NRC INDUSTRIES

RemRad
Radiation Monitoring Systems

REV.B

SM-400
LOW ENERGY
ION CHAMBER SURVEY
METER

OPERATION AND MAINTENANCE
MANUAL

RemRad NRC INDUSTRIES
A MEASURE OF EXCELLENCE

M0058

NUCLEAR RESEARCH CORPORATION
WARRINGTON, PA. 18976 U.S.A.

NUCLEAR RESEARCH CORPORATION
125 Titus Avenue, Warrington, PA 18976 U.S.A. Ph: (215) 343-5900 Fax: -4670
E-mail: support@nuc com • Web: www.nrc-ind.com

REVISION PAGE

REVISION LEVEL	DATE	REVISION BY	ECN NUMBER	APPROVAL
A	9/4/87	J.W.	10794	Sue Prasad
B	12/28/87	J.W.	10996	Sue Prasad

Paragraph

1-1.
1-2.
1-3.
1-4.
1-5.
1-6.
1-7.

2-1.
2-2.

3-1.
3-2.
3-3.

4-1.
4-2.
4-3.
4-4.
4-5.

5-1.
5-2.
5-3.
5-4.
5-5.
5-6.
5-7.
5-8.
5-9.

6-1.
6-2.

7-1.
7-2.

TABLE OF CONTENTS

SECTION I. GENERAL INFORMATION.

Paragraph	Title	Page
1-1.	Introduction.	1-1
1-2.	General Description.	1-1
1-3.	Description of Units.	1-1
1-4.	Reference Data.	1-2
1-5.	Equipment Accessories.	1-2
1-6.	Equipment and Publications Required But Not Supplied.	1-2
1-7.	Field Changes and Factory Changes.	1-2

SECTION II. SPECIAL TOOLS AND TEST EQUIPMENT.

2-1.	Special Tools.	2-1
2-2.	Special Test Equipment.	2-1

SECTION III. INITIAL ISSUE AND RESHIPMENT

3-1.	Unpacking.	3-1
3-2.	Operational Check.	3-1
3-3.	Preparation for Storage or Shipment.	3-1

SECTION IV. OPERATING INSTRUCTIONS.

4-1.	Introduction.	4-1
4-2.	Functional Description.	4-1
4-3.	Preparation For Use.	4-1
4-4.	Operational Check.	4-5
4-5.	Radiation Detection and Measurement.	4-5

SECTION V. MAINTENANCE INSTRUCTIONS.

5-1.	Introduction.	5-1
5-2.	Scheduled Maintenance Action Index.	5-1
5-3.	Operational Checkout and Theory.	5-1
5-4.	Troubleshooting, General.	5-3
5-5.	Troubleshooting Index.	5-4
5-6.	Troubleshooting Procedures.	5-4
5-7.	Repair, General	5-12
5-8.	Repair Procedures.	5-12
5-9.	Adjustment and Calibration.	5-15

SECTION VI. DIAGRAMS.

6-1.	Introduction.	6-1
6-2.	Contents.	6-1

SECTION VII. ILLUSTRATED PARTS BREAKDOWN.

7-1.	Introduction.	7-1
7-2.	Instructions For Use.	7-1

LIST OF TABLES

SECTION I

Table	Title	Page
1-1.	Reference Data.	1-3
1-2.	Equipment, Accessories and Documents Supplied.	1-4

SECTION II

2-1.	Special Test Equipment	2-2

SECTION IV

4-1.	SM-400 Radiation and Energy Level Capabilities.	4-6

SECTION V

5-1.	Frequency of Inspection and Operational Checks.	5-2
5-2.	Maintenance Turn-On Procedure.	5-5
5-3.	Troubleshooting Index.	5-6
5-4.	SM-400 System Troubleshooting Chart.	5-7
5-5.	Meter Circuit Trouble Analysis.	5-9
5-6.	Power Supply Trouble Analysis.	5-10
5-7.	Ion Chamber Assembly Troubleshooting Analysis.	5-11

SECTION VII

7-1.	SM-400 Group Assembly Parts List.	7-2

LIST OF ILLUSTRATIONS

Figure	Title	Page
	SECTION I	
1-1	SM-400 Low Energy Ion Chamber Survey Set	1-0
	SECTION III	
3-1	SM-400 In Carrying Case	3-2
	SECTION IV	
4-1	SM-400 Controls and Indicators	4-2
4-2	SM-400 Overall Functional Block Diagram	4-3
4-3	Battery Installation	4-4
4-4	End Cap Installation and Check Source Operation	4-4
4-5	Gamma and X-Ray Response	4-6
	SECTION V	
5-1	Source Alignment	5-15
	SECTION VI	
6-1	SM-400 Overall Schematic Diagram	6-3
6-2	SM-400 Overall Wiring Diagram	6-5
	SECTION VII	
7-1	Panel Assembly Parts Location	7-6
7-2	Case Assembly Parts Location	7-7
7-3	Ion Chamber Assembly, A2	7-8
7-4	Power Supply P.C. Board, A1	7-9

WARNING

The Cap Cover Assembly of the SM-400 Low Energy Ion Chamber Survey Meter has a Thorium-232 Check Source of 0.03 microcuries. Care should be taken to avoid touching the check source or ingesting items that come in contact with it; DO NOT ATTEMPT TO DETACH THE CHECK SOURCE, TO PREVENT INJURY.

a

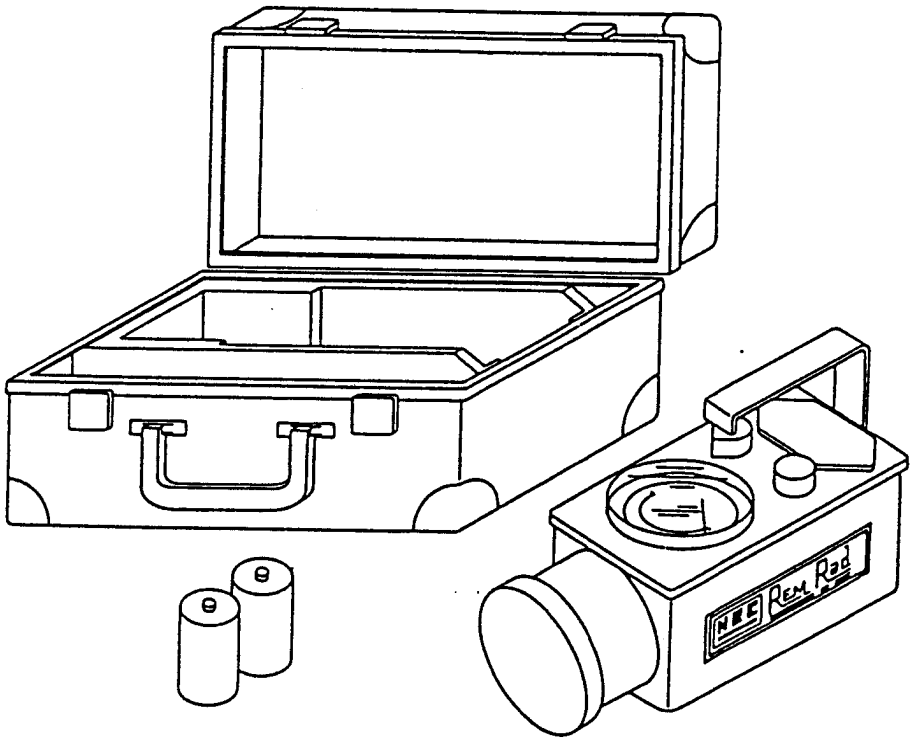


Figure 1-1. SM-400 Low Energy Ion Chamber Survey Set.

(Blank 1-0)

SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION. This technical manual is in effect upon receipt. Extracts of this manual may be made to facilitate the preparation of other Department of Defense documents. This manual applies only to the Low Energy Ion Chamber Survey Meter, SM-400 manufactured under Contract F41608-83-D-0058. This set is identified as the SM-400 throughout this manual.

1-2. GENERAL DESCRIPTION. The SM-400 is a portable, battery-operated radiation survey meter capable of measuring Alpha, Beta, Gamma and X-Ray radiation with energy levels specified in Table 1-1. Refer also to Figure 4-5. which shows the energy response. The type of detector used is an ion chamber with a very thin mylar window which permits detection of low energy radiation. The Ion Chamber is an integral part of the instrument. Power to operate the instrument is supplied by two BA-30 "D" size batteries which can easily be replaced. A ruggedized meter is used to indicate the intensity of radiation. The enclosure is a two-piece aluminum casting. All seams have gaskets to prevent moisture from entering to ensure reliable operation during adverse conditions. IMPORTANT. See CAUTION located at the end of this Section concerning the Ion Chamber.

