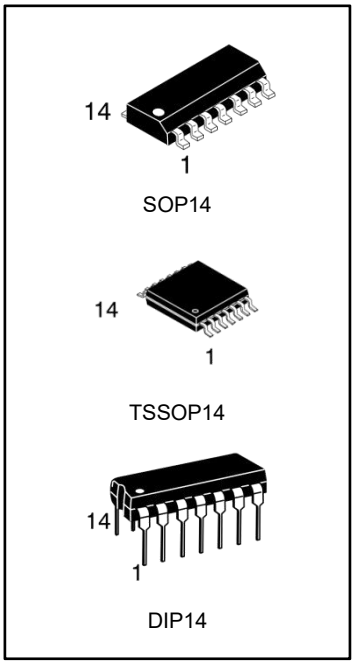
LOW POWER QUAD OPERATIONAL AMPLIFIER

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 pow- er supply voltage.



Features

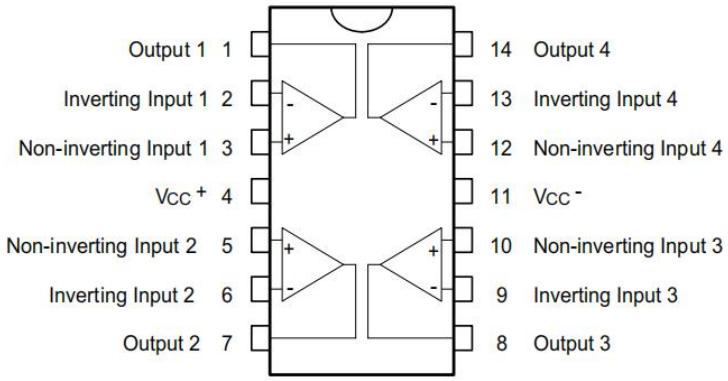
- WIDE GAIN BANDWIDTH: 1.3MHz
- INPUT COMMON-MODE VOLTAGE RANGE INCLUDES GROUND
- LARGE VOLTAGE GAIN: 100dB
- VERY LOW SUPPLY CURRENT/AMPLI: 375μA
- LOW INPUT BIAS CURRENT: 20nA
- LOW INPUT OFFSET CURRENT:2nA
- WIDE POWER SUPPLY RANGE: SINGLE SUPPLY: +3V TO +30V
- DUAL SUPPLIES: ±1.5V TO ±15V

ORDERING INFORMATION

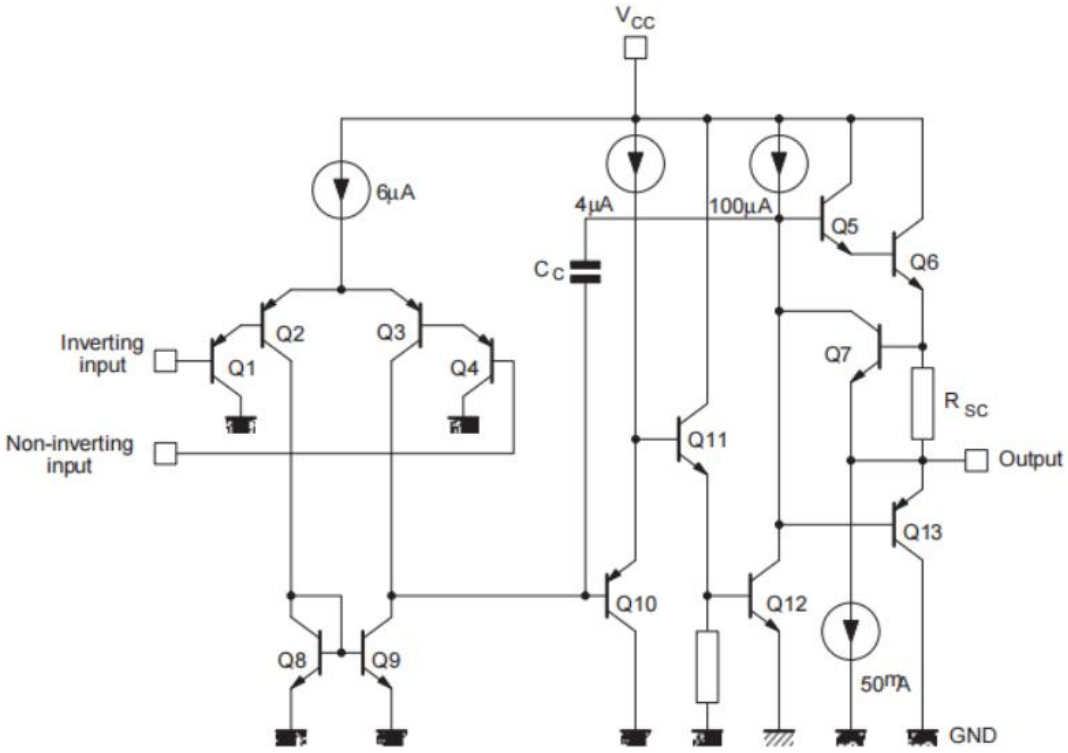
DEVICE	Package Type	MARKING	Packing	Packing Qty
LM2902PG	DIP14	LM2902	TUBE	1000/box
LM2902DRG	SOP14	LM2902	REEL	2500/reel
LM2902PWRG	TSSOP14	LM2902	REEL	2500/reel

