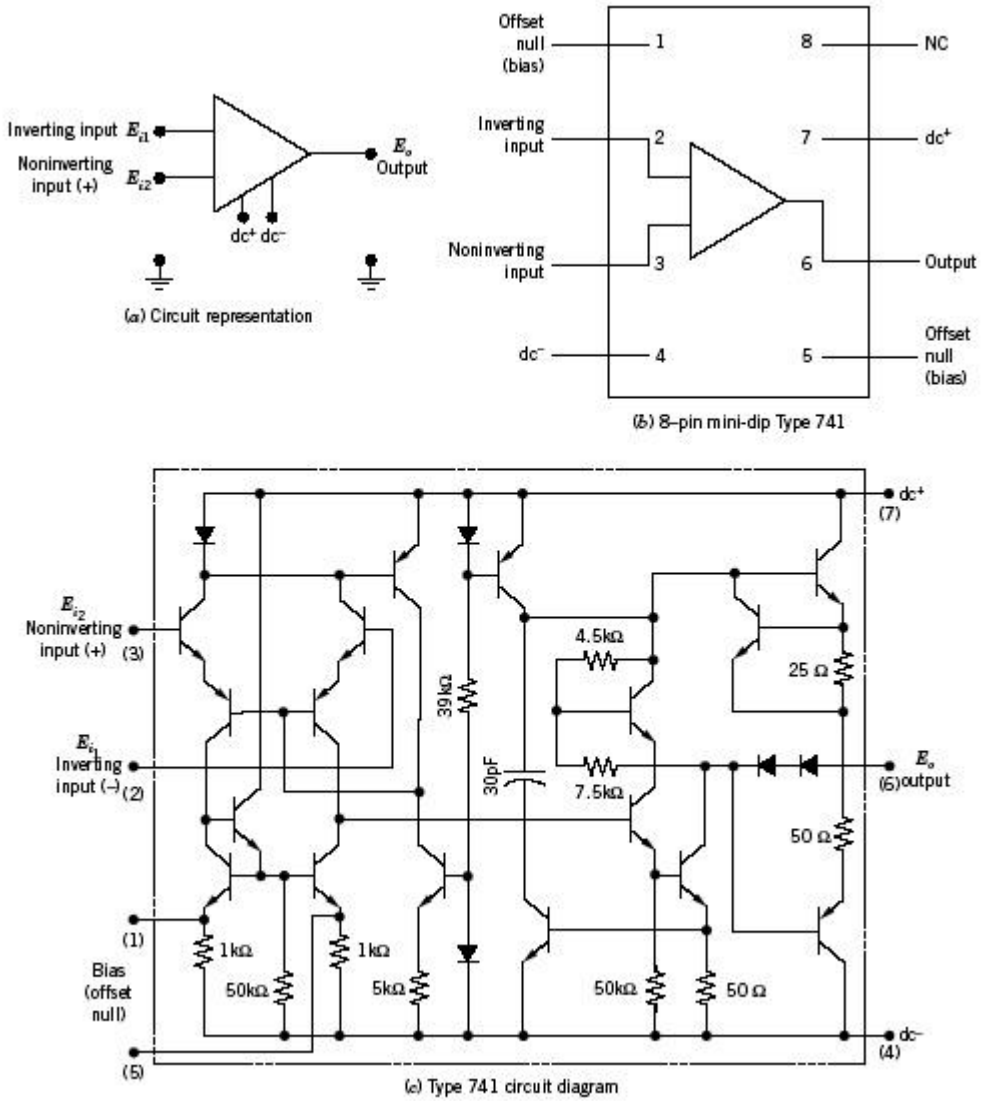


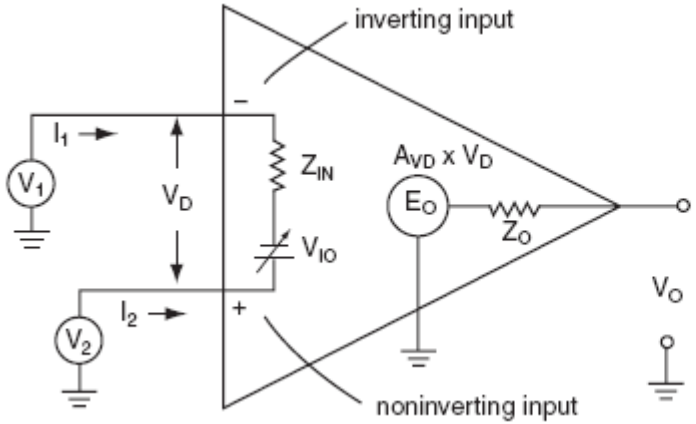
(a) Circuit representation

(b) 8-pin mini-dip Type 741

(c) Type 741 circuit diagram

Figure 6.19 Operational amplifier.

