SWITCHING SYSTEM NO. 307
LINE TRANSFER CIRCUIT UNIT
DESCRIPTION

CONTENTS PAGE

1. GENERAL

1.01 This is one of a series of sections describing the station control equipment associated with switching system No. 307. This section is issued to describe the function and operation of J53037B and J53037F line transfer circuits (SD-69507-01).

1.02 Switching system No. 307 (Fig. 1) is a communications control system designed for installation on a customer's premise. The system performs such functions as switching voice or data locally or intercity over switched networks. The switching functions may be initiated either manually or automatically, depending upon the application.

1.03 A block diagram of the station control equipment is shown in Fig. 2. The function of this equipment is to provide the station switching and control required to originate outgoing calls to a 4-wire central office and to complete incoming calls from the central office.

1.04 The key telephone set allows an operator to establish voice contact with operators at other stations and to initiate data transmission between stations. The line circuit provides transmission line termination and control circuits for the key telephone set and the customer and data equipment. The sequence circuit provides automatic control of the synchronization required between data sets and between customer-provided equipment. The dual access switch provides a means for completing a connection to one of two central offices or to another dual access switch. The alarm circuit detects the failure of the following: dc power fuses, ringing power supply, 205A data set carrier signal, 205A data set ready signal, and 110v ac power supply. When an alarm

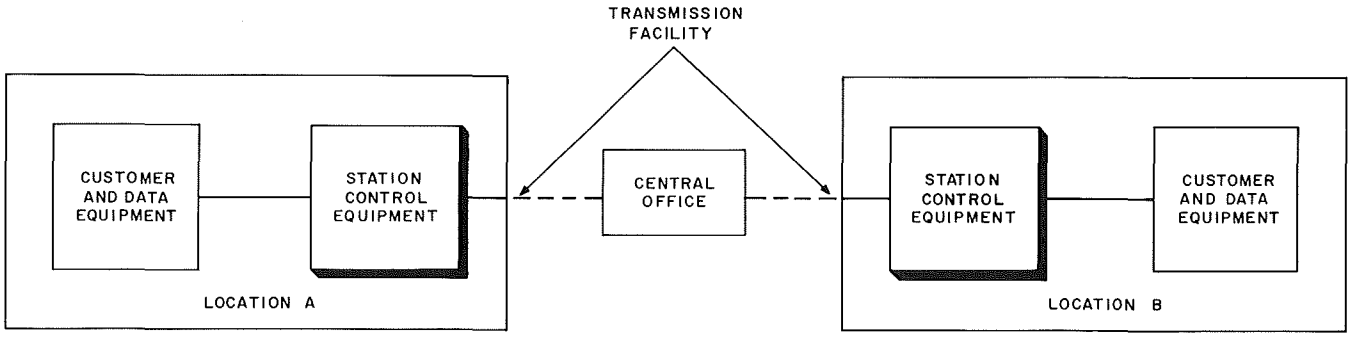


Fig. 1 — Switching System No. 307

is detected, the alarm circuit provides a signal to the key telephone set.

1.05 The J53037F line transfer circuit is installed at voice stations in the switching system to provide switching of a 4-wire communication line between a clear voice telephone and secure data equipment. Circuits in the transfer circuit also enable the central office to remotely test the data equipment used in the system.

1.06 The J53037B line transfer circuit is used at high speed send/receive (HS S/R) stations. This line transfer circuit is more complex than the line transfer circuit used at voice stations. In addition to transferring the line from a clear voice telephone to secure data equipment, this circuit enables an HS S/R set to originate or receive secure calls automatically. The J53037B line transfer circuit also enables the central office to remotely test the data equipment used in the system.

1.07 Refer to Fig. 3 for a simplified block diagram illustrating the functions of the line transfer circuits.

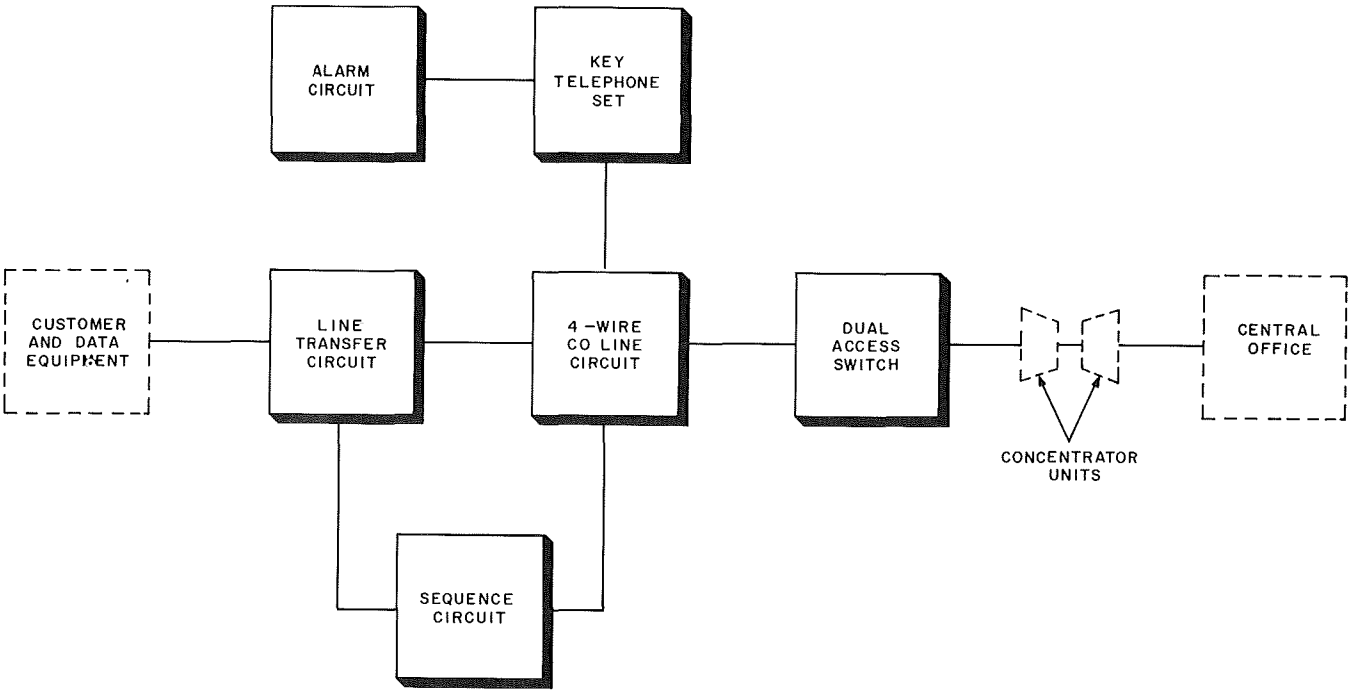


Fig. 2 — Station Control Equipment

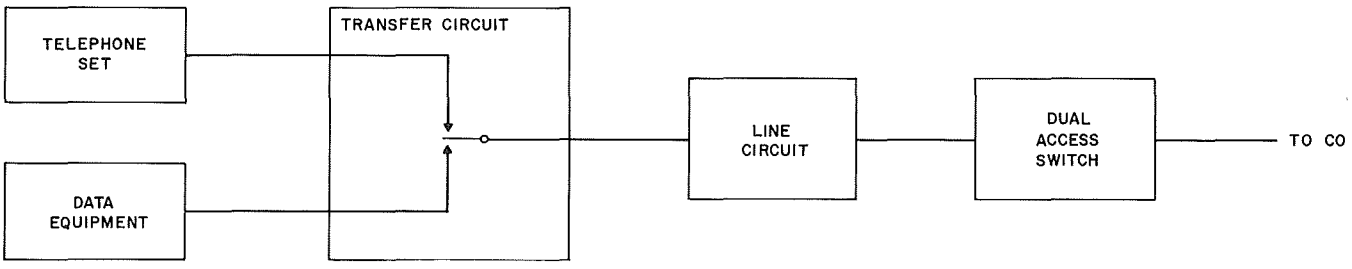


Fig. 3 — Transfer Circuit — Simplified Functional Diagram

2. EQUIPMENT DESCRIPTION

Line Transfer Circuit Unit (Voice Station)

2.01 The voice station line transfer circuit unit (see Fig. 4) contains 4 wire-spring relay structures, 2 polar relay structures, 1 component board, 2 attenuator pads, and 2 terminal strips. This equipment is attached to a 189A mounting plate which is 2 inches high and 23 inches wide. This unit is factory-wired and may be mounted on a sliding panel in a control cabinet along with other station control equipment.

Line Transfer Circuit Unit (HS S/R Station)

2.02 The line transfer circuit unit (see Fig. 5) contains 15 wire-spring relay structures, 2 polar relay structures, 4 attenuator pads, 7 component boards, 1 potentiometer, and 4 terminal strips. This equipment is attached to a 228A mounting plate which is 6 inches high and 23 inches wide. This unit is factory-wired and may be mounted on a sliding panel in a control cabinet along with other station control equipment.

3. FUNCTIONAL DESCRIPTION

A. J53037F Line Transfer Circuit

3.01 The line transfer circuit is installed at voice stations to provide transfer switching of a 4-wire communication line between a clear voice telephone and secure voice data equipment. The circuit also provides means for remote testing of the data equipment from the central office. The following paragraphs discuss these major functions in detail under separate headings. In the discussion which follows, reference should be made to SD-69507-01 (not attached) and also to Sequence Charts (SC) 1 and 2. Sequence Charts 1 and 2 provide a graphic presentation of the time order of operation of the relays in the line transfer circuit.

Establishing Clear Voice Calls

3.02 When a clear voice call is to be made from a voice station, the line transfer circuit will function in the following manner.

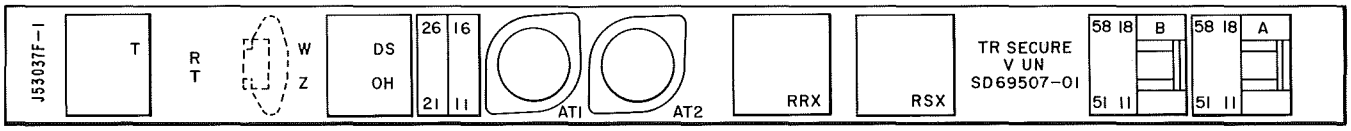


Fig. 4 — J53037F Line Transfer Circuit Unit

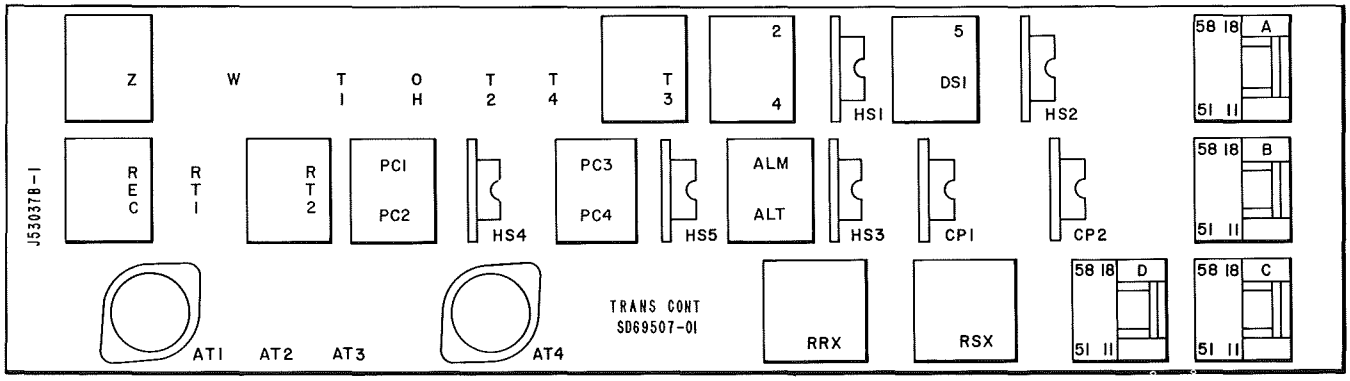


Fig. 5 — J53037B Line Transfer Circuit Unit

3.03 To establish a clear call the key telephone set handset is removed from the switchhook. The LINE key is operated and after dial tone is received, the desired station is called (in the conventional manner), or a call from a remote station is answered. The transmit and receive pairs are passively connected through the break contacts of T relay and back to the 4-wire CO line circuit.

