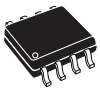
TSH150

WIDE BANDWIDTH AND BIPOLAR INPUTS SINGLE OPERATIONAL AMPLIFIER

- LOW DISTORTION
- GAIN BANDWIDTH PRODUCT : 150MHz
- UNITY GAIN STABLE
- SLEW RATE : 190V/µs
- VERY FAST SETTLING TIME : 20ns (0.1%)



D
SO8
(Plastic Micropackage)

DESCRIPTION

The TSH150 is a wideband monolithic operational amplifier, internally compensated for unity-gain stability.

Low noise and low distortion, wide bandwidth and high linearity make this amplifier suitable for RF and video applications. Short circuit protection is provided by an internal current-limiting circuit.

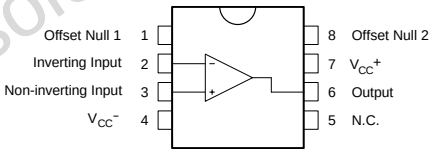
The TSH150 has internal electrostatic discharge (ESD) protection circuits and fulfills MILSTD883C-Class2.

ORDER CODE

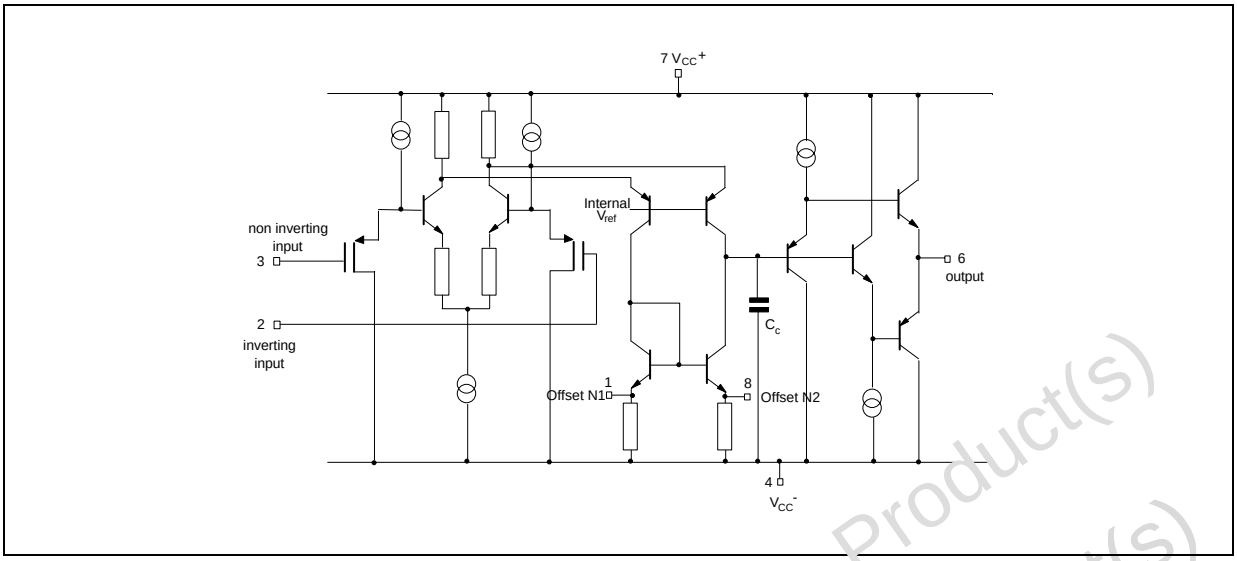
Part Number	Temperature Range	Package
		D
TSH150I	-40°C, +125°C	•

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

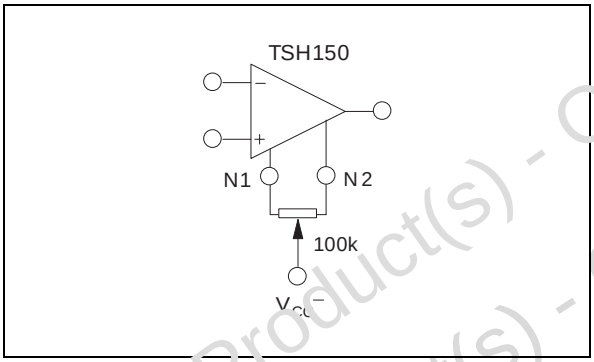
PIN CONNECTIONS (top view)



