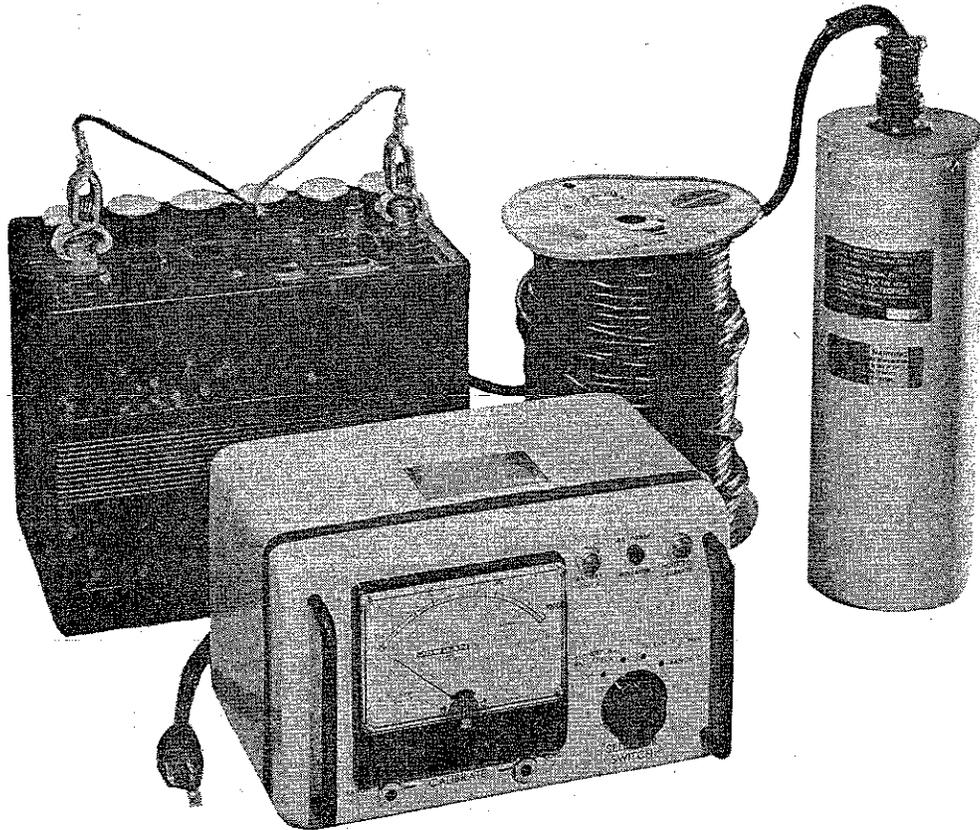


**operating
and maintenance
INSTRUCTIONS**



Radiation Monitoring Instrument

Fixed Station—Gamma Only

Jordan Model 711

FCDA Item No. CD V-711 Model No. 1



3025 W. MISSION RD., ALHAMBRA, CALIF., ATLantic 9-5075

OPERATING AND MAINTENANCE
INSTRUCTIONS

Radiation Monitoring Instrument, Fixed Station
Gamma Only

JORDAN MODEL 711
FCDA Item No. CD V-711
Model 1

JORDAN ELECTRONICS
A Division of The Victoreen Instrument Company
3025 West Mission Road
Alhambra, California

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OPERATING AND MAINTENANCE INSTRUCTIONS

1.0 GENERAL DESCRIPTION

1.1 Use of the Instrument

The Jordan CD V-711 is a fixed station monitoring instrument for use in group shelters, fire stations, and other buildings to provide occupants with remote measurement of outside radiation.

1.2 Instrument Components

The instrument comprises two major components. The CONTROL UNIT and the REMOTE UNIT. The CONTROL UNIT includes all electronic circuitry, power supplies, controls, and the indicating meter. The REMOTE UNIT includes the sensing element and a radioactive source for checking calibration.

1.3 Ranges and Spectral Response

The Jordan CD V-711 measures gamma radiation over the ranges 1.0 to 1,000 mr/hr and 1.0 to 1,000 r/hr with an accuracy of + 20% within the energy spectrum .080 to 1.2 Mev. The readings within this energy spectrum are within 15% of the Cobalt-60 readings.

1.4 Sensing Element

The sensing element is an ionization chamber and is supplied with a 200 foot cable for remote location.

1.5 Power Supply

Normally the power supply operates from a source of 110 V 60 cycle AC. A 12 V automotive battery is used as a reference voltage to stabilize the power supply and automatically supplies the power to the instrument in the event of A. C. power failure. The instrument will operate continuously for 36 hours on a fully charged 75 ampere-hour, 12 volt, battery.

1.6 Check Source

A small source of radioactive material is built into the remote unit and can be rotated by pressing a button on the control unit to irradiate the chamber and provide a check point at 1,000 mr/hr (1 r/hr).

1.7 Physical Features

The dimensions of the instrument are 5 5/8" high, 10" wide and 6 5/8" deep. The volume excluding the meter, knobs, and handles is 372 cubic inches. The dimensions of the remote unit are 4" dia. x 11" long. The volume is 138 cubic inches. The weight of the instrument is 7 1/2 pounds. The weight of the remote unit is 4 1/16 pounds.

