Industry-Standard Operational Amplifiers

1.Description

The LM2904 is the industry-standard operational amplifier which includes different channels of high-voltage (36V) op amps.The device provides outstanding value for cost-sensitive applications, with features including low offset, common-mode input range to ground.The stardard op amps series simplify circuit design with enhanced features such as unity-gain stability and lower quiescent current of 250 μA per amplifier (typical).

The amplifier is available in industry standard packages.

2.Features

- Wide supply range of 3 V to 36 V
- Quiescent current: 250 μA/CH (Typical)
- Wide bandwidth (unity gain): 0.7 MHz
- Large Voltage Gain: 100dB (Typical)
- Low Input Bias Current: 20nA (Typical)
- Low Input Offset Voltage: 2mV (Typical)
- Common-mode input voltage range in-cludes ground, enabling direct sensing near ground
- Large Output Voltage Swing: 0V to VCC - 1.5V

3.Applications

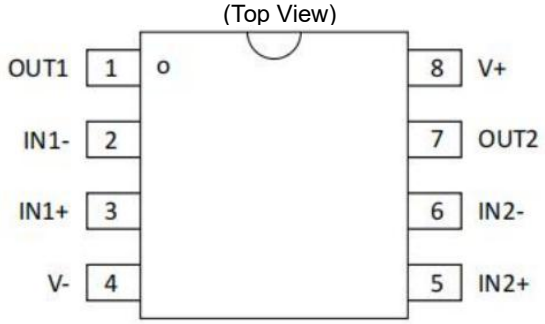
- Merchant network and server power supply units
- Multi-function printers
- Power supplies and mobile chargers
- Motor control: AC induction, brushed DC, brush- less DC, high-voltage, low-voltage, permanent magnet, and stepper mot
- Desktop PC and motherboard
- Indoor and outdoor air conditioners
- Washers, dryers, and refrigerators
- AC inverters, string inverters, central inverters, and voltage frequency drives
- Uninterruptible power supplies
- Electronic point-of-sale systems

4.Order information

Mode	Package	Ordering Number	Packing Option
LM2904	SOP8	LM2904YSOP8G/TR	Tape and Reel,4000
	MSOP8	LM2904YMSOP8G/TR	Tape and Reel,4000

5.Pin Configuration

8-Pin SOP, MSOP
(Top View)



6.Pin Description

Pin		I/O	Description
Name	No.		
IN1–	2	I	Inverting input, channel 1
IN1+	3	I	Noninverting input, channel 1
IN2–	6	I	Inverting input, channel 2
IN2+	5	I	Noninverting input, channel 2
OUT1	1	O	Output, channel 1
OUT2	7	O	Output, channel 2
V+	8	—	Positive (highest) power supply
V-	4	—	Negative (low) supply or ground (for single-supply operation)

7.Absolute Maximum Ratings

Over operating ambient temperature (unless otherwise noted)[1]

Parameter			Min	Max	Unit
Supply voltage [(V+) – (V–)]			0	40	V
Signal input pins	Voltage	Common-mode	-0.3	40	V
		Differential		40	V
Temperature	Specified, T_A	LM2904	–40	125	°C
	Junction, T_J			150	
	Storage,T_{stg}		-65	150	

[1] Stresses beyond those listed under Absolute Maximum Ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

8.ESD Ratings

Parameter	Description	Value	Unit
V_{ESD} Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001[1]	±500	V
	Charged-device model (CDM), per JEDEC specification JESD22-C101[1]	±1000	

[1] JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process

[2] JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

9.Thermal Information

Thermal Metric	SOP-8	Unit
$R\theta_{JA}$ Junction-to-ambient thermal resistance	124.7	°C/W
$R\theta_{JC(top)}$ Junction-to-case (top) thermal resistance	67	

10.Recommended Operating Conditions

Over operating ambient temperature (unless otherwise noted)

Symbol	Parameter	Min	Max	Unit
V_S	Supply voltage (VS = [V+] – [V–])	3	36	V
V_{CM}	Common-mode voltage	V–	(V+)-0.3	V
T_A	Operating ambient temperature	–40	125	°C

