

Isolated Ground Faults Detection and Troubleshooting Switching and Transmission Systems

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1. General

1.1

Purpose

This practice:

- Provides instructions for ensuring the integrity of the isolated ground system in switching and transmission systems.
- Introduces the requirement for testing isolated ground leads to other ground sources.

NOTE: Current equipment installations must be performed to meet single-point ground and isolated power configurations. Because card failures and equipment breakdown can contaminate the isolated ground system, Maintenance must routinely verify the system's integrity.

1.2

Filing

Instructions

and

Supersedures

File this practice in numerical order 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_

NOTE: This practice does not supersede any requirements specified in other GTE Telephone Operations grounding practices (795-805-xxx series).

1.3

Responsibility

This practice was published by the GTE Telephone Operations Administrative Services Department. For more information about this practice, contact the GTE Telephone Operations Headquarters Central Office Construction Support Department.

1.4

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 Test Tools

The following test tools are required for use in identifying ground faults on Leads 41, 41A, and/or other isolated ground leads:

- Analog or digital ohmmeter.
NOTE: Digital ohmmeters might be difficult to read because of capacitance between the frame and the floor or between the frame and superstructure.
- Current flow ammeter with AC/DC capability.
- Torque wrench and sockets.
- Box-end wrenches.
- Tone generator, such as one of the following:
 - Halcyon 704.
 - HP3935A.
 - Any other adjustable tone source.
- PR80A with PR81, PR82, and PR83 Tunable Amplifier (with headset), Pan Number 637271, or equivalent (refer to PSB 3307, Item 40).

To assist in locating ground faults through tone detection, an inductive pickup wand/coil should be made for use with the tunable amplifier. A typical assembly can be fabricated from the following materials:

- Standard two-wire cord board-type plug.
- Two-wire cord (approximately six feet long).
- Inductive pickup coil (relay coil).

NOTE: Although AE Part Numbers D281733 and D284776-A work best, almost any single-winding relay coil can be used.

NOTE: This inductive pickup wand must be made locally until GTE is able to have a vendor manufacture it.

2.2 Definitions

The following chart defines the acronyms used in this practice.

Acronym	Definition
AE	Automatic Electric
dB	Decibel
DSX	Digital Signal Cross-Connect
DTUF	Digital Trunk Unit Frame
FGB	Floor Ground Bar
HF	High Frequency
HP	Hewlett Packard

(continued)

2. Overview, continued

2.2 Definitions, continued

Acronym	Definition
Hz	Hertz
LVG	Low Voltage Ground
MGB	Master Ground Bar
MTU	Multi-Terminal Unit
NOC	Network Operations Center
OSP	Outside Plant
PDUF	Power Distribution Unit Frame
PSB	Product Standardization Bulletin

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...
Practice 795-805-XXX	Grounding Requirements
PSB 3307*	Amplifier Tunable – PR80A

* PSBs are published by the GTE Telephone Operations Standardization Management Department.

3. Ground Integrity-Testing and Troubleshooting

3.1 Detecting AC/DC Current

To identify ground faults on Leads 41, 41A and/or other isolated ground leads, take current readings (AC and DC) on the leads at the MGB/FGB, using an AC/DC ammeter. GTE requires 0 current flow on isolated ground leads.

NOTE: On-line systems trouble detection and troubleshooting must not disrupt customer service unless the NOC determines that such a disruption is absolutely necessary. All such work must be performed during the maintenance window (usually 11 p.m.4 a.m. but adjustable by the NOC and Switch Maintenance).

Some offices have switches connected to a ground window bar, collection bar, etc. to establish an isolated ground plane. In these offices, check the frame isolated ground lead at the respective ground bar.

3. Ground Integrity-Testing and Troubleshooting,

continued

3.2 Troubleshooting AC/DC Current Leakage

If current is present on any isolated ground lead, use the AC/DC ammeter and the procedures in the following chart to trace current leakage back to its source.

