L4 CARRIER
OVERALL SYSTEM
DESCRIPTION
LINE CONNECTING CIRCUITS

CONTENTS PAGE

1. GENERAL

1.01 Line connecting circuit SD-50621 serves as the junction in the L4 main stations for connections to the L4 transmitting and receiving repeaters, L5 basic jumbogroup trunks (BJGT), MMX-2C and LMD terminals, automatic line switching, and remote control system equipment.

1.02 This section is reissued to correct errors, to expand the explanations, and to show later equipment arrangements. Arrows are used to indicate significant changes.

1.03 A simplified block diagram of the line connecting circuit is shown in Fig. 1. Line connecting equipment is provided in all main stations and can be arranged to serve the following functions, in various combinations, as required by the L4 system layout.

(a) Connect a receive line to a transmit line for through transmission.

(b) Connect a receive line to a transmit line for branching.

(c) Connect a receive line to an MMX-2C terminal, LMD terminal, or L5 BJGT.

(d) Connect the received 512-kHz line pilot to a synchronization circuit for the primary frequency supply.

(e) Connect an MMX-2C terminal, LMD terminal, or L5 BJGT to a transmit line.

(f) Insert one or both of the line pilots on a transmit line.

(g) Connect command carrier signals from a control center to a regular transmit line in each route.

(h) Connect the command carrier signals from a regular receive line of each route to the associated loopback circuit.

(i) Connect switching signals to the transmit lines and from the receive lines.

(j) Connect an output of a monitoring oscillator to a transmit line. For a receive line, the monitoring oscillator signal is applied at the power separation filter in the line receiving bay. One monitoring oscillator serves two transmit and two receive lines in a cable.

(k) Block the received monitoring oscillator signals at each main station having a control center.

(l) Block one or both of the line pilots.

(m) Block the multiplex signals of one or more adjacent mastergroups in the L4 spectrum on a receive line.

(n) Block the equalizer test signals from entering the MMX-2C terminal and from entering a transmit line via the branching circuit.

(o) Block the switching signals.

1.04 Line connecting equipment is mounted in the main station line transmitting, line receiving, and control connecting bays (Fig. 2). These bays also contain the main station repeaters, equalizers, memory and logic units, coaxial line switches, loopback circuits of the remote control system, dc-dc converters, and fuse panels.

1.05 ***Line transmitting bay*** J68877A (Fig. 2) is factory wired to serve two lines but may be initially equipped to serve only one line. The following line connecting equipment may be provided for each line, depending on the requirements of the line and of the main station:

(a) Transmitting MMX-2 connecting panel J68877BH

(b) L4/LMD interface panel J68877EB

(c) ➧Jack and hybrid panel ED-51423 (Fig. 3) or ED-50710(MD).➧

1.06 ***Line receiving bay*** J68877B (Fig. 2) is factory wired and equipped to serve one receive line. The line connecting equipment provided in this bay may include the following, depending on the requirements of the line and of the station.

(a) Receiving MMX-2 connecting panel J68877BG

(b) Line branching panel J68877BJ

(c) Mastergroup blocking panel J68877AW

(d) Monitoring oscillator signal blocking panel J68877BD

(e) A equalizer test signal blocking panel J68877BP

(f) B equalizer test signal blocking panel J68877BR

(g) ➧Jack and hybrid panel ED-51424 (Fig. 4) or ED-50711(MD).➧

1.07 ***Control connecting bay*** J68877G (Fig. 2) is factory wired to serve ten receive and ten transmit lines in a route. A ***route*** is the transmit and receive coaxial lines in one cable extending in one direction from a main station.

1.08 Line connecting equipment in the control connecting bay includes circuits to supply the L4 line pilots to as many as ten transmit lines and a 512-kHz synchronization circuit which selects the 512-kHz pilot received on a designated line. In addition, the control connecting bay includes the coaxial line switches, the B equalizer test signals supply, and the loopback circuit of the remote control system.

1.09 The frequency allocations of the L4 system are shown in Fig. 5. Line connecting equipment is provided for each line, as required, to pass, branch, and/or block the various signals.

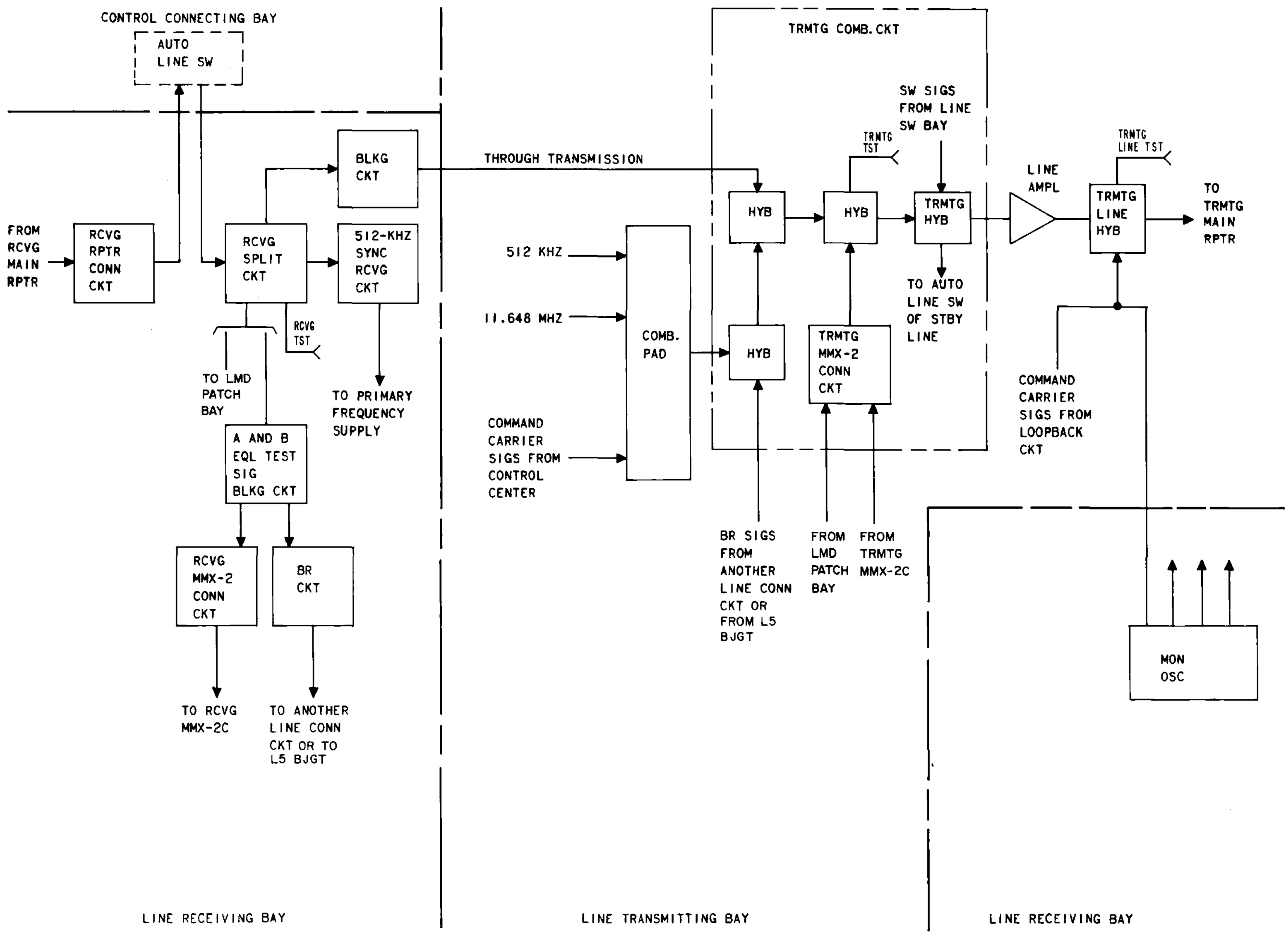
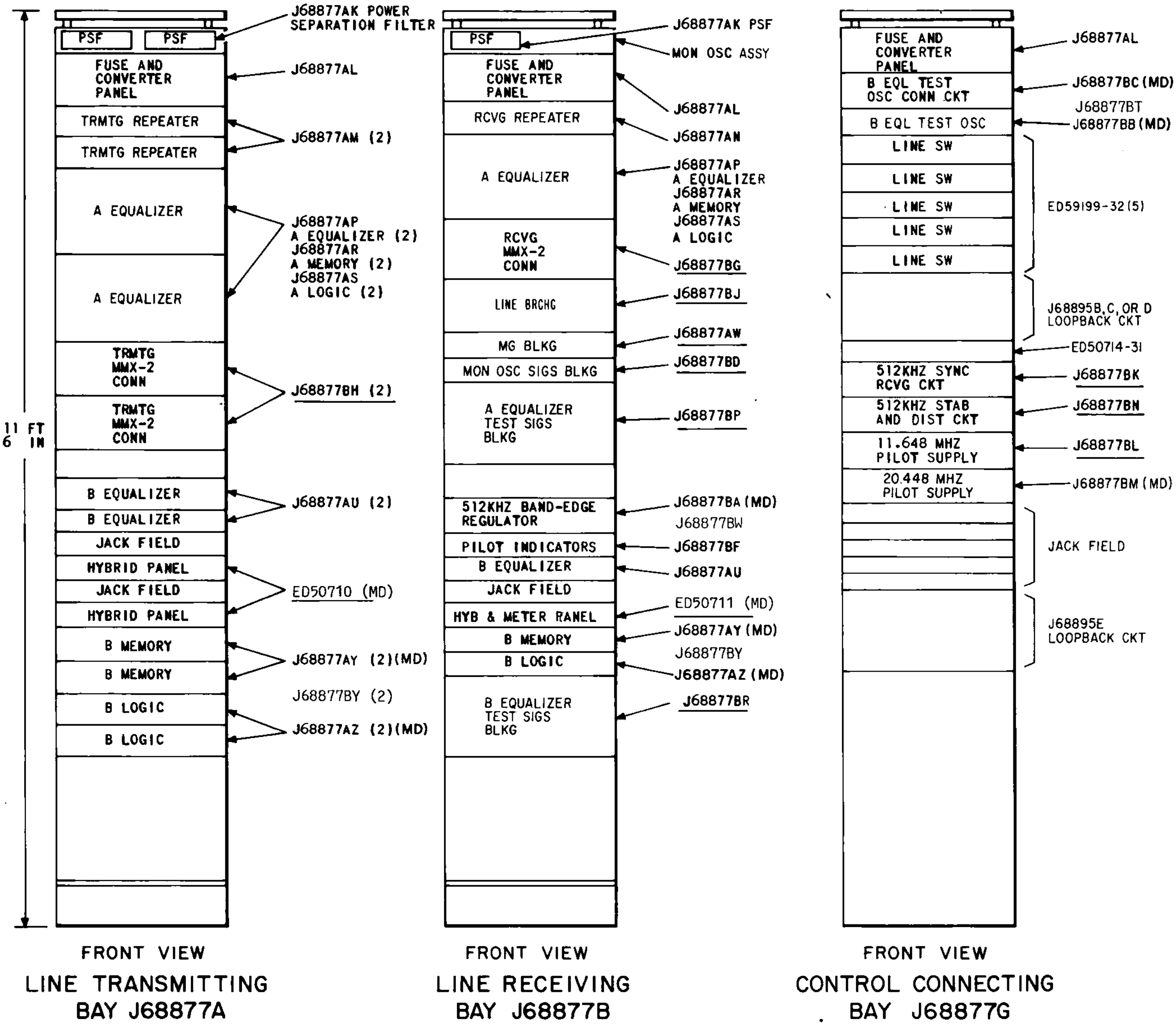


Fig. 1—Line Connecting Circuit



NOTE:

LATER PANEL DESIGNATIONS ARE IN PARENTHESES.
LINE CONNECTING CIRCUIT PANEL DESIGNATIONS ARE UNDERLINED.

Fig. 2—L4 Equipment Arrangements in Main Station Bays

1.10 Simplified block diagrams of line connecting circuits for regular and standby L4 lines are shown in Figures 23 and 24, respectively. One line connecting circuit, with appropriate options, is required for each line. The arrangement required depends on the transmission functions of the associated line.

