TYPE N AND ON2 CARRIER TELEPHONE SYSTEMS
DEVIATION REGULATOR
GENERAL INFORMATION — MAINTENANCE CONSIDERATIONS

CONTENTS — PAGE

1. GENERAL

(A) General

1.01 This section and associated sections in this subdivision of information describe the methods for making tests and adjustments on the deviation regulator used on fully equipped N (channels 2 to 13) and ON2 carrier telephone systems.

1.02 This section is reissued to change the title and correct references to show Plant Series section numbers in the associated sections of this subdivision. This section replaces Issue 2, dated August 1960.

(B) Description of Deviation Regulator

1.03 Type N and ON2 carrier telephone systems longer than 150 miles may have transmission variations caused by temperature changes, that exceed the regulating ability of the N repeaters and receiving terminal. Under such conditions a deviation regulator will provide the additional regulation required. A deviation regulator provides regulation in one direction on the high-frequency line. It is used in conjunction with a low-high N carrier repeater at a locally powered repeater station. Although deviation regulators are provided in pairs (one regulator in each direction of transmission), the two members of a pair (W-E and E-W) need not be placed at the same repeater point.

1.04 The deviation regulator operates under the control of the carrier frequencies of channels 2 through 13 of an N carrier system, or the twelve carrier frequencies of an ON2 carrier system. The frequencies involved are 176 kc through 264 kc.

1.05 The deviation regulator receives the twelve carrier frequencies from the type N low-high repeater and passes them through four thermistor-controlled networks as shown in Fig. 1.

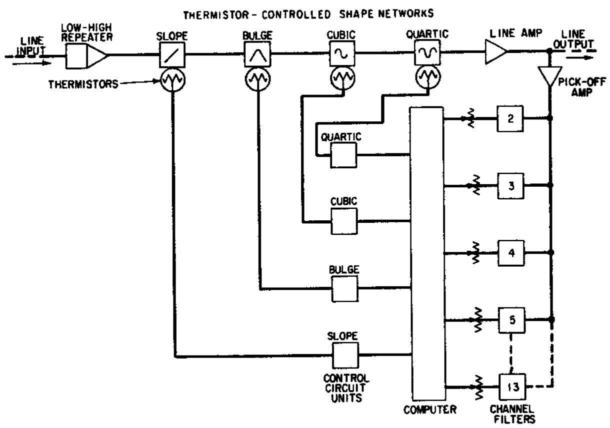

Fig. 1 — Block Schmematic of Deviation Regulator

1.06 Each network introduces a transmission frequency characteristic to the incoming carrier of a different shape called slope, bulge, cubic, and quartic, respectively. The general shapes of the network characteristics are indicated in Fig. 2.

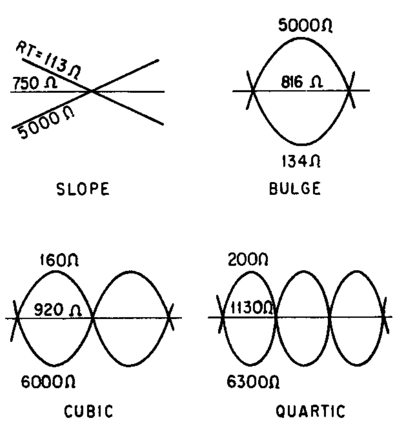

Fig. 2 — Shape Network Characteristics

1.07 The amount and sign of each shape depends upon the resistance of an associated thermistor. The slope and bulge networks are basically required for changes in cable characteristics, while the cubic and quartic networks compensate principally for changes in repeater characteristics.

1.08 The twelve carrier frequencies pass from the shape networks through a line amplifier which compensates for the 53 db flat loss of the networks. A pick-off amplifier which is connected to the output of the line amplifier delivers the twelve carriers to twelve band-pass filters. The filters separate the carriers into twelve individual ac voltages as shown in Fig. 3. A computer analyzes the residual departure from ideal of these twelve voltages into the slope, bulge, cubic, and quartic components. From each of these components a pair of ac voltages is derived that are rectified to produce plus and minus dc voltages. These are combined to produce a dc voltage which determines the thermistor current required for regulation.

1.09 The deviation regulator does not provide flat regulation. This is taken care of by the associated low-high repeater and the next repeater point on the line.

