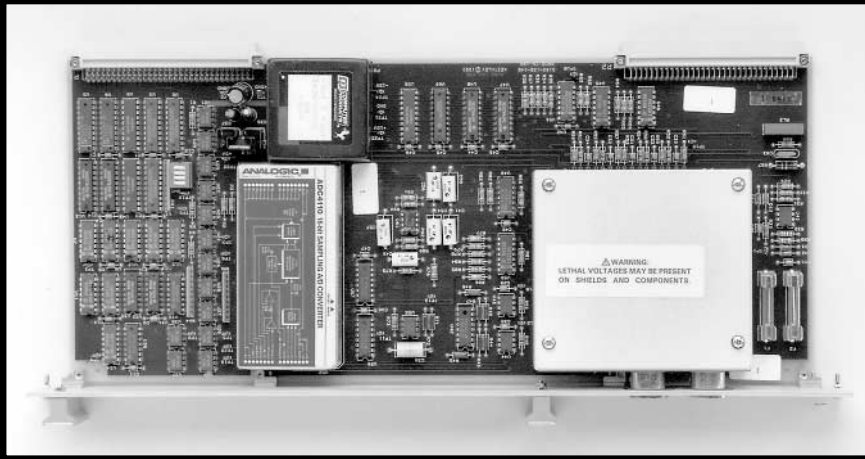


9162-PAU

S400 Series Picoammeter



System component for use with:

- VAX-based S400 Systems
- UNIX-based S400 Systems

APPLICATIONS

- MOS characterization and modeling
- Sub-threshold characterization
- Measurements of leakage currents below 1nA
- Bipolar device modeling
- DRAM cell characterization
- CCD dark current measurements
- Diode leakage

High Speed, Low Current Measurements

The Model 9162-PAU is a high speed VME-based module, designed to simplify making picoamp-level current measurements rapidly. The module's raw measurement speed is less than 1ms per reading. It offers nine current ranges from 20mA to 200pA full scale, with 7.6fA resolution on the most sensitive measurement range. This complements the Model 9110-VIMS for fast, accurate current measurements of less than 100pA. The Model 9162-PAU is also an excellent higher speed alternative to the Model 9160-SMM electrometer module when that module's extended low level resolution is not required. The 9162-PAU is designed for system-level applications, so its settling time is tuned to the settling times of other system components. As a result, the 9162-PAU simplifies optimizing resolution, accuracy, and speed tradeoffs.

Fully Floating Inputs

Much like Keithley's earlier picoammeter modules for parametric testing applications, the 9162-PAU is a negative feedback electrometer. The low input of the module can be driven to $\pm 200V$ from ground, which allows maximum flexibility in measurement configurations. The inputs to the 9162-PAU are fully guarded to minimize any leakage paths through the switching matrix and DUT cables. To minimize any offset voltages that can be developed, the module has full Kelvin sensing on the high and low inputs.

User Selectable Filter Modes

Three user selectable filter modes are available to minimize noise interference. For measurements on the higher current ranges, the "no filter" mode allows higher measurement speed. When measuring lower currents, a simple R-C filter with a 50ms settling time can be used to remove random noise. For very low level current measurements, a five-pole Gaussian filter with a 200ms settling time can be used to eliminate most environmental and line noise effects. A line cycle integrator function removes AC noise caused by 50/60Hz power line interference.

Enhanced Autorange Operation

The 9162-PAU's full autorange capability simplifies making measurements over a wide dynamic range. Two autorange features are particularly useful for ensuring the highest possible speed. A "sticky" autorange algorithm can be used to command the module to remain on the last measurement range used, then to range up or down as necessary for the next measurement. This approach speeds testing when a series of current values are to be recorded. Another feature, the LORANGE command, allows users to limit the bottom range during autorange measurements. This command is useful when the full resolution of the lower ranges is not necessary. In addition to autoranging, users also have the option to select the measurement range.

Supports All Standard LPT Functions

The S400 Series system software identifies the 9162-PAU as IMTRx (a standard current meter designation), so the module supports all standard measurement functions. For example, it can take advantage of the software's linear SWEEP function to simplify acquiring curves. SEARCH and TRIGGER functions are also available to speed the device characterization process.

Compatible with Choice of Matrices or Direct Connect Option

The 9162-PAU is compatible with both the standard Model 9133/4 matrix card and the Model 9174-HSM high speed, low current matrix card. This matrix cuts delay times by 50 to 90 percent for measurements below 1nA, providing significantly enhanced throughput. An alternative version of the 9162-PAU, the Direct Connect PAU, by-passes the matrix entirely, eliminating current leakage paths, for higher speeds and greater low level measurement accuracy.

