

## 1.24V ADJUSTABLE SHUNT VOLTAGE REFERENCE

- **1.24V TYP OUTPUT VOLTAGE**
- **ULTRA LOW OPERATING CURRENT :**  
60 $\mu$ A maximum at 25°C
- **HIGH PRECISION @ 25°C**  
+/- 1%  
+/- 0.5%
- **HIGH STABILITY WHEN USED WITH CAPACITIVE LOADS**
- **INDUSTRIAL TEMPERATURE RANGE:**  
-40 to +85°C
- **100ppm/°C TEMPERATURE COEFFICIENT**

### DESCRIPTION

The TS432 is an adjustable low power shunt voltage reference providing an output voltage from 1.24V to 10V over the industrial temperature range (-40 to +85°C). Available in SOT23-3 surface mount package, it can be designed in applications where space saving is a critical issue.

The low operating current is a key advantage for power restricted designs. In addition, the TS432 is very stable and can be used in a broad range of application conditions.

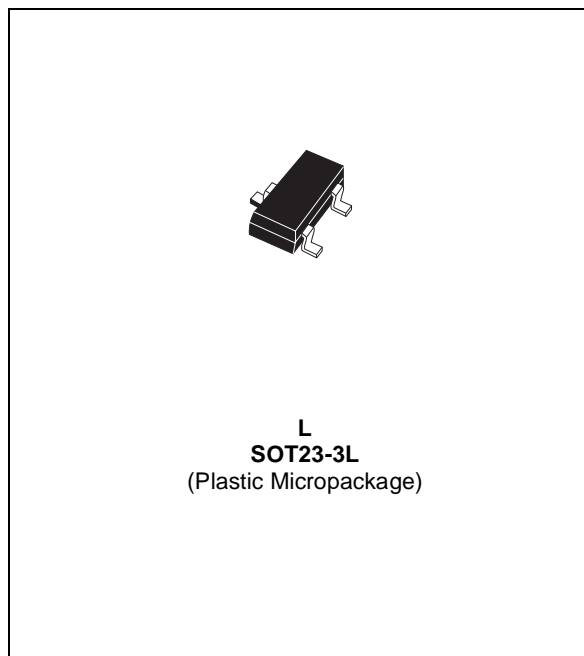
### APPLICATION

- Computers
- Instrumentation
- Battery chargers
- Switch Mode Power Supply
- Battery operated equipments

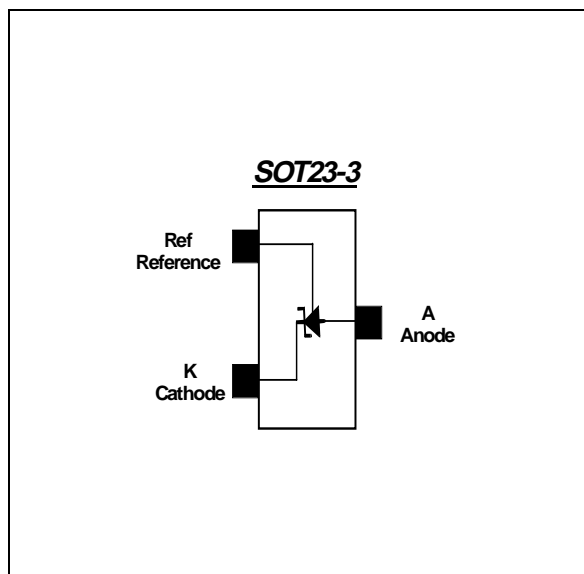
### ORDER CODE

Precision	SOT23-3	SOT23 Marking
1%	TS432ILT	L235
0.5%	TS432AILT	L236
Single temperature range: -40 to +85°C		

LT = Tiny Package (SOT23-3) - only available in Tape & Reel (LT)



### PIN CONNECTIONS (top view)



**ABSOLUTE MAXIMUM RATINGS**

Symbol	Parameter	Value	Unit
$V_K$	Cathode voltage	12	V
$I_K$	Cathode current	-10 to +20	mA
$I_{REF}$	Reference input current	-0.05 to +3	mA
$P_D$	Power dissipation <sup>1)</sup> SOT23-3	340	mW
$R_{THJA}$	Thermal resistance junction to ambient for SOT23-3	360	°C/W
$T_{LEAD}$	Lead temperature (soldering 10 seconds)	250	°C
$T_{STG}$	Storage temperature	-65 to +150	°C
$T_J$	Junction temperature	150	°C
ESD	Human Body Model (HBM)	1.5	kV
	Machine Model (MM)	150	V

