

L MULTIPLEX TERMINALS

OVERALL LINEUP OF CHANNEL GROUPS

INITIAL AND MAINTENANCE

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1. GENERAL

1.01 The channel group (CH GP) is a facility providing 12 voice-frequency channels in each direction of transmission between two points. The CH GP consists of a channel bank at each terminal office with one or more L GROUPS (LG) or R GROUPS (RG) serving as a group bandwidth (60 to 108 kHz) transmission path between the two channel banks. The individual LG and RG segments are joined together at intermediate offices by means of an LL CONNECTOR (LL CONN). This section provides information about this type facility, furnishes initial lineup procedures, and provides troubleshooting guides for use in maintaining proper overall alignment.

1.02 The initial lineup of a CH GP should be approached on the basis that all of its individual equipment components have been tested and meet their individual transmission requirements. Also, each intermediate LG or RG Plant Control office should have previously established continuity and set the overall 104.08-kHz group pilot level of each intermediate LG or RG segment. The complete overall CH GP can then be aligned by making

progressive pilot and channel #2 tone adjustments from the transmitting channel bank to the receiving channel bank.

1.03 One of the important facts to be remembered about an overall CH GP transmission slot (60 to 108 kHz) is that it does *not* have a flat frequency response. Filter characteristics and equalization factors along the route cause the upper and lower edges of the band to become rolled off. These effects add, so that long and complex channel groups sometimes have several dB level differences between the channels in the middle of the band and those at the edges of the band. These channel differences are equalized by adjustments of the individual channel DEMOD POTS at the receive end so that all 12 channels are at a +7 dBm output level. However, the overall roll-off characteristics of the line make it difficult to evaluate transmission at some intermediate point in the facility. (It is very important that intermediate point transmission levels always be adjusted by 104.08-kHz pilot and channel #2 tone measurements only. Efforts to make adjustments at other channel frequencies will usually be misleading and cause system misalignment.)

1.04 Each LG and RG segment requires the presence of a 104.08-kHz pilot for alarm and regulation purposes. This pilot is always inserted at the transmitting output of a channel bank and should, ideally, travel the entire length of the CH GP layout to the receiving channel bank. However, since the #1 group pilot of a supergroup also serves as the supergroup regulating pilot, it must always be reinserted on the transmitting end of each new supergroup. For this reason, the overall CH GP pilot can be made continuous through all LL CONN points except where an LL CONN feeds into a group #1 slot. (All group #1 slots must be equipped to block and reinsert the 104.08-kHz pilot.)

2. REFERENCES

Bell System Practices

- 356-011-503 In-Service Adjustment of Transmitting 104.08-kHz Group Pilots
- 356-015-500 Channel Bank Transmission Tests
- 356-015-520 Channel Bank 104-kHz Carrier Leak Tests
- 356-020-502 Group Connector In-Service Loss Adjustment
- 356-022-501 Overall Channel Noise Tests
- 356-115-501 Supergroup Demodulator In-Service Loss Adjustment (LMX-1)
- 356-120-501 Group Demodulator In-Service Loss Adjustment (LMX-1)
- 356-215-501 Supergroup Demodulator In-Service Loss Adjustment (LMX-2)
- 356-220-501 Group Demodulator In-Service Loss Adjustment (LMX-2)

Drawings

- SD-50103-02 Group Pilot Insert Unit Types

3. APPARATUS

3.01 The only required apparatus is a transmission measuring set capable of measuring the pilot and tone levels and frequencies of the channel group and patch cords as required.

Note: Depending upon the type of test set used, it may be necessary to provide two 135- to 75-ohm repeat coils and a 75-ohm attenuator with a value of 1.0 dB.

4. INITIAL LINEUP OF A CHANNEL GROUP

4.01 This test should be conducted just prior to placing the CH GP in service initially. It should be performed at *each* receiving terminal office for both directions of transmission. The procedure below provides only the tests for one direction and should be reconducted in the opposite direction to verify the quality of the entire transmission route. Overall coordination for the tests should be the responsibility of the office designated "CONTROL" on the channel group card.

4.02 The requirements of the 104-kHz carrier leak tests in Section 356-015-503 must be satisfactorily met for the transmitting terminal channel bank before this test is conducted.

