



SP431

High Voltage Adjustable Precision Shunt Regulators

DESCRIPTION

The SP431 is high-voltage three-terminal adjustable voltage references, with specified thermal stability over applicable industrial and commercial temperature ranges. Output voltage can be set to any value between V_{REF} (2.5V) and 36V with two external resistors. These devices have a typical output impedance of 0.25Ω . Active output circuitry provides a very sharp turn-on characteristic, making the SP431 excellent replacements for low-voltage Zener diodes in many applications, including onboard regulation and adjustable power supplies.

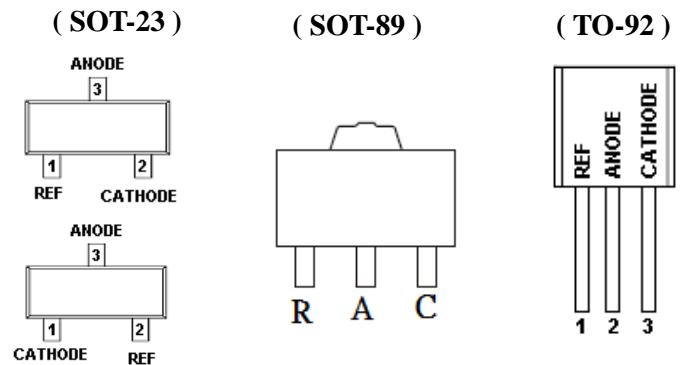
APPLICATIONS

- Battery Power Equipment
- Linear Regulators
- Switch Power Supply
- Cellular Phone
- Digital Cameras
- Computer Disk Drivers
- Instrumentation

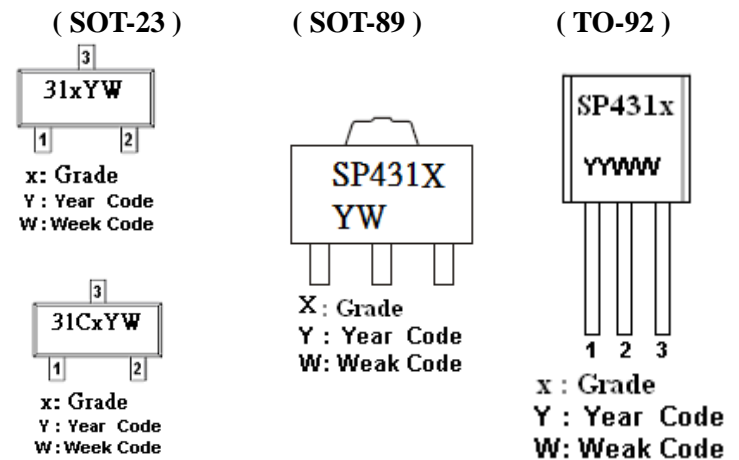
FEATURES

- ◆ Low Output Noise
- ◆ Adjustable Output Voltage, $V_o = V_{ref}$ to 36V
- ◆ Low Operational Cathode Current
- ◆ 0.25Ω Typical Output Impedance

PIN CONFIGURATION



PART MARKING





SP431

High Voltage Adjustable Precision Shunt Regulators

PIN DESCRIPTION: SP431AS23RGB/SP431BS23RGB/ SP431AS89RGB/ SP431BS89RGB

Pin	Symbol	Description
1	R	REF
2	C	CATHODE
3	A	ANODE

PIN DESCRIPTION: SP431AT92AGB/SP431BT92AGB

Pin	Symbol	Description
1	R	REF
2	A	ANODE
3	C	CATHODE

PIN DESCRIPTION: SP431CAS23RGB/SP431CBS23RGB

Pin	Symbol	Description
1	C	CATHODE
2	R	REF
3	A	ANODE

ORDERING INFORMATION

Part Number	Voltage Tolerance	Package	Part Marking
SP431AS23RGB	0.5%	SOT-23	31AYW
SP431BS23RGB	1.0%	SOT-23	31BYW
SP431AS89RGB	0.5%	SOT-89	SP431A
SP431BS89RGB	1.0%	SOT-89	SP431B
SP431CAS23RGB	0.5%	SOT-23	31CAYW
SP431CBS23RGB	1.0%	SOT-23	31CBYW
SP431AT92AGB	0.5%	TO-92	SP431A
SP431BT92AGB	1.0%	TO-92	SP431B

※ Week Code : A ~ Z (1 ~ 26) ; a ~ z (27 ~ 52)

※ SP431AS23RGB/SP431BS23RGB : Tape Reel ; Pb – Free; Halogen – Free

※ SP431AS89RGB/SP431BS89RGB : Tape Reel ; Pb – Free; Halogen – Free

※ SP431CAS23RGB/SP431CBS23RGB : Tape Reel ; Pb – Free; Halogen – Free

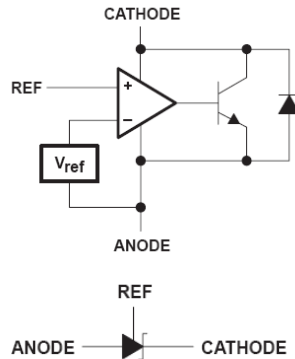
※ SP431AT92AGB/SP431BT92AGB : Tape Ammo ; Pb – Free; Halogen – Free



