ZETRON

Model 2540 FASTNet Switch
Installation and Maintenance Manual

Part No. 025-9260C

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WARRANTY STATEMENT

Zetron's warranty is published in the current Zetron *United States Price Book*.

FEDERAL COMMUNICATIONS COMMISSION (FCC) REGULATIONS

To comply with FCC regulations, the following requirements must be met:

1. This FASTNet Switch, 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 insure a smooth installation. Three C.O. connection methods are possible:
    a. In the End-to-End configuration: The FCC registration number of this system (EYB5Q5-19269-OT-E), ringer equivalence number (0.4B), service order code (9.0Y), facility interface code (02LS2), and connection jack (RJ21X) must be reported.
    b. In the two-wire DID configuration: The FCC registration number of this system (EYB5Q5-19269-OT-E), ringer equivalence number (0.0B), service order code (9.0Y & AS.3), facility interface code (02RV2-T) and connection jack (RJ21X) must be reported.
    c. In the two-wire E&M configuration: The FCC registration number of this system (EYB5Q5-19269-OT-E), ringer equivalence number (0.0B), service order code (9.0Y & AS.3), facility interface code (TL11M telco end, TL11E Zetron end), and connection jack (RJ2EX) must be reported.
2. This FASTNet Switch, 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 insure a smooth installation. Four telephone connection methods are possible:
    a. In the End-to-End Loop Start configuration: The FCC registration number of this system (EYB5Q5-19269-OT-E), ringer equivalence number (0.4B), service order code (9.0Y), facility interface code (02LS2), and connection jack (RJ21X) must be reported.
    b. In the End-to-End Ground Start configuration: The FCC registration number of this system (EYB5Q5-19269-OT-E), ringer equivalence number (0.0B), service order code (9.0Y), facility interface code (02GS-2) and connection jack (RJ21X) must be reported.
    c. In the two-wire E&M configuration: The FCC registration number of this system (EYB5Q5-19269-OT-E), ringer equivalence number (0.0B), service order code (9.0Y & AS.3), facility interface code (TL11M telco

end, TL11E Zetron end), and connection jack (RJ2EX) must be reported.

d. In the two-wire DID (tie-trunk) configuration: The FCC registration number of this system (EYB5Q5-19269-OT-E), ringer equivalence number (0.0B), service order code (9.0Y & AS.3), facility interface code (02RV2-T), and connection jack (RJ21X) 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 the FCC rules for a Class A digital device. Operation is subject to the following two conditions:
    a. This device may not cause harmful interference.
    b. This device must accept any interference received, 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 any time a mobile radio answers a call or a voice prompt is played.
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 Zetron, Inc. or an authorized Zetron repair station.

INSTALLATION WARNING

This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with this manual and applicable FCC regulations, may cause interference to radio communications.

Installation of the FASTNet Switch should be accomplished by personnel with experience in radio and telephone interconnect circuitry. Specialized knowledge in telephone systems is important to ensure a smooth interface when connecting with the Telco network.

COPYRIGHT NOTICE

TRADEMARKS

CANADIAN DEPARTMENT OF COMMUNICATIONS 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.

Model 2540/2540EX Load Number: 69

The load number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to the telephone loop used by the device, to prevent overloading. 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.

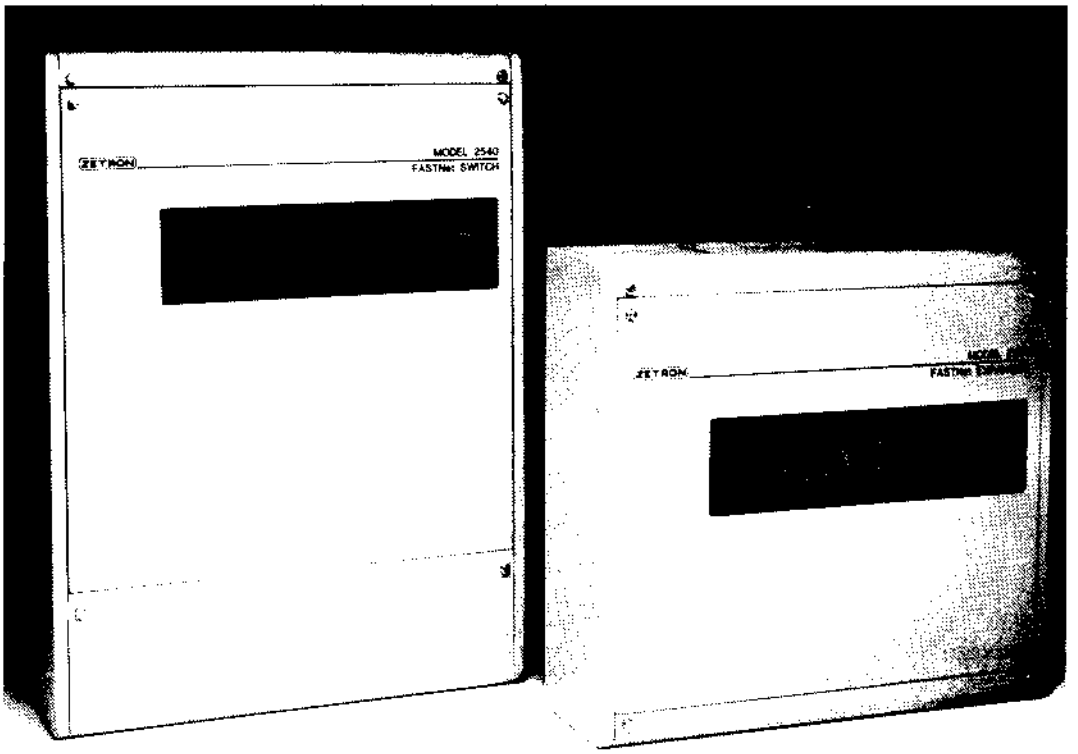
CANADIAN COMPLIANCE NOTICE

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.

AVIS CANADIEN

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.

1. INTRODUCTION AND SPECIFICATIONS



INTRODUCTION

The Model 2540 FASTNet Switch is a digital switch, much like a PBX, used for networking simple LTR sites into one wide-area LTR network. Three manuals describe the Model 2540. Table 1-1 lists the Model 2540 manuals and describes their contents.

Table 1-1. Model 2540 Manuals

Manual Title	Zetron Part No.	Description
Operation and Programming Manual	025-9270	Presents an overview of the features of the Model 2540 and explains how to program the Model 2540 using Netbase, the PC-based database manager for the Model 2540. Also included is information about the Trunk Card Editor.
Installation and Maintenance Manual	025-9260	Presents step-by-step installation instructions with adjustment and troubleshooting procedures. Also included are the product specifications and theory of operation.
Schematics Manual	025-9266	Presents the parts lists, schematic drawings, and silkscreens for the Model 2540.

PURPOSE OF THIS MANUAL

This manual is provided to assist you in the installation of your Zetron Model 2540 FASTNet Switch. Step-by-step installation instructions are provided to simplify the process. Information relating to adjustments, troubleshooting, theory of operation, and a complete list of equipment specifications is also provided to help you maintain the equipment.

CONTENTS OF THIS MANUAL

This manual is divided into seven sections and five appendices (A-E). The following paragraphs contain a synopsis of each section and describe the basic purpose and content of each.

SECTION 1, INTRODUCTION AND SPECIFICATIONS - This section outlines this manual and provides technical specifications for each of the system components: the FASTNet chassis as well as the trunk cards, voice storage system, etc.

SECTION 2, THEORY OF OPERATION - This section presents the theory of operation for the FASTNet Switch. Circuit descriptions are provided for each of the cards, excepting the trunk interface cards (in Section 4), and the ADPCM Voice Card (in Section 5). This section also contains a complete set of sequential lists, which describe the sequence of events that occur when calls are processed by the FASTNet Switch (call processing charts). A complete set of timing diagrams for the telco side of the system is contained at the end of the section.

SECTION 3, SYSTEM INSTALLATION - This section contains the information necessary to install and adjust the FASTNet Switch, excepting the trunk interface cards (Section 4), and the ADPCM Voice Card (in Section 5). The information is contained in the form of checklists and step-by-step procedures. Where appropriate, procedures in this section refer to information contained in specific sections of this manual. Section 7 contains specific examples of this process.

SECTION 4, TRUNK CARDS AND CONNECTIONS - This section provides information that relates to the telco side of the FASTNet Switch. Detailed wire listings for the RJ2EX trunk connectors (located on the backplane of the FASTNet Switch) which interface to the telephone company lines are listed by connector number. These wire lists are provided for both the Model 2540 and Model 2540EX chassis. Trunk card operation, configuration, and adjustment for DID, E&M, or E-E TELCO interfaces are provided in this section. Installation and adjustment procedures are given for the optional Dial Click Decoder and MF Decoder cards.

SECTION 5, VOICE STORAGE SYSTEM - This section describes the voice storage system used in the FASTNet Switch. It describes the operation of the voice system, how to install the voice card, how to set the mode switches on the card, how to use the test pins to troubleshoot the voice card, and finally, how to upgrade the software on the card.

SECTION 6, TROUBLESHOOTING AND REPAIR PROCEDURES - This section provides some troubleshooting information that you can use when clearing problems in the FASTNet Switch. The information provided covers symptoms and remedies, front panel lamp indications, progress tones, and the office computer.

SECTION 7, PRACTICAL EXAMPLES - This section provides a "walk-through" approach for installing a complete FASTNet Switch. Several typical interfaces are discussed with references to appropriate sections [of this manual] where specific information resides. A companion wire list (table format) of these interfaces is included in Appendix E.

APPENDICES:

Appendix A: Recommended Test Equipment

Appendix B: FASTNet Assembly Part Numbers

Replacement part numbers for various assemblies and components.

Appendix C: Power Conversion Table (for 600Ω terminated lines)

Appendix D: Hexadecimal/Binary/Decimal Equivalency Table

Appendix E: FASTNet Switch Final Wiring List Sample

Table of Section 7 examples, as they would be wired.

SYSTEM SPECIFICATIONS

Model 2540 FASTNet Switch

Physical	30" tall, 22" wide, 7" deep 75 lb. fully configured Wall or frame mounting
Power Supply	AC input: 115/230 volts AC ±10%, 47-63 Hz DC input option: 40-70 volts DC 300 Watts maximum
Environmental	+50 to +120 degrees Fahrenheit (+10 to +50 degrees Celsius) 10,000 foot (3,000 meter) altitude 8% to 80% relative humidity, non-condensing
Card Slots	6 computer, 10 trunk Positive lock retainer bars

Model 2540 Expansion

Physical	21" tall, 22" wide, 7" deep 60 lb. fully configured Wall or frame mounting
Power Supply	AC input: 115/230 volts AC ±10%, 47-63 Hz 200 Watts maximum
Environmental	+40 to +120 degrees Fahrenheit (+5 to +50 degrees Celsius) 10,000 foot (3,000 meter) altitude 8% to 80% relative humidity, non-condensing
Card Slots	3 computer, 10 trunk Positive lock retainer bars

LIGHTNING PROTECTION

Arc arresters right on the telephone demarcation/punch-down blocks can shunt hazardous voltages at their source. These easily replaceable protection modules protect your equipment investment and increase client satisfaction. Ask your Zetron sales person how to order punch down blocks with built in protectors.

Additional protection for the primary power line may be obtained from other vendors, and should be employed to protect from lightning strikes to power lines.

Proper grounding techniques are critically important to ensure proper lightning suppression and reliable operation of the Model 2540 FASTNet Switch.

CAUTION

Operating the Model 2540/2540EX without adequate voltage suppression devices on the telephone and radio connections may result in costly damage not covered by warranty. Protection kits and applications assistance are available from Zetron.

OPERATING POWER

The internal power supply on the Model 2540/2540EX operates from 115 or 230 volts AC and provides all internal operating voltages, including the 48 volts for DID telephone trunks. A power supply option is available to operate the Model 2540 directly from 48 V telco-style battery supply.

An uninterruptible power supply (UPS) option (802-9049) obtains standby power from storage batteries and keeps the system operating through brownouts or blackouts. Zetron's standard UPS is a 400VA unit with 30 minute capacity (Part No. 802-9049) with built in storage batteries. Higher capacity UPS options may be available as required. With an uninterruptible power supply the (Model 2540 Main Chassis) system can continue to process calls for up to 30 minutes or until the power returns (less time if Model 2540 Expand Chassis are used). DID trunks remain in service during UPS operation to facilitate the telephone company requirements for those lines. With the repeaters also on uninterruptible power, calls and messaging traffic can ride through power losses with no interruption of service. Other UPS equipment can provide more capacity and even power repeater equipment; call Zetron for applications assistance.

TRUNK CARD SPECIFICATIONS (702-9547 AND 702-9460)

Field Configured	Central office DID selector-level PABX 2-wire trunk End-to-End loop start ring and overdial E&M Type I 2-Wire Audio (FIC TL-11E) Local operator telephone set/CRT/computer End-to-End ground start and overdial
Card Status Lamps	Select, Test 1, Test 2, Test 3
Line Status Lamps	Ring, Loop, Answer, Modem
Input	DTMF 16-tone pairs (0-9,*,#,A-D) Dial pulse (digits 0-9) Dial click option (digits 0-9) MF decoder option
Connector	Board edge to 50-pin RJ2EX for 8 trunks
Telco Audio Input	Voice AGC limited -28 dBm to +10 dBm Voice silence detect -20 dBm ±3 dBm threshold Progress tones designed for networking
Telco Audio Output	702-9547 2-wire; -50 dBm to -9 dBm 702-9460 4-wire; -50 dBm to -6 dBm
Audio Bandwidth	300 to 3500 Hz ±1 dB
DTMF Detect	Standard 16-tone pair frequencies Minimum tone-pair duration 45 ms Minimum Inter-digit Time 45 ms Up to 11 digits per second
Disconnect Detect	no loop current (programmable, 150 ms & up) no VOX (programmable, 2500 ms & up) dial tone detect (programmable, 3000 ms & up) digit input time-out (programmable, 5 sec. & up)
Wink Detect Valid Range	120 to 310 ms

Line Coupling	600-ohm Transformer, Adjustable balance duplex hybrid	
FCC Registration	EYB5Q5-19269-OT-E	
	Ringer Equivalency Number:	0.4B E-E 0.0B DID
DOC Registration	702-9547 Revision D and later only trunk circuits.	
	Load Number:	69

DID Selector Level / PABX Trunk Configuration (702-9547)

Connections	2-wire Tip, Ring	
Supervision	Reverse battery	
Battery Source	To telco 48 V ±3 VDC; Current limited 40 mA ±10 mA	
Loop Closure	Detect threshold 6 mA ±3 mA	
Pulse Acceptance	Rate	5 to 22 pulses per second
	Minimum inter-digit time	100 ms
	DTMF acceptance	40 to 300 ms
Supervision Control	Immediate dial	150 ms ±50 ms
	Wink start delay	240 ms ±20 ms

End-to-End / PABX Extension Configuration (702-9547)

Connections	2-wire Tip, Ring; Loop or Ground Start	
Battery Source	From telco/PABX	
Ring Detect	16 Hz to 66 Hz 40 V to 150 V AC rms	
Answer After Ring	Programmable	0 to 30 seconds delay

PABX E&M (2-Wire) Configuration (702-9547)

Connections	2-wire Tip, Ring, E, M	
Supervision	Closure to -48V on M-lead Closure to ground on E-lead*	
Battery Source	From telco/from switch; current limited 15 mA*	
Pulse Acceptance	Rate	5 to 22 pulses per second
	Minimum inter-digit time	100 ms
	DTMF acceptance	40 to 300 ms
Answer Supervision	Closure to ground on E-lead	150 ms ±50 ms
	Closure to -48V on M-lead*	

*Special Matrix plug on 702-9547 only.

Operator Local Phone Configuration (702-9547)

Connections	2-wire tip, ring	
Supervision	Reverse battery, answer beeps or computer modem	
Battery Source	To phone 48 ±3 VDC; Current limited 40 ±10 mA	
Loop Closure	Detect threshold 6 mA ±3 mA	
Pulse Acceptance	Rate	5 to 22 pulses per second
	Minimum inter-digit time	100 ms
	DTMF acceptance	40 to 300 ms

E&M Type I Configuration (702-9460)

Connections	6-wire Tip1, Ring1, Tip2, Ring2, E, M		
Supervision	Revision A and B Audio Daughter Board		
	M-lead:		Closure to -48 V
		OR	Closure to ground
Battery Source	From telco/from switch		
Pulse Acceptance	Rate		5 to 22 pulses per second
	Minimum inter-digit time		100 ms
	DTMF acceptance		40 to 300 ms
Answer Supervision	Revision A Audio Daughter Board		
	E-lead:		Closure to ground
		OR	Closure to -48V
	Revision B Audio Daughter Board		
	E-lead:		Closure to ground
		OR	Closure to -48V
		OR	"OPEN" E-lead

NOTE: Jumper settings for Revision A boards control both trunks A and B simultaneously, whereas independent control of the above specified operations is provided for trunks A and B on Revision B boards.

VOICE SYSTEM SPECIFICATIONS

ADPCM Voice System (702-9459)

Audio In/Out	8-bit PCM with μ-Law companding to 12 bits Time division PCM multiplexed audio highway
Audio Bandwidth	200 Hz to 3400 Hz, ±1 dB
Recording Method	Transcoding to 4-bit ADPCM at 32Kbits/sec Double buffers for each channel DMA transfer to hard disk for permanent storage
Storage	Files in protected partition of hard disk End-of-file indication for precise audio cutoff
Message Length	No minimum Maximum limited only by mass memory capacity (although the FASTNet Switch may limit voice recordings to a more practical size)
End of Message	Precision replay without wasting voice time
Pause Compression	Software selectable Performed before disk transfer to conserve activity Fast audio attack prevents initial syllable cutoff, also minimizes noise falsing Selectable decay rate allows customized pause length
Operation	Sixteen independent channels Each may be recording or playing, Entirely software controlled by the FASTNet Switch, no special training required for callers, Diagnostics and error recovery provided by the FASTNet Switch control software
LED Indicators	One LED to show voice memory activity One LED to show program memory activity Two LEDs for test information Four LEDs to indicate channel activity

Continued next page

2. THEORY OF OPERATION

OVERVIEW

This section presents the theory of operation for the FASTNet Switch. Circuit descriptions are provided for each card. A complete set of call processing charts describe the sequence of events that takes place when calls are processed by the FASTNet Switch. Complete timing diagrams for the telco side of the system and the radio side of the system are on pages 2-23 through 2-46.

The Model 2540 FASTNet Switch system is composed of multiple microprocessor systems, whose software intensive architecture allows rapid upgrades and changes to the system, according to changing requirements. A central processing unit (CPU) (Part No. 702-9456) controls all internal operations in accordance with a FASTNet Switch program stored on hard disk. The CPU provides system power-down detection, system reset, software "watchdog", system clock calendar, timing for the PCM highway, progress tones, temperature, and system status lights. A 300/1200/2400-baud modem card (Part No. 802-0039) connects to the office computer for database management and remote maintenance. With the local connection option (Part No. 950-9071), the CPU also provides an RS-232 interface for direct connection of the office computer without requiring a dial-up telephone line for user management. The hard disk card (Part No. 815-9127) contains disk storage to hold the switch software, trunk/voice card firmware, user database, system log files, and voice files to operate the Model 2540 FASTNet Switch.

SYSTEM STARTUP

After an input power cycle or a remote Netbase "reboot" command, the CPU card resets all cards in the system. Each card in the system blinks its lights for a few seconds to indicate it is alive. The CPU card then performs a test on the system memory (about 30 seconds) during which time most of the system lights are static.

The CPU then loads the Disk Operating Software (DOS) from the boot portion of the hard disk. DOS in turn accesses the file named "AUTOEXEC.BAT", which does some preliminary setup work and then runs the file "CUSTBOOT.BAT", which sets up the 2540 FASTNet Switch for call routing by loading the switch software from the hard disk and initiating its execution. The CPU first flashes the TMP, COMB, COMA, and T4 through T1 LEDs, and then sets the T1-T4 LEDs to reflect the positions of switches C1-C4.

The Switch software then initializes each peripheral (Trunk, Voice, Modem, etc.) card and loads its operating firmware from hard disk. Specific firmware filenames and operating parameters (valid phone blocks, etc.) are tailored for each card slot by the config file. Since the firmware is stored on hard disk and not in ROMs, Zetron can update any installed Model 2540 FASTNet Switch with just a telephone call.

As software is loaded into an interface card, the card's SELECT light comes ON. Trunk cards (702-9547 and 702-9460 blink their TEST 3 light. The Switch software causes the SELECT and TEST light to behave this way until firmware loading is complete (8 to 15 seconds) for that card. Once all firmware is loaded and the CPU has tested the cards for proper operation, the 2540 FASTNet Switch goes on-line for call routing. The CPU continually polls the microprocessors on each interface card for any required service. The distributed multiple microprocessors of the 2540 Switch dedicate intelligence right where it is needed. Each processor guarantees instant service to a telephone caller or radio. Having multiple processors also means that as the system is expanded with more cards, more computer power is also added to keep throughput high and users happy.

SYSTEM INDICATORS

CPU Indicators

The CPU Card (702-9456) indicators show status of various system operations as follows:

T1 through T4	The T1 through T4 LEDs are irrelevant during normal operation time. These will display the status of DIP switches C1 through C4 during part of the reset cycle (refer to the System Startup subsection on page 2-1). These are also useful for troubleshooting in the rare event of a disk error or system crash in which program execution in the CPU is halted (refer to Section 6).
COM A	The COM A LED indicates serial data activity via the Local Serial Port (P2). If the optional cable (Zetron Part No. 709-7086) is installed and connected to a local IBM PC (or compatible) loaded with Netbase, then access and data transfer may be indicated by short periods of darkness when the link is transferring data. The LED will be mostly dark with a short flash on every 2 - 4 seconds when the link is connected but idle.
COM B	The COM B LED indicates data transfer to the local serial logging printer connected to the Printer Port (P1). This is probably not installed if a computer terminal with printer is installed to the Local Port, yet could be if a full-time independent logging printer is desired.
MDM	The MDM LED lights when NETBASE is active on the telephone line modem that is installed into Slot 3 of the FASTNet Switch chassis. This LED is illuminated during both transmit and receive serial data packets that are processed between the CPU and the remote Netbase computer terminal via the modem and telephone line interface.

TMP	This indicator is provided to alert the system operator of major heat problems. The TMP LED will light if the terminal is operating above its upper temperature limit (approximately 150 degrees F). Poor air circulation may cause the ambient temperature within the Model 2540 chassis to elevate. If this LED comes on, the maintenance technician should monitor the ambient air temperature inside the chassis more closely. Illumination of this LED will not halt or otherwise interfere with normal FASTNet Switch operation. Logging data will contain a temperature indication at the beginning of each log file.
RST	The RST LED will be on when a CPU reset is occurring.
DMA	The DMA LED indicates Direct Memory Access transfers; these include data file reads and writes as well as voice file transfers.
EMS	The EMS LED indicates accesses to the Expanded Memory System, used by both the SCSI Hard Card (Standard Voice Option) and the optional SCSI Hard Drive (Expanded Voice Option) in the FASTNet system. This LED is illuminated nearly continuously.
FLT	The FLT LED is on when a fault condition has been detected, or during System Boot-up.

Expand Card Indicators

The Expand Card (702-9458) is an option that is only used with the Model 2540/ 2540EX Expansion Option. In that case, two of these cards will be used, one per chassis assembly. Indicators operate as described below:

MST	The MST LED is lit if this card has been configured to be the Master Expand Card, which should reside in the main FASTNet 2540 Switch Chassis, Slot 5.
SLV	The SLV LED indicates that this card has been configured as the Slave Expand Card, which should reside in the FASTNet 2540EX Expansion Chassis, Slot 3.
RD	The RD LED indicates that a "Read" operation is in progress for the card.
WR	The WR LED shows that a "Write" operation is in progress for the card.
+12V	The +12V LED indicates that positive voltage is present on the +12 VDC power supply bus. Brightness intensity will vary with actual voltage level. Measurement is required to accurately verify that required voltages are present.
+5V	The +5V LED indicates that positive voltage is present on the +5 VDC power supply bus. (Operation is similar to +12V LED.)
-5V	The -5V LED indicates that negative voltage is present on the -5 VDC power supply bus. (Operation is similar to +12V LED.)
-12V	The -12V LED indicates that negative voltage is present on the -12 VDC power supply bus. (Operation is similar to +12V LED.)

Voice Messaging and ADPCM Card Indicators

The ADPCM Card (702-9459) is responsible for I/O conversions between the PCM audio bus and the SCSI disk drive storage formats. The front panel indications are described below:

MEM	MEM is constantly illuminated under normal operation, following boot-up.
PRG	PRG indicates that Program Memory (which controls this card) and control or status functions are currently mapped on the CPU Bus by the ADPCM Card. Normally, this is on constantly and behaves similar to the MEM indicator.
TS1	TS1 illuminates whenever one or more ADPCM channels are presently recording (writing) to the SCSI disk drive(s).
TS2	TS2 illuminates during ADPCM playback (reading) from the SCSI disk drive(s) to the ADPCM Bus by one or more channels.
CHANS 1/4	CHANS 1/4 indicates loading status; i.e., 1/4 or 25% of all ADPCM channels are currently busy.
CHANS 1/2	CHANS 1/2 indicates loading status; i.e., 1/2 or 50% of all ADPCM channels are currently busy.
CHANS 3/4	CHANS 3/4 indicates loading status; i.e., 3/4 or 75% of all ADPCM channels are currently busy.
CHANS 1/1	CHANS 1/1 indicates loading status; i.e., all or 100% of all ADPCM channels are currently busy.

Call Processing and Trunk Card Indicators

The Dual Telco Trunk Card (702-9457) and Dual 4-Wire Trunk Card (702-9460) indicators operate virtually identically.

SELECT	The SELECT LED is lit whenever the trunk card is currently being polled (accessed) by the CPU Card.
TEST 1	The TEST 1 LED indicates audio activity present in the Trunk A circuitry. This includes Dial Pulse, DTMF, MF, or voice signals.
TEST 2	The TEST 2 LED indicates audio activity present in the Trunk B circuitry. It is similar to the TEST 1 LED for Trunk A.
TEST 3	The TEST 3 LED becomes active after (although it appears to be simultaneous) the trunk card is polled by the CPU Card, yielding an "I'm alive" signal to the CPU and to the service technician observing these LEDs.

The following indicators are identical for both Trunks A and B:

RING	The RING LEDs illuminate during "Ring" signal decoding of the appropriate trunk for inbound interconnect calling.
LOOP	The LOOP LEDs indicate the presence of "Loop" current sensed during interconnect, for End-to-End and DID interfaces; or they indicate the presence of inbound line supervision for E&M interfaces.
ANSWER	The ANSWER LEDs indicate Line Supervision is present for outbound dialing, or that Line Seizure is present for inbound dialing.
MODEM	The MODEM LEDs are not used at this time by the FASTNet Switch.

Idle Indicators

After all cards are initialized and operating parameters loaded, the system does its housekeeping on the hard disk and goes into the normal idle state. It scans each Trunk card looking for incoming calls. If the SELECT LED and the TEST 3 LED light simultaneously, it indicates data transactions between the CPU and the trunk interface cards. It is normal to see a slower blink rate for trunk cards configured for outgoing-only (from the FASTNet Switch), than for trunk cards configured for bi-directional or inbound-only. This gives incoming calls a higher priority.

SYSTEM OPERATION

CPU Card

Advanced large scale integrated (LSI) circuits pack an entire computer, including 512K bytes or more of memory, onto one 4"x13" circuit card. FASTNet Switch software loaded from the SCSI hard disk at power-on operates in RAM on this card and acts as traffic manager and diagnostic maintenance controller for the microprocessors on all the trunk cards.

The CPU provides the master reset signal, watchdog timer, non-volatile RAM, a real-time clock, PCM Bus synchronization pulses, a temperature sensor, and A/D conversion.

Power-on reset timing and a watchdog circuit help to recover from any software faults or high energy noise, such as RFI or circulating ground currents, which might interfere with or stop system operation. Front panel indicators are addressable by the CPU to show operating system status. The watchdog and reset circuits are composed of U25 and U64. U64 provides the initial 300-millisecond power-up reset pulse. U25 is the watchdog timer. The system must write to it once a second to keep it from initializing a reset pulse. The watchdog is disabled from resetting the system for about 4 minutes from power up in order to allow the system to boot completely. The watchdog can be permanently disabled by placing switch 7, labeled "WAT", in the A position.

The non-volatile RAM and real time clock functions are provided by a special socket in which U50 resides. The socket eliminates the need for a separate real-time clock circuit board on the IBM Bus.

The clock signal is a 2.048 MHz square wave that synchronizes the serial data. Eight clock pulses constitute a PCM "slot". Audio is converted into 8-bit words, via the Trunk Cards and ADPCM Cards, and then presented in one Slot. A "frame" is composed of 24 slots. The "sync pulse" marks the beginning of a frame and is one clock cycle of duration with a period of about 125 microseconds (8 KHz sampling rate). Each slot can be thought of as a channel carrying unidirectional audio information (just like a radio channel).

The CPU Card also provides the central timing logic for two 24-slot, PCM, digitized audio highways, which all the circuit cards use for passing audio among them. Each PCM Highway is composed of three signals: digitized audio data, clock and sync. The data is a time-multiplexed serial signal and can be encoded or decoded by the Model 2540 trunk cards or ADPCM Card. The audio signals are translated between PCM and ADPCM formats by the transcoder ICs on the ADPCM Card(s). The ADPCM formatted data is then dumped onto the IBM Bus, where the CPU controls data flow to or from the SCSI hard drive.

