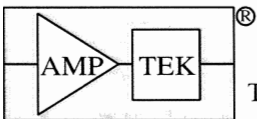


# **COOL-X**

## **X-Ray Generator with Pyroelectric Crystal**

### **Operating Manual**



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## Radiation Precautions

The COOL-X is intended to generate x-rays up to 35 keV during normal heating and cooling phases. However, ambient or room temperature fluctuations will also result in producing a small amount of x-rays.

**WHEN NOT IN USE OR IN STORAGE, ALWAYS KEEP THE PROTECTIVE METAL COVER ATTACHED TO THE FRONT OF THE COOL-X.**

The COOL-X normally emits x-rays in the forward output direction. However, radiation in other directions is possible and should be addressed with shielding and/or monitoring in the final application.

## Caution

**This device produces X-Rays when energized.  
To be operated only by qualified personnel.**

## Beryllium Window Caution

The front of the COOL-X is made of a 10 mils (250  $\mu\text{m}$ ) Beryllium window.

DO NOT REMOVE the metal cover from the COOL-X until ready to use. The Be window is extremely brittle and can shatter easily. Do not have any object come into contact with the window. Do not touch the window because oil from the fingers will cause it to oxidize. The window cannot be repaired. If the window is broken the COOL-X element must be replaced.

**Beryllium windows damaged by improper handling will not be covered by the warranty.**

Radiation levels external to the x-ray generator housing with the cover on does not exceed 2.5 mrem/h measured 5 cm from the surface of the housing in accordance with Requirements 5.2.2.1.1 and 5.2.2.2.2 of the NBS Handbook for Radiation Safety for X-Ray Diffraction and Fluorescence Analysis Equipment (for more information, please see <http://www.msc.com/Documentation/pdf/nbs111.pdf>).

## COOL-X Miniature X-Ray Generator with Pyroelectric Crystal

**Important – Read the precautions on page 2 of this manual before operating this equipment.**

### OPERATING INSTRUCTIONS

1) The COOL-X Pyroelectric X-ray generator is completely enclosed inside the small TO-8 package at the tip of the extender.

**TURN OFF POWER TO THE COOL-X WHEN NOT IN USE.**

2) The Controller is enclosed inside the metal box. The function of the Controller is to supply power to the X-ray generator, monitor its temperature and automatically change the heating and cooling phases of the cycle.

