DATA SET 113CR-L1A/2
TRANSMITTER-RECEIVER
SINGLE SET
TEST PROCEDURES

CONTENTS PAGE

1. GENERAL

1.01 This section contains procedures to be used when testing data set (DS) 113CR-L1A/2 on an initial installation or during a maintenance visit.

1.02 Whenever this section is reissued, the reason for reissue will be contained in this paragraph.

1.03 Before proceeding with any tests of the data set, verify the following:

(a) That the data loop has been tested and meets requirements specified in the section entitled Data Systems—DATA-PHONE® Service and Data Access Arrangement on Direct Distance Dialing Network— Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines (314-205-501)

(b) That the telephone portion of the installation meets standard dc talk, signaling, and supervision requirements

(c) That the data set options agree with the service order.

Take necessary steps to ensure customer is not billed for test calls. Refer to the section entitled Crediting Charges on Test Calls (010-250-001).

1.04 This section is divided into five parts. Part 2, TEST CAPABILITIES, provides information on and procedures for all the tests associated with DS 113CR-L1A/2. This includes both tests which require no test equipment and those requiring such

equipment as the 914C data test set (DTS). Parts 3, INSTALLATION TESTS, and 4, MAINTENANCE TESTS, provide the recommended sequence in which to perform the various tests when installing DS 113CR-L1A/2 or investigating a trouble report. Part 5, SUPPLEMENTARY TESTS, is provided as an aid to troubleshooting for the experienced craft employee.

Caution: If the data set is removed from the mounting, it should be handled by the nonconductive surfaces only. Otherwise, certain circuit components may be damaged.

Note: When inserting data set back into the mounting, push it all the way in to ensure proper contact with the connectors in the rear of the mounting.

2. TEST CAPABILITIES

2.01 The test circuitry built into DS 113CR-L1A/2 permits the following tests to be performed.

A. Analog Loopback Test

2.02 This test can be initiated by either of two methods:

- The AL button is operated.
- Customer-provided equipment (CPE) applies an ***on*** condition to the CN lead.

2.03 In the analog loopback test mode (Fig. 1), the data set is isolated from the telephone line. During this test the data set circuits are modified to keep both the transmitter and the receiver in the f2 mode. The output of the transmitter is looped via an attenuating circuit to the receiver. During this test, the telephone set and telephone ringer remain functional.

2.04 The analog loopback test is performed in the following manner.

(a) The AL button is depressed or the CN lead is turned ***on*** by the CPE. The MB lamp lights, indicating that the data set is in the AL test mode. The TM lamp is also lighted if the AL test button is depressed. The SD lamp is off only if the BA lead is marking. If the CD lead is ***off,*** the MC lamp remains lighted.

(b) When the CD lead is turned ***on,*** the data set goes through the handshaking sequence. TR and MR lamps are lighted, and after a slight delay, the MC lamp goes off and the CB and CF leads are turned ***on.***

Note: If option ZE is installed, the CC lead remains ***off*** for the duration of the test. If option ZF is installed, the CC lead is turned ***on.*** Some terminals require the CC ***on*** indication to be able to proceed with this test.

(c) The CPE can now send data signals which will be modulated by the transmitter, looped back to the receiver, demodulated, and presented to the CPE via the BB lead. In this way the CPE, in a full-duplex mode, can test the complete operation of the data set and its own capability to generate and read data signals. The data signals may be observed at the SD and RD lamps.

Note: The CPE should not send steady space if the receive space disconnect—YES option (V) is installed in the data set. Each time the handshaking sequence is completed, the data set cycles through the disconnect sequence upon detection of the steady space signal. The MR and MC lamps alternately light and go off when CPE sends steady space.

(d) Release of the AL button and/or turning ***off*** of the CN lead restores the station and lamps to the normal idle condition.

B. Local Self Test

2.05 Depressing the ST and AL buttons on the front of the data set initiates the local self test.

2.06 Depressing the AL button causes the data set to go into the analog loopback mode. The data set is conditioned as described in Part 2A.

