

SECTION 592-016-500
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DATA SET 202D TRANSMITTER-RECEIVER TEST PROCEDURES

1. GENERAL

1.01 This section covers test procedures which may be used at time of installation and on repair visits.

1.02 This section is reissued to add tests for private line applications. Change arrows indicate the additions.

1.03 Before proceeding with any test, verify that:

- (1) For switched network applications, the loop has been tested and meets requirements specified in section entitled Data Systems-On Direct Distant Dialing (DDD) Network, DATA PHONE Services-Transmission Requirements, DATA-PHONE Subscriber Lines (314-205-500).
- (2) For private line applications, the loop has been tested and meets requirements specified in section entitled Private Line Data Circuits, voice bandwidth circuits for miscellaneous data, Over-All Tests and Requirements (314-410-500).
- (3) Telephone portion of installation meets standard dc talk, signaling, and supervision requirements.



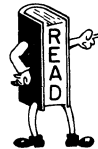
Confirm that data set strapping options agree with service order.

1.04 Fig. 1 and Table A furnish printed wiring board assembly identification information. Fig. 1 shows an older model of the data set. Newer models differ slightly in appearance.

1.05 The following tests are described in this section:

- Ground noise test

- Interface test
- Loop-Back test with Data Test Center
- End-to-End test
- Round-trip dynamic test with far-end customer



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

2. GROUND NOISE TEST

2.01 When required (see Section 592-016-200), measure the noise between the data set ground and the business machine ground using a 6A impulse counter as follows:

- (1) Connect business machine ground to top IN binding post of 6A impulse counter.
- (2) Connect data set ground to the bottom IN binding post of 6A impulse counter.



Do not ground 6A for this test.

- (3) Set WTG switch to VOICE BAND.
- (4) Set REF LEV DBRN toggle switch to ADD 30.
- (5) Set REF LEV DBRN rotary switch to 60.
- (6) Set MINUTES switch to 15.
- (7) Reset counter to 0000 by use of RESET lever.

