PC5 POWER SUPPLY BOARD FOR AMPTEK DETECTORS AND PREAMPLIFIERS

The PC5 is a power supply for the detector and preamplifier. It provides (1) the high voltage bias for the detector (either polarity, up to 1500 V), (2) power for the thermoelectric cooler (with closed loop temperature control), and (3) the low voltages required for the preamplifier (+/-5V or +/-8.5V).

The settings of the PC5 must match the configuration of the preamplifier and detector or the components may be damaged. The user is not meant to modify the PC5 configuration.

The PC5 may come with a subset of the connectors installed than shown in this document. Only the connectors that are compatible with the ordered configuration are installed.

The PC5 can be used with Amptek's DP5 signal processor or with a custom signal processor. Figure 1 shows the two most common configurations.

1. With the DP5 as shown at the top, the DP5 controls the PC5. It turns on the power supplies, controls the high voltage bias and temperature by DACs, monitors the actual high voltage and temperature, and checks the bias polarity. The input power (5 VDC) can be supplied into the DP5 (via a standard plug) or into the PC5 (via an 8 pin header). Communications may be through the DP5 or RS232 communication is possible through the PC5.
2. With a different processor, the PC5 uses potentiometers and fixed resistors to determine the configuration. It is not under software control and provides no readout. Power is supplied through the PC5's 8 pin header or through a plug on the PC5.

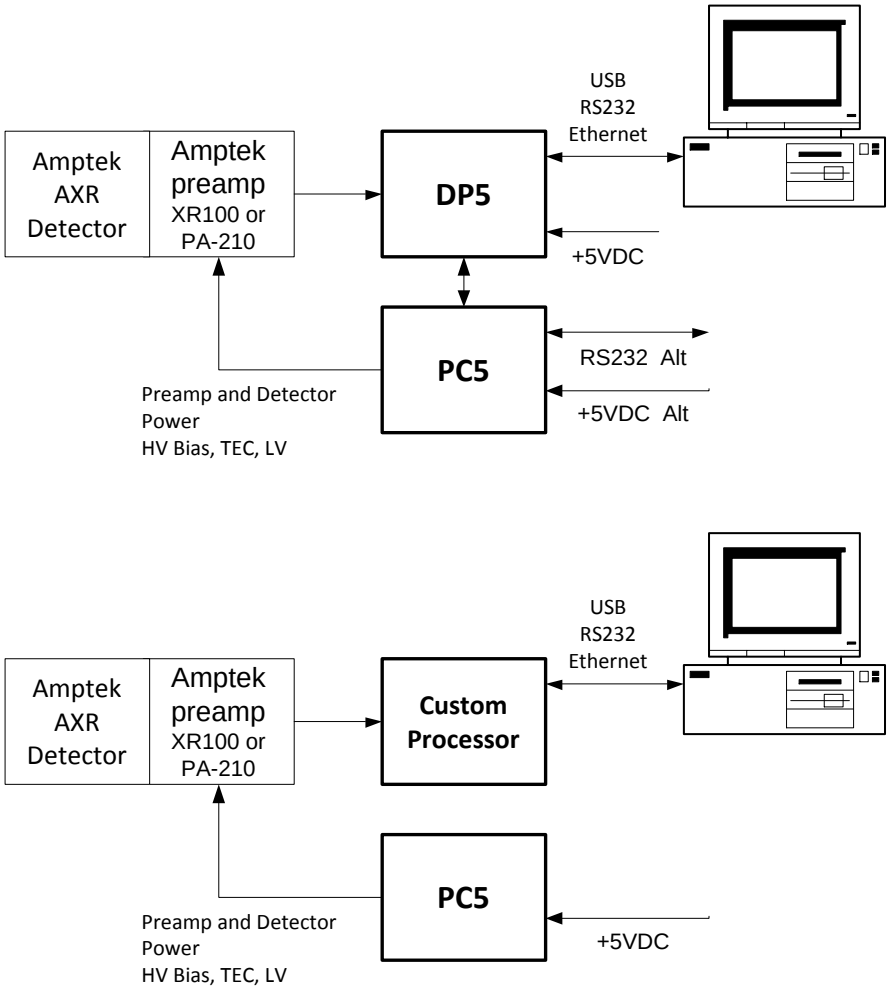

Figure 1. Block diagram of the two system configurations.

