

NORTEL Digital Multiple System (DMS) Switching Systems Grounding Engineering Applications

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1. General

1.1 Purpose

This practice:

- Clarifies interfacing NORTEL, Inc., switching system grounding with GTE Telephone Operations grounding schemes for central offices.
- Describes how the grounding of NORTEL DMS-10 and DMS-100/200/TOPS switching systems, DMS-1 Urban remote cabinets, and other NORTEL remote systems are connected to GTE central office grounding systems.
- Supplements the NORTEL Practices for GTE applications.

NOTE: GTE installations must be made consistent with the procedures documented in this practice.

1.2 Filing Instructions and Supersedures

Discard all previous issues and associated addenda of this practice and file this issue numerically in your GTE Telephone Operations practices set.

This practice supersedes and cancels:

- All policies, procedures, general instructions, letters, and memoranda which address this subject.
- Any document which provides information contrary to the information contained in this practice.

1. General, continued

- 1.3 Reason for Reissuing** This practice has been reissued to:
- Incorporate multiple changes in the content.
 - Replace all occurrences of Northern Telecom and NTI with their new name - NORTEL.

NOTE: Read this entire practice to ensure your familiarity with the new information.

- 1.4 Responsibility** This practice was published by the GTE Telephone Operations Enterprise Services Department. For more information about this practice, contact the GTE Telephone Operations Headquarters Protection Engineering Department.

- 1.5 Disclaimer** This practice was prepared solely for the use of GTE Telephone Operations. It must be used only by its employees, customers, and end users when installing, operating, maintaining, and repairing GTE Telephone Operations' equipment, facilities, and services. Any other use of this practice is forbidden. The information contained in this practice may not be applicable in all circumstances and is subject to change without notice. By using this practice the user agrees that GTE Telephone Operations will have no liability (to the extent permitted by applicable law) for any consequential, incidental, special, or punitive damages that may result.

2. Overview

- 2.1 Definitions** The following chart provides definitions for the acronyms used in this practice.

Acronym	Definition
AAE	Auxiliary Access Equipment
AC	Alternating Current
AWG	American Wire Gauge
BPG	Building Principal Ground
CBN	Common Bonding Network
CBT	Computer Based Training
CEV	Controlled Environmental Vault
CO	Central Office
DC	Direct Current

(continued)

2. Overview, continued

2.1 Definitions, continued

Acronym	Definition
DMS	Digital Multiplex System
DMS SPG	DMS Single-Point Ground
ECPGB	Entrance Cable Protection Ground Bar
EGC	Equipment Grounding Conductor
FBE	Framework Bonding Equalizer
FG	Frame Ground
FGB	Floor Ground Bar
GWSP	Ground Window Splice Plate (DMS-10 power frame)
IBN	Isolated Bonding Network
ICB	Integrated Collection Bar
IGZ	Isolated Ground Zone
IMAP	Integrated Maintenance and Administration Position
kcmil	One Thousand Circular Mils – MCM
LRE	Logic Return Equalizer
m	meter
MAP	Maintenance and Administration Position
MDF	Main Distribution Frame
MGB	Master Ground Bar
NORTEL	NORTEL, Inc.
PCU	Power Control Unit
PDU	Power Distribution Unit
PCE	Position Controller Equipment

(continued)

2. Overview, continued

2.1 Definitions, continued

Acronym	Definition
SPG	Single Point Ground
TOPS	Traffic Operator Position System
TOPS MP	TOPS Multipurpose
TOPS MPX	TOPS Multipurpose Extended
UPS	Uninterruptible Power Supply
VE	Vertical Equalizer
VGR	Vertical Ground Riser

2.2 Terminology

The table below provides some terms that have different usage or meaning between NORTEL and GTE.

What NORTEL Calls...	GTE Calls..
AC Equipment Grounding Conductor (ACEG)	Green wire (EGC)
Building Principal Ground (BPG)	Master Ground Bar (MGB)
Common Bonding Network (CBN)	integrated Ground Zone
Isolated Bonding Network (IBN)	Isolated Ground Zone (IGZ)
Vertical Ground Riser (VGR)	Vertical Equalizer (VE)

2. Overview, continued

2.3 References

The following chart provides sources of supplementary information relating to this practice. The documents could be required for performing certain tasks.

See...	For Information About...
	DMS-100 Systems
297-2271-156*	TOPS 04
297-2281-156*	TOPS MP
297-2291-1 56*	TOPS MPX
297-3401-1 87*	DMS-10 Systems
795-805-071	Central Office Grounding Systems – Engineering Applications
795-805-072	AC Service Grounding Engineering Applications
795-805-073	Transmission Equipment – Central Office Grounding
795-805-074	Inspecting Central Office Grounding and Electrical Protection
795-805-075	Remote Electronic Service Area Grounding Systems-Engineering Considerations
887-000-001	Requesting Deviations from Protection Practice Requirements
938-360-010	Outside Plant Engineering of Digital Loop Carrier System
938-360-012	Power Pedestal – Description and Application

* available from NORTEL.

