BATTERY FEEDERS
RESISTANCE MEASUREMENTS
CUSTOMER EQUIPMENT

1. GENERAL

1.01 This section describes a method of measuring the resistance of cable conductors used as battery feeders from a central office or building battery to a PBX or station system not equipped with a local power plant. A method of measuring the resistance of cable pairs used for charging local storage batteries is also described.

1.02 The section is reissued to add information for the Nos. 507 and 557A PBXs and for station systems, to omit the allowable feeder resistance tables, and to bring the section up to date. This is a general revision, therefore, arrows usually used to indicate changes have been omitted.

1.03 The most desirable method of furnishing a battery supply will be that which results in the most economical operation. The source of supply is determined by the assignment office after considering the allowable feeder resistance and other factors involved. It is not intended that this section be used on a routine basis, but rather as a verification test following installation or rearrangements, if desired, or when trouble is experienced.

1.04 Both metallic and ground return feeder arrangements are covered herein. Ground return to a central office battery shall not be used unless authorized by specific local instructions. Where building batteries have local chargers and are locally grounded, bonded house cable sheath or equivalent bonded return to the battery may be used to effect a savings in house cable conductors.

1.05 In measuring the resistance of feeders of Nos. 505 and 506 PBXs fed from a battery of more than 28 volts but not over 50 volts, the use of a 35-type test set is specified. For battery feeders in this voltage range, the circuit drawings for these PBXs call for a No. 11C resistance lamp in the battery side of the feeder at the central office. The lamp resistance varies with the current flowing through it, hence, the usual test of feeder resistance does not yield a true result. The 35-type test set is used to provide a value of load current (100 milliamperes) for which the lamp resistance is known and may be allowed for.

2. APPARATUS

2.01 PBX Battery Feeder Test Set per KS-7114 (SD-66417-01), (includes three 6-foot meter cords).

2.02 35-Type Test Set.

2.03 One 2W17A Cord consisting of W2M Cord, 6 feet long, equipped with one No. 310 Plug, one No. 360B Tool, and one No. 360C Tool.

2.04 Two KS-6278 Test Clips (or equivalent).

2.05 W1U Cords (or equivalent), as required.

3. METHOD

Cautions: In order to insure against service interruptions, care should be taken that the battery feeder circuit is not opened until the circuit is closed through the meter, and that the feeder circuit is closed before the meter is disconnected.

To prevent damage, because of overheating, to the load resistors which are enclosed within the base of the KS-7114 test set, the depressed time of the 40 OHMS or 120 OHMS key should not exceed the time interval between readings and in no case shall exceed 20 seconds.

The load resistor keys should be depressed when no load, or a light load, is on the equipment in order that the total current flow will not exceed the capacity of the supply fuse which is 2 amperes for 24-volt feeders and 1-1/3 amperes for 48-volt feeders, except for the Nos. 555 and 557A PBXs which are fused with 1-1/3 ampere fuses in all cases. Apply the load resistors in the following order until a reading as near as possible to, but not exceeding, the capacity of the supply fuse is obtained: 120 ohms; 40 ohms; 30 ohms, by depressing both keys.

At the completion of the tests, verify that any straps removed or opened during the tests have been properly restored.

Single Position Cord PBX, Cordless PBX, or Station System Fed from Battery of 28 Volts or Less, and Single Position Cord PBX, or No. 507 PBX Fed from Battery of 45 to 50 Volts, each with a Single Fuse at Supply end.

3.01 Connect the test set, as shown in Fig. 1, to the battery feeder terminals of the equipment. Make the connections so that the current supplied by all conductors in a group of feeders is carried through the meter.

3.02 Depress the PRESS FOR VOLTAGE key and observe the voltage for a short period. When checking 24-volt feeders, also depress and lock the PRESS FOR 25V key. The voltage should be steady except for fluctuations caused by changes in the equipment load.

