SP432
Low Voltage Adjustable Precision Shunt Regulators

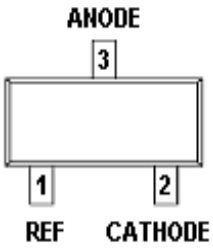
DESCRIPTION
The SP432 is low-voltage three-terminal adjustable voltage references, with specified thermal stability over applicable industrial and commercial temperature ranges. Output voltage can be set to any value between VREF (1.24V) and 20V with two external resistors. These devices have a typical output impedance of 0.25Ω. Active output circuitry provides a very sharp turn-on characteristic, making the SP432 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

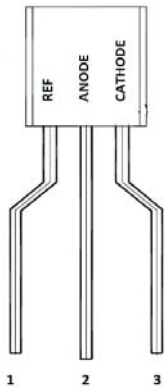
FEATURES
- Low-Voltage Operation --- Down to 1.24 V
- Adjustable Output Voltage, Vo = Vref to 20 V
- Low Operational Cathode Current --- 80uA (Typ)
- 0.25Ω Typical Output Impedance

PIN CONFIGURATION

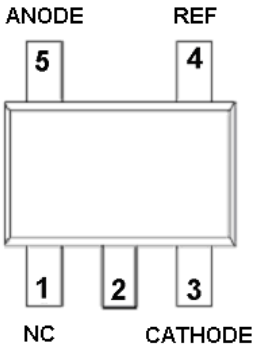
SOT-23



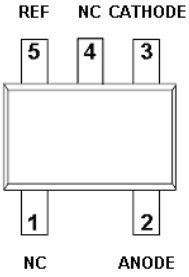
TO-92



SOT-23-5L



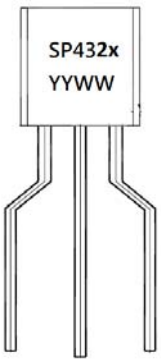
SOT-353 (SC-70)



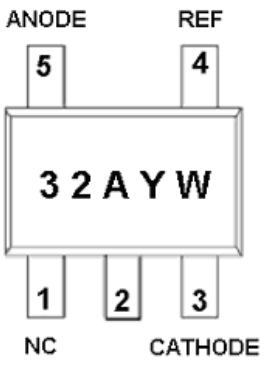
PART MARKING

SOT-23

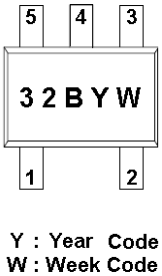
TO-92



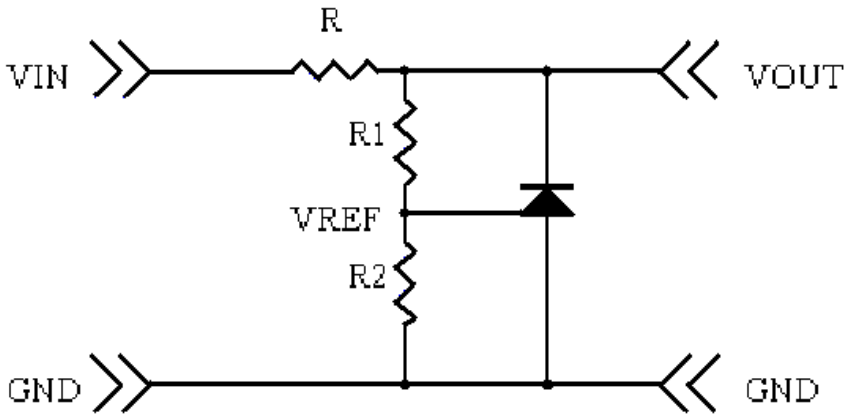
SOT-23-5L



SOT-353 (SC-70)



