DATA SET 101C

IDENTIFICATION AND OPERATION

1. INTRODUCTION

1.01 This section is reissued to provide additional descriptive information for the data set 101C, change Tables A and B, and add block diagram, Fig. 1. It will also include operation of the data set as well as key and lamp functions of the associated attendant set. Due to extensive changes marginal arrows have been omitted.

1.02 Data set 101C is used with WADS C and 4-row, 100-speed TWX service.

1.03 The appropriate sections covering teletypewriters (TTY) should be consulted for information concerning the 33- and 35-type TTYs referred to in this section.

1.04 Tables A and B contain features and component parts of data sets 101A, 101B, and 101C. A general description of data sets 101A and 101B is covered in Section 591-012-100.

TABLE A

COMPARISON OF DATA SETS 101A, 101B, and 101C

Electronic Plug-in Units (Cards)		
101A	101B	101C
MODULATOR	MODULATOR	MODULATOR
HYBRID	HYBRID	HYBRID
LIMITER	LIMITER	LIMITER
DISCRIMINATOR	DISCRIMINATOR	DISCRIMINATOR
KEYER	KEYER	RESTRAINER
TIMER	TIMER	TIMER
ANSWER-BACK	ANSWER-BACK	SEND BREAK TIMER
Relays		
AN	AN	AN
CON	CON	CON
M	M	M
OR	OR	OR
S	S	S
RU	RU	RU
CY	CY	CY
-	RB (Equipped Not Used)	RB
-	-	RS (On Restrainer)
Terminal Strip D76 to D85 Wires and Cabling		
Not Equipped*	Equipped (Not Used)	Equipped

*Was equipped with K option on 101A.

TABLE B

FEATURES OF TELETYPEWRITER SERVICE USING DATA SETS

101A, 101B, AND 101C

Station Components	TWX					WADS		DLSTTS*
Teletypewriter	M15	M19	M28	M33	M35	M33	M35	M28
Keyboard	3 Row	3 Row	3 Row	4 Row	4 Row	4 Row	4 Row	3 Row
Speed	60	60	60	100	100	100	100	60/100
Code Levels	5	5	5	8	8	8	8	5
Service	TWX	TWX	TWX	TWX	TWX	WADS C	WADS C	WADS B
Data Set	101A or 101B	101A or 101B	101A or 101B	101C or 105A	101C or 105A	101C or 105A	101C or 105A	101A or 101B
Subscriber Set	691A	691A	689A	Part of Teletypewriter SD-3D009-01				689B

* Developmental line switching teletypewriter service.

2. GENERAL

2.01 Data set 101C is intended for WADS C and 4-row TWX service. The station associated with data set 101C will consist of an attendant set (built into TTY) and 100-speed, 4-row, 8-level, 33- or 35-type TTY equipment.

2.02 The data set 101A was developed primarily for use with TWX 60-speed, 3-row service. The station consists of the data set, a subscriber set (689- or 691-type), and 60-speed, 5-level TTY equipment such as 15-, 19-, or 28-type.

2.03 The data set 101B was developed to provide a set which would function in exactly the same manner and provide the same terminals as the data set 101A, but which could be readily converted into a data set 101C when required. For this purpose, relay RB is provided but not utilized in data set 101B. Terminal strip D76 to D85 is also provided, together with wires and cabling preparatory to its use after conversion to data set 101C.

2.04 Data set 101C contains seven cards. Five are identical to those in the data set 101B, namely, the DISCRIMINATOR, MODULATOR, HYBRID, LIMITER, *and TIMER* cards. Two of the 101B cards have no application in data set 101C: the ANSWER-BACK and the KEYER cards. Two new cards are required and fit in the equivalent slots of the last two mentioned cards: the SEND BREAK TIMER and RESTRAINER cards. Data sets 101B and 101C are also equipped with a receive-break relay RB and an additional terminal strip numbered D76 through D85.

2.05 Certain components, eg, capacitor C2 and receptacle T, which are no longer required may still be present in data set 101C if the set is derived by conversion from a data set 101B. Data sets manufactured as data set 101C will not have these components.

