

297-2281-156

DMS-100 Family

**TOPS MP**

## Power Distribution and Grounding Guide

This guide applies to all BCS levels Standard 03.04 May 1995

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# TOPS MP

## Power Distribution and Grounding Guide

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# Publication history

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## May 1995

Standard 03.04 was issued to add information on monitor bezels or anti-glare screens and on the relative humidity range for rooms containing TOPS MP workstations.

## December 1992

Standard 03.03 was released for the following reasons.

- to comply with the generic design intent, terminology, and definitions of applicable Northern Telecom Corporate Standards
- to improve the composition, arrangement, and structure of the subject content
- to limit the technical content specifically to the TOPS MP system
- to simplify and improve the text, figures, and tables

Release 03.03 contained only minor technical changes; however, its content was extensively revised and modified to present the TOPS MP power and grounding information in a clear and direct form. All pages were issued without revision bars.

## March 1990

Standard 03.02 composed NTP 297-2281-156 in a new typographical style (restructured format). Its technical content was extensively revised and expanded.



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## About this document

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TOPS MP is a subsystem of the DMS-100 Family of Digital Multiplex Switching (DMS) Systems. This guide is based on the principles developed for DMS-100F and contained in *DMS-100 Family Power Distribution and Grounding Guide*, 297-1001-156.

### Application of this document

This guide describes the power and grounding requirements for the Traffic Operator Position System Multipurpose (TOPS MP). The requirements in this guide are to ensure controlled and protected distribution of dc and ac power to TOPS MP equipment. The grounding system provides immunity, within generally industry-accepted standards, from operational and transient phenomena that could be hazardous to personnel and to equipment. This document is written for personnel having responsibility for plant-equipment planning, engineering, installation, and maintenance.

More than one version of this document may exist. To determine whether you have the latest version of this document, check the release information in *DMS-100 Family Guide to Northern Telecom Publications*, NTP 297-1001-001.

### References

References listed as prerequisites are essential for an understanding of this guide. Those listed as informative contain detailed information concerning other items mentioned in this guide, but are not essential. References are inserted at the appropriate places in the text.

#### Prerequisite references

- ANSI T1.313-1991: *Electrical Protection for Telecommunications Central Offices and Similar Type Facilities*
- ANSI T1.321-1995: *Electrical Protection for Network Operator-Type Equipment Positions*
- NTP 297-1001-156: *DMS-100 Family Power Distribution and Grounding Guide*

- *Rural Electrification Administration (REA) Telecommunications Engineering and Construction Manual, Section 810: Electrical Protection of Electronic Analog and Digital Central Office Equipment*
- TR-NPL-000314: *Generic Requirements for Telephone Headsets Used at Bell Operating Company (BOC) Operator Consoles*
- TR-NWT-000295: *Isolated Ground Planes; Definition and Application to Telephone Central Offices*

### **Informative references**

- ANSI/NFPA No. 70: *National Electrical Code-1990*
- ANSI/NFPA No. 75: *Protection of Electronic Computer/Data Processing-1989*
- ANSI/NFPA No. 78: *Lightning Protection Code-1989*
- CSA C22.1: *Canadian Electrical Code-1990*
- Federal Information Processing Standard (FIPS) Pub 94: *Guideline on Electrical Power for ADP Installations*
- ISOX00: *Isolated Systems Grounding Topology*
- ISOX07ZA: *Digital Multiplex System AC Grounding*
- NTP 297-1001-450: *Provisioning Guide*
- PLN-2281-001: *TOPS MP Technical Specification*

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# 1 Introduction

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## 1.1 Definitions

The following definitions conform as closely as possible to those of the National Electrical Code (NEC) and the Canadian Electrical Code (CEC).

### 1.1.1 ac equipment grounding (ACEG) conductor (green wire)

A conductor used to protect personnel from injury. The ACEG conductor does not normally carry current. It is permanently bonded to the serving panel ground and to metal parts of electrical equipment that do not normally carry current. The ACEG conductor is an insulated conductor for the applications covered by this document.

### 1.1.2 ac service entrance ground

The ground reference point for all ac-powered equipment. It must also be connected to the building principal ground.

### 1.1.3 battery return (BR)

A conductor that carries the -48 V return current. Although BR conductors are not grounding conductors, they are referenced to ground by the battery return reference (BRR) conductor of the dc power plant.

### 1.1.4 battery return reference (BRR)

A grounding conductor used to connect the battery return of the dc power plant to ground.

### 1.1.5 bonding

The permanent joining of non-current carrying metallic parts to form an electrically conductive path, which ensures electrical continuity and the capacity to safely conduct any current likely to be imposed upon the path.

### 1.1.6 bonding network (BN)

A set of interconnected conductive structures that provides an electromagnetic shield for electronic systems and personnel at frequencies from dc to low rf. The term *electromagnetic shield* denotes any structure used to divert, block, or impede the passage of electromagnetic energy. In general, a BN

need not be connected to earth, but all BNs considered in this document require an earth connection.

### **1.1.7 building principal ground (BPG)**

The main point within a building at which the ground reference potential is established. The BPG is directly referenced to earth by such means as water pipes and/or electrodes driven into the earth.

### **1.1.8 common bonding network (CBN)**

The principal means for effecting bonding and grounding inside a telecommunication building. It is the set of metallic components that are intentionally or incidentally interconnected to form the principal bonding network in a building. These components include: structural steel or reinforcing rods, metallic plumbing, ac power conduit, ac equipment grounding conductors, bonding conductors, and cable racks. The CBN has a mesh topology and is connected to the building grounding electrode system.

### **1.1.9 DMS single point ground (DMS SPG)**

A single point where the framework bonding equalizer (FBE), the logic return equalizer (LRE), the serving ac equipment grounds (ACEG), the integrated collector bar (ICB), and the serving dc-power plant battery return reference (BRR) are connected to ground. The DMS SPG is usually one of the following types of busbars: building principal ground (BPG), floor ground bar (FGB), dedicated SPG bar, or a dedicated section of the serving dc-power plant battery return (BR) bar. In some old (non-ISG) configurations, the framework ground bus (rather than the FBE and LRE) is connected to the DMS SPG.

### **1.1.10 floor ground bar (FGB)**

A copper bar on each floor of a building provided for equipment grounding. It is connected to the VGR and effectively extends the the BPG to each floor level.

### **1.1.11 framework bonding equalizer (FBE) bar**

A copper plate mounted on insulators and used in an ISG DMS system to bond DMS frames and cabinets to ground.

### **1.1.12 ground**

A metallic connection, whether intentional or accidental, between an electric circuit or equipment and the earth, or some conducting body that serves in place of the earth. Typically, a ground is a connection to earth obtained by a grounding electrode.

**1.1.13 incidental ground**

An unplanned grounding connection.

**1.1.14 integrated collector bar (ICB)**

An insulated copper plate used for bonding to the DMS SPG all metallic objects that are outside the IBN but within 2 m (7 ft) of the IBN and that are not already connected to the DMS SPG. These metallic objects include any noninsulated metallic objects that could be intentionally or unintentionally connected to the building CBN and cannot be insulated from the CBN.

**1.1.15 isolated bonding network (IBN)**

A bonding network that has a single point of connection to either the CBN or another IBN.

**1.1.16 isolation**

The arrangement of parts of equipment, a system, or a facility to prevent uncontrolled electrical contact within or between parts.

**1.1.17 logic return equalizer (LRE) bar**

An isolated copper plate with a single connection to the DMS SPG. The logic return of DMS equipment frames and cabinets are referenced to the LRE. No other connections are made to the LRE.

**1.1.18 no-break ac load**

An ac load that cannot tolerate any interruption. For DMS-100F, a no-break ac load is normally fed from an inverter powered by the -48 V plant serving the switch. Inverters used in the IBN are not equipped with ac line bypass facilities.

**1.1.19 protected ac load**

An ac load that should operate during a prolonged loss of commercial power and that can tolerate only minimal interruption times. An interruption can vary from a few milliseconds up to approximately five seconds.

**1.1.20 single point ground (SPG)**

A single connection used to reference equipment or a system to ground. In the IBN arrangement, no dc current flows through the single point connection unless a fault condition exists.

**1.1.21 vertical ground riser (VGR)**

A continuous conductor extending ground potential throughout the height of a multifloor building. The size of this conductor is either 750 kcmil or is equal to or larger than the largest conductor used for power distribution in the building. The FGBs on various floors are connected to the VGR.

## 1.2 Abbreviations and acronyms

The following list is provided as a reference for a quick identification of abbreviations and acronyms used in this document.

**ac:** alternating current

**ACEG:** alternating current equipment ground

**AWG:** American Wire Gauge

**BPG:** building principal ground

**BR:** battery return

**BRR:** battery return reference

**CBN:** common bonding network

**CBT:** computer based training

**CEC:** Canadian Electrical Code

**CO:** central office

**CSA:** Canadian Standards Association

**dc:** direct current

**DMS:** Digital Multiplex System

**DMS SPG:** DMS single point ground

**EMI:** electromagnetic interference

**ESD:** electrostatic discharge

**FBE:** framework bonding equalizer

**FG:** framework ground

**FGB:** floor ground bar

**FSP:** frame supervisory panel

**IBN:** isolated bonding network

**IGP:** isolated ground plane

- IGZ:** isolated ground zone
- ISG:** isolated system ground
- kcmil:** thousand circular mils
- LR:** logic return
- LRE:** logic return equalizer
- MGB:** main ground bus (BCC terminology)
- MGB:** master ground bar (REA terminology)
- NEC:** National Electrical Code
- NRTL:** nationally recognized testing laboratory
- NTP:** Northern Telecom Publication
- REA:** Rural Electrification Administration
- SPG:** single point ground
- TOPS MP:** Traffic Operator Position System Multipurpose
- TR:** Technical Reference (Bell Communications Research)
- UL:** Underwriters Laboratories
- UPS:** uninterruptible power supply
- VGR:** vertical ground riser
- W/h:** watts per hour

### 1.3 Cross reference of terms

Table 1-1 is a quick cross-reference of terms used by Northern Telecom, the BOCs, REA, and others.