2.4 Form

The Inspection – Central Office Grounding and Electrical Protection, Form 90001528 is referenced in this practice.

Order this form through normal supply channels.

3. Engineering Guidelines

3.1 Basic Guidelines

In order to ensure compatibility with GTE's grounding philosophy when NORTEL switching equipment is installed in a GTE Telephone Operations facility, the following apply:

- NORTEL's guidelines are applicable within the switch area as modified by this practice.
- GTE's guidelines are applicable outside the perimeter of the NORTEL switch.

3.2 NORTEL's Guidelines

The following chart provides a list of NORTEL practices which are applicable for grounding within the perimeter of the NORTEL switch and associated equipment in it's IGZ.

See NORTEL Practice...	For Information About...
297-1001-156	DMS-100 Systems
297-2271- 156	TOPS 04
297-2281-156	TOPS MP
297-2291- 156	TOPS MPX
297-3401-187	DMS-10 Systems

NOTE: The most current NORTEL Guideline issues were used in the preparation of this GTE practice. These practicess are subject to change by NORTEL.

3.3 GTE's Guidelines

GTE's guidelines for the equipment located outside the IGZ (including any NORTEL furnished transmission systems equipment) are provided in the GTE Telephone Operations Practices listed in Section 2.3.

Following these practices:

- Ensures proper personnel safety.
- Ensures equipment protection according to manufacturer warranties.
- Prevents misunderstandings by the manufacturer and GTE personnel.

3.4 Deviations

All exceptions:

- Must be documented in accordance with the guidelines provided in GTE Telephone Operations Practice 887-000-001.
- Require the approval of the Regional Operations (Protection) support staff.

4. Grounding Electrode

4.1 General

The ground resistance to earth of the CO electrode must comply with the objectives specified in GTE Telephone Operations Practices:

- 795-805-071.
- 795-805-075.

NOTE: These practices specify resistance objectives lower than the 5 ohms recommended by NORTEL.

5. Master Ground Bar/Floor Ground Bar

5.1 General

The CO grounding system must have a single MGB.

Larger building structures can require an extension of the basic building grounding system with:

- FGBs.
- Vertical equalizers between floor levels (Lead 18).
- Horizontal equalizers between ground bars on the same floor level (Lead 15).

GTE Telephone Operations Practices 795-805-071 and 795-805-075 have specific requirements for the MGB which must be met. The requirements include, but are not limited to the following:

- Use of two-hole compression connectors.
- Arrangement (Zoning) of the leads terminating at the MGB.
- isolation from building walls and building steel.
- Surface cleaning and preparation for bars and connectors.
- Tagging and identification of conductors at the MGB.

NOTE: The MGB can serve as the DMS SPG as indicated in Section 10.

5.2 Ground Window

The Ground Window is:

- The interface or transition point between the isolated and integrated ground planes.
- Either:
 - A bus bar.
 - OR
 - An area around the bus bar.

NOTE: There must be no additional paths to ground beyond the Ground Window and inside the isolated ground plane.

5.3 Job Completion Procedures

On each project or work order NORTEL installs, they must complete Form 900001528 for all the cables that are terminated to the MGB or FGB during that project or work order.

6. Entrance Cable Bonding

- 6.1** GTE Telephone Operations Practice 795-805-071 details the required methods used to bond metal shields of copper conductor and light waveguide cables entering the CO.
- General**

7. Entrance Cable Protection Ground Bar

- 7.1** Standard GTE integration of the protector module ground with the MDF must be provided for personnel safety
- General**
- The MDF protector module grounds must **not** be isolated from the MDF framework.
- The ECPGB must use Leads 23, 23A, 24, and 24A as required by GTE Telephone Operations Practice 795-805-071.

8. AC Power

- 8.1** DMS installations ordered:
- General**
- After April 1, 1991, must comply with the AC power requirements listed in this section.
 - Prior to the April 1, 1991, are not to be retrofitted to comply with the requirements listed in this section unless equipment damages or failures can be attributed to AC power surges or lightning.

NOTE: AC power-feeding equipment other than the DMS switching systems must comply with the requirements of GTE Telephone Operations Practice 795-805-072.

- 8.2** Power standards differ between GTE and NORTEL as follows:
- Inverters**
- GTE requires that modems, announcers, etc., be engineered for DC power to prevent external AC power requirements in the DMS frames.
 - NORTEL requires DC-to-AC inverters to power AC equipment located in the DMS frames that is not connected to external AC service.

NOTE: All inverters located within the IGZ must be isolated from the frame (relay rack). Do not feed isolated and non-isolated loads from the same inverter.

Do not use the AC input to inverters when the inverter is in the IGZ area. This preserves the AC-free concept.

8. AC Power, continued

8.3

Center-Aisle Lighting

Center-aisle lighting must be provided in new:

- DMS installations.
- Equipment line-ups added to existing DMS switches.
- Metallic light fixtures and their metallic supports must be isolated from equipment frames (relay racks).

NOTE: Frame additions to existing frame line-ups can continue in the current method of lighting.

