DATA SET 201CR-L1C
TRANSMITTER-RECEIVER
SINGLE SET
TEST PROCEDURES USING 921A DATA TEST SET

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1. GENERAL

1.01 This section contains test procedures using the 921A data test set (DTS) and the self-test capabilities of data set (DS) 201CR-L1C. Test procedures using the 914-type DTS and the self-test capabilities of DS 201CR-L1C are contained in Section 592-036-500. These procedures are to be used when testing DS 201CR-L1C on an initial installation or during a maintenance visit.

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

Test Capabilities

1.03 Test circuitry built into DS 201CR-L1C permits the following self tests to be performed: analog loopback, end-to-end, and receiver margin. The test circuitry also facilitates the remote test of the data set from a test center. Additional tests require the use of external test equipment such as the 921A DTS.

1.04 The 921A DTS (Fig. 1) is a portable, general purpose data test set that provides the serial testing capabilities of the 914C DTS and is compatible with the 914C DTS for the testing of serial data sets. The 921A DTS also provides additional testing capabilities that are described in Section 107-402-100. Input to the 921A DTS is made through a 20-button keyboard. A 32-character display provides operator prompting and test results.

2. INSTALLATION TESTS

2.01 This part provides the sequence in which tests are to be performed following installation of the data set. This test sequence provides a