PIN CONNECTIONS (top view)

DIP14/SOP14/TSSOP14



SCHEMATIC DIAGRAM (1/4 LM2902)



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Value	Unit
V_{CC}	Supply Voltage	±16 to 32	V
V_{id}	Differential Input Voltage	+32	V
V_I	Input Voltage	-0.3 to +32	V
	Output Short-circuit to Ground 1)	Infinite	
P_{tot}	Power Dissipation N Suffix D Suffix	500 400	mW
I_{in}	Input Current 2)	50	mA
T_{oper}	Operating Free-Air Temperature Range	-40 to +85	°C
T_{stg}	Storage Temperature Range	-65 to +150	°C

1. 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.
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 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.

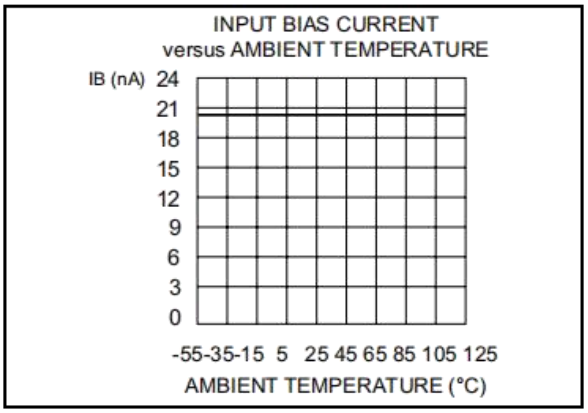
ELECTRICAL CHARACTERISTICS

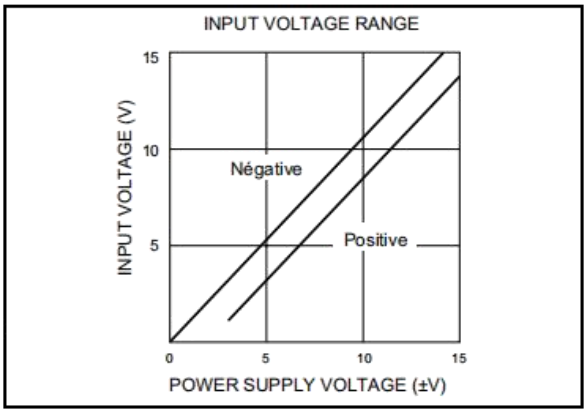
VCC+ = 5V, Vcc- = Ground, VO = 1.4V, Tamb = 25°C (unless otherwise specified)

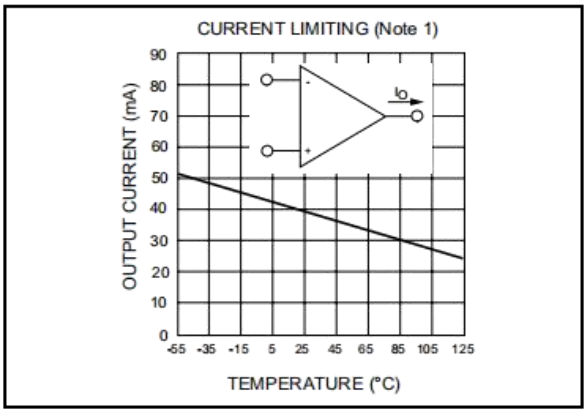
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage 1) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.		2	7 9	mV
I_{io}	Input Offset Current T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.		2	30 40	nA
I_{ib}	Input Bias Current 2) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.		20	150 300	nA
A_{vd}	Large Signal Voltage Gain V_{CC}^+ = +15V,RL =2kΩ, VO = 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	110		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 V_{CC}= +5V V_{CC} = +30V		0.7 1.5 0.8 1.5	1.2 3 1.2 3	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 ($R_S \le$ 10kΩ) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.	70 60	80		dB
I_O	Output Short-circuit Current(V_{id} = +1V) V_{CC} = +15V, V_O = +2V	20	40	70	mA
I_{sink}	Output Sink Current (V_{id} = -1V) V_{CC} = +15V, V_O = +2V V_{CC} = +15V, V_O = +0.2V	10 12	20 50		mA µA
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 $T_{min} \le T_{amb} \le T_{max}$. ($V_{cc}$ + 5V), R_L = 2kΩ $T_{min} \le T_{amb} \le T_{max}$. T_{amb} = +25°C	 26 26 27 27 3.5 3	 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		0.4		V/µs