<b>Table 1-1 Cross reference of terms</b>			
<b>NT</b>	<b>BOC</b>	<b>REA</b>	<b>OTHERS</b>
battery return (BR)	-48 V return	N/A	- battery ground - dc return - positive discharge bus - power return
building grounding system	CO GRD	central office protection grounding	- COG - CO ground
building principal ground (BPG)	- OPGPB - PGP bus	master ground bar (MGB)	- COG - CO GRD bus - facility ground - OPGP - principal ground point (PGP) - reference point 0 - zero potential reference point
common bonding network (CBN)	integrated ground plane	integrated ground zone	- integrated ground system
DMS SPG	main ground bus (MGB)	master ground bar (MGB)	- main ground bar (MGB)
floor ground bar (FGB)	- CO GRD - CO ground bar - CO ground bus	floor bar	- COG - COGB - C.O. GRD
framework bonding equalizer (FBE) bar			- FG - framework ground - framework ground bus
isolated bonding network (IBN)	isolated ground plane	isolated ground zone (IGZ)	- isolated ground system (IGS)
logic return (LR)			- logic ground - signal ground
logic return equalizer (LRE)			- logic ground
vertical ground riser (VGR)	- vertical equalizer - vertical riser		- C.O. ground riser - equipment ground riser - GRD riser - riser - VERT EQLR



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## 2 Hardware

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The TOPS MP hardware provided by Northern Telecom is UL Listed or UL Recognized and CSA Certified. Any additional equipment should be tested for compliance with applicable standards by a qualified NRTL.

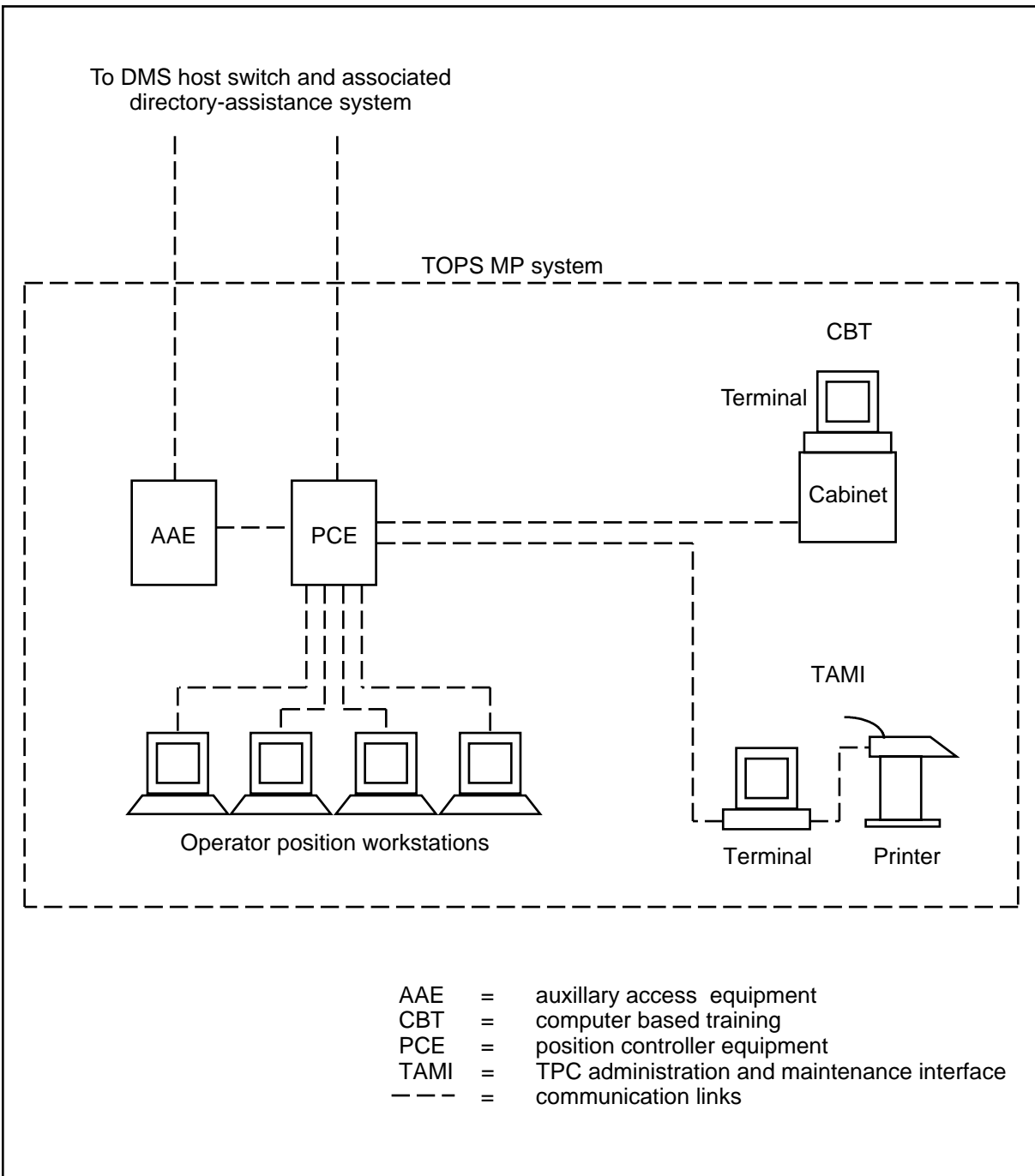
TOPS MP equipment can be installed in areas that have conventional flooring, raised flooring, or dropped ceilings.

The TOPS MP hardware at a system site includes a varied number of operator workstations, one or more auxiliary access equipment (AAE) cabinets, and one or more position controller equipment (PCE) cabinets. TOPS hardware also includes a TPC administration and maintenance interface (TAMI) terminal. Computer based training (CBT) equipment for operator personnel may also be included (see Figure 2-1).

The following recommendations apply to any additional equipment used at a TOPS MP operator position:

- Equipment housing should be plastic to reduce electrostatic discharge (ESD) occurrences.
- Power to additional operator equipment should be provided by the receptacles serving associated TOPS MP operator positions.

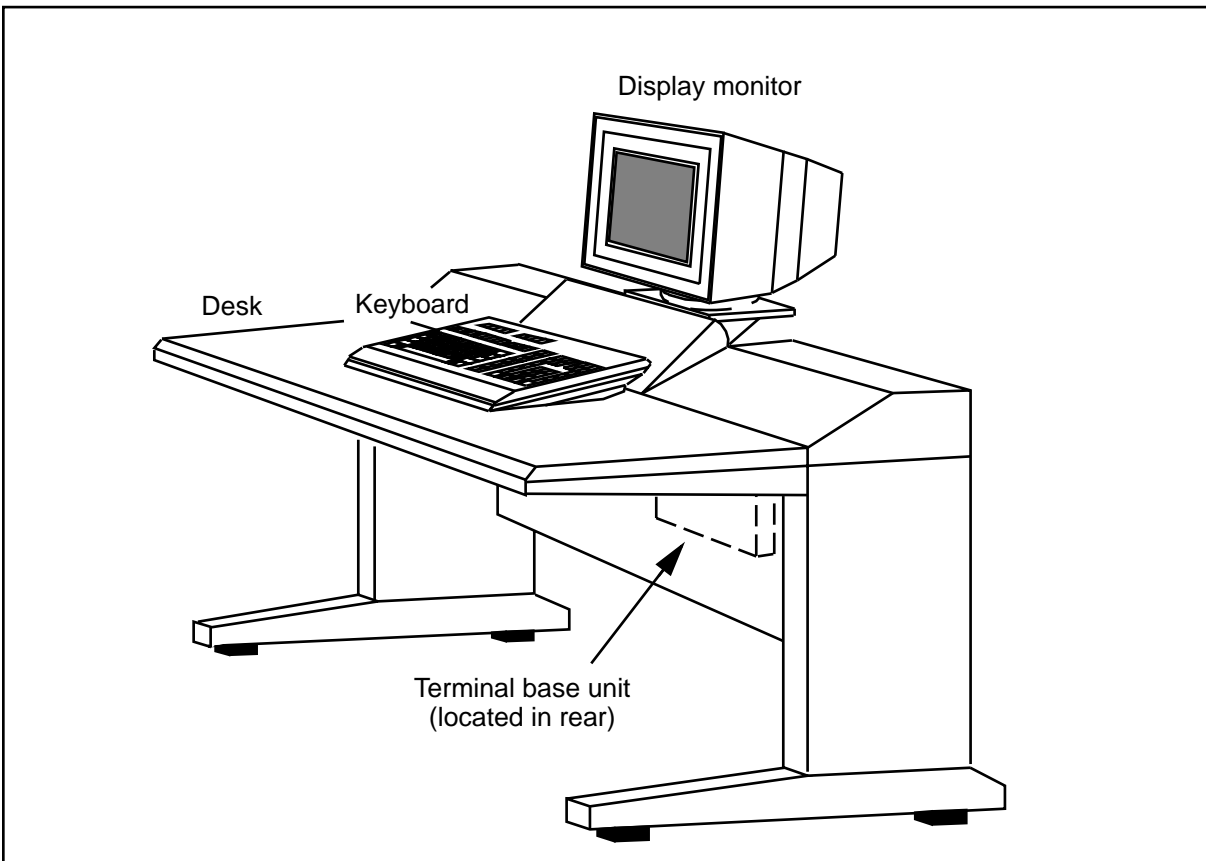
**Figure 2-1**  
**TOPS MP system hardware**



## 2.1 TOPS MP workstation

The TOPS MP operator position may use an integrated workstation or a modular workstation. The modular workstation has a display monitor, terminal base unit (monitor controller), and a keyboard. The integrated workstation includes an adjustable desk as well as a display monitor, terminal base unit, and keyboard (Figure 2-2).

