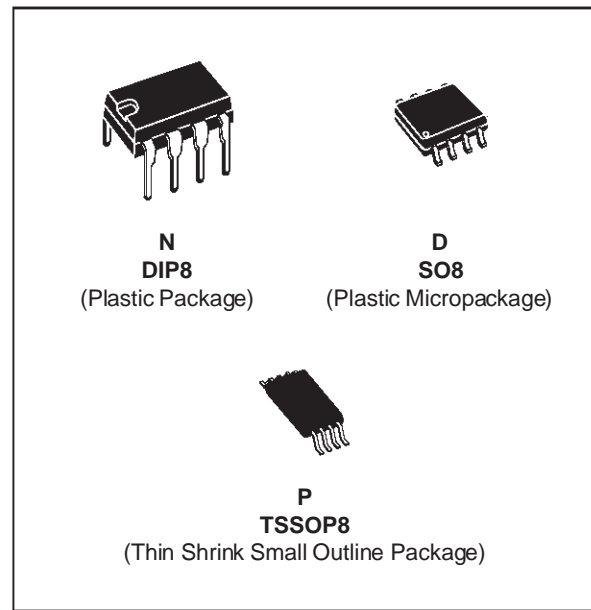




LM2904

LOW POWER DUAL OPERATIONAL AMPLIFIERS

- INTERNALLY FREQUENCY COMPENSATED
- LARGE DC VOLTAGE GAIN : 100dB
- WIDE BANDWIDTH (unity gain) : 1.1MHz (temperature compensated)
- VERY LOW SUPPLY CURRENT/OP (500 μ A) - ESSENTIALLY INDEPENDENT OF SUPPLY VOLTAGE
- LOW INPUT BIAS CURRENT : 20nA (temperature compensated)
- LOW INPUT OFFSET CURRENT : 2nA
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
- DIFFERENTIAL INPUT VOLTAGE RANGE EQUAL TO THE POWER SUPPLY VOLTAGE
- LARGE OUTPUT VOLTAGE SWING 0V TO ($V_{CC} - 1.5V$)



DESCRIPTION

This circuit consists of two independent, high gain, internally frequency compensated which were designed specifically for automotive and industrial control system. It operates from a single power supply over a wide range of voltages. The low power supply drain is independent of the magnitude of the power supply voltage.

Application areas include transducer amplifiers, dc gain blocks and all the conventional op-amp circuits which now can be more easily implemented in single power supply systems. For example, these circuits can be directly supplied with off the standard + 5V which is used in logic systems and will easily provide the required interface electronics without requiring any additional power supply.

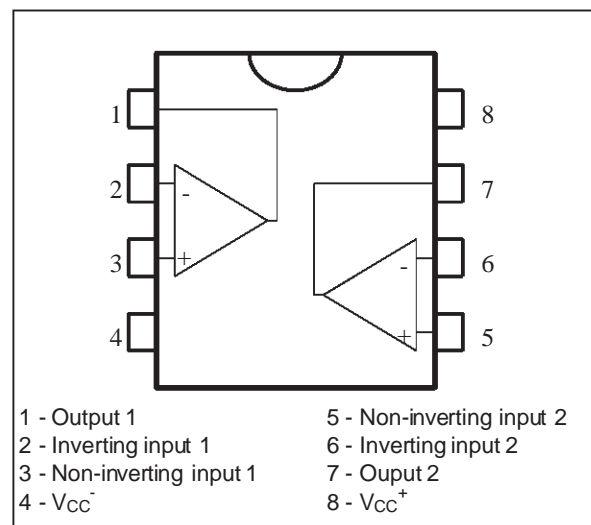
In the linear mode the input common-mode voltage range includes ground and the output voltage can also swing to ground, even though operated from only a single power supply voltage.

ORDER CODES

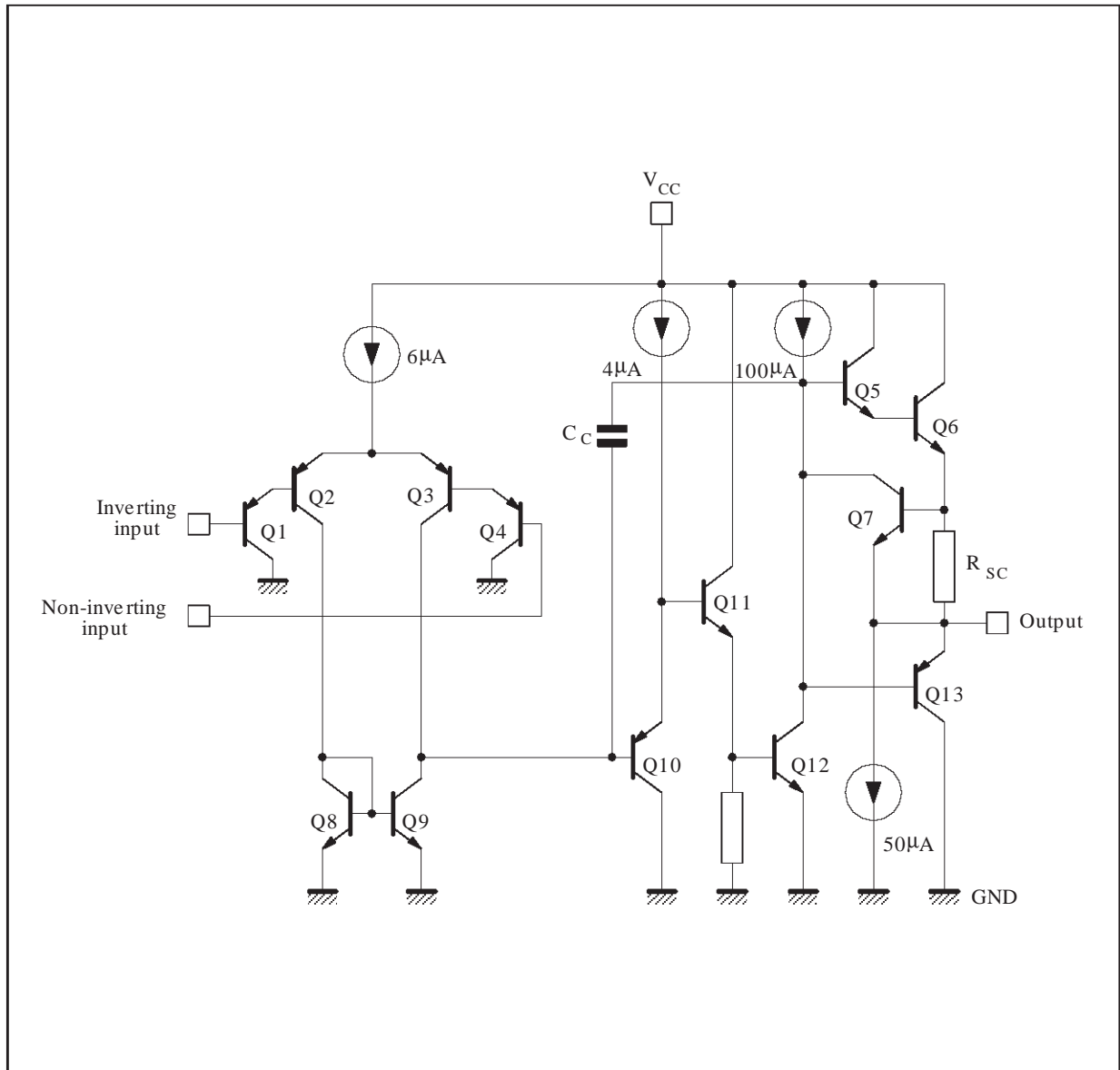
| Part Number | Temperature Range | Package | | |
|-------------|-------------------|---------|---|---|
| | | N | D | P |
| LM2904 | -40°C, +125°C | • | • | • |

