

ADJUSTABLE PRECISION SHUNT REGULATORS

AN431

General Description

The AN431 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 AN431 precision reference is offered in two voltage tolerance: 0.5% and 1.0%.

These ICs are available in SOT-23 package.

Features

- Programmable Precise Output Voltage from 2.5V to 36V
- 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 100mA
- 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 Type of AN431

ADJUSTABLE PRECISION SHUNT REGULATORS

AN431

Pin Configuration

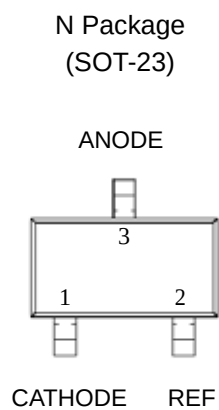


Figure 2. Pin Configuration of AN431 (Top View)

Functional Block Diagram

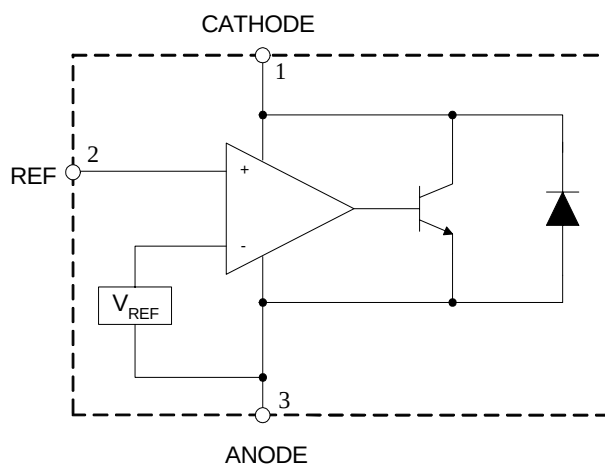
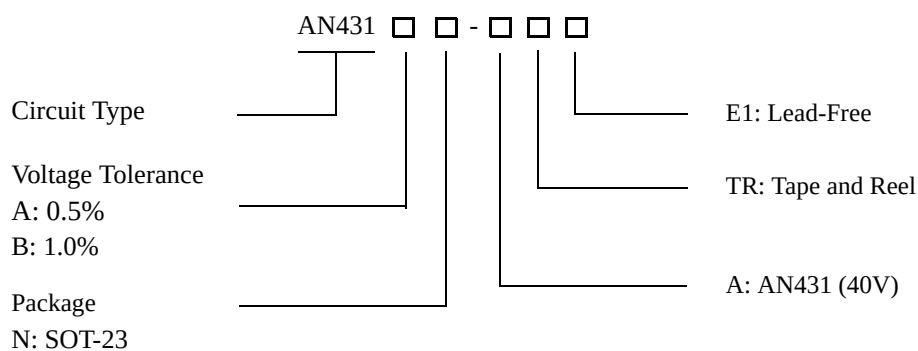


Figure 3. Functional Block Diagram of AN431

ADJUSTABLE PRECISION SHUNT REGULATORS

AN431

Ordering Information



Package	Temperature Range	Voltage Tolerance	Part Number	Marking ID	Packing Type
SOT-23	-40 to 125°C	0.5%	AN431AN-ATRE1	EB1	Tape & Reel
		1.0%	AN431BN-ATRE1	EB2	Tape & Reel

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

ADJUSTABLE PRECISION SHUNT REGULATORS

AN431

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	370	mW
Junction Temperature	T_J	150	°C
Storage Temperature Range	T_{STG}	-65 to 150	°C
ESD (Human Body Model)	ESD	2000	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



ADJUSTABLE PRECISION SHUNT REGULATORS

AN431

Electrical Characteristics

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

Parameter	Test Circuit	Symbol	Conditions	Min	Typ	Max	Unit
Reference Voltage	0.5%	4	$V_{KA} = V_{REF}$, $I_{KA} = 10\text{mA}$	2.487	2.500	2.512	V
	1.0%			2.475	2.500	2.525	
Deviation of Reference Voltage Over Full Temperature Range	4	ΔV_{REF}	$V_{KA} = V_{REF}$, $I_{KA} = 10\text{mA}$	0 to 70°C	4.5	8	mV
				-40 to 85°C	4.5	10	
				-40 to 125°C	4.5	16	
Ratio of Change in Reference Voltage to the Change in Cathode Voltage	5	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	$I_{KA} = 10\text{mA}$	$\Delta V_{KA} = 10\text{V to } V_{REF}$	-1.0	-2.7	mV/V
				$\Delta V_{KA} = 36\text{V to } 10\text{V}$	-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 125°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



