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 VREF (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

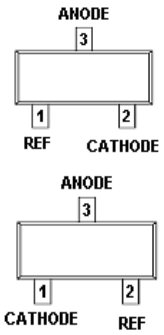
- Battery Power Equipment
- Linear Regulators
- Switch Power Supply
- Cellular Phone
- Digital Cameras
- Computer Disk Drivers
- Instrumentation

FEATURES

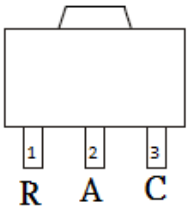
- Low Output Noise
- Adjustable Output Voltage, VO=Vref to 36V
- Low Operational Cathode Current
- 0.25Ω Typical Output Impedance

PIN CONFIGURATION

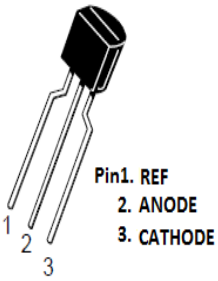
(SOT-23)



(SOT-89)

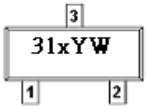


(TO-92)

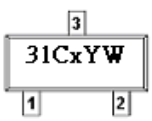


PART MARKING

(SOT-23)

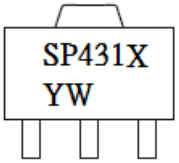


x: Grade
Y : Year Code
W : Week Code



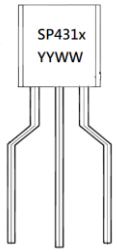
x: Grade
Y : Year Code
W : Week Code

(SOT-89)



X : Grade
Y : Year Code
W: Week Code

(TO-92)



X : Grade
Y : Year Code
W : Week Code

PIN DESCRIPTION: SP431AS23RGB/SP431BS23RGB

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

PIN DESCRIPTION: SP431AS89RGB/ SP431BS89RGB/ SP431AT92AGB/SP431BT92AGB

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

PIN DESCRIPTION: SP431CAS23RGB/SP431CBS23RGB

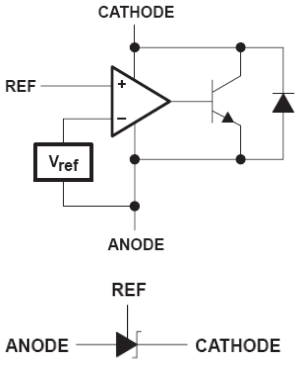
Pin	Symbol	Description
1	C	CATHODE
2	R	REF
3	A	ANODE

ORDERING INFORMATION

Part Number	Voltage Tolerance	Package	Part Marking
SP431AS23RGB	0.4%	SOT-23	31A
SP431BS23RGB	1.0%	SOT-23	31B
SP431AS89RGB	0.5%	SOT-89	SP431A
SP431BS89RGB	1.0%	SOT-89	SP431B
SP431CAS23RGB	0.4%	SOT-23	31CA
SP431CBS23RGB	1.0%	SOT-23	31CB
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

BLOCK DIAGRAM



ABSOULTE MAXIMUM RATINGS (T_A=25°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
Power Dissipation ,T_A=25°C	P_D	1.04	W
Operation Junction Temperature Range	T_J	-40 ~ +150	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	°C
Lead Temperature for 10 seconds	T_{SOL}	260	°C
Thermal Resistance-Junction to Ambient (TO-92)	Θ_{JA}	140	°C/W
Thermal Resistance-Junction to Case (TO-92)	Θ_{JC}	60	°C/W
Thermal Resistance-Junction to Ambient (SOT-89)	Θ_{JA}	85	°C/W
Thermal Resistance-Junction to Case (SOT-89)	Θ_{JC}	45	°C/W
Thermal Resistance-Junction to Ambient (SOT-23)	Θ_{JA}	250	°C/W
Thermal Resistance-Junction to Case (SOT-23)	Θ_{JC}	120	°C/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.

