CANBERRA

M0057

TECHNICAL MANUAL

for

AN/PDR-70

(SNOOPY NP-2)

NEUTRON SURVEY METER

Canberra Industries, Inc.
800 Research Parkway - Meriden, Connecticut 06450 - Tel. 203-238-2351 - Fax 203-235-1347

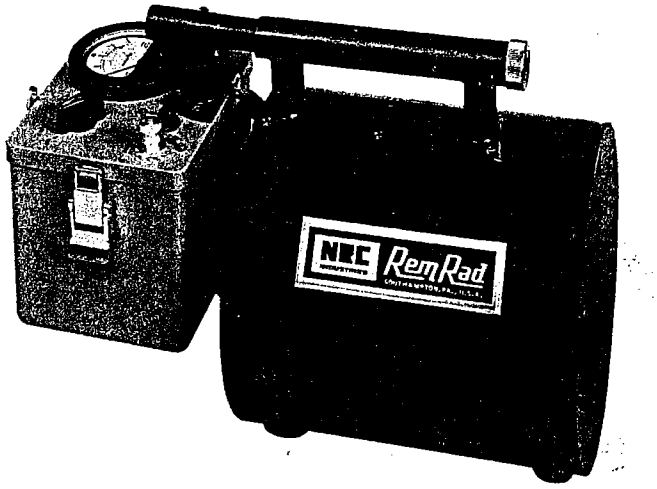
Canberra Industries, 800 Research Parkway, Meriden, CT 06450
Tel: 203-238-2351 FAX: 203-235-1347
http://www.canberra.com/

The information in this document describes the product as accurately as possible, but is subject to change without notice.

Printed in the United States of America.

SNOOPY PORTABLE NEUTRON MONITOR

IGNORES GAMMAS TO GIVE YOU ACCURATE NEUTRON DOSE RATES



GENERAL DESCRIPTION

NRC's SNOOPY, Model NP-2 is the first truly portable REM reading neutron monitor with dose response corresponding to the human body. This instrument is based on a design by I.O. Anderson and J. Braun[1], and further work by UCLRL.[2]

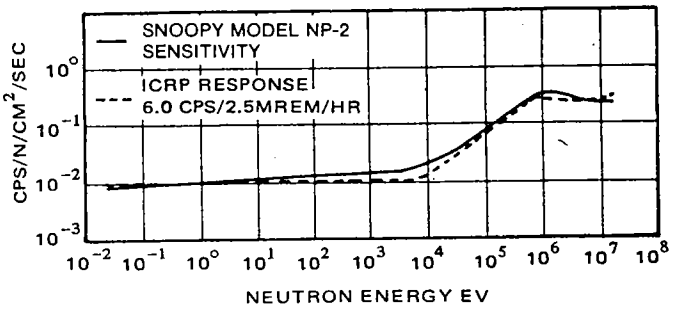
The most significant feature of the instrument is a complex moderator/attenuator which gives true REM/hr measurement capability independent of neutron energies in the range of 0.025 ev to 15 mev. The instrument has four accurate linear ranges of 2, 20, 200, and 2000 mrem/hr full scale, and is gamma insensitive up to 500 R/hr. Tests at UCLRL show that the instrument is truly capable of measuring a complex neutron spectrum rich in intermediate energy neutrons to within +10% of the theoretical ICRP dose rate.

The integral construction of the moderator and electronics in the NP-2 yields an instrument which is easily hand-carried for routine neutron surveys by methods typically used with portable survey instruments.

In the past, one of the greatest problems in Health Physics has been that of accurate neutron dosimetry, particularly when the neutron dose is large due to intermediate neutrons in the range of 10 ev to 100 Kev. The NP-2 is ideally suited for REM dose measurements near accelerators, reactors, neutron generators, and isotopic neutron sources. It has high sensitity and accuracy at low dose rates plus the excellent stability characteristics associated with instruments using BF_3 detectors as compared to the drift associated with equipment using photomultipliers and crystals.

The instrument consists of a unique moderator/attenuator assembly, BF detector, and associated electronics used to convert the detector pulse output to a meter reading and scaler signal. The neutron dose reading is presented in mrem/hr. The scaler signal is useful if integrated dose information rather than rate is desired and if accurate measurements at very low count rates are required.

SNOOPY PORTABLE NEUTRON MONITOR
MODEL NP-2



Energy response, response of Model NP-2 compared with ICRP response.

[1]I.O. Anderson and J. Braun, "A Neutron REM Counter" AE-132.

[2]"Evaluation of a Neutron REM Dosimeter", Hazards Control Quarterly, Report #18, UCLRL 12167.

MODERATOR/ATTENUATOR

The neutron monitor has an output reading which is directly proportional to the dose rate in mrem/hr of an incident neutron flux in the energy range of 0.024 ev (thermal) to 15 mev. This dose measurement is uniquely accomplished by modering and attenuating the incident flux.

The incident neutrons with an energy greater than thermal are moderated through elastic scattering in the polyethylene cylinder. Thermal neutrons are partially absorbed by capture in the boron impregnated plastic sleeve. To further adjust the instrument response to within +10% of the theoretical ICRP curve, the boron sleeve has 10mm holes over 22% of its surface area to allow some of the thermal neutrons to penetrate. The boron B^{10} in the attenuator sleeve has a neutron cross section closely proportional to the inverse square root of the neutron energy. After the neutrons are thermalized and attenuated by the moderator, they are counted by a stable BF_3 proportional counter.

A predominant problem of presently used neutron monitors is high sensitivity to gamma radiation. Use a BF_3 detector in the NP-2 eliminates this problem since the response to gamma pile-up does not occur in fields up to 500 R/hr.

The NP-2 is designed so that calibration in the field is easy to perform. The instrument is calibrated in a known neutron flux at the factory. After this calibration, the instrument response to RA-Be neutron source of known yield is measured. In this manner, the recorded response to a readily available source of reproducible geometry can be given the user to facilitate periodic field calibration checks. Instruments may be returned to the factory for factory calibration at a fixed charge.

MODEL NP-2 SPECIFICATIONS

SYSTEM SPECIFICATIONS

Sensitivity: 6000 counter per mrem

Gamma sensitivity: No response to Gamma Radiation in fields up to 500R/hr of Cs^{137}

Dynamic range: Four linear ranges: 0-2 mrem/hr., 0-20 mrem/hr., 0-200 mrem/hr., 0-2000 mrem/hr.*

Background: Less than 5 counts per minute.

Operating temperature: -10°C to +50°C

Accuracy: ±10% of theoretical ICRP dose rate.

Energy range: Thermal (0.025 ev) to 15 mev.

Directionality: ±20%

Weight: 25 lbs., including electronics.

Overall dimensions: 16" long, 9.6" in diameter.

DETECTOR SPECIFICATIONS

Type: BF_3 proportional counter with active length of 2", fill pressure 60 cm Hg.

Resolving time: Approximately 1 μsec.

Plateau slope: 4% per 100V max.

Operating voltage: 1750-1950 v.d.c.

Detector connection: MHV series.

POWER SUPPLY-RATEMETER SPECIFICATIONS

Output Reading: (a) Meter, linear, 3-1/2" round ruggedized, 0-50 μA., 2% full scale accuracy; (b) Scaler output greater than 1v negative, 1 μsec. rise time, capacitive coupled.

Audio output: For headset.

Panel controls: (a) Power OFF and range selector; (b) battery check pushbutton.

Time constant: Selected by range switch; (a) 3 sec for 2 highest ranges; (b) 8.5 sec for 0-20 mrem/hr range; (c) 30 sec for 0-2 mrem/hr.

Internal controls: (a) High voltage adjust; (b) Sensitivity adjust; (c) Calibrate.

Power requirements: 3 "D" size batteries.

Voltage supplies: (a) High voltage: 1750-2000 v.d.c. at 20 μA. Regulated to better than ±1% for temperature and battery life; (b) Low voltage.

External connections: Scaler, BNC type, headset BNC.

***Optional ranges:** Available upon request.

PRINTED IN U.S.A.

ERRATA DATA FOR TECHNICAL MANUAL
AN/PDR-70 (SNOOPY) NP-2
Neutron Survey Meter

SECTION 2 - INSTALLATION (Page 2-1), Paragraph 2-3 INSPECTION AND ADJUSTMENT

After the batteries have been installed in the radiacmeter, check the battery condition by ....
INSERT: setting the range switch to $X10^3$ and,
continued: pressing the BATT. CHECK/METER RESET push button. Etc...

SECTION 3 - OPERATION (Page 3-2), Paragraph 3-2 OPERATING PROCEDURE (b), (1)

READS: Place RANGE knob to OFF.

INSERT: Place RANGE knob to $X10^3$.

ALSO: (3) DELETE ENTIRE PARAGRAPH
(4) BECOMES (3)
(5) BECOMES (4)
Page 3-3 - (6) BECOMES (5)
(7) BECOMES (6)
(8) BECOMES (7)

TABLE 3-2 - OPERATING INSTRUCTIONS, 1. NORMAL OPERATION (Page 3-3)

STEP 2 - DELETE: Press BATT. CHECK/METER RESET push button and check battery voltage.

SECTION 4 - TROUBLE SHOOTING (Page 4-1), Paragraph 4-4 TROUBLE SHOOTING PROCEDURE, (a.):

DELETE: Press the BATT. CHECK/METER RESET push button and observe the reading on the meter.

SECTION 5 - MAINTENANCE (Page 5-1), Paragraph c START UP PROCEDURE, (2):

(INSERTS UNDERLINED):

Set the RANGE knob to $X10^3$ and the BATT. CHECK/METER RESET to the depressed position to check the battery voltage.

NRC INDUSTRIES DIVISION NUCLEAR RESEARCH CORPORATION
125 TITUS AVENUE, P.O. BOX H, WARRINGTON, PA 18976
(215) 343-5900

10-1-82
eaf

REVISION PAGE

REVISION LEVEL	DATE	REVISION BY	ECN NUMBER	APPROVAL
A	12-17-91	AC	11679-73	

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

SECTION 1

GENERAL INFORMATION

1-1. SCOPE

This technical manual contains information that is necessary for the operation, calibration, maintenance, and repair of Radiac Set AN/PDR-70, and is in effect upon receipt. Extracts from this publication may be made to facilitate the preparation of other Department of Defense publications.

1-2. GENERAL INFORMATION.

Radiac Set AN/PDR-70 is a portable instrument designed to measure directly the biological dose rate of neutrons ranging in energy from thermal to 15 MEV. The equipment provides a readout signal on a meter calibrated directly in millirem per hour.

1-3. DESCRIPTION OF UNITS.

a. The probe houses a BF_3 proportional counter, a boron-loaded attenuator, and an inner and outer polyethylene moderator. The outer moderator is the housing. A fixed handle is provided for convenience in using the probe. The probe is a cylinder 8.5 inches in diameter by 9.4 inches long with a handle which protrudes 2-3/4 inches above the outside diameter, and feet which protrude 1/2 inches diagonally opposite the handle. A watertight cap protrudes from one face of the cylinder a distance of 1-3/16 inches. The probe electrically attaches to the radiacmeter via a waterproof coaxial connector located on the cap.

b. The electronic circuits for amplifying, measuring, and displaying the radiac probe signal are contained in the radiacmeter, along with the battery enclosure and low and high voltage power supply circuits. The cover is also a front panel which includes a connector for the headset or an external scaler, a permanently attached flexible cable for connection to the radiac probe, a battery condition push button, which is also a meter reset control, and an operation control knob for selection of meter range. A handle is provided for ease in carrying the instrument. The radiacmeter is a box whose dimensions are 5-3/4 inches high by 7-1/8 inches wide by 5-3/8 inches deep, with the handle extending 2-3/4 inches above and 4-1/4 inches beyond one side.

1-4. REFERENCE DATA.

Table 1-1 contains a tabulation of reference data for the radiac set.

TABLE 1-1. CHARACTERISTICS

ITEM	CHARACTERISTICS
Operating Range	0 to 2000 millirem per hour, neutron.
Power Requirements	3 Battery BA-30 (1.5-volt D cell), self-contained.
Operating Temperature Range	$-10^{o}C$ to $+50^{o}C$. ($14^{o}F$ to $122^{o}F$)
Operating Humidity	0 - 95% humidity.
Operating Gamma Background	500 roentgens per hour maximum (137_{Cs} - 137_{Ba})
Output Signal	Electrical meter with 4 ranges. Audio/Scaler output, negative pulse.
Inter-Range Linearity	± 10%
Directionality	± 20%
Linearity	± 10%
Accuracy	Dependent of neutron energy from 0 to 15 mev for a field rich in intermediate energies as shown in figure 3-1.

1-5. EQUIPMENT SUPPLIED.

Table 1-2 lists the equipment supplied with the radiac set.

TABLE 2-1. EQUIPMENT SUPPLIED

QTY PER EQUIP	NOMENCLATURE NAME	UNIT NO.	OVER-ALL DIMENSIONS (IN.) HEIGHT	WIDTH	DEPTH	VOLUME (CU FT)	WEIGHT (LB)
1	Radiacmeter	1	8.4	7.1	9.5	0.33	5.1
1	Probe, Radiac	2	11.3	8.5	10.8	0.60	19.5
2	Technical Manual for Radiac Set AN/PDR-70	--	11.0	8.5	----	----	----

SECTION 2

INSTALLATION

2-1. UNPACKING AND HANDLING.

To operate the Radiac Set with the probe and radiacmeter attached, insert the end of the radiacmeter handle into the open end of the probe handle. Engage the probe handle screw into the radiacmeter handle and tighten the screw with a clockwise rotation of several turns. The cap on the probe will nest into a semicircular extension of the side of the radiacmeter. It is suggested that the interconnecting cable be wrapped around the cap on the probe to take up the slack.

CAUTION

The shoulder strap may be attached to the radiacmeter for convenience in carrying the set when probe is separated from radiacmeter. When the probe and radiacmeter are attached, the shoulder strap must not be attached to the radiacmeter.

