

ADJUSTABLE PRECISION SHUNT REGULATORS

AS431

General Description

The AS431 series ICs are three-terminal adjustable shunt regulators with guaranteed thermal stability over a full operation range. These ICs feature sharp turn-on characteristics, low temperature coefficient and low output impedance, which make them ideal substitutes for Zener diodes in applications such as switching power supply, charger and other adjustable regulators.

The output voltage of these ICs can be set to any value between V_{REF} (2.5V) and the maximum cathode voltage (36V).

The AS431 precision reference is offered in two band-gap tolerance: 0.4% and 0.8%.

These ICs are available in 4 Packages: TO-92, SOT-23-3, SOT-23-5 and SOT-89 .

Features

- Programmable Precise Output Voltage from 2.5V to 36V
- Very Accurate Reference Voltage: 0.15% Typical
- High Stability under Capacitive Load
- Low Temperature Deviation: 4.5mV Typical
- Low Equivalent Full-range Temperature Coefficient with 20PPM/°C Typical
- Low Dynamic Output Resistance: 0.15Ω Typical
- Sink Current Capacity from 1mA to 100 mA
- Low Output Noise
- Wide Operating Range of -40 to 125°C

Applications

- Charger
- Voltage Adapter
- Switching Power Supply
- Graphic Card
- Precision Voltage Reference

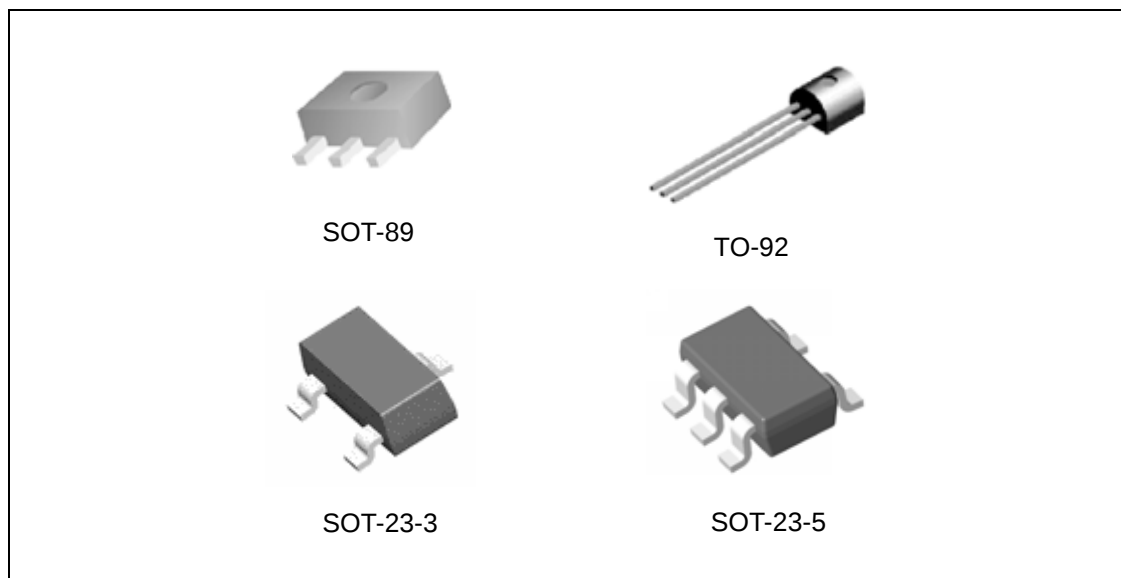


Figure 1. Package Types of AS431

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Pin Configuration

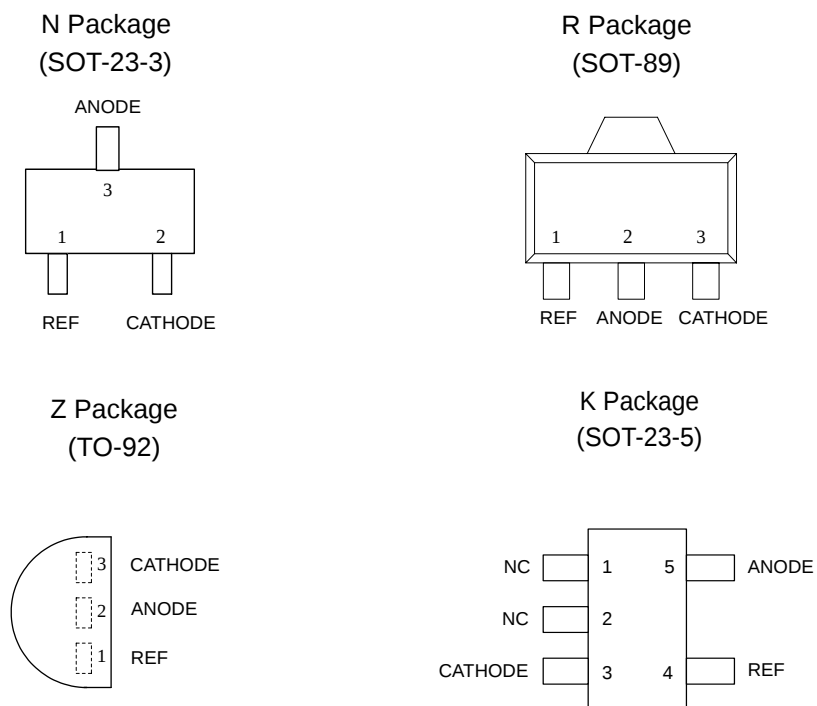


Figure 2. Pin Configuration of AS431 (Top View)