1. Pd has been calculated with  $T_{amb} = 25^{\circ}C$ ,  $T_j = 150^{\circ}C$  and  $R_{thja} = 360^{\circ}C/W$  for the SOT23-3L package

**OPERATING CONDITIONS**

Symbol	Parameter	Value	Unit
$V_K$	Cathode voltage	1.24 to 10	V
$I_K$	Cathode current	60 $\mu$ to 12m	A
$T_{AMB}$	Ambient temperature	-40 to +85	°C

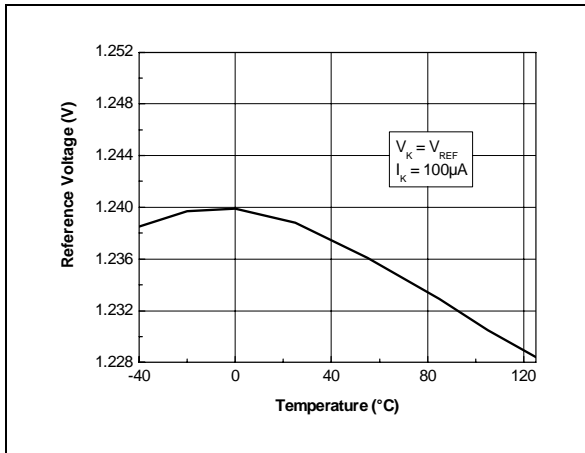
**ELECTRICAL CHARACTERISTICS**

$T_{amb} = 25^{\circ}C$  (unless otherwise specified)

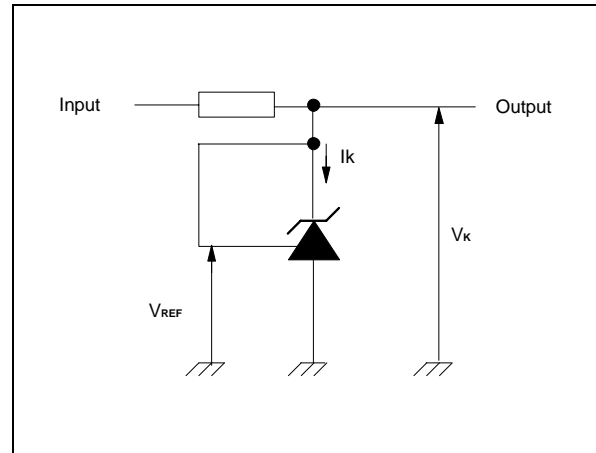
Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
$V_{REF}$	Reference voltage	$I_K = 100\mu A$ , $V_K = V_{REF}$		1.24		V
		TS432 (1%)	1.228		1.252	
		TS432A (0.5%)	1.234		1.246	
$\Delta V_{REF}$	Reference voltage tolerance over temperature	$I_K = 100\mu A$ , $V_K = V_{REF}$		7	16	mV
$I_{KMIN}$	Minimum operating current	$T_{amb} = 25^{\circ}C$		40	60	$\mu A$
		$-40^{\circ}C < T_{AMB} < +85^{\circ}C$			65	
$\Delta V_{REF}$	Reverse breakdown voltage change with operating current range	$I_{KMIN} < I_K < 1mA$		0.7	1.5	mV
		$-40^{\circ}C < T_{AMB} < +85^{\circ}C$			2	
		$1mA < I_K < 12mA$		2	4	
		$-40^{\circ}C < T_{AMB} < +85^{\circ}C$			6	
$\Delta V_{REF}/\Delta V_K$	Reference voltage change with output voltage change	$I_K = 10mA$ , $V_K = 10V$ to $V_{REF}$		1.8	2.5	mV/V
		$-40^{\circ}C < T_{AMB} < +85^{\circ}C$			3	
$I_{REF}$	Reference input current	$I_K = 10mA$ , $R_1 = 10K\Omega$ , $R_2 = +\infty$		50	100	nA
		$-40^{\circ}C < T_{AMB} < +85^{\circ}C$			200	
$I_{OFF}$	Off-state cathode current	$V_{REF} = 0$ , $V_K = 10V$		1	100	nA
		$-40^{\circ}C < T_{AMB} < +85^{\circ}C$			150	
$R_{KA}$	Static impedance	$\Delta I_K = 100\mu A$ to 12mA		0.25	0.5	$\Omega$
$K_{VH}$	Long term stability	$I_K = 100\mu A$ , $t = 1000hrs$		120		ppm
$E_N$	Wide band noise	$I_K = 100\mu A$ 100Hz < F < 10kHz		200		nV/ $\sqrt{Hz}$