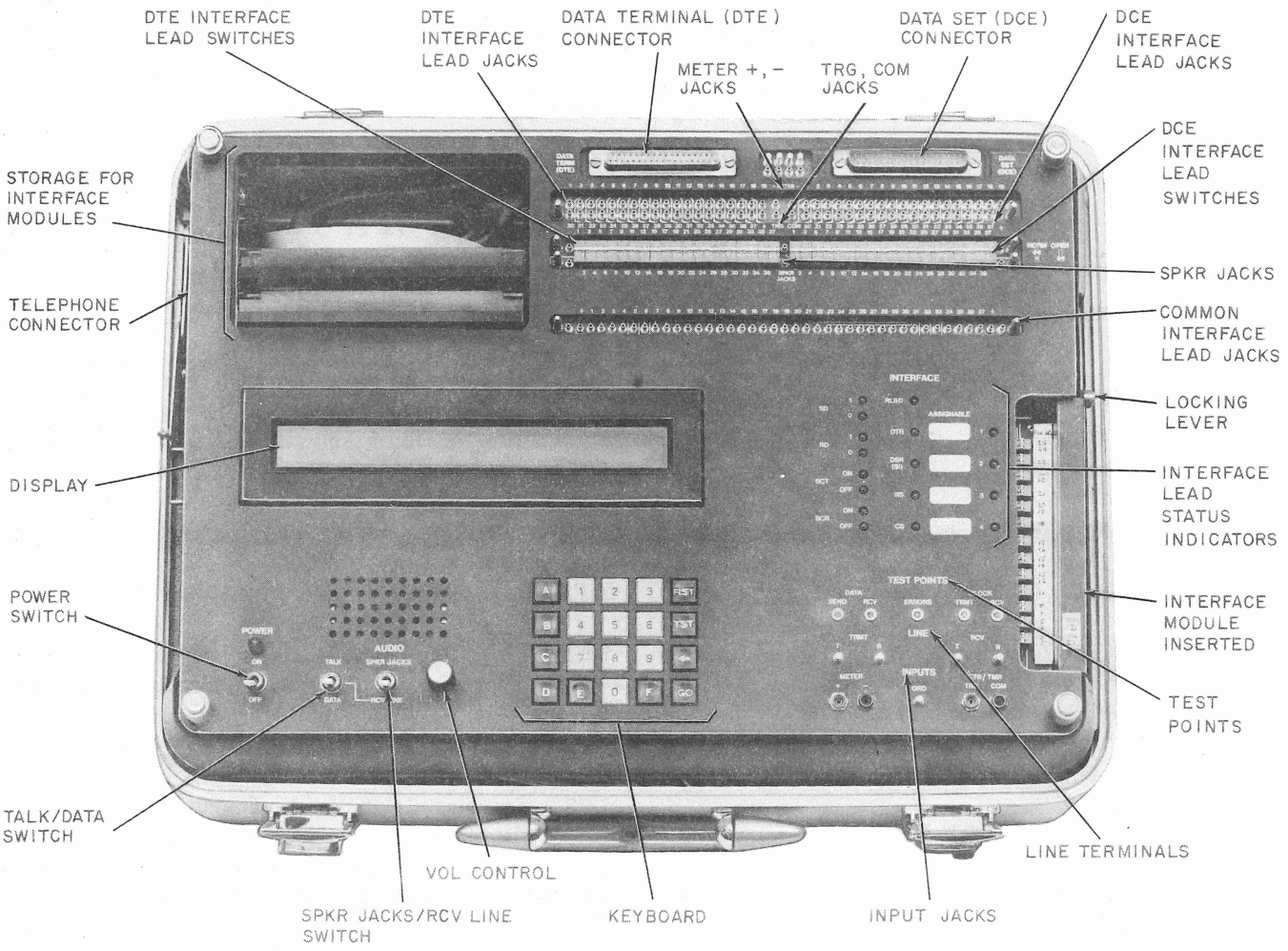

Fig. 1—921A Data Test Set—Front Panel

method of verifying that the installation is satisfactory. The self-test features of the data set are used for all installation testing—external test equipment is not required.

2.02 Before proceeding with the tests, verify that the local loop meets the requirements specified in Section 314-205-501. Refer to Fig. 2 for the installation test sequence.

3. MAINTENANCE TESTS

3.01 This part provides the sequence in which tests are to be performed when clearing a trouble report and during a maintenance visit to the data station.

3.02 When a trouble report is received, a test center is responsible for isolating the trouble to the data station or the transmission facility. The procedure for doing this is shown in Fig. 3.

3.03 If the trouble seems to be in the data station equipment, a telephone company (telco) employee must be dispatched to conduct more extensive tests at the data station. The following equipment should be taken on a trouble visit:

- Spare data set
- 921A DTS

3.04 Refer to Fig. 4 for the sequence in which tests are to be performed by the telco employee at the data station. If the data set is

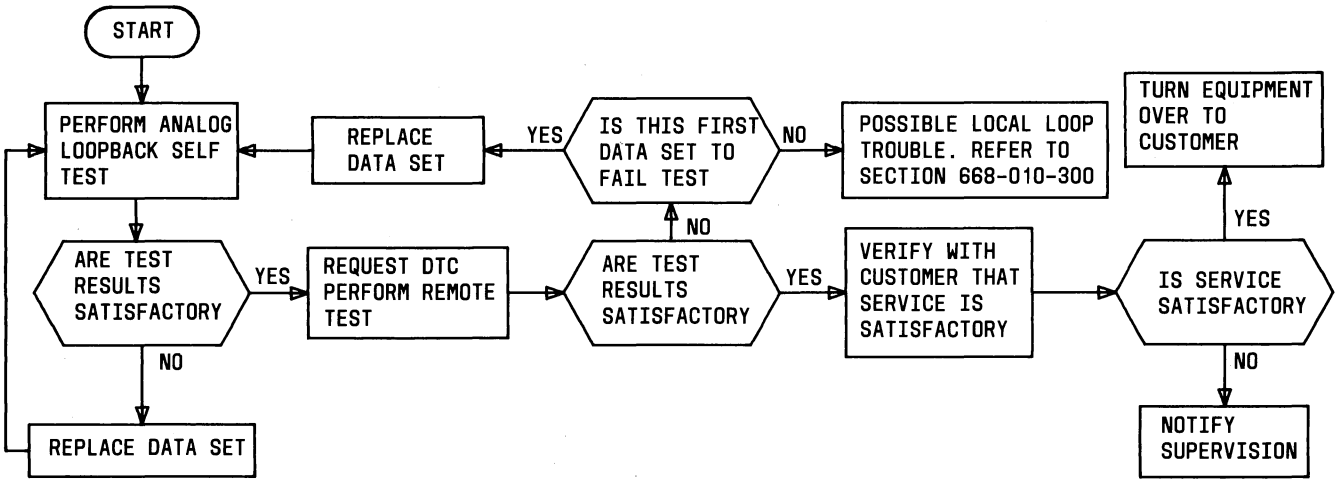

Fig. 2—Installation Test Sequence

replaced, the defective data set should be tagged with a description of the trouble, carefully packed, and returned to the service center for repair. Verify that the replacement data set is equipped with the proper options before placing the data set in service.

3.05 If the trouble persists after the tests have been completed, proceed as follows:

(a) Check that options installed in data set agree with those specified on service order.

(b) Verify that customer-provided equipment (CPE) has been tested and is operating properly.

