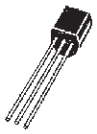
SGS-THOMSON MICROELECTRONICS

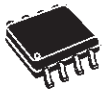
TL1431

PROGRAMMABLE VOLTAGE REFERENCE

- ADJUSTABLE OUTPUT VOLTAGE : V_{ref} to 36V
- SINK CURRENT CAPABILITY : 1 to 100mA
- TYPICAL OUTPUT IMPEDANCE : 0.2Ω
- 0.4% AND 0.25% VOLTAGE PRECISION



Z
TO92
(Plastic Package)



D
SO8
(Batwing Plastic Micropackage)

DESCRIPTION

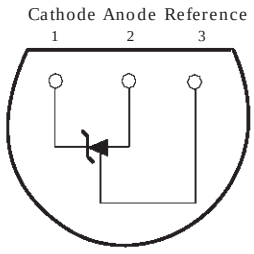
The TL1431 is a programmable shunt voltage reference with guaranteed temperature stability over the entire temperature range of operation.
The output voltage may be set to any value between V_{ref} (approximately 2.5V) and 36V with two external resistors.
The TL1431 operates with a wide current range from 1 to 100mA with a typical dynamic impedance of 0.2Ω.

ORDER CODES

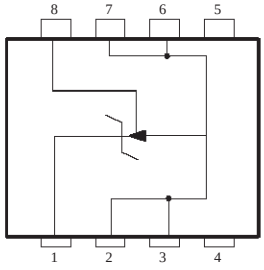
Part number	Temperature Range	Package	
		Z	D
TL1431C/AC	-20°C, +70°C	•	•
TL1431I/AI	-40°C, +105°C	•	•

PIN CONNECTIONS

TO92
(Top view)



SO8
(Top view)



1 - Cathode
2 - Anode
3 - Anode
4 - N.C.
5 - N.C.
6 - Anode
7 - Anode
8 - Reference

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{KA}	Cathode to Anode Voltage	37	V
I_K	Continuous Cathode Current Range	-100 to +150	mA
I_{ref}	Reference Input Current Range	-0.05 to +10	mA
T_{oper}	Operating Free-air Temperature Range TL1431C/AC TL1431I/AI	-20 to +70 -40 to +105	°C
T_{stg}	Storage Temperature Range	-65 to +150	°C

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{KA}	Cathode to Anode Voltage	V_{ref} to 36	V
I_K	Cathode Current	1 to 100	mA

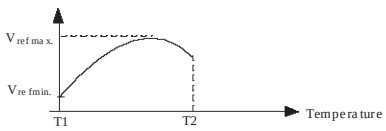
ELECTRICAL CHARACTERISTICS

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

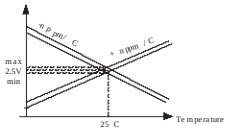
Symbol	Parameter	TL1431C			TL1431AC			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{ref}	Reference Input Voltage - (figure 1) $V_{KA} = V_{ref}$, I_K = 10mA T_{amb} = 25°C	2.490	2.500	2.510	2.493	2.500	2.507	V
ΔV_{ref}	Reference Input Voltage Deviation Over Temperature Range - (figure 1, note1) $V_{KA} = V_{ref}$, I_K = 10mA, $T_{min.} \le T_{amb} \le T_{max.}$		3	20		3	20	mV
$\frac{\Delta V_{ref}}{\Delta T}$	Temperature Coefficient of Reference Input Voltage - (note 2) $V_{KA} = V_{ref}$, I_K = 10mA, $T_{min.} \le T_{amb} \le T_{max.}$		±13	±90		±13	±90	ppm/°C
$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage - (figure 2) I_K = 10mA, ΔV_{KA} = 36V to 3V	-2	-1.1		-2	-1.1		mV/V
Iref	Reference Input Current - (figure 2) I_K = 10mA, R_1 = 10kΩ, R_2 = ∞ T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$		1.5	2.5 3		1.5	2.5 3	µA
ΔI_{ref}	Reference Input Current Deviation Over Temperature Range - (figure 2) I_K = 10mA, R_1 = 10kΩ, R_2 = ∞ $T_{min.} \le T_{amb} \le T_{max.}$		0.2	1.2		0.2	1.2	µA
I_{min}	Minimum Cathode Current for Regulation - (figure 1) $V_{KA} = V_{ref}$		0.5	1		0.5	0.6	mA
I_{off}	Off-State Cathode Current - (figure 3)		180	500		180	500	nA
$\lvert Z_{KA} \rvert$	Dynamic Impedance - (figure 1, note 3) $V_{KA} = V_{ref}$, ΔI_K = 1 to 100mA, f ≤ 1kHz		0.2	0.5		0.2	0.5	Ω

