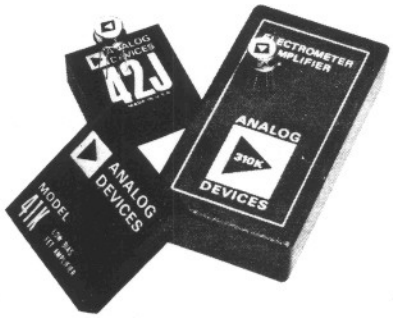
ELECTROMETER-ULTRA LOW BIAS CURRENT
MODELS 310, 311, 41, 42, AD523



GENERAL DESCRIPTION

Amplifiers with bias currents less than 1pA are classified as suitable for electrometer use where frequency response and voltage drift are usually secondary requirements. Both varactor bridge and FET input designs are employed to achieve these bias currents ranging from one pico amp (10^{-12} A) to ten femptoamps (10^{-14} A).

Available with either inverting, noninverting or differential inputs, these amplifiers are used as current to voltage converters with high impedance transducers such as photomultiplier tubes, flame detectors, pH cells and radiation detectors. To minimize RFI and other noise pickup problems, the varactor modulated amplifiers, operating at 10fA, are available with shielded cases.

VARACTOR BRIDGE ELECTROMETERS

MODEL 310 (INVERTING), MODEL 311 (NONINVERTING)

These operational amplifiers feature extremely low input bias currents and high input impedances. They are applicable to a wide range of electrometer applications which have been traditionally fulfilled using vacuum tube types. Because of varactor bridge inputs, the solid state models 310 and 311 are best suited for applications characterized by extremely high source impedance or where infinitesimal currents must be measured or amplified accurately. In principle, the varactor bridge amplifier design is similar to that of the vibrating reed electrometers (parametric), but with the inherent advantages of solid state circuitry.

Typical specifications for models 310 and 311 include open loop gain of 100dB, 2kHz unity gain response, 0.4V/msec slew rate, initial bias current of 10^{-14} A, with 10^{-15} A/°C current stability, and low current and voltage noise of 10^{-15} A and 10μV p-p (1Hz bandwidth) respectively. Two voltage drift selections are available: 310J, 311J with 30μV/°C, and 310K, 311K with 10μV/°C. Each is housed in an aluminum enclosure for improved shielding.

Model 310, with inverting input only, is most appropriate for use with current source signals such as gas chromatographs flame detectors and photomultiplier tubes. It is also useful for precision long term integrators or where extremely wide dynamic current range is needed as in log compression amplifiers. Current to voltage converters may also be developed using a feedback resistor for setting the conversion scale factor.

Model 311 has a single noninverting input for measuring voltage from very high source impedances where bias currents would create substantial offset errors. Such sources include pH cells or stored capacitor charge as found in long term track and hold applications. Common mode rejection is 100dB at ±25V with $10^{14}\Omega$ impedance to ground for reduced source loading errors.

FET INPUT ELECTROMETERS

MODELS 41, 42, AD523 (MONOLITHIC): This family of FET input amplifiers fully complements the varactor bridge

	Lowest Cost High Gain FET		
	42		
Model	J	K	L
Open Loop Gain			
DC Rated Load, min		100,000	
Rated Output, min		±10V@5mA	
Frequency Response			
Unity Gain, Small Signal		1MHz	
Full Power Response, min		4kHz	
Slewing Rate, min		0.25V/μs	
Overload Recovery		10ms	
Input Offset Voltage			
Initial, 25°C, (adj. to zero)		±2mV[1]	
Avg. vs. Temp (0 to 70°C) max	±50	±15	±25μV/°C
vs. Supply Voltage		±25μV/%	
vs. Time		±250μV/mo.	
Input Bias Current			
Initial, 25°C, max	350fA	100fA	75fA
Inverting Input (Varactor)		---	
Non-Inverting Input (Varactor)		---	
Avg. vs. Temp (0 to 70°C)		0, -4pA[3]	
Input Impedance			
Differential		$10^{13}\Omega$//3pF	
Inverting Input (to common)		----	
Non-Inverting Input (to common)		----	
Common Mode (FET)		$10^{13}\Omega$	
Input Noise			
Voltage, 0.01 to 1Hz, p-p		6μV	
5Hz to 50kHz, rms		8μV	
Current, 0.1 to 10Hz, p-p		5fA	
1 to 100Hz, rms (Varactor)		----	
Input Voltage Range			
Common Mode Voltage, min		±10V	
Common Mode Rejection		66dB@±1V	
Max Safe Differential Voltage		±15V	
Power Supply Range (VDC)		±(12 to 18)V	
Rated Specification (VDC)		±15V@2mA	
Temperature Range			
Operating, Rated Specifications		0 to +70°C	
Package Outline		QB-1	
Case Dimensions		1.1" x 1.1" x 0.57"	
Price			
1-9	$32	$38	$42
10-24	$30	$36	$39

