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GTD-5®
EAX

Engineering and Installation
Ground Isolation

AG Communication Systems

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1. GENERAL

1.01 This practice provides information on ground isolation for GTD-5® EAX installations.

1.02 This practice is reissued for general updating. Remove the previous issue of this practice from the binder or microfiche file and replace it with this issue.

2. OVERVIEW

2.01 Ground isolation is provided for all GTD-5 EAX Base Unit installations, Remote Unit initial installations, all additions to existing installations, and other manufactured electronic switch installations. (Refer to part 9 for documentation references.) For those existing installations that do not have ground isolation, retrofit material can be provided at the option of the telephone company. Details of the equipment isolation installation are covered in drawing H-440000-K for GTD-5 EAX Base Unit and Remote Unit installations.

2.02 The GTD-5 EAX uses three ground distribution systems (Low Voltage Ground (LVG), Frame Ground (FG), and Line Protection Ground (LPG)) along with the power distribution system. The three systems are separate but may originate from a single source.

2.03 The following terminology is used interchangeably depending upon the manufacturer equipment being discussed:

(a) A positive potential is referred to as +, return, Main Grounding (MG), + GRD, or + MB.

(b) A negative potential is referred to as Neg, -48, Main Battery (MB), or -MB.

(c) A safety ground is referred to as Frame Ground (FG), Chassis Ground, or Unit Ground. It is not used to complete a circuit path.

2.04 The first of the two additional systems is the isolated electronic LVG system, which consists of copper ground planes on the frame backplanes that are cabled to a common reference point (isolated ground system). One LVG cable multiple for the common control-type frames and one LVG cable multiple for the outside plant type frames are required.

2.05 The second system is the FG system, which is part of the integrated ground system that consists of all equipment frame metal parts, superstructure, ac conduit, standard ac service (green wire) grounds, reinforcing rods, water pipe, building steel, and all other incidental central office grounds (integrated ground system). The equipment frame grounds are cabled to a Master Ground Bar (MGB) or Floor Ground Bar (FGB).

2.06 In addition, the GTD-S EAX may use a third ground system called the LPG system. The LPG is used to shunt lightning voltage to ground to protect the line circuit from damage. The LPG system can only be used in conjunction with the GTD-5 EAX FE-16248 Standard Line Circuit Card (SLCC).

3. PURPOSE OF ISOLATION

Isolation Benefits

3.01 Isolation of the GTD-5 EAX equipment frames from the integrated ground system of the building provides a method of checking the integrity of the built-in backplane-to-frame isolation of the GTD-5 EAX. This check again verifies the integrity of the single-point ground system. This ensures that the GTD-S EAX circuitry is referenced to a single ground potential and that fault currents and noise found in

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the integrated ground system have minimum impact on the switch's operation.

3.02 The primary purpose of ground isolation capability for digital switches is to provide a means of finding and eliminating electrical ground faults (shorts) that may occur during shipping and installation, or thereafter. Once the equipment is placed in service, the isolation may be used as a tool by the maintenance craftsperson to trace system grounding problems. An example of such a problem is a short in a frame between the LVG and FG.

3.03 In the event of a short within an equipment frame, isolation between the superstructure and the equipment frames eliminates the current-carrying path of foreign currents found on the superstructure. These currents can be generated from ac lights, integrated transmission racks, or chassis-grounded equipment, etc.

3.04 Eliminating existing ground faults is of primary importance in maintaining the integrity of digital circuitry during unusual circumstances such as during a lightning storm.

3.05 It is important to note that ail digital equipment frames must be grounded, even though they are isolated from the building, from superstructure, and from each other. Frame grounding is achieved on a per-frame basis through the use of a lug and XX6 cable that taps into a frame-ground cable-run over the lineup. This isolates a single frame while maintaining the frame ground on other frames in the lineup. Engineering includes this method of frame grounding on the JD-XXXXX-EPDG drawing or equivalent.

