Central Office Grounding Transmission Equipment

Contents

(continued)

Contents, continued

1. General

1.1 Purpose

This practice describes the recommended methods for grounding transmission equipment in Central Offices (COs). The equipment includes:

- Pulse Code Modulation (PCM) carrier.
- Signaling.
- Digital Cross-Connect Systems (DCCS).
- Data.
- Telegraph.
- Analog carrier.
- Private line equipment.

1.2 Filing Instructions and Supersedures

Discard all previous issues and associated addenda of this practice and file this issue numerically in your 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.

1.3 Reason for Reissuing

This practice has been reissued to incorporate multiple changes in the content. Read this entire practice to ensure your familiarity with the new information.

1.4 Responsibility

This practice was published by the GTE Enterprise Services Department. For more information about this practice, contact the GTE Network Services Headquarters Access Design Support Department.

1.5 Disclaimer

This practice was prepared solely for the use of GTE Network Services. It must be used only by its employees, customers, and end users when installing, operating, maintaining, and repairing GTE Network Services' 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 Network Services 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 Background

Historically, transmission equipment has used an integrated grounding system, which means that the battery return (+48V) was tied at various points to the frame ground (protective ground).

The single point ground (SPG) method keeps these two paths isolated except at a single point., which is the Master Ground Bar (MGB), thus the name single point ground.

To accomplish this isolation, there are several considerations:

1. The user must understand that there are two types of grounds.
   - One is the battery return (+48V), which is a current carrying path, and for the purpose of this document, is always referred to as battery return.
   - The second ground is frame ground. Under no fault conditions, this ground should have no current flow. It exists for protection purposes only. These grounds are always referred to in this document as frame ground or ground.
2. Some equipment, particularly older vintage carrier and test equipment, was designed to tie battery return to the chassis, thus integrating the battery return to frame ground, which should now be kept separate. Special treatment of this equipment is required (see Section 8.4).
3. New SPG relay racks being placed in an existing office with integrated grounded racks require special isolation to prevent:
   - Extraneous grounds from the floor.
   - Any overhead cable rack or grid.
   - Any adjacent integrated grounded relay racks (see Section 8.5).
4. SPG requirements do not require the addition of a Power Distribution Unit Frame (PDUF). If a common PDUF serves both switching and transmission equipment, the PDUF is, likely, already isolated, and if so might be readily used to power SPG equipment. If a separate integrated grounded transmission PDUF exists, or the common PDUF is integrated, take steps to isolate the battery return. Either a separate isolated bus must be added, or the existing bus must be insulated from the frame. See Section 8.5 for additional information and standard hardware.
5. As a final caution, the engineer must be aware that there is no way to partially implement single point grounding within a relay rack. If complete isolation is not achieved between battery return and frame ground, the grounds remain integrated, and nothing has been accomplished. If in doubt about a particular situation, contact Protection Engineering Support, or Transmission Engineering Support for assistance.

2.2 Planning Concerns

Retrofits involving SPG systems from an integrated ground system must be incorporated into the planning and engineering phase. See Section 8.1 for the implementation schedule. Any deviation from this practice must be approved by Network Services engineering staff.

2.3 Definitions

The following chart provides definitions for the acronyms and terms used in this practice.

Acronym or Term	Definition
AWG	American Wire Gauge
Bonding	Joining two or more surfaces by mechanical and/or electrical means for the purpose of achieving: • Low impedance connection. • Voltage equalization. The mechanical means used are compression or wire-wrapping. The electrical means used is soldering.
CO	Central Office
DC	Direct Current
DCCS	Digital Cross-Connect System
DSUF	Disconnect Switch Unit Frame
DSX	Digital Cross-connection
DS1	Digital Signal at 1.54 Megabits
DS3	Digital Signal at 45 Megabits
DTMF	Dual Tone Multiple Frequency
ECPGB	Entrance Cable Protector Ground Bar
FGB	Floor Ground Bar
Grounding	Proper grounding of an assembly is attained only by connecting the assembly to the site ground network. An assembly can be: • A shelf or panel. • An arrangement of shelves or panels collectively bonded to a rack. • An arrangement of racks collectively bonded to each other.
HF	High Frequency
ICEP	Inductive Coordination and Electrical Protection
IGZ	Isolated Ground Zone

(continued)

2.3 Definitions

Acronym or Term	Definition
LVGB	Low Voltage Ground Bar
MCM	Thousand Circular Mils
MDF	Main Distributing Frame
MGB	Master Ground Bar
PCDF	Power Control Distribution Frame
PCM	Pulse Code Modulation
PCUF	Power Control Unit Frame
PDUF	Power Distribution Unit Frame
RSC	Register Sender Control
SPC	Stored Program Controlled
SPG	Single Point Ground
VF	Voice Frequency

2.4 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...
205-002-501	Isolated Ground Faults—Detection and Troubleshooting—Switching and Transmission Systems
256-050-207	Terminating Power Cable Using Compression Connectors and Lugs
795-001-070	Switching Systems Power Cabling and Fusing—Engineering Applications
795-805-071	Central Office Grounding Systems—Engineering Applications
795-805-072	AC Service Grounding Engineering Applications
795-805-074	Inspecting Central Office Grounding and Electrical Protection

(continued)

2.4 References, continued

See...	For Information About...
795-805-075	Remote Electronic Serving Area Grounding Systems – Engineering Considerations
887-030-085	Radio Station Protection – Engineering Considerations
887-903-026	Five-Pin Protection Module – Application

3. Single Point Ground (SPG) System

3.1 Definition

In the SPG system, the grounded terminal of the battery, circuit ground, and discharge ground are deliberately isolated in the load equipment from its framework. All elements in the power system that require grounding are isolated from contact with other grounds, except for a single point.

The SPG method keeps these two paths isolated except at a single point, which is the MGB, thus the name single point ground.

There are two types of grounds. One is the battery return (+48V), which is a current carrying, and is referred to as battery return.

The second ground is frame ground. Under no fault conditions, this ground should have **no** current flow. It exists for protection purposes only. This ground is referred to as frame ground or simply ground.

NOTE: This procedure prevents currents in the ground paths from circulating through any part of the SPG system and return current of the DC power system from straying to other parts of the frames and superstructures.

3.2 Implementation

Implementing the SPG system begins on a new frame contiguous but physically and electrically separated from existing frames by a one-inch air gap or insulating material. When new equipment mounted in the new frame using the SPG is wired with the circuit isolated from the chassis, the SPG is accomplished in the new frame.

This method minimizes problems associated with DC power return currents flowing in the equipment frames.

3.3 Direct Current (DC) Power

The following chart shows how to minimize magnetic coupling.

Step	Minimizing Magnetic Couplers
1	Run the power cabling (feeder and distribution) to transmission systems and special service with parallel paired conductors of equal size.
2	Tightly lash parallel conductors to eliminate stray fields caused by power loops. **NOTE: This requirement applies to all DC power cabling (e.g., 24 volt, 48 volt, ± 130 volt). The return buses of the DSUFs and PDUFs serving transmission equipment must be insulated from frames.**

Where A and B feeders serve a single fuse panel, two return conductors are required for the two feeders. All A and B fused and return conductors must be lashed in parallel.

3.4 Frame Ground

First identify the equipment to be installed as being SPG. Refer to Section 3.8 when:

- Any question arises.

  OR
- Salvaged equipment is being reused.

NOTE: Refer to Practice 205-002-501 for additional information.

Once the metal of the frame is isolated from the electrical unit, a system will be provided to ground the chassis and/or frame. Ground all transmission equipment frames to the MGB/FGB via leads:

- 41A.
- 58A.
- 59A.

NOTE: The superstructure must be grounded via Lead 57A.

On transmission bays supported by a PDUF, connect Leads 53A and 38A directly to the frame metal.

3.4 Frame Ground, continued

Use the following chart to select the proper gauge for Lead 53A based on the fuse size.

SIZE OF FUSE AT DSUF (Largest fuse used at the DSUF, PCUF, or PCDF feeding transmission equipment)	MINIMUM GAUGE OF LEAD 53A**	GAUGE OF LEAD 41A*	GAUGE OF LEAD 58A*	GAUGE OF LEAD 59A
250 amperes or less	2/0 AWG	2/0 AWG	No. 2 AWG	No. 6 AWG
400 amperes	250 MCM	2/0 AWG	No. 2 AWG	No. 6 AWG
600 amperes	500 MCM	2/0 AWG	No 2. AWG	No. 6 AWG
1000 amperes	750 MCM	2/0 AWG	No. 2 AWG	No. 6 AWG
Larger than 1000 amperes specially designed, consult HQ engineering staff.				

NO TE: All gauges are made of insulated copper.

* Extend Lead 41A (58A in smaller installations) to the MGB/FGB bar by running it along with the power cables feeding the transmission equipment all the way to the serving PDUF.

** **NOTES:**

- Run Lead 53A along with the power cables feeding the transmission equipment PDUF all the way to the source at the battery, then from the battery to the MGB or FGB. On this last part of the run, keeping Lead 53A close to Lead 37 or 38 is important.
- Bond Lead 53A to each runway or grid section supporting the power cables and space the connections no more than 15 feet (5m) apart.
- One Lead 53A could serve more than one PDUF in the transmission equipment area. In this arrangement, Lead 53A is extended from ground bar only if the same power cable route is used by each PDUF.
- Omit Lead 53A whenever remote fuse distribution or PDUF is not used to serve transmission equipment.

3.4.1 Leads 41A, 58A, and 59A

Lead 41A originates at the FGB/MGB and runs to the ends of the equipment lineups, where connection to multiple leads 58A are made. Because this is the main feeder, it is the largest diameter cable of the three leads. This conductor is always 2/0 stranded and must be parallel to the DC power cables to the PDUF.

For Lead 58A, one of these leads runs the length of each lineup in the overhead cable rack. It connects at the end of the lineup to Lead 41. Leads 59A are tapped off this lead at each relay rack. Lead 58A is sized to be a #2 stranded conductor. In small offices, where there is only one transmission lineup, lead 58A can be extended to the FGB/MGB replacing Lead 41A.

3.4 Frame Ground, continued

Lead 59A completes the connection to each relay rack from Lead 58A. It connects to Lead 58A in the overhead cable rack and connects to the top of each relay rack. Lead 59A is a #6 stranded conductor and must be limited to the maximum length of 3 feet (1m).

NOTE: If the power system ampere capacity is added to, and larger fuses are provided at the DSUF feeding the transmission PDUFs, only the gauge of Lead 53A is affected. The gauges of Leads 41A. 58A, and 59A are not affected. See the chart in this section.

3.5 Superstructure

Lead 57A is required to bond the cable grid or runway systems to the MGB/FGB (see Exhibit 11). The following chart shows the steps to use to bonding the transmission system cable grid or runway system to the FGB.

Use of 57A requires the isolation of the transmission superstructure from all other superstructures. Lead 57A is not needed when the transmission superstructure is not isolated from other superstructures grounded by Lead 57.

Step	Bonding the Transmission System Cable Grid or Runway System to the FGB
1	Connect Lead 57A to a centrally located area of the transmission equipment on the grid or runway system.
2	Use a two-hole compression lug to attach this lead to the cable grid or runway system.

3.6 Safety Leads

3.6.1 Lead 38A

Lead 38A must be installed only when multiple floor installations occur as shown in Exhibits 3 and 5. This lead minimizes the chance of difference in potential developing between the transmission equipment frames and other equipment frames should the building become energized during a lightning strike or a major AC power fault.

3.6.2 Lead 53A

Where the remote power distribution frames, fuse panels, breaker panels, etc., are placed between the primary fusing and the individual transmission equipment frames, Lead 53A safety ground (and Lead 38A where appropriate) is required. Lead 53A is only required to ground the frame of a power distribution board (PDUF) fed by a DSUF. Also this power bay must be electrically and physically isolated from any SPG equipment.

3.6 Safety Leads, continued

3.6.2 Lead 53A, continued

The following chart shows the steps to take to use Lead 53A to ground the frame supporting PDUF.

Step	Using Lead 53A to Ground the Frame Supporting PDUF
1	Select gauge of Lead 53A from the chart in Section 3.4.
2	Connect Lead 53A to the MGB and to the frame supporting the PDUF.
3	Run Lead 53A along the power cables feeding the PDUF where it originates.
4	After reaching the battery room where the power feeder originates, extend Lead 53A to the MGB/FGB in a route close to Lead 37 or 38.
5	In the section of the run of Lead 53A, between the PDUF and the battery room, bond Lead 53A to the cable tray supporting the power feeder. **NOTE: Provide a bond to every section of the cable rack with a maximum of 15 feet (5m) between bonds (see Exhibit 11). Refer to Practice 256-050-207.**

3.7 Typical Power Wiring Block Diagrams

The following chart shows which exhibits show typical power wiring block diagrams for transmission and special service equipment racks.

