

(PDACS)
POWER DISTRIBUTION ALARM AND CONTROL SYSTEM
DESCRIPTION, OPERATION, INSTALLATION/MAINTENANCE

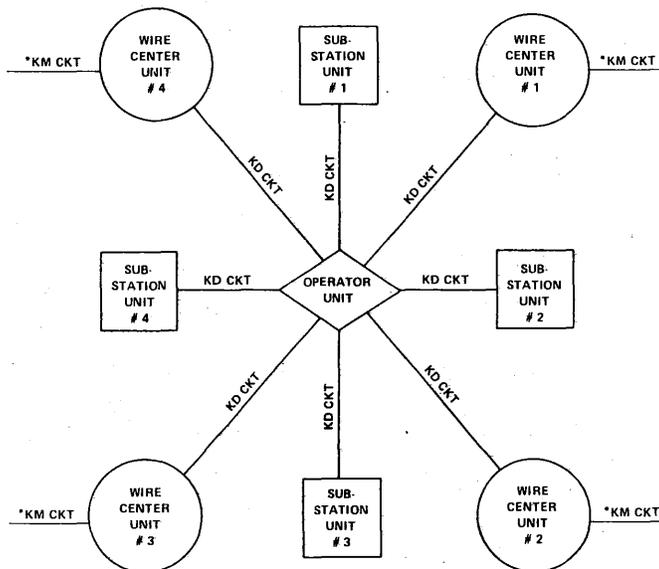
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1. GENERAL

1.01 This section describes the Power Distribution Alarm and Control System (PDACS) offered to the electric power industry as a means to monitor and remotely control, from a centralized location, the operation of substation equipment and line sectionalizing switches in the primary power distribution network.

1.02 PDACS circuitry involves telephone company (TElCo) equipment at wire centers (central offices [CO]), power utility substations, and the power utility dispatchers location. The circuits interface with customer provided (CP) relay contacts and relay windings at substations, and with CP control modules at sectionalizing switch locations. (See Fig. 1.)

1.03 Status and control of substation apparatus is provided. Priority status conditions at a substation cause an automatic alarm to be transmitted to the distribution operator. Nonpriority status conditions do not bring in an alarm, but are stored at the substation unit, and reported the next time the opera-



* This designation plus two digits is the circuit number from the C.O. to the sectionalizing switch. The suffix is also the HMDF block terminal number, and is the power company select code for the switch connected to that circuit.

Typical PDAC System

Fig. 1

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tor interrogates the substation. Upon any interrogation of the substation, all status conditions whether priority or nonpriority, will be reported to the distribution operator.

1.04 Control of substation apparatus is accomplished by addressing the specific device desired with "Touch-Tone®" signaling.

1.05 The state (open or closed) of each line sectionalizing switch along a primary distribution feeder, together with indication of whether or not fault current has flowed through it, is available upon interrogation by the distribution operator through a wire center unit. Opening and closing of these switches is also under *Touch-Tone* command.

1.06 A voice grade private line circuit is required between the operator's location and each wire center involved. A similar circuit is required between the operator and each substation location. Each of these circuits carries only *Touch-Tone* signals and each may not exceed 8 dB at 1,000 Hz net loss.

1.07 Individual metallic paired facilities not exceeding 1500 ohms loop resistance are required to carry direct current between the serving wire center and each associated field switch location. The measured insulation resistance of these pairs (tip-to-ring and to-ground) shall not be less than 500,000 ohms.

1.08 The physical facilities serving substations may require special high-voltage protective measures. Since direct current is not required over the operator-to-substation path, an isolation transformer capable of passing *Touch-Tone* signaling will suffice when such protection is required. The metallic loop pairs to individual sectionalizing switch locations will require only standard fuseless station protection with gas tube back-up utilizing 123B1A protectors. Questions regarding protection should be referred to the Protection Engineering group.

1.09 The distribution operator can exercise tele-control functions of substation apparatus at each substation within his distribution area. Similarly, the operator can, through the wire center unit, exercise telecontrol functions of sectionalizing switches located in the primary distribution feeders powered from each substation. The operator unit is connected to the substation and wire center units over 3 kHz private line facilities. Data exchange over these facilities is by means of *Touch-Tone* signals.

1.10 The wire center unit requires a separate metallic cable pair from the wire center to each sectionalizing switch. Data exchange over these metallic facilities is accomplished using a series of direct current potentials.

1.11 No form of circuit assurance is provided by this system. Any failure of 3 kHz or metallic facilities will be detected only when an attempt is made to use the system. No form of signaling redundancy nor test of received data is provided.

1.12 PDACS provides status reports for up to 100 discrete conditions at each substation, operator control of up to 100 discrete devices at each substation, as well as status and control of up to 100 sectionalizing switch locations from each wire center. The operator unit can accommodate up to a total of 16 wire center and substation units.

1.13 Information in this section is based on the following drawings and circuit description:

Operator Unit

Circuit Schematic	PSD-1G002-01
Circuit Description	PCD-1G002-01
Wiring Information	PT-1G002-10
Manufacturing Information	PJ1G002A-1, B-1, C-1, D-1

Substation Unit

Circuit Schematic	PSD-1G003-01
Circuit Description	PCD-1G003-01
Wiring Information	PT-1G003-10
Manufacturing Information	PJ1G003A-1

Wire Center Unit

Circuit Schematic	PSD-1G004-01
Circuit Description	PCD-1G004-01
Wiring Information	PT-1G004-10
Manufacturing Information	PJ1G004A-1

Notes:

1. If this section is to be used with equipment or apparatus reflecting later issue(s) of the drawings, reference should be made to the PSDs and PCDs to determine the extent of the changes and the manner in which the practice may be affected.

2. Requests for drawings or related information should be directed to:

Design Services
450 Mission Street, Room 201
San Francisco, CA 94105
(415 + 542-7111)

1.14 Related Sections are:

- 460-110-100 — Special Safeguarding Measures and Special Service Protection
- 660-005-011 — Office Responsibilities — Special Services
- 660-100-011 — Customer Trouble Report Analysis Plan — Categories of Trouble Reports and Classes of Service Measured
- 660-101-300 — General Routine for Handling Trouble Reports in the Plant Service Center

- 811-999-006PT — Engineering Design Requirements

- SI 138 — SSMB

1.15 Major equipment units in the system are:

- Operator unit with console and display. (USOC-ZZAUW)
- Substation unit. (USOC-ZZAUZ)
- Wire center unit. (USOC-ZZAUY)
- CP module at switch locations.

1.16 This equipment is of the same basic physical and electrical design as that provided by an earlier Bay Sector Special Services Design Group development. Circuit packs included in this system may be used as replacements for printed wiring assemblies used in the original Bay Sector design. Bay Sector drawings BA-69191, BA-69192, BA-90187, and BA-90241 are rated Manufacture Discontinued (Mfr Disc). The replacing Pacific Company (PAC) Standard drawings are shown in Table A.

TABLE A

BAY SECTOR DESIGN (Mfr Disc)		PACIFIC COMPANY STANDARD	
BA-69191	SUBSTATION UNIT	PJ1G003A	PSD-1G003-01
BA-69192	OPERATOR UNIT	PJ1G002A, B, C, & D	PSD-1G002-01
BA-90187	WIRE CENTER UNIT	PJ1G004A	PSD-1G004-01
CIRCUIT PACK	TITLE		EQUIPMENT
BA-90241-01-1	LINE SWITCH DECODER UNIT (C1)		PTS-338, G1
BA-90241-01-2	ENERGIZER CIRCUIT UNIT (C2)		PTS-338, G2
BA-90241-01-3	-24V REGULATOR UNIT (C3)		PTS-338, G3
BA-90241-01-4	CLOCK DUPLEXER & LINE CIRCUIT UNIT (C4)		PTS-338, G4
BA-90241-01-5	SUBSTATION STATUS DETECTOR UNIT (D1)		PTS-338, G5
BA-90241-01-6	TRANSFER CIRCUIT, COMMON AUDIBLE CONTROL & STATUS LAMP DISPLAY (D2)		PTS-338, G6
BA-90241-01-7	ALARM LAMP TEST CIRCUIT UNIT (D3)		PTS-338, G7
BA-90241-01-8	STATUS DETECTOR UNIT (S1)		PTS-338, G8
BA-90241-01-9	ALARM COUNTER & DECODER PRIORITY & MINOR ALARMS UNIT (S2)		PTS-338, G9
BA-90241-01-10	PP & XY DECODER, RECLOSE & WAKE UP CLOCK DUPLEXER & LINE UNIT (S4)		PTS-338, G10
BA-90241-01-11	LINE CIRCUIT UNIT (LC)		PTS-338, G11
BA-90241-01-12	DIGIT VERIFICATION UNIT (D4)		PTS-338, G12
BA-90241-01-13	DC TO DC CONVERTER (C5)		PTS-338, G13

2. DESCRIPTION

Equipment Units

Operators Unit with Console and Display

2.01 The operator unit is designed to work with a modified 6B6 console and display unit (PJ1G002D). (See Fig. 2.)

2.02 The PJ1G002A Operator Unit is arranged for 23-inch frame mounting. It requires 12 inches of mounting space for the operator unit, 7 inches for one group of 12 line circuits, 7 inches for the KS-15620, L22 rectifier, 4 inches for the KS-15894, L2 rectifier. The complete unit mounts in an ED-91180-72 cabinet modified per PJ1G002C.

Substation Unit

2.04 The PJ1G003A Substation Unit is arranged for 23-inch frame mounting. It requires 32 inches of mounting space. The unit mounts in an ED-91180-72 cabinet.

Wire Center Unit

2.05 The PJ1G004A Wire Center Unit is arranged for 23-inch frame mounting. It requires 14 inches of mounting space. The unit is to be frame mounted in the CO.

