

## DATA SYSTEMS — COMMON CIRCUITS, EQUIPMENT AND PROCEDURES

### DATA TEST CENTER

#### 905A DATA TEST SET — TRANSMISSION TESTS OF DATASPEED TAPE SENDER UNIT

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#### 1. GENERAL

1.01 This section has been reissued to describe the TRANSMISSION REQUIREMENTS and TEST PROCEDURES to be used in connection with testing DATASPEED TAPE SENDER UNITS using a 905A DATA TEST SET at the DATA TEST CENTER. The margin arrows and arrow brackets usually used to indicate changes in a section have been omitted because of a complete revision of the text.

1.02 The 905A DATA TEST SET is used in conjunction with a DATA SET 202A and a 902-type DATA TEST SET at a DATA TEST

CENTER, to receive DATASPEED signals for test purposes, from outlying DATASPEED TAPE SENDERS.

1.03 The 905A DATA TEST SET is a "rack mounted unit" which has the capability of counting the number of errors received and measuring the distortion of the transmitted signal by means of the 902 DATA TEST SET. Information concerning the operation and transmission capabilities of the 905A DATA TEST SET is covered in Section 314-825-502, Issue 2.

1.04 The 905A DATA TEST SET is used as a *measure of proficiency* for all DATA-SPEED TAPE SENDERS within its geographical area, therefore, it should be installed and tested with great care in order to make it as reliable as possible. The DATA SET 202A is terminated at the DATA TEST CENTER on a test circuit that may be assigned to either a specific telephone number or coded termination. The test circuit is, in turn, connected to a class 5 or higher ranking office. The test circuit should be selected and aligned with great care. It should meet or better the DATA-PHONE transmission objectives shown in Section 314-205-500 (TRANSMISSION REQUIREMENTS—DATA-PHONE SUBSCRIBER LINES). The 905A DATA TEST SET is connected to the DATA SET 202A by means of a cable equipped with a 25-pin connector on each end. The 905A DATA TEST SET is, in turn, connected to the 902 DATA TEST SET by a cable equipped with a 15-pin connector on each end.

#### 2. TEST SIGNAL CAPABILITIES OF THE 905A

2.01 The 905A DATA TEST SET is capable of generating or receiving sixteen different types of DATASPEED test signals, which

are repeated continuously as long as the selector switch is in a particular mode. Where there is a difference of information levels (5, 6, 7 or 8 levels), the unused information levels are generated. However, they are so arranged that they do not affect the received signal. The START-STOP code as used for 5-level teletypewriter code (Baudot Code) is as follows: START, 1st, 2nd, 3rd, 4th, 5th, STOP. The DATASPEED START-STOP code equivalent is as follows: START, ZERO, 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, STOP.

**2.02** The 905A is arranged to *generate* or *receive* a (1050 bits-per-second) 10 unit, DATASPEED START-STOP code when operating in the *send mode*. In the *receive mode* the 905A DATA TEST SET will generate a similar signal at a bit rate derived from the 902 DATA TEST SET (1050 bits-per-second), which is synchronized to the incoming data signal under test. When a 5-level teletypewriter tape is sent via TYPE 1 (5-level only) DATASPEED, all ten pulses are sent. The information levels 1 through 5 are used as information bits, levels ZERO, 6 and 7 are not used; however, they are generated and are transmitted as *marking bits*. The START bit is always a *space* and the STOP bit is always a *mark*. The TYPE 1 DATASPEED TAPE RECEIVER is so arranged (via transistor circuitry) as to recognize the five informa-

tion bits only, thus the ZERO, 6 and 7 bits, although they are transmitted as marking bits, have no equivalent circuit cards in the DATASPEED TAPE RECEIVER UNIT.

**2.03** With the TYPE 2 DATASPEED (5, 6, 7 or 8 level), the unused bits are as follows:

- (a) TYPE 2 — 5-level operation — 0 is an unused bit and is *spacing*; 6 and 7 are unused bits and are *marking*.
- (b) TYPE 2 — 6-level operation — 6 and 7 are unused bits and are *marking*.
- (c) TYPE 2 — 7-level operation — 7 is an unused bit and is *marking*.
- (d) TYPE 2 — 8-level operation — There are no unused bits. With the TYPE 2 signal, the start bit is always *spacing* and the stop bit is always *marking*.