The CPU card provides six slots, or channels, of prompting tones available to any card on the PCM Highways. Prompting tones are generated on dedicated PCM channel slots for "1 KHz Beep", "Out of Service" whoop, TELCO "Dial Tone", TELCO "Ringing" tone, TELCO "Busy" tone, and a "Silent" tone.

RS-232 Interface with the CPU Card

An RS-232C compatible input/output option provides direct connection between the office computer and the 2540 FASTNet Switch via P2 on the lower backplane. This port operates up to 4800 baud. A Zetron 60-foot cable (Part No. 709-7086) is used for this purpose.

The connector to the card is brought out on a cable ending in a female dB-25. The end of the cable marked by a dot must connect to the Local Computer's serial port. In order to enable troubleshooting or construction of a cable in the field, the pin-out for this cable is shown in Table 2-1: Zetron Serial Cable (709-7086) to Local Computer Wiring. The approximate maximum cable length which can provide reliable service, assuming good quality shielded twisted pair cabling, is shown relative to selected baud rate in Table 2-2: RS-232 Cable Length vs Data Speed.

Table 2-1: Zetron Serial Cable (709-7086) to Local Computer Wiring

IBM PC DB-25 (DB-9)		Computer Function	Model 2540 Function	Model 2540 DB-25
1	(--)	Shield	Not Connected	1
2	(3)	Transmit Data	Receive Data	3
3	(2)	Receive Data	Transmit Data	2
4	(--)	Request To Send	Not Used	--
5	(--)	Clear To Send	Not Used	--
6	(--)	Data Set Ready	Not Used	--
7	(5)	Ground	Ground	7
8	(1)	Carrier Detect	Data Terminal Ready	20
20	(4)	Data Terminal Ready	Carrier Detect	8

Table 2-2: RS-232 Cable Length vs Data Speed

Data Speed (Baud Rate)	Cable Length (Feet)
300	500
600	400
1200	300
2400	250
4800	100

Note: These lengths do not meet RS-232C specifications, but are practical in real environments without excessive EMI (Electro-Magnetic Interference) signals.

A series of switches at the top of the CPU card are used to set various hardware and software options as shown in Table 2-3: Model 2540 CPU Card, LED and Switch Functions.

An optional Local Logging Printer Interface (950-9118) may be obtained if a logging printer is desired at the switch site. This option includes two ICs and a cable, which is wired as shown in Table 2-4: Local Logging Printer Cable (709-7085) Wiring.

Table 2-3: Model 2540 CPU Card, LED and Switch Functions

Model 2540 CPU Card LEDs	
LED Label	**Function**
T1 T2 T3 T4	Three modes for these indicators: 1. Show C1-C4 Setting during BOOT. 2. Show Error Code during HALT. 3. Unused during Normal Operation. (Shows ERROR CODE if HALT occurs)
COM A	Local RS-232 Activity (NetBase, etc.)
COM B	Local RS-232C Log Printer Activity
MDM	Remote (Modem) Netbase Activity
TMP	Temperature out of range
RST	System Re-BOOT Initiated
DMA	Direct Memory Access in Progress - OR- CPU Internal 64K RAM Access in Progress
EMS	Expanded Memory Activity in Progress
FLT	System Fault Detected

Model 2540 CPU Card Switches		
Switch	**Used by...**	**Position A/B**
C1	NetBase	A = Ignore Password
C2	Unused	B = Require Password
C3	Unused	for System Access
C4	Unused	from computer ...
		(Local or Modem)
D1, D2	Zetron Only	**A** = Always Set Here **B** = Factory Use ONLY.
WAT	Watchdog	A = Disabled **B** = Enabled
RST	Reset CPU	A = Reset **B** = RUN

Table 2-4: Local Logging Printer Cable (709-7085) Wiring

Model 2540 FASTNet Switch Female DB-25 Cable Connector	**Serial Log Printer** Male DB-25 Cable Connector
1 ——— 1 2 ——— 3 7 ——— 7 4, 5, 6 all jumpered together 6, 8, 20 all jumpered together	

Modem Card (802-0039)

A 300/1200/2400 baud multi-speed modem on this circuit card provides the dial-up remote port for Zetron maintenance of the 2540 FASTNet Switch. Two telco modular RJ11C connectors on edge of the card provide convenient connection points for the input telephone line and a bridged telephone. Software on the CPU card constantly polls the modem card for any incoming telephone call and connects the system maintenance computer (assuming that the system maintenance computer dialed the modem) to the FASTNet Switch diagnostic software system. The communications protocol used on this port is Zetron proprietary software (NETLINK) and is therefore inaccessible to any normal, off-the-shelf communications software packages that may attempt to invade the system. The pin-outs for the modular connectors labeled "WALL" and "PHONE" are shown in Table 2-5.

The configuration DIP switches are accessible from the top side of the FASTNet main chassis card cage, where the TELCO jacks of the Modem are located. These component locations are illustrated in Figure 2-1: Modem Top View. The "Comm Port" selected by the Modem hardware MUST match the software address defined in the Trunk Card Editor file. Set the DIP switches as indicated in Table 2-6: Modem Comm Port Assignment.

Table 2-5: Modem TELCO Jack Wiring

Pin No.	Signal Name	Function
1	---	Unused
2	TIP 1	Coupled between "Phone" and "Wall" jacks
3	RING	TELCO "RING" wire
4	TIP	TELCO "TIP" wire
5	RING 1	Coupled between "Phone" and "Wall" jacks
6	---	Unused

Note: These pinouts apply to both "modular" telephone jacks of the Modem Card (802-0039)

Table 2-6: Modem Comm Port Assignment

Switch Settings		Functional Description
S1	S2	
OFF	**OFF**	**Comm Port 1**
ON	OFF	Comm Port 2
OFF	ON	Comm Port 3
ON	ON	Comm Port 4

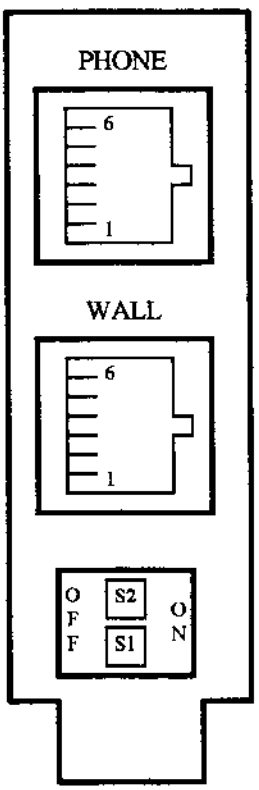


Figure 2-1: Modem Top View

This Modem Card can *share* a TELCO Line with one of the trunk cards (Dual TELCO End-to-End type only) in order to economize overhead site expenses. To facilitate this usage, the

Trunk Card Editor (TCE) file must be programmed accordingly. Next, the Modem "Wall" jack would be connected to the Central Office modular jack, while the modular (RJ66M425) jack of the FASTNet Cable Kit (from the FASTNet End-to-End Trunk) *is then wired to the Modem "Phone" jack.* Figure 2-2, illustrates this configuration of hardware. Please refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for TCE programming instructions.

WARNING:

This Modem is NOT compatible with "GROUND START" TELCO lines!

Use ONLY "LOOP START" End-to-End lines.

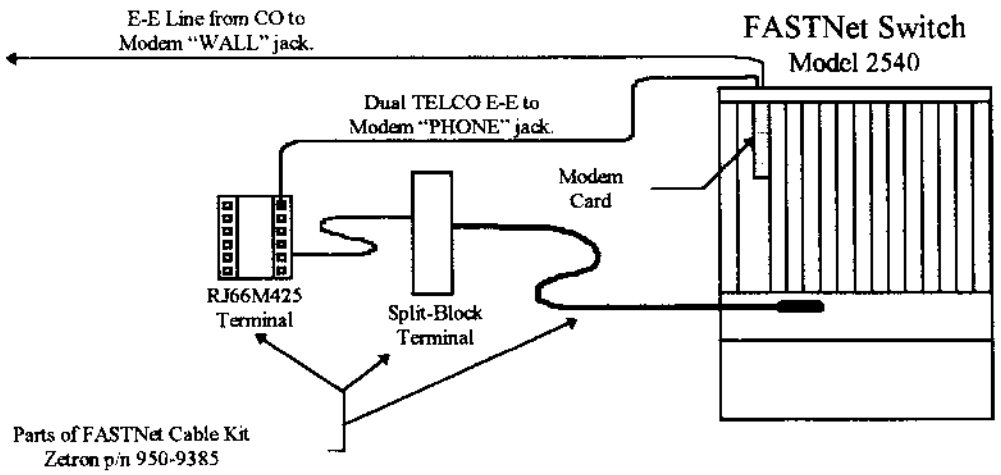


Figure 2-2: Configuration for Modem and End-to-End trunk "Line Sharing"

SCSI Hard Disk Card (815-9127)

SCSI stands for "Small Computer System Interface." It is a high speed, industry standard interface used to access the Model 2540 FASTNet Switch disk drive for program and voice storage.

Zetron installs special data formatting onto the Hard Disk Drive, which stores FASTNet Switch software files along with special high-speed voice files. This proprietary formatting method guarantees a high degree of data integrity when using the disk for demanding voice read or write applications. The Hard Card has a minimum of 85 megabytes of capacity for program and voice storage. The SCSI hard disk card will support two-hour voice messaging, or the four-hour option if ordered.

SCSI Hard Drive / Extended Voice Storage Options

The SCSI disk drive is mounted below the card slots and above the power supply. There is a power supply cable for the disk drive and a ribbon cable that is the SCSI bus. The SCSI bus connects to the host adapter, a small card that is required with SCSI and installed into Slot 1 of the FASTNet Switch.

This voice file system requires more memory. The Zetron CPU needs 1 megabyte total memory installed for the 12-hour size Voice Messaging, and 2 megabytes for the 20+ hour size. All Zetron FASTNet Switches are equipped with at least 1 megabyte of CPU memory: nine 1 megabyte chips are installed in sockets U14-U22 for 1 megabyte; eighteen chips are installed into sockets U5-U22 for two megabytes.

An optional redundant "mirrored" memory is being developed for future use as a voice storage fail-safe backup system. Although this option is not yet available, hardware provisions (extra power pigtail and pre-fabricated mounting holes) are incorporated into your FASTNet Switch to facilitate easy upgrade in the future.

The information shown in Table 2-7: CPU Memory Requirements for SCSI Options, will help determine CPU Card memory requirements for Voice Storage (Hard Drive) options.

Table 2-7: CPU Memory Requirements for SCSI Options

ADPCM Voice Storage Capacity (Hours)	CPU Memory Required	SCSI "Hard Drive" Required (Part No.)
2/4	1 Mb	815-9127
6	1 Mb	950-9404
12	1 Mb	950-9332
24	2 Mb (1 Mb Added)	950-9333
48	2 Mb (1 Mb Added)	950-9336

Model 2540EX Expansion Chassis Option

The 2540EX is under control of the 2540 main chassis and communicates via the 709-9458 Expand boards and interconnecting shielded 50-pin ribbon cable (709-7108) or 68-pin round cable (709-7298). The Expand boards use high speed bus transceivers to interface with each other through the shielded cable. Refer to Section 7 of this manual for Rev B Expand Card notes if a 50-pin flat ribbon cable is used. *This text refers to 702-9458C Expand Boards.*

The Expand cards can be configured as a Master (2540) or Slave (2540EX) unit. The direction of each card is determined by the installation of one 'berg' jumper (JP1), and seven DIP jumpers (JP2-JP8) which connect the receive outputs of the transceivers, where appropriate. These DIP Jumpers are located on 'Rev C' cards as shown in the illustration of Figure 2-3: Model 2540 Rev C Expand Card Jumpers. The revision of the card is the letter following the "702-9458" part number on the Expand PCB. For Model 2540 units which utilize 'Rev B' cards, please refer to the previous revision of this manual (Part No. 025-9260B) or contact Zetron at (206) 820-6363 for assistance. We have improved the ribbon cable interface and modified the jumper selection for this 'Rev C' version card. Jumper installation is shown in Table 2-8: Expand Card Jumper Configurations, as related to FASTNet chassis installation.

In addition to the DIP jumpers, the bus termination impedance must be correct to prevent data errors. A characteristic impedance of 120 ohms is used. This is accomplished by installing the resistor packs (RP1, 2, 4, 5, 6) *only* into the boards at *each end* of the buss cable. Refer to Table 2-9: Expand Card Resistor Pack Configurations.

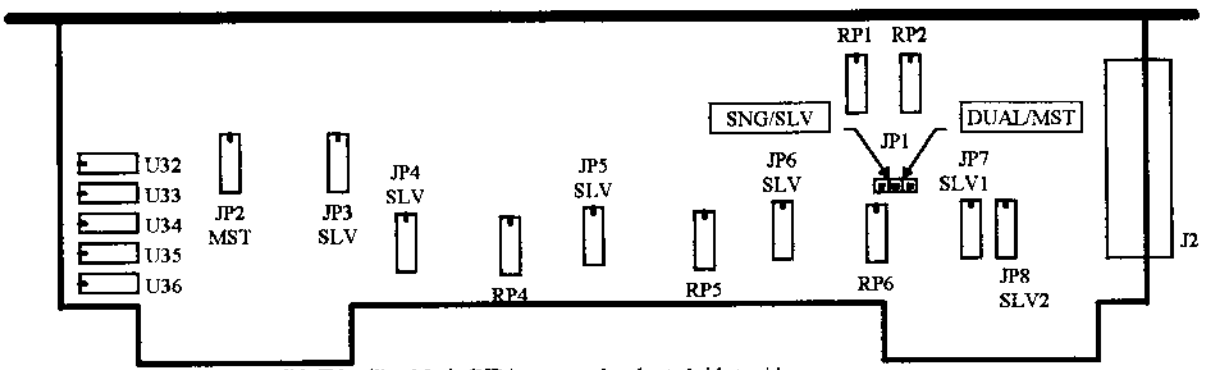


Figure 2-3: Model 2540 Rev C Expand Card Jumpers

All applicable IBM-PC Bus signals are transmitted from the main chassis and received at the expansion chassis. These signals include all address lines and the appropriate control lines. The data bus is bi-directional and can be thought of as an extended-wired "OR" configuration. The IBM-PC Bus write data is provided to both the main and slave chassis.

Table 2-8: Expand Card Jumper Configurations

Jumper		Master Configuration (Trunks 1-10)	Slave 1 (Trunks 11-20)	Slave 2 (Trunks 21-30)
JP1	(BERG Type)	"DUAL/MST"	"SNG/SLV"	"DUAL/MST"
JP2	MST	INSTALLED	OPEN	OPEN
JP3	SLV	OPEN	INSTALLED	INSTALLED
JP4	SLV	OPEN	INSTALLED	INSTALLED
JP5	SLV	OPEN	INSTALLED	INSTALLED
JP6	SLV	OPEN	INSTALLED	INSTALLED
JP7	SLV1	OPEN	INSTALLED	OPEN
JP8	SLV2	OPEN	OPEN	INSTALLED

Table 2-9: Expand Card Resistor Pack Configurations

Resistor Pack	20 Trunk System			40 Trunk System			60 Trunk System		
	Master	Slave 1	Slave 2	Master	Slave 1	Slave 2	Master	Slave 1	Slave 2
RP1	n/a	n/a	n/a	Installed	Installed	n/a	Installed	OPEN	Installed
RP2	n/a	n/a	n/a	Installed	Installed	n/a	Installed	OPEN	Installed
RP4	n/a	n/a	n/a	Installed	Installed	n/a	Installed	OPEN	Installed
RP5	n/a	n/a	n/a	Installed	Installed	n/a	Installed	OPEN	Installed
RP6	n/a	n/a	n/a	Installed	Installed	n/a	Installed	OPEN	Installed

The slave chassis is enabled to drive the data lines back to the main chassis during read operations only. These lines will not be driven if the slave chassis data bus is inactive. If the read data is coming from the main chassis, it will drive the main bus directly. The expansion card data drivers will not interfere since they are open collector.

The PCM data is handled similarly, although it is complicated by the fact that there is no control signal, such as with the PC read strobes MEMR and IOR, to enable the appropriate drivers. This situation is overcome by an interlock signal. When one side of the PCM bus starts to drive low, the transmitted signal blocks the other side from driving back. When the signal goes inactive, a delayed counterpart of the transmitted signal is used to block backwards transmission for an interval sufficient to prevent unwanted oscillation.

Dual TELCO Card (702-9457)

The Dual TELCO Card can interface one or two sets of telephone lines to the FASTNet Switch. These telephone lines are connected to the Dual TELCO Card through the Z-bus, which resides on the lower backplane. TELCO line assignments are determined dependent upon the slot that the Dual TELCO Card resides in and the punch-down block wiring correlations. Each slot has access to two separate unique telephone lines.

The Dual TELCO Card can interface different types of lines. Dual four position matrix plugs determine the type of interface provided for each trunk. The two trunks need not be set to the same line type.

- In the DID position, the interface is for C.O. Selector level, local or PABX loop-start trunks.
- The E-E position is for End-to-End operation, usually as a PABX extension or C.O. End-to-End service.
- The E & M position is typically for PABX trunks using E & M, 2-wire audio signaling. This is NOT compatible with 4-wire signaling (Dual 4-Wire Card 702-9460 required for that).
- In the GND ST position, the interface is for PABX or CO ground start trunks.

Two detectors are used on each of the two phone lines: a loop detector and a ring detector. The ring detectors are used to detect TIP/RING signaling such as ring bursts and non-E&M dial clicks. The loop detectors are used for sensing TIP/RING Loop Current, which is evaluated for loop-start, ground-start, and some E&M Lines. Trunk A loop detector's threshold is set by R57 and R59. Trunk B loop detector's threshold is set by R64 and R66. The remainder of the trunk line control consists of relay control plus current-limiting and noise suppression for the (-48 VDC) power supply: DS15, DS16 and C2 for Trunk A, DS13, DS14 and C3 for Trunk B.

Full-duplex hybrids separate the incoming and outgoing audio. The circuitry effectively cancels out the outgoing audio from the incoming audio. Device U26 for Trunk A and U27 for Trunk B form variable capacitive and resistive networks to match the impedance of each telephone line. Each trunk is provided with two adjustments: R Balance and C Balance. These balance controls are used to "match" the hybrid circuitry to the telephone lines. The better the match, the less reflected impedance generated, and therefore less "sidetone" created. Sidetone is the voltage dropped across the reflected impedance, and manifests itself in the form of "echo" or "feedback".

Trunk A incoming audio is amplified by U28 and level adjusted by R17. Trunk B incoming audio is amplified by U4 and level adjusted by R9. The amplified outputs are then fed into the Envelope Detector, AGC, Modem and DTMF decoder for each trunk.

The Trunk A Envelope Detector consists of U28 and associated components. The DC voltage across C53 is connected to an analog input of the microprocessor U14. The Trunk B Envelope Detector consists of U4 and associated components. The DC voltage across C12 is connected to an analog input of U14, as well. The detect threshold is a programmable parameter due to this use of the microprocessor's analog to digital inputs. These Envelope Detectors are used to provide input for the VOX Disconnect feature of this card. Normally this VOX Disconnect is NOT used because any 'long' quiet gap during a telephone conversation would in fact hang-up the call, thereby annoying users.

The AGC circuits for trunks A and B use their respective envelope detector outputs as control voltage inputs. Each is composed of a FET and a peak (envelope) detector. The varying source-drain voltage of the FET introduces distortion that is minimized by feedback from U28 (U4 for trunk B). The peak detector's threshold determines the nominal peak to peak output level the AGC will attain. The output of each AGC is applied to the PCM Combo Codecs via an analog switch: Codec U8 via U7 for trunk A; and Codec U5 via U6 for trunk B.

The Switch software communicates with the Dual TELCO Card microprocessor through the dual-port RAM U35. The RAM appears in the I/O map of the FASTNet Switch system only when the card is "selected". U33 and a portion of U37 make up the select circuitry.

Each Dual Telco card has a unique select address determined by the setting of the DIP switch SW2 and JP5. These address settings are critical to the correct operation of the card. Refer to Section 4 of this manual for specific information and instructions.

The card becomes NOT selected when any other card is selected, thus only one card is present in the IBM I/O map at any given instant.

The reset line of the Dual TELCO Card microprocessor can be controlled by the IBM bus via a portion of U37. Resetting normally occurs as a result of one of two methods: (1) a hardware reset is initiated upon power-up of the FASTNet Switch; (2) a system reset is initiated from the Netbase interface, which will terminate the Netbase interface during events. Following the onset of a system reset, the Netbase will be able to re-link with the system after a lapse of 2 minutes.

SW1 is a push-button switch that creates a non-maskable XIRQ interrupt used for testing purposes at the factory. No field service functions are provided for this switch.

Dual 4-Wire Card (702-9460)

The Dual 4-Wire Card can interface one or two sets of telephone lines to the FASTNet Switch. These telephone lines are connected to the Dual 4-Wire Card through the Z-bus, which resides on the lower backplane. TELCO line assignments are determined dependent upon the slot that

the Dual 4-Wire Card resides in, and the punch-down block wiring correlations. Each slot has access to two separate unique telephone lines.

The Dual 4-wire Card (702-9460) is basically a variation of the Dual TELCO Card (702-9457). Subsequently, the only difference of circuitry is in the TELCO interfacing circuitry; the Dual Matrix cards are replaced with an Audio Daughter Board, and some circuitry is deleted from the main trunk board. The DTMF, PCM coding / decoding, RAM, microprocessor, and modem circuits are identical to the Dual TELCO Card.

The Dual 4-Wire trunk card interfaces 4-wire E&M balanced signaling from the Z-Bus to the Audio Daughter Board, which resides on the Dual 4-Wire Card and interfaces via the Matrix Jacks. The Audio Daughter Board translates the balanced 4-wire audio into single-ended 4-wire audio, and then feeds that signaling to/from the PCM coding circuitry. E&M signals are directly fed to the Dual 4-Wire Card for processing.

Please note that audio pair and E&M labeling for this product is consistent with that assigned by TELCO CO specifications (i.e. M2540 labels are identical to TELCO labels) These labels are defined as listed below:

M Lead = Supervision Signal From TELCO

E Lead = Return Supervision TO TELCO

TIP/RING = "TO TELCO" Audio from FASTNet Switch

TIP1/RING1 = "FROM TELCO" Audio to FASTNet Switch

Clarification notes appear throughout this manual to help avoid "E" and "M" label confusion, which justifiably arises from a lack of rigid industry standardization. Originally "M" represented "MOUTH" or source outbound control signaling, and "E" represented "EAR" or inbound supervisory signaling. Confusion arises when the perspective is shifted from the 'source' to the 'load' device. Diagrams and examples are provided to avoid this confusion in Section 7 (Practical Examples) of this manual.

The M-Lead detector used on each of the two phone lines feed into the "Loop" detector circuitry described under the Dual TELCO Card. Trunk A routes into U1 and associated circuitry; Trunk B into U2.

The E-Lead drivers are routed from the Supervision A signaling to the E-Lead. The Trunk A E-Lead is driven by relay K1; Trunk B from relay K2.

Incoming and outgoing audio are processed separately and therefore are completely isolated from one another. To-Trunk audio is processed by R16 (To Tel) and U26B (pins 5-6-7) for Trunk A; R8 and U27 (pins 1-2-3) for Trunk B. From-Trunk audio is processed by R17 (From Tel) and U28 for Trunk A; R27 and U4 for Trunk B.

No balancing circuitry is required for E&M 4-wire Type I or circuitry, and therefore U26A (pins 1-2-3) and U27B (pins 5-6-7) are not used for this board. Associated circuitry is not installed.

Amplified outputs are then fed into the Envelope Detector, AGC, Modem and DTMF decoder for each trunk. Trunk A's Envelope Detector consists of U28 and associated components. The DC voltage across C53 is connected to an input of the microprocessor U14. Trunk B's Envelope Detector consists of U4 and associated components. The DC voltage across C12 is connected to an input of U14, as well. The detect threshold is a programmable parameter due to this use of the microprocessor's analog to digital inputs.

The AGC circuits for trunks A and B use their respective envelope detector outputs as control voltage inputs. Each is composed of a FET and a peak (envelope) detector. The varying source-drain voltage of the FET introduces distortion that is minimized by feedback from U28 (U4 for trunk B). The peak detector's threshold determines the nominal peak to peak output level the AGC will attain. The output of each AGC is applied to the PCM Combo Codecs via an analog switch: Codec U8 via U7 for trunk A; and Codec U5 via U6 for trunk B.

The Switch software communicates with the Dual 4-Wire Card microprocessor through the dual-port RAM U35. The RAM appears in the I/O map of the FASTNet Switch system only when the card is "selected". U33 and a portion of U37 make up the select circuitry.

Each Dual 4-Wire card has a unique select address determined by the setting of the DIP switch SW2 and JP5. These address settings are critical to the correct operation of the card. Refer to Section 4 of this manual for specific information and instructions.

The card becomes NOT selected when any other card is selected, thus only one card is present in the IBM I/O map at any given instant.

The reset line of the Dual 4-Wire Card microprocessor can be controlled by the IBM bus via a portion of U37. Resetting normally occurs as a result of one of two methods: (1) a hardware reset is initiated upon power-up of the FASTNet Switch; (2) a system reset is initiated from the Netbase interface, which will terminate the Netbase interface during events. Following the onset of a system reset, the Netbase will be able to re-link with the system after a lapse of 2 minutes.

SW1 is a push-button switch that creates a non-maskable XIRQ interrupt used for testing purposes at the factory.

Dual Dial Click Option (702-9119)

In some rural areas, DTMF (Touch-Tone) dialing is not normally available or used. This makes it difficult to use the Model 2540 on end-to-end phone lines, and requires the caller to overdial the mobile user number. The signaling that comes through from a rotary dial telephone line is in the form of audible clicks from the phone's contacts opening and closing as the dial turns.

This type of telephone can be supported on the FASTNet Switch by adding the Dual Dial Click Detector option board and companion software.

For use with rotary dial phones, the TELCO must pass residual audio clicks of the dial turning, without disconnecting the caller. The optional Dial Click Detector Card, with special software, converts these clicks into a usable overdial number. This conversion process generally works, but each installation should be tested before having callers rely upon overdial click interpretation. Note that most electronic 'Universal Dial' phones with FET loop current interrupters do not provide clicks that are sharp enough to be passed through TELCO equipment.

The Dial Click board processes the incoming audio clicks from the phone line and converts them into high/low digital pulses that are read by software. Since dials turn at different and varying speeds, and sometimes produce extra clicks during their rotation, the software is designed to be extra smart in interpreting these clicks and converting them back into the 0-9 digits dialed by the caller. The process is not 100% perfect and it is advised that dialing via different phone company central offices be attempted before assuring users that their calls will work reliably. If dial click detection proves unsatisfactory, a DID (direct inward dial) line will be needed to call reliably from rotary telephones.

The Dual Dial Click board is installed onto J5 of either the Dual TELCO Card (702-9457) or the Dual 4-Wire Card (702-9460). The Dual Dial Click card is installed so that it lies down toward the bottom of the particular trunk card, anchored by a standoff. Special standoff changes are required if an Audio Daughter Board is installed onto the trunk card.

Trunk A audio comes in on J5 pin 7 and the resulting digital signal is output to J5 pin 8. Trunk B audio comes in on J5 pin 9 and the resulting digital signal is output to J5 pin 10. Each channel of audio passes through its own bandpass filter to remove any speech component and properly shape the pulses. Trunk A's filter is built around half of U2 and trunk B's filter is built around half of U5. Variable gain amplifiers (Trunk A - half of U1, Trunk B - half of U4) allow for field adjustment of the filter output to a constant peak level.

The output of these amplifiers is full wave rectified by the other halves of U1 for trunk A and U4 for trunk B. The resulting waveforms are used to drive the comparators, comprised of half of U2 for trunk A and half of U5 for trunk B. The outputs of the comparators are inverted via transistors Q1 for trunk A and Q2 for trunk B. The inversion results in a digital logic 1 being present on the corresponding output pin whenever a dial click is detected. The comparator outputs also drive detector lamps DS1 (Trunk A) and DS2 (Trunk B) on the Dual Dial Click Option board.

Dual MF Decoder Option

When activated by the Dual trunk software, and enabled in the configuration settings, the 78A207 MF decoder chips on the MF board will generate an interrupt to the Dual Trunk's CPU when an MF tone pair is decoded. The CPU reads the MF board's status to determine which half of the dual trunk generated the interrupt, and which MF tone pair was received.

The MF board can also generate MF tones, using an 87C751 and a resistor ladder network.

JP1 = A ;("B" only used during factory testing)

MF signaling is used by the TELCO CO to perform CO Switch functions. This format differs significantly from DTMF signaling. The DTMF and MF format tone pairs are shown in Table 2-10: MF and DTMF Tone Pairs, to illustrate some basic differences between the two formats - a technician "listening" to the line audio probably would not differentiate these tone pairs. Inbound MF feed digit signals will always include "framing" tones (KP and ST), which are not used by LTR controllers, and are therefore stripped off by the MF Decoder circuit. Additionally, MF formatting requires strict timing protocol, whereas DTMF is merely serial input without restrictive time constraints. For example: to send feed digits "4527", the CO sends MF code "KP 4527 ST" or "B4527C" to the FASTNet Switch, which in turn sends the decoded "4527" signal to the appropriate other trunk interface.