3.03 With no load or a light load on the equipment, and while there is no change in the equipment load, take the voltage reading, then release the PRESS FOR VOLTAGE key and take the current reading.
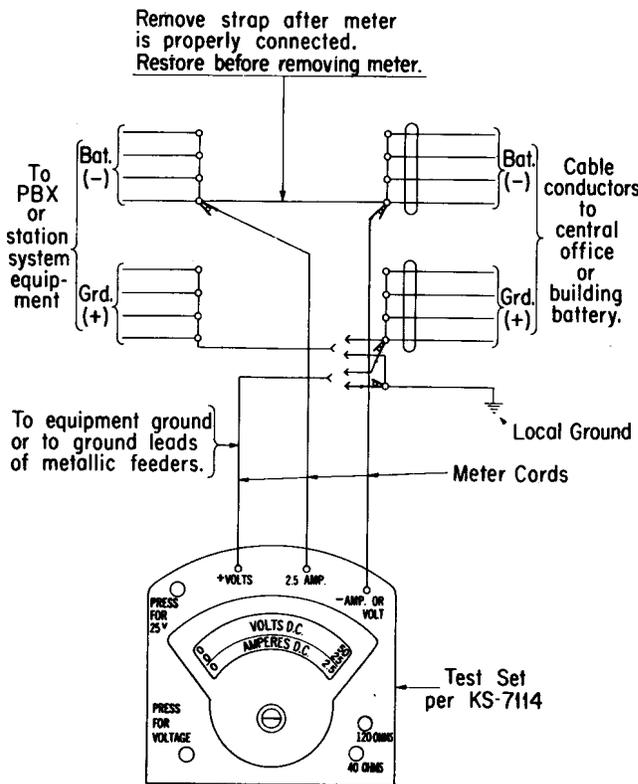

Fig. 1

3.04 Immediately after taking these voltage and current readings (first pair of readings), depress the 120 OHMS or 40 OHMS key, or both, to obtain a current as near as possible to the capacity of the battery supply fuse. Read the current and then depress the PRESS FOR VOLTAGE key and read the corresponding voltage while the 120 OHMS or 40 OHMS key, or both, are still depressed. These are the second pair of the set of readings required to make a measurement.

> Note: To insure that the readings are obtained under the same load conditions, the time interval between readings shall be as short as possible.

3.05 To calculate the resistance of the feeder, divide the difference of the voltage readings by the difference of the current readings:

Example:

> V1 (First voltage reading)   22.0
> A1 (First current reading)   .05
> A2 (Second current reading)   .85
> V2 (Second voltage reading) 14.8

$$R \text{ (Feeder resistance)} = \frac{V1 - V2}{A2 - A1} = \frac{22.0 - 14.8}{.85 - .05} = 9.0 \text{ ohms}$$

3.06 To insure accuracy, take several sets of readings until the computed results of three sets of readings check within 5%. Take an average of these three resistance values to obtain the resistance of the battery feeders.

3.07 Check the feeder resistance obtained from the above calculations with that on the record for the PBX, or with the tables of allowable resistance shown on the circuit drawings.

3.08 If the measured resistance is found to be higher than that determined in 3.07, an inspection should be made to determine the reason for this condition. Test each conductor

for continuity by opening the proper strap and, with the test set connected as a voltmeter, verify that battery is obtained over each battery conductor, and that ground is obtained over each ground conductor where metallic return is used to a central office or building battery. Count the number of conductors in the feeder and verify this count with the record for the equipment.

3.09 If the measured resistance is found to be appreciably lower than that determined in 3.07, it should be reported to the assignment office.

Two (or More) Positions, Nonmultiple Type PBX

3.10 The battery supply for a nonmultiple PBX of two or more positions is composed of a group of feeders for each position with the groups strapped together at the PBX. When making resistance measurements of feeders with this arrangement, open the strapping between groups and connect the test set to one group in the same manner as described in 3.01 for a single position PBX. Be sure that the test set connections are made to the battery and ground feeders of the same group. Make the measurement for each position separately as described in 3.02 to 3.09.

No. 505 or No. 506 PBX Fed from Battery of More than 28 Volts but Not Over 50 Volts Through a Resistance Lamp in the Central Office

3.11 Connect the 35-type test set as shown in Fig. 2. If a 35-type test set not arranged to read voltage is used, connect the KS-7114 test set also, as shown in Fig. 2.

