3-ROW TELETYPEWRITER STATION
DATA SET 101A FOR "DATA-PHONE"® SERVICE
TESTS AND INSTALLATION METHODS

CONTENTS PAGE

1. GENERAL

1.01 This section covers the installation and tests of 3-row DATA-PHONE stations using Data Set 101A.

1.02 At the present time, station arrangements availabe for 3-row DATA-PHONE service utilize Data Set 101A per SD-71025-01, a 689 subscriber set per SD-71023-01, and a 223B handset per SD-3D045-01. All are mounted in either a Model 28 ASR (attended) or Model 28 RO (unattended) teletypewriter (TTY).

1.03 Fig. 1, 2, and 3 are illustrations of the data set and can be used to identify the following major components:

- Terminal strips
- Wire spring relays
- Filters
- Cords
- Electronic plug-in units or cards

  J70148A L1—Discriminator

  J70148B L1 or L4—Modulator

  J70148C L1—Hybrid

  J70148D L1—Limiter

  J70148E L1—Timer

  J70148F L1—Answer-Back Drum (28 TTY)

  J70148G L1—Keyer

- Rectifier: Data Set 101A contains its own power supply. The power supply is a semiconductor ferroresonant regulated-type rectifier and delivers both positive and negative 20 volts, 0.5 amp dc. Stations supplied with dc power will require a KS-15982 inverter to furnish power for the data set only. Rectifier number is J87215A-L1 (SD-81536-01).

1.04 Following is a list of tools required for placing a DATA-PHONE station in service.

- Teletypewriter maintenance tools
- Hand test set 1011 or 1013-type
- Northeast Electronics Test Set Model No. TTS-28, or equivalent
- Inserter extractor (wire) tool, KS-19092-L1
- 6H Impulse Counter
- Carrying case for plug-in printed circuit cards

- Spare set of plug-in printed circuit cards

Test set TTS-28 should be in vertical position when used to prevent erroneous readings.

1.05 Fig. 4 is a block diagram of a typical 3-row DATA-PHONE station.

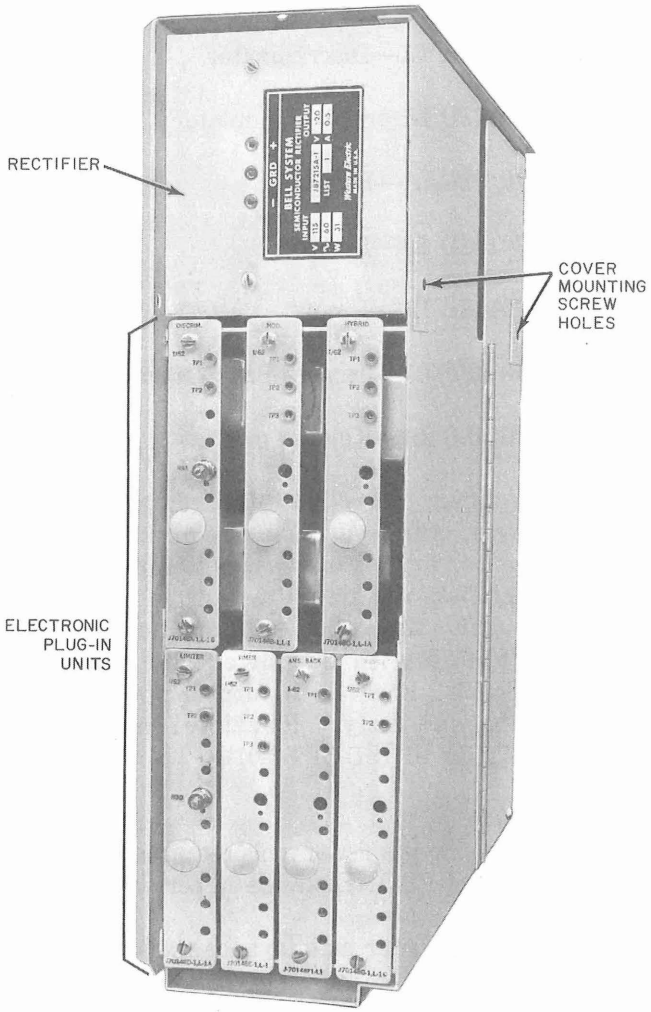

Fig. 1—Data Set 101A—Front View—Cover Removed

1.06 Fig. 5 is a simplified block diagram of Data Set 101A.

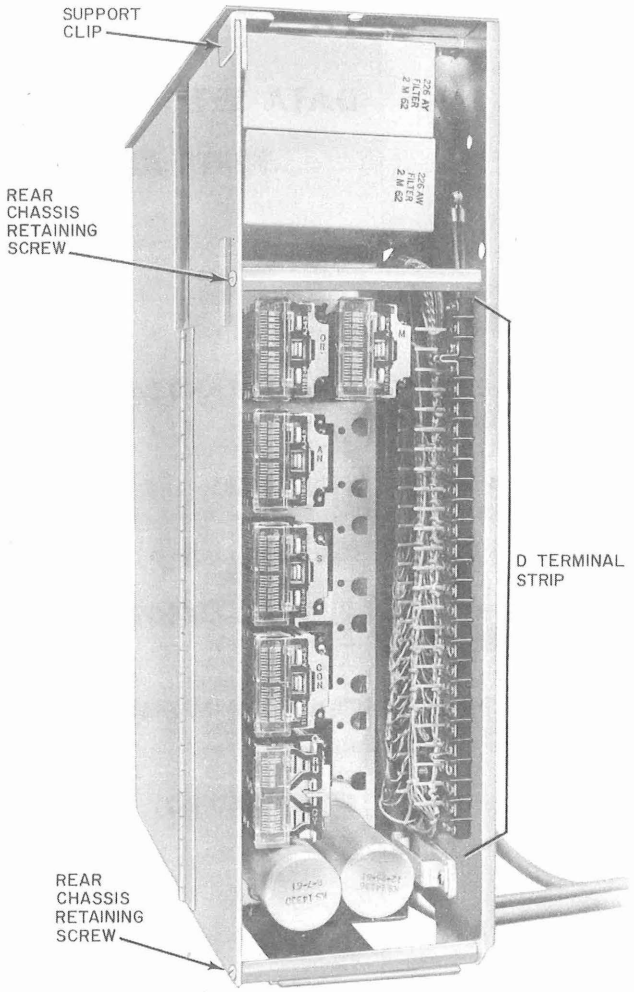

Fig. 2—Data Set 101A—Rear View—Cover Removed

2. RECORDING STATION LOOP AND DATA SET INFORMATION

2.01 Form E-4905 (Fig. 6) has been provided for recording loop design values and data set information for future reference in maintaining the loop and station equipment.

