COMMUNICATIONS MASTER FILE

# TM 11-2036

WAR DEPARTMENT TECHNICAL MANUAL

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B-27

# TEST SET I-181,

I-181-A + I-181-B.

**RESTRICTED.** DISSEMINATION OF RESTRICTED MATTER. The information contained in restricted documents and the essential characteristics of restricted materiel may be given to any person known to be in the service of the United States and to persons of undoubted loyalty and discretion who are cooperating in Government work, but will not be communicated to the public or to the press except by authorized military public relations agencies. (See also par. 28, AR 380–5, 15 Mar 1944.)

*WAR DEPARTMENT 30 AUGUST 1944*

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WAR DEPARTMENT,
WASHINGTON 25, D. C., 30 August 1944.

I-181-A + I-181A

TM 11-2036, Test Set I-181, is published for the information and guidance of all concerned.

[A. G. 300.7 (9 May 44).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
*Chief of Staff.*

OFFICIAL:

J. A. ULIO,
*Major General,*
*The Adjutant General.*

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I Bn 1; T/O&E 1-457T.

I Bn 11; T/O&E 11-15, 11-95, 11-18.

IC 11; T/O&E 11-97, 11-107, 11-127, 11-237, 11-287, 11-587, 11-592, 11-597.

For explanation of symbols, see FM 21-6.

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# DESTRUCTION NOTICE

**WHY** —To prevent the enemy from using or salvaging this equipment for his benefit.

**WHEN**—When ordered by your commander.

**HOW** —1. Smash—Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. Cut —Use axes, handaxes, machetes.

3. Burn —Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. Explosives—Use firearms, grenades, TNT.

5. Disposal—Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

**USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.**

**WHAT**—1. Smash—Meter, resistors, rheostats, potentiometers, switches and fuses.

2. Cut —Wiring behind the front panel.

3. Burn —Technical manuals, circuit label.

4. Bend —Contact springs of all keys.

5. Bury or scatter—Any or all of the above pieces after breaking.

# DESTROY EVERYTHING

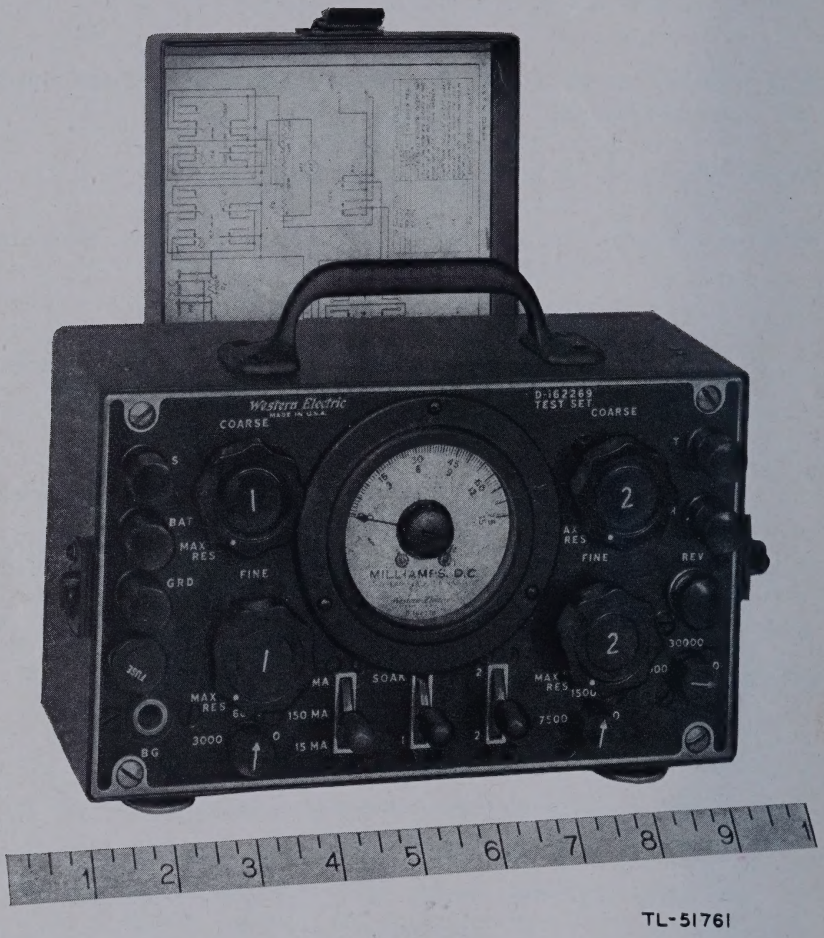



*Figure 1. Test Set I-181, cover removed.*

# SECTION I
# DESCRIPTION

## 1. GENERAL.

Test Set I-181 I-181A + I-181B is a current-flow type relay adjusting set. The test set is particularly adapted for use with smaller installations of communication equipments, where simplicity of operation and portability are important considerations. The primary function of the current-flow test set is to measure and control the amount of current flow through the winding of a relay, drop, or similar electromagnetic apparatus which is being tested or adjusted. Test Set I-181 also may be used as a d-c milliammeter over 3 meter scale ranges of 0-15 milliamperes, 0-75 milliamperes, and 0-150 milliamperes. Figure 1 shows the test set with cover removed. Certain accessories required for use with the test set are listed in paragraph 4.

## 2. EQUIPMENT FEATURES.

**a. General.** The test set is assembled in a metal casing equipped with a detachable cover and with a carrying handle attached to one side. All of the apparatus is attached to the top panel of the test set. This panel is removable, for access to wiring and parts.

**b. Panel Apparatus.** The arrangement of the meter, binding posts, jacks, and control apparatus on the top panel of the test set is shown in figure 1.

(1) The milliammeter is equipped with shunts which provide three scale ranges, 0-15, 0-75, and 0-150 milliamperes full scale. The pointer has a 210° arc of rotation. The selection of the scale ranges is by means of the key designated 75MA-~~105~~150MA-15MA (key K4).

(2) The circuit control keys designated SOAK-1 (key K6) and 2-2 (key K3) select the circuit path to be used to apply current to the apparatus being tested. These keys are unoperated in their normal or middle positions. Their operation in either direction closes the circuit through one of the circuit paths as indicated by the designations on the test set panel.

(3) The rheostats (knobs designated 1 and 2) provide variable adjustment of resistance in paths 1 and 2. Both knobs designated by the numeral 1 are associated with path 1; the upper knob, as indicated on the panel, provides a coarse adjustment by control of the 5,000-ohm

