



LM2904

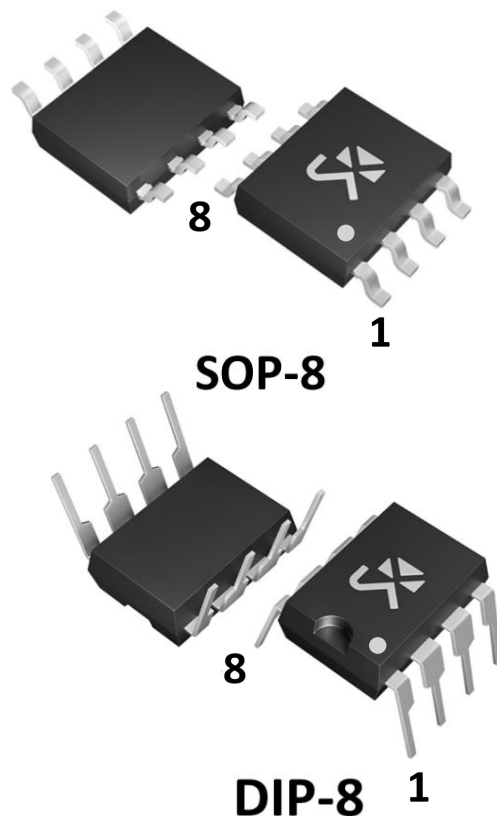
Industrial Grade Dual Channel Operational Amplifier

Features

- Low power consumption: 350 μ A per amplifier
- Wide operating voltage range: 3V~32V
- Unity gain stable
- Gain bandwidth product(GBW): 1MHz
- Slew rate(SR): 0.3V/ μ s
- 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 350 μ A 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.

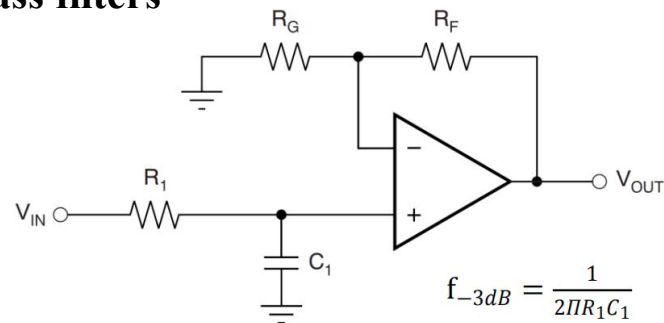
Ordering Information

Type	Marking	Package
LM2904-D8	LM2904	DIP-8
LM2904-P8	LM2904	SOP-8



LM2904

Single-stage low-pass filters



$$\frac{V_{OUT}}{V_{IN}} = \left(1 + \frac{R_F}{R_G}\right) \left(\frac{1}{1 + sR_1 C_1}\right)$$

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°C 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	°C
Maximum Operating Junction Temperature	T _J		150	°C
Storage Temperature	T _{STG}	-65	150	°C
Electrostatic Discharge	V _{ESD}		±1000	V



LM2904

Electrical Characteristics($T_A=25^{\circ}\text{C}$, $V_{CC}=[V^+]-[V^-]=5\text{V}$, unless otherwise noted)