2.02 When completed, form E-4905 should be placed in the upper left-hand corner of the data set faceplate beneath the identifying stenciling.

2.03 Design information obtained from service order and/or station or circuit layout record card, as well as the data set information determined

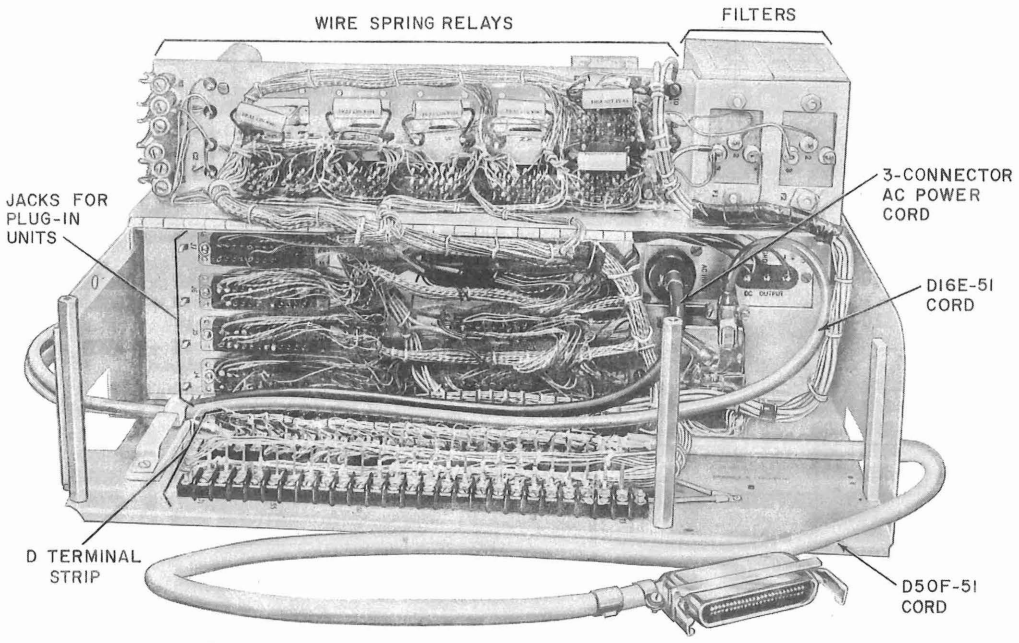

Fig. 3—Data Set 101A—Wiring and Terminal Strips—Rear Chassis Open

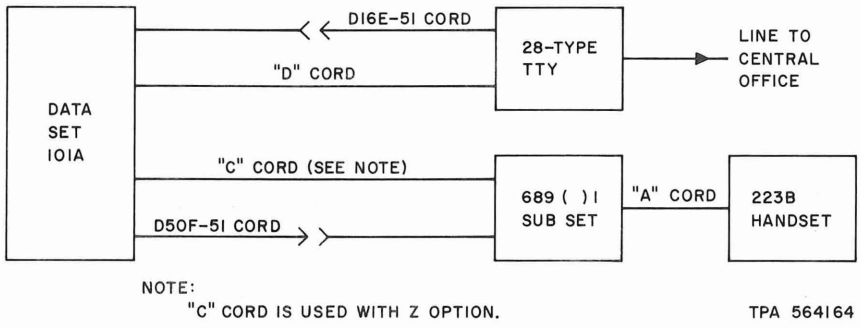

Fig. 4—Block Diagram of a Typical 3-Row DATA-PHONE Station

during the initial installation, should be recorded on the form as follows:

(1) Data Set 101-type: Enter letter "A" in blank space provided.

(2) Circuit No.: Enter DATA-PHONE station number.

(3) Divided Access Line Circuit: Check box for DALC not provided.

(4) Expected Measured Loss (EML): Enter loop design loss for 1000 Hz as shown on station or circuit layout record card. Refer to Table A for loop limits and place check in appropriate block.

(5) Data Set Send Pad: Enter, from station or circuit layout record card and/or service order, prescribed value of loss to be strapped into F1 and F2 pads.