Table 2-10: MF and DTMF Tone Pairs

Coded Digit	MF Format Name	Tone Pair Frequencies	
		MF Format Tones	DTMF Format Tones
1	1	700, 900	697, 1209
2	2	700, 1100	697, 1336
3	3	900, 1100	697, 1477
4	4	700, 1300	770, 1209
5	5	900, 1300	770, 1336
6	6	1100, 1300	770, 1477
7	7	700, 1500	852, 1209
8	8	900, 1500	852, 1336
9	9	1100, 1500	852, 1477
*	---	NO TONE	941, 1209
0	---	NO TONE	941, 1336
#	---	NO TONE	941, 1477
A	0	1300, 1500	697, 1633
B	KP	1100, 1700	770, 1633
C	ST	1500, 1700	852, 1633
D	ST1	900, 1700	941, 1633
E	ST2	1300, 1700	NO TONE
F	ST3	700, 1700	NO TONE

CALL PROCESSING SEQUENCES AND TIMING DIAGRAMS

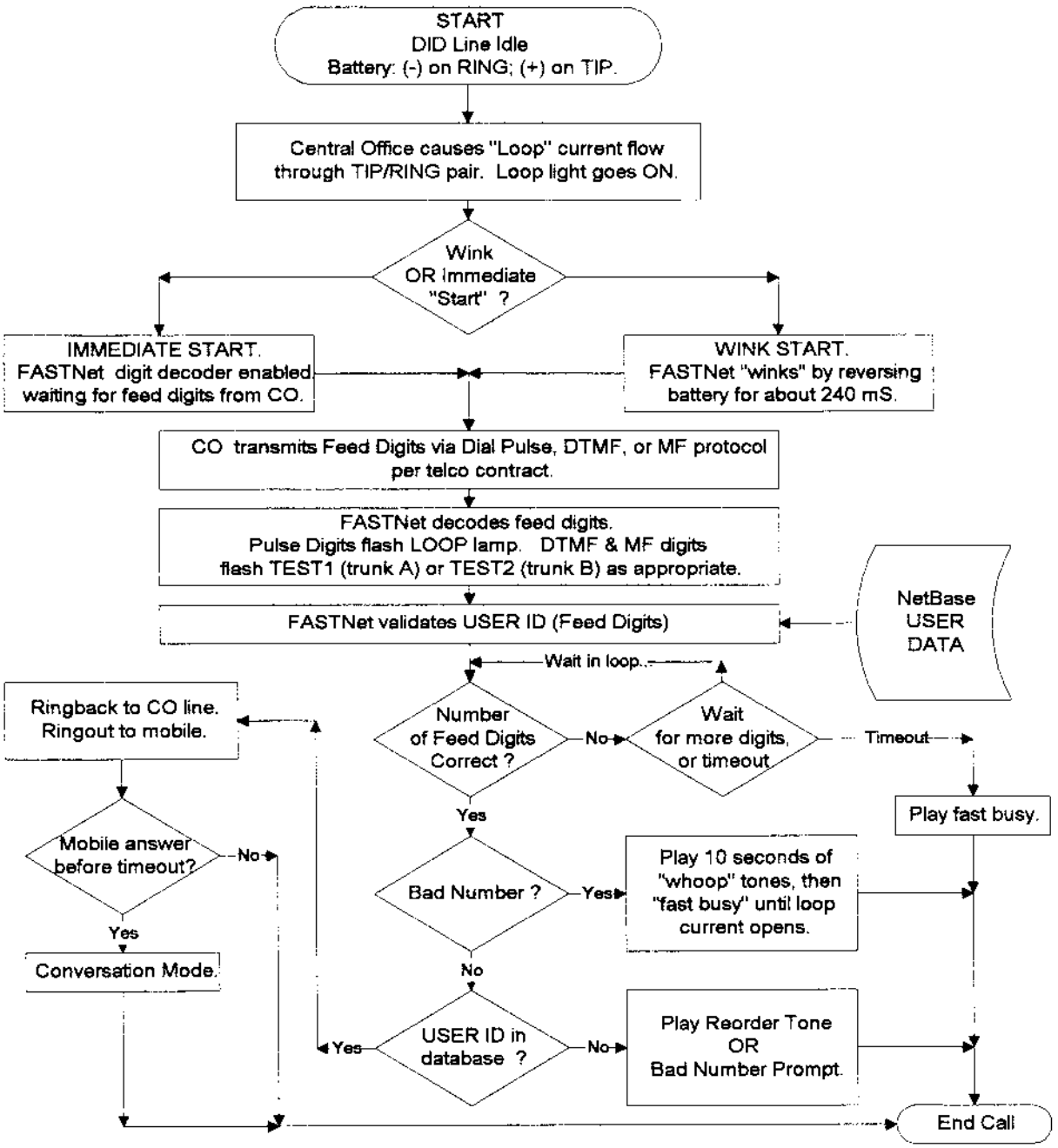
This subsection describes the sequence of events that occurs when a telephone caller attempts to access the FASTNet Switch. Start with the flowchart for your particular kind of telephone interface. Note that options, such as Call Saver Voice Messaging and System Voice Prompts with Client Personalized Greetings, alter the flowcharts in small ways.

The timing diagrams provided in this subsection illustrate the relations between the various interface signals of the trunk cards (Dual TELCO Card 702-9457 or Dual 4-Wire Card 702-9460 as applicable) and the Telco System. The names and the timing values are described in the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270). There are separate diagrams for each type of telephone circuit configuration.

Central Office DID (Selector Level)

The FASTNet Switch uses a Dual Telco DID trunk for this interface.

This is an *INBOUND-ONLY* dialing format ... CO → FASTNet



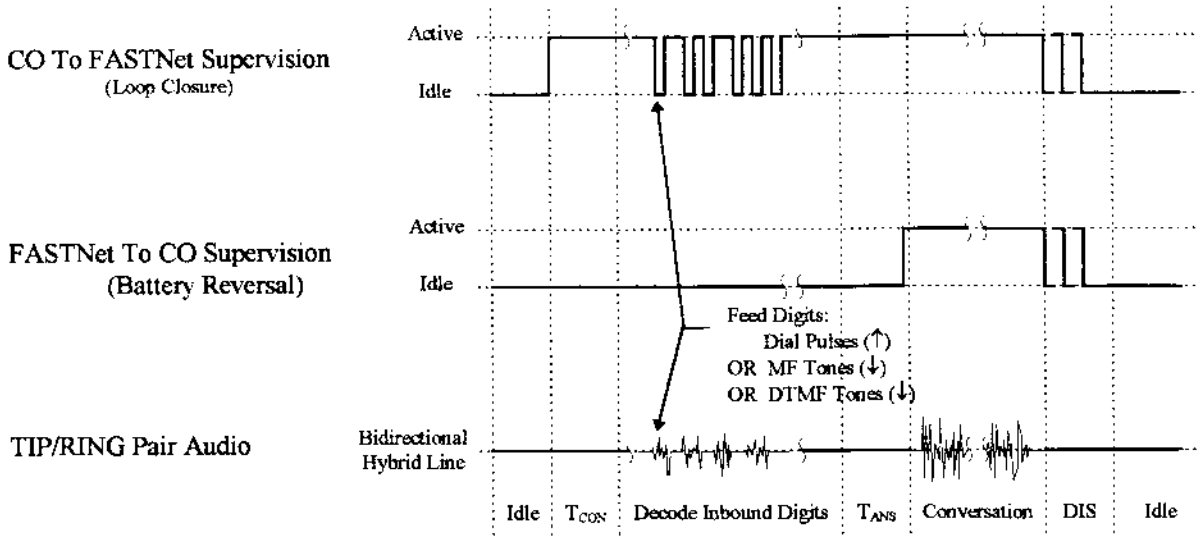


Figure 2-4: Central Office DID Interface Timing; Immediate Start

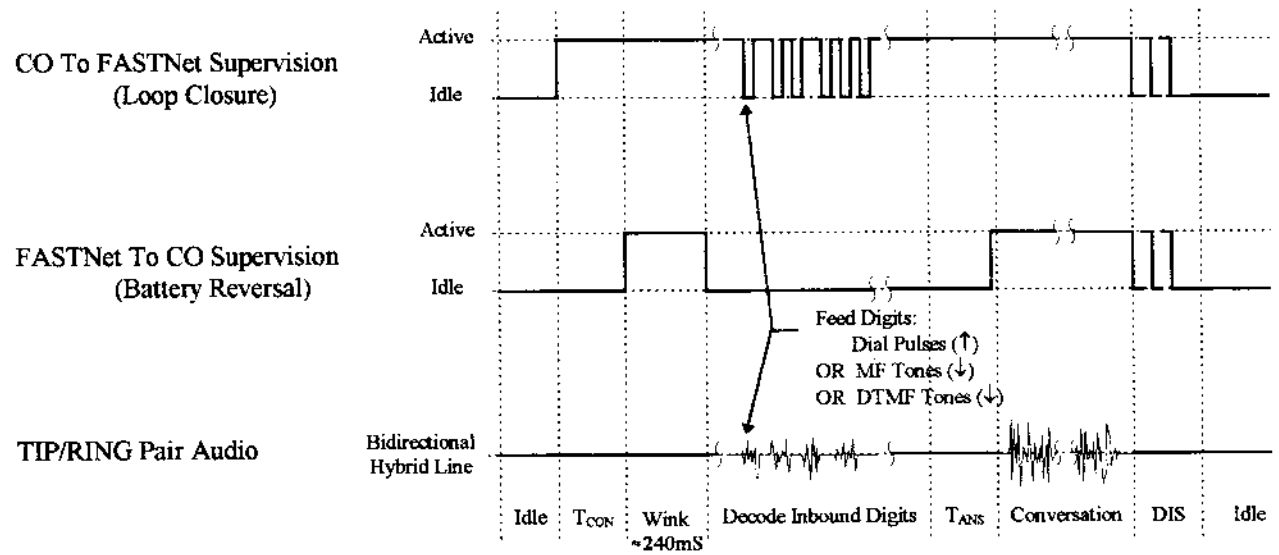


Figure 2-5: Central Office DID Interface Timing; Wink Start

Timebase Terms:

Idle: Line not in use.

T_{CON}: Connect Time; Interval between line seizure and commencement of Feed Digits.

Wink: 240 mS pulse to CO acknowledging CO supervision; Ready signal for Feed Digits. (120-310 mS)

Decode: Interval in which FASTNet receives *Dial Pulse, MF, or DTMF* Feed Digits from the CO.

T_{ANS}: Answer Time; ID *validation* Interval, proceed if valid; Ringout to dialed-trunk.

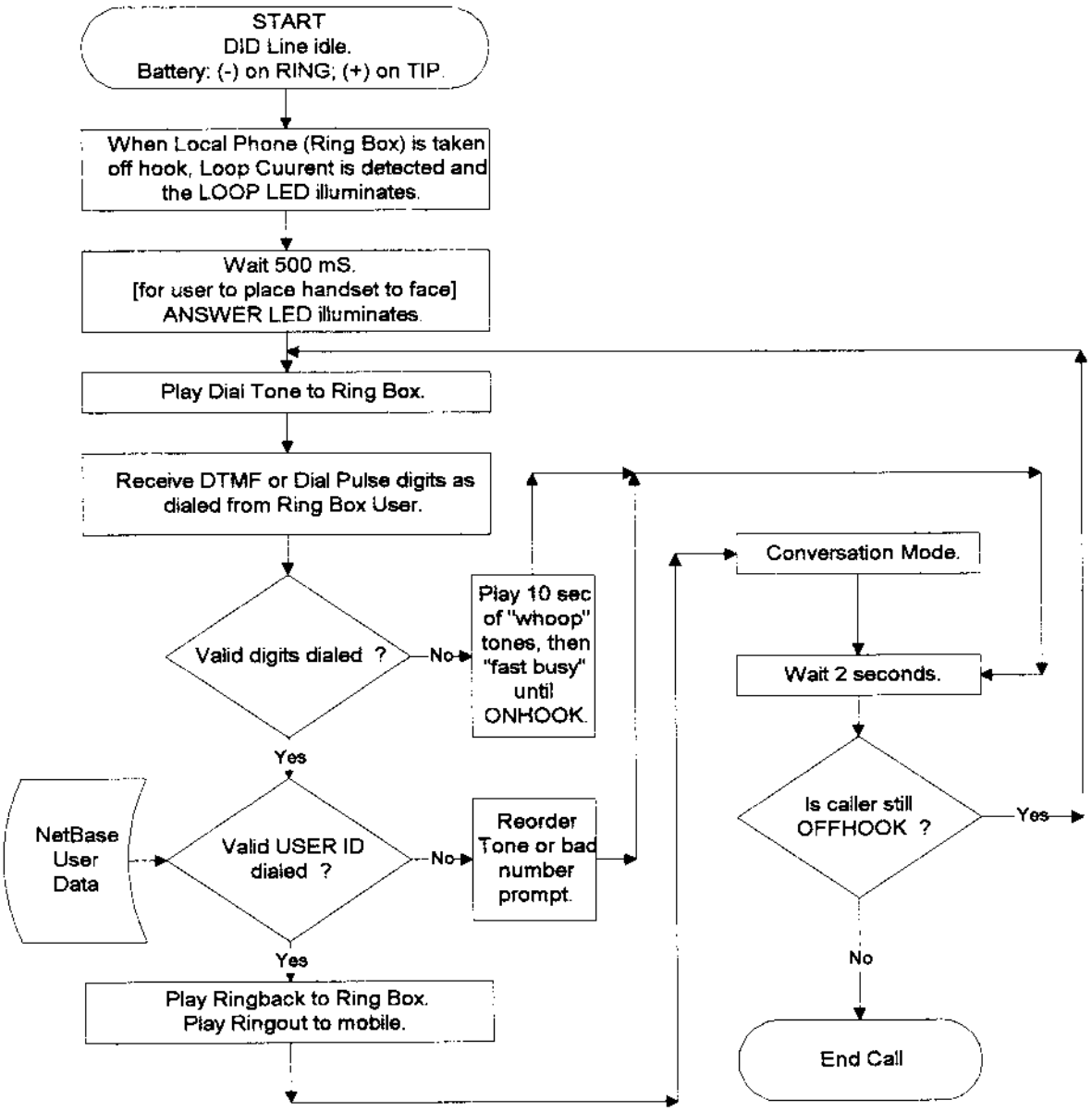
Conversation: Conversation Mode; DTMF overdialing and voice activities.

DIS: Disconnect; Either CO or FASTNet, or both, may open TIP/RING LOOP (>1550 mS) to end call.

Local Phone with Ringbox

The FASTNet Switch uses a Dual Telco DID trunk for this interface.

Inbound Call Sequence:



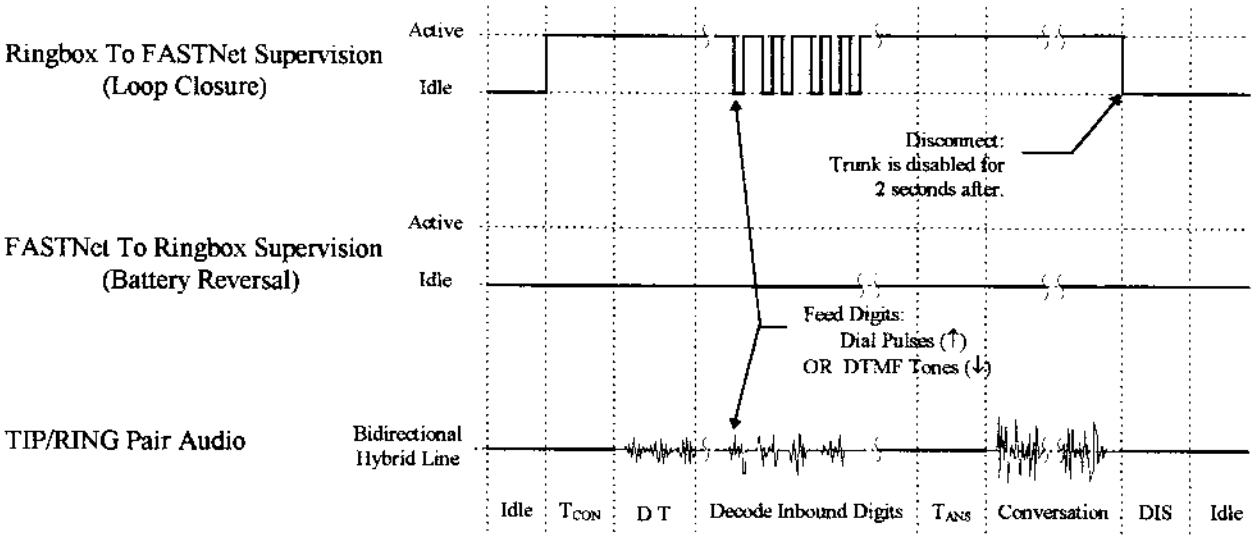


Figure 2- 6: Ringbox Inbound to FASTNet Timing

Timebase Terms:

Idle: Line not in use.

T_{CON}: Connect Time; Interval between line seizure and commencement of Feed Digits; (500 mS)

DT: DIAL TONE is generated to the Ringbox telephone equipment (Timing set in NetBasc).

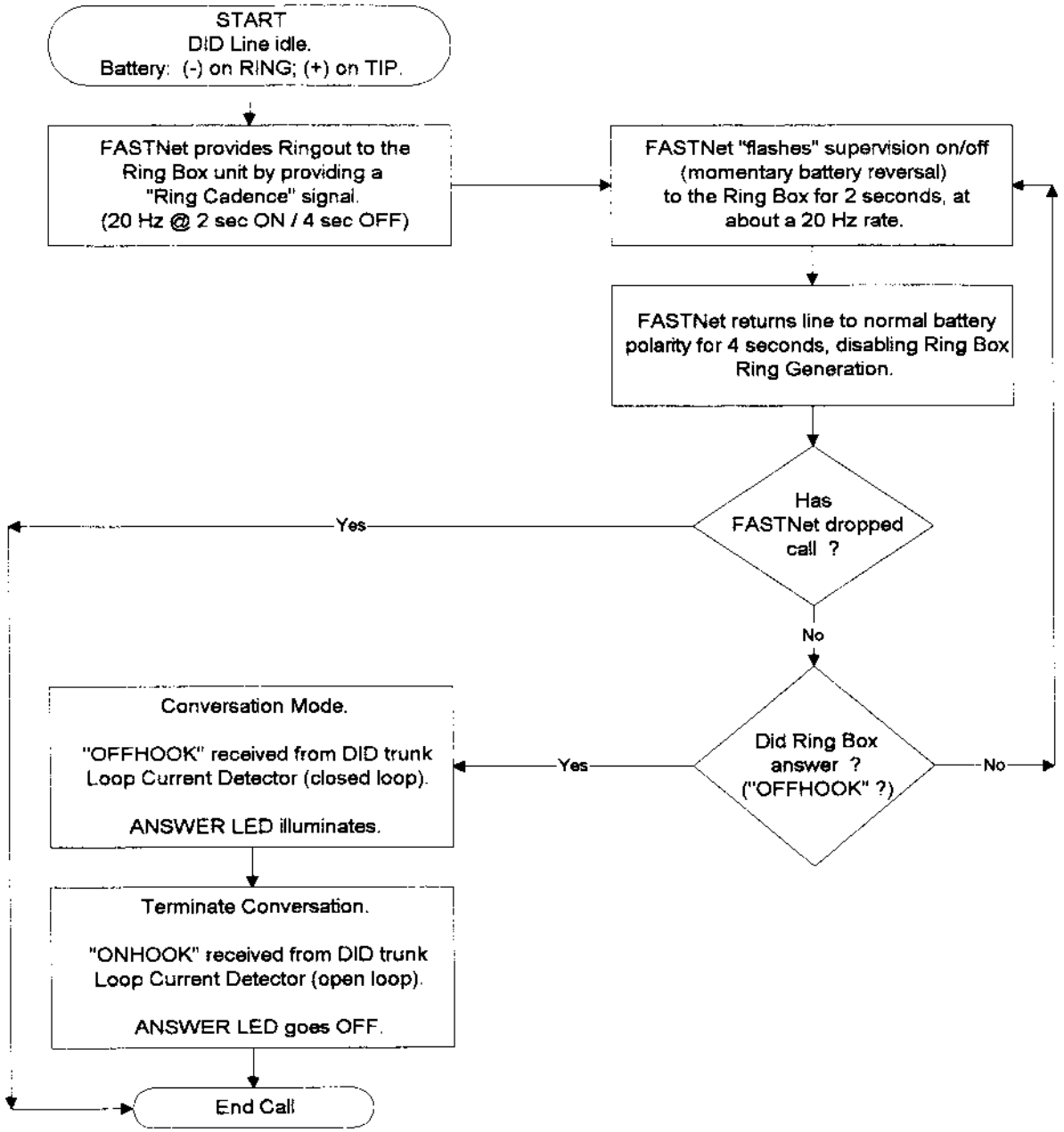
Decode: Interval in which FASTNet receives *Dial Pulse or DTMF* Dialed Digits from the Ringbox.

T_{ANS}: Answer Time; ID *validation* Interval, proceed if valid; Ringout to dialed-trunk.

Conversation: Conversation Mode; DTMF overdialing and voice activities.

DIS: Disconnect; Ringbox opens TIP/RING LOOP to end call.

Outbound Call Sequence:



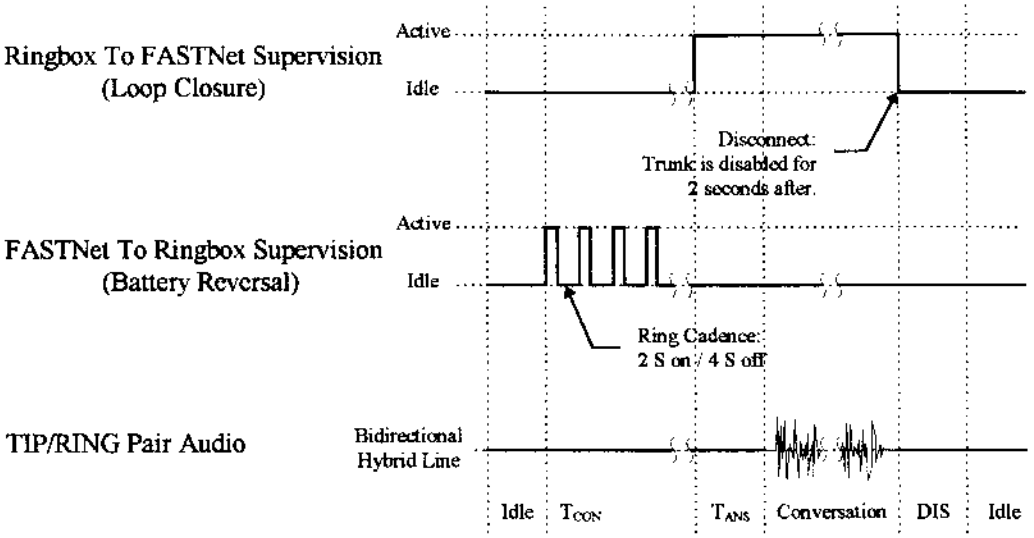


Figure 2-7: FASTNet Outbound to Ringbox Timing

Timebase Terms:

Idle: Line not in use.

T_{CON}: Connect Time; Interval in which FASTNet executes ringout (Ring Cadence signal, 2S on / 2S off) to the Ringbox.; Ringbox generates 20 Hz Ringing to telephone equipment during Cadence "on" cycle.

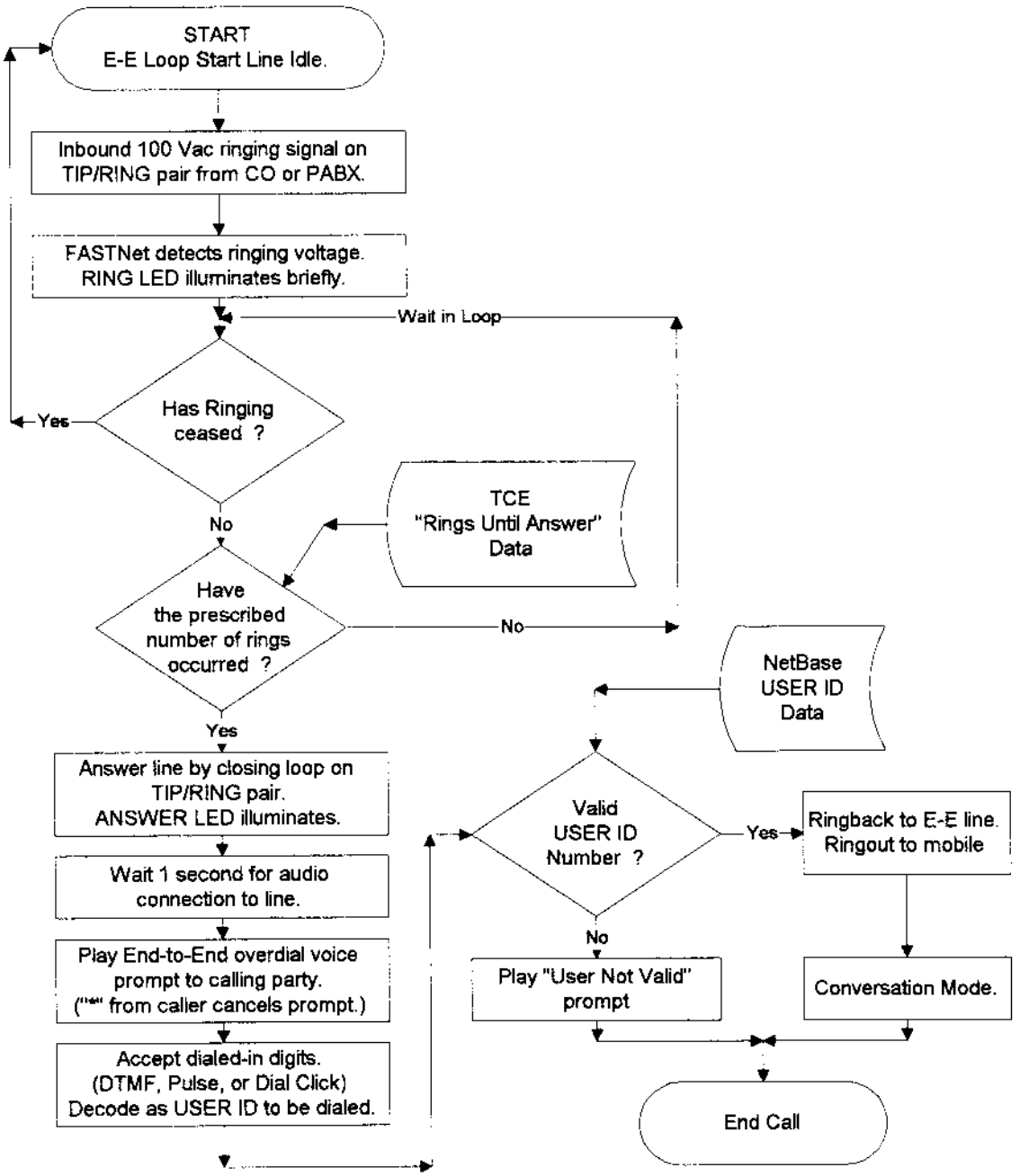
T_{ANS}: Answer Time; Ringbox telephone equipment goes OFF-HOOK.

Conversation: Conversation Mode; DTMF overdialing and voice activities.

DIS: Disconnect; Ringbox telephone equipment ON-HOOK and opens TIP/RING LOOP to end call.

End-to-End Loop Start (Central Office or PABX station)

Inbound Call Sequence:



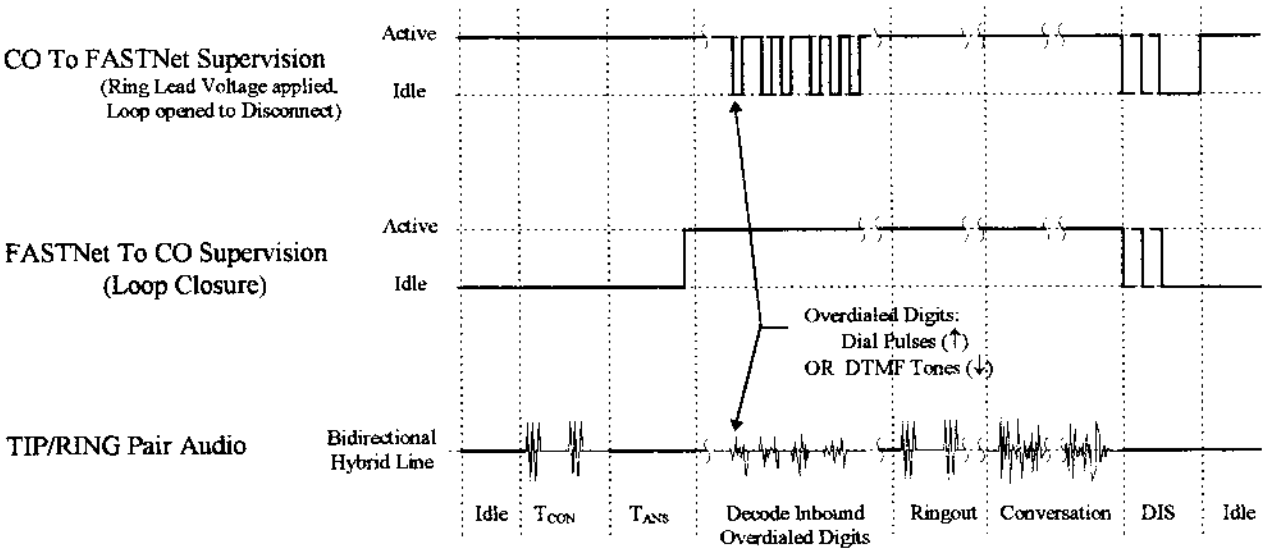


Figure 2-8: CO to FASTNet End-to-End (DOD) Loop Start Trunk; Timing

Timebase Terms:

Idle: Line not in use.

