

LM4250 Programmable Operational Amplifier

General Description

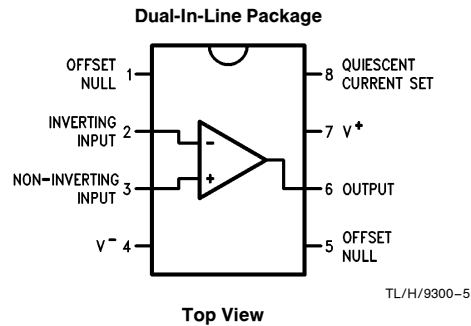
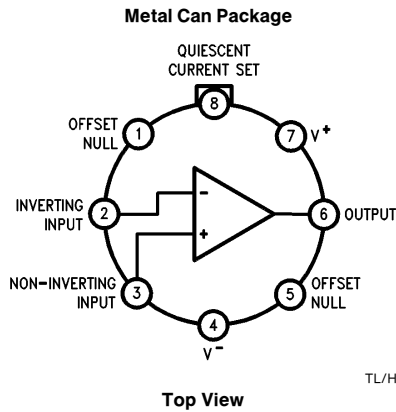
The LM4250 and LM4250C are extremely versatile programmable monolithic operational amplifiers. A single external master bias current setting resistor programs the input bias current, input offset current, quiescent power consumption, slew rate, input noise, and the gain-bandwidth product. The device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



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	8-Pin Surface Mount	M08A
LM4250J LM4250J-MIL		8-Pin Ceramic DIP	J08E
LM4250H LM4250H-MIL	LM4250CH	8-Pin Metal Can	H08C

Absolute Maximum Ratings

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/Distributors for availability and specifications.
(Note 2)

	LM4250	LM4250C
Supply Voltage	±18V	±18V
Operating Temp. Range	-55°C ≤ T _A ≤ +125°C	0°C ≤ T _A ≤ +70°C
Differential Input Voltage	±30V	±30V
Input Voltage (Note 1)	±15V	±15V
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°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°C	-65°C to +150°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 3)	800V	

Note 1: For supply voltages less than ±15V, the absolute maximum input voltage is equal to the supply voltage.

Note 2: Refer to RETS4250X for military specifications.

Note 3: Human body model, 1.5 kΩ 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
±1.5V	25.6 MΩ	5.04 MΩ	2.5 MΩ	492 kΩ	244 kΩ
±3.0V	55.6 MΩ	11.0 MΩ	5.5 MΩ	1.09 MΩ	544 kΩ
±6.0V	116 MΩ	23.0 MΩ	11.5 MΩ	2.29 MΩ	1.14 MΩ
±9.0V	176 MΩ	35.0 MΩ	17.5 MΩ	3.49 MΩ	1.74 MΩ
±12.0V	236 MΩ	47.0 MΩ	23.5 MΩ	4.69 MΩ	2.34 MΩ
±15.0V	296 MΩ	59.0 MΩ	29.5 MΩ	5.89 MΩ	2.94 MΩ