**Note :** Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design.

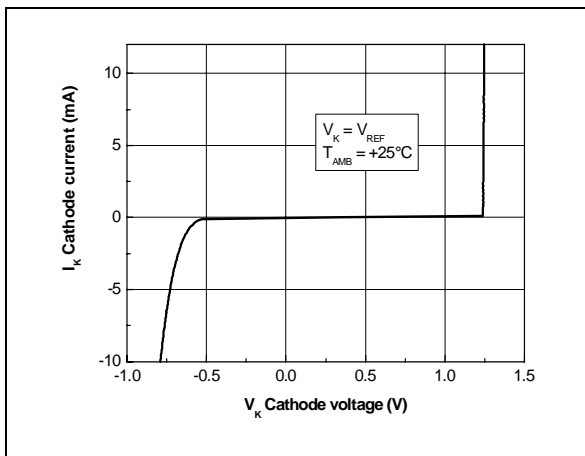
Reference voltage vs temperature



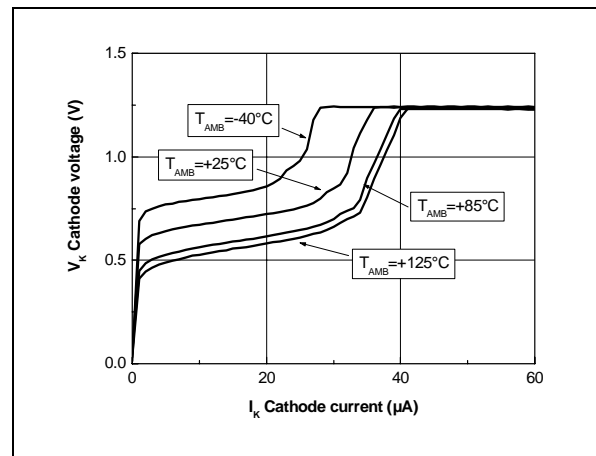
Test circuit for  $V_K = V_{REF}$



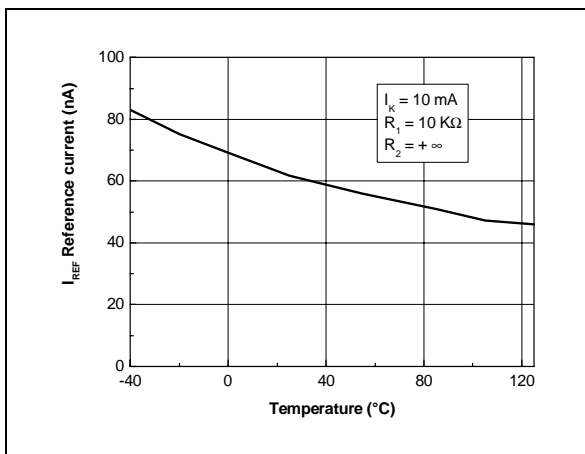
Cathode voltage vs cathode current



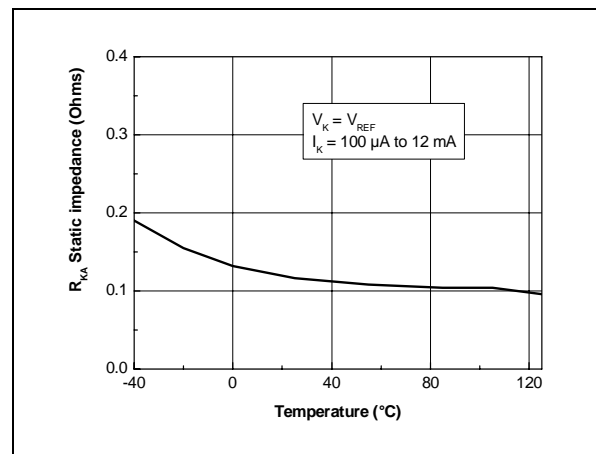
