DATA SET 202B
TRANSMITTER-RECEIVER
TEST PROCEDURES

CONTENTS PAGE

1. GENERAL

1.01 This section covers tests which are to be made at the time of installation and also when clearing routine troubles.

1.02 This section is being reissued to divide the procedures into installation and maintenance test parts and to add 914B tests. Description of the 914B is covered in Section 107-101-100. Because of extensive revision, change arrows have been omitted.

1.03 If the set fails to meet installation test requirements, replace entire set. Maintenance test requirements are recommended for further trouble analysis on telephone company premises.

1.04 If the set meets test requirements:

(a) Confirm with customer that business machine and associated cords have been checked.

(b) Check for cord and connector defects.

(c) Check for intermittent troubles in inside wire, drops, protector, etc.

When replacing a data set connected to a private line, provision must be made to terminate the line in a 600-ohm resistor to avoid interference to data transmission between other data sets on the same system and to provide a load for any toll repeater equipment.

- On 4-wire private lines, this can be accomplished by operating the 6017AP key to the test position.
- On 2-wire private lines, call the nearest toll central office and request them to terminate the line temporarily.

1.05 Before proceeding with any tests of the data set, the following should have been completed:

- Verify with local test center that loop has been tested and meets requirements as specified in Section 314-410-500.
- Check that telephone portion of installation meets standard dc, talk, signaling, and supervision requirements.
- Check that data set strapping options agree with service order.

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

2. INSTALLATION TEST PROCEDURES

2.01 Tests in this part should be performed after the data set has been installed to ensure that the installation is ready to be placed in service. In addition to these tests, the installer should assure that data can be transmitted and/or received using the business machine and data set at both the near- and far-end data terminal.

2.02 Although these tests are primarily for use at time of installation, consideration should be given to employment during maintenance visits if the nature of the trouble indicates that this type of test would be useful.

A. Ground Noise Test

2.03 The purpose of this test is to measure the impulse noise between the data set ground and the business machine ground.

2.04 The 6A impulse counter is required to carry out the test. For calibration and initial lineup of the 6A impulse counter, refer to Section 103-620-100.

2.05 Measure the impulse noise using a 6A impulse counter as follows:

(a) Connect business machine ground to the top IN binding post of 6A counter.

(b) Connect data set ground to the bottom IN binding post of 6A counter.

Do not ground 6A for this test.

(c) Set WTG switch to VOICE BAND.

(d) Set REF LEV DBRN toggle switch to ADD 30.

(e) Set REF LEV DBRN rotary switch to 60.

(f) Reset counter to 0000 by use of RESET switch.

(g) Set MINUTES switch to 15.

2.06 If any counts are registered in a 15-minute period, grounding arrangements must be improved.

B. Loop-Back Test

2.07 The purpose of this test is to check sensitivity of the data set, frequency, level of mark and space signals, and slicing point.

2.08 This test cannot be performed unless the data set has a TEST button or is connected to an auxiliary telephone that has a TEST button.

2.09 Call nearest data test center and request a loop-back test for a Data Set (DS) 202B. When instructed to do so, depress the TEST button and hang up.

2.10 The test center can now check sensitivity of the data set, frequency, level of mark and space signals, and slicing point.

2.11 At end of test, data test center restores the set to normal by removing carrier frequency from the line.

3. MAINTENANCE TEST PROCEDURES

3.01 Tests in this part are intended to be used as troubleshooting aids. The interface test in combination with the loop-back test in Part 2 should enable the tester to isolate the trouble to either the business machine or data set. Dynamic tests permit end-to-end testing of a data system allowing evaluation of data set performance using the normal transmission facility. The dynamic test may be of value if attempting to isolate trouble to the data station or connecting facilities. If facility problems are suspected at the near end, a data test center near the far end should be called for a dynamic test.

3.02 For private line installations, the requirements for the dynamic test apply on an end-to-end basis. On the switched network, the dynamic test requirements apply from the station to a near-end data test center.