STEP	PROCEDURE
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FROM THE CONTROL OFFICE

- 1 Request transmitting terminal personnel to verify that the group pilot insert unit is of the correct type and is properly designated. It should be of a type to insert a 104.08-kHz pilot (per SD-50103-02) and designated on the faceplate of the pilot insert unit as to its function. (See ED-50230-30 for designations.) (A group 6 type unit is first choice; group 5 or 7 type units are more costly substitutes.)
- 2 Request the transmitting terminal personnel to insert a 1-kHz test tone at a level of -13 to -16 dBm into the CH 2 MOD IN jack and then measure the level of the channel 2 tone (103 kHz) and the group pilot (104.08 kHz) at the CH BANK OUT ALT jack.

Requirement: The 103-kHz channel 2 tone shall be -42 ± 0.3 dBm; the 104.08-kHz group pilot level, -62.0 dBm.

STEP**PROCEDURE**

- 3 If the requirements are *not* met, the levels should be adjusted per Sections 356-015-500 and 356-011-503, as required.

AT THE FIRST LL CONN POINT FROM THE TRANSMITTING TERMINAL

- 4 Adjust the 104.08-kHz group pilot for a zero (0) indication on the GR SCANNER meter.
- 5 Verify that the transmitting group has the correct type of pilot insert unit installed and that it is properly designated per ED-50230-30.

Requirements:

- (a) The group 1 slot shall contain a G5 unit to block and reinsert the 104.08-kHz pilot.
- (b) The group 2-5 slots shall contain a G6 unit (or substitute) strapped for cut-through operation. (See SD-50103-02 for other types of insert units suitable for cut-through operation.)

Note: The 104.08-kHz pilot should always be cut through at an LL connector point, *except* where the connector feeds into a group 1 slot.

- 6 Measure the 103-kHz and/or the 104.08-kHz levels at the GR CONN OUT ALT jack on the transmitting group to evaluate transmission through the office LL CONN.

Requirements:

- (a) **At a pilot block and reinsert point:** The 103-kHz tone shall be -42.0 dBm. If *not*, adjust the loss of the LL CONN to meet the requirement. The 104.08-kHz pilot shall be -62.0 dBm. If *not*, adjust the potentiometer on the pilot insert unit to meet the requirement.
- (b) **At a through-pilot point:** The 104.08-kHz pilot shall be -62.0 dBm. If *not*, adjust the loss of the LL CONN to meet the requirement. (See Section 356-020-502.)

AT EACH SUCCESSIVE INTERMEDIATE LL CONN POINT

- 7 Successively progress to each remaining point, from the transmitting end to the receiving end, and conduct Steps 4, 5, and 6 at each point in turn.

AT THE RECEIVING END TERMINAL POINT

- 8 Adjust the receiving 104.08-kHz group pilot for a zero (0) indication on the GR SCANNER meter.
- 9 Measure the channel 2 tone (103-kHz) and the group pilot (104.08-kHz) level at the GR TST jack.

STEP

PROCEDURE

Requirements:

- (a) The 104.08-kHz pilot level shall be -35.0 dBm.
- (b) The 103-kHz tone level should be -15 dBm for a short system and somewhat higher for the more complex layouts. Since 103 and 104.08 kHz fall near the edge of the slot bandpass, the steep slope of the transmission curve will cause the 20-dB spread relationship of the two tones to change between the transmitting end and the receiving end of the system. The effect could amount to as much as a 1.0-dB discrepancy for long and complex systems; however, the average requirement is ± 0.5 dB.
- 10 Record the 103-kHz tone level measured in Step 9 on the circuit order card for the system. (It will become the key reference point to be used in evaluating overall channel group alignment.)
- 11 Request transmitting terminal office personnel to apply test tone level to the MOD IN jack of each of the 12 channels at the transmitting end.
- 12 At the receiving end, measure the test tone level received at the DEMOD OUT jack.
- Requirement:** $+4$ or $+7$ dBm
- 13 If the requirement is *not* met, adjust as required. (Overall transmission is satisfactory as long as the proper level can be obtained with the DEMOD POT adjustment.)
- 14 Conduct the overall channel noise tests of Section 356-022-501 for each of the 12 channels.

