ANALOG MULTIPLEX TERMINAL EQUIPMENT

LMX-2

TRANSMITTING CIRCUITS

GROUP AND SUPERGROUP MODULATORS

IN-SERVICE TESTS

The purpose of this test is to measure and, if necessary, to adjust the gain of each group and supergroup modulator circuit so that all group pilots are at the same power at the SG BK OUT TST jack.

This section is reissued to change the procedure for adjusting supergroups equipped with supergroup connectors and to provide a procedure for in-service adjustment of group modulators assigned to N3-L junctions. Arrows are used to indicate significant changes. ***Equipment Test Lists are not affected.***

Note: ▶See Section 855-335-108 for detailed information concerning N3-L junctions. N3-L junctions should ***not*** be assigned to any of the following groups:

1. Group 1 of any supergroup
2. Group 5 of supergroups 1 and 13
3. Group 2 of supergroups 3, 4, 5, 6, and 7 of L60A, L120A, and L600A terminals
4. Group 2 of supergroups 13, 14, 15, 16, 17, 25, 26, and 27 of L1860 terminals.◀

Each group modulator circuit in a group bank:

(a) Accepts the basic group band (60 to 108 kHz), at -42 dBm, from either the output of a channel bank or group connector

(b) Amplifies this signal with a 231A amplifier which has a nominal gain of 8.3 dB with a ±2 dB adjustment range

(c) Translates this signal to an allocated slot in the basic supergroup band (312 to 552 kHz).

This translated signal is combined with the translated signals from four other group modulator circuits. The combined signals are amplified by a 231B ▶or 231F amplifier,◀ which has a nominal gain of 28 dB, and are delivered to the GR BK OUT jacks at approximately -25 dBm. Hence, a gain of approximately 17 dB exists between the GR MOD IN jacks and the GR BK OUT jacks.

Note: The group pilot is 20 dB below transmission level.

Method of Testing:

(1) Measure all group 1 pilots (315.92 kHz) at GR BK OUT B jacks (Chart 1); adjust to -45 dBm with ADJ control on the group 1 transmitting amplifiers.

(2) Measure all translated supergroup pilots at SG BK OUT TST jacks (SG bank C2A, Chart 2) or at DSG BK OUT TST jacks (SG banks C2B and C2C, Chart 3); adjust to -63.4 dBm with SG ADJ control.

(3) Measure all translated pilots for groups 2 through 5 at SG BK OUT TST or at DSG BK OUT TST jack (Chart 4); adjust each to -63.4 dBm with ADJ control on the associated group transmitting amplifiers.

(4) ◗Measure 104.08-kHz pilot for group modulators assigned to N3-L junctions; adjust for correct level at GR BK OUT jack.◖

CHART **PAGE**

APPARATUS:

The tests in this section require suitable transmission test equipment. Refer to Section 356-010-500 and select, from available equipment, a receiving unit having the following capabilities:

Receiving Test Equipment capable of detecting, from 75-ohm circuits, signals between 104 and 3080 kHz at powers of -45 to -83.4 dBm.

Pilot Filter Set J68858AT (Section 103-407-101)

P2BJ Cords, as required

CHART 1

TRANSMITTING GROUP BANK (GROUP 1)

The group amplifier for group 1 of each supergroup is adjusted with the RTE connected to the GR BK OUT B or SG CONN OUT B jack.

STEP	PROCEDURE
	Note: The transmitting amplifier for group 1 is adjusted in this chart. The transmitting amplifiers for groups 2 through 5 are adjusted in Chart 4. The requirements in this test are based on the assumption that the 104.08-kHz group pilot power at the GR MOD IN jack is -62.0 dBm ±0.1 dB. The power may be measured as prescribed in Section 356-011-503.
1	Prepare the receiving test equipment (RTE) for a 75-ohm terminated measurement of the 315.92-kHz (translated 104.08-kHz) pilot at -45 dBm (-55 dBm if pilot filter set 58AT is used) for the group 1 modulator circuit being tested.
	Caution: Before proceeding with this test, ensure that a 1000-Hz test signal is not present on channel 2 of the group 1 under test. A 1000-Hz test signal on channel 2 may result in a 3-dB measurement error at group pilot frequencies if the selectivity of the measuring instrument is not adequate.
2	Connect the RTE to the GR BK OUT B jack [patch (1), Fig. 1].
3	Measure the power of the 315.92-kHz group 1 pilot.
	Requirement: -45.0 dBm ±0.1 dB (group 1 only).
4	Proceed to Step 6 if the requirement is met. Otherwise, adjust the ADJ control on the transmitting group amplifier assigned to group 1 to meet the requirement.
	Note: If the supergroup being measured is equipped with a supergroup connector instead of a group bank, connect RTE to the SG CONN OUT B jack. Adjust the GAIN control (C1 supergroup connector) or ADJ control (C2 supergroup connector) to provide an output of -45.0 dBm ±0.1 dB for group 1 pilot only.
5	Perform out-of-service tests as prescribed in Section 356-205-502 to locate trouble if the requirement of Step 3 cannot be met.
6	Disconnect the test equipment.