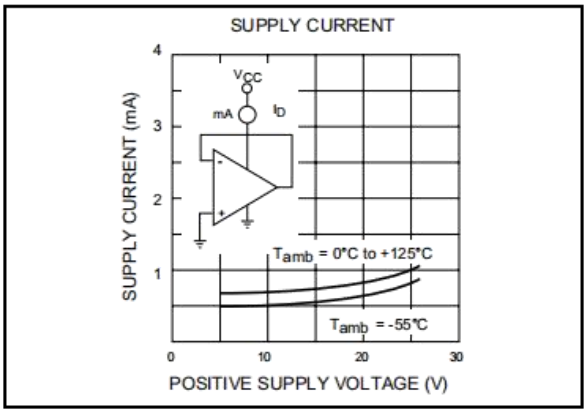
Symbol	Parameter	Min.	Typ.	Max.	Unit
GBP	Gain Bandwidth Product V_{cc} = 30V,V_{in} = 10mV, R_L = 2kΩ, C_L = 100pF		1.3		MHz
THD	Total Harmonic Distortion f = 1kHz, A_V = 20dB, R_L = 2kΩ, V_o = 2Vpp, C_L = 100pF, V_{cc} = 30V		0.015		%
e_n	Equivalent Input Noise Voltage f = 1kHz, R_S = 100Ω, V_{cc} = 30V		40		$\frac{nV}{\sqrt{Hz}}$
DV_{io}	Input Offset Voltage Drift		7	30	μV/°C
DI_{io}	Input Offset Current Drift		10	200	pA/°C
V_{O1}/V_{O2}	Channel Separation 4) 1kHz ≤ f ≤ 20kHz		120		dB

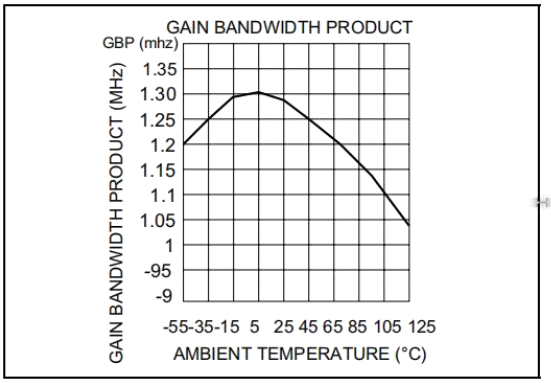
1. VO = 1.4V, RS = 0Ω, 5V < VCC + < 30V, 0V < Vic < V CC+ - 1.5V
2. The direction of the input current is out of the IC. This current is essentially constant, independent of the state of the output, so no loading charge change exists on the input lines
3. The input common-mode voltage of either input signal voltage should not be allowed to go negative by more than 0.3V. The upper end of the common-mode voltage range is VCC+ –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.

