

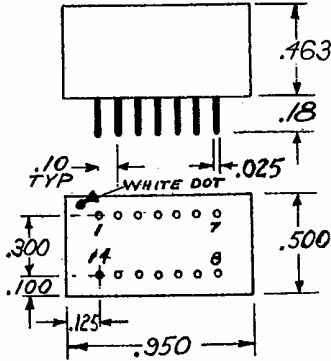


**SOLID STATE  
ELECTRONICS  
CORPORATION**

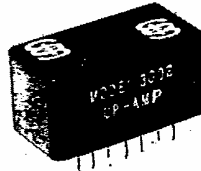
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**MODEL 3002 SOLID STATE SILICON  
DIFFERENTIAL OPERATIONAL  
DC AMPLIFIER**

**FOR LOW-LEVEL INSTRUMENTATION & BRIDGE APPLICATIONS**



THIS UNIT PLUGS INTO A STANDARD 14 PIN DUAL-IN-LINE (DIP) SOCKET, OR IT CAN BE WIRED OR SOLDERED DIRECTLY TO A PRINTED WIRING BOARD.



ACTUAL SIZE

**ADDITIONAL FEATURES**

Completely Solid State Silicon Design  
Hybrid Integrated Circuit  
DC and AC operation  
Differential or Single-Ended Input  
Inverted and Non-Inverted Operation  
Large Differential Voltage Range

High Gain-Bandwidth Product  
Differential Input, Single Ended Output  
Versatile, Precise Transfer Functions  
High Linearity, Low Distortion, Low Noise  
Wide Temperature Range  
Solid Encapsulation  
Small Size, Light Weight, Rugged

**TYPICAL APPLICATIONS**

Precision Differential Operational Amplifier For Analog Computers  
Thermocouple, Strain Gage and Transducer Bridges  
Low Level Instrumentation  
Log Period Integrators  
Summation, Subtraction, Differentiation

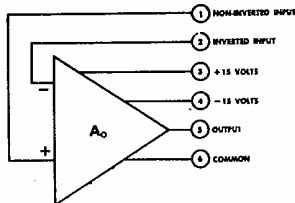
High Performance Voltage Followers  
High Input Impedance Isolation Amplifiers  
Precision Comparators, Regulators, Simulators  
Reference Voltage and Power Supply Regulators  
Active Filters

**TYPICAL OPERATING CHARACTERISTICS (25°C)**

Open-Loop Voltage Gain .....	20 x 10 <sup>6</sup> (146 db)
Common Mode Rejection .....	100 db
Output Voltage Range (R <sub>L</sub> > 10K) .....	± 14 volts
Output Current Range .....	± 5 milliamperes
Gain-Bandwidth Product .....	2 mcps
Differential Input Resistance .....	300 megohms
Common Mode Input Resistance .....	1000 megohms
Output Impedance .....	100 ohms
Frequency Response (Gain = 1000) .....	10 kcps
Operating Temperature Range .....	-55°C. to +125°C.
Supply Voltages and Currents .....	± 15 volts
Supply Currents .....	To +28 ma, - 17ma
Power Consumption .....	200 milliwatts

**MECHANICAL-ENVIRONMENTAL CHARACTERISTICS**

**DIMENSIONS:**  
0.50 x 0.95 x 0.47 inches  
**WEIGHT:**  
Nominal 8 grams.  
**ENCLOSURE:**  
Solid epoxy encapsulated plug-in unit  
**SHOCK:**  
10,000 G.  
**VIBRATION:**  
100 G, zero to 2000 cps.  
**ACCELERATION:**  
5,000 G.



CONNECTIONS

0.6 MICROVOLT/°C. TEMPERATURE DRIFT  
5 MICROVOLT/ WEEK OFFSET VOLTAGE DRIFT  
2 PICOAMP/°C. OFFSET CURRENT DRIFT  
300 MEGOHM INPUT IMPEDANCE  
WIDE COMMON MODE RANGE

NO FREQUENCY COMPENSATION REQUIRED  
SHORT CIRCUIT PROTECTION  
ZERO OFFSET VOLTAGE NULL CAPABILITY  
NO LATCH-UP

**GENERAL DESCRIPTION**

The Model 3002 is a variable high gain, differential input, single-ended output DC operational amplifier suitable for low level instrumentation and bridge input applications. The differential input capability and the extremely high open-loop gain allows versatile utilization of external networks and closed-loop negative feedback to achieve exceptional stability, high linearity and precise predictable transfer functions.

The design is completely solid state and uses only silicon semiconductors and integrated circuits. An active internal low power temperature regulator isolated within a high thermal resistance package, is used to maintain a constant substrate temperature above the highest ambient up to 125°C. This provides very stable DC amplification, thereby replacing complex chopper stabilized amplifiers. Typical stability is 0.6 microvolts per degree C. and 5 microvolts per week, ideal for analog application with thermocouple bridges, strain gage transducers, long time constant integrators, comparators, precision analog computers, analog-to-digital and digital-to-analog converters. A wide common mode voltage range and elimination of "latch-up" make the Model 3002 useful as a voltage follower.

High gain (20 million open-loop, 1000 closed-loop) and a wide range of operating voltages assures excellent performance in integrator, summing amplifier and all feedback applications. Additional features include output short-circuit protection of indefinite duration and no requirement for external frequency compensation. Internal 6db/octave roll-off provides stability in closed-loop applications.