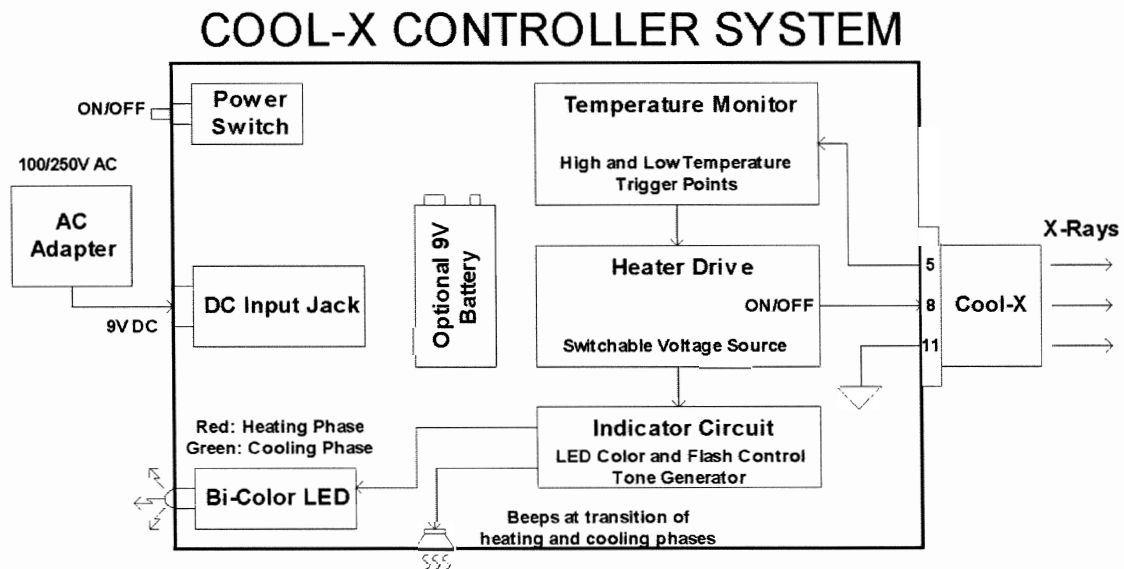


Figure 1

Please see Appendix A if the COOL-X emitter element is to be used away from its Controller.

3) Power to the Controller is supplied by either a 9 Volt battery or an AC adapter. Both are provided with the unit. The preferred operation of the COOL-X is with the AC adapter. If battery operation is required, remove the 4 small screws from the top of the box and insert the provided 9 Volt battery to the terminals.

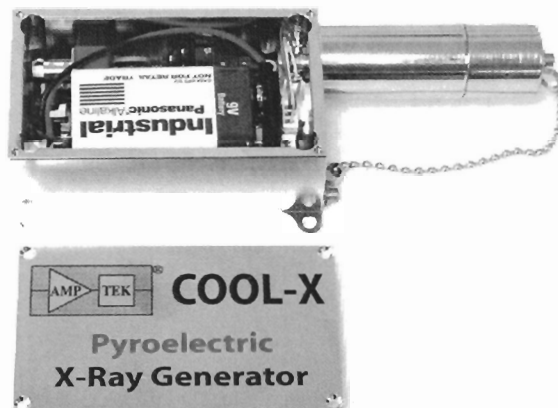


Figure 2

- 4) The COOL-X should be mounted on a firm surface using the 4 mounting tabs of the box.
- 5) Connect the AC adapter to the back of the box and remove the front metal cover.

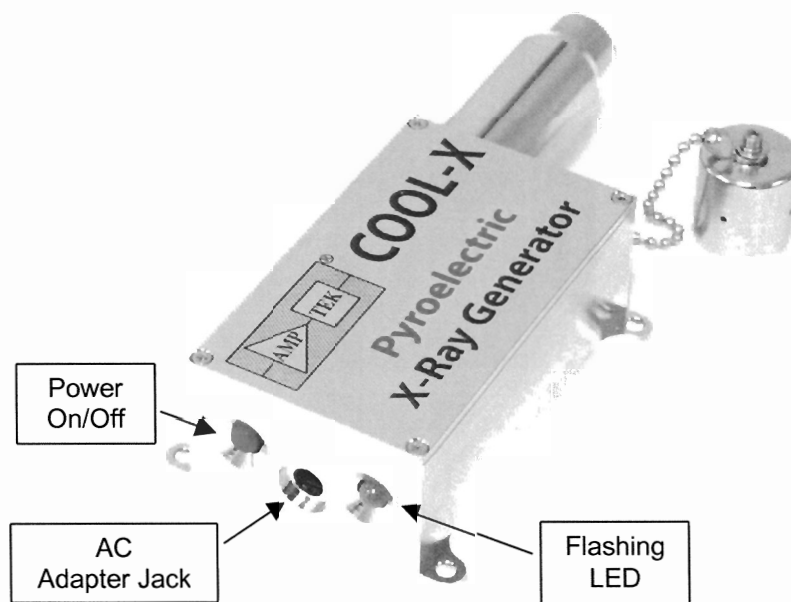


Figure 3

- 6) Press the RED power button to start the heating phase of the cycle.
- 7) The LED will flash RED for the duration of the heating phase.

