

## DATA COUPLER F-57951

### DESCRIPTION, INSTALLATION, MAINTENANCE, AND TESTING

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#### 1. GENERAL

**1.01** This section provides installation and maintenance instructions for Data Coupler F-57951 (Fig. 1). Detailed information is contained in ES- and CD-1D173-02.

**1.02** Information in this section was previously covered in Section 598-072-100, Issue 1, and an addendum to the section dated October 1968.

**1.03** The data coupler is a line-powered unit which permits customer-owned and -maintained apparatus to be connected to the DDD network. The data coupler contains circuits which will limit the average power output of the customer apparatus to a value which will not be detrimental to the overall function of the network. The uniform service order code (USOC) for this item is CDT.

**1.04** The customer must be informed, at the time the coupler is installed, of the maximum permissible output level for his apparatus. The maximum permissible output level may vary between 0 and -10 dBm in 1-dB steps, according

to the 1000-Hz loss of the local loop. The output level of the customer apparatus is the power measured at the customer interface into a 600-ohm resistive load. The coupler will be adjusted to clip signal peaks when the average power level exceeds the permissible level.

*Note:* The maximum permissible level will be marked on the data coupler at the time of installation.

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

**1.06** The service offering in which the data coupler is used provides the customer with end-to-end transmission performance essentially equivalent to DATA-PHONE® service. Because the customer 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.

#### 2. DESCRIPTION

##### A. Physical Description

**2.01** The data coupler is a wall-mounted unit, 4-3/4 inches wide by 7-3/4 inches high by 1-3/4 inches deep. The unit weighs 1-1/4 pounds. The unit is constructed of a metal base and has a grey plastic cover.

**2.02** The data coupler contains one printed circuit pack which contains the active circuitry for the unit. Two terminals are provided for connecting

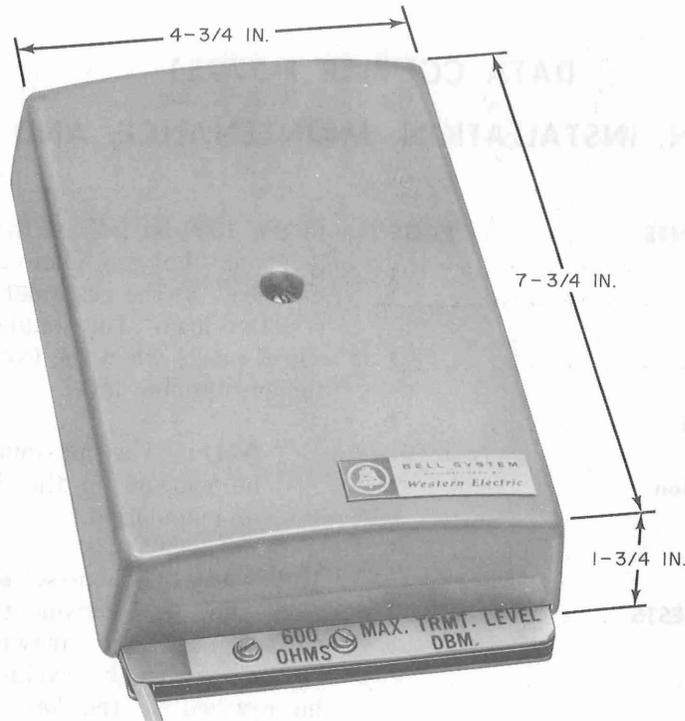


Fig. 1—Data Coupler F-57951

the customer apparatus, and a D4BJ-61 cord for connecting to the telephone line or associated telephone set (Fig. 2). Slots on the base are provided for mounting the unit on the wall. Terminals located on the circuit pack are strapped by the installer to limit the input to the data coupler and to adjust the clipping level.

#### B. Functional Description

**2.03** The data coupler monitors the output of the customer apparatus. When the rms level of this output, averaged over any 3-second period, exceeds a predetermined level, a peak limiter is activated. The limiter will clip signal peaks as long as the rms output from the customer apparatus exceeds the permissible level. The data coupler presents a nominal 2-dB insertion loss at 1000 Hz to the circuit.

**2.04** Power is supplied to the data coupler by the central office battery supply. The polarity guard circuit (see Fig. 3) provides the correct polarity regardless of the polarity of the central office battery. Varistors RV1 through RV7

develop the required potential difference to power the data coupler circuits.