2.06 The 33- and 35-type TTY equipment required for WADS C and 4-row TWX service is listed below.

(a) Keyboard Send and Receive (33KSR and 35KSR)

(b) Automatic Send and Receive (33ASR and 35ASR)

(c) Receive Only (33RO and 35RO)

(d) Receiving Only Typing Reperforator (35ROTR)

(e) Receiving Only Nontyping Reperforator (35RONTR)

2.07 All 4-row TWX and WADS stations operate at 100-wpm. As is the case

in 3-row TWX service, the alphabet characters are printed only in capital letters. Although an 8-bit code is used for transmitting the various characters and control codes, only seven of the bits contain the intelligence; the eighth bit is absorbed by the equipment. An 8-bit code was selected for this service in order to permit regular TTY equipment to send and receive any of the 8-hole punched paper tapes used by office machines and computers.

2.08 Start-stop operation is provided by the use of a single bit start element and a double bit stop element; thus, 11 bits are transmitted for each character. The equipment operates at 110 bits (ten characters) per second.

2.09 The block diagram of a typical 4-row TWX or WADS C station is shown in Fig. 1. It consists of 33- or 35-type teletypewriter equipment, a built-in attendant set, and a data set 101C. The attendant set provides the keys, lamps, ringer, dial, speaker, and optional handset for operating the station. The data set converts the dc teletypewriter signals to voice-frequency signals for transmission over telephone facilities.

2.10 The features available with 4-row TWX station arrangements and WADS C station arrangements are for all practical purposes the same. The main difference is that all WADS stations use pushbutton calling whereas 4-row TWX

