



TSM103/A

DUAL OPERATIONAL AMPLIFIER AND VOLTAGE REFERENCE

OPERATIONAL AMPLIFIER

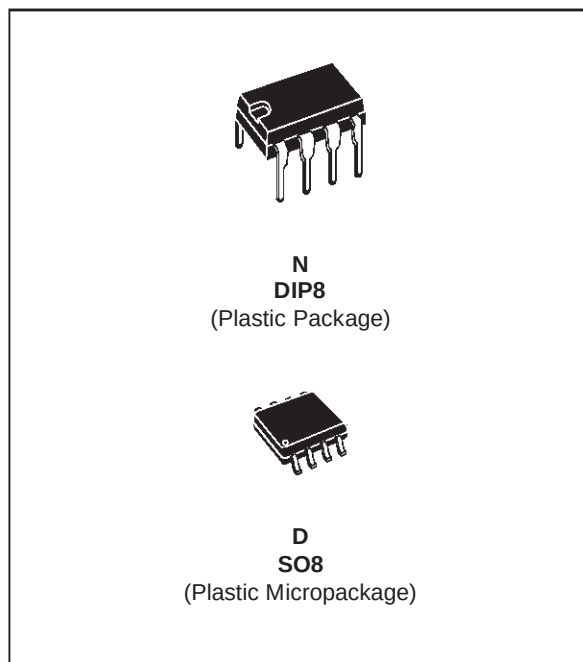
- LOW INPUT OFFSET VOLTAGE : 0.5mV
typ. for TSM103A
- LOW SUPPLY CURRENT : 350µA/op.
(@ $V_{CC} = 5V$)
- MEDIUM BANDWIDTH (unity gain) : 0.9MHz
- LARGE OUTPUT VOLTAGE SWING : 0V to
($V_{CC} - 1.5V$)
- INPUT COMMON MODE VOLTAGE RANGE
INCLUDES GROUND
- WIDE POWER SUPPLY RANGE : 3 to 32V
 ± 1.5 to $\approx 16V$

VOLTAGE REFERENCE

- FIXED OUTPUT VOLTAGE REFERENCE
2.5V
- 0.4% AND 1% VOLTAGE PRECISION
- SINK CURRENT CAPABILITY : 1 to 100mA
- TYPICAL OUTPUT IMPEDANCE : 0.2Ω

DESCRIPTION

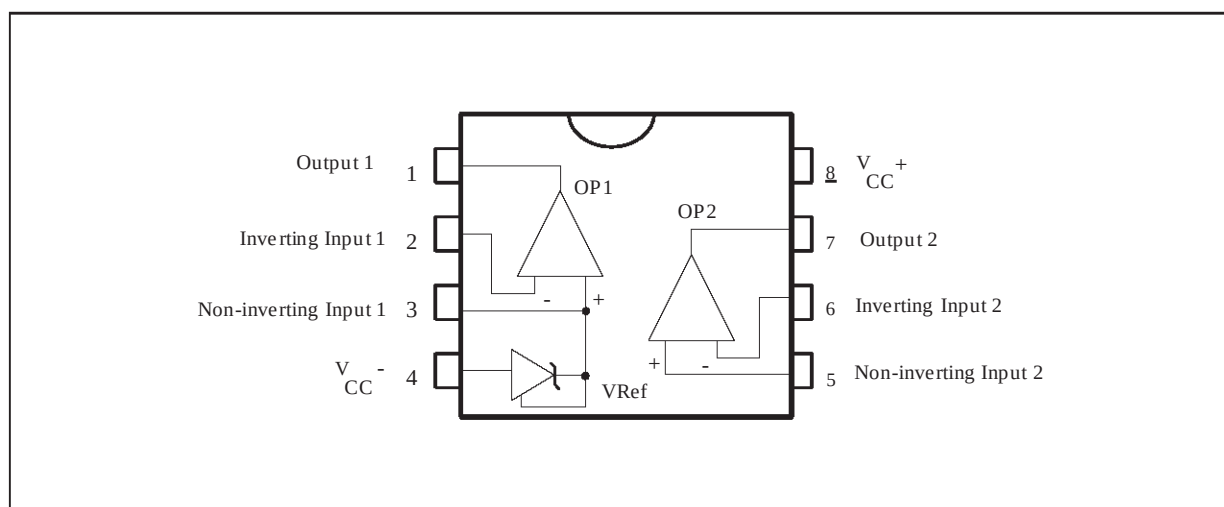
The TSM103 is a monolithic IC that includes one independent op-amp and another op-amp for which the non inverting input is wired to a 2.5V fixed Voltage Reference. This device is offering space and cost saving in many applications like power supply management or data acquisition systems.