**Figure 2-2**  
TOPS MP workstation



The adjustable desk supplied by Northern Telecom meets the intent of UL 1286, *Standards for Safety of Office Furnishings*, and is designed to facilitate grounding requirements. When an operating company provides its own desk for a TOPS MP display, terminal base, and keyboard (modular workstation) the desk should conform to the grounding requirements for the TOPS MP integrated workstation specified in this guide.

The headset interface of a TOPS MP workstation is designed for headsets that meet the *Generic Requirements for Telephone Headsets Used at Bell Operating Company (BOC) Operator Consoles*, Issue 1, TR-NPL-000314, published by Bell Communications Research (Bellcore).

## 2.2 TAMI equipment

TOPS MP administration and maintenance at an operator services center is performed with a TAMI terminal. The TAMI terminal may be located local to or remote from the MP workstation area. The TAMI is a VT100/200 (or compatible) terminal. Communication between the TAMI and TOPS MP equipment is always ac coupled by the use of modems. The TAMI modem that directly links to the TOPS MP is located in the AAE cabinet. The modem that is directly connected to the TAMI is usually a standalone ac modem located at the TAMI. A printer (LA-75, Omni-800, DECWriter IV, or compatible printer) may be connected directly to the TAMI.

## 2.3 CBT equipment

Computer based training (CBT) for TOPS MP operators is implemented with a World Institute of Computer Assisted Training (WICAT) system. A video display terminal and equipment cabinet make up a CBT unit. The CBT is a microprocessor-based unit with direct communication links of up to 30.5 m (100 ft) to an associated PCE cabinet.

## 2.4 AAE cabinet

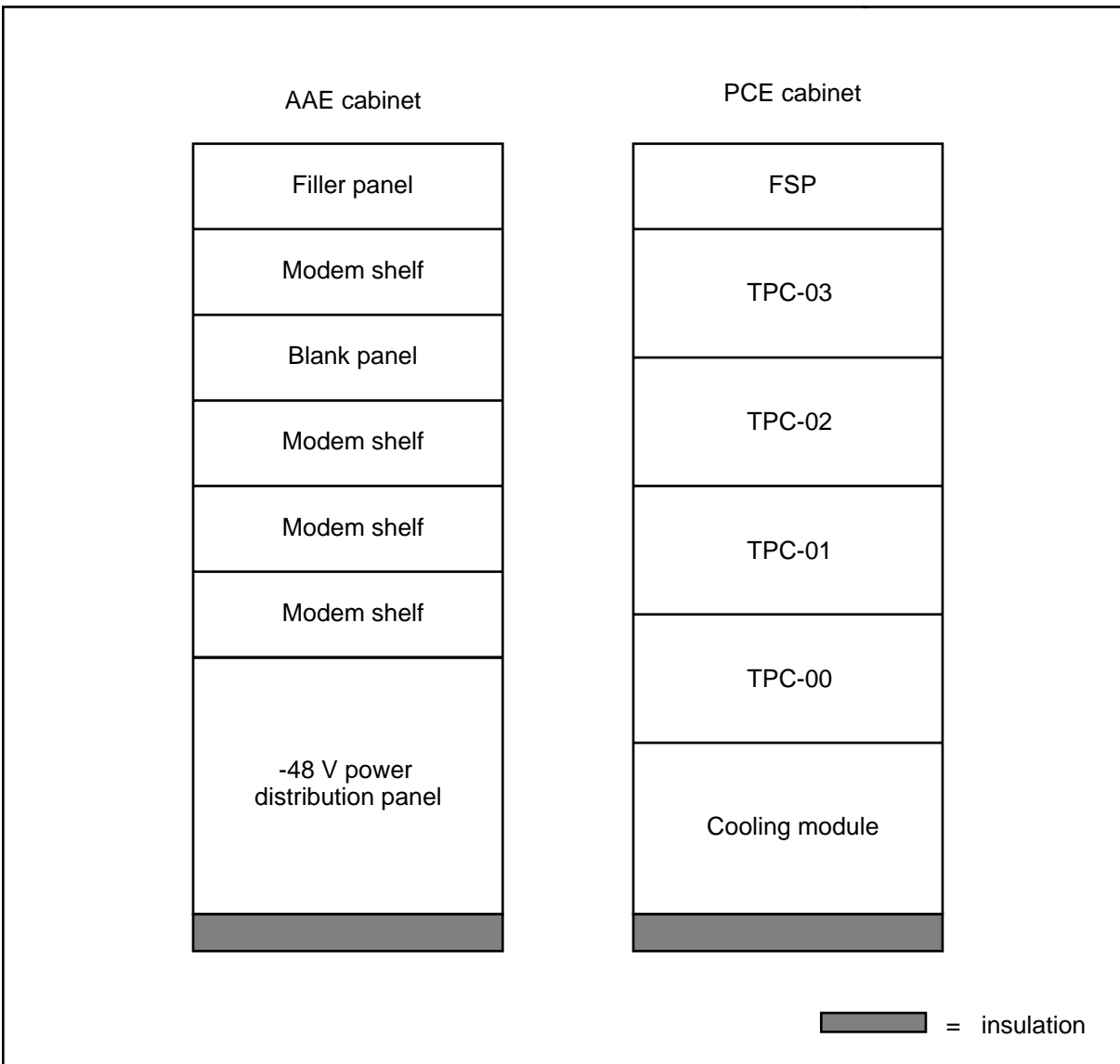
An AAE cabinet (Figure 2-3) contains a power distribution panel which distributes dc power for up to four PCE cabinets. The maximum cabling distance between an AAE and a PCE cabinet is 30.5 m (100 ft).

The AAE cabinet also contains modem shelves. DC powered modems are preferred. One modem shelf accommodates up to sixteen 212-compatible units. One 212 modem is required for each TOPS position controller (TPC) shelf in a PCE cabinet. The other modem shelves contain DSU cards for use with the database access feature.

## 2.5 PCE cabinet

The PCE cabinet is used to control up to 16 TOPS MP workstations. This cabinet contains a frame supervisory panel (FSP), TOPS position controller (TPC) shelves, and a cooling module.

**Figure 2-3**  
**AAE and PCE cabinets**





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## 3 Power distribution

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The requirements described in this chapter ensure a controlled and protected distribution of power to the TOPS MP system. Power sources for the TOPS MP shall conform to applicable requirements of *DMS-100 Family Power Distribution and Grounding Guide*, 297-1001-156 and the following paragraphs.

### 3.1 AC power

A 120 V, 60 Hz power source provided by the operating company is used to power TOPS MP workstations, TAMI equipment, and trainer equipment. NTP 297-1001-156 contains guidelines for use of the following ac power equipment:

- commercial ac
  - ac panel dedicated to TOPS MP operator equipment, or
  - branch circuits (when very little ac power is needed)
- special ac
  - stand-alone inverter
  - uninterruptible power source
  - standby engine alternator
  - isolation transformer

Operating companies usually treat TOPS MP workstations and associated equipment as no-break loads powered from appropriate ac power sources. A dedicated distribution panel is usually used to feed branch circuits to the equipment.

When operator equipment is collocated with its associated host DMS switch in the same building, ac power is usually supplied from an inverter deriving its -48 V dc input from the same power plant used by the host switch. Operator equipment remote from the host switch is usually powered from an uninterruptible power supply (UPS). The inverter or UPS must have the capacity to power all the MP workstations. A 20-position operator services center, for example, requires an inverter or UPS with at least a 2-kVA rating (20 x 120 x 0.75).

The UPS should be an inverter preferred type with a static transfer unit that transfers to alternate power within 1/4 cycle of an undervoltage or overvoltage condition. Also, the reserve time of the UPS should maintain power through typical durations of commercial power outage. The output protection in the UPS shall be coordinated with the overcurrent protection in the distribution panel. The UPS is normally placed in close proximity (within one floor) of the TOPS MP operator equipment.

### 3.2 TOPS MP workstation

The TOPS MP workstation is powered through a cable and plug assembly attached to the rear of the workstation's display monitor (Figure 3-1). The workstation is ac-powered (120 V, 60 Hz) and has a power consumption of 72 W/h and a current drain of 0.75 A.

Standard brown receptacles (straight-blade) are recommended for the power plugs of the TOPS MP workstations. The receptacles should be located to accommodate direct connection to the workstations. Receptacles may be floor or wall mounted using multi-outlet poles or metal raceways. Except for very temporary purposes, an extension cord shall not be used to connect a workstation to a receptacle.

Where required by the customer for the reduction of EMI on the grounding circuit, isolated ground receptacles (orange) are permitted within the TOPS MP area. The installation of isolated ground receptacles shall comply with NEC Article 250-74 or CEC Section 10-906. An isolated ground receptacle is not intended for use in reducing objectionable stray currents [see NEC Article 250-21(d)].

