POWER EQUIPMENT DESCRIPTION

NO. 3 ELECTRONIC SWITCHING SYSTEM

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Table

A. No. 3 ESS DC-to-DC Converters . . 3

1. GENERAL

A. Purpose

1.01 This section describes the power equipment used in the No. 3 Electronic Switching System (ESS) and provides the functions and physical relationships within the integrated power system.

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

B. Characteristics

1.03 The primary power required by the No. 3 ESS is -48 volts direct current. This power is derived from 208/240-volt, 60-Hz, single-phase commercial ac power via rectifiers charging a -48 volt battery string. All other voltages required within the No. 3 ESS are derived either directly or indirectly from the -48 volts direct current. Voltages other than the primary -48 volts are +3, +5, -5, +12, +24, +48, and +130/-130 volts direct current. These voltages are required within the No. 3 ESS to power various circuits (Table A). Test voltages of +20, +100, +116, -116, and +200 volts direct current are available on the test frame.

1.04 The dc-to-dc converters supply the various voltages other than -48 volts used in the No. 3 ESS. The +24, +48, and +130/-130 volt dc power converters are located on the miscellaneous power frame (Fig. 1) in 80C apparatus housing, while the other power converter modules are mounted in the user equipment frames (Table A).

2. PHYSICAL DESCRIPTION

A. 151A Power Plant

2.01 The 151A power plant consists of a double-bay power frame (Fig. 2) that contains rectifiers, filters, distribution fuses, and power control and alarm circuitry to supply -48 volt power; and a single-bay supplementary power frame that contains rectifiers and reserve batteries. This plant will supply up to 400 amperes direct current to the No. 3 ESS equipment and associated toll and transmission equipment.

2.02 The -48 volt plant frameworks (ED-5A001-70 and ED-5A002-70) are 25 inches wide, 7 feet high, and 18 inches deep. These types of frameworks are also used for the maintenance, test, and processor frames, which are in the same lineup as the power frames (Fig. 3).

2.03 The 151A power plant will require one or two strings of battery cells, depending on the No. 3 ESS office load. These batteries may be either the rectangular KS-15544 or the cylindrical KS-20472 and will be arranged in 2-tiered single rows. A maximum of two strings can be accommodated and will be placed along the nongrowth wall of the office (Fig. 3).

B. Power Frame

2.04 The -48 volt double-bay power frame alone is capable of supplying up to 200 amperes. Bay 0 of this frame contains one 100-ampere rectifier, control and alarm circuitry, and a maximum of four distribution fuse panels. Bay 1 contains two additional 100-ampere rectifiers and the battery charge circuit breakers (Fig. 2).

C. Supplementary Power Frame

2.05 The supplementary power frame, which is optional, is available to provide up to 200 amperes additional capacity for the -48 volt power plant. This frame provides two 100-ampere rectifiers (for increasing the overall capacity of the plant to 400 amperes) and additional fusing (Fig. 2).

D. Miscellaneous Power Frame

2.06 The miscellaneous power frame is a single-bay frame. It contains the office ringing and

TABLE A

NO. 3 ESS DC-TO-DC CONVERTERS

CODE	INPUT	OUTPUT	LOCATION	USE
188A 189A	—48 Vdc	+24 Vdc, 8 A	Miscellaneous Power Frame	Power for circuits in the test, maintenance, processor, control frames, and miscellaneous frames
184A	—48 Vdc	+48 Vdc 1.8 A	Miscellaneous Power Frame	Power for superimposed ringing and dial-tone first circuits
184B	—48 Vdc	+130 Vdc, 1/4 A —130 Vdc, 1/4 A	Miscellaneous Power Frame	Power for coin control circuits and false cross ground circuits
A8	—48 Vdc +24 Vdc	+3 Vdc, 5 A	Maintenance Processor and Control Frames	Power for 3A central control circuits, maintenance circuits, store controller circuits, and peripheral control circuits
S3	—48 Vdc +24 Vdc	+5 Vdc, 4 A	Maintenance and Processor Frames	Power for 3A central control and main store
S5	—48 Vdc	1—13 Vdc, 2 A	Network Frame	Power (battery boost) for junctor circuits and customer dial pulse receiver
S7	—48 Vdc	+5 Vdc, 5.6A	Processor Frame	Power for main store and TDC
S9	—48 Vdc +24 Vdc	—5 Vdc +12 Vdc	Processor Frame	Power for main store

tone (RT) plant, converters, filters, and distribution fuses for +24, +48, and +130/-130 volts (Fig. 1).

2.07 The ringing and tone plant is self-contained and consists of many separate units. It is located in the lower half of the miscellaneous power frame. Cabling tie points for the ringing and tone leads are provided by the distribution fuse panels (ringing) and a distribution panel (tone).

2.08 The three power converters, which provide +24, +48, and +130/-130 volt dc power, are the 180-type, plug-in converter modules. These converters are housed in two individual converter units located in the upper half of the miscellaneous power frame. One unit provides +24 volt output; the second unit provides the +48 and +130/-130 volt output. The +24 volt unit has three mounting plates, two of which utilize 80-type apparatus mountings for the plug-in converters. Each +24 volt converter consists of two plug-in units, one for the rectifier and filter and one for the inverter. Each mounting plate contains two converters for a total of four 8-ampere converters per two units. The third mounting plate contains the alarm circuitry and distribution fusing. The complete unit is divided into A- and B-buses with a capacity of 16 amperes per bus.

2.09 The +48 and +130/-130 volt unit consists of one mounting plate which contains two 80-type apparatus housings. One houses the +48 volt converter and the other the +130/-130 volt converter. The remaining space on the mounting plate is assigned to distribution fusing and alarm circuitry. To provide both A- and B-busing, two units are provided on the frame. The upper unit is assigned to the A-bus and the lower unit to the B-bus.