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

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

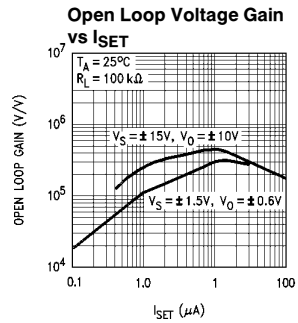
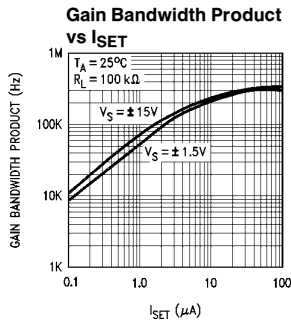
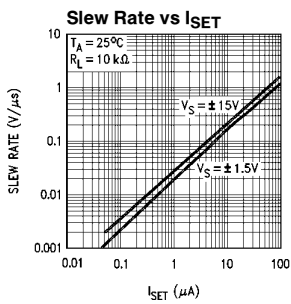
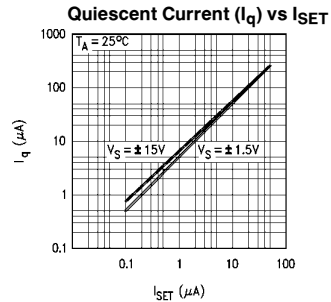
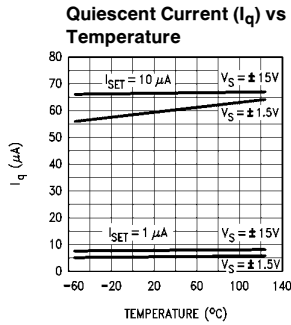
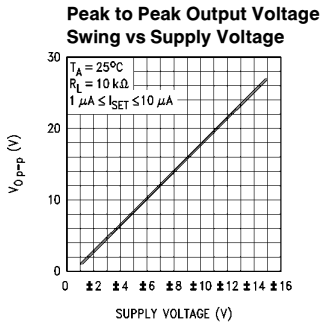
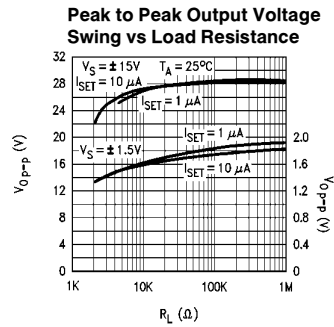
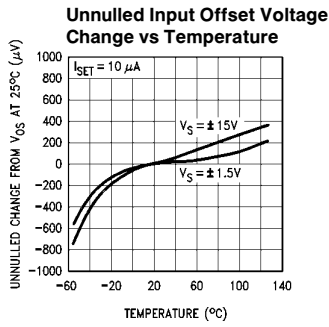
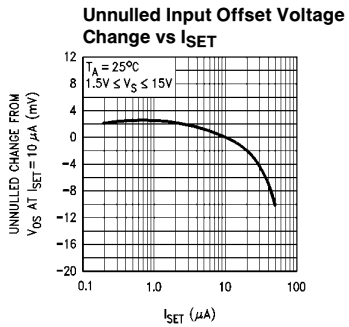
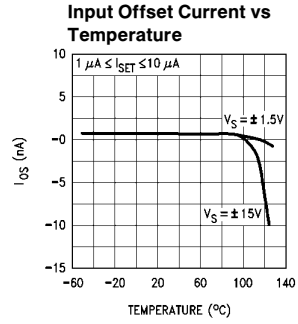
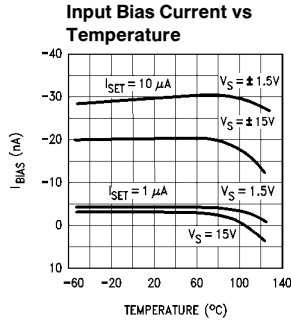
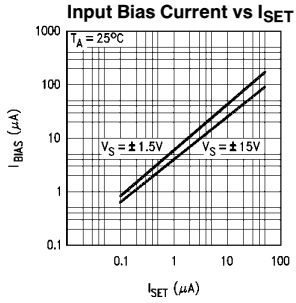
Parameter	Conditions	$V_S = \pm 15\text{V}$			
		$I_{SET} = 1\ \mu\text{A}$		$I_{SET} = 10\ \mu\text{A}$	
		Min	Max	Min	Max
V_{OS}	$R_S \leq 100\ \text{k}\Omega$, $T_A = 25^{\circ}\text{C}$		3 mV		5 mV
I_{OS}	$T_A = 25^{\circ}\text{C}$		3 nA		10 nA
I_{bias}	$T_A = 25^{\circ}\text{C}$		7.5 nA		50 nA
Large Signal Voltage Gain	$R_L = 100\ \text{k}\Omega$, $T_A = 25^{\circ}\text{C}$ $V_O = \pm 10\text{V}$, $R_L = 10\ \text{k}\Omega$	100k		100k	
Supply Current	$T_A = 25^{\circ}\text{C}$		$10\ \mu\text{A}$		$90\ \mu\text{A}$
Power Consumption	$T_A = 25^{\circ}\text{C}$		$300\ \mu\text{W}$		$2.7\ \text{mW}$
V_{OS}	$R_S \leq 100\ \text{k}\Omega$		4 mV		6 mV
I_{OS}	$T_A = +125^{\circ}\text{C}$ $T_A = -55^{\circ}\text{C}$		25 nA 3 nA		25 nA 10 nA
I_{bias}			7.5 nA		50 nA
Input Voltage Range		$\pm 13.5\text{V}$		$\pm 13.5\text{V}$	
Large Signal Voltage Gain	$V_O = \pm 10\text{V}$, $R_L = 100\ \text{k}\Omega$ $R_L = 10\ \text{k}\Omega$	50k		50k	
Output Voltage Swing	$R_L = 100\ \text{k}\Omega$ $R_L = 10\ \text{k}\Omega$	$\pm 12\text{V}$		$\pm 12\text{V}$	
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			$11\ \mu\text{A}$		$100\ \mu\text{A}$
Power Consumption			$330\ \mu\text{W}$		$3\ \text{mW}$

