DATA SET 209A-L1
TRANSMITTER-RECEIVER
TEST PROCEDURES

CONTENTS PAGE

CONTENTS PAGE

1. GENERAL

1.01 This section contains information concerning procedures to be used when testing data set (DS) 209A-L1 on an initial installation or during a maintenance visit. Overall procedures to be followed when investigating the trouble report are outlined in Section 592-032-300. Procedures for testing DS 209A-L1 when installed in a point-to-point, point-to-point multiplexing, and digital data system subrate off-net installations are provided in this section. Also provided in this section are procedures for testing data sets 209A-L1, 208A-type, and 201C-type when installed in a 9600-bits per second (bps) multiplex system. These tests are in addition to tests normally required for installation and maintenance of the data sets.

1.02 This section is reissued to incorporate information previously contained in Section

592-032-501. Since this reissue constitutes a general revision, arrows ordinarily used to denote changes have been omitted.

1.03 This section is divided into seven parts. Part 1, GENERAL, contains general information pertaining to testing DS 209A-L1. Part 2, TEST FACILITIES AVAILABLE, describes the test capabilities of the data set. Part 3, INSTALLATION TESTS, describes the tests necessary to verify an installation. Part 4, MAINTENANCE TESTS, describes the tests to be performed during a trouble visit. Part 5, TEST PROCEDURES, describes and gives a step-by-step procedure for the various tests necessary to install and maintain data set 209A-L1. Part 6, SUPPLEMENTARY TESTS, describes the tests to be performed when normal testing has failed to isolate trouble. Part 7, REFERENCES, provides documentation information pertaining to data sets used in multiplexing systems.

1.04 The analog loop-back test and the digital loop-back test to distant end require duplex capability from the data test set (DTS). The 914C DTS provides this capability; however, if a 914B DTS must be used, a 903-type DTS is required to obtain duplex capability. A 511-bit random word is transmitted when using the 914C DTS and a 63-bit random word is transmitted when using the 914B—903 DTS combination.

1.05 The CA-CB and CG-CF interval tests require the use of a 3300-ohm resistor pin (yellow) to eliminate the effect of contact bounce caused by the 914-type DTS switches. If this pin is not available, a 3000/4000-ohm resistor can be connected from pin 9 to pin 4 on the 914-type interface selector switch panel.

1.06 The test equipment required to perform test procedures given in this section consists of a 914C DTS or a 914B DTS and a 903-type DTS.

2. TEST FACILITIES AVAILABLE

2.01 DS 209A-L1 is tested with a 914-type DTS. The analog loop-back test and end-to-end and remote loop-back tests to either a serving test center (STC) or distant data set can be performed to check for proper status of interface signals and to record data errors.

2.02 Test circuitry built into DS 209A-L1 permits the analog loop-back, end-to-end, and the remote loop-back tests without the use of external test equipment. The compromise equalizer test, which determines the optimum compromise equalizer option setting, is also performed using the data set self-test feature.

A. Self-Test Features

2.03 The self-test features of the data set make use of the pushbutton switches and status indicators located at the front of the data set. For a description of the switches and indicators, refer to Section 592-032-100. Table A depicts the test switch positions and indicators during test and normal operation. The self tests do not test the customer interface circuits.

Status Indicator Test

2.04 The lamp test (LP) switch is a nonlocking switch that, when depressed, illuminates the multiplex and data set status indicators to ensure their proper operation. The LP switch can be depressed at any time since it does not affect normal data operation.

Analog Loop-Back Self Test

2.05 The analog loop-back self-test mode is entered by depressing the analog loop (AL) and self test (ST) locking switches. Depression of the AL switch connects the data set transmitter output to its own receiver input through an attenuation network. Depressing the ST switch forces the internal request to send (CA) ***on***, transmits a steady mark on the data set internal SD lead, and enables the ER indicator to be used to indicate received errors. The analog loop-back self test does not test the telephone interface.

Digital Loop-Back Self Test to Distant End

2.06 In this test the distant-end data set is placed in the digital loop (DL) mode to act as a regenerator. The local data set is placed in the self-test mode by depressing the ST switch. This causes the local transmitter to send steady marks to the distant-end receiver, where the recovered data is looped around to its transmitter at the customer interface of the data set. The distant-end transmitter now transmits this data back to the local receiver, where the ER indicator is conditioned to indicate any errors made in transmission.

TABLE A

DATA SET 209A-L1 TEST SWITCH POSITIONS AND INDICATOR STATUS

SWITCH OR INDICATOR	NORMAL OPERATION	ANALOG LOOP-BACK SELF TEST	REMOTE LOOP-BACK FROM STC	DIGITAL LOOP-BACK† SELF-TEST TO DISTANT END	END-TO-END SELF TEST		LED INDICATOR TEST
					LOCAL	DISTANT-END DATA SET	
LP Switch							X
AL Switch		X					
ST Switch		X		X	X	X	
DL Switch			X				
ON Indicator	ON	ON	ON	ON	ON	ON	ON
MR Indicator	*Note 1*	OFF	OFF	OFF	OFF	OFF	ON
RS Indicator	*Note 2*	ON	*Note 3*	ON	ON	ON	ON
CS Indicator	*Note 4*	ON	*Note 4*	ON	ON	ON	ON
CO Indicator	*Note 5*	ON	*Note 5*	ON	ON	ON	ON
ER Indicator	*Note 6*	*Note 7*	*Note 8*	*Note 7*	*Note 7*	*Note 7*	ON
TM Indicator	OFF	ON	ON	ON	ON	ON	ON

X = Switch depressed; Blank = Switch not depressed
† = Assumes distant-end data set is in digital loop mode

Note 1: Monitors state of data-set-ready circuit.
Note 2: ON when data is being transmitted.
Note 3: ON when line signal is being transmitted by STC.
Note 4: ON after completion of CA-CB interval (7.5 or 147 ms). Stays ON for completion of data transmission.
Note 5: On when line signal is being received.
Note 6: Indicates state of adaptive equalizer. When on, equalizer is in need of retraining, or when CO is OFF.
Note 7: OFF except when errors occur.
Note 8: ON when CO indicator is off. When CO indicator is on, indicates state of adaptive equalizer. When on, equalizer is in need of retraining.

End-to-End Self Test

2.07 The end-to-end self-test mode is entered by depressing the ST switches at both data sets. This action causes both transmitters to turn on and transmit steady marks. At both receivers, test circuits enable the ER indicator to be used to indicate any errors made in transmission.

B. Tests Using External Equipment

2.08 A 914C or a 914B and a 903 DTS can be used to perform all tests given in this section that are necessary to install and maintain the data set. By using the 914-type DTS, the customer interface is tested, timing intervals are measured, certain power supply voltages are checked, and actual error runs are performed.

> ***Caution: Certain 914B DTSs are susceptible to power line transients which may cause the fuse in the 914B DTS 5-volt power supply to fail. To avoid this problem, do not unplug the data set while power is applied to the 914B. If the fuse in the 914B DTS 5-volt supply fails, the counter will count continuously and will refuse to reset.***

Analog Loop-Back Test

2.09 This test using a 914-type DTS is functionally the same as the analog loop-back self test. The 914-type DTS provides a more inclusive test of the data set customer interface circuits by transmitting test data through the data set customer interface and not utilizing the DS 209A-L1 internal word generator.

Digital Loop-Back Test

2.10 This test using a 914-type DTS is functionally the same as the digital loop-back self test. The 914-type DTS provides a more inclusive test of the data set interface circuits and the data channel. The digital loop-back mode is entered by depressing the DL switch which permits a remote terminal or an STC to test data transmission on a regenerative basis through the data set by looping around the received data to send data at the customer interface. Also connected at the customer interface are CG to CA and DD to DA leads. These circuits are disconnected at the customer interface so that the local customer-provided equipment (CPE) will not be able to monitor them.

End-to-End Test

2.11 The end-to-end test using a 914-type DTS is functionally the same as the end-to-end self test. The 914-type DTS provides a more inclusive test of both data sets and the connecting facility. One data set can be located in an STC. The end-to-end test consists of transmitting a random word and establishing an error rate at the receiving end.

3. INSTALLATION TESTS

3.01 After DS 209A-L1 has been installed, it must be tested to determine if it is operating properly. The compromise equalizer options must be installed and tested as given in Part 5F.

