



# TS27M4C,I,M

## PRECISION LOW POWER CMOS QUAD OPERATIONAL AMPLIFIERS

- LOW POWER CONSUMPTION : **150µA/op**
- OUTPUT VOLTAGE CAN SWING TO GROUND
- EXCELLENT PHASE MARGIN ON CAPACITIVE LOADS
- STABLE AND LOW OFFSET VOLTAGE
- THREE INPUT OFFSET VOLTAGE SELECTIONS

### DESCRIPTION

These devices are low cost, low power quad operational amplifiers designed to operate with single or dual supplies. These operational amplifiers use the ST silicon gate CMOS process allowing an excellent consumption-speed ratio. These series are ideally suited for low consumption applications.

Three power consumptions are available allowing to have always the best consumption-speed ratio:

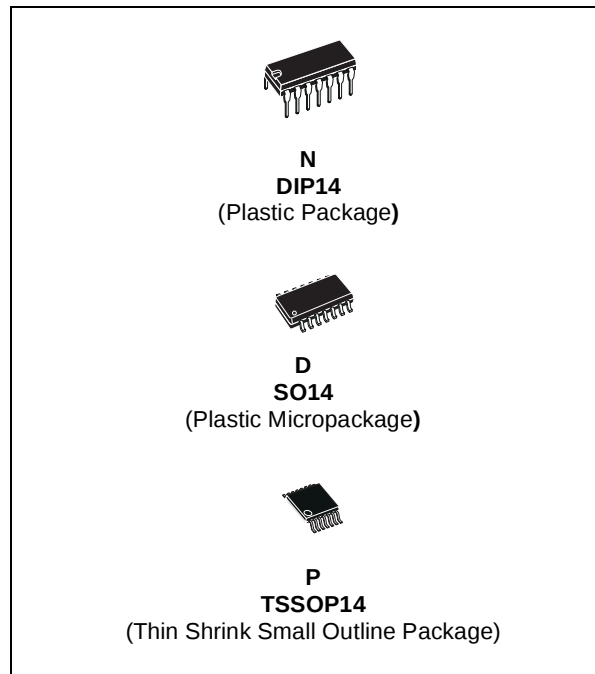
- ☐  $I_{CC} = 10\mu A/amp.$ : TS27L4 (very low power)
- ☐  $I_{CC} = 150\mu A/amp.$ : TS27M4 (low power)
- ☐  $I_{CC} = 1mA/amp.$ : TS274 (standard)

These CMOS amplifiers offer very high input impedance and extremely low input currents. The major advantage versus JFET devices is the very low input currents drift with temperature (see figure 2).

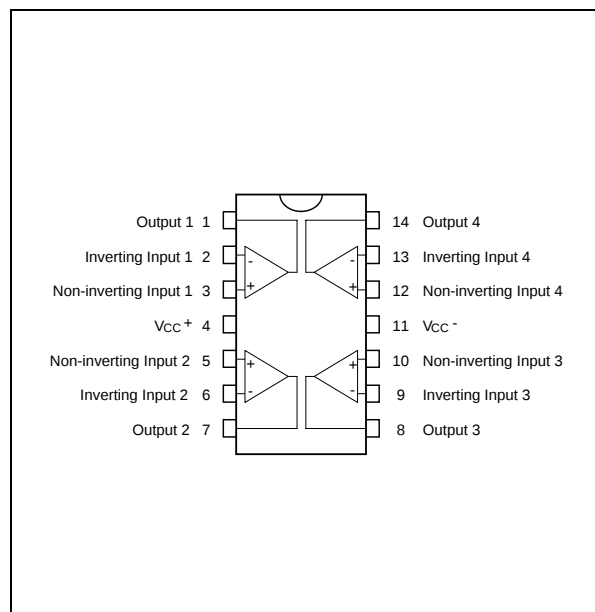
### ORDER CODE

| Part Number                | Temperature Range | Package |   |   |
|----------------------------|-------------------|---------|---|---|
|                            |                   | N       | D | P |
| TS27M4C/AC/BC              | 0°C, +70°C        | •       | • | • |
| TS27M4I/AI/BI              | -40°C, +125°C     | •       | • | • |
| TS27M4M/AM/BM              | -55°C, +125°C     | •       | • | • |
| <b>Example : TS27M4ACN</b> |                   |         |   |   |

