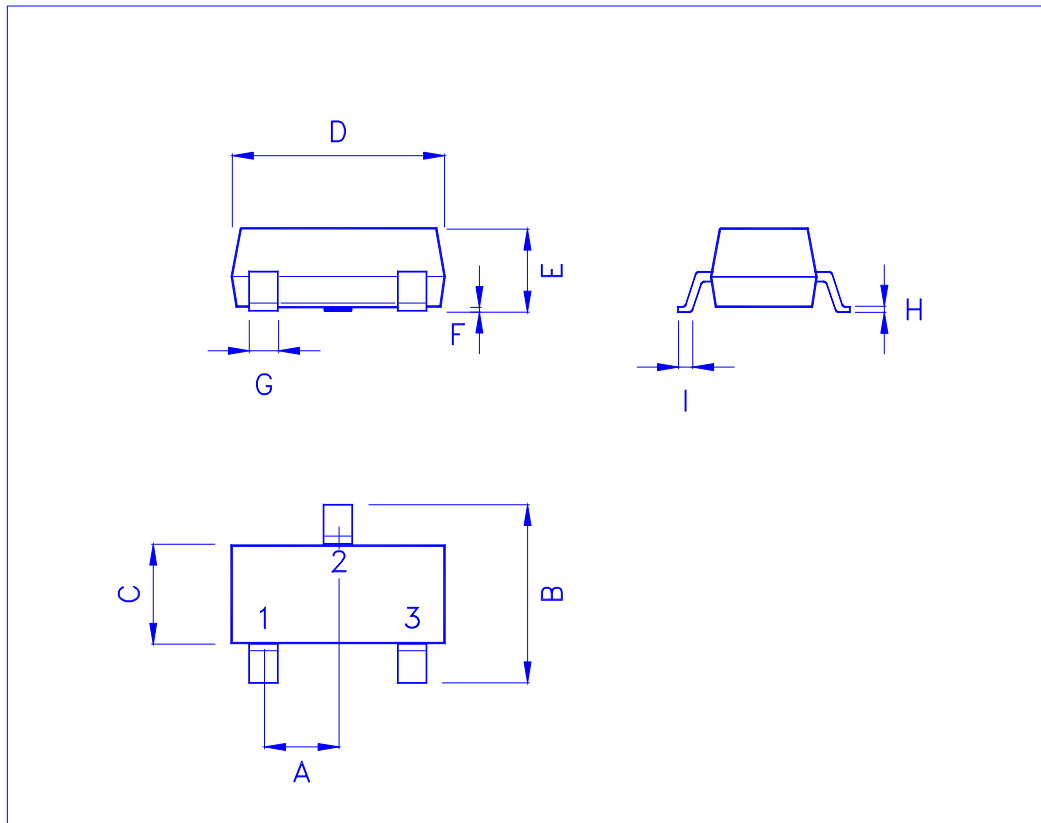
TO-92 MECHANICAL DATA

| Dimension | mm | | | Dimension | mm | | |
|-----------|-------|------|-------|-----------|-------|-------|-------|
| | Min. | Typ. | Max. | | Min. | Typ. | Max. |
| A | 4.445 | | 5.207 | H | 2.413 | 2.540 | 2.667 |
| B | 4.318 | | 5.334 | I | 0.356 | | 0.533 |
| C | 12.7 | | 15.5 | J | | | |
| D | 0.356 | | 0.533 | K | | | |
| E | 1.143 | 1.27 | 1.397 | L | | | |
| F | 3.175 | | 4.191 | M | | | |
| G | 0.762 | | 1.270 | N | | | |



