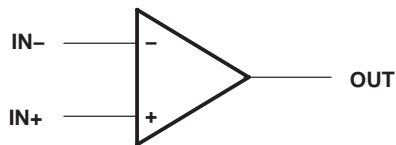




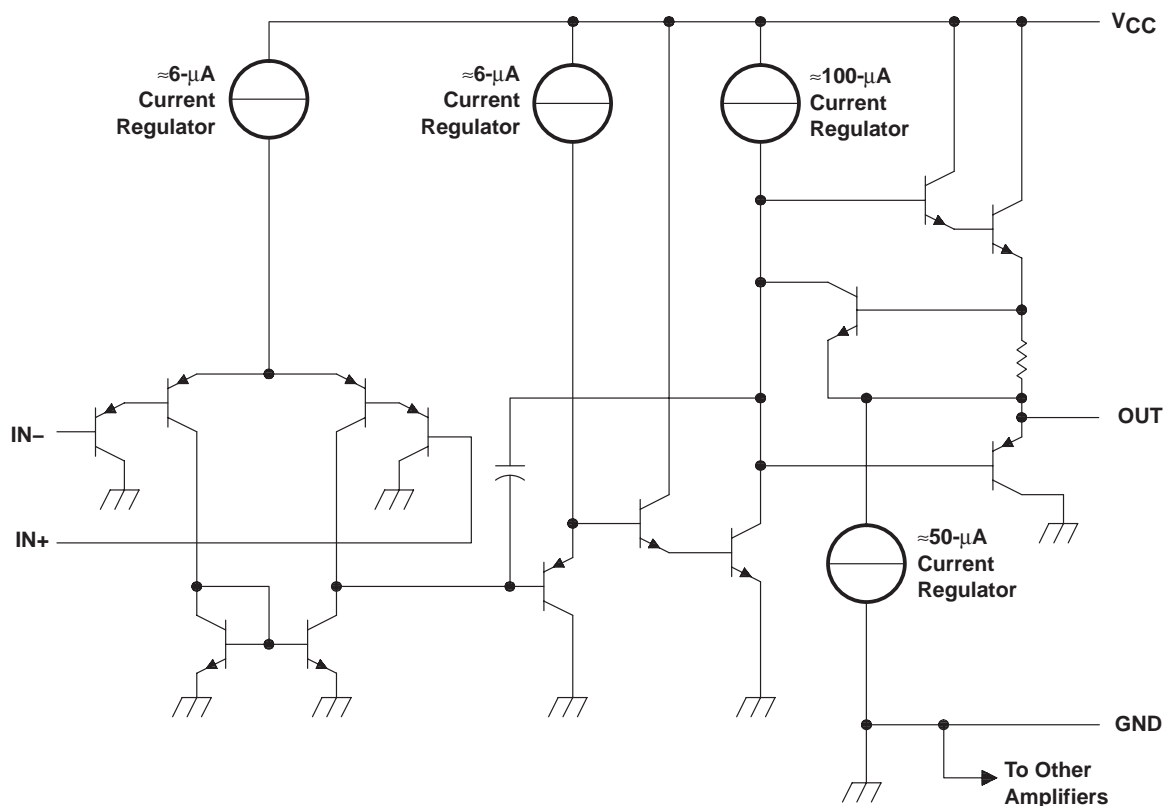
# LM2902-Q1 QUADRUPLE OPERATIONAL AMPLIFIER

SGLS178D – AUGUST 2003 – REVISED DECEMBER 2004

## symbol (each amplifier)



## schematic (each amplifier)



COMPONENT COUNT (TOTAL DEVICE)	
Epi-FET	1
Transistors	95
Diodes	4
Resistors	11
Capacitors	4

# LM2902-Q1 QUADRUPLE OPERATIONAL AMPLIFIER

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## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

	LM2902-Q1	LM2902KV-Q1	UNIT
Supply voltage, $V_{CC}$ (see Note 1)	26	32	V
Differential input voltage, $V_{ID}$ (see Note 2)	$\pm 26$	$\pm 32$	V
Input voltage, $V_I$ (either input)	-0.3 to 26	-0.3 to 32	V
Duration of output short circuit (one amplifier) to ground at (or below) $T_A = 25^\circ\text{C}$ , $V_{CC} \leq 15\text{ V}$ (see Note 3)	Unlimited	Unlimited	
Package thermal impedance, $\theta_{JA}$ (see Notes 4 and 5)	D package (0 LFPM)	101	$^\circ\text{C}/\text{W}$
	PW package	113	
Operating virtual junction temperature, $T_J$	142	142	$^\circ\text{C}$
Storage temperature range, $T_{stg}$	-65 to 150	-65 to 150	$^\circ\text{C}$

<sup>†</sup> 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.