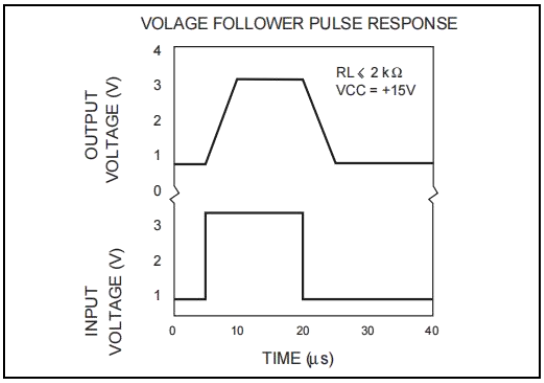


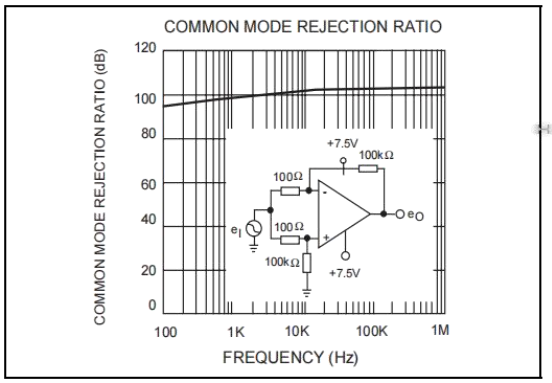


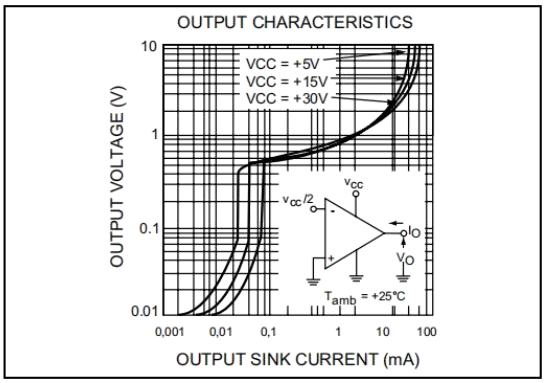


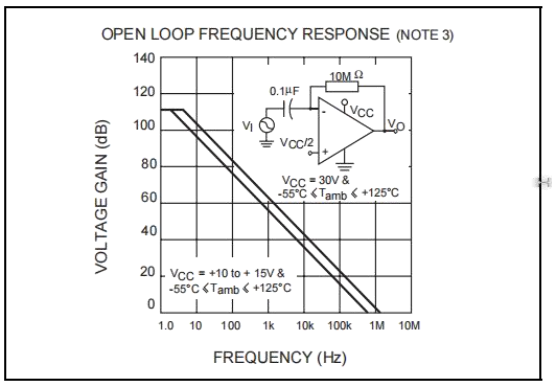


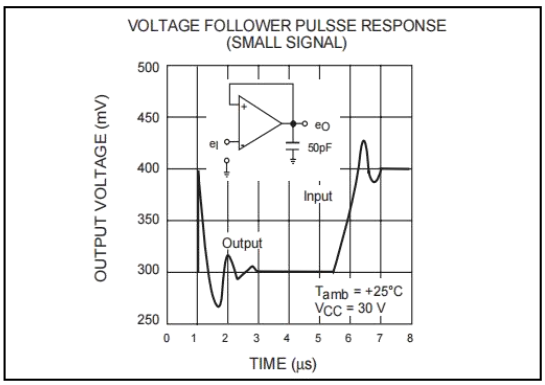

GAIN BANDWIDTH PRODUCT
GBP (mhz)
GAIN BANDWIDTH PRODUCT (MHz)
1.35
1.30
1.25
1.2
1.15
1.1
1.05
1
-95
-9
-55-35-15 5 25 45 65 85 105 125
AMBIENT TEMPERATURE (°C)

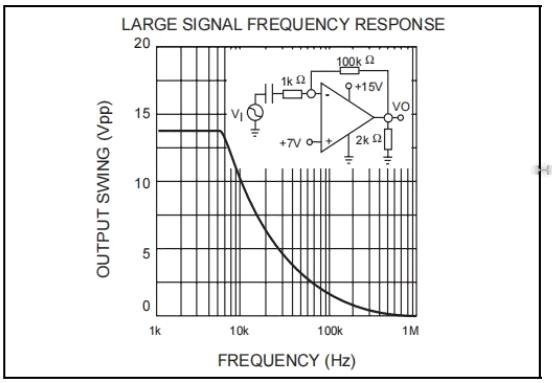

VOLAGE FOLLOWER PULSE RESPONSE
OUTPUT VOLTAGE (V)
INPUT VOLTAGE (V)
RL ≤ 2 kΩ
VCC = +15V
TIME (µs)

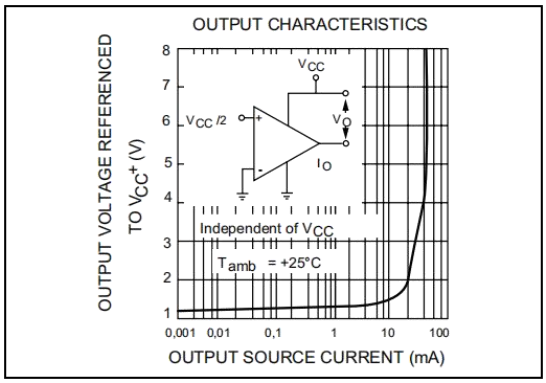

COMMON MODE REJECTION RATIO
COMMON MODE REJECTION RATIO (dB)
+7.5V
100kΩ
100Ω
100Ω
100kΩ
+7.5V
FREQUENCY (Hz)