OPAMP



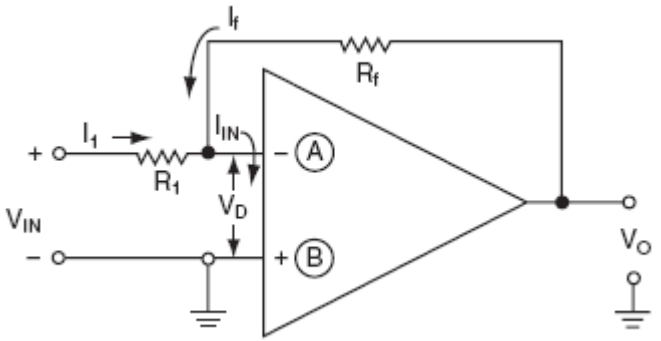
I_1, I_2 = Input currents
V_D = Differential input voltage
Z_{IN} = Input impedance
V_{IO} = Input offset voltage
A_{VD} = Open-loop differential voltage gain
Z_O = Output impedance
V_O = Output voltage

Ganho de malha aberta muito alto - A
Alta razão de rejeição de modo comum – CMRR
Alta impedância de entrada
Baixa impedância de saída

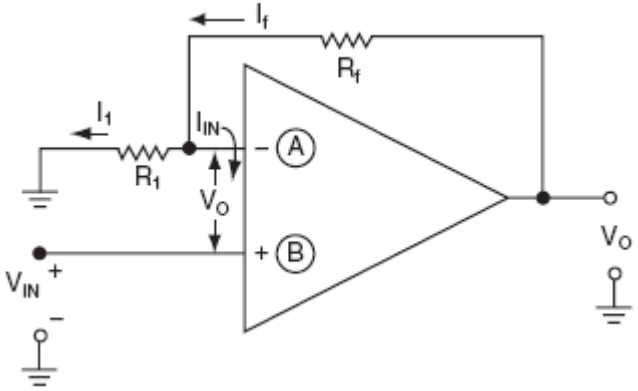
OPAMP

Configurações simples

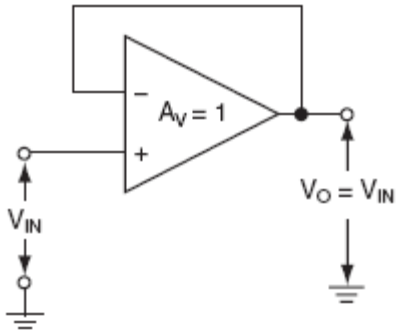
Amplif. Inversor



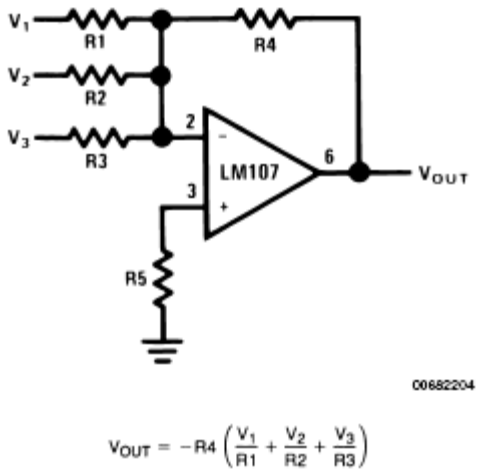
Amplif. Não-Inversor



Seguidor de tensão



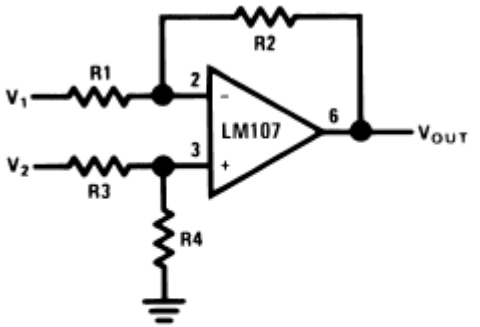
Somador



$$V_{OUT} = -R4\left(\frac{V_1}{R1} + \frac{V_2}{R2} + \frac{V_3}{R3}\right)$$

OPAMP

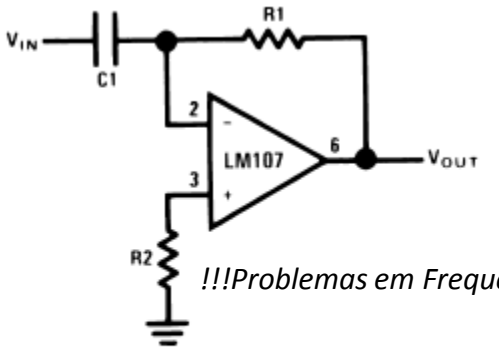
Amplif. de Diferença



00682205

$$V_{OUT} = \left(\frac{R1 + R2}{R3 + R4}\right)\frac{R4}{R1}V_2 - \frac{R2}{R1}V_1$$

