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.

DIP-14

SOP-14

TSSOP-14

QFN-16 3*3

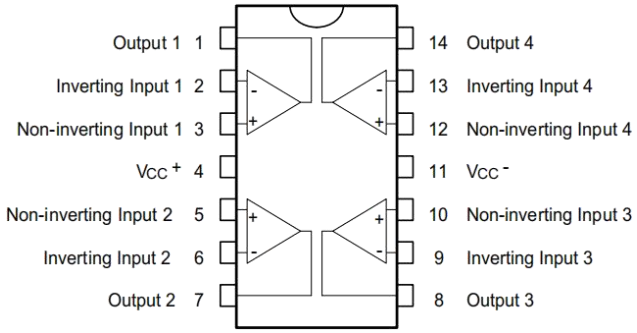
FEATURES

- 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

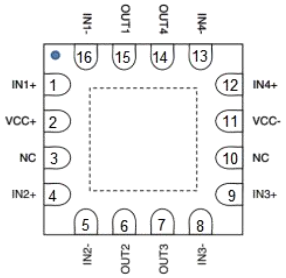
ORDERING INFORMATION

DEVICE	Package Type	MARKING	Packing	Packing Qty
LM2902N	DIP-14	LM2902	TUBE	1000pcs/box
LM2902M/TR	SOP-14	LM2902	REEL	2500pcs/reel
LM2902MT/TR	TSSOP-14	LM2902	REEL	2500pcs/reel
LM2902LQ/TR	QFN-16 3*3	LM2902,2902	REEL	5000pcs/reel

PIN CONNECTIONS (top view)

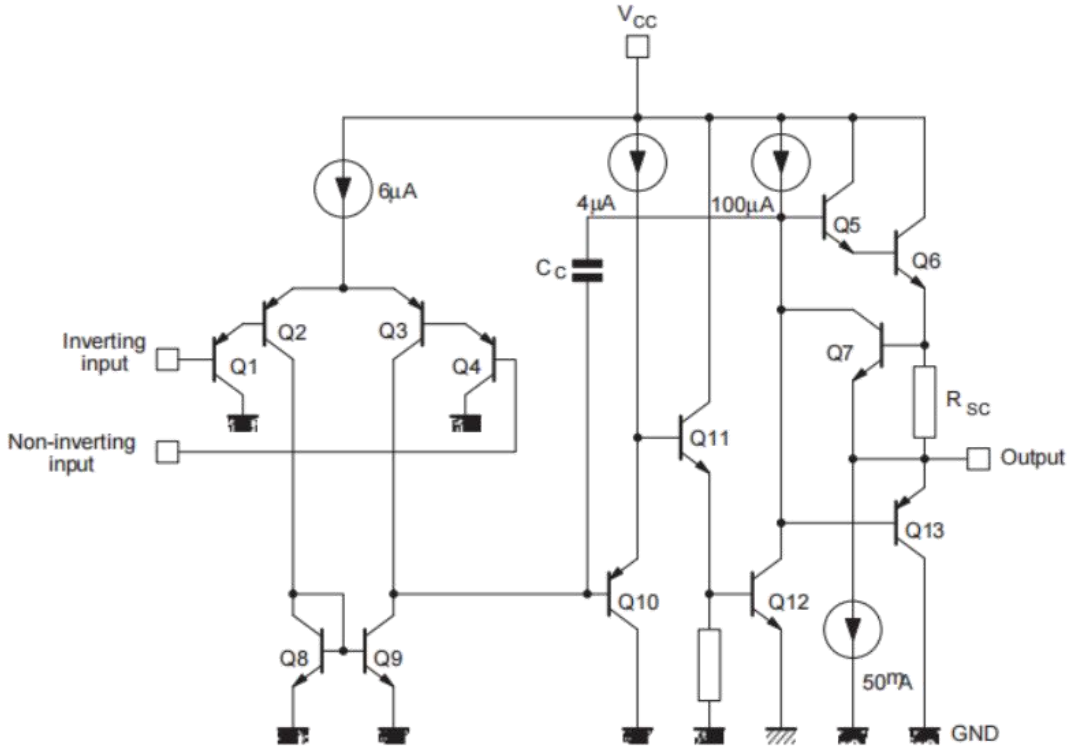


DIP-14/SOP-14/TSSOP- 14



QFN-16 3*3

SCHEMATIC DIAGRAM (1/4 LM2902)



ABSOLUTE MAXIMUM RATINGS (1)

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 2)	Infinite	
Ptot	Power Dissipation N Suffix D Suffix	500 400	mW
I_{in}	Input Current 3)	50	mA
T_{oper}	Operating Free-Air Temperature Range	-40 to +85	°C
T_{stg}	Storage Temperature Range	-65 to +150	°C
T_L	Lead Temperature (Soldering, 10 seconds)	260	°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.

