

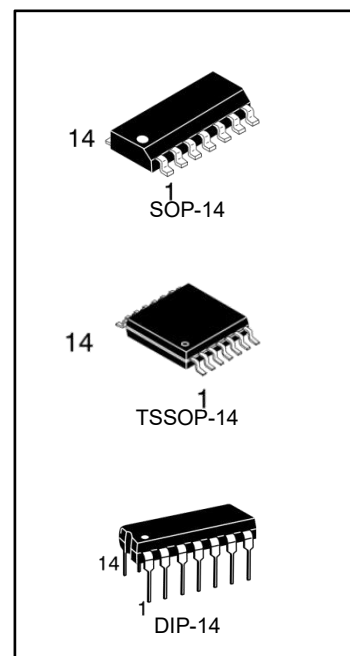
## LOW POWER QUAD OPERATIONAL AMPLIFIER

### DESCRIPTION

This circuit consists of four independent, high gain, internally frequency compensated operational amplifiers which were designed specially for automotive and industrial control systems. It operates from a single power supply over a wide range of voltages. Operation from split power supplies is also possible and the low power supply current drain is independent of the magnitude of the power supply voltage.

### FEATURES

- Wide Gain Bandwidth: 1.3Mhz
- Input Common-Mode Voltage Range Includes Ground
- Large Voltage Gain: 100dB
- Very Low Supply Current/Ampli: 375μA
- Low Input Bias Current: 20nA
- Low Input Offset Current: 2nA
- Wide Power Supply Range: Single Supply: +3V To +30V
- Dual Supplies: ±1.5V To ±15V

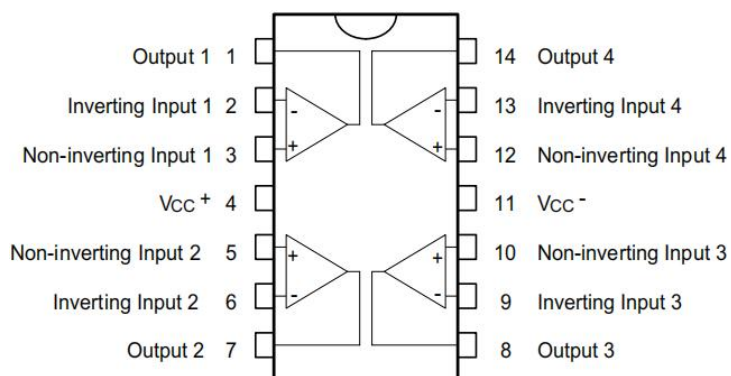
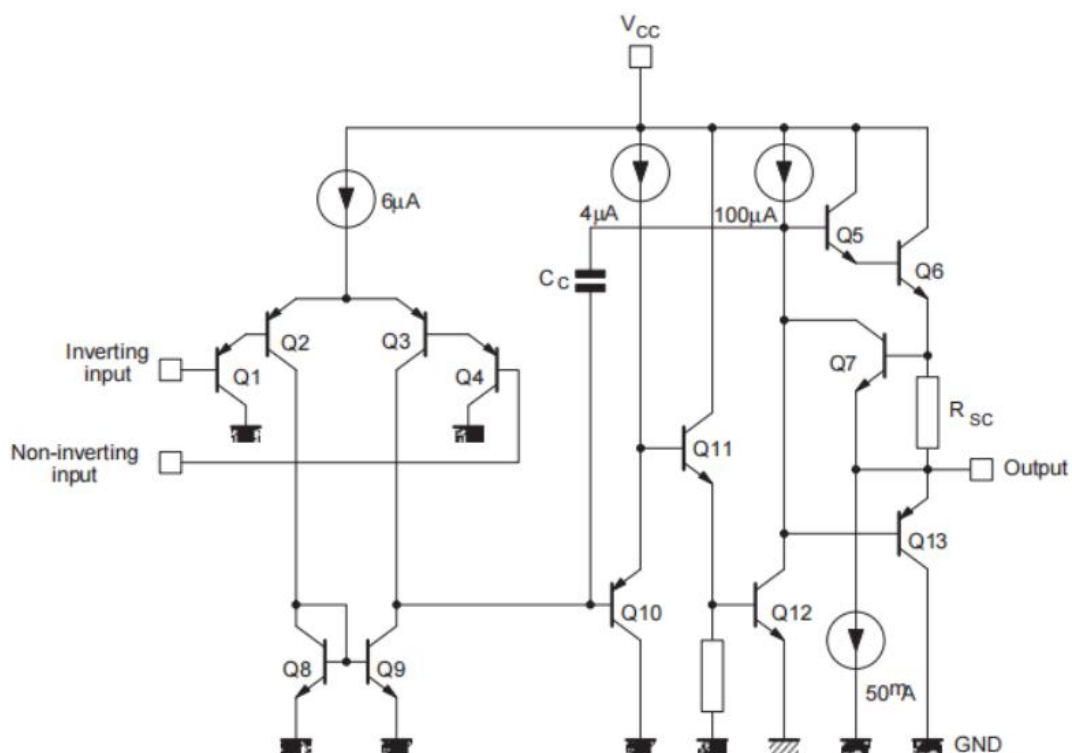