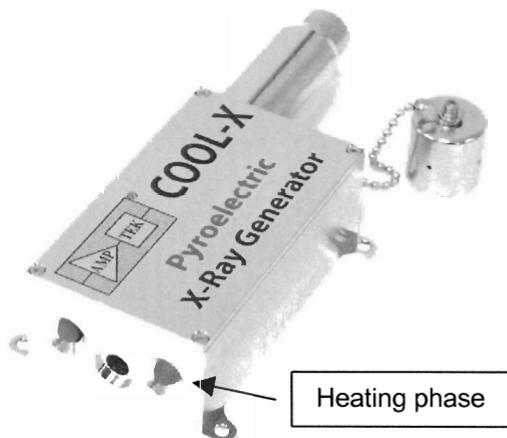


Figure 4

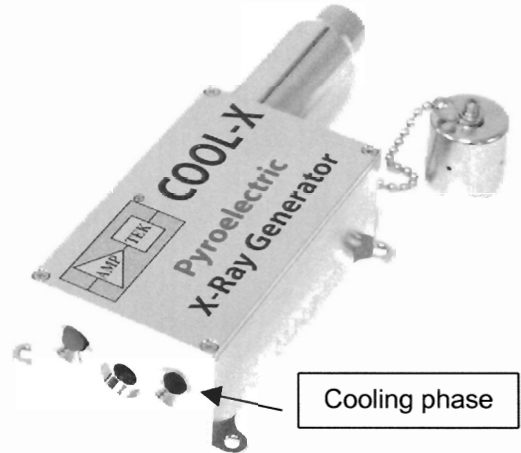


Figure 5

- 8) KEEP ALL PERSONNEL AWAY FROM THE FRONT OF THE COOL-X.

### CAUTION: X-RAYS ARE PRESENT

- 9) When the cooling phase starts, the LED will automatically start flashing GREEN. This pattern of flashing red/green will continue until the red power button is pressed again. Power to the unit is toggled ON/OFF every time the power button is pressed. When the power is OFF, the LED is also OFF.

- 10) At the start of a cycle and in between the heating/cooling phases a “BEEP” sound will be heard from a small internal speaker to indicate the transition of phases. If the sound interferes with the x-ray detector due to microphonic pick-up, the speaker can be disconnected. To disconnect the speaker, remove the cover by removing the 4 small screws from the top. Locate the small black jumper marked “Beep”. Move the jumper over one pin to eliminate the sound.

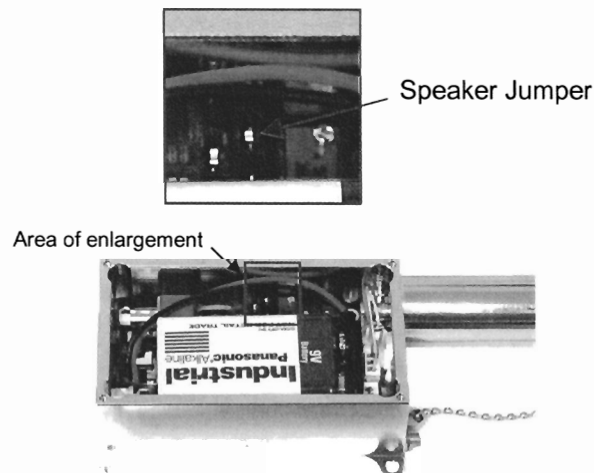


Figure 6

## **WARRANTY INFORMATION**

### **Lifetime of the COOL-X**

When not in use, power to the COOL-X should be turned OFF. The COOL-X is not designed for continuous operation; therefore its lifetime will depend on how it is used.

If used intermittently, for about 1-3 hours per day, the estimated lifetime of the COOL-X can be extended to well over 1000 hours. Continuous use of the COOL-X will shorten its lifetime to approximately 200 hours.

## APPENDIX A

### Operation of the COOL-X away from its Controller

The Amptek COOL-X, x-ray generator is designed to be used as an integrated unit together with its Controller in normal room temperature applications  $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ . Operating the unit outside these temperature conditions may result in faulty operation or damage to the COOL-X emitter.

