Summary

Features

- Connects one AB4 series 4-channel SiPM base
- Wideband DC-coupled signal path
- Buffers 4 SiPM position signals for an oscilloscope or ADC
- Sums 4 SiPM position signals with gain and offset adjust, for use by an external discriminator
- SiPM array bias using a precision variable HV power supply with over-current shutdown, voltage monitor, and current monitor

Standard accessories

- 3 ft. 16-conductor micro-pitch cable assembly
- 12V, 1A desktop power supply

Part numbers

SiPMIM4-BNC	BNC receptacles
SiPMIM4-LEMO	LEMO EP.00 receptacles

Local SiPM signals

- 4 buffered SiPM position signals
- 1 sum of 4 SiPM position signals

Position signals and sum have individually jumper-selectable polarity and AC or DC coupling

Controls

- SiPM position signal sum gain and offset adjust
- HV power supply over-current fault reset
- Local SiPM bias voltage adjust
- Remote SiPM bias voltage control input

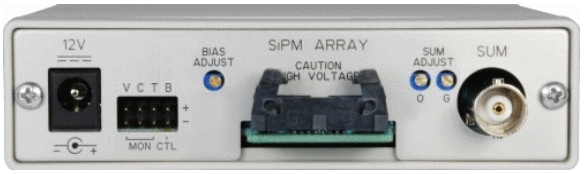
Monitor signals

- SiPM base temperature, bias voltage, bias current

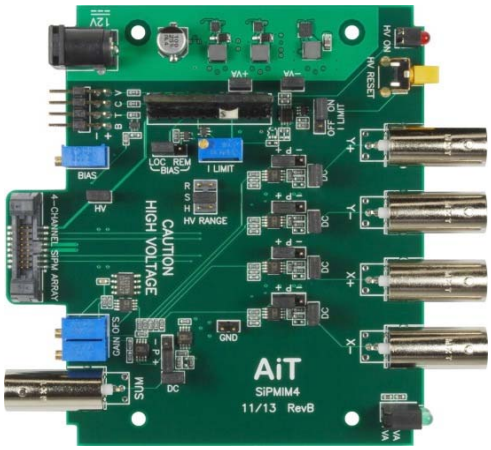
SiPM Base signals

- 4 SiPM position signals
- SiPM bias voltage
- Amplifier power
- Base temperature

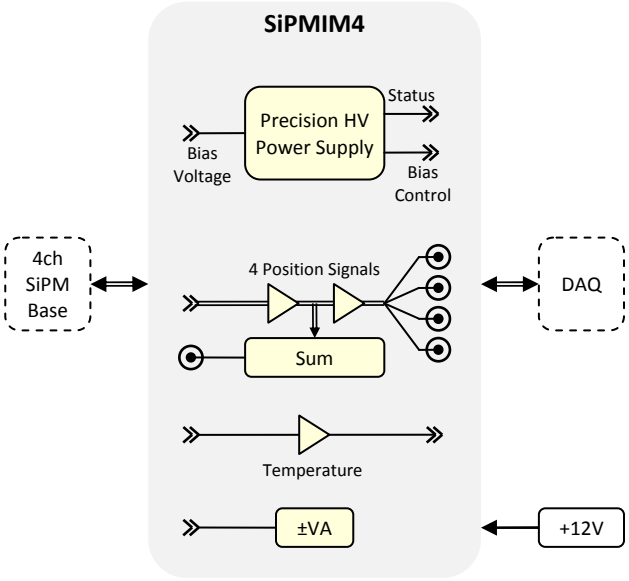
Enclosure Front (BNC Version)



