L MULTIPLEX TERMINALS
COMMON EQUIPMENT
J68858 SCANNER AND TEST AND ALARM CIRCUITS
DESCRIPTION

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1. GENERAL

1.01 This section describes the scanning and measuring equipment which provides alarm features and continuous monitoring, on a time-shared basis, to detect transmission and regulation deviations in LMX group and supergroup terminal equipment.

1.02 This section is reissued to:

(a) Clarify the function of the indicator OFF/ON switch.

(b) Indicate the proper location of the GR MEAS jacks.

(c) Clarify the source and function of the 104.08-kHz calibration signal.

Arrows have been used to indicate significant changes.

1.03 One of the features included in the design of LMX-2 is the addition of pilot-controlled regulated amplifiers to the receiving group and supergroup equipment (Section 356-200-100), thereby improving overall transmission stability. Related features are the addition of automatic scanning and alarm circuits, group and supergroup pilot measuring circuits, and circuits for measuring regulation deviations in the receiving group and supergroup equipment.

1.04 The improvement program for LMX-1 (Section 356-100-100) included the addition of supergroup (but not group) regulation and the scanner, test, and alarm circuits in LMX-2. However, the group-gain meter would be inoperative while measuring LMX-1 group pilots.

1.05 Figure 1 is a block schematic of the scanner and test and alarm circuits. Each scanner can serve up to three L600A or L1860A receiving bays. Provisions also are made to include scanning of spare supergroup and group banks. Each multiplex measuring set is limited to 100-foot cabling to the bank being served.

1.06 The automatic monitoring of group and supergroup pilots at receiving group and supergroup terminals allows, by periodic sampling, a check of the continuity of terminal and line equipment.

1.07 If the scanner for the supergroup demodulator circuits detects that the automatic gain control is operating outside the effective operating range of the regulator, a relay in the end-of-range circuit operates and initiates an alarm.

1.08 A latching circuit operates and holds the proper end-of-range lamp for circuit identification, but the scanning process is not stopped. The alarm function will continue to operate until it is manually reset.

1.09 In group demodulator circuits equipped for automatic regulation (LMX-2), the scanner operation monitors the gain circuits in the same

