SYSTEM CENTURY®
DIGITAL CENTRAL OFFICE

POWER AND ALARM SYSTEM
DESCRIPTION

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1. INTRODUCTION

1.01 This section describes the equipment and circuitry used for generation and distribution of power and alarms in SYSTEM CENTURY Digital Central Offices (DCOs) equipped with local line switches (LLS).

2. RELATED INFORMATION

2.01 General.

A Sales and Instructional Literature Index of latest available publications can be obtained from your Stromberg-Carlson sales representative or from Publications Services, Stromberg-Carlson Corporation, P.O. Box 1698, Sanford, Florida 32771.

2.02 Related Sections.

The following sections are recommended for use with this document:

01-012-03	Central-Office Grounding, Engineering Considerations
23-055-05	Service Group Circuits, Description

3. GENERAL

3.01 The nominal operating voltage of the digital central office (DCO) is 48 volts, dc, powered by 24 lead-acid storage cells and associated battery chargers. Low-voltage power for operation of the electronic portion of the system is derived from dc-to-dc converters.

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3.02 Ringing generators, operating from the 48-volt dc supply, and digital precise tone generators are provided in duplicate. Ringing generators are sized according to ultimate office requirements.

3.03 Office alarms are indicated locally, both audibly and visually, and can be indicated remotely. Alarm checking and canceling can be done from a remote location.

4. POWER SOURCES

4.01 General.

a. The primary source of power for the DCO system is the commercial ac power supplied by the local utility company. This ac power is converted to dc power of the proper voltage levels, regulated, and filtered before being used by the system. The necessary conversion, regulation, and filtering is done by the rectifier/charger units, the output voltages of which are set to the float level of the office battery (−52 to −54 volts dc). Although float voltage is usually maintained, exchange battery is referred to as −48 volts.

b. The office battery is a source of emergency power during a commercial ac power failure, as well as a noise filter in the power system. Auxiliary, engine-driven generators are recommended for use as standby sources of ac power.

4.02 Rectifier/Charger Units.

a. The rectifier/charger units, located near the battery rack, rectify the commercial ac power to provide regulated −53 volts dc and maintain the office battery in a charged condition. In addition, the units contain sufficient filtering circuitry to reduce the ripple of the output. The required regulated voltage output is adjustable and can be verified by a voltmeter on the front panel of the rectifier/charger units. Other controls and monitoring devices on the panel include an on/off switch, associated pilot lamp, and a dc ammeter that monitors the output current of the unit. Other features include an overload protection circuit that automatically lowers the output voltage if an excessive current surge should occur and an alarm that indicates a low-voltage condition if the voltage drops below the minimum required.

b. Rectifier units are available with outputs of 100 or 200 amperes. Any combination can be used to satisfy the office load requirements. It is a recommended practice to provide sufficient rectifiers so that if one rectifier fails, the remaining units can carry the busy-hour drain. The busy-hour drain is the average current drain in a 60-minute period during which the greatest current is imposed on the dc power supply.

4.03 Office Battery.

The office battery is floated across the dc output of the rectifier/charger units. This battery consists of 24 cells connected in series and can be located either in a separate room or in the same room as the electronic equipment.

4.04 Emergency Power Equipment.

a. In some offices, operating conditions dictate the necessity for an auxiliary, emergency ac generator to be used as a standby power source. The capacity of the emergency power equipment is dependent upon the size of the office, air-conditioning requirements, lighting requirements, etc. The SYSTEM CENTURY DCO requires emergency ac power equipment in conjunction with a 3-busy-hour, or greater, battery reserve capacity for each office. This equipment should be in a separate room.

b. Various types of emergency ac power equipment are available. They may be powered by diesel, gasoline, natural gas, or gas turbine engines. The fuel reserve capacity must be sufficient to handle a 3-day commercial power outage, unless local conditions warrant a larger reserve.

c. A load transfer control provided with the emergency power generator automatically starts the generator when commercial ac power fails. The plant runs for a minimum of 15 minutes when started. A time-exerciser option can be provided to automatically start and stop the plant at regular intervals as part of routine maintenance procedures.

5. DC POWER SUPPLIES

5.01 Cell Power Supplies.

Each cell in the line/trunk and LLS frames contains a power-supply printed wiring board assembly (PWBA) (dc-to-dc converter) that provides all power re-

quirements for the cell. Operating from the −48-volt office battery, the power supplies provide the following current-limited outputs:

a. −48 volts fused for relay drive.

b. −48-volt fused and filtered talking battery.

c. ±5-volt current-limited regulated logic supply.

d. ±8-volt and −15-volt current-limited analog supply.

