

## DATA COUPLING UNIT F-58118

### DESCRIPTION, INSTALLATION, MAINTENANCE, AND TESTING

CONTENTS	PAGE
1. GENERAL . . . . .	1
2. DESCRIPTION . . . . .	3
A. Physical Description . . . . .	3
B. Functional Description . . . . .	3
3. INSTALLATION . . . . .	4
4. MAINTENANCE AND TESTS . . . . .	8
A. Insertion Loss Test . . . . .	10
B. Interface Test . . . . .	12
C. Limiter Operational Test . . . . .	13

#### 1. GENERAL

1.01 This section contains installation and maintenance information for Data Coupling Unit F-58118 (Fig. 1 and 2). Detailed information is contained in ES- and CD-1D195-02.

1.02 The coupling unit is used to connect automatic data terminals to the telephone network. It consists of an automatic answering and origination control circuit, and a line coupling circuit. Normal voice telephone service can be provided externally. The unit will limit the signal power applied to the telephone line to a level that will maintain approximately -12 dBm maximum power at the serving central office. Out-of-band components of the signals, resulting from clipping, are filtered to protect other services. The uniform service order code (USOC) for this item is CDR (*without* telephone company-provided power), or CDP (*with* telephone company-provided power).

1.03 The customer must be informed at the time the unit is installed of the maximum permissible output level of his apparatus. This maximum

permissible output level will vary between 0 and -8 dBm in 4-dB steps, depending on the 1000-Hz loss of the local loop plus the insertion loss of the coupler. The output level of the customer's apparatus is the power measured at the customer interface into a 600-ohm resistive load. The unit will be adjusted to clip signal peaks when the peak power level exceeds the permissible level. This adjustment will be 0, -4, or -8 dBm.

*Note:* The maximum permissible level must be marked on the unit at the time of installation.

1.04 Power for the control circuit is obtained from the customer-provided terminal. The furnished power must be between  $\pm 18$  and 26 volts dc, with a corresponding current drain between 36 and 50 ma. As an option, the customer may request the telephone company to furnish the power at an additional charge. A suitable power source is the 28A1 power unit (Section 167-445-101) or the 19B2 power unit (Section 167-440-201).

1.05 Any telephone set equipped with an exclusion key, or equivalent, may be used to provide voice communication. The internal connections to the exclusion (talk) key must be rewired so the key can be used to transfer between the talk and data modes of operation.

1.06 The service offering in which the unit is used provides the customer with end-to-end transmission performance essentially equivalent to DATA-PHONE® service. Because the customer's apparatus, over which the Bell System has no design control, may contribute significantly to error performance, the Bell System cannot assume responsibility for the accuracy of the transmitted data. The end-to-end facilities, including the local loop, will be adjusted and maintained to the DATA-PHONE service requirements. These requirements are specified in Section 314-205-501 for local loops and Section 314-205-500 for the DDD network.

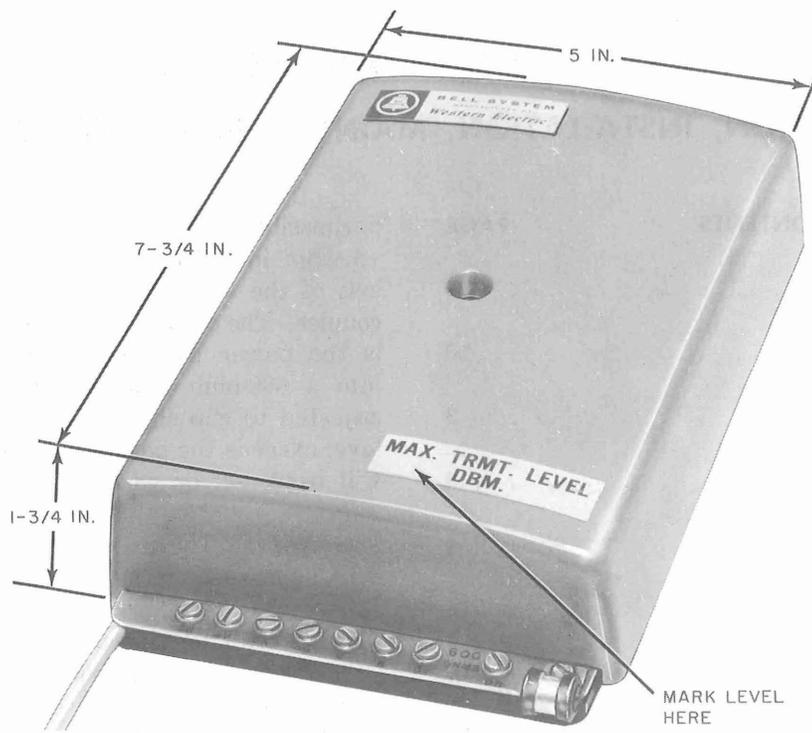


Fig. 1—Data Coupling Unit F-58118

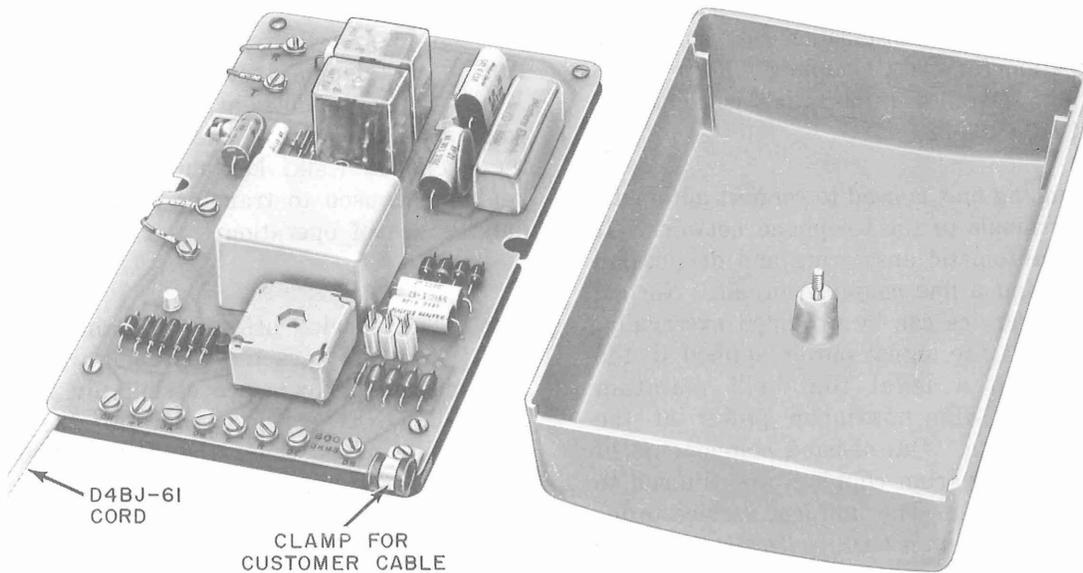


Fig. 2—Data Coupling Unit, Interior View

## 2. DESCRIPTION

### A. Physical Description

**2.01** The data coupling unit is a wall-mounted unit measuring 5 inches wide, by 7-3/4 inches high, by 1-3/4 inches deep. The unit weighs 1-3/4 pounds. The unit is constructed of a black metal base and has a gray plastic cover. Slots on the base are provided for mounting the unit on a wall or other vertical surface.