(c) Check for physical damage to data station equipment.

(d) Verify that all cords and connectors are properly connected.

(e) Check for intermittent trouble in station wiring.

(f) Verify that data set and CPE are connected to a common ground.

(g) If trouble persists, request help from immediate supervisor.

4. TEST PROCEDURES

4.01 This part provides the procedures for the installation and maintenance tests.

A. Analog Loopback Self Test

4.02 This test checks the data set transmitter and receiver. The customer interface is not checked. Test data generated by the data set is looped back internally from the transmitter output to the receiver input. The received data is compared to the original data. Data errors and data set condition are indicated by the data set status lamps. The DL switch can be used to force a loss of synchronization to verify that the data set will recognize a data set failure condition.

4.03 Perform the test as follows:

(1) Ensure that data set is not transmitting or receiving data.

(2) Depress AL and ST switches on data set.

(3) Observe data set status lamps for at least 30 seconds.

Requirement: MC lamp is off continuously. All other lamps are lighted.

(4) Depress RO switch on data set.

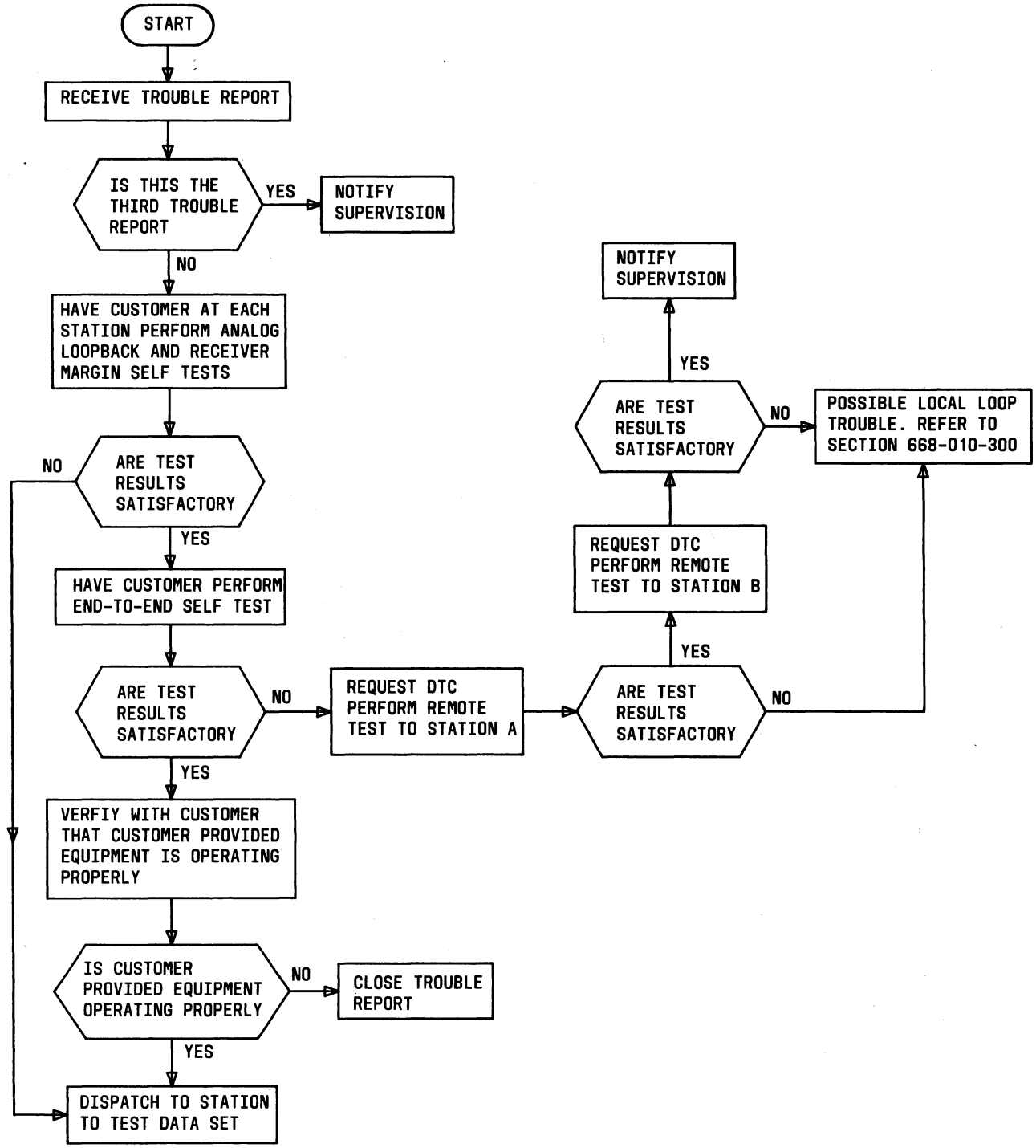

Fig. 3—Clearing Trouble Report

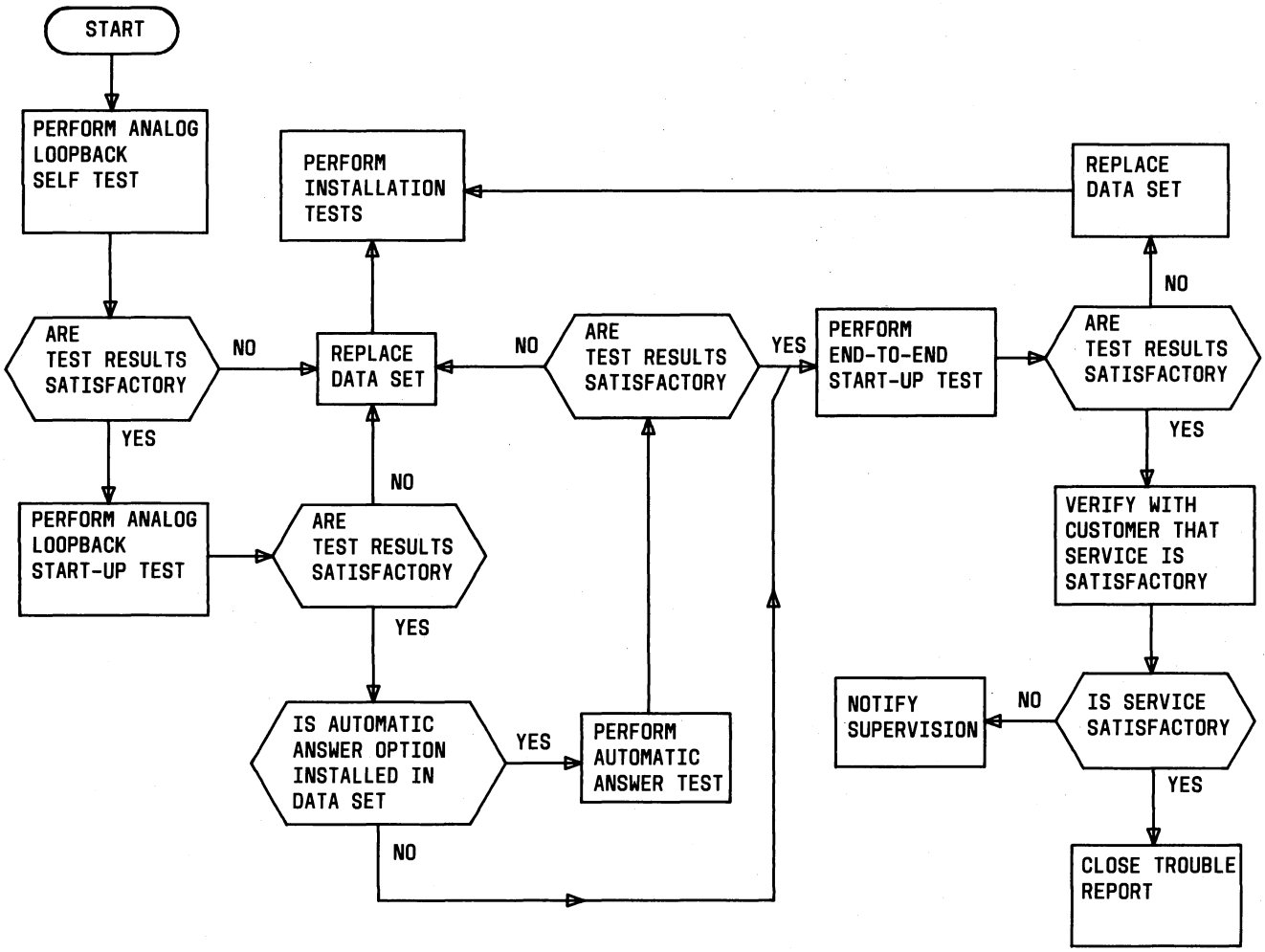

Fig. 4—Maintenance Test Sequence

Requirement: RS, CS, and CO lamps go off. MC lamp lights.