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



Typical Characteristics

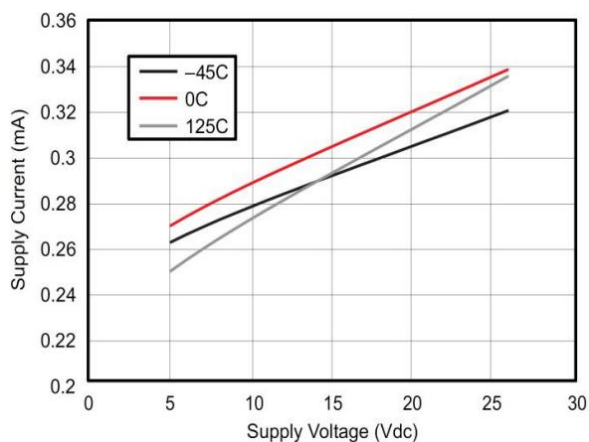


Figure 1 Supply Current vs. Supply Voltage

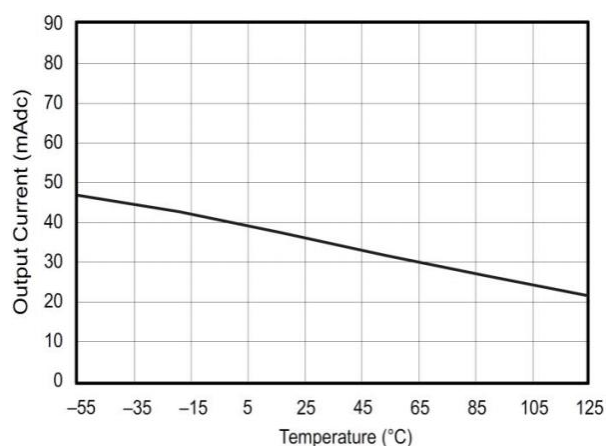


Figure 2 Maximum Output Current vs. Ambient Temperature

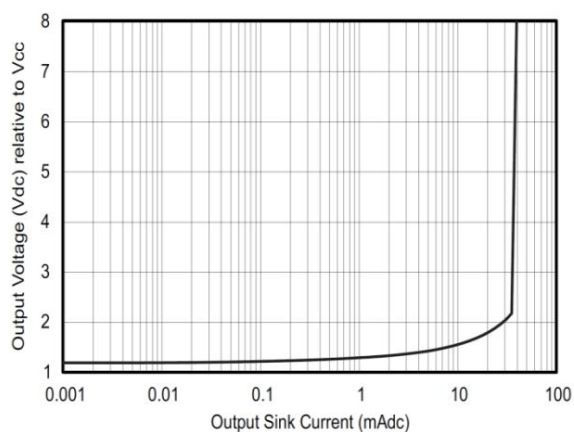


Figure 3: Output Sink Current vs. Output Voltage Relative to Vcc

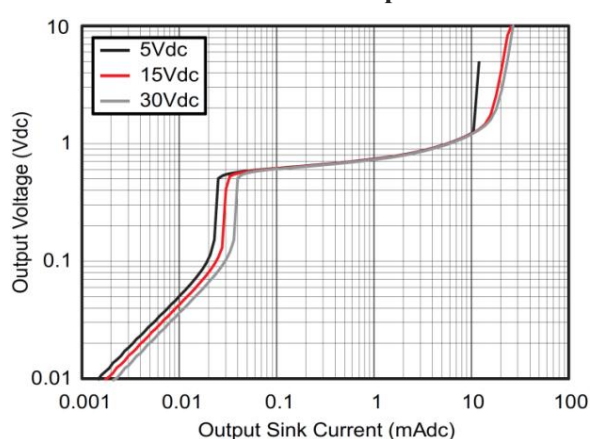


Figure 4: Maximum Sink Current vs. Output Voltage

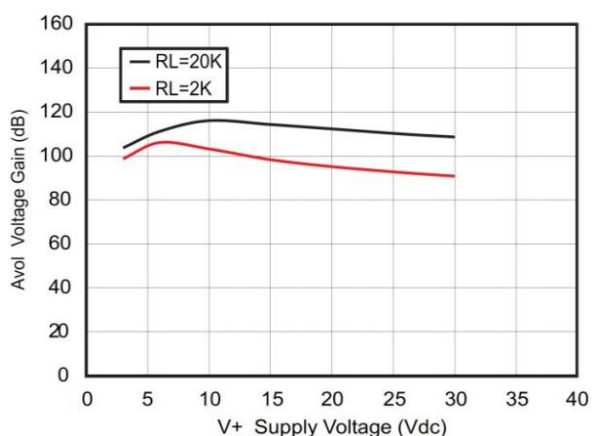


Figure 5 Open-Loop Output Gain vs. Supply Voltage

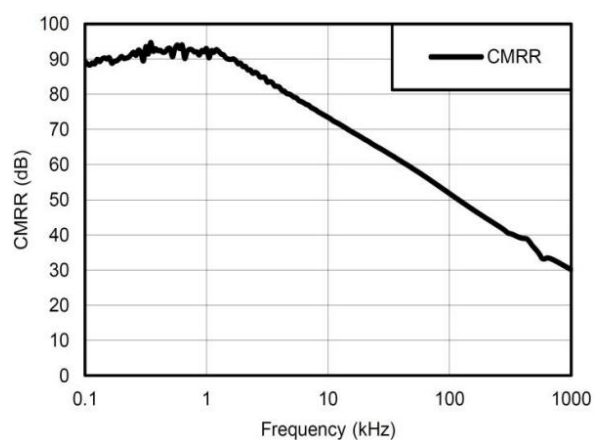


Figure 6 Common-Mode Rejection Ratio (CMRR) vs. Frequency

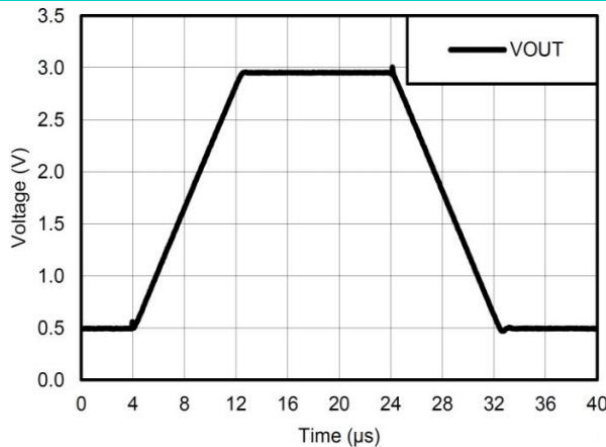