1-3. DESCRIPTION OF UNITS. The SM-400 set consists of the units shown in Figure 1-1. and listed in Table 1-2.

a. Low Energy Ion Chamber Survey Meter, SM-400. Contains the following major circuits: Ion Chamber and Electrometer Amplifier Circuit, Meter Circuit and Power Supply Circuit. Front panel controls consist of a Selector Switch that has seven positions: the OFF position which removes battery power, the BAT position for checking battery condition and five sensitivity positions of 300, 100, 30, 10 and 3 which are used to select full scale meter sensitivities from 300 mR/hr down to 3 mR/hr. Also on the front panel is a ZERO ADJ control that is used to adjust for zero meter indication when no radiation is present. The SM-400 can be calibrated by removing a front panel screw to gain access to an internal calibration adjust potentiometer. The front panel assembly does not require removal except for corrective maintenance procedures.

b. End Cap Assembly. The End Cap Assembly when installed on the Ion Chamber provides the following functions:

1. Protects the thin mylar window on the Ion Chamber from damage.

2. Prevents Alpha, Beta and Low Energy Gamma and X-Ray radiation from being detected.

3. Permits performance of an operational check. The Th-232 check source, contained in the end cap, can be switched to the OPEN position and provides a meter reading when the Selector Switch is set to the 3 mR/hr position.

c. Carrying Case. The carrying case provides protection for the SM-400 during transit and storage. A compartment is provided for storing the BA-30 batteries and manuals. A carrying handle is provided for convenience.

1-4. REFERENCE DATA. The reference data for the SM-400 is listed in Table 1-1.

1-5. EQUIPMENT ACCESSORIES. Table 1-2. lists the dimensions and weights of all the components of the SM-400.

1-6. EQUIPMENT AND PUBLICATIONS REQUIRED BUT NOT SUPPLIED. None

1-7. FIELD CHANGES AND FACTORY CHANGES. None

CAUTION

The Ion Chamber is sealed against the environmental effects of moisture, dust, body oils and similar contaminants. It is extremely important that caution be exercised to maintain this sealing. With the exception of the Tube Window Assembly (Item 1) and the Grill Assembly (Item 2) sub-assemblies as indicated in Figure 7-3, the Ion Chamber is a non-repairable assembly and requires replacement. Temporary repairs to the mylar window may be made by carefully applying scotch type tape in event of a puncture. Replacement of any or all of the subassemblies above requires prior cleaning of the white collector mount (Item 5) found within the tube assembly, using a small amount of cleaning alcohol. Care must be taken to prevent damage of the black carbon coating within, which can be dissolved by alcohol. Under no circumstances should attempts be made to repair the Electrometer Amplifier (Item 6, Figure 7-3); the plate covering the Amplifier (Item 7, Figure 7-3) must not be removed.

Table 1-1. Reference Data

ITEM	DESCRIPTION
Nameplate Data	
Radiation Survey Set	Low Energy Ion Chamber Survey Set, SM-400 Supply: Internal Batteries Consists of: Low Energy Ion Chamber Survey Meter, SM-400, End Cap Assembly and Carrying Case.
Radiation Survey Meter	Low Energy Ion Chamber Survey Meter, SM-400 Supply: Internal Batteries.
Dimensions and Weights	See Table 1-2
Operating Temperature	-40°C to +60°C
Power Requirements	2 Each internal BA-30, 1.5 Volts, "D" Cells. Battery life greater than 100 hours when operated four hours a day.
Accuracy	± 10% of true dose at mid-spectral response
Range Indication	Meter type indication provided on five ranges: 300 mR/hr, 100 mR/hr, 30 mR/hr, 10 mR/hr and 3 mR/hr.
Energy Range	With End Cap removed from Ion Chamber: Alpha - Greater than 4 MeV Beta - Greater than 100 keV Gamma & X-Ray - 6.5 keV to 1.3 MeV With End Cap installed on Ion Chamber: Gamma & X-Ray only - 30 keV to 1.3 MeV
Battery Check	Meter indication of battery condition provided.
Check Source Data (Part of End Cap Assembly)	Thorium 232, 0.03 Microcuries.

Table 1-2. Equipment, Accessories, and Documents Supplied.

QTY.	NAME	NOMENCLATURE DESIGNATION	OVERALL DIMENSIONS (Inches)			WEIGHT (lbs.)	VOLUME	
			HEIGHT	WIDTH	DEPTH		(cu.in.)	(cu.ft.)
1	Radiation Survey Meter (with batteries)	SM-400 (Commercial)	7	4.5	10	5	315	0.18
1	Case, Carrying	Case, SM-400 (Commercial)	8	7.5	14	2.5	840	0.49
1	End Cap Assembly, includes Check Source (Th-232)	End Cap SM-400 (Commercial)	0.875	3.5	-	0.125	8.42	0.005

SECTION II

SPECIAL TOOLS AND TEST EQUIPMENT

2-1. SPECIAL TOOLS. There are no special tools required to operate, maintain or disassemble the SM-400. A "pencil" soldering iron will be useful as will be solder wick for component removal. Care should be taken when soldering to apply minimum heat and to avoid burning nearby leads and components. A heat sink (such as long nose pliers, alligator clips, etc.) is required when soldering semiconductors. Disturb lead dressing as little as possible. Take care to keep foreign particles (dust, smoke, metal filings, solder, etc.) out of the radiacmeter during repair.

WARNING

Area where soldering is being accomplished should be well ventilated to prevent breathing of harmful fumes.

2-2. SPECIAL TEST EQUIPMENT. Although any normally equipped repair and calibration depot would have sufficient electronic instrumentation, particular models or styles would facilitate electronic troubleshooting and repair. Table 2-1. lists a grouping of some of the preferred test equipment. Only one of each category is needed. The stock listed item shown in the respective block is the AF equivalent test equipment.

NOTE

The low level Th-232 check source that is part of the end cap assembly is intended to be used as an operational check only. A known source of Gamma radiation such as derived from an AN/UDM or D0062 Calibrator is required to calibrate the instrument.

Table 2-1. Special Test Equipment

NAME	MFR/MODEL NO.	NATIONAL STOCK NUMBER	USE
Multimeter	Simpson 269 or similar	None	General Troubleshooting
Oscilloscope	Tektronix 465/USM425	6625-01-032-6914	Power Supply Waveforms
Radiac Calibrator	UDM-1, UDM-1A or D0062	6665-00-669-0077, 6665-00-556-8825, or 6665-00-819-6606	Radioactive Source for Calibration

SECTION III

INITIAL ISSUE AND RESHIPMENT

3-1. UNPACKING. When unpacking the SM-400, shown in its case in Figure 3-1, perform the following steps:

NOTE

If the SM-400 is shipped in a corrugated carton, complete only Steps 4 through 7.

STEP 1. Cut the two metal bands from the wooden shipping crate.

STEP 2. Pull out the nails securing the top cover and remove the cover.

STEP 3. Lift out the inner package.

STEP 4. Remove the outer corrugated carton.

STEP 5. Remove the foil bag and inner corrugated carton.

STEP 6. Remove the SM-400.

STEP 7. Open the carrying case and remove corrugated filler and wadding.

3-2. OPERATIONAL CHECK. Perform an operational check as outlined in Section IV.

3-3. PREPARATION FOR STORAGE OR SHIPMENT.

a. If instrument is placed in long-term storage or is being shipped, ensure the following:

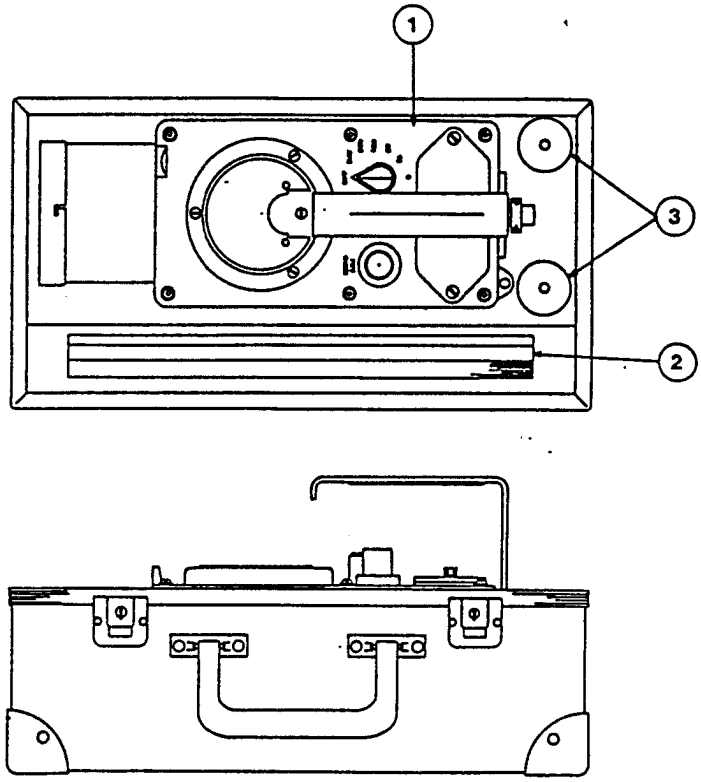
STEP 1. The SM-400 is turned off and all batteries are removed.

STEP 2. SM-400 is properly stored in case.

STEP 3. Carrying Case is closed and secured.

b. If instrument is placed in short-term storage (without batteries installed), batteries will be placed in plastic bag and will be taped to the outside of the carrying case or stored inside the carrying case. Batteries may be stored under refrigeration and are not required to be placed in plastic bags while being

stored in this manner. Batteries that have been stored under refrigeration should be allowed to reach ambient temperature before being used to power the SM-400, to assure maximum battery life.



1. SURVEY METER
2. TECHNICAL MANUAL(S)
3. BATTERY (BA-30)

Figure 3-1. SM-400 In Carrying Case.

SECTION IV

OPERATING INSTRUCTIONS

4-1. INTRODUCTION. This section contains the functional description and instructions for preparing the unit for use, checking operation and performing radiation measurements. Figure 4-1. shows the controls and indicators.

