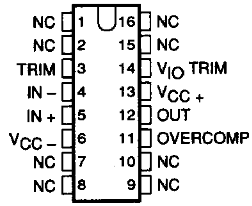
D3239, MAY 1988 – REVISED MARCH 1989

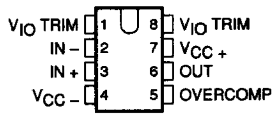
- **Very Low Input Noise Voltage: 1.1 nV/√Hz Max , 0.85 nV/√Hz Typ at 1 kHz for LT1028AM, LT1028AC**
- **Low Peak-To-Peak Input Noise Voltage . . . 35 nV Typ at f = 0.1 Hz to 10 Hz**
- **Noise Voltage and Current 100% Tested**
- **Gain-Bandwidth Product . . . 50 MHz Min**
- **Slew Rate . . . 11 V/µs Min**
- **Input Offset Voltage . . . 40 µV Max at 25°C for LT1028AM, LT1028AC**
- **Offset Voltage Temperature Coefficient . . . 0.8 µV/°C Max for LT1028AM, LT1028AC**
- **Applications:**
  - **Low-Noise Frequency Synthesizers**
  - **High-Quality Audio**
  - **Infrared Detectors**
  - **Accelerometer and Gyro Amplifiers**
  - **350-Ω Bridge Signal Conditioning**
  - **Magnetic Search Coil Amplifiers**
  - **Hydrophone Amplifiers**

DW PACKAGE (TOP VIEW)

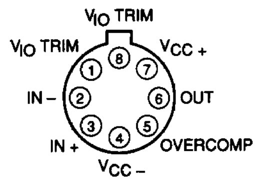


NC – No internal connection

JG OR P PACKAGE (TOP VIEW)



L PACKAGE (TOP VIEW)



Pin 4 (L package) is in electrical contact with the case.

description

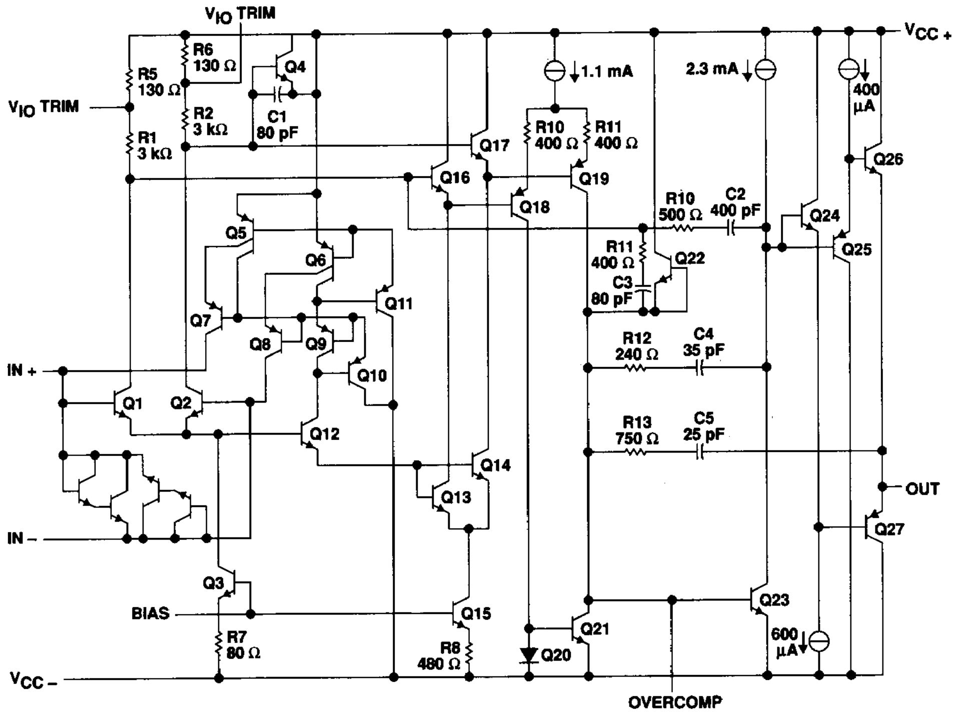
The LT1028 features excellent noise performance combined with high-speed specifications, distortion-free output, and true precision parameters. Although the LT1028 input stage operates at collector currents of nearly 1 mA to achieve low voltage noise, the input bias current is only 25 or 30 nA at 25°C. The noise voltage of the LT1028 is less than the noise of a 50-Ω resistor. Therefore, even in very-low-source-impedance transducer or audio amplifier applications, the device's contribution to total system noise will be negligible.

The LT1028AM and LT1028M are characterized for operation over the full military temperature range of –55°C to 125°C. The LT1028AC and LT1028C are characterized for operation from 0°C to 70°C.