4. EQUIPMENT TO BE ISOLATED

Frames

4.01 All GTD-5 EAX frames, including the Miscellaneous Equipment Frame (MISF), Miscellaneous Utility Frame A (MUFA), Miscellaneous Utility Frame B (MUFB), Miscellaneous Utility Frame C (MUFC), Miscellaneous Utility Frame D (MUFD), Miscellaneous Utility Frame E (MUFE), and Peripheral Test Console Frame (PTCF), are isolated from the floor, superstructure, and from each other.

4.02 Power frames PDUF, PCDF, and Disconnect Switch Unit Frame (DSUF) are to be isolated from the floor when these frames are placed in a continuous frame lineup with GTD-5 EAX frames. Battery racks do not need to be isolated from the floor or wails.

4.03 Any frame containing one or more Chargers (CHGR's) must be physically and electronically separated/isolated from any frames continuous with GTD-5 EAX frames, since Telephone Influence Factor (TIF) capacitors in the battery chargers allow ac current leakage onto the charger cabinets. The charger frames must be bonded by (Leads 31 and 32) conductors per GTE Practices 795-805-071 and 795-805-072.

4.04 Charger (CHGR) frames normally do not require floor ground isolation materials because they are considered outside the “ground window.” However, the overhead cable rack to the charger bay should be isolated similar to the method outlined in drawing H440000-K, Issue 8, Figure 903.

4.05 It is not essential that the frame-to-frame isolation be maintained in an absolute condition after verification of isolation is achieved. Any incidental metal-to-metal contact that may exist between frames can be removed before proceeding with ground system troubleshooting operations on a particular frame or lineup.

4.06 The Peripheral Test Console Desk (PTCD) console does not have any particular isolation hardware associated with it. However, it must be located on a nonconductive surface, and the console must not come in direct contact with cable runway, ducts, or

ac conduit (unless isolation material is used). Additionally, the console must not come in direct contact with building steel, such as a steel column or floor plate.

EAX Frame Junctioning

4.07 Adjacent Standard Hardware Electronic Systems (SHAE) frames with front cableways are junctioned with a fiberglass junction plate (EF-16742). Frames without front cableways are junctioned with standard metal plates. If necessary, since these junction plates are easily accessible, the metal plates can be removed during isolation integrity verification in order to isolate a particular frame.

4.08 Two pairs of fiber-insulated washers are provided for cable brackets at the rear of frames which maintain isolation at these points, eliminating the problem of having to remove brackets during troubleshooting operations.

4.09 On some early installations before isolation became a standard, a junction between frames was created by the front cableway cable-retaining brackets. When necessary for troubleshooting, remove the cover, and the screws on one side of each bracket. Insulate between the bracket and the frame, using suitable material. When finished with troubleshooting, do not remove the insulation. Replace the metal screws with nylon screws and reinstall the cover. Current installations provide nylon screws and insulators so that removal of the front cover is the only requirement.

4.10 A casual metallic junction between adjacent frames may exist at the top of the frames where the cable tie bracket of one frame touches the bracket of the adjacent frame. If required for troubleshooting, insulate between these brackets and between any other similar casual metallic contact points.

Superstructure

4.11 Isolate overhead superstructure, including channel iron or two-bar channel, and cable runway, cable grid, or cable trough from the tops of equipment frames. Isolate new superstructure from existing superstructure in colocated offices, using the method and material required as identified in drawing H-440000-K, latest issue.

4.12 Isolate freestanding, end-aisle panels from the floor and from the channel iron or two-bar channel supporting them.

Miscellaneous Equipment

4.13 Isolate all miscellaneous equipment in EAX frames MUFA, MUFB, MUFC, MUFD, MUFE, MISF, PTCF, or other miscellaneopus frames from the frame and from each other.

4.14 Miscellaneous equipment is any equipment not manufactured by the switch manufacturer that mounts in a frame in the electronic switchroom.

4.15 Many pieces of equipment, such as Lorain ringing generator shelves and Lorain +50 Vdc supplies do not have the + MB tied internally to the chassis via the circuitry. They may, however, have a wire, (usually green), which ties + MB to FG. Remove this strap after ensuring that polarity of the 50V inputs to the unit is correct. Proper isolation for equipment of this type, which does not have an internal circuit ground connection between + 50 Vdc and chassis ground, can be achieved by removing the (usually green) chassis ground strap.