ELECTRICAL CHARACTERISTICS (T_A=25°C , Unless otherwise specified)

Parameter	Symbol	Conditions		Min.	Typ.	Max.	Unit
Reference Voltage	V_{REF}	$V_Z = V_{REF}$ I_Z = 10mA	SP431AS23RGB SP431CAS23RGB	2.485	2.495	2.505	V
			SP431AS89RGB SP431AT92AGB	2.482	2.495	2.508	
			SP431BS23RGB SP431BS89RGB SP431CBS23RGB SP431BT92AGB	2.47	2.495	2.52	
Reference Voltage	V_{REF}	$V_Z = V_{REF}$ I_Z = 1mA	SP431AS23RGB SP431CAS23RGB	2.485	2.495	2.505	V
			SP431AS89RGB SP431AT92AGB	2.482	2.495	2.508	
			SP431BS23RGB SP431BS89RGB SP431CBS23RGB SP431BT92AGB	2.47	2.495	2.52	
VREF Temp Deviation	V_{DEV}	T_A=-40°C~+85°C $V_Z = V_{REF}$, I_Z = 10mA			10	25	mV
		T_A=-40°C~+125°C $V_Z = V_{REF}$, I_Z = 10mA			20	35	
Ratio of change in VREF to change in Cathode voltage	ΔV_{REF} / ΔV_Z	I_Z = 10mA ΔV_Z = 36V ~ V_{REF}			-1.4	-2.7	mV / V
Reference Input Current	I_{REF}	R_1=10KΩ , R_2 = ∞ , I_Z = 10mA			2	4	uA
IREF Temp Deviation	$I_{REF(DEV)}$	T_A=-40°C~+85°C R_1=10KΩ , R2 = ∞ , I_Z = 10mA			0.8	2.5	uA

Off state Cathode Current	$I_{Z(OFF)}$	V_{REF} = 0V	V_Z = 36V	0.1	0.5	uA
Dynamic output impedance	R_Z	f < 1KHZ , $V_Z = V_{REF}$ I_Z = 1mA ~ 100mA		0.25	0.5	Ω
Minimum Operation Current	$I_{Z(MIN)}$	$V_Z = V_{REF}$		0.4	0.7	mA

TESTING CIRCUIT

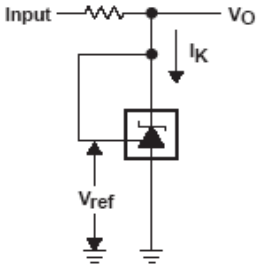


Figure 1. Test Circuit for $V_{KA} = V_{ref}$, $V_O = V_{KA} = V_{ref}$

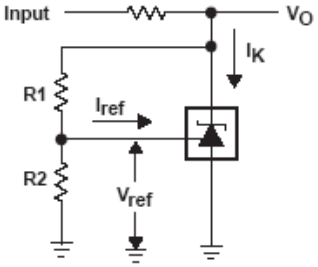


Figure 2. Test Circuit for $V_{KA} > V_{ref}$, $V_O = V_{KA} = V_{ref} \times (1 + R1/R2) + I_{ref} \times R1$

