

PRIVATE LINE TELEPHONE SERVICE
CENTRALIZED MANUAL CONTROL SYSTEM
ANTI-AIRCRAFT OPERATIONS FOR DEFENDED AREAS
TESTS AND ADJUSTMENTS

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1. INTRODUCTION

1.01 This section describes procedures used for test and adjustments of the special purpose private line circuits which have been developed to provide the communication needs for the Army Anti-Aircraft Operations Control system for Defended Cities and Strategic Areas. A description of this system is given in Section 310-505-100. The procedures apply principally to central office equipment.

1.02 Three types of private line networks are used to provide the communication needs of the system. The first is a 4-wire multistation network arranged for 2-way transmission and 2-way signaling connecting the Center, Subcenter, and batteries within a particular sector ("grouped" condition). Under certain conditions, this network may be subdivided into 2-way lines as follows:

(1) A 4-wire voice channel may be established between the Center and each Subcenter. This may be arranged for either 2-way operation on a 4-wire basis ("divided" condition) with 2-way signaling or for one-way operation on each of two one-way channels, one of which provides communication between Center and Subcenter, the other between Subcenter and Center ("split" condition). No signaling is provided for this latter condition.

(2) In the "split" or "divided" condition a 2-way 4-wire voice multistation network with 2-way signaling may be provided between each Subcenter and all batteries within its control. In addition, provisions are made for the division of this network into 2-way 4-wire circuits extending between each subsector and the batteries associated with it ("split sector" condition). A maximum of four subsectors may be accommodated.

1.03 The second type is a 2-way transmission, 2-way signaling, 4-wire point-to-point circuit between the Sector Radar Station and the Subcenter. This circuit may be connected to the circuit extending between the Center and Subcenter in the "grouped" or "divided" condition only.

1.04 The third type is a 2-wire point-to-point private line network arranged for 2-way transmission and 2-way signaling between the Center and various Liaison Locations.

1.05 An additional feature of the over-all network is a capability for connecting the various networks between the Center and Subcenters together in a "conference" condition. This is controlled by the Center. Networks may be conferenced only in "grouped" or "divided" conditions. The "split" condition disassociates the line to the Subcenter from the conferencing equipment at the Center.

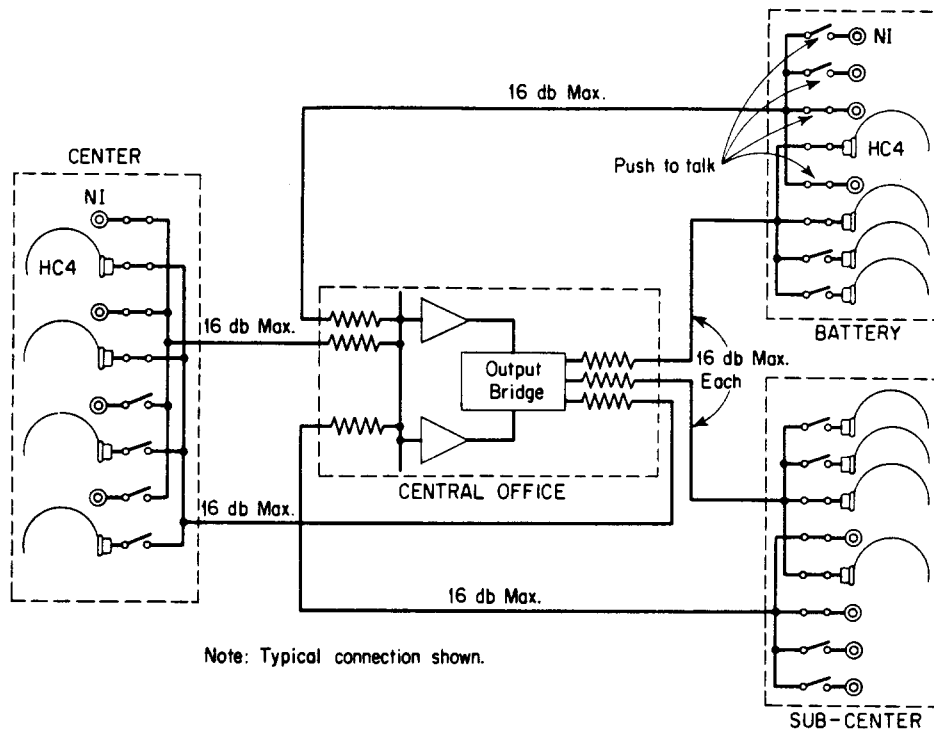


Fig. 1 - Arrangement for "Grouped" Condition

1.06 Because of the importance of the circuits and possibility of high room noise conditions, a grade of transmission of +2 db T+R effective is taken as the design limit for the system with the exception of the Center to Radar circuit which is used only during periods of light load. On the average, however, the effective transmission between the various points is as follows:

