TSM104W/A

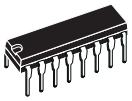
QUAD OPERATIONAL AMPLIFIER AND PROGRAMMABLE VOLTAGE REFERENCE

OPERATIONAL AMPLIFIERS

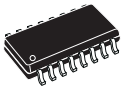
- LOW SUPPLY CURRENT : 375µA/op. (@ V_{CC} = 5V)
- LOW INPUT BIAS CURRENT : 20nA
- MEDIUM SPEED : 0.9MHz
- LOW INPUT OFFSET VOLTAGE : 0.5mV typ for TSM104WA
- WIDE POWER SUPPLY RANGE : ±1.5V to ±15V
- 2kV ESD PROTECTION

VOLTAGE REFERENCE

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



N
DIP16
(Plastic Package)



D
SO16
(Plastic Micropackage)

ORDER CODE

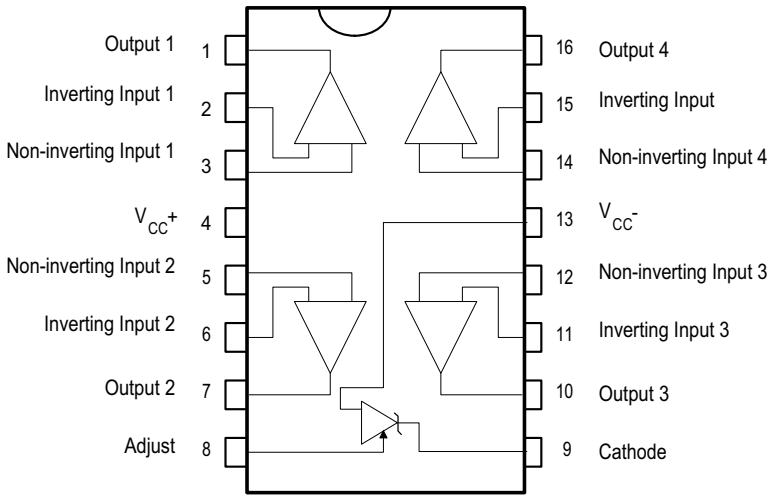
Part Number	Temperature Range	Package	
		N	D
TSM104WI/AI	-40°C, +105°C	•	•

N = Dual in Line Package (DIP)
D = Small Outline Package (SO) - also available in Tape & Reel (DT)

DESCRIPTION

The TSM104W is a monolithic IC that includes four op-amps and an adjustable shunt voltage reference. This device is offering space and cost saving in many applications like power supply management or data acquisition systems.

PIN CONNECTIONS (top view)



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 Vcc + 0.3	V
	Output Short-circuit Duration	Infinite	
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)	150	°C/W
ESD	Electrostatic Discharge Protection	2	kV

ELECTRICAL CHARACTERISTICS

V_{CC}^+ = 5V, V_{CC}^- = 0V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min	Typ	Max	Unit
I_{CC}	Total Supply Current, excluding current in the Voltage Reference				mA
	V_{CC}^+ = 5V, no load				
	$T_{min.} < T_{amb} < T_{max.}$		1.4	2.4	
	V_{CC}^+ = 30V, no load				
	$T_{min.} < T_{amb} < T_{max.}$			4	