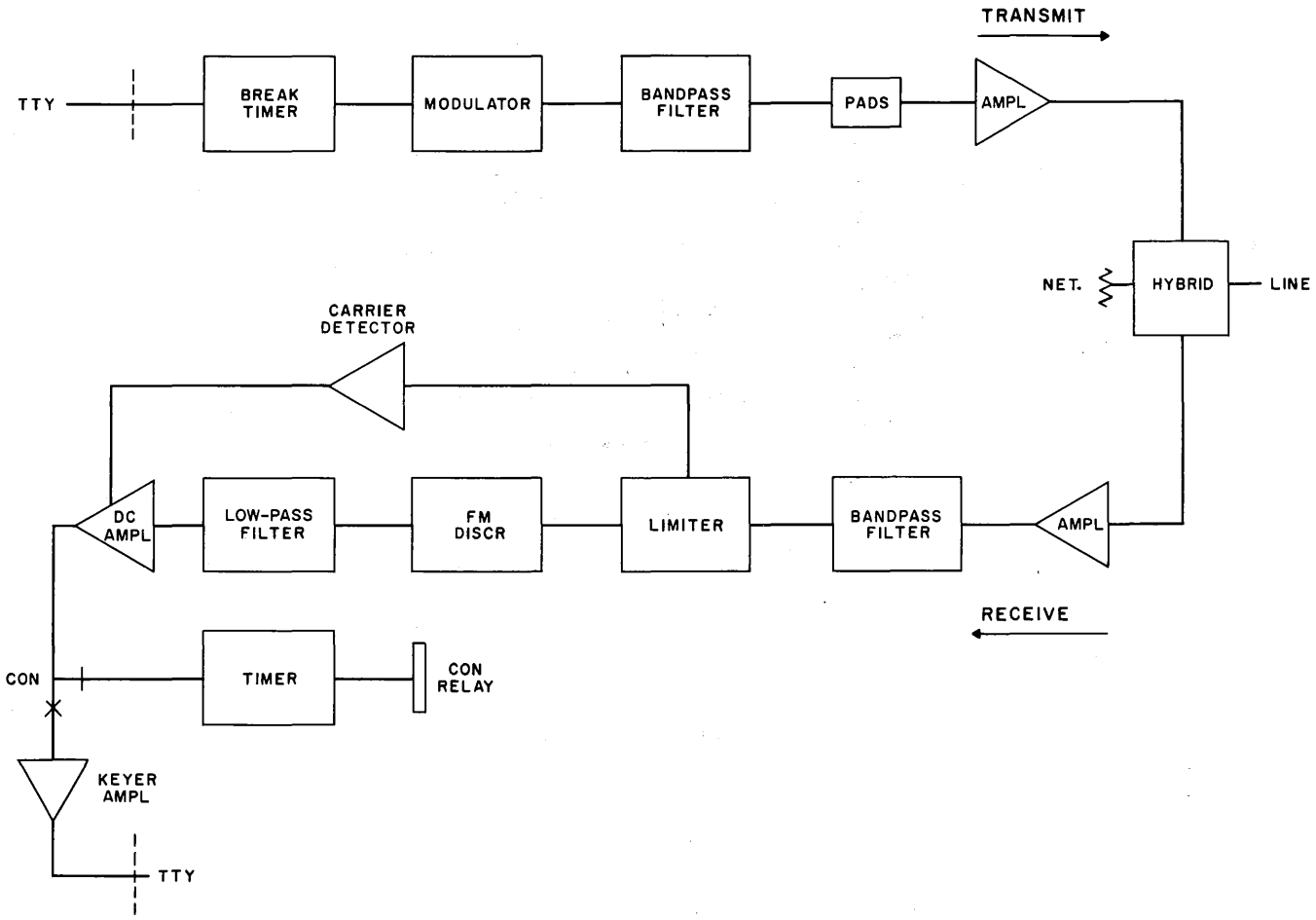

Fig. 5—Data Set 101A—Block Diagram

(6) Trip Ringing Feature: Check proper block to indicate option used. Wiring options are shown in Table B.

(7) Installed By: Enter initials of person making installation tests.

(8) Date: Enter date of initial installation and subsequent dates when any changes in entries on the form are made.

(9) Hybrid Network: Check proper block to indicate whether hybrid network strapping is required, as indicated on station or circuit layout record card.

(10) Desensitizing Network: Record the appropriate desensitizing network strapping.

(11) Data Set Output Reference Measurement: Record results of tests described in 4.19.

(12) Other Data Set Features: Indicate other data set features provided such as half-duplex operation (option X), full-duplex operation, etc. (See Table B.)

2.04 Table B shows the station function with associated wiring option and whether or not option was furnished by factory.

3. INSTALLATION OF DATA SET

3.01 DATA-PHONE stations will be fully assembled at the distributing house prior to shipment.

3.02 If it is necessary to move a DATA-PHONE station, do not lift or move by exerting upward force on the data set. Should the data set

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DATA SET 101 (1) TYPE
DATA SET AND LOOP DESIGN VALUES

E-4905
(3-63)

(2) CIRCUIT NO. _____

(3) DIVIDED ACCESS LINE CIRCUIT
YES ☐ NO ☐

(4) EXPECTED MEASURED LOSS (EML)
(SEE B.S.P. 314-300-300 FOR 4-WIRE EML MEASUREMENT)

1000 CPS _____ DBM
2300 CPS _____ DBM
LOOP LOSS LIMITS ☐ ±1 DB ☐ ±2 DB

(5) DATA SET SEND PAD
F1 PAD _____ DB
F2 PAD _____ DB

(6) TRIP RINGING FEATURE
(FORMERLY DIAL LONG LINE EXTENSION FEATURE)
☐ DURING SILENT AND RINGING INTERVAL (OPT. T)
☐ DURING SILENT INTERVAL ONLY (OPT. S)

(7) INSTALLED BY _____

(8) DATE _____

(9) HYBRID NETWORK
☐ NO STRAP ☐ STRAP 27-28

(10) DESENSITIZING NETWORK
(LIMITER) A TO _____
(SEND BREAK TIMER) G TO _____ } 101 C ONLY
J TO _____

(11) DATA SET OUTPUT REFERENCE MEASUREMENT
F1M (TP1-TP2) _____ DBM
F2M (TP1-TP2) _____ DBM

(12) OTHER DATA SET FEATURES
☐ HALF DUPLEX (OPT. X)
☐ FULL DUPLEX

Fig. 6—Form E-4905

TABLE A

LOOP LIMITS

TYPE OF LOOP	AML LIMITS
Without Repeaters or Carriers	EML ±1 dB
With E7 Repeaters Only	EML ±1 dB
With All Other Repeaters and/or Carrier	EML ±2 dB

disengage from bottom mounting bracket, its only support would be the top mounting screws. This would cause damage to either the teletypewriter cabinet or data set framework.

3.03 To minimize inductive interference to data signals on the data line, station wire should ***not*** be carried in the same run as cables to other business machines or lines carrying other teletypewriter service. Where this condition cannot be met, it will be necessary to use SK (shielded) station wire between data set and cable distribution terminal or building entrance.

3.04 A 3-conductor power cord is used to connect TTY to a 117-volt 60-Hz ac power supply. Customer must furnish a 3-wire outlet, not under control of a switch.

