DATA SET 101C

TESTS AND INSTALLATION METHODS

1. GENERAL

1.01 This section covers the tests and installation methods for Data Set 101C developed for use on 4-row TWX services using the 100-speed, 8-level, 33- or 35-type teletypewriters (TTY's) and an attendant circuit which is built into the TTY. Data Set 101C provides means for converting the dc pulses from the teletypewriter to ac signals at frequencies suitable for transmission over the DDD switching system.

1.02 This section is reissued to include the following:

(a) Desensitizing pad selection (Table D)

(b) Additional information on TOUCH-TONE® dial

(c) Listing of associated BSP's

(d) Minor changes to the practice

1.03 For information regarding the TTY and coding of the drum answer-back, refer to the sections covering the appropriate apparatus.

1.04 The reference BSP's associated with this section are as follows:

(a) Data Set 101C — Used With 4-Row TWX Locating Trouble and Test Procedures (591-013-300)

(b) Data Set 101C — Identification and Operation (591-013-100)

(c) Power Supply for Teletypewriter Apparatus (570-003-010)

(d) J94006A (6A) Impulse Counter — Description Operation and Maintenance (103-620-100)

(e) 24A Loop Checker — (105-280-100)

(f) Crediting Charges on Test Calls — (010-250-001)

(g) TWX Subscriber Line Circuit Order, Routine, and Trouble Investigation Tests — (314-300-300)

2. IDENTIFICATION

2.01 A station arrangement consists of the following units:

- Data Set 101C (SD-3D007-01)
- Attendant circuit (supplied with the TTY as part of the call control unit), (SD-3D009-01)
- 33- or 35-type, 100-speed, 8-level TTY.

2.02 Data Set 101C contains seven electronic plug-in units (cards) as follows:

- J70148A L1 Discriminator
- J70148B L1 or L4 Modulator
- J70148C L1 Hybrid
- J70148D L1 Limiter
- J70148E L1 Timer
- J70148M L1 Send Break Timer
- J70148N L1 Restrainer

2.03 Data Set 101C contains its own semiconductor ferroresonant regulated rectifier (J87215A) which delivers both positive and negative 20-volt, 0.5 amp dc.

2.04 Refer to section entitled Data Set 101C Used With 4-Row TWX Locating Trouble and Test Procedures (591-013-300) if the requirements outlined herein cannot be met.

2.05 Refer to section entitled Data Set 101C Identification and Operation (591-013-100), SD-3D007-01, and CD-3D007-01 for a detailed description and operation of Data Set 101C.

2.06 Following is a list of tools and testing apparatus required for placing a 4-row TWX station in service:

- Standard TTY maintenance tools
- 1011-type handset
- Northeast Electronics test set model No. TTS-28
- 24A loop checker
- 164C4 transmission measuring set (See note)
- Inserter extractor (wire) tool, KS-19092, List 1
- Carrying case for data set cards
- Spare set of plug-in printed circuit data set cards
- 907A Data Test Set equipped with J79907A, List 5 test card, if available
- Maintenance test card J70148AA, List 1A
- SD-3D007-01 and CD-3D007-01 (Data Set)
- SD-3D009-01 and CD-3D009-01 (Attendant Set)

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

Note: 164C4 transmission measuring set is required when it is necessary to perform more extensive transmission tests than those outlined herein. These tests are covered in section entitled Data Set 101C Used With 4-Row TWX Locating Trouble and Test Procedures (591-013-300).

2.07 No routine maintenance is required for Data Set 101C.

3. RECORDING STATION LOOP AND DATA SET INFORMATION

3.01 Form E-4905 (Fig. 1) has been provided for recording loop design values and data set information for future reference in maintaining the loop and station equipment.

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

3.03 Design information obtained from service order and/or station or circuit layout record card, as well as the data set information determined during the initial installation, should be recorded on the form as follows:

(1) Data Set 101C Type: Enter letter "C" in blank space provided.

(2) Circuit No.: Enter TWX directory number of the station as shown on service order or station layout card.

(3) Divided Access Line Circuit: There will be no DALC on 4-row TWX service.

(4) Expected Measured Loss (EML): Enter loop design loss for 1000 and 2300 Hz as shown on station or circuit layout record card. Refer to Table B 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.

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

(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 required, as indicated in Table D.