Step	Tracing Current Leakage
1	<p>If current flow exists on any Lead 41, 41A, and/or other isolated ground lead:</p> <ul style="list-style-type: none">A. Use the ammeter to trace the lead to the equipment lineups.B. Determine which lineups contain ground faults.
2	<ul style="list-style-type: none">A. To trace current flow to a specific frame, use the ammeter to read the ground lead attached to the frames.B. When you suspect a frame to be the source of the current fault, make current readings of the positive and negative DC power leads. <p>NOTE: The leads entering the frame should have the same current reading on both the positive and negative leads; if the readings are not the same, a short to positive is likely.</p> <p>If you cannot trace the current leakage source back to positive battery, the source could be from such items as:</p> <ul style="list-style-type: none">• An LVG.• Other DC reference point leads.• Shorts to the:<ul style="list-style-type: none">- Floor.- Superstructure.- AC conduits.
3	<p>Make a careful visual inspection to eliminate any obvious causes of the current leakage, such as shorts caused by:</p> <ul style="list-style-type: none">• Foreign matter. <p>OR</p> <ul style="list-style-type: none">• Wire shiners.
4	<p>If current leakage persists and you can pursue the problem (the site is not on-line):</p> <ul style="list-style-type: none">A. Using the procedures specified in systems practices and manufacturers' documentation, power down the frame.B. Disconnect the LVG and/or reference ground leads that enter the frame.C. Unseat all printed wiring cards.D. Using the ground fault tone generator and amplifier (see Section 4), locate the fault.

Repeat these procedures until all current is removed from Leads 41, 41A, and/or other isolated ground leads.

3. Ground Integrity-Testing and Troubleshooting,

continued

3.3 Detecting Non-AC/DC Ground Faults

After all current has been removed from isolated ground leads at the MGB/FGB or ground window bar/collection bar, perform the following procedures.

Step	Detecting Non-AC/DC Ground Faults
1	Lift Leads 41, 41A, and/or other isolated ground leads from the ground bar.
2	Using an analog ohmmeter, check for ground faults. NOTE: Digital ohmmeters might be difficult to read because of capacitance between the frame and the floor or between the frame and superstructure.

A reading of 25 megohms or greater indicates acceptable isolation from other ground sources. If the leads are clear, reconnect them to the bar, ensuring proper:

- Lug preparation.
- Torquing.

3.4 Troubleshooting Non-AC/DC Ground Faults

This section describes troubleshooting procedures for ground faults in non-isolated and isolated equipment frames.

3.4.1 Non-Isolated Equipment Frames

Using non-isolated equipment frames is an old installation procedure normally referred to as "integrated grounding." Isolated ground leads must not be tied to this type of equipment because doing so corrupts the single-point ground concept.

Because early installations of equipment frames did not isolate from the floor or overhead ironwork, ground faults within the frames are extremely difficult to locate. However, unless service problems are being experienced, retrofitting for isolation is not recommended.

3.4.2 Isolated Equipment Frames

Troubleshooting ground faults in isolated equipment frames involves the types of installation shown in the following chart.

Type of Installation	Explanation/Troubleshooting Procedures
Single Ground Lead to the First Frame in a Lineup	In this type of installation, the frames are isolated from the: <ul style="list-style-type: none">● Superstructure.● Floor.● Other ground sources.