TYPICAL APPLCATION CIRCUIT



PIN DESCRIPTION

SP432AS23RGB/SP432BS23RGB

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

SP432AS25RGB/SP432BS25RGB

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

SP432AS35RGB/SP432BS35RGB

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

SP432BT92AGB

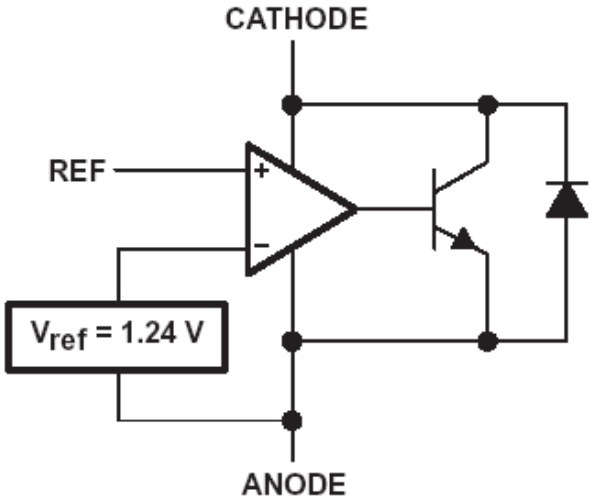
Pin	Symbol	Description
1	R	REF
2	A	ANODE
3	C	CATHODE

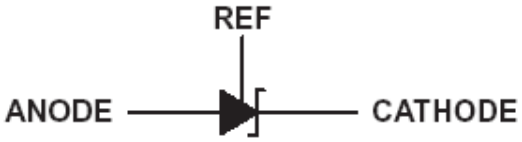
ORDERING INFORMATION

Part Number	Voltage Tolerance	Package	Part Marking
SP432AS23RGB	0.5%	SOT-23	32A
SP432BS23RGB	1.0%	SOT-23	32B
SP432AS25RGB	0.5%	SOT-23-5L	32A
SP432BS25RGB	1.0%	SOT-23-5L	32B
SP432BT92AGB	1.0%	TO-92	SP432B
SP432AS35RGB	0.5%	SOT-353	32A
SP432BS35RGB	1.0%	SOT-353	32B

※ SP432AS23RGB : Tape Reel ; Pb – Free; Halogen – Free
※ SP432BS23RGB : Tape Reel ; Pb – Free; Halogen – Free
※ SP432AS25RGB : Tape Reel ; Pb – Free; Halogen – Free
※ SP432BS25RGB : Tape Reel ; Pb – Free; Halogen – Free
※ SP432BT92AGB : Tape Ammo ; Pb-Free; Halogen – Free
※ SP432AS35RGB : Tape Reel ; Pb – Free; Halogen – Free
※ SP432BS35RGB : Tape Reel ; Pb – Free; Halogen – Free

BLOCK DIAGRAM





ABSOULTE MAXIMUM RATINGS

(T_A=25℃ Unless otherwise specified)

Parameter	Symbol		Value	Unit
Cathode Voltage	V_Z		20	V
Continuous Cathode Current	I_Z		100	mA
Reference Current	I_{REF}		3	mA
Power Dissipation ,T_A=25℃	P_D		0.95	W
Operation Junction Temperature Range	T_J		-40 ~ +150	℃
Storage Temperature Range	T_{STG}		-65 ~ +150	℃
Lead Temperature Range (Soldering 10sec.)	T_{SOL}		260	℃
Thermal Resistance	Θ_{JA}	TO-92	140	℃/W
		SOT-23	206	
		SOT-23-5L	206	
		SOT-353	252	

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℃ , Unless otherwise specified)