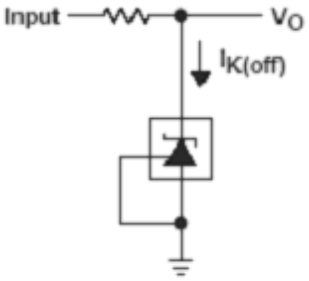


Figure 3. Test Circuit for $I_{K(off)}$

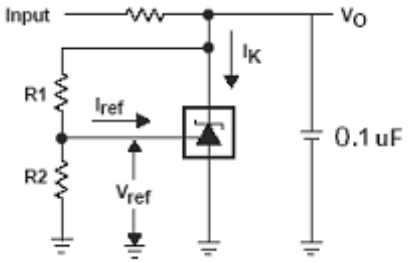
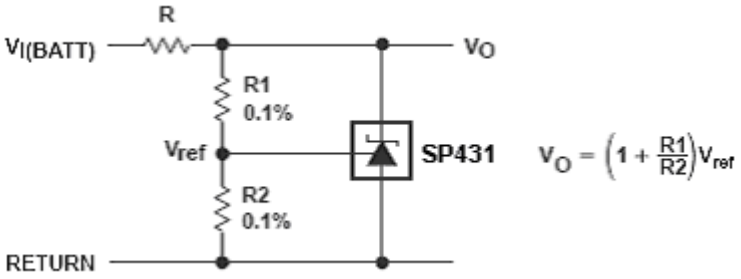
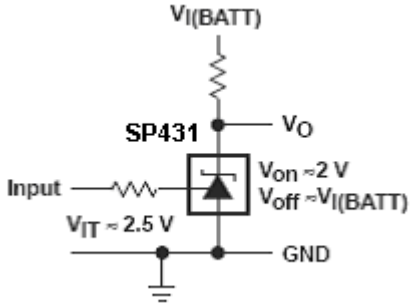


Figure 4. Test Circuit for $V_{KA} > V_{ref}$, $V_O = V_{KA} = V_{ref} \times (1 + R1/R2) + I_{ref} \times R1$

