LM2902

Low power quad operational amplifier

Features

- Wide gain bandwidth: 1.3MHz
- Input common-mode voltage range includes negative rail
- Large voltage gain: 100dB
- Very low supply current per amp: 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

Description

This circuit consists of four independent, high gain, internally frequency compensated operational amplifiers designed especially 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 power supply voltage.

N
DIP14
(Plastic package)

D
SO-14
(Plastic micropackage)

P
TSSOP14
(Thin shrink small outline package)

2 Absolute maximum ratings

Table 1. Absolute maximum ratings (AMR)

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage (1)	±16 to 33	V
V_{id}	Differential input voltage (2)	+32	V
V_{in}	Input voltage	-0.3 to +32	V
	Output short-circuit duration (3)	Infinite	s
T_j	Maximum junction temperature	150	°C
I_{in}	Input current (4)	50	mA
T_{stg}	Storage temperature range	-65 to +150	°C
R_{thja}	Thermal resistance junction to ambient(5) SO-14 TSSOP14 DIP14	 105 100 80	°C/W
R_{thjc}	Thermal resistance junction to case(5) SO-14 TSSOP14 DIP14	 31 32 33	°C/W
ESD	HBM: human body model(6)	370	V
	MM: machine model(7)	150	V
	CDM: charged device model(8)	1500	V

1. All voltage values, except differential voltage are with respect to network ground terminal.
2. Differential voltages are the non-inverting input terminal with respect to the inverting input terminal.
3. Short-circuit from the output to V_{CC}^+ can cause excessive heating and eventual destruction. The maximum output current is approximately 20mA, independent of the magnitude of V_{CC}^+.
4. 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 V_{CC} 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.
5. $R_{thja/c}$ are typical values.
6. Human body model: A 100pF capacitor is charged to the specified voltage, then discharged through a 1.5kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins are floating.
7. Machine model: A 200pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5Ω). This is done for all couples of connected pin combinations while the other pins are floating.
8. Charged device model: all pins and the package are charged together to the specified voltage and then discharged directly to the ground through only one pin. This is done for all pins.

3 Operating conditions

Table 2. Operating conditions

Symbol	Parameter	Value	Unit
V_{CC}	Supply voltage	3 to 30	V
V_{icm}	Common mode input voltage range $T_{min} \leq T_{amb} \leq T_{max}$	V_{CC}^{+} - 1.5 V_{CC}^{+} -2	V
T_{oper}	Operating free-air temperature range	-40 to +125	°C

4 Electrical characteristics

Table 3. V_{CC}^+ = 5V, V_{CC}^- = Ground, V_o = 1.4V, T_{amb} = 25°C (unless otherwise specified)

Symbol	Parameter	Min.	Typ.	Max.	Unit
V_{io}	Input offset voltage (1) $T_{min} \le T_{amb} \le T_{max}$		2	7 9	mV
DV_{io}	Input offset voltage drift		7	30	µV/°C
I_{io}	Input offset current $T_{min} \le T_{amb} \le T_{max}$		2	30 40	nA
DI_{io}	Input offset current drift		10	200	pA/°C
I_{ib}	Input bias current (2) $T_{min} \le T_{amb} \le T_{max}$		20	150 300	nA
A_{vd}	Large signal voltage gain V_{CC}^+ = +15V, R_L=2kΩ, V_o = 1.4V to 11.4V $T_{min} \le T_{amb} \le T_{max}$	50 25	100		V/mV
SVR	Supply voltage rejection ratio (R_S ≤10kΩ) $T_{min} \le T_{amb} \le T_{max}$	65 65	110		dB
I_{cc}	Supply current, all amps, no load V_{CC}^+ = +5V V_{CC}^+ = +30V $T_{min} \le T_{amb} \le T_{max}$ V_{CC}^+ = +5V V_{CC}^+ = +30V		 0.7 1.5 0.8 1.5	 1.2 3 1.2 3	mA
CMR	Common-mode rejection ratio (R_S ≤ 10kΩ) $T_{min} \le T_{amb} \le T_{max}$	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 R_L = 2kΩ $T_{min} \le T_{amb} \le T_{max}$ R_L = 10kΩ $T_{min} \le T_{amb} \le T_{max}$ V_{CC}^+ = +5V, R_L = 2kΩ $T_{min} \le T_{amb} \le T_{max}$	 26 26 27 27 3 3.5	 27 28		V
V_{OL}	Low level output voltage (R_L = 10kΩ) $T_{min} \le T_{amb} \le T_{max}$		5	20 20	mV
SR	Slew rate V_{CC}^+ = 15V, V_{in} = 0.5 to 3V, R_L = 2kΩ, C_L = 100pF, unity gain		0.4		V/µs