(C) N and ON2 Carrier Telephone System High-Frequency Line

1.10 Although the deviation regulator was designed to take care of transmission variations due to temperature changes on long haul N and ON2 carrier systems, it will also compensate for other unwanted deviations in carrier level. When this happens, part of the range of the regulator is used for equalization, and its full range is not available for temperature corrections.

1.11 CARE SHOULD BE TAKEN TO VERIFY THAT THE HIGH-FREQUENCY LINE PRECEDING A DEVIATION REGULATOR, HAS BEEN PROPERLY ALIGNED BEFORE THE REGULATOR IS PLACED IN SERVICE. The tests and adjustments which are made on the high-frequency line, prior to lining up a system, are not included in this series of sections. Tests and adjustments for N carrier repeaters and associated equipment are described in the sections covering N and ON2 carrier systems.

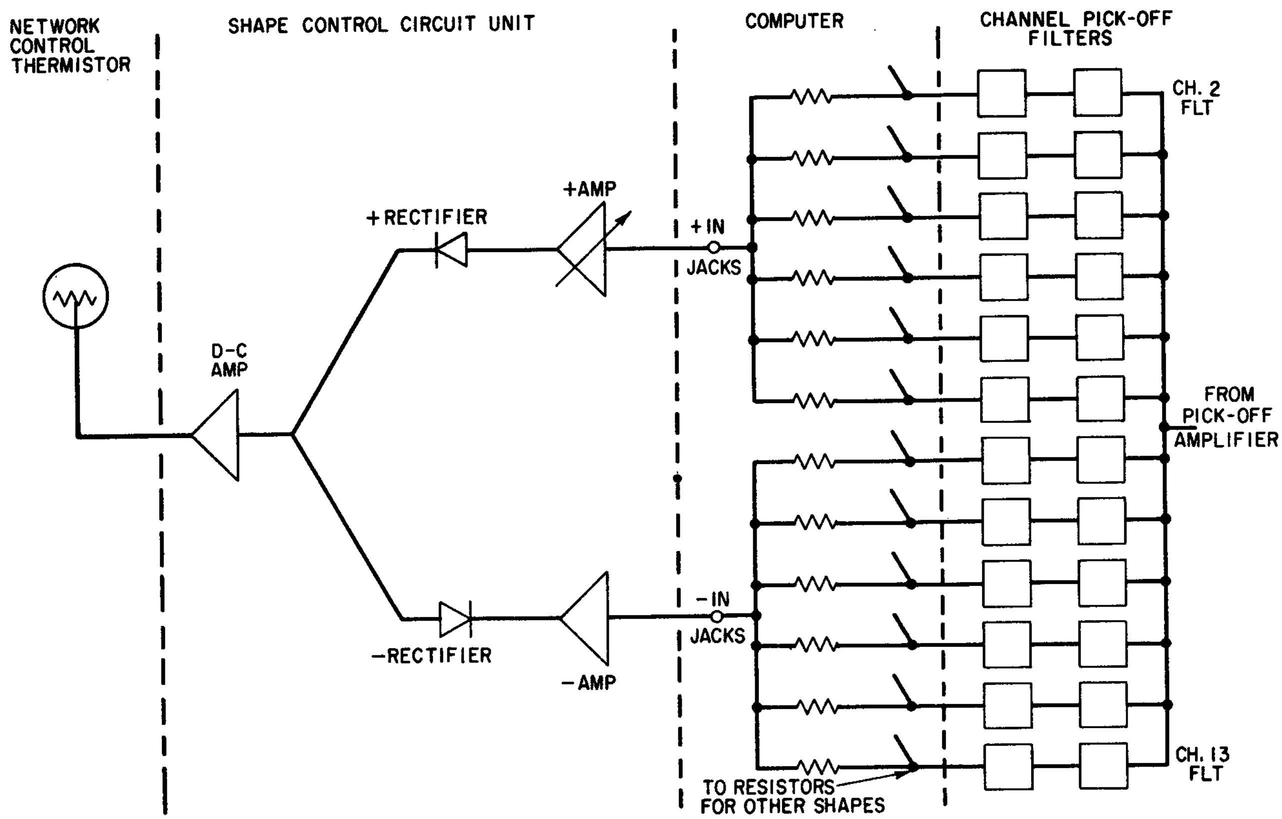

Fig. 3 — Deviation Regulator Computer Circuit

(D) Effect of Missing Carrier

1.12 When an N channel or ON twin channel unit is removed from a system, a deviation regulator will try to correct for the missing carrier. The amount of change introduced into the transmission characteristic varies with the particular channel missing, but is a maximum of 2 db in the worst case. As this change is slower than the action of the N channel or ON twin channel regulator, no serious system problem will usually exist.