### ORDERING INFORMATION

DEVICE	Package Type	MARKING	Packing	Packing Qty
LM2902PG	DIP-14	LM2902	TUBE	1000/box
LM2902DRG	SOP-14	LM2902	REEL	2500/reel
LM2902DRG4	SOP-14	LM2902	REEL	4000/reel
LM2902PWRG	TSSOP-14	LM2902	REEL	2500/reel

**PIN CONNECTIONS** (top view)

DIP-14/SOP-14/TSSOP- 14


**SCHEMATIC DIAGRAM** (1/4 LM2902)


**ABSOLUTE MAXIMUM RATINGS <sup>(1)</sup>**

Symbol	Parameter	Value	Unit
V <sub>CC</sub>	Supply Voltage	±16 to 32	V
V <sub>id</sub>	Differential Input Voltage	+32	V
V <sub>I</sub>	Input Voltage	-0.3 to +32	V
	Output Short-circuit to Ground <sup>2)</sup>	Infinite	
P <sub>tot</sub>	Power Dissipation N Suffix	500	mW
	D Suffix	400	
I <sub>in</sub>	Input Current <sup>3)</sup>	50	mA
T <sub>oper</sub>	Operating Free-Air Temperature Range	-40 to +85	°C
T <sub>stg</sub>	Storage Temperature Range	-65 to +150	°C
T <sub>L</sub>	Lead Temperature (Soldering, 10 seconds)	245	°C

1. Absolute Maximum Ratings indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is intended to be functional, but specific performance is not ensured.
2. Short-circuit from the output to VCC can cause excessive heating if VCC > 15V. The maximum output current is approximately 40mA independent of the magnitude of VCC. Destructive dissipation can result from simultaneous short-circuit on all amplifiers.
3. 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 VCC 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.

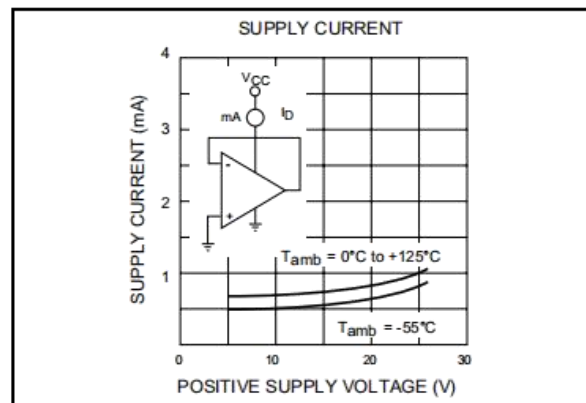
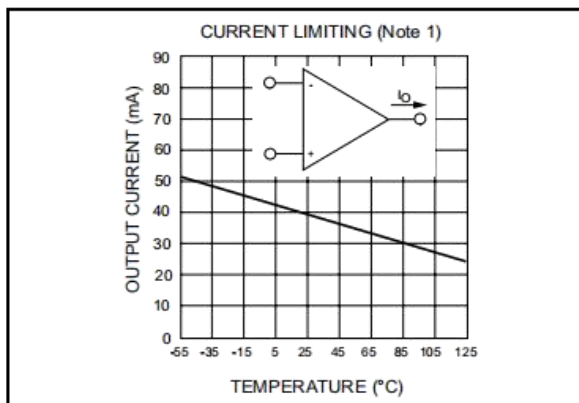
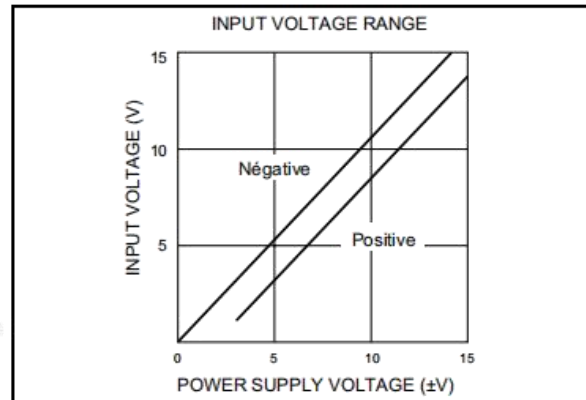
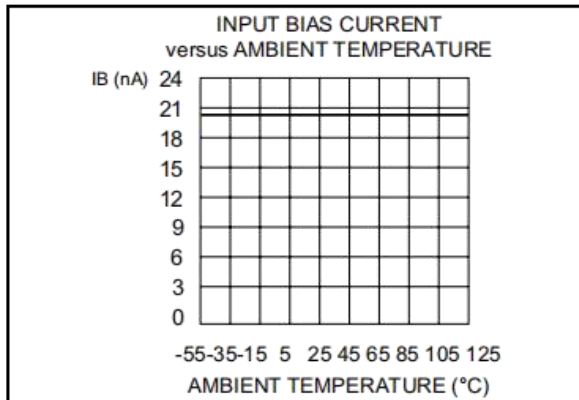
## ELECTRICAL CHARACTERISTICS