In normal operation, the COOL-X cycles through heating and cooling phases. Heat-sinking of the emitter head (TO-8 package) to provide the proper cooling profile is accomplished by having good thermal contact with the COOL-X Controller housing. Normal air convection is usually adequate to dissipate the heat from the housing but performance can be improved by attaching the housing to a metal plate with 4 screws.

Operation of the COOL-X emitter (TO-8) away from its Controller must be done very carefully, taking into account the following considerations:

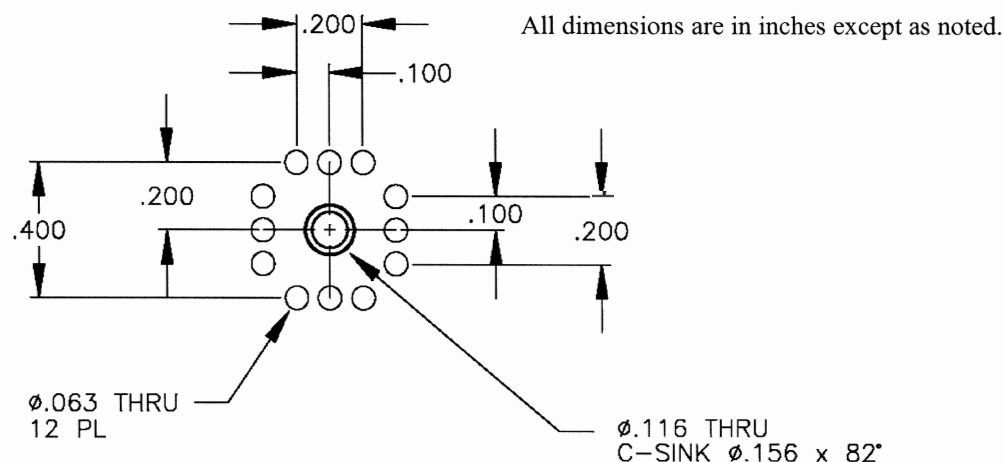
#### 1) Heat-sinking:

The TO-8 emitter head must be mounted on a heat-sink which is kept at room temperature. The hole pattern for the TO-8 for attaching it to the heat-sink is provided below. The Control electronics should also be mounted on a metal plate and kept at approximately the same temperature as the TO-8. This is important because the temperature sensor in the Control circuit refers to a matched temperature sensor inside the TO-8 emitter head in order to maintain the proper temperature differentials and temperature limits throughout the heating and cooling phases of the cycle.

#### 2) Grounding:

The temperature sensor inside the TO-8 emitter head has a normal output voltage in the range of 0.560 to 0.410 volts corresponding to temperatures of  $35$  to  $125^{\circ}\text{C}$ . The temperature sensor shares a common ground with the crystal heater which normally draws about 400 mA of current during the heating phase. It is important to maintain a low impedance Ground return between the TO-8 (Pin 11) emitter housing and the Controller circuit board ground (4 corner screws) to prevent overheating or damage to the emitter. A 60 millivolt difference between the two grounds will result in a  $40^{\circ}\text{C}$  error in the temperature sensor. This may likely result in damage to the emitter AND VOID WARRANTY.

