LOCAL AREA DATA CHANNELS
TESTS AND REQUIREMENTS

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FIGURES

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1. GENERAL

1.01 This section provides the test procedures to be performed on a Local Area Data Channel (LADC) during installation and maintenance periods. These channels provide for baseband transmission of data signals between two customer terminal locations, within a serving wire center area.

1.02 Whenever this section is reissued, the reason for reissue will be listed in this paragraph.

1.03 LADC's use nonloaded metallic facilities exclusively, with limited amounts of bridged tap. The facilities may reside entirely within the customer premises or may be routed through the Serving Central Office (SCO). When the facilities are routed through the SCO, some testing may be accomplished from the Local Test Desk (LTD).

1.04 The tests covered are the following:

LTD (One Employee) Tests

Test A—Foreign Voltage: This procedure checks for foreign voltage on the cable pairs. The test may be made at a data station, the SCO, or another convenient test access midpoint.

Test B—Insulation Resistance: This test checks the resistance between the cable pairs, and between the cable pairs and ground. The test may be made at a data

station, the SCO, or another convenient test access midpoint.

Test C—Loop Resistance: The loop resistance procedure verifies that the loop resistance of each cable pair meets the maximum DC resistance requirement for installation. For subsequent tests, this resistance value should meet the bench-mark resistance value recorded on the CLRC.

Test D—Insertion Loss: This measurement is made to verify that the channel meets the maximum insertion loss requirements for installation. This test also checks that load coils are not present on the cable pairs and associated bridged taps.

Test E—Background Noise: This test is made using the 6F Voiceband Noise Measuring Set (NMS) equipped with a 497D weighting network. This set is used to measure both, background noise and impulse noise counts. For best results, the measurement should be made during a busy-hour period in the central office.

Test F—Impulse Noise: The impulse noise test follows in sequence along with the background noise test. The same apparatus and equipment are used for making both tests.

1.05 Tests A, B, and C are DC measurements that ***must*** be performed during installation periods. These tests may be made from one of the data stations or from a convenient test access midpoint, such as the SCO. During maintenance periods the tests are performed as required.

1.06 Tests D, E, and F are AC measurements that ***must*** be performed during installation periods. These tests are made at the data stations on and end-to-end basis. During maintenance periods the tests are performed as required.

A. Testing Responsibility

1.07 Initial trouble sectionalization to the TELCO provided service should be performed by the customer. Use of any and all data set testing features by the customer should be encouraged.

B. Test Access

1.08 When a LADC is routed through the SCO, DC tests A, B, and C may be made at the LTD. Access is obtained at the Main Distributing Frame (MDF) using MDF test cords which connect to LTD test trunks. When long test trunks are used, the resistance of the test trunks must be measured and subtracted from the overall loop resistance.

1.09 A typical arrangement showing test access to a LADC routed through a SCO is shown in Fig. 1. The pair identification T, R, and T1, R1 is for 4-wire channels. However, channels are also offered on a 2-wire basis and when provided, only the T, R leads are tested.

1.10 For end-to-end testing, test access is obtained at the data station terminal block. If 500Z channel protection units are used, the AC tests D, E, and F should be performed from the customer side (CT and CR terminals). Refer to Part 4.

2. TEST EQUIPMENT

2.01 This part provides a listing of the test equipment required for testing LADCs. In many instances equivalent test equipment may be used if the suggested test equipment is not available. Some examples of equivalent test equipment are given when applicable.

A. Apparatus Required for CO Testing

2.02 The test apparatus required when testing from the SCO is entirely contained in the LTD, 14-type, or 16-type. (One portable volt-ohm-milliammeter (VOM), KS-14510-L1, or KS-16979-L1, or equivalent, if an LTD is not available.)

