



## TSH10

### 140MHz BANDWIDTH LOW NOISE SINGLE OPERATIONAL AMPLIFIER

- LOW NOISE :  $6\text{nV}/\sqrt{\text{Hz}}$
- GAIN BANDWIDTH PRODUCT : 140MHz
- UNITY GAIN STABLE
- SLEW RATE :  $150\text{V}/\mu\text{s}$
- STANDARD PIN OUT

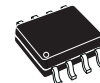
#### DESCRIPTION

The TSH10 is a low cost wide bandwidth single operational amplifier featuring low input noise of  $6\text{nV}/\sqrt{\text{Hz}}$ . Other features as unity gain stability, fast settling time and high linearity make it suitable for any application requiring speed and precision as high resolution video or DAC buffer.

#### ORDER CODE

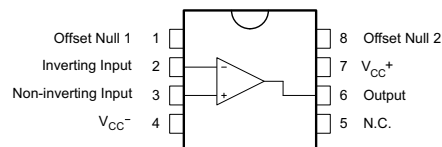
| Part Number | Temperature Range | Package |
|-------------|-------------------|---------|
|             |                   | D       |
| TSH10I      | -40°C, +125°C     | •       |

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

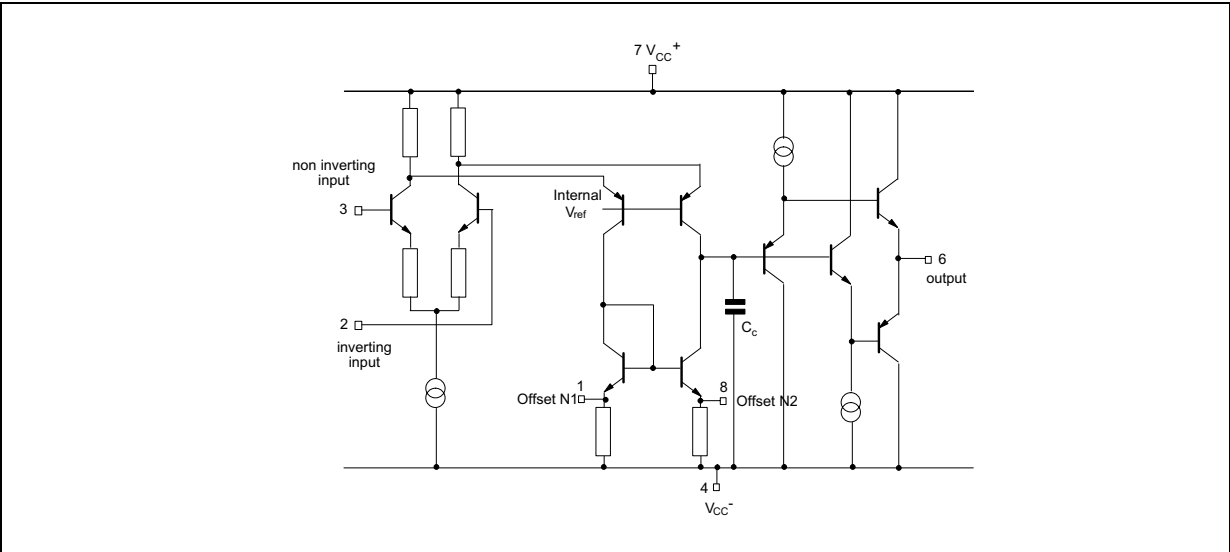


**D  
SO8**  
(Plastic Micropackage)

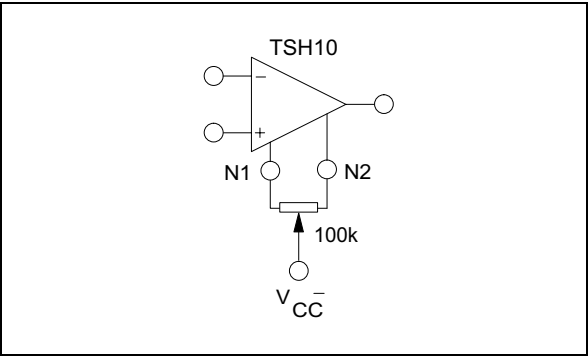
#### PIN CONNECTIONS (top view)



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 Inputs<br>Current On Offset Null Pins | $\pm 50$<br>$\pm 20$ | V    |
| $T_{oper}$ | Operating Free-Air Temperature range             | -40 to +125          | °C   |
| $T_{stg}$  | Storage Temperature Range                        | -65 to +150          | °C   |

