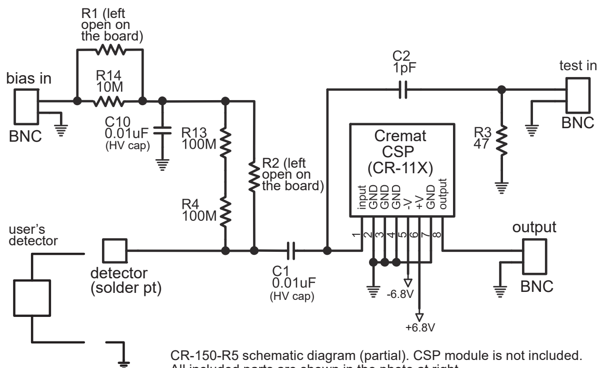
CR-150-R5 evaluation board: application guide

May, 2014 rev. 5

Board dimensions: 3.7 in. x 2.3 in x 0.063 in.

The CR-150-R5 prototyping test board will aid the experimenter in using and evaluating Cremat's charge sensitive preamplifiers (CSPs). The board has an 8-pin socket for the insertion of the CSP module, as well as power connectors, a power supply regulation circuit and other components needed to filter the detector bias. The CR-150-R5 can be used with any of Cremat's CSP modules: CR-110, CR-111, CR-112, and CR-113. Cremat's shaping amplifier modules (CR-200 series) are NOT compatible with this board.

The CR-150 uses 'AC coupling' between the detector and preamplifier input as is shown below:



CR-150-R5 schematic diagram (partial). CSP module is not included.
All included parts are shown in the photo at right.
A complete schematic diagram can be found at:
http://cremat.com/CR-150-R5-schematic.pdf

Power Requirements:

The CR-150-R5 evaluation board can be powered in either of two methods: The first method is to apply both positive and negative DC power to the CR-150-R5 board. A 3-terminal connector block is supplied for this purpose. The user should provide a supply voltage to the power input of the CR-150 within the range of +/-8 V to +/-15 V.

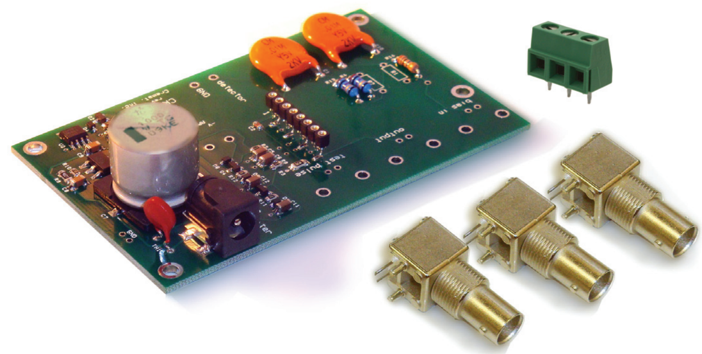
The second method is to connect a +24V wall-mount power supply to the 'barrel-style' power connector on the CR-150-R5 board. Cremat offers a suitable wall-mount power supply for this purpose, which can be used internationally (model CR-24V).

Changing the 'bias resistor':

'AC-coupled' circuits use a bias resistor through which bias is supplied to the detector. On the CR-150-R5 board the bias resistor is 200 megohms, which is realized through the two 100 megohm series resistors R13 and R4. A voltage drop forms across the bias resistor due to the current flowing though it (which is the same as the detector current). If the voltage drop across the bias resistor is too small (less than about 100 mV), the electronic noise (thermal noise) of the bias resistor starts to become significant in the detection circuit. On the other hand, if the voltage drop across the bias resistor is too large, the voltage across the detector may be significantly (perhaps unexpectedly) less than the applied bias voltage. This is true because the 10 megohm bias supply filter resistor, the 200 megohm bias resistor, and the detector are all in series; voltage drops forming across the resistors subtract from the voltage appearing across the detector. Keep in mind that most voltmeters cannot accurately measure voltage drops across very large resistances, so the best method is to use your knowledge of the approximate detector current to calculate this voltage drop.