Cathode voltage vs cathode current



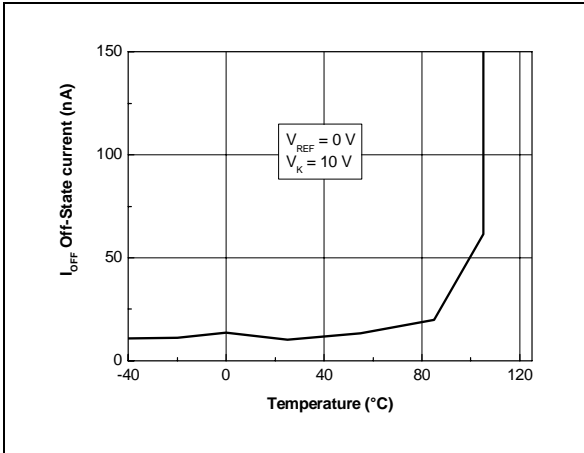
Reference input current vs temperature



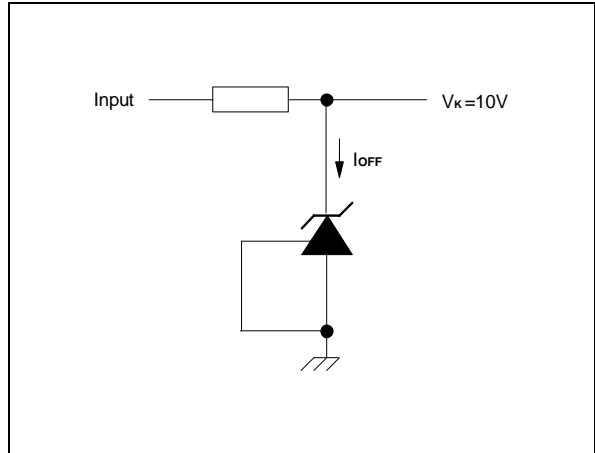
Static impedance vs temperature



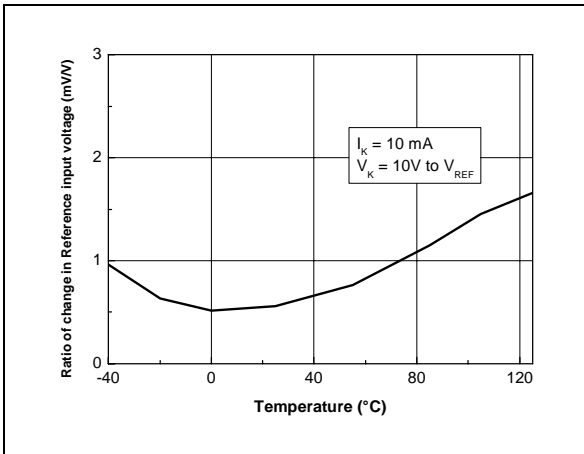
Off-State current vs temperature



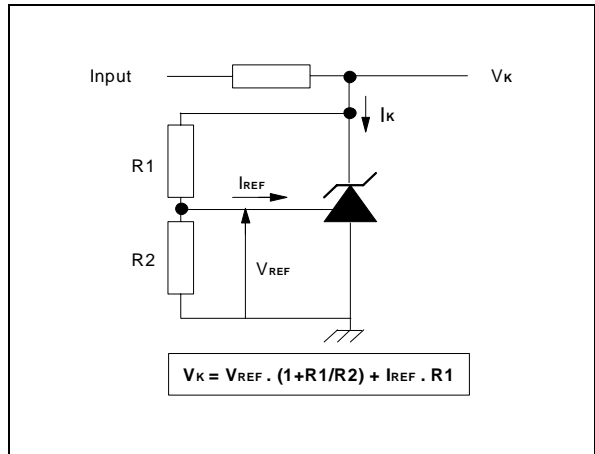
Test circuit for Off-State current measurement