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BLOCK DIAGRAM



ABSOLUTE MAXIMUM RATINGS

($T_A=25^{\circ}\text{C}$ Unless otherwise specified)

Parameter	Symbol	Value	Unit
Cathode Voltage	V_Z	37	V
Continuous Cathode Current	I_Z	150	mA
Reference Current	I_{REF}	10	mA
Operation Junction Temperature Range	T_J	-40 ~ +150	$^{\circ}\text{C}$
Storage Temperature Range	T_{STG}	-65 ~ +150	$^{\circ}\text{C}$
Lead Temperature Range (Soldering 10sec.)	T_{SOL}	260	$^{\circ}\text{C}$
Thermal Resistance	Θ_{JA}	140	$^{\circ}\text{C}/\text{W}$

The IC has a protection circuit against static electricity. Do not apply high static electricity or high voltage that exceeds the performance of the protection circuit to the IC.



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ELECTRICAL CHARACTERISTICS

($T_A=25^{\circ}\text{C}$, Unless otherwise specified)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Reference Voltage	V_{REF}	$V_Z = V_{REF}$ $I_Z = 10\text{mA}$	SP431AS23RGB SP431AS89RGB SP431CAS23RGB SP431AT92AGB	2.482	2.495	2.508	V
			SP431BS23RGB SP431BS89RGB SP431CBS23RGB SP431BT92AGB	2.47	2.495	2.52	
Reference Voltage	V_{REF}	$V_Z = V_{REF}$ $I_Z = 1\text{mA}$	SP431AS23RGB SP431AS89RGB SP431CAS23RGB SP431AT92AGB	2.482	2.495	2.508	V
			SP431BS23RGB SP431BS89RGB SP431CBS23RGB SP431BT92AGB	2.47	2.495	2.52	
VREF Temp Deviation	V_{DEV}	$T_A=-40^{\circ}\text{C}\sim+85^{\circ}\text{C}$ $V_Z = V_{REF}$, $I_Z = 10\text{mA}$			10	25	mV
		$T_A=-40^{\circ}\text{C}\sim+125^{\circ}\text{C}$ $V_Z = V_{REF}$, $I_Z = 10\text{mA}$			20	35	
Ratio of change in VREF to change in Cathode voltage	$\Delta V_{REF} / \Delta V_Z$	$I_Z = 10\text{mA}$ $\Delta V_Z = 36\text{V} \sim V_{REF}$			-1.4	-2.7	mV / V
Reference Input Current	I_{REF}	$R_1=10\text{K}\Omega$, $R_2 = \infty$, $I_Z = 10\text{mA}$			2	4	μA
IREF Temp Deviation	$I_{REF(DEV)}$	$T_A=-40^{\circ}\text{C}\sim+85^{\circ}\text{C}$ $R_1=10\text{K}\Omega$, $R_2 = \infty$, $I_Z = 10\text{mA}$			0.8	2.5	μA
Off state Cathode Current	$I_{Z(OFF)}$	$V_{REF} = 0\text{V}$	$V_Z = 36\text{V}$		0.1	0.5	μA
Dynamic output impedance	R_Z	$f < 1\text{KHZ}$, $V_Z = V_{REF}$ $I_Z = 1\text{mA} \sim 100\text{mA}$			0.25	0.5	Ω
Minimum Operation Current	$I_{Z(MIN)}$	$V_Z = V_{REF}$			0.4	0.7	mA



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TESTING CIRCUIT

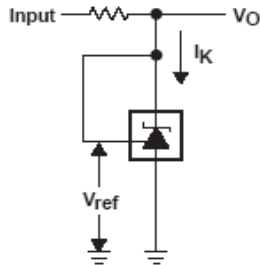


Figure 1. Test Circuit for $V_{KA} = V_{ref}$.
 $V_O = V_{KA} = V_{ref}$

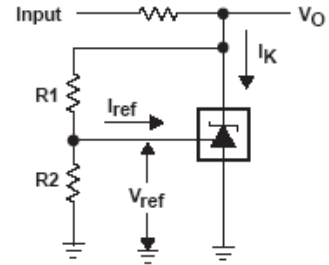


Figure 2. Test Circuit for $V_{KA} > V_{ref}$.
 $V_O = V_{KA} = V_{ref} \times (1 + R1/R2) + I_{ref} \times R1$