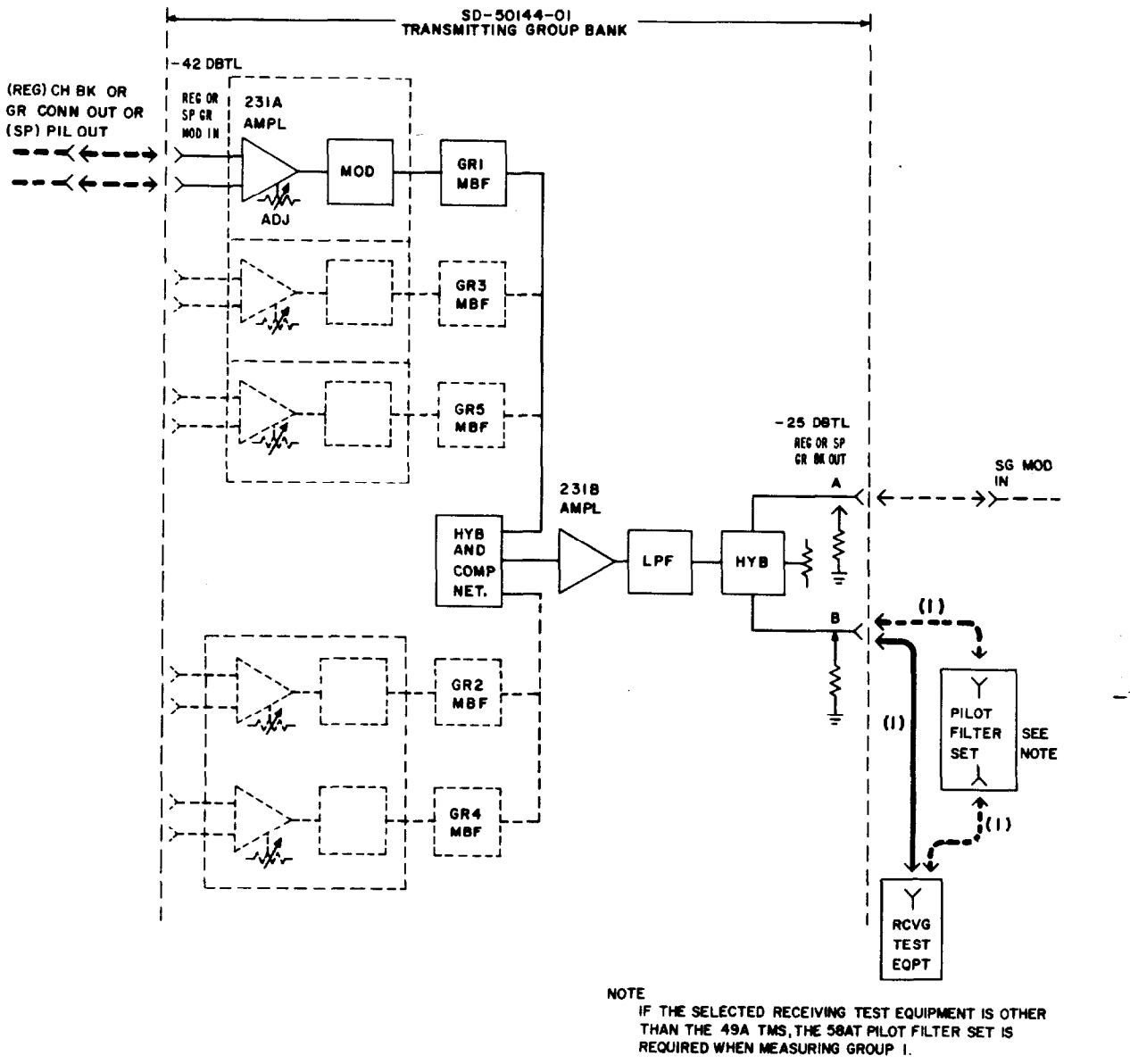

Fig. 1—Group Modulator In-Service Gain Test

CHART 2

C2A TRANSMITTING SUPERGROUP MODULATOR J68858F

Each supergroup modulator circuit in a supergroup bank:

(a) Accepts the basic supergroup band (312 to 552 kHz), at a transmission level of -25 dB, from either a group bank or a supergroup connector

CHART 2 (Cont)

(b) Translates the received basic supergroup band into the proper frequency allocation for transmission over a carrier or a radio facility.

The translated output of each supergroup modulator circuit, combined with the output of all other supergroup modulator circuits in the supergroup bank, is delivered to the supergroup bank output jacks at a transmission level of -43.4 dB. Thus, a loss of 18.4 dB exists between the SG MOD IN jack and the SG BK OUT or DSG BK OUT jack, whichever is applicable.

Note: Supergroups 1, 3, and 13, ***when used*** in a C2A bank, include amplification to provide the required output level.

Early production of the L600A and the L1860A multiplex transmitting terminals used supergroup modulator shelf assembly J68858F (Fig. 2). The supergroup modulator and bandpass filters are contained in slide-in units J68858AC (Fig. 2).

The SG PAD control, used for adjusting the output level of the regular C2A supergroup modulator circuit, is located on the group bank shelf (Fig. 3 and 4) associated with that particular supergroup. The SP SG PAD control, used for adjusting the output level of the spare C2A supergroup modulator circuit, is located on the spare supergroup modulator equipment on the spare supergroup modulator shelf.