Electrical Characteristics LM4250C ($0^{\circ}\text{C} \leq T_A \leq +70^{\circ}\text{C}$ unless otherwise specified.) $T_A = T_J$

Parameter	Conditions	$V_S = \pm 1.5\text{V}$			
		$I_{SET} = 1\ \mu\text{A}$		$I_{SET} = 10\ \mu\text{A}$	
		Min	Max	Min	Max
V_{OS}	$R_S \leq 100\ \text{k}\Omega$, $T_A = 25^{\circ}\text{C}$		5 mV		6 mV
I_{OS}	$T_A = 25^{\circ}\text{C}$		6 nA		20 nA
I_{bias}	$T_A = 25^{\circ}\text{C}$		10 nA		75 nA
Large Signal Voltage Gain	$R_L = 100\ \text{k}\Omega$, $T_A = 25^{\circ}\text{C}$ $V_O = \pm 0.6\text{V}$, $R_L = 10\ \text{k}\Omega$	25k		25k	
Supply Current	$T_A = 25^{\circ}\text{C}$		8 μA		90 μA
Power Consumption	$T_A = 25^{\circ}\text{C}$		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		$\pm 0.6\text{V}$		$\pm 0.6\text{V}$	
Large Signal Voltage Gain	$V_O = \pm 0.5\text{V}$, $R_L = 100\ \text{k}\Omega$ $R_L = 10\ \text{k}\Omega$	25k		25k	
Output Voltage Swing	$R_L = 100\ \text{k}\Omega$ $R_L = 10\ \text{k}\Omega$	$\pm 0.6\text{V}$		$\pm 0.6\text{V}$	
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

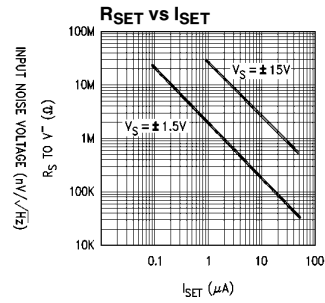
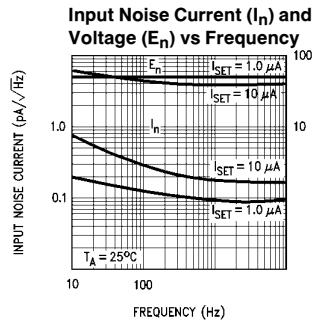
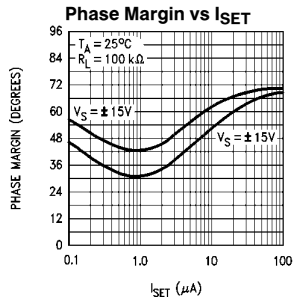
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		$I_{SET} = 1\ \mu\text{A}$		$I_{SET} = 10\ \mu\text{A}$	
		Min	Max	Min	Max
V_{OS}	$R_S \leq 100\ \text{k}\Omega$, $T_A = 25^{\circ}\text{C}$		5 mV		6 mV
I_{OS}	$T_A = 25^{\circ}\text{C}$		6 nA		20 nA
I_{bias}	$T_A = 25^{\circ}\text{C}$		10 nA		75 nA
Large Signal Voltage Gain	$R_L = 100\ \text{k}\Omega$, $T_A = 25^{\circ}\text{C}$ $V_O = \pm 10\text{V}$, $R_L = 10\ \text{k}\Omega$	60k		60k	
Supply Current	$T_A = 25^{\circ}\text{C}$		11 μA		100 μA
Power Consumption	$T_A = 25^{\circ}\text{C}$		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
Input Voltage Range		$\pm 13.5\text{V}$		$\pm 13.5\text{V}$	
Large Signal Voltage Gain	$V_O = \pm 10\text{V}$, $R_L = 100\ \text{k}\Omega$ $R_L = 10\ \text{k}\Omega$	50k		50k	
Output Voltage Swing	$R_L = 100\ \text{k}\Omega$ $R_L = 10\ \text{k}\Omega$	$\pm 12\text{V}$		$\pm 12\text{V}$	
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			11 μA		100 μA
Power Consumption			330 μW		3 mW

