

Converting a DT-590A/PDR-56F “X-Ray” Probe into a General- Purpose NaI(Tl) Gamma Probe

David Prutchi

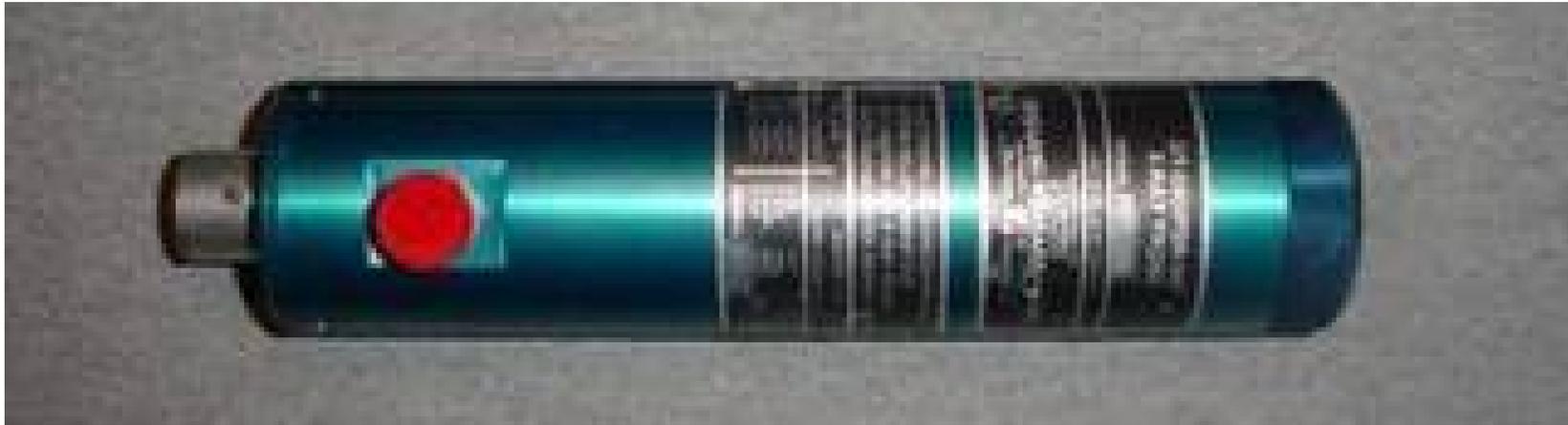
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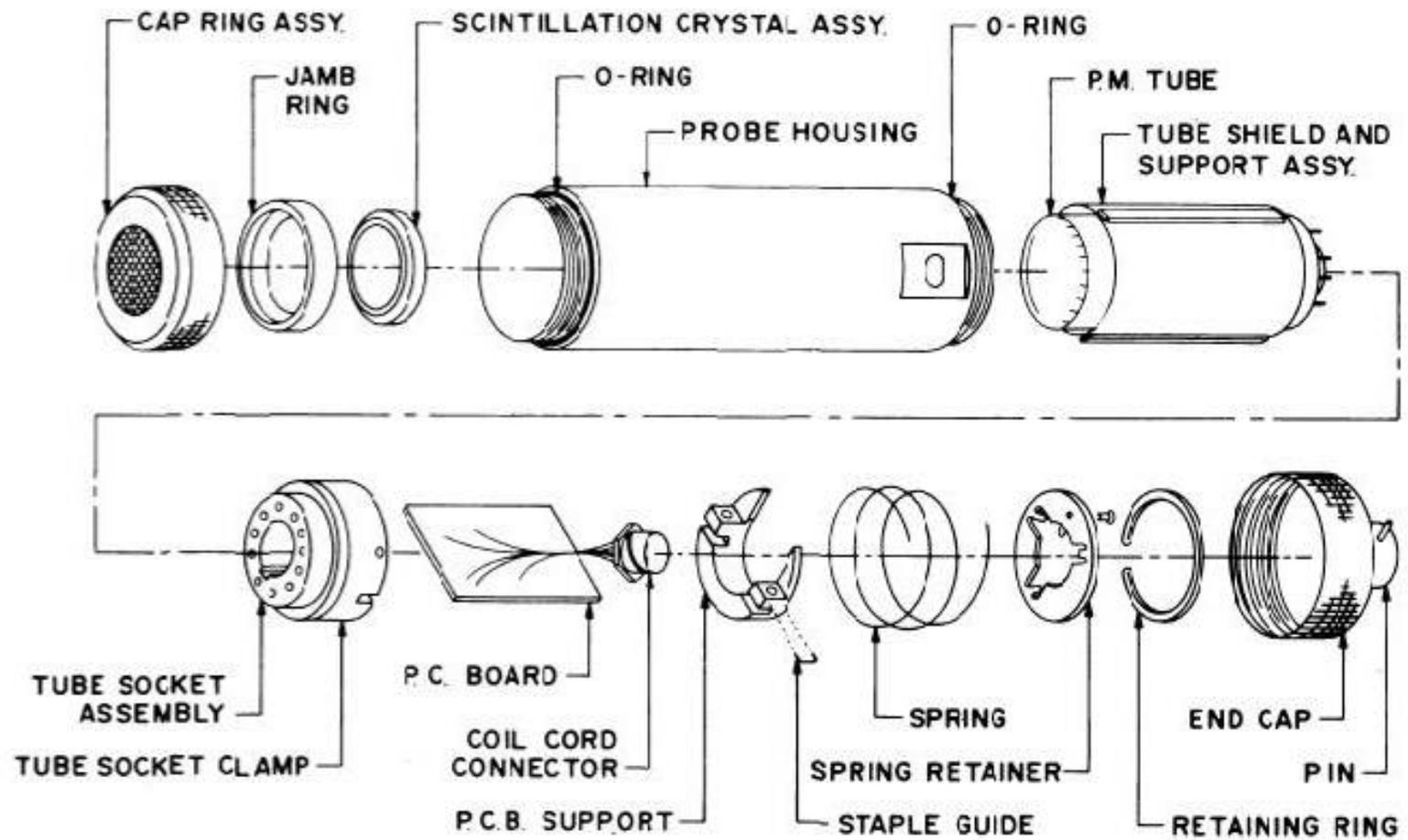
- The Radiac Set, AN/PDR-56 is a portable scintillation type instrument used for detection of alpha contamination. The system includes a large and small interchangeable probe with a probe extension. The AN/PDR-65/65A system measures gamma intensities to 10,000 cGy/hr; and records cumulative doses to 9,999 cGy/hr.