(1)With external 4.99k trim.
(2)With trim terminal open.
(3)Max bias at 70°C.
(4)Signal input only.

designs for electrometer applications. Available in three package sizes, these designs provide high input impedance, sub-picoamp bias currents and improved bandwidth characteristics. They may be used single-ended or differentially for making low level current or voltage measurements from photo/ion current transducers, pH cells, photometers or, in general, where speed and low input capacitance are essential for accurate measurements at high impedance levels as found in automated test systems. Other applications include fast integrators, charge amplifiers, differentiators and long term integrators. In addition, these carrier-less units overcome certain RFI problems which may arise in extremely noisy environments using the varactor bridge modulator types.

Model 42 J/K/L: Undoubtedly one of the best values for OEM designs, this differential FET amplifier has 110dB open loop gain, for improved closed loop accuracy, 1MHz unity gain response and CMR of 66dB at ±1V CMV. It is available in three current selections ranging from 0.35pA to 75fA. Each device features all hermetically sealed semiconductors, with monolithic front end, in a compact module for improved reliability and good thermal transient response.

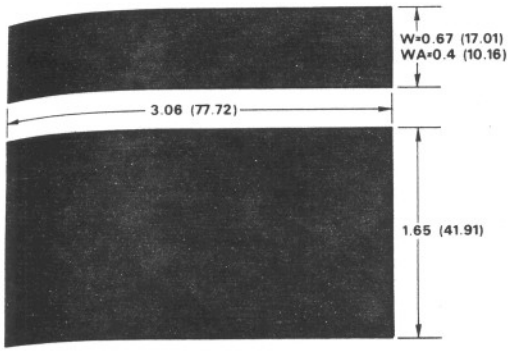
Model 41 J/K/L: This device combines outstanding bias current and drift specifications with speed and full differential input capability for use in a broad range of electrometer and integrator applications as well as for wideband differential and buffer circuitry. Typical specifications include 50kHz full power response, 94dB CMR at ±5V (80dB at ±10V), 100dB gain for improved closed loop performance, and three bias current and drift selections: 41J, 0.5pA and 25μV/°C; 41K, 0.25pA and 10μV/°C; and 41L, 0.15pA and 25μV/°C. Special packaging techniques assure 10^{13} input impedance, free from internal current leakage paths, and a maximum 4pA bias current rating at +70°C.

Model AD523: This unit is a very low bias current IC op amp. It features maximum steady-state bias currents (either input) as low as 0.25pA, in a special low-leakage TO-99 metal can package that minimizes case leakage by utilizing a special guard pin and high resistivity glass insulation. The AD523 is short circuit protected and offset voltage nullable, and features drift of 15μV/°C, slew rate of 4V/μsec, and large signal voltage gain of 25,000 V/V. It is available in J, K, L (0 to +70°C) and S (−55°C to +125°C) specification versions. (See also Linear IC Section).

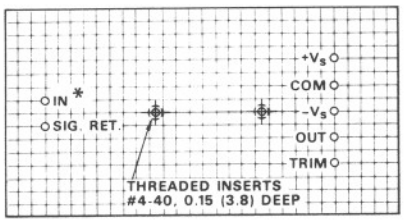
Discrete						Microcircuit		
Wideband High CMR 41			Varactor Inverting 310		Varactor Non-Inverting 311		Differential 0.25pA Guarded Input AD523	
J	K	L	J	K	J	K	J	K	L
100,000			100,000		100,000		25,000	40,000	40,000
±10V@5mA			±10V@5mA		±10V@5mA		±10V@5mA		
1MHz 50kHz 3V/μs 2μs			2kHz 7Hz 0.4V/ms 10ms		2kHz 7Hz 0.4V/ms 10ms		500kHz 50kHz typ 3.0V/μs 6μs		
±25	±2mV[2] ±10 ±10μV/% ±250μV/mo.	±25μV/°C	±30	Adjust to zero ±10μV/°C ±100μV/% ±100μV/mo.	±30	Adjust to zero ±10μV/°C ±100μV/% ±100μV/mo.	±50mV ±90 ±30	±20mV ±30 ±15 —	±20mV ±60μV/°C ±15μV/%
0, -0.5pA	-0.25pA — — 0, -4pA[3]	-0.15pA		— ±10fA ±1nA ±1fA/°C[4]		— ±1nA ±10fA ±1fA/°C[4]	0, -1.0pA	-0.5 — — 2x/10°C	-0.25pA
10^{13} Ω//3pF --- --- 10^{13} Ω			3 x 10^{11} Ω --- --- ---		3 x 10^{11} Ω 10^{9} Ω 10^{14} Ω ---		10^{12} Ω --- --- 10^{13} Ω		
8μV 10μV 5fA ---			10μV 10μV(1 to 100Hz) 1fA (0.01 to 1Hz) 2fA		10μV 10μV(1 to 100Hz) 1fA (0.01 to 1Hz) 2fA		20μV --- --- ---		
±10V 94dB@±5V ±15V			NA NA ±300V		±25V 100dB@±25V ±300V		±8V 70dB min ±10V	80dB min	80dB min
±(12 to 18)V ±15V@8mA			±(12 to 18)V ±15V@+15, -6mA		±(12 to 18)V ±15V@+15, -6mA		±(5 to 18)V ±15V@7mA		
0 to +70°C			0 to +70°C		0 to +70°C		0 to +70°C		
F-2 1.5" x 1.5" x 0.4"			W-1 3" x 1.65" x 0.67"		W-1 3" x 1.65" x 0.67"		TO-99 (guard pin 8 conn. to case)		
$53 $50	$64 $59	$75 $71	$59 $55	$95 $90	$62 $58	$100 $95	$21 $21	$25 $25	$28 $28

