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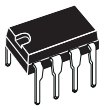
LM2904W

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 (500µA)
- 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)
- ESD INTERNAL PROTECTION : **2kV**



N
DIP8
(Plastic Package)

D
SO8
(Plastic Micropackage)

P
TSSOP8
(Thin Shrink Small Outline Package)

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 ssystems. 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.

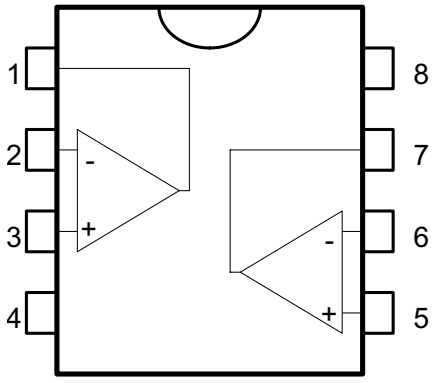
In the linear mode the input common-mode voltage range includes ground and the output voltage can also swing to groung, even though operated from only a single power supply voltage.

ORDER CODE

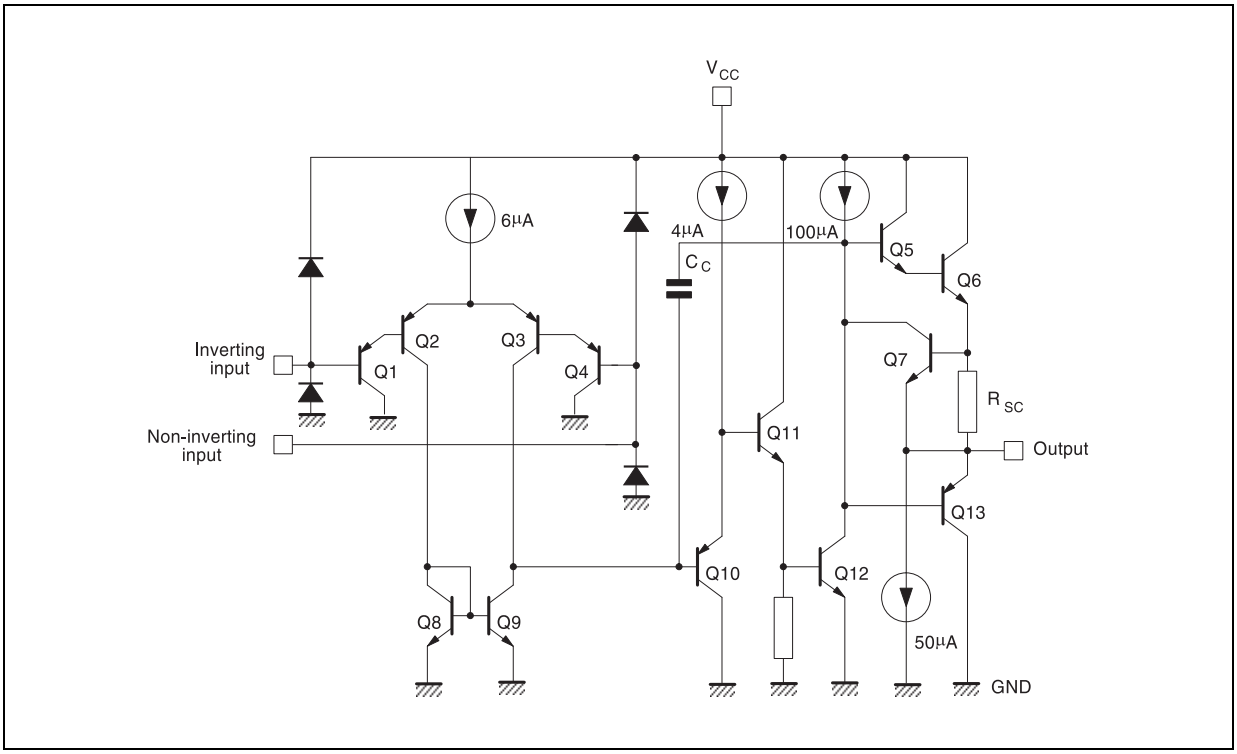
Part Number	Temperature Range	Package		
		N	D	P
LM2904W	-40°C, +125°C	•	•	•

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)