- NOTES:
1. All voltage values, except differential voltages and  $V_{CC}$  specified for the measurement of  $I_{OS}$ , are with respect to the network GND.
  2. Differential voltages are at  $IN+$  with respect to  $IN-$ .
  3. Short circuits from outputs to  $V_{CC}$  can cause excessive heating and eventual destruction.
  4. Maximum power dissipation is a function of  $T_J(\text{max})$ ,  $\theta_{JA}$ , and  $T_A$ . The maximum allowable power dissipation at any allowable ambient temperature is  $P_D = (T_J(\text{max}) - T_A)/\theta_{JA}$ . Operating at the absolute maximum  $T_J$  of  $142^\circ\text{C}$  can affect reliability.
  5. The package thermal impedance is calculated in accordance with JESD 51-7.

# LM2902-Q1

## QUADRUPLE OPERATIONAL AMPLIFIER

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electrical characteristics at specified free-air temperature,  $V_{CC} = 5\text{ V}$  (unless otherwise noted)

PARAMETER	TEST CONDITIONS†	$T_A$ ‡	LM2902-Q1			UNIT
			MIN	TYP§	MAX	
$V_{IO}$ Input offset voltage	$V_{CC} = 5\text{ V to } 26\text{ V}$ , $V_{IC} = V_{ICRmin}, V_O = 1.4\text{ V}$	25°C	3	7		mV
		Full range			10	
$I_{IO}$ Input offset current	$V_O = 1.4\text{ V}$	25°C	2	50		nA
		Full range			300	
$I_{IB}$ Input bias current	$V_O = 1.4\text{ V}$	25°C	-20	-250		nA
		Full range			-500	
$V_{ICR}$ Common-mode input voltage range	$V_{CC} = 5\text{ V to } 26\text{ V}$	25°C	0 to $V_{CC} - 1.5$			V
		Full range	0 to $V_{CC} - 2$			
$V_{OH}$ High-level output voltage	$R_L = 10\text{ k}\Omega$	25°C	$V_{CC} - 1.5$			V
	$V_{CC} = 26\text{ V}$ , $R_L = 2\text{ k}\Omega$	Full range	22			
	$V_{CC} = 26\text{ V}$ , $R_L \geq 10\text{ k}\Omega$	Full range	23	24		
$V_{OL}$ Low-level output voltage	$R_L \leq 10\text{ k}\Omega$	Full range	5	20		mV
$AVD$ Large-signal differential voltage amplification	$V_{CC} = 15\text{ V}$ , $V_O = 1\text{ V to } 11\text{ V}$ , $R_L \geq 2\text{ k}\Omega$	25°C	100			V/mV
		Full range	15			
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin}$	25°C	50	80		dB
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC}/\Delta V_{IO}$ )		25°C	50	100		dB
$V_{O1}/V_{O2}$ Crosstalk attenuation	$f = 1\text{ kHz to } 20\text{ kHz}$	25°C	120			dB
$I_O$ Output current	$V_{CC} = 15\text{ V}$ , $V_{ID} = 1\text{ V}$ , $V_O = 0$	25°C	-20	-30	-60	mA
		Full range	-10			
	$V_{CC} = 15\text{ V}$ , $V_{ID} = -1\text{ V}$ , $V_O = 15\text{ V}$	25°C	10	20		
		Full range	5			
$I_{OS}$ Short-circuit output current	$V_{CC}$ at 5 V, $V_O = 0$ , GND at -5 V	25°C	±40	±60		mA
		Full range	0.7		1.2	
$I_{CC}$ Supply current (four amplifiers)	$V_O = 2.5\text{ V}$ , No load	Full range	0.7		1.2	mA
	$V_{CC} = 26\text{ V}$ $V_O = 0.5 V_{CC}$ , No load	Full range	1.4		3	

† All characteristics are measured under open-loop conditions, with zero common-mode input voltage, unless otherwise specified.

