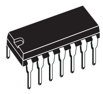
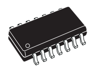
# TS27L4C,I,M

## PRECISION VERY LOW POWER CMOS QUAD OPERATIONAL AMPLIFIER

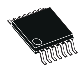
- VERY LOW POWER CONSUMPTION : **10µA/op**
- OUTPUT VOLTAGE CAN SWING TO GROUND
- EXCELLENT PHASE MARGIN ON CAPACITIVE LOADS
- STABLE AND LOW OFFSET VOLTAGE
- THREE INPUT OFFSET VOLTAGE SELECTIONS



**N**
**DIP14**
(Plastic Package)



**D**
**SO14**
(Plastic Micropackage)



**P**
**TSSOP14**
(Thin Shrink Small Outline Package)

### 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:

- $I_{CC}$ = 10µA/amp.: TS27L4 (very low power)
- $I_{CC}$ = 150µA/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).

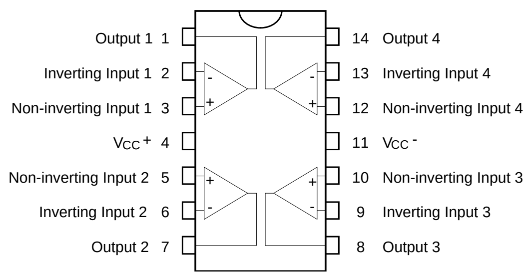
### ORDER CODE

| Part Number | Temperature Range | Package | | |
|---|---|---|---|---|
| | | N | D | P |
| TS27L4C/AC/BC | 0°C, +70°C | • | • | • |
| TS27L4I/AI/BI* | -40°C, +125°C | • | • | • |
| TS27L4M/AM/BM | -55°C, +125°C | • | • | • |
| **Example :** TS27L4ACN | | | | |

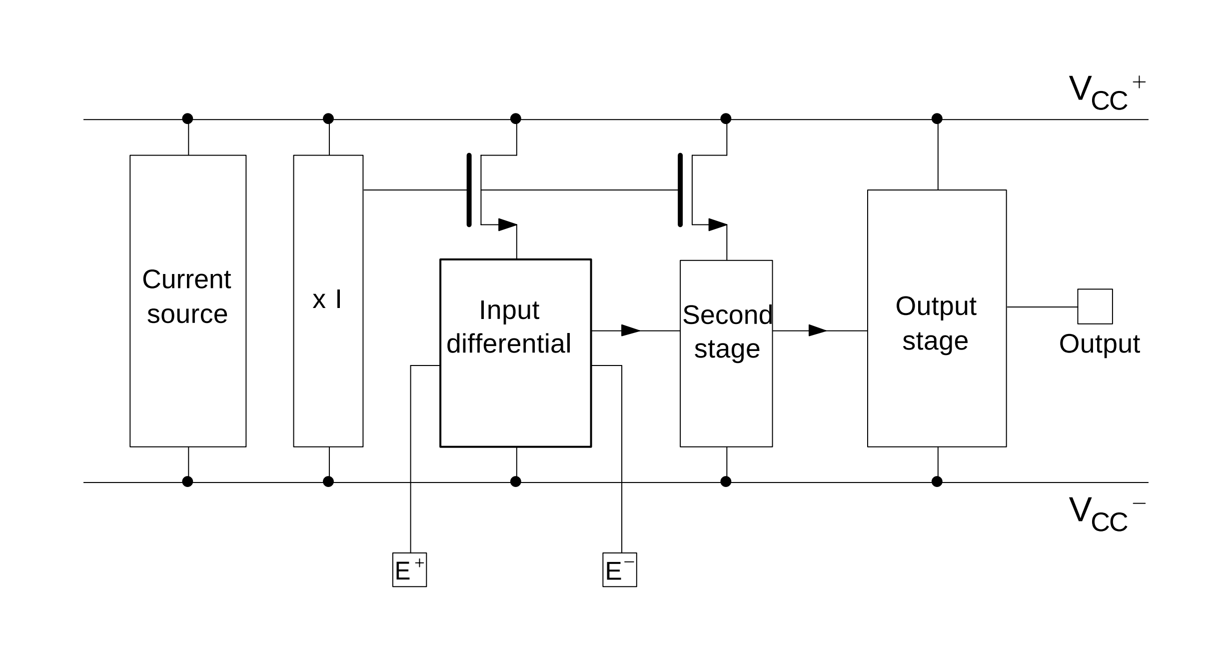
**N** = Dual in Line Package (DIP)
**D** = Small Outline Package (SO) - also available in Tape & Reel (DT)
**P** = Thin Shrink Small Outline Package (TSSOP) - only available in Tape & Reel (PT)