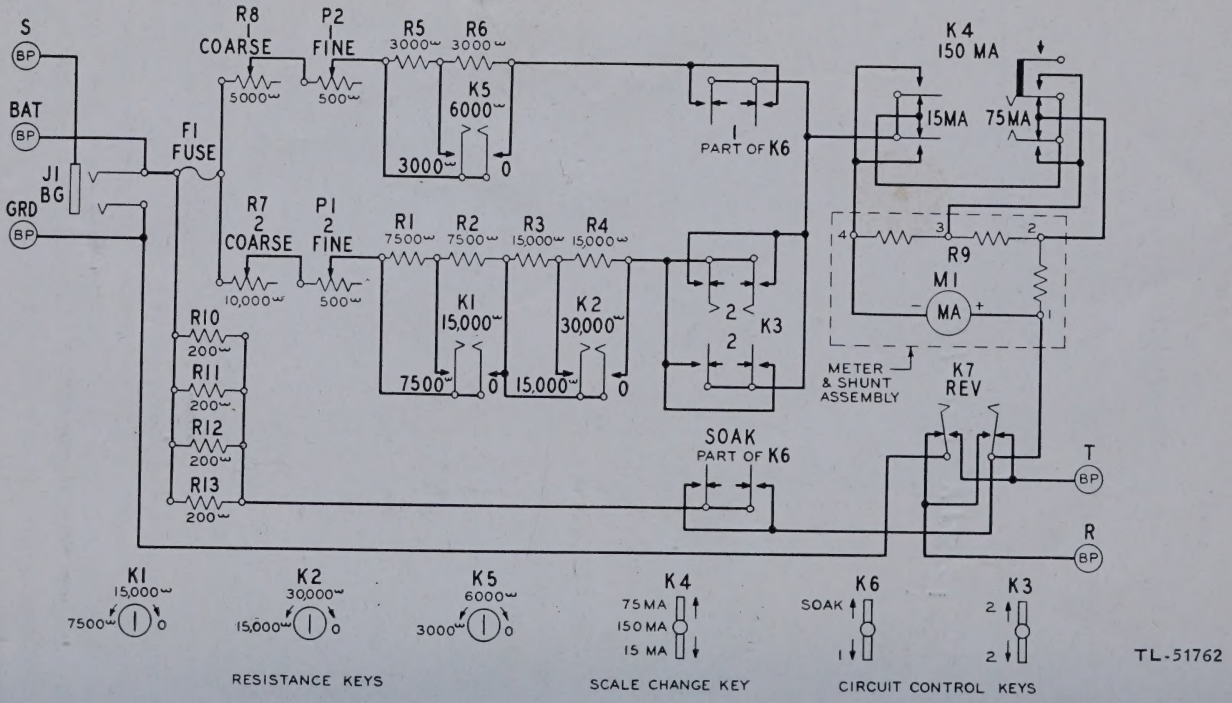



*Figure 2. Test Set I-181, schematic diagram.*

rheostat R8 (fig. 2). The lower knob provides a fine adjustment by control of the 500-ohm rheostat P2. Similarly, both knobs designated 2 are associated with path 2; COARSE knob 2 controls the 10,000-ohm rheostat R7 and FINE knob 2 controls the 500-ohm rheostat P1. These four current-regulating rheostats are arranged so that when they are turned to their full counterclockwise position, maximum resistance is in the circuits. In this position the numerals on the knobs are vertical as shown in figure 1, and the indicating dots are opposite panel marks MAX RES. The direction of rotation of the knobs corresponds to the direction of resulting swing of the milliammeter needle.

(4) Three-position twist-type keys provide adjustment of resistance in steps by the control of the fixed resistors in circuit paths 1 and 2. The key designated 3,000-6,000-0 (key K5) is associated with circuit path 1 and is located below the rheostat knobs of path 1. The keys designated 7,500-15,000-0 (key K1) and 15,000-30,000-0 (key K2) are associated with circuit path 2 and are located on the same side of the panel as the rheostat knobs of path 2.

(5) Binding post BAT, GRD, T, R, S, and jack BG provide for external connections to the test set. Key REV reverses the connections from binding posts T and R.

## 3. WEIGHT AND DIMENSIONS.

**a. Weight.** Approximately 9 pounds.

**b. Dimensions.**

Length: 8-3/4″
Width: 5-1/8″
Height: 5-1/8″

(SEE TM 203C) C2

**c. Handle.** The handle extends approximately 1-1/4″ outside these dimensions. The feet and cover latches each extend approximately 3/8″ beyond the dimensions above.

3.1 See TM 11-203C-C2

## 4. ACCESSORIES.

Two types of test cords and several types of connecting tools, used with Test Set I-181, are contained in Tool Equipment TE-123 and are listed in paragraphs 4a and 4b.

**a. Cords.** (1) The No. D-162184 (2W17A) is a 2-conductor cord (fig. 3) 6 feet long, terminated on one end with a No. 310 plug, for connection to jack BG; at the other end each conductor terminates in a socket-type connector (No. 360 tool). A No. 360B tool (black) terminates the ring conductor; a No. 360C tool (white) terminates the tip conductor.

(2) The No. D-165537 (1W13B) is a single-conductor red cord (fig. 3) terminated on each end with a socket-type connector No. 360A tool, (red).

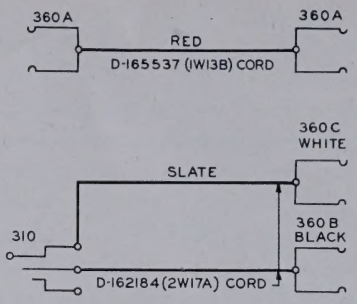



*Figure 3. Test cords for making connections.*

**b. Connecting Tools.** These tools fit into the No. 360-type socket connectors on the test cords and provide means for making connections to various kinds of apparatus and to test set terminals. The following are the commonly supplied tools:

(1) The No. 364 tool is a spade terminal, for connecting to binding posts.

(2) The No. 365 tool and the KS-6278 clip are suspender-type clips of different sized jaws, for connecting to winding terminals, protector terminals, etc.

(3) The No. 419A tool is a spring jaw, tweezer type connector for making contact to narrow terminals such as those at the rear of relays, or to relay springs, etc., particularly where spacing between adjacent terminals is very small.

(4) The No. 361B tool is designed for connecting to the winding terminals of E, R, and similar type relays, from the front or adjusting side rather than from the wiring side of the relay.

(5) The No. 428A tool is similar to the No. 361B tool for connecting to the front side of 149, 162, 178 and similar type relays.

(6) The No. 509A tool is used for connecting to the windings from the front side of U, UA, and Y type relays.

(7) The No. 411A tool is a test pick with an adjustable length test prod.

SEE TM 11-2036 C-2

**c. Fuses.** A Littelfuse No. 1044, 1/8-ampere, type 3AG fuse protects the meter and other test set apparatus; spare fuses of this type are required for the test set and should be requisitioned in accordance with SIG 8 I-181.

# SECTION II
# INSTALLATION AND OPERATION

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**5. GENERAL.**

**a.** The current-flow test set provides a means for regulating and for measuring the values of current applied to the windings of relays and similar electrical apparatus, for testing and adjusting purposes. This usage involves the connection of the test set at a particular point in the electrical circuit of the apparatus under test. It also involves connecting to the test set in a particular way, and usually, connecting battery or ground supply to the test set. It may require preliminary preparation, such as the blocking of other relays operated or non-operated or closing or opening particular contacts in the circuit under test.

**b.** Information of this nature, which is necessary for current-flowing apparatus, is usually found in the technical manuals pertaining to the equipment, together with the current values on which each relay (or similar apparatus) is to be checked for proper performance and the values to which the equipment must be readjusted. In some cases, this information is provided in circuit requirement tables (fig. 4) associated with the schematic circuit drawings. When circuit requirement tables are the source of this information, it will be found under the following column headings:

(1) CIRCUIT PREPARATION.
  (*a*) BLOCK.
  (*b*) CONN. BAT.
  (*c*) CONN. GRD.
(2) TEST SET PREP.
(3) SEE TEST NOTE NO.
(4) DIRECT CURRENT FLOW REQ.

**6. CURRENT-FLOW PROCEDURES.**

The steps which must be followed in current-flowing apparatus, listed in the order in which the work is done, are given in paragraphs 7 to 13, inclusive.

