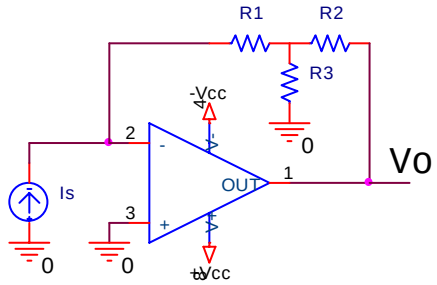
SENSORES OPTICOS (enero-2005)

Para acondicionar sensores que proporcionan salida en corriente con una pequeña sensibilidad es necesario utilizar resistencias de valor elevado para obtener la suficiente ganancia. La “red en T” permite obtener resistencias equivalentes de valor elevado sin necesidad de utilizar componentes de gran valor óhmico.



a) Determinar la expresión de la resistencia equivalente de la red en T.

b) Determina el error absoluto a la salida asociado a la tensión offset del A.O.

c) Determina el error absoluto a la salida asociado a las corrientes de polarización de entrada del A.O.

SENSORES OPTICOS

Se dispone de un fotodiodo que tiene una sensibilidad de 0.43 µA/µW, una capacidad parásita de 20 pF y una resistencia de fugas de 100 MΩ. Se conecta a un amplificador de transimpedancia con R = 10 MΩ y C = 2 pF, basado en el TLC2201B, alimentado entre 0 y 5 V. Si a la salida se conecta un filtro que deja pasar la banda entre 10 Hz y 10 kHz, ¿Cuál es la tensión de ruido a la salida?

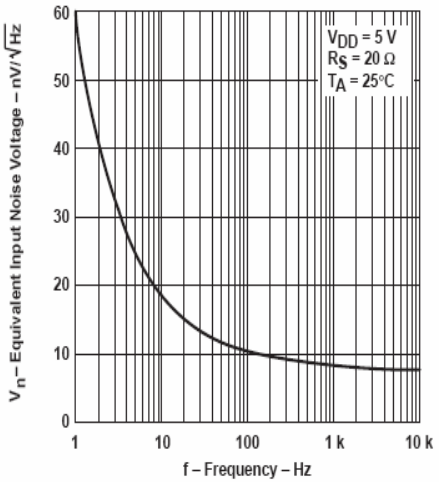
- **B Grade Is 100% Tested for Noise**
  30 nV/√Hz Max at f = 10 Hz
  12 nV/√Hz Max at f = 1 kHz
- **Low Input Offset Voltage . . . 500 μV Max**
- **Excellent Offset Voltage Stability With Temperature . . . 0.5 μV/°C Typ**
- **Rail-to-Rail Output Swing**
- **Low Input Bias Current**
  1 pA Typ at T_A = 25°C
- **Common-Mode Input Voltage Range Includes the Negative Rail**
- **Fully Specified For Both Single-Supply and Split-Supply Operation**

description

The TLC220x, TLC220xA, TLC220xB, and TLC220xY are precision, low-noise operational amplifiers using Texas Instruments Advanced LinCMOS™ process. These devices combine the noise performance of the lowest-noise JFET amplifiers with the dc precision available previously only in bipolar amplifiers. The Advanced LinCMOS™ process uses silicon-gate technology to obtain input offset voltage stability with temperature and time that far exceeds that obtainable using metal-gate technology. In addition, this technology makes possible input impedance levels that meet or exceed levels offered by top-gate JFET and expensive dielectric-isolated devices.

The combination of excellent dc and noise performance with a common-mode input voltage range that includes the negative rail makes these devices an ideal choice for high-impedance, low-level signal-conditioning applications in either single-supply or split-supply configurations.

TYPICAL EQUIVALENT
INPUT NOISE VOLTAGE
vs
FREQUENCY



TLC220x, TLC220xA, TLC220xB, TLC220xY
Advanced LinCMOS™ LOW-NOISE PRECISION
OPERATIONAL AMPLIFIERS
SLOS175 – FEBRUARY 1997

TLC2201I electrical characteristics at specified free-air temperature, V_{DD} = 5 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A†	TLC2201AI			TLC2201BI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	V_{IC} = 0, R_S = 50 Ω	25°C		80	200		80	200	μA
			Full range			350			350	
α_{VIO}	Temperature coefficient of input offset voltage		Full range		0.5			0.5		μV/°C
	Input offset voltage long-term drift (see Note 4)		25°C		0.001	0.005		0.001	0.005	μV/mo
I_{IO}	Input offset current		25°C		0.5			0.5		pA
			Full range			150			150	
I_{IB}	Input bias current		25°C		1			1		pA
			Full range			150			150	
V_{ICR}	Common-mode input voltage range	R_S = 50 Ω	Full range	0 to 2.7			0 to 2.7			V
V_{OH}	Maximum high-level output voltage	R_L = 10 kΩ	25°C	4.7	4.8		4.7	4.8		V
			Full range	4.7			4.7			
V_{OL}	Maximum low-level output voltage	I_O = 0	25°C		0	50		0	50	mV
			Full range			50			50	
A_{VD}	Large-signal differential voltage amplification	V_O = 1 V to 4 V, R_L = 500 kΩ	25°C	150	315		150	315		V/mV
			Full range	100			100			
		V_O = 1 V to 4 V, R_L = 10 kΩ	25°C	25	55		25	55		
			Full range	15			15			
CMRR	Common-mode rejection ratio	V_{IC} = V_{ICR}min, V_O = 0, R_S = 50 Ω	25°C	90	110		90	110		dB
			Full range	85			85			
k_{SVR}	Supply voltage rejection ratio ($\Delta V_{DD\pm}/\Delta V_{IO}$)	V_{DD} = 4.6 V to 16 V	25°C	90	110		90	110		dB
			Full range	85			85			
I_{DD}	Supply current	V_O = 2.5 V, No load	25°C		1	1.5		1	1.5	mA
			Full range			1.5			1.5	

