DATA SYSTEMS — COMMON CIRCUITS, EQUIPMENT AND PROCEDURES
STATION TEST LINES
2-WAY STATION TEST LINE USING SD-70926-01
USE AT TELEGRAPH TESTBOARDS OR SERVICEBOARDS

CONTENTS PAGE

1. GENERAL

1.01 This section covers the use at telegraph testboards or serviceboards of the station test line that uses the 2-Way Station Test Line Circuit per SD-70926-01.

1.02 A description of this station test line is included in Section 314-810-100. The circuit order and routine tests required to put the test line into service and to maintain it are included in Section 314-810-300. The maintenance tests required on the test line circuit (SD-70926-01), as a piece of central office equipment, are included in Section A204.752.

1.03 This test line works as a subscriber line from a serving central office either in the regular message (DDD) network or in the dedicated data line switching (DLS) network. It terminates in a test position of a test center telegraph testboard or serviceboard. When so provided, it furnishes the test center with means for communicating and making tests with certain data intercommunicating subscribers. These subscribers must be ones that use the "Data Set 101A" associated with TTY equipment for data intercommunicating purposes. Examples are Boeing and other wide area data service (WADS) subscribers in the DLS network and teletypewriter (TWX) subscribers in the DDD network.

2. NEED FOR SEPARATE DLS AND DDD TEST LINES

2.01 As presently visualized, when the test line is used to originate or to answer a call over the DLS network, the TTY operating speed will be 100 wpm. Such calls would be those to or from Boeing or other WADS subscribers. When the test line is used to originate or answer a call over the DDD network, the operating speed will be 60 wpm. Such calls would be those to or from TWX subscribers or to or from Boeing subscribers when operating in the TWX mode.

2.02 There is nothing about the test line circuit, per se, that is speed discriminative, at least in the 60 to 100 wpm range. However, when it comes to answering a call, it is essential that the TTY used for answering be arranged for the same speed as that used by the calling party. Otherwise, garbled copy and confused operating procedures would result. The test line circuit, however, is not arranged to indicate automatically the speed of the incoming call. Accordingly, separately listed test lines must be provided for 60 and 100 wpm speed. In specific cases, where traffic justifies it, additional lines of either type may be provided on a hunting basis.

3. TESTING PROCEDURES AT TELEGRAPH TESTBOARDS OR SERVICEBOARDS

3.01 Charts 1 thru 10, at the rear of this section, provide step-by-step procedures involved in establishing test connections and in performing the desired tests. These charts are:

Chart 1 — Originating a Data Intercommunicating Call

Chart 2 — Answering a Data Intercommunicating Call

Chart 3 — Disconnecting on a Data Intercommunicating Call

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Chart 4 — Originating and Disconnecting on Call to Test Lines such as the 1 MW Test Line

Chart 5 — Arranging Test Line for HDX or FDX Operation

Chart 6 — Interchanging Use of Frequencies ***F1*** and ***F2***

Chart 7 — Testing Under the HDX Mode

Chart 8 — Testing Under the FDX Mode

Chart 9 — Measuring Level and Frequency of Carrier Incoming from Station

Chart 10 — Originating and Disconnecting on Call to Office "Loop-Around" Test Line

3.02 Foldout Figs. 1, 2, and 3 show, in block diagram form, the circuits, test equipment, jacks, cords, plugs, etc., referred to in the charts. Fig. 1 covers the hub-operated arrangement of the test line circuit as used at service and facility positions of a No. 2 or 9B telegraph serviceboard. Fig. 2 covers the arrangement when the hub-operated test line circuit is used at hub test positions of a No. 9 telegraph testboard. Fig. 3 covers the neutral-loop operated arrangement of the test line circuit as used at test positions of a No. 9 telegraph testboard.

3.03 Each chart includes an informational discussion and notes. These are to explain "why the test" or "why the step". In general, any numbered step may be used at a No. 2 or 9B serviceboard or a No. 9 telegraph testboard (hub or neutral-loop operated). Where there is a sufficient difference in the procedures, separate sub-lettered steps are used. Sub-letter "a" applies to Nos. 2 or 9B serviceboards using arrangements per Fig. 1. Sub-letter "b" applies to No. 9 telegraph testboards using the hub-operated arrangements per Fig. 2. Sub-letter "c" applies to No. 9 telegraph testboards using the neutral-loop operated arrangements per Fig. 3.

3.04 The charts do not indicate when the particular tests should be made. Neither do they indicate the limits or requirements that should be met. This information will be included in those BSP's that prescribe the testing procedures to be used on station installation work and in trouble investigations.

3.05 The operating charts in this section are based on the arrangements of the test line circuit as shown in Issue 3 of SD-70926-01. Figs. 1, 2, and 3 of the section are, except for two changes, copies of Sheets D2, D3, and D4 of SD-70926-01, Issue 3. One change — included in Figs. 1, 2, and 3 — covers the inclusion of a jack-terminated VF amplifier. This is for use with a 72A frequency meter when measuring at the (LEV IN) jack of the test line circuit. The second change — included in Fig. 2 — provides schematic information on a typical TLT.

3.06 ***Amplifier for Use at (LEV IN) Jack:*** The 72A frequency meter requires an input level of at least −22 dbm. The level at the (LEV IN) jack will, in many cases, be substantially less than this. An amplifier is required, therefore, to boost such weak signals when it is desired to measure the frequency of the incoming carrier signal. This arrangement is not now provided at the board for use with the test line. Accordingly, the arrangement shown in Figs. 1, 2, and 3 and used in the manner described in Chart 5 is only tentative and must be locally engineered. If the arrangement ultimately provided differs from this, then the CD- sheet should be used as a reference for operating instructions pending a revision of this section.

PURPOSE: To Originate a Data Intercommunicating Call.

DISCUSSION: In originating a call, it is necessary to determine whether a DLS or a DDD test line should be used for the intended tests. As discussed in Part 2 of the text, a DLS test line requires that the TTY and associated transmission measuring equipment and signal sources be arranged for 100 wpm speed. A DDD test line requires that they be arranged for 60 wpm speed. The step-by-step procedures below assume that these determinations and arrangements have been made.

TEST STEP	TEST PROCEDURE AND VERIFICATION
1.	Select idle (dark lamps) test line.
2a — SVC BD	Patch (SET) cord to (TTY 1) jack of selected test line. Operate (S1) key of cord to (SEND ON TTY) to prepare for later use.
2b — TST BD (HUB)	Patch (TTY) cord to (SEND & REC-A) jack of hub, testing and misc. circuit. Operate (K1) key of this circuit to (HUB) position. Patch between (TEST) jack of this circuit and (TTY 1) jack of selected test line.
2c — TST BD (LOOP)	Patch (TTY) cord to (SND 1) jack of selected test line.
	VERIFICATION: (ORIG BSY) lamp lights at all appearances.
3a — SVC BD	Patch (CALL) cord to (DIAL) jack. Operate (S1) key of cord to the (TALK) position.
3b or 3c TST BD (HUB or LP)	Patch the (TALK) or (TEST) cord of the telegraph test circuit to the (DIAL) jack.
	VERIFICATION: (CONN) lamp lights at all appearances. When the switching office is ready to receive the call-directing pulses, dial tone will be heard in the head telephone set associated with the telephone cord or telegraph test circuit.
4.	Dial pulse call station number using dial set associated with telephone cord or telegraph test circuit. Audibly monitor tone signals during progress of call. ***This is necessary in order to know when the called station goes off-hook. It is then necessary to proceed promptly to Step 5.*** Audible monitoring will also be helpful in localizing difficulties in the establishment of the call. ***VERIFICATION:*** The off-hook condition at the called station may be assumed when the ringing signal is heard to stop and an audible continuous tone (2225 cycles) is heard on the line.