8.4

AC Outlets

The AC outlets installed in frames must:

- Be powered by the DC-to-AC inverters.
- Conform to the single-point ground system.
- Be insulated from the framework.
- Have a green wire ground.
- Be adequately labeled to restrict their use to:
 - Test equipment.
 - Rack-mounted SPG equipment.

NOTE: Floor buffers, hand tools, etc., must use non-isolated outlets outside the DMS switch.

8.5

End Guards

The end guards can be replaced with new AC-free end guards arranged for:

- Inverter-fed (one per odd line-up) outlets.
- Low-voltage control switches for center-aisle lighting.

9. DC Power System Grounding

9.1

General

Frameworks:

- Of the rectifiers, battery rack, main power panel, and subsequent power distribution bays are electrically isolated from the DC return power.
- Outside the DMS IGZ area are grounded by Leads 31 through 36.

NOTES: Refer to GTE Telephone Operations Practice 795-805-071 for more information.

Leads 53A and 38A must be applied appropriately to remote power distribution outside the DMS equipment frames.

A remote DMS DC power distribution bay powers only isolated equipment. Non-isolated equipment requires a separate power distribution.

9. DC Power System Grounding, continued

9.2 Rectifiers

In modular power boards, the chargers (rectifiers) are mounted on the same rack as the PCU/PDU and sometimes the batteries.

In newer Modular Power Board designs many of the rectifier frames and shelves, frame ironwork, EGC post, and rectifier chassis are all tied together via deliberate ground connections.

In these cases:

- Tie Lead 29 to the AC ground position on the charger shelves.
- Ensure deliberate ground connections between:
 - Lead 29 AC ground positions and the chassis of the rectifier shelf.
 - Chassis of the rectifier shelf and the Frame Ironwork.

NOTE: The deliberate ground connection can be via a ground strap or a through the use of approved external tooth star-type and flat-type washers.

- Tie Lead 31 (from the MGB) to the ironwork of the Modular Power Board frame supporting the rectifier shelves. The connection must be to a non-painted surface utilizing compression lugs and approved joint compound. Lead sizes will be a minimum of a #6 AWG stranded conductor.

All ground connections must be deliberate. When the requirements of this section can not be met, Lead 32 must be added to terminate on the same point (electrically) as Lead 29 on a one per charger shelf basis (refer to GTE Telephone Operations Practice 795-805-072).

9.3 Lead 37

Lead 37 connects the return ground battery terminal (battery post or splice plate above the battery) to the nearest MGB or FGB on the same floor.

Lead 37 is sized as follows:

- 2/0 AWG if the:
 - Building is one story (no VE Lead 18 used).
 - Office drain is less than 200 amps.
 - Lead is less than 30 feet (9m) long.
- 350 kcmil if the:
 - Building is one story (no VE Lead 18 used).
 - Office drain is less than 500 amps.
 - Lead is less than 50 feet (15m) long.
- 750 kcmil if the:
 - Building is multi-story.
 - Office drain is more than 500 amps.
 - Lead is more than 50 feet (15m) long.

NOTE: Walk-in huts and CEVs must use a minimum of 2/0 AWG.

10. Electronic Switching System Grounding

10.1

DMS SPG

This section:

- Provides GTE's standards for the location and the designation of the DMS SPG.
- Addresses the proper:
 - Selection of the DMS SPG location to satisfy requirements.
 - Placement in GTE facilities.

The DMS SPG must be established and maintained to allow fault currents to have only a single point to access the DMS switching system.

NOTE: NORTEL practices dictate the grounding requirements within the DMS switching systems (IGZ area).

10.2

Location Restrictions

Do NOT locate the switching systems (DMS-10 or 100) more than one floor away from the DC power plant.

Separations of more than one floor must be reviewed by the Headquarters Engineering staff (Switching and Protection groups) to ensure that the arrangement meets GTE's and NORTEL's protection requirements.

10.3

Seven-Foot Rule

The "seven-foot" (2m) rule:

- Requires a seven-foot (2m) air space around the equipment that is not connected to the DMS SPG.
- Ensures that personnel in the area cannot contact surfaces having differences in potentials.
- Requires an insulating screen where the seven-foot (2m) separation cannot be obtained.

NORTEL's seven-foot (2m) rule is applicable to GTE's installations **only** when the DMS switching equipment is located in a different floor level from the DC power plant. (See Exhibits 2 and 4.)

The seven-foot (2m) rule does **not** apply when the DMS switching equipment is located on the same floor level with the MGB/FGB which also serves other equipment in the immediate area.

Exhibits 1 and 3 include equalization of voltages (to prevent potential differences) through the requirements of GTE Telephone Operations Practices 795-805-071, 795-805-073, and 095-805-075.

10.4

Integrated Collection Bar

The ICB provides personnel protection by equalizing voltages of the different metallic elements in the integrated zone. NORTEL used the ICB to meet the requirements of the seven-foot (2m) rule.

Since GTE's grounding concept minimizes potential differences throughout the CO, the ICB is not required for DMS site unless the DMS switching equipment is located in a different floor level from the MGB. (See Exhibits 2 and 4.)

