

System Manual

EDACS[®]

Enhanced Local Interconnect (ELI)

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NOTE

Repairs to this equipment should be made only by an authorized service technician or facility designated by the supplier. Any repairs, alterations or substitution of recommended parts made by the user to this equipment not approved by the manufacturer could void the user's authority to operate the equipment in addition to the manufacturer's warranty.

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REGULATORY COMPLIANCE

FEDERAL COMMUNICATIONS COMMISSION (FCC) REGULATIONS

1. This Telephone Interconnect, before its connection to a **Telephone Central Office**, must be reported to the "CENTRALIZED OPERATIONS GROUP" of the local area Telephone Company (not the business office) by the user, installer, or Installation Supervisor to ensure a smooth installation. The following three Central Office telephone connection configurations are possible:
 - a. **End-to-End configuration:** The FCC registration number of this device (AXAUSA-21009-OT-E), ringer equivalence number (0.4B), and connection jack (RJ-11) must be reported.
 - b. **Four-Wire E&M configuration:** The FCC registration number of this device (AXAUSA-21009-OT-E), ringer equivalence number (0.0B), service order code (9.0Y & AS.3), facility interface code (TL11M telco end, TL11E Ericsson GE end), and connection jack (RJ2GX) must be reported.
 - c. **Two-wire DID configuration:** The FCC registration number of this system (AXAUSA-21009-OT-E), ringer equivalence number (0.0B), service order code (9.0Y & AS.3), facility interface code (02RV2-T), and connection jack (RJ11) must be reported.
2. This Telephone Interconnect, before its connection to a **Telephone Private Branch Exchange (PBX)**, must be reported to the "MAINTENANCE GROUP" of the local area Telephone Supplier by the user, installer, or Installation Supervisor to ensure a smooth installation. The following four Private Branch Exchange telephone connection configurations are possible:
 - a. **End-to-End Loop Start configuration:** The FCC registration number of this device (AXAUSA-21009-OT-E), ringer equivalence number (0.4B), service order code (9.0Y), facility interface code (02LS2), and connection jack (RJ-11) must be reported.
 - b. **End-to-End Ground Start configuration:** The FCC registration number of this device (AXAUSA-21009-OT-E), service order code (9.0Y), facility interface code (02GS2), ringer equivalence number (0.0B), and connection jack (RJ-11) must be reported.
 - c. **Four-wire E & M trunk configuration:** The FCC registration number of this device (AXAUSA-21009-OT-E), ringer equivalence number (0.0B), service order code (9.0Y & AS.3), facility interface code (TL11M telco end and TL11E Ericsson GE end), and connection jack (RJ2GX) must be reported.
 - d. **Two-wire DID (tie-trunk) configuration:** The FCC registration number of this system (AXAUSA-21009-OT-E), ringer equivalence number (0.0B), service order code (9.0Y & AS.3), facility interface code (02RV2-T), and connection jack (RJ11) must be reported.
3. The total of all ringer equivalence numbers on any one line should not exceed 5.0 for best performance.
4. This device complies with Part 15 of FCC Rules. Operation of this device is subject to the following two conditions:
 - a. Device must not cause harmful interference.
 - b. Device must accept any interference, including interference that may cause undesired operation.
5. This device must not be installed on coin-operated or multi-party telephone lines.
6. **DID answer supervision:** Allowing this equipment to be operated in such a manner as to not provide for proper answer supervision on DID calls is a violation of Part 68 of FCC rules.
7. **E&M answer supervision:** Allowing this equipment to be operated in such a manner as to not provide for proper answer supervision on E&M calls is a violation of Part 68 of FCC rules.
8. Answer supervision will be returned within 500 ms after any of the following three conditions:
 - a. Incoming call is answered by the called station.

REGULATORY COMPLIANCE (Cont.)**FEDERAL COMMUNICATIONS COMMISSION (FCC) REGULATIONS**

- b. Incoming call is routed to a dial prompt.
- c. Incoming call is routed to a recorded announcement that can be administered by the CPE (Customer Premise Equipment) user.
- 9. If this unit malfunctions, the telephone company may disconnect service temporarily. If disconnection is necessary, the telephone company must attempt to notify the user in advance, if possible. If not, they must notify the user as soon as they are able.
- 10. Repair work on this device must be done by Ericsson GE, or an authorized repair station.

DOC REGISTRATION

The Canadian Department of Communications label identifies certified equipment. The certificate means that the equipment meets certain telecommunications network protective, operational, and safety requirements. The Department does not guarantee the equipment will operate to a user's satisfaction.

Before installing this equipment, make sure you are permitted to connect it to the facilities of the local telecommunications company. You must also install the equipment using an acceptable method of connection. In some cases, you may also extend the company's inside wiring for single line individual service by means of a certified connector assembly (telephone extension cord). You should be aware, however, that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by a user to this equipment, or equipment malfunctions, may give the telephone communications company cause to request the user to disconnect the equipment.

For your own protection, make sure that the electrical ground connections of the power utility, telephone lines, and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION

Do not attempt to make electrical ground connections yourself; contact the appropriate electric inspection authority or electrician.

GTI Load Number: 10

The load number (LN) assigned to each terminal device denotes the percentage of the maximum allowable load to prevent overloading, to be connected to the telephone loop used by the device. The termination on a loop may consist of any combination of devices, subject to the requirement that the total of the load numbers of all the devices not exceed 100.

DOC COMPLIANCE NOTICE

This digital apparatus does not exceed the Class A limits for radio noise emissions for digital apparatus as set out in the Radio Interference Regulations of the Canadian Department of Communications.

DOC AVIS DE CONFORMATION

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la classe A prescrites dans le Règlement sur le brouillage radioélectrique édicté par le ministère des Communications du Canada.

SPECIFICATIONS

Dimensions:

Master GTI..... 1.75" H x 19.00" W x 12.00" D
GTI 1.75" H x 19.00" W x 12.00" D
IAM 1.75" H x 19.00" W x 7.00" D

Environmental:

Temperature Range 0° to 70° C (32° to 158° F)
Relative Humidity 95% (max.)

Power:

Input Voltage..... 12 Volts dc (nominal)
Input Power
Master GTI..... 12 Watts (max.) / 8 Watts (avg.)
GTI 12 Watts (max.) / 8 Watts (avg.)
IAM..... 6 Watts (avg.)

EDACS Repeater Types:

..... MASTR II
..... MASTR IIe
..... MASTR III

PSTN Line Types:

..... End-to-End, Loop Start
..... End-to-End, Ground Start
..... 2/4-Wire E&M, Microwave
..... 2/4-Wire E&M, Type I
..... Direct Inward Dial (DID)

PSTN Dialing Types:

Encoded by GTI:

..... Rotary Dial (Dial Pulse)
..... Push-Button Dial (DTMF)
..... Multifrequency R1/R2

Decoded by GTI (Overdialed):

..... Rotary Dial (Dial Click)
..... Push-Button Dial (DTMF)
..... Multifrequency R1/R2

INTRODUCTION

This manual describes the installation, configuration, and operation of the Enhanced Local Interconnect (ELI) option. A companion manual, the Global Telephone Interconnect (GTI) Configurator user's guide (LBI-39077), describes how to use the GTI Configurator software to configure the GTI units used in the ELI option.

Although the objective of this manual is to provide information in the order it should be needed, completely read the applicable section before starting the installation or configuration.

DESCRIPTION

OVERVIEW

The ELI option is a telephone switching system that allows authorized radio users to make and receive telephone interconnect calls on their EDACS radios without dispatcher assistance. Under the direction of the Site Controller computer, it can connect any one of up to 20 available EDACS repeater channels to any one of up to 32 available telephone lines, and maintain up to 20 interconnect calls at any one time.

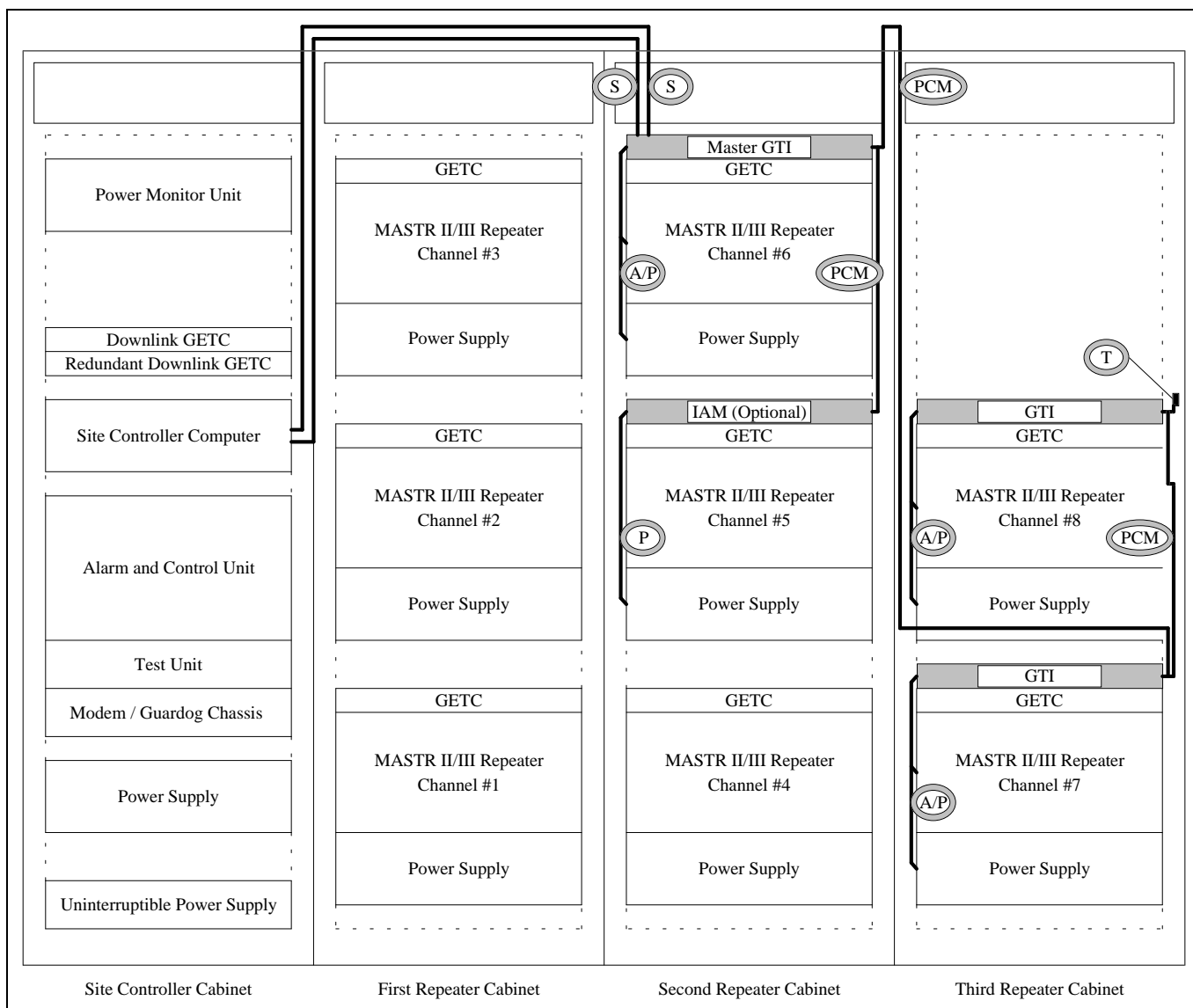


Figure 1 - Location of ELI Components in a Typical EDACS Installation

The Site Controller computer directs up to 16 levels of toll call restrictions, up to 15 rotary hunt sequences, 8 dequeuing priority levels, and inbound interconnect enable/disable assignments, for each ID number. It also accumulates interconnect call activity data for the System Manager.

The standard ELI option consists of one or more GTI units, one GTI Interface card, one set of two GTI Configurator software diskettes, one set of two Site Controller computer Personality PROMs, and the necessary cables and hardware. The ELI option may also consist of an optional Interconnect Accounting Manager (IAM) unit. The GTI interface card is to be installed into one of the GTI units making it the Master GTI.

The ELI option utilizes a distributed switching system architecture that distributes the switching function between the separate GTI units rather than concentrating it at a centrally located telephone switch. Additionally, each GTI unit receives its power from a separate repeater power supply.

A typical ELI installation containing two GTI units, a Master GTI, and an optional IAM is shown in Figure 1. The function of each cable and bus termination shown, is as follows (see parts list for part numbers):

S - The serial data cables connect the Master GTI to the Site Controller computer. (Two are used.)

P - The power cable connects the optional IAM to the power supply of the associated repeater. (One is used if an IAM is supplied.)

A/P - The audio/power cable connects a GTI or Master GTI to a MASTR II/III repeater and its power supply. (One is used for each GTI or Master GTI assigned to a MASTR II/III repeater.)

PCM - The PCM/Data bus sections connect each GTI, the Master GTI, and the optional IAM in a daisy-chain. (Section lengths depend upon the position of the units. The total number of bus sections is one less than total number of units used.)

T - The termination for the PCM/Data bus terminates the high channel end of the bus. (One is used.)

GTI UNITS

Each GTI (Global Telephone Interconnect) unit contains both a radio channel interface and a telephone line interface. For each interface, the GTI contains both analog-to-digital and digital-to-analog converters, and a digital signal processor. The relation of these circuits to the audio paths is shown in Figure 2.

The radio channel interface provides the following functions:

- Decodes DTMF from radio for radio-originated call.
- Sends ringback or busy tone to radio for radio-originated call.
- Sends ringing signal to radio for telephone-originated call.

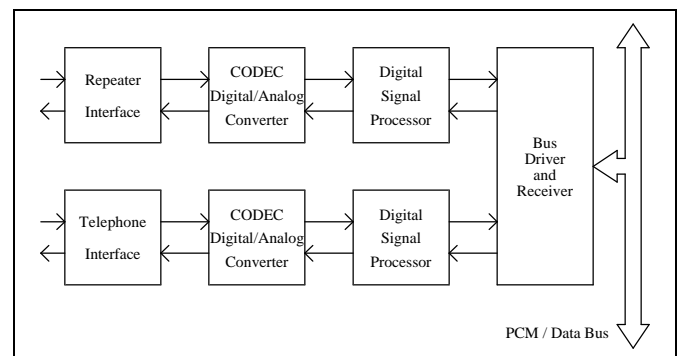


Figure 2 - GTI Audio Paths

The telephone line interface provides the following functions for telephone-originated calls:

- Detects signaling from telephone line.
- Applies signaling to seize telephone line.
- Detects and decodes overdialed telephone number digits from telephone line.
- Sends voice prompts to telephone line.
- Detects end-of-call signaling from telephone line.
- Removes signaling to drop telephone line.

The telephone line interface provides the following functions for radio-originated calls:

- Applies signaling to seize telephone line.
- Detects signaling from telephone line.
- Generates and applies telephone number digits to telephone line.
- Sends voice prompts to telephone line.
- Detects end-of-call signaling from telephone line.
- Removes signaling to drop telephone line.

One GTI converts the analog audio signal (from the radio channel connected to it) into a digital signal for placement onto the PCM/Data bus. Another GTI (or the same GTI) converts the digital signal from the PCM/Data bus back to an audio signal (for the telephone line connected to it). A similar route is taken by the signal from the telephone line to the radio channel. Each radio channel has its own time slot on PCM/Data bus so as not to interfere with any other radio channel.

GTI INTERFACE BOARD

The GTI Interface board serves as the information and command interface between the Site Controller computer and all the GTI units in the system. It is installed in only one GTI unit, which then becomes the Master GTI.

GTI CONFIGURATOR SOFTWARE

The GTI Configurator software is a PC-based, menu-driven program (supplied in both 3.5-inch and 5.25-inch floppy formats) that allows the system operator to change parameters in the GTI database, retrieve GTI call records, and monitor the system activity.

IAM

The optional IAM (Interconnect Accounting Manager) is a microprocessor-based call-detail buffer, containing two megabytes of battery-backed RAM to provide storage for up to 60,000 call detail records, compatible with the EDACS Billing Correlation Unit. At the completion of each call, a call detail record of that call is sent to the IAM. The IAM

provides a serial data port for a printer to be connected, to print real-time records of calls being placed on the system. Records can also be retrieved from the IAM at any time using the PC-based GTI Configurator software. Call detail records contain the following information:

- Record Type
- Start Time
- Elapsed Time
- Call Type
- Radio User ID
- Line Number
- Channel Number
- Phone Number Dialed (up to 20 digits)
- System Number
- Node Number

INSTALLATION

OVERVIEW

The installation of the ELI option has been divided into 14 steps, which are described in this section. Not all steps will apply to all installations. Some steps involve more than one activity.

Table 1 shows a flow chart of the installation activities for various pieces of equipment. The activities to the right of a heavy vertical line should not be started until all those activities to the left of the line have been completed for that piece of equipment. The number in a circle to the left of each activity indicates the installation step in the text where the activity is described.

These 14 installation steps plus the configuration of the Site Controller database (contained in the Configuration section of this manual) and the configuration of the GTI database (contained in the GTI Configurator software user's guide) are summarized in the Installation Checklist at the end of this manual. Make a copy of this checklist, and check off items as they are completed.

Table 1 - Sequence of Installation Activities (with Step # References)

EQUIP	STEP #	INSTALLATION ACTIVITIES
MDR Radios	①	Check Software Group #
Site Controller Computer	②	Verify VAX Configuration
	③	Check Application Software Group #
	③	Replace Personality PROMs
Standard GTI Units	④	Assign Radio Chan
	⑤	Record Software Version #s
	⑥	Set Up Phone Interface
	⑦	Set DIP Switches
	⑨	Mount with Radio Chan Equip
	⑩	Connections
Master GTI	④	Assign Radio Chan
	⑤	Record Software Version #s
	⑥	Set Up Phone Interface
	⑦	Set DIP Switches
GTI Interface Board	⑧	Install GTI Interface Board
	⑤	Record Software Version #
	⑨	Mount with Radio Chan Equip
IAM	④	Assign Radio Chan
	⑪	Record Software Version #
	⑨	Mount with Radio Chan Equip
	⑫	Connections
	⑬	Set DIP Switches
GETC	⑭	GETC Modification

1. RADIO SOFTWARE

The **1st step** to install the ELI option applies only to MDR full-duplex radios. If you plan to use this type of radio with your ELI system, make sure each radio contains 344A4271Gx software (where x = 2 or higher). See the manual for the radio to get instructions on where to find the software.