A. Interface Test (901 Data Test Set)

3.03 The purpose of this test is to measure the level of control signals supplied to the customer.

3.04 The following equipment is required at the station:

- 901 Data Test Set
- KS-16979-L1 volt-ohm-milliammeter or equivalent.

3.05 The data set must be used with a 565-type telephone set or equivalent.

3.06 Perform interface tests per Table A. Figure 1 is a block diagram showing equipment setup for interface tests.

B. Interface Test (914B Data Test Set)

3.07 The purpose of this test is to measure the level of control signals supplied to the customer.

3.08 The 914B DTS is required at the station.

3.09 The data set must be equipped with a 565-type telephone set or equivalent.

3.10 The 914B DTS is required at the station.

(a) Set the controls of the 914B DTS as follows:

- Depress all A interface selector switches.
- INTERFACE MODE to VOLTAGE.
- METER FUNCTION to VOLT INT.
- METER RANGE to 30 DCV.
- METER POLARITY to NOR.
- VERTICAL MONITOR to position 9.

Note: Every time VERTICAL MONITOR switch position is changed, place METER FUNCTION to OFF position first to avoid meter damage.

(b) Set up the 914B DTS matrix as shown in Fig. 2.

(c) Plug the 914B DTS into a 117-volt ac outlet. Turn the 914B DTS on by depressing POWER button.

(d) Connect data set interface to interface jack A of the 914B DTS.

(e) Measure 15 to 20 volts dc.

(f) Set the controls on the 914B DTS as follows:

(1) METER FUNCTION to OFF

(2) METER POLARITY to REV

(3) VERTICAL MONITOR to position 10

(4) METER FUNCTION to VOLT INT.

(g) Measure 15 to 20 volts dc.

(h) Call local test center. Go to data mode.

(i) Depress TALK button.

(j) Place VERTICAL MONITOR to position 6.

(k) Measure zero volts [Interlock (Off)].

(l) Set the controls on the 914B DTS as follows:

(1) METER FUNCTION to OFF.

(2) METER RANGE to X100 ohms.

(3) METER FUNCTION to VOLT/OHM EXT.

(4) Zero the ohmmeter.

(5) Connect METER INPUT terminals to TP1 and TP2.

(6) COUNTER to BIT ERRORS.

(m) Measure an open circuit.

(n) Insert an additional matrix plug in 21 by S4 on 914B DTS matrix board.

(o) Request ringback from test center. Depress AUTO key when using Z option.

(p) Ohmmeter should indicate a contact closure during ring portion of ringing cycle.

(q) Ohmmeter should indicate an open contact during silent portion of ringing cycle.

TABLE A

INTERFACE OUTPUT TESTS

STEP*	ACTION	901A OR B			METER SETTING	TEST POINT		METER READING	INTERFACE LEAD
		TEST SWITCH		TOGGLE SWITCH		PROBE POSITION			
		A	B			+	−		
1	Plug 901 into 202 connector.	OFF	OFF	ATT	60 volts dc	C	A	0 volts	
2	Call local test center. Go to data mode. †	OFF	1	UNATT	60 volts dc	C	A	15 to 20 volts†	−Power
3	Stay in data mode. Disconnect test probes before moving TEST switch B to 2.	OFF	2	UNATT	60 volts dc	A	C	15 to 20 volts†	+Power
4	1. Disconnect test probes before moving TEST switches. 2. Pick up handset. 3. Depress TALK button on 202.	1	OFF	UNATT	12 volts dc	A	C	0 volts‡	Interlock (Off)
5	Disconnect test probes before moving toggle switch.	OFF	OFF	ATT	X10,000	B	C	Approximately 300,000 ohms	Ring indicator (Off)
6	1. Request ringback from test center. 2. Depress AUTO button when using Z option.	OFF	OFF	ATT	X10,000	B	C	Approximately 100,000 ohms during ring cycle	Ring indicator (On)
7	Move toggle switch during silent interval.	OFF	OFF	UNATT	X10,000	B	C	Approximately 300,000 ohms during silent interval§	Ring indicator (On)
8	Disconnect probe from B before setting meter.	1	OFF	UNATT	12 volts dc	A	C	6 to 10 volts	Interlock (On)