*** TS27L4BID : For delivery information, please contact your ST sales representative or distributor.**

### PIN CONNECTIONS (top view)



## BLOCK DIAGRAM




## ABSOLUTE MAXIMUM RATINGS

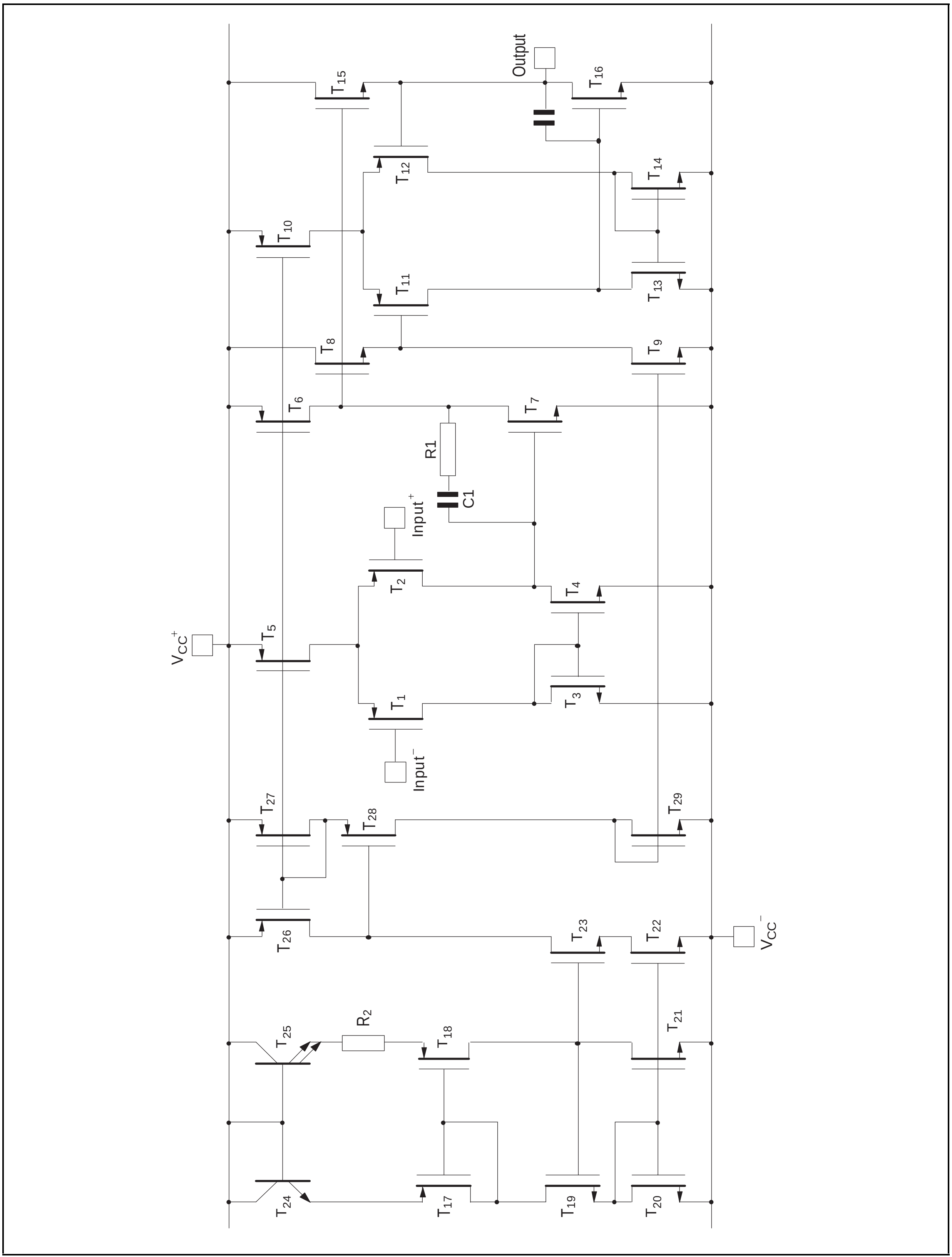
| Symbol | Parameter | TS27L4C/AC/BC | TS27L4I/AI/BI | TS27L4M/AM/BM | Unit |
|---|---|---|---|---|---|
| $V_{CC}^+$ | Supply Voltage [1] | 18 | | | V |
| $V_{id}$ | Differential Input Voltage [2] | ±18 | | | V |
| $V_i$ | Input Voltage [3] | -0.3 to 18 | | | V |
| $I_o$ | Output Current for $V_{CC}^+ \geq 15V$ | ±30 | | | mA |
| $I_{in}$ | Input Current | ±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 TS27L4)