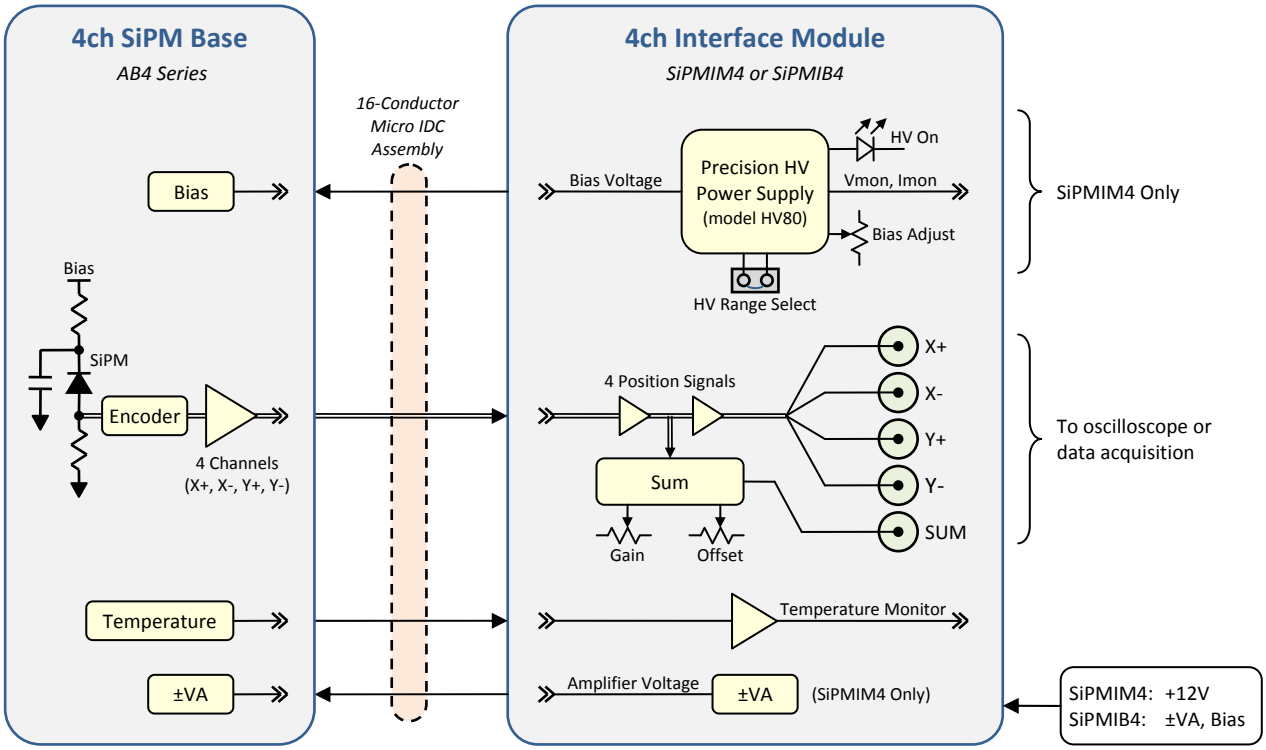
Enclosure Back (BNC Version)



