SWITCHED SERVICES NETWORKS USING CENTRAL OFFICE SWITCHING MACHINES TRANSMISSION TESTING METHODS IN 2-WIRE NO. 5 CROSSBAR OFFICES

CONTENTS PAGE

1. GENERAL

1.01 This section describes methods for transmission testing in 2-wire No. 5 crossbar offices. The methods are based on the use of the 17E testboard and associated facilities. These are class SS-3 offices in the hierarchy type SSN or outer ring offices in the hub type SSN. These arrangements are described in Section 310-200-100. The tests described in this section are performed to meet the requirements on circuit orders and at routine intervals as specified in Section 310-200-300.

1.02 Part 2 of this section dealing with transmission tests on network trunks describes the procedures to be used in a control office. If the distant office is also a 2-wire office, it may also refer to this part of the section when assisting with the tests. When the distant office is a 4-wire office, it will normally have control, and the 2-wire office will assist on tests as described in Section 310-200-500.

1.03 Parts of this section dealing with tests on access lines and subscriber lines assume that the testman at the distant PBX or station will call in when ready for tests and will then assist in tests under the direction of personnel at the 17E testboard.

1.04 Description of the 17E testboard and its operation will be found in Section 310-281-100 and associated sections. It is necessary that the milliwatt supplies and transmission measuring equipment be carefully calibrated in accordance with their associated sections, and that all test pads be carefully adjusted in accordance with Section 310-281-300.

1.05 The following test equipment may be required for the various tests covered by this section:

(1) KS-19260 Oscillator and 23A TMS or KS-19353 Oscillator and 23A TMS or 21A TMS and 2AB Auxiliary Test Set or Northeast Electronics TTS-4 equipped with variable cover.

(2) 6D Noise Measuring Panel or 3A Noise Measuring Set and 6A Impulse Counter.

(3) Envelope Delay Measuring Sets — KS-15877 Transmitter and KS-15878 Receiver, or equivalent.

The following sets may be useful:

(4) 901A or B Data Test Set

(5) 902A or B Data Test Set

(6) 903A or B Data Test Set

1.06 When making routine tests or trouble investigations requiring that a facility be taken out of service, customer release of the circuit must be obtained in accordance with administrative practices, before starting tests.

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When the circuit is restored to service, it should be reported in the proper manner and the customer notified, if appropriate.

1.07 When a testman is required at a PBX or subscriber station, he may also refer to this section when assisting on tests. Additional information on testing methods at PBXs is contained in Section 310-200-502. Additional information on testing methods at subscriber stations is provided in Section 310-200-503.

1.08 This section uses the terms expected measured loss (EML) and actual measured loss (AML). These terms are applied in the same manner as in the DDD network. They are defined in Section A304.478.01/E26.040.01.

1.09 The use of balance test lines, as prescribed in this section for impulse noise measurements, assumes that the test line is modified to eliminate the pulses of noise due to timed disconnect. Where the test line is not modified, it will be necessary to make the measurements on a manual basis.

1.10 Dial test lines are referred to in this section by their 100 series code designation or an equivalent. When dial test lines are terminated on a line link frame, they will generally be reached by pulsing forward an AB + 5 telephone number. When terminated on a trunk line frame, they may be reached by either an arbitrary NNX code or an NNX-XXXX telephone number. This arrangement is required in some offices to permit access and station lines to reach the dial test lines for testing purposes. It may be necessary to pulse forward four digits to reach the proper test lines at 4-wire offices. A local directory of test lines should be kept at each office.

1.11 Transmission tests are made using the transmission and noise measuring circuit per SD-95900-01. Circuits are connected to the TST-MEAS or 101-MEAS jack as appropriate for testing. When portable or bay-mounted test sets are to be used, they are connected through the transmission and noise measuring circuit using the VF IN jack, or to other test jacks as specified. A simplified diagram of the arrangement is shown in Fig. 1. For detailed instructions on operation of the circuit, see Section 310-281-501. Delay distortion measuring equipment is connected at the circuit patch bay, if provided. If not provided, it must be connected at the 2W IN jack of the No. 1 type term set.

1.12 It is expected that there will be very few circuits of the type requiring over-all singing point tests. In those cases where the tests are required on circuit order, the test requirements are furnished on the CLR card. The tests should be made with the 2D Singing Point Test Set as described in Section E36.150.

2. TESTS ON NETWORK TRUNKS

(A) General

2.01 This part of the section covers tests on network trunks between two 2-wire No. 5 offices. A typical arrangement of this type of trunk is shown in Fig. 2. Procedures are described for the control office, but the noncontrol office may also use this part when assisting in the tests. Where the distant office is a 4-wire No. 5 office, it will normally have control, and assistance is provided in testing as specified in Section 310-200-500.