4.16 By isolating the piece of equipment from the frame that it is mounted in, the isolation is ensured. Once the + MB input is isolated from the chassis, an external chassis ground strap must be added between the unit and the frame in which it is mounted.

4.17 All new GTD-5 EAX frames in which miscellaneous equipment is installed have plastic inserts (EF-16917-A) that push into square mounting holes in the frame uprights. These inserts isolate the equipment from the frame. Isolate equipment from other equipment above and below it by maintaining an air gap of at least 1/32 inch between units when mounting the units. This is done by placing a shim between the units while mounting them; remove the shim after maintenance of the air gap is assured.

4.18 If it is not possible to maintain the air gap with this method, install fiberglass reinforced isolating tape (F-6475-P or equivalent) along the contacting edges of both units.

4.19 All miscellaneous units must have their chassis ground in one of two ways:

(a) If the chassis is an integral part of the circuit because of unit design, + MB will provide ground potential for the unit and isolation between the unit and other units. The frame in which it is mounted must not be jumpered across with a chassis ground lead.

(b) If the chassis is isolated from the circuitry, (+ MB is not common to the chassis), a chassis ground strap must be installed between the unit and the frame in which it is mounted. The external chassis ground strap must be of the same gauge wire (at a minimum) as the power feeder (input) of the unit. Refer to Section 795-805-071 for a method of identifying chassis grounds.

Distributing Frames

4.20 The Combined Distributing Frame (CDF) is required to electrically integrate with the overhead superstructure in accordance with AGCS Practice 795-805-071. Therefore, isolation materials are not required.

AC Hardware and Service

4.21 To avoid compromising the electronic frame isolation, all ac conduits and receptacle boxes must be made of nonconductive material. Any conduits, ducts, light fixtures, receptacles, etc, that are metallic, must not come in direct contact with the isolated equipment frames.

4.22 Equipment in the electronic switch area that requires ac service must be served from three-wire brown outlets or three-wire orange outlets that are served by ac circuits dedicated for this purpose, and must not serve equipment beyond the switch perimeter.

4.23 Orange (three-wire) outlets have a green ground-wire that must be connected to ground at the main ac enclosure only. These orange outlets are to be used for powering portable test equipment only. (Refer to Practice 795-805-071.)

4.24 If equipment mounted in the GTD-5 EAX area has both ac and dc power requirements, the dc power feeder must not be from the same Power Distribution Unit (PDU) bus that powers other GTD-5 EAX equipment.

5. PROCEDURE FOR GTD-5 EAX GROUND ISOLATION VERIFICATION

Frame Power Connection Integrity Verification

5.01 Ground system problems could occur during shipment of frames or after frames are received on site. The following visual checks are required prior to power connection (tapping).

5.02 Inspect backplane power bus bar soldered connections for properly soldered

joints. This means that the connector pins should be completely covered with solder, and no flux should be visible between the pin and solder. If such a condition exists, the remedy is to wire wrap a slate-colored 24-gauge wire to an adjacent connector power pin.

5.03 Backplane power bus screws should be tight and should not touch adjacent bus bars. Bend the bus bars away from each other if they are touching. If it is not possible to bend the bars, Tak-Pak an Integrated Circuit (IC) insulator (P/N EF-16508-A) to one of the bus bars at the point of contact to prevent shorting.

5.04 Visually inspect the push-on power-wire connectors for proper seating at both the power-supply-interconnect card and at the frame side-mounted terminal strips. Perform this activity twice; once prior to frame erection and once after installation and test completion. Include all red, blue, and brown wires in this inspection.

5.05 Visually inspect all isolation details to ensure that they have been installed completely and correctly, and that casual or incidental ground shorts do not exist between the frames and building steel, ac conduits, etc.

Frame Ground Isolation Integrity Verification

5.06 Mnemonic definitions used in the following isolation verification include MB1, MB2, MB3, MB4 = Main Grounds 1, 2, 3,4.

5.07 Test the listed grounds in all their combinations for isolation between each other before connecting (tapping) to the system + BUS ground bar and floor ground bar.