2.07 Depressing the ST button causes the following to occur (Fig. 2):

- Turns ***off*** the CB, CC, and CF leads
- Opens the BA and BB leads

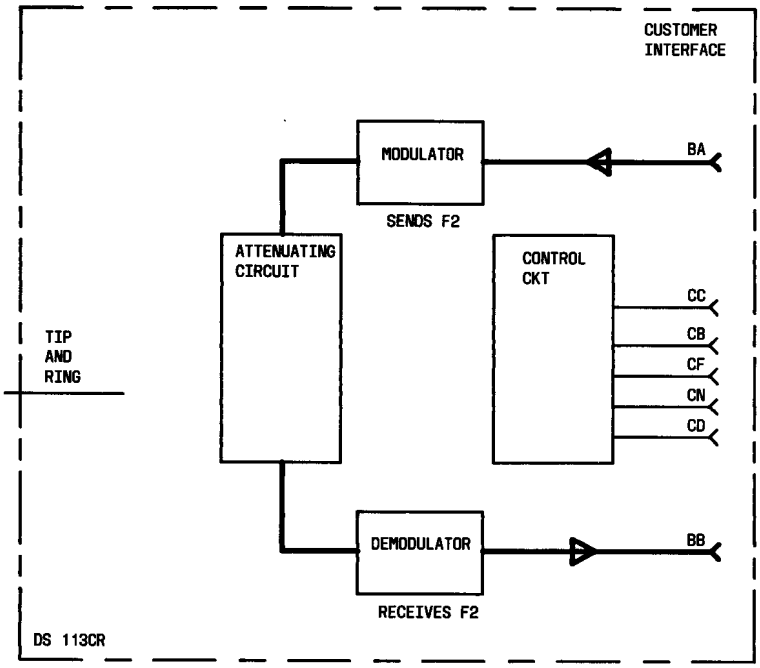


Fig. 1—Analog Loopback Test Mode—Simplified Block Diagram

- Arranges DS 113CR-L1A/2 to ignore the CN and CD leads
- Simulates ***on*** condition of CD circuit
- Connects an approximate 300-baud signal generator to the transmitting circuit and connects a bias detector to the output of the receiver.

2.08 In the local self test (Fig. 3), the data set goes through the handshaking sequence. The square wave signal is applied to the transmitter, looped through an attenuating circuit to the receiver, and the demodulated signal is checked by the bias detector. In this way, most of the circuits of the data set are checked. The MC lamp goes off after a short delay if the bias of the received data signal is under 20 percent. All other lamps except TR are lighted, indicating proper operation of the set. The TR lamp is lighted if the CPE has the CD lead turned ***on.***

C. End-to-End Self Test

2.09 To perform an end-to-end self test (Fig. 2), a call is set up to a DS 100-type which operates in the answer mode equipped with a self test button. The ST buttons are operated at both ends, and then the data mode is entered in the normal way. The test can be performed with or without a terminal connected to the data set. The following lamp pattern should occur:

- The TR lamp may be ignored.
- The TM and SD lamps are lighted.
- The MR lamp lights when entering the data mode.
- The RD lamp lights when data is received from the far-end data set.
- The MC lamp is lighted initially, but goes off if the signal from the far end is received with less than 35-percent distortion. The off condition of the MC lamp at the far-end data set indicates the proper reception of the 300-baud signal generated by the near-end data set.

Note: On noisy connections, the MC lamp may go off but flash occasionally, indicating a "hit" or error.