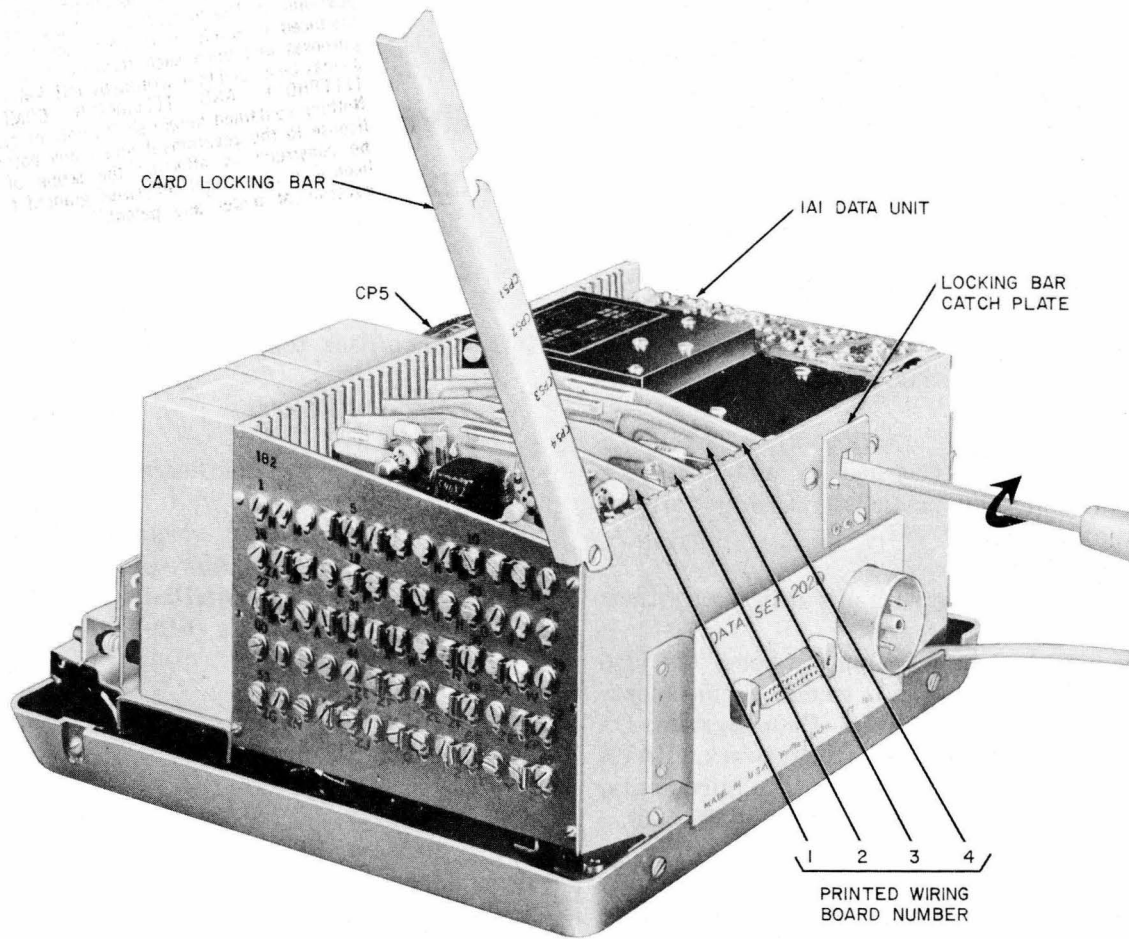


Fig. 1—Printed Wiring Board Location

2.02 If any counts are noted in a 15-minute period, grounding arrangements must be improved as covered in section entitled Data Set 202D-Type, Installation (592-016-200).

3. INTERFACE TEST

Note: On private line circuits, arrangements must be made to provide the data test center with access to the circuit.

3.01 The following equipment is required at the station:

- 901-type Data Test Set (Fig. 2) or equivalent
- Interface Test Adapter (Fig. 2)—J79901B

- KS-14510 List 1 volt-ohm-milliammeter or equivalent

- 1011-type handset

3.02 A block diagram illustrating the equipment set for interface tests is shown in Fig. 3.

3.03 The interface test adapter shall be arranged as shown in Fig. 4 for sets wired for voltage interface (wiring option *N*) and as per Fig. 5 for sets wired for 202A/B type interface (wiring option *M*).

Note: In order to avoid damage to data sets arranged for 202A/B type interface, it is important that the interface test adapter *not* be connected to data set until adapter is arranged as per Fig. 5.

TABLE A
PRINTED WIRING BOARD IDENTIFICATION

PRINTED WIRING BOARD DESIGNATION (See Fig. 1)	PRINTED WIRING BOARD FUNCTION	PRINTED WIRING BOARD ASSEMBLY NUMBER	
		OLD CODES	NEW CODES*
1	Test Circuitry	A-835166	AS 21
2	Modulator	A-835167 or A-835224†	AS 22 or AS 39
3	Carrier Detector	A-835168	AS 23 or AS 40
4	Demodulator	A-835169	AS 24 or AS 41
5	Miscellaneous (CPS 5)	A-152939	

* AS 22, AS 23, and AS 24 are found in Data Sets 202D1 and D2.
AS 39, AS 40, and AS 41 are found in Data Sets 202D3 and D4.
AS 21 is found in both.

† A-835167 was superseded by A-835224 and rated manufacture discontinued before the AS cards were produced.

3.04 Conduct interface tests with data test center as shown in Table B for sets arranged for voltage interface and as per Table C for sets arranged for 202A/B type interface. For installations without Data Auxiliary Set 804A type, steps 5 and 7 of the tables do not apply.

3.05 If unable to meet test requirements, replace data set.



If data set is replaced, verify that new data set is strapped correctly.

4. LOOP-BACK TEST WITH DATA TEST CENTER

4.01 Take handset of data auxiliary set off-hook, depress TALK key, and call nearest data test center.

Note: On service applications where Data Auxiliary Set 804A type is not used, originate call on an adjacent telephone set. On private

line circuits, arrangements must be made to provide the data test center with access to the circuit.