**2.02** The unit contains one printed circuit pack which contains the active circuitry for the unit. Eight screw terminals are provided for connecting the customer's apparatus. See Table A for the designation of each lead present at the interface terminals. A D4BJ-61 cord is included for connecting to the telephone line (Fig. 2). Terminals located on the circuit pack are strapped by the installer to adjust the clipping level of the unit.

**TABLE A**

**INTERFACE LEAD DESIGNATIONS**

LEAD	DESIGNATION
DR	DATA RING
DT	DATA TIP
R	RING INDICATOR
C	COMMON (RETURN FOR CONTROL SIGNALS)
DM	DATA COUPLER READY
DA	DATA MODEM READY
+V	POSITIVE VOLTAGE
OH	OFF-ON HOOK (DIAL PULSING LEAD)

### B. Functional Description

**2.03** The coupling unit provides a contact closure which indicates to the business machine that ringing signals have been detected. The closure follows the ringing, ie, closes and opens each half-cycle. The business machine, in response to the contact closure, provides signals which cause the unit to seize the line, trip ringing, and cut through the transmission path. A 2- to 5-second

delay is provided to allow time for network switching and supervisory functions before the transmission path is completed. A limiter circuit and low-pass filter are provided to protect the telecommunications network. Provisions also permit the business machine to originate calls automatically. A block diagram of the unit is shown in Fig. 3, and a more detailed description of operation is provided in the following paragraphs.

#### **2.04 Automatic Answering:**

Ringing causes the R relay to operate and release during each half-cycle of the 20-Hz signal. The R relay contact closes for about 50 percent of the period of the ringing signal, providing a contact closure to C for the business machine. (Dial pulsing may cause the R relay to operate momentarily.) When the business machine is ready and is satisfied that ringing has been received, the OH lead is closed. The OH relay operates and closes the loop. To complete the establishment of the data transmission path, the business machine closes the DA lead to C. (The DA and C leads can be connected [closed] at all times except during the dialing interval.) The timer causes a 2- to 5-second delay and then the DM relay operates, removes the low resistance shunt from the line, and closes the DM lead to C to indicate to the business machine that the line may be used to transmit data.

#### **2.05 Transmission:**

The transmission path is shunted by an optional selection of varistors to limit the level of the customer signals. The customer signals pass through a low-pass filter to reduce the out-of-band components of any clipped signal. This prevents the signals from causing disturbance to the DDD network. The signals then pass through the transformer and the OH contact to the telephone line.

#### **2.06 Call Origination:**

The OH and DA leads are closed to C by the business machine to initiate a call. When the DM contact closes, the business machine may detect dial tone or assume it is present and initiate blind dialing. The DA lead is opened and the OH lead is pulsed to generate dial pulses. The pulsing sequence and timing requirements are as follows: (see Fig. 4)

- (1) Open DA.
- (2) Delay 20 msec.
- (3) Open OH for 50 msec.

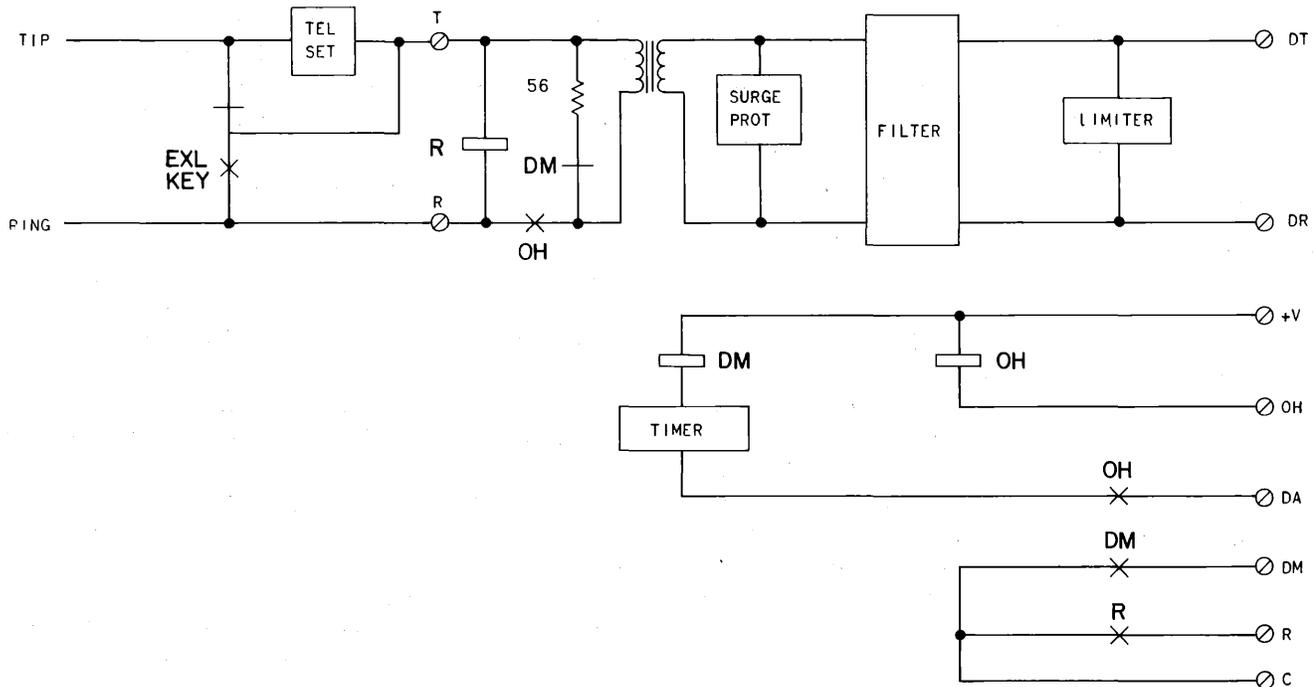


Fig. 3—Data Coupling Unit, Block Diagram

- (4) Close OH for 50 msec.
- (5) Repeat 3 and 4 for the number of pulses, eg, a total of 5 openings of OH for the digit 5.
- (6) After the test pulse of a given digit, delay 600 msec and start the first pulse of the next digit.
- (7) After all digits have been generated, close both OH and DA.
- (8) After a 2- to 5-second period, the DM lead closes and the business machine can wait for an indication that the called station has answered.

