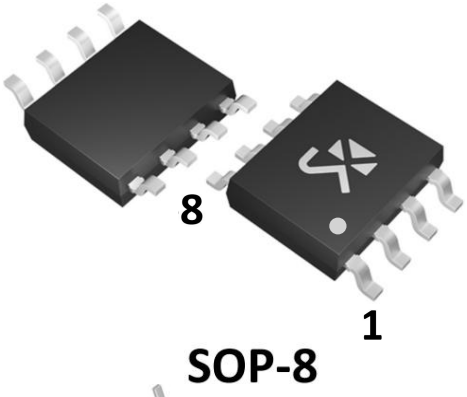
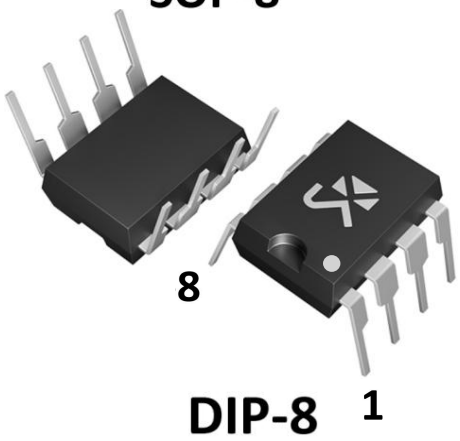
LM2904

Industrial Grade Dual Channel Operational Amplifier

Features

- Low power consumption: 350μA per amplifier
- Wide operating voltage range: 3V~32V
- Unity gain stable
- Gain bandwidth product(GBW): 1MHz
- Slew rate(SR): 0.3V/μs
- Low input offset voltage(VOS): 3mV(Typ.)
- Package:DIP-8/SOP-8





Applications

- Commercial network and server power supply units
- Multifunctional printers
- Power supplies and mobile charger
- Desktop computer and motherboards
- Indoor and outdoor air conditioners
- Washing machines, dryers, refrigerators
- Programmable logic controllers
- Electronic point-of-sale(POS) systems
- Control of various motors
- AC, string, and central inverters and frequency converters

Description

The LM2904 consists of two independent, high-gain, frequency-compensated operational amplifiers (op-amps) designed to operate from a single power supply over a wide voltage range. The minimum operating voltage is 3V, and the maximum operating voltage reaches 32V.

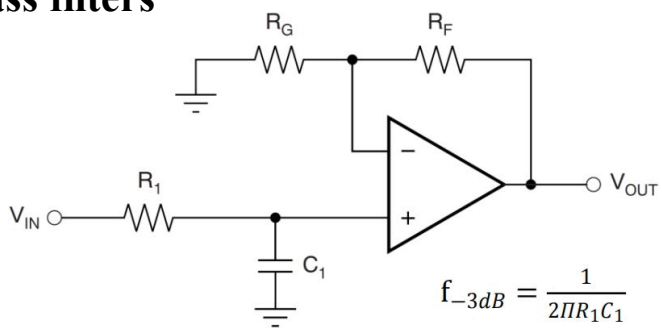
With a supply current of approximately 350μA per op-amp, the LM2904 provides a gain-bandwidth product (GBW) of 1MHz and is unity-gain stable. In addition, the LM2904 features a low offset voltage, with a typical value of 3mV at room temperature. Its wide operating temperature range allows it to meet the requirements of most application scenarios and environments.

It can be used in all op-amp circuits that are easy to implement in single-supply voltage systems. Such circuit devices can directly use the standard 5V power supply in digital systems without the need for additional power supply equipment.

Ordering Information

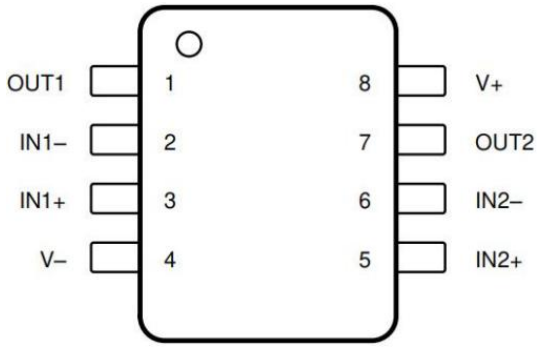
Type	Marking	Package
LM2904-H8	LM2904	DIP-8
LM2904-P8	LM2904	SOP-8