2. SITE CONTROLLER HARDWARE

The **2nd step** to install the ELI option is to verify that the Site Controller computer is a VAX model. PDP models will not support the ELI option. Since some PDP models have been upgraded to a VAX model, you cannot tell if it is a PDP or VAX from the outside. To know for sure, you must look inside the PDP system chassis and check what cards are installed. PDP models that have been upgraded to a VAX model will have their cards arranged in the card cage as shown in Figure 3.

KA620-BA	
MS630-BB	
MRV11-D	H3656-00
CQ1610#1	
CQ1610#2	
EMPTY	
EMPTY	
EMPTY	

Figure 3 - Card Layout for PDP Upgraded to VAX

If you find that the Site Controller computer is a PDP model, upgrade kits are available through Ericsson Service Parts. Alternatively, the PDP model may be replaced with the current 19A149302P9 VAX model.

3. SITE CONTROLLER SOFTWARE

The **3rd step** to install the ELI option consists of the following two parts:

1. Check the revision of the Application Software PROMs (replacement might be necessary).
2. Replace the Personality PROMs.

Both sets of PROMs are located on the PROM card in the Site Controller computer. Access to the PROM card in the latest VAX version of the Site Controller computer is through the back. Use the following procedure:

3. Turn off the Site Controller computer.
4. Loosen the two fastener screws holding the back panel to the chassis (see Figure 4).

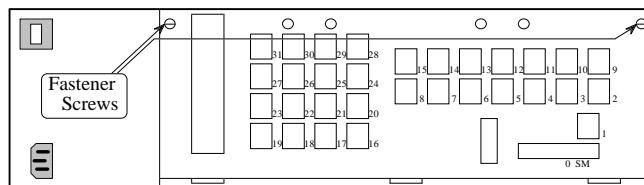


Figure 4 - Location of Fastener Screws on Computer

3. Rotate the back panel down and out of the way (be careful not to damage the ribbon cables).
4. Remove the PROM Card (see Figure 5) by pulling on the two tabs fastened to the front edge of the card. (Observe standard handling practices for static sensitive components.)

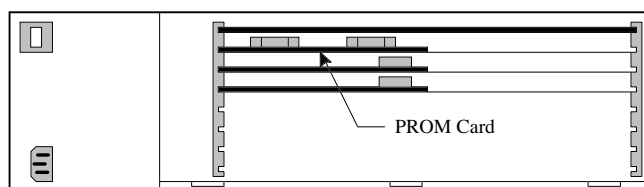


Figure 5 - Location of PROM Card in Computer

Access to the PROM card in previous VAX versions and older PDP versions that were upgraded to a VAX version is through the top. Use the following procedure:

1. Turn off the Site Controller computer.
2. Pull the Site Controller computer chassis all the way forward on its slide-out track.
3. Pull up the top cover and the attached card cage.
4. Remove the PROM Card (see Figure 6) by pulling on the two tabs fastened to the front edge of the card. (This is a three-handed operation - observe standard handling practices for static sensitive components.)

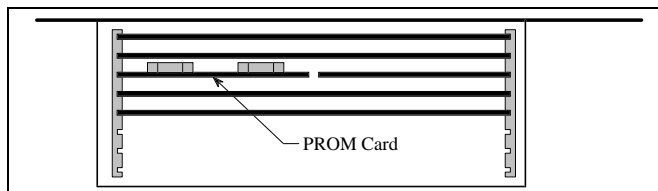


Figure 6 - Location of PROM Card in Older Computer

The location of the Application Software and Personality PROMs on the PROM card is shown in Figure 7. When replacing PROMs, be sure to get each new PROM in the correct location and the notched end facing the right direction. Be especially careful of location numbers 01 and 02 since these numbers are used for both types of PROMs.

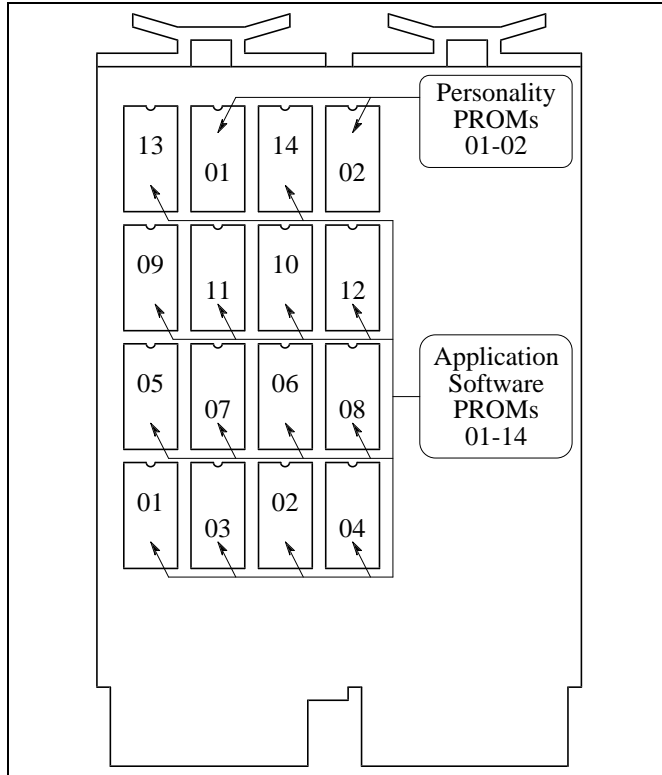


Figure 7 - Location of PROMs on PROM Card

Application Software PROMs

Each of the 14 Application Software PROMs must be marked 344A3265Gx, where x = 5 or higher. (x = 4 or lower does not support the ELI option.) Figure 8 shows where to find the software revision number and the PROM location number on a typical Application Software PROM label.

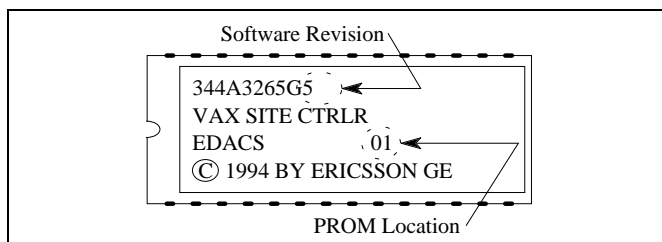


Figure 8 - Application Software PROM Label

Personality PROMs

Each of the two Personality PROMs must be replaced when you install the ELI option, regardless of the version of the Application Software PROMs. The new Personality PROMs must have ELI selected as the interconnect mode. In addition, the new Personality PROMs should have other ELI parameters programmed correctly (see the Configuration section). Figure 9 shows where to find the PROM location number on a typical Personality PROM label.

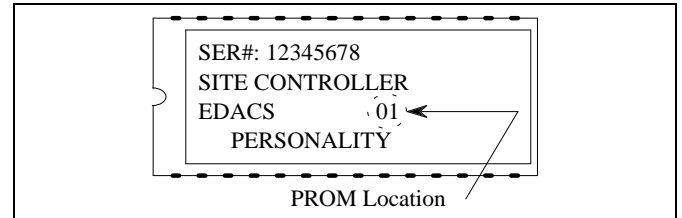


Figure 9 - Personality PROM Label

4. RADIO CHANNEL ASSIGNMENTS

The **4th step** to install the ELI option, is to assign each GTI unit (including the Master GTI) and the optional IAM to a radio channel. Once this relationship is established, the telephone interface inside the GTI units and the DIP switches on the side of the GTI units can be set up. Then the GTI units can be mounted.

Although the optional IAM is not functionally associated with any specific radio channel, it is mounted with a specific radio channel as if it was. This forces it to be in a predictable location relative to the GTI units so that cables of the correct length can be provided for its connection.

Until they are mounted there is an opportunity to get them mixed up and mounted with the wrong radio channel. To assure that this doesn't happen, the radio channel assignments can be temporarily marked on the GTI units, or the GTI units can be set up and mounted one at a time.

The method used to assign GTI units to radio channels is to assign all of the standard GTI units first, followed by the Master GTI, and finally the optional IAM. Start by assigning the first standard GTI to the highest numbered radio channel, the next GTI to the next highest numbered radio channel, and so on until all standard GTI units, then the Master GTI, and finally the optional IAM (if supplied) are assigned.

You may use some other method. However, using the method described here assures that the supplied cables will

be the correct length and the PCM/Data Bus will be as short as possible. (The PCM/Data Bus must not exceed 120 feet in length).

5. GTI SOFTWARE

The **5th step** to install the ELI option is to record the version number of all software on each board in each GTI unit. Each standard GTI unit has a Main board and a Processor board. One standard GTI unit is made into a Master GTI unit by adding a third board, the Interface board. Keep this information with this manual for future reference. If a problem is later encountered with the equipment, this information may be essential to help with the diagnosis.

Main Board

NOTE

Revision-A Main boards do not support narrowband systems. If you have a narrowband system, you must use revision-D or later Main boards.

The Main board contains the GTI 552 and GTI DSP software at the locations shown in Figure 10. The first Main boards, identified by the manufacturer's number 702-9588A, require different software than current Main boards, identified by the manufacturer's number 702-9588D. These two boards are referred to as revision-A Main boards and revision-D Main boards respectively.

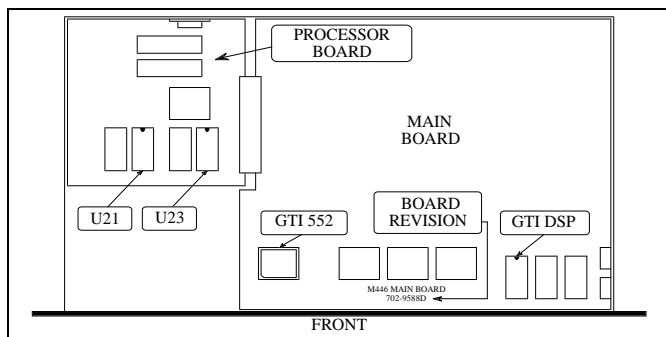


Figure 10 - GTI Software Locations

Revision-A Main boards

CAUTION

Revision-A Main boards require version 1.x GTI 552 and GTI DSP software. Do not use version 2.x or higher GTI 552 or GTI DSP software with revision-A Main boards.

For a revision-A Main board, the GTI 552 software is stored in U63 and requires version 1.x software (where x = any number). A sample label for U63 is shown in Figure 11. (The actual version number of the software supplied may be different than that shown.)

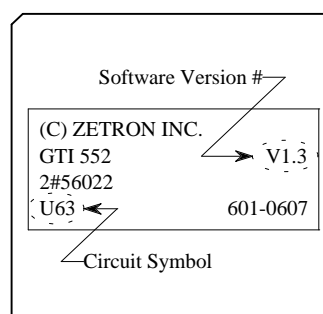


Figure 11 - GTI 552 Software Label for V1.x

For a revision-A Main board, the DSP software is stored in U72 and requires version 1.x software (where x = any number). A sample label for U72 is shown in Figure 12. (The actual version number of the software supplied may be different than that shown.)

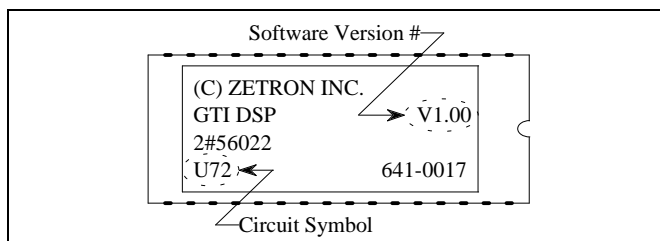


Figure 12 - GTI DSP Software Label for V1.x

Revision-D Main boards

NOTE

Revision-D Main boards require version 2.x or higher GTI 552 and GTI DSP software. Do not use version 1.x GTI 552 or GTI DSP software with revision-D Main boards.

For a revision-D Main board, the GTI 552 software is stored in U50 and requires version 2.x software (where x = any number) or higher. A sample label for U50 is shown in Figure 13. (The actual version number of the software supplied may be different than that shown.)

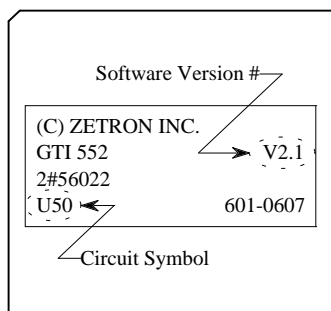


Figure 13 - GTI 552 Software Label for V2.x

For a revision-D Main board, the DSP software is stored in U57 and requires version 2.x software (where x = any number) or higher. A sample label for U57 is shown in Figure 14. (The actual version number of the software supplied may be different than that shown.)

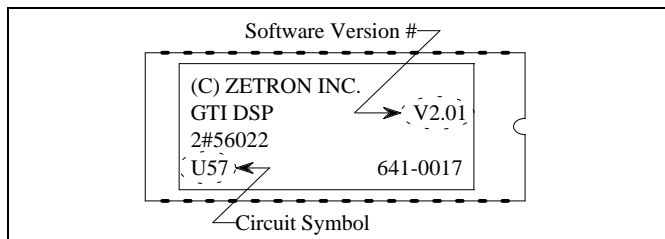


Figure 14 - GTI DSP Software Label for V2.x

Processor Board

The Processor board contains the GTI Main software in U21 and U23. A sample label for U21 is shown in Figure 15. The label for U23 is identical except for the circuit symbol. (The actual version number of the software supplied may be different than that shown.)

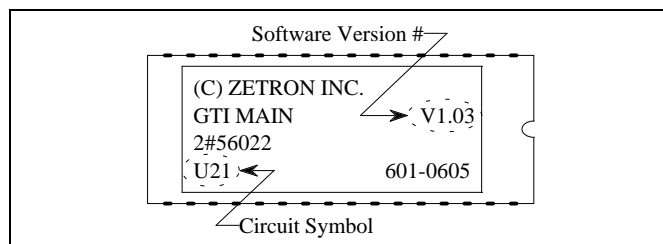


Figure 15 - GTI Main Software Label

CAUTION

When using both revision-A and revision D Main boards in the same ELI system, the GTI MAIN software installed in U21 and U23 on the Processor board must be version 2.x or higher. This applies to all Processor boards in the ELI system.

Interface Board

The Interface board contains the GTI Master software at the locations shown in Figure 16.

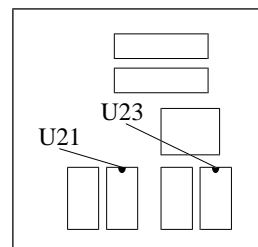


Figure 16 - GTI Interface Board Software Locations

The GTI Master software is stored in U21 and U23. A sample label for U21 is shown in Figure 17. The label for U23 is identical except for the circuit symbol. (The actual revision of the software supplied may be different than that shown.)

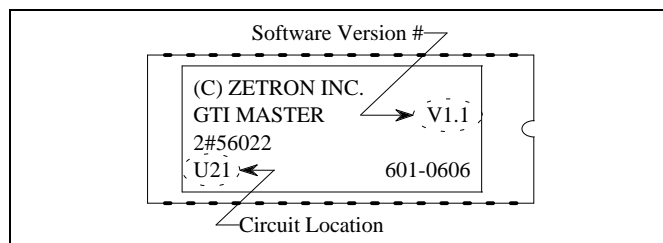


Figure 17 - GTI Master Software Label

6. GTI TELEPHONE INTERFACE

The **6th step** to install the ELI option is to configure each GTI telephone interface to match the type of telephone circuit to be connected to it. Some older Main boards, identified by the manufacturer's number 702-9588A, are configured differently than the current Main boards, identified by the manufacturer's number 702-9588D. These two boards are referred to as revision-A Main boards and revision-D Main boards respectively.

NOTE

Revision A Main boards do not support Direct Inward Dial (DID) telephone lines. If you need to have a DID telephone line connected to a GTI unit, that GTI unit must contain a revision-D or later Main board.

Revision-A Board

The revision-A Main board uses 15 jumpers (JP1 through JP15) and two fuses (F2 and F3) to configure the telephone interface. Set the jumpers and fuses to match the type of circuit to be connected to it. Figure 18 shows the locations of these jumpers and fuses on the revision-A Main board, and Table 2 lists the jumper and fuse configurations for four common types of telephone circuits. Figures 19 through 22 show simplified schematics of these four configurations.

Many other configurations of the GTI telephone interface are possible. Table 3 shows which jumpers and fuses to use to obtain each specific interface characteristic. Figure 23 shows a simplified schematic of the interface, including key components and the location of each jumper and fuse. If a jumper or fuse is not specifically required for a characteristic, remove it. Not all characteristics are compatible with each other. For example, the interface cannot be configured for a -48 V reference for the E-Lead and at the same time be configured for an external reference for the M-Lead.

Be careful of terms when talking or reading about the telephone circuit that the GTI unit is to interface. Terms such as send, receive, in, out, E-Lead, and M-Lead are sometimes defined differently by different people and from different points of reference. The terms used in this manual are defined as follows:

- 4-Wire Send - audio voice signals from GTI unit to telephone circuit.
- 4-Wire Rec - audio voice signals from telephone circuit to GTI unit.
- M-Lead - telephone circuit supervision signal from GTI unit to telephone circuit.
- E-Lead - telephone circuit supervision signal from telephone circuit to GTI unit.

