

**4A SWITCH UNIT**  
**DESCRIPTION OF SYSTEM OPERATION**  
**NO. 101 ELECTRONIC SWITCHING SYSTEM**

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**1. GENERAL**

**1.01** This section briefly describes the operation of the 4A switch unit (J1H018) of the No. 101 Electronic Switching System (ESS). The 4A switch unit consists of a line connector (J1H014) and a 3A switch unit (J1H013). Description of system operation of the 3A switch unit is described in Section 240-101-102. The 3A switch unit is referred to as a 3A time division switch (TDS) when used as part of the 4A switch unit.

**1.02** This section is reissued to change reference from Section 240-101-103 to Section 240-101-102 covering the 3A switch unit and to update the section to include the latest information. Since this reissue covers a general revision, arrows ordinarily used to indicate changes have been omitted.

**1.03** A 4A switch unit can accommodate up to 332 trunks and 2000 lines at an average traffic rate approximately 3.5 ccs per line. The line capacity is dependent upon the traffic characteristics of the customer. A 4A switch unit consisting of a line connector and a 3A TDS having a line concentration ratio of 4 to 1 is shown in Fig. 1.

**1.04** In a 4A switch unit, all station lines are always connected to the line connector. The line connector has a 4-wire data link, consisting of a 4-wire data trunk with data transmitters and receivers, to the control unit. The line connector data link is in addition to the 4-wire data link for the 3A TDS. Each 3A TDS with 120 time slots requires one 4-wire data link, and a 3A TDS with more than 120 time slots requires two 4-wire data links.

**1.05** A line connector using a line concentration ratio of 4 to 1 can be equipped for as many as 2048 terminals and 510 B links. The B links are the talking paths between the line connector and the 3A TDS. The 3A TDS can terminate up to 332 trunks. Trunks can only be terminated on the 3A TDS. Each 3A TDS can have six digit trunks for each time division control (TDC). Each TDC has 60 talking time slots.

**1.06** Figure 1 is the 2000 line arrangement for a fully equipped line connector using 510 B links. The 3A TDS can have two, three, or four time division controls. The maximum number of data links, digit trunks, and attendant consoles will depend upon the number of time division controls

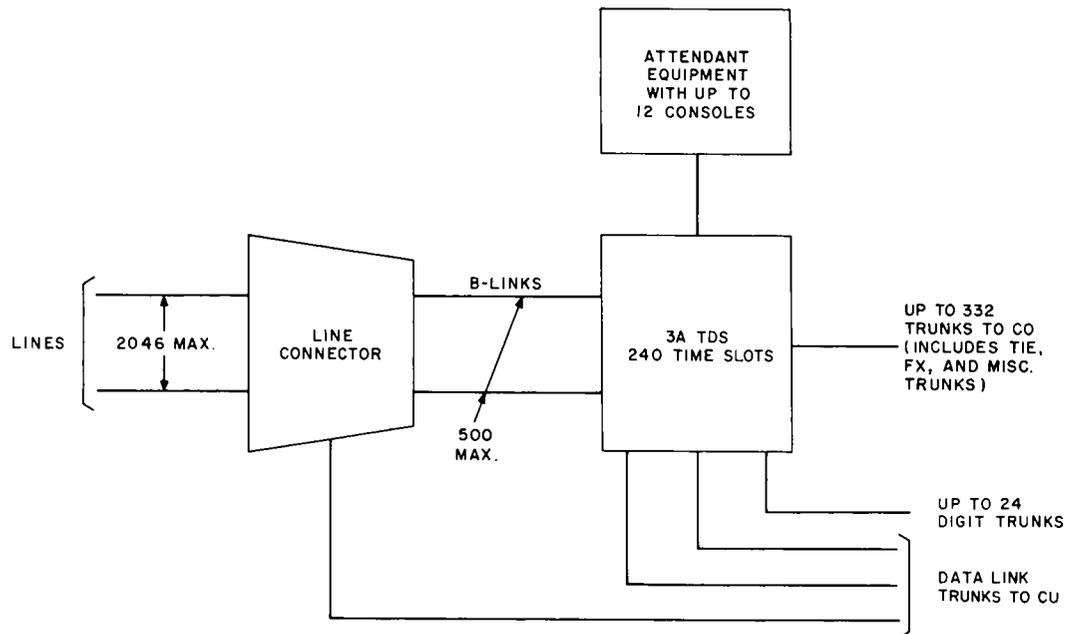


Fig. 1—Basic 4A Switch Unit Configuration

equipped. Up to 332 trunks, including direct inward dialing (DID), non-DID, tie, foreign exchange (FX), and miscellaneous trunks can be connected to the 3A TDS.

**1.07** The 4A switch unit provides two stages of switching. One stage, in the line connector, is space division being made by ferreed switches, and the other stage in the 3A TDS is time division being made by connecting the talking path for about 800 nanoseconds every 86 microseconds. The two stages are connected by B links between the line connector and the TDS.

**1.08** The line connector serves to detect an off-hook, and upon order from the control unit, to connect a line to one of the B links. At the completion of the call, the line connector disconnects by order from the control unit. The 3A TDS controls all attendant functions directly, as covered in Section 240-101-102.

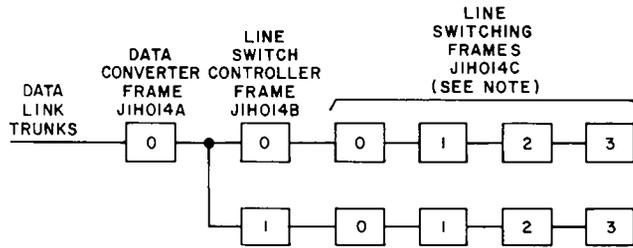
**1.09** A line to trunk call involves the time division connection of the trunk to the intergroup bus in the 3A TDS, the time division connection of the intergroup bus to a B link to the line connector, and connection through two ferreed switches in the line connector to the line. Tone, dialing, and ringing connections are set up in a

similar manner, except the related circuit replaces the trunk. A line-to-line call involves two sets of ferreed switches plus the time division connections in the 3A TDS.

**1.10** Figure 2 shows in block form the maximum line connector equipment that can be used in a 4A switch unit. A line connector has a J1H014A data converter frame and one or two J1H014B line switch control frames. Each line switch control frame can control up to four J1H014C line switching frames, each capable of terminating 256 lines.