Single-stage low-pass filters



$$\frac{V_{OUT}}{V_{IN}} = \left(1 + \frac{R_F}{R_G}\right)\left(\frac{1}{1 + sR_1C_1}\right)$$

Pin Description

Pin Number	Pin Name	I/O	Description	Pin Configuration Diagram
1	OUT1	O	Op-Amp 1 Output	
2	IN1-	I	Op-Amp 1 Inverting Input	
3	IN1+	I	Op-Amp 1 Non-Inverting Input	
4	V-	P	Ground	
5	IN2+	I	Op-Amp 2 Non-Inverting Input	
6	IN2-	I	Op-Amp 2 Inverting Input	
7	OUT2	O	Op-Amp 2 Output	
8	V+	P	Positive Supply	

Absolute Maximum Ratings (T_A=25℃ unless otherwise noted)

Parameter	Symbol	Minimum	Maximum	Unit
Supply Voltage	V_{CC}	-0.3	±18 or 36	V
Differential Input Voltage	V_{ID}	-36	+36	V
Input Voltage	V_I	-0.3	36	V
Operating Ambient Temperature	T_A	-40	125	℃
Maximum Operating Junction Temperature	T_J		150	℃
Storage Temperature	T_{STG}	-65	150	℃
Electrostatic Discharge	V_{ESD}		±1000	V

Electrical Characteristics(T_A=25℃, V_{CC}=[V+]-[V-]=5V, unless otherwise noted)

Parameter	Symbol	Test Condition		Min	Typ	Max	Unit
Supply Current/Amplifier	I_{CC}	V_O=2.5V, I_O=0A			350	600	μA
Common-mode Voltage	V_{CM}	V_{CC}=5V to 32V		V-		(V+)-2	V
Common-mode Rejection Ratio	C_{MRR}	V_{CC}=5V to 32V, V_{CM}=0V		65	80		dB
Input Offset Voltage	V_{OS}	V_{CC}=5V to 32V, V_{CM}=0V, V_O=1.4V			3	7	mV
Input Offset Voltage Drift	dV_{OS}/dT				7		μV/℃
Power Supply Rejection Ratio	P_{SRR}	V_{CC}=5V to 32V		65	100		dB
Channel Isolation	V_{O1}/V_{O2}	f=1kHz to 20kHz			120		dB
Input Bias Current	I_B	V_O=1.4V			-20	-250	nA
Input Offset Current	I_O	V_O=1.4V			2	50	nA
Input Offset Current Drift	dI_{OS}/dT				10		pA/℃
Voltage Output Swing	V_O	Positive Rail	V_{CC}=32V,R_L=2kΩ	28	30		V
			V_{CC}=32V,R_L≥10kΩ	28	30.5		V
		Negative Rail	V_{CC}=32V,R_L≤2kΩ		5	20	mV
Output Current	Source	V_{CC}=15V, V_O=0V, V_{ID}=1V		-20	-30		mA
	Sink	V_{CC}=15V, V_O=15V, V_{ID}=-1V		10	20		mA
		V_{ID}=-1V, V_O=200mV			30		μA
Short-circuit Current	I_{SC}	V_{CC}=10V,V_O=V_{CC}/2			±40	±60	mA
Open-Loop Voltage Gain	A_{OL}	V_{CC}=15V, V_O=1V to 11V, R_L≥2kΩ		25	100		V/mV
Gain Bandwidth Product	GBW				1		MHz
Slew Rate	SR	G=+1			0.3		V/uS
Input Voltage Noise Density	e_n	f=1kHz			40		nV/$\sqrt{Hz}$