4.02 When instructed by data test center, depress TEST key. Hold it depressed until TEST lamp lights.

4.03 Place handset of data auxiliary set on-hook.

4.04 Data test center originates test call to data set. (Disregard momentary ringing of bell.)

4.05 Data set is now under control of data test center.

4.06 At end of test, data test center releases data set from test mode (as indicated by TEST lamp going out).

5. END-TO-END TESTS

5.01 The following test equipment is required at *each* station:

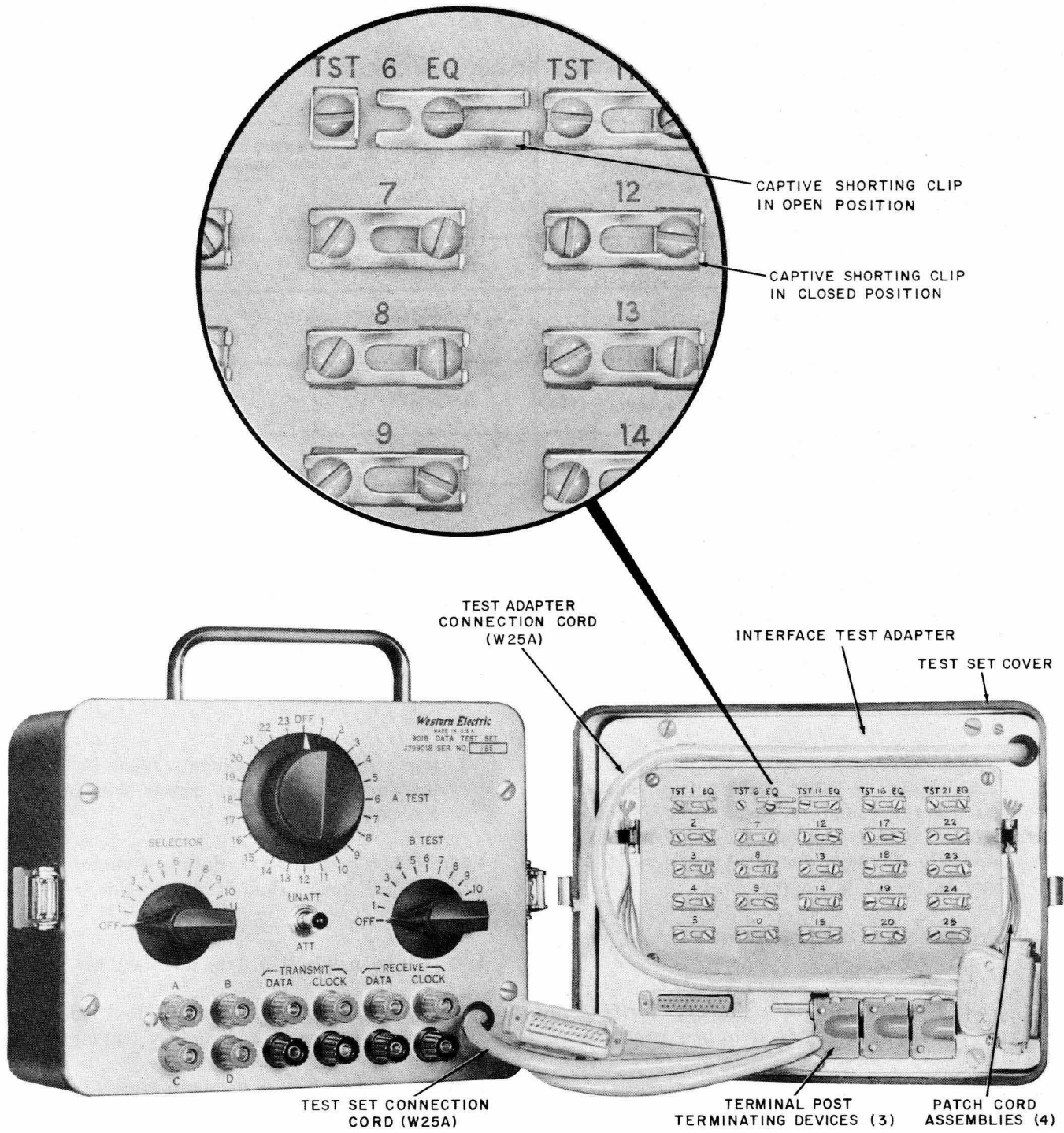


Fig. 2—901B Data Test Set

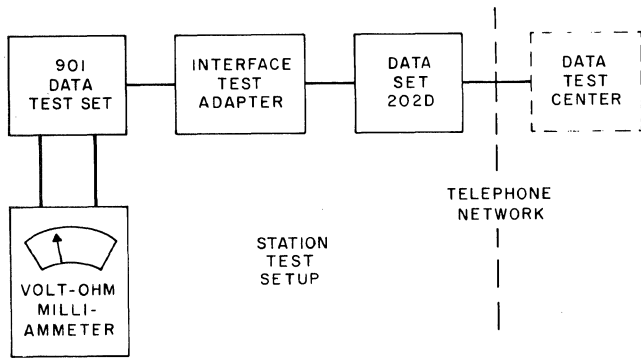


Fig. 3—Block Diagram Interface Test

- 901-type Data Test Set or equivalent
- Interface Test Adapter—J79901B
- 902-type Data Test Set
- 903-type Data Test Set
- 1011-type Hand Set