Table 3. V_{CC}^+ = 5V, V_{CC}^- = Ground, V_o = 1.4V, T_{amb} = 25°C (unless otherwise specified)

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 = $2V_{pp}$, C_L = 100pF, V_{CC}^+ = 30V		0.015		%
e_n	Equivalent input noise voltage f = 1kHz, R_S = 100Ω, V_{CC}^+ = 30V		40		$\frac{nV}{\sqrt{Hz}}$
V_{O1}/V_{O2}	Channel separation (3) 1kHz ≤ f ≤ 20kHz		120		dB

1. V_O = 1.4V, R_S = 0Ω, 5V < V_{CC}^+ < 30V, 0V < V_{ic} < 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 there is no change in the loading charge on the input lines.
3. Due to the proximity of external components ensure stray capacitance does not cause coupling between these external parts. This typically can be detected as this type of capacitance increases at higher frequencies.

6.2 SO-14 package information

Figure 29. SO-14 package mechanical drawing

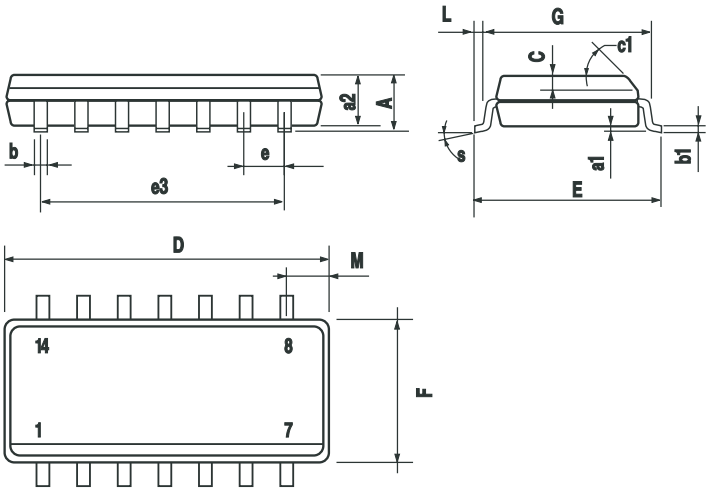

Table 5. SO-14 package mechanical data

Ref.	Dimensions					
	Millimeters			Inches		
	Min.	Typ.	Max.	Min.	Typ.	Max.
A			1.75			0.068
a1	0.1		0.2	0.003		0.007
a2			1.65			0.064
b	0.35		0.46	0.013		0.018
b1	0.19		0.25	0.007		0.010
C		0.5			0.019	
c1	45° (typ.)					
D	8.55		8.75	0.336		0.344
E	5.8		6.2	0.228		0.244
e		1.27			0.050	
e3		7.62			0.300	
F	3.8		4.0	0.149		0.157
G	4.6		5.3	0.181		0.208
L	0.5		1.27	0.019		0.050
M			0.68			0.026
S	8° (max.)					

7 Ordering information

Table 7. Order codes

Order code	Temperature range	Package	Packing	Marking
LM2902N	-40°C, +125°C	DIP14	Tube	LM2902N
LM2902D LM2902DT		SO-14	Tube or tape & reel	2902
LM2902PT		TSSOP14 (Thin shrink outline package)	Tape & reel	
LM2902YD(1) LM2902YDT(1)		SO-14 (Automotive grade level)	Tube or tape & reel	2902Y
LM2902YPT(2)		TSSOP14 (Automotive grade level)	Tape & reel	

1. Qualified and characterized according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent.
2. Qualification and characterization according to AEC Q100 and Q003 or equivalent, advanced screening according to AEC Q001 & Q 002 or equivalent are on-going.