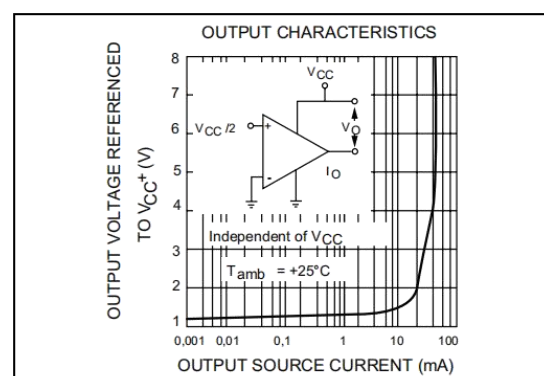
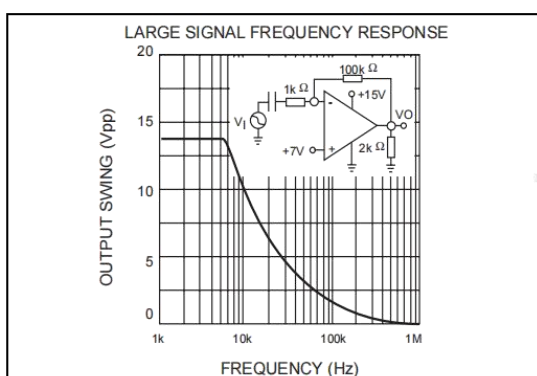
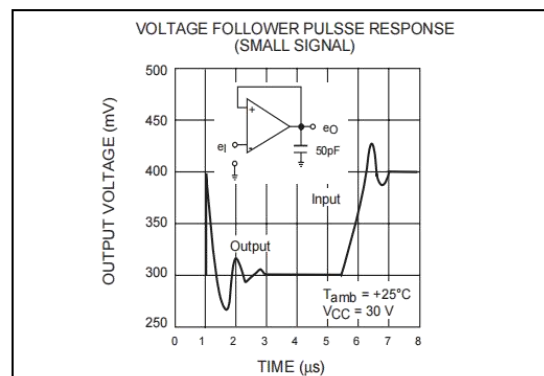
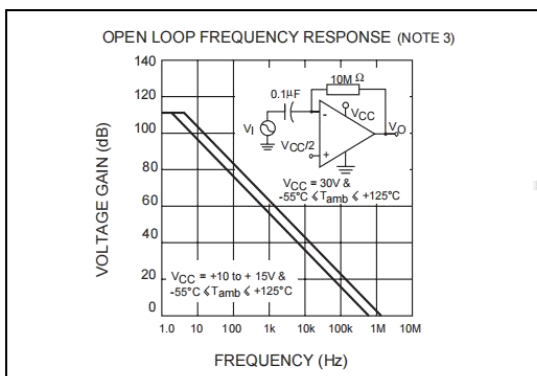
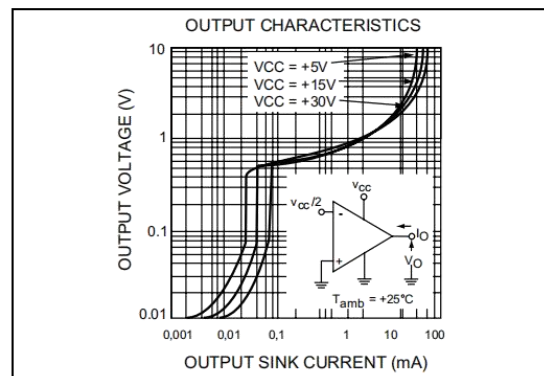
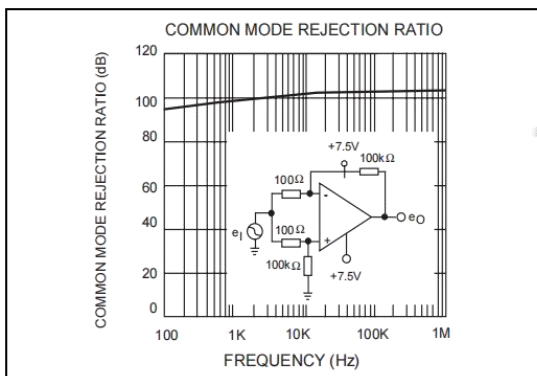
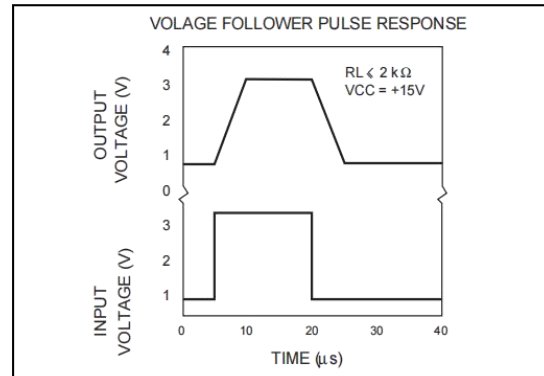
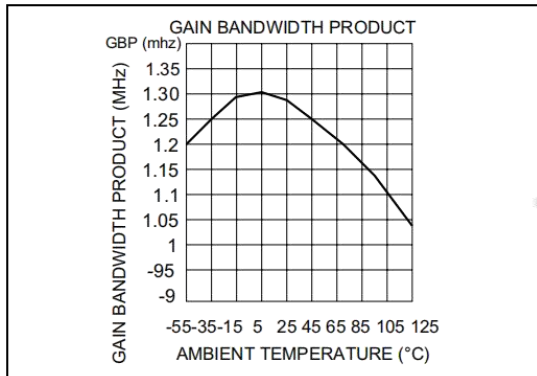
VCC+ = 5V, Vcc- = Ground, VO = 1.4V, Tamb = 25°C (unless otherwise specified)