E. Test Frame

2.10 The test frame contains the -48 volt dc to 110-volt, 60-Hz power inverter. This inverter provides the ac power for the ac protected loads in the No. 3 ESS office in case of commercial

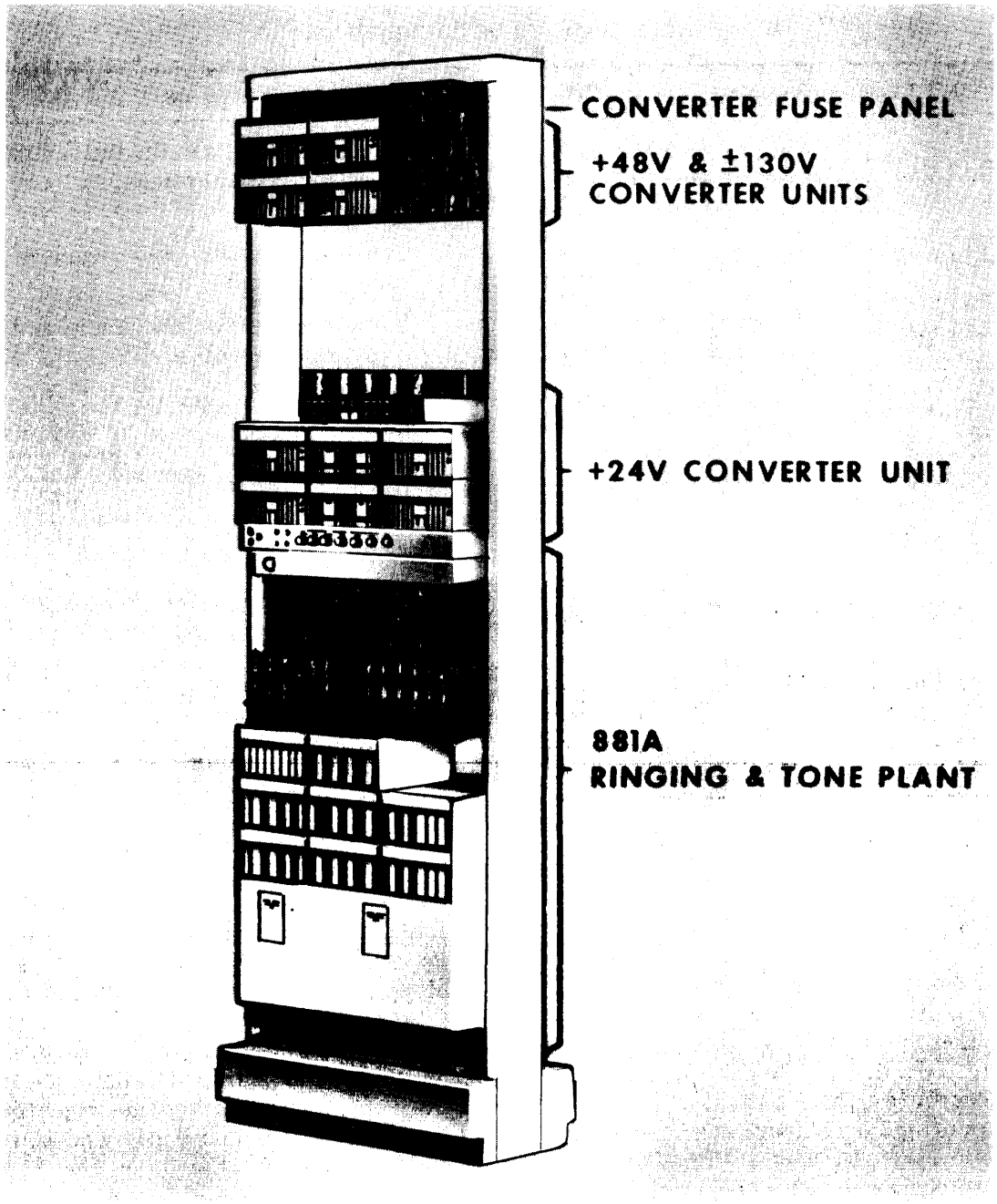


Fig. 1—Miscellaneous Power Frame

power failure (Fig. 4). An idle line control unit for the maintenance teletypewriter (TTY) is mounted on the inverter, and ac distribution circuit breakers are contained within the inverter.

F. Power Distribution

2.11 Each equipment frame receives -48 volt power via feeders from the power frame distribution fuse board. Each equipment frame requires two power feeders, one from bus A and one from bus B, except for the test frame. These feeders are individually fused at the power board on the power frame and are then paired with the return ground feeder and cabled to the equipment frame. A complete cable loop includes the feeder fuse, the power feeder, the equipment frame filter (when used), and the return feeder. Power