### 3. TEST EQUIPMENT

**3.01** Information pertaining to the description and operation of test equipment in a DATA TEST CENTER, is covered in other practices in the Plant Series of Bell System Practices.

**3.02** At the DATASPEED TAPE SENDER location, it is desirable to have the items shown in TABLE I available for test purposes.

TABLE I	
DATASPEED TAPE SENDER — TEST EQUIPMENT	
TYPE	SECTION
901 DATA TEST SET	107-100-100
902 DATA TEST SET	107-300-100
903 DATA TEST SET	107-200-100
OPTIONAL TEST EQUIPMENT	SECTION
905B DATA TEST SET	314-825-502
OSCILLOSCOPE OR	E40.624
TEST POINT SIGNAL MONITOR	592-800-501

#### 4. PRELIMINARY TEST PROCEDURE — DATA TEST CENTER

4.01 The function of the DATA TEST CENTER in connection with tests of DATASPEED equipment is to assist various field forces with the initial installation of equipment, detection of malfunctions and coordination of data services. The SERVING OFFICE TEST CENTER will be the *controlling test center* for all DATASPEED testing within its area. It has the responsibility of receiving all customer reports, and following up these reports to assure that a trouble has been cleared as quickly as possible.

4.02 The 904 TYPE A DATA TEST CENTER has the capabilities of performing static type tests with data sets that have a "loop-back" feature. The "loop-back" feature allows the data set to be tested from a remote location and does not require Telephone Company personnel in attendance at the data set location. The 904 TYPE B DATA TEST CENTER has the capabilities of performing dynamic tests with a number of different types of data sets and associated equipment. In general, it may be assumed that the 904 TYPE B DATA TEST CENTER will be equipped with a 905A DATA TEST SET and has the capabilities of testing DATASPEED transmission.

#### 5. TRANSMISSION TESTS TO BE MADE IN CONNECTION WITH THE INSTALLATION OF A DATASPEED TAPE SENDING UNIT

5.01 Upon receipt of information of the installation of a DATASPEED TAPE SENDER UNIT at a customers' location, the SERVING LOCAL TEST CENTER should proceed as follows:

- (a) The subscriber line should meet the transmission test requirements shown in Section 314-205-500 (TRANSMISSION REQUIREMENTS-DATAPHONE SUBSCRIBER LINES).
- (b) The DATA SET 202A should meet the test requirements shown in Sections 592-013-100, 592-013-200 and 592-013-500.
- (c) The DATASPEED TAPE SENDER UNIT should meet the test requirements shown in Sections 592-800-500 and 592-800-501.

#### 6. INITIAL INSTALLATION TESTS USING THE 905A DATA TEST SET AT THE DATA TEST CENTER

6.01 A loop of test tape is provided with each tape sender unit. This tape consists of the 14 character test code as shown in Fig. 1 of this section. The 14 character test code is designed to exercise all the functions of the tape sender units' transistorized circuitry as well as the mechanical operation.

6.02 *The initial installation and alignment tests of the tape sender unit should be completed prior to delivery of the equipment to the customers' location.*

6.03 Upon notification by the craftsman that he is ready to make dynamic tests, in connection with the initial alignment of the DATASPEED TAPE SENDER UNIT, the tester will make a *line evaluation test* using 902 and 903 DATA TEST SETS (see Sections 107-300-100 and 107-200-100). Run the tests for *five minutes: no more than 10 errors* should be received during this five-minute interval. *Peak distortion should not exceed 20%*. If this requirement can not be met, release the telephone line under test and call again, until a satisfactory error run has been made. If a satisfactory error run *can not* be made, after five attempts, the tester at the DATA TEST CENTER should advise the test center supervisor. After a successful error run has been made, *do not* release the telephone line under test. The craftsman at the outlying location will insert the 14 character test code tape into the tape reader gate and proceed to send. The tape should be sent for a period of *two minutes*; no more than *four* random errors should be received during the two minute period.

6.04 If a number of pulses are lost or gained during the tests described in Par. 6.03, the DATASPEED TAPE SENDER UNIT should be checked and realigned, if necessary, as described in Section 592-800-501.

