



# TSH31

## 280MHz BANDWIDTH MOS INPUT SINGLE OPERATIONAL AMPLIFIER

- VERY LOW INPUT CURRENT : 2pA typ
- GAIN BANDWIDTH PRODUCT : 280MHz
- GAIN OF 2 STABILITY
- SLEW RATE : 300V/ $\mu$ s
- STANDARD PIN OUT

### DESCRIPTION

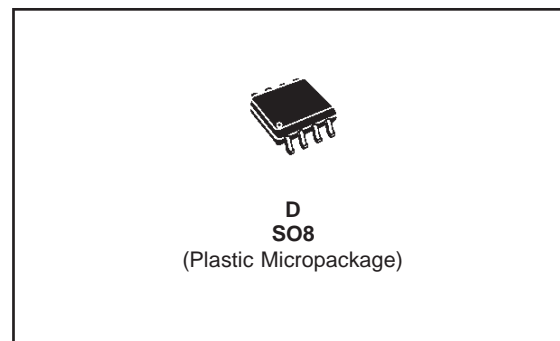
The TSH31 is a low cost wide bandwidth single operational amplifier featuring extremely low input current of 2pA typ.

Other features as high slew rate, fast settling time and high linearity make it suitable for many applications requiring speed and very high input impedance as photo cell amplifier, Fet probe, high speed precision integrator, sample and hold circuit.

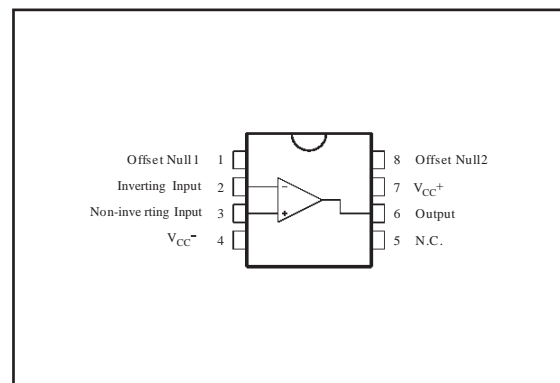
### ORDER CODE

| Part Number | Temperature Range | Package |
|-------------|-------------------|---------|
|             |                   | D       |
| TSH31I      | -40°C, +125°C     | •       |