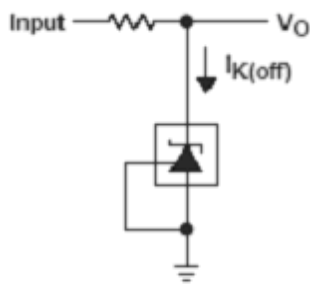


Figure 3. Test Circuit for $I_{K(off)}$

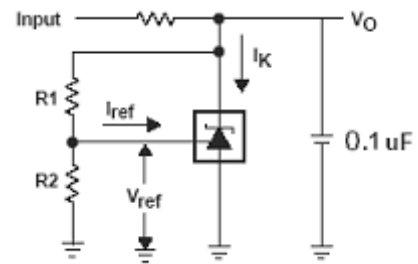


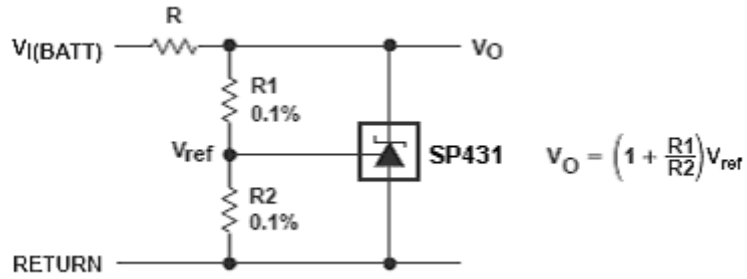
Figure 4. Test Circuit for $V_{KA} > V_{ref}$.
 $V_O = V_{KA} = V_{ref} \times (1 + R1/R2) + I_{ref} \times R1$



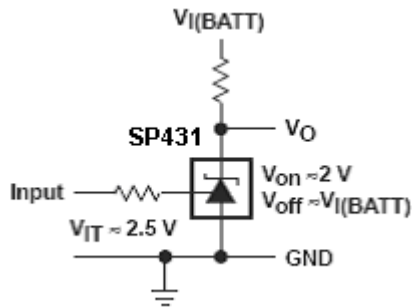
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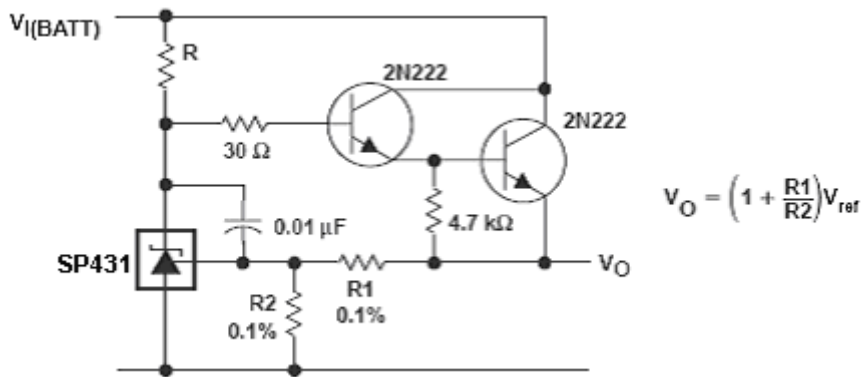
APPLICATION CIRCUIT



Shunt Regulator



Single-Supply Comparator With Temperature-Compensated Threshold



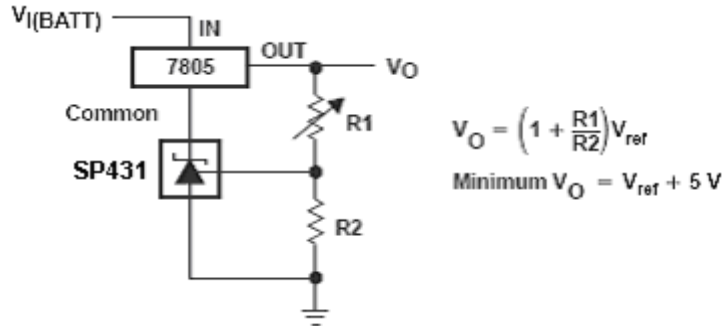
Precision High-Current Series Regulator



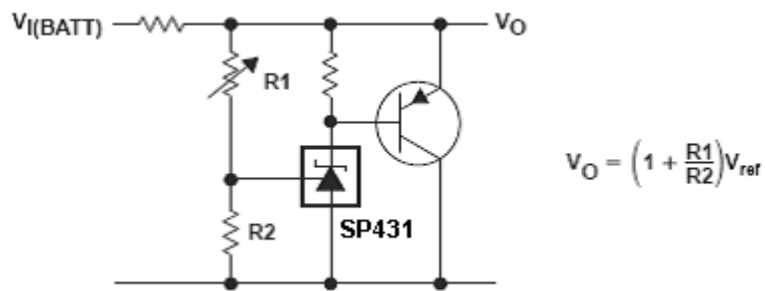
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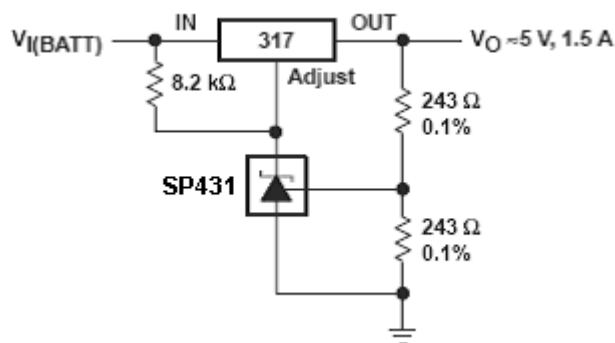
APPLICATION CIRCUIT