## ELECTRICAL CHARACTERISTICS

$V_{CC}^{+} = +10V$, $V_{CC}^{-} = 0V$, $T_{amb} = +25°C$ (unless otherwise specified)

| Symbol | Parameter | TS27L4C/AC/BC | | | TS27L4I/AI/BI TS27L4M/AM/BM | | | Unit |
|---|---|---|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | Min. | Typ. | Max. | |
| $V_{io}$ | Input Offset Voltage<br>$V_O = 1.4V$, $V_{ic} = 0V$ TS27L4C/I/M<br>TS27L4AC/AI/AM<br>TS27L4B/C/I/M<br>$T_{min} \le T_{amb} \le T_{max}$ TS27L4C/I/M<br>TS27L4AC/AI/AM<br>TS27L4B/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 | | µV/°C |
| $I_{io}$ | Input Offset Current note 1)<br>$V_{ic} = 5V$, $V_O = 5V$<br>$T_{min} \le T_{amb} \le T_{max}$ | | 1 | 100 | | 1 | 200 | pA |
| $I_{ib}$ | Input Bias Current - see note 1<br>$V_{ic} = 5V$, $V_O = 5V$<br>$T_{min} \le T_{amb} \le T_{max}$ | | 1 | 150 | | 1 | 300 | pA |
| $V_{OH}$ | High Level Output Voltage<br>$V_{id} = 100mV$, $R_L = 1M\Omega$<br>$T_{min} \le T_{amb} \le T_{max}$ | 8.8<br>8.7 | 9 | | 8.8<br>8.6 | 9 | | V |
| $V_{OL}$ | Low Level Output Voltage<br>$V_{id} = -100mV$ | | | 50 | | | 50 | mV |
| $A_{vd}$ | Large Signal Voltage Gain<br>$V_{iC} = 5V$, $R_L = 1M\Omega$, $V_o = 1V$ to $6V$<br>$T_{min} \le T_{amb} \le T_{max}$ | 60<br>45 | 100 | | 60<br>40 | 100 | | V/mV |
| GBP | Gain Bandwidth Product<br>$A_v = 40dB$, $R_L = 1M\Omega$, $C_L = 100pF$, $f_{in} = 100kHz$ | | 0.1 | | | 0.1 | | 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>$T_{min} \le T_{amb} \le T_{max}$ | | 10 | 15<br>17 | | 10 | 15<br>18 | µA |
| $I_o$ | 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>$R_L = 1M\Omega$, $C_L = 100pF$, $V_i = 3$ to $7V$ | | 0.04 | | | 0.04 | | V/µs |
| $\phi m$ | Phase Margin at Unity Gain<br>$A_v = 40dB$, $R_L = 1M\Omega$, $C_L = 100pF$ | | 45 | | | 45 | | Degrees |
| $K_{OV}$ | Overshoot Factor | | 30 | | | 30 | | % |
| $e_n$ | Equivalent Input Noise Voltage<br>$f = 1kHz$, $R_s = 100\Omega$ | | 68 | | | 68 | | $\frac{nV}{\sqrt{Hz}}$ |
| $V_{o1}/V_{o2}$ | 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