(5) Release RO switch.

Requirement: All lamps are lighted except MC.

(6) Depress DL switch on data set.

Requirement: MC lamp blinks. All other lamps are lighted.

(7) Release DL, AL, and ST switches.

Requirement: ON and MC lamps are lighted. All other lamps are off.

B. End-To-End Self Test

4.04 This test checks the receiver and transmitter of a local and a distant data set and the facilities connecting the data sets. The customer interfaces are not checked. Since the data sets operate half-duplex, the transmitters and receivers are tested separately. This test requires that the local DS 201CR-L1C be connected to a distant DS 201C-type through a telephone channel and that both data sets be in the data mode. The distant data set may be a 201CR-L1C, 201C-L1C, or 201C-L1. If the distant data set is a 201CR-L1C or 201C-L1C, the DL switch on the distant data set can be used to inject errors into the data stream to verify proper operation of the test.

4.05 Perform the test as follows:

(1) Establish voice communication between the data stations and arrange to conduct an end-to-end self test.

(2) Ensure that neither data set is transmitting or receiving data.

(3) On transmitting data set, depress ST switch.

(4) On receiving data set, depress ST and RO switches.

(5) Place both data sets in data mode.

Requirement: On transmitting data set, all lamps are lighted except CO.

Requirement: On receiving data set, all lamps are lighted except RS, CS, and MC.

(6) On transmitting data set, depess DL switch.

Requirement: On receiving data set, MC lamp blinks.

(7) On transmitting data set, release DL switch.

(8) On receiving data set, observe MC lamp for ten 1-minute periods.

Requirement: MC lamp does not blink more than an average of two blinks per 1-minute period.

(9) Perform end-to-end test in opposite direction by releasing RO switch on original receiving data set and depressing RO switch on original transmitting data set.

(10) Repeat (6) through (8).

(11) On both data sets, release test switches.

Requirement: On both data sets, TM lamp goes off.

C. Receiver Margin Self Test

4.06 In this test, the data set is in the analog loopback mode, but the receiver compromise equalizer is bypassed and the distortion threshold at which the MC indicator will light is reduced. The MC indicator acts not only as an indicator of errors in the locally looped data stream, but also blinks on for 50 ms whenever the peak signal distortion measured by the demodulator exceeds the "half-way" point to the receiver decision threshold. The DL switch can be used to force an out-of-sync condition and cause the MC indicator to blink.

4.07 Perform the test as follows:

(1) Ensure that data set is not transmitting or receiving data.

(2) Depress AL and RT switches on data set.

(3) Observe data set status lamps for at least 30 seconds.

Requirement: MC and MR lamps are off. All other lamps are lighted.

(4) Depress DL switch on data set.

Requirement: MC lamp blinks.

(5) Release DL switch.

Requirement: MC lamp goes off.

(6) Release AL and RT switches.

Requirement: ON and MC lamps are lighted. All other lamps are off.

D. Remote Test

4.08 This test allows a data test center (DTC) to check the data set transmitter and receiver and the facilities connecting the data set and the data test center. The customer interface is not checked.

4.09 Perform the test as follows:

(1) Contact DTC and request a remote test.

(2) When directed by DTC, depress RT switch on data set.

(3) DTC performs remote test. If requested by DTC, depress DL switch on data set to inject errors into data stream.

(4) When directed by DTC, release test switches.