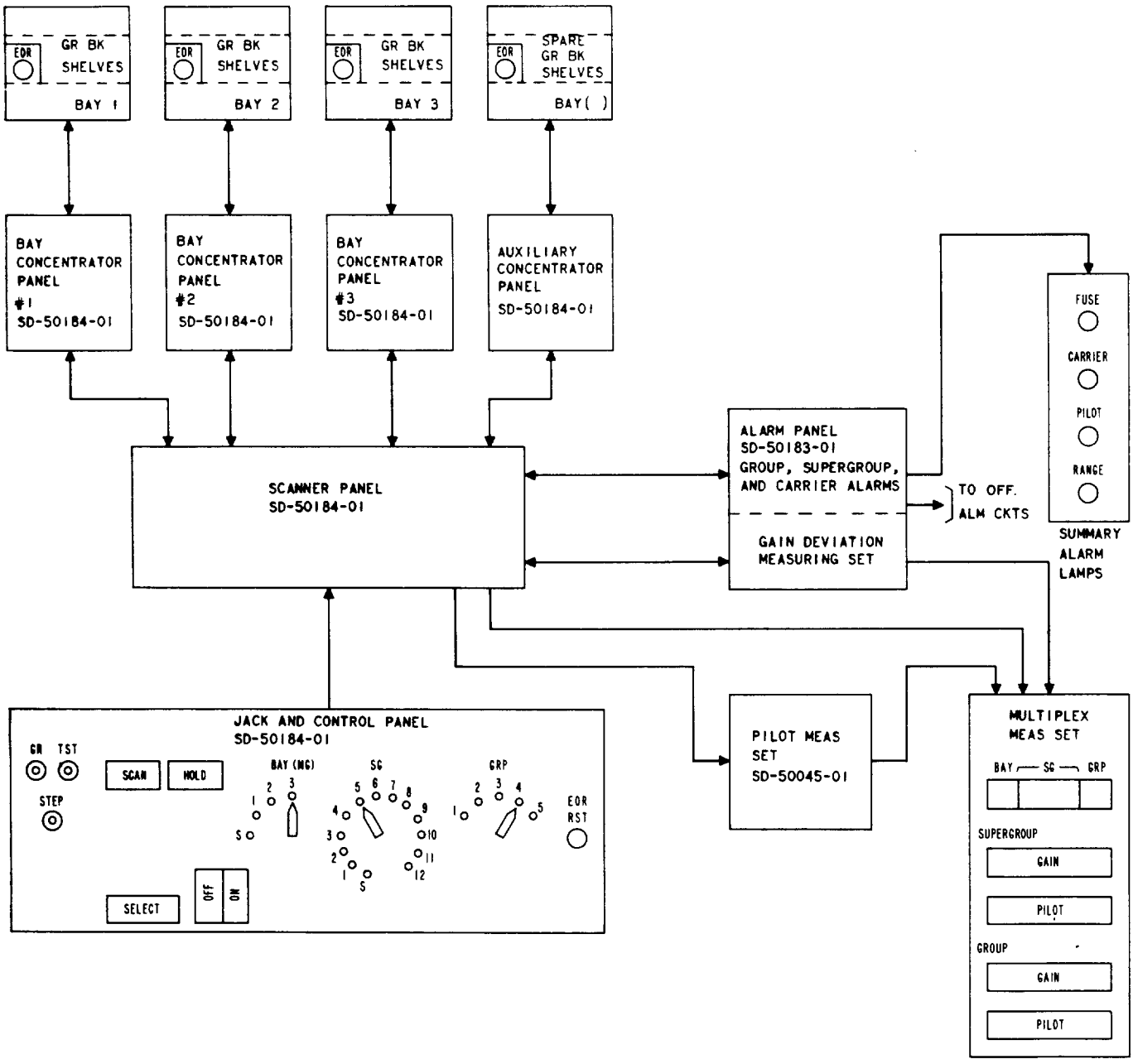

Fig. 1—Scanner and Test and Alarm Circuits—Block Diagram

manner as described for supergroups. In addition, the receiving group amplifier being monitored is automatically connected to a GR MEAS jack at the multiplex measuring set. This output is a feature of both regulated LMX-2 and nonregulated LMX-1 groups.

1.10 The pilot power at the output of the supergroup and group selected for monitoring is indicated on supergroup and group pilot DB meters. The meters are calibrated to show a maximum pilot deviation of ± 1.0 dB.

2. PILOT DEVIATION MEASURING CIRCUITS

2.01 The J68774P pilot-measuring set (SD-50045-01) measures the received power of the group and supergroup pilot frequencies. Pilot-measuring

sets furnished with early LMX-2 carrier terminals were equipped only to measure the 92- and 424-kHz pilots. J68774P, List 8 specifies the filters and amplifiers required when these terminals were modified to measure the 104.08- and 315.92-kHz pilots. List 7 provides, on new panels, amplifiers and filters to measure the 104.08- and 315.92-kHz pilots. The powers are measured in decibels relative to nominal and are displayed on separate 0-center meters (Fig. 2) having ± 1 dB scales with 0.1-dB scale divisions. The pilot to be measured is connected to the measuring set through the scanner. Adjustable sources of the pilot frequencies stabilized to ± 0.05 dB are used for calibrating the measuring circuits.

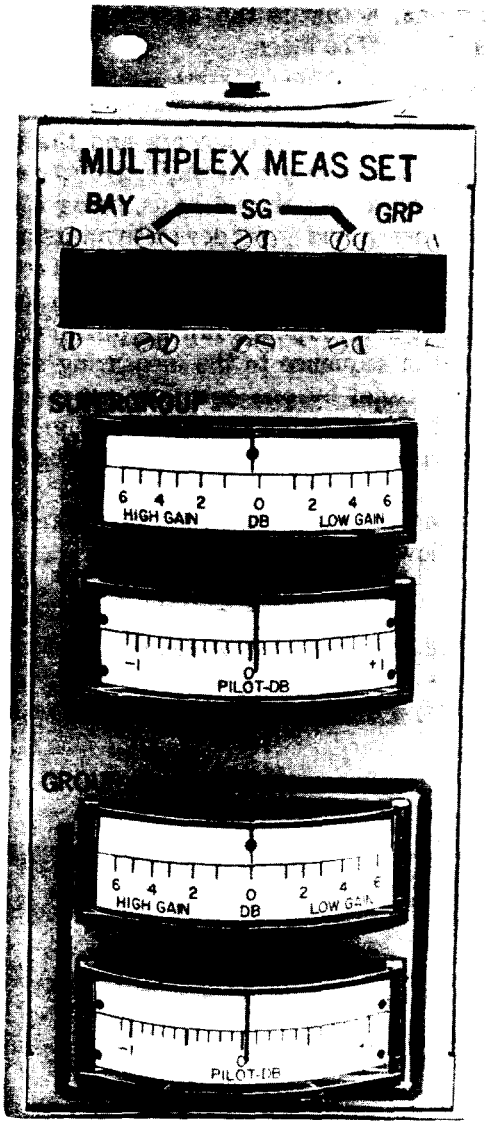

Fig. 2—Multiplex Measuring Set Meter Display

2.02 The 104.08-kHz group pilot is selected by a filter at the input of the group measuring circuit. The filter has a narrow bandpass characteristic to ensure that only the desired pilot signal will be passed. The filtered pilot frequency is amplified in a solid state tuned amplifier with a nominal power gain of approximately 45 dB at the pilot frequency. A manually adjustable gain control provides a range of approximately 6 dB to compensate for variations in filter losses and circuit parameters. Feedback stabilizes the amplifier against changes in supply voltage and temperature variations. The amplifier output is rectified, smoothed, and fed through a meter-adjusting circuit to the group pilot deviation meter.