See Exhibit...	For Information About Single Point Grounding...
2	50 Volt Wiring for Transmission Equipment on a Single Floor
3	50 Volt Wiring for Transmission Equipment on Multiple Floors
4	Composite ± 130 Volt Battery Plant Wiring for Transmission Equipment on a Single Floor
5	Composite ± 130 Volt Battery Plant Wiring for Transmission Equipment on Multiple Floors
6	Composite ± 130 Volt Converter Wiring for Transmission Equipment on a Single Floor
7	Composite ± 130 Volt Converter Wiring for Transmission Equipment on Multiple Floors

3.8 Circuitry Bonded to Chassis

Equipment units mounted in SPG frames must have circuitry electrically isolated from the unit's chassis, or the chassis must be installed using isolation material. Whenever the equipment manufacturer bonds the input power return, logic reference, or any other circuit return to the equipment framework, the equipment circuitry is not isolated and has a chassis ground. Use insulating hardware to physically and electrically isolate equipment with chassis grounds. Do not insulate any equipment free of chassis ground. Use insulating hardware to physically and electrically isolate equipment with "chassis grounds." Do **not** insulate any equipment free of "chassis grounds."

Refer to Practice 795-805-071 for additional information on grounding and isolating equipment.

3.9 Digital Cross-Connect Systems

DCCS are to be treated as separate electronic switching systems per Practice 795-805-071. Comply with the information in the topic *Separation of Central Office Systems* and other topics under *DC Power System Grounding.*

3.10 Logic Grounding

Logic ground is the reference, non current-carrying conductor, associated with the low voltage DC supply used with solid-state components in digital switches and transmission equipment. The is **not** the low voltage return conductor, which is a current-carrying conductor.

Example:
In the GTD-5, the low voltage return conductor **is** a current-carrying conductor and is referenced in the PDU battery return. Logic ground leads are not current-carriers and are referenced to the MGB.

RS-232 cable connections are a common method of connecting electronic equipment to allow these devices to communicate. The cables also provide the ability to establish a ground system as well as a logic reference system (Pin #1 is Chassis Ground and Pin #7 is Logic Ground). This is necessary for equipment that does not already have a separate ground system.

The RS-232 grounding is:

- Not needed in a GTE CO IGZ.

  AND

- Provides ground loops with the potential for damage and service outages.

Devices that use an RS-232-type interface and are located within the IGZ should be equipped with an isolator of some type.

This can be accomplished either with:

- An optical isolator.

  OR

- The use of back-to-back modems.

All AC powered devices that are located or service devices in the IGZ must be fed from inverter-derived power and not commercial AC power. The RS-232 connections on these devices must be equipped with isolators.

3.10 Logic Grounding, continued

Do not install equipment, which is logic common with chassis in an integrated frame. Some vendor equipment comes with the chassis integrated with logic conductors which cannot be isolated. This integration would make the chassis common with logic and battery return, and via the RS-232, would compromise the isolated equipment tied to it.

4. Grounding Aluminum Racks

4.1 General Information

Aluminum and its alloys produce a nonconductive oxide after only a few seconds' exposure to air. The normal build up of dirt and grease further increases the "natural" insulation on aluminum surfaces.

NOTE: Bonding to such a surface is explained in Section 4.7.

4.2 Hardware Requirements

The mating surfaces of hardware used for bonding or grounding to aluminum racks must be made of:

- Aluminum.
- Cadmium plate.
- Zinc plate.
- Tinned copper.

4.3 Preparation of Connectors and Surfaces

All lug connections and their mating surfaces must be cleaned and lightly coated with a nonoxidizing-type conductive grease or compound as follows:

- MC 760293 (or equivalent) for copper and steel surfaces.
- MC 760294 (or equivalent) for aluminum surfaces.

NOTES: Using the incorrect compound damages lug connections.

Painted surfaces must be scraped, cleaned, and lightly coated with the applicable compound.

4.4 Fasteners for Bonding or Grounding Aluminum Racks

All fasteners (bolts, screws, etc):

- Attaching to aluminum must be aluminum, cadmium, or zinc-plated steel, or tinned copper using a nonoxidizing-type conductive compound (see Section 4.3).
- Securing the surfaces of bonding devices together must use Belleville®-type washers under the heads of the screws or bolts to maintain compression on the mating surfaces.

4.5 Rack to Office Grounds – Aluminum Racks

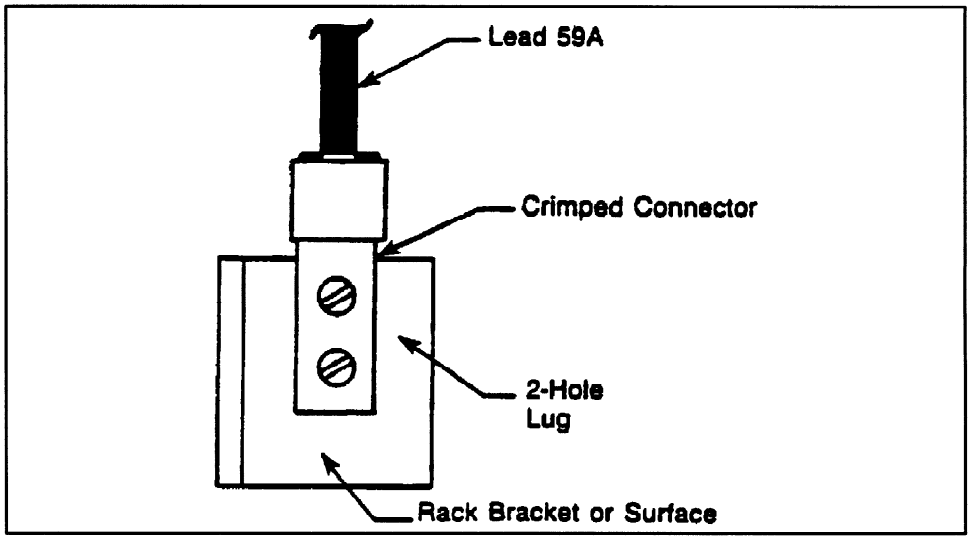
Each rack must be connected to the transmission equipment MGB or to the FGB as:

- Explained in Section 3.4.
- Shown in Exhibits 1 through 5.

4. Grounding Aluminum Racks, continued

4.6 Aluminum Rack – Ground

The following illustration shows that the equipment frame must have a #6 AWG ground lead (Lead 59A) run from Lead 58A to the connector.



4.7 Surface Treating Aluminum

The following chart shows how to prepare the contact surfaces for an electrical connection.

Step	Preparing Contact Surfaces
1	Clean both surfaces to remove dirt, paint, and oxides using aluminum oxide paper, 300 grit or finer.
2	Apply a thin coat of a nonoxidizing-type conductive compound to both surfaces according to the directions on the container (see Section 4.3).
3	Close and tighten the connection immediately.
4	Remove any excess joint compound according to the instructions on the container.

5. Grounding Steel Racks

5.1 General Information

Sections 5.2 through 5.5 provide the guidelines to cover steel rack assemblies.

5.2 Steel Racks – Ground

Connect each rack to Lead 58A via Lead 59A.

5.3 Copper Ground Bars

Do not use horizontal copper ground bars on transmission equipment frames, except the frame supporting PDUF (see Exhibit 1).

5.4 Equipment Shelf Grounding

If isolated equipment is being installed in a painted aluminum or steel rack, a ground strap must be installed between the relay rack mounting face and the equipment shelf. This ensures continuity between the equipment shelves and the frame ground. The preassembled relay rack can be shipped with a bare solid #6 type power cable running vertically down one side of the relay rack. Individual shelf frame grounds are then connected to the bare #6 cable. This is another acceptable means by which to provide frame ground on painted relay racks.

If the relay rack is aluminum and is not painted, the equipment is fastened directly to the rack face and shelf frame ground can also be terminated directly to the rack face.

The rack face on the aluminum relay rack or the ground strap or #6 bare conductor on the steel or painted relay rack also is in the place at which the shield for any high frequency cabling is to be terminated, if the manufacturer has not made provisions for terminating the shield directly on the equipment.

NOTE: All high frequency shields must be terminated at the equipment end only.

5.5 Ground Strap Method

The following chart describes the ground strap method.

If the...	The Ground Strap...
Mounting flanges of the shelves or panels are secured to the front of the rack	Must be mounted upright on the front of the left rack.
Mounting flanges of the shelves or panels are secured to the rear of the rack	Must be mounted upright on the rear of the right upright.
Shelves and panels are a mixture of front- and rear-mounted types	Is not to be used. Use the #6 bare solid wire method as described above.

NOTE: Use a continuous piece of ground strap long enough to reach from the top to the bottom of the rack.

6. Transmission Cable

6.1 High Frequency T Carrier Lines

The high frequency PCM carrier type lines must have shields grounded at the switching system end of the cables. The DSX end of such cable shields must be ungrounded.

Cables from the DSX to the transmission equipment must have shields grounded at the transmission equipment end only. Do **not** bridge the DSX ends of the T line shields across the DSX.

The HF transmit pairs must be labeled down one side of the rack and the HF receive pairs must be on the opposite side when non-shielded paris are used.

7. Grounding Transmission Cable

7.1 General Information

Various forms of noise can be reduced and often eliminated by installing cables properly. The exact remedies required for a particular situation are often determined by experiment. The procedures in this section are good practice, however.

7.2 HF Leads – Digital Facilities

HF (>200 kHz) transmit and receive cables carrying digital signals within balanced pair, shielded cables or individually shielded pairs must have:

- Approximate cable shield grounding (see Practice 795-805-071).
- A one-foot separation from any of the following cables:
  - Surge carrying cables (e.g., entrance cables Leads 23 and 24 types).
  - Ringing or DTMF pad/coin control.

Transmit and receive digital facility leads (cables) require **no** separation when balanced pair, shielded cables or individually shielded pairs are used for cabling within the CO facilities.

NOTE: The conditions described in this section do not apply to all dielectric digital fiber optic cables, which are immune to electrical inductive properties.

7.3 Cables – Protection and Noise

There are only two accepted standard methods for termination and protection of HF cable pairs.

In the first method, use:

- A separate HF protector frame.

  OR
- HF cabinet.

In the second method, use rack-mounted HF protectors isolated from the rack.

NOTE: The MDF can be used for HF termination in SPC switching offices.

Termination and grounding requirements for HF (T1 and DLC) connections when a separate HF protector frame of the HF Cabinet has not been provided in an SPG office.

7.3 Cables – Protection and Noise, continued

Ideally, the facility should terminate on a dedicated carrier frame. However, GTE realizes that this is not always feasible, particularly where customer T1s are involved. Therefore, the MDF can be utilized in SPG offices for termination of T1s to customers or DLCs. In such instances, shielded jumper wire should be used on the MDF.

Offices that are not SPG must have a HF protector frame or HF Cabinet. SPG offices should have a HF protector frame or HF Cabinet, but can have a termination point at the MDF for the distribution of T1 facilities.

If an MDF connector (protector) is used for a T1 line (HF) the following must take place:

- Transmission Engineering must provide a termination point (terminal block) on the MDF for the transmission equipment.
- Transmission Engineering must provide a shielded cable run from the transmission equipment to a designated terminal block on the MDF.
- The cable must be grounded at the transmission equipment end and the shield connected to the terminal block. A multiple must be placed to other pins creating a termination point for shielded jumpers.
- The circuit is jumpered to the assigned protector pair using a shielded jumper with the shield connected at the terminal block.
- No special treatment is required for grounding of the connector (protector). All protectors on the MDF must be grounded via Lead # 24 to the ECPGB.

Use the following chart where a separate HF protector frame is used.

Step	Terminating and Protecting Transmission Cable Pairs
1	Perform the following steps: A. Splice the tip cables to cables in the cable vault or tip and splice area. B. Run the tip cables to the dedicated transmission protectors (PCM-CXR). **NOTE: Do NOT extend these cable pairs to the MDF, since this creates a problems bridge tap.**
2	Physically and electrically isolate transmission protector module bases from the frame, cabinet, or rack. **NOTE: This prevents surge currents from flowing through the ironwork into integrated transmission racks, causing equipment component damage.**
3	Bond the protector module bases with #6 AWG, Lead 24A.
4	Use Lead 24 (#6 AWG) to bond the protector module base to Lead 23A (#1 AWG) that connects to the closest MGB/FGB on the same floor.
5	Use shielded paired cables from the transmission protector to HF tie cables and/or the transmission equipment.

7.3 Cables – Protection and Noise, continued

See Practice 887-903-026 for the appropriate protector modules to use.

7.4 Shielded Balanced Pair Cable Grounds

The primary purpose of a shield is to prevent crosstalk or noise from external sources from entering into the cable pair.

Crosstalk or noise is induced by:

- The varying electromagnetic fields.

  AND

- Capacitive coupling of the electrical fields.

Adding a shield to the balanced pair generally:

- Prevents inductive coupling into the pair:

  AND

- Greatly reduces capacitive coupling.

Grounding the shield at one end reduces capacitive coupling, thereby eliminating electrostatic induction. Grounding the shield at both ends reduces electromagnetic induction; however, do not use this method inside the CO to avoid noise associated with shield currents and ground loops.