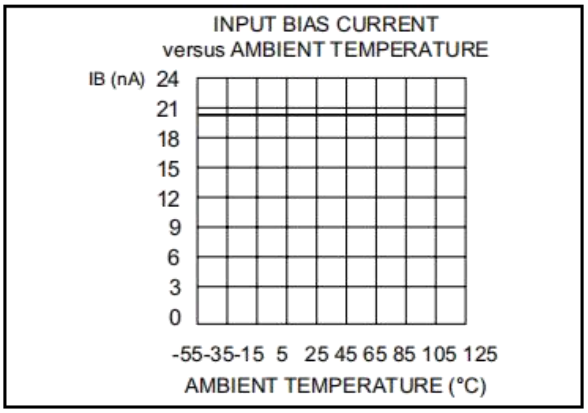
ELECTRICAL CHARACTERISTICS

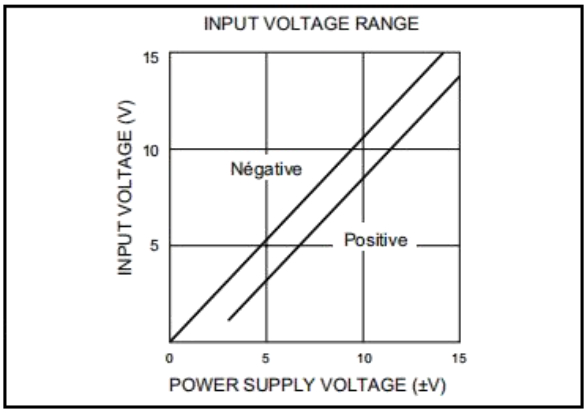
VCC+ = 5V, Vcc- = Ground, VO = 1.4V, Tamb = 25°C (unless otherwise specified)

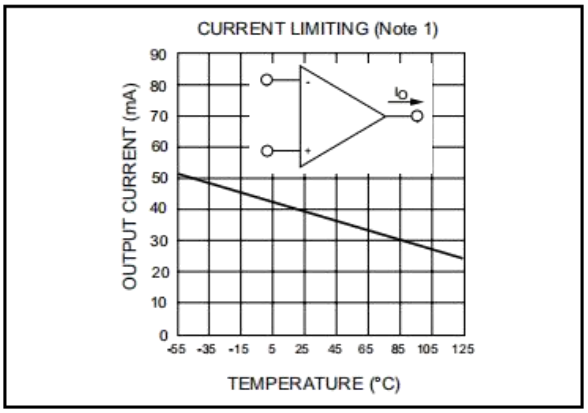
Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input Offset Voltage 1) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.		2	7 9	mV
I_{io}	Input Offset CurrentT_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.		2	30 40	nA
I_{ib}	Input Bias Current 2) T_{amb} = +25°C $T_{min} \le T_{amb} \le T_{max}$.		20	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

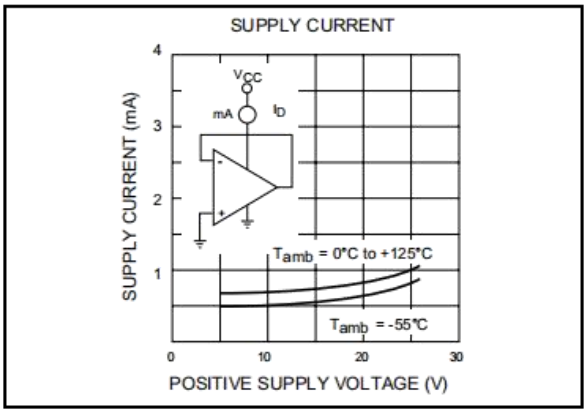
Symbol	Parameter	Min.	Typ.	Max.	Unit
GBP	Gain Bandwidth Product V_{cc} = 30V,V_{in} = 10mV, R_L = 2kΩ, C_L = 100pF		1.3		MHz
THD	Total Harmonic Distortion f = 1kHz, A_V = 20dB, R_L = 2kΩ, V_o = 2Vpp, C_L = 100pF, V_{cc} = 30V		0.015		%
e_n	Equivalent Input Noise Voltage f = 1kHz, R_S = 100Ω, V_{cc} = 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