Power supplies are also mounted in the common-control and maintenance and administration frames to provide power for cells in these frames.

5.02 Coin-Control Power Supplies.

The coin-control power supplies in power, ringing, and test access selector (PRT) frame convert the −48-volt office battery to the 130 volts required by pay-station coin mechanisms. The power supply has two 130-volt outputs to provide both ±130 volts for coin-return and coin-collection functions. Two power supplies are normally operated in parallel, with one capable of carrying the load if the other one fails. The power supplies have overload protection and low-voltage detection circuits.

6. POWER MONITORS

6.01 A power monitor continuously measures the output voltage levels of all low-voltage power supplies mounted in a given cell. Should a monitored voltage vary beyond a predetermined allowable tolerance, an alarm will be generated by the power monitor and transmitted to the service group diagnostics circuit. At the same time, a light-emitting diode (LED), normally lighted to indicate a satisfactory voltage level, goes dark.

6.02 Individual, power-monitor PWBAs are provided in each cell of the common control and maintenance and administration frames. In the line/trunk frames, a power monitor is an integral part of the power supply PWBA in each cell. In the LLS frames, a power monitor is an integral part of the maintenance and diagnostic controller PWBAs.

7. MAIN DISCHARGE CONTROL

7.01 One main discharge control panel is required for each 1920 ports; 2 panels can be mounted in each main discharge control frame (also called battery discharge frame or BDF). Each panel contains a 0- to 600-ampere ammeter, a 0- to 100-volt dc voltmeter, −48-volt main circuit breakers for the redundant A and B call-processing systems, and an alarm for the −48-volt supplies. In addition, the top panel in the frame contains two customer-equipment and two ac/dc inverter −48-volt circuit breakers and an associated alarm lamp; 3-ampere grasshopper fuses used to light a common alarm lamp for charger, meter, and customer alarm failures; and a 10-ampere grasshopper fuse to light the lamp when an alarm failure occurs. See figures 1 and 2.

7.02 The two meters indicate the current and voltage being applied through the 48-volt main circuit breakers. Three-ampere grasshopper fuses, in parallel with the 48-volt main and customer-equipment circuit breakers, light the associated alarm lamp when a circuit breaker opens.

7.03 The main discharge control panels provide an interface for −48-volts from the rectifier/chargers or batteries and the power distribution panels in the power frame(s). See figure 3.

8. POWER DISTRIBUTION

8.01 The power distribution panels (fig. 4) receive −48-volt power from the main discharge control panel(s) and distribute it to each frame and to customer equipment through dedicated circuit breakers. Power is distributed to the left and right sides of the LLS frames by circuit breakers X and Y, respectively, on the frames. When a circuit breaker is opened, an associated alarm lamp on the power distribution panel lights. An alarm lamp on the power distribution panel is also lighted by a grasshopper fuse when a remote equipment alarm condition occurs.

8.02 At each frame, the −48-volt power is applied to a terminal block and then distributed to each cell through a power bus. In the cells, dc-to-dc converters reduce the voltage to the required levels and distribute it to the PWBAs, as required.

9. GROUNDING

9.01 The system uses separate frame, logic, and −48-volt signal grounds and cannot tolerate excessive transient voltages or noise that may be injected into the ground system. A special grounding system is, therefore, used to electrically isolate the equipment from the building steel, superstructure, etc., except at one point. This is the single-point-ground concept. Physically, the single-point-ground connection is provided by a centrally located copper bus bar.