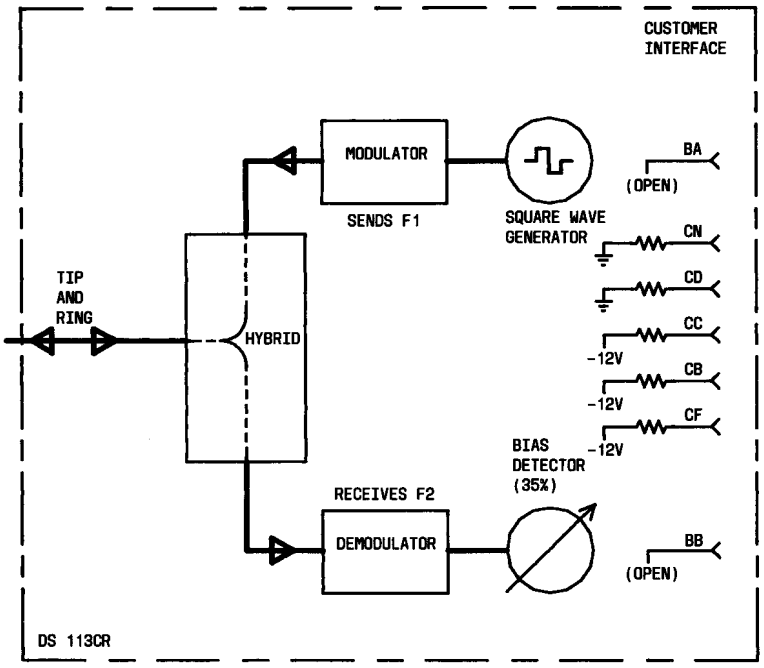


Fig. 2—Self Test Mode—Simplified Block Diagram

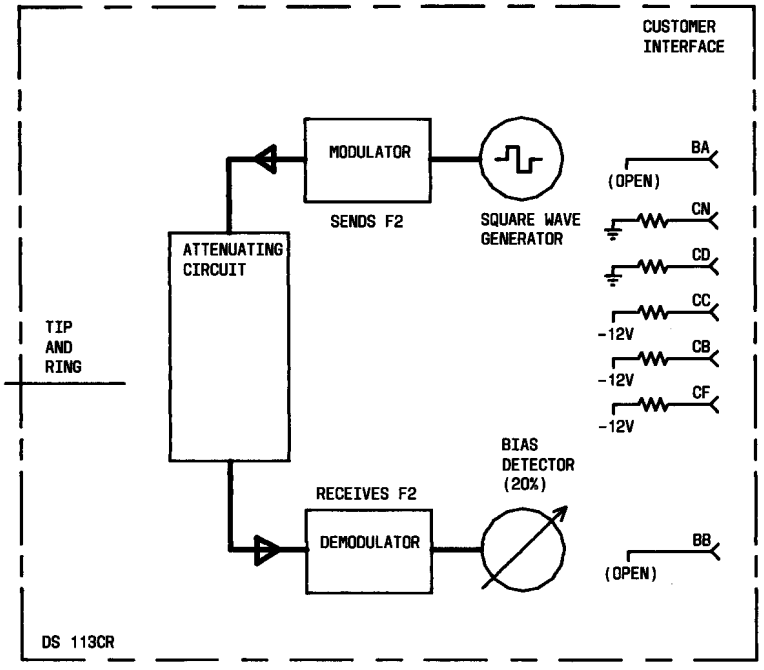


Fig. 3—Local Self Test Mode—Simplified Block Diagram

D. Digital Loopback Test

2.10 A digital loopback test is usually set up at the request of the test center and provides a means whereby the test center can measure round-trip distortion. The digital loopback test is initiated by operating the DL button on the data set and entering the data mode in the normal manner.

2.11 Entering the digital loopback test mode (Fig. 4) causes the data set internally to loop BB (receive data) to BA (send data) and simulate an ***on*** condition of the CD (data terminal ready) circuit. In addition, this causes the following to occur:

- Turns ***off*** CB, CC, and CF leads.
- Clamps BB lead marking.
- Arranges the data set to ignore BA, CD, and CN leads.
- Turns off MB and RD lamps, if lighted.
- Lights MR and TM lamps.
- TR and SD lamps may be ignored.

Note: MC lamp turns off when carrier from data test center (DTC) is received.

E. Digital Loopback From Far-End Data Set and Self Test at Near-End Data Set

2.12 If the far-end data set does not have a self test button but is provided with a digital loopback feature, it is still possible to perform an end-to-end self test, but the results may be ambiguous. Have the far-end data set placed in the digital loopback mode. Depress the ST button on the near-end DS 113CR-L1A/2 and enter the data mode in the normal manner. The square wave generated by the near-end DS 113CR-L1A/2 makes one complete round trip. The signal detector of DS 113CR-L1A/2 checks if the round-trip distortion exceeds 35 percent. If the MC lamp goes off, there is a very strong indication that both data sets and the line facilities are satisfactory.

Note: There is a slight possibility that the bias may be excessive in at least one direction, but that this bias is compensated for by bias of the opposite polarity in the other direction.

