DEPARTMENT OF THE ARMY
TECHNICAL MANUAL

DEPARTMENT OF THE AIR
FORCE TECHNICAL ORDER

TM 11-2513
TO 16-40-1193-5

# TEST SETS

# I-193-A, I-193-B

# AND I-193-C

*DEPARTMENTS OF THE ARMY AND THE AIR FORCE*
*MARCH 1952*

AGO 3086B—Mar

TM 11–2513
*C 3

CHANGE
No. 3

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *12 April 1967*

# TEST SETS I–193–A, I–193–B, AND I–193–C

TM 11–2513, 24 March 1952, is changed as follows:

*Page 1*, paragraph 1 (as changed by C 2, 27 Sep 63).

Delete the designation "*a*".

Delete subparagraph *b*.

After paragraph 1, delete paragraph 1.1 (added by C 2, 27 Sep 63) and substitute:

## 1.1. Index of Publications

Refer to the latest issue of DA Pam 310–4 to determine whether there are new editions, changes, or additional publications pertaining to this equipment. DA Pam 310–4 is an index of current technical manuals, technical bulletins, supply manuals (types 7, 8, and 9), supply bulletins, lubrication orders, and modification work orders available through publications supply channels. The index lists the individual parts (–10, –20, –35P, etc.) and the latest changes to and revisions of each equipment publication.

Paragraph 2 (as changed by C 2, 27 Sep 63). Delete paragraph 2 and substitute:

## 2. Forms and Records

*a. Reports of Maintenance and Unsatisfactory Equipment.* Use equipment forms and records in accordance with instructions in TM 38–750.

*b. Report of Damaged or Improper Shipment.* Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700–58 (Army), NAVSANDA Publication 378 (Navy), and AFR 71–4 (Air Force).

*c. Reporting of Equipment Manual Improvements.* Report of errors, omissions, and recommendations for improving this equipment manual by the individual user is encouraged. Reports should

*This change supersedes C 2, 27 September 1963.

be submitted on DA Form 2028 (Recommended Changes to DA Publications) and forwarded direct to Commanding General, U.S. Army Electronics Command, ATTN: AMSEL–MR–NMP–AD, Fort Monmouth, N.J., 07703.

*Page 6*, paragraph 7*a*, line 8 (as changed by C 2, 27 Sep 63). After "used." add: The wiring of socket CB4 in the I–193–C differs from the wiring of CB4 in the I–193–A and I–193–B. Socket CB4 in the I–193–C is wired to permit testing Sigma relay No. 7JOZ–160T.

*Page 23*, paragraph 25, chart (as changed by C 2, 27 Sep 63). Delete and substitute:

| Federal stock No. | Item | Use |
|---|---|---|
| 5350–271–7939 | Sandpaper, abrasive, #000. | Remove rust and corrosion from metal parts. |
| 8305–267–3015 | Cloth, textile | Clean various parts of equipment. |
| 7930–395–9542 | Cleaning Compound | Clean grease, fungus, and ground-in dirt from cases and parts of equipment. |

*Page 25*. Delete sections II and III changed by C 2, 27 Sep 63 and substitute:

## Section II. PREVENTIVE MAINTENANCE SERVICES

### 27. Scope of Maintenance

The maintenance duties assigned to the operator and organizational repairman of the test set are listed below, together with a reference to the paragraphs covering the specific maintenance functions. The tools and test equipment required are listed in paragraph 25.

*a*. Operator's daily preventive maintenance checks and services (para 29.2).

*b*. Operator's weekly preventive maintenance checks and services (para 29.3).

*c*. Organizational monthly preventive maintenance checks and services (para 30.2).

*d*. Organizational quarterly preventive maintenance checks and services (para 30.3).

*e*. Troubleshooting (para 32).

*f.* Cleaning (para 29.1).

*g.* Touchup painting (para 31).

## 28. Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce downtime, and to assure that the equipment is serviceable.

*a. Systematic Care.* The procedures given in paragraphs 29.1 through 29.3, 30 through 30.3, and 31 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

*b. Preventive Maintenance Checks and Services.* The preventive maintenance checks and services charts (para 29.2, 29.3, 30.2, and 30.3) outline functions to be performed at specifiic intervals. These checks and services are to maintain Army electronic equipment in a combat-serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operations in maintaining combat serviceability, the charts indicate what to check, how to check, and what the normal conditions are; the *References* column lists the illustrations, paragraphs, or manuals that contain detailed repair or replacement procedures. If the defect cannot be remedied by performing the corrective actions listed, higher category maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38–750.

## 29. Preventive Maintenance Checks and Services Periods

Preventive maintenance checks and services of the equipment are required daily, weekly, monthly, and quarterly.

*a.* Paragraph 29.2 specifies the checks and services that must be accomplished daily (or at least once each week if the equipment is maintained in a standby condition).

*b.* Paragraphs 29.3, 30.2, and 30.3 specify *additional* checks and services that must be performed on a weekly, monthly, and quarterly basis, respectively.

## 29.1. Cleaning

Inspect the exterior of the test set. The exterior surfaces should be clean and free of dirt, grease, and fungus.

*a.* Remove loose dirt with a clean soft cloth.

***Warning:*** **Prolonged breathing of cleaning compound is dangerous; make certain that adequate ventilation is provided. Cleaning compound is flammable; *do not* use near a flame. Avoid contact with the skin; wash off any that spills on your hands.**

*b.* Remove grease, fungus, and ground-in dirt from the cases; use a cloth dampened (not wet) with cleaning compound.

*c.* Remove dirt from plugs and jacks with a brush.

***Caution:*** **Do not press on the meter face (glass) when cleaning the meter may become damaged.**

*d.* Clean the front panel, meter, and control knobs; use a soft clean cloth. If dirt is difficult to remove, dampen the cloth with water; mild soap may be used for more effective cleaning.

## 29.2 Operator's Daily Preventive Maintenance Checks and Service Chart

| Sequence No. | Item | Procedure | References |
|---|---|---|---|
| 1 | Completeness | Check to see that the equipment is complete (TM 11–6625–210–10P). | TM 11–6625–210–10P. |
| 2 | Exterior surfaces | Clean the exterior surfaces, including the panel and meter glasses. Check the meter glass and indicator lenses for cracks. | Para 29.1. |
| 3 | Connectors | Check the tightness of all connectors. | |
| 4 | Controls and indicators | While making the operating checks (item 5), check to see that the mechanical action of each knob, dial, and switch is smooth and free of external or internal binding, and that there is no excessive looseness. Also, check the meter for sticking or bent pointer. | |
| 5 | Operation | Operate the equipment according to paragraph 35 | Para 35. |

## 29.3. Operator's Weekly Preventive Maintenance Checks and Services Chart

| Sequence No. | Item | Procedure | References |
|---|---|---|---|
| 1 | Cables | Inspect cords, cables, and wires for chafed, cracked, or frayed insulation. Replace connectors that are broken, arced, stripped, or worn excessively. | Fig. 1 and 2. |
| 2 | Handles and latches | Inspect handles, latches, and hinges for looseness. Replace or tighten as necessary. | Fig. 1 and 2. |
| 3 | Metal surfaces | Inspect exposed metal surfaces for rust and corrosion. Clean and touch up paint as required. | Fig. 1, 2, 3, and 4; para 29.1 and 31. |

## Section III. ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

### 30. Scope of Organizational Maintenance

*a.* This section contains instructions covering organizational maintenance of Test Sets I–193–A, I–193–B, and I–193–C.

*b.* Organizational maintenance consists of the following:

(1) Monthly preventive maintenance checks and services (para 30.2).

(2) Quarterly preventive maintenance checks and services (para 30.3).

(3) Removal and testing of pluckout parts (para 33).

(4) Cleaning (para 29.1).

(5) Touchup painting (para 31).

### 30.1. Tools, Materials, and Test Equipment Required

The tools, materials, and special test equipment required for organizational maintenance are listed in paragraphs 25 and 26.

## 30.2. Organizational Monthly Preventive Maintenance Checks and Services Chart

| Sequence No. | Item | Procedure | References |
|---|---|---|---|
| 1 | Pluckout items | Inspect seating of pluckout items | Fig. 4. |
| 2 | Relays | Inspect the relays for dirt, corrosion, and burned contacts | Para 25 and fig. 8 and 9. |
| 3 | Jacks | Inspect the jacks for snug fit and good contact | Para 25 and fig. 3. |
| 4 | Terminal block | Inspect terminal box CB5 for loose connections and cracked or broken insulation. | Fig. 31 and 32. |
| 5 | Connecting blocks | Inspect the connecting blocks for dirt, corrosion, and cracked or broken insulation. | Fig. 3. |
| 6 | Resistors and capacitors | Inspect the resistors and capacitors for cracks, blistering, or other defects. | Fig. 29 and 32. |
| 7 | Gaskets and insulators | Inspect gaskets, insulators, bushings, and sleeves for cracks, chipping, and excessive wear. | Fig. 29, 30, and 31. |
| 8 | Interior | See that the interior of the chassis and cabinet is clean | Fig. 29, 30, and 31. |

## 30.3. Organizational Quarterly Preventive Maintenance Checks and Services Chart

| Sequence No. | Item | Procedure | References |
|---|---|---|---|
| 1 | Publications | See that all publications are complete, serviceable, and current | DA Pam 310–4. |
| 2 | Modifications | Check DA Pam 310–4 to determine if new applicable MWO's have been published. All URGENT MWO's must be applied immediately. All NORMAL MWO's must be scheduled. | TM 38–750 and DA Pam 310–4. |
| 3 | Spare parts | Check all spare parts (operator and organizational) for general condition and method of storage. There should be no evidence of overstockage, and all shortages must be on valid requisitions. | TM 11–6625–210–10P and TM 11–6625–210–20P. |

## 31. Touchup Painting

Clean rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to the applicable cleaning and refinishing practices specified in TB SIG 364 and TM 9–213.

*Page 28,* section IV (as changed by C 2, 27 Sep 63). Make the following changes:

Add heading: Section IV. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE.

Change the designation of paragraph 32 to 34.

Add the following paragraphs deleted by C 2, 27 Sep 63:

## 32. Scope

The troubleshooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is limited necessarily in scope by the tools, test equipment, and replaceable parts issued. With the exception of replacing operated fuses and faulty indicator lamps and the electrical adjustment of 255-type relays, troubleshooting is merely a general identification of the trouble and a recommendation that the trouble be repaired by qualified repair personnel.

## 33. Visual Inspection

*a.* Failure of the equipment to operate properly will usually be caused by one or more of the following faults.

(1) Improperly connected power cords.

(2) Worn, broken, or disconnected cords or plugs.

(3) Operated fuse.

(4) Relay out of adjustment or contacts burned because of overloads.

(5) Wiring broken because of excessive vibration.

*b.* When the equipment fails and the cause is not apparent immediately, check as many of the above items as is practicable before starting a detailed examination of the component parts of the system. If possible, obtain information from the operator of the equipment regarding the performance at the time trouble occurred.

*Page 58,* paragraph 52, chart (as changed by C 2, 27 Sep 63). Make the following changes:

Add after last item:

| Fig. or par. No. | Description |
|---|---|
| Fig. 32.1 | Partial schematic diagram (I–193–C). |

Add the following note below the chart:

*Note.* The circuitry of the I–193–C is shown in figure 32, except for the circuitry of socket CB4 (fig. 32.1).

*Page 76.* Add chapter 5.1 after chapter 5:

# CHAPTER 5.1
# DEPOT OVERHAUL STANDARDS FOR TEST SETS I–193–A, I–193–B, AND I–193–C

## 59.1. Applicability of Depot Overhaul Standards

The tests outlined in this chapter are designed to measure the performance capability of a repaired equipment. Equipment that is to be returned to stock should meet the standards given in these tests.

## 59.2. Applicable References

*a. Repair Standards.* Applicable procedures of the depots performing these tests and the general standards for repaired electronic equipment given in TB SIG 355–1, TB SIG 355–2, and TB SIG 355–3 form a part of the requirements for testing this equipment.

*b. Modification Work Orders.* Perform all modification work orders applicable to this equipment before making the tests specified. DA Pam 310–4 lists all the available MWO's.

## 59.3. Test Facilities Required

The following equipments, or suitable equivalents, will be employed in determining compliance with the requirements of these standards.

*a. Test Equipment.*

| Equipment | Federal stock No. | Quantity reqd | Applicable literature |
|---|---|---|---|
| Frequency Meter AN/TSM–16 | 6626–542–1666 | 1 | TM 11–6625–218–12 |
| Multimeter TS–352/U | 6625–242–5023 | 1 | TM 11–5527 |
| Power Supply PP–1209C/FG | 6130–823–2729 | 1 | TM 11–5805–239–12 |

*b. Additional Equipment*

| Component | Quantity reqd |
|---|---|
| Resistor, 273 ohms ±5%, 1 w | 1 |
| Resistor, 1,540 ohms ±5%, 1 w | 1 |

## 59.4. General Mechanical and Electrical Test Requirements

*a. Meter M1.* The pointer of M1 shall rest on center-scale zero (with no dc power applied). Check the M1 zero indication with the test set in both the upright and horizontal positions.

*b. Polar Relays.* Polar relays S1 and S2, used in the tests, shall meet the requirements of Test Set I–193 (*). An I–193(*) other than the one under test shall be used to determine the acceptability of these relays.

*c. Lever Switches.* The lever switches (K1 through K6) should move freely and smoothly through all positions. The contacts should close with a slight *follow* when the switches are operated.

*d. Dc Power.* All of the following requirements shall be met with the test set operating on a 130-volt dc supply. Test set cord shall be plugged into jack J1.

## 59.5. Blown Fuse Indicator Test

Remove fuse F1, and check to see that the neon indicating lamp LP1 lights. Restore the fuse to its holder.

## 59.6. Bias Adjusting Circuit of Relay S2 Test

Place switch K6 in the DOTS HIGH position, and all other switches in midposition. Adjust ADJ DOTS BIAS potentiometer P1. It shall be capable of adjusting the bias of relay S2 to zero (0) indication on meter M1.

## 59.7. Frequency of Opens and Closures (Dots) Test

*a.* Prepare Frequency Meter AN/TSM–16 for operation in accordance with instructions in chapter 2, TM 11–6625–218–12.

*b.* With relay S2 in its socket, connect a test lead between terminal 6 on the S2 connecting block and the Adapter Connector UG–641/U on the frequency meter. Connect another test lead between terminal 3 on the S2 connecting block and the ground binding post on the frequency meter. Make the following frequency measurements:

(1) Place switch K6 on the I–193(*) in the DOTS LOW position. The frequency meter should indicate a frequency between 9 and 11 dots per second.
(2) Place switch K6 in the DOTS HIGH position. The frequency meter should indicate a frequency between 19 and 22 dots per second.

## 59.8. Current Values Test

*a. Connector Block CB2 or CB4 Current Test.*

***Caution:*** **When making current tests, the meter polarity must conform with the polarity indicated in figure 32 for a positive (+) value. For a negative (−) value, the meter test leads must be reversed.**

(1) Connect a 273-ohm ±5 percent, 1-watt resistor between terminals 2 and 7 on CB2 or CB4 relay connecting block (no relay in block).
(2) Connect test leads between the milliammeter circuit of Multimeter TS–352/U and terminals 3 and 6 of the CB2 or CB4 relay connecting block. Use the 2.5-ma or 10-ma range as required.

*Note.* When testing the I–193–C, connect a 273-ohm ±5 percent, 1-watt resistor between terminals 2 and 7 of CB2, or terminals 5 and 2 of CB4. Connect the TS-352/U milliammeter between terminals 3 and 6 of CB2 or terminals 1 and 3 of the CB4 relay connecting block.

(3) With the test set switches positioned as specified in the following chart, the current indicated by the TS–352/U must be within the listed required current value range.

| Switch position | | | | | | Required current value range (ma) |
|---|---|---|---|---|---|---|
| K1 | K2 | K3 | K4 | K5 | K6 | |
| SENSITIVITY | SPACE | Midposition | CB2 OR CB4 | TST REL | DOTS HIGH | +4.7 to +5.3 |
| SENSITIVITY | SPACE | OPERATE | CB2 OR CB4 | TST REL | DOTS HIGH | −0.72 to −0.78 |
| SENSITIVITY | SPACE | NON OPR | CB2 OR CB4 | TST REL | DOTS HIGH | −0.26 to −0.30 |
| SENSITIVITY | MARK | Midposition | CB2 OR CB4 | TST REL | DOTS HIGH | −4.7 to −5.3 |
| SENSITIVITY | MARK | OPERATE | CB2 OR CB4 | TST REL | DOTS HIGH | +0.72 to +0.78 |
| SENSITIVITY | MARK | NON OPR | CB2 OR CB4 | TST REL | DOTS HIGH | +0.26 to +0.30 |

*b. Connector Block CB1 or CB3 Current Test.*

***Caution:*** **When making current tests, the meter polarity must conform with the polarity indicated in figure 32 for a positive (+)value. For a negative (−) value, the meter leads must be reversed.**

(1) Connect a 1,540-ohm ±5 percent, 1-watt resister between terminals 3 and 6 of the CB1 or CB3 relay connecting block (no relay in block). Remove the TS–352/U milliammeter circuit test leads from the CB2 or CB4 connecting block, and connect them to terminals 8 and 9 of the CB1 or CB3 connecting block.

(2) With the test set switches positioned as specified in the following chart, the current indicated by the TS–352/U must be within the listed required current value range.

| Switch position | | | | | | Required current value range (ma) |
|---|---|---|---|---|---|---|
| K1 | K2 | K3 | K4 | K5 | K6 | |
| SENSITIVITY | SPACE | Midposition | CB1 OR CB3 | TST REL | DOTS HIGH | −2.5 to −2.7 |
| SENSITIVITY | SPACE | OPERATE | CB1 OR CB3 | TST REL | DOTS HIGH | +0.38 to +0.41 |
| SENSITIVITY | SPACE | NON OPR | CB1 OR CB3 | TST REL | DOTS HIGH | +0.12 to +0.15 |
| SENSITIVITY | MARK | Midposition | CB1 OR CB3 | TST REL | DOTS HIGH | +2.5 to +2.7 |
| SENSITIVITY | MARK | OPERATE | CB1 OR CB3 | TST REL | DOTS HIGH | −0.38 to −0.41 |
| SENSITIVITY | MARK | NON OPR | CB1 OR CB3 | TST REL | DOTS HIGH | −0.12 to −0.15 |

## 59.9. Operational Test

*a.* Insert a 255A relay, known to be in good operating condition and properly adjusted, into the CB2 connecting block.

*b.* With the test set switches positioned as specified in the following chart, the required panel meter readings must be attained.

| Switch position | | | | | | Required panel meter indications |
|---|---|---|---|---|---|---|
| K1 | K2 | K3 | K4 | K5 | K6 | |
| BIAS | MARK | Midposition | CB2 OR CB4 | TST REL | DOTS HIGH | The meter pointer should not vibrate more than one-half of one division to either side of zero. |
| SENSITIVITY | MARK | Midposition | CB2 OR CB4 | TST REL | DOTS HIGH | 100 to the left of zero. |
| SENSITIVITY | MARK | NON OPR | CB2 OR CB4 | TST REL | DOTS HIGH | 100 to the left of zero. |
| SENSITIVITY | MARK | OPERATE | CB2 OR CB4 | TST REL | DOTS HIGH | 100 to the right of zero. |
| SENSITIVITY | SPACE | Midposition | CB2 OR CB4 | TST REL | DOTS HIGH | 100 to the right of zero. |
| SENSITIVITY | SPACE | NON OPR | CB2 OR CB4 | TST REL | DOTS HIGH | 100 to the right of zero. |
| SENSITIVITY | SPACE | OPERATE | CB2 OR CB4 | TST REL | DOTS HIGH | 100 to the left of zero. |

*Page 81,* paragraph 7, appendix I (as changed by C 2, 27 Sep 63). Add the following references:

| | |
|---|---|
| DA Pam 310–4 | Index of Technical Manuals, Technical Bulletins, Supply Manuals (types 7, 8, and 9), Supply Bulletins, Lubrication Orders, and Modification Work Orders. |
| TB SIG 355–1 | Depot Inspection Standard for Repaired Signal Equipment. |
| TB SIG 355–2 | Depot Inspection Standard for Refinishing Repaired Signal Equipment. |
| TB SIG 355–3 | Depot Inspection Standard for Moisture and Fungus Resistant Treatment. |
| TB SIG 364 | Field Instructions for Painting and Preserving Electronics Command Equipment. |
| TM 9–213 | Painting Instructions for Field Use. |
| TM 11–5805–239–12 | Operator and Organizational Maintenance Manual: Power Supplies PP–1209/FG, PP–1209A/FG, PP–1209B/FG, and PP–1209C/FG. |
| TM 11–6625–210–10P | Operator's Maintenance Repair Parts and Special Tool Lists: Test Sets I–193–A, I–193–B, and I–193–C. |
| TM 11–6625–210–20P | Organizational Maintenance Repair Parts and Special Tool Lists and Maintenance Allocation Chart for Test Sets I–193–A, I–193–B, and I–193–C. |
| TM 11–6625–210–35P | Field and Depot Maintenance Repair Parts and Special Tool Lists: Test Sets I–193–A, I–193–B, and I–193–C. |
| TM 11–6625–218–12 | Organizational Maintenance Manual: Frequency Meter AN/TSM–16. |
| TM 11–6625–366–15 | Organizational, DS, GS, and Depot Maintenance Manual: Multimeter TS–352 B/U. |
| TM 38–750 | Army Equipment Record Procedures. |

*Page 82* (as changed by C2, 27 Sep 63). Delete appendix II.

*Facing page 92,* figure 32 (fold-out) (as changed by C 2, 27 Sep 63). Make the following changes:

Change the caption to: *Test Sets I–193–A and I–193–B, schematic diagram.*

Change NOTE 4 to: RELAYS SHOWN IN CB1 THROUGH CB4 ARE NOT PART OF THE TEST SET.

Add NOTE 5:

5. TEST SET I–193–C IS IDENTICAL EXCEPT FOR CIRCUITRY OF CB4. SEE SCHEMATIC DIAGRAM, CB1 THROUGH CB4, I–193–C (fig. 32.1).

Add figure 32.1 (as added by C 2, 27 Sep 63) after figure 32.

*Figure 32.1 Schematic diagram, CB1 through CB4, I–193–C.*





GPO 811—537—2

By Order of the Secretary of the Army:

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| USACRREL (2) | 29–11 |
| Sig FLDMS (2) | 29–15 |
| Units org under fol TOE | 29–16 |
| (2 ea): | 29–21 |
| 7 | 29–25 |
| 7–100 | 29–26 |
| 11–35 | 29–35 |
| 11–36 | 29–36 |
| 11–56 | 29–41 |
| 11–57 | 29–56 |
| 11–95 | 29–75 |
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| 11–117 | 29–105 |
| 11–155 | 29–109 |
| 11–157 | 32–52 |
| 11–158 | 37 |
| 11–500(AA–AC) | 37–100 |
| 11–587 | 47 |
| 11–592 | 57–100 |

*NG:* State AG (3).

*USAR:* None.

For explanation of abbreviations used, see AR 320–50.

U.S. Government Printing Office: 1967—255-596/7393B

811—537—1

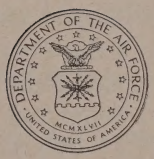
*TM 11–2513/TO 16–40–193–5*

*This manual supersedes TM 11–2513, 21 June 1944, including C1, 30 April 1948, C2, 8 August 1949, and C3, 13 December 1950*

# TEST SETS

# I–193–A, I–193–B AND I–193–C




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DEPARTMENTS OF THE ARMY AND
THE AIR FORCE

WASHINGTON 25, D. C., *24 March 1952*

TM 11–2513/TO 16–40–I 193–5 is published for the information and guidance of all concerned.

[AG 413.44 (7 Mar 52)]

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Tech Svc (1); Tech Svc Bd (1); AFF Bd (ea Svc Test Sec) (1); AFF (5); AA Comd (2); OS Maj Comd (5); Base Comd (5); Log Comd (5); A (20); MDW (5); CHQ (2); FT (2); Sch (5) except 11 (25); Gen Dep (2); Dep 11 (20) except Sig Sec, Gen Dep (10); Tng Div (2); POE (10), OSD (2); Lab 11 (5); Mil Dist (3); 4th & 5th Ech Maint Shops 11 (3); Two (2) copies to each of the following T/O&E's: 11–16; 11–17; 11–107; 11–127; 11–500, CA, CB, CC, CD; 11–587; 11–592; 11–597.

*NG:* Same as Active Army except one copy to each unit.

*ORC:* Same as Active Army except one copy to each unit.

For explanation of distribution formula, see SR 310–90–1.

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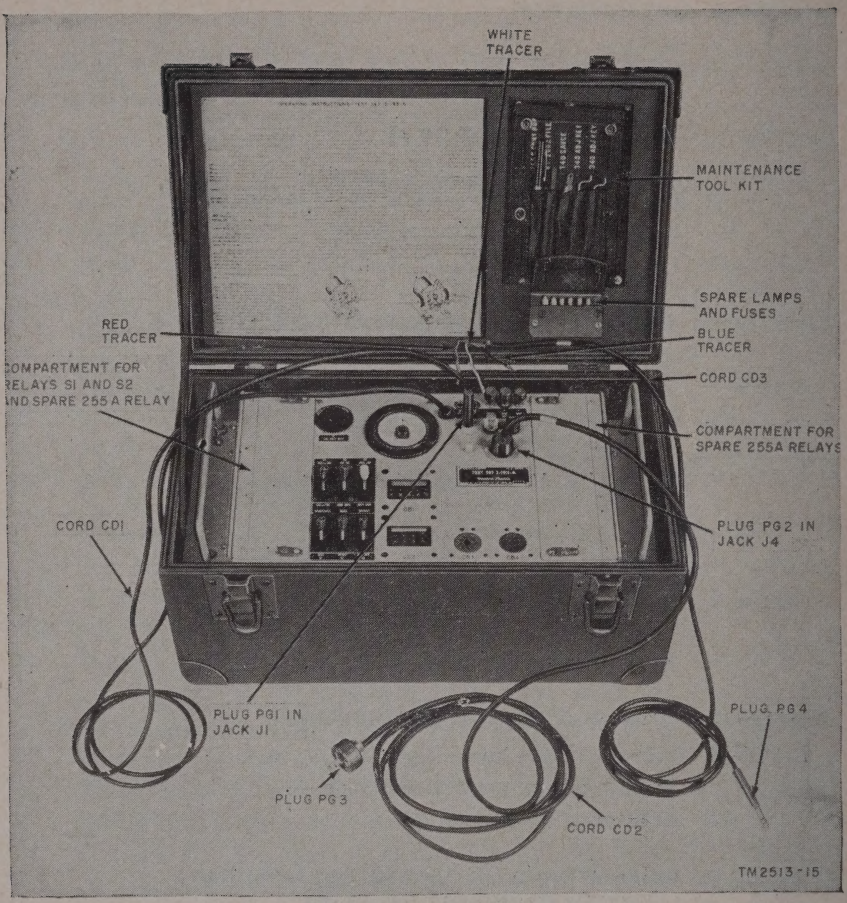



*Figure 1. Test Set I–193–A, cover raised.*

*This manual supersedes TM 11–2513, 21 June 1944, including C1, 30 April 1948, C2, 8 August 1949, and C3, 13 December 1950*

# CHAPTER 1
# INTRODUCTION

## Section I. GENERAL

### 1. Scope

*a.* This technical manual is published for the information and guidance of the personnel to whom this equipment is issued. It contains a physical description of the equipment, operating instructions, repair of equipment, instructions for removing the equipment from service and repacking for shipment or limited storage, and instructions for demolishing the equipment to prevent enemy use. This manual applies only to Test Sets I–193–A, I–193–B, and I–193–C.

*b.* Appendix I contains a list of references including supply catalogs, technical manuals on associated equipment, and other available publications applicable to the equipment. Appendix II contains an identification table of parts.

### 2. Forms and Records

The following standard forms will be used for reporting unsatisfactory conditions of Army equipment and in performing preventive maintenance:

*a.* DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–5 (Army), and AFR 71–4 (Air Force).

*b.* DA AGO Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700–45–5.

*c.* AF Form 54, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700–45–5 and AFR 65–26.

*d.* Use other forms and records as authorized.

## Section II. DESCRIPTION AND DATA

### 3. Purpose and Use

*a.* Test Sets I–193–A, I–193–B, and I–193–C (figs. 1 and 2) are portable test sets used to test and adjust 255-type polar relays. These include relays 255A, D–163119A (similar to 255A except that the relay has been moistureproofed), and D–164816 (figs. 6 through 9). Circuits for testing these polar relays for bias and for sensitivity of operate and nonoperate current values are included in each unit. The electrical operating characteristics of the relay under test are determined by deflections of the test set meter needle. In addition, the test set contains a circuit that produces and sends a continuous series of impulses, called dots, for testing external telegraph circuits.

*Note.* Test Sets I–193–A, I–193–B, and I–193–C are similar in external appearance and identical in operation. A specific model of the test set will be referred to in the text by its supplement letter—for example, Test Set I–193–A. When all models of the unit are under discussion, however, the test set will be referred to as Test Set I–193–(*).

*b.* Test Set I–193–(*) operates from a power source of 115/130 volts dc (direct current). This may be battery from associated telegraph equipment or power provided by a rectifier or power unit. An oscillator circuit converts the dc necessary for operation to 10- or 20-cps (cycles per second) ac (alternating current) for testing and line-up purposes.

### 4. Physical Description

*a.* Test Set I–193–(*) is inclosed in a plywood carrying case with a hinged cover. Handles for carrying the unit are located on each end of the case. All the lever switches, a potentiometer, jacks and connectors for operation of the unit, the connecting blocks for testing polar relays, and the meter are located on the front panel of the equipment (fig. 3). A kit containing tools for maintenance and adjustment of 255-type polar relays, a case containing spare fuses and lamps, and operating instructions for the test set are mounted inside the cover of the case.

*b.* A hinged compartment for carrying three spare polar relays is located on the right-hand side of the front panel (fig. 4). On the left-hand side, a similar compartment mounts the two polar relays used in the test set and has space for carrying a spare relay. These two compartments are fastened with slide-type latches.

*c.* All of the test set apparatus is mounted on the back of the operating panel. It can be reached for maintenance purposes by loosening the two captive screws on the flanges at each end of the

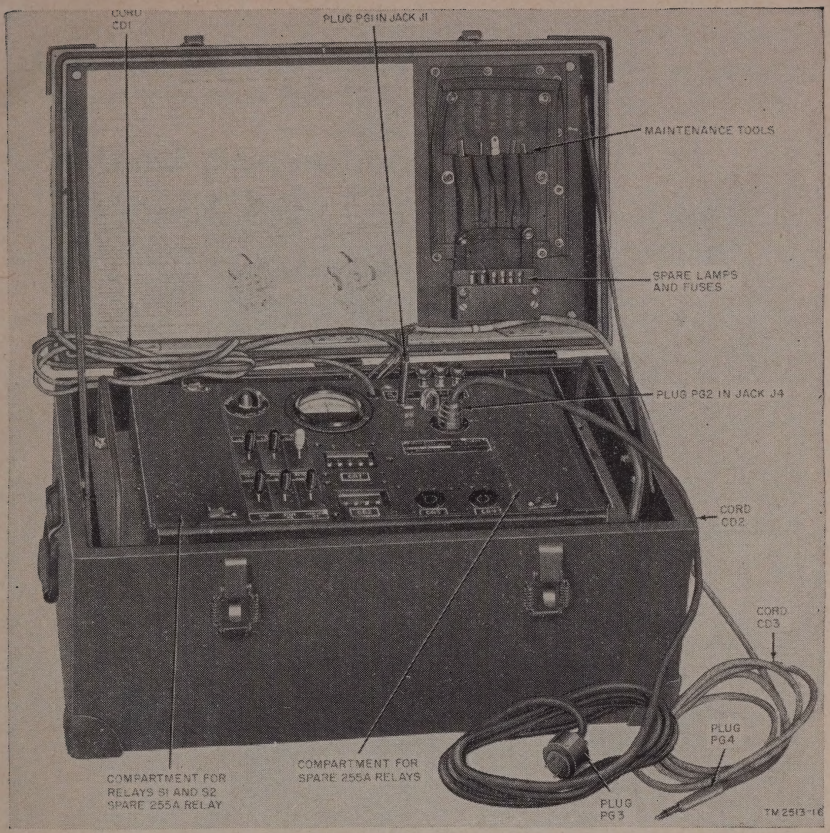



*Figure 2. Test Set I–193–B, cover raised.*

panel, which secure the unit to the rubber shock mountings in the case, and then lifting the unit from the case by the metal handles. The equipment circuit label is mounted in the bottom of the case.

*d.* Three cords are provided with the test set. The power input cord (CD1) is a two-conductor cord 8 feet long. One end is connected to a terminal board inside the test set, the other end is equipped with a telephone-type plug. A clip mounted on the test set panel holds the plug when the cord is not in use. A three-conductor power cord (CD3) 8 feet long is used when a terminal or intermediate repeater is used as a source of battery. This cord is secured to the cover of the test set by a retaining screw. The white, red, and blue tracers on one end of the cord are fitted with pin-type terminals for connection to the test set binding posts, the other end is equipped with a telephone-type plug. The power cord (CD2) is 10 feet long. The polarized plug at one end of the cord is inserted in the test set connector when the power source is a rectifier or power unit.