2.03 A filter selects the 315.92-kHz supergroup pilot at the input of the supergroup measuring circuit. This filter has a narrow bandpass characteristic to ensure that only the desired pilot signal is passed. The filter also contains an input impedance-compensating network which keeps the input impedance at 75 ohms. The filtered supergroup pilot power is so low that a preamplifier, with a fixed gain of approximately 18 dB, is used between the pilot filter and the tuned amplifier. Feedback stabilizes the gain of the preamplifier against changes in supply voltage and temperature. The tuned amplifiers for the supergroup pilot frequencies have the same general form and gain capabilities as the group pilot frequency amplifiers described in 2.02. The amplifier output is rectified and the resulting dc signal is fed through a meter-adjusting circuit to the supergroup pilot deviation meter.

2.04 A test frequency supply circuit is included in the pilot-measuring set to provide means for calibrating the group and supergroup measuring circuits. ♦A stabilized source of the group pilot frequency is derived from the spare stabilizing unit in the J68857S and W 104.08-kHz pilot supplies or from the primary distribution bus associated with the J68857AG 104.08-kHz independent pilot supply.♦ The power is reduced to -35 dBm by means of a splitting pad, a fixed pad, and an adjustable pad before it appears at the pair of normally terminated GR CAL jacks. The adjustable pad is used to compensate for cable losses. The splitting pad provides a path to a modulator where 104.08 kHz is modulated with 420 kHz to produce 315.92 kHz. An adjustable pad is used to compensate for differences in modulator losses; this pad provides a -48.5 dBm power at the SG CAL jack. In early production, a 368A plug was used to terminate this jack when not in use. In later production, a

self-terminating jack is used. The power at both calibrating jacks is reduced by 1 dB upon operation of the −1 DB SCALE key, which provides a means for calibrating the −1 dB point on the pilot deviation meters.

3. RECEIVING AMPLIFIER GAIN DEVIATION MEASURING CIRCUITS

3.01 The regulator alarm panel (Fig. 3) contains the gain-monitoring circuits for the group regulated amplifiers and the supergroup regulated amplifiers. These monitoring circuits drive the gain deviation meters and actuate the end-of-range alarms. When the monitors find an end-of-range condition in any of the five group amplifiers or in the associated supergroup amplifier, the end-of-range alarm lamp on that shelf lights. The end-of-range alarm lamp remains lighted until manually reset, while the scanner continues to check other group and supergroup amplifiers without interrupting the usual sequence of operation. Other circuits on the alarm panel receive loss-of-pilot, loss-of-carrier, and fuse alarms, and actuate the bay summary alarm lamps and office alarms.

3.02 The thermistor in the feedback circuit of the regulated group and supergroup amplifiers has two elements: a heating element and a thermistor element. The temperature of the heating element is controlled by the current produced by the amplified and rectified pilot signal which is picked off at the output of the receiving amplifier. The thermistor element is indirectly heated by the heating element, and the resistance of the thermistor element will change inversely with the temperature of the heating element. Changes in the resistance of the thermistor cause variations in the amount of feedback shunted to ground, thereby varying the gain of the amplifier. This function is shown in Fig. 4.

3.03 The resistance of the thermistor is directly proportionate to the gain of the receiving amplifier. When a receiving group or supergroup amplifier is connected to the scanner, a very low direct current is applied to the thermistor from the scanner. The voltage drop across the thermistor element is used to bias the input of the differential amplifier (part of the 234B) so that the amplified and rectified output reflects the negative or positive change of the thermistor resistance from nominal. When this output exceeds a prescribed maximum or falls below a prescribed minimum, the gain deviation-monitoring circuit, through scanner connections, actuates the associated bay alarm lamp and an office alarm.

3.04 The scanner provides means for measuring the received pilot powers and the gains of the regulated group and supergroup receiving amplifiers on a time-shared basis, using a common pilot-measuring and gain deviation measuring set. A maximum of three receiving bays (each containing 60 regular group amplifiers, 5 spare group amplifiers, and 12 regular supergroup amplifiers) can be connected in sequence to the measuring set and to the alarm panel by one complete scanner circuit. Up to 12 spare supergroup amplifiers can be included in the scanning of three receiving bays.