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Fast, Low Current Measurements with S400 Systems

SEMICONDUCTOR

9162-PAU

S400 Series Picoammeter

Diagnostic and Calibration Support

The S400 Series standard system diagnostic package includes all the software tools needed to test the 9162-PAU fully. The diagnostics package provides routines for performing quick checks of four points per range, as well as more exhaustive tests of 20 points per range. The module is fully software calibrated with a gain and offset correction for each range, much like other S400 Series instruments.

Range	Resolution	Accuracy (% rdg + offset) ³	Instrument Fixed Range Settling Time to 0.1% ¹
20 mA	0.763 μ A	0.1% + 5 μ A	1 ms
2 mA	76.3 nA	0.1% + 500 nA	1 ms
200 μ A	7.63 nA	0.1% + 50 nA	1 ms
20 μ A	763 pA	0.1% + 5 nA	2 ms
2 μ A	76.3 pA	0.1% + 500 pA	2 ms
200 nA	7.63 pA	0.2% + 50 pA	3 ms
20 nA	763 fA	0.5% + 5 pA	3 ms ²
2 nA	76.3 fA	0.8% + 2 pA	15 ms ²
200 pA	7.63 fA	1.0% + 1 pA ⁴	15 ms ²

NOISE (200pA range/200ms filter):

Normal: 0.5pA rms (3pA p-p) typical.
Direct: 60.0fA rms (400fA p-p) typical.

INPUT BURDEN:

Normal: $100\mu V + 100\mu V \cdot (I_{meas}/I_{full-scale})$.
Direct: $100\mu V + 2\Omega \times I_{meas}$.

SENSING:

Normal: Remote Kelvin sensing.
Direct: Remote Kelvin sensing on Input LO only.

COMMON MODE VOLTAGE: $\pm 200V$

INPUT LO TO CHASSIS IMPEDANCE: $0.01\mu F$ in series with 470Ω .

CALIBRATED OVERRANGE CAPABILITY: Approximately 25% of range.

Notes:

- For Direct Connect PAU option only. Settling time reflects the delay from a change in the measured parameter to a measurement within 0.1% of its final value.
- System default uses 200ms filter on these ranges.
- Specifications apply to through matrix operation.
- Input Leakage Current: 9133/4 Matrix: 1pA typical.
9174-HSM Matrix: 500fA typical.
Direct: 250fA typical.

NOTE: These specifications apply for a bias of 0.0V after proper zeroing. For bias values other than 0.0V the following typical matrix specifications should be included when using a Keithley standard Model 9133/4 or 9174-HSM Matrix:

Shunt Leakage-to-Ground: 1.0pA/V

Adjacent Channel Leakage: 0.3pA/V

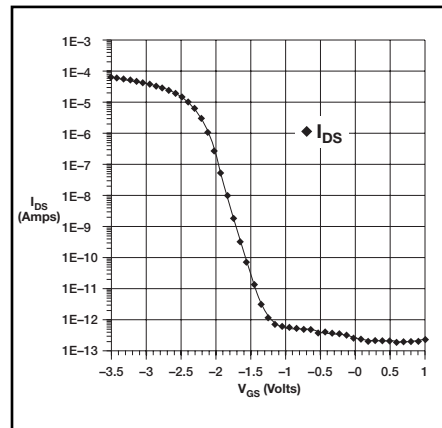
When using the Model 9174-HSM matrix, include the following maximum leakage specifications:

12-Pin Board

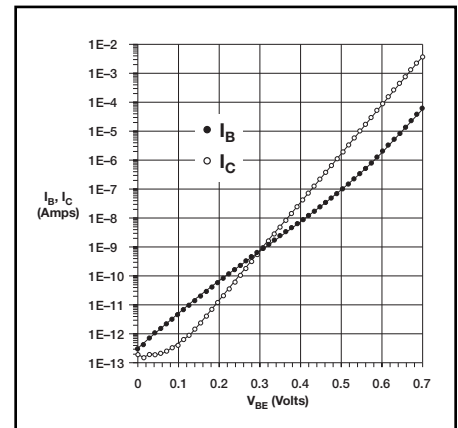
Pin to Ground: 0.01 pA/V
Pin to Pin: 0.005 pA/V

48-Pin System

Pin to Ground: 0.03 pA/V
Pin to Pin: 0.015 pA/V



This plot illustrates the excellent resolution of the Model 9162-PAU. The high speed measurement capability allows routine collection of low current data.



The capability of having multiple units allows simultaneous measurement of more than one parameter as shown above.

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