### 3.3 TAMI equipment

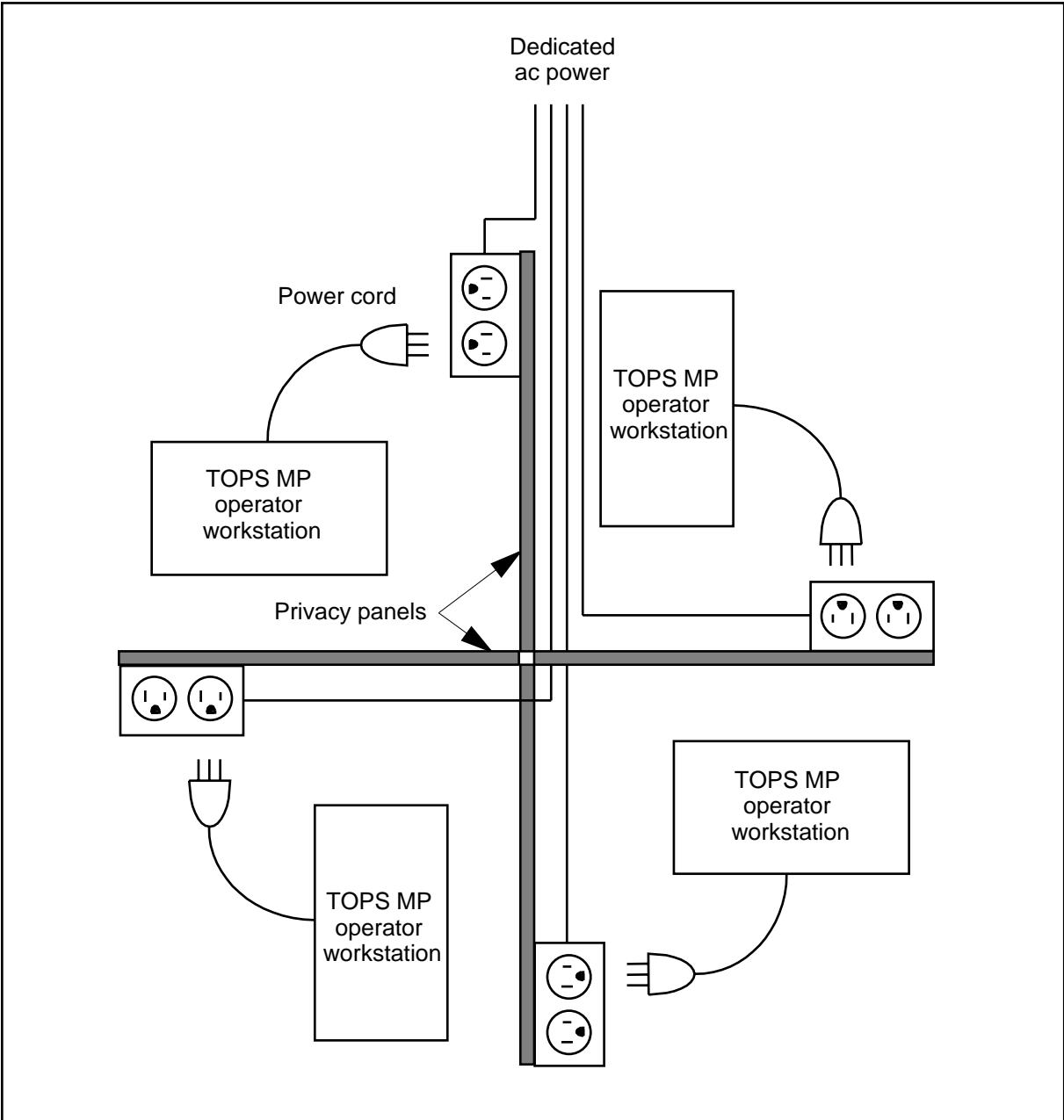
The TAMI terminal can be powered (120 V, 60 Hz) from commercial ac, an inverter, or a UPS. When a printer is used with the TAMI terminal, it should be powered from the terminal or from the same source as is the TAMI terminal.

### 3.4 CBT equipment

The CBT terminal can be powered directly from the CBT equipment cabinet. The cabinet is ac-powered (120 V, 60 Hz) and treated as a no-break load powered from an appropriate power source. It has a power consumption of 250 W/h and a current drain of 12 A. It is recommended that the CBT cabinet be powered from the same power distribution panel as is the TOPS MP.



Figure 3-1  
Power to TOPS MP workstations



### 3.5 AAE cabinet

Power from the dc power plant is required at a nominal voltage of -48 V. Two primary power feeders, designated A feeder and B feeder, are fused at 70 A (100 A maximum) from the main power panel and connected to an AAE cabinet for secondary distribution (Figure 3-2) to four PCE cabinets. Both battery and return conductors have the same current carrying capacity and are routed in close proximity to each other. The feeder conductor size is determined by the distance between the main power panel and the AAE cabinet.

Power feeder sizes are based on a current draw of 45 A by an AAE with four PCE cabinets, and on a maximum voltage drop of 0.75 V across the round trip length of the conductor (from the main power panel to the AAE, and back from the AAE to the main panel).

A power distribution panel (PDP) in the AAE cabinet is used to provide secondary power the PCE cabinets. The PDP can power four PCE cabinets. Secondary power feeders are fused at 20 A in the PDP and evenly assigned to the primary A and B feeders. Both battery and return conductors have the same current carrying capacity and are routed in close proximity to each other.

An AAE cabinet may also be used to distribute dc power to the channel bank equipment that links the TOPS MP to a remote DMS host switch. (Channel banks are usually provided by the operating company and are located external to the DMS cabinet area.)

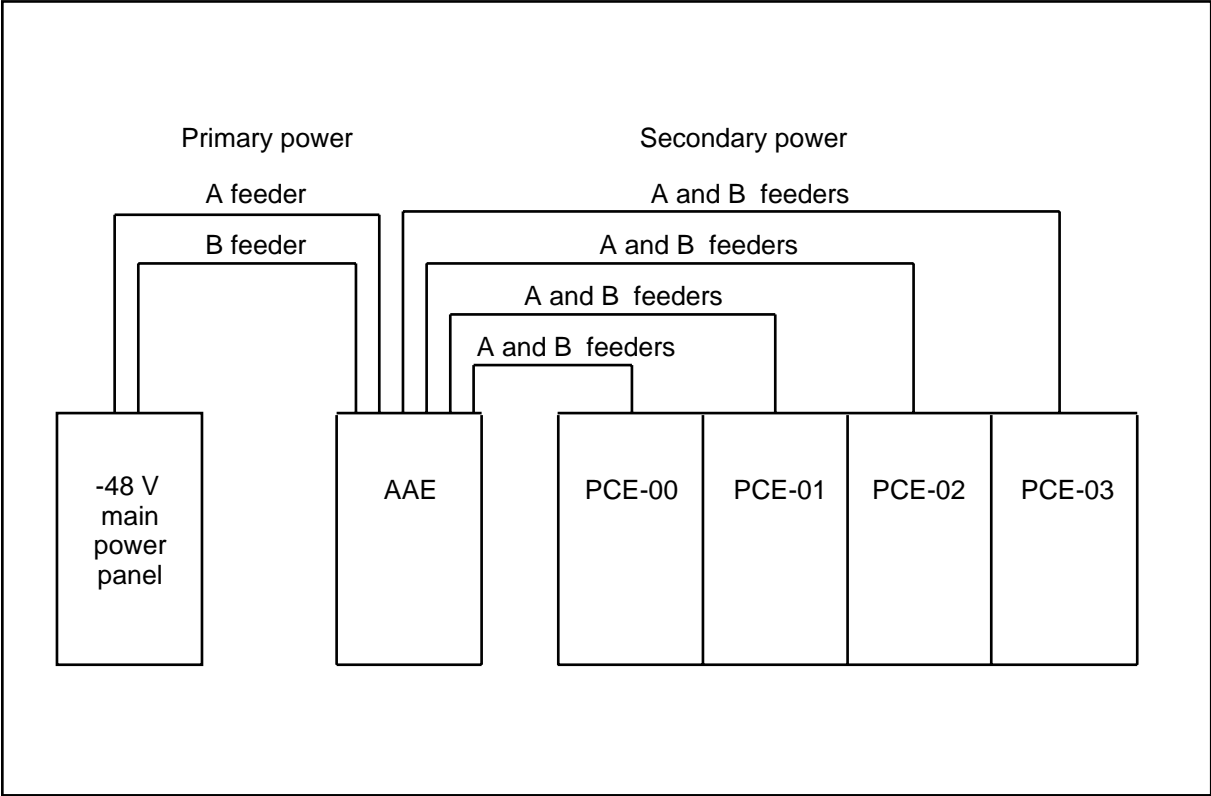
### 3.6 PCE cabinet

Power to the PCE cabinets is distributed from a power distribution panel (PDP) in the AAE cabinet. PCE cabinets may be located in one or more lineups.

Each PCE cabinet is dc-powered (-48 V), with a power consumption of 1200 W/h and a current drain of 11 A on each secondary A and B power feeder. A frame supervisory panel (FSP) in the PCE distributes power to internal cabinet loads.

The maximum voltage drop between the AAE (PDP output) and a PCE cabinet is 1.0 V. Under battery discharge and maximum voltage drop conditions, the minimum voltage measured at the input terminals (bulkhead, EMI filter) on each PCE cabinet shall not be less than -42.75 V. Under battery equalization and negligible voltage drop conditions, the maximum voltage measured at each PCE cabinet shall not be greater than -55.8 V.

**Figure 3-2**  
**Power distribution to AAE and PCE cabinets**





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## 4 Grounding

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The grounding system provides immunity, within general industry accepted standards, from operational and transient phenomena that could be hazardous to personnel and to equipment. The grounding of hardware and power sources for the TOPS MP shall conform to applicable requirements of *DMS-100 Family Power Distribution and Grounding Guide*, 297-1001-156 and the following paragraphs.

TOPS MP operator workstation equipment should be installed in the common bonding network (CBN). If required by an operating company, TOPS MP workstations can be installed in an isolated bonding network (IBN). The AAE and PCE cabinets are DMS-type cabinets, and are always placed in an IBN.

A single point ground (SPG) must be assigned for TOPS MP equipment located in an IBN. The SPG is the common ground reference for all TOPS MP equipment and associated power supplies.

### 4.1 CBN grounding

The monitor and terminal base unit of a TOPS MP workstation installed as part of the CBN are grounded by way of the ac equipment ground (ACEG) conductor of the power cord which extends from the rear of the monitor unit. In addition, the ESD ground stud of the terminal base unit is bonded to the furniture ground stud located on the furniture.