Typical Performance Characteristics



TL/H/9300-6

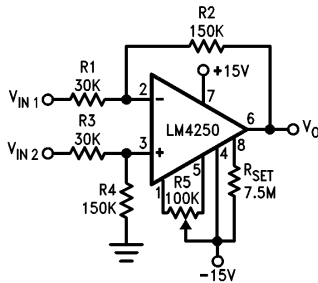
Typical Performance Characteristics (Continued)



TL/H/9300-7

Typical Applications

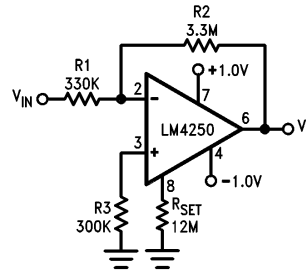
X5 Difference Amplifier



Quiescent $P_D = 0.6\text{ mW}$

TL/H/9300-3

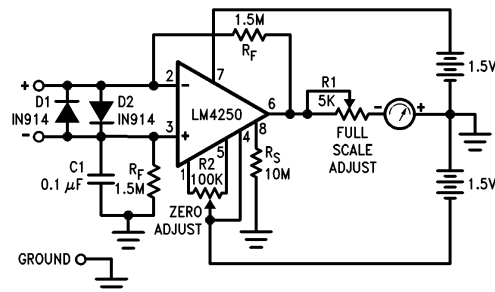
500 Nano-Watt X10 Amplifier



Quiescent $P_D = 500\text{ nW}$

TL/H/9300-4

**Floating Input Meter Amplifier
100 nA Full Scale**



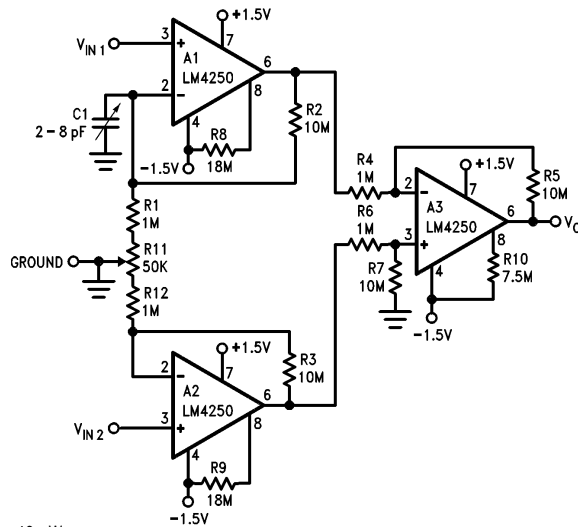
Quiescent $P_D = 1.8\ \mu\text{W}$

*Meter movement (0-100 μA , 2 k Ω) marked for 0-100 nA full scale.

TL/H/9300-8

Typical Applications (Continued)

X100 Instrumentation Amplifier 10 μ W



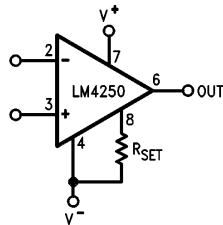
Note 1: Quiescent $P_D = 10 \mu$ W.

Note 2: R2, R3, R4, R5, R6 and R7 are 1% resistors.

Note 3: R11 and C1 are for DC and AC common mode rejection adjustments.

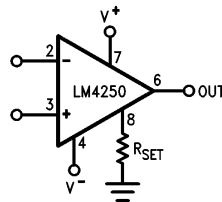
TL/H/9300-9

R_{SET} Connected to V⁻



TL/H/9300-10

R_{SET} Connected to Ground



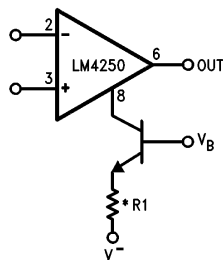
TL/H/9300-11

I_{SET} Equations:

$$I_{SET} \approx \frac{V^+ + |V^-| - 0.5}{R_{SET}} \quad \text{where } R_{SET} \text{ is connected to } V^-.$$

$$I_{SET} \approx \frac{V^+ - 0.5}{R_{SET}} \quad \text{where } R_{SET} \text{ is connected to ground.}$$