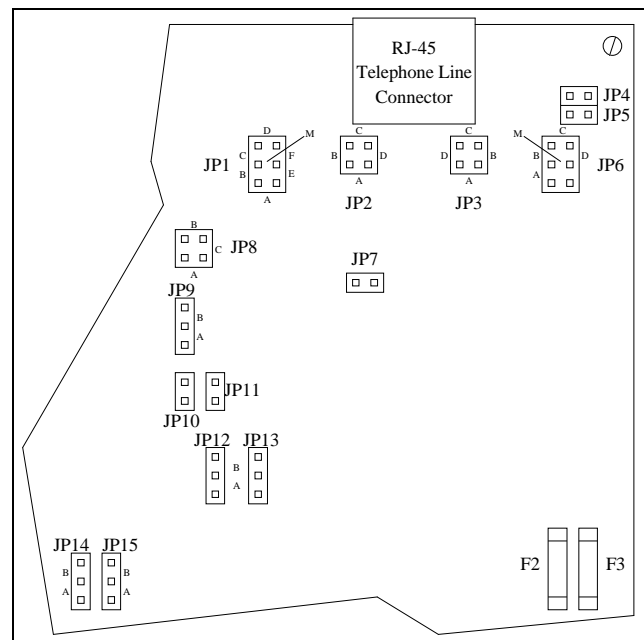


Figure 18 - Revision-A Main Board Jumper Locations

Table 2 - Revision-A Main Board Configurations by Line Type

TELEPHONE LINE TYPE	JUMPER POSITIONS FOR JP1 THROUGH JP15															FUSES F2&F3
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
End-to-End Loop Start	-	B	B	-	-	-	-	A	B	-	-	-	A	A	A	OUT
End-to-End Ground Start	D+M	B	B	-	-	-	-	B	A	-	-	B	A	A	A	IN
4-Wire E&M, Microwave	E	A+C	A+C	IN	IN	C+M	-	-	-	IN	IN	A	-	B	B	OUT
4-Wire E&M, Type I	E	A+C	A+C	-	-	C+M	-	-	-	IN	IN	B	-	B	B	IN

End-to-End, Loop Start

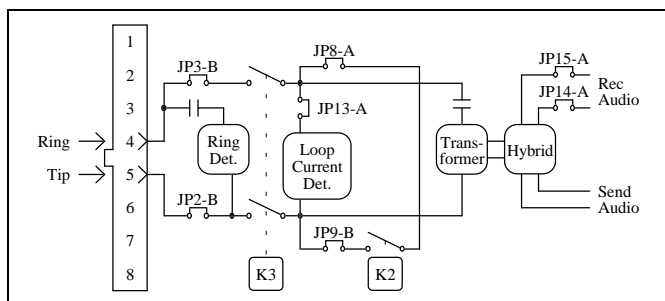


Figure 19 - End-to-End, Loop Start Configuration

Figure 19 shows the GTI telephone interface configured per Table 2 for End-to-End, Loop Start. Two wires are needed to connect to the telephone company side. Battery for the loop current is provided by the telephone office.

End-to-End, Ground Start

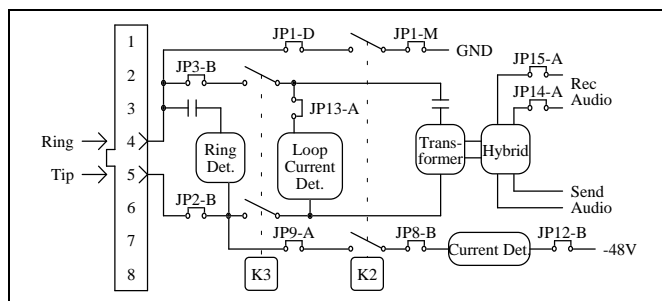


Figure 21 - End-to-End, Ground Start Configuration

Figure 21 shows the GTI telephone interface configured per Table 2 for End-to-End, Ground Start. Two wires are needed to connect to the telephone company side. Battery for the loop current is provided by the telephone office.

4-Wire E&M, Microwave

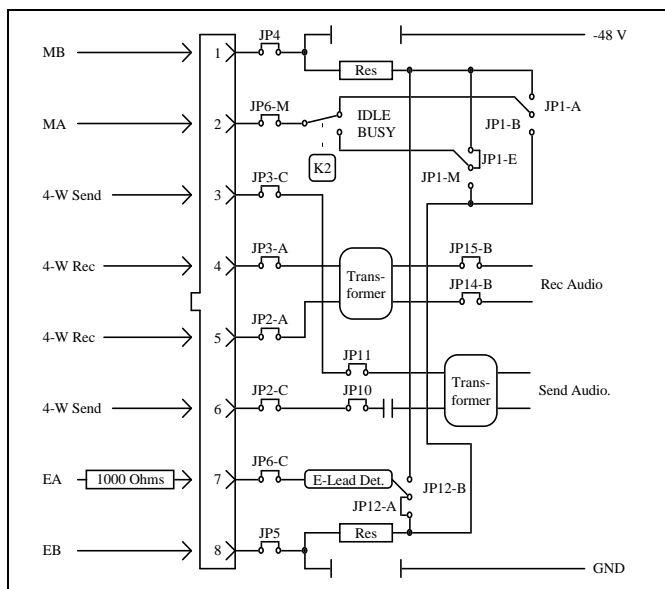


Figure 20 - 4-Wire E&M, Microwave

Figure 20 shows the GTI telephone interface configured per Table 2 for 4-Wire E&M, Microwave. Eight wires are needed to connect to the telephone company side, and 1000 ohms must be installed in series with the E-Lead. The interface interprets the absence of E-Lead current as an idle condition. The interface provides an opened-loop M-Lead for an idle condition and a closed-loop for a busy condition.

4-Wire E&M, Type I

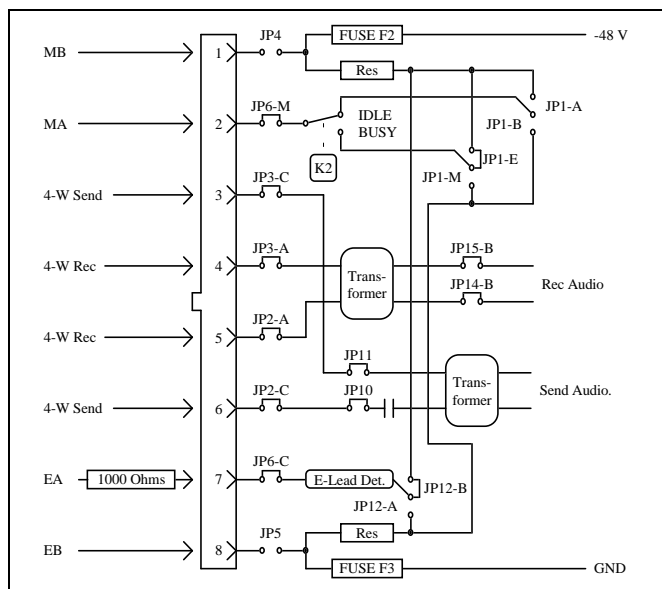


Figure 22 - 4-Wire E&M, Type I

Figure 22 shows the GTI telephone interface configured per Table 2 for 4-Wire E&M, Type I. Six wires are needed to connect to the telephone company side, and 1000 ohms must be installed in series with the E-Lead. The interface interprets the absence of E-Lead current as an idle condition. The interface provides an open M-Lead for an idle condition and applies -48 V for a busy condition.

Table 3 - Revision-A Main Board Configurations by Interface Characteristic

INTERFACE CHARACTERISTIC	JUMPER POSITIONS FOR JP1 THROUGH JP15															FUSES	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	F2	F3
Audio Circuit																	
2-Wire		B	B											A	A		
4-Wire		A+C	A+C											B	B		
Signaling																	
Loop Start								A	B				A				
Ground Start								B	A			B	A				
E&M						C+M				IN	IN						
E-Lead Reference																	
External Reference					IN							A					OUT
Internal Ground					OUT							A					IN
Internal -48 V				OUT	OUT							B				IN	
Idle M-Lead Reference																	
External Reference	A			IN								not B				OUT	
Internal Ground	B			OUT													IN
Internal -48 V	A			OUT												IN	
Busy M-Lead Reference																	
External Reference	E			IN								not B				OUT	
Internal Ground	M			OUT													IN
Internal -48 V	E			OUT												IN	

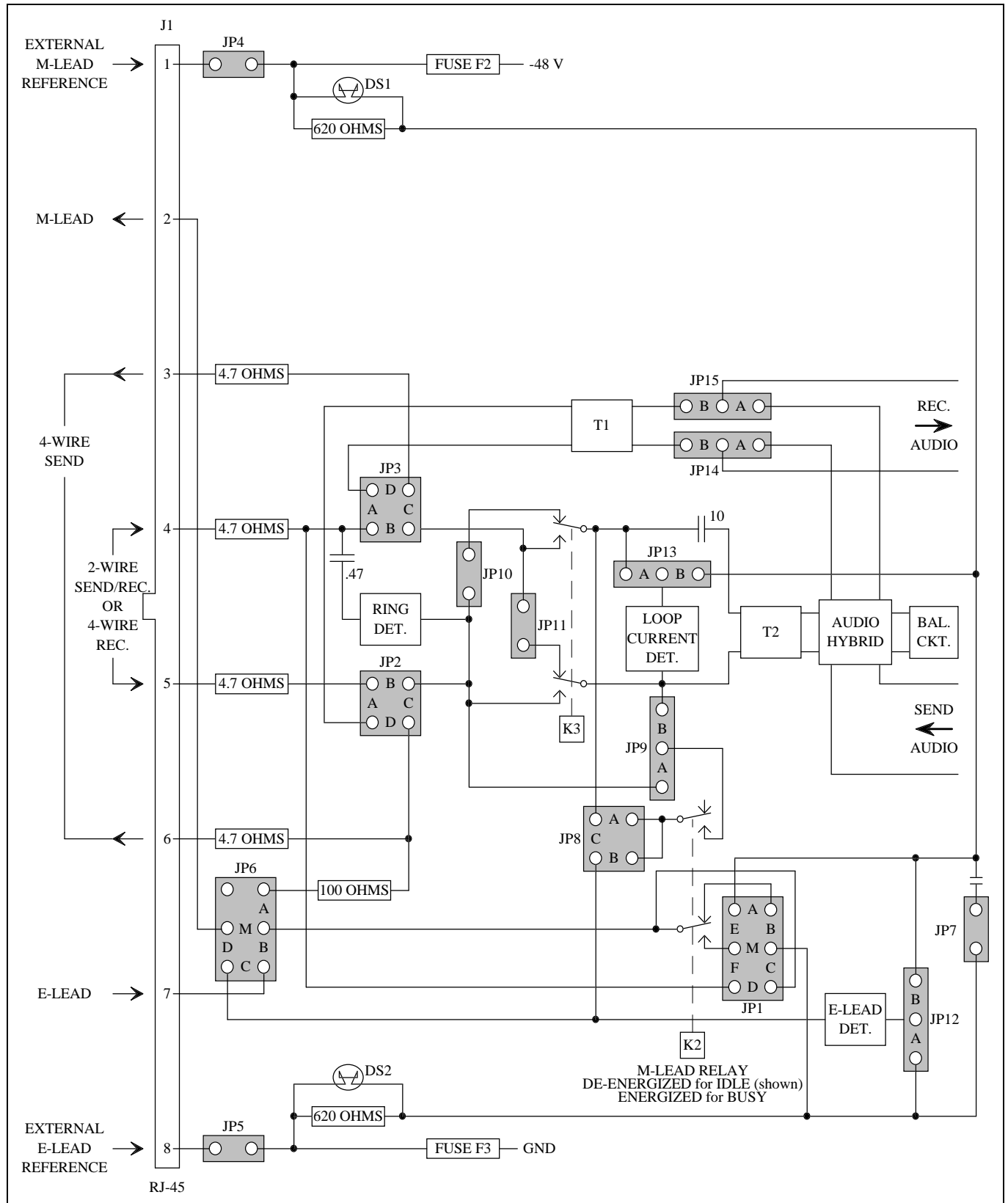


Figure 23 - Revision A Main Board Telephone Interface

Revision-D Board

The revision-D board contains two jumpers (JP3 and JP4) and a matrix card connector (J5) to configure the telephone interface. Set the jumpers and insert the Matrix card to match the type of telephone line to be connected to it. Figure 24 shows the locations of the jumpers and the Matrix card connector. Table 4 lists which jumpers and Matrix card are used for each supported type of telephone line.

Three matrix cards are supplied with each GTI unit. They are labeled E-E (for End-to-End), DID (for direct inward dial), and 4-W (for 4-Wire E&M). The matrix card will fit into J5 two ways, but only one way is correct. Be sure that the A1 end of the matrix plug goes into the A1 end of J5.

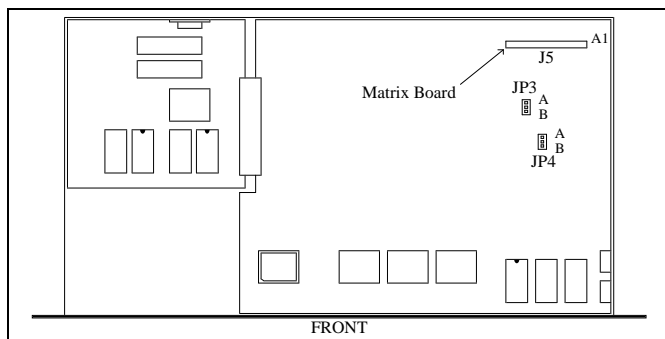


Figure 24 - Revision-D Main Board Jumper Locations

Table 4 - Revision-D Main Board Configurations

TELEPHONE LINE TYPE	JP3	JP4	MATRIX CARD
End-to-End, Loop Start	B	A*	E-E
End-to-End, Ground Start	B	A*	E-E
4-Wire E&M, Microwave	A	A*	4-W
4-Wire E&M, Type I	A	A*	4-W
DID	B	A*	DID

*Use the B position when the distance to the PBX is short (gives better hybrid balance).

The End-to-End and DID Matrix cards contain no jumpers to configure. However, the 4-Wire E&M matrix card has three jumpers (JP1 through JP3) to configure. The function of each jumper is shown in Figure 25.

7. GTI DIP SWITCH SETTINGS

The **7th step** to install the ELI option, is to set the two banks of DIP switches through openings in the right side of

the GTI chassis. The orientation of the DIP switches is shown in Figure 26.

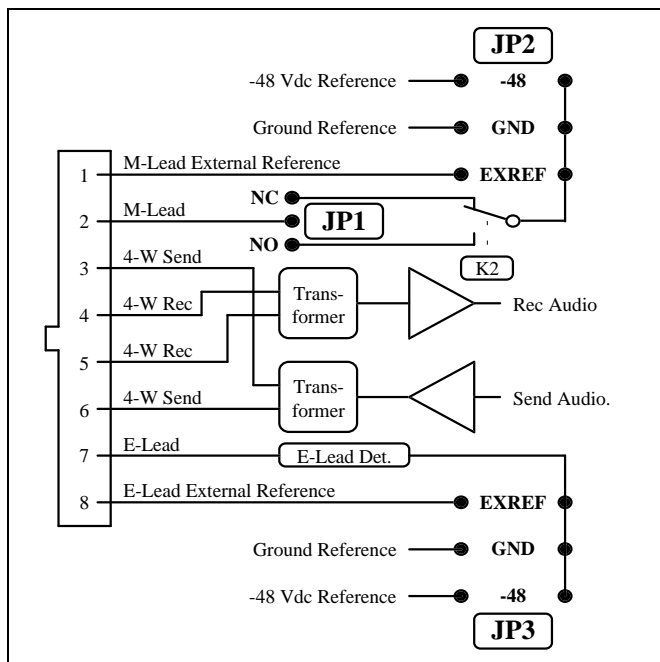


Figure 25 - 4-Wire E&M Matrix Card Configuration

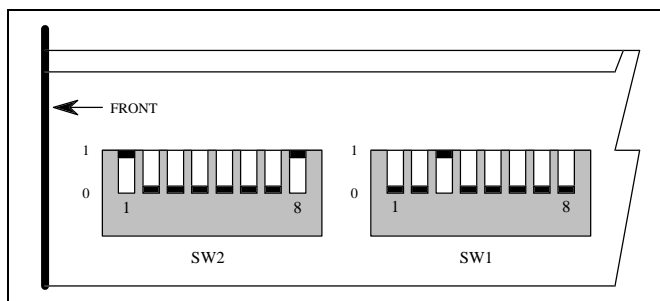


Figure 26 - GTI Unit DIP Switch Orientation

Switches 1 through 4 in the left-hand bank (SW2) of DIP switches are set to identify the type of telephone line to be connected to the GTI unit. Switch 5 is not used. Switches 6 through 8 are used to set the baud rate for the serial data port to the GTI Configurator terminal.

Switches 1 through 6 in the right-hand bank (SW1) of DIP switches are set to match the radio channel number connected to the GTI unit. (This will also be the line number of the telephone line connected to that GTI unit.) Switches 7 and 8 are not used.

Table 5 summarizes the defined switch settings for both banks (SW2 and SW1) of DIP switches. "1" means the DIP switch lever is up; "0" is down. Switch combinations not shown are not supported by the ELI option.