(E) Regulator Performance on N Carrier Systems With Schedule A or B Program Circuits

1.13 Under normal conditions, a schedule A or B program channel can be placed on any N carrier system, which has been initially aligned with all twelve channel carriers according to one of the regular line-up procedures discussed below. From a regulation standpoint, a program circuit consists of channels 5 and 7 missing and a carrier up 5 db from nominal at channel 6. A reversing tone may also be present at times. This tone is a carrier 5 db down from normal at the frequency of channel 5. When channels 5, 6 and 7 are replaced with a program channel unit, the regulator should still perform satisfactorily, not distorting any channel carrier by more than about 1 db.

2. TESTING CONSIDERATIONS

(A) Preliminary Tests and Inspections

2.01 The preliminary dc tests and inspections covered in these sections should be completed and cathode activity tests made on all electron tubes prior to any initial line-up work on the deviation regulator.

2.02 When current is fed from a power supply point through a deviation regulator to an adjacent repeater, it is bypassed through the regulator by means of simplex connections on the input and output transformers. Therefore, the regulator must be installed in the terminal with the amplifier unit in place before the power to the adjacent repeater is adjusted.

(B) Line-up Tests and Adjustments

2.03 The line-up tests outlined in these sections follow a definite sequence. For this reason, they should not be used in part for trouble shooting or for routine testing. Routine tests and adjustments and procedures for trouble shooting are covered in a separate series of sections.

2.04 There are two procedures for performing the line-up tests on a deviation regulator. The particular method used will depend upon the results desired when the regulator is placed in service.

2.05 One line-up procedure, called Method A, gives line equalization at the expense of regulating range during extreme temperature conditions (hot or cold).

2.06 The second line-up procedure, called Method B, gives maximum regulating range, but provides no equalization for the high-frequency line.

2.07 Regardless of the method used, a line-up procedure consists of two series of tests; (1) Tests and adjustments which are made before the regulator is placed in service; and (2) tests and adjustments which are made after the regulator is connected to the high-frequency line.

2.08 The choice of the line-up precedure for a particular deviation regulator is a transmission engineering consideration and is not the responsibiilty of the employee involved in adjusting the apparatus. The recommended line-up procedure should be transmitted to the employee by circuit layout card or other suitable means. Wherever possible, all of the regulators at a location should be lined up by the same method to avoid confusion to the person responsible for the maintenance of the equipment.

(C) Maintenance Tests

2.09 Cathode activity tests should be made on all electron tubes involved before any maintenance tests are performed.

2.10 The maintenance tests and adjustments on a deviation regulator are separated into two groups; (1) routine in-service tests which may be made without interrupting service; and (2) out-of-service tests and adjustments which may be made with the deviation regulator either in a switched condition, or disconnected from the high-frequency line (bypassed because of trouble).

2.11 The in-service maintenance tests may be performed on the deviation regulator without risk of interrupting service if the procedures are properly followed. They may be made on a scheduled basis as a routine check of the operation of the regulator.

2.12 The out-of-service tests are made only when there is trouble suspected or when the deviation regulator has failed.

2.13 The out-of-service maintenance tests require the use of the 2M switching set and measurements are made of the carriers present on the high-frequency line. However, when the regulator fails completely it may be expedient to bypass it and perform a complete realignment.

2.14 Included as part of the out-of-service tests is a point-to-point testing method which may be useful for isolating trouble in the deviation regulator network circuits.

(D) Cathode Activity Tests on Electron Tubes

2.15 The in-service electron tube tests are made with the 2P tube test set which is normally used for testing tubes in N carrier repeaters. Out-of-service tests are made with a Hickok tube tester.

2.16 The procedure for making the in-service cathode activity tests is similar to the method used for testing tubes in an N carrier repeater except that some of the selector switch positions on the 2P tube test set are not used.

Also, because of the design of the deviation regulator control circuit units, full scale adjustments cannot be obtained on the 2P tube test set in some instances. These exceptions are explained in the tube testing procedure.