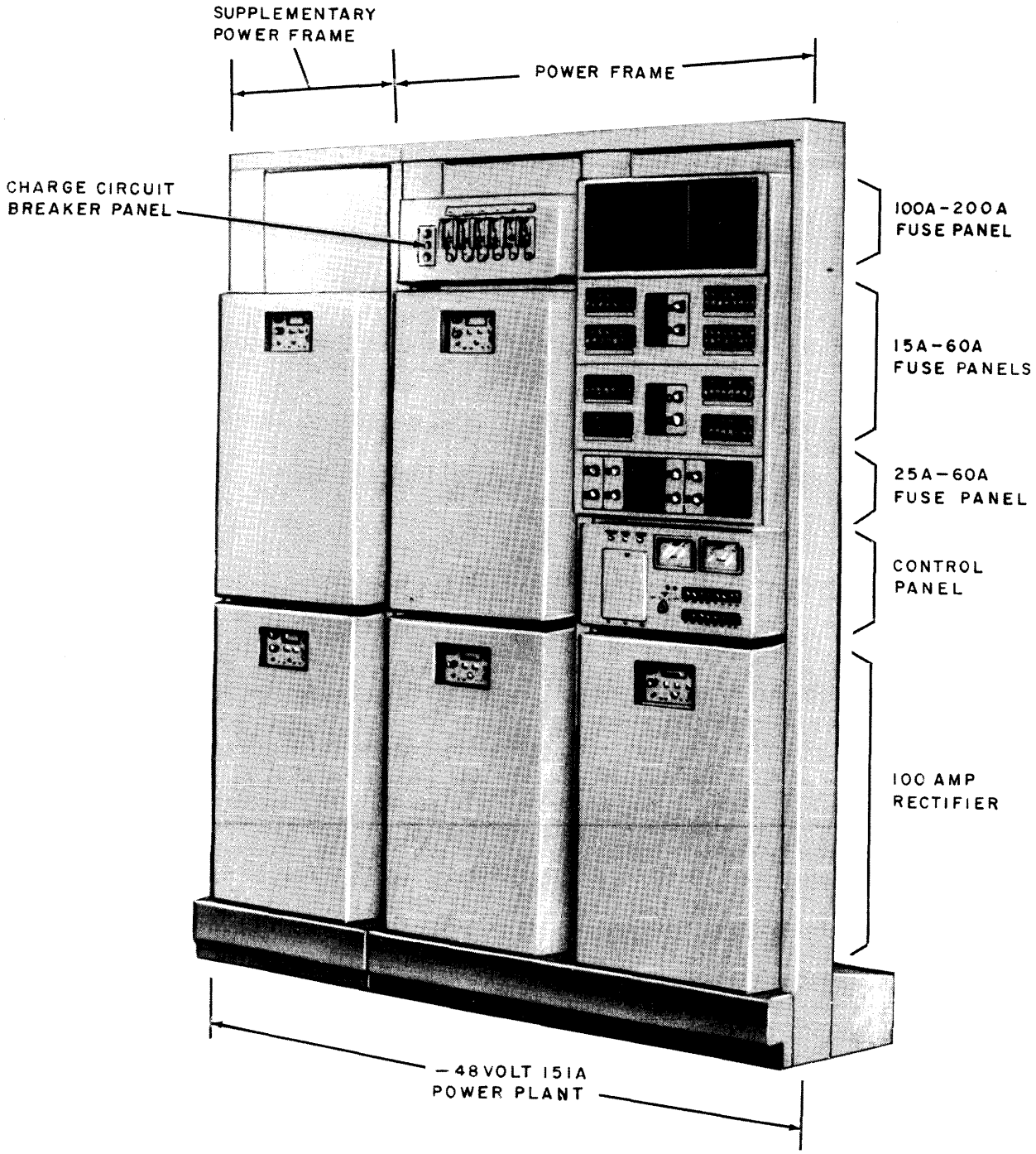
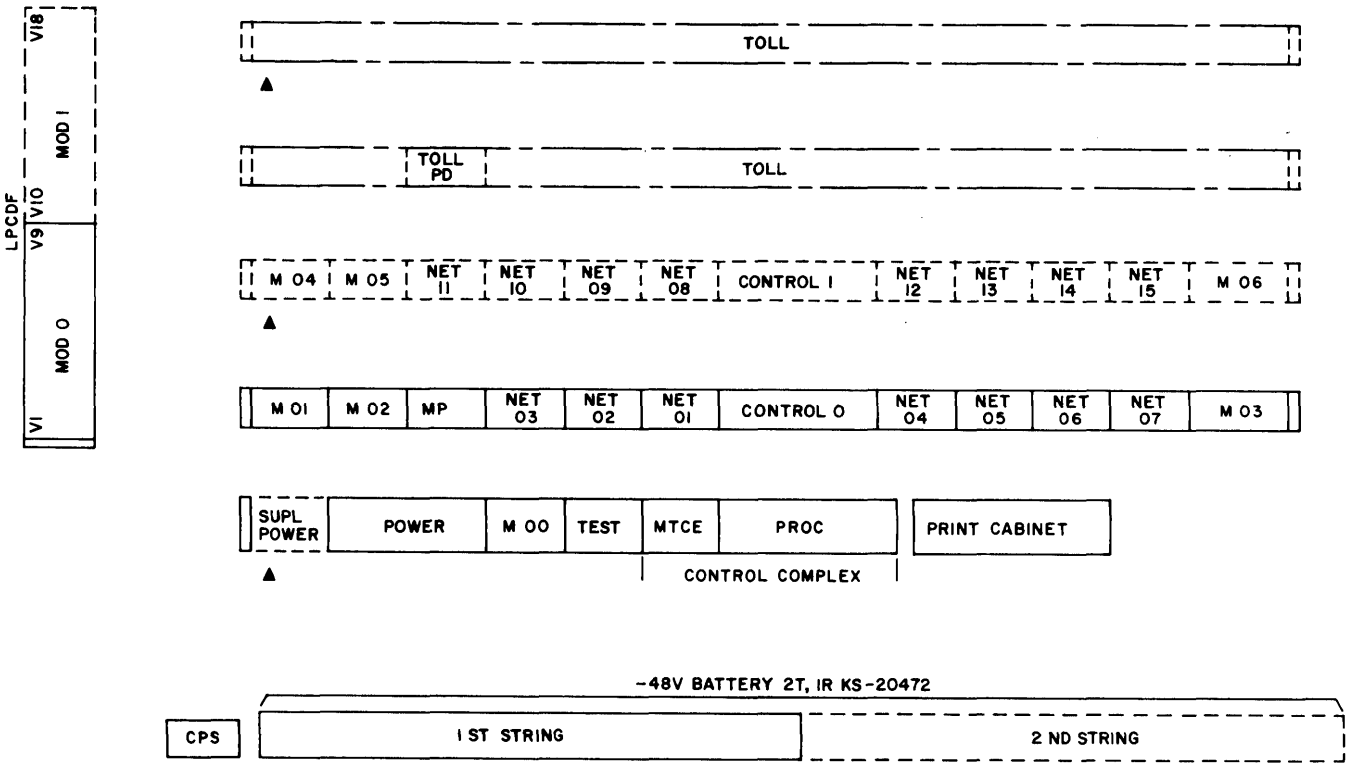


Fig. 2—151A Power Plant

distribution to the toll equipment is via the power distributing (PD) unit, J1C085A, located on a toll equipment frame. The No. 3 ESS -48 volt 151A power frame is equipped to bus up to 200 amperes to the toll PD unit (Fig. 3 and 5).

G. Additional Power

2.12 Additional power equipment (converter, filter, and fuse panels) is provided on user equipment.



NOTES:
1. SOLID LINES INDICATE 2100 LINE OFFICE.
2. DASHED LINES INDICATE GROWTH TO A 4500 LINE OFFICE.
3. MINIMUM REQUIRED FLOOR SPACE IS 22 FT. X 41 FT. 8 IN.

LEGEND:
PROC - PROCESSOR FRAME
MTCE - MAINTENANCE FRAME
M 00-06 MISCELLANEOUS FRAME
MP - MISCELLANEOUS POWER FRAME
NET (01-15) NETWORK FRAMES
LPCDF - LOW PROFILE COMBINED DISTRIBUTING FRAME
PD - POWER DISTRIBUTION
MOD - MODULE
V - VERTICAL
CPS - CIRCUIT PACK STORAGE
▲ - DENOTES MAINTENANCE AISLE (FRAME EQUIPMENT FACES THIS AISLE)

Fig. 3—No. 3 ESS Office Layout

H. Service Entrance

2.13 A service entrance cabinet, which is provided for commercial ac power input by the operating company, should contain a manual transfer switch and fuse distribution. The transfer switch allows the distribution fuses for the essential loads to be disconnected from the commercial power source so that a portable ac power plant can be connected in an emergency; e.g., commercial power loss.

I. Nonessential, Essential, and Protected Loads

2.14 The ac loads within the No. 3 ESS office are divided into nonessential, essential, and protected loads. During a commerical power outage, essential loads are connected to an emergency ac generator provided by the operating company. Essential and protected loads are defined as being necessary for the operation and maintenance of the telephone switching and transmission equipment; all other loads are referred to as nonessential.