A. Point-to-Point, Point-to-Point Multiplexing, and Digital Data System Applications

3.02 Refer to Fig. 1 for the sequence of tests to be performed and to Part 5 for test procedures.

B. Many-Point Multiplexing Applications

3.03 When the entire multiplex system has been installed and all analog links have been tested individually, the system must be tested. A digital loop-back test must be performed on each multiplex channel to its corresponding remote data set. Coordination is required with the control STC to ensure that the remote data set is in the digital loop-back mode and none of the data sets between the remote extensions are in a test mode.

3.04 End-to-end digital loop-back testing of the complete multiplex system can be done from either end with one exception. ***A digital loop-back test (with external test equipment) cannot be performed to a DS 209A which has the slave out option installed.***

End-to-End Digital Loop-Back Testing From a DS 201C-Type Extension

3.05 If the extension data set (at the location originating the test) is a 201C-type, the self-test feature can be used to perform the digital loop-back test to the distant-end data set. (The

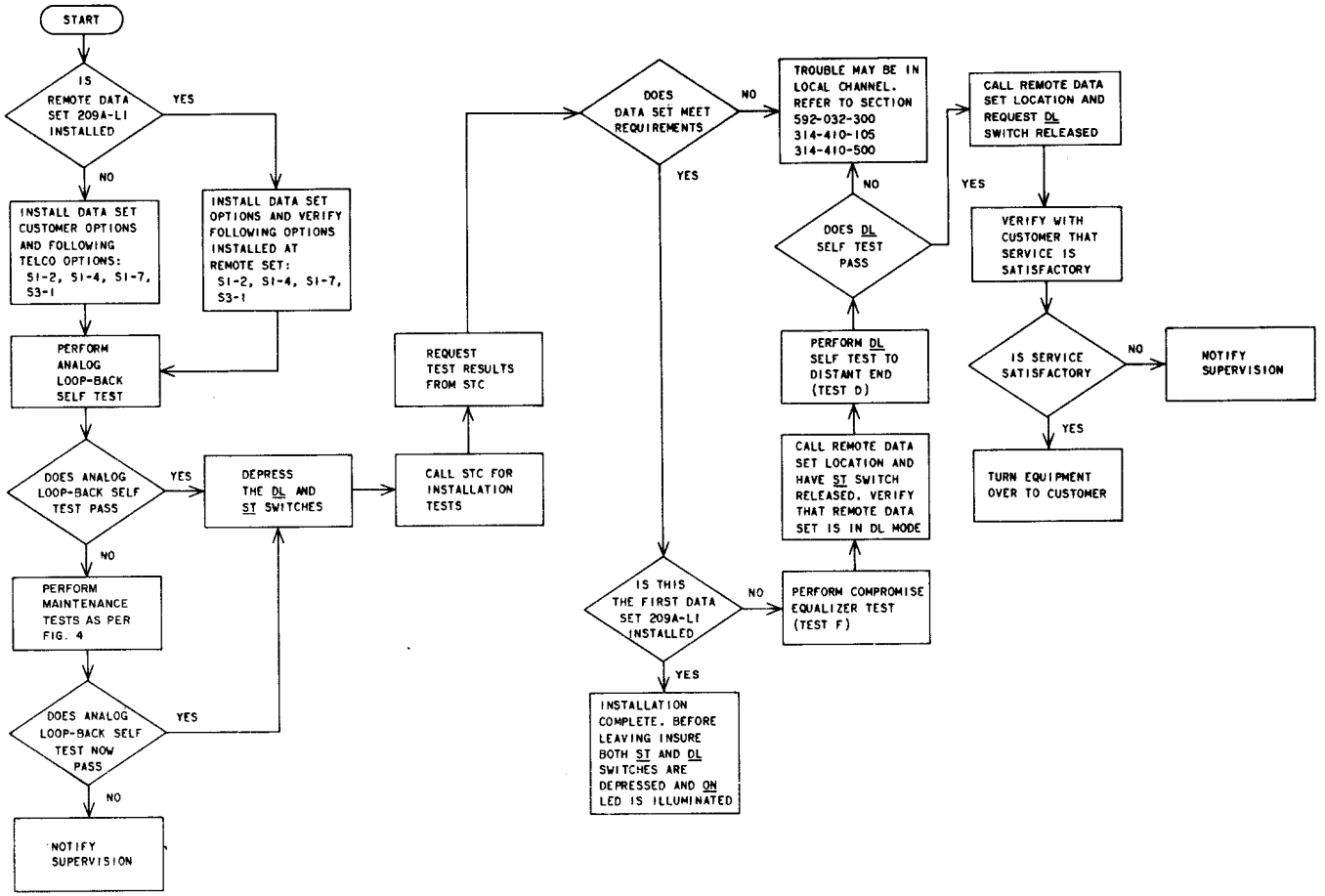


Fig. 1—Installation Testing Flowchart

M23B cord must be connected while this test is being performed.)

(1) Verify that the DL switch is depressed on the distant-end data set.

(2) Depress the ST switch on DS 201C-type. Check that the MC lamp is off and all other lamps are lighted.

(3) Observe the MC lamp for five 1-minute test periods.

Requirement: Error requirements will vary depending on system configuration. Refer to Fig. 2.

(4) If the system does not pass the test, refer to Section 592-032-300.

(5) To return the data set to normal operation, release the ST switch.

(6) Have the distant-end data set released from the digital loop-back mode.

(7) Notify the control STC of the test results.

End-to-End Digital Loop-Back Testing From a DS 209A-L1 or From a DS 208A-Type or 209A-L1 Extension

3.06 This test requires duplex testing capability from the 914-type DTS. If a 914C DTS is not available, a 914B-903 DTS combination will provide duplex capability. If an extension DS 208A-type or 209A-L1 is located at the station originating the test, the M23B cord must be connected while this test is performed. This test verifies that random data can be sent from the local transmitter to the remote receiver, looped back on the digital side to the remote transmitter, and be transmitted back to the local receiver. The received data (BB) lead at the local receiver is then checked for errors.

Note: The self-test feature available on DS 208A-L1A or 209A-L1 must not be used for this digital loop-back test.

3.07 Perform the following procedure for the end-to-end test using the 63- or 511-bit random word. This test consists of transmitting random data and establishing a block error rate. The block size is measured in approximately 1000-bit blocks.

(1) Connect the equipment and set the controls on the 914C DTS as shown in Fig. 3.

Note: This test is written to make use of a 914C DTS. If a 914C DTS is not available, connect the 903-type DTS to the 914B DTS and set the controls as shown in Fig. 3.

(2) Verify that the local data set is not in any test mode.

(3) Verify that the distant-end data set is in the digital loop-back mode and all intermediate data sets are not in any test mode.

(4) Apply power to the data set and then to the 914-type DTS.

Requirements: At the local data set if testing DS 209A-L1, the ON, RS, CS, CO, and MR indicators are lighted. The ER and TM indicators are off. At the local data set if testing DS 208A-L1, the ON, RS, CS, and CO indicators are lighted. The ER, AL, and DL indicators are off. At the local data set if testing DS 208A-L1A, the ON, CO, MR, RS, and CS indicators are lighted. The ER indicator is off. At the 914-type DTS, DS1 (CA), DS2 (CB), DS3 (CC), DS4 (CF), DS5 (QM), and DS6 (CG) are lighted. The NO CLOCK and NO DATA lamps are off.

(6) If the 903-type DTS is used, depress and release the START button.

(7) Reset the counter on the 914-type DTS by pressing the RESET switch. The counter will indicate transmission errors that occur.

(8) Verify that the error counter is functioning properly by pulling interface selector switch 3A out on the 914-type DTS.

Requirement: At the 914-type DTS, the error counter counts rapidly, and shortly thereafter the NO DATA lamp lights.

(9) At the 914-type DTS, depress the interface selector switch 3A.