Output Control of a Three-Terminal Fixed Regulator



High-Current Shunt Regulator



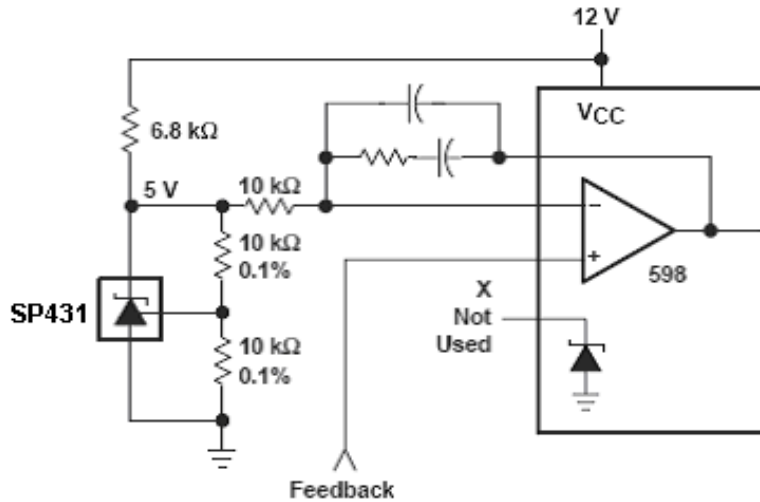
Precision 5-V 1.5-A Regulator



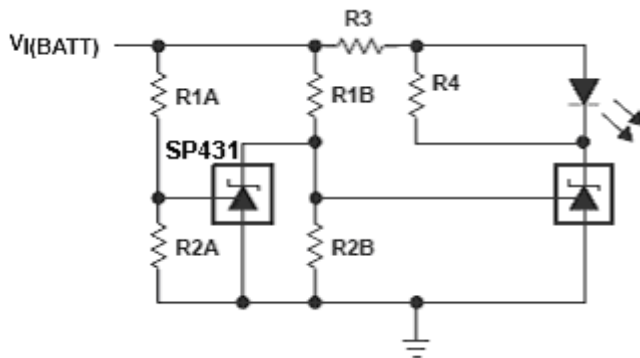
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APPLICATION CIRCUIT