Table 5 - Defined DIP Switch Settings for GTI Units

BANK SW2 DIP SWITCH # 1 2 3 4 5 6 7 8	SEE PARAMETER BELOW	BANK SW1 DIP SWITCH # 1 2 3 4 5 6 7 8	GTI UNIT #
	Telephone Line Type:	1 0 0 0 0 0 X X	1
		0 1 0 0 0 0 X X	2
		1 1 0 0 0 0 X X	3
0 0 0 X X X X X	No Telephone Line Connected	0 0 1 0 0 0 X X	4
1 0 0 X X X X X	2-Wire End-to-End loop start	1 0 1 0 0 0 X X	5
0 1 0 X X X X X	2-Wire End-to-End ground start	0 1 1 0 0 0 X X	6
		1 1 1 0 0 0 X X	7
1 1 0 X X X X X	Direct Inward Dial (DID)	0 0 0 1 0 0 X X	8
0 0 1 X X X X X	4-Wire E&M Microwave	1 0 0 1 0 0 X X	9
1 0 1 X X X X X	4-Wire E&M Type 1		
		0 1 0 1 0 0 X X	10
X X X 0 X X X X	Immediate Start	1 1 0 1 0 0 X X	11
X X X 1 X X X X	Wink Start	0 0 1 1 0 0 X X	12
		1 0 1 1 0 0 X X	13
		0 1 1 1 0 0 X X	14
		1 1 1 1 0 0 X X	15
	Configurator Terminal Serial Data Rate:	0 0 0 0 1 0 X X	16
X X X X X 0 0 0	300 Baud	1 0 0 0 1 0 X X	17
X X X X X 1 0 0	1200 Baud	0 1 0 0 1 0 X X	18
X X X X X 0 1 0	2400 Baud		
		1 1 0 0 1 0 X X	19
X X X X X 1 1 0	4800 Baud	0 0 1 0 1 0 X X	20
X X X X X 0 0 1	9600 Baud	1 0 1 0 1 0 X X	21
X X X X X 1 0 1	19200 Baud	0 1 1 0 1 0 X X	22
		1 1 1 0 1 0 X X	23
		0 0 0 1 1 0 X X	24
		1 0 0 1 1 0 X X	25
		0 1 0 1 1 0 X X	26
		1 1 0 1 1 0 X X	27
	0 = DIP Switch Lever Down 1 = DIP Switch Lever Up X = DIP Switch Lever Down or Up	0 0 1 1 1 0 X X	28
		1 0 1 1 1 0 X X	29
		0 1 1 1 1 0 X X	30
		1 1 1 1 1 0 X X	31
		0 0 0 0 0 1 X X	32

8. GTI INTERFACE BOARD MOUNTING

The **8th step** to install the ELI option, is to make a Master GTI from a standard GTI by adding the GTI Interface board. Each standard GTI contains two printed circuit boards, mounted as shown in Figure 27. A third board, the GTI Interface board, is added to one GTI unit at a site, making it the Master GTI.

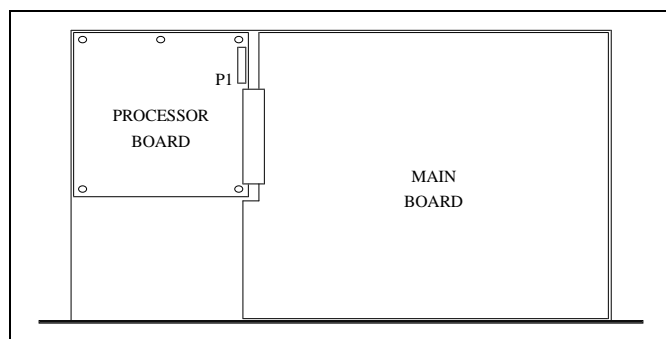


Figure 27 - GTI Circuit Board Layout

After the cover has been removed, add the GTI Interface board as follows:

1. Remove the five screws (don't throw them away) holding the GTI Processor board, and replace them with five screw-in standoffs supplied with the GTI Interface board.
2. Carefully position the GTI Interface board above the GTI Processor board, so that the 14 pins of P1 on the GTI Processor board line up with the 14-pin socket on the under side of the GTI Interface board, and push the GTI Interface board down to the standoffs.
3. Fasten the GTI Interface board to the standoffs using the five screws removed in step 1.

9. GTI & IAM MOUNTING

The **9th step** to install the ELI option, is to mount the standard GTI units, the Master GTI, and optional IAM (if supplied). Be sure that the following items have been completed before mounting:

- Recorded all software version numbers
- Installed GTI interface card in Master GTI
- Set up telephone interface
- Set DIP switches (GTI units and Master GTI)

The method used to mount GTI units in repeater cabinets is to mount all of the standard GTI units first, followed by the Master GTI. Start by mounting the first standard GTI just above the GETC for the highest numbered radio channel, the next GTI just above the GETC for the next highest numbered radio channel, and so on until all standard GTI units, and then the Master GTI are mounted.

You may use some other method. However, using the method described here assures that the supplied cables will be the correct length and the PCM/Data Bus will be as short as possible. (The PCM/Data Bus must not exceed 120 feet in length).

The 350A1154G1 GTI hardware kit, supplied with each GTI unit, provides a pair of offset brackets to brace the rear of the GTI unit to the back rails of the cabinet.

10. GTI CONNECTIONS

The **10th step** to install the ELI option, is to make the connections to the GTI units (including the Master GTI). All of the connections can be made to the connectors on the rear panel as shown in Figure 28.

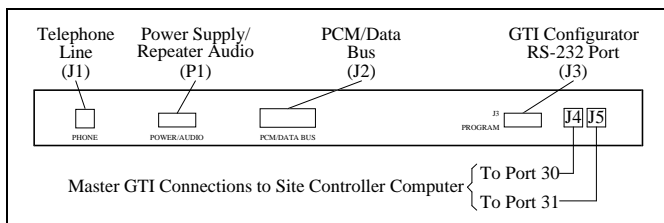


Figure 28 - Connections to GTI

Telephone Line

The ELI Interface module, in the EDACS Interface panel at the top of each repeater cabinet, is used to

consolidate the telephone connections for 6 telephone lines from up to 6 GTI units into a single 25-pair IDC telco connector for connection to a Type 66 (or equivalent) punchblock and the telephone company. A second 25-pair IDC telco connector is provided on each module to allow a 25-pair cable to connect this module in tandem with a similar module in an adjacent repeater cabinet.

CAUTION

All telephone lines must come through protected punchblocks (or equivalent protection) before being connected to this equipment.

For each GTI that is to be connected to a telephone line, connect a phone cable from the female 8-pin modular RJ-45 connector in the back of the GTI to one of the female 8-pin modular RJ-45 connectors (J1 through J6) on the front of the GTI Interface module in the EDACS Interface Panel at the top of the cabinet (see Figure 29). Use a phone cable that matches the location of the GTI unit:

- Use a 44" 19B803829P1 phone cable when the GTI is located with the top repeater.
- Use a 60" 19B803829P2 phone cable when the GTI is located with the middle repeater.
- Use a 76" 19B803829P3 phone cable when the GTI is located with the bottom repeater.

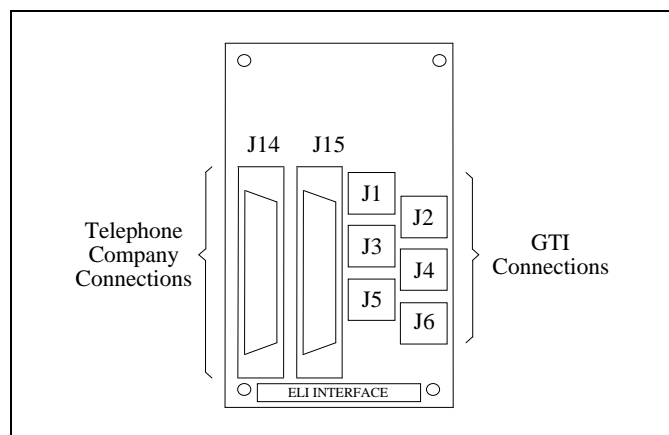


Figure 29 - Connections to ELI Interface Module

MASTR III Power Supply/Audio

If the GTI unit is to be connected to a MASTR III repeater channel, connect a 19B803830P1 cable from the male 1x6-pin Molex connector on the back of the GTI

(marked "POWER/AUDIO") to P4 on the MASTR III repeater T/R Shelf backplane, and to P801 on the repeater power supply, as shown in Figure 30. Note that the power supply end of the cable comes with pins attached to wires, but no connector shell. These pins are to be inserted into the existing connector shell already connected to P801 on the power supply. Insert the pin on the red wire into pin position 3 and the pin on the black wire into pin position 6.

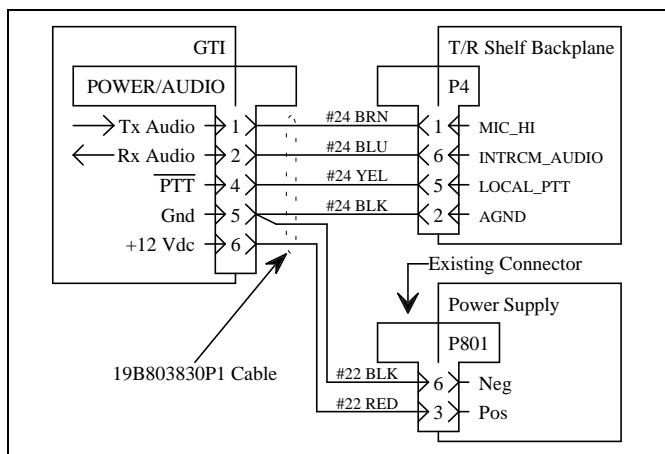


Figure 30 - MASTR III Connections

MASTR II or IIe Power Supply/Audio

If the GTI unit is to be connected to a MASTR II or IIe repeater channel, the existing 19C320811G15 or G16 harness for the MASTR II or IIe repeater channel must be modified. The modification involves two existing connectors on the harness: P40 - a 1x6-pin Molex connector, and P41 - a 1x2-pin Molex connector. These connectors will be found secured to the harness as it goes to J1201, J1202, J1203, and J1204 on the backplane of the repeater. Use the following procedure to rearrange the wires from these two connectors into the single connector, P40, and then connect it to the GTI unit:

1. Remove pin 1 from the shorter connector, P41, using a small screwdriver or scribe to depress the tongue of the pin in the open slot in the side of the connector while you pull gently on the wires going to the pin. Insert the pin into the longer connector, P40, as pin 6.
2. Remove pin 2 from the shorter connector, P41, and insert the pin back into the longer connector, P40, as pin 5.
3. Remove pin 3 (attached to the two W/Y/BN colored wires) from the longer connector, P40, and insert the pin back into the same connector, but now as pin 4.

4. Cut the short loop of white wire between pins 1 and 2 in the longer connector, P40.
5. Remove pin 1 from the longer connector, P40, and insert the pin back into the same connector, but now as pin 3.

NOTE

Once the MASTR II or IIe repeater harness has been modified per steps 4 and 5, a GTI unit must be connected to the repeater harness at all times to complete the audio loop of the repeater. If the GTI unit ever needs to be removed, you must reconnect the jumper cut in step 4. Because of the pin change in step 5, the jumper will be needed between pins 2 and 3.

Plug this rearranged P40 into the male 1x6-pin Molex connector (marked "POWER/AUDIO") on the back of the GTI. See Figure 31.

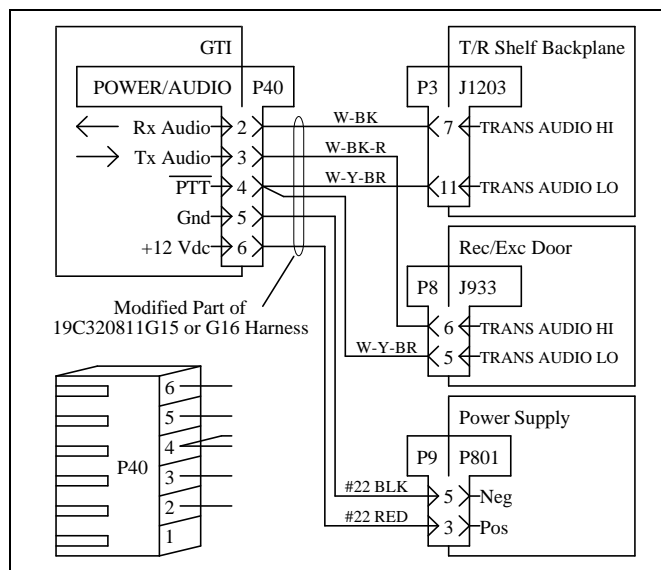


Figure 31 - MASTR II & IIe Connections

PCM/Data Bus

The PCM/Data bus is made up of a PCM/Data bus termination plug and one or more 12-pair shielded cables daisy-chained between each GTI, the Master GTI, and the optional IAM (if present). These cables have a stackable 24-pin connector on one end, and a standard 24-pin connector on the other.

To install the data bus cables, connect the IAM unit (if present) first, then the Master GTI unit, and finally the standard GTI units (from the lowest channel to the highest

channel). Plug the standard connector of the first cable directly into the first unit, and the stackable connector of the first cable directly into the second unit. Then plug the standard connector of the second cable into the stackable connector of the first cable (which is plugged into the second unit), and the stackable connector of the second cable directly into the third unit. Continue connecting the cables in this way until all units are connected together. Then, plug the PCM/Data bus termination plug into the stackable connector of the last cable (which is plugged into the last unit).

Figure 1 shows the standard routing for a typical ELI system. Figure 32 shows the pin-out information for PCM/Data bus cables.

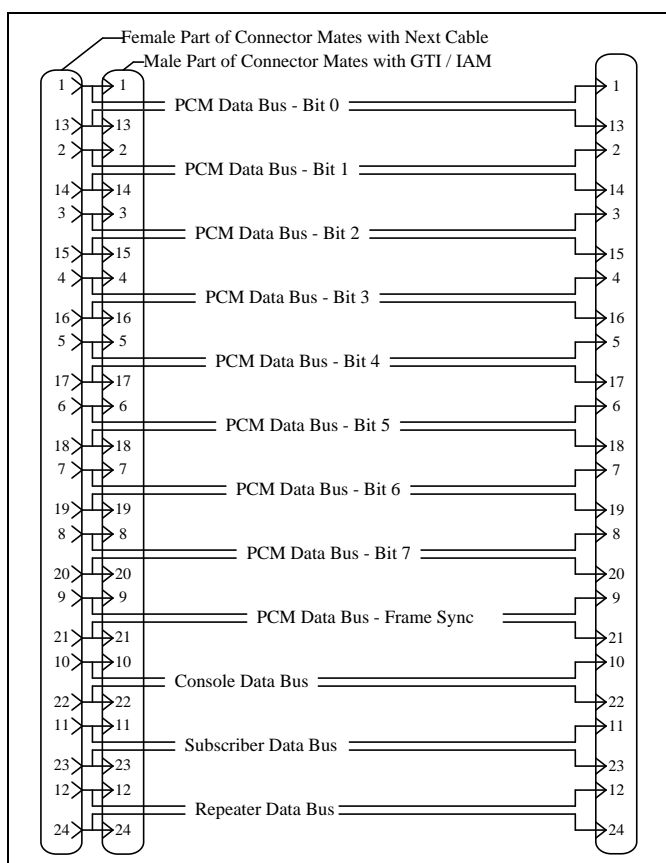


Figure 32 - PCM/Data Bus Cable

Site Controller Computer

Two data cables must connect the Master GTI to the Site Controller computer. Connect a 19B803826P1 cable from the left female RJ-11-6 connector on the back of the Master GTI, to Port 30 on the back of the Site Controller computer. Connect a 19B803826P2 cable from the right female RJ-11-6 connector on the back of the Master GTI, to Port 31 on the back of the Site Controller computer. The

locations of Ports 30 and 31 on the back of the Site Controller computer are shown in Figure 33.

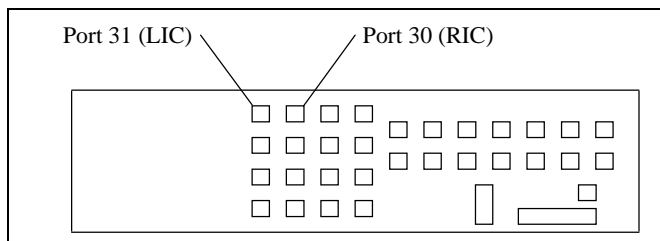


Figure 33 - Site Controller Computer Connections

11. IAM SOFTWARE

The **11th step** to install the ELI option applies only if an IAM was supplied. Record the software version number marked on the software PROM in the IAM unit. If a problem is later encountered with the equipment, the software version number may be essential to help with the diagnosis.

The location of the software PROM in the IAM unit is shown in Figure 34.

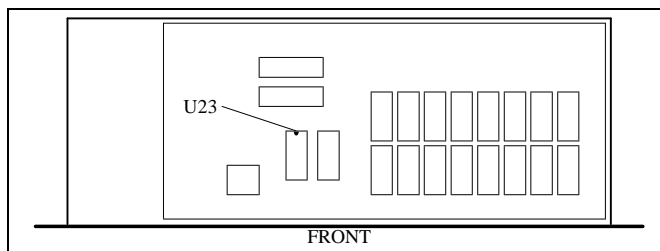


Figure 34 - IAM Software Locations

The IAM software is stored in U23 in the IAM. A sample label for U23 is shown in Figure 35. The actual version number of the software supplied may be different than that shown.

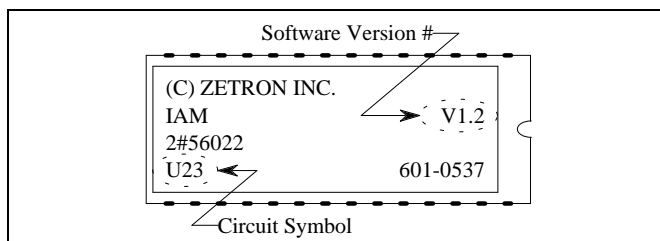


Figure 35 - IAM Software Label

12. IAM CONNECTIONS

The **12th step** needed to install the ELI option applies only if an IAM was supplied. All connections to the IAM are made to connectors on the rear panel, as shown in Figure 36.

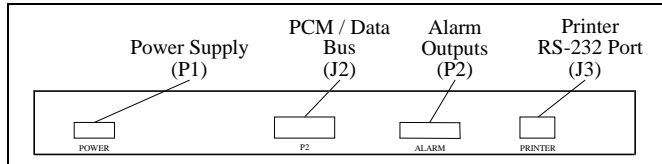


Figure 36 - IAM Rear Panel Connections

Power Supply

Connect a 19B803968P1 cable from the male 1x6-pin Molex connector on the back of the IAM (marked "POWER") to P801 on the repeater power supply, as shown in Figure 37. Note that the power supply end of the cable comes with pins attached to the wires, but no connector shell. These pins are to be inserted into the existing connector shell already connected to P801 on the power supply.