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

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



2. The temperature coefficient is defined as the slopes (positive and negative) of the voltage vs temperature limits whithin which the reference voltage is guaranteed.



3. The dynamic Impedance is defined as $\lvert Z_{KA} \rvert = \frac{\Delta V_{KA}}{\Delta I_K}$

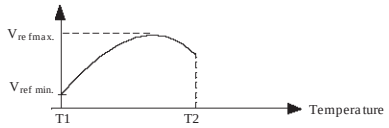
ELECTRICAL CHARACTERISTICS

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

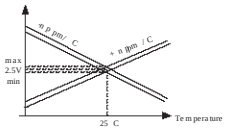
Symbol	Parameter	TL1431I			TL1431AI			Unit
		Min.	Typ.	Max.	Min.	Typ.	Max.	
V_{ref}	Reference Input Voltage - (figure 1) $V_{KA} = V_{ref}$, I_K = 10mA T_{amb} = 25°C	2.490	2.500	2.510	2.493	2.500	2.507	V
ΔV_{ref}	Reference Input Voltage Deviation Over Temperature Range - (figure 1, note1) $V_{KA} = V_{ref}$, I_K = 10mA, $T_{min.} \le T_{amb} \le T_{max.}$		7	30		7	30	mV
$\frac{\Delta V_{ref}}{\Delta T}$	Temperature Coefficient of Reference Input Voltage - (note 2) $V_{KA} = V_{ref}$, I_K = 10mA, $T_{min.} \le T_{amb} \le T_{max.}$		±22	±100		±22	±100	ppm/°C
$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	Ratio of Change in Reference Input Voltage to Change in Cathode to Anode Voltage - (figure 2) I_K = 10mA, ΔV_{KA} = 36 to 3V		-1.1	-2		-1.1	-2	mV/V
Iref	Reference Input Current - (figure 2) I_K = 10mA, R_1 = 10kΩ, R_2 = ∞ T_{amb} = 25°C $T_{min.} \le T_{amb} \le T_{max.}$		1.5	2.5 3		1.5	2.5 3	µA
ΔI_{ref}	Reference Input Current Deviation Over Temperature Range - (figure 2) I_K = 10mA, R_1 = 10kΩ, R_2 = ∞ $T_{min.} \le T_{amb} \le T_{max.}$		0.5	1		0.8	1.2	µA
I_{min}	Minimum Cathode Current for Regulation (figure 1) $V_{KA} = V_{ref}$		0.5	1		0.5	0.7	mA
I_{off}	Off-State Cathode Current - (figure 3)		180	500		180	500	nA
$\|Z_{KA}\|$	Dynamic Impedance - (figure 1, note 3) $V_{KA} = V_{ref}$, ΔI_K = 1 to 100mA, f ≤ 1kHz		0.2	0.5		0.2	0.5	Ω

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

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



2. The temperature coefficient is defined as the slopes (positive and negative) of the voltage vs temperature limits whithin which the reference voltage is guaranteed.