3.12 Operate the BAT & GRD CO key of the 35-type test set. Depress the No. 1 telegraph key and adjust the No. 1 rheostat until a current of 100 milliamperes is indicated on the meter. Release the telegraph key. If a No. 35D or No. 35F test set is used, operate the REV key.
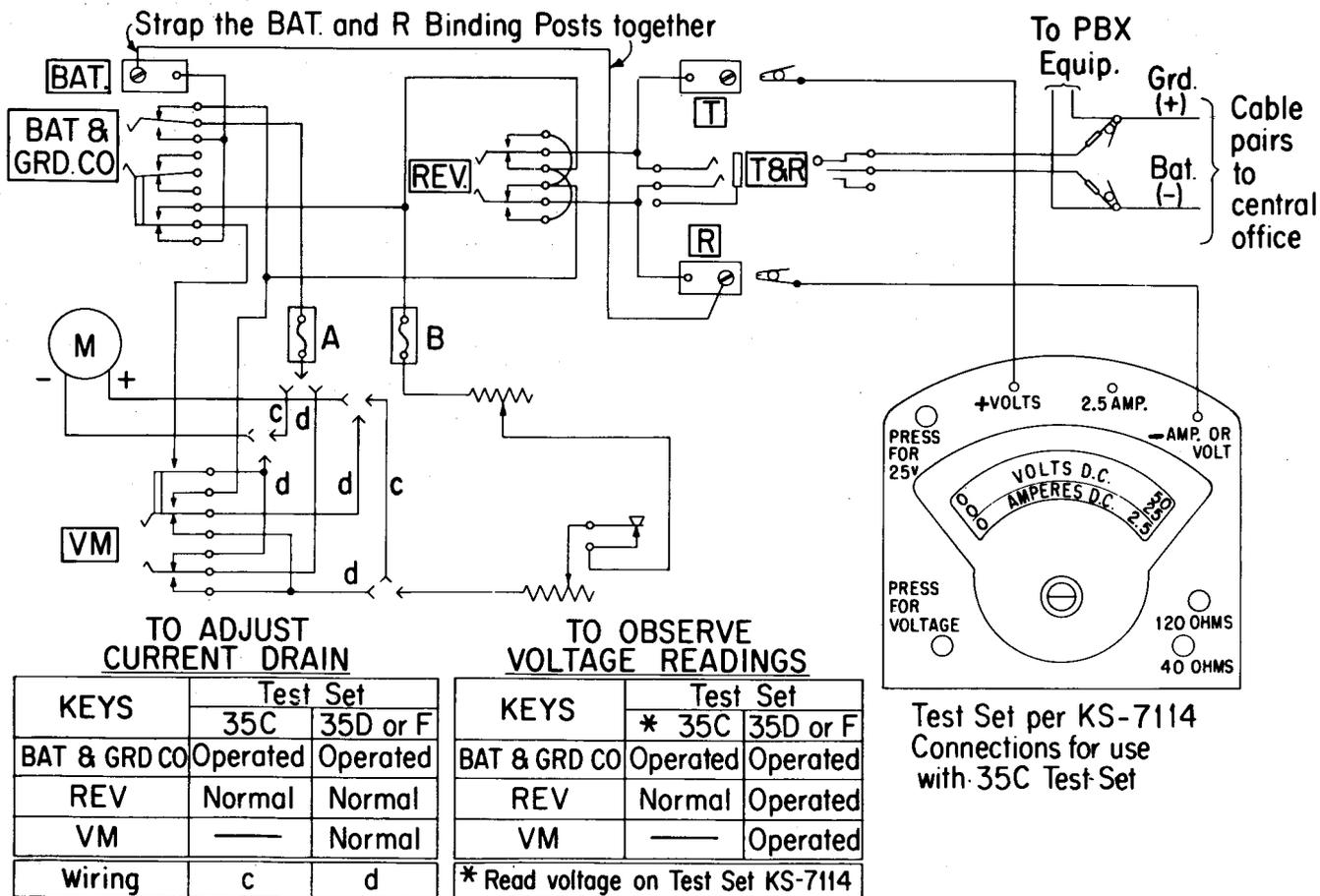

Fig. 2

KEYS	Test Set	
TO ADJUST CURRENT DRAIN	35C	35D or F
BAT & GRD CO	Operated	Operated
REV	Normal	Normal
VM	———	Normal
Wiring	c	d

KEYS	Test Set	
TO OBSERVE VOLTAGE READINGS	* 35C	35D or F
BAT & GRD CO	Operated	Operated
REV	Normal	Operated
VM	———	Operated
* Read voltage on Test Set KS-7114		

Test Set per KS-7114
Connections for use
with 35C Test Set

3.13 Operate the VM key of the 35-type test set, or depress the PRESS FOR VOLTAGE key of the KS-7114 test set, and read the no load voltage V1. Depress the No. 1 telegraph key and read the load voltage V2.

3.14 The feeder resistance (see 3.06) may be computed as follows: Feeder resistance = 10 (V1 — V2) — 14 ohms.

Example:

V1 (First voltage reading (no load)) = 47.6

V2 (Second voltage reading (.100 amp. load)) = 40.4

Feeder resistance = 10 (47.6 — 40.4) — 14 =

10 (7.2) — 14 = 72 — 14 = 58 ohms.

Station System with Multiple Fusing

3.15 When the maximum load of a station system exceeds the capacity of a single fuse, additional fuses are provided at the station end of the feeders equal in number to those provided at the supply end and separate groups of feeders are employed for each fuse.