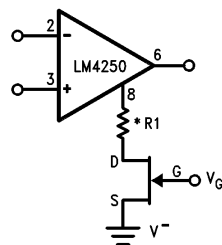
Transistor Current Sourcing Biasing



*R1 limits I_{SET} maximum

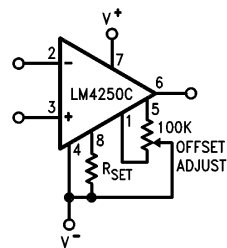
TL/H/9300-12

FET Current Sourcing Biasing



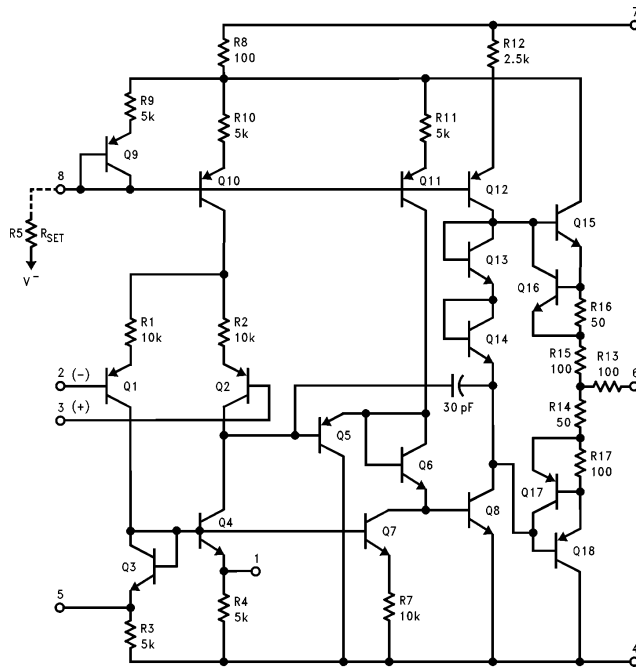
TL/H/9300-13

Offset Null Circuit



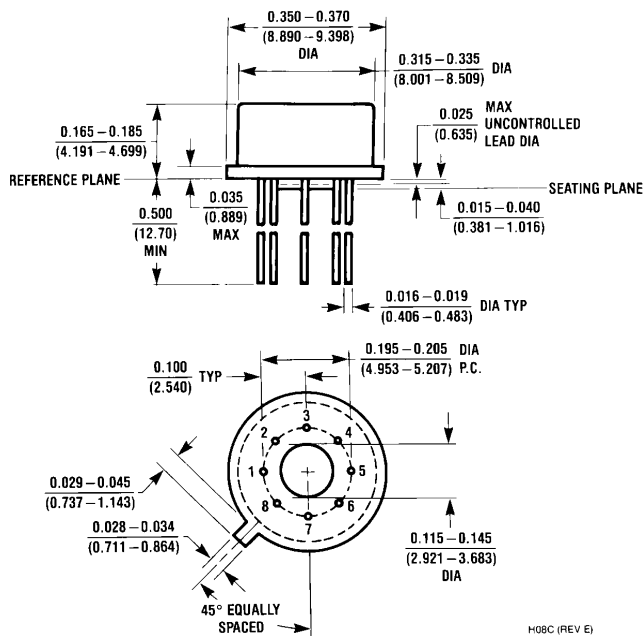
TL/H/9300-14

Schematic Diagram



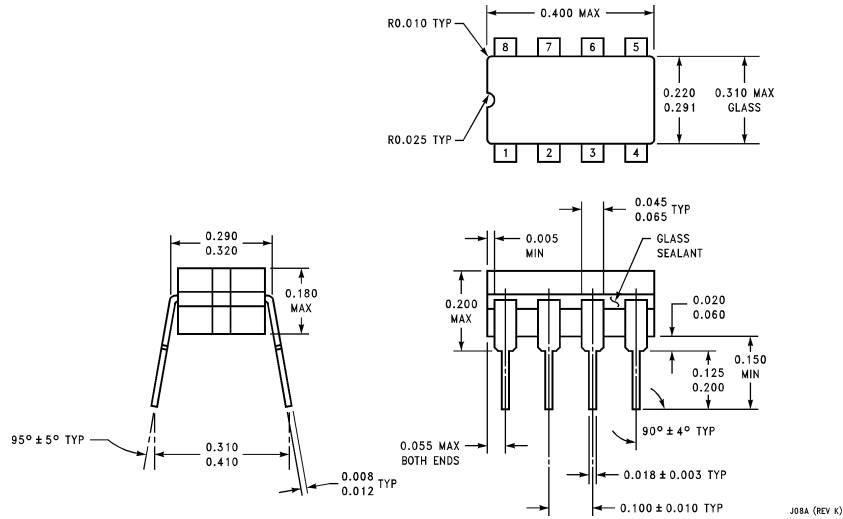
TL/H/9300-1

Physical Dimensions inches (millimeters)

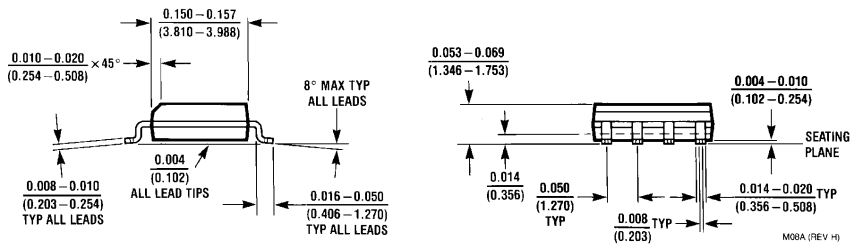
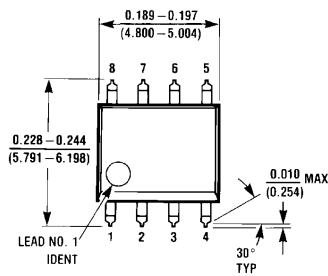


Metal Can Package (H)