Example : LM2904D

PIN CONNECTIONS (top view)



SCHMATIC DIAGRAM (1/2 LM2904)



ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | LM2904 | Unit |
|-------------------|--|-------------|------|
| V _{CC} | Supply Voltage | +32 | V |
| V _i | Input Voltage | -0.3 to +32 | V |
| V _{id} | Differential Input Voltage | +32 | V |
| | Output Short-circuit Duration - (note 2) | | |
| P _{tot} | Power Dissipation | 500 | mW |
| I _{in} | Input Current - (note 1) | 50 | mA |
| T _{oper} | Operating Free-air Temperature Range | -40 to +125 | °C |
| T _{stg} | Storage Temperature Range | -65 to +150 | °C |

ELECTRICAL CHARACTERISTICS
 $V_{CC}^+ = +5V$, $V_{CC}^- = \text{Ground}$, $V_O = 1.4V$, $T_{amb} = 25^\circ C$ (unless otherwise specified)

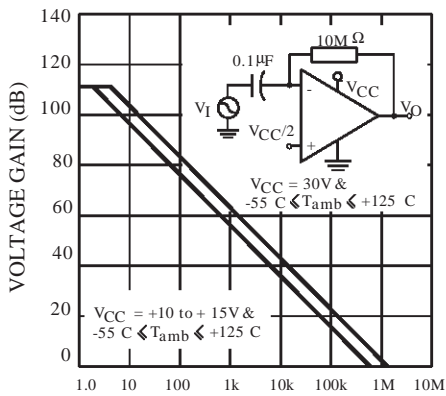
| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|--------------|---|----------------------|----------|------------------------------------|---------------|
| V_{io} | Input Offset Voltage - (note 3) $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ | | 2 | 7 9 | mV |
| I_{io} | Input Offset Current $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ | | 2 | 30 40 | nA |
| I_{ib} | Input Bias Current - (note 4) $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ | | 20 | 150 200 | nA |
| A_{vd} | Large Signal Voltage Gain ($V_{CC} = +15V$, $R_L = 2k\Omega$, $V_O = 1.4V$ to $11.4V$) $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ | 50 25 | 100 | | V/mV |
| SVR | Supply Voltage Rejection Ratio ($R_S = 10k\Omega$) ($V_{CC}^+ = 5$ to $30V$) $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ | 65 65 | 100 | | dB |
| I_{CC} | Supply Current, all Amp, no Load $V_{CC} = +5V$, $T_{min.} \leq T_{amb} \leq T_{max.}$ $V_{CC} = +30V$, $T_{min.} \leq T_{amb} \leq T_{max.}$ | | 0.7 | 1.2 2 | mA |
| V_{icm} | Input Common Mode Voltage Range ($V_{CC} = +30V$) - (note 6) $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ | 0 0 | | $V_{CC}^+ - 1.5$ $V_{CC}^+ - 2$ | V |
| CMR | Common-mode Rejection Ratio ($R_S = 10k\Omega$) $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ | 70 60 | 85 | | dB |
| I_{source} | Output Source Current ($V_{CC} = +15V$, $V_O = 2V$, $V_{id} = +1V$) | 20 | 40 | 60 | mA |
| I_{sink} | Output Current Sink ($V_{id} = -1V$) $V_{CC} = +15V$, $V_O = 2V$ $V_{CC} = +15V$, $V_O = +0.2V$ | 10 12 | 20 50 | | mA μA |
| V_{OPP} | Output Voltage Swing ($R_L = 2k\Omega$) $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ | 0 0 | | $V_{CC}^+ - 1.5$ $V_{CC}^+ - 2$ | V |
| V_{OH} | High Level Output Voltage ($V_{CC}^+ = 30V$) $T_{amb} = 25^\circ C$ $R_L = 2k\Omega$ $T_{min.} \leq T_{amb} \leq T_{max.}$ $T_{amb} = 25^\circ C$ $R_L = 10k\Omega$ $T_{min.} \leq T_{amb} \leq T_{max.}$ | 26 26 27 27 | 27 28 | | V |
| V_{OL} | Low Level Output Voltage ($R_L = 10k\Omega$) $T_{amb} = 25^\circ C$ $T_{min.} \leq T_{amb} \leq T_{max.}$ | | 5 | 20 20 | mV |
| SR | Slew Rate ($V_{CC} = 15V$, $V_I = 0.5$ to $3V$, $R_L = 2k\Omega$, $C_L = 100pF$, unity gain) | 0.3 | 0.6 | | V/ μs |
| GBP | Gain Bandwidth Product ($V_{CC} = 30V$, $f = 100kHz$, $V_{in} = 10mV$, $R_L = 2k\Omega$, $C_L = 100pF$) | 0.7 | 1.1 | | MHz |
| THD | Total Harmonic Distortion ($f = 1kHz$, $A_v = 20dB$, $R_L = 2k\Omega$, $V_{CC} = 30V$, $C_L = 100pF$, $V_O = 2$ pp) | | 0.02 | | % |

ELECTRICAL CHARACTERISTICS (continued)