SCHEMATIC DIAGRAM (1/2 LM2904W)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	+32	V
V_{id}	Differential Input Voltage	-0.3v to Vcc + 0.3	V
V_I	Input Voltage	-0.3v to Vcc + 0.3	V
ESD	Human Body Model 3)	2	kV
	Output Short-circuit Duration 1)	Infinite	s
p_{tot}	Power Dissipation	500	mW
I_{in}	Input Current 2)	50	mA
T_{oper}	Operating Free-Air Temperature Range	-40 to +125	°C
T_{stg}	Storage Temperature Range	-65 to +150	°C

1. Short-circuits from the output to V_{cc} can cause excessive heating if Vcc^+ > 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.
2. This input current only exists 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 diodes 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 than an input is driven negative.
   This is not destructive and normal output will set up again for input voltage higher than -0.3V
3) Human body model, 100pF discharged through a 1.5KΩ resistor, into pin to pin of device.

OPERATING CONDITIONS

Symbol	Parameter	Value	Unit
V_{CC}^+	Supply Voltage	3 to 30	V
V_{icm}	Common Mode Input Voltage Range	V_{CC}^+ - 1.5	V

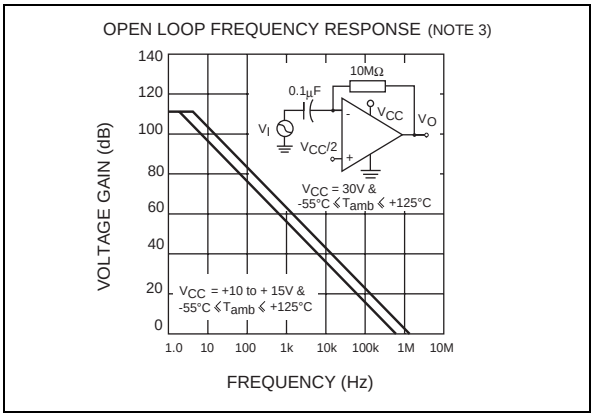
ELECTRICAL CHARACTERISTICS

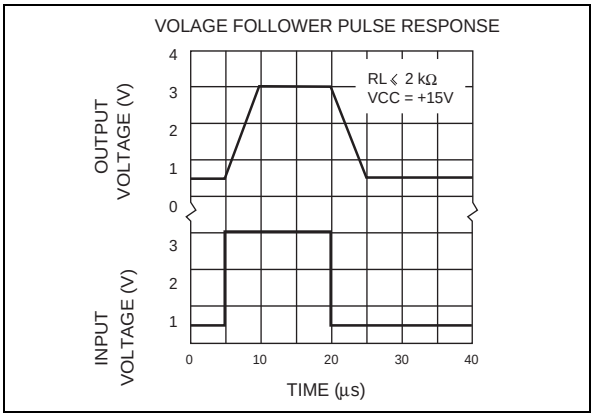
V_{CC}^+ = 5V, V_{cc}^- = Ground, V_O = 1.4V, T_{amb} = 25°C (unless otherwise specified)