- | | |
|---|-------------|
| (1) Center to Subcenter or Subcenter to batteries ("grouped" condition) | -1.0 db T+R |
| (2) Center to Subcenter ("divided" condition) | +1.5 db T+R |
| (3) Center to Subcenter ("split" condition) | -3.0 db T+R |
| (4) Subcenter to Center ("split" condition) | + .5 db T+R |
| (5) Subcenter to Radar | +2.0 db T+R |
| (6) Center to Radar ("Radar grouped" condition) | +5.0 db T+R |

1.07 The maximum line loss between any location and the central office where amplification is located is limited to 16 db. That is, in order to provide +2 db T+R effective transmission between the Center and the Subcenter or Subcenter and batteries in the "grouped"

condition which establishes limiting transmission, the maximum line loss that can be accommodated between any location and a central amplifier with the amplifier set at maximum gain is 16 db (see Fig. 1). This is based on the simultaneous use of two positions at each terminal location. In the event that the requirements for simultaneous use of the positions are not as specified, 1.5 db loss is added for each additional position at each location and the permissible line loss is reduced between central amplifier and each terminal by one half the sum of the additional terminal losses. The standard facilities for private line telephone service are used.

2. MULTISTATION 2-WAY 4-WIRE NETWORK ("GROUPED CONDITION")

(A) General

2.01 A 4-wire multistation network arranged for 2-way transmission and 2-way signaling is provided between the Center, Subcenter and all batteries associated with the particular sector in the "grouped" condition. Fig. 1 shows the general circuit arrangement for one subsector and Fig. 2 the arrangement for a sector divided into subsectors. One central amplifier arrangement is incorporated in the network for each subsector. It is located at a Telephone Company central office serving the subsector.

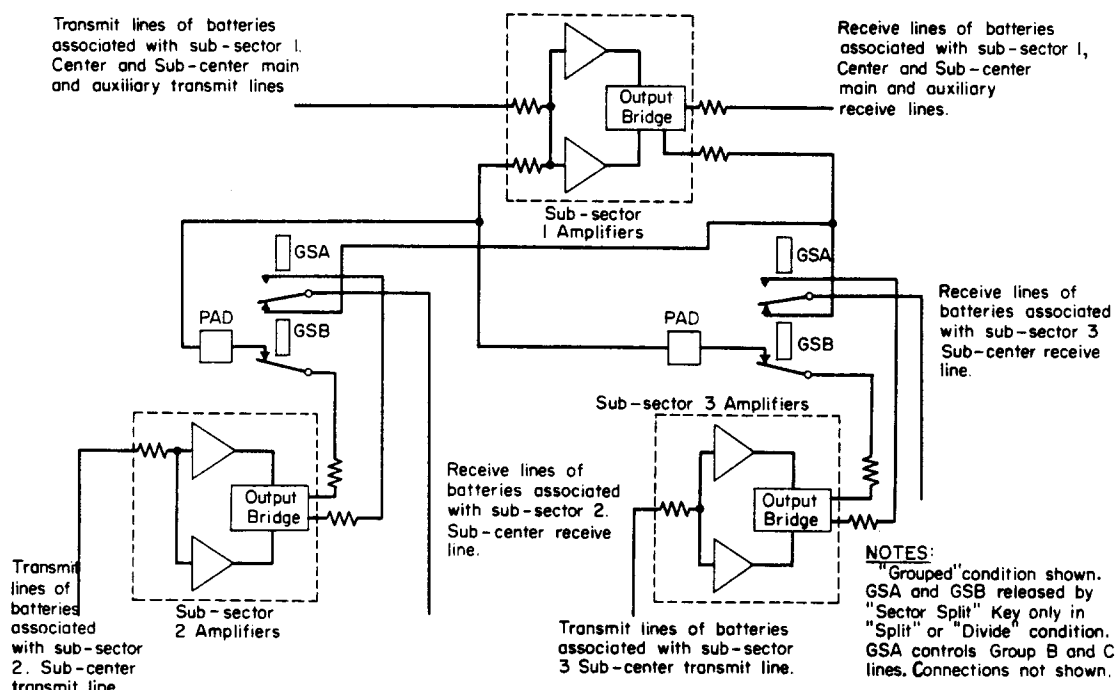
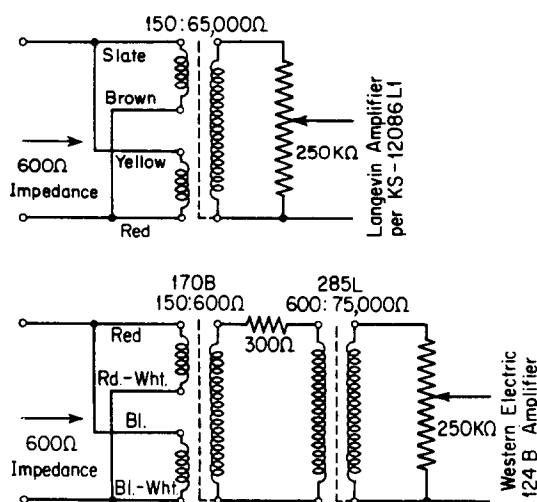