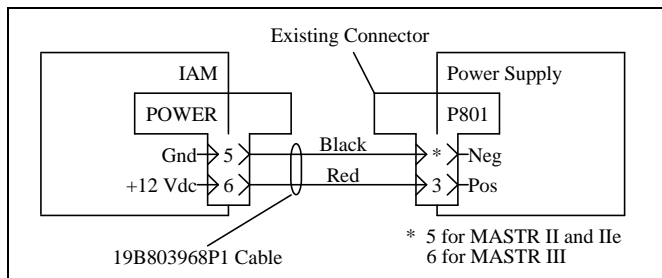


Figure 37 - IAM Power Supply Connections

For a power supply connected to a MASTR III repeater, insert the pin on the red wire into pin position 3 and the pin on the black wire into pin position 6.

For a power supply connected to a MASTR II or IIe repeater, remove the existing pins in pin positions 3 and 5, and tie back. Then insert the pin on the red wire into pin position 3 and the pin on the black wire into pin position 5.

PCM/Data Bus

Connect the PCM/Data bus cables as instructed in the previous section for the GTI units.

Alarm Outputs

The IAM provides three open-drain alarm outputs for the user to connect to an alarm system, if desired. These alarm outputs will go through indeterminate states during IAM power-up or reset. If the Active High output configuration is selected by setting DIP switch section 7 to the up position, all alarms will be active if the IAM loses power. Conversely, if the Active Low output configuration is selected by setting DIP switch section 7 to the down position, no alarms will be active if the IAM loses power. The standard ELI option does not provide a cable for this connection, but pin-out information is shown in Figure 38. Pins 7 through 10 are not used.

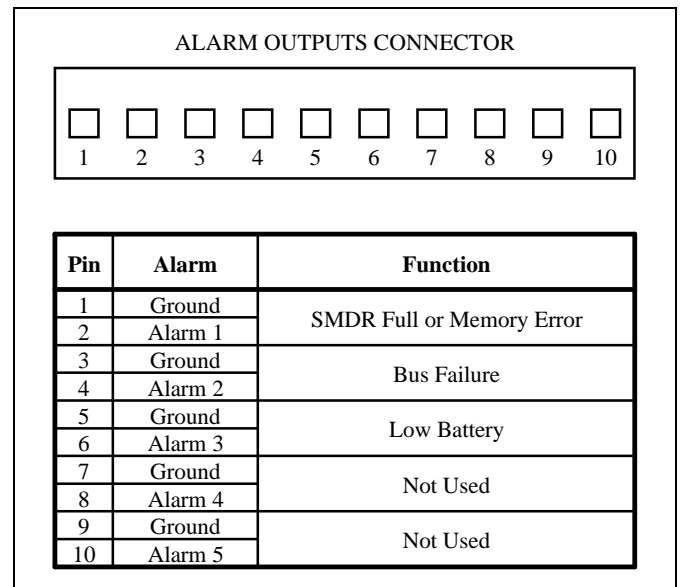


Figure 38 - IAM Alarm Outputs

Printer RS-232 Port

A female 9-pin RS-232 serial printer port, labeled "PRINTER", is provided in the rear panel of the IAM allowing you to connect a printer to keep real-time records of calls being placed on your system (a record is printed after each call ends). The proper baud rate for the port can be selected using DIP switch sections 2 through 4. The serial printer port can be turned off and on using DIP switch section 5. The proper handshaking protocol for your printer can be selected using DIP switch section 6. The IAM can use both hardware and software handshaking, or just software handshaking. The standard ELI option does not provide a cable for this connection, but pin-out information is shown in Figure 39.

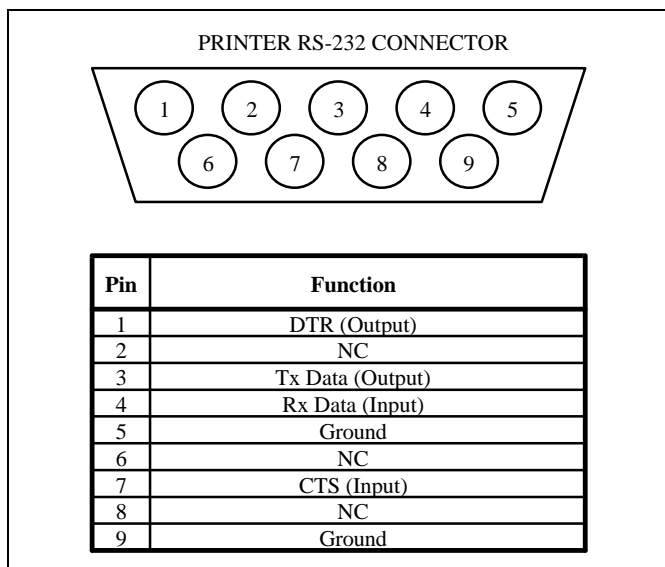


Figure 39 - IAM Printer RS-232 Port

Connecting a serial printer can sometimes entail some trial and error to get things set up properly. If you need to change any of the DIP switch settings, be sure to do a soft reset on the IAM (the IAM will only look at the DIP switch settings as part of the reset sequence).

A soft reset is accomplished by pushing the RESET button on the front panel two times. If the time between the two pushes is too short or too long, the reset will be aborted. The two pushes should be about 1/2 second apart. When the two pushes of the Reset button are spaced correctly, the front panel LEDs will all flash simultaneously as the IAM resets.

13. IAM DIP SWITCH SETTINGS

The **13th step** to install the ELI option applies only if an IAM was supplied. Set the bank of DIP switches on the front of the IAM unit as needed. Figure 40 shows the layout of the DIP switches and the function of each. Be sure not to put all the DIP switches in the down position (the software does not support this combination). Switch 8 is not used. Set switch 1 to the operate (down) position.

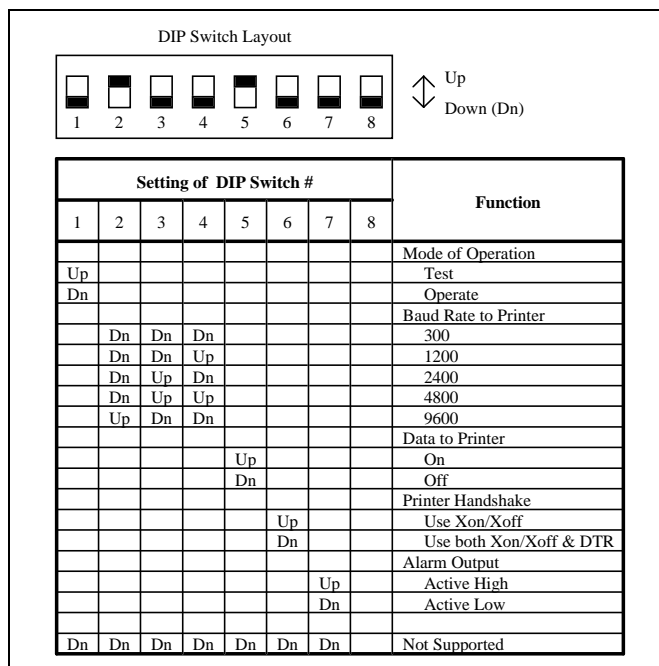


Figure 40 - IAM DIP Switch Settings

The position of each DIP switch (except switch 5 which controls data to the printer) is read only when the unit is reset. This means that changing the position of any of the other DIP switches will have no effect until the unit is reset or power-cycled.

14. GETC MODIFICATION

The **14th step** needed to install the ELI option applies only to MASTR III repeaters. If a MASTR III repeater will be connected to a GTI unit or the Master GTI, the associated GETC must be modified. (This does not apply to MASTR II or IIe EDACS repeaters.)

Remove power from the GETC shelf and pull out the tray containing the circuit boards until you can reach the connectors along the rear edge of the main circuit board. Disconnect the connector going to J7 (third connector from the right). Carefully extract pin 8, using a small screwdriver or scribe to depress the tongue of the pin in the open slot in the side of the connector while you pull gently on the wire going to the pin. Tape the pin to the cable and reconnect the connector to J7.

CONFIGURATION

OVERVIEW

The user configurable parameters for the ELI option reside in two locations: the Site Controller computer's database and the GTI units' database. The configuration of these two databases is covered in this section.

SITE CONTROLLER DATABASE

The overall operation of the ELI option is controlled by the software in the Site Controller computer and the active configuration of the Site Controller computer's database. This active configuration must reflect the installed telephone interconnect hardware and the desired operational characteristics.

Operation without System Manager

If the Site Controller computer is not connected to a System Manager, the active configuration of its database will always be the default configuration contained in its Personality PROMs. Therefore, this default configuration must reflect the installed telephone interconnect hardware and the desired operational characteristics.

If the telephone interconnect hardware or the desired operational characteristics change, it will be necessary to order a new set of Site Controller computer Personality PROMs. To assure that the new PROMs will accurately reflect these changes, it is important to pay particular attention to the following two data fields used by the Site Controller personality programmer to make the new Personality PROMs. (This is because telephone lines are typically numbered differently in the ELI option than they were in the previous telephone interconnect option.)

Max Line - Defines the highest telephone line number used. For the ELI option, the standard procedure is to assign telephone line numbers to the highest equipped radio channel numbers, with the telephone line numbers corresponding to the channel numbers. Therefore, a seven-channel ELI site with three telephone lines would have telephone line numbers five through seven, and you would enter 7 in the Max Line field.

Rotary Defaults - Defines which line numbers are to be considered when hunting for an available line. This field should only list existing line numbers. Listing non-existent line numbers may delay the line assignments for radio-initiated interconnect calls. In the previous example, line

numbers one through four would not exist and should not be entered in the Rotary Defaults field.

Operation with System Manager

If the Site Controller computer is connected to a System Manager, the default configuration contained in its Personality PROMs is not as critical, since it can be re-configured with the System Manager. However, it must still specify the ELI option, and should reflect the installed telephone interconnect hardware and the desired operational characteristics well enough to run the interconnect system in an emergency. (Whenever the Site Controller computer loses power or is reset, the active configuration of the Site Controller computer's database is (and will operate by) the default configuration until an update of the latest database can be obtained from the System Manager.)

The following user-configurable database parameters apply to local telephone interconnect systems in general. They have been grouped by function, rather than System Manager menu selection. The System Manager menu selection and panel references are given, following each parameter and its description, to help you locate the data field for the parameter. Not all parameters are used for the ELI system. Notes specifically for the ELI system are shown where they apply.

General Limits for Site

- **Interconnect** - This 24-channel row of parameters defines (for the site) if a channel is equipped for telephone interconnect calls. Default is no (N) for all channels. Enter Y for yes, or leave N for no. Note that GTI units are usually placed on the highest available channel numbers.

Site/Device Definition (menu selection 10)
Channel Configuration (panel 1:4)

- **Line Active** - This column of parameters defines (for the site) if a line is available for interconnect calls. Default is no (N) for all lines. Enter Y for yes, or leave N for no. Note that a line number gets its number from the radio channel number that shares the same GTI Unit. Also note that GTI Units are placed on the highest available channel numbers first.

Line Definition (menu selection 14)
Line Parameters (pages 1 & 2)

- **Pulse Dial** - This column of parameters defines (for the site) if a line uses pulse dialing. Default is no (N) for all lines. Note that the ELI system will ignore this parameter, so there is no point in changing it from its

default value. However, the equivalent of this parameter must be set in the GTI user database. (See the GTI Configurator Software user's guide, LBI-39077.)

Line Definition (menu selection 14)

Line Parameters (pages 1 & 2)

- **Message Conv Limit** - This 4-digit field defines (for the site) the conversation time limit (in seconds) for interconnect calls (and message trunking). Default is 300 seconds. Enter a number from 10 to 2550.

Site/Device Definition (menu selection 10)

Site Parameters (panel 2:4)

Channel Assignment Parameters

- **Interconnect Hang Time** - This 2-digit field defines (for the site) the time (in seconds) between an unkey command and channel drop. Default is 30 seconds. Do not enter a number larger than 60 (see note).

Site/Device Definition (menu selection 10)

Site Parameters (panel 2:4)

Channel Assignment Parameters

NOTE

Although the Interconnect Hang Time (IHT) can be set higher than 60 seconds, the GTI unit will wait no more than 60 seconds for a telephone-originated call to be answered. Therefore, setting the IHT to more than 60 seconds will not allow more than 60 seconds for the call to be answered.

The voice prompt played to the caller (as the result of an unanswered telephone-originated call) will depend upon whether the IHT or the 60-second GTI interval expires first. If the IHT is set to less than 60 seconds, it will expire first and the GTI unit will play voice prompt #6. (Default = Call is disconnecting) If the IHT is set to more than 60 seconds, the 60-second GTI interval will expire first and the GTI unit will play voice prompt #5. (Default = Radio didn't answer) If the IHT is set exactly to 60 seconds, either voice prompt #5 or #6 may be played, due to slight timing variances.

- **Max # Concurrent Intercon** - This 2-digit field defines (for the site) the maximum number of simultaneous telephone interconnect calls permitted. Default is 2.

Site/Device Definition (menu selection 10)

Site Parameters (panel 2:4)

Channel Assignment Parameters

Who Can Receive Calls

- **Inb Interconnect** - This 1-digit field defines (for each logical unit ID) if inbound interconnect calls are allowed for this specific logical unit ID. Default is no (N). Enter Y for yes, or leave N for no.

Logical Unit Definition (menu selection 11)

Radio Parameters (panel 2:3)

Radio Features

- **Inb Interconnect** - This 1-digit field defines (for each group ID) if inbound interconnect calls are allowed for this specific group ID. Default is no (N). Enter Y for yes, or leave N for no.

Group Definition (menu selection 12)

Group Parameters (panel 2:3)

Features

Who Has What Priority

- **Interconnect** - This 1-digit field defines (for each logical unit ID) which of eight queuing priority levels (from 0 to 7) is to be applied to this specific logical unit ID for interconnect calls. Default is the lowest priority (0).

Logical Unit Definition (menu selection 11)

Radio Parameters (panel 2:3)

Call Priority

- **Interconnect** - This 1-digit field defines (for each group ID) which of eight queuing priority levels (from 0 to 7) is to be applied to this specific group ID for interconnect calls. Default is the lowest priority (0).

Group Definition (menu selection 12)

Group Parameters (panel 2:3)

Call Priority

Who Has What Toll Call Restrictions

- **Digit Patterns** - This column of parameters defines (for the site) up to 16 digit patterns for the first four digits of an outgoing interconnect call. An X used as a digit in a

pattern allows that digit to be any number from 0 to 9. Four periods is used to represent an unused pattern. Default is unused (....) for all patterns.

Toll Call Restrictions (menu selection 15)
Toll Call Parameters (panel 1:1)

- **Restriction Levels** - These 16 columns of parameters define (for the site) which of 16 digit patterns will be permitted for each of the 16 toll call restriction levels. Default is no (N) for each of the 16 digit patterns for each of the 16 toll call restriction levels. Enter Y for yes, or leave N for no.

Toll Call Restrictions (menu selection 15)
Toll Call Parameters (panel 1:1)

- **Toll Call Restrictions** - This 2-digit field defines (for each logical unit ID) which of 16 toll call restriction levels (from 0 to 15) is to be applied to this specific logical unit ID for interconnect calls. Default is restriction level zero (0).

Logical Unit Definition (menu selection 11)
Radio Parameters (panel 2:3)
Interconnect

Who Has What Rotary Hunt Sequence

- **Interconnect Rotary Definition** - These 15 rows of parameters define a 16-line rotary hunt sequence for each of the 15 non-zero Rotary Numbers. Default is zero (0) for each line. Starting from the left, assign the valid line numbers in any order. Leave the unassigned line numbers set to zero (0). Note that a line number gets its number from the radio channel number that shares the same GTI Unit. Also note that GTI Units are placed on the highest available channel numbers first. Assigning non-existent line numbers will delay the rotary hunt sequence.

Rotary Definition (menu selection 13)
Interconnect Rotary Definition (panels 1:2 & 2:2)

- **Rotary Number** - This 2-digit field defines (for each logical unit ID) which rotary number (from 0 to 15) is to be applied to this specific logical unit ID. Default is none (0). This number (other than 0 for none) is meaningless by itself. The actual rotary hunt sequence telling which line numbers are searched and in what order (while searching for an available line) is defined by the **Interconnect Rotary Definition**.

Logical Unit Definition (menu selection 11)
Radio Parameters (panel 2:3)
Interconnect

NOTE

For someone to be able to make a radio-initiated interconnect call, a **Dedicated Line** or **Rotary Number** must be defined for that logical unit ID. The default values for these parameters define line 1 as the **Dedicated Line** and no **Rotary Number** to each logical unit ID. Therefore each logical unit ID has access to line 1.

In an ELI system, line number 1 will typically not exist. In that case the default values for **Dedicated Line** and **Rotary Number** will block all outgoing interconnect calls from each logical unit ID.

Therefore, you must assign a **Rotary Number** to each logical unit ID and one or more valid line numbers to each of these assigned rotary numbers in the **Interconnect Rotary Definition**, or assign a valid line number as the **Dedicated Line** for each logical unit ID. We recommend using the **Rotary Number** and **Interconnect Rotary Definition**.

Who Has What Dedicated Line

- **Dedicated Line** - This 3-digit field defines (for each logical unit ID) the line number to be dedicated to outgoing interconnect calls. Default is line 1. Enter a line number, or 0 for denial. It is recommended that you enter 0 for denial, and use unique rotary hunt sequences to define dedicated lines.

Logical Unit Definition (menu selection 11)
Radio Parameters (panel 2:3)
Interconnect

- **Dedicated To Unit** - This column of parameters defines (for the site) the logical unit ID to which each line is dedicated. Default is no logical unit ID (0) for all lines. Enter a logical unit ID, or leave 0 for no logical unit ID. It is recommended that you leave 0 for no logical unit ID, and use unique rotary hunt sequences to define dedicated lines.

Line Definition (menu selection 14)
Line Parameters (pages 1 & 2)

RECOMMENDATION

It is recommended that all dedicated line assignments be set up by using the **Rotary Number** and **Interconnect Rotary Definition** parameters, not the **Dedicated Line** parameter. Set the **Dedicated Line** parameter to none (0), and assign a unique **Rotary Number** and a single unique line number in the corresponding **Interconnect Rotary Definition** for each logical unit ID requiring a dedicated line.

