

Engineering Guidelines for Grounding Lucent Technologies Switching Equipment in GTE Facilities

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1. General

- 1.1 Purpose** This practice:
- Provides engineering guidelines for grounding Lucent Technologies (formerly AT&T) equipment located in GTE Telephone Operations' facilities.
 - Describes how the grounding of the Lucent Technologies 5ESS switching system (hosts and remotes) are connected to GTE central office (CO) grounding systems.
 - Supplements Lucent Technologies' practices for GTE applications.
- NOTE: GTE installation procedures must be consistent with 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.
 - E - SW - AT&T 235-060-072 Grounding Procedures for AT&T Switching Systems.
- 1.3 Reason for Reissuing** This practice has been reissued to:
- Incorporate multiple changes in the content.
 - Reflect changes agreed to by Lucent Technologies and GTE.
 - Clarify procedures.
- 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 Headquarters Protection Engineering Support Department.
- 1.5 Disclaimer** This practice was prepared solely for the use of GTE Telephone Operations. It must be used only by its employees, contractors, 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 and terms used in this practice.

Acronym or Term	Definition
ACEG	AC Equipment Grounding
Bonding	The permanent joining of metallic parts to form an electrically conductive path that assures: <ul style="list-style-type: none">• Electrical continuity.• The capacity to conduct safely any current imposed.
CB	Collection Bar
CEV	Controlled Environment Vaults
CO	Central Office
Conductor	A material – usually wire, cable, or bar – suitable for carrying an electric current.
DLC	Digital Loop Carrier
DSU	Disconnect Switch Unit -The first fuse location on the load side of the power plant that: <ul style="list-style-type: none">• Contains the single or multiple main fuses for the entire DC power system.• Can contain disconnect switches for each main fuse.• Can be called the main power board.• Can serve local and remote PDUs.
ECPGB	Entrance Cable Protector Ground Bar

(continued)

2. Overview, continued

2.1 Definitions, continued

Acronym or Term	Definition
Effectively Grounded	<ul style="list-style-type: none">Intentionally connected to the earth through a ground connection or connections of sufficiently low impedance. AND <ul style="list-style-type: none">Having sufficient current-carrying capacity to prevent the buildup of voltages that can result in hazards to connected equipment or persons.
FG	Frame Ground
FGB	Floor Ground Bar
GPDF	Global Power Distribution Frame
Ground	A conducting connection between any electrical circuit or equipment and: <ul style="list-style-type: none">The earth. OR <ul style="list-style-type: none">A body that serves in place of the earth.
Grounded	Connected: <ul style="list-style-type: none">Directly to ground.Through a conducting object that provides a low-impedance path to the earth.
Grounded Conductor	A conductor grounded intentionally
Grounding Conductor	A conductor: <ul style="list-style-type: none">Used to establish a ground.That connects a device, equipment, wiring system, or another conductor with the grounding electrode(s).
Grounding System	The combination of conducting elements used to connect all equipment to the earth.

(continued)

2. Overview, continued

2.1 Definitions, continued

Acronym or Term	Definition
Ground Window	A dimensional transition zone consisting of a sphere with a three-foot radius that is the interface between the integrated ground plane and a given isolated ground plane.
GWB	Ground Window Bar
GWE	Ground Window Equalizer
ICB	Integrated Collection Bar
IGZ	Isolated Ground Zone
Incidental Ground	An unplanned, accidental connection to ground.
Integrated Zone	The area in a CO where all the equipment is connected intentionally or incidentally to ground through more than one point.
Isolated Zone	The area in a CO where the equipment is: <ul style="list-style-type: none">• Insulated from the building.• Grounded by a single connection through the main ground bus (or ground window).
kcmil	One thousand circular mils. Replaces MCM.
Main Ground Bus	Bus bar or bars located within the ground window that provide the electrical interface for connections between the site's integrated ground plane and the isolated ground plane.
MCC	Master Control Center
MGB	Master Ground Bar
MMSU	Modular Metallic Service Unit
NEC	National Electrical Code
OPGP	Office Principal Ground Point: <ul style="list-style-type: none">• Area where various CO grounding conductors are connected.• Allows the conductors access to the grounding electrode system.
PCDF	Power Control Distribution Frame
PDF	Power Distribution Frame

(continued)