Fig. 2 - Central Amplifier Arrangements



Amplifier Gain = 66 db between nominal impedances

Fig. 3 - Input Modifications for 124B and KS-12086 L1 Amplifiers

(B) Central Amplifier Test

2.02 The nominal gain of the 124B type or the KS-12086 L1 central amplifier is 66 db using the input arrangements of Fig. 3. The gain of each amplifier for each subsector

should be adjusted using a 1000 cps tone applied at the central office. With the central amplifier adjusted for normal operating condition, apply a -36 dbm signal from a 600-ohm source by plugging into the AMP IN jacks as shown in Fig. 4. Adjust the gain of each amplifier to read the following on the volume indicator across the amplifier output:

Number of Input Lines Connected to the Amplifier Input	Volume Indicator Reading
11	+3.0
10	+2.4
9	+1.7
8	+0.9
7	+0.1
6	-0.8
5	-1.9
4	-3.0
3	-4.3
2	-5.9

Adjust all other central amplifiers in the same manner.

2.03 In order to determine that the two amplifiers for a particular central office arrangement are connected in the proper phase at the output, the reading across each amplifier output should be compared to the reading across the load. In order to make this check,

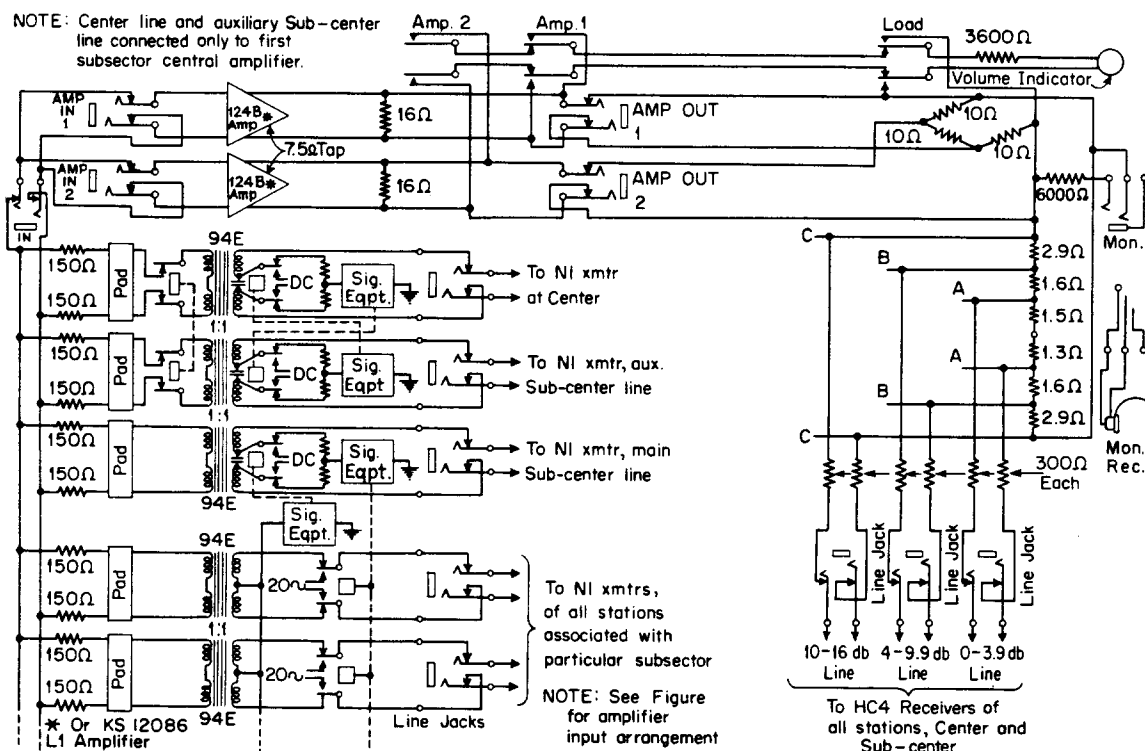


Fig. 4 - Subsector Central Amplifier Arrangement

apply the 1000-cycle -34 dbm test tone into the IN jacks of the central amplifier arrangement as shown in Fig. 4. If the phasing is proper, the readings across the load and each amplifier output should be within 1 db of each other.

2.04 The maximum number of input lines that may be accommodated by the central amplifier input arrangement is 11. This provides a margin of 3 db gain in the amplifier which affords compensation for reduction in gain due to tube aging, etc.

2.05 The volume indicator meter used for lining up and checking the circuit is connected to the output of either amplifier or across the load by means of a pushbutton key arrangement. Although it is inserted at a low impedance point, it provides a meter reading corresponding to the VU level at the Group C line terminals.