GTE, when required by Section 10.3, must order an ICB for DMS equipment areas (DMS-10 and DMS-100/200). The ICB must then be:

- Provided by NORTEL.
- Connected to the DMS SPC by an insulated copper conductor sized per Exhibit 6.

10. Electronic Switching System Grounding, continued

10.4
**Integrated
Collection Bar,
continued**

When required by Section 10.3, the ICB must be connected to integrated objects in close proximity to the switch such as:

- Auxiliary framing.
- Cable rack(s).
- Air-handling ducts.
- Plumbing.
- Conduits above the DMS equipment.

NOTE: Do not bond the fire protection systems (Halon, etc.) to the ICB.

**10.5
DMS-10**

For the DMS-10 switching systems (including Remote Line Concentrating Modules, Remote Subscriber Line Equipment, and Remote Subscriber Line Module) the DMS SPG must be designated as described in the following chart.

**If the DMS-10 Switching
System and DC Power
Plant. Are Located...**

Then...

On the same floor

- The MGB/FGB is the DMS SPG.
- Lead 37 bonds to the same MGB/FGB in this floor level area with the DMS-10.
- The GWSP does not have a conductor bonding it to the MGB/FGB. Lead 37 provides that bond.

Bond the Frame Ground Bar to the I Zone of the MGB/FGB.

NOTE: Refer to Exhibit 1 for details and size conductors.

One floor away

- The MGB on the same floor level with the power plant is the DMS SPG.
- Lead 37 bonds to the MGB (DMS SPG) in the same floor level area with the power plant.
- The GWSP does not have a conductor bonding it to the MGB/FGB. Lead 37 provides the conductor bonding.

Bond the Frame Ground Bar to the I Zone of the MGB/FGB and ICB to the N Zone of the MGB.

NOTE: Refer to Exhibit 2 for details and size conductors.

10. Electronic Switching System Grounding, continued

10.6 DMS-100/200/ TOPS

For the DMS-100/200 switching systems and the TOPS, the DMS SPG must be designated as described in the following chart.

If the DMS-100/200/TOPS Switching System and DC Power Plant Are Located...	Then...
On the same floor	<ul style="list-style-type: none">● The MGB/FGB is the DMS SPG.● Lead 37 extends the Battery Return Bus to the MGB. Bond the: <ul style="list-style-type: none">● FBE, LRE, and MAP leads to the I Zone of the MGB/FGB.● IMAP to the N Zone of the MGB/FGB. NOTE: Refer to Exhibit 3 for details and size conductors.
One floor away	<ul style="list-style-type: none">● The MGB on the same floor level with the power plant is the DMS SPG.● Lead 37 extends the Battery Return Bus to the MGB. Bond the: <ul style="list-style-type: none">● FBE, LRE, MAP to the I Zone of the MGB.● ICB to the N Zone of the MGB.● IMAP to the N Zone of the MGB/FGB. NOTE: Refer to Exhibit 4 for details and size conductors.

10.7 TOPS Positions

The TOPS positions can be located in the:

- CBN or Integrated Ground Plane.
- IGZ or Isolated Ground Plane.

NOTE: The Integrated Ground Plane is the preferred location.

Grounding requirements for each are included in 297-2281-I 56.
(See Exhibit 5.)

The use of commercial AC power must comply with GTE Telephone Operations Practice 795-805-072.

10. Electronic Switching System Grounding, continued

10.7 TOPS Positions, continued

10.7.1 TOPS MP

The TOPS MP arrangements are configured as follows:

- TOPS equipment (AAE, PCE, CBT, etc.) is designed to meet isolated ground plane requirements.
- Operator positions must be installed in an integrated ground plane.

NOTE: The operator positions can be installed in an isolated ground plane if required.

Isolated TOPS MP equipment:

- Must be located in an area close to the DMS SPG.
- Can be located away from the DMS SPG if the following requirements are met:
 - An isolated power plant and inverters feeds the TOPS MP equipment.
 - A separate DMS SPG is set up for the TOPS MP equipment.
 - The TOPS equipment ground leads must be sized and connected to the Isolated (I) zone.

10.7.2 IMAP

IMAP equipment must be:

- Located on the same floor as the DMS equipment.
- Bonded to the DMS SPG or the FGB (whichever is nearest).

10.8 DMS-1 DLC

GTE Telephone Operations Practices 795-805-075, 938-360-010, and 938-360-012 specify the AC power and the cabinet grounding requirements.

The point of connection for two Lead 5s and one Lead 13 is the cabinet ground bar that is equivalent to the MGB.

The electrode ground system test resistance required by NORTEL is higher than that required by GTE. The GTE requirements MUST be met.

Separate AC surge protection at the AC service disconnect must be provided as indicated in the GTE Telephone Operations Practices mentioned in Section 2.3. The AC equipment grounding green wire conductor must be bonded to the DMS-1 Urban cabinet immediately on entry.