Circuit Board



AB4 Series 4-Channel SiPM Evaluation System



Summary

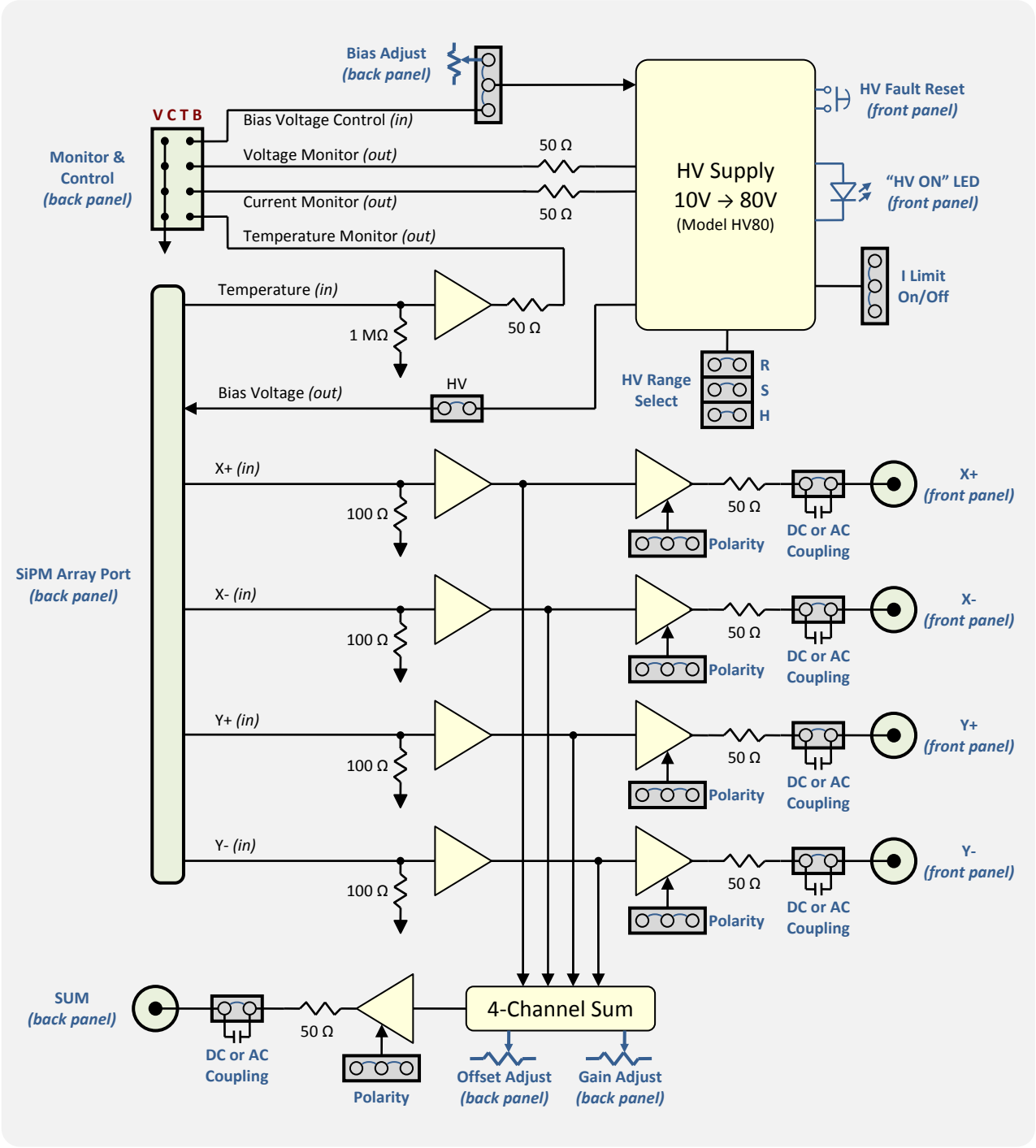
A 4-channel SiPM array evaluation system consists of an AB4 series 4-channel SiPM Base plus a SiPMIM4 (“IM4”) Interface Module or SiPMIB4 (“IB4”) Interface Board. The AB4 connects to the IM4 or IB4 through a micro-pitch ribbon cable that permits versatile placement of the Base.

The IM4 and IB4 buffers four SiPM position signals and forms an analog sum of all SiPM position signals. Position signals and sum are provided on five BNC receptacles or optional LEMO EP.00 coaxial receptacles for use with an oscilloscope or external data acquisition. The sum may be used to form a trigger.

SiPMIM4 and SiPMIB4 Differences

The IM4 is provided in an aluminum enclosure and requires only an external 12V DC power supply. It internally generates the amplifier voltages and bias voltage required by the Base. The IM4 position signal outputs and sum output have jumper-selectable polarity and jumper-selectable AC or DC coupling. The IB4 is a low-cost unenclosed circuit board that requires external amplifier voltages and bias voltage to be provided through screw terminals.