2. Overview, continued

2.1 Definitions, continued

Acronym or Term	Definition
Power Distribution Unit (PDU)	<ul style="list-style-type: none"> Is often fed locally or remotely by a DSU. Can provide the first fuse location on the load side of the battery power plant in smaller office applications. When the PDU serves as the first fuse location, it can be called the main power board. Subsequent PDUs can be served from the main fuses. Can contain single or multiple main fuses and distribution fuses.
SPG	<p>Single Point Ground - Refers to the grounding of a system or equipment to a ground plane via a single connection. The SPG functions to equalize potential differences between otherwise unconnected planes.</p> <p>For digital electronic systems, SPG implies:</p> <ul style="list-style-type: none"> An isolated ground zone (plane). A dedicated DC power return. A single connection between the IGZ to reference ground.
STLWS	Supplementary Trunk Line Workstation
THHN	Type of insulated conductor. Insulation is thermoplastic and heat resistant.
VE	Vertical Equalizer

2.2 Terminology

The following chart includes some terms that have different usage or meaning between tucent Technologies and GTE.

What Lucent Technologies Calls...	GTE Calls...
Central Office Ground (CO GRD)	Master Ground Bar (MGB)
Integrated Ground Plane	Integrated Ground Zone
Isolated Ground Plane (IGP)	Isolated Ground Zone (IGZ)
Main Ground Bus (MGB)*	Ground Window Bar (GWB)
Office Principal Ground Bar (OPGB)	Master Ground Bar (MGB)

* In multiple floor offices, the floor ground bus may act as the GWB

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...
795-805-071	Central Office Grounding Systems - Engineering Applications
795-805-072	AC Service Grounding - Engineering Applications
795-805-073	Central Office Grounding -Transmission Equipment
795-805-075	Remote Electronic Serving Area Grounding Systems-Engineering Considerations
887-000-001	Requesting Deviations from Protection Practice Requirements
887-903-026	Five-Pin Protector Modules - Application
938-360-010	Outside Plant Engineering of Digital Loop Carrier Systems
938-360-012	Power Pedestal - Description and Application

3. Engineering Guidelines

3.1 Basic Guidelines

To ensure compatibility with GTE's grounding philosophy when Lucent Technologies' switching equipment is installed in a GTE Telephone Operations facility, the following applies:

- Lucent Technologies' guidelines are applicable on the isolated side of the collection bus bar (i.e., within the switch area) and as modified by this practice.
- GTE's guidelines are applicable on the integrated side of the collection bus bar (i.e., outside the perimeter of the Lucent Technologies switch).

3. Engineering Guidelines, continued

3.2 Lucent Technologies' Guidelines

Lucent Technologies' guidelines for the equipment located within the IGZ are provided by the engineering drawings and associated Lucent Technologies' practices that are in effect when the equipment is ordered (refer to NSEP 52.75, 12/7/94 or later).

3.3 GTE's Guidelines

GTE's guidelines for the equipment located within the integrated zone (including any Lucent Technologies transmission systems equipment) are in the 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 or 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 support staff (Protection).

3.5 Interface

The interface point between Lucent Technologies' and GTE's guidelines is at the collection bus bar (see Exhibit 1).

The Ground Window location is now the OPGB or MGB. The Ground Window is extended into the 5ESS area (IGZ) via a 750 kcmil cable to a CB as Lead 85. Lead 85 provides an extension of the OPGB/MGB (or Ground Window) within the 5ESS area in order to terminate all ground cables in the switch area. The CB is designed to accommodate both an isolated and integrated side. This eliminates the need to run any ground cables back to the OPGB/MGB (GWB), such as Leads 80 - 89. These leads can now terminate on the CB.

NOTE: In multiple floor offices the floor ground bus may act as the GWB.

3.6 Collection Bus Bar

The CB is GTE's name for Lucent Technologies' main ground bus. The CB is connected to the MGB/FGB via Lead 8.5 which does not carry current under normal conditions.

NOTE: The CB is not over three-feet (1 m) long and is drilled to accept two-hole compression lugs.

3. Engineering Guidelines, continued

3.7 Collection Bar Connection

The frame grounding conductors belonging to the isolated ground plane of the Lucent Technologies switching equipment are connected to the CB.

3.8 Temporary Disconnections

If any lead connected to the CB cause operating problems or induce unacceptable noise in the GTE System, GTE reserves the right to temporarily disconnect them. The disconnected leads are reconnected when the problem is resolved.