STEP	PROCEDURE
1	Prepare the RTE for a 75-ohm terminated measurement of the translated 315.92-kHz supergroup pilot (Table A) for the supergroup to be tested at -63.4 dBm.

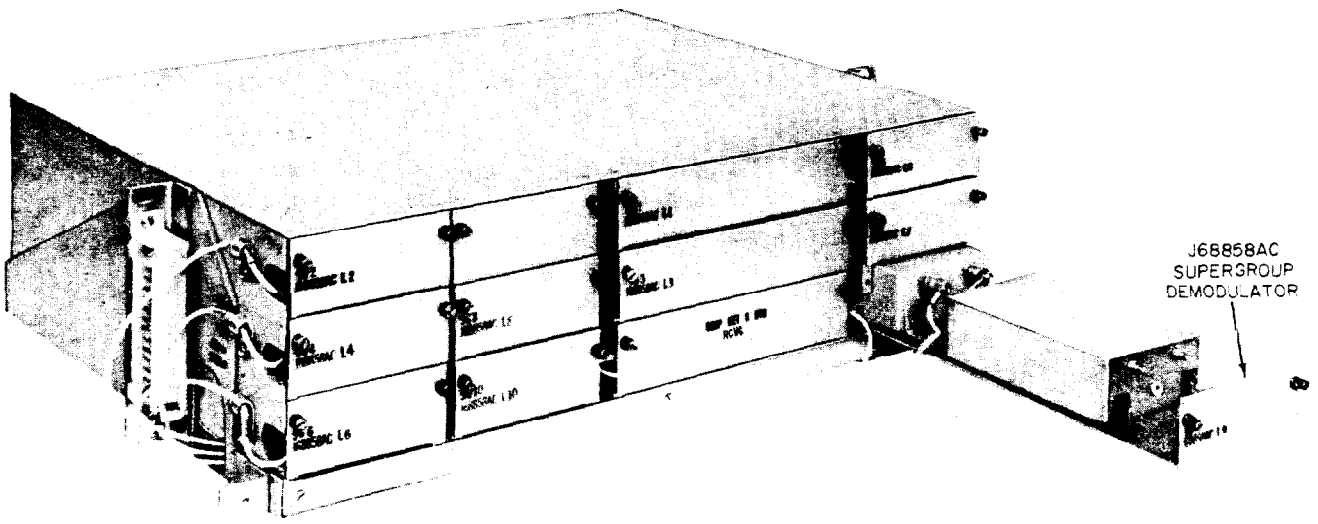

Fig. 2—C2A Supergroup Modulator Shelf Assembly J68858F

CHART 2 (Cont)

STEP	PROCEDURE

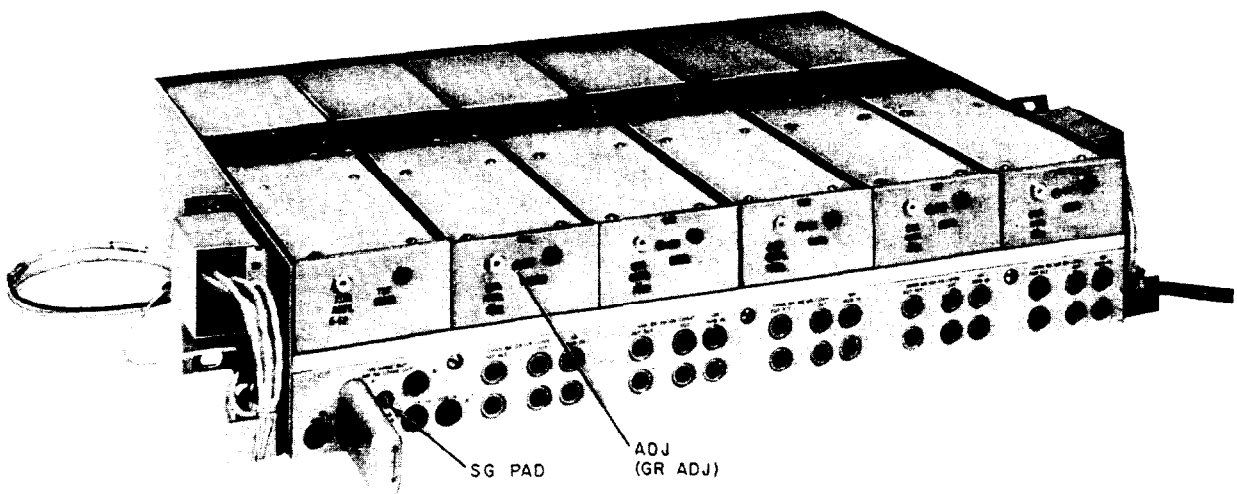

Fig. 3—Transmitting Group Bank Shelf Assembly

2 Connect the RTE to the SG BK OUT TST jack of the regular or spare supergroup being tested [patch (1), Fig. 4].

Caution: Connect the patch cord to the test equipment before making the connection to the SG BK OUT TST jack.