3. The dynamic Impedance is defined as $|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_K}$

Figure 1 : Test Circuit for $V_{KA} = V_{ref}$

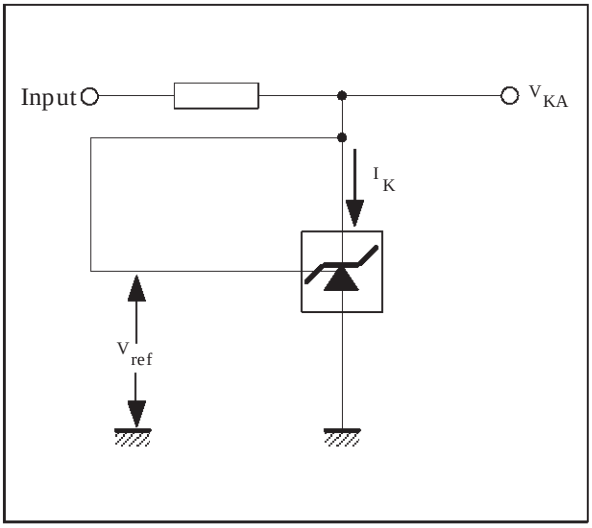


Figure 2 : Test Circuit for $V_{KA} > V_{ref}$

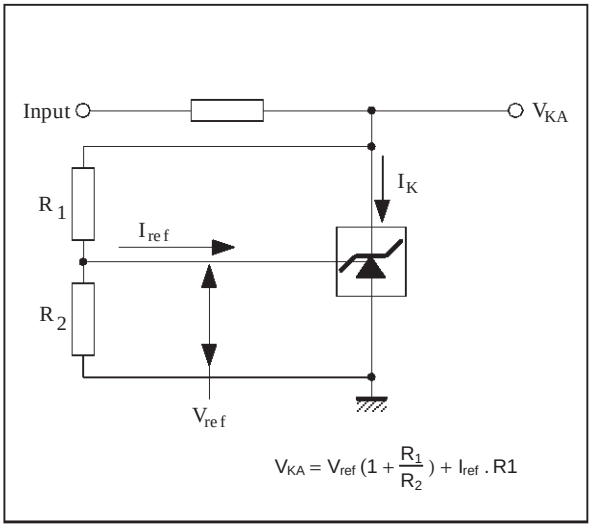


Figure 3 : Test Circuit for I_{off}

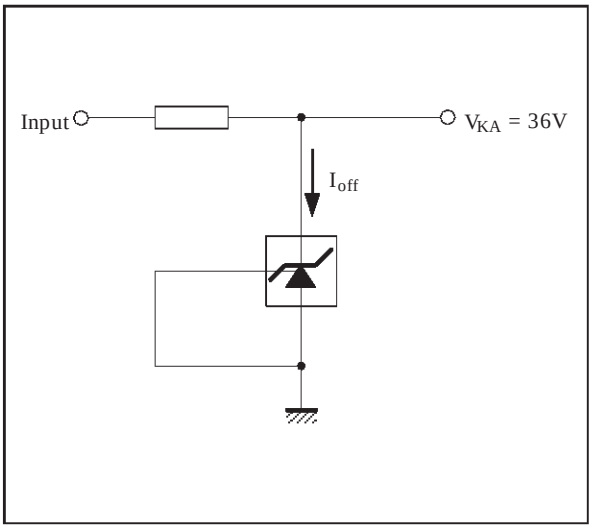
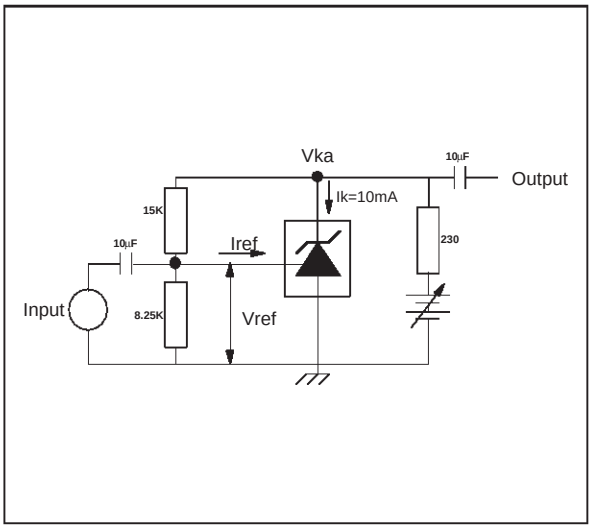
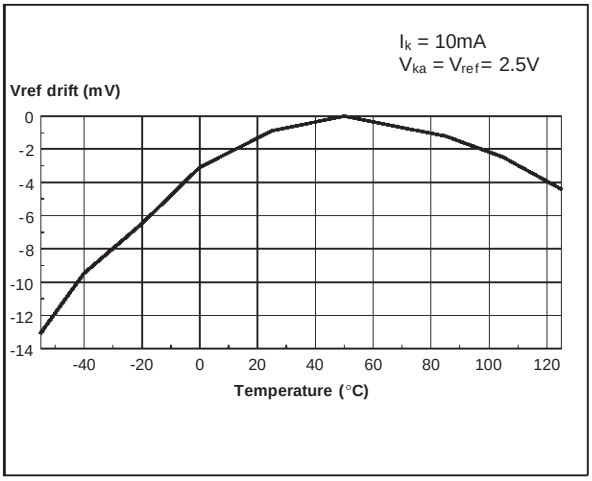