2. REPEATER CONNECTING CIRCUIT

2.01 A ***repeater connecting circuit*** (Figures 23 and 24) is always provided for each line to connect the receiving main station repeater to the receiving automatic line switch. The repeater connecting circuit accepts the L4 line signals from

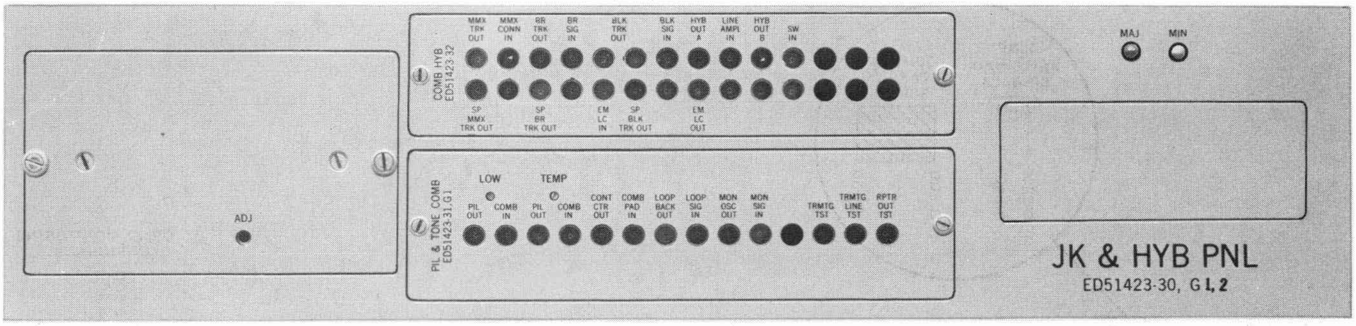


Fig. 3—▶Transmitting Jack and Hybrid Panel◀

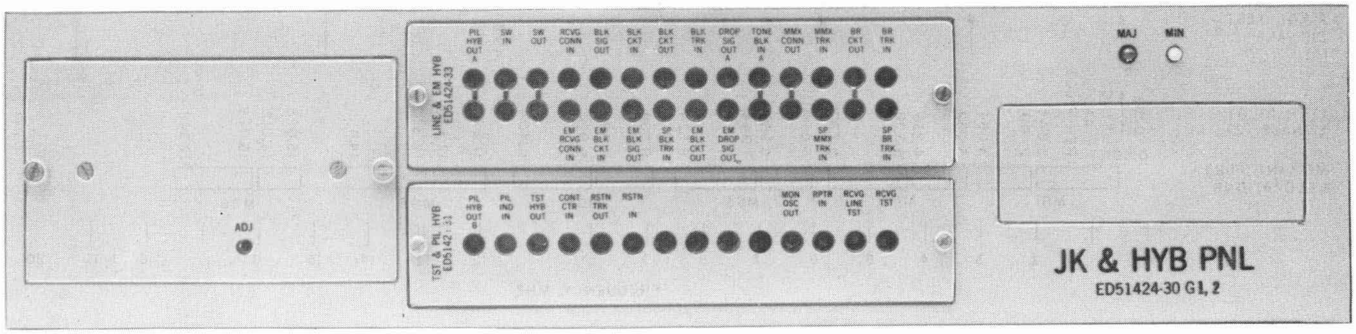


Fig. 4—▶Receiving Jack and Hybrid Panel◀

the receiving main station repeater and blocks or passes the monitoring oscillator signals, as required. Monitoring oscillator signals are controlled from and observed at a control center for trouble locating.

2.02 At main stations which have a control center, a blocking filter prevents the monitoring oscillator signals from passing into the next line section. This filter has more than 40-dB loss in the monitoring oscillator band, 18.50 to 18.56 MHz, and a 2-dB flat loss to the remainder of the L4 band. At main stations which ***do not have*** a control center, a 2-dB pad is substituted for the filter to maintain proper signal levels. The monitoring oscillator signals pass to the next main station which ***will have*** a control center.

2.03 A repeater connecting circuit includes a 397 cable equalizer to compensate for gain deviations due to the cable to and from the line switches in the control connecting bay. An amplifier provides 15-dB gain, adjustable ±2 dB, and connects to an unequal hybrid. The high-loss (9 dB) side of the hybrid connects the L4 line signals to the pilot indicator circuit which selects the line pilots. The line pilots are detected and the resulting dc voltages are used to control the receiving line switches for that line. The low-loss (1 dB) side of the hybrid connects the L4 line signal through the receiving line switches to the receiving splitting circuit.

2.04 Command carrier signals received on a designated regular line of each route are connected from the LOOP BRDG OUT jack to the loopback circuit of the remote control system.

3. RECEIVING SPLITTING CIRCUIT

3.01 A ***receiving splitting circuit*** (Figures 23 and 24) is always provided for each line and is arranged to accept two inputs and to provide three outputs. The L4 signals received on a regular line are connected via the receiving splitting circuit to one or more of the following:

(a) An MMX-2C receiving bay

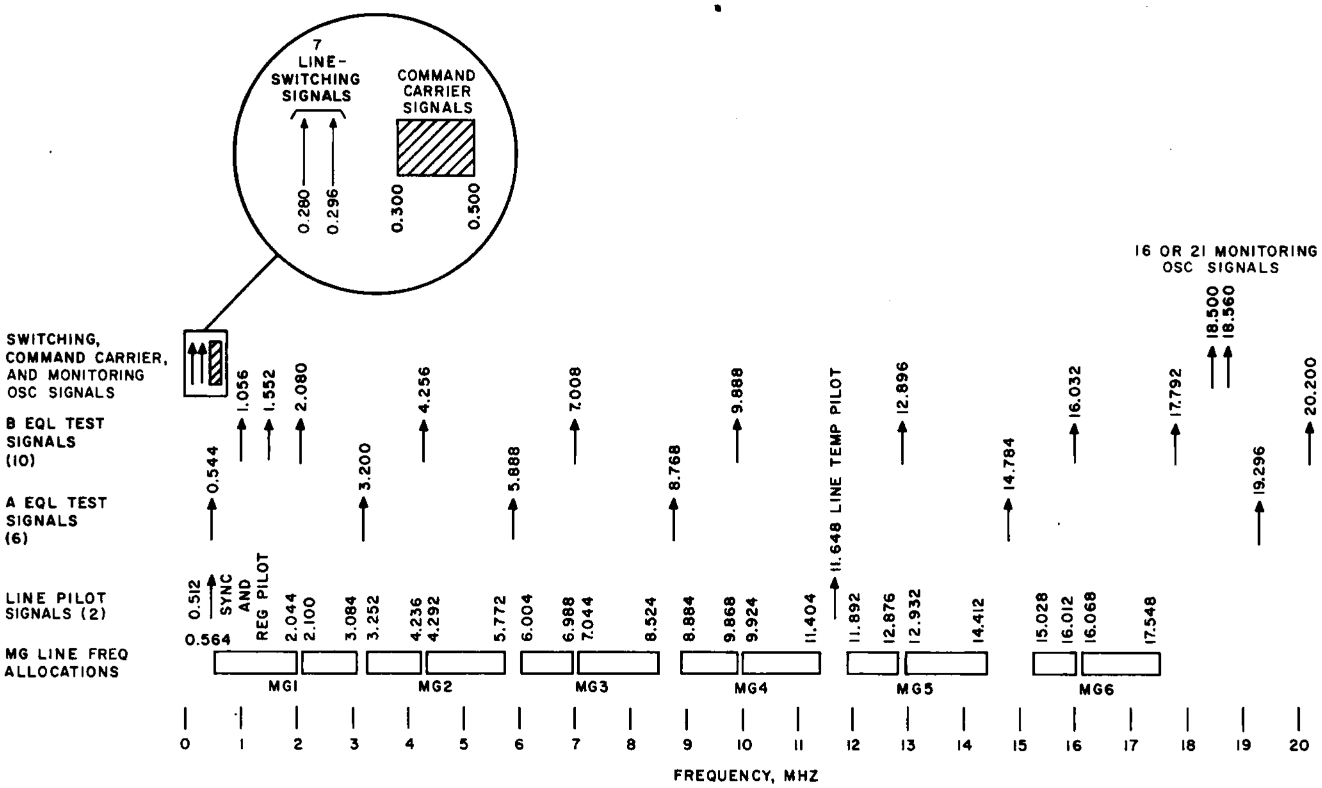


Fig. 5—L4 Frequency Allocations

(b) A transmit line via the blocking circuit

(c) A different transmit line or an L5 BJGT via the branching circuit.

3.02 The first input at hybrid 1 is the received L4 signal from the repeater connecting circuit. The second input, for regular lines only, can be applied at the RSTN IN jack which is used during service restoration of the same line in case of line failure not corrected by line switching.

3.03 One of the outputs of hybrid 1 connects to the BLK SIG OUT jack for connection to the blocking circuit via the BLK CKT IN jack. The other output of hybrid 1 connects to unequal hybrid 2 which splits the signal.

3.04 The high-loss (5 dB) side of hybrid 2 connects through a splitting pad to the SYNC SIG OUT jack (regular lines only) and to the RCVG TST jack provided for in-service transmission measurements. The SYNC SIG OUT jack connects to the synchronization receiving circuit, when provided, via the SYNC SIG IN jack.

3.05 The low-loss (2 dB) side of hybrid 2 provides a signal appearance which may be used on ***regular*** lines for mastergroup dropping and/or branching and on ***standby*** lines for connecting signals to a restoration patch bay. For dropping or branching, the signal is connected directly to the equalizer test signals blocking circuit. For restoration, the signal from the standby line appears at the RSTN SIG OUT jack which may be patched to the RSTN TRK IN jack. A multimastergroup trunk to the restoration patch bay includes a de-emphasis network and blocks all line pilots.

3.06 An ***emergency line connecting circuit*** permits bypassing a portion of the receiving splitting circuit. Signals at the SW OUT jack in the line receiving bay may be patched to the adjacent EM LC IN jack. The EM LC OUT jack is provided ***either*** adjacent to the BLK SIG OUT jack to serve as a bypass for through transmission ***or*** adjacent to the DROP SIG OUT A jack to serve as a bypass for signals dropped to an MMX-2C terminal via a receiving MMX-2 connecting circuit. The EM LC OUT jack location will depend on whether the through or the dropped signals have priority for this protection. A pad is included in the emergency line connecting circuit to reduce signals to the proper level at the EM LC OUT jack.

4. ♦SYNCHRONIZATION RECEIVING CIRCUIT

4.01 A ***synchronization receiving circuit*** is required at each main station equipped with a primary frequency supply. This circuit selects the 512-kHz or 2.048-MHz synchronization signal received on a designated line and distributes synchronization signals to the required locations in the main station.

4.02 A 512-kHz synchronization receiving panel J68877BK (Fig. 6) receives the entire spectrum from a designated L4 receive line via the SYNC SIG OUT jack on the receiving jack and hybrid panel. The 512-kHz synchronization signal is selected, amplified, and distributed to as many as three primary frequency supplies. Synchronization receiving panel J68877BK includes an adjustable amplifier which permits output power adjustment. A TST jack and the amplifier gain control are mounted on the front of this panel.

4.03 A 2.048-MHz synchronization receiving panel J68942A (Fig. 6) receives the entire spectrum from a designated L4 receive line via the SYNC SIG OUT jack on the receiving jack and hybrid panel. The 2.048-MHz synchronization signal is selected, amplified, and distributed via one or two distribution hybrid panels ED-52336-30 which provide up to 16 outputs. Synchronization receiving panel J68942A includes two adjustable amplifiers which permit output power adjustment. The amplifier gain controls are mounted on the front of this panel.

4.04 If the designated line fails and is not protected by switching, the synchronization signal is lost. A relay in the synchronization receiving circuit operates and terminates the output of the distribution amplifier. This prevents hits in the primary frequency supply, which will operate in a free-running manner until the synchronization signal is restored.♦

5. MASTERGROUP BLOCKING CIRCUIT

A. General

5.01 A ***mastergroup blocking circuit*** provides a through signal path from a receive line to a transmit line.

5.02 For a ***standby*** line, a blocking circuit blocks all line pilot, command carrier, and line switching signals.

5.03 For a ***regular*** line, a blocking circuit serves one or more of the following functions:

(a) Connects mastergroup and/or line pilot signals from a receive line to a transmit line

(b) Blocks any combination of adjacent mastergroups at line frequencies

(c) Blocks line switching signals

(d) Blocks all or half of the command carrier signals

(e) Blocks the 11.648-MHz line pilot signal

(f) Passes the 512-kHz line pilot signal.