(11) Data Set Output Reference Measurement: Record the results of tests outlined in 5.20, Steps 5 and 6.

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

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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 ☐ ±1DB ☐ ±2DB

(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. 1 — Form E-4905, Data Set and Loop Design Values

4. INSTALLATION OF DATA SET

4.01 TWX stations will be fully assembled and tested at the Western Electric Company distributing house or telephone company service center prior to shipment.

4.02 Table A shows the station function with associated wiring option and whether option was furnished by the factory.

4.03 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 TTY service. Where this condition cannot be met, it will be necessary to use SK (shielded) station wire between the data set and cable distribution terminal or building entrance.

Note: When shielded cable is used, only one end of the shield must be grounded. ←

4.04 The Data Set 101C will operate within an ambient temperature range of 50 to 110°F. The station equipment should not be installed in customer locations where these limits are exceeded.

4.05 Data Set 101C requires a power source of 105 to 120 volts, 60 Hz, 31 watts to operate the J87215A rectifier which is furnished as a part of the data set. The data set obtains ac power via interconnection with its associated

TABLE A

FUNCTIONS AND ASSOCIATED WIRING OPTIONS

FUNCTION	WIRING OPTION	FACTORY-PROVIDED	D TERMINAL STRIP STRAPPING
Half-Duplex	X	Yes	73-74
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
Full-Duplex	Remove "X" Option	No	

TTY. A 3-conductor power cord is used to connect the TTY to the 60-Hz commercial ac power supply. The customer must furnish a 3-wire outlet not under control of a switch and within the voltage limitations for the proper operation of the TTY as outlined in the section entitled Power Supply For Teletypewriter Apparatus (570-003-010) covering the power supply requirements for TTY apparatus.

4.06 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 room with TWX stations. All ac power sources in the room should be served from the same 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.

4.07 If a transient ground condition is suspected, the 6A Impulse Counter may be used to verify and isolate trouble. Refer to section entitled 6A Impulse Counter Description, Operation and Maintenance (103-620-100), and conduct test as follows:

Do not ground 6A for this test:

(1) Connect one ground to J2.
(2) Connect other ground to J3.
(3) Set switch S1 to VOICEBAND.
(4) Set switches S2 and S3 to total 90 dbrn.
(5) Set timer for 15 minutes.
(6) Reset counter to 0.

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

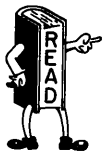
4.08 Bonding grounds may eliminate trouble when a visual inspection shows that a multiple ground condition exists.

5. TESTS AND INSPECTIONS

5.01 The following tests and inspections should be performed sequentially as outlined in 5.04 through 5.26.

5.02 All adjustments will have been made at the factory prior to shipment. The send pads on the HYBRID card will have been strapped (1-2) and (3-4) to provide no attenuation in both the f_1 and f_2 frequency bands.

5.03 Desensitizing network of the LIMITER will have been strapped (A to B), also the SEND BREAK TIMER (G to K), for maximum sensitivity. 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, are factory-set and are not to be adjusted unless specified. When a DISCRIMINATOR or LIMITER card is changed, R4A and R3D may be checked as outlined in section entitled Data Set 101C Used With 4-Row TWX Locating Trouble and Test Procedures (591-013-300).

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.

Loop Check

5.04 Check the loop using the 24A loop checker in accordance with the instructions outlined in section entitled 24A Loop Checker (105-280-100).

Note: When test or demonstration calls are made, refer to section entitled Crediting Charges On Test Calls (010-250-001).

5.05 ***Measurement of Loop Loss — Using Test Set TTS-28***

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

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

(3) Connect 1011-type handset to TTS-28 TEL terminals.

(4) Using 1011-type handset, 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.

(6) AML of loop at 2300 Hz should be made with the test center at the originating central office.

5.06 Expected measured loss (EML) shown on station or circuit layout record card was calculated at the time of "prescription design." EML should be entered on form E-4905. If actual measured loss (AML) is not within limits shown in Table B, loop should be turned back for repair.

TABLE B

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

5.07 Return loss measurements should be made if specified on the station or circuit layout record card. Refer to the section entitled TWX Subscriber Line Circuit Order, Routine and Trouble Investigation Tests (314-300-300) for methods of making return loss tests. 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.***

5.08 Make a visual inspection of data set for:

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

5.09 With all connections made between data set, attendant set, and TTY, and all plug-in units firmly seated in their proper positions, proceed with following tests.