Continued on Sheet 2

CHART 1 (Sheet 1 of 2)

ORIGINATING A DATA INTERCOMMUNICATING CALL

CHART 1 (Continued)

TEST STEP	TEST PROCEDURE AND VERIFICATION
5.	When the called station is heard to go off-hook, ***promptly*** remove cord from (DIAL) jack. ***VERIFICATION:*** The (CONN) lamp will go out after a short delay during which the test line will recognize the incoming 2225-cycle carrier and will automatically respond by transmitting to the called station a steady marking signal of 1270 cycles. This mutual exchange of carrier signals will condition the test line circuit and the station for teletypewriter communication.
6.	The called station will respond in one of several ways, depending on station arrangements, as follows: a. Automatic multi-character answerback (WADS or TWX automatic answer 28) b. Automatic "V" character answerback (15, 19, or 28) c. Manual identification from keyboard (Attended send-receive station) ***VERIFICATION:*** Answerback will be printed out on position TTY.
7.	Communicate with called station, using position TTY, giving identification and stating purpose of call. ***VERIFICATION:*** Both sides of the conversation will be printed out on the position TTY.
8.	Proceed with tests, as required, in the manner as covered by other charts in this section.
9.	On completion of tests, disconnect on call per Chart 3 procedures.

PURPOSE: To Answer a Data Intercommunicating Call.

DISCUSSION — VERIFICATION: When a station calls the test center, the (ANS) lamp will light at all appearances and an audible signal will be given by the auxiliary signal circuit.

DISCUSSION — SPEED COMPATIBILITY: To avoid garbled copy, it is necessary that the teletypewriter to be used for answering the call and for subsequent tests, be arranged for the same speed as that which the calling station is using. With the presently proposed use of the DLS and DDD networks, it may be assumed that a call incoming over the DLS test line will be at a 100 wpm speed and one incoming over the DDD test line will be at 60 wpm speed. Test signal sources and transmission measuring equipment used for tests over the test line should also be arranged for the same speed. See paragraphs 2.01 and 2.02 of text.

TEST STEP	TEST PROCEDURE AND VERIFICATION
1a — SVC BD	Patch (SET) cord to (TTY 1) jack of test line. Operate (S1) key to (SEND ON TTY) to prepare for later transmission of test center identification.
1b — TST BD (HUB)	Patch (TTY) cord to (SEND & REC-A) jack of hub, testing and misc. circuit. Operate (K1) key of this circuit to (HUB) position. Patch between (TEST) jack of this circuit and (TTY 1) jack of test line.
1c — TST BD (LOOP)	Patch (TTY) cord to (SND 1) jack of test line.
	VERIFICATION: (TERM BSY) and (CONN) lamps light at all appearances, (ANS) lamp goes out and the audible signal is silenced. The circuit now causes an off-hook indication to be presented to the switching office. After a short guard interval (to assure the off-hook signal is properly recorded at the ***calling*** office), it also causes a marking carrier frequency of 2225 cycles to be sent to the calling station. At the calling station, this will be recognized and a marking carrier frequency of 1270 cycles will be caused to be sent to the test center. This mutual exchange of carrier signals will condition the test line circuit and the station for teletypewriter communication. The (CONN) lamp will now go out as an indication that the connection has been completed and is ready for teletypewriter communication. ***Note:*** If the (CONN) lamp does not go out promptly, it may indicate that the call is from a regular telephone. To clear such a connection, all cords should be removed and the (CLR) key operated momentarily.
2.	From position keyboard, type station identification. ***VERIFICATION:*** Both sides of ensuing conversation will be printed out on the position TTY.
3.	Proceed with tests, as required, in the manner as covered by other charts in this section.
4.	On completion of tests, disconnect on call per Chart 3 procedures.

CHART 2 – ANSWERING A DATA INTERCOMMUNICATING CALL

PURPOSE: To Disconnect on an Originating or Terminating Call.

DISCUSSION: The operations necessary to disconnect a call may be initiated either at the test center or at the station. If initiated at the test center, a sequence of circuit operations will automatically occur that has the result of restoring both the test center and station equipment to the idle circuit condition and of providing an on-hook signal to the respective switching offices. If the disconnect sequence is initiated at the station, a one-second spacing signal is sent from the station during its clearing sequence after which the station goes on-hook. At the test center, the one-second incoming spacing carrier, or later loss of incoming carrier, will provide indications (visual and/or audible) to prompt the necessary manual clearing actions at that point.

What has just been said does not fully apply to a "Terminate Only" station assigned to a hunting group. Such a station will go thru and complete all phases of its disconnect sequence except for the return of the on-hook signal to its office. This will not be returned until the last station in the group becomes busy. Until this happens, the station will appear/busy at the office.

TEST STEP	TEST PROCEDURE AND VERIFICATION
1 — ALL BOARDS	***DISCONNECT INITIATED AT STATION:*** Remove cords from all jack appearances of test line and momentarily depress (CLR) key. ***VERIFICATION:*** (CLR) lamp lights momentarily after which all lamps are extinguished. An on-hook indication is given to the office.
	DISCONNECT INITIATED AT STATION: ***VERIFICATION:*** ***If cord is patched to*** (TTY 1) ***or*** (SND-1, -2, or -3) ***jack:*** (CLR) lamp lights; the (ORIG BSY) or (TERM BSY) lamp goes out; and teletypewriter (if patched in) runs open or prints garbled copy due to noise on line. In a SVC BD, if the (CONN LEG) of the test signal cord is connected to the (TTY 1) jack, the (SUPV) lamp of the cord will light. ***VERIFICATION:*** ***If a cord is patched to the*** (TTY 2) ***or*** (REC-1 or -2) ***jack (FDX test connections):*** No change in lamp signals occurs. The teletypewriter (if patched in) runs open or prints garbled copy due to noise on the line. ***VERIFICATION:*** ***If a cord is patched to the*** (LEV IN) ***jack (for level or frequency measurements):*** The equipment connected to the jack will indicate the loss of carrier by a loss in reading or a different (and probably erratic) reading due to noise.
1 — ALL BOARDS	Remove cords from all jack appearances and momentarily depress (CLR) key. ***VERIFICATION:*** (CLR) lamp lights momentarily and all lamps are extinguished. An on-hook indication is given to the office.

CHART 3 – DISCONNECTING ON A DATA INTERCOMMUNICATING CALL

PURPOSE: Originating and Disconnecting on Call to Test Lines such as the 1 MW Test Line, Ringer Test Line, etc.

DISCUSSION: Charts 1 and 3 cover the procedures for originating and disconnecting on a data intercommunicating call to a station that uses the "Data Set 101A". It is also possible, however, to originate a call, for telephone communication or test purposes, to terminations that do not use the data set. Such calls might be those to the 1 MW (one-milliwatt) test line, the telephone ringer test line, or a transmission test line (such as the subscriber transmission test — STT — line at a DLS office master test frame). On such calls, the sequence of operations in the 2-way station test line circuit will not (except in the presence of noise simulating received F2 frequency) progress beyond the stage where the called station is heard to go off-hook. Normal telephone communication is then possible over the cord patched to the (DIAL) jack. In addition, transmission measurements may be made at the (LEV IN) jack. Procedures are covered below.