4-2. FUNCTIONAL DESCRIPTION. Refer to Figure 4-2. which shows the overall functional block diagram. Radiation entering the Ion Chamber will cause collection current to flow that is proportional to the intensity of radiation. The collection current is amplified by the electrometer amplifier circuit so that it is of sufficient amplitude to provide current to the meter, permitting the meter to be calibrated to indicate the amount of radiation that is being detected. The necessary voltages to operate the Ion Chamber and the Electrometer are obtained from the output of a regulated DC/DC converter that receives its input power from two BA-30, 1.5 V batteries that are connected in series. Theory of operation of the individual functional sections is contained in Paragraph 5-3.

4-3. PREPARATION FOR USE.

STEP 1. Open carrying case.

STEP 2. Remove Survey Meter from case.

STEP 3. Loosen battery cover screws, remove battery cover and insert batteries (2- BA-30, 1.5 Volt "D" Cell). Observe polarity markings on the top of the panel under the battery cover (See Figure 4-3.).

CAUTION

When operating the SM-400 without the protective cover, do not touch the mylar window or allow the window to come into contact with sharp objects. Damage to the mylar window may cause the SM-400 to be inoperative.

NOTE

Battery life will be considerably increased if the SM-400 Selector Switch is placed in the "OFF" position except when being used to check operation or perform radiation measurements, however, a two minute warmup is suggested prior to use.

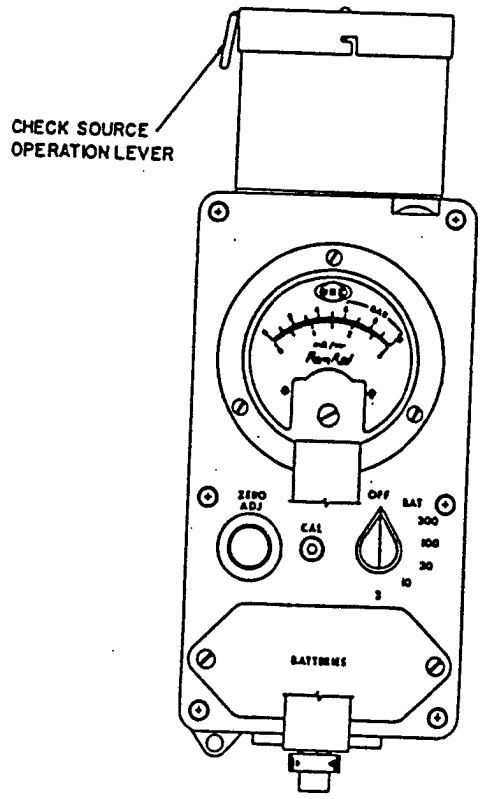


Figure 4-1. SM-400 Controls and Indicators.

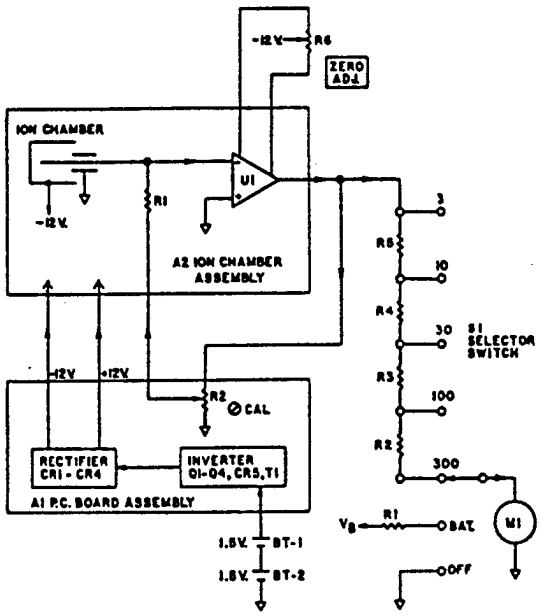


Figure 4-2. SM-400 Overall Functional Block Diagram

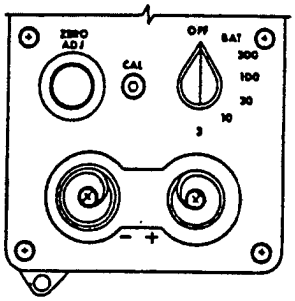


Figure 4-3. Battery Installation

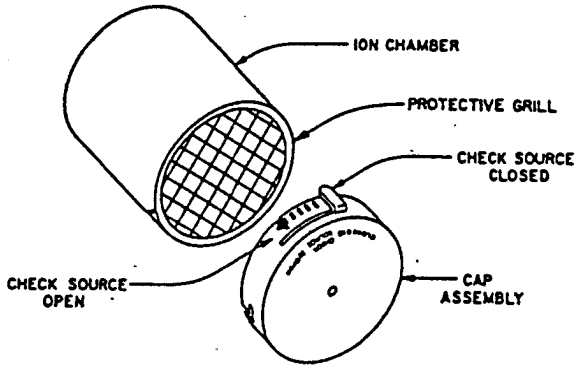


Figure 4-4. End Cap Installation and Check Source Operation.

4-4. OPERATIONAL CHECK. The operational check to be performed includes battery check, zero adjust check and radiation measurement check and is accomplished with the following procedures:

a. Battery Check. Rotate the Selector Switch to the BAT position; if the meter indicates below minimum reading, replace the batteries by following the procedure described in Paragraph 4-3., Step 3.

b. Zero Adjust. Place the SM-400 in an area free of radiation. Set the Selector Switch to the 300 mR/hr position, place the check source in CLOSED position (Figure 4-4.), wait at least two minutes for warm up, rotate the Selector Switch clockwise, pausing momentarily at each step for the meter transient to subside. Observe if zero meter reading is obtained on each step. If the meter does not indicate between 0 and 0.2 mR/hr on the 3 mR/hr range, unlock the ZERO ADJ Control and adjust for a reading between 0 and 0.2 mR/hr. After adjustment is complete, lock the control.

NOTE

Occasional upscale meter indications of 3 to 4 small divisions on the 3 mR/hr range may be ignored. These are due to natural Alpha particles in the detector material.

c. Radiation Measurement Check. The Th-232 check source that is part of the End Cap Assembly provides a convenient method of checking the overall operation of the SM-400. With the Selector Switch set to the 3 position (or the 10 position if reading is greater than 3mR/hr), the meter indication must increase between 0.5 mR/hr and 5 mR/hr when the check source is placed in the OPEN position (Figure 4-4). Recalibration as described in Paragraph 5-9 must be performed if this requirement is not met.

CAUTION

Place the check source in the CLOSED position before performing radiation measurements to prevent incorrect readings.

The SM-400 is now ready for use if all of the above requirements have been met.

4-5. RADIATION DETECTION AND MEASUREMENT. Refer to Table 4-1 and Figure 4-5., to determine the types and energy level of radiation that can be measured and whether the End Cap Assembly must be removed. The End Cap should be left on the Ion Chamber to provide protection for the mylar window, except when measuring Alpha, Beta or low energy Gamma and X-Ray radiation.

The procedure to detect and measure radiation is as follows: Place the Selector Switch in the 300 position; if the meter indicates less than 20% of full scale, rotate the selector switch clockwise, momentarily pausing at each step for the meter transient to subside, until the meter indicates less than 100% of full scale.

CAUTION

Do not touch the mylar window or allow sharp objects to come into contact with the mylar window. Damage to the window could cause the SM-400 to become inoperative.

Table 4-1. SM-400 Radiation and Energy Level Capabilities.

TYPE OF RADIATION	ENERGY LEVEL	END CAP
Alpha	Above 4 MeV	Removed
Beta	Above 100 keV	Removed
Gamma and X-Ray	6.5 keV to 1.3 MeV (Below 30 keV, Grill Assembly must also be removed)	Removed
(See Figure 4-5. for response curve)	30 keV to 1.3 MeV	Installed

NOTE: Alpha and Beta radiation will not be detected with End Cap installed.

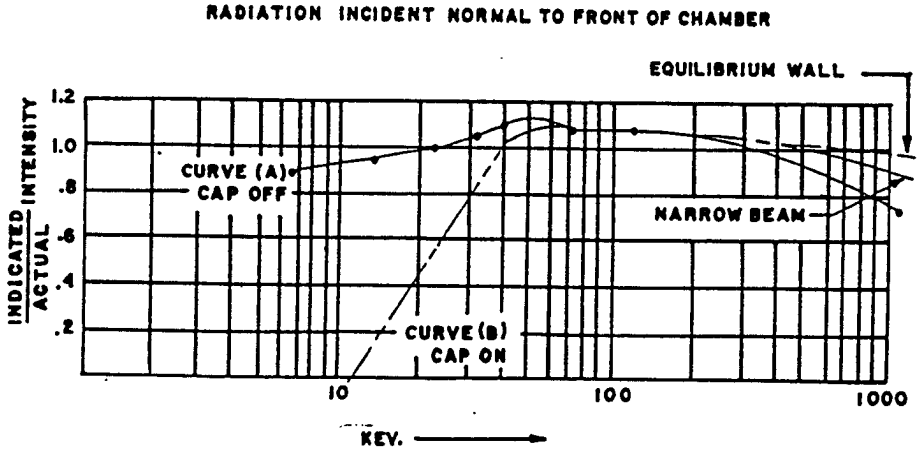


Figure 4-5. Gamma and X-Ray Energy Response.