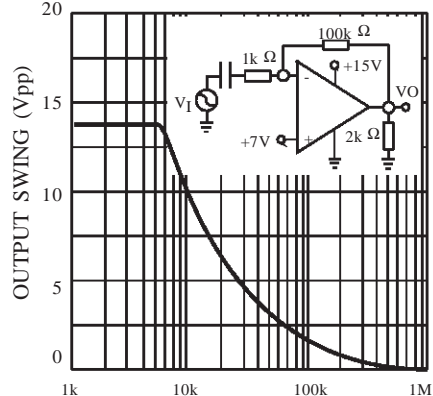
| Symbol | Parameter | Min. | Typ. | Max | Unit |
|-----------------|---|------|------|-----|-------------------|
| DV_{io} | Input Offset Voltage Drift | | 7 | 30 | $\mu A/^{\circ}C$ |
| DI_{io} | Input Offset Current Drift | | 10 | 300 | $pA/^{\circ}C$ |
| V_{O1}/V_{O2} | Channel Separation (note 5) $1kHz \leq f \leq 20kHz$ | | 120 | | dB |

- Notes :
- This input current only exist when the voltage at any of the input leads is driven negative. It is due to the collector-base junction of the input PNP transistor becoming forward biased and thereby acting as input diode clamps. In addition to this diode action, there is also NPN parasitic action on the IC chip. This transistor action can cause the output voltages of the Op-amps to go to the V_{CC} voltage level (or to ground for a large overdrive) for the time duration that an input is driven negative. This is not destructive and normal output will set up again for input voltage higher than $-0.3V$.
 - Short-circuits from the output to V_{CC} can cause excessive heating if $V_{CC}^+ > 15V$. The maximum output current is approximately 40mA independent of the magnitude of V_{CC} . Destructive dissipation can result from simultaneous short-circuits on all amplifiers.
 - $V_O = 1.4V$, $R_s = 0\Omega$, $5V < V_{CC}^+ < 30V$, $0 < V_{ic} < V_{CC}^+ - 1.5V$.
 - The direction of the input current is out of the IC. This current is essentially constant, independent of the state of the output so no loading change exists on the input lines.
 - Due to the proximity of external components insure that coupling is not originating via stray capacitance between these external parts. This typically can be detected as this type of capacitance increases at higher frequencies.
 - The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is $V_{CC}^+ - 1.5V$. But either or both inputs can go to +32V without damage.

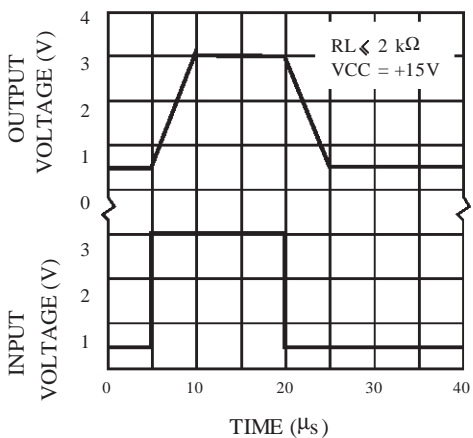
OPEN LOOP FREQUENCY RESPONSE (NOTE 3)