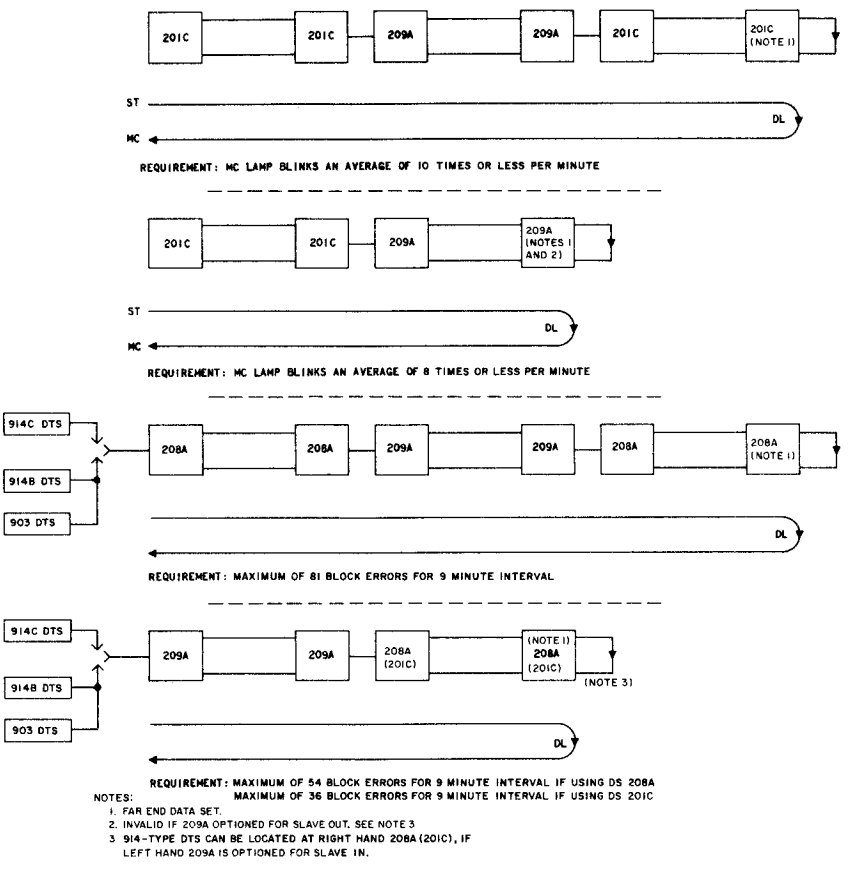


Fig. 2—Installation Test Requirements

(10) Reset the counter to zero by pressing the RESET switch. Perform a 9-minute error run and record the total number of errors.

Requirement: Error requirements will vary depending on system configuration. Refer to Fig. 2.

(11) If the system does not meet requirements, refer to Section 592-032-300.

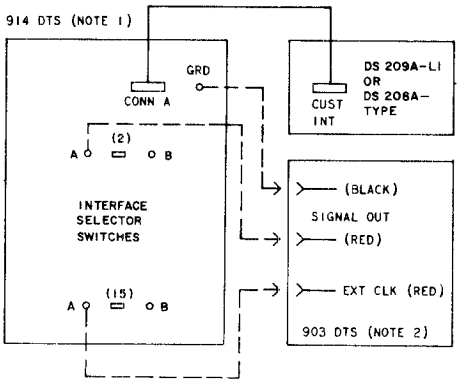
(12) Upon satisfactory completion of the test, disconnect test equipment and restore installation to normal.

(13) Have distant-end data set released from the test mode.

(14) Notify the control STC of the test results.

C. One-to-Many Multiplexing Applications

3.08 When the entire multiplex system has been installed and all analog links have been tested individually, the system must be tested end-to-end. A digital loop-back test must be performed on each multiplex channel. If the end-to-end testing is originated from the remote extension, refer to Part 3B (many-point multiplexing) for test procedures. If the end-to-end testing is originated from the



NOTES:

1. SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE MODE	VOLTAGE
TEST SET MODE	SER(914C DTS)
	RCV SER(914B DTS)
COUNTER	2WL(914C DTS)
	16WL(914B DTS)
RCV BIT RATE	EXT +
RCV WORD LENGTH	511(914C DTS)
	63(914B DTS)
TRANSMIT BIT RATE (914C)	EXT +
TRANSMIT WORD LENGTH (914C)	511
SIG LEV	±4V
SWITCH S1	ON
SWITCH S2	OFF
SAMPLE WIDTH	.5 US
INTERFACE SELECTOR SWITCHES	ALL INTERFACE SELECTOR SWITCHES MUST BE PUSHED IN(FOR 914B-903 COMBINATION 2A AND 15A MUST BE PULLED OUT).
WORD SYNC	AUTO

2. SET SWITCHES ON 903 DTS AS FOLLOWS

SWITCH	SETTING
BIT RATE	EXT CLOCK
TRIGGER	(+) POSITIVE
RANDOM DOT	RANDOM

3. 914 DTS INDICATOR LAMPS CORRESPOND TO THE FOLLOWING INTERFACE LEADS

LAMP	FUNCTION		EIA
DS1	REQUEST TO SEND	(RS)	CA
DS2	CLEAR TO SEND	(CS)	CB
DS3	DATA SET READY	(DSR)	CC
DS4	CARRIER ON	(CO)	CF
DS5	EQUALIZER MODE	(QM)	
DS6	SIGNAL QUALITY DETECTOR	(COV)	CG

4. THIS PIN IS REQUIRED ONLY IF THE DS209A-L1 IS E/W OPTION WA, WC, WE, OR WG.

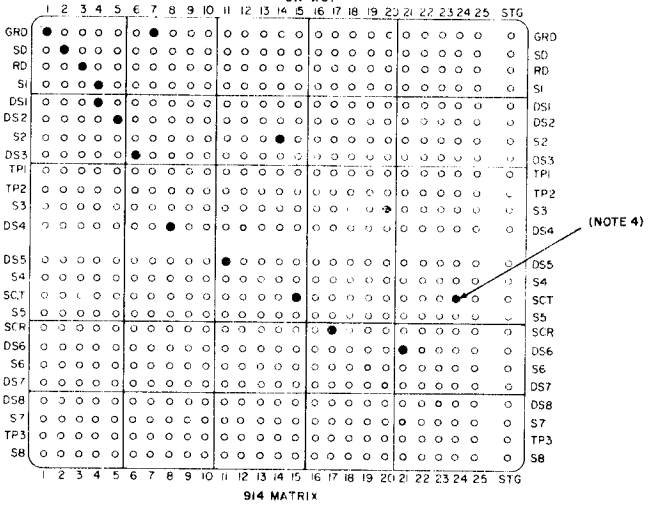


Fig. 3—Test Setup Using 914-Type DTS and 903-Type DTS

DS 209A, the test must be performed from each connector of the DS 209A to each of the remote extension data sets. Coordination is required with the control STC to ensure that the remote extension data set is in the digital loop-back mode and none of the data sets between DS 209A-L1 and the remote extensions are in a test mode. The test is conducted as directed in 3.06 and 3.07 through each interface connector being used. In order to perform this test, the local DS 209A-L1 must have the multiplex selector switch positioned the same as DS 209A-L1. Upon satisfactory completion of this test, restore the multiplex selector switch to the 9600 position.

4. MAINTENANCE TESTS

4.01 The test procedure provides a method of isolating a trouble within the data set to a circuit pack (CP) or group of CPs. It is assumed that the maintenance procedures outlined in Section 592-032-300 have been followed prior to dispatching the telephone company (telco) employee. Refer to Section 314-410-105 for information pertaining to the high-performance data conditioning which must be installed on the basic 3002-type channel used by a DS 209A-L1. If the probable cause of trouble is in the private line (PL) facilities, refer to the section entitled Private Line Data Circuits—Voice Bandwidth Circuits for Miscellaneous Data—Overall Tests and Requirements (314-410-500). If the probable cause of trouble is in data auxiliary set (DAS) 828A, refer to the section entitled Data Auxiliary Set 828A—Maintenance and Test Procedures (598-080-500).

4.02 The overall maintenance test sequence is contained in the flowchart shown in Fig. 4. The maintenance test sequence consists of five basic functional tests:

- Power Supply Test
- CA-CB Interval Test
- CG-CF Interval Test
- Analog Loop-Back Test
- End-to-End Test.

The tests are written such that the flowchart may be entered at any point without performing all preceding tests. The ground noise and start-up error tests are not included in Fig. 4 as maintenance tests. These tests should be performed as required.