3.05 The four major parts of the scanner are as follows:

(a) The jack and control panel (Fig. 5) contains the bay, supergroup and group selector switches, a jack strip, an end-of-range pushbutton,

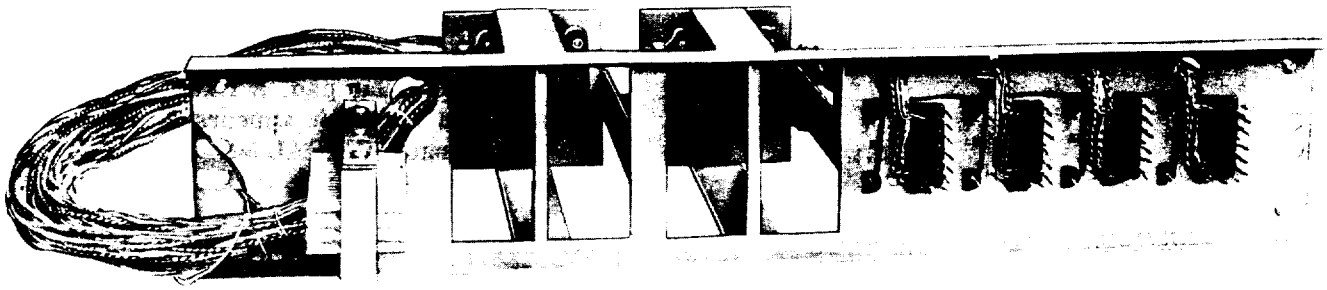

Fig. 3—Regulator Alarm Panel

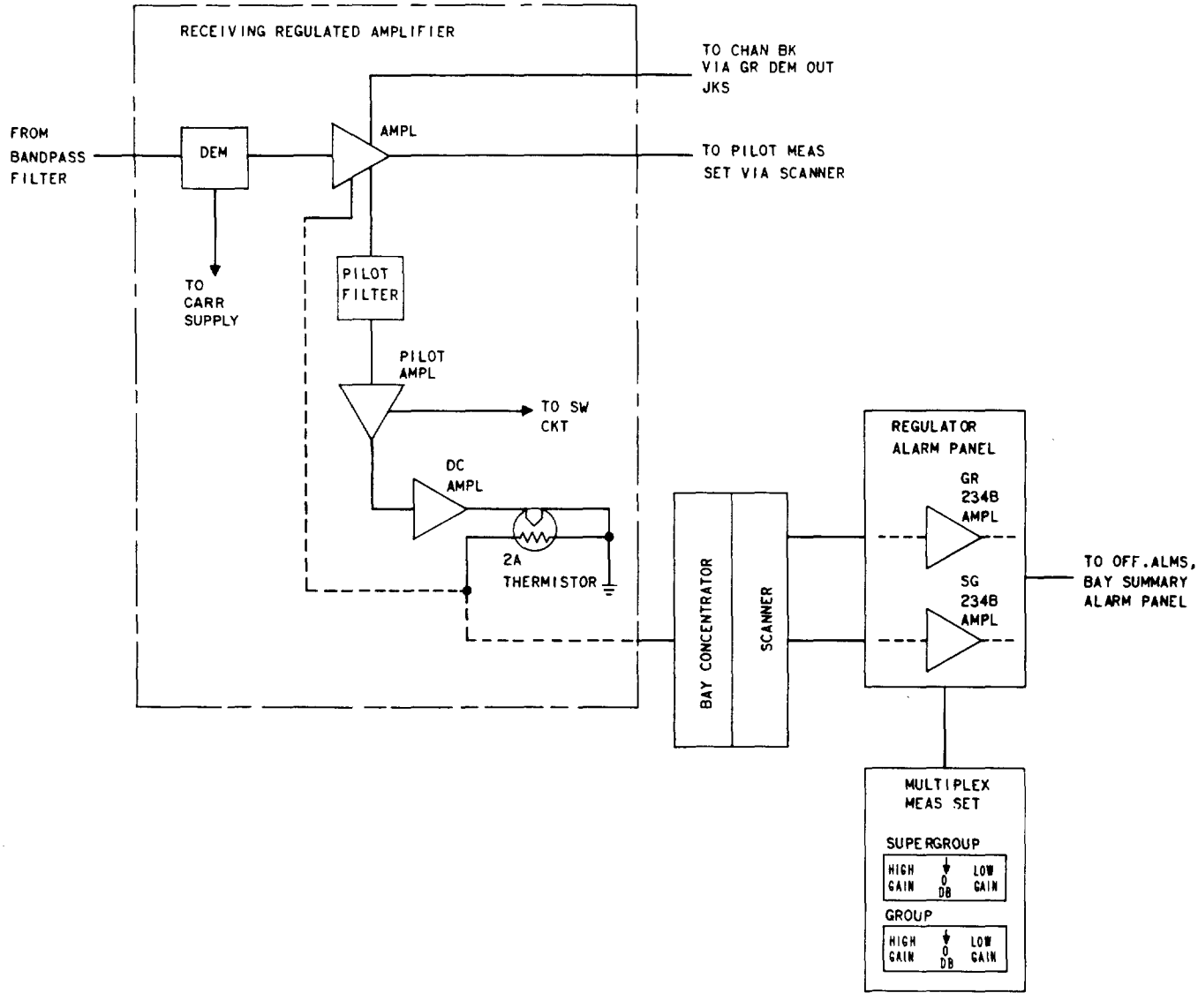

Fig. 4—Receiving Regulated Amplifier Gain and Alarm Circuits

and the mode controls which enable the scanner to be set for automatic or manual testing.