2.0 THEORY OF OPERATION

2.1 Ionization Chamber

The sensing element in the Jordan CD V-711 is a high pressure ionization chamber. The electrometer tube is mounted inside the chamber and its grid is connected only to the collector. Several advantages are the result of this unique construction. Most important is that the plate current of the electrometer tube is a logarithmic function of dose rate. Also the very high impedance circuits are all contained within the chamber in an atmosphere of pure dry argon gas and circuits passing to the outside of the chamber are at low impedance and not subject to leakage due to moisture and contamination.

2.2 Measuring Circuit

The measuring circuit is supplied with 85 volts at the arm of the filament current control R27. (See fig. 3). Current flows through the voltage divider circuit R27, R18, R19, R20, and R21, and through the filament of the electrometer tube to ground. Plate voltage is taken at the bottom of R20 and plate current flows through the meter to the plate of the electrometer tube providing the indication of dose rate. The sensitivity controls R25 and R26 are used to shunt the meter to provide the proper span on each range. From a source more positive than the plate voltage, a bucking current is taken through R23 and R24 to buck out all plate current below 1.0 mr/hr or 1.0 r/hr and adjust the bottom-scale calibration.

2.3 Power Supplies

The MEASURING CIRCUIT POWER SUPPLY comprises the transistor oscillator, transformer, silicon rectifier bridge and voltage regulator tubes. This power supply operates from a 12 volt source at all times. The input current flows through the REGULATOR transistor, which, when AC power is available, holds the input voltage at the battery voltage minus the emitter-base voltage. If the AC power fails, current will flow from the battery through the base and emitter to operate the measuring circuit power supply.

The TRICKLE CHARGER supplies a small amount of base current to the REGULATOR TRANSISTOR plus a small current to keep the battery at full charge. Power is supplied from the AC power source.

The SOURCE MOTOR POWER SUPPLY is a transistor oscillator to supply 110 V 60 cycles to operate the source motor. Its power is taken at all times from the battery.

3.0 INSTALLATION

3.1 Inspection

Unpack the instrument and inspect carefully all components for

damage in shipment. Included are the CONTROL UNIT, the REMOTE UNIT, the REMOTE UNIT CABLE, BATTERY CABLE, AC POWER CABLE, and REMOTE UNIT MOUNTING BRACKETS. If damage is evident, do not attempt to operate the instrument until it has been checked by a competent service technician. Otherwise damage to the sensing element or transistors may result.

3.2 Battery

THE INSTRUMENT MUST NOT BE OPERATED WITHOUT A 12 V AUTOMOTIVE BATTERY ATTACHED.

This is not supplied with the instrument. Observe the polarity markings on the battery clips when connecting to the battery. Turn the selector switch to the off position before connecting the battery. Plug the battery cable into the receptacle marked BATTERY on the back of the instrument. The negative terminal of the battery does not operate at ground potential, so do not connect it to a ground.

3.3 AC Power

With the selector switch in the OFF position, plug the AC power cable into the receptacle marked AC POWER on the back of the unit and plug the AC plug into the power line receptacle. Ground is obtained from the "third prong" on this plug.

3.4 Remote Unit

The REMOTE UNIT CABLE is supplied with a male connector on one end and a female on the other. Plug the male connector into the connector on the back of the CONTROL UNIT and the female connector into the connector on the REMOTE UNIT.

The REMOTE UNIT can be mounted in any location up to 200 feet from the control unit. Attach the mounting bracket to the desired surface and hang the remote unit as shown in Fig. 1.

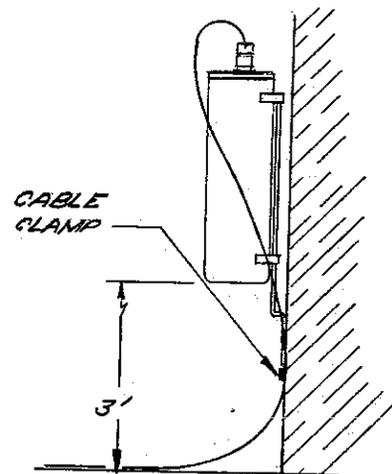


Fig. 1
Remote Unit
Mounting

3.5 Battery Check

Turn the selector switch to the STANDBY AND BATTERY CHECK POSITION and press the button marked BATTERY CHECK. The meter should indicate not less than 11.5 V. If the battery is lower than 11.5 V, charge it or obtain a better one.

4.0 OPERATION

4.1 Operational Checks

4.1.1 Turn the selector switch to STANDBY and let the instrument warm up for 30 minutes.

- 4.1.2 Check the battery voltage according to 3.5.
- 4.1.3 Turn the selector switch to RANGE 1 (mr/hr). Operate the source motor by pressing and holding for 10 seconds the button marked HOLD TO CALIBRATE. Adjust the CALIBRATE CONTROL marked RANGE 1 until the meter reads exactly 1,000 mr/hr. While still holding the button, switch to RANGE 2 (r/hr) and adjust the CALIBRATE CONTROL marked RANGE 2 until the meter reads exactly 1.0 r/hr. The instrument is now ready for use.