3.04 When the handset is removed off-hook, the switchhook applies ground to OH lead which operates the OH relay. Relay OH is provided as a security device which (when equipped with (X) option) will terminate the transmitting and receiving pairs in resistors if the handset is removed off-hook at any time during secure voice transmission. When (W) option is used, the contacts of OH relay are strapped for each of the 4-wire lines, so that regardless of whether OH relay is operated or released it has no effect on secure voice transmission.

Establishing Secure Voice Calls

3.05 When a secure voice call is to be made from a voice station, a clear voice connection must first be established with the called station as described in 3.03. The line transfer circuit will then function as follows.

3.06 When clear voice connection has been established, the operators at both stations decide which data speed will be used. If 2400 bps is to be used no action is required, DS (data speed) relay remains nonoperated, and its contacts will normally supply +6 volts via SS (speed select) lead to instruct secure data equipment that normal 2400 bps speed will be used. If 1200 bps is the desired speed, the operator will momentarily operate and release the nonlocking 1200 BPS key on the key telephone set. This action will momentarily apply ground to the S(DSK) (data speed key) lead via the line circuit to operate the DS relay. The DS relay locks to ground on the DSL (data speed lock) lead from the line circuit. The operation of the DS relay applies ±10 volts to L(DSK) lead which lights the 1200 BPS key lamp on the key telephone set. Also when the DS relay operates, −6 volts will be applied via SS lead to instruct secure data equipment that 1200 bps data speed will be used.

3.07 The operator (still off-hook) now momentarily operates the nonlocking SEC VCE (T1) transfer key on the key telephone set. Depressing the SEC VCE key places ground on the TR1 lead via the line circuit which operates the W relay. Operation of the W relay places ground on COH (control off-hook) lead to the line circuit.

3.08 Release of nonlocking SEC VCE key at the key telephone set will remove ground from TR1 lead and also from the power side of the Z relay coil. Relay Z operates.

3.09 When Z relay operates, the L(T1) lead to the key telephone set is connected to the LW (lamp wink) lead from the line circuit. This connection provides a winking signal to the key telephone set SEC VCE transfer key lamp. The operation of the Z relay connects leads TT2 and TT3 together to enable the line circuit to maintain off-hook signals to the central office. The key telephone handset is now placed on-hook. This action removes ground from the OH lead and OH relay releases. (See 3.04 for explanation of the OH relay function.) With (Z) option, when the handset is placed on-hook, momentary ground is applied via LK lead to operate T relay which locks to ground through its own contacts. With (Y) option, the T relay will operate immediately after the W relay operates whether or not the handset is on-hook.

3.10 When T operates, the tip and ring leads are connected to the data equipment (205A data set); the L(T1) lead is transferred from the LW lead to the LSY lead where wink voltage continues to be supplied until sequencing is completed by the sequence circuit. In addition, ground is applied via SEQ (sequence) lead to the sequence circuit to initiate the sequencing operation. When the customer data equipment has synchronized, it will apply −6 volt signals to leads RSX (ready send) and RRX (ready receive). Relays RSX and RRX will operate and apply −6 volt signals via leads RSX and RRX to the sequence circuit indicating a ready condition. The functions of the transfer circuit in enabling a secure call are now complete.

Termination of Voice Calls

3.11 In order to release the station control equipment, the key telephone handset must be taken off-hook, the T1 key depressed, and the

handset replaced on-hook. Depressing the T1 key releases the W and Z relays and ground is removed from both the SEQ and COH leads. Release of Z relay opens the TT2 to TT3 loop and extinguishes the SEC VCE L(T1) transfer lamp on the key telephone set. The release of Z relay releases T relay for (Z) option. For the (Y) option, T releases when W releases. When T releases, the tip and ring leads are disconnected from the 205A data set. When the handset is replaced on-hook the OH relay releases. The station control equipment is now released.

3.12 To terminate clear voice calls, the key telephone handset is placed on-hook and station control circuits are released.

Remote Test (205A Data Set)

3.13 A remote test of the 205A data set is normally requested by and conducted from a test center. The station key telephone set rings and is answered by the operator at the voice station in the normal manner. The test center and the operator agree on the data speed to be used in the test. If 1200-bps data speed is to be used the operator operates and releases the 1200 BPS key on the key telephone set. The function of the circuit up to this point is the same as for establishing a secure voice call as described in 3.06.

3.14 The operator then momentarily depresses the TEST 205 (RT1) key on the key telephone set. This action applies ground to the RT1 (remote test 1) lead which operates RT and W relays. Release of TEST 205 key removes ground from the power side of the Z relay causing it to operate. Relays W and Z lock to ground on RTL (remote test lock) lead, and RT relay locks through its own contacts to ground supplied by the W relay.

3.15 Operation of RT relay prevents ground from being applied via SEQ lead to the sequence circuit, applies +6 volts via RMT lead to the 205A data set to indicate a request for remote test operation, and removes —24 volts from RTS lead to the line circuit.

3.16 After W and Z relays operate, circuit operation up to the point of remote testing by the central office is identical to circuit operation discussed in 3.09 through 3.10 with the following exceptions.

(a) The SEC VCE transfer key on the key telephone set will receive continuous lamp wink signals throughout the test via LW lead from the line circuit and lead LYS from the sequence circuit.

(b) The TEST 205 lamp on the key telephone set will receive lamp wink signals via lead L(RT1) when W relay operates. When T relay operates, the lamp wink signal on lead L(RT1) is switched to a steady ±10 volt signal to light the TEST 205 lamp steadily.

3.17 Release of the line transfer circuit after completion of remote test of the 205A data set is normally controlled from the test center which removes ground via the line circuit from RTL lead.

3.18 Removal of ground from RTL lead will remove locking ground from W and Z relays which release. Release of W relay removes ground from COH lead to the line circuit, and also removes locking ground from RT relay which releases. Release of Z relay removes locking ground from T relay which releases.

3.19 Release of the RT relay:

(a) Applies —24 volts via RTS lead to line circuit,

(b) Applies —6 volts to RMT lead to instruct the 205A data set that the transfer circuit has returned to normal, and

(c) Disconnects L(RT1) lead to TEST 205 key lamp at the key telephone set extinguishing the lamp.

3.20 Release of T relay disconnects the transmission pairs from the data set and returns the transfer circuit to normal.

3.21 To terminate a remote test from the voice station key telephone set, the release is initiated by removing the handset from the switchhook.

3.22 The TEST 205 key is momentarily operated and released which places ground on the power side of W relay coil causing W to

release. Release of W relay opens the RTL lead ground to Z relay causing Z to release. From this point, the release of the transfer circuit is identical to that described in 3.18 through 3.20. When the handset is replaced on-hook, the OH relay releases. The transfer circuit is now released.

B. J53037B Line Transfer Circuit

3.23 The line transfer circuit is installed at HS S/R stations to provide transfer control and switching of a 4-wire communication line between a clear voice key telephone set and an HS S/R set. Transfer to the key telephone set provides clear voice connection between HS S/R stations in order to initiate manual sending or receiving of high speed data. Transfer to the HS S/R set provides for automatic sending or receiving of data. The line transfer circuit is designed to operate in any one of the following modes: manual send, manual receive, automatic send, or automatic receive.

3.24 In addition to the major functions described in 3.23 the line transfer circuit also provides switching to enable remote testing of the 205A data set and of the 404A data set. The following paragraphs discuss these functions under separate headings. In the discussion which follows, reference should be made to SD-69507-01 (not attached) and to SC3 through SC8, which provide a graphic presentation of the time order of operation of the relays and other apparatus in the line transfer circuit.

Automatic Send Mode (See SC3)

3.25 The automatic send data mode is initiated from the HS S/R set by operating the ADDRESS key to contact the desired station. The desired data speed is selected and if the speed selected is 2400 bps, the 2400 BPS key is operated. This action operates an interface relay which connects lead B1B to lead 18 to operate the DS1 (data speed 1) relay, which applies +6 volts via the SS (speed select) lead to instruct the 205A data set that selected data speed is 2400 bps. If the selected speed is 1200 bps, the 1200 BPS key is operated. This action removes −6 volts from lead 18 to release the DS1 relay and −6 volts is applied via the SS lead to instruct the 205A data set that the selected data speed is 1200 bps.

3.26 Call precedence is determined by the operation of one of four precedence keys which are available at the HS S/R set. All four precedence keys may not be provided on each unit. Operation of the selected precedence key operates an interface relay and applies −6 volts via its corresponding lead, either lead 27, 28, 29, or 30 to operate either (precedence) PC1, PC2, PC3, or PC4 relay, respectively. The operation of the relay applies −48 volts via precedence lead P1, P2, P3, or P4 through the line circuit to the remote concentrator.

3.27 The START key is operated and released on the HS S/R set. Operation of the key operates an interface relay and applies −6 volts from the HS S/R set via lead 2 (HS S/R set off-hook) to operate relay 2. Operation of relay 2 places ground via the COH lead to the line circuit, and also to T2 relay which operates. Operation of the T2 relay places +6 volts on RSD (request send) lead which enables the 404A set to communicate with the remote 404A set. The operation of T2 also opens the RN3 to RN4 (or RN2) (ringing) lead loop to the line circuit. The operation of T2 relay applies ground to T1 relay causing it to operate. Operation of T1 relay places −24 volts on SO (S operate) lead to the line circuit and transfers the transmitting and receiving pairs to the 404A data set. It also opens the LF to LF2 (lamp flash) lead loop to the line circuit.

3.28 At this point no additional functions of the line transfer circuit occur until the called station answers and all necessary signaling is exchanged by the 404A data sets. When the signaling is completed, −6 volts is applied via lead 4 due to the HS S/R interface relay operating to indicate that the HS S/R set is ready for high speed data transmission.

3.29 When −6 volts is applied to lead 4, relay 4 operates. Operation of relay 4 places ground on T4 relay which operates. Operation of T4 relay places −24 volts on RR (ready receive) lead to the sequence circuit, and opens PR (prepare receive) lead loop from the customer data equipment to the sequence circuit. The operation of T4 relay also places ground on T3 relay which operates.

3.30 Operation of T3 relay initiates the following action.

(a) Switches the transmitting tip and ring leads from the 404A to the 205A data set.

(b) Continues to place —6 volts on the CON (confirm) lead which instructs the 205A set that no carrier will be received from the remote station.

(c) Applies ground via SEQ lead to the sequence circuit which initiates synchronization.

3.31 At this point no additional functions occur at the line transfer circuit until synchronization is complete. When synchronization is completed, a +6 volt RDY (ready) signal is applied from the sequence circuit.