**1.11** A line switch frame contains eight concentrators. A concentrator has two stages of ferreed switching with 32 line appearances and 16 B link appearances. The B links are connected in parallel for a 4 to 1 concentration ratio. Figure 3 shows how the concentrators are connected for a 4 to 1 concentration ratio.

**1.12** Station numbers are assigned in pairs and a translation from station number to line connector equipment number (scan point number) or vice versa is made by translation in the control unit. Changes in station equipment terminations may be necessary to balance the load on the B links. Station lines can be transferred to other concentrators or within a concentrator without



| CAPACITY TABLE                              |                       |               |
|---|-----------------------|---------------|
| EQUIPMENT                                   | LINE CONTROL CAPACITY | LINE CAPACITY |
| DATA CONVERTER FRAME                        | 2048                  | 0             |
| LINE SWITCH CONTROLLER FRAME                | 1024                  | 0             |
| LINE SWITCHING FRAME                        | 0                     | 256           |
| CONCENTRATOR (PART OF LINE SWITCHING FRAME) | 0                     | 32            |

NOTE:

EACH LINE SWITCHING FRAME IS EQUIPPED WITH EIGHT 2:1 CONCENTRATORS FOR A TOTAL OF 256 LINES; HOWEVER B LINKS ARE MULTIPLIED FOR 4:1 LCR RESULTING IN 64 B LINK OUTPUTS PER LINE SWITCHING FRAME (LSR).

Fig. 2—Line Connector Frames for a 4A Switch Unit Equipped with the Maximum Number of Line Terminals

changing the station number. However, these changes must be accompanied by administration changes in directory number to line connector equipment number (LCEN) tables and in LCEN to directory number tables.

2. EQUIPMENT AND OPERATION

2.01 The 4A switch unit (Fig. 4) consists of the line connector and the 3A TDS. These send messages over data links to the control unit located at a central office in response to changes in line, trunk, or circuit conditions (ie, off-hook, on-hook, or flash). The control unit contains memory and logic circuits needed to control switch unit operation. The control unit sends data messages over data links to the line connector and to the 3A TDS to produce the desired connections or changes in connections required for call processing.

2.02 The 3A TDS functions the same as when it is used alone (see Section 240-101-102), except connection is made to the line connector rather than to lines. To increase the trunk capacity of

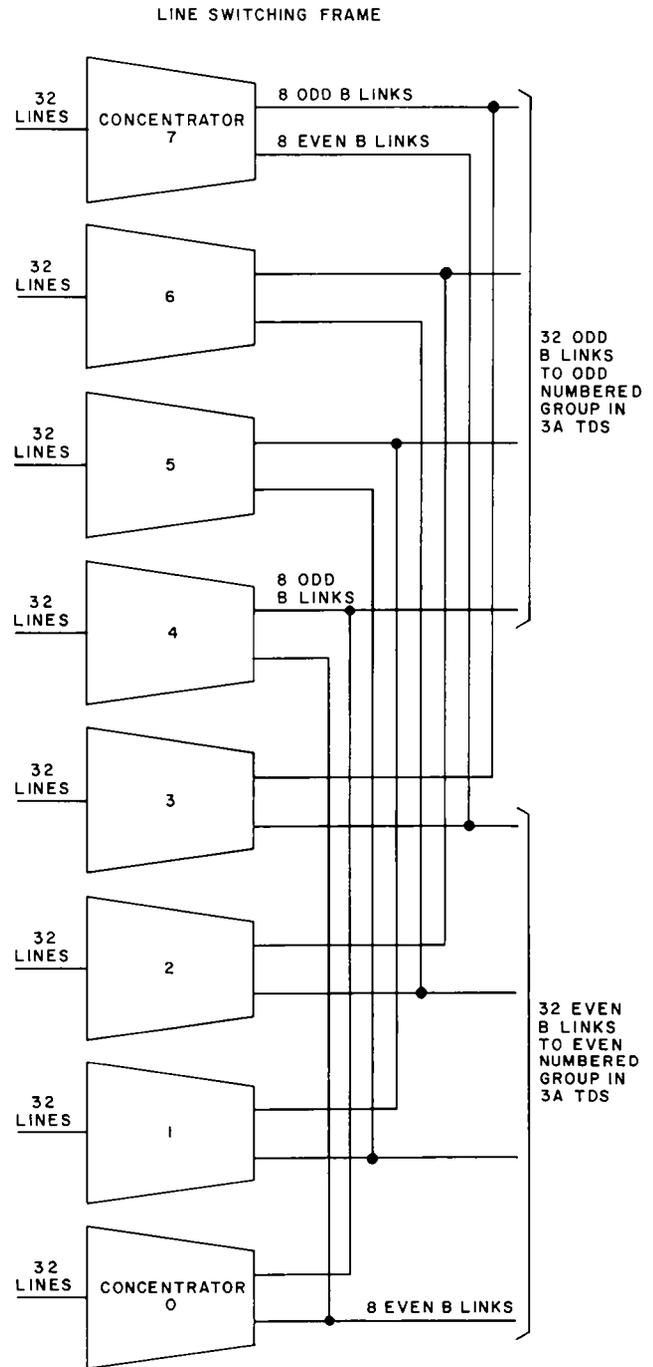


Fig. 3—4A Switch Unit B-Link Connections for 4:1 LCR

the 3A TDS, groups 0, 1, 2, 3, 5, and 6 may be equipped with trunks to permit a maximum of 332 trunk circuits. Group 7 is for up to six 6-party conference circuits. Groups 8 through 15 provide for a maximum of 510 B links.

