

The ML8-P is an A/D converter and digital I/O board for PC/AT compatible computers. The ML8-P has the following:

- An 8-channel multiplexed, 8-bit successive approximation A/D converter with sample and hold. The maximum voltage of each channel is ± 5 volts with a resolution of 0.039 volts (39 millivolts). Inputs are single ended with a common ground and can withstand a continuous overload of ± 30 volts and very brief transients. All inputs are fail safe, that is, open circuit when the computer power is off. A/D conversion time is 30 microseconds minimum and depends on the speed of the software.
- Seven bits of TTL digital I/O are provided consisting of one output port of 4 bits and one input port of 3 bits.
- One precision +5.00v (± 0.2 v) reference voltage output from the A/D converter reference. This output can source/sink 5mA and the voltage is slightly adjustable by the A/D full scale trim pot.
- An external hardware interrupt input is provided that can select any of the PC interrupt levels 2-7 and allow user programmed interrupt routines to provide background data acquisition or interrupt driven control. The ML8-P includes status and control registers that make interrupt handshaking a simple procedure. The interrupt input is positive edge triggered and may be connected to any external TTL compatible trigger source.
- PC bus power (+5 and ± 12 VDC) and other I/O connections are available on the rear connector. This makes for simple addition of input signal conditioning circuits, expansion multiplexers, or user designed interfaces.
- Installation and calibration program.

The ML8-P is designed for low precision data acquisition and control applications. The 8 bits provide 255 states spanning -5.00 volts to +4.96 volts. This provides better than 1% bipolar resolution which is often adequate for many measurement, control and graphing applications.

To extend the capabilities of ML8-P, the following modules can be connected to the main DB-37 pin I/O connector.

- The optional Screw Terminal Connector Board - All I/O lines on the rear connector are connected to miniature screw terminal connectors. A small breadboard with ± 12 VDC and +5VDC power is available for amplifiers, filters, and other user supplied circuits. The screw terminal connector board is Industrial Computer Source part number UTB-K.
- The optional Expansion Multiplexer and Instrumentation Amplifier - The AT-16 multiplexes 16 differential inputs to a single analog output suitable for connection to any of the analog input channels of ML8-P. AT-16 boards are cascadable so that up to 8 boards can be attached to a single ML8-P providing a total of 128 channels. The AT-16 provides software programmable gains. A cold junction

compensation sensor is also included for software compensation of thermocouples.

4-20mA Current Loops

Process control current loop transducers are easily interfaced to the ML8-P by adding a suitable shunt resistor across the input. Since the maximum current will be 20mA and the maximum input range is +5V, a 250 ohm precision shunt resistor is required. A low temperature coefficient, metal film or wire wound resistor provides the needed stability with time and temperature. Using this interface, the 4-20mA working range of the current loop corresponds to 102 bits of input, a resolution of 1%.

Reference Voltage

The 5V A/D voltage reference (V_{ref}) is brought out for users. It may be used for offsetting signals but should not be heavily loaded. The maximum available output current is 5mA.

Using Digital Input/Output

The ML-8P provides four TTL/DTL compatible digital outputs (OP1-4) and three TTL/DTL compatible digital inputs. The digital outputs correspond to bits 4 through 7 of the control register and are accessed by writing to the control register. When you write to the control register, you will usually need to maintain the state of bits D0 through D3 that control the multiplexer address and interrupt enable. The multiplexer address bits 0 through 2 can always be determined by reading the status register, so the only stat that has to be stored is whether or not the interrupt is enabled.

Digital output can sink 8 mA (5 standard TTL loads or 20 LSTTL loads). If you wish to interface to CMOS, 1K ohm pull-up resistors connected to the +5V line should be connected to the outputs.

If AT16-P expansion interface is used, then the digital outputs are usually fully committed to providing the sub-multiplex address.

Digital inputs are available through bits 4 through 6 of the status register. The digital data is easily obtained by masking out these bits using a logical AND operation. The inputs present a -0.4mA loading corresponding to 1 LSTTL load.

Adding More Analog Inputs

For inexpensive temperature measurement in the -50 to +125 C temperature range, semiconductor temperature transducers are a good choice. The AD590 (Analog Devices) provides a constant current source with an output of 273uA at 0 degrees C and a scaling of 1uA/degree C. The LM335 (National Semiconductor) provides an output of 2.73 volts at 0 degrees C and a temperature coefficient of 10mV/degree C. These devices are powered by +12V from the computer. These devices may interface directly to the ML8-P or interface to the ML8-P through a simple operational amplifier. These give better resolution than a thermocouple for ambient temperature measurements and are easier to interface.