ELECTRICAL CHARACTERISTICS

V_{CC}^+ = 5V, V_{cc}^- = Ground, V_O = 1.4V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage TSM104W, T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$ TSM104WA, T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$		 1 0.5	 5 6 3 4	mV
ΔV_{io}	Input Offset Voltage Drift		7		µV/°C
Iio	Input Offset Current $T_{min} \le T_{amb} \le T_{max}$		2	30 50	nA
I_{ib}	Input Bias Current $T_{min} \le T_{amb} \le T_{max}$		20	150 200	nA
A_{vd}	Large Signal Voltage Gain V_{CC} = 15V, R_L = 2k V_O = 1.4V to 11.4V $T_{min} \le T_{amb} \le T_{max}$	 50 25	 100		V/mV
SVR	Supply Voltage Rejection Ratio V_{CC} = 5V to 30V	 65	 100		dB
Vicm	Input Voltage Mode Voltage Range V_{CC} = + 30V see note[1)] $T_{min} \le T_{amb} \le T_{max}$	 0 0		 Vcc^+ -1.5 Vcc^+-2	V
CMR	Common Mode Rejection Ratio $T_{min} \le T_{amb} \le T_{max}$	70 60	85		dB
I_{source}	Output Current Source V_o = 2V, V_{cc} = +15V, V_{id} = +1V	 20	 40		mA
I_o	Output 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 R_L = 10k, V_{CC}^+ = 30V T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$	 27 27	 28		V
V_{OL}	Low Level Output Voltage R_L = 10k $T_{min} \le T_{amb} \le T_{max}$		 5	 20 20	mV
SR	Slew Rate at Unity Gain V_i = 0.5 to 3V, V_{CC} = 15V R_L = 2kΩ, C_L = 100pF, unity gain	0.1	0.3		V/µs
GBP	Gain Bandwith 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 = 2, V_{CC} = 30V C_L = 100pF, V_o = 2Vpp		 0.02		%
e_n	Equivalent Input Noise Voltage f = 1kHz, V_{CC} = 30V, R_s = 100Ω		50		$\frac{nV}{\sqrt{Hz}}$
Cs	Channel Separation 1kHz < f < 20kHz		 120		dB

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 Vcc+0.3V without damage.