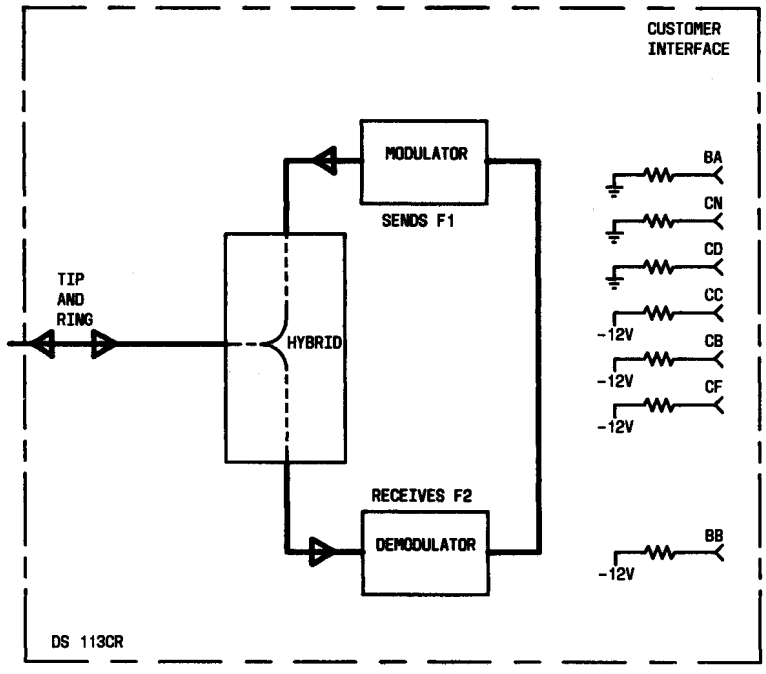


Fig. 4—Digital Loopback Test Mode—Simplified Block Diagram

A successful test indicates that all circuits of both data sets seem to be working. If the MC lamp does not go off, the only conclusion that can be drawn is that the round-trip distortion exceeds 35 percent. As the bias distortion in the two directions of transmission may be additive, no conclusion about the proper operability of the sets and the line facilities can be drawn.

F. Interface Test From 904-Type Data Test Center

2.13 The interface test verifies that valid signals sent by a 904-type DTC are received and are available to the customer at the DS 113CR customer interface. The interface test also verifies that valid signals are sent to the 904-type DTC from DS 113CR and that all optional features used are functional.

2.14 The following equipment is required for the interface test:

- 914C DTS
- 904-type DTC.

2.15 Perform the test as follows:

(1) At 914C DTS, program matrix, set switches, and connect data set as shown in Fig. 5.

(2) If receive space disconnect—YES option (V) is installed in DS 113CR, remove by installing option Y.

(3) At DS 113CR, release AL, ST, and DL test buttons and connect power plug to ac receptacle.

Requirement: All data set lamps except MC are off.

(4) At 914C DTS, operate POWER switch to ON.

(5) At 914C DTS, operate switch S7 to ON.

Requirement: TR lamp lights.

Note: Interface lead CD is in the ***on*** condition.

(6) At DTS, set FUNCTION switch to VOLT INT.

(7) Set RANGE switch to DCV-10.

Requirement: DTC meter indicates between 5.0 and 8.0 Vdc.

Note: Interface lead BB is in mark condition (mark hold).

(8) At DTS, set FUNCTION switch to OFF.

(9) Set VERTICAL MONITOR switch to 8.

(10) Set FUNCTION switch to VOLT INT.

Requirement: Meter indicates between 5.0 and 8.0 Vdc.

Note: Interface lead CF is in the ***off*** condition.

(11) Set FUNCTION switch to OFF.

(12) Set VERTICAL MONITOR switch to 5.

(13) Set FUNCTION switch to VOLT INT.

Requirement: Meter indicates between 5.0 and 8.0 Vdc.

Note: Interface lead CB is in the ***off*** condition.

(14) Set FUNCTION switch to OFF.

(15) Set VERTICAL MONITOR switch to 6.

(16) Set FUNCTION switch to VOLT INT.

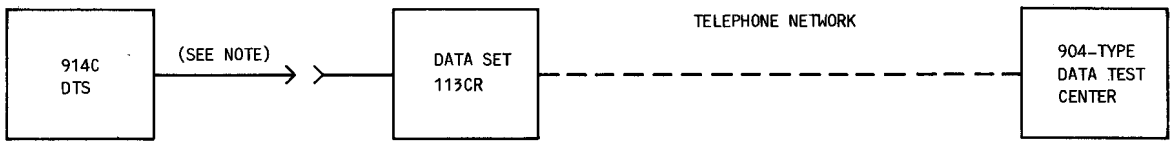
Requirement: Meter indicates between 5.0 and 8.0 Vdc.

Note: Interface lead CC is in the ***off*** condition.