Incoming calls to the station test line are always answered in the TTY communication mode. Accordingly, calls should not be made to it if the intended communication will be in the telephone mode. Instead, it should be arranged for the test center to originate the necessary call.

TEST STEP	TEST PROCEDURE AND VERIFICATION
1 — ALL BOARDS	***A. TO ESTABLISH TEST CALL:*** Use Step 1 thru Step 4 procedures of Chart 1. ***Note:*** The equipment patched to the (TTY 1) or (SND-1, -2, or -3) jack will not be used in the tests covered below and need not be conditioned for TTY communication as specified in Step 2 of Chart 1. The patch must be made, however, to prepare the path for presenting the off-hook signal to the office and to complete the path for dialing to the (DIAL) jack. ***VERIFICATION:*** This will vary depending on test line called. See below.
	B. CALL TO 1 MW TEST LINE: Such a call would ordinarily be made to check the loss of the test line. If the line uses 4-wire gain elements, this test will check only the loss in the receiving direction. ***VERIFICATION:*** The test tone (1000 cycles now, but a 2300-cycle, dial-up tone may be made available later) will be heard in the position headset.
1 — ALL BOARDS	Patch 13A (or equivalent 600-ohm transmission measuring set) to (LEV IN) jack. Remove patch to (DIAL) jack. ***VERIFICATION:*** Level of incoming test tone will be indicated on TMS. Record reading.
2 — ALL BOARDS	Disconnect by removing patch to (LEV IN) jack and momentarily depressing (CLR) key. ***VERIFICATION:*** (CLR) lamp lights momentarily. The (ORIG BSY) and (CONN) lamps go out.
	Continued on Sheet 2

CHART 4 (Continued)

TEST STEP	TEST PROCEDURE AND VERIFICATION
	C. CALL TO RINGER TEST LINE: ***VERIFICATION:*** Tone will be heard in the position headset as a signal to proceed with ringer test.
1 — ALL BOARDS	Disconnect by removing patch to (DIAL) jack and the (TTY 1) or (SND-1, -2, or -3) jack and momentarily depressing (CLR) key. ***VERIFICATION:*** (CLR) lamp lights momentarily. The (ORIG BSY) and (CONN) lamps go out. After a short pause, station will be rung as evidenced by lighted (ANS) lamp and audible signal.
2 — ALL BOARDS	Answer call using Chart 1, Step 1 procedure. The TTY equipment patched to the (TTY 1) or (SND-1, -2, or -3) jack need not be conditioned for TTY communication. ***VERIFICATION:*** (TERM BSY) and (CONN) lamps light at all appearances. (ANS) lamp goes out and audible signal is silenced. (CONN) lamp should stay lit as an indication that the call was not a regular incoming Data call.
3 — ALL BOARDS	Disconnect by removing patch to (TTY 1) or (SND-1, -2, or -3) jack and momentarily depressing (CLR) key. ***VERIFICATION:*** (CLR) lamp lights momentarily. The (TERM BSY) and (CONN) lamps go out.
	D. CALL TO TRANSMISSION TEST LINE SUCH AS THE STT LINE: Such a call would ordinarily be made to permit 2-man, 2-way transmission testing of the facilities used on the station test line circuit, or to put the test line circuit in a condition where it will provide a static termination while measurements (such as return loss) are being made at the office. ***VERIFICATION:*** Called station will orally answer in normal manner. No change in lamp signals at the service center.
1 — ALL BOARDS	Arrange with called station for intended tests. Patch appropriate 600-ohm transmission or noise measuring equipment or oscillator (as agreed) to (LEV IN) jack. Remove patch to (DIAL) jack. To recover talking ability after agreed time interval, restore patch to (DIAL) jack and remove patch to (LEV IN) jack. Repeat sequence as required. ***CAUTION:*** Always make patch to second jack before removing patch from first jack. This is to avoid losing connection.
2 — ALL BOARDS	On completion of tests, disconnect by removing patch to (LEV IN) or (DIAL) jack and momentarily depressing (CLR) key. ***VERIFICATION:*** (CLR) lamp lights momentarily. The (ORIG BSY) and (CONN) lamps go out.
1 — ALL BOARDS	*E. CALL TO OFFICE "LOOP-AROUND" TEST LINE:* See Chart 11.

CHART 4 (Sheet 2 of 2)

ORIGINATING AND DISCONNECTING ON CALL TO TEST LINES SUCH AS THE 1 MW TEST LINE

PURPOSE: To Arrange Test Line for Half-Duplex (HDX) or Full-Duplex (FDX) Communication and Testing.

DISCUSSION — HDX OPERATION: The patch to the test line circuit jack required to originate a call (per Chart 1 procedures) or to answer a call (per Chart 2 procedures) automatically conditions the test line circuit for HDX communication and testing. In this condition, alternate, one-way communication may take place between the test center and the station. Test signals (undistorted, distorted, normal level, and reduced level) may be sent to the station. Test signals (keyboard or tape) may be sent to the test center for bias and distortion measurements. The ability to "break" against incoming signals may be tested at each end. The procedures to be used for these several tests are covered in Chart 7.

DISCUSSION — FDX OPERATION: The test line circuit may also be arranged, by appropriate patches as covered below, to permit FDX testing on the established connection. This requires a coordinated action at the station whereby the receiving and sending branches of the station MODEM unit are effectively tied together. Under these conditions, signals sent from the test center will key the transmitting side of the station MODEM. The signals will then be returned to the test center where they may be measured. In this case, the measurements may include distortion, level, and frequency. This simultaneous, 2-way transmission of signals constitutes the FDX operation of the circuit. It is to be noted, however, that it does not permit FDX communication between the test center and the station attendant. Procedures covering tests to be made under the FDX mode are covered in other charts. The procedures below cover only the steps required to put the connection in the FDX mode of operation.

TEST STEP	TEST PROCEDURE AND VERIFICATION
1 — ALL BOARDS	Request station to operate (TEST) key of his data set and to stand by for bell signal and further instructions.
2 — SVC BD	Transfer patch to (TTY 1) jack from (TTY 1) to (TTY 2) jack. Operate (S1) key of TTY cord circuit to (SEND ON TTY) position. Send RY's from keyboard.
2 — TST BD (HUB)	Operate (LEG-HUB) key of hub, testing, and misc. jack circuit to (LEG) position. Transfer path to (TTY 1) jack from (TTY 1) to (TTY 2) jack. Patch (TTY) cord of a second telegraph test circuit to (REC ONLY) jack via a properly adjusted TLT. Send RY's from keyboard of TTY associated with first telegraph test circuit, i.e., one patched to (SEND & REC-A) jack. If a second (TTY) cord is not available, patch a test signal source to (SEND & REC-A) jack and reuse (TTY) cord at (REC ONLY) jack.
2 — TST BD (LOOP)	Patch (TTY) cord of a second telegraph test circuit to (REC 1) jack. Send RY's from keyboard of TTY associated with first telegraph test circuit, i.e., one patched to (SND-1, -2 or -3) jack. If a second (TTY) cord is not available, patch a test signal source to (SND-1, -2 or -3) jack and reuse (TTY) cord at (REC 1) jack.
	VERIFICATION: When RY's are received on typing unit of the receiving TTY, it is a verification that the (TEST) key has been operated and the FDX mode is operative. Proceed with tests as required and as covered in Charts 8 and 9.