NOTE

The Ion Chamber Window can be placed in closer proximity to the radioactive source by removing the protective grill assembly. This procedure should be used only when it is required to measure radiation from a weak source. Removal of the protective grill assembly is accomplished by removing the two screws on the end of the Ion Chamber and carefully pulling the protective grill assembly out of the Ion Chamber. The mylar window is completely unprotected when the protective grill assembly is removed and extreme care must be exercised to prevent damage to the window. Refer to Figure 4-4 which shows the location of the protective grill assembly.

SECTION V

MAINTENANCE INSTRUCTIONS

5-1. INTRODUCTION. Scheduled maintenance is that maintenance required to be performed on the equipment at regular scheduled intervals whether or not the equipment is in use. The purpose of scheduled or preventive maintenance is to keep the equipment in good working order and to insure proper performance when the equipment is needed.

5-2. SCHEDULED MAINTENANCE ACTION INDEX. The maintenance checks and procedures of Table 5-1. shall be performed at the intervals indicated unless the intervals are modified by the MAJCOM.

5-3. OPERATIONAL CHECKOUT AND THEORY. The operational checkout described in Paragraph 4-4. will check all functional sections for proper operation. The theory of operation of each of the individual functional sections is provided in this paragraph. Reference should be made to Figure 6-1., Overall Schematic Diagram.

a. Ion Chamber. Due to ionization, radiation entering the Ion Chamber will cause a collection current to flow that is proportional to the intensity of radiation. The dimensions of the SM-400 Ion Chamber are such that a collection current of .085 pA will flow when the intensity of radiation is 3 mR/hr. The very thin mylar window on the front of the chamber will permit Alpha, Beta and low energy Gamma and X-Ray radiation to be detected. High energy Gamma and X-Ray radiation can enter through the wall of the chamber and also through the window. The operating voltage of the Ion Chamber is -12 V, which is above the saturation level, so moderate changes in voltage will not affect accuracy.

b. Electrometer Amplifier. The Electrometer Amplifier receives its input from the Ion Chamber and is used to provide the current gain necessary to drive the meter circuit. Operational Amplifier, U1 is connected as an inverting amplifier. Resistor, R1 is connected as the feedback resistor providing a sensitivity of 1V/pA to 2V/pA depending on the setting of Potentiometer, R2 which is the CAL control.

Offset voltage is adjusted for zero by Potentiometer, R6 which is the front panel ZERO ADJ control. Capacitor, C1 limits the frequency response so that random current pulses will not cause excessive output voltage fluctuations.

c. Meter Circuit. The meter circuit receives its input from the electrometer amplifier when the Selector Switch, S1 is set to any of the five radiation measuring ranges. The full scale reading on Meter, M1 is determined by Resistors R2 through R5 which are selected by the Selector Switch. When the Selector Switch is set at the BAT position, Resistor R1 is selected and Meter M1 will indicate battery condition. When the Selector Switch is in the OFF position, the meter terminals are shorted together to protect the meter.

Table 5-1. Frequency of Inspection and Operational Checks.

WHAT TO CHECK	WHEN TO CHECK	HOW TO CHECK	PRECAUTIONS
Batteries and Battery Compartment (with Batteries installed)	14 Days	Inspect Batteries for leaks or swelling. Clean battery compartment with solution of baking soda (Sodium Bicarbonate) and water when corrosion is discovered.	Battery compartment must be thoroughly dry before installing batteries. Insure range switch is turned off before storing instrument.
Batteries and Battery Compartment (without Batteries installed)	28 Days		
Exterior Instrument Surface	28 Days	Wipe with clean, dry cloth to remove all dirt and dust.	None
Operational Check (stored with batteries installed)	14 Days	Perform operational check as outlined in Section IV, Paragraphs 4-3 and 4-4.	
Operational Check (stored without batteries installed)	28 Days		

d. Power Supply. The power supply circuit is located on P. C. Board Assembly, A1 and receives its power input from two BA-30, 1.5 V batteries that are connected in series. The output of the DC/DC converter provides the regulated +12V and -12V required for the operation of the Ion Chamber and the Electrometer Amplifier. The battery voltage is converted to a.c. by a Transformer coupled Oscillator. Battery voltage is applied to the primary winding of Transformer, T1 when Transistor, Q1 is conducting. Energy stored in the primary winding is released when Transistor, Q1 is not conducting. The positive feedback obtained from the feedback winding of Transformer, T1 causes Transistor, Q1 to be turned off and on, and sustains oscillation. Since the energy from the primary of T1 is rapidly released, the voltage appearing on the inputs of the voltage doubler circuits consisting of Diodes, CR1 through CR4 and Capacitors, C1 through C4, will be higher than the battery voltage and of opposite polarity. The d.c. output voltage of a voltage doubler is equal to the peak-to-peak a.c. voltage applied to its input. Regulation is accomplished by applying a portion of the negative voltage output to the non-inverting input of a voltage comparator consisting of Transistors, Q2 and Q4. The inverting input of the voltage comparator is connected to a voltage reference which is Zener Diode, CR5. When the negative voltage output exceeds -12V, the output of the voltage comparator will go negative, causing the oscillator to stop by turning off the Feedback Control Transistor, Q3. Transistor, Q3 will turn back on when the negative voltage output is less than -12V.

5-4. TROUBLESHOOTING, GENERAL. Troubleshooting of the SM-400 will be easier if an orderly procedure is used. Procedures in this section are intended to help localize trouble in defective components quickly.

a. Symptom Recognition. This is the first step in troubleshooting procedure and is based on a complete knowledge and understanding of equipment operating characteristics. All equipment troubles are not the direct result of component failure. Therefore, 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. See Table 5-1 for Maintenance Turn-On Procedures.

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

c. Listing Probable Faulty Function. The next step in logical troubleshooting 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. See Figure 4-2., Paragraph 4-2., and Paragraph 5-3.

5-5. TROUBLESHOOTING INDEX. The troubleshooting index for the SM-400 is shown in Table 5-3.

5-6. TROUBLESHOOTING PROCEDURES.

a. Preliminary Check - General. Before proceeding with any electrical tests, the following mechanical inspection procedure should be followed:

1. The instrument housing should be examined for any mechanical damage.

2. The range switch should be turned to its various positions to see that the switch knob and meter scales index properly.

3. The meter should be examined. Observe the meter needle to see that it is not bent. Observe whether the needle is mechanically zeroed. Meter zeroing may be accomplished by turning the meter zero adjusting screw located on the front of M1.

4. The battery cover should be removed, and the battery contacts inspected for cleanliness. Check to ensure that the batteries have been properly installed and that the battery condition (BAT) on selector switch indicates satisfactorily.

5. The instrument housing should now be opened by loosening the six captive screws holding the housing and cover together. Visually examine the internal assembly.

6. Turn the Selector Switch, S1 and observe the operation of the switch to see that it appears to be working satisfactorily.

Any troubles found in the above steps should be corrected before proceeding any further. The instrument should be prepared for operation and the procedure followed as indicated in Table 5-2. References should be made to Figure 6-2 and Figure 5-4.

b. Troubleshooting. Refer to the Troubleshooting Index, Table 5-3. which provides references to which step or steps of System Troubleshooting Table 5-4. are required to locate the trouble. Performance of all of the steps contained in Table 5-4. will assure complete checkout of the SM-400. The steps should be performed in the sequence listed. References are provided in Table 5-4 to Troubleshooting Charts 5-5, 5-6 and 5-7 for the individual functional sections. The Schematic Diagram, Figure 6-1. shows voltages and waveforms.

Table 5-2. Maintenance Turn-On Procedure.

STEP	OBSERVE	REFERENCE
1. Preliminary Procedure		
a. Examine instrument case for mechanical damage.		
b. Turn Selector Switch to its various positions.	Proper switch indexing.	Paragraph 4-4,b.
c. Examine meter.	If meter needle is bent.	(Turn in to PMEL.)
	If meter mechanical zero is not properly set.	(Rotate Meter Adjust Screw to obtain Zero Reading).
d. Remove battery cover.	Cleanliness of battery contacts. Proper installation of batteries.	Table 5-1
2. Set Selector Switch in BAT position, place check source in CLOSED position.	Meter should indicate within the area marked BATTERY.	Paragraph 4-4,a.
3. Set Selector Switch in 300 position.	Meter should indicate zero.	Paragraph 4-4,b.
4. Set Selector Switch in 100 position.	Meter should indicate zero.	Paragraph 4-4,b.
5. Set Selector Switch in 30 position.	Meter should indicate zero.	Paragraph 4-4,b.
6. Set Selector Switch in 10 position.	Meter should indicate zero.	Paragraph 4-4,b.
7. Set Selector Switch in 3 position.	Meter should indicate between 0 and 0.2 mR/hr.	Paragraph 4-4,b.
8. Place check source in OPEN position. Selector Switch in 3 position.	Meter should indicate between 0.5 mR/hr and 3 mR/hr.	Paragraph 4-4,c.

Table 5-3. Troubleshooting Index

FUNCTIONAL AREA	TROUBLESHOOTING PARAGRAPH	TROUBLESHOOTING TABLE	FUNCTIONAL DESCRIPTION PARAGRAPH
Overall	5-6.	5-4.	4-2.
Meter Circuit	5-6,b.	5-5.	5-3,c.
Power Supply	5-6,b.	5-6.	5-3,d.
Ion Chamber Assembly	5-6,b.	5-7.	5-3,a,b.