ADJUSTABLE PRECISION SHUNT REGULATORS

AN431

Electrical Characteristics (Continued)

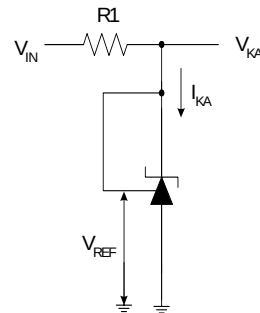


Figure 4. Test Circuit 4 for $V_{KA}=V_{REF}$

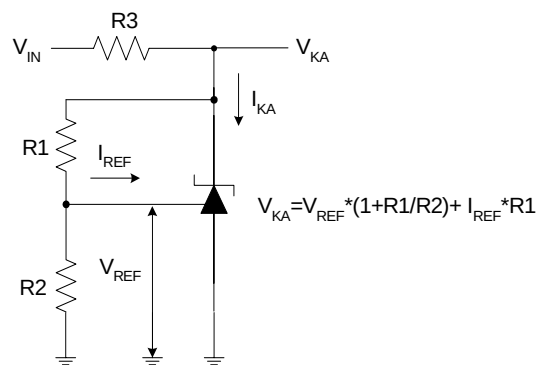


Figure 5. Test Circuit 5 for $V_{KA}>V_{REF}$

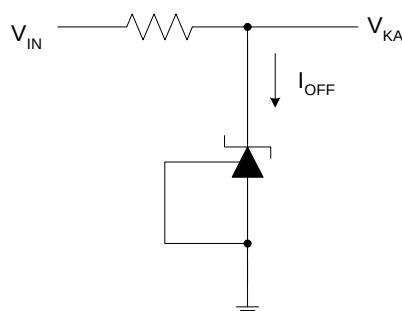


Figure 6. Test Circuit 6 for I_{OFF}

ADJUSTABLE PRECISION SHUNT REGULATORS

AN431

Typical Performance Characteristics

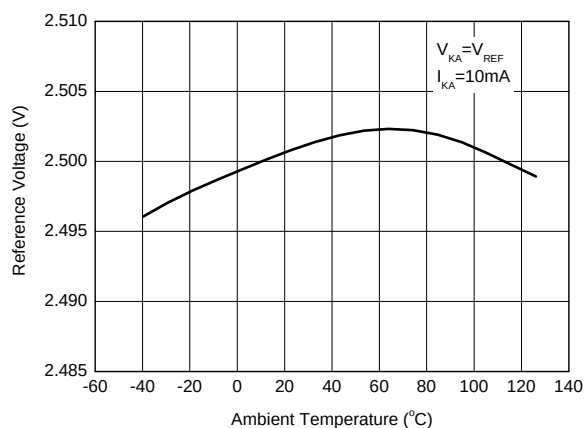


Figure 7. Reference Voltage vs. Ambient Temperature

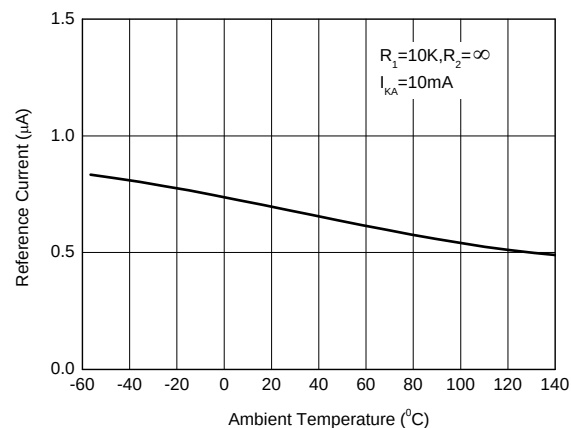


Figure 8. Reference Current vs. Ambient Temperature

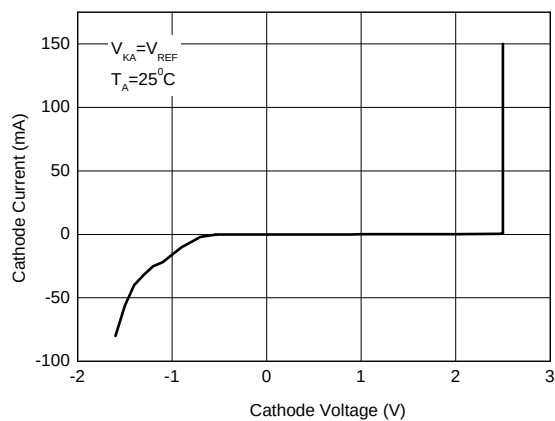


Figure 9. Cathode Current vs. Cathode Voltage

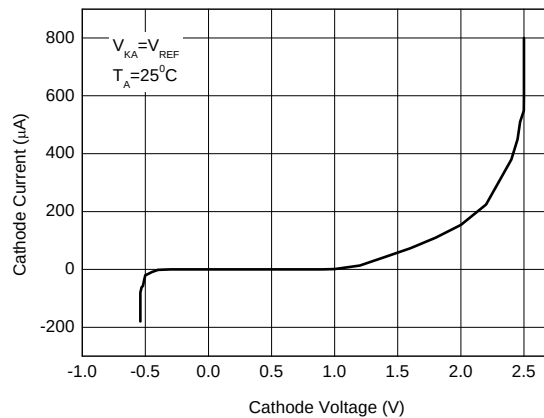


Figure 10. Cathode Current vs. Cathode Voltage

ADJUSTABLE PRECISION SHUNT REGULATORS

AN431

Typical Performance Characteristics (Continued)