**2.05** Signals from the customer apparatus are connected to the data coupler through transformer T1. The detector circuit is connected across the transformer and continuously monitors the level of the customer signals. The signals are coupled to the detector and integrator by an isolating amplifier. The amplifier input is developed across the level adjusting network. The amplifier output is applied to the detector which develops a voltage that is proportional to the rms value of the customer signal. The detector voltage is averaged over any 3-second interval by the integrator circuit. If the average exceeds the permissible input level, the integrator output activates the switch circuit which, in turn, operates the clipping circuit. The clipping circuit, which is connected across transformer T1, clips the peaks of the customer signals. The clipping circuit is adjustable to provide clipping in two ranges; 0 to -4 dBm, and -5 to -10 dBm.

**2.06** Customer signals that average less than the permissible level are coupled to the line,

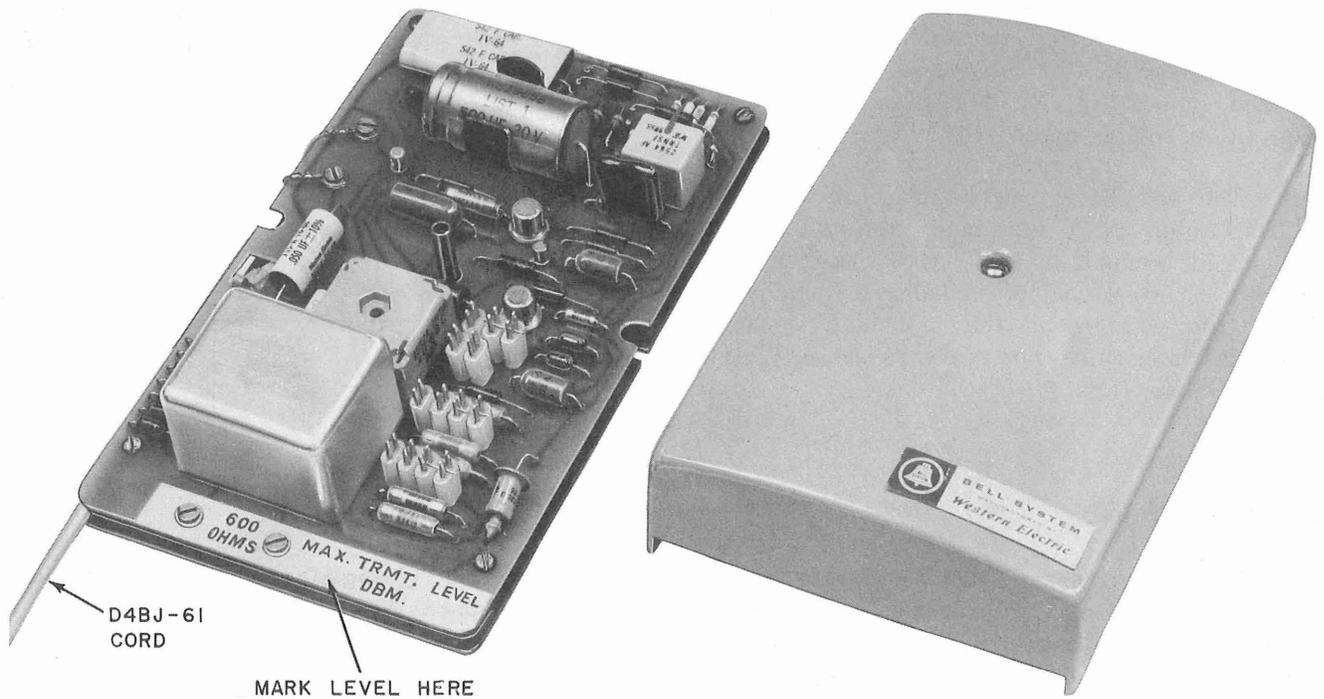


Fig. 2—Data Coupler, Interior View

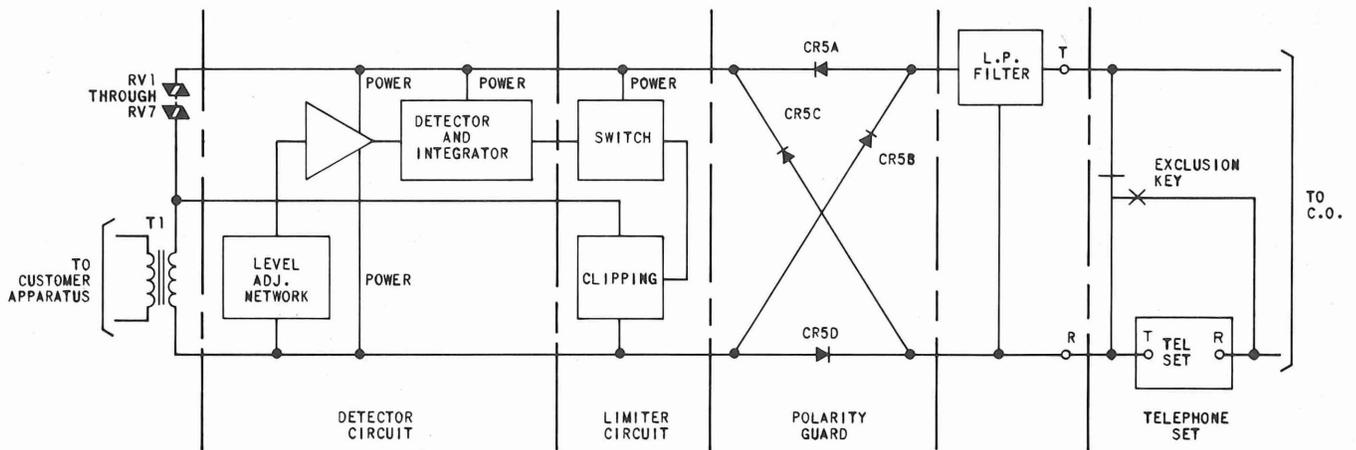


Fig. 3—Data Coupler, Block Diagram

without alteration, through the low-pass filter. The filter limits the energy of out-of-band frequencies generated by the clipping circuit to a level that will not disturb wider-than-voiceband service signals on the network.

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 apparatus unaltered, except for possible 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 may be degraded whenever the transmitted signals exceed the permissible level.