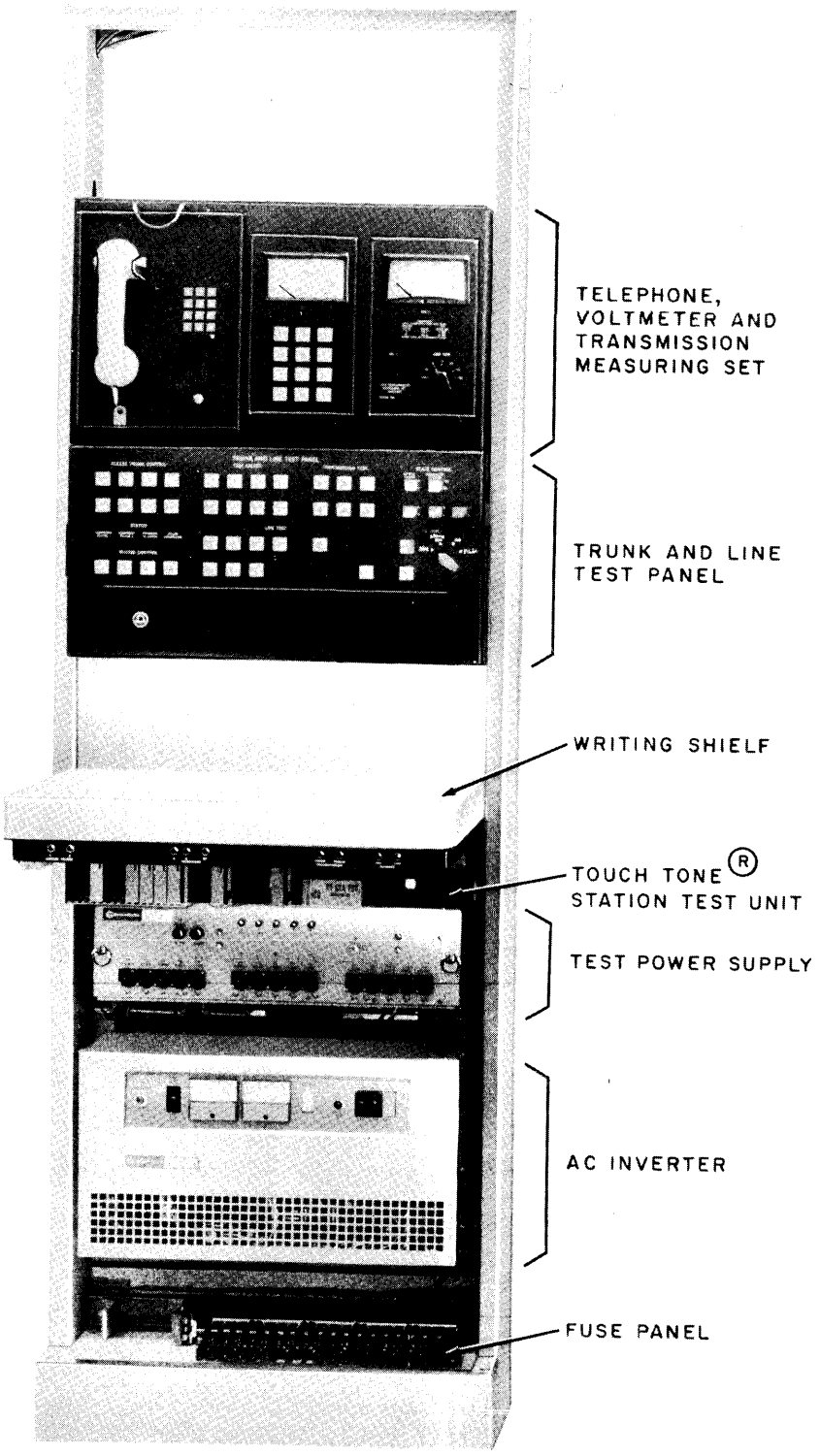


Fig. 4—Test Frame

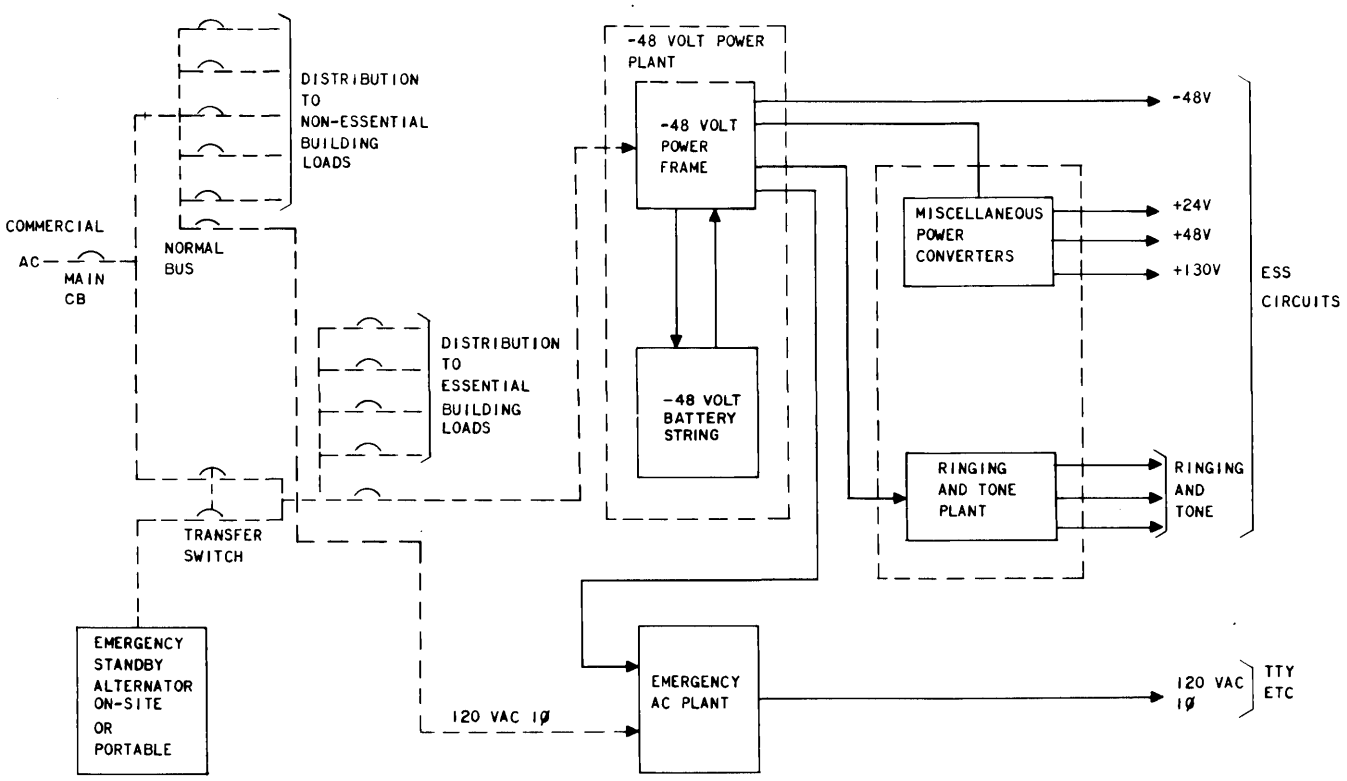


Fig. 5—-48 Volt Plant and Distribution

Essential building loads are heating and/or air conditioning to maintain the office temperature, necessary lighting, and outlets for maintenance equipment. Essential ESS loads are the power plant rectifiers and frame base outlets. Protected loads are the maintenance TTY and one recorded announcement machine if it provides overload announcement. Loads that are served by protected alternating current obtain power from the -48 volt dc-to-ac inverter (2.10) when commercial power fails. Normally, these loads receive power from the commercial ac source.

3. FUNCTIONAL DESCRIPTION

A. Introduction

3.01 Commercial 208/240-volt, 60-Hz, single-phase ac power is rectified and filtered in the power frame to supply the No. 3 ESS with a -48 volt dc source. Other required voltages are derived from the -48 volt supply by dc-to-dc converters and dc-to-ac inverters. The -48 volt power is supplied to every equipment frame in the office. The +24, +48, and +130/-130 volt converters, which supply power to specified circuits on the equipment frames, are located on the miscellaneous power frame. The remaining converters (+3 volt, +5 volt, 200 volt, etc.) supply power only to the frames on which they are located and are essentially part of circuitry on that frame.