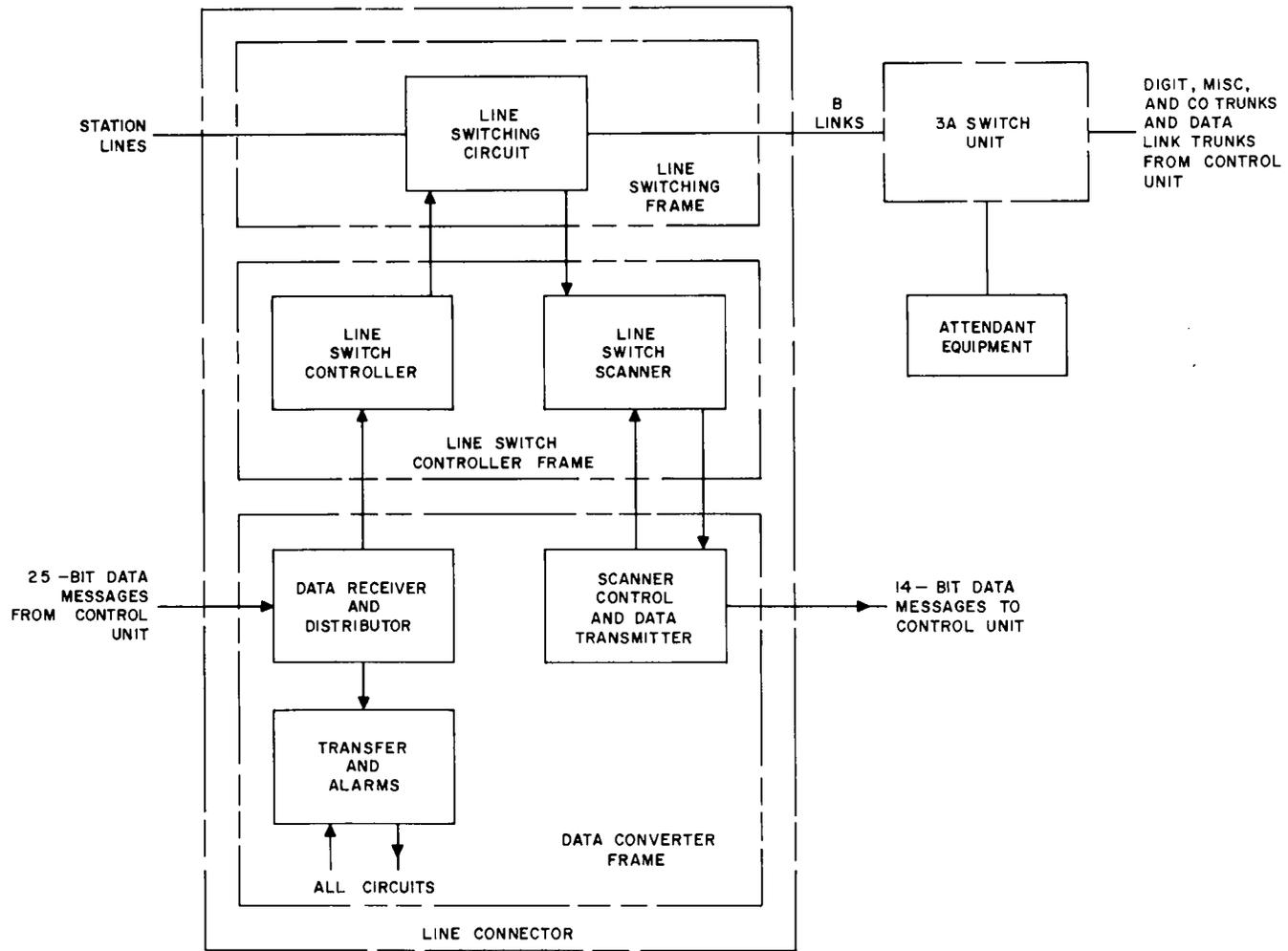


Fig. 4—4A Switch Unit Block Diagram

**2.03** The line connector is comprised of three different types of frames. These are the line switching frame, the line switch controller frame, and the data converter frame.

**2.04** The line switching circuits contain ferrod sensors and ferreed relay line concentrators. When a line goes off-hook, the line switch scanner detects a change in the sensor output. The scanner control and data transmitter determine which lines are being scanned and send a 14-bit message to the control unit over the data link, indicating the line connector equipment number that went off-hook.

**2.05** The control unit determines the A link (the connection between the two ferreed switches) and the B link that are to be connected in the circuit. A 25-bit message is transmitted to the line

connector data receiver and distributor. Also, the control unit alerts the 3A TDS portion of the program to expect a message from the 3A TDS indicating the B link has gone off-hook. The 25-bit message contains the order to be carried out (connect in this case), the line switching frame, concentrator, concentrator line, and B link on the concentrator which are involved in the connection. The data distributor gates the message to the line switch controller. The line switch controller will operate path select relays and pulse the ferreed cross points of the line switching circuits. The selected ferreeds close to connect the line, A link and B link together. For a connect order, a cutoff ferreed is also operated to disconnect the ferrod sensor for the line so that additional off-hooks will not be detected. The B link will now appear off-hook in the 3A TDS. This will be handled just

as in normal 3A TDS operation. In this instance, the B link will be connected to a digit trunk so that dialing may occur.

**2.06** When the line goes on-hook, the 3A TDS detects the change in scan point condition and sends a 14-bit data message to the control unit. The control unit determines from its memory what changes need to be made in the 3A TDS and in the line connector. A 47-bit message is sent to the 3A TDS to cause it to disconnect the time division connection, and a 25-bit message is sent to the line connector. The 25-bit message is similar to the connect message, except that the order is now a disconnect which causes the line switch controller to disconnect the line from the A link and to release the cutoff ferreed, thus restoring the ferrod sensor so that the next off-hook occurrence of the line will be detected.

**2.07** Other messages are sent to the line connector to perform tests and to switch on-line and standby equipment. The line connector also sends messages to the control unit to indicate status of equipment, failures of tests, receipt of messages with bad parity, and equipment failures.

### 3. LINE CONNECTOR

**3.01** The line connector (Fig. 5) connects station lines to B links in response to messages on the data link from the control unit. It also sends a message over the data link to the control unit when a station line goes off-hook. Flashing and on-hooks are recognized at the 3A TDS.

**3.02** The line connector circuits are divided physically into a data converter frame, one or two line switch controller frames, and one to four line switching frames for each controller frame.

**3.03** The data converter frame contains data receiver and distributor circuits and scanner control and data transmitter circuits. All data messages are handled through these circuits. Also, the scanning of lines is controlled by circuits of the data converter frame.

**3.04** The line switch controller frame carries out orders for tests and changes in station line and B link connections and performs scanning functions to locate station lines that go off-hook.

**3.05** The line switching frame contains the circuits that actually connect and disconnect the station lines and the B links. It contains the ferrod sensors that are used in the detection of station requests for service.

