



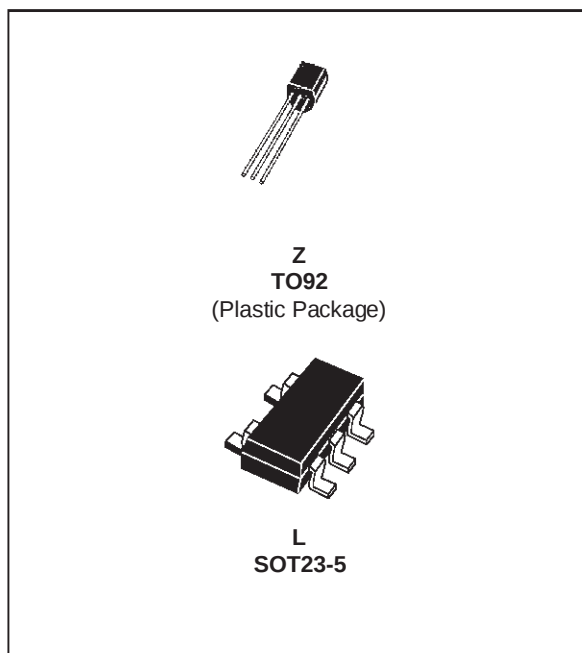
TS431

LOW VOLTAGE ADJUSTABLE SHUNT REFERENCE

- LOW VOLTAGE OPERATION : 1.24 TO 6V
- 2% and 1% VOLTAGE PRECISION
- WIDE RANGE CATHODE CURRENT : 25 μ A TO 30mA
- LOW OUTPUT IMPEDANCE : 0.25 Ω
- HIGH STABILITY WHILE OPERATING WITH CAPACITIVE LOAD
- ESD PROTECTION :
 - 5kV (Human Body Model)
 - 200V (Machine Model)
- OPTIMIZED FOR HIGH TEMPERATURES

DESCRIPTION

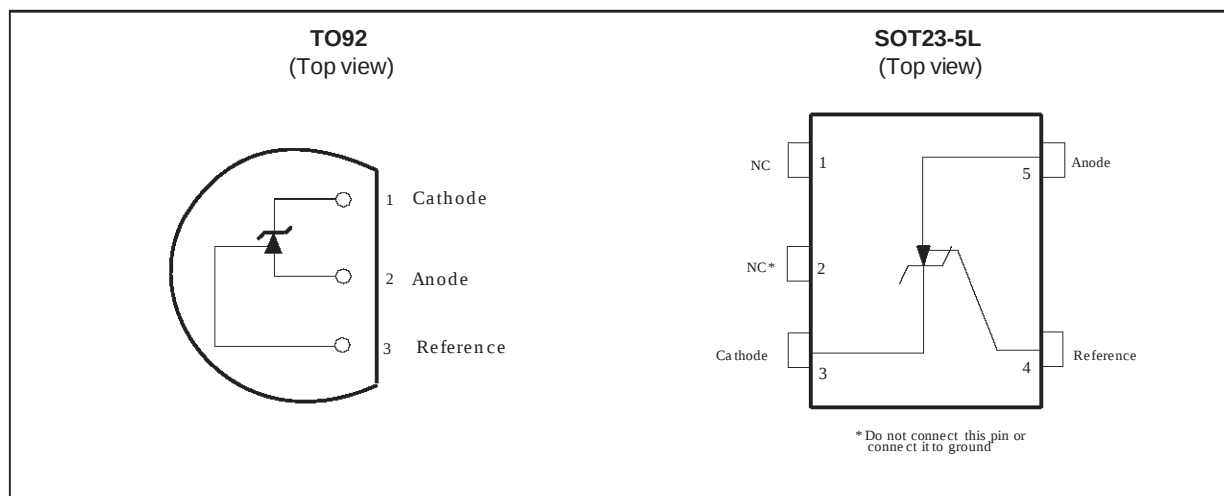
The TS431 is a three terminals programmable shunt Voltage Reference optimized for high temperatures. However, it can operate from -40°C up to +125°C. The output voltage is set by two external resistors to any value between 1.24 and 6V. When driving an optocoupler, the TS431 is particularly interesting to regulate 3.3V switching power supplies.