**2.08** The telephone line interface of the data coupler is a standard common-battery loop-current termination that can be associated with standard network control signaling arrangements. Either the coupler or the associated network controlling apparatus must always be on-line to hold the connection.

### 3. INSTALLATION

**3.01** The data coupler should be mounted on the wall near the terminal block to which the telephone line is connected. The telephone set should be placed near the customer apparatus so the operator can easily operate the data key and the controls on the customer apparatus.

**3.02** The data coupler 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 coupler chassis as a template to mark the positions of the screws.

**3.03** The data coupler and the associated network control signaling apparatus (telephone set, key telephone equipment, etc) may be connected in accordance with the typical wiring diagrams in Fig. 4 and 5. Terminal location is shown in Fig. 6. There is no restriction on the customer-provided transmission path to the customer's transmitting equipment.

**Note:** The Bell System responsibility terminates at the interface of the coupling unit.

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

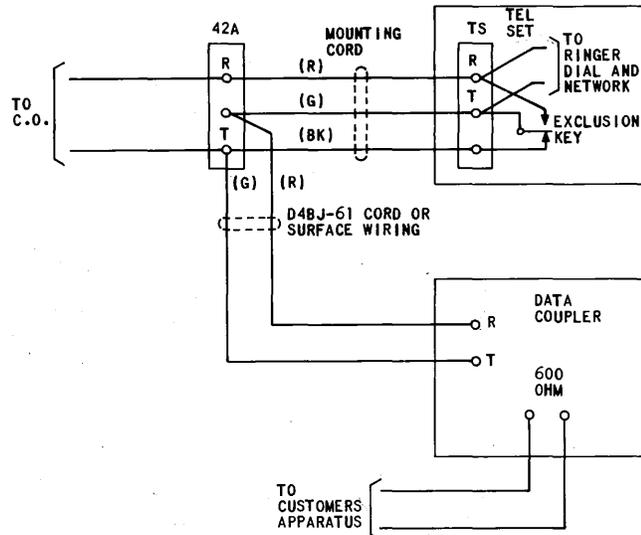


Fig. 4—Typical Wiring Diagram with Associated Telephone Set

#### Input Level and Clipping Range Adjustments

**3.05** The data coupler must be adjusted to limit the signal power level to, or below, -12 dBm at the serving central office. The combined loss of the local loop and coupler (the coupler loss is normally 2 dB) must be known to properly adjust the coupler. If the combined loss is not known, measure the loss as follows.