Typical Characteristics

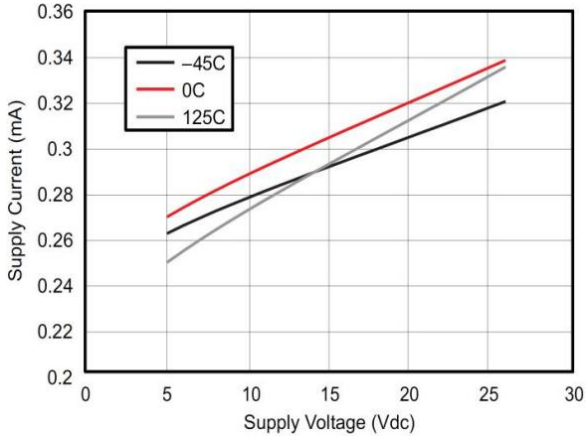


Figure 1 Supply Current vs. Supply Voltage

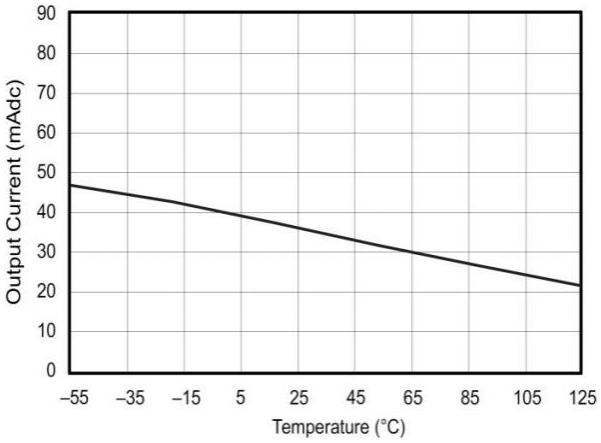


Figure 2 Maximum Output Current vs. Ambient Temperature

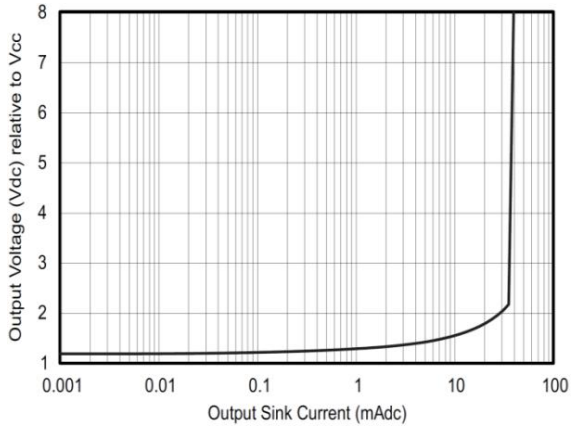


Figure 3: Output Sink Current vs. Output Voltage Relative to Vcc

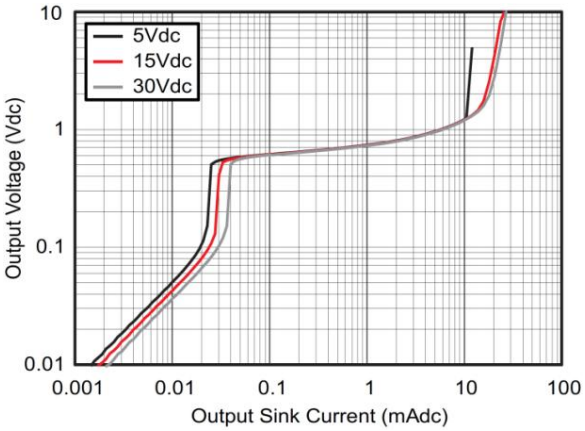


Figure 4: Maximum Sink Current vs. Output Voltage

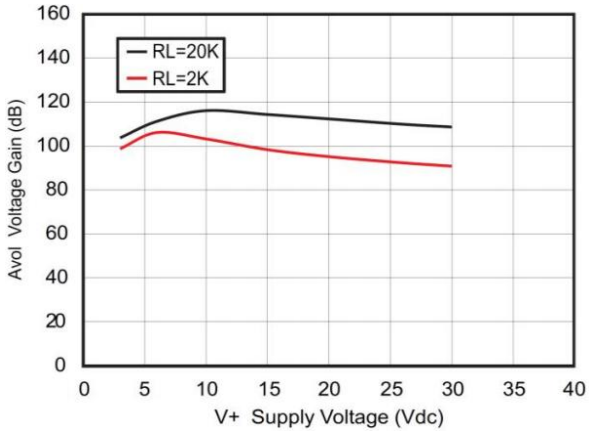


Figure 5 Open-Loop Output Gain vs. Supply Voltage

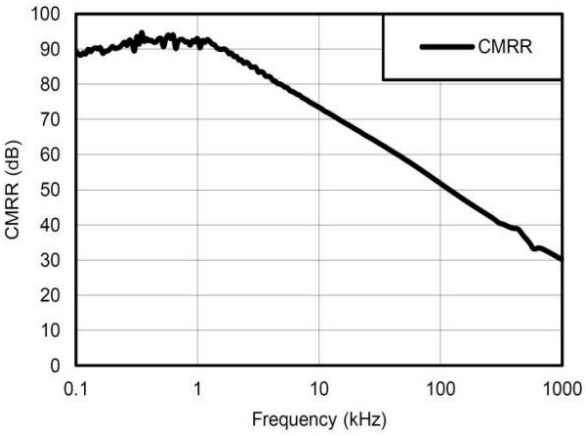


Figure 6 Common-Mode Rejection Ratio (CMRR) vs. Frequency

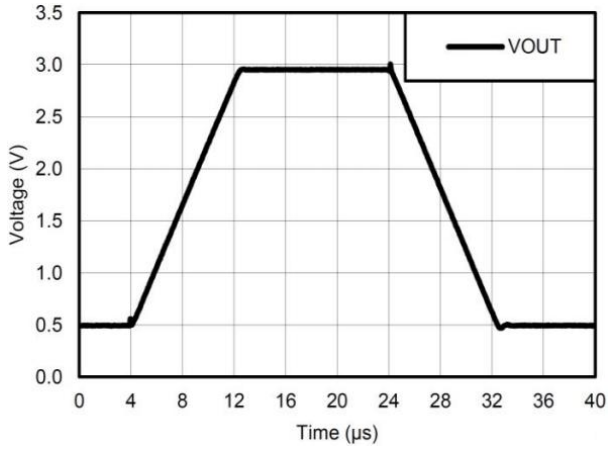


Figure 7: Voltage Follower Large-Signal Response (50pF)

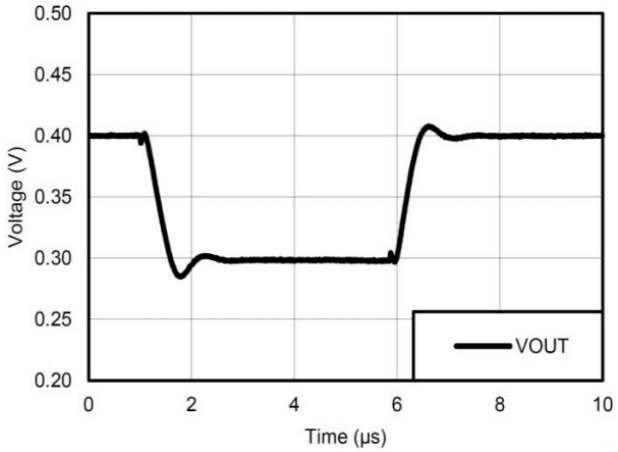


Figure 8: Voltage Follower Small-Signal Response (50pF)

Application Notes