2-2. POWER REQUIREMENTS.

The radiacmeter operates from three (3) self-contained 1-1/2 volt dry-cell batteries, size D. If the condition of the batteries is suspected to be deteriorated for any reason, new batteries (type BA-30) must be obtained from stores at the time of use in order to ensure reliable operation.

2-3. INSPECTION AND ADJUSTMENT.

After the batteries have been installed in the radiacmeter, check the battery condition by pressing the BATT. CHECK/METER RESET push button. The meter on the front panel should read in the scale section marked BATT. No adjustment of the radiacmeter or probe is required for operation. All controls are centralized in one control knob.

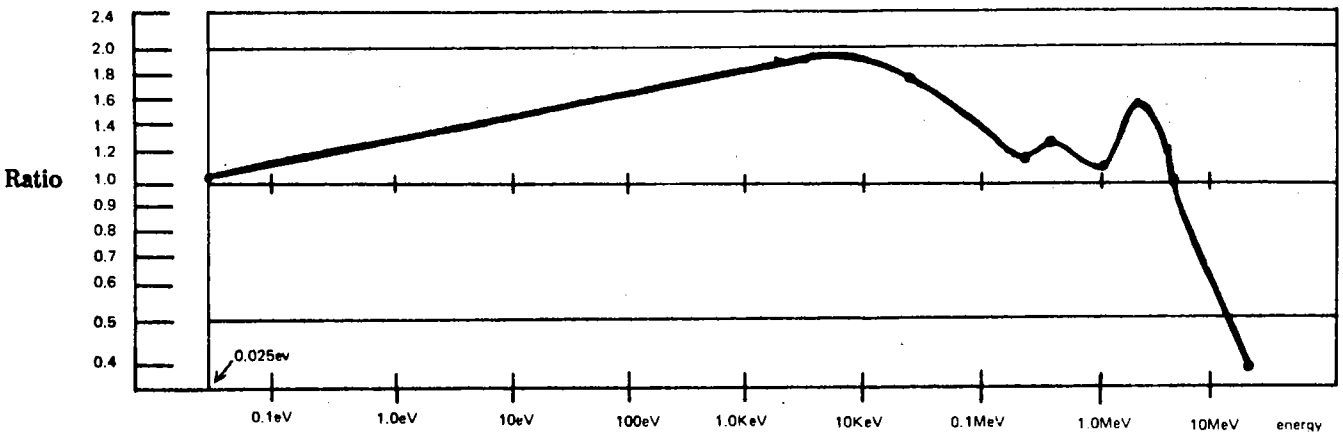


Figure 3-1. Ratio of measured response to theoretical response as a function of Neutron energy

SECTION 3

OPERATION

3-1 FUNCTIONAL OPERATION.

The radiac set is a portable survey instrument which measures the biological dose rate of neutrons which produce a field at the radiac probe. (See figure 3-1 for a curve of actual response compared to theoretical.) The neutron energy is changed by the detector to electrical pulses which are applied to a transistorized amplifier and counting circuit. The count-rate circuit output signal, whose magnitude is directly proportional to the number of counts per minute received from the probe, drives the indicating meter. The meter is calibrated in the biological dose rate unit of millirem per hour. The output signal can be displayed in three ways: by a meter on the front panel of the radiacmeter, by an external scaler which stores a count once for each count generated by the probe, or by a headset which is provided with the radiac set.

3-2. OPERATING PROCEDURE.

a. DESCRIPTION OF CONTROLS. Table 3-1 lists the nomenclature and function of the radiacmeter controls and indicators. Fig. 3-2 illustrates the location of all controls and indicators which are located on the panel of the radiacmeter.

b. SEQUENCE OF OPERATION. The following paragraphs describe the operating procedure for the radiac set.

(1) Place RANGE knob to OFF.

(2) Press the BATT. CHECK/METER RESET push button. The meter pointer should read above the scale section marked BATT. If the reading is below the BATT. scale section, replace all three batteries. (Refer to paragraph 5-2b.)

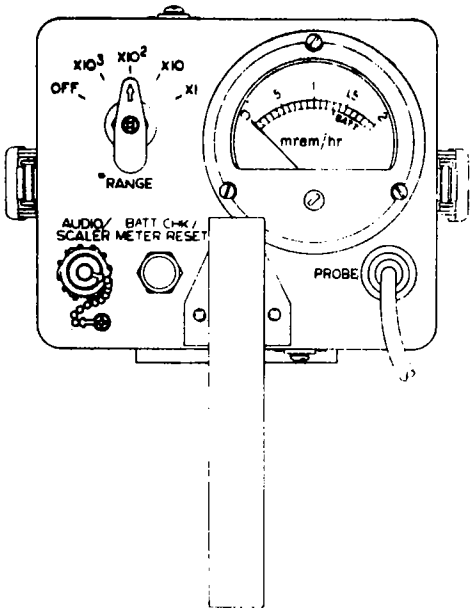


Figure 3-1. Radiacmeter Controls and Indicators

TABLE 3-1. CONTROLS AND INDICATORS

NOMENCLATURE	FUNCTION
BATTERY CHECK/ METER RESET	Displays charge level of batteries. Scale on meter illustrates minimum acceptable level. Simultaneously discharges the time constant capacitors to reset the meter pointer to zero when the push button is released.
RANGE	Energizes equipment and selects range of reading.
OFF	Disconnects batteries from equipment circuit.
$X10^3$	Regulates the meter circuit to display 2000 millirem per hour as full scale, 3 second time constant.
$X10^2$	Regulates the meter circuit to display 200 millirem per hour as full scale, 3 second time constant.
X10	Regulates the meter circuits to display 20 millirem per hour as full scale, 8.5 second time constant.
X1	Regulates the meter circuits to display 2 millirem per hour as full scale, 30 second time constant.

(3) Rotate the RANGE knob to the $X10^3$ position. This applies power to the circuits. Repeat step 2 to be sure that the batteries maintain proper voltage under load.

(4) To measure dose rate, start with the RANGE knob at the $X10^3$ position and observe the meter reading after 10 seconds. If the reading is quite low, set the RANGE knob to the $X10^2$ position and wait 10 seconds. If the reading again is low, rotate the RANGE knob to X10 and wait 30 seconds. If the reading again is low, rotate the RANGE knob to X1 and wait 90 seconds. As each range is selected, the appropriate dose rate in mrem/hr. is the meter reading times the number indicated on the RANGE switch.

(5) To reset the meter to zero, press the BATT. CHECK/METER RESET push button and hold it depressed for two or three seconds. While the push button is depressed, the meter pointer will indicate the battery condition. When the push button is released, the meter pointer will move to zero then upscale from zero to its new position. The meter reading may be reset to

zero at any time with the BATT. CHECK/METER RESET push button. This control is particularly useful on the X10 and X1 ranges, on which the time constants are relatively long. The meter pointer slowly moves down scale when the neutron field strength is decreased, and some reading error may be made if the operator does not wait for the pointer to reach its new position. The meter reset circuit returns the circuit to a zero level so that the meter pointer moves up to the new position when the push button is released.

(6) An external scaler will store a count for each pulse generated by the probe, regardless of the meter scale selected by the RANGE Control. To use an external scaler, remove the protective cap from the AUDIO/SCALER receptacle on the front panel of the radiacmeter and attach a scaler cable connector to the receptacle. The scaler sensitivity must be such that it will accept 3 to 5 volt negative pulses at 5000 ohm impedance.

CAUTION

a. Adjust the scaler input sensitivity and time constant control (if any) using care that the scaler does not record spurious noise pulses from the radiac set.

b. A separate calibration of count rate vs. dose rate is required when a scaler is used.

(7) To use the headset, remove the protective cap from the AUDIO/SCALER receptacle on the front panel of the radiacmeter and attach the headset connector to the receptacle. One pulse will be heard for each pulse generated by the probe.

(8) To attach the carrying strap to the radiacmeter, clip the strap to the tabs provided on the opposite ends of the radiacmeter.

CAUTION

The shoulder strap may be attached to the radiacmeter for convenience in carrying the set when probe is separated from radiacmeter. When the probe and radiacmeter are attached, the shoulder strap must not be attached to the radiacmeter.

(9) To turn off the equipment, rotate the RANGE control knob to the OFF position.

3-3. SUMMARY OF OPERATING PROCEDURES.

Table 3-2 contains a step-by-step operating procedure for use by an experienced operator.

3-4. OPERATOR'S MAINTENANCE.

No maintenance is required by the operator except for the verification of adequate battery condition each time the instrument is operated. Refer to paragraph 5-1b for battery replacement procedure. Refer to paragraph 5-3 for calibration information.

TABLE 3-2. OPERATING INSTRUCTIONS

I. NORMAL OPERATION	
STEP 1	Attach interconnecting cable to connector on probe.
STEP 2	Press BATT. CHECK/METER RESET push button and check battery voltage. Rotate RANGE knob to $X10^3$ and press BATTERY CHECK/METER RESET push button. Replace batteries if below minimum level.
STEP 3	Keep RANGE knob to $X10^3$ position and observe meter reading.
STEP 4	If reading is low, rotate RANGE knob to $X10^2$ position and check reading on meter after 10 seconds.
STEP 5	If reading is low, rotate RANGE knob to X10 position and check reading, after 30 seconds.
STEP 6	If reading is low, rotate RANGE knob to X1 position and check reading, after 90 seconds.
STEP 7	If reading is high and is slowly moving lower, as when the Radiac Set is taken away from a high neutron field to a lower neutron field, press the BATT. CHECK/METER RESET push button for two or three seconds, then release it. The meter pointer will move to zero, then slowly move upscale to indicate the new reading.
II. TURNING EQUIPMENT OFF	
STEP 1	Rotate RANGE control knob to OFF position.
STEP 2	If long-term storage is expected (in excess of one month), remove batteries to prevent corrosion damage to the radiacmeter.

SECTION 4

TROUBLE SHOOTING

4-1. GENERAL.

This section contains information required to locate the cause of an equipment malfunction or performance deterioration.

4-2. TEST POINTS.

Significant data, such as waveforms and voltages throughout the radiacmeter, are identified at test points on the schematic diagram (figure 5-5).

4-3. LOGICAL TROUBLE SHOOTING.

The trouble-shooting procedures are based on six logical steps contained in paragraphs 4-3a through 4-3f.

a. SYMPTOM RECOGNITION. - This is the first step in the troubleshooting procedure and is based on a complete knowledge and understanding of the equipment operating characteristics. All equipment troubles are not the direct result of component failure; therefore, a trouble in an equipment is not always easy to recognize since all conditions of less-than-peak performance are not always apparent. This type of equipment trouble is usually discovered while accomplishing preventive maintenance procedures. It is important that the "not-so-apparent" troubles, as well as the apparent troubles, be recognized.

b. SYMPTOM ELABORATION. - After an equipment trouble has been "recognized", all the available aids designed into the equipment should be used to elaborate further on the original trouble symptom. Use of the front-panel control and other built-in indicating aids should provide better identification of the original trouble symptom. Also checking or otherwise manipulating the control knob may eliminate the trouble.

c. LISTING PROBABLE FAULTY FUNCTION. - The next step in logical trouble shooting is to formulate a number of "logical choices" as to the cause and likely location (functional section) of the trouble. The "logical choices" are mental decisions which are based on knowledge of the equipment operation, a full identification of the trouble symptom, and information contained in this manual. The overall functional description and its associated block diagram should be referred to when selecting possible faulty functional sections.

d. LOCALIZING THE FAULTY FUNCTION. - For the greatest efficiency in localizing trouble, the functional sections which have been selected by the "logical choice" method should be tested in an order that will require the least time. This requires a mental selection to determine which section to test first. The selection should be based on the validity of the "logical choice" and the difficulties in making the necessary tests. If the tests do not prove that functional section to be at fault, the next selection should be tested and so on until the faulty functional section is located. As an aid in this process, the manual contains a functional description and a block diagram. Waveforms are included at the significant check points on the schematic diagram to aid in isolating the fault. Also test data (such as information on control settings, critical adjustments, and required test equipment) are supplied to augment the functional description and block diagram.

e. LOCALIZING TROUBLE TO THE CIRCUIT. - After the faulty functional section has been isolated, it is often necessary to make additional "logic choices" as to which test data for individual circuits or groups of circuits comprising the functional section are included in this section.

f. FAILURE ANALYSIS. - After the trouble (faulty component, misalignment, etc.) has been located (but prior to performing corrective action), the procedures followed up to this point should be reviewed to determine exactly why the fault affected the equipment in the manner it did. This review is usually necessary to make certain that the fault discovered is actually the cause of the malfunction and not just the result of the malfunction.

4-4. TROUBLE SHOOTING PROCEDURE.

The following procedures provide for recognization of the equipment trouble and the steps necessary to find the faulty component or misalignment.

WARNING

The radiacmeter contains voltages in excess of 1900 volts. Observe all safety precautions when trouble shooting the equipment.