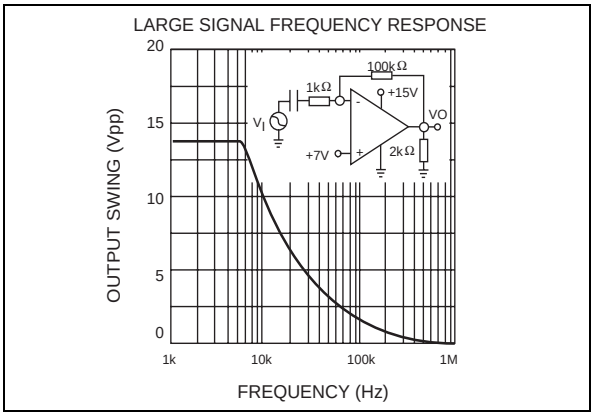
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage [1] T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$.		2	7 9	mV
I_{io}	Input Offset Current T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$.		2	30 40	nA
I_{ib}	Input Bias Current [2] T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$.		20	150 200	nA
A_{vd}	Large Signal Voltage Gain V_{CC}^+ = +15V,R_L=2kΩ, V_o = 1.4V to 11.4V T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$.	50 25	100		V/mV
SVR	Supply Voltage Rejection Ratio ($R_S \le$10kΩ) T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$.	65 65	100		dB
I_{cc}	Supply Current, all Amp, no load T_{amb} = 25°C V_{CC} = +5V $T_{min} \le T_{amb} \le T_{max}$. V_{CC} = +30V		0.7	1.2 2	mA
V_{icm}	Input Common Mode Voltage Range (V_{cc}= +30V)[3] T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$.	0 0		V_{CC}^+ -1.5 V_{CC}^+ -2	V
CMR	Common-mode Rejection Ratio (R_S = 10kΩ) T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$.	70 60	85		dB
I_{source}	Output Short-circuit Current V_{CC} = +15V, V_o = +2V, V_{id} = +1V	20	40	60	mA
I_{sink}	Output Sink Current V_O = 2V V_{CC} = +5V V_O = +0.2V V_{CC} = +15V	10 12	20 50		mA
V_{OPP}	Output Voltage Swing (R_L = 2kΩ T_{amb} = 25°C $T_{min} \le T_{amb} \le T_{max}$	0 0		V_{CC}^+ -1.5 V_{CC}^+ -2	V
V_{OH}	High Level Output Voltage (V_{cc} + 30V) T_{amb} = +25°C R_L = 2kΩ $T_{min} \le T_{amb} \le T_{max}$. T_{amb} = +25°C R_L = 10kΩ $T_{min} \le T_{amb} \le T_{max}$.	26 26 27 27	27 28		V
V_{OL}	Low Level Output Voltage (R_L = 10kΩ) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$		5	20 20	mV
SR	Slew Rate V_{cc} = 15V, Vi = 0.5 to 3V, R_L = 2kΩ, C_L = 100pF, unity gain	0.3	0.6		V/µs
GBP	Gain Bandwidth Product f = 100kHz V_{cc} = 30V,V_{in} = 10mV, R_L = 2kΩ, C_L = 100pF	0.7	1.1		MHz

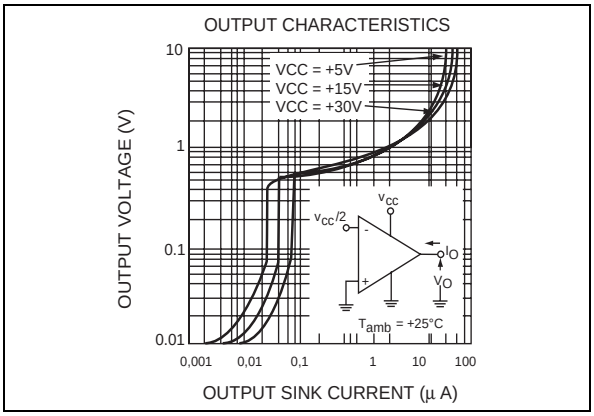
Symbol	Parameter	Min.	Typ.	Max.	Unit
THD	Total Harmonic Distortion f = 1kHz, A_V = 20dB, R_L = 2kΩ, V_o = 2Vpp, C_L = 100pF, V_{cc} = 30V		0.02		%
DV_{io}	Input Offset Voltage Drift		7	30	µV/°C
DI_{io}	Input Offset Current Drift		10	300	pA/°C
V_{O1}/V_{O2}	Channel Separation [4] 1kHz ≤ f ≤ 20kHz		120		dB

1. V_O = 1.4V, R_S = 0Ω, 5V < V_{CC}^+ < 30V, 0V < V_{ic} < V_{CC}^+ - 1.5V
2. 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 charge change exists on the input lines
3. 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.
4. 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 frequences.

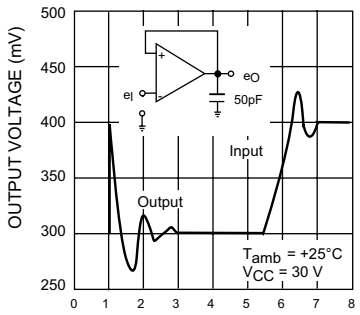




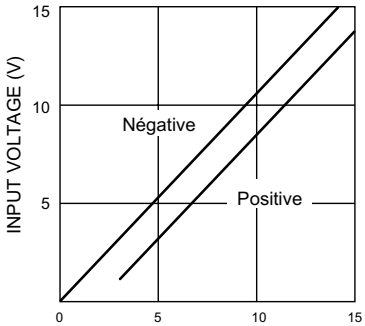




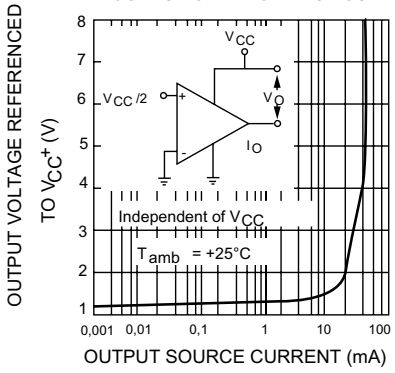
VOLTAGE FOLLOWER PULSSE RESPONSE
(SMALL SIGNAL)