5.08 The way to test for proper isolation is to use a Volt0Ohm Meter (VOM) or Digital Volt-Ohm Meter (DVOM) set to the 20K resistance range and test every frame for any type of meter reading between the listed grounds. The testing should be done by the following method, proceeding from all column (A) tests (Table 1) to the column (F) test.

5.09 If any test indicates a shorted condition, isolate the fault to its source and remove the cause.

5.10 The following are typical areas where a short could occur:

(a) Analog printed wiring cards where more than one ground comes into the card.

(b) The Magnetic Tape Unit Frame (MTUF), in which the tape unit door hinge arm must be isolated from the case (FG). Material to accomplish this isolation consists of a bushing and washer.

(c) A Control and Memory Complex Frame (CMCF) that has Base-Issue-1 backplanes (FB-16733 and FB-16734).

5.11 Any of the following frames may contain vendor (non-AGSC) equipment that could have internal connections, either by circuit or by wire, between + MB and FG or chassis. It is recommended that the vendor equipment be tested for proper ground isolation before and after installation into the appropriate frame and before any power/ground connections are made. The following frames contain vendor equipment: MISF, MUFA, MUFB, MUFC, MUFD, MUFE, and PTCF. Other possibilities could exist.

5.12 If frames are tapped into lineup power feeders and a fuse opens, the MB lead must be disconnected at the new frame(s) for troubleshooting.

5.13 Using a DVOM or VOM set to the 20K scale, check all frames for ground faults between the frame grounds and the

Table 1. Isolation Testing Leads.

A	B	C	D	E	F
MB1 TO ++MB2MB2	MB2 TO +MB3	MB3 TO + MB4	MB4 TO LVG	LVG TO FG	FG TO I-PG
MB1 TO +MB3	MB2 TO + MB4	MB3 TO LVG	MB4 TO FG	LVG TO LPG	
MI31 TO +MB4	MB2 TO LVG	MB3 TO FG	MB4 TO LPG		
MB1 TO LVG	MB2 TO FG	MB3 TO LPG			
MB1 TO FG	MB2 TO LPG				
MB1 TO LPG					

superstructure. No faults should exist. When all faults are cleared, make the FG and LVG connections.

5.14 Ground superstructure (grid or runway) via 2/0 cable from the FGB (ground lead #57) to a central location on the GTD-5 EAX switchroom grid or runway (Practice 795-805-071 and drawing ECD-17005-001).

5.15 Ensure that FG is present on the steel of every frame in the office and on the superstructure, and that no potential exists between the frame the superstructure.

5.16 After the equipment is fully installed and cabled, with all cards inserted in their slots, and all frames fully powered, use a clamp-on ammeter or equivalent, such as F. W. Bel CG-100D, to measure current flow on each frame ground lead. The current flow should measure zero.

6. TROUBLESHOOTING

6.01 In general, troubleshooting ground faults in an on-line environment is limited to meter reading and visual inspection, since LVG and +MB leads cannot be disconnected. Make a reasonable effort to eliminate any identified ground faults.

Procedure

6.02 If a current flow exists in any frame ground lead, remove the metallic junction plates (if used), kickplates, front cable way covers or other unintentional frame-to-frame connections from between the selected frames. By measuring the current flow on the frame-grounding lead, it is possible to determine which of the frames in the lineup has the current flow.

6.03 Measure the + 50 Vdc and -50 Vdc current entering and leaving the frame on the red and blue power-feeder cables. The current entering should match the current leaving the frame. If a mismatch is found, a + 50 Vdc-to-frame-ground short exists. The short must be found and eliminated.

6.04 If a leakage current still exists, this indicates that an electronic-groundplane (LVG)-to-frame-ground short exists. A visual inspection should be carefully made to eliminate any obvious causes, such as shorts caused by foreign matter, or by wire shiners. If leakage current persists, and where it is possible to pursue the problem (the site is not on-line), proceed as follows:

(a) Power down the frame using the proper power-down procedures.

(b) Disconnect the LVG brown wire that enters the frame.

(c) Disconnect signal cables entering the frame.