NOTE: Refer to GTE Telephone Operations Practices 795-805-075, 938-360-010, and 938-360-012 for the AC power and the cabinet grounding requirements.

Exhibits

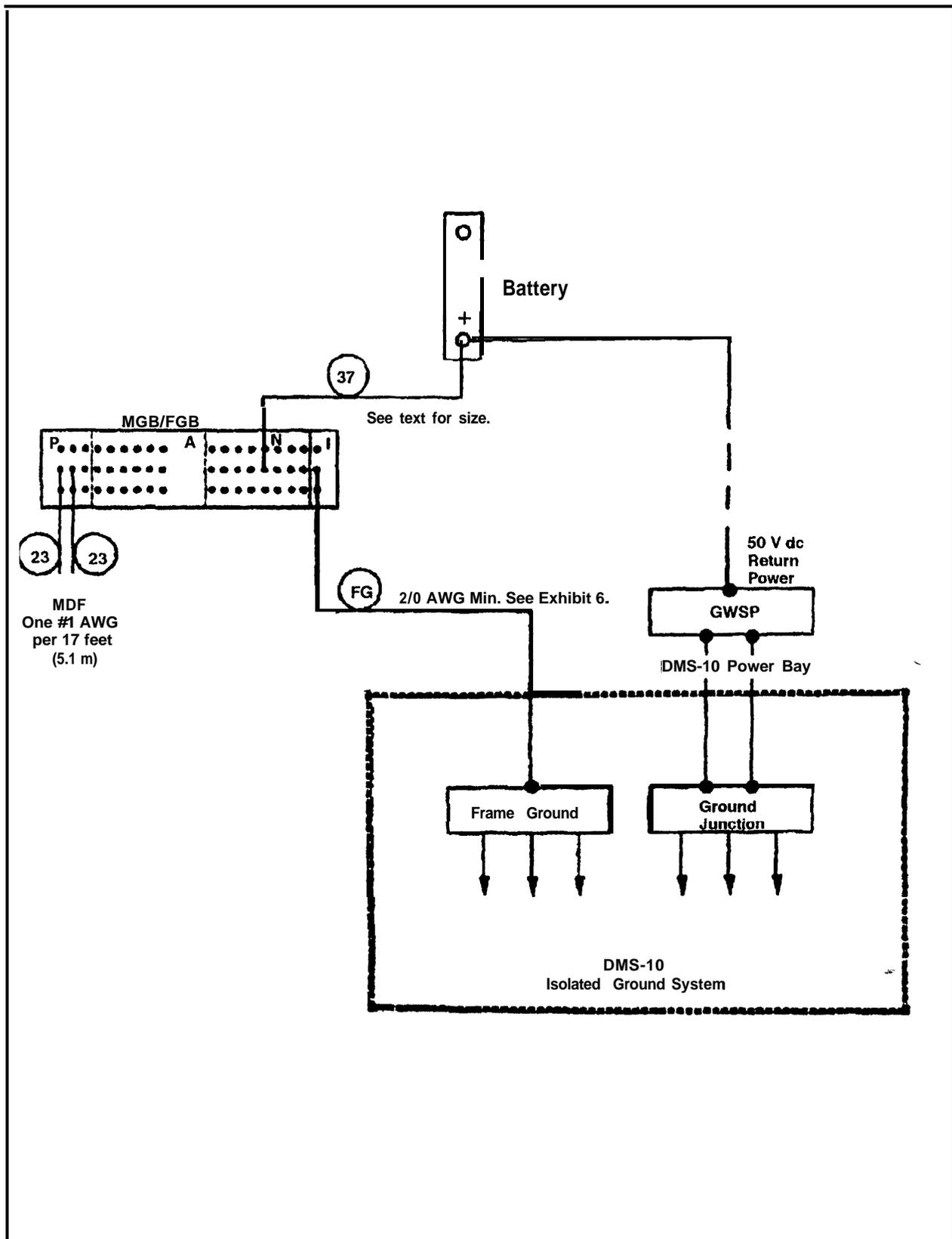


Exhibit 1 - DMS-10 with DC Power on the Same Floor

Exhibits

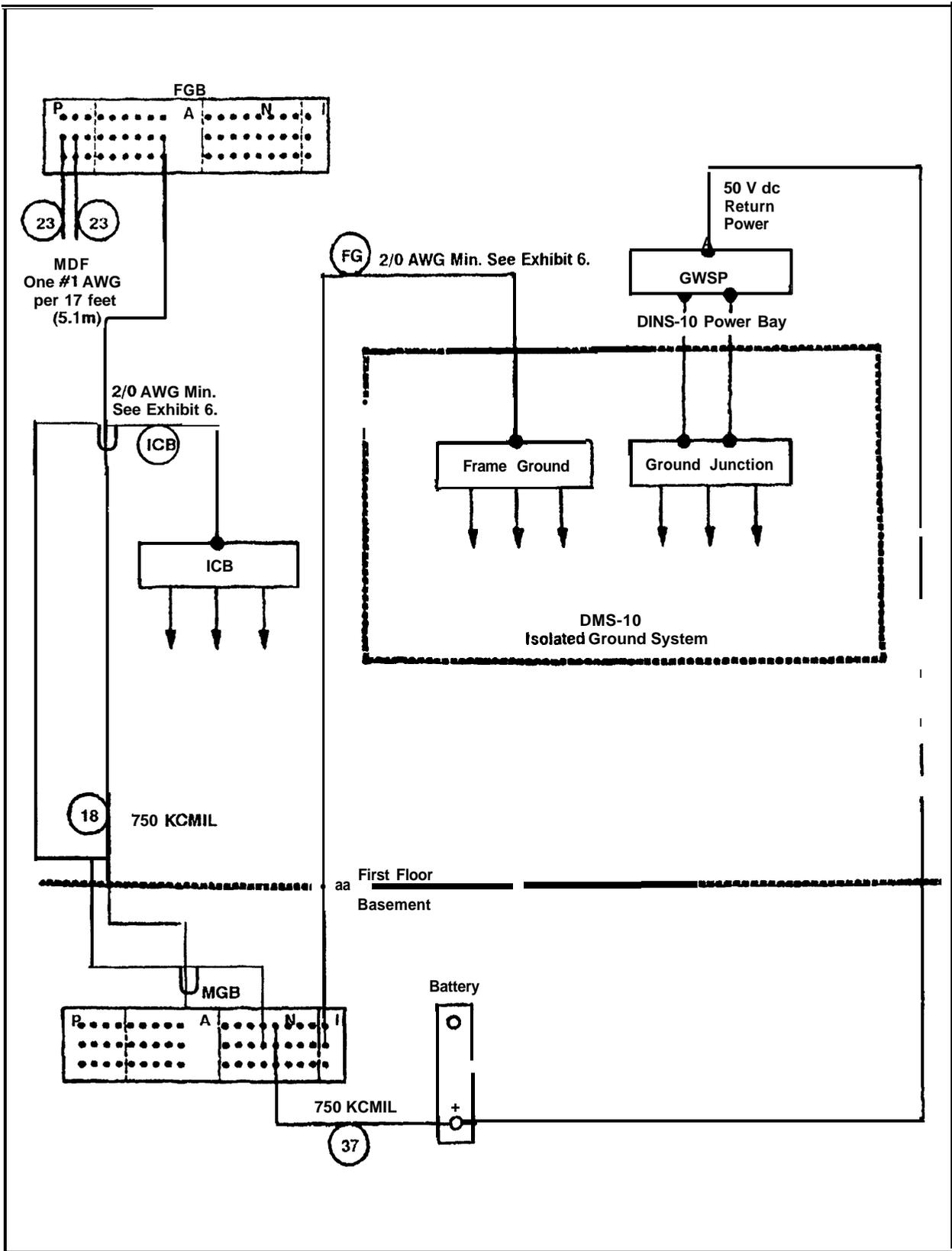