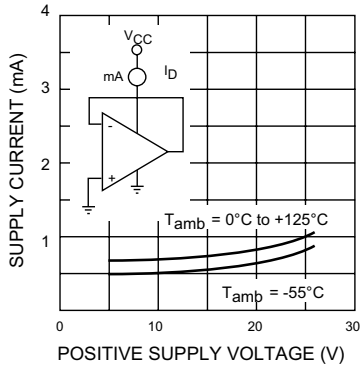
INPUT VOLTAGE RANGE



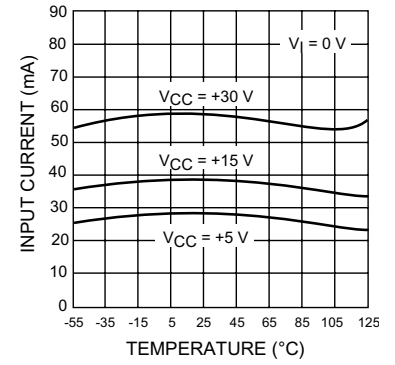
OUTPUT CHARACTERISTICS

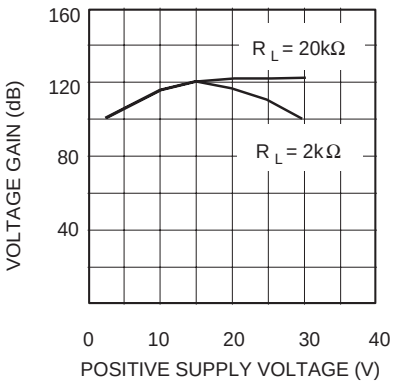


SUPPLY CURRENT

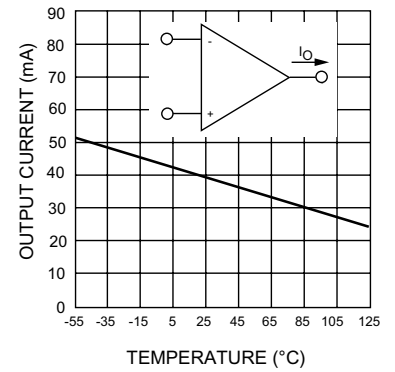


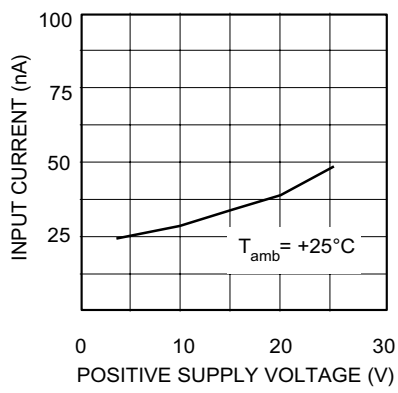
INPUT CURRENT (Note 1)