ORDER CODES

Part number	Temperature Range	Package	
		N	D
TSM103I/AI	-40°C, +105°C	•	•

PIN CONNECTIONS



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V _{CC}	Supply Voltage	36	V
V _{id}	Differential Input Voltage	36	V
V _i	Input Voltage	-0.3 to +36	V
T _{oper}	Operating Free-air Temperature Range	-55 to +125	°C
T _j	Maximum Junction Temperature	150	°C
R _{thja}	Thermal Resistance Junction to Ambient (SO package)	175	°C/W

ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Min	Typ	Max	Unit
I _{CC}	Total Supply Current, excluding Current in the Voltage Reference V _{CC} ⁺ = 5V, no load T _{min.} < T _{amb} < T _{max.} V _{CC} ⁺ = 30V, no load T _{min.} < T _{amb} < T _{max.}		0.7	1.2 2	mA

OPERATOR 2 (independent op-amp)
 $V_{CC}^+ = +5V$, $V_{CC} = \text{Ground}$, $V_O = 1.4V$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage TSM103, $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ TSM103A, $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$		1 0.5	4 5 2 3	mV
DV_{io}	Input Offset Voltage Drift		7		$\mu V/^\circ C$
I_{io}	Input Offset Current $T_{min.} \leq T_{amb} \leq T_{max.}$		2	30 50	nA
I_{ib}	Input Bias Current $T_{min.} \leq T_{amb} \leq T_{max.}$		20	150 200	nA
A_{vd}	Large Signal Voltage Gain $V_{CC} = 15V$, $R_L = 2k$, $V_O = 1.4V$ to $11.4V$ $T_{min.} \leq T_{amb} \leq T_{max.}$	50 25	100		V/mV
SVR	Supply Voltage Rejection Ratio $V_{CC}^+ = 5V$ to $30V$	65	100		dB
V_{icm}	Input Common Mode Voltage Range $V_{CC} = +30V$ - see note 1 $T_{min.} \leq T_{amb} \leq T_{max.}$	0 0		$(V_{CC}^+) - 1.5$ $(V_{CC}^+) - 2$	V
CMR	Common Mode Rejection Ratio $T_{min.} \leq T_{amb} \leq T_{max.}$	70 60	85		dB
I_{source}	Output Current Source $V_{CC} = +15V$, $V_O = 2V$, $V_{id} = +1V$	20	40		mA
I_O	Short Circuit to Ground $V_{CC} = +15V$		40	60	mA
I_{sink}	Output Current Sink $V_{id} = -1V$, $V_{CC} = +15V$, $V_O = 2V$	10	20		mA
V_{OH}	High Level Output Voltage $V_{CC}^+ = 30V$ $T_{amb} = 25^\circ C$, $R_L = 10k$ $T_{min.} \leq T_{amb} \leq T_{max.}$	27 27	28		V
V_{OL}	Low Level Output Voltage $R_L = 10k$ $T_{min.} \leq T_{amb} \leq T_{max.}$		5	20 20	mV
SR	Slew Rate at Unity Gain $V_i = 0.5$ to $3V$, $V_{CC} = 15V$ $R_L = 2k$, $C_L = 100pF$, unity gain	0.2	0.4		V/ μs
GBP	Gain Bandwidth Product $V_{CC} = 30V$, $R_L = 2k$, $C_L = 100pF$ $f = 100kHz$, $V_{in} = 10mV$	0.5	0.9		MHz
THD	Total Harmonic Distortion $f = 1kHz$ $A_V = 20dB$, $R_L = 2k$, $V_{CC} = 30V$ $C_L = 100pF$, $V_O = 2V_{pp}$		0.02		%

Note 1 : The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is $V_{CC}^+ - 1.5V$. But either of both inputs can go to +36V without damage.