#### 7. ACCEPTANCE TEST OF THE DATASPEED TAPE SENDER UNIT

7.01 Acceptance tests are required to assure that the DATASPEED equipment is *working properly after delivery to the custom-*

*ers' location.* Upon notification by the craftsman, at the customers' location, that he is ready to make dynamic tests in connection with the installation of the DATASPEED TAPE SENDER UNIT, the tester will make a *line evaluation test* of the circuit using a 902 and 903 DATA TEST SET. Run the test for *five minutes: no more than 10 errors* should be received during this five minute interval. *Peak distortion should not exceed 20%*. If this requirement can not be met, release the telephone line under test and have the craftsman call again, until a satisfactory error run has been made. If a satisfactory error run *can not* be made after five attempts, the tester at the DATA TEST CENTER should advise the test center supervisor. After a successful error run has been made, *do not* release the line under test. The craftsman at the outlying location should insert the 14 character test message tape into the tape reader gate and proceed to send for a period of thirty seconds. The tester will record the number of errors received at the completion of each test. Repeat this procedure until a total of four tests have been received. Do not release the line under test. Two of the total of four tests should be error free, one test may have no more than two errors, any one of the total of four tests may be disregarded. If this requirement can not be met, repeat the series of four tests once again. If the second series of four (thirty-seconds-each) tests can meet requirements, the tests will be regarded as acceptable.

**7.02** The tester should originate calls to other DATA TEST CENTERS involved with the customers' DATASPEED network. He will advise them that they are ready to send tests to the DATASPEED TAPE RECEIVER UNITS involved, on a network operation basis. Each DATASPEED TAPE RECEIVER UNIT location should receive a series of ten, 10-second tests from the DATASPEED TAPE SENDER under test. In each instance, out of a total of ten test tapes received, four test tapes should be error free, four test tapes should have no more than one error each, any two test tapes of the ten received, may be disregarded. The test calls should be made alternately, in both directions, until the ten tests are completed.

## **8. MAINTENANCE TESTING USING THE 905A DATA TEST SET AT THE DATA TEST CENTER**

**8.01** The four general categories of trouble that may be encountered with the DATASPEED equipment are as follows:

- 1. DATA SET, SUBSCRIBER LOOP AND TRANSMISSION FACILITIES TROUBLES.**
- 2. AC POWER AND POWER DRIVEN COMPONENTS OF THE DATASPEED EQUIPMENT.**
- 3. INTERNAL CIRCUIT MALFUNCTIONS OF THE DATASPEED EQUIPMENT.**
- 4. MECHANICAL TROUBLES, DUE TO WEAR, RESULTING IN LOSS OF COMPONENT SYNCHRONIZATION WITHIN THE DATASPEED EQUIPMENT.**

**8.02** Many different types of trouble conditions can be detected, analyzed and corrected by the DATA TEST CENTER personnel. It is assumed in the following paragraphs that the DATA-PHONE subscriber loop and the data set have been tested locally, prior to the actual testing of the DATASPEED TAPE SENDER UNIT.

**8.03** Upon notification of trouble with the DATASPEED unit, the tester at the DATA TEST CENTER will call the customers' DATASPEED TAPE SENDER UNIT. The tester should question the customers' attendant and try to determine the nature of the trouble, make arrangements to test, and if possible, take appropriate corrective action.

**8.04 POWER FAILURE:** This condition can be detected by conversation with the attendant. With the *POWER SWITCH "ON"* the yellow "*POWER ON LAMP*" should be "*LIGHTED*", "*TAPE WINDER*" motor should start when the "*WINDER PUSHBUTTON*" is "*OPERATED*" and the "*TAPE READER*" motor should start when the "*READER PUSHBUTTON*" is "*OPERATED*". If all of these tests fail to give an indication of a source of power, have the attendant check to see if the power cord is plugged into the AC outlet. If the cord is plugged into the AC outlet, but all or part of the equip-

ment does not function, a repairman should be dispatched to check for blown fuses, overload conditions and short circuits.

#### **8.05 TAPE READER UNABLE TO READ**

**TAPE:** With the AC power "ON" and the tape reader motor "OPERATING"; have the attendant place a test tape in the readers' gate with the three-position handle in *STOP* or *FREE WHEEL*. The attendant should then press the "DATA" button on the DATA SET 202A and operate the three-position handle to *RUN*. If the reader sounds like it is reading tape, but the tape does not feed through, have the attendant reposition the tape or substitute a new test tape. If the new test tape does not feed, the trouble is a mechanical feed trouble or located in the transistorized circuitry. A repairman should be dispatched to the customers' location.

