ADJUSTABLE PRECISION SHUNT REGULATORS HWD 431

General Description

The HWD431 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 HWD431 series ICs contain two voltage types, 40V and 20V. The output voltage of both types can be set to any value between V_{REF}(2.5V) and the corresponding maximum cathode voltage.

The HWD431 precision reference is offered in two band-gap tolerance: 0.4% and 0.8%.

The 4 main packages have low thermal impedance which allows operation over a wide range of -40 to 125^{o}C.

Features

- Programmable precise output voltage from 2.5V to 36V or 18V
- 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/^{o}C typical
- Low dynamic output resistance: 0.2Ω typical
- Sink current capacity from 1mA to 100 mA
- Low output noise
- Available in 4 packages: TO-92, SOT-23-3, SOT-89 and SOIC-8

Applications

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

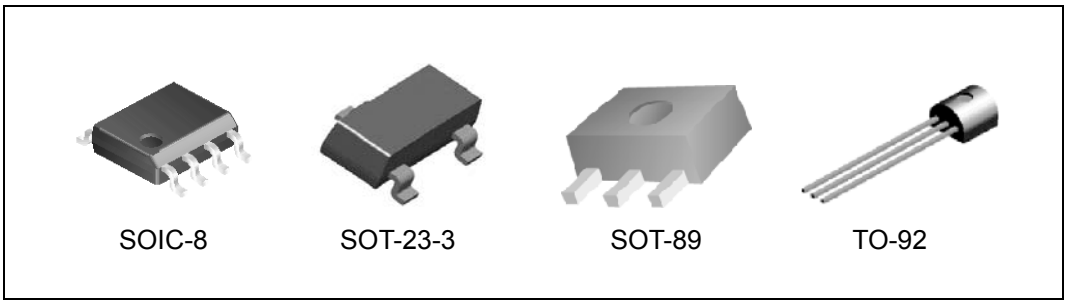


Figure 1. Package Types of HWD431

Pin Configuration

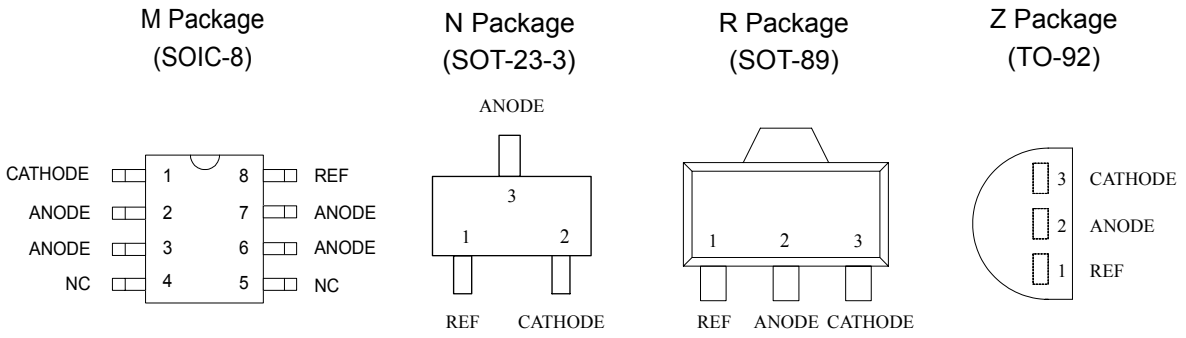


Figure 2. Pin Configuration of HWD431

Functional Block Diagram

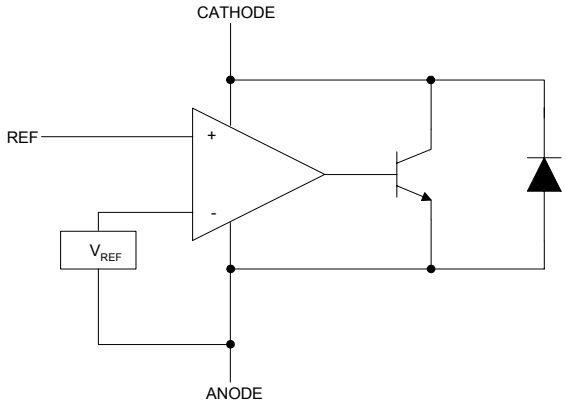


Figure 3. Functional Block Diagram of HWD431

Ordering Information for 40V products

Package	Temperature Range	Voltage Tolerance	Part Number	Marking ID	Packing Type
SOT-23-3	-40°C~125°C	0.4%	HWD431AN-A	DAN-A	Reel
		0.8%	HWD431BN- A	DBN-A	Reel
TO-92		0.4%	HWD431AZ-A	HWD431AZ-A	Bulk/Ammo
		0.8%	HWD431BZ-A	HWD431BZ-A	Bulk/Ammo
SOIC-8		0.4%	HWD431AM-A	HWD431AM-A	Tube
		0.8%	HWD431BM-A	HWD431BM-A	Tube
SOT-89		0.4%	HWD431AR-A	431A	Reel
		0.8%	HWD431BR-A	431B	Reel