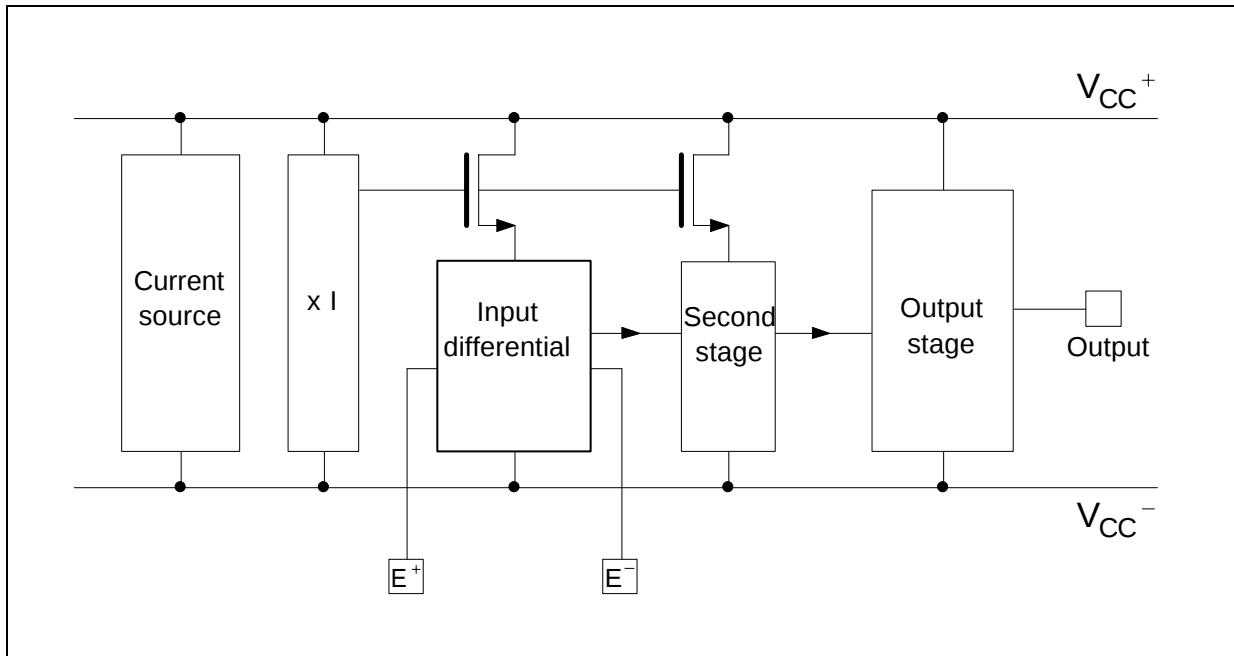
**N** = Dual in Line Package (DIP)  
**D** = Small Outline Package (SO) - also available in Tape & Reel (DT)  
**P** = Thin Shrink Small Outline Package (TSSOP) - only available in Tape & Reel (PT)



### PIN CONNECTIONS (top view)



## BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATINGS

| Symbol     | Parameter                                | TS27M4C/AC/BC | TS27M4I/AI/BI | TS27M4M/AM/BM | Unit |
|------------|------------------------------------------|---------------|---------------|---------------|------|
| $V_{CC}^+$ | Supply Voltage <sup>1)</sup>             | 18            |               |               | V    |
| $V_{id}$   | Differential Input Voltage <sup>2)</sup> | $\pm 18$      |               |               | V    |