1.Application Introduction

The LM2904 op-amp is widely used in various signal conditioning circuits. The input can be connected before the power supply V_{CC}, enabling flexibility in power supply circuit design.

2.Typical Application

A typical application of the op-amp is an inverting amplifier. When a positive voltage is applied to the input terminal, a negative voltage with the same amplitude can be obtained; similarly, it can convert a negative voltage to a positive one.

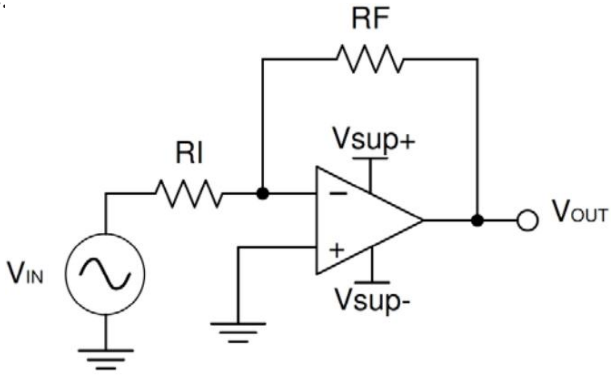


Figure 9: Application Schematic Diagram

3.Circuit Requirements

The selected supply voltage must be greater than the input voltage range and output voltage range. For example, if this application amplifies a ±0.5V signal to ±1.8V, setting the supply voltage to ±12V is sufficient for this application.

