

LM4250

Programmable Operational Amplifier

General Description

The LM4250 and LM4250C are extremely versatile programmable monolithic operational amplifiers. A single external master bias current setting resistor programs the input bias current, input offset current, quiescent power consumption, slew rate, input noise, and the gain-bandwidth product. The device is a truly general purpose operational amplifier.

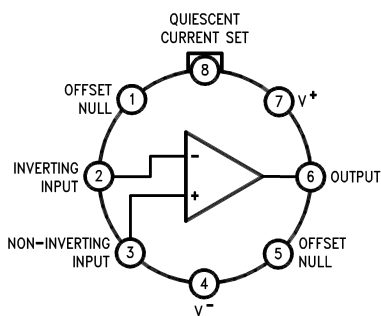
The LM4250C is identical to the LM4250 except that the LM4250C has its performance guaranteed over a 0°C to +70°C temperature range instead of the -55°C to +125°C temperature range of the LM4250.

Features

- $\pm 1\text{V}$ to $\pm 18\text{V}$ power supply operation
- 3 nA input offset current
- Standby power consumption as low as 500 nW
- No frequency compensation required
- Programmable electrical characteristics
- Offset voltage nulling capability
- Can be powered by two flashlight batteries
- Short circuit protection

Connection Diagrams

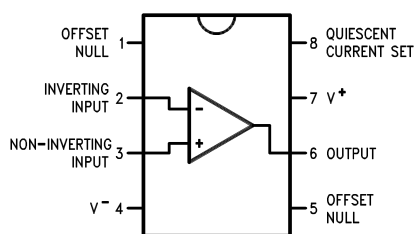
Metal Can Package



DS009300-2

Top View

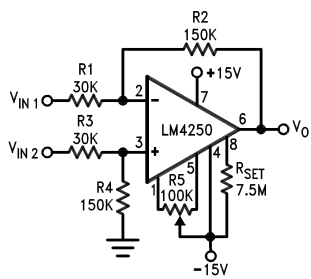
Dual-In-Line Package



DS009300-5

Top View

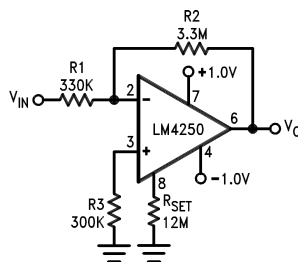
X5 Difference Amplifier



DS009300-3

Quiescent $P_D = 0.6\text{ mW}$

500 Nano-Watt X10 Amplifier



DS009300-4

Quiescent $P_D = 500\text{ nW}$

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.

(Note 3)

	LM4250	LM4250C
Supply Voltage	$\pm 18\text{V}$	$\pm 18\text{V}$
Operating Temp. Range	$-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$	$0^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$
Differential Input Voltage	$\pm 30\text{V}$	$\pm 30\text{V}$
Input Voltage (Note 2)	$\pm 15\text{V}$	$\pm 15\text{V}$
I_{SET} Current	150 nA	150 nA
Output Short Circuit Duration	Continuous	Continuous
T_{JMAX}		
H-Package	150°C	100°C
N-Package		100°C
J-Package	150°C	100°C
M-Package		100°C
Power Dissipation at $T_A = 25^{\circ}\text{C}$		
H-Package (Still Air)	500 mW	300 mW
(400 LF/Min Air Flow)	1200 mW	1200 mW
N-Package		500 mW
J-Package	1000 mW	600 mW
M-Package		350 mW
Thermal Resistance (Typical) θ_{JA}		
H-Package (Still Air)	165°C/W	165°C/W
(400 LF/Min Air Flow)	65°C/W	65°C/W
N-Package		130°C/W
J-Package	108°C/W	108°C/W
M-Package		190°C/W
(Typical) θ_{JC}		
H-Package	21°C/W	21°C/W
Storage Temperature Range	-65°C to $+150^{\circ}\text{C}$	-65°C to $+150^{\circ}\text{C}$
Soldering Information		
Dual-In-Line Package		
Soldering (10 seconds)	260°C	
Small Outline Package		
Vapor Phase (60 seconds)	215°C	
Infrared (15 seconds)	220°C	

See AN-450 "Surface Mounting Methods and Their Effect on Product Reliability" for other methods of soldering surface mount devices.

ESD tolerance (Note 4) 800V

Note 1: "Absolute Maximum Ratings" indicate limits beyond which damage to the device may occur. Operating Ratings indicate conditions for which the device is functional, but do not guarantee specific performance limits.

Note 2: For supply voltages less than $\pm 15\text{V}$, the absolute maximum input voltage is equal to the supply voltage.

Note 3: Refer to RETS4250X for military specifications.

Note 4: Human body model, 1.5 k Ω in series with 100 pF.

