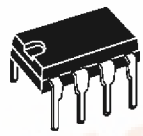
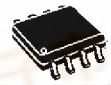
TSH150

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%)



N
DIP8
(Plastic Package)



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.

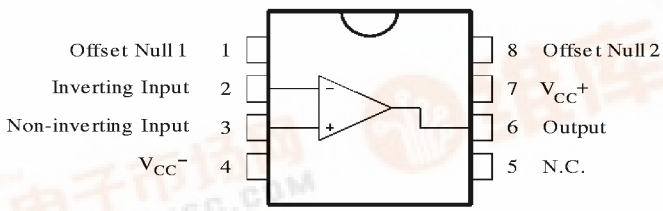
The TSH150 has internal electrostatic discharge (ESD) protection circuits and fulfills MILSTD883C-Class2.

ORDER CODES

Part Number	Temperature Range	Package	
		N	D
TSH150C	0°C, 70°C	•	•
TSH150I	-40°C, 125°C	•	•

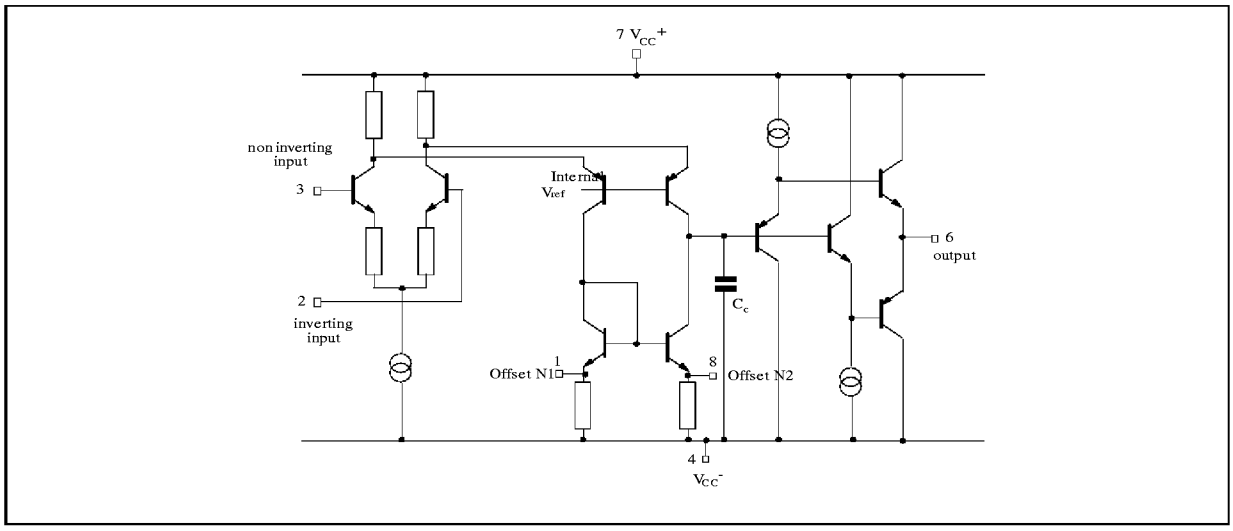
150-01.TBL

PIN CONNECTIONS (top view)

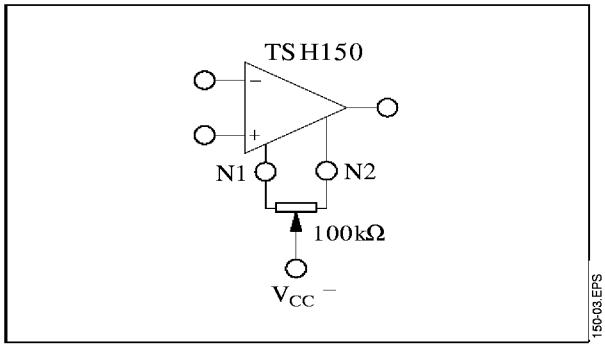


150-01.EPS

SCHEMATIC DIAGRAM



INPUT OFFSET VOLTAGE NULL CIRCUIT



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	±7	V
V_{id}	Differential Input Voltage	±5	V
V_i	Input Voltage Range	±5	V
I_{in}	Current On Inputs Current On Offset Null Pins	±50 ±20	mA
T_{oper}	Operating Free-Air Temperature Range TSH150C TSH150I	0 to +70 -40 to +125	°C
T_{stg}	Storage Temperature Range	-65 to 150	°C