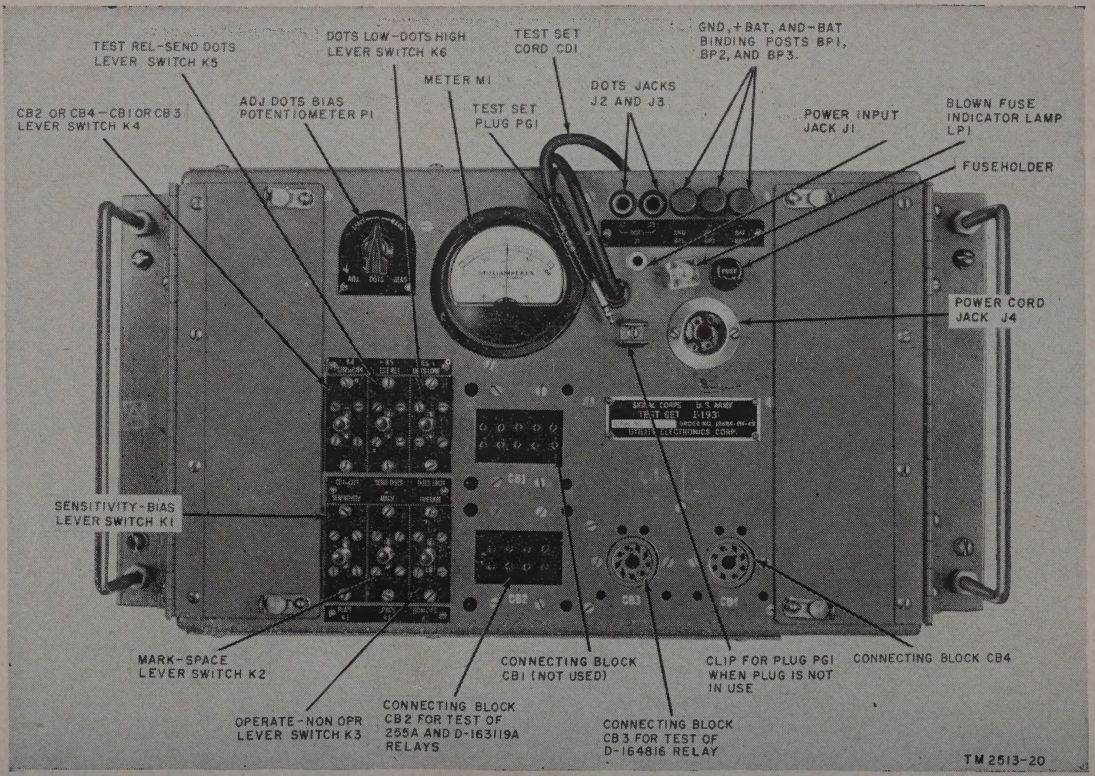



*Figure 3. Test Set I–193–C, front panel showing equipment designations.*

*e.* Test Set I–193–(*) is 23 inches long, 12¾ inches wide, and 11¾ inches high. The unit weighs 63 pounds and displaces approximately 1.8 cubic feet.

## 5. Technical Characteristics

| | |
|---|---|
| Operating power | 115/130 volts dc at 10 watts. |
| Power source | Associated telegraph equipment.<br>Rectifier.<br>Power unit. |
| Output frequency | 10- or 20-cps ac. |
| Meter scale | 0 to 100 ma dc each side in steps of 5 ma. |

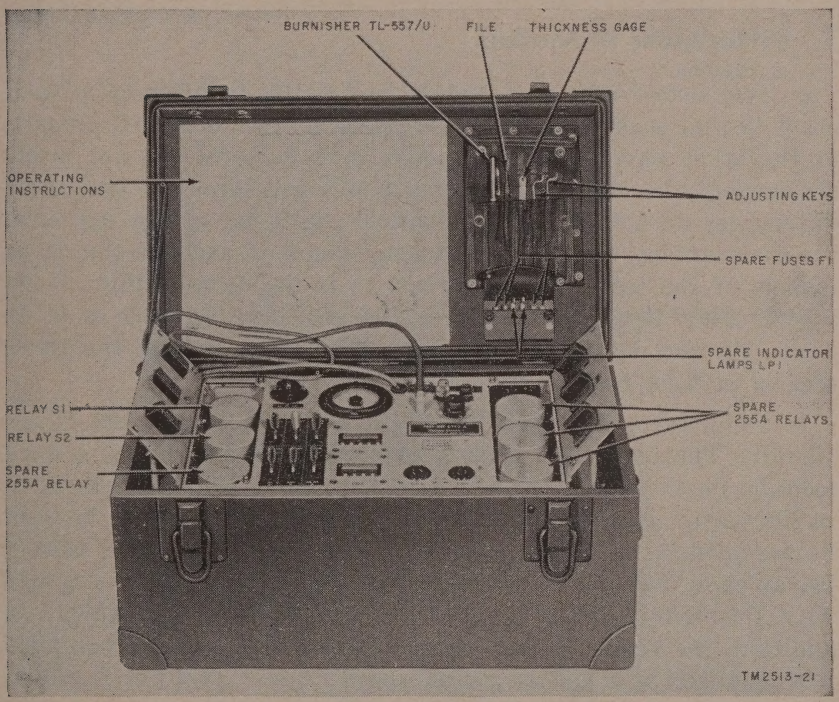



*Figure 4. Test Set I–193–A, front panel with relay compartments open.*

## 6. Packaging Data

Packaging of Test Set I–193–A, I–193–B, or I–193–C is the same for both oversea and domestic shipment (fig. 5). The test set cords are coiled and secured with cotton tape and placed in the carrying case. The face of the panel is covered by cushioning

material, and some desiccant may be placed on the cushioning before the panel is closed. The entire case is cushioned by cells or pads of corrugated fiberboard, or both. These cells and/or pads are placed between all surfaces of the case and a corrugated fiberboard box, and desiccant is secured within the cells. The box is closed and sealed with paper tape, the corners are blunted by a wooden mallet, and the box is placed in a moisture-vaporproof barrier that is heat-sealed. The barrier-wrapped box is then inclosed in a second corrugated fiberboard box which is fitted into a nailed wooden box lined with moistureproof barrier material. The closed shipping container is reinforced with metal straps. The packaged test set is 30 inches long, 16 inches wide, and 15 inches high. The package weighs 135 pounds and displaces approximately 4.2 cubic feet.

## 7. Differences in Models

*a.* Test Sets I–193–A, I–193–B, and I–193–C differ from each other in that each contains some apparatus that differs from each of the other two models. Although certain parts are not interchangeable, the electrical characteristics are the same and these differences do not affect the identical operation of the test sets. To some extent, the interior arrangement of each of the three models of the test set is different, as is the color coding of the wiring used. Refer to the data in the identification table of parts (app. II) for details of apparatus differences among the three models of Test Set I–193–(*).

*b.* Externally, Test Sets I–193–A, I–193–B, and I–193–C are similar. The panel and chassis of Test Set I–193–B has a dark metallic finish while Test Sets I–193–A and I–193–C are finished in light gray enamel. If the meter in Test Set I–193–A has not been replaced, it differs from that used in later units in that it has an open face and a correcting adjustment. The meter supplied with Test Sets I–193–B and I–193–C are hermetically sealed. In addition, the relay compartments of some test sets are equipped with connecting blocks to mount spare relays. Test Set I–193–C, however, does not have this equipment.

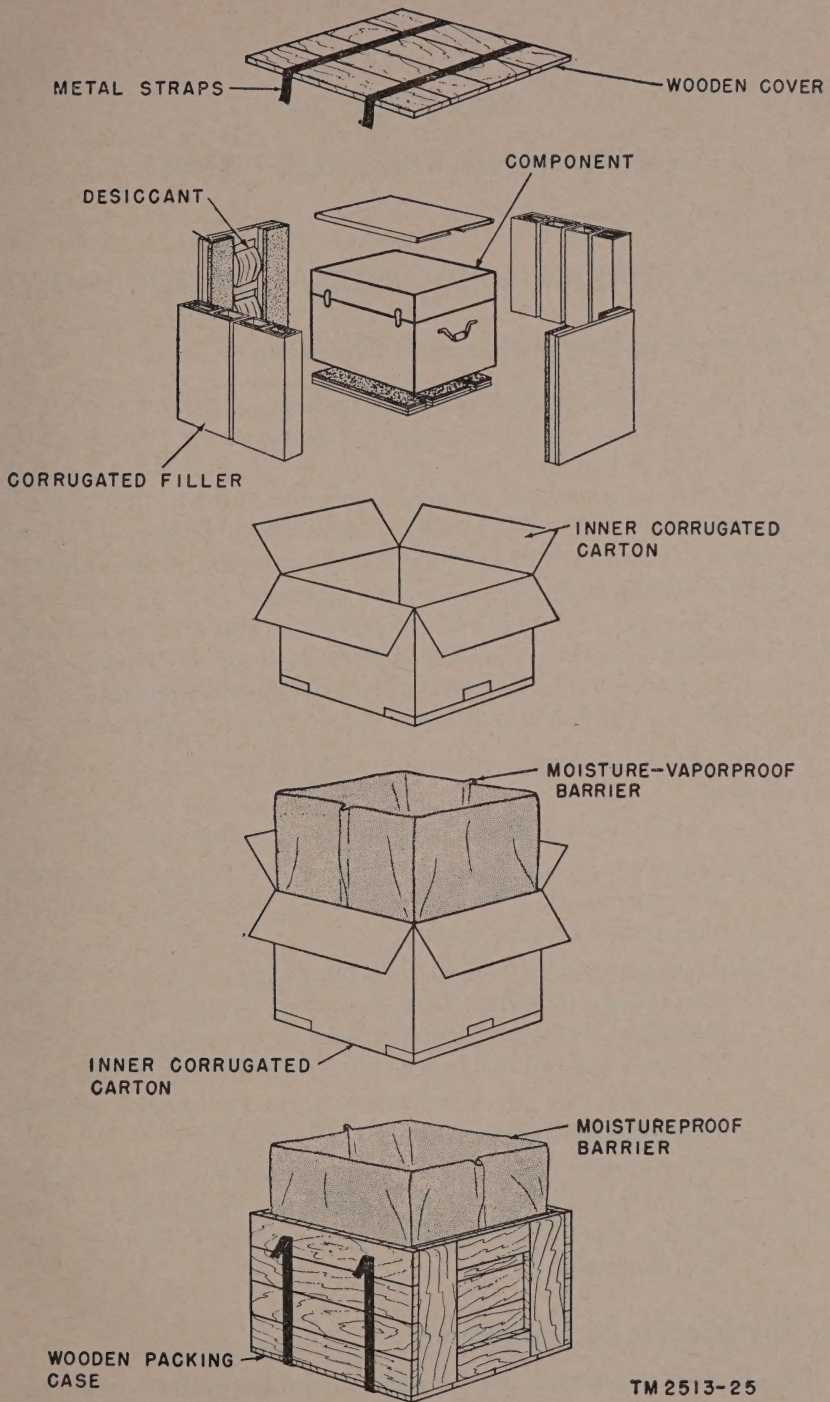



*Figure 5. Test Set I–193–A, I–193–B, or I–193–C, packaging details.*

# CHAPTER 2
# OPERATING INSTRUCTIONS

## Section I. SERVICE UPON RECEIPT OF EQUIPMENT

### 8. Uncrating, Unpacking, and Checking

*a. General.* Test Set I–193–(*) is packed for either oversea or domestic shipment, and the shipping container is secured with metal straps. When new equipment is received, select a location where it may be unpacked without exposure to dust, dirt, and excessive moisture. Be careful when uncrating and unpacking the equipment. Avoid thrusting tools into the interior of the shipping container. When unpacking, do not damage packing materials and containers any more than is necessary. These materials may be used when repacking the unit for storage or for shipment to depot repair shops. Store the interior packaging materials and containers carefully inside the wooden shipping container.

*b. Step-By-Step Instructions for Uncrating and Unpacking Equipment.*

(1) Cut the metal straps with a suitable cutting tool.

(2) Remove the top of the shipping container with a tri-saw box opener. If a box opener is not available, a standard nail puller may be used.

(3) Cut the barrier seal so that the barrier will be damaged as little as possible. Lift the boxed equipment from the shipping container. Cut the seals on the outer fiberboard box and lift the packaged unit from this container.

(4) Carefully cut the moisture-vaporproof barrier and remove the equipment from the interior box.

(5) Thoroughly check the equipment against the shipping documents to see if any equipment is missing. Thoroughly inspect the equipment for possible damage during shipment.

### 9. Installation of Equipment

Locate Test Set I–193–(*) on any convenient table or other flat surface near the source of battery supply. The test set may be

operated from battery supplied by associated telegraph equipment, by equipment such as Repeater TG–30 or Repeater TG–31, from power supplied by a rectifier or power unit, or from an auxiliary power source other than a rectifier or power unit. When the test set has been placed in its operating location, open the hinged cover and connect the available source of 115/130-volt dc (par. 10).

## 10. Power Supply Connections

*Note.* Before connecting the test set, check the voltage of the available d-c power supply with a suitable voltmeter.

*a. Associated Telegraph Equipment.* To connect the test set to the battery supply of associated telegraph equipment, insert the plug of power cord CD1 in the TST SET BAT jack on the jack panel of the telegraph equipment.

*b. Repeater TG–30 or TG–31.*

(1) Connect the pin terminal end of cord CD3 to the test set as follows: the white tracer to the +BAT binding post, the blue tracer to the —BAT binding post, and the red tracer to the GND binding post.

(2) Insert the plug of power cord CD3 in the TST SET battery supply jack of Repeater TG–30 or TG–31.

*Note.* If Repeater TG–30 is used, set the LINE switch of the repeater on position 2.

(3) Insert the plug of power cord CD1 into jack J1 of the test set.

*c. Rectifier or Power Unit.*

(1) Insert the polarized plug of power cord CD2 into jack J4 of the test set.

(2) Insert the two-pronged plug (PG3) of power cord CD2 in the receptacle in Rectifier RA–87, Rectifier RA–37, or an equivalent low-impedance power supply or into the receptacle of Power Unit PE–77–A or its equivalent.

*Note.* Do not use a rectifier or power unit which is used to supply power to any other equipment.

(3) Connect the GND binding post of the test set to ground unless the rectifier or power unit used for the source of power already has its negative side grounded.

(4) To check the polarity of the power supply, operate switch K5 to SEND DOTS and connect plug PG1 of the test set cord CD1 to jack J1.

(5) Observe the meter indication. If the meter needle deflects to the right, reverse plug PG3 of the power cord in the rectifier or power unit receptacle. Return switch K5 to normal.

*d. Auxiliary Power Source.*

(1) Connect the +BAT binding post of the test set to the positive (+) side of the auxiliary low-impedance power source, and connect the —BAT binding post to the negative (—) side of the power source. Ground the negative side of the power source unless it is already grounded.

(2) To check the polarity of the power supply, operate switch K5 to SEND DOTS and connect plug PG1 of the test set cord CD1 to jack J1.

(3) Observe the meter indication. If the meter needle deflects to the right, interchange the wires connected to the +BAT and —BAT binding posts of the test set.

(4) Restore switch K5 to its normal position.

## 11. Service Upon Receipt of Used or Reconditioned Equipment

*a.* Follow the instructions given in paragraph 8 for uncrating, unpacking, and checking the equipment.

*b.* Check the used or reconditioned test set against a new equipment, if available. Make sure that no wiring has been changed and that no parts have been damaged. If wiring has been changed, note the changes on the applicable wiring diagram (figs. 33 through 35). Operate the equipment according to the procedures outlined in the equipment performance checklist (par. 35) to make sure that it is operating properly.

# Section II. CONTROLS, METER, AND MISCELLANEOUS EQUIPMENT

## 12. Controls and Their Uses

| Control | Location | Use |
|---|---|---|
| SENSITIVITY—BIAS switch K1. | Lower left-hand corner of panel. | To test a relay for bias or sensitivity. The bias test determines whether the pole pieces are at equal distances from the relay armature. The sensitivity test determines whether the clearance from each pole piece to the relay armature is correct. The sensitivity test also is a check on contact adjustment. |

| Control | Location | Use |
|---|---|---|
| MARK—SPACE switch K2. | Lower left-hand corner of panel. | Used in operate and nonoperate tests of relays to apply operate and nonoperate current values in both the marking and spacing directions of the relay windings. |
| OPERATE—NON OPR switch K3. | Lower left-hand corner of panel. | To check the sensitivity of a relay to operate and nonoperate current. Operate current is the lowest value of current that will cause the relay to operate. Nonoperate current is the highest value of current at which the relay will not operate. |
| CB2 OR CB4—CB1 OR CB3 switch K4. | Left-hand side of panel. | In the normal CB2 or CB4 position, a relay under test inserted in connecting block CB2 or CB4 is connected in the circuit. Operated to the CB1 or CB3 position, a relay under test inserted in connecting block CB3 is connected in the circuit. (Connecting block CB1 is not used.) |
| TEST REL—SEND DOTS switch K5. | Left-hand side of panel. | Used to select type of operation. The TEST REL position is used when testing the operation of a relay. The SEND DOTS position is used when lining up telegraph circuits. |
| DOTS LOW—DOTS HIGH switch K6. | Left-hand side of panel. | Produces 10- or 20-cycle ac in DOTS LOW or DOTS HIGH position, respectively. |
| ADJ DOTS BIAS potentiometer P1. | Upper left-hand corner of panel. | Used to adjust the dots-producing circuit to zero bias. |

## 13. Meter and Its Use

The meter is used to determine the electrical characteristics of a polar relay by deflection of its needle. When bias is being tested, the meter indicates by deflection the percent of time that the armature of the relay remains on its right-hand or left-hand contact. When sensitivity is being tested, the meter needle gives a full-scale deflection to the right when the relay armature touches the right-hand contact and a full-scale deflection to the left when the armature touches the left-hand contact. In tests for operate and nonoperate current values for relay adjustment in conjunction with the sensitivity test, the meter deflects to the right or left of zero to indicate an operate or nonoperate value of current in the

proper direction to operate the armature to the mark or space contact, or to indicate the application of a soak current in the direction opposite to that which operates the relay armature to the mark or space contact. (The meter indications given in paragraphs 17 and 18 are based on a power supply of 130 volts dc. If the power supply is lower, the amount of deflection of the meter needle will be correspondingly less.)

## 14. Miscellaneous Equipment and Its Use

| Equipment | Location | Use |
|---|---|---|
| Connecting block CB1. | Center of panel___ | Not used. |
| Connecting block CB2. | Bottom of panel___ | Connects two-winding relay 255A or D–163119A in test set circuit for testing and adjusting. |
| Connecting block CB3. | Lower right-hand side of panel. | Connects three-winding relay D–164816 in test set circuit for testing and adjusting. |
| Connecting block CB4. | Lower right-hand corner of panel. | Connects two-winding 255-type relay in test set circuit for testing and adjusting. |
| Jack J1_____ | Upper right-hand corner of panel. | Connects power supply circuit to test set through cord CD1 when repeater, rectifier, power unit, or an auxiliary source of dc is used as a power supply. |
| DOTS jacks J2 and J3. | Upper right-hand corner of panel. | Used to connect dots-producing circuit to associated telegraph equipment for testing purposes. If the telegraph equipment is furnished with a single jack, a patching cord with single plugs is used in jack J2. If the equipment is equipped with a twin jack, a patching cord with twin plugs is inserted in jacks J2 and J3. Patching cords are not furnished with the test set. |
| +BAT binding post_ | Upper right-hand corner of panel. | Connects positive battery to positive side of power source such as a terminal or intermediate repeater. |
| —BAT binding post_ | Upper right-hand corner of panel. | Connects negative battery to negative side of power source such as a terminal or intermediate repeater. |
| GND binding post___ | Upper right-hand corner of panel. | Connects test set to ground when negative side of power source used is not grounded. |

| Equipment | Location | Use |
|---|---|---|
| Connector J4 | Upper right-hand corner of panel. | Polarized receptacle for use with power cord CD2 when rectifier or power unit is used as a power source. |
| Fuse F1 | Upper right-hand corner of panel. | Overload protection in power input circuit. |
| Signal lamp LP1 | Upper right-hand corner of panel. | Lighted, the lamp indicates that fuse F1 has operated. |
| Input power cord CD1 | Upper right-hand side of panel. | Connects test set to source of dc when its plug PG1 is inserted in the TST SET BAT jack of associated telegraph equipment, or into the test set jack J1 when any other power source is used. The cord is attached to terminal board CB5 inside the test set. |
| Power cord CD2 | Not attached to test set. | Connects the test set to a power source such as a rectifier or power unit. The polarized plug PG2 is inserted into connector J4 of the test set, and plug PG3 is inserted in a receptacle in the outlet of the power unit or rectifier. When cord CD2 is used, the plug of input power cord CD1 must be inserted in test set jack J1. |
| Power cord CD3 | Secured to test set cover by retaining screw. | Connects the test set to a power source such as a terminal or intermediate repeater. The white, blue, and red tracers, terminating in pin-type terminals, are attached to the +BAT, —BAT, and GND binding posts of the test set, and plug PG4 is inserted into the TST SET jack of the repeater. When power cord CD3 is used, the plug of input power cord CD1 must be inserted in jack J1 of the test set. |

## Section III. OPERATION UNDER USUAL CONDITIONS

### 15. Preliminary Starting Procedures

*a.* Determine that the power source to be used is 115- to 130-volt dc.

*b.* Connect the test set to the power source in accordance with directions in paragraph 10.

*c.* Connect the GND binding post of the test set to ground unless the power source used already has its negative side grounded.

## 16. Checking for 10- and 20-Cycle Alternating Current

Before operating the test set, check to be sure that the equipment is producing 10- and 20-cycle ac. Proceed as follows:

*a.* Operate switch K6 to DOTS HIGH for 20-cycle ac or to DOTS LOW for 10-cycle ac. Leave all other switches at midposition. The meter needle should vibrate near its zero position until the movement of the needle is an equal distance to both the right and left of zero.

*b.* If the meter needle fails to vibrate near zero, restore switch K6 to midposition and again operate the switch to DOTS HIGH or to DOTS LOW.

*c.* If the meter needle still fails to vibrate near zero, replace relay S1 with an identical relay that is known to be in good adjustment. If a spare relay is not available, adjust relays S1 and S2 on another Test Set I–193–(*) according to directions in paragraph 19.

*d.* When the meter needle is vibrating near zero, turn the knob of the ADJ DOTS BIAS potentiometer until the average meter indication is zero.

## 17. Bias Test of Relay

The bias test is used to determine whether the pole pieces of the relay are at equal distance from the relay armature. If the relay pole pieces are in correct adjustment in relation to the armature, the meter needle will vibrate near zero and will not remain on one side of zero longer than on the other side. To test a relay for bias, proceed as follows:

*a.* Place the relay to be tested in the correct connecting block. Relays 255A and D–163119A (fig. 6) are inserted in connecting block CB2, and relay D–164816 (fig. 7) in connecting block CB3. If connecting block CB2 is used, leave switch K4 in its normal CB2 OR CB4 position. If connecting block CB3 is used, operate switch K4 to the CB1 OR CB3 position.

*b.* Operate switch K6 to DOTS HIGH. This will produce a 20-cycle ac and the armature of the relay under test will oscillate between the space and mark contacts at approximately 20 cps.

*c.* Operate switch K5 to TST REL. This connects the contacts

of the relay under test to the meter circuit. As the relay armature oscillates between its contacts, the meter will be deflected off zero, first to one side and then to the other.

*d.* Operate switch K1 to BIAS. The meter needle should not deflect more than one-half of one scale division to the right or left of zero.

*e.* If the meter needle is held to one side of its deflection longer than to the other side, it indicates that there is a greater percentage of bias in either the marking or spacing direction, depending on which side the meter needle is held for the longer period of time, and the relay pole pieces are out of adjustment. Adjust in accordance with directions in paragraph 19.

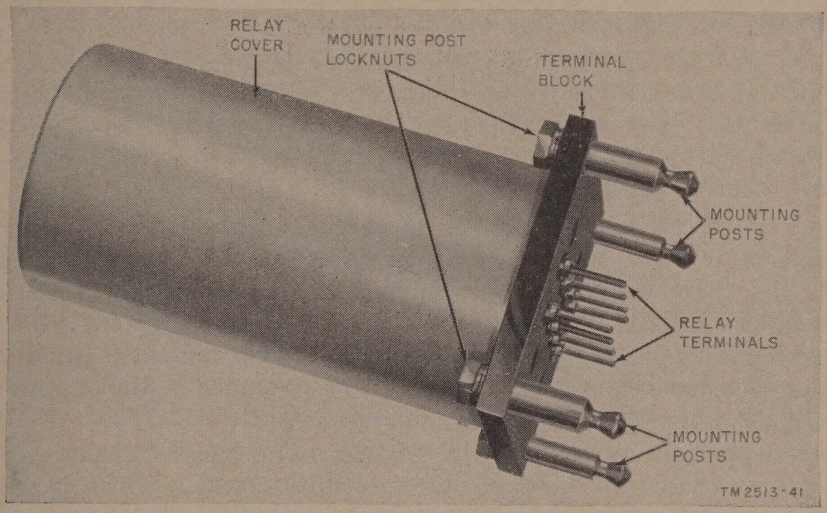



*Figure 6. Relay 255A or D–163119A, terminal end.*

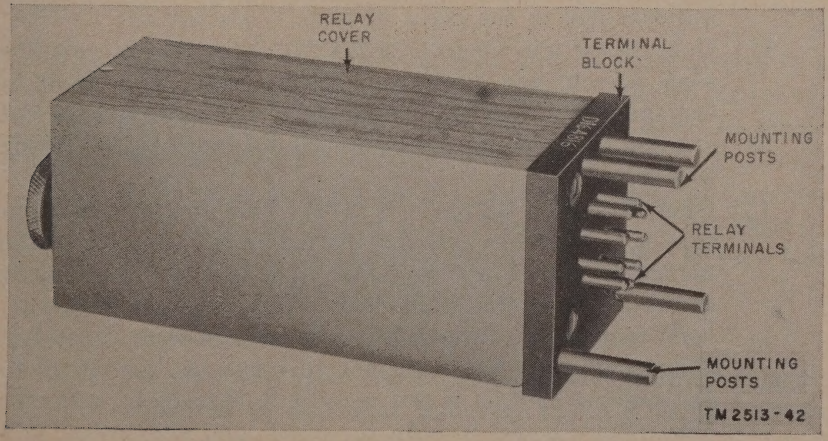



*Figure 7. Relay D–164816, terminal end.*

## 18. Sensitivity Test of Relay

The pole pieces of the relay under test can be at equal distances from the armature (par. 17) and the relay can still be out of adjustment, thus affecting its sensitivity. The sensitivity test of a relay is made to determine whether the clearance from each pole piece to the relay armature is correct and, at the same time, to check on contact adjustment. When testing for sensitivity, operate and nonoperate current values are applied to the relay windings in both the marking and spacing directions. Operate current is the lowest value of current that will cause the relay armature to operate. Nonoperate current is the highest value of current at which the relay armature will not operate. To test a relay for sensitivity, proceed as follows:

*a. General.* Place the relay in the correct connecting block and operate switch K4 to the position corresponding to the connecting block used (par. 17*a*). Operate switch K6 to DOTS HIGH and switch K5 to TST REL, and restore switch K1 to SENSITIVITY. All other switches are at normal.

*b. Application of Soak Current and Operate and Nonoperate Current Values.* Before operate or nonoperate current is applied to the relay windings, soak current is applied so that a fixed magnetic condition will exist in the relay windings before either operate or nonoperate current is applied. Soak current is greater in value than the operating current and is applied in the opposite direction to operate and nonoperate current.

(1) Operate switch K2 to SPACE. This applies a soak current in a direction opposite to that which will hold the relay armature in the spacing position. The armature should be on the *marking* contact and the meter should indicate 100 to the right of zero.

(2) Operate switch K3 to OPERATE. This disconnects the soak current and applies an operate value of current in the spacing direction. The armature should move to the *spacing* contact and the meter should indicate 100 to the left of zero.

(3) Operate switch K3 to NON OPR. This applies a momentary soak current, causing the armature to move to the *marking* contact and the meter to deflect 100 to the right of zero. After the momentary application of soak current, nonoperate current is applied in a spacing direction. This current is not sufficient to move the armature to the spacing contact if the relay is in correct adjustment. The relay should remain on mark and the meter still should indicate 100 to the right of zero.

(4) Operate switch K2 to MARK and return switch K3 to normal. This applies soak current in a spacing direction and the armature should move to the *spacing* contact. The meter should indicate 100 to the left of zero.

(5) Operate switch K3 to OPERATE. This disconnects soak current and connects operate current in a marking direction. The relay armature should move to the *marking* contact and the meter should indicate 100 to the right of zero.

(6) Operate switch K3 to NON OPR. This removes current in the marking direction and applies soak current, thus causing the armature to move to the *spacing* contact and the meter needle to deflect to 100 to the left of zero. After the momentary application of soak current, nonoperate current is applied in a marking direction. This, however, is not sufficient to move the armature to the mark contact if the relay is properly adjusted. The armature should remain on the spacing contact and the meter should continue to indicate 100 to the left of zero.

## 19. Relay Adjustment

*a. General.*

(1) Power and relay connections for adjusting a relay are the same as for relay testing. Place the relay to be adjusted in the correct connecting block. Refer to figures 8 and 9 for the location of the pole piece screws, the tension nuts, and the contact screws.

(2) Remove the relay cover. Back off the pole piece screws as far as possible with the adjusting key supplied with the test set.

(3) Use the adjusting key to turn both contact screws in a direction which moves them away from the armature until there is an observable clearance between the armature and both of the stationary contacts.

(4) Operate switch K4 to the position which corresponds with the connecting block used (par. 17*a*). Operate switch K5 to TST REL. Leave switches K1, K2, K3, and K6 in their normal positions.

*b. Armature Travel Adjustment.*

(1) Advance the right-hand contact screw until the meter deflection to the right indicates that the contact screw just touches the armature. Back off the right-hand screw

for a distance equal to one-third the angle between adjacent holes in the contact screw.

(2) Follow the same procedure with the left-hand contact screw. In this case, the meter needle will be deflected to the left of zero.

(3) Check armature travel limits of .003 to .005 inch with the thickness gage. Before using the blades, wipe them with a clean, lint-free cloth moistened with solvent (SD). Do not touch the blades with the fingers. Hold the armature lightly against one contact and check the contact gap between the armature and the other stationary contact. The .003-inch gage should pass through the contact gap easily while the .005-inch gage should require some pressure. Check the contact gap on the opposite side in the same manner.

(4) If the armature travel limit is less than .003 inch or more than .005 inch, repeat the adjustment.

*c. Pole-Piece Screw Adjustment.*

(1) Use the adjusting key to advance the right-hand pole-piece screw until it is near the armature.

(2) Tighten the tension nut on the right-hand pole-piece screw until a noticeable increase of force is required to move the pole-piece screw. On relay 255A or D–163119A, turn the knurled tension nut with the fingers. On relay D–164816, turn the tension nut with the adjusting key inserted in the slot of the nut.

(3) Continue to advance the right-hand pole-piece screw until it touches and moves the armature far enough to cause the armature to close the left-hand contact. This will be indicated by deflection of the meter needle to the left.

(4) Back off the right-hand pole-piece screw more than one-fourth turn and less than one-half turn.

(5) Advance the left-hand pole-piece screw with the adjusting key until it is near the armature. Tighten the tension nut according to directions in (2) above.

(6) Operate switch K6 to DOTS HIGH and switch K1 to BIAS. The meter needle will vibrate. Advance or retract the left-hand pole-piece screw until the average meter indication is zero.

(7) Test the relay for sensitivity (par. 18).

(8) If the operate tests for sensitivity fail, make the relay more sensitive—that is, adjust it to operate on less cur-

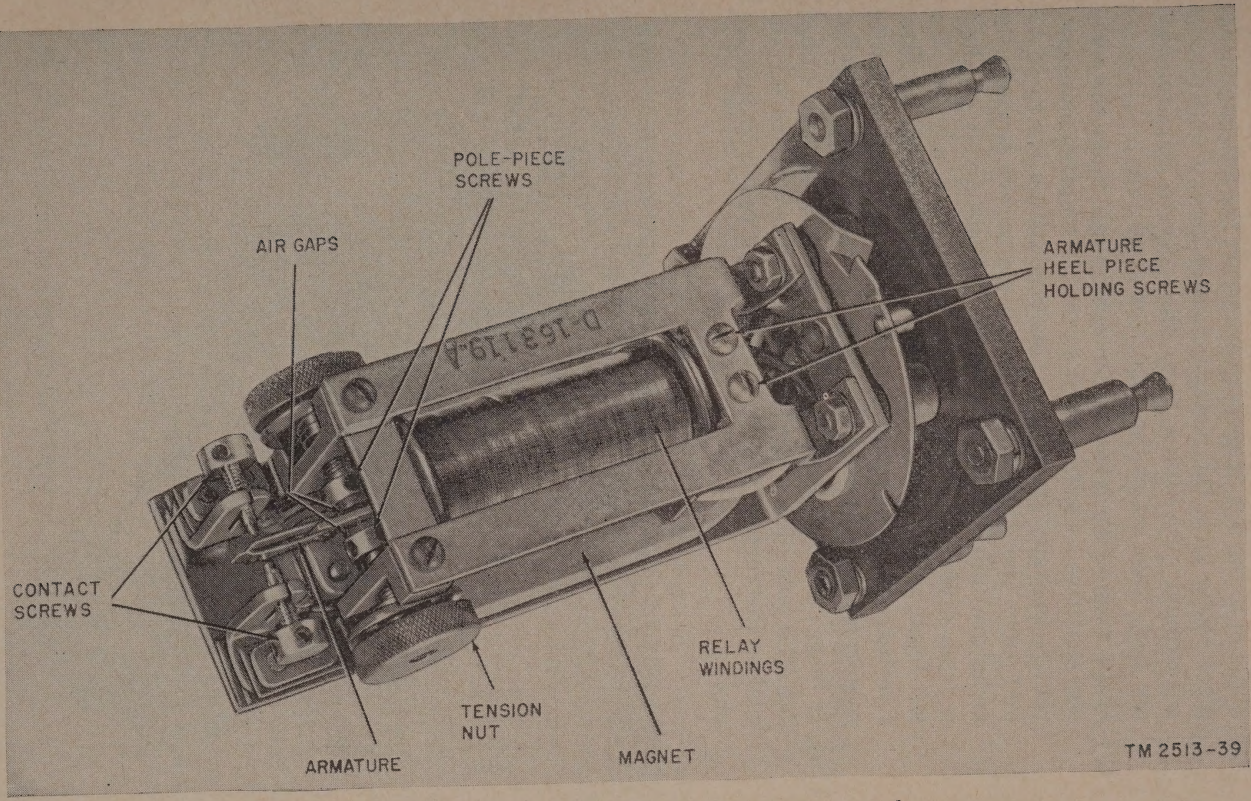



*Figure 8. Relay 255A or D–163119A, cover removed.*

rent. To do this, operate switch K1 to BIAS and turn the right-hand pole-piece screw away from the armature until the meter needle deflects about one-half a scale division to the left of zero, then retract the left-hand pole-piece screw until the meter indicates zero. Continue the adjustment procedures until the operate requirements are met, then retest the relay for sensitivity.