### SCANNING

**3.06** The line scanner ferrods are scanned 16 at a time. Outputs from the ferrod sensor matrix in the line switching circuit are applied to the line scanner circuits of the line scanner. Any line that has gone off-hook and whose cutoff ferreed has not disconnected its ferrod will be recognized by the scanner. If an off-hook is detected, scanning is stopped and the scan point number of the line is transmitted to the control unit. Scanning is controlled by a binary counter in scanner control. This counter supplies the scan point number which is included in the message to the control unit. The state of the binary counter is translated by the address translator into the group of 16 lines that is to be scanned. This information is applied by cable drivers to the access circuits of the scanners. The access circuit enables the line scanner output circuit and activates one of 64 crosspoints in the core matrix. The core matrix output for the crosspoint addressed causes the group of 16-line ferrods corresponding to the binary counter state to be interrogated. The 16 ferrod outputs are applied to the enabled line scanner output circuit. Also, if there is no trouble in the interrogate path of the ferrods, an all-seems-well output will allow the scan results to be used. The scan result is stored temporarily in the input register circuit. If an off-hook is detected, the binary counter is stopped by the sending mode control circuit. Each line switch scanner circuit is able to scan all lines in the line switching frames (up to four) with which it can work.

### MESSAGE FORMATION

**3.07** With the scanner stopped, the binary state of the counter represents the scan point number of the line that has gone off-hook. This scan point number is transmitted as part of the message to the control unit.

**3.08** The sending mode control determines when a message is to be sent and times the transmission of each message bit. The message forming circuit sends the start bit (Fig. 6A) followed by the highest order bit of the scan point number,

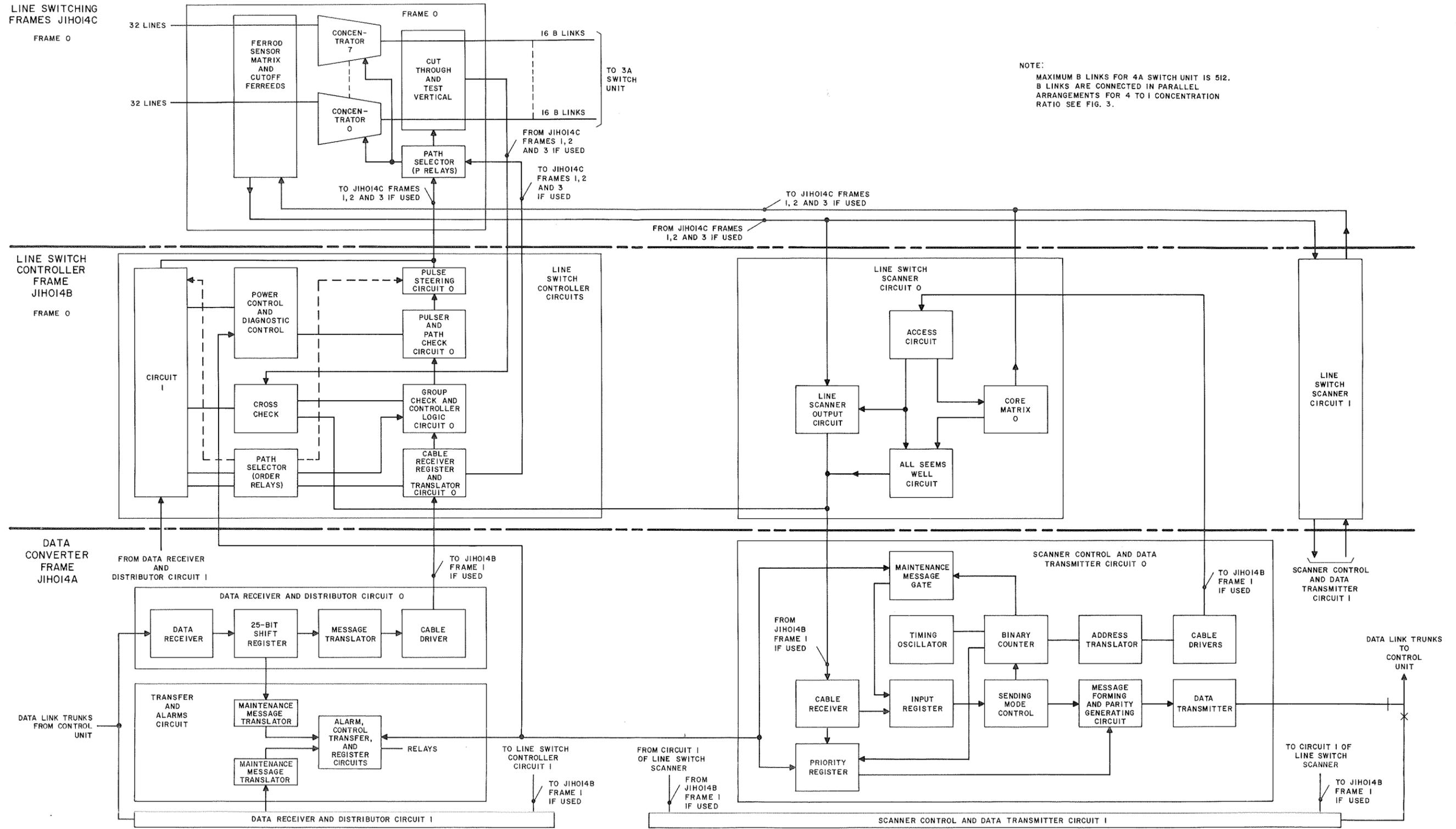


Fig. 5—Line Connector Block Diagram

which in turn is followed by the other bits of the scan point number. Bit 13 is a status bit which is a 1 for line messages or a 0 for a maintenance or a priority message. The parity generating circuit counts the ones transmitted and causes the fourteenth bit to make the total number of ones in the message odd. The data transmitter changes its output frequency according to the bit being transmitted; for a 1 the output frequency is 1150 cps, and for a 0 the output frequency is 1850 cps.

serially as 1150 cps and 1850 cps signals that are detected by the data receiver as 1s and 0s, respectively, and are fed to a 25-bit shift register.

**MESSAGE RECEPTION AND TRANSLATION**

**3.09** A 25-bit message from the control unit controls all actions at the line connector, except for manual control of power at the frame and transfer of data links. This message is received

**3.10** When all 25 bits have been received and the parity of the message has been checked, the message is acted on by the message translator of the distributor circuit if bits 4 and 5 are 01 (Fig. 6B) or by the maintenance message translator of the transfer and alarms circuit if bits 4 and 5 are 10 (Fig. 6C).