PWM Converter With Reference

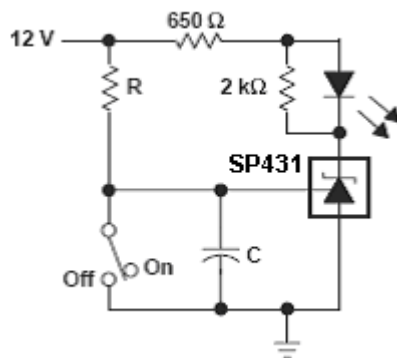


$$\text{Low Limit} = \left(1 + \frac{R1B}{R2B}\right) V_{ref}$$

$$\text{High Limit} = \left(1 + \frac{R1A}{R2A}\right) V_{ref}$$

LED on When Low Limit < $V_{I(BATT)}$ < High Limit

Voltage Monitor



$$\text{Delay} = R \times C \times I_n \left(\frac{12V}{12V - V_{ref}} \right)$$

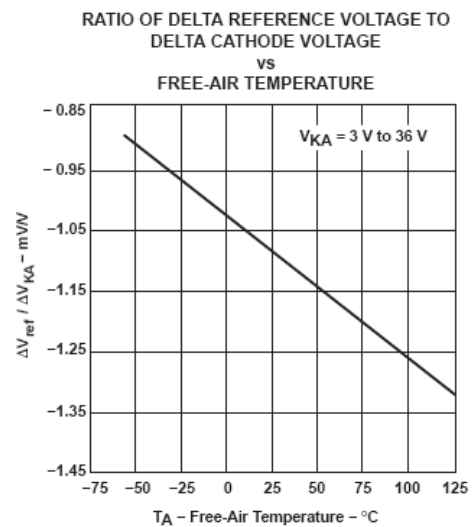
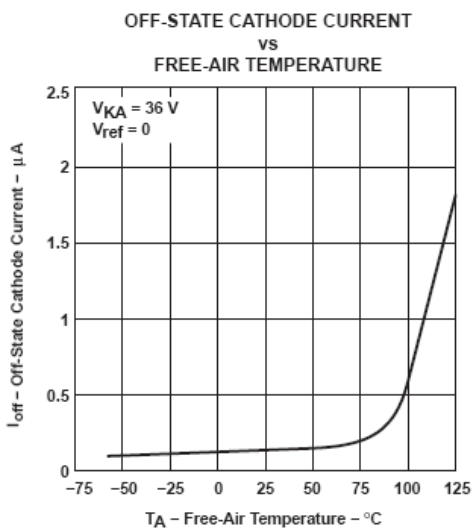
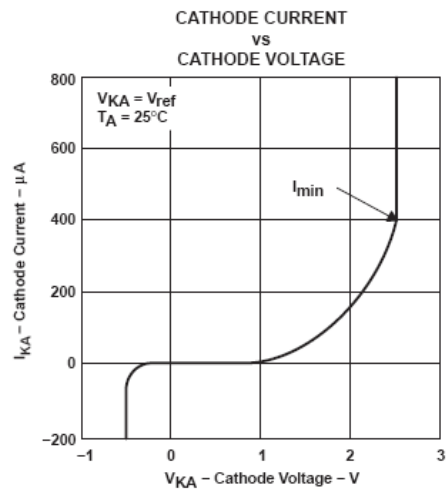
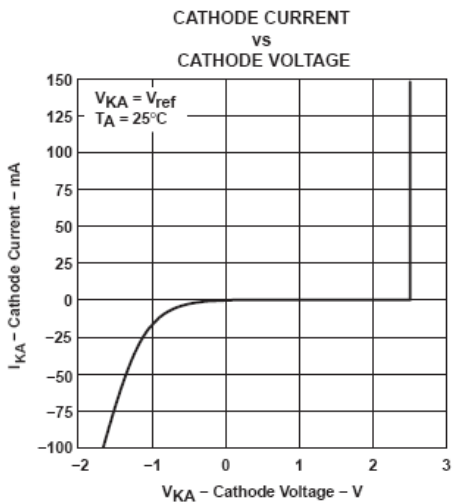
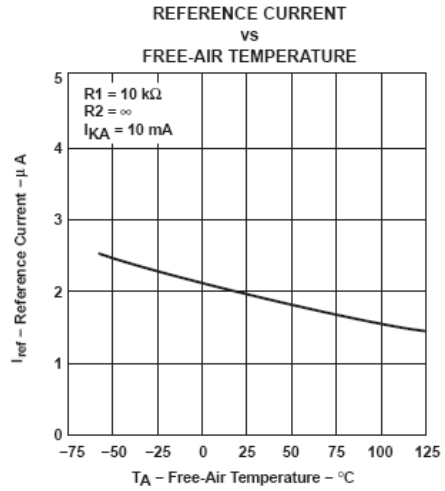
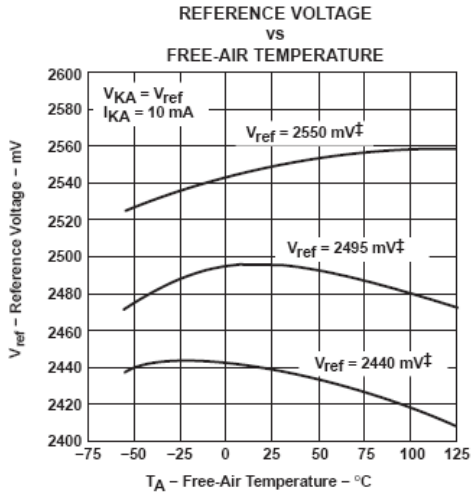
Delay Timer