SCHEMATIC DIAGRAM



INPUT OFFSET VOLTAGE NULL CIRCUIT



MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	±7	V
V_{id}	Differential Input Voltage	±5	V
V_i	Input Voltage	±5	V
I_{in}	Current On Inputs Current On Offset Null Pins	±50 ±20	V
T_{oper}	Operating Free-Air Temperature range	-40 to +125	°C
T_{stg}	Storage Temperature Range	-65 to +150	°C

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	±3 to ±6	V
V_{ic}	Common Mode Input Voltage Range	V_{CC}^- +2 to V_{CC}^+ -1	V

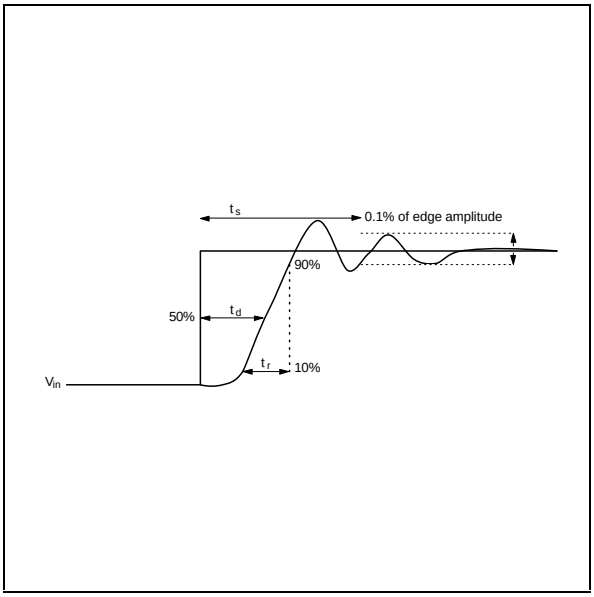
ELECTRICAL CHARACTERISTICS

V_{CC} = ±5V, T_{amb} = 25°C (unless otherwise specified)