The solid state miniature design assures stable operation through severe modes of shock, vibration and acceleration. Its reliable performance makes it particularly suited for aerospace, military, industrial and medical applications.

### ABSOLUTE MAXIMUM RATINGS

Supply Voltage	±18 Volts
Differential Input Voltage	±10 Volts
Output Current	±5 milliamperes
Common Mode Input Voltage	±15 volts
Differential Input Voltage	±10 volts
Operating Temperature	-55°C. to +125°C.
Storage Temperature	-65°C. to +150°C.
Lead Temperature (Soldering, 60 sec.)	300°C.
Output Short-Circuit Duration	Indefinite
(Ground or Supplies, 75°C.)	

### TYPICAL ELECTRONIC CHARACTERISTICS AT 25°C.

SYMBOL	CHARACTERISTIC	MAGNITUDE	UNITS
A <sub>o</sub>	NON-INVERTED OPEN-LOOP VOLTAGE GAIN	20 x 10 <sup>6</sup>	—
(CMR)	COMMON MODE REJECTION	100	decibels
E <sub>CM</sub>	COMMON MODE INPUT VOLTAGE RANGE	±15	volts
R <sub>ID</sub>	DIFFERENTIAL INPUT RESISTANCE	300	megohms
R <sub>CM</sub>	COMMON MODE INPUT RESISTANCE	1000	megohms
Z <sub>o</sub>	OUTPUT IMPEDANCE	100	ohms
E <sub>o</sub>	OUTPUT VOLTAGE RANGE (R <sub>L</sub> > 2K ohms)	±13	volts
I <sub>o</sub>	OUTPUT CURRENT RANGE	±5	milliamps
$\frac{\Delta A}{\Delta T}$	CLOSED-LOOP DC VOLTAGE GAIN STABILITY VS TEMPERATURE CHANGE	A=1000; R <sub>i</sub> =50Ω; R <sub>f</sub> =50KΩ	.0005%/°C.
$\frac{\Delta A_o}{\Delta V_s}$	OPEN-LOOP DC VOLTAGE GAIN CHANGE VS SUPPLY VOLTAGE CHANGE	ΔV <sub>s</sub> = ±3 Volts	0.1%/volt
$\frac{\Delta A}{\Delta V_s}$	CLOSED-LOOP DC VOLTAGE GAIN CHANGE VS SUPPLY VOLTAGE CHANGE	A=1000; R <sub>f</sub> =50KΩ; R <sub>i</sub> =50Ω	.001%/volt
E <sub>oF</sub>	OUTPUT VOLTAGE OFFSET, REFERRED TO INPUT (OR DC INPUT VOLTAGE OFFSET)	2 000	microvolts
$\frac{\Delta E_{oF}}{\Delta T}$	OUTPUT VOLTAGE OFFSET CHANGE VS TEMPERATURE CHANGE REFERRED TO INPUT	0.6	microvolts/°C.
$\frac{\Delta E_{oF}}{\Delta V_s}$	OUTPUT VOLTAGE OFFSET CHANGE VS SUPPLY VOLTAGE CHANGE, REFERRED TO INPUT (R <sub>i</sub> < 100K ohms)	80	microvolts/volt
I <sub>oF</sub>	OUTPUT CURRENT OFFSET, REFERRED TO INPUT	3.0	nanoamps
$\frac{\Delta I_{oF}}{\Delta T}$	OUTPUT CURRENT OFFSET CHANGE VS TEMPERATURE CHANGE, REFERRED TO INPUT	2	picoamps/°C.
E <sub>N</sub>	OUTPUT NOISE VOLTAGE, REFERRED TO THE INPUT. (BW=10 to 500 cps, R <sub>i</sub> < 50 ohms)	3	microvolts rms
E <sub>D</sub>	LONG TERM OUTPUT VOLTAGE DRIFT REFERRED TO INPUT (R <sub>i</sub> < 50 ohms)	5	microvolts/week
A <sub>o</sub> f <sub>c</sub>	OPEN-LOOP GAIN-BANDWIDTH PRODUCT	2	megacycle/sec.
f <sub>c</sub> (1)	UNITY-GAIN FREQUENCY RESPONSE	20	kilocycles/sec.
f <sub>c</sub> (100)	FREQUENCY RESPONSE AT GAIN OF 100	20	kilocycles/sec.
I <sub>b</sub>	INPUT BIAS CURRENT	12	nanoamperes
$\frac{\Delta I_b}{\Delta T}$	INPUT BIAS CURRENT CHANGE VS TEMPERATURE CHANGE	15	picoamperes/°C.
t <sub>r</sub>	TRANSIENT RESPONSE RISE TIME (UNITY GAIN, 5% OVERSHOOT)	0.3	microseconds
$\frac{\Delta E_o}{\Delta t}$	SLEW RATE (UNITY GAIN)	0.5	volts/microsecond
R <sub>L</sub>	LOAD RESISTANCE, MINIMUM RECOMMENDED	2	kilohms
V <sub>s</sub>	SUPPLY VOLTAGES	+15 & -15	volts
I <sub>s</sub>	NOMINAL SUPPLY CURRENT (each supply)	+28, -17	milliamperes
P <sub>C</sub>	POWER CONSUMPTION	200	milliwatts

### APPLICATION CIRCUITS