5.02 A block diagram illustrating the equipment set up for end-to-end tests is shown in Fig. 6.

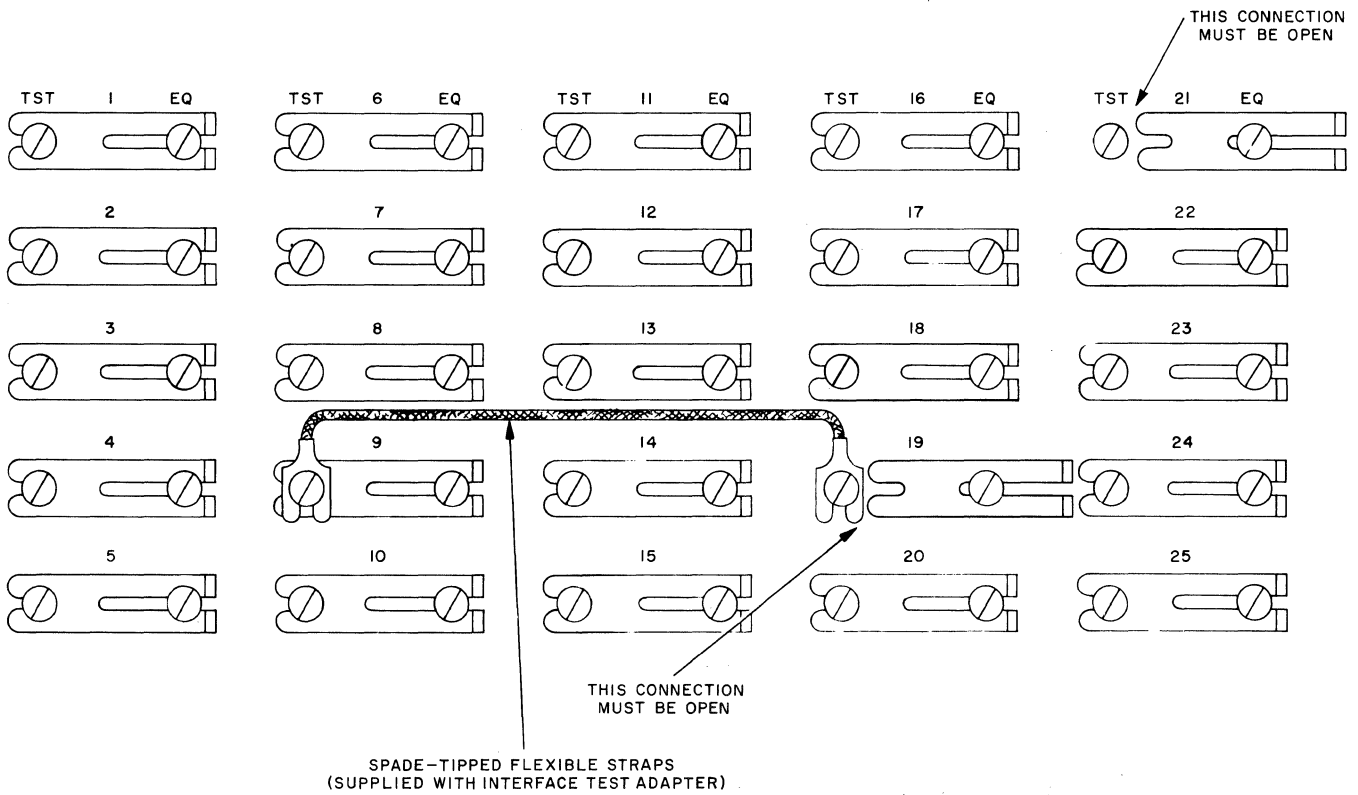


Fig. 4—Interface Test Adapter, Connection Arrangement—Voltage Interface (Wiring Option N)



Verify that test equipment is in good operating condition.

5.03 Refer to the appropriate sections covering operational and calibration tests. Sections

covering data test sets specified in these tests are indicated in Table D.

5.04 The block diagram shows the equipment set up at the two terminals for testing one direction of transmission. The test setup is reversed at each end to test the other direction of transmission.

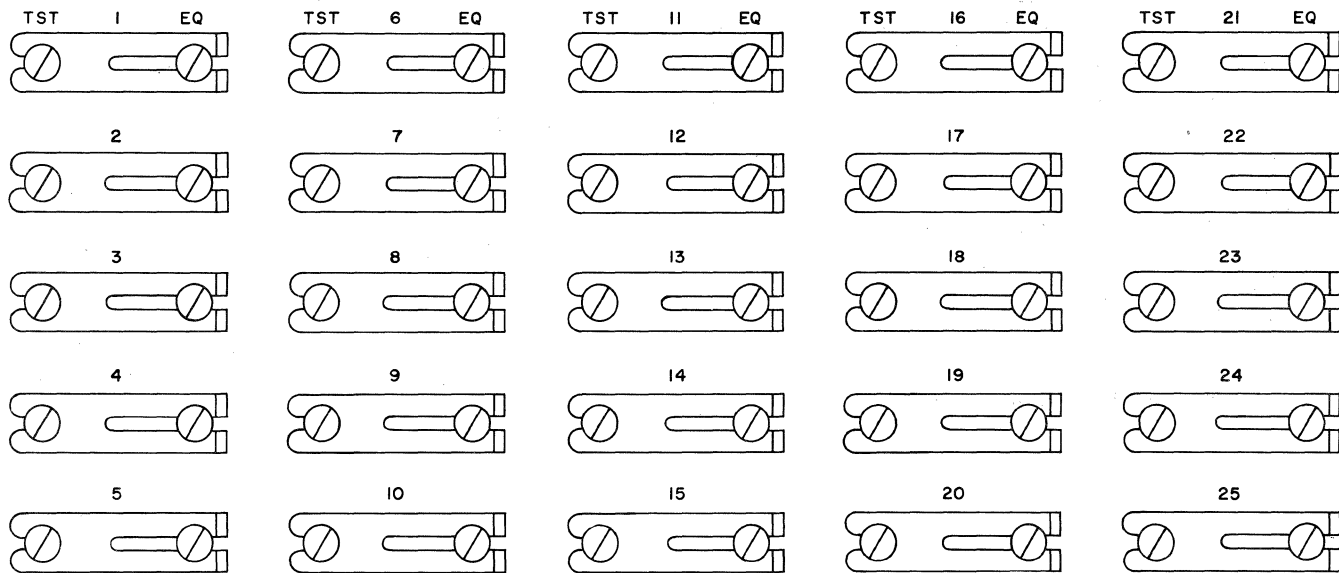


Fig. 5—Interface Test Adapter, Connection Arrangement—202A/B Type Interface (Wiring Option *M*)

This checks the transmitter and receiver of both data sets and the two directions of transmission of the connecting facilities.

