TS431

LOW VOLTAGE ADJUSTABLE SHUNT REFERENCE

- **LOW VOLTAGE OPERATION : 1.24 TO 6V**
- **2% AND 1% VOLTAGE PRECISION**
- **WIDE OPERATING RANGE CATHODE CURRENT : 60µA TO 30mA**
- **LOW OUTPUT IMPEDANCE : 0.2Ω**
- **TYPICALLY STABLE FOR ANY CAPACITIVE LOADS**
- **ESD PROTECTION :**
  2kV (Human Body Model)
  200V (Machine Model)
- **100ppm/°C TEMPERATURE COEFFICIENT**

Z
TO92
(Plastic Package)

L
SOT23-5
(Plastic Micropackage)

DESCRIPTION

The TS431 is a low voltage three terminals programmable shunt Voltage Reference. The output voltage can be set to any value between Vref (1.24V) and 6V with two external resistors. The TS431 is able to operate at a lower voltage (1.24V) and lower cathode current than the widespread TL431 and TL1431 shunt voltage reference.

When driving an optocoupler, the TS431 is particularly interesting to regulate 3.3V switching power supplies.

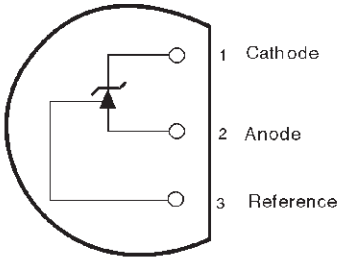
ORDER CODE

Part Number	Temperature Range	Package		SOT-23 Marking
		Z	L	
TS431I	-40°C, +125°C	•	•	L272
TS431AI		•	•	L271

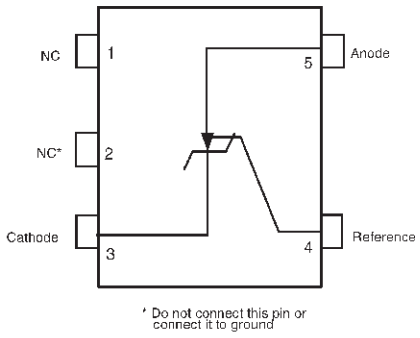
Z = TO92 Plastic package
LT = Tiny Package (SOT23-5) - only available in Tape & Reel (LT)

PIN CONNECTIONS (top view)

TO92
(Top view)



SOT23-5
(Top view)



* Do not connect this pin or connect it to ground

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{KA}	Cathode to Anode Voltage	10	V
I_k	Continuous Cathode Current Range	-20 to +40	mA
I_{ref}	Reference Input Current Range	-0.05 to +3	mA
P_d	Power Dissipation[1] TO92 package SOT23-5 package	625 500	mW
T_{oper}	Operating Free Air Temperature Range	-40 to +125	°C
T_{std}	Storage Temperature Range	-65 to +150	°C

1. Tj=150°C, Tamb=25°C with Rthja=200°C/W for TO92 package and Rthja=250°C/W for SOT23-5L package

OPERATING CONDITIONS

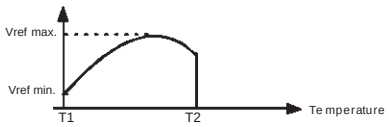
Symbol	Parameter	Value	Unit
V_{KA}	Cathode to Anode Voltage	1.24 to 6	V
I_k	Cathode Current	0.06 to 30	mA

ELECTRICAL CHARACTERISTICS

TS431 T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Vref	Output Voltage $V_{KA} = V_{ref}$ @ I_k = 100µA	T_{amb} = 25°C	1.215	1.240	1.265	V
ΔV_{ref}	Output Voltage Change [1) 2)] I_k = 100µA, $V_{KA} = V_{ref}$	0 < T_{amb} < +70°C -40 < T_{amb} < +85°C -40 < T_{amb} < +105°C -40 < T_{amb} < +125°C			9 16 18 21	mV
$\left\|\frac{\Delta Vref}{\Delta Vka}\right\|$	Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage	I_K = 10mA V_{KA} = 6V to V_{ref}		1.8	2.7	mV/V
I_{ref}	Reference Input Current	I_K = 10mA		70	160	nA
ΔI_{ref}	Reference Input Current Deviation Over Temperature Range	I_K=10mA R_1=10kΩ R_2=∞ -40 < T_{amb} < +85°C -40 < T_{amb} < +125°C		70 90	160 240	nA
I_{min}	Minimum Cathode Current for Regulation	$V_{KA} = V_{ref}$		40	60	µA
I_{off}	Off-State Cathode Current	V_{KA} = 6V , V_{ref} = 0		0.001	0.1	µA
R_{KA}	Static Impedance	$V_{KA} = V_{ref}$, I_K = 0.1 to 15mA		0.2	0.4	Ω

1. Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design.
2. ΔV_{ref} is defined as the difference between the maximum and minimum values obtained over the full temperature range. $\Delta V_{ref} = V_{ref\ max.} - V_{ref\ min.}$

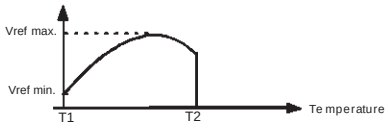


ELECTRICAL CHARACTERISTICS

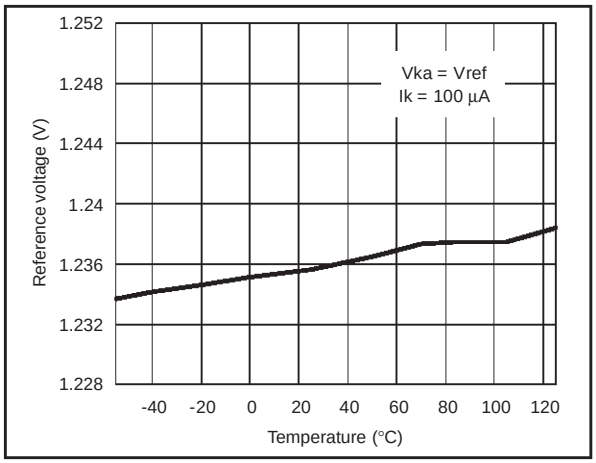
TS431A T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Vref	Output Voltage $V_{KA} = V_{ref}$ @ I_k = 100µA	T_{amb} = 25°C	1.228	1.240	1.252	V
ΔV_{ref}	Output Voltage Change [1) 2)] I_k = 100µA, $V_{KA} = V_{ref}$	0 < T_{amb} < +70°C -40 < T_{amb} < +85°C -40 < T_{amb} < +105°C -40 < T_{amb} < +125°C			9 16 18 21	mV
$\left\|\frac{\Delta Vref}{\Delta Vka}\right\|$	Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage	I_K = 10mA V_{KA} = 6V to V_{ref}		1.8	2.7	mV/V
I_{ref}	Reference Input Current	I_K = 10mA		70	160	nA
ΔI_{ref}	Reference Input Current Deviation Over Temperature Range	I_K=10mA R_1=10kΩ R_2=∞ -40 < T_{amb} < +85°C -40 < T_{amb} < +125°C		70 90	160 240	nA
I_{min}	Minimum Cathode Current for Regulation	$V_{KA} = V_{ref}$		40	60	µA
I_{off}	Off-State Cathode Current	V_{KA} = 6V , V_{ref} = 0		0.001	0.1	µA
R_{KA}	Static Impedance	$V_{KA} = V_{ref}$, I_K = 0.1 to 15mA		0.2	0.4	Ω

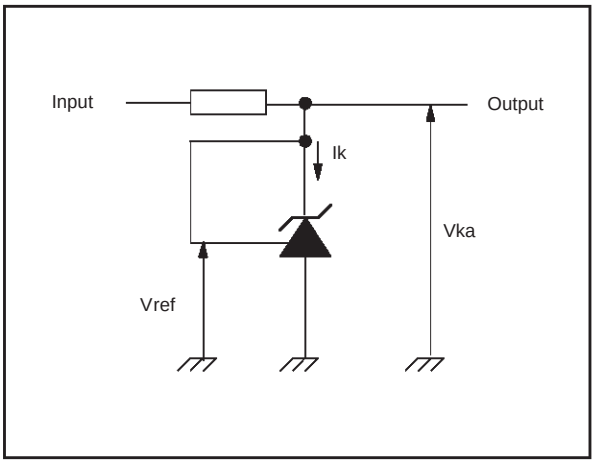
1. Limits are 100% production tested at 25°C. Limits over temperature are guaranteed through correlation and by design.
2. ΔV_{ref} is defined as the difference between the maximum and minimum values obtained over the full temperature range. $\Delta V_{ref} = V_{ref\ max.} - V_{ref\ min.}$