#### TO-8 EMITTER MECHANICAL DIMENSIONS

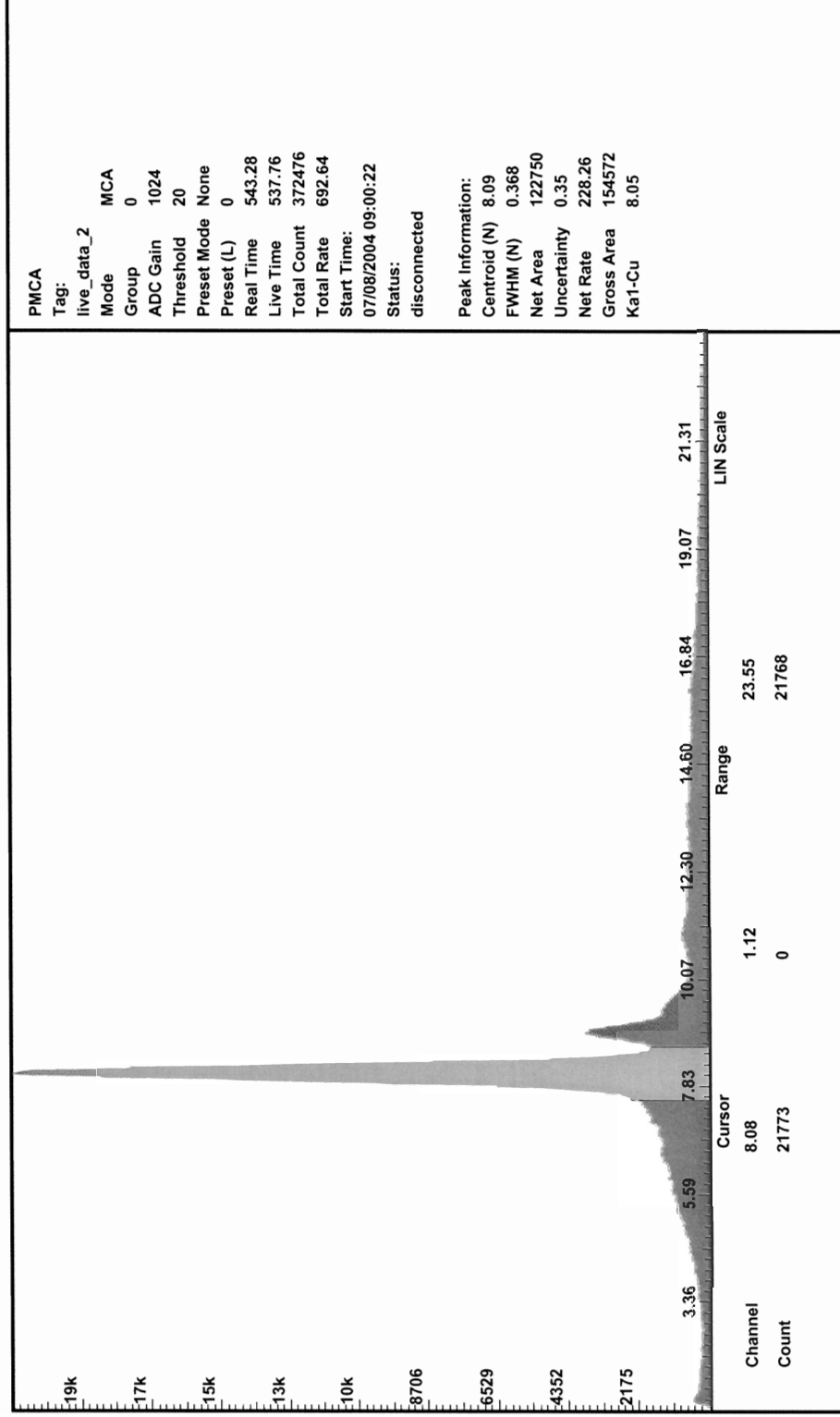


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Cool-X Spectrum (Linear Plot)



Cool-X S/N 313

ECX S/N 5523

Spectrum taken with AmptekXR100T-CdTe system.

Vd = 3.5 V, Vh = 0.411 V, VI = 0.565 V

Tmax = 125 C, th = 39 sec., tc = 69 sec.