4.2 Taking Readings

It is always advisable to perform the adjustments in 4.1.3 immediately before taking readings.

To take a reading, switch to RANGE 1. If the meter goes off scale at the low end, the radiation intensity is less than 1.0 mr/hr. If the meter goes off scale at the high end, the radiation intensity is greater than 1,000 mr/hr and you must switch to RANGE 2 (r/hr) to take a reading. BE SURE TO DETERMINE WHICH RANGE THE SELECTOR SWITCH IS ON to determine whether the readings are in MILLI-ROENTGENS per hour or ROENTGENS per hour.

The scale is divided into three decades; 1-10, 10-100, and 100-1000. The minor divisions within each decade are marked with numerals 2 through 9. If the readings are in the 10-100 decade, these numerals signify 20 through 90 and if the readings are in the 100-1000 decade these numerals signify 200 through 900.

4.3 Normal Operation

When AC power is available, it is wise to let the instrument run continuously. The selector switch can be set to standby or Range 1 or Range 2 as desired.

4.4 Emergency Operation

4.4.1 Warm-up Time

When AC power has failed and the instrument is operating on battery, it may be wise to turn the instrument on only to take readings. When the instrument is operated in this manner, errors due to lack of warm-up may result. IT IS IMPERATIVE TO ADJUST THE CALIBRATION AGAINST THE CHECK SOURCE immediately before taking readings. This will reduce these errors to a maximum of approximately 30% of the reading. When this error must be minimized, the instrument should be left on for 30 minutes prior to adjusting and reading.

4.4.2 Check Source

If the check source is used to adjust the calibration,

special precautions must be taken to eliminate errors caused by ambient background radiation.

When the background radiation is 50 mr/hr or less, the source can be used in the normal manner. The background will cause an error or minus 5%. This is caused by adjusting the calibration on Range 1 to 1000 mr/hr when the total dose rate including source and background is 1,050 mr/hr.

When the background is higher, the error will be greater. Therefore, a special procedure must be used to reduce this error. This can be done as follows:

1. Read the indicated radiation level.
2. Add to this reading 1000 mr/hr (for Range 1), or 1 r/hr for Range 2.
3. Press and hold the source pushbutton and adjust the reading to background plus 1000 mr/hr or 1 r/hr.

For example, if the indicated radiation is 200 mr/hr, the adjustment should be made at 1200 mr/hr on Range 1 and 1.2 r/hr on Range 2.

4. It may be necessary to take a new reading after calibrating by this method and repeat the process until, with the source turned on, the reading is 1000 mr/hr (or 1 r/hr) plus the indicated background radiation.

5.0 OPERATOR'S MAINTENANCE

5.1 Battery

The battery should be checked periodically with the hydrometer and by using the battery check feature on the instrument. The battery voltage should remain between 12.0 and 12.5 and the specific gravity of the electrolyte should be 1.250. Low readings indicate a faulty battery or low trickle charge rate. Refer to the battery manufacturer's instructions or to Section 7 for corrective procedures.

5.2 Voltage Regulator and Reference Tubes

To insure continuous, reliable operation VT-1, VT-2, and VT-3 should be replaced once each year of operation. Although the life of these tubes is not limited to a year, the failure probability increases rapidly after this time of continuous duty, and failure could occur when no replacements are available.

6.0 PREVENTIVE MAINTENANCE

6.1 General

The procedures outlined in 5.1 and 5.2 are required as preventive maintenance.

6.2 Radiological Safety

The capsule of radioactive strontium (Sr^{90}) must be checked once each six months to determine that it is still properly sealed and not leaking. The accepted method, called a WIPE TEST is described below. See section 7.2.2 to gain access to the Sr^{90} source.

WARNING

THIS TEST MUST BE PERFORMED ONLY BY A PERSON COMPETENT AND EXPERIENCED IN HANDLING OF RADIOACTIVE MATERIALS. STRONTIUM-90 IS A DEADLY POISON AND MUST BE HANDLED AS SUCH. DO NOT TOUCH THE SOURCE WITH YOUR FINGERS. DO NOT POINT THE SOURCE TOWARD YOUR BODY. DO NOT SMOKE OR PUT ANYTHING IN YOUR MOUTH UNTIL YOU HAVE WASHED CAREFULLY AND CHECKED YOUR HANDS WITH A SENSITIVE GEIGER COUNTER FOR CONTAMINATION.

The wipe test is performed as follows:

1. Remove the source from the source holder by unscrewing first the backing plug and then the source. Use a screwdriver that locks into the slot and holds the source after it is removed.
2. Dampen a cotton swab such as a "Q-tip" with water and wipe the entire surface of the source.
3. Allow the swab to dry and, using a geiger counter, compare the amount of radiation (if any) from the swab to that from a calibrated Sr^{90} source of .05 microcuries.
4. If any reading is obtained from the swab there is a possibility that the source is contaminated, but still safe. It should be checked again a week later. If the geiger counter indicates that more than .05 microcuries is picked up on the swab, the source should be sealed in a glass bottle and disposed of as authorized by the AEC. If a second check on a suspected leaky source again shows activity, this source must also be treated as leaky and disposed of as authorized by the AEC.