(E) Test Requirements

2.17 In most cases the test requirements in these sections are given in actual scale readings on a specified meter. Any corrections made necessary by using a meter calibrated for one impedance in a different impedance circuit have been included in the requirements. For this reason, meters other than those specified should not be used unless it is certain that equivalent results can be obtained.

2.18 An exception to the above paragraph involves some tests where a correction must be applied to level measurements because of a deviation in input or output regulator impedances from the nominal values. Where such corrections must be applied, attention is called to it in the section.

2.19 In these sections, when reference is made to a test point or a control on the deviation regulator or test equipment, the designation of the test point or control is given in bold type exactly as shown on the equipment or test sets.

2.20 In some tests on the deviation regulator, requirements are expressed in "dbm." When a test tone level is expressed in "dbm," the power of the test tone at the circuit point concerned is so many db greater or less than a reference power of 1 milliwatt (0 dbm). For example, a signal level expressed as —20 dbm is a power 20 db less than 1 milliwatt. Similarly, a signal level 20 db greater than 1 milliwatt is expressed as +20 dbm.

2.21 If a requirement is given as a meter reading in "db" and not "dbm," it is an indication that the requirement is simply a reading on the meter and does not specify an actual amount of power.

(F) Effects of Thermistors

2.22 Part of the line-up of a deviation regulator consists of adjusting the four control circuit units. Each unit controls the characteristics of a thermistor in an associated shape network. The thermistors in the four networks have a heating and cooling time lag. Care should be taken to wait until a thermistor has completely heated or cooled before proceeding with any test or adjustment. When testing through the deviation regulator, attention should also be given to the fact that a varying thermistor in one network can affect the results of a test through another.

3. PLACEMENT OF PLUG-IN UNITS

(A) General

3.01 The active elements of a deviation regulator are plug-in units. As shown schematically in Fig. 4, they consist of a line and pick-off amplifier designated AMP and four control circuit units designated SLOPE, BULGE, CUBIC, and QUARTIC, respectively. Fig. 5, a front view drawing of the deviation regulator shows the position of the units on the regulator mounting bracket.

3.02 Extreme care must be exercised when inserting the plug-in units into the deviation regulator mounting bracket. The spring fingers of the small jack terminals of the multicontact jacks are easily bent out of shape. When one is bent, it may not only prevent good contact in that jack, but because of improper seating of the connector it may prevent proper contact in the other jack terminals of the jack assembly.

(B) Placing Plug-in Units in Service

3.03 When a plug-in unit is inserted into the mounting, feel for the proper positioning of the connector with its jack assembly, then firmly push the unit home. If more force than this seems to be required, remove the unit and examine the connector and jack assembly for bent or broken parts.

3.04 The method for replacing damaged individual jack terminals without replacing the entire jack assembly is covered in Section A509.207.

3.05 Care should be taken in placing the cover-plate on the amplifier and control unit mountings to see that the stud and the spring