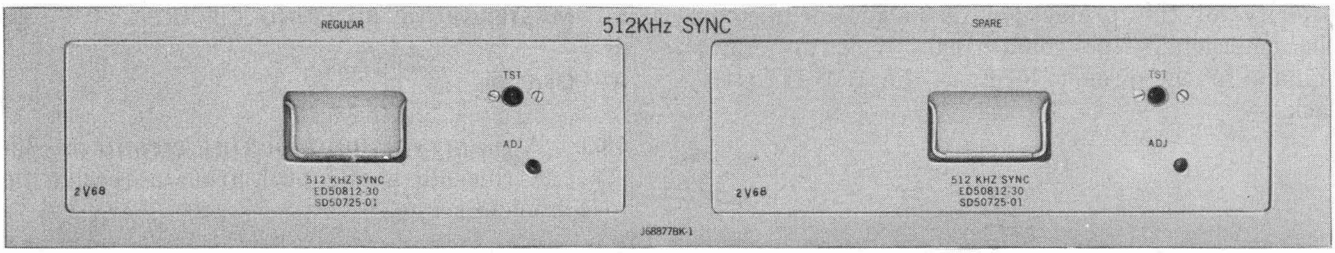
An ***emergency blocking circuit*** permits bypassing the blocking circuit for a regular line by patching.

B. Regular Lines

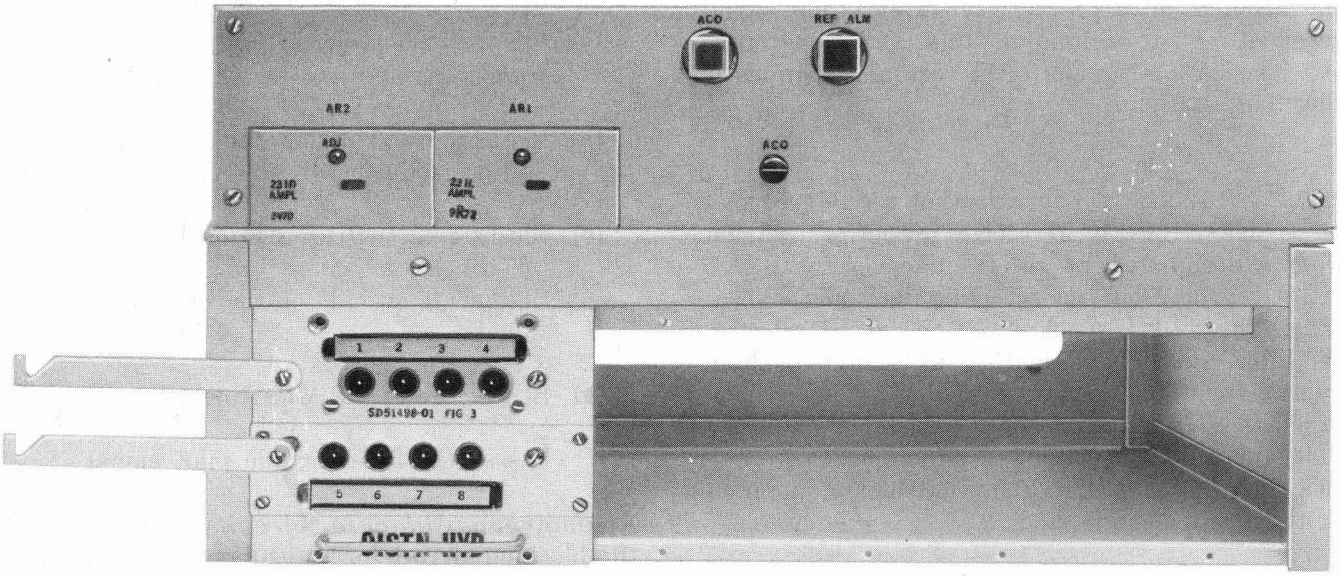
5.04 There are six basic arrangements of the blocking circuit to provide a through signal path between regular lines. These arrangements are described in the following paragraphs.

Block All Mastergroups

5.05 The blocking circuit shown in Fig. 7 is used when all received mastergroups are branched and/or dropped (connected to an MMX-2C terminal) at a main station. This circuit includes an adjustable pad and passes ***only*** the 512-kHz line pilot from a receive line to a transmit line. This line pilot is used for synchronizing the primary frequency supplies at the following main stations. The 11.648-MHz line pilot is reinserted at the line connecting circuit for the transmit line.



A. 512-kHz Synchronization Receiving Panel



B. 2.048-MHz Synchronization Receiving Panel

Fig. 6—➧Synchronization Receiving Panels⬅

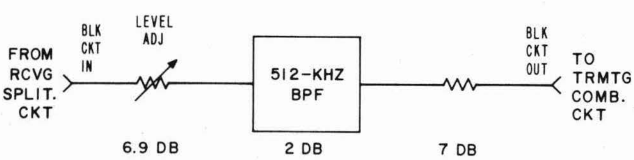


Fig. 7—Block All Mastergroups

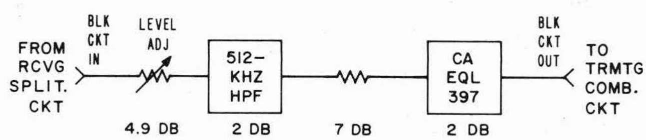


Fig. 8—Pass All Mastergroups, Block Line Switching, and Block Command Carrier Signals

Pass All Mastergroups, Block Line Switching, and Block Command Carrier Signals

5.06 The blocking circuit (Fig. 8) is used when all received mastergroups are connected through at a main station, ***except*** for the lines at an intermediate main station in a 2-section control arrangement. This exception is explained later in this section.

5.07 This circuit passes ***all*** signals above 512 kHz. Line switching and command carrier signals are blocked from the succeeding line section. A cable equalizer compensates for gain deviations introduced by the cable between the line receiving and line transmitting bays. An adjustable pad permits signal level adjustment.

Block Low-End Mastergroups and Pass 512-kHz Pilot

5.08 Five different filter combinations are used for blocking adjacent low-end mastergroups (Fig. 9A). All line switching and command carrier signals are blocked.

5.09 The 512-kHz line pilot is required for synchronizing the primary frequency supplies and is passed by one path between the splitting and combining filters. A level adjustment is provided in this path. The passed high-end mastergroups are connected through the other path between these filters. Where mastergroups 1 through 4 are blocked, the 11.648-MHz pilot will be ***partially*** blocked by the filters and the 11.648-MHz band-elimination filter is required to eliminate this pilot completely. This pilot is reinserted in the line connecting circuit for the transmit line. Where mastergroups 1 through 5 are blocked, the 11.648-MHz pilot is completely blocked and the band-elimination filter is not required. The LEVEL ADJ pad and cable equalizer provide the required flat loss at the BLK CKT OUT jack.

Block Middle Mastergroups

5.10 Ten different filter combinations are used for blocking adjacent middle mastergroups (Fig. 9B). This blocking circuit always passes at least mastergroups 1 and 6 and blocks all line switching and command carrier signals.

5.11 The 512-kHz pilot is always passed regardless of the filter arrangement provided. If mastergroup 4 or 5 is blocked, the 11.648-MHz pilot must be blocked and reinserted. A LEVEL ADJ pad and cable equalizer are provided.

Block High-End Mastergroups

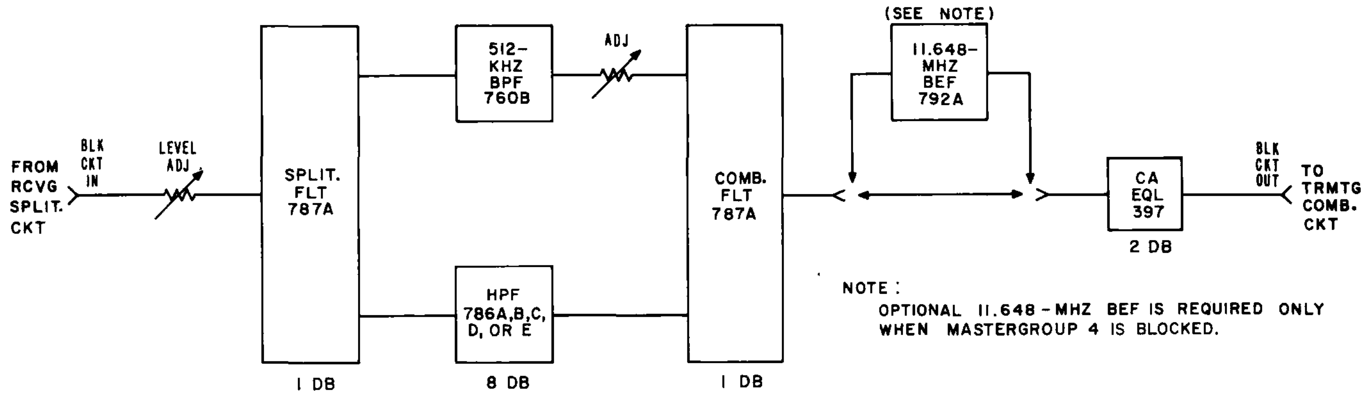
5.12 Five different filter combinations are used for blocking high-end mastergroups (Fig. 9C). All line switching and command carrier signals are blocked.

5.13 The 512-kHz pilot is passed in all arrangements of this blocking circuit. Where mastergroups 5 and 6 are blocked, the 11.648-MHz pilot is partially blocked and an 11.648-MHz band-elimination filter is provided. Where mastergroups 4 ***and*** 5 are blocked, the 11.648-MHz pilot is completely blocked and the band-elimination filter is not required. A blocked pilot is reinserted in the line connecting circuit for the transmit line. A LEVEL ADJ pad and cable equalizer are provided.

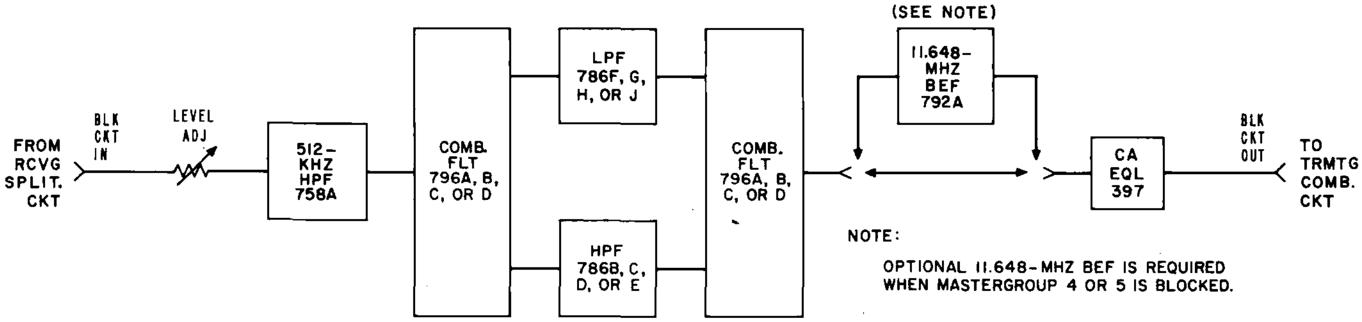
Block Command Carrier Signals in 2-Section Control

5.14 A simplified block diagram of the three main stations in a 2-section control arrangement is shown in Fig. 10. Command carrier signals from a control center are sent over a regular line to a remote main station where the signals are looped back to the selected line. The equalizing repeaters in the same direction of transmission in both the near and far sections respond to the same command carrier frequencies. Thus, command carrier signals sent to the far-section equalizing repeaters must be blocked at the intermediate main station so these signals cannot reach the near-section equalizing repeaters. For regular lines, there are two blocking arrangements (Fig. 11) for the line connecting circuits at an intermediate main station. One arrangement is used for the lines in one direction; the other arrangement, for the lines in the opposite direction. Both arrangements block line switching signals, pass the line pilot signals, and pass either the upper or lower half of the command carrier signals.