AVAILABLE OPTIONS

T_A	V_{IO} max AT 25°C	PACKAGE			
		SMALL OUTLINE (DW)	CERAMIC DIP (JG)	METAL CAN (L)	PLASTIC DIP (P)
0°C to 70°C	40 µV	—	LT1028ACJG	LT1028ACL	LT1028ACP
	80 µV	LT1028ACDW	LT1028CJG	LT1028CL	LT1028CP
– 55°C to 125°C	40 µV	—	LT1028AMJG	LT1028AML	—
	80 µV	—	LT1028MJG	LT1028ML	—

schematic



All component and current values shown are nominal.

absolute maximum ratings over operating free-air temperature range (unless otherwise noted)

Supply voltage, V_{CC+} (see Note 1): LT1028AM, LT1028M	22 V
LT1028AC, LT1028C	16 V
Supply voltage, V_{CC-} (see Note 1) LT1028AM, LT1028M	– 22 V
LT1028AC, LT1028C	– 16 V
Differential input current (see Note 2)	± 25 mA
Input voltage range, V_I (any input, see Note 1)	$V_{CC\pm}$
Duration of output short-circuit at (or below) 25°C (see Note 2)	unlimited
Operating free-air temperature, T_A: LT1028AM, LT1028M	– 55°C to 125°C
LT1028AC, LT1028C	0°C to 70°C
Storage temperature range	–65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds: D or P package	300°C
Lead temperature 1,6 mm (1/16 inch) from case for 60 seconds: JG or L package	260°C

NOTES: 1. All voltage values, except differential voltages, are with respect to the midpoint between V_{CC+} and V_{CC-}.
2. The specified values for this parameter takes into account junction temperature increase due to supply and output currents.

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electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15$ V (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	LT1028M			LT1028AM			UNIT
				MIN	TYP	MAX	MIN	TYP	MAX	
V_{IO}	Input offset voltage	See Note 3	25°C		20	80		10	40	µV
			−55°C to 125°C			180			120	
α_{VIO}	Temperature coefficient of input offset voltage		−55°C to 125°C		0.25	1		0.2	0.8	µV/°C
	Input offset voltage long-term drift	See Note 4	25°C		0.3			0.3		µV/mo
I_{IO}	Input offset current	$V_{IC} = 0$	25°C		18	100		12	50	nA
			−55°C to 125°C			180			90	
I_{IB}	Input bias current	$V_{IC} = 0$	25°C		30	180		25	90	nA
			−55°C to 125°C			300			150	
V_{ICR}	Common-mode input voltage range		25°C	± 11	± 12.2		± 11	± 12.2		V
			−55°C to 125°C	± 10.3			± 10.3			
V_{OM}	Maximum peak output voltage swing	$R_L \ge 2$ kΩ	25°C	± 12	± 13		± 12.3	± 13		V
			−55°C to 125°C	± 10.3			± 10.3			
		$R_L \ge 600$ Ω	25°C	± 10.5	± 12.2		± 11	± 12.2		
A_{VD}	Large-signal differential voltage amplification	$V_O = \pm 12$ V, $R_L \ge 2$ kΩ	25°C	5	30		7	30		V/µV
		$V_O = \pm 10$ V, $R_L \ge 2$ kΩ	−55°C to 125°C	2			3			
		$V_O = \pm 10$ V, $R_L \ge 1$ kΩ	25°C	3.5	20		5	20		
			−55°C to 125°C	1.5			2			
		$V_O = \pm 10$ V, $R_L \ge 600$ Ω	25°C	2	15		3	15		
r_{ic}	Common-mode input resistance		25°C		300			300		MΩ
r_{id}	Differential-mode input resistance		25°C		20			20		kΩ
c_i	Input capacitance		25°C		5			5		pF
z_o	Output impedance	$V_O = 0$, $I_O = 0$, Open loop	25°C		80			80		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = \pm 11$ V	25°C	110	126		114	126		dB
		$V_{IC} = \pm 10.3$ V	−55°C to 125°C	100			106			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm} / \Delta V_{IO}$)	$V_{CC\pm} = \pm 4$ V to ± 18V	25°C	110	132		117	133		dB
		$V_{CC\pm} = \pm 4.5$ V to ± 16V	−55°C to 125°C	104			110			
I_{CC}	Supply current		25°C		7.6	10.5		7.4	9.5	mA
			−55°C to 125°C			13			11.5	

NOTES: 3. Input offset voltage measurements are performed by automatic test equipment approximately 0.5 seconds after applying power.
4. Input offset voltage long-term drift refers to the average trend line of offset voltage versus time over extended periods after the first 30 days of operation. Excluding the initial hour of operation, changes in V_{IO} during the first 30 days are typically 2.5 µV.