(9) If the nonoperate tests for sensitivity fail, make the relay less sensitive by adjusting it so that it requires more current to operate. To do this, operate switch K1 to BIAS and turn the right-hand pole-piece screw toward the armature until the meter needle deflects about one-half a scale division to the right of zero, then advance the left-hand pole-piece screw until the meter indicates zero. Continue the adjustment procedures until the nonoperate requirements are met, then retest the relay for sensitivity.

(10) If tests for both operate and nonoperate current values fail, the pole pieces are too far from the armature. Adjust as instructed in (9) above until all requirements are met.

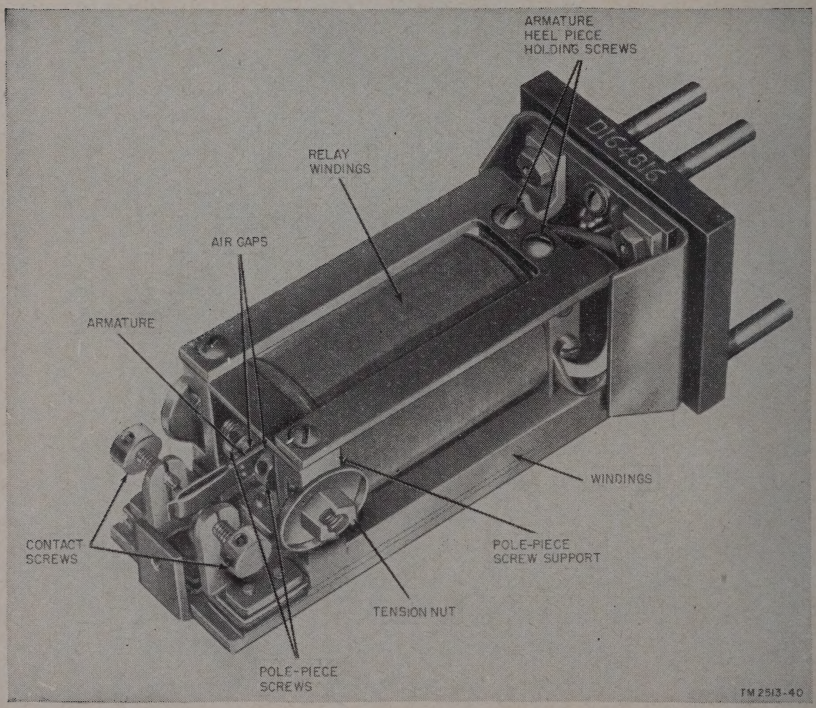



*Figure 9. Relay D–164816, cover removed.*

## 20. Sending Dots

*a.* If the telegraph equipment to be tested has a single jack for testing purposes, connect the DOTS jack J2 of the test set to the associated jack of the telegraph equipment with a patching cord having a single plug at each end. If the telegraph equipment is equipped with a twin jack, connect the DOTS jacks J1 and J2 to the telegraph equipment with a patching cord having a twin plug at each end.

*Note.* Patching cords are not furnished with Test Set I–193–(*).

*b.* Operate switch K6 to DOTS HIGH to send 20 dots per second, or to DOTS LOW to send 10 dots per second.

*c.* OPERATE switch K5 to SEND DOTS.

# Section IV. OPERATION UNDER UNUSUAL CONDITIONS

## 21. General

When operating Test Set I–193–(*) in regions where extreme cold, heat, humidity, moisture, and sand conditions prevail, special precautions must be taken to keep the equipment in operating condition at all times. Paragraphs 22 through 24 give instructions for minimizing the effect of these unusual operating conditions.

## 22. Operation in Arctic Climates

Since Test Set I–193–(*) is intended for indoor use, it will be exposed to extreme cold only when in storage or transport. When possible, house and use the equipment in a heated shelter. If the test set has been exposed to the cold it will begin to sweat and will continue to do so until it reaches room temperature. This condition also arises when the equipment warms up during the day after exposure during a cold night. When the test set has reached room temperature, dry it thoroughly before attempting to operate the unit. Perform preventive maintenance operations (par. 29) more frequently to keep the unit as moisture-free as possible.

## 23. Operation in Desert Climates

The main problem when operating the equipment in desert climates is to prevent dirt, dust, and sand from filtering into the equipment. If possible, house and use the equipment in a dust-proof shelter. Since such a building is seldom available, however,

make the shelter as dust-free as possible by hanging wet sacking over windows and doors, covering inside walls with heavy paper, and preventing the side walls of tents from flapping in the wind by securing them with sand. Be sure that the relay compartments are latched at all times except when a relay is being replaced. Close and latch the lid of the test set case when the unit is not in use and cover it with canvas or other material.

## 24. Operation in Tropical Climates

When operated in tropical climates, the test set should be used in a building or shelter. The high relative humidity of such climates causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the ambient air. Inspect and clean the equipment frequently to keep it free from rust, corrosion, and fungus growth. Keep the equipment as dry as possible. Place a lighted electric bulb or a small bag of desiccant in the compartment containing the test set relays to help prevent moisture from entering the relay windings.

# CHAPTER 3

# ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

## Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

### 25. Tools and Materials for Preventive Maintenance

The tools and materials necessary to perform preventive maintenance operations are listed below. These tools and materials may be obtained through regular supply channels.

| Signal Corps stock No. | Item | Used to |
|---|---|---|
| 6Z7500–0000 | ABRASIVE, sheet: sandpaper; #0000. | Remove rust and corrosion from metal parts. |
| CE supply No. 38–3606.300.200 | BRUSH, paint: soft hair; flat; 1" wide. | Remove dust, dirt, and lint from switches, control, binding posts, and from interior of equipment. |
| 6G184.1 | CARBON TETRACHLORIDE. | Remove gummy deposits from switch and jack contacts. |
| 6Z1989 | CLOTH, textile: cheesecloth; lint-free. | Clean various parts of equipment. |
| 6R40848/1 | SCREW DRIVER TL–386/U: slot drive. | Tighten loose mounting screws. |
| QM supply No. 51–S–4381–1 | SOLVENT, dry cleaning (SD). | Clean grease, oil, and corrosion from equipment. |
| 6Z7360 | STICK, orange_____ | Remove fungus growth from apparatus. |
| 6N8583 | TAPE TL–83: friction; ¾" wide. | Repair wiring insulation. |

### 26. Special Tools Issued with Test Set

Special tools used to clean and adjust relays—both the relays used in Test Set I–193–(*) and those being tested—are carried in a tool kit attached inside the cover of the test set. These special tools are listed below and are shown in figure 10.

| Tool | Description | Used to |
|---|---|---|
| Adjuster, spring (two adjusting keys). | Nickel silver rod with parallel offset one end, black fiber handle on straight end; marked 340. | Adjust relay contact gap and pole-piece screws. |
| Burnisher TL–557/U____ | Fountain pen type handle containing six burnisher blades and six wire burnishers; marked 265C. | Clean and burnish relay contacts. |
| File_____ | Jeweler's type; #6 cut; KS–2662. | Dress relay contacts. |
| Gage, thickness_____ | U-shaped case forms nest for gages; 12 leaves, .002″ through .012″ and .018″ thick; marked 74D. | Measure relay contact gap for armature travel. |

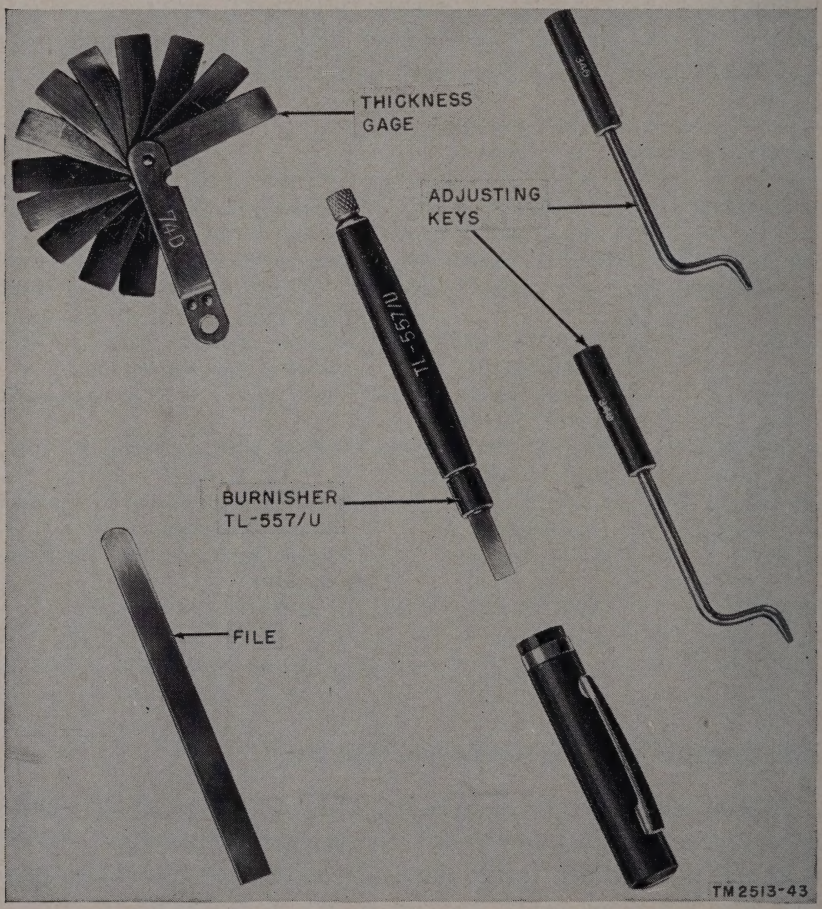



*Figure 10. Relay maintenance tools.*

## Section II. PREVENTIVE MAINTENANCE SERVICES

### 27. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment, usually when it is not in use, to keep it in such good working order that break-downs and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from trouble shooting and repair since its object is to prevent certain troubles from occurring. See AR 750–5 for information on organizational, field, and base maintenance.

### 28. General Preventive Maintenance Techniques

*a.* Use No. 0000 sandpaper to remove corrosion.

*b.* Use a clean, dry, lint-free cloth or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten or brush with solvent (SD) and then wipe the parts dry with a cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride and wipe them dry with a dry cloth.

***Caution:*** Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. Make sure adequate ventilation is provided.

*c.* If available, dry compressed air may be used at a line pressure not exceeding 60 psi to remove dust from inaccessible places. Be careful, however, or mechanical damage from the air blast may result.

*d.* For further information on preventive maintenance techniques, refer to TB SIG 178.

### 29. Performing Preventive Maintenance

The following checklist shows the operator how to maintain the equipment so that trouble shooting and repair can be reduced to a minimum. The list shows what, when, and how to check, and precautions to be taken before, during, and after checking the equipment. The operations are self-explanatory.

| Item | What to check | When to check | How to check | Precautions |
|---|---|---|---|---|
| 1 | Exterior of unit. | Weekly | Inspect for damaged places, chipped paint, dirt, dust, grease, rust, corrosion, broken or loose switch and control knobs, and loose or missing screws. Tighten all loose screws and replace any that are missing. Tighten the set screw on the side of the potentiometer control knob. Wipe off dirt and grease with a clean, dry cloth. Use a cloth slightly moistened with solvent (SD) to remove dirt, or corrosion which cannot be removed with a dry cloth. Remove rust or corrosion which cannot be removed with solvent (SD) with No. 0000 sandpaper and wipe with a dry cloth. | Do not tighten screws carelessly. Screws tightened beyond the pressure for which they are designed will be damaged or broken. |
| 2 | Interior of unit and carrying case. | Monthly | Lift the unit from the carrying case by the handles on each side of the front panel. Wipe the interior of the case with a dry cloth and remove dirt adhering to the case with solvent (SD). Inspect the apparatus mounted on the back of the front panel for dust, dirt, fungus growth, corrosion, loose or missing mounting screws, loose connections at apparatus terminals, broken leads, and defective insulation. Clean dirt and dust from the apparatus and wiring with a sash brush or another soft brush. Wipe accessible parts with a clean, dry cloth. If fungus growth is present, be sure that the equipment is thoroughly dry before brushing it off. Remove heavy fungus growth with an orange stick and wipe the apparatus with a clean cloth moistened with solvent (SD). Loosen corrosion that cannot be removed with solvent (SD) with No. 0000 sandpaper. | Disconnect all power before performing preventive maintenance operations. Upon the completion of the operations, reconnect the power and check the equipment for satisfactory operation. Tighten screws and nuts securely but do not overtighten. Be careful not to break connections or damage wiring. Do not get solvent (SD) on switch, jack, or relay contacts or on insulators. Never use a damp or wet cloth to clean equipment wiring. |

| | | | | |
|---|---|---|---|---|
| 3 | Switches, control, and jacks. | Semi-annually | Inspect the mechanical action of each lever switch by operating the switch to each position several times. Note that the contacts close with a slight follow when the switch is operated. Inspect the mechanical action of the potentiometer control by operating the control through its entire range several times. Note that the shaft neither binds nor is extremely loose. Inspect the mechanical action of the jacks by inserting a plug into the jacks. Inspect all terminals. Inspect for dirt and corrosion on all exposed elements and inspect the contacts of all switches and jacks and the relays. Tighten loose assembly screws with a suitable screw driver. | After performing preventive maintenance operations, reconnect the power and check the equipment for satisfactory operation. |

## Section III. WEATHERPROOFING

### 30. Weatherproofing

*a. General.* Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials.

*b. Tropical Maintenance.* A special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained fully in TB SIG 13 and TB SIG 72.

*c. Winter Maintenance.* Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained fully in TB SIG 66 and TB SIG 219.

*d. Desert Maintenance.* Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained fully in TB SIG 75.

### 31. Rustproofing and Painting

*a.* When painted metal finishes have been badly marred or damaged, prevent rust and corrosion by touching up bared surfaces. Use No. 0000 sandpaper to clean the surface down to the bare metal until it is bright and smooth. Apply matching paint with a small brush.

***Caution:*** Do not use steel wool to remove rust. Small particles of metal may fall into the unit and cause internal electrical shorting and grounding of surfaces.

*b.* If complete repainting is necessary, follow the directions for refinishing given in paragraph 59.

## Section IV. TROUBLE-SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

### 32. Scope

The trouble-shooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is limited necessarily in scope by the tools, test equipment, and replaceable parts issued. With the exception of replacing operated fuses and faulty indicator lamps and the electrical adjustment of 255-type relays, trouble-shooting is merely a general identification

of the trouble and a recommendation that the trouble be repaired by qualified repair personnel.

## 33. Visual Inspection

*a.* Failure of the equipment to operate properly will usually be caused by one or more of the following faults:

(1) Improperly connected power cords.
(2) Worn, broken, or disconnected cords or plugs.
(3) Operated fuse.
(4) Relay out of adjustment or contacts burned because of overloads.
(5) Wiring broken because of excessive vibration.

*b.* When the equipment fails and the cause is not apparent immediately, check as many of the above items as is practicable before starting a detailed examination of the component parts of the system. If possible, obtain information from the operator of the equipment regarding performance at the time trouble occurred.

## 34. Trouble-Shooting (Using Equipment Performance Checklist)

*a. General.* The equipment performance checklist (par. 35) will help to locate trouble in the equipment. The list gives the item to be checked, the normal indications and tolerances of correct operation, and the corrective measures that can be taken by the operator. To use this list, follow the items in numerical sequence.

*b. Action Or Condition.* For some items, the information given in the action or condition column consists of various switch and control settings under which the item is to be checked. For other items it represents an action that must be taken to check the normal indication given in the normal indication column.

*c. Normal Indications.* The normal indications listed include the visible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

*d. Corrective Measures.* The corrective measures listed are those corrections which the operator can make without turning in the equipment for repairs. A reference in the table to paragraphs in Chapter 5 indicates that trouble-shooting by an experienced repairman is necessary. If the set is completely inoperative or if the recommended corrective measures do not yield results, trouble-shooting is necessary. However, if the tactical situation requires that service be maintained, and if the set is not completely inoperative, the operator must keep the set in operation as long as it is possible to do so.

## 35. Equipment Performance Checklist

| | Item | Action or condition | Normal indications | Corrective measures |
|---|---|---|---|---|
| PREPARATORY | 115/130-volt dc supply. | Check with suitable voltmeter if uncertain of output voltage of power supply. | | |
| | Associated telegraph equipment, or— | Plug power cord CD1 into TST SET battery supply jack of telegraph equipment. | | |
| | Repeater TG–30 or TG–31, or— | Connect white, blue, and red tracers of cord CD3 to +BAT, —BAT, and GND binding posts of test set, and plug other end of cord into TST SET jack on repeater. (Set LINE switch on Repeater TG–30 in position 2.) Plug power cord CD1 into jack J1 of test set. | | |
| | Power unit or rectifier, or— | Connect polarized end of power cord CD2 to test set connector, plug other end into outlet receptacle of power source. Plug power cord CD1 into jack J1 of test set. | | |
| | Switch K5_____ | Operate to SEND DOTS_____ | Meter needle deflects to left_____ | If meter needle deflects to right, polarity of power plug is reversed. Reverse plug in outlet receptacle of power unit or rectifier. |

| | | | | |
|---|---|---|---|---|
| PREPARATORY | Switch K5 | Restore to normal | | |
| | Auxiliary power source. | Connect +BAT binding post to + side of power source and —BAT binding post to — side. Ground — side of power source. | | |
| | Switch K5 | Operate to SEND DOTS | Meter needle deflects to right | If meter needle deflects to right, polarity of connection is reversed. Interchange wires connected to +BAT and —BAT binding posts. |
| | Switch K5 | Restore to normal. | | |
| OPERATION | Switch K6 | Operate to DOTS HIGH and to DOTS LOW. | Meter needle vibrates near zero, indicating that test set is producing 20-cycles ac with switch on DOTS HIGH or 10-cycle ac with switch on DOTS LOW. | If meter needle fails to vibrate near zero, restore switch K6 to normal and again operate to DOTS HIGH or DOTS LOW. If meter needle still fails to vibrate near zero, relay S1 is faulty. Replace relay S1 with one known to be in good adjustment. |
| STOP | Switch K6 | Restore to normal | Meter needle rests on zero. | |
| | 115/130-volt dc supply. | Disconnect from test set. | | |

# CHAPTER 4
# THEORY

## Section I. THEORY OF TEST SET I–193–(*)

### 36. General

*a.* Test Set I–193–(*) is designed for testing and adjusting electrically 255-type polarized relays used in telegraph equipment and for sending a series of impulses, called dots, for use in lining up external telegraph equipment. The test set operates from a d-c power source of 115 to 130 volts. This power may be supplied by telegraph equipment or by a rectifier or power unit, or any other available source of dc, which is not used to supply power to any other equipment.

*b.* The test set contains six basic circuits. An oscillating circuit produces an ac at a frequency of approximately 10 or 20 cps which is necessary for testing. A dots producing and sending circuit transmits a series of dots to interrupt another circuit external to the test set at a frequency of either 10 or 20 interruptions per second. These interruptions are generally used for equipment line-up purposes. A metering circuit indicates the electrical condition of a relay under test by oscillation or deflection of the meter needle. This circuit also is used to adjust the dots-producing circuit for zero bias. A soak current circuit, used when testing the sensitivity of a relay, applies a necessary magnetic condition to a relay before operate and nonoperate current values are applied. The operate and nonoperate circuits are used to apply operate and nonoperate current, respectively, in both the marking and spacing directions to a relay under test, Paragraphs 37 through 43 contain detailed descriptions of the functioning of the circuits comprising the test set.

### 37. Test Set Circuit with Battery Supply Connected

With the battery supply connected and all switches at normal (midposition), the M (mark) contacts of relay S1 are held closed. This circuit is shown in figure 11. Negative battery from the power source flows through the 7–2 winding of relay S1, resistor R9,

normally made DOTS LOW and DOTS HIGH contacts of switch K6, the windings of filter FL1, and fuse F1 to the positive terminal of the power source. The direction of this current through the 7–2 winding of the relay establishes a polarity within relay S1 which tends to hold the M (mark) contacts closed.

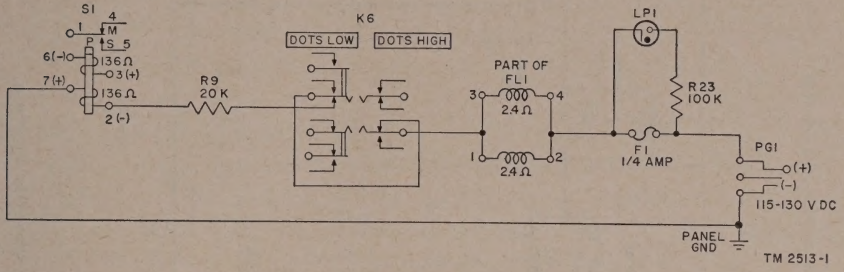



*Figure 11. Circuit for holding relay S1 at space, schematic diagram.*

## 38. Oscillating Circuit for Producing 20 Cycles per Second

*a.* The oscillating circuit for producing 20-cps ac when the test set is connected to a d-c power source is shown in figure 12. Negative battery flows from the power source, through the 7–2 winding of relay S2, potentiometer P1, normally made DOTS LOW contacts of switch K6, resistor R20, filter FL1, and fuse F1 to the positive terminal of the power source. The direction of this current through the 7–2 winding of relay S2 assures closure of the M contacts of the relay. A circuit which consists of resistors R18 and R19 is connected in parallel with that portion of the original circuit which includes the 7–2 winding of relay S2 and potentiometer P1.

*b.* Operation of switch K6 to the DOTS HIGH position causes a current to flow into and charge the capacitance bank consisting of capacitors C2 through C6. A negative potential is connected directly to the capacitors. A positive potential is connected from the positive terminal of the power source through fuse F1, filter FL1, operated DOTS HIGH contacts of switch K6, resistor R1, the M contacts and the 6–3 winding of relay S1, the 6–3 winding of relay S2, and the windings of reactor (retardation coil) L1 to the opposite plates of the capacitance bank. The amplitude build-up of the current flow will be retarded appreciably by the circuit impedances. Thus, while relays S1 and S2 will operate ultimately, their operation will be delayed until the current has reached the relay-operating value.

*c.* As relay S1 operates, its M contacts open and its S (space) contacts close. Opening of the M contacts disconnects the positive

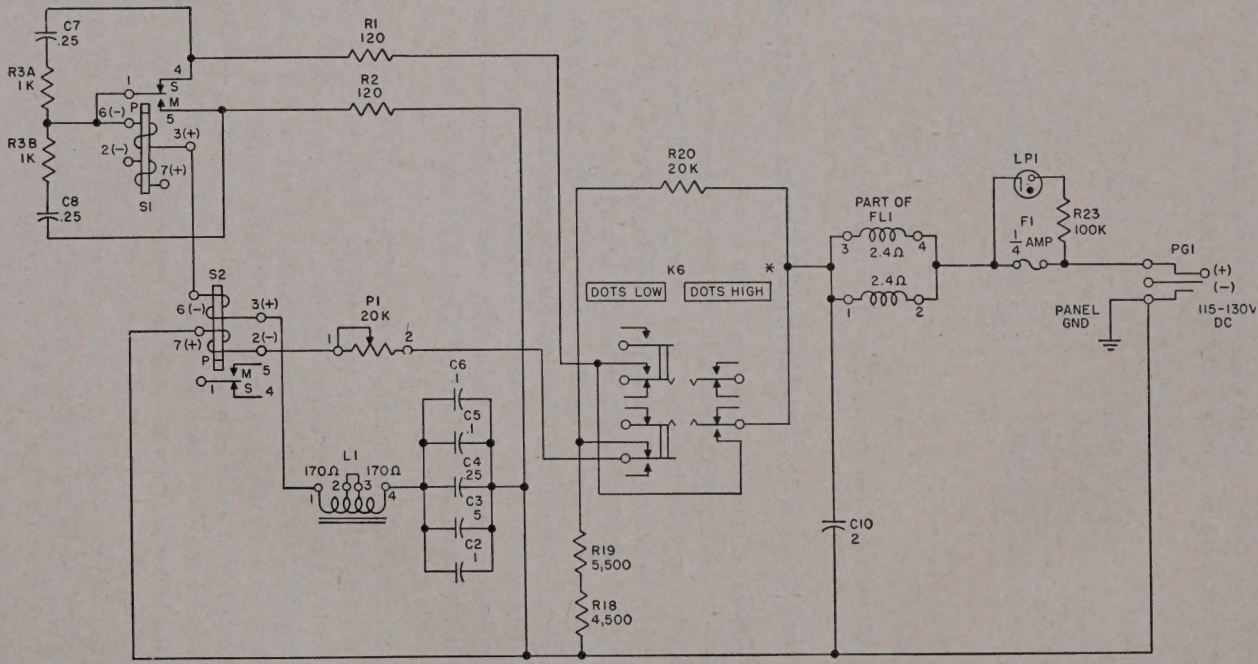



*Figure 12. Oscillating circuit for producing 20 cycles per second schematic diagram.*

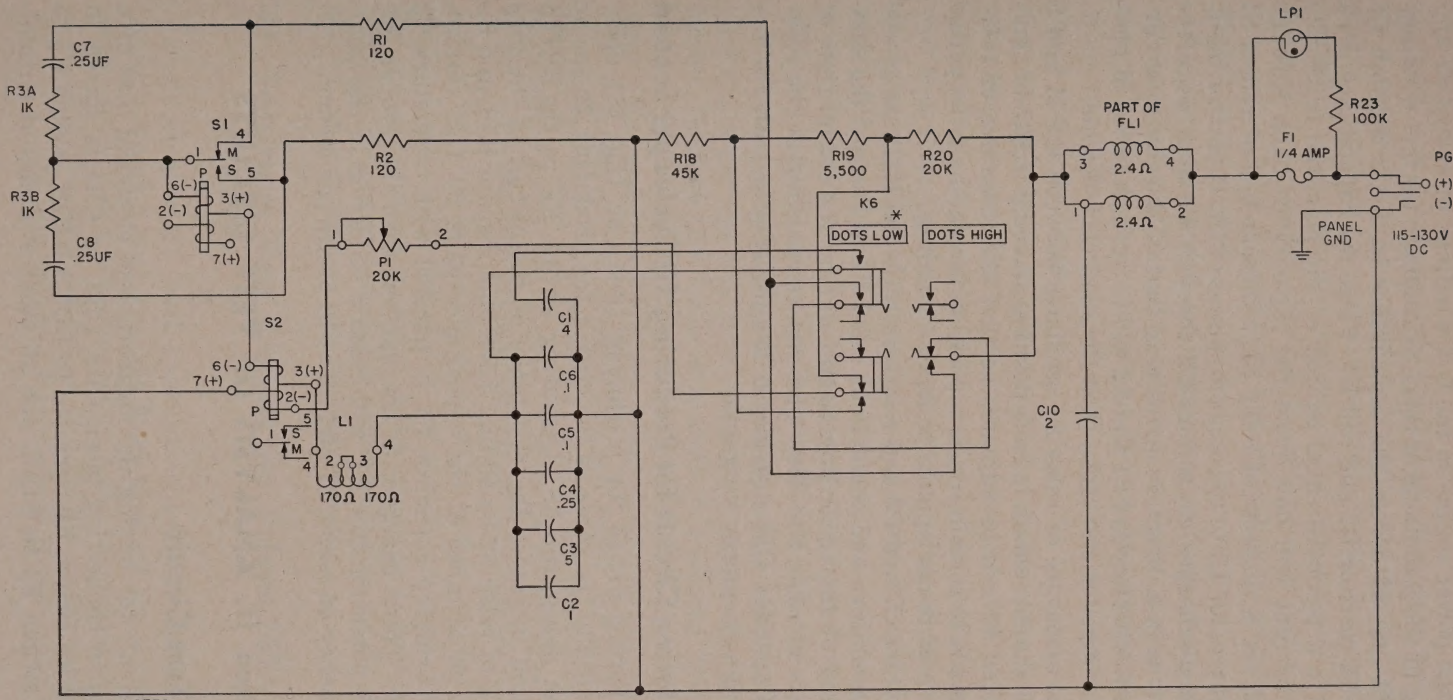



*Figure 13. Oscillating circuit for producing 10 cycles per second, schematic diagram.*

lead from the power source to the 6–3 windings of relays S1 and S2. Closing of the S contacts of relay S1 connects the 6–3 windings of relays S1 and S2 across the capacitance bank C2 through C6 in series with resistor R2 and coil L1. Since the capacitance bank is charged to a potential equal to that of the potential originally applied, a current will flow from the capacitance bank through resistor R2, the S contacts of relay S1, windings 6–3 of relays S1 and S2, and reactor L1 to the opposite plates of the capacitor bank. This action discharges capacitors C2 through C6 and, since the current flow is in a direction opposite to that of the charging current, the contacts of relays S1 and S2 will move back to the M position. This completes one cycle, then the next cycle begins.

*d.* As the armature of relay S1 oscillates between the M and S positions, it should remain in each position an equal length of time. Potentiometer P1 can be adjusted so that the armature of relay S2 can be made to remain in the S position for one-half the period of each cycle of the ac applied to its 6–3 winding.

*e.* Capacitors C7 and C8 and resistors R3A and R3B are placed across the armature and contacts of relay S1 to prevent the complete opening of the oscillating circuit during the travel time of the armature of relay S1. They also reduce sparking at the relay contacts. Capacitor C10 provides a low-impedance path for undesirable high-frequency currents.

### 39. Oscillating Circuit for Producing 10 Cycles per Second

The oscillating circuit for producing 10-cps ac (fig. 13) operates substantially the same as the circuit for producing 20-cps ac described in paragraph 38. Operating switch K6 to the DOTS LOW position increases the resistance of the circuit to the bias winding 7–2 of relay S2 by adding 5,500-ohm resistor R19, and increases the capacitance of the capacitance bank by 4 $\mu$f (microfarads) by bridging capacitor C1 in parallel with capacitors C2 through C6. These changes, in conjunction with the proper adjustment of potentiometer P1, will cause a reduction in the oscillating frequency of relays S1 and S2 to 10 cycles per second.

## Section II. ANALYSIS OF TEST CIRCUITS

### 40. Bias Test Circuit

*a.* The circuit for testing the magnetic and electrical bias of a relay placed in connecting block CB2, CB3, or CB4 is shown in figure 14. With switch K6 operated to DOTS HIGH, switch K5 to TST REL, switch K1 to BIAS, and all other switches at normal,

two oscillating circuits are established within the test set. Relay S1 is caused to oscillate by the charging and discharging of capacitors C2 through C6 of the capacitance bank. A second oscillating circuit is set up when a portion of the power from the circuit of relay S1 is connected through the relay under test into capacitor C9. The circuit impedances and capacitances regulate the frequency of oscillation.

*b.* Since the current oscillating into and out of capacitor C9 has an a-c characteristic, the polarity of the relay under test will change at the same frequency as that of the current flowing in its windings. The armature of this relay thus will oscillate between the M and S positions.

*c.* The M and S contacts of the relay under test are connected to the meter circuit. With switch K5 operated to the TST REL position and the M contacts of the relay under test closed, a current will flow from the negative side of the power source through the M contacts of the relay under test, resistors R7 and R6 in series, meter M1, resistor R4, filter FL1, and fuse F1 to the positive side of the power source. The direction of this current through meter M1 will cause the meter needle to be deflected to the right of zero.

*d.* When the armature of the relay under test moves to the S position, a current will flow from the negative side of the power source, through the S contacts, through operated TST REL contacts of switch K5, meter M1, resistors R6, R7, and R5 in series, filter FL1, and fuse F1 to the positive side of the power source. The direction of this current through meter M1 is in a direction opposite to that of the previous pulse. Thus the meter needle will be deflected to the left of zero. The meter needle thus will vibrate in step with the oscillating armature of the relay under test.

*e.* If the armature of the relay under test is held to the S contact longer than to the M contact, the meter indicates, by deflection, the percent of marking bias. If the armature is held to the S contact for the longer period, the meter indicates, by its deflection to the left of zero, the percent of spacing bias.

## 41. Sensitivity Test Circuits for Relays 255A and D–163119A

*a. Application of Soak Current.* Figure 15 shows the circuit through which a soak current flows through the windings of the relay under test when that relay is the two-winding relay 255A or D–163119A. Relay 255A or D–163119A is inserted in connecting block CB2, and switch K4 remains in its normal CB2 OR CB4 position.