PC5 DESCRIPTION

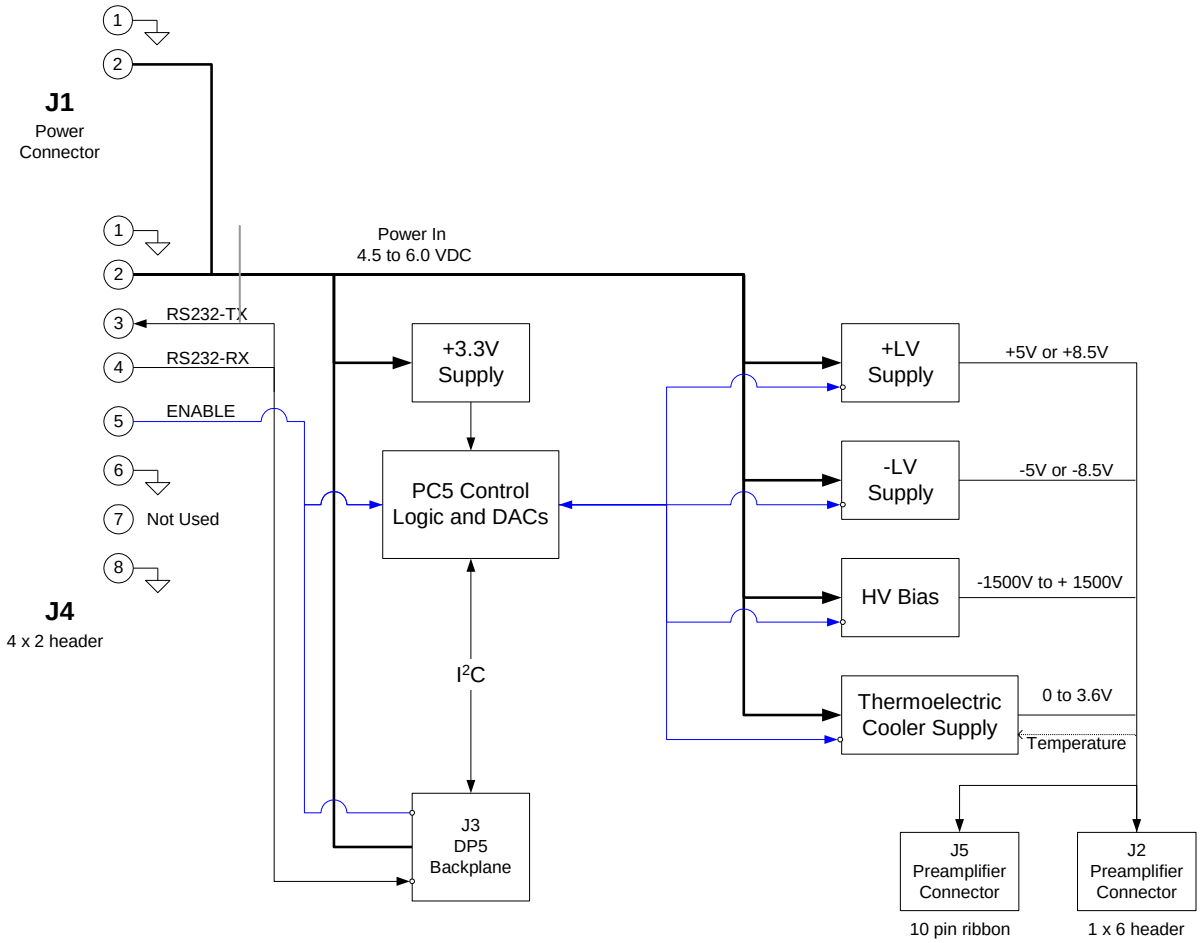

Figure 2. PC5 Schematic

The PC5 contains several separate switching regulators. Four provide the power for the preamplifier and detector: two low voltages for the preamplifier, the HV bias for the detector, and the power for the thermoelectric cooler. There are several important details for this circuit.