3.05 A check of the ground should be made to verify that a ***good*** ground exists. This precaution is particularly necessary where other business machine equipment is located in the same

TABLE B

FUNCTIONS AND ASSOCIATED WIRING OPTIONS
FOR DATA SET 101A

FUNCTION	WIRING OPTION	FACTORY PROVIDED	D TERMINAL STRIP STRAPPING
Half Duplex	X	Yes	73-74
Full Duplex	Remove X	No	
Connecting circuit arranged to trip ringing during silent and ringing intervals	T*	Yes	53-54
Connecting circuit arranged to trip ringing only during silent period	S*	No	51-52 55-56

* Earlier models were factory-furnished with T option, later models are factory-furnished with S option.

room. All 117-volt power sources in the room should be served from the same ac service cabinet so that the same ground bus feeds each outlet. This measure is necessary to prevent introduction of noise potentials which might otherwise develop and cause data errors.

3.06 If a transient ground condition is suspected, the 6H impulse counter may be used to verify and isolate trouble. For information on the 6H impulse counter, refer to Section 103-620-101. Connect 6H impulse counter and conduct test as follows.

Note: A 6A impulse counter may be used if a 6H impulse counter is not available.

(1) Using a 2W43A test cord or equivalent, (310 plug on one end, alligator clips connected to tip and sleeve on the other end) connect between the grounds to be tested and the 310 MEAS jack on the 6H impulse counter.

(2) Set DIAL-MEAS switch to DIAL.

(3) Set the DBRN dial to 90.

(4) Reset counter to 0.

(5) Set the MINUTES control to 15.

At the end of the 15-minute test period, there should be ***no*** reading on the counter. If there is a reading on the counter, grounding conditions must be improved.

3.07 Bonding grounds may eliminate trouble when a visual inspection does show that a multiple ground condition exists.

4. TESTS AND INSPECTIONS

4.01 The following tests and inspections should be performed sequentially as outlined in 4.09 through 4.20. All adjustments will be made at the factory prior to shipment.

4.02 Send pads on the HYBRID card will have been strapped (1-2) and (3-4) to provide no attenuation in both the F1 and F2 frequency bands.

4.03 Desensitizing network of the LIMITER will have been strapped (A to B) for maximum sensitivity and hybrid balance resistor R9C (terminals 27 and 28 on HYBRID unit) should be strapped when making line-up tests, if required.

Potentiometers R3D (LIMITER), R4A (DISCRIMINATOR), and R20B (when provided on modulator unit of data set 101B) are factory set and are not to be adjusted unless specified. Where a DISCRIMINATOR or LIMITER card is changed, R3D and R4A may be checked as outlined in Section 591-012-300.

Note: If for some reason all plug-in units are removed from a data set, it is recommended that they be reinstalled in the same data set from which they were removed. Even though all plug-in units are completely interchangeable, the factory makes a final touch-up adjustment on potentiometers in LIMITER and DISCRIMINATOR units. Unless these units stay with the same data set in which they were received, the advantage of factory adjustment is lost. Substitutions should be made ***only*** to replace defective units.

To prevent transistor damage in KEYER unit, disconnect ac power to rectifier J87215A before performing any of the following operations.

- Removing or inserting **KEYER** unit, or T connector.
- Opening any part of teletypewriter selector magnet circuit.

4.04 Measure the loop loss by using test set TTS-28.

(1) Position TTS-28 FUNCTION switch to TEL SET—DIAL.

Note: To assure accurate measurements, TTS-28 meter must be used in a vertical position.

(2) Connect incoming loop to terminals + and − of TTS-28.

(3) Connect hand test set to TTS-28 TEL terminals.

(4) Using hand test set, dial designated number for 1000-Hz (1 milliwatt) tone at originating central office.

(5) When 1000-Hz tone is received, position meter FUNCTION switch to DBM 900Ω TERM—0 position. Meter reading is actual measured loss (AML) of loop at 1000 Hz.

Note: The transmit level can be adjusted in 2 dB steps from 0 dB to −14 dB by strapping the f1 and f2 send data pad. The f1 and f2 pads should be strapped for identical send levels. The level arriving at the central office should be within 2 dB of −12 dB but should not exceed −12 dB. To determine the required strap, subtract the AML at 1000 Hz from −12 dB. (Example: with an AML of −5 dB, −12 dB less −5 dB = −7 dB, therefore a −8 dB strap is required.

4.05 Expected measured loss (EML) shown on station layout card was calculated at the time of "prescription design." If AML is not within limits shown in Table A, loop should be turned back for repair.

4.06 If loop is within limits, remove connections from TTS-28 and proceed with tests and inspections as outlined. ***Do not connect loop to data set at this time.***

4.07 Make a visual inspection of data set for:

- Improper position of relay contact springs
- Broken plug-in units
- Improper position of plug-in units.

4.08 With all connections made between data set, subscriber set, and teletypewriter and all plug-in units firmly seated in their proper positions, proceed with the following tests.

4.09 Power Supply Voltage Measurement

STEP	ACTION	VERIFICATION
1	Plug teletypewriter and data set power cords into proper receptacles.	

STEP	ACTION	VERIFICATION
2	With TTS-28 FUNCTION switch on OHMS—X1 position, test for continuity between GND test point on rectifier and data set frame.	Should read 0 (short).
3	Position TTS-28 FUNCTION switch to VDC—30.	
4	Measure between + and GND test points on rectifier.	Should read +20 volts ±3 volts.
5	Measure between − and GND test points on rectifier.	Should read −20 volts ±3 volts.
6	Compare the results of Steps 4 and 5.	Positive and negative voltages should be nearly equal, the difference not to exceed 2 volts.