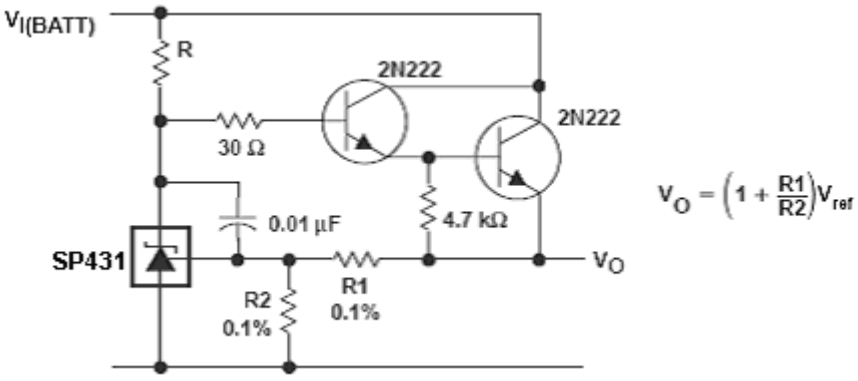
APPLICATION CIRCUIT



Shunt Regulator

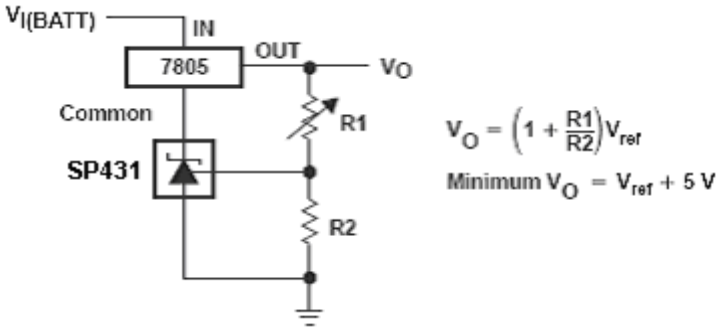


Single-Supply Comparator With Temperature-Compensated Threshold

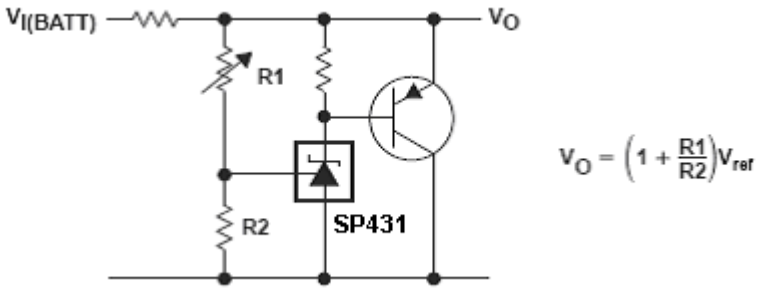


Precision High-Current Series Regulator

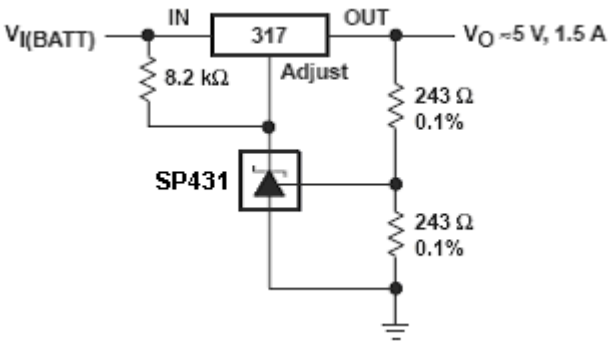
APPLICATION CIRCUIT



Output Control of a Three-Terminal Fixed Regulator

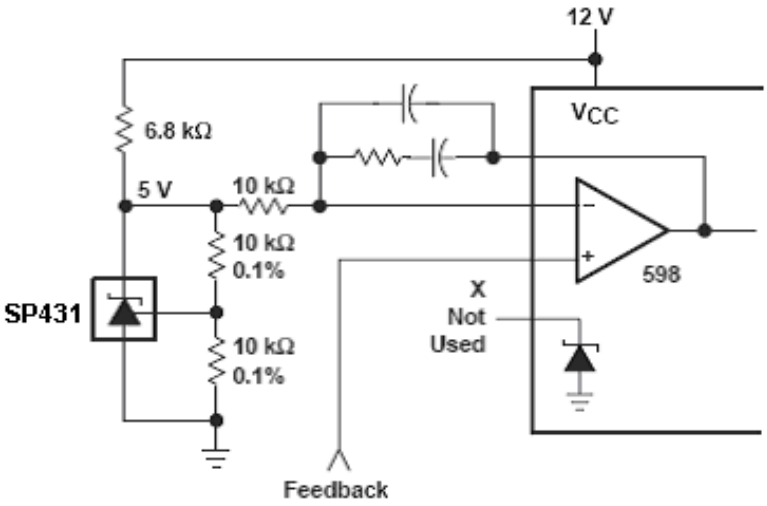


High-Current Shunt Regulator

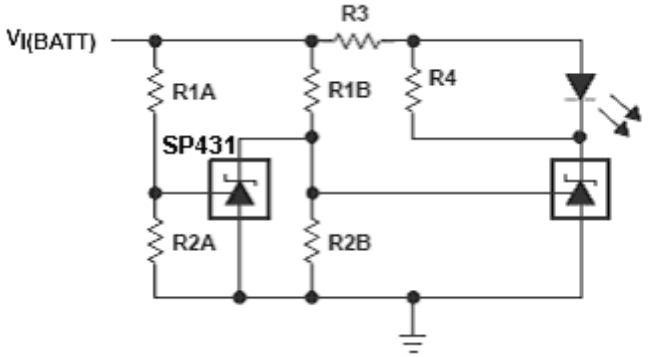


Precision 5-V 1.5-A Regulator

APPLICATION CIRCUIT



PWM Converter With Reference

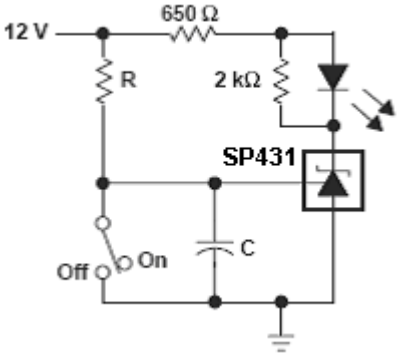


$$\text{Low Limit} = \left(1 + \frac{R1B}{R2B}\right)V_{ref}$$

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

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

Voltage Monitor

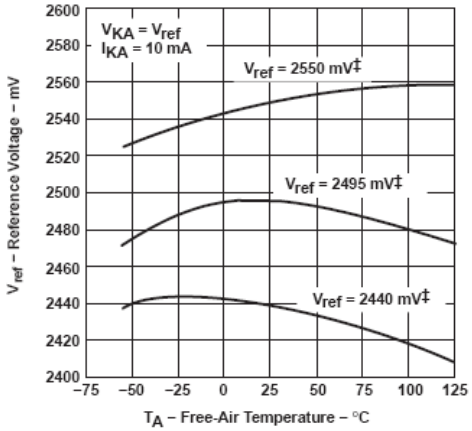


$$\text{Delay} = R \times C \times \ln\left(\frac{12\ V}{12\ V - V_{ref}}\right)$$