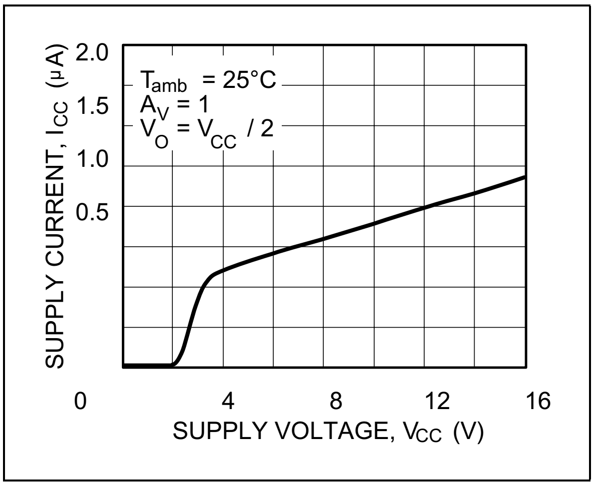



**Figure 2 :** Input Bias Current versus Free Air Temperature

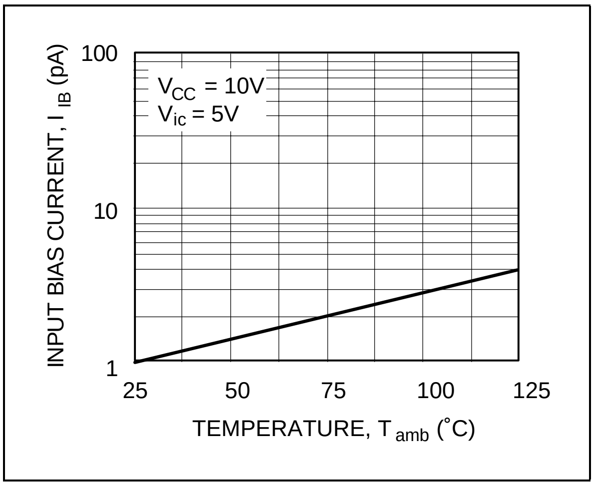



**Figure 3a :** High Level Output Voltage versus High Level Output Current

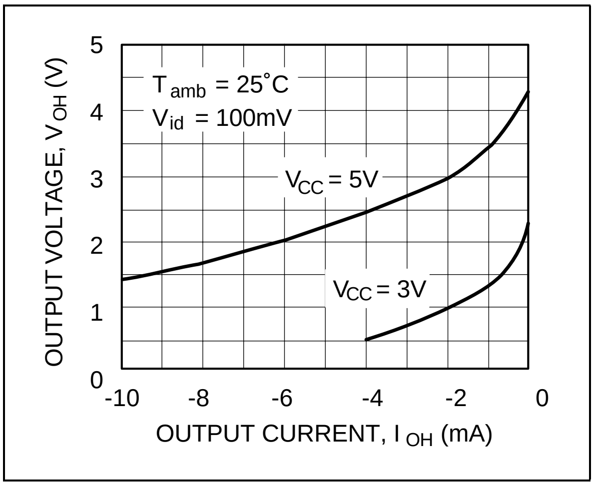



**Figure 3b :** High Level Output Voltage versus High Level Output Current

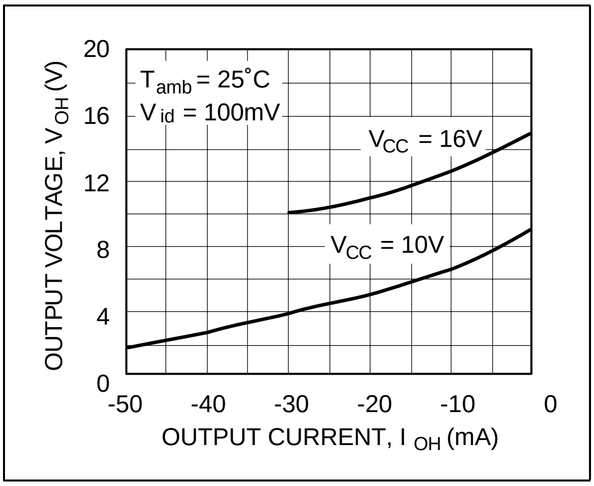