5.10 *Power Supply Voltage Measurement*

STEP	ACTION	RESULTS
1	Plug TTY and data set power cords into proper receptacles.	
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	Place (+) probe in (+) test point on rectifier and (—) probe on GRD.	Should read 20 ±3 volts.
5	Place (—) probe to (—) test point on rectifier and (+) probe to GRD.	Should read 20 ±3 volts.
6	Compare voltages obtained in Steps 4 and 5.	Positive and negative voltages should be nearly equal, the difference not to exceed 2 volts.

5.11 *Preliminary Station Test*

STEP	ACTION	RESULTS
1	Check that all keys on attendant 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 1011-type handset to TEL SET terminals of TTS-28.	
4	Connect TTS-28 terminals + and — to test jacks TP1 and TP2, respectively, on HYBRID unit.	
5	Depress nonlocking ANS key. Step 6 should be performed within 8 seconds after depressing ANS key, otherwise machine will time out.	***AN*** relay operates, lamp on ANS key lights, and TTY motor starts. After a delay of approximately 1 second, ***M*** relay operates, f_{2m} tone is heard in 1011-type handset.
6	Depress CLR key.	***RB*** and ***S*** relays operate momentarily, releasing ***AN*** and ***M*** relays. Lamp on ANS key extinguishes without lighting lamp on CLR key.

STEP	ACTION	RESULTS
7	Depress nonlocking ORIG key.	***OR*** relay operates and lamp on ORIG key lights. TTY motor starts.
8	Allow LOW PAPER switch on TTY to operate.	Buzzer sounds and light on BUZ RLS key lights.
9	Depress locking BUZ RLS key.	Buzzer silences. Light remains lit.
10	Release LOW PAPER switch and depress CLR key.	Light on BUZ RLS key goes out, BUZ RLS key restores to normal, and machine turns off.
11	If station is equipped with a PAPER OUT switch (sprocket feed TTY only), repeat Step 7 and perform Steps 12 and 13.	
12	Allow PAPER OUT switch to operate.	Machine clears out.
	Note: Station cannot answer or reoriginate as long as PAPER OUT switch is down.	
13	Release PAPER OUT switch.	
14	Depress ANS key.	Approximately 8 seconds after f_{2m} tone is heard in 1011-type handset, station will automatically go on-hook without lamp on CLR key lighting.
15	Remove HYBRID unit and depress locking TST key.	Lamp on TST key lights.
	Note: It is recommended that plug-in units not be pulled entirely out of their slides; this will reduce the possibility of damaging them.	
16	Manually operate ***AN*** relay and after five seconds do Step 17. ←	Lamp on ANS key lights. TTY turns on and runs closed. ***AN*** relay remains operated (locks up under control of its own contacts). ***M*** relay does not operate.
17	Depress CLR key. ←	***AN*** relay releases without lamp on CLR key lighting. TST and ANS lamps go out.
18	Reinsert HYBRID card in data set.	
19	Depress locking LCL key.	Lamp on LCL key lights, ***CY*** relay operates. TTY starts and machine runs closed. No character will be printed.
20	Type repeated characters on keyboard of TTY.	Local copy should be without errors.

STEP	ACTION	RESULTS
21	Depress BREAK key on TTY keyboard.	Machine will run open for a maximum of 2 characters. Keyboard will not lock and BRK-RLS lamp will not light.
22	Manually operate and momentarily hold operated ***M*** and ***CON*** relays.	Drum answer-back is triggered. TTY types sequence of selected characters.
23	Depress nonlocking HERE IS key on TTY keyboard.	Drum answer-back is triggered. TTY types sequence of selected characters.
24	Operate ***OR*** and ***RB*** relays. (They will lock up.)	Machine may run open. Lamps on ORIG key and BRK-RLS key light.
25	Depress BRK-RLS key.	***RB*** relay releases.
26	Depress CLR key.	***CY*** and ***OR*** relays release and TTY motor stops. TTY selector magnet remains marking.

Data Set Level Adjustments

5.12 Terminals + and — of TTS-28 should remain connected to TP1 and TP2 respectively, of HYBRID unit. Position TTS-28 FUNCTION switch to DBM 900Ω TERM, 0. Power switch ON.