150-02.TBL

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

150-03.TBL

ELECTRICAL CHARACTERISTICS

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

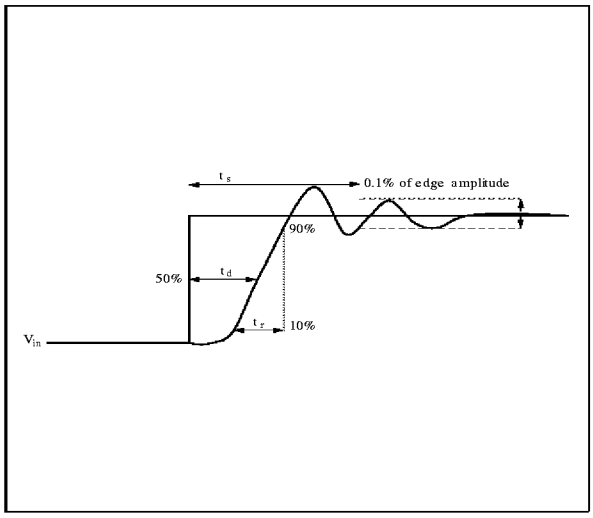
Symbol	Parameter		TSH150C, I			Unit
			Min.	Typ.	Max.	
V_{io}	Input Offset Voltage $T_{min} \le T_{amb} \le T_{max.}$			0.3	5 7	mV
DV_{io}	Input Offset Voltage Drift $T_{min} \le T_{amb} \le T_{max.}$			10		µV/°C
I_{ib}	Input Bias Current			5	30	µA
I_{io}	Input Offset Current			0.1	2	µA
I_{CC}	Supply Current, no load					mA
		$V_{CC} = \pm 5V$		23	30	
		$V_{CC} = \pm 3V$		21	28	
		$V_{CC} = \pm 6V$		25	40	
	$T_{min} \le T_{amb} \le T_{max.}$	$V_{CC} = \pm 5V$			32	
A_{vd}	Large Signal Voltage Gain $V_o = \pm 2.5V$					V/V
		$R_L = \infty$	800	1300		
		$R_L = 100\Omega$	300	850		
		$R_L = 50\Omega$	200	650		
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 $V_{CC} = \pm 5V$ to $\pm 3V$		50	70		dB
V_o	Output Voltage	$R_L = 100\Omega$	± 3	+3.5 -3.7		V
		$R_L = 50\Omega$	± 2.8	+3.3 -3.5		
	$T_{min} \le T_{amb} \le T_{max.}$	$R_L = 100\Omega$	± 2.9			
		$R_L = 50\Omega$	± 2.7			
I_o	Output Short Circuit Current $V_{id} = \pm 1V$, $V_o = 0V$		± 50	± 100		mA
GBP	Gain Bandwidth Product $A_{VCL} = 100$, $R_L = 100\Omega$, $C_L = 15pF$, f = 7.5MHz			150		MHz
SR	Slew Rate $V_{in} = \pm 2V$, $A_{VCL} = 1$, $R_L = 100\Omega$, $C_L = 15pF$		100	190		V/µs
e_n	Equivalent Input Voltage Noise $R_S = 50\Omega$					$\frac{nV}{\sqrt{Hz}}$
		fo = 1kHz		7		
		fo = 10kHz		6.5		
		fo = 100kHz		6.2		
		fo = 1MHz		5.5		
K_{ov}	Overshoot $V_{in} = \pm 2V$, $A_{VCL} = 1$, $R_L = 100\Omega$, $C_L = 15pF$			5		%
t_s	Settling Time 0.1% - (note 1) $V_{in} = \pm 1V$, $A_{VCL} = -1$			20		ns
t_r, t_f	Rise and Fall Time - (note 1) $V_{in} = \pm 100mV$, $A_{VCL} = 2$			3.5		ns
t_d	Delay Time - (note 1) $V_{in} = \pm 100mV$, $A_{VCL} = 2$			2.5		ns
Øm	Phase Margin $A_{VM} = 1$, $R_L = 100\Omega$, $C_L = 15pF$			50		Degrees
THD	Total Harmonic Distortion $A_{VCL} = 10$, f = 1KHz, $V_o = \pm 2.5V$, no load			0.02		%
FPB	Full Power Bandwidth - (note 2)					MHz
	V_o = 5Vpp, $R_L = 100\Omega$			12		
	V_o = 2Vpp, $R_L = 100\Omega$			30		