3 Measure the power of the translated pilot at the SG BK OUT TST jack.

Requirement: -63.4 dBm ±0.1 dB

4 ▶Proceed to Step 8 if the requirement is met. Otherwise, proceed to Step 6 if the supergroup is equipped with a group bank ***or*** proceed to Step 5 if the supergroup is equipped with a supergroup connector.

5 Perform the procedure in Section 356-025-502 to check for the proper input and output signal levels at the supergroup connector.

6 Adjust the SG PAD control associated with the supergroup modulator to meet the requirement at the SG BK OUT TST jack.

Note: Trouble is indicated if the requirement of Step 3 cannot be met.

CHART 2 (Cont)

STEP	PROCEDURE

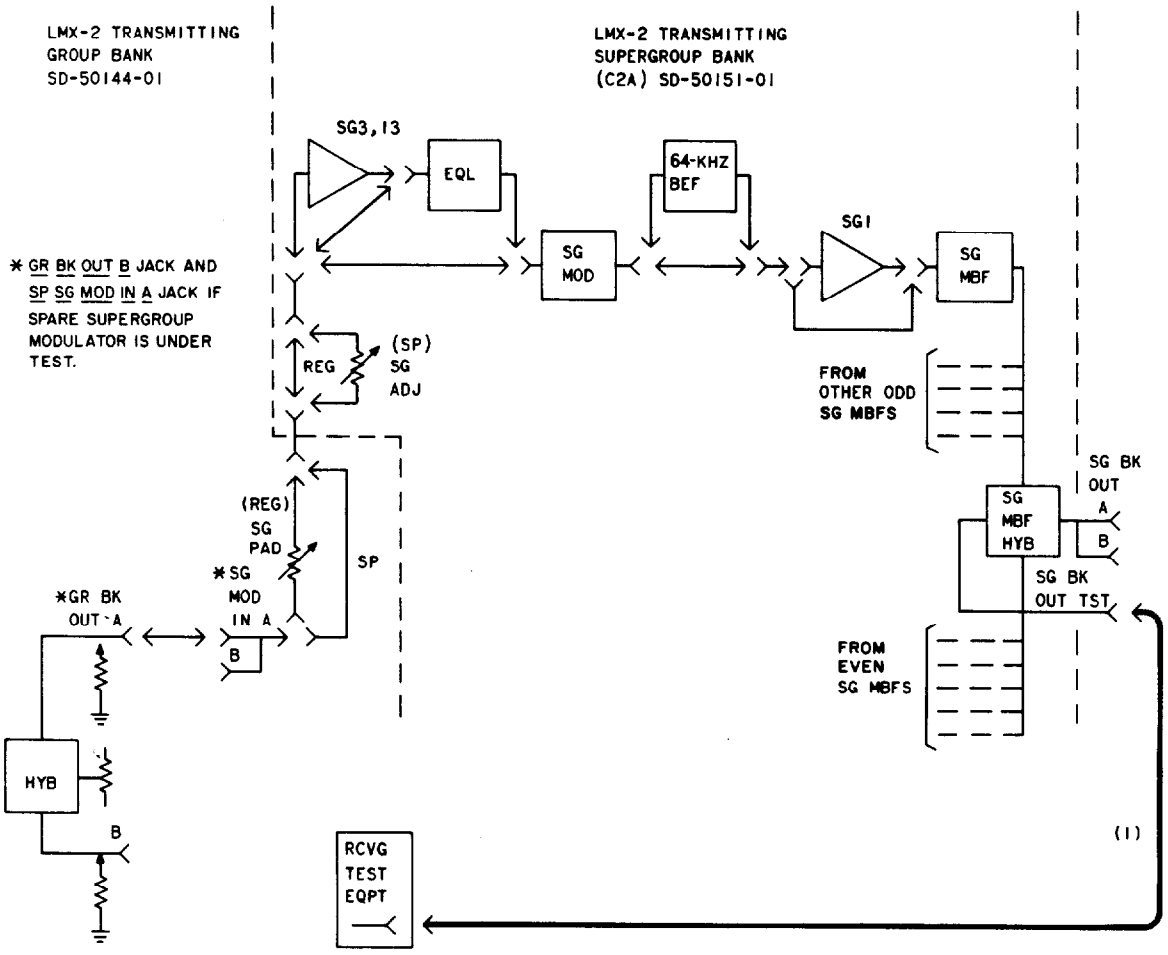

Fig. 4—Supergroup Modulator In-Service Loss Test

7 Perform out-of-service tests per Section 356-210-502 if the requirement of Step 3 cannot be met.

8 Repeat Steps 1 through 7, as required, for each supergroup modulator to be tested.

9 Proceed to Chart 4 after all supergroups are tested.

TABLE A

SUPERGROUP PILOT FREQUENCIES

	L600A TERMINAL					
INPUT PILOT FREQUENCY (KHZ)	OUTPUT PILOT FREQUENCY (KHZ) FOR SUPERGROUPS 1-10					
	1	2*	3	4	5	
315.92	296.08	315.92	800.08	1048.08	1296.08	
	6	7	8	9	10	
	1544.08	1792.08	2040.08	2175.92	2784.08	
	L1860A TERMINAL					
INPUT PILOT FREQUENCY (KHZ)	OUTPUT PILOT FREQUENCY (KHZ) FOR SUPERGROUPS 12-18, D25-D28					
	12*	13	14	15	16	17
315.92	315.92	800.08	1048.08	1296.08	1544.08	1792.08
	18	D25	D26	D27	D28	
	2040.08	2336.08	2584.08	2832.08	3080.08	

* Use pilot filter set 58AT when measuring SG2 or SG12 if the selected RTE is other than the 49A Measuring System.