B. Apparatus Required for End-to-End Testing

2.03 The following apparatus is required when testing end-to-end between the two data stations:

- One KS-14510-L1 multimeter or equivalent
- Two HP-3551A test sets or equivalent
- Two 6F NMSs or equivalent, with C-message and flat weighting network 497D

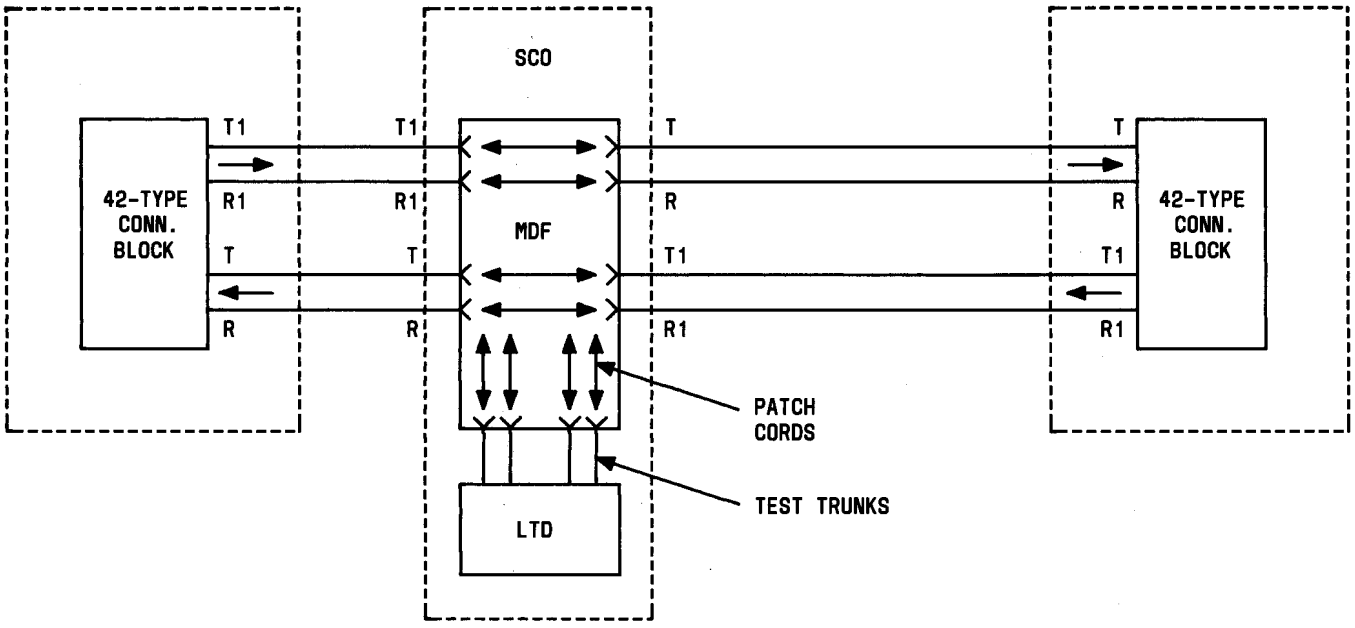


Fig. 1—Test Access to a Local Area Data Channel Routed through the Serving Central Office

- Two 135 ohm resistors, per wire pair.

3. OVERALL CHANNEL TESTS

3.01 This part provides the test procedures to be followed during installation and maintenance of LADCs. The procedures consist of DC and AC measurements performed between the two data stations, with the data sets disconnected. If any of the test requirements are not met, proceed according to instructions given in the Test Procedure or Section 314-410-311.

Required Tests

3.02 All of the tests (A through F) covered in this part ***must*** be performed during initial channel installation in the order given. Testing should be completed far enough in advance of the data sets installation, to allow time to locate and correct problems that may exist. For maintenance, perform the tests as required.