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PERFORMANCE CHARACTERISTICS

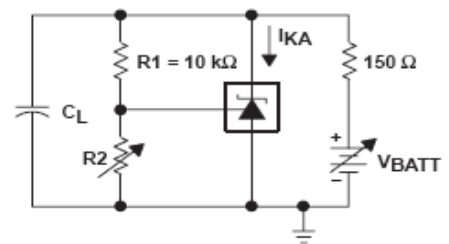
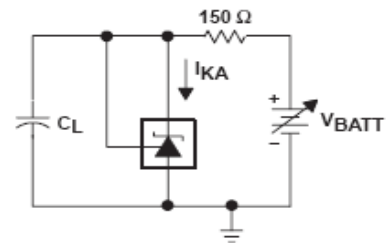
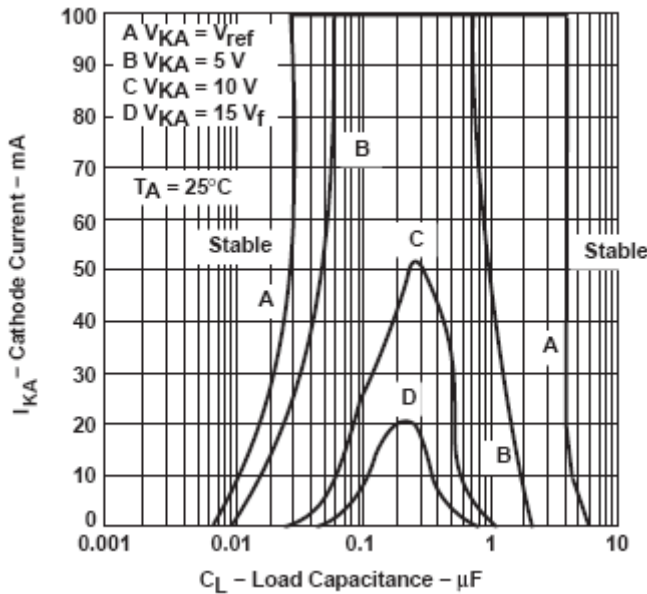
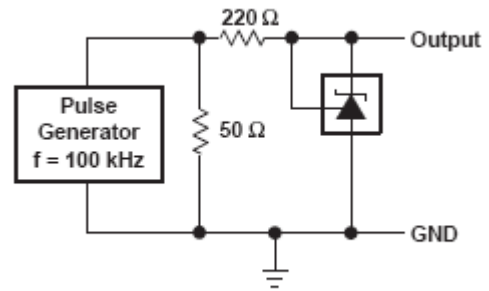
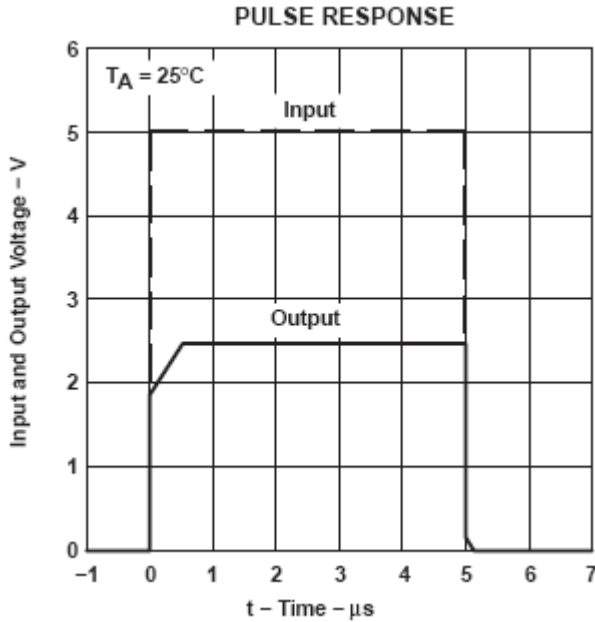




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PERFORMANCE CHARACTERISTICS

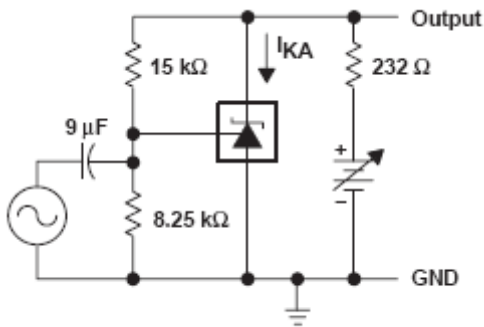
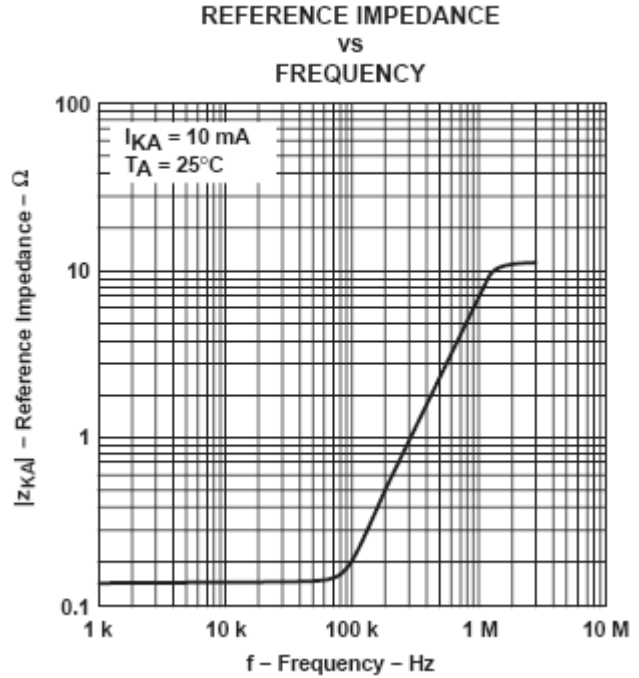
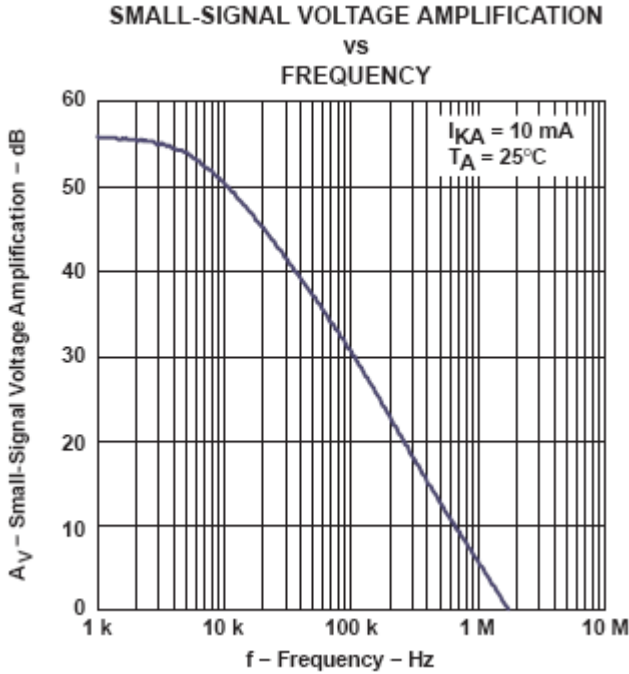