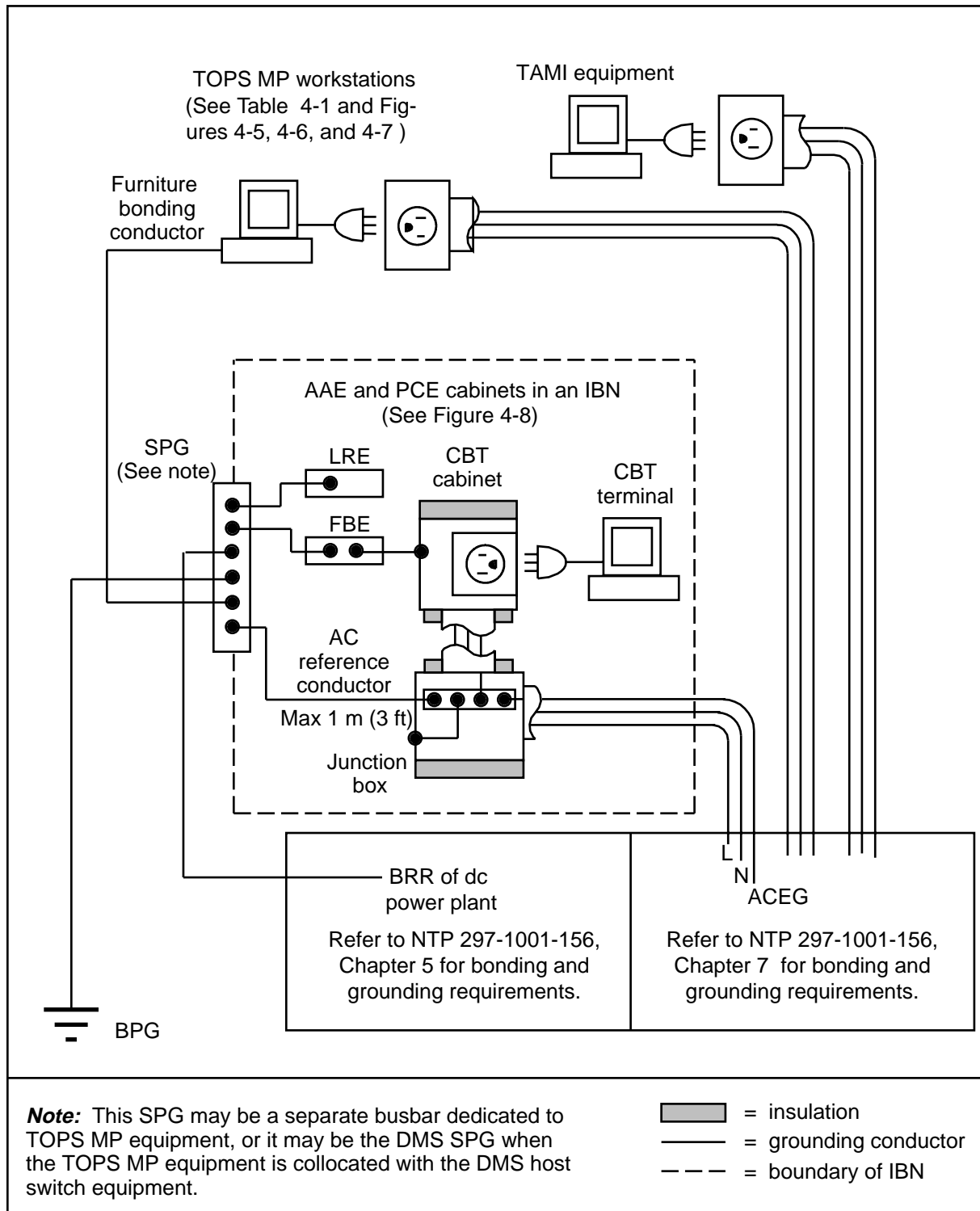
TOPS MP furniture in the CBN may be bonded by way of a furniture bonding conductor to a floor ground bar (FGB). In a single-floor installation (Figure 4-1), this FGB is sometimes also used as the SPG of the AAE and PCE cabinets. A typical CBN multifloor installation is shown in Figure 4-2.

In a raised floor installation, a ground plane/grid that is bonded to the FGB may be used in place of the furniture bonding conductor to bond the TOPS MP furniture.

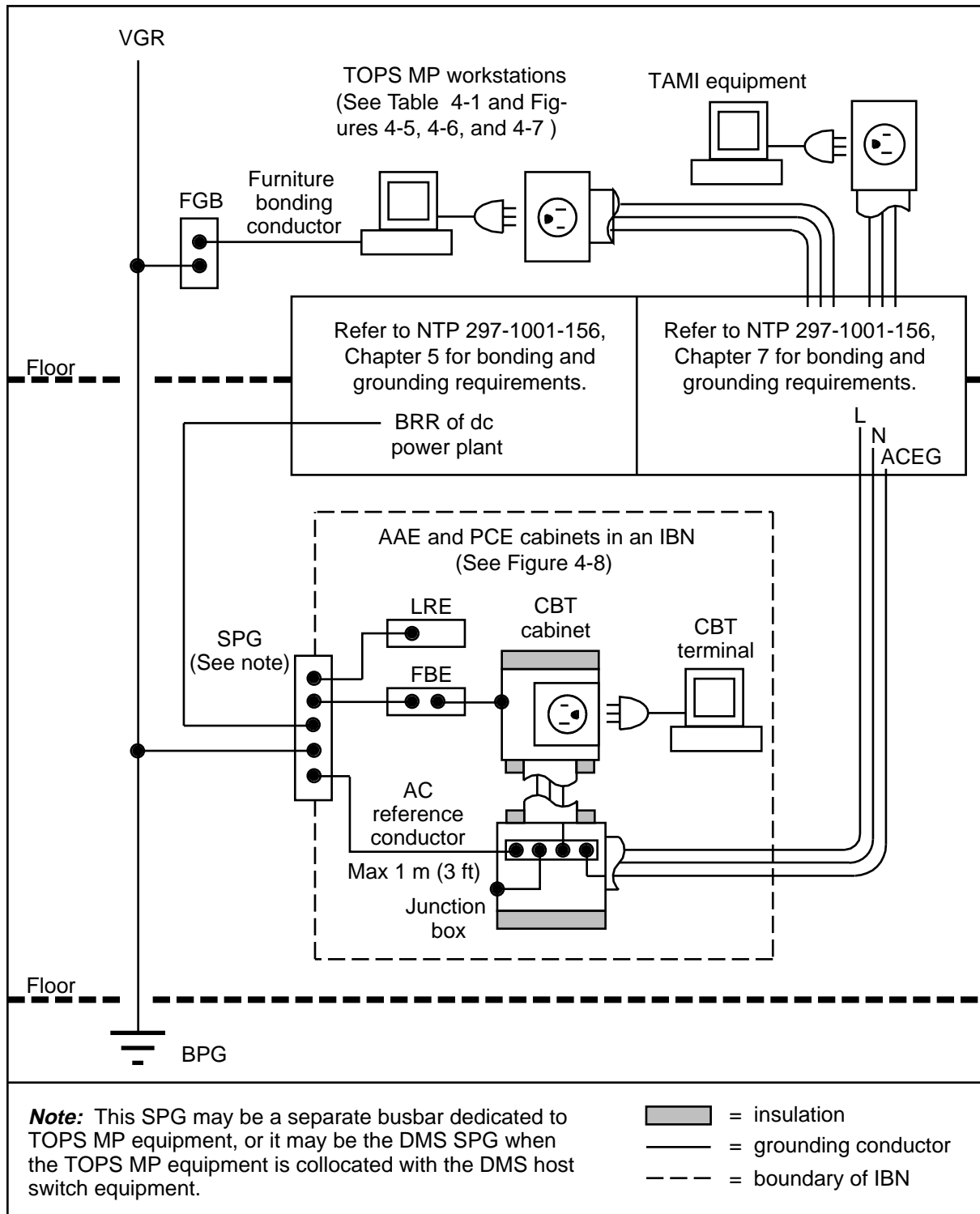
The metal raceway and ac distribution panel serving the TOPS MP operator positions are not required to be insulated.

4-2 Grounding

**Figure 4-1**  
**CBN grounding: typical single-floor installation**



**Figure 4-2**  
**CBN grounding: typical multifloor installation**



## 4.2 IBN grounding

Although the recommended configuration for TOPS MP workstations is in the CBN, workstations can be installed in an IBN if required by an operating company.

For TOPS MP workstations in an IBN, the monitor and terminal base unit are grounded by way of the ACEG conductor of the power cord which extends from the rear of the monitor unit. In addition, the ESD ground stud of the terminal base unit is bonded to the furniture ground stud located on the furniture.