(continued)

3. Ground Integrity-Testing and Troubleshooting,

continued

3.4 Troubleshooting Non-AC/DC Ground Faults, continued

3.4.2 Isolated Equipment Frames. continued

Type of Installation	Explanation/Troubleshooting Procedures
Single Ground Lead to the First Frame in a Lineup (cont.)	<p>Lead 41, 41A, or another isolated ground lead ties directly to the first frame in the lineup. The frames:</p> <ul style="list-style-type: none">• May or may not be bolted together.• Have conductivity straps from one frame to another. <p>Using the tone generator and amplifier (see Section 4) follow the tone down the lineup until it goes from a strong tone at the side of the frame closest to the ground lead connection to a weak tone on the side of the frame farthest from the ground lead connection_ This frame should be the one with the fault.</p>
Each Frame Has a Ground Lead Connection	<p>In this type of installation, the frames are isolated from the:</p> <ul style="list-style-type: none">0 Superstructure.• Floor.• Other ground sources. <p>Lead 41, 41A, or another isolated ground lead ties to another ground cable running the length of the equipment lineup (typically Lead 58 or 58A). Each equipment frame is separately tied to this lead.</p> <p>Using the tone generator and amplifier (see Section 4):</p> <ol style="list-style-type: none">1. Follow the tone down Lead 41 to the branch cable that has the strongest tone.2. Follow the tone to the branch lead going into the frame with the strongest tone. This frame should be the one with the fault.
GTD-5 Switches with Two Lead 41's	<p>On older issues of the GTD-5, two Lead 41's were provided in a lineup, one for common control frames and another for OSP frames. This created a ground loop for Lead 41.</p> <p>To troubleshoot this type of installation, use the tone generator and amplifier (see Section 4) to apply a tone between the ground bar and each Lead 41 or 41A isolated ground lead.</p>

4. Using the Tone Generator and Amplifier

4.1 Operating Procedures

When you suspect a short, use the tone generator and amplifier to perform the following procedures.

Step	Using the Tone Generator and Amplifier
1	<p>WARNING: To avoid a potential shock hazard and damage to equipment, remove all AC/DC current from the isolated ground leads before you lift the leads and attach the tone generator.</p> <p>Lift Leads 41, 41 A, and/or other isolated ground leads from the ground bar.</p>
2	<p>Hook up the tone generator between the isolated ground lead (Leads 41, 41 A, and/or other isolated ground leads) and the ground bar.</p> <p>NOTE: If a continuity path exists, the tone will be transmitted over the leads. The tone will be strongest where the connection/short exists within the equipment room.</p>
3	<p>Tone present on a lead indicates a continuity path beyond the point to which you are listening. If you hear such a tone:</p> <ul style="list-style-type: none">A. Go to the farthest point within the office.B. Clear the ground faults back toward the tone source. <p>NOTE: The tone will divide across all fault paths. The strongest tone received indicates the lowest impedance path.</p>
4	<ul style="list-style-type: none">A. Clear each fault as you find it.B. Proceed to the next path. <p>NOTE: There will be an increase in tone volume as you clear faults in the next lowest impedance path.</p>

4.2 Tone Generator Setup

Before you begin troubleshooting procedures, set the tone generator between 900 and 1000 Hz at 0 or +1 dB.

When actually performing troubleshooting, determine through trial and error the best specific frequency to use. Without adjusting the tone generator, when you work around power supplies or other frequency-generating equipment, you might mistake equipment-produced tones for the tone generator's tones.

NOTE: Because the tone amplifier is tunable to only 1000 Hz, use levels under 1000 Hz for the tone generator.

4. Using the Tone Generator and Amplifier, continued

4.3

Use the following procedures to set up the amplifier.

Amplifier Setup

Step	Setting Up the Amplifier
1	Connect the tone generator across the affected cables.
2	Select the desired frequency.
3	At the point of connection (normally the ground bar), tune in the amplifier to the strongest signal: A. Move the Selector switch to the Coarse setting. B. Turn the Coarse Adjustment knob until you detect the tone. C. Move the Selector switch to the Fine Tune setting. D. Turn the Fine Tune knob to tune into the strongest signal. NOTE: You might bump one of the tuning knobs during troubleshooting. Occasionally, return to the tone source and verify the proper tuning of the amplifier.

5. Troubleshooting Hints

5.1

Use the following chart as a guide when tracing tones.