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

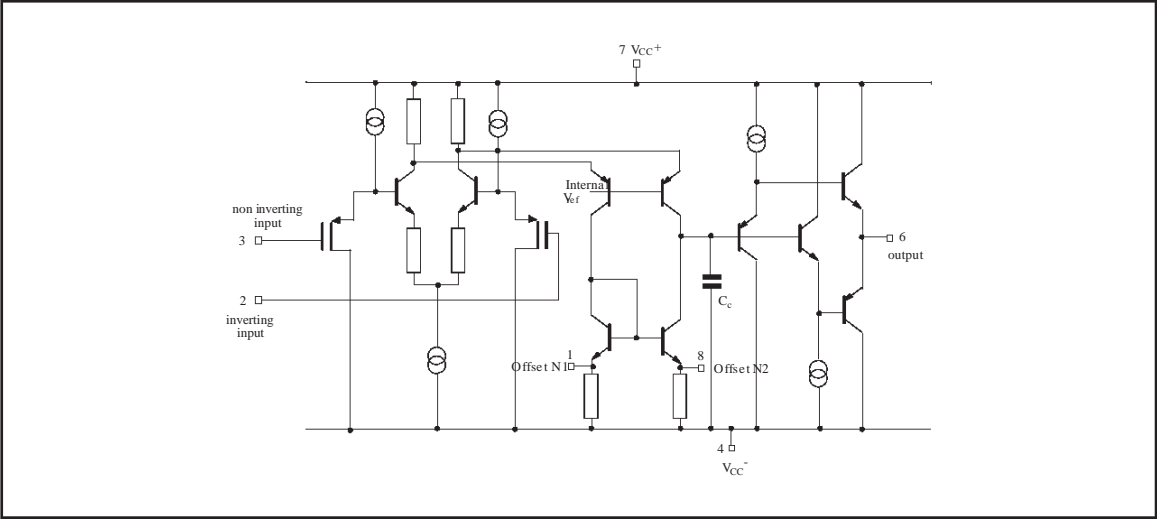


### PIN CONNECTIONS (top view)

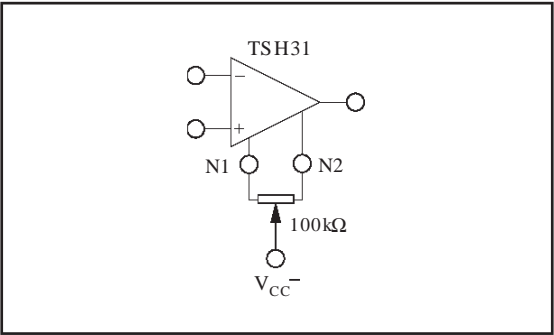


TSH31

SCHEMATIC DIAGRAM



INPUT OFFSET VOLTAGE NULL CIRCUIT



MAXIMUM RATINGS

| Symbol     | Parameter                            | Value       | Unit        |
|------------|--------------------------------------|-------------|-------------|
| $V_{CC}$   | Supply Voltage                       | $\pm 7$     | V           |
| $V_{id}$   | Differential Input Voltage           | $\pm 5$     | V           |
| $V_i$      | Input Voltage                        | $\pm 5$     | V           |
| $I_{in}$   | Current On Offset Null Pins          | $\pm 20$    | $\mu A$     |
| $T_{oper}$ | Operating Free-Air Temperature range | -40 to +125 | $^{\circ}C$ |

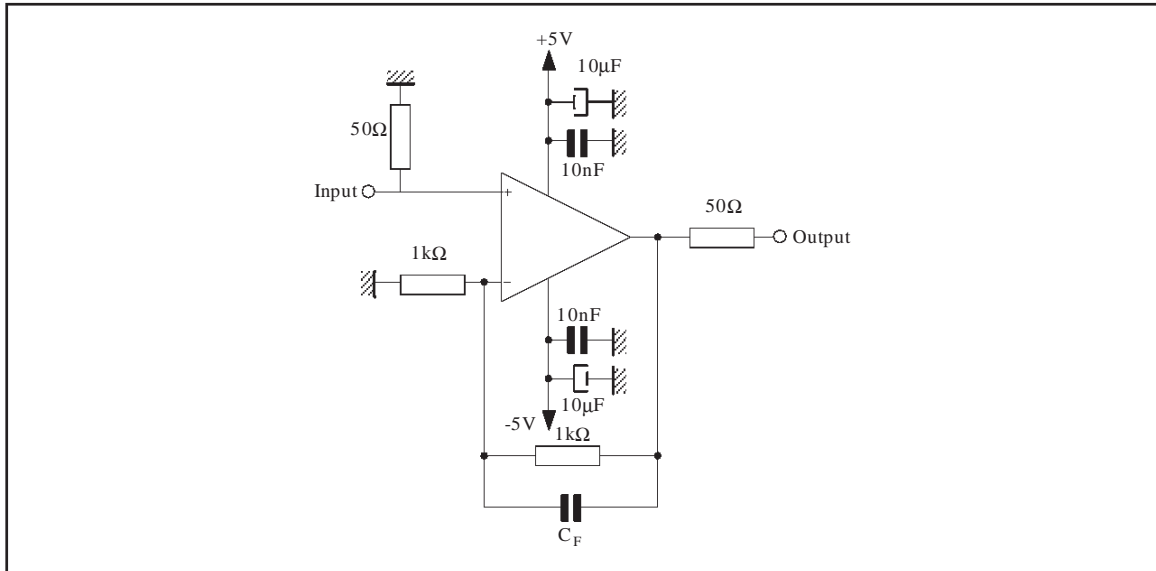
OPERATING CONDITIONS

| Symbol   | Parameter                       | Value                        | Unit |
|----------|---------------------------------|------------------------------|------|
| $V_{CC}$ | Supply Voltage                  | $\pm 3$ to $\pm 6$           | V    |
| $V_{ic}$ | Common Mode Input Voltage Range | $V_{CC}^-$ to $V_{CC}^+ - 3$ | V    |