Functional Block Diagram

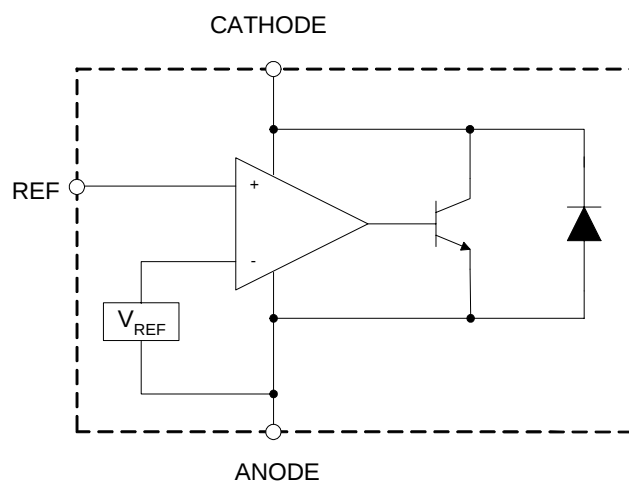
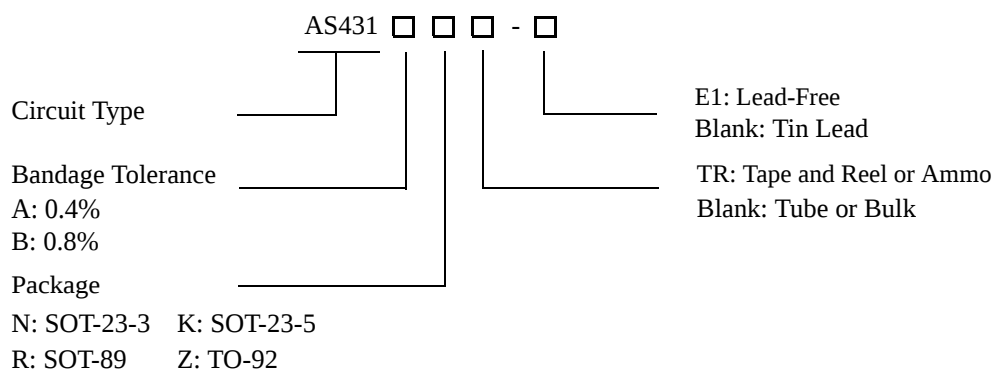


Figure 3. Functional Block Diagram of AS431



Ordering Information



Package	Temperature Range	Voltage Tolerance	Part Number		Marking ID		Packing Type
			Tin Lead	Lead Free	Tin Lead	Lead Free	
SOT-23-3	-40 to 125°C	0.4%		AS431ANTR-E1		EB5	Tape & Reel
		0.8%		AS431BNTR-E1		EB6	Tape & Reel
SOT-23-5	-40 to 125°C	0.4%		AS431AKTR-E1		E6H	Tape & Reel
		0.8%		AS431BKTR-E1		E6I	Tape & Reel
TO-92	-40 to 125°C	0.4%		AS431AZ-E1		AS431AZ-E1	Bulk
		0.4%		AS431AZTR-E1		AS431AZ-E1	Ammo
		0.8%		AS431BZ-E1		AS431BZ-E1	Bulk
		0.8%		AS431BZTR-E1		AS431BZ-E1	Ammo
SOT-89	-40 to 125°C	0.4%		AS431ARTR-E1		E43G	Tape & Reel
		0.8%		AS431BRTR-E1		E43H	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "E1" suffix in the part number, are RoHS compliant.

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Absolute Maximum Ratings (Note 1)

Parameter	Symbol	Value	Unit
Cathode Voltage	V_{KA}	40	V
Cathode Current Range (Continuous)	I_{KA}	-100 to 150	mA
Reference Input Current Range	I_{REF}	10	mA
Power Dissipation	P_D	Z, R Package: 770	mW
		N, K Package: 370	
Junction Temperature	T_J	160	°C
Storage Temperature Range	T_{STG}	-65 to 150	°C
Package Thermal Impedance	θ_{JA}	N Package: 330	°C/W
		Z Package: 150	
		R Package: 50	
		K Package: 250	
ESD (Human Body Model)		4000	V

Note 1: Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Symbol	Min	Max	Unit
Cathode Voltage	V_{KA}	V_{REF}	36	V
Cathode Current	I_{KA}	1.0	100	mA
Operating Ambient Temperature Range		-40	125	°C



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Electrical Characteristics for AS431

Operating Conditions: $T_A = 25^\circ\text{C}$, unless otherwise specified.