Resistor Biasing

Set Current Setting Resistor to V^-

V_S	I_{SET}				
	0.1 μA	0.5 μA	1.0 μA	5 μA	10 μA
$\pm 1.5V$	25.6 M Ω	5.04 M Ω	2.5 M Ω	492 k Ω	244 k Ω
$\pm 3.0V$	55.6 M Ω	11.0 M Ω	5.5 M Ω	1.09 M Ω	544 k Ω
$\pm 6.0V$	116 M Ω	23.0 M Ω	11.5 M Ω	2.29 M Ω	1.14 M Ω
$\pm 9.0V$	176 M Ω	35.0 M Ω	17.5 M Ω	3.49 M Ω	1.74 M Ω
$\pm 12.0V$	236 M Ω	47.0 M Ω	23.5 M Ω	4.69 M Ω	2.34 M Ω
$\pm 15.0V$	296 M Ω	59.0 M Ω	29.5 M Ω	5.89 M Ω	2.94 M Ω

Electrical Characteristics

LM4250 ($-55^\circ C \leq T_A \leq +125^\circ C$ unless otherwise specified.) $T_A = T_J$

Parameter	Conditions	$V_S = \pm 1.5V$			
		$I_{SET} = 1 \mu A$		$I_{SET} = 10 \mu A$	
		Min	Max	Min	Max
V_{OS}	$R_S \leq 100 k\Omega$, $T_A = 25^\circ C$		3 mV		5 mV
I_{OS}	$T_A = 25^\circ C$		3 nA		10 nA
I_{bias}	$T_A = 25^\circ C$		7.5 nA		50 nA
Large Signal Voltage Gain	$R_L = 100 k\Omega$, $T_A = 25^\circ C$ $V_O = \pm 0.6V$, $R_L = 10 k\Omega$	40k		50k	
Supply Current	$T_A = 25^\circ C$		7.5 μA		80 μA
Power Consumption	$T_A = 25^\circ C$		23 μW		240 μW
V_{OS}	$R_S \leq 100 k\Omega$		4 mV		6 mV
I_{OS}	$T_A = +125^\circ C$ $T_A = -55^\circ C$		5 nA 3 nA		10 nA 10 nA
I_{bias}			7.5 nA		50 nA
Input Voltage Range		$\pm 0.6V$		$\pm 0.6V$	
Large Signal Voltage Gain	$V_O = \pm 0.5V$, $R_L = 100 k\Omega$ $R_L = 10 k\Omega$	30k		30k	
Output Voltage Swing	$R_L = 100 k\Omega$ $R_L = 10 k\Omega$	$\pm 0.6V$		$\pm 0.6V$	
Common Mode Rejection Ratio	$R_S \leq 10 k\Omega$	70 dB		70 dB	
Supply Voltage Rejection Ratio	$R_S \leq 10 k\Omega$	76 dB		76 dB	
Supply Current			8 μA		90 μA

Parameter	Conditions	$V_S = \pm 15V$			
		$I_{SET} = 1 \mu A$		$I_{SET} = 10 \mu A$	
		Min	Max	Min	Max
V_{OS}	$R_S \leq 100 k\Omega$, $T_A = 25^\circ C$		3 mV		5 mV
I_{OS}	$T_A = 25^\circ C$		3 nA		10 nA
I_{bias}	$T_A = 25^\circ C$		7.5 nA		50 nA
Large Signal Voltage Gain	$R_L = 100 k\Omega$, $T_A = 25^\circ C$ $V_O = \pm 10V$, $R_L = 10 k\Omega$	100k		100k	
Supply Current	$T_A = 25^\circ C$		10 μA		90 μA
Power Consumption	$T_A = 25^\circ C$		300 μW		2.7 mW
V_{OS}	$R_S \leq 100 k\Omega$		4 mV		6 mV
I_{OS}	$T_A = +125^\circ C$ $T_A = -55^\circ C$		25 nA 3 nA		25 nA 10 nA
I_{bias}			7.5 nA		50 nA
Input Voltage Range		$\pm 13.5V$		$\pm 13.5V$	

Electrical Characteristics (Continued)

Parameter	Conditions	$V_S = \pm 15V$			
		$I_{SET} = 1 \mu A$		$I_{SET} = 10 \mu A$	
		Min	Max	Min	Max
Large Signal Voltage Gain	$V_O = \pm 10V$, $R_L = 100 \text{ k}\Omega$ $R_L = 10 \text{ k}\Omega$	50k		50k	
Output Voltage Swing	$R_L = 100 \text{ k}\Omega$ $R_L = 10 \text{ k}\Omega$	$\pm 12V$		$\pm 12V$	
Common Mode Rejection Ratio	$R_S \leq 10 \text{ k}\Omega$	70 dB		70 dB	
Supply Voltage Rejection Ratio	$R_S \leq 10 \text{ k}\Omega$	76 dB		76 dB	
Supply Current			11 μA		100 μA
Power Consumption			330 μW		3 mW