4.03 When any test shown in Fig. 4 (with the exception of the power supply test) fails, the following procedure should be performed. A list of CPs used in each test is given. These CPs (in the order of appearance) should be individually replaced with the test being repeated after each CP replacement. If the test fails after a CP is replaced, in order to avoid replacing a CP which may not be defective, the original CP should be reinstalled and the next CP in the list replaced. This procedure should be repeated until all the recommended CPs have been replaced. Removal of ac power is not required while replacing CPs.

4.06 In the unusual instance when the data set is obviously malfunctioning but CP replacements do not clear up the cause of trouble, it is recommended that the problem be referred to supervision according to local instructions.

4.07 Proceed to Fig. 4 to begin the maintenance test sequence.

5. TEST PROCEDURES FOR DATA SET 209A-L1

5.01 This part describes the various test procedures and provides step-by-step procedure for performing the tests.

5.02 If a procedure requires that an option be installed in the set which is not specified on the service order or circuit layout record card, remove the option at the end of the test and verify that all the specified options are installed in the set.

A. Analog Loop-Back Self Test

5.03 The analog loop-back self test is initiated by depressing the AL and ST locking switches located on the data set front. Depression of the AL switch connects the transmitter to the receiver through an attenuation network. Depression of the ST switch turns on the data set internal request- to-send lead, transmits steady marks on the data set internal SD lead, and conditions the ER indicator to be used to indicate errors. Since steady marks were transmitted, any spaces detected by the error circuitry constitute errors. Each bit error lights the ER indicator for approximately 100 ms.

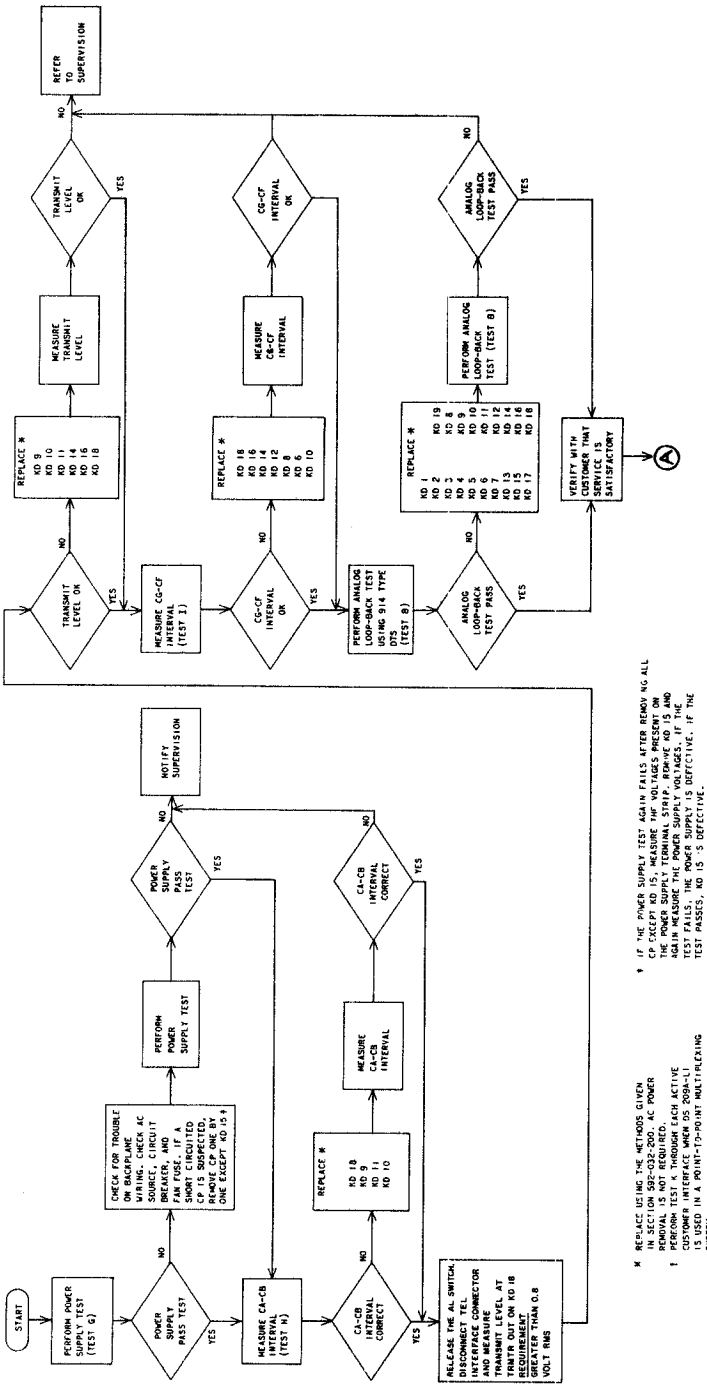


Fig. 4—Maintenance Test Sequence (Sheet 1 of 2)

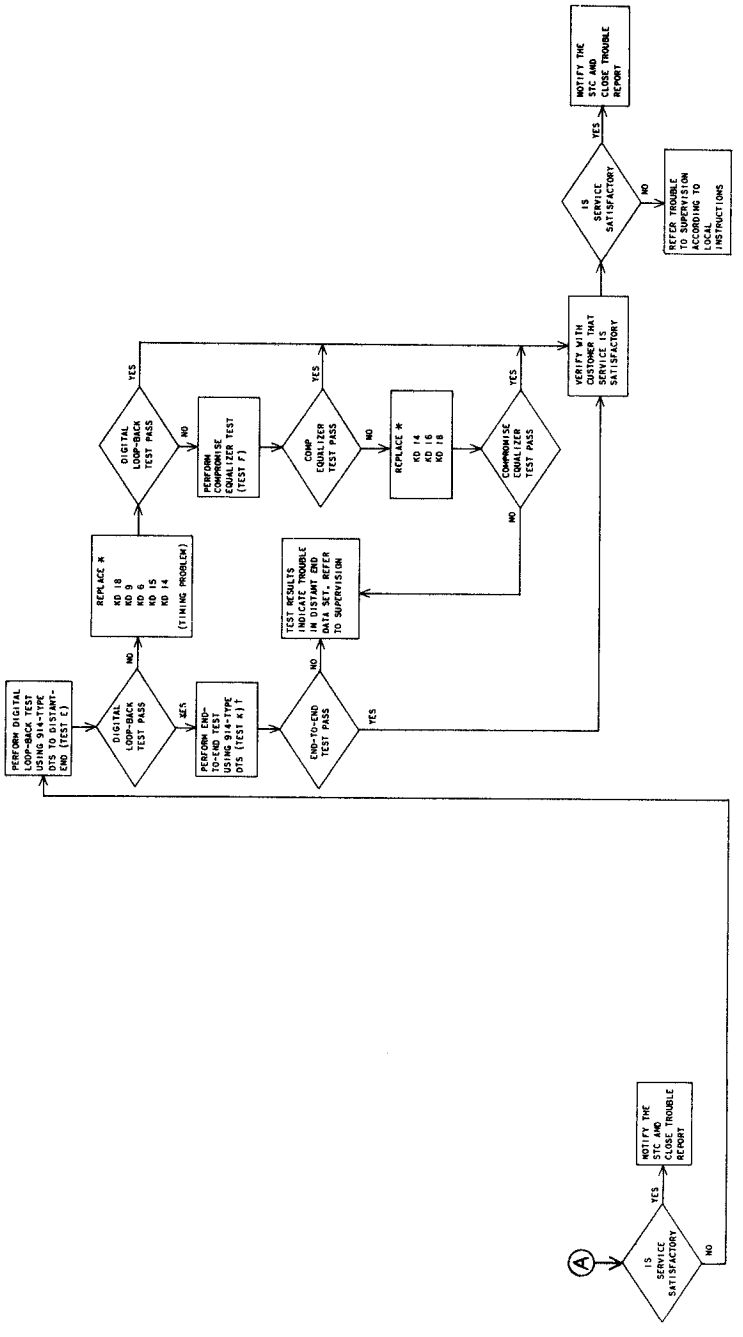


Fig. 4—Maintenance Test Sequence (Sheet 2 of 2)

5.04 Perform the following procedure for the analog loop-back self test.

(1) Apply ac power to the data set.

(2) Depress and hold the LP switch.

Requirement: All status indicators on the data set are lighted. (See Table A.)

(3) Release the LP switch and depress the AL and then the ST switch.