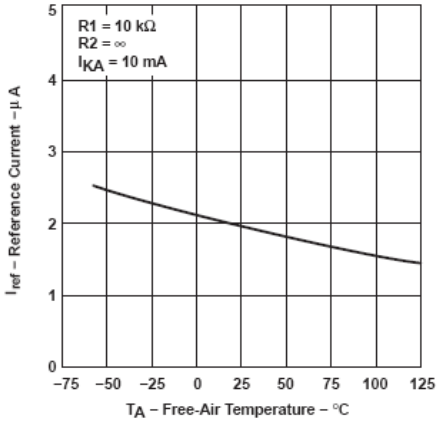
Delay Timer

PERFORMANCE CHARACTERISTICS

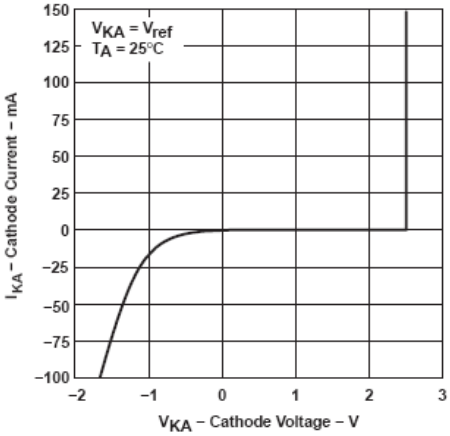
REFERENCE VOLTAGE
vs
FREE-AIR TEMPERATURE



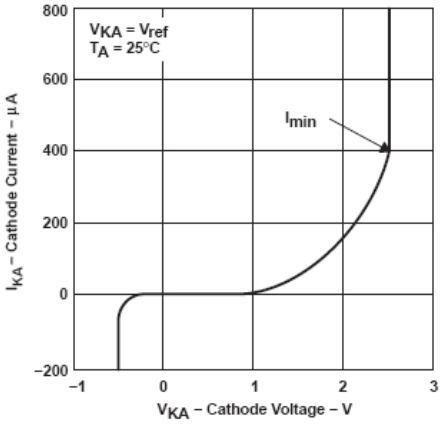
REFERENCE CURRENT
vs
FREE-AIR TEMPERATURE