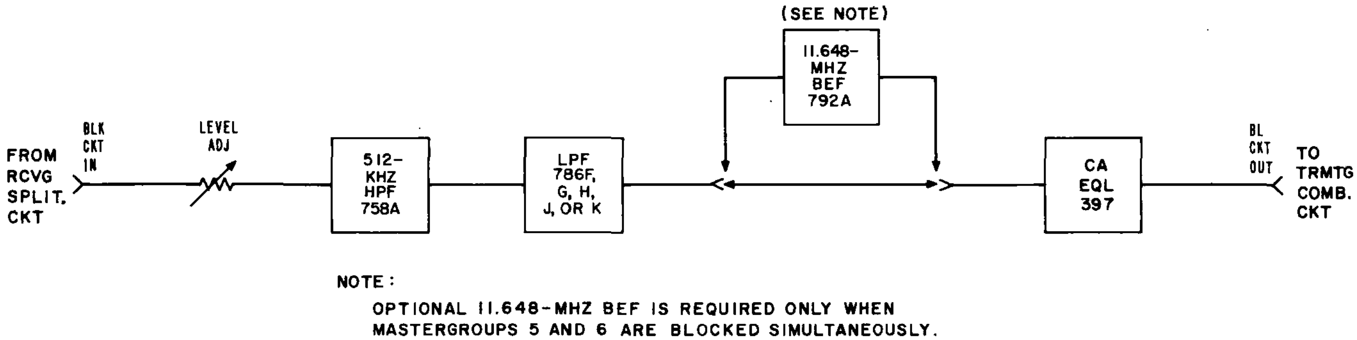
5.15 Assume that a regular line fails between the west and intermediate main stations (Fig. 10). At the west main station, a line switch operates and connects the regular line signals to the standby line. At the intermediate main station, line switches operate and connect the standby receive line to the line connecting circuit for the failed regular receive line and connect the failed regular receive line to the line connecting circuit



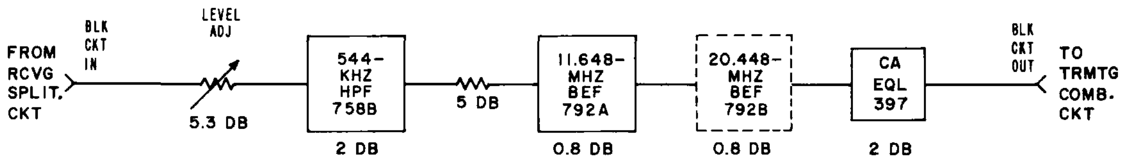
A. Block Low-End Mastergroups and Pass 512-kHz Pilot



B. Block Middle Mastergroups



C. Block High-End Mastergroups



D. Standby Line Blocking Circuit

Fig. 9—Mastergroup Blocking Arrangements

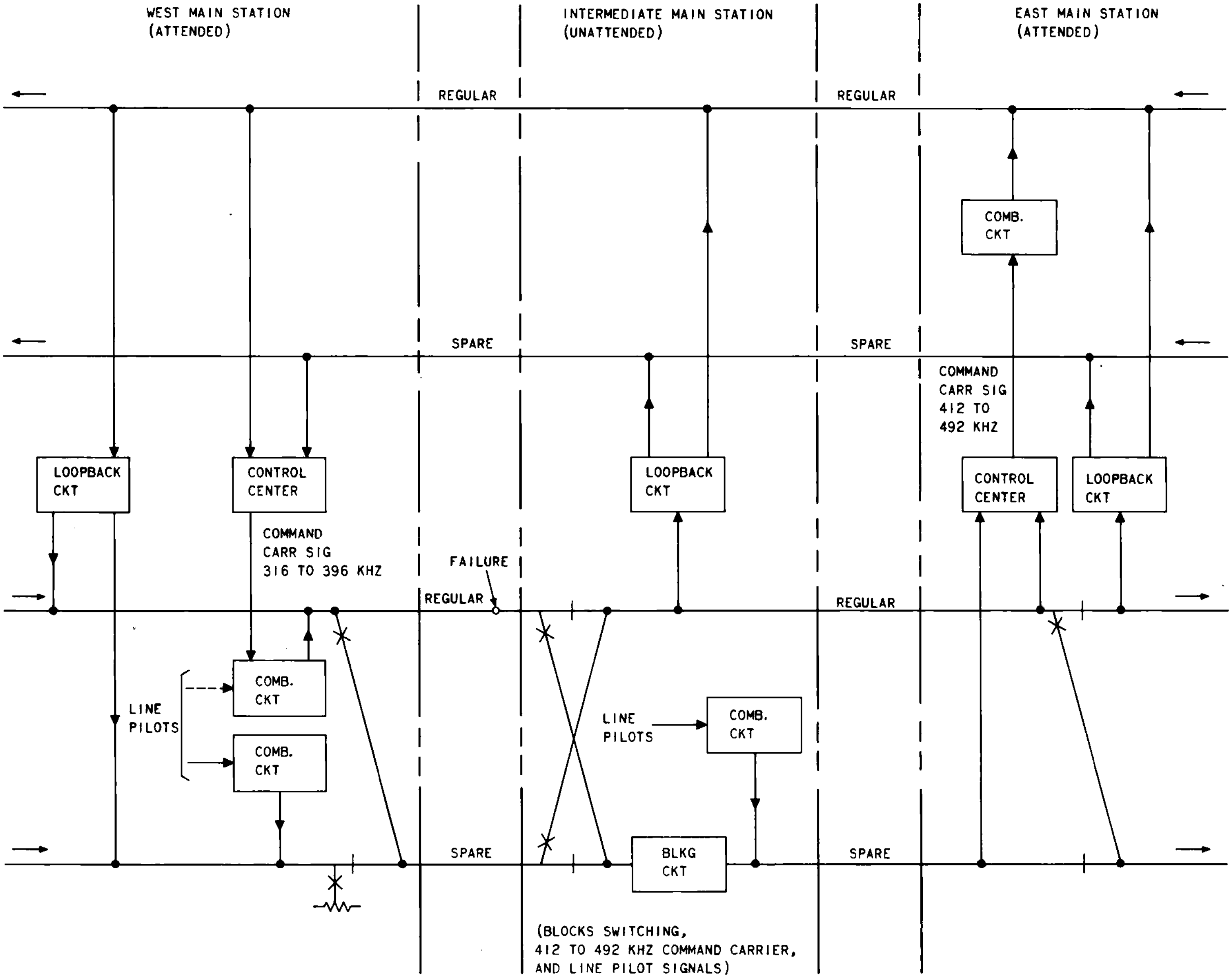


Fig. 10—Two-Section Control Arrangement

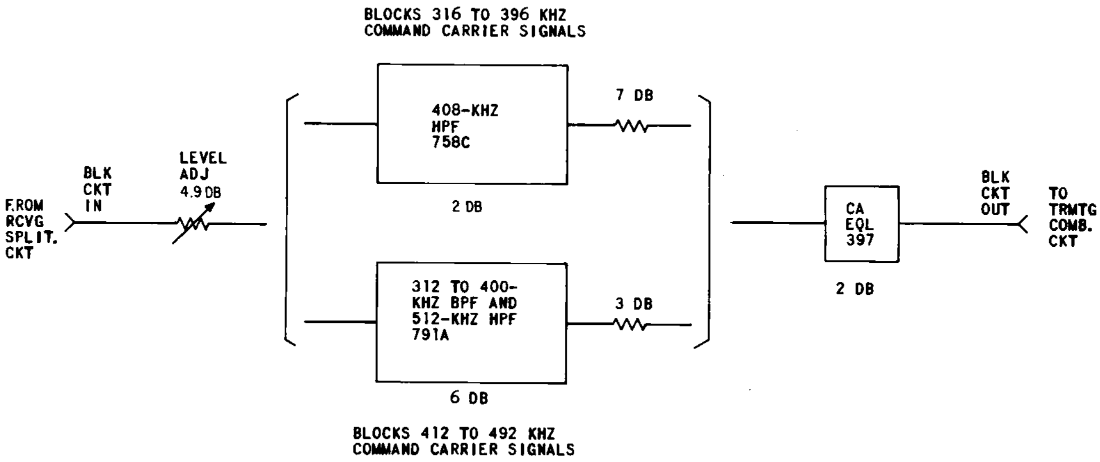


Fig. 11—Block Command Carrier Signals in 2-Section Control

for the standby receive line. This line switching arrangement maintains service and a signal path from the failed regular line to the east main station control center via the standby line between the intermediate and east main stations.

C. Standby Lines

Block Command Carrier, Line Switching, and Pilot Signals

5.16 For standby lines at all main stations, the blocking circuit used is shown in Fig. 9D. This circuit blocks ***all*** command carrier, line switching, and pilot signals. Line pilots are reinserted in the line connecting circuit for the standby transmit line at each main station.

6. EQUALIZER TEST SIGNALS BLOCKING CIRCUIT

6.01 When equalizing an L4 line, equalizer test signals are applied at an equalizing or main station repeater upon command from a control center. An ***equalizer test signals blocking circuit*** (Fig. 12) is provided for a regular receive line where mastergroup branching and/or dropping is performed. This blocking circuit is required to prevent equalizer test signals from entering another line or system via the dropping or branching connection.

6.02 The received L4 spectrum is connected through a hybrid to parallel paths, each of which contains the same equipment. Each path contains band-elimination filters for the A and B equalizer test signals and six adjustable amplifiers. The filters offer more than 50-dB loss to equalizer test signals and the amplifiers compensate for filter losses at the other L4 line frequencies.

6.03 ➧Two output hybrids provide four equal-level outputs. Two outputs, BR SIG OUT A and B, are for connections to a line branching panel and two outputs, DROP SIG OUT A and B, are for connection to a receiving MMX-2 connecting panel. When branching is required, the branched signals are connected to the IN A and B jacks on the line branching panel. Similarly, when mastergroup dropping is required, a receiving MMX-2 connecting panel is provided and the dropped signals are connected to the J2 and MMX CONN IN B jacks on this panel.➧

6.04 Equalizer test signals turned on at any repeater location may go down the line to the next frogging point. ***Frogging*** involves frequency translation of the mastergroups and is performed at main stations approximately 800 miles apart. Thus, equalizer test signals may pass through several main stations at which mastergroup dropping and/or branching are performed. Coordination among control centers in a frogging section is required for equalization of the L4 lines in the different control sections.

6.05 B equalizer test signals and digital signals cause mutual interference. For an L4 line carrying digital signals, the digital signals must be removed when the B equalizers are to be adjusted.

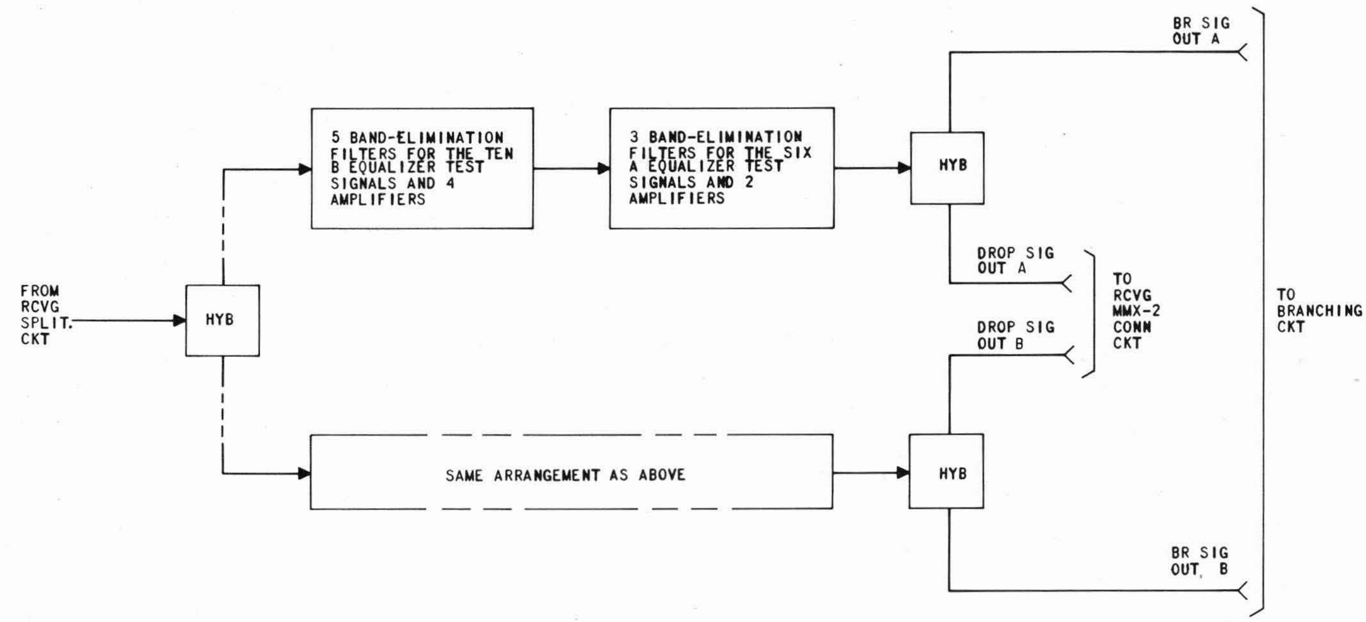


Fig. 12—Equalizer Test Signals Blocking Circuit

7. RECEIVING MMX-2 CONNECTING CIRCUIT

7.01 A ***receiving MMX-2 connecting circuit*** (Fig. 23) is required to connect the multiplex signals received on a regular line to an MMX-2C terminal for mastergroup dropping. A receiving MMX-2 connecting panel is shown in Fig. 13.