E. Initial Test Setup for 921A DTS

4.10 Perform the initial test setup for the 921A DTS when used to test DS 201CR-L1C as follows:

STEP	ACTION	VERIFICATION
1	Connect data set to DTS using interface cable and Electronic Industries Association (EIA) adapter cord provided with DTS. ***Note:*** The interface cable is equipped with two 37-pin connectors. The 6-inch adapter cord is equipped with a 37-pin female connector and a 25-pin male connector. Connect interface cable from DATA SET (DCE) connector on DTS to 37-pin connector on adapter cord. Insert 25-pin connector on adapter cord into customer interface connector on data set.	
2	Connect DTS to a 105- to 129-Vac 60-Hz power source.	
3	Apply power to data set.	Data set ON lamp lights.
4	On front of DTS, set POWER switch to ON.	POWER lamp lights.
5	Press RST on keyboard. ***Note:*** If RST is pressed during a test, the test is ended and the DTS recycles to this step.	Display reads (briefly) version number of DTS. DTS then performs self tests. If DTS is defective, display reads— TEST FAILED If DTS is satisfactory, display reads— DATA SET:
6	Remove EIA RS-232-C interface module from storage and ensure that all 25 interface module switches are in TERM position.	
7	On right side of DTS, ensure that locking lever is in OPEN position.	
8	Insert interface module into slot.	
9	Move locking lever to CLOSE position.	
10	On front of DTS, ensure that all 37 DCE interface lead switches are in NORM position.	
11	Enter 62 on keyboard. ***Note:*** To delete a wrong entry on keyboard during any test, press back arrow (←).	Display reads— DATA SET: 62

STEP	ACTION	VERIFICATION
12	Press GO.	Display reads— BIT RATE:
13	Enter 24.	Display reads— BIT RATE: 24
14	Press GO. ***Note:*** If GO or TST is pressed at an unauthorized point in a test, the test is ended and the DTS recycles to this step.	Display reads— TEST SEQ:

F. Analog Loopback Test

4.11 In this test, an analog loopback block error run is performed. The block error run checks the data set transmitter and receiver and the customer interface. Test data is generated by the 921A DTS and looped back internally from the data set transmitter output to the receiver input. The received data is compared to the original data by the DTS. Data errors are indicated by the DTS display.

4.12 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	On data set, depress AL switch.	TM lamp lights.
3	On DTS, enter 55.	Display reads— TEST SEQ: 55
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
6	Enter 2.	Display reads— ????? BITS IN A BLOCK
7	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
8	Enter 0300. ***Note:*** To perform functions listed below, press associated key.	

STEP	ACTION	VERIFICATION
	KEY FUNCTION A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-sync condition.	Display reads (briefly)— 0300 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE, total sync losses, total blocks received, and total blocks in error. ***Requirement:*** No blocks in error.
9	On data set, release AL switch.	TM lamp goes off.

G. CA-CB (RS-CS) Interval Test

4.13 This test measures the interval between the time the request-to-send (CA) lead is turned ***on*** and the clear-to-send (CB) lead turns ***on.***

4.14 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	On data set, depress AL switch.	TM lamp lights.
3	On DTS, enter 30.	Display reads— TEST SEQ: 30
4	Press GO. ***Note:*** To repeat test, press A.	Display reads RS-CS (CA-CB) interval in milliseconds. ***Requirement:*** 138 to 158 ms
5	On data set, release AL switch.	TM lamp goes off.

H. Transmitter Clock Test

4.15 This test measures the frequency of the transmitter clock signal, DB (SCT), on the transmitter signal element timing lead.

4.16 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:

STEP	ACTION	VERIFICATION
2	Enter 47 48 17 47.	Display reads— TEST SEQ: 47 48 17 47
3	Press GO.	Display reads (briefly)— TEST COMPLETE Display then reads— SW CONN: X=?? Y=??
4	Enter 04 03.	Display reads (briefly)— SW CONN: X=04 Y=03 Display then reads— SW CONN: X=?? Y=??
5	Press GO.	Display reads (briefly)— TEST INTERRUPTED For Version 2 and higher DTS: Display then reads (briefly)— CROSS CONNECTIONS MANUALLY SET Display then reads transmitter clock frequency in hertz. ***Requirement:*** 2399 to 2401 Hz.
6	Press GO.	Display reads (briefly)— TEST INTERRUPTED For Version 2 and higher DTS: Display then reads (briefly)— CROSS CONNECTIONS MANUALLY SET Display then reads (briefly)— TEST COMPLETE Display then reads— TEST SEQ:

I. Transmitter Output Test

4.17 This test uses the 921A DTS to make an audio check of the transmitted signal. Since the output termination is the actual telephone line impedance, an accurate measurement of the output level is difficult to obtain.