3.9 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.

NOTES: Lead 37's point of attachment must be within three feet (1 m) of the battery's positive terminal to maximize the filtering effect of the battery.

Exhibit 1 shows Lead 37 terminating at the ground discharge side of the bus bar of the Lucent Technologies Power Plant (J85500A or the J85500G). This allows GTE to measure all current load fed from that power plant.

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 (9 m) 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 (15 m) long.
- 750 kcmil if the:
 - Building is multistory.
 - Office drain is more than 500 amps.
 - lead is more than 50 feet (15 m) long.

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

When using several ground splice plates over the PCDF/GPDFs, the plates are connected in series with a 750 kcmil cable. The last splice plate must not be connected to the first so as not to form a loop.

3. Engineering Guidelines, continued

3.10 Positive Shunt System

Lucent Technologies uses a positive shunt system in its new power plants. Lead 37 is connected on the discharge side of the shunt in offices equipped with a Lucent Technologies power plant with a positive shunt system (see Exhibit 1).

NOTES: ECS-type power plants are generally used with small hosts and remote offices. Larger MCS-type power plants are located with the battery plant in order to keep Lead 37 in close proximity (within three feet (1 m)) to the batteries.

The distance from the discharge (+) bar to the battery post (+) must not exceed three feet (1 m).

Split or dual bus is not needed for the 5ESS switch. Separate fuse/breakers must be used for isolated and nonisolated loads.

NOTE: Do not use the same fuse/breaker for both isolated and nonisolated loads.

3.11 Current Flow

There must not be current flowing, under normal conditions, between the CB and The MGB/FGB (Lead 85).

NOTE: Current flow indicates that the integrity of the IGZ was violated. The fault must be located and corrected.

3.12 Lead Designations

See Exhibit 2 for lead designations and standard conductor sizes. Leads terminating at the MGB must use the lead designations established by Exhibit 2 in GTE Telephone Operations Practice 795-805-071.

All grounding conductors inside the GTE CO (including remote buildings and CEVs but excluding cabinets) are jacketed or insulated. One exception is Lead 83 which can be a bare copper conductor.

The power plant discharge ground bar and the battery return busbars (located above the PCDF/GPDF) are not used as the CB. Only battery return leads terminate on them.

3. Engineering Guidelines, continued

3.13 Modular Boards

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 there are deliberate ground connections between the:
 - Lead 29 AC ground positions and the chassis of the rectifier shelf.
 - Rectifier shelf chassis and the frame ironwork.

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

- 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 nonpainted surface using the compression lugs and an approved joint compound.
- Lead size (from Lead 31 to the equipment) must be a minimum of a #6 stranded.

All ground connections must be deliberate. When the requirements of this section cannot be met, Lead **32** must be added and terminated at the same point (electrically) as Lead 29 on a one per charger shelf basis (refer to GTE Telephone Operations Practice 795805072).

3.14 Lucent Technologies' Six-Foot Rule

Lucent Technologies' six-foot (2 m) rule:

- Is applicable to GTE's installations only when the 5ESS switching equipment is located on a different floor level than the DC power plant.
- Does not apply when the 5ESS switching equipment is located on the same floor level with the MGB/FGB which also serves other equipment in the immediate area which is grounded per GTE Telephone Operations Practices.

The requirements contained in GTE Telephone Operations Practices 795-805-071, 795-805-072, 795-805-073, and 795-805-075 provide bonding requirements for the equalization of voltages to prevent potential differences.

GTE's grounding concept minimizes potential differences throughout the CO, common bonding is not required for the 5ESS sites unless the 5ESS switching equipment is located on a different floor level than the MGB.

3. Engineering Guidelines, continued

3.15

Location

The location requirements are as follows:

- Do not locate the switching system more than one floor away from the DC power plant.
- Separations of more than one floor are reviewed by the Headquarters Engineering Support Staff (Switching, Power and Protection Groups) to ensure that GTE and Lucent Technologies protection requirements are met.

3.16

Master Ground Bar (MGB)

GTE Telephone Operations Practices 795-805-071 and 795805075 have specific requirements for the MGB that must be met. MGB requirements include the following:

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

The OPGP/MGB is zoned with Surge Producer cables (P), Surge Absorber cables (A), Integrated (N), and Isolated (I) separated (refer to GTE Telephone Operations Practice 795-805-071, Exhibit 1).