**7. PRELIMINARY CIRCUIT PREPARATION.**

**a.** Before connecting to the apparatus which is to be current-flowed,

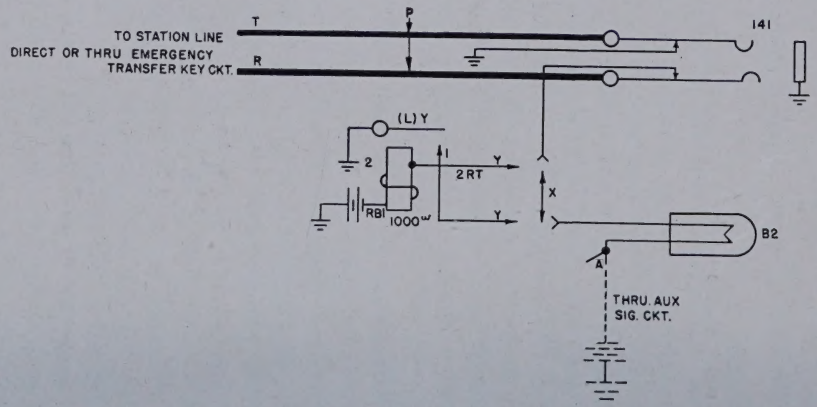
CIRCUIT REQUIREMENTS

551A OR 551B STATION LINE CIRCUIT (STA L)

CKT. ISS. NO 1 2 3 4 5

| APPARATUS DESIG. | APPARATUS CODE | MECH REQ B.S.P. FIG. | MECH REQ CONT. PRESS | MECH REQ ARM. TRVL | CIRCUIT PREPARATION SEQ SW POS. | CIRCUIT PREPARATION BLOCK | CIRCUIT PREPARATION TEST CLIP DATA CONN. BAT | CIRCUIT PREPARATION TEST CLIP DATA CONN. GRD. | TEST SET PREP. | SEE TEST NOTE NO. | DIRECT CURRENT FLOW REQ. TEST WDG. | TEST FOR | AFTER SOAK MA | TEST MA | READJ. MA | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RELAYS | | | | | | | | | | | | | | | | |
| L * | E5 | 1 | L | 15 | | | | RT (L) | GRD. | 2 | | 0 | | 8.4 | 8 | INSERT REAR PLUG IN JACK. |
| | | | | | | | | RT (L) | GRD | | | R | | 2.8 | 3 | " " " " " |
| L * | A5 | D | | | | | | 2RT (L) | GRD. | 2 | | 0 | | 8.4 | 8 | " " " " " |
| | | | | | | | | 2RT (L) | GRD. | | | R | | 2.6 | 2.8 | " " " " " |

TEST NOTES:
1. * INDICATES THAT THERE IS MORE THAN ONE RELAY WITH THE SAME DESIGNATION.
2. PRIOR TO ISSUE 5-D, TEST VALUE WAS 9 MA.




TL7590

*Figure 4. Circuit requirements table as found on circuit drawings.*

it is often necessary to set up certain conditions in the circuit in which the apparatus is located, in order to block off battery or grounded conditions, etc., which might interfere with the test. This circuit preparation is indicated in the technical manual, or in the circuit requirements table column headings under BLOCK or INSULATE or SEE TEST NOTE NO.

**b.** In the BLOCK column, an entry such as (B) NO, or (B) O, indicates that the relay B should be blocked nonoperated (NO), or operated (O). An entry with numerals first, followed by a letter in ( ), such as 1 and 2 (A), indicates that the No. 1 and No. 2 contacts of the relay A should be insulated from each other during the test.

**c.** In the SEE TEST NOTE NO. column, reference may be made to an accompanying note giving instructions covering special conditions relating to the testing or adjusting of the apparatus.

**8. TEST SET PREPARATION AND CONNECTIONS.**

**a. General.** How the test set is connected to the relay to be current-flowed, and to battery or ground, depends on the way the relay is connected in its circuit. The required current flow test set preparation usually falls into one of the following classes:

(1) B/G: battery-ground preparation.
(2) BAT: battery preparation.
(3) GRD: ground preparation.
(4) M: metallic preparation (neither battery nor ground).
(5) NGB: nongrounded battery preparation.

The method to be used for the particular relay to be tested is indicated in the maintenance instructions of the technical manual for the equipment, or in circuit requirement tables in the column TEST SET PREP. An explanation of each of these types of preparation is contained in subparagraphs b through f below.

**b. B/G Test Set Preparation.** This preparation is used for relays having both the battery and the ground not directly connected, but supplied from other sources. Both battery and ground, therefore, are supplied to the relay under test *by way of the test set.* See figure 5.

(1) Connect terminal BAT of the test set to the negative (—) side of the battery supply to be used for test.
(2) Connect terminal GRD of test set to ground.
(3) Connect single-conductor test cords (D-165537) to the tip (T) and ring (R) terminals of the test set; these are for connection to the relay to be tested.

**c. BAT Test Set Preparation.** This preparation is used for relays which have ground connected directly to one winding terminal, with the opposite terminal accessible, free of other battery or ground paths, for test connection. The test battery therefore is furnished *through*

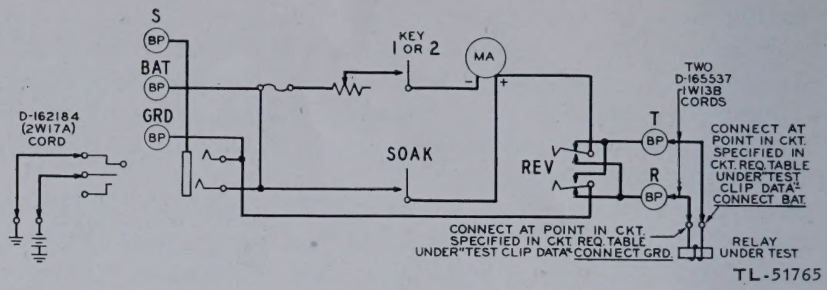



*Figure 5. B/G (BAT. and GRD.) test set preparation and connections to relay. (For NGB test set preparation use nongrounded battery.)*

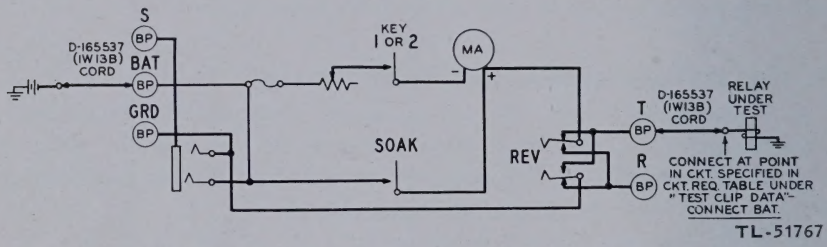



*Figure 6. BAT test set preparation and connections to relay.*

*the test set.* See figure 6.

(1) Connect terminal BAT of the test set to the negative (—) side of the battery supply to be used for test.

(2) Connect a single-conductor test cord (D-165537) to terminal T of the test set; this is for connection to the relay to be tested.

**d. GRD Test Set Preparation.** This preparation is used for relays which have battery directly connected to one relay winding terminal, with the other winding terminal free for testing access. Test ground is therefore supplied *through the test set.* See figure 7.

(1) Connect terminal T of test set to ground.

(2) Connect a single-conductor test cord (D-165537) to terminal BAT of test set; this is for connection to the relay to be tested.

**e. M Test Set Preparation (Neither Battery nor Ground).** This preparation is used for relays which have at least two windings, one of which is directly connected to battery and the other to ground, with access available to the other terminal of each of these windings for connection to the test set. See figure 8.

(1) Connect terminals T and R of the test set together, using a single-conductor test cord (D-165537) or a strap wire.

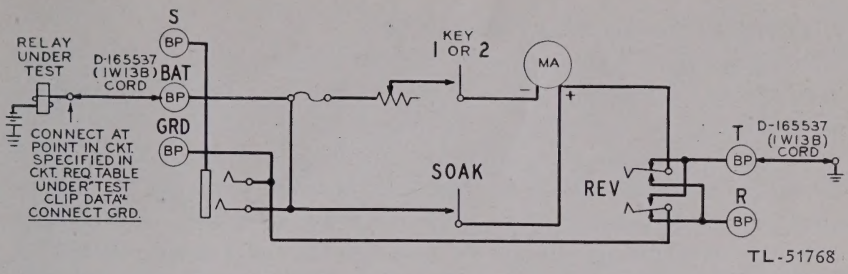



*Figure 7. GRD test set preparation and connections to relay.*

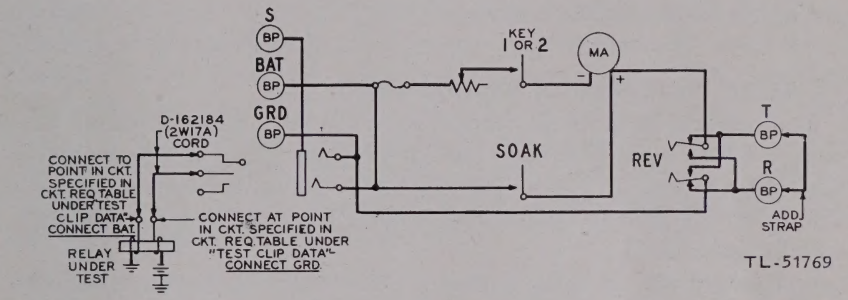



*Figure 8. M (Metallic) test set preparation and connections to relay.*

(2) Insert the plug of a D-162184 cord in jack BG of test set *or* use two D-165537 cords, connecting one to the BAT and one to binding post GRD; these are for connection to the relay to be tested.