If the detector current is expected to exceed approximately 10 nA, you may consider shunting the 200 megohm bias resistor and 10 megohm bias supply filter resistor to lower these resistances. This would reduce their voltage drops and to prevent them from becoming significant in your application. The CR-150-R5 board has resistor positions marked R1 and R2 which are intentionally left empty. These are positions intended to give the user the option to shunt the 200 megohm bias resistor (using R2) and the 10 megohm filter resistors using R1. Users should apply shunting resistors with the aim of producing voltage drops of approximately 0.5 volt across them. Note that it is not necessary to be precise in this value - achieving values within a factor of 3 of the target should be sufficient.

As an example, consider testing a large area avalanche photodiode (APD) having a leakage current of 200 nanoamps. This would theoretically create a voltage drop of 40 volts across the 200 megohm resistor and another 2 volts across the 10 megohm filter resistor. This could be a problem because the gain of an APD is highly dependent on the bias voltage, and the actual APD bias is less than the applied bias by the amount of the 40 volt drop across these resistors. To improve the situation, the user should insert a 3.3 megohm resistor into position R2 reducing the voltage drop to 0.66 volts. A 3.3 megohm resistor should also be inserted into R1, producing a total resistor voltage drop of approximately 1.3 volt.



The table below can be used to determine values for the shunt resistors R1 and R2:

leakage current range:			R1	R2
0	to	10 nA	(left open)	(left open)
10 nA	to	30 nA	(left open)	22M
30 nA	to	100 nA	(left open)	10M
100 nA	to	300 nA	3.3M	3.3M
300 nA	to	1 µA	1M	1M
1 µA	to	3 µA	330k	330k
3 µA	to	10 µA	100k	100k
10 µA	to	30 µA	33k	33k

After soldering to the CR-150-R5 board, be sure to clean any residue (such as the solder flux) from the board. Residue left at the 'detector' terminal or at the bias resistor shunt (R2) can degrade the noise performance of the detection system.

The CR-150-R5 board comes with the parts shown above, consisting of three PC-mount BNC connectors and a 3 terminal connector block for the application of DC power. Because the user might not want to use these connectors, they have been supplied unassembled to the board.

Electrical Shielding:

Cremat's CSPs are sensitive, and operating them in an unshielded environment will usually result in the amplification of unwanted stray signals. For this reason we recommend using the CR-150-R5 board inside a shielded enclosure. We offer the CR-150-BOX-R5 (available separately) which provides shielding for the CR-150-R5 board and is easily assembled and operated. For more information on this product, see our web site http://cremat.com

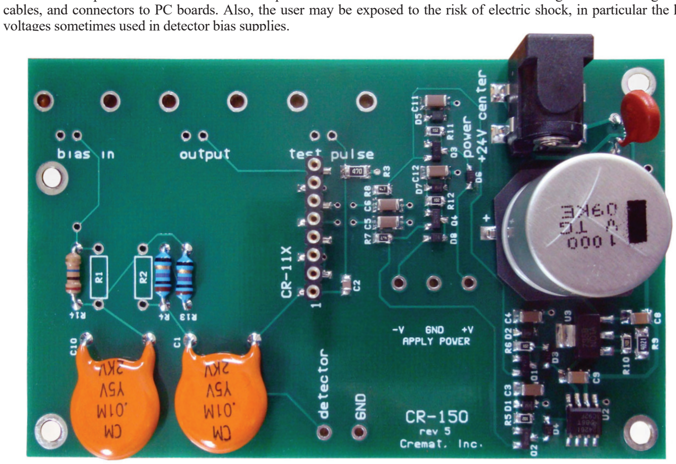
Voltage Rating

The CR-150 board can be used with detector voltages up to 2000V. BNC connectors, however, are only rated for voltages up to 500V. To use bias voltages higher than 500V, we recommend that SHV-type high voltage coaxial connectors be used instead of the BNC connectors in both the 'bias in' and 'detector' positions.

Video describing how to assemble and use this board now available here:

https://youtu.be/izmDvdpK5L8

Caution: Set-up of the CR-150-R5 board requires the user to be comfortable with soldering and connecting wires, cables, and connectors to PC boards. Also, the user may be exposed to the risk of electric shock, in particular the high voltages sometimes used in detector bias supplies.



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