But either of both inputs can go to +36V without damage

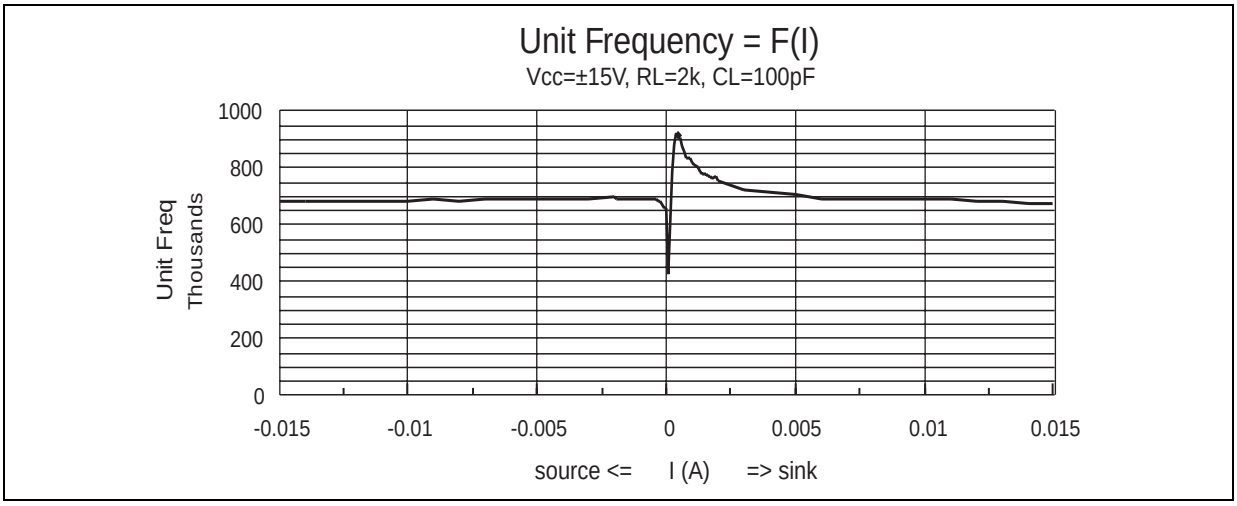
VOLTAGE REFERENCE

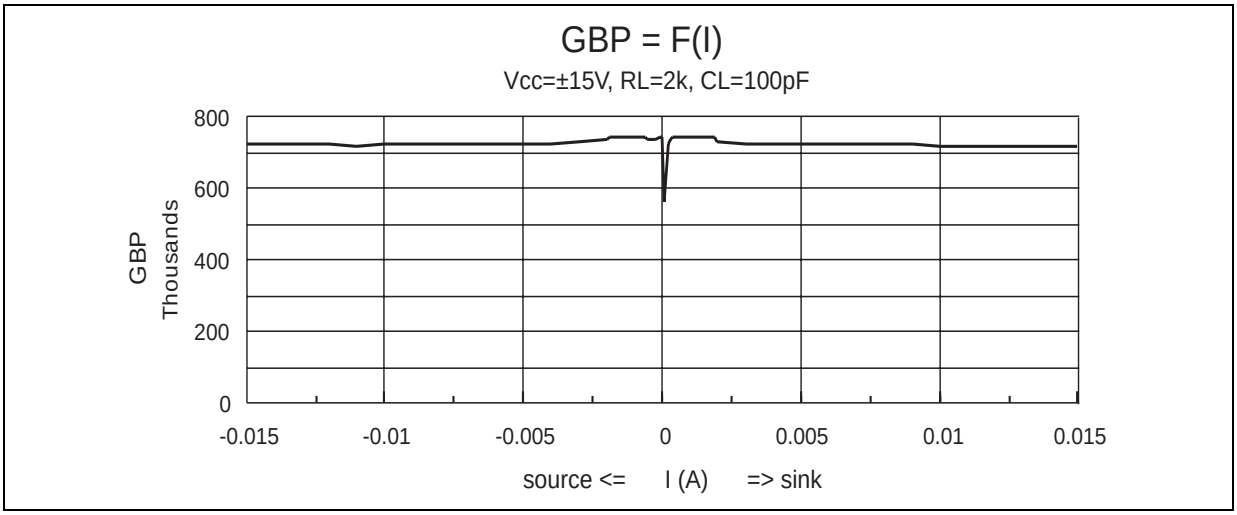
Symbol	Conditions	Value	Unit
I_k	Cathode Current	1 to 100	mA

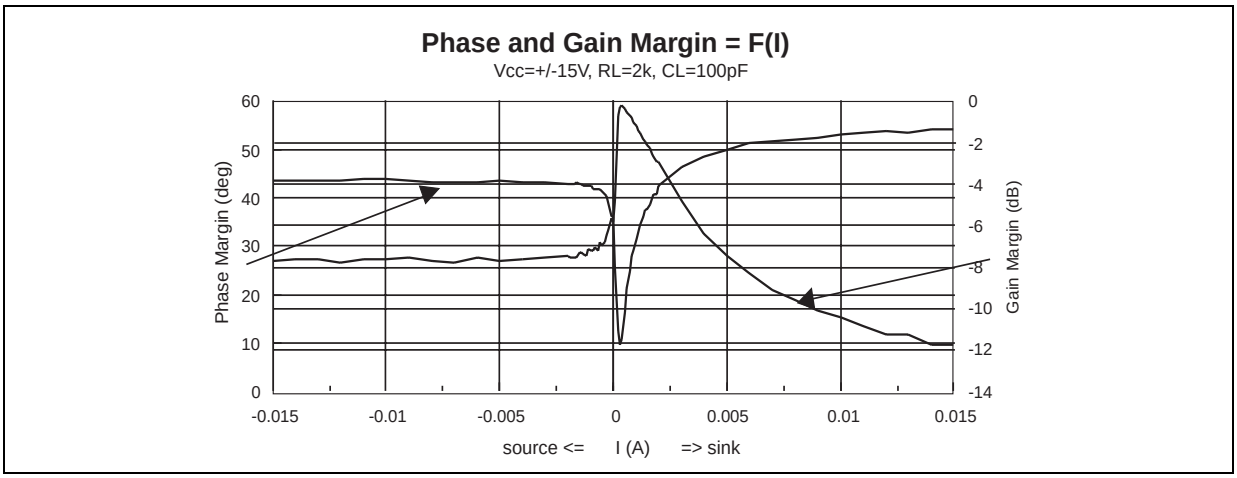
Symbol	Parameter	Min	Typ	Max	Unit
V_{ref}	Reference Input Voltage TSM104W, T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$ TSM104WA, T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$	 2.475 2.45 2.49 2.48	 2.5 2.5	 2.525 2.55 2.51 2.52	V
ΔV_{ref}	Reference Input Voltage Deviation Over Temperature Range $V_{KA} = V_{ref}$, I_K = 10mA $T_{min} \le T_{amb} \le T_{max}$		 7	 30	mV
$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	Ratio of Change in Reference Input Voltage to Charge in Cathode to Anode Voltage I_K = 10mA, ΔV_{KA} =36V to 3V	 -2	 -1.1		mV/V
I_{ref}	Reference Input Current I_K = 10mA $T_{min} \le T_{amb} \le T_{max}$		1.5	2.5 3	µA
ΔI_{ref}	Reference Input Current Deviation over T° Range		0.8	1.2	µA
I_{min}	Minimum Cathode Current for Regulation $V_{KA} = V_{ref}$		 0.5	 1	mA
I_{off}	Off-State Cathode Current		180	500	nA
$\lvert Z_{KA} \rvert$	Dynamic Impedance - note 1 $V_{KA} = V_{ref}$, ΔI_K = 1 to 100mA, f < 1kHz		0.2	0.5	Ω