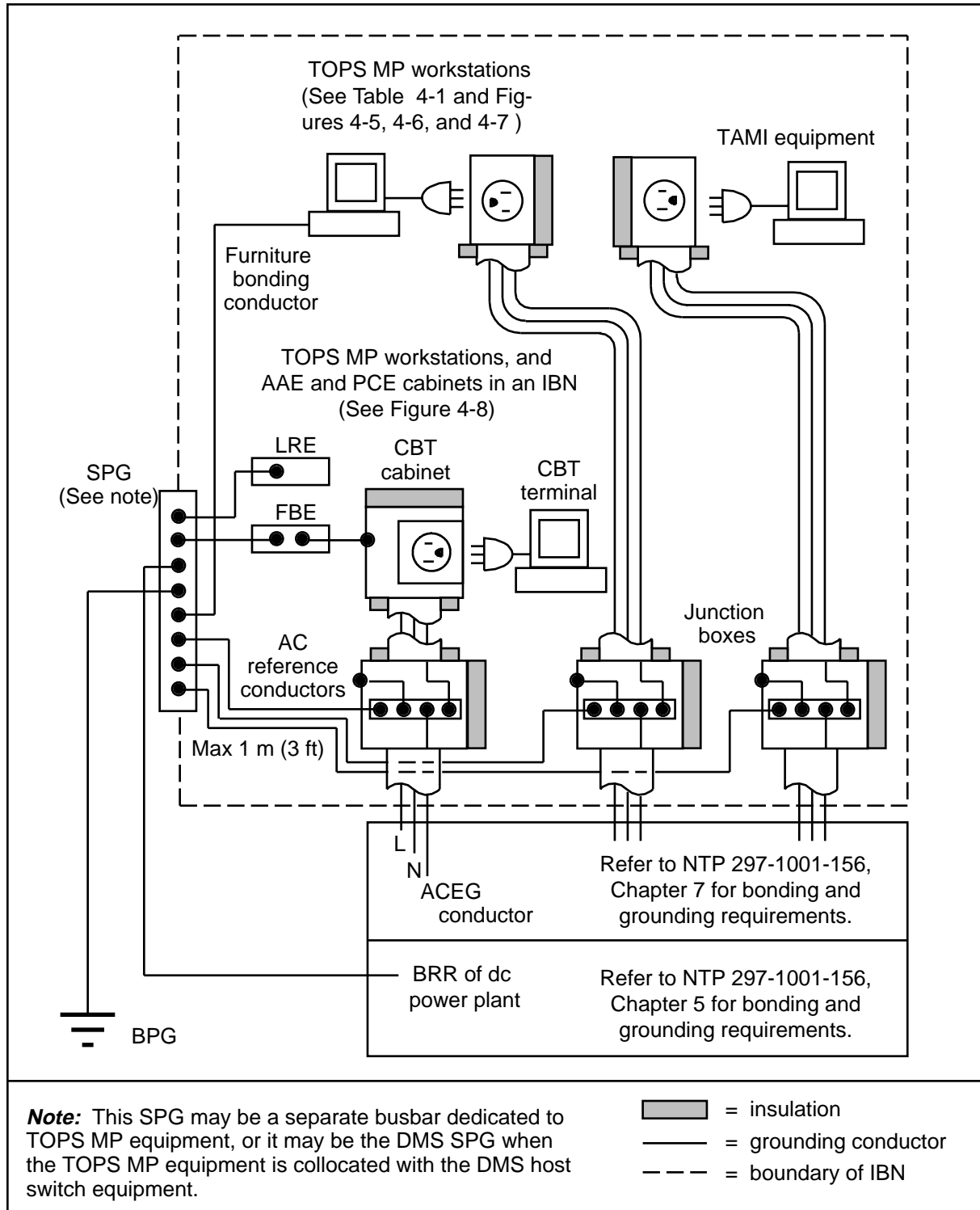
TOPS MP furniture in an IBN is typically bonded by way of a furniture bonding conductor to an SPG. This SPG may be a separate busbar dedicated to the TOPS MP workstations, or it may be the same SPG that is used for the AAE and PCE cabinets when the workstation area is located within one floor of the AAE/PCE area.

All equipment located in an IBN must be insulated from the floor and intentionally grounded only to the SPG. Typical IBN grounding installations for the TOPS MP workstations are shown in Figures 4-3 and 4-4. The following grounding requirements apply:

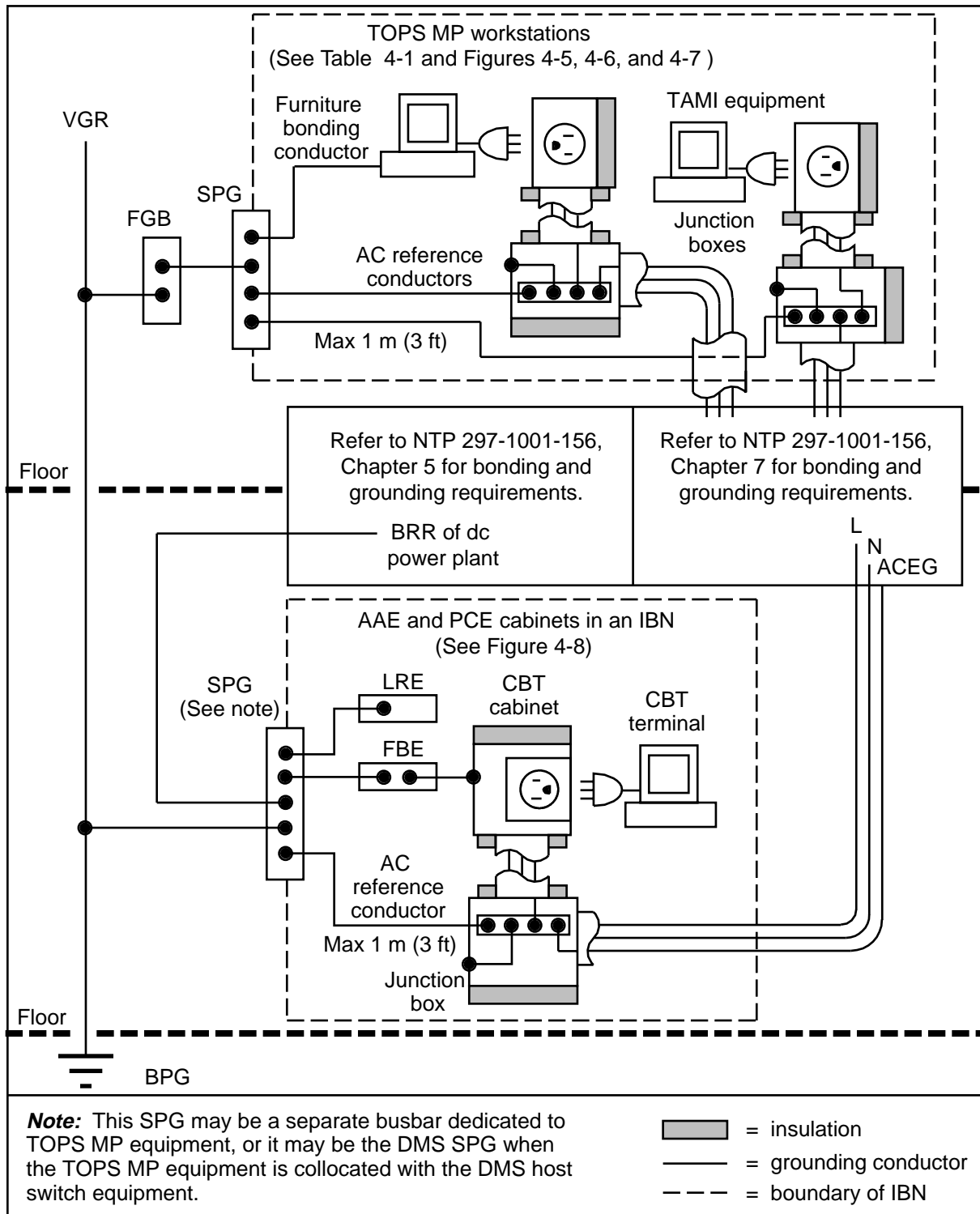
- The ac grounding conductors of the distribution panel serving operator positions should be bonded to the SPG with a conductor no longer than 1 m (3 ft), unless otherwise agreed to by the operating company.
- Other than the SPG connection, it is not permissible to make additional connections from operator equipment and associated metal raceways to the CBN.
- The metal raceway of the ac distribution serving the TOPS MP operator position is insulated from the CBN.
- Workstations located in an IBN shall not share the same enclosed floor area with other TOPS MP or equivalent devices located in the CBN. A minimum of 2 m (7 ft) shall separate the outermost boundary of an IBN from the CBN. Operator headset cords and similar extendable metallic units are included in determining the outermost boundary of an IBN.
- Personal lights, fans, heaters, and other ac powered equipment should not be placed within 2 m (7 ft) of any TOPS MP workstation. If this 2 m (7 ft) separation is not possible, the following guidelines must be observed:
  - Insulating screens or barriers should be installed between the TOPS MP and other equipment in the CBN.
  - Metallic objects (other than TOPS MP equipment) shall be bonded to the SPG either directly or through an integrated collector bar (ICB). This bonding is not required if these metallic objects are insulated from contact by an insulating screen or are already bonded to the SPG.



**Figure 4-3**  
**IBN grounding: typical single-floor installation**



**Figure 4-4**  
**IBN grounding: typical multifloor installation**



### 4.3 TOPS MP workstation

TOPS MP workstations cannot be farther than 305 m (1000 cable ft) from associated PCE cabinets, and shall be located within one floor of the point at which their ac distribution panel is grounded.

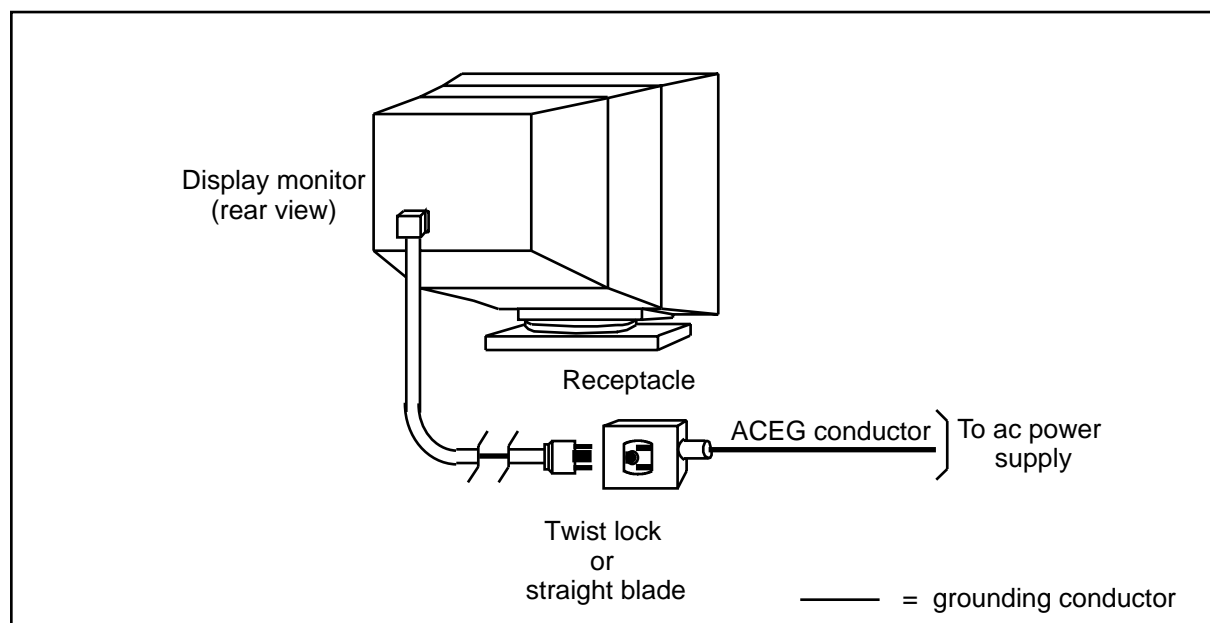
A large group of TOPS MP workstations can be arranged to suit the floor plan of an operating company. If desks and any privacy panels with metallic content are supplied by the operating company, they should conform to the grounding requirements of this guide.