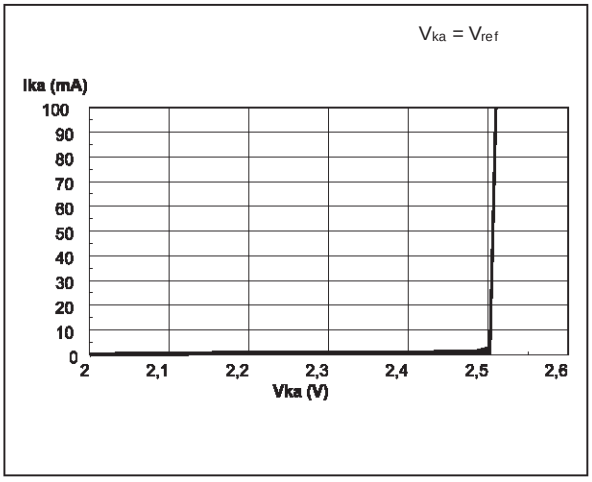
Figure 4 : Test Circuit for Phase Margin and Voltage Gain



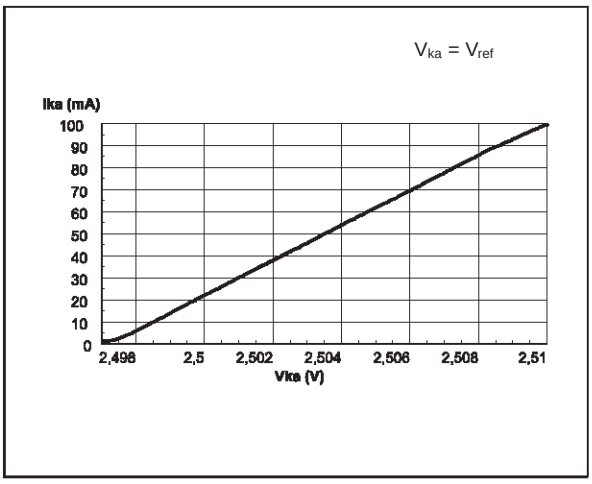
DRIFT (mV) vs TEMPERATURE (^{o}C)