CAUTION

When performing resistance measurements on transistors, use only an electronic type ohmmeter. When soldering or unsoldering semiconductors, use a heat sink between the semiconductor and the connection being soldered or unsoldered.

a. Press the BATT. CHECK/METER RESET push button and observe the reading on the meter. Rotate RANGE knob to $X10^3$ and press the BATT. CHECK/METER RESET push button again to observe battery voltage with the set energized. The reading should be above the line marked BATT. If the reading is below the acceptable region, replace all three batteries (refer to paragraph 5-1b).

b. Set the RANGE knob to the $X10^3$ position and observe the meter. With the probe in no neutron field, there should be no meter reading. Rotate the knob to the 10^2 position and again check that there is no meter reading. Rotate the knob to the 1 position and again check that there is no meter reading. If a reading is observed on the meter in the absence of a neutron flux, set the RANGE knob to OFF, and check the probe cable connectors for cleanliness. The radiacmeter is extremely sensitive to very small pulses, which can be

generated by high voltage discharge caused by dirt or moisture on the connectors. Clean the connector with dry alcohol, but if the cable is damaged or the connector is very dirty, replace the entire probe cable assembly. Open the radiacmeter enclosure and check the connectors and components for dirt or moisture, and clean if required.

c. With the knob in the X1 position and the headset connected to the AUDIO/SCALER receptacle on the front panel of the radiacmeter, listen for pulses. No more than 4 or 5 pulses should be heard in the space of a minute in the absence of a neutron field.

d. If faulty operation is indicated, and the connectors are clean, check the set for faulty contacts on the connectors or switch terminals. Check that grounded connectors are not faulty, and that the shields at the printed board assemblies are grounded. Replace the radiacmeter enclosure, set the RANGE knob to $X10^3$, and listen for pulses in the headset with the probe cable connected and disconnected from the probe to determine if the counter or cable in the probe assembly require cleaning, and clean if necessary.

e. Return the knob to the $X10^3$ position and, if possible, place the probe in a neutron field whose neutron dose rate, in millirem per hour, is known. Set the RANGE knob to the position which best displays the neutron dose rate, and observe the meter reading on the radiacmeter. If the reading differs widely from that expected from the calibration jig, faulty operation is indicated.

f. Perform the electrical checkouts described in the following paragraphs and then calibrate the Radiac Set. If all other tests on the electrical circuits indicate satisfactory operation, and the Radiac Set functions improperly in a neutron field, replace counter V1 and calibrate the set.

4-5. OVERALL FUNCTIONAL DESCRIPTION

a. The probe contains a BF_3 proportional counter which produce pulses resulting from neutron interactions occurring within it. The BF_3 proportional counter is essentially a thermal neutron detector, but the AN/PDR-70 radiac set is designed to respond to thermal, epithermal, and fast neutrons. The probe contains components which moderate and attenuate neutrons so that the net incident flux at the BF_3 proportional counter is a thermal and low epithermal flux representative of the tissue equivalent dose rate due to the neutron field.

b. (See figure 4-1) The probe housing is polyethylene, which has a high hydrogen content. The hydrogen presents a large scattering cross section to the neutrons. Through elastic collisions with the hydrogen atoms the fast and epithermal neutrons give up a large part of their energy and are reduced to thermal neutrons. A cylindrical attenuator containing boron-10 isotope surrounds an inner moderator which contains the proportional counter. The thermal neutron flux density resulting from moderation by the probe housing of all the neutrons in the field are attenuated as a result of the high scattering cross-section of the boron-10. The boron-10 isotope has a neutron cross-section which is proportional to the square root of neutron energy. Some of the neutrons arriving at the attenuator are scattered and prevented from reaching the BF_3 proportional counter. Neutrons which are not thermalized and which are not attenuated will be thermalized by the inner polyethylene

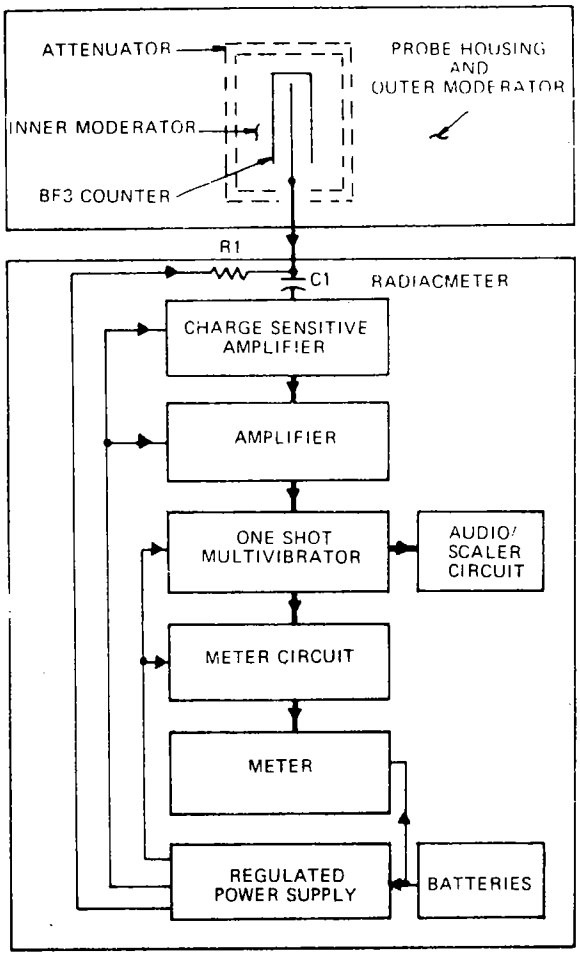


Figure 4-1. Radiac Set Block Diagram

moderator. The combined effect of the 2.25 inch thickness of boron attenuator, and 0.75 inch thickness of inner polyethylene moderator gives a probe pulse rate output proportional to tissue equivalent dose rate of the neutron field. The output from the probe is connected to an amplifier circuit through an interconnecting cable.

c. The amplifier output pulses are connected to a one-shot multivibrator circuit which operates when the amplified pulses exceed a given amplitude. The output of the one shot circuit operates the linear ratemeter circuit and the AUDIO/SCALER output circuit. The linear ratemeter consists of a linear pump circuit whose output is connected to the display meter. The AUDIO/SCALER output circuit consists of a buffer stage which couples pulses to the AUDIO/SCALER panel connector.

d. Power for the radiacmeter is supplied by three 1-1/2 volt dry-cell batteries (self-contained). The battery voltage is converted to ac by means of an oscillator circuit, and again converted to dc by a regulated power supply.

4-6. PROBE.

a. CIRCUIT DESCRIPTION. (See Figures 4-1 and 5-5.) The neutron detector, located within the probe housing, is a BF_3 proportional counter. The counter consists of a cylindrical metal shell with a center anode wire maintained at a high positive potential with respect to the shell. Boron-trifluoride gas is contained within the shell and neutrons are detected by their interaction

with the boron. The Thermal neutron-boron reaction produces a charged (alpha) particle which ionizes the gas. The ionization event causes a burst of electrons to arrive at the center anode wire. From this point, the charge produced by the burst of electrons is coupled by an interconnecting cable to the input of the charge sensitive amplifier.

The BF_3 proportional counter is a completely sealed device with a coaxial connector at one end. A short coaxial cable connects the detector to a coaxial connector on the waterproof cap mounted at one end of the probe housing. This connector accepts a six foot coaxial cable that is captivated at the radiacmeter. This cable carries the high voltage (approximately 1900 volts) from the radiacmeter to the probe proportional counter, and carries the electronic pulse from the probe to the amplifier within the radiacmeter.

b. TEST DATA. - The following paragraphs provide test data for the probe.

(1) PERFORMANCE INDICATORS. - The RANGE knob is the only control affecting operation of the probe. When the knob is set in any position except OFF, power is supplied to the probe.

(2) ADJUSTMENTS AND ALIGNMENT. - The probe does not require adjustment or alignment.

(3) TEST PROCEDURE. - To test the probe for malfunctions, perform the following procedures:

(a) Set the RANGE knob to the X1 position.

(b) Place the probe in a neutron field exceeding 1 mrem per hour.

(c) The radiacmeter meter reading should be upscale.

(d) Remove the probe from the neutron field; the meter reading should return to zero.

4-7. AMPLIFIER Q1-Q2, Q3-Q4, Q5-Q6

a. CIRCUIT DESCRIPTION (See Figure 5-5). - Pulses from the probe are coupled to a charge-sensitive amplifier on component board 2A4 via capacitor C1. The amplifier utilizes transistors Q1 and Q2 in a circuit in which the main negative feedback element is C2. Each pulse from the detector is a burst of electrons, constituting a quantity of electronic charge, which produces a voltage across capacitor C2. This voltage appears across resistor R9 because of the bootstrap action of C4. The current flow in transistor Q2 is equal to the charge on C2 divided by the product of C2 and R9, and the output voltage is the product of this current and the impedance in the collector circuit of Q2. Negative feedback due to the high internal gain of the circuit reduces the effect of the connecting cable, proportional counter, and stray circuit capacitances. Diode CR1 provides protection from overload by accidental shorting of the radiacmeter input connector when the probe is not connected.

Feedback amplifier Q3-Q4, and common emitter amplifier Q5 provide voltage gain, which can be adjusted by R10. Negative feedback in Q5 amplifier is provided by the emitter resistor.

The amplifier circuit is supplied with low voltage (14 volts) through pin 7 of J-4, and decoupled by R-27 and C10.

b. TEST DATA. - The following paragraphs provide test data for the amplifier.

(1) TEST EQUIPMENT AND SPECIAL TOOLS. - Electronic Multimeter, a triggered oscilloscope, a pulse generator, and an input coupling circuit are required to provide test and circuit adjustments for the amplifier as shown in figure 4-2.

(2) PERFORMANCE INDICATORS. - The operation of the amplifier is affected only by the control knob.

(3) ADJUSTMENTS AND ALIGNMENT. - The amplifier requires adjustment or alignment only in the event of a major service repair. Adjust the amplifier as follows:

(a) Remove the radiacmeter from its enclosure to expose amplifier gain adjustment R10, which is partly hidden by the shield on the circuit board.

(b) Connect the probe interconnecting cable via the input coupling circuit, to the Function Generator as indicated in figure 4-2.

(c) Adjust the Function generator to provide a pulse rate of 60 H_z at 25 millivolt amplitude (negative polarity) and 0.3 usec rise time. Measure the pulse at test point 1 on figure 4-2.

(d) Rotate the RANGE control to the $X10^2$ position. Press the BATTERY CHECK/METER RESET push button to ensure that the batteries are in good condition.

(e) Adjust R10 to the setting at which triggering is just constant, as indicated by an upward deflection of the meter pointer, or by an audible signal in a headset connected to the AUDIO/SCALER receptacle.

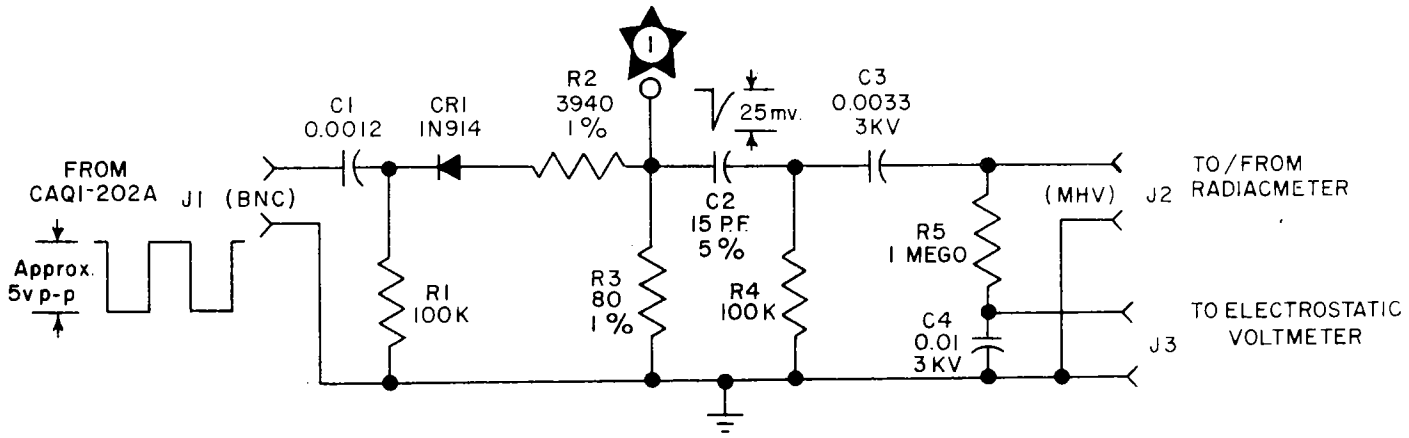


Figure 4-2. Input Coupling Circuit

NOTE

External noise may affect the amplifier adjustment while the radiacmeter is removed from its enclosure. Check the final adjustment of R10 after the radiacmeter is returned to its enclosure.

(f) This completes the amplifier adjustment.

(g) Remove test equipment.

(4) TEST PROCEDURE. - To test the amplifier for malfunction, perform the following procedures:

(a) Remove the radiacmeter from its enclosure.

(b) Set the RANGE knob to the $X10^3$ position.

(c) Connect the oscilloscope test probe between test point 1 and ground.

(d) Insert pulses into the input from the function generator which is described in 4.7b (1).

(e) Check the waveform (See figure 5-5).

(f) Remove test equipment.

4-8. ONE-SHOT MULTIVIBRATOR Q7-Q8.

a. CIRCUIT DESCRIPTION (See figure 5-5.) - A positive output pulse from the amplifier of +3 volts is sufficient to trigger the one-shot multivibrator Q7-Q8 via coupling capacitor C12 and diode CR3. When the pulse amplitude is approximately 3 volts, Q7 and Q8 amplify the pulse sufficiently to generate 12 volts from collector of Q8 to ground. Positive feedback is applied to the input via R32 and the range capacitor C11, C13, C14, or C16. A Zener diode-connected transistor, CR4, conducts when the voltage between collector Q8 and emitter Q7 is greater than 6.5 volts. The operation of the circuit is such that when the collector of Q8 is at 12 volts, the base of Q7 is at 6 volts via the range capacitor and the series combination of R32, R29, and the emitter of Q7 is at 5.5 volts. This fulfills the requirement that CR4 maintain the 6.5 volts difference between collector Q8 and emitter Q7.

Diode CR2 prevents the common terminal of the range capacitors from going negative with respect to ground.