5.05 These tests measure the distortion and error rate of the data system. The transmitting data set is driven by a 903-type Data Test Set (63-bit word generator). At the receiving end, the data set feeds the data signals to a 902-type Data Test Set (distortion measuring and error checking set). Also at the receiving end, a 903-type Data Test Set is used to deliver to the 902 test set a signal identical to the signal sent from the transmitting end. The 902 test set synchronizes these two signals, measures the peak distortion, and counts the number of errors in the received data.

5.06 The following switch settings and connections are to be made for switched network and private line testing. The test procedure for switched network is given in A and the test procedure for private line is given in B.♦

Transmitting End

Note: The following test checks circuitry furnished on printed wiring board assembly No. 2. (On four-wire applications, circuitry on printed wiring board No. 5 is also checked.)

- 901-type Data Test Set

SELECTOR to Position 4 (if 901B is used)

SELECTOR to 202A (if 901A is used)

A TEST to Position 8

B TEST to OFF

UNATT-ATT to UNATT

- 903-type Data Test Set

TRIGGER to + (plus)

RANDOM-DOT to RANDOM.

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

(1) 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.)

(2) On the interface test adapter, strap or open connections as per Fig. 4 (for sets arranged for voltage interface) or Fig. 5 (for sets arranged for 202A/B type interface).

TABLE B
INTERFACE TEST — VOLTAGE INTERFACE (N OPTION)

STEP	PREPARATION	901 TEST SET		VOLT-OHM-MILLIAMMETER				INTERFACE LEAD AND CONDITION	PRINTED WIRING BOARD ASSEMBLY NUMBER (See Fig. 1 and Table A)	
		TEST SWITCH		TOGGLE SWITCH	SCALE	CONNECT PROBE				READING
		A	B			+	-			
1	Set SELECTOR to 202A (if 901A is used). Set SELECTOR to position 4 (if 901B is used).	-	-	-	-	-	-	-	-	
2	Connect interface test adapter (arranged per Fig. 4) to interface of data set. Connect 901 to interface test adapter.	OFF	1	ATT	60VDC	C	A	19.0 ±1.5	Negative power supply	-
3	Disconnect meter probes before moving test switch.	OFF	2	ATT	60VDC	A	C	18.5 ±1.5	Positive power supply	-
4		2	OFF	ATT	12VDC	C	A	8.0 ±3.0	BB(mark)	4
5	Change meter scale before moving test switch	1	OFF	ATT	60VDC	C	A	18.5 ±1.5	CC(OFF)	1
6	NOTE: If data set is not wired for auto answer (Q wiring), temporarily connect it that way now.*	OFF	OFF	ATT	60VDC	C	B	16.5 ±2.0	CE(OFF)	1
7	Request data test center to place call to data set. NOTE: Meter pointer will be off scale to the left of zero during silent portion of ringing cycle.	OFF	OFF	ATT	12VDC	B	C	6.5 ±3.0 (during ring portion of ringing cycle)	CE(ON)	1
8	Ringer in data auxiliary set should stop ringing; data and talk lamps should light.	1	OFF	UNATT	12VDC	A	C	9.2 ±1.0	CC(ON)	1
9	Request data test center send 1200 ±10 Hz at -10 dbm level.	5	OFF	UNATT	12VDC	A	C	8.0 ±3.0	CF(ON)	3
10	Request data test center send 2200 ±10 Hz at -10 dbm level.†	2	OFF	UNATT	12VDC	A	C	8.0 ±3.0	BB(space)	4
11‡	If reverse channel (T wiring) is not provided, temporarily connect it that way now.	OFF	OFF	UNATT	12VDC	C	D	8.0 ±3.0	SB(OFF)	Data unit 1A1
12‡	Request data test center send 387 ±3 Hz at -10 dbm for 30 seconds.	OFF	OFF	UNATT	12VDC	D	C	11.0 ±3.0	SB(ON)	Data unit 1A1
13‡	Request data test center measure reverse channel tone frequency. Requirements: §	17	OFF	UNATT	-	-	-	-	-	-
14	End of test. Restore to pretest condition.									

* Maintain communication with data test center on another line if possible, otherwise it will be necessary to communicate with data test center via data auxiliary set by switching from talk to data modes using talk and data keys.