Capacitive coupling to the pair is reduced by the cable shield, providing a ground plane exists between the interfering source and disturbed pair.

Cables from the DSX to the transmission equipment must have shields grounded at the transmission equipment end only. Do **not** bridge DSX ends of the shields across the DSX.

If the Cable Runs...	The Shield (s) Must Be Grounded At...
Between two pieces of transmission equipment, and no DSX jack field is located within the cable run,	One location only.
Between the switch and the transmission equipment, and if no DSX jack field is located within the cable run.	Only at the transmission equipment end.

7. Grounding Transmission Cable, continued

7.5 Coaxial Cable

Unbalanced circuits working into coaxial cable can only be free from external interference if the integrity of the coaxial shield is maintained throughout the circuit. The coaxial shield is actually provided by the outer conductor of the coaxial cable. The outer conductor must be continuous. When a 75 ohm coax connector is used, the outer conductor must be isolated from the shelf and connected to the isolated circuit ground. The outer conductor must be grounded only at one end of the cable.

NOTE: Install cables in accordance with GTE specifications.

7.6 Voice Frequency (VF) and Signaling Leads

VF and signaling leads are normally run in multipair cables in accordance with existing plant procedures. Run VF and signaling leads in separate cables to avoid introducing impulse noise into the VF pairs.

8. Integrated Grounds

8.1 Applications

Integrated transmission equipment has the power circuit return connected to the metal chassis or shelf in which it is mounted.

Since this method of feeding power created ground loops that defeat the SPG desired on digital CO DC power plants, new equipment frames engineered after March 1, 1990 must be powered and grounded by the SPG system.

Existing integrated grounded transmission frames engineered before March 1, 1990, can remain and additional equipment can be added to those frames.

Whenever integrated frames cause an operational equipment problem, the 8.2 integrated transmission equipment must be retrofitted to an SPG system.

8.2 Grandfathering

Before June 1, 1990, transmission equipment used an integrated grounding system. This means that the battery return (+48) was tied at various points to frame ground.

Equipment installed after June 1, 1990, must be installed as SPG. The SPG method keeps return battery (+48) and frame ground (protective ground) isolated except at a single point, which is the MGB.

Equipment installed before June 1, 1990, can be grandfathered and left in place. All grandfathered equipment bays must comply with the integrated grounding method and is **not** excepted "as is" (see Exhibit 9). Equipment additions within such frames must continue the method used in that frame. Integrated method "A" is **not** permitted in new frames, even when it exists in one or all the frames in the line up or area. Mixing SPG and Method "A" in the same frame is not GTE-approved.

8.2 Grandfathering, continued

Retrofitting of existing equipment frames to SPG is required when:

- Engineering judgement dictates that this is advantageous to retrofit existing racks; i.e., labor cost effective, small number of integrated racks, etc.
- Coincident with office change out or rearrangement and a manageable number of frames is involved. In this case, there is no need to isolate equipment frames from each other.
- The entire frame or relay rack is vacated, due to removals.
- Noise or other problems are related to existing power and grounding.
- A safety hazard exists.
- Existing frames fail to conform to the requirements of Method "A".
- There is a mixture of grounding methods within the same frame.
- DC power distribution conductors are shared between frames that are configured for different grounding methods.
- DC power is supplied to the frames without sufficient return conductor to carry the engineered requirement or none exists.

NOTE: As long as GTE has both methods (SPG and Integrated) in the same office, they must be kept separate at all times (except at the MGB).

8.3 Other Considerations

New COs will be implemented as SPG. In this case, there is no need to isolate relay racks from each other.

8.4 SPG Treatment of Integrated Ground Equipment

If the manufacturer's equipment shelf is integrated grounded and it is being installed in an isolated ground relay rack, the shelf must be insulated from the relay rack. No frame ground will be terminated on this shelf.

A list of transmission equipment which is configured with integrated grounding is being compiled at this time and will be added to this document as soon as it is available.

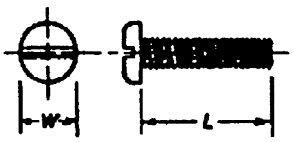
8.4 SPG Treatment of Integrated Ground Equipment, continued

The following is a list of parts for isolating an integrated equipment shelf from a relay rack.

MATERIAL CODE	PART NUMBER	DESCRIPTION
884502	SB111308	NYLON, PAN HEAD MACHINE SCREW
884510	SB-1134	NYLON WASHER, FLAT

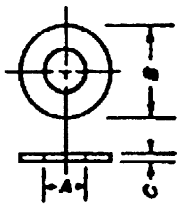
PAN HEAD MACHINE SCREW

PART NO.	NOM. SIZE	L	W
SB-1113-08	12	1"	27/64"



FLAT WASHER

PART NO.	A	B	C
SB-1134	1/4"	9/16"	1/16"
SB-1135	3/8"	3/4"	1/16"
SB-1136	7/16"	7/8"	1/16"



3 - ISOLATION MATERIAL FOR INTERGATED SHELF

8.5 Isolation Requirements of SPG Relay Racks in the Integrated Grounded Offices

If new relay racks are to be installed in an existing office which presently is integrated grounded, the new racks must be isolated from the floor and overhead iron work. While the new racks can be placed in the same line up with existing integrated racks, they must be separated by a one-inch air gap. This prevents the new isolated relay racks from being used as a current carrying device and allows for isolated and integrated equipment to be colocated.

Do not use bonding plates between an integrated and isolated rack, as this totally defeats the isolation of the new rack. Bond like racks such as two integrated or two isolated grounded type racks.

When adding a rack between two existing integrated racks, install the new rack as integrated.

8.5 Isolation Requirements of SPG Relay Racks in the Integrated Grounded Offices, continued

8.5.1 Method for Isolating 1-Inch (25.4 mm) Rectangular Tube or Pipe

The method for isolating the 1-inch (25.4 mm) pipe or rectangular tube is shown in the following chart.

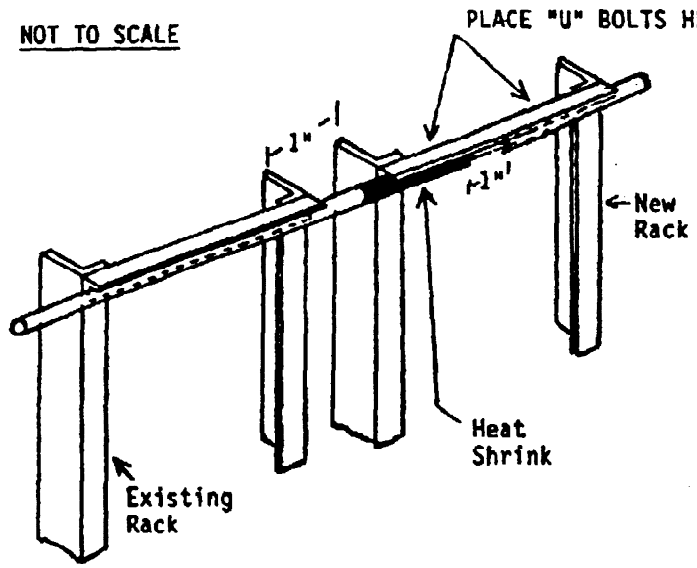
Step	Method for Isolating the 1-Inch (25.4 mm) Pipe or Rectangular Tube
1	Provide a one-inch space between the existing integrated racks and the new isolated rack.
2	If the existing pipe/tube can extend at least half way through the new isolated rack, then cut the tube/pipe ½ "(12.7 mm) from center of the new isolated rack.
3	Cover the existing tube/pipe with heat shrink to isolate the pipe/tube from the new relay rack.
4	"U" bolt the existing pipe/tube to the new rack top angle and, if possible, to the superstructure.
5	Add a new pipe/tube maintaining a one-inch space from the existing tube/pipe.
6	"U" bolt the new pipe/tube to the new racks top angle and, if possible, to the superstructure. **NOTE: By "U" bolting both the old and new pipes/tubes to a common relay rack top angle, structural strength and isolation can be maintained.**
7	If the pipe/tube does not protrude half way into the new rack, cut the pipe or tube ½ "(12.7 mm) from center on the existing integrated rack.
8	Put heat shrink over the new pipe/tube.
9	"U" bolt both old and new pipes/tubes to the existing rack.

Continuity must be broken only at the point at which the integrated racks end and the isolated racks begin. Once this has been completed, continuity can exist on adjacent isolated racks added in the future. These new isolated racks can also butt up next to each other. The floor and superstructure isolation must continue.

8.5 Isolation Requirements of SPG Relay Racks in the Integrated Grounded Offices, continued

8.5.1 Method for Isolating One-Inch Rectangular Tube or Pipe, continued

The following illustration shows the isolation of rectangular tube or pipe.



Isolation of rectangular tube or 1" pipe from relay rack.

4 - ISOLATION OF RECTAGULAR TUBE OR PIPE

MATERIAL CODE	PART NUMBER	DESCRIPTION
*883141	FIT22124	HEAT SHRINK 2"
*883116	FIT2211124	HEAT SHRINK 1.5"

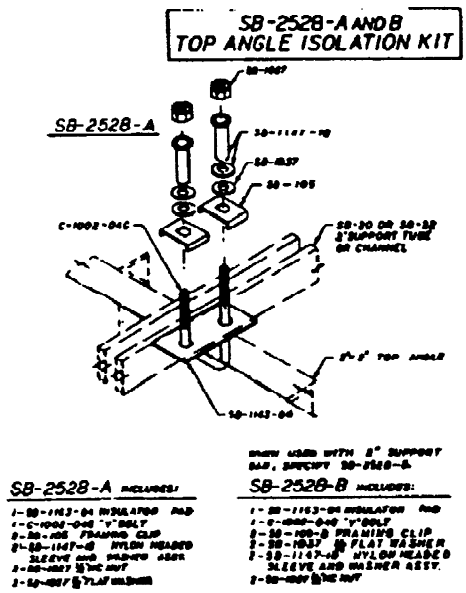
* - ITEMS ORDERED BY THE BOX.

8.5 Isolation Requirements of SPG Relay Racks in the Integrated Grounded Offices, continued

8.5.2 Isolation Material for Superstructure

The following is a list of parts to provide isolation of a new relay rack from extraneous grounds.

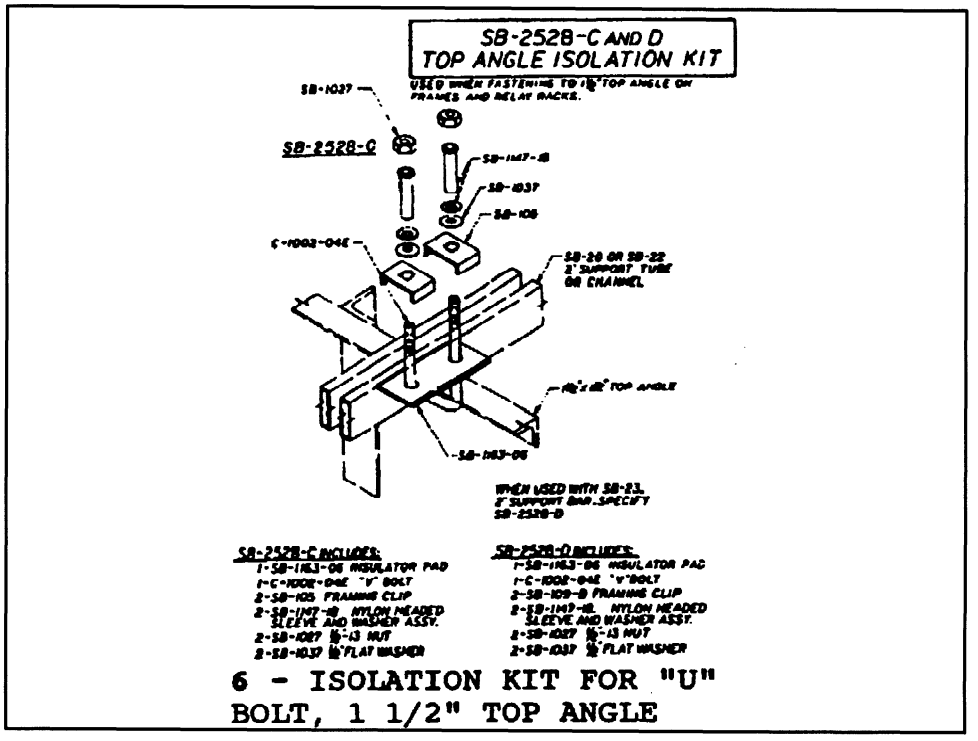
MATERIAL CODE	PART NUMBER	DESCRIPTION
883921	SB2528A	ISOLATION KIT, TOP ANGLE ("U" bolt for 2" top angle, used with 2" channel)
883922	SB2528B	ISOLATION KIT, TOP ANGLE ("U" bolt for 2" top angle, used with 2" support bar)
883923	SB2528C	ISOLATION KIT, TOP ANGLE ("U" bolt for 1 1/2" top angle, used with 2" channel)
883924	SB2528D	ISOLATION KIT, TOP ANGLE ("U" bolt for 1 1/2" top angle, used with 2" support bar)
883925	SB2529A	ISOLATION KIT, TOP ANGLE ("J" bolt for 2" top angle)
883926	SB2529B	ISOLATION KIT, TOP ANGLE ("J" bolt for 1 1/2" top angle)