Architecture



(out) = output from the SiPMIM4, *(in)* = input to the SiPMIM4

= Jumper (select only one position per block)

Specifications

SiPM Position Signal Buffers

Rise time	< 3 ns
Bandwidth (in → out)	120 MHz
Gain (in → out)	0.25 (100Ω source, 50Ω load)
Input voltage	±3V max., 100Ω input impedance
Output polarity	Positive or negative *(jumper selectable)*
Output coupling	DC or AC *(jumper selectable)*
AC-coupling capacitance	0.1 µF
Output voltage	±1V max. (50Ω load), 50mA max., 50Ω output impedance

SiPM Position Signal Sum

Rise time	< 4 ns
Bandwidth	80 MHz at min. gain, 50 MHz at max. gain
Gain adjust	0.25 → 2.5 *(25-turn potentiometer)*
Input offset adjust	±700mV, with in → sum gain = 1 *(25-turn potentiometer)*
Output polarity	Positive or negative *(jumper selectable)*
Output coupling	DC or AC *(jumper selectable)*
AC-coupling capacitance	0.1 µF
Output voltage	±1V max. (50Ω load), 50mA max., 50Ω output impedance

Temperature Monitor

Input voltage	+3V max., 1 MΩ input impedance
Output voltage	+3V max., 20mA max., 50Ω output impedance
Gain	1

Bias Power Supply

Output voltage	10V → 80V, 2mA max. 4mA max. with over-current fault disabled (see **warnings**)
Load regulation	< 0.01%
Setpoint linearity	< 0.01%
Initial accuracy	< 0.05%, trimmable
Local bias control	*(25-turn potentiometer, jumper selectable range)*
High range	65V → 80V
Low range	28V → 33V
Remote bias control	0V → 2.5V control = 0V → 80V bias 1 MΩ input impedance
Voltage monitor	0V → 2.5V output = 0V → 80V bias 20mA max., 50Ω output impedance
Current monitor	0V → 2V output = 0mA → 2mA bias current, 10% min. accuracy 20mA max., 50Ω output impedance
Output over-current fault	>2mA output current disables HV power supply until reset
Fault reset	Resets HV power supply fault latch and momentarily bypasses the over-current fault circuit to enable the HV power supply
Over-current fault disable (*I Limit* Jumper = OFF)	Placing the *I Limit* jumper in the OFF position will disable the over-current fault circuit. It may be necessary to disable the over-current fault circuit if >2mA bias current is required. Please note the **warnings** about disabling the over-current fault circuit.
Fault bypass time	1 second typ.

Local reset	Front-panel pushbutton
WARNING	Disabling the over-current fault circuit or repeating HV reset during a persistent fault condition may damage system components. Identify and remove the cause of the fault, restart the HV power supply at a safe voltage, then slowly restore normal bias voltage.

Base Amplifier Voltage

±2.8V, 200mA max. with VA = ±3.3V
±4.5V, 200mA max. with VA = ±5.0V

Power Supply Requirements

+12V DC
60mA typ. with ±VA=3.3V, 90mA typ. with ±VA=5.0V
(Iq, no signal, no load, HV on)

LEDs

V+	Green = Positive amplifier voltage on
V-	Green = Negative amplifier voltage on
HV ON	Red = HV power supply enabled