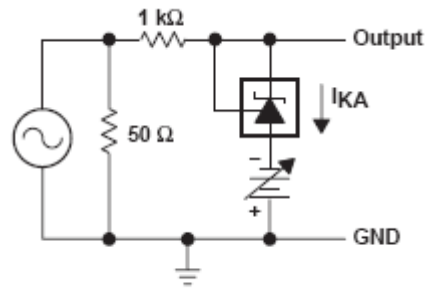
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PERFORMANCE CHARACTERISTICS



TEST CIRCUIT FOR VOLTAGE AMPLIFICATION



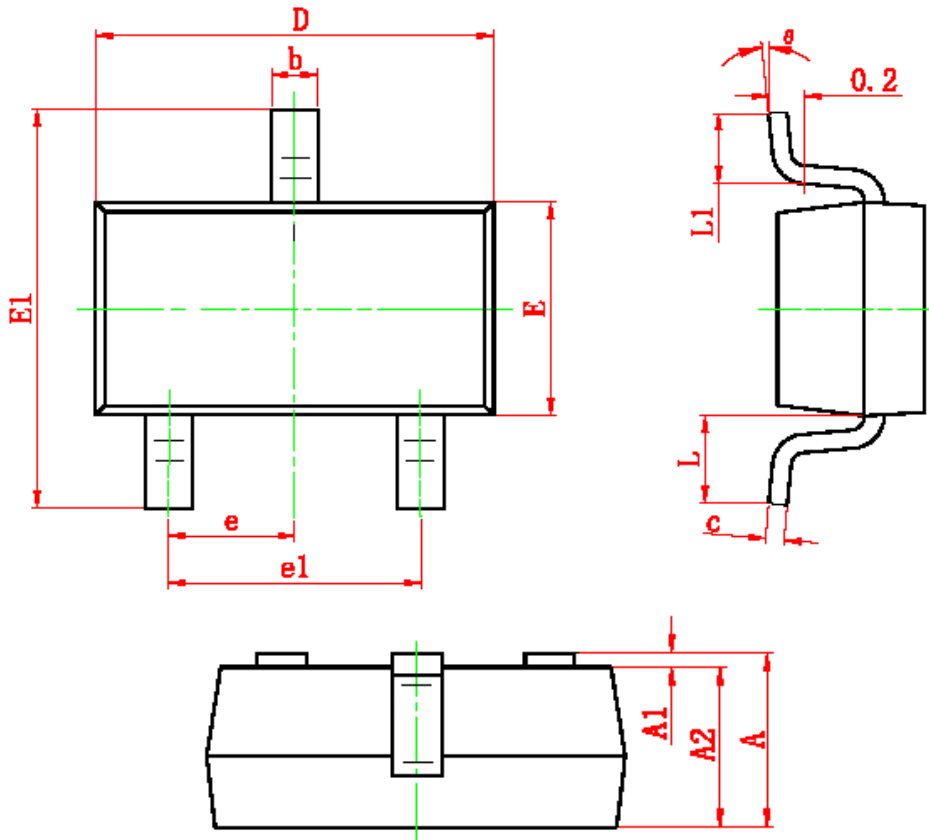
TEST CIRCUIT FOR REFERENCE IMPEDANCE



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SOT-23 PACKAGE OUTLINE



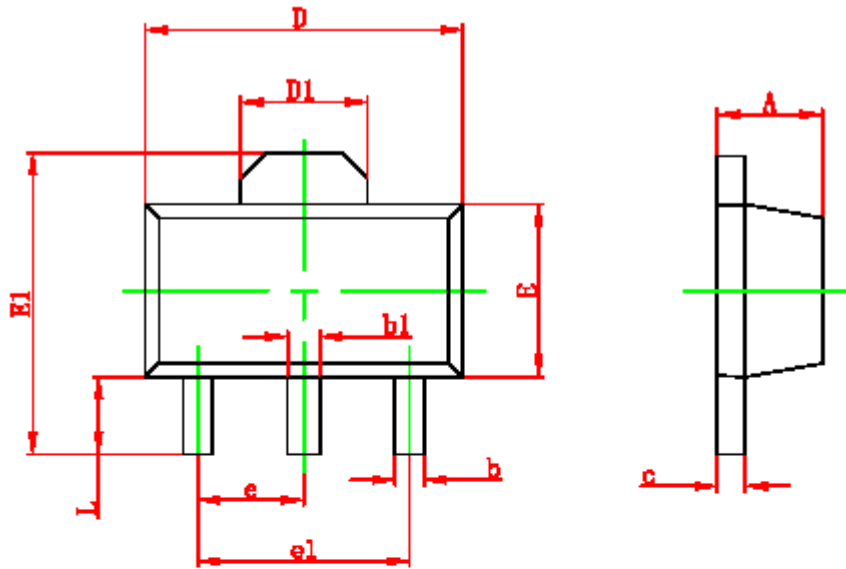
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.900	1.200	0.035	0.043
A1	0.000	0.100	0.000	0.004
A2	0.900	1.100	0.035	0.039
b	0.300	0.500	0.012	0.020
c	0.080	0.150	0.003	0.006
D	2.800	3.000	0.110	0.118
E	1.200	1.400	0.047	0.055
E1	2.250	2.550	0.089	0.100
e	0.950 TYP		0.037 TYP	
e1	1.800	2.000	0.071	0.079
L	0.550 REF		0.022 REF	
L1	0.300	0.500	0.012	0.020
θ	0°	8°	0°	6°



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SOT-89 PACKAGE OUTLINE



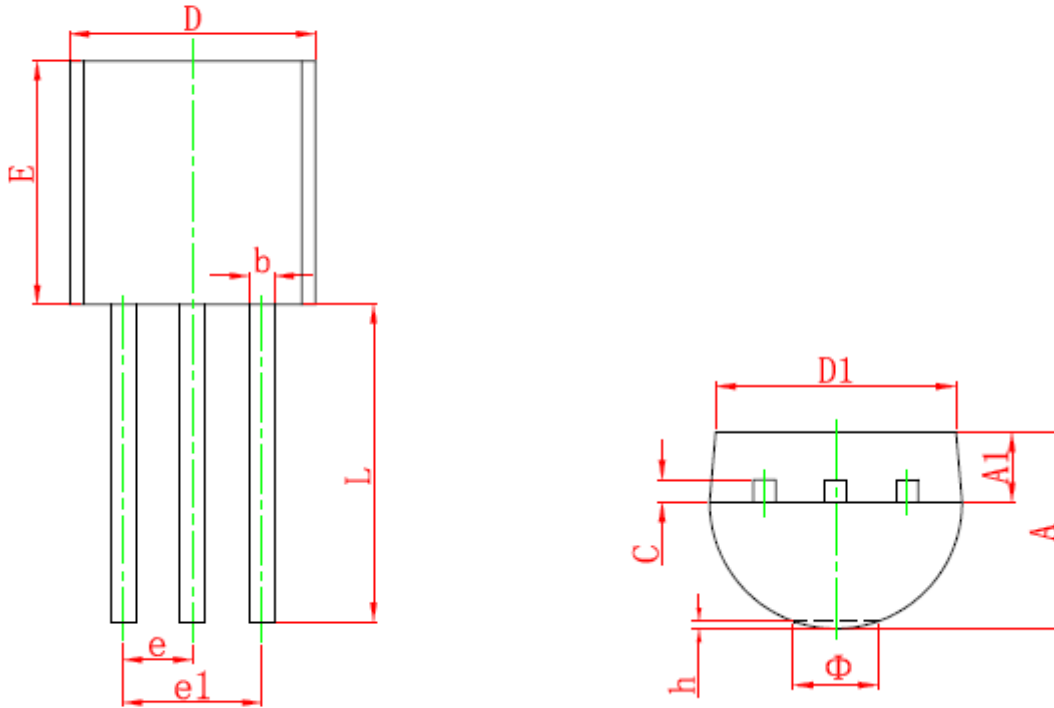
Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF.		0.061 REF.	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TYP.		0.060 TYP.	
e1	3.000 TYP.		0.118 TYP.	
L	0.900	1.200	0.035	0.047



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TO-92 PACKAGE OUTLINE



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.300	3.700	0.130	0.146
A1	1.100	1.400	0.043	0.055
b	0.380	0.550	0.015	0.022
c	0.360	0.510	0.014	0.020
D	4.400	4.700	0.173	0.185
D1	3.430		0.135	
E	4.300	4.700	0.169	0.185
e	1.270 TYP		0.050 TYP	
e1	2.440	2.640	0.096	0.104
L	14.100	14.500	0.555	0.571
Φ		1.600		0.063
h	0.000	0.380	0.000	0.015



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SYNC Power Corporation

7F-2, No.3-1, Park Street

NanKang District (NKSP), Taipei, Taiwan 115

Phone: 886-2-2655-8178

Fax: 886-2-2655-8468

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