Existing telephone interconnect systems that currently have dedicated lines defined by using non-zero values for the **Dedicated Line** and **Dedicated To Unit** parameters, can continue to use this method with the ELI system. However, because the lines are typically numbered differently for the ELI system, some reconfiguring of the line numbers will probably be necessary. If you find this to be the case, you may want to change to the recommended method at this time, as described above.

GTI DATABASE

Some user-configurable parameters for the ELI system reside in the active configuration of the GTI database, in each GTI unit. The GTI database is configured with the GTI Configurator software, using an office PC connected through a data link to one GTI unit. The re-configured GTI database will be cloned to each other GTI unit that is connected to this one GTI unit.

Local Data Link

Using a local data link between an office PC and one GTI unit, requires less equipment and is less complicated to

set up than a remote data link. A local data link should not exceed 50 feet in length and requires the following four items:

1. **PC-Based Terminal (Not Supplied)** - The customer must supply a PC-based terminal with the following features:
 - IBM-compatible 386 or better
 - MS-DOS version 3.2 minimum operating system
 - 10 MB available hard drive
 - 640 KB minimum RAM (recommend 2 MB)
 - 1.2 MB 5.25-inch or 1.44 MB 3.5-inch floppy drive
 - Monochrome or color monitor
 - Available male 9-pin RS-232 port (If a male 9-pin serial port is not available, an adapter will be required.)
2. **RS-232 Data Cable (Supplied)** - A 10-foot 19D903985P72 cable is supplied with male and female 9-pin connectors.
3. **GTI Configurator Software (Supplied)** - The GTI Configurator software is supplied in both 3.5 and 5.25-inch floppy formats.
4. **GTI Configurator User's Guide (Supplied)**

Figure 41 shows how an office PC with a 9-pin COM port is connected to a GTI unit. Figure 42 shows how an office PC with a 25-pin COM port is connected to a GTI unit.

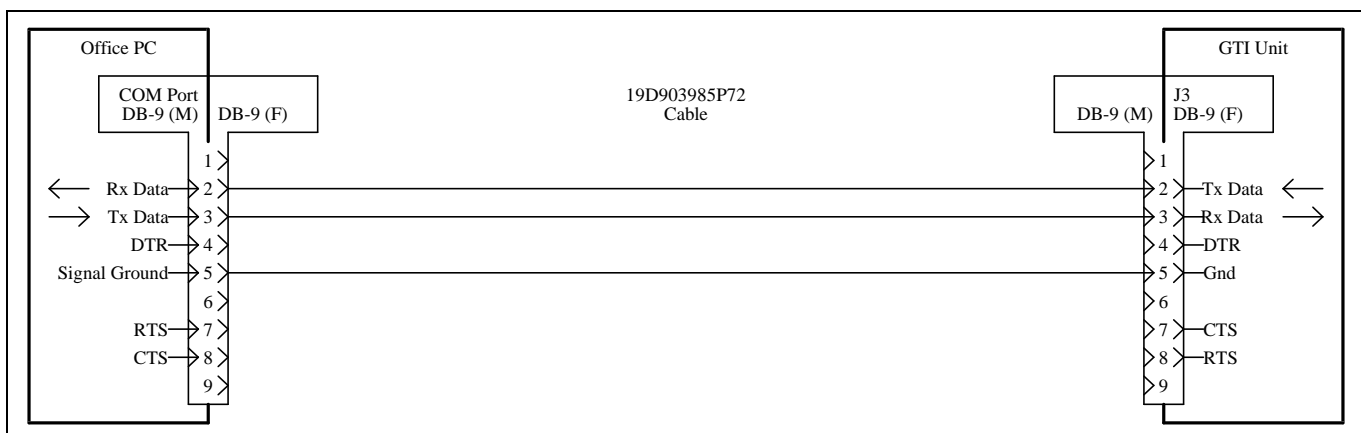


Figure 41 - Local GTI Connection for 9-Pin COM Port

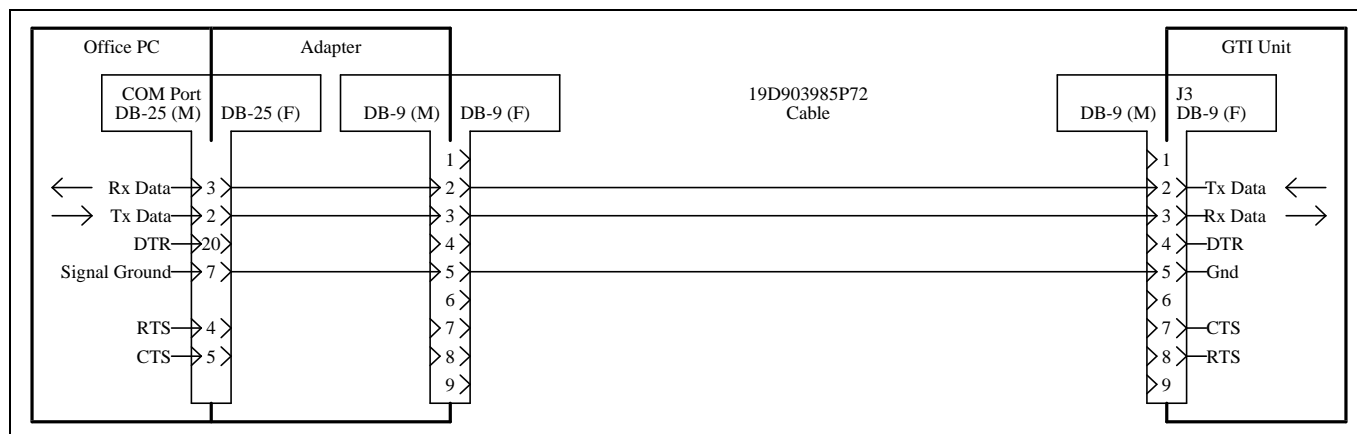


Figure 42 - Local GTI Connection for 25-Pin COM Port

Remote Data Link

A remote data link using data modems will be required if the GTI database must be configured from a location over 50 feet from the GTI units. The amount of additional equipment required will depend upon which one of the following two methods is used:

1. **Internal GTI Modem** - Use the internal 1200-baud modem built into each GTI unit and the telephone line connected to a GTI unit. This method requires the following additional equipment:
 - 1200-baud modem at GTI Configurator location (internal or external - cable required if external)
 - Available telephone line at GTI Configurator location and a cable to connect from the telephone line to the modem

2. **External Modem** - Use an external modem at the GTI unit location connected to the RS-232 port on the back of a GTI unit. This method requires the following additional equipment:

- External modem at the GTI unit location and a cable to connect it to the RS-232 port on the back of a GTI unit
- Matching modem at the GTI Configurator location (internal or external - cable required if external)
- Available telephone line or other communication circuit and a cable to connect from it to the modem (at both locations)

For additional information about using a remote data link, see the Data Link To GTI Units section in the GTI Configurator software user's guide.

OPERATION

GTI UNITS

The location of the indicators and reset button on the front panel of each GTI unit (including the Master GTI) is shown in Figure 43.

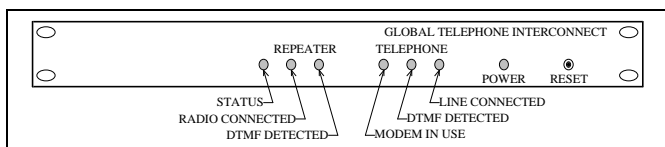


Figure 43 - Front Panel of GTI Unit

Indicators

Status Indicator

The red LED, labeled “STATUS”, should be lit whenever the unit is synchronized with the Master GTI (the LED should flicker approximately twice a second). The unit should automatically synchronize, but in the event that it doesn’t, momentarily press the button labeled “RESET”.

Repeater Indicators

Of the two red LEDs for the “REPEATER” interface, one is lit when the “RADIO (is) CONNECTED” and the other is lit when “DTMF (is) DETECTED” from the radio.

Telephone Indicators

Of the three red LEDs for the “TELEPHONE” interface, one is lit when the “MODEM (is) IN USE”, one is lit when “DTMF (is) DETECTED” from the telephone line, and one is lit when the telephone “LINE (is) CONNECTED”.

Power Indicator

Whenever power is applied, the green LED, labeled “POWER”, should be lit (there is no off/on switch).

Resets

Soft Reset

A soft reset does not alter any user-configurable parameters in a GTI unit’s user database. Pushing the RESET button on the front panel of a standard GTI unit initiates a soft reset for that GTI unit only. Pushing the

RESET button on the Master GTI initiates a simultaneous soft reset for all the GTI units. A simultaneous soft reset of all GTI units can also be made through the GTI Configurator software.

Hard Reset

A hard reset returns each user-configurable parameter in each GTI unit’s user database back to the factory default value, but does not alter any voice prompts that have been recorded. A simultaneous hard reset of all GTI units can only be made through the GTI Configurator software. Power-cycling the GTI units does not perform a hard reset.

Alarms

The Site Controller computer can receive two types of alarm messages from the Master GTI. One, called the LIC alarm (after an earlier interconnect system), indicates a connection problem between the Site Controller computer and the Master GTI, or a problem in the Master GTI itself.

The other type of alarm message, called the RIC alarm (after a second part of the same earlier interconnect system), indicates a connection problem between the Site Controller computer and a specific GTI unit, or a problem in the specific GTI unit itself. A RIC alarm can be received for each specific GTI unit.

IAM

Skip this section if your ELI system is not equipped with an IAM. The location of the DIP switch, indicators, and reset button on the front panel of the IAM is shown in Figure 44.

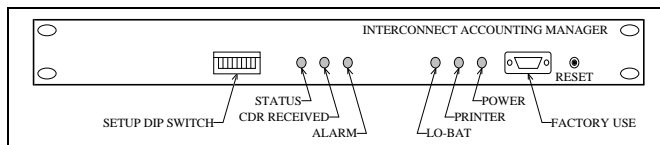


Figure 44 - Front Panel of IAM

Indicators

Status Indicator

The red LED, labeled “STATUS”, should be lit whenever the unit is synchronized with the Master GTI (the LED should flicker periodically at a rate of approximately twice a second). The unit should automatically synchronize with the Master GTI within a couple of minutes of being

powered-up, but in the event that it doesn't, momentarily press the button labeled "RESET".

CDR Received Indicator

The red LED labeled "CDR RECEIVED" should be lit momentarily each time a call record is received by the IAM.

Alarm Indicator

The red LED labeled "ALARM" should be lit whenever a fault (such as the call record buffer is full or the data bus has failed) is detected.

Low-Battery Indicator

The red LED labeled "LO-BAT" should be lit when a run-down battery backup for RAM is detected. This condition can only be detected during power-up after an extended power outage.

Printer Indicator

The red LED labeled "PRINTER" should not be lit when DIP switch section #5 (for the output to the printer) is off (down position).

The red LED labeled "PRINTER" should be lit when DIP switch section #5 (for the output to the printer) is on (up position). It should go off and on with the receipt of XOFF and XON signals respectively from a connected printer. It should flicker at a fast rate if no printer is connected.

Power Indicator

Whenever power is applied, the green LED, labeled "POWER", should be lit (there is no off/on switch).

Printer

The data to the printer can be turned on and off with DIP switch section 5. Up is on and down is off. Do not reset the IAM for this section of the DIP switch.

Resets

Soft Reset

A soft reset is accomplished by pushing the RESET button on the front panel for about 2 seconds, or until all the front panel LED indicators that were off, flash on simultaneously and then back off.

Clearing RAM

There may be occasions when the RAM needs to be cleared (such as after replacing a RAM chip). The RAM is cleared by using the Clear Call Detail Buffers operation in the GTI Configurator software, or by using the hardware-based procedure described here.

CAUTION

Retrieve all call detail records that you want to keep, using the Retrieve Call Detail Data operation in the GTI Configurator software, before clearing the RAM. When the RAM is cleared, all call detail records stored in RAM will be lost.

To clear the RAM using the RESET button on the front of the IAM, use the following procedure:

1. Write down the present positions of the DIP switches located on the back panel.
2. Set DIP switch 1 to the up (test) position and DIP switches 2 through 8 to the down position.
3. Push the RESET button on the front panel for about 2 seconds, or until all the front panel LED indicators that were off, flash on simultaneously and then back off.
4. Set DIP switch 1 to the down (operate) position and DIP switches 2 through 8 to the positions noted in step 1.
5. Push the RESET button on the front panel for about 2 seconds, or until all the front panel LED indicators that were off, flash on simultaneously and then back off.

To verify that the RAM has been cleared, use the Status info operation in the GTI Configurator software to look at the number of records for each telco line. For more information, see the GTI Configurator software user's guide.

Backup

The IAM has the capacity to hold 60,000 records in battery backed RAM. Every effort has been made to ensure that this memory won't be corrupted in normal operation. However, one must not forget about the possibly of component failure in the IAM, or more likely an external influence (such as a lightning strike, technical error, etc.) that could cause the loss of records stored in the IAM. Therefore, you should download the billing data often and backup the data then stored in the office PC to ensure that, if

an accident occurs, the loss of data (potential revenue) will be minimized.

As the operation of the IAM is autonomous, the ELI system will continue to process telephone calls, even if the IAM has failed, the IAM memory is full, or the IAM is disconnected from the PCM/Data bus. There is an option in the GTI Configurator that will halt the call processing if there is a bus failure (between units). Because the standard placement of the IAM is at one end of the bus, it is possible that there won't be any indication to users of the system if the IAM is not able to store call records.

However, the IAM has alarm outputs that can be used to notify the user of a memory or bus problem that may result in the loss of billing data. For more information, see the subsequent section on alarm outputs.

Status

The status of the IAM can be read by using the GTI Configurator software. The GTI Configurator software will show if an IAM is present, the number of call records presently stored, the amount of memory free and memory used, any alarm conditions, etc. See the GTI Configurator software user's guide for more information about accessing the IAM for status messages.

Alarms

As described in the installation section, three open drain alarm outputs are provided to alert external equipment in case of problems. Because the IAM does not immediately affect other devices, its operation (or lack of operation) is not immediately obvious, unless someone at the site observes the front panel LEDs, the status of the IAM is read via the GTI Configurator software, or these alarm outputs are monitored.

Alarm 1 - SMDR Full or Memory Error - indicates either the SMDR storage is full or a memory error has occurred. In either case, one should access the site (using the GTI Configurator), read the status of the IAM, and download the billing data (if possible).

Alarm 2 - Bus Failure - is sent if there is a PCM/DATA bus failure and the IAM can't communicate with the GTI units to receive billing data.

Alarm 3 - Low Battery - is active if the battery backup for RAM is low and should be replaced. (This condition will only be detected during power-up after an extended outage.)

It should be noted that these alarm outputs will go through indeterminate states during IAM power-up or reset.

It is recommended that the normally-closed output option be selected (see DIP Switch Settings), so that the presence of individual alarms will indicate the intended alarms, and the presence of all alarms will indicate that the IAM has lost power.

INTERCONNECT CALLS

Overview

The operation of the Enhanced Local Interconnect (ELI) system is controlled by the Site Controller computer. The Site Controller computer makes radio channel and telephone line assignments, based on availability, and the constraints of its active database configuration. For a site that is not connected to a System Manager, the active database configuration is nothing more than what has been programmed into the Site Controller computer's Personality PROMs. For a site that is connected to a System Manager, the active database configuration is the latest site database received from the System Manager.

The Site Controller computer supervises the GTI units by sending and receiving messages over two 19.2 Kbaud serial data links to the Master GTI. (All messages between the Site Controller computer and individual GTI units must first go through the Master GTI.) Message bytes are made up of 8 data bits, 1 stop bit, and no parity bit.

The following terms are used to simplify the descriptions in this section:

- Telephone-originated call - a call from a telephone, through a telephone line connected to an EDACS repeater site, to one or more radios using that EDACS repeater site.
- Radio-originated call - a call from a radio using an EDACS repeater site, through a telephone line connected to that EDACS repeater site, to a telephone.
- Line-connected GTI - the GTI unit connected to the telephone line for the interconnect call being described.
- Channel-connected GTI - the GTI unit connected to the radio channel for the interconnect call being described.

Note that a line-connected GTI and a channel-connected GTI may be the same physical GTI unit or different physical GTI units. Although each GTI unit is capable of being connected to one line and to one channel,

the Site Controller computer makes each radio channel and telephone line assignment, based on availability and the constraints of its active database configuration, not on whether they share the same GTI unit.

Detection of telephone hang-up depends on signaling provided to the line-connected GTI. To determine if a line provides the necessary signaling, connect a scope across the line to monitor the DC voltage. At the end of the call, there must be a loss of voltage for 100 milliseconds or more. Telephone hang-up typically can be detected on End-to-End with battery removal (many COs now provide this type of line, but it cannot always be ordered), E&M Type 1, and DID lines. Telephone hang-up typically cannot be detected on PBX lines and microwave links (which emulate end-to-end lines).

Telephone-Originated Call

The sequence of steps for a telephone-originated call is as follows:

DETECTING THE CALL

1. Somewhere in the telephone system, a user dials the telephone number of a subscriber line connected to a GTI unit.
2. The line-connected GTI detects the call by sensing the presence of a ringing voltage (or an E-lead signal), and sends a message to the Site Controller computer (Port 31) indicating that a call has been detected by this GTI unit.
3. The Site Controller computer checks to see if it is permitted to add another telephone interconnect call. (There may be a limit on the number of telephone interconnect calls allowed at any one time.)
 - N. If the Site Controller computer is not permitted to add another telephone interconnect call, it lets the call go unanswered. This ends the sequence here.
4. If the Site Controller computer is permitted to add another telephone interconnect call, it checks to see if a working channel with a GTI is available.
 - N. If no working channel with a GTI is available, the Site Controller computer lets the call go unanswered. This ends the sequence here.

ANSWERING THE CALL

5. If a working channel with a GTI is available, the Site Controller computer allocates the channel for the interconnect call.