TABLE A (Cont)

INTERFACE OUTPUT TESTS

STEP*	ACTION	901A OR B			METER SETTING	TEST POINT		METER READING	INTERFACE LEAD
		TEST SWITCH		TOGGLE SWITCH		PROBE POSITION			
		A	B			+	−		
9	Disconnect test probes before moving TEST switch A.	2	OFF	UNATT	12 volts dc	C	A	6 to 10 volts	Receive data (Off)
10	Disconnect test probes before moving TEST switch A (skip 3).	4	OFF	UNATT	12 volts dc	C	A	6 to 10 volts	Clear to send (Off)
11	It is not necessary to disconnect test probes for Steps 11 and 12.	5	OFF	UNATT	12 volts dc	C	A	6 to 10 volts	Carrier on (Off)
12		6	OFF	UNATT	12 volts dc	C	A	6 to 10 volts	Receive data (Off)
13	Disconnect test probes before moving TEST switch A.	7	OFF	UNATT	12 volts dc	A	C	6 to 10 volts	Receive data (On)
14	Disconnect test probes before moving TEST switch A (skip 8 and 9).	10	OFF	UNATT	12 volts dc	A	C	6 to 10 volts	Clear to send (On)
15	Disconnect test probes. DATA light on 202 should go out.	10	OFF	ATT					
16	Depress TALK key and have test center release line.								

* SELECTOR switch on 901A shall be set to 202A for these tests before plugging into data set. If 901B is used, SELECTOR switch must be set on 4.

† If unable to go to data mode or voltages are out of limits, check power supply fuses.

‡ Meter may indicate voltage momentarily but should return to 0.

§ TEST lamp should light 3 to 4 seconds. Test center hears 1200-Hz tone, DATA lamp lights.

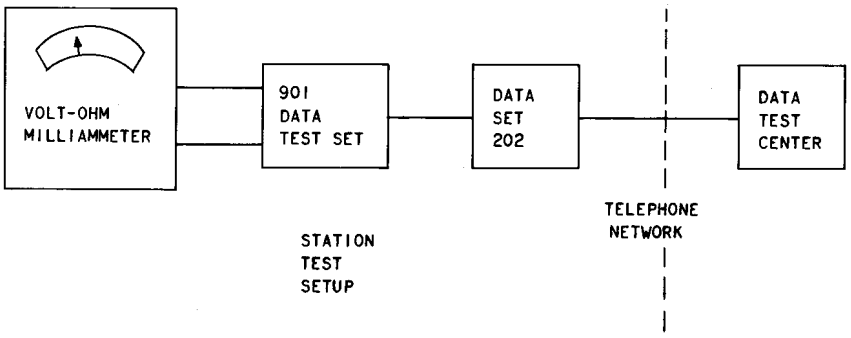

Fig. 1—Interface Test, Block Diagram

(r) Set the 914B DTS controls as follows:

(1) Disconnect METER INPUT leads.

(2) METER FUNCTION to OFF.

(3) METER RANGE to 30 DCV.

(4) VERTICAL MONITOR to position 3.

(5) METER POLARITY to REV.

(6) METER FUNCTION to VOLT INT.

(s) Measure 6 to 10 volts dc [Receive data (Off)].

(t) Place VERTICAL MONITOR to position 5.

(u) Measure 6 to 10 volts dc [Clear to send (Off)].

(v) Place VERTICAL MONITOR to position 8.

(w) Measure 6 to 10 volts dc [Carrier on (Off)].

