TSM103W

Dual Operational Amplifier and Voltage Reference

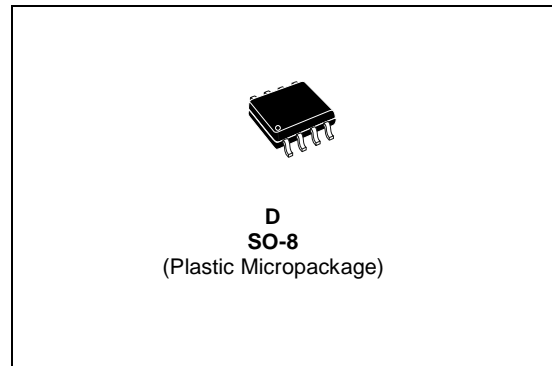### OPERATIONAL AMPLIFIER

- **LOW INPUT OFFSET VOLTAGE : 0.5mV typ.**
- **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 ±16V**
- **1.5kV ESD PROTECTION**
- **VOLTAGE REFERENCE**
- **FIXED OUTPUT VOLTAGE REFERENCE 2.5V**
- **±0.4% OR ±0.7% VOLTAGE PRECISION**
- **SINK CURRENT CAPABILITY : 1 to 100mA**
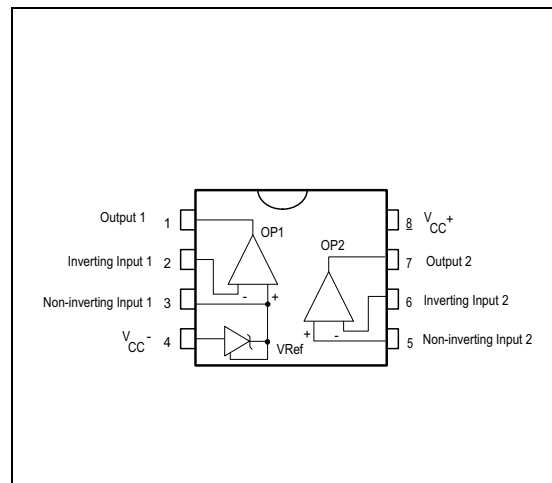- **TYPICAL OUTPUT IMPEDANCE : 0.2Ω**

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.

D
SO-8
(Plastic Micropackage)

PIN CONNECTIONS (top view)

Output 1	1		8	V_{CC}^+
Inverting Input 1	2		7	Output 2
Non-inverting Input 1	3		6	Inverting Input 2
V_{CC}^-	4		5	Non-inverting Input 2

ORDER CODE

Part Number	Temperature Range	Package	Packaging
TSM103WID			Tube
TSM103WIDT	-40, +105°C	SO-8	Tape & Ree
TSM103WAID			Tube
TSM103WAIDT			Tape & Reel

1   ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	36	V
V_{id}	Differential Input Voltage	Vcc + 0.6	V
V_i	Input VoltageL	-0.3 to Vcc + 0.3V	V
T_{stg}	Storage temperature range	-65 to + 150	°C
Ik	Continuous cathode current range	-100 to 150	mA
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

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
Vcc	DC Supply Conditions	3 to 32	V
I_k	Vref Cathode Current	1 to 100	mA
T_{oper}	Operating Free-air Temperature Range	-40°C, +105°C	°C

2   ELECTRICAL CHARACTERISTICS

Symbol	Parameter	Min.	Typ.	Max.	Unit
I_{CC}	Total Supply Current, excluding Current in the Voltage Reference Vcc+ = 5V, no load Tmin. < Tamb < Tmax. Vcc+ = 30V, no load Tmin. < Tamb < Tmax		0.7	1.2 2	mA

OPERATOR 2 (independent op-amp)

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 V_{icm} = 0V TSM103WA, T_{amb} = 25° $T_{min.} \leq T_{amb} \leq T_{max.}$ TSM103W, T_{amb} = 25° $T_{min.} \leq T_{amb} \leq T_{max.}$		0.5 1	2 3 4 5	mV
DV_{io}	Input Offset Voltage Drift		7		μV/°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
Avd	Large Signal Voltage Gain V_{CC} = 15V, R_L = 2k, Vo = 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
Vicm	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, Vo = 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°C, R_L = 2k $T_{min.} \leq T_{amb} \leq T_{max}$ T_{amb} = 25°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 = 100pF, unity gain	0.2	0.4		V/μs

Symbol	Parameter	Min.	Typ.	Max.	Unit
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		%
e_n	Equivalent Input Noise Voltage f = 1kHz, Rs = 100Ω Vcc = 30V		50		nV/$\sqrt{}$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 Vcc+ 0.3V without damage.