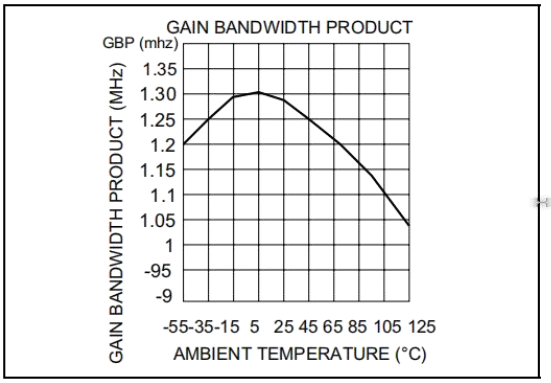
1. VO = 1.4V, RS = 0Ω, 5V < VCC + < 30V, 0V < Vic < V CC+ - 1.5V
2. The direction of the input current is out of the IC. This current is essentially constant, independent of the state of the output, so no loading charge change exists on the input lines
3. The input common-mode voltage of either input 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.

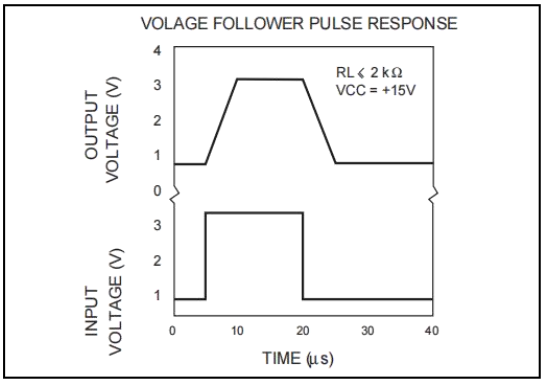


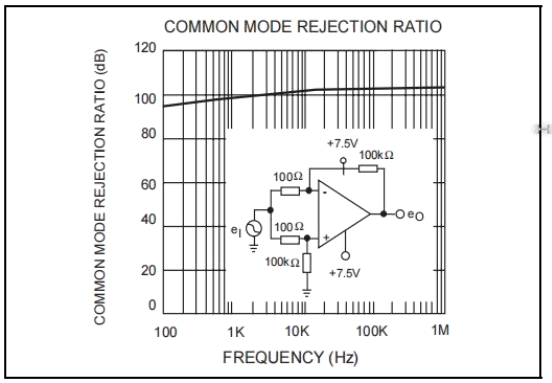


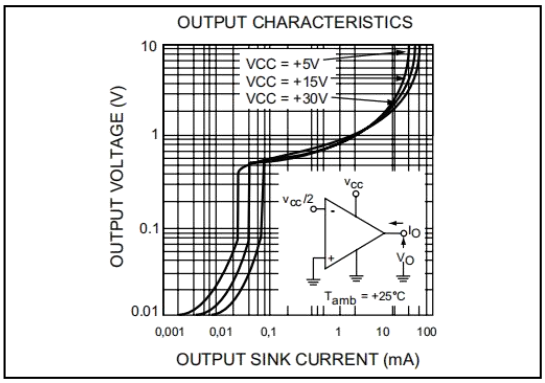


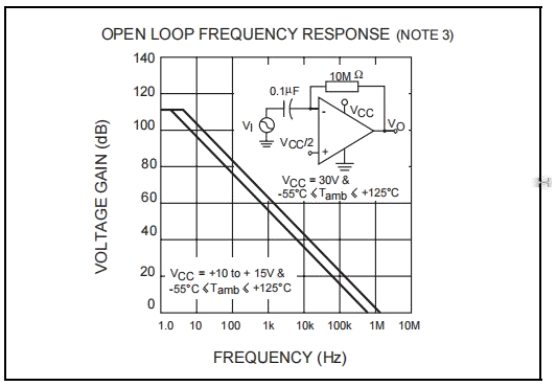


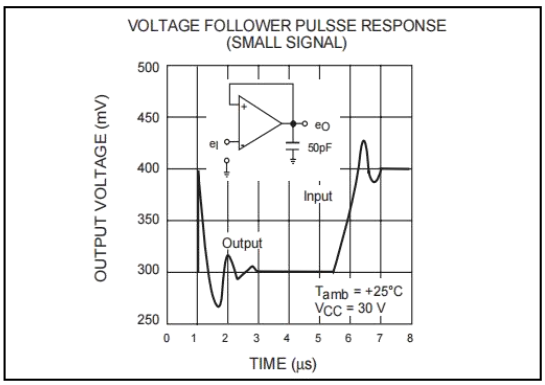

GAIN BANDWIDTH PRODUCT
GBP (mhz)
GAIN BANDWIDTH PRODUCT (MHz)
1.35
1.30
1.25
1.2
1.15
1.1
1.05
1
-95
-9
-55-35-15 5 25 45 65 85 105 125
AMBIENT TEMPERATURE (°C)