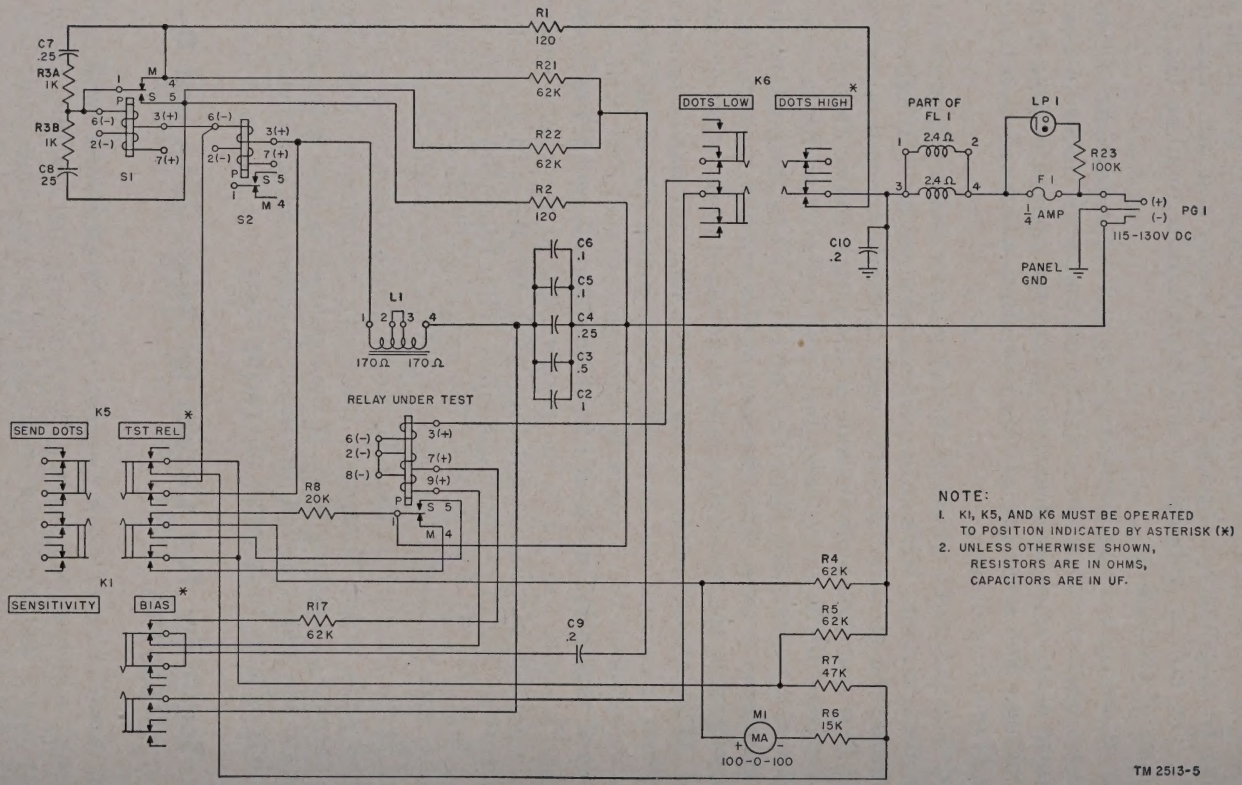



*Figure 14. Circuit for testing bias of relay under test, schematic diagram.*

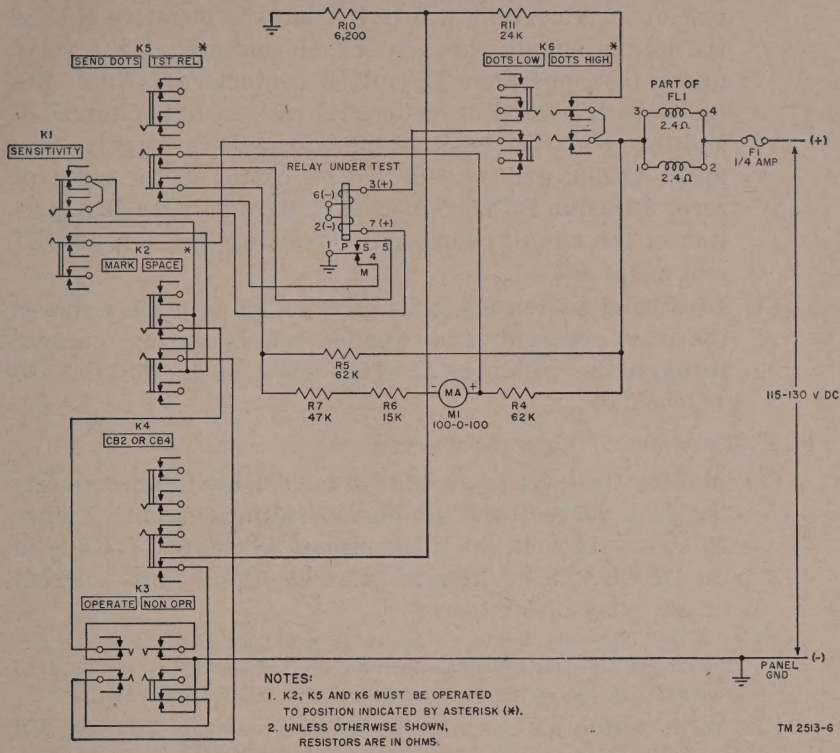



*Figure 15. Soak current circuit to test sensitivity of relays 255A and D–163119A, schematic diagram.*

(1) With switch K2 operated to SPACE, switch K5 operated to TST REL, switch K6 operated to DOTS HIGH, and all remaining switches at normal (midposition), a current is established from the negative side of the power source through two pairs of normally made contacts of switch K3, operated contacts of switch K2, normally made contacts of switch K1, the 7–2 and 6–3 windings of the relay under test, normally made contacts of switches K6 and K1, operated SPACE contacts of switch K2, two pairs of normally made contacts of switch K3, normally made contacts of switch K4, resistor R11, operated DOTS HIGH contacts of switch K6, filter FL1, and fuse F1 to the positive side of the power source. Resistor R10 is connected in parallel with the windings of the relay under test.

(2) The direction of this soak current through the windings of the relay under test will hold the relay armature in the M position. With the armature of the relay under

test at M, a current will flow from the negative side of the power supply through the M contacts of the relay under test, operated TST REL contacts of switch K5, resistors R7 and R6, meter M1, resistor R4, filter FL1, and fuse F1 to the positive side of the power supply. The meter needle will be deflected off center to the right of zero. Resistor R5 is connected in parallel with that portion of the circuit composed of resistors R4, R6, and R7 and meter M1.

(3) Operating switch K3 to its OPERATE position removes the soak current and applies an operating current through the windings of relay 255A or D–163119A (*b* (1) below).

*b. Application Of Operate Current.*

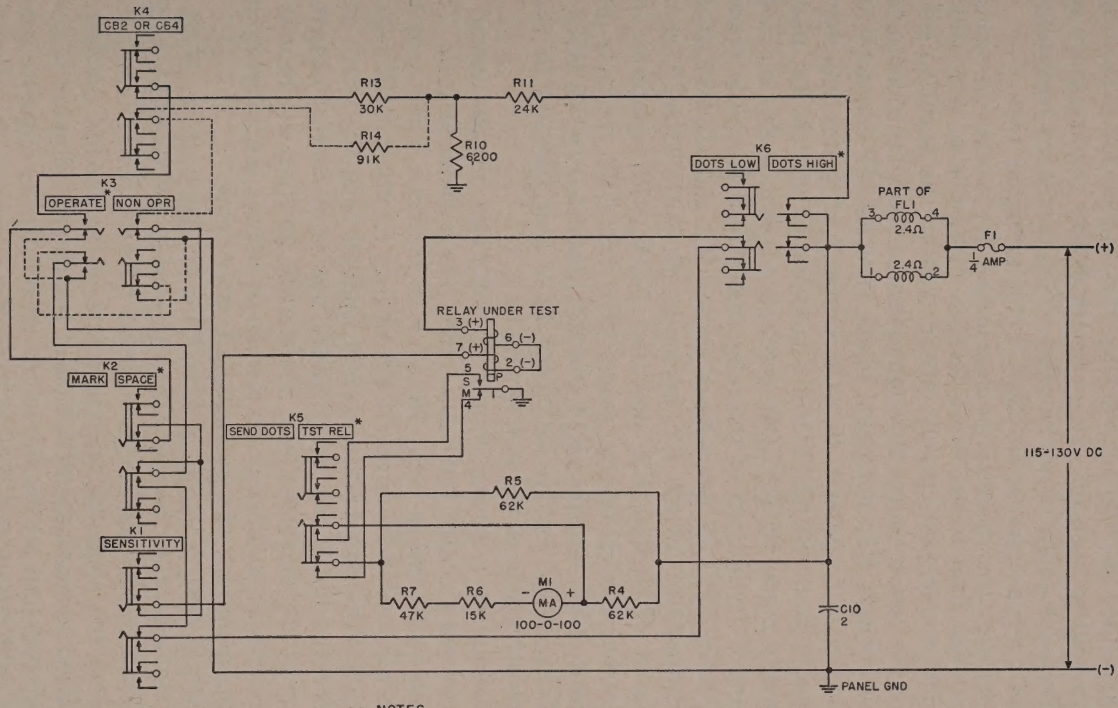
(1) Moving the lever of switch K3 to OPERATE disconnects the soak current and applies operating current. Figure 16 shows, in solid lines, the circuit when switch K3 is in the OPERATE position after application of soak current to the relay under test.

*Note.* The dotted lines in figure 16 show the changes in the circuit when the OPERATE position of switch K3 is restored to normal and the switch is operated to the NON OPR position.

(2) With switch K2 operated to SPACE, switch K5 operated to TST REL, and switch K6 to DOTS HIGH (the soak current described in *a* above), switch K3 is operated to its OPERATE position. This establishes a circuit from the negative side of the power source through normally made NON OPR contacts of switch K3, operated OPERATE contacts of switch K3, operated SPACE contacts of switch K2, normally made contacts of switch K1, normally made DOTS LOW contacts of switch K6, windings 3–6 and 2–7 of the relay under test, normally made contacts of switch K1, operated SPACE contacts of switch K2, operated OPERATE contacts of switch K3, normally made contacts of switch K4, resistors R13 and R11, operated DOTS HIGH contacts of switch K6, filter FL1, and fuse F1 to the positive side of the power source. The armature of the relay under test will move to the S position, and the meter needle will be deflected to the left of zero.

*Note.* The meter circuit is similar to that described in paragraph 40*e*. In this case, however, the meter indicator will be approximately 100 off zero.

*c. Application Of Nonoperate Current.* Operating switch K3 to its NON OPR position will restore the contacts in the OPERATE




NOTES

1. K2, K3, K5, AND K6 MUST BE OPERATED TO POSITION INDICATED BY ASTERISK (*).
2. DOTTED LINES SHOW PARTIAL CIRCUIT CHANGE WHEN K3 IS MOVED FROM OPERATE TO NON OPR.
3. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.

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*Figure 16. Operate and nonoperate current circuits to test sensitivity of relays 255A and D–163119A, schematic diagram.*

position to normal and close the normally open contacts in the NON OPR position (fig. 16). This switching disconnects 30,000-ohm resistor R13 from the circuit and connects 91,000-ohm resistor R14 into the circuit. As switch K3 is moved from OPERATE to NON OPR, a soak current in the mark direction is applied to the relay under test during the time that switch K3 is passing through its neutral position. This current causes the armature to move to the mark contacts of the relay. This increased resistance reduces the operate current through the relay under test.

*Note.* The dotted lines shown on the diagram (fig. 16) indicate the change in circuit resulting from moving switch K3 from OPERATE to NON OPR.

(1) The nonoperate current circuit is from the negative side of the power source through operated NON OPR contacts of switch K3, normally made OPERATE contacts of switch K3, operated SPACE contacts of switch K2, normally made SENSITIVITY contacts of switch K1, normally made DOTS LOW contacts of switch K6, the 3–6 and 2–7 windings of the relay under test, normally made SENSITIVITY contacts of switch K1, operated SPACE contacts of switch K2, normally made OPERATE contacts of switch K3, operated NON OPR contacts of switch K3, normally made CB2 OR CB4 contacts of switch K4, resistors R14 and R11, operated DOTS HIGH contacts of switch K6, filter FL1, and fuse F1 to the positive side of the power supply.

(2) Assuming a power supply of 130 volts dc, the operate current through the relay under test is reduced from .75 ma to .28 ma in relay 255A or D–163119A when switch K3 is moved from its OPERATE to its NON OPR position. The nonoperate current applied is in the space direction, but if the relay under test is in correct adjustment the armature will not change position as the current is of insufficient amplitude to change the position of the armature of a correctly adjusted relay.

*d. Reversing Direction Of Current Flow In Application Of Operate and Nonoperate Current.* Moving switch K2 from SPACE to MARK will restore the contacts in the SPACE position to normal and close the normally open contacts in the MARK position. This operation reverses the direction of the current flowing in the relay under test and moves the meter needle to the opposite side of its zero calibration, but does not otherwise change the circuits as outlined in *b* and *c* above.

## 42. Sensitivity Test Circuit for Relay D–164816

*a. Application Of Soak Current.* Figure 17 shows the circuit through which a soak current flows through the 3–6 and 8–9 wind-

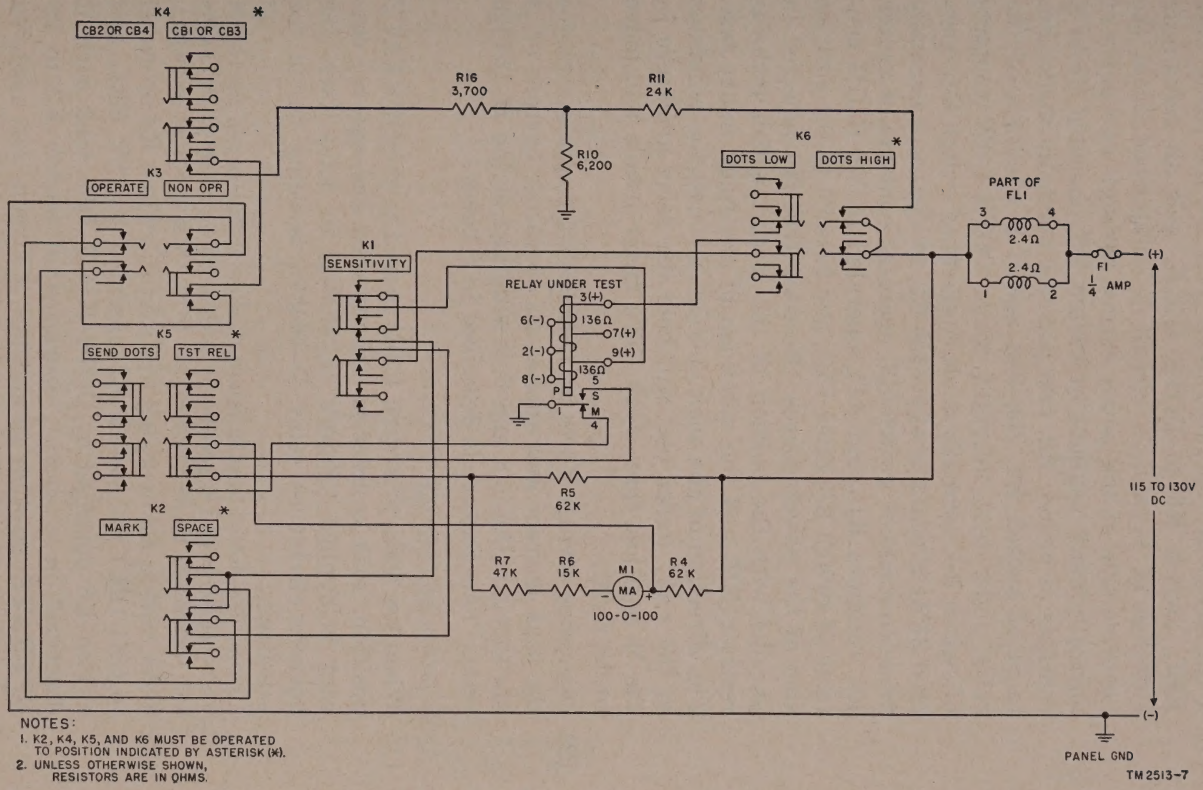



*Figure 17. Soak current to test sensitivity of relay D–164816, schematic diagram.*

ings of the relay under test when that relay is the three-winding relay D–164816. Relay D–164816 is inserted in connecting block CB3, and switch K4 is operated to CB1 OR CB3.

(1) With switch K2 operated to SPACE, switch K5 to TST REL, switch K6 to DOTS HIGH, and all remaining switches at normal, a circuit is established from the negative side of the power source through two pairs of normally made contacts of switch K3, operated SPACE contacts of switch K2, two pairs of normally made contacts of switch K1, the 9–8 and 6–3 windings of the relay under test, normally made DOTS LOW contacts of switch K6, normally made contacts of switch K1, operated SPACE contacts of switch K2, two pairs of normally made contacts of switch K3, operated contacts of switch K4, resistors R16 and R11, operated DOTS HIGH contacts of switch K6, filter FL1, and fuse F1 to the positive side of the power source. Resistor R10 is connected in parallel with the portion of the circuit which includes resistor R16 and the windings of the relay under test. The direction of the soak current through the windings of the relay under test will hold the relay armature in the M position (par. 41*a*). The meter needle will move to the right.

(2) Operating switch K3 to its OPERATE position removes the soak current and applies an operating current of .4 ma through the 9–8 and 6–3 windings of the D–164816 relay. This feature is described in *b* below.

*b. Application of Operate Current.*

(1) When the lever of switch K3 is moved to the OPERATE position, soak current is disconnected and operate current is applied. Figure 18 shows, in solid lines, the operate circuit as relay D–164816 is being tested for sensitivity.

*Note.* The dotted lines in figure 18 show the change in the circuit when the OPERATE position of switch K3 is restored to normal and the switch is operated to the NON OPR position (*c* below).

(2) With switch K2 operated to SPACE, switch K4 operated to CB1 OR CB3, switch K5 operated to TST REL, and switch K6 operated to DOTS HIGH (the soak current described in *a* above), operation of switch K3 to its OPERATE position establishes a circuit for applying operate current to the relay under test as follows: Starting at the negative side of the power supply, current will flow through normally made NON OPR contacts of switch K3, operated OPERATE contacts of switch K3, operated

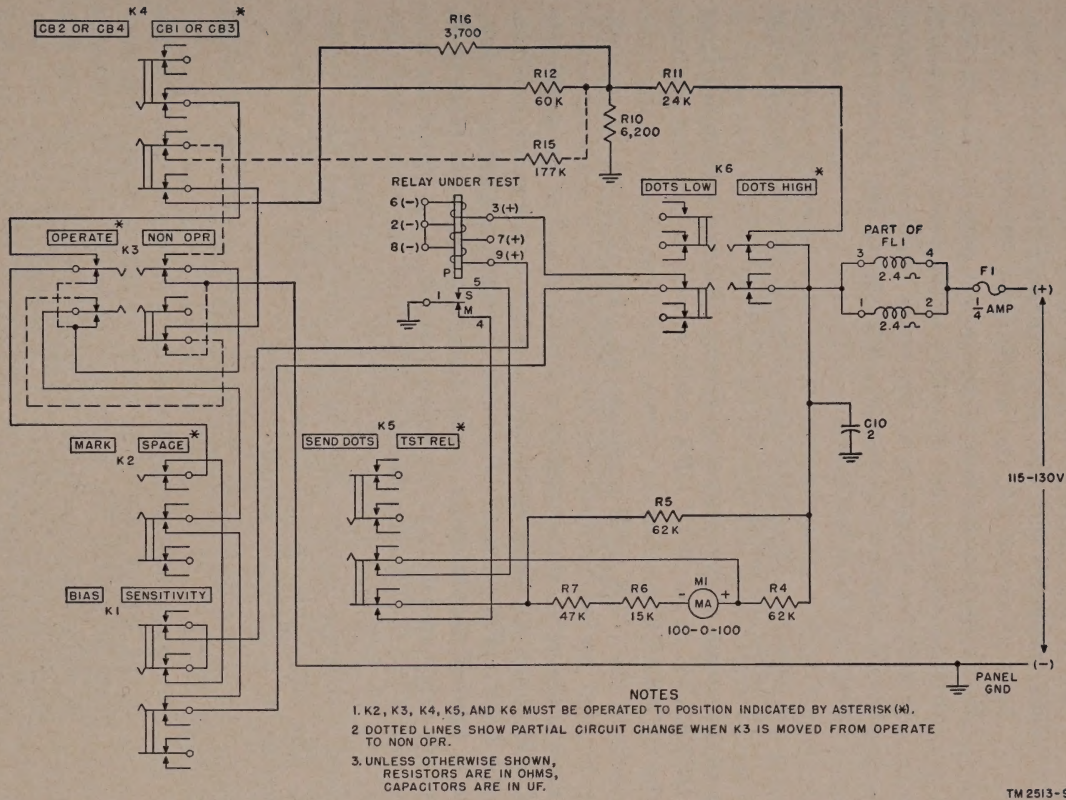



*Figure 18. Operate and nonoperate current circuits to test sensitivity of relay D–164816, schematic diagram.*

SPACE contacts of switch K2, normally made SENSITIVITY contacts of switch K1, normally made DOTS LOW contacts of switch K6, the 3–6 and 8–9 windings of the relay under test, two pairs of normally made SENSITIVITY contacts of switch K1, operated SPACE contacts of switch K2, operated OPERATE contacts of switch K3, operated CB1 OR CB3 contacts of switch K4, resistors R12 and R11, operated DOTS HIGH contacts of switch K6, the windings of filter FL1, and fuse F1 to the positive side of the power supply. The operate current, in a reverse direction to the soak current which caused the armature of the relay under test to move to the M position (*a* above), will cause the armature to move to the S position.

*Note.* The meter circuit operates in the same manner as described in paragraph 40*e*. In this case, however, the meter needle will be deflected approximately 100 scale divisions to the left.

*c. Application of Nonoperate Current.* Moving switch K3 from its OPERATE to its NON OPR position will restore the contacts in the OPERATE position to normal and close the normally open contacts in the NON OPR position (fig. 18). During the momentary neutral period between the two positions, a soak current is applied to the relay under test in a direction and of an amplitude that will cause the relay armature to move to the mark position. As the NON OPR contacts of switch K3 close, a nonoperate current is applied to the relay under test in a direction tending to move the relay armature to the space position. This switching also disconnects the 60,000-ohm resistor R12 from the circuit and connects the 177,000-ohm resistor R15 in to the circuit, and the increased resistance reduces the current through the relay under test. The amplitude of this current is not sufficient to move the armature of a correctly adjusted relay.

*Note.* The dotted lines in figure 18 indicate the change in circuit resulting from moving switch K3 from OPERATE to NON OPR.

(1) The nonoperate current circuit is from the negative side of the power source through operated NON OPR contacts of switch K3, normally made OPERATE contacts of switch K3, operated SPACE contacts of switch K2, normally made SENSITIVITY contacts of switch K1, normally made DOTS LOW contacts of switch K6, the 3–6 and 8–9 windings of the relay under test, two pairs of normally made SENSITIVITY contacts of switch K1, operated SPACE contacts of switch K2, normally made OPERATE contacts of switch K3, operated NON OPR contacts of switch K3, operated CB1 OR CB3 contacts

of switch K4, 177,000-ohm resistor R15, 24,000-ohm resistor R11, operated DOTS HIGH contacts of switch K6, filter FL1, and fuse F1 to the positive side of the power supply.

(2) Assuming a power supply of 130 volts dc, the current through the windings of the relay under test is reduced from its operate value of .4 ma to .14 ma. If the relay under test is in correct adjustment, its armature will not change position.

*d. Reversing Direction of Current Flow In Application of Soak Operate and Nonoperate Current.* Moving switch K2 from the SPACE to the MARK position and operating switch K3 to normal (fig. 15) will restore the contacts of the SPACE position of switch K2 to normal. This operation reverses the direction of the current flowing in the relay winding and moves the relay armature to the S position. The meter needle will deflect to the left side of its zero calibration, but the circuits for the application of operate and nonoperate current as outlined in *b* and *c* above otherwise are not changed.

## 43. Dots Producing and Sending Circuit

*a. Testing Bias of Relay S2.* Before connecting the armature and contact 4 of relay S2 to an external telegraph circuit, the bias of dots-producing relay S2 must be tested. This circuit is shown in figure 19. Switch K5 is operated to SEND DOTS.

(1) With the M contacts of relay S2 closed, a negative current will flow through the upper normally made SEND DOTS contacts of switch K5, the M contacts of relay S2, the lower normally made SEND DOTS contacts of switch K5, the lower and upper normally made TST REL contacts, in series, of switch K5, resistor R6, meter M1, resistor R4, filter FL1, and fuse F1 to the positive terminal of the power source. This causes the meter needle to move off center and to the right.

(2) When the armature of relay S2 moves from the M to the S position, a negative current will flow through resistor R8, the lower normally made TST REL contacts of switch K5, meter M1, resistor R6, the upper normally made TST REL contacts of switch K5, resistor R5, filter FL1, and fuse F1 to the positive terminal of the power source. The direction of current flow through meter M1 is in a direction opposite to that described in (1) above. Thus, the meter needle will be deflected off center in a direction

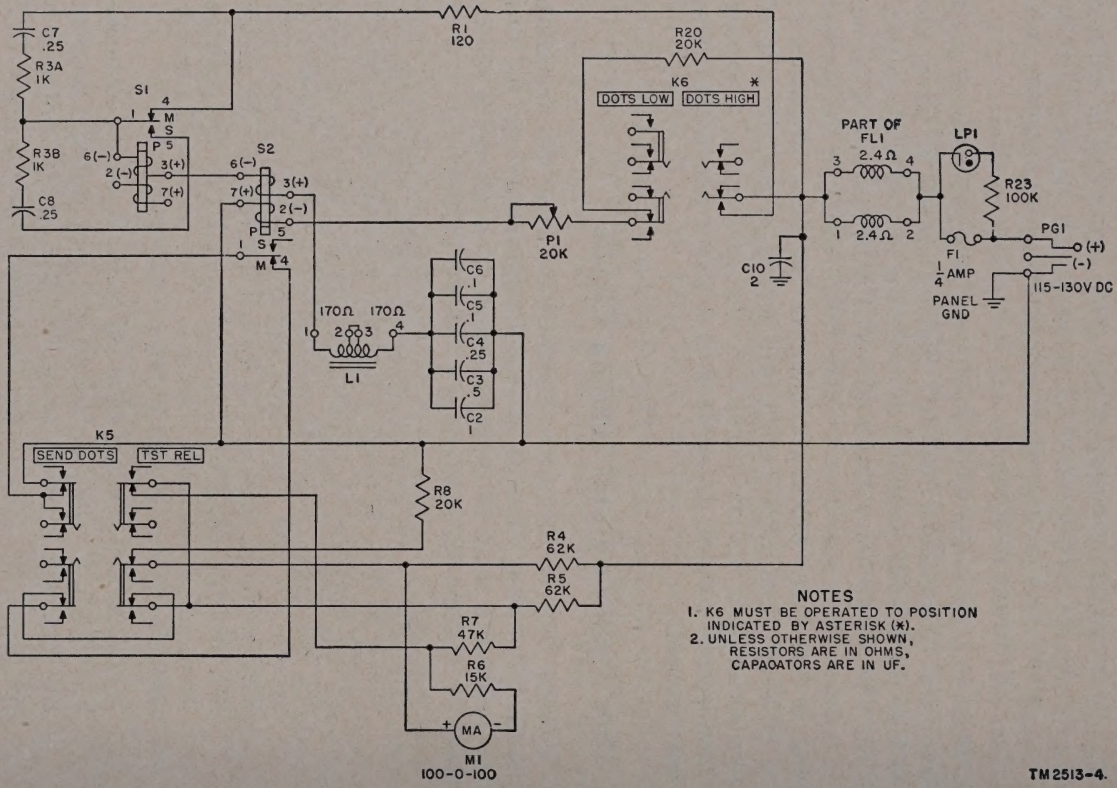



*Figure 19. Circuit for testing bias of relay S2, schematic diagram.*

opposite to that which occurred when the M contacts were closed.

(3) The time period during which the meter needle remains on either side of zero indicates the length of time that the armature of relay S2 remains on the M or S contact of the relay.

*b. Producing And Sending Dots.*

(1) The circuit for producing and sending 20 dots per second into an external telegraph circuit is shown in figure 20. The circuit for producing 20-cps ac is described in paragraph 38. There it is shown that the armature of relay S2 oscillates between its M and S contacts at a rate of 20 times per second. Switch K6 is operated to DOTS HIGH.

(2) If a powered circuit external to the test set is connected to jacks J2 and J3 and switch K5 is operated to SEND DOTS, such a circuit will be closed and opened alternately in step with the movement of the M contacts of relay S2. These interruptions to the external circuit are referred to as dots.

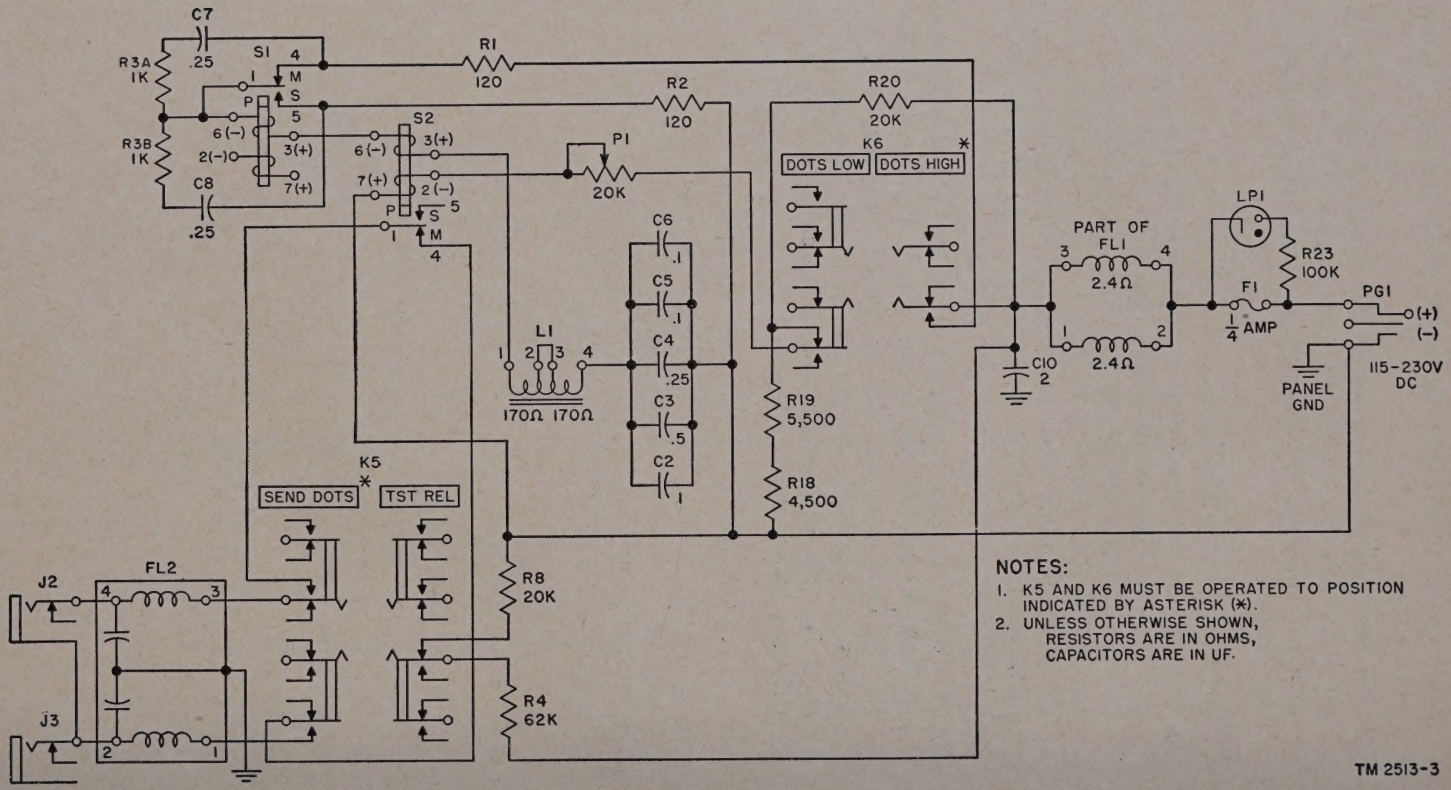



*Figure 20. Circuit for producing and sending 20 dots per second, schematic diagram.*

# CHAPTER 5
# FIELD MAINTENANCE INSTRUCTIONS

*Note.* This chapter contains information for field maintenance. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available and by the skill of the repairman.

## Section I. PREREPAIR PROCEDURES

### 44. Tools, Materials, and Test Equipment

In addition to the tools and materials given in paragraphs 25 and 26, the tools, materials, and test equipment required for reconditioning, adjusting, and repairing Test Set I–193–(*) are listed in *a* and *b* below.

*a. Tools and Materials.*

| Stock No. | Name of item and description | Used to |
|---|---|---|
| 6R41163 | ADJUSTER: spring | Adjust relay springs. |
| NSNA | BURNISHER, jack sleeve: hardwood pin. | Burnish jack sleeves. |
| 6R40870J | GAGE TL–559/U: 0–150 grams | Measure tension of switch and relay springs. |
| NSNA | OIL, lubricating: light; WECo #KS–6232. | Clean jack sleeves in solution with petroleum spirits. |
| 6G1516 | PASTE, metal polish | Clean plugs. |
| 6G236.1 | PETROLEUM SPIRITS: cleaning fluid. | Clean jack sleeves in solution with light lubricating oil. |
| 6R4740–5 | PLIERS: parallel jaw | Adjust switch springs. |
| 6R4735–6 | PLIERS TL–369/U: duck-billed | Straighten bends and kinks in switch springs. |
| 6R40848/1 | SCREW DRIVER TL–386/U: slot drive. | Remove switch and jack spring assembly screws and mounting screws. |
| 6N7531 | SOLDER M–31 | Resolder equipment wiring. |
| 6R24617 | SOLDERING IRON TL–117 | Resolder equipment wiring. |
| 6Z8666 | TOOTHPICKS: hardwood; flat one end, pointed other end. | Clean switch contacts. |

*b. Test Equipment.* The only test equipment required for testing Test Set I–193–(*) is a voltmeter capable of reading 130 volts dc. This may be Electronic Voltmeter TS–505/U, or any available voltmeter having the required d-c range.