Table 5-4. SM-400 System Troubleshooting Chart

STEP	TEST POINT FIGURES	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
1		Set Selector Switch in BAT position.	Meter should indicate within the area marked BATTERY.	Replace batteries if they do not check good. If there is no meter indication and the batteries are known to be good, check M1, S1 and the applicable circuitry to and from S1. Refer to Table 5-5.
2		Set Selector Switch in 300 position.	Meter should indicate zero.	Observe whether indication is correct, and then go to Step 3.
3		Set Selector Switch in 100 position.	Meter should indicate zero.	Observe whether indication is correct and then go to Step 4.
4		Set Selector Switch in 30 position.	Meter should indicate zero.	Observe whether indication is correct, and then go to Step 5.
5		Set Selector Switch in 10 position.	Meter should indicate zero.	Observe whether indication is correct and then go to Step 6.

Table 5-4. SM-400 System Troubleshooting Chart (Continued)

STEP	TEST POINT FIGURES	PRELIMINARY ACTION	NORMAL INDICATION	NEXT STEP
6		Set Selector Switch in 3 position.	Meter should indicate between 0 and 0.2 mR/hr, adjust front panel ZERO ADJ if necessary.	If correct, go to Step 7; if unable to zero meter, go to Step 8.
7		Install End Cap Assembly on Ion Chamber, place check source lever in OPEN position.	Meter should indicate between 0.5 mR/hr and 3 mR/hr with the Selector Switch set to the "3" position.	If Radiacmeter responds, the unit may just require calibration. If unit fails to respond, then perform Steps 8 through 10.
8	(1) on P.C. Board Assy. A1 (6-6.)	Connect common lead of d.c. Voltmeter or Multimeter to the negative battery terminal, connect other lead to TP-1.	+12V ± 10% d.c. reading on Voltmeter or Multimeter.	Observe reading, go to Step 9.
9	(2) on P. C. Board Assy. A1 (6-6.)	Connect common lead of d.c. Voltmeter or Multimeter to negative battery terminal, connect other lead to TP-2.	-12V ± 10% d.c.	If correct reading is obtained in Steps 8 and 9, go to Step 10. If readings are incorrect, refer to Power Supply Troubleshooting Chart, Table 5-6.
10		Install End Cap Assembly on Ion Chamber, place check source lever in OPEN position as in Step 7.	Meter should indicate at least 0.5 mR/hr with the Selector Switch in the "3" position.	If reading is obtained, just calibration may be required. If no reading is obtained, go to Table 5-5.

Table 5-5. Meter Circuit Trouble Analysis.

STEP	TEST POINT (FIGURE)	TEST EQUIPMENT	CONDITIONS	NORMAL INDICATION		IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
1	+Battery Terminal to +Meter, M1 terminal (6-3.)	Multimeter or Ohmmeter	Remove batteries from SM-400. Selector Switch in BAT position.	68.1 K ohms ± 5%		Battery Check Circuit satisfactory.	Check Selector Switch, S1 and Resistor R1 located on Selector Switch, S1.
2	J1, Pin 5 to + Meter M1 terminal (6-3).	Same as Step 1.	Batteries removed from SM-400. Selector Switch rotated to positions shown.	Switch Setting	Resistance + 5%	Go to Step 3.	Selector Switch, S1
				3	Contin.		Resistor, R5
				10	4.02K		Resistor, R4
				30	15.52 K		Resistor, R3
				100	55.72 K		Resistor, R2
				300	168.72K		Resistors R2 through R5 are located on Selector Switch, S1.
							Go to Step 3.
3	None	None	Install batteries in SM-400. Place Selector Switch in BAT position.	Meter indicates in BAT range with good batteries installed.		Meter circuit is functioning properly.	If normal indications were obtained in Steps 1 and 2, Meter M1 is defective.

Table 5-6. Power Supply Circuit Trouble Analysis.

STEP	TEST POINT (FIGURE)	TEST EQUIPMENT	RADIACMETER CONTROLS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
1	(1) (6-6.)	Multimeter or d.c. Voltmeter.	Selector Switch in BAT position.	+12V ± 1.2 V d.c.	Proceed to Step 2.	Proceed to Step 2.
2	(2) (6-6.)	Same as Step 1.	Same as Step 1.	-12V ± 1.2V d.c.	Power Supply satisfactory if indication is normal in Steps 1 and 2.	Proceed to Step
3	(3) (6-6.)	Same as Step 1.	Same as Step 1.	0.7 V ± 30%	Power Supply satisfactory if +12V at 1 is also correct.	Check Transistors Q1, Q2, Q3 and Q4. Go to Step 4.
4	Transformer T1: Term. 2 (6-6.)	Oscilloscope	Same as Step 1	Waveform Amplitude 12 V (+10%) (See Figure 6-1. which shows waveform.)	Proceed to Step 5, if indication at Step 1 was abnormal.	Check Capacitors C2, C4, C5, C6, Diodes CR3, CR4, CR5 and Transformer T1.
5	(1)	Same as Step 1.	Same as Step 1.	+ 12V d.c. ± 1.2 V.	Power Supply functioning properly.	Check Diodes CR1 and CR2, Capacitors C1 and C3.

Connect common lead to Negative Battery Terminal.

Table 5-7. Ion Chamber Assembly Troubleshooting Analysis.

STEP	CONDITIONS	PROCEDURE	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
1	1. Meter Circuit and Power Supply must be operating properly. 2. End Cap installed with check source in CLOSED position. 3. Selector Switch in 3 mR/hr position. 4. Locate unit in area free of radiation	Unlock ZERO ADJ. Control. Rotate ZERO ADJ. Control to change reading on Meter M1.	Rotating ZERO ADJ. Control must be capable of providing a reading of from 0 and 0.2 mR/hr on Meter M1. (Occasional upswings of the Meter caused by background radiation should be ignored. Refer also to Note in Para. 4-4b).	Proceed to Step 2.	FIRST: 1. Reconfirm troubleshooting steps in Tables 5-4 thru 5-6. 2. Accomplish Step 1 again. SECOND: 1. If still abnormal, replace Ion Chamber Assembly. 2. If Normal, go to Step 2.
2	Same as Step 1, except source is in OPEN position.		Meter indicates at least 0.5 mR/hr., higher than when source was in CLOSED position.	Calibrate unit if any disassembly or repair was accomplished during troubleshooting	Return unit for higher level maintenance.

5-7. REPAIR, GENERAL. The SM-400 has been designed for ease of maintenance and repair. The troubleshooting procedures described in Paragraph 5.6 must be followed to determine the cause of the trouble, rather than unnecessary replacement of components that could cause additional problems. All internal components must be clean and free of moisture to ensure accurate and reliable radiation measurements. Refer to Paragraph 5-8 for assembly and component replacement instructions. Problems caused by components located in the Ion Chamber Assembly, A2, must be corrected by replacement of the entire assembly. The caution stated in Section I applies and is repeated here for convenience.

CAUTION

The Ion Chamber is sealed against the environmental effects of moisture, dust, body oils and similar contaminants. It is extremely important that caution be exercised to maintain this sealing. With the exception of the Tube Window Assembly (Item 1) and the Grill Assembly (Item 2) sub-assemblies as indicated in Figure 7-3, the Ion Chamber is a non-repairable assembly and requires replacement. Temporary repairs to the mylar window may be made by carefully applying scotch type tape in event of a puncture. Replacement of any or all of the subassemblies above requires prior cleaning of the white collector mount (Item 5) found within the tube assembly, using a small amount of cleaning alcohol. Care must be taken to prevent damage of the black carbon coating within, which can be dissolved by alcohol. Under no circumstances should attempts be made to repair the Electrometer Amplifier (Item 6, Figure 7-3); the plate covering the Amplifier (Item 7, Fig. 7-3) must not be removed.

5-8. REPAIR PROCEDURES.

a. Ion Chamber Replacement (A2MP-1). (See Figure 7-3)

1. Remove four 2-56 screws holding the Ion Chamber housing to the base plate, and pry loose carefully.

2. Use reverse procedure to re-install or replace the Ion Chamber. Be sure grounding strap that connects between the Ion Chamber and case is in place as shown in Figure 7-2, Item 9.

CAUTION

Install End Cap Assembly on Ion Chamber to prevent possible damage during replacement procedure.

b. Ion Chamber Assembly, A2, Replacement. (See Figure 7-3)

1. Loosen six captive screws on the top of the front panel and lift panel out.

2. Separate Connectors J1 and J2.

3. Remove four nuts and associated hardware that are located inside the housing assembly that holds the Ion Chamber in place, remove the Ion Chamber Assembly from the housing.

4. To re-install or replace Ion Chamber Assembly, use reverse procedure.

c. Electrometer Amplifier (A2A1) Component Access. (See Figure 7-3)

1. This is a non-repairable component (See Para. 5-7).

2. The four screws and associated hardware that hold the access plate in place should never be loosened or removed. They should be checked periodically for tightness.

d. Printed Circuit Board Replacement (1A1).

1. Remove top panel as described in b., Step 1.

2. Separate Connectors J1 and J2.

3. Remove the two nuts, two screws and associated hardware that secures P. C. Board.

4. Remove the printed circuit board.

5. Replace with new (or repaired) printed circuit board.

6. Replace the two nuts, two screws and associated hardware that secures the P. C. Board.

7. Connect Connectors J1 and J2.

8. Replace panel, ensuring all wiring is contained inside case and tighten six captive screws that secure the front panel.