3.17

Digital Loop Carrier (DLC) Cabinets

The DLC cabinets requirements are as follows:

- GTE Telephone Operations Practices 795-805-075, 938-360-010, and 938-360-012 specify the cabinet grounding and AC power requirements for DLCs.
- Two Lead 5s and one Lead 13 terminate at a cabinet ground bar that is equivalent to the MGB. This ground bar must hold two-hole compression lugs.
- Protector modules furnished by Lucent Technologies must be a solid state type 6ESE). Refer to GTE Telephone Operations Practice 887-903-026.

3.18

Distributing Frames

The distributing frames requirements are as follows:

- GTE specifications do not allow isolation of protectors from the MDF framework. Ground the connector block to the ECPGB with Leads 23, 23A, 24, and 24A (refer to GTE Telephone Operations Practice 795-805-071).
- There must be a grounding conductor (Lead 23) from the ECPGB to the MGB every 17 feet (5.1 m) beginning with vertical 1. No protector vertical should be more than 8.5 feet (2.5 m) away from Lead 23.
- When the modular-type distributing frame does not have an ECPGB, a 3/0 AWG stranded or solid bare copper conductor is placed along the length of, and bonded to, the distributing frame to serve as the ECPGB.

3. Engineering Guidelines, continued

3.19 AC Grounding

All commercial AC wiring brought into the switch area must be in nonmetallic conduit. The AC grounding conductor (ACEG or green wire) is run within the nonmetallic conduit. Lead 20 is run from the AC panel to the OPGP/MGB. The following receptacles are used:

- Isolated (orange) receptacles are used for AC circuits that are commercially powered (i.e., outside of the IGZ). This type of receptacle requires a separate isolated ground bus (refer to GTE Telephone Operations Practice 795-805-072).
- Regular (brown) receptacles are used for AC circuits that are inverter fed.
- For nonessential AC (i.e., end-aisle receptacles) Lucent Technologies must provide nonmetallic conduit and boxes, plastic receptacle covers, and a third-wire ground (ACEG). Label the receptacles to indicate their usage and power source location.
- For essential AC receptacles Lucent Technologies must provide nonmetallic conduit and boxes from the inverter to the equipment frames, a third-wire ground (ACEG), and standard brown receptacles.

NOTE: When local conditions require the use of metallic conduit and/or receptacle boxes, the outlets (receptacles) installed in the equipment frames and the conduit must be Isolated from the framework (in IGZ).

3.20 Lighting

Metallic light fixtures and their metallic supports must be isolated from equipment frames (relay racks). Frame additions to the existing frame line-up can continue using the existing method of lighting

3.21 Commercial AC Cabling

Commercial power cabling must be fated, as a minimum, THHN (refer to NEC Table 310-13). The cabling must not be routed or run on cable runways. The grounding cables can be either black or green in color.

3.22 Modems

GTE requires that modems (announcers, etc.) be engineered for DC power to prevent the use of external (commercial) AC power in the IGZ area of the switch.

3.23 Inverters

All inverters are considered Separately Derived Sources. The inverters:

- Installed inside the IGZ must be isolated from the frame (relay rack).
- Regardless of physical location (inside or outside of the IGZ) all inverters must have a lead 20A.

Lead 20A (refer to GTE Telephone Operations Practice 795-805-072) goes from the N (neutral) and G (ground) terminals at the output (AC) side of the inverter directly to the MGB/FGB.

NOTE: The N (neutral) and G (ground) terminals at the output (AC) side of the inverter are connected together as required by the NEC.

3. Engineering Guidelines, continued

3.23 Inverters, continued

The choices for placing Lead 20A are:

- Preferred – Run an individual Lead 20A from each inverter to the MGB/FGB.
- Alternate- Run an individual Lead 20A from each inverter to the top of the rack/frame and H-tap to #1 AWG conductor going to the MGB/FGB.

NOTE: The inverters described in Section 3.23 have DC input and AC output. There is no secondary AC input (or if one exists it is not used).

3.24 Storage Cabinets

The following methods are used when grounding Spare Card/Circuit Pack storage cabinets:

- If the metallic cabinet is in the IGZ it is grounded by connecting Lead 54 to the MGB/FGB.
- When the cabinet is outside the IGZ it is grounded to the MGB/FGB via lead 54.