OPERATOR 1 (op-amp with non-inverting input connected to the internal Vref)

 $V_{CC}^+ = +5V$, $V_{CC}^- = \text{Ground}$, $T_{amb} = 25^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $V_{icm} = 0V$ TSM103, $T_{amb} = 25^\circ\text{C}$ $T_{min.} \leq T_{amb} \leq T_{max.}$ TSM103A, $T_{amb} = 25^\circ\text{C}$ $T_{min.} \leq T_{amb} \leq T_{max.}$		1 0.5	4 5 2 3	mV
DV_{io}	Input Offset Voltage Drift		7		$\mu\text{V}/^\circ\text{C}$
I_{ib}	Input Bias Current negative input		20		nA
A_{vd}	Large Signal Voltage Gain $V_{icm} = 0V$ $V_{CC} = 15V$, $R_L = 2k$		100		V/mV
SVR	Supply Voltage Rejection Ratio $V_{icm} = 0V$ $V_{CC}^+ = 5V$ to $30V$	65	100		dB
I_{source}	Output Current Source $V_o = 2V$ $V_{CC} = +15V$, $V_{id} = +1V$	20	40		mA
I_o	Short Circuit to Ground $V_{CC} = +15V$		40	60	mA
I_{sink}	Output Current Sink $V_{id} = -1V$, $V_{CC} = +15V$, $V_o = 2V$	10	20		mA
V_{OH}	High Level Output Voltage $V_{CC}^+ = 30V$ $T_{amb} = 25^\circ\text{C}$, $R_L = 10k$ $T_{min.} \leq T_{amb} \leq T_{max.}$	27 27	28		V
V_{OL}	Low Level Output Voltage $R_L = 10k$ $T_{min.} \leq T_{amb} \leq T_{max.}$		5	20 20	mV
SR	Slew Rate at Unity Gain $V_i = 0.5$ to $2V$, $V_{CC} = 15V$ $R_L = 2k$, $C_L = 100pF$, unity gain	0.2	0.4		V/ μs
GBP	Gain Bandwidth Product $V_{CC} = 30V$, $R_L = 2k$, $C_L = 100pF$ $f = 100kHz$, $V_{in} = 10mV$	0.5	0.9		MHz
THD	Total Harmonic Distortion $f = 1kHz$ $A_V = 20dB$, $R_L = 2k$, $V_{CC} = 30V$ $C_L = 100pF$, $V_o = 2V_{pp}$		0.02		%

VOLTAGE REFERENCE

Symbol	Parameter	Value	Unit
I_K	Cathode Current	1 to 100	mA

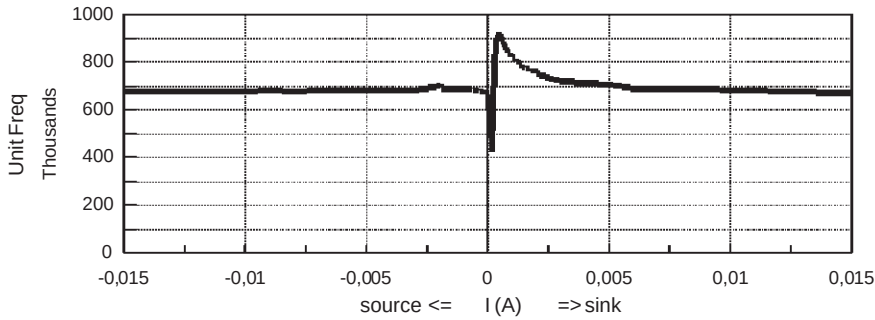
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{ref}	Reference Input Voltage TSM103, $T_{amb} = 25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ TSM103A, $T_{amb} = 25^{\circ}C$ $T_{min.} \leq T_{amb} \leq T_{max.}$	2.475 2.45 2.49 2.48	2.5 2.5	2.525 2.55 2.51 2.52	V
ΔV_{ref}	Reference Input Voltage Deviation Over Temperature Range $V_{KA} = V_{ref}$, $I_K = 10mA$ $T_{min.} \leq T_{amb} \leq T_{max.}$		7	30	mV
I_{min}	Minimum Cathode Current for Regulation $V_{KA} = V_{ref}$		0.5	1	mA
$ Z_{KA} $	Dynamic Impedance - (note 1) $V_{KA} = V_{ref}$, $\Delta I_K = 1$ to 100mA, $f < 1kHz$		0.2	0.5	Ω