3.32 The +6 volt signal applied to RDY lead from the sequence circuit is applied through a path provided by the break contacts of nonoperated OH and Z relays via lead 21 to the HS S/R set when (X) option is used. The contacts of OH relay are bypassed when (W) option is used. After the +6 volt RDY signal is applied to lead 21, transmission of high speed data begins.

3.33 When data transmission is completed, release of the line transfer circuit is initiated when —6 volts is removed from leads 2 and 4 by the HS S/R set. This action initiates the release of all operated relays and in so doing accomplishes the following.

(a) Ground is removed from COH lead to the line circuit.

(b) The PR lead loop is closed.

(c) Ground is removed from the SEQ lead to the sequence circuit.

(d) —6 volts is retained on CON lead to the 205A data set.

(e) —24 volts is removed from SO lead to the line circuit and from RR lead to the sequence circuit.

(f) Transmitting and receiving pairs are switched back to the line circuit at T1 relay contacts.

(g) Station control equipment releases circuits.

Automatic Receive Mode (See SC4)

3.34 Automatic incoming receive data calls cause the line circuit to ground the TM (timing) lead.

3.35 When ground is placed on TM lead, it causes timing circuit transistor TM1 to turn off and TM2 to turn on, operating T2 relay. Operation of T2 relay opens RN2 (RN4) to RN3 (ringing) lead loop to the line circuit, and places +6 volts on RSD lead to 404A data set to enable the 404A set. Operation of T2 relay also places ground on T1 relay, which operates.

3.36 Operation of T1 relay transfers the transmitting and receiving pairs to the 404A data set, and places —24 volts on SO lead to the line circuit. It also opens the LF to LF2 lead loop to the line circuit.

3.37 At this point no additional functions of the line transfer circuit occur until incoming signals result in the application of —6 volts via lead 2 (machine off-hook) to operate relay 2.

3.38 The receiving data speed for the 205A data set is controlled by the remote HS S/R set via the local HS S/R set. If the data speed is to be 2400 bps, —6 volts will be applied via lead 18 causing DS1 relay to operate. Operation of DS1 relay applies +6 volts via SS lead to the 205A data set instructing it to receive at 2400 bps. If data speed is to be 1200 bps, —6 volts will be removed from lead 18 and DS1 relay will release, applying —6 volts via SS lead to instruct the 205A data set to receive at 1200 bps. After TOUCH-TONE signaling is completed, the machine switches into the data mode by applying —6 volts via lead 5 (receive high speed data) causing relay 5 to operate.

3.39 Operation of relay 2 places ground on COH lead to the line circuit and applies a holding ground to T2 relay. The holding ground on T2 is necessary because the TM2 transistor in the timing circuit will turn off approximately 3 seconds after turning on, thus removing the initial ground from T2 relay.

3.40 Operation of relay 5 will place a ground on T3 relay which operates. Operation of relay T3 will:

(a) Transfer the receiving pair from the 404A data set to the 205A data set,

(b) Apply +6 volts on CON lead to instruct 205A data set to wait for synchronization pattern from remote station,

(c) Open PS lead loop between the customer unit and sequence circuit, and

(d) Place ground on SEQ lead to sequence circuit which initiates synchronization.

3.41 When synchronization is complete, +6 volts is applied to RDY lead from the sequence circuit. The +6 volts on RDY is applied to the HS S/R set via lead 21 to enable the receiving of high speed data.

3.42 When data transmission is completed, release of the line transfer circuit is initiated from the HS S/R set by the removal of −6 volts on leads 2 and 5. The loss of the signal initiates the release of all operated relays and in so doing accomplishes the following.

(a) Removes ground from COH and SEQ leads.

(b) Closes PS lead loop.

(c) Applies −6 volts to CON lead.

(d) Closes LF to LF2 lead loop.

(e) Removes −24 volts from SO lead to line circuit.

(f) Applies −6 volts on RSD lead.

(g) Closes RN3 to RN2 (RN4) lead loop.

(h) Switches transmit and receive pairs back to the line circuit.

(i) Causes station control equipment to release circuits.

Manual Send Mode (See SC5)

3.43 Before the station operator initiates the manual send data call, the appropriate data speed is selected, and the appropriate key is operated on the HS S/R set.

3.44 A manual send data call is initiated from the HS S/R station by removing the key telephone handset off-hook, operating the LINE key, calling the desired remote HS S/R station. When required, a precedence key is also operated as described in 3.26. The precedence key required is located on the key telephone set instead of the HS S/R set.

3.45 When the handset is off-hook, the switchhook applies ground to OH (off-hook) lead which operates the OH relay as discussed in 3.04. In addition, +6 volts is applied to lead 25 (manual off-hook) and −6 volts to lead 21 (blind) to the HS S/R set.

3.46 When the called station answers and data transmission is ready to be initiated, the nonlocking SEND DATA (T1) key is momentarily operated at the key telephone set. Operation of the key applies ground to W relay which operates and locks to ground through its own contacts. Operation of W relay applies ground via COH lead to the line circuit and also applies +6 volts on CON lead to the 205A data set instructing the set to wait for synchronization pattern from the remote station. Operation of W relay also connects LSY lead from the sequence circuit to L(T1) lead to key telephone set SEND DATA lamp and the lamp winks.

3.47 Release of SEND DATA (T1) key removes ground from power side of Z relay causing Z to operate. Operation of Z relay initiates the following.

(a) Applies +6 volts to lead 25 (manual off-hook) to HS S/R set. The +6 volt supply from Z relay to lead 25 is required as a second source to replace voltage being supplied from OH relay contacts. The second source is required whenever the contacts of T1 relays disconnect the existing supply or when the OH relay is released.

(b) Applies +6 volts on lead 16 (manual send) to HS S/R set to instruct the HS S/R set that the manual send mode is being used.

(c) Connects leads TT2 and TT3 together to enable the line circuit to maintain off-hook signals to the central office.

3.48 The key telephone handset is replaced on-hook. This action removes ground from OH lead, and OH relay releases. Replacing the handset on-hook for the (Z) option also applies ground momentarily, via the line circuit and LK lead, to T1 relay which operates and locks on its own contacts.

3.49 Operation of T1 relay closes through the tip and ring pairs to the 205A data set, places ground on SEQ lead to the sequence circuit to initiate synchronization, and applies —24 volts on SO lead to the line circuit.

3.50 Via the (Y) option, operations are the same as described in 3.48 and 3.49 except that T1 relay operates immediately after W relay operates.

3.51 At this point no additional function of the line transfer circuit occurs until sequencing is completed. When sequencing is completed, ±10 volts is applied from the sequence circuit via the L(T1) lead to the SEND DATA lamp on the key telephone set, which lights steadily. Ground is placed on RDG (ready ground) lead to T4 relay which operates. The operation of T4 relay operates T3 relay which in turn, operates T2. Operation of T4 relay also opens the PR lead loop from the customer unit to the sequence circuit.

3.52 Operation of T3 relay applies +6 volts on RSD (request send) to enable the 404A data set. Operation of T2 relay transfers the receive tip and ring pair to the 404A data set and applies a +6 volt signal to lead 21 which instructs the HS S/R set that the system is ready to transmit high speed data. High speed data transmission begins.

3.53 When data transmission is completed, release of the line transfer circuit is initiated by removing the key telephone handset off-hook. This action places ground on OH lead and operates OH relay. The operation of relay OH places —6 volts on lead 21. The SEND DATA (T1) key is operated and released. This action releases all operated relays except OH in the line transfer circuit. Release of the relays performs the following functions.

(a) Extinguishes the SEND DATA (T1) key lamp.

(b) Removes ground from COH and SEQ leads.

(c) Removes —24 volts from SO lead.

(d) Closes the PR loop from the customer unit to the sequence circuit.

(e) Reestablishes clear voice path over which verbal verification of the data transmittal can be established.

3.54 The handset is returned on-hook and ground is removed from OH lead releasing OH relay. Release of OH relay applies —6 volts on lead 25 to the HS S/R set signaling manual on-hook. The station control equipment is now released.

Manual Receive Mode (See SC6)

3.55 A manual incoming receive data call causes the line circuit to place a ground on the TM (timing) lead. Ground on the TM lead causes transistors TM1 and TM2 in the timing circuit to operate which in turn causes T2 and T1 relays to operate as described in 3.35 and 3.36.

3.56 Approximately 3 seconds after the timing circuit operates, transistor TM1 turns on and TM2 turns off automatically. This action causes T2 relay to release which removes ground from T1 relay releasing T1. Release of T2 relay places —6 volts on RSD lead which is an inhibit voltage. The —24 volts on SO lead to the line circuit is removed and the tip and ring pairs are disconnected from the 404A data set. At the receiving station, the key telephone set rings with an interrupted ring, and the LINE lamp flashes. The key telephone handset is now removed from the switchhook.

3.57 From this point on, the operation of the line transfer circuit for the manual receive data mode is generally similar in sequence and function to the manual send data mode covered in 3.43 through 3.54 with the following exceptions.

(a) REC DATA (T2) key is operated and released instead of SEND DATA (T1).

(b) The establishment of precedence is associated only with the send data mode.

(c) When the REC DATA key is operated, REC relay operates at the same time W operates. When REC relay operates, it connects LSY lead to L(T2) lead. This causes the REC DATA key lamp to wink. When Z operates, it maintains a —6 volt (manual receive data) signal on lead 16 to the HS S/R set. (Note that the functions performed by REC relay were performed in manual send data mode by the Z relay which applied +6 volts on lead 16. LSY lead was connected to L(T1) to cause SEND DATA lamp to wink.)

(d) After synchronization is completed, ±10 volts on LSY lead is applied via L(T2) lead to REC DATA lamp which lights steadily, instead of SEND DATA lamp.

(e) When ground is placed on RDG lead, T3 relay operates and opens PS loop from the customer unit to the sequence circuit. (Note that in the send data mode, T4 relay opened the PR loop.)

(f) The T2 relay, when operated, transfers the transmit tip and ring pair to the 404A instead of transferring the receive tip and ring pair.

3.58 The line transfer circuit is now in the receive data mode, and data transmission proceeds. When data has been received, the line transfer circuit is released from the receive data mode in the same manner as for the send data mode, except as follows.

(a) REC DATA (T2) key is operated and released instead of the SEND DATA (T1) key.

(b) Relay REC releases at the same time as W and Z relays.

(c) Relay REC extinguishes the REC DATA lamp instead of the W relay extinguishing the SEND DATA lamp on the key telephone set.

(d) The T4 relay is not a part of the receive data mode.

(e) The T3 relay closes the PS lead loop between the customer unit and the sequence circuit instead of the T4 relay closing the PR lead loop.

C. Remote Tests

General

3.59 The line transfer circuit provides the switching and control required for the remote testing of the 205A data set and the 404A data set. These tests are conducted by the test center under control of the HS S/R station. The purpose of the tests is to determine that the data sets are functioning properly. When the line transfer circuit is conditioned for remote tests, either the 205A data set or the 404A data set is connected to the 4-wire tip and ring leads. Station control is exercised from the HS S/R key telephone set. The HS S/R set is inoperative during remote testing. The following paragraphs and associated sequence charts SC7 and SC8 describe the operation of the line transfer circuit during remote tests.