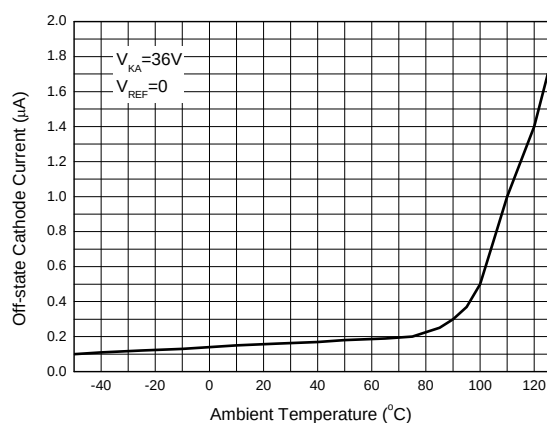


Figure 11. Off-state Cathode Current vs. Ambient Temperature

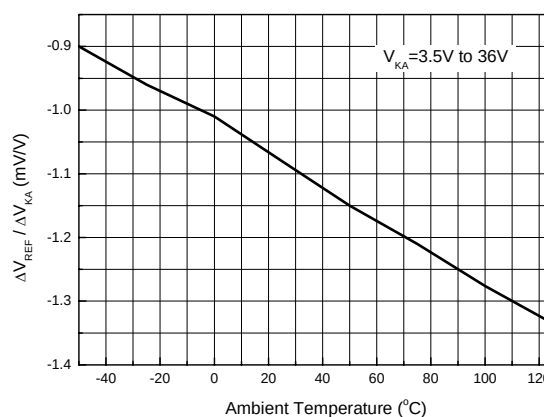


Figure 12. Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage

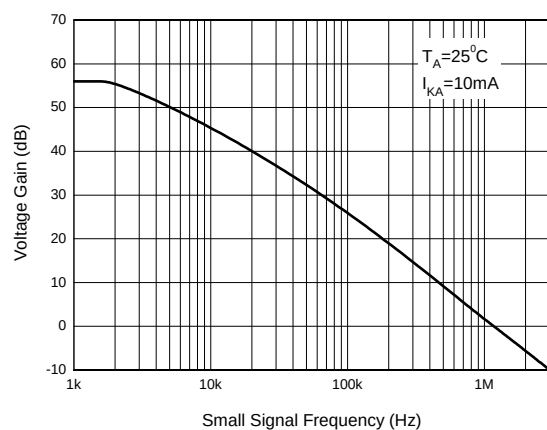
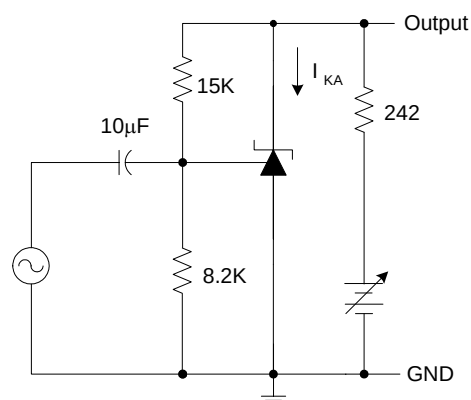


Figure 13. Small Signal Voltage Gain vs. Frequency



ADJUSTABLE PRECISION SHUNT REGULATORS

AN431