**Note:** A 1/4-watt 600-ohm resistor, a Hewlett-Packard 400D vacuum tube voltmeter (or equivalent bridging-type meter), and a KS-19353-L4 oscillator (or equivalent) are required for the installation. The VTVM requires approximately a 5-minute warm-up for accurate readings.

- (1) Remove all straps from the level option terminals (lettered A through H, J and K, Fig. 6), and the limiter clipping option terminals (lettered L, M, and N).
- (2) Connect the resistor across the customer terminals (marked 600 OHM).
- (3) Dial the milliwatt supply (1000-Hz) at the central office, and operate the data key so that the received signal passes through the coupler.

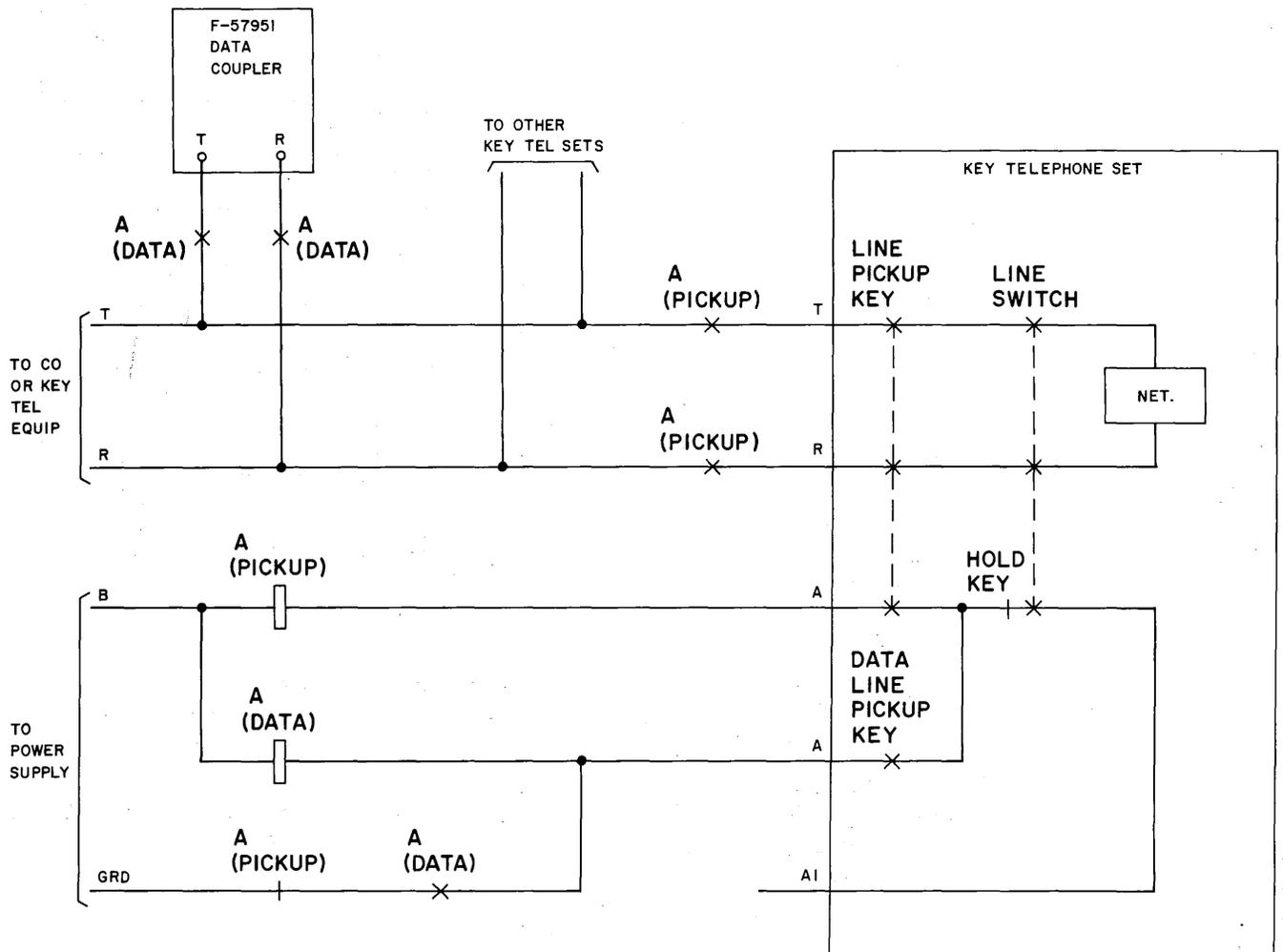


Fig. 5—Typical Wiring Diagram with Associated Key Telephone Equipment

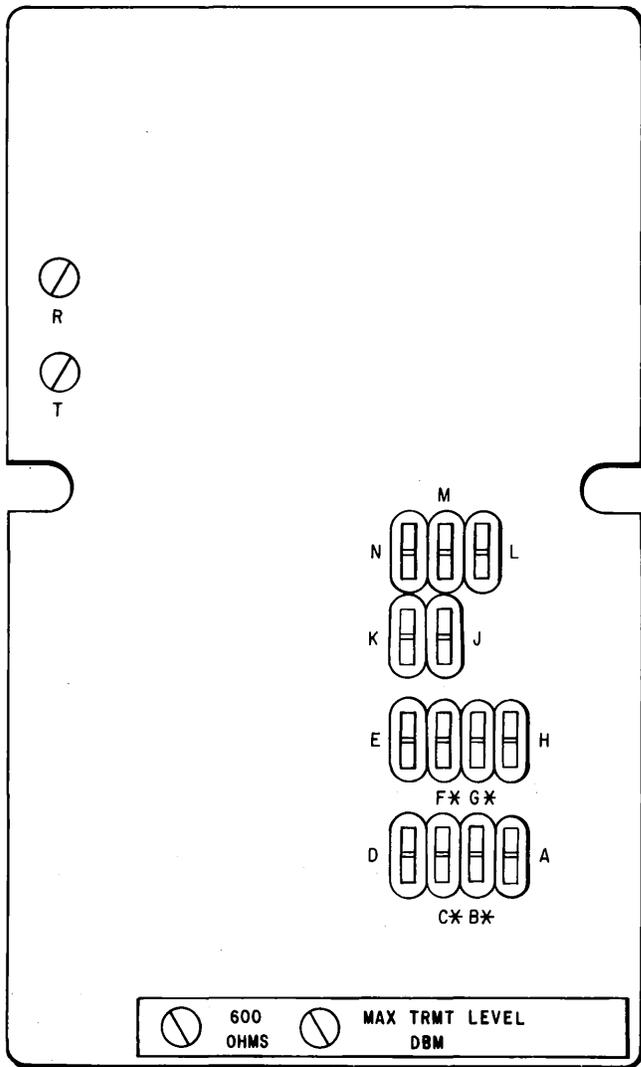
- (4) Measure the level in dBm of the signal across the 600-ohm resistor with the VTVM.
- (5) The loss in dB of the line and coupler is indicated by this measurement; eg, if the meter reads -5.7 dBm, the loss of the line and coupler is 5.7 dB.