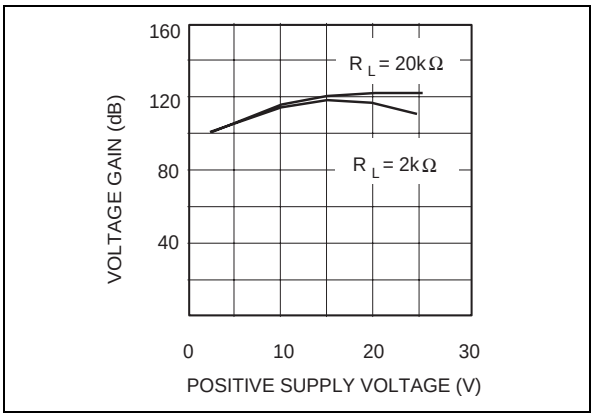


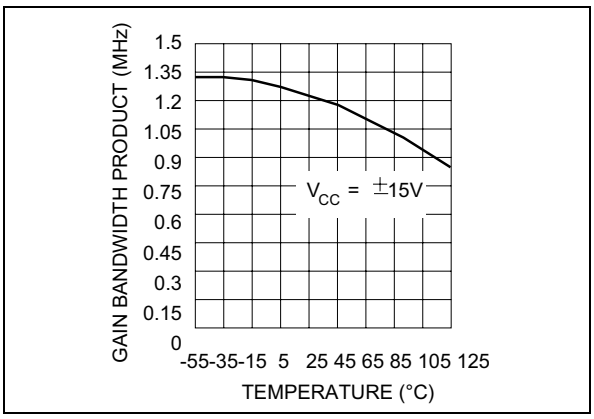


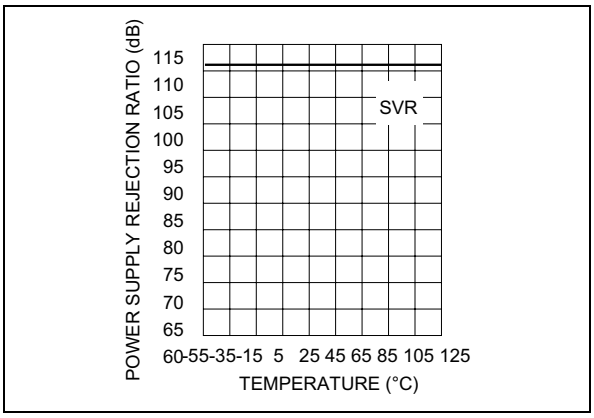
CURRENT LIMITING (Note 1)