† End of test. If reverse channel is not equipped, restore data set to pretest condition. (If a wiring option was connected temporarily for test as per Step 6, remove.)

‡ When reverse channel is equipped, it should be tested at time of installation, (even though its use may not be required initially).

§ Requirements: Without carrier facilities 387 ±3 Hz
With carrier facilities 387 ±12 Hz

TABLE C

INTERFACE TEST — 202A/B TYPE INTERFACE (M OPTION)

STEP	PREPARATION	901 TEST SET			VOLT-OHM-MILLIAMMETER			INTERFACE LEAD AND CONDITION	PRINTED WIRING BOARD ASSEMBLY NUMBER (See Fig. 1 and Table A)	
		TEST SWITCH		TOGGLE SWITCH	SCALE	CONNECT PROBE				READING
		A	B			+	-			
1	Set SELECTOR to 202A (if 901A is used). Set SELECTOR to position 4 (if 901B is used).	-	-	-	-	-	-	-	-	
2	Connect interface test adapter (arranged per Fig. 5) to interface of data set. Connect 901 to interface test adapter.	OFF	1	ATT	60VDC	C	A	19.0 ±1.5	Negative power supply	-
3	Disconnect meter probes before moving test switch.	OFF	2	ATT	60VDC	A	C	18.5 ±1.5	Positive power supply	-
4		2	OFF	ATT	12VDC	C	A	8.0 ±3.0	BB(mark)	4
5	Change meter scale before moving test switch	1	OFF	ATT	60VDC	C	A	0 ±0.7	CC(OFF)	1
6	NOTE: If data set is not wired for auto answer (Q wiring), temporarily connect it that way now.*	OFF	OFF	ATT	X10,000	B	C	Approximately 300,000Ω	RI(OFF)	-
7	Request data test center to place call to data set. Ringer in data auxiliary set should ring.	OFF	OFF	ATT	X10,000	B	C	Approximately 100,000Ω (During ring portion of ringing cycle)	RI(ON)	-
8	Ringer in data auxiliary set should stop ringing; data and talk lamps light.	1	OFF	UNATT	12VDC	A	C	9.2 ±1.0	CC(ON)	1
9	Request data test center send 1200 ±10 Hz at -10 dbm level.	5	OFF	UNATT	12VDC	A	C	8.0 ±3.0	CF(ON)	3
10	Request data test center send 2200 ±10 Hz at -10 dbm level.†	2	OFF	UNATT	12VDC	A	C	8.0 ±3.0	BB(space)	4
11‡	If reverse channel (T wiring) is not provided, temporarily connect it that way now.	OFF	OFF	UNATT	12VDC	C	D	8.0 ±3.0	SB(OFF)	Data unit 1A1
12‡	Request data test center send 387 ±3 Hz at -10 dbm for 30 seconds.	OFF	OFF	UNATT	12VDC	D	C	11.0 ±3.0	SB(ON)	Data unit 1A1
13‡	Request data test center measure Frequency of reverse channel tone. Requirements: §	17	OFF	UNATT	-	-	-	-	-	-
14	End of test. Restore to pretest condition.									

* Maintain communication with data test center on another line if possible, otherwise it will be necessary to communicate with data test center via data auxiliary set by switching from talk to data modes using talk and data keys.

† End of test. If reverse channel is not equipped, restore data set to pretest condition. (If a wiring option was connected temporarily for test as per Step 6, remove.)

‡ When reverse channel is equipped, it should be tested at time of installation, (even though its use may not be required initially).

§ Requirements: Without carrier facilities 387 ±3 Hz
With carrier facilities 387 ±12 Hz

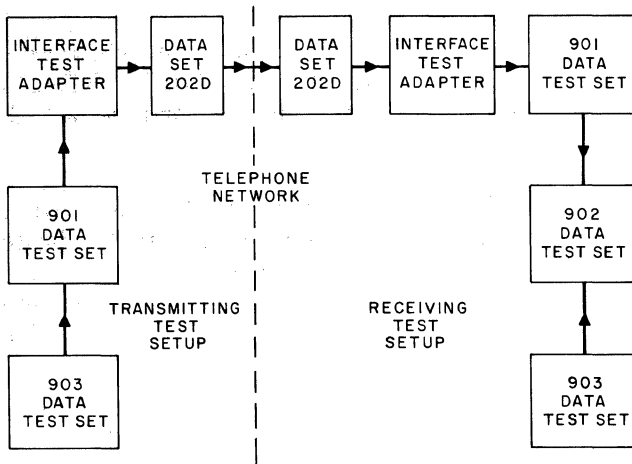


Fig. 6—Block Diagram—End-to-End Test

TABLE D

DATA TEST SET	SECTION
901-type (and adapter)	107-100-100
902-type	107-300-100
903-type	107-200-100

- (3) Connect interface test adapter to interface connector of data set (in place of business machine cord).
- (4) Connect 901-type Data Test Set to connector of interface test adapter.
- (5) Connect the power cord of 903 set to 117-volt ac outlet. Turn power switch ON.