3.02 To assure reliability, the distribution of the -48 volts is duplicated (A-bus and B-bus) and fed independently to each of the duplicated units and half of the replicated circuits. In addition, voltage converters that provide the other voltage levels are duplicated to prevent single faults from causing major service outages (Fig. 6 and 7).

B. 151A Power Plant

3.03 The -48 volt 151A power plant consists of a power frame and a supplementary power frame, which contain rectifiers, distribution fuses, power control and alarm circuitry, and reserve batteries. The plant supplies a maximum of 400 amperes direct current to the No. 3 ESS switching equipment and the toll and transmission equipment. The 24-cell battery string serves as a backup

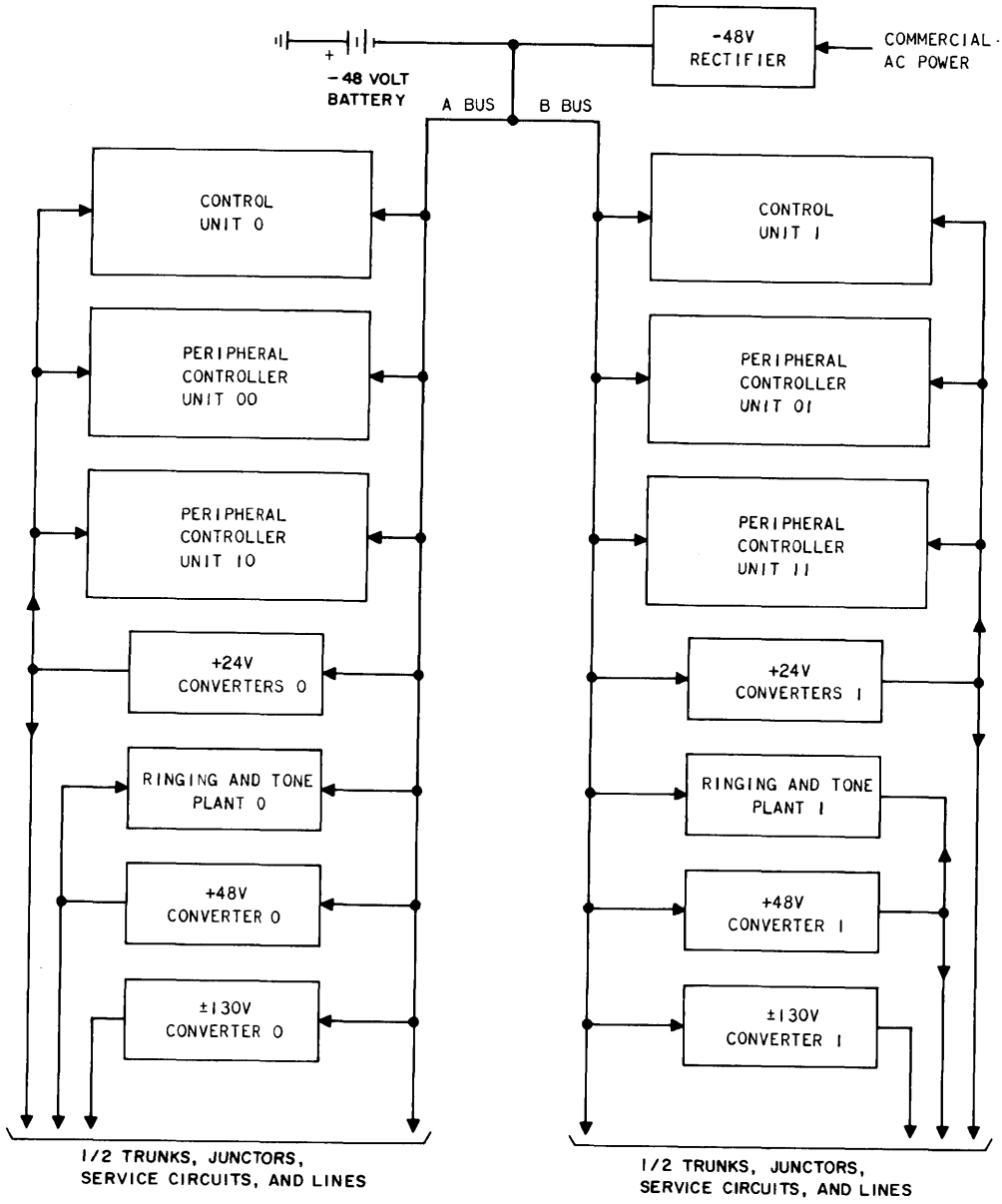


Fig. 6—No. 3 ESS Power Distribution and Duplication

power source in case of commercial power failure. Voltage limits at the output of the power plant are -43.75 volts minimum to -52.50 volts maximum. The maximum allowable voltage drop between the power plant and equipment frames (user circuit) is 1.0 volt, including voltage drop through the filters; therefore, the minimum voltage at the equipment frames is -42.75 volts. The maximum surge voltage is -60 volts.