Typical Performance Characteristics (Continued)

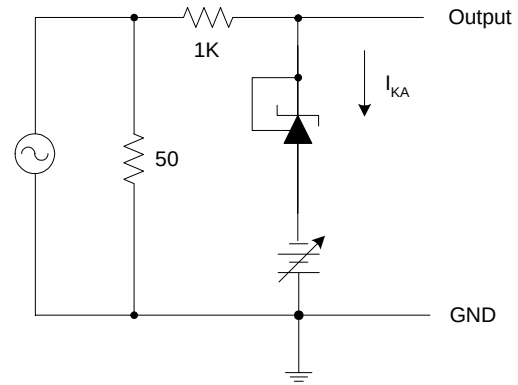
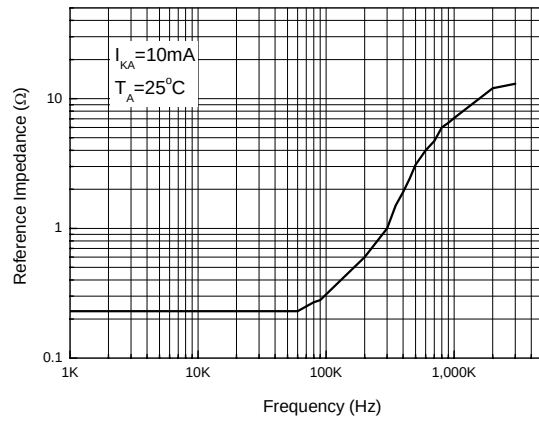


Figure 14. Reference Impedance vs. Frequency

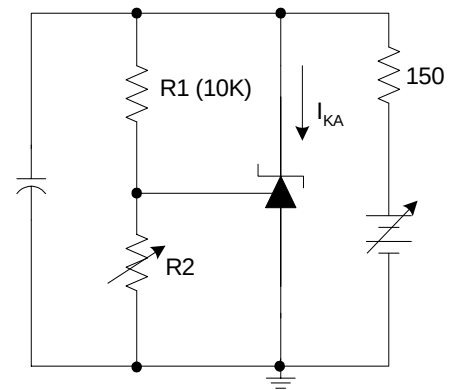
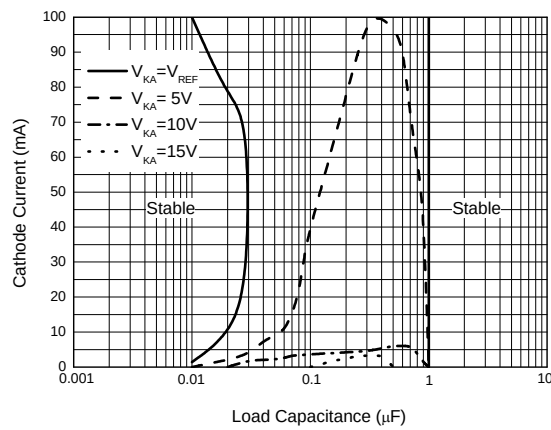


Figure 15. Stability Boundary Conditions vs. Load Capacitance

ADJUSTABLE PRECISION SHUNT REGULATORS

AN431

Typical Performance Characteristics (Continued)