- (6) Remove the 600-ohm resistor from the coupler terminals, and restore the connection to normal.

**3.06** Table A shows the level option terminals that may be selected for a particular installation. The known combined loss of the loop and coupler, or the measured value obtained in 3.05(5), determines the row to use under the

MEASURED LEVEL column. The intersection of this row and the column marked NOMINAL determines the proper terminals. Strap the terminals using 24-gauge bare wire, firmly seated to ensure good contact.

**3.07** Since the line impedance can vary over a wide range for different installations, it may be necessary to alter the NOMINAL strapping made in 3.06. To determine if a change is necessary, perform the following with the NOMINAL strapping connected.

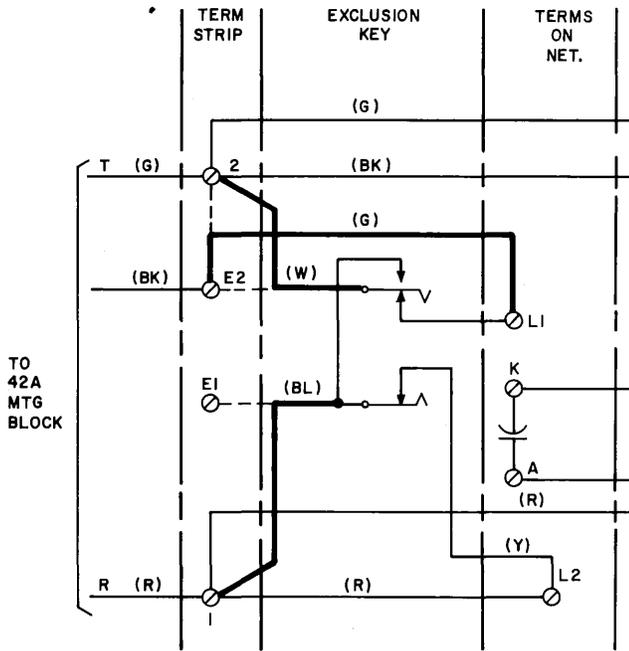
- (1) Set the oscillator for a 1000-Hz frequency and a 600-ohm output impedance.