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Operational Amplifiers

electrical characteristics at specified free-air temperature, $V_{CC\pm} = \pm 15$ V (unless otherwise noted)

	PARAMETER	TEST CONDITIONS	T_A	LT1028C MIN	LT1028C TYP	LT1028C MAX	LT1028AC MIN	LT1028AC TYP	LT1028AC MAX	UNIT
V_{IO}	Input offset voltage	See Note 3	25°C		20	80		10	40	µV
			0°C to 70°C			125			80	
α_{VIO}	Temperature coefficient of input offset voltage		0°C to 70°C		0.2	1		0.1	0.8	µV/°C
	Input offset voltage long-term drift	See Note 4	25°C		0.3			0.3		µV/mo
I_{IO}	Input offset current	$V_{IC} = 0$	25°C		18	100		12	50	nA
			0°C to 70°C			130			65	
I_{IB}	Input bias current	$V_{IC} = 0$	25°C		30	180		25	90	nA
			0°C to 70°C			240			120	
V_{ICR}	Common-mode input voltage range		25°C	± 11	± 12.2		± 11	± 12.2		V
			0°C to 70°C	± 10.5			± 10.5			
V_{OM}	Maximum peak output voltage swing	$R_L \geq 2$ kΩ	25°C	± 12	± 13		± 12.3	± 13		V
			0°C to 70°C	± 11.5			± 11.5			
		$R_L \geq 600$ Ω	25°C	± 10.5	± 12.2		± 11	± 12.2		
		RL ≥ 600 Ω, See Note 2	70°C	± 9	± 10.5		± 9.5	± 11		
A_{VD}	Large-signal differential voltage amplification	$V_O = \pm 12$ V, $R_L \geq 2$ kΩ	25°C	5	30		7	30		V/µV
		$V_O = \pm 10$ V, $R_L \geq 2$ kΩ	0°C to 70°C	3			5			
		$V_O = \pm 10$ V, $R_L \geq 1$ kΩ	25°C	3.5	20		5	20		
			0°C to 70°C	2.5			4			
		$V_O = \pm 10$ V, $R_L \geq 600$ Ω	25°C	2	15		5	15		
r_{ic}	Common-mode input resistance		25°C		300			300		MΩ
r_{id}	Differential-mode input resistance		25°C		20			20		kΩ
c_i	Input capacitance		25°C		5			5		pF
z_o	Output impedance	$V_O = 0$, $I_O = 0$, Open loop	25°C		80			80		Ω
CMRR	Common-mode rejection ratio	$V_{IC} = \pm 11$ V	25°C	110	126		114	126		dB
		$V_{IC} = \pm 10.3$ V	0°C to 70°C	106			110			
k_{SVR}	Supply-voltage rejection ratio ($\Delta V_{CC\pm} / \Delta V_{IO}$)	$V_{CC\pm} = \pm 4$ V to ± 18V	25°C	110	132		117	133		dB
		$V_{CC\pm} = \pm 4.5$ V to ± 16V	0°C to 70°C	107			114			
I_{CC}	Supply current		25°C		7.6	10.5		7.4	9.5	mA
			0°C to 70°C			11.5			10.5	

NOTES: 2. The specified values for this parameter takes into account junction temperature increase due to supply and output currents.
3. Input offset voltage measurements are performed by automatic test equipment approximately 0.5 seconds after applying power.
4. Input offset voltage long-term drift refers to the average trend line of offset voltage versus time over extended periods after the first 30 days of operation. Excluding the initial hour of operation, changes in V_{IO} during the first 30 days are typically 2.5 µV.

operating characteristics, $V_{CC\pm} = \pm 15$ V, $V_{IC} = 0$, $T_A = 25°C$

PARAMETER		TEST CONDITIONS	LT1028M, LT1028C			LT1028AM, LT1028AC			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
SR	Slew rate	$A_V = -1$	11	15		11	15		V/µs
V_{NPP}	Peak-to-peak equivalent input noise vlotage	f = 0.1 Hz to 10 Hz		35	90		35	75	nV
V_n	Equivalent input noise voltage	f = 10 Hz, See Note 5		1	1.9		1	1.7	nV/√Hz
		f = 1 kHz		0.9	1.2		0.85	1.1	
I_n	Equivalent input noise current	f = 10 Hz, See Note 6		4.7	12		4.7	10	pA/√Hz
		f = 1 kHz, See Note 6		1	1.8		1	1.6	
GBW	Gain bandwidth product	f = 20 kHz	50	75		50	75		MHz

NOTES: 5. 10-Hz equivalent input noise voltage is tested on a sample basis. For other test requirements, please contact the factory. This statement has no bearing on testing or nontesting of other parameters.

6. Noise current is defined and measured with balanced source resistors. The resulting voltage (after subtracting the resistor noise on an RMS basis) is divided by the sum of the two source resistors to obtain noise current. Maximum 10-Hz noise current can be inferred from testing at 1 kHz.