7.02 This circuit extends the transmission paths from the equalizer test signals blocking circuit to a trunk which connects to an MMX-2C terminal. Each path includes a de-emphasis network and an adjustable amplifier. Both paths connect to a 223E switch.

7.03 One signal path is ***working*** and is connected by the switch to the MMX CONN OUT jack via a cable equalizer. The cable equalizer compensates for gain deviations introduced by the cable in the

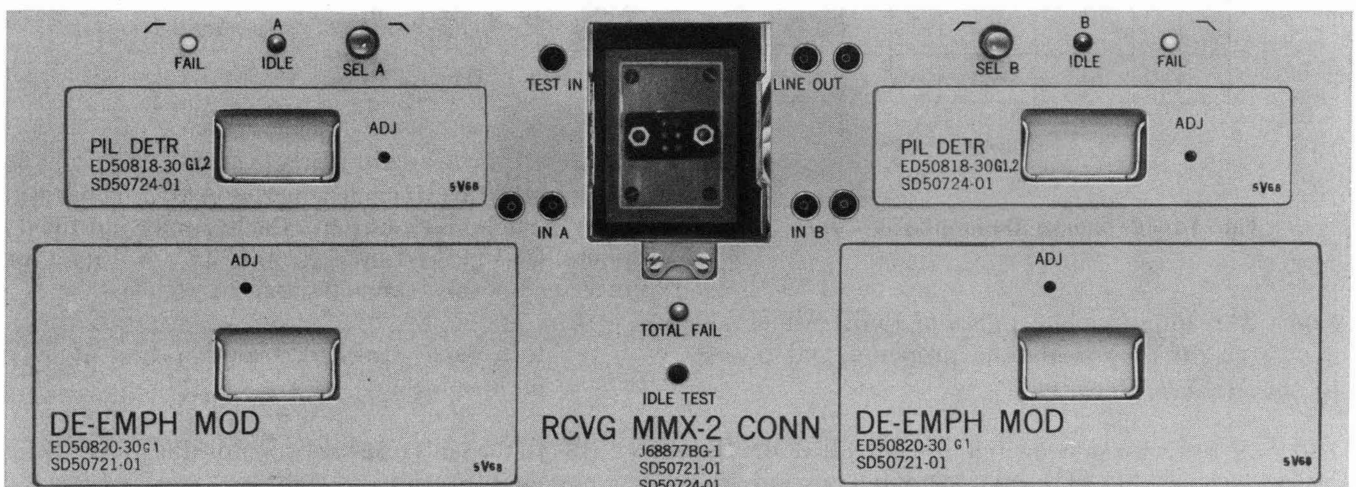


Fig. 13—Receiving MMX-2 Connecting Panel

trunk from the line receiving bay to the MMX-2C terminal.

7.04 The other signal path is ***idle*** and is connected by the switch to the IDLE TEST jack on the receiving MMX-2 connecting panel. Neither path has priority; either path can be the working or the idle path.

7.05 The signals on an L4 line are ***preemphasized*** to improve transmission. Signals at 17.5 MHz are connected to the L4 lines at a level 6.1 dB higher than signals at 500 kHz. De-emphasis networks are provided in the receiving MMX-2 connecting panel to restore the received signal to a flat level-frequency characteristic. A de-emphasis network has a loss-frequency characteristic (Fig. 14) which is the inverse of the preemphasis. The output of the de-emphasis network is flat across the multimastergroup band: 564 kHz to 17.548 MHz.

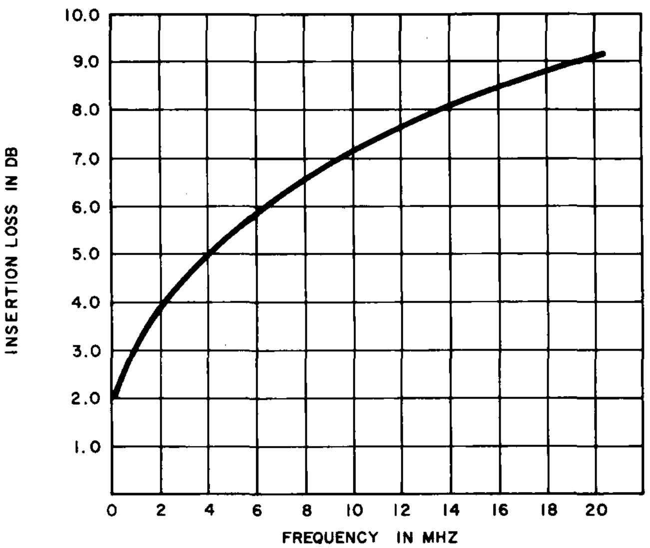


Fig. 14—Receiving De-emphasis Curve

7.06 The amplifier has a gain of 15 dB adjustable ±2 dB to provide the proper signal power to the MMX-2C terminal.

7.07 A transmission switch is controlled by the received 512-kHz pilot signal. Loss of the 512-kHz pilot signal in the working path will automatically connect the other path to the output circuit. This path now becomes the working path and the failed path is connected to the IDLE TEST jack. Service may also be transferred manually. Switching is so arranged that no switch will occur on simultaneous loss of pilot in both paths.

8. LINE BRANCHING CIRCUIT

8.01 A ***line branching circuit*** (Fig. 23) is required to connect the multiplex signal received on a regular line to an L4 or L5 transmit line different from the one connected via the blocking circuit in the through transmission path. ♦A line branching panel is shown in Fig. 15.♦

8.02 This circuit extends the two transmission paths from the equalizer test signals blocking circuit to a trunk which connects to the line connecting circuit for a transmit line. Each path includes filters for blocking line pilots, command carrier signals, and unwanted mastergroup signals. A cable equalizer is provided in each path to compensate for gain deviations due to the cable from the line receiving bay to the line transmitting bay or to the L5 BJGT bay.

8.03 The transmission switch is identical to the switch for the receiving MMX-2 connecting circuit and is also controlled by the received 512-kHz line pilot signal. To prevent interference with the 512-kHz pilot on the transmit line, the 512-kHz signal is blocked by the high-pass filter which follows the transmission switch.

8.04 Three arrangements of the branching circuit are shown in Fig. 16; one for branching the low-end, one for the middle, and one for the high-end mastergroups.

9. LINE PILOT SUPPLIES

9.01 ***Line pilot supplies*** for 512 kHz and 11.648 MHz are included in the control connecting bays in each main station. Each supply can furnish pilots for up to ten transmit lines. Pilots are inserted in the transmit lines as follows:

(a) Into each ***standby*** transmit line at every main station

(b) Into each ***regular*** transmit line at a terminal main station

(c) Into a ***regular*** transmit line where required because of line pilot blocking in the blocking

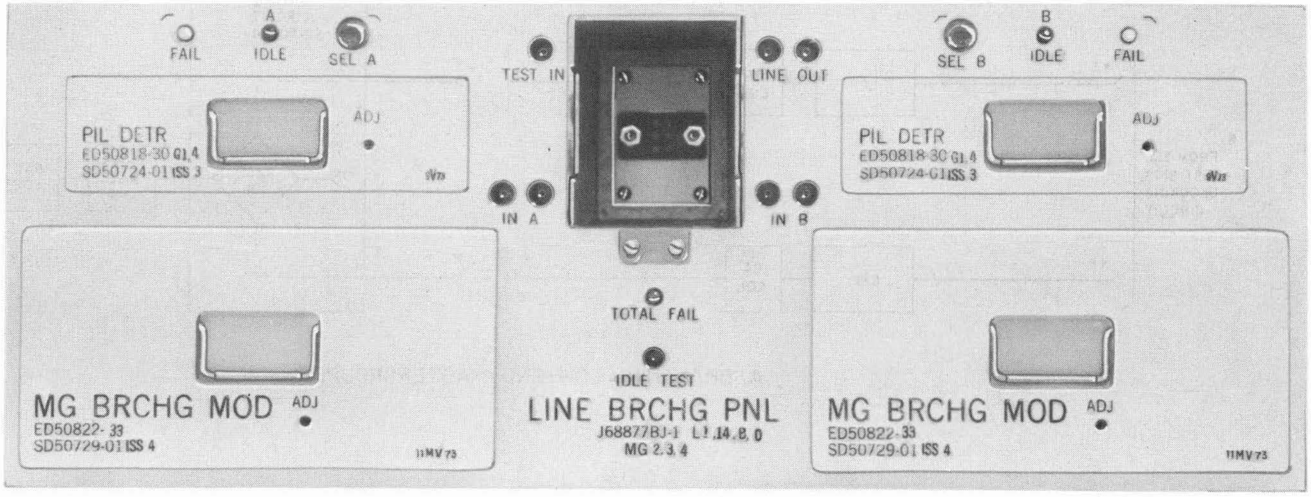


Fig. 15—Line Branching Panel

circuit and during line switching when the line terminate switch is operated.

9.02 The 512-kHz supply also provides 512-kHz switching signals for up to ten transmitting MMX-2 connecting circuits.

9.03 The 512-kHz pilot stabilization and distribution circuit (Fig. 17) receives a 512-kHz signal from a primary frequency supply and provides 20 outputs. Two stabilization circuits, each consisting of a regulator, filter, and detector, are connected through a logic and switching circuit to the distribution circuit.

9.04 The regulator amplifies and limits the 512-kHz signal which is connected through a 512-kHz bandpass filter to a detector and to a switch. Regulator output will change less than 0.01 dB with a 5-dB level change at the regulator input. If the regulator input falls below -30 dBm, the output will be cut off automatically. This is to prevent transmission of a degraded pilot signal.

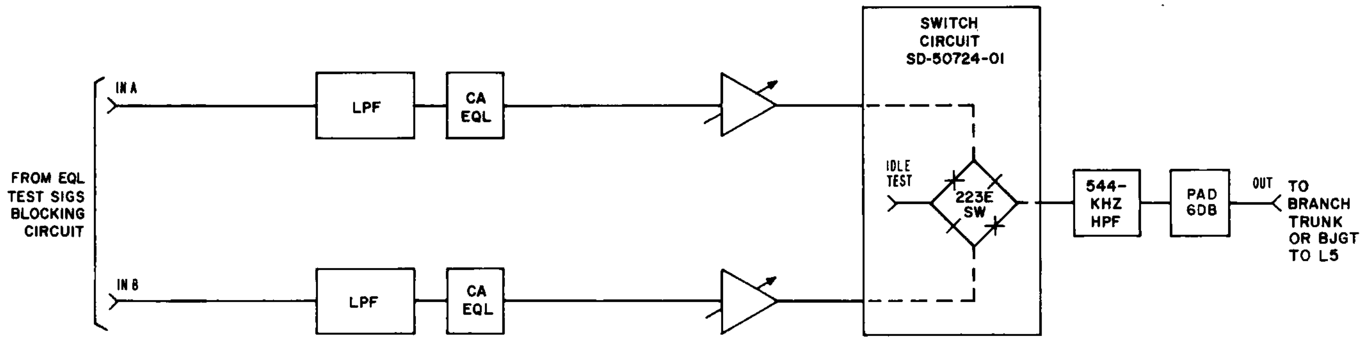
9.05 Automatic switching between the two sides is initiated by the detectors which will respond if the detector input level varies more than 0.5 dB. Each detector has a NULL ADJ control used to set the detector null at the proper input level and a WIDTH control used to set the detector width, usually ±0.5 dB.