TLC2201I operating characteristics at specified free-air temperature, V_{DD} = 5 V

PARAMETER		TEST CONDITIONS	T_A†	TLC2201AI			TLC2210BI			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate at unity gain	V_O = 0.5 V to 2.5 V, R_L = 10 kΩ, C_L = 100 pF	25°C	1.8	2.5		1.8	2.5		V/μs
			Full range	1.2			1.2			
V_n	Equivalent input noise voltage (see Note 5)	f = 10 Hz	25°C		18	35		18	30	nV/√Hz
		f = 1 kHz	25°C		8	15		8	12	
$V_{N(PP)}$	Peak-to-peak equivalent input noise voltage	f = 0.1 to 1 Hz	25°C		0.5			0.5		μV
		f = 0.1 to 10 Hz	25°C		0.7			0.7		
I_n	Equivalent input noise current		25°C		0.6			0.6		fA/√Hz
	Gain-bandwidth product	f = 10 kHz, R_L = 10 kΩ, C_L = 100 pF	25°C		1.8			1.8		MHz
ϕ_m	Phase margin at unity gain	R_L = 10 kΩ, C_L = 100 pF	25°C		45°			45°		

† Full range is –40°C to 85°C.

NOTE 5: This parameter is tested on a sample basis for the TLC2201A and on all devices for the TLC2201B. For other test requirements, please contact the factory. This statement has no bearing on testing or nontesting of other parameters.

SENSORES OPTICOS

Se desea acondicionar la señal del fotodiodo HP 5082-4204 mediante un amplificador corriente-tensión (transimpedancia -R con una pequeña C en paralelo en la realimentación-) usando el A.O. OPA128J de Burr-Brown, cuyas características se adjuntan.

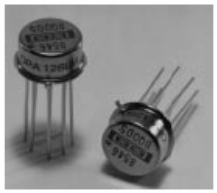
A 770 nm, la sensibilidad del fotodiodo es de 0.5 μA/μW, su resistencia de fugas es de 100 GΩ, y su capacidad cuando no se polariza inversamente es de 6.5 pF. Entre el A.O. y el montaje se añaden 3.5 pF más.

Si el A.O. se supone ideal, ¿cuánto debe valer R para tener a la salida una sensibilidad de 1V/μW?

¿Qué error se produce si, ignorando que la ganancia en lazo abierto del A.O es limitada, suponemos que a 10 kHz la sensibilidad es la misma que a baja frecuencia?

¿Qué error produce a 10 kHz la limitada resistencia de entrada del A.O?

BURR-BROWN®



OPA128

Difet® Electrometer-Grade OPERATIONAL AMPLIFIER

FEATURES

- ULTRA-LOW BIAS CURRENT: 75fA max
- LOW OFFSET: 500µV max
- LOW DRIFT: 5µV/°C max
- HIGH OPEN-LOOP GAIN: 110dB min
- HIGH COMMON-MODE REJECTION: 90dB min
- IMPROVED REPLACEMENT FOR AD515 AND AD549

APPLICATIONS

- ELECTROMETER
- MASS SPECTROMETER
- CHROMATOGRAPH
- ION GAUGE
- PHOTODETECTOR
- RADIATION-HARD EQUIPMENT

DESCRIPTION

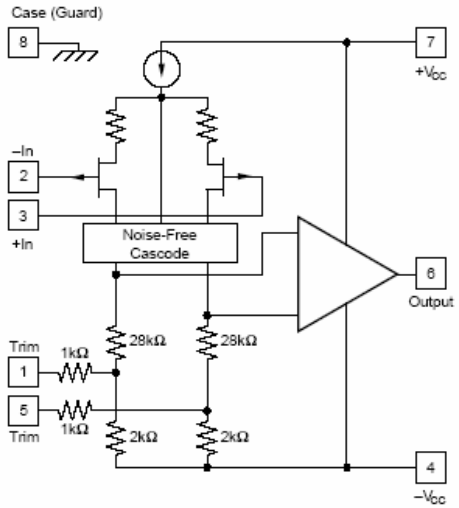
The OPA128 is an ultra-low bias current monolithic operational amplifier. Using advanced geometry dielectrically-isolated FET (***Difet***®) inputs, this monolithic amplifier achieves a performance level exceeding even the best hybrid electrometer amplifiers.