ORDER CODES

Part Number	Temperature Range	Package	
		Z	L
TS431I/AI	-40°C, +125°C	•	•

PIN CONNECTIONS (top view)



TS431

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, TO92 package @ $T_{amb.} = 25^{\circ}C$ Power dissipation, SO23-5 package @ $T_{amb.} = 25^{\circ}C$	625 500	mW
T_{oper}	Operating Free-air Temperature Range	-40 to +125	$^{\circ}C$
T_{stg}	Storage Temperature Range	-65 to +150	$^{\circ}C$

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{KA}	Cathode to Anode Voltage	V_{ref} to 6	V
I_K	Cathode Current	0.025 to 30	mA

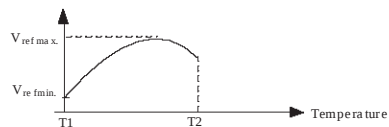
TS431

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

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{ref}	Output Voltage $V_{KA} = V_{ref}$ @ $I_K = 100\mu A$	$T_{amb} = 25^{\circ}C$	1.215	1.240	1.265	V
ΔV_{ref}	Output Voltage Change - note 1 $I_K = 100\mu A$, $V_{KA} = V_{ref}$	$0 < T_{amb} < +70^{\circ}C$ $0 < T_{amb} < +105^{\circ}C$ $0 < T_{amb} < +125^{\circ}C$ $-20 < T_{amb} < +105^{\circ}C$ $-40 < T_{amb} < +85^{\circ}C$ $-40 < T_{amb} < +125^{\circ}C$			15 20 25 30 35 40	mV
$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage	$I_K = 10mA$ $V_{KA} = 6V$ to V_{ref}			2.7	mV/V
I_{ref}	Reference Input Current	$I_K = 10mA$		30	100	nA
ΔI_{ref}	Reference Input Current Deviation Over Temperature Range	$I_K = 10mA$ $R_1 = 10k\Omega$ $R_2 = \infty$		30	60	nA
I_{min}	Minimum Cathode Current for Regulation	$V_{KA} = V_{ref}$		25	40	μA
I_{off}	Off-State Cathode Current	$V_{KA} = 6V$, $V_{ref} = 0$		0.001	0.1	μA
$ Z_{KA} $	Dynamic Impedance	$V_{KA} = V_{ref}$, $f < 1kHz$ $I_K = 0.1$ to $15mA$		0.25	0.4	Ω

Notes : 1. ΔV_{ref} is defined as the difference between the maximum and minimum values obtained over the full temperature range.