7.0 CORRECTIVE MAINTENANCE

7.1 Tools Required

Screwdriver with 1/8" blade
Screwdriver with 1/4" blade
Diagonal cutters
Long nosed pliers
Small soldering iron
Simpson Model 260 or equivalent volt-ohm-milliammeter

7.2 Disassembly

7.2.1 Control Unit

Turn switch to "off" position. Remove two screws on rear and two screws on bottom of case. Remove connectors and slide control unit out of case.

7.2.2 Remote Unit

WARNING: THE REMOTE UNIT CONTAINS A SEALED CAPSULE OF RADIOACTIVE STRONTIUM (Sr^{90}). THIS IS CONTAINED IN THE RED BLOCK INSIDE THE REMOTE UNIT. Only persons trained in handling of radioactive materials should open the remote unit. Extreme care should be exercised in working with or near this Sr^{90} source. Sr^{90} is A DEADLY POISON.

To open the remote unit, remove the four screws holding the cap into the case, grasp the cable connector and, taking care not to pull on the cable itself, pull the cap out of the case. Do not let the cap travel more than three inches when pulled out of the case, or the wires inside will be broken.

7.3 Calibration

A calibrated source of radioactive material should be used to calibrate the instrument. To obtain a field of 1000 r/hr, approximately 50 curies of Co^{60} or an equivalent source of another isotope is required. A satisfactorily accurate calibration can be obtained by setting the high range at the 100 r/hr point against a 5 curie Co^{60} source.

The instrument should be calibrated as follows:

1. Turn the instrument on and let it warm up for 30 minutes.
2. Set both CALIBRATE CONTROLS on the front panel to the center of their range.
3. Remove the backing plug that locks the Sr^{90} source in position.
4. Place the Remote Unit in a field of 1000 mr/hr.
5. Turn both SENS. CONTROLS (R_{25} and R_{26}) full clockwise.
6. Switch to Range 2 and adjust the coarse calibrate control R_{22} to make the meter read 1 r/hr.
7. Switch to Range 1 and adjust the CALIBRATE control to make the meter read 1000 mr/hr.
8. Remove the Co^{60} field and adjust the Sr^{90} source by turning it in its threaded holder to make the meter read 1000 mr/hr when the source is rotated to irradiate the chamber.

9. Replace the backing plug in the threaded source holder to lock the source and recheck the setting of the Sr⁹⁰ source.
10. Switch to Range 2. Place the remote unit in a field of 100 r/hr and adjust the SENS. 2 control (R₂₅) to make the meter read 100 r/hr.
11. Remove the 100 r/hr field, press the HOLD TO CALIBRATE button until the Sr⁹⁰ source turns to its stop and adjust the Range 2 CALIBRATE control to make the meter read 1 r/hr.
12. Repeat steps 10 and 11 until both readings are proper.
13. Check the intermediate points on the scale i. e., 2 5 10 20 50 100 500 1000.
14. Readjust the high end of the scale to distribute any errors that appear at the intermediate points. For example, if the reading is 10% low at 50 r/hr, adjust the 100 r/hr point to 105 r/hr. This will cause the 50 r/hr point to read approximately 47, or 6% low. Since the Sr⁹⁰ check source is used on both ranges, the 1 r/hr and 1000 mr/hr points must be set exactly and this technique can be used only at the end of the scale opposite the check point.
15. To calibrate the low range, place the remote unit in a field of 1 mr/hr, set the selector switch to RANGE 1 and adjust the CALIBRATE control for Range 1 for a reading of 1 mr/hr.
16. Operate the Sr⁹⁰ source by pressing and holding the HOLD TO CALIBRATE button and adjust the SENS. 1 control R₂₆ to obtain a reading of 1000 mr/hr.
17. Check the intermediate points i. e., 2 5 10 20 etc.
18. If errors appear, shift some of the error to the 1 mr/hr end in a manner similar to Step 14. The 1000 mr/hr point must be set at exactly 1000 mr/hr.

7.4 Trickle Charge Adjustment

The charge rate to the battery, when AC is available, should be no less than zero when the line voltage is 90 V and the battery is fully charged. It should be no more than 50 ma when the line voltage is 120 V and the battery is fully charged.

To measure the charge rate, turn the instrument off and insert the Simpson 260 V. O. M. in series with one battery lead. If the AC power is disconnected, the current drain will be approximately 1.6 amps. Set the V. O. M. to the 10 ampere range and switch to more sensitive ranges to obtain the charge current reading.

The trickle charge is adjusted with R-2 which is the adjustable tap resistor under the chassis.