T_{CON}: Connect Time; Interval in which CO Rings FASTNet.

T_{ANS}: Answer Time; FASTNet Closes Loop to seize inbound call.

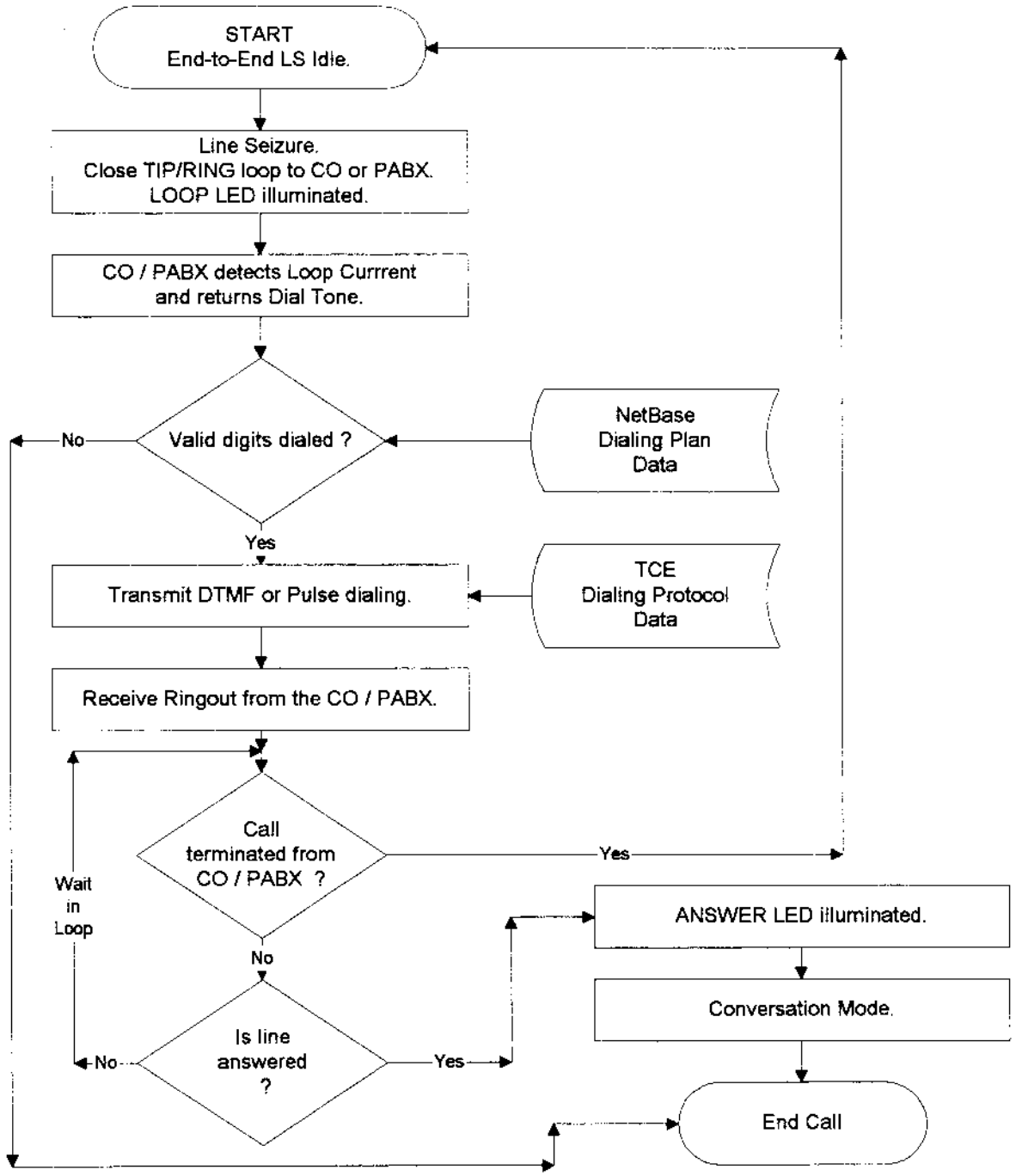
Decode: Interval in which FASTNet receives *Dial Pulse or DTMF* Digits from the CO.

Ringout: FASTNet connects destination trunk, and rings out to desired party.

Conversation: Conversation Mode; DTMF overdialing and voice activities.

DIS: Disconnect; Either CO or FASTNet, or both, may open TIP/RING LOOP (>1550 mS) to end call.

Outbound Call Sequence:



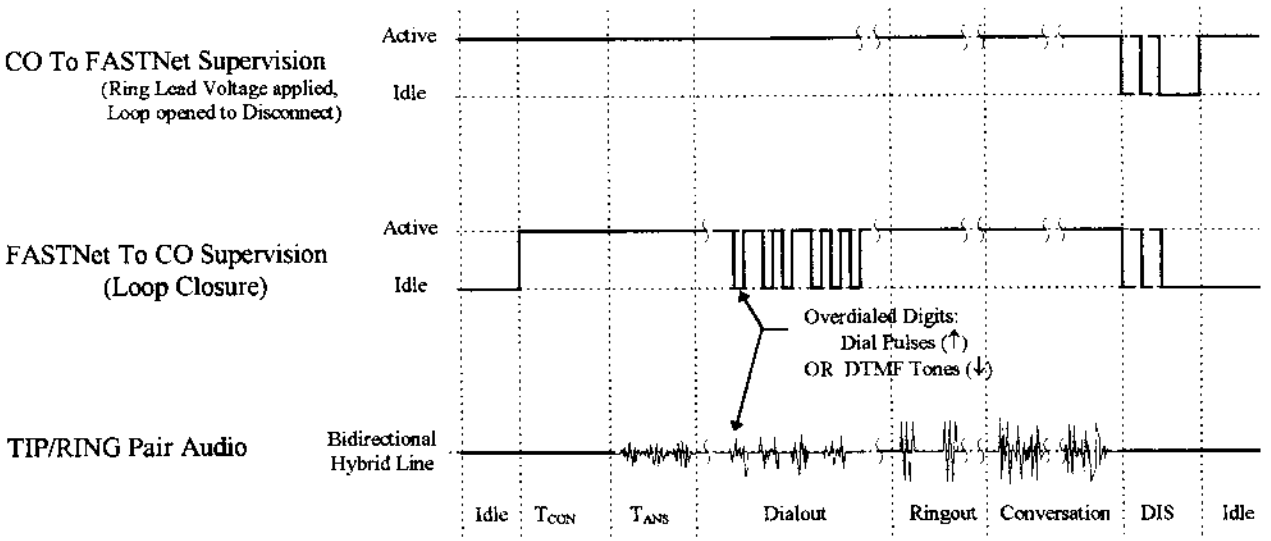


Figure 2-9: FASTNet to CO End-to-End (DOD) Loop Start Trunk; Timing

Timebase Terms:

Idle: Line not in use.

T_{CON}: Connect Time;FASTNet seizes line and awaits Dial Tone from CO.

T_{ANS}: Answer Time; CO returns Dial Tone to FASTNet.

Dialout: Interval in which FASTNet user overdials to the CO *(Dial Pulse or DTMF)*.

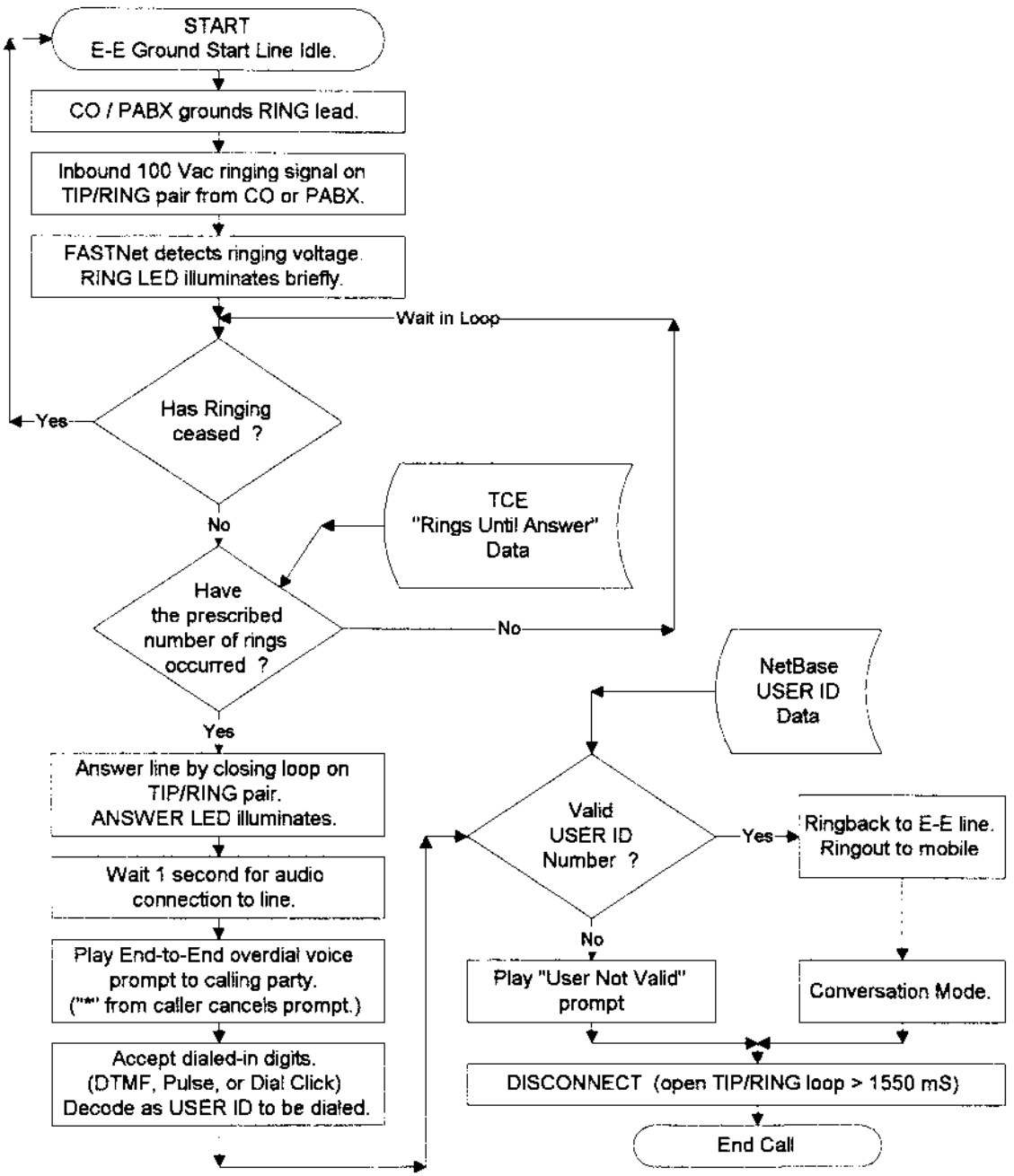
Ringout: CO rings dialed-trunk.

Conversation: Conversation Mode; DTMF overdialing and voice activities.

DIS: Disconnect; Either CO or FASTNet, or both, may open TIP/RING LOOP (>1550 mS) to end call.

End-to-End Ground Start (CO or PABX Trunk)

Inbound Call Sequence:



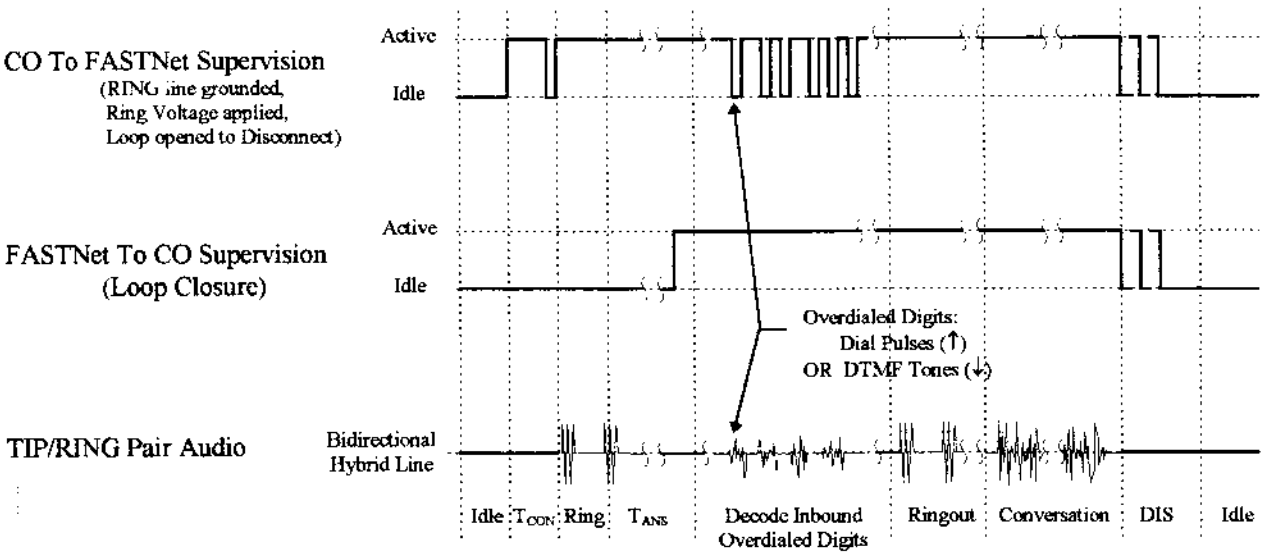


Figure 2-10: CO to FASTNet End-to-End Ground Start; Timing

Timebase Terms:

Idle: Line not in use; Loop closed at CO with battery applied to TIP/RING.

T_{CON}: Connect Time; Interval in which CO Grounds "RING" (≈400 mS) to FASTNet.

Ring: CO sends Ring voltage to FASTNet on TIP/RING pair.

T_{ANS}: Answer Time; FASTNet detects Ground Start pulse and/or Ring signal; Closes Loop to seize inbound call.

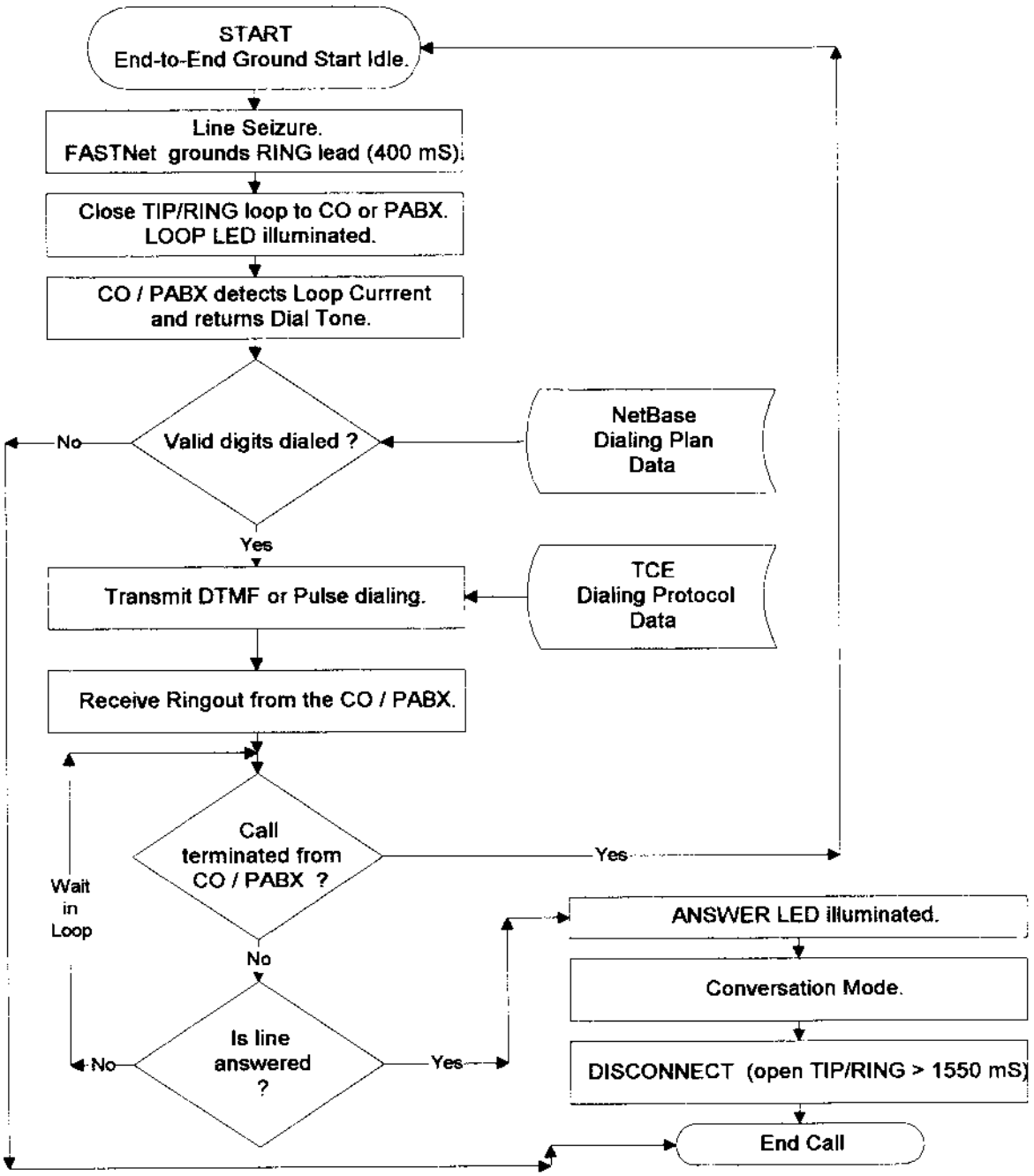
Decode: Interval in which FASTNet receives *Dial Pulse or DTMF* Digits from the CO.

Ringout: FASTNet connects destination trunk, and rings out to desired party.

Conversation: Conversation Mode; DTMF overdialing and voice activities.

DIS: Disconnect; Either CO or FASTNet, or both, may open TIP/RING LOOP (>1550 mS) to end call.

Outbound Call Sequence:



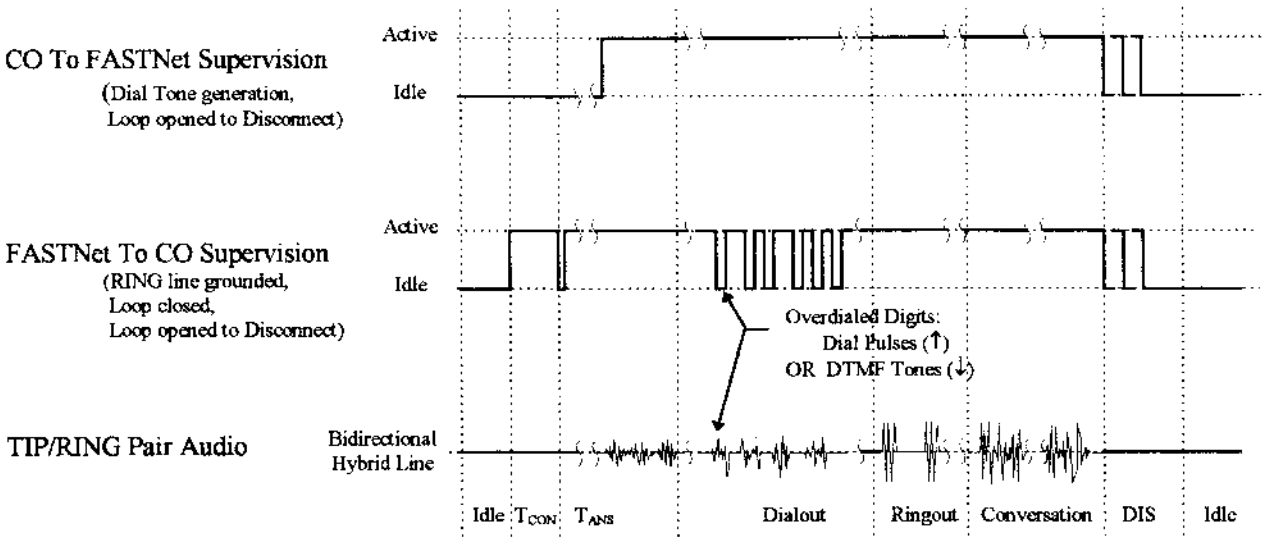


Figure 2-11: FASTNet to CO End-to-End Ground Start; Timing

Timebase Terms:

Idle: Line not in use. "Loop" closed at CO with battery applied.

T_{CON}: Connect Time; FASTNet grounds RING (≈400 mS) to seize line, closes TIP/RING LOOP, and awaits Dial Tone from CO.

T_{ANS}: Answer Time; Dial Tone returned from CO indicating 'ready' status.

Dialout: Interval in which FASTNet dials to the CO *(Dial Pulse or DTMF)*.

Ringout: CO rings dialed-trunk and provides ring audio on TIP/RING line.

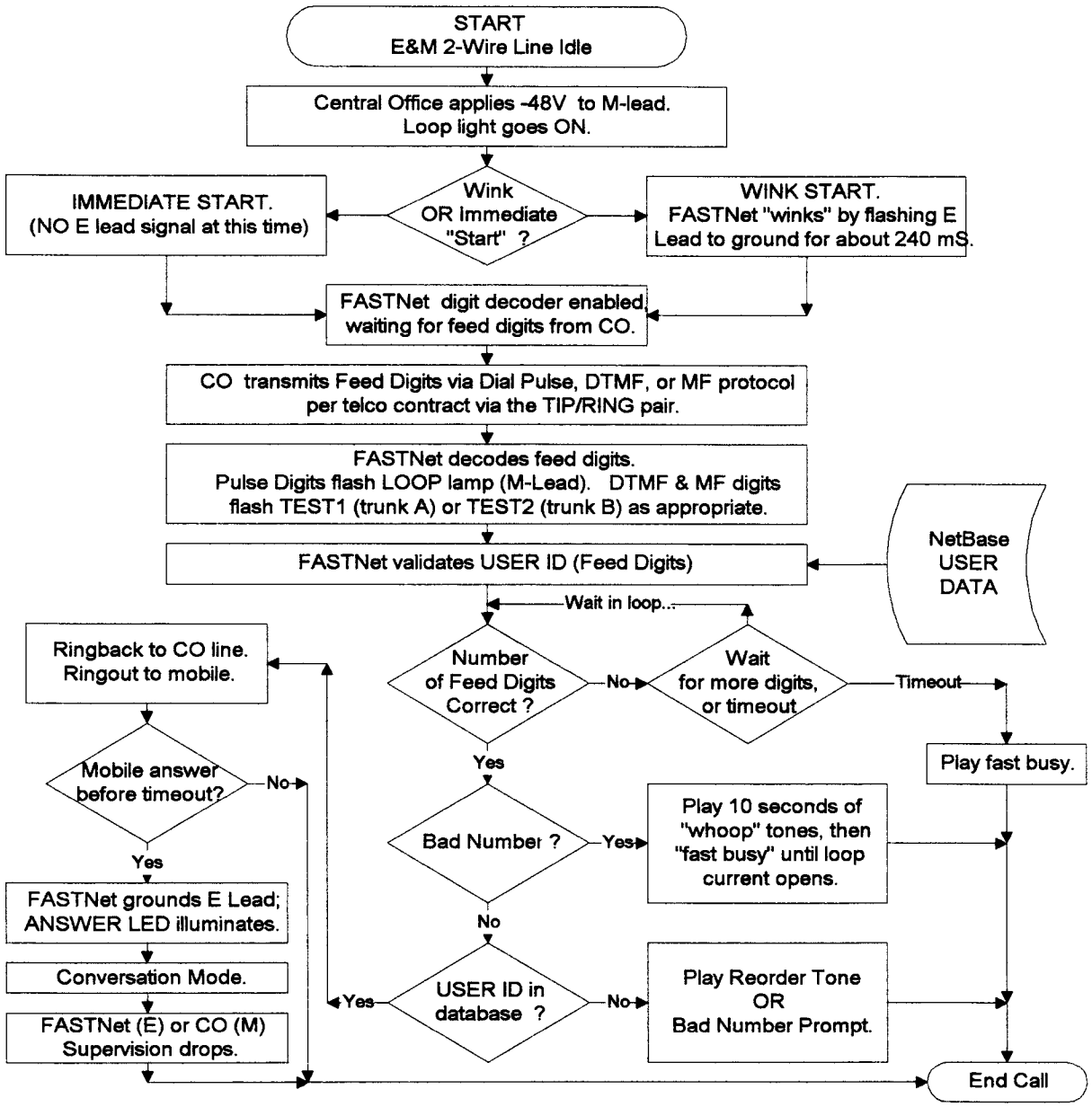
Conversation: Conversation Mode; DTMF overdialing and voice activities.

DIS: Disconnect; Either CO or FASTNet, or both, may open TIP/RING LOOP (>1550 mS) to end call.

CO or PABX Tie-Trunk, E&M 2-Wire

E&M 2-Wire trunks provide hybridized Type I interfaces, primarily for paging or control functions from the CO or PABX system, and utilize the Dual TELCO trunk card (702-9457).

Inbound Call Sequence:



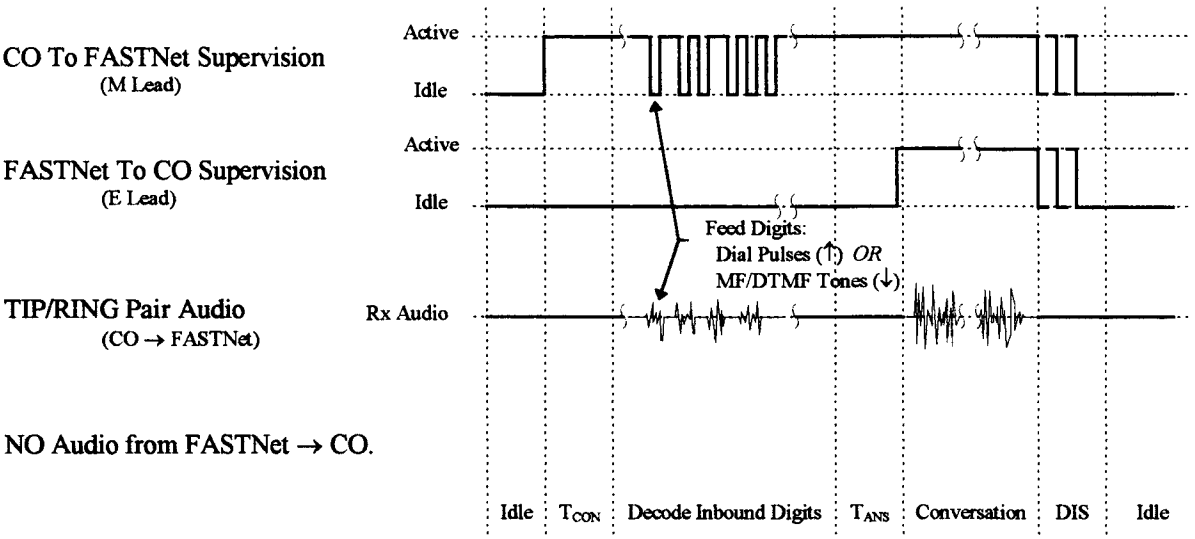


Figure 2-12: CO to FASTNet, E&M 2-Wire Immediate Start; Timing

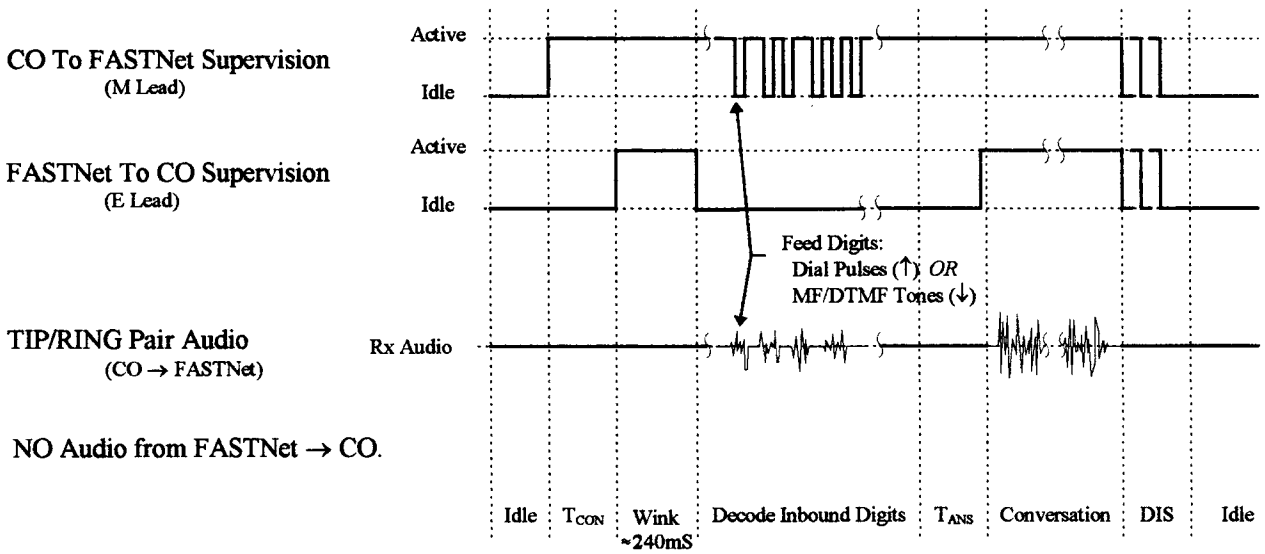


Figure 2-13: CO to FASTNet, E&M 2-Wire Wink Start; Timing

Timebase Terms:

Idle: Line not in use.