$$\Delta V_{ref} = V_{ref \text{ max.}} - V_{ref \text{ min.}}$$



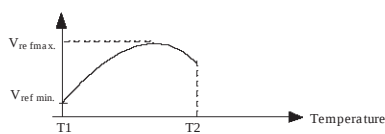
TS431A

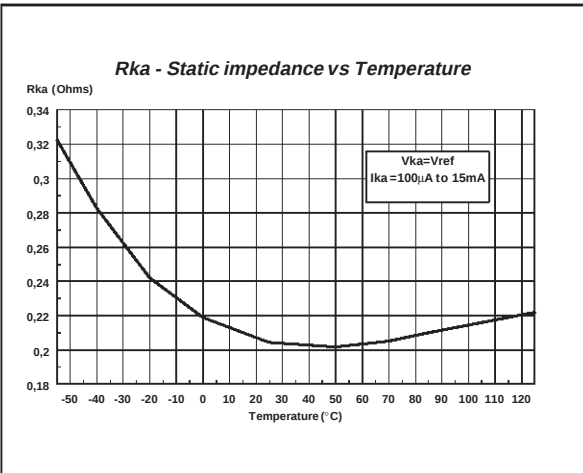
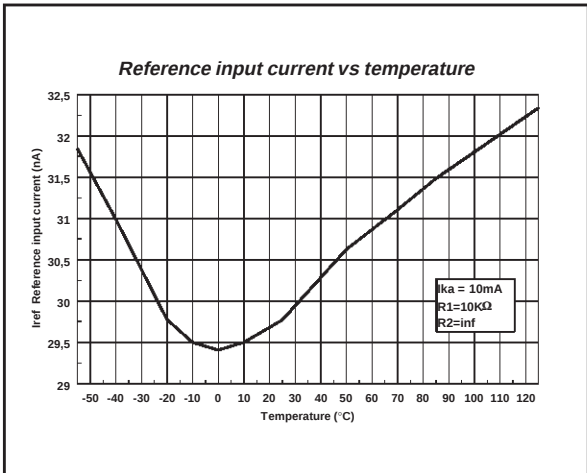
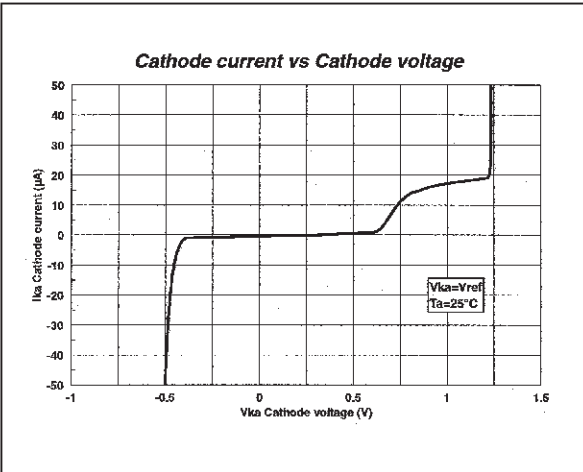
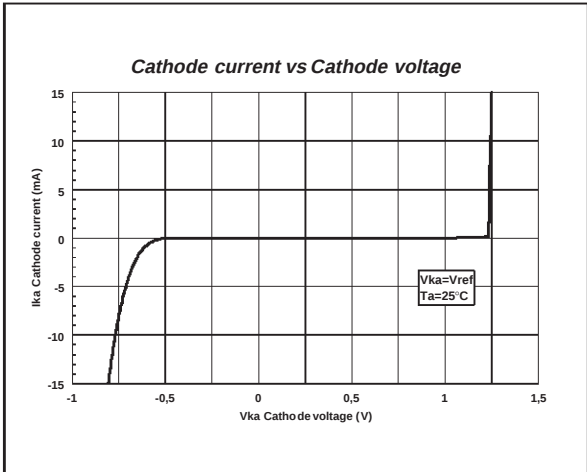
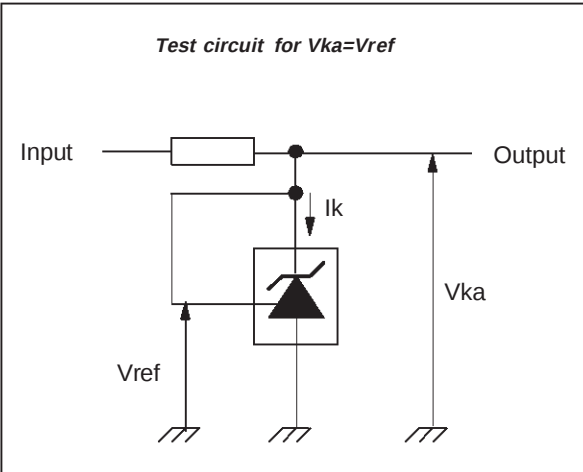
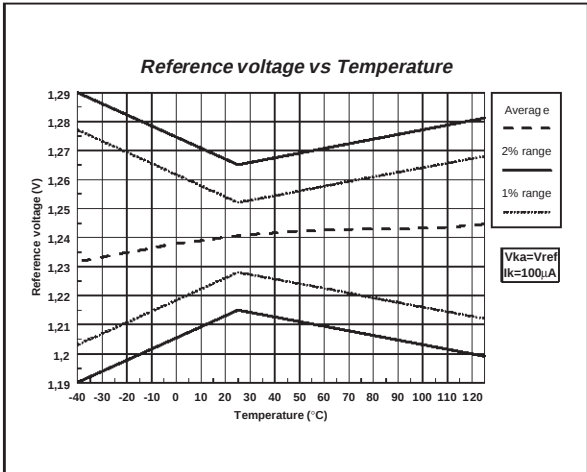
ELECTRICAL CHARACTERISTICS $T_{amb} = 25^{\circ}\text{C}$ (unless otherwise specified)