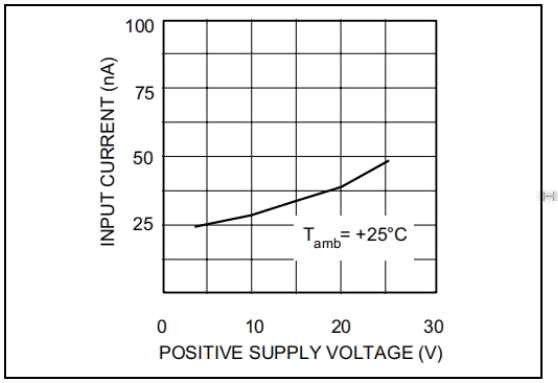

OUTPUT CHARACTERISTICS
VCC = +5V
VCC = +15V
VCC = +30V
OUTPUT VOLTAGE (V)
Tamb = +25°C
OUTPUT SINK CURRENT (mA)

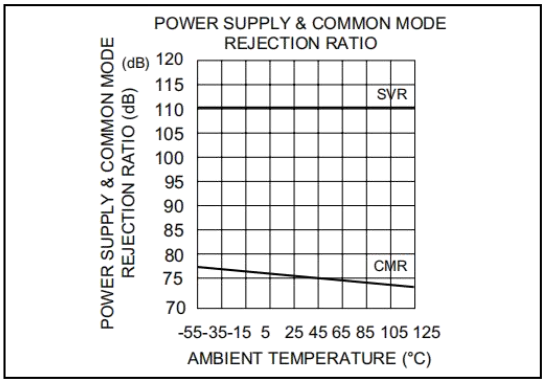

OPEN LOOP FREQUENCY RESPONSE (NOTE 3)
10MΩ
0.1µF
VCC/2
VCC = 30V &
-55°C ≤ Tamb ≤ +125°C
VCC = +10 to + 15V &
-55°C ≤ Tamb ≤ +125°C
VOLTAGE GAIN (dB)
FREQUENCY (Hz)

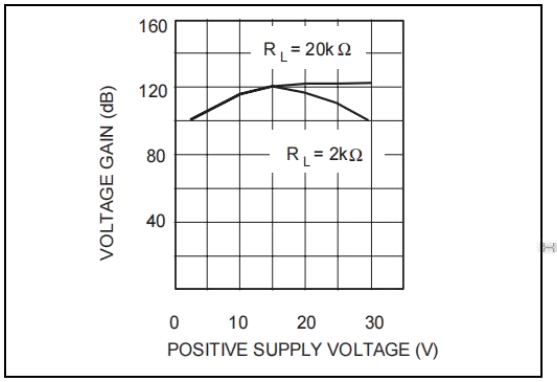

VOLTAGE FOLLOWER PULSSE RESPONSE
(SMALL SIGNAL)
50pF
Input
Output
Tamb = +25°C
VCC = 30 V
OUTPUT VOLTAGE (mV)
TIME (µs)

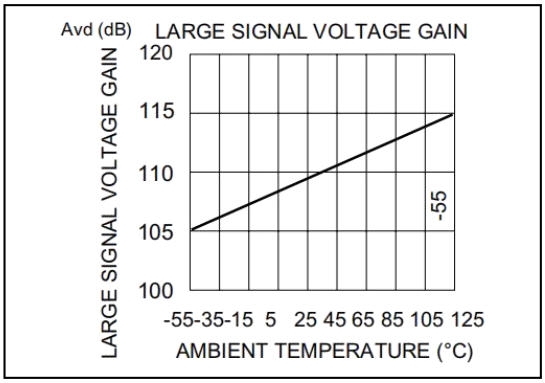

LARGE SIGNAL FREQUENCY RESPONSE
100k Ω
1k Ω
+15V
+7V
2k Ω
OUTPUT SWING (Vpp)
FREQUENCY (Hz)


OUTPUT CHARACTERISTICS
OUTPUT VOLTAGE REFERENCED TO VCC+ (V)
Independent of VCC
Tamb = +25°C
OUTPUT SOURCE CURRENT (mA)


INPUT CURRENT (nA)
100
75
50
25
T_{amb}= +25°C
0
10
20
30
POSITIVE SUPPLY VOLTAGE (V)