The short duration input pulse soon falls to zero, and the selected range capacitor C11, C13, C14, or C16 discharges via R32 and R29, until Q8 collector is at approximately 10 volts. The emitter of Q7 is now at a voltage that does not allow CR4 to conduct, and the range capacitor begins to discharge rapidly through the base-emitter circuit of Q7. Amplifier action of Q7 and Q8 cause the voltage to rapidly fall to nearly zero. The multivibrator will then accept the next input pulse.

The range capacitors control the width of the one-shot multivibrator pulse in steps of 10 times, from 3.6 milliseconds for the lowest range (X1) to 3.6 microseconds for the highest ($X10^3$) range. This pulse is coupled to the AUDIO/SCALER circuit and to the ratemeter circuit.

b. TEST DATA. - The following paragraphs provide test data for the one-shot multivibrator circuit.

(1) TEST EQUIPMENT AND SPECIAL TOOLS. - The following test equipment is required to test the one-shot multivibrator circuit:

(a) Oscilloscope.

(b) Function Generator CAQI-202A

(2) PERFORMANCE INDICATORS. - The RANGE switch is the only control that affects the one-shot multivibrator.

(3) ADJUSTMENTS AND ALIGNMENT. - The one-shot multivibrator does not require adjustment or alignment.

(4) TEST PROCEDURE. - To test the one-shot multivibrator circuit, perform the following procedures:

(a) Remove the radiacmeter from its enclosure.

(b) Connect the test probe of the oscilloscope between test point 2 and ground (See figure 5-4).

(c) Insert pulses from the function generator by performing steps 4-7b (3) (a) and (b) and increase the output of the function generator about 10%. Set the pulse rate at approximately 60 Hz.

(d) Set the RANGE knob to $X10^2$.

(e) Check the waveform at test point 2 as the generator output is increased. (See figure 5-5.)

(f) Remove the test equipment.

4-9. AUDIO/SCALER CIRCUIT Q9.

a. CIRCUIT DESCRIPTION. (See figure 5-5.) - The positive pulse from the multivibrator is connected through R36 to the base of Q9. Transistor Q9, connected in a common emitter circuit, inverts the pulses. The capacitor C18 from the emitter of Q9 to ground lengthens the short pulses when the $X10^2$ and $X10^3$ ranges are used. Headset HT1 connects through J3 and capacitor C20 to the collector of Q9, and senses the pulses passing through Q9.

An external scaler with negative polarity input circuit may be connected to J3 in place of the headset HT1. The input impedance should be 5K to 10K ohms. The output pulse at J3 will be 3 to 5 volts. The scaler sensitivity must be adjusted carefully to avoid erroneous counting.

b. TEST DATA. - The following paragraphs provide test data for the AUDIO/SCALER circuit.

(1) TEST EQUIPMENT AND SPECIAL TOOLS. - Function Generator CAQI-202A is required to test the AUDIO/SCALER circuit.

(2) PERFORMANCE INDICATORS. - The RANGE knob is the only control which affects the AUDIO/SCALER circuit.

(3) ADJUSTMENTS AND ALIGNMENT. - The AUDIO/SCALER circuit does not require adjustment or alignment.

(4) TEST PROCEDURE. - To test the AUDIO/SCALER circuit, perform the following procedures:

(a) Connect the function generator (as in 4-8b 4(b).

(b) Set the RANGE knob to $X10^2$.

(c) Check for pulses in the headset, or for correct indication on a scaler, when either is connected to the radiacmeter.

(d) Remove test equipment.

4-10. RATEMETER CIRCUIT Q10-Q11.

a. CIRCUIT DESCRIPTION. (See figure 5-5.) - Meter M1 is connected between ground via S-2 contacts 5 and 6, and resistor R41 to gate Q11. The current

flow through the gate is regulated by the CALIBRATE control R43, when positive pulses are applied from the one-shot multivibrator via emitter follower Q10. The current pulses charge the selected integrating capacitor C19, C21, C22, and the meter circuit and R41 discharge the capacitor. The meter current indicated is linearly in proportion to the number of pulses that are applied.

The pulse width also regulates the meter current. Pulse width at the one-shot multivibrator is 3.6 microseconds when S1A1 is at the $X10^3$ position and C16 is connected in the multivibrator circuit. The width increases by a factor of 10 as the range is changed from $X10^3$ to $X10^2$ to X10 to X1. A pulse repetition rate of approximately 3000H_Z is required for full scale meter indication on the $X10^3$ range, and 300, 30 and 3 H_Z are required on the $X10^2$, X10, and X1 range positions respectively. The pulse rate is directly related to the number of pulses produced at the probe, which in turn provides the dose adjusted rate in a neutron field. R43 is adjusted to calibrate the meter reading in mrem/hr indication when the probe is in a known neutron field strength.

The RC time constant of the meter circuit regulates the charging and discharging time of the circuit and controls the amount of fluctuation of the meter pointer when the pulse rate is varying in a random manner. Capacitor C22 is connected to ground in the circuit on the X1 range by switch S1A-1 terminal, and the circuit RC time constant is 30 seconds. When the switch is at the X10 position, Capacitor C21 is connected to ground and the time constant is 8.5 seconds. When the switch is at the $X10^2$ and $X10^3$ positions, capacitor C19 is connected to ground and the time constant is 3 seconds. The voltage across any capacitor is only discharged by the meter circuit, so that when the switch is changed from range to range the meter may immediately indicate a reading.

Switch S1 terminals A1-1 and A5 short circuit the meter when the set is OFF, to provide damping of the meter movement during shipping of the radiac set.

Battery condition is indicated on the meter via R42 when S2 is depressed. Terminals 4 and 5 of S2 connect the positive terminal of meter M1 to ground, while terminals 5 and 6 disconnect the negative terminal from ground. A fresh set of batteries will cause an indication just off scale, and a depleted set of batteries (2.8 volts) will cause an indication at the meter segment marked "BATT." At the same time that S2 connects R42 to the meter, terminals 1 and 2 of S2 connect the output of Q11 to ground. Any charge on the capacitors C19, C21 or C22, which is connected in the meter circuit, is reduced to zero, thereby resetting the meter circuit.

b. TEST DATA. - The following paragraphs provide test data for the ratemeter circuit:

(1) TEST EQUIPMENT AND SPECIAL TOOLS. - The following test equipment is required to test the meter circuit:

(a) Electronic Multimeter.

(b) Function Genrator.

(2) PERFORMANCE INDICATORS. - The following controls affect the meter circuit:

(a) RANGE knob.

(b) Variable resistor R43.

(c) Push button switch S2.

(3) ADJUSTMENTS AND ALIGNMENT. - To electrically adjust the meter circuit, perform the following procedures:

CAUTION

Do not attempt to measure neutron dose rate with the Radiac Set after the electrical adjustments. The meter circuit final adjustment must be carried out in accordance with the calibration procedure for Radiac Set AN/PDR-70.

(a) Connect the probe interconnecting cable via the input coupling circuit, to the Function Generator as indicated in figure 4-2.

(b) Set the RANGE knob to the $X10^3$ position.

(c) Set the pulse rate to 2400 H_Z and gradually increase the output of the Function Generator until the radiacmeter is indicating a steady output at J-3

(d) Remove the radiacmeter from its enclosure and adjust R-43 until the meter reading is 1.5.

(e) Replace the radiacmeter in its enclosure and check that the reading is still at 1.5.

(4) TEST PROCEDURE. - To test the meter circuit, perform the following procedures:

(a) Connect the Function Generator as in 4-10b (3).

(b) Set the RANGE knob at the $X10^3$ position.

(c) Set the pulse rate to 2400 H_Z and gradually increase the output of the Function Generator until a steady indication is observed on the radiacmeter.

(d) Check that the meter indicates 1.5.

(e) Remove test equipment.

4-11. POWER SUPPLY Q12-Q13 on Component Assembly 2A5.

a. CIRCUIT DESCRIPTION. (See figure 5-5.) - A negative potential of 4.5 volts from the three dry-cell batteries (connected in series) is supplied to Q13 through S1B and the filter circuit L1 and C24. When the switch is first turned on, Q13 conducts, energizing the primary winding of T1. Q13 operates as a free running blocking oscillator, whose output voltage is controlled by Q12 with positive feedback through R48 and the feedback winding of T1, thereby regulating the output voltage during battery life.

CR7 and CR9 function as a voltage doubler, producing approximately +20 volts. Voltage sensing is provided by three transistors connected to operate as a 20.4 volt zener diode (CR5, CR6, and CR8), serving as a reference for the base of Q12 which in turn controls Q13. High battery voltage compensation is provided by R46 and Zener diode CR10. Filter circuit L1 and C24 improve the waveform and regulation of the oscillator.

High voltage is provided by a conventional voltage quadrupler CR11 through CR14 and C29 through C32. Filtering is provided by R50, R51, R52, and C33, C34, C35. The capacitors are discharged through R49 when the set is turned off.

High voltage fine adjustment is provided by R44 which also serves as part of an RC filter circuit for the amplifier low voltage supply. Taps on transformer T1 provide coarse HV output adjustment. Terminals across the transistors which serve as zener diodes CR5, CR6, CR8 permit adjustment of the zener reference in 1/2 volt steps. Each has a collector-emitter voltage of about 6.6 volts, which may be increased by shorting a base terminal to its collector terminal. These adjustments provide a means to set the high voltage from 1700 volts to 2150 volts by by R44 and an even wider range by use of the taps.

NOTE

The value of the high voltage will determine the exact values of the lines labeled +19.5v and L.V. on figure 5-4. When the high voltage is at +1950v, these lines are at +19.5 and +14 volts, respectively.

b. TEST DATA. - The following paragraphs provide test data for the power supply circuit.

(1) TEST EQUIPMENT AND SPECIAL TOOLS. - The following test equipment is required to test the power supply:

(a) Oscilloscope.

(b) Electrostatic voltmeter 0 - 3000 volts dc.

(2) PERFORMANCE INDICATORS. - The following controls affect the operation of the power supply:

(a) RANGE knob.

(b) Variable resistor R44.

(3) ADJUSTMENTS AND ALIGNMENT. - To adjust the power supply, perform the following procedures:

(a) Remove the radiacmeter from its housing.

(b) Connect the electrostatic voltmeter from TP4 to ground.

(c) Set the RANGE knob to $X10^3$ position.

(d) Adjust R44 to the correct high voltage of 1925 volts.

(e) Remove test equipment.

(4) TEST PROCEDURE. - To test the power supply for malfunctions, perform the following procedures:

(a) Set the RANGE knob to $X10^3$ position, press the BATTERY CHECK/METER RESET push button and observe the battery - voltage level. (Replace the batteries if the reading is below the BATT. region.)

(b) Connect the oscilloscope test lead between test point 3 and ground to check the oscillator dc and ac voltages. (See figure 5-5.)

(c) Connect the electrostatic voltmeter between test point 4 (see figure 5-5) and ground to check that the high voltage is 1925 volts.

(d) Remove test equipment.

SECTION 5

MAINTENANCE

5-1. PREVENTIVE MAINTENANCE

a. STORAGE. – When storing the radiac set for any length of time after use, remove the three batteries to prevent their corroding the radiacmeter.

b. BATTERY REPLACEMENT. – To replace batteries, proceed as follows:

(1) Set the RANGE knob to OFF.

(2) Invert the radiacmeter and remove the bottom cover by loosening the 4 captive screws on the cover. Do not attempt to loosen the 8 small screws on the enclosure.

(3) Remove the cover completely to expose the eject strap. Pull the strap away from the enclosure to lift the batteries.

(4) Install 3 fresh BA-30 batteries, observing polarity markings.

(5) Replace the cover and tighten the 4 screws, observing that the eject strap is inside the compartment.

c. START UP PROCEDURE. – Prior to putting the radiac set into use, perform the following procedure:

(1) Obtain three BA-30 dry cells from stores and install in the battery compartment, observing the polarity markings on the battery eject strap.

(2) Set the RANGE knob to the BATT. CHECK/ METER RESET position to check the battery voltage.

(3) Connect the probe cable on the radiacmeter to the receptacle on the probe.

NOTE

The connectors on the probe cable and on the probe must be free of dirt and moisture. Ensure that the connectors are clean. Use only dry alcohol in cleaning.

5-2. REPAIR.

a. REMOVAL. – All parts and subassemblies may be removed in a conventional manner except for the detector assembly. To remove the counter tube V1, proceed as follows: (See Figure 5-2.)

(1) Disconnect the radiacmeter cable.

(2) Remove the 12 screws that mount the end cap to the probe. Pull the end cap away from the housing.

(3) Remove the short cable from the end cap to V1.

(4) Pull the inner moderator section away from the assembly. This exposes the tube V1.

(5) If V1 is replaced, record the plateau range of the replacement and refer to Section 4-10 and 4-11 for recalibration and high voltage adjustment.

b. REASSEMBLY. – To reassemble the detector assembly, proceed as follows:

(1) Place the counter back into the assembly and replace the moderator section.

(2) Reconnect the short cable to the counter.

(3) Replace the gasket, end cap and 12 screws, and carefully tighten the screws.

5-3. PARTS WHICH, IF REPLACED, REQUIRE RECALIBRATION OF EQUIPMENT.

a. Capacitor C-11, C-13, C-14, or C-16.

b. Calibration potentiometer R-10.

c. Meter multiplier R-41.

d. HV adjust R-44

e. Meter calibration adjust R-43.

f. Proportional Counter V1.

g. Printed Circuit Assembly 2A4.

h. Printed Circuit Assembly 2A5

i. Meter 2M1

LEGEND FOR FIGURE 5-1.