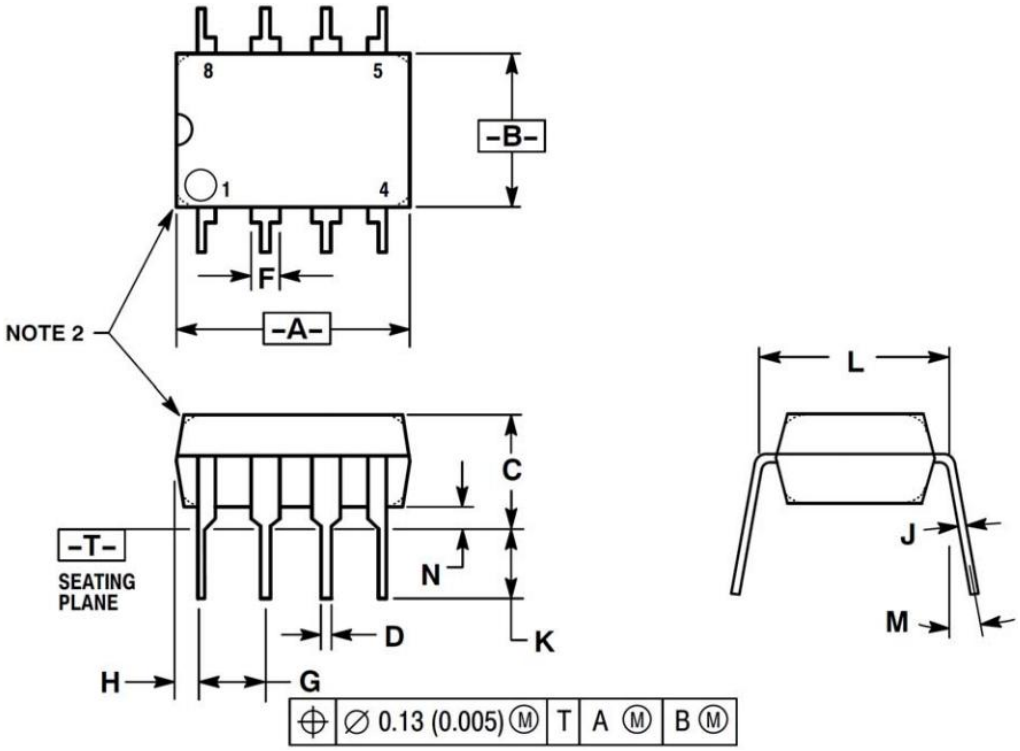
$$A_V = \frac{V_{OUT}}{V_{IN}} = \frac{1.8}{-0.5} = -3.6$$

In the above example, if a 10kΩ resistor is used for RI, it means a 36kΩ resistor should be used for RF.