Parameter		Test Circuit	Symbol	Conditions	AS431			Unit
					Min	Typ	Max	
Reference Voltage	0.4%	4	V_{REF}	$V_{KA} = V_{REF}$, $I_{KA} = 10\text{mA}$	2.490	2.500	2.510	V
	0.8%				2.480	2.500	2.520	
Deviation of Reference Voltage Over-temperature		4	ΔV_{REF}	$V_{KA} = V_{REF}$, $I_{KA} = 10\text{mA}$		4.5	8	mV
						4.5	10	
Ratio of Change in Reference Voltage to the Change in Cathode Voltage		5	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	$I_{KA} = 10\text{mA}$		-1.0	-2.7	mV/V
						-0.5	-2.0	
Reference Current		5	I_{REF}	$I_{KA} = 10\text{mA}$, $R1 = 10\text{K}\Omega$, $R2 = \infty$		0.7	4	μA
Deviation of Reference Current Over Full Temperature Range		5	ΔI_{REF}	$I_{KA} = 10\text{mA}$, $R1 = 10\text{K}\Omega$, $R2 = \infty$, $T_A = -40$ to 85°C		0.4	1.2	μA
Minimum Cathode Current for Regulation		4	$I_{KA}(\text{Min})$	$V_{KA} = V_{REF}$		0.4	1.0	mA
Off-state Cathode Current		6	$I_{KA}(\text{Off})$	$V_{KA} = 36\text{V}$, $V_{REF} = 0$		0.05	1.0	μA
Dynamic Impedance		4	Z_{KA}	$V_{KA} = V_{REF}$, $I_{KA} = 1$ to 100mA , $f \leq 1.0\text{KHz}$		0.15	0.5	Ω



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Electrical Characteristics (Continued)

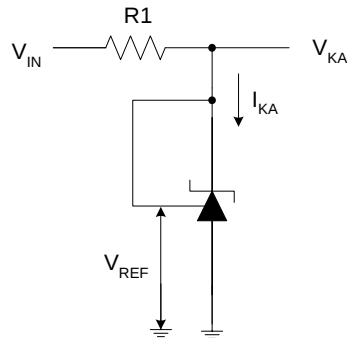


Figure 4. Test Circuit 4 for $V_{KA}=V_{REF}$

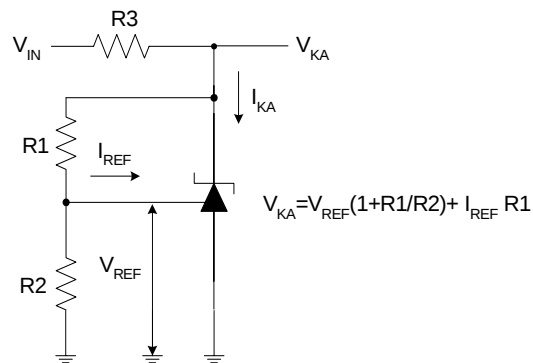


Figure 5. Test Circuit 5 for $V_{KA}>V_{REF}$

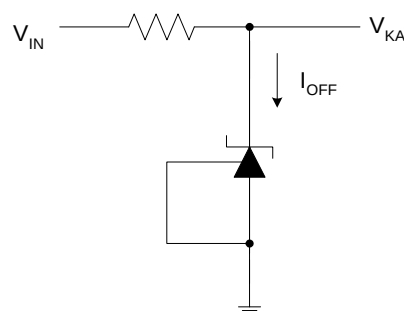


Figure 6. Test Circuit 6 for I_{OFF}

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Typical Performance Characteristics