Exhibit 2 - DMS-10 with DC Power One Floor Away

Exhibits

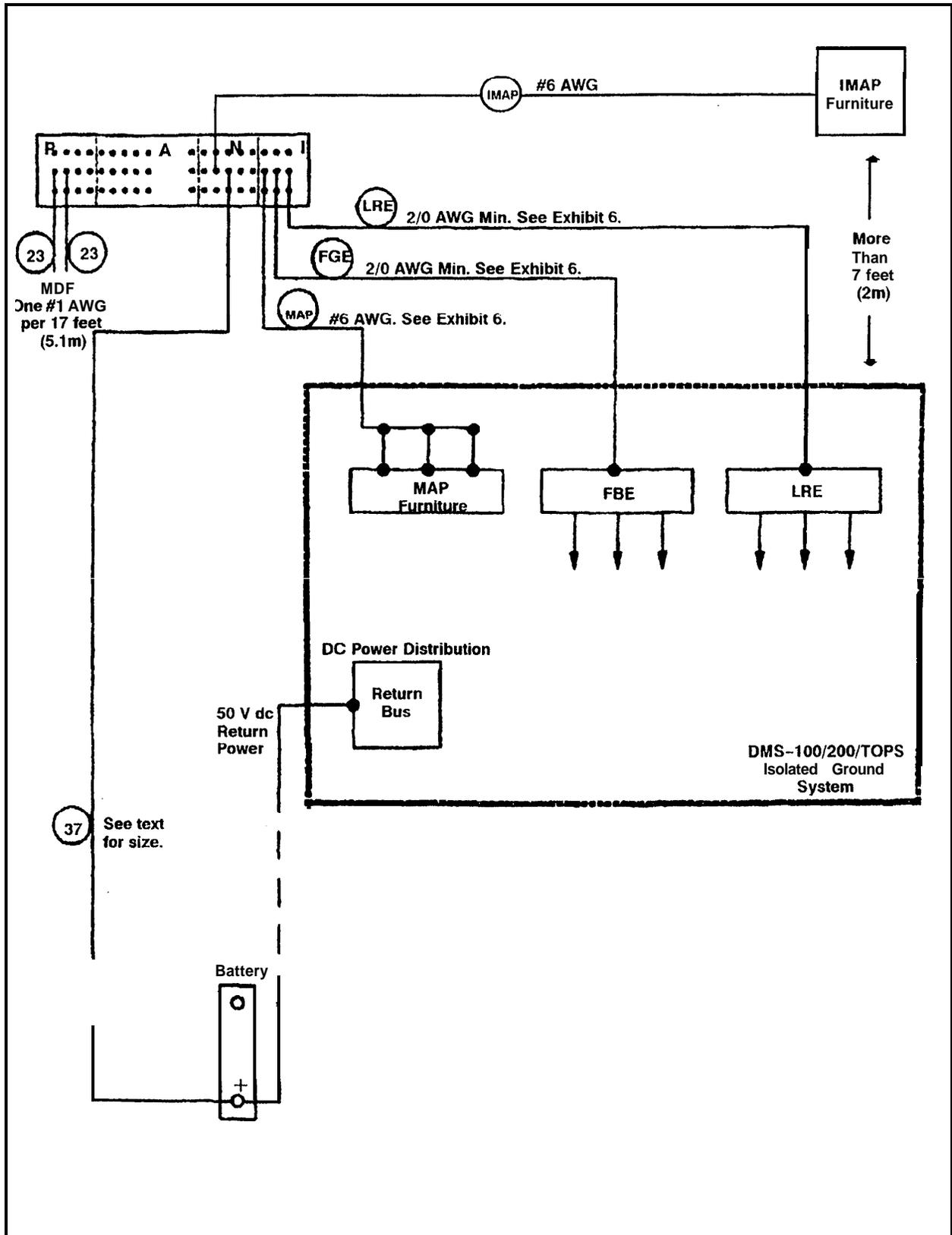


Exhibit 3 - DMS-100/200/TOPS with DC Power on the Same Floor

Exhibits

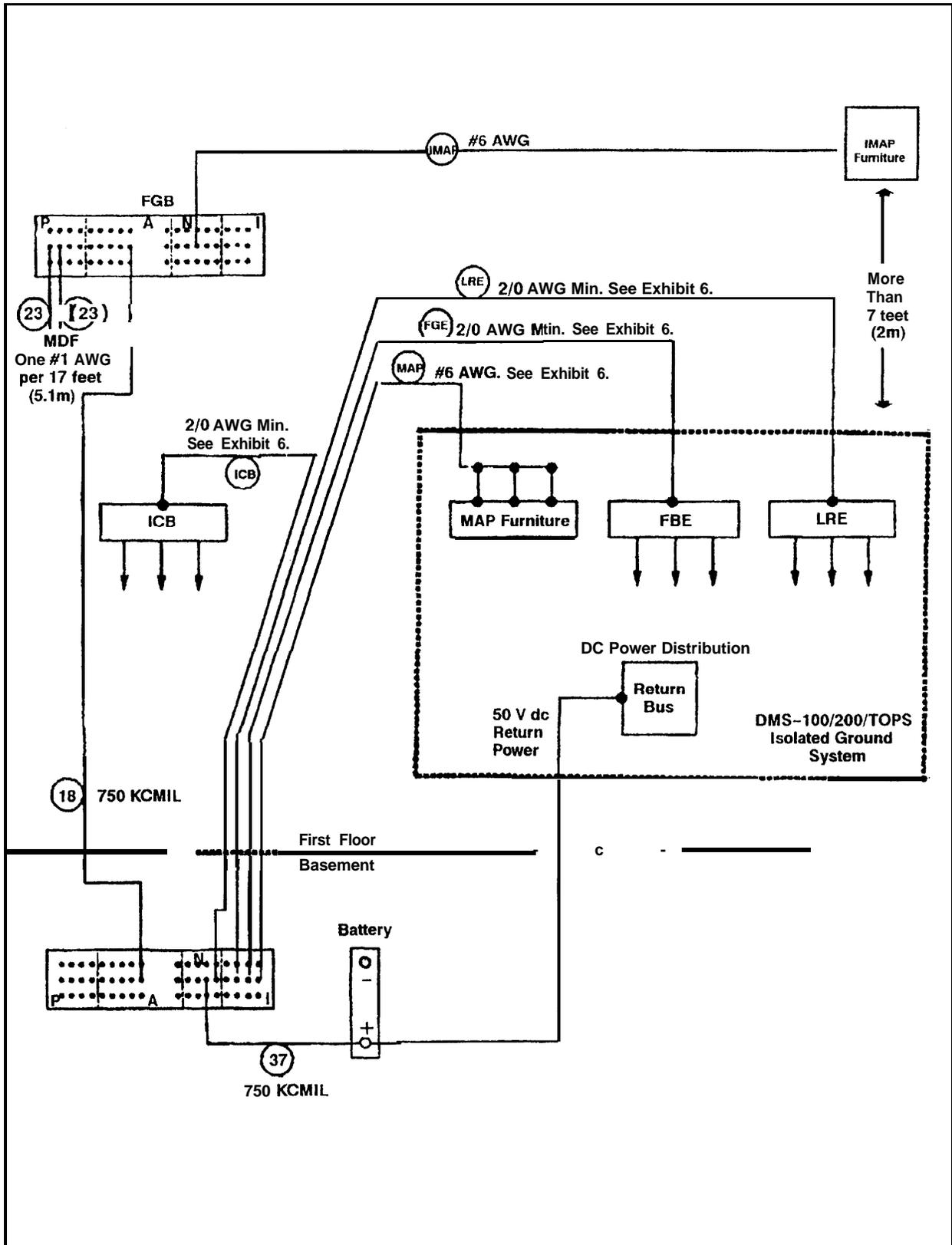


Exhibit 4 - DMS-100/200/TOPS with DC Power One Floor Away