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

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

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage V_{icm} = 0V TSM103WA, T_{amb} = 25° $T_{min.} \leq T_{amb} \leq T_{max.}$ TSM103W, T_{amb} = 25° $T_{min.} \leq T_{amb} \leq T_{max.}$		0.5 1	2 3 4 5	mV
DV_{io}	Input Offset Voltage Drift		7		µV/°C
I_{ib}	Input Bias Current negative input		20		nA
Avd	Large Signal Voltage Gain V_{CC} = 15V, R_L = 2k, Vo = 1.4V to 11.4V $T_{min.} \leq T_{amb} \leq T_{max}$		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°C, R_L = 2k $T_{min.} \leq T_{amb} \leq T_{max.}$ T_{amb} = 25°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 = 100pF, unity gain	0.2	0.4		V/µs

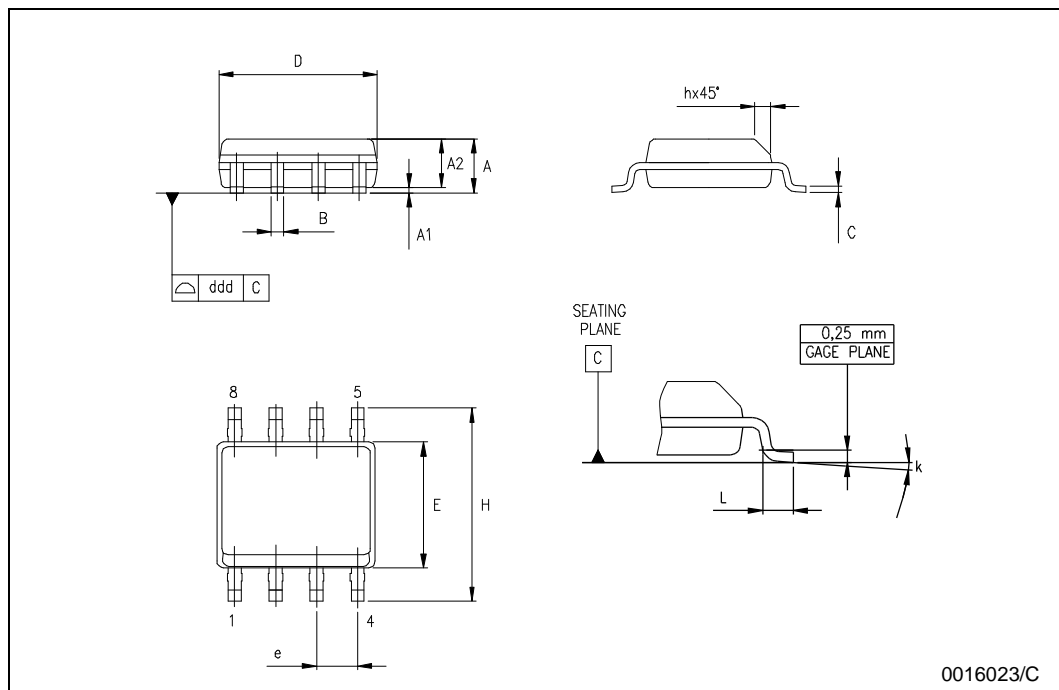| Symbol	Parameter	Min.	Typ.	Max.	Unit
GBP	Gain Bandwidth Product $V_{CC} = 30V, R_L = 2k, C_L = 100pF$ $f = 100kHz, V_{in} = 10mV$	0.5	0.9		MHz
THD	Total Harmonic Distortion $f = 1kHz$ $A_V = 20dB, R_L = 2k, V_{CC} = 30V$ $C_L = 100pF, V_o = 2V_{pp}$		0.02		%

VOLTAGE REFERENCE

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{ref}	Reference Input Voltage, Ik=10mA TSM103WA ±0.4% $T_{amb} = 25°C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ TSM103W ±0.7% $T_{amb} = 25°C$ $T_{min.} \leq T_{amb} \leq T_{max.}$	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

SO-8 MECHANICAL DATA

DIM.	mm.			inch		
	MIN.	TYP	MAX.	MIN.	TYP.	MAX.
A	1.35		1.75	0.053		0.069
A1	0.10		0.25	0.04		0.010
A2	1.10		1.65	0.043		0.065
B	0.33		0.51	0.013		0.020
C	0.19		0.25	0.007		0.010
D	4.80		5.00	0.189		0.197
E	3.80		4.00	0.150		0.157
e		1.27			0.050	
H	5.80		6.20	0.228		0.244
h	0.25		0.50	0.010		0.020
L	0.40		1.27	0.016		0.050
k	$8°$ (max.)					
ddd			0.1			0.04

0016023/C

3 SUMMARY OF CHANGES

Date	Revision	Description of Changes
	1-2	First Release
02-April-2004	3	1 - Vid=Vcc+0.6 modified on AMR table - page 2 2 - Add Ik parameter on AMR table - page 2 3 - Avd test condition equal on both tables Operator 1 & Operator 2 - pages 3 & 4