NOTE

To facilitate troubleshooting, battery voltage is supplied to P. C. Board A1 when the battery terminal nuts are removed and the assembly is lifted from the battery terminals. This feature is provided by direct wiring between the battery terminals and the Selector Switch.

e. Selector Switch (S1) Replacement. (Figure 7-1., Item 1)

1. Remove top panel as described in b., Step 1.

2. Separate Connectors J1 and J2.

3. Unsolder two meter wires. Note polarity.

4. Loosen knob screw and remove knob using 0.050 allen wrench.

5. Unscrew the 3/8-32 hex nut mounting, the switch bushing and remove switch assembly.

6. Replace switch assembly using reverse procedure.

f. Meter (M-1) Replacement. (Figure 7-1, Item 22)

1. Remove top panel as described in b., Step 1.

2. Unsolder two meter wires. Note polarity.

3. Remove three screws and associated hardware that hold meter, remove meter.

4. Replace meter using reverse procedure.

g. Zero Potentiometer (R1) Replacement. (Figure 7-1, Item 2)

1. Remove top panel as described in b., Step 1.

2. Unsolder wires, noting color coding and location on terminals.

3. Loosen knob using 0.050 inch allen wrench.

4. Unscrew 3/8-32 hex nut on switch bushing, removing locking assembly and potentiometer from panel.

5. Replace Potentiometer by using reverse procedure.

5-9. ADJUSTMENT AND CALIBRATION.

WARNING

Calibration of the SM-400 may be undertaken only at an authorized Radiac repair facility by qualified technicians since the radioactive sources required for calibration can be hazardous to personnel.

a. General. The SM-400 is calibrated at time of manufacture. Recalibration is required after maintenance has been performed, and otherwise at a minimum of every six (6) months. Component replacement can affect calibration.

b. Equipment Required For Calibration. Radiac Calibrators UDM-1, UDM-1A, D0062 or any calibrated Cesium-137, Cobalt-60 or Radium-226 Gamma source is sufficient for complete equipment calibration.

1. Calibration equipment should be set up as shown in the figure below, so that the source is perpendicular to the center of the chamber axis and at the same level as the chamber center. The source activity should allow desired readings at a minimum distance of 36 inches.

2. A small screwdriver and a #10 allen wrench are required.

c. Zero Adjust - R1. Prior to calibration and in a radiation free area, unlock the ZERO ADJ CONTROL and adjust for a reading of 0 to 0.2 mR/hr on the 3 mR/hr range using procedure described in Paragraph 4-4b.

d. Calibration Adjust A1R6.

1. With end cap in place, check source in CLOSED position and range switch on 30 mR/hr range, place SM-400 Ion Chamber in a 20 mR/hr Gamma field. If unit reads between 18 and 22 mR/hr, no adjustment is necessary; otherwise, potentiometer A1R6 should be adjusted.

2. Using a small #10 allen wrench, remove screw from position on top of panel marked "CAL" and adjust Potentiometer, A1R6, through the calibration access hole for correct reading. Clockwise rotation of Potentiometer A1R6 causes an upscale reading, counter clockwise gives a downscale reading.

3. Check the other ranges at 2/3 of full scale in appropriate radiation fields, For example, the 0 to 3 range is checked at 2 mR/hr, the 0 to 10 range at 6.6 mR/hr, the 100 range at 66 mR/hr and the 0 to 300 range at 200 mR/hr. Reading should be within ±10% of full scale markings.

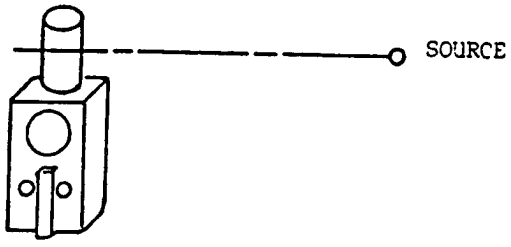


Figure 5-1. Source Alignment.

SECTION VI

DIAGRAMS

6-1. INTRODUCTION. This Section contains the overall schematic and the wiring diagram that are referred to in other Sections of this Manual.

6-2. CONTENTS:

a. SM-400 Overall Schematic (Figure 6-1). The complete schematic of the SM-400, including voltages and waveforms necessary for troubleshooting is provided in Figure 6-1.

b. SM-400 Overall Wiring Diagram (Figure 6-2). Shows the complete wiring diagram showing interconnection of assemblies and components.