Remote Test 1 (205A Data Set) (See SC7)

3.60 When remote testing of the 205A data set is required, the data speed is selected, either 1200 bps or 2400 bps, as described in 3.25. The switching functions of the line transfer circuit are initiated by removing the key telephone handset from the switchhook and operating the LINE key. With the handset off-hook, OH relay operates and applies —6 volts to lead 21 and +6 volts to lead 25 to the HS S/R set. The TEST 205 key (RT1) on the key telephone set is operated momentarily and applies ground via S(RT1) lead to the line transfer circuit causing RT1 and W relays to operate.

3.61 When RT1 relay operates, it locks through its own contacts. The operation of RT1 relay removes —24 volts from RTS lead to the line circuit. The signal on RMT lead to the 205A data set is switched from —6 volts to +6 volts. A lamp wink signal is applied to the TEST 205 key at the key telephone set as a result of L(RT1) lead being connected to LW lead. A —6 volt signal is maintained on lead 16 to the HS S/R set when RT1 relay operates. Also, the SEQ lead loop is opened.

3.62 When W relay operates, it locks to ground applied via RTL (remote test lock) lead from the line circuit. The operation of the relay applies ground via the COH lead to the line cir-

cuit. The relay also switches the signal on the CON lead to the 205A data set from —6 volts to +6 volts. A —6 volt signal is maintained via lead 21 (HS S/R blind) to the HS S/R set. The operation of W relay will also remove —24 volts from RS lead to the sequence circuit and connect L(T1) lead to LSY lead to provide lamp wink at the key telephone set transfer key. Relay Z operates when TEST 205 key is released.

3.63 When relay Z operates, it locks through its own contacts. The operation of Z relay closes both the RN3 to RN2 (RN4) (ringing) loop and the LF loop to the line circuit.

3.64 When the (Z) option is used (see 3.48), and the handset is placed on-hook, a momentary ground is applied via LK lead to operate T1 relay. Relay OH is released when the handset is on-hook.

3.65 When T1 relay operates, it locks through its own contacts. The operation of T1 relay:

(a) Applies —24 volts via SO lead to the line circuit,

(b) Closes the TT2 to TT3 lead loop to the line circuit,

(c) Switches L(RT1) lead from LSY lead (supplying lamp wink) to a steady ±10 volt signal, and

(d) Connects the tip and ring pairs to the 205A data set.

The line transfer circuit has now completed the operations necessary to allow remote testing of the 205A data set.

3.66 The use of the (Y) option (see 3.50) will allow remote testing to function as described with one exception. With the (Y) option installed, T1 relay will operate immediately after W relay operates.

3.67 When the remote testing of the 205A data set is completed, the release of the line transfer circuit may either be initiated by the test center or by action at the station key telephone set.

3.68 When release is initiated by the central office, ground is removed from the RTL lead releasing W and Z relays. When W and Z relays release, T1 and RT1 relays release. This action performs the following.

(a) Removes ground from COH lead.

(b) Opens the TT2 to TT3 loop.

(c) Removes voltage from SO lead.

(d) Extinguishes lamp TEST 205.

(e) Disconnects tip and ring connection from 205A data set.

(f) Applies —24 volts via RTS lead to line circuit.

(g) Applies —6 volts via RMT lead to 205A data set.

The line transfer circuit is now fully released.

3.69 When release is initiated from the station key telephone set, the handset is removed and the TEST 205 key (RT1) is operated. This action applies ground to the power side of the operated W relay, causing it to release. When W relay releases, T1, RT1, and Z relays release as described in 3.68. When the handset is placed on-hook, the line transfer circuit is fully released.

Remote Test 2 (404A Data Set) (See SC8)

3.70 The operation of the line transfer circuit for establishing conditions required to remote test the 404A data set is similar to that described in 3.60 through 3.68. The following are differences encountered in the line transfer circuit operation. Comparison of SC8 for Remote Test 2 and SC7 for Remote Test 1 and the following list of differences will enable an understanding of the circuit operation.

(a) Data speed is not applicable to the 404A data set.

(b) TEST 404 key (RT2) is operated instead of TEST 205 key (RT1).

(c) Relay RT2 operates instead of relay RT1.

(1) A +6 volt signal is applied via RMT lead to the 404A data set instead of to the 205A data set.

(2) Lead L(RT2) instead of L(RT1) is connected to LW lead.

(d) Application of ground via LK lead operates T2 relay instead of T1 relay. Operation of T2 relay:

(1) Switches L(RT2) lead from LW to ±10 volts.

(2) Applies +6 volts via RSD lead to the 404A data set.

(3) Operates T1 relay.

(4) Connects tip and ring pairs to the 404A data set rather than to the 205A data set.

(e) For terminating the remote 404A data set test from the central office:

(1) Relays W and Z release. Release of Z relay causes T2 and T1 relays to release.

(2) Relay RT2 instead of RT1 relay is released.

(3) Voltage is removed from L(RT2) lead instead of L(RT1).

(4) The tip and ring leads are removed from the 404A data set instead of the 205A data set

(5) A −6 volts is applied to RMT lead to the 404A data set rather than to the 205A data set.

(f) For terminating a remote test from the key station telephone set:

(1) The TEST 404 key rather than the TEST 205 key is operated.

(2) The release of W relay will cause the release of RT2 relay (instead of RT1 relay) and Z relay. The release of RT2 relay releases T2 relay which releases T1 relay.

(3) The line transfer circuit is now fully released.

4. REFERENCES (NOT ATTACHED)

4.01 The following drawings and sections provide additional information.

SD-69504-01 — Switching System No. 307, Block Diagram

SD-69505-01 — Telephone and Key Circuit

SD-69506-01 — 4-Wire CO Line Circuit

SD-69507-01 — Line Transfer Circuit

SD-69508-01 — Sequence Circuit

SD-69509-01 — Dual Access Switch Circuit

SD-69510-01 — Alarm Circuit

480-714-101 — 4-Wire CO Line Circuit Unit, Description

480-714-103 — Sequence Circuit Unit, Description

480-714-104 — Dual Access Switch, Description

480-714-105 — 2626A1 Key Telephone Set, Description

480-714-106 — Alarm Circuit, Description

480-714-301 — 4-Wire CO Line Circuit Unit, Maintenance Tests

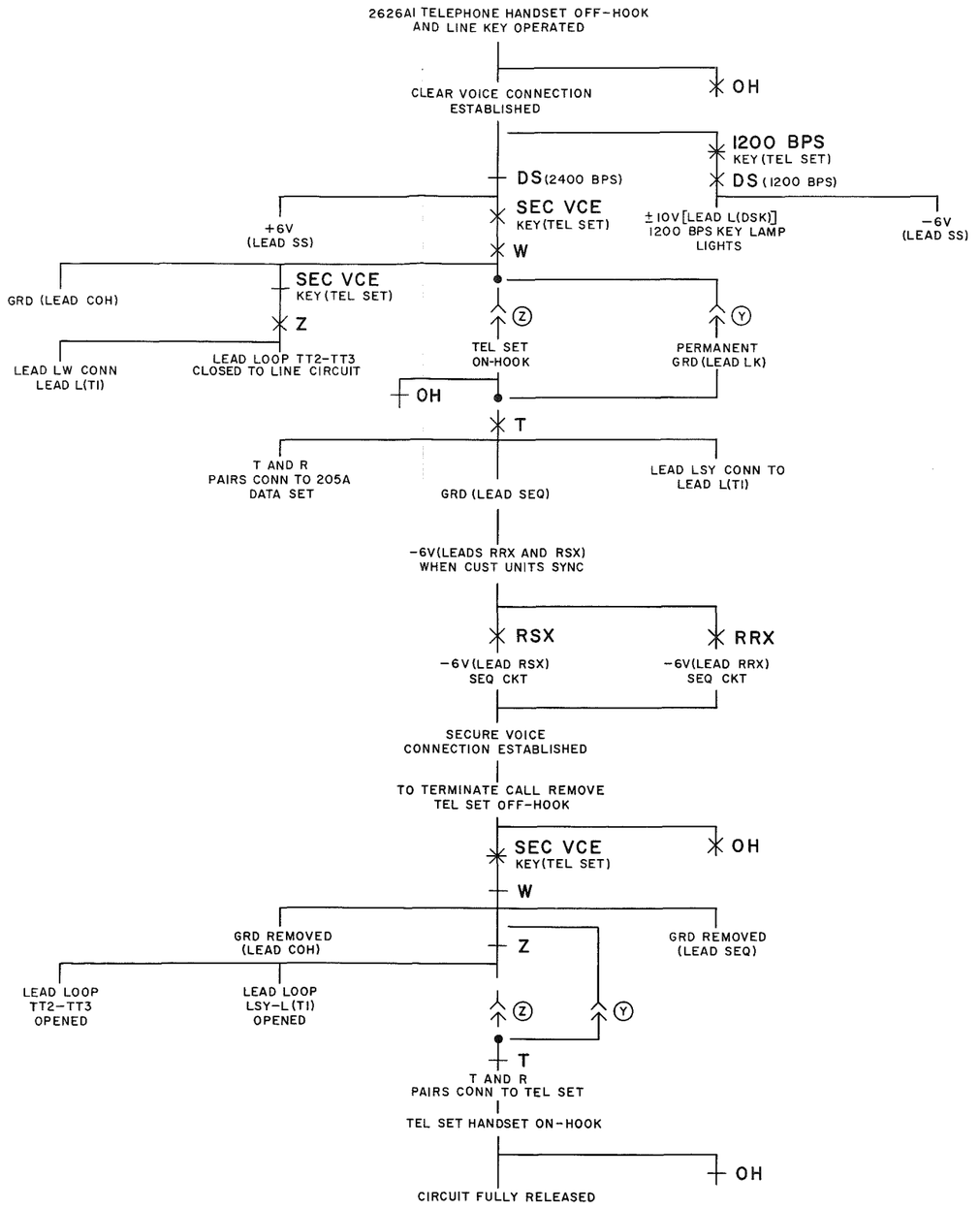
480-714-302 — Line Transfer Circuit Unit, Maintenance Tests