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{ref}	Output Voltage $V_{KA} = V_{ref} @ I_K = 100\mu\text{A}$	$T_{amb} = 25^{\circ}\text{C}$	1.228	1.240	1.252	V
ΔV_{ref}	Output Voltage Change - note 1 $I_K = 100\mu\text{A}, V_{KA} = V_{ref}$	$0 < T_{amb} < +70^{\circ}\text{C}$ $0 < T_{amb} < +105^{\circ}\text{C}$ $0 < T_{amb} < +125^{\circ}\text{C}$ $-20 < T_{amb} < +105^{\circ}\text{C}$ $-40 < T_{amb} < +85^{\circ}\text{C}$ $-40 < T_{amb} < +125^{\circ}\text{C}$			15 20 25 30 35 40	mV
$\left \frac{\Delta V_{ref}}{\Delta V_{KA}} \right $	Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage	$I_K = 10\text{mA}$ $V_{KA} = 6\text{V to } V_{ref}$			2.7	mV/V
I_{ref}	Reference Input Current	$I_K = 10\text{mA}$		30	100	nA
ΔI_{ref}	Reference Input Current Deviation Over Temperature Range	$I_K = 10\text{mA}$ $R_1 = 10\text{k}\Omega$ $R_2 = \infty$		30	60	nA
I_{min}	Minimum Cathode Current for Regulation	$V_{KA} = V_{ref}$		25	40	μA
I_{off}	Off-State Cathode Current	$V_{KA} = 6\text{V}, V_{ref} = 0$		0.001	0.1	μA
$ Z_{KA} $	Dynamic Impedance	$V_{KA} = V_{ref}, f < 1\text{kHz}$ $I_K = 0.1 \text{ to } 15\text{mA}$		0.25	0.4	Ω

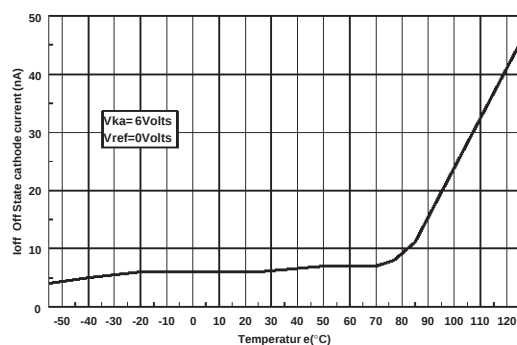
Notes : 1. ΔV_{ref} is defined as the difference between the maximum and minimum values obtained over the full temperature range.