HV Reset Pushbutton

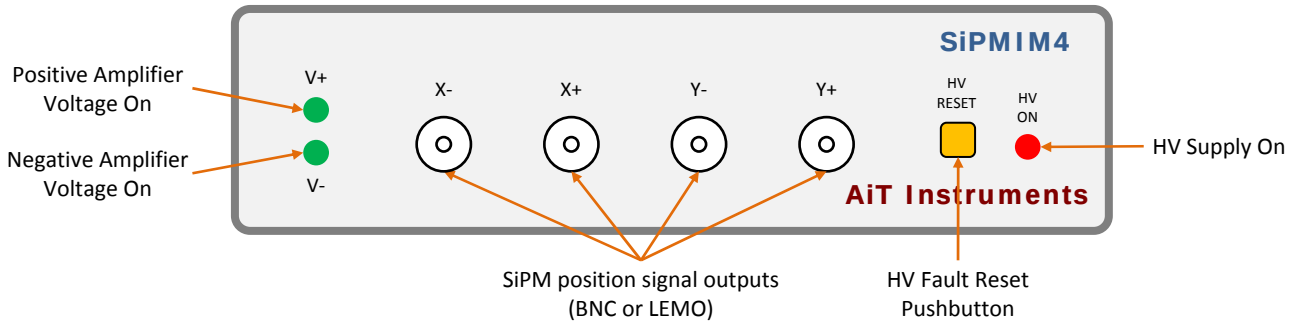
Resets a HV power supply fault

Mechanical

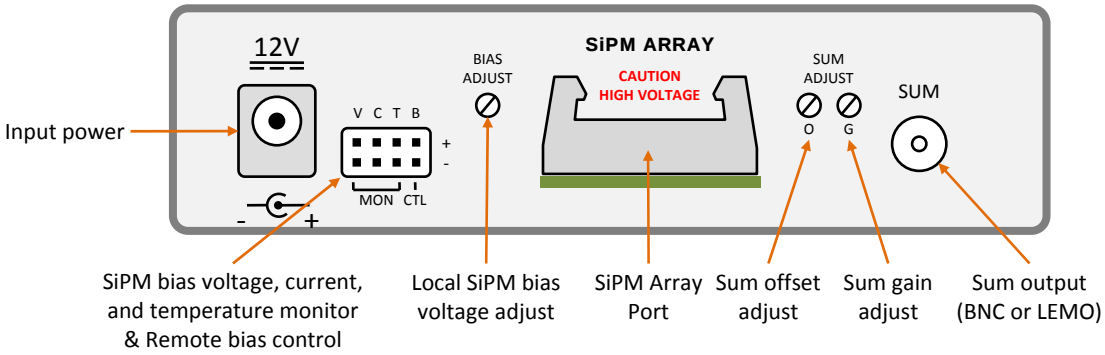
PCB overall dimensions	3.725” x 3.940”
PCB mounting holes, 4 each	0.12” diameter, accepts #4 hardware Do not exceed 0.25” dia. mounting hardware
Enclosure dimensions	4.18”(W), 3.40”(L), 1.15”(H)
Enclosure material	Aluminum
Connectors	
SiPM ARRAY	8-pin, 2-row latch-eject header, 0.050” pin pitch Mating assembly = Samtec FFSD-08-D-XX.XX-01-N XX.XX = length in inches
VCTB MON/CTL	8-pin, 2-row header, 0.1” pin pitch
X+, X-, Y+, Y-, SUM	BNC or LEMO EP.00 coaxial receptacles
12V	Circular barrel power jack, 2.1mm ID, 5.5mm OD, center positive