- In addition to emitting 5.1 MeV alpha particles, the element Plutonium-239 also emits gamma rays in the energy range of 14 to 21 keV. Because these gamma rays are more penetrating than the alpha particles, they travel further in matter and air and can be detected at further distances from the ground.
- The “x-ray” probe for the AN/PDR-56 uses a $\text{CaF}_2(\text{Eu})$ scintillator/photomultiplier combination to detect the 14-21 keV gammas from Pu-239. The x-ray probe is an assembly which includes the amplifier-discriminator circuits integral to the phototube scintillator housing. The discriminator is a single channel analyzer adjusted to detect Pu-239 gamma rays.

Why replace the $\text{CaF}_2(\text{Eu})$ crystal?

- Europium doped calcium fluoride $\text{CaF}_2(\text{Eu})$ is a low density scintillation crystal with a high light output. Thanks to its low Z value it is well suited for the detection of low-energy gamma photons (“x-rays”).
- $\text{NaI}(\text{Tl})$ scintillation crystals are used in most standard applications for detection of gamma-radiation because of their unequalled high light output and the excellent match of the emission spectrum to the sensitivity of photomultiplier tubes, resulting in a good energy resolution.



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Figure 3-7. X-Ray Probe, Exploded View

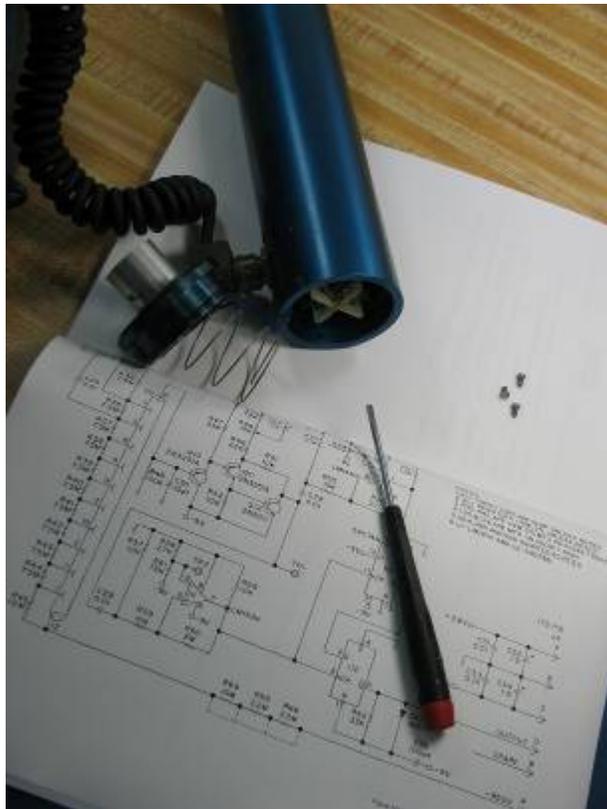
Use a large rubber grommet to adapt NaI(Tl) assembly. Remove mesh and light screen from end cap.