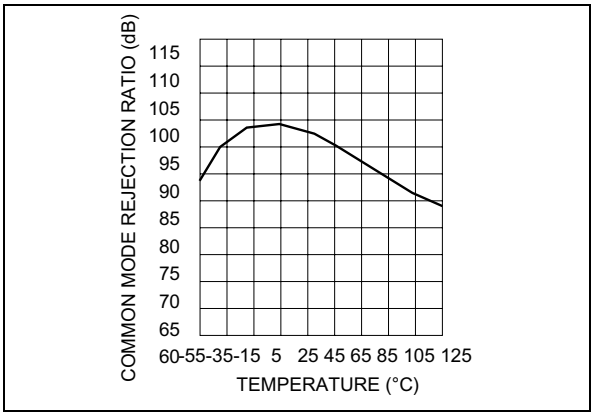






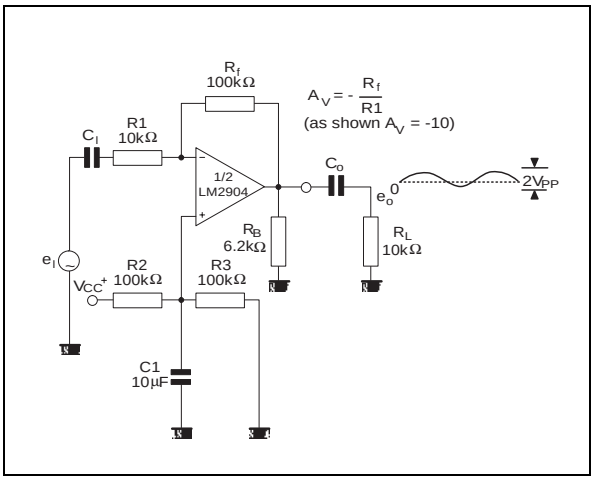




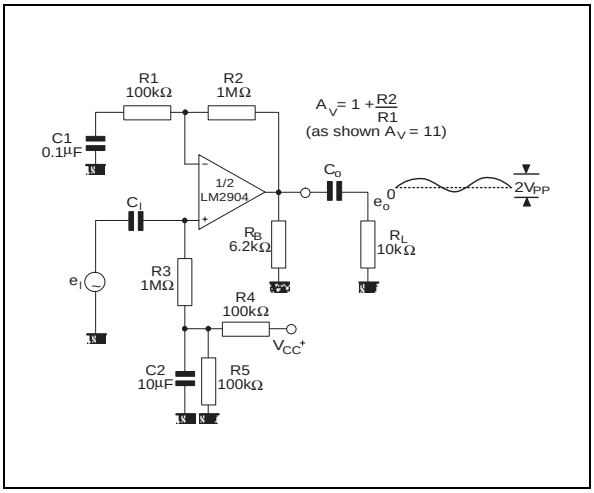


TYPICAL SINGLE - SUPPLY APPLICATIONS

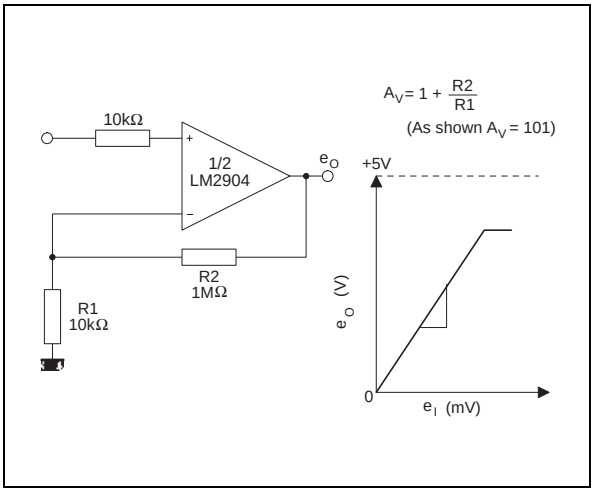
AC COUPLED INVERTING AMPLIFIER



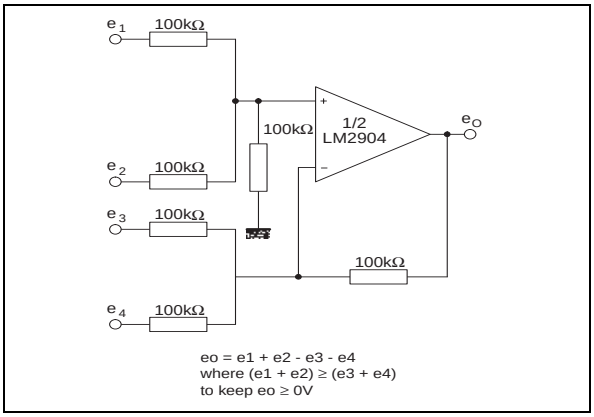
AC COUPLED NON-INVERTING AMPLIFIER



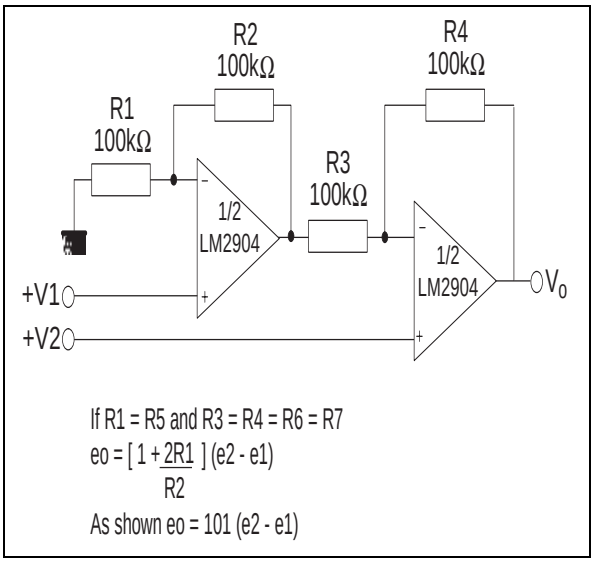
NON-INVERTING DC GAIN



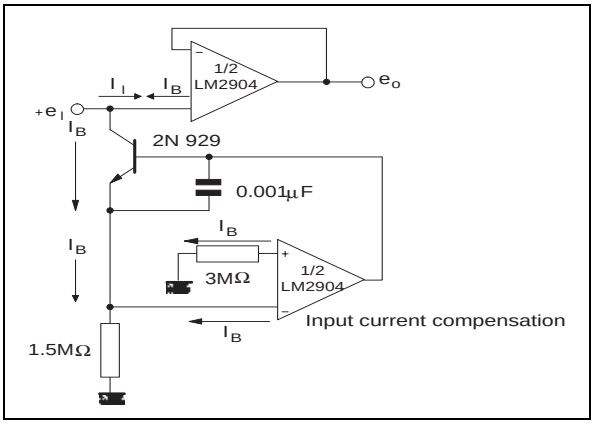
DC SUMMING AMPLIFIER



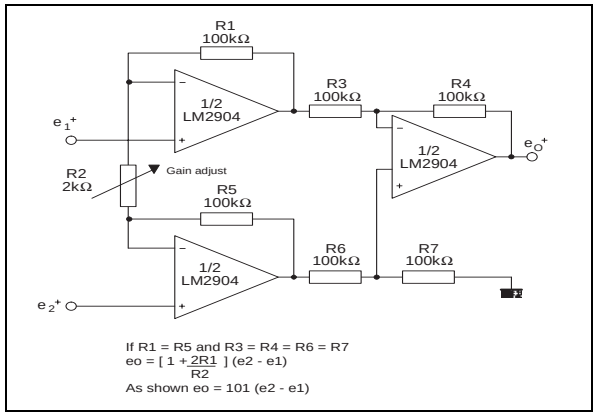