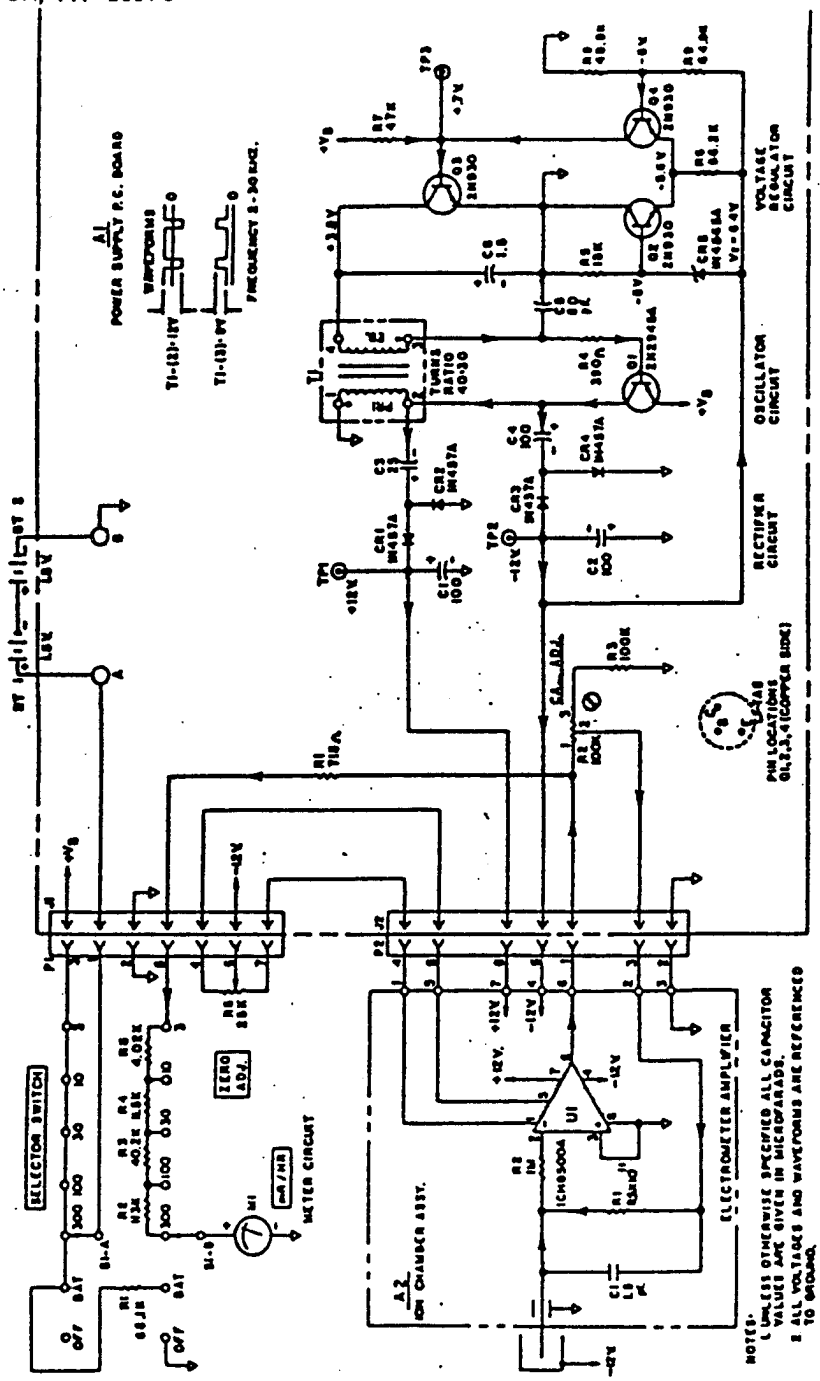


Figure 6-1. SM-400 Overall Schematic Diagram

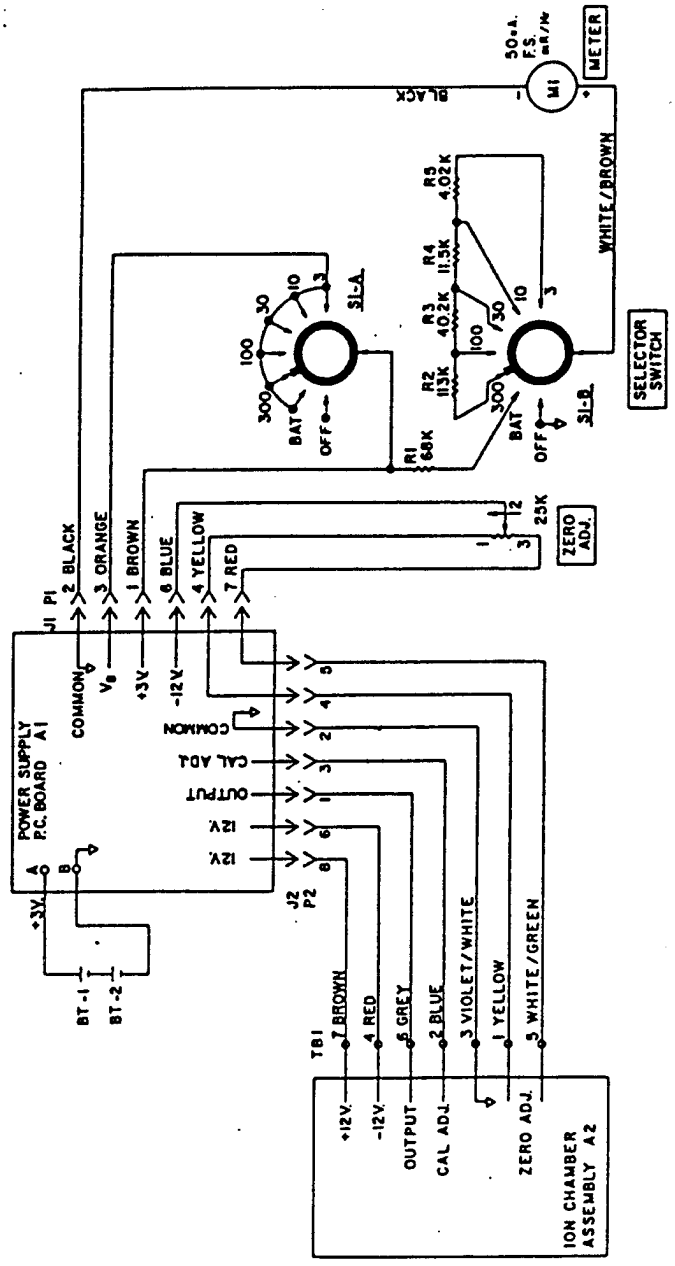


Figure 6-2. SM-400 Overall Wiring Diagram.

SECTION VII

ILLUSTRATED PARTS BREAKDOWN

7-1. INTRODUCTION. This Section contains information for procurement of replacement parts.

7-2. INSTRUCTIONS FOR USE:

a. Applicability. This parts list applies only to the SM-400 Low Energy Ion Chamber Survey Meter manufactured by Nuclear Research Corporation, FSCM 96696 under Contract No. F41608-83-D-0058.

b. Specifications. This parts list has been prepared in accordance with MIL-M-38807. Instructions for use as described in this specification are applicable.

c. Usable On Codes. Usable On Codes are not applicable. All parts listed apply only to the equipment specified.

d. Federal Supply Codes. The column labeled "FSCM" contains the Federal Supply Code Number for all parts that do not have military part numbers.

e. Parts Locations. Refer to the parts location illustrations contained in this section for locating the part. The figure number and the item number or reference symbol number can then be determined so that procurement information can be obtained from the Maintenance Parts List.

Table 7-1. SM-400 Maintenance Parts List.

FIGURE & INDEX NUMBER	PART NUMBER	FSCM	1234567 DESCRIPTION	UNITS PER ASSY.	USABLE ON CODE	SMR CODE
7-1			FRONT PANEL ASSEMBLY	REF.		
-1	C7752	96696	.SELECTOR SWITCH ASSEMBLY, Complete with Resistors, cable and attaching hardware.	1		PAFZZN
-1	RN55C6812F		..RESISTOR, Metal Film, 68.1K, 1%, ⅛W, (R1).	1		PAFZZN
-1	RN55C1133F		..RESISTOR, Metal Film, 113K, 1%, ⅛W, (R2).	1		PAFZZN
-1	RN55C4022F		..RESISTOR, Metal Film, 40.2 K, 1%, ⅛W, (R3).	1		PAFZZN
-1	RN55C1152F		..RESISTOR, Metal Film, 11.5 K, 1%, ⅛ W, (R4).	1		PAFZZN
-1	RN55C4021F		..RESISTOR, Metal Film, 4.02 K, 1%, ⅛W, (R5).	1		PAFZZN
-2	73JA-20K	12697	..RESISTOR, Variable, 20K.	1		PAFZZN
-3			.P.C. BOARD ASSEMBLY, A1, Consists of all parts shown in Figure 7-4.	REF.		
-4	D7774	96696	.PANEL.	1		XA
-5	1505-M10-F06-632	04729	.STANDOFF, P. C. Board Mounting.	2		XB
-6	MS9021-168	96906	.O-RING, 7.25 in. Dia. .094 in. wall.	1		PAFZZN
-7	2670	83330	.WASHER, Nylon, Flat.	6		PAFZZN
-9	8014	96696	.KNOB, Black.	1		PAFZZN
-10	KL701	2B549	.LOCK, Knob.	1		PAFZZN
-11	A3401	96696	.SPRING, Battery.	2		PAFZZN
-12	A7784	96696	.WASHER, Insulating.	1		PAFZZN
-13	2660	83330	.WASHER, Shoulder.	1		PAFZZN
-14	MS35215-53		.SCREW, Pan Hd., 6-32 x 3/4, S.S.	2		PAFZZN
-15	317169	96696	.WASHER, Flat #6, S.S.	10		PAFZZN
-16	317313	96696	.WASHER, Lock #6, S.S.	6		PAFZZN
-17	308156	96696	.NUT, Hex, 6-32, S.S.	4		PAFZZN
-18	A7783-1	96696	.SCREW, Captive	6		PAFZZN
-19	600327-005	96696	.WASHER, Lock, Internal Tooth, #6, S.S.	2		PAFZZN
-20	311691	96696	.SCREW, Bnd. Hd., 6-32 x 5/16", S.S.	2		PAFZZN
-21	600980	96696	..HARDWARE, Supplied with Meter, Index Number 22.	REF.		
-8	7790	96696	KNOB, Black Modified	1		PAFZZN

Table 7-1. SM-400 Maintenance Parts List (Continued)

FIGURE & INDEX NUMBER	PART NUMBER	FSCM	1234567 DESCRIPTION	UNITS PER ASSY.	USABLE ON CODE	SMR CODE
7-1						
-22	600980	96696	.METER, 0-50 mA., Special Scale, Complete with mounting hardware.	1		PAFZZN
-23	38031-3-F4	50394	.SCREW, Button Hd., 10-32 X 1/4.	1		PAFZZN
-24	37520060	85446	.WASHER, Nylon #10.	1		PAFZZN
-25	A6770	96696	.RETAINER, Extension Shaft.	1		PAFZZN
-26	A6780	96696	.SPRING, For Extension Shaft.	1		PAFZZN
-27	A7808	96696	.SHAFT, Extension.	1		PAFZZN
-28	1416-4	83330	.LUG, Solder.	2		PAFZZN
-29	1195C	83330	.NUT, Hex, 3/8-32, Ni Plated Brass.	1		PAFZZN
-30	1220-08	78189	.WASHER, Lock, 3/8 in., Cad Plated.	1		PAFZZN
-31	B-7755	96696	BATTERY COVER ASSEMBLY	1		AFFFF
7-2	C-7756		CASE ASSEMBLY	REF.		
-1	C-7764	96696	CASE, Aluminum.	1		XB
-2	C-7757		ION CHAMBER ASSEMBLY, Consists of all parts shown in Figure 7-3.	REF.		AFFFF
-3	B7760	96696	.END CAP ASSEMBLY, Non-repairable, must be replaced as a complete assembly.	1		PAFZZN
-4	B7761	96696	.HANDLE, Carrying. ATTACHING HARDWARE:	1		PAFZZN
-5	601013	96696	..RING, Retaining.	1		PAFZZN
-6	A7785	96696	..NUT, Handle.	1		PAFZZN
-7	A7782	96696	..WASHER, Threaded.	1		PAFZZN
-8	601014	96696	..WASHER, Tension.	1		PAFZZN
-9	A7825	96696	..STRAP, Grounding. ATTACHING HARDWARE: Two 2-56 x 3/16 Pan Hd. Screws, S.S.	1		MFF
7-3	C7757	96696	ION CHAMBER ASSEMBLY. Non-repairable except for replacement of Index Numbers 1 through 4.	1		AFFFF
-1	B7763	96696	.TUBE WINDOW ASSEMBLY, Non-repairable, replace as a complete assembly. ATTACHING HARDWARE: Three 2-56 x 3/16 F.H. S.S. Screws.	1		PAFZZN

Table 7-1. SM-400 Maintenance Parts List (Continued).