- The PC5 supply voltage must be between +4.5 and +6.0 VDC. Power can be supplied via J1, or J4, or from the DP5 via J3. If the DP5 is installed it can be powered via the PC5 J1 or J4.
- The power dissipated will depend on many variables. The PC5, preamplifier, and detector typically draw a maximum of 1.5 W (300 mA at 5 V). The PC5 and DP5 together typically draw 3.0 W (600 mA at 5 V).
- Nominal switching frequencies are >1 MHz, except for the HV bias which switches at 50 kHz.
- The enable pin can be controlled from the DP5 or J4.
- The PC5 control logic is generally under control of the DP5 via I^2C. This enables the various supplies, determines the set point, and monitors the values which are reported back to the DP5. If no DP5 is used then potentiometers and resistors are installed to provide fixed control.

HV Bias Supply Discussion

A simplified schematic for the HV supply is shown in the schematic below for positive polarity. The output is divided by a factor of 500 into the error amplifier circuit. TP12 measures the HV set point while TP13 measures the actual HV bias. Both measure 2 mV/V, so for a 240 V bias these test points should be 0.48 V. For use with a DP5, VR1 is not installed and the DAC controls the value. For use without a DP5, VR1 is installed (along with other components) and the DAC is disconnected.

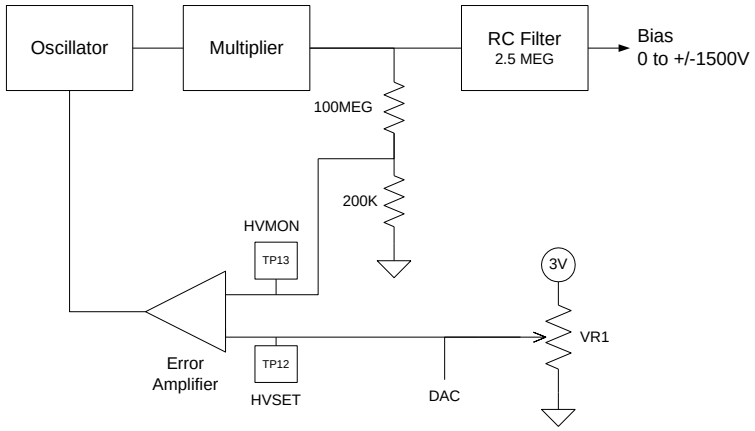

Figure 3. Schematic for HV Bias supply circuit.

- Negative polarity is similar but the divider output is inverted. Both HVMON and HVSET are still positive. Changing polarity requires removal and installation of several zero ohm resistors and is done at the factory.
- The bias polarity and magnitude are selected based on the detector in use. These are very important, since the wrong polarity or excess magnitude can cause irreparable damage to a detector. This type of damage is not covered under warranty.
- The output RC filter has a series resistance of 2.5 MΩ. This provides current limiting (0.6 mA maximum) but it also means that the bias on the detector is lower than that reported by the monitor, due to ohmic losses across the resistors. Also note that the output of the filter, at the J2 or J5 connector, cannot be measured with a conventional DVM (input impedance 10 MΩ). A high impedance probe is required.

THERMOELECTRIC COOLER DISCUSSION

The control circuit for the thermoelectric cooler is shown in the schematic below. This circuit maintains a fixed temperature rather than a fixed output voltage. A temperature sensor is located in the detector hybrid. The conditioning circuitry generates an output of 10 mV/K (2.2 V at 220 K). This is compared to the set point to generate the error signal.