Ordering Information for 20V products

Package	Temperature Range	Voltage Tolerance	Part Number	Marking ID	Packing Type
SOT-23-3	-40°C~125°C	0.4%	HWD431AN-B	DAN-B	Reel
		0.8%	HWD431BN-B	DBN-B	Reel
TO-92		0.4%	HWD31AZ-B	HWD431AZ-B	Bulk/Ammo
		0.8%	HWD431BZ-B	HWD431BZ-B	Bulk/Ammo
SOIC-8		0.4%	HWD431AM-B	HWD431AM-B	Tube
		0.8%	HWD431BM-B	HWD431BM-B	Tube
SOT-89		0.4%	HWD431AR-B	431C	Reel
		0.8%	HWD431BR-B	431D	Reel

HWD 431 A N - A

Circuit Type

Bandgap Tolerance
- A: 0.4%
- B: 0.8%

A: HWD431(40V)
B: HWD431(20V)

Package
- M: SOIC-8
- N: SOT-23
- R: SOT-89
- Z: TO-92

Absolute Maximum Ratings

(Operation temperature range applies unless otherwise specified.)

Parameter	Symbol	Value	Unit
Cathode Voltage	V_{KA}	HWD431 (40V): 40	V
		HWD431 (20V): 20	
Cathode Current Range (Continuous)	I_{KA}	-100 ~ +150	mA
Reference Input Current Range	I_{REF}	10	mA
Power Dissipation	P_D	M,Z,R Package: 770	mW
		N Package: 370	
Junction Temperature	T_J	160	^oC
Storage Temperature Range	T_{STG}	-65~+150	^oC
Package Thermal Impedance	Q_{JA}	M Package: 150	$^oC/W$
		N Package: 330	
		Z Package: 150	
		R Package: 50	

Note: 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 Operation Ratings" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

Recommended Operation Ratings

Parameter	Symbol	Min.	Max.	Unit
Cathode Voltage	V_{KA}	V_{REF}	HWD431(40V): 36	V
			HWD431(20V): 18	
Cathode Current	I_{KA}	1.0	100	mA
Operating Ambient Temperature Range		-40	125	^oC

Electrical Characteristics

Operating Conditions: T_A=25°C unless otherwise specified.

Parameter		Test Circuit	Symbol	Conditions		HWD431 (40V)			Unit
						Min.	Typ.	Max.	
Reference Voltage	0.4%	4	V_{REF}	$V_{KA}=V_{REF}$, I_{KA}=10mA		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}= 10mA	0 to 70°C	-	4.5	8	mV
					-40 to 85°C	-	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}=10mA	ΔV_{KA}= 10V to V_{REF}	-	-1.0	-2.7	mV/V
					ΔV_{KA}= 36V to 10V	-	-0.5	-2.0	
Reference Current		5	I_{REF}	I_{KA}=10mA,R1=10KΩ, R2=∞		-	0.7	4	μ A
Deviation of Reference Current Over Full Temperature Range		5	ΔI_{REF}	I_{KA}=10mA, R1=10KΩ R2=∞, T_A=-40 to 85°C		-	0.4	1.2	μ A
Minimum Cathode Current for Regulation		4	I_{KA} (MIN)	$V_{KA}=V_{REF}$		-	0.4	1.0	mA
Off-State Cathode Current		6	I_{KA} (OFF)	V_{KA}=36 V, V_{REF}=0			0.05	1.0	μ A
Dynamic Impedance		4	Z_{KA}	$V_{KA}=V_{REF}$, I_{KA}=1 to 100mA, f≤1.0KHz		-	0.15	0.5	Ω

Electrical Characteristics

Operating Conditions: T_A=25°C unless otherwise specified.

Parameter		Test Circuit	Symbol	Conditions		HWD431 (20V) Min.	Typ.	Max.	Unit
Reference Voltage	0.4%	4	V_{REF}	$V_{KA}=V_{REF}$, I_{KA}=10mA		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}=10mA	0 to 70°C	-	4.5	8	mV
					-40 to 85°C	-	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}=10mA	ΔV_{KA}= 10V to V_{REF}	-	-1.0	-2.7	mV/V
					ΔV_{KA}= 18V to 10V	-	-0.5	-2.0	
Reference Current		5	I_{REF}	I_{KA}=10mA, R1=10KΩ, R2=∞		-	0.7	4	μ A
Deviation of Reference Current Over Full Temperature Range		5	ΔI_{REF}	I_{KA}=10mA, R1=10KΩ,R2=∞ T_A=-40 to 85°C		-	0.4	1.2	μ A
Minimum Cathode Current for Regulation		4	I_{KA} (MIN)	$V_{KA}=V_{REF}$		-	0.4	1.0	mA
Off-State Cathode Current		6	I_{KA} (OFF)	V_{KA}=18V, V_{REF}=0		-	0.05	1.0	μ A
Dynamic Impedance		4	Z_{KA}	$V_{KA}=V_{REF}$, I_{KA}=1 to 100mA f≤1.0KHz		-	0.2	0.5	Ω