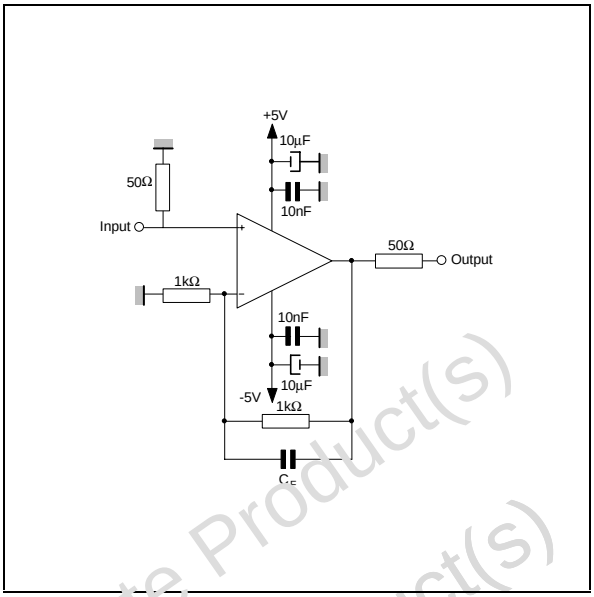
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage $T_{min.} \le T_{amb} \le T_{max}$		0.3	5 7	mV
DV_{io}	Input Offset Voltage Drift $T_{min.} \le T_{amb} \le T_{max.}$		10		µV/°C
I_{ib}	Input Bias Current		5	30	µA
I_{io}	Input Offset Current		0.1	2	µA
I_{CC}	Supply Current, no load V_{CC} = ±5V V_{CC} = ±3V V_{CC} = ±6V $T_{min.} \le T_{amb} \le T_{max}$ V_{CC} = ±5V		23 21 25	30 28 40 3[illegible]	mA
Avd	Large Signal Voltage Gain Vo = ±2.5V $R_L = \infty$ R_L = 100Ω R_L = 50Ω	800 300 200	1300 850 650		V/V
V_{icm}	Input Common Mode Voltage Range	-3 to +4	3.5 to +4.5		V
CMR	Common-mode Rejection Ratio $V_{ic} = V_{icm\ min.}$	60	100		dB
SVR	Supply Voltage Rejection Ratio V_{CC} = ±5V to ±3V	50	70		dB
V_o	Output Voltage R_L = 100Ω R_L = 50Ω R_L = 100Ω $T_{min.} \le T_{amb} \le T_{max}$ R_L = 50Ω	±3 ±2.8 ±2.9 ±2.7	+3.5 -3.7 +3.3 -3.5		V
I_o	Output Short Circuit Current Vid = ±1V, Vo = 0V	±50	±100		mA
GBP	Gain Bandwidth Product A_{VCL} = 100, R_L = 100Ω, C_L = 15pF, f = 7.5MHz		150		MHz
SR	Slew Rate V_{in} = ±2V, A_{VCL} = 1, R_L = 100Ω, C_L = 15pF	100	190		V/µs
e_n	Equivalent Input Voltage Noise R_s = 50Ω f_o = 1kHz f_o = 1k0Hz f_o = 100kHz f_o = 1MHz		7 6.5 6.2 5.5		nV/√Hz
K_{ov}	Overshoot V_{in} = ±2V, A_{VCL} = 1, R_L = 100Ω, C_L = 15pF		5		%
t_s	Settling Time 0.1% [1] V_{in} = ±1V, A_{VCL} = -1		20		ns
t_r, t_f	Rise and Fall Time (see note 1) V_{in} = ±100mV, A_{VCL} = 2		3.5		ns
t_d	Delay Time (see note 1) V_{in} = ±100mV, A_{VCL} = 2		2.5		ns
ϕm	Phase Margin A_{VM} = 1, R_L = 100Ω, C_L = 15pF		50		Degrees
THD	Total Harmonic Distortion A_{VCL} = 10, f = 1kHz, V_o = ±2.5V, no load		0.02		%
FPB	Full Power Bandwidth [2] Vo = 5Vpp, R_L = 100Ω Vo = 2Vpp, R_L = 100Ω		12 30		MHz

1. See test waveform figure
2. Full power bandwidth = $\frac{SR}{\Pi Vopp}$

TEST WAVEFORM



EVALUATION CIRCUIT



PRINTED CIRCUIT LAYOUT

As for any high frequency device, a few rules must be observed when designing the PCB to get the best performances from this high speed op amp. From the most to the least important points :

- Each power supply lead has to be bypassed to ground with a 10nF ceramic capacitor very close to the device and a 10µF tantalum capacitor.
- To provide low inductance and low resistance common return, use a ground plane or common point return for power and signal.
- All leads must be wide and as short as possible especially for op amp inputs. This is in order to decrease parasitic capacitance and inductance.
- Use small resistor values to decrease time constant with parasitic capacitance.
- Choose component sizes as small as possible (SMD).
- On output, decrease capacitor load so as to avoid circuit stability being degraded which may cause oscillation. You can also add a serial resistor in order to minimise its influence.
- One can add in parallel with feedback resistor a few pF ceramic capacitor C_F adjusted to optimize the settling time.