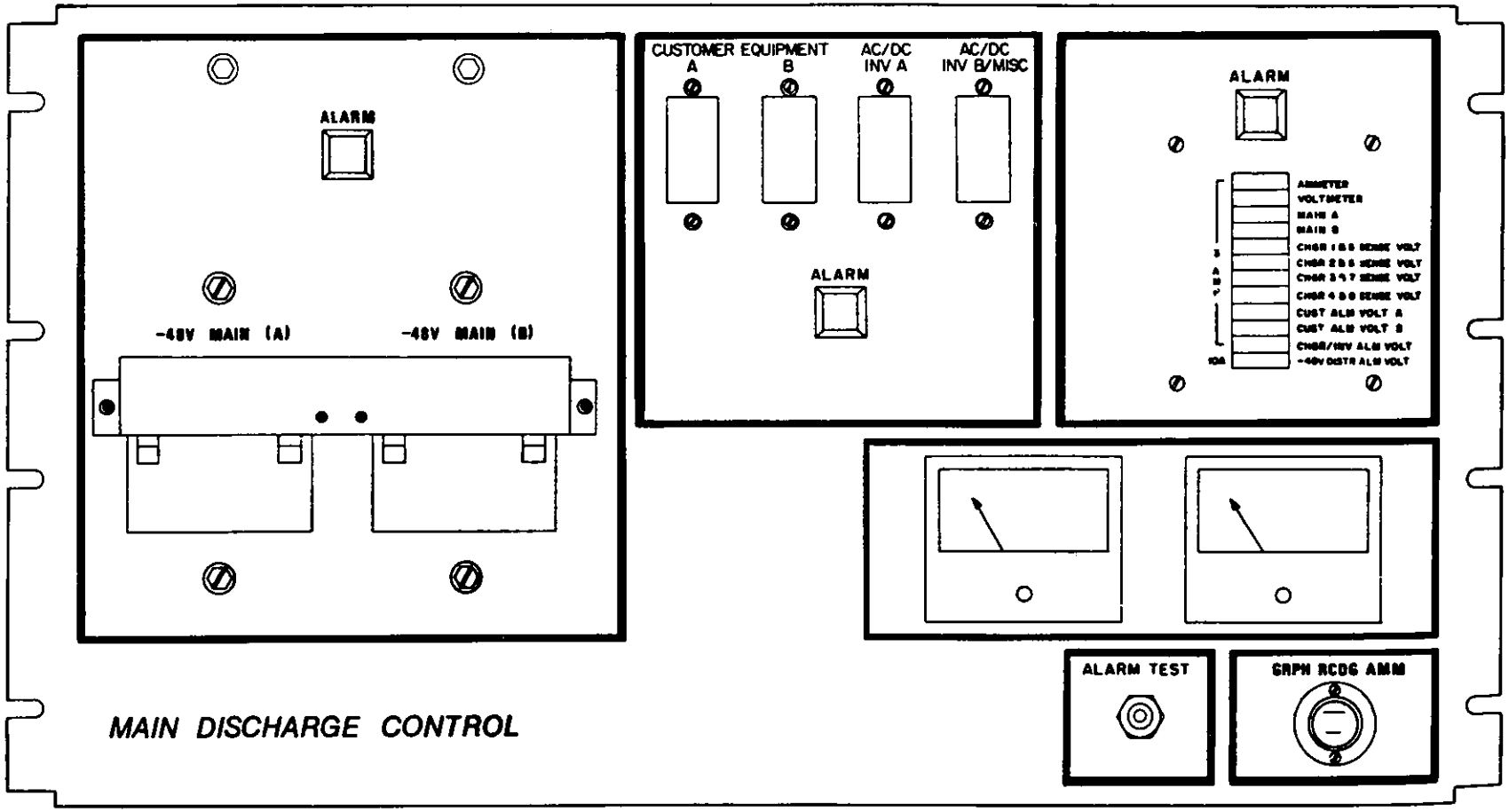

Figure 1. Upper Main Discharge Control Panel Mounted on MDCF

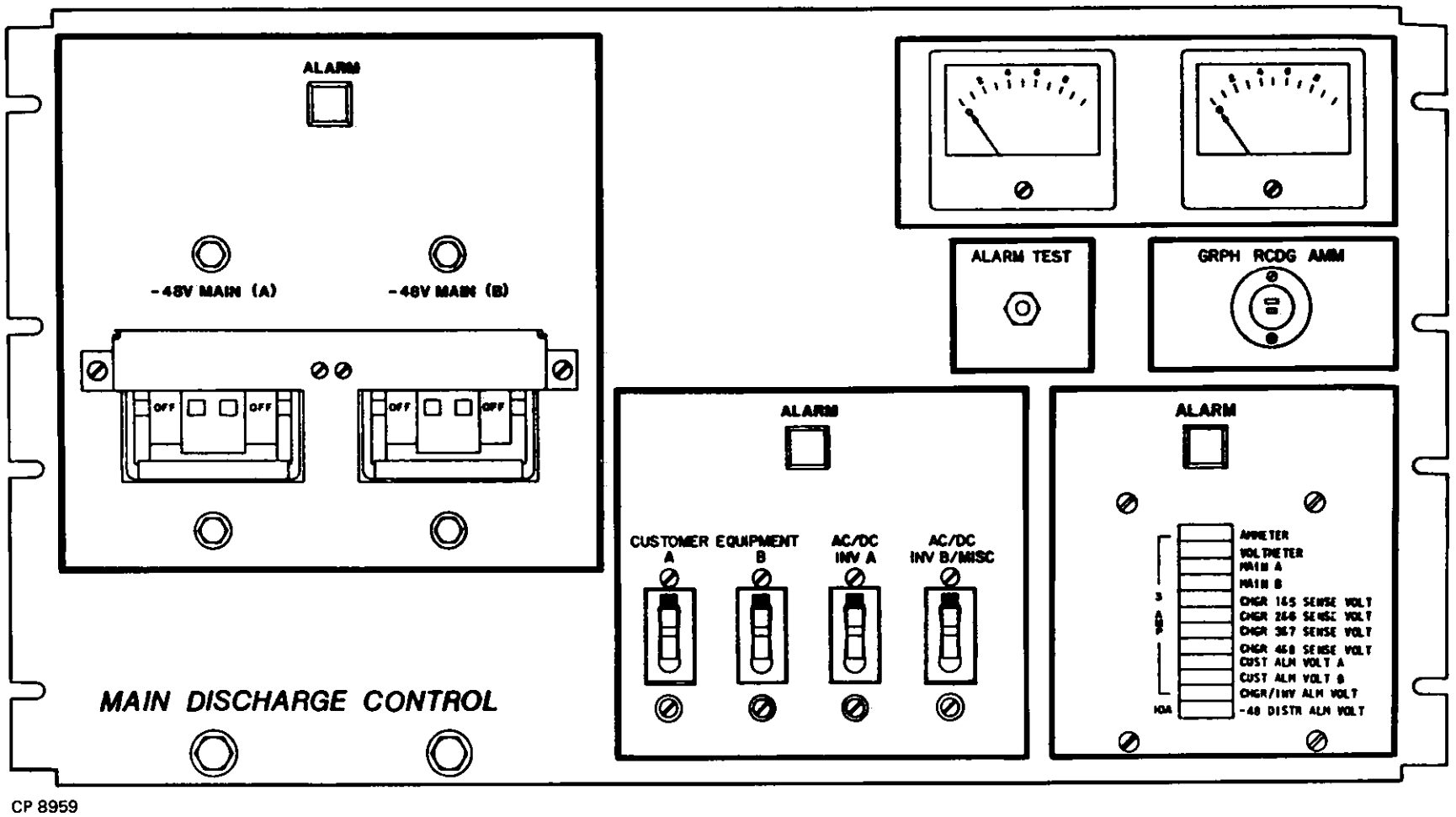

Figure 2. Lower Main Discharge Control Panel Mounted on MDCF

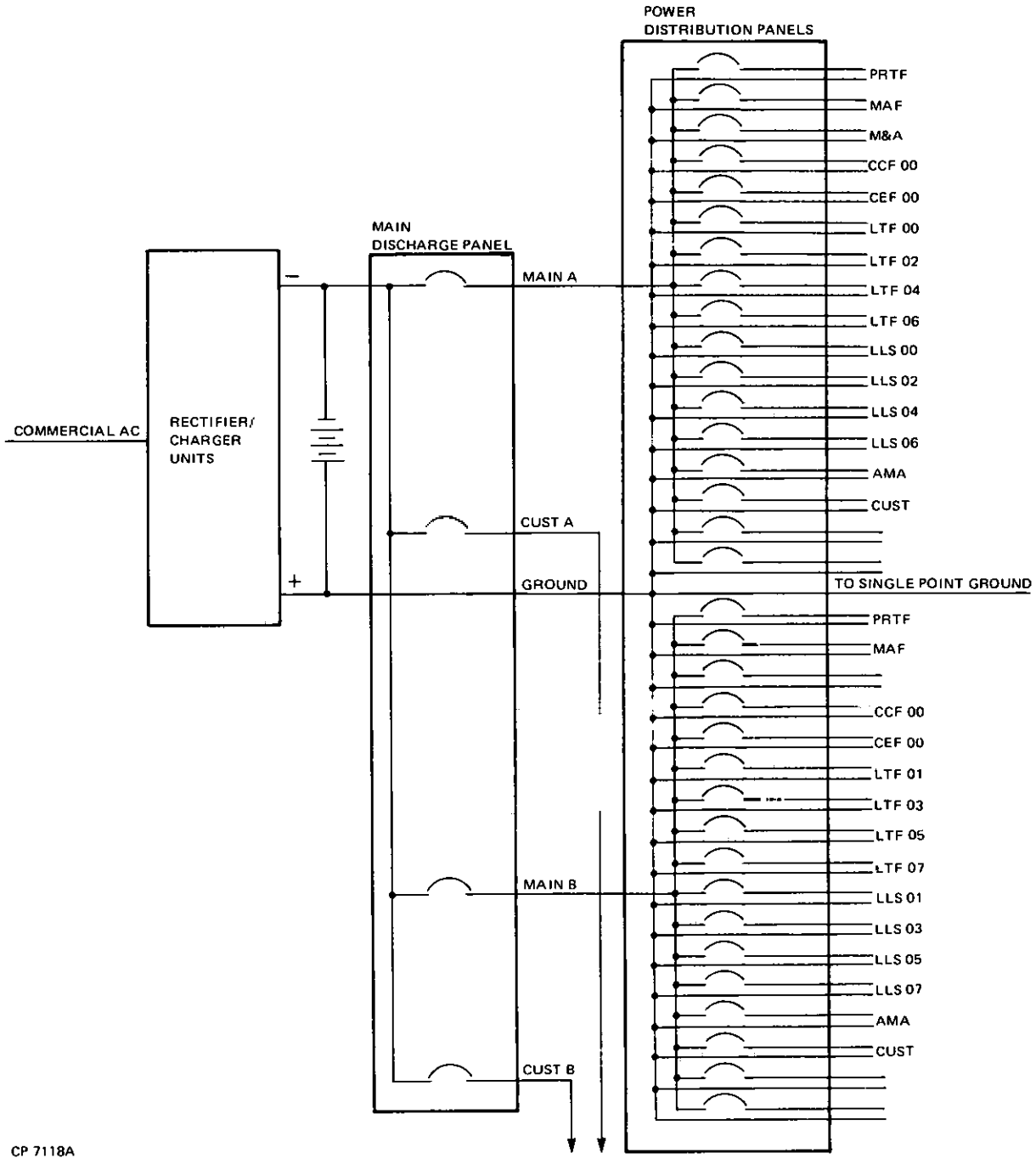

Figure 3. Typical Power Distribution System for 1920 Ports

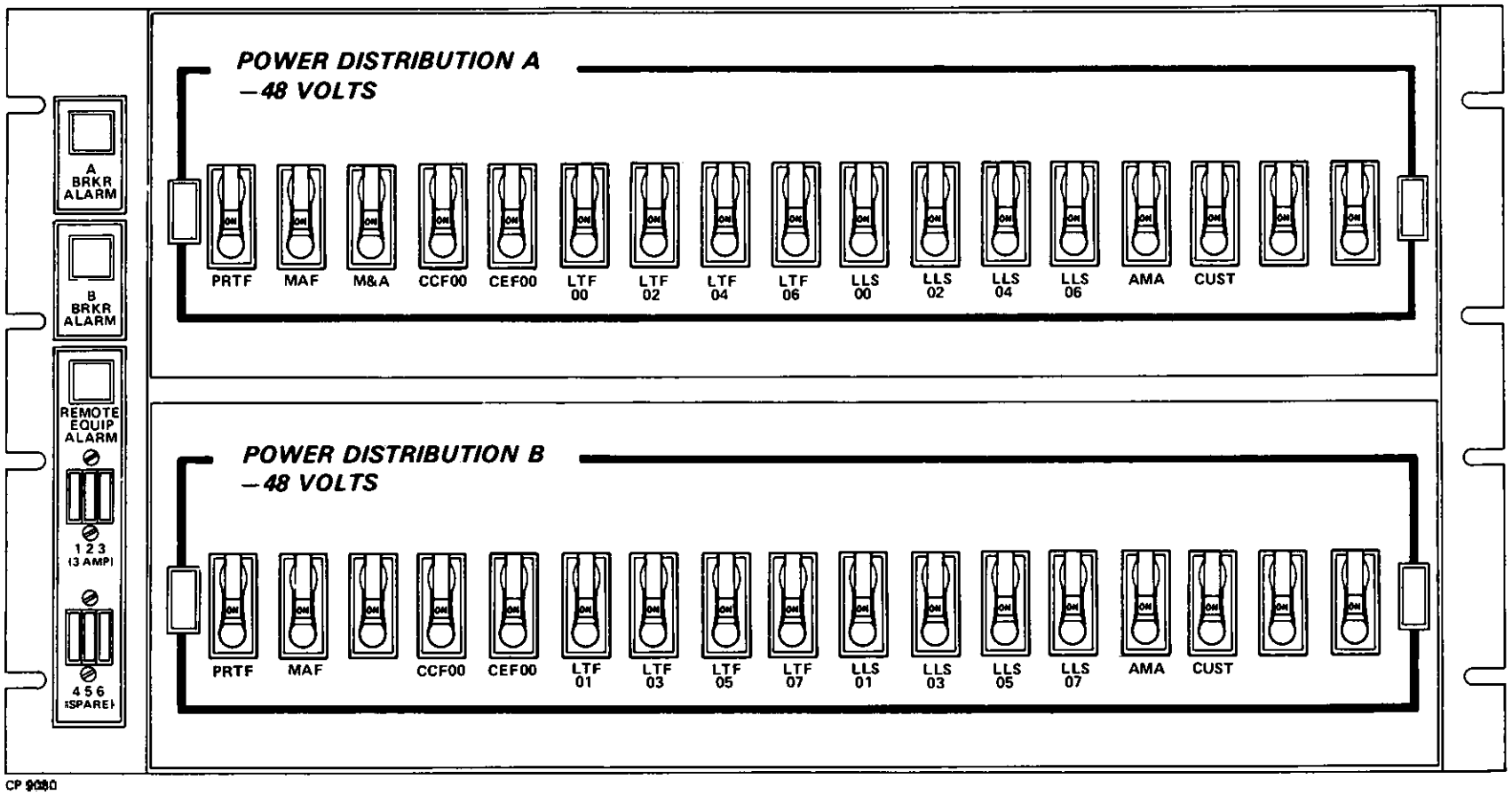

Figure 4. Typical Power Distribution Panels Mounted on Power, Ringing, and Test Access Selector Frame

9.02 For more details on grounding and protection, refer to the section titled *Central-Office Grounding, Engineering Considerations*, referenced in paragraph 2.02.

10. ALARM SYSTEM

10.01 General.

a. The DCO alarm system provides both local and remote alarm indications. The alarms are triggered by hardware- or software-detected faults. Locally, the alarm system provides both visual and audible alarm indicators that are broken down into three priorities for REA systems (catastrophic, major, and minor) or four priorities for standard systems (office emergency, group emergency, alert, and nonemergency). In addition, more detailed alarm indications are provided by indicators on the basic maintenance panel and by printouts.