(C) Input Pad Strapping

2.06 Each line connected to the input of the central amplifier arrangement is connected to the input of the amplifier through a repeating coil, pad, and protective resistors. The transformer is used for signaling purposes, the pad is used to equalize the levels of signals received due to differing line lengths, while the protective resistors protect the circuit in the event of line faults. The pad, see Fig. 5,

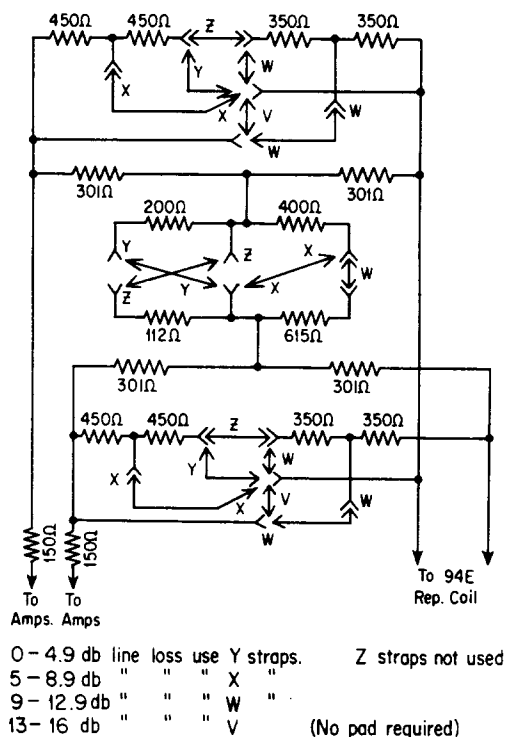


Fig. 5 - Input Pad Strapping

is adjusted in 4 db steps depending upon the length of line associated with it as follows:

<u>Transmitting Line Loss</u>	<u>Pad Loss</u>
0-4.9 db	12 db
5-8.9 db	8 db
9-12.9 db	4 db
13-16 db	0 db

3. POINT-TO-POINT CIRCUITS BETWEEN CENTER AND SUBCENTER ("SPLIT" AND "DIVIDED" CONDITIONS)

(A) General

3.01 In the "split" condition two separate one-way circuits are provided between the Center and Subcenter in each direction. In the "divided" condition 2-way 4-wire circuits are provided between the Center and Subcenter. Figs. 6 and 7 show the central office, Center and Subcenter arrangements. Two-way signaling is employed for the "divided" condition, while no signaling is employed for the "split" condition.

(B) Central Amplifier Test

3.02 The central office arrangement for the "split" and "divided" conditions is shown in Fig. 7. In these conditions, the Center transmitting and receiving lines as well as the Subcenter auxiliary transmitting and receiving lines are connected together through V3 amplifiers or pads to establish separate circuits between the Center and Subcenter.

3.03 Selection of either V3 amplifier or pad is dictated by the total loss between the Center and Subcenter including the loss caused by two positions at each terminal point for the "divided" condition. The central office amplifier is adjusted so that the effective transmission between terminations at the Center and Subcenter is +2 db effective T+R. This means that the total loss between the Center and Subcenter line jacks is 10 db at 1000 cycles or, assuming 5 db loss at each terminal in the "divided" condition, 20 db loss at 1000 cycles between Center and Subcenter.

3.04 If the loss between Center and Subcenter line jacks at 1000 cycles is 8.5 db or less, a pad is used as the central office adjusted in 2 db steps as follows: (An allowance of 1.5 db is included for central office losses)

<u>Measured Line Losses AAOC - Central Office - Subcenter</u>	<u>Adjust Pad Loss To</u>
0-2.5 db	6 db
2.6-4.5 db	4 db
4.6-6.5 db	2 db
6.6-8.5 db	0 db

3.05 If the line loss between Center and Subcenter line jacks at 1000 cycles is more than 8.5 db, V3 amplifiers are used with gain settings as given by the following formula:

$$V3 \text{ gain (db)} = \text{line loss} - 8.5 \text{ db}$$

Gain measurement techniques for V3 amplifiers are given in the Section entitled, "V3 Amplifier."

4. POINT-TO-POINT 2-WAY 4-WIRE LINE TO SECTOR RADAR STATIONS

4.01 A 4-wire point-to-point circuit arranged for 2-way transmission and 2-way signaling is provided between a Subcenter and its associated sector radar station as shown in Fig. 8. This circuit incorporates a feature for use during the "grouped" or "divided" condition which permits connection to the line to the Center.

4.02 The maximum line loss between Subcenter and Radar Station is limited to 3 db. For lines of additional loss, V3 amplifiers should be employed with a gain setting as follows: (An allowance of 1.5 db is included for central office losses)

$$V3 \text{ gain} = \text{line loss} - 1.5 \text{ db}$$

The gains of the auxiliary V3 amplifiers are adjusted using techniques described in the Section entitled, "V3 Amplifier."