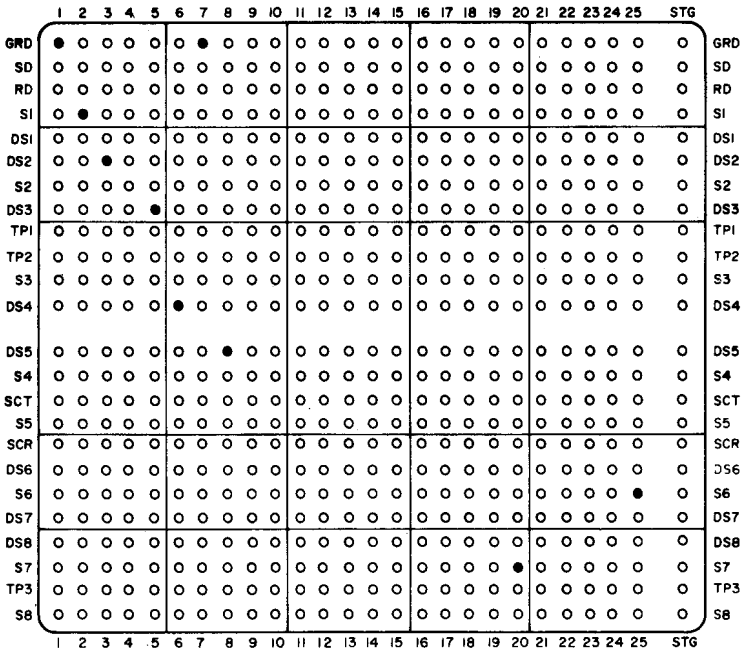
(17) Set FUNCTION switch to OFF.

(18) At associated telephone set, lift handset, depress red DATA key, and then hang up handset.

Requirements: Line key lamp and MR lamp light and remain lighted after handset is placed on-hook. If option ZD is installed,



NOTES:
1. CONNECT CORD FURNISHED WITH 914C DTS BETWEEN CUSTOMER CONNECTOR OF DS 113C AND CONNECTOR A ON 914C DTS
2. SET SWITCHES AS SPECIFIED IN TEXT. INITIALLY SET SWITCHES AND PROGRAM MATRIX AS FOLLOWS:



SWITCH	SETTING
POWER	ON
SELECTOR A	ALL DEPRESSED
S1-S8	ALL OFF
INTERFACE MODE	VOLTAGE
VERTICAL MONITOR	3
POLARITY	REV
FUNCTION	OFF
RANGE	DCV-10

Fig. 5—Interface Test—904 Data Test Center

DS4 lamp lights. (Interface lead CC is in the ***on*** condition.)

If option ZC is installed, DS4 lamp is off. (Interface lead CC is in the ***off*** condition.)

Note: DS4 will go off (data set will disconnect) after approximately 15 seconds.

(19) If DS 113CR has option ZC installed, set FUNCTION switch to VOLT INT.

Requirement: Meter indicates between 5.0 and 8.0 Vdc.

(20) Set FUNCTION switch to OFF. At associated telephone, lift handset and depress the line key.

Requirement: Line key lamp and MR lamp go off. DS4 lamp goes off (if lighted).

(21) Operate S7 to OFF.

(22) Operate S6 to ON.

Requirement: MB lamp lights.

(23) At associated telephone set, lift handset.

Requirement: Dial tone is heard.

(24) Replace handset.

(25) Operate S6 to OFF.

Requirement: On data set, MB lamp goes off.

(26) Operate S7 to ON.

(27) Call the DTC and request continuous f_2 (2225 ±5 Hz) mark be sent.

Note: All tones from the DTC should be at the maximum level permitted by the DTC.

(28) When tone is heard, depress DATA key and place handset on-hook.

Requirement: The associated line key lamp lights.

(29) Set VERTICAL MONITOR switch to 3.

(30) Set FUNCTION switch to VOLT INT.

Requirements: Meter indicates between 5.0 and 8.0 Vdc. RD lamp is off.

Note: Interface lead BB is in the mark condition.

(31) Set FUNCTION switch to OFF.

(32) Set VERTICAL MONITOR switch to 5.

(33) Set METER POLARITY switch to NOR.

(34) Set FUNCTION switch to VOLT INT.

Requirement: Meter indicates between 5.0 and 7.0 Vdc. DS3 lamp is lighted.

Note: Interface lead CB is in the ***on*** condition.

(35) Set FUNCTION switch to OFF.

(36) Set VERTICAL MONITOR switch to 8.

(37) Set FUNCTION switch to VOLT INT.

Requirement: Meter indicates between 5.0 and 7.0 Vdc. DS5 lamp is lighted. MC lamp is off.

Note: Interface lead CF is in the ***on*** condition.

(38) Set FUNCTION switch to OFF.