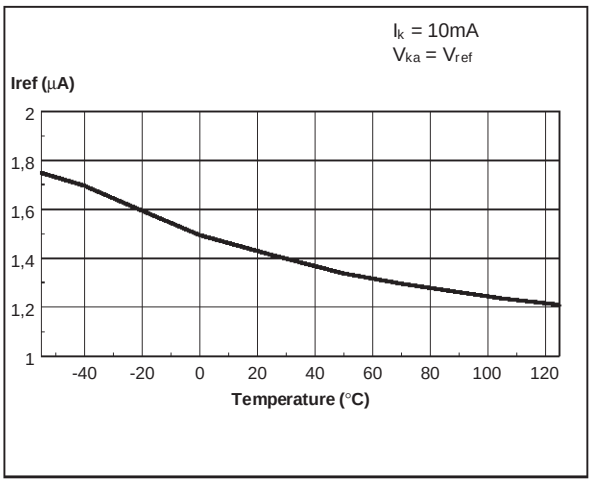
CATHODE CURRENT vs CATHODE VOLTAGE



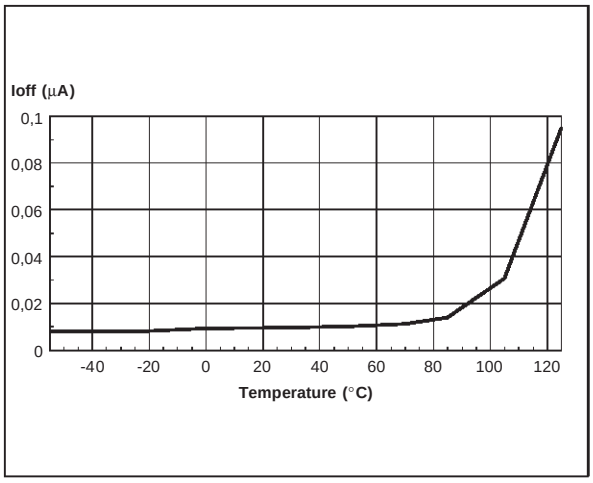
CATHODE CURRENT vs CATHODE VOLTAGE (detailed version)



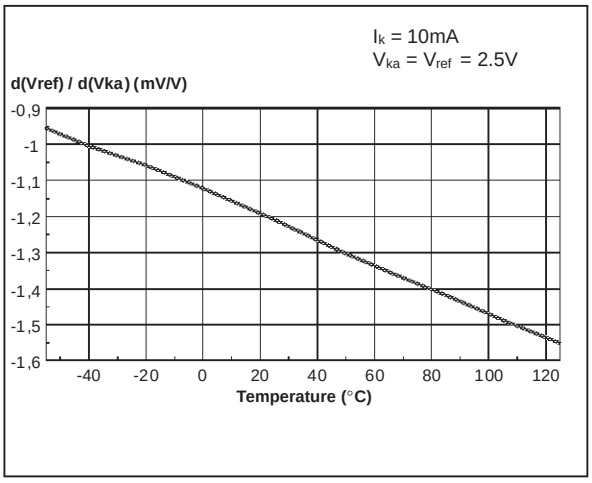
REFERENCE CURRENT vs TEMPERATURE



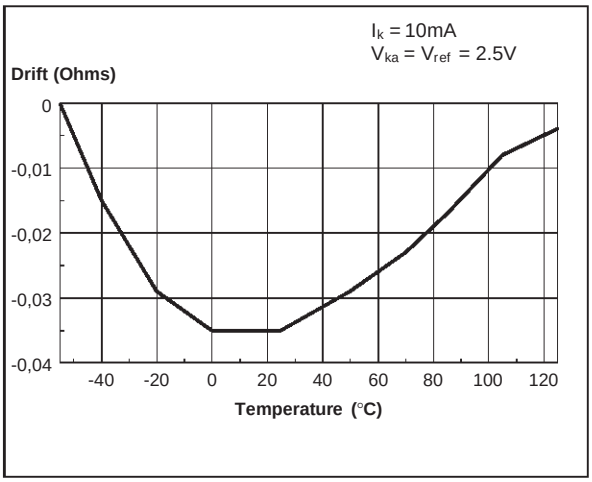
OFF-STATE CATHODE CURRENT vs TEMPERATURE



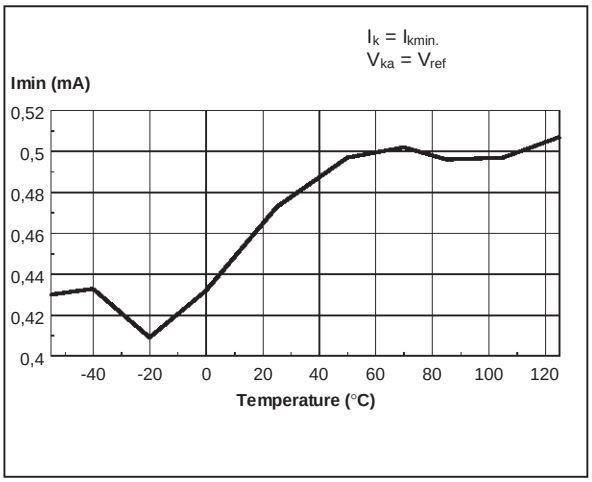
RATIO OF CHANGE IN V_{ref} TO CHANGE IN V_{KA} vs TEMPERATURE