(d) Unseat all printed wiring cards.

(e) Locate the fault using a VOM or DVOM set to the 20K scale.

6.05 Using this method, the fault can be isolated to a given four-file backplane by disconnecting the LVG conductor between the upper and the lower halves of the frame.

6.06 Any non-AGCS manufactured, dc-powered electrical equipment purchased from outside sources and mounted in a GTD-5 EAX area requires the following special precautions:

(a) The equipment must first be isolated from the frame.

(b) Each unit of equipment must first be checked for the presence of a chassis ground before input power is connected as follows:

(1) Remove the input dc and any ac power conductors, then start the test.

CAUTION

FAILURE TO REMOVE THE INPUT CONDUCTORS MAY CAUSE HARM TO PERSONNEL PERFORMING THE TEST, MAY DAMAGE THE TEST EQUIPMENT, AND/OR DAMAGE THE UNIT UNDER TEST.

(2) Using a Digital Voltmeter (DVM) or VOM,set the resistance scale to 10 kilohms or higher.

(3) Set power switches on the unit under testbt ON.

CAUTION

FAILURE TO FOLLOW THIS STEP WILL ALLOW CERTAIN TYPES OF CHASSIS GROUNDS TO GO UNDETECTED.

(4) Ground one test probe of the DVM or VOM to the bare metal chassis of the unit under test. Touch the other DVM or VOM test probe to each of the input power conductors (+ and - for dc; black (hot), white (neutral), and green wire for ac). Record the resistance for each reading.

(5) Ground the other test probe of the DVM or VOM to the metal chassis of the unit under test.

(6) Use the remaining test probe, per step 4, to touch each input conductor and record the readings.

(7) If all readings are 25 megohms or higher, then no chassis ground exists and a chassis ground strap must be installed.

(8) If one or more readings is under 25 megohms, a chassis ground is present and the unit's manual must be checked for an input ground strap that may be removed.

The insulating hardware between the unit panel and the equipment frame is to remain to permit future isolation and resistance whether or is not there is a chassis ground in existence.

(10) If no chassis ground exists, prepare a chassis-to-frame

ground strap using the same gauge wire as the unit's power input.

(11) If a chassis ground does exist between any one of the ac input conductors (black (hot), neutral, green wire ground), leave these steps and go to step (c) for special requirements to prevent defeating the GTD-5 EAX frame isolation and defeating the electronic ground.

(c) For units already powered, use an F. W. Bell CG-1000D Current Gun or equivalent, to check for currents on the equipment frame ground leads when the units are activated. Because this method cannot detect each instance of chassis ground, follow the bove steps (1) through (11) to be certain.

6.07 The following additional precautions must be taken for electrical equipment mentioned in paragraph 5.05 that also requires ac power and that is identified with the chassis ground:

(a) The ac power is provided from a source that is separate from the isolated ac ground source.

(b) The equipment is isolated from the frame and from other equipment in the frame.

(c) The dc power for the equipment must not originate from the same power that is dedicated to GTD-5 equipment. If the ac and dc have a common gound, do not connect any GTD-5 EAX leads to the unit that allow foreign potentials or grounds to enter the GTD-5 EAX. This is required only if the ac ground and dc positive bus of the unit are not common but the ac ground is common to the chassis; then ground the chassis to the frame with an appropriately sized strap.

Assistance

6.08 If current leakage paths that cannot be found are encountered, contact the appropriate staff group, or GTD-5 EAX Technical Assistance Center (TAC) for assistance. No unsolved problems of this type should remain in the system at turnover.

7. EQUIPMENT POWER DISTRIBUTION AND GROUND VERIFICATION

Procedure

7.01 Review the Equipment Power Distribution and Grounding (EPDG) drawing for the site at this point to ensure that all specified cable runs that are part of the grounding scheme are installed and in their proper location. Also ensure that all runs that should be present are present as detailed in the documentation and in this procedure.

Assistance

7.02 If any runs specified on the EPDG drawing conflict with grounding practices or if any runs are missing as described in the practices or other documents, inform the job engineer. If action is indicated, document the problem(s) and ensure that corrective action is taken.