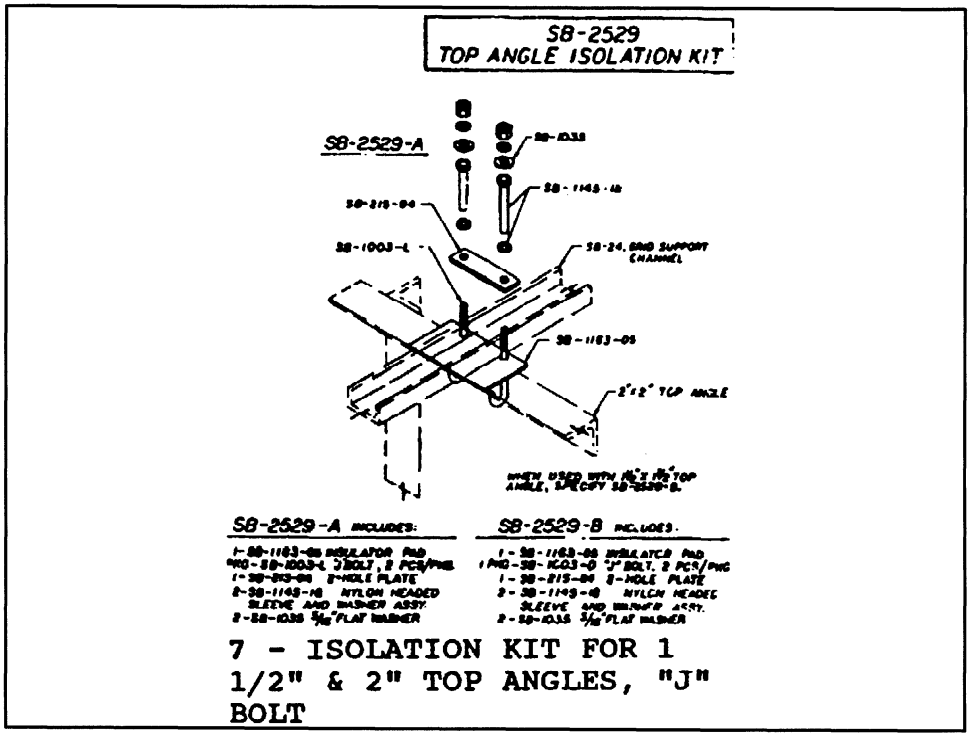
5 - ISOLATION KIT, "U" BOLT, FOR 2" TOP ANGLE

8.5 Isolation Requirements of SPG Relay Racks in the Integrated Grounded Offices, continued

8.5.2 Isolation Material for Superstructure, continued



6 - ISOLATION KIT FOR "U" BOLT, 1 1/2" TOP ANGLE

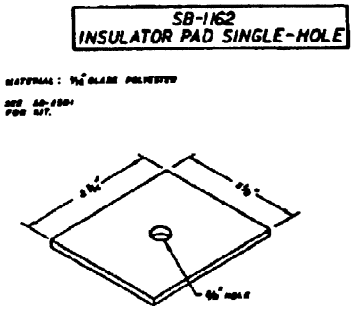


7 - ISOLATION KIT FOR 1 1/2" & 2" TOP ANGLES, "J" BOLT

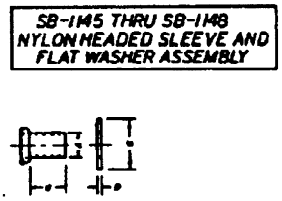
8.5 Isolation Requirements of SPG Relay Racks in the Integrated Grounded Offices, continued

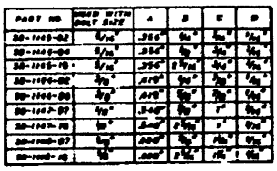
8.5.3 Equipment for Isolating Between Relay Racks

MATERIAL CODE	PART NUMBER	DESCRIPTION
884532	SB1162	INSOLATOR PAD, SINGLE HOLE
752848	SB114602	NYLON HEADED SLEEVE & FLAT WASHER



8 - INSOLATOR PAD FOR BETWEEN RELAY RACKS





9 - SLEEVE AND FLAT WASHER

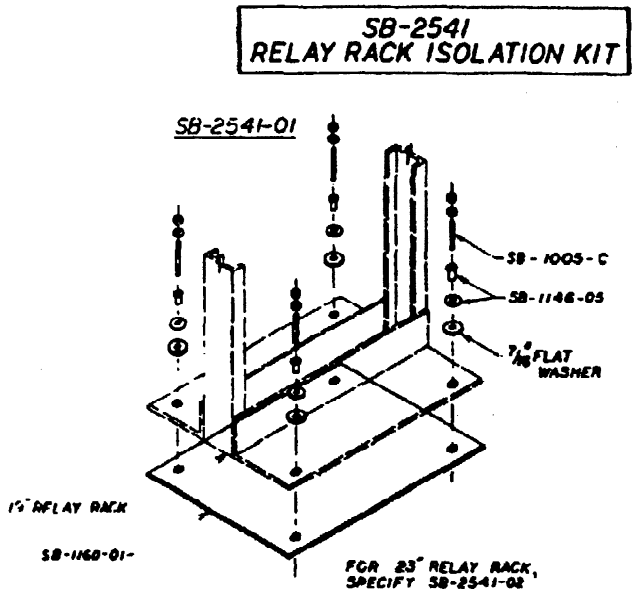
8.5.4 Equipment for Isolating Between Relay Racks From Floor

The following is as list of equipment for isolating between relay racks from the floor.

MATERIAL CODE	PART NUMBER	DESCRIPTION
883929	SB254101	ISOLATION KIT, 19" WIDE BASE, FLOOR SUPPORTED RELAY RACK
883930	SB254102	ISOLATION KIT, 23" WIDE BASE, FLOOR SUPPORTED RELAY RACK
883931	SB254201	ISOLATION KIT, 19" EQUAL FLANG RELAY RACK
883932	SB254202	ISOLATION KIT, 23" EQUAL FLANG RELAY RACK
308269	SB254701	ISOLATION KIT, 19" UNEQUAL FLANG RELAY RACK
308270	SB254702	ISOLATION KIT, 23" UNEQUAL FLANG RELAY RACK

8.5 Isolation Requirements of SPG Relay Racks in the Integrated Grounded Offices, continued

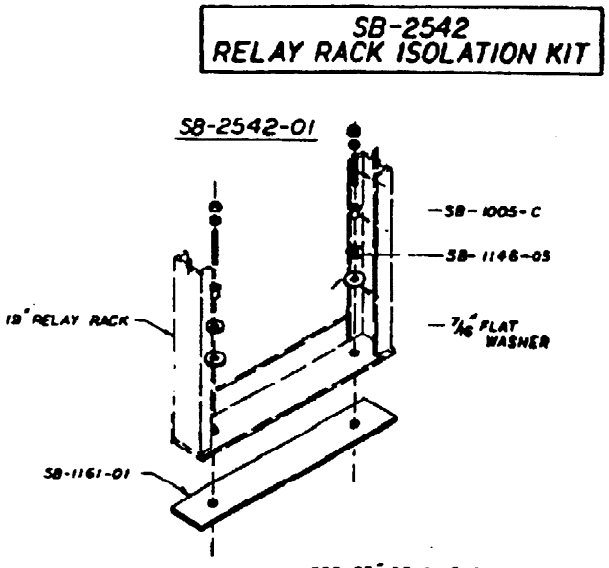
8.5.4 Equipment for Isolating Between Relay Racks From Floor, continued



10 - ISOLATION KIT FOR FREE STANDING RACK

8.5 Isolation Requirements of SPG Relay Racks in the Integrated Grounded Offices, continued

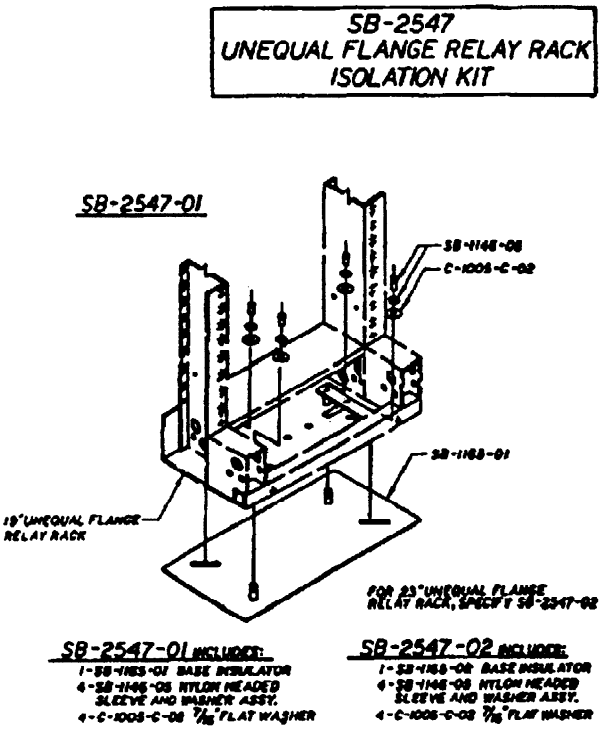
8.5.4 Equipment for Isolating Between Relay Racks From Floor, continued



11 - ISOLATION KIT FOR CHANNEL RACK

8.5 Isolation Requirements of SPG Relay Racks in the Integrated Grounded Offices, continued

8.5.4 Equipment for Isolating Between Relay Racks From Floor, continued



12 - ISOLATION KIT FOR FREE STANDING RACK

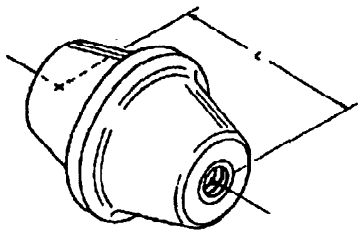
8.6 PDUF Requirements for SPG

The following is a list of equipment for isolating the PDUF + positive bus.

MATERIAL CODE	PART NUMBER	DESCRIPTION
*884522	SB1155	NYLON INSULATOR, STANDOFF 2 1/2" LONG WITH 3/8"-16 THREAD
*884523	SB1156	NYLON INSULATOR, STANDOFF 2 1/2" LONG WITH 1/2"-13 THREAD
*884524	SB1157	NYLON INSULATOR, STANDOFF 2 5/8" LONG WITH 5/8"-11 THREAD

* - ONLY ONE OF THE ABOVE INSULATOR TYPES ARE REQUIRED.

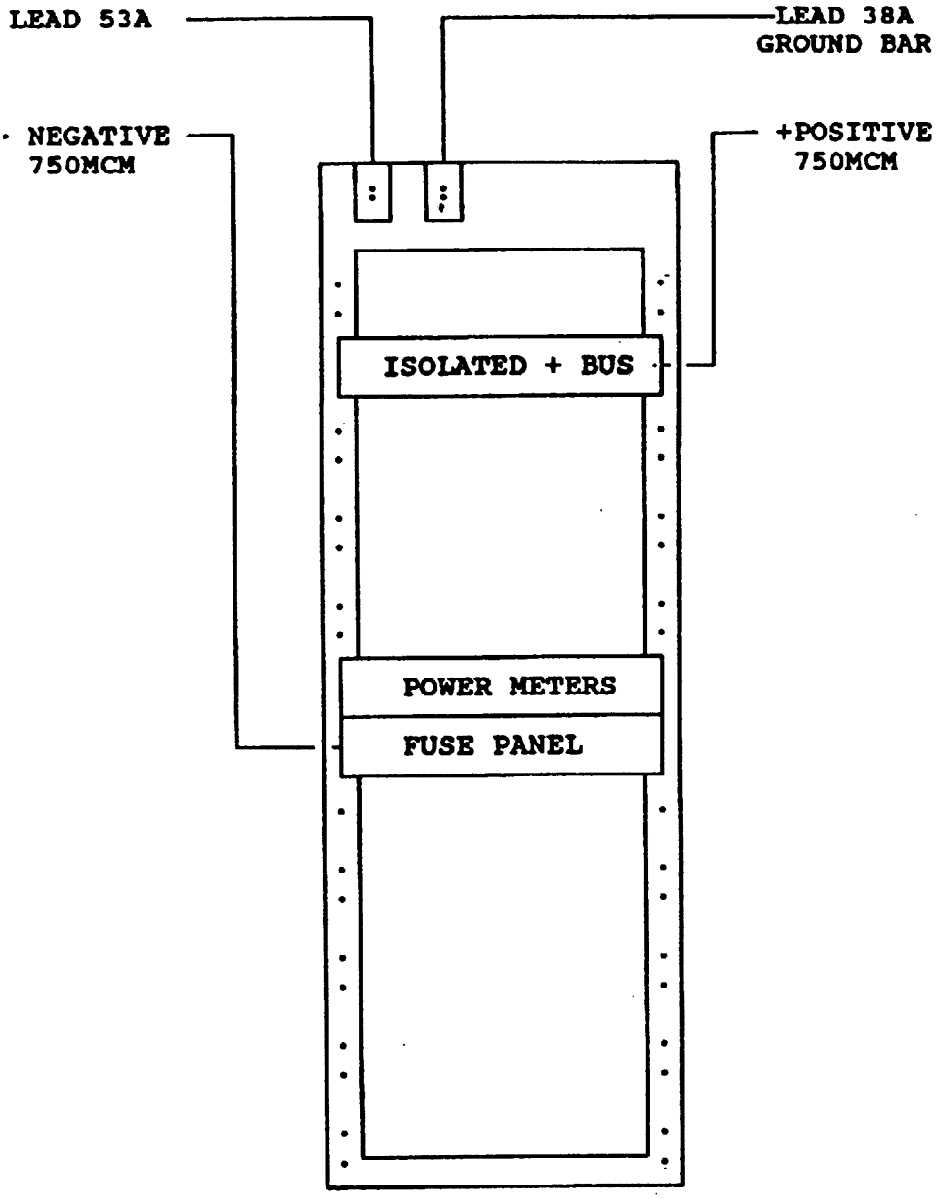
SB-1155 THRU SB-1157
STAND-OFF INSULATOR