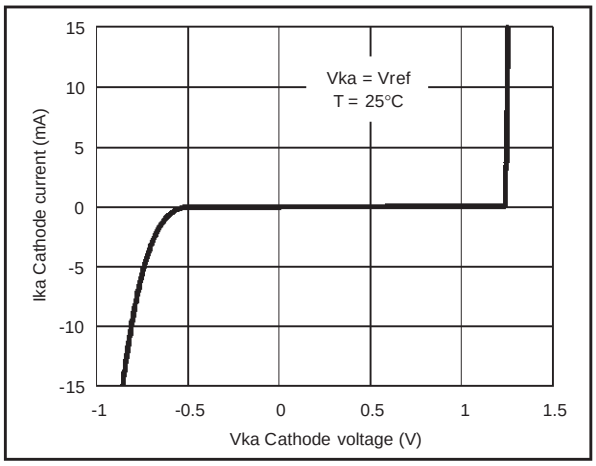
Reference voltage vs temperature



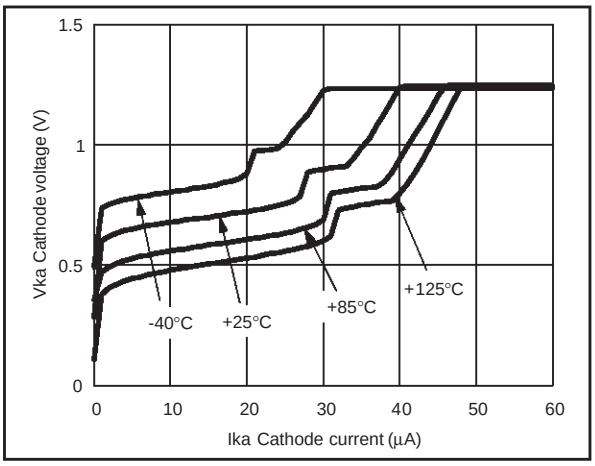
Test circuit for Vka = Vref



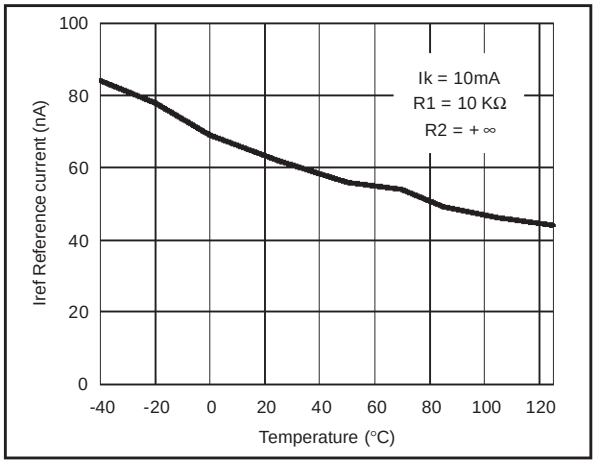
Cathode voltage vs cathode current



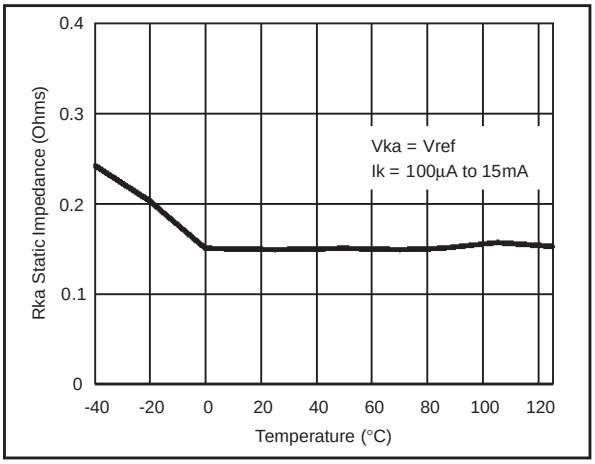
Cathode voltage vs cathode current



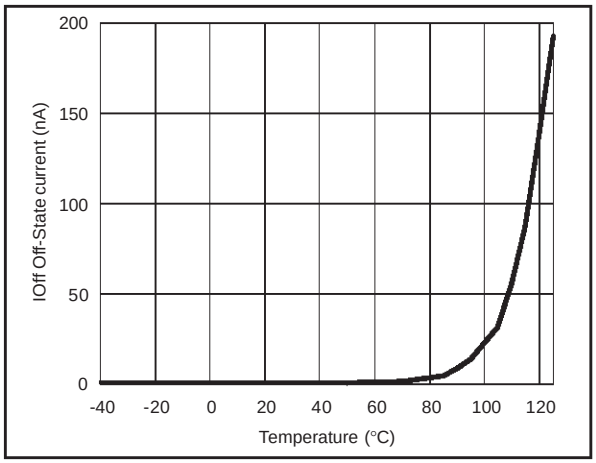
Reference input current vs temperature