## 45. Removal of Pluck-Out Parts

The fuse, the blown fuse indicator lamp, and the relays can be removed without unsoldering connections. These parts are called pluck-out parts as they do not require complicated disconnection procedures. No disassembly is necessary except the removal of the test set from the case when replacing the indicator lamp.

*a. Indicator Light.* To remove the lamp, loosen the locknut on the under side of the panel which holds the lamp cap in place, and remove the lamp cap. When the indicator lamp has been replaced, secure the lamp cap in place by tightening the locknut.

*b. Fuse.* To remove the fuse, turn the fuse cap in the direction indicated by the arrow on the cap and pull out the cap and fuse.

*c. Relays.* To remove the relays, open the compartment on the left-hand side of the front panel and pull the relays out of their connecting blocks. A replaced relay cannot be seated improperly in the connecting block as the two mounting posts on the left, and the holes through the chassis which accommodate these posts, are larger than the two on the right.

## 46. Inspecting, Cleaning, and Testing Removed Parts

*a. Inspecting and Cleaning.* Check the removed relays for mechanical adjustment and dirty or built-up contacts. If necessary, clean the relay according to instructions in paragraph 49. Inspect the indicator lamp for burned base and broken filament. Inspect the fuse visually for continuity, loose ferrules, and charring.

*b. Testing.* Adjust the relays mechanically according to directions in paragraph 57. Replace the test set relays with two 255A relays that are known to be in good adjustment, and insert the relays to be tested, one at a time, in connecting block CB2. Test for electrical performance and adjust in accordance with instructions in paragraphs 17 through 19.

## 47. Inspecting and Cleaning Chassis Assembly

*a. Inspecting.* Make a visual inspection of the test set to determine the general condition of the equipment when it is turned in for repair. Remove the equipment from the case and proceed as follows:

(1) Inspect the wiring for broken leads, brittle insulation, and corrosion.

(2) Inspect for broken connections to switches, jacks, connecting blocks, and other apparatus. Check for defective soldered connections.

(3) Test the operation of all switches. They should not bind, and the contacts should close with a slight follow when the switch is operated. Inspect for corrosion, dirt, or other foreign material which might affect operation. Check for broken or bent switch springs.
(4) Examine the operation of the potentiometer control. The shaft should move freely and smoothly without binding.
(5) Inspect the relay contacts for dirt and build-ups.
(6) Inspect the power cords for damaged or broken insulation. Check for bent or broken prongs on connectors, for dirty or corroded plugs, and for tightness of pin-type connectors.
(7) Inspect for loose or missing screws.
(8) If there is no indication of damage or fault, connect the equipment for operation and follow the procedures given in the equipment performance checklist (par. 35) to see whether the test set is operating properly.

*b. Cleaning.*

(1) Clean the outside of the equipment with a clean, lint-free cloth.
(2) Remove dirt and salt spray from the exterior of the equipment only with a cloth moistened with clear water. Allow the equipment to dry thoroughly before attempting any further cleaning.
(3) Remove the equipment from the case. Use air pressure, if air pressure is available, to blow out accumulated dust, dirt, sand, lumps of solder, and wire cuttings. Apply the air pressure so that dust is blown away from switch contacts. If air pressure is not available, brush accumulated dust and dirt from the interior of the equipment with a soft bristled brush. Be careful not to damage equipment wiring. Use probe sticks of wood or insulating material to dislodge caked dirt, and use toothpicks or their equivalent for hard-to-reach places.
(4) Remove oil and grease with a cloth moistened with solvent (SD). Wipe dry with a clean, dry cloth.
(5) Remove rust, corrosion, fungus growth, and similar foreign material on the structural framework with No. 0000 sandpaper or a scratch brush, and clean with solvent (SD) when necessary.

## 48. Cleaning and Burnishing Switch and Jack Contacts

*a. Cleaning Contacts.*

(1) To clean contacts, flush the contacts with carbon tetra-

chloride applied with a clean toothpick. Dip the flat end of the toothpick into the carbon tetrachloride to a depth of about one-half inch and deposit the liquid on the contacts without rubbing. Hold the contacts slightly separated during this process.

(2) Dip the flat end of another toothpick into the carbon tetrachloride and deposit it on the contact, also without rubbing, to flush away the dirt that was loosened on the first application. Be careful to keep the carbon tetrachloride away from the insulators.

(3) When the contacts are thoroughly dry, burnish them so that no deposit or residue from the solution or other foreign material remains on the contacts.

*b. Burnishing Contacts.*

(1) Burnish contacts with the steel blade of the contact burnisher. Clean the contact burnisher before using by wiping the blade with a clean, dry cloth. During the burnishing process, wipe the blade frequently with a cloth moistened with carbon tetrachloride.

(2) When burnishing normally open contacts, press the contacts together by hand to give a slight pressure on the blade of the burnisher. When contacts are normally closed, the tension of the springs usually will furnish sufficient pressure against the burnisher. On springs which have a heavy tension, lift one of the springs away to insert the blade of the burnisher.

(3) Rub the burnisher against the contacts two or three times. Do not use abrasives other than the burnisher blade.

*c. Burnishing Pitted Contacts.* Pitted contacts do not always indicate that the contact must be replaced. Frequently, jacks and switches can be reconditioned by cleaning and burnishing. Burnish pitted contacts in the same manner as nonpitted contacts. However, additional strokes of the burnisher blade may be required. When contacts are badly pitted, use the ball-type burnisher furnished with the burnishing tool.

*d. Checking Adjustment.* After switch contacts have been cleaned and burnished check the mechanical action of the switch in accordance with directions in paragraph 58.

## 49. Burnishing Relay Contacts and Cleaning Relay

*a. Burnishing Contacts.*

(1) Burnish the relay contacts with the steel blade of the contact burnisher. Clean the blade of the contact bur-

nisher before using by wiping with a clean, dry cloth. During the burnishing process, wipe the blade frequently with a cloth moistened with carbon tetrachloride.

(2) Insert a tapered orange stick between the flexible contact springs to prevent damage to the springs. Be careful, however, not to insert the stick far enough to bend the springs. Back off one of the contact screws about 1 turn, and turn the other contact screw up until it touches the armature contact. Insert the blade of the contact burnisher between the contacts and draw the blade back and forth two or three times. Repeat the process on the opposite pair of contacts. Do not use abrasives other than the burnisher blade.

*b. Burnishing Pitted Or Built-Up Contacts.*

(1) If the contacts are pitted or built up, remove the pits or build-ups with the file. Back off the contact screw on the side where pits or build-ups are present, and insert a tapered orange stick between the contact springs as when burnishing contacts (*a*(2) above). Insert the file between the contacts and file the contacts one at a time, moving the file in and out parallel with the axis of the armature several times.

***Caution:*** The armature contacts are made of moderately soft alloy. Be careful not to remove too much metal with the file.

(2) When pits or build-ups have been removed, burnish the contacts as instructed in *a* above.

*c. Cleaning Relay.*

(1) *Cover.* Invert the relay cover and tap it to loosen dirt. Wipe the cover inside and out with a clean, lint-free cloth.

(2) *Pole pieces.* Loosen the tension nuts on the pole-piece screws and back off the pole-piece screws as far as they will go. Wind the end of an orange stick with one or two layers of fresh friction tape. Remove any foreign material on the pole pieces by *pressing* the taped end against each pole piece so that any dirt or foreign material will be embedded in the tape. Discard the tape after it has been used once.

***Caution:*** Do not use the contact burnisher on the pole pieces. Do not rub the pole pieces with the friction tape.

*d. Checking Adjustment.* After the relay has been cleaned and the contacts burnished, check the mechanical adjustment of the relay in accordance with instructions in paragraph 57. Adjust the relay electrically in the test set as directed in paragraph 19.

## 50. Cleaning Jack Springs and Sleeve

*a. Cleaning Springs.* Use a plug which has recently been cleaned and from which all cleaning paste has been removed to clean the crimps of the tip and ring springs which make contact with the plug. Insert and withdraw the plug two or three times. While inserting the plug into the jack, rotate the plug against the springs. It is not practical to clean the tip and ring springs thoroughly. If it is necessary to disassemble the spring assembly for any reason, however, wipe the parts with a clean, dry cloth.

*b. Cleaning Sleeve.*

(1) *Cleaning with jack sleeve burnisher.* If a portable motor and a flexible shaft are available, place a clean burnisher in the handpiece of the flexible shaft. If a hand-drill is used, place the tool in the hand-drill chuck. When the tool is rotating, insert it into the jack opening with the axis of the tool perpendicular to the face of the jack. Application of the tool for a few seconds should clean the surface of the flare. In some cases, however, it may be necessary to apply the tool at a slight angle to clean spots that are particularly dirty.

(2) *Cleaning with cotton cloth.*

(*a*) Make a solution of solvent (SD) and 2 percent by volume of light oil, using 17 drops of oil for each ounce of solvent (SD). The solution should be made in quantities of 2 ounces or less, depending on the number of jacks to be cleaned. Keep the container tightly corked except when moistening the cloth.

(*b*) Fold a piece of clean, lint-free cloth, about 5 inches long and 1½ inches wide, along its length so that the strip will be about ¾ inch wide. Insert one end of an orange stick into the fold at one end of the cloth, and wrap the cloth spirally around the orange stick so that the folded edge is exposed. There should be about 3 turns of the cloth per inch of length. Hold the end of the cloth with the fingers or fasten it by some suitable means.

(*c*) Moisten the end of the cloth with the solution. Insert the wrapped orange stick into the sleeve of the jack and rub back and forth, contacting all of the surfaces of the sleeve. Be careful not to touch the springs of the jack more than is necessary. Repeat this process as required until the cloth is clean when it is removed from the sleeve.

## Section II. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

*Warning:* Contact with 130 volts dc can cause fatal injuries. In all cases where the maintenance required might cause contact with the power supply, disconnect the power cord.

### 51. Trouble-Shooting Procedure

The first step in servicing a defective test set is to sectionalize the fault. Sectionalization means tracing the fault to a major component or circuit. The second step is to localize the fault—that is, to trace it to the defective part responsible for the abnormal condition. Careful observation of the performance of the test set may aid in sectionalizing the fault to a particular circuit. For example, the meter indications under certain conditions of operation may indicate whether various switches and the associated circuits are functioning properly. For the most part, however, the majority of faults in Test Set I–193–(*) must be localized by checking voltage, resistance, and circuit continuity. The test outlined in *a* through *e* below will help to isolate the source of trouble. To be effective, these tests should be made in the order given.

*a. Visual Inspection.* Carefully inspect the equipment to be sure that there is no mechanical binding of switches which might damage the equipment. As instructed in paragraph 47*a*, make a visual inspection of the equipment for any sign of damage such as loose or missing screws, nuts, and bolts, loose or poorly soldered connections, dirty, pitted, or built-up contacts on switches, jacks, and relays, damaged insulation, and exposed wiring which might be the cause of shorts with other wiring, terminals, or ground. Through such visual inspection, frequently it is possible to discover the trouble or to determine in which circuit or stage the trouble exists. In addition, visual inspection is valuable in that further damage to the equipment, resulting from improper maintenance methods, may be avoided and future failures forestalled.

*b. Check Of Power Supply.* Check the power supply with a suitable voltmeter to be sure that it is within the required 115- to 130-volt dc range.

*c. Operational Test.* The operational test (par. 54) is important because frequently it indicates the general location of trouble. In many instances, the information obtained will determine the exact location of the fault. So that this information may be utilized fully, all symptoms must be interpreted in relation to one another.

*d. Trouble-Shooting Chart.* Trouble symptoms can be section-

alized and, in most cases, localized by checking the symptoms in the trouble-shooting chart (par. 55).

*e. Intermittent Trouble.* When checking for abnormal conditions, do not overlook the possibility of intermittent trouble. If an intermittent trouble is present or suspected, try to make it appear by tapping or jarring the equipment. The trouble may not be in the test set but in the power supply cord or in the connectors, cr the trouble may be caused by external conditions such as the power source. Test for such conditions, if possible.

## 52. Trouble-Shooting Data

The material supplied in this manual will help in the rapid location of faults. Consult the following trouble-shooting data:

| Fig. or par. No. | Description |
|---|---|
| Fig. 32 | Complete schematic diagram. |
| Figs. 11 through 20 | Circuit schematic diagrams. |
| Figs. 21 through 28 | Simplified schematic diagrams. |
| Figs. 33 through 35 | Wiring diagrams. |
| Figs. 29 through 31 | Illustrations showing location of parts. |
| Par. 35 | Equipment performance checklist. |
| Par. 55 | Trouble-shooting chart. |

## 53. General Precautions

Whenever Test Set I–193–(*) is serviced, carefully observe the following precautions:

*a.* Disconnect the power supply when working around the power supply cords or connectors. Contact with 130 volts dc can be fatal.

*b.* Careless replacement of parts often makes new faults inevitable. Pay particular attention to the following points:

(1) Before a part is unsoldered, note the position of the leads. If a part has a number of connections, tag each of the leads before removing the part.

(2) Be careful not to damage other leads by pushing or pulling them out of the way.

(3) Do not allow drops of solder to fall into the set. Excess solder may cause short circuits.

(4) A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints. A poorly soldered joint is one of the most difficult faults to find.

(5) When a part is replaced, place it in the same position as the original part.

(6) When wiring is replaced, use wiring of the same length and gage as the original wiring. If the color coding is

changed, note the change on the applicable wiring diagram (fig. 33, 34, or 35).

## 54. Operational Test

Connect the equipment for operation and check in accordance with directions in the equipment performance checklist (par. 35). Frequently, a study of the checklist will indicate the general location of the trouble.

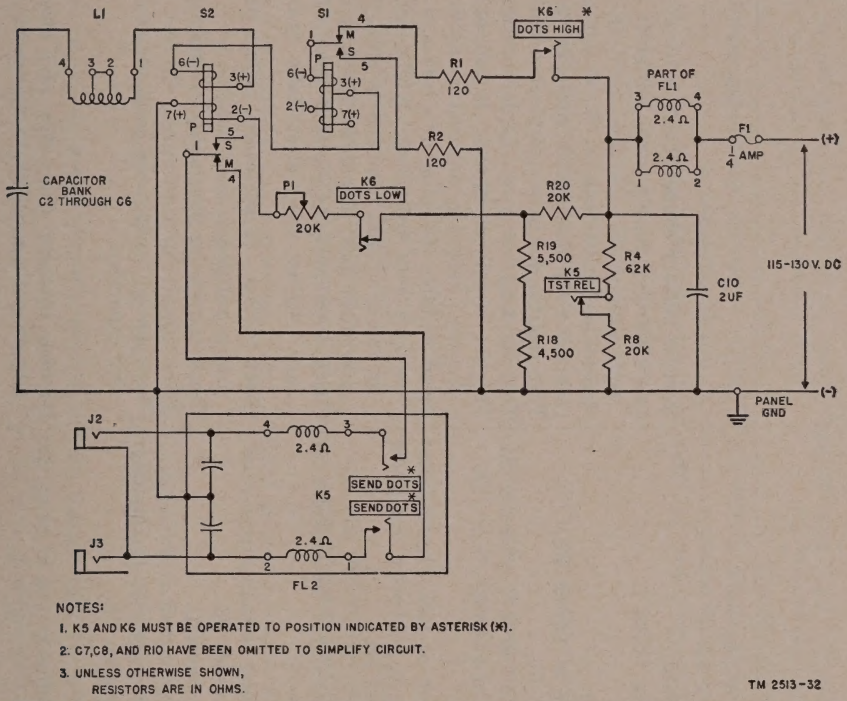



*Figure 21. Oscillating circuit for producing 20 cycles per second and sending 20 dots per second, simplified schematic diagram.*

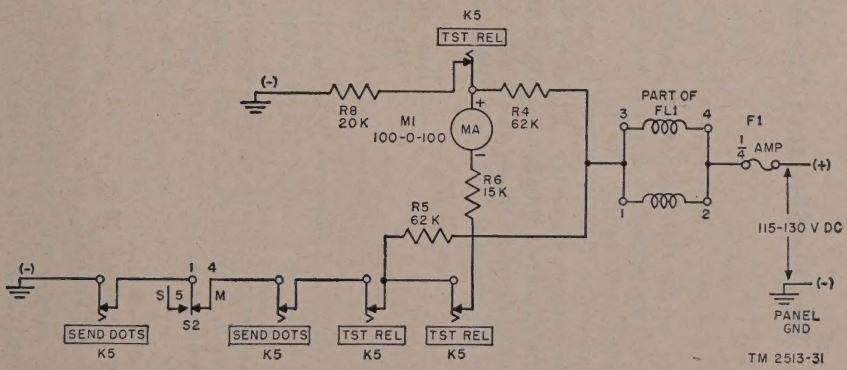



*Figure 22. Metering portion of circuit for testing bias of relay S2, simplified schematic diagram.*

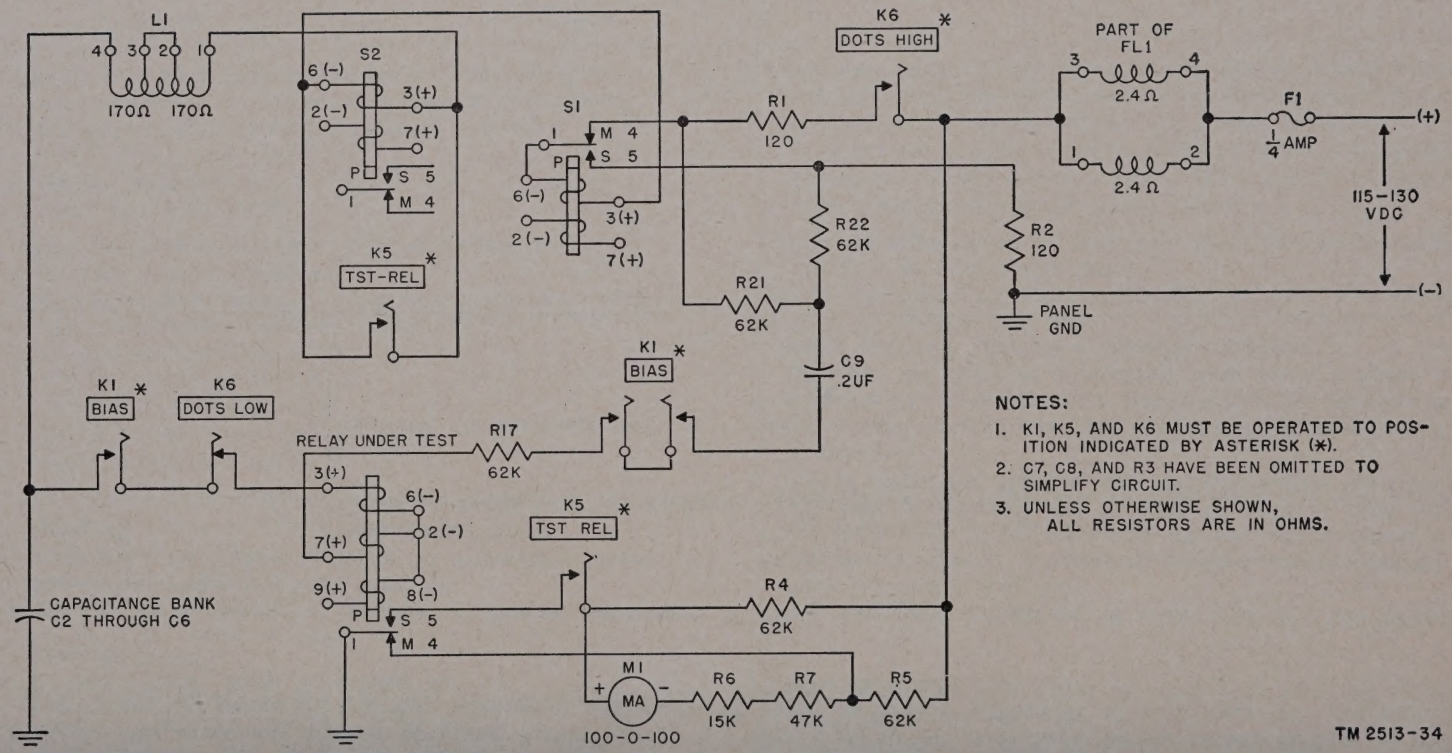
## 55. Trouble-Shooting Chart

| Symptom | Probable trouble | Correction |
|---|---|---|
| Meter needle fails to deflect to left when battery is connected and switch K5 is operated to SEND DOTS. (Armature of relay S1 fails to move to mark contact.) Refer to figure 11. | Battery reversed. | Reverse battery connections. |
| | Battery supply failed. | Check battery supply with voltmeter. Replace unsuitable battery supply. |
| | Operated fuse. | Replace defective fuse. |
| | Dirty contacts in switch K6. | Clean and burnish switch contacts (par. 48). |
| | Open resistor R9. | Test resistor for open. Replace defective resistor. |
| | Open bias winding 2–7 in relay S1. | Test winding for open. Replace defective relay. |
| | Open wiring in circuit. | Test for circuit continuity. Repair or replace defective wiring. Resolder defective soldered connections. |
| | Poor connection at jack J1, connector J4, or jack or connector supplying power to test set. | Insert suitable test plug into jack and check plug and jack connections with voltmeter. While testing, turn and rock plug up and down and from side to side. Adjust or replace a defective power jack. Repair or replace a defective power cord plug. |
| | Improper mechanical adjustment of relay S1. | Check mechanical adjustment (par. 57) and readjust if necessary. Adjust relay electrically (par. 19). |
| Meter needle fails to vibrate near zero when switch K6 is operated to DOTS HIGH and all other switches are at normal. (Circuit is failing to produce 20 cps.) Refer to figure 12. | Improper biasing voltage across winding 2–7 of relay S2. | Check voltage. If necessary, adjust potentiometer P1 to obtain proper voltage. |
| | Open biasing circuit. | Check circuit for continuity. Correct any defects. |
| | Open operating circuit. | Check circuit for continuity. Correct any defects. |
| | Short-circuited capacitor in capacitor bank C2 through C6. | Check across capacitance bank for short circuit. Replace defective capacitor. |
| With switch K6 at DOTS HIGH and switch K5 at | Dirty mark contacts 1–4 at relay S2. | Burnish contacts (par. 49) and check relay for mechanical adjustment (par. 57). |

| | | |
|---|---|---|
| SEND DOTS, test set fails to send 20 dots per second. Refer to figure 20. | Contacts 1–4 of relay S2 out of adjustment. | Adjust contacts (par. 57) and adjust relay electrically (par. 19). |
| | Dirty contacts in SEND DOTS section of switch K5. | Burnish contacts (par. 48). |
| | Contacts in SEND DOTS section of switch K5 out of adjustment. | Adjust for contact alinement (par. 58). |
| | Defective filter FL2. | Check for open filter windings and for short-circuited capacitor. If filter is defective, replace it. |
| Meter fails to vibrate with switch K6 at DOTS HIGH. (Space contacts 1–4 of relay S2 open and close.) Refer to figure 21. | Open in the normally closed portion of the circuit. | Check the circuit for continuity. Correct defects where found. |
| | Open or short-circuited resistor wired in parallel with meter M1. | Check resistors R4, R5, R6, and R7 for opens and short circuits. Replace defective resistor. |
| | Defective meter. | Check the condition of the meter in a circuit other than the one in which it is being used. If the meter is found to be defective, replace it. |
| Operating circuit fails when testing external relay for bias. Refer to figure 23. | Open relay S1 operating circuit. | Check continuity of circuit and correct faults found. |
| | Improper mechanical adjustment of relay S1. | Check mechanical adjustment of relay (par. 57) and adjust relay electrically (par. 19). |
| | Relay S2 oscillates on the test. | Check contacts in TST REL section of switch K5 which normally short-circuit windings 3–6 of relay S2 with switch K5 at TST REL. Burnish (par. 48) or readjust (par. 58), as required. |
| | Short-circuited capacitor in capacitance bank C2 through C6. | Check capacitors C2 through C6 for short circuit. Replace defective capacitor. |
| | Open in circuit which causes relay under test to operate. | Check operating circuit for continuity. Correct any faults found. |
| | Short-circuited capacitor C9. | Check capacitor for short circuit. Replace if defective. |
| | Defective resistor R21, R22, or R17. | Check for proper resistance values. Replace defective resistors. |

| Symptom | Probable trouble | Correction |
|---|---|---|
| Circuit fails when soak current is applied (switches K2, K5, and K6 at MARK, TST REL, and DOTS HIGH, respectively). Refer to figures 24 and 25. | Open soak current circuit. | Check soak current circuit for continuity. Correct defects found. |
| | Soak current circuit fails. | Check soak current circuit for continuity. Correct defects found. |
| | Improper polarity. | Improperly poled battery will move the relay armature to the mark instead of space contacts when soak current is applied (meter needle will deflect to left). Check and, if necessary, reverse the polarity at the power source. |
| Meter needle fails to deflect to left (relay armature fails to move to mark position) when operate current is applied. Switches K2, K3, K5, and K6 at MARK, OPERATE, TST REL, and DOTS HIGH, respectively. Refer to figures 26 and 27. | Open operating circuit. | Check operating circuit for continuity (solid lines in figures 26 and 27). Correct defects found. |
| | Improper mechanical adjustment of relay S1. | Check mechanical adjustment of relay (par. 57) and adjust relay electrically (par. 19). |
| Meter needle fails to deflect to right (relay armature fails to return to space position) when switch K3 is moved from OPERATE to NON OPR. Refer to figures 26 and 27. | Improper mechanical adjustment of relay S1. | Check mechanical adjustment of relay (par. 57) and adjust relay electrically (par. 19). |
| Meter needle deflects to left (relay armature moves from space to mark position) when switch K3 is moved from OPERATE to | Improper mechanical adjustment of relay S1. | Check mechanical adjustment of relay (par. 57) and adjust relay electrically (par. 19). |
| | Open nonoperate circuit. | Check nonoperate circuit for continuity (combination of solid and dotted lines in figures 26 and 27). Correct defects found. |

| | | |
|---|---|---|
| NON OPR. Refer to figures 26 and 27. | | |
| Relay S1 fails to operate on line current with switch K6 at DOTS LOW. Refer to figure 28. | Open operating circuit. | Check circuit for continuity. Correct defects found. |
| | Improper mechanical adjustment of relay S1. | Check mechanical adjustment of relay (par. 57) and adjust relay electrically (par. 19). |
| Relay S2 fails to operate on line current with switch K6 at DOTS LOW. Refer to figure 28. | Improper mechanical adjustment of relay S2. | Check mechanical adjustment of relay (par. 57) and adjust relay electrically (par. 19). |
| | Relay S2 improperly biased. | Check biasing current. If necessary, readjust potentiometer P1. |
| | Open biasing circuit. | Check biasing circuit for continuity. Correct defects found. |
| | Circuit producing in excess of 10 cps. | Check contacts associated with capacitor C1 in DOTS LOW section of switch K6. Burnish (par. 48) or readjust (par. 58), as required. |
| | Capacitor C1 short-circuited. | Select a safe, suitable tool and short circuit the terminals of capacitor C1. A snappy spark indicates that the capacitor is all right. No spark or a relatively weak spark indicates a faulty capacitor. Replace a defective capacitor. |

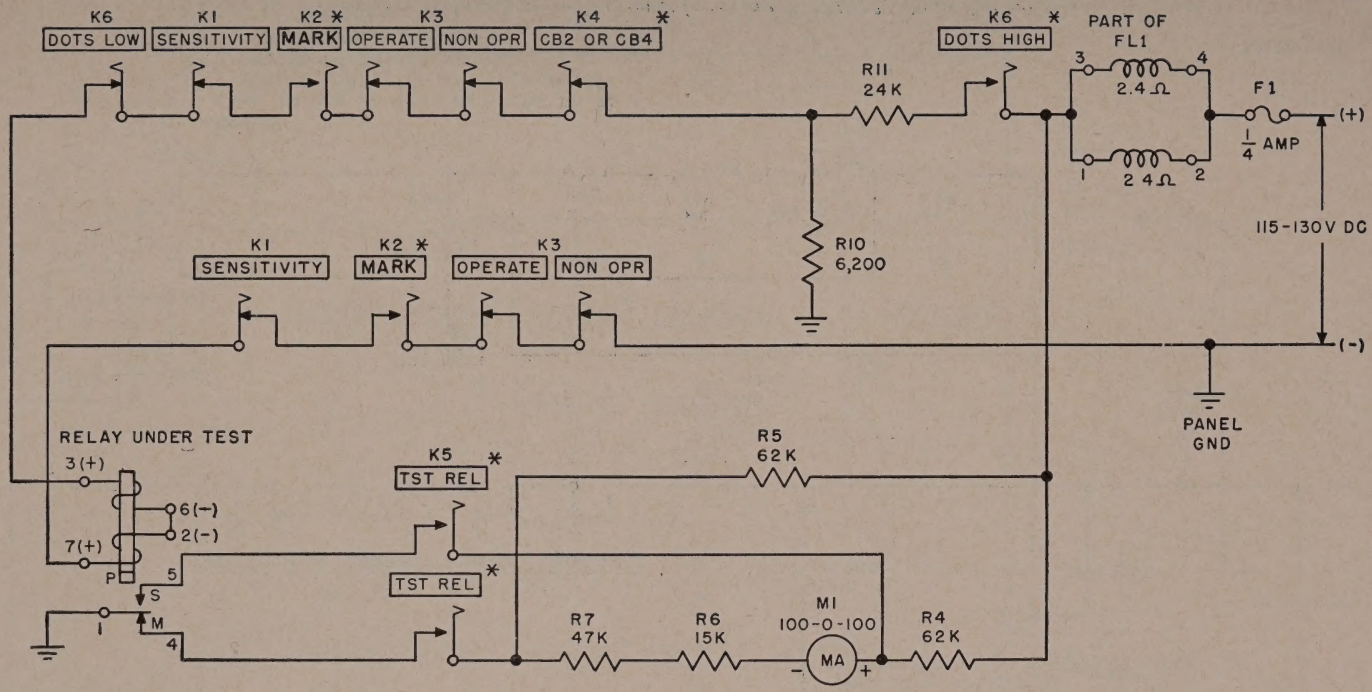



NOTES:

1. K1, K5, AND K6 MUST BE OPERATED TO POSITION INDICATED BY ASTERISK (*).
2. C7, C8, AND R3 HAVE BEEN OMITTED TO SIMPLIFY CIRCUIT.
3. UNLESS OTHERWISE SHOWN, ALL RESISTORS ARE IN OHMS.

TM 2513-34

*Figure 23. Circuit for testing bias of relay under test, simplified schematic diagram.*

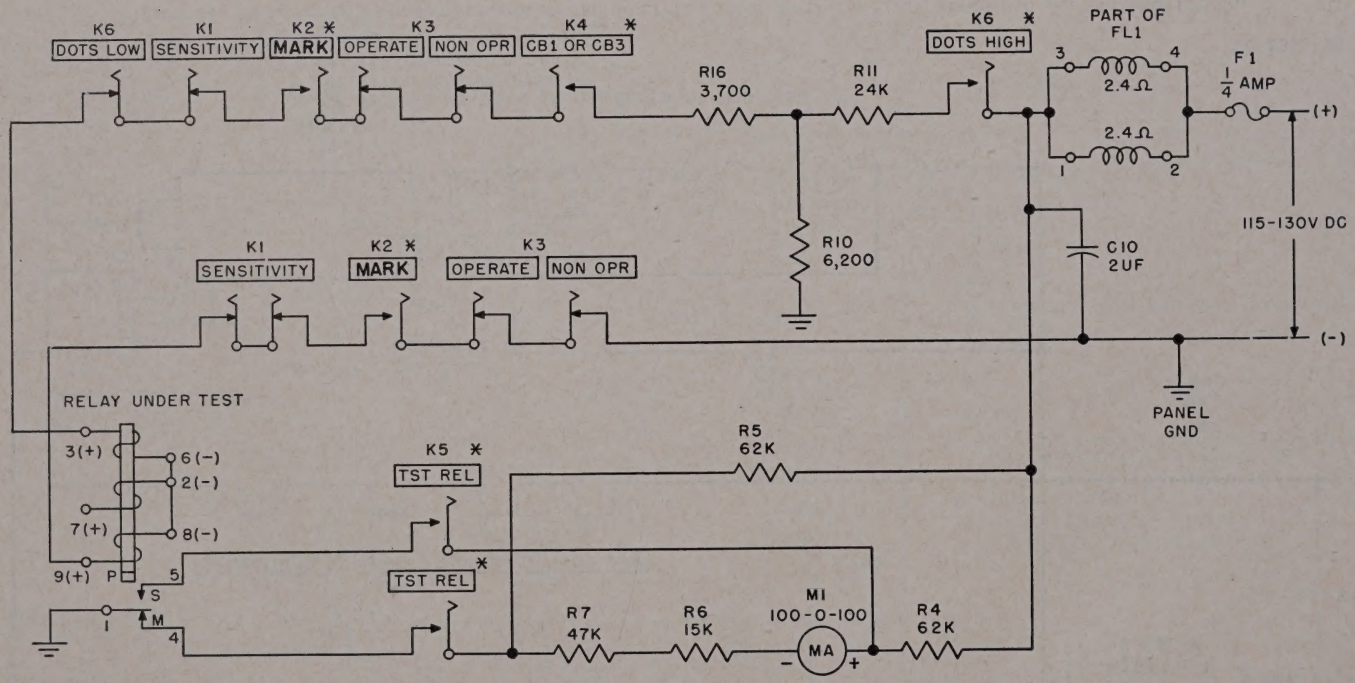



NOTES:

1. K2, K5, AND K6 MUST BE OPERATED TO POSITION INDICATED BY ASTERISK (*)
2. UNLESS OTHERWISE NOTED, RESISTORS ARE IN OHMS.