SP432AS23RG & SP432AS25RG & SP432AS35RG							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Unit**
Reference Voltage	V_{REF}	$V_Z = V_{REF}$ I_Z = 10mA	T_A=25℃	1.234	1.24	1.246	V
			T_A=-40℃~+80℃	1.222		1.258	
VREF Temp Deviation	V_{DEV}	T_A=-40℃~+80℃ $V_Z = V_{REF}$, I_Z = 10mA			10	25	mV
Ratio of change in VREF to change in Cathode voltage	$\Delta V_{REF} / \Delta V_Z$	I_Z = 10mA ΔV_Z = 16V ~ V_{REF}			-1.0	-2.7	mV / V
Reference Input Current	I_{REF}	R_1=10KΩ , R2 = ∞ , I_Z = 10mA			0.15	0.5	uA
IREF Temp Deviation	$I_{REF(DEV)}$	T_A=-40℃~+80℃ R_1=10KΩ , R_2 = ∞ , I_Z = 10mA			0.1	0.4	uA
Off state Cathode Current	$I_{Z(OFF)}$	V_{REF} = 0V	V_Z = 6V		0.5	1.0	uA
			V_Z = 12V				
Dynamic output impedance	R_Z	f < 1KHZ , $V_Z = V_{REF}$ I_Z = 1mA ~ 100mA			0.25	0.4	Ω
Minimum Operation Current	$I_{Z(MIN)}$	$V_Z = V_{REF}$			30	80	uA

SP432BS23RG & SP432BS25RG & SP432BT92AG & SP432BS35RG							
Parameter	**Symbol**	**Conditions**		**Min.**	**Typ.**	**Max.**	**Unit**
Reference Voltage	V_{REF}	$V_Z = V_{REF}$ I_Z = 10mA	T_A=25℃	1.228	1.24	1.252	V
			T_A=-40℃~+80℃	1.215		1.265	
VREF Temp Deviation	V_{DEV}	T_A=-40℃~+80℃ $V_Z = V_{REF}$, I_Z = 10mA			10	25	mV
Ratio of change in VREF to change in Cathode voltage	$\Delta V_{REF} / \Delta V_Z$	I_Z = 10mA ΔV_Z = 16V ~ V_{REF}			-1.0	-2.7	mV / V
Reference Input Current	I_{REF}	R_1=10KΩ , R_2 = ∞ , I_Z = 10mA			0.15	0.5	uA
IREF Temp Deviation	$I_{REF(DEV)}$	T_A=-40℃~+80℃ R_1=10KΩ , R2 = ∞ , I_Z = 10mA			0.1	0.4	uA
Off state Cathode Current	$I_{Z(OFF)}$	V_{REF} = 0V	V_Z = 6V		0.5	1.0	uA
			V_Z = 12V				
Dynamic output impedance	R_Z	f < 1KHZ , $V_Z = V_{REF}$ I_Z = 1mA ~ 100mA			0.25	0.4	Ω
Minimum Operation Current	$I_{Z(MIN)}$	$V_Z = V_{REF}$			30	80	uA

APPLICATION CIRCUIT

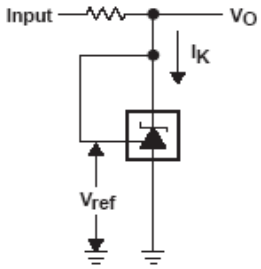


Figure 1. Test Circuit for $V_{KA} = V_{ref}$, $V_O = V_{KA} = V_{ref}$

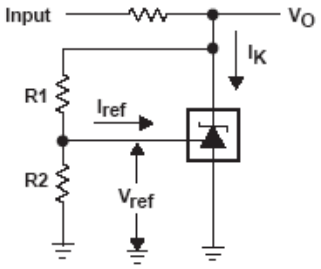


Figure 2. Test Circuit for $V_{KA} > V_{ref}$, $V_O = V_{KA} = V_{ref} \times (1 + R1/R2) + I_{ref} \times R1$

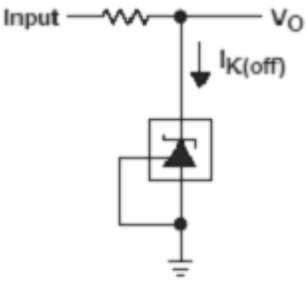


Figure 3. Test Circuit for $I_{K(off)}$

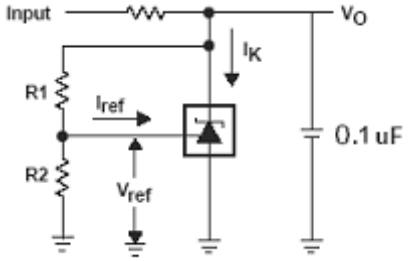


Figure 4. Test Circuit for $V_{KA} > V_{ref}$, $V_O = V_{KA} = V_{ref} \times (1 + R1/R2) + I_{ref} \times R1$