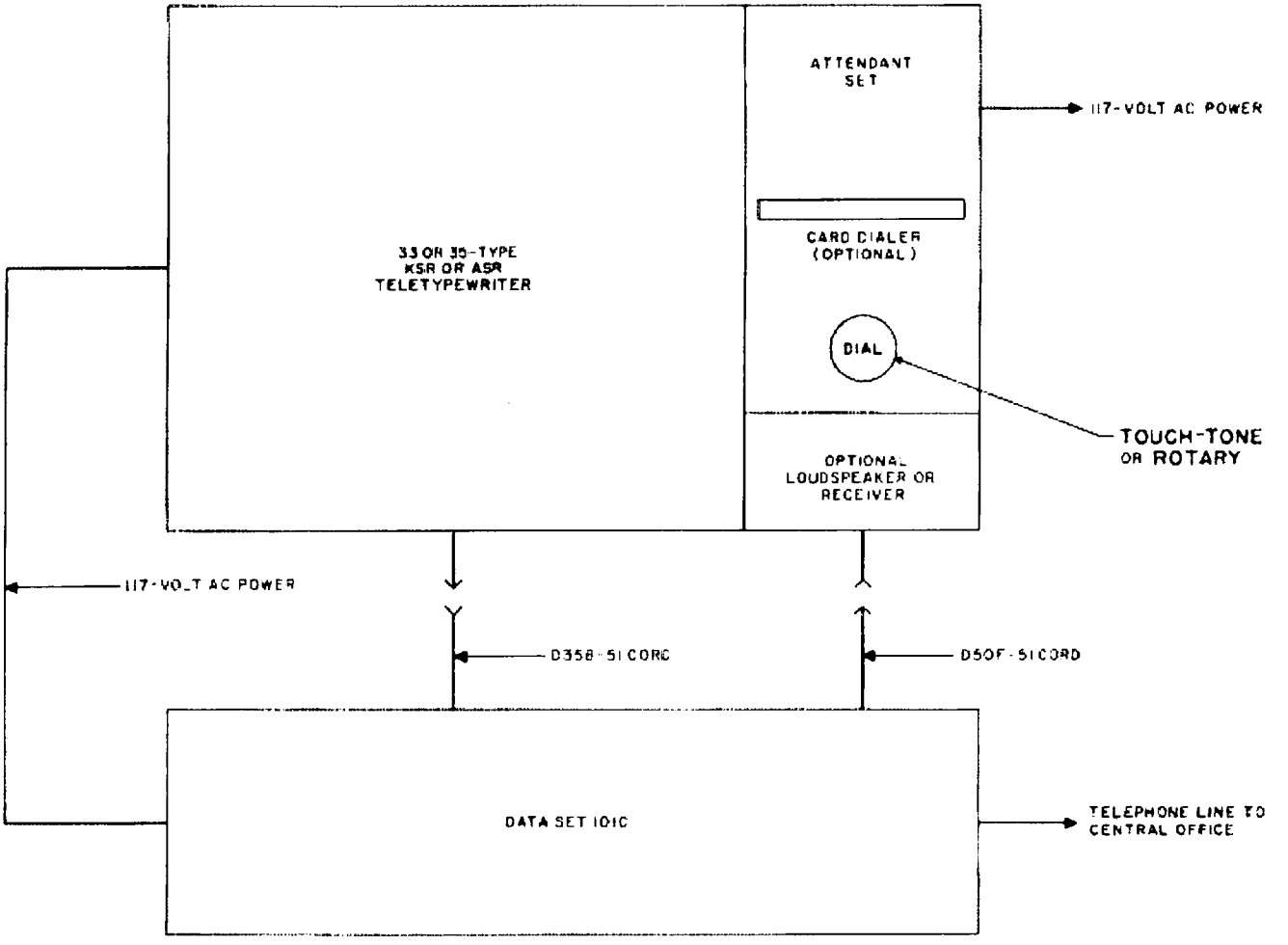

Fig. 1 - Block Diagram of Typical 4-Row TWX or WADS C Station

stations normally use a regular rotary dial. Pushbutton calling, ie, TOUCH-TONE operation, is available on 4-row TWX stations on an optional basis. Only originate-terminate station arrangements are offered. Although 4-row TWX stations are capable of receiving calls automatically, an attendant must be present when the station is sending traffic.

2.11 The principal features provided by WADS C and 4-row TWX are listed below:

- Transmission from 4-row keyboards and 8-level transmitter-distributors (TDs).
- Drum answer-back is standard equipment.
- Connect and disconnect time reduced by data set timing.
- Fast disconnect without a "hit" character by the transmission of an "end of transmission" character.
- Electronic break detection and a break indicating lamp.
- Loudspeakers and TOUCH-TONE dialers are standard equipment. (TOUCH-TONE dialers are optional on 4-row TWX service.)
- Added control keys (in attendant circuit).

  (a) Nonlocking lighted break release (BRK-RLS) key, whose lamp indicates the reception of a break signal.

  (b) Locking lighted buzzer release (BUZ-RLS) key which silences an alarm buzzer in the TTY and whose lamp indicates the buzzer has been silenced.
- Station can be placed in a "dont't answer" mode by external switches such as the "low paper" switch of the TTY.
- Station can be made or held busy by external switches such as the "out-of-service" switch.
- Data set provides proper outputs to activate the mode switching circuits of its associated TTY.

3. DESCRIPTION

3.01 The attendant sets used with 4-row TWX and WADS stations are built into the cabinet of the TTY equipment. Their purpose is to provide the attendant with a means to dial, to monitor the progress of a call, and to house control keys.

3.02 The following keys and lamps are provided with 4-row TWX and WADS C stations.

(a) Originate Key (ORIG): This key is used to originate a call. Depressing this key causes the lamp in the key to light, the data set to go off-hook, and the send and receive circuitry in the data set to go into the originate mode; that is, to receive signals in the f_2 band (2025 or 2225 cycles per second) and to send signals in the f_1 band (1070 or 1270 cycles per second.)

(b) Clear Key (CLR): This key is operated by the attendant to restore the station to normal from any other mode. The lamp in the CLR key enclosure lights during the disconnect cycle, whether the station is disconnected automatically or by depressing the CLR key.