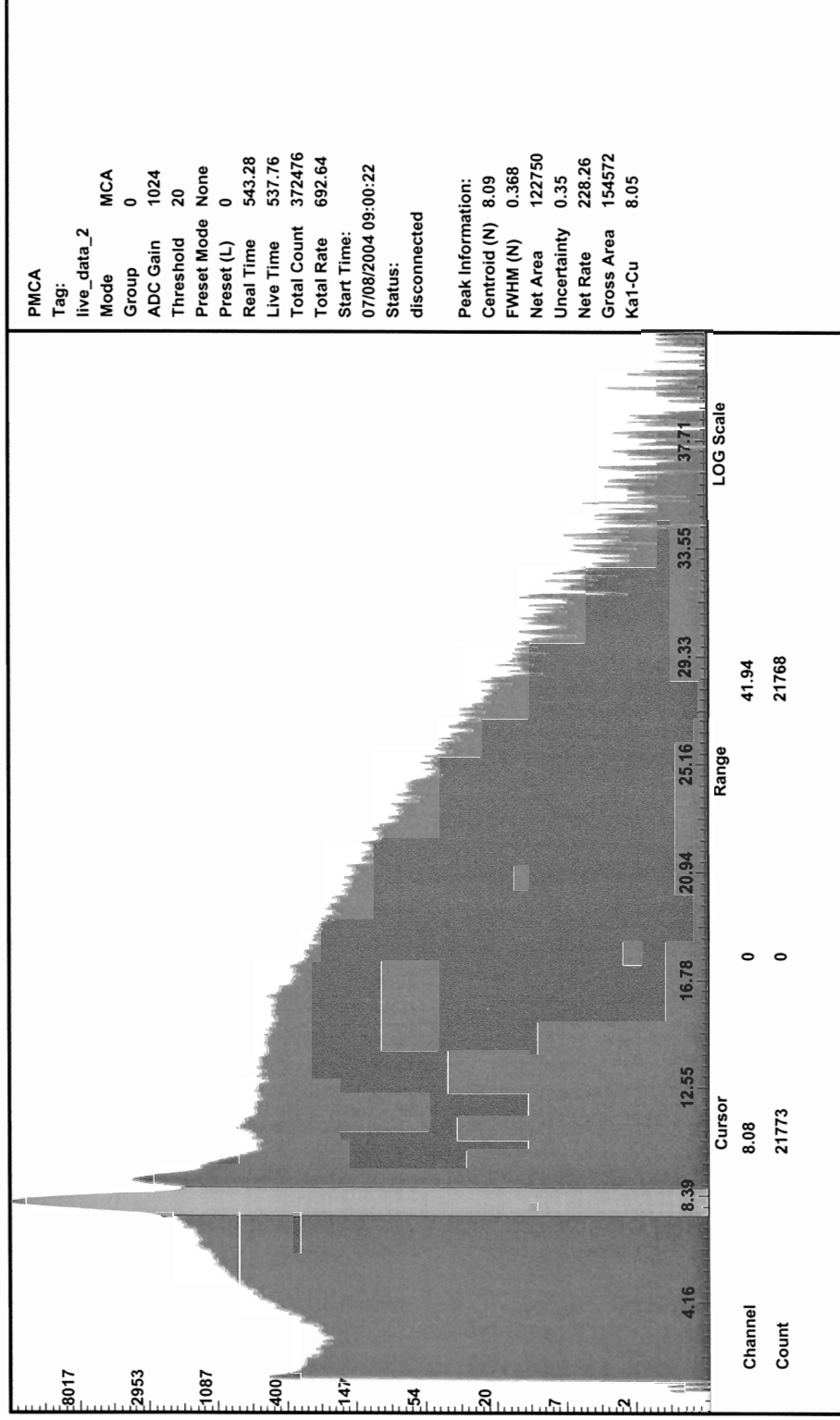


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Cool-X Spectrum (Log Plot)



Cool-X S/N 313

ECX S/N 5523

Spectrum taken with AmptekXR100T-CdTe system.