2.02 In addition to the normal work that is done on circuit orders in advance of transmission testing, certain other tests should be made which can have an effect on transmission. They are:

(a) Over-all pulsing tests, particularly when the circuit consists of various facilities in tandem, in accordance with Plant Series Practices, Division 179.

(b) Echo suppressor tests in accordance with Sections E26.171 and E33.353, when suppressors are part of the circuit.

(c) Balance tests. These should be completed at both ends of the circuit in accordance with Section 310-200-550.

(B) Over-all Transmission Tests

2.03 ***1000-Cycle Loss Measurements —***

(a) Make Circuit Order Tests as follows:

Step 1 — Seize the trunk at its test jack and pulse forward the code to reach the distant Code 101 trunk, or equivalent.

Step 2 — When the distant office answers, request 1000-cycle test tone to be sent for a few seconds. Measure the received level using the TEST-MEAS jack.

Step 3 — Request the distant office to measure. Send 1000-cycle test tone for a few seconds and obtain the distant office measurement.

Step 4 — Record the AML. The meter readings are equal to −(AML) dbm.

(b) Routine tests are made to Code 104 if available. (Otherwise, proceed as in (a) above.) To test to Code 104 or equivalent, proceed as follows:

Step 1 — Seize the trunk at the test jack and pulse forward the code to reach the distant Code 104 test trunk or equivalent.

Step 2 — Listen or observe for the start signal. When received, send 1000-cycle test tones for 1-3 seconds.

Step 3 — Return to the measure condition. The distant test line will start to send 1000-cycle test tones. Read the received level. After a few seconds, the level will drop. Read the received level again.

Step 4 — Compute and record the AMLs. The first reading is the far-to-near measurement. The meter reading is −(AML) dbm. Subtract the second meter reading from the first reading. The result is equal to the AML for the near-to-far direction. Compare with the EMLs shown on the CLR card.

For more detailed information on the use of Code 104 test lines, see Section A702.685/E40.752.

2.04 ***Attenuation-Frequency Tests*** — These tests are made on circuit order if the trunk is not equalized. If the facility is equalized, these tests are superseded by those in Paragraph 2.07. To make these tests, proceed as follows:

Step 1 — Seize the trunk at the test jack and pulse forward the code to reach the Code 101 trunk or equivalent at the distant office. When the distant office answers, arrange to have test tones sent on each of the following frequencies in order — 300, 700, 1000, 2300, 3000 cps. The oscillator should be connected through the TEST-MEAS jack and VF IN jack at the distant testboard. (Note: Any one of several variable and step-type oscillators may be used. Regardless of type, the output should be measured to be 0 dbm at each frequency.)

Step 2 — Measure and record the received level at each frequency.

Step 3 — Arrange with the distant office to take measurements. Send test tone on each of the following frequencies in order — 300, 700, 1000, 2300, 3000 cps. (Check oscillator output for 0 dbm at each frequency.) The oscillator should be connected through the TEST-MEAS jack and VF IN jack.

Step 4 — Record the meter reading taken on each frequency at the distant office.

Step 5 — Compare the meter reading at each frequency with the meter reading at 1000 cycles. The difference in db is compared with requirements.

2.05 ***Steady Noise Measurements*** — Steady noise measurements must be made during the busy hour in both directions of transmission in order to show the worst condition. They may be made after the 1000-cycle or multifrequency loss measurements, while the circuit is in the test condition. Alternately, each office connects the noise measuring circuit to the circuit while the other office connects a termination (900 ohms in 2-wire offices). The tests may be made simultaneously. On routine tests, the following procedure may be used, with the control office coordinating, if balance test lines are available:

Step 1 — Alternately at each office, seize the trunk at the test jack and pulse forward the code to reach the balance test line at the distant end.

Step 2 — When ringing is tripped, patch the circuit to the noise measuring circuit and make a noise measurement.

Step 3 — Record the meter reading in each direction. Correct it by adding the AML and compare with requirements.

2.06 ***Impulse Noise Measurements*** — These measurements are required in both directions of transmission. They require a half hour of testing time during the busy hours to obtain the worst noise condition. The control office makes tests in one direction and coordinates the tests of the distant office in the opposite direction. The following procedure is used at either office:

Step 1 — The requirement is 59 dbrnc 0. The correction is equal to the 1000-cycle AML. Subtract it from 59 dbrnc 0. Set the level control on the 6A Impulse Counter to the corrected value. If the knob cannot be set to this value, use the next higher setting.