Exhibits

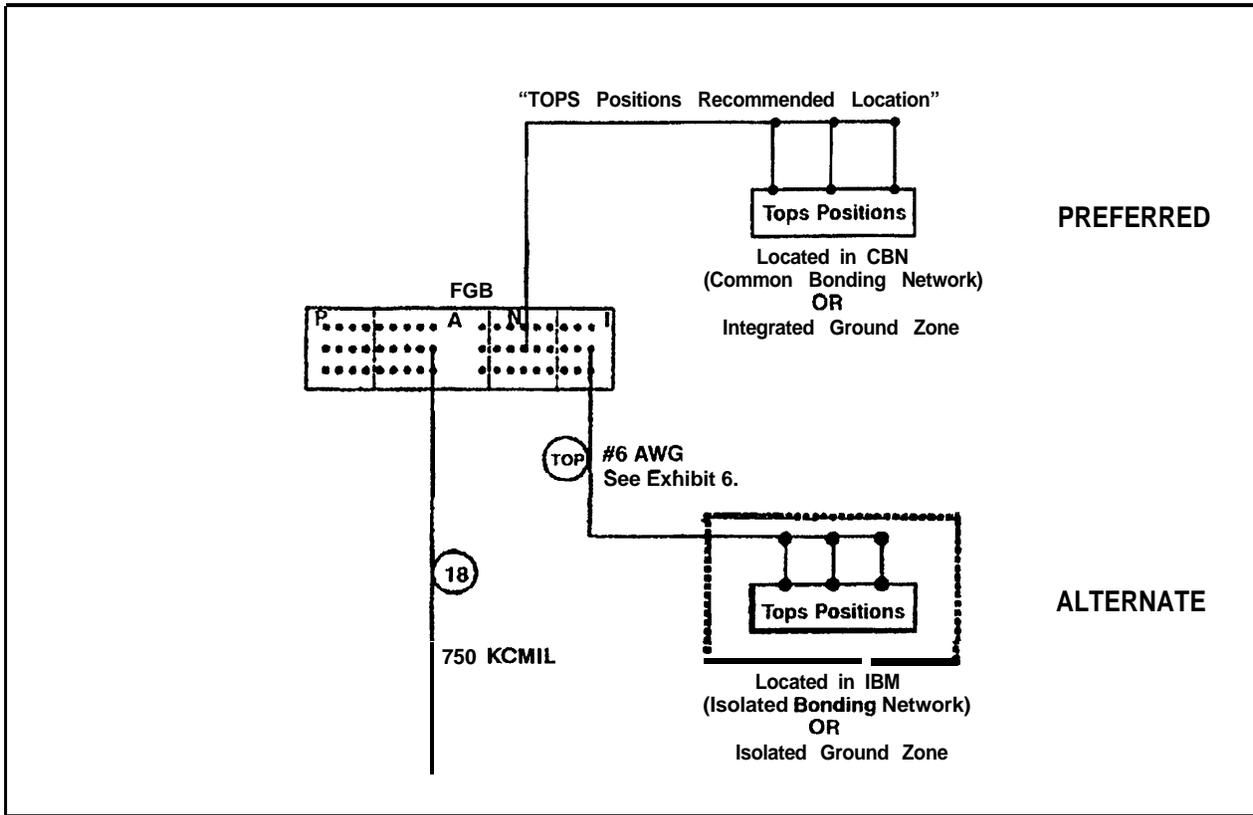


Exhibit 5 - TOPS Positions on a Different Floor from DMS-100/200 and Not Sharing DC Power

Lead	From	To	Size
FG	DMS-10	SPG	Note 1
FBE	DMS-100	SPG	Note 1
ICB	DMS (all)	SPG	Note 1
LRE	DMS-100	SPG	Note 1
MAP	TOPS	SPG/FGB	#6 AWG
TOP	TOPS	SPG/FGB	#6 AWG

Notes:

- Use #2/0 AWG for 0-50 feet (0-15m).
Use 350 KCMIL for 50-150 feet (15-45m).
Use 750 KCMIL for > 150 feet (> 45m).
- Use #6 AWG for 0-400 feet (0-122m).
Use #4 AWG for 400-700 feet (122-213m).
Use #3 AWG for 700-1,000 feet

Exhibit 6 DMS Grounding Conductor Sizing