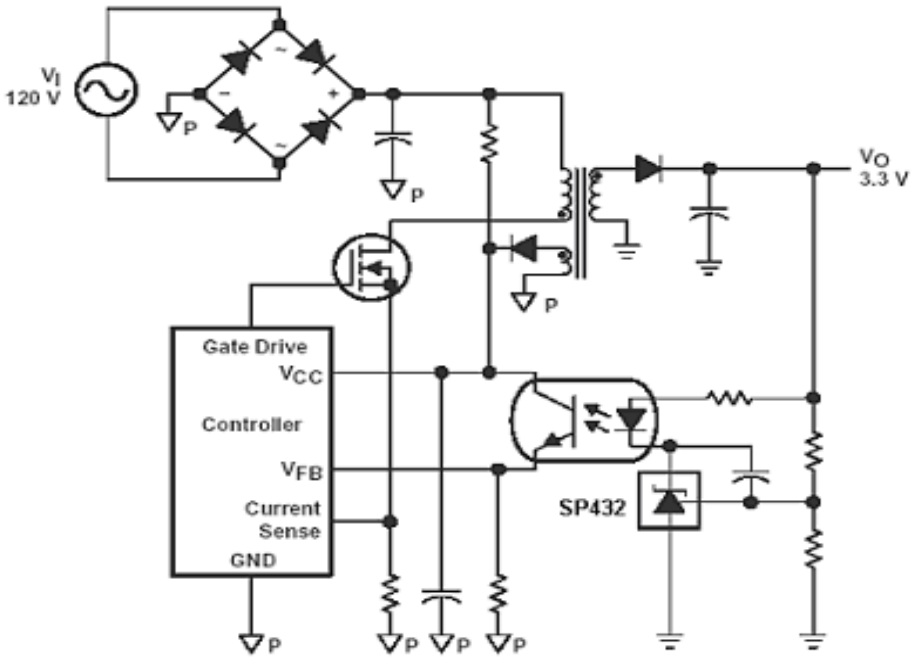
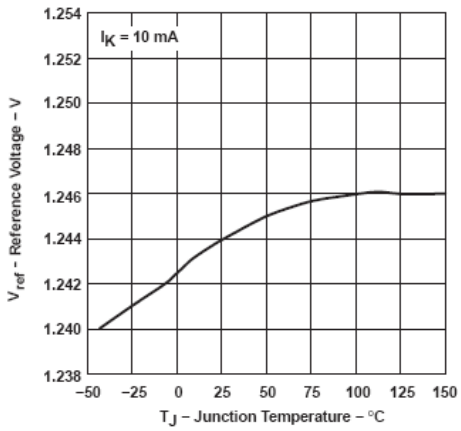


Figure 5. Flyback with isolation using SP432 as voltage reference and error amplifier

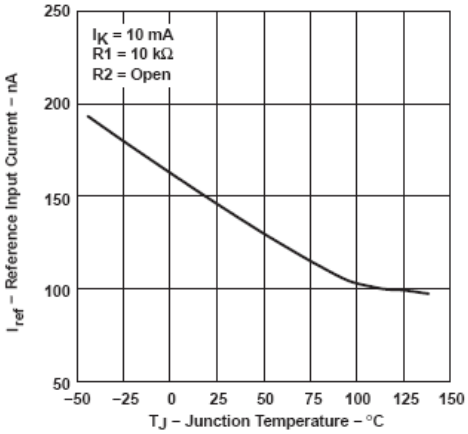
※ To improve the stability of output voltage, Figure 4, a 0.1uf capacitor is recommended between cathode to anode