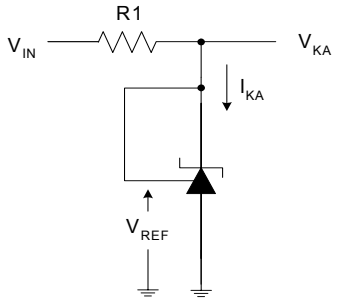


Figure 4. Test Circuit 4 for $V_{KA}=V_{ref}$

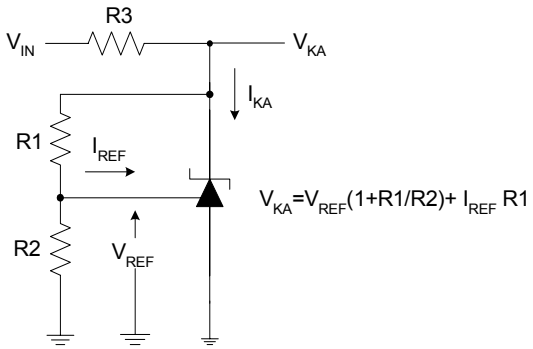


Figure 5. Test Circuit 5 for $V_{KA}>V_{ref}$

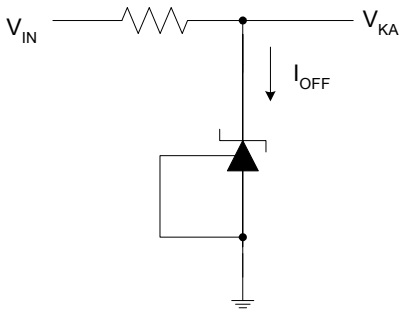


Figure 6. Test Circuit 6 for I_{OFF}

Typical Characteristics

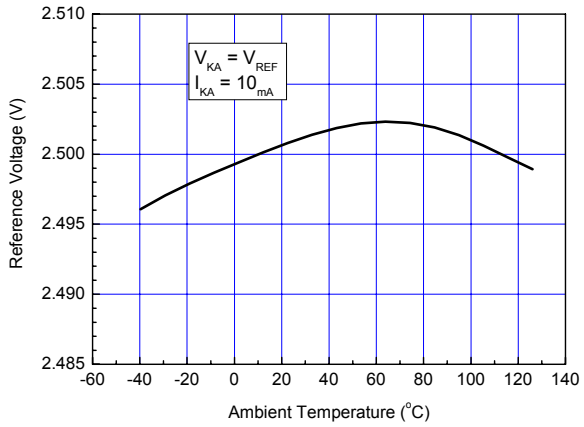


Figure 7. Reference Voltage vs. Ambient Temperature

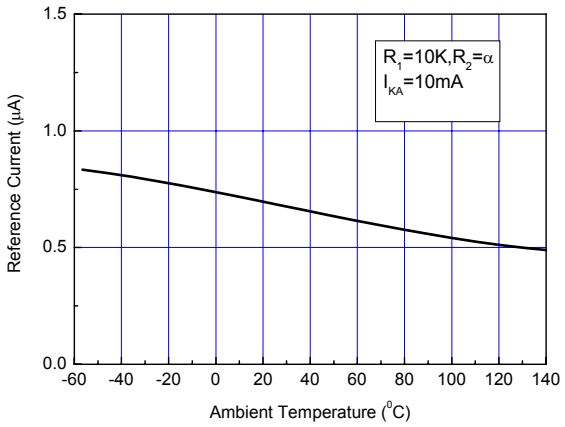


Figure 8. Reference Current vs. Ambient Temperature

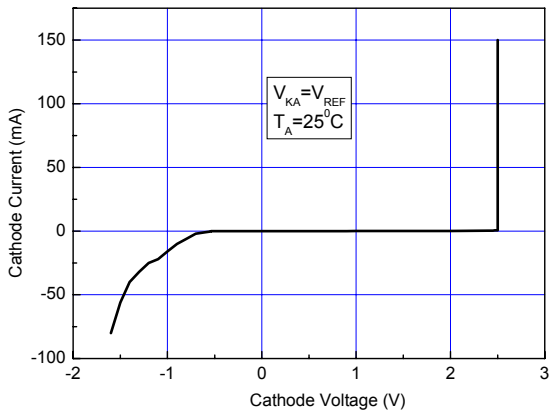


Figure 9. Cathode Current vs. Cathode Voltage

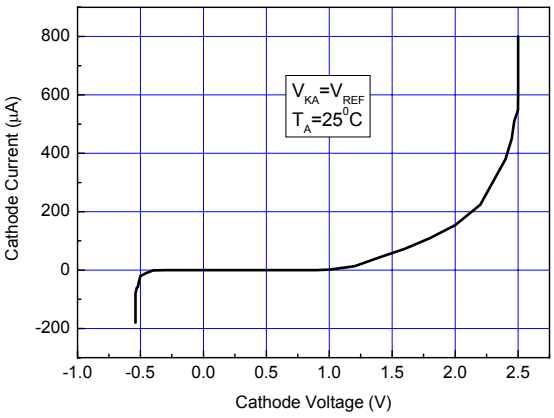


Figure 10. Current vs. Cathode Voltage

Typical Characteristics (Continued)