Enclosure Front & Back Panels

Front Panel

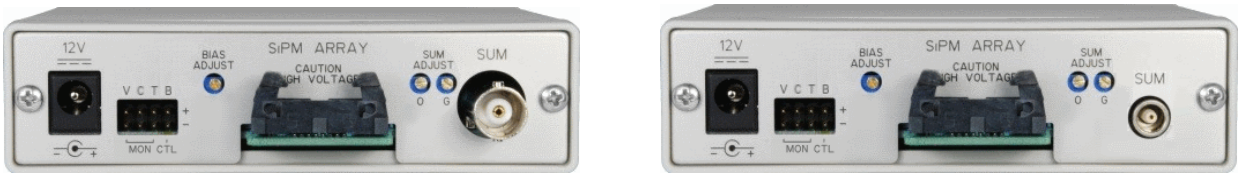


Back Panel



BNC Connectors **LEMO Connectors**

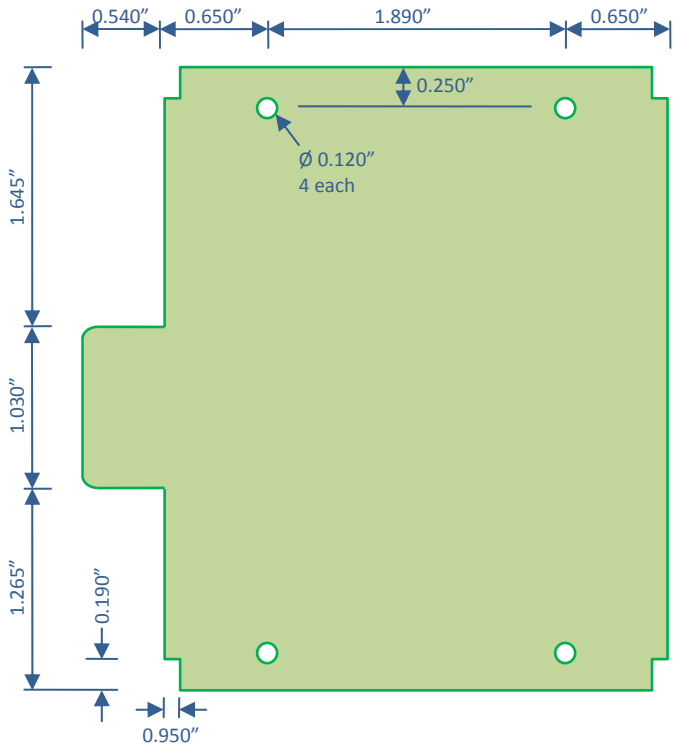
Enclosure Front



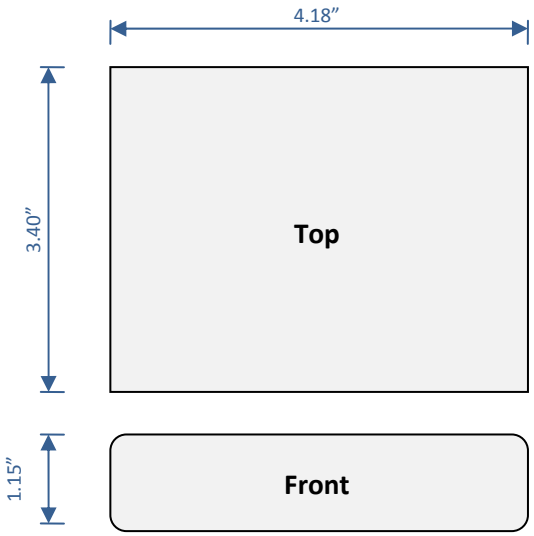
Enclosure Back

Mechanical

Circuit Board



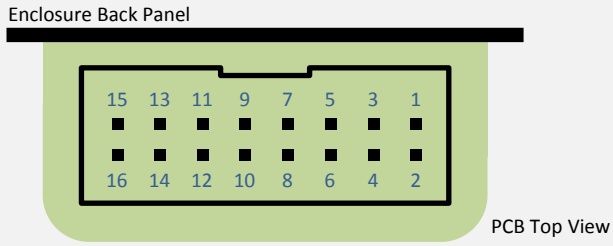
Enclosure



Connectors

4-Channel SiPM Array Port

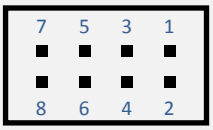
16-pin 0.050" latch-eject header



Pin	Function	Pin	Function
1	Temperature	2	GND
3	X-	4	GND
5	X+	6	GND
7	-VA	8	GND
9	+VA	10	GND
11	Y-	12	GND
13	Y+	14	GND
15	+Bias	16	GND