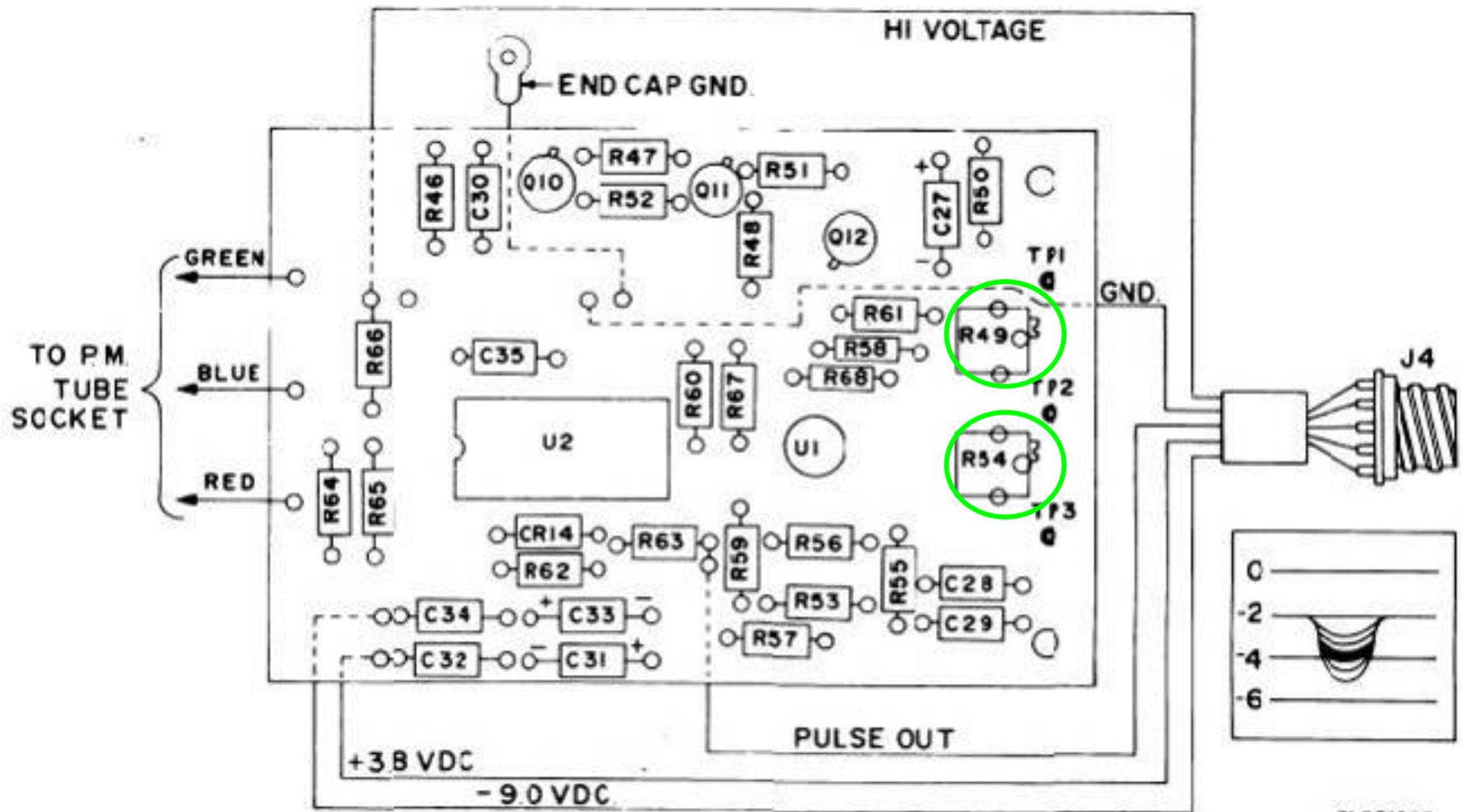


Coat the PMT face with index-matching gel and screw cap

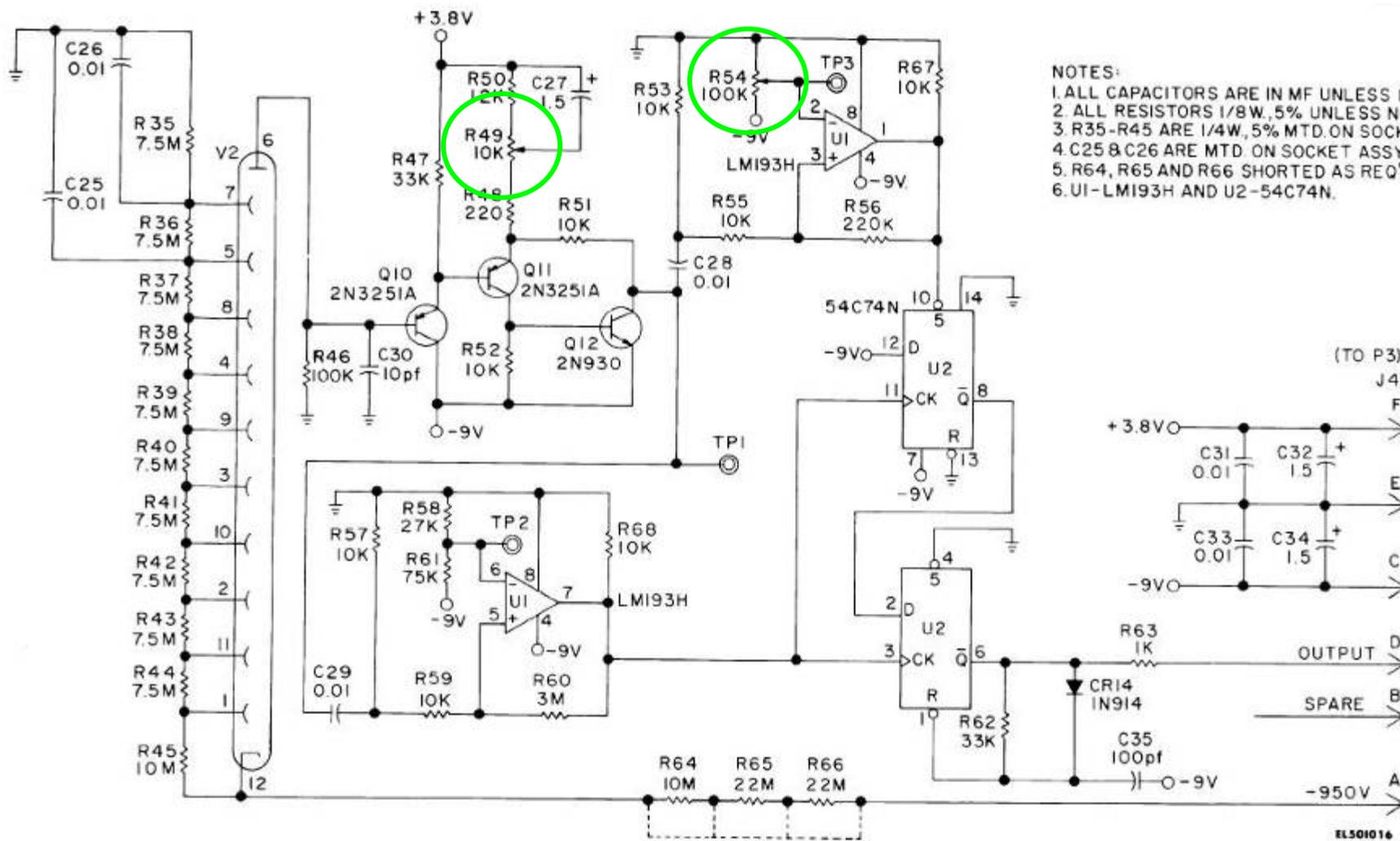


Tweak settings of the single-channel analyzer to your desired response (single-channel or wide-open with “grass” rejection)





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- NOTES:
1. ALL CAPACITORS ARE IN MF UNLESS NOTED.
 2. ALL RESISTORS 1/8W, 5% UNLESS NOTED.
 3. R35-R45 ARE 1/4W, 5% MTD. ON SOCKET ASSY.
 4. C25 & C26 ARE MTD. ON SOCKET ASSY.
 5. R64, R65 AND R66 SHORTED AS REQ'D.
 6. U1-LM193H AND U2-54C74N.

I keep an unmodified probe for detecting low-energy gamma rays (<100keV) and a modified probe for 100keV to 1.3MeV gamma rays.