Electrical Characteristics

LM4250C ($0^\circ C \leq T_A \leq +70^\circ C$ unless otherwise specified.) $T_A = T_J$

Parameter	Conditions	$V_S = \pm 1.5V$			
		$I_{SET} = 1 \mu A$		$I_{SET} = 10 \mu A$	
		Min	Max	Min	Max
V_{OS}	$R_S \leq 100 \text{ k}\Omega$, $T_A = 25^\circ C$		5 mV		6 mV
I_{OS}	$T_A = 25^\circ C$		6 nA		20 nA
I_{bias}	$T_A = 25^\circ C$		10 nA		75 nA
Large Signal Voltage Gain	$R_L = 100 \text{ k}\Omega$, $T_A = 25^\circ C$ $V_O = \pm 0.6V$, $R_L = 10 \text{ k}\Omega$	25k		25k	
Supply Current	$T_A = 25^\circ C$		8 μA		90 μA
Power Consumption	$T_A = 25^\circ C$		24 μW		270 μW
V_{OS}	$R_S \leq 10 \text{ k}\Omega$		6.5 mV		7.5 mV
I_{OS}			8 nA		25 nA
I_{bias}			10 nA		80 nA
Input Voltage Range		$\pm 0.6V$		$\pm 0.6V$	
Large Signal Voltage Gain	$V_O = \pm 0.5V$, $R_L = 100 \text{ k}\Omega$ $R_L = 10 \text{ k}\Omega$	25k		25k	
Output Voltage Swing	$R_L = 100 \text{ k}\Omega$ $R_L = 10 \text{ k}\Omega$	$\pm 0.6V$		$\pm 0.6V$	
Common Mode Rejection Ratio	$R_S \leq 10 \text{ k}\Omega$	70 dB		70 dB	
Supply Voltage Rejection Ratio	$R_S \leq 10 \text{ k}\Omega$	74 dB		74 dB	
Supply Current			8 μA		90 μA
Power Consumption			24 μW		270 μW

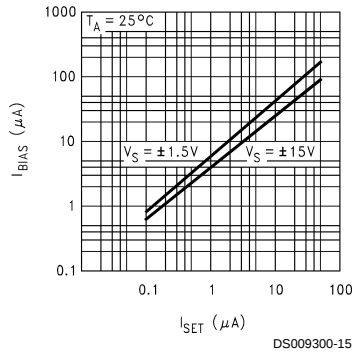
Parameter	Conditions	$V_S = \pm 15V$			
		$I_{SET} = 1 \mu A$		$I_{SET} = 10 \mu A$	
		Min	Max	Min	Max
V_{OS}	$R_S \leq 100 \text{ k}\Omega$, $T_A = 25^\circ C$		5 mV		6 mV
I_{OS}	$T_A = 25^\circ C$		6 nA		20 nA
I_{bias}	$T_A = 25^\circ C$		10 nA		75 nA
Large Signal Voltage Gain	$R_L = 100 \text{ k}\Omega$, $T_A = 25^\circ C$ $V_O = \pm 10V$, $R_L = 10 \text{ k}\Omega$	60k		60k	
Supply Current	$T_A = 25^\circ C$		11 μA		100 μA
Power Consumption	$T_A = 25^\circ C$		330 μW		3 mW
V_{OS}	$R_S \leq 100 \text{ k}\Omega$		6.5 mV		7.5 mV
I_{OS}			8 nA		25 nA
I_{bias}			10 nA		80 nA

Electrical Characteristics (Continued)

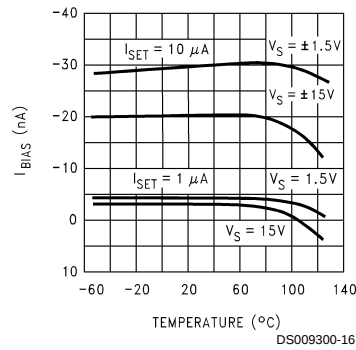
Parameter	Conditions	$V_S = \pm 15V$			
		$I_{SET} = 1 \mu A$		$I_{SET} = 10 \mu A$	
		Min	Max	Min	Max
Input Voltage Range		$\pm 13.5V$		$\pm 13.5V$	
Large Signal Voltage Gain	$V_O = \pm 10V, R_L = 100 k\Omega$ $R_L = 10 k\Omega$	50k		50k	
Output Voltage Swing	$R_L = 100 k\Omega$ $R_L = 10 k\Omega$	$\pm 12V$		$\pm 12V$	
Common Mode Rejection Ratio	$R_S \leq 10 k\Omega$	70 dB		70 dB	
Supply Voltage Rejection Ratio	$R_S \leq 10 k\Omega$	74 dB		74 dB	
Supply Current			11 μA		100 μA
Power Consumption			330 μW		3 mW