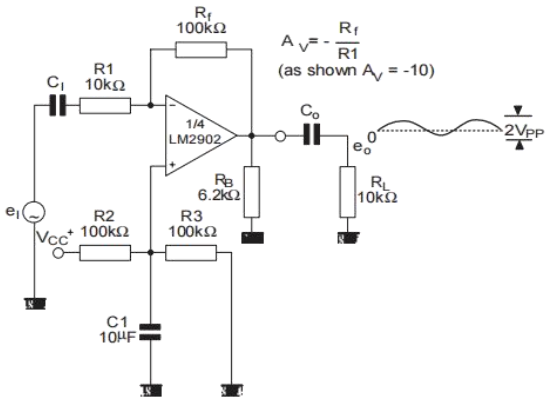

POWER SUPPLY & COMMON MODE REJECTION RATIO
POWER SUPPLY & COMMON MODE REJECTION RATIO (dB)
(dB)
120
115
110
105
100
95
90
85
80
75
70
SVR
CMR
-55-35-15 5 25 45 65 85 105 125
AMBIENT TEMPERATURE (°C)


VOLTAGE GAIN (dB)
160
120
80
40
R_L = 20kΩ
R_L = 2kΩ
0
10
20
30
POSITIVE SUPPLY VOLTAGE (V)

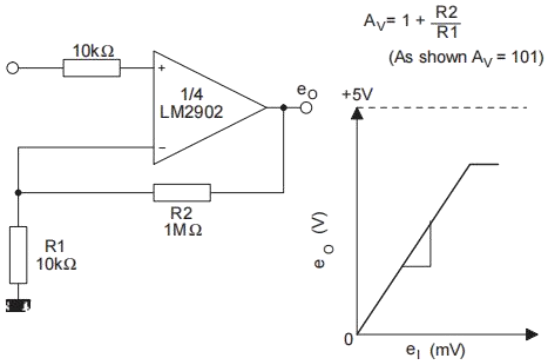

Avd (dB)
LARGE SIGNAL VOLTAGE GAIN
LARGE SIGNAL VOLTAGE GAIN
120
115
110
105
100
-55
-55-35-15 5 25 45 65 85 105 125
AMBIENT TEMPERATURE (°C)

TYPICAL SINGLE - SUPPLY APPLICATIONS

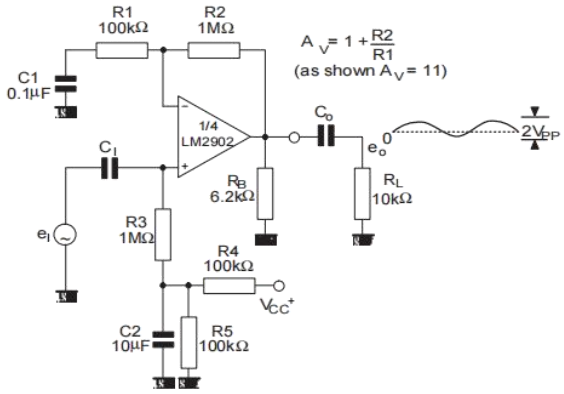
AC COUPLED INVERTING AMPLIFIER



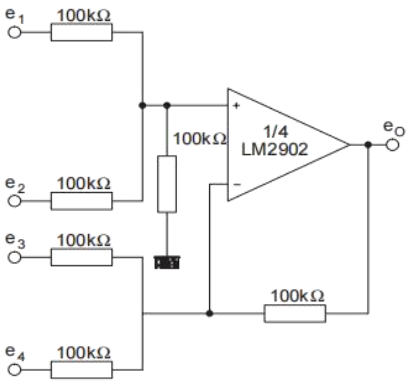
NON-INVERTING DC GAIN



AC COUPLED NON-INVERTING AMPLIFIER

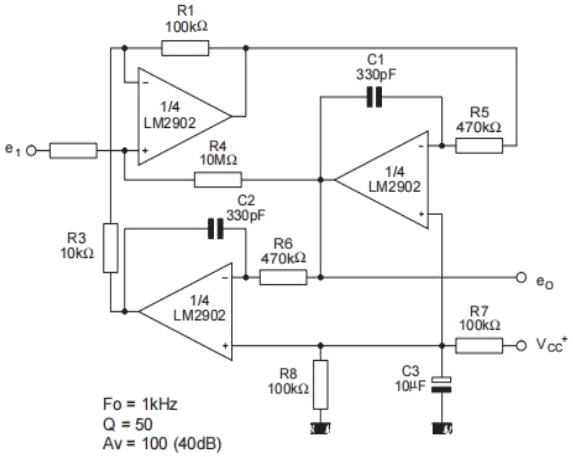


DC SUMMING AMPLIFIER



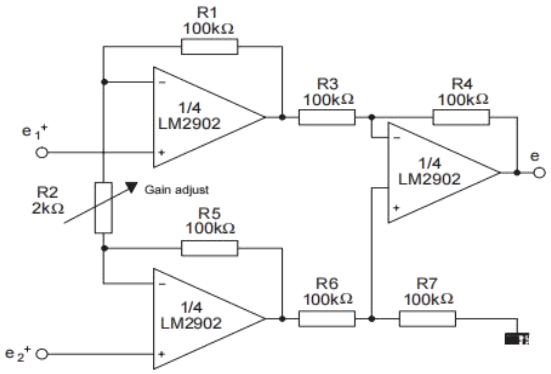
eo = e1 + e2 - e3 - e4
where (e1 + e2) ≥ (e3 + e4)
to keep eo ≥ 0V