(c) Answer Key (ANS): The answer key is used to answer an incoming call when the station is in the local mode. Depressing the ANS key lights the ANS lamp and puts the data set in the terminating mode; that is, it sends signals in f_2 band and receives signals in the f_1 band.

(d) Test Key (TST): This key is operated when it is desired to connect the dc output of the data set to the dc input of the data set for maintenance reasons. The lamp in the key housing lights when the key is depressed.

(e) Local Key (LCL): Depressing this key lights the lamp in the key enclosure and permits the typing unit to be driven from the keyboard without the

data set going off-hook. This mode is used by the attendant to practice or to punch tape with local copy. Incoming calls will not be answered automatically, but the ringing indication will be present.

(f) Buzzer Release (BUZ-RLS): This key is used to silence the audible alarm resulting from a low-paper or paper-out condition. The lamp in the buzzer release key remains lit as long as the key is depressed or the paper alarm condition exists.

(g) Out-of-Service Key (OUT-OF-SVC): The OUT-OF-SVC key is used whenever it is necessary to take a station out of service. When this key is operated to its locking position the OUT-OF-SVC lamp is lit, the station is put in a don't answer mode, and the ringer is disconnected, although the ANS lamp can flash when ringing is applied to the line. To restore a station to service, it is only necessary to return this key to its NORMAL position unless the station is in a terminal hunting group. In this case, the key should be operated to the RESTORE position long enough to hear dial tone; the key will automatically return to the NORMAL position when it is released. When the key is in RESTORE the ORIG lamp lights.

(h) Break Release Key (BRK-RLS): This key is used to unblind the data set signal input previously blinded by the receipt of a break signal from the distant station. The lamp in the BRK-RLS key lights when a break signal is detected and remains lit until the BRK-RLS key is depressed.

(i) Restrain Lamp (REST): A high intensity lamp (REST) lights when a restraining signal is received from a 4-row to 3-row converter used in transmission to 3-row TWX stations on the DDD switching plan. The lamp remains lit until the restraining signal is removed. The purpose of this feature is to limit the sending speed from 4-row machines transmitting at 100 wpm to 3-row machines receiving at 60 wpm.

3.03 The keys and lamps provided for WADS receive-only stations are the same as those provided for WADS C stations except that the BRK-RLS key and lamp and the REST lamp are omitted and the LCL key is disabled. The ORIG key is used for maintenance purposes only.

3.04 WADS RO stations do not have a keyboard, and therefore are not capable of transmitting a message.

3.05 In all other respects WADS RO stations have the same features as are available with WADS C station arrangements. A loudspeaker is not provided with RO stations. However, a handset is provided for use with OUT-OF-SVC key. The handset is required in this case because it is necessary to monitor for dial tone when the station is restored to service. See discussion under Out-of-Service Key in 3.02.

Restrainer

3.06 The restraint signal is generated and transmitted by the central office data converter. This signal is a frequency-shifted tone keyed at a 50-cycle per second rate between a steady marking tone and 50 cycles below the marking tone. Therefore, the restraint signal will be one of two frequencies depending upon whether the 100-wpm machine is the originating or terminating station. These frequencies are either the f_{1m} or f_{2m} signal warbled by 50 cycles, eg, 1270 to 1220 cps or 2225 to 2175 cps.

3.07 The restrainer circuit in data set 101C recognizes the restraint signal and causes the following actions to be taken during the period when the signal is being received.

(1) Lights the REST lamp. (This informs the attendant to decrease typing speed.)

(2) Causes TD to stop. When restrainer signal ceases, the TD will automatically restart.

(3) The CO data converter interrupts restrainer signal by transmitting a break signal when the number of charac-

ters in storage reaches 17. Receipt of the break signal locks REST lamp in the ON condition as an indication that a break signal was transmitted to avoid overflow of the data converter storage. In this case, the REST lamp will remain ON until the BRK-RLS key is operated.

(4) A disconnect signal is transmitted if the number of characters in the data converter storage unit reaches 20. A disconnect signal will return all elements of the data set to on-hook condition and thus the REST lamp will be extinguished. When this condition occurs the call will have to be re-initiated.