Figure 7: Voltage Follower Large-Signal Response (50pF)

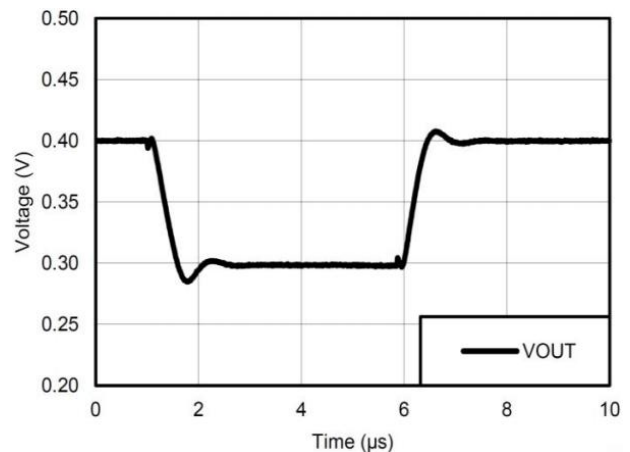


Figure 8: Voltage Follower Small-Signal Response (50pF)

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.

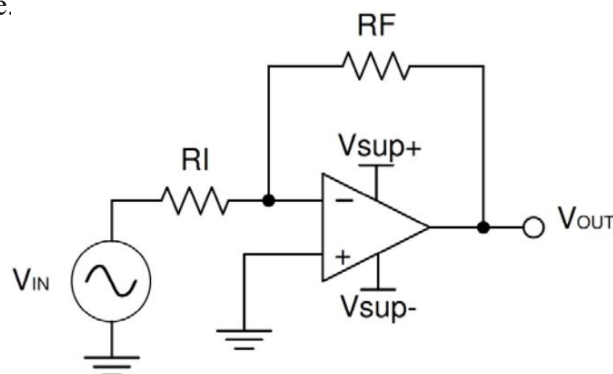


Figure 9: Application Schematic Diagram

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 $\pm 0.5V$ signal to $\pm 1.8V$, setting the supply voltage to $\pm 12V$ is sufficient for this application.

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

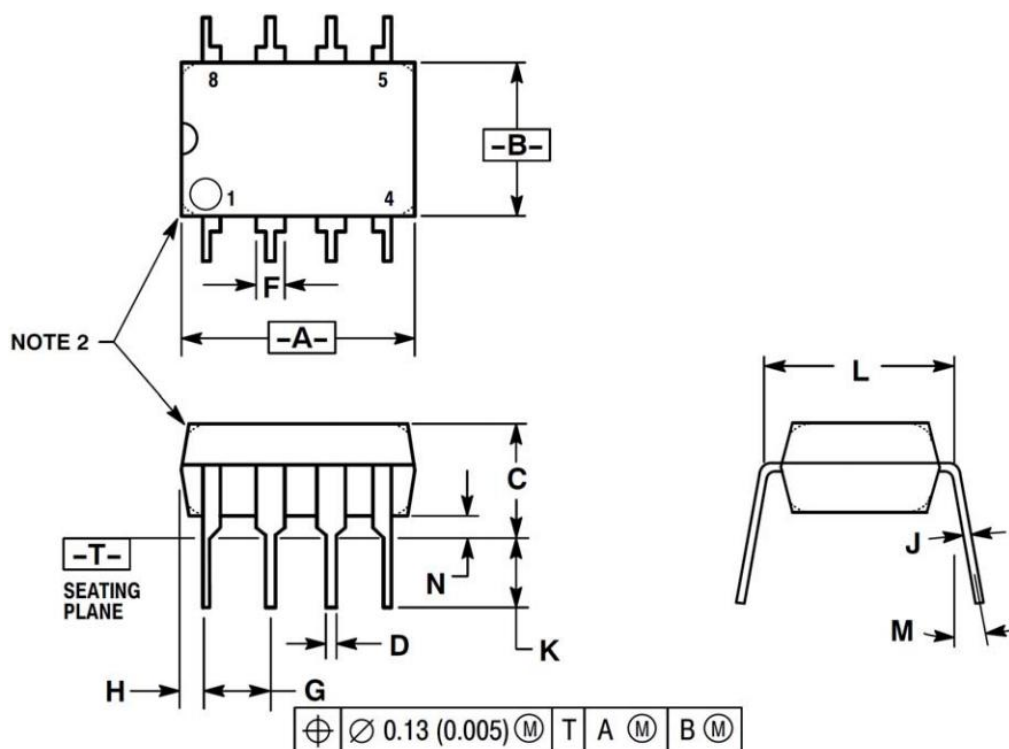
In the above example, if a $10k\ \Omega$ resistor is used for R_I , it means a $36k\ \Omega$ resistor should be used for R_F .