HIGH INPUT Z, DC DIFFERENTIAL AMPLIFIER



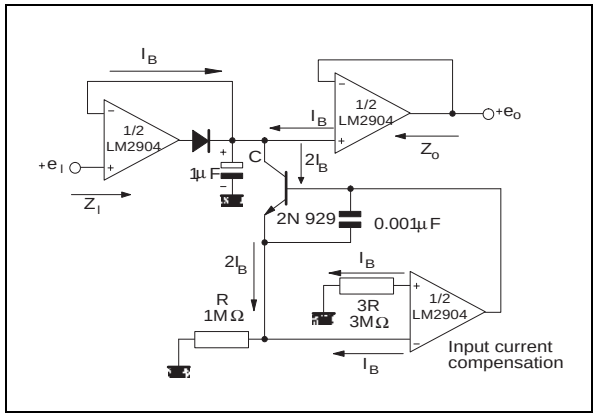
USING SYMMETRICAL AMPLIFIERS TO REDUCE INPUT CURRENT



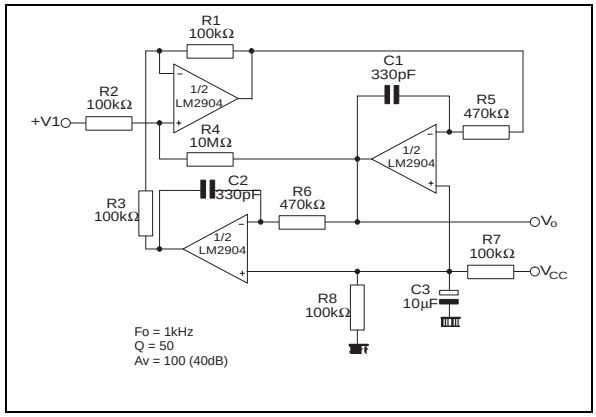
HIGH INPUT Z ADJUSTABLE GAIN DC INSTRUMENTATION AMPLIFIER



LOW DRIFT PEAK DETECTOR

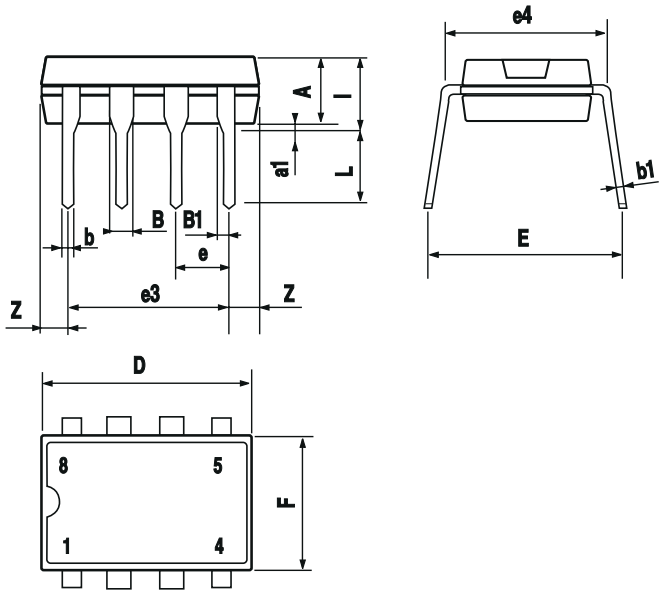


ACTIVER BADPASS FILTER



PACKAGE MECHANICAL DATA

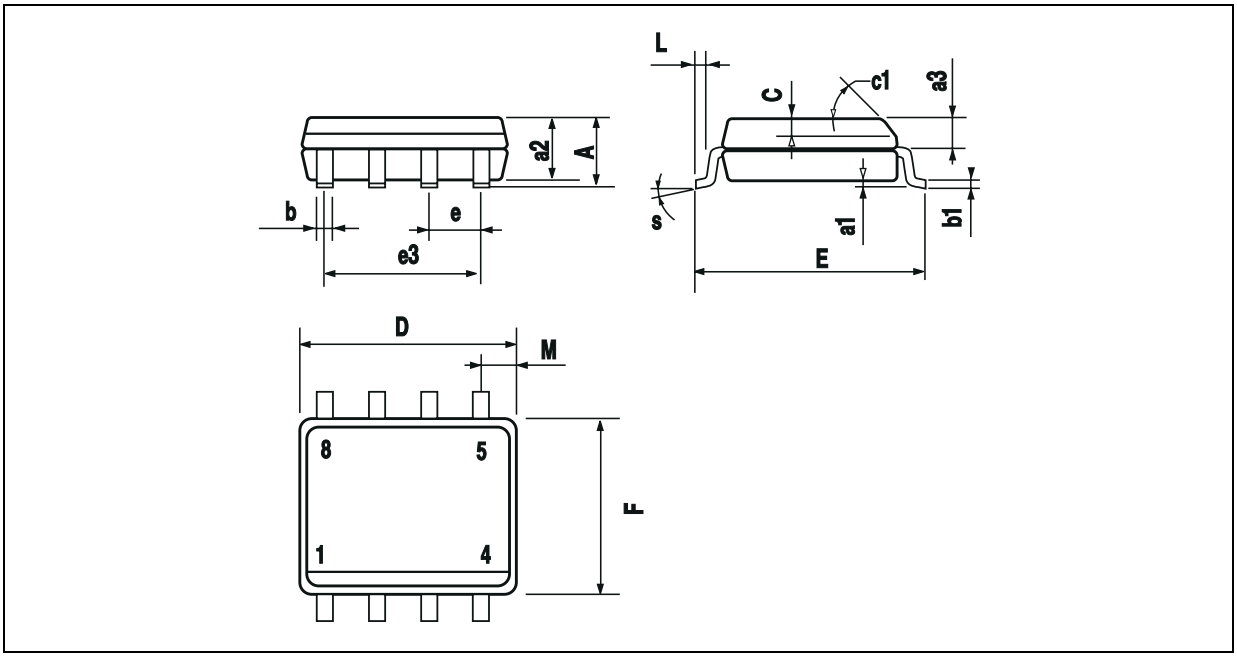
8 PINS - PLASTIC DIP



Dim.	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			0260