150-04.TBL

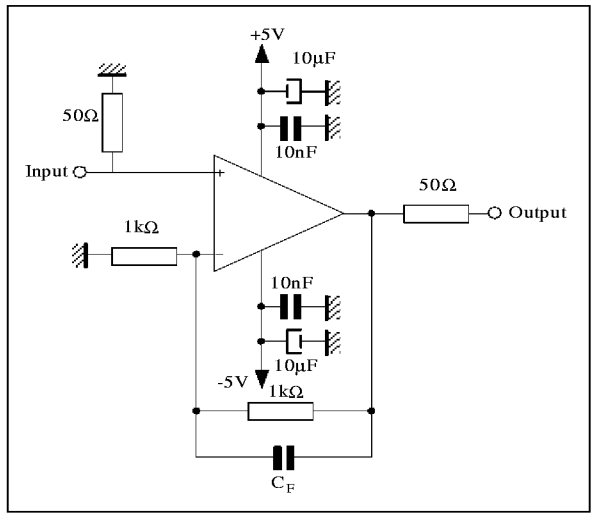
Note 1 : See test waveform figure

Note 2 : Full power bandwidth = $\frac{SR}{\Pi\ V_{opp}}$

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. Be aware on TSH150 device of the I_{io} error and input noise currents with high feedback resistor values.
- 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

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

Applies to : TSH150C,I

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** Standard Linear Ics Macromodels, 1993.
** CONNECTIONS :
* 1 INVERTING INPUT
* 2 NON-INVERTING INPUT
* 3 OUTPUT
* 4 POSITIVE POWER 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 1.5000000e+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
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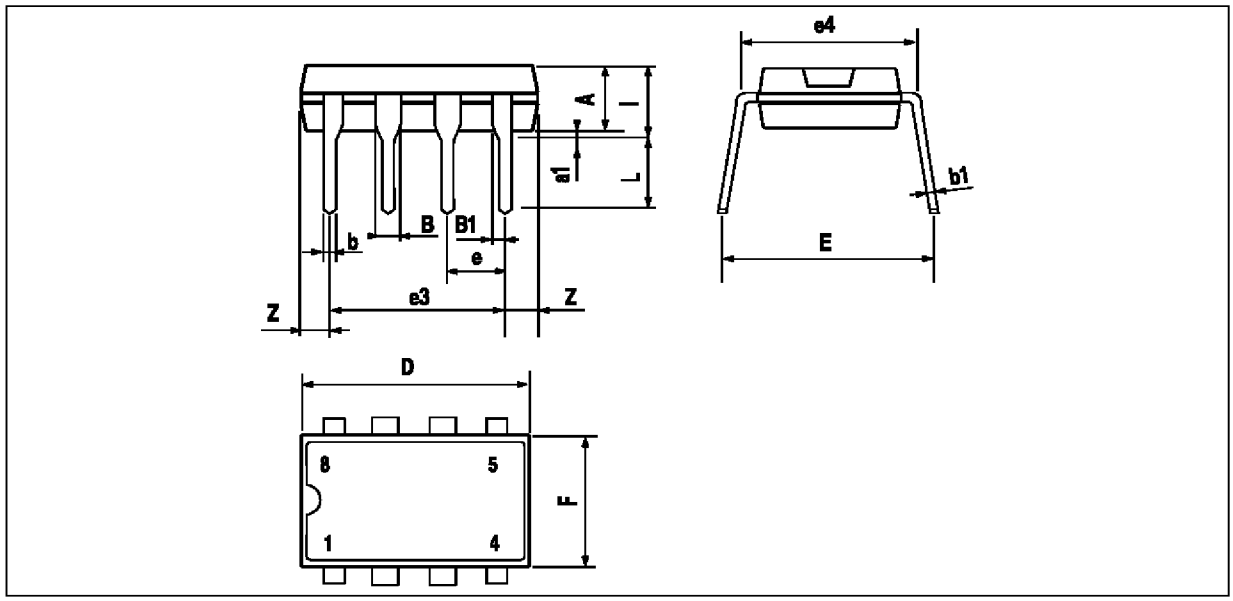
ELECTRICAL CHARACTERISTICS