DC Tests

3.03 The following tests are performed on the cable pairs to locate foreign voltage, opens, shorts, crosses, or grounds:

Test A—Foreign Voltage
Test B—Insulation Resistance
Test C—Loop Resistance

Test A—Foreign Voltage

3.04 Test Procedure:

STEP	PROCEDURE
1	At each data station, disconnect the data set from the circuit and leave the cable pairs open-circuited.
2	At one data station, set the KS-14510-L1 meter range switch to the 60 VOLT DC scale.

STEP	PROCEDURE
3	Connect the meter to the following cable pairs and check for a voltage reading: T and R T1 and R1* T and GRD R and GRD T1 and GRD* R1 and GRD* * 4-wire channels ***Requirement:*** Voltage reading less than ±1 Vdc
4	If voltage readings meet the above requirement, proceed to the insulation resistance test procedure.
5	If a voltage reading exceeded the requirement on any wire or pair, the faulty pair must be repaired or replaced.

Test B—Insulation Resistance

3.05 Test Procedure:

STEP	PROCEDURE
1	At each data station, verify that the cable pairs are open-circuited and not shorted to each other or ground.
2	At one data station, set the KS-14510-L1 meter range switch to the OHMS by 10,000 scale and zero adjust the meter.
3	Measure insulation resistance between: T and R, R and R1* T and R1*, R and T1* T and T1*, T1 and R1* * 4-wire channels ***Requirement:*** Each insulation resistance reading must be greater than 300 Kohms.
4	Measure insulation resistance between: T and GRD R and GRD

STEP	PROCEDURE
	T1 and GRD* R1 and GRD*
	*4-wire channels
	Requirement: Each insulation resistance reading must be greater than 300 Kohms.
5	If the requirement of Steps 3 and 4 are met, proceed to the loop resistance test procedures.
6	If the requirement of Steps 3 and 4 are ***not*** met, the faulty cable pair must be repaired or replaced.

Test C—Loop Resistance

3.06 Test Procedure:

STEP	PROCEDURE
1	At one of the data stations, short the T, R pair.
2	At the other data station, set the KS-14510-L1 meter range switch to the OHMS X100 scale and zero adjust the meter.
3	Measure the resistance of the T, R loop.
	Requirement: The resistance reading must be less than or equal to the limit specified for the channel length provided, and the value is recorded as RL1 on the CLRC. If the test is not an installation test, then the loop resistance must equal RL1 ±20 percent. Refer to Table A for the DC loop resistance requirement.
4*	Remove the short from the T, R pair and place it across the T1, R1 pair.
5*	Measure the resistance of the T1 and R1 loop.
	Requirement: The resistance reading must be less than or equal to the limit specified for the channel length provided and the value is recorded as RL2 on the CLRC. If the test is not an installation test, then the loop resistance must equal RL2 ±20 percent. Refer to Table A for the DC loop resistance requirement.
6	If the requirement of Steps 3 and 5 are met, remove the short on the cable pair and proceed to the AC tests.
7	If the requirement of Steps 3 and 5 are ***not*** met, there may be a faulty cable pair. If faulty, the cable pair must be repaired or replaced.

STEP	PROCEDURE

Note: When the channel is routed through the SCO the loop resistance of each cable pair ***must*** be measured at the LTD and recorded on the CLRC for future reference. The end-to-end total DC resistance should be less than or equal to the limit specified in Table A for the channel length provided.

* 4-Wire Channels

TABLE A

DC LOOP RESISTANCE REQUIREMENTS

CHANNEL LENGTH (MILES)	MAXIMUM MEASURED DC RESISTANCE (OHMS)
1	500
2	1000
3	1500
4	2000
5	2500
6	3000

AC Tests

3.07 The following tests are performed on the channel to ensure that the insertion loss and noise requirements are met:

Test D—Insertion Loss
Test E—Background Noise
Test F—Impulse Noise

If the noise requirements cannot be met, the problem may be caused by pair imbalance. Refer this type of problem to the cable repair group.