1. Handle assembly A1
2. Thumbscrew
3. O-ring
4. Nut, self-locking
5. Screw
6. Outer moderator, MP1
7. Rubber bumper MP7
8. Screw
9. Attenuator, rear MP3
10. Attenuator, sleeve MP4
11. Inner moderator MP6
12. Attenuator, front, MP2
13. Proportional counter, V-1, and connector, J-1
14. Plug, moderator MP5
15. Cable assembly, A2, with P1 and J2
16. Gasket, probe MP8
17. Cap, probe MP9
18. Washer
19. Screw

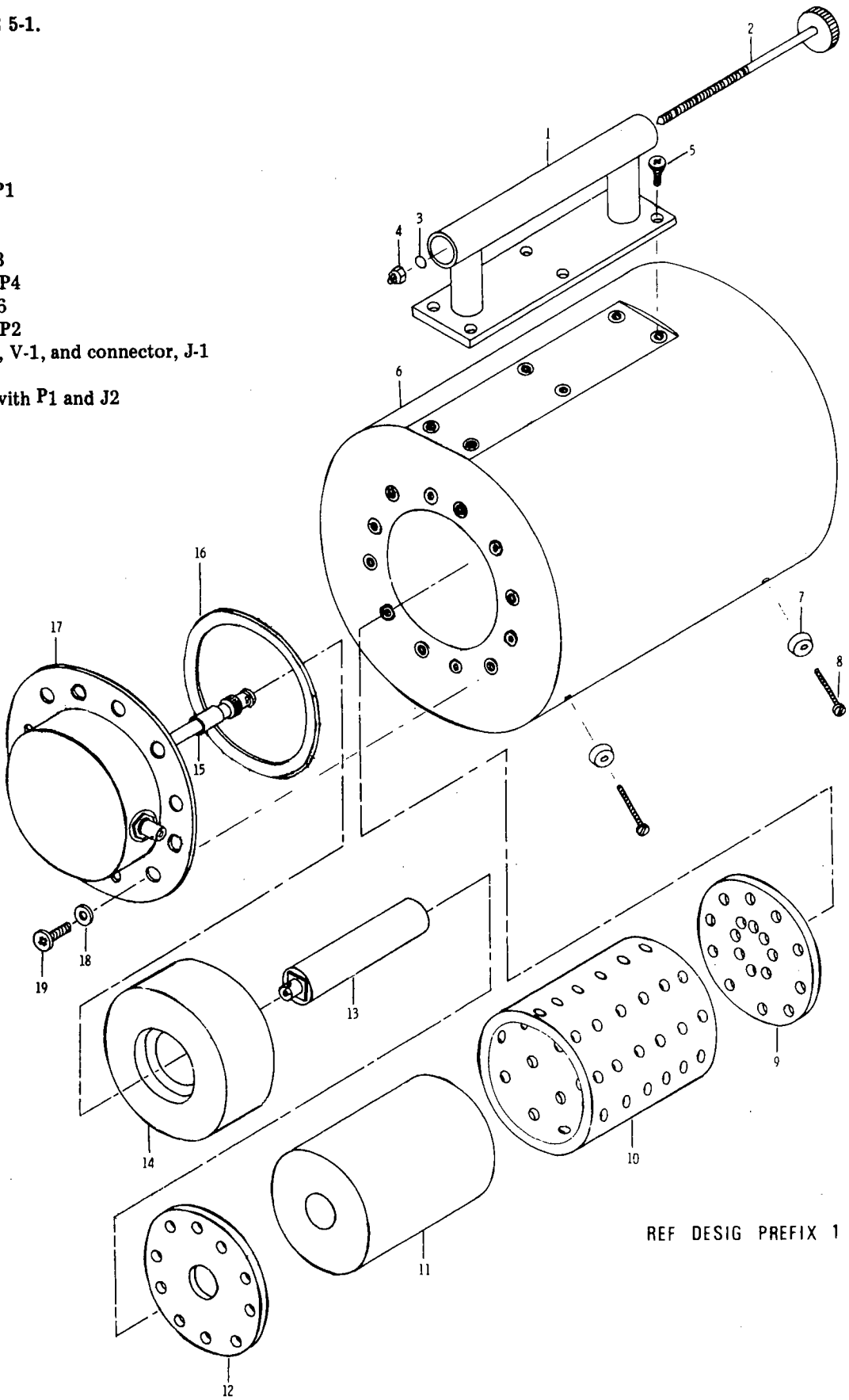


Figure 5-1. Radiac Probe, Exploded View

5-5 INTERCONNECTING AND WIRE LISTS.

Table 5-1 lists all interconnections between the circuit board connectors, cover, and radiacmeter enclosure assembly. This is cross-referenced between all major and minor replaceable items.

TABLE 5-1. WIRE LIST, INTERCONNECTING POINTS

FROM	TO	COLOR	FROM	TO	COLOR	FROM	TO	COLOR
J4-			S1A-			J3	J4-16	Blue (Shl'd)
A thru N	Not Used		5	S2-5	Red			
P	S1-A1-4	White	11	J4-9	Black	BT1(+)	Ground	Black
R	Not Used					BT1(-)	BT2(+)	Red
S	Not Used		S1-A1					
T	Not Used		1	S2-4	Red	BT2(+)	BT1(-)	Red
U	S1-A1-3	Black	2	S1-A1-3	Bare	BT2(-)	BT3(+)	Red
V	Not Used		3	S1-A1-2	Bare			
3	C1 (Input)		3	J4-U	Black	BT3(+)	BT2(-)	Red
4	Not Used		4	J4-P	White	BT3(-)	S1B-5	Green
7	J5-H	Bare	5	J4-17	Black			
8	J5-J	Bare	7	Not Used		M1(+)	S2-4	Red
9	S1A-11	Black	8	J4-11	Red	M1(-)	S2-6	White
10	S2-1	Red	9	J4-12	Green			
11	S1-A1-8	Red	10	J4-14	White			
12	S1-A1-9	Green	11	J4-15	Red			
13	S2-4	Black						
14	S1-A1-10	White	S1B-					
15	S1-A1-11	Red	5	BT-3(-)	Green			
16	J3	Blue (Shl'd)						
17	S1-A1-5	Black	S1-B1-					
18	Ground	Bare	1	Not Used				
			2	J5-T	White			
J5-								
A	N/A		S2-					
B	N/A		1	J4-10	Red			
C	Not Used		2	R40				
D	R_2 (H.V.)		2	S2-5	Black			
E thru G	Not Used		4	S1-A1-11	Red			
H	J4-7	Bare	4	J4-13	Black			
J	J4-8	Bare	4	M1(+)	Red			
K thru S	Not Used		5	S2-2	Black			
T	S1-B1-2	White	5	S1A-5	Red			
U	Not Used		5	Ground	White			
V	Ground	Bare	6	M1 (-)	White			
1 thru 18	Not Used							

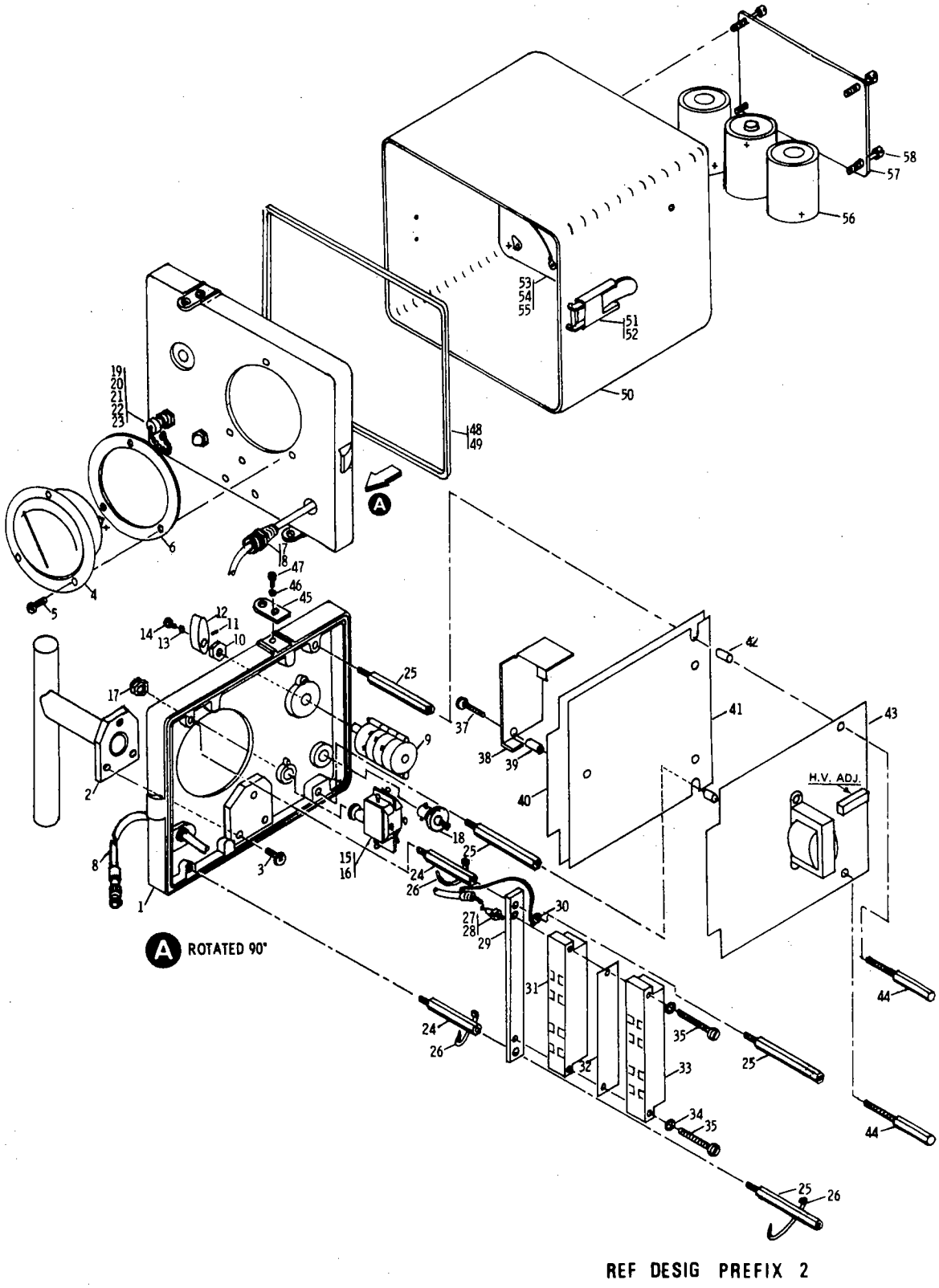


Figure 5-2. Radiacmeter, Exploded View

LEGEND FOR FIGURE 5-2

1. Cover
2. Handle
3. Seelscrew
4. Meter
5. Screw
6. Gasket, Meter
7. Cable grip assembly
8. Cable Assembly with Connector, P-2
9. Rotary Switch, S-1
10. Hexseal nut
11. Pin
12. Knob
13. Lockwasher
14. Screw
15. Pushbutton Switch, S-2
16. Hex nut (on switch)
17. Hexseal nut with boot
18. Receptacle, J-3
19. Hex nut
20. Lockring
21. Cap with chain
22. Screw
23. Lockwasher
24. Spacer, hex, connector
25. Spacer, hex, printed circuits
26. Wire Clamp
27. Insulated terminal
28. Lockwasher
29. Plate, connector mounting
30. Ground Terminal
31. Connector, J-4
32. Insulator
33. Connector, J-5
34. Lockwasher
35. Screw
36. Screw
37. Screw
38. Amplifier shield (part of 2A4)
39. Spacer
40. Printed circuit assembly 2A4
41. Printed circuit shield (part of 2A4)
42. Spacer
43. Printed cifcuit assembly 2A5
44. Spacer, hex, guard post
45. Strap support
46. Lockwasher
47. Screw
48. Gasket, cover
49. Adhesive, rubber
50. Enclosure assembly
51. Latch
52. Seal, rivet
53. Battery enclosure Assembly
54. Screw
55. Gasket, Battery enclosure
56. Battery Cell, BT-1, BT-2 BT-3
57. Cover, battery
58. Captive screw