Requirement: After a brief retraining interval, the ON, RS, CS, CO, and TM indicators are lighted. The ER and MR indicators are off.

Note: If the indicators do not give the above indications, or if the ER indicator continues to flash, the data set has failed the analog loop-back self test.

(4) End of test. Depress, then release the ST and AL switches to restore the data set to normal operating condition.

B. Analog Loop-Back Test Using a 914-Type DTS

5.05 The analog loop-back test using a 914-type DTS is functionally the same as the analog loop-back self test. The 914-type DTS provides a more inclusive test of the data set customer interface circuits by generating test data and not utilizing the DS 209A-L1 internal word generator. This test must be performed using each active customer interface.

5.06 Perform the following procedure for the analog loop-back test using the 63- or 511-bit random word.

(1) Connect the equipment and set the controls of the 914C DTS as shown in Fig. 3.

Note: This test is written to make use of a 914C DTS. If a 914C is not available, connect the 903-type DTS to the 914B DTS and set the controls as shown in Fig. 3.

(2) Depress the data set AL switch.

(3) Apply power to the data set and then to the 914-type DTS.

(4) Operate the data set multiplex selector switch to the 9600 bps position.

Requirements: At the data set, the ON, RS, CS, CO, MR, and TM indicators are lighted. The ER indicator is off. At the 914-type DTS, DS1 (CA), DS2 (CB), DS3 (CC), DS4 (CF), DS5 (QM) and DS6 (CB) lamps are lighted. The NO CLOCK and NO DATA lamps are off.

Note: If the DSR on in AL mode option is not installed, the MR indicator and the DS3 (CC) lamp are off.

(5) If the 903-type DTS is used, depress and release the START button.

(6) Reset the counter on the 914-type DTS by pressing the RESET switch. The counter will indicate transmission errors that occur.

(7) Verify that the error counter is functioning properly by pulling interface selector switch 3A out on the 914-type DTS.

Requirement: On the 914-type DTS, the error counter counts rapidly and shortly thereafter the NO DATA lamp is lighted.

(8) On the 914-type DTS, depress the interface selector switch 3A.

(9) Reset the counter to zero by pressing the RESET switch. Perform a 1-minute error run and record the total number of errors.

Requirement: DTS counter registers 0 block errors during a 1-minute error run.

(10) If the data set under test is equipped with 4-wire switched carrier [option XF (S5-3) or XH (S5-7)], position switch S1 of the DTS to OFF.

Requirement: At the data set, the RS, CS, and CO indicators are off. At the DTS, DS1 (CA), DS2 (CB), and DS4 (CF) lamps are off.

(11) End of test. Restore the data set to normal operating condition.

C. Remote Loop-Back Test From STC

5.07 When instructed by the STC, place the data set in the digital loop-back mode by depressing the DL switch and verifying that the MR indicator is off and the TM indicator is lighted. (Refer to Table A.)

5.08 After receiving the test results from the STC, restore the data set to normal operating condition by depressing to release the DL switch and verifying that the MR indicator is lighted.

D. Digital Loop-Back Self Test to Distant End

5.09 When instructed by the STC, this test is performed from the local data set to a distant-end data set. The distant-end data set must be in the digital loop-back mode and should have been previously tested by the STC. The local data set is placed into the self-test mode by depressing the ST locking switch. This turns on the local transmitter and applies steady marks to the data set internal SD lead. The steady marks are transmitted to the distant-end receiver, where the recovered data is looped around to the transmitter on the digital side of the data set. The distant-end transmitter now transmits this data back to the local receiver, where the ER indicator is used to indicate any errors made in transmission.

5.10 Perform the following procedure:

(1) Verify that the distant-end data set is in the DL mode and the ON indicator is lighted.

(2) Apply power to the local data set.

(3) Depress the self-test (ST) locking switch.

Requirements: The ON, RS, CS, CO, and TM indicators are lighted and the MR indicator is off. Since the ER indicator responds to errors received, it should be off.

(4) Perform a 5-minute error run.

Requirement: Acceptable performance is indicated by a total of 30 or less blinks of the ER indicator.

(5) End of test. Restore both data sets (local and distant-end) to normal operating condition.

E. Digital Loop-back Test Using 914-Type DTS to Distant End

5.11 The distant-end data set must be in the digital loop-back mode and should have been previously tested by the STC. This test verifies that data can be sent from the local transmitter to the remote receiver, looped back on the digital side to the remote transmitter, and be transmitted back to the local receiver. The received data (BB) lead at the local receiver is then checked for errors. This test must be performed using each active customer interface connector.

5.12 Perform the following digital loop-back test to distant end using the 63- or 511-bit random word.

(1) Connect the equipment and set the controls of the 914C DTS as shown in Fig. 3.

Note: This test is written to make use of a 914C DTS. If a 914C is not available, connect the 903-type DTS to the 914B DTS and set the controls as shown on Fig. 3.

(2) Verify that options YJ (S3-8) and YN (S6-8) are installed.

(3) If the local data set is equipped with the slave option WI (S6-5), temporarily remove this option and install option WJ (S6-4) before performing the test.

(4) Verify that the distant-end data set is in the digital loop-back mode, with the multiplex selector switch to 9600, and that the ON indicator is lighted.

(5) Apply power to the local data set and then to the 914-type DTS.

(6) Operate the data set multiplex selector switch to the 9600 bps position.

Requirements: At the data set, the ON, RS, CS, CO, and MR indicators are lighted. The ER and TM indicators are off. At the DTS, DS1 (CA), DS2 (CB), DS3 (CC), DS4 (CF), DS5 (QM), and DS6 (CG) lamps are lighted. The NO CLOCK and NO DATA lamps are off.

(7) If the 903-type DTS is used, depress and release the START button.

(8) Reset the counter on the 914-type DTS by pressing the RESET switch. The counter will indicate transmission errors that occur.

(9) Verify that the error counter is functioning properly by pulling interface selector switch 3A out on the 914-type DTS.

Requirement: At the 914-type DTS, the error counter counts rapidly and shortly thereafter the NO DATA lamp is lighted.

(10) At the 914-type DTS, depress the interface selector switch 3A.

(11) Reset the counter to zero by pressing the RESET switch. Perform a 5-minute error run and record the total number of errors.

Requirement: Total is less than 30 block errors.

(12) End of test. Restore both data sets (local and remote) to normal operating condition.

F. Compromise Equalizer Test

5.13 This test determines the optimum setting of the compromise equalizer in the local data set. This test must be performed upon initial installation of the local data set after the remote data set has been tested previously by the STC. An analog loop-back self test should be performed prior to performing the compromise equalizer test.

5.14 A VOM or a 914-type DTS is required at the local data set. The dispatch of a telco employee to the distant-end data set location is not required; however, the distant-end data set must have the DL and ST switches depressed. In this test, an effort is made to minimize the negative test voltage at test points located on KD16 CP. The signals at these test points provide an indication of the performance by the data set. Lower magnitude voltages indicate good performance, while higher magnitude voltages represent poorer performance. If the factory-supplied options (WK, WN, WP, WS) result in a voltage indication of −1.25 volts or less, the data channel has adequate equalization for good performance. The complete compromise equalizer test need not be performed under these conditions.

5.15 Perform the following procedure:

(1) Call the STC and verify that options WK(S1-4), WN(S1-2), WP(S3-1), WS(S1-7), XG(S5-6), or XI(S5-8) are installed in the distant-end data set. (Disregard additional options not listed.)

(2) Refer to Fig. 5 and install options WN(S1-2), WK(S1-4), WS(S1-7), XG(S5-6), or XI(S5-8) in the local data set. (Disregard additional options not listed.)

(3) Verify that the distant-end data set is in the digital loop-back mode and that the ST switch is depressed.

(4) Position the multiplex selector switch of the local data set to 2400 bps. (This conditions the ***quality 2 out*** test point on KD16 of the local data set to indicate the quality of the received signal at the distant-end data set.)

(5) Apply power to the local data set.

(6) Depress the ST switch of the local data set. Ignore momentary blinking of the status indicators. The ER indicator is lighted while the ST switch on the distant-end data set is depressed.

All voltage measurements in this test are negative with respect to analog ground. Therefore, the positive (+) terminal must be connected to analog ground to obtain a positive meter indication.

(7) Measure and record the dc voltage at ***quality 1 out*** test point as shown in Fig. 5.