$V_{CC} = \pm 5V$, $T_{amb} = 25^{o}C$ (unless otherwise specified)

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

PACKAGE MECHANICAL DATA

8 PINS - PLASTIC DIP



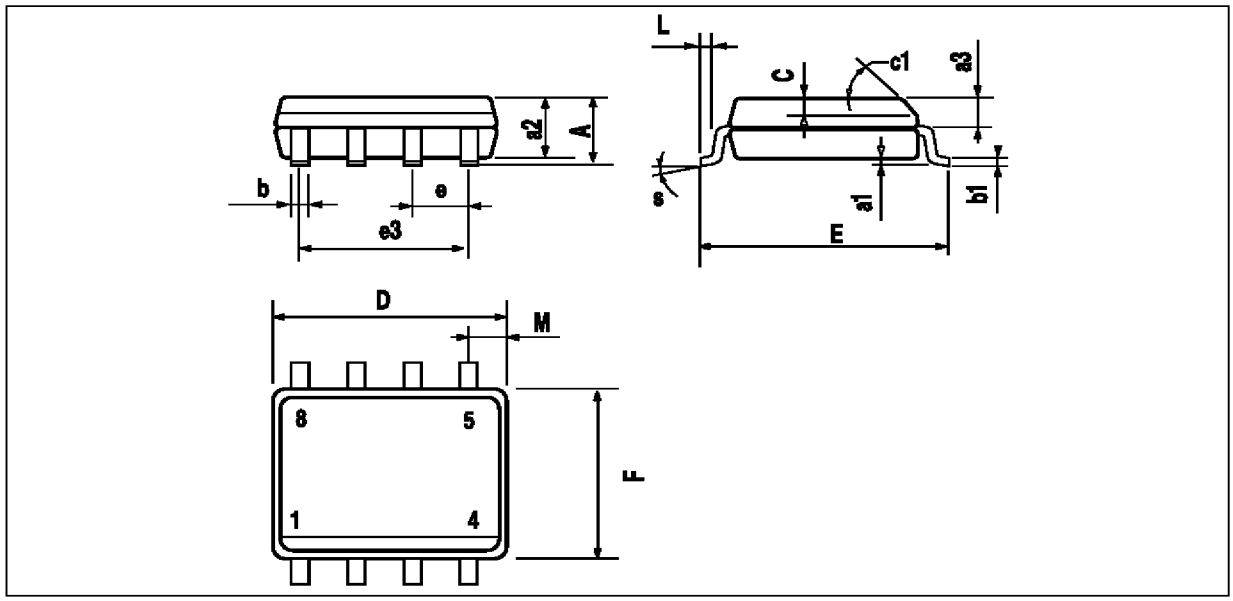
PM-DIP8.EPS

Dimensions	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			0260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

DIP8.TBL

PACKAGE MECHANICAL DATA

8 PINS - PLASTIC MICROPACKAGE (SO)



PM-SO8.EPS

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.)					

SO8.TBL

ORDER CODE :