Step 2 — Seize the trunk at its test jack and pulse forward the code to reach the distant balance test line. After the ringing is tripped, patch the circuit to the 6A Impulse Counter through the cord circuit using conversion jacks.

Step 3 — Set the timer of the counter to 30 minutes and set it in operation per Section 103-620-100. The test will proceed automatically without attention from the testman. When the timer has stopped, read the counter.

2.07 ***Attenuation Equalization Tests*** — When the trunk is equalized to adjust the attenuation-frequency characteristics, these tests supersede the multifrequency tests of Paragraph 2.04. Section 310-200-300, Table 5 provides the requirements for several types of treatment. Other requirements to be met will be indicated by a code on the CLR card or by local instruction. The testman must know the requirements before proceeding. The procedure of Paragraph 2.04 may be used to set up the circuit and make measurements, with the following exception: Make tests at 100-cycle intervals in the range 300-1000 cps. Make tests at 200-cycle intervals in the range 1000-3200 cps. Subtract the readings from the 1000 cps reading and compare the differences with requirements.

2.08 ***Delay Equalization Tests*** — Special treatment may be provided to equalize the effect of envelope delay distortion. This consists of the use of delay equalizers. The equalizers are specified on the CLR card. They may be fixed or variable. When the equalizers are variable, the setting may be specified, or a nominal setting may be used for initial tests. The requirements for several types of treatment are indicated in Section 310-200-300, Table VI, and other special treatment may be specified in local instructions. The set of requirements to be met is indicated by a code on the CLR card or by local instructions. The testman must know the specific requirements before beginning tests. The tests require the use of the KS-15877 Transmitter and the KS-15878 Receiver or equivalents. Instructions on measuring techniques with this equipment are provided in Section E40.673.1. The test sets are connected at the circuit patch bay, if provided, or to the 2W IN jack on the No. 1 type term set. The test procedure is as follows:

Step 1 — Turn on the measuring equipment and allow it to stabilize for 30 minutes. Request the distant office to do the same.

Step 2 — Establish a talking circuit with the distant office via order wire and arrange to begin the tests.

Step 3 — Seize the trunk to be tested and pulse forward the code to reach the Code 101 trunk at the distant office.

Step 4 — Request the distant office to connect a delay test receiver. Connect the delay test transmitter to the proper test jack.

Step 5 — Proceed with delay measurements as specified in Section E40.673.1.

Step 6 — After completion of the above tests, request the distant office to connect a delay test transmitter. Connect a delay test receiver in place of the delay test transmitter.

Step 7 — Repeat the delay measurements in the other direction of transmission.

If adjustable equalizers are provided, the tests may be repeated with different settings until the requirements are met. If the requirements cannot be met with the equalizers specified on the CLR card, the equalizers should not be changed. The data should be forwarded through lines of organization for corrective action.

3. TESTS ON ACCESS LINES

(A) General

3.01 Access lines connect the 2-wire No. 5 crossbar office with the customers' PBXs. The PBX may be a No. 5 CENTREX, and the general arrangement is the same as in Fig. 2. This arrangement utilizes a carrier channel.

3.02 Other types of PBXs are used. When the distance is short, the line may consist only of cable pairs as shown in Fig. 3. When the distance is great, the line may consist of a carrier channel extended on cable pairs as shown in Fig. 4.

3.03 Tests to No. 5 CENTREXES are made to code test lines or to a jack-ended test trunk at the master test frame. Two-man tests are made in the usual manner if the office is attended, or by prearrangement if the office is unattended.

3.04 Tests to other PBXs equipped with dial test lines make maximum possible use of the test lines. Two-man tests are made to a jack-ended test line by prearrangement.

3.05 When PBXs are not equipped with dial test lines, all tests are made on a two-man basis by prearrangement, to a listed number appearance or manual appearance in the PBX switchboard multiple. The test procedures in this part of the section assume that prearrangements are made, and the distant testman calls in when available for testing.

3.06 In addition to the normal work associated with circuit orders, in advance of transmission testing, certain other tests should be made which can have an effect on transmission. They are:

(a) Over-all pulsing tests, particularly when the circuit consists of various facilities in tandem.

(b) Balance tests at the 2-wire office in accordance with Section 310-200-550.

(c) Balance tests at the PBX, if required, in accordance with Section 310-350-500.

3.07 The following procedures apply on all access lines with test jack appearances at the testboard. Those not equipped with test jacks must be tested using the TM jack at the master test frame.

(B) Over-all Transmission Tests

3.08 ***1000-Cycle Loss Measurements*** — Circuit order tests are made to terminations at the PBX as follows:

(a) No. 5 CENTREX — To equivalent 101 test jack at the MTF.

