



TSM103W

DUAL OPERATIONAL AMPLIFIER AND VOLTAGE REFERENCE

OPERATIONAL AMPLIFIER

- LOW INPUT OFFSET VOLTAGE : 0.5mV typ.
- LOW SUPPLY CURRENT : 350 μ A/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 $\pm 16V$
- 1.5kV ESD PROTECTION

VOLTAGE REFERENCE

- FIXED OUTPUT VOLTAGE REFERENCE 2.5V
- $\pm 0.4\%$ OR $\pm 0.7\%$ VOLTAGE PRECISION
- SINK CURRENT CAPABILITY : 1 to 100mA
- TYPICAL OUTPUT IMPEDANCE : 0.2 Ω

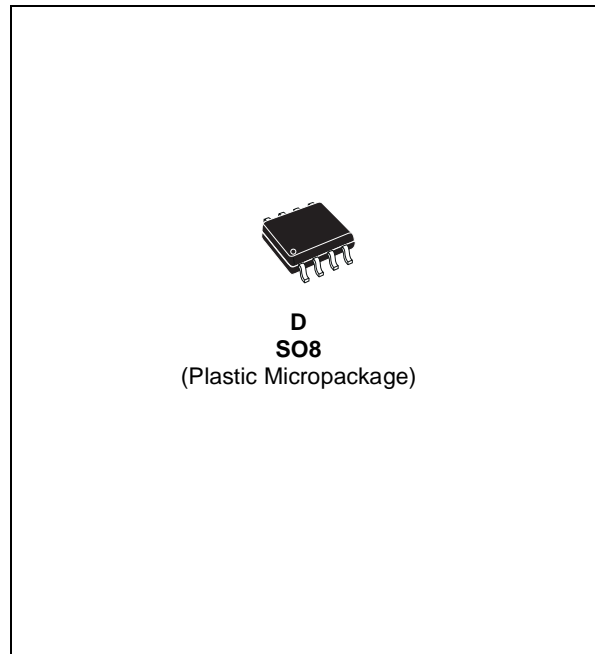
DESCRIPTION

The TSM103W 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 offers both space and cost savings in many applications such as power supply management or data acquisition systems.

ORDER CODE

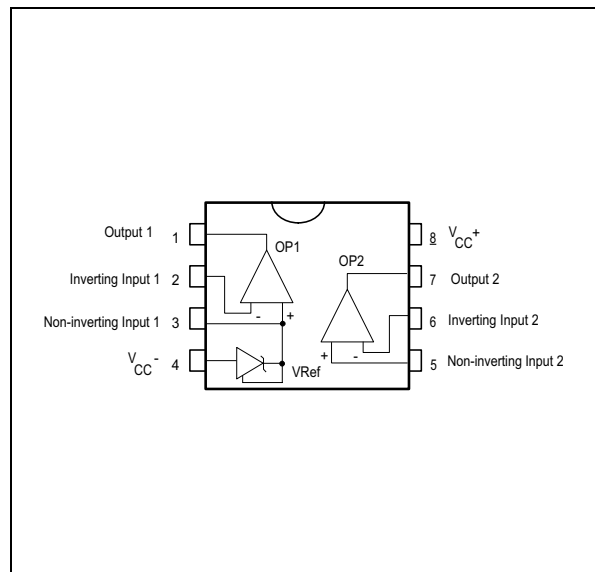
Part Number	Temperature Range	Package
		D
TSM103W	-40°C, +105°C	•
TSM103AW	-40°C, +105°C	•

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



D
SO8
(Plastic Micropackage)

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 $V_{CC} + 0.3V$	V
T_{oper}	Operating Free-air Temperature Range	-40 to +105	°C
T_j	Maximum Junction Temperature	150	°C
R_{thja}	Thermal Resistance Junction to Ambient (SO package)	175	°C/W
T_l	Maximum Lead Temperature (10 seconds maximum)	260	°C
ESD	Electrostatic Discharge Protection	1.5	kV

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)
 $V_{CC}^+ = +5V$, $V_{CC} = \text{Ground}$, $V_o = 1.4V$, $T_{amb} = 25^\circ\text{C}$ (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $V_{icm} = 0V$ TSM103AW, $T_{amb} = 25^\circ$ $T_{min.} \leq T_{amb} \leq T_{max.}$ TSM103W, $T_{amb} = 25^\circ$ $T_{min.} \leq T_{amb} \leq T_{max.}$		0.5 1	2 3 4 5	mV
DV_{io}	Input Offset Voltage Drift		7		$\mu\text{V}/^\circ\text{C}$
I_{io}	Input Offset Current $T_{min.} \leq T_{amb} \leq T_{max.}$		2	75 150	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 $V_{id} = -1V$, $V_{CC} = +15V$, $V_o = 2V$ $V_{CC} = +15V$, $V_o = 0.2V$	10 12	20 50		mA μA
V_{OH}	High Level Output Voltage $V_{CC}^+ = 30V$ $T_{amb} = 25^\circ\text{C}$, $R_L = 2k$ $T_{min.} \leq T_{amb} \leq T_{max.}$ $T_{amb} = 25^\circ\text{C}$, $R_L = 10k$ $T_{min.} \leq T_{amb} \leq T_{max.}$	26 26 27 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 $3V$, $V_{CC} = 15V$ $R_L = 2k$, $C_L = 100\text{pF}$, unity gain	0.2	0.4		V/ μs
GBP	Gain Bandwidth Product $V_{CC} = 30V$, $R_L = 2k$, $C_L = 100\text{pF}$ $f = 100\text{kHz}$, $V_{in} = 10\text{mV}$	0.5	0.9		MHz
THD	Total Harmonic Distortion $f = 1\text{kHz}$ $A_V = 20\text{dB}$, $R_L = 2k$, $V_{CC} = 30V$ $C_L = 100\text{pF}$, $V_o = 2V_{pp}$		0.02		%
e_n	Equivalent Input Noise Voltage $f = 1\text{kHz}$, $R_s = 100\Omega$ $V_{CC} = 30V$		50		nV/ $\sqrt{\text{Hz}}$