Laser-trimmed thin-film resistors give outstanding voltage offset and drift performance.

A noise-free cascode and low-noise processing give the OPA128 excellent low-level signal handling capabilities. Flicker noise is very low.

The OPA128 is an improved pin-for-pin replacement for the AD515.

Difet® Burr-Brown Corp.



OPA128 Simplified Circuit

SPECIFICATIONS

ELECTRICAL

At V_{CC} = ±15VDC and T_A = +25°C unless otherwise noted. Pin 8 connected to ground.

PARAMETER	CONDITIONS	OPA128JM			OPA128KM			OPA128LM			OPA128SM			UNITS
		MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	MIN	TYP	MAX	
BIAS CURRENT[1]														
Input Bias Current	V_{CM} = 0VDC, $R_L \geq 10k\Omega$		±150	±300		±75	±150		±40	±75		±75	±150	fA
OFFSET CURRENT[1]														
Input Offset Current	V_{CM} = 0VDC, $R_L \geq 10k\Omega$		65			30			30			30		fA
OFFSET VOLTAGE[1]														
Input Offset Voltage	V_{CM} = 0VDC		±280	±1000		±140	±500		±140	±500		±140	±500	µV
Average Drift	$T_A = T_{MIN}$ to T_{MAX}			±20			±10			±5			±10	µV/°C
Supply Rejection		80	120		90	120		90	120		90	120		dB
			±1	±100		±1	±32		±1	±32		±1	±32	µV/V
NOISE														
Voltage: f_O = 10Hz			92			92			92			92		nV/√Hz
f_O = 100Hz			78			78			78			78		nV/√Hz
f_O = 1kHz			27			27			27			27		nV/√Hz
f_O = 10kHz			15			15			15			15		nV/√Hz
f_B = 10Hz to 10kHz			2.4			2.4			2.4			2.4		µVrms
f_B = 0.1Hz to 10Hz			4			4			4			4		µVp-p
Current: f_B = 0.1Hz to 10Hz			4.2			3			2.3			3		fA, p-p
f_O = 0.1Hz to 20kHz			0.22			0.16			0.12			0.16		fA/√Hz
IMPEDANCE														
Differential			10^{13} || 1			10^{13} || 1			10^{13} || 1			10^{13} || 1		Ω || pF
Common-Mode			10^{15} || 2			10^{15} || 2			10^{15} || 2			10^{15} || 2		Ω || pF
VOLTAGE RANGE[4]														
Common-Mode Input Range		±10	±12		±10	±12		±10	±12		±10	±12		V
Common-Mode Rejection	V_{IN} = ±10VDC	80	118		90	118		90	118		90	118		dB
Open-Loop Voltage Gain	$R_L \geq 2k\Omega$	94	128		110	128		110	128		110	128		dB
Unity Gain, Small Signal	[2]	0.5	1		0.5	1		0.5	1		0.5	1		MHz
Full Power Response	20Vp-p, R_L = 2kΩ		47			47			47			47		kHz
Slew Rate	V_O = ±10V, R_L = 2kΩ	0.5	3		1	3		1	3		1	3		V/µs
Settling Time, 0.1%	Gain = –1, R_L = 2kΩ		5			5			5			5		µs
0.01%	10V Step		10			10			10			10		µs
Overload Recovery, 50% Overdrive[3]	Gain = –1		5			5			5			5		µs
Voltage Output	R_L = 2kΩ	±10	±13		±10	±13		±10	±13		±10	±13		V
Current Output	V_O = ±10VDC	±5	±10		±5	±10		±5	±10		±5	±10		mA
Output Resistance	DC, Open Loop		100			100			100			100		Ω
Load Capacitance Stability	Gain = +1		1000			1000			1000			1000		pF
Short Circuit Current		10	34	55	10	34	55	10	34	55	10	34	55	mA
Rated Voltage			±15			±15			±15			±15		VDC
Voltage Range, Derated Performance		±5		±18	±5		±18	±5		±18	±5		±18	VDC
Current, Quiescent	I_O = 0mADC		0.9	1.5		0.9	1.5		0.9	1.5		0.9	1.5	mA
Specification	Ambient Temp.	0		+70	0		+70	0		+70	–55		+125	°C
Operating	Ambient Temp.	–55		+125	–55		+125	–55		+125	–55		+125	°C
Storage	Ambient Temp.	–65		+150	–65		+150	–65		+150	–65		+150	°C
θ Junction-Ambient			200			200			200			200		°C/W

NOTES: (1) Offset voltage, offset current, and bias current are measured with the units fully warmed up. Bias current doubles approximately every 11°C. (2) Sample tested. (3) Overload recovery is defined as the time required for the output to return from saturation to linear operation following the removal of a 50% input overdrive. (4) If it is possible for the input voltage to exceed the supply voltage, a series protection resistor should be added to limit input current to 0.5mA. The input devices can withstand overload currents of 0.3mA indefinitely without damage.

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