b. For remote alarm reporting, alarms are also categorized according to priority and then sent to a remote location by the alarm-sending circuit if not responded to within 5 minutes.

c. Power failures are detected by power monitors (par. 6), fuses, and circuit breakers and reported to the maintenance processor. Hardware and software faults are monitored by continuous maintenance software programs. Upon detection of a fault, the maintenance programs cause alarms to be activated and a teletypewriter message to be printed out. Faults may be detected as follows:

1. Certain types of failures are detected by time-slot-interchange (matrix switch), matrix switch/port control system or service group diagnostics circuits and reported to the maintenance processor and switchover control.

2. Failures, such as absence of tone or low generator-output level, are detected by inherent failure detection circuitry and reported to service group diagnostics.

3. Failures in redundant equipment are detected by the maintenance processor or switchover control that, after diagnostic tests, may cause the faulty circuit(s) to be switched off-line.

d. The maintenance and diagnostic controller is the alarm gathering point for the LLS frame. Alarms are reported to the maintenance processor by way of the line switch controller. The maintenance and diagnostic controller also can cause faulty LLS circuits to be taken off-line.

10.02 Basic Maintenance Panel.

The basic maintenance panel contains the following alarm and status indicators: [An asterisk (*) indicates an alarm used only on the standard panel; a dagger (†) indicates an alarm used only on the REA panel].

*a. ALARM 1 and OFFICE EMER.
Audible and visual alarms, respectively, that indicate one or more of the following conditions:

1. System inoperative.

2. All calls blocked.

3. Calls blocked in one common control sector.

4. Both programable ringing generators inoperative.

5. DSU: remote unit inoperative, total span outage, or inability to interpret message.

*b. ALARM 2 and GROUP EMER.
Audible and visual alarms, respectively, that indicate one or more of the following conditions:

1. Calls blocked in one port group.

2. Degraded service throughout system.

3. Primary programable ringing generator failure.

4. DSU: span outage (degraded service), span transfer failure, charger failure and inoperative standby ac source.

5. DTI: Thresholds exceeded (frame loss, slips, bipolar violations), DTI cell out of service, or span failure.

*c. ALARM 3 and NON EMER.
Audible and visual alarms, respectively, that indicate one or more of the following conditions:

1. Administrative and diagnostic functions operative but degraded.

2. Redundancy lost; degraded service on active side.

3. Degraded service on one common control sector.

4. Port fault detected by test call generator.

5. Cumulative line/trunk permanent.

6. High or low battery voltage.

7. DSU: ringing generator failure, loss of frame sync, cumulative permanent alarm, party detect failure, paystation power supply failure, illegal entry of remote facility, environment of remote facility outside normal limits, loss of cable pressure.

8. Carrier of radio failure.

*d. ALARM 4 and ALERT.

Audible and visual alarms, respectively, that indicate one or more of the following conditions:

1. Redundancy lost; on-line side functioning.

2. Environment outside normal limits; system operational.

3. Battery charger failure.

4. Commercial ac power failure; standby ac generator inoperative.

5. Nonservice-affecting fault (x or y ringing generator, interrupter, test call generator, etc.).

6. Sensor-reported fault (cable pressure, forced entry into building, etc.).

†e. ALARM 1 and CATASTROPHE.