Note 1 : the dynamic impedance is defined as $|Z_{KA}| = \Delta V_{KA} / \Delta I_K$

OPERATIONAL AMPLIFIERS

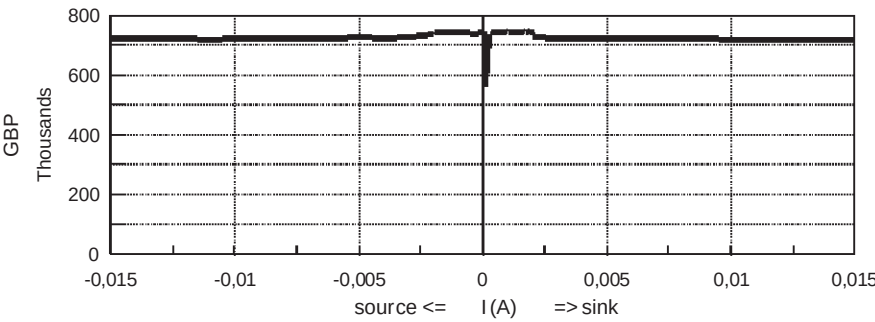
Unit Frequency = $F(I)$

$V_{cc} = \pm 15V$, $R_L = 2k$, $C_L = 100pF$



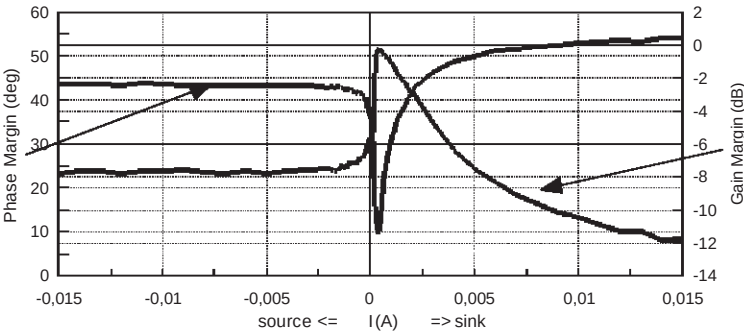
GBP = $F(I)$

$V_{cc} = \pm 15V$, $R_L = 2k$, $C_L = 100pF$

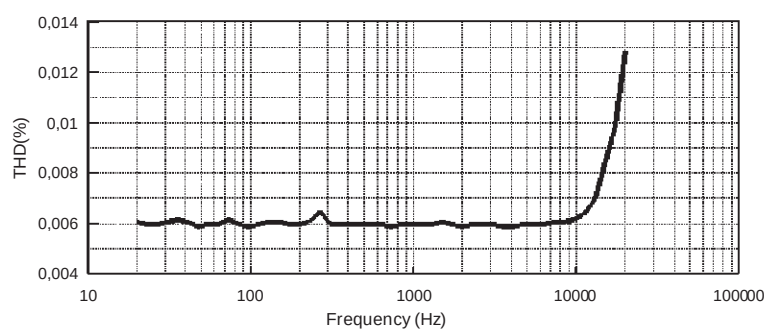


Phase and Gain Margin = $F(I)$

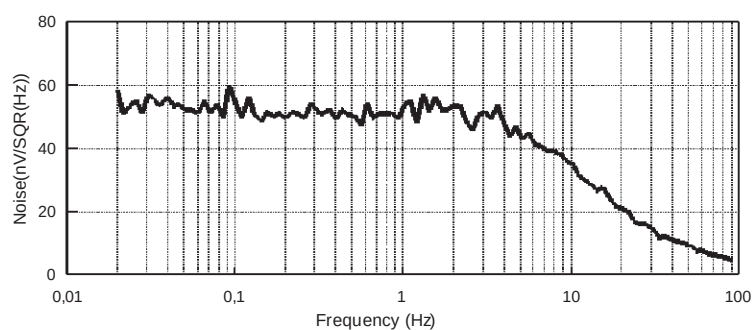
$V_{cc} = \pm 15V$, $R_L = 2k$, $C_L = 100pF$



Total Harmonic Distorsion THD = F(freq)

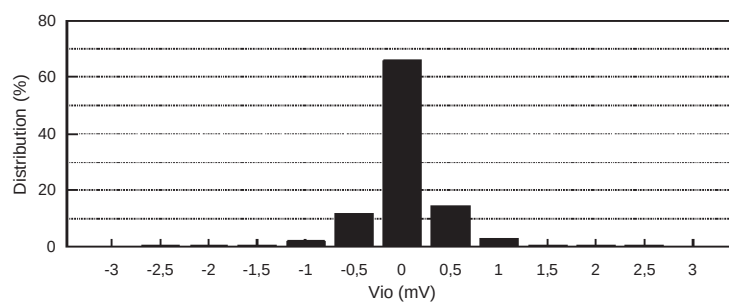


Noise = F(frequency)