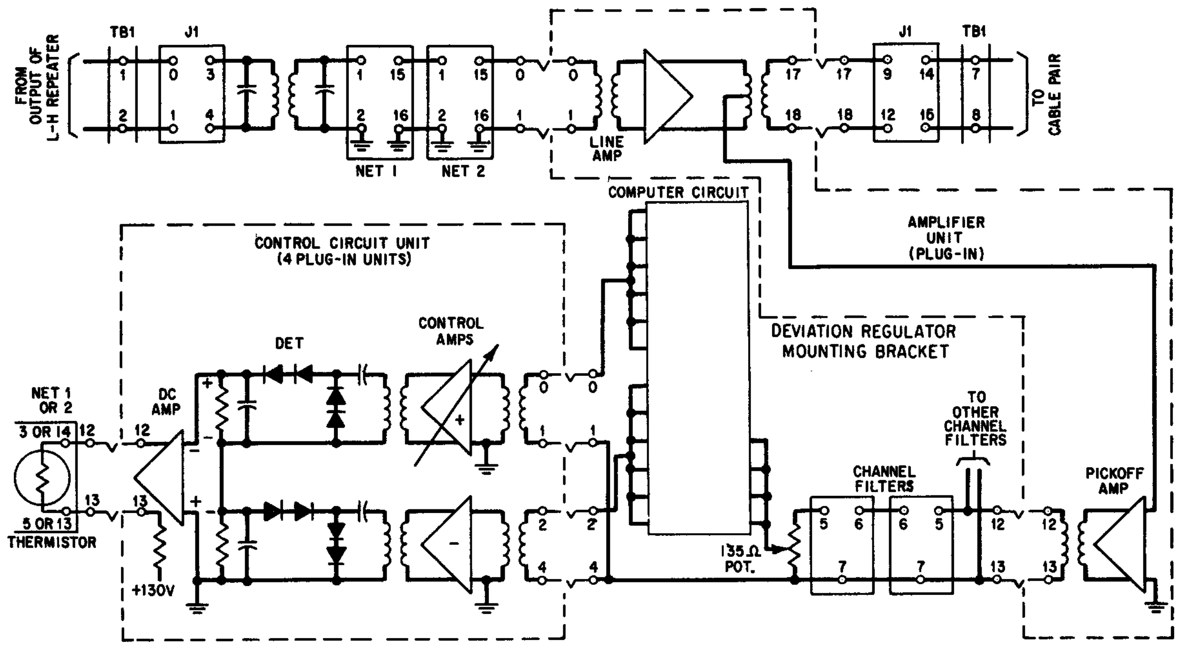

Fig. 4 — Deviation Regulator Plug-in Units

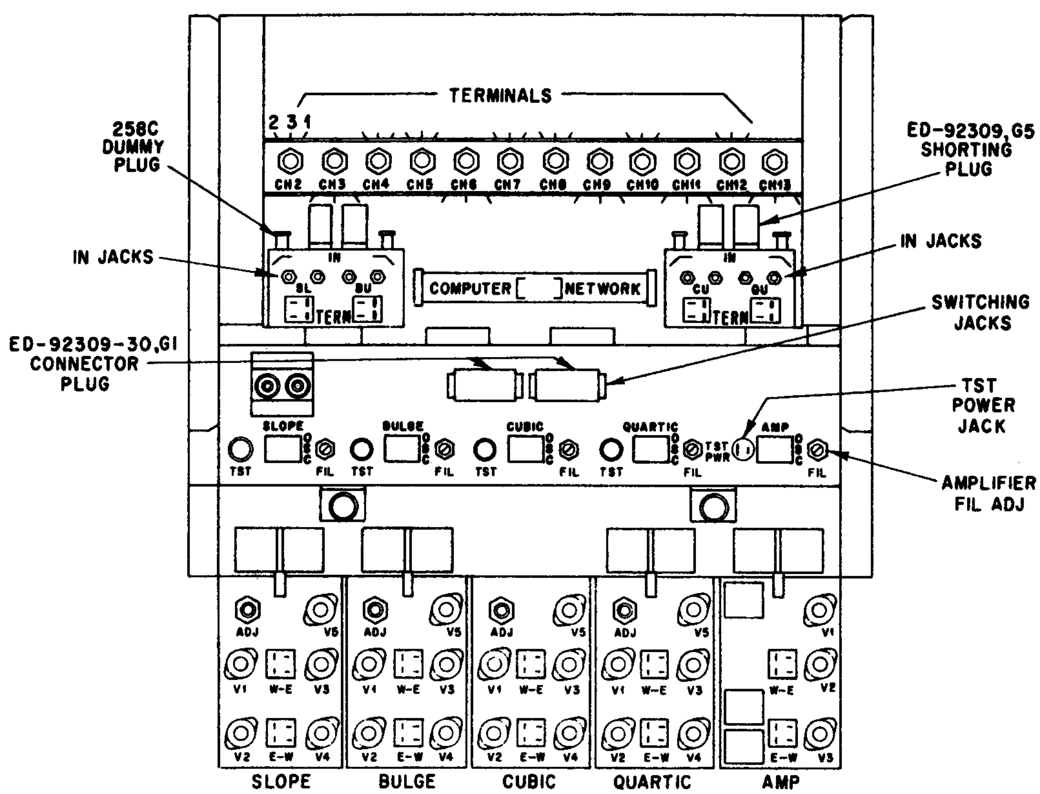

Fig. 5 — Front View of Deviation Regulator

wire of the Dzus fastener are not damaged in locking the fastener. Only a quarter of a turn is required to reach the locking point. The stud should not be forced beyond that point.

(C) Removing Plug-in Units from Service

3.06 When a case of trouble in a deviation regulator is isolated to a given plug-in unit, the defective item may be replaced with another good unit. Trouble may be localized by substituting good units for questionable ones. Faulty plug-in units should be returned to a centralized repair point, where they can be tested and made ready for return to service.