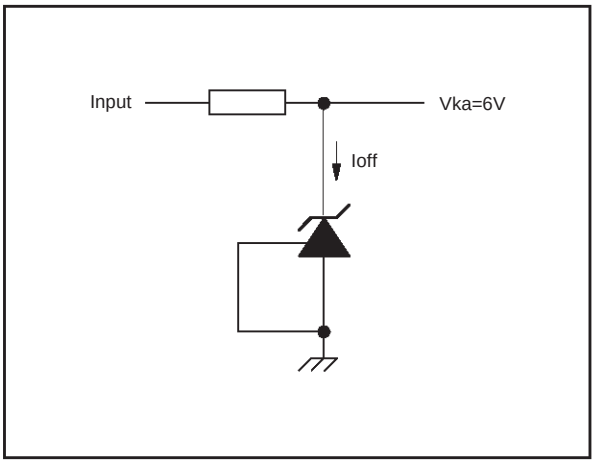
Static impedance vs temperature



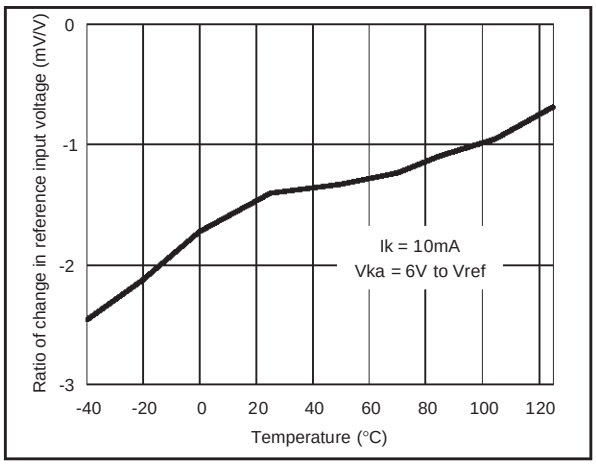
Off-State current vs temperature



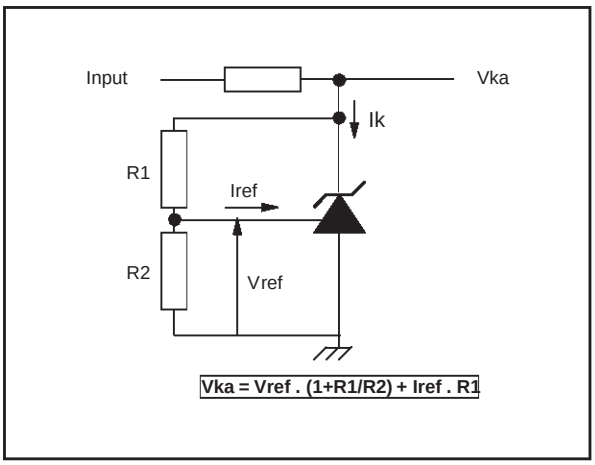
Test circuit for Off-State current measurement



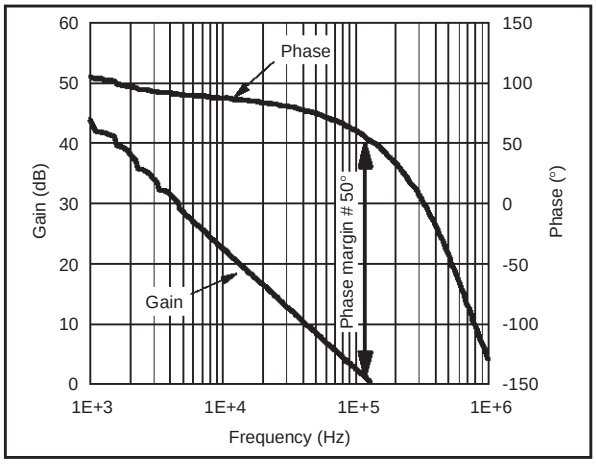
Ratio of change in reference input voltage to change in Vka voltage vs temperature