**f. NGB (Nongrounded Battery) Test Set Preparation.** This preparation is used when relays are connected to a battery or ground lead in such a way that the proper polarity of test current cannot be applied by using the grounded office battery supply. This preparation requiring the use of a nongrounded battery is identical with that shown for the B/G application in figure 5, except that instead of the office battery and ground, a separate battery, nongrounded, such as a 22-1/2-volt or 45-volt dry cell battery, is used. See figure 5.

(1) Connect terminal BAT to the negative (—) side and terminal GRD to the positive (+) side of the nongrounded battery supply.

(2) Connect single-conductor test cords (D-165537) to terminals T and R of the test set; these are for connection to the relay to be tested.

## 9. CONNECTION TO RELAY UNDER TEST.

Paragraph 8, covering test set preparation and connections, includes instructions for the connection of cords to the test set for the purpose of connecting to the relay to be tested. These cords must be connected to the proper relay winding terminals or other points in the circuit in accordance with the technical manual covering the equipment, or as indicated in the circuit requirement tables. In the latter case, the columns CONN BATT and CONN GRD under CIRCUIT PREPARATION show this information. Follow the instructions in figures 5, 6, 7, or 8. Note that CONN BATT indicates the point of connection to a relay winding for a test cord which will supply battery *through the test set circuit,* likewise CONN GRD indicates point of connection to a relay winding for a test cord which will supply ground *through the test set circuit.*

## 10. RELAY PERFORMANCE REQUIREMENTS.

The requirements for performance of a relay when a specified current value is passed through its winding are given in the technical manuals applying to the equipment or in circuit requirement tables. The following general definitions explain the electrical requirements usually specified.

**a. Operate (O).** A relay is said to *operate* if, when current is connected to its winding, the armature moves sufficiently from its unoperated position to cause all normally open contacts to close and all normally closed contacts to open.

**b. Nonoperate (NO).** A relay is said to *nonoperate* if, when current is connected to its winding, the armature does not move from the unoperated position. On some types of relays the armature may move slightly, but not sufficiently to close the open contacts or to cause the closed contacts to become unreliable.

**c. Hold (H).** A relay is said to *hold* if, after the relay has operated and the current is reduced abruptly, the armature "holds" or does not move from the operated position.

**d. Release (R).** A relay is said to *release* if the armature moves from its operated to its unoperated position and all normally open contacts are open and all normally closed contacts are closed. Current flow requirements for *release* specify the current on which a relay must release after it has been operated. This involves reduction of the current from an "operate," "hold," or "soak" value to a steadily maintained "release" value, *without interruption of the current.*

**(e) "Soak" Requirements.** For certain relays, it is necessary to establish a definite magnetic condition in their cores before they are tested or readjusted to their electrical requirements. To obtain this magnetic condition, a comparatively heavy current is passed through

their windings immediately before they are tested or readjusted. This is termed a "soak." The nonadjustable "soak" value applied by Test Set I-181 is suitable for most relays. However, for WE Y-type and polar-type relays, the "soak" value has a critical relation to the other current-flow values, and therefore must be set up on circuit path 1 or 2 as a regulated, measured value as specified in the technical manual or on the circuit requirements table.

**11. TESTING PROCEDURES.**

Having connected the test set to the relay or other apparatus to be tested and when required, to a battery or ground supply as covered in paragraphs 8 and 9, the resistances in the test set should be adjusted by means of the resistance control knobs and keys, until the required amount of current is established through the relay winding. The procedure to be followed in the operation of the test set, when testing a relay for its "operate" (O) requirement is described in paragraph 12. This same general procedure is followed when applying the other types of current-flow requirements or combinations of requirements, except as modified by paragraph 13. The procedure to be followed when a "soak" current is specified in the current-flow requirements of a relay is explained in paragraph 13.

**12. PROCEDURE WHEN TESTING FOR "OPERATE" (O).**

**a. Choice of Circuit Path.** Either circuit path 1 or 2 may be used. Circuit path 2 has a higher maximum resistance than path 1, therefore it is possible to establish lower current values with circuit path 2.

**b. Setting of Keys.** Check the setting of the knobs and keys of the test set before starting the test.

(1) Key REV should be in its operated, that is, its depressed position and should remain in this position during the test unless otherwise specified in the technical manual or circuit requirements table.

(2) The meter scale change key should be in its 150 MA position.

> **CAUTION:** In order to avoid damage to the meter movement, *do not change the position of the meter scale change key except under the following conditions:* When the meter reading is less than 75 MA (below the half way mark when using the 150 MA scale) the meter scale key may be changed to its 75 MA position, in order to obtain a more accurate reading. When the meter reading on either the 0-150 MA or 0-75 MA scale is less than 15 MA, the meter scale key may be changed to its 15 MA position for a more accurate reading.
> *Always return the scale change key to the 150 MA position before reducing the resistance in the circuit.*

(3) Turn all resistor knobs and keys to their MAX RES position (full counterclockwise position for 1 and 2 knobs).

> **CAUTION:** To avoid excessive current through the meter, always start with *maximum resistance* in the circuit paths. To obtain the required current reading, the resistance should be reduced *gradually,* so that there will not be a sharp increase in the current which may exceed the full scale value of the meter.

**c. Adjustment of Current Value.** Operate the control key associated with the path to be used; adjust the test set resistance control until the meter indicates the current value specified for the test. Make preliminary adjustments of resistance with the COARSE rheostat knob, keeping the FINE rheostat knob *at its MAX RES position.* If an approximately correct meter reading can be obtained with the COARSE knob, the FINE knob is then used to obtain a more accurate value of current. If the required current reading cannot be obtained with the COARSE and FINE rheostats, return both rheostat knobs *to their MAX RES position before* reducing the resistance by use of the twist keys. Take out resistance with the twist keys *one step at a time,* until the value of current specified for the test can be obtained within the range of the rheostats.

**d. Making the Test.** After the required current value has been set up on the circuit path being used, the test for the "operate" requirement (when no "soak" is specified) is made in the following manner. Release the circuit control key (1 or 2) to its center position; this will open the circuit through the relay connected for test so that the relay is unoperated; then reoperate the control key to apply the current through the relay winding, and observe the performance of the relay. The relay should "operate" (O) as defined in paragraph 10a.

## 13. PROCEDURE FOR APPLYING OTHER THAN "OPERATE" REQUIREMENTS.

The same general test set procedure that is detailed in paragraph 12 for the "operate" requirement is followed when applying other types of electrical requirements. However, certain additional steps in the procedure are necessary to properly apply some requirements or combinations of requirements. For example, when the relay being tested must meet several electrical requirements it is preferable and in some cases necessary to use both circuit paths 1 and 2 of Test Set I-181, setting up and applying the current values in a certain way. Reference should be made to the following information.

**a. "Soak" Requirement Using "Soak" Circuit Path.** The electrical requirements for a relay may specify that the tests for performance of the relay must be preceded by a "soak" (par. 10e). In general, when a "soak" is specified for any type of WE relay other than a WE Y-type relay or a polar-type relay (par. 27), it is satisfactory to use the nonadjustable current value provided by the "soak" path of Test Set I-181. Apply this "soak" current by operating the SOAK control key for 1 or 2 seconds; then release the key, and within 1 or 2 seconds apply the associated electrical requirement to the relay. For applying "soak" current to WE Y-type or polar-type relays, see subparagraph b below.