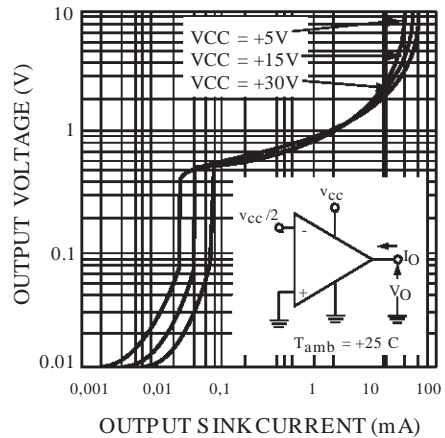
LARGE SIGNAL FREQUENCY RESPONSE



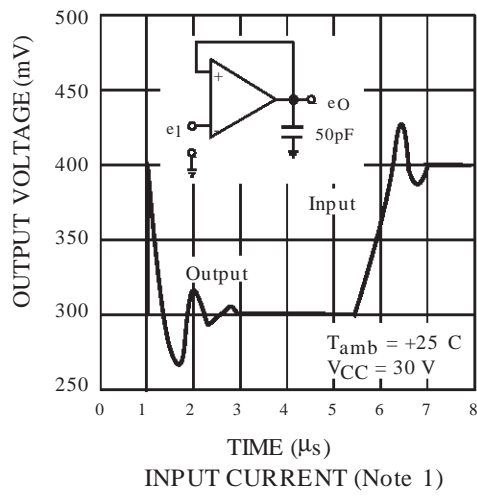
VOLAGE FOLLOWER PULSE RESPONSE



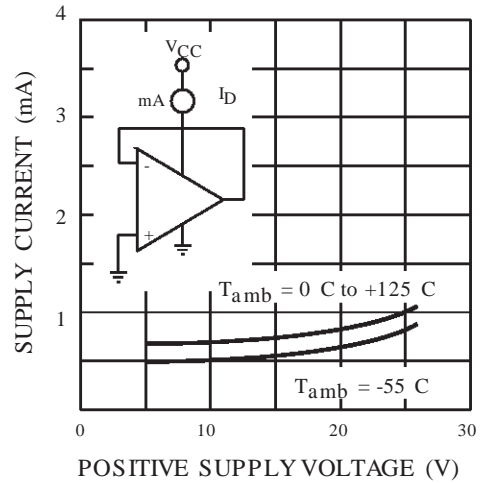
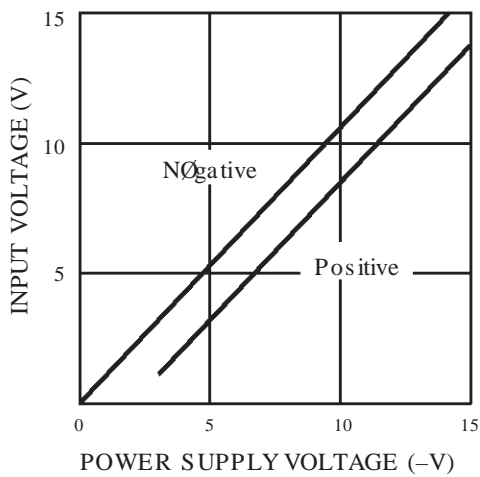
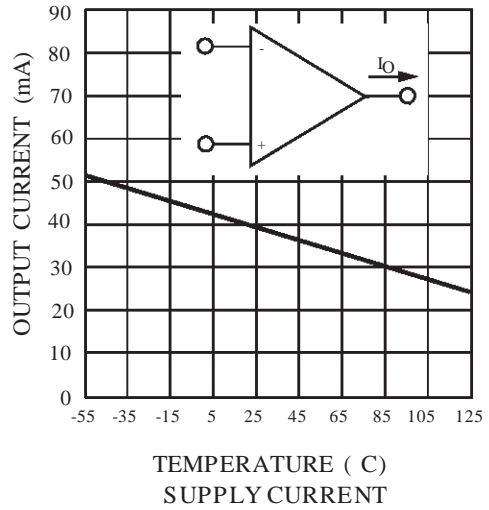
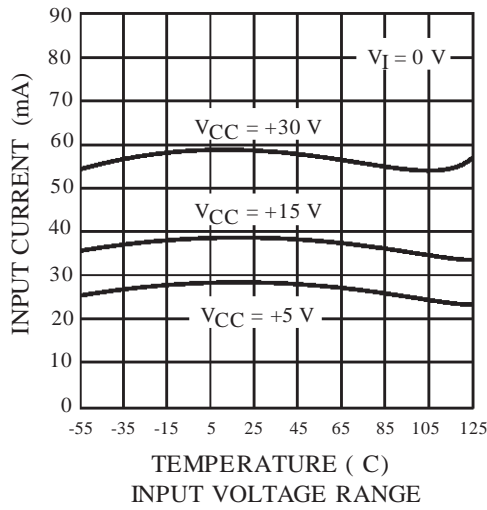