4.10 Preliminary Station Test

STEP	ACTION	VERIFICATION
1	Check that all keys on subscriber set are released and station is in an on-hook condition.	
2	Position FUNCTION switch on TTS-28 to TEL SET—DIAL. Power switch off.	
3	Connect a hand test set to TEL SET terminals of TTS-28.	
4	Connect TTS-28 terminals + and − to test jacks TP1 and TP2 on HYBRID unit.	
5	Depress nonlocking ORIG key.	OR relay operates and lamp on ORIG key lights.
6	Depress nonlocking CLEAR key.	S relay operates momentarily, releases OR relay, and extinguishes ORIG lamp without lighting lamp on CLEAR key.
7	Depress nonlocking ANS key.	AN relay operates, lamp on ANS key lights. After a delay of approximately 1 second, M relay operates. F2M tone is heard in hand test set.
8	Depress CLEAR key.	S relay operates momentarily, releases AN and M relays. Lamp on ANS key extinguishes without lighting lamp on CLEAR key.
	Note: Follow Steps 9 through 17 for unattended stations only.	

STEP	ACTION	VERIFICATION
9	Depress ANS key.	Approximately 8 seconds after F2M tone is heard in hand test set, station will automatically go on-hook without lamp on CLEAR key lighting.
10	Remove HYBRID unit and depress (locking) TEST key (see Note). ***Note:*** It is recommended that plug-in units not be pulled entirely out of their slides. This will reduce the possibility of damaging them.	Lamp on TEST key lights.
11	Manually operate AN relay.	Lamp on ANS key lights. AN relay remains operated (locks up under control of its own contacts). M relay does not operate.
12	Five seconds after operating AN relay, depress CLEAR key.	AN relay releases without lamp on CLEAR key lighting. TEST and ANS lamps both go out.
13	Reinsert HYBRID card in data set.	
14	Depress (locking) LOCAL key.	Lamp on LOCAL key lights, CY relay operates, and TTY motor starts. The TTY may receive LTRS but no hit character will be printed.
15	Type repeated characters on keyboard of TTY.	Local copy will be without errors.
16	Depress BREAK key on TTY keyboard.	TTY will run open for a few characters, then keyboard will lock.
17	On unattended stations equipped with drum answer-back, manually operate and hold operated momentarily M and CON relays.	Drum answer-back is triggered. TTY types sequence of selected characters.
18	Depress nonlocking HERE IS key on TTY keyboard.	DRUM answer-back is triggered. TTY types sequence of selected characters.
19	Depress KBD UNLK key on TTY keyboard.	
20	Type FIGS—C on TTY keyboard.	On DATA-PHONE stations a colon will be printed. (On 28-type unattended machines, answer-back drum will not be triggered.)
21	Depress CLEAR key.	CY relay releases and TTY motor stops. TTY selector magnet remains marking, with exception of possible LTRS character, until motor comes to a complete stop without printing a hit character. After about 20 seconds there may be a slight buzzing sound. This indicates that blinding circuit is operating and selector

STEP	ACTION	VERIFICATION
		magnet is changing from mark to space condition.
22	After the TTY has been turned off for about 1 minute, blinding circuit can be checked by grounding terminal D61 with a test cord.	MST relay in TTY operates and TTY runs open, indicating no signals are being received from data set.
23	Remove test cord ground from terminal D61.	MST relay releases and TTY motor stops running.
24	To check drum ANSWER-BACK card, Z option, manually operate M relay.	TTY motor will start running. Machine will run open. Answer-back drum will not be triggered.
25	Release M relay.	TTY motor will stop running.

Data Set Output Test

Position TTS-28 FUNCTION switch to DBM 900Ω—TERM 0. Power switch ON.

4.11 Terminals + and − of TTS-28 should remain connected to TP1 and TP2 of HYBRID unit.

STEP	ACTION	VERIFICATION
1	Pull TIMER unit. Manually operate OR and CON relays.	TTY motor starts and machine runs open. Lamp on ORIG key lights.
2	Note level reading of F1M tone (1270 Hz) on TTS-28 meter.	Tone level should be between −1.0 and +1.5 dBm.
3	Depress CLEAR key.	ORIG lamp goes out. TTY motor stops. Lamp on CLEAR key lights.
4	Note level reading of F1M tone (1070 Hz) on TTS-28 meter. ***Note:*** Level difference between F1M and F1S tones shall not exceed 0.5 dB.	Tone level should be between −1.0 and +1.5 dBm.
5	Manually operate AN relay.	OR and CON relays release. Lamp on ANS key lights.
6	Manually operate CON relay.	TTY motor starts and machine runs open.
7	Note level reading of F2M tone (2225 Hz) on TTS-28 meter.	Tone level should be between −1.0 and +1.5 dBm.
8	Depress CLEAR key.	TTY motor stops. Lamp on ANS key goes out and lamp on CLEAR key lights.

STEP	ACTION	VERIFICATION
9	Note level reading of F2S tone (2025 Hz) on TTS-28 meter. ***Note:*** Level difference between F2M and F2S tones shall not exceed 0.5 dB.	Tone level should be between −1.0 and +1.5 dBm.
10	Re-insert TIMER.	Lamp on CLEAR key goes out and station goes on-hook.
11	Remove connections between TTS-28 and HYBRID unit.	

4.12 Strapping F1 and F2 Output Pads.

STEP	ACTION	VERIFICATION
1	Strap pad losses in HYBRID unit as called for on station layout card and/or service order. See Table C for strapping combinations and related pad values.	
2	Position FUNCTION switch on TTS-28 to DBM 900Ω TERM 0. Power switch ON.	
3	Connect TTS-28 terminals + and − to jacks TP1 and TP2 of the HYBRID unit.	
4	Remove TIMER unit.	
5	Manually operate OR and CON relays.	TTS-28 reading should be between +1.0 and −1.5 dBm of F1M specified output pad value.
6	Release OR and CON relays.	
7	Manually operate AN and CON relays.	TTS-28 reading should be between +1.0 and −1.5 dBm of F2M specified output pad value.
8	Release AN and CON relays.	

HYBRID Card Strapping

4.13 Remove HYBRID card and strap balancing network (terminals 27 and 28) as indicated on station layout card and/or service order. See Table D for values for loaded and nonloaded loops. Record information on Form E-4905. Replace HYBRID card.