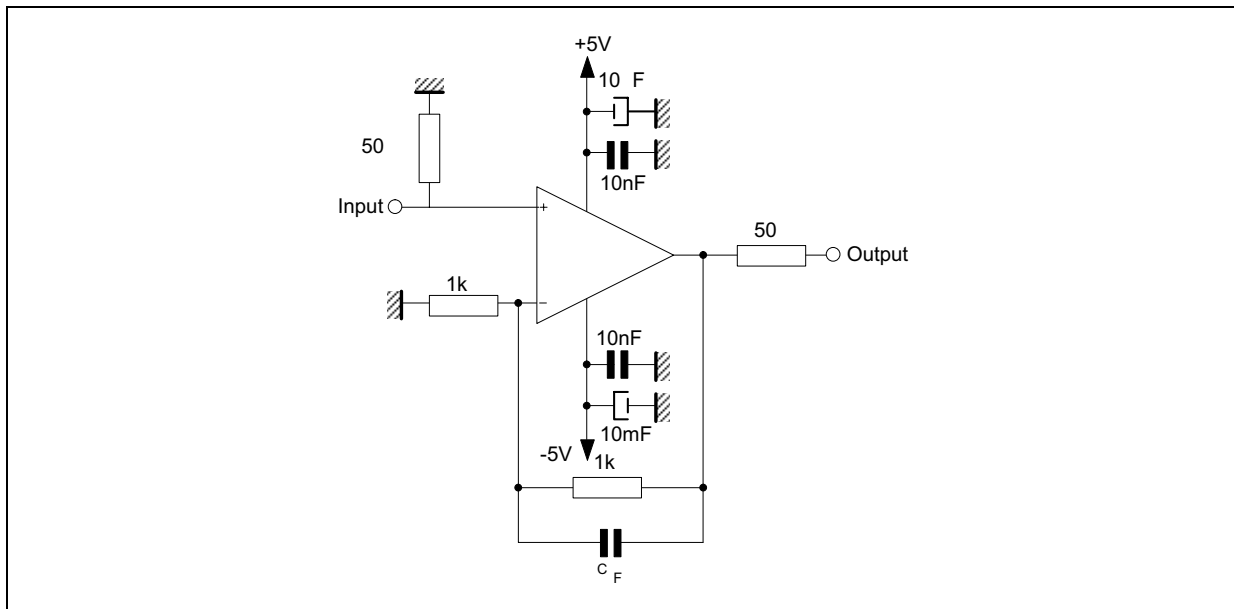
OPERATING CONDITIONS

| Symbol   | Parameter                       | Value                            | Unit |
|----------|---------------------------------|----------------------------------|------|
| $V_{CC}$ | Supply Voltage                  | $\pm 3$ to $\pm 6$               | V    |
| $V_{ic}$ | Common Mode Input Voltage Range | $V_{CC}^- + 2$ to $V_{CC}^+ - 1$ | 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                                                         |           | 1            | 10   | 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                                                           |           | 5            | 30   | $\mu A$           |
| $I_{io}$  | Input Offset Current                                                         |           | 0.1          | 10   | $\mu A$           |
| $I_{CC}$  | 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                                              | -3 to +4  | -3.5 to +4.5 |      | V                 |
| CMR       | Common-mode Rejection Ratio<br>$V_{ic} = V_{icm \text{ min.}}$               | 55        | 100          |      | V                 |
| SVR       | Supply Voltage Rejection Ratio<br>$V_{CC} = \pm 5V$ to $\pm 3V$              | 45        | 70           |      | 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>$A_{VCL} = 100$ , $R_L = 100\Omega$ , $f = 7.5MHz$ |           | 140          |      | MHz               |
| SR        | Slew Rate<br>$V_{in} = \pm 2V$ , $A_{VCL} = 1$ , $R_L = 100\Omega$           |           | 150          |      | V/ $\mu s$        |
| $e_n$     | Equivalent Input Voltage Noise<br>$f = 1MHz$                                 |           | 6            |      | nV/ $\sqrt{Hz}$   |
| $\phi_m$  | Phase Margin<br>$A_{VM} = 1$ , $R_L = 100\Omega$ , $C_L = 15pF$              |           | 40           |      | Degrees           |

## EVALUATION CIRCUIT



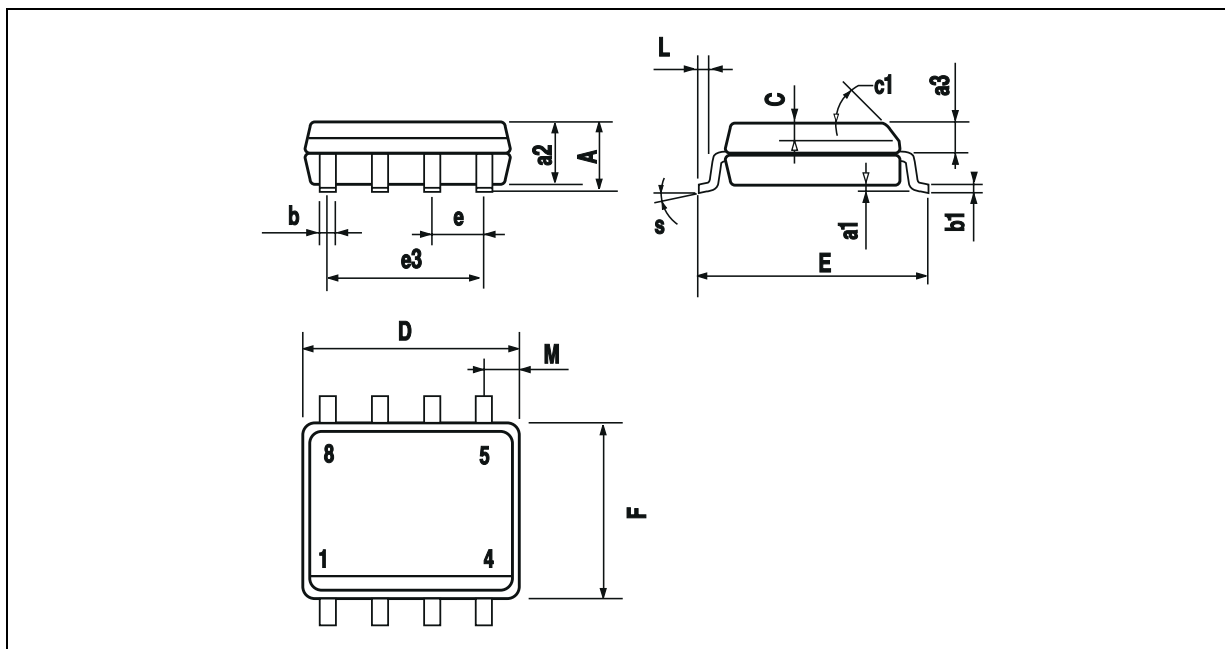
## PRINTED CIRCUIT LAYOUT

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. Be aware on TSH10 device of the I<sub>io</sub> 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<sub>F</sub> 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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