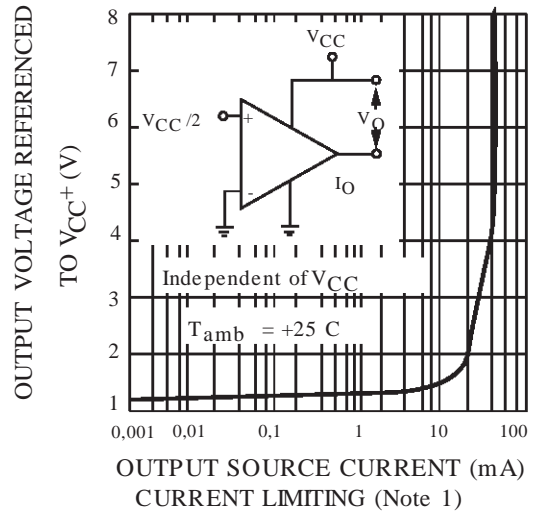
OUTPUT CHARACTERISTICS

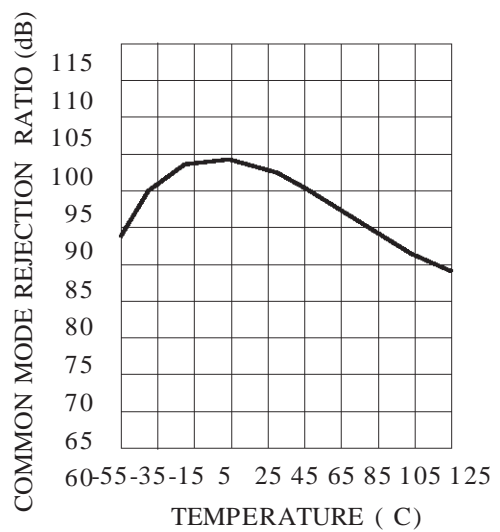
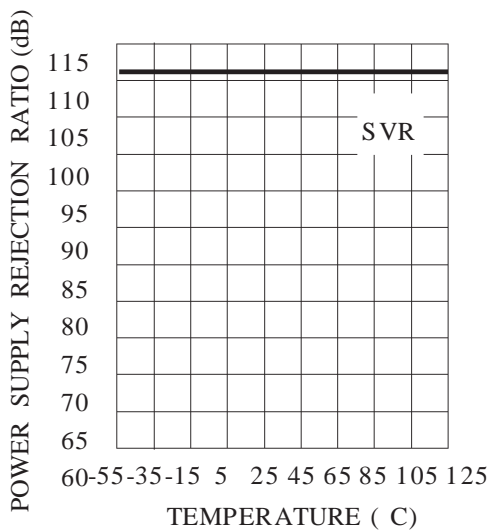
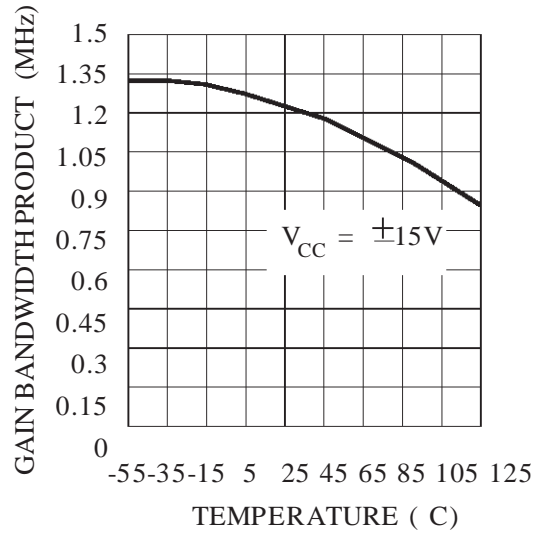
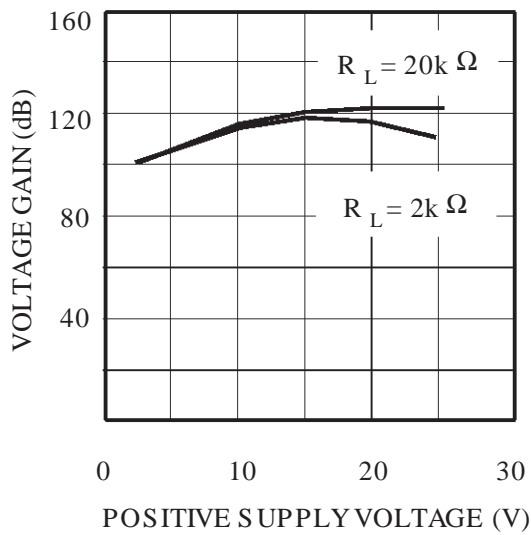
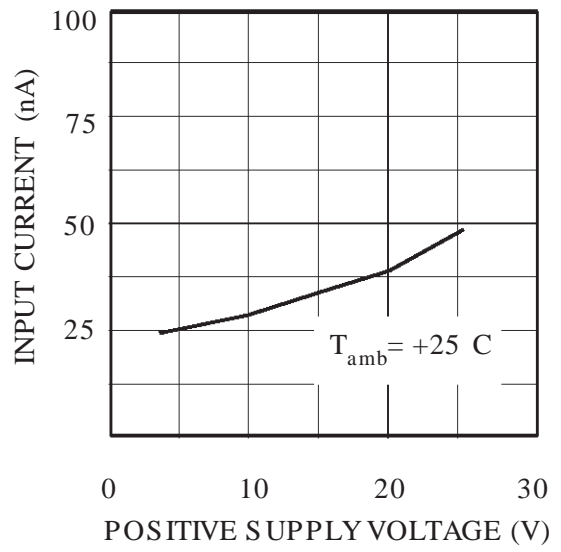
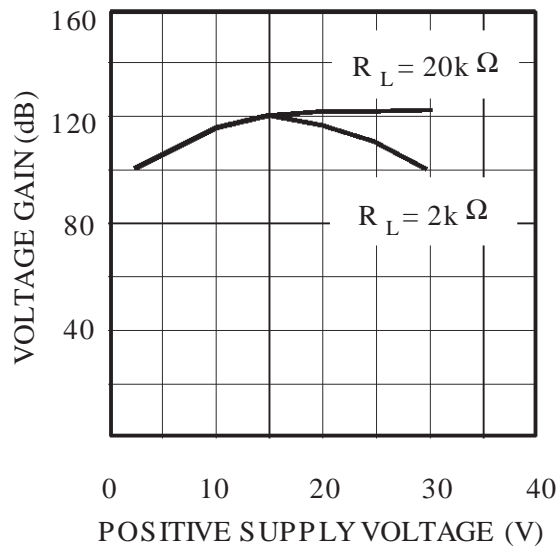