9.06 Normally, both sides are working and either side may be connected to the distribution circuit according to the condition of the switch. Assume that side A is connected through the switch to the distribution circuit and side B is connected to the IDLE TST jack. On the front panel (Fig. 18), the green PILOT B IDLE lamp will be lighted. ***Manual*** transfer to side B can be initiated by momentarily depressing the PILOT B SELECT pushbutton. If side A fails, ***automatic*** transfer to side B will occur. In this case, side B will be connected to the output, the yellow PILOT A ALM lamp will light, and a minor alarm will result. If both sides are outside the detector limits, side A will be connected to the output, the red PILOT ALM lamp will light, and a major alarm will result.

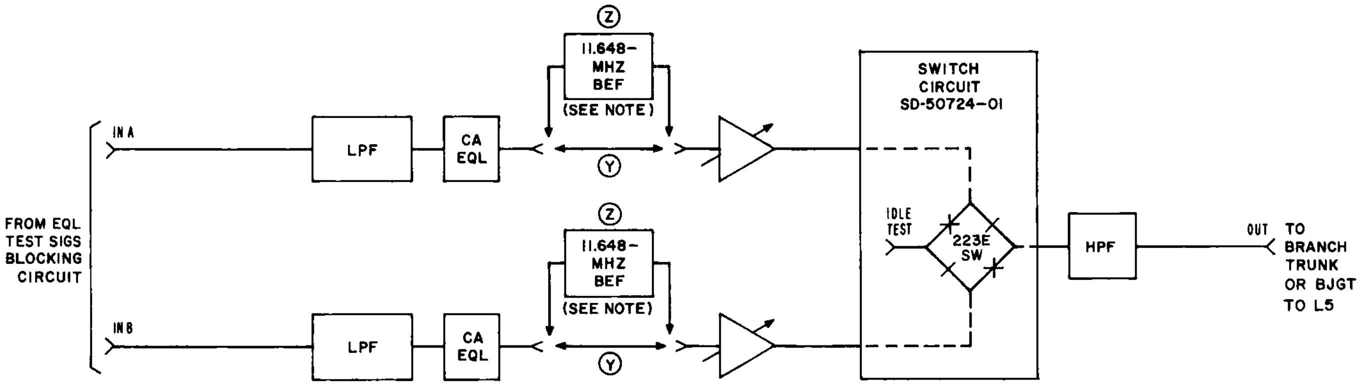
9.07 The distribution bus provides 20 outputs at -30 dBm. Ten of these outputs may be connected by a remote closure from the receiving automatic line switch to meet service restoration requirements. This arrangement facilitates reinsertion of the 512-kHz pilot. This feature may be bypassed by a wiring option when the pilot is permanently inserted, for example, at a terminal main station.

9.08 Two 68B oscillators are used in the 11.648-MHz generator, as shown in Fig. 19.

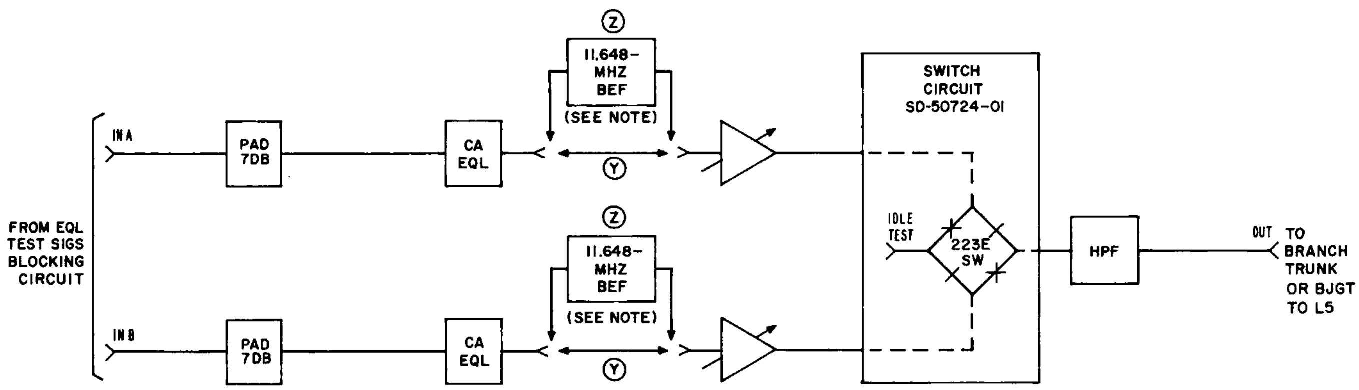
9.09 The pilot generator includes two oscillators with provisions for selecting either oscillator to provide pilot while the other serves as standby. In case the working oscillator fails, an automatic



A. BRANCHING LOW-END MASTERGROUPS



B. BRANCHING MIDDLE MASTERGROUPS



C. BRANCHING HIGH-END MASTERGROUPS

NOTE:
OPTION Z IS PROVIDED WHEN MASTERGROUP 4 AND/OR 5 IS BRANCHED.
OTHERWISE, OPTION Y IS USED.

Fig. 16—Branching Arrangements

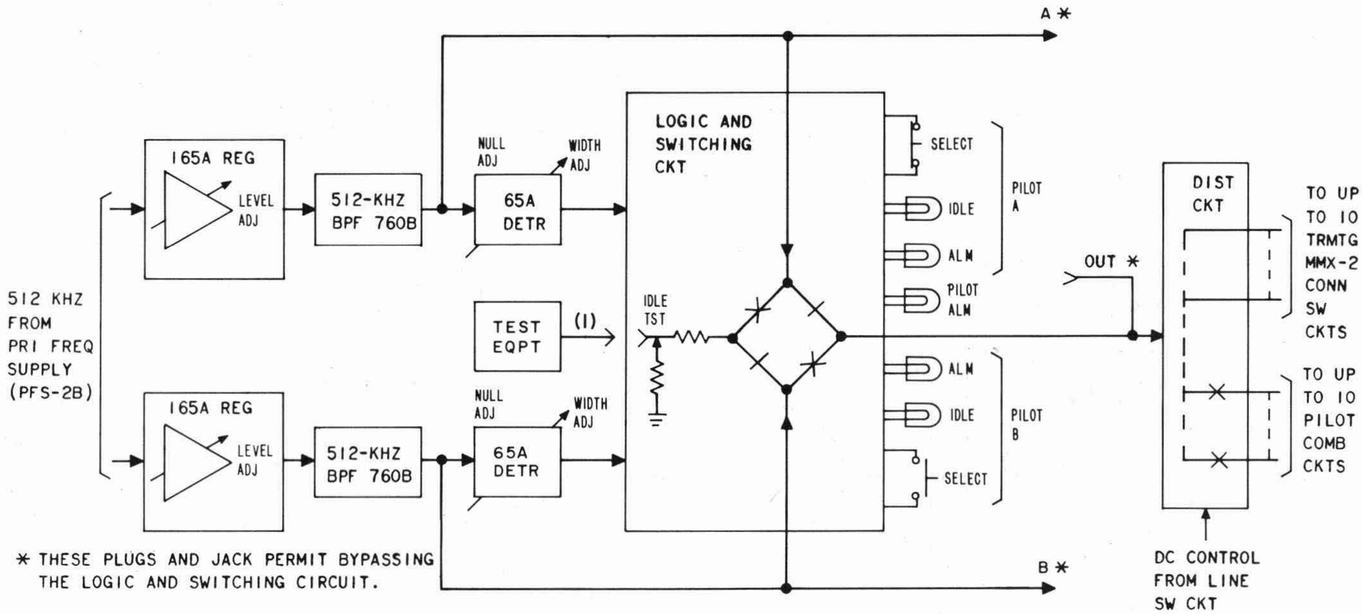


Fig. 17—512-kHz Pilot Circuit

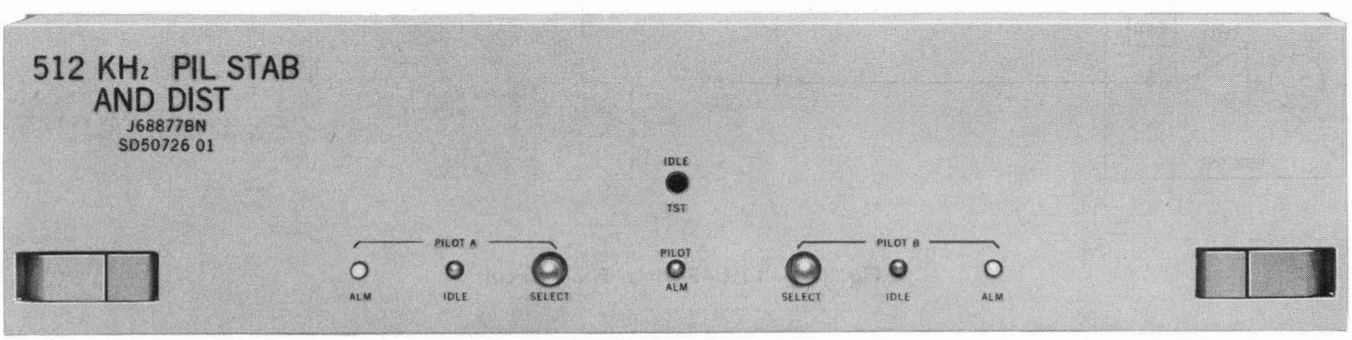


Fig. 18—512-kHz Pilot Panel

transfer to the standby oscillator occurs. Manual switching is provided to facilitate maintenance and testing. An inhibit circuit prevents manual switching to an oscillator that has failed.

9.10 The first stage of the oscillator is crystal controlled. The second stage is a buffer amplifier with temperature-compensated amplitude limiting. A potentiometer designated LEVEL provides a ±0.5 dB adjustment of the +5 dBm nominal power. One output feeds the distribution circuit through the transfer circuit and the other is used to drive the oscillator alarm.

9.11 An oscillator alarm circuit monitors the output of each oscillator. If the output falls approximately 4 dB, a normally operated alarm relay is released. This action lights one of the alarm lamps on the generator panel (Fig. 20) and initiates an office alarm.

9.12 The transfer control circuit logically combines dc signals from the oscillator alarm circuits and controls the transfer circuit. Two select switches are provided for manual transfer from one oscillator to the other.