Test D—Insertion Loss

3.08 When performed during initial installation, this test will verify that the channel meets the insertion loss requirements, and that load coils are not present on the cable pairs and associated bridged taps. The actual measured loss (AML) should be less than or equal to the insertion loss requirements given in Table B for the particular channel length being provided. The AML should be recorded on the CLRC as a bench-mark value. Insertion loss measured during a maintenance test must be within 3 db of value measured at installation; however, insertion loss must always be less than or equal to the limits specified in Table B.

3.09 This test requires two HP-3551A test sets or equivalent (one at each end).

3.10 Test Procedure:

STEP	PROCEDURE
1	After turning power ON and allowing the set to warm up for five minutes, operate the controls on each HP-3551A as follows: FUNCTION to REC TERM (blue) IMP to 135 RECEIVE to TONE NORMAL
2	Depress the DISPLAY & MONITOR SEND LEVEL pushbutton switch and set the SEND LEVEL RANGE dBm switch vernier to -10 dBm.
3	Depress the DISPLAY & MONITOR SEND FREQ pushbutton switch and set the SEND FREQUENCY RANGE switch and vernier to the applicable test frequency from Table B.
4	Connect the output terminals (black) to the transmit pair (T1, R1 for a 4-wire channel).
5	Connect the input terminals (blue) to the receive pair (T, R for a 4-wire channel).
6	Depress the DISPLAY & MONITOR RECEIVE LEVEL pushbutton switch to display the received test signal level. ***Note:*** To display the received test signal frequency, the DISPLAY & MONITOR RECEIVE FREQ pushbutton switch must be pressed in.
7	Read the received level and record the insertion loss on the CLRC or equivalent. ***Requirement:*** Refer to Table B ***Note:*** The Insertion Loss (dB) = Transmit Level (dBm) - Received Level (dBm). For example, if Transmit Level = -10 dBm and Received Level = -25 dBm, then Insertion Loss = -10 - (-25) = 15 dB.
8	Repeat Steps 3, 6, and 7 at each test frequency indicated in Table B for the particular channel length provided.
9	If test results meet requirements, disconnect test equipment from both ends and proceed to the noise measurements test procedures.
10	If test results do ***not*** meet the requirements, notify cable assignment desk and have the values of the expected measured losses (EML) checked on records.

TABLE B

INSERTION LOSS REQUIREMENTS FOR INITIAL INSTALLATION TESTS

CHANNEL LENGTH (MILES)	TEST FREQUENCY (KHz)	* MAXIMUM MEASURED LOSS (dB)
1	1.0	10.5
	2.4	12.0
	4.8	15.0
	9.6	19.0
	19.2	22.5
2	1.0	14.5
	2.4	16.5
	4.8	20.5
	9.6	27.5
	19.2	35.5
3	1.0	18.0
	2.4	21.0
	4.8	27.0
	9.6	36.5
	19.2	50.0
4	1.0	21.0
	2.4	26.0
	4.8	34.0
	9.6	46.0
5	1.0	23.5
	2.4	30.5
	4.8	39.5
	9.6	53.5
6	1.0	26.5
	2.4	33.0
	4.8	43.5
	9.6	58.5

*includes the 500Z channel protection unit losses

Test E—Background Noise

3.11 The background noise test will require two measurements: one using C-message weighting and the other using flat weighting. The desired weighting is obtained by proper orientation of the 497D weighting network when plugging it into the 6F NMS. At each end of the circuit, the following equipment or apparatus will be required:

One 6F NMS or equivalent, with C-message and flat weighting network (497D).

One 135 ohm resistor, per wire pair.