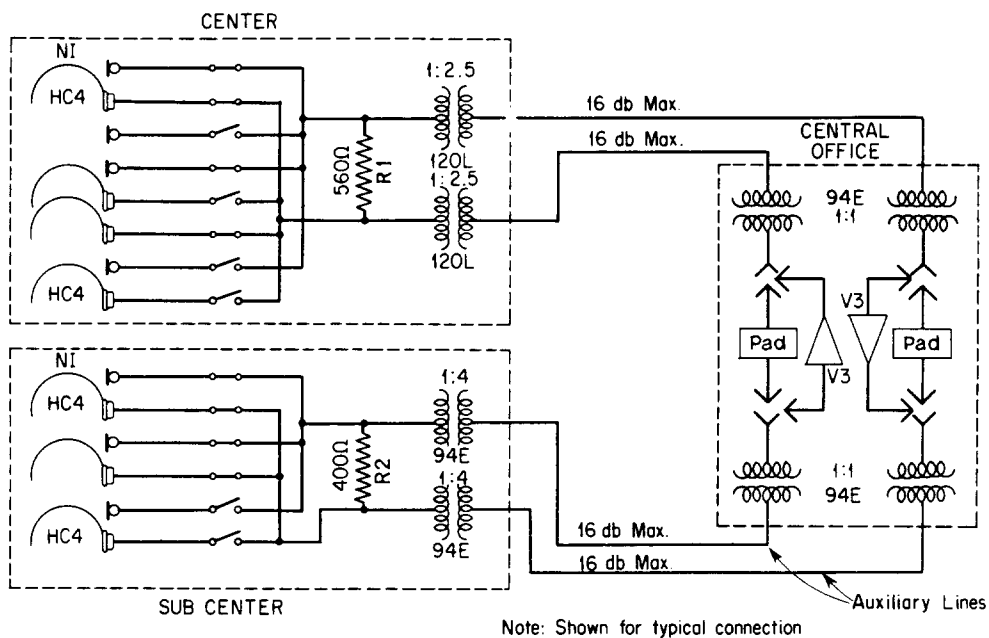
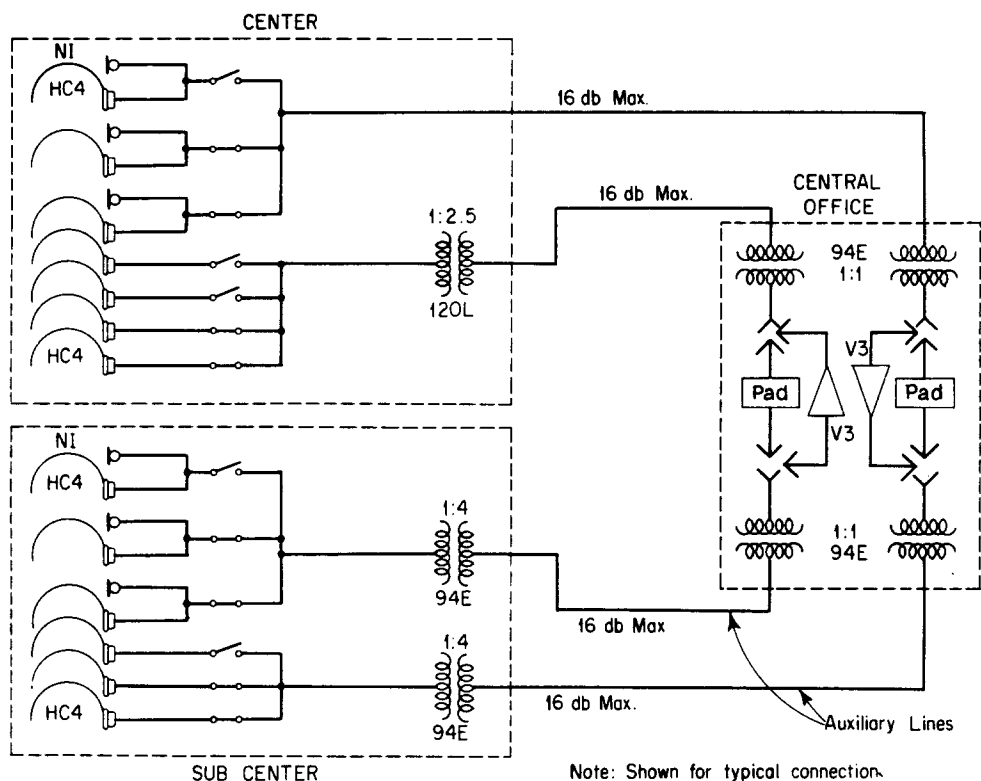