(x) Place VERTICAL MONITOR to position 3.

(y) Operate 914B DTS switch S1.

(z) Measure 6 to 10 volts dc [Receive data (Off)].

(aa) Set the 914B DTS controls as follows:

(1) METER FUNCTION to OFF

(2) METER POLARITY to NOR

(3) S2 to ON

(4) METER FUNCTION to VOLT INT.

(bb) Measure 6 to 10 volts dc [Receive data (On)].

(cc) Place VERTICAL MONITOR to position 5.

(dd) Measure 6 to 10 volts dc [Clear to send (On)].

(ee) Depress TALK key and have test center release line.

C. Back-to-Back Test

3.11 The purpose of this test is to check data sets suspected of high distortion troubles.

3.12 The following equipment is required at the station:

- 901 Data Test Set
- 902 Data Test Set
- Two 903 Data Test Sets.

3.13 Figure 3 shows test set arrangements for back-to-back tests.

3.14 In this test, the transmitter is driven by the number one 903 DTS (63-bit serial generator). The receiver output is fed to the 902 DTS (distortion-measuring and error-checking set). The number two 903 DTS delivers synchronous signals to the 902 DTS. The 902 test set synchronizes these two signals and measures the peak distortion present in the data set. The 901 DTS is used to gain access to the necessary interface leads and to