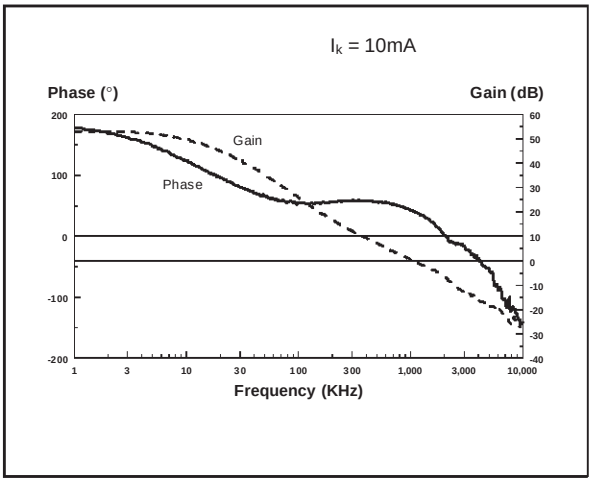
DRIFT OF R_{KA} vs TEMPERATURE



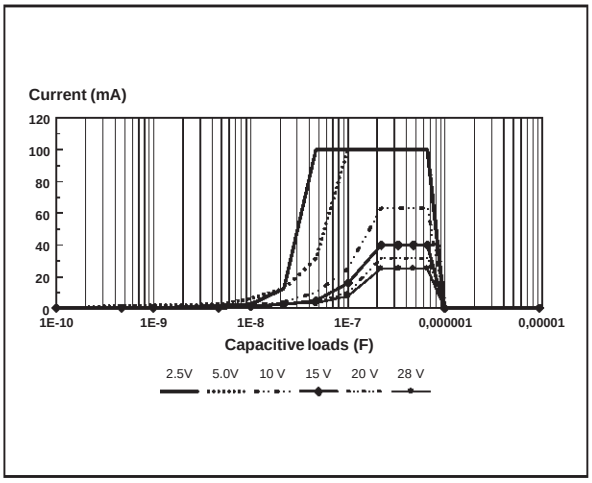
MINIMUM OPERATING CURRENT vs TEMPERATURE