The TOPS MP workstation is grounded by the ACEG conductor of the power cord which extends from the rear of the monitor unit (Figure 4-5).

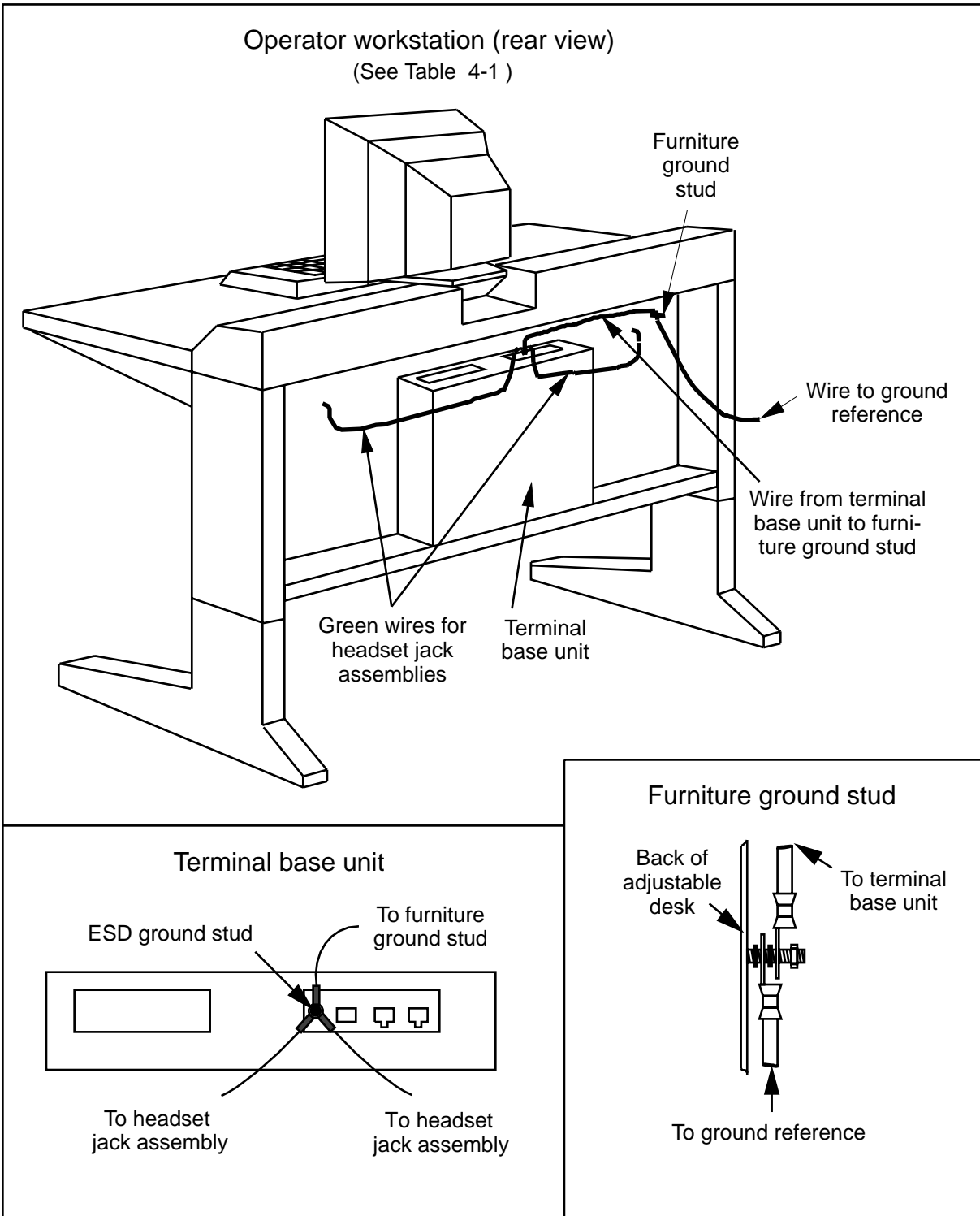
The TOPS MP adjustable desk is designed to facilitate the grounding of a large group of workstations. The ESD ground wires of the two headset jack assemblies are bonded to the ESD ground stud of the terminal base unit. The ESD ground stud of the terminal base unit is bonded to the furniture ground stud on the desk, which is in turn bonded to the furniture bonding conductor (Figure 4-6). A ground bar assembly can be used to bond the workstations together in clusters. A typical configuration is shown in Figure 4-7.

If a conductive bezel or anti-glare screen guard with an ESD ground wire is provided for the display monitor, the ground wire should be connected to a nearby ground reference or to the ESD ground stud of the terminal base unit.

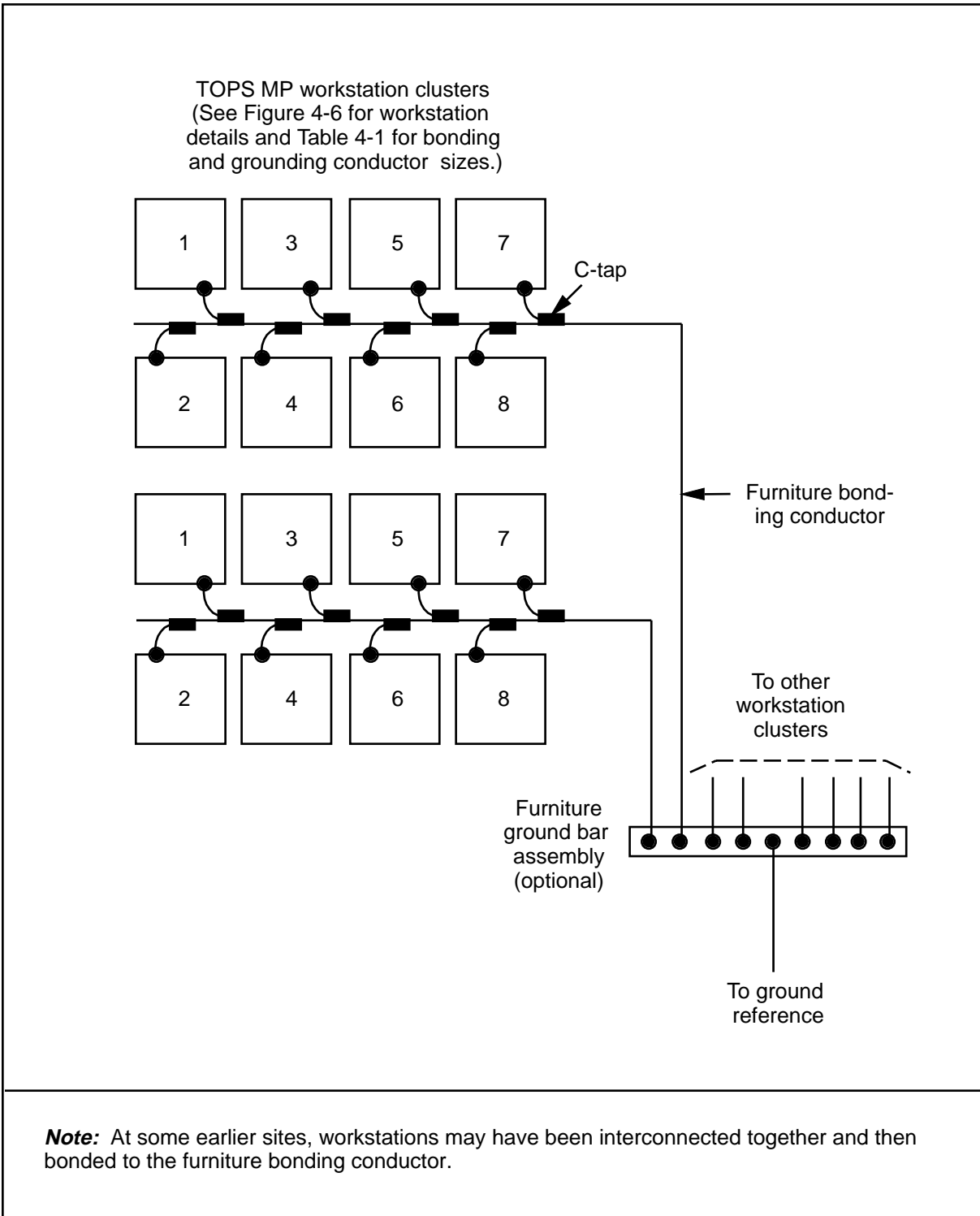
**Figure 4-5**  
Grounding the TOPS MP terminal



**Figure 4-6**  
**Grounding the TOPS MP workstation**



**Figure 4-7**  
**Workstation bonding: typical configuration**



<b>Table 4-1 Bonding and grounding conductor sizes for TOPS MP workstation</b>		
<b>Conductor</b>	<b>Size</b>	<b>Length/impedance</b>
Headset jack assembly to ESD ground stud on terminal base	No. 14 AWG	
ESD ground stud on terminal base to furniture ground stud	No. 10 AWG	As short as possible ( $< 1$ ohm)
Furniture ground stud to furniture bonding conductor	No. 10 AWG	As short as possible ( $< 1$ ohm)
Furniture bonding conductor to furniture ground bar assembly	No. 6 AWG (minimum)	$< 1$ ohm
Furniture ground bar assembly to ground reference	No. 1/0 AWG	$< 1$ ohm

#### 4.4 Equipment cabinets

The AAE and PCE cabinets are always placed in an IBN (see Figures 4-1 through 4-4). The SPG for the cabinets may be a separate dedicated bar, or it may be provided by one of the following busbars:

- the building principal ground (typically in single-floor buildings)
- the floor ground bar (typically in multifloor buildings)
- a section of the battery return bar of the serving dc-power plant

When AAE and PCE cabinets are collocated with the equipment frames or cabinets of the DMS host switch, the DMS SPG can also be used as the SPG of the TOPS MP equipment cabinets.