3.25 Miscellaneous Equipment

Miscellaneous, non-Lucent Technologies, integrated equipment i.e., 4-Tel, should be isolated from the frame.

Ground the integrated equipment using the following methods. If the equipment:

- Includes an internal connection to the battery return, the battery return is the ground for the equipment.
- Does not have an internal connection to the battery return, an external ground lead is run from the chassis to the MGB/FGB.

NOTE: Do not use Lead 41 (or equivalent).

3.26 Transmission Equipment

The transmission equipment requirements are as follows:

- GTE requires that all new transmission equipment be installed in an isolated zone.
- New equipment frames:
 - Are isolated from the floor and overhead framework.
 - Added in a lineup with existing integrated equipment must be separated by a minimum of 1 inch (25 mm) air gap.
- There must not be any connections between the integrated frames and the isolated frames.
- When a new equipment frame is installed between two existing integrated frames and there is not sufficient space to establish a 1 inch (25 mm) air gap, the new frame must be an integrated frame.

NOTE: Transmission equipment must be installed and grounded (refer to GTE Telephone Operations Practices 795-805-071 and 795-805-073).

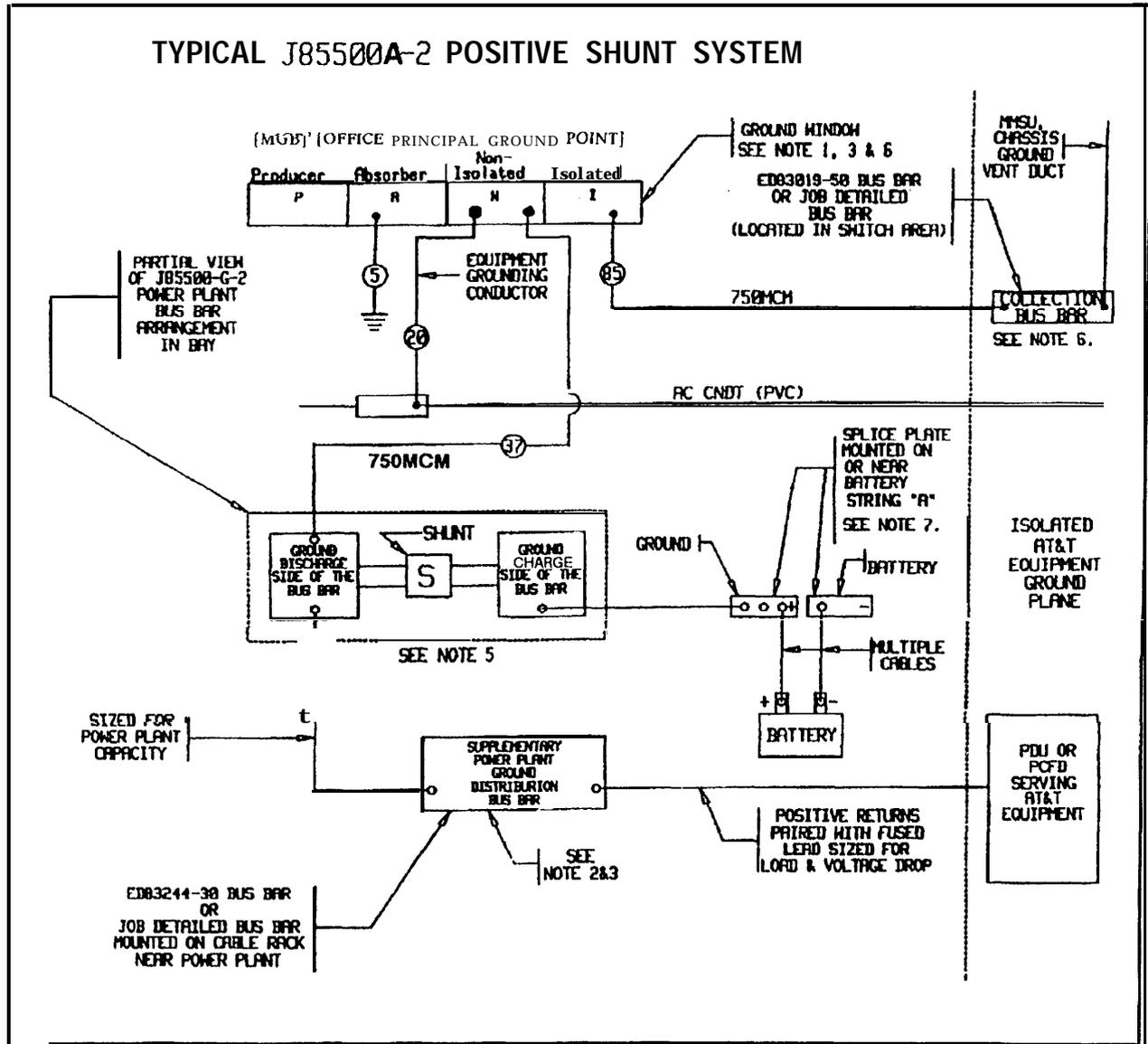


Exhibit 1 - Positive Shunt System (Page 1 of 3)

Exhibits, continued

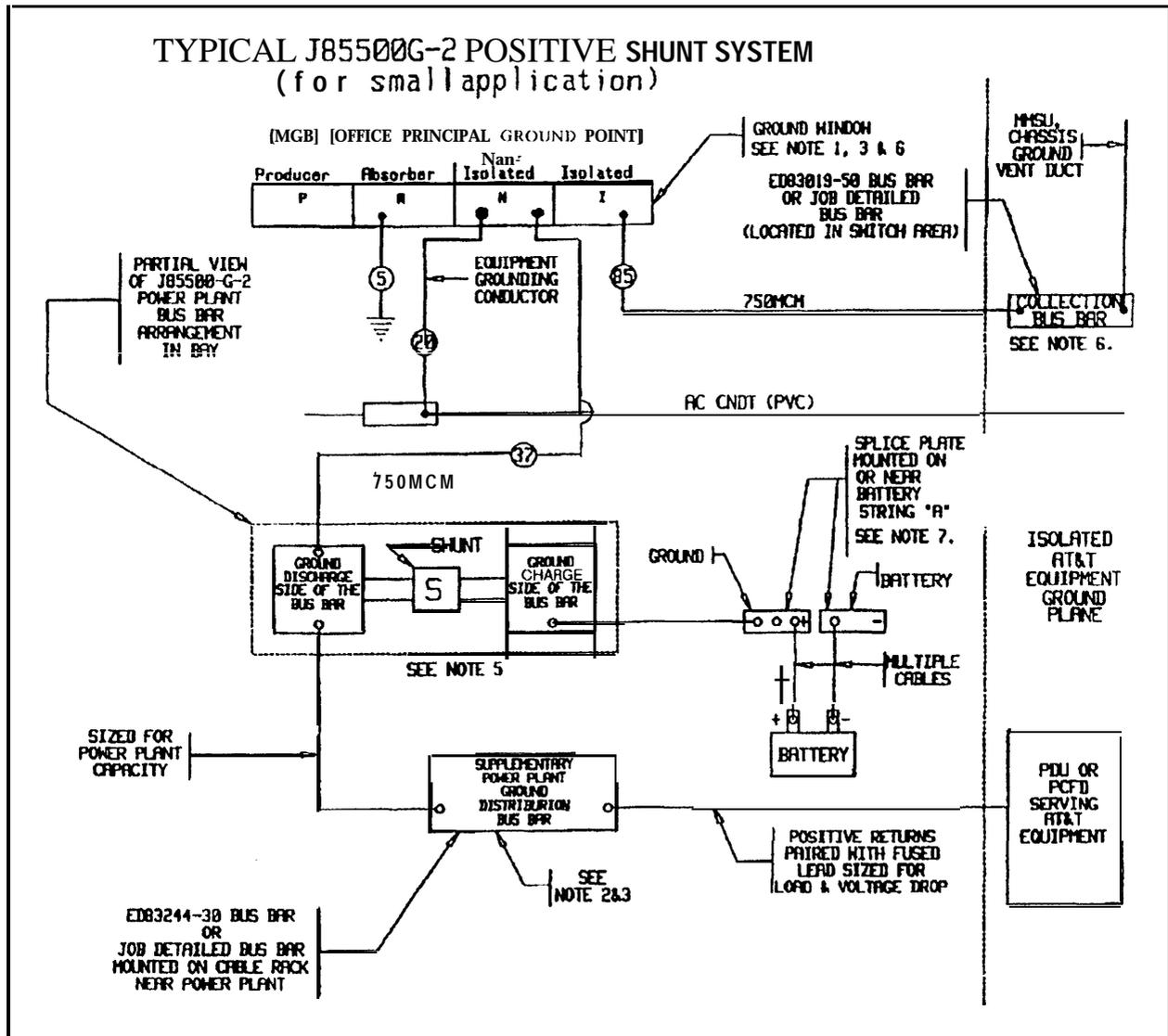


Exhibit 1 - Positive Shunt System (Page 2 of 3)