CHART 3

C2B OR C2C TRANSMITTING SUPERGROUP MODULATOR

Supergroup modulator shelf assembly J68858U (Fig. 5) contains the C2B supergroup bank comprised of the ten adjustable 4095A networks and the bandpass filter units for supergroups 13 through 18 and D25 through D28 in the L1860A terminal. Supergroup modulator shelf assembly J68858W contains the C2C supergroup bank comprised of only nine adjustable 4095A networks and the bandpass filter units for supergroup 1 and supergroups 3 through 10 in the L600A terminal. Supergroup shelf assembly J68858V (Fig. 6) contains the 4095B modulator network and bandpass filter unit which provides supergroup 2 in the L600A terminal or supergroup 12 in the L1860A terminal. The ADJ control, used for adjusting the output level of each supergroup modulator circuit, is located on the front of the 4095 network (Fig. 5).

CHART 3 (Cont)

STEP	PROCEDURE
1	Prepare the RTE for a 75-ohm terminated measurement of the translated supergroup pilot (Table A) for the supergroup to be tested at -63.4 dBm.

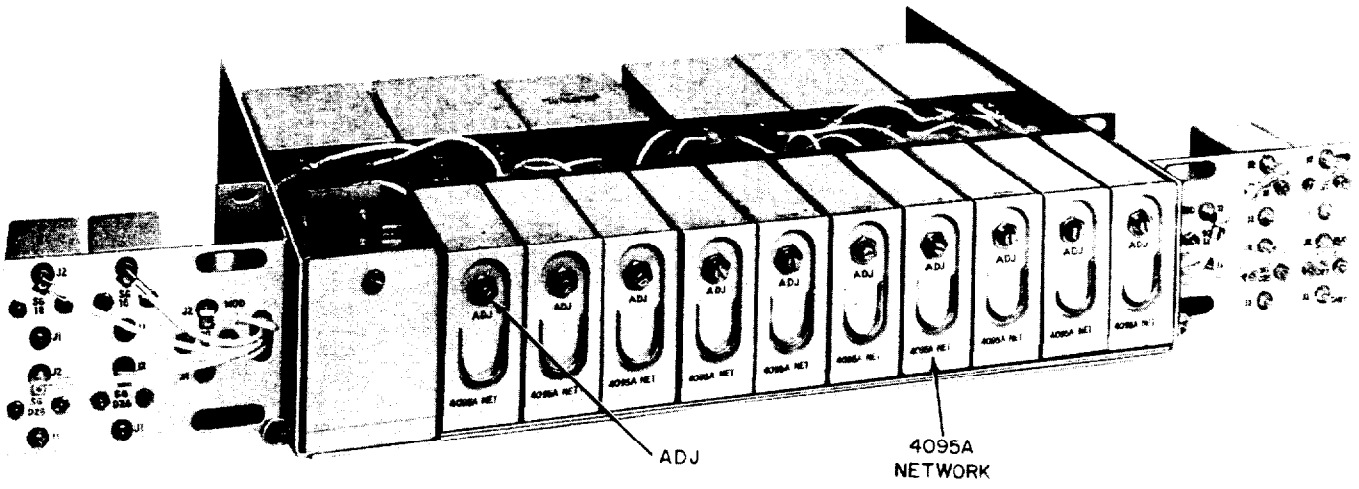

Fig. 5—C2B Universal Supergroup Bank Shelf Assembly J68858U

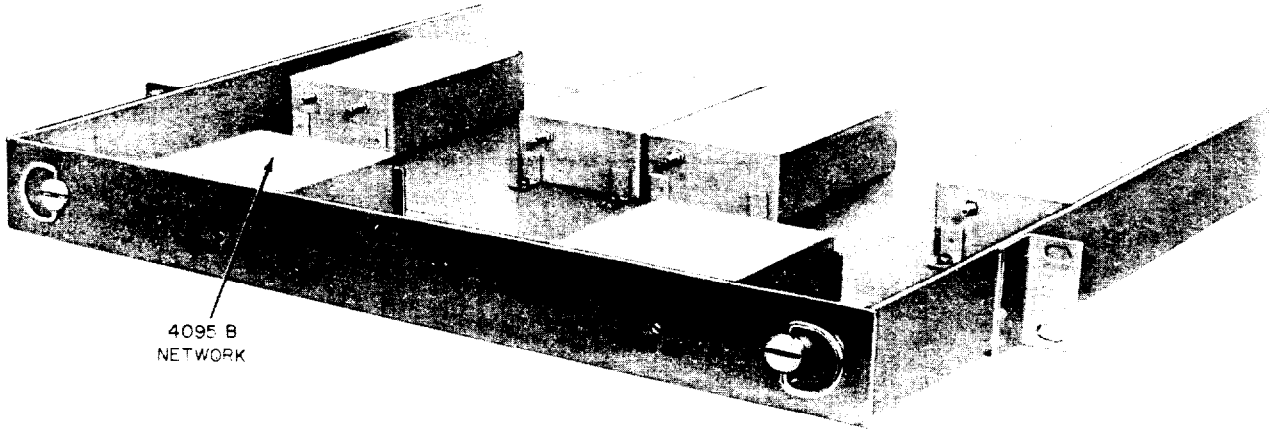

Fig. 6—Universal Shelf Assembly J68858V Supergroup 2 or 12

CHART 3 (Cont)