$$\Delta V_{ref} = V_{ref \text{ max.}} - V_{ref \text{ min.}}$$

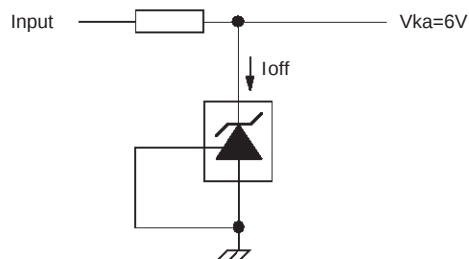




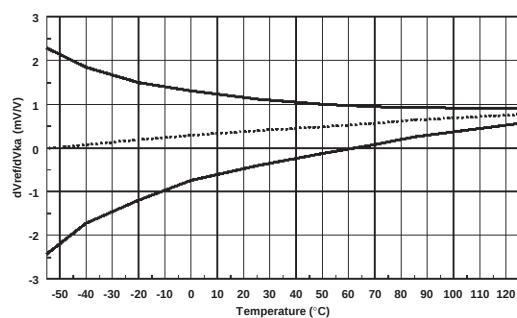
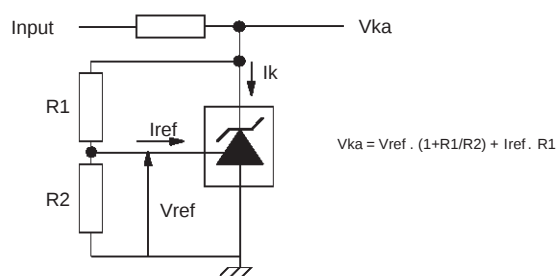
Off State cathode current vs temperature



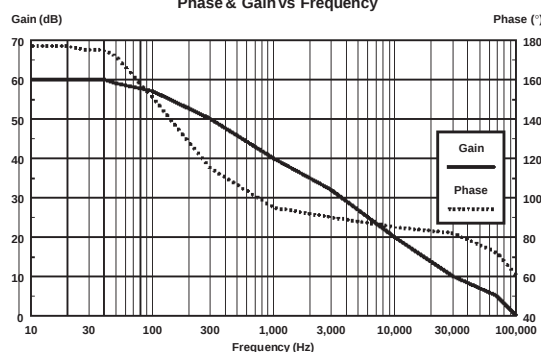
Test circuit for Off-state current measurement



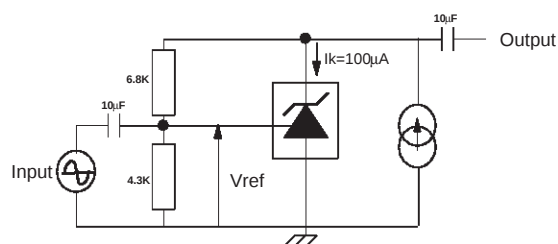
Ratio of change in Reference input voltage to change in cathode voltage vs temperature

Test circuit for $V_{ka} > V_{ref}$ 

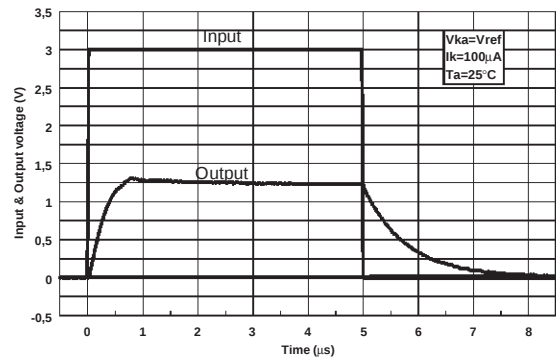
Phase & Gain vs Frequency



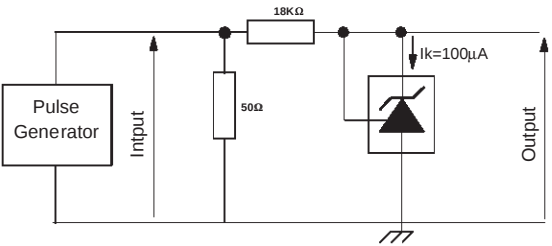
Test circuit for Phase & Gain measurements