Tracing Tones

If...	Then...
You cannot hear a tone that you have traced into a frame	Check the: <ul style="list-style-type: none">• J-bolts.• Floor anchors.
	<hr/>
	If the... The Tone...
	<hr/>
	Fault is within the frame Will lead to the fault.
	<hr/>
Frame has AC outlets	Might be heard: <ul style="list-style-type: none">• Around the outlet.• On the conduit where the AC comes into the frame.

(continued)

5. Troubleshooting Hints, continued

5.1

Tracing Tones, continued

If...	Then...
The tone takes you to miscellaneous equipment	Consider that miscellaneous equipment such as the following might produce false faults: <ul style="list-style-type: none">● Wiltron unit.● Cable analyzer unit.● 4-TEL unit.● AC modems. To check the equipment: <ol style="list-style-type: none">1. Lift the chassis ground from the equipment.2. Test for a short between the chassis ground terminal and return battery.

If...	Then...
You read a short	The equipment must be remounted with isolation materials. NOTE: If the equipment cannot be remounted, it must be sent to the manufacturer for modification.

The equipment tests clear	<ol style="list-style-type: none">1. Leave the lead open until you have cleared all other ground faults.2. Make a note that the lead has been lifted from the equipment to ensure that the lead is reconnected when the ground faults have been cleared.
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6. Typical Trouble Conditions

6.1

Previously

Detected Faults

Several faults have been detected in previous troubleshooting procedures. Use the following list as an aid in your troubleshooting activities:

- Incorrect installation of integrated-designed equipment.
 - J-bolts shorted between the equipment frame and overhead ironwork.
 - No insulators at the top of the frame.
 - Frames bolted to:
 - Concrete floors without isolation material.
 - Computer floors too tightly or without insulators.
 - AC outlets within the frames grounded to the equipment frame by:
 - Metal conduit.
 - OR
 - Third-wire ground.
 - DC lighting grounded through Lead 41.
 - Metal AC conduit not isolated from the equipment frames.
 - Lead 41 tied to:
 - A rectifier.
 - PDU/bays.
 - 4-TEL units mounted without isolation.
 - Metal covers on modems or other equipment touching the frame:
 - Ironwork.
 - OR
 - Shelves.
 - Modems in contact with shelves.
 - Pay telephones grounded to an equipment frame.
 - Solder or metal shavings in the backplanes.
 - Shorts within power supplies between frame ground and LVG.
 - Pinched wires in the backplane area.
 - HF cable shields from the DTUF that are grounded:
 - At the DSX end.
 - On the DTUF.
- NOTE: HF cable shields should not be grounded at the DSX.**
- Surge protectors with metal covers in contact with equipment frames.
 - ZOO-volt power supplies grounded to the frame by green-wire ground.
 - Integrated-powered converters and inverters not isolated from frame ground.
 - Wiltron power supplies.
 - Corner beads in drywall in contact with the equipment frame.
 - 9575 Cable Analyzer Panel (Part Number 9270-D-671 6, Serial Number 538000 and earlier).

NOTE: The unit should be stamped MK-1

6. Typical Trouble Conditions, continued

6.1 Previously Detected Faults, continued

Some previously detected faults pertain to the GTD-5. Use the following list as an aid in your troubleshooting activities:

- Lead 41 grounded at the top of the processor frames through a metal panel on the backplane to the LVG bus.
- Screws and nuts:
 - Inside the backplane behind the power supplies.
 - Between the power supplies and the frame.
- Brackets on the back of the frame in contact with the LVG bus screw.
- Positive battery leads running up the side of the frames that are:
 - Cut through the lead insulation.
 - Grounded to the frames.
- Screws too long in the:
 - Piggybacks touching the backplane.
 - Test panel.
- 966 Berry Test Set mounted in the equipment frame without:
 - Isolation materials.
 - Isolation from other equipment.
- Hinges in the MTUs with bad bushings causing a short to ground.