(39) Set VERTICAL MONITOR switch to 6.

(40) Set FUNCTION switch to VOLT INT.

Requirement: Meter indicates between 5.0 and 7.0 Vdc. DS4 lamp is lighted.

Note: Interface lead CC is in the ***on*** condition.

(41) Set FUNCTION switch to OFF.

(42) At the associated telephone, lift handset and depress line key.

(43) Request DTC to retransmit f2 mark (2225 Hz) and sweep to f2 space (2025 Hz) when data set responds with f1 mark.

(44) When tone is heard, operate DATA key. Observe DS3 and DS5 lamps. Ignore DS4. Hang up the handset.

Requirements: DS5 lamp lights approximately 1/2 second before DS3 lamp lights. When DTC sweeps to space, DS2 lamp lights. DS3 and DS5 lamps remain lighted.

Note 1: Interface leads CB and CF are in the ***on*** condition.

Note 2: This test checks the carrier detector ability to hold during a space signal.

(45) At DTS, set VERTICAL MONITOR switch to 3.

(46) Set FUNCTION switch to VOLT INT.

Requirement: Meter indicates between 5.0 and 7.0 Vdc. RD lamp is lighted.

Note: Interface lead BB is in the space condition.

(47) Set FUNCTION switch to OFF.

(48) Operate S1 to ON.

Requirement: SD lamp lights. Data set transmits f1 space (1070 Hz) to DTC.

(49) Operate S1 to OFF.

(50) Operate S7 to OFF then immediately to ON.

Requirement: If option U is provided, data set disconnects immediately. DS2, DS3, DS4, and DS5 go off at the same time.

If option T is provided, data set transmits f_1 space for 3 seconds then disconnects. DS2 and DS3 go off immediately. DS4 and DS5 go off 3 seconds later.

(51) At associated telephone, lift handset and depress line key. Call DTC and request the DTC to send f2 mark until the data set responds with f1 mark, then after several seconds remove the f2 mark.

(52) When tone is heard, operate DATA key and observe lamps DS3, DS4, and DS5.

Requirement: If options R and B are provided, the data set does not disconnect. DS5 goes off when DTC removes f_2 mark. DS3 and DS4 remain lighted.

If options R and A are provided, the data set does not disconnect. DS3 and DS5 go off when DTC removes f2 mark. DS4 remains lighted.

If options S and B are provided, the data set disconnects. DS5 goes off when DTC removes f_2 mark. DS3 and DS4 go off about 1/4 second later.

If options S and A are provided, the data set disconnects. DS3 and DS5 go off when DTC removes f2 mark. DS4 goes off about 1/4 second later.

(53) If data set did not disconnect, terminate call to DTC by operating S7 to OFF and then to ON.

(54) At data set, disconnect power plug from ac receptacle.

(55) If option V was removed in (2), install option V in data set.

(56) Ensure that all the correct options are installed in the data set.

(57) Connect power plug to ac receptacle.

(58) Call DTC and request the center to send f2 mark, and when data set responds with f1 mark, sweep to f2 space.

(59) When tone is heard, operate DATA key. Observe lamps DS2, DS3, DS4, and DS5.

Requirement: If option Y is provided, data set does not disconnect. DS2 lights when DTC sweeps to f2 space. DS3, DS4, and DS5 remain lighted.

If option V is provided, data set disconnects. DS2 lights when DTC sweeps to f2 space. About 1 1/2 seconds later DS3, DS4, and DS5 go off.

(60) At DTS, set switch S7 to OFF.

(61) At DS 113CR, disconnect power plug from ac recptacle.

(62) Disconnect DTS from data set connector J8 and restore normal connection.

(63) At DS 113CR, connect power plug to ac receptacle.

3. INSTALLATION TESTS

3.01 This part provides the sequence in which tests are to be performed at the time of installation, to verify that the data set is operating properly. These procedures utilize built-in test features and do not require any external test equipment. When a data station trouble is experienced, these procedures should also be performed prior to performing maintenance tests to aid in localizing data station trouble. If DS 113CR-L1A/2 is suspected as the cause of the trouble, replace it and repeat tests before turning the equipment back to the customer.

A. Local Self Test

3.02 Perform the local self test. Refer to paragraph 2.05 through paragraph 2.08.

B. Transfer From Talk to Data Mode

3.03 This test checks the ability of the data set to transfer from the talk mode to the data mode.

The data set automatically drops the call approximately 14 seconds after the red DATA key is depressed.