3.12 Test Procedure:

STEP	PROCEDURE
	Perform the following steps at both ends of the circuit:
1	Connect the 6F NMS and a 135 ohm resistor to the T, R pair as shown in Fig. 2.
2*	Connect the other 135 ohm resistor between the T1, R1 pair.
3	Plug in the C-message weighting network 497D on the 6F NMS and calibrate the set.
4	After calibration is complete, set the FUNCTION switch to 600 ohm/BRIDGE.
5	Adjust the DBRN dial to obtain a meter reading in the upper half of the meter scale. The background noise level is the sum of the DBRN dial setting and the meter reading. ***Requirement:*** Less than or equal to 11 dBrnC
6	Reposition the 497D network for flat weighted measurements, calibrate the set, and make sure the FUNCTION switch is set to 600 ohm/BRIDGE.
7	Adjust the DBRN dial to obtain a meter reading in the upper half of the meter scale. The background noise level is the sum of the DBRN dial setting and the meter reading. ***Requirement:*** Less than or equal to 28 dBrn
8	If BOTH background noise requirements are met, proceed to the impulse noise test procedures.
9	If any background noise requirement is ***not*** met, begin trouble repair work on the cable pair or request a new pair assignment.

* 4-wire channels

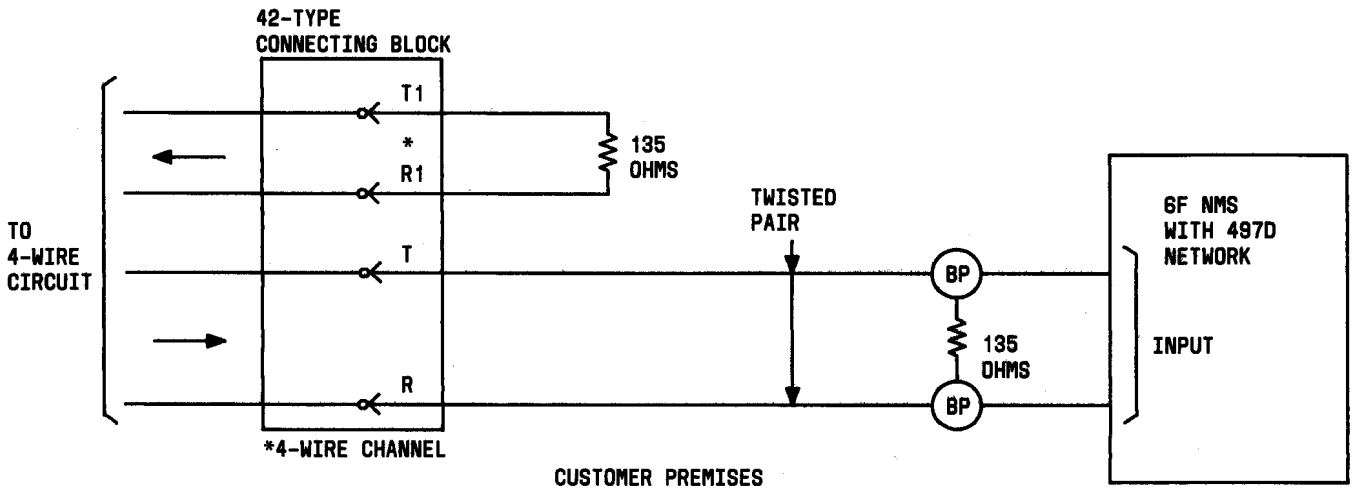


Fig. 2—Test Connection for Noise Measurements

Test F—Impulse Noise

3.13 Test Procedure:

STEP	PROCEDURE
1	Verify that the equipment is connected for flat weighted measurements, as given in Steps 1, 2, and 6 of 3.12.
	At both locations
2	Adjust the 6F NMS for an impulse noise threshold of 44 dBrn.
3	Reset the counter to 00 and make a 15 minute run. At the end of this time, read the total number of counts recorded on the counter.
	Requirement: Less than or equal to 15 counts/15 minute.
4	If the impulse noise requirement is met, disconnect all test equipment and test leads from the circuit.
5	Remove the 135 ohm resistors from the station terminal block.

STEP	PROCEDURE
6	If the impulse noise requirement is ***not*** met, request a new pair assignment.