| $V_i$      | Input Voltage <sup>3)</sup>              | -0.3 to 18    |               |               | V    |
| $I_o$      | Output Current for $V_{CC}^+ \geq 15V$   | $\pm 30$      |               |               | mA   |
| $I_{in}$   | Input Current                            | $\pm 5$       |               |               | mA   |
| $T_{oper}$ | Operating Free-Air Temperature Range     | 0 to +70      | -40 to +125   | -55 to +125   | °C   |
| $T_{stg}$  | Storage Temperature Range                | -65 to +150   |               |               | °C   |

1. All values, except differential voltage are with respect to network ground terminal.

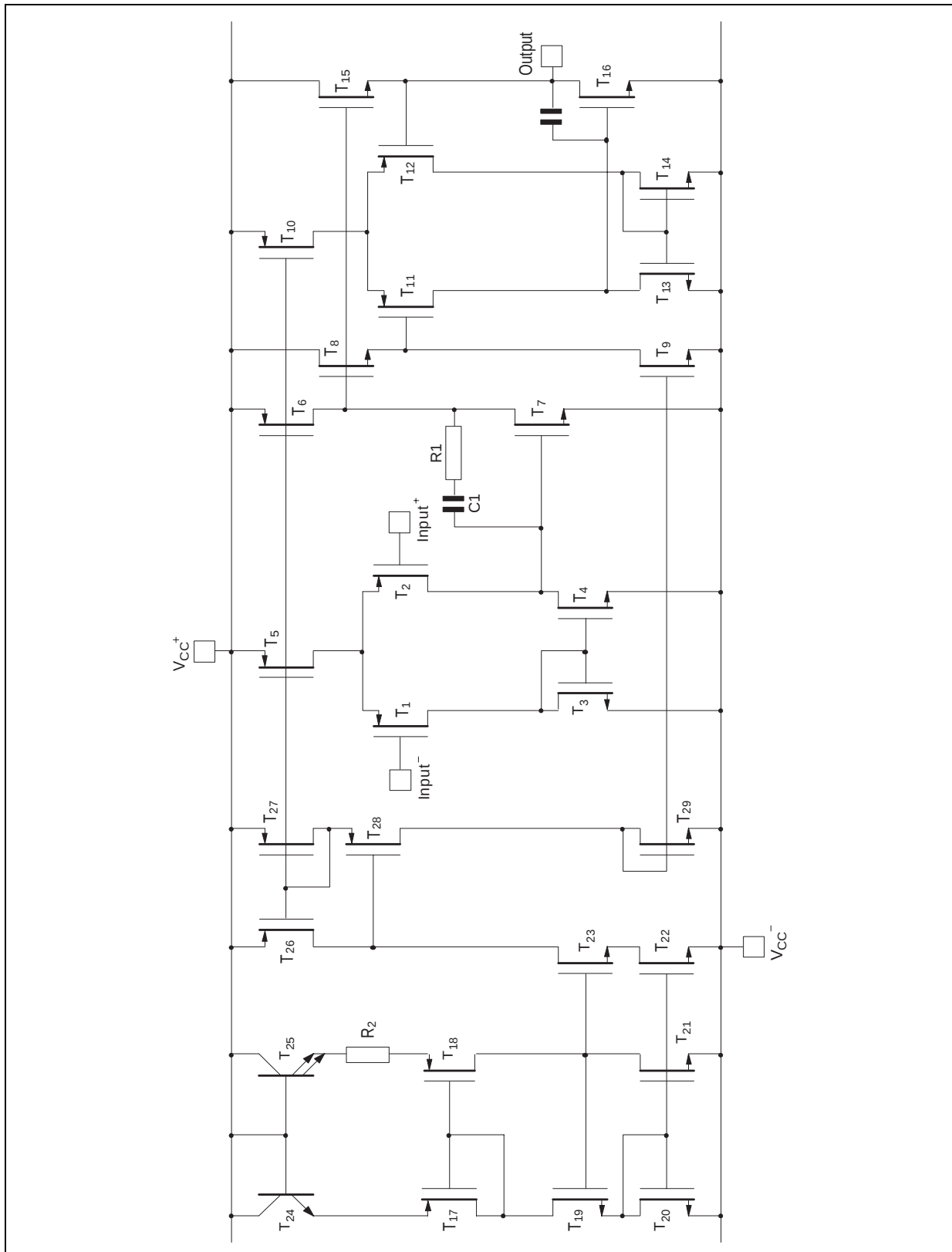
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.