7.5 Trouble Shooting

7.5.1 Calibration. If the calibration is found to be in error, the instrument should be re-calibrated according to the procedure outlined in 7.3 and its stability observed for several days before taking further steps to correct the apparent malfunction.

7.5.2 Fuse. If the instrument is inoperative, check first the fuse F-1 which is mounted underneath the chassis. If the fuse is blown, determine the cause before attempting to operate the instrument or damage may result.

7.5.3 Voltage Measurements. If a malfunction is suspected, check the voltages as indicated on the circuit diagram. Check first the voltage on the arm of the FILAMENT ADJUST control R₂₇. This should be 83 to 87 volts. If this voltage is correct, check the other voltages in the measuring circuit. If this voltage is not correct, check the regulator tubes VT-1, VT-2, and VT-3 and the voltages in the Measuring Circuit Power Supply.

If the source motor fails to function, check the output voltage of the Source Motor Power Supply.

7.5.4 Transistor Tests.

One Clevite type 1108 transistor (Q₁) and four type 1104 are used. These can be tested with the Simpson 260 V. O. M. as follows:

Switch the meter to the R x 1 scale and connect as follows:

Connections	Reading
Red lead to emitter Black lead to Collector Base - no connection	100 Ω or higher
Same connections but short base to collector	4 Ω or lower
Same connections but short base to emitter	2000 Ω or higher

7.5.5 Trouble Shooting Hints

The following symptoms and corrective procedures will be useful in trouble shooting.

1. Filament voltage on pin B of chamber connector reads 85 volts.
Check for open connections between Control Unit and chamber. Check for open filament at chamber connector.
2. No output from Measuring Circuit Power Supply.
Starting at VT-3, check the voltages back to T-2. Check Q₄ and Q₅.

4. Source Motor inoperative.
 Check voltage from pins E and F on remote unit connector back to T-3. Check Q₂ and Q₃. Check for mechanical sticking of source mechanism.

4. Erratic Indications.
 Check the connectors in the remote unit circuit for dirt or moisture between the pins.

Check the torroids for grounds to the chassis.

8.0 REPLACEMENT PARTS

8.1 Mechanical Components

No. Req'd.	Description & Function	Jordan Pt. No.
1	Panel, Front	MS-0348
1	Case	MS-0352
1	Bracket, Chassis support	MS-0349
1	Gasket, Connectors	HG-0053
1	Case, Remote Unit	MT-0012
2	Handle	MM-0227
1	Knob	HK-0011

8.2 Maintenance Supply Parts

Suggested supply for five instruments for one year of operation.

Qty.	Circuit Symbol	Description & Function	Jordan Pt. No.
5	VT-1	OA2 Voltage Regulator	VT-OA2
5	VT-2	OA2 Voltage Regulator	VT-OA2
5	VT-3	85A2 Voltage Regulator	VT-85A2
5	E-1	Pilot Lamp #47	EL-0001
5	E-2	Pilot Lamp #47	EL-0001
1	M-1	Meter, 4 1/2" Rectangular 0-30 μ a .	EI-0017
1		Remote Unit Assembly	AU-0011

8.3 Names and addresses of Manufacturers

- Allen Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wisc.
- Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N. Y.
- California Transformer Co., 915 Maridian, So. Pasadena, Calif.
- Clevite Corp., 241 Crescent Street, Waltham 54, Mass.
- Eldema Corp., 9844 Remer Street, El Monte, Calif.
- Hopkins Engineering Co., Inc. 12900 Foothill Blvd. San Fernanco, Calif.
- International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.
- Oak Mfg. Co., 1260 No. Clybourn Aven., Chicago 10, Ill.
- P. R. Mallory & Co., Inc. 34 So. Gray St., Indianapolis, Ind.
- Phaotron Electronic Inst. Co., 151 Pasadena Ave., So. Pasadena, Calif.
- Sarkes Tarzian, Inc., 415 College Ave., Bloomington, Ind.
- Solar Mfg. Co., 4553 Seville, Los Angeles, California
- Sprague Electric Co., 125 Marshall St., No. Adams, Mass.
- Switch Craft, Inc., 1320 No. Halsted St., Chicago 22, Ill.