(b) The scanner panel (Fig. 6) contains the wire-spring relays which form the "walking" circuits used to connect the group and supergroup outputs from each concentrator to the measuring circuits in a regular sequence, when operated in the automatic mode on a time-shared basis.

(c) The bay concentrator panel (Fig. 7) contains the wire-spring relays which are used to combine the level and gain-measuring leads from each group and supergroup receiving amplifier in a bay into common measuring leads which connect to the common pilot and gain-measuring circuits.

(c) The auxiliary concentrator panel (Fig. 8) contains wire-spring relays which perform the same function for the spare supergroup amplifiers as the bay concentrator does for the regular supergroup amplifiers.

3.06 Three basis modes of operation—hold, select, and scan—are provided in the scanner. Any mode can be chosen by depressing the appropriate key on the control panel. In the hold mode, the

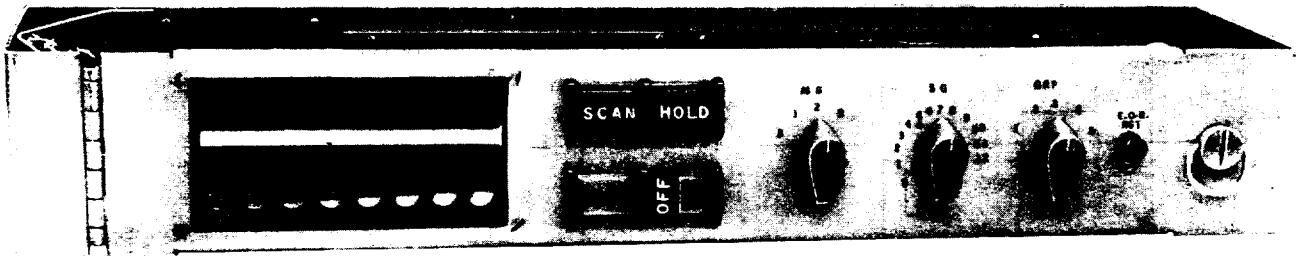

Fig. 5—Jack and Control Panel

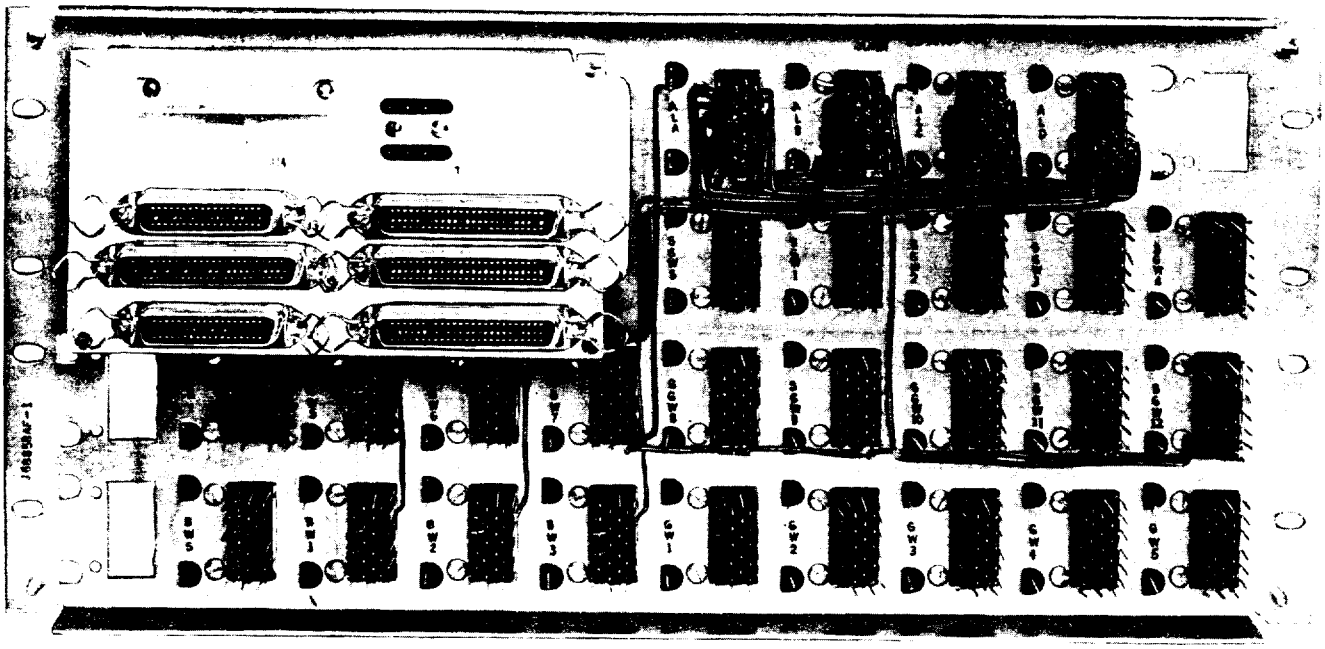

Fig. 6—Scanner Panel

scanner stops and maintains the connections between the amplifier upon which it stopped and the measuring set so that prolonged measurements can be made. In the select mode, any group or supergroup receiving amplifier can be selected manually for measurement without waiting