Requirement: 1.25 volts or less. If this requirement is met, proceed to (18).

(8) Remove option shorting jack S1-4 and reinstall at S1-5.

(9) Measure the dc voltage at ***quality 1 out*** test point as shown in Fig. 5.

(10) Install the option shorting jack (either S1-4 or S1-5) which results in the minimum negative voltage magnitude indication (VOM indicates less than 2 volts dc).

Note: Good performance of the data channel is indicated by 0.75 volts dc, while marginal performance is indicated by a test voltage greater than 2.0 volts dc.

(11) Install option WM (S1-1) in the local data set.

(12) Measure and record the dc voltage at ***quality 1 out*** test point as shown in Fig. 5.

(13) Remove option shorting jack S1-1 and reinstall at S1-3.

(14) Measure and record the dc voltage at ***quality 1 out*** test point as shown in Fig. 5.

(15) Remove option shorting jack S1-3 and reinstall at S1-2.

(16) Measure the dc voltage at ***quality 1 out*** test point as shown in Fig. 5.

(17) Install option shorting jack S1-1, S1-2, or S1-3, which results in the minimum negative voltage magnitude indication (VOM indicates less than 2 volts dc).

(18) Install option WP (S3-1) in the local data set.

(19) Disconnect the VOM negative test lead from ***quality 1 out*** test point and connect to ***quality 2 out*** test point.

(20) Measure and record the dc voltage at ***quality 2 out*** test point. (Refer to Fig. 5.)

Requirement: 1.25 volts or less. If this requirement is met, the test is concluded. Return both data sets to normal operating conditions.

(21) Remove option shorting jack S3-1 and reinstall at S3-3.

(22) Measure the dc voltage at ***quality 2 out*** test point.

(23) Install either option shorting jack S3-1 or S3-3, which results in the minimum negative voltage magnitude indication (VOM indicates less than 2 volts dc).

(24) Install option WR (S1-6) in the local data set.

(25) Measure and record the dc voltage at test point ***quality 2 out.***

(26) Remove option shorting jack S1-6 and reinstall at S1-8.

(27) Measure and record the dc voltage at ***quality 2 out*** test point.

(28) Remove option shorting jack S1-8 and reinstall at S1-7.

(29) Measure the dc voltage at ***quality 2 out*** test point.

(30) Install option shorting jack S1-6, S1-7, or S1-8, which results in the minimum negative voltage magnitude indication (VOM indicates less than 2 volts dc).

Requirements: Test voltage at both ***quality 1 out*** and ***quality 2 out*** is less than 2.0 volts dc.

Note: If requirements for the compromise equalizer are not met, a telco employee must be dispatched to the distant-end data set location. This data set must have the options specified in (1) installed in order to perform the compromise equalizer test. If the required options are not installed during the test, repeat the test with the options installed. If the options were installed during the original test or if the second test also fails, refer to the appropriate Bell System Practices for maintenance procedures concerning the facility and DS 209A-L1.

(31) End of test. Return both data sets to normal operating conditions.

G. Power Supply Test

5.16 The power supply test checks that ac voltage appears at the power supply input and then measures the +12, +5, and −12 volt supply voltages

OPTION	FEATURE	REMOVE JACK		INSTALL JACK		PROVIDE
		SWITCH	POSITION	SWITCH	POSITION	
WA	ELASTIC STORE ENABLE 1 IN	S3	4	S2	1	ONE PER STATION
WB *	ELASTIC STORE ENABLE 1 OUT	S2	1	S3	4	
WC	ELASTIC STORE ENABLE 2 IN	S3	6	S2	3	ONE PER STATION
WD *	ELASTIC STORE ENABLE 2 OUT	S2	3	S3	6	
WE	ELASTIC STORE ENABLE 3 IN	S2	4	S2	5	ONE PER STATION
WF *	ELASTIC STORE ENABLE 3 OUT	S2	5	S2	4	
WG	ELASTIC STORE ENABLE 4 IN	S2	8	S2	7	ONE PER STATION
WH	ELASTIC STORE ENABLE 4 OUT	S2	7	S2	8	
WI	SLAVE IN	S6	4	S6	5	ONE PER STATION
WJ *	SLAVE OUT	S6	5	S6	4	
WK *	COMPROMISE EQUALIZER RECEIVE SLOPE IN	S1	5	S1	4	ONE PER STATION
WL	COMPROMISE EQUALIZER RECEIVE SLOPE OUT	S1	4	S1	5	
WM	COMPROMISE EQUALIZER RECEIVE PHASE HI	S1	2 OR 3	S1	1	ONE PER STATION
WN *	COMPROMISE EQUALIZER RECEIVE PHASE OUT	S1	1 OR 3	S1	2	
WO	COMPROMISE EQUALIZER RECEIVE PHASE LO	S1	1 OR 2	S1	3	
WP *	COMPROMISE EQUALIZER TRMTR SLOPE IN	S3	3	S3	1	ONE PER STATION
WQ	COMPROMISE EQUALIZER TRMTR SLOPE OUT	S3	1	S3	3	
WR	COMPROMISE EQUALIZER TRMTR PHASE HI	S1	7 OR 8	S1	6	ONE PER STATION
WS *	COMPROMISE EQUALIZER TRMTR PHASE OUT	S1	6 OR 8	S1	7	
WT	COMPROMISE EQUALIZER TRMTR PHASE LO	S1	6 OR 7	S1	8	
XF	4W SWITCHED CARRIER (SWITCHED RS) AND AUTO RETRAIN	S5	6 OR 7 OR 8	S5	3	ONE PER STATION
XG *	4W CONTINUOUS CARRIER (SWITCHED RS) AND AUTO RETRAIN	S5	3 OR 7 OR 8	S5	6	
XH	4W SWITCHED CARRIER (SWITCHED RS) AND NO AUTO RETRAIN	S5	3 OR 6 OR 8	S5	7	
XI	4W CONTINUOUS CARRIER (CONTINUOUS RS) AND AUTO RETRAIN	S5	3 OR 6 OR 7	S5	8	
YC *	INTERNAL TIMING	S6	3	S6	2	ONE PER STATION
YD	EXTERNAL TIMING	S6	2	S6	3	
YI *	DAS 828- OR 829- TYPE USED	S3	8	S6	6	ONE PER STATION
YJ	DAS 828- OR 829- TYPE NOT USED	S6	6	S3	8	
YM	DSR ON IN ANALOG LOOP MODE	S6	8	S5	1	ONE PER STATION
YN *	DSR OFF IN ANALOG LOOP MODE	S5	1	S6	8	
YW	1-SECOND HOLDOVER OUT	S5	5	S5	4	ONE PER STATION
YX *	1-SECOND HOLDOVER IN	S5	4	S5	5	

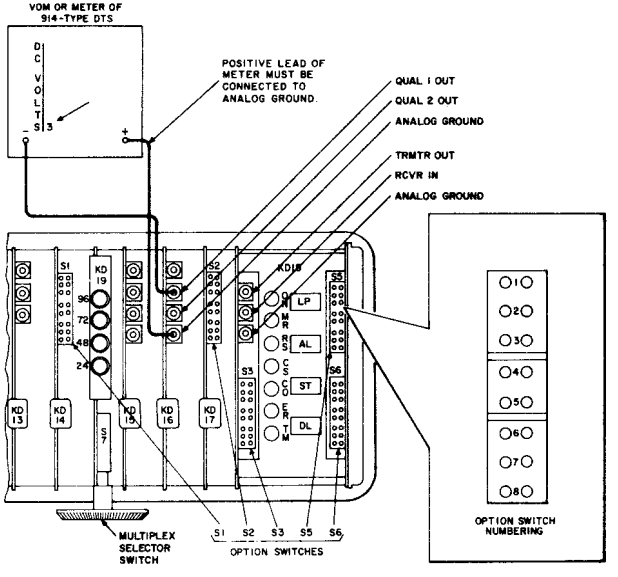


Fig. 5—Compromise Equalizer Test Setup

at the customer interface. The only test equipment required is a 914-type DTS.

5.17 Perform the following procedure:

(1) Connect the data set to the 914-type DTS. The only programming pins required in the matrix are at crosspoints GRD-1 and GRD-7.

(2) Apply power to the data set and then to 914-type DTS.