STEP	ACTION	RESULTS
1	Pull TIMER unit and manually operate ***AN*** relay.	TTY turns on and runs closed. Lamp on ANS key lights.
2	Manually operate ***CON*** relay.	Machine runs open.
3	Note level reading of f_{2m} tone (2225 Hz) on TTS-28 meter.	Tone level should be between —1.0 and +1.5 dbm.
4	Depress CLR key.	TTY runs closed. Lamp on ANS key goes out and lamp on CLR key lights.
5	Note level reading of f_{2s} tone (2025 Hz) on TTS-28 meter.	Tone level should be between —1.0 and +1.5 dbm.
	Note: Level difference between f_{2m} and f_{2s} tones will not exceed 0.5 db.	
6	Release ***AN*** relay.	TTY motor stops.
7	Manually operate ***OR*** relay.	TTY motor starts and machine runs closed. Lamp on ORIG key lights.
8	Operate ***CON*** relay. Note level reading of f_{1m} tone (1270 Hz) on TTS-28 meter.	Tone level should be between —1.0 and +1.5 dbm. Machine runs open.

STEP	ACTION	RESULTS
9	Depress CLR key.	ORIG lamp goes out. Machine runs closed. Lamp on CLR key lights.
10	Note level reading of f_{1s} tone (1070 Hz) on TTS-28 meter.	Tone level should be between —1.0 and +1.5 dbm.
	Note: Level difference between f_{1m} and f_{1s} tones must not exceed 0.5 db.	
11	Reinsert TIMER.	Lamp on CLR key goes out and station goes on-hook.
12	Manually operate ***OR*** relay.	TTY motor starts and machine runs closed. ORIG lamp lights.
	Note: Omit Steps 13 through 19 if station is not equipped with a TOUCH-TONE dialer. ←	
13	Simultaneously depress keys 4 and 5 of TOUCH-TONE dial. (Tone will be heard in loudspeaker.)	Level reading must be the same or not lower than —1.5 db of f_{1m} as measured in Step 8. If not, adjust PT potentiometer as shown in the section entitled Data Set 101C Used with 4-Row TWX Locating Trouble and Test Procedures (591-013-300).
14	Simultaneously depress keys 6 and 9 of TOUCH-TONE dial. (Tone will be heard in loudspeaker.)	Level reading must be the same or between —0.5 and +1.5 db of f_{1m} as measured in Step 8.
15	Release ***OR*** relay.	TTY motor stops. ↰
16	Depress ORIG key.	ORIG lamp will light.
17	Dial central office TOUCH-TONE test circuit.	
18	After contact is established, depress and release sequentially each button 1-0.	Two short tones indicates normal TOUCH-TONE dial operation. One short tone indicates TOUCH-TONE dial failure.
19	If dial failure occurs repeat Step 18. (Repeating Step 18 is done to eliminate possible error in dial operation.)	If second test fails replace TOUCH-TONE dial. ↲
20	Remove connections between TTS-28 and HYBRID unit.	

5.13 Remove HYBRID card and strap balancing network (terminals 27 and 28) as indicated on station or circuit layout record card and/or service order. Record information on form E-4905. Replace HYBRID card.

Use 24-gauge strap wire and KS-19092 List 1 inserter tool to strap balancing network. Rear of wedge terminal must be supported to prevent damage to printed wiring board.

STEP	ACTION	RESULTS
1	Connect incoming line to station on terminals D34 and D35.	
2	Depress ORIG key.	TTY motor turns on and ORIG lamp lights. Dial tone should be heard in loudspeaker.
3	Dial the 900-ohm quiet termination number.	
4	When connection has been established, pull out TIMER and SEND BREAK TIMER cards far enough to disconnect.	
5	Set FUNCTION switch on TTS-28 to DBM BRIDGE, +10 position. Connect + and — terminals to TP1 and TP2, respectively, 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 no high-level signals are 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 position. Connect terminals + and — between GND on the rectifier and TP3, respectively, on the HYBRID card.	Level reading should not be more positive than —5.0 dbm for f_{1m} tone. (This is a check of the hybrid balance at 1270 Hz.)
	Note: If an E7 repeater is used in the loop, reading for f_{1m} should not be more positive than 0.0 dbm.	
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 f_{2m} tone. (This checks the hybrid balance for 2225 Hz.)
	Note: If an E7 repeater is used in the loop, reading for f_{2m} should not be more positive than 0.0 dbm.	