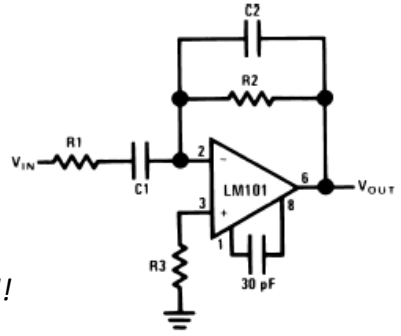
Diferenciador



00682206

$$V_{OUT} = -R1C1\frac{d}{dt}(V_{IN})$$

!!!Problemas em Frequências Altas!!!



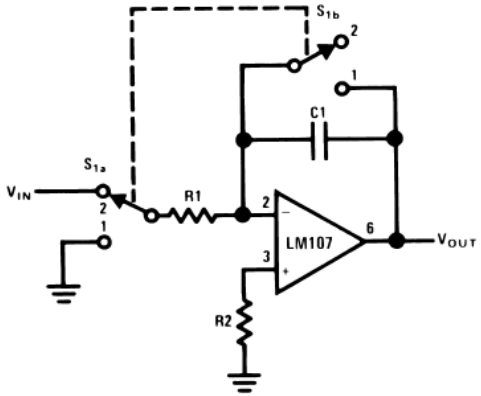
00682207

$$f_c = \frac{1}{2\pi R2C1}$$

$$f_h = \frac{1}{2\pi R1C1} = \frac{1}{2\pi R2C2}$$

$$f_c < f_h < f_{unity\ gain}$$

Integrador



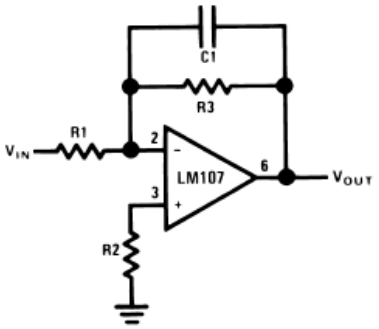
00682209

$$V_{OUT} = \frac{1}{R1C1}\int_{t_1}^{t_2} V_{IN}\,dt$$

$$f_c = \frac{1}{2\pi R1C1}$$

$R1 = R2$

Filtro PB



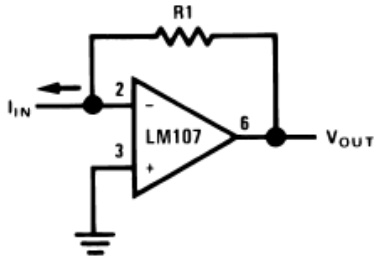
00682211

$$f_L = \frac{1}{2\pi R1C1}$$

$$f_c = \frac{1}{2\pi R3C1}$$

$$A_L = \frac{R3}{R1}$$

Conversor I-V

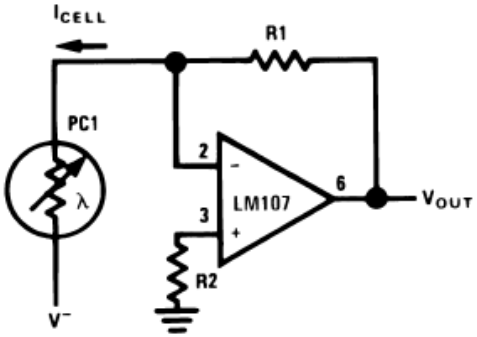


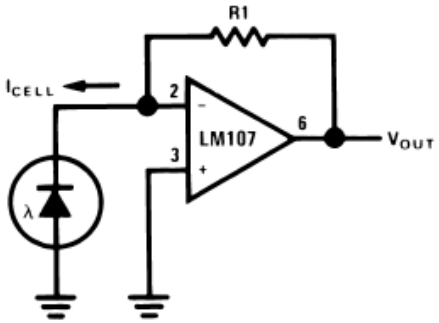
00682213

$$V_{OUT} = I_{IN}\,R1$$

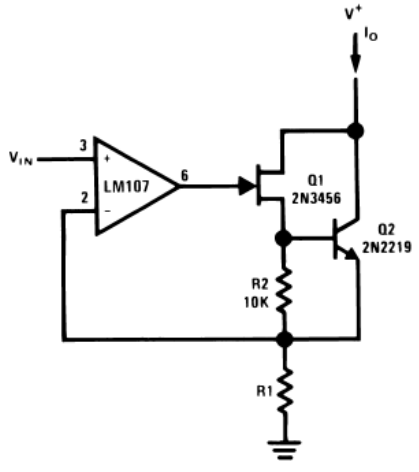
OPAMP

Amplif. p/ Célula Fotocondutora e fotovoltaica





Fonte de Corrente



$$I_O = \frac{V_{IN}}{R1}$$

An Applications Guide for Op Amps

National Semiconductor
Application Note 20
February 1969

Características Importantes (Exemplo de caso)

ANALOG DEVICES

Low Noise, Precision Operational Amplifier

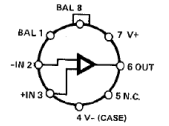
OP-27

ABSOLUTE MAXIMUM RATINGS (Note 4)

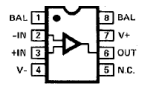
Supply Voltage ..... ±22V
Input Voltage (Note 1) ..... ±22V
Output Short-Circuit Duration ..... Indefinite
Differential Input Voltage (Note 2) ..... ±0.7V
Differential Input Current (Note 2) ..... ±25mA
Storage Temperature Range ..... –65°C to +150°C