5. MAINTAINING LINEUP OF A WORKING CHANNEL GROUP

5.01 A channel group should hold its alignment over an extended period of time provided transmitting 104.08-kHz pilot levels are held stable, receiving 104.08-kHz pilot levels are kept adjusted to zero, and ***channel DEMOD POTS are left alone.*** Whenever testing operations indicate a level discrepancy in a single channel of a working channel group, carrier personnel must take steps to locate the exact cause of the trouble from an overall system standpoint. (***Never adjust a channel DEMOD POT without verifying overall channel group alignment.***)

5.02 Transmission through a working system is subject to some level fluctuations around nominal values. Levels within this operating range should be considered "normal," not requiring attention. For the CH GP, this operating range should be ± 1.0 dB. Except in special cases, carrier personnel should not be expected to expend time correcting for these small discrepancies. (One special case would be where several voice channels in tandem are off in the same direction so as to make testboard levels intolerable.)

5.03 The following procedure is to be followed by carrier personnel when answering requests for transmission measurements at the 4W board.

STEP

PROCEDURE

- 1 Conduct the transmission tests requested by the distant office and report the results to them. (See ***Note 1*** and ***2.***)

STEP	PROCEDURE
	<p>Note 1: Channel DEMOD levels found between +6 and +8 dB should be discussed with the requesting office and efforts made to leave the levels as is, if at all practicable. If it is determined that adjustments <i>must</i> be made, the steps below <i>must</i> be followed.</p> <p>Note 2: Channel DEMOD levels found to be more than 1.0 dB from nominal should be verified by having a test tone applied directly to the MOD IN jack at the transmitting 4W board. The test tone should be 1-kHz at -13 to -16 dBm. The level should then be measured at the receiving end DEMOD OUT jack and, if still over 1 dB off, the channel group alignment should be checked as described in the steps of this test.</p> <p>PREPARATION FOR ALIGNMENT TESTS</p> <p>2 Check the CH GP layout card to see if the system operates with a through pilot or has one or more pilot insert points. (Anytime an intermediate LL CONN feeds into a group 1 slot, the pilot is blocked and reinserted.) If a through-pilot system, proceed to Step 3. If a pilot insert system, proceed to Step 6.</p> <p>ALIGNMENT OF THROUGH-PILOT SYSTEM</p> <p>3 At the <i>transmitting</i> CH GP terminal office, measure and adjust, as required, the 104.08-kHz pilot level at the CHAN BK OUT ALT jack.</p> <p>Requirement: -62.0 dBm</p> <p>4 At the <i>receiving</i> CH GP terminal office, observe the 104.08-kHz pilot level received and adjust the level to zero (0) on the GR SCANNER meter, as required. (Through-pilot type systems need not have pilot adjustments made at intermediate point locations.)</p> <p>5 At the <i>transmitting and receiving</i> offices, use an idle channel as a patching facility to remove each nondata channel in the CH GP from service (one at a time). At the <i>transmitting</i> office, insert a 1-kHz test tone at a level of -13.0 or -16.0 dBm into the MOD IN jack of the channel; while at the <i>receiving</i> end, measure the test tone level received at the DEMOD OUT jack and, if necessary, adjust the DEMOD POT for the proper level (+4 or +7 dBm). Repeat this step until all channels have been properly aligned.</p> <p>ALIGNMENT OF A SYSTEM WITH INTERMEDIATE PILOT INSERT POINTS</p> <p>6 From the controlling office, arrange to have channel 2 service turned down, or patched off, and a 1-kHz test tone at the proper level applied to the CH 2 MOD IN jack at the transmitting office.</p> <p>7 At the transmitting office, measure the tone and pilot levels at the CHAN BK OUT ALT jack.</p> <p>Requirement: Adjust pilot level to -62.0 dBm. Adjust tone level to -42.0 ±0.3 dBm.</p>