ACTIVER BADPASS FILTER



Fo = 1kHz
Q = 50
Av = 100 (40dB)

HIGH INPUT Z ADJUSTABLE GAIN DC INSTRUMENTATION AMPLIFIER

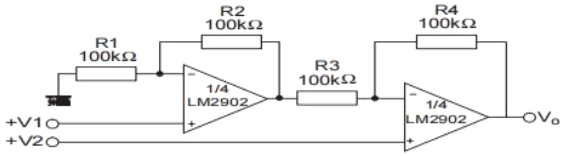


If R1 = R5 and R3 = R4 = R6 = R7

$eo = [\,1 + \frac{2R1}{R2}\,](e2 - e1)$

As shown eo = 101 (e2 - e1)

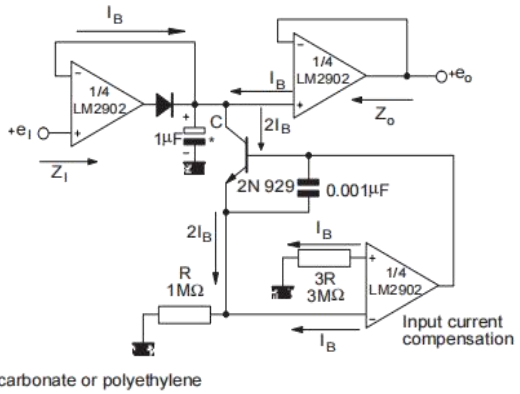
HIGH INPUT Z, DC DIFFERENTIAL AMPLIFIER



$eo = [\,1 + \frac{R4}{R3}\,](e2 - e1)$

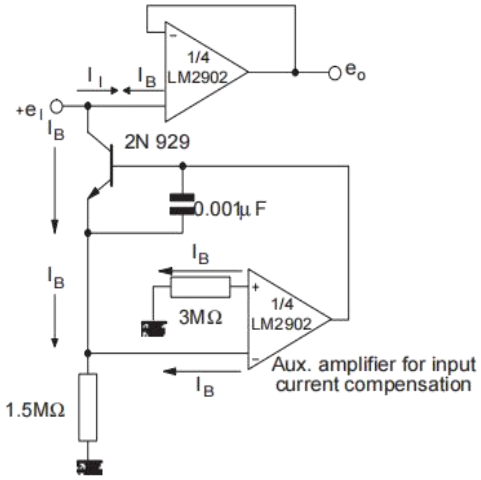
As shown eo = (e2 - e1)