for the scanner to reach it in the normal sequence. This is done by setting the switches on the control panel to the designations for the bay, supergroup, and the group of the amplifier chosen and then depressing the SELECT key. The relays will immediately connect the chosen amplifier to the measuring sets and maintain the connections. In the scan mode, the "walking" relay circuits successively connect the group amplifiers of one supergroup to the measuring set and to the alarm circuits and then step to the next supergroup and repeat the cycle. When all the groups and supergroups of one bay have been scanned, the bay "walking" relay circuit steps to the next bay and continues to scan. After all bays have been scanned, the entire cycle is repeated.

3.07 To facilitate the use of the scanner for routine maintenance, a STEP jack and a plug, cord, and hand-held key assembly are provided for operation of the scanner from a position near the amplifier being measured and adjusted. The

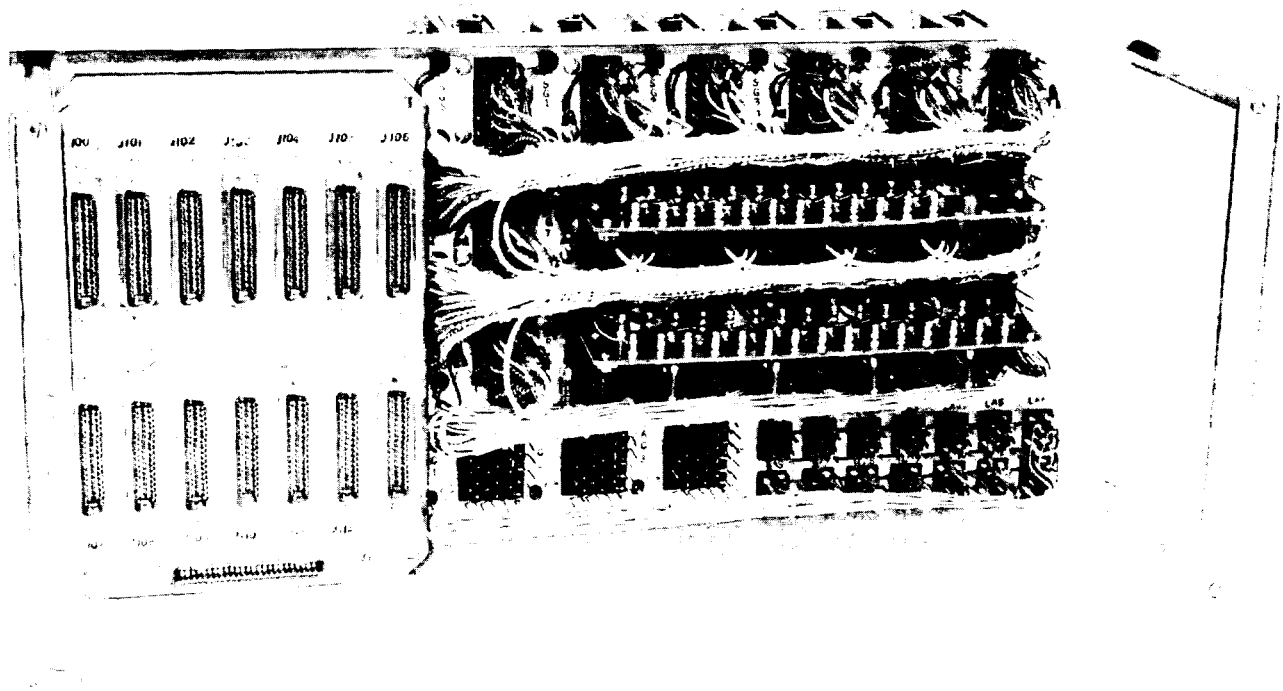

Fig. 7—Concentrator Panel

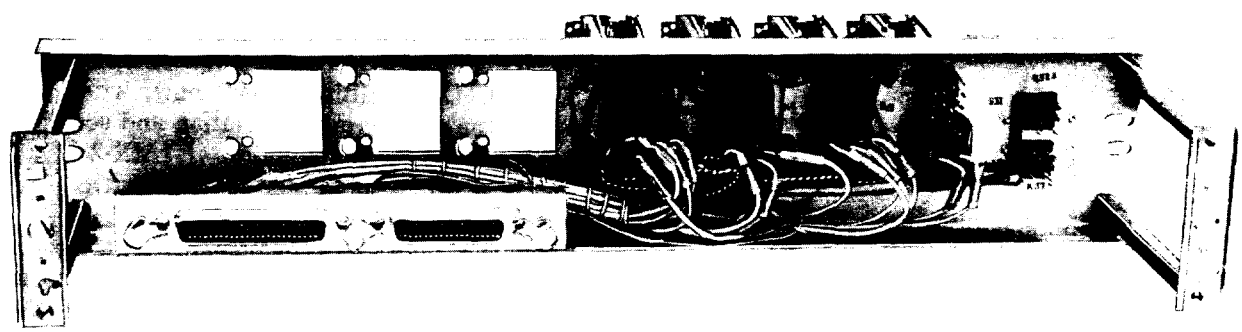

Fig. 8—Auxiliary Concentrator Panel

scanner HOLD key is depressed and the plug, cord, and key assembly is inserted into the STEP jack on the scanner jack and control panel. Each operation of the key advances the scanner one amplifier position in the selected bank.