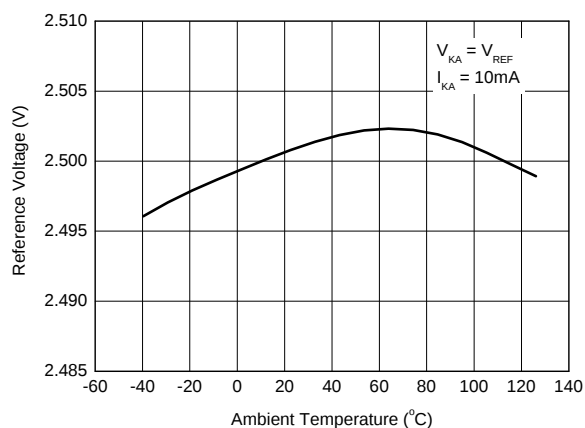


Figure 7. Reference Voltage vs. Ambient Temperature

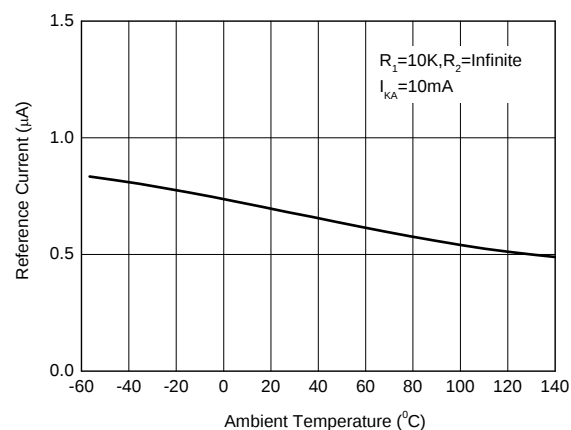


Figure 8. Reference Current vs. Ambient Temperature

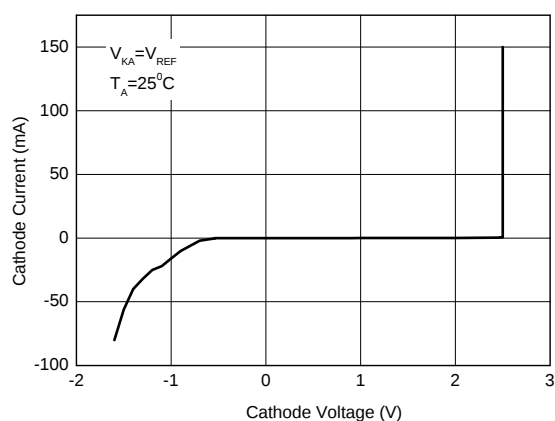


Figure 9. Cathode Current vs. Cathode Voltage

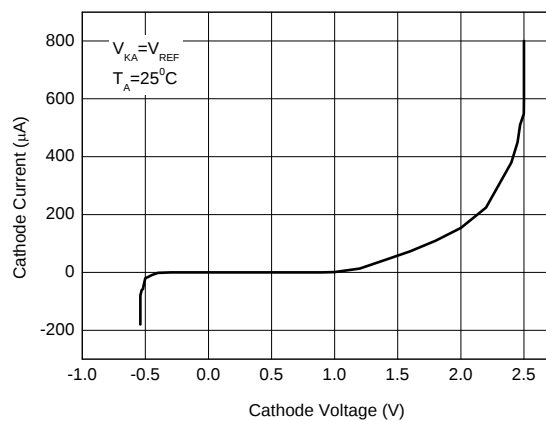


Figure 10. Cathode Current vs. Cathode Voltage

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Typical Performance Characteristics (Continued)