STEP	ACTION	RESULTS
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 and SEND BREAK TIMER cards. Momentarily operate CLR key.	All relays should release. Station is now in the on-hook condition.

5.14 ***Strapping f_1 and f_2 Output Pads***

STEP	ACTION	RESULTS
1	If requirements of 5.13 are met, strap pad losses in hybrid unit as called for on station or circuit layout record card and/or service order. See Table C for strapping combinations and related pad values. Record on form E-4905.	
2	Disconnect incoming line from station.	
3	Position FUNCTION switch on TTS-28 to DBM 900Ω TERM, 0. Power switch ON.	
4	Connect TTS-28 terminals + and — to jacks TP1 and TP2, respectively, of the HYBRID unit.	
5	Remove TIMER unit.	
6	Manually operate ***OR*** and ***CON*** relays.	TTY turns on and runs open. Meter is reading f_{1m}. This reading must not be more than 1.5 db or less than 1.0 db of value f_1 output pad.
7	Release ***OR*** and ***CON*** relays.	TTY turns off.
8	Manually operate ***AN*** and ***CON*** relays.	TTY turns on and runs open. Meter is reading f_{2m}. This reading must not be more than 1.5 db or less than 1.0 db of value f_2 output pad.
9	Release ***AN*** and ***CON*** relays.	TTY turns off.
10	Replace TIMER unit.	

TABLE C

STRAPPING CHART

SEND F_2 db	PADS F_1 db	STRAP CONNECTION (ON HYBRID UNIT)
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)
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)

5.15 *Space-Hold (Carrier Fail) Test*

STEP	ACTION	RESULTS
1	TTS-28 should remain connected as described in 5.14, Steps 3 and 4.	
2	Connect ground to jack TP1 on DISCRIMINATOR unit with a test lead.	This isolates frequency detecting network from discriminator output. When ***CON*** relay is operated, the discriminator output is determined solely by the space-hold circuit.
3	Depress ORIG key.	TTY motor starts, ***OR*** relay operates, and ORIG lamp lights.
4	Operate ***CON*** relay manually. (Relay locks up.)	Machine runs open for approximately 1 second. ***S, RB,*** and ***CY*** relays operate. ORIG lamp goes out. Lamps on CLR and BRK-RLS keys light. TTY motor stops and 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.	***AN*** relay operates. ANS lamp lights. TTY motor starts. 1 second later, ***M*** relay operates.
6	Manually operate ***CON*** relay.	Machine runs open for less than 1 second. ***S, CY,*** and ***RB*** relays operate. CLR lamp lights and ANS lamp goes out. CLR lamp will stay lit for about 1 second, then extinguish. TTY motor stops. All relays will release. Station is now in normal on-hook condition
7	Remove ground from TP1 of DISCRIMINATOR unit.	

5.16 *Desensitizing Pad Strapping*

STEP	ACTION	RESULTS
1	Remove LIMITER and SEND BREAK TIMER units.	
2	Select and strap desensitizing pad in accordance with Table D.	

TABLE D

DESENSITIZING PAD

TWX CIRCUIT WITH 2300-HZ LOSSES (DB)	DESENSITIZING PAD (DB) TO BE USED	STRAPPING ON CIRCUIT PACK	
		SEND BREAK TIMER	LIMITER
0-2	8	G-K	A-D
2.1-4	6	J-K, G-H	A-C
4.1-6	4	G-K	A-C
6.1-8	2	J-K, G-H	A-B
8.1 and greater	0 (zero)	G-K	A-B

STEP	ACTION	RESULTS
3	Record strapping information on form E-4905.	
4	Remove connections from data set to TTS-28.	

5.17 *Check Wiring Option*

- Connecting circuit arranged to trip ringing during both silent and ringing intervals (option ***T*** per Table A).

STEP	ACTION	RESULTS
1	Connect incoming line to station.	
2	See Table A and check D terminal strip on data set for proper wiring option.	Should be strapped for ***T*** option.
3	Ground punching 39 on D terminal strip.	Lamp on ORIG key lights. (This turns on speaker amplifier.)
4	Manually operate and hold operated ***RU*** relay.	***AN*** relay operates. TTY turns on and dial tone can be heard in loudspeaker. ANS lamp lights.
5	Release ***RU*** relay.	After about 1 second, ***M*** relay operates; f_2 tone is now heard in loudspeaker with dial tone.
6	Depress CLR key.	***AN*** and ***M*** relays release. TTY stops running. Station is now in on-hook condition.
7	Remove ground from D39.	Lamp on ORIG key goes out.