‡ Full range is -40°C to 125°C.

§ All typical values are at  $T_A = 25^\circ\text{C}$ .



# LM2902-Q1 QUADRUPLE OPERATIONAL AMPLIFIER

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**electrical characteristics at specified free-air temperature,  $V_{CC} = 5\text{ V}$  (unless otherwise noted)  
(continued)**

PARAMETER	TEST CONDITIONS†		$T_A$ ‡	LM2902KV-Q1			UNIT
				MIN	TYP§	MAX	
$V_{IO}$ Input offset voltage	$V_{CC} = 5\text{ V to }32\text{ V}$ , $V_{IC} = V_{ICRmin}$ , $V_O = 1.4\text{ V}$	Non-A devices	25°C	3	7	mV	
			Full range	10			
		A-suffix devices	25°C	1	2		
			Full range	4			
$\Delta V_{IO}/\Delta T$ Temperature drift	$R_S = 0\ \Omega$	Full range	7		$\mu\text{V}/^\circ\text{C}$		
$I_{IO}$ Input offset current	$V_O = 1.4\text{ V}$	25°C	2	50	nA		
		Full range	150				
$\Delta I_{IO}/\Delta T$ Temperature drift		Full range	10		$\text{pA}/^\circ\text{C}$		
$I_{IB}$ Input bias current	$V_O = 1.4\text{ V}$	25°C	-20	-250	nA		
		Full range	-500				
$V_{ICR}$ Common-mode input voltage range	$V_{CC} = 5\text{ V to }32\text{ V}$	25°C	0 to $V_{CC} - 1.5$		V		
		Full range	0 to $V_{CC} - 2$				
$V_{OH}$ High-level output voltage	$R_L = 10\text{ k}\Omega$	25°C	$V_{CC} - 1.5$		V		
	$V_{CC} = 32\text{ V}$ , $R_L = 2\text{ k}\Omega$	Full range	26				
	$V_{CC} = 32\text{ V}$ , $R_L \geq 10\text{ k}\Omega$	Full range	27				
$V_{OL}$ Low-level output voltage	$R_L \leq 10\text{ k}\Omega$	Full range	5	20	mV		
$A_{VD}$ Large-signal differential voltage amplification	$V_{CC} = 15\text{ V}$ , $V_O = 1\text{ V to }11\text{ V}$ , $R_L \geq 2\text{ k}\Omega$	25°C	25	100	V/mV		
		Full range	15				
Amplifier-to-amplifier coupling¶	$f = 1\text{ kHz to }20\text{ kHz}$ , input referred	25°C	120		dB		
CMRR Common-mode rejection ratio	$V_{IC} = V_{ICRmin}$	25°C	60	80	dB		
$k_{SVR}$ Supply-voltage rejection ratio ( $\Delta V_{CC}/\Delta V_{IO}$ )		25°C	60	100	dB		
$V_{O1}/V_{O2}$ Crosstalk attenuation	$f = 1\text{ kHz to }20\text{ kHz}$	25°C	120		dB		
$I_O$ Output current	$V_{CC} = 15$ $V_O = 0$	$V_{ID} = 1\text{ V}$ ,	25°C	-20	-30	-60	mA
			Full range	-10			
	$V_{CC} = 15$ $V_O = 15\text{ V}$	$V_{ID} = -1\text{ V}$ ,	25°C	10	20		
			Full range	5			
	$V_{ID} = -1\text{ V}$ , $V_O = 200\text{ mV}$	25°C	12	40		$\mu\text{A}$	
$I_{OS}$ Short-circuit output current	$V_{CC}$ at 5 V, GND at -5 V	$V_O = 0$ ,	25°C	$\pm 40$	$\pm 60$	mA	
$I_{CC}$ Supply current (four amplifiers)	$V_O = 2.5\text{ V}$ , No load		Full range	0.7	1.2	mA	
	$V_{CC} = 32\text{ V}$ $V_O = 0.5 V_{CC}$ , No load		Full range	1.4	3		

† All characteristics are measured under open-loop conditions, with zero common-mode input voltage, unless otherwise specified.

‡ Full range is  $-40^\circ\text{C}$  to  $125^\circ\text{C}$ .

§ All typical values are at  $T_A = 25^\circ\text{C}$ .