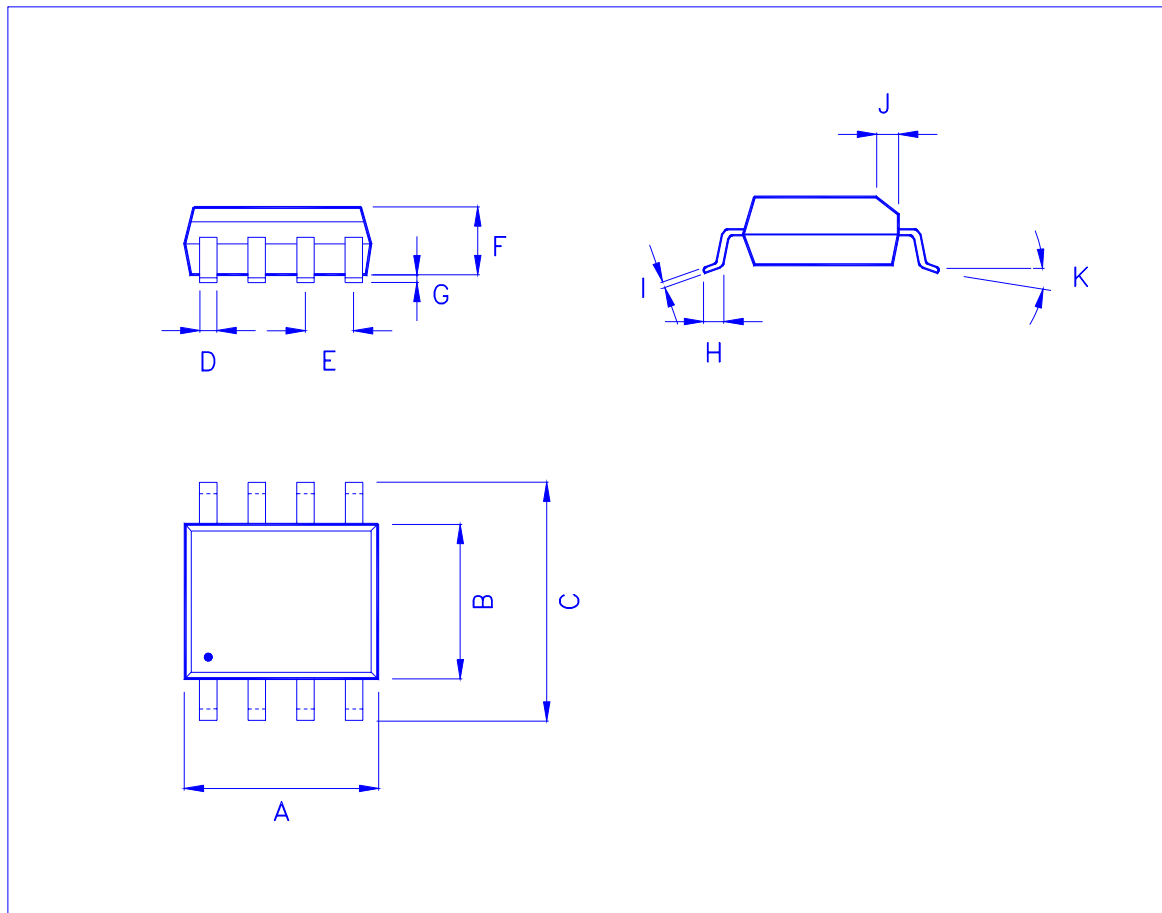
SOT-23 (M3) MECHANICAL DATA

| Dimension | mm | | | Dimension | mm | | |
|-----------|------|------|------|-----------|------|------|------|
| | Min. | Typ. | Max. | | Min. | Typ. | Max. |
| A | | 0.95 | | H | 0.10 | 0.15 | 0.25 |
| B | 2.60 | 2.80 | 3.00 | I | 0.37 | | |
| C | 1.40 | 1.60 | 1.80 | J | | | |
| D | 2.70 | 2.90 | 3.10 | K | | | |
| E | 1.00 | 1.10 | 1.30 | L | | | |
| F | 0.00 | | 0.10 | M | | | |
| G | 0.35 | 0.4 | 0.5 | N | | | |



SOIC-8 (D) MECHANICAL DATA

| Dimension | mm | | | Dimension | mm | | |
|-----------|------|------|------|-----------|------|------|------|
| | Min. | Typ. | Max. | | Min. | Typ. | Max. |
| A | 4.8 | | 5.0 | H | 0.4 | | 1.27 |
| B | 3.8 | | 4.0 | I | 0.18 | | 0.25 |
| C | 5.8 | | 6.2 | J | | 0.22 | |
| D | 0.35 | | 0.48 | K | 0° | | 8° |
| E | | 1.27 | | L | | | |
| F | | | 1.65 | M | | | |
| G | 0.1 | | 0.25 | N | | | |



SOT-23 (M5) MECHANICAL DATA

| Dimension | mm | | | Dimension | mm | | |
|-----------|------|------|------|-----------|------|-----------|------|
| | Min. | Typ. | Max. | | Min. | Typ. | Max. |
| A | 1.0 | 1.10 | 1.30 | e | | 1.90(TYP) | |
| A1 | 0.00 | | 0.10 | H | 2.60 | 2.80 | 3.00 |
| A2 | 0.70 | 0.80 | 0.90 | L | 0.37 | | |
| b | 0.35 | 0.40 | 0.50 | | | | |
| C | 0.10 | 0.15 | 0.25 | | | | |
| D | 2.70 | 2.90 | 3.10 | | | | |
| E | 1.40 | 1.60 | 1.80 | | | | |