11.Electrical Characteristics

For V_S(Total Supply Voltage) = (V+) – (V–) = 5V - 36V at T_A = 25°C (unless otherwise noted)

Parameter		Test Conditions	Min	Typ	Max	Unit
Offset Voltage						
V_{OS}	input offset voltage	V_S = 5V to 30V, V_{CM} = 0,V_O = 1.4V		2	7	mV
		V_S = 5 V to 30V, V_{CM} = 0, V_O = 1.4V, T_A = –40°C to 125°C			10	
dVos/dT	Drift	T_A= –40°C to 125°C		7		μV/°C
PSRR	Power-supply rejection ratio	V_S = 3 V to 30 V, T_A= –40°C to 125°C	60	100		dB
	Channel separation	f = 1 kHz to 20 kHz		120		dB
Input Voltage Range						
V_{CM}	Common-mode voltage range	V_S = 5V to 30V, T_A = –40°C to 125°C	V–		(V+) - 2	V
CMRR	Common-mode rejection ratio	V_S = 5 V to 30 V, V_{CM} = 0	60	80		dB
Input Bias Current						
IB	Input bias current	V_{CM} =0		-20	-200	nA
		V_{CM} =0,T_A= –40°C to 125°C			-500	
IOS	Input offset current	V_{CM} = 0		5	50	nA
		V_{CM} =0,T_A= –40°C to 125°C			150	
Noise						
e_n	Input voltage noise density	f = 1 kHz		40		nV/√Hz
Open-Loop Gain						
A_{OL}	Open-loop voltage gain	V_S = 15V, V_O = 1V to 11V, R_L > 2KΩ		85	100	dB
		V_S = 15V, V_O = 1V to 11V, R_L > 2KΩ, T_A = –40°C to 125°C	82			
Frequency Response						
GBW	Gain bandwidth product			0.7		MHz
SR	Slew rate	V_S = 5 V, G = +1		0.3		V/μs

11.Electrical Characteristics (Continued)

For V_S(Total Supply Voltage) = (V+) – (V–) = 5V - 36V at T_A = 25°C (unless otherwise noted)

Parameter		Test Conditions	Min	Typ	Max	Unit
Output						
V_O	Output swing from positive rail	V_S = 30V, R_L = 2kΩ, T_A= –40°C to 125°C			4	V
		V_S = 30 V, R_L = 10kΩ, T_A = –40°C to 125°C			3	
	Output swing from negtive rail	V_S = 5V, R_L = 10kΩ, T_A= –40°C to 125°C			20	mV
I_O	Output Source Current	V_S = 15 V, V_O = 2 V, V_{ID} = 1 V	20	40		mA
		V_S = 15 V, V_O = 0 V, V_{ID} = 1 V, T_A= – 40°C to 125°C	10			
	Output Sink Current	V_S = 15 V, V_O = 0 V, V_{ID} = 1 V, T_A= – 40°C to 125°C	5			
I_{SC}	Short-circuit current	V_S = 15 V		±40	±40	mA
Power Supply						
I_Q	Quiescent current per amplifier	V_S = 30 V,T_A= –40°C to 85°C		375	1050	μA
		V_S = 5 V,T_A= –40°C to 85°C		250	620	