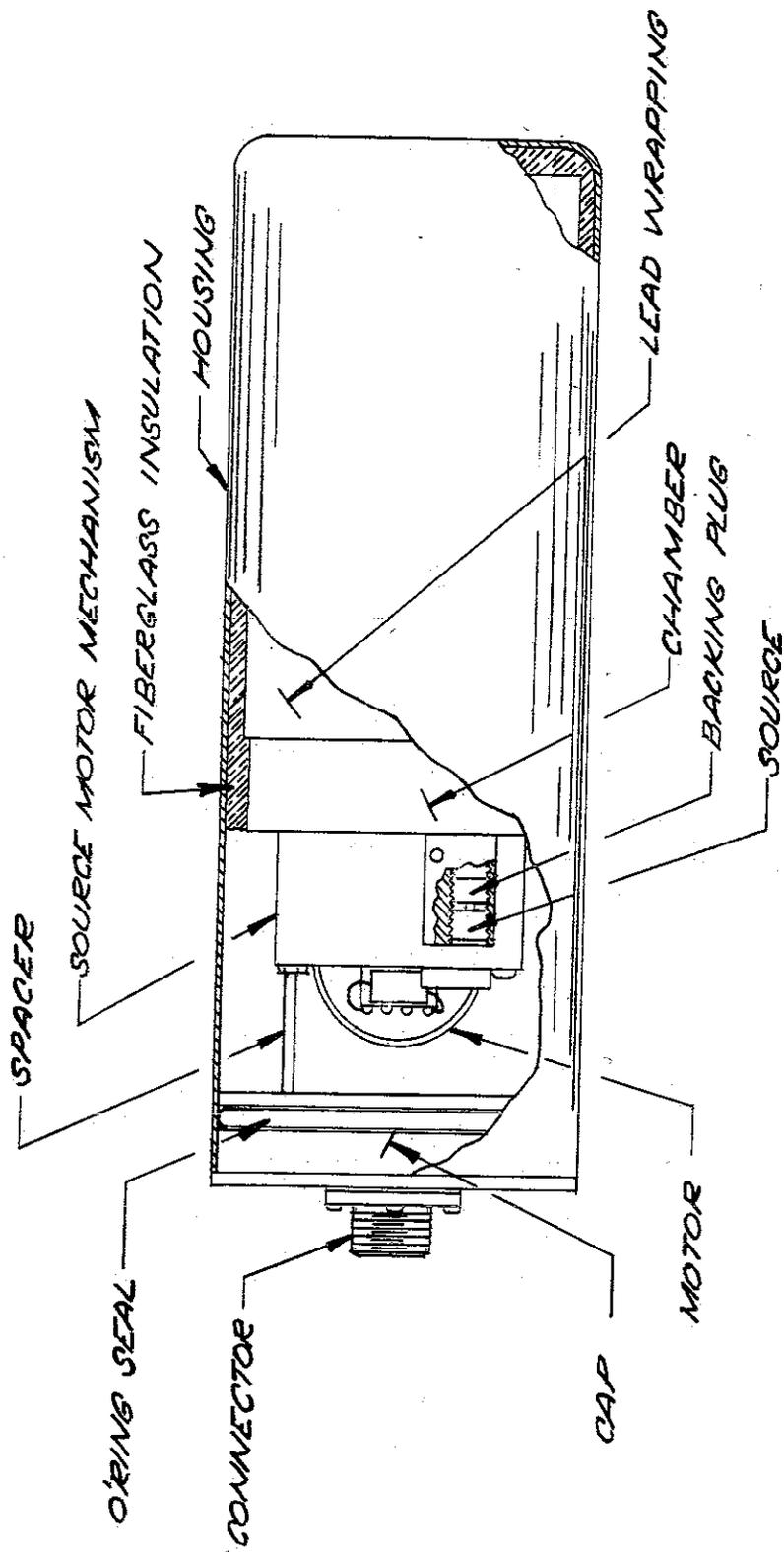


Figure 2 Remote Unit Construction

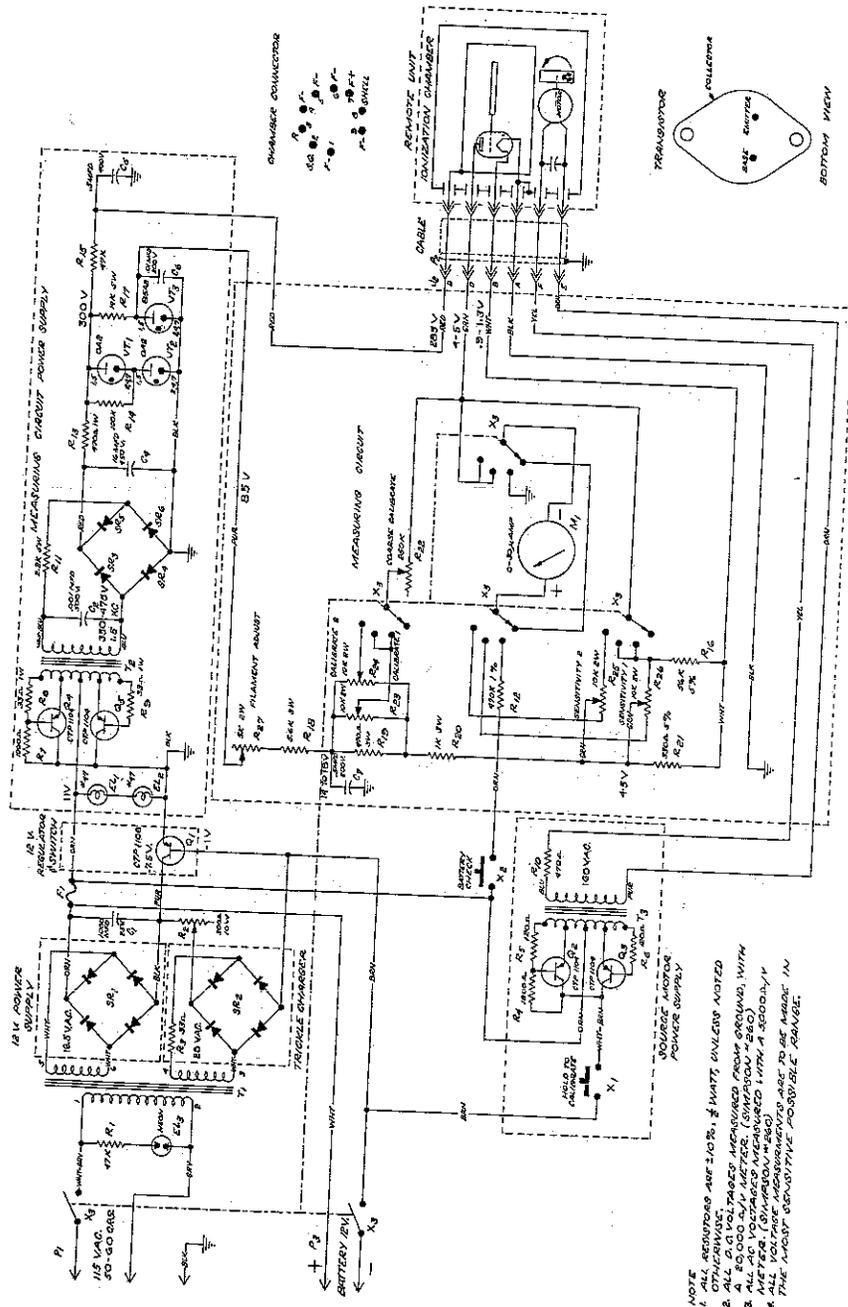


Figure 3 Wiring Diagram

8.4 Electrical components

Circuit Symbol	Description & Function	Manufacturer	Mfr's Type No.	Jordan Part No.
C1	Capacitor, Electrolytic, 1000 mfd 25 V., Filter, 12 V power	P. R. Mallory	WP059	CE-0013
C2	Capacitor, Disc Ceramic .001 mfg 500V., Filter, Meas. ckt. Power Supply	Solar		CC-5103
C3	Capacitor, Metallized Paper, .1 mfg 200 V Filter, Source motor (in remote unit)	Hopkins	P12D	CP-2105
C4	Capacitor, Electrolytic, 16 mfd, 450 V Filter, Meas. ckt. power supply	P.R. Mallory	TC74	CE-0014
C5	Capacitor, Metallized Paper, .5 mfd 400 V Integrator, Shell Voltage	Hopkins	P54D	CP-4505
C6	Capacitor, Disc Ceramic, .01 mfd 200 V Filter, Meas. Ckt. Voltage	Solar		CC-2104
C7	Capacitor, Metallized Paper, .5 mfd 200 V Filter, Meas. Ckt. Voltage	Hopkins	P52DS	CP-2505
EL1	Lamp, Meter #47, Meter Light	G. E.	47	EL-0001
EL2	Lamp, Meter #47, Meter Light	G.E.	47	EL-0001
EL3	Light, Neon power, AC Power Indicator	Eidema Corp.	1B2-1029	EL-0009
F1	Fuse, 2 amp, slo-blo, Circuit Protection	Littlefuse	315002	FU-0006
J1	3 pin F. Plug, AC Power Connector	AN 3106A14S-7S		JF-0036
J2	6 pin F. Receptacle, Remote Unit Connector	AN3102 A-14S-6S		JF-0039
J3	2 Pin F. Plug, Battery Connector	AN 3106A-14S-9S		JF-0037
M1	4 1/2 Rect meter, 0-30 μ amp. 3 k ohms, Indicator, Dose Rate	Phaotron	Prestige	EL-0017
P1	3 Pin M. Receptacle, AC Power Connector	AN 3102A-14S-7P		JM-0033
P2	6 Pin M. Plug, Remote Unit Connector	AN 3106A-14S-6P		JM-0035
P3	2 Pin M. Receptacle, Battery Connector	AN 3102A-14S-9P		JM-0034
Q1	Transistor, Power, Regulator, 12V	Clevite	CTP 1108	ET-0007
Q2	Transistor, Power, Oscillator Source Motor	Clevite	CTP 1104	ET-0006
Q3	Transistor, Power, Oscillator Source Motor	Clevite	CTP 1104	ET-0006
Q4	Transistor, Power, Oscillator, meas. ckt. pwr. supply	Clevite	CTP 1104	ET-0006
Q5	Transistor, Power, Oscillator, meas. ckt. pwr. supply	Clevite	CTP 1104	ET-0006
R1	Resistor, Carbon, 47 K 10% 1/2 W, Neon Indicator Supply	Allen Bradley	EB4731	RC-0473