Fig. 6A (Top) - Center to Subcenter Circuit in "Split" Condition

Fig. 6B (Bottom) - Center to Subcenter Circuit in "Divided" Condition

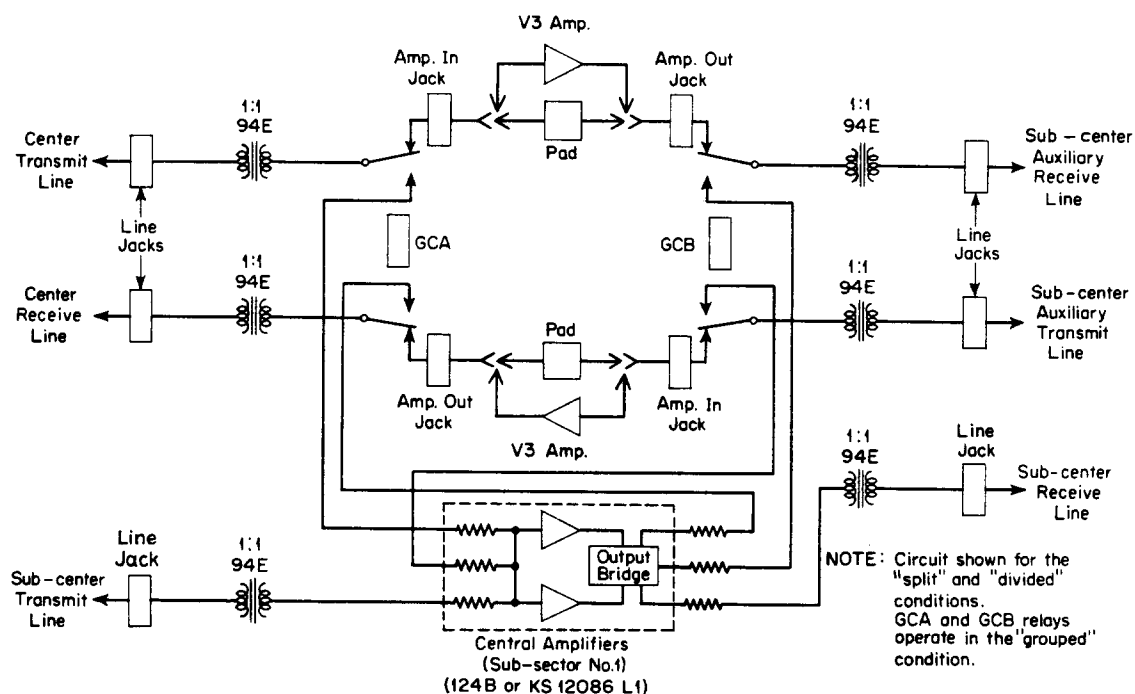


Fig. 7 - Central Office Arrangements Involved in Various Conditions

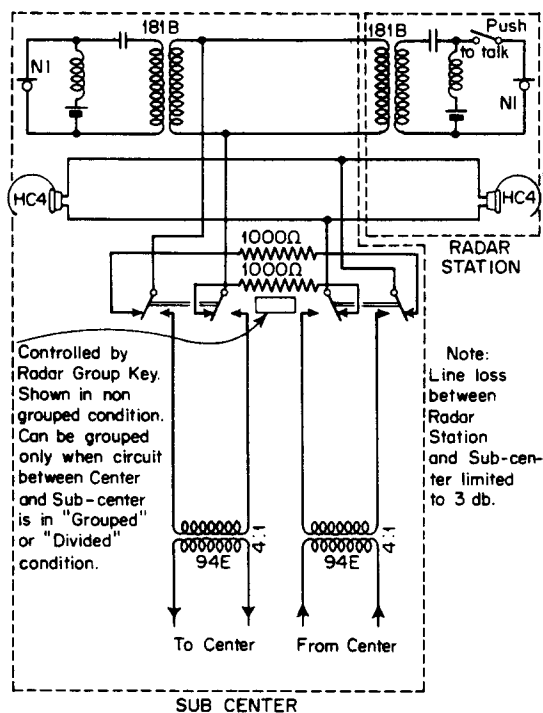


Fig. 8 - Sector Radar Circuit

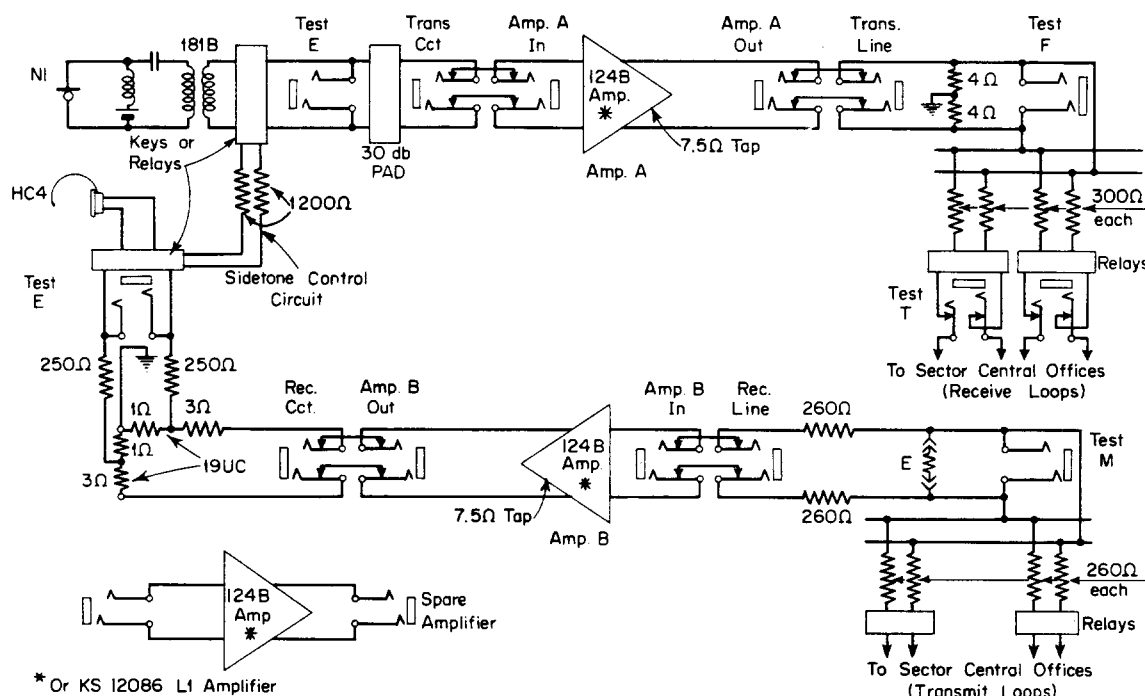


Fig. 9 - Conference Arrangement at the Center

5. CONFERENCE CONDITION

(A) Amplifier Adjustments

5.01 Conference Transmitting Amplifier: At the Center provision is made for connection of all 2-way 4-wire circuits to Subcenters in a 2-way communication arrangement. This permits the Center to have simultaneous 2-way voice communication with all stations connected to all sector and subsector lines. It does not, however, permit such communication between any two other members of the conference arrangement since no such operating requirement is entailed. Fig. 9 shows the conference amplifier arrangement at the Center. The transmitting conference amplifier should be so adjusted that the loss between the transmitting position (Test E jack) and the line side of the 300-ohm resistors is 4 db. In the "divided" condition the sidetone control path adds an additional 1 db. This assures that the terminal loss at the Center in the conferenced condition is approximately equal to the terminal loss in any of the nonconferenced conditions. The following procedure should be used to set the conference transmitting amplifier gain.