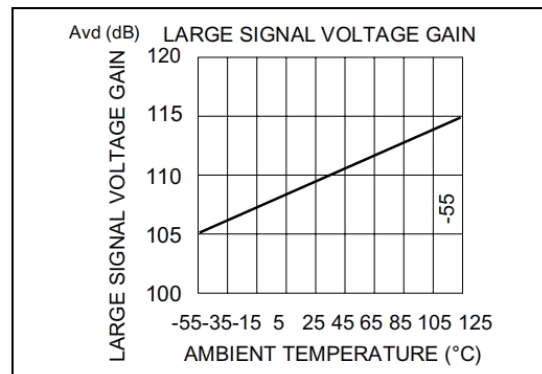
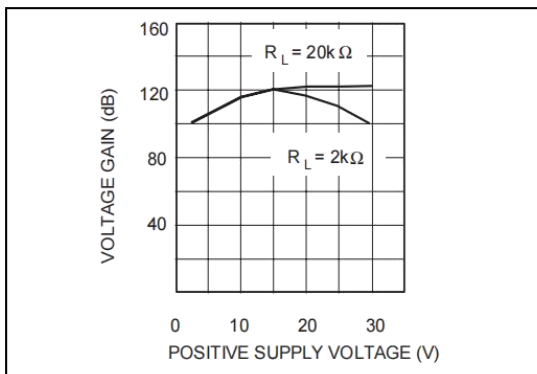
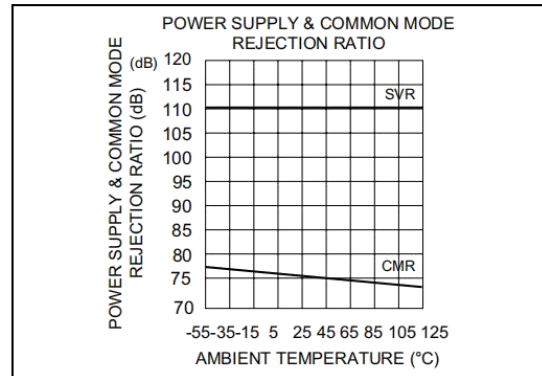
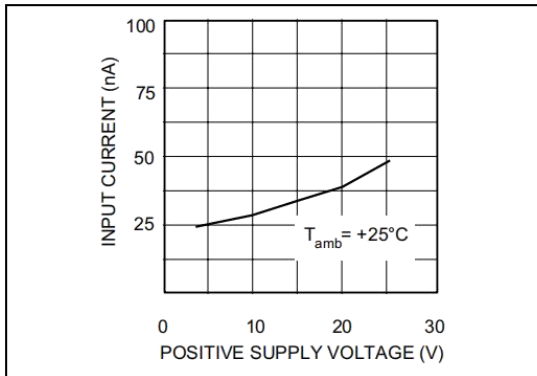
Symbol	Parameter	Min.	Typ.	Max.	Unit
Vio	Input Offset Voltage <sup>1)</sup> Tamb = +25°C Tmin ≤ Tamb ≤ Tmax.		2	7 9	mV
Iio	Input Offset Current Tamb = +25°C Tmin ≤ Tamb ≤ Tmax.		2	30 40	nA
Iib	Input Bias Current <sup>2)</sup> Tamb = +25°C Tmin ≤ Tamb ≤ Tmax.		20	150 300	nA
Avd	Large Signal Voltage Gain Vcc+ = +15V, RL = 2kΩ, VO = 1.4V to 11.4V Tamb = +25°C Tmin ≤ Tamb ≤ Tmax.	50 25	100		V/mV
SVR	Supply Voltage Rejection Ratio (RS ≤ 10kΩ) Tamb = +25°C Tmin ≤ Tamb ≤ Tmax.	65 65	110		dB
Icc	Supply Current, all Amp, no load Tamb = +25°C VCC = +5V Tmin ≤ Tamb ≤ Tmax. VCC = +30V VCC = +5V VCC = +30V		0.7 1.5 0.8 1.5	1.2 3 1.2 3	mA
Vicm	Input Common Mode Voltage Range (VCC = +30V) <sup>3)</sup> Tamb = +25°C Tmin ≤ Tamb ≤ Tmax.	0 0		VCC -1.5 VCC -2	V
CMR	Common-mode Rejection Ratio (RS ≤ 10kΩ) Tamb = +25°C Tmin ≤ Tamb ≤ Tmax.	70 60	80		dB
Io	Output Short-circuit Current (Vid = +1V) VCC = +15V, VO = +2V	20	40	70	mA
Isink	Output Sink Current (Vid = -1V) VCC = +15V, VO = +2V VCC = +15V, VO = +0.2V	10 12	20 50		mA μA
VOH	High Level Output Voltage (Vcc + 30V) Tamb = +25°C RL = 2kΩ Tmin ≤ Tamb ≤ Tmax. Tamb = +25°C RL = 10kΩ Tmin ≤ Tamb ≤ Tmax. (Vcc + 5V), RL = 2kΩ Tmin ≤ Tamb ≤ Tmax. Tamb = +25°C	26 26 27 27 3.5 3	27 28		V
VOL	Low Level Output Voltage (RL = 10kΩ) Tamb = +25°C Tmin ≤ Tamb ≤ Tmax		5	20 20	mV
SR	Slew Rate Vcc = 15V, Vi = 0.5 to 3V, RL = 2kΩ, CL = 100pF, unity gain		0.4		V/μs