3.14 If all the test requirements in part 3 are met, the channel should be suitable for service.

4. CHANNEL PROTECTION UNIT

4.01 This part contains descriptive information and procedures required for installing and maintaining the 500Z Channel Protection Unit (CPU) (Fig. 3), which is required at each end of a wire pair when customer provided data sets are used. ***Use of this unit does not negate the need for standard station protection as described in Section 460-100-400.***

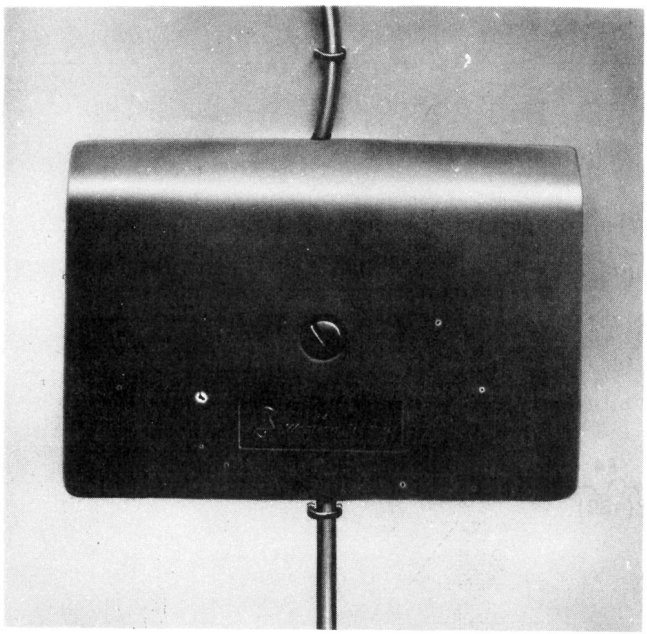


Fig. 3—Typical Installation of a 500Z Channel Protection Unit

A. Description

4.02 The 500Z CPU is a passive device designed to protect the facilities against hazardous voltage and longitudinal imbalance. The CPU provides a 2-wire interface between the data set and the telephone line. Where a 4-wire interface is required, two 500Z CPUs must be used.

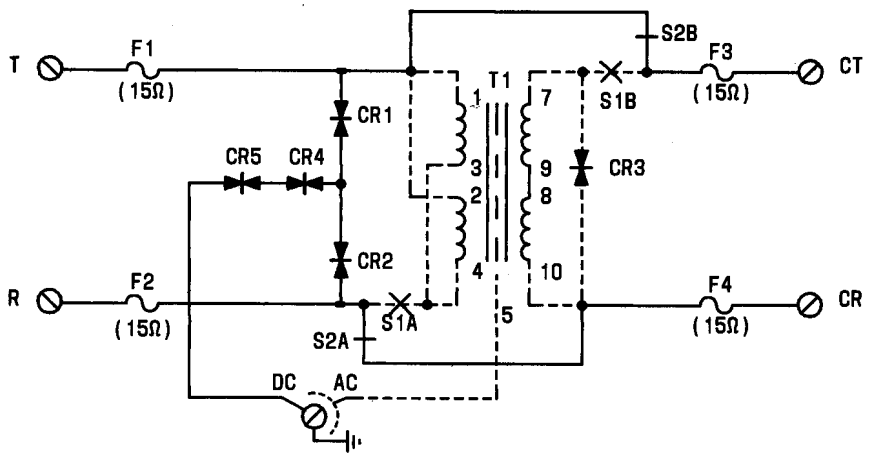
4.03 Figures 4 and 5 show the CPU protective circuit optioned for DC and AC, respectively. The DC option is used when the data sets require DC continuity for operational of maintenance purposes. The AC option is used when DC continuity is not required. One of the two options must be installed prior to placing the channel in service. The option to be installed should be specified on the service order.