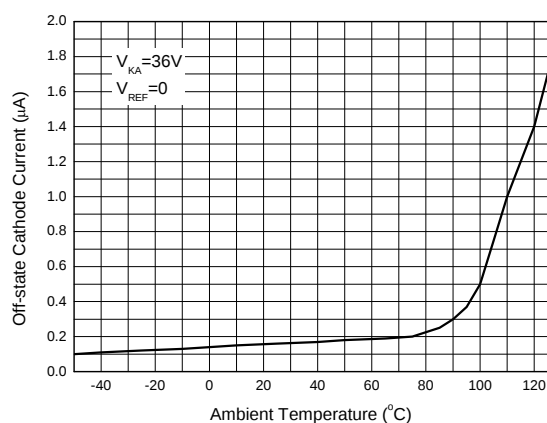


Figure 11. Off-state Cathode Current vs. Ambient Temperature

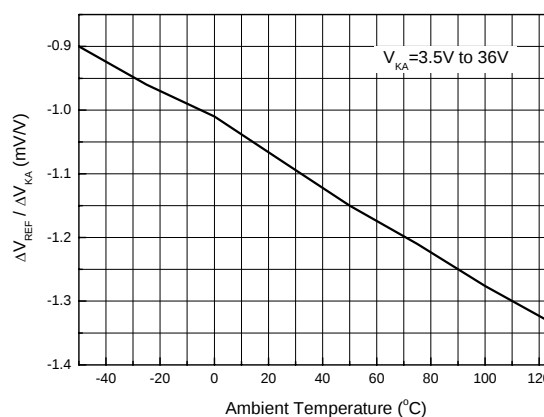


Figure 12. Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage

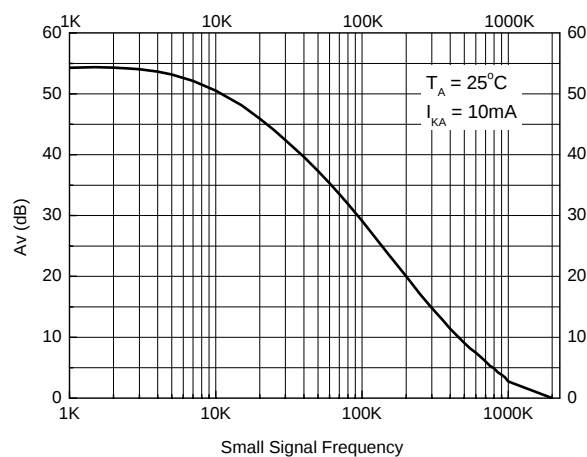
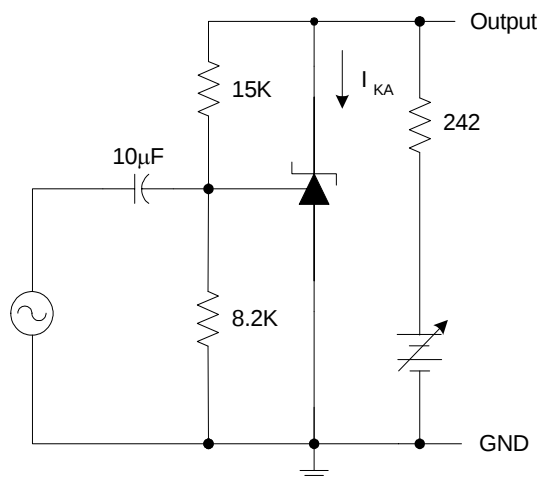


Figure 13. Small Signal Voltage Gain vs. Frequency





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Typical Performance Characteristics (Continued)

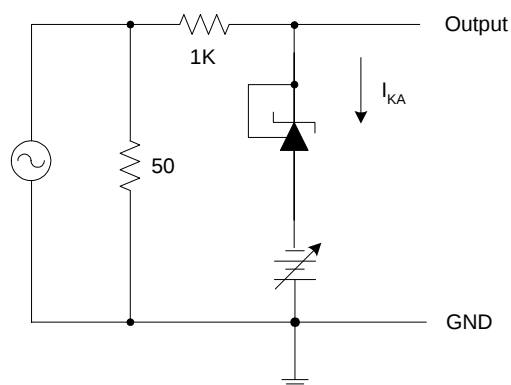
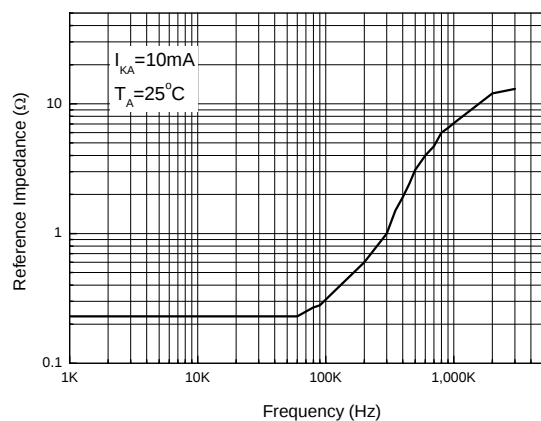


Figure 14. Reference Impedance vs. Frequency

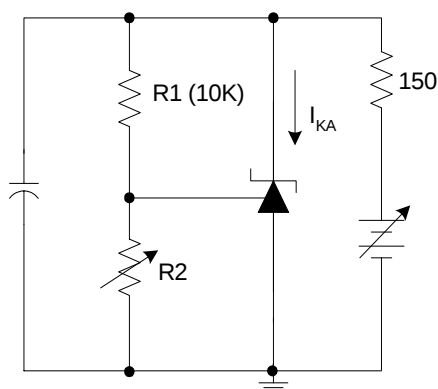
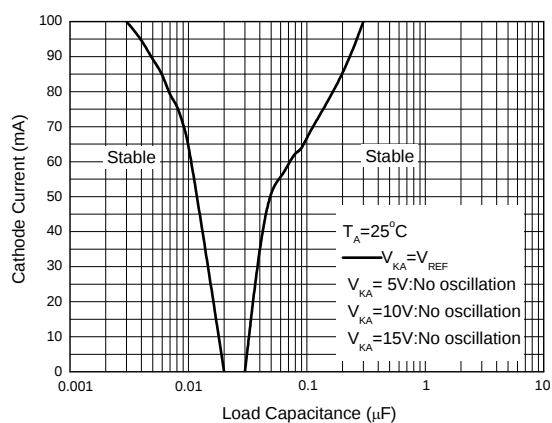


Figure 15. Stability Boundary Conditions vs. Load Capacitance

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Typical Performance Characteristics (Continued)