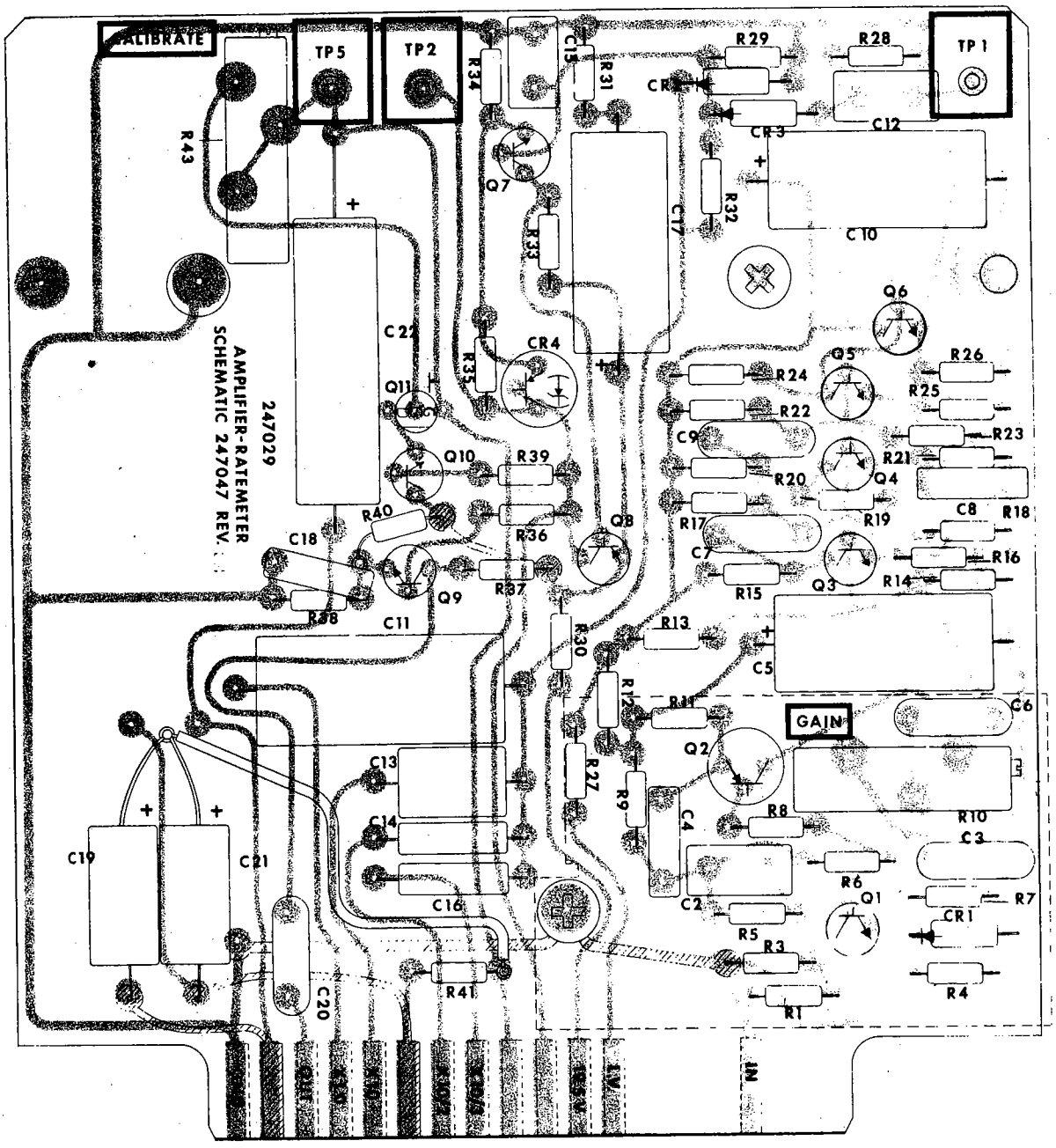
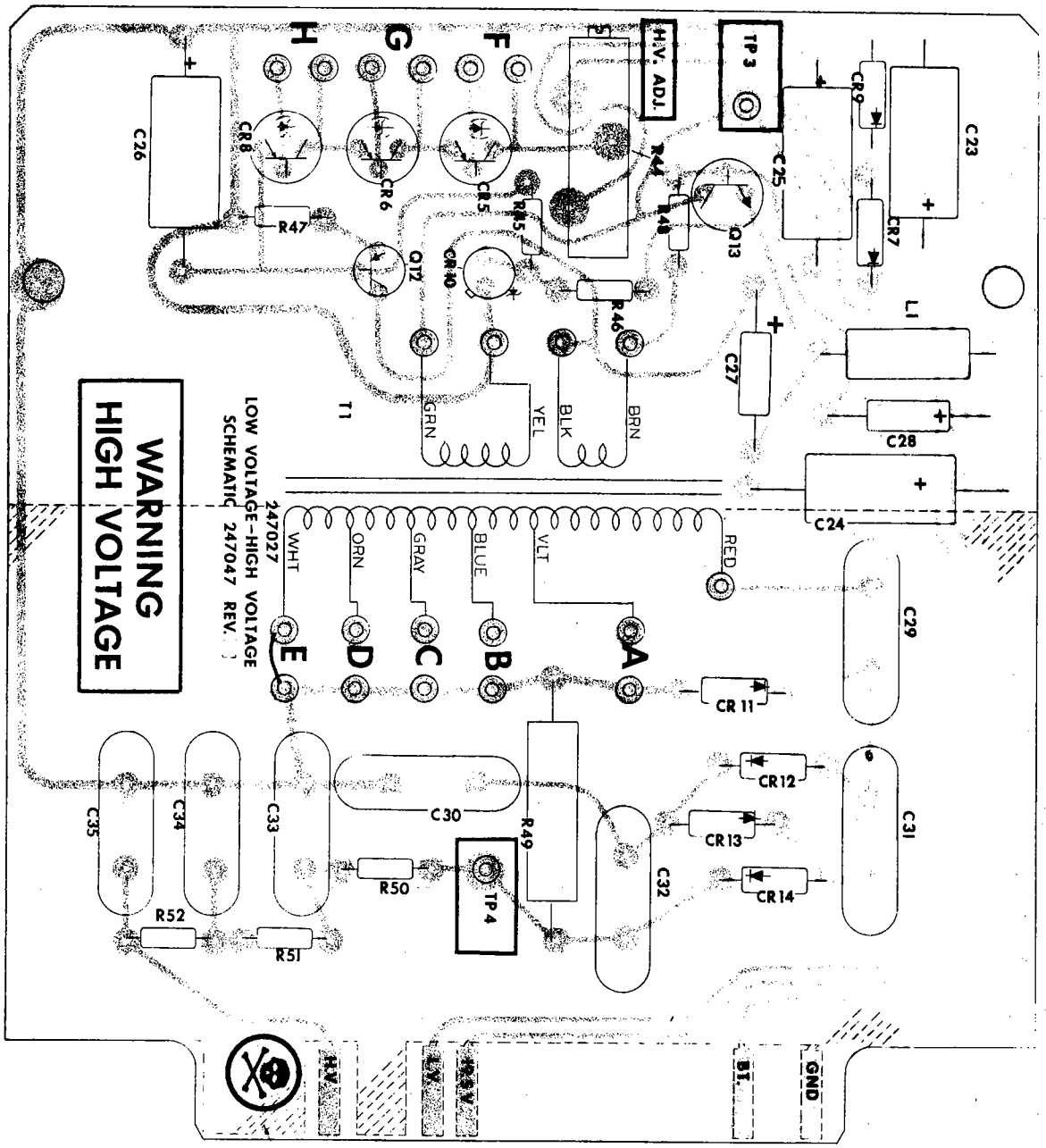


Figure 5-3. Component Board 2A4



COAT DOTTED AREA
ON BOTH SIDES AFTER
(NOTE MASKING AROUND FIN
ON CIRCUIT SIDE)

Figure 5-4. Component Board 2A5

PART LOCATION INDEX

REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC	REF DESIG	LOC
BT1	2L	CR1	8D	R1	7D	R40	17C
BT2	2L	CR2	13E	R2	7F	R41	18E
BT3	2L	CR3	14D	R3	7E	R42	19J
C1	7F	CR4	16D	R4	8D	R43	19J
C2	8B	CR5	4J	R5	8C	R44	4G
C3	9E	CR6	5J	R6	8C	R45	6K
C4	9C	CR7	6G	R7	8E	R46	6K
C5	10D	CR8	6J	R8	9C	R47	7J
C6	10D	CR9	6H	R9	9B	R48	7K
C7	11C	CR10	6K	R10	9D	R49	12L
C8	12E	CR11	10K	R11	9C	R50	12L
C9	12C	CR12	11K	R12	10B	R51	13L
C10	13C	CR13	11K	R13	10C	R52	13L
C11	13F	CR14	12K	R14	10D	S1A	15G,17G
C12	14D	HT1	21D	R15	11C	S1B	4K
C13	13F	J1	3D	R16	11D	S2	18G,18H
C14	14F	J2	4D	R17	11C	T1	9J
C15	15D	J3	20D	R18	11D	V1	2D
C16	15F	J4	7F,12F,14F,1SF	R19	11C		
C17	15C		17F,18F,19F,20C	R20	12C		
C18	17E	J5	4G,8G,5L	R21	12E		
C19	17E	L1	5L	R22	12C		
C20	18C	M1	19G	R23	12E		
C21	18E	P1	3D	R24	13C		
C22	18E	P2	4D	R25	13E		
C23	5H	P3	21D	R26	13E		
C24	6L	Q1	8D	R27	14B		
C25	6G	Q2	9D	R28	14E		
C26	6J	Q3	11D	R29	14E		
C27	7K	Q4	12D	R30	15B		
C28	7L	Q5	13D	R31	15C		
C29	10H	Q6	13D	R32	15E		
C30	10L	Q7	15D	R33	15C		
C31	11H	Q8	16D	R34	15E		
C32	11L	Q9	17D	R35	16E		
C33	12L	Q10	18D	R36	17D		
C34	13L	Q11	18E	R37	17C		
C35	14L	Q12	6H	R38	17E		
		Q13	8K	R39	17D		

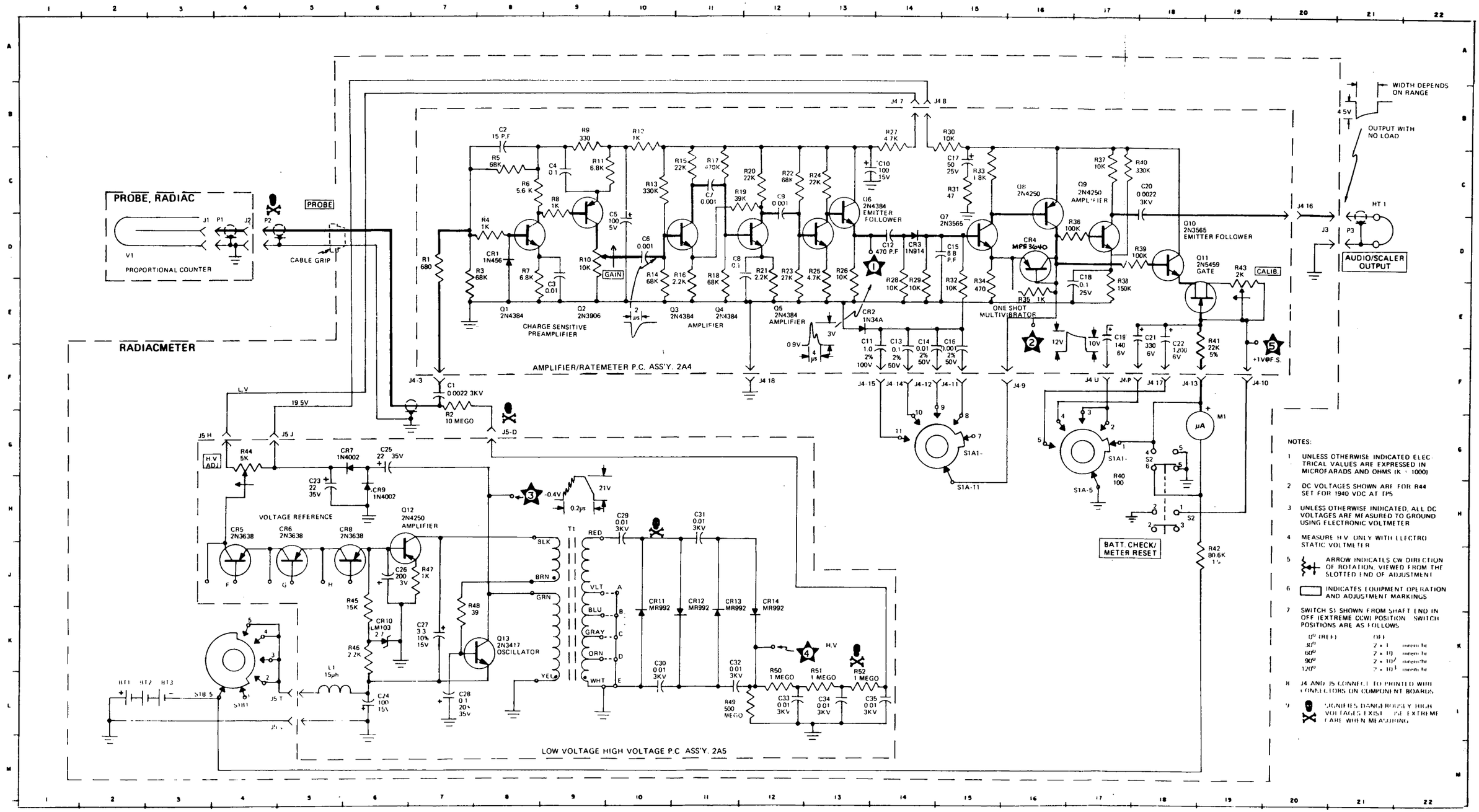


Figure 5-5. Radiac Set AN/PDR-70, Schematic Diagram

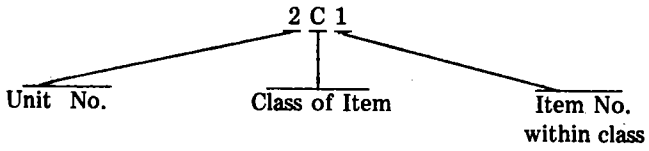
SECTION 6

PARTS LIST

6-1. INTRODUCTION.

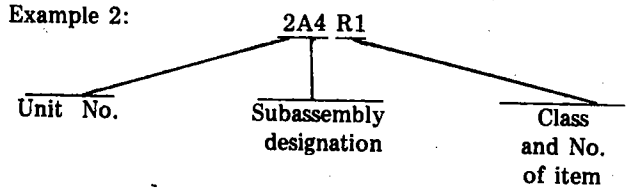
a. REFERENCE DESIGNATIONS. - The unit numbering method of assigning reference designations has been used to identify units, assemblies, subassemblies, and parts. This method has been expanded as much as necessary to cover adequately the various degrees of subdivision of the equipment. Subassembly and item numbers are assigned in numerical sequence for the whole equipment. Examples of this unit numbering method and typical expansions of the same are illustrated by the following:

Example 1:



Read as: First (1) capacitor (c) in second unit (2)

Example 2:



Read as: First (1) resistor (R) in fourth (4) subassembly (A) in second (2) unit

b. REF DESIG PREFIX. - Partial reference designations are used on the equipment and illustrations. The partial reference designations consist of the class letter(s) and the identifying number. The complete reference designations may be obtained by placing the proper prefix before the partial reference designations. Prefixes are provided on illustrations following the notation "REF DESIG PREFIX."

6-2. LIST OF UNITS.

Table 6-1 is a listing of the units comprising the equipment. The units are listed by unit numbers in numerical order. Thus, when the complete reference designation is known, this table will furnish the identification of the unit in which the part is located, since the first number of a complete reference designation identifies the unit. Table 6-1 also provides the following information for each unit listed:

(1) quantity per equipment, (2) official name, (3) designation, (4) colloquial name, and (5) location of the first page of its parts listing in Table 6-2.