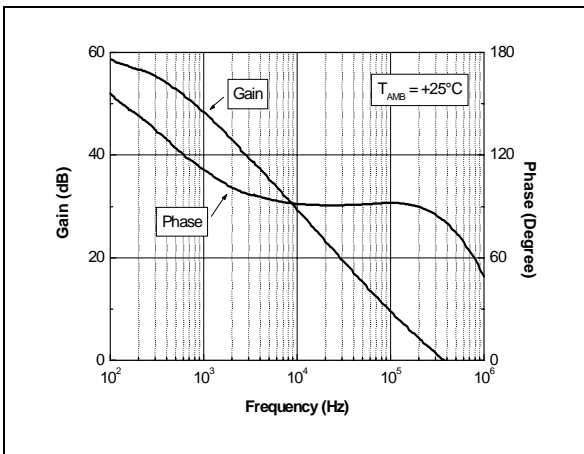
Ratio of change in reference input voltage to change in  $V_K$  voltage vs temperature



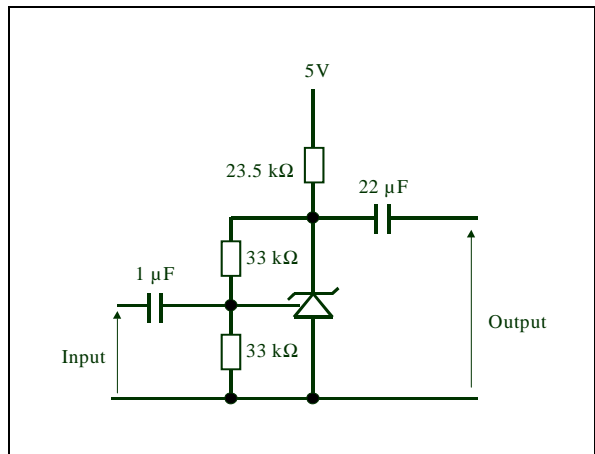
Test circuit for  $V_{KA} > V_{REF}$



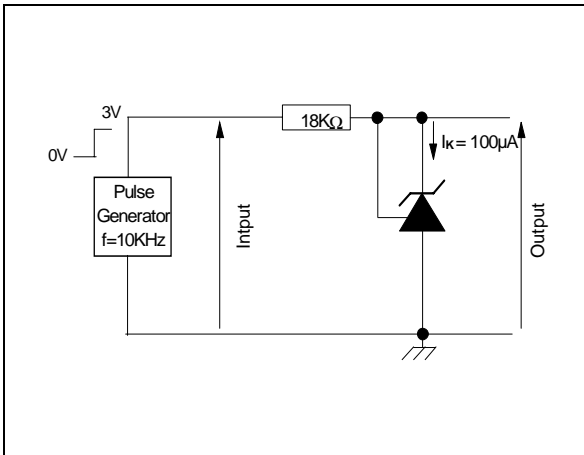
Phase and Gain vs frequency



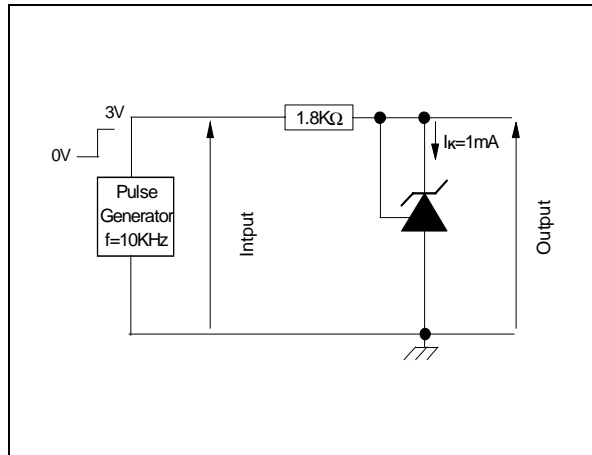
Test circuit for phase and gain measurement



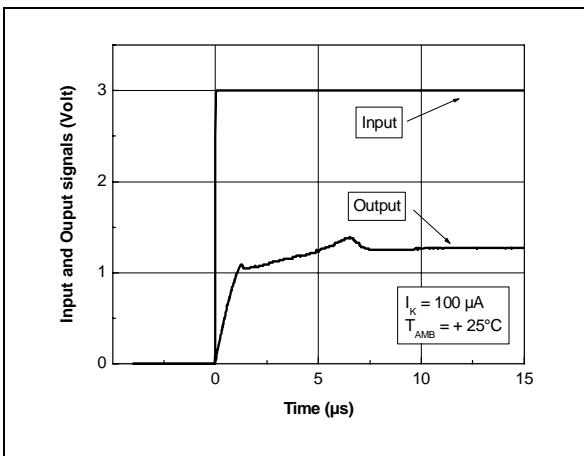
Test circuit for pulse response at  $I_K=100\ \mu\text{A}$