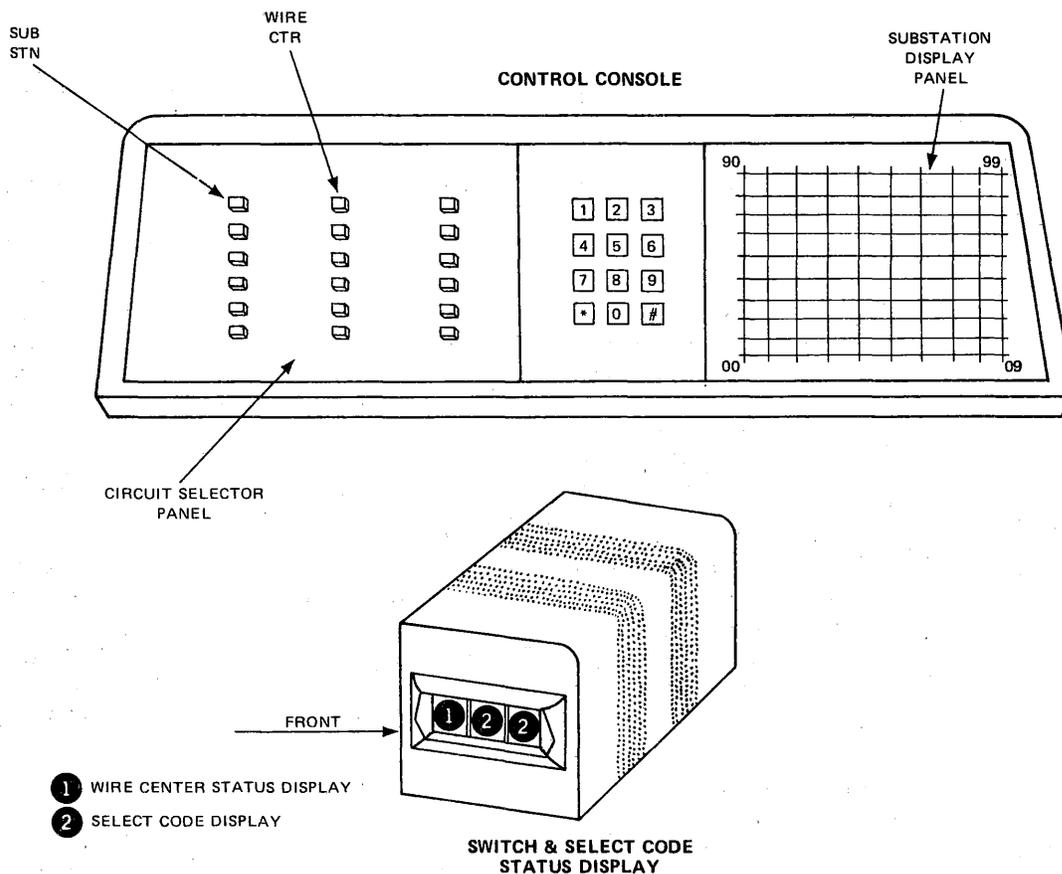
CP Sectionalizing Switch Module

2.06 The switch terminal module was designed as part of the overall PDAC system, but is provided by the customer. The unit is a small incapsulated, solid-state device that is plugged into the stored energy mechanism cabinet on each sectionalizing switch equipped pole.

Power

2.07 Power requirements for the system are as follows:

- The operator unit is powered from unit equipped power supplies providing -48 Vdc and +24 Vdc.



Control Console
Fig. 2

- The substation unit is powered from a unit equipped power supply providing -48 Vdc.
- The wire center unit will be powered from CO power source. The voltages required are -48 and +130 Vdc.

Current Drain

2.08 Current drain for the operator and substation units fall within the limits of the unit equipped power supplies.

2.09 Current drain for the wire center unit is approximately 120 mA for the +130 Vdc and 500 mA for the -48 Vdc.

Limitations

2.10 The market for PDACS service has dictated a number of economies in circuit design, thereby imposing certain system limitations. The tipping cable leakage resistance for metallic facilities between the wire center and the sectionalizing switch must be not less than 500,000 ohms. If cable plant troubles result in a lower leakage resistance, accurate reporting of conditions at the sectionalizing switch cannot be guaranteed.

2.11 The CP sectionalizing switch module, when sensed by a 2.5 mA current, must provide voltages which fall within limits shown in Table B. If module output voltages at any time fall outside these limits, the correct reporting of conditions at the sectionalizing switch cannot be guaranteed.

TABLE B
C2X-AC-SWITCH MODULE OUTPUTS

SWITCH MODULE CONDITION	OUTPUT VOLTAGE	
	MAXIMUM	MINIMUM
A. CONTROL LINE SHORT	-5.00V	0.00V
B. CLOSED, FAULT	-15.00V	-5.00V
C. CLOSED, CLEAR	-25.00V	-15.00V
D. OPEN, FAULT	-35.00V	-25.00V
E. OPEN, CLEAR	-45.00V	-35.00V
F. CONTROL LINE OPEN	AND ABOVE	-45.00V

2.12 If 60 Hz longitudinal voltages in excess of 15 volts RMS are induced at the wire center unit, proper operation of the system cannot be guaranteed.

2.13 Performance of *Touch-Tone* circuits is guaranteed only to a temperature of 120° F,

as measured at the surface of the printed wiring boards. There is some likelihood that outdoor mounting of the substation unit may, under certain geographical and seasonal conditions, result in temperatures exceeding this limit.

2.14 TELCo voice grade facilities between distribution operator, wire center, and substation must have a 1,000 Hz net loss not to exceed 8 dB. The loop resistance of the metallic cable pair between the wire center and each sectionalizing switch module shall not exceed 1500 ohms.

3. OPERATION

Note: This part covers general description of operation only. For detailed description, order material directly from Design Services (see 1.13, Note 2).

Operator Unit

3.01 The distribution operator controls PDACS using a modified 6B6 telephone console. When substation equipment generates a priority status condition, such as a tripped circuit breaker, a *Touch-Tone* signal is transmitted to the distribution operator. Receipt of this signal causes a visual and audible alarm on the console. The operator initiates data exchange with the substation by depressing the flashing console line key, and then requests a status report by depressing a *Touch-Tone* key (#). All status conditions at the substation are displayed by lamps 00 to 99 on the console lamp panel.

Substation Unit

3.02 When substation equipment generates a non-priority status condition, such as a change in transformer tap position, the status change is stored at the substation unit, but no *Touch-Tone* alarm signal is transmitted to the operator. These nonpriority status changes will be reported the next time the operator interrogates the substation. Nonpriority statuses are assigned inputs 00 to 49 and priority statuses are assigned inputs 50 to 99.

3.03 The operator may control substation apparatus by transmitting the appropriate 2-digit *Touch-Tone* address (00 to 99), followed by the *Touch-Tone* execute signal (*). Upon sensing the execute signal, the substation unit will provide a 500 ms contact closure toward CP relays.

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Wire Center Unit

3.04 The operator can interrogate the status of sectionalizing switches located along the primary power distribution feeder by initiating data exchange with the appropriate wire center unit. This is accomplished by depressing the console line key associated with the wire center, and sending to the wire center a *Touch-Tone* address for the switch. Circuitry in the wire center unit connects to the sectionalizing switch module, provided by the power utility, over a metallic cable pair which is part of the TELCo outside plant. The wire center unit determines the position of the sectionalizing switch (open or closed) and the status of its associated fault current defector (fault or clear). *Touch-Tone* signals are then transmitted to the operator and displayed on the wire center status display unit over rear projection readout devices. Four conditions are possible at the switch location and are reported as SW OPEN CLEAR, SW OPEN FAULT, SW CLOSED CLEAR, and SW CLOSED FAULT.

3.05 Two additional rear projection readout messages, CNTL LINE SHORT and CNTL LINE OPEN, are provided for the operator. These messages indicate the condition of the metallic cable pair between the wire center and the sectionalizing switch which has been addressed.

Sectionalizing Switch

3.06 The operator can toggle the sectionalizing switch, causing it to open if in a closed position, or close if in an open position. This is done by sending an appropriate *Touch-Tone* signal (*) to the wire center unit. The wire center will respond to a toggle command only if one of the four valid status conditions is received from the switch location.

3.07 When sectionalizing switches are activated, a loud report can be heard at the pole location. The arm and rod of the unit travels upward about 15 inches and generates a force of approximately 450 pounds. A slight momentary vibration of the pole takes place.

Note: There is no potential from electric shock from the unit or associated hardware.

3.08 When a toggle command has been transmitted, a rear projection readout message CAP CHARGE is displayed to the distribution operator. This indicates that the wire center unit has responded to the toggle command, and that charging current is being transmitted to the sectionalizing switch module.

3.09 Local verification of the 2-digit *Touch-Tone* address is provided on the wire center status display unit. All transmitted *Touch-Tone* addresses are locally monitored at the operator's location. This verification is intended to serve as a scratchpad memory for the operator, and does not infer that the address was received and properly decoded at substation or wire center. If the operator detects an incorrect address, he/she may abort the address by transmitting a canceling *Touch-Tone* signal (#).

Service Restorer Feature

3.10 Occasionally on a primary distribution feeder, the power company chooses to provide a switch known as a service restorer. This is a more sophisticated switch than the usual sectionalizing switches.

3.11 A service restorer has the ability to sense a fault and trip itself to the open condition, time for a given period, then try to reclose. If the fault is momentary, the service restorer will remain closed. If the fault still exists, the restorer will open again. After several attempts to reclose, if the fault still exists, the restorer will lock itself out.

3.12 When a service restorer is tied to PDACS and trips due to any fault condition, a tone will be transmitted over a 3 kHz voice grade private line circuit to the nearest PDACS equipped substation. This voice grade circuit shall not exceed 8 dB at 1,000 Hz net loss.

3.13 The tone transmitter at the service restorer location and the tone receiver at the substation are CP equipment.

3.14 The reason for taking this tone circuit to a substation is because the PDACS substation unit is the only way to bring in an automatic alarm to the distribution operator.

3.15 Once the distribution operator has stasured the substation and determined that a service restorer has tripped, he/she can interrogate the restorer through a wire center unit by either of two addresses.

- One 2-digit address will interrogate the status of the restorer itself and will receive one of the same status conditions as for a regular sectionalizing switch.
- The second 2-digit address will indicate the status of two relays associated with the service restorer.

3.16 PDACS circuitry requires that the address to interrogate the two relays be assigned in the 90-99 count. When a 10-digit of 9 is dialed by the distribution operator, it transfers the incoming signals to messages appropriate to the restorer relays from those of a regular sectionalizing switch.

3.17 The two metallic circuits from a wire center unit to a service restorer shall be of the same type as those provided for regular sectionalizing switches.

3.18 The voice grade private line from a service restorer location to a PDACS substation unit, besides not exceeding 8 dB at 1000 Hz net loss, only need be terminated on a standard station protector the same as for the metallic circuits from a CO unit.

3.19 The possibility of special high-voltage protective devices being required on any TELCO provided facilities into a power company substation always exists and questions regarding this type of protection should be referred to the Protection Engineering group.

4. INSTALLATION/CONNECTIONS

4.01 The following PT and PSD drawings provide wiring information and connection details. These drawings may be ordered from Design Services (1.13, Note 2).

PSD-1G002-01/PT-1G002-10 — Power Distribution Alarm and Control System — Operator Unit

PSD-1G003-01/PT-1G003-10 — Power Distribution Alarm and Control System — Substation Unit

PSD-1G004-01/PT-1G004-10 — Power Distribution Alarm and Control System — Wire Center Unit

4.02 Installation tests shall be performed, as outlined in Part 5, on all new units to ensure proper operation before turn-up.