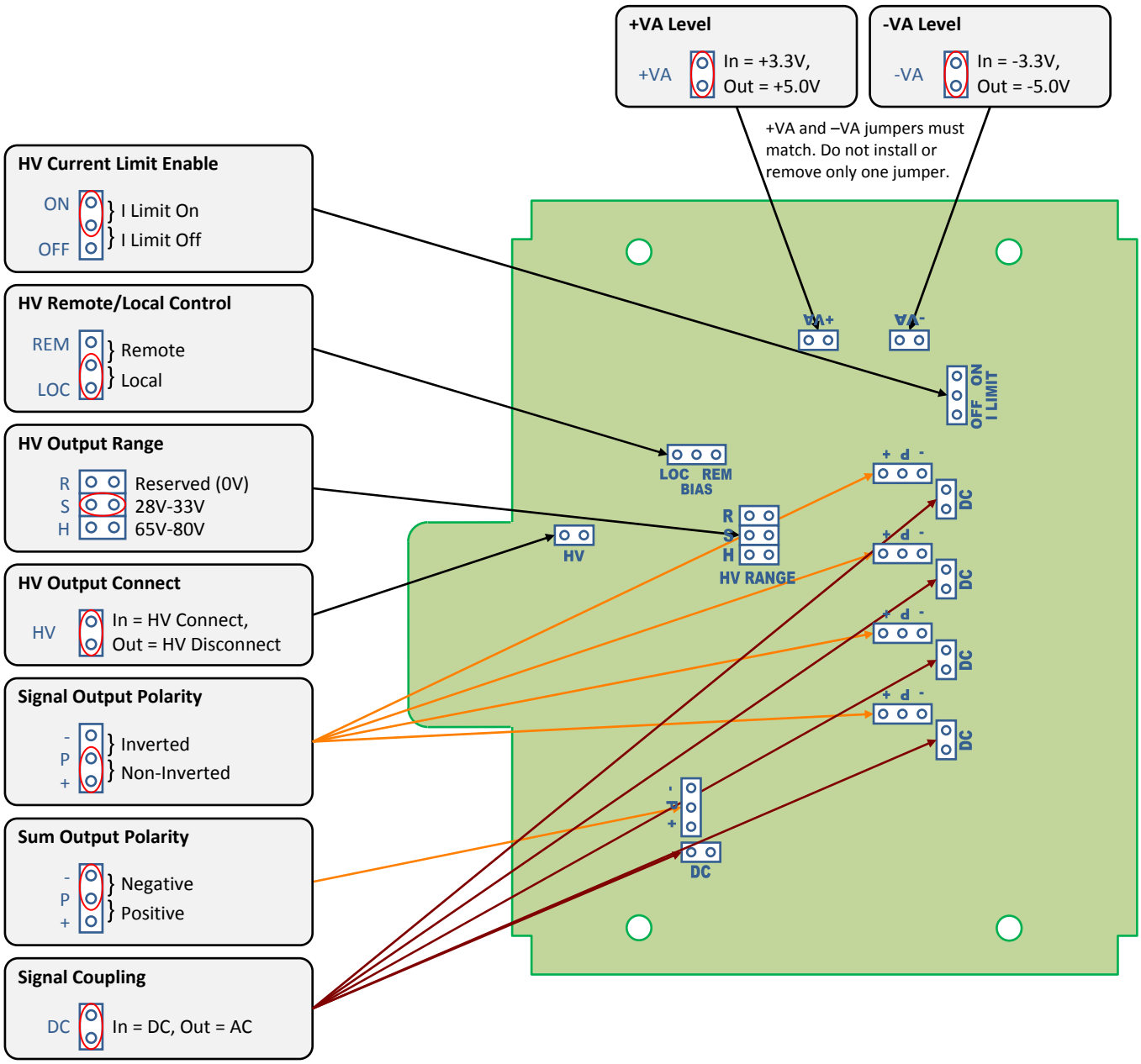
VCTB MON/CTL

8-pin header



Pin	Function	Pin	Function
1	Remote Bias	2	GND
3	Temperature	4	GND
5	Bias Current	6	GND
7	Bias Voltage	8	GND

Jumpers



Operation

Summary

Routine operating parameters can be adjusted through back-panel potentiometers. Occasional settings are configured by on-board jumpers, requiring enclosure disassembly.