PART NO.	THREAD	L	WT. LBS.
SB-1155	3/8"-16	2 1/2"	0.30
SB-1156	1/2"-13	2 1/2"	0.31
SB-1157	5/8"-11	2 5/8"	0.38

13 - STAND-OFF FOR PDUF GROUND BAR

8.6
PDUF
Requirements
for SPG,
continued

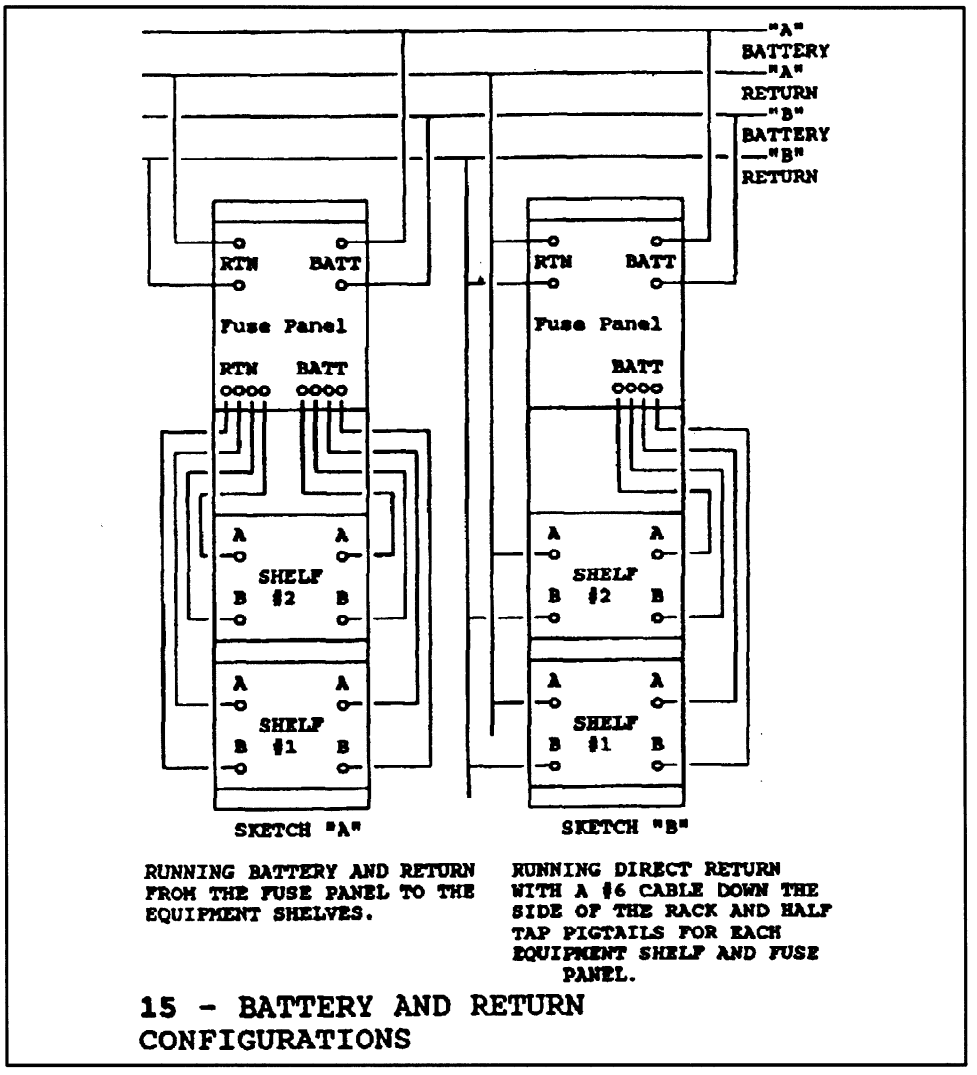


For further detail refer to GTEP Practice 795-805-073 Exhibit #1.

14 - PDUF REQUIREMENTS

8.7 Battery and Return Configurations of Standard Transmission Equipment

The following illustration shows the battery and return configurations of standard transmission equipment.



When there are no return terminals or an insufficient quantity or size of return termination points on the fuse panel, use sketch "B". Otherwise, use sketch "A".

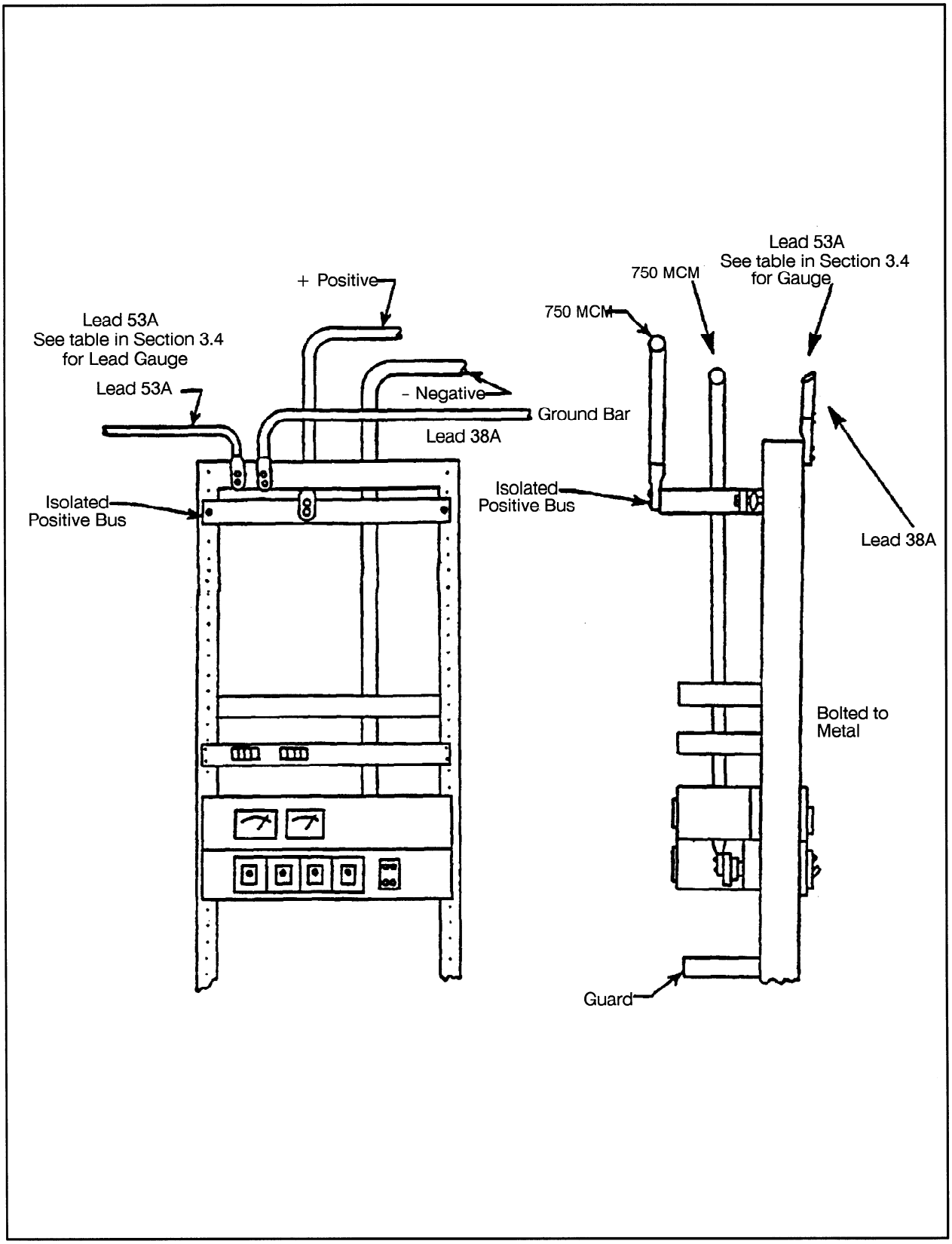
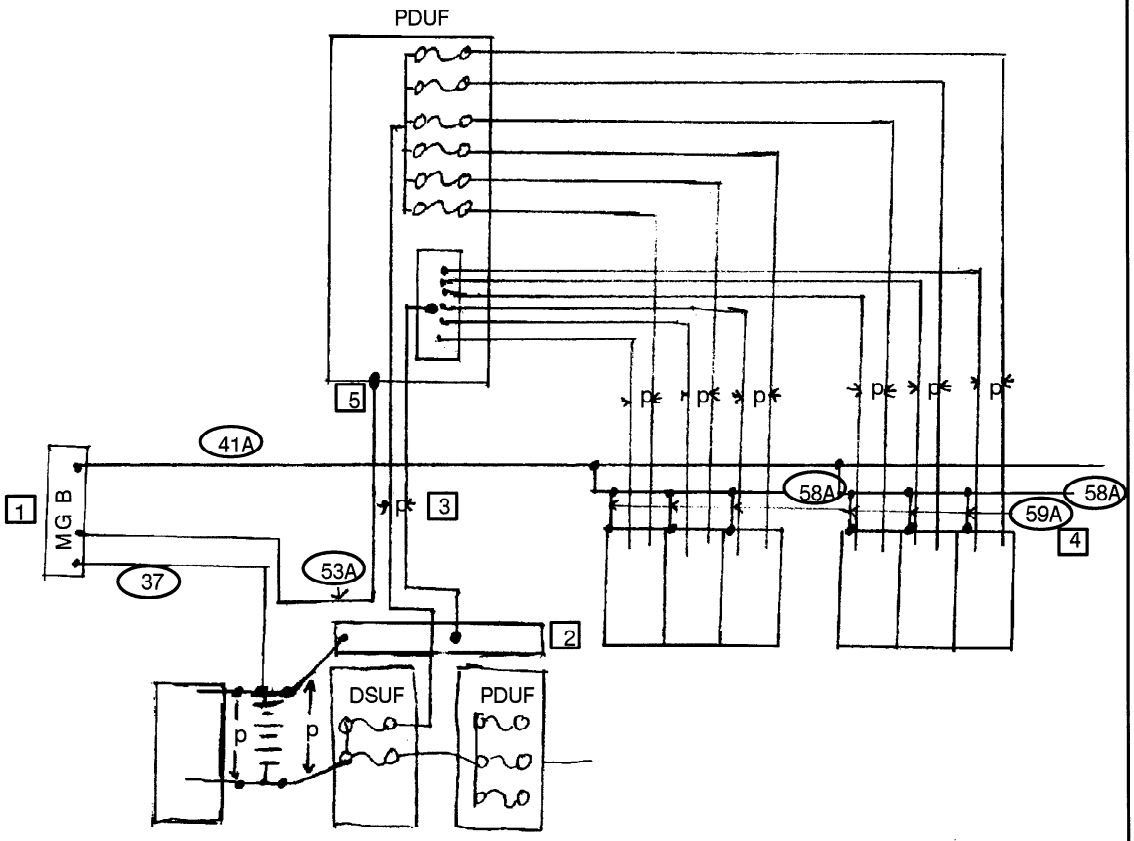


Exhibit 1 - Grounding of Typical Distribution Fuse Bay Frame



NOTES: 1 See Practice 795-805-071 for details.