3. The magnitude of the input and the output voltages must never exceed the magnitude of the positive supply voltage.

## OPERATING CONDITIONS

| Symbol     | Parameter                       | Value                 | Unit |
|------------|---------------------------------|-----------------------|------|
| $V_{CC}^+$ | Supply Voltage                  | 3 to 16               | V    |
| $V_{icm}$  | Common Mode Input Voltage Range | 0 to $V_{CC}^+ - 1.5$ | V    |

## SCHEMATIC DIAGRAM (for 1/4 TS27M4)

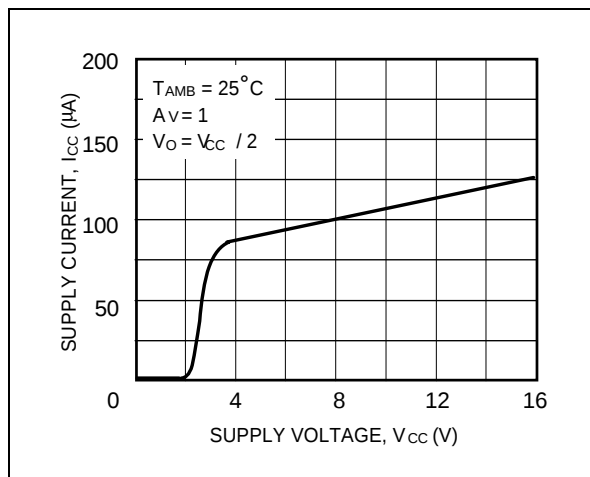
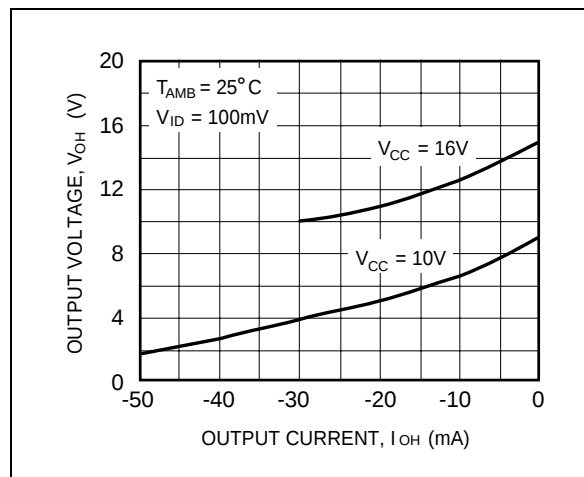
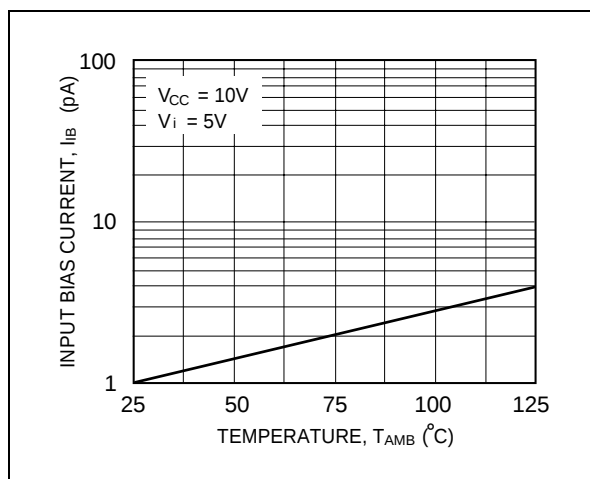
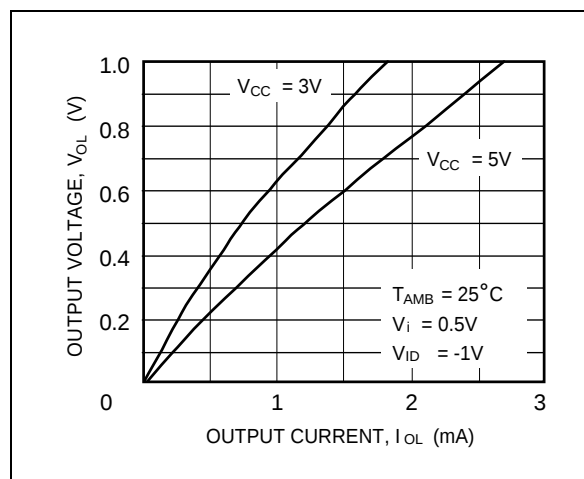
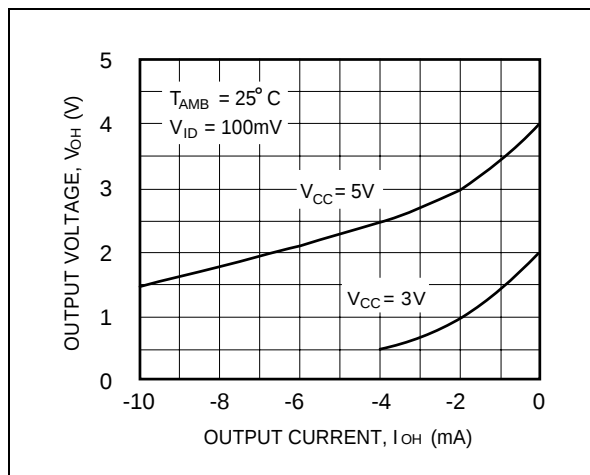
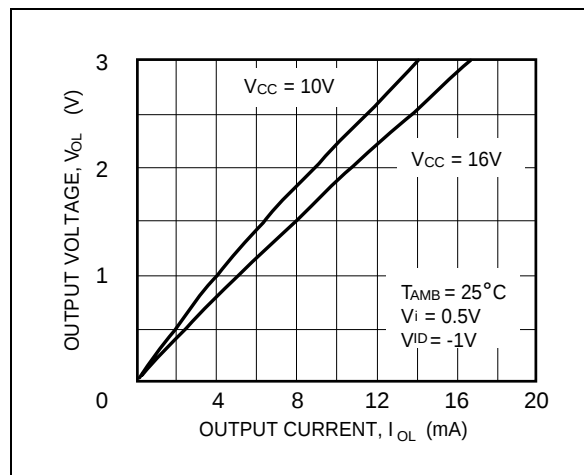