5.18 *Checking Wiring Option*

- Connecting circuit arranged to trip ringing only during silent interval (option ***S*** per Table A).

STEP	ACTION	RESULTS
1	See Table A and check D terminal strip for proper option.	Should be strapped for ***S*** option.
2	Ground punching 39 on D terminal strip.	ORIG lamp lights. (This turns on speaker amplifier.)
3	Manually operate ***RU*** relay.	***AN*** relay will operate. TTY turns on. ***No*** dial tone is heard in loudspeaker. ***M*** relay does not operate.
4	Release ***RU*** relay.	After about 1 second, ***M*** relay operates.

STEP	ACTION	RESULTS
5	Depress CLR key.	TTY stops. Station is now restored to on-hook condition.
6	Remove ground from D39.	ORIG lamp goes out.

5.19 ***Checking Send Side of 4-Wire Facilities With Assistance of Back-Up Test Center***

STEP	ACTION	RESULTS
1	Arrange for test center to meet station on SD-98100 loop-around at TWX serving central office.	
2	Depress ORIG key.	ORIG lamp lights, TTY turns on, and dial tone is heard in loudspeaker.
3	Dial loop-around test number.	
4	Advise back-up test center output of f_{1m} as measured in 5.14, Step 6.	Test center will determine AML of send side of 4-wire facilities. If loop is not within limits as stated in Table B, it must be turned back for repair.
5	If limits are met, depress CLR key.	Station is now in on-hook condition.

5.20 ***Data Set Output Reference Tests***

STEP	ACTION	RESULTS
1	Depress ORIG key.	ORIG lamp lights, TTY turns on, and dial tone should be heard in loudspeaker.
2	Dial 900-ohm quiet termination number at originating central office.	
3	After establishing connection, pull out TIMER unit far enough to disconnect.	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, respectively, on HYBRID unit. Power switch ON.	
5	Manually operate ***CON*** relay.	Record f_{1m} tone level reading on form E-4905. TTY turns open.
6	Manually operate ***CON*** and ***AN*** relays.	Record f_{2m} tone level reading on form E-4905.

STEP	ACTION	RESULTS
	Note: Subsequent readings on repair visits should be within ±1.0 db of readings obtained in Steps 5 and 6.	
7	Release *CON* and *AN* relays and remove connections to TTS-28 meter.	
8	Depress CLR key.	
9	Replace TIMER unit.	Station should now restore to on-hook condition.

5.21 ***End of Transmission (EOT) Test***

STEP	ACTION	RESULTS
1	Strap terminal 63 to 75 on D terminal strip. (This simulates an EOT signal sent by the station.)	Lamp on CLR key lights.
2	Remove DISCRIMINATOR unit.	Lamp on CLR key goes out.
3	Reinsert DISCRIMINATOR unit.	Lamp on CLR key lights.
4	Remove strap from D63 to D75.	Lamp on CLR key goes out. Station is now in normal on-hook condition.

5.22 ***Ringer Adjustment***

- ***If office has ringback equipment:***

STEP	ACTION	RESULTS
1	Depress ORIG key.	ORIG lamp lights, TTY turns on, and dial tone should be heard in loudspeaker.
2	Dial local ringback test number.	
3	Depress LCL key.	Ringer will sound and can now be adjusted. ANS lamp will flash.
4	Depress ANS key. (CLR key is not used to go from local to answer mode since it is possible to disconnect falsely.)	Lamp on ANS key lights. Since station receives no f_{1m} tone, it will disconnect in about 8 seconds and go into an on-hook condition.
5	Depress CLR key.	Station goes into on-hook condition.

- ***If office does not have ringback equipment:***

6	Call back-up test center and request that your station be called.	
7	Depress LCL key. While station is ringing, adjust ringer to customer satisfaction.	LCL lamp will light. Bell will ring.

STEP	ACTION	RESULTS
8	When completed, depress ANS key and CLR key.	

5.23 A test call must be made to an automatic data test line (ADTL) on each installation as a final test before leaving customer's premises.

5.24 Either a "programmed" or "break-controlled" test can be made with an ADTL used for testing 8-level, 100-speed stations.