VOLTAGE FOLLOWER PULSE RESPONSE (SMALL SIGNAL)



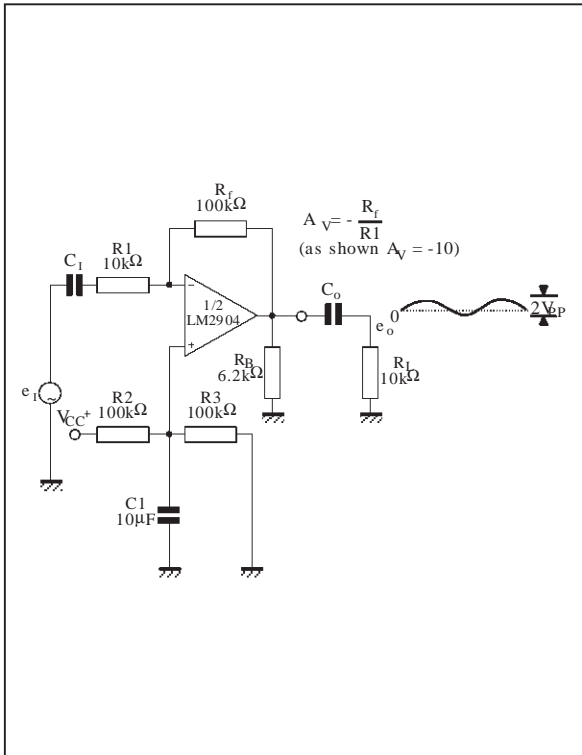
OUTPUT CHARACTERISTICS



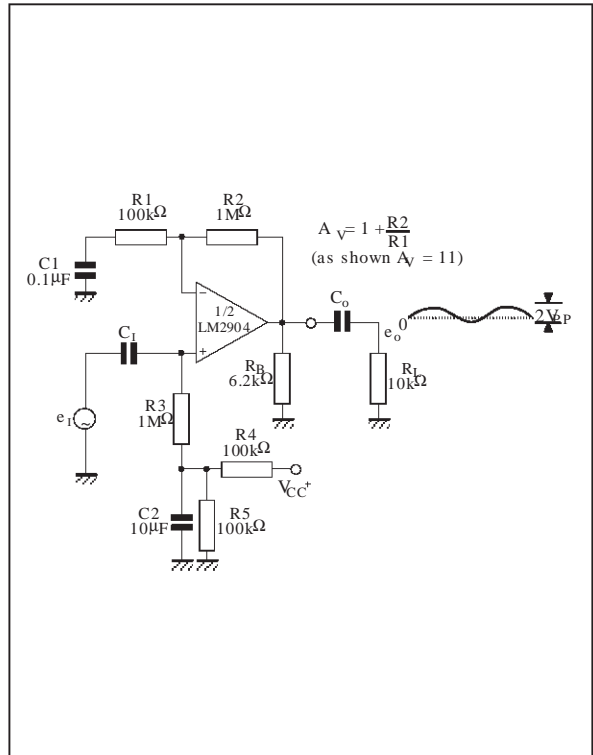


TYPICAL APPLICATIONS (single supply voltage) $V_{CC} = +5V_{DC}$

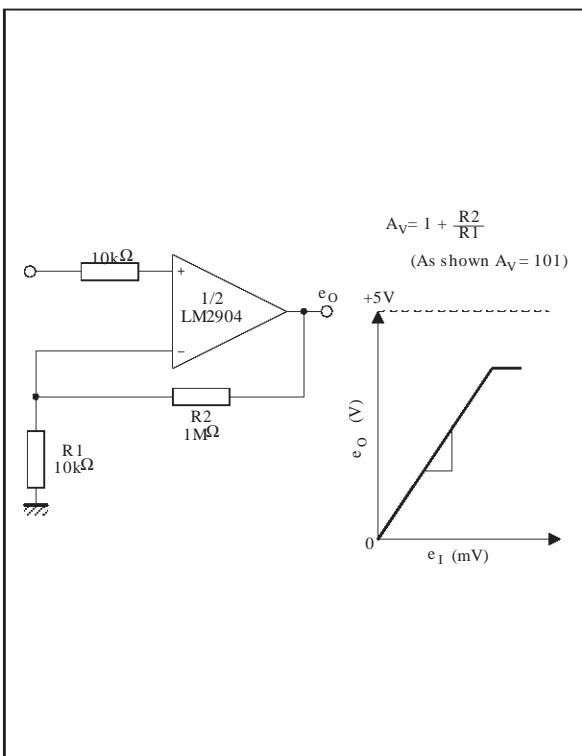
AC COUPLED INVERTING AMPLIFIER



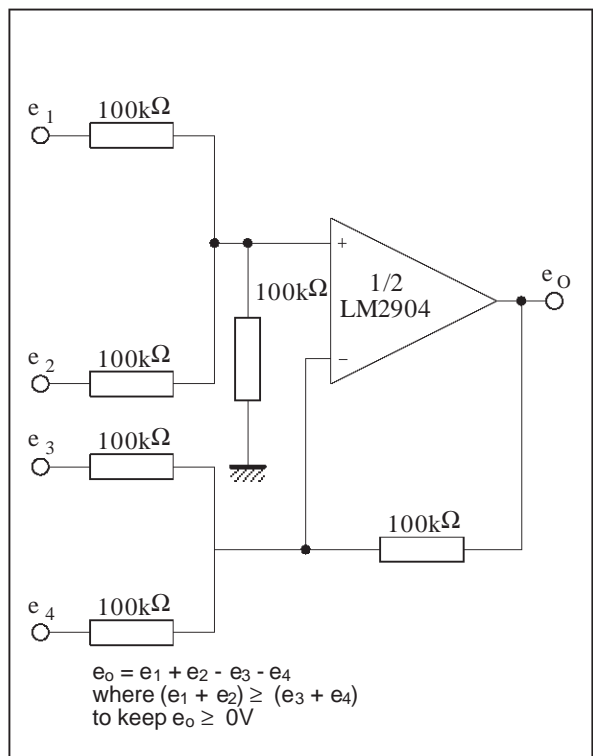
AC COUPLED NON-INVERTING AMPLIFIER



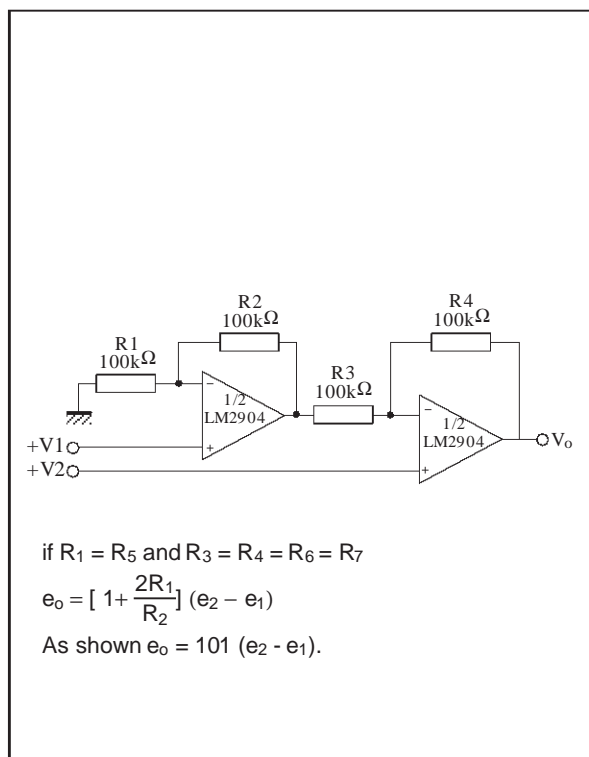
NON-INVERTING DC AMPLIFIER



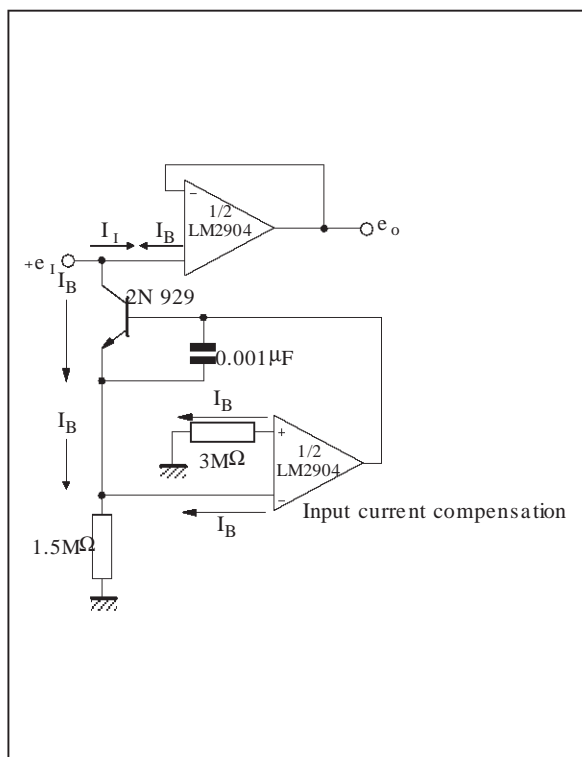
DC SUMMING AMPLIFIER



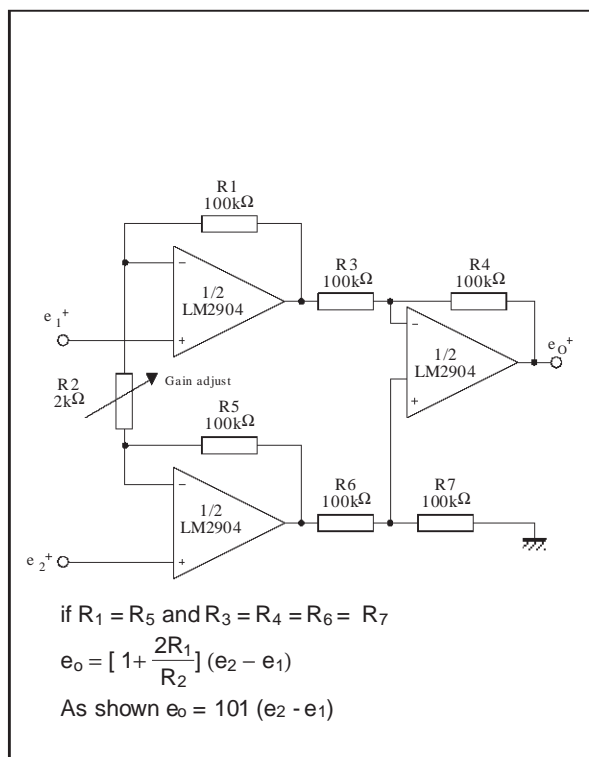
HIGH INPUT Z, DC DIFFERENTIAL AMPLIFIER



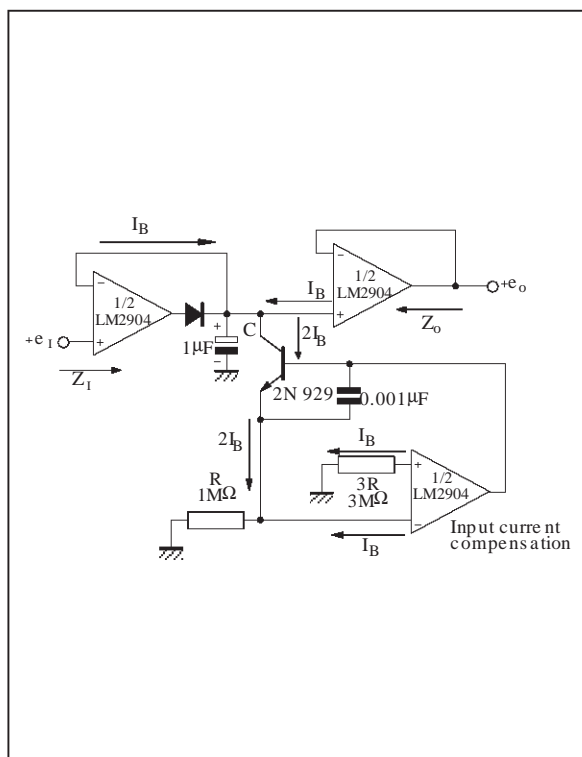