STEP	PROCEDURE
8	At each intermediate pilot insert office, progressing from the transmitting office toward the receiving end, adjust the receiving 104.08-kHz pilot level to zero (0) on the GR SCANNER meter and proceed to Step 9.
9	At each intermediate pilot insert point, after completing Step 8, measure the channel 2 test tone and pilot levels at the transmitting LL CONN ALT jack. <i>Requirement:</i> Adjust the pilot level to -62 dBm with the potentiometer on the PIL INSERT UNIT, and the channel 2 test tone level to -42 dBm with the gain adjustment on the LL CONN.
10	At the receiving CH GP terminal office, adjust the 104.08-kHz pilot level to zero (0) on the GR SCANNER meter.
11	Measure the channel 2 test tone level at the GROUP TEST jack. <i>Requirement:</i> The level received shall be ± 0.25 dB of the value recorded on the circuit layout card during initial lineup.
12	Using channel 2 as a patching facility, apply the test tone at the MOD IN jack of all nondata channels not adjusted and adjust the appropriate DEMOD POT for the proper level at the DEMOD OUT jack at the receiving terminal office.
13	When all nondata channels have been adjusted, restore channel 2 to its normal condition.

6. VERIFYING CHANNEL GROUP PILOT INSERT UNITS ON A WORKING SYSTEM

6.01 The pilot insert units of an in-service CH GP cannot be removed from their mounting sockets without a service interruption. (Service can be cleared by patching off the associated CH BK or LL CONN.) If an office does not clearly designate the front of a unit during initial lineup to show the options used, it is more difficult to acquire the information at a later date. This procedure provides some testing techniques whereby a control office can verify the pilot insert unit conditions of a working CH GP.

6.02 Most CH GPs should be operating with a through-pilot from the transmitting CH BK to the receiving CH BK. (Plant Extension Engineering personnel make efforts to see that CH BKs are

not assigned to the group #1 slots where practicable.) A small quantity of CH GPs are found with the pilot reinserted at one intermediate point, and there may be a few with two or more reinsert points.

6.03 It is the responsibility of the CH GP control office (receiving end) to see that intermediate point pilot insert units conform to system needs and do not reinsert pilots unnecessarily. (Reinsert only when feeding a group #1 slot.) Intermediate pilot reinsert points cause a CH GP to have less level stability and to require more maintenance efforts. (*Wrong pilot insert unit options, causing unnecessary pilot reinsertion, must be eliminated.*)

6.04 The following test procedure makes reference to the typical system block diagram (office F controlling the work) shown in Fig. 1.