**2.06** Regular telephone service may be provided on an optional basis. The exclusion key, or equivalent, must be wired so that the coupling unit is connected to the line when the handset is on-hook. The key can be operated to permit use of the telephone. The coupling unit may also be used with key telephone equipment.

**2.07** The circuit paths between the tip and ring terminals and transformer are bi-directional. This permits received signals to be coupled to the customer's apparatus, unaltered except for incidental filtering of out-of-band frequencies. In half-duplex operation, the level of the received signals will be well below the threshold of limiting; therefore, the detector and limiting circuits will not be activated. In full-duplex operation, the received signals will be degraded whenever the transmitted signals exceed the permissible level.

**2.08** Answer tones, reverse-channel signals, etc, are not provided by the coupling unit. The customer must provide these signals when desired.

### 3. INSTALLATION

**3.01** The coupling unit must be mounted vertically on the wall near the terminal block to which the telephone line is connected. The telephone set, if used, should be placed near the customer's apparatus so the operator can easily operate the talk key and the controls on the customer's apparatus.

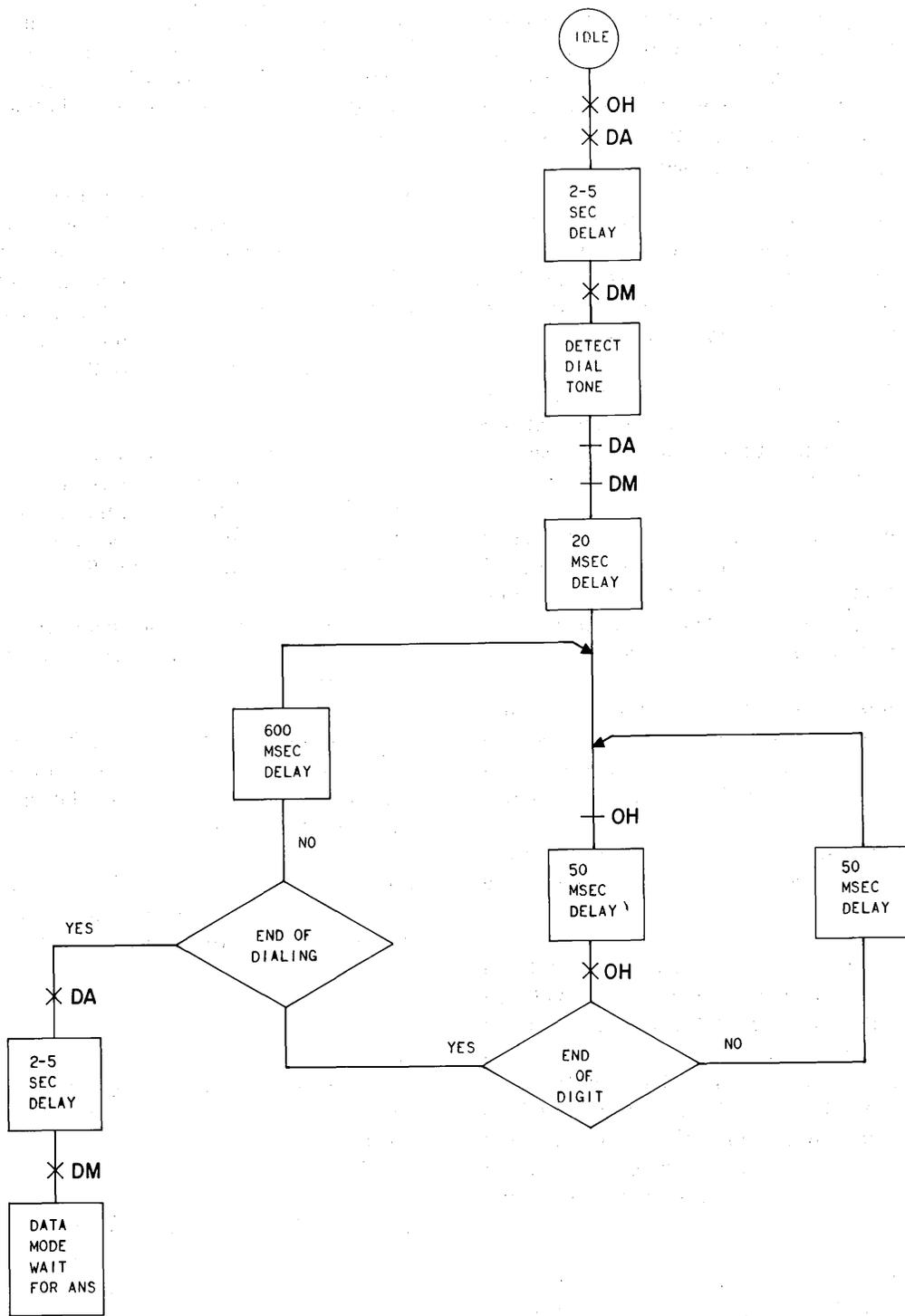


Fig. 4—Automatic Calling Sequence Diagram

## SECTION 590-103-102

**3.02** The coupling unit must be located within range of the interface cord provided by the customer. The length of this cord is determined by the ability of the customer-provided terminal to properly present and detect the signals at the coupler interface. An arrangement using 50 feet of 24-gauge copper wire is typical.

**3.03** The unit is fastened to the wall with two screws. The screws should be driven into the wall 4-1/4 inches apart, and not less than 4-1/2 inches above the top of the baseboard or other obstruction which will be below the unit.

**Note:** Remove the cover by loosening the screw in the center of the cover and use the chassis as a template to mark the positions of the screws.

**3.04** The unit and telephone set are connected in accordance with the wiring diagram in Fig. 5. Terminal location is shown in Fig. 6. A cable clamp (Fig. 2) is provided to serve as a strain relief for the customer cable.