6. The Site Controller computer sends a message (Port 31) to the line-connected GTI, directing it to answer the call.
7. The line-connected GTI answers the call by completing the dc path for the loop current (or applying the M-Lead signal), and lights the "LINE CONNECTED" indicator on its front panel.
8. The telephone exchange detects the loop current (or the M-Lead signal) indicating that the call has been answered, and removes the ringing voltage (or the E-Lead signal) from the line.
9. The Site Controller computer directs the line-connected GTI to apply dial tone to the line.
10. The Site Controller computer directs the line-connected GTI to look for DTMF signals.
11. The Site Controller computer starts a rapid polling mode of operation to poll the Master GTI more frequently than usual. The fast polling is used during the anticipated dialing process to speed the processing of the dialed digits.
12. The caller hears the dial tone from the line-connected GTI, and starts sending DTMF digits.

IDENTIFYING CALLED ID

13. The line-connected GTI detects the first DTMF digit, momentarily lights the "DTMF DETECTED" red LED on the front panel, and reports the digit to the Site Controller computer.
14. The Site Controller computer directs the line-connected GTI to stop sending a dial tone to the calling line, and sets up a counter to count the received DTMF digits.
15. The Site Controller computer checks the first DTMF digit to see if it is a #, *, or number from 0 to 9. If the first DTMF digit is a #, the call is identified as a Voiceguard call, but the counter is not advanced. If the first DTMF digit is a *, the call is identified as a group call, and the counter is advanced by one. If the first DTMF digit is a number from 0 to 9, the digit is stored in the ID buffer and the counter is advanced by one).
16. The line-connected GTI detects the next DTMF digit, momentarily lights the "DTMF DETECTED" red LED on the front panel, and reports the digit to the Site Controller computer.
17. The Site Controller computer receives the report from the line-connected GTI, stores the digit in its ID buffer,

advances the counter by 1, and checks to see if the counter has reached 5.

N. If the counter has not reached 5, return to step 16.

18. If the counter has reached 5, the Site Controller computer has now received all digits of the ID, and directs the line-connected GTI to stop looking for DTMF signals.

19. The Site Controller computer checks to see if the ID is allowed to receive interconnect calls.

N. If the call is not allowed, the Site Controller computer sends a message to the line-connected GTI instructing it to send the call denied tone (or voice prompt) and hang up. This ends the sequence here.

OBTAINING WORKING CHANNEL

20. If the call is allowed, the Site Controller computer checks to see if a working channel with a GTI is available.

N. If no working channel with a GTI is currently available, the Site Controller computer queues the call. When the call comes out of queue, continue to next step.

21. If a working channel with a GTI is available, the Site Controller computer sends a message (Port # is the channel # of control channel) to the control channel GETC to send the working channel assignment to the radio(s) with the Logical or Group ID called.

22. The radio(s) with the Logical or Group ID called receives the working channel assignment and tunes to the assigned working channel.

23. The Site Controller computer sends a message (Port 30), directing the channel-connected GTI unit to apply a ringing tone to the called radio(s) and the line-connected GTI unit to apply a ringback tone to the calling telephone.

24. A radio user hears the ringing tone and pushes the PTT switch.

25. The assigned working channel GETC detects the radio transmission on the assigned working channel and sends a radio keyed message to the Site Controller computer. If the Site Controller computer does not receive this message within 60 seconds (about 10 rings), it sends a hang up message to the line-connected GTI and a disconnect message to the working channel GETC.

26. If the Site Controller computer receives the radio keyed message within 60 seconds, it sends a connect audio message (Port 30) to the Master GTI, directing the line-connected GTI to connect the audio from the line to the PCM bus and channel-connected GTI to connect the audio from the channel to the PCM/Data bus. The audio path should now be connected between the calling telephone and the called radio.

27. The Site Controller computer sends a message (Port 30) to the Master GTI, directing the line-connected GTI to look for DTMF digits.

ENDING THE CALL

28. To end the telephone interconnect call, the caller presses the # key on the DTMF keypad and hangs up. (If the telephone does not have a # key, the caller can just hang up.)

29. When the line-connected GTI detects the DTMF # digit or end of call signaling (if the line provides it), the Master GTI sends a message to the Site Controller computer indicating that the telephone has been hung up.

The called radio user can also terminate the call by pushing the EXIT, SPC, or designated button on the radio (see the operator's manual for the radio). This causes the radio to transmit a disconnect signal to the assigned working channel GETC.

30. When the Site Controller computer receives a hang up message from the Master GTI, a disconnect message from the Working Channel GETC, or the conversation time limit is exceeded, the Site Controller computer ① sends a message (Port 30) to the Master GTI directing the channel connected GTI to extract itself from the audio loop of the assigned working channel and the line-connected GTI to hang-up the line, and ② sends a message (Port # is the channel # of assigned working channel) to the assigned working channel GETC directing it to terminate the call.

Radio-Originated Call

A request for a telephone interconnect call can be made from any radio that is equipped with the controls to place a telephone interconnect call. However, a telephone line will not be connected and the trapped telephone interconnect digits will not be re-dialed to the telephone line until the Site Controller computer has verified the following:

- A telephone interconnect call is allowed from that radio ID.

- The trapped telephone interconnect digits meet the toll call restrictions for that radio ID.
- The Site Controller computer receives the digital stream terminator digit.
- All other system parameter and protocol requirements are met along the way.

A telephone interconnect number is a string of decimal numbers (digits). The string can be anywhere from 0 to 32 digits long. It can be pre-programmed, pre-stored, or manually keyed just prior to pressing the PTT switch. The radio automatically adds a terminator digit to the end of a pre-programmed or pre-stored telephone interconnect number. However, you must manually add the terminator digit (press the * Key) at the end of telephone interconnect number that you have just manually keyed into the radio. When a working channel is assigned, all digits including the terminator digit are sent digitally to the assigned working channel GETC.

A telephone interconnect number may be a complete or partial telephone number. (An example of a partial telephone number is an access code plus an area code.) When the telephone interconnect number is only a partial telephone number, the caller must supply the remaining digits of the telephone number as overdialed digits, after the telephone line has been connected and the trapped interconnect digits have been re-dialed on the telephone line. These overdialed digits are sent as dual-tone audio bursts directly through the channel connected GTI and line-connected GTI to this telephone line, without trapping and re-dialing.

The toll call restrictions test is performed on the first 4 interconnect digits, or as many of the first 4 interconnect digits as it has received before receiving the terminator digit. The lack of the terminator digit will not hold up the toll call restrictions test once 4 interconnect digits are received, but the terminator digit must be received before the telephone line is connected and the trapped interconnect digits are re-dialed to the telephone line.

If less than 4 interconnect digits have been received by the time the terminator digit is received, the Site Controller computer adds wild-card digits to the end of the string of received interconnect digits, until it has 4 digits for the toll call restrictions test. Each wild-card digit is tested for all possible values from 0 to 9.

The following sequence of steps describes the main events involved in a radio-initiated telephone interconnect call:

OBTAINING A WORKING CHANNEL

1. The radio user sets the radio for an interconnect call, selects a pre-programmed or pre-stored interconnect telephone number (or manually keys an interconnect telephone number followed by the * key), and pushes the PTT switch.
2. The radio sends an interconnect call request on the control channel.
3. The control channel GETC receives the request for an interconnect call, and sends the request to the Site Controller computer.
4. The Site Controller computer receives the request for an interconnect call, and checks to see if it is permitted to add another interconnect call.

If the Site Controller computer is not allowed to add another interconnect call, it directs the control channel GETC to send a busy signal to the calling radio. This ends the sequence here.

5. If the Site Controller computer is allowed to add another interconnect call, it checks to see if interconnect calls are allowed from the calling radio.

If interconnect calls are not allowed from the calling radio, the Site Controller computer directs the control channel GETC to send a call-denied signal to the calling radio. This ends the sequence here.

6. If interconnect calls are allowed from the calling radio, the Site Controller computer checks to see if it is receiving an alarm from the Master GTI.

If the Site Controller computer is receiving an alarm from the Master GTI, it directs the control channel GETC to send a call-denied signal to the calling radio. This ends the sequence here.

7. If the Site Controller computer is not receiving an alarm from the Master GTI, it checks to see if a telephone line with a GTI is available.

If a telephone line with a GTI is not available, the Site Controller computer directs the control channel GETC to send a busy signal to the calling radio. This ends the sequence here.

8. If a telephone line with a GTI is available, the Site Controller computer allocates the telephone line for the interconnect call and checks to see if a working channel with a GTI is available.

If a working channel with a GTI is not available, the Site Controller computer queues the request and directs the control channel GETC to send a queued call signal to the calling radio. When the call request comes out of queue, continue to the next step.

9. If a working channel with a GTI is available, the Site Controller computer directs the control channel GETC to send the working channel assignment to the calling radio, and directs the assigned working channel GETC to look for the digits from the calling radio.

INTERCONNECT DIGITS

10. The calling radio receives the working channel assignment, tunes to the assigned working channel, and sends the pre-programmed, pre-stored, or manually keyed interconnect digits with the terminator digit to the assigned working channel GETC.
11. The assigned working channel GETC receives the interconnect digits and terminator digit, and sends them to the Site Controller computer.
12. As the Site Controller computer receives the digits, it counts and stores each interconnect digit, and looks for the terminator digit. As soon as it counts 4 interconnect digits received or sees the terminator digit, it performs the toll call restrictions test for that radio ID, using wild-card digits if necessary.

If the received interconnect digits fail the toll call restrictions test, the Site Controller computer directs the assigned working channel GETC to terminate the call and de-allocate the telephone line. This ends the sequence here.

If the received interconnect digits pass the toll call restrictions test and the Site Controller computer has received the terminator digit, skip step 13.

13. If the received interconnect digits pass the toll call restrictions test, but the Site Controller computer has not received the terminator digit, the Site Controller computer will continue to receive, count, and store each

interconnect digit until ① it sees the terminator digit, ② the received interconnect digits exceed the maximum storage capacity of 32, or ③ the allowed hang time expires.

If the Site Controller computer receives too many interconnect digits or does not receive the terminator digit within the allowed hang time, it directs the assigned working channel GETC to terminate the call and de-allocate the telephone line. This ends the sequence here.

RE-DIALED DIGITS

14. If the Site Controller computer receives the terminator digit within the allowed hang time, it ① directs the assigned working channel's GTI (channel-connected GTI) to insert itself into the channel's audio loop, and ② directs the allotted telephone line's GTI (line-connected GTI) to take the line off-hook and look for dial tone (or E-lead signal).
15. When the line-connected GTI detects dial tone (or E-lead signal), it sends a dial tone detected message to the Site Controller computer. The caller should hear a dial tone, but will hear nothing for an E-lead signal.
16. When the Site Controller computer receives the dial tone detected message, it sends the interconnect digits (that have been trapped and stored) to the line-connected GTI for re-dialing (DTMF or dial pulse) to the connected line. The caller should hear these dual-tone audio bursts or dial clicks as the digits are dialed.

OVERDIALED DIGITS

17. If the telephone interconnect number was only a partial telephone number, the caller must now supply the remaining digits of the telephone number as overdialed digits. These overdialed digits are sent as dual-tone audio bursts directly through the channel connected GTI and line-connected GTI to this telephone line, without trapping and re-dialing. All overdialed digits are logged into the call record.

ENDING THE CALL

18. The normal method to end a radio-originated telephone interconnect call is for the caller to press the EXIT, SPC, or designated button on the radio (see the operator's manual for the radio). This causes the radio to transmit a digital end-of-call signal to the assigned working channel GETC.
19. The assigned working channel GETC receives the end-of-call signal from the calling radio, and sends end-of-call information to the Site Controller computer.
20. When the Site Controller computer receives the end-of-call information (or the conversation time limit is exceeded), it ① directs the channel-connected GTI to extract itself from the audio loop of the assigned working channel, ② directs the line-connected GTI to hang-up the line, and ③ directs the assigned working channel GETC to terminate the call.

TROUBLESHOOTING

The hardware used in the ELI system is extremely reliable, making component failure the unlikely cause of most problems. The most common causes of problems are as follows:

1. The **Site Controller computer** may have a version of the Application Software that does not support the ELI option, a personality that does not specify the ELI option, telephone interconnect parameters that are not adequately defined in the database, or a PROM leg bent under a PROM during installation of new Application Software or Personality.
2. A **GTI Unit** may have jumper positions that are incorrect for type of telephone line connected, DIP switch settings that are incorrect for the radio channel / line number, user-configurable parameters that are not correctly defined in the database, or no telephone line connected.
3. An **interconnect cable** may be missing, be connected to the wrong connector, or have a pin pushed back in a connector.

Table 6 lists some of the possible causes and the corresponding corrective action for various symptoms that might be observed. It is assumed that non-interconnect calls (such as group calls) are operating normally for the LIDs and GIDs to be used for interconnect calls.

Table 6 - Troubleshooting Symptoms

SYMPTOM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
No interconnect calls can be placed to or from a MASTR II or IIe Repeater channel, and the GTI unit connected to this channel won't stay synchronized. or No interconnect or radio-to-radio calls can be placed to or from a MASTR III Repeater channel, and the transmitter stays keyed all the time ("TRANSMIT" LED on System Module stays lit).	The GTI unit (that is connected to the repeater) is connected to an open or unterminated PCM/Data bus. An unterminated section of PCM/Data bus can act as an antenna to pick up stray signals that could interfere with the synchronization of the GTI unit, causing it to continually reset in an attempt to regain synchronization.	Make sure that the PCM Bus Termination is connected to the PCM/Data bus at the highest channel end. Make sure that the PCM/Data bus is connected between all GTI units. Check for defective PCM/Data bus cable.

(Continued)

Table 6 (Cont.) - Troubleshooting Symptoms

SYMPTOM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
All radio-originated interconnect calls from all LIDs get call denied tone.	Personality in Site Controller computer does not specify ELI option.	Replace present Personality PROMs with PROMs that specify ELI option.
	Database in Site Controller computer has no radio channel defined for interconnect calls.	Set the Interconnect parameter (in the Site Controller computer database) to Y for one or more interconnect channel numbers.
	Database in Site Controller computer has no dedicated line number or rotary hunt sequence defined for any LID.	Set the Dedicated Line parameter (in the Site Controller computer database) to 0 for each LID. Specify a rotary hunt sequence for each LID (in the Site Controller computer database) by assigning a non-zero Rotary Number to each LID, and defining a line number* sequence in the Interconnect Rotary Definition for each assigned rotary number. *These line numbers must match GTI-equipped radio channel numbers.
All radio-originated interconnect calls from all LIDs get busy tone.	Database in Site Controller computer has zero defined for the number of concurrent interconnect calls.	Set the Max # Concurrent Intercon parameter (in the Site Controller computer database) to 1 or more.
	Database in Site Controller computer has no (or the wrong) line number defined for interconnect calls.	Set the Line Active parameter (in the Site Controller computer database) to Y for one or more line numbers.
All telephone-originated interconnect calls are unanswered on all lines.	Site Controller computer not connected to the Master GTI.	Check 19B803826P1 and P2 data cable connections.
	Jumpers and/or DIP switches in each GTI set incorrectly for line type.	Check GTI jumper locations and DIP switch positions.
	GTI line type database configured incorrectly for each line.	Check GTI database configuration.
	DIP switches in each GTI set for incorrect GTI unit number.	Check GTI DIP switch positions.
	Database in Site Controller computer has zero defined for the number of concurrent interconnect calls.	Set the Max # Concurrent Intercon parameter (in the Site Controller computer database) to 1 or more.

(Continued)

Table 6 (Cont.) - Troubleshooting Symptoms

SYMPTOM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
All telephone-originated interconnect calls are unanswered on one or more (but not all) lines.	Bus connection problem between Master GTI and affected GTI(s).	Check 19B803828P1 and P2 bus cable connections between Master GTI and affected GTI(s).
	Jumpers and/or DIP switches in GTI(s) connected to affected line(s) set incorrectly for line type.	Check jumper locations and DIP switch positions in GTI(s) connected to affected line(s).
	Line type of affected line(s) incorrectly configured in GTI database.	Check GTI database configuration.
	DIP switches in GTI(s) connected to affected line(s) set for incorrect GTI unit number(s).	Check DIP switch positions in GTI(s) connected to affected line(s).
All telephone-originated interconnect calls are denied on all lines.	All GIDs and LIDs are denied inbound calls in the Site Controller computer database.	Set the Inb Interconnect parameter (in the Site Controller computer database) to Y , for each GID or LID that is to receive inbound interconnect calls.
	LID 16383 is wide area enabled and no interconnect channels are wide area enabled.	Set the Wide Area Enable parameter (in the Site Controller computer database) to N , for LID 16383. or Set the Wide Area parameter (in the Site Controller computer database) to Y , for each radio channel that is to be used for interconnect calls.
All telephone-originated interconnect calls have no audio from telephone to radio (audio from radio to telephone is OK).	Application Software in Site Controller computer does not support the ELI option.	Replace the present Application Software PROMs with PROMs marked 344A3265Gx, where x=5 or higher.
	Personality in the Site Controller computer does not specify the ELI option.	Replace the present Personality PROMs with PROMs that specify the ELI option.
Billing data does not contain the correct ID and channel information.	Application Software in Site Controller computer does not support the ELI option.	Replace the present Application Software PROMs with PROMs marked 344A3265Gx, where x=5 or higher.
	Personality in the Site Controller computer does not specify the ELI option.	Replace the present Personality PROMs with PROMs that specify the ELI option.