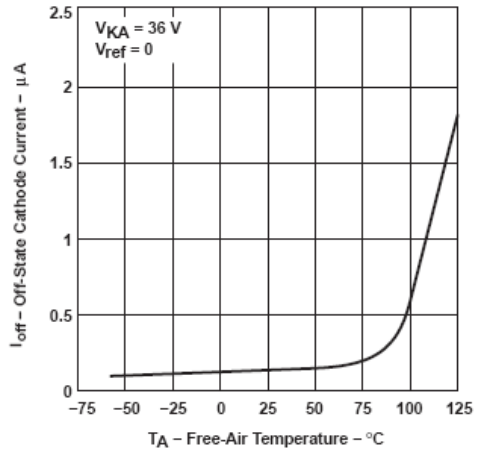
CATHODE CURRENT
vs
CATHODE VOLTAGE



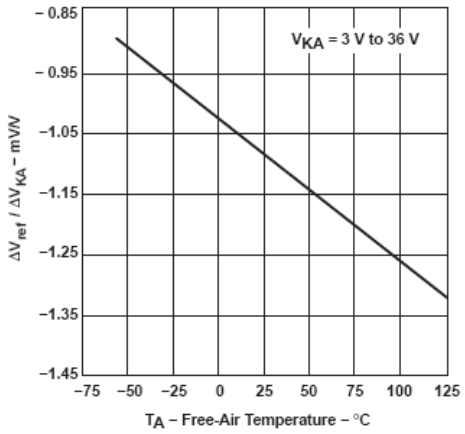
CATHODE CURRENT
vs
CATHODE VOLTAGE



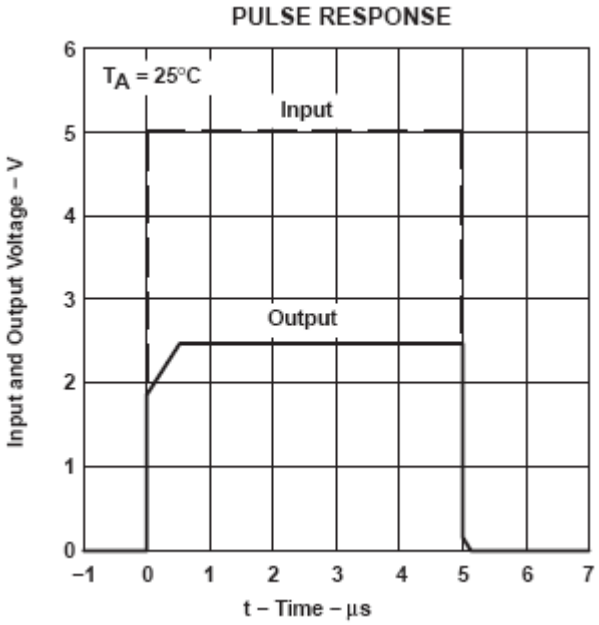
OFF-STATE CATHODE CURRENT
vs
FREE-AIR TEMPERATURE