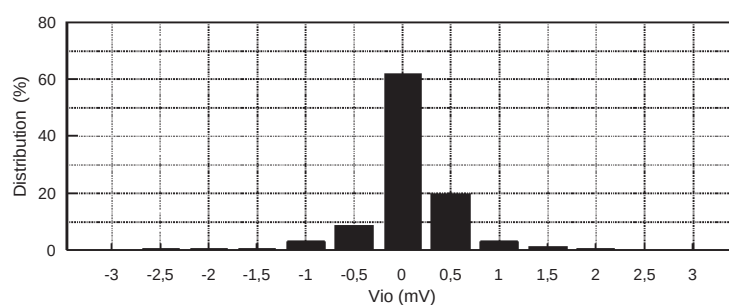
Vio Distribution - Operator 1

Vcc+=5V, Vcc-=0V

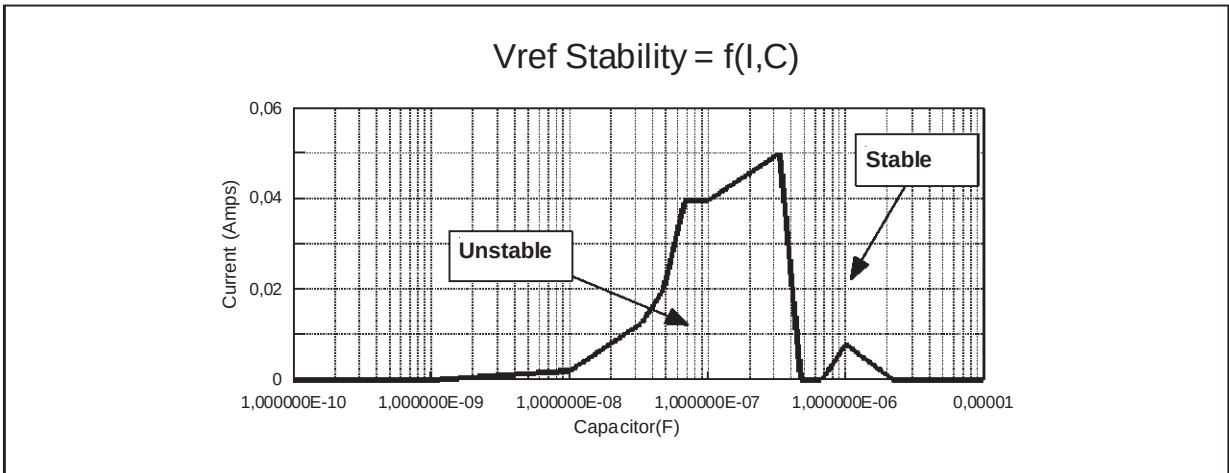
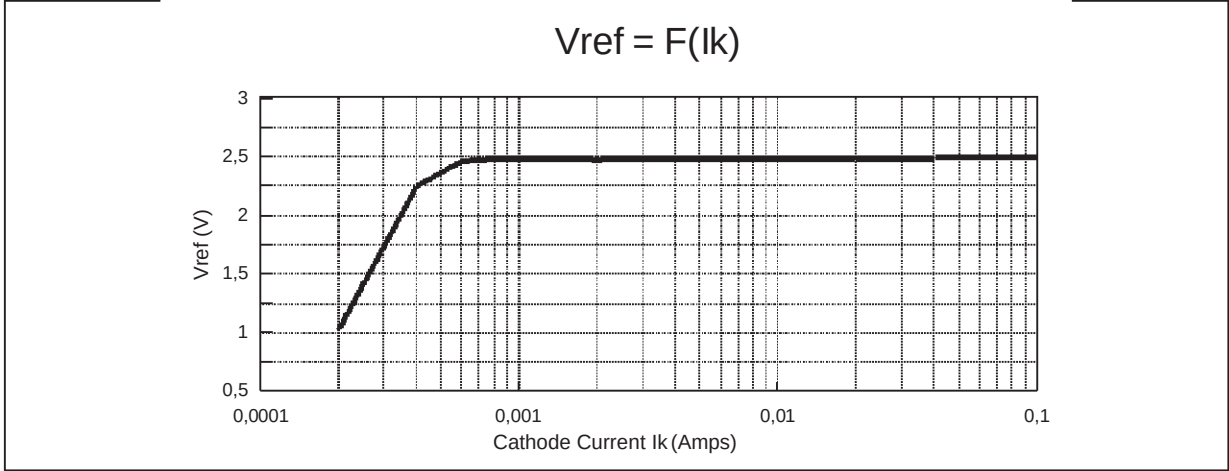