**Figure 4a :** Low Level Output Voltage versus Low Level Output Current

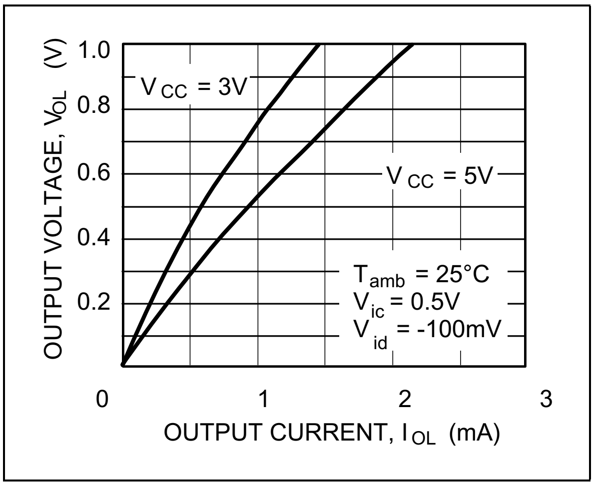



**Figure 4b :** Low Level Output Voltage versus Low Level Output Current

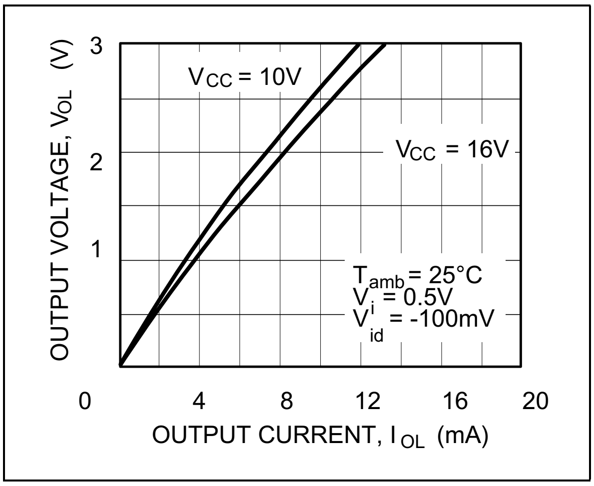


**Figure 5 :** Open Loop Frequency Response and Phase Shift

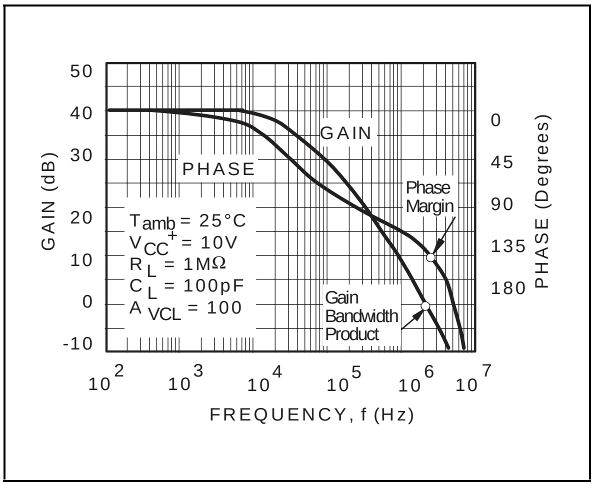



**Figure 8 :** Phase Margin versus Capacitive Load

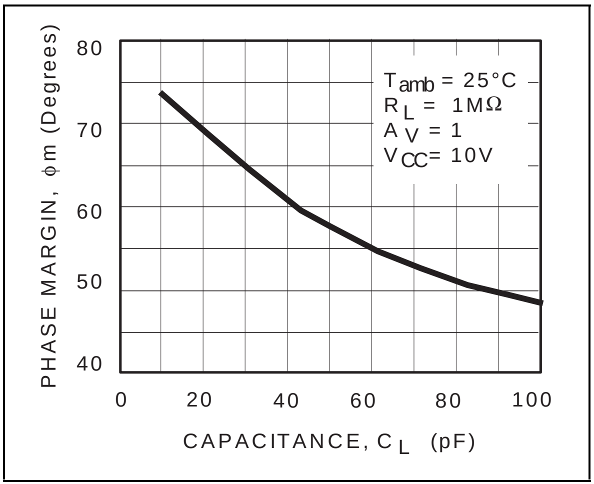