3.16 The test set connections to be used for a resistance measurement will be determined by the traffic load of the station system.

3.17 During a period of no load or light load, connect the test set and place straps (A) as shown in Fig. 3. Short lengths of inside wire or W1U cords, or equivalent, may be used for straps. These connections provide for carrying the current supplied by all feeder groups through the meter, and for measuring all feeder groups as a unit.

3.18 Remove the fuse from each group of feeders. When the last fuse is removed, observe the reading on the meter. If this reading is less than 1.6 amperes, make the tests as described in 3.02 to 3.09. When depressing the load resistor keys, be careful that the capacity of the meter is not exceeded.

3.19 If, after removing the last fuse, the meter reading exceeds 1.6 amperes, remount the fuses and restore the feeder groups to their normal condition by removing straps (A). The test should be postponed until a lighter load period, or the individual feeder groups may be measured one at a time if the meter reading indicated that the capacity of the remaining groups will not be exceeded.
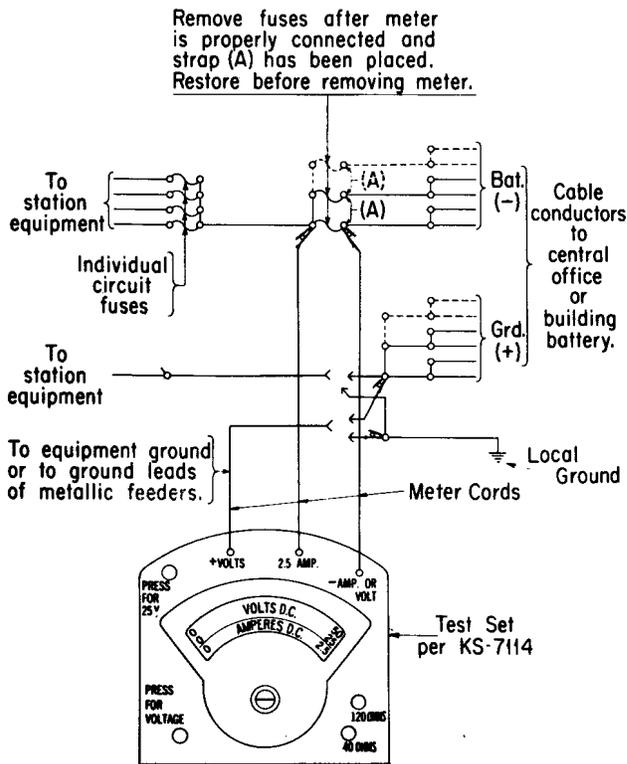
3.20 To measure an individual group, isolate the group by removing its fuse and the ground connection from the other groups, and make the meter connections as shown in Fig. 4.

3.21 Depress the PRESS FOR VOLTAGE key and, when checking 24-volt feeders, depress and lock the PRESS FOR 25V key. Observe the voltage for a short period. The voltage should be steady. If a fluctuation is observed it indicates an abnormal condition such as foreign ground potential, drains to other equipment, cable conductor faults, or that the conductors of the group being measured are not completely isolated from the other groups.

3.22 The voltage observed shall be considered the voltage of the central office or building battery because of the no load condition of the feeder.

3.23 Release the PRESS FOR VOLTAGE key, and depress the 120 OHMS or 40 OHMS key, or both, to obtain a current reading as near the middle of the meter scale as possible. The operation of these keys connect 120 ohms, 40 ohms, or 30 ohms, respectively, in series with the ammeter winding of the meter.

3.24 To calculate the resistance of the feeders, divide the voltage reading by the current reading and subtract the value of the load resistance:

Example:

In this example both the 120 OHMS and 40 OHMS keys were depressed to obtain the current reading.