**ELECTRICAL CHARACTERISTICS**
 $V_{CC}^+ = +10V$ ,  $V_{CC}^- = 0V$ ,  $T_{amb} = +25^\circ C$  (unless otherwise specified)

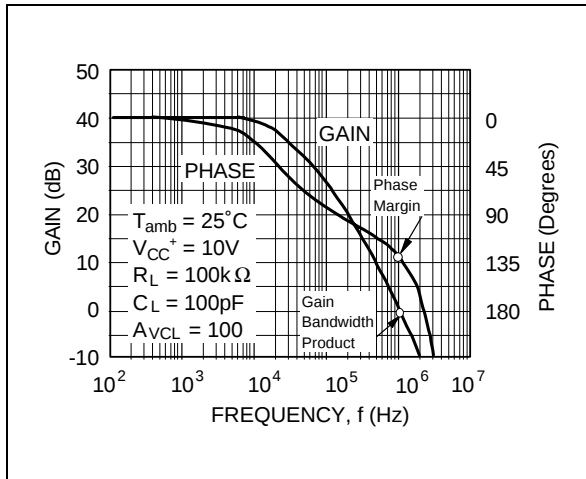
| Symbol          | Parameter                                                                                                                                                                                       | TS27M4C/AC/BC |                    |                                | TS27M4I/AI/BI<br>TS27M4M/AM/BM |                    |                                  | Unit                   |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------|--------------------------------|--------------------------------|--------------------|----------------------------------|------------------------|
|                 |                                                                                                                                                                                                 | Min.          | Typ.               | Max.                           | Min.                           | Typ.               | Max.                             |                        |
| $V_{io}$        | Input Offset Voltage<br>$V_O = 1.4V$ , $V_{ic} = 0V$<br>TS27M4C/I/M<br>TS27M4AC/AI/AM<br>TS27M4B/C/I/M<br>$T_{min} \leq T_{amb} \leq T_{max}$<br>TS27M4C/I/M<br>TS27M4AC/AI/AM<br>TS27M4B/C/I/M |               | 1.1<br>0.9<br>0.25 | 10<br>5<br>2<br>12<br>6.5<br>3 |                                | 1.1<br>0.9<br>0.25 | 10<br>5<br>2<br>12<br>6.5<br>3.5 | mV                     |
| $DV_{io}$       | Input Offset Voltage Drift                                                                                                                                                                      |               | 2                  |                                |                                | 2                  |                                  | $\mu V/^\circ C$       |
| $I_{io}$        | Input Offset Current note 1)<br>$V_{ic} = 5V$ , $V_O = 5V$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                               |               | 1                  | 100                            |                                | 1                  | 200                              | pA                     |
| $I_{ib}$        | Input Bias Current - see note 1<br>$V_{ic} = 5V$ , $V_O = 5V$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                            |               | 1                  | 150                            |                                | 1                  | 300                              | pA                     |
| $V_{OH}$        | High Level Output Voltage<br>$V_{id} = 100mV$ , $R_L = 100\Omega$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                        | 8.7<br>8.6    | 8.9                |                                | 8.7<br>8.5                     | 8.9                |                                  | V                      |
| $V_{OL}$        | Low Level Output Voltage<br>$V_{id} = -100mV$                                                                                                                                                   |               |                    | 50                             |                                |                    | 50                               | mV                     |
| $A_{vd}$        | Large Signal Voltage Gain<br>$V_{ic} = 5V$ , $R_L = 100k\Omega$ , $V_O = 1V$ to $6V$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                     | 30<br>20      | 50                 |                                | 30<br>10                       | 50                 |                                  | V/mV                   |
| GBP             | Gain Bandwidth Product<br>$A_v = 40dB$ , $R_L = 100k\Omega$ , $C_L = 100pF$ , $f_{in} = 100kHz$                                                                                                 |               | 1                  |                                |                                | 1                  |                                  | MHz                    |
| CMR             | Common Mode Rejection Ratio<br>$V_{ic} = 1V$ to $7.4V$ , $V_O = 1.4V$                                                                                                                           | 65            | 80                 |                                | 65                             | 80                 |                                  | dB                     |
| SVR             | Supply Voltage Rejection Ratio<br>$V_{CC}^+ = 5V$ to $10V$ , $V_O = 1.4V$                                                                                                                       | 60            | 80                 |                                | 60                             | 80                 |                                  | dB                     |
| $I_{CC}$        | Supply Current (per amplifier)<br>$A_v = 1$ , no load, $V_O = 5V$<br>$T_{min} \leq T_{amb} \leq T_{max}$                                                                                        |               | 150                | 200<br>250                     |                                | 150                | 200<br>300                       | $\mu A$                |
| $I_o$           | Output Short Circuit Current<br>$V_O = 0V$ , $V_{id} = 100mV$                                                                                                                                   |               | 60                 |                                |                                | 60                 |                                  | mA                     |
| $I_{sink}$      | Output Sink Current<br>$V_O = V_{CC}$ , $V_{id} = -100mV$                                                                                                                                       |               | 45                 |                                |                                | 45                 |                                  | mA                     |
| SR              | Slew Rate at Unity Gain<br>$R_L = 100k\Omega$ , $C_L = 100pF$ , $V_i = 3$ to $7V$                                                                                                               |               | 0.6                |                                |                                | 0.6                |                                  | V/ $\mu s$             |
| $\phi_m$        | Phase Margin at Unity Gain<br>$A_v = 40dB$ , $R_L = 100k\Omega$ , $C_L = 100pF$                                                                                                                 |               | 45                 |                                |                                | 45                 |                                  | Degrees                |
| $K_{OV}$        | Overshoot Factor                                                                                                                                                                                |               | 30                 |                                |                                | 30                 |                                  | %                      |
| $e_n$           | Equivalent Input Noise Voltage<br>$f = 1kHz$ , $R_s = 100\Omega$                                                                                                                                |               | 38                 |                                |                                | 38                 |                                  | $\frac{nV}{\sqrt{Hz}}$ |
| $V_{o1}/V_{o2}$ | Channel Separation                                                                                                                                                                              |               | 120                |                                |                                | 120                |                                  | dB                     |

1. Maximum values including unavoidable inaccuracies of the industrial test.

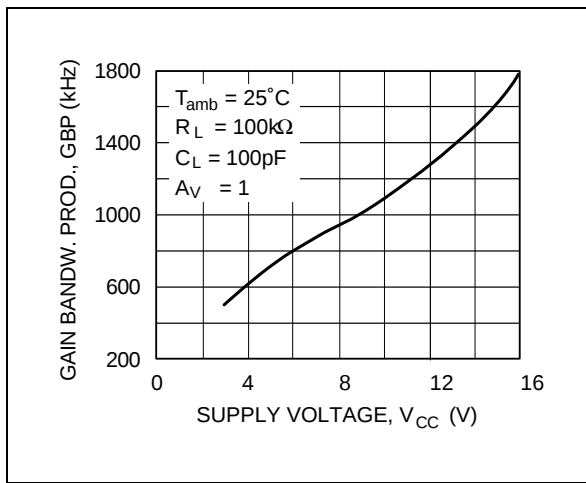
## TYPICAL CHARACTERISTICS

**Figure 1 :** Supply Current (each amplifier) versus Supply Voltage**Figure 3b :** High Level Output Voltage versus High Level Output Current**Figure 2 :** Input Bias Current versus Free Air Temperature**Figure 4a :** Low Level Output Voltage versus Low Level Output Current**Figure 3a :** High Level Output Voltage versus High Level Output Current**Figure 4b :** Low Level Output Voltage versus Low Level Output Current