**b. "Soak" Requirement Using Circuit Path 1 (Regulated "Soak" Current Value).** (1) When a "soak" is required for WE Y-type or polar-type relays, the "soak" path of Test Set I-181 cannot be used, since the "soak" current applied to these relays must be one of the exact value specified in the electrical requirements. Path 1 or path 2 of the test set therefore must be used since the current applied over either of these paths may be regulated as to value.

(2) Establish the value of current required for the test for performance of the relay (either "operate," "nonoperate," "release," or "hold") on circuit path 2; then establish the current value specified for the "soak" on path 1. To apply the "soak," operate the path 1 control key for 1 or 2 seconds, then release the control key, and within 1 or 2 seconds apply the associated electrical requirement by operating the path 2 control key.

**c. "Nonoperate (NO)" Requirements.** The procedure for testing a relay for "operate" is given in paragraph 12. The procedures are the same when applying a nonoperate test. As will be seen from the definition of "nonoperate" paragraph 10b, the relay must be in an unoperated (released) position just before applying the "nonoperate" value of current. Therefore, when a "soak" current value is specified to precede the application of "nonoperate" current, apply the "soak" momentarily, then allow the relay to release, after which immediately apply the "nonoperate" value of current. The relay should not operate. Do not apply the "operate" or "nonoperate" test with circuit path 1, while maintaining the current value for "hold" on path 2 as covered in paragraph 13d, since this will prevent the relay from releasing to its unoperated position.

**d. "Hold (H)" or "Release (R)" Requirements.** When a hold or release requirement (par. 10c and 10d) must be met, the current through the relay winding must be reduced directly from an "operate" or "soak" value to a steadily maintained "hold" or "release" value without interrupting the current or reducing it below the current value specified for the test being made ("hold" or "release"). There-

fore, establish the "hold" or "release" current value on circuit path 2 with the "2" control key in its locking position and *leave the "2" control key in its locking position* while setting up and applying a value of current great enough to cause the relay to operate (the "operate" value of current using circuit path 1, or the "soak" requirement using the "soak" path or circuit path 1). After applying the "operate" or "soak" current, release the control key for the circuit path being used, keeping the "2" control key still in its locking position. The relay should perform as required by the test being made (either "hold" or "release" in accordance with paragraphs 10c or 10d.

**e. Use of Locking Position of Control Key.** When the *locking* position of the 2 circuit control key is used to maintain a value of current (as the "hold" or "release" value) and a higher value is established and applied over circuit path 1, the current on circuit path 2 forms part of the total current required to set up the higher current value applied by operation of control key "1." Therefore, a change in the current setting of path 2 or opening of this path by the release of path 2 control key will affect the value of current which will be applied by operation of path 1 control key and will make it necessary to readjust path 1 resistors. This should be kept in mind when setting up and applying, in turn, different values of current with path 2 (such as "operate," "nonoperate," "hold," "release") preceded each time by a "soak" or other current value applied over path 1.

**14. USE AS A MILLIAMMETER.**

Test Set I-181 may be used as a milliammeter, by adding a strap across binding posts T and R and using binding posts BAT and GRD, or the tip and ring of jack BG as meter terminals. The "2" circuit of the set is the most convenient for this use, since control key "2" may be operated to, and left in its operated position to provide continuity through the test set and meter. The "2-COARSE" and "2-FINE" rheostats must be turned to their extreme *clockwise* positions, and both the 0-7500-15000 and the 0-15000-30000 twist keys turned to their *0* positions, in order to eliminate resistance in series with the meter within the test set. The resistance of the test set used as a milliammeter is approximately 15 ohms as a 15-milliampere meter; 10 ohms as a 75-milliampere meter, and 9 ohms as a 150-milliampere meter. These values include the resistance of the meter M1 and the fuse F1. The resistance of the fuse is approximately 7.9 ohms.

# SECTION III
# FUNCTIONING OF PARTS

**15. GENERAL.**

A schematic of the test set circuit is shown in figure 2. The circuit is arranged with three separate control paths, so that three separate current values can be applied to the apparatus to which the set is connected, without changing the test connections. These three paths are path 1, path 2, and the SOAK path. The value of current applied by using path 1 or path 2 can be regulated and read on the meter. The SOAK path is not adjustable as to current value. It provides a fixed value of "soak" or heavy current.

**16. PATHS 1 AND 2.**

Paths 1 and 2 both include the milliammeter, a rheostat, potentiometer and key-controlled resistors by means of which the amount of current can be regulated. Rheostats R7 and R8 provide a "coarse" series resistance adjustment. Potentiometers P1 and P2 are used as "fine" series resistance adjustment rheostats. The fixed resistors R5 and R6 in path 1 are controlled by key K5. In path 2, fixed resistors R1 and R2 are controlled by key K1, and R3 and R4 are controlled by key K2. The maximum total series resistance provided in path 1 is 11,500 ohms; in path 2, 55,500 ohms. Paths 1 and 2 are both protected by the 1/8-amp fuse F1 and are connected to the milliammeter by way of the meter-scale change key K4. Operation of key K4 selects the scale range of the meter. The meter has three scale ranges; 0-150 MA, 0-75 MA, and 0-15 MA.

**17. SOAK PATH.**

The "soak" circuit path is not connected through the meter or fuse and is not provided with adjustable resistors. A 50-ohm protective resistor, consisting of the 200-ohm resistors R10, R11, R12, and R13 in parallel (fig. 2), is provided in the SOAK path. Except for the voltage drop resulting from this resistor, the full battery voltage can be applied to an external circuit connected to this circuit path. This is sometimes required as a means of applying a "soak" or saturating current as part of the electrical requirements of certain relays or other apparatus. Paragraph 10e explains "soak" requirements more fully.

**18. CIRCUIT CONTROL KEYS.**

Current is connected over path 1, path 2, and the SOAK path by operation of the circuit control keys, which are designated in figure 2 as K3 and K6. Keys K3 and K6 are three-position keys and are non-operated when in their normal or middle position. Key K3, when operated in either direction, connects the current through circuit path 2. Key K3 is locking in one of its operated positions and non-locking in the other. Key K6 connects the current through circuit path 1 when operated in one direction and through the "soak" circuit path when operated in the other direction. Key K6 is non-locking in both operated positions.

**19. CONNECTIONS TO EXTERNAL CIRCUIT.**

Binding posts designated BAT, GRD, T, R, and S are provided for making connections to an external circuit or the apparatus to be tested and to battery and ground. Jack J1 (designated BG) may be used instead of binding posts BAT and GRD. As shown in figure 2, the tip of jack J1 connects to binding posts GRD and the ring of the jack connects to binding post BAT. Plug PL-51 or equal (WE No. 110 or No. 310) may be connected to this jack.

**20. REVERSING KEY.**

The reversing key K7 (designated on front panel of Test Set I-181 as REV) is provided to permit reversing the direction of the current flow through an external circuit connected to binding posts T and R.

# SECTION IV
# MAINTENANCE

**NOTE: Failure or unsatisfactory performance of equipment will be reported on W.D., A.G.O. Form No. 468. If form is not available, see TM 38-250.**

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**21. GENERAL.**

Test Set I-181 will require comparatively little maintenance, if the precautions given in paragraphs 8, 12, and 13 are followed. The meter is a delicate instrument and, while it is protected by a fuse, it will be damaged by frequent overloading. Sharp reduction of the resistance and use of too low a scale range should be carefully avoided.

**22. FUSE.** SEE TM-11-2036 C-2

The test set is provided with a 3AG, 1/8-amp fuse, Littelfuse No. 1044. The fuse is inside the fuse extractor post designated FUSE located adjacent to jack BG. To replace a fuse, unscrew and remove the center of the extractor fuse pose. The fuse, which force-fits into the clip of the removable portion, should be pulled free and a new fuse pressed into the tubular clip, the extractor replaced and screwed down fully to the end of the thread travel. Be sure to use a 3AG Littelfuse No. 1044 fuse. Fuses of other codes may be of a different length and will not make proper contact. Also, a fuse of greater than 1/8-amp rating will not properly protect the meter. Other types of 3AG fuses may have a considerably higher resistance, which becomes objectionable when using the instrument as a milliammeter.