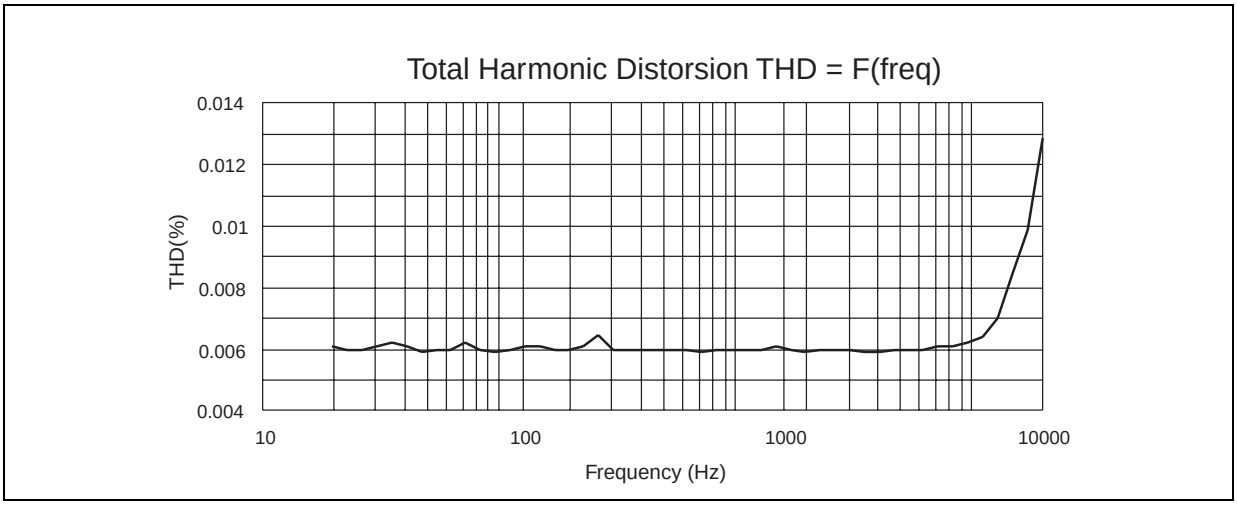
1) The dynamic impedance is defined as $\lvert Z_{KA} \rvert = \frac{\Delta V_{KA}}{\Delta V I_K}$