- (1) Leave the conference key unoperated. In this condition, neither the conference position telephone circuit nor the sector 2-way speech circuit lines are connected to the amplifier circuit.
- (2) Apply a 1000 cps -10 dbm from a 600-ohm source to the Test E jack at the entrance to amplifier A. Adjust the gain of the transmitting amplifier so that the signal level as

measured at the Test F jack is approximately 0.3 volt as measured on any voltmeter. (The impedance across which the reading is made is approximately 8 ohms.)

5.02 Conference Receiving Amplifier: The loss from any receiving line to the HC4 receiver at the conference position is compensated for by proper adjustment of the conference receiving amplifier. No tone measurement is required for this gain adjustment. The amplifier is adjusted to give ample volume in the receiver of the conferencing position when the conferencing key is operated.

(B) Pad Adjustment

5.03 The balanced "H" pad at the input to the conference receiving amplifier is adjusted according to the number of sector lines. The resistance "E" is adjusted as follows:

Number of 4-Wire Lines on Conference Circuit	Code	Resistance
3	18EL	112
4	19PN	124
5	18E	140

6. TONE DEVICE

6.01 By use of a 50B recorder-connector, an intermittent tone is applied to each Center transmitting line at the Center. The tone is transmitted to the outlying sectors from the Center whenever the line is not being used for speech transmission as a check on circuit operation. Fig. 10 shows the connection of the recorder-connector to the circuit.