3.04 Perform the test as follows:

(1) Observe that only the MC lamp is lighted.

(2) Depress line key, lift handset, and depress DL key.

Requirement: TM lamp lights.

(4) Depress red DATA key.

Requirement: MR lamp and associated line key lamp light.

(5) Release DL key.

C. Transfer From Data to Talk Mode

3.05 This test checks the ability of the data set to transfer from the data mode to the talk mode.

3.06 Perform the test as follows:

(1) Observe that only the MC lamp is lighted.

(2) Enter the data mode by lifting the handset, depressing the DL key, and depressing the associated line key and then the red DATA key. Hang up the handset.

Requirement: TM and MR lamps and associated line key lamp light.

Note: Timing is important. The next step must be performed before 14 seconds have expired or the data set will automatically drop the call.

(4) Lift handset and depress the associated line key.

Requirement: MR lamp and associated line key lamp go off.

(5) Release DL key. Connect the CPE.

4. MAINTENANCE TESTS

4.01 The procedure given in Fig. 6 should be used as an aid in sectionalizing trouble. This information, usually provided to the DTC, is included here for use by those locations where the trouble is reported to and investigated by the local repair force.

4.02 When dispatched to customer location to investigate a trouble report, proceed as follows.

(1) Upon arrival at the customer location, the telco employee should make a quick visual inspection of the data set. Verify that power is applied. Check also for other possible causes of trouble, such as cable and connector defects.

(2) If this initial check does not reveal a trouble condition, proceed as indicated in Fig. 7.

5. SUPPLEMENTARY TESTS

5.01 These tests can be used as an aid in isolating a trouble condition.

A. End-to-End Self Test

5.02 The performance of the data channel is quickly tested by the end-to-end self test. This test simultaneously checks the transmitter and receiver of both data sets and the two directions of transmission of the connecting facility. The customer interface circuits are not tested by the end-to-end self test. Follow the procedure specified in paragraph 2.09 to perform an end-to-end self test. If the data sets pass the local self test and the digital loopback test, but fail the end-to-end test, the probable cause is either excessive channel loss or noise.

B. Customer Interface Loopback

5.03 A loopback can be affected by replacing the customer interface connector with the test mode connector (TM 840128748). When the test mode connector is installed, the following occurs:

(1) Transmit data in looped back via receive data.