Order Number LM4250H, LM4250CH or LM4250H-MIL
NS Package Number H08C

Physical Dimensions inches (millimeters) (Continued)

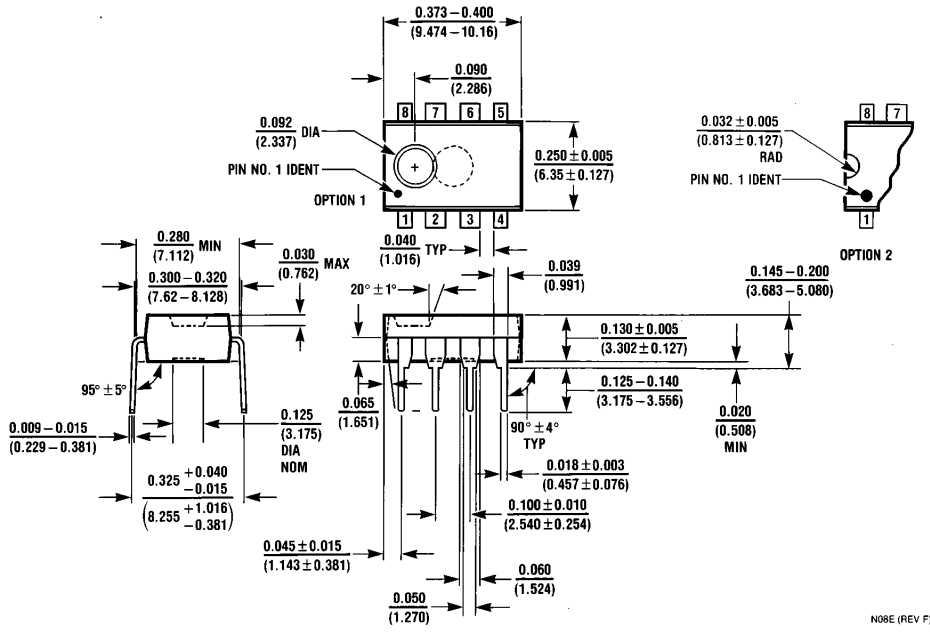


Ceramic Dual-In-Line Package (J)
Order Number LM4250J, or LM4250J-MIL
NS Package Number J08A



Small Outline Package (M)
Order Number LM4250M
NS Package Number M08A


Physical Dimensions inches (millimeters) (Continued)



LIFE SUPPORT POLICY

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2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

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