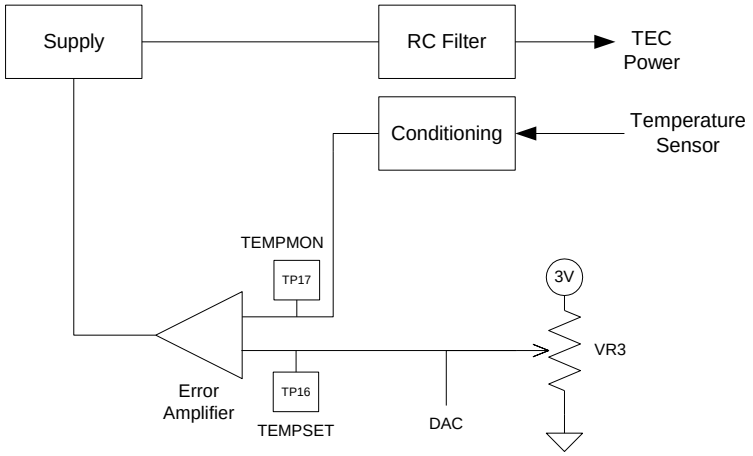

Figure 4. Schematic for thermoelectric cooler supply circuit.

For use with a DP5, VR1 is not installed and the DAC controls the value. For use without a DP5, VR1 is installed (along with other components) and the DAC is disconnected. There exists a maximum temperature differential which a given cooler can achieve. If the set point is lower than this, then the supply will provide maximal cooling (with an output current limit) but the detector temperature is no longer regulated. It will change as the system temperature changes.

A typical two-stage cooler can generate an 85 °C ΔT. Example: If room temperature is 20 °C, then the maximum cold temperature is -65 °C. It is vital that the detector temperature remain constant. Therefore the set point must be set such that no matter what the ambient temperature reaches, the detector temperature stay constant. Example: If room temperature is 40 °C the temperature set point must be set such that this is regulated, so the coldest the detector can be set to is -45 °C. This means that even at 20 °C room temperature the detector will be at -45 °C, but it will be constant from 20 to 40 °C.

CONNECTORS AND SPECIFICATIONS

J1: Power Connector

Part#: MQ172-3PA(55), mates with MQ172-3SA-CV

Pin 1: Power In (+4.5 to +6 VDC)

Pins 2, 4, 5: Ground

Pin 3: No Connect

J2: Power Connector to XR100

Part#: Molex 22-28-8062

Pin 1: Detector temperature. This is an input to the PC5 from the detector

Pin 2: HV Bias. From 0 to +/-1500V, depending on the detector.

Pin 3: -8.5 or -5V. Supplies power to the preamp

Pin 4: +8.5 or +5V. Supplies power to the preamp

Pin 5: Ground

Pin 6: TC+. Provides power to the thermoelectric cooler. Should not exceed 4 V.

J2 is a 1x6 header. It mates with Molex C-Grid Crimp Connector. Housing P/N 50-57-9006, terminal P/N 16-02-0119. DigiKey part numbers are WM2804-ND and WM2568CT-ND, respectively.

J3 : DP5 Backplane Connector

Documented and described in the DP5 Manual.

J4: Power and RS232

Part#: Molex 71764-0108

Pin 1: Ground

Pin 2: Power In (+4.5 V to +6 VDC)

Pin 3: RS232-TX (output from DP5)

Pin 4: RS232-RX (input to DP5)

Pin 5: Shut down. Holding this pin low turns off the supplies to the preamp and detector.

Pin 6: Ground

Pin 7: Not used

Pin 8: Ground

J4 is a 4x2 header. It mates with Molex C-Grid Crimp Connector. Housing P/N 22-55-2081, terminal P/N 16-02-1114. DigiKey part numbers are WM2521-ND and WM2556-ND, respectively.