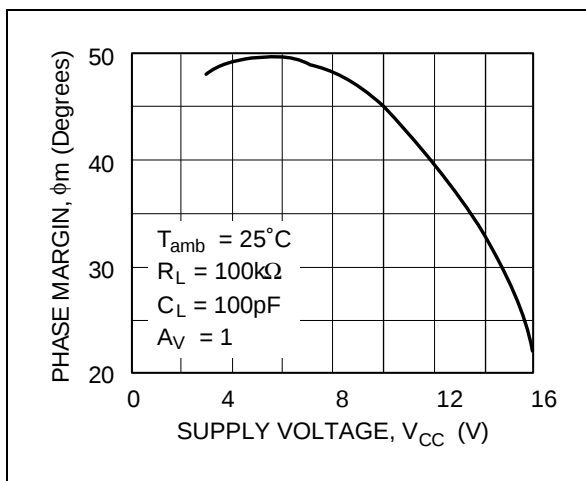
**Figure 5 : Open Loop Frequency Response and Phase Shift**



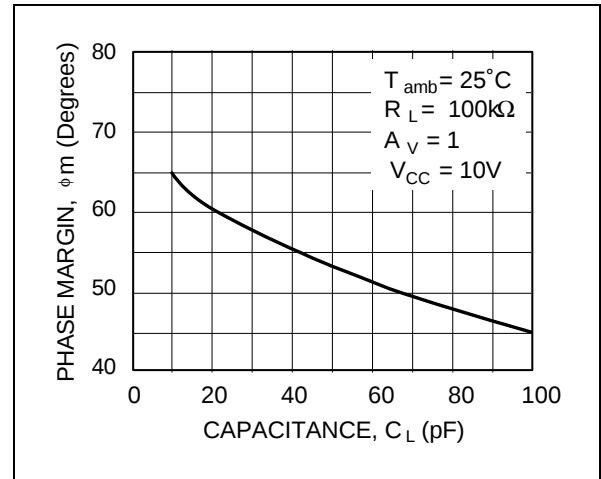
**Figure 6 : Gain Bandwidth Product versus Supply Voltage**



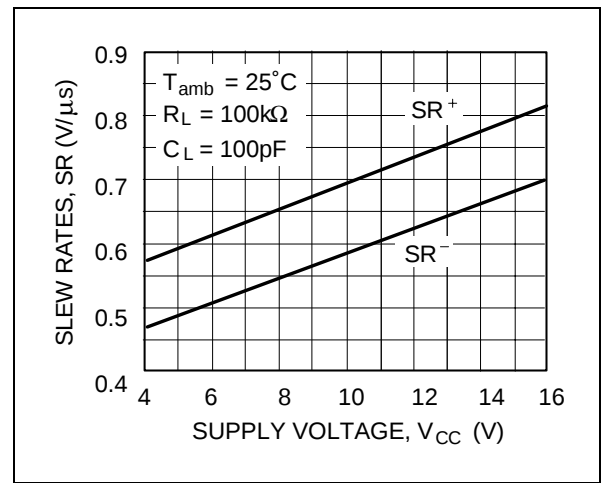
**Figure 7 : Phase Margin versus Supply Voltage**



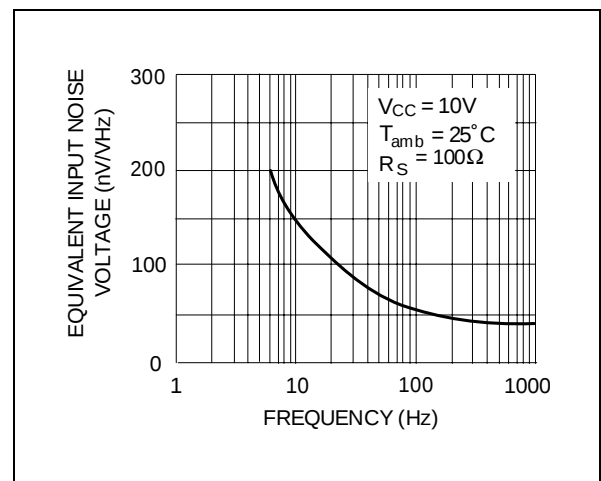
**Figure 8 : Phase Margin versus Capacitive Load**