i			5.08			0.200
L	3.18		3.81	0.125		0.150
Z			1.52			0.060

PACKAGE MECHANICAL DATA

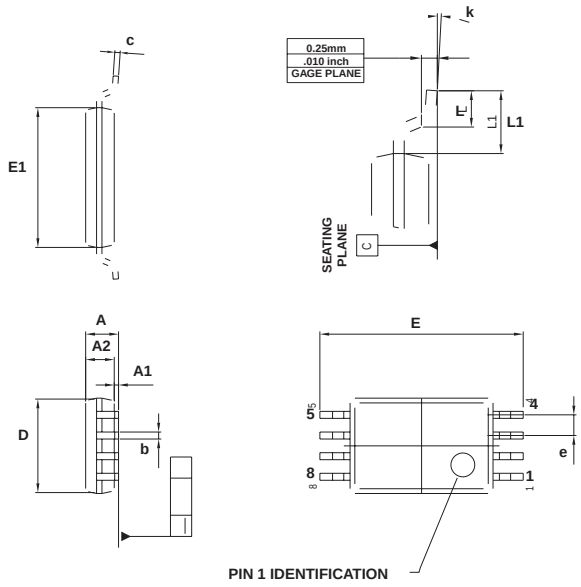
8 PINS - PLASTIC MICROPACKAGE (SO)



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.)					

PACKAGE MECHANICAL DATA

8 PINS -THIN SHRINK SMALL OUTLINE PACKAGE



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
L	0.45	0.600	0.75	0.018	0.024	0.030
L1		1.000			0.039	

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