480-714-303 — Sequence Circuit Unit, Maintenance Tests

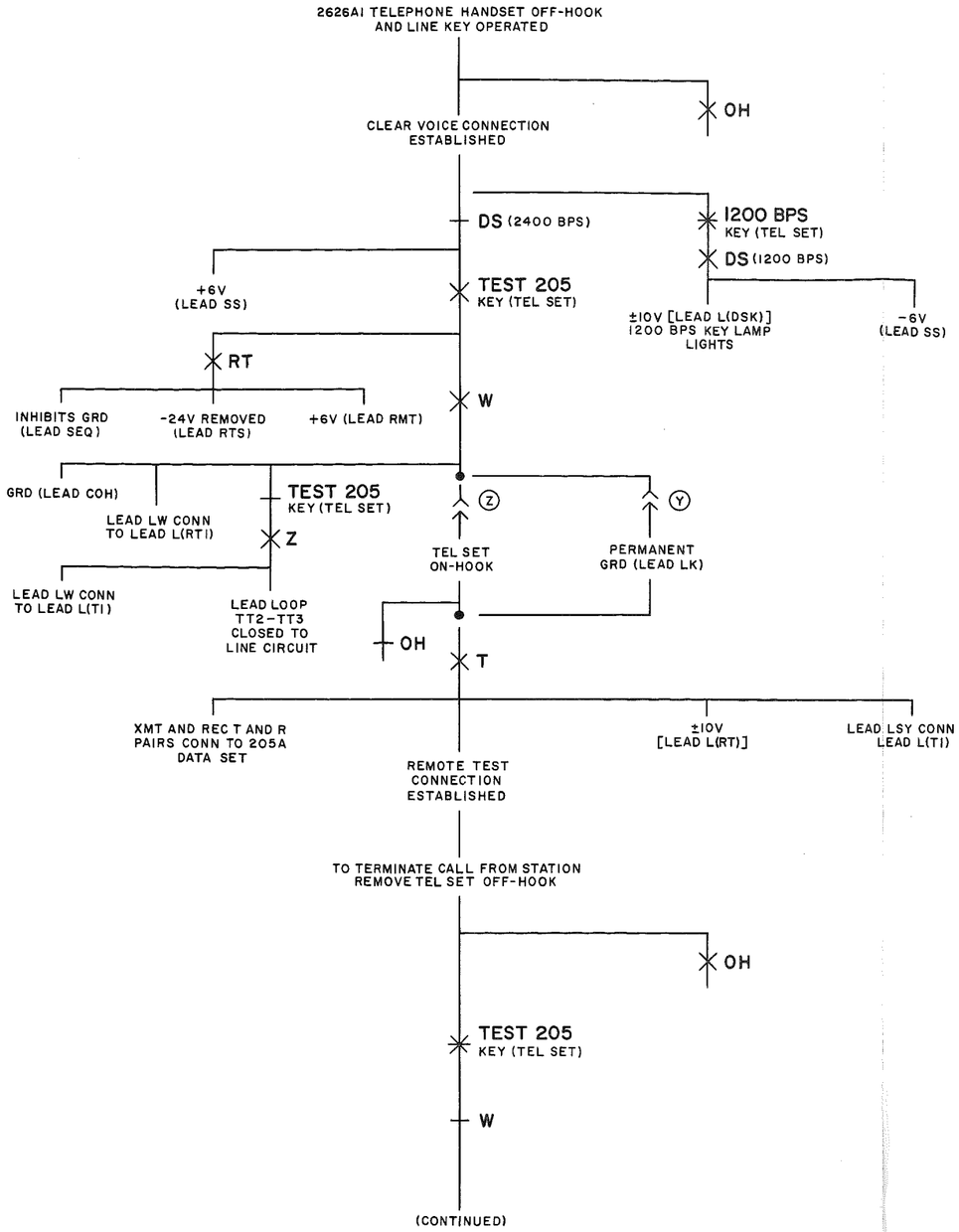
480-714-304 — Dual Access Switch, Maintenance Tests

480-714-305 — 2626A1 Key Telephone Set, Maintenance Tests

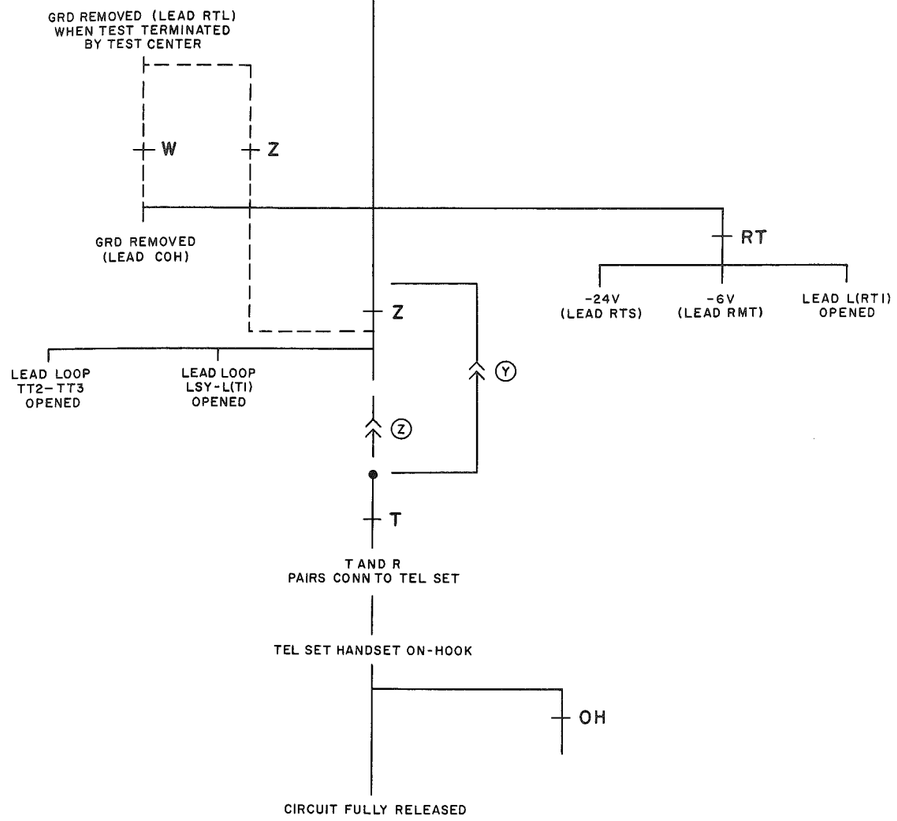
480-714-306 — Alarm Circuit, Maintenance Tests

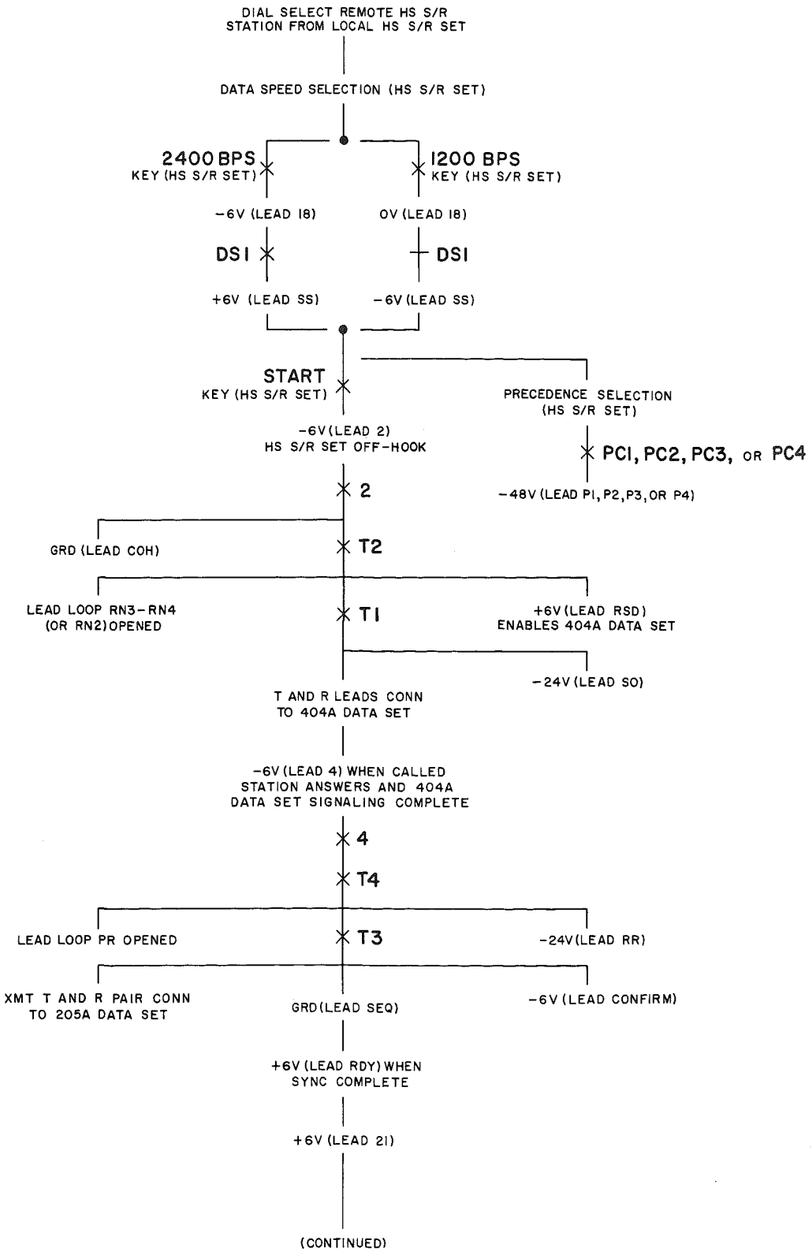


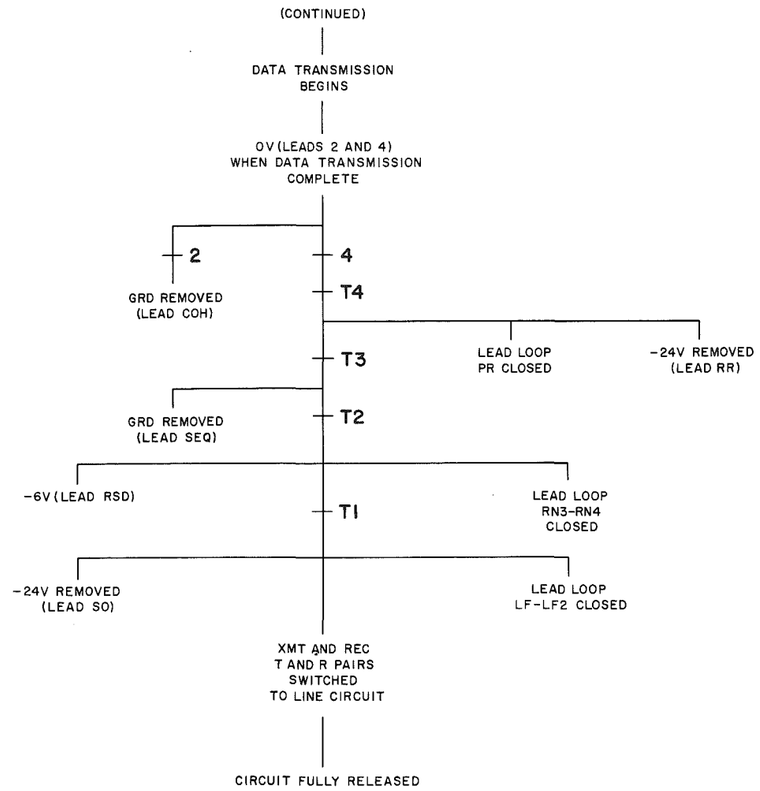
SC1 — Line Transfer Circuit — Voice Call