Package Information

DIP-8

Dimensions in mm



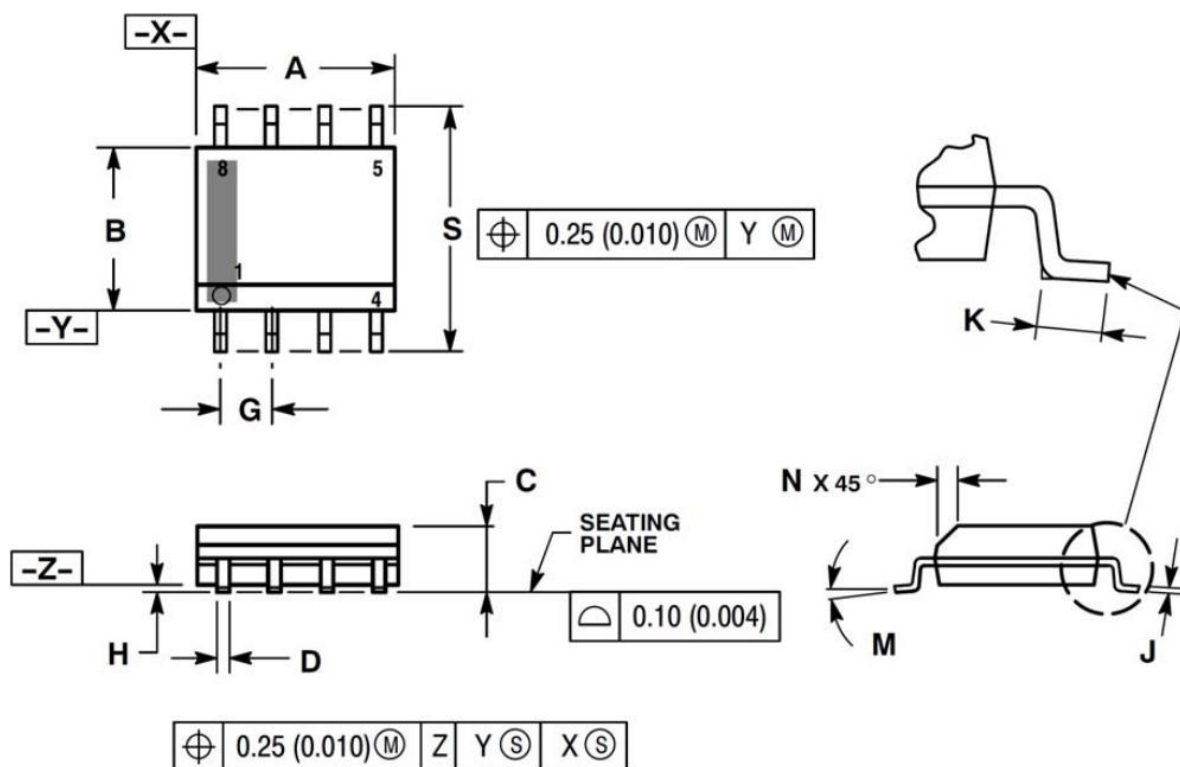
Symbol	Millimeter(mm)		Inch(in)	
	Min	Max	Min	Max
A	9.4	10.16	0.37	0.4
B	6.1	6.6	0.24	0.26
C	3.94	4.45	0.155	0.175
D	0.38	0.51	0.015	0.02
F	1.02	1.78	0.04	0.07
G	2.54		0.1	
H	0.76	1.2	0.03	0.05
J	0.2	0.3	0.008	0.012
K	2.92	3.43	0.115	0.135
L	7.62		0.3	
M	-	10°	-	10°
N	0.76	1.01	0.03	0.04



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



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