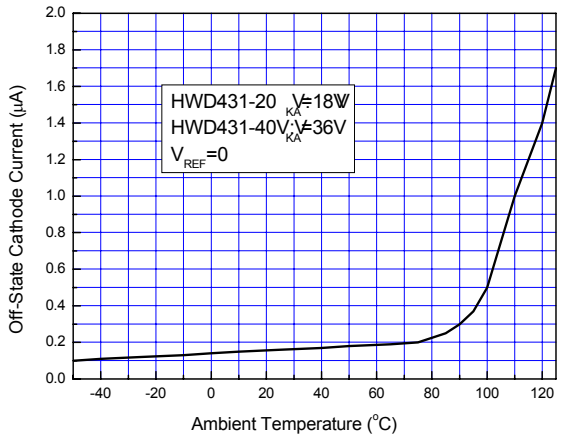


Figure 11. Off-state Cathode Current vs. Ambient Temperature

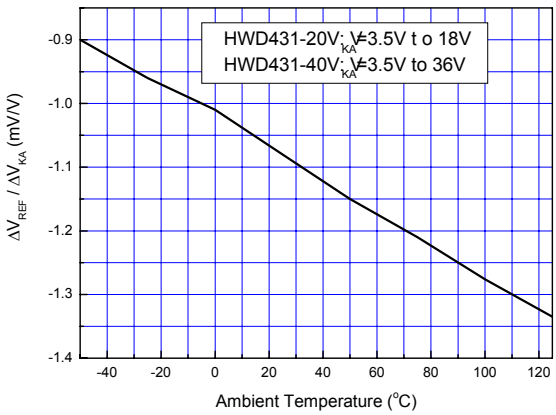
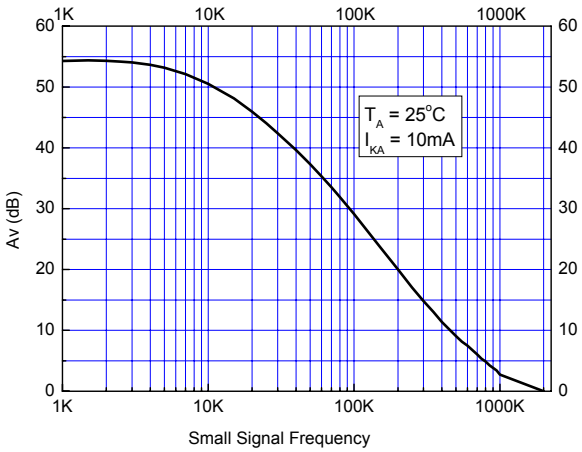


Figure 12. Ratio of Delta Reference Voltage to the Ratio of Delta Cathode Voltage



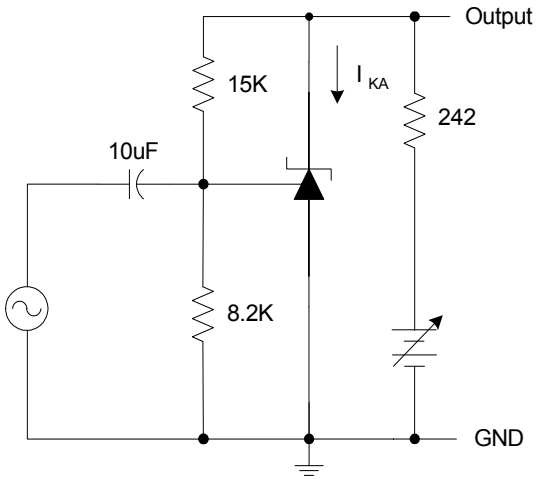


Figure 13. Small Signal Voltage Gain vs. Frequency

Typical Characteristics (Continued)