**3.11** A maintenance message causes the transfer circuits to operate relays which enable a standby circuit or make a maintenance roll call. In a maintenance roll call, the control unit requests the status, on-line or off-line, of the duplicated

STATUS:

- 0—FOR MAINTENANCE OR PRIORITY MESSAGE
- 1—FOR LINE CONNECTOR MESSAGE

| BIT     | 1                     | 2                | 3           | 4           | 5           | 6      | 7      | 8      | 9 | 10 | 11 | 12 | 13                         | 14                         |
|---------|-----------------------|------------------|-------------|-------------|-------------|--------|--------|--------|---|----|----|----|----------------------------|----------------------------|
| MEANING | S<br>T<br>A<br>R<br>T | 1<br>0<br>2<br>4 | 5<br>1<br>2 | 2<br>5<br>6 | 1<br>2<br>8 | 6<br>4 | 3<br>2 | 1<br>6 | 8 | 4  | 2  | 1  | S<br>T<br>A<br>T<br>U<br>S | P<br>A<br>R<br>I<br>T<br>Y |
|         | =1                    | SCAN POINT       |             |             |             |        |        |        |   |    |    |    |                            |                            |

A 14-BIT MESSAGE TO CONTROL UNIT

| BIT     | 1                     | 2                | 3                               | 4                     | 5                               | 6                | 7           | 8   | 9                          | 10  | 11                              | 12  | 13                         | 14   | 15   | 16    | 17    | 18    | 19     | 20     | 21     | 22     | 23      | 24      | 25      |          |
|---------|-----------------------|------------------|---------------------------------|-----------------------|---------------------------------|------------------|-------------|---|----------------------------|---|---------------------------------|---|----------------------------|------|------|-------|-------|-------|--------|--------|--------|--------|---------|---------|---------|----------|
| MEANING | S<br>T<br>A<br>R<br>T | S<br>C<br>A<br>N | A<br>D<br>D<br>R<br>E<br>S<br>S | O<br>R<br>D<br>E<br>R | N<br>O<br>T<br>U<br>S<br>E<br>D | L<br>S<br>C<br>F | L<br>S<br>F | C<br>O<br>N<br>N<br>E<br>C<br>T<br>O<br>R | L<br>I<br>N<br>E<br>I<br>N | C<br>O<br>N<br>N<br>E<br>C<br>T<br>O<br>R | B<br>L<br>I<br>N<br>K<br>I<br>N | C<br>O<br>N<br>N<br>E<br>C<br>T<br>O<br>R | P<br>A<br>R<br>I<br>T<br>Y |      |      |       |       |       |        |        |        |        |         |         |         |          |
|         | 1                     | 1                | 0/1                             | 0                     | 1                               | 0                | 0           | 0   | 0                          | 1:2                                       | 1:4                             | 1:8                                       | 1:16                       | 1:32 | 1:64 | 1:128 | 1:256 | 1:512 | 1:1024 | 1:2048 | 1:4096 | 1:8192 | 1:16384 | 1:32768 | 1:65536 | 1:131072 |

B 25-BIT LINE SWITCH CONTROLLER FRAME MESSAGE FROM CONTROL UNIT

| BIT     | 1                     | 2                | 3                               | 4                               | 5                               | 6                | 7                               | 8                               | 9                | 10                              | 11                              | 12               | 13                              | 14                         | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---------|-----------------------|------------------|---------------------------------|---------------------------------|---------------------------------|------------------|---------------------------------|---------------------------------|------------------|---------------------------------|---------------------------------|------------------|---------------------------------|----------------------------|----|----|----|----|----|----|----|----|----|----|----|
| MEANING | S<br>T<br>A<br>R<br>T | S<br>C<br>A<br>N | A<br>D<br>D<br>R<br>E<br>S<br>S | N<br>O<br>T<br>U<br>S<br>E<br>D | M<br>E<br>S<br>S<br>A<br>G<br>E | B<br>I<br>T<br>S | N<br>O<br>T<br>U<br>S<br>E<br>D | M<br>E<br>S<br>S<br>A<br>G<br>E | B<br>I<br>T<br>S | N<br>O<br>T<br>U<br>S<br>E<br>D | M<br>E<br>S<br>S<br>A<br>G<br>E | B<br>I<br>T<br>S | N<br>O<br>T<br>U<br>S<br>E<br>D | P<br>A<br>R<br>I<br>T<br>Y |    |    |    |    |    |    |    |    |    |    |    |
|         | 1                     | 1                | 0/1                             | 1                               | 0                               | 0                | 0                               | 0                               | 0                | (SAME AS BITS 18 TO 22)         | 0                               | 0                | 0                               | (SAME AS BITS 10 TO 14)    | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |

C 25-BIT TRANSFER AND ALARMS MESSAGE FROM CONTROL UNIT

**Fig. 6—Line Connector Message Formats**

equipment such as scanner controls and data distributors. The status of each equipment circuit is kept in a maintenance register. The roll call will result in maintenance messages being transmitted to the control unit. Numerous equipment changes can be made to maintain service and to permit repairs to be performed, since the circuits in the data converter frame and in the line switch controller frame are duplicated.

**3.12** A line switch message will be applied by the cable driver to the line switch controller. The line switch controller circuit to which the message is addressed will translate the order and the path portion of the message.

### CONTROL OF LINE SWITCHING CIRCUITS

**3.13** The order portion of the message is applied to the path selector of the line switch controller circuit where it energizes the selected order relay. The path portion of the message is applied to the path selector of the line switching frame where it energizes a P1xx relay, a P2xx relay, and a P3xx relay. Figures 7 and 8 show a typical path selected by P101, P205, and P306 for the different orders that can be applied. The cut-through relay contacts, shown in the B link of the talking path, open the tip and ring leads during the time ferreed switching is occurring. The cutoff ferreed serves to disconnect the line ferrod on a line connect order and to connect the line ferrod after the call is terminated.

**3.14** The group check and controller logic circuits check that one and only one relay in each of the order P1xx, P2xx, and P3xx relay groups operates. Those circuits also time the operation of the other control circuits.

**3.15** Before the selected connection is cut through, the cross-check circuit tests the line for foreign potentials that would indicate a trouble condition on the line involved.

**3.16** The diagnostic control circuits permit manual control of the mode of operation of the line switching controller circuits by using the manual pushbutton keys, designated OFF-0, OFF-1, and NOR.

**3.17** The power control circuit provides distribution of power to the line switching controller frame.

**3.18** When the path-select relays and cut-through (CT) relay have operated, the pulse and path-check circuit initiates a high current pulse. The path of this current pulse is determined by which order relay is energized. Contacts of the order relays form the pulse steering circuit. This circuit determines how the current is applied to two of the points (A00, A10, and D00), as shown in Fig. 7 and 8. Order 3 is to test the pulser operation. During this check, the pulse is applied across a known resistance. If this test passes, the trouble can be isolated to the pulse path. The pulse-path circuit checks for grounds in the pulse path, although a ground will not prevent the pulse circuit from operating.