TM 2513-36

*Figure 24. Sensitivity test soak current circuit for relay 255A or D-163119A, simplified schematic diagram.*




NOTES:
1. K2, K4, AND K6 MUST BE OPERATED TO POSITION INDICATED BY ASTERISK (*)
2. UNLESS OTHERWISE SHOWN, RESISTORS ARE IN OHMS.

TM 2513-35

*Figure 25. Sensitivity test soak current circuit for relay D–164816, simplified schematic diagram.*

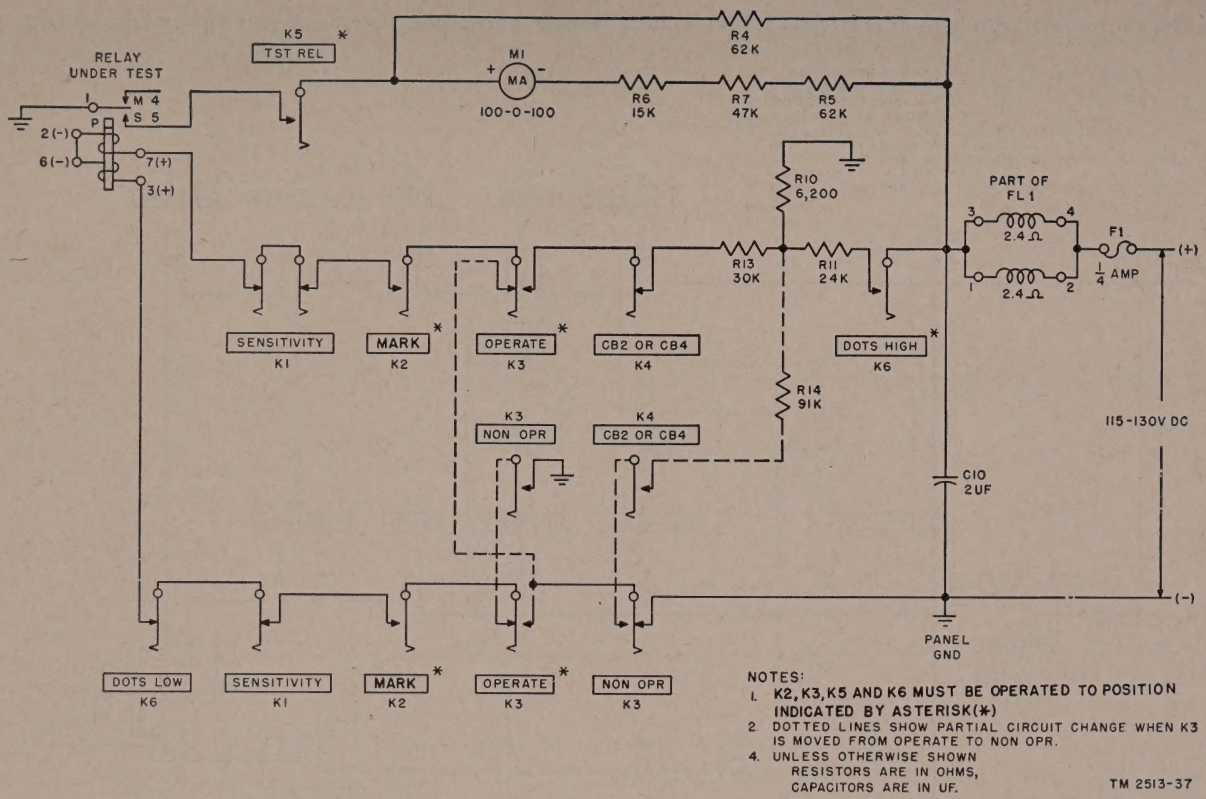



*Figure 26. Sensitivity test operate and nonoperate current circuits for relay 255A or D–163119A, simplified schematic diagram.*

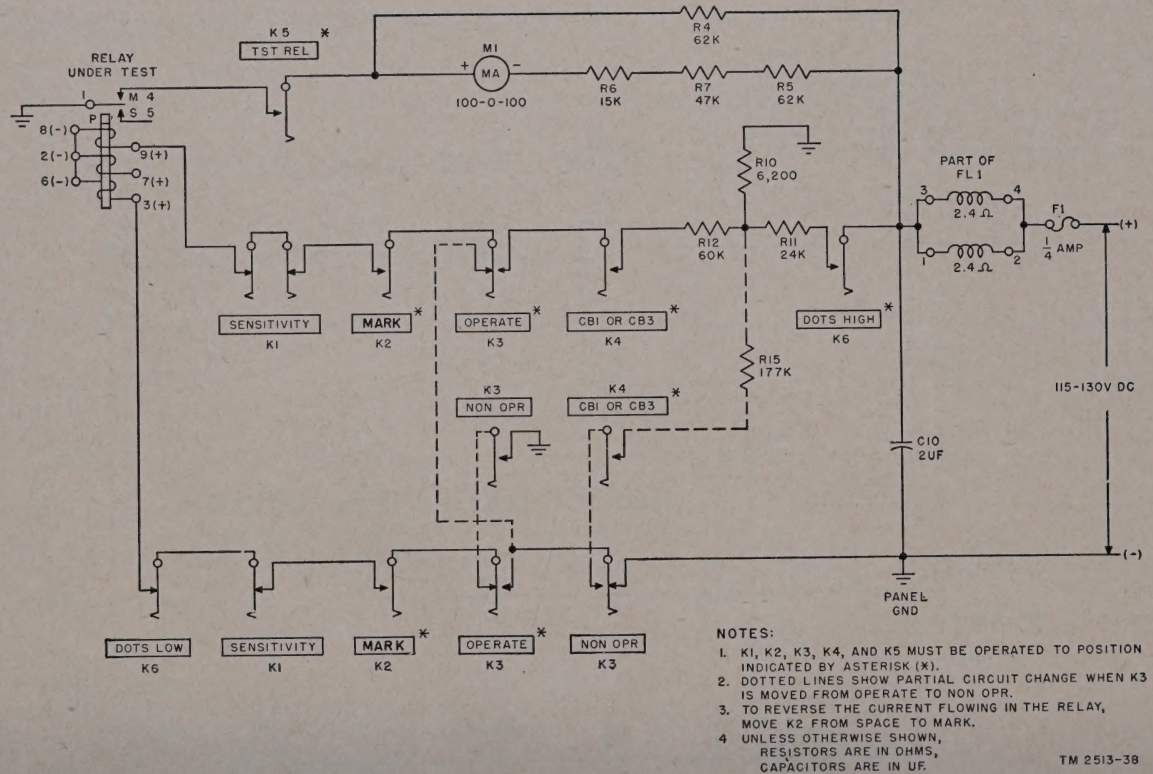



*Figure 27. Sensitivity test operate and nonoperate current circuits for relay D–164816, simplified schematic diagram.*

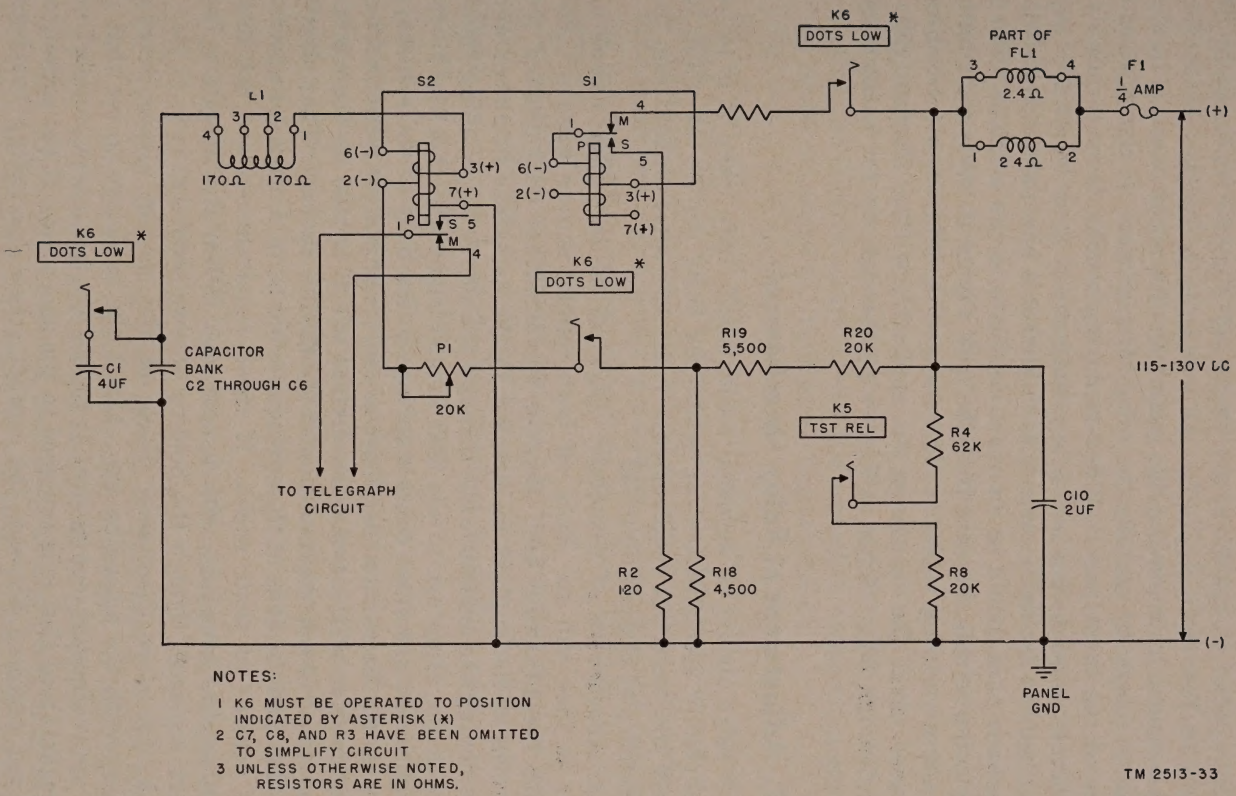



*Figure 28. Oscillating circuit for producing 10 cycles per second alternating current, simplified schematic diagram.*

## Section III. REPAIRS

### 56. Replacement of Parts

No special instructions are necessary for the replacement of parts in Test Set I–193–(*). All parts can be reached easily for replacement by removing the equipment from the case or, in the case of relays, by opening the relay compartment on the left-hand side of the front panel. When removing wiring from terminals, either by unsoldering or by loosening screw type terminals, tag each wire to facilitate correct wiring when a new part is installed. The new part should be an exact duplicate of the original. When replacing wiring, be sure that the new wiring is the same length as the wire being replaced. If wiring with different color-coding is used, make the change on the applicable wiring diagram (figs. 33 through 35). Refer to figures 29 through 31 for location of parts.

### 57. Adjustment of Relay (Mechanical)

A relay should be adjusted mechanically only when it is to be completely reconditioned or when the relay cannot be made to meet the electrical requirements (par. 19) after it has been inspected and cleaned (par. 49).

*a. Appearance of Armature.* Back off the pole-piece screws as far as they will go. Back off both contact screws several turns with the adjusting key. Remove the armature by loosening the screws in the supporting bracket in the armature heelpiece and by moving the armature out through the slot in the winding spool. Check the armature to see that it is straight and that the rivets holding the armature contact springs to the body of the armature are tight. Make sure that there are no irregular projections from that portion of the armature surface which is held by the clamping piece. Check the condition of the flexible springs. They should be flat, and the ends of the springs should be in contact for at least 25 percent of their width. If these requirements are not met, replace the armature with a new one. When the armature has been replaced, tighten the holding screws securely.

*b. Armature Clearance.* Back off the contact screws several turns with the adjusting key. Check the armature to see that it is approximately equidistant from the contact screw supporting brackets and that it is centered in the spool slot. If the armature is not centered between the contact screw supporting brackets, loosen the screws holding the armature heelpiece and realine the armature. Tighten the screws. If the armature is not centered horizontally in the spool slot, loosen the screws that hold the front

and rear spool heads to the frame of the relay, move the coil to the right or left, as required, and tighten the screws. If the armature is not centered vertically in the spool slot, slightly loosen the screws holding the armature to its heelpiece and move the armature up or down to bring the stationary screw contacts and the armature contacts into proper alinement. Tighten the screws.

*c. Contact Alinement.* Both the right- and left-hand screw contacts should be entirely within the area of the armature contacts. When this requirement is not met, loosen the armature heelpiece screws and line up the contacts, at the same time being careful to keep the armature centered in the slot. Tighten the heelpiece screws. If the armature contacts cannot be alined in this manner, or if the contact screws are not in line, loosen the screws which hold the contact screw brackets to the base of the relay and move the brackets until the contacts are in alinement. If the contacts are alined by moving the contact screw brackets, set the brackets so that the contact screws strike the armature contacts as near to the center as possible. Tighten all screws firmly.

*d. Pole-Piece Screw Alinement.* Both pole-piece screws should be in line with each other and at right angles to the armature. Check with the pole-piece screws turned in toward the armature. If the pole-piece screws are not in alinement, loosen the top and bottom screws which hold the pole-piece screw support and move the pole-piece screws into alinement by hand. Tighten the screws securely.

*e. Tightness of Contact Screws.* If the contact screws do not hold an adjustment, remove the screws from the brackets and force the split ends of the bracket closer together with a pair of pliers. Replace the contact screws.

*f. Tightness of Mounting and Assembly Screws.* Check the terminal block mounting screws which hold the base of the relay to the terminal block. If the relay base is loose, tighten the screws with a screw driver. Be sure that the assembly screws on the relay base are tight. If the screws are loose, tighten them with a screw driver.

*g. Tightness of Relay Terminals, Nuts, and Cover (Relays 255A and D–163119A Only).*

(1) The mounting posts should be held firmly to the terminal block by their associated locknuts. If the locknuts are loose, tighten them with a $\frac{3}{8}$-inch wrench.

(2) The relay terminals should be straight and held firmly to the terminal block by locknuts. If the relay terminals are loose, tighten the locknuts with a $\frac{5}{32}$-inch wrench. If the relay terminals are not straight, straighten them

with pliers. Be careful not to twist the connecting wires from the terminals.

(3) The cover locking plate should hold the relay cover firmly against the terminal block. In addition, it should be possible to remove the cover without tools. Adjust the cover locking plate with pliers at the crimp in the locking plate.

## 58. Adjustment of Switches

When the lever type switches used in Test Set I–193–(*) meet the specified minimum requirements given in subparagraphs *a* through *e* below, the switches are in satisfactory operating condition. If the requirements are not met, however, readjust for maximum requirements. When a switch is adjusted for one requirement only, all other requirements must be rechecked to be sure that they are still met. Before proceeding with adjustments, inspect the switch for dirt or other foreign material between the springs which might interfere with operation of the switch. If such deposits are present, remove them with a clean toothpick which has been dipped in carbon tetrachloride.

*a. Contact Alinement.* Contacts should line up so that the point of contact falls wholly within the boundary of the opposing contact at all times during contact. If the contacts do not line up satisfactorily, loosen the spring assembly screws slightly and shift the springs until the contacts are in alinement. Tighten the assembly screws securely and recheck the contact alinement. Check all other requirements again to be sure that the requirements are still met.

*b. Contact Separation and Spring Clearance.* The separation between any pair of contacts should be a minimum of .014 inch on test, or a minimum of .016 inch when the spring is readjusted. Similar separation requirements apply to adjacent springs designed never to make contact and, under all conditions, between any spring and the switch framework. If the spring is bowed or bent and the requirements are not met, straighten the spring before proceeding with any adjustment. To straighten a spring, apply the parallel jaw pliers to the spring just back of the bow or bend and, while exerting pressure to the right or left, as required, draw the pliers upward toward the spring contact. Repeat this operation until the spring is in satisfactory condition. Proper adjustment also requires that the spring be in line with its line of movement and approximately parallel with adjacent springs. Adjust for contact separation by placing the pliers just below the contact and adjusting the spring toward or away from the associated spring, as required.

*c. Contact Pressure.* Closed contacts should have a minimum pressure of 50 grams on test, or a minimum of 55 grams when the spring is readjusted. If the springs are bowed or bent, straighten them as directed in subparagraph *b* above before making adjustments. To adjust a spring for contact pressure, place the pliers on the spring just above the spring pile-up and gently rotate the pliers to the right or left, as required. When adjusting contact pressure, be careful not to disturb the adjustment of properly adjusted springs.

*d. Contact Follow.* Normally open and closed contacts should have a minimum contact follow of .008 inch on test, or a minimum of .010 inch when the spring is readjusted. With the parallel jaw pliers, adjust for contact follow by adjusting the position of the stop spring or by reducing the tension of the plunger spring slightly. The tension adjustment should not be great enough to interfere with any of the previous adjustments.

*e. Spring Separators.* The spring separators should not rub on the springs through which they pass when the switch lever is operated. If a separator rubs on a spring through which it passes, loosen the spring assembly screws slightly and shift the spring as required. When satisfactory separator adjustment has been made, check to see whether contact alinement has been retained and tighten the spring assembly screws securely. Recheck the separators and alinement of contacts.

## 59. Refinishing

*a. General.* Check the appearance and condition of the finish of all metal surfaces. The finish should show no decided wear, and no bare metal should be exposed because of shipping or scratches on the surface. Refinish surfaces where the finish has been removed completely or worn through. Retouch such surfaces if the bare parts are restricted to small areas, but refinish the entire surface if the bare or damaged areas are large. Discolored, spotted, stained, or faded surfaces are permissible if the original finish is intact.

*b. Refinishing procedures.* After sanding or scratch brushing, refinish affected surfaces to match the original finish. Apply one coat of lacquer to parts having a bright metal finish. Apply one coat of matching enamel or paint to painted surfaces. Do not apply lacquer to contact parts of jacks, switches, or the potentiometer, or to other surfaces which might affect the mechanical or electrical functioning of the equipment.

*c. Preservative Applications.* After the unit has been completely refinished, moistureproof and fungiproof the equipment according to instructions in paragraph 30*b*.

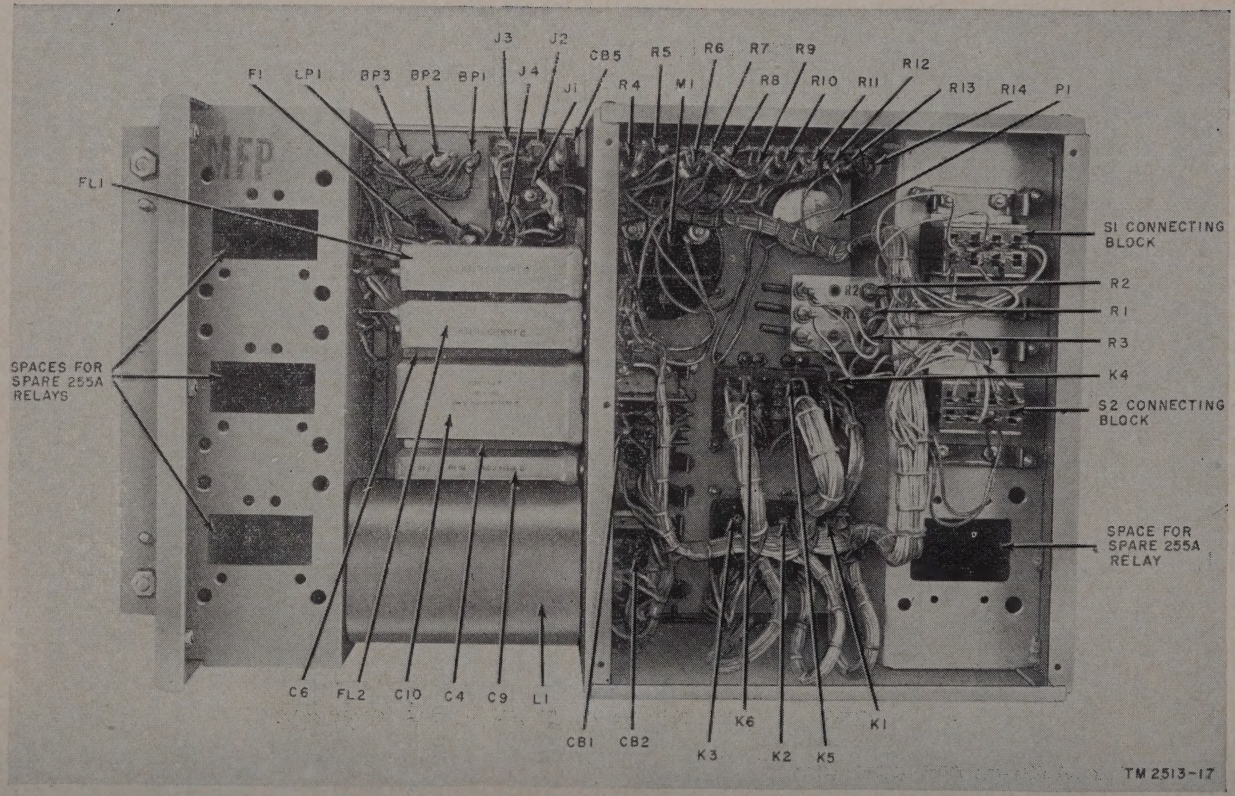



*Figure 29. Test Set I–193–A, wiring side of panel.*

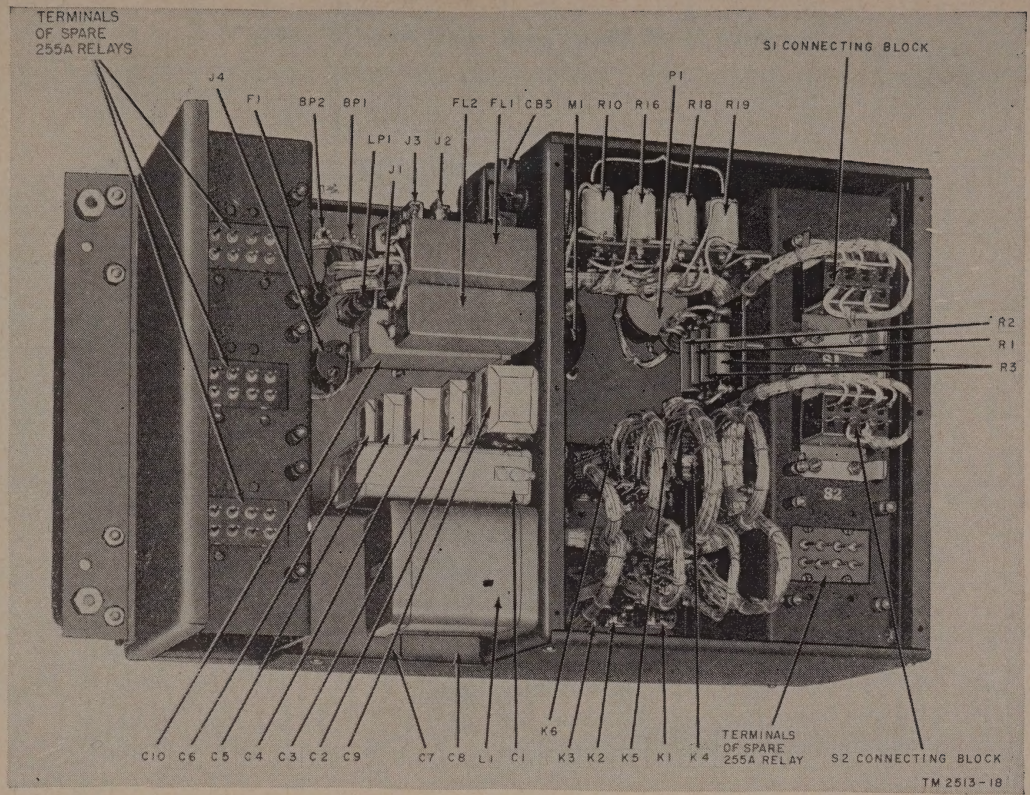



*Figure 30. Test Set I–193–B, wiring side of panel.*

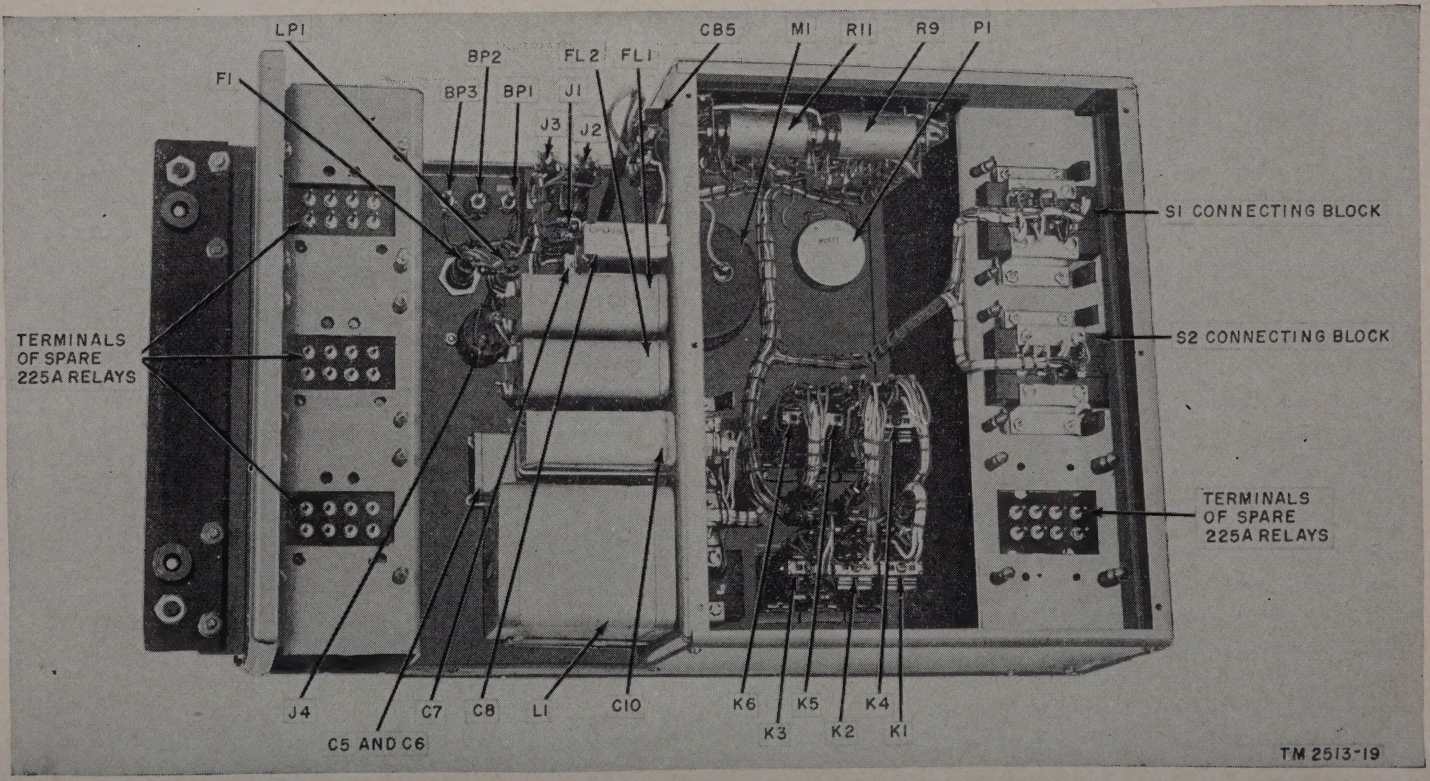



*Figure 31. Test Set I–193–C, wiring side of panel.*

# CHAPTER 6
# SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

## Section I. SHIPMENT AND LIMITED STORAGE

### 60. Removing from Service

*a.* Disconnect the test set from the power source.

*b.* If a ground lead is connected to the GND binding post, disconnect the lead.

*c.* Set all the lever switches at midposition.

*d.* Coil and tie the power cords, and place the loose cords in the recesses at either end of the front panel under the carrying handles.

*e.* Close and latch the relay compartment covers.

*f.* Check the relay maintenance tools to see that they are in place, and snap shut the flaps of the tool kit and the spare parts kit.

### 61. Repacking for Shipment or Limited Storage

*Note.* As far as possible, use the original packaging materials which were saved at the time the equipment was unpacked.

*a.* Place small bags of desiccant on the front panel of the equipment and cushion the face of the unit with cells or pads of corrugated fiberboard. Close and latch the lid of the case.

*b.* Place the equipment in a corrugated fiberboard box and cushion the case on all sides with pads or cells of corrugated fiberboard. Place bags of desiccant in the fiberboard cells. Close the box, seal it with paper tape, and place in a moisture-vaporproof barrier. Heat-seal the barrier.

*c.* Inclose the barrier-wrapped package in a second close-fitting corrugated fiberboard box. Seal this box with waterproof tape.

*d.* Place the packaged unit in a wooden shipping container lined with waterproof barrier material. Nail the lid on the box and reinforce the box with flat metal straps (fig. 5).

## Section II. DEMOLITION OF MATÉRIEL TO PREVENT ENEMY USE

### 62. Methods of Demolition

*a. Smash.* Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

*b. Cut.* Use axes, handaxes, machetes.

*c. Burn.* Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

*d. Explode.* Use firearms, grenades, TNT.

*e. Dispose.* Burn in slit trenches, fox holes, other holes. Throw into streams. Scatter.

*f. Other.* Use anything immediately available for destruction of this equipment.

### 63. Methods of Destruction

When ordered by your commander, destroy all equipment to prevent its being used or salvaged by the enemy.

*a. Smash* (par. 62*a*) the switches, jacks, meter, potentiometer control, control panel, connectors, plugs, terminal boards, relays, retardation coil, filters, resistors, capacitors, fuses, and indicator light.

*b. Cut* (par. 62*b*) the wooden case, all power cords, and wiring.

*c. Burn* (par. 62*c*) the wooden case, cords, wiring, resistors, capacitors, Signal Corps forms, office records, and technical manuals.

*d. Bury* or *scatter* (par. 62*e*) the destroyed parts in slit trenches or fox holes, or throw them into streams.

*e. Destroy* everything.

# APPENDIX I

# REFERENCES

*Note.* For availability of items listed, check SR 310–20–3 for field manuals and JANAP's. Check SR 310–20–4 for technical manuals and technical bulletins. Check SR 310–20–5 for Army regulations and special regulations.

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## 1. Regulations

*a. Army.*

AR 380–5_____Safeguarding Military Information.

AR 750–5_____Maintenance of Supplies and Equipment (Maintenance Responsibilities and Shop Operation).

*b. SPECIAL.*

SR 310–20–3____Index of Training Publications (Field Manuals, Training Circulars, Firing Tables and Charts, Army Training Programs, Mobilization Training Programs, Graphic Training Aids, Joint Army-Navy Air Force Publications, and Combined Communications Board Publications).

SR 310–20–4____Index of Technical Manuals, Technical Regulations, Technical Bulletins, Supply Bulletins, Lubrication Orders, Modification Work Orders, Tables of Organization and Equipment, Reduction Tables, Tables of Allowances, Tables of Organization, and Tables of Equipment.

SR 700–45–5____Unsatisfactory Equipment Report (Reports Control Symbol CSGLD–247).

SR 745–45–5___, AFR 71–4 } Report of Damaged or Improper Shipment (Reports Control Symbols CSGLD–66 (Army) and AF–MC–U2 (Air Force)).

## 2. Technical Manuals on Auxiliary Equipment and Test Equipment

TM 11–903_____Power Units PE–77, PE–77–A, PE–77–B, PE–77–C, PE–77–D, and PE–77–E.

TM 11–955_____Rectifier RA–37.

TM 11–957_____Rectifier RA–87.

TM 11–2005____Repeater Set TC–19 (Intermediate, Telegraph).

TM 11–4410____Repeater TG–30 (Terminal), Repair Instructions Operational Requirements.

TM 11–5511____Electronic Multimeter TS–505/U.

## 3. Painting, Preserving, and Maintenance

TB SIG 13_____Moistureproofing and Fungiproofing Signal Corps Equipment.

TB SIG 66_____Winter Maintenance of Signal Equipment.

TB SIG 72_____Tropical Maintenance of Ground Signal Equipment.

TB SIG 75_____Desert Maintenance of Ground Signal Equipment.

TB SIG 123____Preventive Maintenance Practices for Ground Signal Equipment.

TM 9–2851_____Painting Instructions for Field Use.

## 4. Decontamination

TM 3–220_____Decontamination.

## 5. Demolition

FM 5–25_____Explosives and Demolitions.

## 6. Packaging and Packing Information

*a. Military (JAN) Specifications.*

JAN–D–169(4)_Desiccants (Activated).

JAN–P–105A___Packaging and Packing for Overseas Shipment — Boxes, Wood, Cleated, Plywood (for boxes whose weight of contents does not exceed 1000 pounds).

JAN–P–106A___Packaging and Packing for Overseas Shipment — Boxes; Wood, Nailed (for weight of contents not in excess of 1,000 pounds).

JAN–P–116(2)_Packaging and Packing for Overseas Shipment — Preservation, Methods of.

MIL–B–131A___Barrier-Material; Water-Vaporproof, Flexible.

JAN–P–658(1)—Packaging and Packing of Electrical Equipment and Spare Parts (Electronic, Electrical, and Electro-Mechanical).

MIL–L–10547—Liners, Case, Waterproof.

MIL–STD–129—Marking of Shipments.

*b. Federal Specification.*

UU–T–111b—Tape, Paper, Gummed (Kraft).

## 7. Other Publications

TB SIG 25—Preventive Maintenance of Power Cords.

TB SIG 219—Operation of Signal Equipment at Low Temperatures.

TM 11–453—Shop Work.

TM 11–661—Electrical Fundamentals (Direct Current).

TM 11–681—Electrical Fundamentals (Alternating Current).

# APPENDIX II
# IDENTIFICATION TABLE OF PARTS

*Note.* The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O&E, T/A, SIG 7 & 8, list of allowances of expendable material, or another authorized supply basis. The Department of the Army Supply Catalog applicable to the equipment covered in this manual is SIG 7 & 8–I–193. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1.