**3.05** The exclusion key on the telephone set must be rewired to provide the necessary talk and data control functions. Figure 7 shows the rewiring necessary for a 502-type telephone set.

**3.06** When the coupling unit is to be associated with key telephone equipment, connect the unit as shown in Fig. 8.

**3.07** The coupling unit is adjusted to limit the customer signal power to a level which will not exceed a -12 dBm signal level at the serving central office. The 1000-Hz insertion loss of the local loop must be known and added to the 2-dB insertion loss, at 1000 Hz, of the coupling unit to arrive at the maximum allowable customer level. If the insertion loss of the loop is not known, perform the insertion loss test as outlined in Part 4.

**3.08** Table B shows the level option terminals that may be strapped for a particular installation. The known combined loss of the loop and coupler, or the value measured in the insertion loss test determine the row to use in Table B under the LOOP AND COUPLER INSERTION LOSS column. The intersection of this row and the LEVEL OPTION TERMINALS column determines the appropriate terminals to be strapped on the

coupler. Strap the proper terminals using 24-gauge bare wire, firmly seated to ensure good contact. Example of strapping: When the measured, or known, combined loss of the loop and coupler is 8.3 dB, a strap should be placed between terminals A and B.

**3.09** The maximum allowable customer signal level is the same as the level option strapped. This value is determined by the OPTION LEVEL STRAPPING column in Table B. Record the value, with pencil or ball-point pen, on the label on the cover of the coupling unit (Fig. 1). Using the example in 3.08, "-4" would be marked on the label.

**3.10** A 2-dB pad, F-58102, must be installed on a local loop which has an insertion loss of 0 or 1 dB (see Table B). Install the pad on a wall or vertical surface near the coupler. Connect the 2-dB pad as shown in Fig. 9.

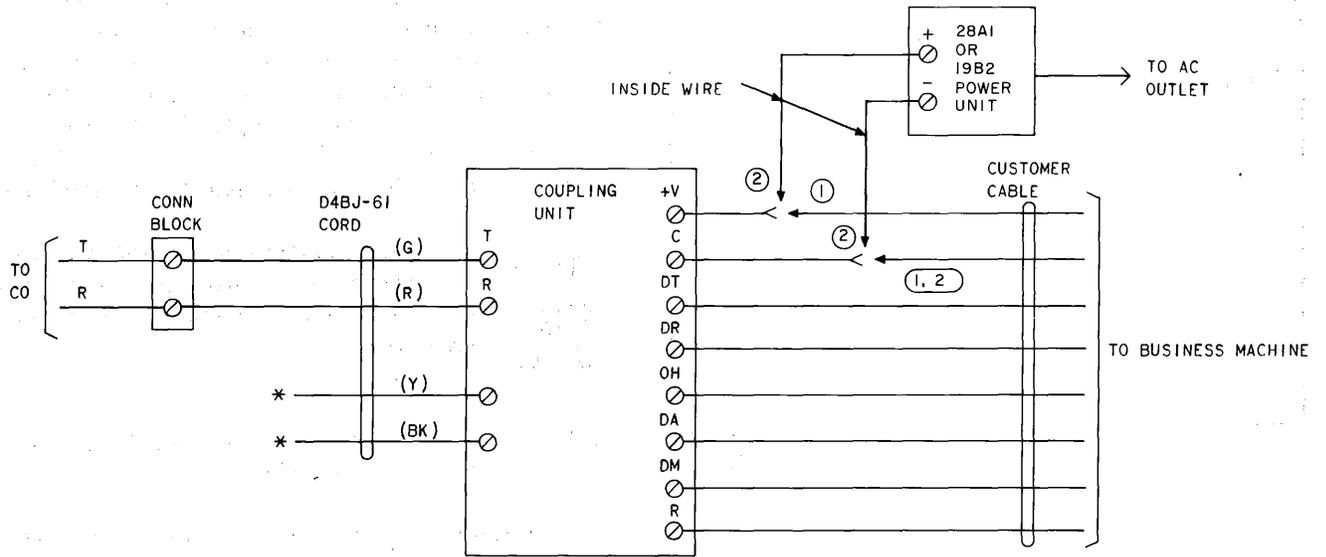
**Note:** The data set connections in Fig. 9 are to be made to the coupling unit in conjunction with Fig. 5.

**3.11** To determine if the coupling unit is presenting, or responding to, the proper conditions on the control leads, perform the interface test as outlined in Part 4.

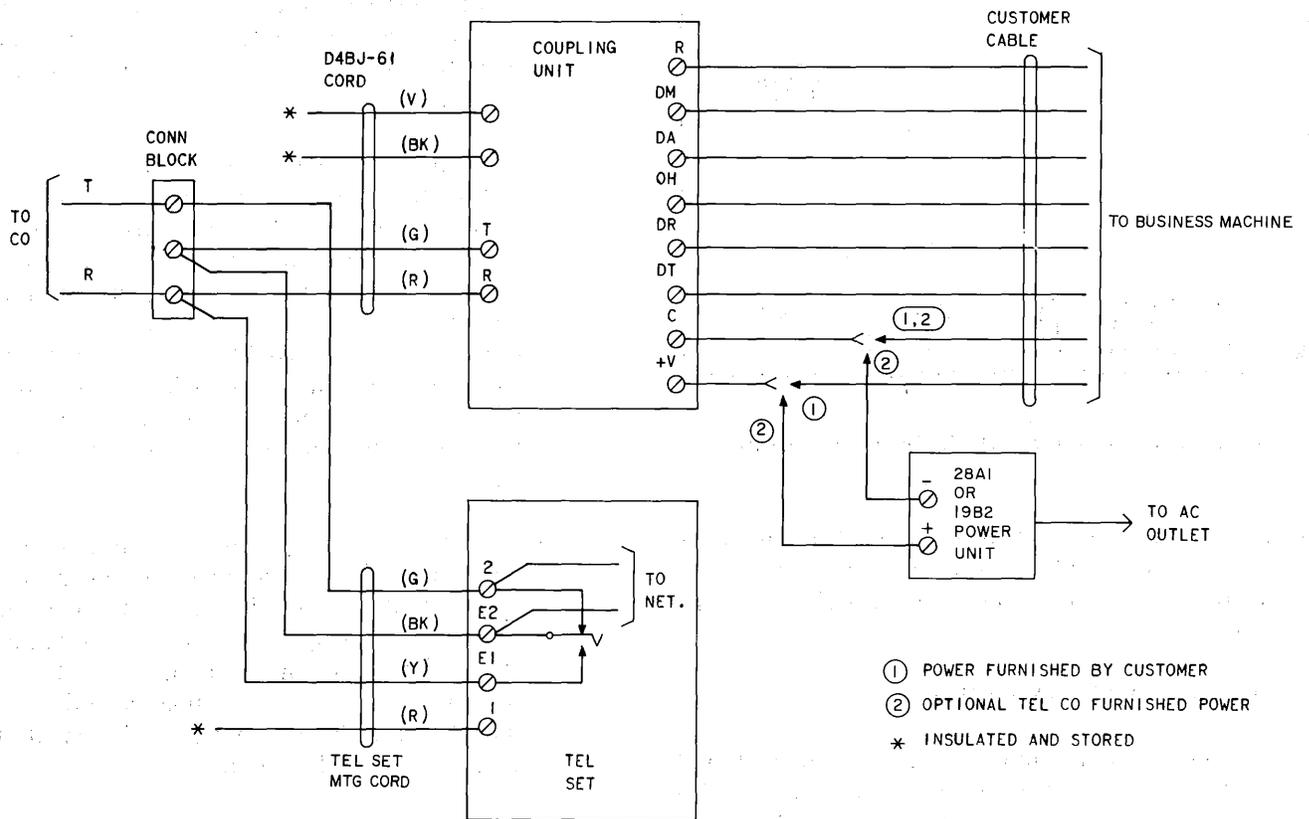
**3.12** The level limiting function of the coupling unit must be checked after installation. Perform the limiter operational test as outlined in Part 4.