The SPG shall be located within one floor of the AAE and PCE equipment and should be within one floor of the dc power plant. There is only one SPG per power plant, and the battery return of the power plant is bonded to this SPG.

AAE and PCE cabinets can be located anywhere in an equipment lineup, but the AAE cabinet is separated by an air space of at least 0.8 m (30 inches) from the PCE cabinets to maintain EMI integrity.

AAE/PCE cabinets are insulated from the floor and from any contact with cable racks, raceways, and other metal surfaces.

Refer to NTP 297-1001-156 (*DMS-100 Family Power and Distribution Guide*) for additional information on DMS SPG and power plant requirements.

#### **4.4.1 AAE cabinet**

A cable is run from the FBE as an FG bonding collector for AAE cabinets in a lineup. The framework of each AAE cabinet is bonded to this collector. Refer to Figure 4-8 and to Table 4-2.

The framework of the AAE cabinet at some earlier sites may have been bonded directly to the SPG, or to the FBE of other existing DMS equipment.

Modems in the AAE cabinet communicate with a modem located at the TAMI terminal position. The logic/signal ground and chassis ground of the modems should be separate (not common).

#### **4.4.2 PCE cabinet**

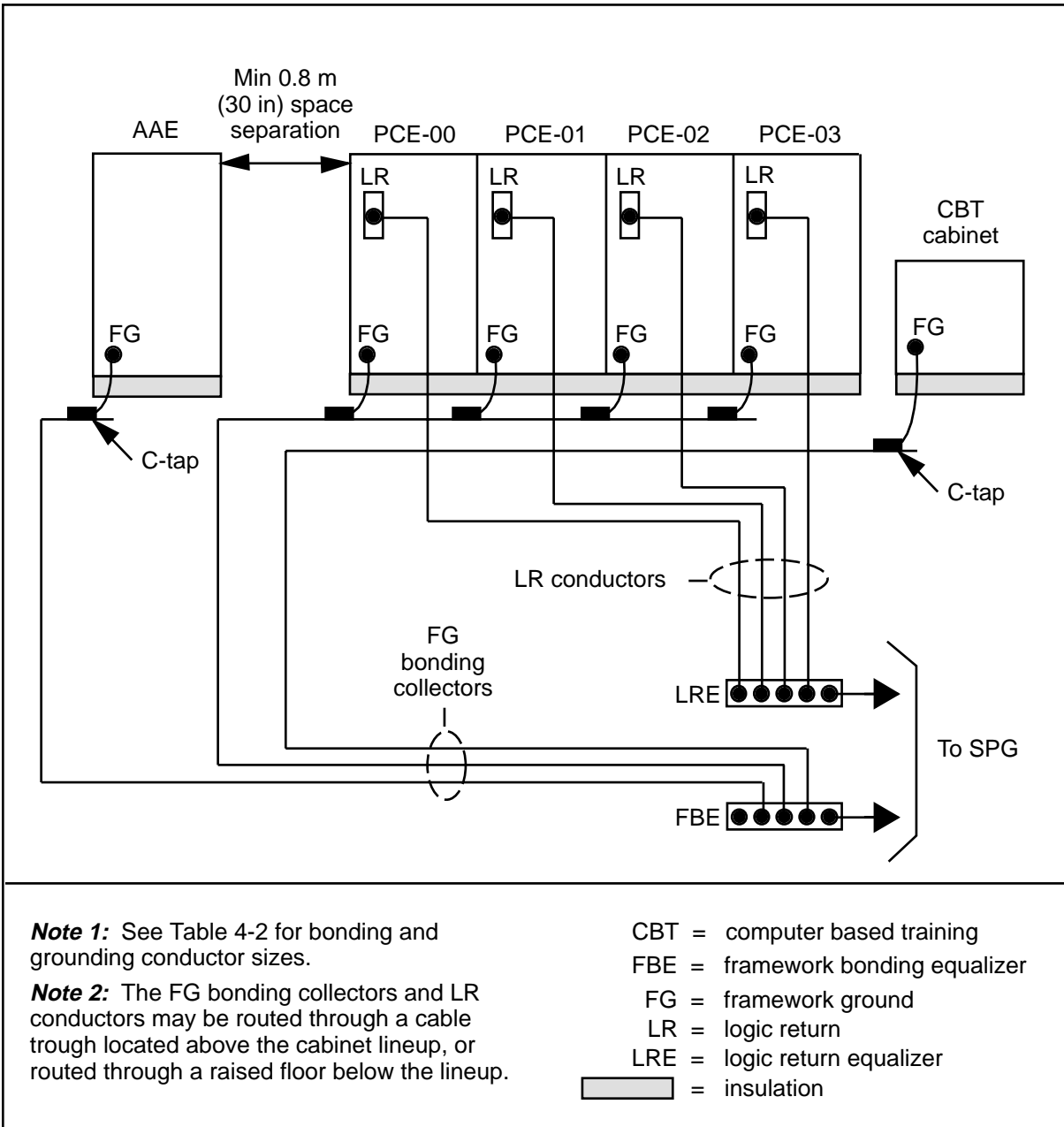
A cable is run from the FBE as an FG bonding collector for PCE cabinets in a lineup. The framework of each PCE cabinet is bonded to this collector.

The logic return (LR) of a PCE cabinet is internally isolated from the cabinet, and is individually connected to the logic return equalizer (LRE). Refer to Figure 4-8 and to Table 4-2.

The framework of the PCE cabinets at some earlier sites may have been bonded together with cables and then bonded to the framework of the AAE cabinet. Also, the logic returns between PCE cabinets may have been interconnected, and then connected directly to the SPG, or to the LRE of other existing DMS equipment.

4-12 Grounding

**Figure 4-8**  
**Grounding the AAE, PCE, and CBT cabinets (IBN)**





<b>Table 4-2 Bonding and grounding conductor sizes for AAE/PCE cabinets</b>		
<b>Conductor</b>	<b>Size</b>	<b>Length</b>
SPG to FBE or LRE	No. 2/0 AWG 350 kcmil 750 kcmil	0-15.2 m (0-50 ft) 15.2-45.7 m (50-150 ft) > 45.7 m (150 ft)
FBE to lineup of AAE, PCE, and CBT cabinets	No. 1/0 AWG No. 4/0 AWG	0-15.2 m (0-50 ft) 15.2-30.5 m (50-100 ft)
FG bonding collector to FG of AAE cabinet	No. 1/0 AWG	As short as possible
FG bonding collector to FG of PCE cabinet	No. 6 AWG	As short as possible
LRE to LR of PCE cabinet	No. 6 AWG No. 1/0 AWG	0-15.2 m (0-50 ft) 15.2-30.5 m (50-100 ft)
FG bonding collector to FG of CBT cabinet	No. 6 AWG	As short as possible

## 4.5 TAMI equipment

TAMI equipment is usually local to the TOPS MP workstation area which may be located close to or remote from the associated AAE and PCE cabinets. The TAMI equipment is usually located in the CBN as shown in Figures 4-1 and 4-2. When TAMI equipment is located in an IBN, the ACEG conductor of its power source should be bonded to the SPG as shown in Figure 4-3 and 4-4.

## 4.6 CBT equipment

The CBT equipment is located within the IBN area of the AAE and PCE cabinets. The ACEG conductor of the CBT should be bonded to the same SPG as are the AAE and PCE cabinets.

The CBT unit is treated as a self-contained framework. The CBT terminal can be powered from and mounted on the CBT cabinet. The CBT framework should be bonded to the FBE. The framework of a CBT unit is insulated from the floor and from any contact with metal raceways, cable racks, AAE and PCE cabinets, and other CBT cabinets.

## 4.7 Channel bank equipment

Channel bank equipment is used to link the TOPS MP system to a remote DMS host switch and is usually provided by the operating company. This equipment is usually located remote from the TOPS MP and DMS equipment. Communication links between the TOPS MP cabinets and channel bank equipment are ac-coupled and dc-isolated.

If a channel bank is powered from the AAE cabinet, the channel bank must be located in the same IBN as is the AAE. Also, the battery return (BR) of the channel bank must be insulated from the chassis of the channel bank, and multiple grounding of the BR is not allowed. The relay rack or frame of the channel bank must be insulated from the floor. The channel bank relay rack or frame is bonded with a No. 6 AWG (or a larger current-sized) conductor to the same SPG as is the AAE cabinet.

## 4.8 Electrostatic discharge

Control of relative humidity can be an effective means for electrostatic discharge (ESD) mitigation. Rooms containing workstations should be maintained within the range of 40 to 55 percent relative humidity.

Normal carpeting can cause excessive build-up of electrostatic charge. The TOPS MP workstation is plastic-encased to prevent ESD and to protect personnel from an electrical hazard. In addition, properly installed ESD-dissipating vinyl or carpet floor covering is recommended for use in the operator position area. An ESD ground mat at each operator position may be used instead of an ESD-dissipating floor.

Service personnel working on a TOPS MP workstation should stand on ESD floor mats and/or wear ESD wrist straps. If servicing is performed at a work bench, the bench top should be covered with a grounded ESD dissipating mat. Circuits to the workbench should be equipped with ground fault circuit interrupters (GFCIs).

Only carpeting that is intended for ESD control and that meets American Association of Textiles, Chemists, and Colorists (AATCC) Test Method 134 without the use of anti-static sprays should be used in the operator area. Anti-static carpet sprays are not dependable, need frequent replenishing, and can damage plastic surfaces and finishes of equipment in the operator area. Also, ordinary floor wax should not be used on ESD-dissipative vinyl flooring. Refer to recommendations of the manufacturer for care of the flooring.



DMS-100 Family

## **TOPS MP**

Power Distribution and Grounding Guide

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