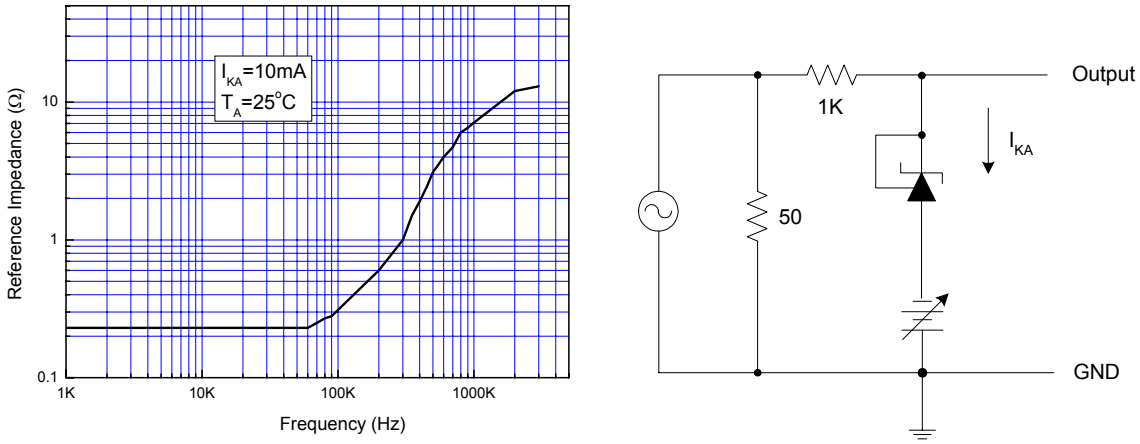


Figure 14. Reference Impedance vs. Frequency

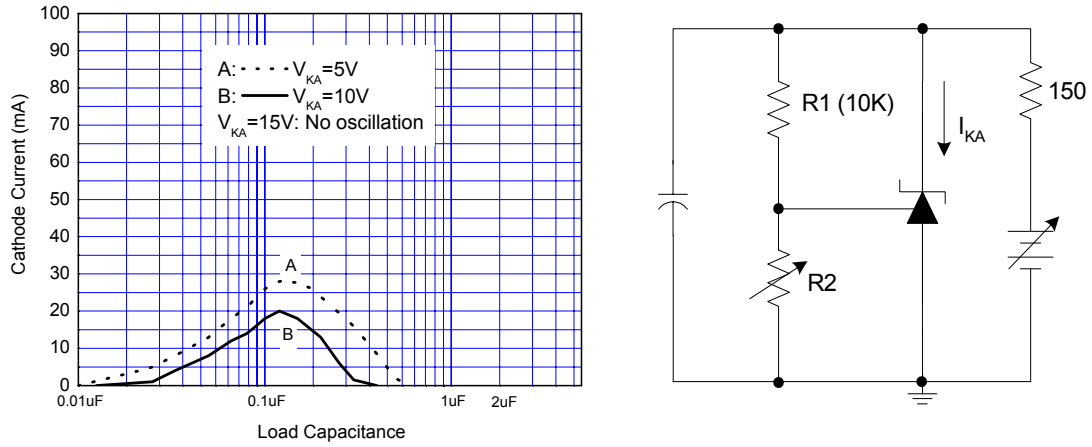


Figure 15. Stability Boundary Conditions vs. Load Capacitance

Typical Characteristics (Continued)