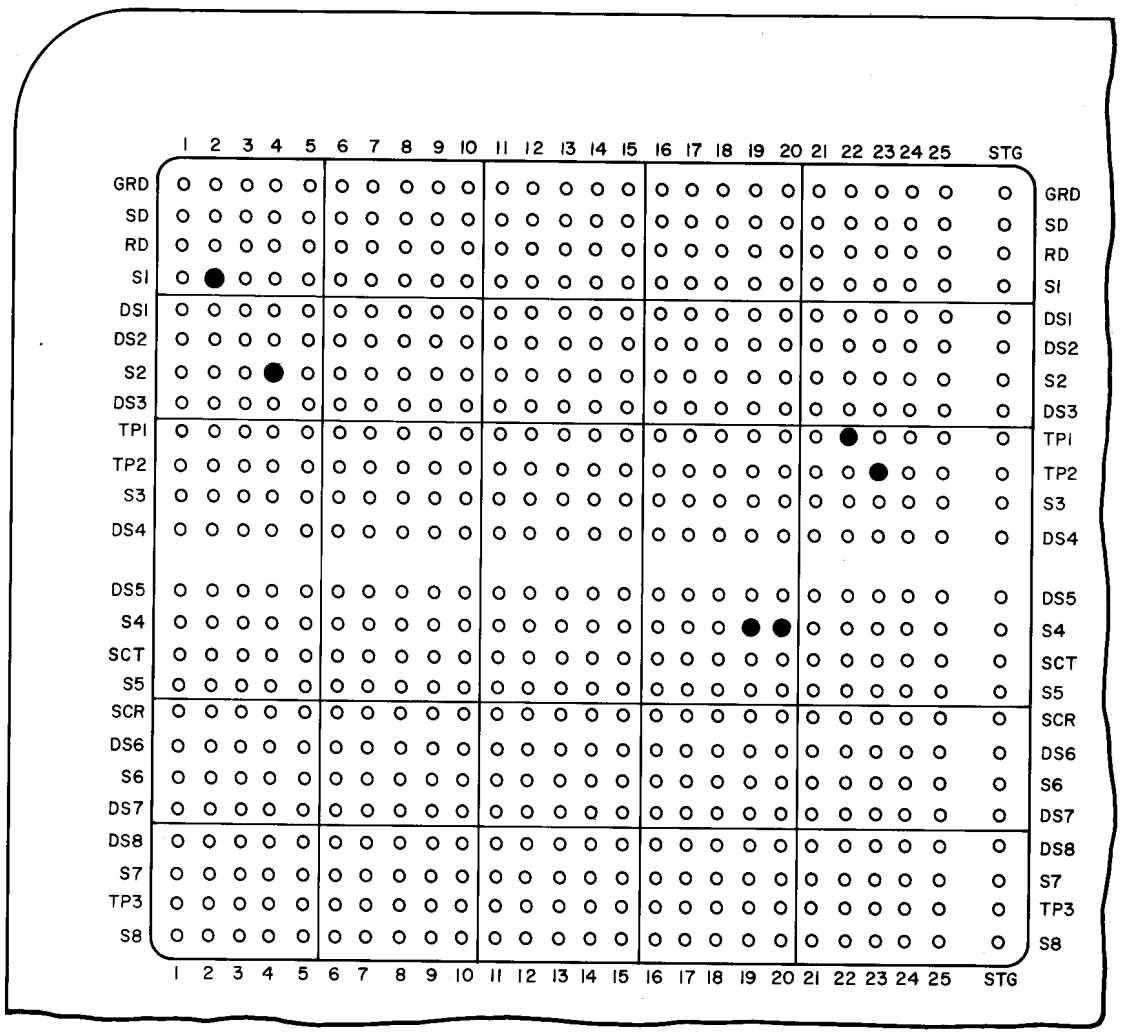

Fig. 2—914B Data Test Set Matrix Board

provide the voltage which places the DS 202B in the transmit mode (turns on carrier).

3.15 Test set controls are set as follows:

●901 DTS

SELECTOR to 202A or 4

A TEST to 8

B TEST to OFF

ATT-UNATT to ATT.

●902 DTS

BIT RATE—Transmitted bit speed.

Meter selection switch to DIST ADJ.

●NUMBER ONE 903 DTS

TRIGGER to +

RANDOM-DOT to RANDOM

BIT RATE—As close to the business machine bit rate as possible, but not lower.

●NUMBER TWO 903 DTS

TRIGGER to +

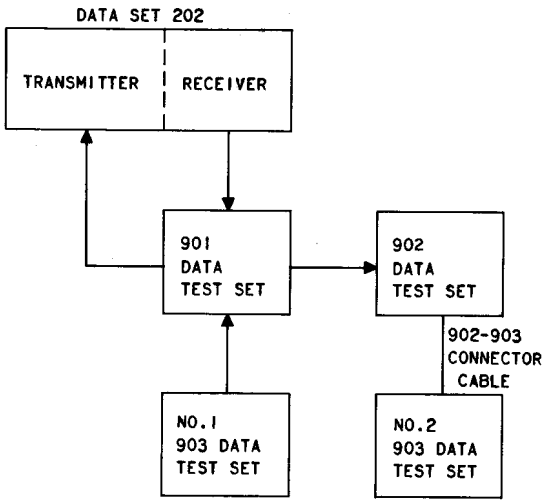

Fig. 3—Back-to-Back Test, Block Diagram

RANDOM-DOT to RANDOM

BIT RATE to EXT CLOCK.

3.16 ***Procedure:***

(a) Run two leads from SIGNAL OUT terminals on the number one 903 test set to the TRANSMIT DATA terminals on the 901 test set.

(b) Run two leads from the RECEIVE DATA terminals on the 901 test set to the DATA IN terminals on the 902 test set.

Each pair of terminals on all data test sets have one red and one black terminal. Connections between test sets must be made red to red and black to black.

(c) Connect the 901 test set to the connector on the data set with the cord provided (in place of the business machine cord).

(d) Connect the 902 test set to the number two 903 test set with the cord provided.

(e) Connect the power cords of the 903 test sets to a 117-volt ac outlet. Turn power switches on.

(f) Momentarily depress start switches on the 903 test sets.

3.17 The BIAS ADJ position on the 902 test set is not used in this test because there is no bias adjustment on DS 202B.

3.18 On the 902 DTS:

(a) Allow the meter selector switch to remain in the DIST ADJ position for several seconds before making distortion adjustments. Zero the meter by means of the DISTORTION adjustment knob.