**23. METER ADJUSTMENT.**

Before using the test set, check the zero reading of the meter. If the meter does not read zero with no current passing through it, correct the position of the pointer, using a screwdriver to turn adjusting screw located at center of meter glass. SEE TM-11-2036 C-

**24. REMOVAL OF TOP PANEL.**

All apparatus of Test Set I-181 is affixed to the top panel. To remove the top panel from the casing, remove the four large screws which are located near each corner of the top panel.

**25. LUBRICATION.**

Lubrication of Test Set I-181 is not required.

**26. MOISTUREPROOFING AND FUNGIPROOFING.**

**a. General** The operation of Signal Corps equipment in tropical areas where temperature and relative humidity are extremely high requires special attention. The following items represent problems which may be encountered in operation:

(1) Resistors fail.

(2) Electrolytic action takes place in resistors causing eventual break-down.

(3) Hook-up wire and cable insulation break down. Fungus growth accelerates deterioration.

(4) Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flash-overs and crosstalk.

(5) Moisture provides leakage paths between battery terminals.

**b. Treatment.** A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun or brush. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing.

**CAUTION:** Varnish spray may have toxic effects if inhaled. To avoid inhaling spray, use respirator if available; otherwise, fasten cheesecloth or other cloth material over nose and mouth.

**c. Step-by-step Instructions for Treating Test Set I-181.**

(1) PREPARATION.

(*a*) Make all repairs and adjustments necessary for proper operation of the equipment.

(*b*) Clean all dirt, dust, rust, fungus, oil, grease, etc., from the equipment to be processed.

(2) DISASSEMBLY.

(*a*) Remove cover from case by releasing catches.

(*b*) Remove four screws from front panel and lift chassis from case.

(*c*) Remove three knobs from key switches.

(*d*) Remove twelve screws holding three key switches to front panel, allowing switches to hang free on attached wires.

(*e*) Unlace and separate wires.

(3) MASKING. Cover the following parts with masking tape:

(*a*) Contacts on key jack (fig. 9(1)).

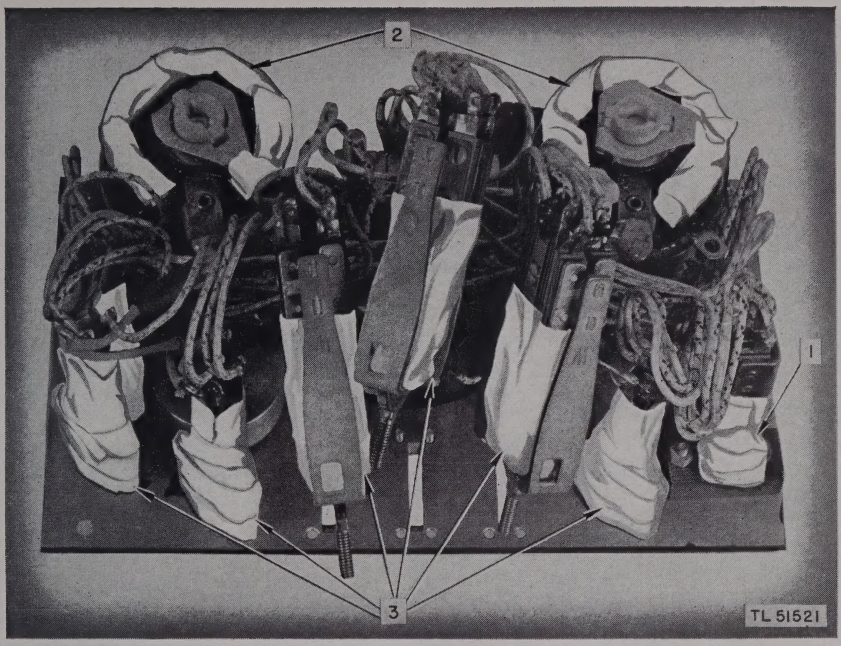



*Figure 9. Test Set I-181, masking beneath top panel.*

(*b*) Contacts on variable resistors (fig. 9(2)).

(*c*) Contacts on key switches (fig. 9(3)).

(4) DRYING. Place equipment in an oven or under heat lamps and dry for 2 to 3 hours at 160° F. *Do not exceed 160° F.* If wax should begin to melt on any of the components, decrease temperature and increase drying time approximately one hour for each 10° drop in temperature.

(5) VARNISHING.

(*a*) Using a spray gun, apply three coats of moistureproofing and fungiproofing varnish to all parts of the test set, including the meter glass and the inside of the metal carrying case. Allow a 15- to 20-minute drying period after each coat.

(*b*) Using a brush, apply varnish to those portions not reached by the spray gun. Be sure to adequately cover all parts with the varnish.

(6) REASSEMBLY.

(*a*) Remove all masking tape.

(*b*) Clean all contacts with varnish remover, and burnish the contacts.

(*c*) Reassemble the set and test its operation.

(7) MARKING. Mark the test set with MFP and the date of treatment.

EXAMPLE: MFP—20 August 1944.

# SECTION V
# SUPPLEMENTARY DATA

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**27. IDENTIFICATION OF WE Y-TYPE AND POLAR-TYPE RELAYS.**

As covered in paragraph 13b, a definite value of "soak" current must be applied in the case of the WE Y-type and polar-type relays. The technical manuals usually indicate which relays are of these types, although in some cases the relay may be designated by the WE code only, without reference to its type. The following WE codes are commonly associated with relays of the above types.

**a.** WE D-161986: Y-type relays.
**b.** WE D-163119: polar (255) type relays.
**c.** WE D-162716: polar (239) type relays.
**d.** WE D-166786: polar (239) type relays.

## 28. MAINTENANCE PARTS LIST FOR TEST SET I-181. I-181-A I-181-B

| REF. SYMBOL | SIGNAL CORPS STOCK NO. | NAME OF PART AND DESCRIPTION | QUAN. PER UNIT | RUNNING SPARES | ORGN. STOCK | 3D ECH | 4TH ECH | 5TH ECH | DEPOT STOCK |
|---|---|---|---|---|---|---|---|---|---|
| T, S, R, BAT, GRD | 3Z737-9 | BINDING POST: Eby No. 41, Commander "P4." | 5 | | | * | * | * | * |
| | 2Z4396-1 | FOOT ASSEMBLY: consists of leather pad and sponge-rubber cushion and two steel mounting plates, triangular - shaped with rounded corners; approx. over-all dimensions 1.1″ x 1.1″ x 0.365″ thk; WE No. P-470771. | 4 | | | * | * | * | * |
| F1 | 3Z2585 | FUSE: 1/8 amp, 7.4-ohm, 250-v; 3AG; Littelfuse No. 1044. | 1 | | * | * | * | * | * |
| | 3Z3285-2 | FUSE EXTRACTOR POST: Bussman HKM. | 1 | | | * | * | * | * |
| | 6Z4700.1 | GLIDE: (Domes of Silence); polished nickel-plated steel; dome-shaped; WE No. P-382975; (7/8″ OD; 7/16″ high including rubber cushion base). | 4 | | | * | * | * | * |

* Indicates stock available.