Typical Performance Characteristics

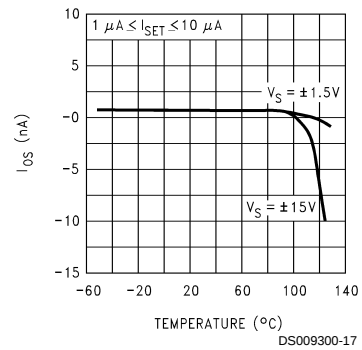
Input Bias Current vs I_{SET}



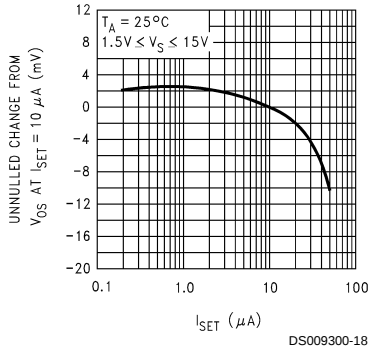
Input Bias Current vs Temperature



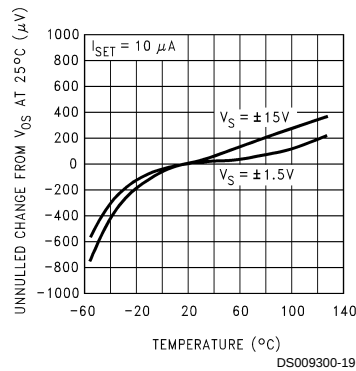
Input Offset Current vs Temperature



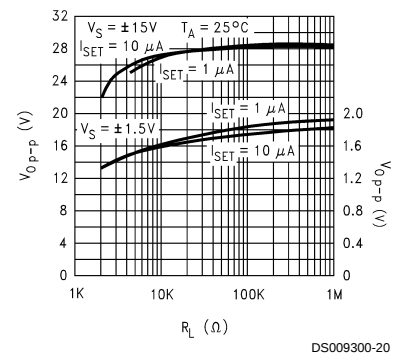
Unnull'd Input Offset Voltage Change vs I_{SET}



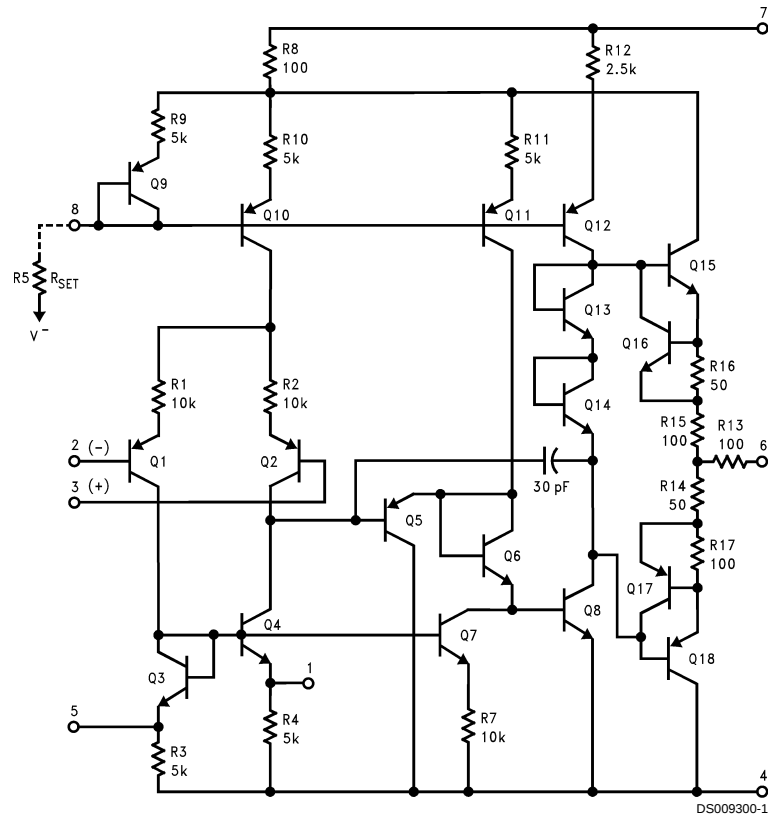
Unnull'd Input Offset Voltage Change vs Temperature



Peak to Peak Output Voltage Swing vs Load Resistance



Schematic Diagram



Ordering Information

Temperature Range		Package	NSC Package Number
Military $-55^{\circ}\text{C} \leq T_A \leq +125^{\circ}\text{C}$	Commercial $0^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$		
	LM4250CN	8-Pin Molded DIP	N08E
	LM4250CM LM4250CMX	8-Pin Surface Mount	M08A
LM4250J-MIL		8-Pin Ceramic DIP	J08E
	LM4250CH	8-Pin Metal Can	H08C