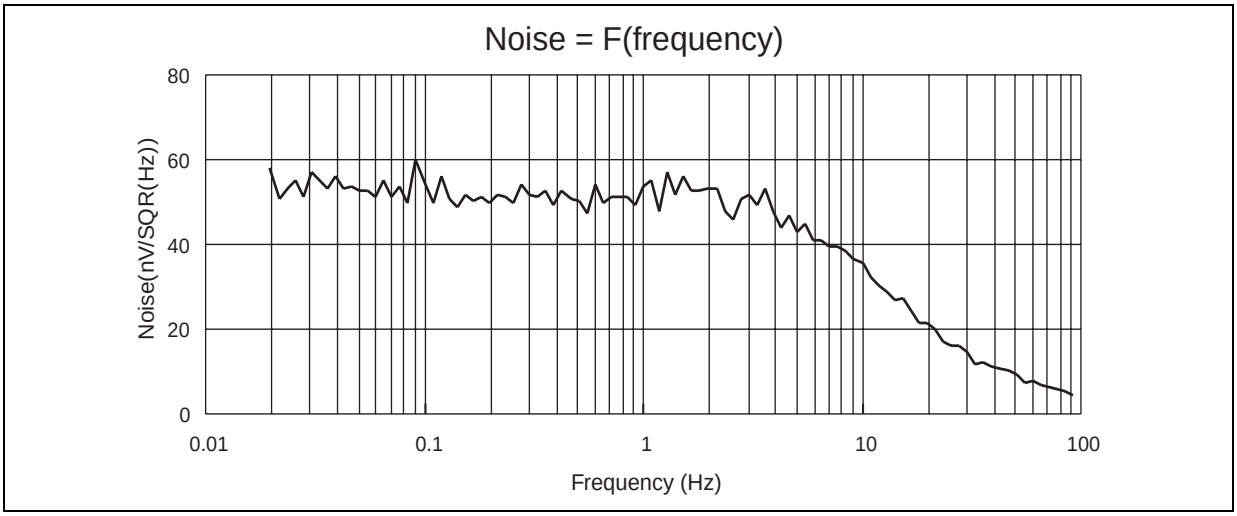
OPERATIONAL AMPLIFIERS

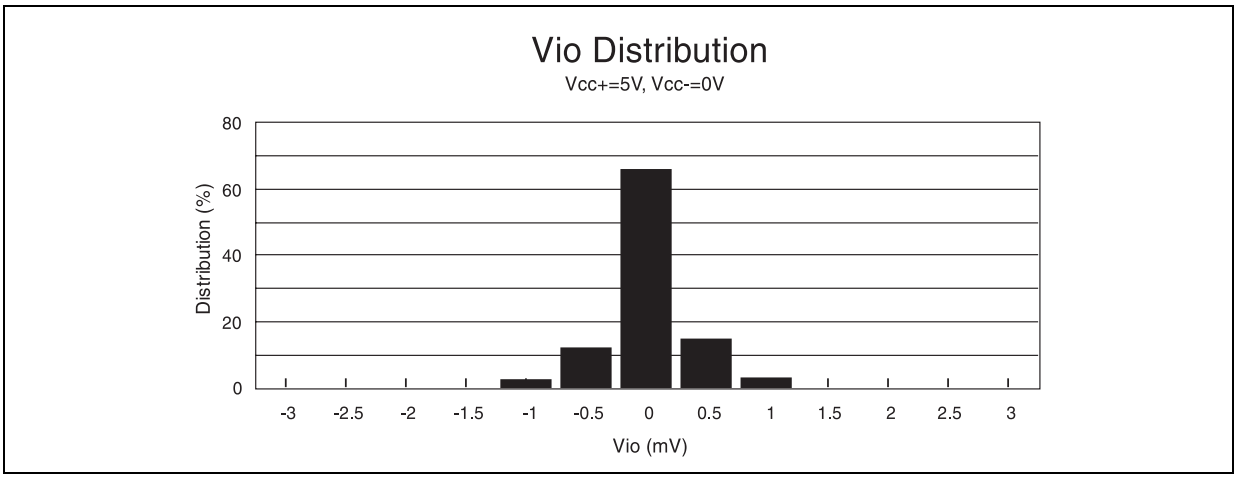




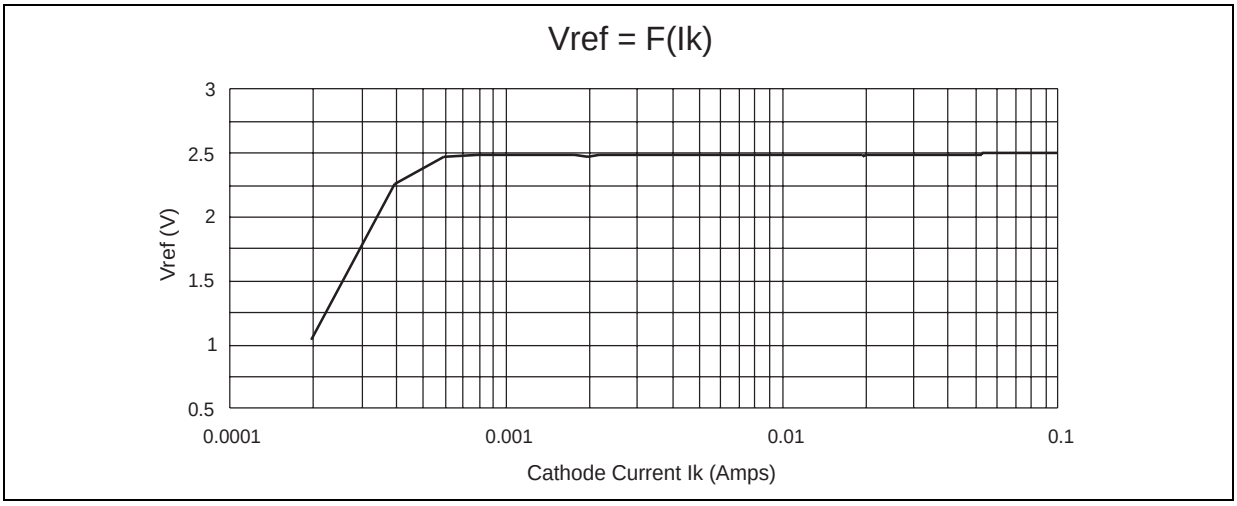