**Figure 6 :** Gain Bandwidth Product versus Supply Voltage

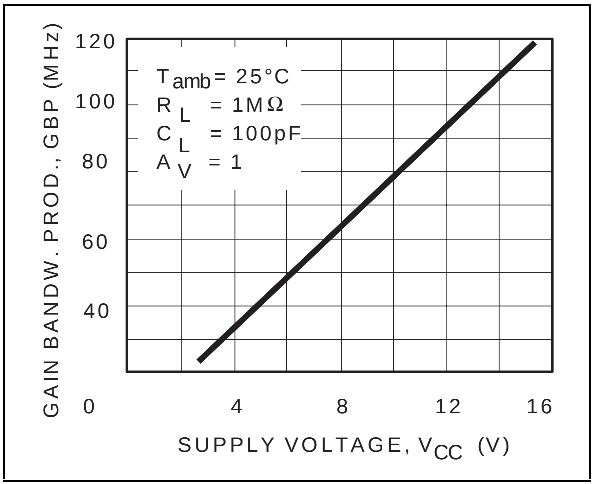



**Figure 9 :** Slew Rate versus Supply Voltage

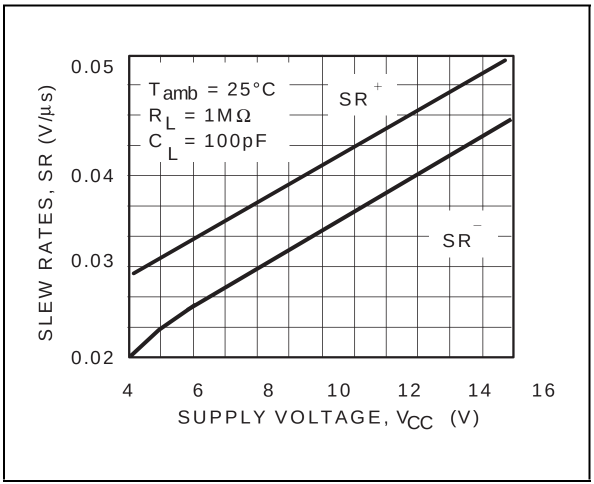



**Figure 7 :** Phase Margin versus Supply Voltage

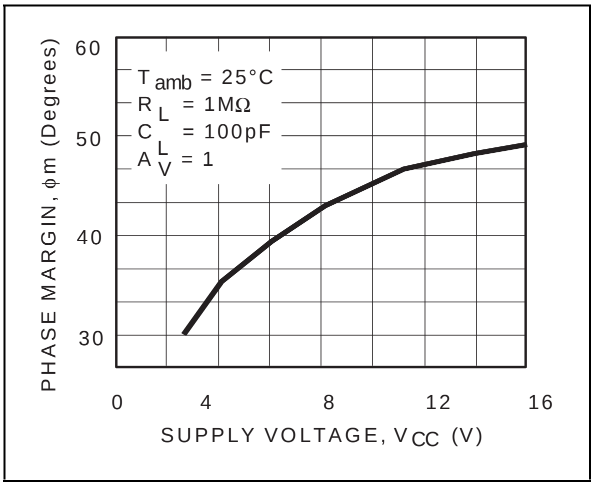
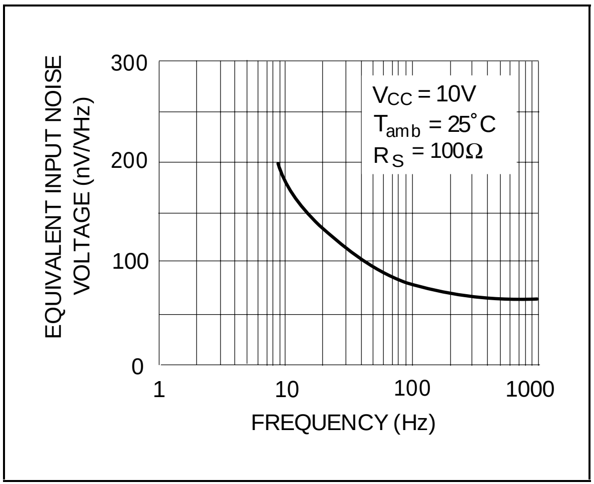
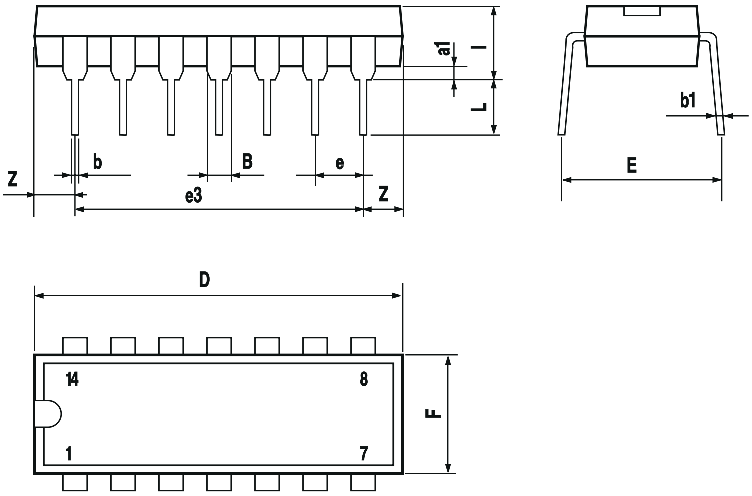