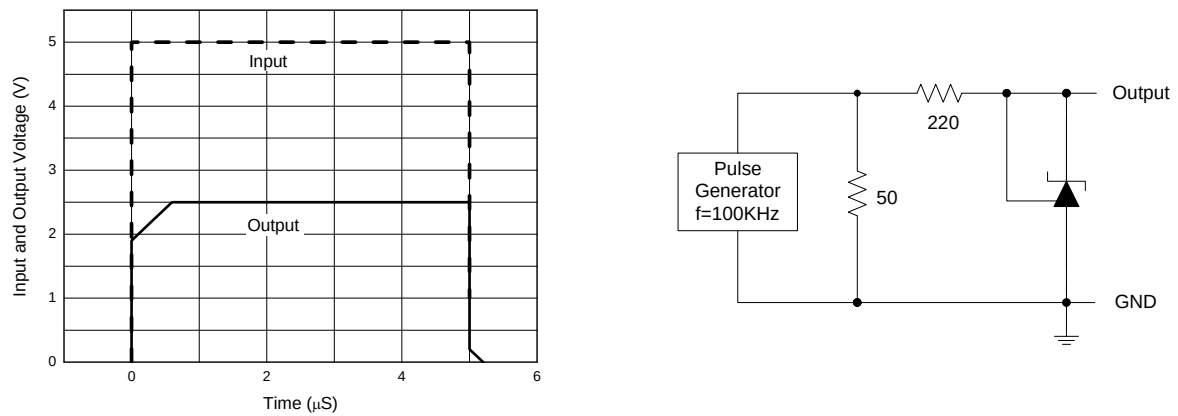


Figure 16. Pulse Response of Input and Output Voltage



ADJUSTABLE PRECISION SHUNT REGULATORS

AN431

Typical Application

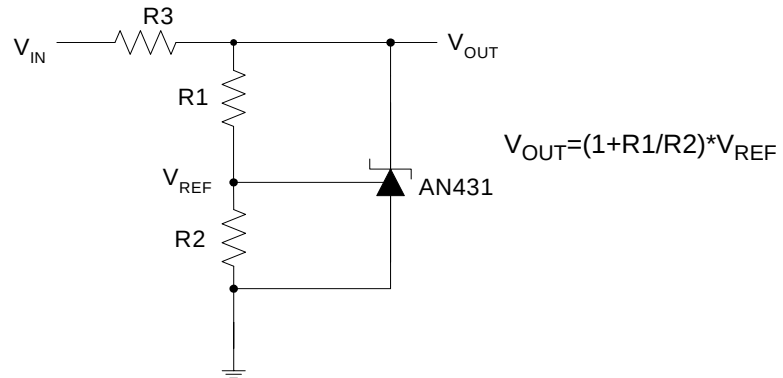


Figure 17. Shunt Regulator

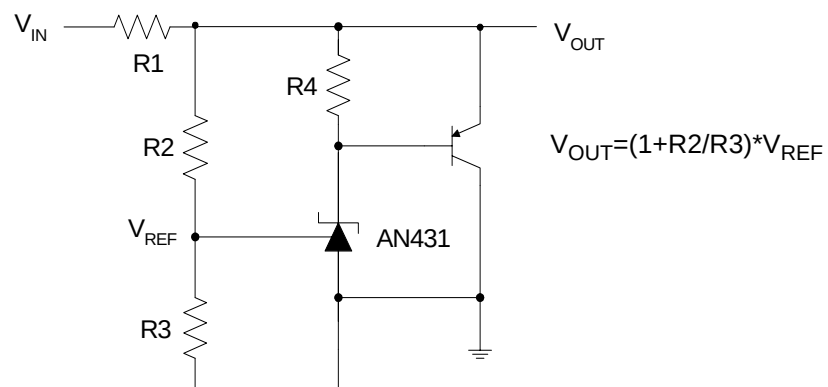


Figure 18. High Current Shunt Regulator