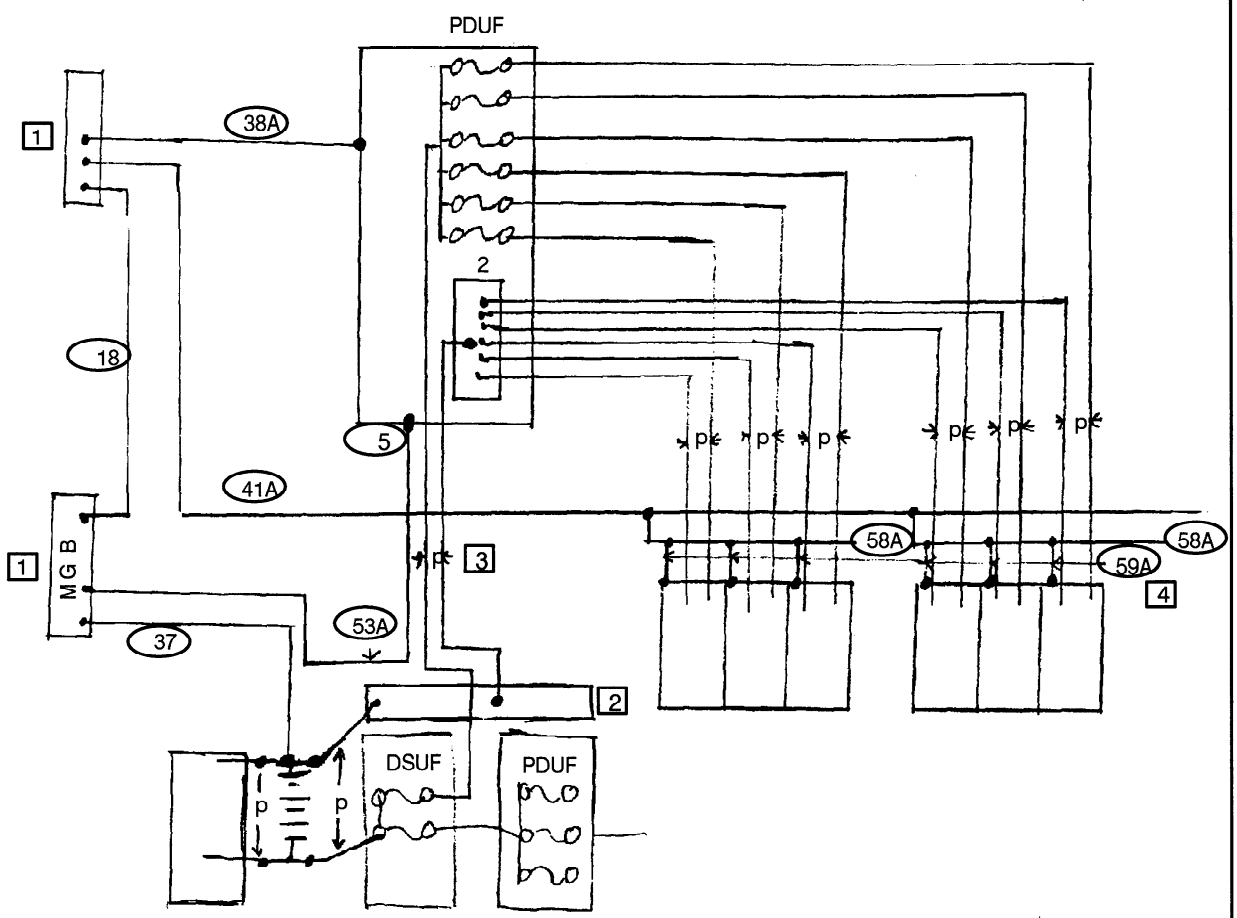
2 Return bus isolated from frame or relay rack.

3 "P" denotes that positive return leads are paired with the negative.

4 Each Lead 59A must be less than three feet.

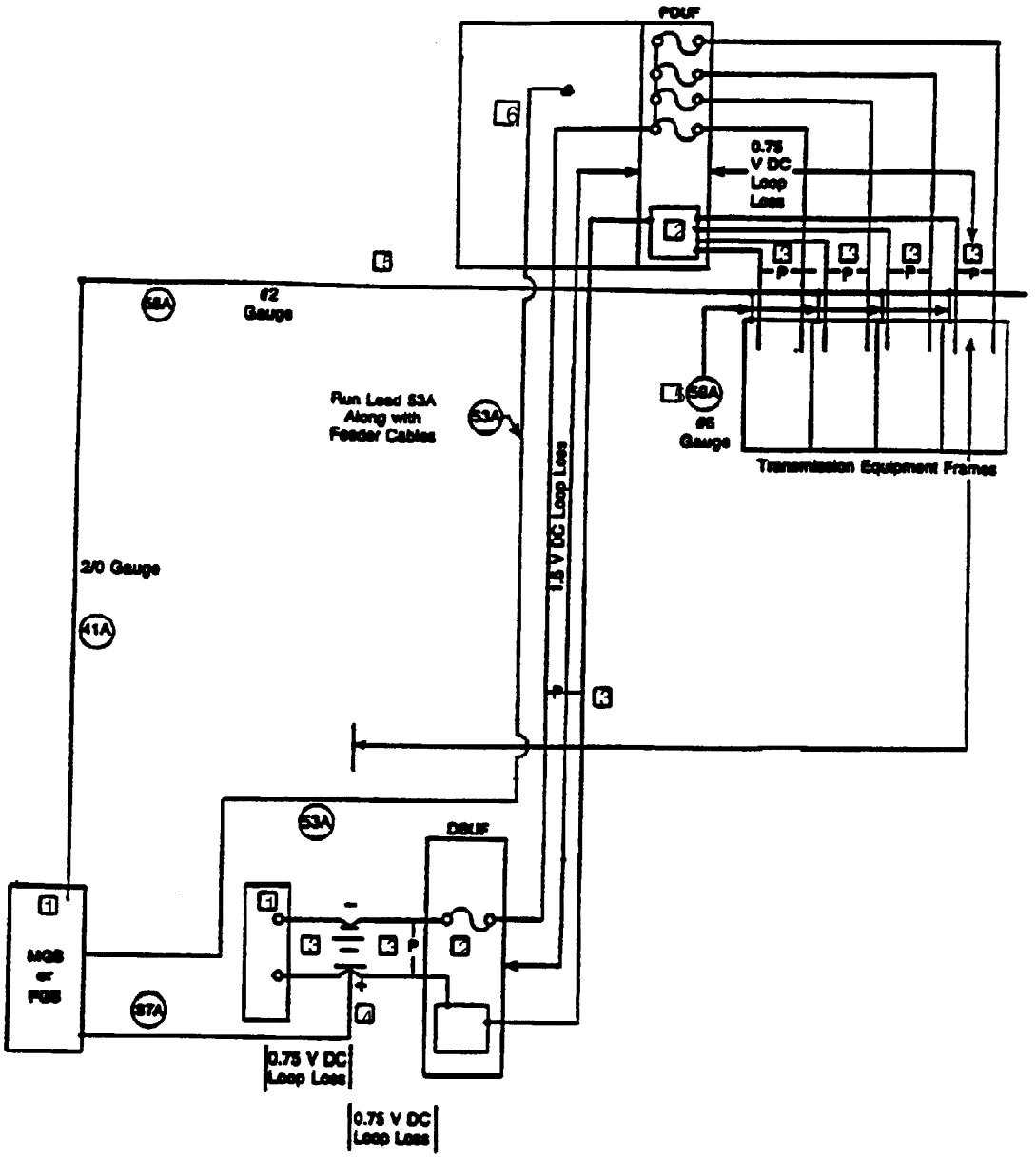
5 Connect to the frame Lead 53A. See Section 3.6.1.

Exhibit 2 - Single Point Grounding 50 Volts Wiring for Transmission Equipment on a Single Floor



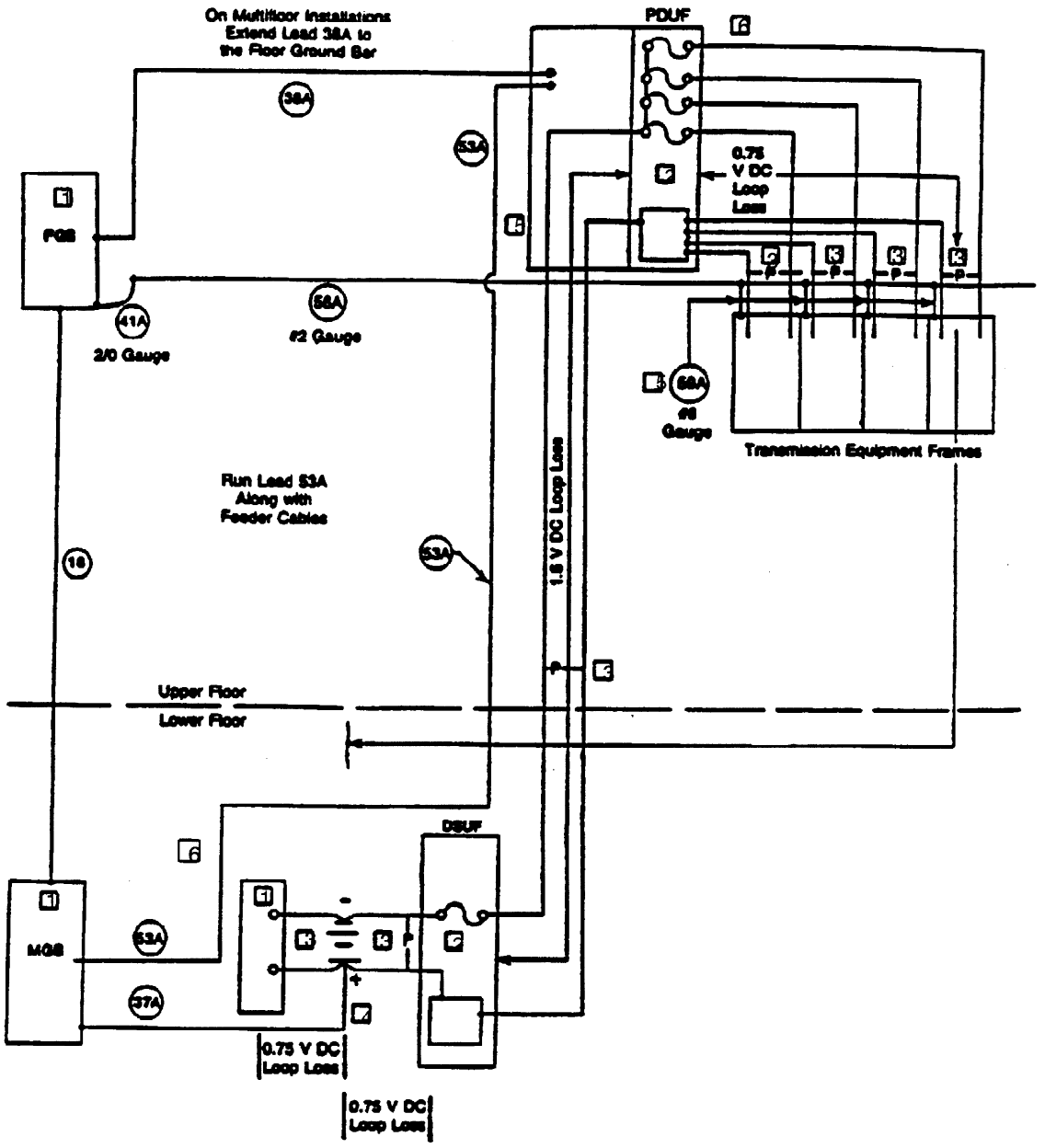
NOTES:
1. See Practice 795-805-071 for details.
2. Return bus isolated from frame or relay rack.
3. "P" denotes that positive return leas are paired with the negative.
4. Each Lead 59A must be less than three feet.
5. Connect to the frame Lead 53A and 38A.