Audible and visual alarms, respectively, that indicate one or more of the following conditions:

1. System inoperative.

2. All calls blocked.

3. Calls blocked in one common control sector.

4. Administrative and diagnostic functions inoperative.

5. Both programable ringing generators inoperative.

6. DSU: remote unit inoperative, total span outage, or inability to interpret message.

†f. ALARM 2 and MAJOR.

Audible and visual alarms, respectively, that indicate one or more of the following conditions:

1. Calls blocked in one port group.

2. Degraded service throughout system.

3. Redundancy lost; degraded service on active side.

4. Redundancy lost; active side functioning properly.

5. Charger failure.

6. Primary programable ringing generator failure.

7. DSU: span outage (degraded service), span transfer failure, charger failure, or commercial ac power failure and inoperative standby ac source.

8. DTI: thresholds exceeded (frame loss, slips, bipolar violations), DTI cell out of service, or span failure.

†g. ALARM 3 and MINOR.

Audible and visual alarms respectively, that indicate one or more of the following conditions:

1. Nonservice-affecting fault (x or y ringing generator, interrupter, test call generator, etc.).

2. Environment outside normal limits; system operational.

3. DSU: ringing generator failure, loss of frame sync, cumulative permanent alarm, party detect failure, paystation power supply failure, illegal entry of remote facility, environment of remote

facility outside normal limits, loss of cable pressure.

h. A or B.
Red LEDs that light to indicate a fault in system-redundant (side A or B) equipment.

i. A and B.
Red LED that lights when the maintenance processor cannot determine which side of the system is faulty or when a data mismatch occurs.

j. CLOCK X or CLOCK Y.
Red LEDs that light when master clock X or Y fails.

k. CPA HALT or CPB HALT.
Red LEDs that light when call processor A or B is halted.

l. LOCAL.
Red LED that lights to indicate that alarms are not being sent to a remote location.

m. MANUAL SW OVER.
Red LED that lights to indicate that automatic switchover between redundant sides A and B is disabled.

n. MP.
Red LED that lights when the maintenance processor malfunctions.

o. MP HALT.
Red LED that lights when the maintenance processor is halted.

p. MP PARITY.
Red LED that lights when maintenance processor memory parity error occurs.

q. NON SYNC.
Red LED that lights when call processors A and B are not synchronized.

r. ON LINE.
Green LEDs that indicate which call processor (A or B) is on-line.

s. PWR.
Red LED that lights when a power fault is detected.

t. REMOTE.
Green LED that lights when alarms can be sent to a remote location.

u. RING X or RING Y.
Red LEDs that light when ringing-generator interrupter, transfer, or monitor circuit X or Y fails.

v. TONE X or TONE Y.
Red LEDs that light when precise tone generator X or Y fails.

10.03 Alarm Sending and Checking.

Alarm indications are sent to an operators position, a managers alarm box, or a 7- or 10-digit number. On receipt of the alarm indication, an alarm checking number must be dialed to obtain specific information on the alarm.

a. Alarm Sending.
The following options are available:

1. Alarm Sending via Operator Trunk.
Fault indications are forwarded via the regular operator trunk group. When a fault occurs, an operator trunk is seized and a request for service generated. On answer, the operator receives a distinctive tone indicating that the alarm checking number should be dialed.

2. Alarm Sending via Dedicated Trunk.
Similar to alarm sending via operator trunk except that a trunk is dedicated to alarm sending. This trunk may be one-way outgoing only or two-way with the incoming route being used for busy verification.

3. Alarm Sending to Managers Alarm Box.
A spare dial leg(s) is used to send battery or ground to a managers alarm box to operate a relay, light a lamp, or do some similar function.

4. Alarm Sending to 7- or 10-Digit Number.

a) The DCO switching system is programed to send a recorded announcement to a 7- or 10-digit number when an alarm occurs. A list of up to 10 alarm reporting numbers can be programed.

b) When an alarm occurs, the first alarm reporting number is automatically dialed and a recorded announcement is sent to the line. A timer is started and, if the alarm checking number is not dialed within a predetermined programable interval, the next number on the list is dialed. The system continues through the list (recycling if necessary) until the alarm checking number is dialed. (If one of the numbers programed is the operator, cycling stops and the operator is called repeatedly until the alarm checking number is dialed.)

c) The recorded announcement is normally made by the telephone company and tells the called party the name of the office, advises that an alarm condition exists, and gives the alarm checking number to be dialed for further information.

b. Alarm Checking.