(b) Dial PBX — To jack-ended test line terminated as extension or to listed number appearance in the switchboard multiple.

(c) Manual PBX — To switchboard appearance. Proceed in the following manner:

Step 1 — Seize the circuit at the test jack and pulse forward the number to reach the PBX test jack or ring on the line.

Step 2 — When the distant testman answers, request that 1000 cycles be sent at 0 dbm. Measure and record the received level.

Step 3 — Request the distant testman to connect a TMS. Send 1000-cycle test tone. Obtain and record the level measured at the distant end.

Step 4 — Compute the AMLs. The measured level in each direction is −(AML) dbm.

Routine tests to PBXs not equipped with dial test lines are made in the same manner as circuit order tests. When dial test lines are provided, make routine tests in the following manner:

Step 1 — Seize the access line at the test jack and pulse forward the number to reach the distant milliwatt test line. Record the received level using the TEST-MEAS jack.

Step 2 — In the same manner, measure the far-to-near direction on all other access lines in the group. Record the received levels.

Step 3 — Compute the far-to-near AMLs as above.

Step 4 — Select an access line as a test circuit and pulse forward the number to reach the milliwatt test line again. Connect the test circuit to the measuring circuit through the TEST-MEAS jack.

Step 5 — Seize another access line in the same group and pulse forward the number to reach the distant balance test line. This will automatically loop through to the circuit connected to the milliwatt test line. Send 1000-cycle test tone on the second line. This step must be done at an adjacent position, unless the CONN cord of the second pair can be connected to a 900-ohm oscillator arranged to send 1000 cycles at −2 dbm.

Step 6 — Read and record the received level from the test circuit.

Step 7 — In the same manner, test all other access lines, leaving the measuring circuit connected at all times to the test circuit. Record the received level for all access lines.

Step 8 — Compute the AMLs for the near-to-far direction. Subtract the loop-around measurement for each access line from the measured received level of the test circuit when connected to the distant milliwatt supply. The difference is the AML in the near-to-far direction for each line.

3.09 ***Attenuation-Frequency Tests*** — Circuit order and routine tests are made in the same manner. They are made to jack-ended test trunks or switchboard appearances at the PBX as described at the beginning of Paragraph 3.08. If the facilities are to be equalized, these tests are superseded by those in Paragraph 3.12. Proceed in the following manner:

Step 1 — Seize the access line at the test jack and pulse forward the number or ring on the line to reach the distant PBX test jack or switchboard appearance.

Step 2 — When the distant testman answers, request that an oscillator be connected to the test jack and arranged to send at 0 dbm for several seconds on the following frequencies: 300, 700, 2300, 3000 cps. The output oscillator at the distant end should be checked at each frequency. Measure and record the received level at each frequency.

Step 3 — Request the distant testman to connect a TMS to the distant test jack. Send test tones for several seconds on each of the following frequencies: 300, 700, 1000, 2300, 3000 cps. Obtain and record the levels measured at the distant PBX. The oscillator is connected through the TEST-MEAS jack and VF IN jack.

Step 4 — Subtract the measurements at each frequency from the measurements at 1000 cycles, and compare the differences with requirements.

3.10 ***Steady Noise Measurements*** — Steady noise measurements may be made on circuit order while the circuit is connected for 1000-cycle loss measurements. Proceed in the following manner:

Step 1 — Request the distant testman to connect a 900-ohm termination at the distant PBX. Connect the noise measuring circuit through the TEST-MEAS jack and make a noise measurement in accordance with Section E40.465.

Step 2 — Connect a 900-ohm termination to the test jack. Request the distant testman to make a noise measurement with a 3A NMS.

Step 3 — Record the meter readings. Correct them by adding the AML, and compare with the noise requirement. Routine measurements are made in the same manner as circuit order tests, when dial test lines are not available at the PBX. When they have been provided, measurements may be made to the PBX balance test line. The distant testman may make tests to the office code 100 test line or equivalent and report the measurements.

3.11 ***Impulse Noise Tests*** — These measurements are required in both directions of transmission. They require a half hour testing time during the busy hours. When a balance test line is not provided at the PBX, the test is made on a two-man basis. To make measurements, proceed as follows, for both circuit order and routine measurements.

Step 1 — Seize the access line at the test jack and pulse forward the code to reach the distant milliwatt supply, or dial or ring on the line to reach the distant testman and request that 1000 cycles be sent at 0 dbm.

Step 2 — Measure the AML. Subtract the AML from 59 dbrnc 0. Set the 6A Impulse Counter to this value. If it cannot be set exactly, use the next higher setting.