8. RETROFIT INSTALLATIONS - GTD-5 EAX

8.01 In general, all of the preceding parts apply to isolation retrofit as well as to initial installations. The main differences are that additional caution must be exercised when verifying isolation in an on-line environment, and that some of the hardware must be disassembled in order to perform isolation verification and trouble-shooting (refer to Sections 5 and 6). When

all ground faults are eliminated from a lineup, reinstall junction material, ac conduits, cable brackets, etc, that were removed from the frames.

8.02 It is recommended that the isolation retrofit be done during non-peak traffic hours (11 p.m. to 5 a.m.).

Tools Required

8.03 In addition to normal installation tools, a DVOM, and a current gun probe, an isolation retrofit installation requires use of the GTD-5 EAX frame dollies, for raising the frames slightly off the floor and two lengths of 2 x 4 wood about 8-feet, 1 inch long. One or more lengths of rope will be required if it is necessary to replace the upright inserts from the tapped-hole type to the square-hole (isolated) type in miscellaneous frames. The rope should be obtained locally.

Procedure

8.04 Installing the isolation material on a retrofit basis should be done one lineup at a time as follows:

(a) The first step is to install and tap the separate frame-ground cables for each frame. (Practice 745-805-071, leads 41, 58, and 59).

(b) Remove the guardrails, kickplates, nuts, and washers from the floor anchors.

(c) Remove all frame-to-frame junction material.

(d) Remove any cable brackets installed between frames.

(e) Remove the J- and U -bolts securing the channel or two-bar to frames in the lineup.

If applicable, disconnect other hardware, such as metal ac service conduits, that might prevent the frame from being raised approximately one-eighth inch off the floor (metal ac service conduits must be disconnected from frames for isolation verification).

(f) Using the frame dollies, raise one frame at a time one-eighth inch and insert the isolation details under the feet of the frame.

If the frame that is raised has a channel or two-bar on top of it, insert the 2 x 4's under the channel or two-bar (one in front and one in the rear of the frame), then lower the frame.

Insert the isolation details in the space between the top of the frame and the channel or two-bar.

Raise the frame again slightly to remove the 2 x 4's.

8.05 When each frame in the lineup has been treated in the above manner, proceed as follows:

(a) Insert the floor anchor isolation material and secure the frames to the floor.

(b) Reinstall the J-bolts or U -bolts at the top of the frames, using appropriate isolation material.

(c) If this lineup has front cableways, install the red isolating-jtinction plates in the cableways at this time.

(d) If the frames contain miscellaneous equipment, remove existing upright adapters one at a time and install the new ones provided for equipment isolation.

Refer to paragraphs 8.06 and 4.13 through 4.19 for additional information on isolation of miscellaneous equipment.

NOTE: If nonconductive floor tile is used in the office under the frames, the

addition of the floor anchor isolation material without frame foot insulators is sufficient to accomplish isolation.

Miscellaneous Equipment and Frames

8.06 When it is necessary to change tapped-hole types of miscellaneous equip-ment brackets of the square-hole type, use the following procedure:

(a) Carefully remove screws from the units (one side of the frame only).

(b) As necessary, use ropes secured to the overhead superstructure and looped around the units for support.

NOTE may be necessary to move the frame slightly to gain access to the screws that secure the adapter brackets to the upright-

(c) After the bracket on one side is replaced, secure the equipment to that side.

(d) Repeat the process with the bracket on the other side of the frame.

(e) Place tape on the top and/or bottom edges of the units where a 1/32 inch air gap is not maintained between units.

(f) Ensure that each mounted unit is isolated from the units above and below.

9. REFERENCES

9.01 The following documents supplement and/or complement the information provided in this section.

TYPE	NUMBER	ISSUE	DESCRIPTION
AGCS Practices:	224-100-100	3	Power and Alarm System Equipment
	795-805-071	6	Central Office Engineering Application
	795-805-072	1	Grounding Service AC Engineering Application
	795-805-073	1	Central Office Grounding Engineering Application
Drawings:	H-440000-K		
	EC-95506		
	ECD-17005-001		