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| | ADJUSTER, spring: ¼" parallel offset one end | Used for adjusting relay contact screws and pole pieces on relay. | 6R41140 |
| | BAG: canvas; olive drab | Tool bag | 6R6555 |
| BP1, BP2, BP3 | BINDING POST TM–186: screw type | Power input connections | 3Z286 |
| CB5 | BOARD, terminal: general purpose connecting block; 4 screw type ter; 1⅝" lg x 1⅛" wd x ½" h o/a. | Termination for CD1, Test Set I–193–C | 2Z9402.44 |
| | BURNISHER TL–557/U | For cleaning and burnishing relay contacts | 6R41065C |
| | BUSHING: .252" OD x .182" ID x .073" thk | Bushing for hole in panel | 6L54004 |
| CD3 | CABLE, power: 2 #18 AWG stranded cond | Power input cord for use with binding posts. | 1B3018–2.4 |
| C5, C6 | CAPACITOR, fixed: paper; single sect.; 100,000 $\mu\mu$f ±10%; 400 vdcw; JAN type CP61B1EE104K. | Oscillator circuit 20-cps tuning capacitors, Test Set I–193–B. | 3DA100–976 |
| C5, C6, C9 | CAPACITOR, fixed: paper; two sect.; 100,000 $\mu\mu$f per sect. ±10%; 600 vdcw; JAN type CP55B4EF104K. | C5, C6—Oscillator circuit 20-cps tuning capacitors, Test Set I–193–C. | 3DA100–1004 |

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|---|---|---|---|
| | | C9—A-c coupling capacitor, Test Set I–193–C. | |
| C9 | CAPACITOR, fixed: paper; two sect.; 100,000 μμf per sect. ±10%; 600 vdcw; JAN type CP69B4EF104K. | A-c coupling capacitor, Test Set I–193–B. | 3DA100–1005 |
| C5, C6 | CAPACITOR, fixed: paper; single sect.; 100,000 μμf ±15%; 600 vdcw; JAN type CP74A1AF104L. | Oscillator circuit 20-cps tuning capacitors, Test Set I–193–A. | 3DA100–139 |
| C9 | CAPACITOR, fixed: paper; single sect.; 200,000 μμf ±10%; 600 vdcw; JAN type CP75A1AF204K. | A-c coupling capacitor, Test Set I–193–A. | 3DA200–5 |
| C4, C7, C8 | CAPACITOR, fixed: paper; single sect.; 250,000 μμf ±10%; 400 vdcw; JAN type CP61B1EE254K. | C4—Oscillator circuit 20-cps tuning capacitor, Test Set I–193–B.<br>C7, C8—Spark reduction capacitors, Test Set I–193–B. | 3DA250–529 |
| C4, C7, C8 | CAPACITOR, fixed: paper; single sect.; 250,000 μμf ±10%; 600 vdcw; JAN type CP61B1EF254K. | C4—Oscillator circuit 20-cps tuning capacitor, Test Set I–193–C.<br>C7, C8—Spark reduction capacitors, Test Set I–193–C. | 3DA250–366 |
| C4, C7, C8 | CAPACITOR, fixed: paper; single sect.; 250,000 μμf ±15%; 400 vdcw; JAN type CP75A1AE254L. | C4—Oscillator circuit 20-cps tuning capacitor, Test Set I–193–A.<br>C7, C8—Spark reduction capacitor, Test Set I–193–A. | 3DA250–41 |
| C3 | CAPACITOR, fixed: paper; single sect.; 500,000 μμf ±10%; 400 vdcw. | Oscillator circuit 20-cps tuning capacitor, Test Set I–193–A. | 3DA500–169 |
| C3 | CAPACITOR, fixed: paper; single sect.; 500,000 μμf ±10%; 600 vdcw; JAN type CP61B1EF504K. | Oscillator circuit 20-cps tuning capacitor, Test Sets I–193–B and I–193–C. | 3DA500–605 |
| C2 | CAPACITOR, fixed: paper; single sect.; 1 μf ±10%; 400 vdcw; JAN type CP61B1EE105K. | Oscillator circuit 20-cps tuning capacitor, Test Set I–193–B. | 3DB1–320 |
| C2 | CAPACITOR, fixed: paper; single sect.; 1 μf ±10%; 400 vdcw; JAN type CP76A1AE105K. | Oscillator circuit 20-cps tuning capacitor, Test Set I–193–A. | 3DB1–117 |
| C2 | CAPACITOR, fixed: paper; single sect.; 1 μf ±10%; 600 vdcw; JAN type CP61B1EF105K. | Oscillator circuit 20-cps tuning capacitor, Test Set I–193–C. | 3DB1–45 |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| C10 | CAPACITOR, fixed: paper; single sect.; 2 μf ±15%; 250 vdcw; JAN type CP76A1HD205L. | A-c bypass capacitor, Test Set I–193–A | 3DB2–117 |
| C10 | CAPACITOR, fixed: paper; single sect.; 2 μf +20% —10%; 600 vdcw; JAN type CP70B1EF205V. | A-c bypass capacitor, Test Sets I–193–B and I–193–C. | 3DB2–92 |
| C1 | CAPACITOR, fixed: paper; 4 μf ±15%; 400 vdcw | Oscillator circuit 10-cps tuning capacitor, Test Set I–193–A. | 3DB4–52 |
| C1 | CAPACITOR, fixed: paper; single sect.; 4 μf ±10%; 600 vdcw; JAN type CP70B1EF405K. | Oscillator circuit 10-cps tuning capacitor, Test Sets I–193–B and I–193–C. | 3DB4–248 |
| | CLIP: for 0–30 amp cartridge fuse | Holds fuse in place | 3Z1016–1 |
| L1 | COIL, telephone retardation: 2 wdg; ea 55 h .03 amp dc, 170 ohms. | Oscillator circuit tuning, Test Set I–193–A | 3C1987–39D |
| CB1 | CONNECTOR, receptacle: 10 rd female cont w/solder lug term; straight type. | Socket for three-winding relay, Test Sets I–193–A and I–193–B. | 2Z9410.125 |
| CB1 | CONNECTOR, receptacle: 10 rd female cont w/ solder lug term; straight type. | Socket for three-winding relay, Test Set I–193–C. | 2Z3071–23 |
| CB2 | CONNECTOR, receptacle: 8 rect female cont; straight type. | Relay socket, Test Sets I–193–A and I–193–B. | 4E318B.1 |
| CB2 | CONNECTOR, receptacle: 8 rect female cont; straight type. | Relay socket, Test Set I–193–C | 2Z3069–53 |
| J4 | CONNECTOR, receptacle: 2 arc-shaped polarized male cont; straight type. | Power input, connects with PG2 | 6Z816 |
| PG2 | CONNECTOR, plug: 2 arc-shaped polarized female cont; straight type. | Power input, part of CD2 | 6Z3151 |
| PG3 | CONNECTOR, plug: 2 flat parallel male cont; straight type. | Power input, part of CD2 | 6Z1735.12 |
| CD1 | CORD, switchboard: 2 #34 AWG tinsel cond; 8′ lg excl term; black. | Power input cord for connection to radio suppression input filter FL1. | 3E4036–96–4 |

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|---|---|---|---|
| | COVER: binding post | Binding post cover | 3Z245/1 |
| | FASTENER, latch: drawbolt; 5¼" lg x $2\frac{15}{16}$" wd x ⅝" thk o/a. | Fasteners for relay compartments, Test Set I–193–A. | 6Z3640 |
| | FASTENER, screw: screw type w/dot head; slotted drive; ¾" lg x ½" dia o/a. | Fasteners for tool and spare fuse and lamp kits. | 6Z8585 |
| F1 | FUSE, cartridge: .25 amp | Overload protection, Test Sets I–193–A and I–193–C. | 3Z2587.1 |
| F1 | FUSE, cartridge: .25 amp | Overload protection, Test Set I–193–B | 3Z2587.2 |
| | GAGE, thickness: flat type; 12 leaves—.002", .003", .004", .005", .006", .007", .008", .009", .010", .011", .012", .018". | Relay contact gap adjustment check | 6R40874D |
| | GASKET: seal; syn rubber; 1 hole; rect shape | | 4F2101A/G1 |
| | HANDLE: carrier; 4½" lg x 4½" wd approx x ⅞" thk o/a | Carrying case handles, Test Set I–193–A | 6Z5007 |
| | HANDLE: lever sw; $\frac{13}{16}$" lg x ⅜" dia | Handle for lever switch | 4C5104.79/5 |
| | HANDLE: lever sw; $\frac{13}{16}$" lg x ⅜" dia | Handle for lever switch, Test Sets I–193–B and I–193–C. | 4C5104.79/6 |
| | HOLDER, fuse: Fuse Post FU–39; extractor type | Holder for F1 | 3Z1939 |
| | INSULATOR, plate: rect shape; $1\frac{5}{8}$" lg | | 6L51075 |
| J1 | JACK, telephone: for 3 cond .2065" dia plug | Power input jack, receives PG1 | 4C4846A |
| J2, J3 | JACK, telephone: for 2 cond .250" dia plug | Dots input connections | 2Z5524 |
| | KNOB: bar type; black bakelite; for ¼" dia shaft | Coupled to P1, adjusts dots bias | 2Z5838 |
| | LABEL: wp paper; 13" lg x 11" wd | Operating instruction label | 6D7593A.1 |
| | LABEL: wp paper; 13" lg x 10" wd | Circuit label | 6D7593A.2 |
| LP1 | LAMP, glow: 110–120 v, 1/10 w; striking v 65 v ac, 90 v dc; #902 slide base. | Fuse alarm indicator light, Test Set I–193–A. | 2Z5888 |
| LP1 | LAMPHOLDER: spcl tp sb | Holder for fuse alarm indicator light, Test Set I–193–A. | 2Z5984.2 |
| | LEAD, test: 3 tinsel cond; 8' lg excl term | Test lead | 3E4035–11.1 |
| LP1 | LIGHT, indicator: w/lens; neon lamp molded into base | Fuse alarm indicator light, Test Sets I–193–B and I–193–C. | 6Z6823–3 |
| M1 | METER, ammeter: dc; range 100–0–100 ma w/multiplier | Relay contact adjustment indicator | 3F910–60 |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| | MOUNT, vibration: sq mtg; 12 lb load rating; 1¾" sq x 2" h o/a. | Unit shock mounting, Test Sets I–193–B and I–193–C. | 2Z8502–1 |
| | MOUNT, vibration: sq mtg; 12 lb load rating; 1¾" sq x ⅝" h o/a. | Unit shock mounting, Test Set I–193–B | 2Z8405–76 |
| | MOUNT, vibration: sq mtg; 10 to 24 lb load rating; 1¾" sq x $1\frac{3}{32}$" h o/a. | Unit shock mounting, Test Set I–193–C | 2Z8405–77 |
| | NUT, anchor: #10–32 NF–2 thd | | 6I2720–32–12.3 |
| PG1 | PLUG, telephone: 3 cond; JAN type PJ–309 | Power input, part of CD1 | 2Z7228A–309 |
| PG4 | PLUG PL–51: 3 cond; JAN type PJ–051 | Power input, part of CD3 | 2Z7151 |
| L1 | REACTOR: filter choke; single wnd; 20 h, 30 ma; 210 ohms dc resistance. | Oscillator circuit tuning, Test Set I–193–B | 3C573N |
| L1 | REACTOR: filter choke; single wnd; 34 h, 35 ma dc; 360 ohms dc resistance. | Oscillator circuit tuning, Test Set I–193–C | 3C554–4 |
| S1, S2 | RELAY, armature: SPDT polarized cont; 2 concentric wnd, 136 ohms ea wnd; min oper v .34 v dc, .00125 amp. | Dots producing circuits | 2Z7585–18 |
| R1, R2 | RESISTOR, fixed: ww; 120 ohms ±5%; 9 w; JAN type RW55J121. | Relay contact current-limiting resistors | 3RW18932 |
| R3 | RESISTOR, fixed: ww; 1000 ohms ±5%; 9 w; JAN type RW55J102. | Spark suppression resistor | 3RW24340 |
| R16 | RESISTOR, fixed: ww; 3700 ohms ±1%; ¼ w; JAN type RB10B37000F. | Relay coil current-limiting resistor in soak current circuit, Test Sets I–193–B and I–193–C. | 3RB5–3700.1 |
| R16 | RESISTOR, fixed: ww; 3700 ohms ±1%; ¼ w; JAN type RB41B37000F. | Relay coil current-limiting resistor in soak current circuit, Test Set I–193–A. | 3RB5–3700 |
| R18 | RESISTOR, fixed: ww; 4500 ohms ±1%; ¼ w; JAN type RB10B45000F. | Voltage divider for adjusting dots bias potential, Test Sets I–193–B and I–193–C. | 3RB5–4500.3 |

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|---|---|---|---|
| R18 | RESISTOR, fixed: ww; 4500 ohms ±1%; ¼ w; JAN type RB51B45000F. | Voltage divider for adjusting dots bias potential, Test Set I–193–A. | 3RB–4500 |
| R19 | RESISTOR, fixed: ww; 5500 ohms ±1%; ¼ w; JAN type RB10B55000F. | Voltage divider for adjusting dots bias potential, Test Sets I–193–B and I–193–C. | 3RB5–5500.1 |
| R19 | RESISTOR, fixed: ww; 5500 ohms ±1%; ¼ w; JAN type RB51B55000F. | Voltage divider for adjusting dots bias potential, Test Set I–193–A. | 3RB5–5500 |
| R10 | RESISTOR, fixed: ww; 6200 ohms ±1%; ¼ w; JAN type RB10B62000F. | Voltage divider in soak current circuit, Test Sets I–193–B and I–193–C. | 3RB5–6200.1 |
| R10 | RESISTOR, fixed: ww; 6200 ohms ±1%; ¼ w; JAN type RB51B62000F. | Voltage divider in soak current circuit, Test Set I–193–A. | 3RB5–6200 |
| R6 | RESISTOR, fixed: ww; 15,000 ohms ±1%; ¼ w; JAN type RB10B15001F. | Voltage divider for adjusting dots bias potential, Test Sets I–193–B and I–193–C. | 3RB6–1500.1 |
| R6 | RESISTOR, fixed: ww; 15,000 ohms ±1%; ¼ w; JAN type RB51B15001F. | Voltage divider for adjusting dots bias potential, Test Set I–193–A. | 3Z6615–44 |
| R8, R20 | RESISTOR, fixed: ww; 20,000 ohms ±1%; ¼ w; JAN type RB10B20001F. | R8—Voltage divider for adjusting bias potential, Test Sets I–193–B and I–193–C.<br>R20—Voltage divider for adjusting bias potential, Test Set I–193–C. | 3RB6–2000 |
| R8 | RESISTOR, fixed: ww; 20,000 ohms ±1%; ¼ w; JAN type RB51B20001F. | Voltage divider for adjusting bias potential, Test Set I–193–A. | 3RB6–2000.7 |
| R9, R20 | RESISTOR, fixed: ww; 20,000 ohms ±1%; ¼ w; JAN type RB13B20001F. | R9—Relay S1 mark current-limiting resistor, Test Set I–193–B.<br>R20—Voltage divider for adjusting bias potential, Test Set I–193–B. | 3RB6–2000.4 |
| R9 | RESISTOR, fixed: ww; 20,000 ohms ±1%; 1 w; JAN type RB14B20001F. | Relay S1 mark current-limiting resistor, Test Set I–193–C. | 3RB6–2000.8 |
| R9, R20 | RESISTOR, fixed: ww; 20,000 ohms ±1%; 1 w_____ | Relay S1 mark current-limiting resistor, Test Set I–193–A. | 3Z6620–81 |
| R11 | RESISTOR, fixed: ww; 24,000 ohms ±1%; ½ w; JAN type RB13B24001F. | Voltage divider in soak current circuit, Test Set I–193–B. | 3RB6–2400.1 |

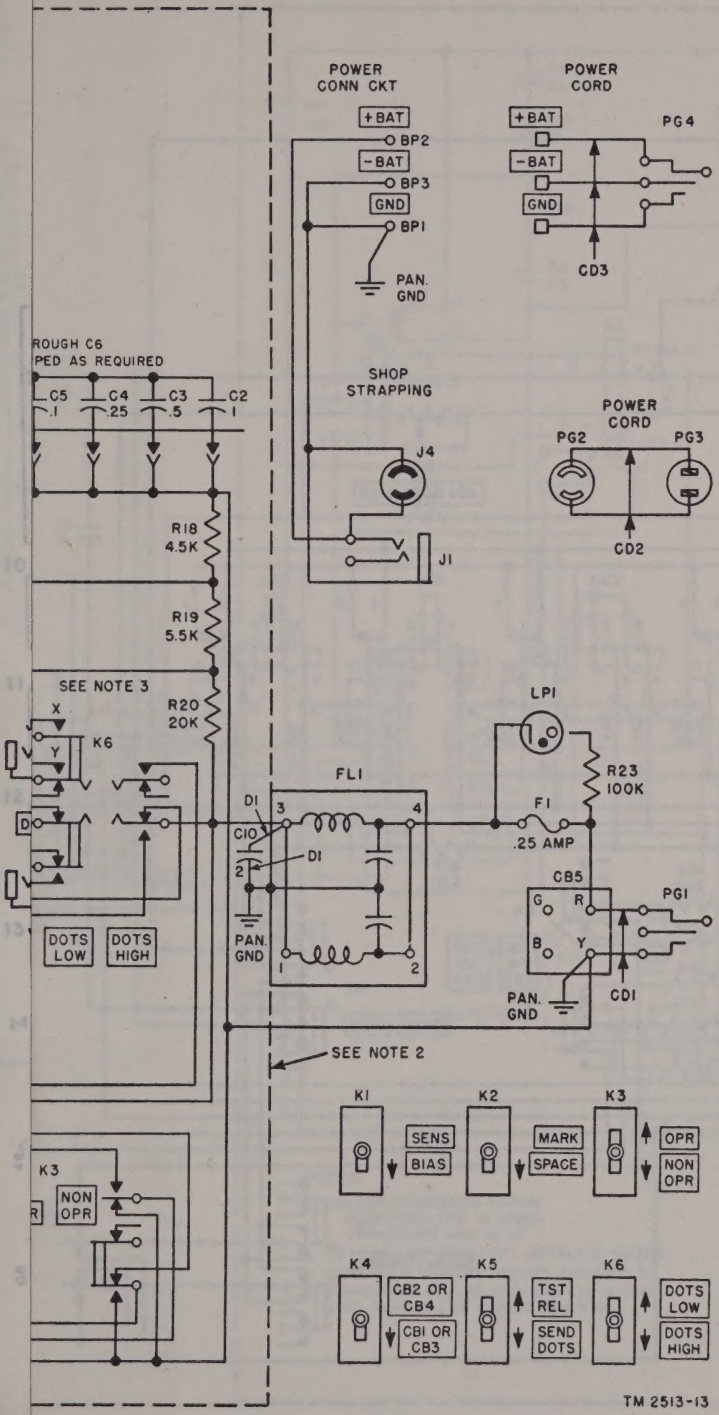
| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| R11 | RESISTOR, fixed: ww; 24,000 ohms ±1%; ¾ w | Voltage divider in soak current circuit, Test Set I–193–A. | 3Z6624–2 |
| R11 | RESISTOR, fixed: ww; 24,000 ohms ±1%; 1 w; JAN type RB14B24001F. | Voltage divider in soak current circuit, Test Set I–193–C. | 3RB6–2400.2 |
| R13 | RESISTOR, fixed: ww; 30,000 ohms ±1%; ¼ w; JAN type RB10B30001F. | Relay coil current-limiting resistor in operate current circuit, Test Set I–193–C. | 3RB6–3000.1 |
| R13 | RESISTOR, fixed: ww; 30,000 ohms ±1%; ½ w; JAN type RB13B30001F. | Relay coil current-limiting resistor in operate current circuit, Test Set I–193–B. | 3RB6–3000.3 |
| R13 | RESISTOR, fixed: ww; 30,000 ohms ±1%; ¾ w | Relay coil current-limiting resistor in operate current circuit, Test Set I–193–A. | 3Z6630–22.1 |
| R7 | RESISTOR, fixed: ww; 47,000 ohms ±1%; ¼ w; JAN type RB10B47001F. | Bias test resistor in meter circuit, Test Sets I–193–B and I–193–C. | 3RB6–4700.2 |
| R7 | RESISTOR, fixed: ww; 47,000 ohms ±1%; ¾ w | Bias test resistor in meter circuit, Test Set I–193–A. | 3Z6647–13 |
| R12 | RESISTOR, fixed: ww; 60,000 ohms ±1%; ¼ w; JAN type RB10B60001F. | Relay coil current-limiting resistor in operate current circuit, Test Set I–193–C. | 3RB6–6000 |
| R12 | RESISTOR, fixed: ww; 60,000 ohms ±1%; ½ w; JAN type RB13B60001F. | Relay coil current-limiting resistor in operate current circuit, Test Set I–193–B. | 3RB6–6000.4 |
| R12 | RESISTOR, fixed: ww; 60,000 ohms ±1%; 1 w | Relay coil current-limiting resistor in operate current circuit, Test Set I–193–A. | 3Z6660–8.1 |
| R4, R5, R21, R22 | RESISTOR, fixed: ww; 62,000 ohms ±1%; ½ w; JAN type RB12B62001F. | R4, R5—Bias test resistor for relay S2 in meter circuit, Test Set I–193–C.<br>R21, R22—A-c voltage divider for relay under test, Test Set I–193–C. | 3RB6–6200.4 |
| R4, R5, R17, R21, | RESISTOR, fixed: ww; 62,000 ohms ±1%; ½ w; JAN type RB13B62001F. | R4, R5—Bias test resistor for relay S2 in meter circuit, Test Set I–193–B. | 3RB6–6200.2 |

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|---|---|---|---|
| R22 | | R17—Limits ac to relay under test with key K6 in DOTS HIGH position, Test Set I–193–B.<br>R21, R22—A-c voltage divider for relay under test, Test Set I–193–B. | |
| R17 | RESISTOR, fixed: ww; 62,000 ohms ±1%; 1 w; JAN type RB14B62001F. | Limits ac to relay under test with key K6 in DOTS HIGH position, Test Set I–193–C. | 3RB6–6200.3 |
| R4, R5, R17, R21, R22 | RESISTOR, fixed: ww; 62,000 ohms ±1%; 1 w | R4, R5—Bias test resistor for relay S2 in meter circuit, Test Set I–193–A.<br>R17—Limits ac to relay under test with key K6 in DOTS HIGH position, Test Set I–193–A.<br>R21, R22—A-c voltage divider for relay under test, Test Set I–193–A. | 3Z6662–4 |
| R14 | RESISTOR, fixed: ww; 91,000 ohms ±1%; ¼ w; JAN type RB10B91001F. | Relay coil current-limiting resistor in operate current circuit, Test Set I–193–C. | 3RB6–9100.3 |
| R14 | RESISTOR, fixed: ww; 91,000 ohms ±1%; ½ w; JAN type RB13B91001F. | Relay coil current-limiting resistor in operate current circuit, Test Set I–193–B. | 3RB6–9100.2 |
| R14 | RESISTOR, fixed: ww; 91,000 ohms ±1%; ¾ w | Relay coil current-limiting resistor in operate current circuit, Test Set I–193–A. | 3Z6691–2 |
| R23 | RESISTOR, fixed: comp; 100,000 ohms ±5%; ½ w; JAN type RC20BF104J. | Current-limiting resistor in fuse alarm circuit. | 3RC20BF104J |
| R15 | RESISTOR, fixed: ww; 177,000 ohms ±1%; ¼ w; JAN type RB1B17702F. | Relay coil current-limiting resistor in non-operate current circuit, Test Set I–193–C. | 3RB7–1770.1 |
| R15 | RESISTOR, fixed: ww; 177,000 ohms ±1%; ½ w; JAN type RB13B17702F. | Relay coil current-limiting resistor in non-operate current circuit, Test Set I–193–B. | 3RB7–1770.2 |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| R15 | RESISTOR, fixed: ww; 177,000 ohms ±1%; 1 w | Relay coil current-limiting resistor in non-operate current circuit, Test Set I–193–A. | 3Z6717G7 |
| P1 | RESISTOR, variable: ww; 20,000 ohms ±10%; 3 w | Adjust dots bias potential | 2Z7281.1 |
| | SCREW, captive: slotted drive; RH; ¼"–20 NC–2 thd; $\frac{13}{16}$" lg. | | 6L7920–4–13.49S |
| CB3 | SOCKET, tube: 9 cont; octal style; retainer ring mtg | Socket for relay, Test Set I–193–B | 2Z8679.13 |
| CB3 | SOCKET, tube: 9 cont; octal style; one-piece saddle mtg | Socket for relay, Test Set I–193–C | 2Z8679.32 |
| CB4 | SOCKET, tube: octal; retainer ring mtg | Socket for two-winding relay, Test Set I–193–B. | 2Z8779–137 |
| CB4 | SOCKET, tube: octal; one-piece saddle mtg | Socket for two-winding relay, Test Set I–193–C. | 2Z8678.336 |
| CB3 | SOCKET ASSEMBLY, tube: 9 cont; octal style | Socket for relay, Test Set I–193–A | 4E400 |
| CB4 | SOCKET ASSEMBLY, tube: octal | Socket for two-winding relay, Test Set I–193–A. | 4E401 |
| | STRAP, retaining | Limits travel of case cover, Test Set I–193–A. | 6Z8269–24 |
| FL1, FL2 | SUPPRESSOR, electrical noise: c/o 2 capacitors and 2 permalloy core coils. | FL1—Radio noise suppression input filter Test Set I–193–A.<br>FL2—Radio noise suppression output filter Test Set I–193–A. | 3Z1892–5.1 |
| FL1, FL2 | SUPPRESSOR, electrical noise: c/o 2 capacitors and 2 iron core coils. | FL1—Radio noise suppression input filter Test Set I–193–B.<br>FL2—Radio noise suppression output filter Test Set I–193–B. | 3Z1891–71 |

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|---|---|---|---|
| FL1, FL2 | SUPPRESSOR, electrical noise: c/o 2 capacitors and 2 iron core coils. | FL1—Radio noise suppression input filter Test Set I–193–C.<br>FL2—Radio noise suppression output filter Test Set I–193–C. | 3Z1891–70 |
| K1, K2, K4 | SWITCH, lever: 2 position locking; cont arrangement—2C and 2C ea position. | K1—SENSITIVITY—BIAS switch, Test Set I–193–A.<br>K2—MARK—SPACE switch, Test Set I–193–A.<br>K4—CB2–CB4—CB1–CB3 switch, Test Set I–193–A. | 3Z9580–11.33 |
| K1, K2, K4 | SWITCH, lever: 2 position locking; cont arrangement—2C and 2C ea position. | K1—SENSITIVITY—BIAS switch, Test Sets I–193–B and I–193–C.<br>K2—MARK—SPACE switch, Test Sets I–193–B and I–193–C.<br>K4—CB2–CB4—CB1–CB3 switch, Test Sets I–193–B and I–193–C. | 3Z9580–30.11 |
| K3 | SWITCH, lever: 2 position nonlocking; cont arrangement—position #1 1B2C, position #2 1C and 1C. | OPR—NONOPR switch, Test Set I–193–A | 4C5104.79BF.1 |
| K3 | SWITCH, lever: 2 position nonlocking; cont arrangement—position #1 1B1C and 1C, position #2 2C and 2C. | OPR—NONOPR switch, Test Sets I–193–B and I–193–C. | 3Z9580–30.14 |
| K5 | SWITCH, lever: Switch SW–159; 2 position locking; cont arrangement—position #1 2C and 2C, position #2 2C and 2C. | TST REL—SEND DOTS switch, Test Set I–193–A. | 4C9896 |
| K5 | SWITCH, lever: 2 position locking; cont arrangement—position #1 2C and 2C, position #2 2C and 2C. | TST REL—SEND DOTS switch, Test Sets I–193–B and I–193–C. | 3Z9580–30.12 |
| K6 | SWITCH, lever: 2 position locking; cont arrangement—position #1 1C1B and 1C1A, position #2 1C and 1C. | DOTS LOW—DOTS HIGH switch, Test Set I–193–A. | 4C5200.69 |
| K6 | SWITCH, lever: 2 position locking; cont arrangement—position #1 1B1C and 1C1A, position #2 1C and 1C. | DOTS LOW—DOTS HIGH switch, Test Sets I–193–B and I–193–C. | 3Z9580.30.1 |

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| CB5 | TERMINAL BOX: for 2 cond cable | Termination for CD1, Test Sets I–193–A and I–193–B. | 4E342A |
| | WASHER, flat: phenol filine; disk shape; 5/8" OD x .189" ID x 1/16" thk. | | 6L52011 |
| | WASHER, flat: rd; 7/8" max OD x .625" min or .640" max ID x .0630" thk. | | 6L75044 |
| | WASHER, lock: rd; 21/32" ID x 7/8" OD x .022" thk | | 6L72228–2 |


POWER CONN CKT
+BAT
BP2
-BAT
BP3
GND
BP1
PAN. GND
POWER CORD
+BAT
PG4
-BAT
GND
CD3
ROUGH C6 PED AS REQUIRED
C5 .1
C4 .25
C3 .5
C2 1
SHOP STRAPPING
J4
J1
POWER CORD
PG2
PG3
CD2
R18 4.5K
R19 5.5K
SEE NOTE 3
R20 20K
X
Y
K6
D
DOTS LOW
DOTS HIGH
D1
C10
2
D1
PAN. GND
FL1
3
4
1
2
LP1
R23 100K
F1 .25 AMP
CB5
G
R
B
Y
PG1
CD1
PAN. GND
SEE NOTE 2
K1
SENS
BIAS
K2
MARK
SPACE
K3
OPR
NON OPR
K3
NON OPR
K4
CB2 OR CB4
CB1 OR CB3
K5
TST REL
SEND DOTS
K6
DOTS LOW
DOTS HIGH
TM 2513-13

| Ref symbol | Name of part and description | Function of part | Signal Corps stock No. |
|---|---|---|---|
| CB5 | TERMINAL BOX: for 2 cond cable | Termination for CD1, Test Sets I–193–A and I–193–B. | 4E342A |
| | WASHER, flat: phenol filine; disk shape; 5/8" OD x .189" ID x 1/16" thk. | | 6L52011 |
| | WASHER, flat: rd; 7/8" max OD x .625" min or .640" max ID x .0630" thk. | | 6L75044 |
| | WASHER, lock: rd; 21/32" ID x 7/8" OD x .022" thk | | 6L72228–2 |