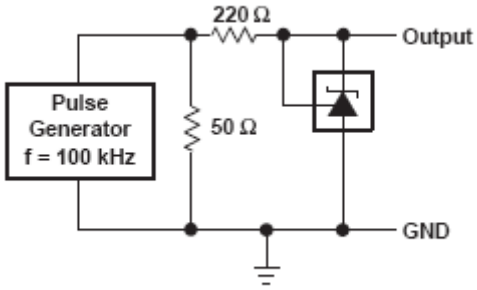


RATIO OF DELTA REFERENCE VOLTAGE TO
DELTA CATHODE VOLTAGE
vs
FREE-AIR TEMPERATURE

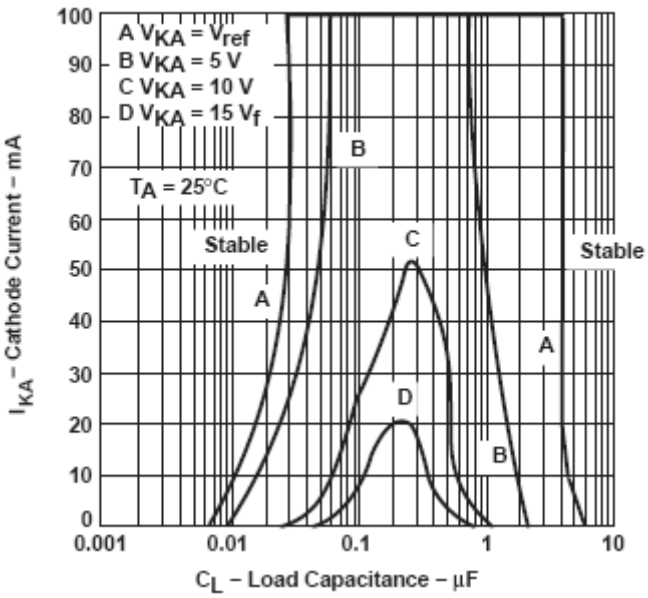


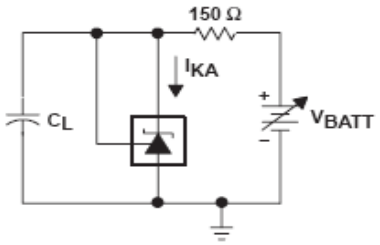
PERFORMANCE CHARACTERISTICS



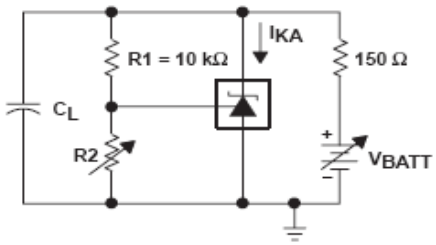


TEST CIRCUIT FOR PULSE RESPONSE





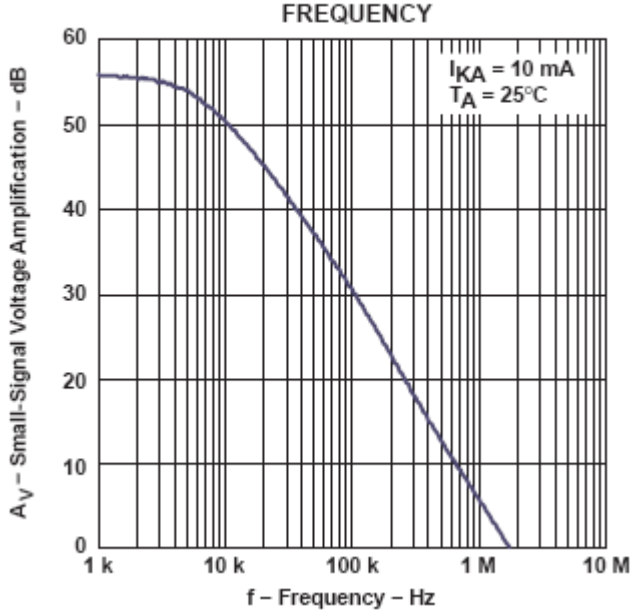
TEST CIRCUIT FOR CURVE A



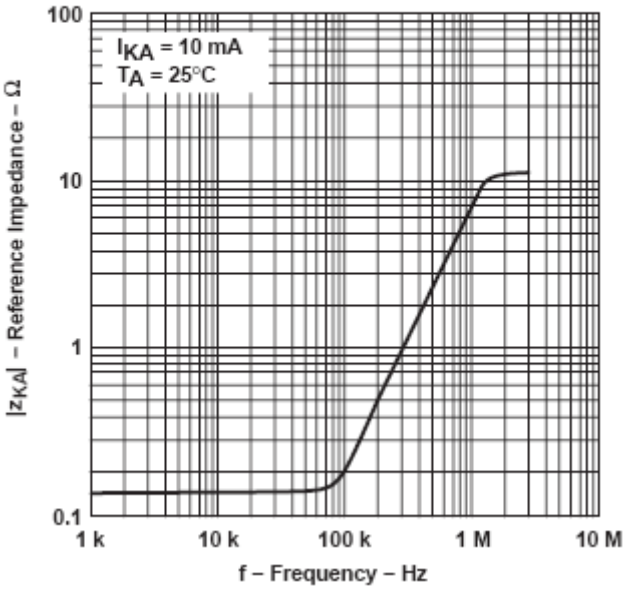
TEST CIRCUIT FOR CURVES B, C, AND D

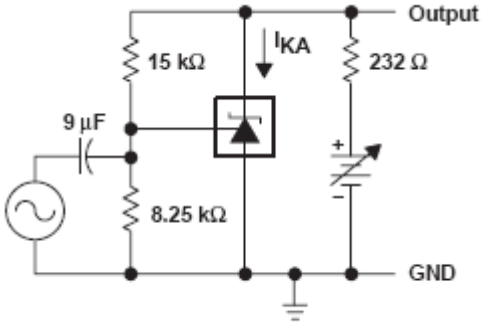
PERFORMANCE CHARACTERISTICS

SMALL-SIGNAL VOLTAGE AMPLIFICATION
vs
FREQUENCY

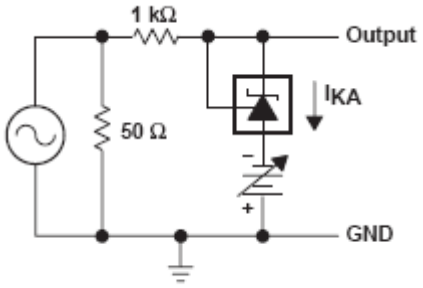


REFERENCE IMPEDANCE
vs
FREQUENCY





TEST CIRCUIT FOR VOLTAGE AMPLIFICATION



TEST CIRCUIT FOR REFERENCE IMPEDANCE

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