3.04 The 24-cell battery (KS-20472 or KS-15544) string provides a minimum 8-hour reserve capacity. This reserve capacity provides sufficient time to connect a portable ac generating plant to the service entrance equipment when a commercial power loss occurs. Charging of the battery string is performed by the -48 volt rectifiers on the power and supplementary power frames.

C. Power Frame

3.05 The -48 volt power frame is capable of supplying a maximum of 200 amperes to the No. 3 ESS office. The rectifiers used in the

power frame are -48 volt, 100-ampere, constant-voltage (voltage-regulated) rectifiers suitable for charging or floating (neither charging nor discharging) a string of 24 battery cells. The input power to the power frame is single-phase, 208/240-volts alternating current (input to the rectifiers). A 112-ampere charge circuit breaker is used to protect the rectifier output charge feeders that run from the rectifiers to the batteries. Discharge fusing is provided in the first bay of the power frame and is divided into A- and B-buses. These fuses serve as a distribution point for the power feeders. A ground bus bar located on the rear of the frame provides the discharge ground terminal points. The power plant control unit consists of a voltmeter, ammeter, and associated control and alarm circuitry. This equipment also provides power alarm outputs to the office alarm circuit.

D. Supplementary Power Frame

3.06 The supplementary power frame provides 200 amperes additional capacity for the 151A power plant when combined with the power frame. It contains two 100-ampere rectifiers that are combined with the three power frame rectifiers at the charge circuit breaker panel.

E. Miscellaneous Power Frame

3.07 The miscellaneous power frame contains the office ringing and tone plant, converters, and distribution fuses for +24, +48, and +130/-130 volts direct current. The ringing and tone plant is used in the No. 3 ESS to generate ringing voltages and tones at frequencies for alerting and signaling purposes. The three converters in the miscellaneous power frame are the 180-type and provide the +24, +48, and ±130 volt dc power. Each converter is equipped with a voltage monitor so that an out-of-limit condition will provide a scan point indication and visual indication. The converters automatically shut down if the converter voltage is much higher than the normal voltage (e.g., +24 volts shutdown +30 volts; +48 volts shutdown +55 volts; ±130 volts shutdown ±142 volts). The +24 volt dc power is divided into A- and B-buses with a capacity of 16 amperes per bus. The ringing and tone plant (881A) supplies the following tones to the system:

- High Tone—480 Hz
- Low Tone—480 Hz and 620 Hz
- Call Waiting—440 Hz
- Busy Tone—480 Hz and 620 Hz, interrupted at 60 ipm
- Confirmation—350 Hz and 620 Hz
- Overflow Tone—480 Hz and 620 Hz interrupted at 120 ipm
- Dial Tone—350 Hz and 440 Hz
- Receiver Off-Hook (ROH)—1400 Hz, 2060 Hz, 2450 Hz, and 2600 Hz.

F. Network Frame

3.08 Two battery boost circuits are provided on each network frame. The battery boost circuit allows the No. 3 ESS to operate with a 1600-ohm customer loop length without special line treatment. The line supervisory voltage is maintained at a minimum of 53.5 volts from the junctor and customer dial pulse receiver circuits.

G. Grounding

3.09 A low-impedance grounding system is provided to ensure personnel safety, low-impedance fault-current path, reduced noise, and reduced electrical interference. The electronic circuitry used within the No. 3 ESS contains low-voltage integrated circuits and discrete components which cannot tolerate transient voltages or noise; therefore, a grounding system that isolates the system from ground disturbances is utilized (Fig. 8).

Office Ground

3.10 The zero voltage reference point for the office ground system is established by connection to a suitable grounding electrode. The ground electrode may be the office water piping system if nonmetallic pipe or insulating couplings are not used. Otherwise, a counter poise ground electrode system must be separately provided.

Equipment Ground

3.11 The grounding system used for the No. 3 ESS equipment is an isolated ground plane with a single point ground reference. The equipment frames are bonded together to form an electrically interconductive mass that is electrically insulated