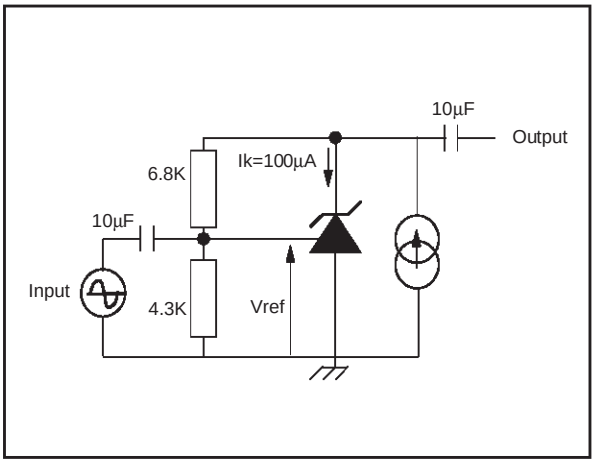
Test circuit for Vka > Vref



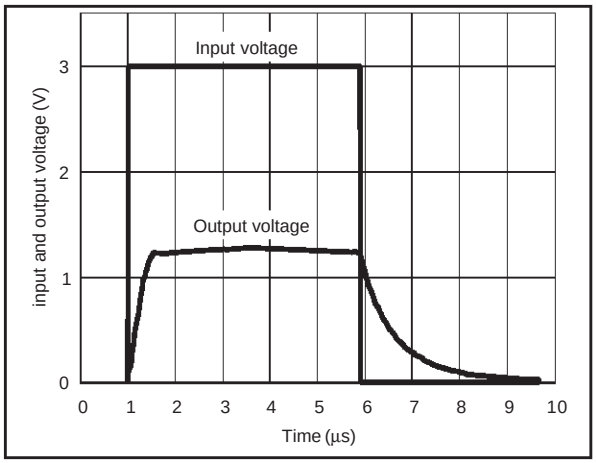
Phase and Gain vs frequency



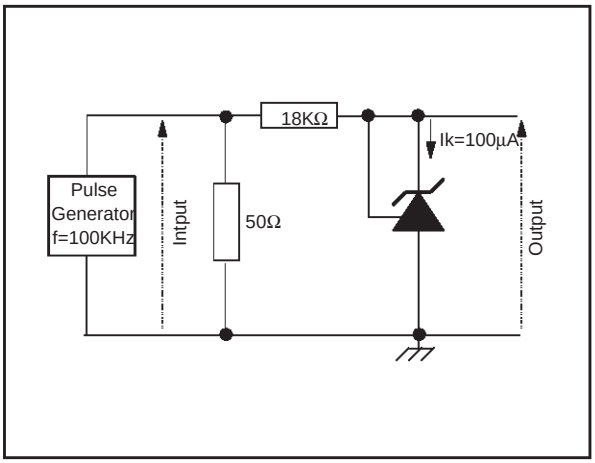
Test circuit for phase and gain measurement