6-3. MAINTENANCE PARTS LIST.

Table 6-2 lists all units and their maintenance parts. The units are listed in numerical sequence. Maintenance parts for each unit are listed alphabetically - numerically by class of part following the unit designation. Thus the parts for each unit are grouped together. Table 6-2 provides the following information:

(1) the complete reference designation of each unit, assembly, subassembly, or part, (2) noun name and brief description, and (3) identification of the illustration which pictorially locates the part.

NOTE

Unless otherwise indicated, all drawing numbers apply to the equipment manufacturer and all part or type numbers apply to the part manufacturer.

6-4. LIST OF MANUFACTURERS.

Table 6-3 lists the manufacturers of parts used in the equipment. The table includes the manufacturer's code used in table 6-2 to identify the manufacturer.

TABLE 6-1. LIST OF UNITS

UNIT NO.	QTY.	NAME OF UNIT	DESIGNATION	COLLOQUIAL NAME	PAGE
1	1	Probe, Radiac	PDR-70	Detector/Moderator	6-2
2	1	Radiac Meter	PDR-70	Electronics Package	6-2
3	3	Battery, Dry	BT-1 through BT-3		6-1

TABLE 6-2. MAINTENANCE PARTS LIST

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
1		PROBE, RADIAC: consists of 1 probe handle assembly, 1 probe cable assembly, neutron moderators, neutron attenuators, and 1 proportional counter, for AN/PDR-70; mfr. 80017, dwg. 247001	5-1
1A1		HANDLE ASSEMBLY, PROBE: contains aluminum handle, thumbscrew, O ring and self-locking nut; mfr. 80017, dwg. 247089	5-1
1A2		CABLE ASSEMBLY, PROBE: contains coaxial cable RG-59B/U, plug P-1 and receptacle J2, with mounting hardware; mfr. 80017, dwg. 247068	5-1
1MP1		MODERATOR, OUTER: low density polyethylene, approximately 8-1/2 in. dia. by 9-1/2 in. long, contains threaded inserts; mfr. 80017, dwg. 247005	5-1
1MP2		ATTENUATOR, NEUTRON, FRONT: boron powder in silicon rubber, 3 in. dia. x 1/4 in. thick, with 12 holes ea. 3/8 in. dia. and one center hole 1-1/8 in. dia; mfr. 80017, dwg. 247032	5-1
1MP3		ATTENUATOR, NEUTRON, REAR: boron powder in silicon rubber, 3 in. dia. x 1/4 in. thick, with 18 holes ea. 3/8 in. dia.; mfr. 80017, dwg. 247033	5-1
1MP4		ATTENUATOR, NEUTRON, SLEEVE: boron powder in silicon rubber, 3 in. dia. by 5-1/2 in. long, 1/4 in. wall thickness, with 91 holes ea. 3/8 in. dia.; mfr. 80017, dwg. 247034	5-1
1MP5		MODERATOR PLUG, NEUTRON: low density polyethylene: 3 in. dia. by 1-1/2 in. thick; mfr. 80017, dwg. 247035	5-1
1MP6		MODERATOR, INNER: low density polyethylene 2-1/2 in. dia. by 5-1/2 in. long; mfr. 80017, dwg. 247036	5-1
1MP7		BUMPER: rubber, black, 1 in. dia. by 3/8 in. high, with mounting hole for No. 6 screw; mfr. 83330, Part No. 2135	5-1
1MP8		GASKET, PROBE: rubber, 45 durometer, 1/16 in. thick; mfr. 80017 dwg. 247008	5-1
1MP9		CAP. PROBE: drawn aluminum, grey enamel finish, mfr. 80017 dwg. 247009	5-1
1MP10		PLATE, IDENT., PROBE: Stainless Steel, .030 in. thick, 4 mounting holes, silver letters on black background; mfr. 80017, dwg. 247010	—
1V1		COUNTER, PROPORTIONAL, NEUTRON: 1 in. dia. by 2 in. long sensitive volume, brass, with 96% enriched BF_3 gas at 60 cm Hg pressure, operating voltage range 1750 to 2000 VDC, plateau 300 volts long with 4% slope per 100 volts, includes UG-931/U connector; mfr. 80017 dwg. 247007	5-1
2		RADIACMETER: Electronics package w/all components assembled for operation except batteries; mfr. 80017, dwg. 247002	5-2
2A3		BOX, BATTERY: contains battery enclosure, spring contacts, solder terminals, rivets, bushings, flat washers and eject strap; assembled with ground strap, gasket, cover and captive screws; mfr. 80017, dwg. 247088	5-2
2A3MP11		GASKET, BATTERY ENCLOSURE: rubber, 45 durometer; mfr. 80017, dwg. 247042	5-2
2A3MP12		COVER, BATTERY ENCLOSURE: aluminum, grey enamel finish, with 4 threaded holes for captive screws; mfr. 80017, dwg. 247045	5-2
2A4		AMPLIFIER - RATEMETER, ASSEMBLY: printed circuit board w/all components assembled for operation; mfr. 80017, dwg. 247029	5-3
2A4C2		CAPACITOR: MIL type CM 05 CD 150J03	5-3
2A4C3		CAPACITOR: fixed, ceramic dielectric, 0.01 uf - 0, + 100%, 500 VDCW; mfr. 00656, Part No. GPD x5U103P5	5-3

TABLE 6-2. MAINTENANCE PARTS LIST (Cont.)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
2A4C4		CAPACITOR: fixed, ceramic dielectric, 0.1 uf ± 20%, 25 VDCW; mfr. 56289, Part No. C23-3C21	5-3
2A4C5		CAPACITOR: fixed, electrolytic, tubular, 100 uf - 10, + 100%, 15 VDCW; mfr. 00656, Part No. CRE473A	5-3
2A4C6		CAPACITOR: fixed, ceramic dielectric, 0.001 uf - 10, + 100%, 500 VDCW; mfr. 00656, Part No. GPD x5U102P5	5-3
2A4C7		Same as 2A4C6	5-3
2A4C8		Same as 2A4C4	5-3
2A4C9		Same as 2A4C6	5-3
2A4C10		Same as 2A4C5	5-3
2A4C11		CAPACITOR: fixed, mylar dielectric, 1.0 uf ± 2%, 50 VDCW; mfr. 13934, Part No. 3X-105-.5F	5-3
2A4C12		CAPACITOR: fixed, mica dielectric, 470 gpf ± 5%, 300 VDCW; mfr. 84171, Part No. DM-15-471	5-3
2A4C13		CAPACITOR: fixed, mylar dielectric, 0.1 uf ± 2%, 50 VDCW; mfr. 13934, Part No. 3X1-104-.5F	5-3
2A4C14		CAPACITOR: fixed, mylar dielectric, 0.01 uf ± 2%, 50 VDCW; mfr. 13934, Part No. 3X1-103-.5F	5-3
2A4C15		CAPACITOR: fixed, ceramic dielectric, 6.8 pf ± 20%, 1000 VDCW; mfr. 00656, Part No. GPDCOH6R8K	5-3
2A4C16		CAPACITOR: fixed, mylar dielectric, 0.001 uf ± 2%, 50 VDCW; mfr. 13934, Part No. 3X1-102-.5F	5-3
2A4C17		CAPACITOR: fixed, electrolytic tubular, 50 uf -10, + 100%, 25 VDCW; mfr. 00656, Part No. CRE617A	5-3
2A4C18		Same as 2A4C4	5-3
2A4C19		CAPACITOR: MIL Type CL65CB141KP3	5-3
2A4C20		CAPACITOR: fixed, ceramic dielectric, .0022 uf ± 20%, 3000 VDCW; mfr. 56289, Part No. 30GA-D22	5-3
2A4C21		CAPACITOR: MIL Type CL65CB331KP3	5-3
2A4C22		CAPACITOR: fixed, electrolytic tantalum, 1200 uf ± 10%, 6 VDCW; mfr. 56289, Part No. 109D128X9006W2	5-3
2A4CR1		SEMICONDUCTOR DEVICE: silicon diode, 200 mw Type 1N456; mfr. 72699, Part No. 1N456	5-3
2A4CR2		SEMICONDUCTOR DEVICE: germanium diode, medium voltage Type 1N34A; mfr. 72699, Part No. 1N34A	5-3
2A4CR3		SEMICONDUCTOR DEVICE: diode, ultrafast planar Type 1N914; mfr. 72699, Part No. 1N914	5-3
2A4CR4		SEMICONDUCTOR DEVICE: transistor, PNP switching transistor, reverse breakdown 6.5 VDC Type VB-S-601841; mfr. 96696, Part No. MPS 3640	5-3
2A4MP28		SHIELD: printed circuit card, copper, glass epoxy backing, coated with high voltage insulation, includes 3 threaded standoffs; mfr. 80017, dwg. 247069	5-3
2A4MP29		SHIELD: preamplifier, aluminum, coated with high voltage insulation mfr. 80017, dwg. 247071	5-2 5-3

TABLE 6-2. MAINTENANCE PARTS LIST (Cont.)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
2A4MP30		COMPONENT BOARD: printed circuit card, glass epoxy base, tin plated circuit, gold plated fingers, includes Ref. No. markings; mfr. 80017, dwg. 247052	5-3
2A4Q1		SEMICONDUCTOR DEVICE: transistor, NPN silicon planar epitaxial low noise type 2N4384; mfr. 93983, Part No. 2N4384	5-3
2A4Q2		SEMICONDUCTOR DEVICE: transistor, PNP silicon general purpose switching and amplifier Type 2N3906; mfr. 80211, Part No. 2N3906	5-3
2A4Q3		Same as 2A4Q1	5-3
2A4Q4		Same as 2A4Q1	5-3
2A4Q5		Same as 2A4Q1	5-3
2A4Q6		Same as 2A4Q1	5-3
2A4Q7		SEMICONDUCTOR DEVICE: transistor, NPN high gain Type 2N3565; mfr. 13715, Part No. 2N3565	5-3
2A4Q8		SEMICONDUCTOR DEVICE: transistor, PNP low level, low noise amplifier Type 2N4250; mfr. 13715, Part No. 2N4250	5-3
2A4Q9		Same as 2A4Q7	5-3
2A4Q10		Same as 2A4Q7	5-3
2A4Q11		SEMICONDUCTOR DEVICE: transistor, silicon junction field effect, general purpose audio and switching Type 2N5459; mfr. 80211, Part No. 2N5459	5-3
2A4R1		RESISTOR: MIL Type RC07GF681K	5-3
2A4R3		RESISTOR: MIL Type RC07GF683K	5-3
2A4R4		RESISTOR: MIL Type RC07GF102K	5-3
2A4R5		Same as 2A4R3	5-3
2A4R6		RESISTOR: MIL Type RC07GF562K	5-3
2A4R7		RESISTOR: MIL Type RC07GF682K	5-3
2A4R8		Same as 2A4R4	5-3
2A4R9		RESISTOR: MIL Type RC07GF331	5-3
2A4R10		RESISTOR: Variable, wirewound, 15 turn, 10K ohms ± 10%, 1/2 watt; mfr. 80294, Part No. 3067P-10K	5-3
2A4R11		Same as 2A4R7	5-3
2A4R12		Same as 2A4R4	5-3
2A4R13		RESISTOR: MIL Type RC07GF334K	5-3
2A4R14		Same as 2A4R3	5-3
2A4R15		RESISTOR: MIL Type RC07GF223K	5-3
2A4R16		RESISTOR: MIL Type RC07GF222K	5-3
2A4R17		RESISTOR: MIL Type RC07GF474K	5-3
2A4R18		Same as 2A4R3	5-3
2A4R19		RESISTOR: MIL Type RC076F393K	5-3
2A4R20		Same as 2A4R15	5-3
2A4R21		Same as 2A4R16	5-3
2A4R22		Same as 2A4R3	5-3
2A4R23		RESISTOR: MIL Type RC07GF273K	5-3
2A4R24		Same as 2A4R15	5-3
2A4R25		RESISTOR: MIL Type RC07GF472K	5-3
2A4R26		RESISTOR: MIL Type RC07GF103K	5-3

TABLE 6-2. MAINTENANCE PARTS LIST (Cont.)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
2A4R27		Same as 2A4R25	5-3
2A4R28		Same as 2A4R26	5-3
2A4R29		Same as 2A4R26	5-3
2A4R30		Same as 2A4R26	5-3
2A4R31		RESISTOR: MIL Type RC07GF470K	5-3
2A4R32		Same as 2A4R26	5-3
2A4R33		RESISTOR: MIL Type RC07GF182K	5-3
2A4R34		RESISTOR: MIL Type RC07GF471K	5-3
2A4R35		Same as 2A4R4	5-3
2A4R36		RESISTOR: MIL Type RC07GF104K	5-3
2A4R37		Same as 2A4R26	5-3
2A4R38		RESISTOR: MIL Type RC07GF154K	5-3
2A4R39		Same as 2A4R36	5-3
2A4R40		Same as 2A4R13	5-3
2A4R41		RESISTOR: MIL Type RC07GF223J	5-3
2A4R43		RESISTOR: variable, wirewound, 15 turn, 2K ohms ± 10%, 1/2 watt, mfr. 80294, Part No. 3067P-2K	5-3
2A5		HIGH VOLTAGE - LOW VOLTAGE, ASSEMBLY: printed circuit board with all components assembled for operation; mfr. 80017, dwg. 247027	5-2
2A5C23		CAPACITOR: fixed, electrolytic tantalum, 22 uf ± 20%, 35 VDCW; mfr. 56289, Part No. 150D226X0035R2	5-4
2A5C24		CAPACITOR: fixed, electrolytic tubular, 100 uf -10 +75%, 15 VDCW; mfr. 14655, Part No. NLW-100-15	5-4
2A5C25		Same as 2A5C23	5-4
2A5C26		CAPACITOR: fixed, electrolytic tubular, 200 uf -10 +75%, 3 VDCW; mfr. 14655, Part No. NLW-350-3	5-4
2A5C27		CAPACITOR: fixed, electrolytic tantalum, 3.3 uf ± 10%, 15 VDCW; mfr. 56289, Part No. 150D335X9015A2	5-4
2A5C28		CAPACITOR: fixed, electrolytic tantalum, 0.1 uf ± 20%, 35 VDCW; mfr. 56289, Part No. 150D104X0035A2	5-4
2A5C29		CAPACITOR: fixed, ceramic dielectric, .01 uf ± 20%, 3000 VDCW; mfr. 56289, Part No. 30GA-S10	5-4
2A5C30		Same as 2A5C29	5-4
2A5C31		Same as 2A5C29	5-4
2A5C32		Same as 2A5C29	5-4
2A5C33		Same as 2A5C29	5-4
2A5C34		Same as 2A5C29	5-4
2A5C35		Same as 2A5C29	5-4
2A5CR5		Same as 2A4CR4	5-4
2A5CR6		Same as 2A4CR4	
2A5CR7		SEMICONDUCTOR DEVICE: Diode, general purpose, low power, type 1N4002; mfr. 80211, Part No. 1N4002	5-4
2A5CR8		Same as 2A4CR4	5-4
2A5CR9		Same as 2A5CR7	5-4
2A5CR10		SEMICONDUCTOR DEVICE: Diode, 2 terminal monolithic voltage regulator, 2.7 VDC; mfr. 12040, Part No. LM103-2.7	5-4