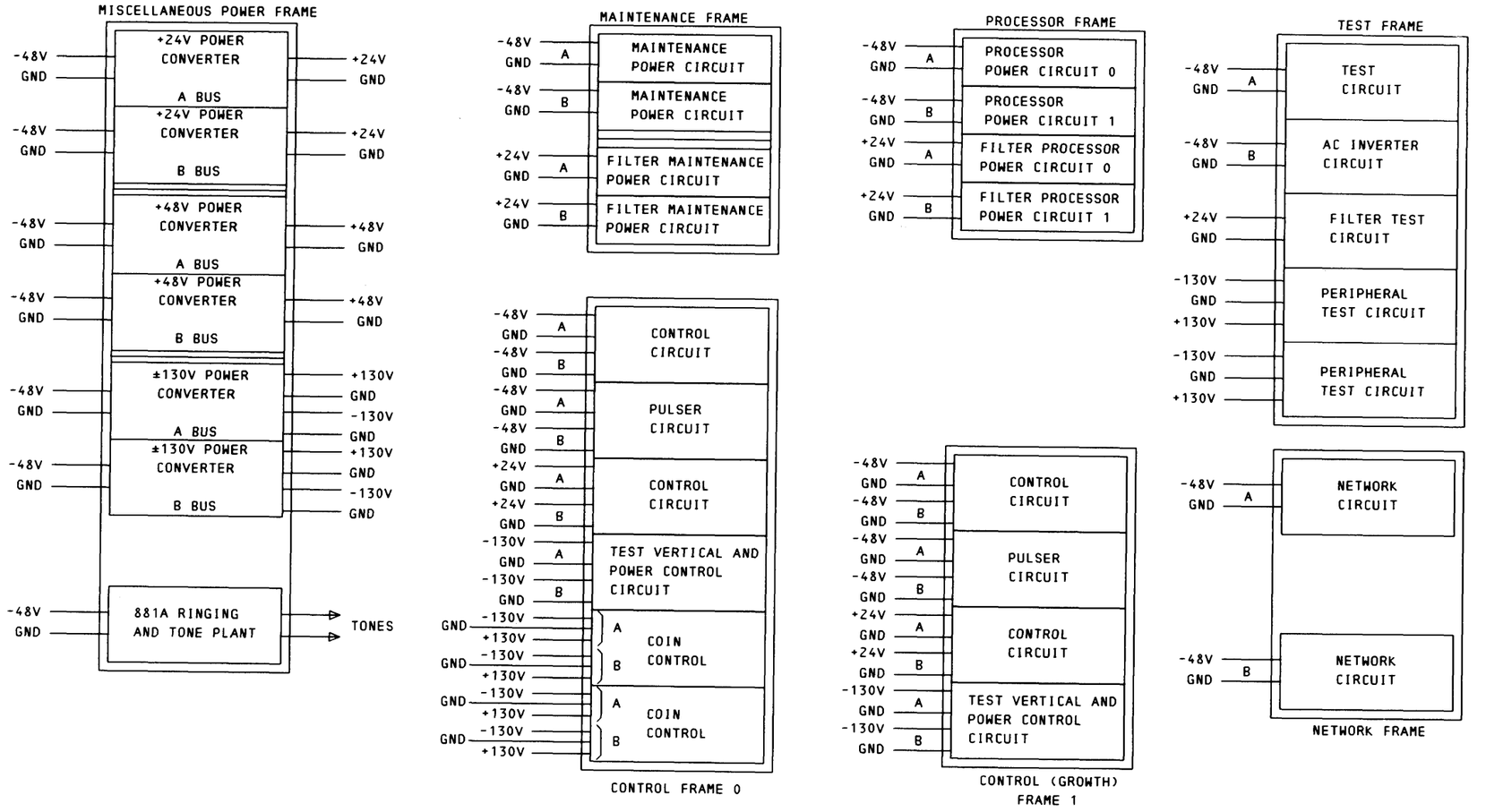


Fig. 7—Frame Power

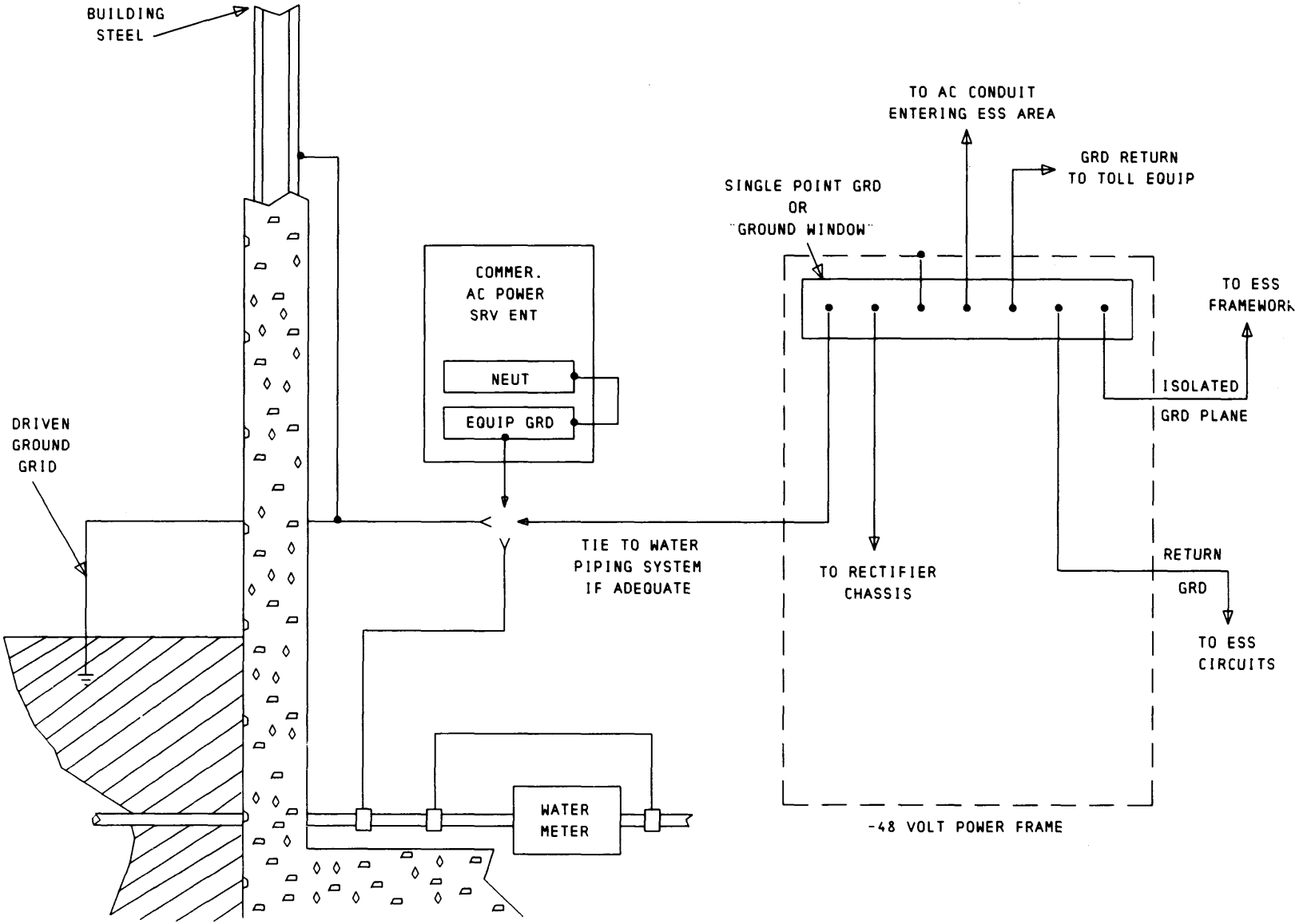


Fig. 8—Grounding Arrangement

from contact with any other grounded metal in the building except at the single point. A single point ground system eliminates the possibility of transient current flow through the office ground plane from outside sources. This single point ground (or ground window) is on the 151A power plant ground bus. It serves as the reference point for ac conduit and/or ac equipment ground leads, equipment-isolated ground plane, and dc power distribution grounds. This single point ground connects to the central office ground or building zero voltage reference point, thereby establishing all grounds within the ESS ground plane with earth ground. Since the isolated ground plane is connected at only one point to the building ground, ground currents generated outside the office are prevented from entering the ESS ground.

H. Power Considerations

AC Power

3.12 Commercial ac power is brought into the No. 3 ESS office and is terminated at the service entrance equipment. From this point, it is distributed to the telephone switching equipment and building loads.