T_{CON}: Connect Time; Interval between line seizure and commencement of Feed Digits.

Wink: 240 mS pulse to CO acknowledging CO supervision; Ready signal for Feed Digits. (120-310 mS)

Decode: Interval in which FASTNet receives *Dial Pulse, MF, or DTMF* Feed Digits from the CO.

T_{ANS}: Answer Time; ID *validation* Interval, proceed if valid; Ringout to dialed-trunk.

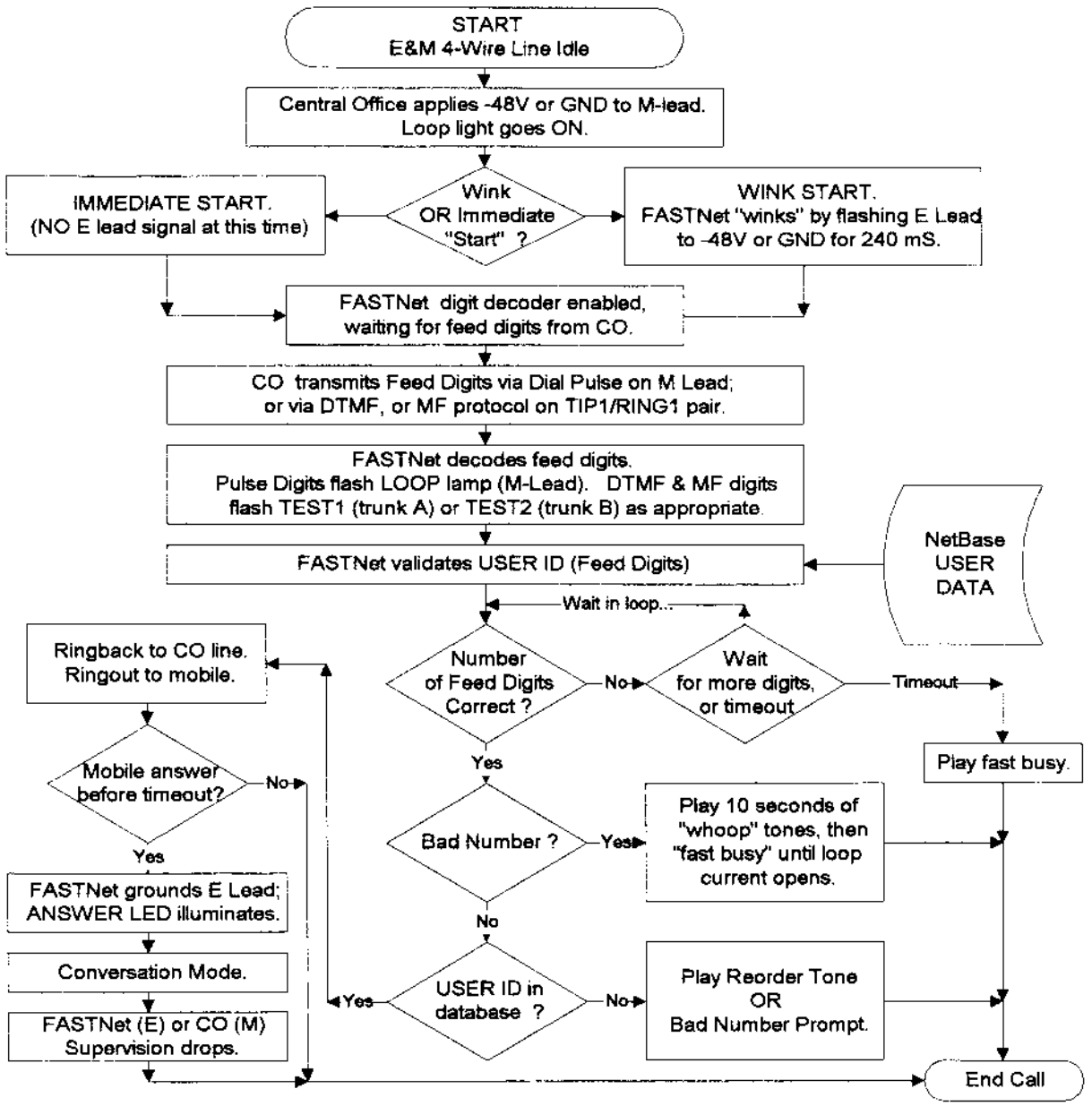
Conversation: Conversation Mode; DTMF overdialing and voice activities.

DIS: Disconnect; Either CO or FASTNet, or both, may open TIP/RING LOOP (>1550 mS) to end call.

CO or PABX Tie-Trunk, E&M 4-Wire

E&M 4-Wire trunks provide bi-directional audio Type I interfaces, normally used for radiotelephone interconnects to the CO or PABX. These utilize the Dual 4-Wire trunk card (702-9460).

Inbound Call Sequence:



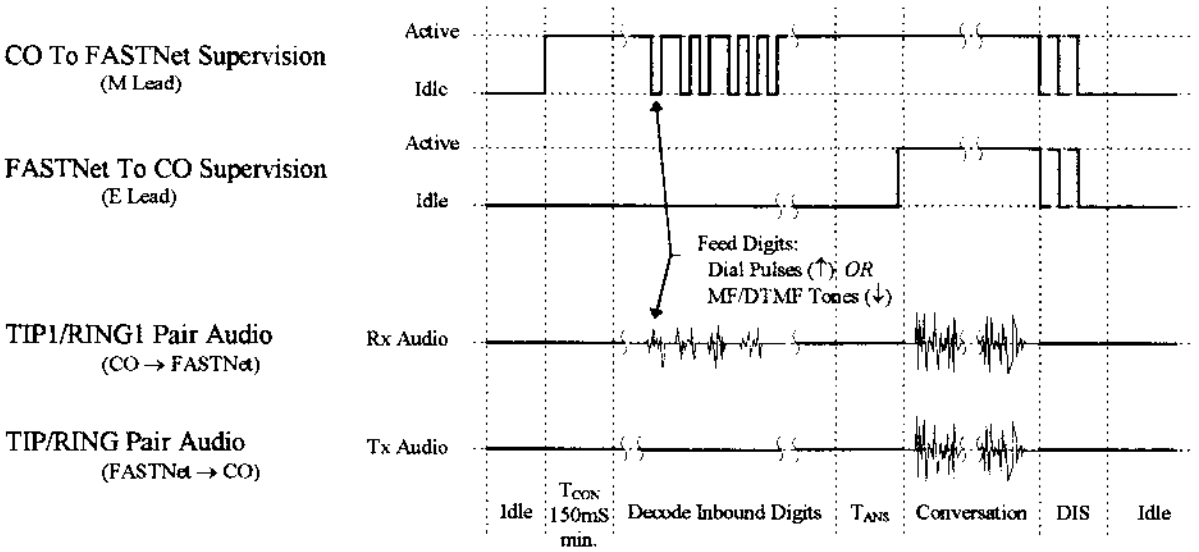


Figure 2-14: CO to FASTNet E&M 4-Wire, Immediate Start; Timing

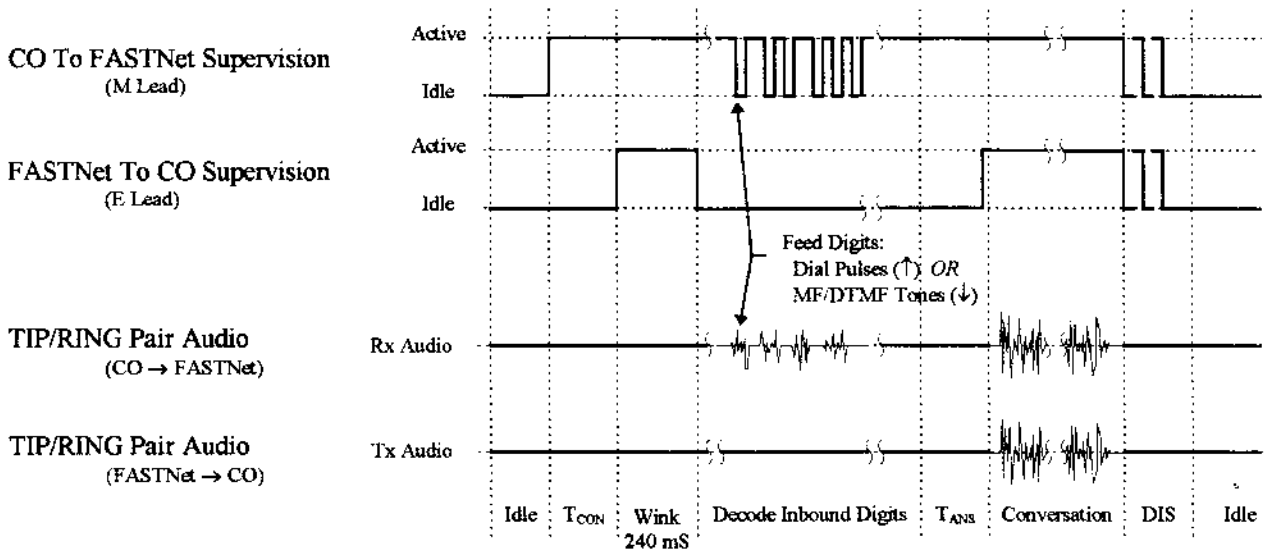


Figure 2-15: CO to FASTNet E&M 4-Wire, Wink Start; Timing

Timebase Terms:

Idle: Line not in use.

T_{CON}: Connect Time; Interval between line seizure and commencement of Feed Digits.

Wink: 240 mS pulse to CO acknowledging CO supervision; Ready signal for Feed Digits. (140-290 mS)

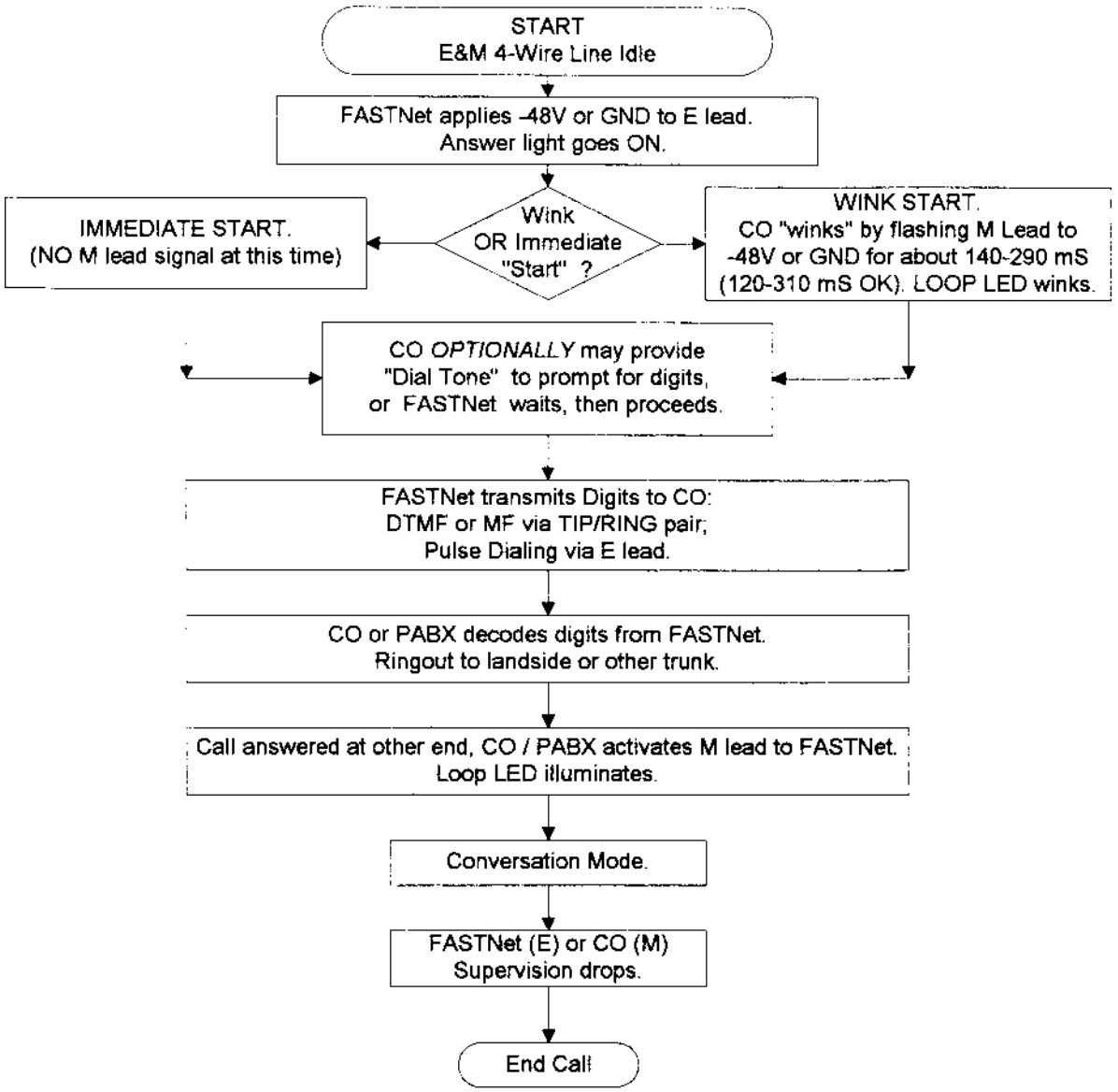
Decode: Interval in which FASTNet receives *Dial Pulse, MF, or DTMF* Feed Digits from the CO.

T_{ANS}: Answer Time; ID *validation* Interval, proceed if valid; Ringout to dialed-trunk.

Conversation: Conversation Mode; DTMF overdialing and voice activities.

DIS: Disconnect; Either CO or FASTNet, or both, open E/M Lead (>1550 mS) to end call.

Outbound Call Sequence:



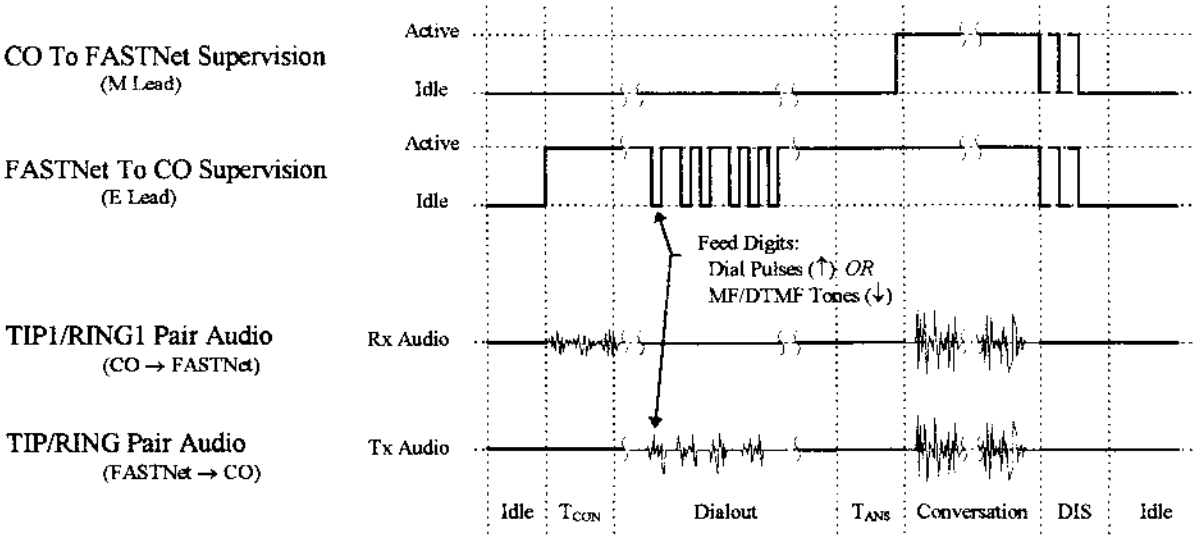


Figure 2-16: FASTNet to CO E&M 4-Wire, Immediate Start; Timing

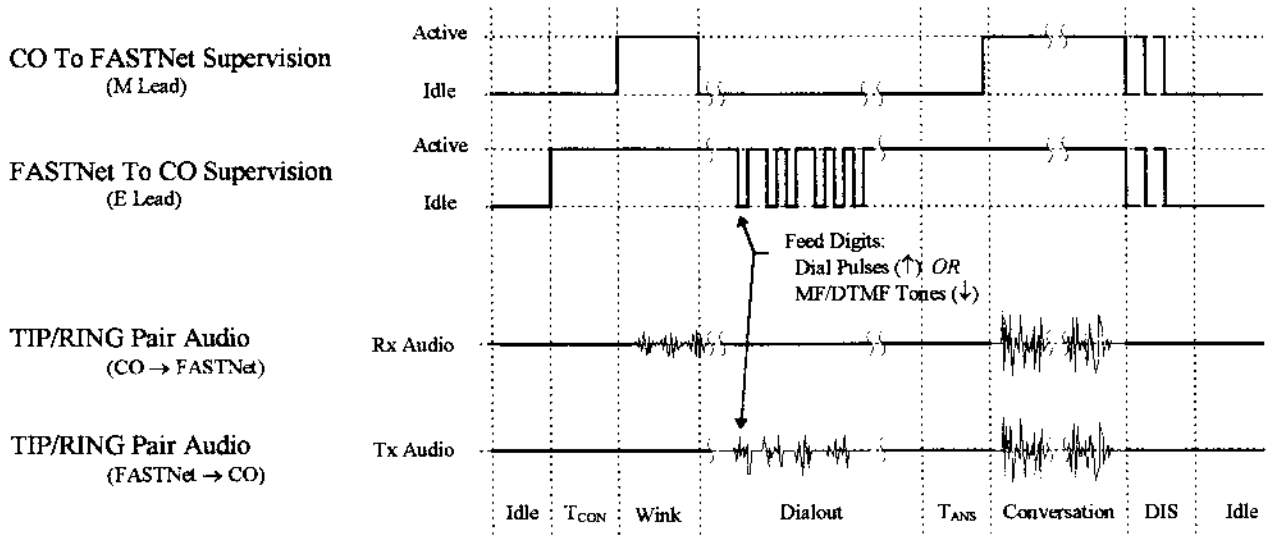


Figure 2-17: FASTNet to CO E&M 4-Wire, Wink Start; Timing

Timebase Terms:

Idle: Line not in use.

T_{CON}: Connect Time; Interval between line seizure and commencement of Feed Digits.

Wink: 140-290 mS pulse *from* CO (120-310 mS accepted);Ready signal for digit feed.

Dialout: Interval in which FASTNet sends *Dial Pulse, MF, or DTMF* Digits to the CO.

T_{ANS}: Answer Time; ID *validation* Interval, proceed if valid; Ringout to dialed-trunk.

Conversation: Conversation Mode; DTMF overdialing and voice activities.

DIS: Disconnect; Either CO or FASTNet, or both, open E/M Lead (>1550 mS) to end call.

Model 49 E&M 4-Wire Interface

This interface is applicable to the Zetron Model 49 Repeater Manager when interfaced to the FASTNet Switch via a Dual 4-Wire (702-9460) trunk card. Only Model 49 units having a Main Board (702-9202) Revision H or above can interface with FASTNet. These units require version 6+ firmware to communicate with FASTNet.

This is also applicable to the Uniden MRS804ZX Repeater. All "ZX" repeaters will interface with FASTNet. Version 6+ firmware is required.

Inbound Call Sequence:

Note: The flow chart for the Inbound Call Sequence is on the following page.

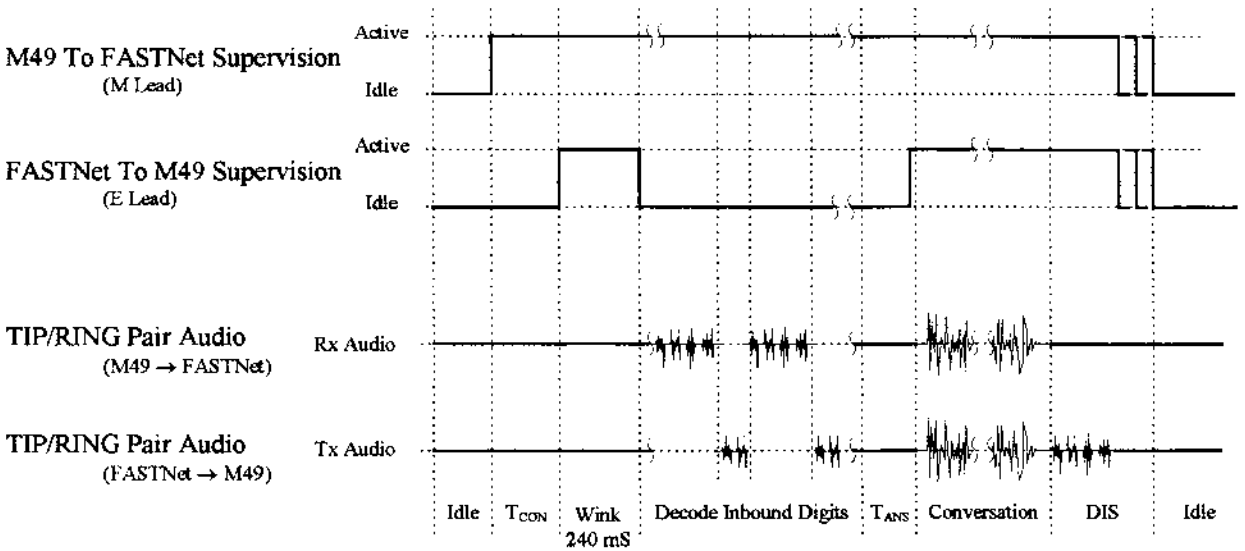
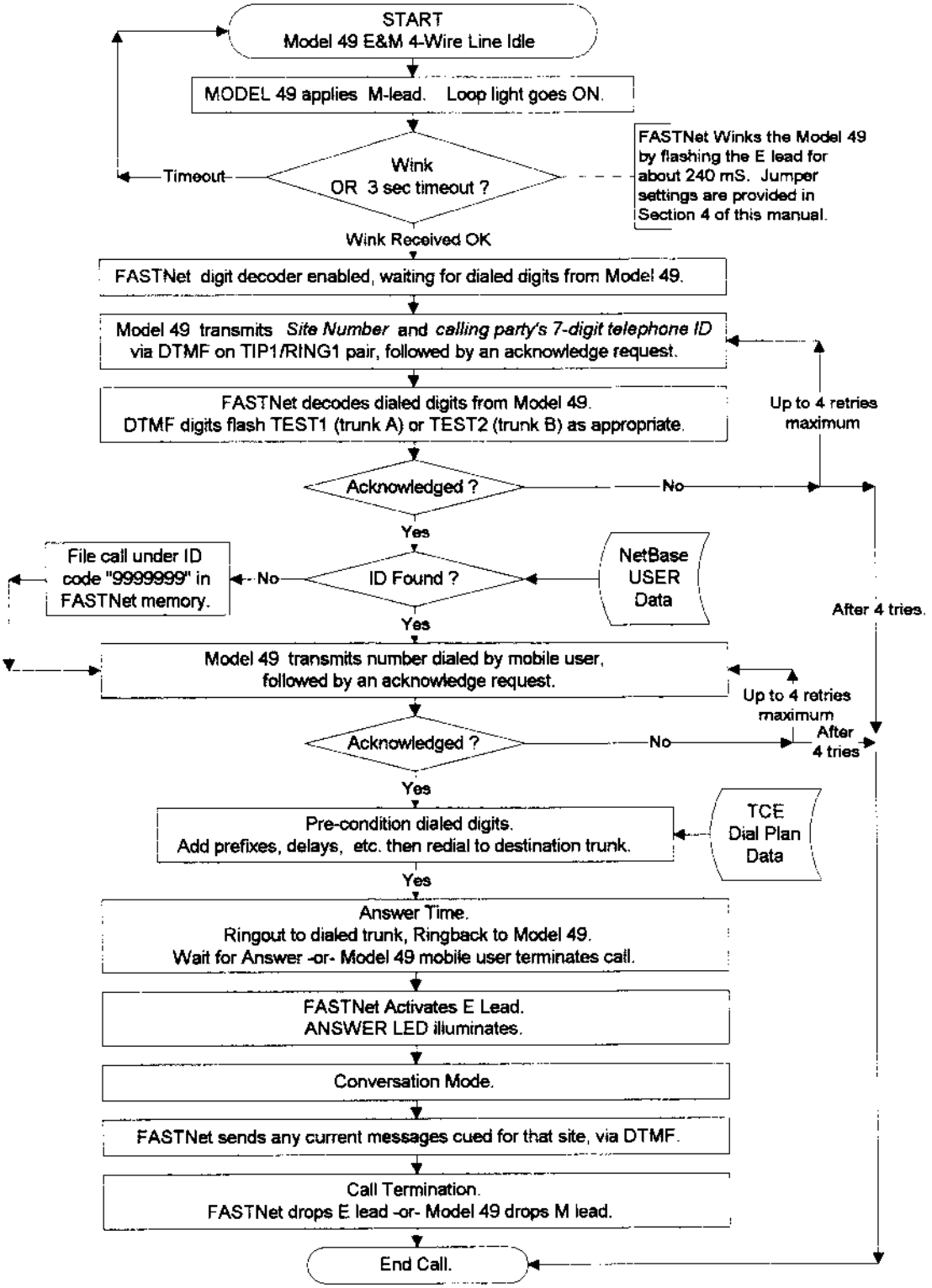


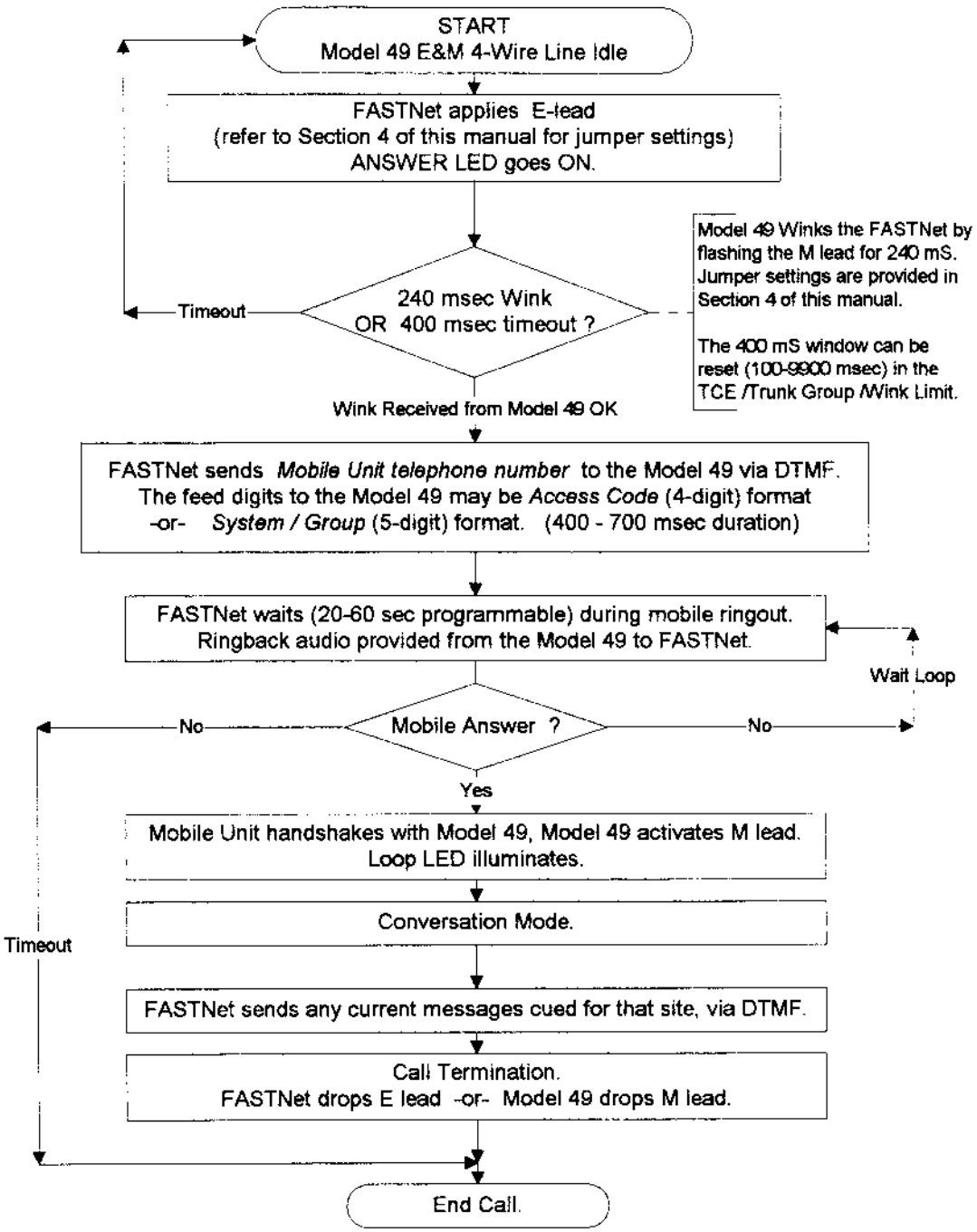
Figure 2-18: Model 49 to FASTNet Interface (E&M 4-Wire); Timing

Timebase Terms:

Idle:	Line not in use.
T_{CON}:	Connect Time; Interval between line seizure and commencement of Feed Digits.
Wink:	240 mS pulse to M49 acknowledging M49 supervision; Ready signal for DTMF Digits.
Decode:	Interval in which FASTNet receives *DTMF* Feed Digits from the Model 49 or MRS804ZX. M49 sends Site #, and Mobile ID, FASTNet acknowledges, M49 sends dialed-digits, FASTNet acknowledges.
T_{ANS}:	Answer Time; Ringout to dialed-trunk.
Conversation:	Conversation Mode; DTMF overdialing and voice activities.
DIS:	Disconnect; Either CO or FASTNet, or both, open E/M Lead (>1550 mS) to end call.