J5: Power and signal for PA-210/PA-230 detector/preamplifier

Part#: Samtec ZF1-10-01-T-WT

Pin 1: Ground

Pin 2: TC+ Provides power to the thermoelectric cooler. Should not exceed 4 V.

Pin 3: +8.5 or +5V. Supplies power to the preamp

Pin 4: -8.5 or -5V. Supplies power to the preamp

Pin 5: Signal return.

Pin 6: Signal Out.

Pin 7: Detector temperature. This is an input to the PC5 from the detector.
Pin 8: GND.
Pin 9: NC
Pin 10: HV Bias. From 0 to +/-1500V, depending on the detector.

J7: Power and signal for PA-210/PA-230 detector/preamplifier

Part#: TMM-102-01-S-D-SM, mates with SMM-102-02-S-D-LC
Pin 1: Signal Out
Pin 3: Signal return
Pin 2 and 4: NC

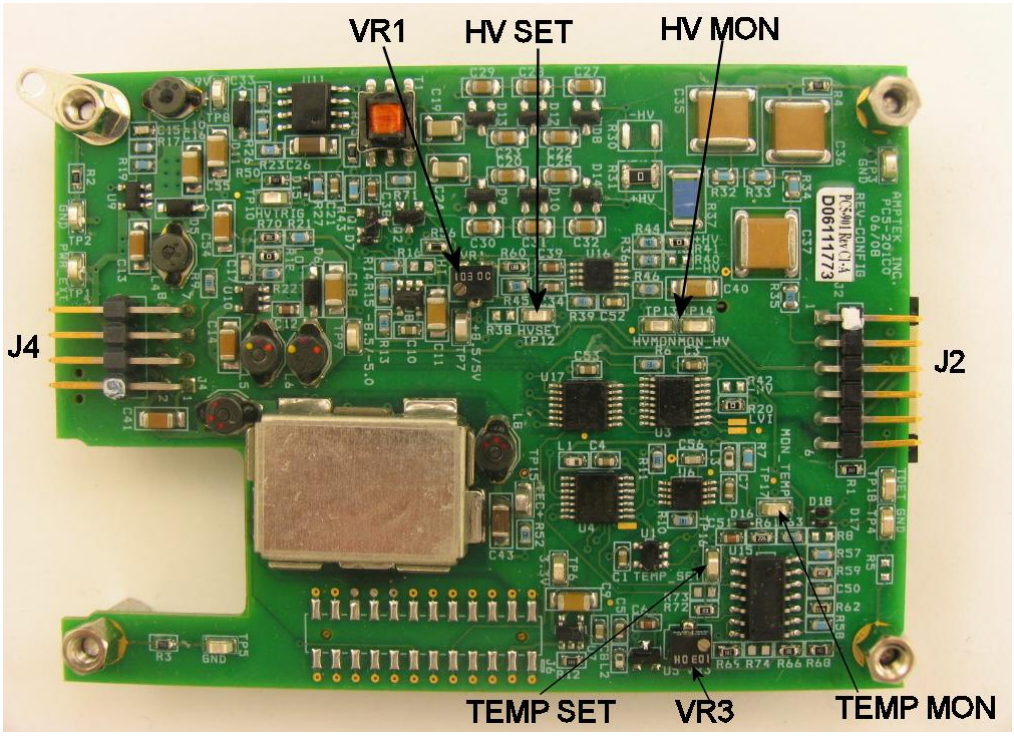

Figure 5. Photo of the top side of the PC5

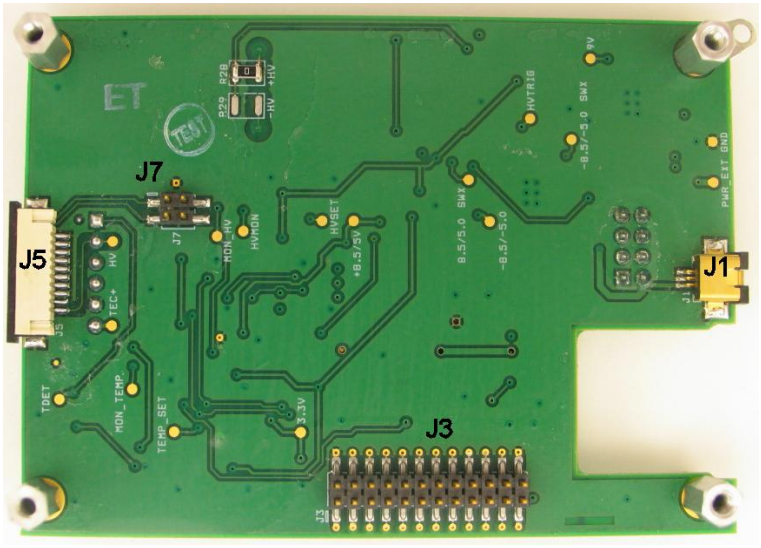

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Figure 6. Photo of the bottom side of the PC5.

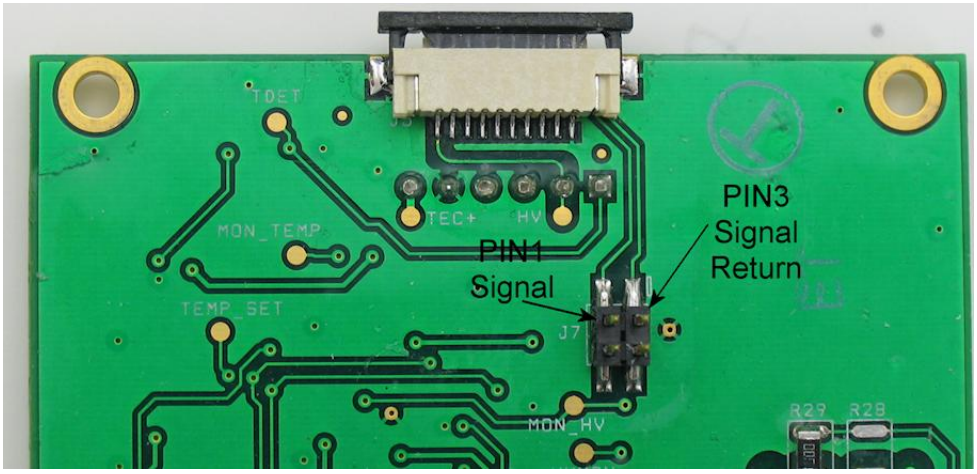

Figure 7. Photo of the bottom on the PC5 showing the flex connector for the PA-210/PA-230 preamplifier and the signal jumper that brings the signal from the PC5 to the DP5. This is needed when using the PC5 with the DP5 and the PA-210/PA-230 preamplifier. If using the PC5 with the XR100 box then these are not needed.