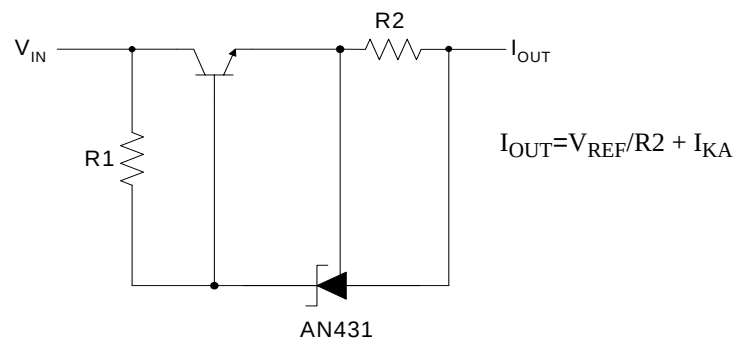


Figure 19. Current Source or Current Limit

ADJUSTABLE PRECISION SHUNT REGULATORS

AN431

Typical Application (Continued)

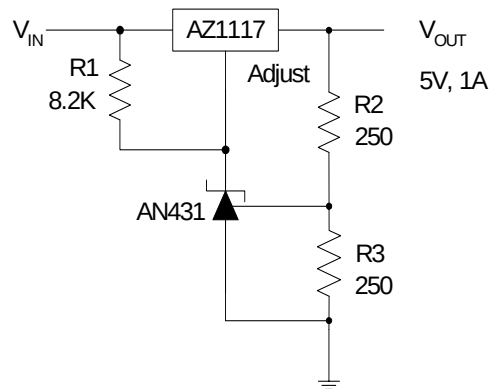


Figure 20. Precision 5V 1A Regulator

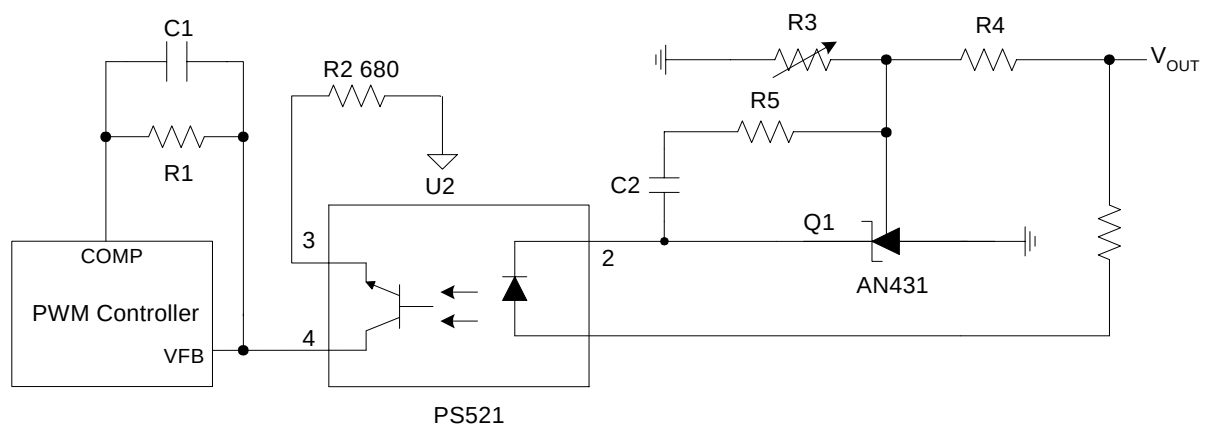
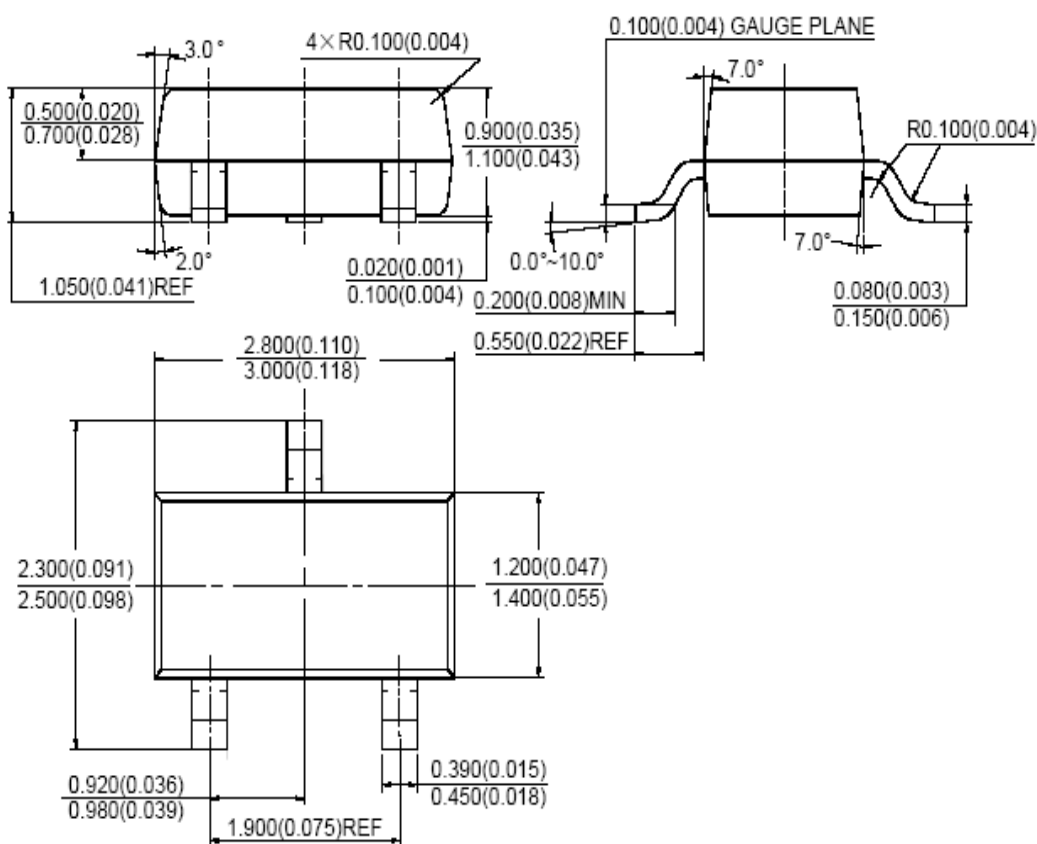