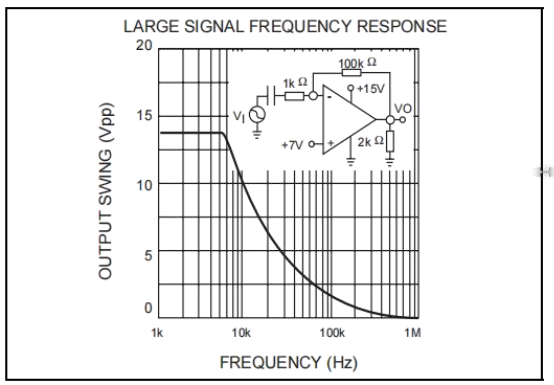

VOLAGE FOLLOWER PULSE RESPONSE
OUTPUT VOLTAGE (V)
INPUT VOLTAGE (V)
RL ≤ 2 kΩ
VCC = +15V
TIME (µs)

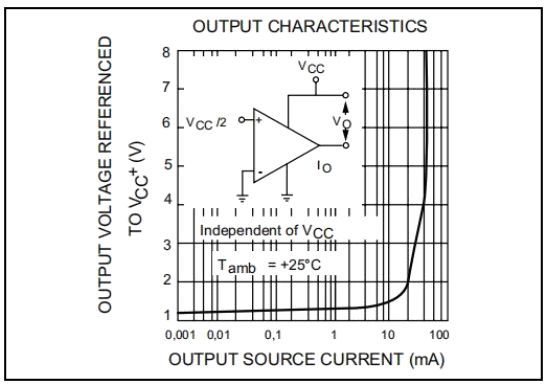

COMMON MODE REJECTION RATIO
COMMON MODE REJECTION RATIO (dB)
+7.5V
100kΩ
100Ω
100Ω
100kΩ
+7.5V
FREQUENCY (Hz)

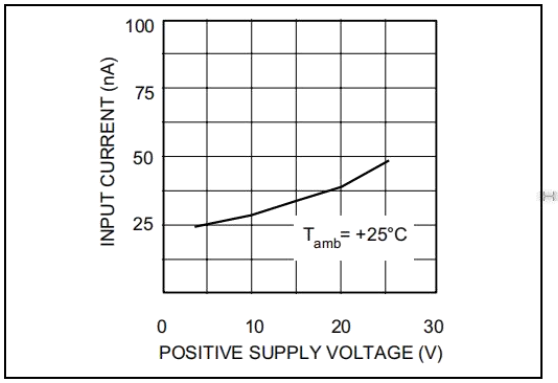

OUTPUT CHARACTERISTICS
OUTPUT VOLTAGE (V)
VCC = +5V
VCC = +15V
VCC = +30V
Tamb = +25°C
OUTPUT SINK CURRENT (mA)

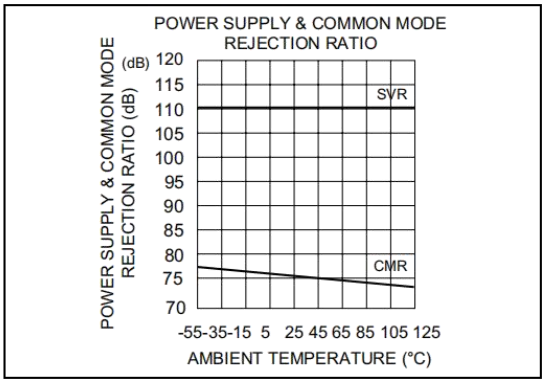

OPEN LOOP FREQUENCY RESPONSE (NOTE 3)
VOLTAGE GAIN (dB)
10MΩ
0.1µF
VCC
VCC/2
VCC = 30V &
-55°C ≤ Tamb ≤ +125°C
VCC = +10 to + 15V &
-55°C ≤ Tamb ≤ +125°C
FREQUENCY (Hz)

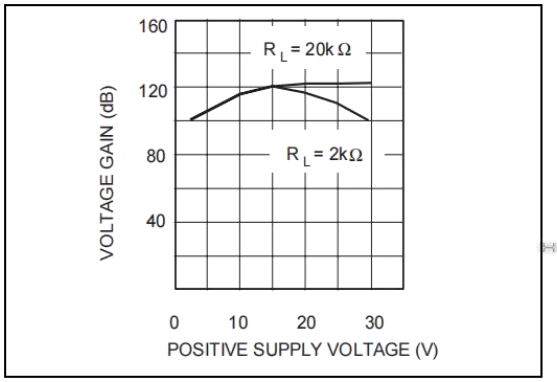

VOLTAGE FOLLOWER PULSSE RESPONSE
(SMALL SIGNAL)
OUTPUT VOLTAGE (mV)
50pF
Input
Output
Tamb = +25°C
VCC = 30 V
TIME (µs)