3.08 When either the HOLD or SELECT key is depressed, a timing circuit is started which automatically returns the scanner to the scan mode of operation after approximately 30 minutes. This precaution prevents the inadvertent neglect of end-of-range monitoring for long periods. If the SCAN key is depressed before that time, normal scanning is resumed immediately. In each case, scanning is resumed starting with the amplifier which was "held" or "selected" manually. During normal scanning, the scanner connects each group amplifier to the pilot-measuring set and to the

gain deviation measuring set for approximately 5 seconds. The supergroup amplifier is connected for the entire time while the five group amplifiers associated with it are being scanned. An interval of approximately 8 seconds is spent on group 1 to allow time for the digital display and the four meters which make up the complete supergroup and group display to be read. During each period, two of the meters on the meter panel show deviations from nominal of the supergroup gain and pilot power, and the other two meters show the deviations of group gain and pilot power of regulated groups or pilot power only of nonregulated groups. The numbers of the bay, supergroup, and group being measured are displayed on the digital readout unit on the meter panel. At the same time, the ALM lamp on each amplifier is lighted while that amplifier is connected to the measuring circuits.

3.09 ▶During intervals when the meters are not being observed or when lamps are to be replaced in the digital display unit, the meters can be disconnected and the battery supply removed from the digital display units by operating the OFF-ON pushbutton on the control panel. The OFF or ON state is shown by the portion of the pushbutton that is lighted. Operation of the OFF-ON pushbutton does not affect the scanning operation or alarm functions of the scanner.◀

4. SCANNER OPTIONS

4.01 The scanner monitors a maximum of 12 completely equipped supergroup shelves plus five spare group amplifiers on a thirteenth shelf, designated SGS in each of three receiving bays. A spare bank of 12 supergroup amplifiers can also be monitored. The spare supergroup bank is designated bay S in the description of the scanner circuits, but it is physically located in one of the three regular receiving bays. A typical receiving bay is not fully equipped with the maximum number of group and supergroup amplifiers. To avoid wasting time in scanning missing amplifiers, missing supergroups, or entire bays not yet installed, provision is made for fast-scanning or bypassing the missing equipment. This is done by means of three relays located on the control panel and designated FS, GRB, and SGB. These relays are energized through the wiring options shown in circuit notes on SD-50184-01.

4.02 During scanning from one group to the next and one supergroup to the next, there is a brief interval when an open circuit appears at the thermistor inputs to the alarm amplifiers. This circuit interruption is sufficient to trigger the end-of-range alarms. A false end-of-range alarm is prevented by sending a trigger signal to the group and supergroup end-of-range alarm amplifiers in the regulator alarm panel (Fig. 3). The trigger signals keep the alarm relays in the amplifiers operated during the scanner transition periods.

4.03 The fast-scan and bypass relays FS, GRB, and SGB send alarm inhibit signals so that dummy thermistor resistances are not required for groups or supergroups that are fast-scanned or bypassed. When the group bypass feature is used alone in the case of a supergroup connector, only the group alarm amplifier is inhibited so that an end-of-range condition in the supergroup amplifier will still trigger the alarm.

4.04 When group or supergroup amplifiers are removed temporarily from positions which are normally scanned, terminating units are required to prevent false end-of-range alarm operation.

5. REMOTE MEASURING CIRCUIT OPTIONS

5.01 LMX-1 multiplex terminals, when modified for supergroup regulation and scanning, can be expanded by the addition of LMX-2 equipment. The LMX-1 and added LMX-2 equipment will normally be located in an equipment area remote from the scanner appearance. The group-gain remote measuring circuit provides a means of monitoring the output power while adjusting the gain of the group amplifier at the amplifier location.

5.02 ▶The group-gain remote measuring circuit for use at the equipment bays is shown in Fig. 9. The NORMAL and REMOTE switch located on the jack and control panel, when operated to the REMOTE position, disconnects the scanner meter display unit (Fig. 2). Inserting a 327A dummy plug in the GR MEAS jacks at the high frequency patch bay completes the connection to the remote measuring trunk. Patch cord connections at the LMX-2 receiving bay or LMX-1 group auxiliary amplifier bay connect the measuring trunk to a portable test meter.