Figure 21. PWM Converter with Reference



SOT-23

Unit: mm(inch)





BCD Semiconductor Manufacturing Limited

<http://www.bcdsemi.com>

IMPORTANT NOTICE

BCD Semiconductor Manufacturing Limited reserves the right to make changes without further notice to any products or specifications herein. BCD Semiconductor Manufacturing Limited does not assume any responsibility for use of any its products for any particular purpose, nor does BCD Semiconductor Manufacturing Limited assume any liability arising out of the application or use of any its products or circuits. BCD Semiconductor Manufacturing Limited does not convey any license under its patent rights or other rights nor the rights of others.

MAIN SITE

BCD Semiconductor Manufacturing Limited

- Wafer Fab

Shanghai SIM-BCD Semiconductor Manufacturing Limited

800, Yi Shan Road, Shanghai 200233, China

Tel: +86-21-6485 1491, Fax: +86-21-5450 0008

BCD Semiconductor Manufacturing Limited

- IC Design Group

Advanced Analog Circuits (Shanghai) Corporation

8F, Zone B, 900, Yi Shan Road, Shanghai 200233, China

Tel: +86-21-6495 9539, Fax: +86-21-6485 9673

REGIONAL SALES OFFICE

Shenzhen Office

Shanghai SIM-BCD Semiconductor Manufacturing Co., Ltd. Shenzhen Office

Advanced Analog Circuits (Shanghai) Corporation Shenzhen Office

Room E, 5F, Noble Center, No.1006, 3rd Fuzhong Road, Futian District, Shenzhen 518026, China

Tel: +86-755-8826 7951

Fax: +86-755-8826 7865

Taiwan Office

BCD Semiconductor (Taiwan) Company Limited

4F, 298-1, Rui Guang Road, Nei-Hu District, Taipei,

Taiwan

Tel: +886-2-2656 2808

Fax: +886-2-2656 2806

USA Office

BCD Semiconductor Corporation

30920 Huntwood Ave. Hayward,

CA 94544, U.S.A

Tel : +1-510-324-2988

Fax: +1-510-324-2788