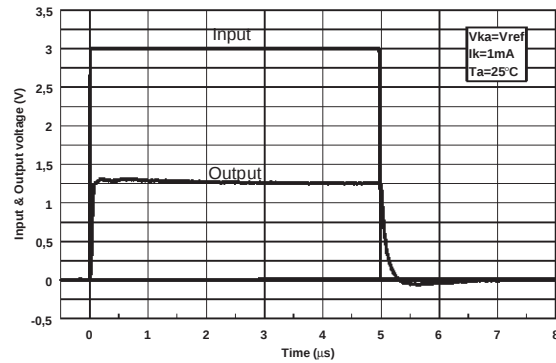
Pulse response for $I_k=100\mu A$



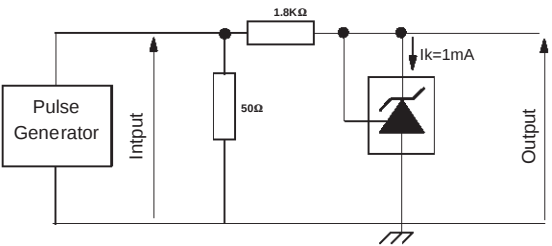
Test circuit for pulse response at $I_k=100\mu A$



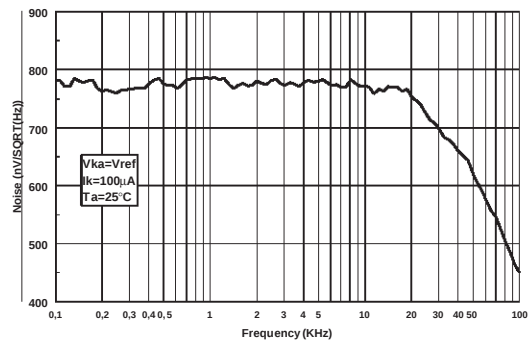
Pulse response for $I_k=1mA$



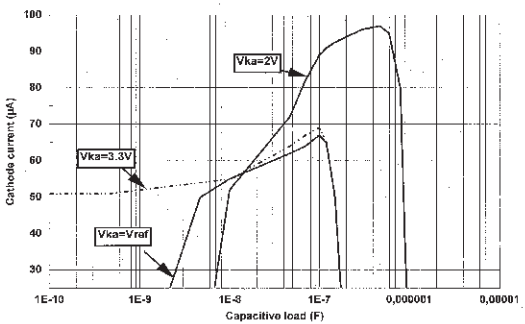
Test circuit for pulse response at $I_k=1mA$