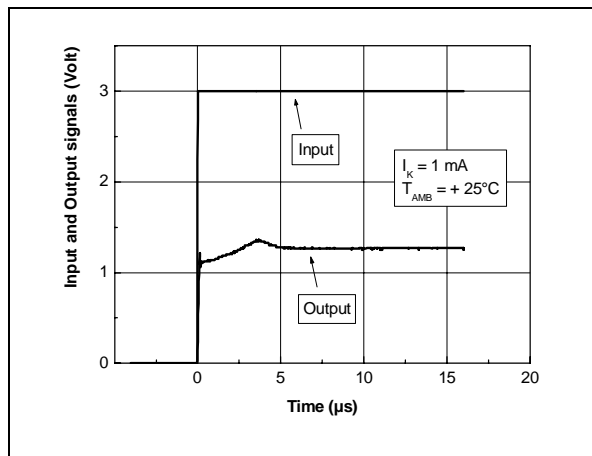
Test circuit for pulse response at  $I_K = 1\ \text{mA}$



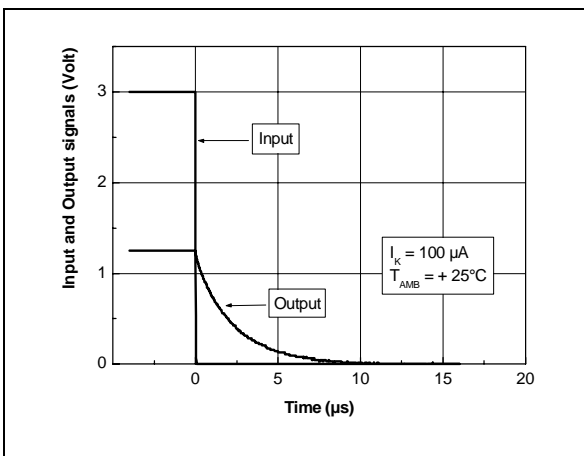
Pulse response at  $I_K = 100\ \mu\text{A}$



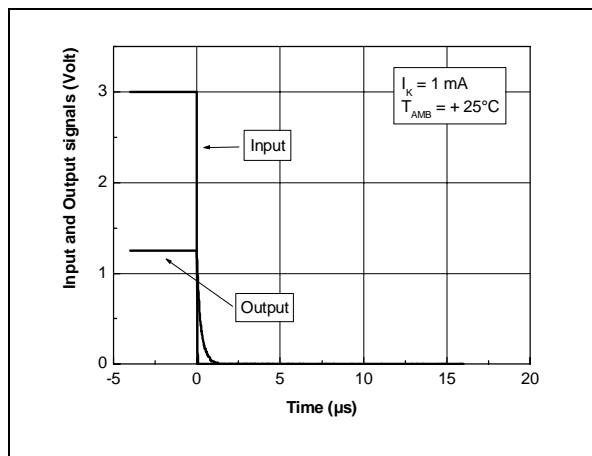
Pulse response at  $I_K = 1\ \text{mA}$



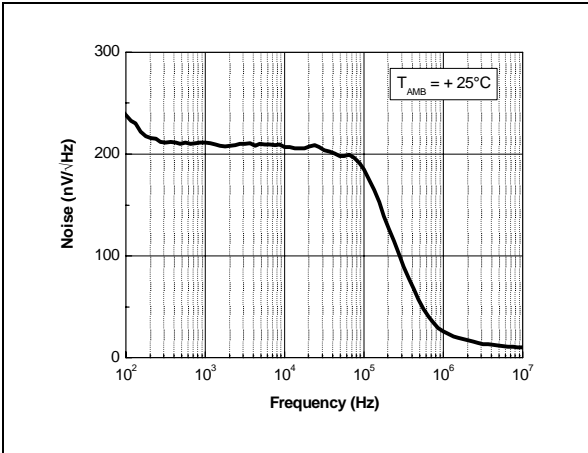
Pulse response at  $I_K = 100\ \mu\text{A}$