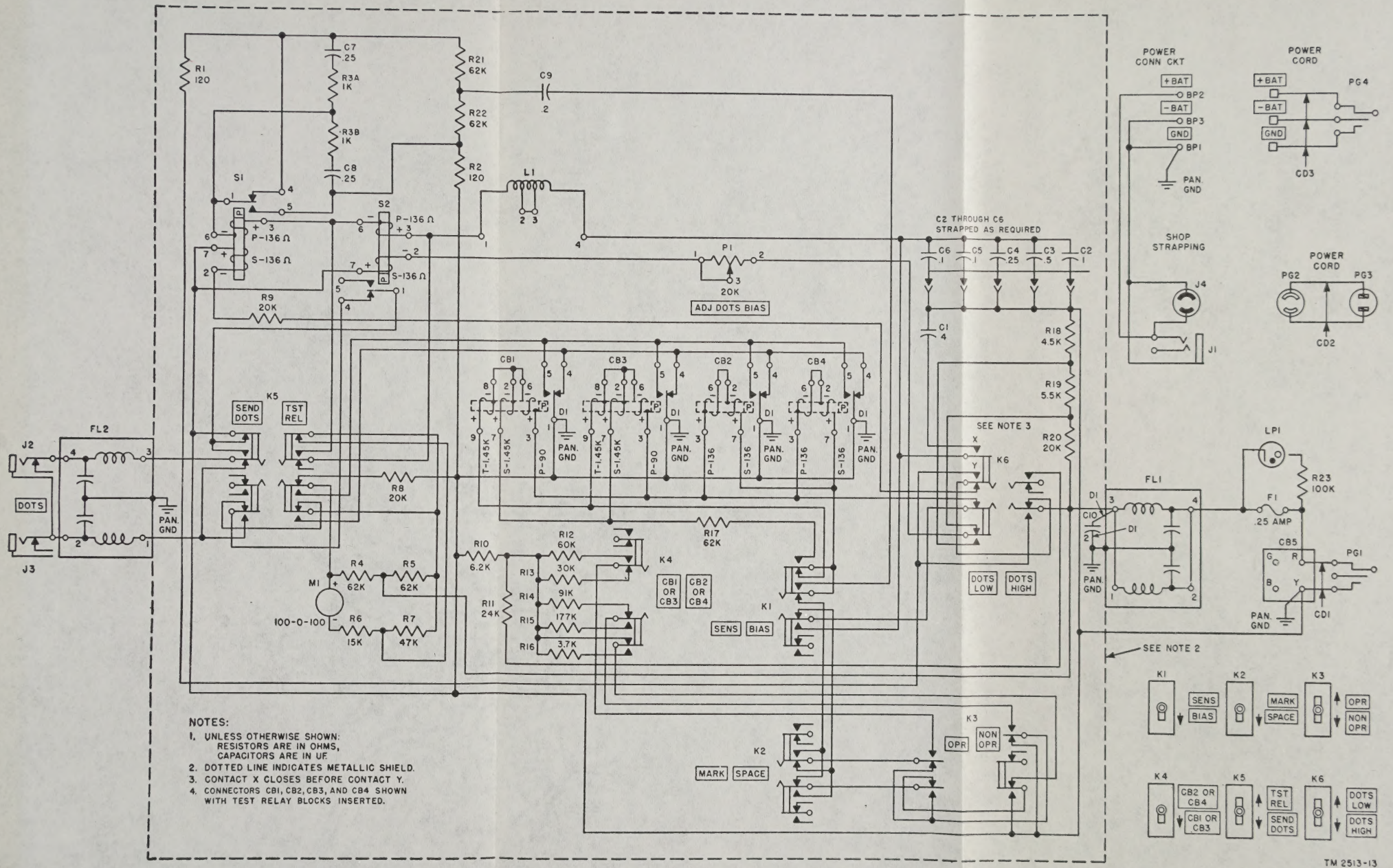



*Figure 32. Test Set I–193–A, I–193–B, or I–193–C, schematic diagram.*

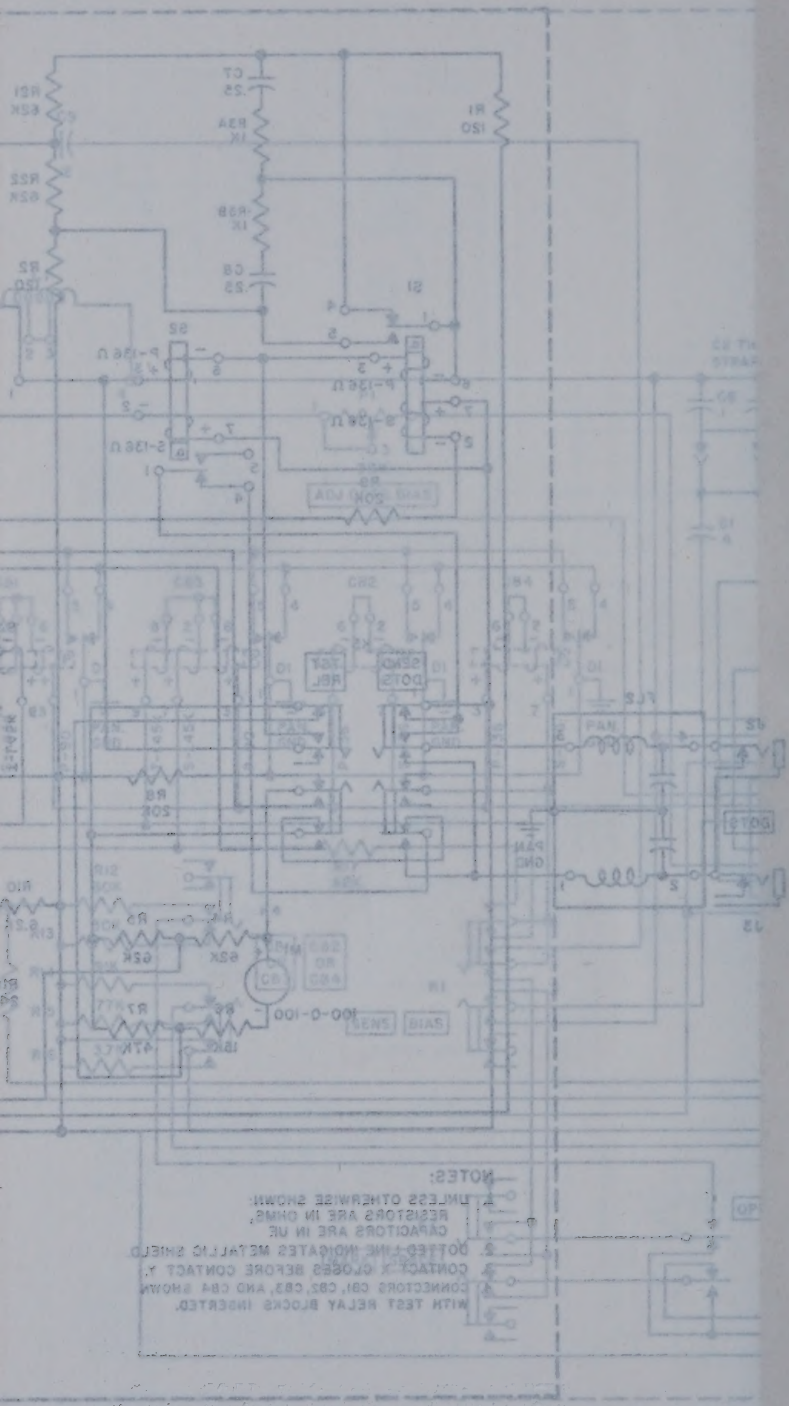
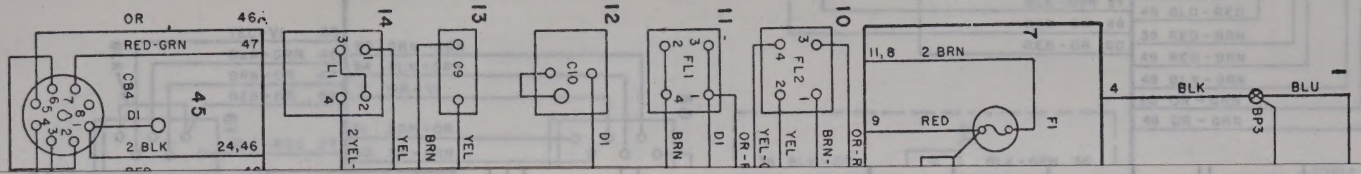
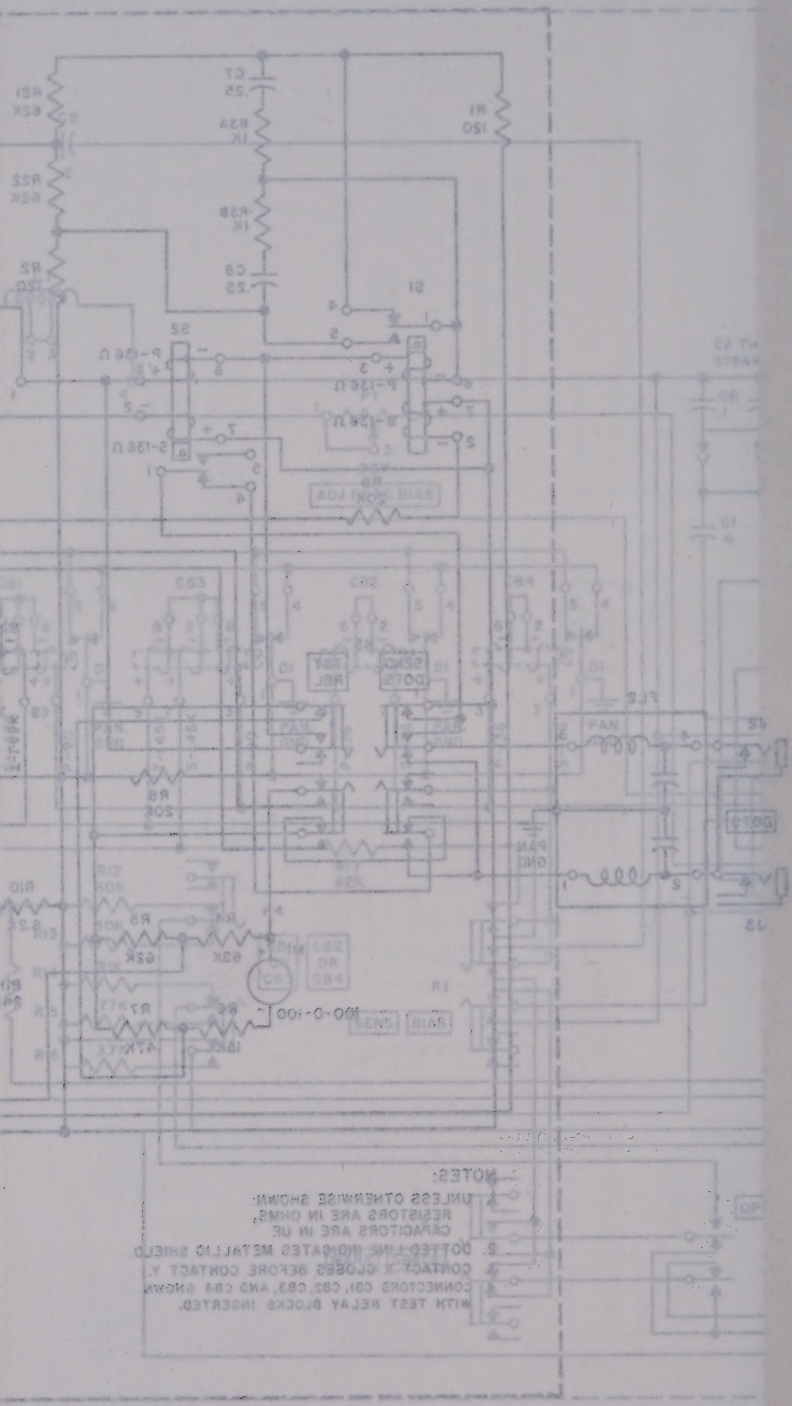


Fig. 2. Test Set I–193–A, I–193–B, or I–193–C, schematic diagram.


OR
46
RED-GRN
47
C84
DI
45
2 BLK
24,46
14
3
DI
LI
4
O2
2 YEL
YEL
13
C9
BRN
YEL
12
C10
DI
11
3
2
FL1
1
4
BRN
DI
OR-
10
3
FL2
1
4
20
YEL
BRN-
OR-R
11,8
2 BRN
7
9
RED
F1
4
BLK
BLU
1
BP3



*Test S-133-A, I-133-B, or I-133-C, schematic diagram.*

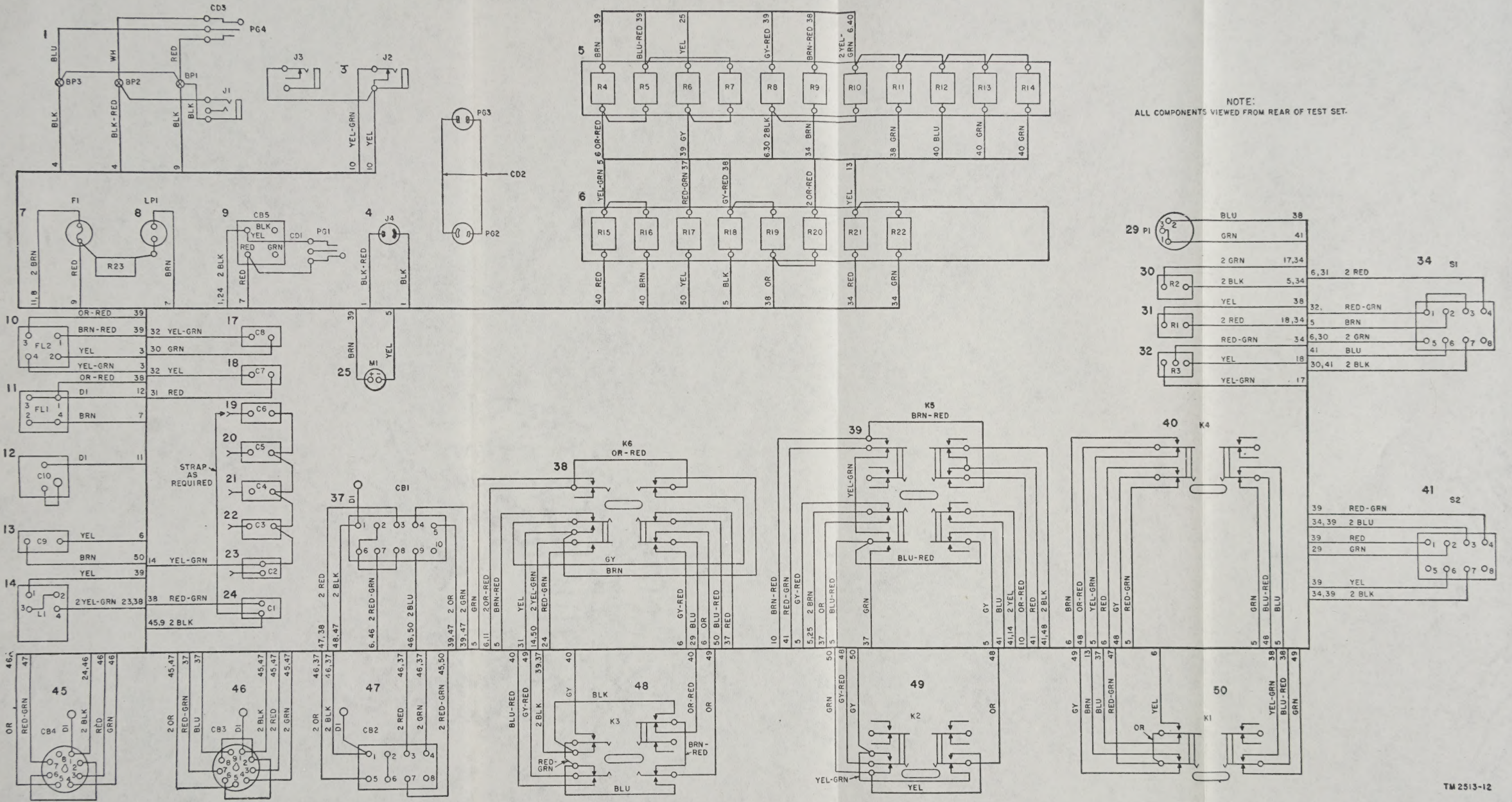



*Figure 33. Test Set I–193–A, wiring diagram.*

NOTES:

1. ALL COMPONENTS VIEWED FROM REAR OF TEST SET.
2. ALL WIRES HAVE WHITE BACKGROUND. COLORS SHOWN ON WIRES ARE TRACER COLORS.
3. CAPACITORS 2,3,4,5, AND 6 ARE SHOWN CONNECTED. DOTTED LINE INDICATES VARIABLE CONNECTIONS WHICH ARE MADE AT FINAL TESTS AT FACTORY.
4. RESISTORS R3 A AND B ARE COMBINED TO OBTAIN REQUIRED RESISTANCE.
5. CAPACITOR C9 CONSISTS OF TWO UNITS CONTAINED IN ONE CASE, CONNECTED TOGETHER TO OBTAIN REQUIRED CAPACITY.

TM 2513-14

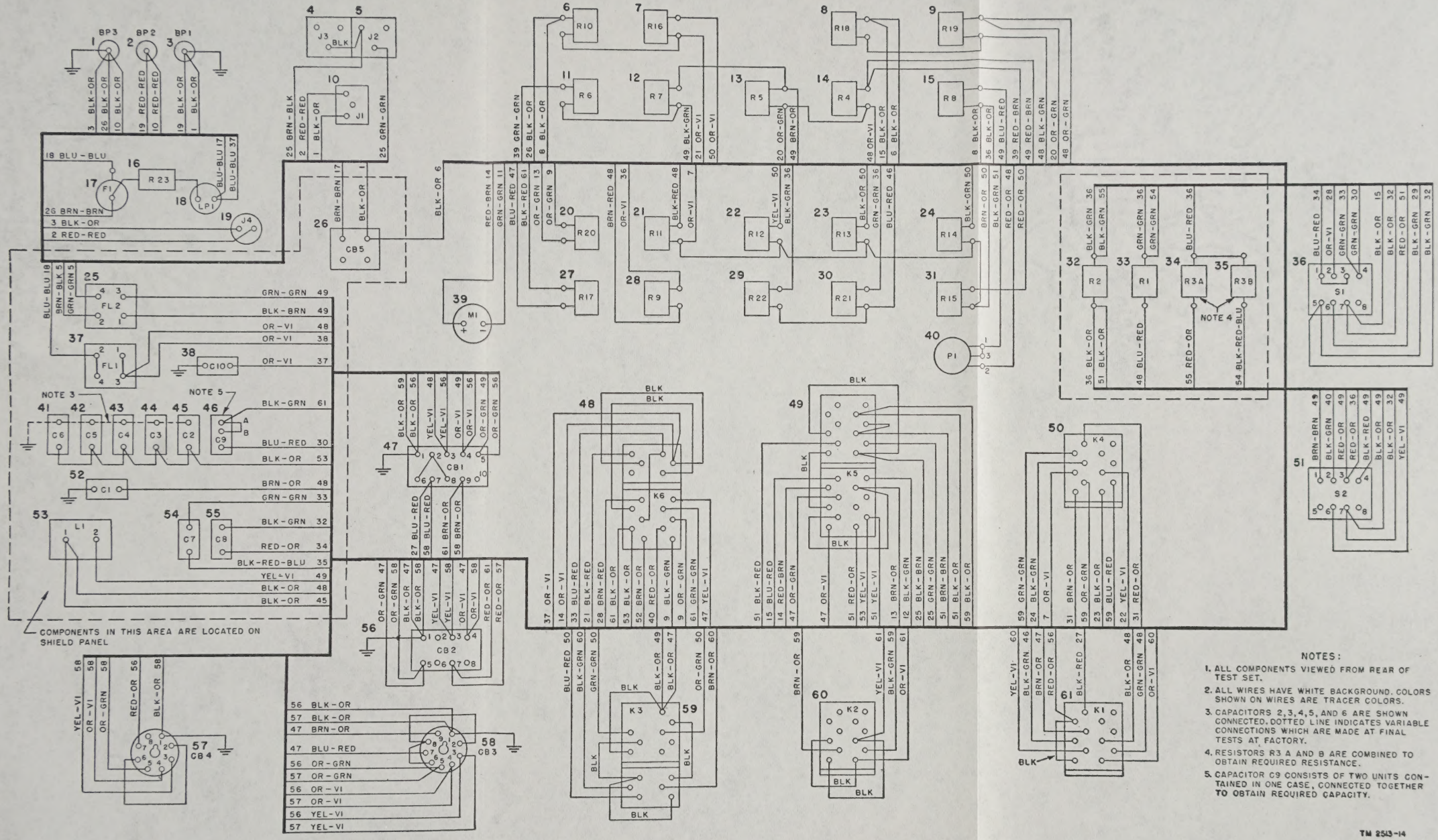



*Figure 34. Test Set I–193–B, wiring diagram.*

NOTES:

1. ALL COMPONENTS VIEWED FROM REAR OF TEST SET.
2. ALL WIRES HAVE WHITE BACKGROUND. COLORS SHOWN ON WIRES ARE TRACER COLORS.
3. CAPACITORS 2, 3, 4, 5, AND 6 ARE SHOWN CONNECTED. DOTTED LINE INDICATES VARIABLE CONNECTIONS WHICH ARE MADE AT FINAL TESTS AT FACTORY.
4. RESISTORS R3 A AND B ARE COMBINED TO OBTAIN REQUIRED RESISTANCE.
5. CAPACITOR C9 CONSISTS OF TWO UNITS CONTAINED IN ONE CASE, CONNECTED TOGETHER TO OBTAIN REQUIRED CAPACITY.

TM 2513-14

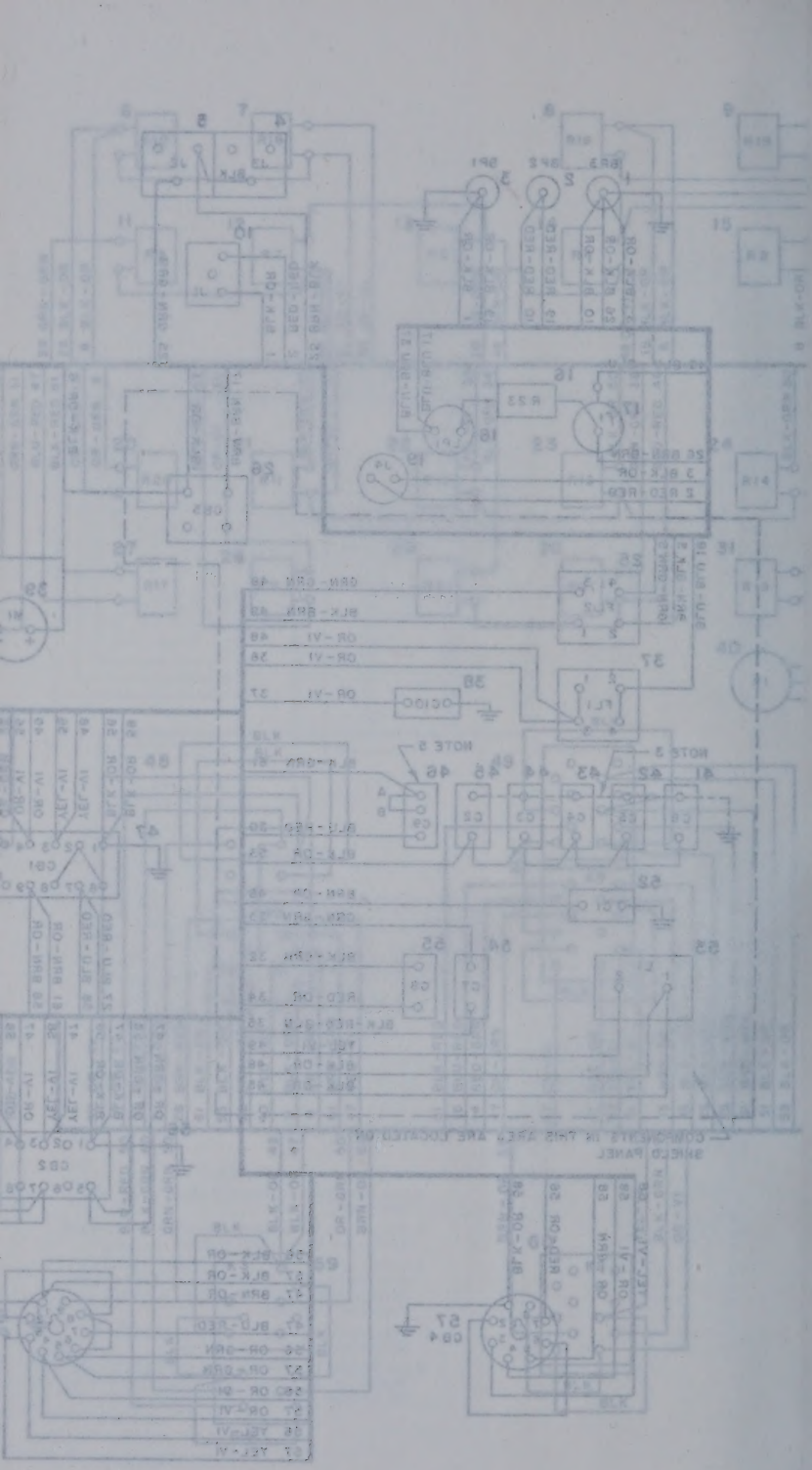


*Figure 31. Test Set I–193–B, wiring diagram.*

NOTES

1- ALL COMPONENTS VIEWED FROM REAR OF TEST SET.
2- CAPACITORS 2,3,4,5,&6 ARE SHOWN CONNECTED. DOTTED LINES INDICATE VARIABLE CONNECTIONS MADE AT THE FACTORY.
3- CAPACITOR C9 CONSISTS OF TWO UNITS CONTAINED IN ONE CASE, CONNECTED TOGETHER TO OBTAIN REQUIRED CAPACITY

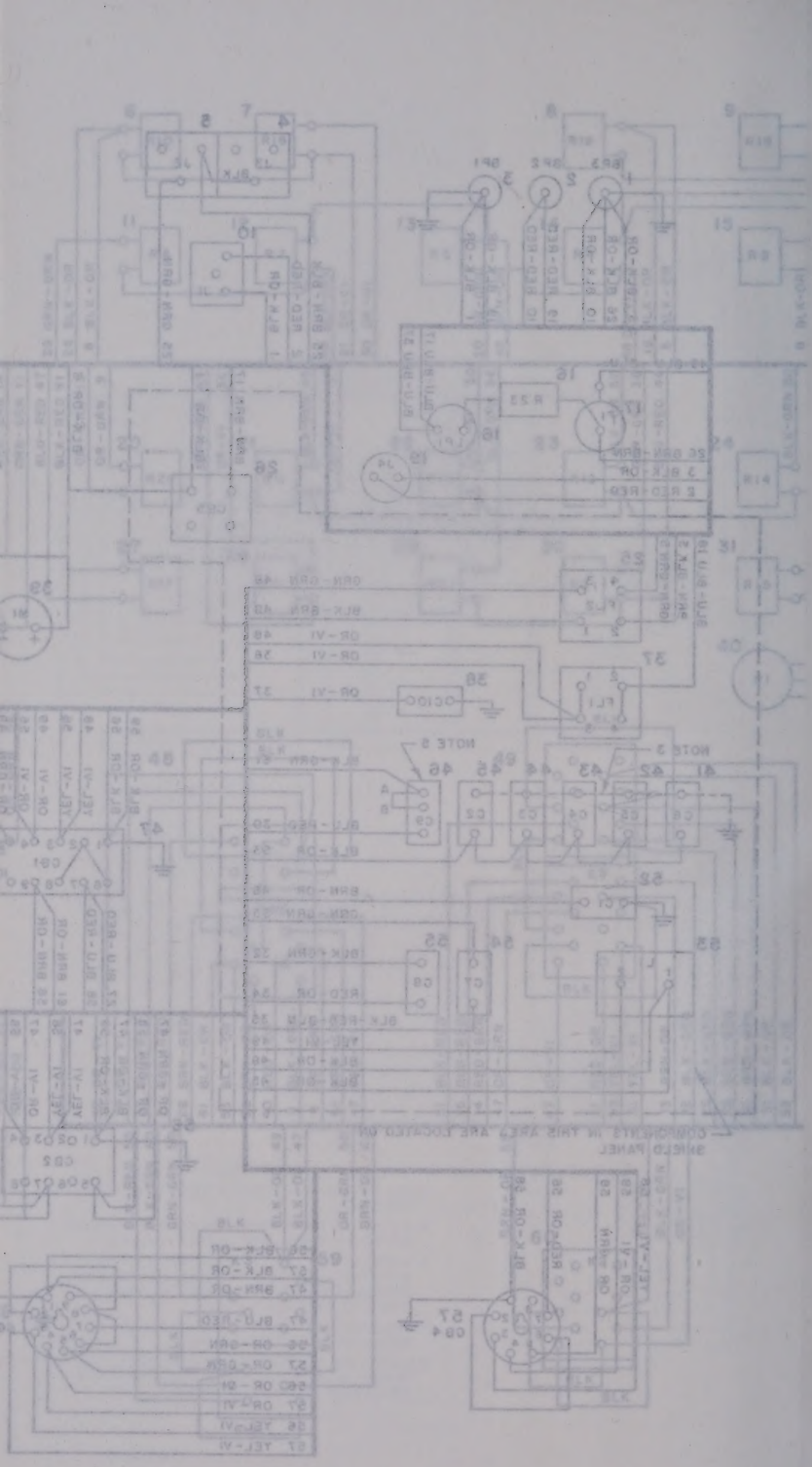


*Figure 34. Test Set I–193–B, wiring diagram.*

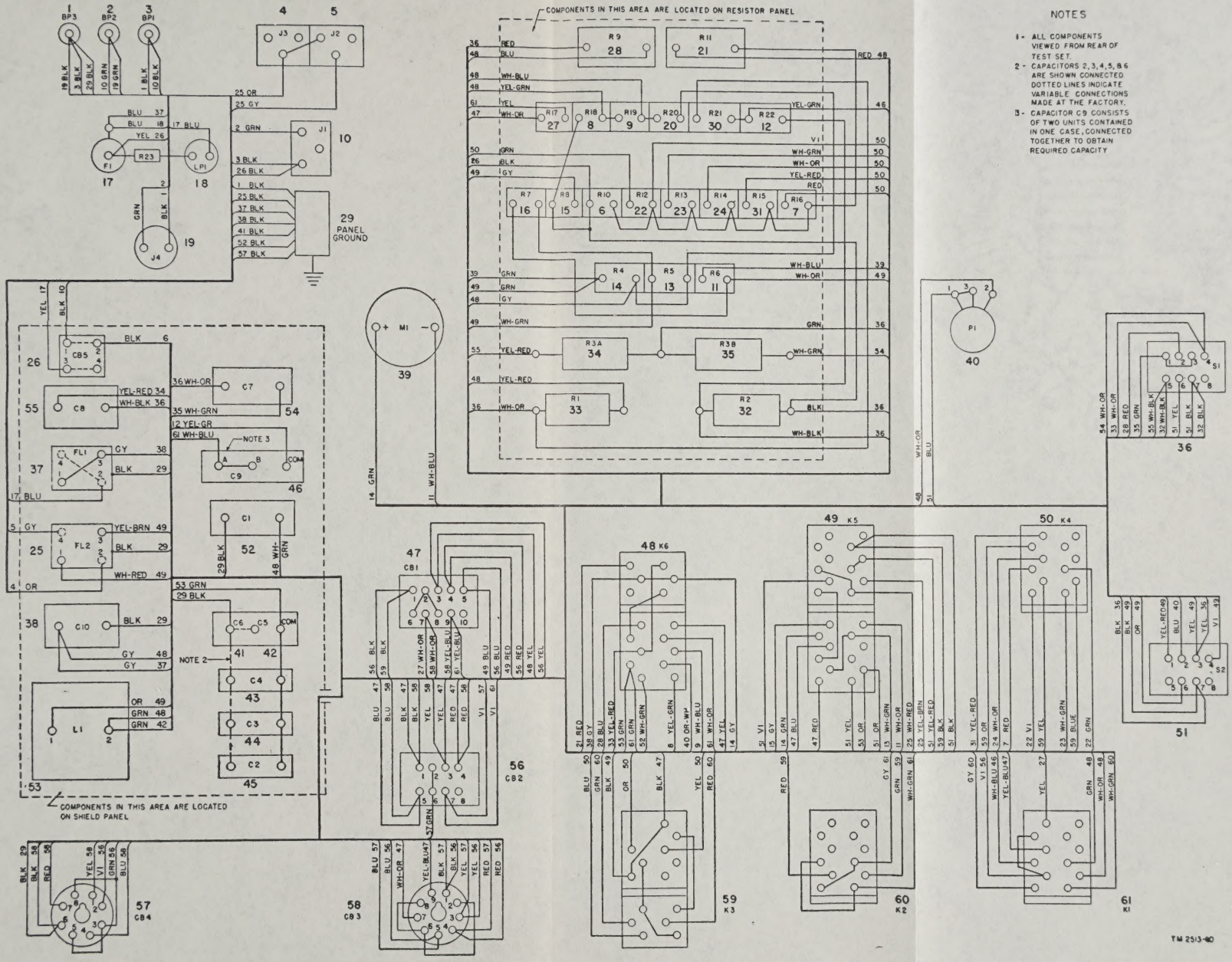



*Figure 35. Test Set I–193–C, wiring diagram.*

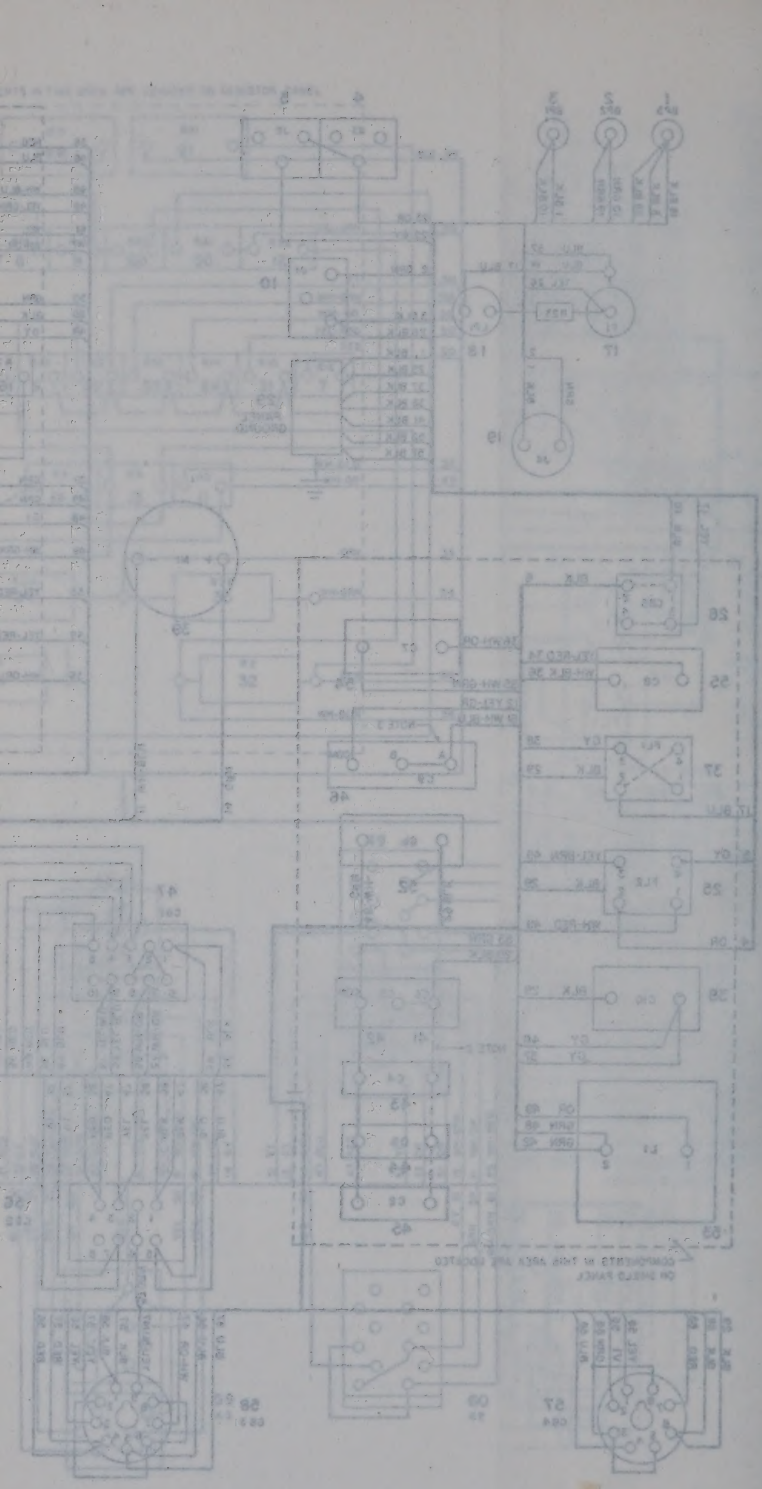


Figure 4-C, wiring diagram.

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