Symbol	Parameter	Min.	Typ.	Max.	Unit
GBP	Gain Bandwidth Product $V_{cc} = 30V, V_{in} = 10mV, R_L = 2k\Omega, C_L = 100pF$		1.3		MHz
THD	Total Harmonic Distortion $f = 1kHz, A_v = 20dB, R_L = 2k\Omega, V_o = 2V_{pp}, C_L = 100pF, V_{cc} = 30V$		0.015		%
$e_n$	Equivalent Input Noise Voltage $f = 1kHz, R_s = 100\Omega, V_{cc} = 30V$		40		$\frac{nV}{\sqrt{Hz}}$
$DV_{io}$	Input Offset Voltage Drift		7	30	$\mu V/^{\circ}C$
$DI_{io}$	Input Offset Current Drift		10	200	$pA/^{\circ}C$
$V_{O1}/V_{O2}$	Channel Separation <sup>4)</sup> $1kHz \leq f \leq 20kHz$		120		dB

1.  $V_O = 1.4V, R_S = 0\Omega, 5V < V_{CC} < 30V, 0V < V_{ic} < V_{CC} - 1.5V$
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 frequencies.

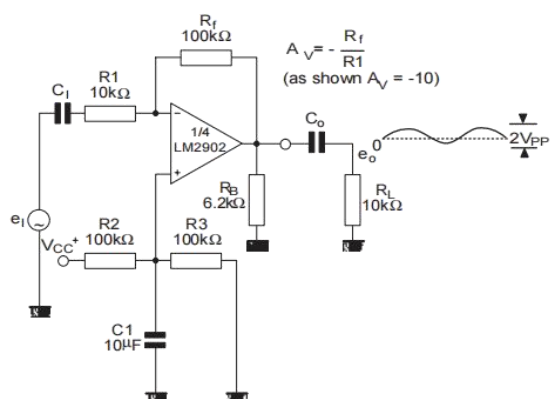




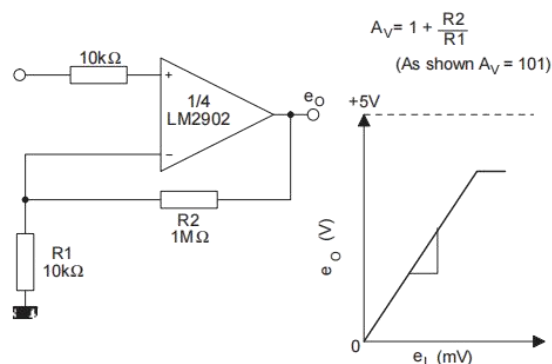


## TYPICAL SINGLE - SUPPLY APPLICATIONS

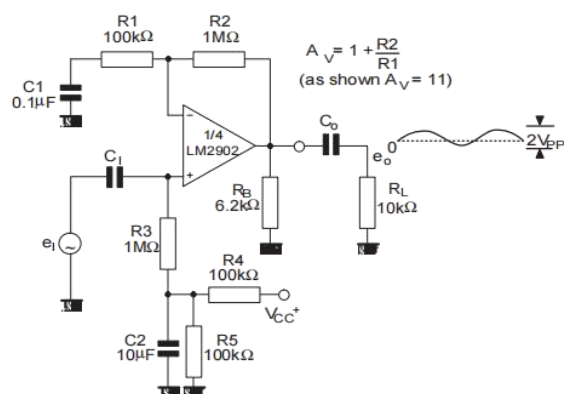
### AC COUPLED INVERTING AMPLIFIER



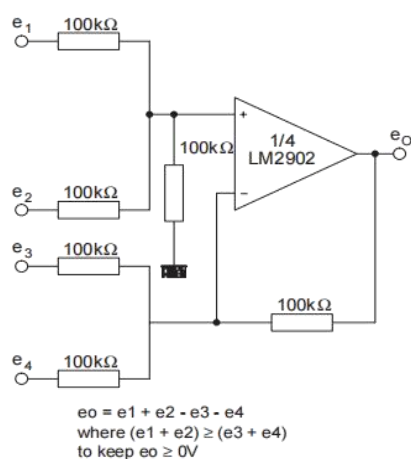
### NON-INVERTING DC GAIN



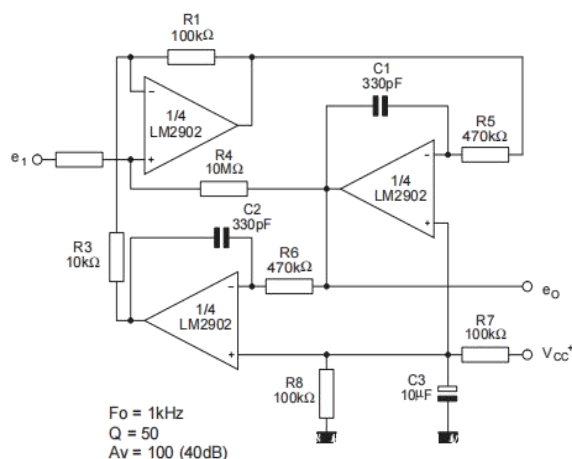
### AC COUPLED NON-INVERTING AMPLIFIER



### DC SUMMING AMPLIFIER

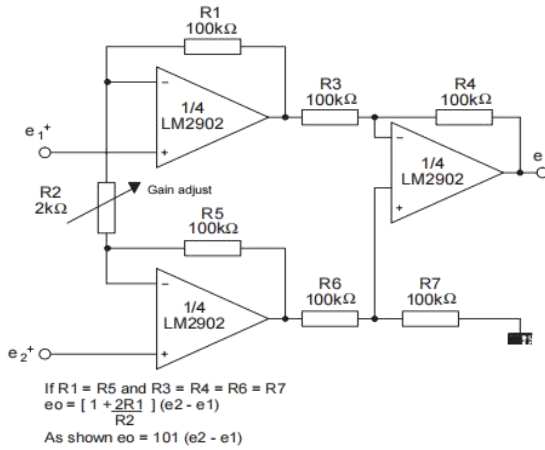


### ACTIVER BADPASS FILTER

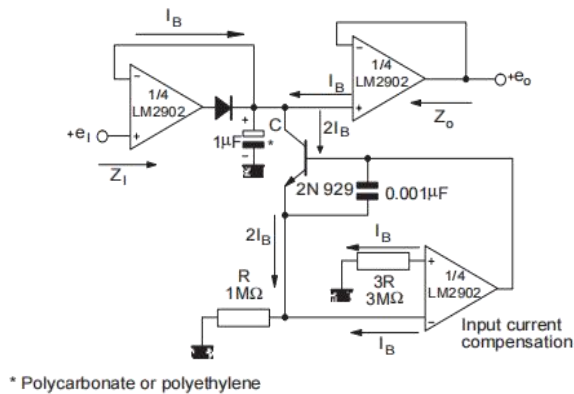