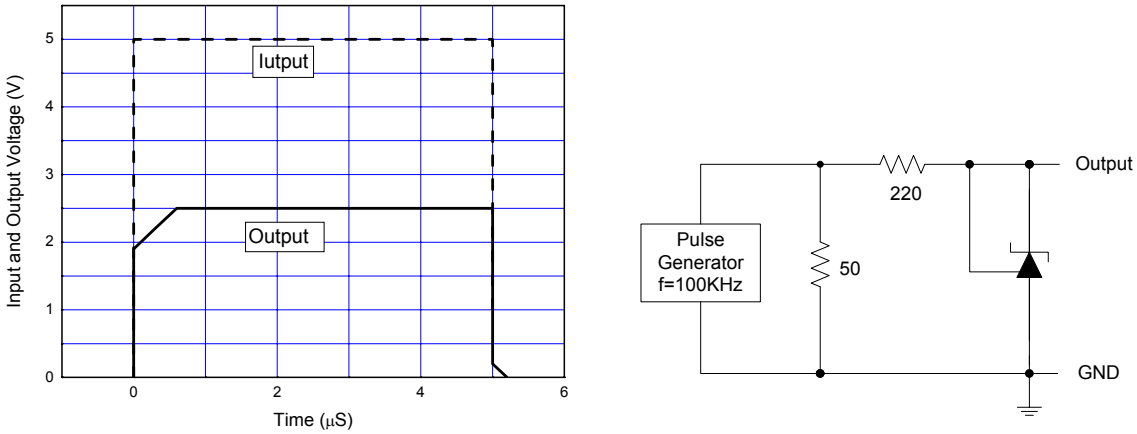


Figure 16. Pulse Response of Input and Output Voltage

Typical Applications

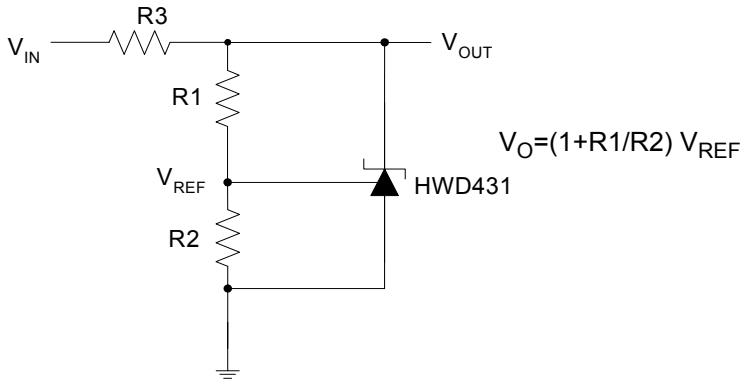


Figure 17: Shunt Regulator

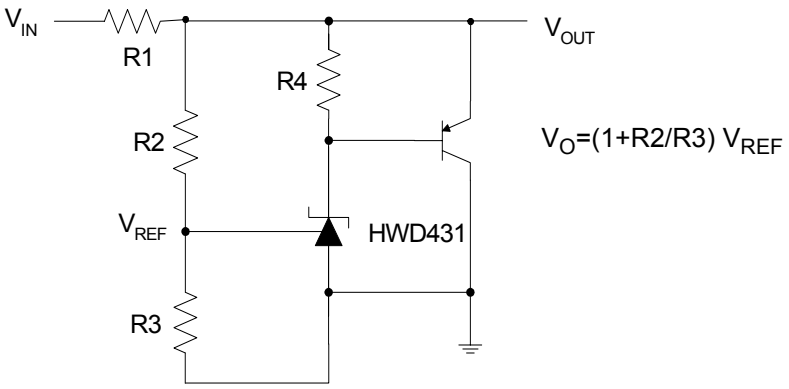


Figure 18: High Current Shunt Regulator

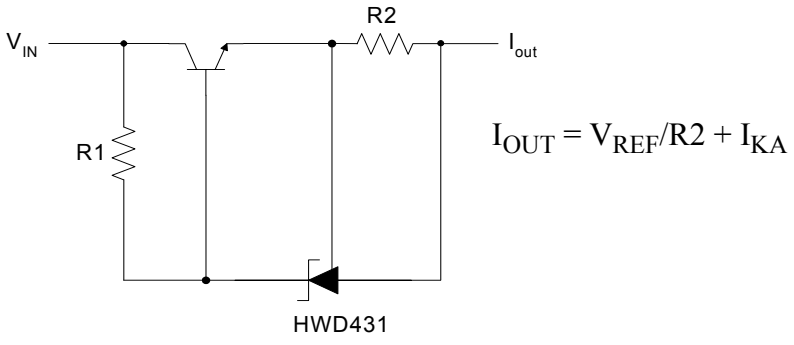


Figure19: Current Source or Current Limit

Typical Applications (Continued)

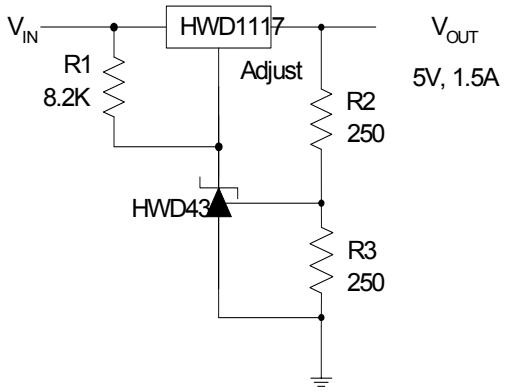


Figure20: Precision 5V 1.5A Regulator

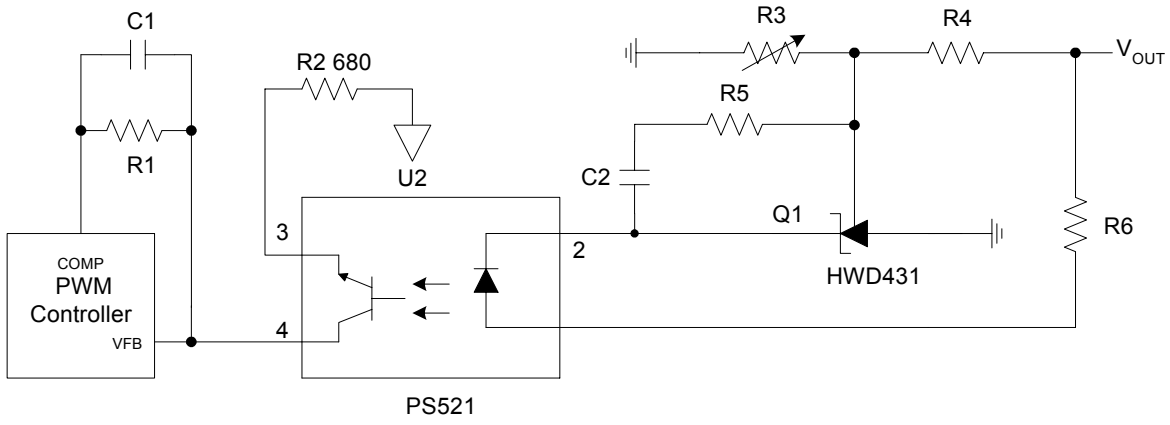
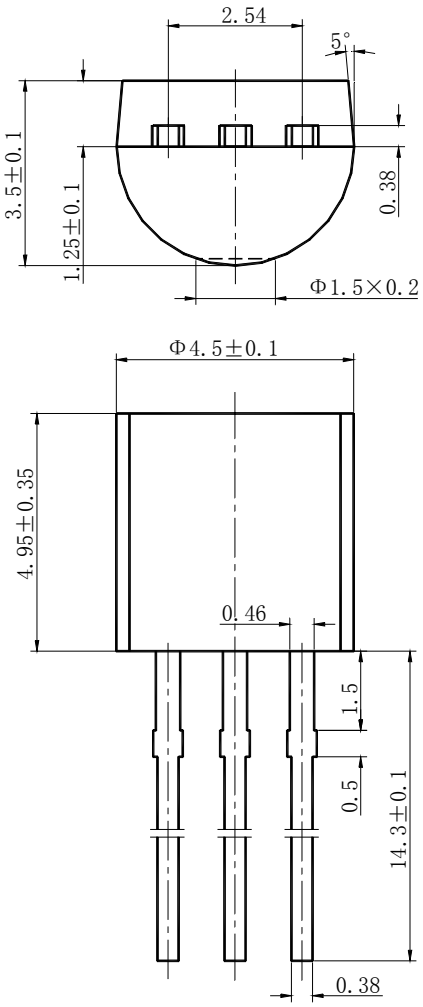