START
Model 49 E&M 4-Wire Line Idle
MODEL 49 applies M-lead. Loop light goes ON.
Wink
OR 3 sec timeout ?
Timeout
FASTNet Winks the Model 49 by flashing the E lead for about 240 mS. Jumper settings are provided in Section 4 of this manual.
Wink Received OK
FASTNet digit decoder enabled, waiting for dialed digits from Model 49.
Model 49 transmits Site Number and calling party's 7-digit telephone ID via DTMF on TIP1/RING1 pair, followed by an acknowledge request.
FASTNet decodes dialed digits from Model 49.
DTMF digits flash TEST1 (trunk A) or TEST2 (trunk B) as appropriate.
Up to 4 retries maximum
Acknowledged ?
No
Yes
ID Found ?
No
File call under ID code "9999999" in FASTNet memory.
NetBase USER Data
After 4 tries.
Yes
Model 49 transmits number dialed by mobile user, followed by an acknowledge request.
Up to 4 retries maximum
Acknowledged ?
No
After 4 tries
Yes
Pre-condition dialed digits.
Add prefixes, delays, etc. then redial to destination trunk.
TCE Dial Plan Data
Yes
Answer Time.
Ringout to dialed trunk, Ringback to Model 49.
Wait for Answer -or- Model 49 mobile user terminates call.
FASTNet Activates E Lead.
ANSWER LED illuminates.
Conversation Mode.
FASTNet sends any current messages cued for that site, via DTMF.
Call Termination.
FASTNet drops E lead -or- Model 49 drops M lead.
End Call.

Outbound Call Sequence:



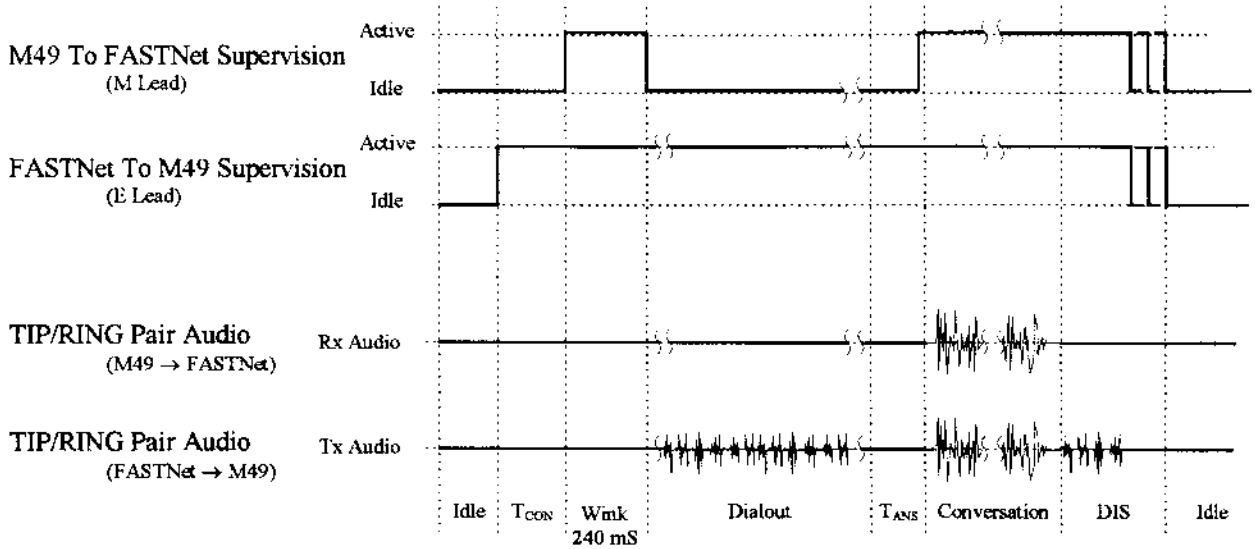


Figure 2-19: FASTNet to Model 49 Interface (E&M 4-Wire); Timing

Timebase Terms:

Idle: Line not in use.

T_{CON}: Connect Time; Interval between line seizure and commencement of Feed Digits.

Wink: 240 mS pulse to M49 acknowledging M49 supervision; Ready signal for DTMF Digits.

Dialout: Interval in which FASTNet dials *DTMF* Digits to the Model 49 or MRS804ZX.

T_{ANS}: Answer Time; Ringout to dialed-trunk; 20 - 60 Seconds programmable maximum.

Conversation: Conversation Mode; DTMF overdialing and voice activities.

DIS: Disconnect; Either CO or FASTNet, or both, open E/M Lead (>1550 mS) to end call.

TELCO HARDWARE DESCRIPTION

The interface signals between the telephone switching system (TELCO CO, PABX, RF Link, Microwave Link, etc.) and the Model 2540 are used for different purposes on different types of circuitry. The text and drawings in this subsection describe the signal usages for each TELCO type.

Central Office DID (Selector Level)

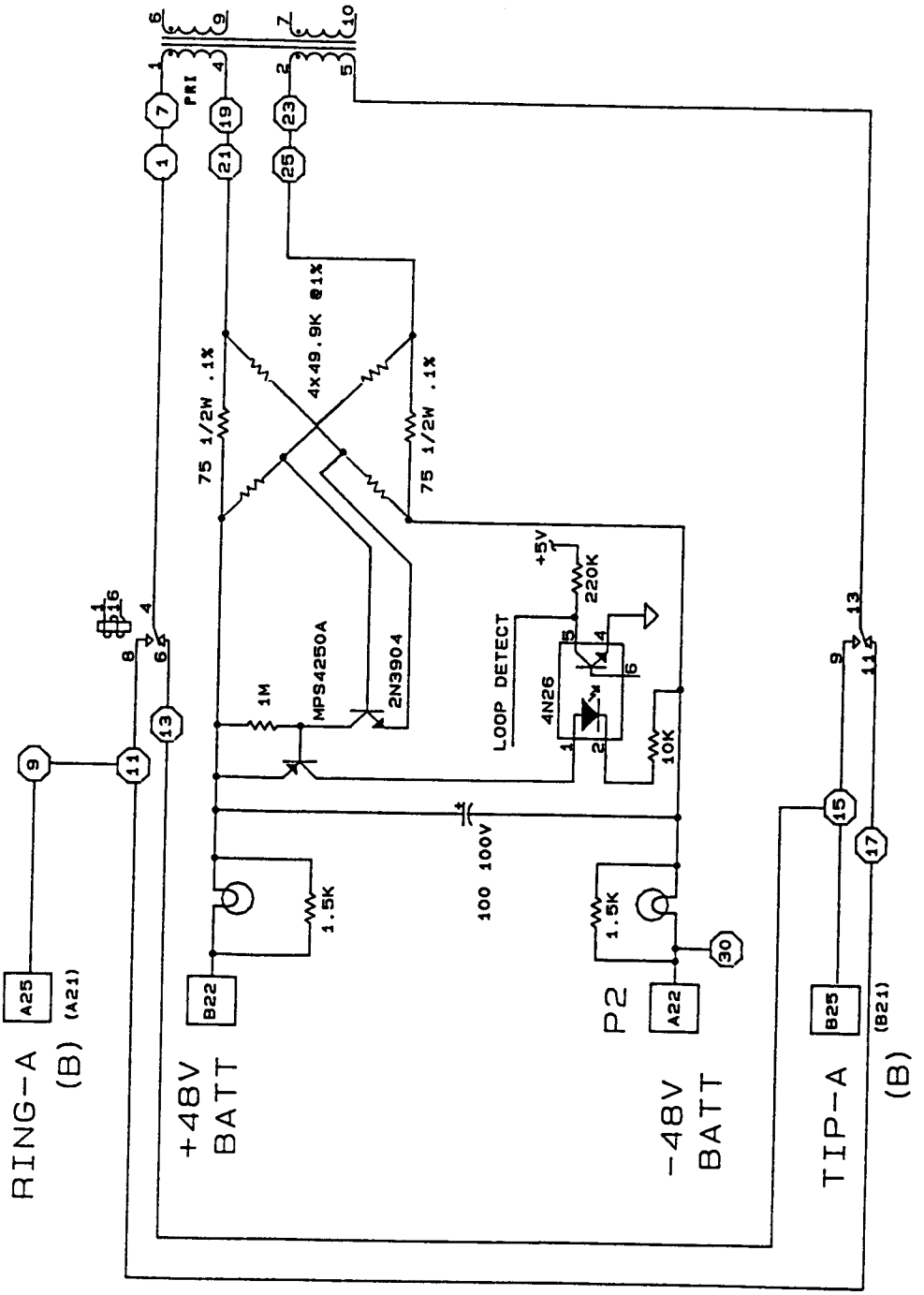
This configuration requires half of a Dual TELCO Card (702-9457).

Please refer to the drawing on the opposite page.

Note: The answer relay is shown in idle condition in this drawing (no call in progress).

Signal Name	Function
RING	Paired with TIP signal / wire. Carries loop current for circuit supervision and balanced audio signal.
TIP	Paired with RING signal / wire. Carries loop current for circuit supervision and balanced audio signal.
(+) 48V Batt	From external power supply and provided to TELCO line.
(-) 48V Batt	From external power supply and provided to TELCO line.
Chassis Gnd	Reference earth ground.
RING 1	Not Used
TIP 1	Not Used
E	Not Used
M	Not Used

DID Configuration (024-0010A)



Central Office End-to-End, Loop Start

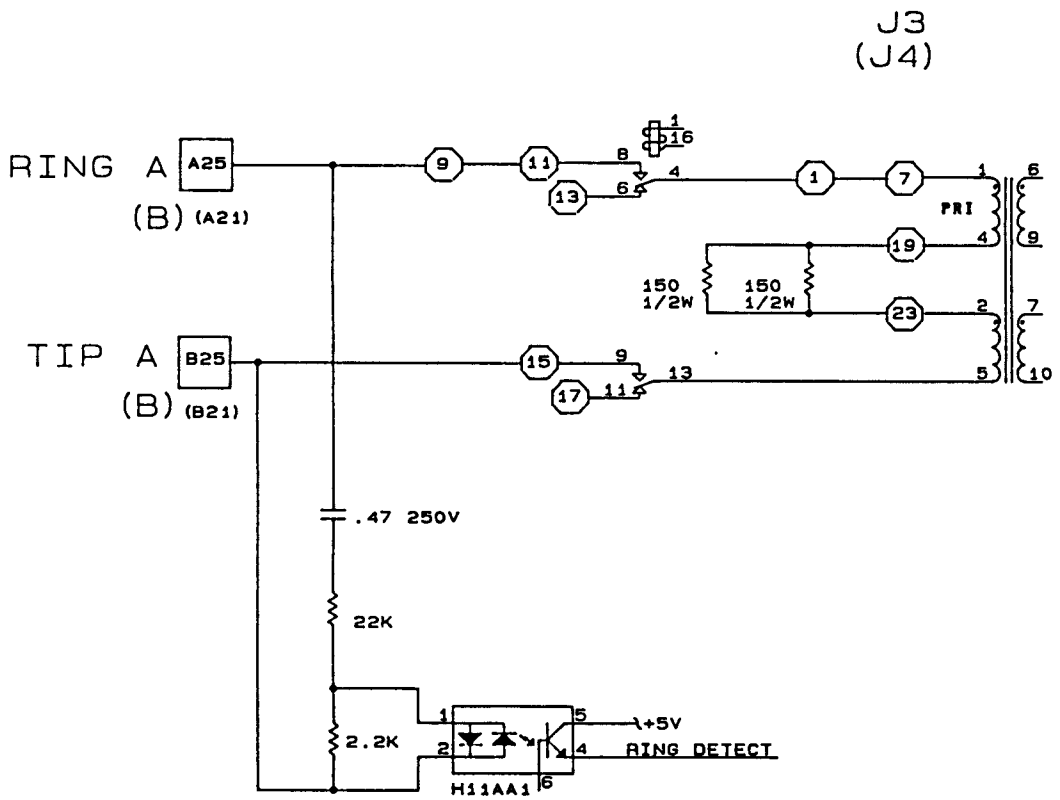
This configuration requires half of a Dual TELCO Card (702-9457).

Please refer to the drawing on the opposite page.

Note: The answer relay is shown in idle condition in this drawing (no call in progress).

Signal Name	Function
RING	Paired with TIP signal / wire. Carries 105 V_{AC} ringing voltage, loop current for circuit supervision, and balanced audio signaling.
TIP	Paired with RING signal / wire. Carries 105 V_{AC} ringing voltage, loop current for circuit supervision, and balanced audio signaling.
Chassis Ground	Reference earth ground.
RING1	Not Used
TIP1	Not Used
E	Not Used
M	Not Used

End-to-End Configuration (024-0009A)



Central Office End-to-End, Ground Start

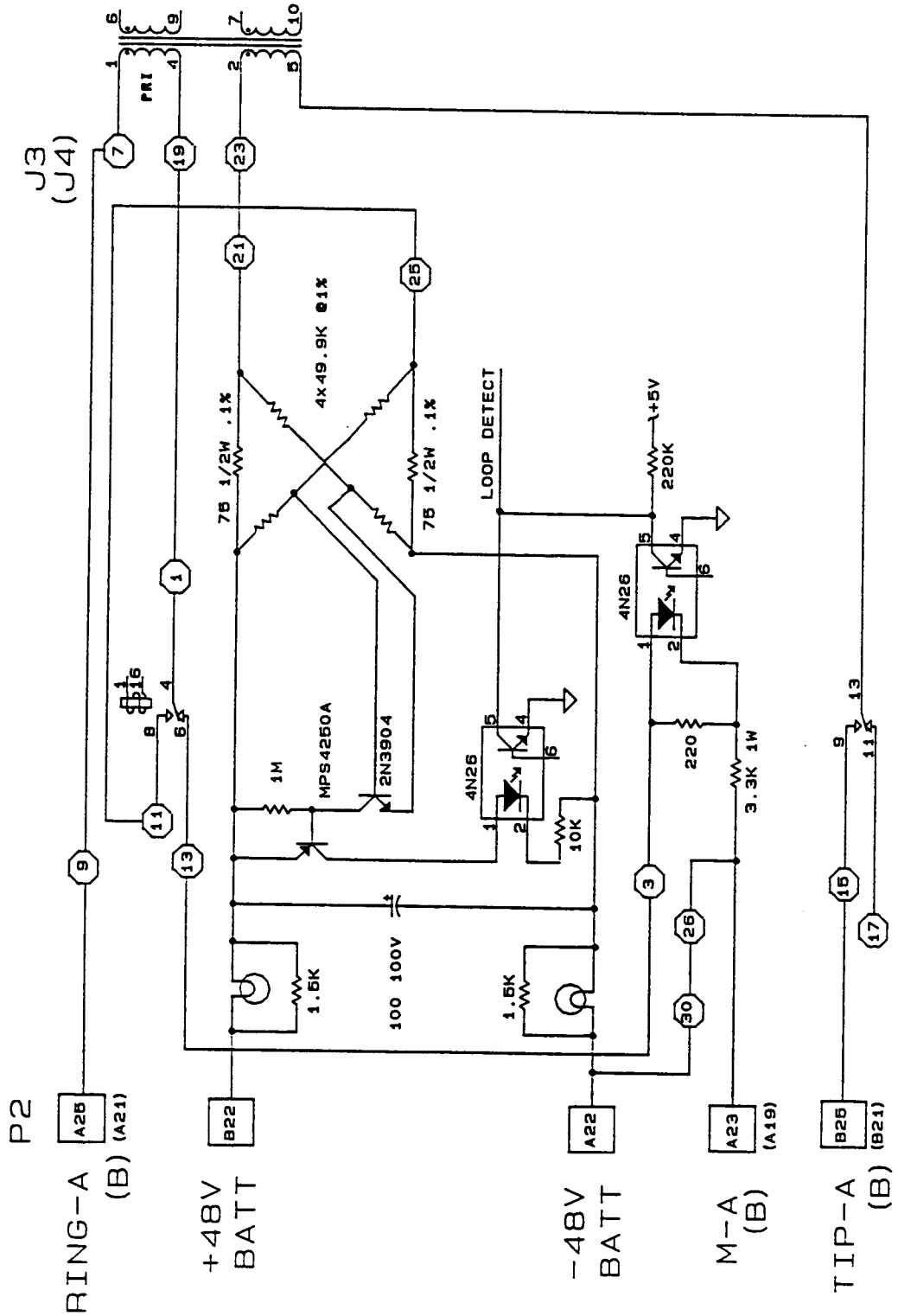
This configuration requires half of a Dual TELCO Card (702-9457).

Please refer to the drawing on the opposite page.

Note: The answer relay is shown in idle condition in this drawing (no call in progress).

Signal Name	Function
RING	Paired with TIP signal / wire. Carries 105 V_{AC} ringing voltage, loop current for circuit supervision, and balanced audio signaling.
TIP	Paired with RING signal / wire. Carries 105 V_{AC} ringing voltage, loop current for circuit supervision, and balanced audio signaling.
(+) 48 V Batt	From external power supply and provided to TELCO line.
(-) 48 V Batt	From external power supply and provided to TELCO line.
Chassis Ground	Reference earth ground.
RING1	Not Used
TIP1	Not Used
E	Not Used
M	Not Used; -48 V_{DC} applied here from Model 2540

Ground Start Configuration (024-0012A)



PABX E&M Type I Tie-Trunk (2-Wire Audio)

This configuration requires half of a Dual TELCO Card (702-9457).

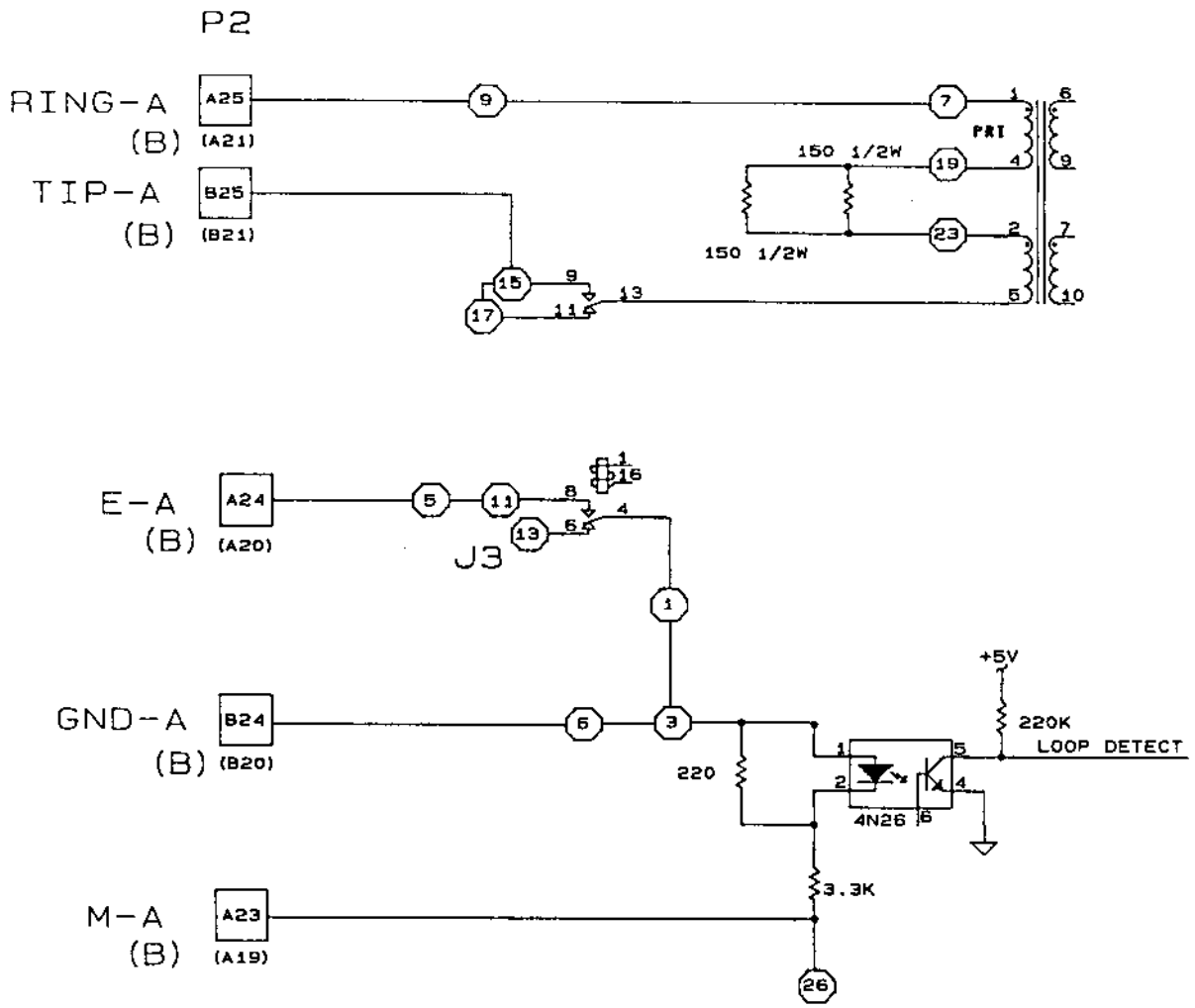
Please refer to the drawing on the opposite page.

Note 1: The answer relay is shown in idle condition in this drawing (no call in progress).

Note 2: This is a two-wire audio, E&M interface only. For 4-Wire E&M interfacing, use the Dual 4-Wire trunk card (702-9460).

Signal Name	Function
RING	Paired with TIP signal / wire. Carries balanced audio signaling to/from FASTNet.
TIP	Paired with RING signal / wire. Carries balanced audio signaling to/from FASTNet.
Chassis Ground	Reference earth ground. Carries return current for Type I E&M signals.
RING1	Not Used
TIP1	Not Used
E	TELCO "E" Lead as defined by TELCO end of the line. Ground referenced control line *TO TELCO* for call supervision.
M	TELCO "M" Lead as defined by TELCO end of the line. Ground referenced control line *FROM TELCO* for call supervision.

E&M 2-Wire Configuration (024-0011A)



E&M 4-Wire Type I - Using Rev A Audio Daughter Board

This configuration requires half of a Dual 4-Wire Card (702-9460).

Please refer to the drawing on the opposite page.

Note 1: The answer relay is shown in idle condition in this drawing (no call in progress).

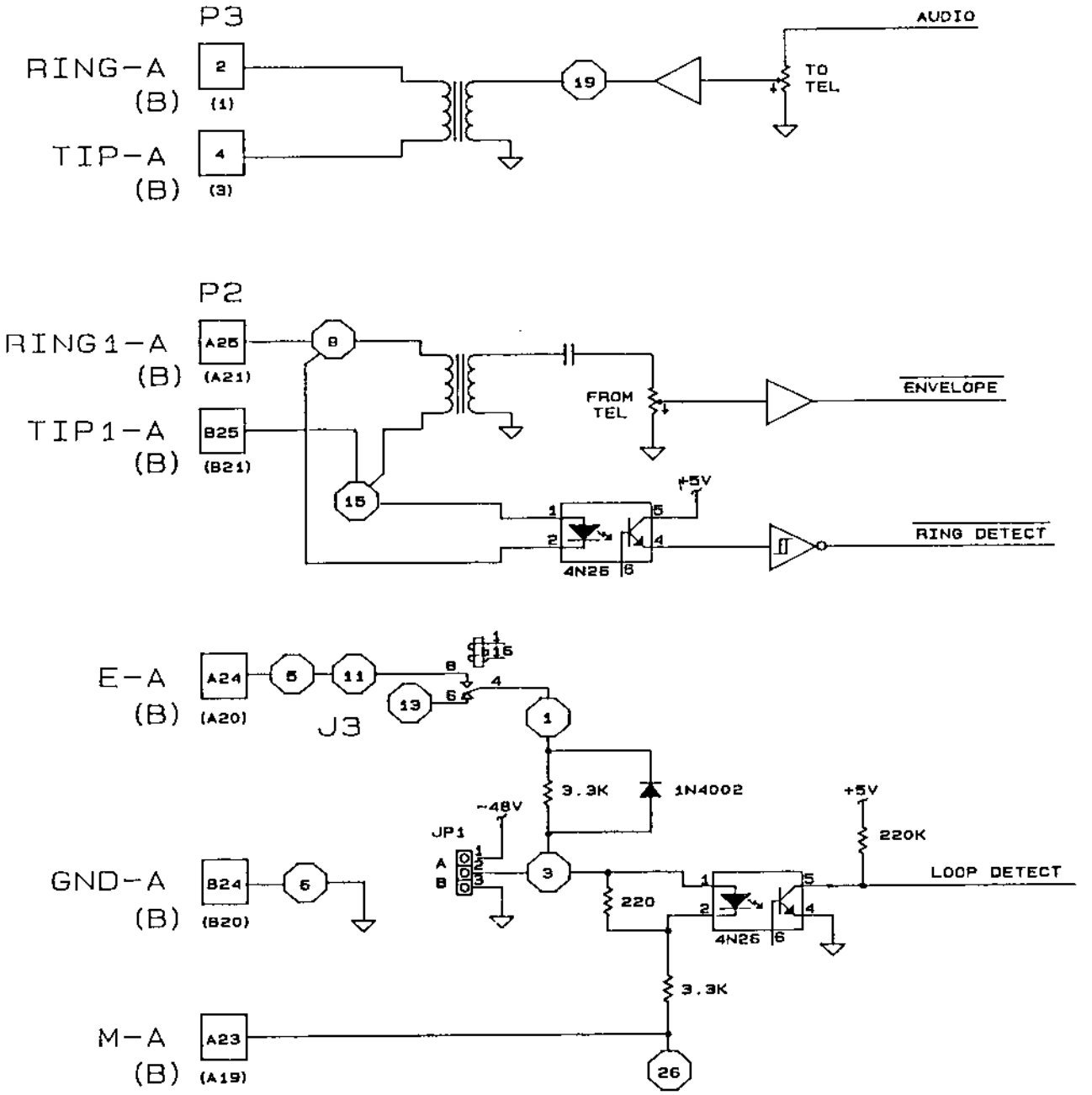
Note 2: This is a 4-wire audio, E&M interface only. For 2-Wire E&M interfacing, use the Dual TELCO trunk card (702-9457).

Signal Name	Function
RING	Paired with TIP signal / wire. Carries outbound (Tx) balanced audio signaling.
TIP	Paired with RING signal / wire. Carries outbound (Tx) balanced audio signaling.
(+) 48 V Batt	From external power supply and provided to TELCO line.
(-) 48 V Batt	From external power supply and provided to TELCO line.
Chassis Ground	Reference earth ground. Carries return current for Type I E&M signaling.
RING1	Paired with TIP1 signal / wire. Carries inbound (Rx) balanced audio signaling and 105 V_{AC} ringing.
TIP1	Paired with RING1 signal / wire. Carries inbound (Rx) balanced audio signaling and 105 V_{AC} ringing.
E	TELCO "E" Lead as defined at TELCO end of the line. Ground referenced control line *TO TELCO* for call supervision.
M	TELCO "M" Lead as defined at TELCO end of the line. Ground referenced control line *FROM TELCO* for call supervision

JP1 Position	Idle State (On-Hook)	Active State (Off-Hook)
A	E-Lead: "OPEN" output M-Lead: ""OPEN" or -48V input	E-Lead: -48V output M-Lead: GND input
B	E-Lead: "OPEN" output M-Lead: ""OPEN" or GND input	E-Lead: GND output M-Lead: -48V input

NOTE: JP1 configures both trunks A and B simultaneously, for the Audio Daughter Board., Rev A.

Type I E&M 4-Wire Configuration (024-0089)



E&M 4-Wire Type I - Using Rev B Audio Daughter Board

This configuration requires half of a Dual 4-Wire Card (702-9460).

Please refer to the drawing on the opposite page.

Note 1: The answer relay is shown in idle condition in this drawing (no call in progress).