R2	Resistor, Wire wound 200 ohms, 10% 5W Trickle Charge Adjust	Ward Lenord	10A-300	RW-5201
R3	Resistor, Carbon, 33 ohms 10%, 1 W Trickle Charge Limit	Allen Bradley	EB3301	RC-1330
R4	Resistor, Carbon, 1800 ohms, 1/2 W 10% Oscillator starting	Allen Bradley	EB1821	RC-0121
R5	Resistor, Carbon 120 ohms, 10% 1/2 W Oscillator Drive	Allen Bradley	EB121	RC-0121
R6	Resistor, Carbon, 120 ohm, 10%, 1/2 W Oscillator Drive	Allen Bradley	EB121	RC-0121
R7	Resistor, Carbon, 1000 ohms, 1/2 W Oscillator Starting	Allen Bradley	EB1021	RC-0272
R8	Resistor, Carbon, 33 ohm 10%, 1 W Oscillator Drive	Allen Bradley	GB3301	RC-1330
R9	Resistor, Carbon, 33 ohm 10%, 1 W Oscillator Drive	Allen Bradley	GB3301	RC-1330
R10	Resistor, Carbon, 470 ohm 10%, 1/2 W Motor Voltage Limit	Allen Bradley	EB471	RC-0471
R11	Resistor, Wire wound, 2.2 K 10%, 5 W Power Supply Filter	Sprague Blue Jacket	27E	RW-5222
R12	Resistor, Carbon, 470 K 1%, 1/2 W Battery Voltage Metering	IRC		RC-0474A
R13	Resistor, Carbon, 470 ohms 10%, 1 W Voltage Limit	Allen Bradley	EB471	RC-1471
R14	Resistor, Carbon, 100 K 10%, 1/2 W Current Equalizer	Allen Bradley	EB151	RC-0104
R15	Resistor, Carbon, 47 K 10%, 1/2 W Integrator, Shell Voltage	Allen Bradley	EB4731	RC-0473
R16	Resistor, Boron Carbon, 56 K 1%, MBC, 1/2 W	I. R. C.	MBC	RX-0017
R17	Resistor, Wire wound, 14 K, 10% 5 W Voltage Divider	Sprague Blue Jacket	27E	RW-5143
R18	Resistor, Wire wound, 5.6 K 10% 3 W Voltage Divider	Sprague Blue Jacket	151E	RW-3562
R19	Resistor, Wire wound, 470 ohms, 10%, 3 W Voltage Divider	Sprague Blue Jacket	151E	RW-3471
R20	Resistor, Wire wound, 1K 10%, 3 W Voltage Divider	Sprague Blue Jacket	151E	RW-3102
R21	Resistor, Boron Carbon, 330 ohms, 1%, 1/2 W, Voltage Divider	IRC	MBC	RX-0018A
R22	Potentiometer, Carbon, 250 K, 10%, 2 W Coarse Calibrate Adjust	Allen Bradley	CLU 2541-SD 040 L	RP-2254
R23	Potentiometer, Wire wound, 10 K 2 W Screw shaft, Calibrate Control, Range 1	Clarostat	43	RP-2103
R24	Potentiometer, Wire wound, 10 K, 2 W Screw shaft, Calibrate Control, Range 2	Clarostat	43	RP-2103