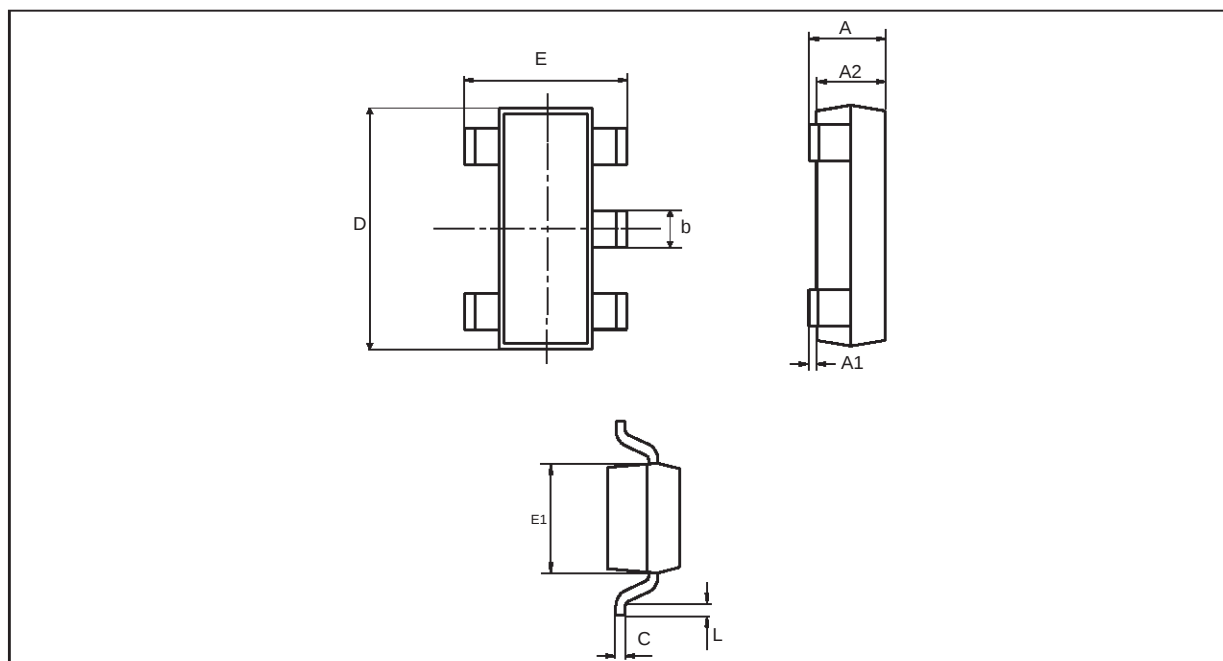


Equivalent Input noise vs frequency



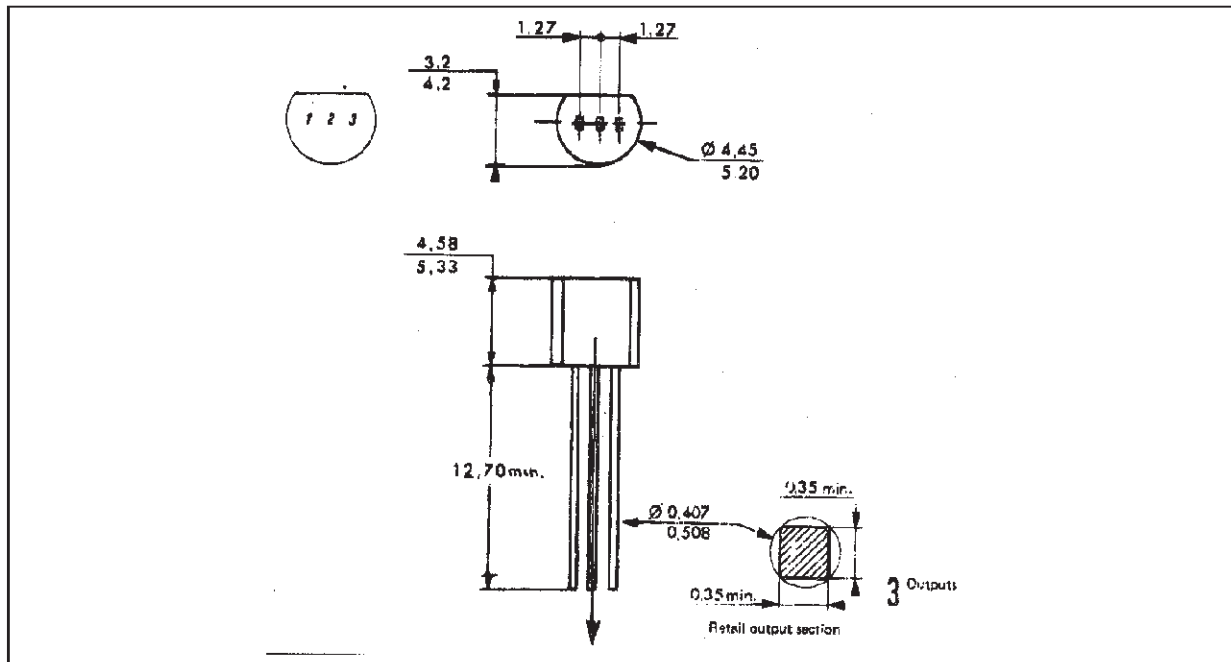
Stability conditions vs Capacitive loads



PACKAGE MECHANICAL DATA**SOT23-5L**

Dimensions	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	0.90	1.45	0.035	0.057
A1		0.15		0.005
A2	0.90	1.30	0.035	0.051
b	0.35	0.50	0.013	0.019
C	0.09	0.20	0.003	0.007
D	2.80	3.00	0.110	0.118
E	2.60	3.00	0.102	0.118
E1	1.50	1.75	0.059	0.068
L	0.10	0.60	0.003	0.023

PACKAGE MECHANICAL DATA **3 PINS - PLASTIC PACKAGE TO92**



Dimensions	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		

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