**3.13** All level measurements and test results made during installation must be recorded on a line trouble history card to assist in analyzing future trouble.

**3.14** In the event the appropriate ac power source is not available at the customer's location for performing the installation tests, the installer must provide a coupling unit that has been properly tested and known to be in good working condition. Add the 2-dB insertion loss of the unit to the estimated measured loss (EML) of the assigned loop. This combined loss of the loop and coupler is used with Table B to determine the proper level option terminals to be strapped. Strap the appropriate terminals as indicated in 3.08.



A. WITHOUT TELEPHONE SET



B. WITH OPTIONAL TELEPHONE SET

- ① POWER FURNISHED BY CUSTOMER
- ② OPTIONAL TEL CO FURNISHED POWER
- \* INSULATED AND STORED

Fig. 5—Installation Wiring Diagram

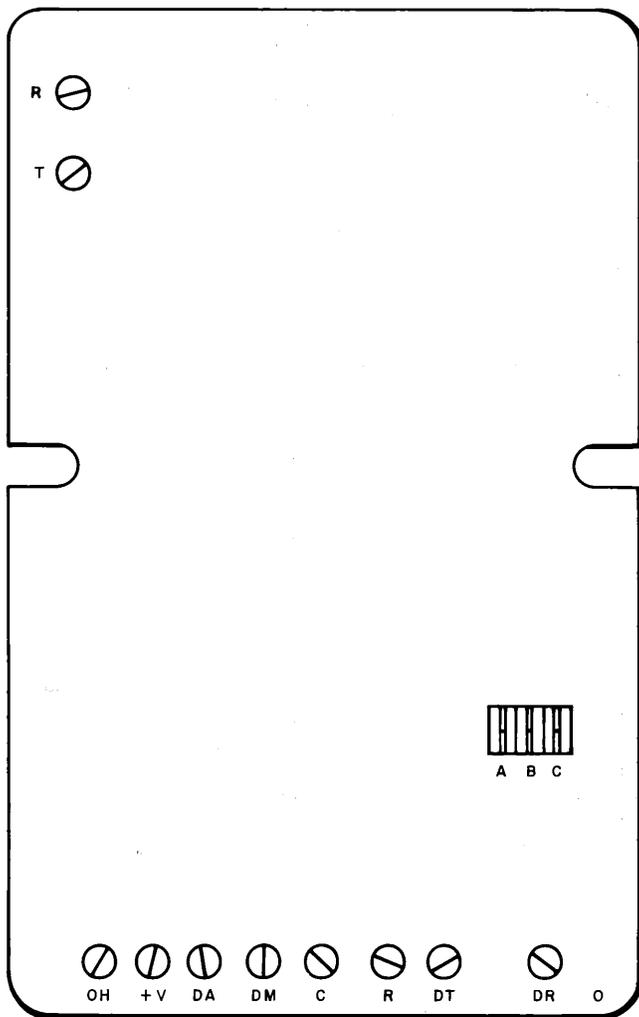


Fig. 6—Data Coupling Unit, Terminal Location

3.15 The installer *will not* connect the customer interface leads to the coupling unit unless requested by, and under the direction of, the customer.

#### 4. MAINTENANCE AND TESTS

4.01 The coupling unit should be removed and returned to the Western Electric service center for credit in the event that installation or maintenance tests indicate faulty operation. Spares are not recommended, and should the coupler become defective subsequent to installation, return the unit to the service center to be junked. The telephone set is maintained in accordance with the Bell System Practices covering the set that is used.

4.02 The coupling unit is not equipped with remote testing features. It will be necessary to dispatch maintenance employees when tests are required to clear troubles. To avoid excessive maintenance costs, it is very important that the trouble symptoms are completely described and analyzed to be reasonably sure that the malfunction is caused by Bell System apparatus or facilities.



*The Bell System does not guarantee a specific error rate for installations using customer owned and maintained apparatus.*

4.03 The most probable troubles that may be expected are as follows:

- Failure of the coupling unit to clip at the proper level. A clipping level that is too high will cause interference to other circuits in the network; a clipping level that is too low will degrade data transmission. This may be corrected by readjusting the level options.
- Improper operating techniques. If the customer does not properly operate the exclusion key and the controls on his apparatus, data transmission will not be possible. Carefully instructing the operating personnel at the time of installation will minimize these troubles. However, the customer should be carefully questioned when a no-transmission trouble is reported to ensure that proper operating techniques have been used.
- Improper dialing symptoms or failing to go off-hook. If the customer equipment does not present pulsing signals with the proper timing relationships, errors in call originations will exist. A high dialing rate by the customer may cause premature failure of the OH relay. The coupling unit is essentially a light duty dialing unit.
- Improper connection of interface cord. If the customer does not connect the leads of the interface cord to the proper terminals on the coupling unit, most any functional trouble symptoms may be reported. The customer should be requested to verify the interface connections.