Step 3 — Connect the 6A Impulse Counter to the cord circuit through conversion jacks. Adjust it in accordance with Section E40.467 and set it to operate for 30 minutes. Note the counter reading at the end of this period.

Step 4 — Send 1000-cycle tone to the distant testman. The distant testman makes a measurement and computes the setting for his 6A Impulse Counter.

Step 5 — Connect a balance termination to the circuit. The distant testman proceeds to take a 30-minute impulse count.

3.12 ***Attenuation Equalization Tests*** — When attenuation equalization is required, these tests supersede the tests of Paragraph 3.09. Proceed as specified in Paragraph 3.09, but make tests at 100-cycle intervals in the range 300-1000 cps and 200-cycle intervals in the range 1000-3200 cps. Subtract each reading from the 1000 cps measurements and compare the differences with requirements.

3.13 ***Delay Equalization Tests*** (if required) — The procedure is the same for circuit order and routine tests. The test sets are connected to the jacks at the circuit patch bay, if provided, or to the 2W IN jack on the No. 1 type term set.

Step 1 — Seize the access line at the test jack and pulse forward the number or ring on the line to reach the distant testman.

Step 2 — Request the distant testman to connect a delay test transmitter. Connect a delay test receiver at the proper test jack. Be sure both units have stabilized for at least 30 minutes. Take measurements across the frequency ranges of interest.

Step 3 — Request the distant testman to connect a delay test receiver. Connect a delay test transmitter in place of the delay test receiver. Send toward the distant end across the frequency range of interest. Obtain the measurements made at the distant end.

Step 4 — If variable equalizers are provided, test on circuit order while making adjustments until requirements are met.

4. TESTS ON KEY STATION LINES

4.01 Key station lines are designed similar to access lines except that they are terminated in 2-wire telephone sets or key equipment. They are tested in the same manner as access lines to manual PBXs. The tests required depend on the type of facility used, as with access lines. Test arrangements required at the station are covered in Section 310-200-503.

4.02 An exception is an arrangement using E1L and E1S SF units or similar line equipment. These circuits do not have appearances at the 17E testboard. The tests may there-

fore be made from the TM jack at the master test frame or cross office using the Code 101 test jack. When testing lines from the TM jack, no test pads are involved.

4.03 Another exception involves noise measurements. When steady noise measurements are made on station lines at the testboard, the meter reading is always corrected by adding 4 db. Measurements made at the station are corrected by adding the AML. For impulse noise measurements, the 6A Impulse Counter is always set to 56 dbrn at the office. At the station, it is set to 59 dbrnc 0 minus the AML.

5. TROUBLE INVESTIGATIONS

5.01 The procedure for trouble investigation will depend somewhat on the trouble indicated and the nature of the facilities making up a circuit. When the trouble report does not definitely indicate the source of trouble, the circuit order test procedure should be followed. When a test requirement cannot be met, the circuit should be sectionalized and the trouble isolated before proceeding further.

5.02 Some troubles may be located by checking the following:

(a) ***DC Tests on Cable Pairs*** — If cable facilities are included in the circuit, verify that tests have been made for opens, shorts, crosses, grounds, etc.

(b) ***Carrier System Tests*** — Verify that the carrier line, including repeaters, radio, etc, is lined up and satisfactory for service, or has been routined within proper intervals.

(c) ***Carrier Channel Net Loss Tests*** — Verify that the carrier channel net loss tests have been completed and the channel satisfactory for service, or that the channel has been routined within the specified interval.

(d) ***Repeater Tests*** — Verify that all repeaters have been tested or routined and adjusted for proper gain as specified on the CLR card.

(e) ***SF Unit Tests*** — Verify that SF unit tests have been made on routine performance in accordance with appropriate practices.

(f) ***DX Unit Tests*** — Verify that DX unit tests have been completed in accordance with Section A220.684.

(g) ***Over-all Pulsing Tests*** — Verify that over-all signaling and pulsing tests have been made in accordance with appropriate sections.

(h) ***Echo Suppressor Tests*** — If specified in the CLR card, verify that the echo suppressors have been cross-connected and that functional tests have been completed or routines made in accordance with Section E26.171, or E33.353.

(i) ***Office Balance Tests*** — Verify that office balance tests on the circuit have been completed per Section 310-200-550.

(j) ***PBX Balance Tests*** — If the circuit terminates in a PBX requiring balance tests, verify that the tests were satisfactorily completed per Section 310-350-500.