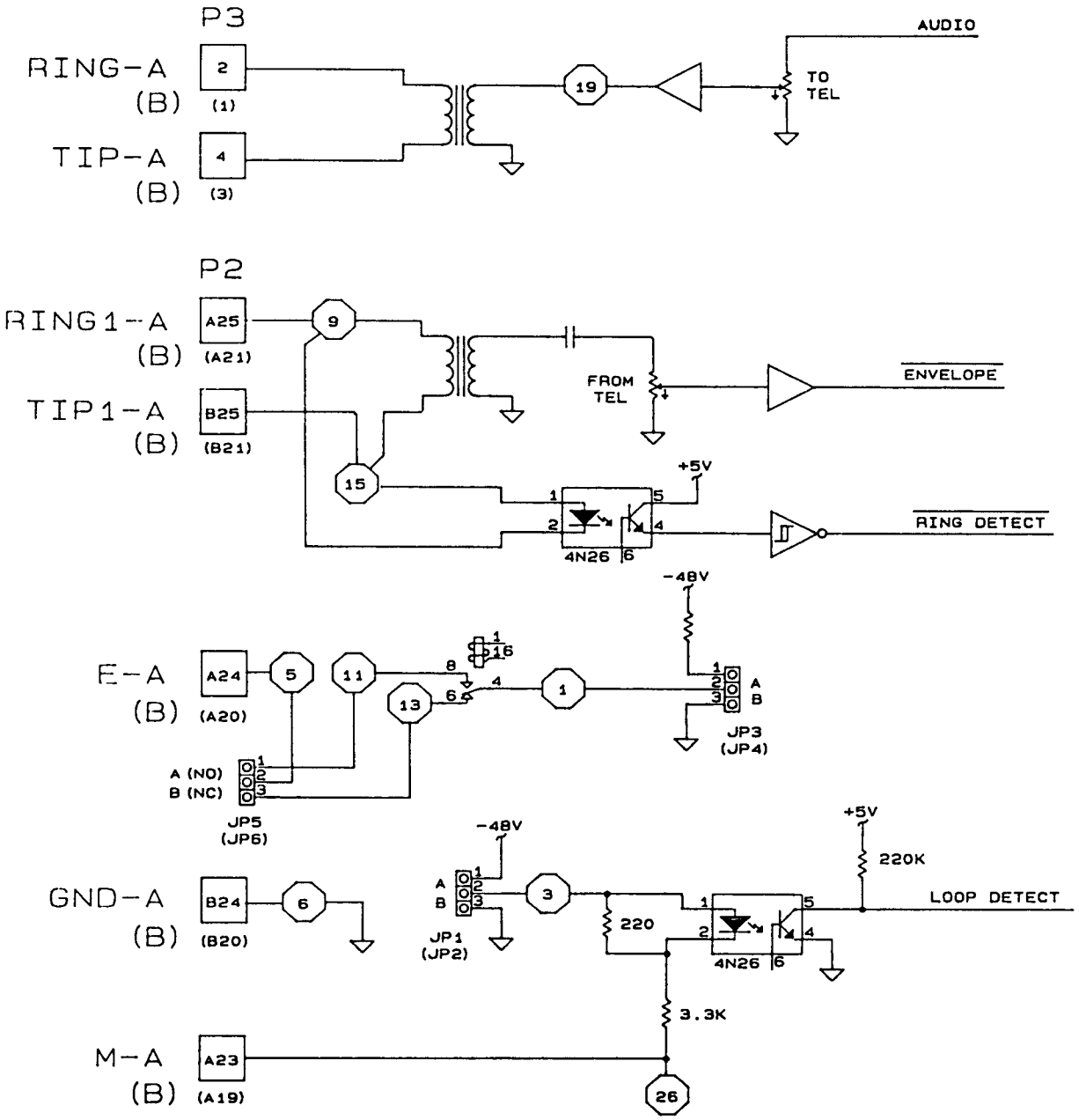
Note 2: This is a 4-wire audio, E&M interface only. For 2-Wire E&M interfacing, use the Dual TELCO trunk card (702-9457).

Signal Name	Function
RING	Paired with TIP signal / wire. Carries outbound (Tx) balanced audio signaling.
TIP	Paired with RING signal / wire. Carries outbound (Tx) balanced audio signaling.
(+) 48 V Batt	From external power supply and provided to TELCO line.
(-) 48 V Batt	From external power supply and provided to TELCO line.
Chassis Ground	Reference earth ground. Carries return current for Type I E&M signaling.
RING1	Paired with TIP1 signal / wire. Carries inbound (Rx) balanced audio signaling and 105 V_{AC} ringing.
TIP1	Paired with RING1 signal / wire. Carries inbound (Rx) balanced audio signaling and 105 V_{AC} ringing.
E	TELCO "E" Lead as defined at TELCO end of the line. Ground referenced control line *TO TELCO* for call supervision.
M	TELCO "M" Lead as defined at TELCO end of the line. Ground referenced control line *FROM TELCO* for call supervision

Jumper Position		Idle State	Active State
Trunk A	Trunk B		
JP1 = A	JP2 = A	M-Lead: "OPEN" or -48V input	M-Lead: "GND" input
JP3 = A	JP4 = A	.....	E-Lead pulled to -48V
JP5 = A	JP6 = A	E-Lead: "OPEN" output (NO relay)	E-Lead: "Closed" output (NO relay)
JP1 = B	JP2 = B	M-Lead: "OPEN" or GND input	M-Lead: -48V input
JP3 = B	JP4 = B	E-Lead pulled to GND	.....
JP5 = B	JP6 = B	E-Lead: "Closed" output (NC relay)	E-Lead: "OPEN" output (NC relay)

NOTE: Jumpers configure trunks A and B independently, for the Audio Daughter Board., Rev B.

Type I E&M 4-Wire Configuration (024-0100A)



3. SYSTEM INSTALLATION

INTRODUCTION

This section contains the information necessary to install and adjust the FASTNet Switch. The information is contained in the form of checklists and step-by-step procedures. Where appropriate, the procedures in this section refer to other sections in this manual.

Installation of the Model 2540 FASTNet Switch is usually accomplished in three major steps:

1. Connect a telco line (or local telephone) and the radio system in a temporary setup for checkout and make it ready for rapid cut over into an existing system. (If this is a new installation, you can install the system in its permanent location and connect the new telco lines for checkout.)

2. Install the system software onto the office computer, enter users into the database, and perform some test calls.

3. Mount and connect the working system into its permanent installation.

The following installation checklist assumes that the Model 2540 FASTNet Switch was shipped pre-configured for such options as: number of trunk cards; types of trunk cards; and installed trunk card options like Dial Click Decoding or MF Decoding, per the "Configuration Questionnaire" submitted with the factory order for the switch.

To install the FASTNet Switch in your facility, complete each of the steps (in order) of the following installation checklist.

CAUTION

ALWAYS TURN OFF POWER BEFORE INSERTING OR REMOVING CARDS!

Removing or inserting cards with power on can cause serious damage to your switch. The Model 2540 FASTNet Switch uses a bus backplane, much like a personal computer, and is not designed for "hot" removal or insertion of cards.

INSTALLATION CHECKLIST

The installation checklist is provided as a "to do" list that will guide you through the *general* steps necessary to install the FASTNet Switch and its operating software. Follow the steps in the checklist, referring to other sections as specified, to install the FASTNet Switch System.

This checklist consists of specific instructions and, in some instances, references to other instructions contained in this manual. When a step in the installation checklist refers you to another procedure in the manual, complete that procedure and then return to where you left off in the installation checklist.

NOTE

Some specific installation examples of FASTNet trunk interfaces are provided, step-by-step, in Section 7 (Practical Examples) of this manual. A wire list of the examples from Section 7 is provided in Appendix E, to illustrate both the complexity, and proper connections for each of the interface types.

It should be noted that the FASTNet Switch System, because of scope and complexity, is absolutely NOT intended to be installed using "plug and play" methods. Careful planning and proper technical expertise are required.

- ❑ 1. Unpack and open the FASTNet Switch cabinet.
  - ❑ a. Unpack the Model 2540 from largest box (save the box).
  - ❑ b. Remove the front door (1/4 turn latches on Model 2540)
  - ❑ c. Remove the top cover
    (unscrew fasteners, then slide the top toward yourself and tilt it up).
  - ❑ d. Check your order against the received items.

- ❑ 2. If your system is equipped with 2-Hour or 4-Hour Voice Storage capability, install the SCSI Hard Disk Card. Otherwise, go to Step 3.

  (Refer to SCSI Hard Disk Card Mounting Information subsection in this section for more details)
  - ❑ a. Unpack the hard disk card from the smaller shipping box.
  - ❑ b. Remove the #4-40 screw from card slot #1. Refer to Figure 3-1: Model 2540 Card Slot Assignments, for the slot location.
  - ❑ c. Install the hard disk card and secure with the #4-40 screw.
  - ❑ d. No formatting is necessary.

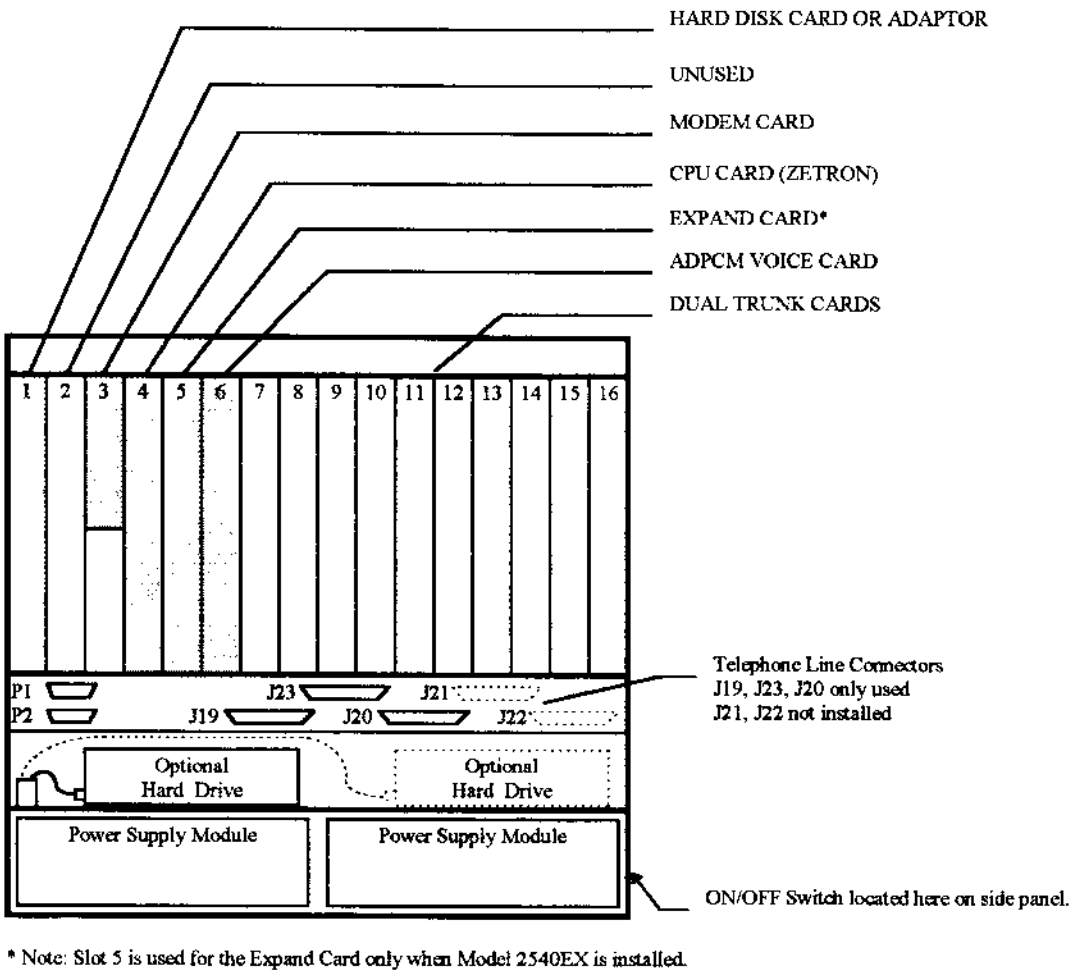


Figure 3-1: Model 2540 Card Slot Assignments

❑ 3. If your system is equipped with a 6-Hour, 12-Hour, 24-Hour or 48-Hour Extended Voice Messaging Option, install the SCSI Hard Disk Drive and Adapter Card.

(Refer to SCSI Hard Disk Card Mounting Information subsection in this section for more details.)

The physical Location of the Hard Drive after installation is illustrated in Figure 3-1: Model 2540 Card Slot Assignments. The Adapter Card resides in Slot 1.

❑ 4. Make sure all circuit cards, in every occupied slot, are firmly seated in the FASTNet Switch cabinet.

❑ 5. Install the Model 2540EX Expansion Chassis Option if purchased.

(Refer to the Model 2540EX Installation subsection in this section)

❑ 6. The office computer that operates the FASTNet Switch's database can be optionally connected as (1) a remote connection via the 2400/1200 baud modem installed into slot 3, or alternatively, as (2) a local (direct) connection established via the Local RS-232C Port "P2". Refer to Figure 3-1: Model 2540 Card Slot Assignments for locations of the connectors, etc.

Depending upon the chosen option, perform either step 6a OR 6b.

❑ a. For the remote computer option, plug the RJ11C modular jack of a TELCO 2-wire cable into the jack labeled LINE or WALL (do not use the jack labeled PHONE) located at the top of the modem card. Connect the other end of the telco cable directly to the telephone wall jack, or TIP/RING pair of an End-to-End (DOD) trunk..

OR

❑ b. Connect the Local Serial Cable (Zetron p/n 709-7086) between the serial port (Refer to Local connector "P2" in Figure 3-1: Model 2540 Card Slot Assignments) and the computer that is loaded with the Zetron Netbase protocol program or the Zetron Trunk Card Editor program.

NOTE: The Serial Cable connector having the dot should be plugged into the computer serial port to ensure proper shielding.

❑ 7. Plug the FASTNet Switch unit into the appropriate AC power source and switch on the power, powering the Model 2540EX unit(s) first. The on/off switch is located on the right-side panel; near the bottom. Be sure all cabinets are powered-on.

(For early Models 2540EX, the switch is located inside the front door of the cabinet.)

❑ 8. With power applied to the FASTNet Switch, check front panel lights for correct operation as described in Section 2, System Indicators.

❑ 9. At this point you can connect either the telephone lines designated for the trunk cards of the FASTNet Switch, or a test telephone that connects temporarily to a DID-configured trunk, for testing purposes.

Connect the telephone lines, or the test telephone, to the trunk card(s) via the RJ2EX connectors on left side of the lower backplane shown in Figure 3-2. Refer to Section 4, Telco Split-Block Terminations for specific connection information.

❑ 10. Connect the repeater control equipment (Model 49 Trunking Repeater Managers) to the Model 2540 as appropriate per the trunk programming assignments.

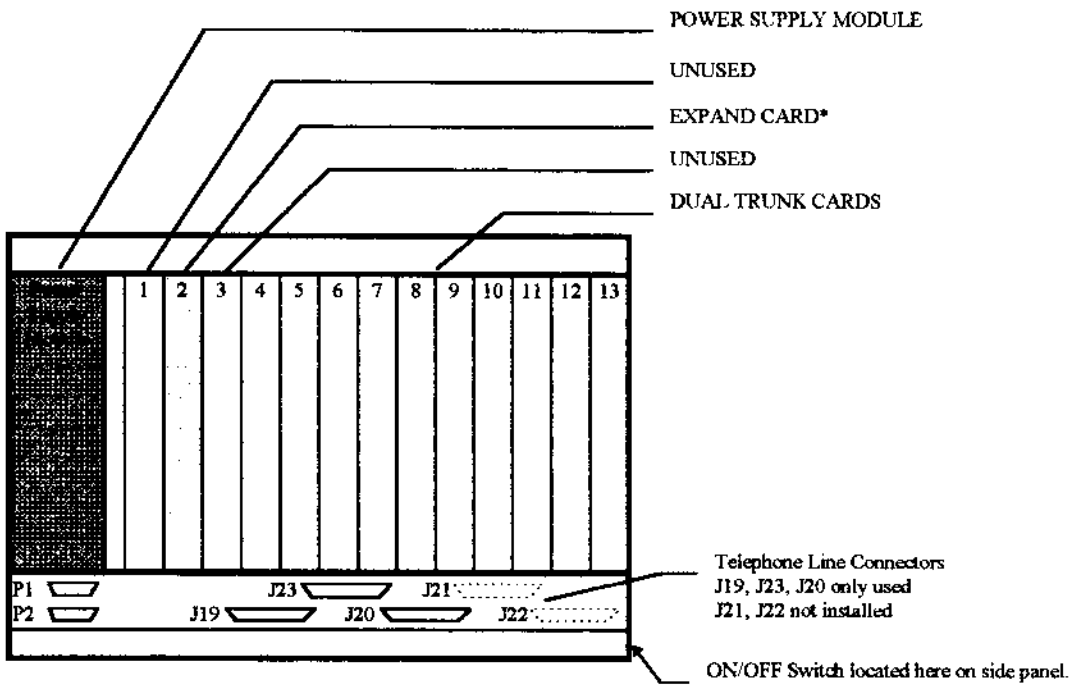
If co-located, the Model 49 Trunking Repeater Managers connect directly from their E&M 4-Wire TELCO Cards to the RJ66M425 miniature 6-wire ("modular") jacks of the optional FASTNet cable kit (950-9385).

❑ 11. Install the office computer software: Netbase, NETLINK, and Trunk Card Editor programs. Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270).

❑ 12. To test operation of the FASTNet Switch, it is necessary at this point to create a "test" user database. This database is created by using Netbase on your office computer as described in the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270). For customer convenience, Netbase can be *installed* over existing Multibase databases of versions 4.0 and higher.

❑ 13. Choose the appropriate trunk card interface (for *each* trunk) from Section 4 and perform the specified adjustments for each trunk.

Note: Section 7 of this manual provides examples of specific interface configurations. Although the trunk slot and address will be unique for each installation, etc., the process for installing each trunk is explained in detail from beginning to completion for each type of interface discussed.



* Note: Slot 2 is used for the Expand Card, which should be configured as a "SLAVE".

Figure 3-2: Model 2540EX Card Slot Assignments

❑ 14. Make several test calls and verify mobile radios ring and audio levels are correct.

Note: The telephone trunk circuits contain AGC circuitry that boosts recorded audio to its maximum. Therefore, do not use the FROM TEL adjustment of the FASTNet Switch trunk card for audio level adjustment; instead,

use the To and From Telco adjustments on the Model 49 telco card per the instructions given in Section 4, Dual 4-Wire Card (702-9460) Adjustments and Configuration.

If you have trouble getting the system to operate normally, refer to Section 6, Troubleshooting and Repair Procedures. FASTNet trunk interfaces will not function reliably if proper grounding practices are not exercised, *especially* Type I E&M trunks, since they utilize *ground-referenced* E and M signals.

Refer to the Signal Grounding subsection of this section for more details.

- ❑ 15. Mount the FASTNet Switch in its final location.

  For the Model 2540, remove the bottom cover (unscrew, slide toward you, and tilt down). Then remove the hard disk card and the circuit cards from slots 1, 2, 15, and 16 to gain access to the mounting holes on the back panel of the FASTNet Switch. Refer to Model 2540 Cabinet Mounting Information subsection in this section for details.

  CAUTION: Always remove the SCSI Hard Card (Slot 1) or the SCSI Hard Drive (located on the shelf below the card cage) before transporting the FASTNet Switch in order to prevent unwarranted permanent damage to these components. Disk drives should be carefully packaged separately for any shipping.

- ❑ 16. Make all permanent telephone line connections to the RJ2EX connectors (J19, J20, J23 of the backplane) via the RJ21X split-block terminals and the RJ66 modular jacks (if used). Refer to Figure 3-3 and Figure 3-4.

- ❑ 17. Perform a final system operational test. TELCO line balancing and level settings may require a final adjustment due to line impedance differences between your test area and final switch site.

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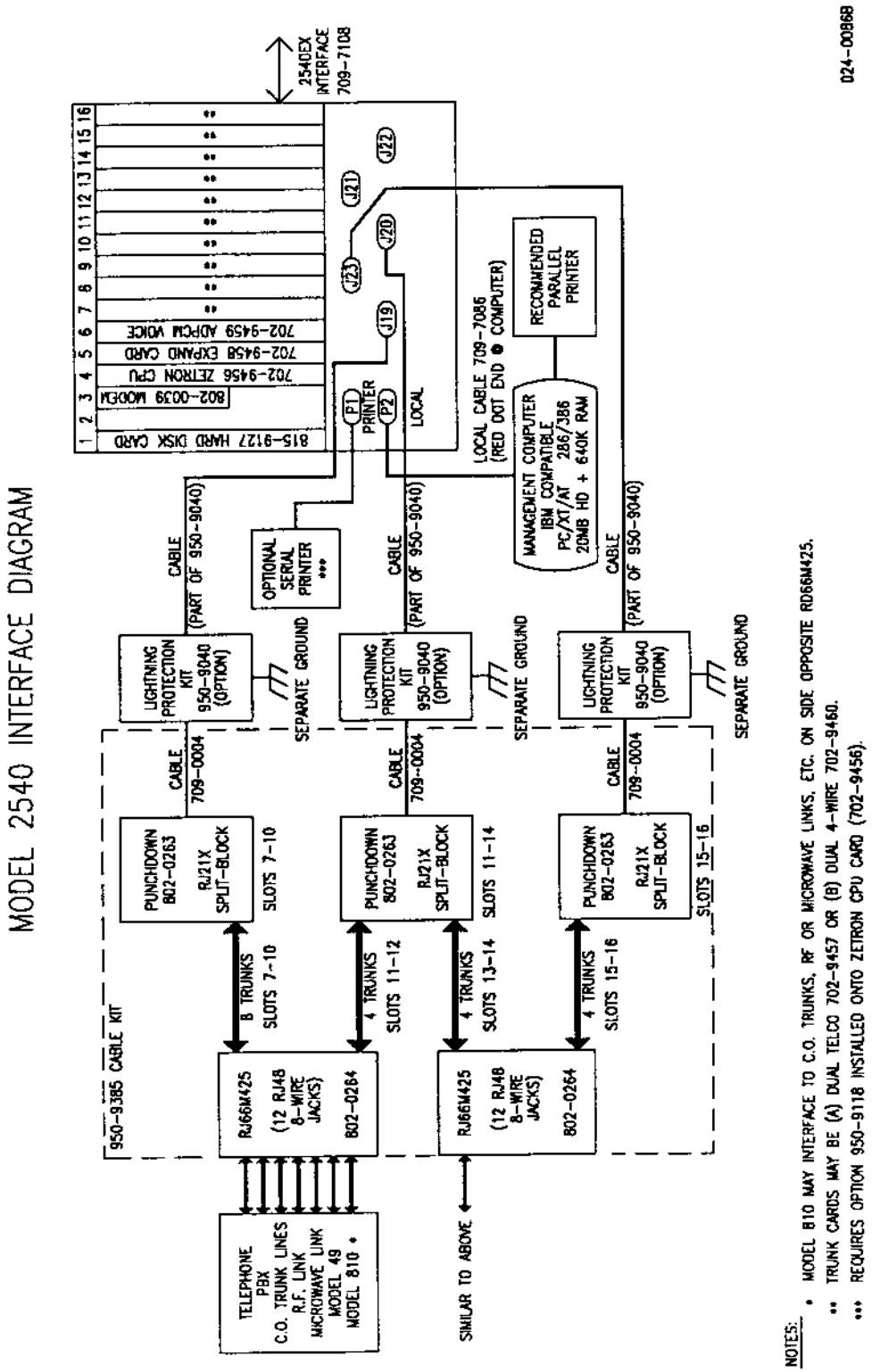

Figure 3-3: Model 2540 Main Chassis Interface Diagram

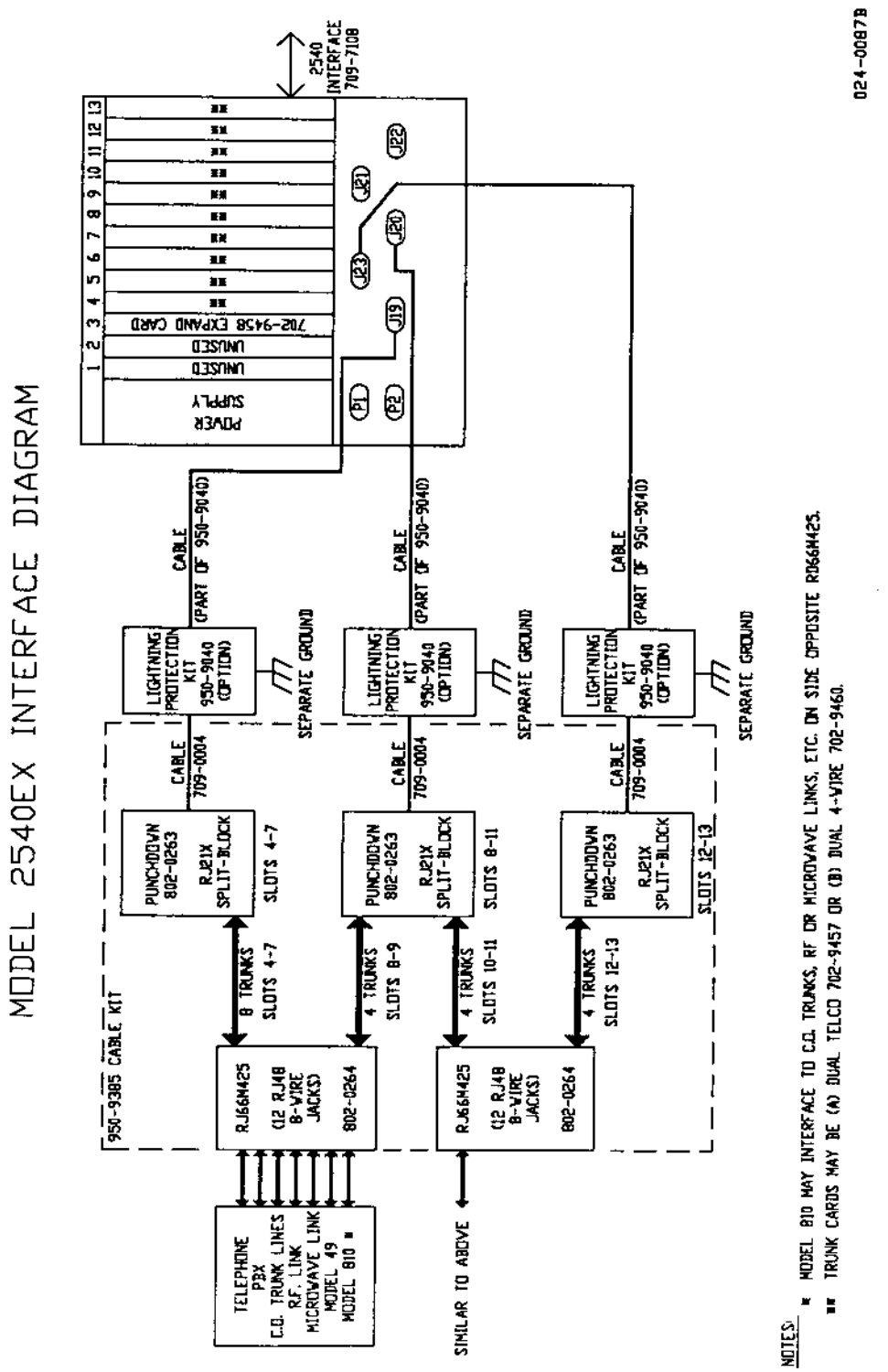

Figure 3-4: Model 2540 Expand Chassis Interface Diagram

SCSI HARD DISK CARD MOUNTING INFORMATION

This procedure is for the 2-Hour and 4-Hour Voice Storage Hardware.

The SCSI Hard Disk Card for the Zetron Model 2540 FASTNet Switch is packed separately to avoid damage to the switch or hard disk during shipment. The hard disk contains all the software for the FASTNet Switch; therefore, it must be installed before operation of the switch can take place. Installation is simple, but the hard disk can be easily damaged. Please follow the instructions below *very carefully*:

- ❑ 1. Be sure power to the Model 2540 FASTNet Switch is turned off.
- ❑ 2. Open the packaging material containing the hard disk. It is a good idea to save the packing materials, including the static-proof jacket, in the event you should ever need to ship your hard disk.

CAUTION

Avoid touching the gold-plated card-edge contacts with fingers, as this will promote oxidation and connector decay.

- ❑ 3. While holding the hard disk card at the top (card-edge finger side) and bottom, align it with the leftmost card guide and card Slot 1. Check to make sure the gold-plated card-edge fingers are centered over the connector. Now firmly press on the top edge of the hard disk above the connector until it is firmly seated in the connector.
- ❑ 4. Use the #4-40 screw, which you removed from Card Slot 1 of the Main Chassis, to fasten the hard disk card. Do not operate the FASTNet Switch until the hard disk is properly secured.

SCSI HARD DISK DRIVE MOUNTING INFORMATION

This procedure is for 6, 12, 24, and 48 -Hour Voice Storage Hardware kits.

The SCSI disk for the Extended Voice Messaging Option is packed separately to avoid damage to the switch or hard disk during shipment. Please follow the instructions below to install the SCSI disk in the Model 2540 (Refer to Figure 3-5):

❑ 1. Be sure power to the Model 2540 FASTNet Switch (and Model 2540EX Chassis, if installed) is turned off.

❑ 2. Attach the two supplied brackets to the SCSI disk using the supplied screws.

PLEASE NOTE

All of the Hard Drive units used by Zetron have exposed circuit components on the bottom and dust covers with labels on top. The electronic connections must be oriented at the left side the Hard Drive when installed. Carefully observe and verify drive orientation before attaching the mounting brackets to the Hard Drive unit.

- ❑ a. The long bracket, having keyhole slots, mounts onto the rear of the Hard Drive unit, such that the stepped ends of the bracket face away from the Hard Drive, and the wide end of the keyholes is downward.
- ❑ b. The angled bracket attaches to the front of the Hard Drive such that the short, angled portion is oriented toward the bottom, and away from, the Hard Drive unit.