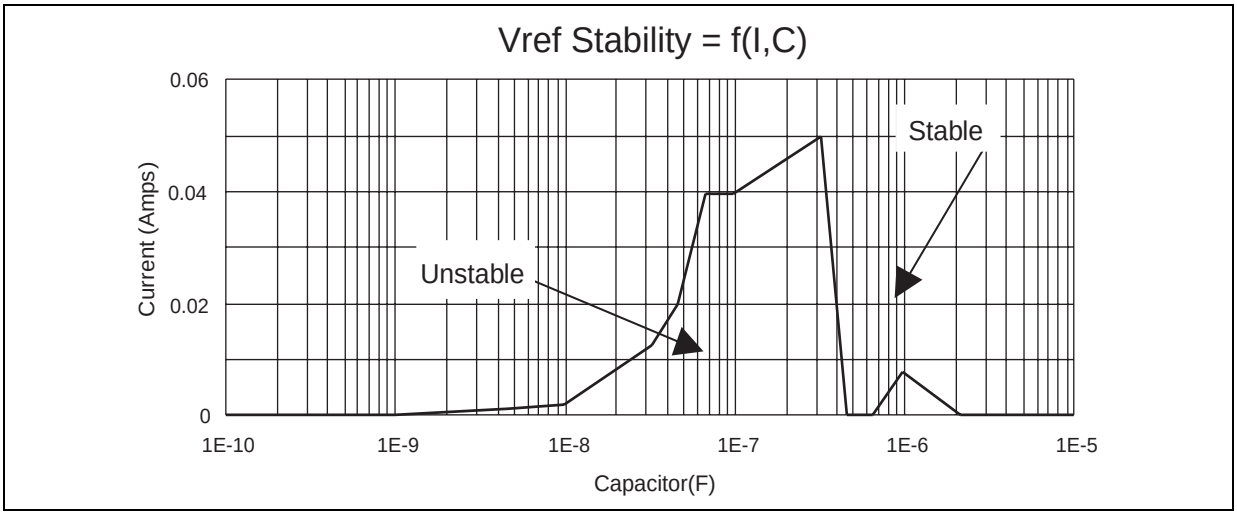

Total Harmonic Distorsion THD = F(freq)
THD(%)
0.014
0.012
0.01
0.008
0.006
0.004
10
100
1000
10000
Frequency (Hz)