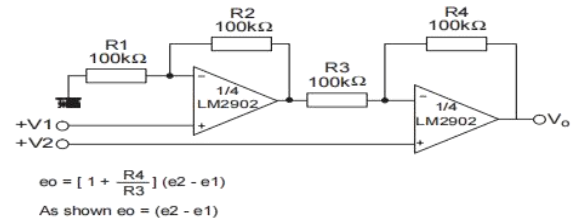
## HIGH INPUT Z ADJUSTABLE GAIN DC INSTRUMENTATION AMPLIFIER



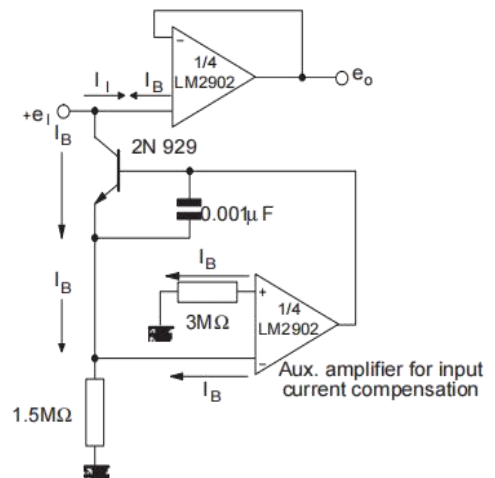
## LOW DRIFT PEAK DETECTOR



## HIGH INPUT Z, DC DIFFERENTIAL AMPLIFIER

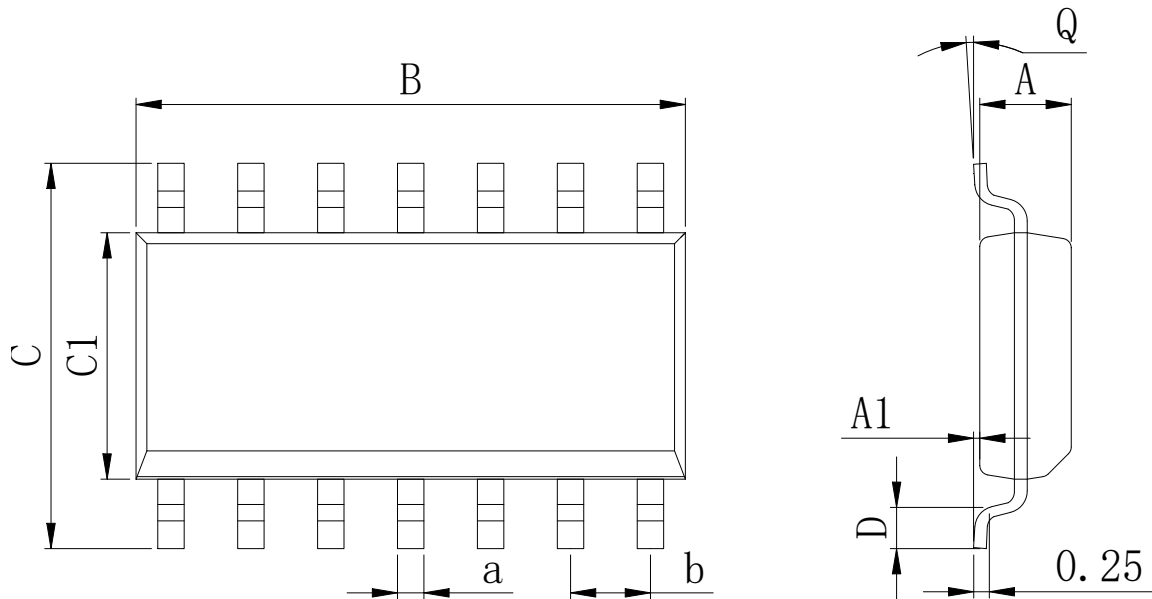


## USING SYMMETRICAL AMPLIFIERS TO REDUCE INPUT CURRENT (GENERAL CONCEPT)



## PHYSICAL DIMENSIONS

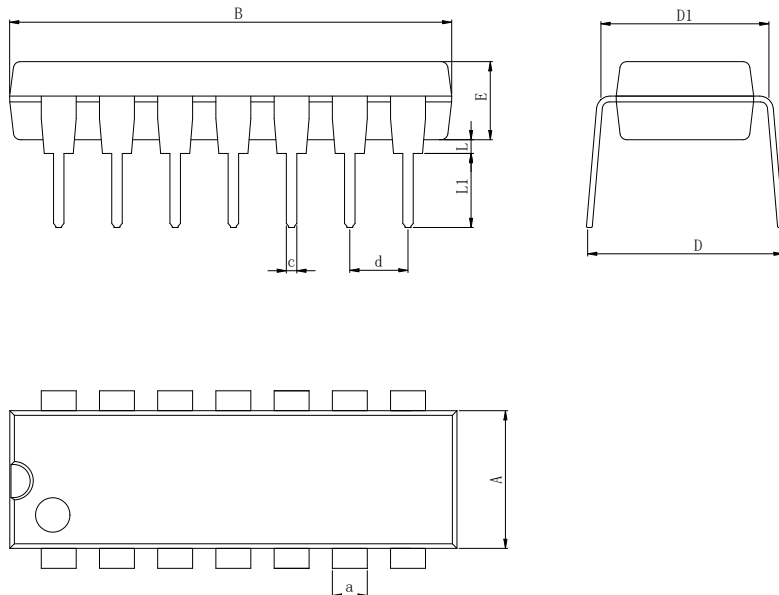
### SOP-14



**Dimensions In Millimeters(SOP-14)**

Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	1.35	0.05	8.55	5.80	3.80	0.40	0°	0.35	1.27 BSC
Max:	1.55	0.20	8.75	6.20	4.00	0.80	8°	0.45	