Use 24-gauge strap wire and use KS-19092-L1 inserter tool to strap balancing network. Rear of wedge terminal must be supported to prevent damage to printed wiring board. Earlier production circuit packs require 22-gauge strap wire and are designated appropriately.

TABLE C

STRAPPING CHART

PAD VALUE dB		STRAP CONNECTIONS ON HYBRID CARD
f_2	f_1	
0	0	(1-2) (3-4)
0	2	(1-7) (2-6) (3-4) (5-23)
0	4	(1-8) (2-9) (3-4) (10-16)
0	6	(1-20) (2-21) (3-4) (16-22)
0	8	(1-20) (2-18) (3-4) (12-17) (16-22) (19-21)
0	10	(1-20) (2-9) (3-4) (8-21) (10-14) (16-22)
0	12	(1-20) (2-9) (3-4) (5-12) (6-8) (7-21) (10-14) (16-22)
0	14	(1-20) (2-9) (3-4) (5-12) (6-8) (7-18) (10-14) (16-22) (17-23) (19-21)
2	2	(1-2) (3-19) (4-18) (11-17)
2	4	(1-7) (2-6) (3-19) (4-18) (5-12) (11-17)
2	6	(1-8) (2-9) (3-19) (4-18) (10-16) (11-17)
2	8	(1-20) (2-21) (3-19) (4-18) (11-17) (16-22)
2	10	(1-20) (2-6) (3-19) (4-18) (5-12) (7-21) (11-17) (16-22)
2	12	(1-20) (2-9) (3-19) (4-18) (8-21) (10-14) (11-17) (16-22)
2	14	(1-20) (2-9) (3-19) (4-18) (5-12) (6-8) (7-21) (11-17) (10-14) (16-22)
4*	4*	(1-2) (3-8) (4-9) (10-15)
4	6	(1-7) (2-6) (3-8) (4-9) (5-12) (10-15)
4	8	(1-8) (2-9) (3-19) (4-6) (5-13) (7-18) (10-16) (11-17)
4	10	(1-20) (2-21) (3-8) (4-9) (10-15) (16-22)
4	12	(1-20) (2-6) (3-8) (4-9) (5-12) (7-21) (10-15) (16-22)

TABLE C — Cont

PAD VALUE dB		STRAP CONNECTIONS ON HYBRID CARD
f_2	f_1	
4	14	(1-20) (2-6) (3-8) (4-9) (5-12) (7-18) (10-15) (16-22) (17-23) (19-21)
6*	6*	(1-2) (3-20) (4-21) (15-22)
6	8	(1-7) (2-6) (3-20) (4-21) (5-12) (15-22)
6	10	(1-8) (2-9) (3-20) (4-21) (10-16) (15-22)
6	12	(1-8) (2-6) (3-20) (4-21) (5-12) (7-9) (10-16) (15-22)
6	14	(1-8) (2-6) (3-20) (4-21) (5-12) (7-18) (9-19) (10-16) (15-22) (17-23)
8 *	8 *	(1-2) (3-19) (4-21) (11-17) (15-22) (18-20)
8	10	(1-7) (2-6) (3-19) (4-21) (5-12) (11-17) (15-22) (18-20)
8	12	(1-8) (2-9) (3-19) (4-21) (10-16) (11-17) (15-22) (18-20)
8	14	(1-8) (2-6) (3-19) (4-21) (5-12) (7-9) (10-16) (11-17) (15-22) (18-20)
10 *	10 *	(1-2) (3-20) (4-9) (8-21) (10-13) (22-15)
10	12	(1-7) (2-6) (3-20) (4-9) (8-21) (10-13) (22-15) (23-5)
10	14	(1-7) (3-20) (4-9) (18-2) (8-21) (10-13) (22-15) (5-23) (19-6) (17-12)
12 *	12 *	(1-2) (5-11) (10-13) (22-15) (3-7) (6-8) (9-20) (21-4)
12	14	(1-19) (2-18) (3-7) (5-11) (6-8) (9-20) (10-13) (17-12) (21-4) (22-15)
14	14	(1-2) (3-19) (4-21) (5-12) (6-8) (7-18) (11-23) (15-22) (10-16) (9-20) (17-13)

* Strapping for DATA-PHONE applications.

TABLE D

HYBRID NETWORK STRAPS

TYPE OF LOOP	LOOP LENGTH	NETWORK VALUE	STRAP CONNECTIONS ON HYBRID CARD
Nonloaded	0 to 6 K ft.*	941 ohms	27 to 28 open
Nonloaded	Over 6 K ft.	442 ohms	27 to 28 closed
Loaded	3 to 6 K ft. from last load point†	941 ohms	27 to 28 open
Loaded	Over 6 K ft. from last load point	442 ohms	27 to 28 closed

* If an E7 repeater is installed within 500 feet of the station, strap 27 to 28.

† If less than 3 K ft. from last load point, capacity buildout must be added to provide an effective minimum end section of at least 3 K ft.

STEP	ACTION	VERIFICATION
1	Connect TEL LINE to station.	
2	Depress ORIG key.	ORIG lamp lights. Dial tone should be heard in loudspeaker or handset.
3	Dial the 900-ohm quiet termination number.	
4	When connection has been established, pull TIMER card. (At unattended stations also pull ANSWER-BACK card.)	
5	Set FUNCTION switch on TTS-28 to DBM BRIDGE—+10 position. Connect + and − terminals to TP1 and TP2 of HYBRID card. TTS-28 power switch ON.	No reading should be obtained when TTS-28 FUNCTION switch is moved to the most sensitive scale (−10). This indicates that there are no high level signals present on loop to cause erroneous readings in the following tests.
6	Remove test leads from TP1 and TP2 of HYBRID card.	
7	Manually operate CON relay.	
8	Set TTS-28 function switch to DBM BRIDGE—0. Connect terminals + and − between GND on the rectifier and TP3 on the HYBRID card.	Level reading should not be more positive than −5.0 dBm for F1M tone. (This is a check of the HYBRID balance at 1270 Hz.)