USING SYMMETRICAL AMPLIFIERS TO REDUCE INPUT CURRENT



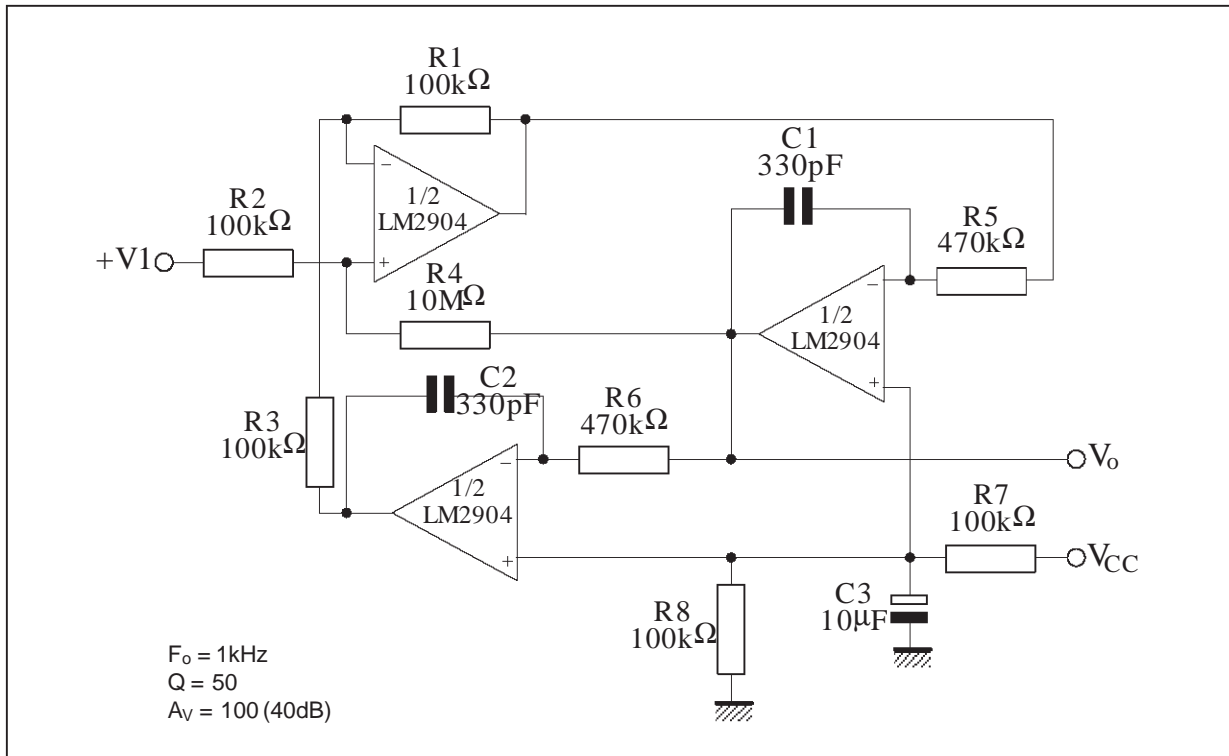
HIGH INPUT Z ADJUSTABLE GAIN DC INSTRUMENTATION AMPLIFIER



LOW DRIFT PEAK DETECTOR

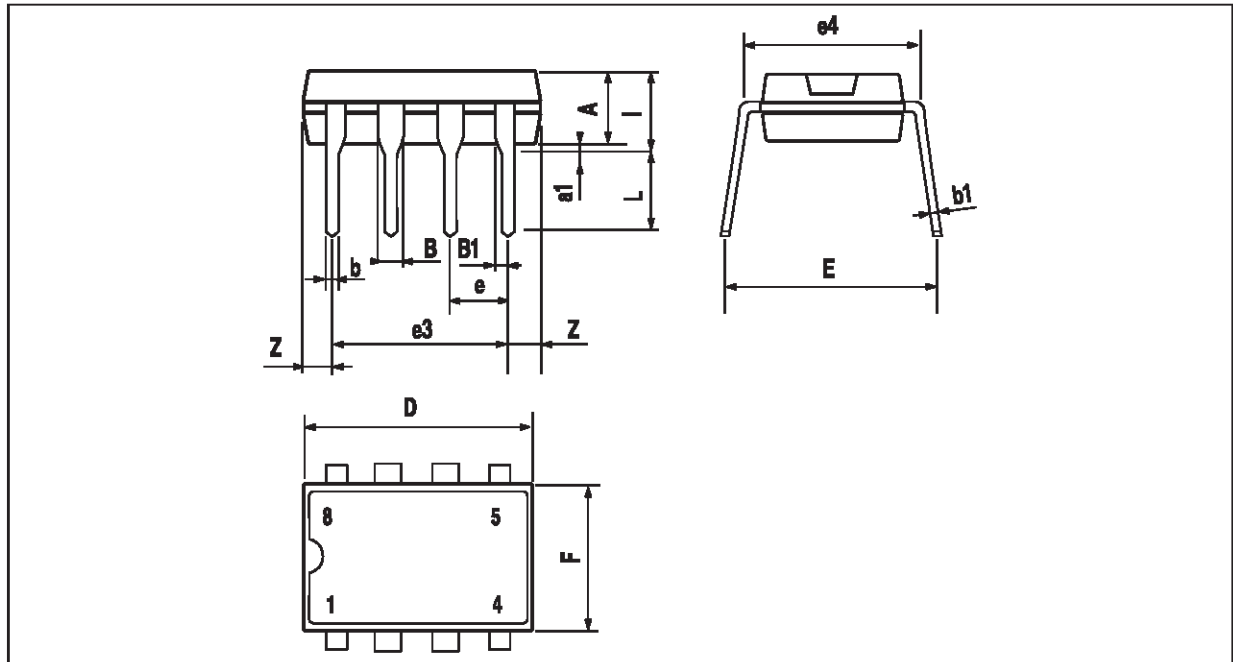


ACTIVE BAND-PASS FILTER



LM2904

PACKAGE MECHANICAL DATA 8 PINS - PLASTIC DIP

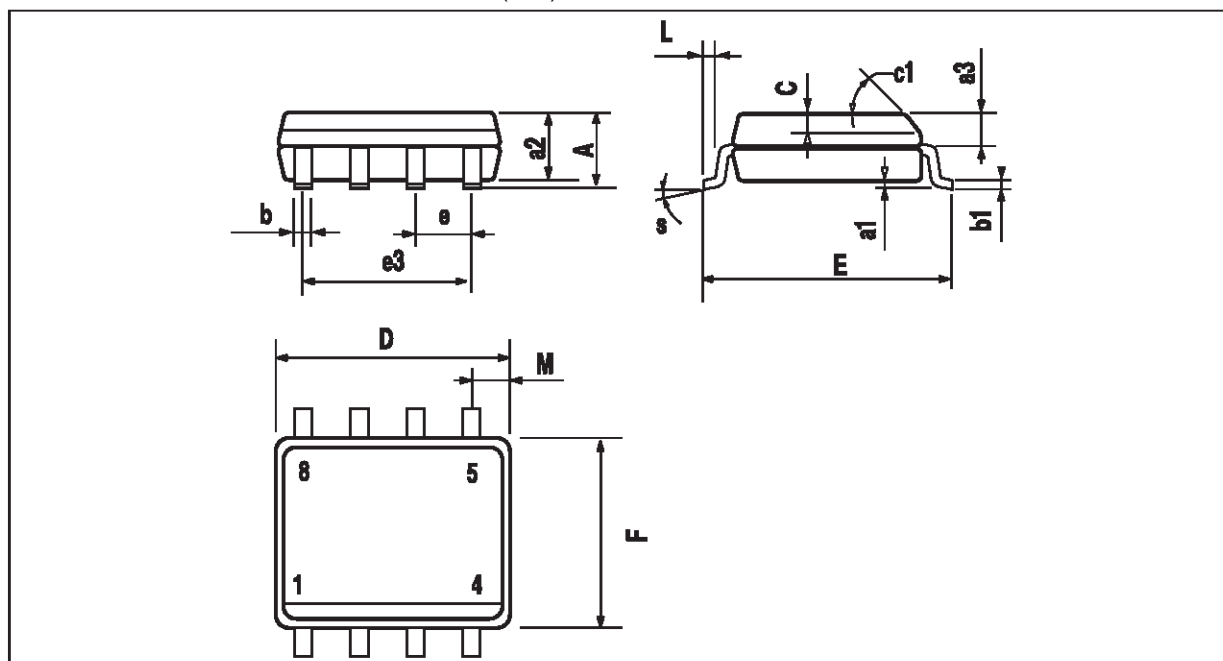


PM-DIP8.EPS

| 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 | | | 0.260 |
| 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)



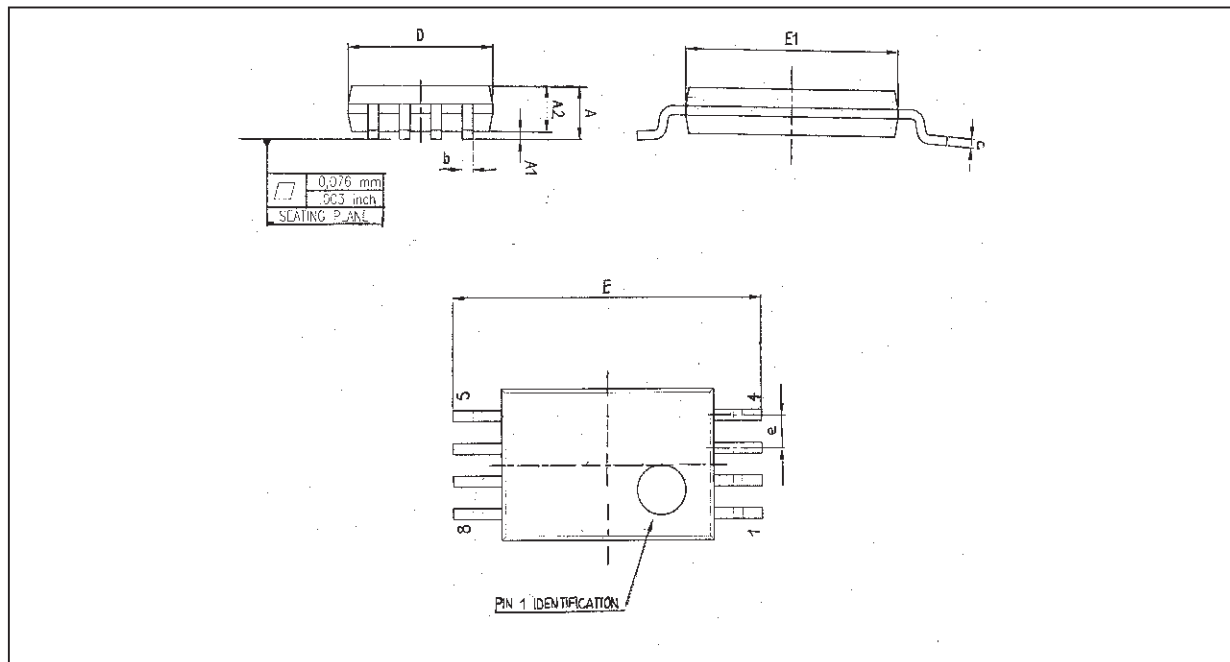
PM-SO8.EPS

| 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

PACKAGE MECHANICAL DATA
8 PINS - THIN SHRINK SMALL OUTLINE PACKAGE

PREVIEW



| 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 | 2.90 | 3.00 | 3.10 | 0.114 | 0.118 | 0.122 |
| 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 trademark of STMicroelectronics

© 1999 STMicroelectronics – Printed in Italy – All Rights Reserved
 STMicroelectronics GROUP OF COMPANIES

Australia - Brazil - Canada - China - France - Germany - Italy - Japan - Korea - Malaysia - Malta - Mexico - Morocco
 The Netherlands - Singapore - Spain - Sweden - Switzerland - Taiwan - Thailand - United Kingdom - U.S.A.

ORDER CODE:



This datasheet has been download from:

www.datasheetcatalog.com

Datasheets for electronics components.