4.18 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	If option YE is installed in data set, set DCE interface lead switch 21 to OPEN and connect	

STEP	ACTION	VERIFICATION
	a jumper wire between DCE interface lead jacks 9 and 21.	
3	Connect data set to DTS using telephone interface cable and adapter cord provided with DTS. ***Note:*** The telephone interface cable is equipped with two 9-pin connectors. The 6-inch adapter cord is equipped with a 9-pin connector and a double-faced, 25-pin connector. Connect interface cable from 9-pin telephone connector on left side of DTS to 9-pin connector on adapter cord. Insert double-faced, 25-pin connector on adapter cord between telephone line connector on data set and telephone line cord.	
4	On front of DTS: (a) Connect meter leads from LINE—TRMT terminals T and R to INPUTS—METER jacks + and -. (b) Connect jumper wires from SPKR JACKS to METER jacks + and - located above SPKR JACKS. (c) Set TALK/DATA switch to DATA. (d) Set SPKR JACKS/RCV LINE switch to SPKR JACKS.	
5	Enter 53.	Display reads— TEST SEQ: 53
6	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
7	Enter 1.	Display reads— MARKING BIT ERROR TEST
8	Place a call to data set from any convenient telephone set. ***Note:*** VOL control adjusts speaker volume.	***Requirement:*** Ringing is heard on DTS speaker followed by answer tone sequence (1 second of silence, 2 seconds of 2021-Hz answer tone, and then continuous line signal from data set).

STEP	ACTION	VERIFICATION
9	Disconnect meter leads, jumper wires, telephone interface cable, and adapter cord.	

J. End-to-End Block Error Test

4.19 This test checks the transmitter and receiver of a local and a distant data set and the facilities connecting the data sets. The customer interfaces are also checked. Identical test data is generated by 921A DTSs at both data sets. This data is transmitted by one of the data sets and compared to the data generated by the DTS at the receiving data set. Data errors are indicated by the DTS display.

4.20 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end block error test. ***Note 1:*** If distant station is not equipped with a 921A DTS, use a test set that provides at least one of the test patterns provided by the 921A DTS and use the same word length at both stations. ***Note 2:*** Procedure at transmitting station must be performed first.	
At transmitting station, perform Steps 2 through 6.		
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	Enter 53.	Display reads— TEST SEQ: 53
4	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
5	Enter 5.	Display reads— 511 BIT ERROR TEST
6	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— 511 BIT ERROR TEST

STEP	ACTION	VERIFICATION
	At receiving station, perform Steps 7 through 15.	
7	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
8	Enter 54.	Display reads— TEST SEQ: 54
9	Press GO.	Display reads (briefly)— SELECT ERROR TEST Display then reads— D=DT 0=SP 1=MK 2=2047 5=511 6=63
10	Enter 5.	Display reads (briefly)— 511 BIT ERROR TEST Display then reads— 1=BIT ERRORS 2=BLOCK ERRORS
11	Enter 2.	Display reads— ????? BITS IN A BLOCK
12	Enter 01024.	Display reads (briefly)— 01024 BITS IN A BLOCK Display then reads— ???? SECONDS
13	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— ???? SECONDS
14	Enter 0900. ***Note:*** To perform functions listed below, press associated key. Keys A through D function at receiving station only. Keys E and F function at transmitting station only. **KEY FUNCTION** A Repeat test. B Display time remaining in test. C Clear display. D End test. E Inject 8 errors into data stream. F Force out-of-snyc condition.	Display reads (briefly)— 0900 SECONDS Display then reads— BLK RCVD=0000 ERR=0000 From this point, display counts number of blocks received and number of blocks in error. If sync is lost during test, display flashes OSYN. If this occurs, test must be repeated by pressing A. At end of test, display reads TEST COMPLETE,

STEP	ACTION	VERIFICATION
		total sync losses, total blocks received, and total blocks in error. ***Requirement:*** Total blocks in error are less than 23.
15	If requirement in Step 14 is not met, press A to repeat test one time.	
16	Perform the end-to-end block error test in the opposite direction. The receiving station now becomes the transmitting station.	

K. Automatic Answer Test

4.21 This test verifies that the data set will automatically answer a call, go to the data mode, and end the call.

4.22 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	If option YE is installed in data set, set DTS DCE interface lead switch 21 to OPEN and connect a jumper wire between DCE interface lead jacks 9 and 21.	
3	On DTS, enter 40.	Display reads— TEST SEQ: 40
4	Press GO.	Display reads— WAITING FOR RI
5	Place a call to data set from any convenient telephone set.	Display reads— RINGING (during ringing period—ring indicator lead ***on***). ASSIGNABLE 1 indicator follows ring indicator lead. After 3 complete ringing cycles, DTR indicator lights (data terminal ready lead ***on***). After several seconds, DSR indicator lights (data set ready lead ***on***). Display then reads— ANSWERED After several more seconds, DTR indicator goes off (data terminal ready lead ***off***). Then DSR indicator immediately goes off (data set ready lead ***off***).