Exhibit 3 - Single Point Grounding 50 Volts Wiring for Transmission Equipment on a Single Floor



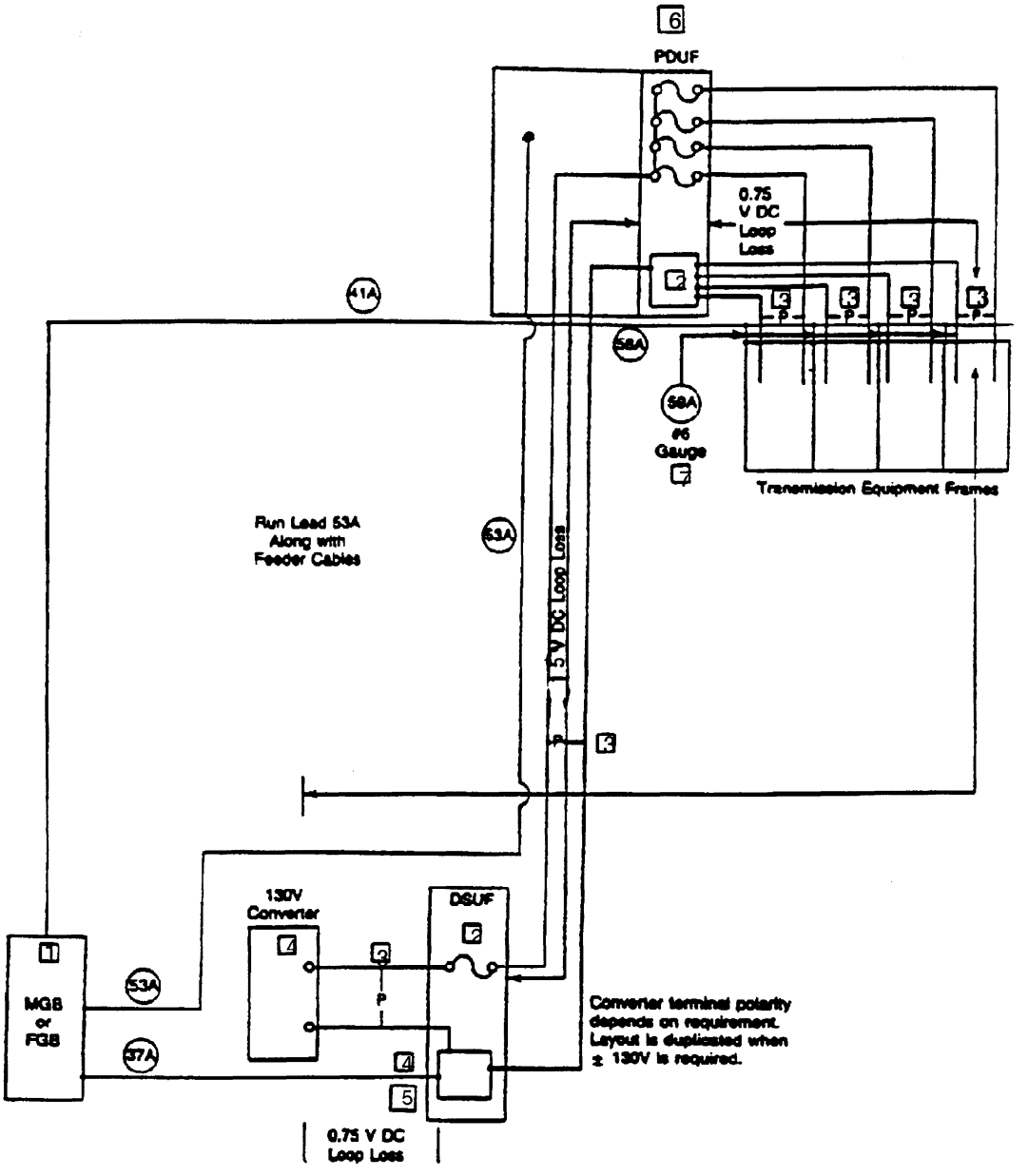
NOTES:
1. See Practice 795-805-071 for details.
2. Return bus isolated from frame or relay rack.
3. "P" denotes that positive return leads are paired with the negative power leads on cable runs.
4. ± 130V terminal.
5. Each Lead 59A must be less than three feet.
6. Extend lead (53A from the frame to the ground bar). See Section 3.4.

Exhibit 4 – Single Point Grounding Composite± 130 Volt Battery Plant Wiring for Transmission Equipment on a Single Floor



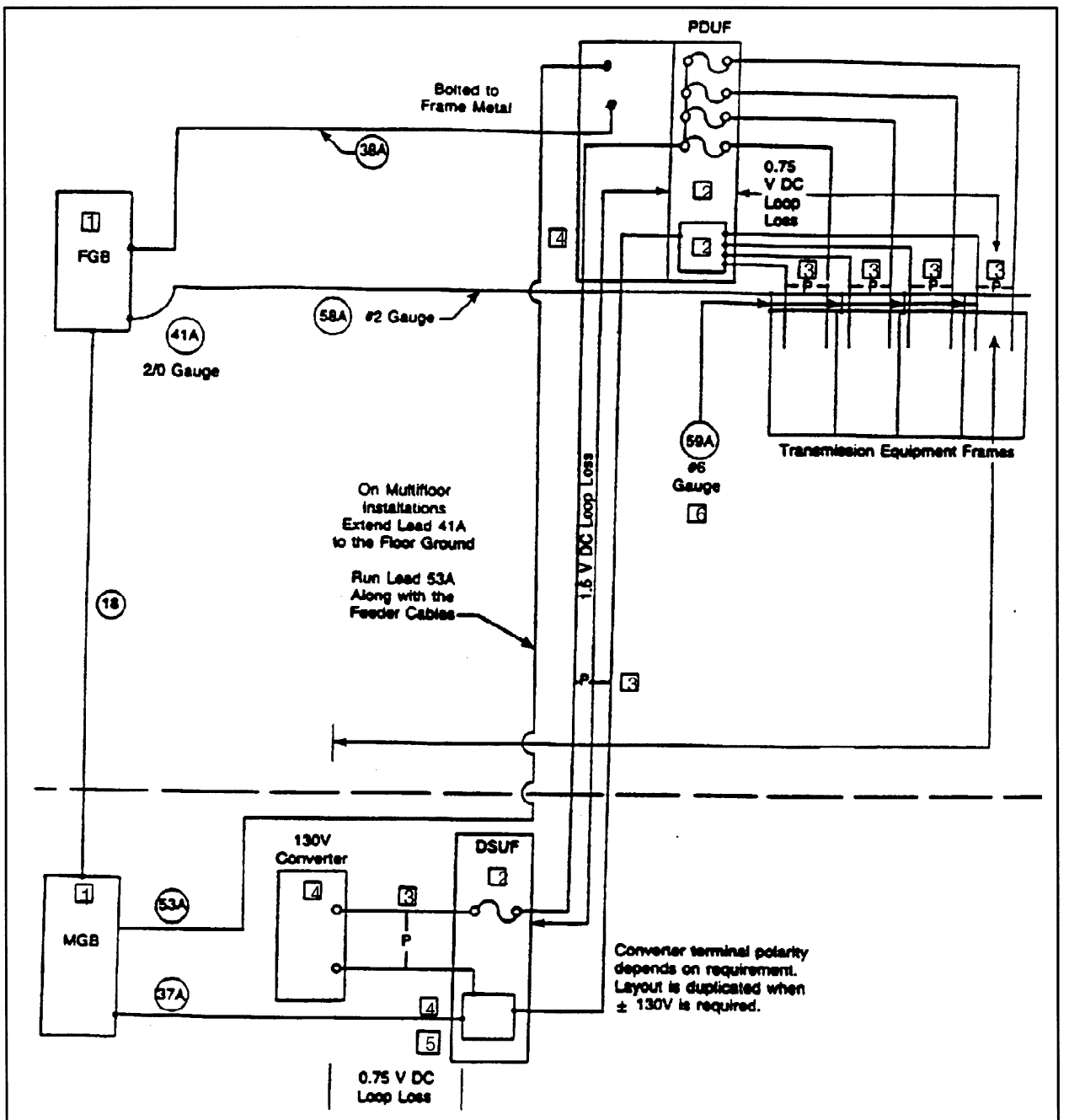
NOTES:
1. See Practice 795-805-071 for details.
2. Return bus isolated from frame or relay rack.
3. "P" denotes that positive return leads are paired with the negative power leads on cable runs.
4. ± 130V terminal.
5. Each Lead 59A must be less than three feet.
6. Provide Lead 53A and connect it to the ground bar.

Exhibit 5 - Single Point Grounding Composite± 130 Volt Battery Plant Wiring for Transmission Equipment on Multiple Floors



NOTES:
1. See Practice 795-805-071 for details.
2. Return bus isolated from frame or relay rack.
3. "P" denotes that positive return leads are paired with the negative power leads on cable runs.
4. ± 130V terminal.
5. In converter operation one lead per unit to FGB.
6. Either DSUF or PDUF not always required.
7. Each Lead 59A must be less than three feet.

Exhibit 6 – Single Point Grounding Composite± 130 Volt Converter Wiring for Transmission Equipment on a Single Floor



NOTES:
1. See Practice 795-805-071 for details.
2. Return bus isolated from frame or relay rack.
3. "P" denotes that positive return leads are paired with the negative power leads on cable runs.
4. ± 130V terminal.
5. In converter operation one lead per unit to FGB.
6. Each Lead 59A must be less than three feet.

Exhibit 7 – Single Point Grounding Composite± 130 Volt Converter Wiring for Transmission Equipment on Multiple Floors

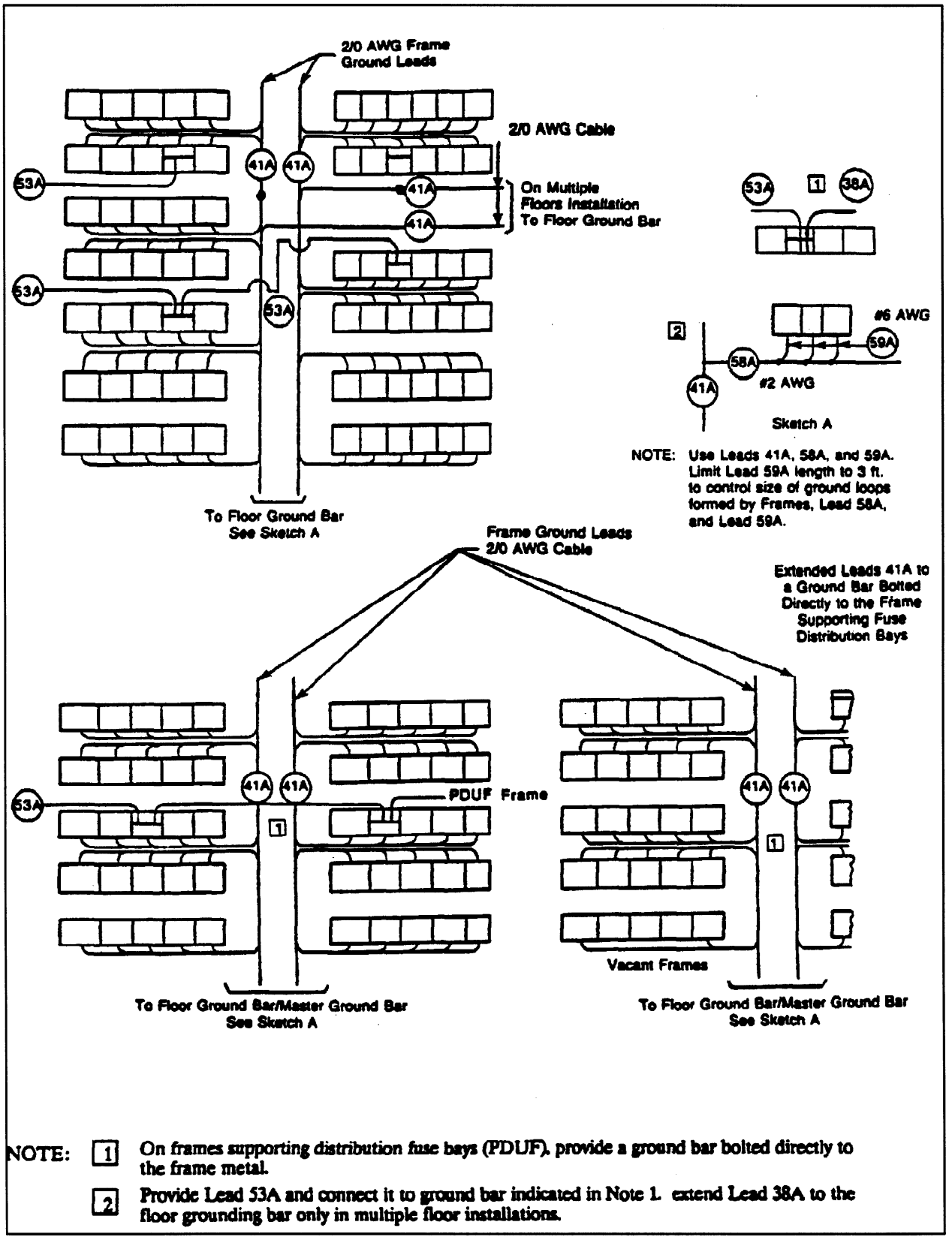
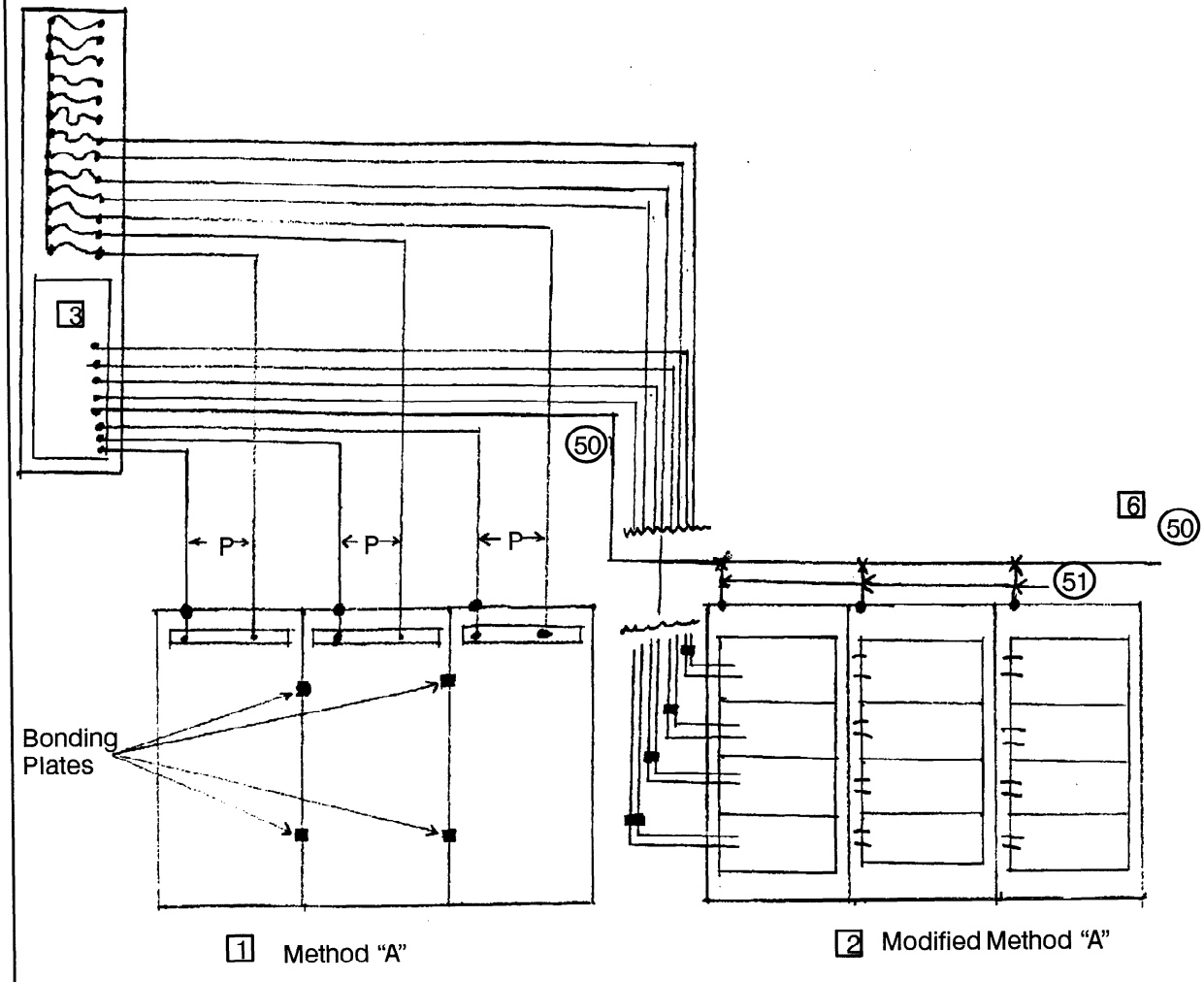