¶ Due to proximity of external components, ensure that coupling is not originating via stray capacitance between these external parts. Typically, this can be detected, as this type of coupling increases at higher frequencies.



# LM2902-Q1 QUADRUPLE OPERATIONAL AMPLIFIER

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operating conditions,  $V_{CC} = \pm 15\text{ V}$ ,  $T_A = 25^\circ\text{C}$

PARAMETER		TEST CONDITIONS	TYP	UNIT
SR	Slew rate at unity gain	$R_L = 1\text{ M}\Omega$ , $C_L = 30\text{ pF}$ , $V_I = \pm 10\text{ V}$ (see Figure 1)	0.5	$\text{V}/\mu\text{s}$
$B_1$	Unity-gain bandwidth	$R_L = 1\text{ M}\Omega$ , $C_L = 20\text{ pF}$ (see Figure 1)	1.2	MHz
$V_n$	Equivalent input noise voltage	$R_S = 100\ \Omega$ , $V_I = 0\text{ V}$ , $f = 1\text{ kHz}$ (see Figure 2)	35	$\text{nV}/\sqrt{\text{Hz}}$

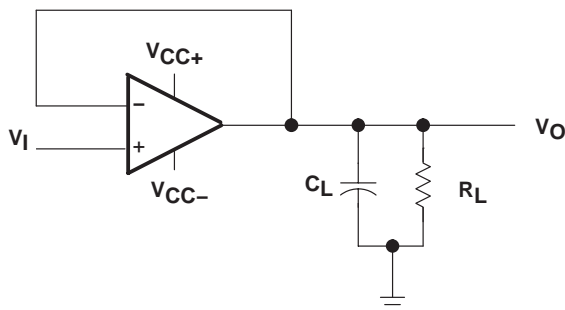


Figure 1. Unity-Gain Amplifier

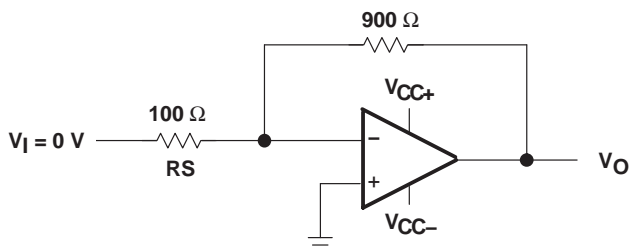


Figure 2. Noise-Test Circuit

**PACKAGING INFORMATION**

Orderable Device	Status <sup>(1)</sup>	Package Type	Package Drawing	Pins	Package Qty	Eco Plan <sup>(2)</sup>	Lead/Ball Finish	MSL Peak Temp <sup>(3)</sup>
LM2902KAVQDRQ1	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
LM2902KAVQPWRQ1	ACTIVE	TSSOP	PW	14	2000	None	CU NIPDAU	Level-1-250C-UNLIM
LM2902KVQDRQ1	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
LM2902KVQPWRQ1	ACTIVE	TSSOP	PW	14	2000	None	CU NIPDAU	Level-1-250C-UNLIM
LM2902QDRQ1	ACTIVE	SOIC	D	14	2500	Pb-Free (RoHS)	CU NIPDAU	Level-2-250C-1 YEAR/ Level-1-235C-UNLIM
LM2902QPWRQ1	ACTIVE	TSSOP	PW	14	2000	None	CU NIPDAU	Level-1-250C-UNLIM

<sup>(1)</sup> The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

<sup>(2)</sup> Eco Plan - May not be currently available - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**None:** Not yet available Lead (Pb-Free).

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

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<sup>(3)</sup> MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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D (R-PDSO-G14)

PLASTIC SMALL-OUTLINE PACKAGE



- NOTES:
- A. All linear dimensions are in inches (millimeters).
  - B. This drawing is subject to change without notice.
  - C. Body dimensions do not include mold flash or protrusion not to exceed 0.006 (0,15).
  - D. Falls within JEDEC MS-012 variation AB.

PW (R-PDSO-G\*\*)

PLASTIC SMALL-OUTLINE PACKAGE

14 PINS SHOWN



4040064/F 01/97

- NOTES: A. All linear dimensions are in millimeters.  
 B. This drawing is subject to change without notice.  
 C. Body dimensions do not include mold flash or protrusion not to exceed 0,15.  
 D. Falls within JEDEC MO-153

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