4. OPERATION

Originating Calls

4.01 To initiate a call, the attendant operates ORIG (originate) key on the attendant circuit. Operation of this key turns on the TTY motor and presents an off-hook signal to the central office. The switching equipment will return dial tone as in the case of a normal telephone call. The attendant circuit has a loudspeaker so that dial tone can be heard. On hearing dial tone, the attendant dials the number of the station to be reached as if this were an ordinary telephone call. The central office equipment is arranged to recognize whether or not the called station is another 4-row station. If it is a 4-row station, the connection will be established directly. If the called number is a 3-row station, the call is routed via a data converter. The originating attendant is able to monitor the progress of the call by listening to call progress tones from the loudspeaker.

4.02 Most attempts to reach the answering station will be automatically answered at the first ring; therefore, the ringback tone may not be heard by the originator. If there is a delay in answering, ringback tone will be heard. If all trunks are busy or the station is busy, appropriate tones will be heard. The call may then be re-originated at some suitable time.

Answering

4.03 When a station that is ready to accept a call is rung, it will automatically answer by turning on its TTY motor and by going off-hook. This will cause the answering station to send an off-hook signal to its serving central office and trip ringing. This off-hook signal is sent back to the originating station's serving office for charge and record purposes.

4.04 If the TTY of the called station is not ready to accept a call or if the LCL key in the attendant circuit is depressed, the automatic answering device is disabled; however, the ringer of the attendant circuit will sound unless the OUT-OF-SVC key is operated.

4.05 It is possible to override the "don't answer" condition at a station by depressing the ANS (answer) key.

Connecting

4.06 When the answering station goes off-hook, a timing interval of approximately 1.4 seconds is generated. No tone is transmitted from the answering station during this interval. This interval is called the single frequency guard interval. Timing is required to guarantee the propagation of the off-hook signal from the answering to the originating office.

4.07 F_{2m} is transmitted from the answering station at the end of the 1.4-second timing interval. The originating station is tuned to recognize the f_2 frequency band. However, no action is taken until the f_{2m} signal has persisted for about 1/2 second. This mark timing interval allows sufficient time for the echo suppressors to be disabled and also to guard against signal initiation by noise. At the end of the mark timing interval, the originating station connects its demodulator output through to the TTY receiver.

4.08 The originating station transmits f_{1m} frequency to the answering station where the demodulator is tuned to the

f_1 band. Frequency f_{1m} is received and timed at the answering station. At the end of about 1/4 second, the demodulator is connected through to the TTY receiver. The data set at the answering station then triggers a device in the TTY which sends an answer-back by generating one or more selected characters. Operation of either TTY keyboard or tape transmitter will cause sending contacts to modulate one of the data transmission channels.

Breaking

4.09 Either station can interrupt the transmission by depressing the BREAK key on the TTY. This causes the transmission of a spacing signal of a fixed duration, regardless of the length of time the key is depressed. This interval (approximately 200 msec) is long enough to enable the other end to identify the signal as a break and not a TTY character and is short enough not to cause a disconnection.

Disconnection

4.10 Either of the two connected stations can initiate a disconnect sequence. The normal method consists of transmission of the EOT (end of transmission) TTY character. This closes a contact in the stunt boxes of both sending and receiving TTY. Each station then times an interval of about 50 msec during which it sends its marking frequency, after which the station restores to its normal on-hook condition. The timed marking interval prevents a hit character from being printed at the other end due to the possible difference in operating times of the circuits. However, this means of disconnecting two stations cannot be used if call has been placed through the TWX assistance operator.

4.11 An alternate way to disconnect consists of the depression of the CLR key at either station. The station will then transmit a three-quarter second burst of spacing carrier to the distant station and cause both stations to go on-hook. However, a hit character may be printed at the distant station during the disconnect sequence. If this method is used and either station is equipped with a data set 105A and a D-controller, it will signal an alarm.