Requirement: The data set ON indicator lights.

(3) If the ON indicator fails to light or lights momentarily and goes off, check the ac source voltage with a VOM.

Requirement: 105 to 130 volts RMS.

Data set 209A-L1 is equipped with a circuit breaker which will trip under excessive current and thermal conditions. To reset the circuit breaker, operate the switch located inside the rear faceplate. The data set cooling fan is under control of the fuse which is located near the circuit breaker. A replacement fuse (AGC 1/2 ampere) is mounted at the front of the data set power unit, or one may be obtained from the maintenance kit (D-180555-L1). The data set is also provided with a self-resetting thermal overload switch which disconnects the power unit if the power unit temperature rises excessively.

(4) Position the VERTICAL MONITOR switch to 9 and the RANGE switch to 30 DCV.

(5) Position the FUNCTION switch to VOLT INT and measure the voltage on the CI9 lead (pin 9 of customer interface).

Requirement: 11.5 to 12.5 volts.

(6) Position the FUNCTION switch to OFF and the VERTICAL MONITOR switch to 25.

(7) Position the FUNCTION switch to VOLT INT and measure the voltage on the CI25 lead (pin 25 of customer interface).

Requirement: 4.5 to 5.5 volts.

(8) Position the FUNCTION switch to OFF, the VERTICAL MONITOR switch to 10, and the POLARITY switch to REV.

(9) Position the FUNCTION switch to VOLT INT and measure the voltage on the CI10 lead (pin 10 of customer interface).

Requirement: 11.5 to 12.5 volts.

(10) Position the FUNCTION switch to OFF.

(11) End of test. Remove test equipment and return to pretest conditions.

H. CA-CB Interval Test

5.18 The CA-CB interval test checks the 8-ms and 147-ms request-to-send/clear-to-send (CA-CB) intervals. Although requirements are given for the three possible options, the data set under test need not be checked for proper operation of all options. Check only the CA-CB interval provided by the option specified on the service order. This test is required ***only*** when the data set under test is optioned for switched request-to-send [XF (S5-3), XG (S5-6), or XH (S5-7)]. A 914-type DTS and the 3300-ohm (yellow) pin are required.

Note: If the associated DAS is in the facility loop-back mode, the CA-CB interval cannot be measured unless option YM is installed in the data set.

5.19 Perform the following procedure:

(1) Connect the data set to the 914-type DTS and set the controls as shown in Fig. 6.

(2) If a 914C DTS is used, position START switch to A ONLY.

(3) Apply power to the data set and then to the DTS.

(4) Depress the AL switch located on DS 209A-L1.

(5) Position the data set multiplex selector switch to 9600.

(6) On the 914-type DTS, add red pins to the programmable matrix in the following positions: 4-TP1, 5-TP2.

(7) Install option YC (S6-2) and the option specified by the service order [XF (S5-3) or XG (S5-6) or XH (S5-7)] in the data set.

(8) On the 914-type DTS, ensure that switch S1 is OFF. Zero the counter by pressing the RESET switch.

(9) Position switch S1 to ON and record the CA-CB interval on the counter.

Requirements: Option XF—130 to 160 ms
Option XG—6.0 to 9.0 ms
Option XH—130 to 160 ms.

Note: Because the COUNTER switch is set to INTERVAL X-10, the counter indicates 13 to 16 for options XF and XH. Similarly, for option XG the COUNTER switch is set to INTERVAL X.1, resulting in an indication of 60 to 90.

(10) To remeasure the CA-CB interval, position switch S1 to OFF and press the RESET switch. When S1 is moved to ON, the CA-CB interval appears on the counter.

(11) End of test. Restore data set to normal operating condition.

I. CG-CF Interval Test

5.20 In this test the interval between CG (initial detection of carrier) and CF (indication to the customer that the data set is in the proper state to receive data) will be measured. A 914-type DTS and the yellow pin (3300 ohms) are required.

5.21 Perform the following procedures:

(1) Connect the data set to the 914-type DTS and position the controls as shown in Fig. 6.

(2) Install option XF (S5-3) in the data set.

(3) Apply power to the data set and then to the 914-type DTS.

(4) Depress the AL switch located on DS 209A-L1.

(5) Position the data set multiplex selector switch to 9600.

(6) On the 914-type DTS, add red pins to the programmable matrix in the following positions: 21-TP1 and 8-TP2.

(7) Ensure that switch S1 is positioned to OFF. Zero the counter by pressing the RESET switch.

(8) If a 914C DTS is used, position the START switch to A ONLY.

(9) Position switch S1 to ON and read the CG-CF interval on the counter.

Requirement: 120 to 140 ms.

Note: Because the COUNTER switch is set to INTERVAL X10, the counter indicates 12 to 14.

(10) To remeasure the CG-CF interval, position switch S1 to OFF and reset the counter. Position switch S1 to ON and read the CG-CF interval on the counter.

(11) End of test. Restore the data set to normal operating condition.

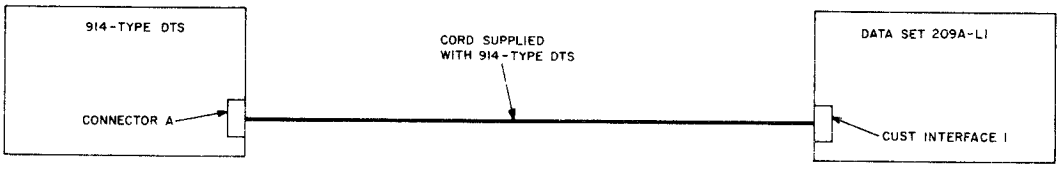
J. End-to-End Self Test

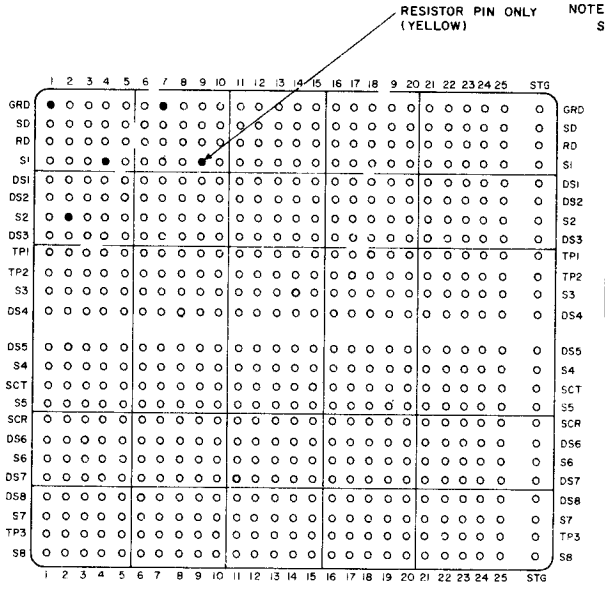
5.22 The performance of the data channel is quickly tested by the end-to-end self test. Depressing the ST switches on both data sets conditions the respective transmitters to transmit steady marks. At both receivers, test circuits enable the ER indicator to be used to indicate any errors made in transmission. This test 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.

5.23 Perform the following procedure for the end-to-end self test.

(1) Ensure that the data sets are connected to the facility and that ac power is applied.

Requirements: ON and MR indicators are lighted.





NOTE:
SET SWITCHES ON 914 DTS AS FOLLOWS:

SWITCH	SETTING
INTERFACE SELECTOR A SWITCHES	DEPRESSED
INTERFACE MODE	VOLTAGE
TEST SET MODE	INTERVAL (914C); RCV SER(914B)
COUNTER	INTERVAL X10
FUNCTION	OFF
BIT RATE	2000
TPI FIRST	+/OPEN
TP2 FIRST	+/OPEN
SI (CA)	OFF
S2 (BA)	OFF

Fig. 6—Interval Test Setup

(2) Depress the ST switches at each data set.

Requirements: ON, RS, CS, TM, and CO indicators are lighted. MR and ER indicators are off.

(3) Perform a 5-minute error run.

Requirements: Acceptable performance is indicated by a total of 30 or less blinks of the ER indicator.

(4) End of test. Restore both data sets (local and distant-end) to normal operating condition.