MACROMODEL

Applies to: TSH150I

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** Standard Linear Ics Macromodels, 1993.
** CONNECTIONS :
* 1 INVERTING INPUT
* 2 NON-INVERTING INPUT
* 3 OUTPUT
* 4 POSITIVEPOWER SUPPLY
* 5 NEGATIVE POWER SUPPLY
.SUBCKT TSH150 1 3 2 4 5 (analog)
*******************************************************
.MODEL MDTH D IS=1E-8 KF=1.568191E-15 CJO=10F
* INPUT STAGE
CIP 2 5 1.000000E-12
CIN 1 5 1.000000E-12
EIP 10 5 2 5 1
EIN 16 5 1 5 1
RIP 10 11 1.040000E+02
RIN 15 16 1.040000E+02
RIS 11 15 3.264539E+02
DIP 11 12 MDTH 400E-12
DIN 15 14 MDTH 400E-12
VOFP 12 13 DC -9.162265E-05
VOFN 13 14 DC 0
IPOL 13 5 1.000000E-03
CPS 11 15 5.757255E-12
DINN 17 13 MDTH 400E-12
VIN 17 5 1.500000e+00
DINR 15 18 MDTH 400E-12
VIP 4 18 0.500000E+00
FCP 4 5 VOFP 2.200000E+01
FCN 5 4 VOFN 2.200000E+01
FIBP 2 5 VOFP 1.000000E-02
FIBN 5 1 VOFN 1.000000E-02
* AMPLIFYING STAGE
FIP 5 19 VOFP 4.370000E+02
FIN 5 19 VOFN 4.370000E+02
RG1 19 5 1.124121E+03
RG2 19 4 1.124121E+03
CC 19 29 2.000000E-09
HZTP 30 29 VOFP 5.574976E+01
HZTN 5 30 VOFN 5.574976E+01
DOPM 19 22 MDTH 400E-12
DONM 21 19 MDTH 400E-12
HOPM 22 28 VOUT 5.000000E+02
VIPM 28 4 5.000000E+01
HONM 21 27 VOUT 5.000000E+02
VINM 5 27 5.000000E+01
EOUT 26 23 19 5 1
VOUT 23 5 0
ROUT 26 3 2.180423E+01
COUT 3 5 1.000000E-12
DOP 19 25 MDTH 400E-12
VOP 4 25 1.511965E+00
DON 24 19 MDTH 400E-12
VON 24 5 1.511965E+00
.ENDS
```

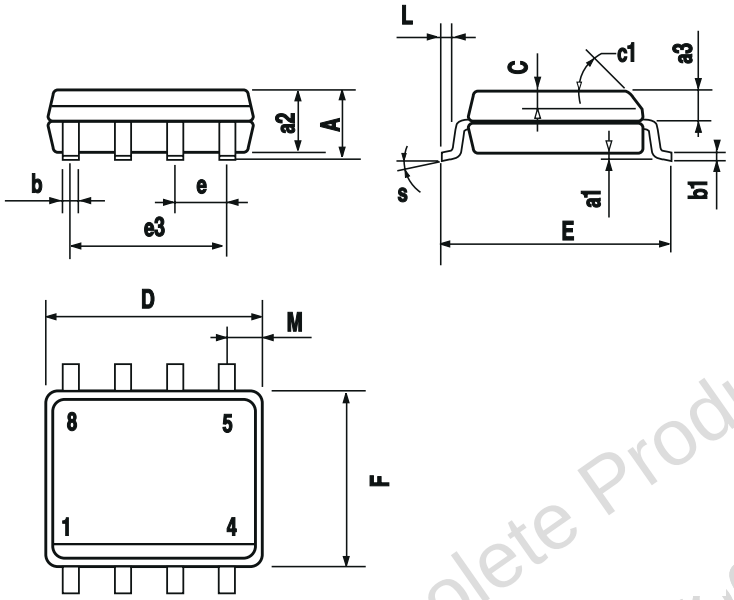
ELECTRICAL CHARACTERISTICS

V_{CC} = ±5V, T_{amb} = 25°C (unless otherwise specificed)

Symbol	Conditions	Value	Unit
V_{io}		0	mV
A_{vd}	R_L = 100Ω	1	V/mV
I_{CC}	No load	21	mA
V_{icm}		-3.5 to 4.5	V
V_{OH}	R_L = 100Ω	+3.6	V
V_{OL}	R_L = 100Ω	-3.6	V
I_{sink}	V_o = 0V	108	mA
I_{source}	V_o = 0V	108	mA
GBP	R_L = 100Ω, C_L = 15pF	147	MHz
SR	R_L = 100Ω, C_L = 15pF	180	V/µs
ϕm	R_L = 100Ω, C_L = 15pF	42	Degrees
t_s	A_v = -1 at 0.1%	22.6	ns

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.)					