CHART 5 — ARRANGING TEST LINE FOR HDX OR FDX OPERATION

PURPOSE: Interchange Use of Frequencies ***F1*** and ***F2*** on Established Test Connection.

DISCUSSION: On a regularly established connection between two stations, frequency ***F1*** (mark = 1270 cps; space = 1070 cps) is used for transmission from originating to terminating station. Frequency ***F2*** (mark = 2225 cps; space = 2025 cps) is used for transmission in opposite direction. The test line circuit, however, has been arranged so that when a call has been established ***from*** the test center ***to*** a station, it is possible to interchange (swap or reverse) frequencies used for transmission. To do this requires coordinated action at the station and at the test center. This is necessary to prevent an automatic disconnect sequence from occurring as result of carrier being momentarily lost during the mode reversal operation. This transmission mode reversal may be used only when working with a 2-way station. It is not applicable when working with a receive-only station as these always receive on ***F1*** and transmit on ***F2.***

The operations required at the station may be performed either by the subscriber or by a station craftsman.

TEST STEP	TEST PROCEDURE AND VERIFICATION
1 — ALL BOARDS	It is assumed that the necessary test call has been established ***from*** the test center ***to*** the station in the normal HDX mode.
2 — ALL BOARDS	Request station to perform (FLIP) operations. ***Note:*** The procedure at the station to do this will be written up in the customer's operating manual and in the BSP's covering station testing procedures. In case instructions must be given, however, these would be: A. Request station to operate (TEST) key and stand by until TTY runs open. He should then depress (CLR) key momentarily and immediately hold (ORIG) key depressed until its associated lamp lights. At this time, his TTY will again run closed and he should communicate with the test center.
3 — ALL BOARDS	Rearrange patches as required (per Chart 5) to set up a FDX testing arrangement at the test center. Send test signals. ***VERIFICATION:*** When these signals are returned to the test center as page copy on the ***receiving*** teletypewriter, it will verify that the station has operated his (TEST) key. It is now safe to proceed to Step 4.
4 — ALL BOARDS	Restore the half-duplex (HDX) testing arrangement that existed prior to Step 3. Operate (FLIP) key momentarily. ***Note:*** At the station, this causes the TTY to run open and alerts the station to proceed with his flip sequence referred to in Step 2.
5 — ALL BOARDS	Communicate with station. Make such tests as are required under the new transmission mode. If additional tests are required under the original mode, the call will have to be disconnected (per Chart 3) and re-established (per Chart 1) from the test center. This is because the test connection cannot be "flopped" from the terminating back to the originating mode at the test center.

CHART 6 – INTERCHANGING USE OF FREQUENCIES F1 AND F2

PURPOSE: Testing Under the Half-Duplex (HDX) Mode.

DISCUSSION: The patch to the test line jack (TTY 1) or (SND-1, 2, or -3), required per Chart 1 to originate or per Chart 2 to answer a data intercommunicating call, automatically conditions the test line circuit for HDX communication and testing. In this condition, alternate, one-way communication may take place between the test center and the station. Test signals (undistorted or distorted at normal or reduced level) may be sent to the station for test purposes as required. Test signals (keyboard or tape) may be sent from the station to the test center for verification and bias and distortion measurements. The ability to "break" against incoming signals may be verified at each end. The equipment patched to the jack may be changed or rearranged as required without changing the initial conditions of the test line circuit.

The procedures to be used, on an established test connection, are given below. It is not necessary that all tests be made or that they be made in the order given.

TEST STEP	TEST PROCEDURE AND VERIFICATION
	SENDING TEST SIGNALS FROM TEST CENTER
	DISCUSSION: Signals may be sent from the test center to check normal operating performance, to determine proper range settings, to make bias and distortion measurements, to determine proper settings for "hit" indicator, etc. Generally they would be sent in connection with trouble investigations.
1a — SVC BD	***A. SEND FROM KEYBOARD:*** Operate (S1) key of TTY cord circuit to (SEND ON TTY) position. Local copy of signals will be received on position TTY. ***"BREAK" VERIFICATION:*** Momentary interruption in page copy which may appear as character errors. See Note 1, Sheet 3. ***B. SEND FOX SIGNALS WITH LOCAL COPY:*** Release (S1) key and connect (CONN SIG) cord of TTY cord circuit to a hub source of straight FOX or distorted (amount and type of distortion as required) FOX signals. Start signals by momentarily depressing (ST SIG) key. Local copy of signals will be received on position TTY. ***"BREAK" VERIFICATION:*** Momentary interruption in page copy which may appear as character errors. See Note 1, Sheet 3. ***C. SEND FOX SIGNALS WITHOUT LOCAL COPY:*** Remove (SET) cord from (TTY 1) jack. Patch (CONN LEG) cord of test signal cord circuit to (TTY 1) jack and patch (CONN SIG) cord of this circuit to a hub source of straight FOX or suitable distorted FOX signals. Start signals by momentarily depressing (ST SIG) key.

Continued on Sheet 2

CHART 7 (Continued)

TEST STEP	TEST PROCEDURE AND VERIFICATION
	"BREAK" VERIFICATION: Signals will stop and cord circuit visual alarm will be brought in. While this patch is still up, communication may be re-established with the station by operating the (S1) key of the test signal cord circuit to the (SEND TTY) position. Restore HDX communication and testing arrangement on completion of test. ***D. SEND SIGNALS AT REDUCED LEVEL:*** Operate (ATT) key of test line circuit. The signals may be of the "A", "B", or "C" type. Restore (ATT) key on completion of this test. (See 4.03 of text.) ***E. MEASURE DISTORTION OF SENT SIGNALS:*** For "A" and "B" signals, depress (READ) key of 118-type TMS associated with the TTY cord circuit. The "C" mode signals, as sent, may not be measured.
1b — TST BD (HUB)	***A. SEND FROM KEYBOARD:*** Local copy of signals will appear on position TTY. ***"BREAK" VERIFICATION:*** Momentary interruption in page copy which may appear as character errors. See Note 1, Sheet 3. ***B. SEND FOX SIGNALS WITH LOCAL COPY:*** Patch a hub source of straight FOX or distorted (amount and type of distortion as required) FOX signals to the unused (SEND & REC — B) jack. Local copy on position TTY. ***"BREAK" VERIFICATION:*** Momentary interruption in page copy which may appear as character errors. See Note 1, Sheet 3. ***C. SEND FOX SIGNALS WITHOUT LOCAL COPY:*** This would not ordinarily be done as there would be no way of detecting a break signal from the station. ***D. SEND SIGNALS AT REDUCED LEVEL:*** Operate (ATT) key of test line. Signals may be "A" or "B". Restore (ATT) key on completion of this test. ***E. MEASURE SENT SIGNALS:*** To measure keyboard signals patch 118-type TMS to unused (SEND & REC-B) jack. To measure FOX signals, patch TMS and signal source to a TLT and patch between the TLT and the (SEND & REC-B) jack.
	Continued on Sheet 3

CHART 7 (Continued)