(k) ***Office Drop Loss Tests*** — Verify that all cross connections, adjustments and pad settings have been made by making office drop loss tests at the near end of the circuit. See Section 310-281-500 for methods using the 17E board. P pad values or repeater gain settings should not vary from specified values by more than 1.0 db. If the office drop losses still remain out of limits and no trouble can be found, the problem should be reported through lines of organization.

5.03 When trouble reports are received concerning data transmission, and it is not clear whether the trouble is in a circuit or in station equipment, it is advisable to make circuit tests using the 900 series portable test sets and attempt to isolate the trouble before starting the more extensive circuit order tests. The sets are covered by Sections 107-200-100 and 107-300-100.

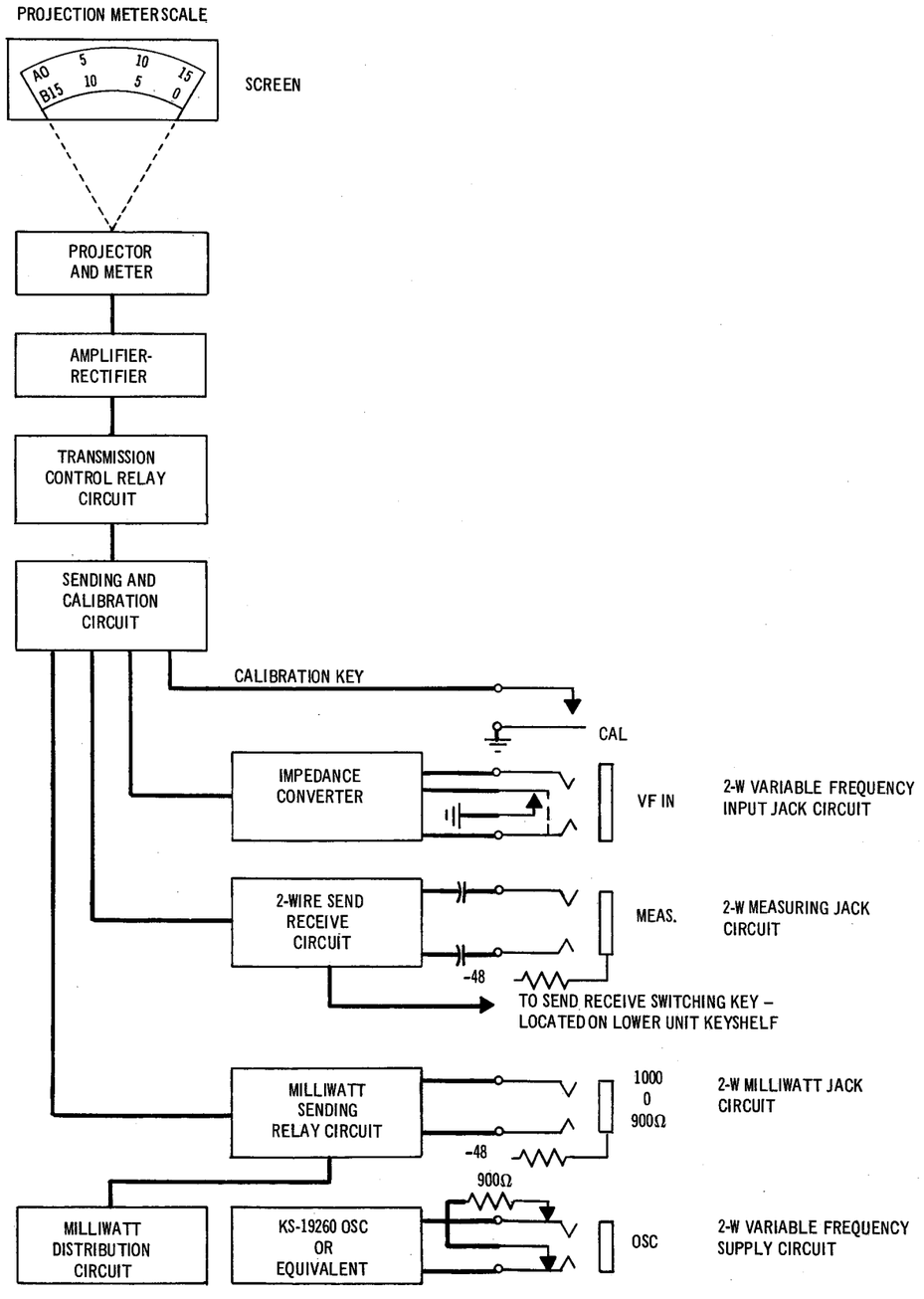

Fig. 1 – Typical Arrangement of Transmission and Noise Measuring Circuit per SD-95900-01 for 17E Testboard