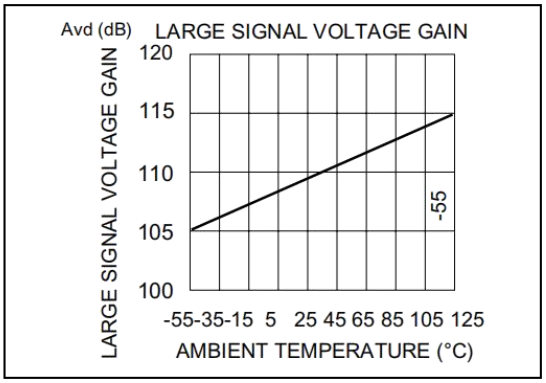

LARGE SIGNAL FREQUENCY RESPONSE
OUTPUT SWING (Vpp)
100k Ω
1k Ω
+15V
+7V
2k Ω
FREQUENCY (Hz)


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)

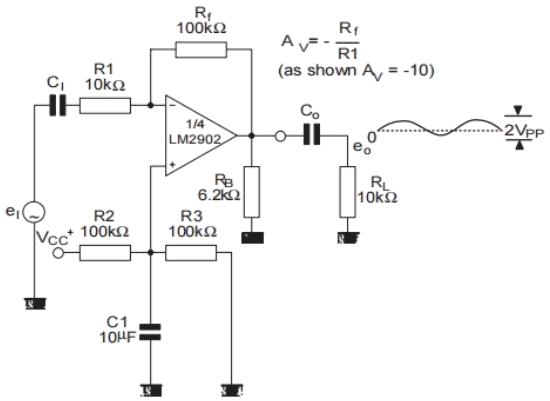

POWER SUPPLY & COMMON MODE REJECTION RATIO
POWER SUPPLY & COMMON MODE REJECTION RATIO (dB)
(dB)
120
115
110
105
100
95
90
85
80
75
70
SVR
CMR
-55-35-15 5 25 45 65 85 105 125
AMBIENT TEMPERATURE (°C)


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

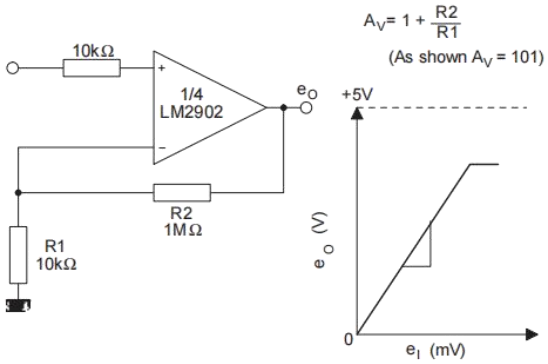

Avd (dB)
LARGE SIGNAL VOLTAGE GAIN
LARGE SIGNAL VOLTAGE GAIN
120
115
110
105
100
-55
-55-35-15 5 25 45 65 85 105 125
AMBIENT TEMPERATURE (°C)