Operator Unit

4.03 The cabinet containing operator unit equipment shall be located in the telephone terminal room on the customer's premises where the distribution operator is located.

4.04 The customer must provide a 117 volt ac outlet near the cabinet location.

4.05 The console and display unit shall be installed in the distribution operator's office, exact location to be specified by the customer.

4.06 Two double-ended and three single-ended A25B cables shall be run between the operator unit equipment and the console and display unit locations. All five cables shall be connector terminated at the console location. The two double-ended cables shall be terminated to connector-ended cables on the operator unit. The three single-ended cables shall be terminated on connecting blocks located inside the operator unit cabinet.

4.07 One additional single-ended A25B cable shall be terminated to a connector-ended cable on the operator unit and on a connecting block inside the operator unit cabinet.

4.08 One connecting block inside the equipment cabinet requires strapping of various terminals.

4.09 Refer to PSD-1G002-01, CAD Fig. 2 through 7, and PT-1G002-10, Tables B through I, for cable terminating and connecting block strapping details.

4.10 Strap and wire line circuit unit located on the operator unit per PSD-1G002-01, CAD Fig. 1.

4.11 On most Operator Unit installations, the customer orders a busy relay and voice coupler. If an order for an operator unit specifies the relay and coupler, the installer shall refer to drawing BSE 6713 for installation information.

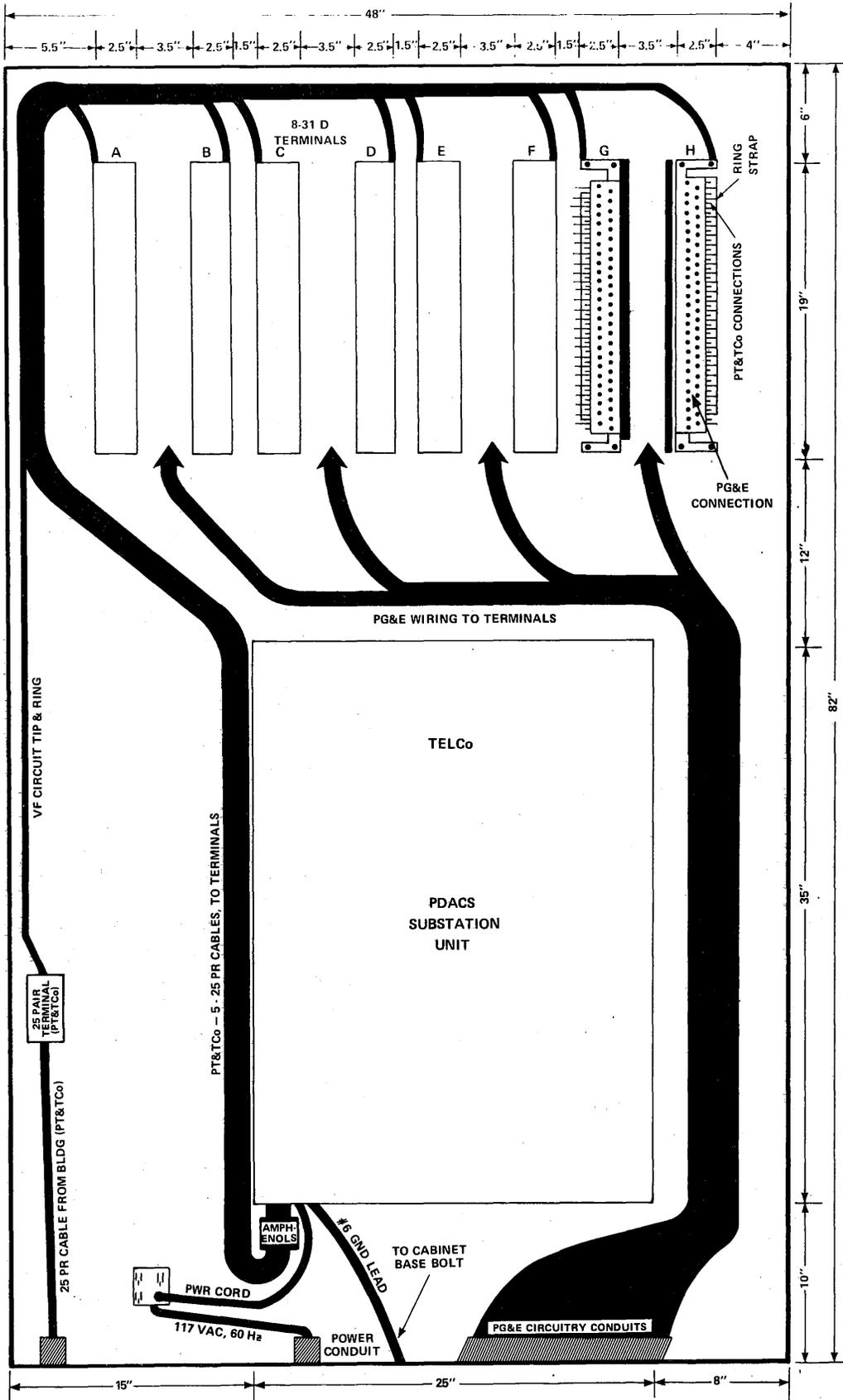
Substation Unit

4.12 The cabinet housing the substation unit shall be mounted inside the metal cabinet provided by the customer, generally located in the substation yard.

4.13 Mount eight 31D connecting blocks, above the substation unit equipment cabinet, with their fanning strips facing each other in pairs. This will require mounting every other connecting block upside down. (See Fig. 3.)

4.14 The right hand terminal of each pair shall be the ring and all eight blocks shall have the

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THIS DIAGRAM PROVIDES GUIDELINES FOR SPACING EQUIPMENT, CABLES, ETC, WHEN INSTALLING PRIMARY DISTRIBUTION ALARM & CONTROL SYSTEM (PDACS) SUBSTATION UNITS.

PDACS Substation Unit – Typical Installation
Fig. 3

ring terminals strapped common as shown on PSD-1G003-01, CAD Fig. 102 through 106.

4.15 Five A25B single-ended cables shall be terminated on the 31D connecting blocks as shown on PSD-1G003-01, CAD Fig. 101 through 106, and PT-1G003-10, Tables B through F. These cables shall be long enough to reach the connector-ended cables coming out of the substation unit cabinet.

4.16 Run a ground wire between the base bolt of the CP cabinet and a mounting bolt of the substation unit equipment cabinet.

4.17 A 25-pair cable shall be run from the TELCo underground cable terminal location at the substation to the PDACS cabinet and terminated on a terminal strip. These pairs will be used to bring the private lines and a telephone line to the PDACS equipment location.

4.18 Figure 3 provides dimensions for locating the substation unit equipment cabinet, the 31D connecting blocks, and the underground cable terminal strip in the CP cabinet.

4.19 The customer will provide 117 volt ac outlets to power the substation unit.

Wire Center Unit

4.20 The Equipment Engineer shall order the wire center unit.

4.21 Western Electric (WE) shall install the wire center unit. It is to be relay rack mounted in a CO.

Drop Wire — Protector Grounding

4.22 The drop wire shall be attached at the standard telephone grade, observing standard practices to maintain climbing space. When served from

buried facilities, use B service wire. Service wire risers require standard U guard protection.

4.23 The protector will be mounted on the same pole as the power company switch control box. The protector will be the demarcation point between the telephone drop wire and the power company station wiring.

4.24 The protector shall be mounted 6 inches below the drop wire drive hook, or 12 inches below the cable messenger, if present. Observe standard practices to maintain climbing space (See Fig. 4.)

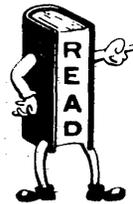
4.25 Provide 123B1A protectors (see Section 460-100-400) installed in 305A2 protector mountings. (See Section 460-100-101.)

4.26 All protectors shall be grounded with 12 gauge wire. If the installation is on a joint pole supporting telephone cable and strand, the protector shall be grounded to the strand. If the installation is on a power company wholly-owned line pole, the protector shall be grounded to a driven ground rod. The vertical grounding conductor must be covered with standard molding.

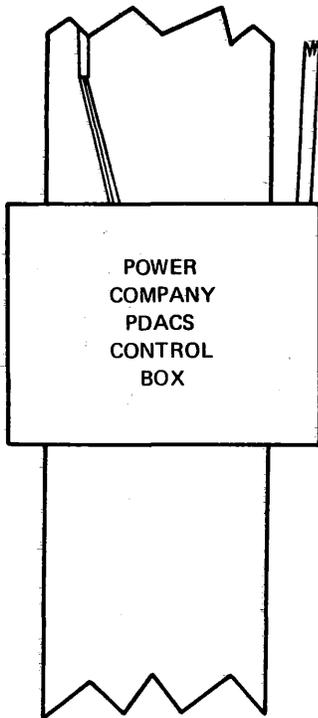
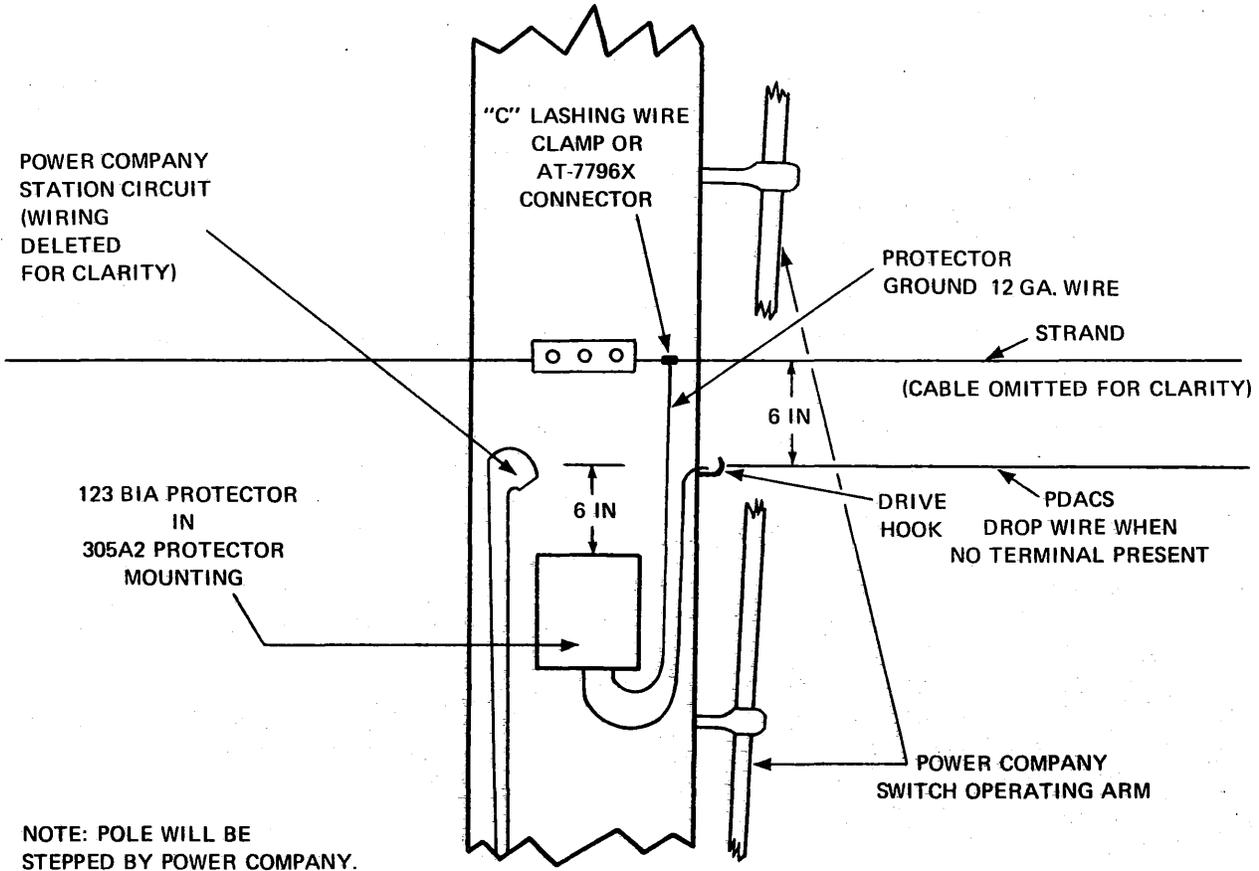
4.27 All poles with the PDACS private line termination, shall be stepped by the power company.