Noise = F(frequency)
Noise(nV/SQR(Hz))
80
60
40
20
0
0.01
0.1
1
10
100
Frequency (Hz)


Vio Distribution
Vcc+=5V, Vcc-=0V
Distribution (%)
80
60
40
20
0
-3
-2.5
-2
-1.5
-1
-0.5
0
0.5
1
1.5
2
2.5
3
Vio (mV)

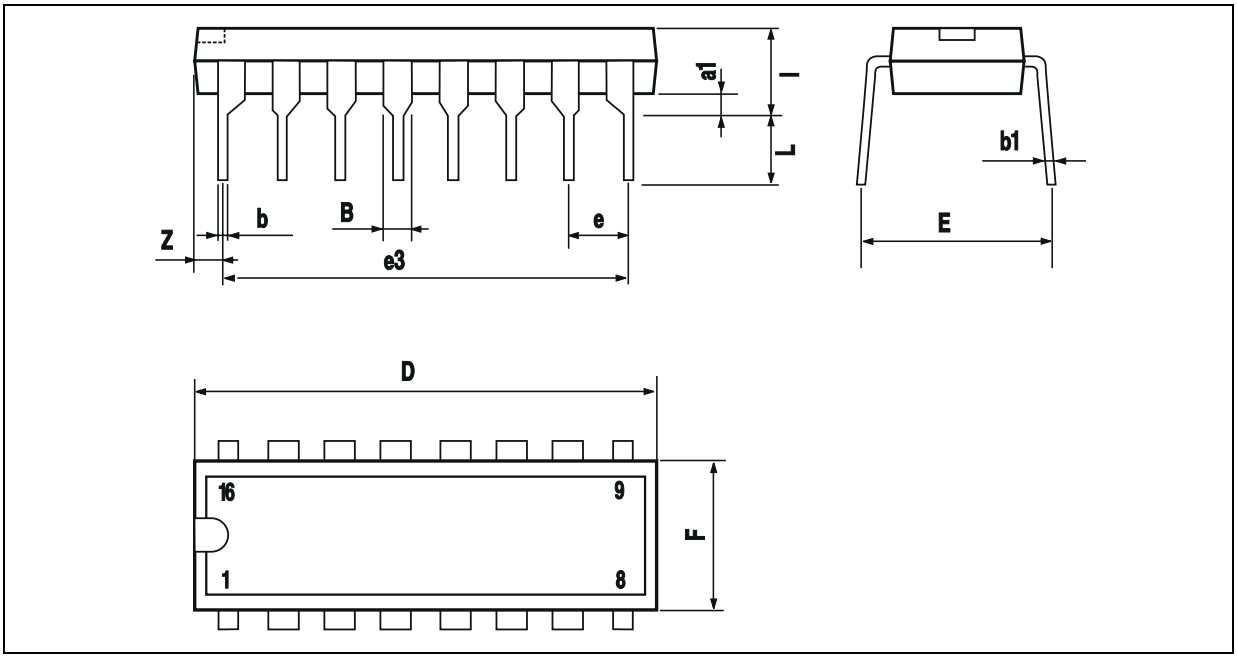
VOLTAGE REFERENCE





PACKAGE MECHANICAL DATA

16 PINS - PLASTIC PACKAGE



Dim.	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
a1	0.51			0.020		
B	0.77		1.65	0.030		0.065
b		0.5			0.020	
b1		0.25			0.010	
D			20			0.787
E		8.5			0.335	
e		2.54			0.100	
e3		17.78			0.700	
F			7.1			0.280
i			5.1			0.201
L		3.3			0.130	
Z			1.27			0.050