Operating Temperature Range
OP-27A, OP-27B, OP-27C (J, Z, RC)..... –55°C to +125°C
OP-27E, OP-27F (J, Z) ..... –25°C to +85°C
OP-27E, OP-27F (P)..... 0°C to +70°C
OP-27G (P, S, J, Z)..... –40°C to +85°C
Lead Temperature Range (Soldering, 60 sec) ..... 300°C
Junction Temperature ..... –65°C to +150°C

PACKAGE TYPE	Θ_{JA} (Note 3)	Θ_{JC}	UNITS
TO-99 (J)	150	18	°C/W
8-Pin Hermetic DIP (Z)	148	16	°C/W
8-Pin Plastic DIP (P)	103	43	°C/W
20-Contact LCC (RC)	98	38	°C/W
8-Pin SO (S)	158	43	°C/W

NOTES:
1. For supply voltages less than ±22V, the absolute maximum input voltage is equal to the supply voltage.
2. The OP-27's inputs are protected by back-to-back diodes. Current limiting resistors are not used in order to achieve low noise. If differential input voltage exceeds ±0.7V, the input current should be limited to 25mA.
3. Θ_{JA} is specified for worst case mounting conditions, i.e., Θ_{JA} is specified for device in socket for TO, CerDIP, P-DIP, and LCC packages; Θ_{JA} is specified for device soldered to printed circuit board for SO package.
4. Absolute maximum ratings apply to both DICE and packaged parts, unless otherwise noted.



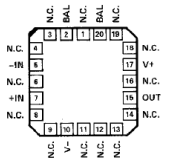
TO-99
(J-Suffix)



8-PIN HERMETIC DIP
(Z-Suffix)

EPOXY MINI-DIP
(P-Suffix)

8-PIN SO
(S-Suffix)



OP-27BRC/883
LCC PACKAGE
(RC-Suffix)

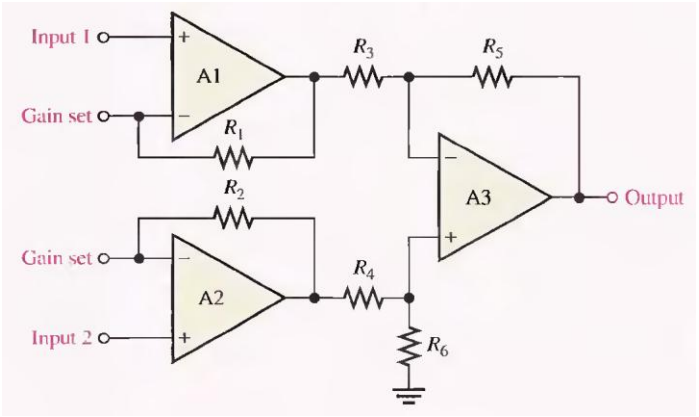
ELECTRICAL CHARACTERISTICS at $V_S = \pm 15V$, $T_A = 25°C$, unless otherwise noted.