Vd = 3.5 V, Vh = 0.411 V, VI = 0.565 V

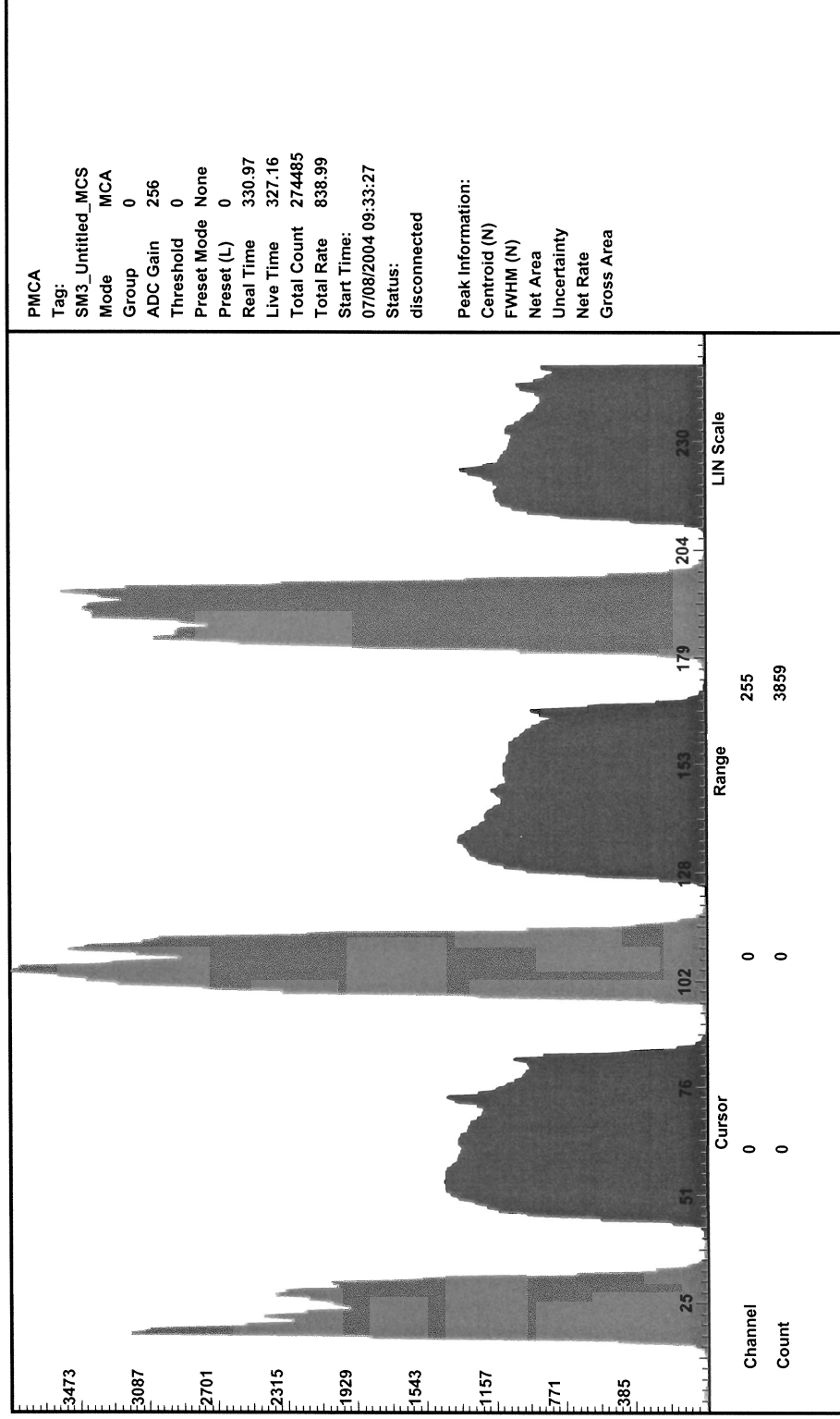
Tmax = 125 C, th = 39 sec., tc = 69 sec.

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Cool-X Counts vs. Time



Cool-X S/N 313  
ECX S/N 5523  
Spectrum taken with Amptek XR100T-CdTe system.  
Red Regions: Heating Counts  
Blue Regions: Cooling Counts