PHASE MARGIN vs FREQUENCY

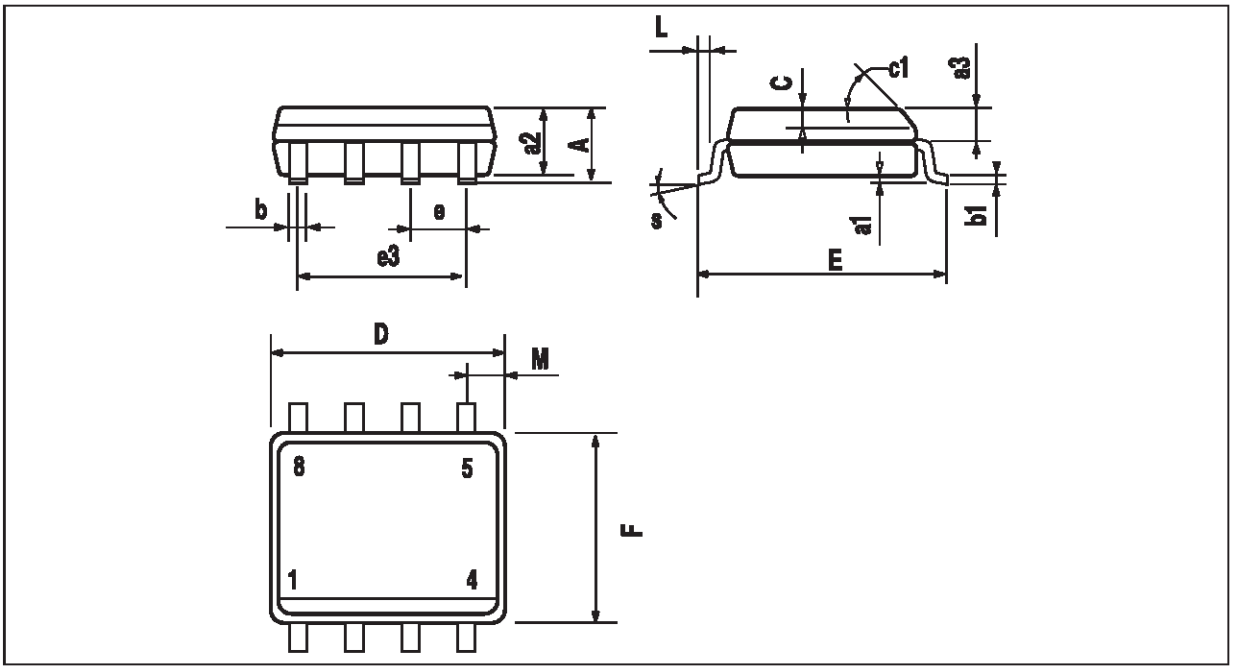


STABILITY FOR CAPACITIVE LOADS



PACKAGE MECHANICAL DATA

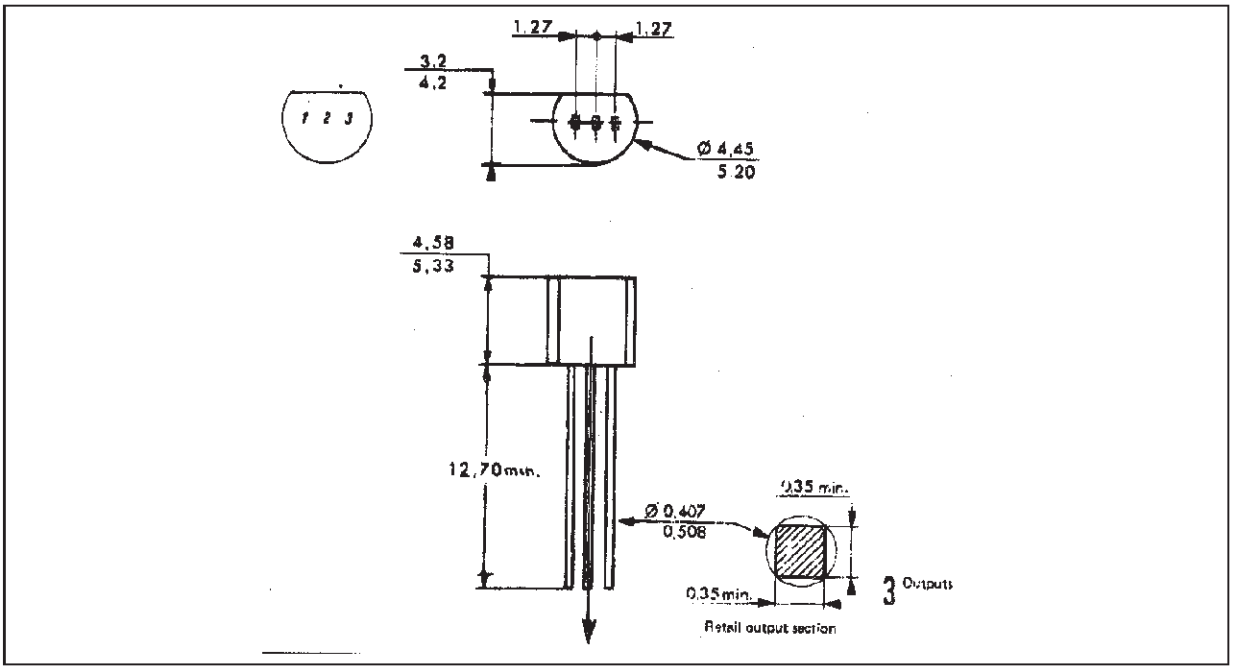
8 PINS - BATWING PLASTIC MICROPACKAGE (SO)



Dimensions	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.069
a1	0.1		0.25	0.004		0.010
a2			1.65			0.065
a3	0.65		0.85	0.026		0.033
b	0.35		0.48	0.014		0.019
b1	0.19		0.25	0.007		0.010
C	0.25		0.5	0.010		0.020
c1	45° (typ.)					
D	4.8		5.0	0.189		0.197
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		3.81			0.150	
F	3.8		4.0	0.150		0.157
L	0.4		1.27	0.016		0.050
M			0.6			0.024
S	8° (max.)					

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		