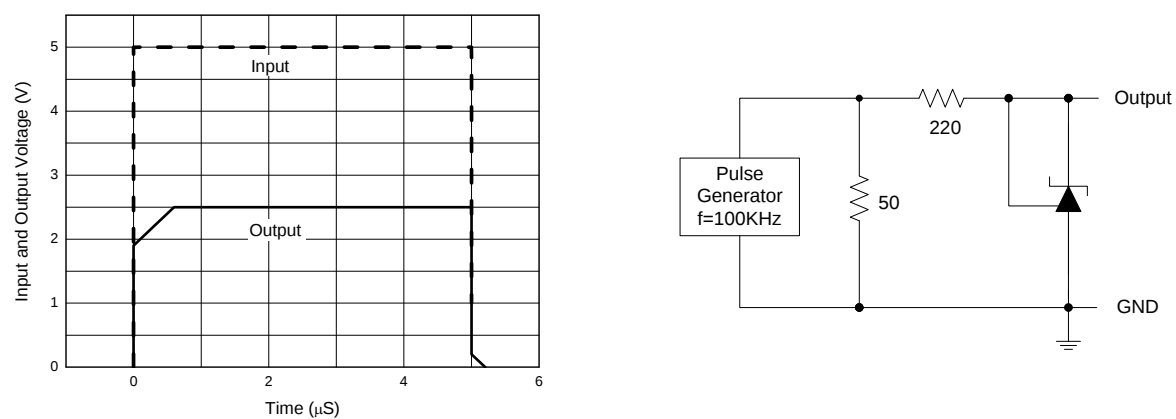


Figure 16. Pulse Response of Input and Output Voltage



ADJUSTABLE PRECISION SHUNT REGULATORS

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Typical Application

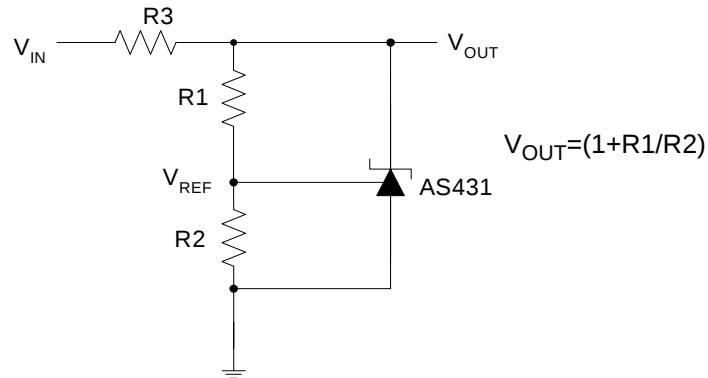


Figure 17. Shunt Regulator

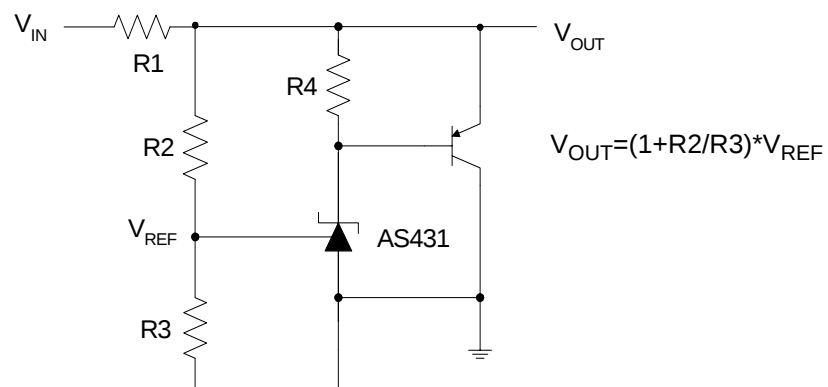


Figure 18. High Current Shunt Regulator

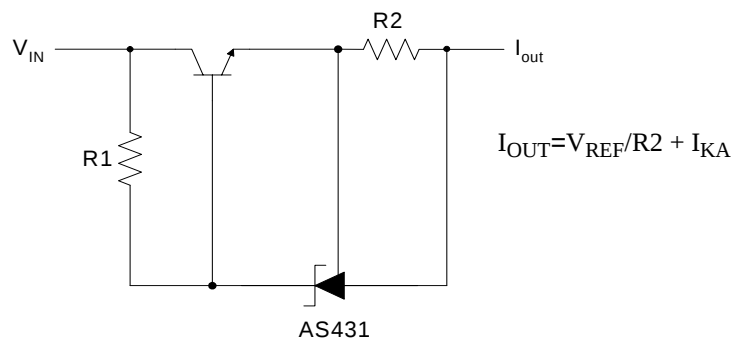
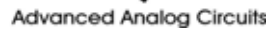
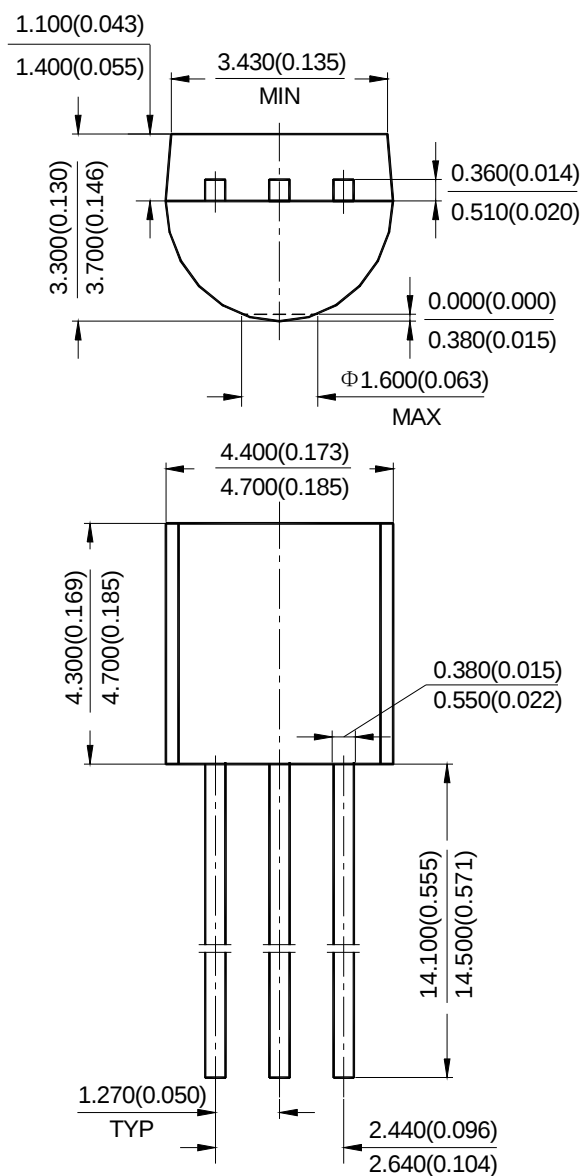