(b) Set the meter selector switch to VOLTS ADJ and zero the meter by the VOLTS adjustment control.

(c) Set the meter selector switch to PHASE ADJ and zero the meter by the PHASE adjustment control.

(d) Set the meter selector switch to DIST MEAS. Depress the WORD SYNC & RESET switch.

3.19 The meter is now indicating peak distortion. One microamp is equal to 1 percent distortion. The maximum allowable distortion is 20 percent.

D. Dynamic Test (901, 902, and 903 Data Test Sets)

3.20 The purpose of this test is to check the transmitter and receiver of both data sets and the connecting facilities in both directions.

3.21 The following equipment is required at each station:

- 901 Data Test Set
- 902 Data Test Set (Receiving end)
- 903 Data Test Set.

3.22 Figure 4 is a block diagram showing the equipment setup at the two terminals for testing one direction of transmission. The test equipment is set up as shown in each location for one direction of the test and then reversed for the other direction. One terminal can be a data test center.

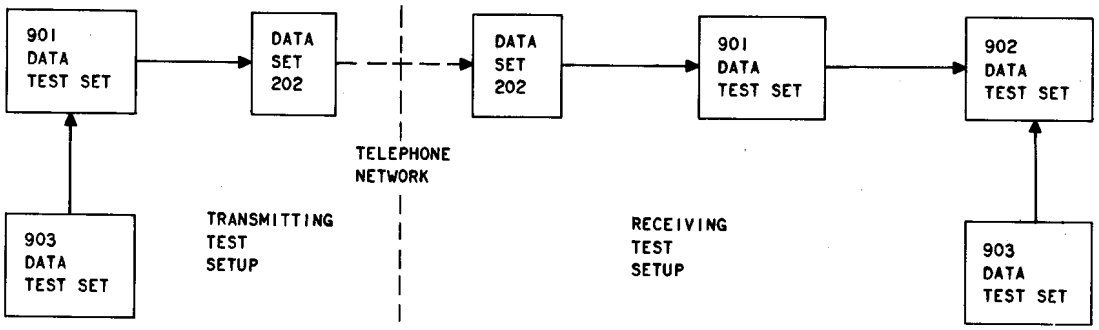

Fig. 4—Dynamic Test, Block Diagram

3.23 In this test, the transmitting DS 202B is driven by a 903 DTS (63-bit word generator). At the receiving end, the data signals are fed to a 902 DTS (distortion-measuring and error-checking set). Also at the receiving end, a second 903 test set delivers an identical signal to the 902 set. The 902 test set synchronizes these two signals, measures the peak distortion present in the system, and counts the number of errors in the received data.

Preparation of Data Sets and Test Sets

Transmitting End

3.24 Transmitting end controls are set as follows:

●901 DTS

A TEST to 8

SELECTOR to 202A or 4

Toggle to UNATT

B TEST to OFF.

●903 DTS

TRIGGER to +

RANDOM-DOT to RANDOM

BIT RATE—As close to business machine bit rate as possible, but not lower.

3.25 Make the following connections between data set and data test sets:

(a) Run two leads from the SIGNAL OUT terminals of the 903 set to TRANSMIT DATA terminals of the 901 set. (Terminals are connected red to red and black to black.)

(b) Connect the 901 test set to the connector of DS 202B with the cord provided (in place of business machine cord).

(c) Connect the power cord of the 903 test set to a 117-volt ac outlet and turn power switch to ON.

Receiving End

3.26 Receiving end controls are set as follows:

●901 DTS

A TEST to OFF

SELECTOR to 202A or 4

Toggle to UNATT

B TEST to OFF.

●902 DTS

BIT RATE to transmitted bit speed.

Meter selection switch to DIST ADJ.