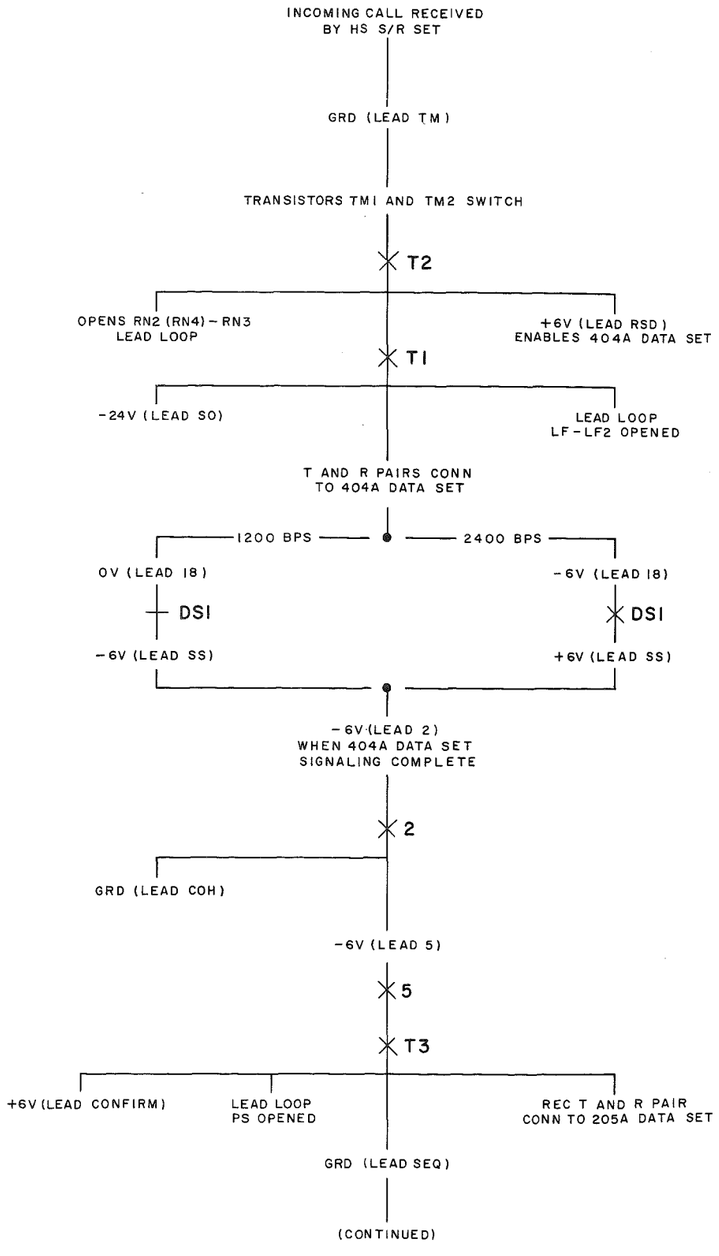

2626AI TELEPHONE HANDSET OFF-HOOK AND LINE KEY OPERATED
OH
CLEAR VOICE CONNECTION ESTABLISHED
DS (2400 BPS)
1200 BPS KEY (TEL SET)
DS (1200 BPS)
+6V (LEAD SS)
TEST 205 KEY (TEL SET)
±10V [LEAD L(DSK)] 1200 BPS KEY LAMP LIGHTS
-6V (LEAD SS)
RT
INHIBITS GRD (LEAD SEQ)
-24V REMOVED (LEAD RTS)
+6V (LEAD RMT)
W
GRD (LEAD COH)
LEAD LW CONN TO LEAD L(RTI)
TEST 205 KEY (TEL SET)
Z
TEL SET ON-HOOK
PERMANENT GRD (LEAD LK)
LEAD LW CONN TO LEAD L(TI)
LEAD LOOP TT2-TT3 CLOSED TO LINE CIRCUIT
OH
T
XMT AND REC T AND R PAIRS CONN TO 205A DATA SET
±10V [LEAD L(RT)]
LEAD LSY CONN TO LEAD L(TI)
REMOTE TEST CONNECTION ESTABLISHED
TO TERMINATE CALL FROM STATION REMOVE TEL SET OFF-HOOK
OH
TEST 205 KEY (TEL SET)
W
(CONTINUED)

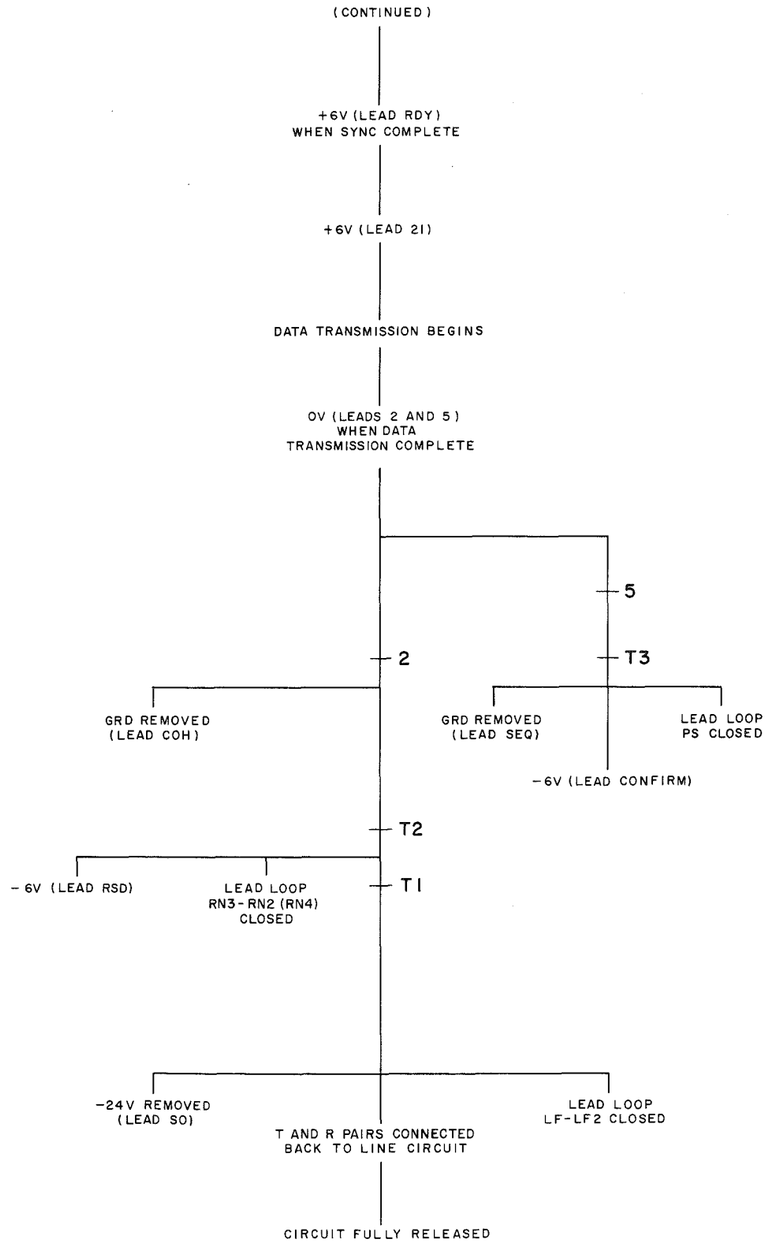
(CONTINUED)


GRD REMOVED (LEAD RTL) WHEN TEST TERMINATED BY TEST CENTER
W
Z
GRD REMOVED (LEAD COH)
RT
-24V (LEAD RTS)
-6V (LEAD RMT)
LEAD L(RTI) OPENED
Z
LEAD LOOP TT2-TT3 OPENED
LEAD LOOP LSY-L(TI) OPENED
Y
Z
T
T AND R PAIRS CONN TO TEL SET
TEL SET HANDSET ON-HOOK
OH
CIRCUIT FULLY RELEASED

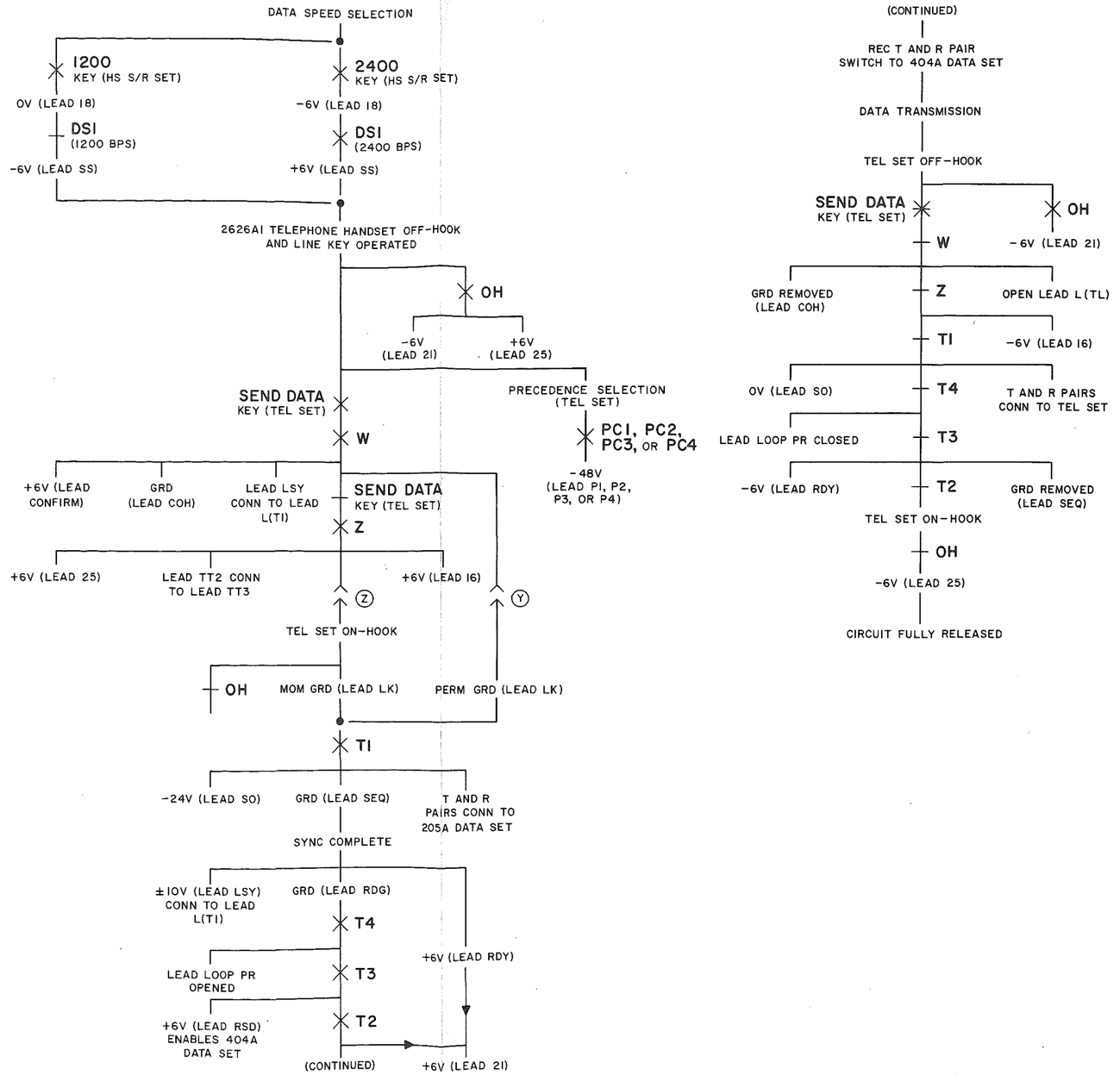

DIAL SELECT REMOTE HS S/R STATION FROM LOCAL HS S/R SET
DATA SPEED SELECTION (HS S/R SET)
2400 BPS KEY (HS S/R SET)
1200 BPS KEY (HS S/R SET)
-6V (LEAD 18)
OV (LEAD 18)
DS1
DS1
+6V (LEAD SS)
-6V (LEAD SS)
START KEY (HS S/R SET)
PRECEDENCE SELECTION (HS S/R SET)
PC1, PC2, PC3, OR PC4
-6V (LEAD 2) HS S/R SET OFF-HOOK
-48V (LEAD P1, P2, P3, OR P4)
2
GRD (LEAD COH)
T2
LEAD LOOP RN3-RN4 (OR RN2) OPENED
T1
+6V (LEAD RSD) ENABLES 404A DATA SET
-24V (LEAD SO)
T AND R LEADS CONN TO 404A DATA SET
-6V (LEAD 4) WHEN CALLED STATION ANSWERS AND 404A DATA SET SIGNALING COMPLETE
4
T4
LEAD LOOP PR OPENED
T3
-24V (LEAD RR)
XMT T AND R PAIR CONN TO 205A DATA SET
GRD (LEAD SEQ)
-6V (LEAD CONFIRM)
+6V (LEAD RDY) WHEN SYNC COMPLETE
+6V (LEAD 21)
(CONTINUED)