Package Information

DIP-8

Dimensions in mm

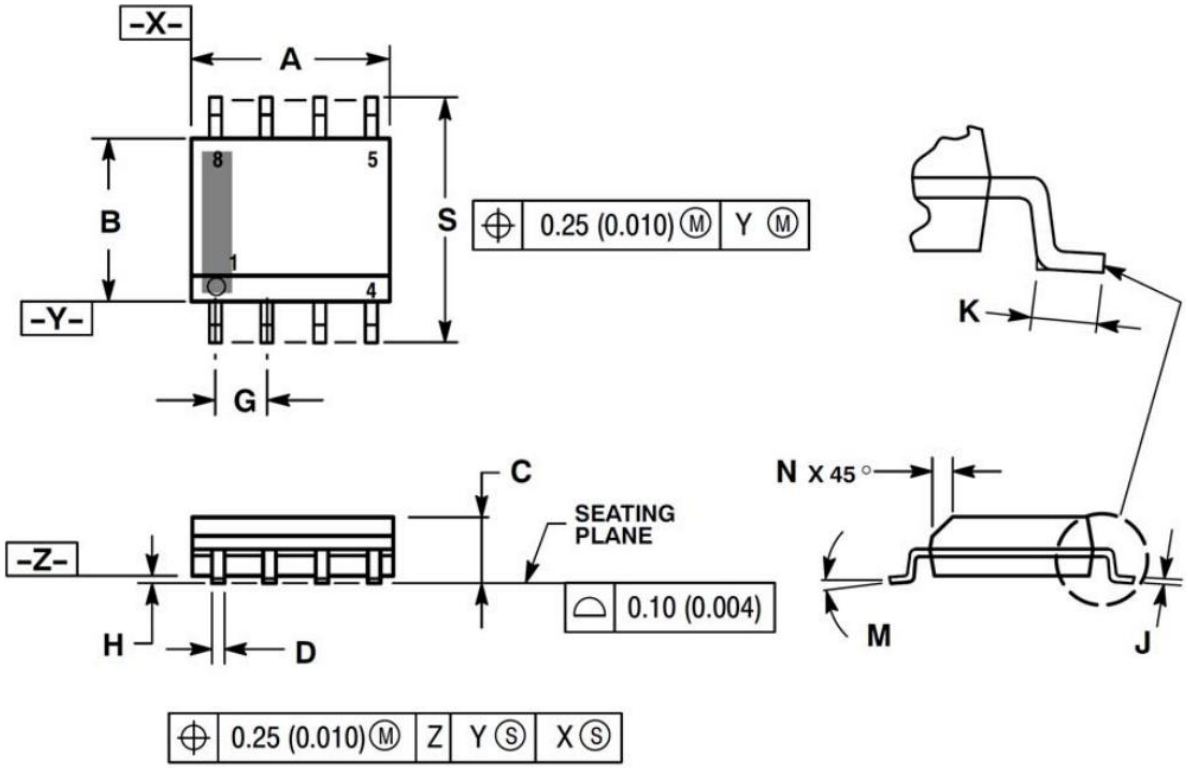


Symbol	Millimeter(mm)		Inch(in)	
	Min	Max	Min	Max
A	9.4	10.16	0.37	0.4
B	6.1	6.6	0.24	0.26
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.02
F	1.02	1.78	0.04	0.07
G	2.54		0.1	
H	0.76	1.2	0.03	0.05
J	0.2	0.3	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62		0.3	
M	-	10°	-	10°
N	0.76	1.01	0.03	0.04

Package Information

SOP-8

Dimensions in mm



Symbol	Millimeter(mm)		Inch(in)	
	Min	Max	Min	Max
A	4.8	5.0	0.189	0.197
B	3.8	4.0	0.15	0.157
C	1.35	1.75	0.053	0.069
D	0.33	0.51	0.013	0.02
G	1.27		0.05	
H	0.1	0.25	0.004	0.01
J	0.19	0.25	0.007	0.01
K	0.4	1.27	0.016	0.05
M	0°	8°	0°	8°
N	0.25	0.5	0.01	0.02
S	5.8	6.2	0.228	0.244

Shikues Disclaimer

1.Accuracy of Information and Right to Modify

The information provided in this document is for reference only. Shikues reserves the right to make changes to this document and to the specifications of the products described herein at any time, without prior notice, for the purpose of improving reliability, function, design, or for any other reason. It is the customer's responsibility to obtain and verify the latest product information and specifications before making any final design, procurement, or usage decisions.

2.No Warranty

Shikues makes no express or implied warranties, representations, or guarantees regarding the suitability of its products for any particular purpose.

Shikues assumes no liability for any assistance provided or for the design of customer products. All products are supplied "as is."

3.Intended Use and Limitation of Liability

The products described in this document are intended for use in general-purpose electronic devices. They are neither designed nor tested nor authorized for use in transportation equipment or applications requiring high reliability. Unless expressly authorized in writing by Shikues, these products must not be used as critical components in life-support systems or any applications where failure could directly pose a risk to human life (including, but not limited to, medical devices, transportation systems, aerospace equipment, nuclear facilities, and safety-critical systems).

Shikues assumes no responsibility or liability for any consequences arising from the use of its products in unauthorized or unintended applications.

Neither Shikues nor its representatives shall be held liable for any resulting damages.

4.Intellectual Property

This document does not grant any express or implied license—whether by estoppel, implication, or otherwise—to use any intellectual property rights of Shikues.