K. End-to-End Test Using 914-Type DTS

5.24 The end-to-end test is performed when it is necessary to identify facility troubles, or when the DS 209A-L1 experiences difficulty while multiplexing two or more Electronic Industries Association (EIA) interfaces. This test checks the transmitter and receiver of both data sets and the two directions of transmission by the connecting facility. One DS 209A-L1 can be located in an

STC. A 914-type DTS is required at both ends of the data channel. By using the 914-type DTS, the customer interface is checked and an actual error count is performed.

End-to-End Test (Duplex)

5.25 Perform the following procedure for a duplex end-to-end test using a 63- or 511-bit random word.

(1) Connect equipment at both data set locations and set the controls of the 914C DTS as shown in Fig. 3.

Note: This test is written to make use of a 914C DTS. If a 914C DTS is not available, connect a 903-type DTS to a 914B DTS as shown in Fig. 3.

(2) Apply power to the data set and then to the 914-type (903-type) DTS.

(3) Establish voice communications between the data stations and verify that neither of the data sets is in a test mode.

(4) If using a 903-type DTS, depress and release the START switch.

Requirements: At each DS 209A-L1, the ON, MR, RS, CS, and CO indicators are lighted. The ER and TM indicators are off. At each 914-type DTS, the DS1, DS2, DS3, DS4, DS5, and DS6 lamps are lighted.

The attendant at each data station must verify that NO DATA and NO CLOCK lamps are off. This indicates that a valid connection has been established between data stations. If either lamp lights during the test, the test must be restarted.

(5) At both data stations, simultaneously depress the DTS RESET and perform a 5-minute error run and record the total errors.

Requirement: Total errors are less than 30 block errors.

(6) As required, repeat the end-to-end test using each active EIA interface when operating in a multiplexing system.

(7) End of test. Restore the data set to normal operating condition. Verify that the correct options are installed in the data set before notifying the customer that service is restored.

End-to-End Test (Half-Duplex)

5.26 Perform the following procedure for a half-duplex end-to-end test using a 63- or 511-bit random word.

(1) Connect equipment at both data set locations and set the controls of the 914-type DTS as shown in Fig. 3.

Note: The 903-type DTS is not required for a half-duplex test.

(2) Apply power to the data set and then to the 914-type DTS.

(3) Establish voice communications between the data stations and verify that neither of the data sets is in a test mode.

(4) On the 914-type DTS at the transmitting end only, position the TEST SET MODE switch to TRMT SER (914B DTS) or SER (914C DTS).

(5) On the 914-type DTS at the receiving end only, position the TEST SET MODE switch to the RCV SER (914B DTS) or SER (914C DTS).

Requirements: At each DS 209A-L1, the ON, MR, RS, CS, and CO indicators are lighted. The ER and TM indicators are off. At each 914-type DTS, the DS1, DS2, DS3, DS4, DS5, and DS6 lamps are lighted.

The attendant at the receiving station should verify that NO DATA and NO CLOCK lamps are off. This indicates that a valid connection has been established between data stations. If either lamp lights during the test, the receiving station attendant must contact the transmitting station and agree to retest.

(6) At both data stations, simultaneously depress the DTS RESET and perform a 5-minute error run and record the total errors.

Requirement: Total errors are less than 30 block errors.

(7) At the end of the prearranged time interval, establish voice communication to discuss the test results and agree to repeat the end-to-end test in the opposite direction if necessary. The transmitting data station now would become the receiving data station. Repeat (4) through (6).

(8) As required, repeat the end-to-end test using each active EIA interface when operating in a multiplexing arrangement.

(9) End to test. Restore the data set to normal operating condition. Verify that the correct options are installed in the data set before notifying the customer that service is restored.

6. SUPPLEMENTARY TESTS

A. Start-Up Error Test

6.01 This test consists of switching on the request-to-send (CA) lead and recording any errors that occur immediately after the lead is switched on, and the data set turns on the clear-to-send (CB) lead. This test is applicable only when the data set under test is optioned for switched request-to-send XF (S5-3), XG (S5-6), or XH (S5-7)]. When testing a DS 209A-L1 that is installed in a point-to-point multiplexing system, perform the start-up error test using each active customer interface.

6.02 Perform the following procedure for the start-up error test:

(1) Connect the equipment and set the controls of the 914-type DTS as shown in Fig. 6.

(2) Position the 914-type DTS COUNTER switch to BIT ERRORS.

(3) Position the 914-type DTS BIT RATE switch to EXT+.

(4) Depress the data set AL switch.

(5) Apply power to the data set and then to the 914-type DTS.

(6) At the DTS, verify that S1 (CA) is OFF.

(7) Reset the DTS counter by momentarily depressing the RESET switch.

(8) Position S1 to ON.

Requirement: Zero errors are indicated by the DTS immediately after CA is switched on.

Note: Disregard any transient errors that may occur when S1 is positioned to OFF.

(9) Repeat (8) for a total of five trials.

(10) End of test. Restore the data set to normal operating condition.

B. Ground Noise Test

6.03 If the data set and CPE are not connected to the same ground, errors may be caused by a potential difference between data set ground and CPE ground. To detect the presence of noise potentials, a test should be made using the 6H impulse counter. This counter is used to count the number of impulse noise peaks during a measured time period. The counter registers only the peaks which exceed a preset level and are separated by approximately 150 ms or more.

6.04 The following test equipment is required to perform the ground noise test:

- 6H impulse counter (or equivalent)
- 914-type DTS
- 2W6A test cord for 6H impulse counter (310 plug on one end, alligator clips connected to tip and ring on the other end).

6.05 For this test, the impulse counter is connected between the grounds of the data set and the CPE. The impulse counter will register when a potential difference of a preset level has developed between the isolated grounds. The 914-type DTS is used only to gain access to the ground interface leads. If the 914-type DTS is not available, any method of gaining access to the interface is acceptable.

Note: For information pertaining to the 6H impulse counter, refer to the section entitled 6H and 6HR Impulse Counters (J94006H and J94006HR)—Description, Operation, and

Maintenance (103-620-101). If the 6H impulse counter is ***not*** available, a 6A impulse counter may be used. For information pertaining to the 6A impulse counter, refer to the section entitled J94006A (6A) Impulse Counter—Description, Operation, and Maintenance (103-620-100).

6.06 Perform the following procedure:

(1) Connect the 914-type DTS connector A to the customer connector on the data set. Connect the 914-type DTS connector B to the data set connector on the CPE. This test assumes that protective ground from the CPE appears at the customer interface.

(2) On the 914-type DTS, remove all programming pins from the matrix. Pull up all A and B interface selector switches.

(3) Connect one clip of the 2W6A cord to switch 1A and connect the other clip to switch 1B. Verify that power is applied to data set and CPE.

(4) Insert the 310 plug into the 310 MEAS jack on the 6H impulse counter.

(5) On the 6H impulse counter, set the DIAL-MEAS switch to MEAS and set the DBRN dial to 90.

(6) Reset the counter on the 6H impulse counter to 0.

(7) Set the MINUTES control to 15. After the 15-minute test has elapsed, record the number of indications by the counter.

(8) Remove clips of the 2W6A cord from 1A and 1B and connect to 7A and 7B.

(9) Reset the counter on the 6H impulse counter to 0.

(10) Set the MINUTES control to 15. After the 15-minute test has elapsed, record the number of indications by the counter.

6.07 At the end of both of the 15-minute periods, there should be no indications on the counter of the 6H impulse counter. If there is an indication on the counter, the grounds must be bonded together according to local instructions. At the end of the test, disconnect the test equipment and restore the data set to pretest condition.

7. REFERENCES

7.01 The following Bell System Practices provide information concernng the data sets used in multiplex systems.

SECTION	TITLE
Data Set 208A-Type	
592-027-100	Description and Operation
592-027-200	Installation
592-027-300	Maintenance
592-027-500	Test Procedures
666-511-503	Test of Services Provided By Data Set 208A-Type From a Private Line Test Room
Data Set 201C-Type	
592-029-100	Description and Operation
592-029-200	Installation
592-029-300	Maintenance
592-029-500	Test Procedures
666-511-501	Test of Services Provided By Data Set 201C From a Private Line Test Room
Data Set 209A-L1	
592-032-100	Description and Operation
592-032-150	Supplementary Information
592-032-200	Installation
592-032-300	Maintenance
666-511-504	Test of Services Provided By Data Set 209A-L1 From a Private Line Test Room