3.07 Except for cases of complete circuit failure, a plug-in unit should be removed from service by one of the methods described in the section before it is replaced. The deviation regulator must then be realigned before being restored to service.

3.08 When one of the plug-in units is loose or removed from the frame, the filament voltages to all of the other units are affected. Care should be taken to assure that all of the plug-in units are firmly seated in their associated jack mountings before any tests or adjustments are made on the deviation regulator.

3.09 If a unit is to be removed from service for more than a few hours and power is to be left on the remaining units, the heater supplies should be readjusted to maintain the proper voltages on the filaments of the other units.

4. TEST EQUIPMENT

(A) General

4.01 The tests on the deviation regulator, covered in this series of sections, require the use of the test equipment listed in Tables A, B, and C. The table columns headed DESIGNATION IN BSP list the abrreviated titles which are used where reference is made to the apparatus in the sections. It is intended that the abbreviated titles will simplify presenting the test descriptions and procedures.

(B) Test Sets

4.02 Table A lists the test sets required for making the tests and adjustments on the deviation regulator. The test equipment should be calibrated periodically according to the appropriate Bell System practice.

4.03 Special consideration should be given to periodically calibrating the KS-15538, Sierra carrier frequency voltmeter (CFVM) an external source of power as described in the section covering its use. The CFVM should be given the local calibration, using the internal injection oscillator, at frequent intervals during the time the tests described in these practices are being performed. The controls should be adjusted for the calibration error previously determined in the calibration with an external source of power.

(C) Associated Test Equipment

4.04 The additional apparatus required for maintaining a deviation regulator falls into two general groups: the standard equipment which may be ordered directly from the Western Electric Company, and equipment which must be made available locally.

4.05 Table B lists the standard equipment and Table C lists the equipment to be provided locally. The figure letters in Table C refer to the drawings (Fig. 6 of this section) which describe the construction of the apparatus.

5. DRAWINGS

5.01 The following drawings are listed for reference only and are not attached to this section:

Deviation Regulator Application Schematic
SD-95186-011

Deviation Regulator Amplifier Circuit
SD-95187-01

Deviation Regulator Control Circuit Unit
SD-95188-01

Deviation Regulator 3AF Test Set
SD-95206-01

N Carrier System Low-High Repeater
SD-95123-01

TABLE A

TEST SETS

DESIGNATION IN BSP	DESCRIPTION
VTVM	Hewlett-Packard Vacuum Tube Voltmeter (400C or D)
200CD	Hewlett-Packard Oscillator (200CD)
VOM	Triplett Volt-Ohm-Milliammeter, Model 630 (KS-14510, L1 or L5), or equivalent.
CFVM	Sierra Carrier Frequency Voltmeter (KS-15538, L1, L2 or L3)
3AF Test Set	Deviation Regulator Test Set (J98703AF)
2J Test Set	Repeater Test Set (J94002J)
2M Switching Set	Repeater Switching Set (J94002M)
2P Test Set	Tube Test Set (J94002P)
____________	Hickok Tube Tester

TABLE B

STANDARD TEST EQUIPMENT

DESIGNATION IN BSP	DESCRIPTION	TYPE
W2DW cord	This cord, or equivalent, used for testing with VTVM.	W2DW cord
W20C cord	6-foot cord used for switching with 2M set and for measuring with CFVM. (2 cords required.)	W20C cord
W8D cord	6-foot power cord for 2M switching set.	W8D cord
265 tool	Includes a 266C tool. Used for making fuse alarm tests.	265 and 266C tools
DUMMY plug	The DUMMY plugs are mounted in the filter and network panel. (Four plugs required.)	258C plug
SHORTING plug	The SHORTING plugs are mounted in the filter and network panel. (Four plugs required.)	ED-92309, G5 plug
ADPTR plug	Switching set adapter plug.	ED-92717-30, G5