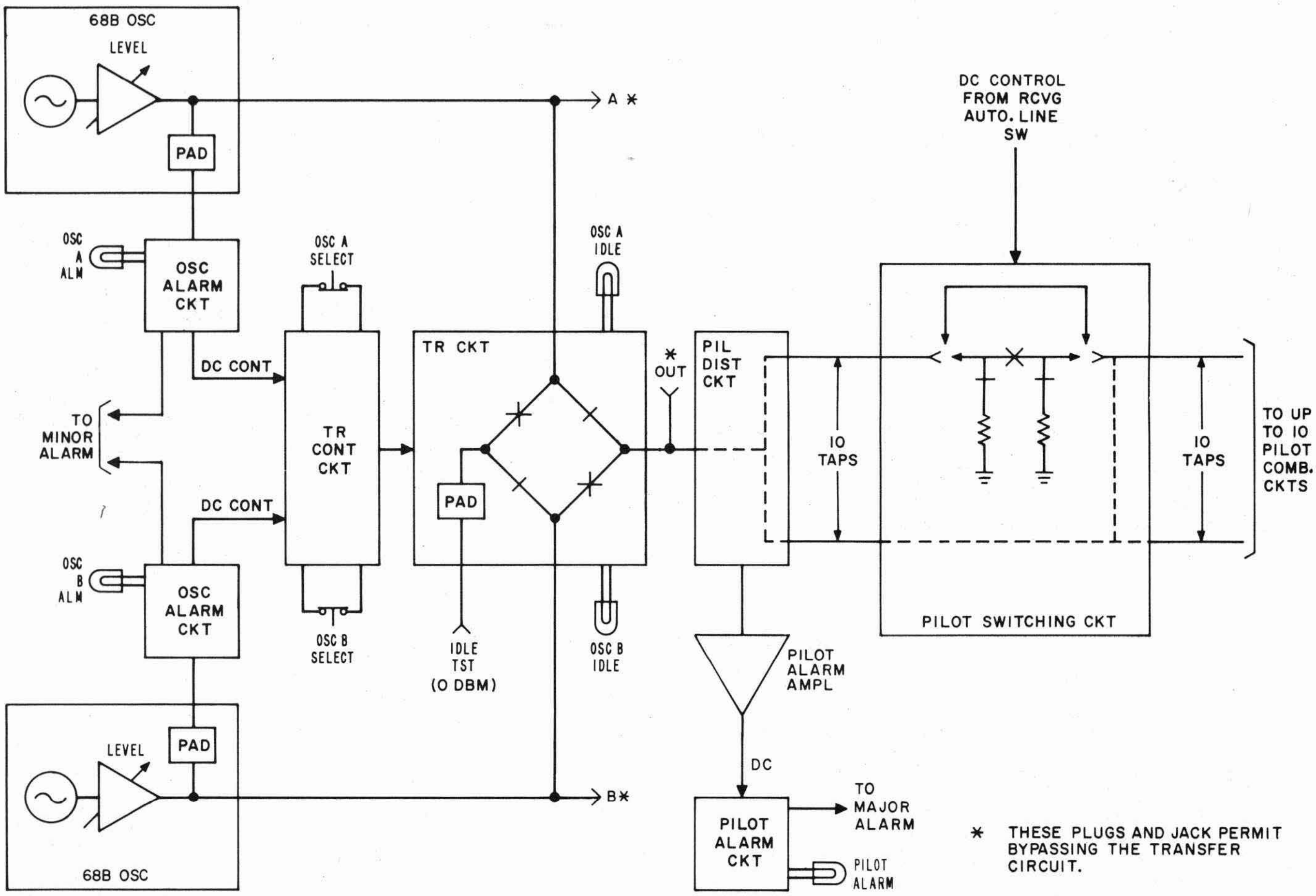


Fig. 19—11.648-MHz Pilot Circuit

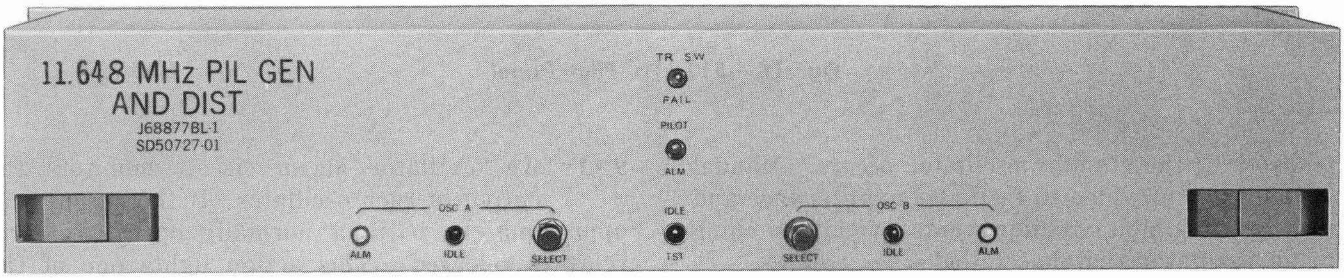


Fig. 20—11.648-MHz Pilot Panel

9.13 The transfer circuit consists of four relays which can transfer each oscillator between the distribution circuit and the IDLE TST jack. A pad in series with the jack reduces the output to 0 dBm. An idle lamp is provided for each oscillator.

9.14 The distribution bus provides 11 outputs to ten pilot switching circuits and, through the pilot alarm amplifier, to the pilot alarm circuit.

9.15 The pilot alarm amplifier provides 9-dB gain between the distribution circuit and the pilot alarm circuit. The pilot alarm circuit is similar to the oscillator alarm circuit. If the pilot input level falls approximately 6 dB, a major office alarm is initiated and the PILOT ALM lamp is lighted.

9.16 Switching is provided in each of the ten taps of the pilot distribution circuit for use during service restoration. The relays, under control of the receiving automatic line switch, cause the pilot to be blocked or transmitted to the connected tap. When the pilot is blocked, proper terminations are applied to both the distribution bus and the line pilot combining network. This switching feature may be bypassed by a wiring option if permanent pilot insertion is required.

10. TRANSMITTING MMX-2 CONNECTING CIRCUIT

10.01 A ***transmitting MMX-2 connecting panel*** (Fig. 21) is provided where analog multiplex signals are to be added to an L4 line. Optional arrangements of this circuit, as shown in Fig. 23, are provided depending on whether this L4 line is carrying digital signals.

10.02 The signal at the output of a transmitting bank in an MMX-2C terminal is connected by a multimastergroup trunk to the MMX TRK OUT jack in a line transmitting bay. A patch plug to the adjacent MMX CONN IN jack connects the signal to one side of a hybrid. A 512-kHz signal from the line pilot supply is applied to the SW PIL IN jack on the other side of the hybrid. The two outputs of the hybrid connect to parallel transmission paths, each of which includes an amplifier providing 15.7-dB gain adjustable ±2 dB. Both transmission paths are arranged similarly.

10.03 Optional connections are shown in Fig. 23. An L4/LMD interface circuit is required wherever analog signals are added to an L4 line carrying digital signals. This circuit includes mastergroup blocking filters to suppress spurious signals that can interfere with digital signals on the L4 line.

10.04 The analog or combined analog and digital signals are connected to a preemphasis network that offers 6.1 dB more loss at 500 kHz than at 17.5 MHz. The higher frequency signals are applied to a transmit line at higher power to reduce the effects of noise on the L4 signals. The signals are restored to a flat loss-frequency

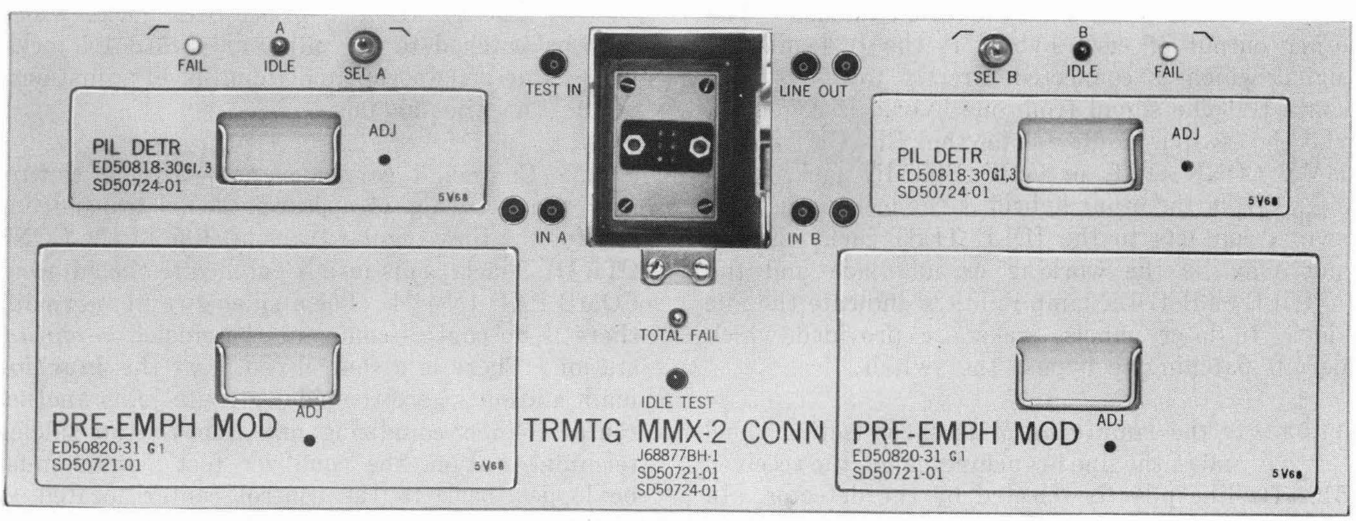


Fig. 21—Transmitting MMX-2 Connecting Panel

characteristic by the de-emphasis network in the receiving MMX-2 connecting panel.

10.05 Both transmission paths connect to a transmission switching circuit. One path is connected through the switch to a 544-kHz high-pass filter which blocks the 512-kHz signal applied at the SW PIL IN jack. This prevents the 512-kHz signal from interfering with the 512-kHz pilot signal on the transmit line. The other path is connected through the switch to the IDLE TEST jack. The transmission switching circuit is similar to the one used for the receiving MMX-2 connecting circuit and the branching circuit and is described in Part 11.

10.06 The multiplex signal for the mastergroups to be added is connected, via a cable equalizer, to the ADD SIG IN jack in the line transmitting bay.

11. TRANSMISSION SWITCHING CIRCUIT

11.01 A ***transmission switching circuit*** (Fig. 22) is a part of the line branching panel, receiving MMX-2 connecting panel, and transmitting MMX-2 connecting panel.

11.02 Two parallel transmission paths connect to the transmission switching circuit at the inputs to hybrids A and B. One output of each hybrid connects, via a 512-kHz bandpass filter and an amplifier, to a detector which controls the transmission switch and associated alarms. The other output of each hybrid is the transmission signal which is connected directly to the switch contacts. The signal from one hybrid is connected via the switch contacts to the BR CKT OUT, MMX CONN OUT, or ADD SIG IN jack. The signal from the other hybrid is connected via other switch contacts to the IDLE TEST jack. Either side may be the working or idle side and the A IDLE or B IDLE lamp lights to indicate the idle side. In later panels, jacks are provided which permit patching to bypass the switch.

11.03 In the ***receiving*** MMX-2 connecting panel and in the line branching panel, the received 512-kHz line pilot is selected by the detector. In the ***transmitting*** MMX-2 connecting panel, a 512-kHz signal from the line pilot supply is connected via the SW PIL IN jack.

11.04 The detector circuit consists of a 512-kHz bandpass filter, an amplifier, and a detector network which detects the presence or absence of the 512-kHz signal. Loss of signal in the idle path will cause the switch and alarm circuit to initiate a minor office alarm and light the appropriate A FAIL or B FAIL lamp. Loss of signal in the working path initiates a minor office alarm, lights the appropriate fail lamp, and ***automatically*** transfers service. If both sides fail, a major office alarm is initiated and the TOTAL FAIL lamp is lighted. Loss of the incoming 512-kHz signal alone will cause a major alarm, but unprotected service will be maintained through side A.

11.05 To facilitate maintenance, service may be ***manually*** transferred from one transmission path to the other by momentarily depressing the SEL A or SEL B pushbutton. A manual transfer to a failed side is automatically inhibited. The controls, indicators, and test jack for a typical transmission switching circuit are mounted on the branching panel and MMX-2 connecting panels.

12. PILOT AND COMMAND CARRIER SIGNAL COMBINING CIRCUIT

12.01 A ***pilot and command carrier signal combining circuit*** (Figures 23 and 24) is always provided and consists of jacks and fixed and adjustable pads for four inputs to the transmitting combining circuit.

12.02 The line pilot signals appear at the LOW EDGE PIL and TEMP PIL jacks which may be patched to the adjacent COMB IN jacks. Adjustable pads permit individual level adjustment of the line pilot signals.

12.03 Command carrier signals from a control center (Fig. 23) appear in the line transmitting bay for the first regular transmit line at the CONT CTR OUT jack. This jack is patched to the adjacent COMB PAD IN jack. For a sideleg route, normally there is no control center at the sideleg ***terminal*** station. There is a control center at the ***junction*** main station where the sideleg route joins another route. When equalizing any line ***to*** the sideleg terminal station, the equalizer test signals must be looped back to the control center located at the sideleg junction station. Equalizer test signals are connected from that receive line at the sideleg terminal station (Fig. 24) via the loopback circuit