PARAMETER	SYMBOL	CONDITIONS	OP-27A/E MIN	OP-27A/E TYP	OP-27A/E MAX	OP-27B/F MIN	OP-27B/F TYP	OP-27B/F MAX	OP-27C/G MIN	OP-27C/G TYP	OP-27C/G MAX	UNITS
Input Offset Voltage	V_{OS}	(Note 1)	—	10	25	—	20	60	—	30	100	µV
Long-Term V_{OS} Stability	V_{OS}/Time	(Notes 2, 3)	—	0.2	1.0	—	0.3	1.5	—	0.4	2.0	µV/Mo
Input Offset Current	I_{OS}		—	7	35	—	9	50	—	12	75	nA
Input Bias Current	I_B		—	±10	±40	—	±12	±55	—	±15	±80	nA
Input Noise Voltage	e_{np-p}	0.1Hz to 10Hz (Notes 3, 5)	—	0.08	0.18	—	0.08	0.18	—	0.09	0.25	µVp-p
Input Noise Voltage Density	e_n	f_O = 10Hz (Note 3)	—	3.5	5.5	—	3.5	5.5	—	3.8	8.0	nV/√Hz
		f_O = 30Hz (Note 3)	—	3.1	4.5	—	3.1	4.5	—	3.3	5.6	
		f_O = 1000Hz (Note 3)	—	3.0	3.8	—	3.0	3.8	—	3.2	4.5	
Input Noise Current Density	i_n	f_O = 10Hz (Notes 3,6)	—	1.7	4.0	—	1.7	4.0	—	1.7	—	pA/√Hz
		f_O = 30Hz (Notes 3, 6)	—	1.0	2.3	—	1.0	2.3	—	1.0	—	
		f_O = 1000Hz (Notes 3, 6)	—	0.4	0.6	—	0.4	0.6	—	0.4	0.6	
Input Resistance — Differential-Mode	R_{IN}	(Note 7)	1.3	6	—	0.94	5	—	0.7	4	—	MΩ
Input Resistance — Common-Mode	R_{INCM}		—	3	—	—	2.5	—	—	2	—	GΩ
Input Voltage Range	IVR		±11.0	±12.3	—	±11.0	±12.3	—	±11.0	±12.3	—	V
Common-Mode Rejection Ratio	CMRR	$V_{CM} = \pm 11V$	114	126	—	106	123	—	100	120	—	dB
Power Supply Rejection Ratio	PSRR	$V_S = \pm 4V$ to $\pm 18V$	—	1	10	—	1	10	—	2	20	µV/V
Large-Signal Voltage Gain	A_{VO}	$R_L \geq 2k\Omega$, $V_O = \pm 10V$	1000	1800	—	1000	1800	—	700	1500	—	V/mV
		$R_L \geq 600\Omega$, $V_O = \pm 10V$	800	1500	—	800	1500	—	600	1500	—	
Output Voltage Swing	V_O	$R_L \geq 2k\Omega$	±12.0	±13.8	—	±12.0	±13.8	—	±11.5	±13.5	—	V
		$R_L \geq 600\Omega$	±10.0	±11.5	—	±10.0	±11.5	—	±10.0	±11.5	—	
Slew Rate	SR	$R_L \geq 2k\Omega$ (Note 4)	1.7	2.8	—	1.7	2.8	—	1.7	2.8	—	V/µs

ELECTRICAL CHARACTERISTICS at $V_S = \pm 15V$, $T_A = 25°C$, unless otherwise noted. (Continued)

PARAMETER	SYMBOL	CONDITIONS	OP-27A/E MIN	OP-27A/E TYP	OP-27A/E MAX	OP-27B/F MIN	OP-27B/F TYP	OP-27B/F MAX	OP-27C/G MIN	OP-27C/G TYP	OP-27C/G MAX	UNITS
Gain Bandwidth Prod.	GBW	(Note 4)	5.0	8.0	—	5.0	8.0	—	5.0	8.0	—	MHz
Open-Loop Output Resistance	R_O	$V_O = 0$, $I_O = 0$	—	70	—	—	70	—	—	70	—	Ω
Power Consumption	P_d	V_O	—	90	140	—	90	140	—	100	170	mW
Offset Adjustment Range		$R_P = 10k\Omega$	—	±4.0	—	—	±4.0	—	—	±4.0	—	mV

Amplificador de Instrumentação



$$A_{cl} = 1 + \frac{2R}{R_G}$$

Alta impedância de entrada
Rejeição de modo comum