PERFORMANCE CHARACTERISTICS

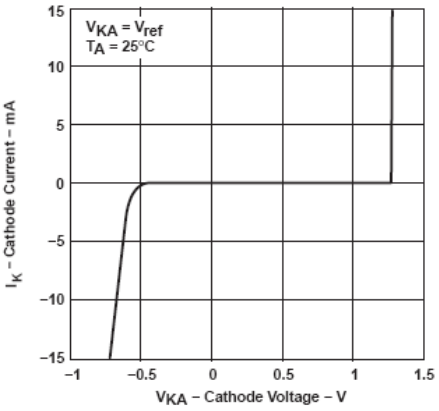
REFERENCE VOLTAGE
vs
JUNCTION TEMPERATURE



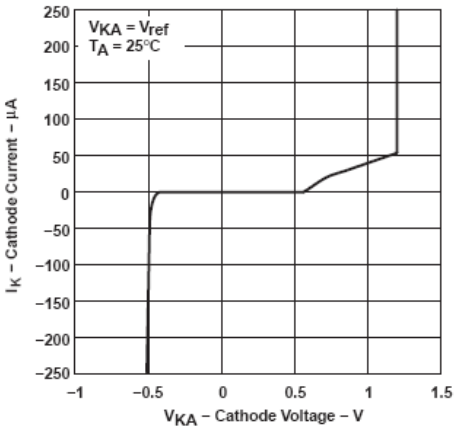
REFERENCE INPUT CURRENT
vs
JUNCTION TEMPERATURE