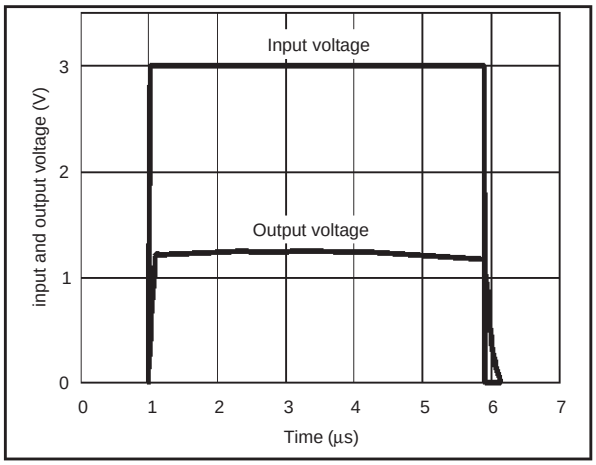
Pulse response at Ik=100µA



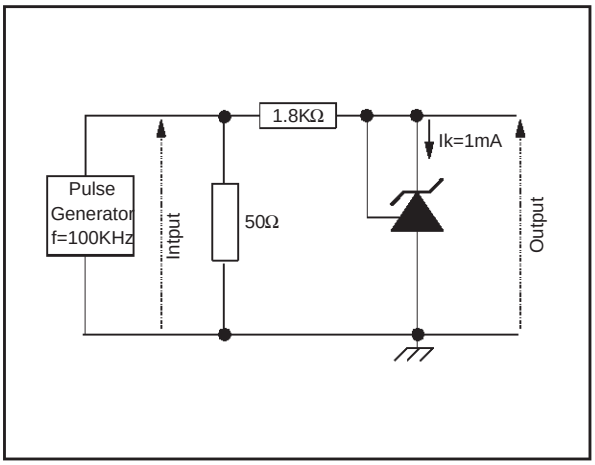
Test circuit for pulse response at Ik = 100µA