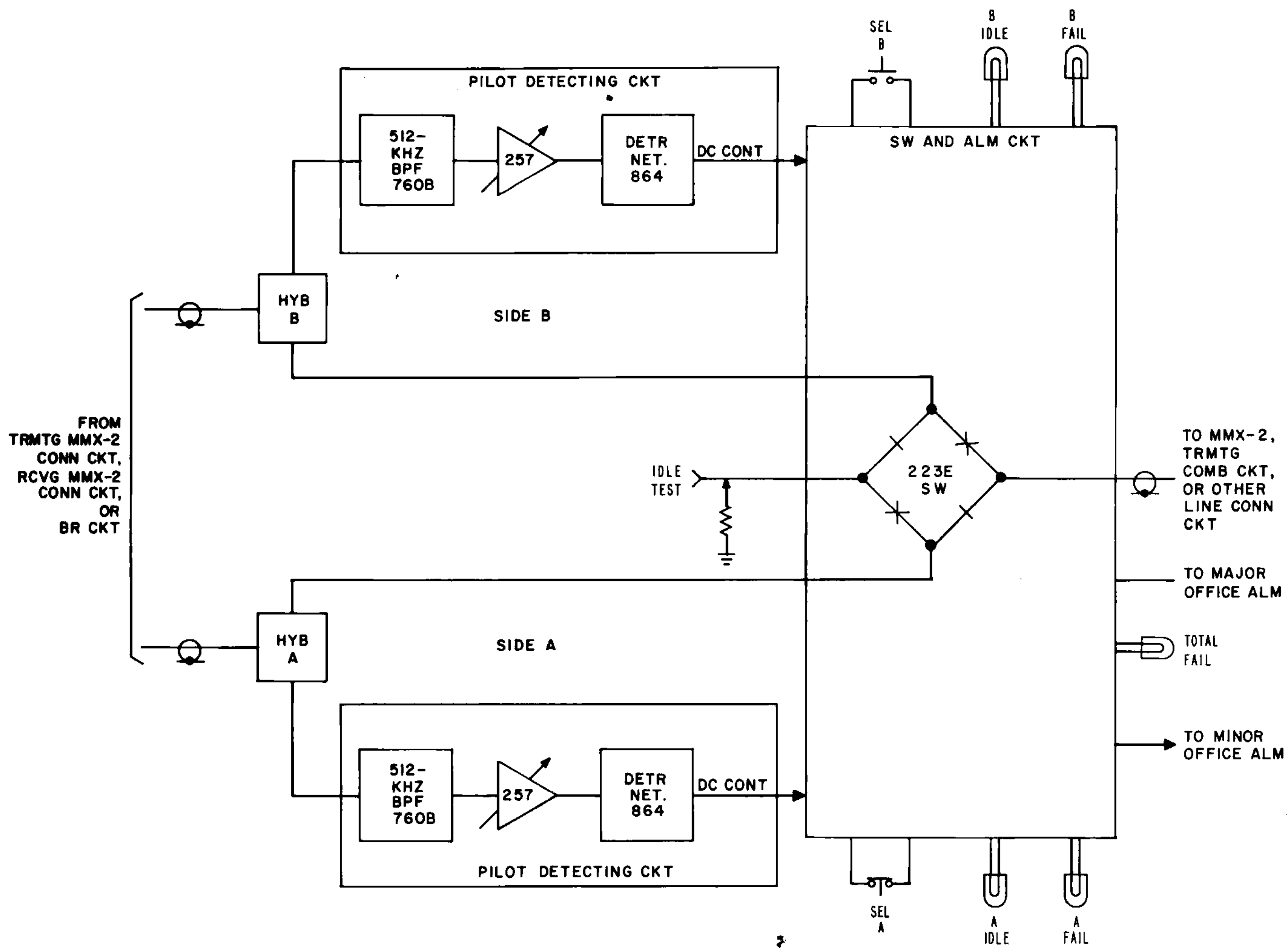


Fig. 22—Transmission Switching Circuit

to the CONT CTR OUT jack for the ***standby*** line transmitting to the sideleg junction station.

13. TRANSMITTING COMBINING CIRCUIT

13.01 A ***transmitting combining circuit*** is always provided for each line. For a ***regular*** line, this circuit is arranged to accept up to five inputs and provide two outputs. For a ***standby*** line, this circuit is arranged for up to four inputs and one output.

Regular Line (Fig. 23)

13.02 Through transmission is via the BLK SIG IN jack, hybrids 4 and 5, transmitting hybrid, line amplifier, and transmitting main repeater to the regular L4 line. Another output from the transmitting hybrid is connected via the SW IN jack to a coaxial line switch in the control connecting bay. In case a regular L4 line fails, the associated switch operates and connects the signals to the standby L4 line.

13.03 Branched signals and L5 added signals are connected via the BR SIG IN jack and hybrid 3. Line pilot and command carrier signals are combined and connected at another input to hybrid 3.

13.04 Signals from a transmitting MMX-2 connecting circuit are connected via the ADD SIG IN jack to hybrid 5, ***or*** signals from the restoration patch bay are connected via the RSTN SIG IN jack.

The TRMTG TST jack is connected at one output of hybrid 5.

13.05 Switching signals are connected to one input of the transmitting hybrid.

Standby Line (Fig. 24)

13.06 Through transmission is via the BLK SIG IN jack, hybrids 4 and 5, transmitting hybrid, line amplifier, and transmitting main repeater to the standby L4 line. An alternate input to the line amplifier is from the coaxial line switches for the regular lines. In case a regular L4 line fails, a switch operates and connects the signals to the standby L4 line.

13.07 Line pilot signals are connected at hybrid 3. Signals from the restoration patch bay are connected via the RSTN SIG IN jack to hybrid 5. The TRMTG TST jack is connected at one output of hybrid 5.

14. LINE AMPLIFIER CIRCUIT

14.01 A ***line amplifier circuit*** (Figures 23 and 24) is always provided for each line. This circuit amplifies signals to the proper level for connection to the transmitting main station repeater. The amplifier has a gain of 15 dB adjustable ±2 dB. For a ***standby*** line, the line amplifier circuit includes a cable equalizer to compensate for gain deviations due to the cable to and from the line switches in the control connecting bay.

14.02 There are three inputs to the transmitting line hybrid.

(a) Signals from the transmitting combining circuit are connected via the line amplifier.

(b) A monitoring oscillator signal is connected via the MON OSC OUT and MON SIG IN jacks.

(c) Command carrier signals from a control center at a remote main station are connected via the loopback circuit and the LOOP BACK OUT and LOOP SIG IN jacks.

14.03 One output of the transmitting line hybrid connects to the transmitting main station repeater via the B and A equalizers. The other output appears at the TRMTG LINE TST jack which serves as a transmission test point.

15. MAINTENANCE

15.01 Those portions of the line connecting circuit which are transmission paths and which include active elements are protected by transmission switching circuits at these critical points. Automatic protection switching is provided by the transmission switching within the line connecting circuit or by the automatic line switching. Manual switch controls facilitate out-of-service maintenance of the protected circuit and part of the associated switching circuit.

15.02 As added transmission protection for a ***regular*** line, emergency bypassing circuits are provided (Fig. 23). If for any reason transmission is interrupted by failure in the transmitting or receiving hybrids or passive blocking circuit, an emergency bypass circuit may be manually patched around the entire through transmission circuit or the dropping circuit, depending on the location of the trouble. Each bypass circuit has a loss equal to that normally introduced by the circuits which are bypassed.

15.03 Transmission test jacks are provided in the through, dropping, branching, and adding portions of the line connecting circuit to facilitate in-service transmission measurements.

15.04 Redundant pilot sources and associated manual switch controls in the 512-kHz and 11.648-MHz pilot supplies facilitate measurement of each pilot signal at the associated IDLE TST jack. While the output of one side is working, the output of the other side appears at the test jack. By operating the appropriate select switch, the working side becomes idle and appears at the test jack for measurement while the idle side becomes the new working side.

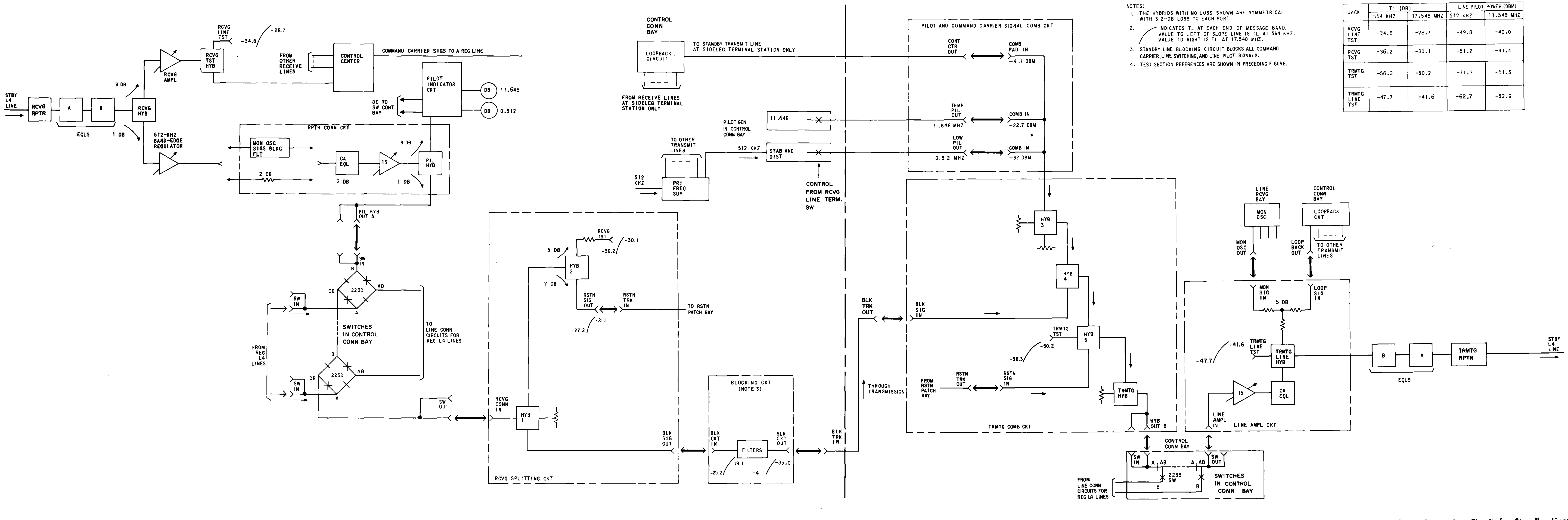
15.05 In the line pilot supplies (Figures 17 and 19), plugs and jacks are provided for bypassing the signal around the switching circuit. This permits maintenance of the switching circuit without losing the pilot signal.

JACK	TL (DB)		LINE PILOT POWER (DBM)	
	564 KHZ	17.548 MHZ	512 KHZ	11.648 MHZ
RCVG LINE TST	-34.8	-28.7	-49.8	-40.0
RCVG TST	-36.2	-30.1	-51.2	-41.4
TRMTG TST	-56.3	-50.2	-71.3	-61.5
TRMTG LINE TST	-47.7	-41.6	-62.7	-52.9

NOTES:

1. THE HYBRIDS WITH NO LOSS SHOWN ARE SYMMETRICAL WITH 3.2-DB LOSS TO EACH PORT.
2. INDICATES TL AT EACH END OF MESSAGE BAND. VALUE AT BOTTOM OF SLOPE LINE IS TL AT 564 KHZ. VALUE AT TOP IS TL AT 17.548 MHZ.
3. CABLE EQUALIZER MAY BE LOCATED AT INPUT OF TRMTG MMX-2 CONNECTING CIRCUIT WHEN ONLY ANALOG SIGNALS ARE ADDED TO AN L4 LINE.
4. OPTIONAL CONNECTIONS SHOWN ARE PROVIDED, AS FOLLOWS:
   - [A] WHEN ONLY ANALOG SIGNALS ARE ADDED TO AN L4 LINE NOT CARRYING DIGITAL SIGNALS.
   - [B] WHEN ANALOG SIGNALS ARE ADDED TO AN L4 LINE CARRYING DIGITAL SIGNALS.
   - [C] WHEN ANALOG AND DIGITAL SIGNALS ARE ADDED.
   - [D] WHEN ONLY DIGITAL SIGNALS ARE ADDED.
   - [E] WHEN EQUALIZER TEST SIGNAL BLOCKING IS INCLUDED.
   - [F] WHEN ONLY DIGITAL SIGNALS ARE DROPPED.

Fig. 23—Line Connecting Circuit for Regular Line



NOTES:

1. THE HYBRIDS WITH NO LOSS SHOWN ARE SYMMETRICAL WITH 3.2-DB LOSS TO EACH PORT.
2. / INDICATES TL AT EACH END OF MESSAGE BAND. VALUE TO LEFT OF SLOPE LINE IS TL AT 564 KHZ. VALUE TO RIGHT IS TL AT 17.548 MHZ.
3. STANDBY LINE BLOCKING CIRCUIT BLOCKS ALL COMMAND CARRIER, LINE SWITCHING, AND LINE PILOT SIGNALS.
4. TEST SECTION REFERENCES ARE SHOWN IN PRECEDING FIGURE.

JACK	TL (DB)		LINE PILOT POWER (DBM)	
	564 KHZ	17.548 MHZ	512 KHZ	11.648 MHZ
RCVG LINE TST	-34.8	-28.7	-49.8	-40.0
RCVG TST	-36.2	-30.1	-51.2	-41.4
TRMTG TST	-56.3	-50.2	-71.3	-61.5
TRMTG LINE TST	-47.7	-41.6	-62.7	-52.9

Fig. 24—Line Connecting Circuit for Standby Line