Exhibits, continued

ENGINEERING NOTES (POWER WILL BE ON THE SHORT ORDER INPUT SHEETS ALSO):

1. GROUNDING PRACTICE 795-805-078 BETWEEN GTE AND LUCENT TECHNOLOGIES AS OUTLINED IN THE SCHEMATIC ABOVE ARE USED IN ALL GTE DIGITAL CENTRAL OFFICES WHETHER NEW POWER PLANTS ARE BEING INSTALLED OR REUSING EXISTING POWER PLANTS. DEVIATIONS FROM THIS SCHEMATIC, WITHOUT PRIOR WRITTEN APPROVAL FROM GTE TELCO ENGINEERING DEPARTMENT WILL HAVE TO BE CORRECTED AT CONTRACTOR'S EXPENSE.
2. MASTER GROUND BAR (MGB) AND OPGP ARE THE SAME BUS BAR IN MULTI-FLOOR BUILDING. THIS COULD ALSO BE A FLOOR GROUND BAR (FGB). MGB IS ESTABLISHED BY GTE.
3. POWER PLANT DISCHARGE GROUND BAR IS NOT TO BE USED AS GROUND WINDOW AND IS FOR BATTERY RETURNS ONLY EITHER THE SUPPLEMENTARY DISTRIBUTION BUS BAR (MOUNTED FROM THE CABLE RACK) OR THE DISCHARGE GROUND BAR (LOCATED WITHIN THE BAY) CAN BE USED FOR BATTERY RETURN TERMINATIONS.
4. CB (COLLECTION BUS) LOCATION IS CUSTOMER SELECTABLE PER GTE CORPORATE PREFERRED IS IN THE SWITCH AREA: BUT CAN ALSO BE IN A POWER ROOM DEPENDING UPON OFFICE CONDITIONS. THE 3 FOOT(1M) LIMITATION TO DISCHARGE GROUND IS NO LONGER IN EFFECT, WITH ALTERNATIVES OUTLINED IN GTE TELEPHONE OPERATIONS PRACTICE 795-805-078.
5. FOR OFFICES UTILIZING J85500A-2 LINEAGE POWER PLANT THIS WOULD BE BUS BAR ASSY. OVER THE BATTERY STAND.
6. THIS CB BUS IS CONSIDERED AN EXTENSION OF THE MGB. REFER TO GTE TELEPHONE OPERATIONS PRACTICE 795-805-071,
7. NOT REQUIRED WHEN BUS BAR ASSY PER J85504A OR B IS USED OVER BATTERY STAND.
8. LEAD 31 IS FROM THE INTEGRATED PART OF THE MGB/FGB.

Exhibit 1 - Positive Shunt System (Page 3 of 3)

Exhibits, continued

LEAD NO.	BY	FOR	FROM	TO	AWG-STD	NOTES
80	EF&I	5ESS	Collection bar isolated side	PDUF (PCFD) or misc cab eqpt grd	1/0	Insulated copper
81	EF&I	5ESS	Collection bar isolated side	Lead 82	1/0	Insulated copper
82	EF&I	5ESS	Lead 81	Aisle frame	6	Insulated copper to bare in trough
83	EF&I	5ESS	Lead 82	Individual eqpt frames	6	Bare copper to each frame
84	EF&I	5ESS	Collection bar isolated side	MCC or STLWS	6	Insulated copper
85	EF&I	5ESS	MGB	Collection Bar	*	Insulated copper
86	EF&I	5ESS	Collection bar integrated side	CB	1/0	Insulated copper
87	EF&I	5ESS	Collection bar integrated side	Lead 88	2	Insulated copper
88	EF&I	5ESS	CB or Lead 87	Metallic objects within 6 ft.	6	Insulated copper
89	EF&I	5ESS	Collection bar isolated side	MMSU quiet grd	16	Insulated copper

* Size per Section 3.9.

Exhibit 2 - Lead Designatlns and Standard Conductor Sires