TYPICAL SINGLE - SUPPLY APPLICATIONS

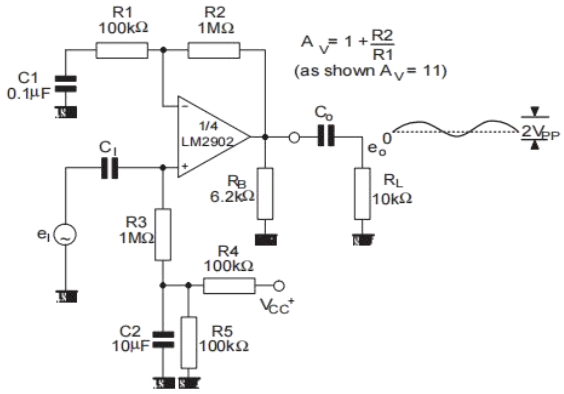
AC COUPLED INVERTING AMPLIFIER



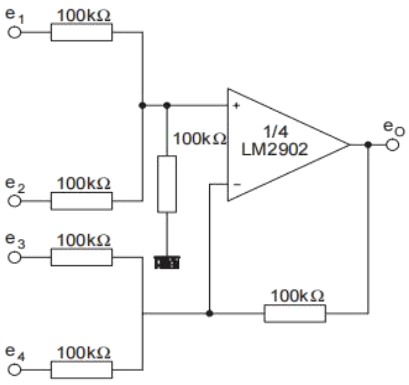
NON-INVERTING DC GAIN



AC COUPLED NON-INVERTING AMPLIFIER

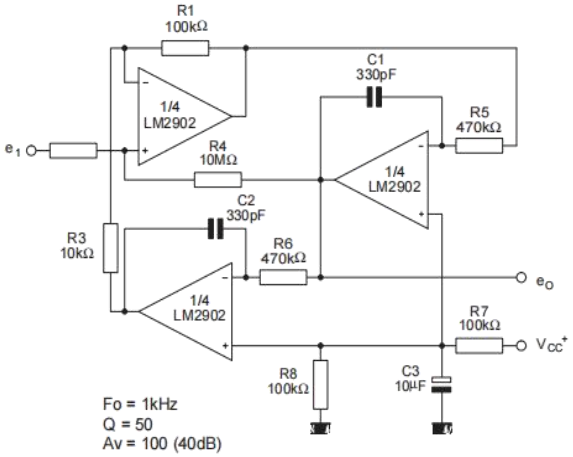


DC SUMMING AMPLIFIER



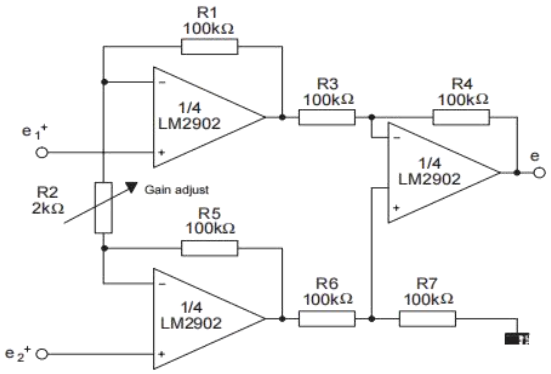
eo = e1 + e2 - e3 - e4
where (e1 + e2) ≥ (e3 + e4)
to keep eo ≥ 0V

ACTIVER BADPASS FILTER



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

HIGH INPUT Z ADJUSTABLE GAIN DC INSTRUMENTATION AMPLIFIER

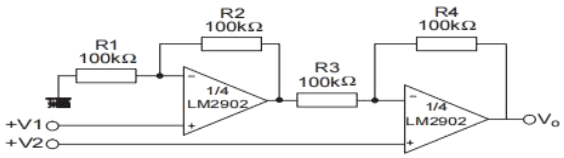


If R1 = R5 and R3 = R4 = R6 = R7

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

As shown eo = 101 (e2 - e1)

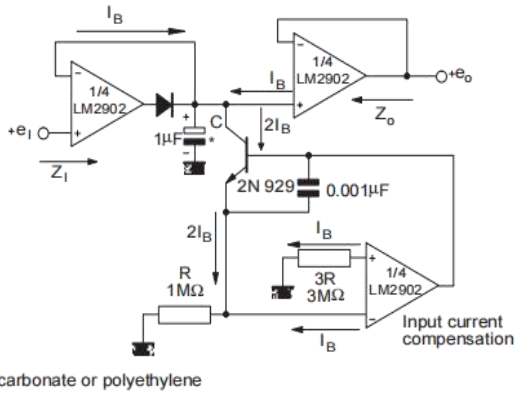
HIGH INPUT Z, DC DIFFERENTIAL AMPLIFIER



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

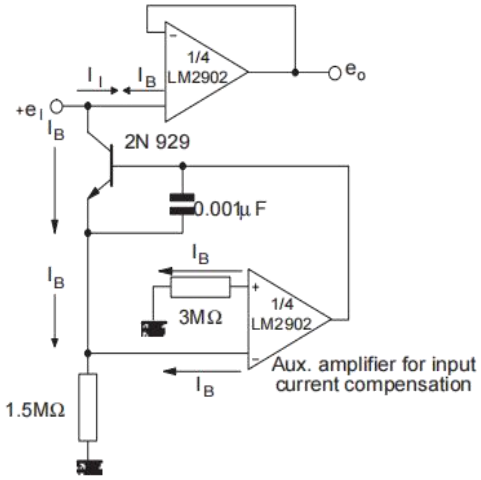
As shown eo = (e2 - e1)