(CONTINUED)
DATA TRANSMISSION BEGINS
OV (LEADS 2 AND 4) WHEN DATA TRANSMISSION COMPLETE
2
4
T4
GRD REMOVED (LEAD COH)
LEAD LOOP PR CLOSED
-24V REMOVED (LEAD RR)
T3
T2
GRD REMOVED (LEAD SEQ)
-6V (LEAD RSD)
LEAD LOOP RN3-RN4 CLOSED
T1
-24V REMOVED (LEAD SO)
LEAD LOOP LF-LF2 CLOSED
XMT AND REC T AND R PAIRS SWITCHED TO LINE CIRCUIT
CIRCUIT FULLY RELEASED

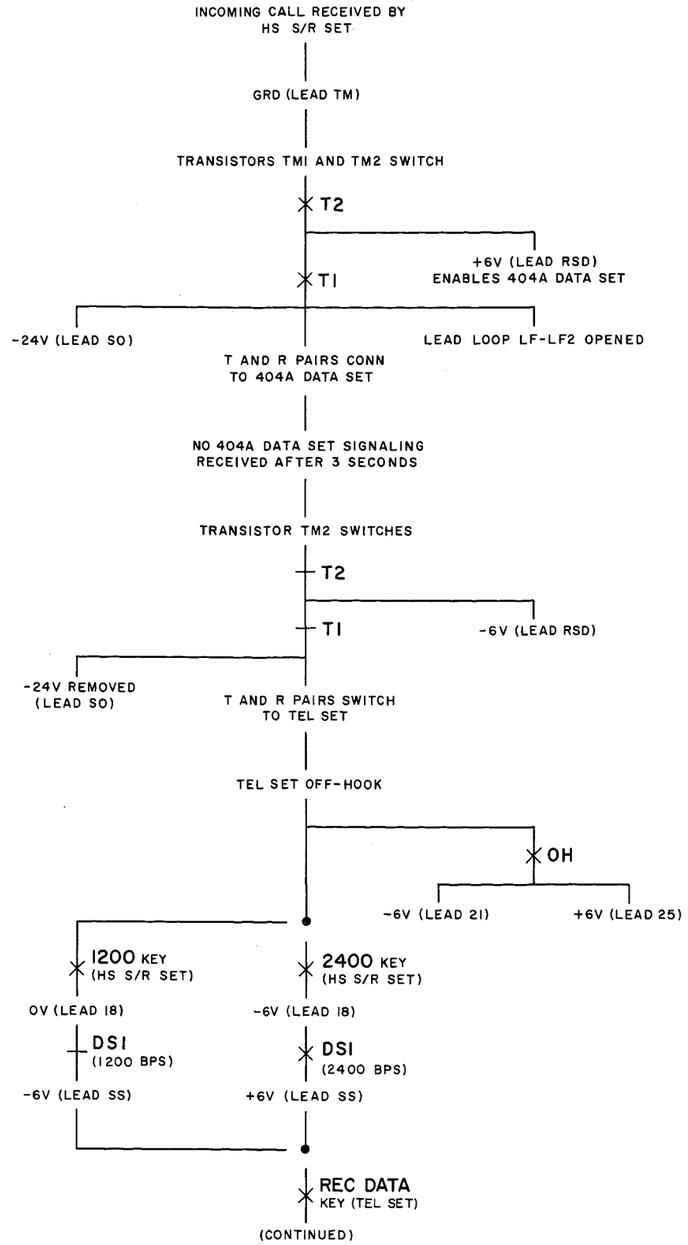


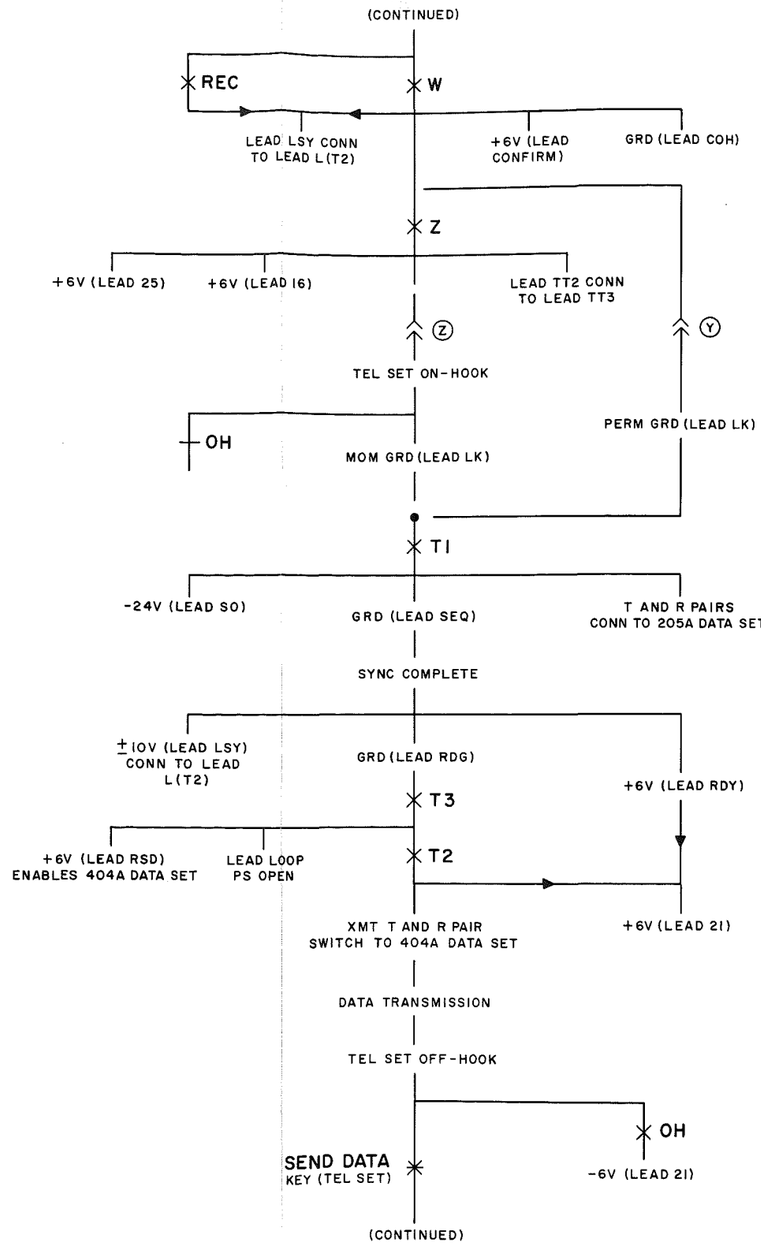


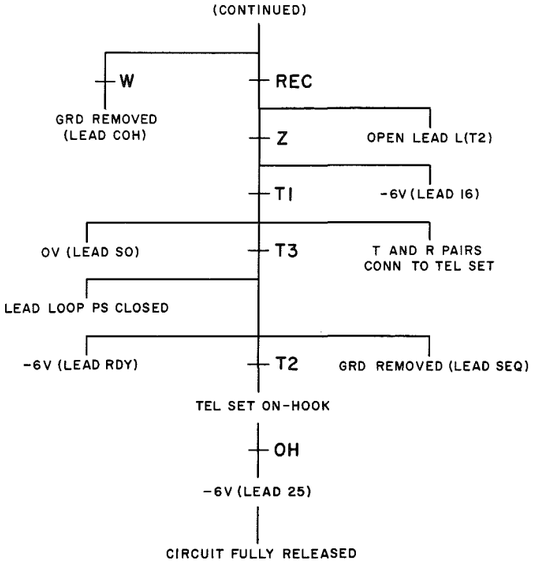
SC4 — Line Transfer Circuit — Automatic Receive Mode