**Figure 9 : Slew Rate versus Supply Voltage**

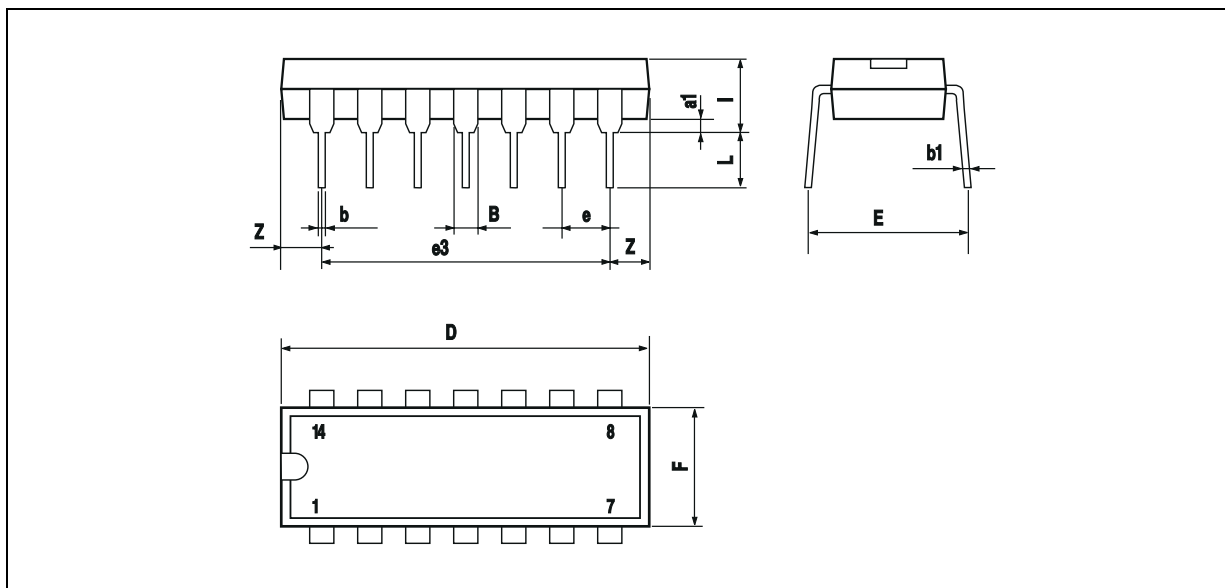


**Figure 10 : Input Voltage Noise versus Frequency**



**PACKAGE MECHANICAL DATA**

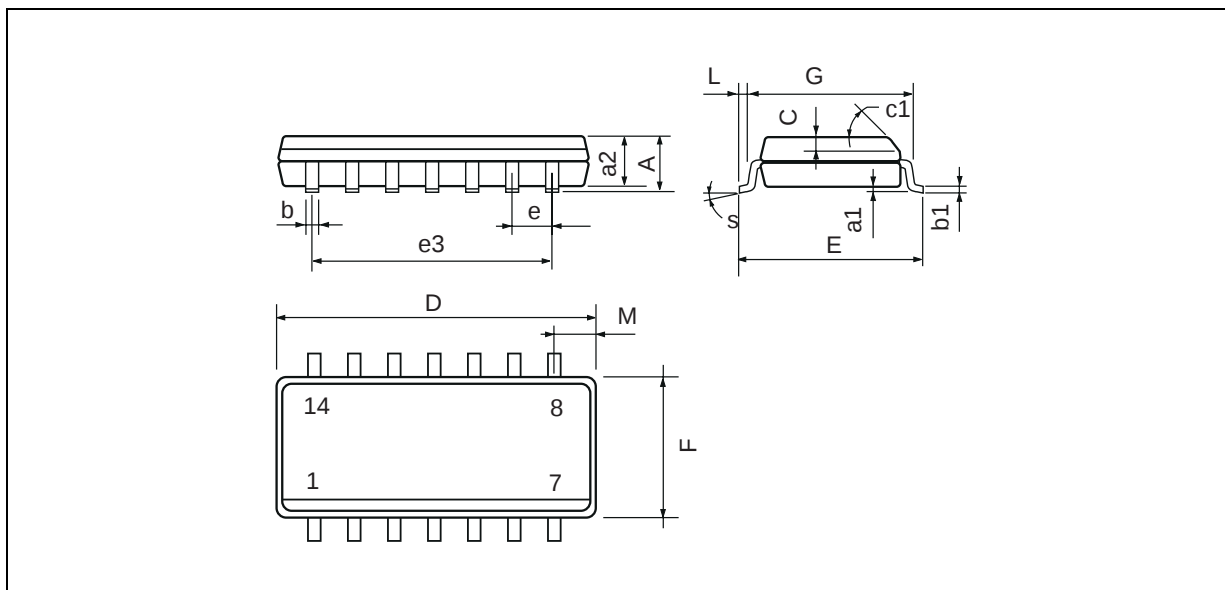
14 PINS - PLASTIC DIP



| Dim.  | Millimeters |       |      | Inches |       |       |
|-------|-------------|-------|------|--------|-------|-------|
|       | Min.        | Typ.  | Max. | Min.   | Typ.  | Max.  |
| $a_1$ | 0.51        |       |      | 0.020  |       |       |
| $B$   | 1.39        |       | 1.65 | 0.055  |       | 0.065 |
| $b$   |             | 0.5   |      |        | 0.020 |       |
| $b_1$ |             | 0.25  |      |        | 0.010 |       |
| $D$   |             |       | 20   |        |       | 0.787 |
| $E$   |             | 8.5   |      |        | 0.335 |       |
| $e$   |             | 2.54  |      |        | 0.100 |       |
| $e_3$ |             | 15.24 |      |        | 0.600 |       |
| $F$   |             |       | 7.1  |        |       | 0.280 |
| $i$   |             |       | 5.1  |        |       | 0.201 |
| $L$   |             | 3.3   |      |        | 0.130 |       |
| $Z$   | 1.27        |       | 2.54 | 0.050  |       | 0.100 |