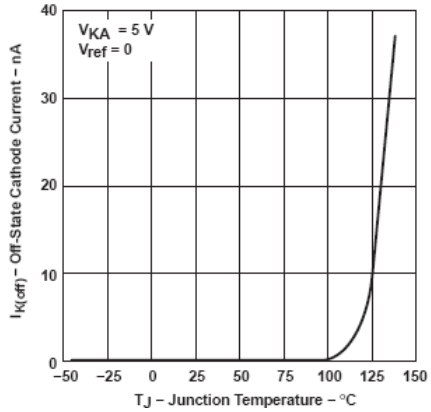
CATHODE CURRENT
vs
CATHODE VOLTAGE



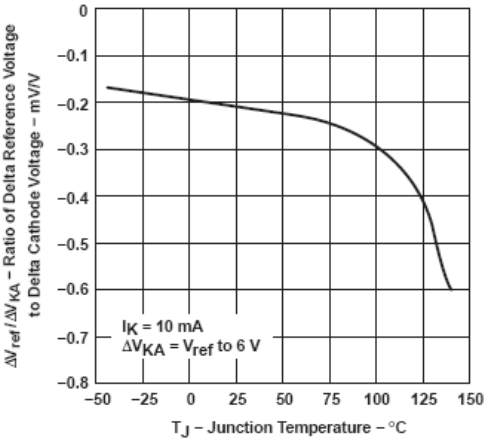
CATHODE CURRENT
vs
CATHODE VOLTAGE



OFF-STATE CATHODE CURRENT
vs
JUNCTION TEMPERATURE

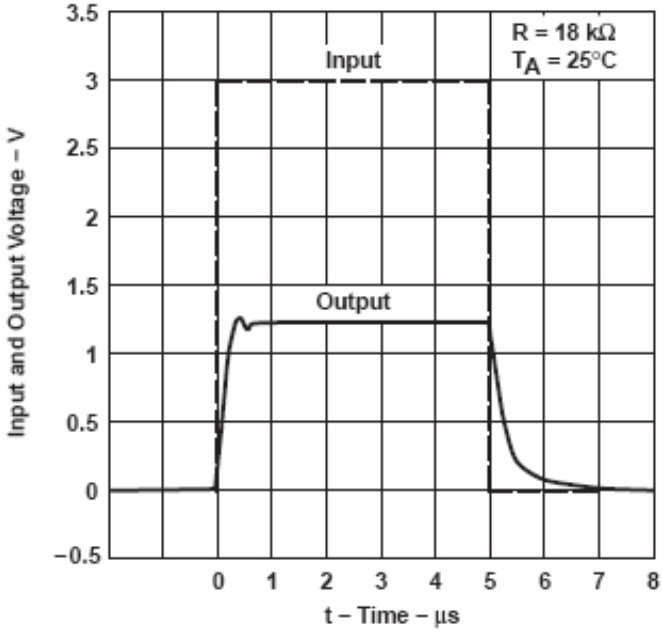


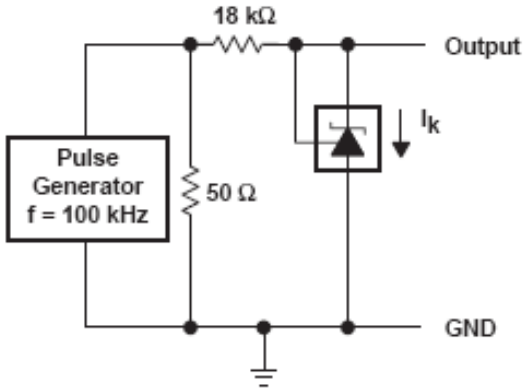
RATIO OF DELTA REFERENCE VOLTAGE
TO DELTA CATHODE VOLTAGE
vs
JUNCTION TEMPERATURE