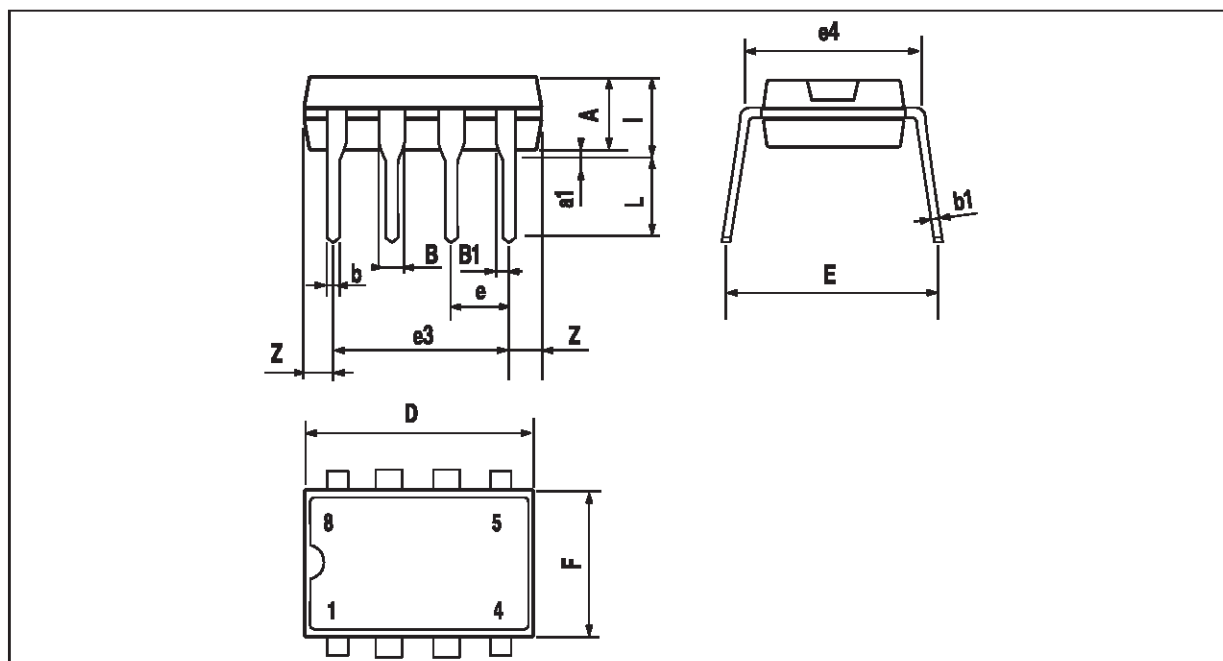
Vio Distribution - Operator 2

Vcc+=5V, Vcc-=0V



VOLTAGE REFERENCE

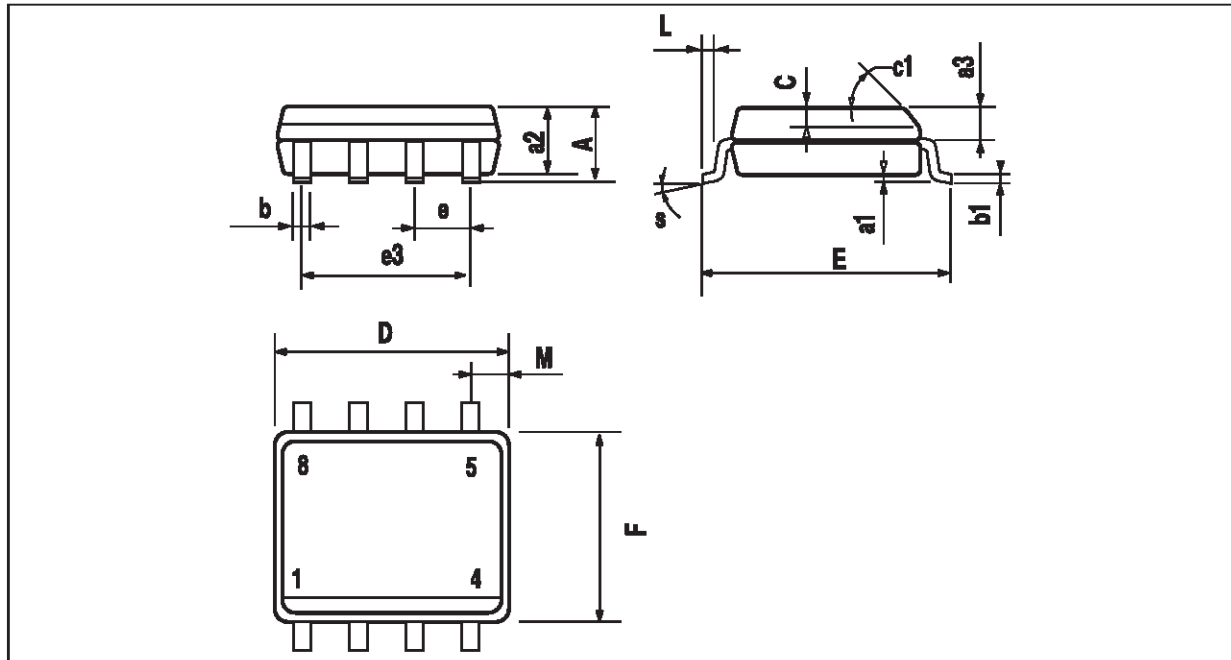


PACKAGE MECHANICAL DATA**8 PINS - PLASTIC PACKAGE**

Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A		3.32			0.131	
a1	0.51			0.020		
B	1.15		1.65	0.045		0.065
b	0.356		0.55	0.014		0.022
b1	0.204		0.304	0.008		0.012
D			10.92			0.430
E	7.95		9.75	0.313		0.384
e		2.54			0.100	
e3		7.62			0.300	
e4		7.62			0.300	
F			6.6			0.260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

PACKAGE MECHANICAL DATA

8 PINS - PLASTIC MICROPACKAGE (SO)



Dim.	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.)					

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