5.25 ***Programmed Test***

STEP	ACTION	RESULTS
1	Depress ORIG key.	TTY turns on and dial tone is heard in loudspeaker. ORIG lamp lights.
2	Dial number of programmed ADTL.	ADTL will send six test sentences shown in Fig. 2, then send GA SEND.
3	Send series of characters from the station. (See Note 2 of Fig. 2)	ADTL will check a minimum number of characters required for accurate measurement. A restraint signal followed by a break signal will then be transmitted to the station.

Note: If these signals are not transmitted within about 8 seconds, the TTY will disconnect.

4	At the station, observe that the REST then BRK-RLS lamps light.	After station stops sending, ADTL will transmit the distortion measurement followed by instruction FLIP. Distortion measurement should not exceed 15 percent. (The distortion measurement appearing on the TTY copy is the maximum distortion received rounded out to the nearest 5 percent. Therefore, 8 percent peak distortion would appear on the copy as 10 percent.)
5	Flip station from call-originating mode to call-terminating mode by depressing the CLR key then immediately depressing the ANS key. Hold ANS key down until the CLR lamp goes out and ANS lamp lights.	ADTL will time just long enough for automatic answer-back to be transmitted from station. Answer-back characters will be printed at station. ADTL will send six test sentences, as shown in Fig. 2, followed by instruction to GA SEND.

Note: If this is not done within about 8 seconds, the TTY will disconnect.

6	Repeat Step 3.	

STEP	ACTION	RESULTS
7	Observe that the REST then the BRK-RLS lamps light at the station.	At conclusion of the distortion measurement, the ADTL will transmit END followed by a clear signal. CLR lamp lights momentarily and station restores to on-hook condition.

5.26 The break-controlled test line may be used as follows:

STEP	ACTION	RESULTS
1	Depress ORIG key.	TTY turns on and dial tone is heard in loudspeaker. ORIG lamp lights.
2	Dial number of ADTL (break-controlled test line).	Immediately after connection is established, the test line will send continuous undistorted "FOX" signals to the station as shown in Fig. 2.
3	Depress BREAK key at station.	BRK-RLS lamp will light. Upon receipt of first break signal, the ADTL will change from undistorted to switched bias (28 percent) "FOX" signals.
4	Depress BRK-RLS key.	BRK-RLS lamp will extinguish.
5	Depress BREAK key at station.	BRK-RLS lamp will light. Upon receipt of second break signal, the ADTL will change from switched lines to combination distortion (28 percent) "FOX" signals.
6	Depress BRK-RLS key.	BRK-RLS lamp will extinguish.
7	Depress BREAK key at station.	BRK-RLS lamp will light. Upon receipt of the third break signal, ADTL will disconnect. A station may disconnect at any time by depressing CLR key.

THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## UNDIST
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## UNDIST
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## SW-DIS
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## SW-DIS
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## DISPAD
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## DISPAD

GA SEND
78IU78IU78IU78IU78IU78IU (See Note 2.)
10% (See Note 4).

FLIP
XXXXXXXX (Station automatic answer-back characters).

THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## UNDIST
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## UNDIST
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## SW-DIS
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## SW-DIS
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## DISPAD
THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## DISPAD

GA SEND
78IU78IU78IU78IU78IU78IU78IU (See Note 2.)
15% (See Note 4).

END

Notes:

1. | | |
   |---|---|
   | CR NULL DELETE LF | Before Each Test Sentence |
   | CR CR LF LF | Before GA SEND |
   | CR LF | Before Percent Distortion |
   | CR LF | Before FLIP |
   | CR LF | Before END |
   | CR LF | After GA SEND |
   | LF | After Percent Distortion |
   | LF | After FLIP |

2. The character sequence 78IU is suggested since it exercises TTY mark and space selecting mechanism for all pulses and provides a good transmission quality test. The ADTL, however, can measure any sequence of characters.

3. ***The break-controlled trunk sends the following test sentence:***

THE QUICK BROWN FOX JUMPED OVER A LAZY DOG'S BACK 1234567890 ## (&$,.)

4. Illustrative distortion reading obtained. Reading appearing on TTY copy is maximum distortion received rounded out to nearest 5 percent; therefore, 8 percent peak distortion would appear on copy as 10 percent.

Fig. 2 — ADTL Programmed Trunk Test Sequence