STEP	PROCEDURE
2	Connect the RTE to the DSG BK OUT TST (or SG BK OUT TST) jack of the regular or spare supergroup bank being tested [patch (1), Fig. 7].
	Caution: Connect the patch cord to the test equipment before making the connection to the DSG BK OUT TST or SG BK OUT TST jack.
3	Measure the power of the translated pilot at the DSG BK OUT TST (or SG BK OUT TST) jack.
	Requirement: -63.4 dBm ±0.1 dB

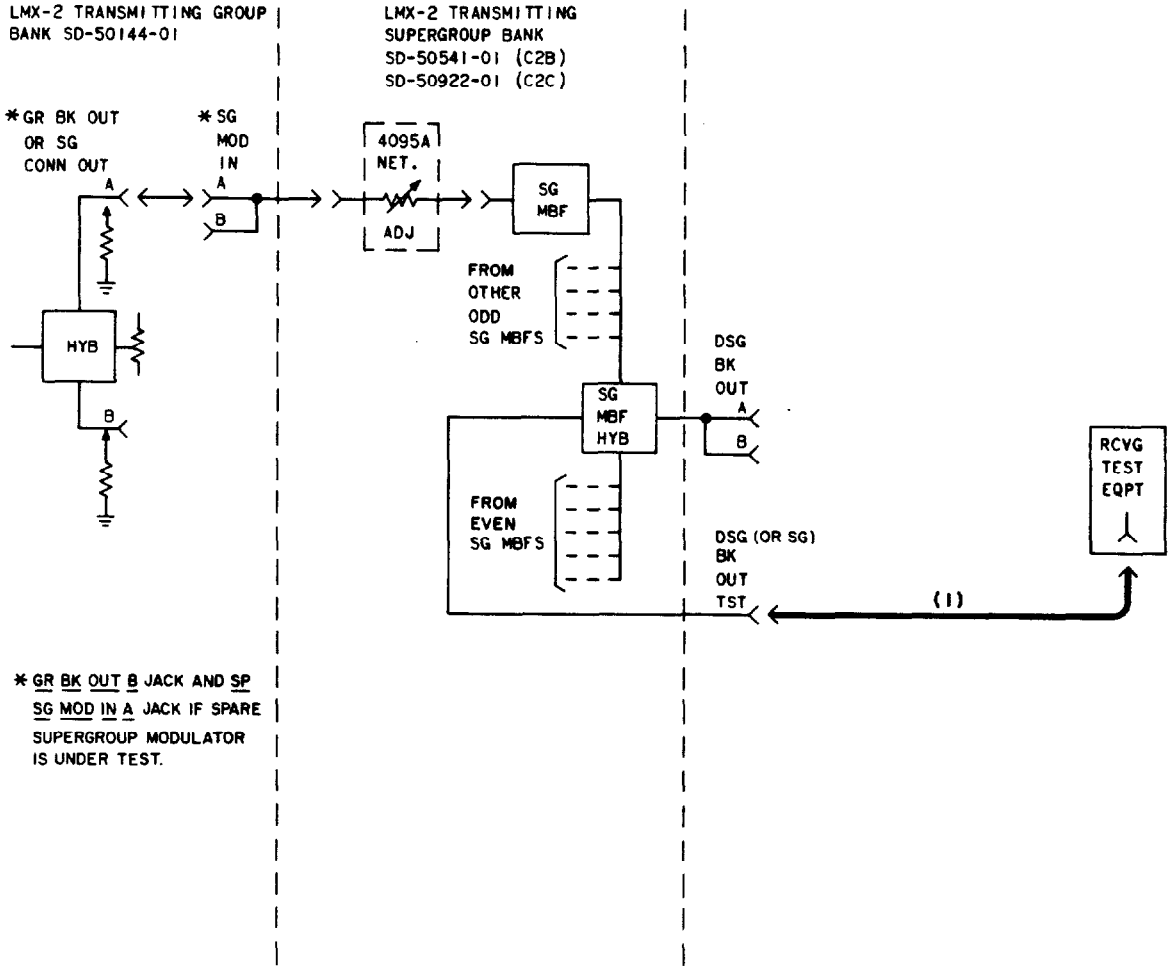

Fig. 7—Supergroup Modulator In-Service Loss Test

CHART 3 (Cont)

STEP	PROCEDURE
4	▶Proceed to Step 7 if the requirement is met. Otherwise, proceed to Step 5.
5	Adjust the ADJ control on the 4095 network (Fig. 5) of the supergroup being tested to meet the requirement in Step 3. ***Note:*** Trouble is indicated if the requirement cannot be met.
6	Perform out-of-service tests per Section 356-210-502 if the requirement of Step 3 cannot be met.
7	Repeat Steps 1 through 6, as required, for each supergroup modulator to be tested.
8	Proceed to Chart 4 after all supergroups are tested.◀