REPLACING PAGE ADDENDUM
Filing Instructions:

1. REMOVE FROM THE SECTION THE PAGES NUMBERED THE SAME AS THOSE ATTACHED TO THIS PINK SHEET.
2. INSERT THE ATTACHED PAGES INTO THE SECTION IN THEIR PLACE.
3. PLACE THIS PINK SHEET AHEAD OF PAGE 1 OF THE SECTION.

DATA SET 101C

TESTS AND INSTALLATION METHODS

1. GENERAL

1.001 This addendum supplements Section 591-013-200, Issue 4. The attached pages must be inserted in the section in accordance with the filing instructions above.

1.002 This addendum is issued to add note after 5.05 (6) and to include strapping arrangements for −11 dB transmission loss in Table C.

5. TESTS AND INSPECTIONS

The following change applies to Part 5 of this section.

(a) 5.05 (6) — note added.
(b) Table C — revised.

Attached:
Page 5 dated September 1969 — Revised
Page 6 dated September 1969 — Reissued
Page 11 dated September 1969 — Reissued
Page 12 dated September 1969 — Revised

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 (C 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 or 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 interchanageable, 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.

►*Note:* The transmit level can be adjusted in 2 dB steps from 0 dB to —14 dB by strapping f_1 and f_2 send data pad. The transmit level of f_1 and f_2 should be equal where loop loss is based on 1000 Hz. f_2 level can be set 2 or 4 dB greater than f_1 to compensate for loss, however the f_2 level arriving at the central office must not exceed —12 dB.◄

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_{2225} 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 PADS 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)
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)

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
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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

DATA SET 101C

USED WITH 4-ROW TWX

LOCATING TROUBLE AND TEST PROCEDURES

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1. GENERAL

1.01 This section is being reissued to add tests using 907A data test set and to make major changes in the text. This practice presents some of the methods that may be used to locate trouble at 4-Row TWX stations using data set 101C. It does not cover all possible conditions but discusses some typical troubles and presents a testing procedure to determine which section of the station or associated equipment is causing the trouble. The station is the teletypewriter (TTY), data set, and attendant set. The associated equipment is the line and central office equipment.

1.02 Obvious TTY defects such as nonreversing ribbon, stiff keyboards, and broken copyholders are not included. These may be cleared by referring to the appropriate Bell System Practices.

1.03 It can be assumed that, where possible, central office equipment trouble has been located and cleared before dispatching to the station. On transmission problems, tests may require coordination between the station and central office or back-up test center. The term "back-up test center" designates the test center

that is arranged to make tests beyond the capabilities of a local test center, automatic data test line (ADTL), and portable station test meter.

1.04 The following precautions should be observed when testing the data set.

Note: When SEND BREAK TIMER is not fully inserted in its slot, the S relay will buzz.

(1) When making voltage readings on the test points (TPs) of data set units, measure to GRD on rectifier, unless otherwise indicated, using Northeast Electronics test set TTS-28 or equivalent.

(2) Never use a 1011-type handset or test picks in the TPs of data set except as specified, as the components of the units in the data set may be damaged.

(3) After operating or working on wire spring relays and/or units check for:

(a) Improper position of contact springs

(b) Broken units

(c) Improper position or seating of units.

(4) When making any tests, data set should be in off-hook condition unless otherwise specified.

(5) Support rear of fiber printed wiring boards on data set units when using inserter-extractor tool to strap wedge-lock terminals. Use only 24-gauge wire.

(6) Data set should be restored to normal or on-hook condition following each complete test.

1.05 Output of rectifier should be measured before making any other tests. Output of rectifier should be +20 ±3 volts and −20 ±3 volts. Disregarding the signs, the difference in numerical values shall not exceed 2 volts.

1.06 Regardless of the reason for visiting a station, a final check of the station should be made with ADTL.

1.07 When a 4-Row TWX station is placed in test mode, certain transmission and performance tests can be made from the nearest back-up station test center. The station can be placed in test mode by depressing the TST key in the attendant set after a call has been originated to the back-up station test center.