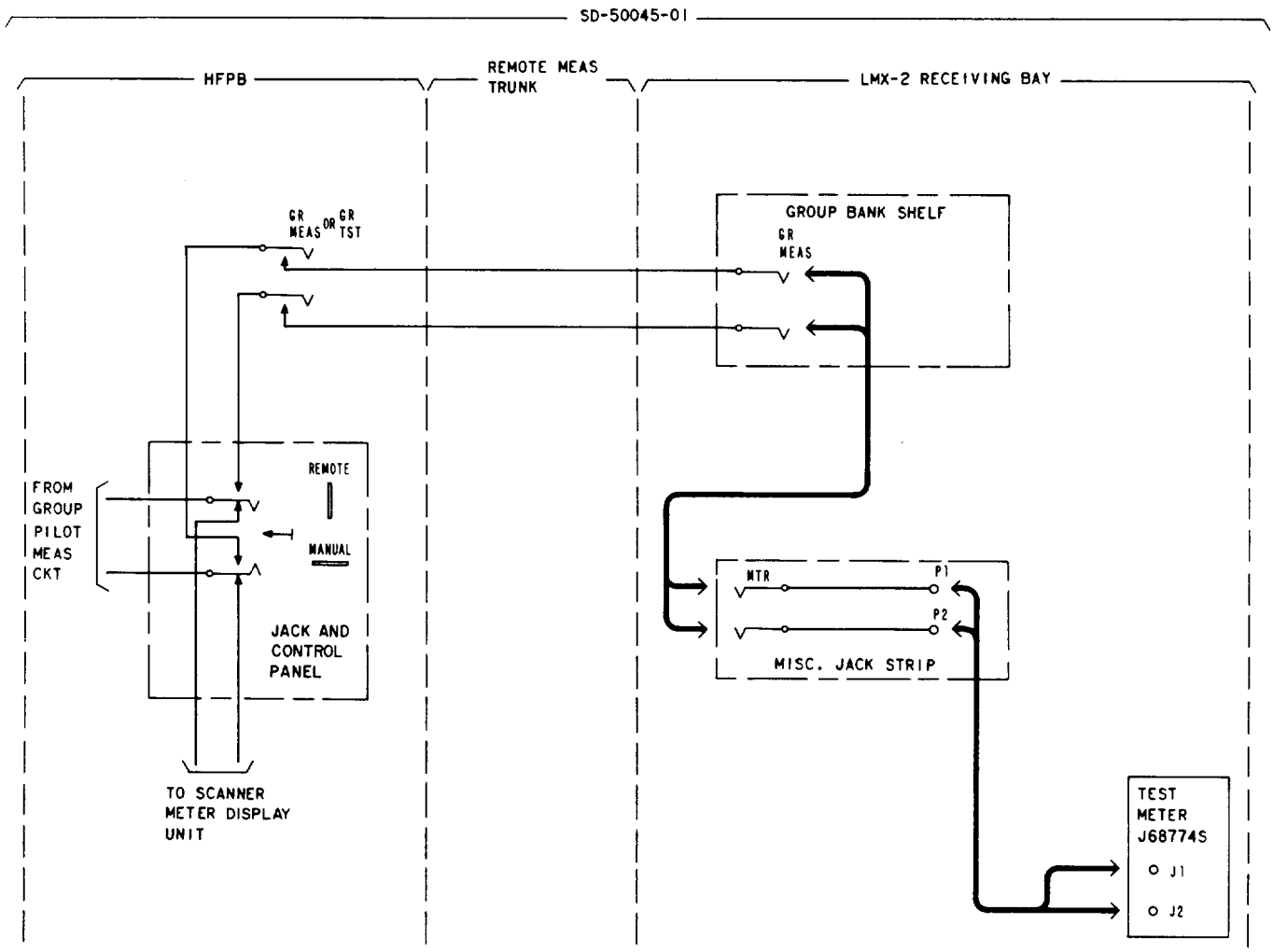

Fig. 9—Group Gain Remote Measuring Circuit

6. Drawings

6.01 The following schematic drawings are related to this section but are not attached:

SD-50045-01	Application Schematic—Group and Supergroup Pilot-Measuring Circuits
SD-50146-02	LMX-2 Receiving Group Regulated Amplifier
SD-50148-02	LMX-2 Receiving Supergroup Regulated Amplifier
SD-50152-01	Application Schematic—Receiving Bay

SD-50178-01	Application Schematic—Scanner and Alarm Circuit	SD-50236-01	Application Schematic—L1860A Receiving Bay
SD-50183-01	Group, Supergroup, and Carrier Alarm Circuits	SD-50379-01	L Multiplex 104.08-kHz Pilot Supply
SD-50184-01	Scanner Circuits—Group and Supergroup	SD-50382-01	104.08-kHz Secondary Group Pilot Distribution
SD-50191-01	Patch Circuits Receiving Spare Supergroup Amplifier	SD-50910-01	104.08-kHz Independent Pilot Supply
SD-50215-01	Range Battery Scanner	SD-59096-01	Application Schematic—Supergroup Bank