Typical Setup for Normal Operation

1. Connect the Base with the Interface Module power off
2. Optionally connect an oscilloscope to the SUM output and one or more position signals
3. Power the Interface Module
4. With SiPM signals present, adjust the SiPM bias voltage, *SUM Offset*, and *SUM Gain* as needed
    a. Adjust SiPM bias until SiPM signals appear, typically at 50µA-150µA bias current
    b. Adjust the *SUM Offset* until the SUM signal baseline is zero
    c. Adjust the *SUM Gain* to the desired level
    d. After adjusting *SUM Gain*, adjust *SUM Offset* as needed
5. Changes in bias voltage may require offset adjustment
6. The SUM signal may be used to trigger an oscilloscope, discriminator, or data acquisition system

SiPM Bias Current Limit

The HV power supply will automatically disable if the output current exceeds its current limit. The over-current circuit is designed to protect only the HV power supply from damaging load currents. It is not designed to protect other equipment or personnel.

An over-current fault may occur during normal operation due to high SiPM bias current, high load capacitance, or high optical signal levels. While the protection circuit may offer incidental protection to the SiPM in some cases, it is not designed to prevent damage to the SiPM.

A fault reset clears an over-current fault latch and momentarily bypasses the protection circuit. Repeating HV resets during a persistent fault condition may damage system components. Identify and remove the cause of the fault, restart the HV power supply at a safe voltage, then slowly restore normal bias voltage.

Placing the I Limit jumper in the OFF position will disable the over-current fault circuit. It may be necessary to disable the over-current fault circuit if >2mA bias current is required. Please note the warnings about disabling the over-current fault circuit.

System Assembly Guidelines

SiPM Cable Assembly

The SiPM micro-pitch cable assembly must be inserted firmly into the header. Correct orientation results in the cable exiting directly away from the Interface Module without interference, and the red index conductor is located on the right side of the connector as seen when facing the back of the unit.

High Voltage

This device must be used only by personnel trained and qualified in safe handling, installation, and operation of high voltage equipment. The optional enclosure does not protect against high voltage exposure.

During operation, high voltage will normally be present in the following components:

- Interface Module circuit board
- SiPM Port signal connector pins
- Exposed base of the SiPM Port signal connector
- SiPM signal cable
- SiPM Base

Enclosure & PCB Mounting

This device is intended to be incorporated into another system or product. The circuit board may be mounted using standard #4 hardware. Mounting hardware should not exceed 0.25” diameter contact area with the circuit board. Allow for adequate ventilation space around the circuit board.

The optional enclosure is provided to simplify bench testing and permits mounting into 19” rack panels. Unassembled enclosure components may have sharp edges. Observe appropriate handling precautions.

Safety Information

WARNING – High Voltage

- High voltage may be present during operation
- High voltage stored on capacitors may be present after power is removed
- Improper handling may result in personnel injury or equipment damage

This high-voltage device must be used only by personnel trained and qualified in safe handling, installation, and operation of high-voltage equipment.

CAUTION – Electrostatic Discharge (ESD) Sensitivity

The circuit board can be damaged by electrostatic discharge. Observe precautions for handling electrostatic sensitive devices. Handle only at static-safe workstations.

High-Gain Photodetectors

High-gain photodetectors such as silicon photomultipliers may conduct damaging currents if exposed to high optical signal levels while the bias voltage is applied, or if the bias voltage exceeds the recommended operating range. These devices must be operated only in low-light conditions, and only within the manufacturer's recommended bias voltage range.

Handling and Disassembly

This product may be provided with or without a protective enclosure. Disassembled enclosure components and circuit boards may contain sharp edges. Take appropriate safety precautions while assembling or disassembling the enclosure and handling disassembled components.

Indoor Use Only

Do not operate this product in a wet/damp environment. Do not operate in an explosive atmosphere.

Use of this product, and AiT Instruments' liability related to use of this product, is further governed by AiT Instruments' standard terms and conditions of sale, which were provided upon purchase of this product.