STEP	ACTION	VERIFICATION
9	Remove connections between TTS-28 and data set.	
10	Flip the station from originate to terminate mode by manually operating AN and M relays.	OR and CON relays release.
11	Reconnect TTS-28 as outlined in Step 8.	Level reading should not be more positive than −5.0 dBm for F2M tone. (This checks the HYBRID balance for 2225 Hz.)
12	If readings obtained in Steps 8 and 11 do not meet requirements, it is an indication of loop impedance difficulty that should be corrected before proceeding with further tests.	
13	Reinsert TIMER card (at unattended stations, also reinsert ANSWER-BACK card). At attended stations momentarily operate CLEAR key.	All relays should release. Station is now in the on-hook condition.

4.14 Space-Hold Test

STEP	ACTION	VERIFICATION
1	TTS-28 should be connected as described in 4.12, Steps 2 and 3.	
2	Connect ground to jack TP1 on DISCRIMINATOR unit with a test lead.	This isolates frequency detecting network from discriminator output, and when CON relay is operated the discriminator output is determined solely by the space-hold circuit.
3	Depress ORIG key.	OR relay operates and ORIG lamp lights.
4	Operate CON relay manually. (Relay locks up.)	(a) TTY motor starts and machine runs open for approximately 1 second. (b) S relay operates. (c) Lamp on CLEAR key lights. (d) ORIG lamp goes out. (e) TTY motor stops. (f) CLEAR lamp will remain lighted for approximately 2 seconds then go out as all relays release. Station is now in normal on-hook condition.
5	Depress ANS key. Next step must be performed before 8-second time-out.	(a) AN relay operates. (b) ANS lamp lights. (c) M relay operates 1 second later. (d) TTY motor starts.

STEP	ACTION	VERIFICATION
6	Manually operate CON relay. (It will lock up under its own contacts.)	(a) Machine runs open for about 1 second. (b) S relay operates. (c) CLEAR lamp lights and ANS lamp goes out. (d) TTY motor stops. (e) CLEAR lamp will remain lighted for approximately 2 seconds then extinguish. (f) All relays will release. Station is now in normal on-hook condition.
7	Remove ground from TP1 of DISCRIMINATOR unit.	

4.15 Desensitizing Pad Strapping

STEP	ACTION	VERIFICATION
1	Remove LIMITER unit.	
2	Strap desensitizing pad as indicated on station layout card and/or service order. See Table E for pad value and strapping combinations.	
3	Record strapping information on data set label (Form E-4905).	
4	Remove connections from data set to TTS-28.	

4.16 Check Wiring Option: Connecting circuit arranged to trip ringing during both the silent and ringing interval.

TABLE E

DESENSITIZING PAD STRAPS

VALUE	STRAP CONNECTION ON LIMITER CARD
8 dB	A to D
4 dB	A to C
0 dB	A to B

STEP	ACTION	VERIFICATION
1	Connect TEL LINE to station.	
2	See Table B and check D terminal strip on data set for proper wiring option.	Should be strapped for T option.

STEP	ACTION	VERIFICATION
3	Manually operate and hold operated RU relay. On attended stations also operate AN relay.	On unattended stations AN relay operates. Dial tone will be heard in receiver. Lamp on ANS key lights.
4	Release RU relay.	After about 1 second, M relay operates. TTY starts and runs closed.
5	Depress CLEAR key.	AN and M relays release. TTY stops running. Station is now in on-hook condition.

4.17 Check Wiring Option: Connecting circuit arranged to trip ringing only during silent interval.

STEP	ACTION	VERIFICATION
1	See Table B and check terminal strip D for proper option.	Should be strapped for S option.
2	Manually operate RU relay. (At attended stations manually operate AN relay.)	At unattended stations AN relay will operate. No dial tone is heard in receiver. M relay does not operate.
3	Release RU relay.	Dial tone is now heard in receiver. After about 1 second, M relay operates.
4	Release AN relay (at attended stations).	
5	Depress CLEAR key.	Station is now restored to on-hook condition.

4.18 Checking Send Side of 4-Wire Facilities with Assistance of a Data Test Center.

STEP	ACTION	VERIFICATION
1	Arrange for the data test center to meet station on SD-98100 loop-around at originating central office.	
2	Depress ORIG key.	ORIG lamp lights. Dial tone is heard in receiver.
3	Dial loop-around test number.	
4	Advise data test center as to output of F1M, measured in 4.12 Step 5.	Data test center will determine AML of send side of 4-wire facilities. If loop is not within limits as stated in Table A, it must be turned back for repair.

STEP	ACTION	VERIFICATION
5	If limits are met, depress CLEAR key.	Station is now in on-hook condition.

4.19 Data Set Output Reference Tests

STEP	ACTION	VERIFICATION
1	Depress ORIG key.	ORIG lamp lights. Dial tone should be heard in receiver.
2	Dial 900-ohm quiet termination number at originating central office.	
3	After establishing connection, pull TIMER unit.	Connection should hold.
4	Position FUNCTION switch on TTS-28 to DBM BRDG—0 position. Connect TTS-28 terminals + and − to test jacks TP1 and TP2 on HYBRID unit. Power switch ON.	
5	Manually operate CON relay.	Record F1M tone level reading on data set label, Form E-4905.
6	Manually operate CON and AN relays.	Record F2M tone level reading on data set label, Form E-4905. Subsequent readings on repair visits should be within $\pm$1.0 dB of F1M and F2M tone reference levels.
7	Release CON and AN relays and remove connections to TTS-28 meter.	
8	Depress CLEAR key.	
9	Replace TIMER unit.	Station should now restore to on-hook condition.

4.20 Ringer Adjustment: Adjust the ringer as follows.

STEP	ACTION	VERIFICATION
1	Depress ORIG key.	ORIG lamp lights. Dial tone should be heard in receiver.
2	Dial local ring-back test number.	
3	Depress LOCAL key.	Ringer can now be adjusted. ANS lamp will flash.