●903 DTS

TRIGGER to +

RANDOM-DOT to RANDOM

BIT RATE to EXT CLOCK.

3.27 Make connections and calibrate test sets as follows:

(a) Run two leads from the RECEIVE DATA terminals of the 901 set to the DATA IN terminals of the 902 set. (Terminals are connected red to red and black to black.)

(b) Connect the 901 test set to the connector of the data set.

(c) Connect the 903 test set to the 902 test set with the cord provided.

(d) Connect the power cord of the 903 set to a 117-volt ac outlet. Turn power switch to ON.

3.28 Calibrate receiving station 902 DTS as follows:

(a) Allow meter selector switch to remain in DIST ADJ position for several seconds before making distortion adjustments. Zero the meter by means of DISTORTION adjustment knob.

(b) Set the meter selector switch to VOLTS ADJ and again zero the meter by the VOLTS adjustment control.

(c) Set the meter selector switch to PHASE ADJ and zero the meter by the PHASE adjustment control.

(d) Set the meter selector switch to DIST MEAS. Depress the WORD SYNC & RESET switch momentarily. All lights should go out.

Note: The BIAS ADJ position on 902 test set is not used in this test because there is no bias adjustment in DS 202B.

Switched Network and Private Line Tests

3.29 Complete dynamic test will involve making two 15-minute and ten 1-minute test calls. Establish voice communication in the manner normally used by the customer.

3.30 During the 15-minute calls, the receiving station should make a minute-by-minute count of errors as indicated by lighted lamps on 902 DTS. To prevent exceeding counter capacity, the RESET button should be depressed at the end of each minute after error count has been noted. Figure 5 illustrates format that can be used for recording test data. Occasionally, a noise burst or "hit" may cause error counter to lose synchronization and indicate continuous errors. The interval up to and including the burst should be tabulated as over 100 bit errors. RESET button on 902 should be depressed to continue tests. It may also be necessary to readjust 902 DTS.

3.31 If requirements are not met on first series of following tests, the test results, together with any other pertinent information, should be referred to the plant member of the project team for analysis and investigation.

Test Call Procedures

3.32 ***Transmitting Station:*** Voice communication is established between the two stations in the normal telephone manner. The transmitter should be connected to the line briefly before initial call begins as follows:

(a) At transmitting station, depress DATA key on telephone set to shift to data mode.

(b) Momentarily depress START switch of 903 test set. Upon release of the switch, receiving station should hear data being transmitted (1200- and 2200-Hz tones).

(c) After a prearranged time interval (approximately 15 seconds), shift back to the talk mode by depressing TALK key.

(d) If receiving station reports data being received, then repeat the action by shifting to the data mode and momentarily depressing START switch on 903 set.

(e) Transmitting station has no further duties until the end of test period.

3.33 ***Receiving Station:*** At the receiving station 902 DTS: Set the meter selector switch to DIST MEAS. Depress the WORD SYNC & RESET switch momentarily and start timing.

Date: _____

Data Test Calls Placed Between:

LOCATION	TEL. # OF TEST LINE OR STATION
(A) _____	_____
(B) _____	_____

Contemplated Customer S.O. Number's _____

Under Control of Data Test Center at _____

LONG DURATION TEST CALLS					BIT ERROR COUNT — MINUTE NUMBER														
ORIGINATED #	ORIGINATED AT	TIME	PEAK DISTORTION AT	PEAK DISTORTION %	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

SHORT DURATION TEST CALLS			SHORT CALL — NUMBER (READINGS AT _____)						SHORT CALL — NUMBER (READINGS AT _____)					
ORIGINATED AT	TIME		1	2	3	4	5		1	2	3	4	5	
		Peak Dist. Reading (%)												
		One Minute Error Count (Bits in Error)												
		Peak Dist. Reading (%)												
		One Minute Error Count (Bits in Error)												

Billing Adjustment (if required) referred to: _____

Parties involved in Tests: _____

Coordinated with tests to other locations at: _____

Comments and Notes:

Fig. 5—Data Set Pre-Service Performance Test Record

3.34 The error counter lamps will light as errors occur and microammeter will now indicate peak distortion. One microamp is equal to 1 percent distortion. The maximum allowable average peak distortion is 20 percent.