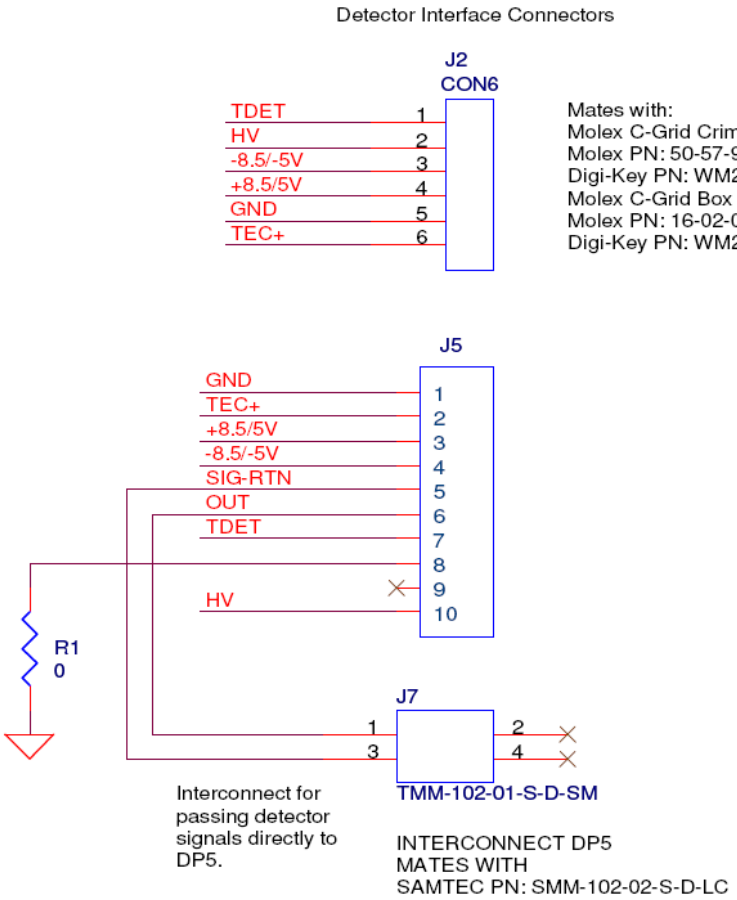

Figure 8. Schematic of the J2, J5, and J7 connectors.

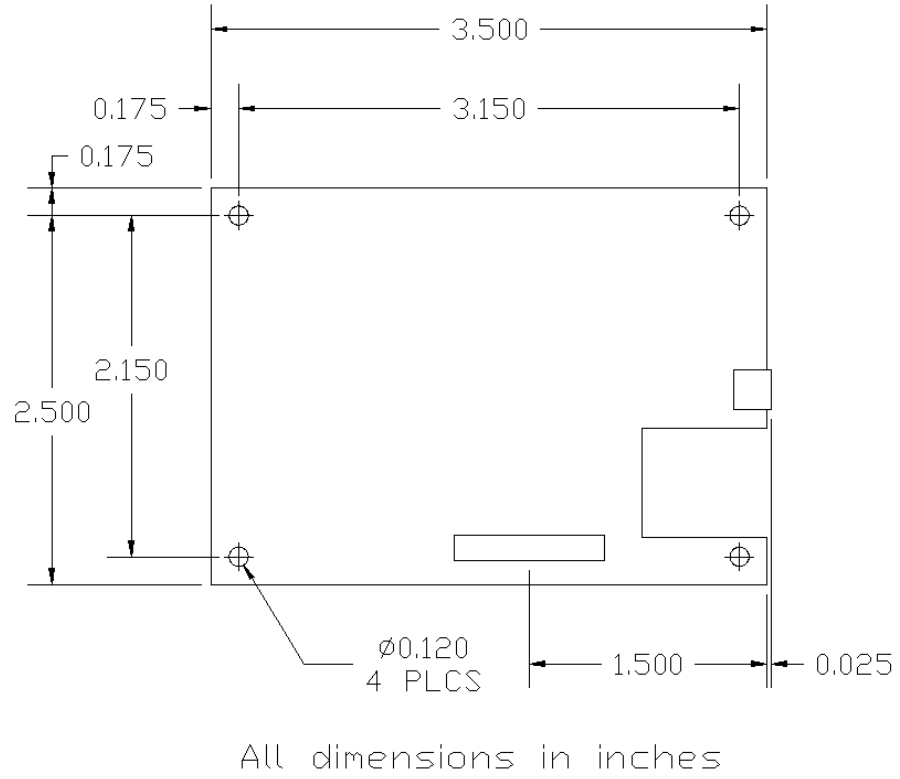

Figure 9. Mechanical overall dimensions.