CHART 4

TRANSMITTING GROUP BANK (GROUPS 2 THROUGH 5)

Group amplifiers for groups 2 through 5 of each supergroup are adjusted with the RTE connected to the SG BK OUT TST or DSG BK OUT TST jack, depending on the type of LMX-2 transmitting supergroup bank. ▶Groups assigned to N3-L junctions are adjusted in Chart 5.◀

STEP	PROCEDURE
	Caution: Modulators for groups assigned to N3—L junctions may be tested in service using procedures in Chart 5.
1	Prepare the RTE for a 75-ohm terminated measurement of the translated group pilots (Table B) to be tested at -63.4 dBm.
2	Connect the RTE to the SG BK OUT TST or DSG BK OUT TST jack of the regular or spare supergroup bank being tested [patch (1), Fig. 4 or 7]. ***Caution: Connect the patch cord to the test equipment before making the connection to the DSG or SG BK OUT TST jack.***
3	Measure the power of the translated group pilots (groups 2 through 5) at the DSG or SG BK OUT TST jack. ***Requirement:*** -63.4 dBm ±0.1 dB

CHART 4 (Cont)

STEP	PROCEDURE

TABLE B

GROUP PILOTS AT SUPERGROUP MODULATOR OUTPUT

GROUP	SUPERGROUP							
	1 OR 11		2 OR 12	3 OR 13	4 OR 14	5 OR 15	6 OR 16	
	CARRIER							
	612	620	NONE	1116	1364	1612	1860	
1	296.08	304.08	315.92	800.08	1048.08	1296.08	1544.08	
2	248.08	256.08	363.92	752.08	1000.08	1248.08	1496.08	
3	200.08	208.08	411.92	704.08	952.08	1200.08	1448.08	
4	152.08	160.08	459.92	656.08	904.08	1152.08	1400.08	
5	104.08	112.08	507.92	608.08	856.08	1104.08	1352.08	
GROUP	SUPERGROUP							
	7 OR 17	8 OR 18	9	10	D25	D26	D27	D28
	CARRIER							
	2108	2356	1860	3100	2652	2900	3148	3396
1	1792.08	2040.08	2175.92	2784.08	2336.08	2584.08	2832.08	3080.08
2	1744.08	1992.08	2223.92	2736.08	2288.08	2536.08	2784.08	3032.08
3	1696.08	1944.08	2271.92	2688.08	2240.08	2488.08	2736.08	2984.08
4	1648.08	1896.08	2319.92	2640.08	2192.08	2440.08	2688.08	2936.08
5	1600.08	1848.08	2367.92	2592.08	2144.08	2392.08	2640.08	2888.08

CHART 4 (Cont)

STEP	PROCEDURE
4	Adjust the ADJ control on the transmitting group amplifier of the group being measured, if required, to meet the requirement.
5	Repeat Steps 1 through 4 for each group being tested.
6	Remove patch (1), Fig. 4 or 7.
	Note: Group pilots may be measured and recorded for future reference. Recorded measurements may be useful in troubleshooting procedures. Group pilots should be -45.0 dBm ±2.0 dB measured at the GR BK OUT B jack. If this tolerance cannot be met, perform out-of-service tests per Section 356-205-502 for the group modulator or per Section 356-210-502 for the supergroup modulator.

CHART 5

TRANSMITTING GROUPS ASSIGNED TO N3-L JUNCTIONS

Group modulators assigned to N3-L junctions are adjusted in service. The combined power of the 104.08-kHz LMX pilot and 104.00-kHz N3 carrier signal is measured at the CH BK OUT ALT jack and at the GR BK OUT B jack. The group amplifier is adjusted so there is a 17-dB gain between these two jacks. Groups not assigned to N3-L junctions are adjusted using procedures in Charts 1 and 4.

STEP	PROCEDURE
	A. Prepare Test Equipment
1	Calibrate pilot filter set J68858AT for 10-dB loss at 104.08 kHz.
2	Connect the output of the pilot filter set to the RTE [patch (1), Fig. 8].
	B. Measure 104.08-kHz Pilot Power
3	Identify the N3-L group under test, at the regular transmitting group bank.
4	Connect the input of the pilot filter set to the CH BK OUT ALT or GR CONN OUT ALT jack [patch (2), Fig. 8]; measure the power of the 104.08-kHz pilot.
5	Adjust the ADJ control, at the pilot insertion unit, for an indication of -72 dBm on the RTE (-62 dBm pilot power less 10-dB filter loss).