\* FOR REFERENCE ONLY - NOT STAMPED ON CIRCUIT BOARD.

Fig. 6—Location of Terminals

- (2) Select the proper scale on the VTVM to measure -15 dBm.
- (3) Connect the 600-ohm resistor and the VTVM to the output terminals of the oscillator.
- (4) Adjust the oscillator output level to obtain a -15 dBm indication on the VTVM across the 600-ohm resistor.
- (5) Disconnect the resistor and VTVM from the oscillator terminals without changing the frequency or level setting on the oscillator.



NOTES:

1. DOTTED LINES SHOW FACTORY WIRING.
2. HEAVY LINES SHOW NECESSARY REWIRING.
3. SEE 502-515-400 FOR FULL SCHEMATIC.

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

- (6) Connect the oscillator to the customer terminals (marked 600 OHM) on the coupler without changing the settings.
- (7) Dial a quiet battery termination at the central office. When the connection is completed, operate the data key.
- (8) Use the VTVM to measure the signal level at the customer terminals on the coupler.
- (9) Refer to Table A; if the measured level is outside the NOMINAL range of -13.1 dBm to -13.7 dBm, remove the strapping connected in 3.06 and restrap the option terminals in accordance with the proper column. Restore data key and place line on-hook.

**3.08** Using the row located in 3.06 and the column marked MAXIMUM ALLOWABLE CUSTOMER LEVEL, determine the value which shall be marked, in pen or pencil, on the coupler label (Fig. 2).

**TABLE A**  
**LEVEL OPTION TERMINALS FOR DATA COUPLER**

MEASURED LEVEL (3.05)	MAXIMUM ALLOWABLE CUSTOMER LEVEL	VOLTMETER READING (IMPEDANCE CHECK 3.07)				
		-15.0 OR BELOW	-15.0 TO -14.3	-14.3 TO -13.7	NOMINAL	-13.1 OR HIGHER
					-13.7 TO -13.1	
-12 or less	0 dBm	A-B, G-H	A-B, G-H	A-B	C-D, E-F, G-H, J-K	None
-11 to -11.9	-1	A-B, E-F, J-K	A-B, E-F, J-K	A-B, G-H	A-B	C-D, E-F, G-H, J-K
-10 to -10.9	-2	A-B, E-F, J-K	A-B, E-F, J-K	A-B, E-F, J-K	A-B, G-H	A-B
-9 to -9.9	-3	A-B, C-D, J-K	A-B, C-D, J-K	A-B, E-F, G-H, J-K	A-B, E-F, J-K	A-B, G-H
-8 to -8.9	-4	A-B, C-D, G-H	A-B, C-D, G-H	A-B, C-D, J-K	A-B, E-F, G-H, J-K	A-B, E-F, J-K
-7 to -7.9	-5	A-B, C-D, E-F, J-K	A-B, C-D, G-H, J-K	A-B, C-D, G-H	A-B, C-D, J-K	A-B, E-F, G-H, J-K
-6 to -6.9	-6	A-B, C-D, E-F, J-K	A-B, C-D, E-F, J-K	A-B, C-D, G-H, J-K	A-B, C-D, G-H	A-B, C-D, J-K
-5 to -5.9	-7	A-B, C-D, E-F, G-H, J-K	A-B, C-D, E-F, G-H	A-B, C-D, E-F, J-K	A-B, C-D, G-H, J-K	A-B, C-D, G-H
-4 to -4.9	-8	A-B, C-D, E-F, G-H, J-K	A-B, C-D, E-F, G-H, J-K	A-B, C-D, E-F, G-H	A-B, C-D, E-F, J-K	A-B, C-D, G-H, J-K
-3 to -3.9	-9	A-B, C-D, E-F, G-H, J-K	A-B, C-D, E-F, G-H, J-K	A-B, C-D, E-F, G-H, J-K	A-B, C-D, E-F, G-H	A-B, C-D, E-F, J-K
-2 to -2.9	-10	A-B, C-D, E-F, G-H, J-K	A-B, C-D, E-F, G-H, J-K	A-B, C-D, E-F, G-H, J-K	A-B, C-D, E-F, G-H, J-K	A-B, C-D, E-F, G-H