(Continued)

Table 6 (Cont.) - Troubleshooting Symptoms

SYMPTOM	POSSIBLE CAUSE(S)	CORRECTIVE ACTION
LIC Alarm with all RIC Alarms	Crossed 19B803826P1 and P2 data cables between Master GTI and Site Controller computer.	Swap connections at either the Master GTI end or the Site Controller computer end.
	Bad GTI Interface card.	Replace GTI Interface card.
	Bad Master GTI unit.	Replace Master GTI unit.
LIC Alarm with no RIC Alarms	Bad 19B803826P2 data cable between the Master GTI and Port 31 on the Site Controller computer.	Replace 19B803826P2 data cable.
	Bad connection to 19B803826P2 data cable between the Master GTI and Port 31 on the Site Controller computer.	Re-seat cable connector on equipment connector.
All RIC Alarms	Bad 19B803826P1 data cable between the Master GTI and Port 30 on the Site Controller computer.	Replace 19B803826P1 data cable.
	Bad connection to 19B803826P1 data cable between the Master GTI and Port 30 on the Site Controller computer.	Re-seat cable connector on equipment connector.
Adjacent RIC Alarms on highest equipped channel numbers	Bad connection to 19B803828P1 or P2 bus cable between the group of adjacent GTI units and the GTI unit for the next lower channel.	Re-seat the connectors at both ends of the bus cable between the group of adjacent GTI units and the GTI unit for the next lower channel.
	Bad 19B803828P1 or P2 bus cable between the group of adjacent GTI units and the GTI unit for the next lower channel.	Replace the bus cable between the group of adjacent GTI units and the GTI unit for the next lower channel.
	Bad stackable connector on the 19B803828P1 or P2 bus cable between the GTI unit for the next lower channel and the GTI unit for the 2nd lower channel.	Replace the bus cable between the GTI unit for the next lower channel and the GTI unit for the 2nd lower channel.
Single RIC Alarm	Bad 19B803828P1 or P2 bus cable connection to a single GTI unit.	Re-seat the connector on the bus cable that connects directly to the single GTI unit.
	Bad 19B803828P1 or P2 bus cable connector attached to a single GTI unit.	Replace the bus cable that connects directly to the single GTI unit.
	Bad single GTI unit.	Replace the single GTI unit.

GLOSSARY

2-Wire Audio Line.....	A 2-Wire audio line uses a single audio pair for passing audio signals in both directions.
4-Wire Audio Line.....	A 4-Wire audio line uses separate audio pairs for passing audio signals in both directions; one audio pair for each direction.
Channel-Connected GTI.....	The Channel-connected GTI is the specific GTI unit connected to the EDACS repeater channel involved in the interconnect call being described.
DID.....	Direct Inward Dialing - A feature which allows callers to dial from the public network straight to a wanted extension on a PABX without intervention by an operator.
DIP Switches	Dual In-Line Package Switches - DIP switches are commonly packaged in banks of eight, but can be more or less.
DSP.....	Digital Signal Processor
DTMF.....	Dual-Tone Multi-Frequency - DTMF is a signaling method using set combinations of two specific voice-band frequencies to represent characters on a keypad (typically includes the numbers 0 through 9). One frequency represents the row number on keypad; the second frequency represents the column number.
E-Lead	The E-Lead is a separate signaling wire associated with some 2-Wire or 4-Wire audio lines, and is used to signal an incoming call from the public telephone network. Signaling is usually detected by the presence or absence of ground or -48 Vdc.
E&M Signaling.....	E&M signaling uses separate leads (separate from the 2-Wire or 4-Wire audio lines) for detecting incoming calls (E-Lead), and sending off-hook and on-hook signals (M-Lead).
EDACS.....	Enhanced Digital Access Communications System
EDACS Interface panel	The panel at the top rear of most EDACS equipment cabinets containing modules that allow quick and easy interconnection of all audio and control functions in an EDACS installation.
ELI.....	Enhanced Local Interconnect - a telephone interface system for use with EDACS repeater channels, under the direction of the Site Controller computer.
ELI Interface Module	The ELI Interface module (used in the EDACS Interface panel at the top of each cabinet containing GTI units) is used to consolidate the telephone line connections for 6 GTI units into a single 25-pair IDC telco connector.
GETC.....	A GETC is a trunking card that can be configured for many applications. The GETC mentioned in this manual is the Station GETC. One Station GETC must be connected to each repeater used in an EDACS installation to permit trunking of that radio channel.
GID.....	Group ID - a unique number used by a group of radios to work with an EDACS system.

GLOSSARY (CONT.)

Ground-Start Signaling	Ground-Start signaling is used to send the local off-hook and on-hook signals to the public telephone network. Off-hook is detected by the presence of a DC loop current between one of the two wires of the 2-Wire audio line and ground.
GTI Unit.....	Global Telephone Interconnect Unit - the interface for one EDACS repeater channel, and one telephone line, in a single unit.
GTI Configurator	The GTI Configurator is the office PC used to run the GTI Configurator software.
GTI Configurator Software	The GTI Configurator software is a PC-based, menu-driven program that allows the system operator to set up the GTI(s) and optional IAM, retrieve GTI call records, and monitor the system activity via a monitor screen.
GTI Interface Board.....	The GTI Interface board is the interface between the Site Controller computer and the Enhanced Local Interconnect (ELI) system. The GTI Interface board is added to one GTI, making it the Master GTI.
IAM.....	Interconnect Accounting Manager - The IAM is a microprocessor-based, call-detail buffer containing two megabytes of battery-backed RAM to provide storage for up to 60,000 interconnect calls.
Inbound Call	An inbound call is a call from a telephone to a radio. This is also referred to as a telephone-originated call.
LED.....	Light-Emitting Diode
LID.....	Logical ID - a unique number used by a radio to work with an EDACS system.
Line-Connected GTI	The line-connected GTI is the specific GTI unit connected to the telephone line involved in the interconnect call being described.
Loop-Start Signaling	Loop-Start signaling is used to send the local off-hook and on-hook signals to the public telephone network. Off-hook is detected by the presence of a DC loop current between the two wires of the 2-Wire audio line.
M-Lead.....	The M-Lead is a separate signaling wire associated with some 2-Wire or 4-Wire audio lines, and is used to send the local off-hook and on-hook signals to the public telephone network. Signaling is usually by application or removal of ground or -48 Vdc.
Master GTI.....	The Master GTI is the specific GTI that has had the GTI Interface card added.
PABX.....	Private Automatic Branch Exchange
PCM.....	Pulse Coded Modulation
PCM / Data Bus	The PCM / Data Bus is used to connect the optional IAM (if present), Master GTI, and all the standard GTI units together. It is actually made up of an 8-bit parallel PCM Data bus, a serial Console Data bus, a serial Subscriber Data bus, and a serial Repeater Data bus.
PSTN	Public Service Telephone Network

GLOSSARY (CONT.)

Radio-Originated Call.....A telephone interconnect call from a radio to a telephone.

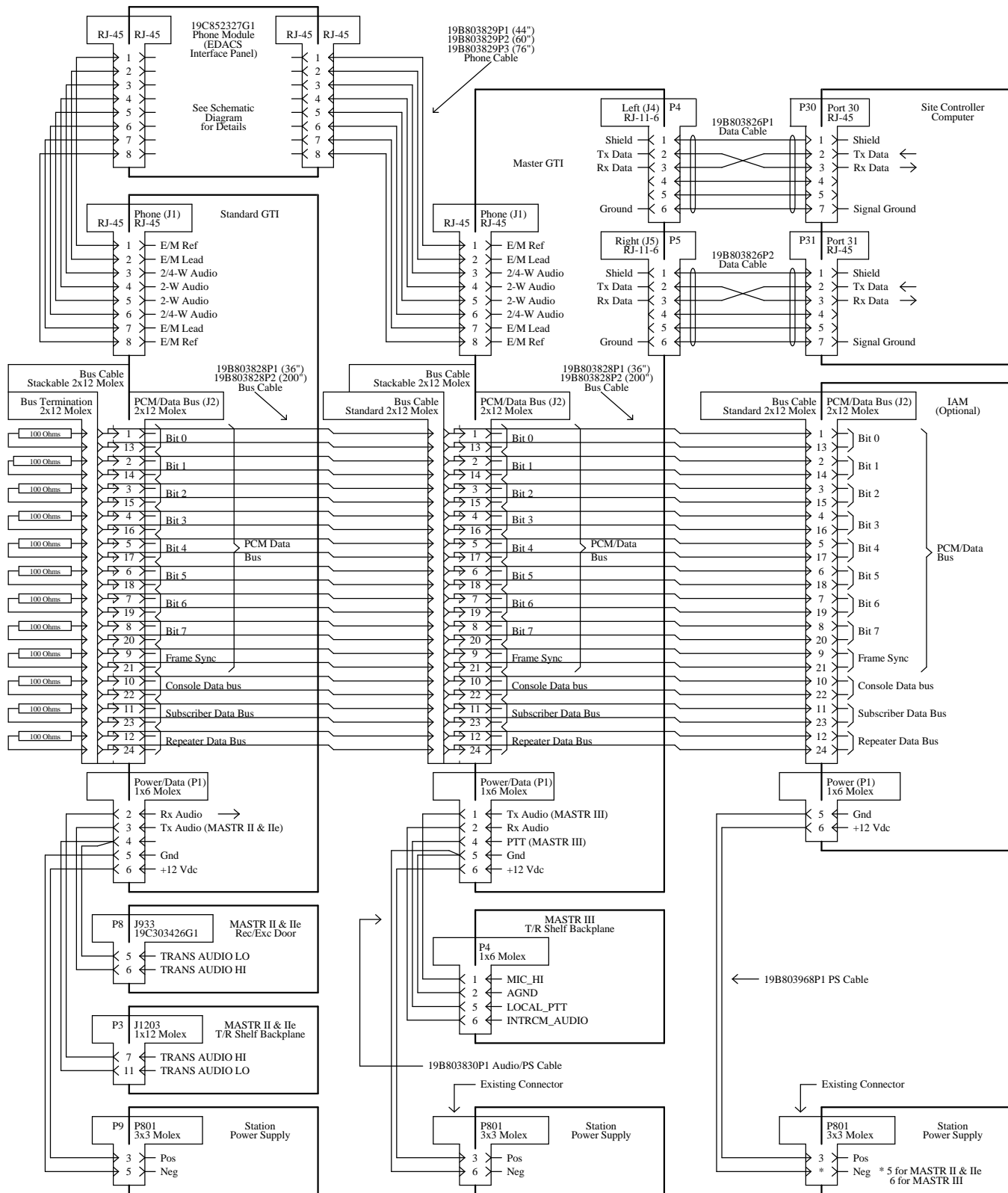
Site Controller DatabaseThe Site Controller Database is the specific information about the site, such as equipment available at the site, validation tables by feature and priority for each Logical (individual) ID and Group ID, etc., maintained by the System Manager. If the site has no System Manager, the Site Controller Database uses the default values contained in the Site Controller computer's two Personality PROMs.

Telephone-Originated CallA telephone interconnect call from a telephone to a radio.

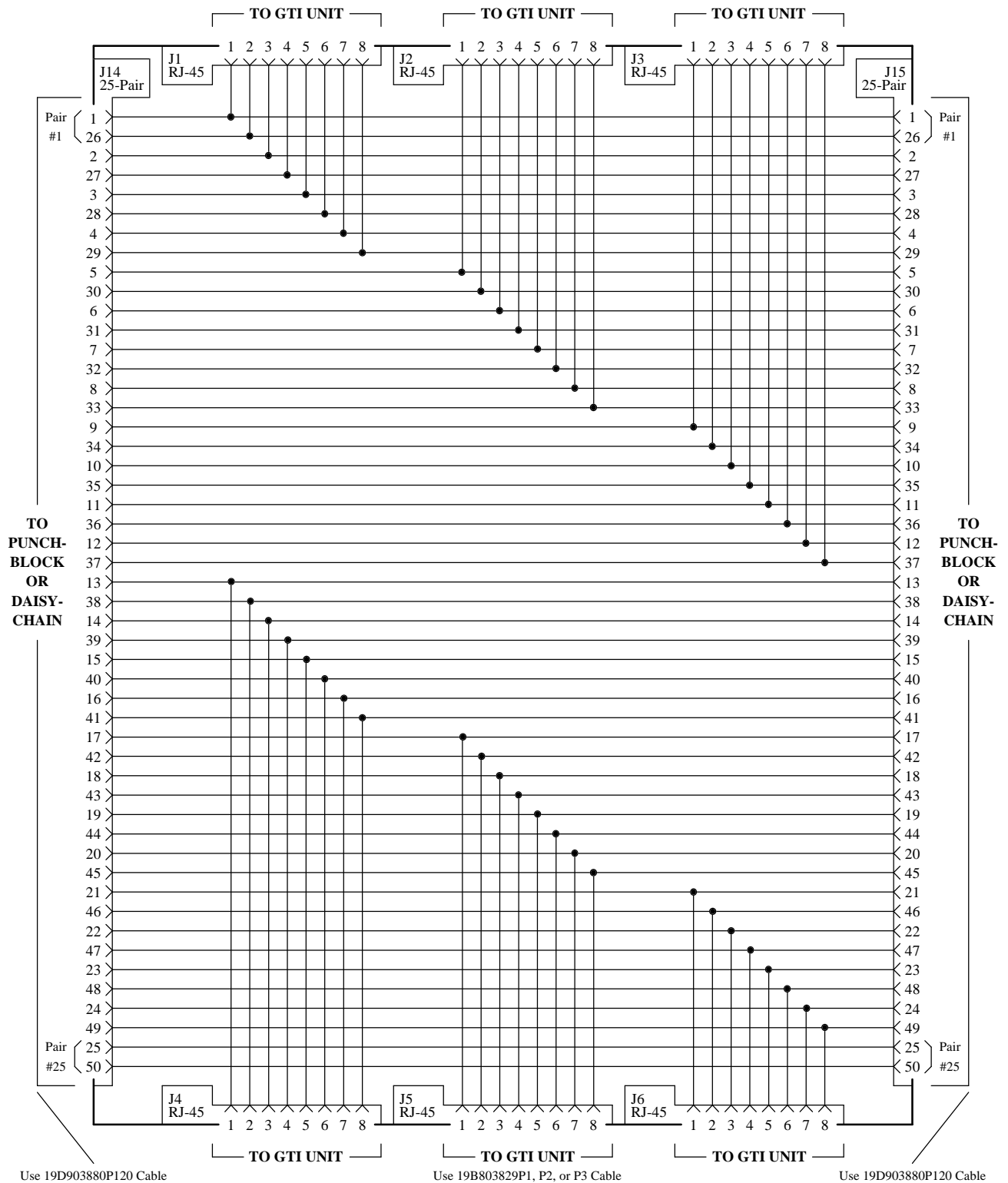
PARTS LIST

SYMBOL	PART NO.	DESCRIPTION
		Master GTI Parts
	19B803752P1	GTI Interface board, including installed software
	19B803826P1	Cable, telephone, 44", top GTI to interface panel
	19B803826P2	Cable, telephone, 60", middle GTI to interface panel
		GTI Configurator Parts
	19D903985P72	Cable, Serial Data, between any GTI and configurator
		IAM Unit Parts
	19B803753P1	IAM Unit, including installed software
	19B803968P1	Cable, power, IAM to power supply

SYMBOL	PART NO.	DESCRIPTION
		GTI Unit Parts
	19B803751P1	GTI Unit, including installed software
	350A1154G1	Kit, hardware, GTI mounting
	19B803830P1	Cable, audio/power, GTI to repeater/power supply
	19B803829P1	Cable, telephone, 44", top GTI to interface panel
	19B803829P2	Cable, telephone, 60", middle GTI to interface panel
	19B803829P3	Cable, telephone, 76", bottom GTI to interface panel
	19B803828P1	Cable, PCM bus, 36", between GTIs, same cabinet
	19B803828P2	Cable, PCM bus, 200", between GTIs, diff. cabinets
	19C852592P1	Termination, PCM bus



ELI Interconnection Diagram



ELI Interface Module 19C852327G1

(Similar to 19D904451, Sh. 1, Rev. 0)

INSTALLATION CHECKLIST

Steps 1 through 14 parallel the main headings in the Installation section of this manual. For more details, see the heading that applies. Step 15 is covered in the Configuration section of this manual. Step 16 is covered in the User's Guide for the GTI Configurator Software, LBI-39077.

1. **RADIO SOFTWARE** - If MDR full-duplex radios are to be used, check to make sure their software is G2 or higher.
2. **SITE CONTROLLER HARDWARE** - Verify that the Site Controller computer is a VAX model (19A149302P5 or higher), not a PDP model.
3. **SITE CONTROLLER SOFTWARE**
 - Check to be sure that the revision of the Application Software PROMs is G5 or higher (replacement might be necessary).
 - Insure that the Personality PROMs have ELI selected as the interconnect mode.
4. **CHANNEL ASSIGNMENTS** - Assign each GTI unit, the Master GTI, and the optional IAM to a specific radio channel.
5. **GTI SOFTWARE** - Record the GTI 552, GTI DSP, and GTI Main software version numbers for each GTI unit (including the Master GTI) and the GTI Master software version number for the Master GTI.
6. **GTI TELEPHONE INTERFACE** - Configure the telephone interface in each GTI unit (including the Master GTI) to match the telephone line to be connected to it.
7. **GTI DIP SWITCH SETTINGS** - Set the DIP switches on the side of each GTI unit (including the Master GTI).
8. **GTI INTERFACE BOARD MOUNTING** - Install the GTI Interface board in the GTI unit that is to be the Master GTI.
9. **GTI & IAM MOUNTING** - Mount the GTI units, Master GTI, and optional IAM (if supplied).
10. **GTI CONNECTIONS** - Make the following connections to the GTI units and Master GTI:
 - Telephone line connection
 - Power / Audio cable connection
 - PCM / Data Bus cable connection
 - Serial Data cable connections (two required - for Master GTI only)
11. **IAM SOFTWARE** - Record the IAM software version number (if supplied).
12. **IAM CONNECTIONS** - Make the following connections to the IAM unit (if supplied):
 - Power cable connection
 - PCM / Data Bus cable connection
 - Alarms (optional - no cables supplied)
 - Printer (optional - no cables supplied)
13. **IAM DIP SWITCH SETTINGS** - Set the DIP switches on the front of the IAM unit (if supplied) as needed.
14. **GETC MODIFICATION** - Modify the GETC in each EDACS MASTR III repeater that will be connected to a GTI unit or Master GTI.
15. **SITE CONTROLLER CONFIGURATION** - Configure the telephone interconnect parameters in the Site Controller computer's active database using the System Manager.
16. **GTI CONFIGURATION** - Configure the GTI Configurator user database using the GTI Configurator software in an office PC (PC and cables not supplied).