3.35 Conducting above tests during the busy hours will provide a variety of test conditions and a wide selection of local switching and toll trunk facilities.

Test Call Requirements

3.36 During 15-minute calls, count errors in 1-minute test periods:

- Disregard the two test periods with highest number of errors.
- Of the remaining 13 test periods, ten periods may have no more than two errors per period.
- The remaining three test periods may have no more than ten errors per period.

3.37 For 1-minute calls:

- No more than ten bit errors shall occur in 8 out of 10 calls.
- The average distortion of 20 percent must not be exceeded in 9 out of 10 calls.

E. Dynamic Test (914B DTS)

3.38 The purpose of this test is to check the transmitter and receiver of both data sets and the connecting facilities in both directions.

3.39 A 914B DTS is required at each station.

3.40 Perform the following steps at the transmitting end using the 914B DTS:

(a) TEST SET MODE to TRMT SER.

(b) BIT RATE—As close to business machine bit rate as possible, but not lower.

(c) SIGNAL LEVEL to $\pm$4V.

(d) WORD LENGTH to 63.

(e) Switch S2 to ON.

(f) Matrix set up as in Fig. 2, except remove pin 2 by S1 and add pin 2 by SD.

(g) INTERFACE MODE to VOLTAGE.

(h) Connect data set interface to 914B Data Test Set interface jack A.

(i) Plug 914B DTS into a 117-volt ac outlet. Turn the 914B DTS on by depressing POWER button.

3.41 Perform the following steps at the receiving end using the 914B DTS:

(a) TEST SET MODE to RCV SER.

(b) COUNTER to BIT ERRORS.

(c) WORD LENGTH to 63.

(d) PHASE to midposition.

(e) BIT RATE to agree with transmitted bit rate.

(f) Matrix set up as in Fig. 2, except remove pin 2 by S1 and add pin 3 by RD.

(g) INTERFACE MODE to VOLTAGE.

(h) Connect data set interface to the 914B DTS interface jack A.

(i) Plug the 914B DTS into a 117-volt ac outlet.

(j) Turn the 914B DTS on by depressing POWER button.

3.42 Establish voice communication between the two stations in the normal manner.

3.43 Shift to data mode at the transmitting station by depressing DATA key and the receiving station should hear data being transmitted.

3.44 After a prearranged interval, shift back to talk mode by depressing TALK key and if the receiving station reports data being received, switch back to data mode.

3.45 Perform the following steps at the receiving end using the 914B DTS:

(a) FUNCTION switch to PHASE ADJ.

(b) SAMPLE WIDTH to 0.5 μ s.

(c) Operate WORD SYNC momentarily to MAN.

(d) Adjust PHASE for null on METER.

(e) Adjust METER FUNCTION to a position other than PHASE ADJ.

(f) Operate RESET momentarily to observe recorded error count on counter display.

3.46 Complete end-to-end tests will involve making two 15-minute and ten 1-minute test calls. Figure 5 illustrates format that can be used for recording test data (omit distortion readings).

Test Call Requirements

3.47 During 15-minute calls, count errors in 1-minute test periods:

- Disregard the two test periods with highest number of errors.
- Of the remaining 13 test periods, ten periods may have no more than two errors per period.
- The remaining three test periods may have no more than ten errors per period.

3.48 For 1-minute calls, no more than ten bit errors shall occur in 8 out of 10 calls.

3.49 If the previous tests indicate trouble in either of the data sets, replace the entire set and repeat all tests. If this repeated test still indicates trouble, refer to the local plant member of the data project team.

3.50 Remove temporary strappings and restore customer data set to normal.