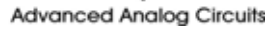
Figure 19. Current Source or Current Limit



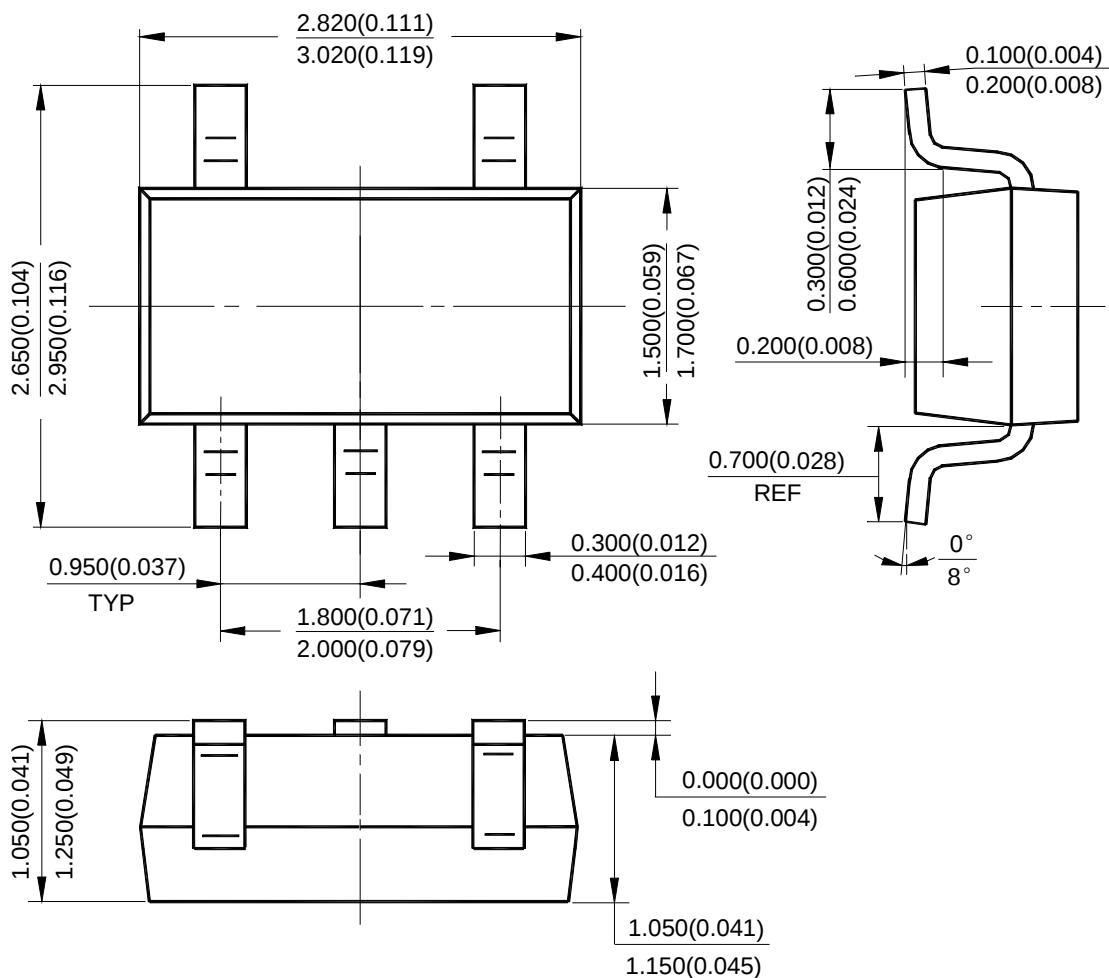
The diagram illustrates a buck converter circuit. The PS521 PWM controller (U2) is configured with a feedback network consisting of a resistor R1 and a capacitor C1 connected to its COMP pin. The VFB pin is connected to the feedback node. The controller's output (pin 3) drives the base of a MOSFET (Q1, AS431). The MOSFET's source is connected to ground, and its drain is connected to the inductor L1. The inductor L1 is in series with a diode (D1) connected to ground. The output voltage V_OUT is taken across the inductor L1. The circuit is powered by a DC source V_IN through a resistor R3. A capacitor C2 is connected between the input and the MOSFET gate. A resistor R5 is connected between the input and the diode cathode. A resistor R4 is connected between the output and the diode cathode. The diode D1 is an AS431.