## 28. MAINTENANCE PARTS LIST FOR TEST SET I-181 (contd).

| REF. SYMBOL | SIGNAL CORPS STOCK NO. | NAME OF PART AND DESCRIPTION | QUAN. PER UNIT | RUNNING SPARES | ORGN. STOCK | 3D ECH | 4TH ECH | 5TH ECH | DEPOT STOCK |
|---|---|---|---|---|---|---|---|---|---|
| | 4C5104.79/6 | HANDLE: key lever; black; WE No. P-132717. | 2 | | | * | * | * | * |
| | 4C4060 | HANDLE: key lever; red; WE No. P-132718. | 1 | | | * | * | * | * |
| J1 BG | 4C4838A | JACK: switchboard; WE No. D-161891-238A. | 1 | | | * | * | * | * |
| K7 | 4C5092B.1 | KEY: switchboard; WE No. 92B, D-161905B. | 1 | | | * | * | * | * |
| K6 | 4C5262JP.1 | KEY UNIT: switchboard; WE No. 2JP, D-162161JP. | 1 | | | * | * | * | * |
| K3, K4 | 4C5262AKL.1 | KEY UNIT: switchboard; WE No. 2AKL, D-162161AKL. | 2 | | | * | * | * | * |
| K1, K2, K5 | 4C5104.98A.1 | KEY: switchboard; WE No. 498A, D-162254A. | 3 | | | * | * | * | * |
| 1 | 2Z5848.20 | KNOB: black; phenolic; engraved 1; WE No. P-383198. | 2 | | | * | * | * | * |
| 2 | 2Z5789-5 | KNOB: black; phenolic; engraved 2; WE No. P-383199. | 2 | | | * | * | * | * |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 3F4181/L1 | LABEL: schematic diagram; black on white; WE No. D-162269 TEST SET; 5″ x 8″. | 1 | | | * | * | * | * |
| | 3F4181/L2 | LABEL: wiring diagram; black on white; WE No. D-162269; (4-1/2″ x 6″). | 1 | | | * | * | * | * |
| | 6Z7559-10 | LATCH PLATE: steel; rectangular suitcase bolt; WE No. P-383066; (over-all dimensions approx 1-1/16″ x 1-7/8″ x 3/8″). | 2 | | | * | * | * | * |
| | 6Z7559-11 | LATCH STRIKER PLATE: steel; rectangular suitcase bolt; WE No. P-383066; (over-all dimensions approx 1-11/16″ x 1″ x 3/8″). | 2 | | | * | * | * | * |
| M1 and R9 | 3F915-40 | MILLIAMMETER AND SHUNT ASSEMBLY: 0-15-ma, 0-75-ma, 0-150-ma; ±2% of full scale on each scale; consists of D-164778 milliammeter with suitable shunts; WE No. P-383205; (over - all dimensions 3-1/2″ diam; 2-7/16″ deep; mounts in 2-5/8″ hole in panel). | 1 | | | | * | * | * |
| | 6L3608-32-9CR | NUT: steel; hex special; 8-32 x 3/32″ thk; 9/16″ across flats; chromate over zinc-plate; WE No. P-383474. | 4 | | | * | * | * | * |

* Indicates stock available.

## 28. MAINTENANCE PARTS LIST FOR TEST SET I-181 (contd).

| REF. SYMBOL | SIGNAL CORPS STOCK NO. | NAME OF PART AND DESCRIPTION | QUAN. PER UNIT | RUNNING SPARES | ORGN. STOCK | 3D ECH | 4TH ECH | 5TH ECH | DEPOT STOCK |
|---|---|---|---|---|---|---|---|---|---|
| P1, P2 | 2Z7278-44 | POTENTIOMETER: 500-ohm, ±10%; wire-wound; straight line taper; 5-w in free air, 3-w enclosed; WE No. KS-8680, 500-ohm, shaft 7/8″ long; (over-all dimensions 1-17/32″ diam x 11/16″ deep; 3 projecting terminals, 15/32″ long; 3/8″-32 threaded mounting bushing; 1/4″ diam shaft extending 1/4″ beyond bushing; rotation 295 degrees). | 2 | | | * | * | * | * |
| R5, R6 | 3RC31BE302J | RESISTOR: fixed; carbon; 3,000-ohm, +5%, —10%; 1-w; metalized-glass tube filament resistance; WE No. KS-8059, 3,000-ohm; (1-1/4″ x 1/4″ cylindrical; molded in phenol plastic; 1-1/2″ axial lead on each end). | 2 | | | * | * | * | * |
| R3, R4 | 3RC31BE153J | RESISTOR: fixed; carbon; 15,000-ohm, +5%, —10%; 1-w; metalized-glass tube filament resistance; WE No. KS-8059, 15,000-ohm; (1-1/4″ x 1/4″ cylindrical; molded in phenol plastic; 1-1/2″ axial lead on each end). | 2 | | | * | * | * | * |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| R1, R2 | 3RC31BE752J | RESISTOR: fixed; carbon; 7,500-ohm, +5%, —10%; 1-w; metalized-glass tube filament resistance; WE No. KS-8059, 7,500-ohm; (1-1/4″ x 1/4″ cylindrical; molded in phenol plastic; 1-1/2″ axial lead on each end). | 2 | | | * | * | * | * |
| R10, R11, R12, R13 | 3Z6020-51 | RESISTOR: fixed; wire-wound; 200-ohm, ±5%; 10-w; WE No. D-163647, 200-ohm. | 4 | | | * | * | * | * |
| R8 | 3Z7350-9 | RHEOSTAT: wire-wound; 5,000-ohm, ±10%; 50-w; 1-amp max; taper-wound; Ohmite No. 0330 except shaft 2-7/16″ lg. from mtg. surface of rheo. with flat in std. position, less knob and with no turn washer in "W" position. | 1 | | | * | * | * | * |
| R7 | 3Z7410-2.1 | RHEOSTAT: wire-wound; 10,000-ohm ±10%; 50-w; 0.07 amp max; taper-wound; Ohmite No. 0332 except shaft 2-7/16″ lg. from mtg. surface of rheo. with flat in std. position, less knob and with no turn washer in "E" position. | 1 | | | * | * | * | * |
| | 6L6832-4ZB | SCREW: machine; steel; FH 8-32 x 1/4″; WE No. P-383467; phosphate finish over zinc plate with black-enameled head. | 4 | | | * | * | * | * |

* Indicates stock available.

## 28. MAINTENANCE PARTS LIST FOR TEST SET I-181 (contd).

| REF. SYMBOL | SIGNAL CORPS STOCK NO. | NAME OF PART AND DESCRIPTION | QUAN. PER UNIT | RUNNING SPARES | ORGN. STOCK | 3D ECH | 4TH ECH | 5TH ECH | DEPOT STOCK |
|---|---|---|---|---|---|---|---|---|---|
| | 6L6632.18ZB | SCREW: machine; steel; FH 6-32 x 1-1/8″; WE No. P-383468; phosphate finish over zinc plate with black-enameled head. | 8 | | | * | * | * | * |
| | 6L6356-3ZB | SCREW: machine; steel; FH 3-56 x 3/16″; WE No. P-383473; phosphate finish over zinc plate with black-enameled head. | 12 | | | * | * | * | * |
| | 6L6832-15.50 | SCREW: machine; brass; OH 8-32 x 15/16″; WE No. P-260417; nickel and zinc plate. | 4 | | | * | * | * | * |
| | 3G1838-21.2 | SPACER: phenol; 5/8″ x 1-5/16″ x 15/32″; WE No. P-383201; with a center hole approx 0.458″ diam. | 1 | | | * | * | * | * |
| | 2Z8807-71 | SPACER: steel; cylindrical; 0.180″ ID; 0.250″ OD; 25/32″ long; (zinc plate; chromate-finish); WE No. P-383204. | 6 | | | * | * | * | * |
| | 6L50103-7 | WASHER: flat; brass; 0.176″ ID; WE No. P-88643; (0.619″ OD; 0.064″ thk). | 5 | | | * | * | * | * |
| | 3G1838-9.10 | WASHER: phenol; 0.384″ ID; 3/64″ x 9/16″ OD; WE No. P-145465. | 5 | | | * | * | * | * |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 6L52009-2 | WASHER: black phenol; fiber; 0.177″ ID; WE No. P-237224; (1/2″ OD; 0.0468″ thk). | 8 | | | * | * | * | * |
| | 6L50209 | WASHER: centering; steel; 0.173″ ID; 7/16″ OD; (provided with a tapered shoulder, 5/16″ OD; cadmium plate); Ward Leonard No. 902. | 8 | | | * | * | * | * |
| | 6L70004-1Z | WASHER: lock; steel; nontangling No. 4 (0.112) x 3/64″ x 1/32″; WE No. P-383476; (chromate finish over zinc plate). | 3 | | | | * | * | * |
| | | WIRE: tinned copper; single No. 20 AWG conductors; stranded; (flame-resistant insulation; double cellulose acetate; butgrate tape; glass braid and lacquer); WE No. KS-8640 Type AS. | | | | | | | |
| | 1B820.29 | BLUE-WHITE. | 3 ft. | | | | | * | * |
| | 1B820.28 | RED-WHITE. | 3 ft. | | | | | * | * |
| | 1B820.27 | GREEN-WHITE. | 3 ft. | | | | | * | * |
| | 1B820.24 | BLACK-WHITE. | 3 ft. | | | | | * | * |
| | 1B820.26 | YELLOW-WHITE. | 3 ft. | | | | | * | * |
| | | LIST OF ACCESSORIES FOR WE NO. D-162269 CURRENT FLOW TEST SET I-181. | | | | | | | |