#### **8.06 The tape reader may appear to read tape,**

however, the *data* is not received at the receiving end. The tester should have the attendant place a test tape in the reader gate, operate the 202A "DATA" button, and attempt to send to the DATA TEST CENTER. The resultant signals should be received on the 905 DATA TEST SET or observed on an oscilloscope. If no signals, or intermittent signals are received, the tester should arrange to have a repairman dispatched to the customers' location.

#### **8.07 ERRORS, GARBLE, GAIN OR LOSS OF**

**PULSES:** The tester should call the customer and attempt to get a description of the nature of the trouble condition. Proceed to test the DATASPEED TAPE SENDER UNIT by asking the attendant to place the 14 character test code tape in the reader gate, depress the "DATA" button on the 202A and operate the three-position handle on the reader to the "RUN" position. The tape should be sent for approximately thirty seconds. No more than one error should be received during the thirty-second test. Under certain conditions, the customer may be able to send acceptable tests to the DATA TEST CENTER, however, they may not be able to send with the same degree of accuracy, to one or more of their associated tape receiver units at distant locations. The tester at the local DATA TEST CENTER should call the DATA TEST CENTER serving the distant end customer. This DATA TEST CENTER conducts similar tests with the customer at both ends

of the circuit. The results of these tests should be forwarded to the original DATA TEST CENTER, who will, in turn, forward the information to the SERVING TEST BUREAU for control purposes.

**8.08** *It is important to remember that because "data transmission" appears to be good between the customer and the DATA TEST CENTER, there is no guarantee that it will work as well with any other location. The DATA TEST CENTERS seldom employ the same routings over the DDD network, as the customer will have between two or more locations. Because of the large selection of routings over the DDD network, it is possible to have two or more DATASPEED locations test within design objectives, in tests with the DATA TEST CENTER. However, because of different routings and additive affects of circuit distortions, they will not work together. Section 314-205-501 (DATA-PHONE SERVICES, TRANSMISSION MAINTENANCE ASPECTS — DDD NETWORK) deals with the transmission parameters of facilities involved with DATA-PHONE services over the DDD network. The objectives shown in this section should be met on all facilities used in connection with DATA-PHONE services.*

#### **8.09 Testing the DATASPEED TAPE SENDER**

with the craftsman at the customers' location is similar to the methods employed in testing a PBX or TELETYPE machine. The tester should note, that the prime purpose of most of the electronic components of the DATASPEED TAPE SENDER UNIT is to convert the parallel binary DATA sensed by the "tape readers" sensing pins into a serial form so that it may be used to drive the DATA SET 202A. The high-speed tape reading unit is equipped with a three-position control handle — (RUN-STOP-FREE WHEEL), a "taut-tape" stop mechanism and "tape-out" sensing control. A magnetic pickup provides a pulse indication of each main shaft cycle, and a universal contact closure occurs with each character sensed. There is a parallel wired output of zero to twenty-eight volts negative dc for each marking bit sensed per revolution of the readers' main shaft. When the "tape reader" is sensing tape, the pulses from the magnetic pickup and universal contact closure are routed to the "transmitting signal converter". The "transmitting signal converter" performs two basic functions:

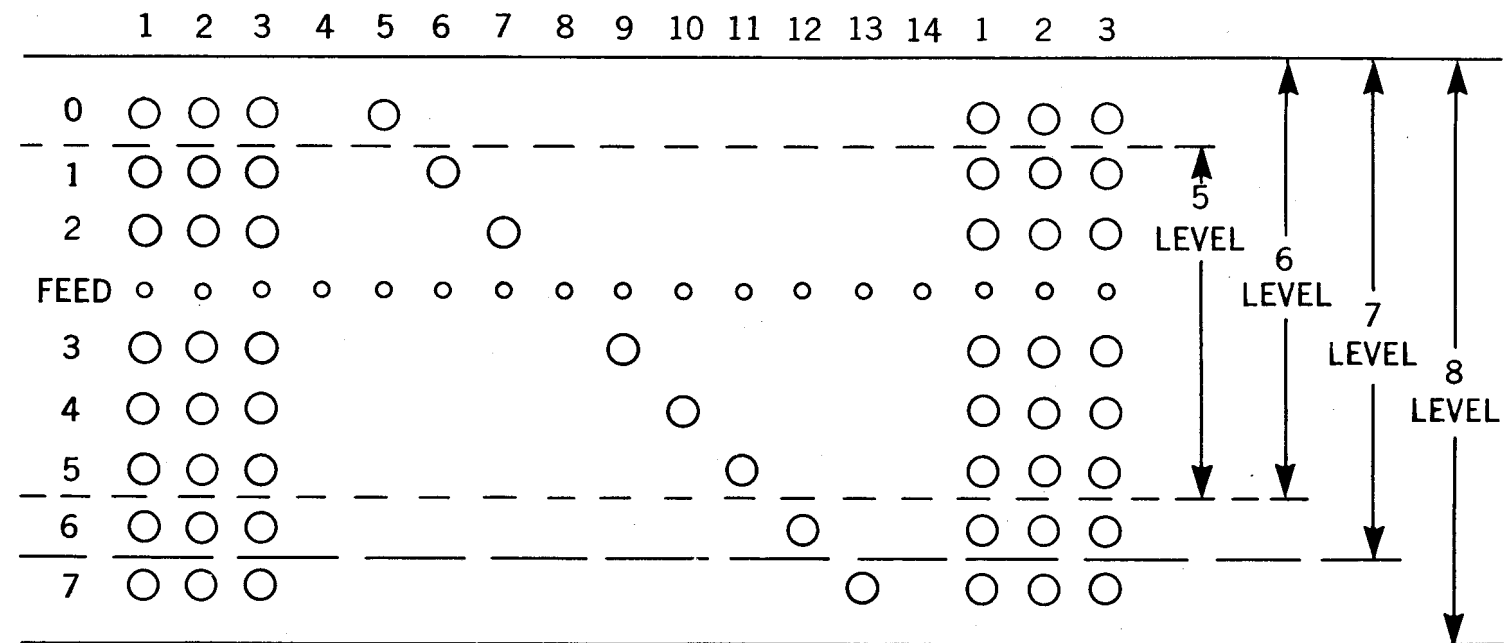
(a) The parallel wire pulses from the tape readers sensing pin contacts are shifted from a zero to twenty-eight volts negative dc to a zero to six volts negative dc operating potential.

(b) The serialized signal developed in the "transmitting distributor" is altered to meet the DATA SET 202A interface requirement of a negative six to positive six volts dc. The "transmitting distributors'" function is to serialize the tape readers' parallel output. The tape readers' pulses are range-sampled in the "transmitting signal converter" and arrive at the distributor's "shift register" in the form of detection "spikes". The coincidence of the magnetic pickup and the universal contact closure initiates the transmitting distributors' cycle. As the cycle proceeds, the shift register is advanced, in order, causing the output signal to appear in serial form with the necessary "stop" and "start" bits added. This signal is returned to the "transmitting signal converter" as a standard binary serialized data signal suitable for driving a DATA SET 202A which, in turn, converts the data signals to voice-frequency tones ( $1200 \pm 20$  cps for mark and  $2200 \pm 20$  cps for space). These tones are transmitted over the DDD network and demodulated by the receiving DATA SET 202A and converted back to a standard binary

serialized data signal. This signal is then converted to parallel form and transferred to the punch magnets of the DATASPEED TAPE RECEIVER UNIT.

## 9. TESTS BETWEEN A DATA TEST CENTER AND REMOTE LOCATIONS

9.01 DATASPEED tests that can be performed with the DATA TEST CENTERS' 905A DATA TEST SET are restricted, in general, to receiving or transmitting DATASPEED signals. The received signal is error checked by the associated 902 DATA TEST SET. The tests shown in this section constitute the minimum amount of possible tests to be made to assure reasonable service. The 905A DATA TEST SET has the capabilities of transmitting or receiving in addition to the *14 CHARACTER TEST CODE* the following test codes: *LETTERS, BLANKS, REVERSALS* and with an optional "*ALTERNATE LETTERS — BLANK DIODE PLUG ASSEMBLY*" a test pattern consisting of an alternate *LETTERS — BLANK* signal, which is useful in determining malfunctions of the DATASPEED UNITS' power supply. Section 314-825-502 Issue 2, describes the additional tests. For a description and illustration of tests between a DATA TEST CENTER and remote DATASPEED locations, see Section 314-825-500, Issue 2.



**Note:** The 905 DATA TEST SET is capable of generating this pattern, inserting stop and start bits, and as necessary, the unused bits, when less than 8-level transmission is employed.

Fig. 1 - The DATASPEED 14 Character (140 Bit) Test Message