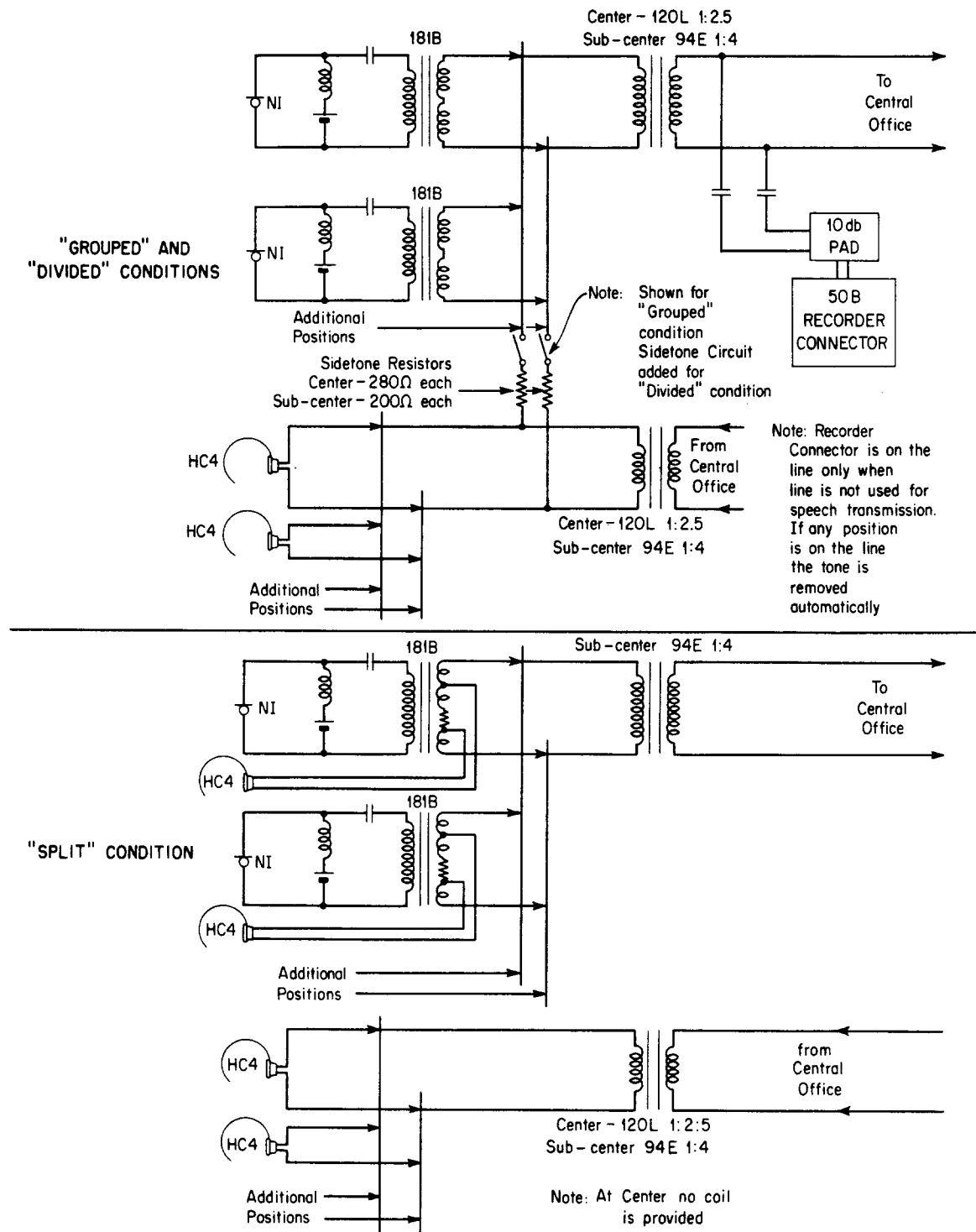


Fig. 10 - Terminal Arrangements at Center and Subcenter

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6.02 The tone will be received at the batteries only in the "grouped" condition. The Subcenter will receive a tone either in the "grouped" or "divided" condition. The tone is removed automatically when the operator's headset at the Center is inserted into the jacks. The tone is removed automatically, also, when the circuit is in the "split" condition. The tone does not provide a bidirectional check of operation since the individual subsector amplifiers other than the first are associated only with transmission from the batteries to the Center in the "grouped" condition, not for transmission from the Center to the batteries. In this latter condition, the subsector No. 1 amplifier only is in the transmission path.

6.03 The -15 vu tone applied at the Center will cause a VU meter for the first subsector amplifier at the central office to read about -11. This reading can be used as a quick check of circuit performance. This -15 vu tone will be received at the batteries at about -32 vu.

7. OVER-ALL TALKING TEST

7.01 After the tests have been completed on the component parts of the circuits, the following tests should be made before the system is furnished to the customer for service. Over-all talking tests should be made in the "grouped," "split," and "divided" conditions among the locations entailed by each switching capability. In the "grouped" condition, for instance, the tests should be made among the Center, Subcenter, and all batteries in a particular sector. In addition, these tests should be made with typical terminations at each location as covered in Section 310-505-100. In general, this will entail two positions at each location. Such tests should also be made in the "conference" condition and in the "radar grouped" condition, observing the above considerations. Monitoring observations should be made at all locations to detect any unsatisfactory noise or crosstalk conditions and to verify that existing line noise conditions are typical. Uniform volume of transmission should be observed at each outlying station on transmission from the Center and Subcenter.

8. OVER-ALL SIGNALING TEST

8.01 Signaling tests should be made at Center, Subcenter, Radar Station, and batteries to verify that the operation is satisfactory.

8.02 During the "grouped" condition, the following features are provided:

- (1) The Center can signal the Subcenter.
- (2) The Subcenter can signal its batteries and the Center.
- (3) The batteries can signal the Subcenter.

During the "split" condition no signaling is provided between the Center and Subcenter. In the "divided" condition, the capabilities are identical to the "grouped" condition.

8.03 When the radar line is not grouped to the Center, the Radar Station and Subcenter may each signal the other. However, in the "radar grouped" condition, the Center may ring the Radar Station concurrently with the Subcenter only. The Radar Station may not signal the Center. In the "conference" condition, the signaling capabilities are as described in the "grouped" condition.

9. AMPLIFIER MAINTENANCE

9.01 If the output of speech or tone from one amplifier as measured with the volume indicator meter can not be made equivalent to the output of any other amplifier by adjusting the proper gain control potentiometer, the amplifier with the low output volume should be removed by inserting dummy plugs into the AMP OUT and AMP IN jacks and should be checked or replaced. With the two dummy plugs in place, the other amplifier will continue to supply the circuits with an over-all gain that is approximately 2.5 db below normal. The amplifier used by these lines should be connected for the normal audio frequency output of approximately 11-1/2 watts using standard 6L6-type tubes.

9.02 Test and adjustment of the 124B amplifier are covered in 024-104-500. When the Langevin amplifier (KS-12086, List 1) is used, the manufacturer's installation and service manual with addendum covering modifications should be used. Test and adjustment of the V3 amplifier are covered in the Section entitled, "V3 Amplifier."