Figure 21: PWM Converter with Reference

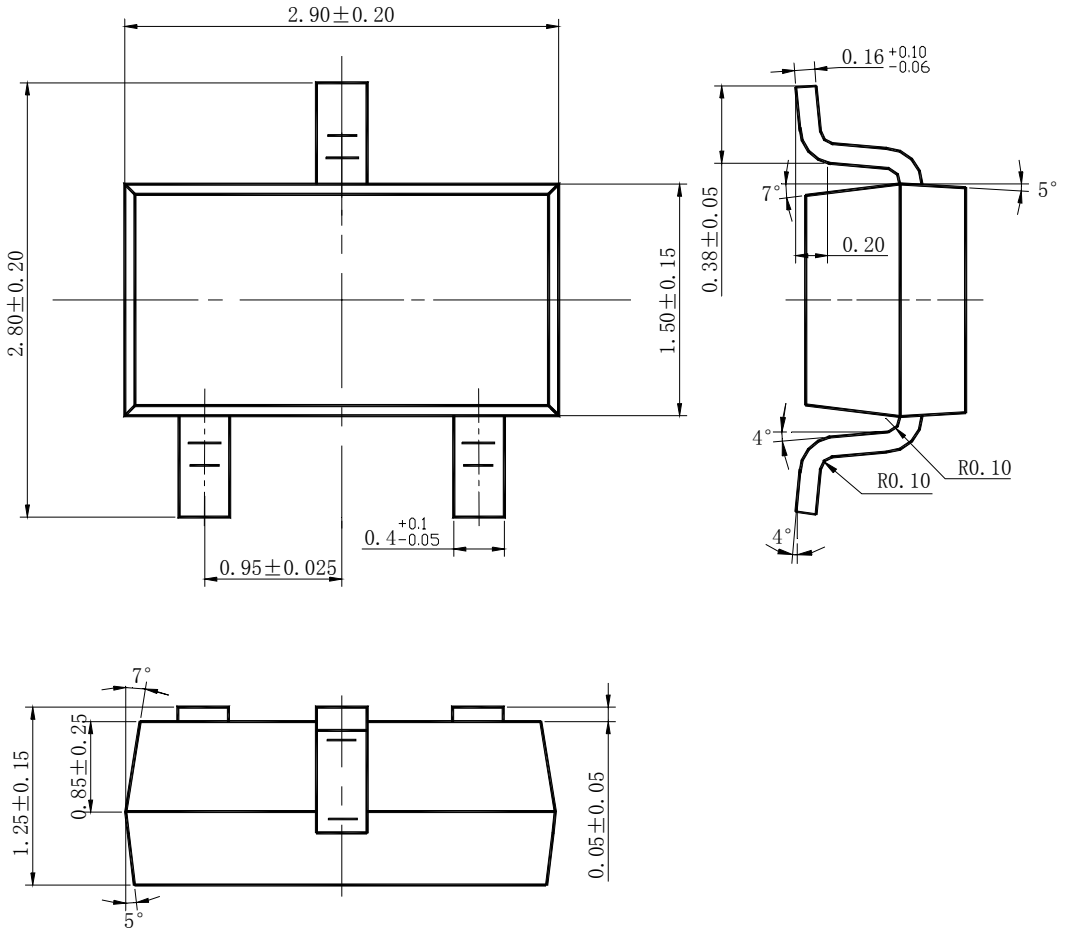
Mechanical Dimensions

TO-92



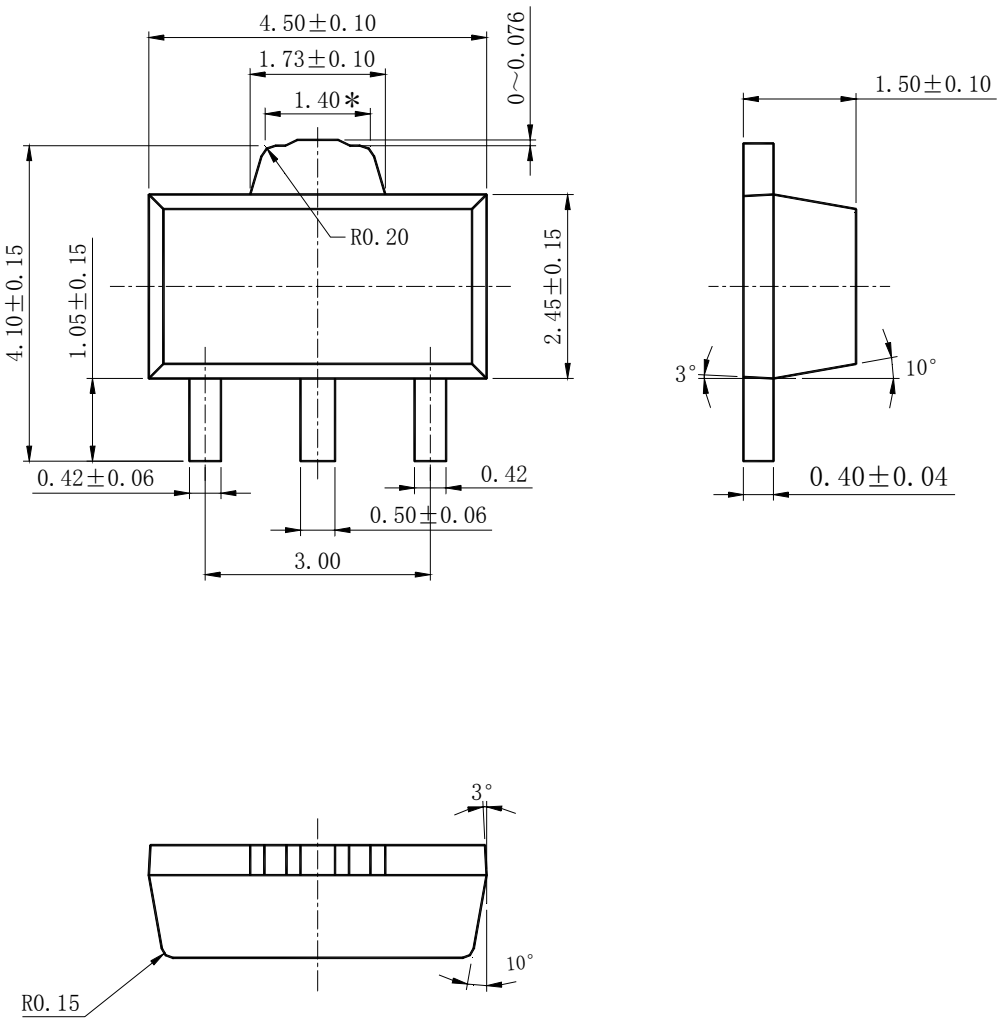
Mechanical Dimensions (Continued)