FIGURE & INDEX NUMBER	PART NUMBER	FSCM	1234567 DESCRIPTION	UNITS PER ASSY.	USABLE ON CODE	SMR CODE
7-3						
-2	A7819	96696	.PROTECTIVE GRILL ASSEMBLY Non-repairable, must be replaced as a complete assembly.	1		PAFZZN
-3	601017-7	96696	.CONNECTOR HOUSING.	1		PAFZZN
-4	08-56-0110	27264	..PIN, Connector, used with Index Number 3.	8		PAFZZN
7-4	C7754	96696	POWER SUPPLY P.C. BOARD ASSEMBLY, A1 (Recommend replace assembly) Index No's 1-20 for reference.	1		PAFDDT
-1	1N457A		.DIODE, Silicon, General Purpose, 500 mW.	4		PAFZZN
-2	1N4565A		.DIODE, 6.4V., Voltage Reference.	1		PAFZZN
-3	TE1211	80183	.CAPACITOR, Tant. 100 uF, 25V.	3		PAFZZN
-4	TE1207	80183	.CAPACITOR, Tant. 25 uF, 25V.	1		PAFZZN
-5	30GAQ50	80183	.CAPACITOR, Ceramic, 50 pF, 3kV.	1		PAFZZN
-6	CSR13G155KM		.CAPACITOR, Tant., 1.5 uF, 50V.	1		PAFZZN
-7	600976-6	96696	.HEADER, 7 Pin.	1		PAFZZN
-8	600976-7	96696	.HEADER, 8 Pin.	1		PAFZZN
-9	2N2945A		.TRANSISTOR, PNP.	1		PAFZZN
-10	2N930		.TRANSISTOR, NPN.	3		PAFZZN
-11	RN55C7150F		.RESISTOR, Metal Film, 715 ohm, 1%, ¼W.	1		PAFZZN
-12	RV6NAYSL104A		.RESISTOR, Variable, 100K, 10%.	1		PAFZZN
-13	RC07GF104J		.RESISTOR, Composition, 100K 5%, ½W.	1		PAFZZN
-14	RC07GF391J		.RESISTOR, Composition, 390 ohm, 5%, ½W.	1		PAFZZN
-15	RN55D1502F		.RESISTOR, Metal Film, 15K, 1%, ¼W.	1		PAFZZN
-16	RN55D5622F		.RESISTOR, Metal Film, 56.2K 1%, ¼W.	1		PAFZZN

Table 7-1. SM-400 Maintenance Parts List (Continued)

FIGURE & INDEX NUMBER	PART NUMBER	FSCM	1234567 DESCRIPTION	UNITS PER ASSY.	USABLE ON CODE	SMR CODE
7-4						
-17	RC07GF473J		.RESISTOR, Composition, 4.7K, 5%, ¼W.	1		PAFZZN
-18	RN55D4992F		.RESISTOR, Metal Film 49.9K, 1%, ¼W.	1		PAFZZN
-19	RN55D6492F		.RESISTOR, Metal Film, 64.9K, 1%, ¼W.	1		PAFZZN
-20	B7778	96696	.TRANSFORMER, Inverter.	1		PAFZZN
1-1	D7741	96696	CARRYING CASE ASSEMBLY	1		XA

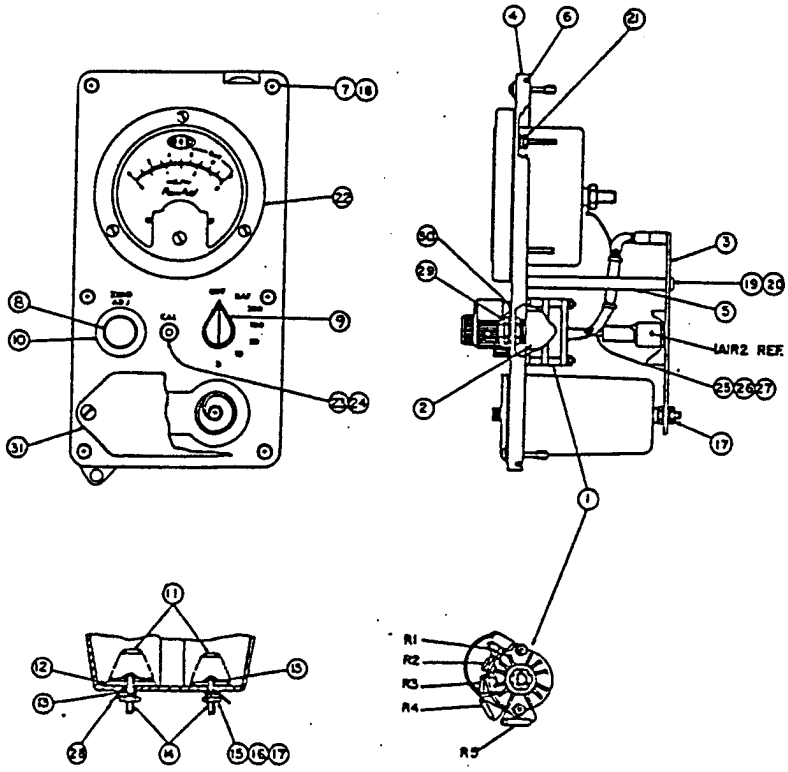


Figure 7-1. Panel Assembly Parts Location

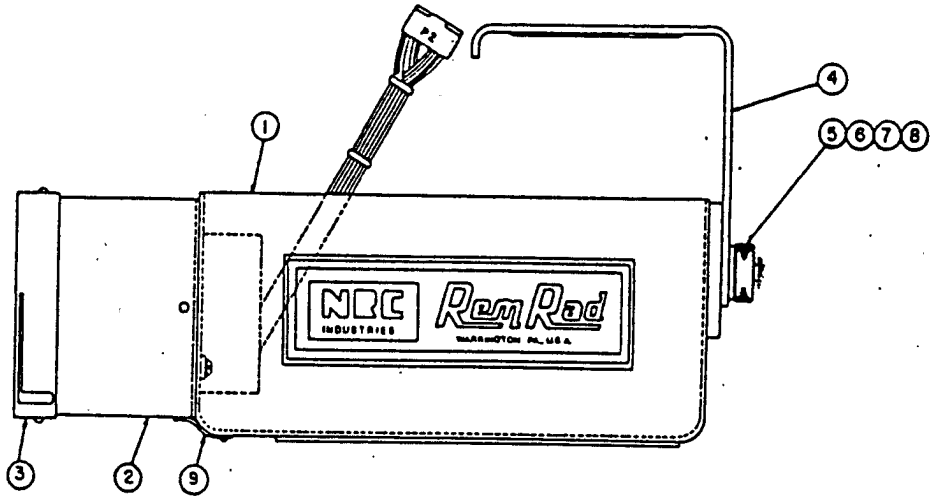


Figure 7-2. Case Assembly Parts Location.

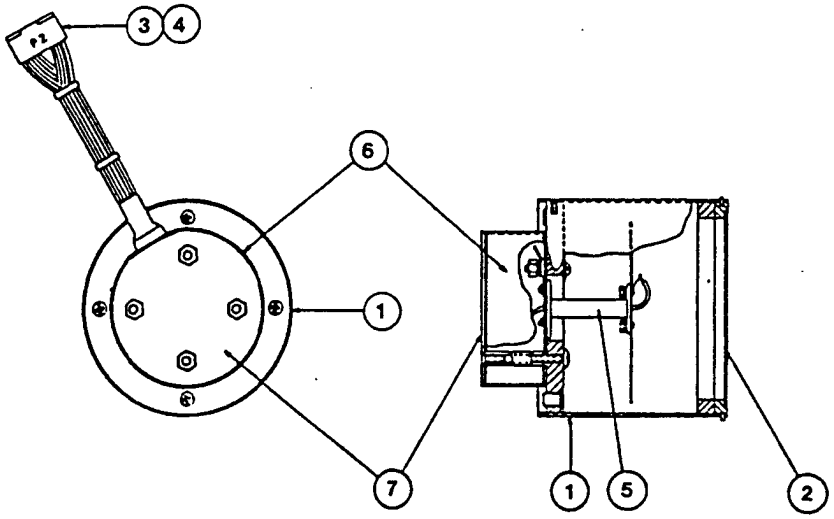
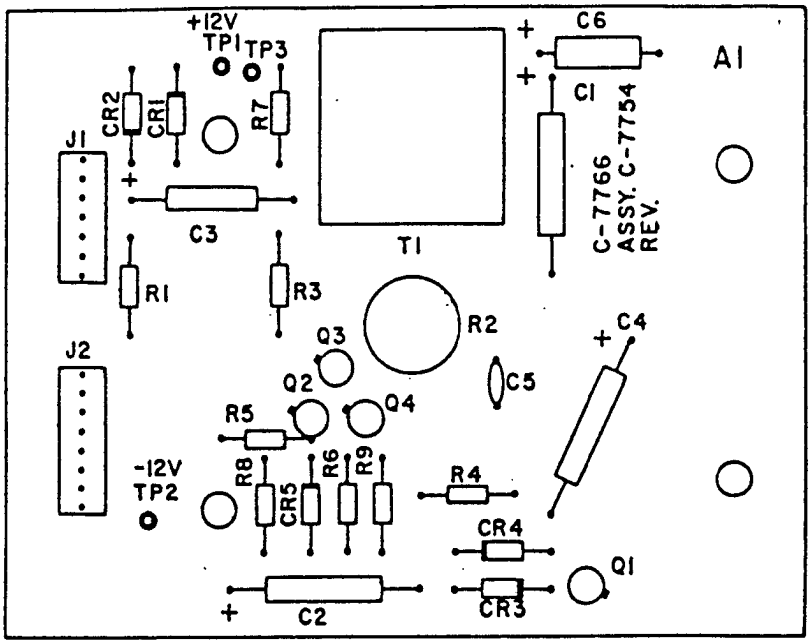


Figure 7-3. Ion Chamber Assembly, A2



ITEM	REF. DESIG.	ITEM	REF. DESIG.
1	CR1,CR2,CR3,CR4	11	R1
2	CR5	12	R2
3	C1,C2,C4	13	R3
4	C3	14	R4
5	C5	15	R5
6	C6	16	R6
7	J1	17	R7
8	J2	18	R8
9	Q1	19	R9
10	Q2,Q3,Q4	20	T1

Figure 7-4. Power Supply P. C. Board, A1 Parts Locations.