W, WA PACKAGES

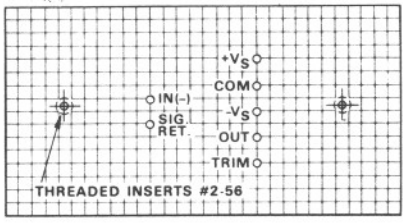
Model	Package	Socket
231	WA-1	AC1014
310	W-1	AC1017
311	W-1	AC1017



W-1

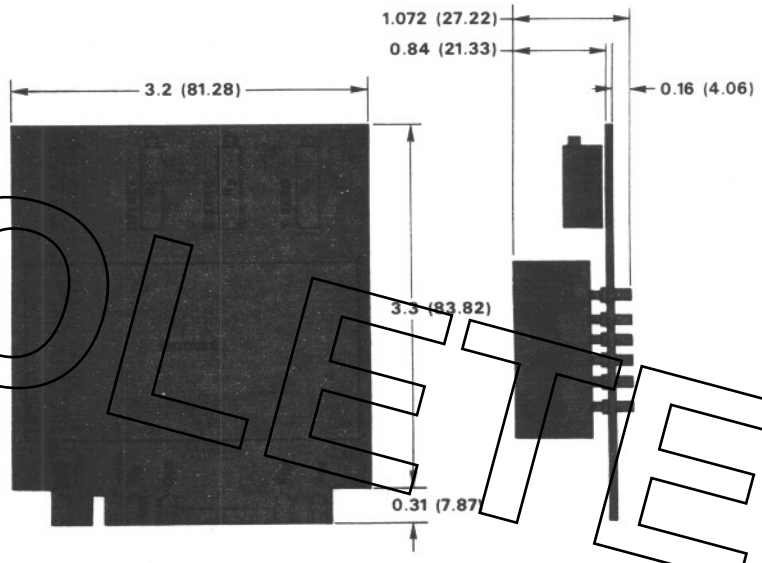


WA-1



* –IN, model 310; +IN, model 311.

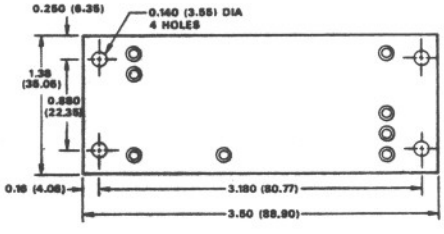
MODEL 425 OUTLINE



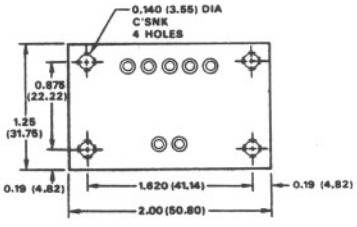
NOTES:
1. Model 425 gain adjust pot in series with X input.
2. Mating connector supplied with unit (ADI part no. 60-42820).

MATING SOCKETS

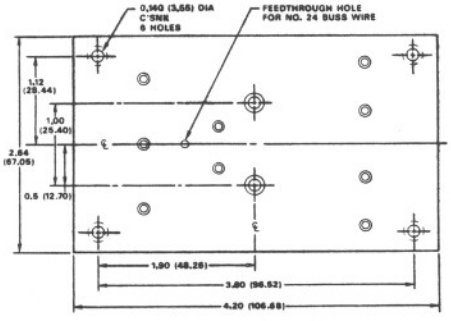
AC1002 @ $3.75



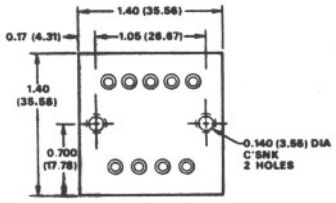
AC1003 @ $3.00



AC1007 @ $8.00



AC1008 @ $3.25
AC1011 @ $3.75
AC1016 @ $3.25
AC1039 @ $3.25



AC1010 @ $3.25