PERFORMANCE CHARACTERISTICS

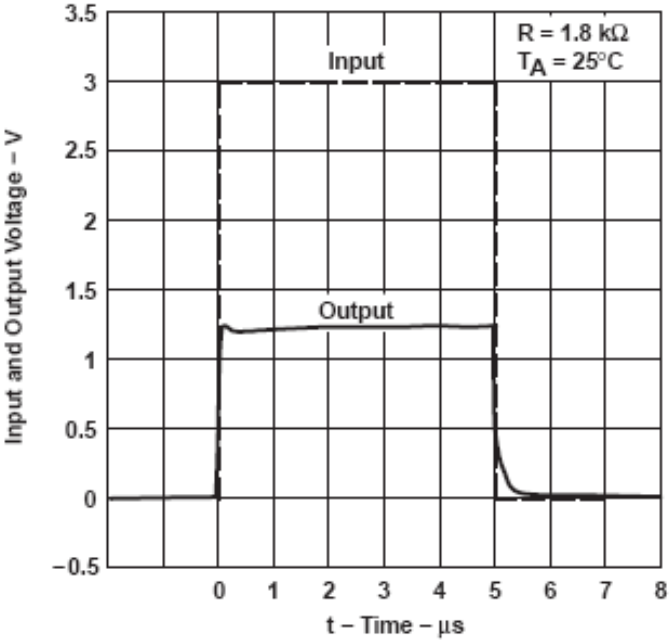
PULSE RESPONSE

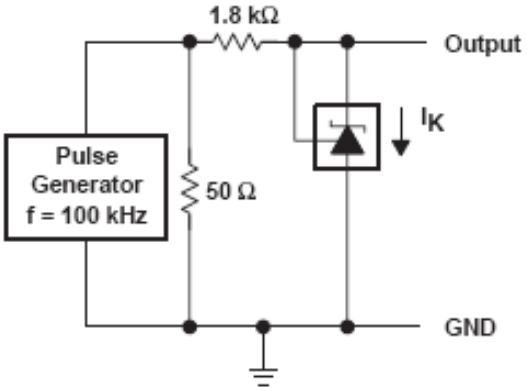




TEST CIRCUIT FOR PULSE RESPONSE

PULSE RESPONSE

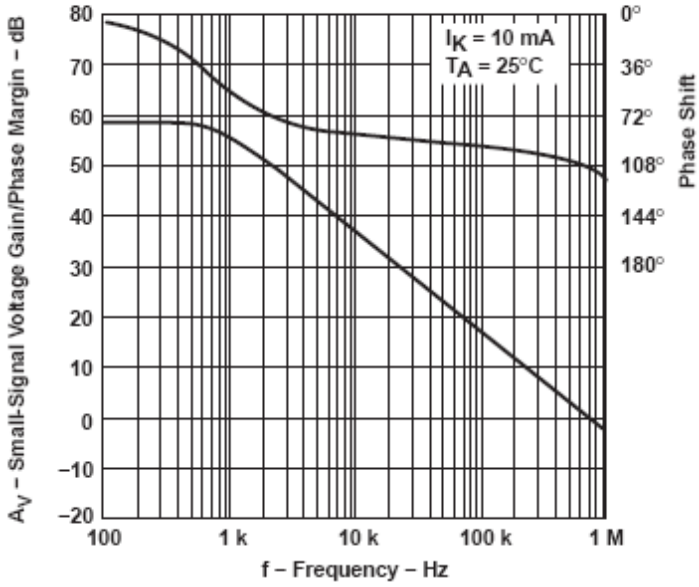




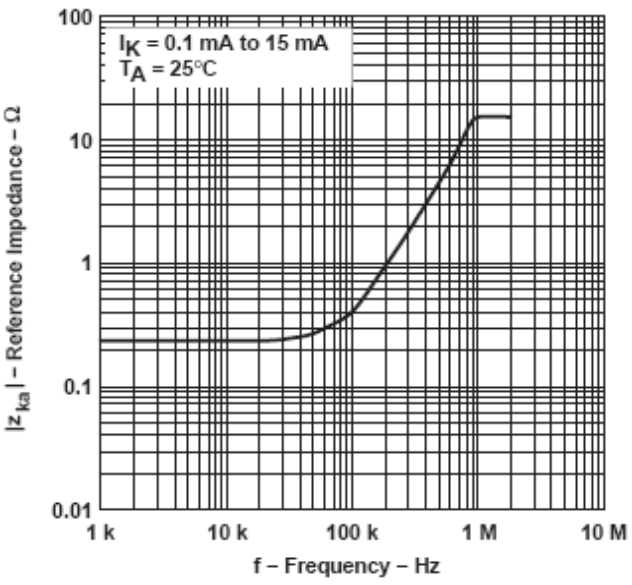
TEST CIRCUIT FOR PULSE RESPONSE

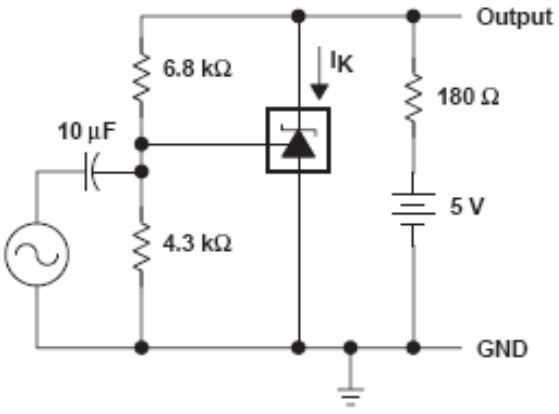
PERFORMANCE CHARACTERISTICS

SMALL-SIGNAL VOLTAGE GAIN/PHASE MARGIN
vs
FREQUENCY

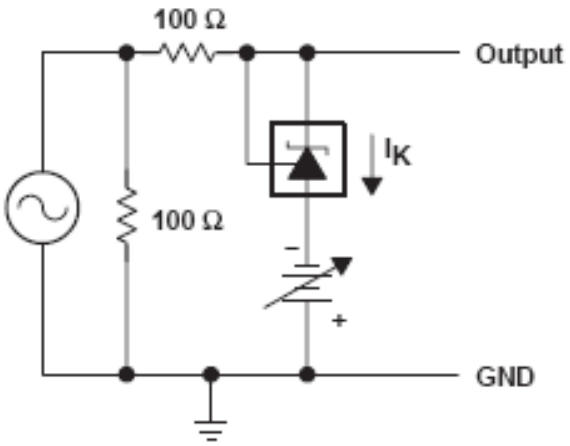


REFERENCE IMPEDANCE
vs
FREQUENCY