STEP	ACTION	VERIFICATION
4	At unattended stations depress ANS key. (CLEAR key is not used to go from local to answer mode since it is possible to disconnect falsely.)	Lamp on ANS lamp lights. Since station receives no F1M tone, it will disconnect in about 8 seconds and go into an on-hook condition.
5	At attended stations depress ANS key.	ANS lamp lights.
6	Depress CLEAR key.	Station goes into on-hook condition.

4.21 A test call must be made to an automatic test line (ATL) on each installation or maintenance visit as a final test before leaving customer premises. The ATL must be accessible from the DDD network and preferably 100 speed. If only a 60-speed ATL is available, connecting tests may still be made but copy will be garbled. See section covering use of ATL.

5. 28-TYPE AUTOMATIC SEND-RECEIVE (ASR) INSTALLATION

5.01 Vertical tabulation (if provided), horizontal tabulation, and form feed will be set up according to customer requirements. Unnumbered forms or blank paper shall be used for this purpose and for all other tests.

Note: If vertical tabulation (upper case H) is provided, it will be initiated by the sequence FIGS, CAR RET, H. This should not be confused with FIGS H which is a disconnect sequence. However, initiating the disconnect sequence will cause vertical tabulation.

5.02 For 28 ASR installations, the installer will prepare a tape consisting of CAR RET, LINE FEED, LTRS, ABC TEST, FIGS F, LTRS, LTRS, CAR RET, LINE FEED, LTRS, FIGS H followed by a series of LTRS characters. This tape will be referred to as the test tape in subsequent paragraphs.

5.03 Perform all tests of Part 4. Check to make sure that the toggle switch under the rear cover to the left of the platen is in the NORMAL position. The switch is labeled NORMAL, REP ON LINE, TAPE COPY (NRT).

5.04 Tests of the DATA-PHONE features

STEP	ACTION	VERIFICATION
1	Check that the TD "bat" handle is in the RUN position, and the NRT switch is in the NORMAL position.	
2	Depress the REC key and insert the test tape into the TD. Depress LOCAL key.	Motor starts and LOCAL lamp and copy lights illuminate.
3	Depress SEND key.	Transmission of tape starts, page copy is received, tape is punched on the typing reperforator, and tape stops after the word TEST. TD RSTRT lamp lights. *Note:* Copy lights will blink when FIGS H is sent. This is a normal indication.
4	Type a few characters to see that proper copy is received from the keyboard.	Both page and tape copy are received from keyboard.

STEP	ACTION	VERIFICATION
5	Depress TD RSTRT key.	TD RSTRT lamp extinguishes, machine carriage returns and line feeds, and tape runs out to end.
6	Operate NRT switch to the TAPE COPY position and depress REC key.	
7	Insert tape into the TD and depress SEND key.	A copy of the tape is punched on the typing reperforator, and no page copy is received on the typing unit.
8	Depress CLR key.	Station returns to idle condition.
9	Operate NRT switch to the REP ON LINE position, depress REC key, insert test tape into the TD, and call an ATL.	When station connects, both page and tape copy are received.
10	When instructed by the ATL to GA SEND, depress SEND key.	Tape runs through to the end without stopping and station disconnects.
11	Depress ORIG key.	Relay OR operates and lamp under ORIG key lights.
12	Operate the paper out switch.	Relay OR drops out and lamp under ORIG key goes out.
13	Release paper out switch and depress ORIG key.	Same as Step 11.
14	Operate paper jam switch simulating a paper jam condition.	Same as Step 12.

6. 28-TYPE RECEIVE ONLY (RO) INSTALLATION

6.01 Perform all tests of Part 4. The HERE IS key will be used when the RO station is required to transmit.

6.02 Tests of DATA-PHONE features.

STEP	ACTION	VERIFICATION
1	Depress LOCAL key.	TTY motor starts and lamp under LOCAL key and copy lights illuminate.
2	Call the station from a nearby telephone.	Station ringer sounds and call is not answered. Lamp under ANS key flashes on and off with ringing.
3	Operate the paper jam switch simulating a paper jam condition. Release LOCAL key by momentarily depressing CLR key.	TTY motor stops, lamp under LOCAL key and copy lights extinguish, ringing continues.

STEP	ACTION	VERIFICATION
4	Operate paper out switch and reset paper jam switch.	Ringing continues.
5	Release paper out switch.	On the next ring, the station AN relay operates, ringing is tripped, lamp under ANS key lights, M relay operates, TTY motor starts and copy lights illuminate; and within 8 seconds after M relay operates, the station will disconnect and go back to the on-hook condition.
6	Call an ATL and when instructed to GA SEND, send FIGS H. (The keyboard cover must be removed for the test and should be replaced immediately after).	The station receives copy from the ATL and disconnects after FIGS H is sent.
7	Perform Steps 11 through 14 inclusive of 5.04.	Same as Steps 11 through 14.

7. TELEPHONE TESTS (ASR AND RO)

7.01 Tests

STEP	ACTION	VERIFICATION
1	Lift handset.	Dial tone is heard in receiver.
2	Dial a nearby telephone.	Ringback tone is heard in receiver and nearby telephone rings.
3	Lift handset of nearby telephone.	Check for voice communications.
4	Replace both handsets.	
5	Depress LOCAL key on RO station only. No action is necessary on ASR stations.	TTY motor starts, copy lights and lamp under LOCAL key lights on RO station.
6	Dial the station from a nearby telephone.	Station ringer sounds.
7	Lift station handset. On RO station, release LOCAL key by momentarily depressing the CLR key thereby stopping the TTY motor and extinguishing the LOCAL lamp and copy lights.	Ringing is tripped and voice communication is possible.
8	Replace handsets.	Station returns to an on-hook condition.

7.02 After completing these tests, check to see that the keyboard cover is securely in place on RO machines and the NRT switch is in the NORMAL position on ASR machines. Connecting tests should be made between the two stations by sending a test tape or dummy tickets to ensure proper operation of the entire system. Refer to Section 591-012-100 for operating procedures.