4.28 It is not required to remove bridge tap from outside plant facilities.

4.29 Provide SSP or SSM per Section 460-110-100, to identify circuits at all appearances.



Caution: Avoid all contact with the power company operation arm. Always place the safety belt between the operating arm and pole. Do not use the operating arm as handhold when changing positions.



Typical PDACS Pole Arrangement
Fig. 4

5. MAINTENANCE**Wire Center Unit****Model 10001 WC Test Set**

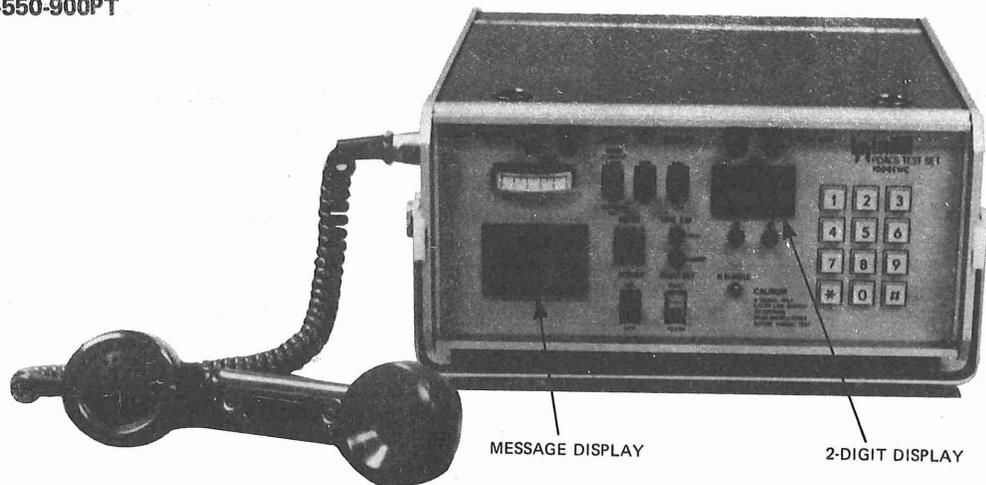
5.01 The LeeMAH Model 1000 WC test set is designed to be used in the installation and maintenance testing of the PDACS wire center unit. (See Fig. 5 and Table C.)

5.02 This test set performs all of the necessary functional tests of the wire center unit to ensure its proper operation. It checks:

- For correct tone decoding and wire line terminal selection.
- Adjustment of the 2.5 mA line sensing current.

TABLE C
FRONT PANEL FUNCTIONS
(See Fig. 5)

BINDING POST	FUNCTION
WIRE CTR LINE	THIS INPUT PROVIDES ACCESS TO THE INTERNAL SIMULATED LINE SWITCH. EXTERNALLY ONE OF THE 100 WIRE LINE TERMINALS OF THE EQUIPMENT IS CONNECTED TO THE INPUT. TIP AND RING POLARITY MUST BE OBSERVED.
TONE CKT	THIS INPUT IS CONNECTED TO THE EQP OR MON JACK OF THE EQUIPMENT UNDER TEST. THE INPUT IS A BALANCED 600 OHM CONNECTION TO THE TEST SETS TONE RECEIVER, ENCODER, AND TALK CIRCUITS. THIS INPUT IS NORMALLY CONNECTED TO THE EQP JACK WHICH OPENS THE PRIVATE LINE CIRCUIT BACK TOWARD THE DISTRIBUTION OPERATOR. USE THE MON JACK IF IT IS NECESSARY TO MONITOR INCOMING OR OUTGOING TONES OR TO TALK OVER THE PRIVATE LINE CIRCUIT.
SWITCHES	
METER (pushbutton)	PROTECTS THE METER FROM ACCIDENTAL OVER-CURRENT DUE TO IMPROPER TESTING. THE BUTTON IS DEPRESSED TO MEASURE CURRENT ON THE METER ON THE 0-5 mA SCALE.
METER (lever switch)	CHANGES THE FULL SCALE READING OF THE METER FROM 0-5 mA TO 0-250 mA. THIS SWITCH MUST BE IN THE SWITCH CURRENT X50 POSITION BEFORE THE EXECUTE FEATURE WILL FUNCTION.
LOOP RES	CHANGES THE LOOP RESISTANCE OF THE SIMULATED LINE SWITCH FROM A FEW OHMS TO 1500 OHMS.
DISPLAY	WORKS IN CONJUNCTION WITH THE 2-DIGIT DISPLAY. IN THE DIGIT VER POSITION, THE TONE ENCODER IS ENABLED AND THE DISPLAY WILL SHOW THE 2-DIGITS OF THE WIRE LINE TERMINAL SELECTED. IN THE MSG POSITION, THE TONE ENCODER IS DISABLED AND THE DISPLAY WILL SHOW THE SINGLE DIGIT CORRESPONDING TO THE TONE SENT FROM THE EQUIPMENT THAT RESULTS IN A MESSAGE. THIS SWITCH MUST BE IN THE DIGIT VER POSITION BEFORE ANY TOUCH-TONE DIGITS CAN BE PULSED.
POWER	URNS THE TEST SET POWER SUPPLY ON AND OFF.
FAULT DET	THIS SWITCH IS PART OF THE SIMULATED LINE SWITCH AND SIMULATES A FAULT DETECTOR FAULT OR CLEAR.
*ENABLE	A LOCKING LEVER TYPE SWITCH. THE TOGGLE HANDLE MUST BE PULLED UP BEFORE THE SWITCH CAN OPERATE. THIS SWITCH WORKS IN CONJUNCTION WITH THE * TONE SIGNAL BUTTON ON THE DIAL. TO SEND THE * (EXECUTE) SIGNAL, THIS SWITCH AND THE * BUTTON MUST BE OPERATED SIMULTANEOUSLY.
LAMPS	
*	INDICATES DECODING OF THE * SIGNAL.
#	INDICATES DECODING OF THE # SIGNAL.
LINE SW	
OPEN	INDICATES THE SIMULATED LINE SWITCH IS OPEN.
CLOSED	INDICATES THE SIMULATED LINE SWITCH IS CLOSED.
DISPLAYS	
2-DIGIT	THIS DISPLAY CONTAINS TWO 7-SEGMENT LED NUMERALS TO INDICATE THE WIRE LINE TERMINAL SELECTED OR THE SINGLE DIGIT CORRESPONDING TO THE TONE SENT FROM THE EQUIPMENT THAT RESULTS IN A MESSAGE.
MESSAGE	THIS DISPLAY IS A PROJECTION READOUT THAT SHOWS THE MESSAGES NORMALLY READ BY THE DISTRIBUTION OPERATOR.
HANDSET	USED TO MONITOR TONES AND TO TALK TO THE DISTRIBUTION OPERATOR OR TELCO TESTBOARD OVER THE PRIVATE LINE CIRCUIT. TO TALK ON THE CIRCUIT, DEPRESS THE HANDSET BUTTON. THE TONE CIRCUIT TEST CORD MUST BE IN THE MON JACK OF THE EQUIPMENT UNDER TEST TO MONITOR OR TALK.



PDACS Wire Center Test Set
(Refer to Table C)
Fig. 5

- For proper operation of the sense current and charging current regulators over maximum and minimum loops.

- For proper signal encoding.

5.03 The test set consists of the following main circuit items:

- Tone receiver and decoding circuit
- Tone encoder and pushbutton pad with execute signal (*) inhibit switch
- 2-digit display
- Message display
- MA meter
- Simulated wire line circuit (consisting of line switch module [model C2XA], fault detector, capacitor, relay, and lamps)
- Telephone push-to-talk handset and talk circuit
- Power supply

Wire Center Unit Tests

5.04 Wire center unit tests are provided in the following:

Chart A — Power Supply Voltages — Checks the -48, -24, +130, and -10 volt boost potentials for proper operation.

Chart B — Duplexer, Line Circuit, and Touch-tone Transmitter — Checks the proper operation of the flip-flop and line circuit. It also checks the transmission level of *Touch-Tone* signals.

Chart C — Line Switch Decoder Circuit — Checks adjustment of line sensing current (2.5 mA).

Chart D — Touch-Tone Receiver and Decoder Circuit — Checks for proper decoding of *Touch-Tone* signals incoming to the unit under test and the continuity and polarity of the 100 wire line terminals from the wire center unit to the distributing frame termination.

Chart E — Energizer Circuit — Checks the circuits ability to charge the CPE switch capacitor and to disconnect when the capacitor discharges.

Chart F — Tone Encoding Circuit — Checks the circuits ability to properly sense all conditions of the simulated line switch and encode the *Touch-Tone* transmitter to send the correct signal to the distribution operator.