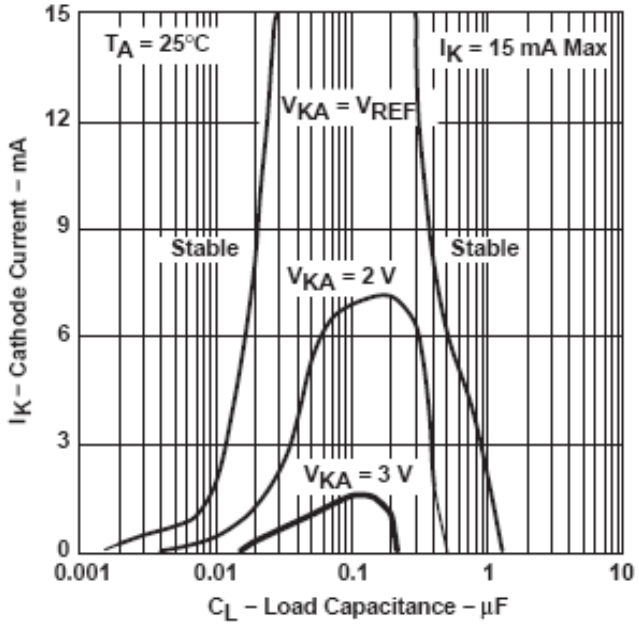
TEST CIRCUIT FOR VOLTAGE GAIN
AND PHASE MARGIN



TEST CIRCUIT FOR REFERENCE IMPEDANCE

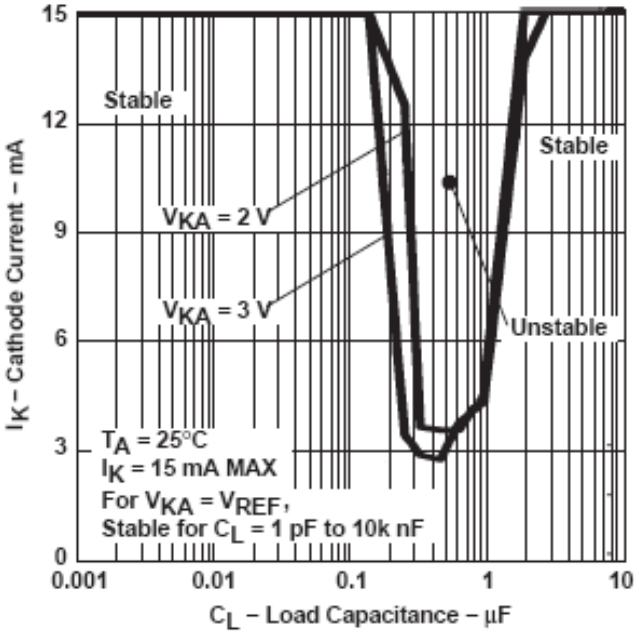
PERFORMANCE CHARACTERISTICS

STABILITY BOUNDARY CONDITION

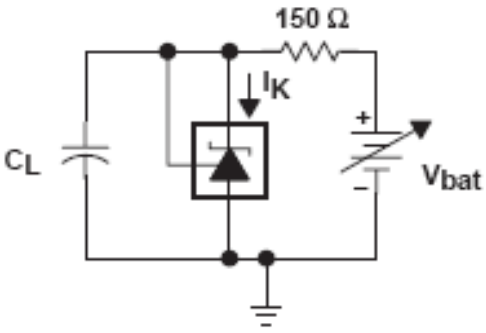


(For 1.0%)

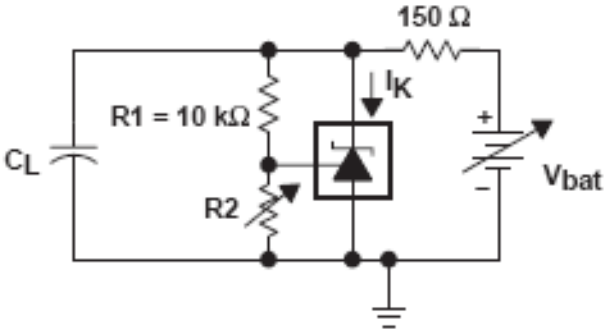
STABILITY BOUNDARY CONDITION‡



(For 0.5%)



TEST CIRCUIT FOR $V_{KA} = V_{REF}$



TEST CIRCUIT FOR V_{KA} = 2 V, 3 V

SYNC Power Corporation
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