12.Typical Characteristics

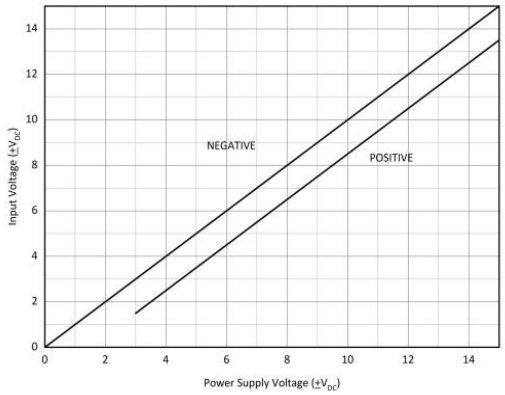


Figure 1: Input Voltage Range vs Power Supply

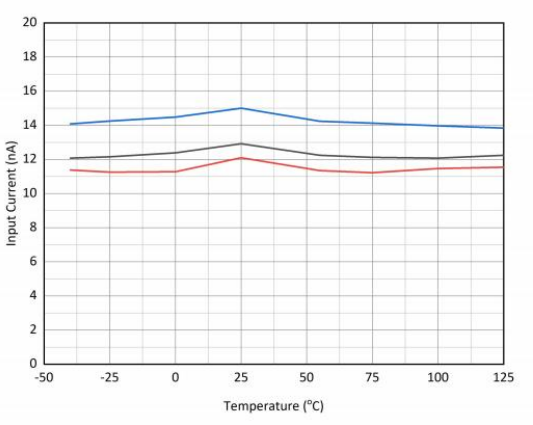


Figure 2: Input Bias Current vs Supply Voltage

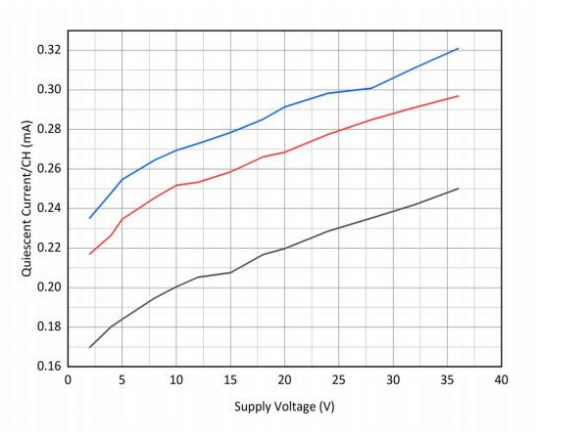


Figure 3: Supply Current per Channel vs Supply Voltage

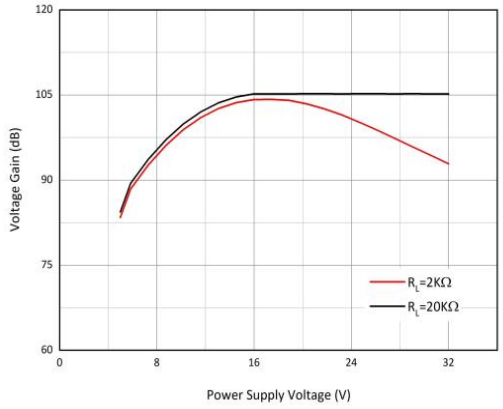


Figure 4: Voltage Gain vs Supply Voltage

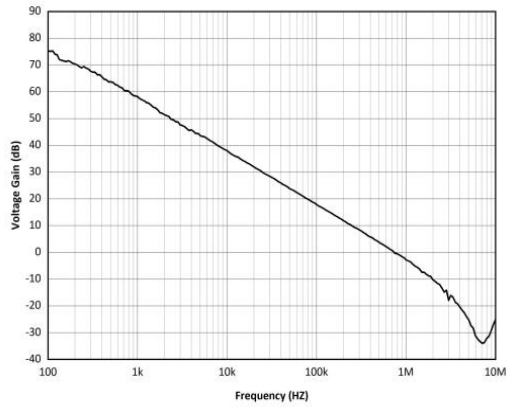


Figure 5: Open Loop Frequency Response

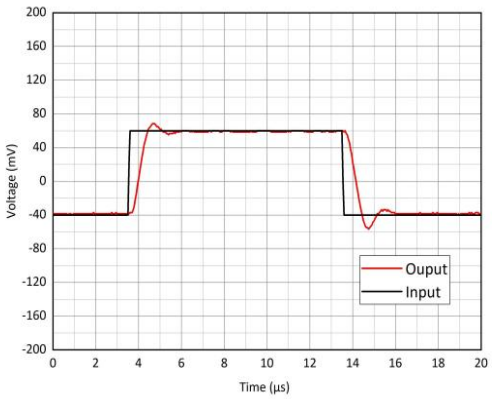


Figure 6: Voltage Follower Small Signal Response

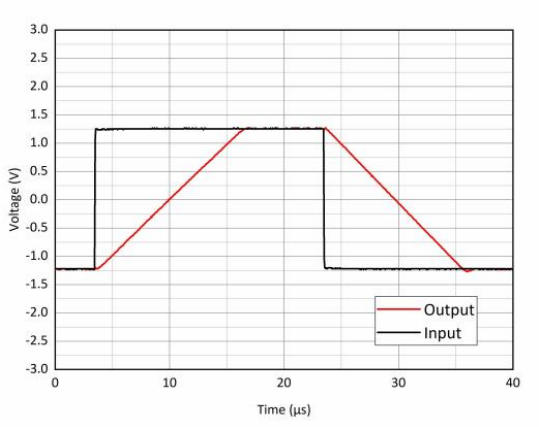


Figure 7: Voltage Follower Large Signal Response

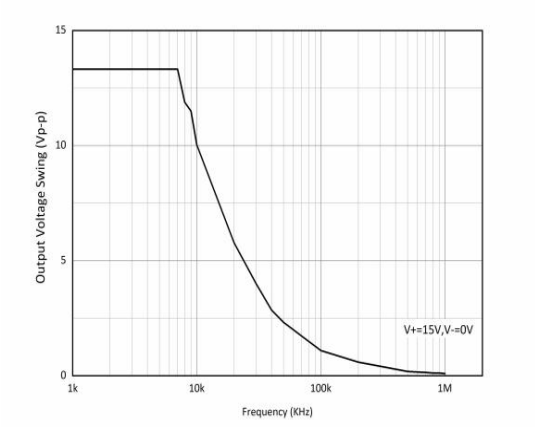


Figure 8: Maximum Output Swing vs Frequency (VCC = 15 V)