**3.09** If the maximum allowable customer level is -5 dBm to -10 dBm, place a strap between the clipping terminals L and M. If the level is 0 dBm to -4 dBm, place the strap between terminals M and N.

#### 4. MAINTENANCE AND TESTS

##### A. Maintenance

**4.01** The data coupler should be removed and returned to the Western Electric service

center for credit in the event that the installation and 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 data coupler 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 data coupler to clip at the proper level. Too high a clipping level will cause interference to other circuits in the network. Too low a clipping level will degrade data transmission. This may be corrected by readjusting the level options.
- Improper operating techniques. If the customer does not properly operate the data 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 insure that proper operating techniques have been used.

**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.

## B. Testing

**4.05** The limiting threshold of the data coupler should be checked following installation and during each maintenance visit. The results of each test should be recorded on a trouble history card to assist in analyzing future troubles and to detect gradual degradation of the service.

**4.06** A KS-19353-L4 oscillator (or equivalent) and a Hewlett-Packard 400D vacuum tube voltmeter (or equivalent bridging-type meter) are

required for the test. A 1/4-watt, 600-ohm resistor is also required.

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

**4.07** The level at which limiting begins is measured as follows.

- (1) Adjust the oscillator for a 1000-Hz frequency and a 600-ohm output impedance.
- (2) Adjust the VTVM to measure -15 dBm.
- (3) Connect the test equipment as shown in Fig. 8.



**The data coupler and telephone set must be connected to the telephone line, and the level option straps (Table A) must be installed before making the test.**

- (4) Dial a "quiet termination" to connect central office battery to the telephone line.
- (5) Operate the data key to connect the data coupler to the line.
- (6) Adjust the oscillator output level to produce a -15 dBm indication on the VTVM.
- (7) Slowly increase the oscillator output level while watching the VTVM. The VTVM indication should track with the increase in level until the threshold of limiting is reached. At this point, the VTVM indication will abruptly **decrease**. The VTVM indication may slowly oscillate around the limiting level.

**Note:** If a distinct decrease in the VTVM indication (1 dB or more) cannot be obtained to indicate the limiting threshold, connect a clip lead between terminals L and N on the data coupler (Fig. 6) and repeat the test procedure.

- (8) Disconnect the leads at the 600-ohm terminals on the data coupler.



**Do not disconnect the VTVM from the oscillator or disturb the oscillator output level adjustment.**

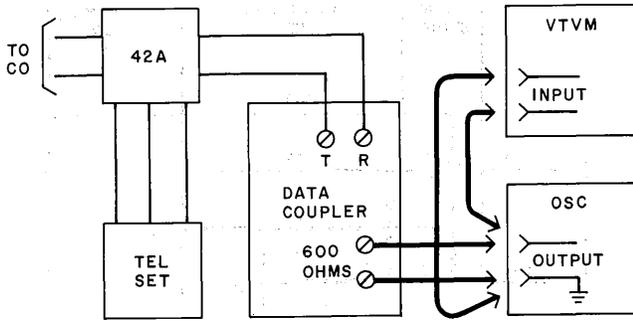


Fig. 8—Test Equipment Connection Diagram

- (9) Connect the 600-ohm resistor between the VTVM input terminals.

**Requirement:** The VTVM must indicate a level which is higher than the maximum

allowable customer level but less than 4 dB higher.

- (10) Remove the clip lead from terminals L and N and replace the cover.

## 5. OPERATION

**5.01** Calls are originated and answered using the telephone set in the normal manner. Transfer from the talk mode to data mode is made by operating the data key. Transfer from data to talk mode, without breaking the connection, is made by restoring the data key. When the handset on the 502-type telephone set is placed in the cradle, the data key is automatically depressed, placing the telephone set in the idle mode.

**Note:** If the 502-type telephone set is used, the handset must remain off-hook during data transmission.