STEP	ACTION	VERIFICATION
		Requirement: Display reads (briefly)—TEST PASSED

L. Analog Loopback Start-Up Test

4.23 This test checks the ability of the data set to begin error-free transmission.

4.24 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
2	On data set, depress AL switch.	TM lamp lights.
3	On DTS, enter 67.	Display reads— TEST SEQ: 67
4	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
5	Enter 2.	Display reads— TRMT: 1=MAN 2=TIMED 3=SW CARR
6	Enter 2.	Display reads— PRESS A TO START
7	Press A. ***Note 1:*** When A is presssed, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays. ***Note 2:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Restart test. C Clear display. D Stop test.	Display reads— BLK RCVD=0000 ERR=0000 *=0000 From this point, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block.
8	At end of about 1 minute, press D.	***Requirement:*** Zero count on ERR and * displays.
9	On data set, release AL switch.	TM lamp goes off.

M. End-to-End Start-Up Test

4.25 This test checks the ability of both data sets to begin error-free transmission. In this test, one end is arbitrarily selected as the controlling station. This station has operating control of the test.

4.26 Perform the test as follows:

STEP	ACTION	VERIFICATION
1	Establish voice communication between the data stations and arrange to conduct an end-to-end start-up test. ***Note:*** Procedure at controlled station must be performed first.	
At controlled station, perform Steps 2 through 7.		
2	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:
3	Enter 68.	Display reads— TEST SEQ: 68
4	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
5	Enter 2.	Display reads— PRESS A TO START
6	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
7	Press A. ***Note:*** When A is pressed in Step 14, a count may appear on BLK RCVD, ERR, and/or * display. If this occurs, press C to clear displays.	Display reads— BLK RCVD=0000 ERR=0000 *=0000 After A is pressed at controlling station, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block. All displays stop counting when D is pressed at controlling station. ***Requirements:*** Count of less than 2 on ERR display and zero count on * display.
At controlling station, perform Steps 8 through 15.		
8	Ensure that initial test setup described in paragraph 4.10 has been performed.	Display reads— TEST SEQ:

STEP	ACTION	VERIFICATION
9	Enter 67.	Display reads— TEST SEQ: 67
10	Press GO.	Display reads— 1=ONE WAY 2=IR SW 3=IR CONT
11	Enter 2.	Display reads— TMRT: 1=MAN 2=TIMED 3=SW CARR
12	Enter 2.	Display reads— PRESS A TO START
13	Place data set in data mode.	On DTS, DSR indicator lights (data set ready lead ***on***) Display continues to read— PRESS A TO START
14	Press A. ***Note 1:*** When A is pressed, a count may appear on BLK RCVD, ERR and/or * display. If this occurs, press C to clear displays. ***Note 2:*** To perform functions listed below, press associated key. **KEY FUNCTION** A Restart test. C Clear display. D Stop test.	Display reads— BLK RCVD=0000 ERR=0000 *=0000 From this point, BLK RCVD display counts number of blocks received, ERR display counts number of received blocks in error, and * display counts number of times DTS transmitted a block but did not receive a block.
15	At end of about 1 minute, press D.	***Requirements:*** Count of less than 2 on ERR display and zero count on * display.

5. REFERENCES

5.01 Additional information concerning the testing of DS 201CR-L1C is contained in the following publications:

SECTION	TITLE
107-402-100	921A Data Test Set—Description and Operation
314-205-501	Data Systems—DATAPHONE® Service and Data Access Arrangements on Direct Distance Dialing Network—Test Requirements for Subscriber, Foreign Exchange, and Remote Exchange Lines
592-036-100	Data Set 201CR-L1C—Transmitter-Receiver—Single Set—Description and Operation

SECTION	TITLE
592-036-200	Data Set 201CR-L1C—Transmitter-Receiver—Single Set—Installation and Connections
592-036-500	Data Set 201CR-L1C—Transmitter-Receiver—Single Set—Test Procedures Using 914-Type Data Test Set
668-010-300	Data Systems—DATAPHONE® Service on Direct Distance Dialing Network—Data Test Center—Trouble Analysis Procedures

5.02 Detailed information concerning DS 201CR-L1C is contained in CD- and SD-1D288-02.