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

| Symbol    | Parameter  | Min.      | Typ.         | Max. | Unit              |
|-----------|--|-----------|--------------|------|-------------------|
| $V_{io}$  | Input Offset Voltage   |           | 3            | 15   | mV                |
| $DV_{io}$ | Input Offset Voltage Drift<br>$T_{min} \leq T_{amb} \leq T_{max}$            |           | 20           |      | $\mu V/^{\circ}C$ |
| $I_{ib}$  | Input Bias Current   |           | 2            | 300  | pA                |
| $I_{io}$  | Input Offset Current   |           | 2            | 200  | pA                |
| $I_{CC}$  | Supply Current, no load<br>$V_{CC} = \pm 5V$                                 |           | 20           | 40   | mA                |
| $A_{vd}$  | Large Signal Voltage Gain<br>$V_o = \pm 2.5V$<br>$R_L = 100\Omega$           | 200       | 800          |      | V/V               |
| $V_{icm}$ | Input Common Mode Voltage Range  | -5 to +2  | -5.5 to +2.5 |      | V                 |
| CMR       | Common-mode Rejection Ratio<br>$V_{ic} = V_{icm \text{ min.}}$               | 55        | 95           |      | dB                |
| SVR       | Supply Voltage Rejection Ratio<br>$V_{CC} = \pm 5V \text{ to } \pm 3V$       | 45        | 65           |      | dB                |
| $V_o$     | Output Voltage<br>$R_L = 100\Omega$  | $\pm 2.5$ | +3.5<br>-3.7 |      | V                 |
| $I_o$     | Output Short Circuit Current<br>$V_{id} = \pm 1V$ , $V_o = 0V$               |           | $\pm 70$     |      | mA                |
| GBP       | Gain Bandwidth Product<br>$A_{VCL} = 100$ , $R_L = 100\Omega$ , $f = 7.5MHz$ |           | 280          |      | MHz               |
| SR        | Slew Rate<br>$V_{in} = \pm 2V$ , $A_{VCL} = 1$ , $R_L = 100\Omega$           |           | 300          |      | V/ $\mu s$        |
| $e_n$     | Equivalent Input Voltage Noise<br>$f = 1MHz$                                 |           | 20           |      | nV/ $\sqrt{Hz}$   |
| $\phi_m$  | Phase Margin<br>$A_{VM} = 1$ , $R_L = 100\Omega$ , $C_L = 15pF$              |           | 40           |      | Degrees           |

## EVALUATION CIRCUIT



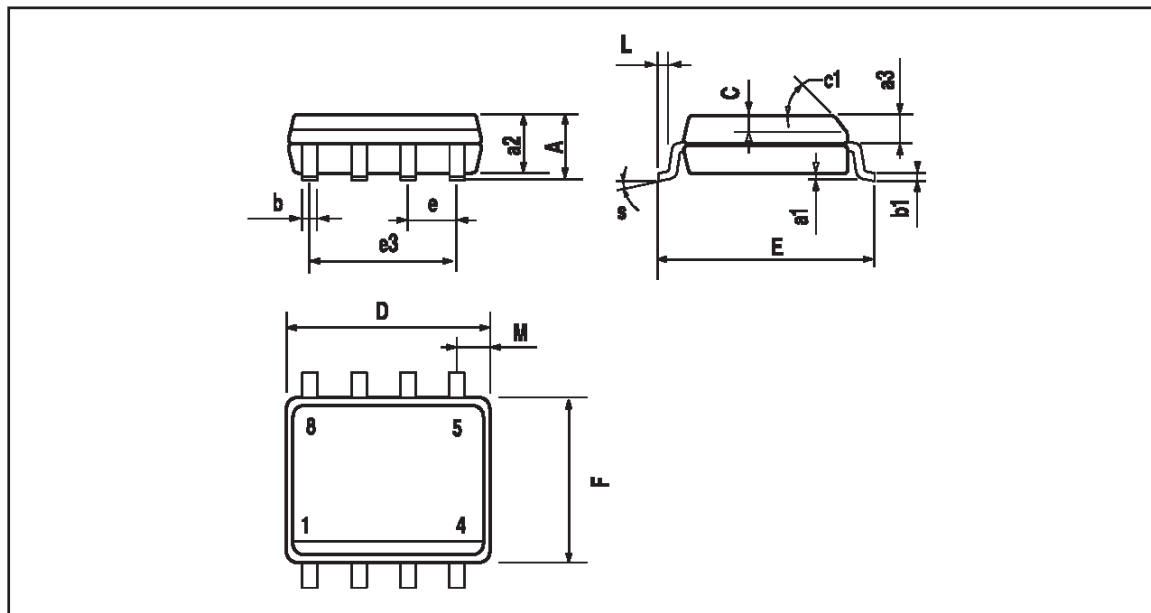
## PRINTED CIRCUIT LAYOUT

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.

**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.)   |      |      |        |       |       |

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