4.04 The CPU protective circuit consists of an Isolation Transformer (T1), fuses F1 through F4, diodes CR1 through CR5, and screw switches S1 and S2. Each screw switch provides two screws (designated A and B) to be used for installing the DC or AC option in accordance with the procedures listed in 4.09.

4.05 The 500Z CPU, when assembled, is 4 inches long, 2.75 inches wide, 1.6 inches high, and weighs about 7 ounces. The CPU consists of a metal baseplate, a light gray plastic cover with center captive screw, and a printed wiring board (PWB). Two keyhole slots are provided in the baseplate for mounting the unit to a wall, a standard conduit box, or other flat surface. The light gray plastic cover of the CPU is made of flame retardant plastic and should not be intercharged with other covers (ivory or light olive gray) which may not have flame retardant characteristics.

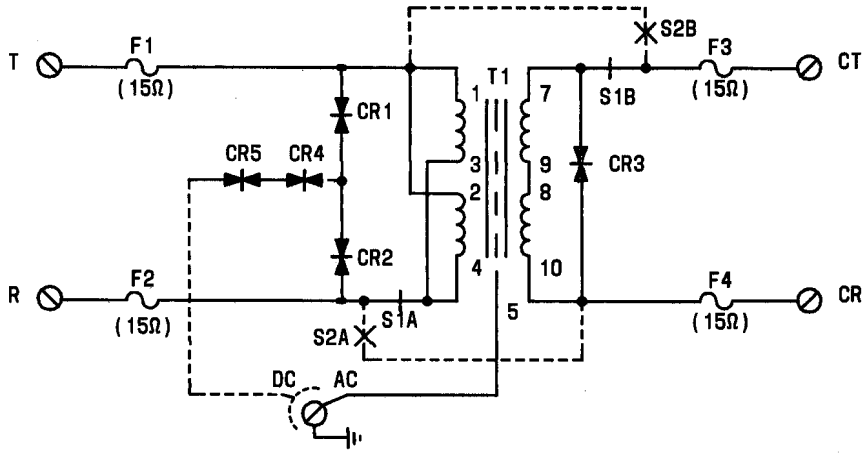
4.06 Two screw terminals (size No. 4 screws) are provided on the component side of the PWB for connecting the telephone line, and two screw terminals (size No. 4 screws) are provided on the printed wiring side of the PWB for connecting the station line. In addition, a third screw terminal is provided on the component side of the PWB for connecting the DC or AC grounding strap to a ground line.

4.07 The PWB can be inserted in the baseplate by placing one of the keying notches in the



NOTE: FOR DC OPTION-
S2 SCREWS CLOSED (—|—)
S1 SCREWS OPEN (—✕—)
DC STRAP GROUNDED
AC STRAP TAPED OR SLEEVED

Fig. 4—DC Protective Circuit



NOTE: FOR AC OPTION-
S1 SCREWS CLOSED (—|—)
S2 SCREWS OPEN (—✕—)
AC STRAP GROUNDED
DC STRAP TAPED OR SLEEVED

Fig. 5—AC Protective Circuit

PWB in the proper keying tab on the baseplate while pulling out on the other tab permitting the PWB to be snapped into place. The process is reversed for removing the PWB. The PWB is installed in the baseplate with only the customer tip (CT) and customer ring (CR) terminals accessible with cover removed. However, the PWB can be ***temporarily*** inserted in the baseplate with the tip (T) and ring (R) terminals accessible during installation and maintenance.

B. Installation

4.08 The installation of the 500Z CPU should comply with general practices to ensure orderly station arrangement and should be located in the vicinity of the station equipment.

(1) All installation connections and tests must be performed prior to connecting station equipment to the CPU.

(2) The loss and noise measurements must be performed with the CPU in place and properly optioned.

4.09 Install the 500Z CPU as follows:

(1) On the CPU, loosen the captive screw located in the center of the plastic cover and remove the cover. (Do not remove screw from cover which is to be reused on same unit.)