**3.19** The current pulse from the pulser controls all ferreed operations in the line switching frame needed to set up and disconnect calls.

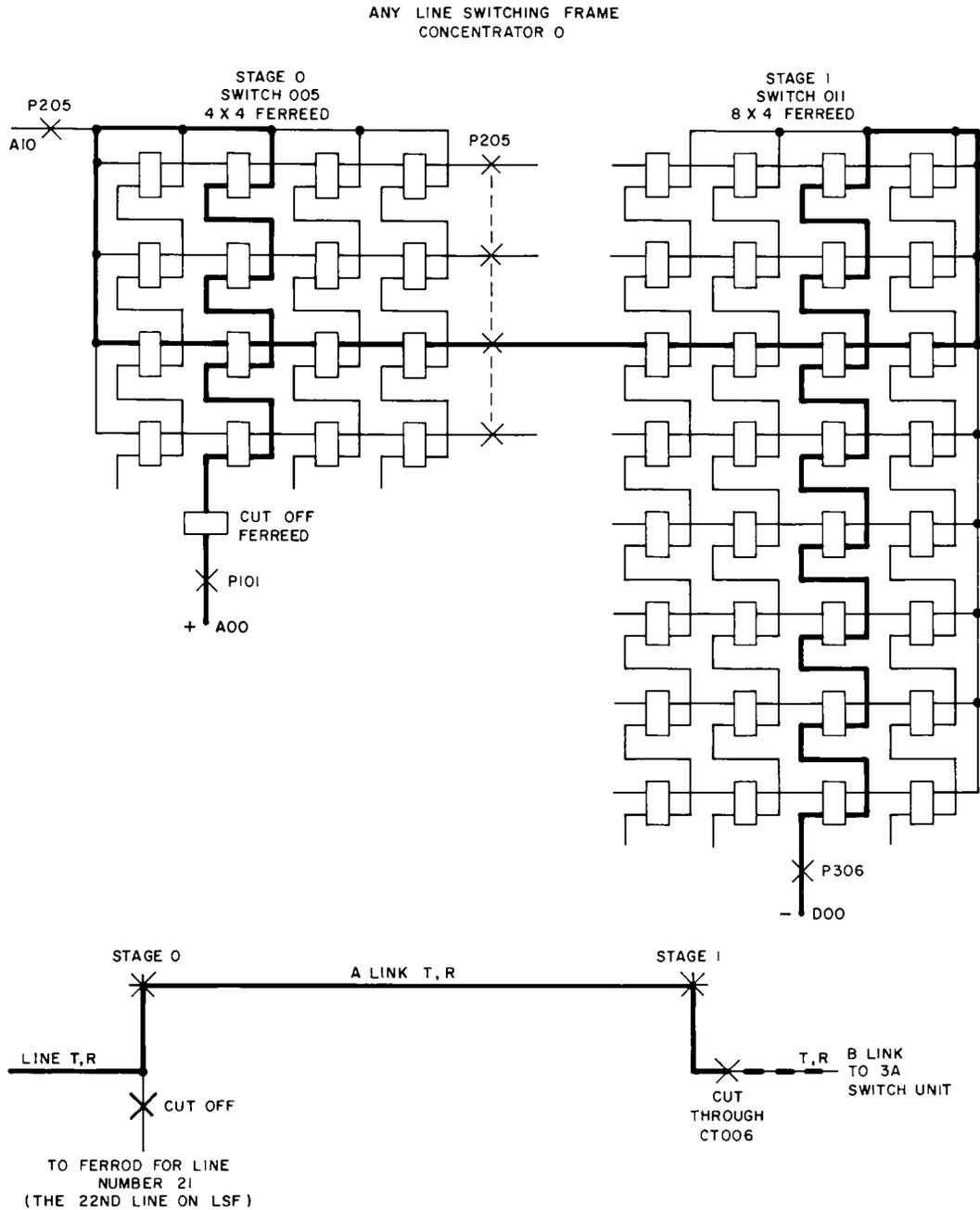
**3.20** The circuits of the line switching frame include the concentrators that contain the two stages of ferreed switching to connect a line to a selected B link. The cut-through and test vertical circuit checks the talking path before it is cut through. The circuit opens the talking path during testing and switching, then connects it so that no current is switched by the ferreed switches. These details are shown functionally in Fig. 7 and 8. The ferrod sensor matrix and the cutoff ferreeds provide means of sensing off-hook originations on all lines. The cutoff ferreed connects or disconnects the line ferrod as requested by the received order.

### TRANSFER AND ALARMS

**3.21** The transfer and alarms circuits provide means of detecting equipment troubles and indicating equipment status. This information is sent to the control unit in maintenance messages. The transfer and alarms circuits also control which of the duplicated circuits of the data converter frame and the line switch controller frames are on-line in accordance with maintenance messages from the control unit.

### 4. 3A TDS

**4.01** One 3A TDS (see Section 240-101-102) is used as part of a 4A switch unit. In a 4A switch unit, B links from line connectors terminate on-the-line circuits of the 3A TDS, and extension stations are connected to the line connector terminals.



**Fig. 7—Order 1 Connect Line to B-Link and Disconnect Ferrod**

**4.02** To handle the large trunk capacity of the 4A switch unit, line groups 5 and 6 in the 3A TDS are used for trunk connections.

**4.03** Digit trunks 7 and 8 of the 3A switch unit are used as spare trunks for the data link

of the line connector and must meet the transmission requirement of data link trunks.