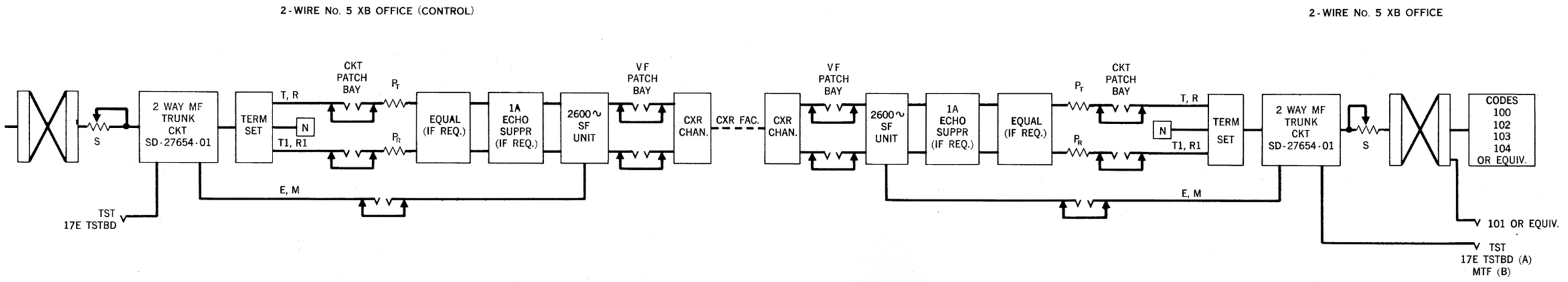

Fig. 2 – Typical Arrangement of

(A) Network Trunk Between Two 2-Wire No. 5 Offices

(B) Access Line to No. 5 CENTREX

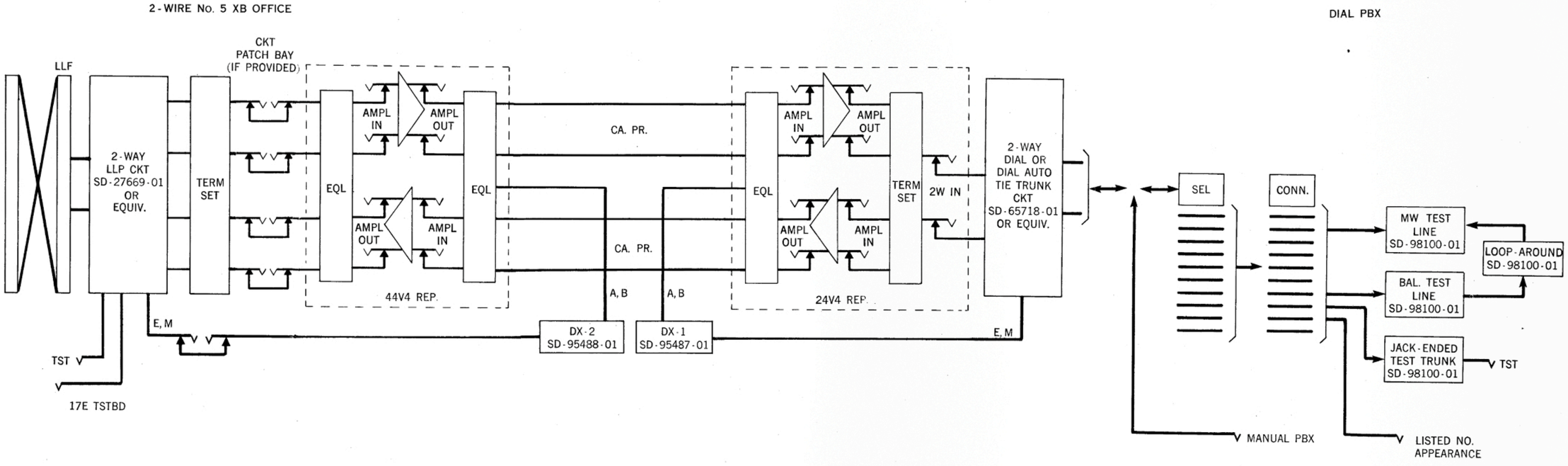

Fig. 3 – Typical Arrangement of an Access Line from a 2-Wire No. 5 Office to a PBX on Cable Pairs