* Indicates stock available.

## 28. MAINTENANCE PARTS LIST FOR TEST SET I-181 (contd).

| REF. SYMBOL | SIGNAL CORPS STOCK NO. | NAME OF PART AND DESCRIPTION | QUAN. PER UNIT | RUNNING SPARES | ORGN STOCK | 3D ECH | 4TH ECH | 5TH ECH | DEPOT STOCK |
|---|---|---|---|---|---|---|---|---|---|
| | 6Q28775 | CLIP: connecting; brass, nickel-finish; WE No. KS-6278; (spring clip with meshed jaw teeth on one end, and 3/32″ diam pin terminal at other end; 1-17/32″ x 3/8″ x 7/16″). | 4 | | | * | * | * | * |
| | 3E2W17A | CORD: WE No. D-162184, 2W17A. | 1 | | | * | * | * | * |
| | 3E1W13B | CORD: 6 ft; moisture-proof; single-conductor with a No. 360A tool with red plug at each end; WE No. D-165537. | 3 | | | * | * | * | * |
| | 3Z2585 | FUSE: 1/8-amp, 250-v; 3AG; Littelfuse No. 1044. | 10 | | | * | * | * | * |
| | 6R41164 | TOOL: switchboard; WE No. 364. | 4 | | | * | * | * | * |
| | 6R41219A | TOOL: switchboard; WE No. 419A. | 2 | | | * | * | * | * |
| | 6R41165 | TOOL: switchboard; WE No. 365. | 1 | | | * | * | * | * |
| | 6R41161B | TOOL: switchboard; WE No. 361B. | 1 | | | * | * | * | * |
| | 6R41228A | TOOL: switchboard; WE No. 428A. | 1 | | | * | * | * | * |
| | 6R41309A | TOOL: switchboard; WE No. 509A. | 1 | | | * | * | * | * |
| | 6R41211A | TOOL: switchboard; WE No. 411A. | 1 | | | * | * | * | * |

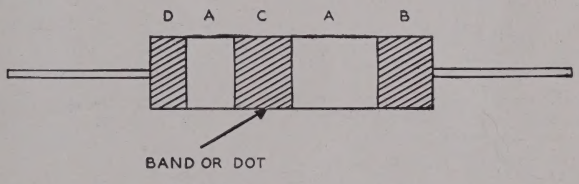
* Indicates stock available.

**RMA Color Codes for *Resistors* (ohms)**

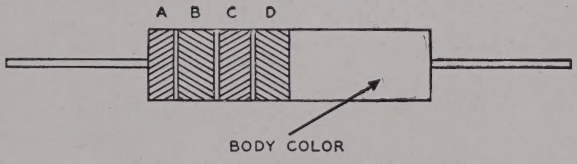
| *Color* | *A 1st Digit* | *B 2nd Digit* | *C Multiplier* |
|---|---|---|---|
| Silver | | | 0.01 |
| Gold | | | 0.1 |
| Black | | 0 | 1.0 |
| Brown | 1 | 1 | 10 |
| Red | 2 | 2 | 100 |
| Orange | 3 | 3 | 1,000 |
| Yellow | 4 | 4 | 10,000 |
| Green | 5 | 5 | 100,000 |
| Blue | 6 | 6 | 1,000,000 |
| Purple | 7 | 7 | 10,000,000 |
| Gray | 8 | 8 | 100,000,000 |
| White | 9 | 9 | |

*D—Tolerance Code:*

**Gold** = 5% Silver = 10% No color = 20%




*Old Color Arrangement*



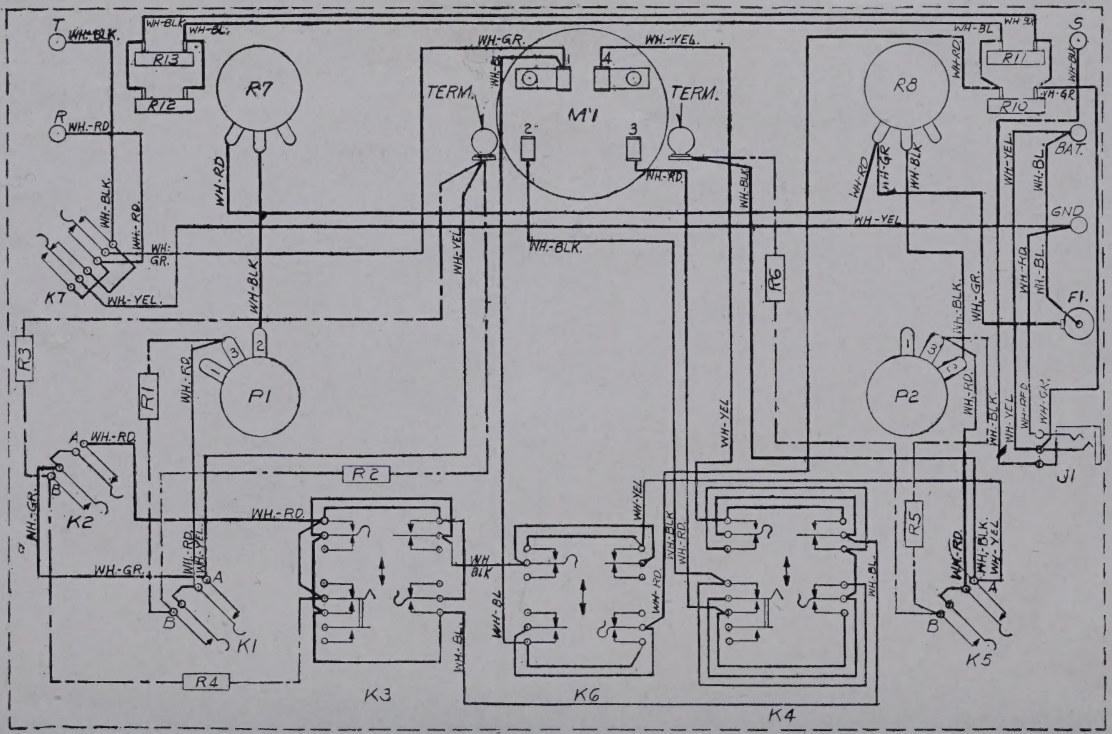

TL-51770

*New Color Arrangement*

Body color (new color arrangement only) indicates type of resistor, as follows:

Black—composition, non-insulated
Tan, olive or white—composition, insulated
Dark brown—wire-wound, insulated

*Figure 10. RMA color code for resistors.*




TL-51866

*Figure 11. Test Set I-181, wiring diagram.*

Signal Corps Order Nos.
20296-Phila-44, 3604
26150-Phila-44, 2
26269-Phila-44, 250

16-40 I 181-5