5.05 Apparatus required:

- 1 — Hewlett Packard 403A Transmission Measuring Set (TMS) (or equivalent E/W 600 ohm termination)
- 1 — KS-14510 Volt-Ohmmeter (or equivalent)
- 1 — PDACS Test Set (Model 10001 WC)

Miscellaneous clip cords and relay blocking tools

5.06 Tests covered in Charts A through F should be made on the wire center unit when installation is complete and before the system is placed in service. These tests can also be used to identify and clear trouble conditions after the system is in service.

CHART A
POWER SUPPLY VOLTAGES

Preparation for Test

- 1 — Remove all PDACS plug-in circuit cards and *Touch-Tone* transmitter.

STEP	ACTION	VERIFICATION
	Test	
1	Connect volt-ohmmeter (+) lead to frame ground and (-) lead to (R) of connector C3. Adjust meter to read -50V dc.	Read -50V \pm 2V on meter.
2	Reconnect (-) lead to (N) of connector C3. Insert circuit card C3.	Read -24V \pm 2V on meter.
3	Replace <i>Touch-Tone</i> transmitter. Manually operate relay VM.	Voltmeter reading in Step 2 shall not change more than 0.5V.
4	Release relay VM and remove test leads. Reconnect the (-) lead to frame ground and (+) lead to (H) of connector C2. Adjust meter to read +130V.	Read +130V \pm 2V on the meter.
5	Remove test leads and reconnect (+) lead to (E) and (-) lead to (B) of connector C5. Insert C5 circuit card. Adjust meter to read -60V. Manually operate relay E.	Read not less than -56V on the meter.
6	Remove test leads and release relay E.	
7	Replace all remaining plug-in circuit cards.	

CHART B

DUPLEXER, LINE CIRCUIT, AND TOUCH-TONE TRANSMITTER

Preparation for Test

- 1 — Remove PDACS printed circuit card C4.

STEP	ACTION	VERIFICATION
	Test	
1	Connect the 403A TMS to terminals (B) and (Z) of connector C4. Use a 600 ohm termination and adjust the meter to read 0 dBm. Manually operate relay VM.	Meter shall read +1.0 dBm \pm 1.0 dBm
2	Reconnect the TMS to (4) and (7) of T1 (or plug into EQP jack). Insert circuit card C4.	Tone bursts at approximately one per second peak at around 0 dBm.
3	Disconnect TMS and release relay VM.	

CHART C

LINE SWITCH DECODER CIRCUIT

Preparation for Test

- 1 — Connect power cord from PDACS test set to a 117V ac outlet.
- 2 — Connect handset to telset connector located on side of test set.
- 3 — Connect a test cord from the TONE CKT binding post on test set to EQP or MON jack on wire center unit.
- 4 — Connect a test cord (knurl on double banana plug to left [polarity must be observed]) from WIRE CTR LINE binding post on test set to SW jack on the equipment.
- 5 — Place test set switches in the following positions:
 - METER — SENSE CURRENT 2.5MA
 - LOOP RES — MIN
 - DISPLAY — DIGIT VER
 - FAULT DET — FAULT
 - POWER — ON
- 6 — All plug-in circuit cards must be in place.
- 7 — Using clip cords at the distributing frame termination, connect the T&R of any unused terminal below 90 to the SW-T&R, polarity must be observed.
- 8 — Clear the test set and equipment by momentarily depressing the # button on the keyset.

STEP	ACTION
	Test
1	Key 2-digit code corresponding to terminal connected to SW-T&R. The digits will appear on the digit display and equipment will operate and respond by sending tone pulses and lighting the message display. Ignore the tones and message at this time.
2	Depress METER switch and adjust R202 on printed card C1 to read 2.5MA on the meter. Place the LOOP RES switch in MAX position. The meter reading should not change. A change in the meter reading would indicate a defective sensing current regulator on the C1 printed card.
3	Clear test set and equipment by momentarily depressing the # button on the keyset.
4	Remove clip cords from distributing frame unless other tests are to be performed.

CHART D

TOUCH-TONE RECEIVER AND DECODER CIRCUIT

Preparation for Test

- 1 — Connect power cord from PDACS test set to a 117V ac outlet.
- 2 — Connect handset to telset connector located on side of test set.
- 3 — Connect a test cord from the TONE CKT binding post on test set to EQP or MON jack on wire center unit.
- 4 — Place test set switches in the following positions:

METER	— SENSE CURRENT 2.5MA
LOOP RES	— MIN
DISPLAY	— DIGIT VER
FAULT DET	— FAULT
POWER	— ON

- 5 — All plug-in circuit cards must be in place.
- 6 — Clear test set and equipment by momentarily depressing the # button on the keyset.

Note: This test will require one person at the wire center unit with the test set and a second person at the HDF termination of the wire center unit. A talk line should be established between the two points to coordinate testing.

STEP	ACTION	VERIFICATION
	Test	
1	Key 0 digit on the keyset of test set.	Relays 0 and TO operate and release Relays TBO, TCO, and TR operate and lock. A digit 0 should appear on the digit display of the test set.
2	Key 0 digit again.	Relay UO operates and releases. Relays VM and E operate. Relays O and UR operate and lock. A second digit 0 should appear on digit display. Pulsing <i>Touch-Tone</i> signal is heard on handset and CNTL LINE OPEN should appear on message display.
3	The person at the distributing frame should short the T-00 and R-00.	Relay E releases and CNTL LINE SHORT appears on message display.
4	Remove the short at the distributing frame and depress # button on test set.	All relays release, tones stop and displays are extinguished.
5	Key code 01 on test set.	Same as Steps 1 and 2 except relay 1 operates and locks.

CHART D (Contd)

STEP	ACTION	VERIFICATION
6	The person at the distributing frame should short the T-01 and R-01.	Same as Step 3.
7	Repeat Steps 11 through 13 for codes 02 through 99.	Same as Steps 1 through 4 except the proper TB- and units relays operate for each code.
8	Clear test set and equipment by momentarily depressing # button on keyset.	
9	Remove test set from equipment unless other tests are to be performed.	
10	After this test is completed at the time of acceptance testing, the T&R of terminal 00 should be strapped at the distributing frame to provide a permanent short. This terminal will be used as a test terminal by the customer.	

CHART E

ENERGIZER CIRCUIT

Preparation for Test

- 1 — Connect power cord from PDACS test set to a 117V ac outlet.
- 2 — Connect handset to telset connector located on side of test set.
- 3 — Connect a test cord from TONE CKT binding post on test set to EQP or MON jack on wire center unit.
- 4 — Connect a test cord (knurl on double banana plug to left [polarity must be observed]) from WIRE CTR LINE binding post on test set to SW jack on equipment.
- 5 — Place test set switches in the following positions:

METER	— SWITCH CURRENT X50
LOOP RES	— MAX
DISPLAY	— DIGIT VER
FAULT DET	— FAULT
POWER	— ON
- 6 — All plug-in circuit cards must be in place.
- 7 — Using clip cords at the distributing frame termination, connect T&R of any unused terminal below 90 to the SW-T&R, polarity must be observed.
- 8 — Clear test set and equipment by momentarily depressing # button on keyset.

CHART E (Contd)

STEP	ACTION	VERIFICATION
	Test	
1	Key 2-digit code corresponding to terminal connected to SW-T&R.	The 2 digits keyed should appear on digit display and flashing message on message display corresponding to status of simulated line. (See Table D.)
2	Place DISPLAY switch in MSG position.	A flashing digit 2 or 6 should appear on the display corresponding to the flashing message. (See Table D.)
3	Return DISPLAY switch to DIGIT VER position. <i>Caution: Incorrect operation of Step 4 may activate customer equipment. Be sure to verify that:</i> <i>a. The SW tip and ring are connected to an unused terminal at the distributing frame.</i> <i>b. The terminal connected to SW is the terminal shown on the display under Step 1.</i>	The 2-digit code originally keyed should reappear on digit display.
4	Operate and hold the *ENABLE switch and momentarily depress the (*) button on the keyset.	The message display should read a flashing CAP CHG. The meter should show the line switch capacitor charging at about 60 mA. (If the LOOP RES switch is in the MIN position, the meter should show the capacitor charging at about 125 mA.) Check both MIN and MAX positions. Within 5 to 8 seconds the simulated line switch should operate and the LINE SW lamps should indicate the change.
5	Place the DISPLAY switch in the MSG position.	A flashing digit 4 or 8 should appear on the display corresponding to the flashing message. (See Table D.) The message display should have changed to the new status of the simulated line.
6	Clear test set and equipment by momentarily depressing the # button on the keyset.	
7	Remove clip cords from distributing frame unless other tests are to be performed.	
8	Remove test set from equipment unless other tests are to be performed.	

CHART F

TONE ENCODER CIRCUIT

Preparation for Test

Note: Perform the Preparation for Test steps set forth in Chart E. The only exception is in Step 5 — be sure to set the LOOP RES switch to MIN position.

STEP	ACTION	VERIFICATION
1	<p>Test</p> <p>Key 2-digit code corresponding to terminal connected to SW-T&R.</p> <p><i>Caution: Incorrect operation of Step 2 may activate customer equipment. Be sure to verify that:</i></p> <p><i>a. The SW tip and ring are connected to an unused terminal at the distributing frame.</i></p> <p><i>b. The terminal connected to SW is the terminal shown on the display.</i></p>	<p>By noting the position of the FAULT DET switch and which of the LINE SW lamps is lit on the test set, and by referring to Table D it can be determined if the flashing message is the correct one.</p>
2	<p>Operate and hold *ENABLE switch and momentarily depress (*) button on the keyset.</p>	<p>The message display should change to read CAP CHG. The meter should show the line switch capacitor charging. The simulated line switch should operate and the LINE SW lamps should indicate the change. The flashing message on the message display should also show the changed switch status.</p>
3	<p>Using Table D, verify all conditions of the simulated line switch for proper decoding and encoding. Clear the test set and equipment between each condition by depressing the # button.</p>	<p>See Steps 1 and 2.</p>
4	<p>Clear test set and equipment by momentarily depressing the # button on the keyset.</p>	
5	<p>Remove clip cords from distributing frame unless other tests are to be performed.</p>	
6	<p>Remove test set from equipment unless other tests are to be performed.</p>	

TABLE D

MESSAGE DISPLAY			KEY		LAMP		DIGIT DISPLAY	RELAY OPRD	REMARKS	
MESSAGE DISPLAYED			FAULT DET		LINE SW		DIGIT DISPLAYED			
			FAULT	CLEAR	OPEN	CLOSED	MSG POS			
CAP CHG							1	SC		
SW CLOSE FAULT	RELAY GND IN RCL IN	*	X				X	2	A	
SW CLOSE CLEAR	RELAY GND OUT RCL IN	*		X			X	4	B	
CNTL LINE OPEN								5	E	REMOVE TEST CORD FROM WIRE CTR LINE BINDING POST
SW OPEN FAULT	RELAY GND IN RCL OUT	*	X		X			6	C	
SW OPEN CLEAR	RELAY GND OUT RCL OUT	*		X	X			8	D	
CNTL LINE SHORT								0	NONE	SHORT WIRE CTR LINE BINDING POST

*Note: Messages in brackets [] are displayed when testing terminals 90 to 99, which are used with service restorer switches.