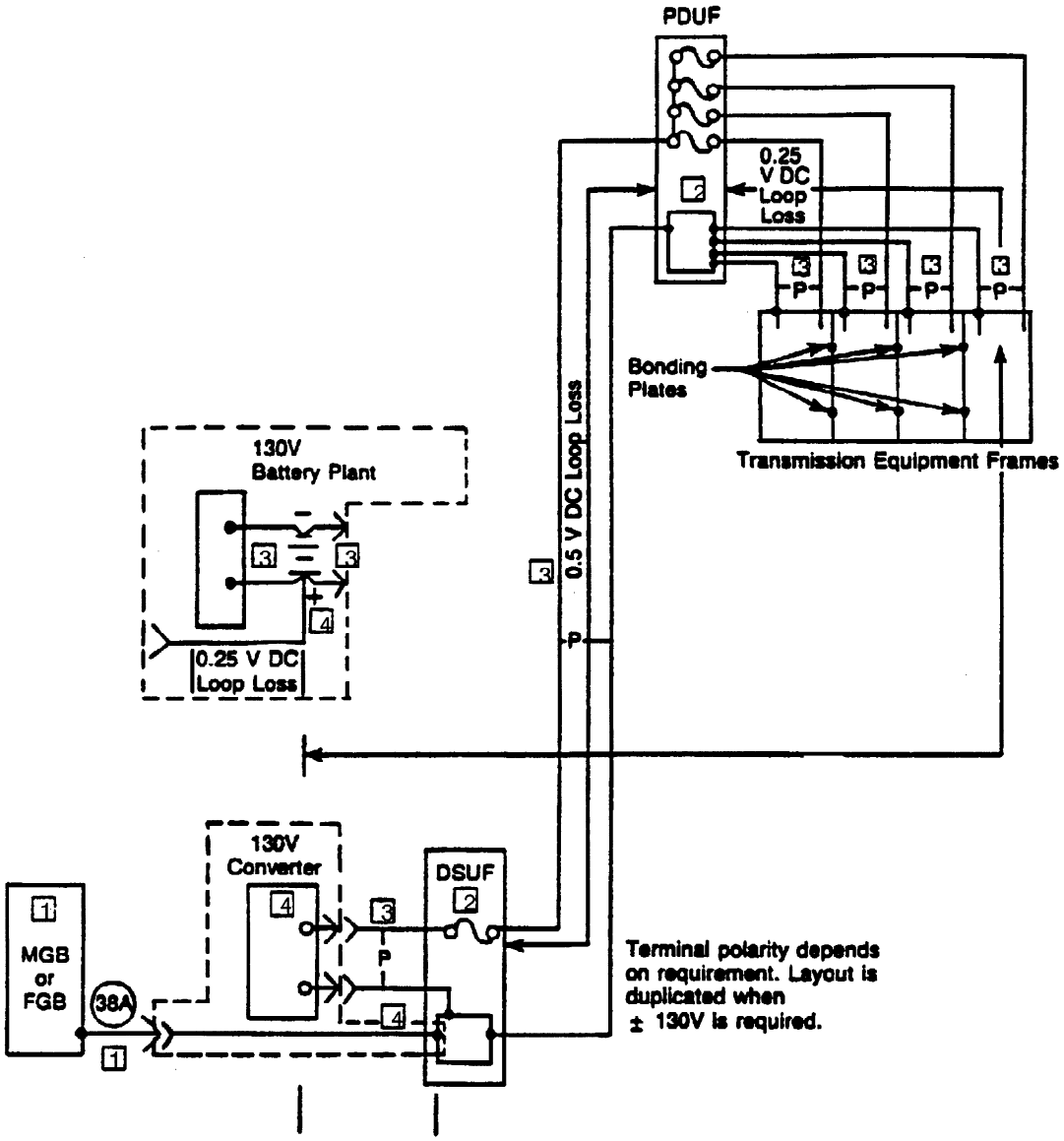
Exhibit 8 – Transmission System Frame Grounding Required for New Installation or Line-ups



NOTES:
1. Not permitted for frame additions or office changeouts.
2. Used when more than two feeders are run to the same bay (i.e., SLC-5 COT) or when plug end cables prevent terminating positive return to chassis (i.e., DDM 2000, OC/3 40C/12).
3. Return bus isolated from frame or relay rack.
4. P denotes that positive return leads are paired with negative power leads on cable runs.
5. Methods B&C are no longer a system standard.
6. Lead 50 must be run to the PDUF Return Bus serving eq frames/relay racks. Use more than one Lead 50 if needed.

Exhibit 9 - Integrated Grounded Composite 50 Volt Wiring for Transmission Equipment

NOTE: Not permitted for frame additions.



NOTES: [1] See Practice 795-805-071 for details.

[2] Return bus isolated from frame or relay rack.

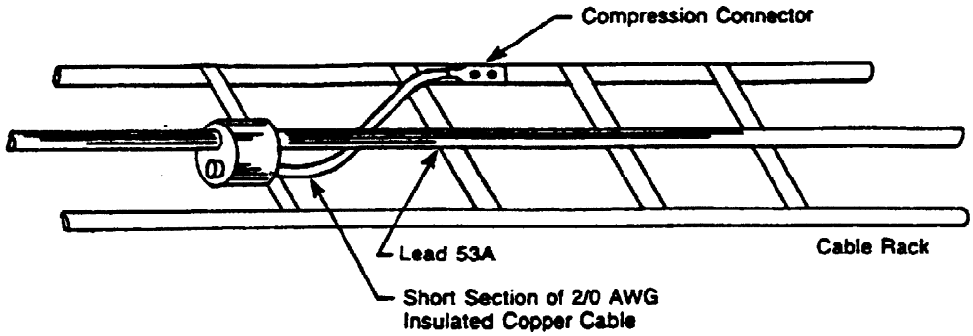
[3] "P" denotes that positive return leads are paired with the negative power leads on cable runs.

[4] ± 130V terminal.

[5] One lead per unit to FGB.

[6] Either DSUF or PDUF not always required.

Exhibit 10 - Existing Integrated Grounded Composite ±130 Volt Wiring for Transmission Equipment



Use a short tail section (10 inches or less) of 2/0 AWG insulated copper cable tapped from Lead 53A and terminated on compression connectors. See GTE Practice 256-050-207, "Terminating Power Cable Using Compression Connectors and Lugs" for proper H-type compression taps and two-hole connectors. Use bolts to connect to the cable steel rack after the metal is drilled, paint scraped, and the contact surfaces cleaned.

Exhibit 11 - Method of Bonding 53A to Supporting Cable Racks

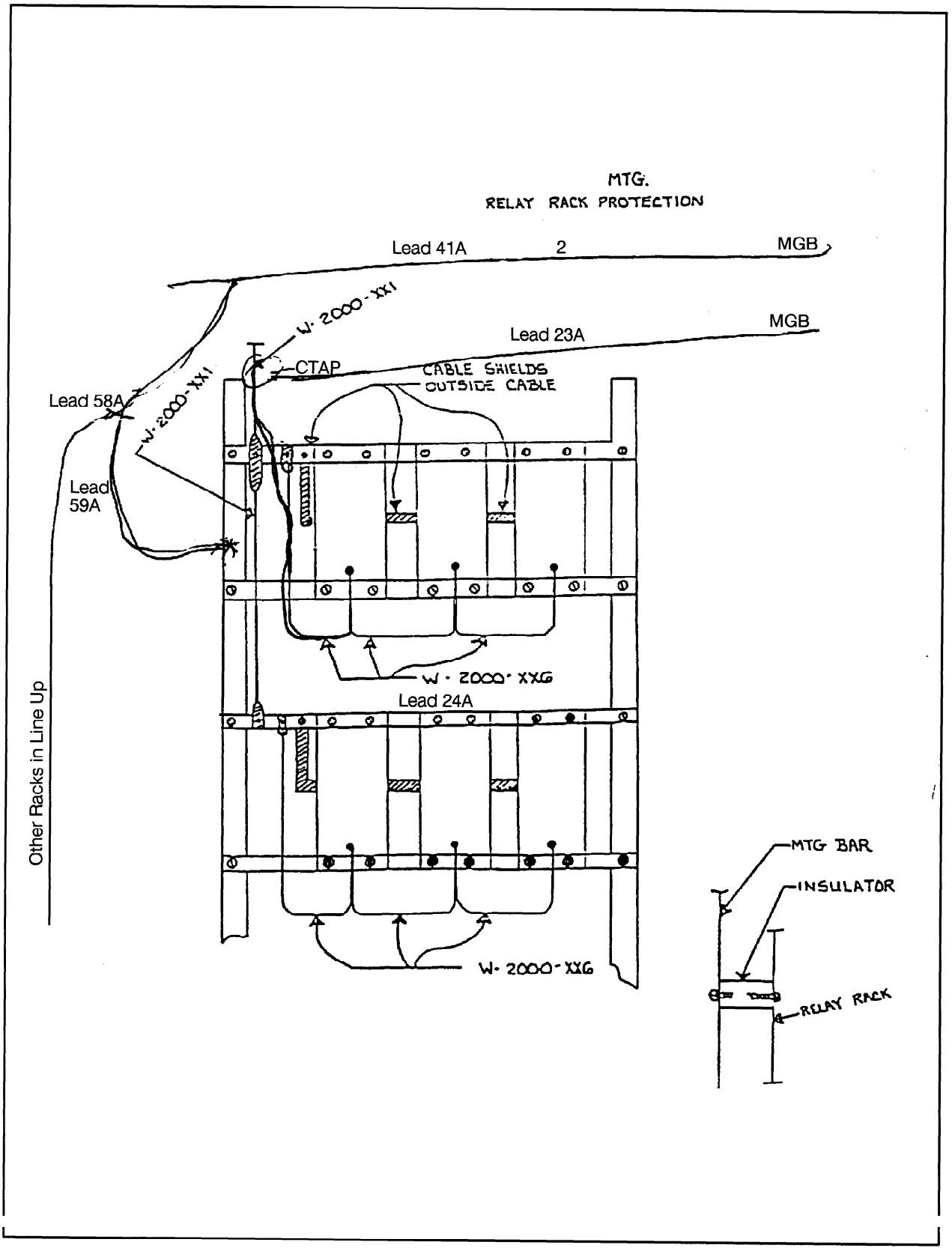


Exhibit 12 – Relay Rack Protection