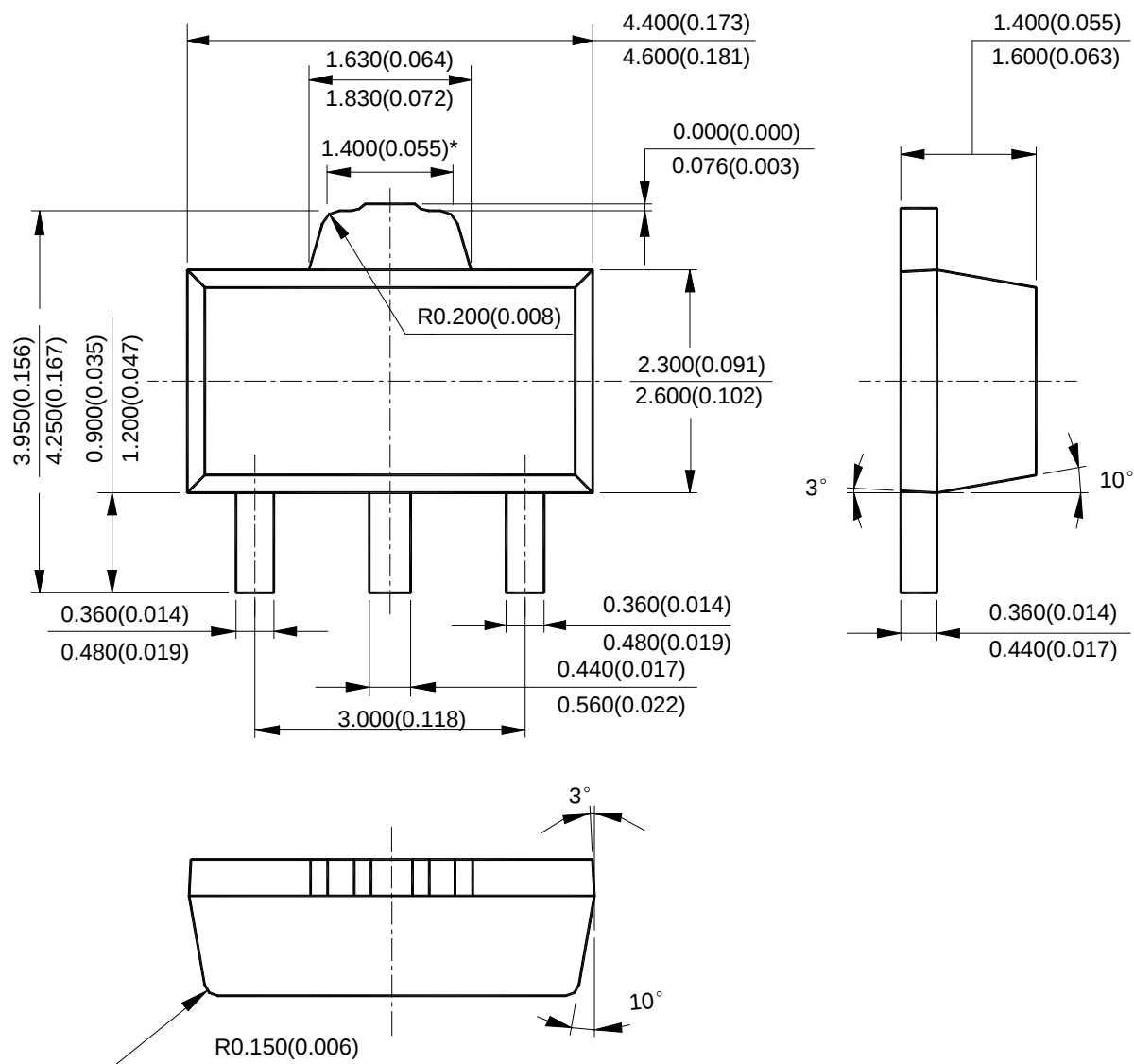
Nov. 2005 Rev. 1. 1

**ADJUSTABLE PRECISION SHUNT REGULATORS****AS431****Mechanical Dimensions****TO-92****Unit: mm (inch)**



SOT-23-3

**ADJUSTABLE PRECISION SHUNT REGULATORS****AS431****Mechanical Dimensions (Continued)****SOT-23-5****Unit: mm(inch)**

**ADJUSTABLE PRECISION SHUNT REGULATORS****AS431****Mechanical Dimensions (Continued)****SOT-89****Unit: mm(inch)**



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