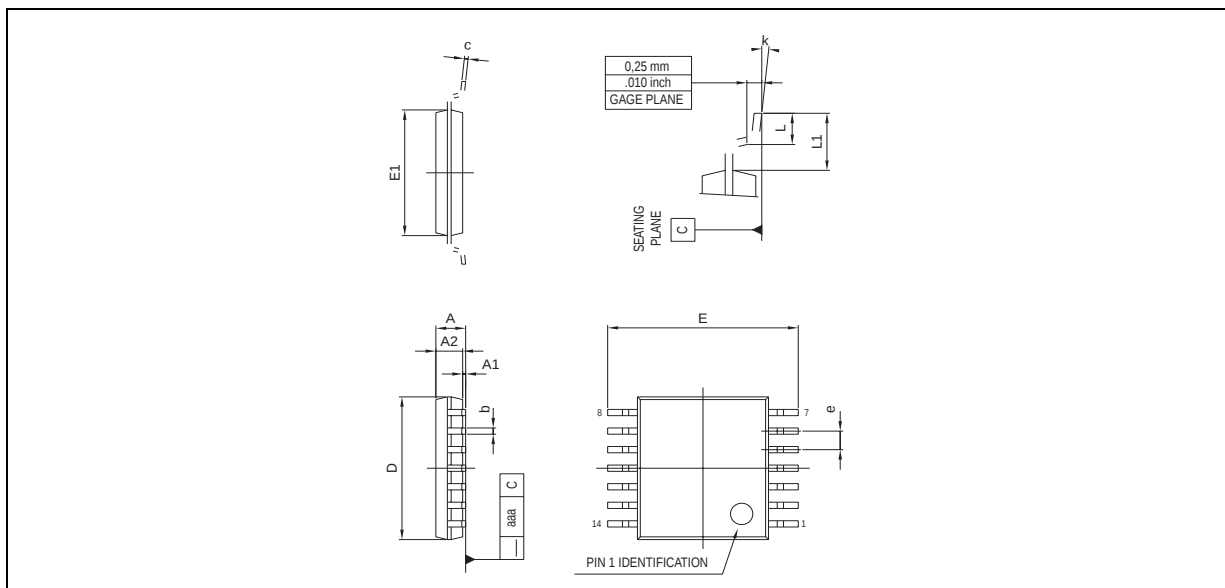
**PACKAGE MECHANICAL DATA**

14 PINS - PLASTIC MICROPACKAGE (SO)



| Dim.  | Millimeters |      |      | Inches |       |       |
|-------|-------------|------|------|--------|-------|-------|
|       | Min.        | Typ. | Max. | Min.   | Typ.  | Max.  |
| A     |             |      | 1.75 |        |       | 0.069 |
| a1    | 0.1         |      | 0.2  | 0.004  |       | 0.008 |
| a2    |             |      | 1.6  |        |       | 0.063 |
| b     | 0.35        |      | 0.46 | 0.014  |       | 0.018 |
| b1    | 0.19        |      | 0.25 | 0.007  |       | 0.010 |
| C     |             | 0.5  |      |        | 0.020 |       |
| c1    | 45° (typ.)  |      |      |        |       |       |
| D (1) | 8.55        |      | 8.75 | 0.336  |       | 0.344 |
| E     | 5.8         |      | 6.2  | 0.228  |       | 0.244 |
| e     |             | 1.27 |      |        | 0.050 |       |
| e3    |             | 7.62 |      |        | 0.300 |       |
| F (1) | 3.8         |      | 4.0  | 0.150  |       | 0.157 |
| G     | 4.6         |      | 5.3  | 0.181  |       | 0.208 |
| L     | 0.5         |      | 1.27 | 0.020  |       | 0.050 |
| M     |             |      | 0.68 |        |       | 0.027 |
| S     | 8° (max.)   |      |      |        |       |       |

Note : (1) D and F do not include mold flash or protrusions - Mold flash or protrusions shall not exceed 0.15mm (.066 inc) ONLY FOR DATA BOOK.

**PACKAGE MECHANICAL DATA****14 PINS - THIN SHRINK SMALL OUTLINE PACKAGE (TSSOP)**

| Dim. | Millimeters |      |      | Inches |        |       |
|------|-------------|------|------|--------|--------|-------|
|      | Min.        | Typ. | Max. | Min.   | Typ.   | Max.  |
| A    |             |      | 1.20 |        |        | 0.05  |
| A1   | 0.05        |      | 0.15 | 0.01   |        | 0.006 |
| A2   | 0.80        | 1.00 | 1.05 | 0.031  | 0.039  | 0.041 |
| b    | 0.19        |      | 0.30 | 0.007  |        | 0.15  |
| c    | 0.09        |      | 0.20 | 0.003  |        | 0.012 |
| D    | 4.90        | 5.00 | 5.10 | 0.192  | 0.196  | 0.20  |
| E    |             | 6.40 |      |        | 0.252  |       |
| E1   | 4.30        | 4.40 | 4.50 | 0.169  | 0.173  | 0.177 |
| e    |             | 0.65 |      |        | 0.025  |       |
| k    | 0°          |      | 8°   | 0°     |        | 8°    |
| l    | 0.50        | 0.60 | 0.75 | 0.09   | 0.0236 | 0.030 |

Information furnished is believed to be accurate and reliable. However, STMicroelectronics assumes no responsibility for the consequences of use of such information nor for any infringement of patents or other rights of third parties which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of STMicroelectronics. Specifications mentioned in this publication are subject to change without notice. This publication supersedes and replaces all information previously supplied. STMicroelectronics products are not authorized for use as critical components in life support devices or systems without express written approval of STMicroelectronics.

© The ST logo is a registered trademark of STMicroelectronics

© 2001 STMicroelectronics - Printed in Italy - All Rights Reserved  
STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - Canada - China - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia  
Malta - Morocco - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States

© <http://www.st.com>