LOW DRIFT PEAK DETECTOR



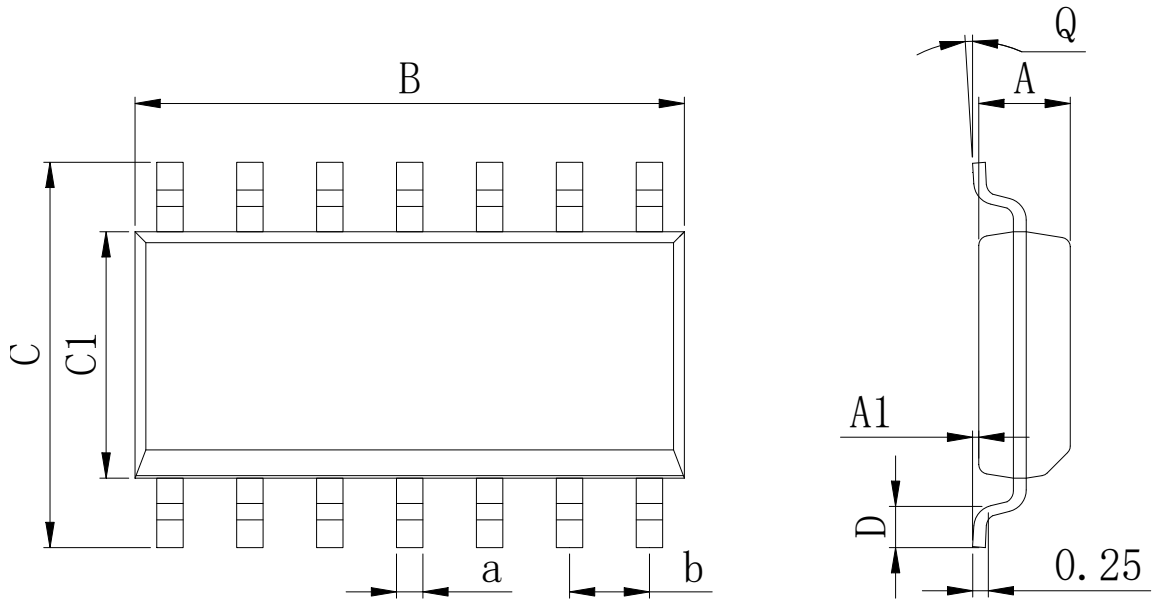
* Polycarbonate or polyethylene

USING SYMMETRICAL AMPLIFIERS TO REDUCE INPUT CURRENT (GENERAL CONCEPT)