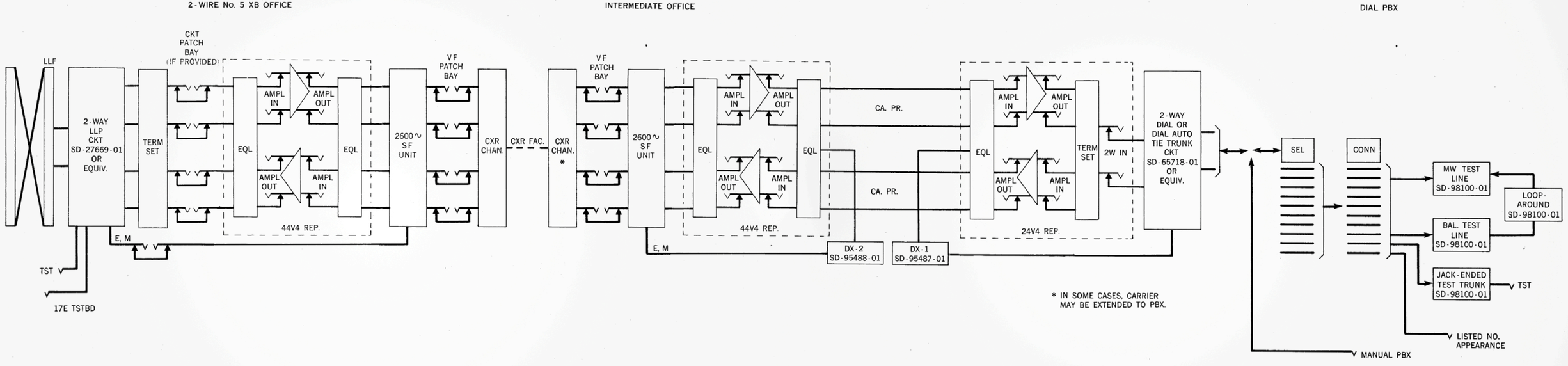

Fig. 4 – Typical Arrangement of an Access Line from a 2-Wire No. 5 Office to a Dial PBX on Carrier and Cable

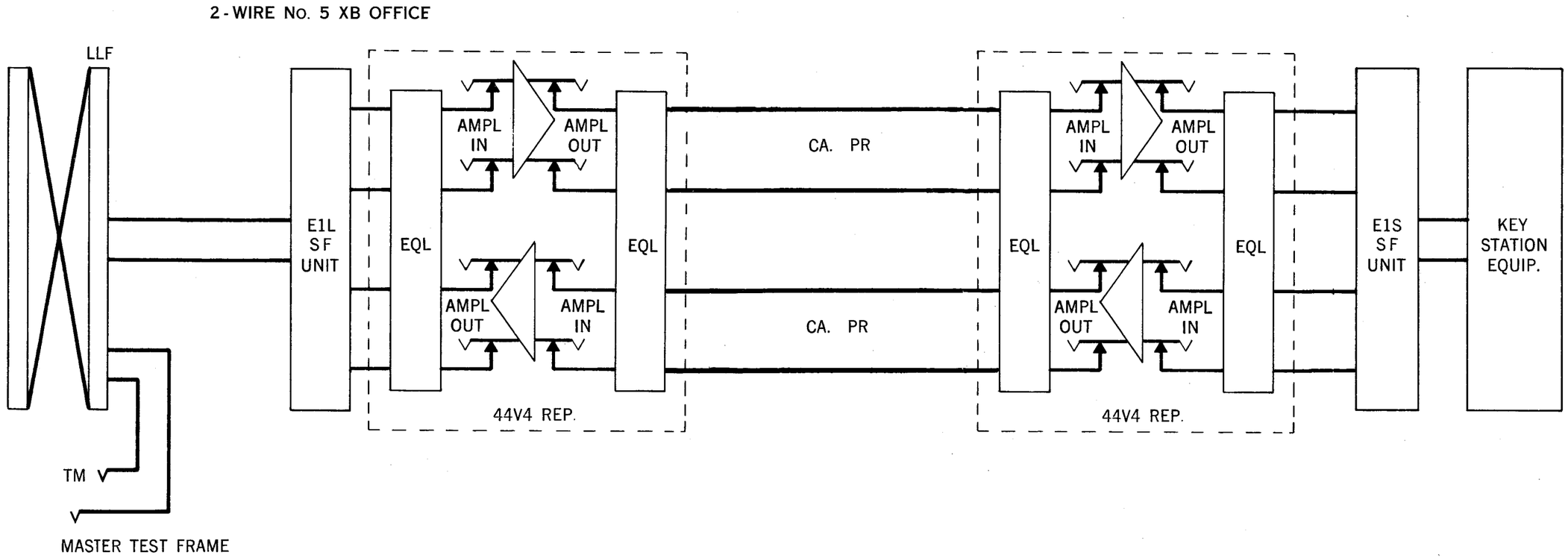

Fig. 5 – Typical Arrangement of a Key Station Line