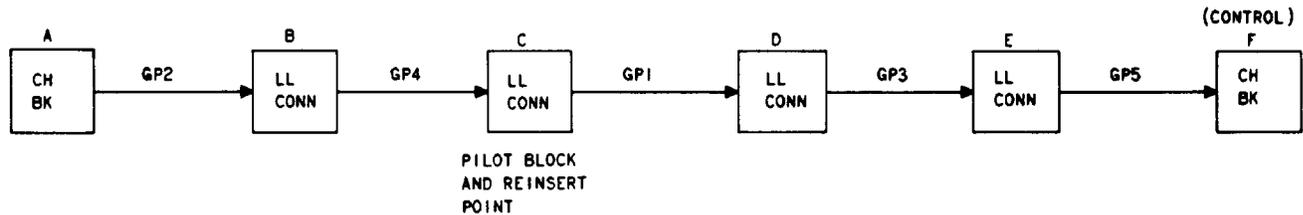


Fig. 1—Typical CH GP System Block Diagram

STEP	PROCEDURE
PREPARATION	
1	At office F (Fig. 1), observe the CH GP circuit order card to visualize a block diagram of the facility layout. Determine each LL CONN point and decide which of them should block and reinsert the 104.08-kHz pilot.
	Rule: Block and reinsert the 104.08-kHz pilot only at points where the LL CONN feeds into the group #1 slot.
2	Condition the LMX scanner so that it remains on the CH GP being verified.
STEPS FOR A CHANNEL GROUP WITH A THROUGH PILOT (END-TO-END)	
3	Contact the distant transmitting terminal of the CH GP and request that the test setup of Fig. 2 be used to cause an abrupt 1-dB level change to be applied to the transmitting side of the system. Exercise caution not to cause a service interruption.
4	At the receiving terminal (F), observe the PILOT METER on the LMX scanner at the time the transmitting office introduces the abrupt 1-dB level change.
	Requirement: The pilot meter should make a 1-dB drop and then regulate back to normal. (The meter should <i>rise</i> and regulate back to normal when the patch is removed.)
5	If the requirement is met, it indicates the pilot traverses the complete facility. Return the system to normal.
6	If the requirement is <i>not</i> met, it indicates the pilot is being blocked and reinserted at one or more intermediate LL CONN points. Each intermediate LL CONN point must be contacted and requested to verify for through-pilot operation using the test setup of Fig. 3.
	CAUTION: DO NOT REMOVE A PILOT INSERT UNIT FROM ITS SOCKET UNLESS SERVICE HAS BEEN PATCHED TO A SPARE LL CONNECTOR.
7	When the intermediate point containing an incorrect pilot insert unit has been identified, verify the facility layout on the circuit order card and then take whatever action is required to correct the trouble. Reconduct Steps 3, 4, and 5, as required, to verify overall operation.