When the alarm checking number is dialed, the caller hears an audible signal indicating the actual alarm classification. Tables 1 and 2 describe the various faults that cause an alarm to be sent for Stromberg-Carlson and REA alarm classifications, respectively.

10.04 Last-Resort Alarm.

a. A last-resort alarm is indicated by lighting a large lamp external to the system. This alarm is initiated when condition 1 or 2 occurs while the panel is in the remote mode:

1. The maintenance processor does not provide a class of alarm within 1 second of the detection of a hardware fault.

2. The maintenance processor times out and one of the following also occurs:

a) Call processor sanity error, parity error, or watchdog timeout.

b) Maintenance processor sanity error or parity error.

c) Port control store parity error.

d) Call processor bus mismatch.

e) Nonsynchronous operation.

f) Clock fault.

g) Ringing fault.

h) Combined power fault.

i) Tone fault.

Table 1. Stromberg-Carlson Alarm-Checking Fault Classification

ALARM CODE	*POSSIBLE FAULT*	*PRIORITY*
No tone	System inoperative.	Emergency
	All calls blocked.	Emergency
	Calls blocked in one common control sector. Both programable ringing generators inoperative	Emergency
	DSU: remote unit inoperative, total span outage, or inability to interpret message.	Emergency

Table 1. Stromberg-Carlson Alarm-Checking Fault Classification (Cont)

ALARM CODE	*POSSIBLE FAULT*	*PRIORITY*
Steady high tone	Calls blocked in one port group.	Group emergency
	Degraded service throughout system	
	Primary programable ringing generator failure	Group emergency
	DSU: span outage (degraded service), span transfer failure, charger failure and inoperative standby ac source.	Group emergency
	DTI: Thresholds exceeded (frame loss, slips, bipolar violations), DTI cell out of service, or span failure.	Group emergency
Steady low tone	Administrative and diagnostic functions operative but degraded.	Nonemergency
	Redundancy lost; degraded service on active side.	Nonemergency
	Degraded service in one common control sector.	Nonemergency
	Port fault detected by test call generator	Nonemergency
	Cumulative line/trunk permanent.	Nonemergency
	High or low battery voltage.	Nonemergency
	DSU: ringing generator failure, loss of frame sync, cumulative permanent alarm, party detect failure, paystation power supply failure, illegal entry of remote facility, environment of remote facility outside normal limits, loss of cable pressure.	Nonemergency
120-ipm busy tone	Carrier or radio failure	Nonemergency
Ringback tone	Redundancy lost; on-line side functioning	Alert
	Environment outside normal limits; system operational.	Alert
	Battery charger failure.	Alert
100-Hz tone	Commercial ac power failure; standby ac generator inoperative.	Alert

Table 1. - Stromberg-Carlson Alarm-Checking Fault Classification (Cont)

ALARM CODE	*POSSIBLE FAULT*	*PRIORITY*
Tick tone	Nonservice-affecting fault (x or y ringing generator, interrupter, test call generator, etc.).	Alert
	Sensor-reported fault (cable pressure, forced entry into building, etc.).	Alert

Table 2. REA Alarm-Checking Fault Classification

ALARM CODE	*POSSIBLE FAULT*	*PRIORITY*
No tone	System inoperative.	Catastrophic
	All calls blocked.	Catastrophic
	Calls blocked in one common control sector.	Catastrophic
	Administrative and diagnostic functions inoperative.	Catastrophic
	Both programable ringing generators inoperative.	Catastrophic
	DSU: remote unit inoperative, total span outage, or inability to interpret message.	Catastrophic
60-ipm busy tone	Calls blocked in one port group.	Major
	Degraded service throughout system.	Major
	Redundancy lost; degraded service on active side.	Major
	Redundancy lost; active side functioning properly.	Major
	Charger failure.	Major
	Primary programable ringing generator failure.	Major
	DSU: span outage (degraded service), span transfer failure, charger failure, or commercial ac power failure and inoperative standby ac source.	Major
	DTI: thresholds exceeded (frame loss, slips, bipolar violations), DTI cell out of service, or span failure.	Major

Table 2. REA Alarm-Checking Fault Classification (Cont)

ALARM CODE	*POSSIBLE FAULT*	*PRIORITY*
1-ring code (ringback tone	Nonservice-affecting fault (x or y ringing generator, interrupter, test call generator, etc.).	Minor
	Environment outside normal limits; system operational.	Minor
	DSU: ringing generator failure, loss of frame sync, cumulative permanent alarm, party detect failure, illegal entry of remote facility, environment of remote facility outside normal limits, loss of cable pressure.	Minor
2-ring code (ringback tone)	No faults.	