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 $V_{CC}^+ - 1.5V$. Both inputs can go to $V_{CC} + 0.3V$ 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 $V_{icm} = 0V$ TSM103AW, $T_{amb} = 25^\circ$ $T_{min.} \leq T_{amb} \leq T_{max.}$ TSM103W, $T_{amb} = 25^\circ$ $T_{min.} \leq T_{amb} \leq T_{max.}$		0.5 1	2 3 4 5	mV
DV_{io}	Input Offset Voltage Drift		7		$\mu\text{V}/^\circ\text{C}$
I_{ib}	Input Bias Current negative input		20		nA
Avd	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 $V_{id} = -1V$, $V_{CC} = +15V$, $V_o = 2V$ $V_{CC} = +15V$, $V_o = 0.2V$	10 12	20 50		mA μA
V_{OH}	High Level Output Voltage $V_{CC}^+ = 30V$ $T_{amb} = 25^\circ\text{C}$, $R_L = 2k$ $T_{min.} \leq T_{amb} \leq T_{max.}$ $T_{amb} = 25^\circ\text{C}$, $R_L = 10k$ $T_{min.} \leq T_{amb} \leq T_{max.}$	26 26 27 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 $2V$, $V_{CC} = 15V$ $R_L = 2k$, $C_L = 100\text{pF}$, unity gain	0.2	0.4		V/ μs
GBP	Gain Bandwidth Product $V_{CC} = 30V$, $R_L = 2k$, $C_L = 100\text{pF}$ $f = 100\text{kHz}$, $V_{in} = 10\text{mV}$	0.5	0.9		MHz
THD	Total Harmonic Distortion $f = 1\text{kHz}$ $A_V = 20\text{dB}$, $R_L = 2k$, $V_{CC} = 30V$ $C_L = 100\text{pF}$, $V_o = 2V_{pp}$		0.02		%

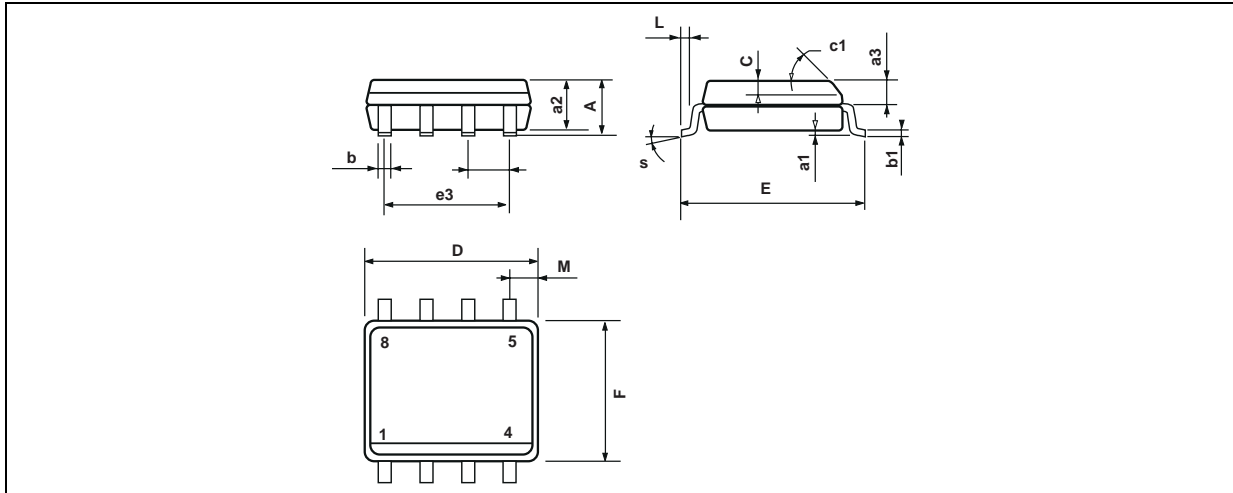
VOLTAGE REFERENCE

Symbol	Parameter	Value	Unit
I_k	Cathode Current	1 to 100	mA

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{ref}	Reference Input Voltage, $I_k=10mA$ TSM103AW $\pm 0.4\%$ $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ TSM103W $\pm 0.7\%$ $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$	2.49 2.48 2.482 2.465	2.5 2.500	2.51 2.52 2.518 2.535	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

1. The dynamic impedance is defined as $|Z_{KA}| = \Delta V_{KA} / \Delta I_K$

PACKAGE MECHANICAL DATA
8 PINS - 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.)					

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