(2) Remove the PWB from the baseplate by pressing outward on one of the two metal tabs of the baseplate.

Do not remove the foam insulator from the PWB. This insulator is provided to prevent contact with the telephone line printed wiring circuits.

(3) Position the baseplate against the mounting surface at the correct location for the CPU. Secure the baseplate in place with two screws through the two keyhole slots provided.

(4) Temporarily insert the PWB in the baseplate with the T and R terminals and the S1 and S2 screw switches accessible.

(5) Install the DC or AC option specified on the service order (CPU is shipped with the AC option installed).

(a) For DC option:

- Tighten (clockwise) both screws in switch S2 on the PWB until contact is made.
- Loosen (counter clockwise) both screws in switch S1 by one complete turn.
- Connect the DC strap to the ground screw terminal.
- Insulate the AC strap with electrical tape or sleeving to prevent electrical contact with other components.

(b) For AC option:

- Tighten (clockwise) both screws in switch S1 on the PWB until contact is made.
- Loosen (counter clockwise) both screws in switch S2 by one complete turn.
- Connect the AC strap to the ground screw terminal.
- Insulate the DC strap with electrical tape or sleeving to prevent electrical contact with other components.

(6) Using an ohmmeter, ensure that the proper option is installed. A reading of approximately 30 ohms between the T and CT terminals, and between the R and CR terminals, indicates that the DC option is being used. No DC continuity should be observed between the same terminals when the AC option is used.

(7) Leaving enough wire length for the PWB to be repositioned so that the CT and CR terminals are accessible, connect the T and R leads from the telephone line to the T and R terminals on the PWB and a ground lead to the ground terminal (located next to the R terminal on the PWB). Standard station wire connected to a station protector ground terminal can be used for the ground lead. When a station protector is not present, refer to Section 460-100-400 Table D, to determine another acceptable grounding point.

(8) Perform the required insertion loss and noise tests at the customer interface (CT and CR terminals of the PWB), in accordance with proper procedures.

(9) After completion of testing, reposition the PWB in the baseplate so that the CT and CR terminal screws are accessible. Do not connect the customer interface leads to the CPU unless requested by and under the direction of the customer.

(10) Install the plastic cover on the CPU and secure the cover in place with the screw provided.

C. Maintenance

4.10 The following maintenance information is provided to assist the TELCO employee during maintenance visits to a station using a 500Z CPU. In all cases, the station equipment line must be disconnected in order to make tests and/or replace a defective CPU. The following precautions must be taken.

(1) Obtain permission from the customer before disconnecting the customer interface leads.

(2) Where possible, it is recommended that the power on the station equipment be turned OFF before the CT and CR leads are disconnected.

(3) After all testing is completed, make sure that the customer interface leads are reconnected properly.

4.11 Maintenance of a 500Z CPU station at the customer premises is limited to local testing, testing with serving or test offices, or replacing a defective unit.

Note: Do not attempt individual component repair or replacement on the PWB.

4.12 When a CPU is found to be defective (eg, 76A fuse blown by lightning or power cross) a properly optioned new unit should be installed.

4.13 If replacing the CPU does not correct the problem, perform a visual inspection and make sure that the applicable AC or DC option is properly installed. Correct any trouble found during the inspection.

5. REFERENCES

5.01 The following sections can be referenced for additional information:

SECTION	TITLE
100-520-101	KS-14510 Meter (Portable Volt-Ohm-Milliammeter) — Description and Operation
103-626-100	6F and 6FR Voiceband Noise Measuring Sets—(J94006F and J94006FR)—Description, Operation, and Maintenance
310-410-311	Local Area Data Channels—Maintenance Procedures
460-100-400	Station Protection and Grounds
634-310-501	Locating Cable Faults with the 96A Test Set
880-102-100	Local Area Data Channels—Engineering Guidelines