TEST STEP	TEST PROCEDURE AND VERIFICATION
1c — TST BD (LOOP)	***A. SEND SIGNALS FROM KEYBOARD:*** Local copy of signals will appear on position TTY. ***"BREAK" VERIFICATION:*** Momentary interruption in page copy which may appear as character errors. See Note 1, Sheet 3. ***B. SEND FOX SIGNALS WITH LOCAL COPY:*** Patch a neutral source of straight FOX or distorted (amount and type of distortion as required) FOX signals to an unused (SND-1, -2, or -3) jack. Local copy on position TTY. ***"BREAK" VERIFICATION:*** Momentary interruption in page copy which may appear as character errors. See Note 1, Sheet 3. ***C. SEND FOX SIGNALS WITHOUT LOCAL COPY:*** This would not ordinarily be done as there would be no way of detecting a break signal from the station. ***D. SEND SIGNALS AT REDUCED LEVELS:*** Operate (ATT) key of test line. Signals may be "A" or "B". Restore (ATT) key on completion of this test. ***E. MEASURE SENT SIGNALS:*** Patch 118-type TMS to unused (SND-1, -2, or -3) jack.
RECEIVE SIGNALS FROM STATION	
	DISCUSSION: These signals would ordinarily be sent for the purpose of measuring distortion of station signals. These would be more or less accurate measurements as contrasted to the "go-no-go" measurement that would be made on a call to the automatic test line. In addition, a test may be made of the test center's ability to "break" station transmission.
2a — SVC BD	***A. MEASURE SIGNALS:*** Operate (S1) key to (SEND ON TTY), or neutral, position. Depress (READ) key of 118-type TMS associated with TTY cord circuit. ***"BREAK" VERIFICATION:*** Momentarily depress (BREAK) key on position TTY. At the station this should be recognized by interruption of transmission.
2b — TST BD (HUB)	***A. MEASURE SIGNALS:*** Patch 118-type TMS to (SEND & REC — B) jack. ***"BREAK" VERIFICATION:*** Momentarily depress (BREAK) key on position TTY. At the station this should be recognized by interruption of transmission.
Continued on Sheet 4	

CHART 7 (Continued)

TEST STEP	TEST PROCEDURE AND VERIFICATION
2c — TST BD (LOOP)	*A. MEASURE SIGNALS:* Patch 118-type TMS to (SND-2 or -3) jack. *"BREAK" VERIFICATION:* Momentarily depress (BREAK) key on position TTY. At the station this should be recognized by interruption of transmission.
Note 1: The "Break" timer at the station generates a controlled interval of a spacing signal. The timing may be checked by having the attendant at the station depress the (BREAK) key for 3 or 4 seconds. The test center receiving TTY will run open for about 0.45 to 0.64 seconds. The interval may be determined by noting the number of blank characters received on position TTY.	

PURPOSE: Testing Under the Full-Duplex (FDX) Mode (Loop-Back Transmission Testing).

DISCUSSION: Chart 5 covers the procedure for placing the test line circuit in its FDX mode of operation to permit loop-back transmission tests. This mode of operation is required to measure the level and frequency of the carrier incoming from the station as covered in Chart 9. It is also required, as an incidental step, in swapping the use of transmission frequencies as covered in Chart 6. Other tests under the FDX mode are covered below. These tests cover the procedures for sending test signals (undistorted or distorted at normal or reduced level) to the station where they will be printed out on the TTY and will, also, be used to key the stations transmitting channel. This will return the signals to the test center where they may be printed out and/or measured. The procedures below assume that the FDX mode of operation has been established per Chart 5.

TEST STEP	TEST PROCEDURE AND VERIFICATION
1a — SVC BD	***A. KEYBOARD SENDING: Received Signals:*** To read copy, operate (S1) key to (SEND ON TTY) position. To measure, also depress (READ) key. ***Sent Signals:*** To read copy, operate (S1) key of cord circuit to (MON IN REGEN) position. To measure, also depress (READ) key of 118-type TMS associated with cord circuit. ***B. FOX SENDING:*** Connect (CONN SIG) cord associated with TTY cord circuit to a hub source of suitable undistorted or distorted FOX signals and start signals by momentarily depressing (ST SIG) key. ***Received Signals:*** To read copy, operate (S1) key to neutral position. To measure, also depress (READ) key. ***Sent Signals:*** To read copy, operate (S1) key to (MON IN REGEN) position. To measure, also depress (READ) key. ***C. SEND AT REDUCED LEVEL:*** Signals of "A" or "B" type may be sent at reduced level by holding depressed the (ATT) key.
1b — TST BD (HUB)	***A. KEYBOARD SENDING: Received Signals:*** Read copy on second TTY patched to (REC ONLY) jack via the (D2) and (LPG) jacks of a TLT. Measure on 118-type TMS patched to TLT (D1) jack. ***Sent Signals:*** Read copy on TTY patched to (SEND & REC) (A) jack. Measure on 118-type TMS patched to (SEND & REC) (B) jack. ***B. FOX SENDING:*** Patch a hub source of suitable undistorted or distorted FOX signals to the (SEND & REC) (B) jack. ***Received Signals:*** Read and measure in same manner as "A" signals. ***Sent Signals:*** Read copy or measure signals by patching TTY cord or 118-type TMS to (SEND & REC) (A) jack. ***C. SEND AT REDUCED LEVEL:*** Signals of "A" or "B" type may be sent at reduced level by holding depressed the (ATT) key.

Continued on Sheet 2

CHART 8 (Continued)

TEST STEP	TEST PROCEDURE AND VERIFICATION
1c — TST BD (LOOP)	*A. KEYBOARD SENDING: Received Signals:* Read copy on second TTY patched to (REC-1 or -2) jack. Measure on 118-type TMS patched to (REC-2 or -1) jack. ***Sent Signals:*** Read copy on TTY patched to (SND 1) jack. Measure on 118-type TMS patched to (SND 3) jack. *B. FOX SENDING:* Patch a neutral source of suitable undistorted or distorted FOX signals to the (SND 2) jack. ***Received Signals:*** Read and measure in same manner as "A" signals. ***Sent Signals:*** Read and measure in same manner as "A" signals. *C. SEND AT REDUCED LEVEL:* Signals of "A" or "B" type may be sent at reduced level by holding depressed the (ATT) key.
2 — ALL BOARDS	On completion of FDX testing, restore HDX communication and testing mode by recalling station by bell signals and requesting the restoration of the (TEST) key. ***VERIFICATION:*** Send signals on sending loop. When they are no longer received on the receiving loop, it will verify that the (TEST) key has been restored. Remove patches to (TTY 2) or (REC-1 or -2) jack and re-establish HDX patch to (TTY 1) or (SND-1, -2, or -3) jack as required.

CHART 8 (Sheet 2 of 2)

TESTING UNDER THE FDX MODE

PURPOSE: To Measure Level and Frequency of Carrier Incoming from Station.

DISCUSSION: The test line circuit is provided with a (LEV IN) jack. When proper equipment is patched to this jack, the test center may measure either the level (dbm) or frequency (cps) of carrier incoming from station. When a patch is made to this jack, the central office line is connected to the jack thru an impedance-matching (900-to-600-ohm) transformer. Also, the MODEM unit of the test line circuit is disconnected, resulting in loss to it of both outgoing and incoming carrier. The logic circuitry, however, is conditioned to maintain the off-hook signal to the central office thru the dc path provided by the transformer and thru contacts of certain relays that depend on whether the test line is in the originating or terminating mode. Status lamp signals are also maintained.