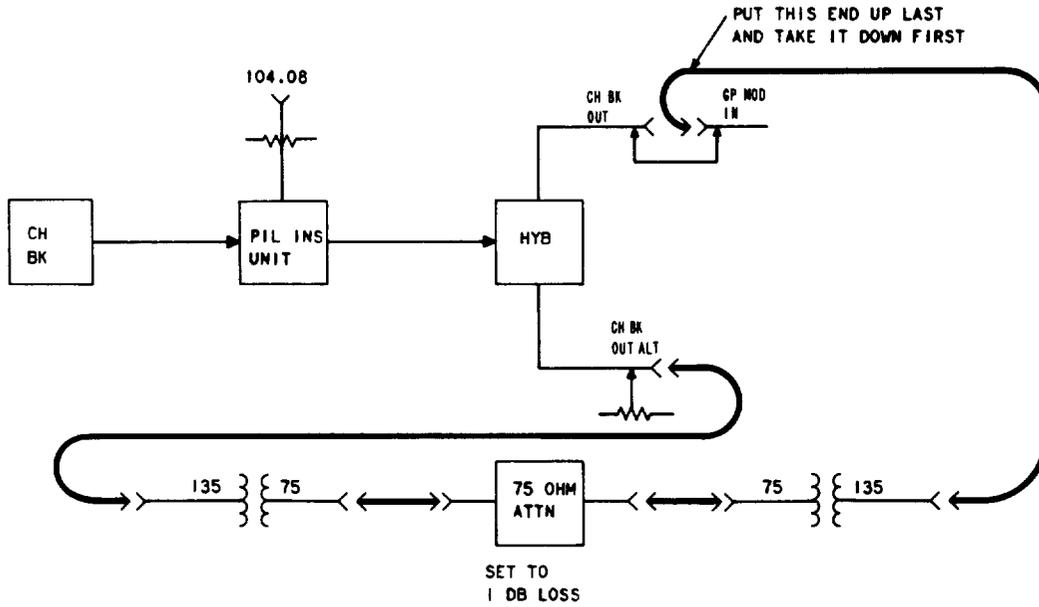


Fig. 2—Test Setup to Verify Through-Pilot Operation

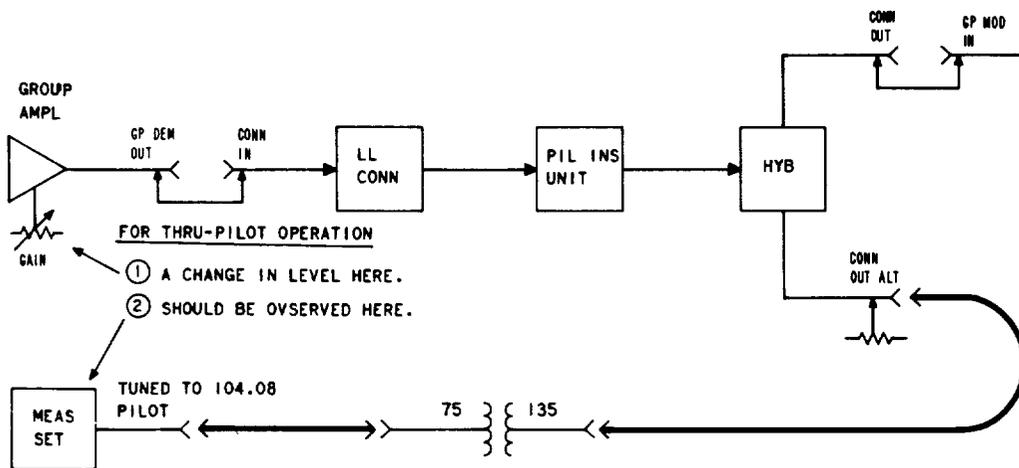


Fig. 3—Test Setup to Locate Pilot Block and Reinsert Location

STEP

PROCEDURE

STEPS FOR A CHANNEL GROUP WITH INTERMEDIATE 104.08-KHz PILOT BLOCK AND REINSERT POINTS

- 8 Contact the intermediate "pilot block and reinsert office" nearest the receiving terminal (office C in the block diagram of Fig. 1). Request that an abrupt 1-dB level change be introduced as described in Step 3.
- 9 At the receiving terminal (F), observe the PILOT METER on the LMX scanner at the time the transmitting office introduces the abrupt 1-dB change.

Requirement: The PILOT METER should make a 1-dB drop and then regulate back to normal. (The indication should *rise* and then regulate back to normal when the patch is removed.)

- 10 If the requirement is *not* met, the procedure of Step 6 must be applied at offices D and E (Fig. 1) to clear the trouble.

Note: Once the requirement of Step 9 is met, it is known that there is a continuous pilot from the transmitting side of office C through to office F. It must now be proven that office C is blocking and reinserting this pilot.

- 11 At office C (Fig. 1), use the test setup of Fig. 4 to verify that the pilot insert unit installed at that location *is* blocking and reinserting the pilot.

Note: After Step 11 has been satisfactorily completed, the next consideration is the section from office A to office C. Office F (control) cannot make observations during this testing sequence, but must ask office C to observe while office A makes level changes.

- 12 Condition the LMX scanner at office C to observe the pilot from office A.

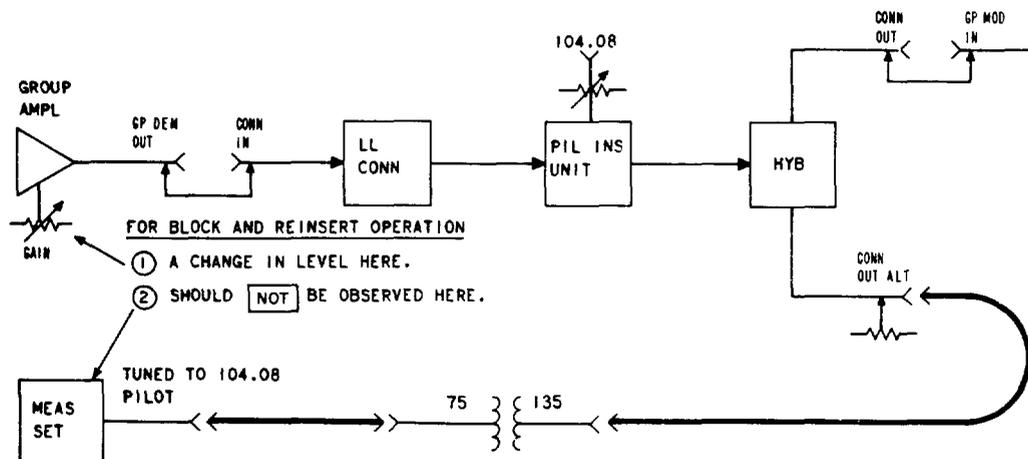


Fig. 4—Test Setup to Verify Pilot Block and Reinsertion

STEP	PROCEDURE
13	At office A, introduce an abrupt 1-dB level change (as in Step 3), while personnel at offices C and F are observing the receiving pilot level. <i>Requirement:</i> The level change at office C should occur as in the requirement of Step 9. There should be no change noted at office F.
14	If the requirement is <i>not</i> met, conduct Step 6 at each intermediate point to clear the trouble.
15	When all requirements have been met, restore all circuits to normal condition.