**4.04** Figure 1 shows the basic blocks of a 4A switch unit. Figure 3 shows connection between concentrators in the line switching frame

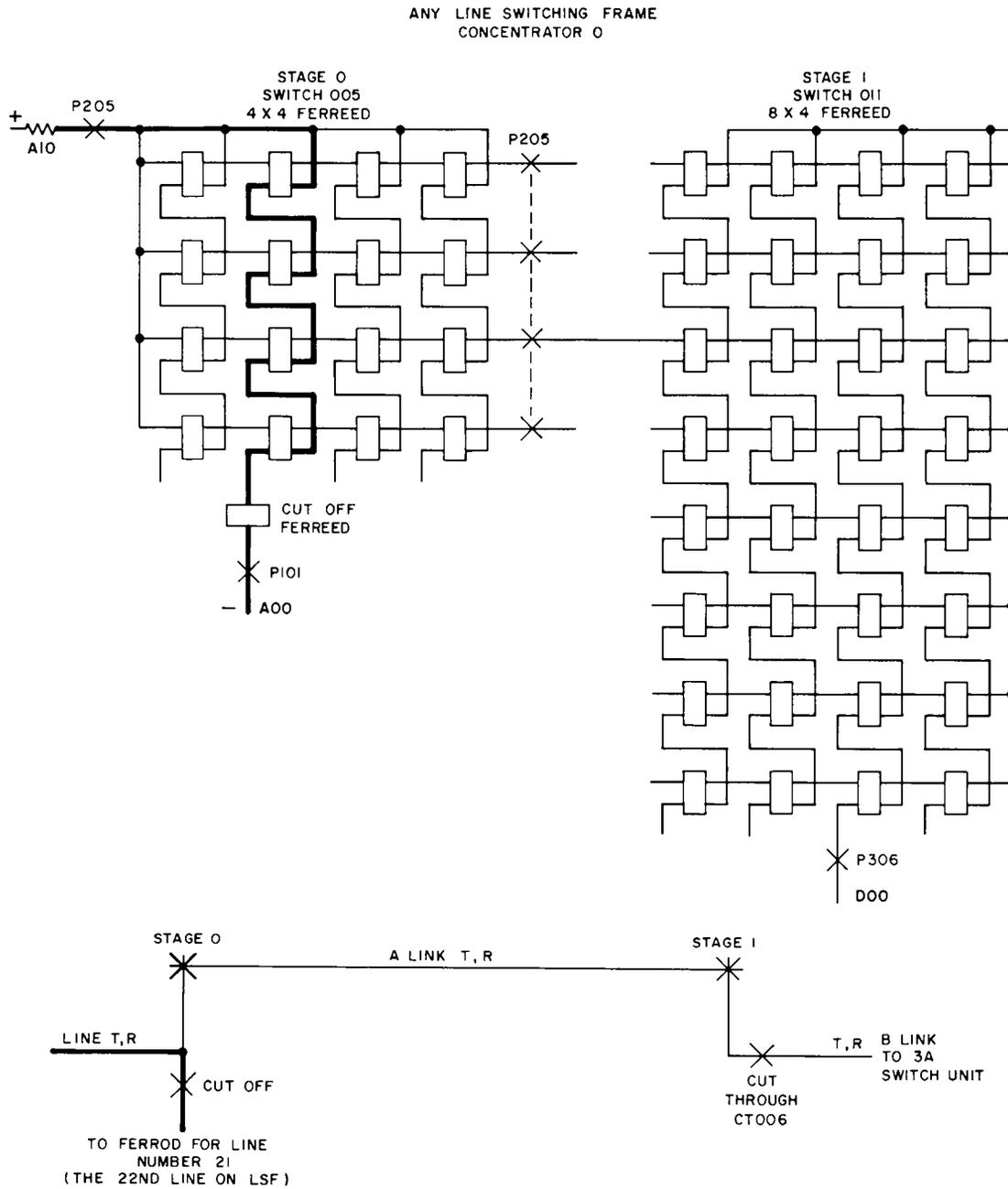


Fig. 8—Order 7 Disconnect Line and Connect Line Ferrod

of a line connector and 3A switch units for 4 to 1 concentration ratios.

## 5. LINE CONNECTOR MESSAGES

### MESSAGES TO CONTROL UNIT

**5.01** The 14-bit messages transmitted by the line connector to the control unit include both maintenance and line messages. These messages are transmitted at 643.4 bits per second with 1150 cps being a 1 and 1850 cps being a 0. The usual message is the line off-hook message. There are two types of maintenance message: normal and priority. Figure 6A shows the format for all messages to the control unit.

**5.02** In the line off-hook message (Fig. 6A), bit 13 is always a 1. Bits 2 through 13 represent the binary scan point number or line connector equipment number (LCEN) of the off-hook line in the line connector. Bit 1 is the start bit and is one for all messages. The parity bit, bit 14, is chosen to make the total number of ones in the message odd.

**5.03** In the maintenance and priority messages, bit 13 is 0; however, the normal maintenance message uses low scan point numbers while the priority message (bad parity, translator failure, and false cross and ground) uses three of the four highest scan point numbers. The maintenance messages are used to indicate which equipment is on-line. All equipment circuits (Fig. 4) of the data converter frame and the line switch controller frame are duplicated. The circuits are identified as 0 and 1. Line connectors with two J1H014B frames use 2-digit indications 00, 01, 10, and 11. The first bit represents the J1H014B frame, and the second bit represents the circuit on the frame. The circuits of the line switching frame are not duplicated and are, therefore, always on-line. The different maintenance and priority messages are listed in Table A with their meanings. These maintenance and priority messages inform the control unit of conditions in the line connector.

### MESSAGES FROM CONTROL UNIT

**5.04** The 25-bit messages, transmitted from the control unit to the line connector, control which scanners and controllers are on-line, ask for a roll call of the maintenance register, and cause operations needed to connect, disconnect, test, or

condition a selected path in the line switching frame. These messages are transmitted at 735.3 bits per second with 1150 cps being a 1 and 1850 cps being a 0.

**5.05** Figure 6C shows the format for a transfer and alarms message. Bits 4 and 5, called the address, are always 10 for a transfer and alarms message. Bits 1 and 2 are one for all messages. Bit 3 is the go-ahead bit. If bit 3 is 1, the scanner can resume scanning. If a go-ahead is not received in 0.5 second, the scanner is free to resume scanning anyway. The actual transfer message is contained twice in the 25-bit message, once in bits 10 through 14, and again in bits 18 through 22. Both of these must be the same if the line connector is to respond to the order. The meanings of the messages are given in Table B. In each case where one circuit is placed on-line, the other is placed in standby.

**5.06** Bit 25 is chosen for an odd number of ones in the message. The other bits of the message are not translated but will be 0.

**5.07** The 25-bit line switching message contains an order to be performed and the path selected. The line switching message format is shown in Fig. 6B. Here the address bits 4 and 5 are always 01. Bits 1 and 2, the start bits, are always ones. Bit 3, the go-ahead bit, is 1 if scanning can begin; otherwise, scanning will start in 0.5 second. Bits 6, 7, and 8 contain the order that is to be performed. The orders are listed in Table C.