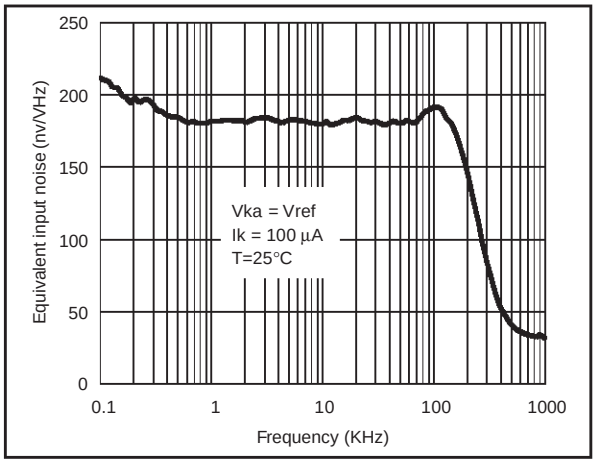
Pulse response at Ik = 1mA



Test circuit for pulse response at Ik = 1mA

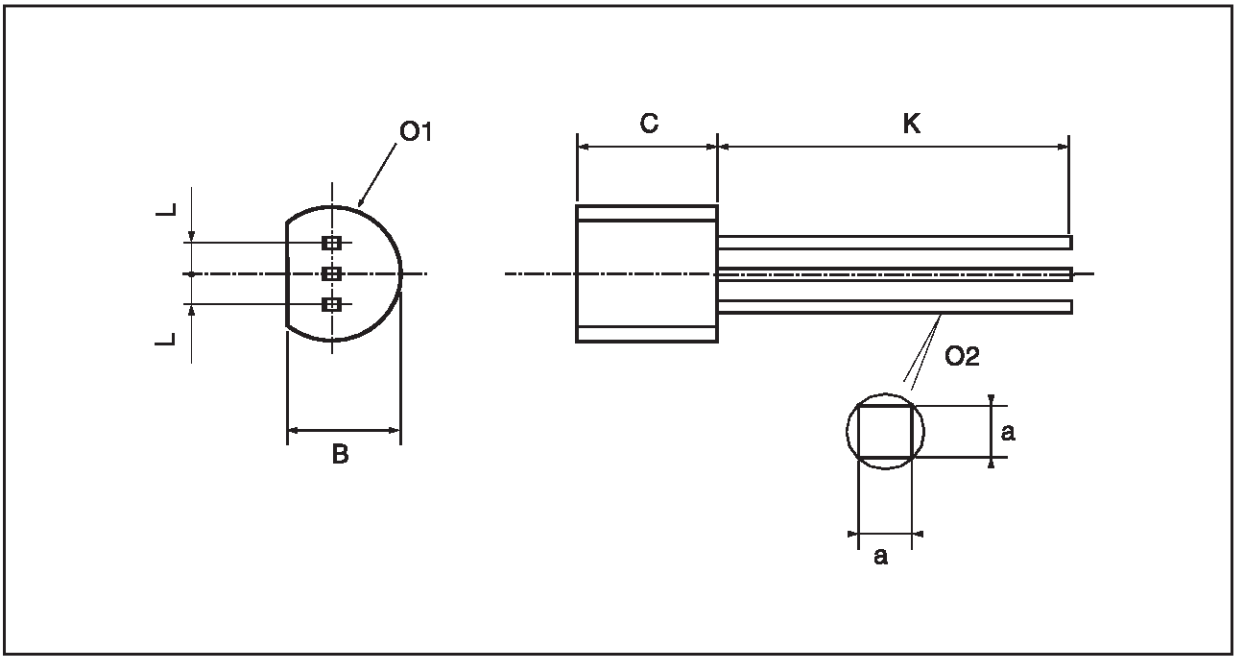


Equivalent input noise vs frequency



PACKAGE MECHANICAL DATA

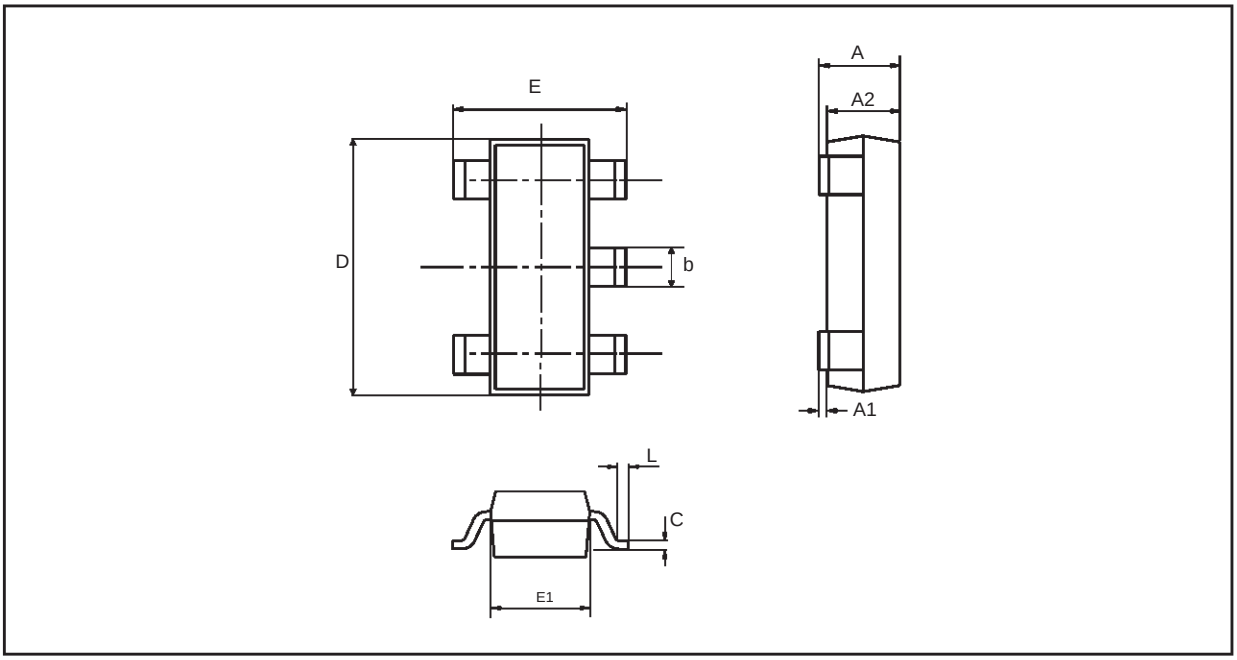
3 PINS - PLASTIC PACKAGE TO92



Dim.	Millimeters			Inches		
	Min	Typ.	Max.	Min.	Typ.	Max.
L		1.27			0.05	
B	3.2	3.7	4.2	0.126	0.1457	0.1654
O1	4.45	5.00	5.2	0.1752	0.1969	0.2047
C	4.58	5.03	5.33	0.1803	0.198	0.2098
K	12.7			0.5		
O2	0.407	0.5	0.508	0.016	0.0197	0.02
a	0.35			0.0138		

PACKAGE MECHANICAL DATA

5 PINS - TINY PACKAGE (SOT23-5)



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A	0.90	1.20	1.45	0.035	0.047	0.057
A1	0		0.15			0.006
A2	0.90	1.05	1.30	0.035	0.041	0.051
B	0.35	0.40	0.50	0.014	0.016	0.020
C	0.09	0.15	0.20	0.004	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
D1		1.90			0.075	
e		0.95			0.037	
E	2.60	2.80	3.00	0.102	0.110	0.0118
F	1.50	1.60	1.75	0.059	0.063	0.069
L	0.10	0.5	0.60	0.004	0.014	0.024
K	0d		10d	0d		10d