Receiving End

Note: The following test checks circuitry furnished on printed wiring board assemblies No. 3 and 4. (On four-wire applications, circuitry on printed wiring board No. 5 is also checked.)

- 901-type Data Test Set

SELECTOR to Position 4 (if 901B is used)

SELECTOR to 202A (if 901A is used)

A TEST to OFF

B TEST to OFF

UNATT-ATT to UNATT

- 902--type Data Test Set

BIT RATE to transmitted bit speed

Meter selection switch to DIST ADJ

TRIGGER- not required

- 903-type Data Test Set

BIT RATE to EXT CLOCK

RANDOM-DOT to RANDOM

TRIGGER to + (plus)

- (1) Run two leads from RECEIVE DATA terminals of the 901 set to DATA IN terminals of the 902 set. (Terminals are connected red to red and black to black.)
- (2) On the interface test adapter, strap or open connections as per Fig. 4 (for sets arranged for voltage interface) or Fig. 5 (for sets arranged for 202A/B type interface).
- (3) Connect the 903 set to the 902 set with the cord provided.
- (4) Connect 901-type Data Test Set to connector of interface test adapter.
- (5) Connect interface test adapter to interface connector of data set (in place of business machine cord).
- (6) Connect power cord of 903 set to 117-volt ac outlet. Turn power switch ON.

A. Switched Network

5.07 Complete end-to-end tests will involve making two 15-minute and ten 1-minute test runs. Establish voice communication in the manner normally used by customer when placing data calls, eg:

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- DDD
- Attendant or operator assisted

5.08 Alternately place calls from each end using Data Auxiliary Set 804A type except where one customer location will always be originating the call. These test calls should be made during busy hours; this will give reasonable assurance that all test calls do not use the same trunks and routes. Perform the following procedure for each test call:

- (1) Establish voice communication between stations.
- (2) The answering (called) station goes from the talk to data mode by depressing DATA key of data auxiliary set.

Note: This test checks circuitry furnished on data unit 3A1.

- (3) When the originating (calling) station attendant hears the 2025-Hz tone change to a lower frequency (either 1200 or 387 Hz), he should go to the data mode by depressing the DATA key.

- (4) The transmitting station momentarily depresses START switch of 903. The transmitting station has no further duties until end of test period.

- (5) The receiving station performs the following steps:

- (a) Allow the 902 meter selection switch to remain in the DIST ADJ position for several seconds before making distortion calibration adjustment. Zero the meter by means of the DISTORTION adjustment knob.

- (b) Move the meter selection switch to VOLT ADJ position and again zero the meter by means of the VOLTS adjustment control.

- (c) Move the meter selection switch to PHASE ADJ and again zero the meter by means of the PHASE adjustment control.

Note: The BIAS ADJ position on the 902 is not used in this test.

- (d) Move the meter selection switch to DIST MEAS. Depress the WORD SYNC & RESET switch momentarily and record the time.

- (e) The microammeter should settle down to some relatively stable value that indicates peak distortion. One microamp is equal to one percent distortion. For example, a meter indication of eight microamps would be eight percent peak distortion.

- (f) The TOTAL ERRORS lamps lighted on the 902 set indicate the number of errors in received data from the time the WORD SYNC & RESET switch was released. For example, if the 8, 4, and 1 lamps are lighted, this would indicate a total of 13 errors.

- (g) See Fig. 7 for example of form for recording test results.

Test Call Requirements

5.09 During 15-minute calls, count errors in one minute test periods:

Note: This test is used to determine acceptability of long term error rate.

- Disregard the two test periods with highest number of errors.
- Total errors in the remaining 13 test periods should be no more than 5.
- The average distortion should not exceed 20 percent. Occasional peaks over 20 percent are permissible.

5.10 For 1-minute calls:

Note: This test is used to determine acceptability of randomly selected facilities available for routing data calls.

- 8 of the 10 calls should have no more than 3 errors each.
- The average distortion of 20 percent should not be exceeded in 9-out-of-10 calls.

Note: The above limits are in no way guaranteed error rates. Except for the

DATA SET PRE-SERVICE PERFORMANCE TEST RECORD

Date: _____

Data Test Calls Placed Between:

	TEL. # OF TEST LINE OR STATION
<u>LOCATION</u>	
(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		PEAK DISTORTION		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	AT	TIME	AT	%															

SHORT DURATION TEST CALLS			SHORT CALL — NUMBER									
ORIGINATED AT	TIME		(READINGS AT _____)					(READINGS AT _____)				
			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. 7—Example of a Log Sheet

occasional extraordinary call, the error rates experienced by the customer should be considerably less.