CHART 5 (Cont)

STEP	PROCEDURE

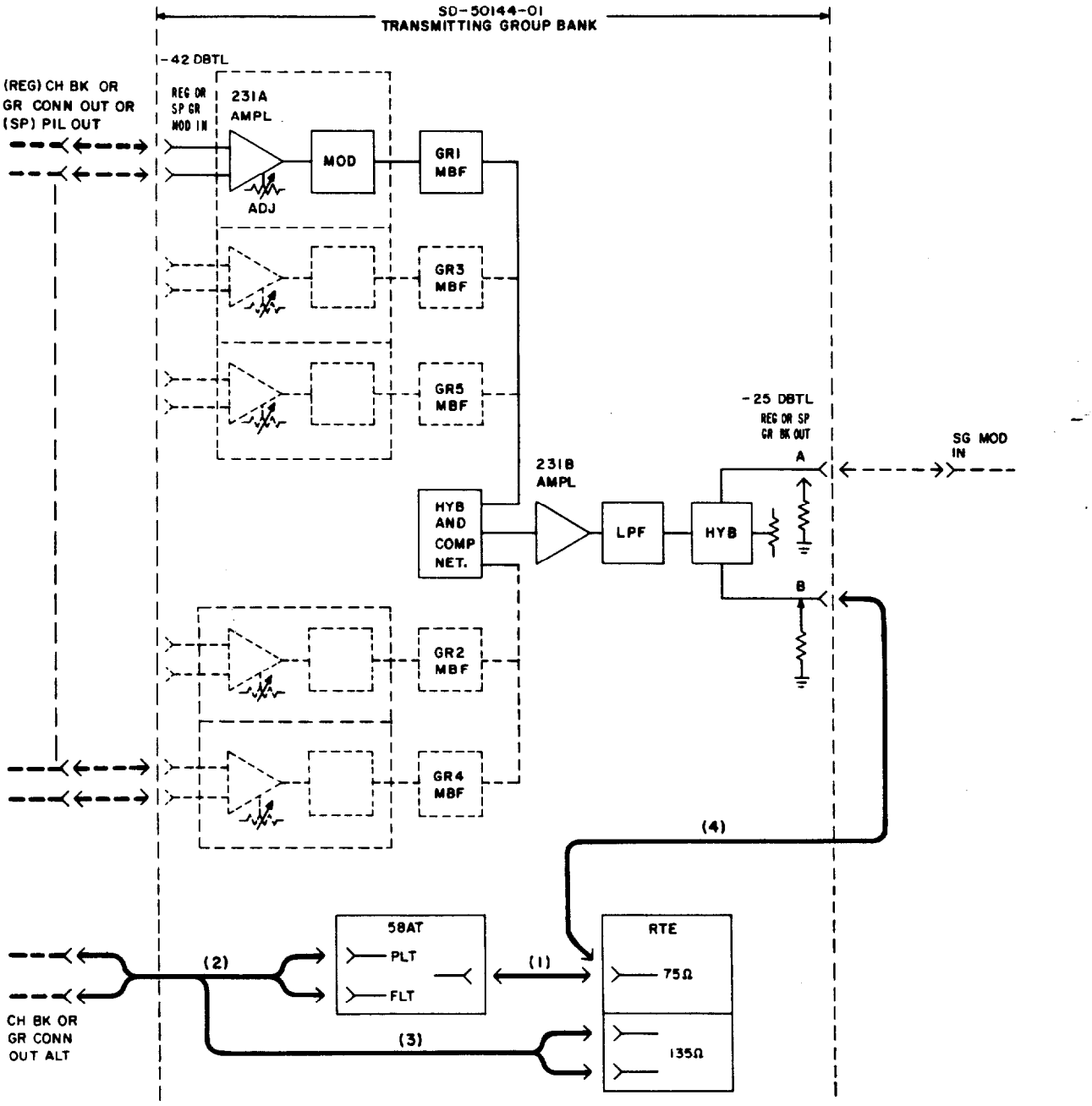

Fig. 8— N3-L Group Modulator In-Service Gain Test

CHART 5 (Cont)

STEP	PROCEDURE
6	Disconnect the pilot filter set from the CH BK OUT ALT or GR CONN OUT ALT jack and from the RTE; ***do not change the 104.08-kHz frequency setting of the RTE.***
	C. Measure Combined Power
7	Connect the RTE to the CH BK OUT ALT or GR CONN OUT ALT jack [patch (3), Fig. 8]; record the RTE indication (combined power of the 104.08-kHz pilot and 104.00-kHz N3 carrier signal).
8	Disconnect the RTE from the CH BK OUT ALT or GR CONN OUT ALT jack.
	D. Adjust Transmitting Group Amplifier
9	Connect the RTE to the GR BK OUT B jack [patch (4), Fig. 8]; tune the RTE to the translated pilot (Table C).
10	Adjust the ADJ control on the associated 231 group amplifier for the group under test to obtain an RTE indication equal to the algebraic sum of the power recorded in Step 7 plus 17 dB; record the adjusted power.

Example:

Combined power (Step 7): -59.1 dBm

Add group modulator gain: 17.0 dB

Power at GR BK OUT B: -42.1 dBm

TABLE C

GROUP PILOTS AT GROUP MODULATOR OUTPUT

INPUT PILOT FREQUENCY (KHZ)	OUTPUT PILOT FREQUENCY (KHZ) FOR GROUPS 1 THROUGH 5				
	1*	2	3	4	5
104.08	315.92	363.92	411.92	459.92	507.92

* Use pilot filter set 58AT when measuring group 1 if the selected RTE is other than the 49A Measuring System.

11 Disconnect the test equipment.