(2) Data terminal ready (CD) lead is turned ***on.***

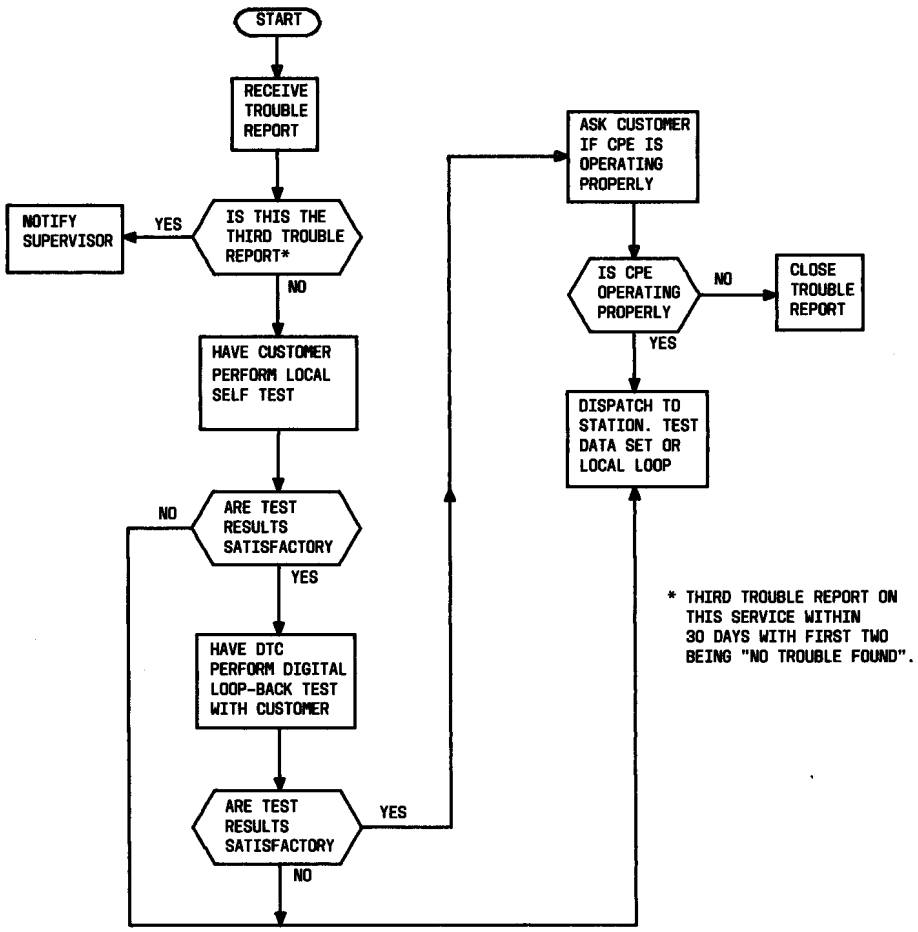


Fig. 6—Maintenance Test Sequence—DS 113CR

(3) The CN lead is turned ***off*** so that the data set is not made busy.

5.04 The advantages of the customer loopback test over the digital loopback test are as follows:

- The EIA interface circuits function normally. They are not clamped as in the digital loopback mode.
- The BA, CD, and CN terminating circuits, including the connections to the EIA connector, are checked.
- The BB driving circuit, including the connection to the EIA connector, is checked.

5.05 If the data set passes the digital loopback test and fails the customer loopback test, the probable cause is a defective data set EIA interface connector.

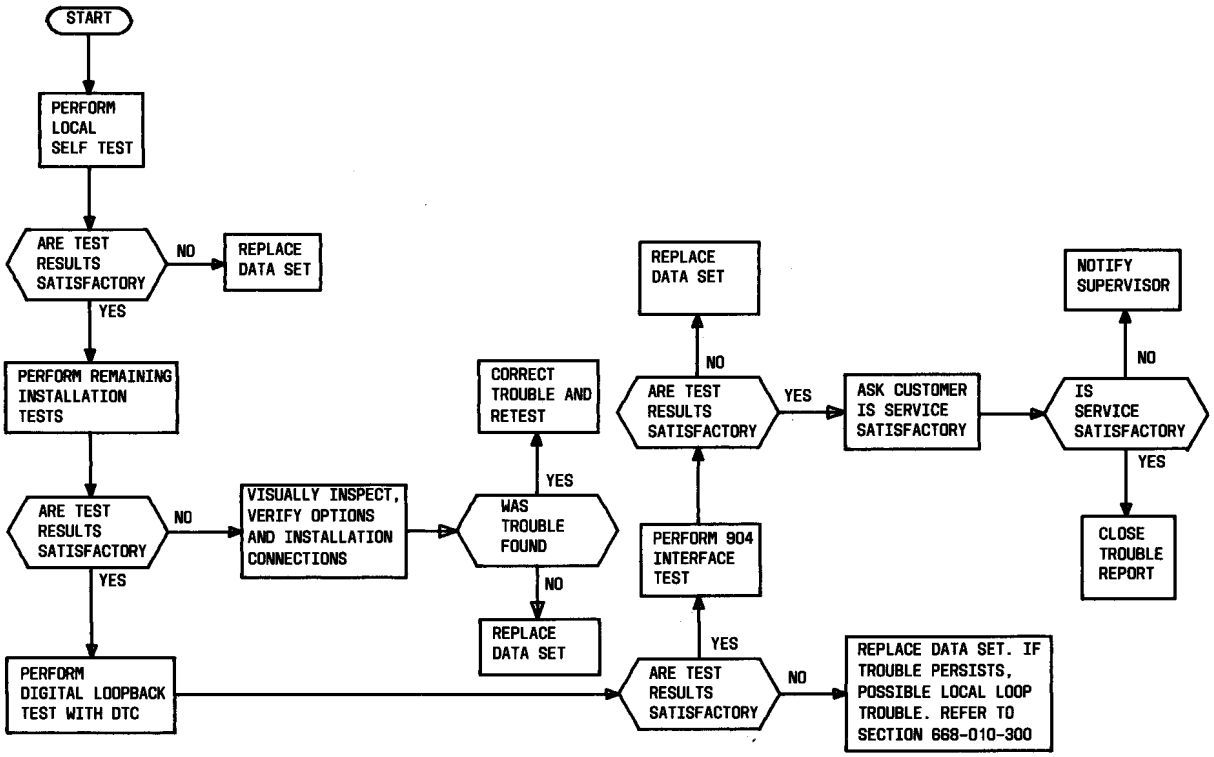


Fig. 7—Station Test Sequence—DS 113CR