1.08 Do not attempt to repair data set units at station location. If trouble is traced to a unit, replace it except for potentiometer adjustments.

1.09 In order to cover as many troubles as possible, they have been grouped under the following headings:

(1) Trouble Originating Calls

(a) TTY does not turn on

(b) No dial tone

(c) Cannot break dial tone

(d) Getting wrong numbers

(e) TTY does not unblind.

(2) Trouble Answering Calls

(a) Bell does not ring

(b) Cannot trip ring

(c) TTY does not turn on

(d) TTY does not unblind

(e) Station disconnects (cut offs).

(3) Trouble Sending

(a) Most stations receive bad copy

(b) One or two stations receive bad copy

(c) Cannot send

(d) Cannot break.

(4) Trouble Receiving

(a) Receiving bad copy from all stations

(b) Receiving bad copy from certain stations

(c) Cannot receive.

(5) TTY Trouble

- Troubles directly connected to the TTY, broken parts, ribbon trouble, line feed troubles, etc.

2. TEST EQUIPMENT

2.01 The following tools, meters, and spare units are necessary for maintenance of data set 101C:

- Teletypewriter Maintenance Tools
- 1011-Type Handset
- Northeast Electronics Test Set Model No. TTS-28
- 164C4 Transmission Measuring Set or Equivalent
- Inserter-Extractor (Wire) Tool, KS-19092, List 1
- Carrying Case for Data Set Units
- Spare Set of Data Set Units
- Maintenance Test Card J70148AA, List 1A
- 907 Data Test Set, J79907A, List 1; Associated List 2 and 3 Connector Cords; and List 5 Test Card
- SD-3D007-01 (Data Set)
- SD-3D009-01 (Attendant Set)

Note: Northeast Electronics Test Set Model No. TTS-28 must be in a vertical position to ensure accurate measurements.

3. TROUBLE ORIGINATING CALLS

3.01 This category includes the troubles in completing a connection to another station. The following tests are checks to aid in sectionalizing the troubles to the major components of the station.

A. TTY Does Not Turn On

STEP	ACTION	RESULT
1	Depress ORIG key.	TTY should turn on; if not, trouble may be defective data set or TTY trouble.
2	Check power using TTS-28 test set or equivalent at ac power outlet.	
3	Depress LCL key.	TTY should turn on; if not, trouble is in TTY.
4	Depress ORIG key.	OR relay operates and ORIG lamp lights, but TTY motor does not start.
5	Ground D32.	Motor should start, indicating trouble in data set wiring. If motor does not start, check wiring to TTY.

B. No Dial Tone (NDT)

STEP	ACTION	RESULT
1	Connect 1011-type handset across D34 and D35.	Dial tone should be heard; if not, trouble is in line or CO equipment. If dial tone is heard, trouble is in data or attendant set.
2	Ground D39 of attendant set and operate ANS key.	ANS and ORIG lamps light, and f_{2m} tone should be heard in speaker, indicating the receive portion of HYBRID unit, LIMITER unit, and loudspeaker are good. Therefore, trouble must be in data set control circuits, dial contacts (rotary dial), line, winding of hybrid coil, or associated wiring.

C. Cannot Break Dial Tone (CBDT)

1	Disconnect loop at connecting block. Place 1011-type handset across loop and attempt to dial.	If unable to dial, trouble is in line or CO equipment.
2	Remove leads on D26 and D27.	
3	Connect 1011-type handset to D26 and D27.	
4	Operate ORIG key. Listen for dial tone, attempt to dial.	If unable to dial, check data set wiring. If able to dial, check attendant set.

D. Getting Wrong Numbers

For Stations Equipped with Rotary Dial —

1	Use dial speed test or operate ORIG key and dial test number.	If results are unsatisfactory, trouble could be in station dial or CO equipment.
2	Bridge 1011-type handset across terminals D34 and D35; dial speed test code.	If results are unsatisfactory, refer to plant service center. If test results are satisfactory, replace station dial.
3	Check customer dialing procedure if all test results are satisfactory.	