**Figure 10 :** Input Voltage Noise versus Frequency



## PACKAGE MECHANICAL DATA

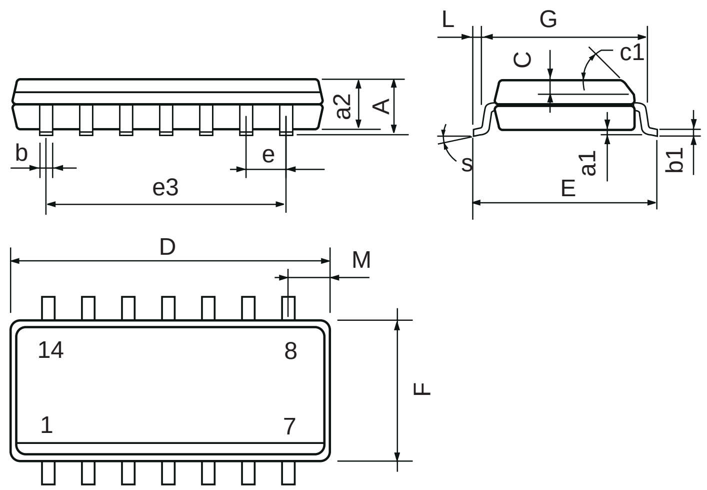
14 PINS - PLASTIC DIP




| Dim. | Millimeters | | | Inches | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| a1 | 0.51 | | | 0.020 | | |
| B | 1.39 | | 1.65 | 0.055 | | 0.065 |
| b | | 0.5 | | | 0.020 | |
| b1 | | 0.25 | | | 0.010 | |
| D | | | 20 | | | 0.787 |
| E | | 8.5 | | | 0.335 | |
| e | | 2.54 | | | 0.100 | |
| e3 | | 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)

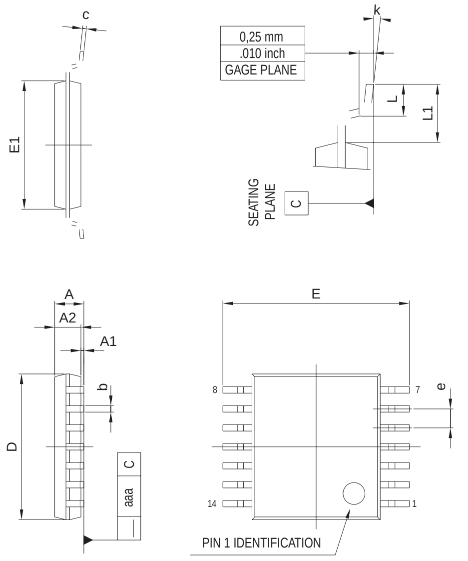



| Dim. | Millimeters | | | Inches | | |
|---|---|---|---|---|---|---|
| | Min. | Typ. | Max. | Min. | Typ. | Max. |
| A | | | 1.75 | | | 0.069 |
| a1 | 0.1 | | 0.2 | 0.004 | | 0.008 |
| a2 | | | 1.6 | | | 0.063 |
| b | 0.35 | | 0.46 | 0.014 | | 0.018 |
| b1 | 0.19 | | 0.25 | 0.007 | | 0.010 |
| C | | 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 |