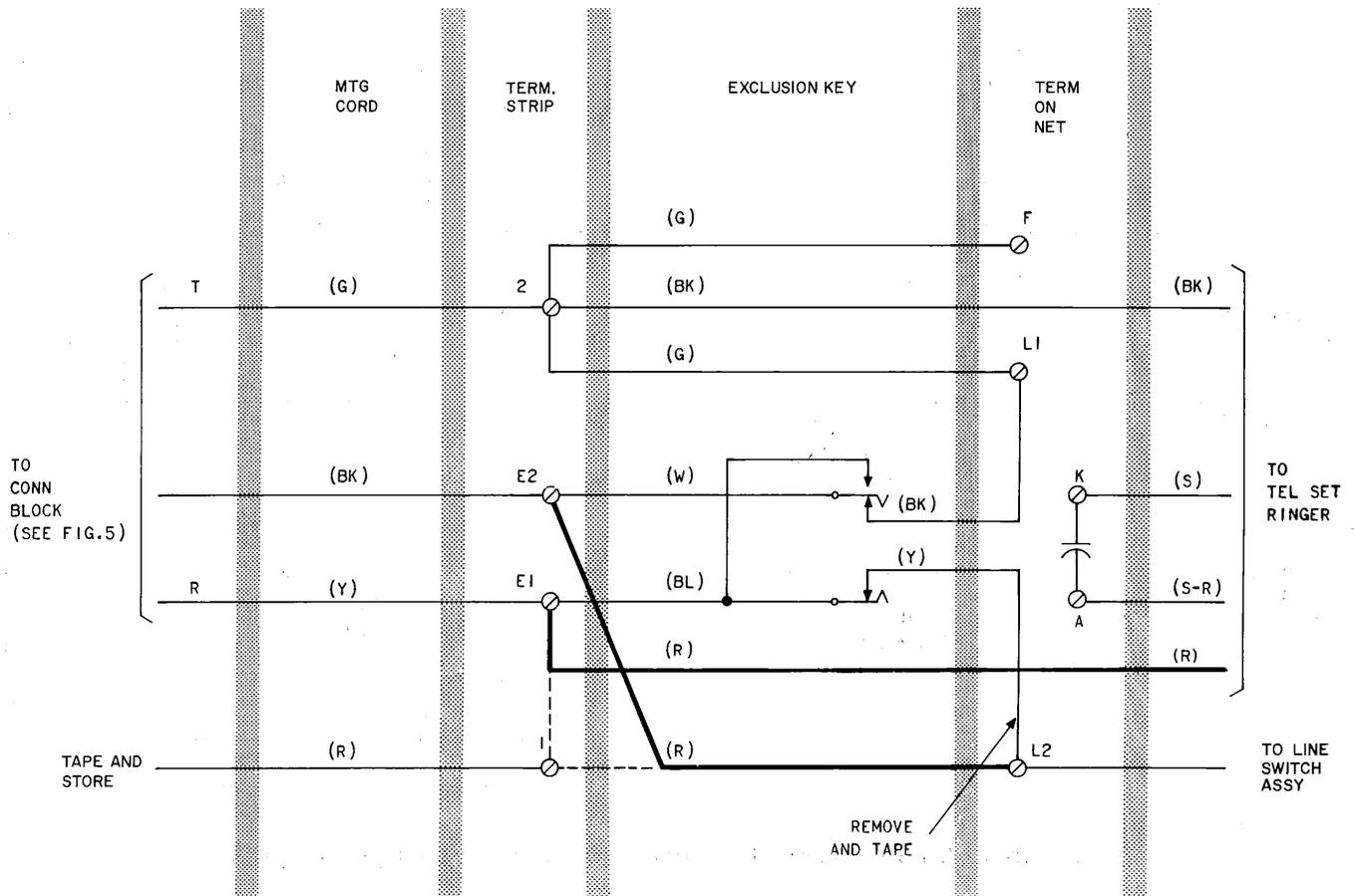


Fig. 7—Typical Rewiring of Exclusion Key Using 502-Type Telephone Set

4.04 When investigating complaints of poor transmission performance, it will be necessary to make end-to-end or local loop transmission tests in accordance with Sections 314-205-501 and 314-205-500. When making these tests, the circuit should be checked with the coupler in the circuit. If the test results are not satisfactory, the test should be repeated without the coupler; this will determine if the coupler is degrading the circuit. With an input equal to or greater than the maximum customer level to the coupling unit, the level of

the transmitted signals measured at the serving central office should not exceed -12 dBm.

4.05 The following test procedures should be used at the time of installation or when troubleshooting stations equipped with the coupling unit:

- Insertion Loss Test
- Interface Test

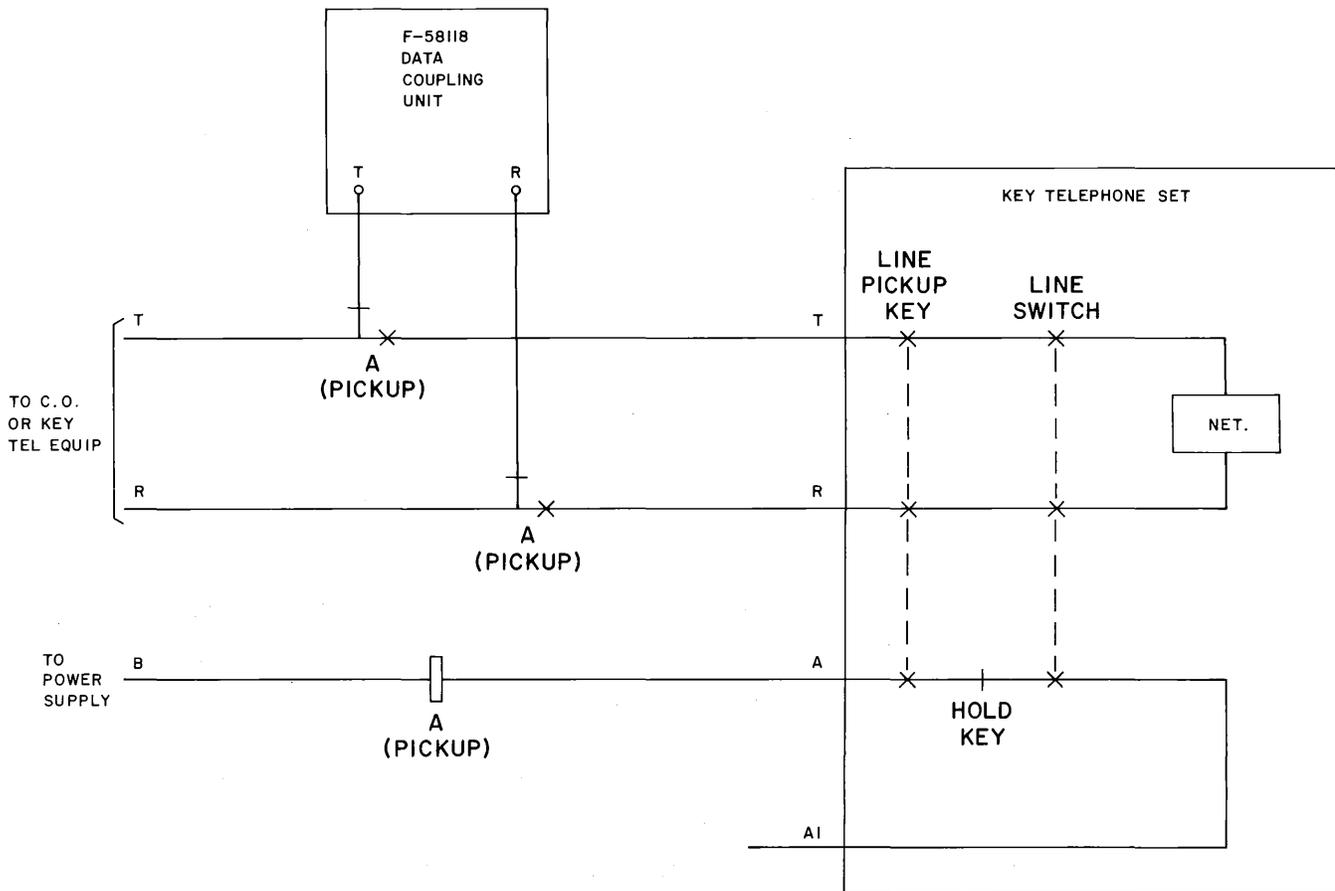


Fig. 8—Typical Data Coupling Unit Connections with Key Telephone Systems

- Limiter Operational Test

- 1011- or 1013-type hand test set.

4.06 The following test equipment is required for the tests:

- 1/4-watt, 600-ohm resistor.
- 1/4-watt, 900-ohm resistor.
- Hewlett Packard 400D vacuum tube voltmeter, or equivalent bridging-type meter.
- KS-19353 L4 oscillator or equivalent.
- KS-14510 L1 volt-ohm-milliammeter, or equivalent.
- J87202 L4 rectifier with the 6-foot J87202A L5 rectifier cord, or equivalent signal power source providing between 18 and 26 volts dc.

#### A. Insertion Loss Test

4.07 The insertion loss test is required to measure the combined loss of the loop and coupler. The results of the test are used to determine the level option terminals which must be strapped in the coupler. The customer's apparatus **must** be disconnected from the coupling unit, and the unit must be connected to the telephone line for this test. Proceed with the test as follows:

- (1) Connect a strap between terminals OH and DA.
- (2) Connect the positive lead of the rectifier to the +V terminal, and the negative lead to the OH terminal. **Do not** connect the rectifier to the ac outlet at this time.

**TABLE B**  
**LEVEL OPTION FOR DATA COUPLING UNIT**

LOOP AND COUPLER INSERTION LOSS dB	OPTION LEVEL STRAPPING dBm	LEVEL OPTION TERMINALS	EXTERNAL PAD dB	MAXIMUM CENTRAL OFFICE LEVEL dBm
(0 + 2) 2	-8	A-B-C	2	-12
(1 + 2) 3				-13
(2 + 2) 4				-12
(3 + 2) 5			NONE	-13
(4 + 2) 6				-14
(5 + 2) 7				-15
(6 + 2) 8	-12			
(7 + 2) 9	-4	A-B	-13	
(8 + 2) 10			-14	
(9 + 2) 11			-15	
(10 + 2) 12	0	NONE		-12

**Note 1:** Coupler insertion loss at 1000 Hz is 2 dB.

**Note 2:** External pad (2 dB, F-58102) is installed as part of local loop to build out the 0- and 1-dB loss loops in order to obtain at least -12 dBm at serving central office. Only one pad is used to facilitate stock and supply procedures.

**Note 3:** Maximum allowable customer signal power level is the same as the level option strapped. Mark coupling unit accordingly.

- (3) Connect the 600-ohm resistor across terminals DT and DR.
- (4) Locate and remove any existing straps on level option terminals A, B, or C (Fig. 6).
- (5) Connect the hand test set across tip and ring of the telephone line, and dial the milliwatt supply (1000-Hz) of the serving central office.

**Note:** If a telephone set has been rewired for association with the coupling unit, remove the handset, operate the exclusion (talk) key, and dial the milliwatt supply.

- (6) When the tone is heard, connect the rectifier to the ac outlet. After a few seconds, remove the hand test set from the line (or replace

the handset on the associated telephone set, restoring the talk key).

- (7) Measure the level in dBm of the signal across the 600-ohm resistor with the VTVM.

**Note:** The VTVM requires approximately a 5-minute warm-up for accurate readings.

- (8) The loss in dB of the line and coupler is indicated by this measurement. For example, if the meter reads -5.7 dBm, the combined loss of the loop and coupler is 5.7 dB.

- (9) Remove the straps and test equipment from the coupler. (The central office connection will terminate.)