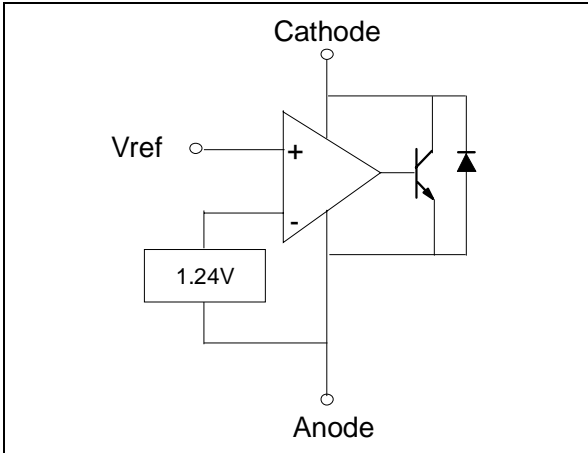
Pulse response at  $I_K = 1\ \text{mA}$



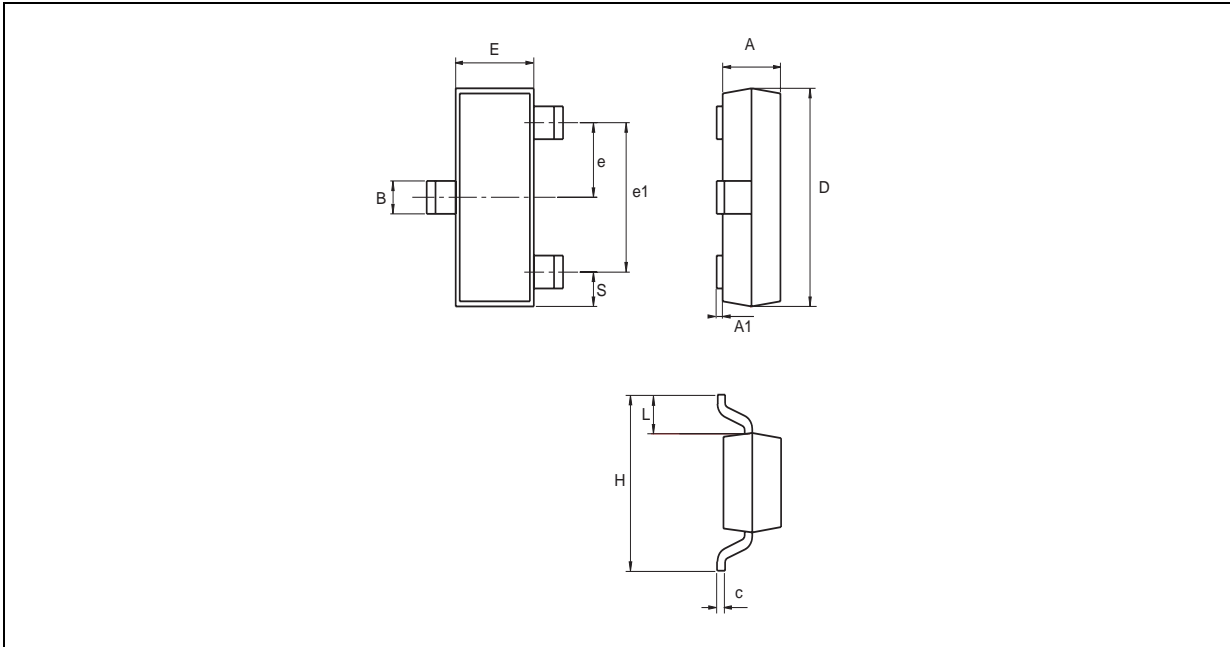
Equivalent input noise vs frequency



Block diagram



**PACKAGE MECHANICAL DATA**  
**3 PINS - TINY PACKAGE (SOT23)**



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.890		1.120	0.035		0.044
A1	0.010		0.100	0.0004		0.004
A2	0.880	0.950	1.020		0.037	0.040
b	0.300		0.500	0.012		0.020
c	0.080		0.200	0.003		0.008
D	2.800	2.900	3.040	0.110	0.114	0.120
E	2.100		2.640	0.083		0.104
E1	1.200	1.300	1.400	0.047	0.051	0.055
e		0.950			0.037	
e1		1.900			0.075	
L	0.400	0.500	0.600	0.016	0.020	0.024
L1		0.540			0.021	
k	0°		8°			

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