Substation Unit

Model 10002 SS Test Set

5.07 The LeeMAH model 10002 SS test set is designed to be used in the installation and maintenance testing of the PDACS substation unit. (See Fig. 6 and Table E.)

5.08 The test set performs all of the necessary substation unit functional tests. To ensure proper operation, it checks for:

- Correct tone decoding and command terminal selection.
- Proper signal encoding.
- Proper command terminal execute potential by providing a simulated command terminal relay.

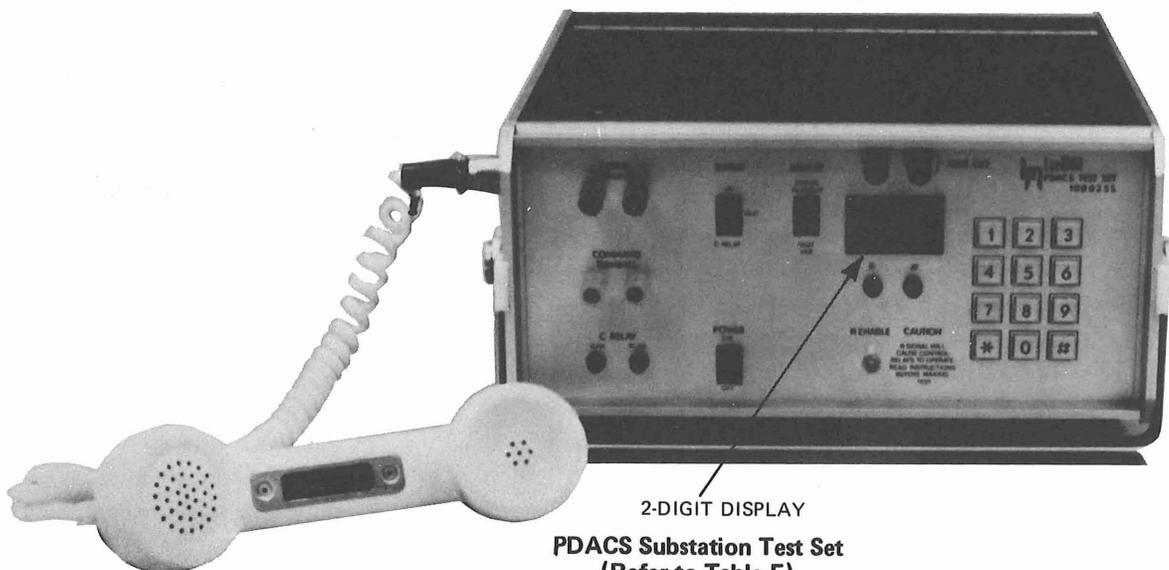
- Proper status terminal reporting by providing a simulated status terminal.

5.09 The test set consists of the following main circuit items:

- Tone receiver and decoding circuit
- Tone encoder and pushbutton pad with execute signal (*) inhibit switch
- 2-digit display
- Simulated command terminal relay
- Simulated status terminal
- Telephone push-to-talk handset and talk circuit
- Power Supply

TABLE E
FRONT PANEL FUNCTIONS
 (See Fig. 6)

BINDING POST	FUNCTION
TONE CKT	THIS INPUT IS CONNECTED TO THE <u>EQP</u> OR <u>MON</u> JACK OF THE EQUIPMENT UNDER TEST. THE INPUT IS A BALANCED 600 OHM CONNECTION TO THE TEST SETS TONE RECEIVER, ENCODER AND TALK CIRCUITS. THIS INPUT IS NORMALLY CONNECTED TO THE <u>EQP</u> JACK WHICH OPENS THE PRIVATE LINE CIRCUIT BACK TOWARD THE DISTRIBUTION OPERATOR. USE THE <u>MON</u> JACK IF IT IS NECESSARY TO MONITOR INCOMING OR OUTGOING TONES OR TO TALK OVER THE PRIVATE LINE CIRCUIT.
STATUS TERMINAL	THE OUTPUT WORKS IN CONJUNCTION WITH THE STATUS SWITCH TO PROVIDE A STATUS CONDITION FOR THE EQUIPMENT UNDER TEST. TIP AND RING POLARITY MUST BE OBSERVED.
COMMAND TERMINAL	THIS INPUT PROVIDES A SIMULATED COMMAND RELAY. THE RELAY OPERATES ON A DC CURRENT PROVIDED BY THE SUBSTATION UNIT DURING A COMMAND FUNCTION. TIP AND RING POLARITY MUST BE OBSERVED.
SWITCHES	
DISPLAY	WORKS IN CONJUNCTION WITH THE 2-DIGIT DISPLAY. IN THE <u>DIGIT VER</u> POSITION, THE TONE ENCODER IS ENABLED AND THE DISPLAY WILL SHOW THE 2 DIGITS OF THE COMMAND TERMINAL SELECTED. IN THE <u>STATUS READOUT</u> POSITION, THE STATUS OF THE SUBSTATION UNIT IS DISPLAYED AFTER THE <u>#</u> SIGNAL IS SENT. THIS SWITCH MUST BE IN THE <u>DIGIT VER</u> POSITION BEFORE ANY <u>TOUCH-TONE</u> DIGITS CAN BE PULSED.
POWER	TURNS THE TEST SET POWER ON AND OFF.
STATUS	WORKS IN CONJUNCTION WITH THE <u>STATUS TERMINAL</u> BINDING POST. THE SWITCH PROVIDES A CLOSED CIRCUIT (<u>STATUS IN</u>) AND AN OPEN CIRCUIT (<u>STATUS OUT</u>) AT THE TERMINALS. IN THE <u>C RELAY</u> POSITION, THE OPEN OR CLOSED CIRCUIT IS UNDER CONTROL OF THE INTERNAL COMMAND (C) RELAY. WHEN THE C RELAY LAMPS INDICATE <u>RLSD</u> THE CIRCUIT IS OPEN AND <u>OPR</u> THE CIRCUIT IS CLOSED.
*ENABLE	A LOCKING LEVER TYPE SWITCH. THE TOGGLE HANDLE MUST BE PULLED UP BEFORE THE SWITCH CAN OPERATE. THIS SWITCH WORKS WITH THE * TONE SIGNAL BUTTON ON THE KEYSSET. TO SEND THE *(EXECUTE) SIGNAL, THIS SWITCH AND THE * BUTTON MUST BE OPERATED SIMULTANEOUSLY.
LAMPS	
*	INDICATES DECODING OF THE * SIGNAL.
#	INDICATES DECODING OF THE # SIGNAL.
C RELAY, OPR	INDICATES THAT THE SIMULATED COMMAND RELAY IS OPERATED.
C RELAY, RLSD	INDICATES THAT THE SIMULATED COMMAND RELAY IS RELEASED.
DISPLAY	
2-DIGIT	CONTAINS TWO 7-SEGMENT <u>LED</u> NUMERALS TO INDICATE THE COMMAND TERMINAL SELECTED AND THE STATUS READOUT.
HANDSET	USED TO MONITOR TONES AND TO TALK TO THE DISTRIBUTION OPERATOR OR TELCO TESTBOARD OVER THE PRIVATE LINE CIRCUIT. TO TALK ON THE CIRCUIT, THE HANDSET BUTTON MUST BE DEPRESSED. THE TONE CIRCUIT TEST CORD MUST BE IN THE <u>MON</u> JACK OF THE EQUIPMENT UNDER TEST TO MONITOR OR TALK.



2-DIGIT DISPLAY
PDACS Substation Test Set
 (Refer to Table E)
Fig. 6

Substation Unit Tests

5.10 Substation unit tests are provided in the following:

Chart G — **Power Supply Voltages** — Checks the -48V rectifier and -24V regulator for proper operation.

Chart H — **Flip-Flop and Touch-Tone Transmitter** — Checks the proper operation of the flip-flop circuit and P and PD relays. It also checks the transmission level of the *Touch-Tone* signals.

Chart I — **Wake-Up Timing Circuit** — Checks the proper timing interval of this circuit.

Chart J — **Status Detector and Control Circuit** Checks the systems proper response to CPE contact closure.

Chart K — **Touch-Tone Decoder and Command Execute Circuit** — Checks for proper decoding of the *Touch-Tone* signals from the operator unit and the integrity of each command lead to provide battery and ground to the CPE relay.

5.11 Apparatus required:

- 1 — Hewlett Packard 403A TMS (or equivalent)
 - 1 — KS-14510 Volt-Ohmmeter (or equivalent)
 - 1 — PDACS Test Set (Model 10002 SS)
- Miscellaneous clip cords and relay blocking tools

5.12 The tests outlined in Charts G through K should be performed on the substation unit when installation is complete and before ac power is applied and the system is placed in service. These tests can also be used to identify and clear trouble conditions after the system is in service.

CHART G

POWER SUPPLY VOLTAGES

Preparation for Test

- 1 — Disconnect private line circuit from equipment under test.
- 2 — Remove all PDACS plug-in circuit cards and *Touch-Tone* transmitter.
- 3 — Arrange to have customer disable their equipment during testing.

STEP	ACTION	VERIFICATION
	Test	
1	Connect the voltmeter (+) lead to the equipment framework and the (-) lead to (R) on connector C3. Adjust meter to read -50V dc. Connect ac power to unit.	Read -50V ±2V on meter.
2	Reconnect (-) lead on voltmeter to (N) on connector C3. Insert circuit card C3.	Read -24V ±2V on meter.
3	Replace <i>Touch-Tone</i> transmitter. Connect a clip cord from ground to (6) of <i>Touch-Tone</i> transmitter connector TT.	Voltmeter reading in Step 2 shall not change more than 0.5 V.

CHART G (Contd)

STEP	ACTION	VERIFICATION
4	Remove test leads and replace all plug-in circuit cards.	
5	Reconnect private line to equipment if no further tests are to be performed.	
6	Customer can restore equipment to normal if no further tests are required.	