R25	Potentiometer, Wire wound, 10 K, 2 W	Clarostat	43	RP-2103
R26	Screw shaft, Sensitivity Control, Range 2	Clarostat	43	RP-2103
R27	Potentiometer, Wire wound, 10 K, 2 W	Clarostat	43	RP-2502
SR1	Screw shaft, Range 1	Int'l. Rectifier	MIB	ER-0006
SR2	Potentiometer, Wire wound, 5 K, 2 W	Int'l. Rectifier	JD507G	ER-0001
SR3	Screw shaft, Filament current adjust	Sarkes Tarzian	M-150	ER-0005
SR4	Rectifier, Selenium Bridge, 12 V Power supply	Sarkes Tarzian	M-150	ER-0005
SR5	Rectifier, Silicon, Measuring ckt. power supply	Sarkes Tarzian	M-150	ER-0005
SR6	Rectifier, Silicon, Measuring ckt. power supply	Sarkes Tarzian	M-150	ER-0005
T1	Transformer, Charger, 110 VAC-12 VAC	Calif. Transformer	M-150	ER-0005
T2	Transformer, Toroid, 1.5 K cps, Meas. ckt. power supply	Calif. Transformer	1079	LX-0004
T3	Transformer, Toroid, 60 cps, Source motor power supply	Calif. Transformer	1091	LX-0005
VT1	Tube, Regulator, 0A2, Measuring circuit voltage regulator	Calif. Transformer	1090	LX-0006
VT2	Tube, Regulator, 0A2, Measuring circuit voltage regulator	R. C. A.	0A2	VT-0A2
VT3	Tube, Regulator, 85A2, Measuring circuit voltage reference	R. C. A.	0A2	VT-0A2
X1	Switch, Push button, N. O. Contact, Source Motor	Amperex	85A2	VT-85A2
X2	Switch, Push button, N. O. Contact, Battery voltage check	Switch Craft	101 SW	SP-0001
X3	Switch, Rotary, Selector	Switch Craft	101 SW	SP-0001
		Oak Mfg. Co.	89307-N2-AC	SR-0015