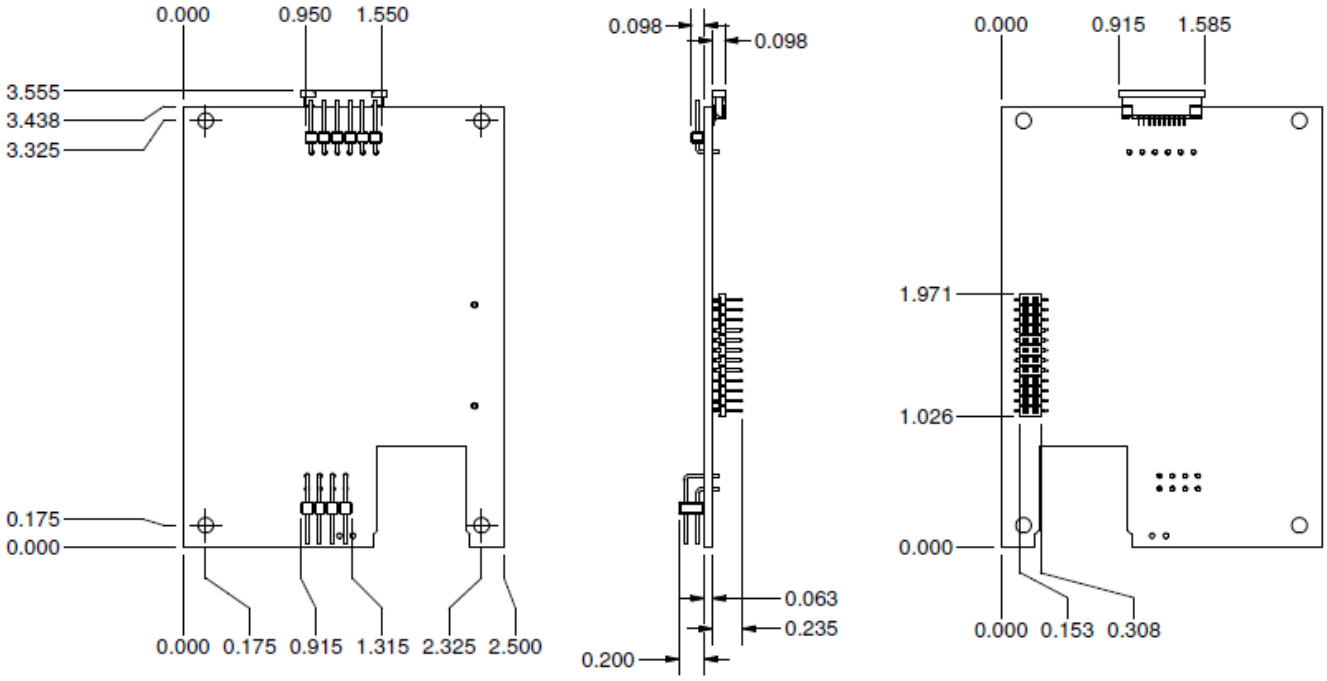

Figure 10. Mechanical connector locations and dimensions. All dimensions in inches.

NOTES ON USING THE PC5 WITHOUT A DP5

The PC5 must be ordered with the correct configuration. It is not intended for the user to change configurations for different products.

XR100

When using the PC5 with an XR100 box the following configuration is needed:

- Preamp power set to +/- 8 V (R16 = 0 Ohm/short, R18 = open).
- J2 connector used to connect power to XR100.
- VR3 and additional components installed for temperature control (installed at factory).
- XR100 Amp Out connected directly to user supplied signal processor.
- Input power is applied either to J1 with the AC adapter or to J4 from a power supply.

PA-210/PA-230

When using the PC5 with a PA-210 or PA-230 the following configuration is needed:

- Preamp power set to +/- 5 V (R16 = open, R18 = 0 Ohm/short).
- VR1 and additional components installed for HV control (installed at the factory).
- J5 installed and connected to PA preamp with flex cable.
- J7 installed. Unlike the XR100 that has a separate signal out, the PA preamps send the signal through the power flex cable. As a result, the signal must be taken from the PC5 J7 connector and then connected to the user supplied signal processor.
- Input power is applied either to J1 with the AC adapter or to J4 from a power supply.