Protected AC Power

3.13 Protected ac power is provided within the telephone switching equipment where circuits must be maintained with no more than a momentary loss of power. This power is provided by a dc-ac inverter, KS-20816, with 500 VA capacity and an overload surge capacity of 750 VA for starting the TTY. Circuits that require protected ac power in the No. 3 ESS are the maintenance TTY and one recorded announcement machine if overload announcement is provided. No other equipment may be connected to this protected ac power.

4. POWER CONTROL AND ALARM

A. Introduction

4.01 The power control in the No. 3 ESS provides the means for manually removing power from the various equipment units in the system as well as the means for automatically detecting and signaling failures in the power equipment and distribution buses. Power is manually removed from equipment being repaired. The power equipment and distribution buses are continually monitored by automatic detection via scan points. A failure detected in this circuitry causes a major power alarm, a minor power alarm, and/or fuse alarm. Power control also involves the use of software for removing equipment from service, for recovering from power failures, and for generating the visual and audible alarms and TTY messages when needed.

Warning: Power is not to be removed from equipment before consulting TOP Maintenance Manual 233-142-100 for procedure and sequence of operation. Improper power removal or restoration can result in equipment damage.

B. Peripheral Controller Unit Power Control

4.02 Power may be manually removed or restored to a peripheral controller unit by operating, in the proper sequence, the REQ, OFF, and ON keys located on the control panel of the control frame. Software monitors the state of these keys as well as any power alarm in the control frame via three scan points. The three scan points are encoded into five states (ON, REQUEST, MINOR POWER ALARM, OFF, and MAJOR POWER ALARM). These states provide the capability for software to recognize power failure, power on/off, and manual request for service.

C. Control Unit Power Control

4.03 Power may be removed from or restored to a control unit (CU) by operating the POWER key/lamp on the 3A central control (3A CC) panel on the processor frame. A control unit consists of the 3A CC and the main store (MAS). Hardware interlocks prevent power from actually being removed unless the CU is operating in the manual mode and locked off-line. Software monitors the state of the POWER keys in both the on-line and off-line CUs. If the keys are operated incorrectly, a minor alarm sounds. Power and fuse failures in a CU are recognized via dedicated scan points and cause the failing CU to be placed off-line and marked out of service. Software generates the appropriate power and fuse alarm in the event of failure.

D. Ringing and Tone Power Control

4.04 Power may be removed from or restored to one side of the ringing and tone (RT) plant by operating one of three keys on the ringing and tone control panel. The three keys on the panel

are interlocking, and only one may be operated at a time. The OOS-0 and OOS-1 (out-of-service) lamps are program-controlled via distributor points and are lighted when either RT0 or RT1 is out of service or unavailable. The PWR OFF lamps (0 and 1) are hardware-controlled and are lighted when power is removed either manually or because of a blown fuse. In addition to removing power when operated, the PWR OFF keys also force the other RT plant side on-line and override program control of this switching function. Fuse failures, ringing inverter, and tone generator failures are recognized via scan points and cause the failing RT plant to be placed off-line and marked out of service. Software generates the dedicated alarms.

E. Other Circuit Power Control

4.05 The system status panel (SSP) has a CIRCUIT POWER key/lamp which is normally lighted when power is on. To remove power, consult the TOP Maintenance Manual for instructions and sequence. Power and fuse failures in these circuits are indicated via scan points.

4.06 When power is to be removed from a +24, +48, or a +130/-130 volt converter, the affected circuits must be removed from service by TTY input messages. Power and fuse failures in these converters are indicated via scan points.

4.07 Power is removed from trunks, service circuits, junctors, and line circuits by manually removing the fuse or fuse pair (talk and signal) associated with the particular circuit of interest. Except for MF receivers and TOUCH-TONE® receivers which have a power-off key, fuse removal is the only way to remove power from these circuits, thus minimizing the effect on other circuits. Trunks, junctors, and line circuits are powered with a maximum of four circuits per fuse pair; the four circuits are all associated with the same peripheral decoder. Service circuits are powered with one fuse pair per circuit. Before removing a fuse, all associated circuits must be removed from service via a TTY input message. Fuse failures in these circuits are indicated via scan points. Power removal in other areas, such as peripheral decoder boards, ferrod boards, and 15A network grids, is also accomplished by manual fuse removal.

5. MAINTENANCE

5.01 Power maintenance is supported by the office alarm structure, which serves as the stimulus for software-controlled diagnostics. Both visual and audible alarm indications are provided. When a particular alarm sounds, a corresponding TTY message indicates the category and source of the alarm. The power alarm classifications (indicated on the system status panel) are as follows.

- ***Major power*** indicates a major failure in the power equipment.
- ***Minor power*** indicates a minor failure in the power equipment.
- ***Fuse*** indicates a blown fuse.
- ***Alarm circuit*** indicates trouble in the office alarm circuit or in its battery supply.

5.02 Duplication of the power bus (Fig. 6) as well as essential dc-to-dc converters ensures continuous service. If trouble occurs in the active (duplicated) power equipment, the 3A CC initiates a switch to the standby power equipment and the appropriate indications are given. Documents containing maintenance information on specific power units are referenced in 6.01.

6. REFERENCES

6.01 The following list of documents contains information which is relevant to this section.

Specifications

KS-15644—Battery

KS-20472—Battery

KS-20816— -48VDC to 110VAC Inverter

184B— -48V to +130/-130V Converter

188A/189A— -48V to +24V Converter

184A— -48V to +48V Converter

J87389— -48V to +3V Converter

J87421— -48V to +5V Converter

J87824A(881A)—Ringing and Tone Plant

Bell System Practices

Section 167-615-100—151A Power Plant Descriptive

Section 167-615-101—151A Power Plant Theory

Section 167-738-100—881A Ringing and Tone Plant Description

Section 167-738-101—881A Ringing and Tone Plant Theory

Section 233-142-100—TOP Maintenance Volume

Section 802-659-160—151A Power Plant

Section 802-001-180—Grounding

7. GLOSSARY

7.01 A glossary of terms is provided to aid in the understanding of definitive words in this section.

Control Unit (CU)—The combination of 3A CC main store, power, and store fuses and the system status panel and control panel.

DC-to-DC Converter—A device that accepts a direct current input voltage and converts it to a determined direct current output voltage and polarity.

DC-to-AC Inverter—A device that accepts an input direct current voltage and changes it to an alternating current voltage.

System Status Panel (SSP)—A panel that provides indications of normal, emergency and alarm conditions in the No. 3 ESS office. The SSP also provides emergency manual control of the system and a test facility.