SOT-23-3



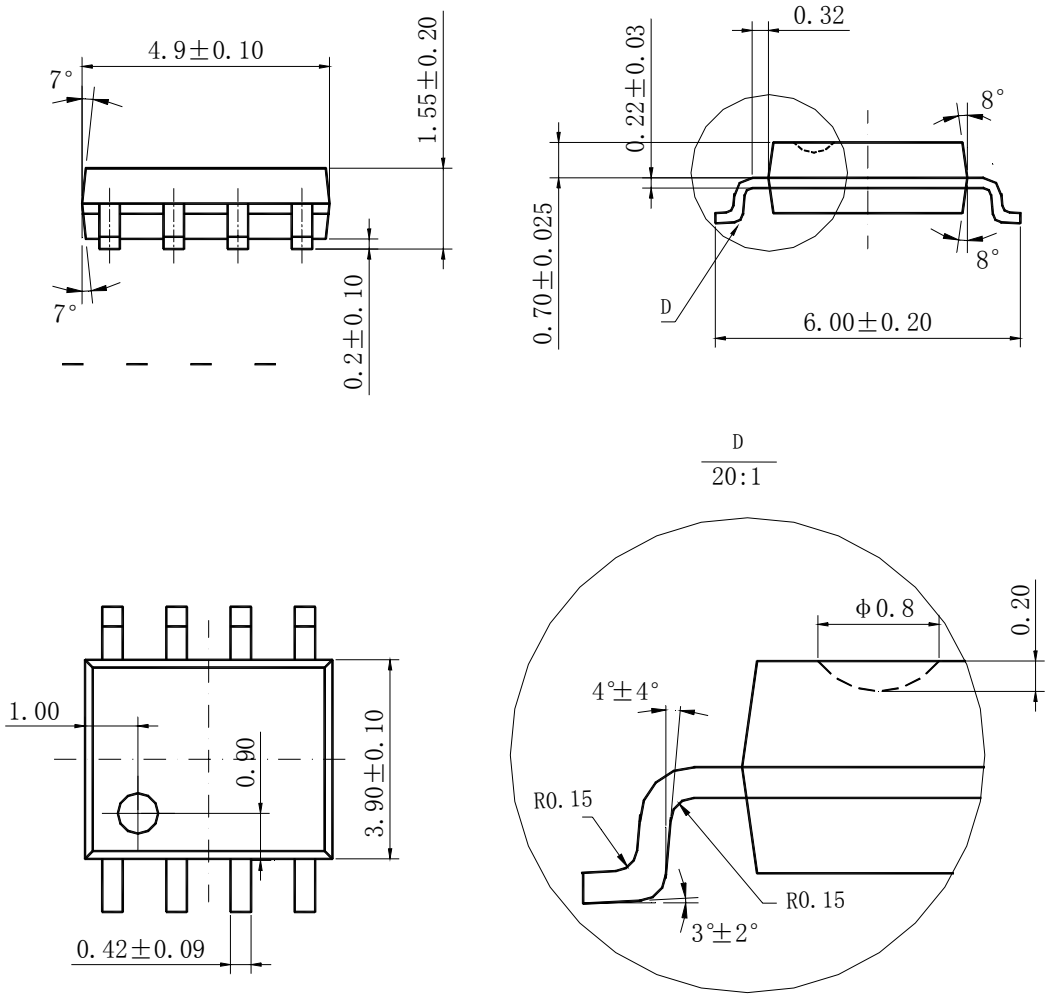
Mechanical Dimensions (Continued)

SOT- 89



Mechanical Dimensions (Continued)

SOIC- 8



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