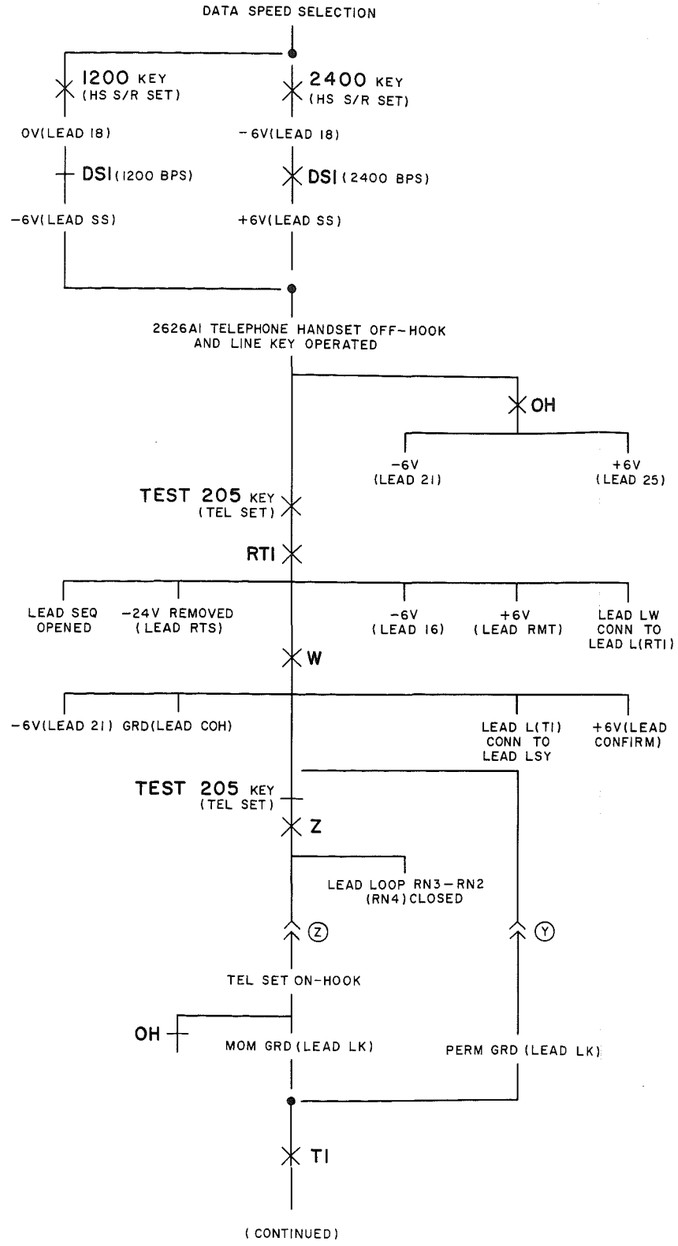


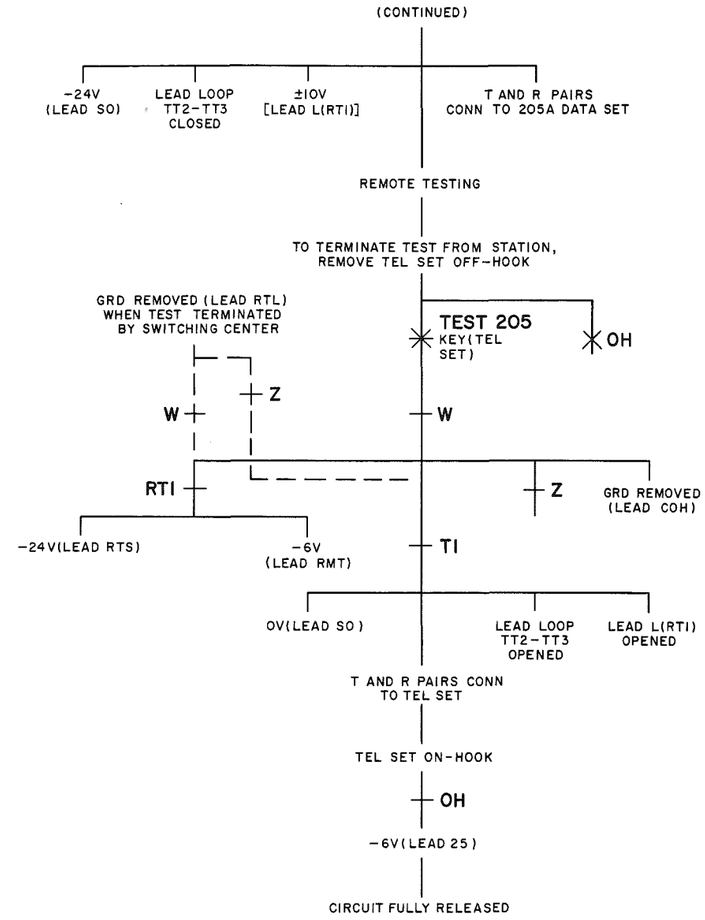
SC5 — Line Transfer Circuit — Manual Send Mode


INCOMING CALL RECEIVED BY HS S/R SET
GRD (LEAD TM)
TRANSISTORS TM1 AND TM2 SWITCH
T2
+6V (LEAD RSD) ENABLES 404A DATA SET
T1
-24V (LEAD SO)
LEAD LOOP LF-LF2 OPENED
T AND R PAIRS CONN TO 404A DATA SET
NO 404A DATA SET SIGNALING RECEIVED AFTER 3 SECONDS
TRANSISTOR TM2 SWITCHES
T2
T1
-6V (LEAD RSD)
-24V REMOVED (LEAD SO)
T AND R PAIRS SWITCH TO TEL SET
TEL SET OFF-HOOK
OH
-6V (LEAD 21)
+6V (LEAD 25)
1200 KEY (HS S/R SET)
2400 KEY (HS S/R SET)
0V (LEAD 18)
-6V (LEAD 18)
DS1 (1200 BPS)
DS1 (2400 BPS)
-6V (LEAD SS)
+6V (LEAD SS)
REC DATA KEY (TEL SET)
(CONTINUED)

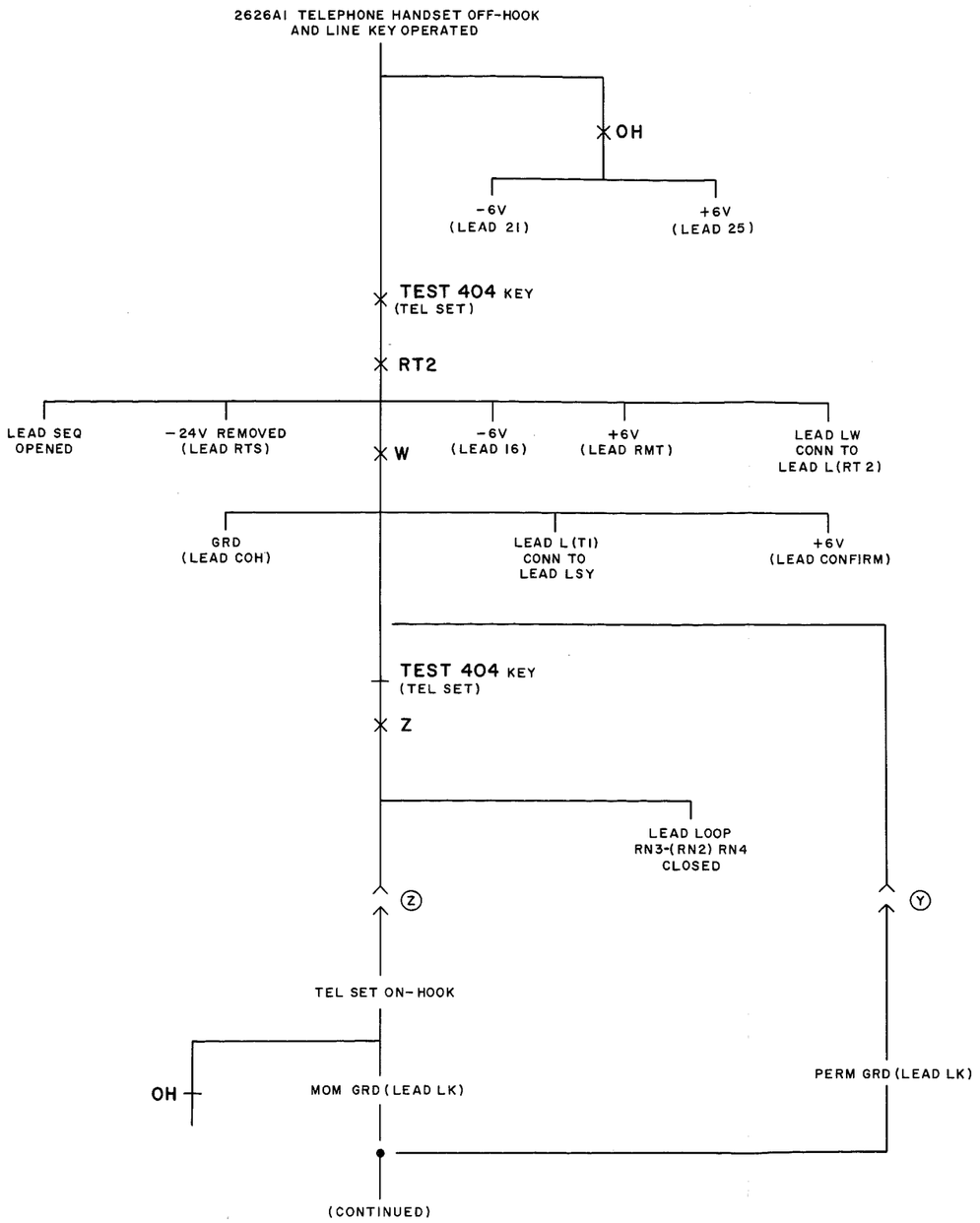

(CONTINUED)
REC
W
LEAD LSY CONN TO LEAD L(T2)
+6V (LEAD CONFIRM)
GRD (LEAD COH)
Z
+6V (LEAD 25)
+6V (LEAD 16)
LEAD TT2 CONN TO LEAD TT3
Z
Y
TEL SET ON-HOOK
PERM GRD (LEAD LK)
OH
MOM GRD (LEAD LK)
T1
-24V (LEAD SO)
GRD (LEAD SEQ)
T AND R PAIRS CONN TO 205A DATA SET
SYNC COMPLETE
±10V (LEAD LSY) CONN TO LEAD L(T2)
GRD (LEAD RDG)
+6V (LEAD RDY)
T3
+6V (LEAD RSD) ENABLES 404A DATA SET
LEAD LOOP PS OPEN
T2
XMT T AND R PAIR SWITCH TO 404A DATA SET
+6V (LEAD 21)
DATA TRANSMISSION
TEL SET OFF-HOOK
OH
SEND DATA KEY (TEL SET)
-6V (LEAD 21)
(CONTINUED)

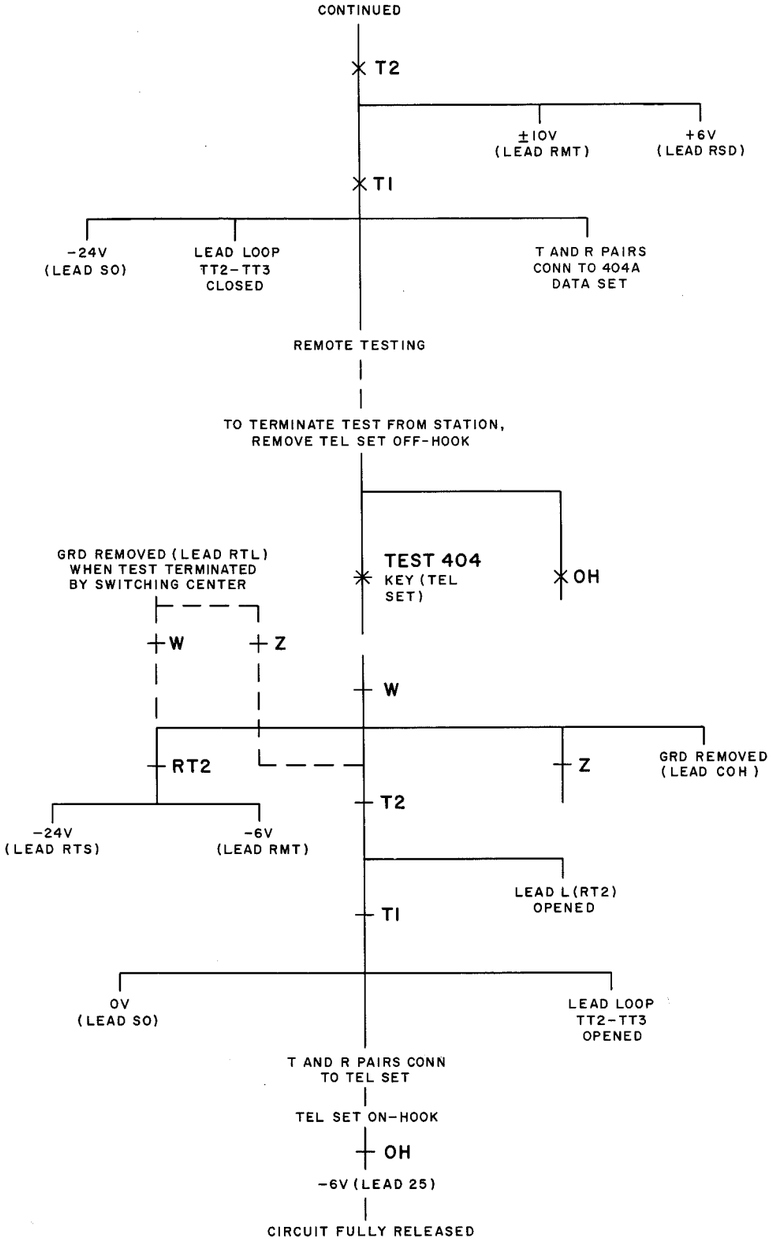

(CONTINUED)
W
REC
GRD REMOVED (LEAD COH)
Z
OPEN LEAD L(T2)
T1
-6V (LEAD 16)
0V (LEAD SO)
T3
T AND R PAIRS CONN TO TEL SET
LEAD LOOP PS CLOSED
-6V (LEAD RDY)
T2
GRD REMOVED (LEAD SEQ)
TEL SET ON-HOOK
OH
-6V (LEAD 25)
CIRCUIT FULLY RELEASED





SC7 — Line Transfer Circuit — Remote Test 1 — 205A Data Set





SC8 — Line Transfer Circuit — Remote Test 2 — 404A Data Set