TABLE 6-2. MAINTENANCE PARTS LIST (Cont.)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
2A5CR11		SEMICONDUCTOR DEVICE: Diode, silicon rectifier, high voltage, low current; mfr. 80211, Part No. MR-992	5-4
2A5CR12		Same as 2A5CR11	5-4
2A5CR13		Same as 2A5CR11	5-4
2A5CR14		Same as 2A5CR11	5-4
2A5L1		CHOKE: Molded tubular, R.F., 15.0 microhenries ± 20%, 670 milliamp max., iron core; mfr. 99800, Part No. 2150-28	5-4
2A5MP31		COMPONENT BOARD: Printed circuit card, glass epoxy base, tin plated circuit, gold plated fingers, including Ref. No. markings; mfr. 80017, dwg. 247049	5-4
2A5Q12		Same as 2A4Q8	5-4
2A5Q13		SEMICONDUCTOR DEVICE: Transistor, NPN medium power, high voltage Type 2N3417; mfr. 24446, Part No. 2N3417	5-4
2A5R44		RESISTOR: variable, wirewound 15 turn, 5K ohms ± 10%, 1/2 watt; mfr. 80294, Part No. 3067P-5K	5-4
2A5R45		RESISTOR: MIL Type RC07GF153K	5-4
2A5R46		Same as 2A4R16	5-4
2A5R47		Same as 2A4R4	5-4
2A5R42		RESISTOR: MIL Type RC07GF390K	
2A5R49		RESISTOR: Fixed, high voltage composition film, 500 meg.ohms ± 20%, 1 watt, 3K.V.; mfr. 75042, Part No. MUX-1-500MEG	5-4
2A5R50		RESISTOR: MIL Type RC07GF105K	5-4
2A5R51		Same as 2A5R50	5-4
2A5R52		Same as 2A5R50	5-4
2A5T1		TRANSFORMER: pulse, 156 turns primary, 13 turns secondary, 6600 turns tertiary with taps at 400 turns, 800 turns, 1200 turns and 1600 turns, channel frame; mfr. 80017, dwg. 247050	5-4
2A6		CABLE ASSEMBLY, RADIACMETER: Coaxial, interconnecting, contains cable RG-59B/U, Type MHV plug P2, cable grip feed through, and shield termination; mfr. 80017, dwg. 247090	5-2
2A7		ENCLOSURE ASSEMBLY: Aluminum, grey enamel finish, with latches, cable strain relief, and rubber cushion; mfr. 80017, dwg. 247091	5-2
2A7MP27		CUSHION: Rubber, 45 durometer, black; mfr. 80017, dwg. 247066	5-2
2C1		CAPACITOR: Fixed, ceramic dielectric, .0022μf ± 20%, 3000 VDCW; mfr. 56289, Part No. 30GA-D22	5-2
2J3		RECEPTACLE: Bulkhead Type BNC, hermetic seal, rear mounting, 50 ohms impedance, with hardware and O-ring seal, Type AUG-911A/U; mfr. 02660, Part No. 31-237	5-2
2J4		CONNECTOR: Printed circuit edge type, double sided, 24 contacts plus 4 contacts for high voltage; mfr. 80017, dwg. 247028	5-2
2J5		Same as 2J4	5-2
2M1		METER: 3-1/2 dia., 50 microamp ± 2%, 3.2K ohms resistance, scale 0-2 mrem/hr., Batt. check from 33.3 microamps to full scale, per MIL-M-10304C; mfr. 80017, dwg. 247024	5-2
2MP13		CAP: Receptacle, male, silicone liner, weatherproof, Type CW-123A, for BNC; mfr. 02660, Part No. 31-026	5-2
2MP14		GASKET: cover, rubber, 45 durometer black; mfr. 80017, dwg. 247057	5-2

TABLE 6-2. MAINTENANCE PARTS LIST (Cont.)

REF DESIG	NOTES	NAME AND DESCRIPTION	FIG. NO.
2MP15		KNOB: Pointer, black with white arrow indicator, for 1/4 dia. shaft with flat; mfr. 82121, Part No. TB3-74000-2	5-2
2MP16		SEAL, SHAFT: Rotary switch hexseal for 1/4 dia. shaft, 3/8-32 threaded bushing; mfr. 97539, Part No. N-9030 1/4	5-2
2MP17		SEAL, BOOT: Pushbutton hexseal, for 15/32-32 threaded bushing; mfr. 97539, Part No. N-3030	5-2
2MP18		COVER: Aluminum casting, grey enamel finish with black characters; mfr. 80017, dwg. No. 247020	5-2
2MP19		PLATE, IDENTIFICATION: Radiacmeter, aluminum foil, solvent activated adhesive back, silver characters on a black background; mfr. 80017, dwg. No. 247025	5-2
2MP20		SPACER: Connector, 1/4 hex brass, male thread one end, female thread other end; mfr. 80017, dwg. No. 247026	5-2
2MP21		SPACER: Plug-in component boards, 1/4 hex brass, male thread one end, female thread other end; mfr. 80017, dwg. 247030	5-2
2MP22		HANDLE ASSEMBLY, RADIACMETER: Aluminum dip brazed, black anodized hard coat; mfr. 80017, dwg. 247031	5-2
2MP23		SPACER: Plug-in component boards, brass cadmium plate, 5/32 I.D.x 5/16 O.D. x 3/8 long; mfr. 71279, Part No. 1916-2	5-2
2MP24		CLAMP: Wire, adjustable, natural color nylon; mfr. 95987, Type WL725	5-2
2MP25		PLAGE: Connector mounting, aluminum, clear anodize finish, mfr. 80017, dwg. 247064	5-2
2MP26		SUPPORT: Carrying strap, single hole mounting, steel, cadmium plate; mfr. 80017, dwg. 247065	5-2
2MP32		SEELSCREW: No. 4-40x 3/8 Long stainless steel with silicon O-ring seal; Phillips head; mfr. 97539, Part No. R/4-40x3/8	5-2
2MP33		SEELSCREW: No. 10-32 x 1/2 long stainless steel with silicon O-ring seal, Phillips head; mfr. 97539, Part No. R/10-32x1/2	5-2
2MP34		POST: Guard, 1/4 hex brass, male thread one end; mfr. 80017, dwg. 247084	5-2
2MP35		PLATE: Backing for battery box, steel cadmium plate, with (8) No. 4-40 tapped holes; mfr. 80017, dwg. 247087	
2MP36		RING: Locking for pushbutton switch, for 15/32 dia. sleeve, stainless steel; mfr. 04009, Part No. 20590-174	5-2
2R2		Same as 2A5R50	5-2
2R42		RESISTOR: Fixed, metal film, 80.6K ohms ± 1%, 1/4 watt; mfr. 75042, Part No. CEB-80.6K	5-2
2S1		SWITCH: Rotary, 3 pole, 5 position, 2 sections, shorting contacts; mfr. 80017, dwg. 247023	5-2
2S2		SWITCH: Pushbutton, double pole, double throw, normally closed, with solder lugs; mfr. 04009, Part No. 3599-E	5-2
2TP7		TERMINAL: Standoff, alkyd insulated, sub miniature, with No. 2-56 mounting stud; mfr. 08089, Part No. 1426A	5-2

6-5. STOCK NUMBER IDENTIFICATION

Allowance Parts List (APL) issued by the Electronics Supply Office (ESO) include Federal Stock Numbers and Source Maintenance and Recoverability Codes. Therefore, reference should be made to the APL prepared for the equipment for stock numbering information.

TABLE 6-3. LIST OF MANUFACTURERS

MFG CODE	NAME	ADDRESS
00656	Aerovox Corp.	New Bedford, Mass.
02660	Amphenol Corp.	Chicago, Ill.
04009	Arrow-Hart and Hegeman Electric Co.	Hartford, Conn.
08089	United States Engineering Co.	Van Nuys, Calif.
12040	National Semiconductor Corp.	
13715	Fairchild Semiconductor Div. of Fairchild Camera and Instr. Co.	Mountain View, Calif.
13934	Midwec Corp.	Scottsbluff, Nebr.
14655	Cornell-Dubilier Corp.	S. Plainfield, N. J.
24446	General Electric	Syracuse, N. Y.
56289	Sprague Electric Co.	N. Adams, Mass.
71279	Cambridge Thermionic Corp.	Cambridge, Mass.
72699	General Instrument Corp.	Hicksville, L. I., N. Y.
75042	International Resistance Co.	Philadelphia, Pa.
80017	Tracerlab Div. of L.F.E. Inc.	Waltham, Mass.
80211	Motorola, Inc.	Phoenix, Ariz.
80294	Bournes, Inc.	Riverside, Calif.
82121	ElectroSwitch Corp.	Weymouth, Mass.
83330	Herman H. Smith Inc.	Brooklyn, N. Y.
84171	Arco Electronics Inc.	New York, N. Y.
93983	Transitron Inc.	New York, N. Y.
	Reuter Stokes	Cleveland, Ohio
95987	Weckesser Co.	Chicago, Ill.
97539	A.P.M. Hexseal Co.	Englewood, N. J.
99800	Delevan Electronics Corp.	Aurora, N. Y.

Warranty

Canberra (we, us, our) warrants to the customer (you, your) that for a period of ninety (90) days from the date of shipment, software provided by us in connection with equipment manufactured by us shall operate in accordance with applicable specifications when used with equipment manufactured by us and that the media on which the software is provided shall be free from defects. We also warrant that (A) equipment manufactured by us shall be free from defects in materials and workmanship for a period of one (1) year from the date of shipment of such equipment, and (B) services performed by us in connection with such equipment, such as site supervision and installation services relating to the equipment, shall be free from defects for a period of one (1) year from the date of performance of such services.

If defects in materials or workmanship are discovered within the applicable warranty period as set forth above, we shall, at our option and cost, (A) in the case of defective software or equipment, either repair or replace the software or equipment, or (B) in the case of defective services, reperform such services.

LIMITATIONS

EXCEPT AS SET FORTH HEREIN, NO OTHER WARRANTIES OR REMEDIES, WHETHER STATUTORY, WRITTEN, ORAL, EXPRESSED, IMPLIED (INCLUDING WITHOUT LIMITATION, THE WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE) OR OTHERWISE, SHALL APPLY. IN NO EVENT SHALL CANBERRA HAVE ANY LIABILITY FOR ANY SPECIAL, EXEMPLARY, PUNITIVE, INDIRECT OR CONSEQUENTIAL LOSSES OR DAMAGES OF ANY NATURE WHATSOEVER, WHETHER AS A RESULT OF BREACH OF CONTRACT, TORT LIABILITY (INCLUDING NEGLIGENCE), STRICT LIABILITY OR OTHERWISE. REPAIR OR REPLACEMENT OF THE SOFTWARE OR EQUIPMENT DURING THE APPLICABLE WARRANTY PERIOD AT CANBERRA'S COST, OR, IN THE CASE OF DEFECTIVE SERVICES, REPERFORMANCE AT CANBERRA'S COST, IS YOUR SOLE AND EXCLUSIVE REMEDY UNDER THIS WARRANTY.

EXCLUSIONS

Our warranty does not cover damage to equipment which has been altered or modified without our written permission or damage which has been caused by abuse, misuse, accident, neglect or unusual physical or electrical stress, as determined by our Service Personnel.

We are under no obligation to provide warranty service if adjustment or repair is required because of damage caused by other than ordinary use or if the equipment is serviced or repaired, or if an attempt is made to service or repair the equipment, by other than our Service Personnel without our prior approval.

Our warranty does not cover detector damage due to neutrons or heavy charged particles. Failure of beryllium, carbon composite, or polymer windows, or of windowless detectors caused by physical or chemical damage from the environment is not covered by warranty.

We are not responsible for damage sustained in transit. You should examine shipments upon receipt for evidence of damage caused in transit. If damage is found, notify us and the carrier immediately. Keep all packages, materials and documents, including the freight bill, invoice and packing list.

Software License

When purchasing our software, you have purchased a license to use the software, not the software itself. Because title to the software remains with us, you may not sell, distribute or otherwise transfer the software. This license allows you to use the software on only one computer at a time. You must get our written permission for any exception to this limited license.

BACKUP COPIES

Our software is protected by United States Copyright Law and by International Copyright Treaties. You have our express permission to make one archival copy of the software for backup protection. You may not copy our software or any part of it for any other purpose.