CHART H

FLIP-FLOP AND TOUCH-TONE TRANSMITTER

Preparation for Test

- 1 — Disconnect private line circuit from equipment under test.
- 2 — Arrange to have customer disable his/her equipment during testing.
- 3 — Remove PDACS plug-in circuit cards S2 and S4.
- 4 — Connect a clip cord from ground to (6) of *Touch-Tone* transmitter connector TT.
- 5 — Connect power cord from PDACS test set to a 117V ac outlet.
- 6 — Connect handset to telset connector located on side of test set.
- 7 — Connect a test cord from TONE CKT binding post on test set to EQP on MON jack on substation unit.

STEP	ACTION	VERIFICATION
	Test	
1	Connect the 403A TMS to frame ground and (12) of the <i>Touch-Tone</i> Transmitter connector TT. Use a 600 ohm termination and adjust meter to read 0 dBm.	Meter shall read +1.0 dBm \pm 1.0 dBm.
2	Remove TMS and clip cord.	
3	Insert circuit cards S2 and S4. Block relay AP operated.	P and PD relays operate at approximately 1 pulse per second. Relay WU operates.
4	Listen in handset of PDACS test set.	Listen for pulsing tone (<i>Touch-Tone</i> 0 at 1 pulse per second).

CHART H (Contd)

STEP	ACTION	VERIFICATION
5	Block released relay PS. Manually operate relay GA.	Relay GA operates and locks. The pulsing rate of relays P and PD increases from approximately 1 to 3 per second.
6	Remove blocking tools and manually release relay WU.	All relays released.
7	Disconnect PDACS test set.	
8	Reconnect private line to equipment if no further tests are to be performed.	
9	Customer can restore equipment to normal if no further tests are required.	

CHART I

WAKE-UP TIMING CIRCUIT

Preparation for Test

- 1 — Disconnect private line circuit from equipment under test.
- 2 — Arrange to have customer disable his/her equipment during testing.

STEP	ACTION	VERIFICATION
	Test	
1	Manually operate relay WU and start timing.	Relay WU operates and locks. At the end of 50 seconds (± 10 seconds) relay WU releases.
2	If no further tests are to be performed, reconnect private line to equipment.	
3	Customer can restore equipment to normal if no further tests are required.	

CHART J

STATUS DETECTOR AND CONTROL CIRCUIT

Preparation for Test

- 1 — Disconnect private line circuit from equipment under test.
- 2 — Arrange to have customer disable his/her equipment during testing.
- 3 — All plug-in circuit cards must be in place.
- 4 — Connect clip cords from tip and ring of DET jack termination on interface terminal strip (B) to tip and ring of a spare status terminal (SC) in the 50 to 99 count on interface terminal strip (observe polarity).
- 5 — Connect power cord from the PDACS test set to a 117V ac outlet.
- 6 — Connect handset to telset connector located on side of test set.
- 7 — Connect a test cord from TONE CKT binding post on test set to EQP or MON jack on substation unit.
- 8 — Connect a test cord (knurl on double banana plug to left [polarity must be observed]) from STATUS TERMINAL binding post on test set to the DET jack on equipment.
- 9 — Connect a test cord (knurl on double banana plug to left [polarity must be observed]) from COMMAND TERMINAL binding post on test set to COM jack on equipment.
- 10 — Place test set switches in the following positions.

DISPLAY — STATUS READOUT
 STATUS — OUT
 POWER — ON

- 11 — Clear test set and equipment by momentarily depressing # button on keyset.

STEP	ACTION	VERIFICATION
	Test	
1	Place STATUS switch to IN position.	Relays AP and WU operate. Relays P and PD start pulsing. Equipment will respond by sending alarm tone. Display will read 00.
2	Press and hold # button on test set keyset.	Relays RLS and PP operate. Relays P and PD stop pulsing.

CHART J (Contd)

STEP	ACTION	VERIFICATION
3	<p>Release # button on keyset.</p> <p><i>Note:</i> For purposes of this test, proper circuit operation can be verified by observing the lamps on the test set and listening to tones on the handset.</p>	<p>A series of three distinct tones should be heard in the handset and first the (*) lamp should light followed by the 2 digits corresponding to the status terminal tied to the DET jack, should appear on the display. At the end of the sequence, the C-relay of the terminal associated with the DET jack operates and locks. All other relays release except for relay WU which releases at the end of the 50 second timing period.</p>
4	Place STATUS switch in OUT position.	
5	Press and release # button on test set.	<p>C- relay associated with status terminal tied to the DET jack releases and action repeats as in Step 3.</p>
6	Press and release # button on test set.	<p>C- relay associated with status terminal tied to the DET jack releases. WU relay releases at end of 50 second timing period.</p>
	<p><i>Note:</i> The above test assumes that only the status terminal associated with the DET jack is activated. After initial installation, the customer will permanently short one terminal to be used as a test terminal. When using the above test to locate trouble both the status terminal tied to the DET jack and the one shorted as a test terminal will indicate on the test set one after the other.</p>	
7	<p>Next check the integrity of each status terminal SC 00 to 99 for proper decoding. With STATUS switch in the OUT position, momentarily short each SC terminal one at a time and then ask for a read-out by pressing # button on the keyset. (This integrity check of all 100 SC terminals would normally be made only at the time of installation of a substation unit).</p>	<p>A series of three distinct tones should be heard in the handset and first the (*) lamp should light followed by the two digits corresponding to the status terminal that has been shorted should appear on the display.</p>
8	Disconnect PDACS test set.	
9	Remove clip cords from DET jack termination on the interface terminal strip.	
10	If no further tests are to be performed, reconnect private line to equipment.	
11	Customer can restore equipment to normal if no further tests are required.	

CHART K

TOUCH-TONE DECODER AND COMMAND EXECUTE CIRCUIT

Preparation for Test

- 1 — Disconnect private line circuit from equipment under test.
- 2 — Arrange to have customer disable his/her equipment during testing.
- 3 — All plug-in circuit cards must be in place.
- 4 — Connect clip cords from tip and ring of DET jack termination on interface terminal strip (B) to tip and ring of a spare status terminal (SC) in the 50 to 99 count on interface terminal strip (observe polarity).
- 5 — Connect clip cords from tip and ring of COM jack termination on interface terminal strip (E) to tip and ring of a spare command terminal (RC) on interface terminal strip (observe polarity).
- 6 — Connect power cord from PDACS test set to a 117V ac outlet.
- 7 — Connect handset to telset connector located on side of test set.
- 8 — Connect a test cord from TONE CKT binding post on test set to EQP or MON jack on substation unit.
- 9 — Connect a test cord (knurl on double banana plug to left- [polarity must be observed]) from STATUS TERMINAL binding post on test set to DET jack on equipment.
- 10 — Connect a test cord (knurl on double banana plug to left- [polarity must be observed]) from COMMAND TERMINAL binding post on test set to COM jack on equipment.
- 11 — Place test set switches in the following positions.

DISPLAY— DIGIT VER
 STATUS — C RELAY
 POWER — ON

- 12 — Clear test set and equipment by momentarily depressing # button on keyset.



Caution: The following tests should never be performed with the CPE relay connected to the RC terminal strip. Always have the customer disable the relays to prevent false operation of their equipment.

STEP	ACTION	VERIFICATION
1	<p>Test</p> <p>Block relay WU operated. Momentarily press digit 0 button on test set.</p>	<p>Relays O and TO operate and release. Relays TBO, TR and TCO operate and lock. A digit 0 should appear on test set display.</p>

CHART K (Contd)

STEP	ACTION	VERIFICATION
2	Momentarily press digit 0 button again.	Relay UO operates and releases. Relays UR, 0 operate and lock. A second digit 0 should appear on the test set display.
3	Momentarily press * button on test set.	Relay XY operates. In approximately 500 ms all relays release
4	Clear test set and equipment by momentarily depressing # button on keyset.	
5	Repeat Steps 1 through 4 for digits 1 to 9.	Same as for Steps 1 through 4 except relay 1 and TB1, 2 and TB2, etc, operate and the digits keyed appear on the test set display.
	<p>THINK <i>Incorrect operation of Step 6 may activate customer equipment. Verify that the customer has disabled all circuits connected to substation unit.</i></p>	
6	Next check the integrity of each command terminal RC 00 to 99. Connect VOM (+) lead to tip and (-) lead to ring of terminal RC-00. <i>Touch-Tone</i> code 00 on test set, then operate and hold *ENABLE switch and momentarily depress (*) button on keyset.	Relays operate in sequence as in Steps 1, 2, and 3. Battery and ground appear on the terminal for approximately 500 ms, and the digits keyed appear on the test set display.
7	Clear test set and equipment by momentarily depressing # button on keyset.	
8	Connect VOM to terminal RC-01 and repeat Step 6 and 7 for code 01.	Same as Step 6 except battery and ground appear on terminal 01.
9	Repeat Step 6 and 7 for all remaining terminals, RC-02-99. (This integrity check of all 100 RC terminals would normally be made only at the time of installation of substation unit.)	Same as Step 6 except battery and ground appear on proper terminal for each code.
10	Key 2-digit code corresponding to RC terminal connected to COM jack.	The 2 digits keyed should appear on test set display.
	<p>THINK <i>Incorrect operation of Step 11 may activate customer equipment. Verify that customer has disabled all circuits connected to substation unit.</i></p>	
11	Operate and hold *ENABLE switch and momentarily depress * button on keyset.	In approximately 500 ms the simulated command relay in the test set should operate and the C relay lamp should change indicating that the relay operated.

CHART K (Contd)

STEP	ACTION	VERIFICATION
12	Place DISPLAY switch in STATUS READ-OUT position.	Display should show 00.
13	Momentarily depress # button on keyset.	If C relay lamps show that the simulated command relay is operated, a series of three tones should be heard in the handset and first the (*) lamp should light followed by the 2 digits corresponding to the status terminal tied to the DET jack should appear on the display. If C relay lamps show that the simulated command relay is released, no status indication will be displayed.
14	Disconnect PDACS test set.	
15	Remove clip cords from DET and COM jack terminations on interface terminal strips.	
16	Reconnect private line to equipment if no further tests are required.	
17	If no further tests are to be performed, the customer can restore his/her equipment.	

Operator Unit

5.13 Operator unit tests are covered in the following:

Chart L — **Power Supply Voltages** — Checks the -48 and +24 rectifiers for proper operation.

Chart M — **Line Circuit** — Checks for proper operation of line circuit and associated line key, lamp and common audible circuit.

Chart N — **Digit Verification Circuit** — Checks digit verification circuit for proper decoding and display of digits keyed on operator console dial.

Chart O — **Wire Center Lamp Display Circuit** — Checks for proper decoding of *Touch-Tone* signals from wire center unit and the circuits ability to display proper messages for each signal received.