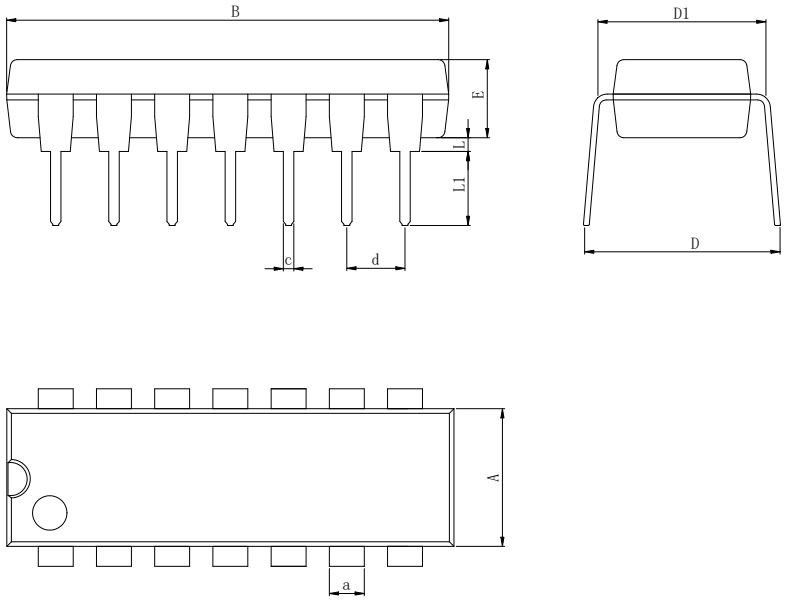
PHYSICAL DIMENSIONS

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	

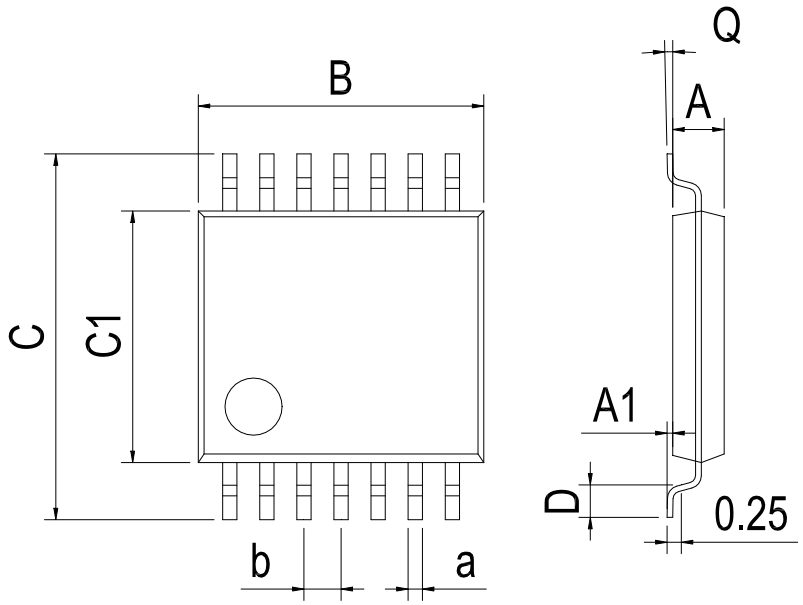
DIP-14



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	

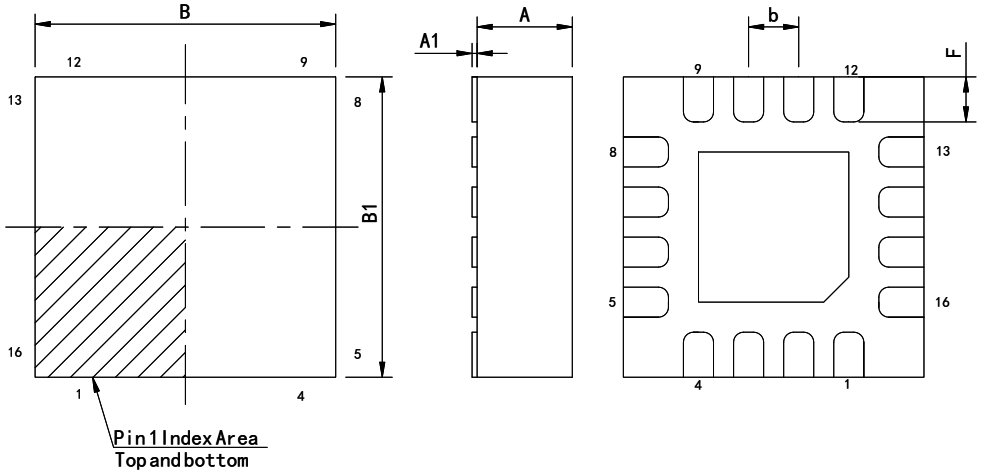
PHYSICAL DIMENSIONS

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	

QFN-16 3*3



Dimensions In Millimeters(QFN-16 3*3)								
Symbol:	**A**	**A1**	**B**	**B1**	**E**	**F**	**a**	**b**
Min:	0.85	0	2.90	2.90	0.15	0.25	0.18	0.50TYP
Max:	0.95	0.05	3.10	3.10	0.25	0.45	0.30	

REVISION HISTORY

REVISION NUMBER	DATE	REVISION	PAGE
V1.0	2011-9	New	1-13
V1.1	2013-9	Update encapsulation type、Updated DIP-14 dimension	1、10
V1.2	2024-10	Update Lead Temperature	3
V1.3	2025-4	Add QFN-16 Packages	1

IMPORTANT STATEMENT:

Huaguan Semiconductor reserves the right to change its products and services without notice. Before ordering, the customer shall obtain the latest relevant information and verify whether the information is up to date and complete. Huaguan Semiconductor does not assume any responsibility or obligation for the altered documents.

Customers are responsible for complying with safety standards and taking safety measures when using Huaguan Semiconductor products for system design and machine manufacturing. You will bear all the following responsibilities: Select the appropriate Huaguan Semiconductor products for your application; Design, validate and test your application; Ensure that your application meets the appropriate standards and any other safety,security or other requirements. To avoid the occurrence of potential risks that may lead to personal injury or property loss.

Huaguan Semiconductor products have not been approved for applications in life support, military, aerospace and other fields, and Huaguan Semiconductor will not bear the consequences caused by the application of products in these fields. All problems, responsibilities and losses arising from the user's use beyond the applicable area of the product shall be borne by the user and have nothing to do with Huaguan Semiconductor, and the user shall not claim any compensation liability against Huaguan Semiconductor by the terms of this Agreement.

The technical and reliability data (including data sheets), design resources (including reference designs), application or other design suggestions, network tools, safety information and other resources provided for the performance of semiconductor products produced by Huaguan Semiconductor are not guaranteed to be free from defects and no warranty, express or implied, is made. The use of testing and other quality control technologies is limited to the quality assurance scope of Huaguan Semiconductor. Not all parameters of each device need to be tested.

The documentation of Huaguan Semiconductor authorizes you to use these resources only for developing the application of the product described in this document. You have no right to use any other Huaguan Semiconductor intellectual property rights or any third party intellectual property rights. It is strictly forbidden to make other copies or displays of these resources. You should fully compensate Huaguan Semiconductor and its agents for any claims, damages, costs, losses and debts caused by the use of these resources. Huaguan Semiconductor accepts no liability for any loss or damage caused by infringement.