The loss of transmitted carrier, due to patch to (LEV IN) jack, would ordinarily cause the distant station to automatically disconnect with loss of its transmitted carrier. Of course, we want to maintain this carrier in order that it may be measured. It is necessary, therefore, that the station be placed in its (TEST) mode before the patch is made to the (LEV IN) jack. The station will now maintain its off-hook condition despite the loss of incoming carrier. Its transmitting carrier will now be keyed by signals received from the test center. As there will be no such signals during the measuring period, the station will transmit a steady spacing signal which may now be measured by patching to the (LEV IN) jack. To measure a steady marking signal, the station data set must be forced into the marking mode. This cannot be done by the subscriber, but it may be done by the station craftsman, when requested.

If the test center is in the originating mode, the station ***F2*** sending frequency will be measured. It is also possible, on such a connection — if it involves a 2-way station — to measure the station ***F1*** sending frequency. This requires the use of Chart 6 procedures that cover transmission mode reversal. If the test center is in the terminating mode, only the station ***F1*** sending frequency may be measured on the particular connection. This assumes that the tests are being made with the subscriber. If they are made with the station craftsman, all four frequencies (***F1*** mark and space and ***F2*** mark and space) may be measured on the one connection. This requires the proper manipulation of certain keys and manual operation of certain relays at the station.

TEST STEP	TEST PROCEDURE AND VERIFICATION
1 — ALL BOARDS	Request station to operate (TEST) key and to stand by for bell signal and further instructions.
2 — ALL BOARDS	Establish a FDX testing arrangement and confirm that station (TEST) key has been operated. Use Chart 5 procedures.
3 — ALL BOARDS	***TO MEASURE LEVEL OF SPACING CARRIER:*** Patch 13A (or equivalent transmission measuring set) to (LEV IN) jack and record reading.

Continued on Sheet 2

CHART 9 (Continued)

TEST STEP	TEST PROCEDURE AND VERIFICATION
4 — ALL BOARDS	***TO MEASURE FREQUENCY OF SPACING CARRIER:*** Patch between (LEV IN) and (AMP IN) jacks and between (AMP OUT) jack and (600-OHM IN) jack of 72A frequency meter. Measure frequency in accordance with BSP covering use of frequency meter. ***Note:*** The amplifier is provided so that weak signals may be boosted sufficiently to drive the 72A. It is normally set to produce 30 db gain.
5 — ALL BOARDS	***TO MEASURE MARKING CARRIER:*** This test requires the assistance of the station craftsman. Remove patch to (LEV IN) jack. Recall craftsman by sending bell signal and request that he put station in a marking mode. ***VERIFICATION:*** Send signals on the sending loop. When they are no longer received on the receiving loop, it may be assumed that the station is now in the steady marking condition.
6, 7 — ALL BOARDS	Repeat Steps 3 and 4 to measure level and frequency of steady marking carrier.
8 — ALL BOARDS	***TO RESTORE HDX COMMUNICATION AND TESTING MODE:*** Remove patch to (LEV IN) jack. Recall station by bell signals and request removal of enforced steady marking condition (if this were imposed by Step 5) the restoral of the (TEST) key. ***VERIFICATION:*** Send signals on sending loop. If Step 5 were used, the receipt of signals on the receiving loop will verify the removal of the imposed steady marking condition. Continue sending signals. When they are no longer received on the receiving loop, it will verify that the (TEST) key has been restored. Restore HDX communication and testing arrangement at center by removal of all patches to the (TTY 2) or (REC-1 or -2) jack and re-establish necessary patches to (TTY 1) or (SND-1, -2, or -3) jack.

CHART 9 (Sheet 2 of 2)

MEASURING LEVEL AND FREQUENCY OF CARRIER INCOMING FROM STATION

PURPOSE: To Originate and Terminate Call to Office "Loop-Around" Test Line.

DISCUSSION: Investigation of trouble reports may often require a test to determine the actual data signal level delivered by a station to its serving office. When the station and responsible test center are both served by the same office (as in the WADS network), this is simple. It merely involves the use of Chart 9 procedures and correcting the level as measured at the test center by the known loss, in the receiving direction, of the station test line. With the TWX station maintenance plan, however, a particular station and the responsible test centers will often be served by different offices. The use of Chart 9 procedures will not produce sufficiently dependable results in such a case. This is because of the unknown loss in the trunk (or trunks) involved in the connection between the test center and the station. A testing procedure involving the use of the "loop-around" circuit is required in this case.

The "loop-around" circuit is a test line circuit installed in the office serving the station. This test line circuit has two switch appearances, each having its own telephone number. When the test center calls the ***first*** appearance, the test line applies a 1000 cps tone of one milliwatt. This tone may be measured at the test center. The measured value may then be taken as the 1000-cycle loss in the receiving direction on the particular connection. The station now calls the ***second*** appearance of the test line circuit. This causes the 1000-cycle tone to be removed. It also causes the subscriber line and the test center 2-way station test line to be connected together. This is done thru equipment that introduces a negligible loss of about 0.1 db.

In connecting to the "loop-around" circuit, both the station and test center are in the originate mode of operation. There is no ***F2*** marking tone on this connection, and the data intercommunicating connect sequence will not be initiated. To initiate the necessary connect sequence, the test center must perform certain operations. The test center procedures involved in establishing the call, in initiating the connect sequence, in data signal level measuring, are covered below.

Note: If these tests are to be made with the subscriber, it must be understood that they can be made only with an "Originate-Terminate" station. "Terminate Only" stations will not be arranged to permit the necessary dialing by the subscriber. However, if the tests are to be made with a telephone employee, he may operate the dial restrict (DR) key to secure necessary dialing ability on a "Terminate Only" station that is not assigned to a hunting group. If the "Terminate Only" station is assigned to a hunting group, the operation of the (DR) key will be ineffectual as these stations will be denied access to dial tone; accordingly, "loop-around" tests cannot be made.

TEST STEP	TEST PROCEDURE AND VERIFICATION
1 — ALL BOARDS	Originate call (using Chart 4 procedure) to ***first*** appearance of "loop-around" circuit in office serving the distant subscriber. If the distant subscriber is provided with a divided access line circuit, this office must be the one used by the subscriber when he originates calls. It is not the office that is used when he is called. ***VERIFICATION:*** When the connection is established, the 1000 cps tone may be heard in position headset.

Continued on Sheet 2

CHART 10 (Continued)

TEST STEP	TEST PROCEDURE AND VERIFICATION
2 — ALL BOARDS	Patch TMS to (LEV IN) jack and ***then*** remove cord from (DIAL) jack. Note and record reading of TMS. This is the 1000 cps loss of the connection (e.g., — 20 db).
3 — ALL BOARDS	Reestablish patch to (DIAL) jack and ***then*** remove TMS from (LEV IN) jack. This will hold connection.
4 — ALL BOARDS	Over another communication channel, instruct customer (or employee) to make a regular data intercommunicating call to the ***second*** appearance of the loop-around circuit. Furnish number to be called. ***VERIFICATION:*** When the customer has been connected to the test line, the 1000 cps tone will no longer be heard in the position headset. Proceed promptly to Step 5. ***At the station*** nothing happens. However, the customer's equipment is still in an audible monitoring condition. If the position (TALK) key were to be operated, the customer could hear what was said. Since voice communication is not permitted, the (TALK) key should not be operated when testing with a customer.
5 — ALL BOARDS	When the 1000 cps tone stops, remove cord from (DIAL) jack. This cuts line thru to the test line circuits MODEM unit. Operate (FLIP) key momentarily. ***VERIFICATION:*** (CLR) lamp lights ***momentarily*** (CONN) lamp goes out ***momentarily*** and stays lit (ORIG BSY) lamp goes out (TERM BSY) lamp lights. About one second later (SF guard interval), ***F2*** mark is sent to the station by the test line circuit. About one second later (***F2*** recognition interval at station) ***F1*** will be sent to test center by station and its motor will turn on. About one second later (***F1*** recognition interval at test center), (CONN) lamp goes out. This indicates that the connect sequence has been completed and that TTY intercommunication may now take place.
6 — ALL BOARDS	On the established connection, using the position TTY, request station to operate (TEST) key, to ignore his TTY running open, and to stand by for bell signal and further instructions.
	Continued on Sheet 3