### DIP-14

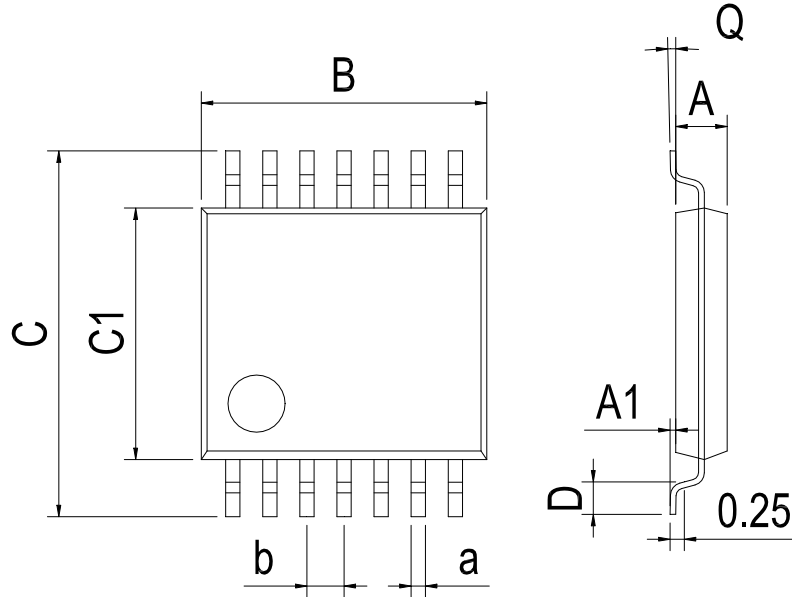


**Dimensions In Millimeters(DIP-14)**

Symbol:	A	B	D	D1	E	L	L1	a	c	d
Min:	6.10	18.94	8.10	7.42	3.10	0.50	3.00	1.50	0.40	2.54 BSC
Max:	6.68	19.56	10.9	7.82	3.55	0.70	3.60	1.55	0.50	

## PHYSICAL DIMENSIONS

TSSOP-14



**Dimensions In Millimeters(TSSOP-14)**

Symbol:	A	A1	B	C	C1	D	Q	a	b
Min:	0.85	0.05	4.90	6.20	4.30	0.40	0°	0.20	0.65 BSC
Max:	0.95	0.20	5.10	6.60	4.50	0.80	8°	0.25	

**REVISION HISTORY**

REVISION NUMBER	DATE	REVISION	PAGE
V1.0	2011-9	New	1-13
V1.1	2023-9	Update encapsulation type、Update Lead Temperature	1、 3

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