**5.08** Figure 7 shows the circuit paths for performing the line connection orders. During the process of setting up and taking down a call, two orders will be received. Each order will determine which two of the three connections (A00, A10, and D00) to the paths are used. The polarity of connection is important when the cutoff ferreed is in the pulse path. The cutoff ferreed is a bipolar ferreed that operates to disconnect the line ferrod when A00 is made positive (+) and to connect the line ferrod when A00 is made negative (-). The ferreed switches in the 4 by 4 and 8 by 4 switches are opened if current passes through only one winding of a switch and are closed if current passes through both windings of a switch (a crosspoint). The cut-through relay opens the tip and ring leads during the time the ferreed switches are being operated to prevent any current in the talking path during switching. After switching is completed,

**TABLE A**  
**MAINTENANCE AND PRIORITY MESSAGES**

| MESSAGE BITS        | MAINTENANCE REGISTER DESIGNATION | MESSAGE (LAST 3 ARE PRIORITY MESSAGES)                               |
|---------------------|----------------------------------|--|
| 2 to 7 8 9 10 11 12 |                                  |  |
| all 0 0 0 0 0 1     | STG0                             | Short to ground in pulser on line switch controller frame 0 (LSCF 0) |
| 0 0 0 1 0           | STG1                             | Short to ground in pulser on LSCF 1                                  |
| 0 0 0 1 1           | FAL                              | Fuse alarm   |
| 0 0 1 0 0           | PR00                             | Power removed from controller 00                                     |
| 0 0 1 0 1           | PR01                             | Power removed from controller 01                                     |
| 0 0 1 1 0           | PR10                             | Power removed from controller 10                                     |
| 0 0 1 1 1           | PR11                             | Power removed from controller 11                                     |
| 0 1 0 0 0           | SBF00                            | Scan access bias failure 00  |
| 0 1 0 0 1           | SBF01                            | Scan access bias failure 01  |
| 0 1 0 1 0           | SBF10                            | Scan access bias failure 10  |
| all 0 0 1 0 1 1     | SBF11                            | Scan access bias failure 11  |
| 0 1 1 0 0           | DGOL0                            | Data receiver—distributor 0 on line                                  |
| 0 1 1 0 1           | DGOL1                            | Data receiver—distributor 1 on line                                  |
| 0 1 1 1 0           | SOL0                             | Scanner control—data transmitter 0 on line                           |
| 0 1 1 1 1           | SOL1                             | Scanner control—data transmitter 1 on line                           |
| 1 0 0 0 0           | LOL00                            | LSCF 0 controller 0 on line  |
| 1 0 0 0 1           | LOL01                            | LSCF 0 controller 1 on line  |
| 1 0 0 1 0           | LOL10                            | LSCF 1 controller 0 on line  |
| 1 0 0 1 1           | LOL11                            | LSCF 1 controller 1 on line  |
| 1 0 1 0 0           | PRA0                             | Power removed from 0 circuit in A frame                              |
| 1 0 1 0 1           | PRA1                             | Power removed from 1 circuit in A frame                              |
| all 1 1 1 0 0       | BP                               | Bad parity message received  |
| 1 1 1 0 1           | TF                               | Translator failure has occurred                                      |
| 1 1 1 1 0           | FCG                              | False cross and ground test failed                                   |

**TABLE B**  
**TRANSFER AND ALARM MESSAGES**

| MESSAGE BITS                         | MESSAGE MEANING  |
|--------------------------------------|--|
| 10 11 12 13 14<br>and 18 19 20 21 22 |  |
| 1 0 0 0 1                            | Put scanner control—data transmitter 0 on line                       |
| 1 0 0 1 0                            | Put scanner control—data transmitter 1 on line                       |
| 1 0 0 1 1                            | Put data receiver and distributor 0 on line                          |
| 1 0 1 0 0                            | Put data receiver and distributor 1 on line                          |
| 1 0 1 0 1                            | Put LSCF 0 controller 0 (C00) on line                                |
| 1 0 1 1 0                            | Put LSCF 0 controller 1 (C01) on line                                |
| 1 0 1 1 1                            | Put LSCF 1 controller 0 (C10) on line                                |
| 1 1 0 0 0                            | Put LSCF 1 controller 1 (C11) on line                                |
| 1 1 0 0 1                            | Make roll call of maintenance register (results in messages of 5.03) |

**TABLE C**  
**LINE CONNECTOR ORDERS**

| BIT 6,7,8 | ORDER  |
|-----------|--|
| 001       | 1 Connect line, disconnect ferrod (connect)            |
| 010       | 2 Test ferreed switches                                |
| 011       | 3 Test pulser (no pulsing of ferreeds)                 |
| 100       | 4 Disconnect line and disconnect ferrod (high and dry) |
| 101       | 5 Connect with ferrod connected (test call)            |
| 111       | 7 Disconnect line, connect ferrod (disconnect)         |

the cut-through relay contacts close to connect the talking path.

**5.09** The path for pulsing the ferreeds is selected by operating three relays. The relays that are to be operated in a line switching frame are determined by bits 13 through 24 of the incoming message. The message gives the line switch controller frame (LSCF), the line switching frame

(LSF), the concentrator in the LSF, the line in the concentrator, and the B link in the concentrator. For Fig. 7 and 8, bits 13 through 24 of the message would be as shown in Table D.

## 6. MAINTENANCE

**6.01** If a failure occurs in the data converter frame or in the line switch controller frame,

**TABLE D**  
**PATH PORTION OF MESSAGE**

| BIT NO.   | 10   | 11  | 12           | 13 | 14 | 15 | 16                      | 17 | 18 | 19 | 20                        | 21 | 22 | 23 | 24 |
|-----------|------|-----|--------------|----|----|----|-------------------------|----|----|----|---------------------------|----|----|----|----|
| STATE     | 0    | 0   | 0            | 0  | 0  | 0  | 1                       | 0  | 1  | 0  | 1                         | 0  | 1  | 1  | 0  |
| EQUIPMENT | LSCF | LSF | Concentrator |    |    |    | Line in<br>Concentrator |    |    |    | B Link in<br>Concentrator |    |    |    |    |
|           |      |     | LSF          |    |    |    |                         |    |    |    |                           |    |    |    |    |

the maintenance program at the control unit will detect the failure and substitute the standby circuit for the defective circuit. If the fault is in the data link, digit trunks 7 and 8 of the 3A TDS will be interchanged with the data link trunks.

**6.02** Circuit pack packaging of the equipment permits easy replacement of defective equipment to facilitate maintenance.

**6.03** For troubles that occur in the unduplicated line switching frame, only certain lines will be affected. Troubles are located by setting up calls locally or by teletypewriter and then checking the state of relays involved in the connection.