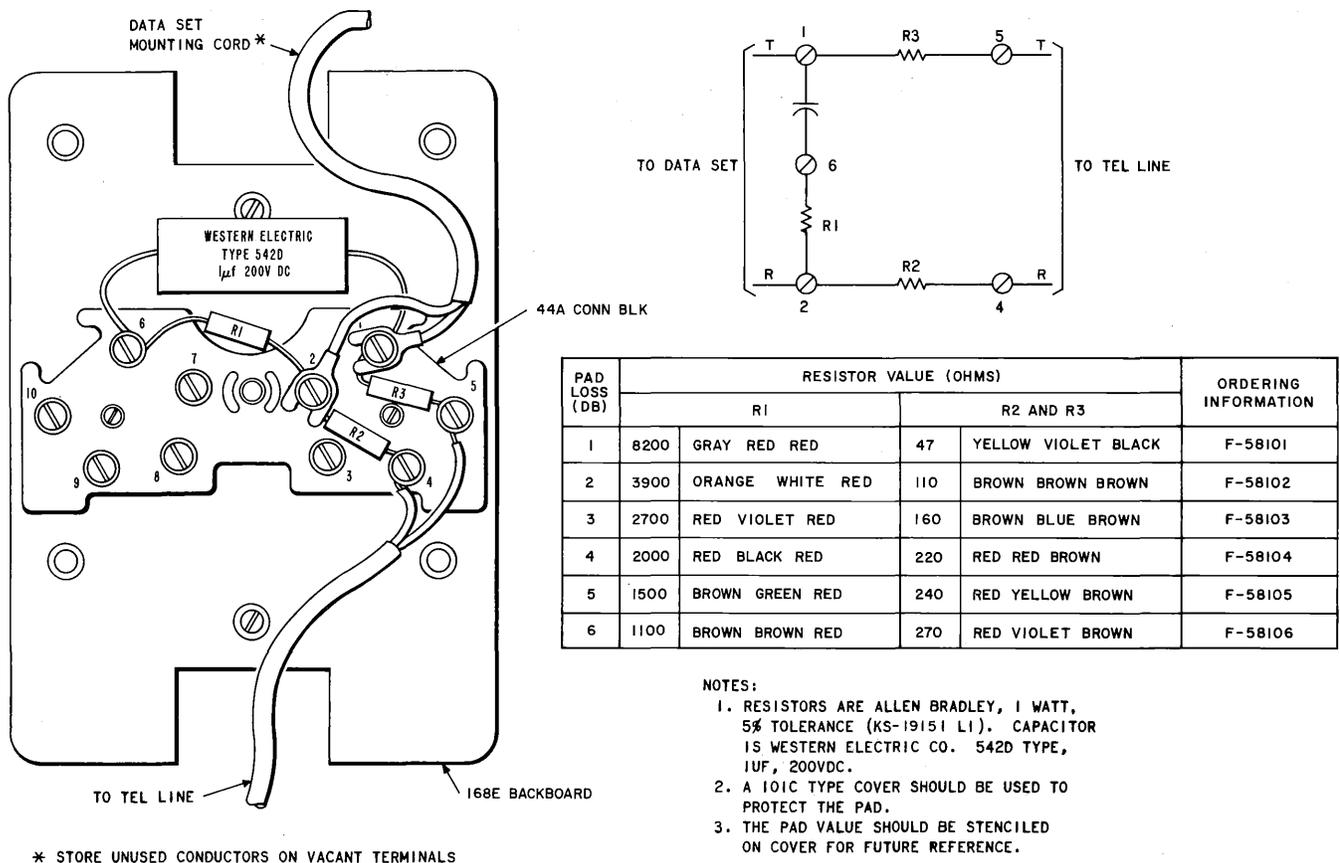


Fig. 9—Typical Installation Wiring of 2-dB Pad

**B. Interface Test**

**4.08** The interface test reasonably assures that the interface terminals of the coupler will respond to proper signals from the customer terminal, or will indicate to the terminal when the coupler is conditioned for the various operational modes.

**4.09** Ensure that the customer's apparatus is disconnected from the coupling unit, and that the unit is connected to the telephone line. Proceed with the test as follows:

- (1) Connect straps between terminals C and DA, and between C and OH.

- (2) Connect the hand test set between terminals DT and DR. Operate the test set switch to the TALK position.

- (3) Connect the rectifier, or the signal power source, between terminals +V and C. After 2 to 5 seconds, dial tone should be heard in the test set.

- (4) Remove strap from terminals C and OH. Dial tone should cease.

- (5) Remove strap from terminals C and DA.

- (6) Connect the volt-ohm-milliammeter between terminals C and R.

- (7) Remove the hand test set from DT and DR, and connect between terminals C and OH.

**Note:** Line control signals such as dial tone, etc, cannot be heard in test set while connected between terminals C and OH.

- (8) Operate switch on hand test set to TALK position. After approximately 5 seconds, dial the ringback code number of the local serving office.

- (9) At the completion of dialing, operate the switch to the MONITOR position. Observe that the meter indication is following the ringing cycle—alternately swinging.

- (10) Remove the volt-ohm-milliammeter from C and R, and connect between terminals C and DM.

- (11) Connect strap between terminals C and DA.

- (12) While observing the volt-ohm-milliammeter, operate the switch on the hand test set from MONITOR to TALK position. After 2 to 5 seconds, the meter should indicate continuity between terminals C and DM.

- (13) Remove the straps and test equipment from the coupling unit.

### C. Limiter Operational Test

**4.10** The limiter operational test verifies that the coupling unit will properly limit an input signal that exceeds a prescribed maximum level.

**4.11** The customer's apparatus and the telephone line must be disconnected from the coupling unit for this test. Proceed with the test as follows:

- (1) Connect strap between terminals C and OH.
- (2) Connect strap between terminals C and DA.
- (3) Connect the 600-ohm resistor between terminals DT and DR.

- (4) Connect the 900-ohm resistor between terminals T and R.

**Note:** Obtain access to terminals T and R by loosening the center screw and removing the cover. Access to the terminals may also be obtained at the appearance of tip and ring on the connecting block which terminates the mounting cord.

- (5) Connect the output of the rectifier between terminals +V and C. Connect the rectifier to ac outlet.

- (6) Set the oscillator for a 1000-Hz frequency and a 600-ohm output impedance. Adjust the output level to agree with customer's maximum allowable level marked on the cover of the coupling unit. Connect the output of the oscillator to terminals DT and DR.

- (7) Measure the signal level across the 900-ohm resistor (tip and ring of the coupler) with the VTVM. The meter indication should read slightly lower (0.2 dB) than the maximum allowable customer level. For example, with a maximum customer level of -8 dBm, -8.2 should be read on the dB scale.

**Note:** A meter indication of -8.2 when using a 900-ohm load is equivalent to -10 dBm across a 600-ohm load.

- (8) Increase the oscillator level output to 10 dB higher than customer's maximum allowable level. The VTVM should immediately indicate an increase in level, however the increase should not exceed  $3 \pm 1$  dB. Using the example in (7), a reading of  $-5.2 \pm 1$  should be indicated on the dB scale.

**Note:** Should the unit fail to limit the increase in level to only  $3 \pm 1$  dB, the limiting function of the coupler is not operating properly and the unit should be replaced.

- (9) Remove straps, resistors, and test equipment, and restore the connection to normal.