LOW DRIFT PEAK DETECTOR



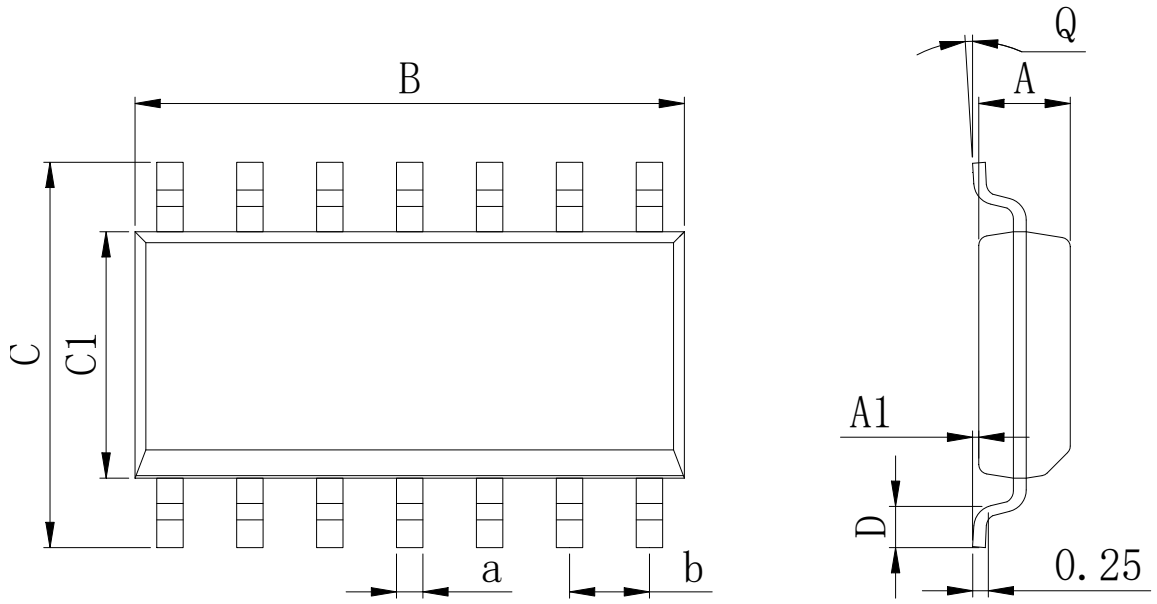
* Polycarbonate or polyethylene

USING SYMMETRICAL AMPLIFIERS TO REDUCE INPUT CURRENT (GENERAL CONCEPT)



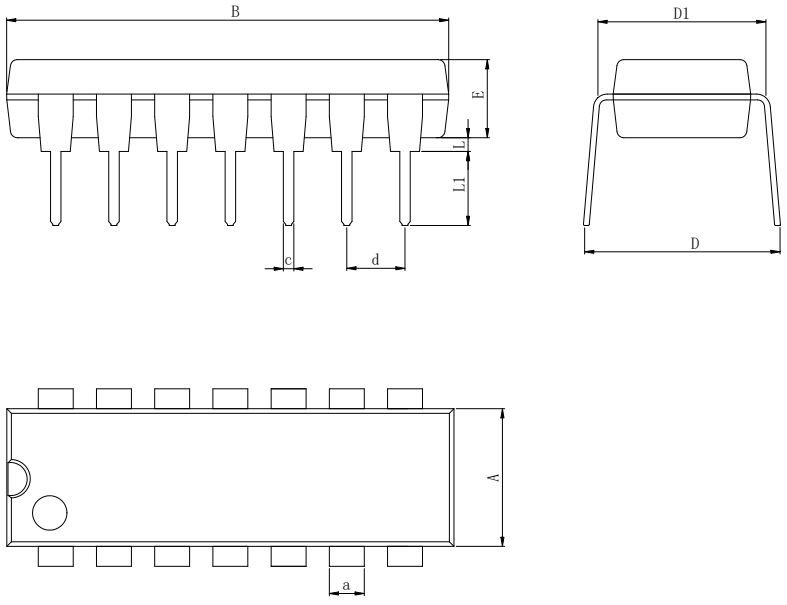
Physical Dimensions

SOP14



Dimensions In Millimeters(SOP14)									
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	

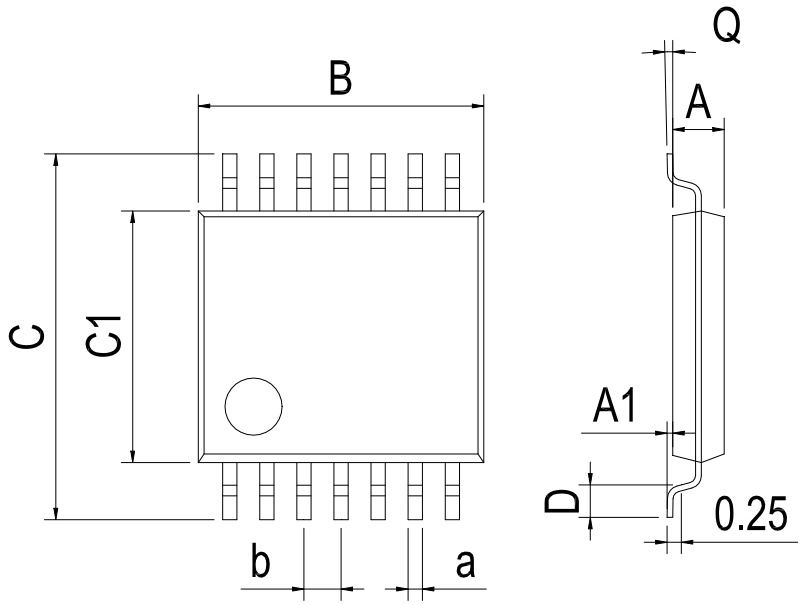
DIP14



Dimensions In Millimeters(DIP14)										
Symbol:	A	B	D	D1	E	L	L1	a	c	d
Min:	6.10	18.94	8.40	7.42	3.10	0.50	3.00	1.50	0.40	2.54 BSC
Max:	6.68	19.56	9.00	7.82	3.55	0.70	3.60	1.55	0.50	

Physical Dimensions

TSSOP14



Dimensions In Millimeters(TSSOP14)									
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	

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