CHART 10 (Sheet 2 of 3)

ORIGINATING AND DISCONNECTING ON CALL TO OFFICE "LOOP-AROUND" TEST LINE

CHART 10 (Continued)

TEST STEP	TEST PROCEDURE AND VERIFICATION
7 — ALL BOARDS	Establish a FDX testing arrangement and confirm that station (TEST) key has been operated. Use Chart 5 procedure.
8 — ALL BOARDS	Patch TMS to (LEV IN) jack. Note and record reading of TMS. This is the level of the ***F1*** spacing (1070 cps) signal as received from the station (e.g., −45 dbm).
9 — ALL BOARDS	The level of the ***F1*** spacing signal as delivered to the customer's serving office = Step 8 − Step 2 readings (e.g., −45 — (−20) = −45+20 = −25 dbm). Compare this value with the level the station should deliver (the proper value should be shown on the station card — usually it will be −15 ±1 dbm) to determine the need for corrective action.
10 — ALL BOARDS	If it is desired to measure the frequency of the ***F1*** spacing signal, proceed to Step 11, otherwise proceed to Step 12.
11 — ALL BOARDS	***MEASURE FREQUENCY OF INCOMING F1 SPACING SIGNAL:*** Remove patch of TMS to (LEV IN) jack. Patch between this jack and VF AMP (AMP IN) jack. Patch 72A frequency meter to (AMP OUT) jack. Measure frequency.
12 — ALL BOARDS	***DISCONNECT:*** Remove Step 8 or Step 11 patches. This cuts line thru to station MODEM. From position keyboard, send bell signals to station and request that he restore (TEST) key. Send RY's. When copy of returned signals cease, it will confirm that the key has been restored. Restore HDX test arrangement at test center. On completion of communication with customer, remove all cords and objects (CLR) key momentarily.

INFORMATION NOTES (CONT):

305. BLOCK DIAGRAM. 2-WAY STATION DATA-PHONE LINE CKT ARRANGED FOR HUB OPERATION IN NO. 2 OR 9B TELEGRAPH SERVICE BOARD.

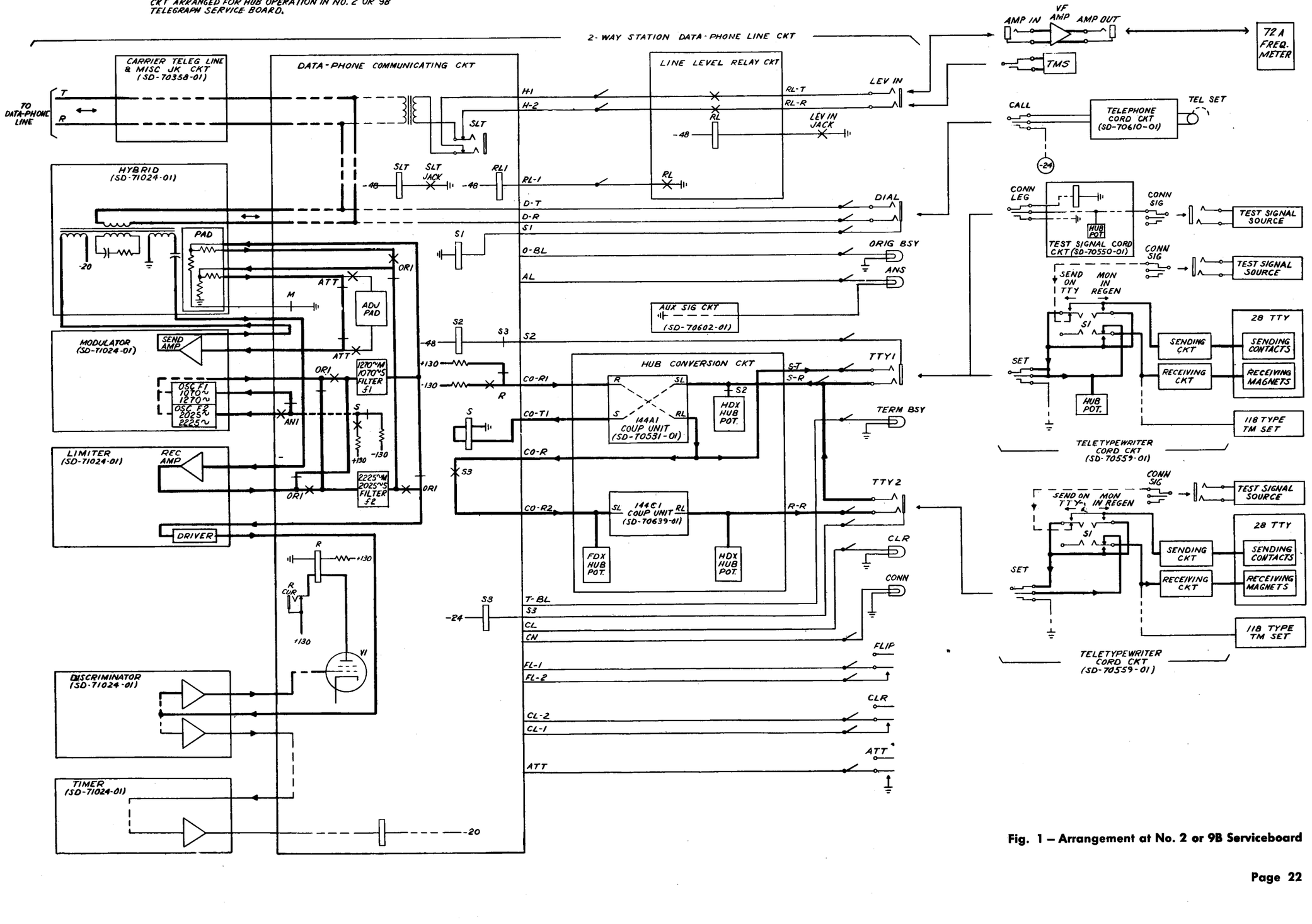
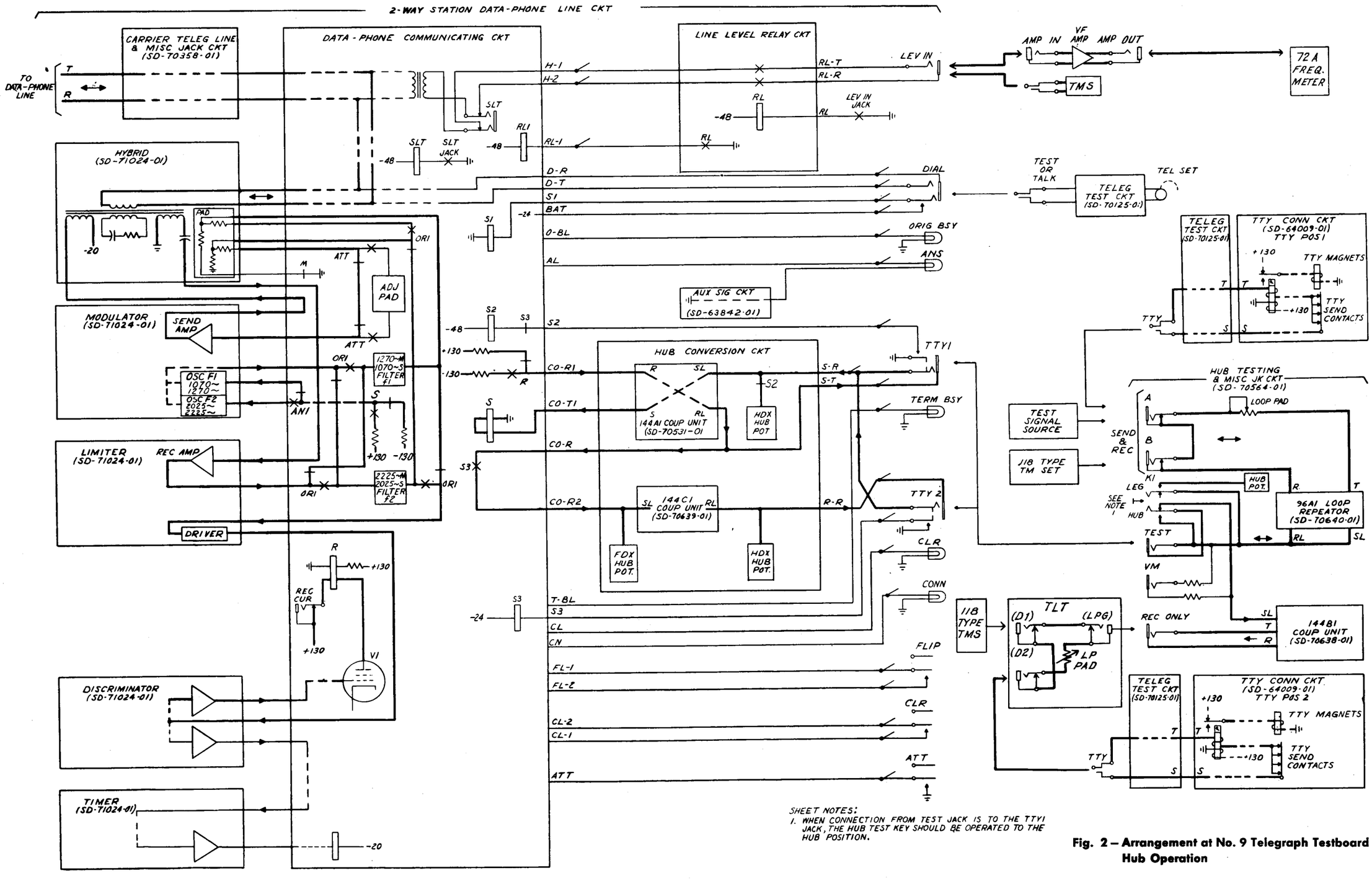