V (Voltage reading) = 24.3

A (Current reading) = .450

$$R \text{ (Feeder resistance)} = \frac{V}{A} - 30 =$$

$$\frac{24.3}{.450} - 30 = 54 - 30 = 24 \text{ ohms.}$$

3.25 As one of the sets of readings mentioned in 3.06, make a measurement as described in 3.21 to 3.23 and, while holding the same key or keys used in 3.23 depressed, take a second voltage reading.
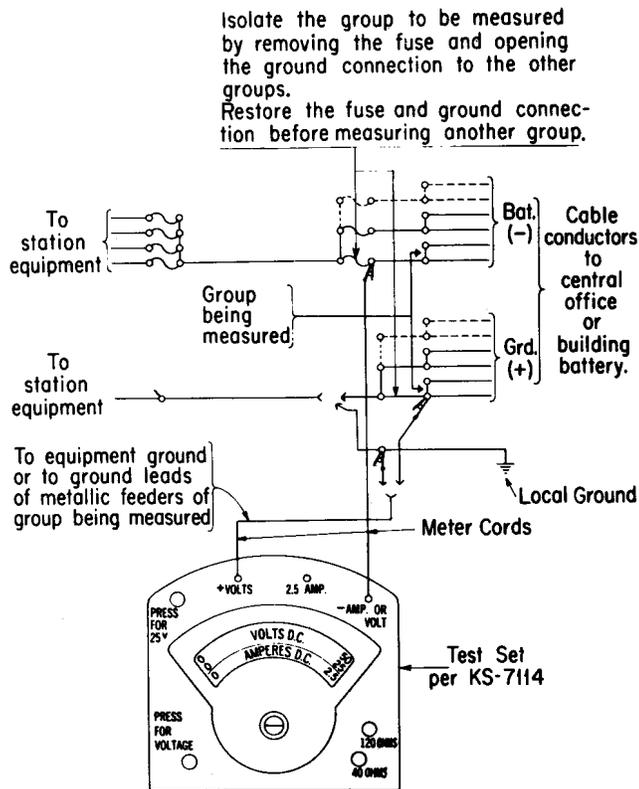
Remove fuses after meter is properly connected and strap (A) has been placed. Restore before removing meter.

Fig. 3

Isolate the group to be measured by removing the fuse and opening the ground connection to the other groups.
Restore the fuse and ground connection before measuring another group.

Fig. 4

3.26 Divide the difference between the voltage readings, by the current reading. Confirming the example in 3.24, the voltage reading taken while both the 120 OHMS and 40 OHMS keys are depressed would be 13.5 volts. The calculation is the same as for a single position PBX:

Example:

$$R \text{ (Feeder resistance)} = \frac{V1 - V2}{A} =$$

$$\frac{24.3 - 13.5}{.450} = \frac{10.8}{.450} = 24 \text{ ohms.}$$

3.27 To obtain the joint resistance of more than two groups in parallel, use the following formula, in the denominator of which there should be as many terms as there are groups in parallel:

$$R_j \text{ (Joint feeder resistance)} = \frac{1}{\dfrac{1}{R1} + \dfrac{1}{R2} + \dfrac{1}{R3} + \text{ etc.}}$$

If only two groups of feeders are involved, multiply the resistance of the two groups and divide the product by the sum of the two resistances:
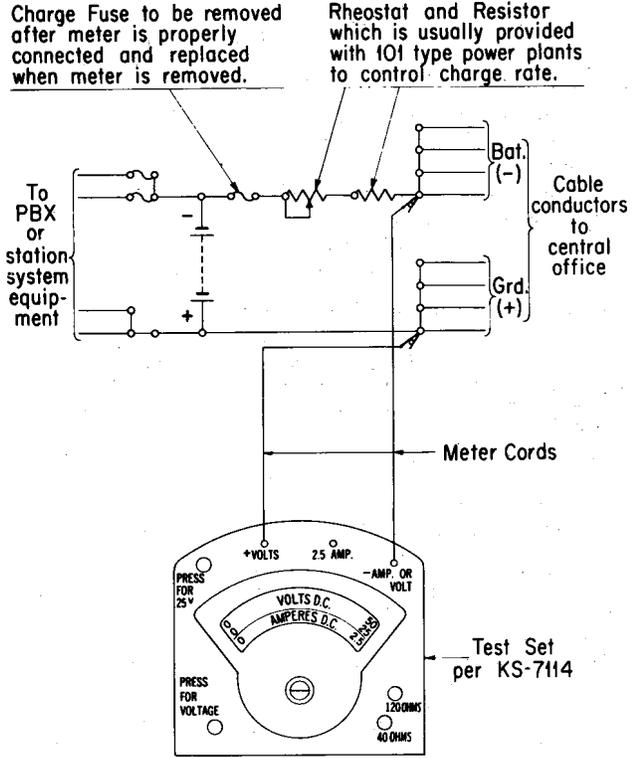
$$R_j \text{ (Joint feeder resistance)} = \frac{R1 \times R2}{R1 + R2}$$

Local Battery Charging Feeders

3.28 With the test connections as shown in Fig. 5, remove the charge fuse which opens the charging current to the local battery.

3.29 With the fuse removed, the measurement is made as described in 3.21 to 3.26.

3.30 Restore the charge fuse at the completion of the test.

Fig. 5