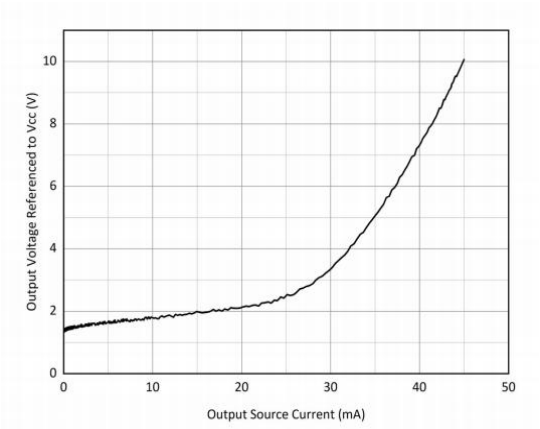


Figure 9: Output Sourcing Characteristics

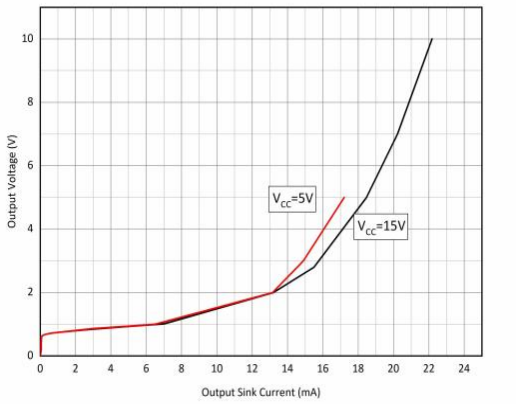


Figure 10: Output Sinking Characteristics

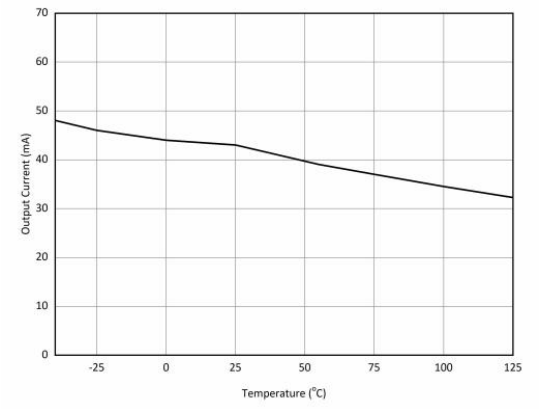
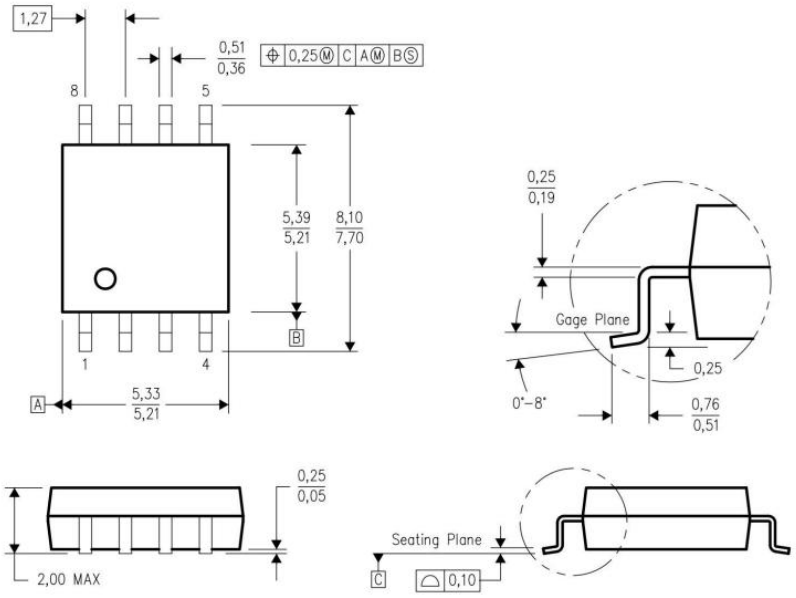


Figure 11: Source Current Limiting

13.Package Outline

(1) SOP8 Package Dimensions :



NOTE:

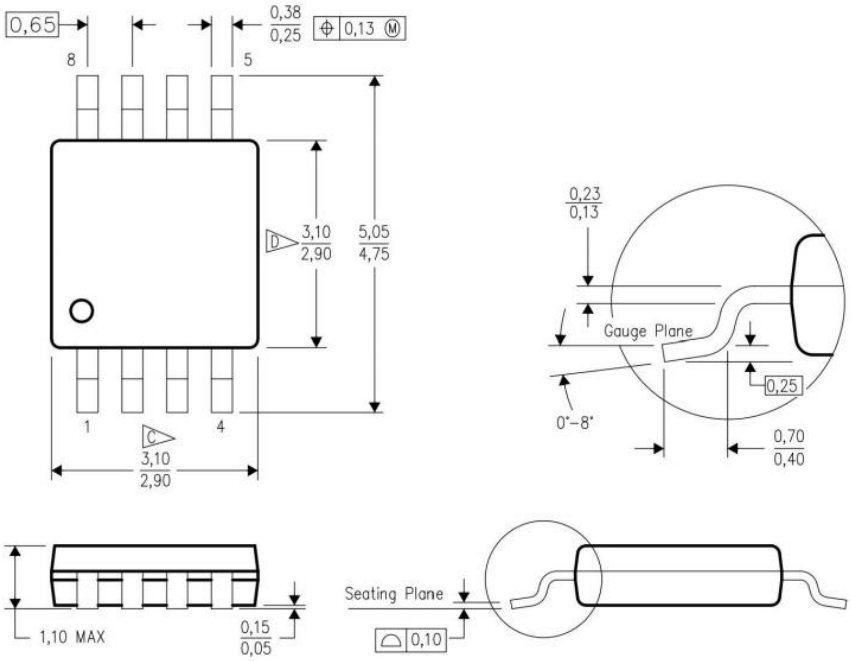
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only.

2. This drawing is subject to change without notice.

3. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.

4. Support pin may differ or may not be present.

(2) MSOP8 Package Dimensions :



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2. This drawing is subject to change without notice.

3. Body dimensions do not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0.25 mm per side.

4. Support pin may differ or may not be present.

14.Important Notice And Disclaimer

● We reserves the right to change the instruction manual without prior notice.

● Any semiconductor product has a certain possibility of failure or malfunction under specific conditions. The buyer is responsible for complying with safety standards and taking safety measures when using our products for system design and overall manufacturing to avoid potential failure risks that may cause personal injury or property damage.

● The improvement of product quality is endless, our company will be dedicated to provide customers with better products.