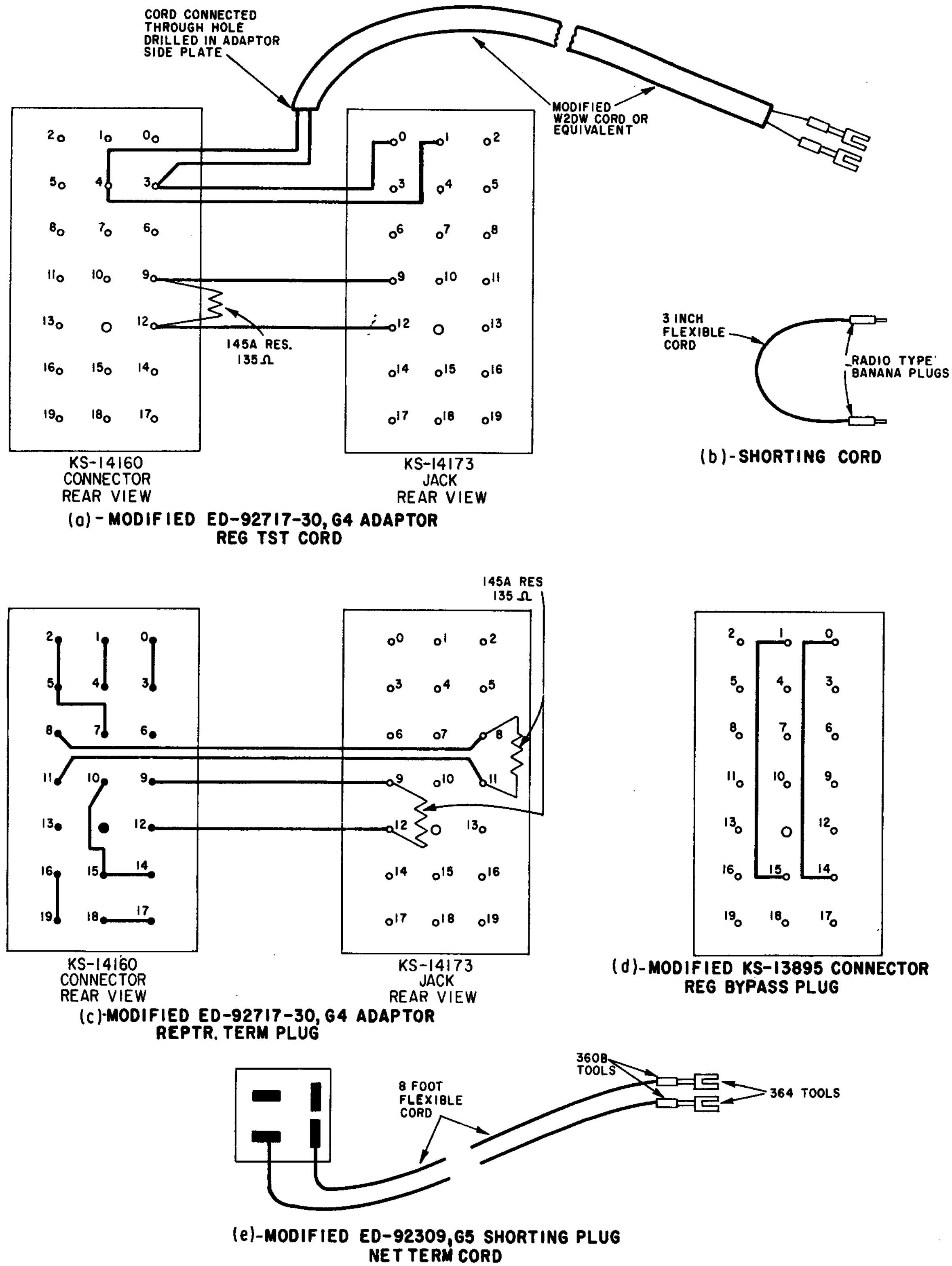

Fig. 6 — Test Equipment

TABLE C

ADDITIONAL TEST EQUIPMENT

(To Be Wired Locally)

DESIGNATION IN BSP	DESCRIPTION	REFERENCE IN FIG. 6
REG TST cord	Cord for connecting the 200CD oscillator to the deviation regulator input. (Spade tipped 2-wire cord connected to a modified ED-92717-30 plug with 135-ohm termination.)	Fig. (a)
SHORTING cord	Short length cord with prods to fit KS-14523 pin jacks.	Fig. (b)
REP TERM plug	135-ohm termination, used for making initial output slope measurement at repeaters or deviation regulators.	Fig. (c)
BYPASS plug	Deviation regulator bypass plug.	Fig. (d)
NET TERM cord	Cord for connecting a decade box to the TERM jacks of a shape network. Used for bypassing a faulty thermistor.	Fig. (e)