Chart P — **Substation Lamp Display Circuit** — Checks for proper decoding of *Touch-Tone* signals from substation unit and the circuits ability to light the proper lamp for each code received.

5.14 Apparatus required:

- 1 — Hewlett Packard 403A TMS (or equivalent)
- 1 — Hewlett Packard 204C Oscillator (or equivalent)
- 1 — KS-14510 Volt-Ohmmeter (or equivalent)
- 1 — Telset, 2500D (or equivalent)

Miscellaneous clip cords and relay blocking tools

5.15 The tests outlined in Charts L through P should be performed on the operator unit when installation is complete and before ac power is applied and the system is placed in service. These tests can also be used to identify and clear trouble conditions after the system is in service.

CHART L
POWER SUPPLY VOLTAGES

Preparation for Test

- 1 — Disconnect any private line circuits that are connected to the equipment under test.
- 2 — Remove all PDACS plug-in circuit cards and line circuit cards.

STEP	ACTION	VERIFICATION
	Test	
1	Connect voltmeter (+) lead to equipment framework and (-) lead to (B) of fuse FA. Adjust voltmeter to read -50V dc. Connect ac power to unit.	Read -50V \pm 2V on meter.
2	Remove test leads and reconnect (-) lead to equipment framework and (+) lead to (A) of connector D2. Adjust voltmeter to read +24V dc.	Read +24V \pm 1V on meter.
3	Remove test leads and replace all plug-in circuit cards.	
4	If no further test are required, reconnect all private line circuits.	

CHART M
LINE CIRCUIT

Preparation for Test

- 1 — Disconnect any private lines that are connected to the equipment under test.
- 2 — Remove plug-in circuit cards from all two circuit line units.
- 3 — Release all the line keys on the console.

CHART M (Contd)

STEP	ACTION	VERIFICATION
	Test	
1	Connect oscillator to terminals (1) and (2) of the first line circuit of the first line unit. Bridge TMS across oscillator terminals. Adjust oscillator for a frequency of 1000 Hz and a level of -20 dBm. Insert a line circuit card in the circuit under test.	Line lamp on console associated with the LINE CKT under test lights. Common audible buzzer operates.
2	Operate line key and listen in console handset.	Line lamp remains lit, buzzer stops and 1000 Hz signal is heard in handset. (Relay DE operates for Y option, substation).
3	Release line key and disconnect oscillator from line circuit and reconnect to terminals (6) and (7) of second line circuit of first line unit and repeat Steps 1 and 2 for this line circuit.	Line lamp of first line circuit is extinguished.
4	Repeat Steps 1, 2, and 3 for all other line units.	
5	Disconnect oscillator and TMS after testing all line units.	
6	If no further tests are required, reconnect all private line circuits to equipment.	

CHART N

DIGIT VERIFICATION CIRCUIT

Preparation for Test

- 1 — Operate one of the console line keys associated with a wire center line circuit.
- 2 — Disconnect any private lines that are connected to the equipment under test.

STEP	ACTION	VERIFICATION
	Test	
1	Press and release digit 0 on console keyset.	Relay ON and ON1 operate and release. Relays W, Z, DSTR-1 and DSTR-2 operate. Digit 0 should appear in tens cell of rear projection display.

CHART N (Contd)

STEP	ACTION	VERIFICATION
2	Press and release digit 0 again.	Relay ON and ON1 operate and release. Relays W and Z release. Digit 0 should appear in units cell of rear projection display.
3	Press and release # button on console keyset.	Relays ON, ON1 and PP operate and release. Relays DSTR-1 and DSTR-2 release and the display extinguishes.
4	Repeat Steps 1, 2, and 3 for codes 01 to 99.	Same as above except correct digits appear on display for each code.
5	Restore line key of wire center circuit being used for test.	
6	If no further tests are required, reconnect all private line circuits to equipment.	

CHART O

WIRE CENTER LAMP DISPLAY CIRCUIT

Preparation for Test

- 1 — Disconnect any private lines that are connected to the equipment under test.
- 2 — Use a 2500D telephone set (or equivalent).

STEP	ACTION	VERIFICATION
	Test	
1	Connect tip and ring of 2500D telset to terminals (3) or (8) and (4) or (9) of a line circuit wired for Z option-wire center. Operate line key associated with this line circuit. Press and hold digit 1 on the telset.	<i>Touch-Tone</i> signal is heard in console handset. The message CAP CHG lights on rear projection display.
2	Release digit 1 and repeat Step 1 for digits 0, 2, 4, 5, 6, 8.	Message is extinguished on release of digit. New message appears for each digit. 0 — CNTL LINE SHORT 2 — SW CLOSED FAULT 4 — SW CLOSED CLEAR 5 — CNTL LINE OPEN 6 — SW OPEN FAULT 8 — SW OPEN CLEAR

CHART O (Contd)

STEP	ACTION	VERIFICATION
3	Press and release digit 9 on console keyset.	Relay ON and ON1 operate and release. Relay W, Z, DSTR-1 and DSTR-2 operate. Digit 9 should appear in tens cell of rear projection display.
4	Using 2500D telset, press and hold one at a time, digits 2, 4, 6 and 8.	<p>The following messages should light on rear projection display.</p> <p>2 — RELAY GND IN RCL IN</p> <p>4 — RELAY GND OUT RCL IN</p> <p>6 — RELAY GND IN RCL OUT</p> <p>8 — RELAY GND OUT RCL OUT</p> <p>Lamp goes out on release of digit. New message appears for each digit.</p>
5	Restore line key of wire center circuit being used for test.	
6	Disconnect 2500D telset.	
7	Reconnect all private line circuits to equipment if no further tests are required.	

CHART P

SUBSTATION LAMP DISPLAY CIRCUIT

Preparation for Test

- 1 — Disconnect any private lines that are connected to the equipment under test.
- 2 — Use a 2500D telset (or equivalent).

CHART P. (Contd)

STEP	ACTION	VERIFICATION
Test		
1	Depress the lamp test key (Hold Key) on the console.	All 100 substation lamps should light.
2	Connect the tip and ring of the 2500D telset to terminals (3) or (8) and (4) or (9) of a line circuit wired for Y option-Substation. Operate the line key associated with this line circuit on the console.	Relay DE operates.
3	Press and release the (*) button on the telset.	Relay XY and DH operates and releases. Relay RS operates and locks.
4	Press and release the 0 digit on the telset.	Relay TO and DH operate and release. Relays TBO, TR, and TCO operate.
5	Press and release the 0 digit again.	Relay UO, DH, and UR operate and release. Relay RS releases. Lamp 00 lights on the substation display.
6	Press and release the # button on the console.	Relays PP, ON and ON1 operate and release. Lamp 00 extinguishes.
7	Repeat Steps 3 through 5 for digits 01 to 99.	Same as above except relays TB-1, TB-2 etc, operate for each group of ten codes (10-19), (20-29, etc).
8	Restore line key of substation circuits being used for test.	
9	Disconnect 2500D telset.	
10	Reconnect all private line circuits to equipment if no further tests are to be performed.	

Local Test Desk

5.16 Test procedures for testing PDACS "KM" type signal channel private lines from a local test desk are as follows:

5.17 Testing for a trouble report of "CONTROL LINE REVERSE" — Shoe cable pair on distributing frame and test out:

1. If pair is straight all the way to the CP switch module, the tester should read a loop resistance equal to the cable pair loop, plus the following resistance depending on what status the module is in (resistance is approximate):

- Switch closed and fault — 5000 ohms
- Switch closed and clear — 9000 ohms
- Switch open and fault — 13000 ohms
- Switch open and clear — 17000 ohms

2. If pair is actually reversed somewhere between the distributing frame and the switch module, the tester should read the cable pair loop resistance and while watching for a few seconds the resistance should increase to infinity as a capacitor discharges.

5.18 Testing for a trouble report of "CONTROL LINE OPEN" — Shoe pair on distributing frame and test out:

1. If pair is actually open, tester should read like any open line (infinite resistance).
2. If pair is not open and is otherwise OK, the tester should read as shown in 5.17, Step 1.

5.19 Testing for a trouble report of "CONTROL LINE SHORT" — Shoe cable pair on distributing frame and test out:

1. If pair is actually shorted, the tester should read the loop resistance to wherever the short exists.
2. If pair is not shorted and is otherwise OK, the tester should read as shown in 5.17, Step 1.

Notes (Related to 5.17 through 5.19):

1. If the tester looks in on any of these tests he/she should read a ground on both sides of line.
2. If pair does not appear reversed when looking out, the distributing frame jumper should be checked to see that it is tied down straight.
3. All these tests must be made with positive test battery on the tip side of the line from the test cord. (Reverse key operated) — This is when testing out.
4. One other test that can be made if necessary, is to dispatch a repair person to the protector on the pole and check tip and ring continuity and polarity back to the distributing frame.
5. Testing on these private lines with test battery cannot operate the customers switch which is connected to the private line.
6. There is a PDACS cutout switch at each pole location in the customers control box. If this switch is in the cutout position, the tester will read a short with the resistance of the cable pair loop.
7. Step 1 under testing for "CONTROL LINE REVERSE" (5.17) is the normal condition that these lines should read.
8. Testing exchange cable pairs associated with voice grade private lines. In all cases the tester should read a loop equal to the cable pair loop resistance. These circuits all terminate into a repeat coil.

6. ORDERING INFORMATION

6.01 This material shall be ordered and returned to the Regional Supply Service Center from Western Electric Company. Be sure to properly pack and protect equipment on returns.

6.02 Order wording for maintenance spares is as follows:

Pack, Circuit

PTS-338, G1	Line Switch Decoder Unit
PTS-338, G2	Energizer Ckt. Unit
PTS-338, G3	-24V Regulator Unit
PTS-338, G4	Clock Duplexer & Line Circuit Unit
PTS-338, G5	Substation Status Detector Unit
PTS-338, G6	Transfer Ckt., Common Audible Control & Status Lamp Display
PTS-338, G7	Alarm Lamp Test Circuit Unit
PTS-338, G8	Status Detector Unit
PTS-338, G9	Alarm Counter & Decoder Priority & Minor Alarms Unit
PTS-338, G10	PP & XY Decoder, Reclose & Wake Up Clock Duplexer & Line Unit
PTS-338, G11	Line Circuit Unit
PTS-338, G12	Digit Verification Unit
PTS-338, G13	DC to DC Converter

6.03 Test Sets shall be ordered directly from the manufacturer, on Form P2 or P2A.

LeeMAH Electronics
520 Chestnut St.
San Francisco, CA 94133

- Set, Test, PDACS, LeeMAH Model 10001 WC (Wire Center)
- Set, Test, PDACS, LeeMAH Model 10002 SS (Substation)