B. Private Line

5.11 The private line end-to-end test will require a 5-minute test run if the customer's complaint indicates excessive errors (more than three errors in 10^5 bits), or a 15-minute test if the complaint indicates random errors. Perform the following procedure for the test call:

- (1) Establish voice communications between stations. This may require the use of an adjacent telephone or a 1011 type handset.
- (2) The transmitting station momentarily depresses START switch of 903. The transmitting station has no further duties until end of test period.
- (3) The receiving station performs the following steps:
 - (a) Allow the 902 meter selection switch to remain in the DIST ADJ position for several seconds before making distortion calibration adjustment. Zero the meter by means of the DISTORTION adjustment knob.
 - (b) Move the meter selection switch to VOLT ADJ position and again zero the meter by means of the VOLTS adjustment control.
 - (c) Move the meter selection switch to PHASE ADJ and again zero the meter by means of the PHASE adjustment control.

Note: The BIAS ADJ position on the 902 is not used in this test.

- (d) Move the meter selection switch to DIST MEAS. Momentarily depress the WORD SYNC & RESET switch.
- (e) The microammeter should settle down to some relatively stable value that indicates peak distortion. One microamp is equal to one percent distortion. For example, a meter indication of eight microamps would be eight percent peak distortion.

Requirement: The average distortion should not exceed 20 percent. Occasional peaks over 20 percent are permissible.

(f) The TOTAL ERRORS lamps lighted on the 902 set indicate the number of errors in received data from the time the WORD SYNC & RESET switch was released. For example, if the 8, 4, and 1 lamps are lighted, this would indicate a total of 13 errors.

Requirement: The maximum allowable number of errors as a function of bit rate is shown in Table E.

TABLE E

BPS	MAXIMUM NUMBER
1000	3
1200	5
1400	6
1600	7
1800	8

6. ROUND-TRIP DYNAMIC TEST WITH FAR-END CUSTOMER

6.01 This test is for four-wire private line applications without Data Auxiliary Set 804A type.

6.02 This test checks the distortion and error rate of the private line data system. The test involves two stations with the following test sets located at one station:

- One—901-type Data Test Set or equivalent
- One—902-type Data Test Set
- Two—903-type Data Test Sets



Verify that test equipment is in good operating condition.

6.03 Refer to the appropriate sections covering operational and calibration tests. Sections covering data test sets specified in this test are indicated in Table D.

6.04 Set the switches of the test sets as follows:

- 901-type Data Test Set

SELECTOR to Position 4 (if 901B is used)

SELECTOR to 202A (if 901A is used)

A TEST to Position 8

B TEST to OFF

- 902-type Data Test Set

BIT RATE to as close to business machine bit rate as possible but *not* lower.

Meter selection switch to DIST ADJ

- No. 1 903-type Data Test Set

BIT RATE—same as 902-type

RANDOM-DOT to RANDOM

TRIGGER to + (plus)

- No. 2 903-type Data Test Set

BIT RATE to EXT CLOCK

RANDOM-DOT to RANDOM

TRIGGER to + (plus)

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

(1) Run two leads from SIGNAL OUT terminals of No. 1 903 set to TRANSMIT DATA terminals of the 901 set. (Terminals are connected red to red and black to black.)

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

(3) Connect No. 2 903 set to the 902 set with the cord provided.

(4) Connect the W25A cord of the 901 set to the interface connector of the data set (in place of the business machine cord).

(5) Connect power cord of both 903 sets to 117-volt ac outlet. Turn power switches to ON.

6.06 The duration of the test will be 5 minutes if the customer's complaint indicates excessive errors (more than three errors in 10^5 bits), or a 15-minute test if the complaint indicates random errors. Perform the following procedure for the test call:

(1) Establish voice communications between stations and have far-end customer depress TEST key. This may require use of an adjacent telephone.

(2) Momentarily depress START switch of both 903 sets.

(3) Allow the 902 meter selection switch to remain in the DIST ADJ position for several seconds before making distortion calibration adjustment. Zero the meter by means of the DISTORTION adjustment knob.

(4) Move the meter selection switch to VOLT ADJ position and again zero the meter by means of the VOLTS adjustment control.

(5) Move the meter selection switch to PHASE ADJ and again zero the meter by means of the PHASE adjustment control.

Note: The BIAS ADJ position on the 902 is not used in this test.

(6) Move the meter selection switch to DIST MEAS. Momentarily depress the WORD SYNC & RESET switch.

(7) The microammeter should settle down to some relatively stable value that indicates peak distortion. One microamp is equal to one percent distortion. For example, a meter indication of eight microamps would be eight percent peak distortion.

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Requirement: The average distortion should not exceed 20 percent. Occasional peaks over 20 percent are permissible.

(8) The TOTAL ERRORS lamps lighted on the 902 set indicate the number of errors in received data from the time the WORD SYNC & RESET switch was released. For example,

if the 8, 4, and 1 lamps are lighted, this would indicate a total of 13 errors.

Requirement: The maximum allowable number of errors as a function of bit rate is shown in Table E.

(9) Set the A TEST switch on the 901 set to position 5 before restoring pretest conditions.◆