Fig. 1 – Arrangement at No. 2 or 9B Serviceboard



SHEET NOTES:
1. WHEN CONNECTION FROM TEST JACK IS TO THE TTY1 JACK, THE HUB TEST KEY SHOULD BE OPERATED TO THE HUB POSITION.

Fig. 2 – Arrangement at No. 9 Telegraph Testboard Hub Operation

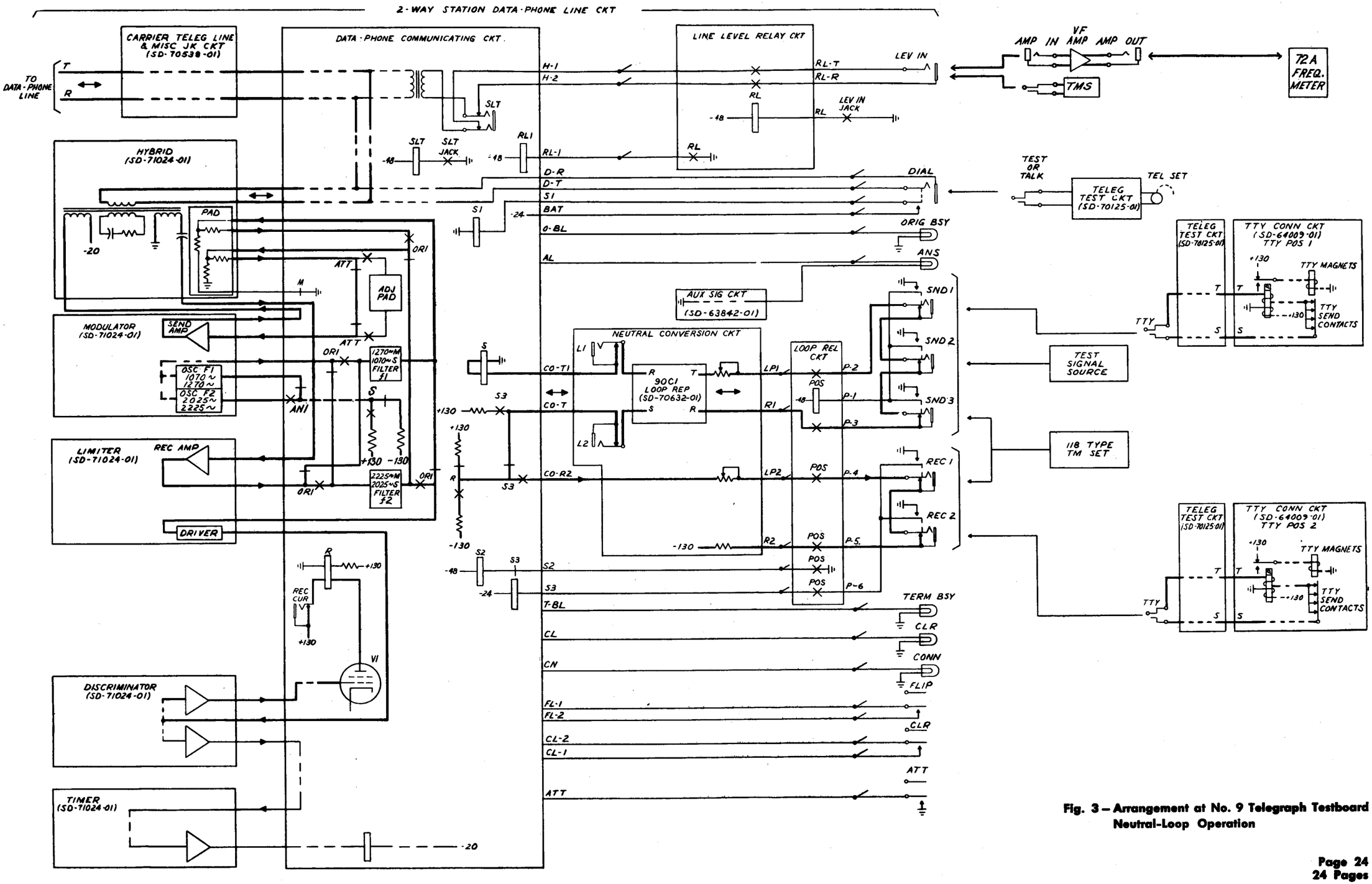


Fig. 3 – Arrangement at No. 9 Telegraph Testboard Neutral-Loop Operation