❑ 3. While holding the SCSI Hard Drive with the connectors facing your left (←), connect the 50-pin cable such that the colored stripe edge of the cable is closest to the front (towards you). Refer to Figure 3-1: Model 2540 Card Slot Assignments.

Note: The SCSI 50-pin ribbon cable should be connected to the SCSI Host Adapter Card, which is plugged into Slot 1. Pin 1 (colored stripe end) of the ribbon cable should be toward the bottom of the FASTNet Switch chassis on the Adapter Card.

❑ 4. Connect the short power cable connector to the jack on the SCSI Hard Drive. Coil the longer lead neatly and tuck behind the other power cables to prevent accidental damage. (The long power cable is for future "mirrored" storage operation.)

Refer to Figure 3-5: Mounting the SCSI Disk into the Model 2540 for the location of the power cable.

Note: The power cable should be pre-installed at the factory, unless you are performing an in-the-field upgrade. The mating connector for this power cable lies at the left rear of the shelf above the power supply, and below the card cage.

- ❑ 5. Fasten the SCSI disk with brackets to the shelf as follows:
  - ❑ a. Approximately 1-1/4" above the same shelf where the SCSI Hard Drive power is connected, there are two pairs of 6-32 pre-threaded holes facing you. Install two 6-32 machine screws (provided with the mounting bracket kit) into the two left holes, but **do not completely tighten them.** (The right pair of holes is for the future "mirrored" drive.)

    Refer to Figure 3-5: Mounting the SCSI Disk into the Model 2540, for location of the Hard Drive unit in the Model 2540 chassis.
  - ❑ b. Carefully place the SCSI rear bracket keyholes over the screws installed in step 5a and lower the disk drive to the shelf.
  - ❑ c. Install the remaining two supplied 6-32 screws into the front bracket holes, anchoring the SCSI Hard Drive assembly to the shelf.
  - ❑ d. Tighten the two rear anchor screws from step 5a.

- ❑ 6. The SCSI Hard Drive is now ready for use.

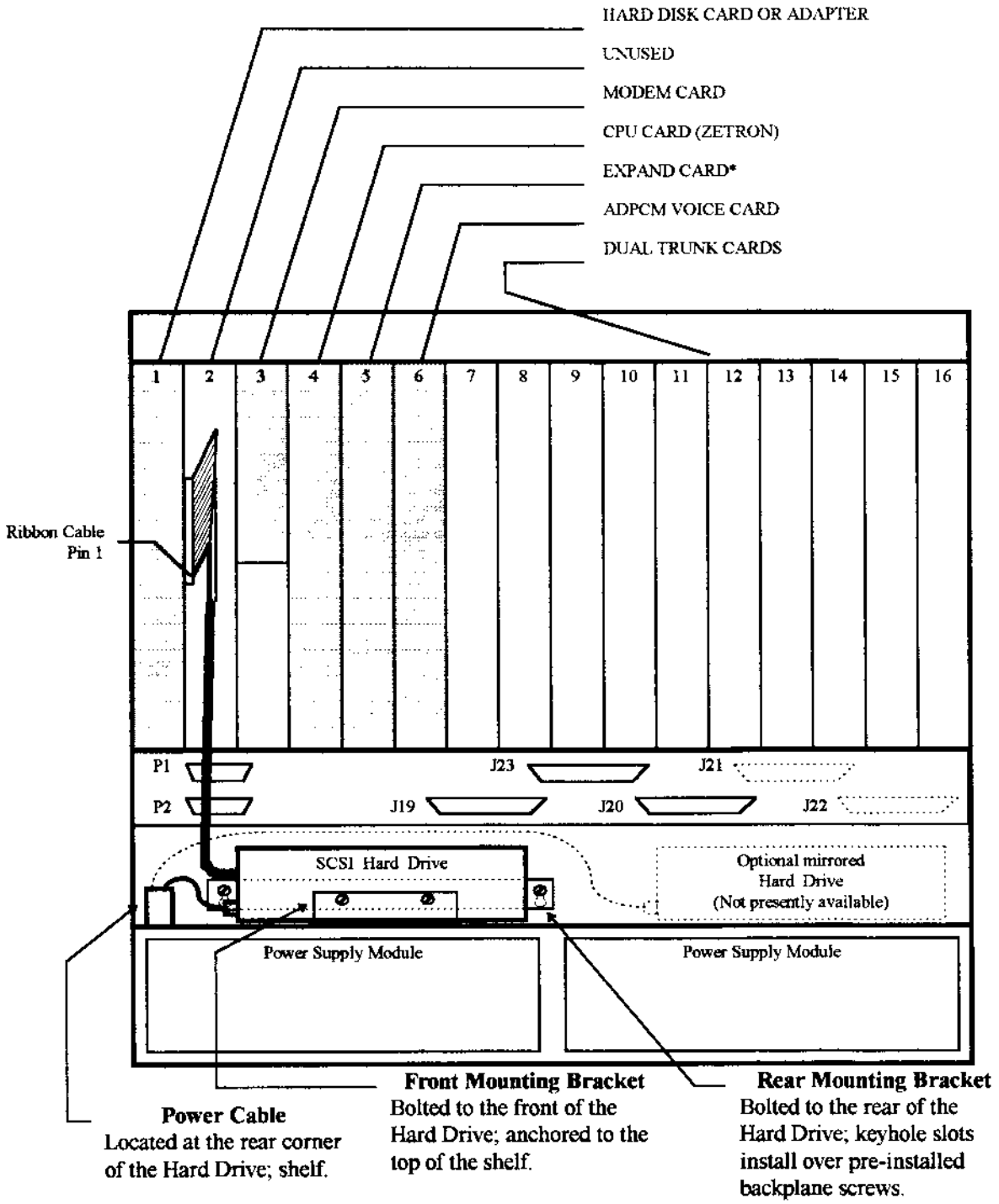

Figure 3-5: Mounting the SCSI Disk into the Model 2540
(Used with Expanded Voice Messaging Options)

MODEL 2540 CABINET MOUNTING INFORMATION

Make sure that the Model 2540 is disconnected from its power source. Remove the front door, top cover and bottom cover to reveal the eight 1/4" diameter mounting holes in the back panel along the left and right sides of the cabinet. These holes are used for wall mounting, using wall anchors or lag bolts. Refer to Figure 3-6: Model 2540 Mounting Template, for the dimensional layout.

Wall mounting to a 3/4" plywood backboard (like PABX equipment) is the most common installation method. Eight rubber grommets have been supplied to use as spacers between the Model 2540 rear panel mounting holes and the plywood mounting surface.

For overall ease of installation, we suggest pre-mounting the entire FASTNet system onto a single, painted plywood sheet, then mount the sheet onto a wall or 19" rack. This could be thoroughly pre-assembled and tested at your shop before final installation. Care should be taken, however, to verify that the final assembly can be easily moved into the site when completed (i.e., check door clearances, corner radii, etc.).

CAUTION

Do not over-tighten the eight mounting bolts.

The aircraft-grade aluminum rear panel can be easily bent.

MODEL 2540EX CABINET MOUNTING INFORMATION

The Expand Chassis should be mounted in the same general procedure used for the Main Chassis, as noted above. However, the dimensional layout of the Expand Chassis is slightly smaller than that of the Main Chassis. Care should be taken to use correct dimensions. Refer to Figure 3-7: Model 2540EX Mounting Template, for the dimensional layout.

Cable Routing

Telephone Trunk and Radio interface connections are brought through the right side on Models 2540 and 2540EX, using 50 conductor cables with FEMALE Amphenol-type connectors. The 50-pin mating connectors are mounted on the backplane circuit boards, visible below the circuit card cage after the unit's front door has been removed. Refer to Figure 3-1 and Figure 3-2 for connector locations in each chassis type.

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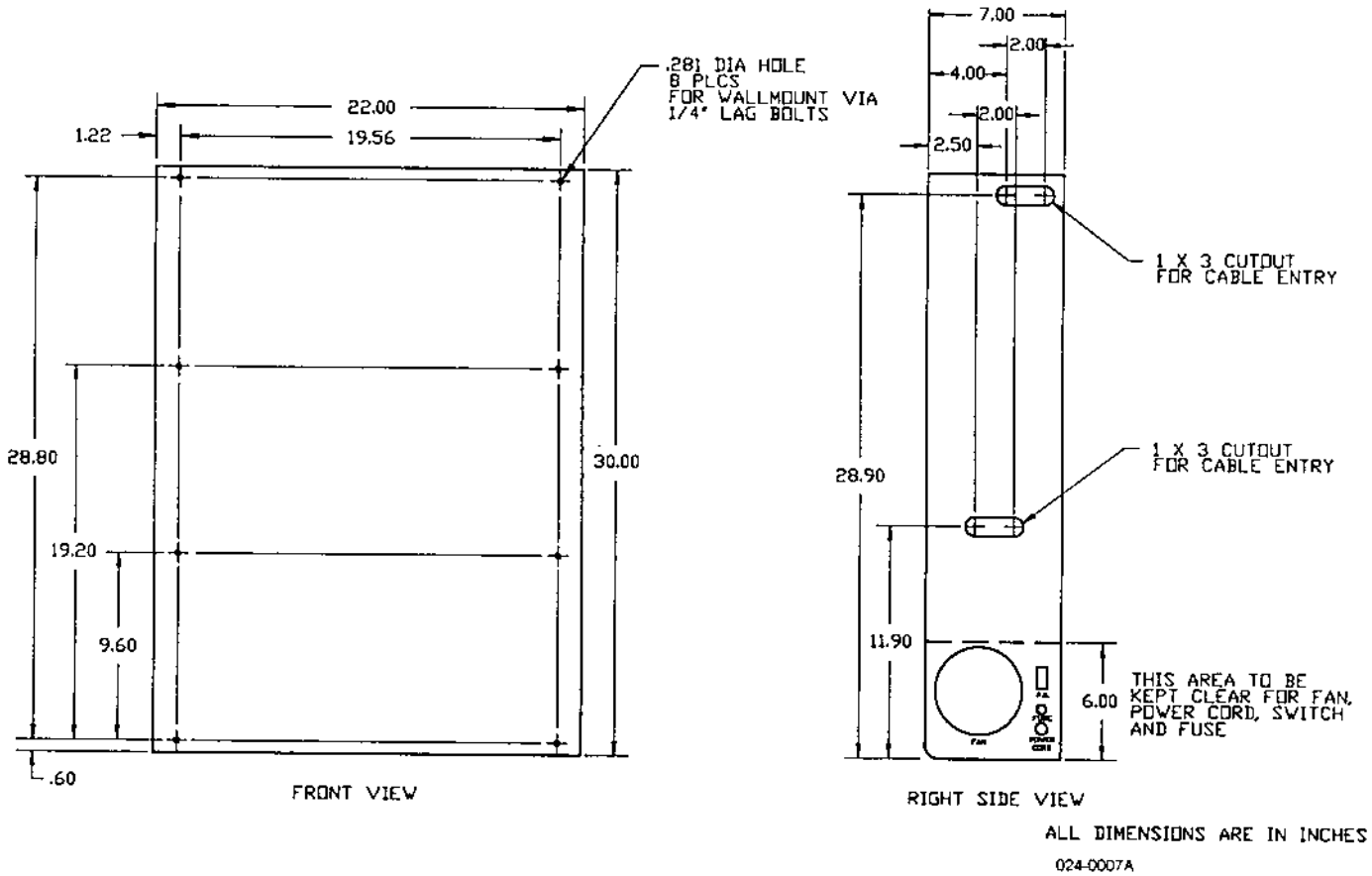
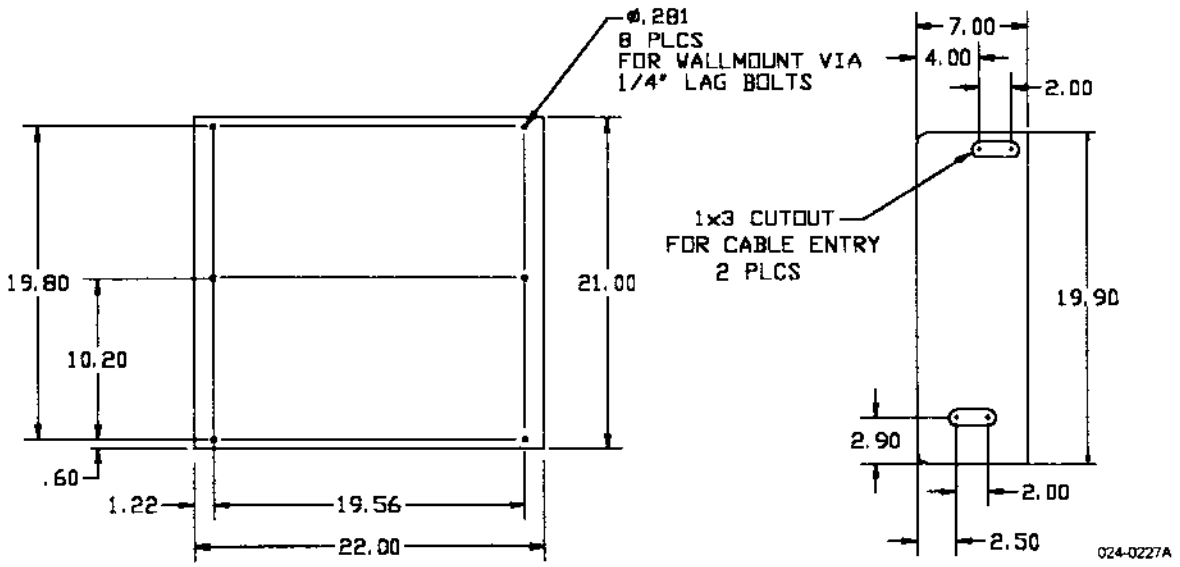


Figure 3-6: Model 2540 Mounting Template



All dimensions are in inches

Figure 3-7: Model 2540EX Mounting Template

MODEL 2540EX INSTALLATION

General

Installing the Model 2540EX Chassis will require approximately 15 minutes of down time on an existing Model 2540 (NOT including trunk interfacing). The required tools are: #1 Phillips screwdriver, 7/16" nutdriver. To install the Model 2540EX, first connect the Model 2540EX chassis and then connect the Model 2540 as follows:

Model 2540EX Chassis Connection

- ❑ 1. Remove the top panel of the Model 2540EX.
- ❑ 2. Install the Expand Card (702-9458) into Slot 2 of the Model 2540EX Chassis. If this has already been done, proceed to Step 3.

  Note: For Revision C (702-9458C) Expand boards, use procedure 2.a. This revision uses round shielded cable with 68-pin D type subminiature connectors.

  For Revision B (702-9458B) Expand boards, use procedure 2.b. This revision uses shielded flat ribbon cable with a grounding clamp and connector assembly.

  - ❑ 2.a.1. Install the (702-9458C) EXPAND card into slot 2 (Card should be configured as a "slave" - refer to Section 2 of this manual for details.)

    Note: This card is configured differently from revision "B".
  - ❑ 2.a.2. Verify that the hex standoffs on top of the card are tight (do not overtighten), and then plug the cable connector onto the top of the EXPAND card. Tighten both securing screws into the hex standoffs, to ensure a positive strain relief *and* a secure ground shield interconnection.
  - ❑ 2.a.3. Proceed to step 3.

- ❑ 2.b.1. Remove the two screws retaining the top half of the (702-9458B) EXPAND card strain-relief bracket and the ground strap. Remove top half bracket and ground strap.
- ❑ 2.b.2. Install the EXPAND card in slot 2 (Card should be configured as a slave - JP3 through JP6 are installed).
- ❑ 2.b.3. Press the female connector of one end of the Model 2540EX chassis interface cable onto the EXPAND card 60-pin male connector, P3. This connector is located at the top edge of the EXPAND card, below the strain relief bracket. Properly oriented, the cable should exit from the top of the unit. Ensure that the connector is not misaligned and is fully seated.
- ❑ 2.b.4. Fold the cable's foil shield back across the cable outer jacket and the lower half of the strain relief bracket. The cable should be routed to the left of the card with the silver side of the foil up and directly above the lower half bracket.
- ❑ 2.b.5. Place the upper half bracket over the cable and lower half bracket, ensuring that the bracket half is in full contact with the silver side of the foil shield. Replace both screws, taking care to place an end lug of the ground strap under the head of the rear screw.
- ❑ 2.b.6. Loosen the rearmost nut at the left of the upper card cage rail. Place the free end lug of the ground strap under this nut and tighten.
- ❑ 2.b.7. Proceed to step 3.

❑ 3. Replace the top panel of the Model 2540EX. Route the interface cable through the provided cutout.

❑ 4. Install new trunk cards in desired slots of Model 2540EX.

Model 2540 Connection

- ❑ 1. Remove power from the Model 2540.
- ❑ 2. Remove the top panel of the Model 2540.
- ❑ 3. Install the EXPAND card into slot 5 of the Model 2540 FASTNet Switch chassis.

Note: *For Revision C (702-9458C) Expand boards, use procedure 3.a. This revision uses round shielded cable with 68-pin D type subminiature connectors.*

For Revision B (702-9458B) Expand boards, use procedure 3.b. This revision uses shielded flat ribbon cable with a grounding clamp and connector assembly.

- ❑ 3.a.1. Install the (702-9458C) EXPAND card into slot 5 (Card should be configured as "master" - refer to Section 2 of this manual for details.)

Note: This card is configured differently from revision "B".

- ❑ 3.a.2. Verify that the hex standoffs on top of the card are tight (do not overtighten), and then plug the cable connector onto the top of the EXPAND card. Tighten both securing screws into the hex standoffs, to ensure a positive strain relief *and* a secure ground shield interconnection.
- ❑ 3.a.3. Proceed to step 4.
- ❑ 3.b.1. Remove any system cards from slots 5 or 6 (ADPCM card). Remove any trunk cards from slots 7 and 8. These are removed to ease access for later steps.
- ❑ 3.b.2. Remove the two screws retaining the top half of the (702-9458B) EXPAND card strain-relief bracket and the ground strap. Remove top half bracket and ground strap.
- ❑ 3.b.3. Install the EXPAND card in slot 5 (Card should be configured as a master- JP3 through JP6 are not installed).
- ❑ 3.b.4. Press the female connector of one end of the Model 2540EX chassis interface cable onto the EXPAND card 60-pin male connector, P3. This connector is located at the top edge of the EXPAND card, below the strain relief bracket. Properly oriented, the cable should exit from the top of the unit. Ensure that the connector is not misaligned and is fully seated.
- ❑ 3.b.5. Fold the cable's foil shield back across the cable outer jacket and the lower half of the strain relief bracket. The cable should be routed to the left of the card with the silver side of the foil up and directly above the lower half bracket.
- ❑ 3.b.6. Place the upper half bracket over the cable and lower half bracket, ensuring that the bracket half is in full contact with the silver side of the foil shield. Replace both screws, taking care to place an end lug of the ground strap under the head of the rear screw.

- ❑ 3.b.7. Loosen the rearmost nut at the left of the upper card cage rail. Place the free end lug of the ground strap under this nut and tighten.
- ❑ 3.b.8. Replace all cards previously removed in step 3.b.1.
- ❑ 3.b.9. Proceed to step 4.

❑ 4. Verify all cards are properly installed and fully seated into their slot connectors.

Note: Suggested slot layout is illustrated in , as noted below:
#1-SCSI Hard Card (or SCSI Host Adapter with Hard Drive if greater than 2 hours of voice storage)
#2-Unused
#3-Modem Card
#4-CPU Card
#5-Expand Card
#6-ADPCM Voice Card
#7 ↔ #16-Dual Trunk Cards

❑ 5. Replace the top panel of the Model 2540 with the bottom panel from the Model 2540EX. Route the interface cable through the provided cutout. Use the old Model 2540 top panel as the Model 2540EX bottom panel.

❑ 6. Restore power to both units, ensuring that the Model 2540EX is powered up before or simultaneously with the Model 2540 main chassis. It is recommended that both units are powered through a single master switch to facilitate this.

Note: No damage will occur if this sequence is not adhered to. However, the Model 2540EX chassis will miss the master reset from the main chassis if it receives its power after the Model 2540. If this occurs, cycle power again in the proper order or momentarily actuate the CPU card reset switch.

Signal Grounding

The Model 2540 Main chassis is equipped with two 6-32 (x 5/8 inch length) studs, located above the hard drive shelf and below the cable access slot on the right side of the chassis. These studs have been provided for grounding the cabinet chassis to a common earth connection for *signal referencing.* A length of 16 AWG green wire is provided with the optional FASTNet Custom Wiring Harness Kit (950-9385) for this purpose *These studs are not intended to be used as lightning suppression grounds*, since all suppression components should be installed onto lines externally before those lines reach the FASTNet system. Refer to the "separate ground" wires shown for lightning suppression in the Model 2540 interface diagrams of Figure 3-3 and Figure 3-4, (also refer to Figure 3-8).

The Expansion Chassis used in 40-trunk and 60-trunk FASTNet applications, attain reference ground(s) via the shielded cable(s) which interconnect to the Main Chassis. Other audio signaling equipment controlled by this switch should also be referenced to this chassis, which in turn should alone be referenced to earth ground at the site Bonding Junction, in order to prevent "ground loops". You may elect to use a barrier strip (not included) for grounding the other equipment to this chassis. To prevent permanent damage not covered under the terms of your warranty, be sure that this signal ground is *not* connected to a lightning ground wire. Additional information regarding signal referencing versus lightning suppression is briefly provided in *Zetron Technical Information Bulletin 027-0069: Proper Signal Grounding Techniques for Radio Sites.*

CAUTION

There are no internal protection devices for lightning strikes, other than some MOV's integrated into the Trunk card interfaces. Use of "primary" suppression devices such as power line protectors, antenna cable protectors, and other lightning suppression for your facility are strongly recommended.

The Zetron Deadbolt provides excellent 5-stage protection for 2-Wire trunks.

(Three Deadbolt units required for E&M 4-Wire trunks: (1) TO TEL audio pair, plus (2) FROM TEL audio pair, plus (3) the E/M pair.)

Secondary protection devices, such as Zetron's 950-9040 kit, further help to protect your equipment investment when primary systems are overwhelmed by severe lightning strikes.

TELCO Ground Reference

Proper telephone interface operation requires a good ground reference from the chassis of the Model 2540 to the Telephone Company ground, especially if using Type I E&M 4-Wire trunks. Type I trunks utilize ground referenced E-Lead and M-Lead signaling, as opposed to the 'floating' contact closures used in Type II E&M communications. You should run a heavy wire (#16 AWG or larger) from one of the lower backplane Z-Bus mounting screws to the telephone demarcation block ground point to ensure a low impedance ground reference.

Lightning Ground Reference

Lightning Grounds typically are routed directly from lightning arrestors/suppressors to the main ground bonding terminal, which in turn is typically soldered or welded directly to the site grounding network (ground rods, etc.). Each lightning protection device should be grounded separately with the shortest possible wire length to the bonding junction. To minimize path resistance and impedance, a large wire gauge (typically 4 AWG) green-colored conductor is used, having minimum bend radii of 8 inches (to minimize inductive effects). Also other wires should be separated at least 4 inches from these grounds to prevent arc-over during lightning strikes.

Further information is provided in *Zetron Technical Bulletin 027-0069: Proper Signal Grounding Techniques for Radio Sites.*

A typical FASTNet system has been illustrated in Figure 3-8: Typical FASTNet System Grounding. This illustration is intended to emphasize three important characteristics of proper system grounding:

(1) *Lightning* and *Signal* ground paths should be separate from each other; Notice that lightning grounds (labeled) and signal grounds (labeled and also denoted by heavy dashed lines) are not the same.

(2) Each lightning ground should connect directly to earth ground, by the shortest possible [low impedance] path;

and (3) Single signal ground paths should be provided for each major equipment system, so that no loops may be formed.
Notice that the "dashed" line paths through the two FASTNet chassis can be compared to two fingers of an open hand, i.e. they do not re-join at the terminating end. This prevents "circulating" currents and subsequent noise problems.

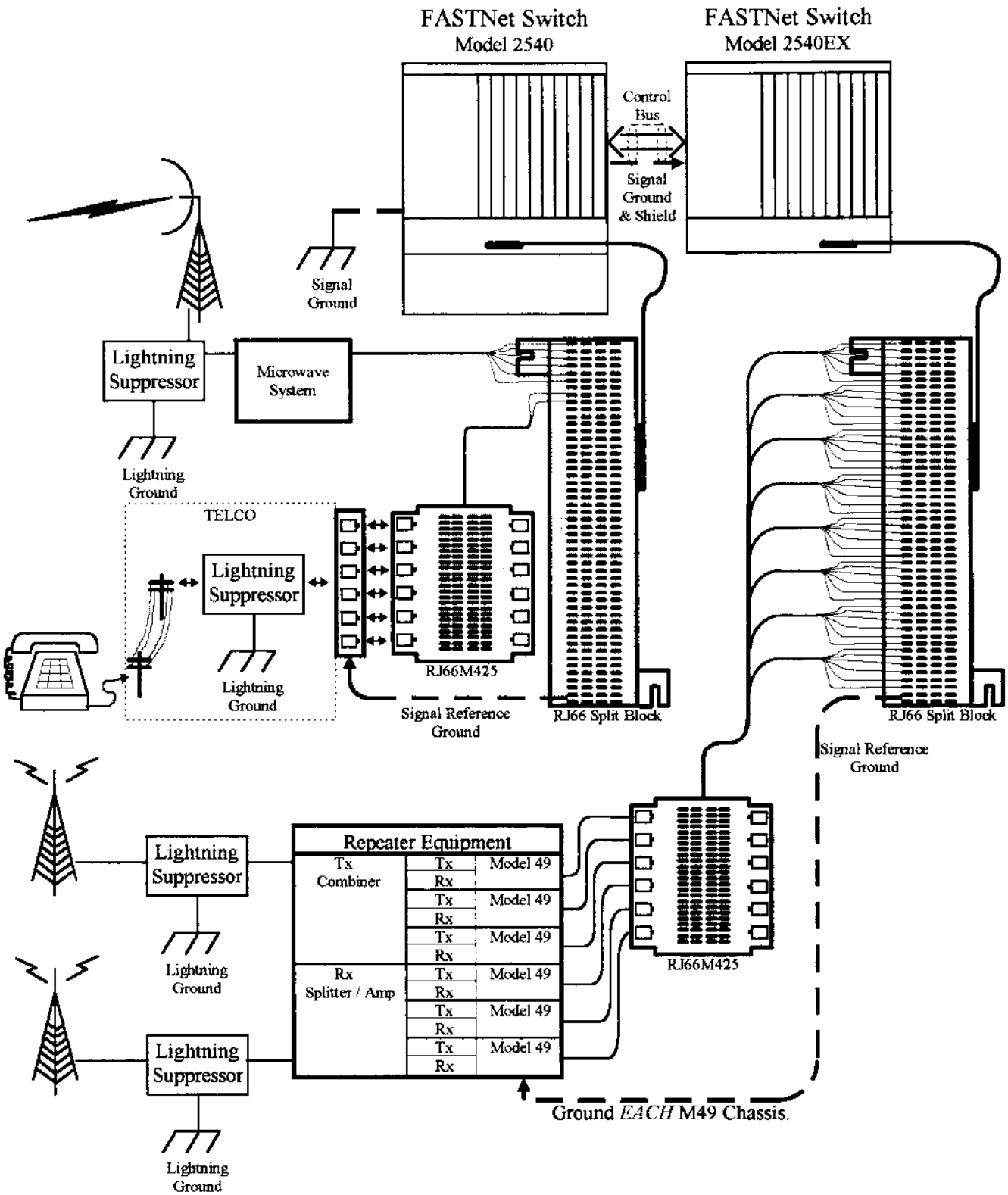


Figure 3-8: Typical FASTNet System Grounding

TOTAL SYSTEM ALIGNMENT PROCEDURE

The following alignment procedure should be performed on the FASTNet Switch after installation is complete in order to ensure correct operation and optimum signal levels.

See Appendix A for the recommended test equipment list.

This alignment procedure is provided as a "to do" list (similar to that given for system installation) that will guide you through the major steps necessary to align and adjust the FASTNet Switch after hardware installation is completed.

❑ 1. Use Netbase to program the user database with a mobile.

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270). For periodic alignment purposes, use the subscriber database that you must construct for normal use, reserving a few ID codes for test purposes.

Program a few mobile or hand-held transceivers for test use.

Once these test mobiles are programmed, be sure to update the FASTNet Switch via the "CommNet Update" function.

❑ 2. Repeater Adjustments.

Refer to your repeater manufacturer's alignment instructions as applicable.

❑ 3. Microwave/ RF Site to Site Link Adjustments.

Refer to your equipment manufacturer's alignment instructions as applicable for your installation.

❑ 4. Mobile or Hand-Held Transceiver Setups.

Refer to the manufacturer's programming and/or alignment specifications. Be sure data is consistent with database in Netbase programming from Step 1.

❑ 5. Model 42/49 adjustments

Refer to the *Model 42 Dispatch Trunking Logic Operation and Installation Manual* (Part No. 025-9251), or the *Model 49 Trunking Repeater Manager Operation and Installation Manual* (Part No. 025-9108) .

Note 1: Model 42 Repeater Managers are "Dispatch Only" and do not directly interface with the FASTNet Switch, but may be installed at a particular radio site in conjunction with "interconnected" Model 49 units. In such case, Model 42 repeat audio levels should be adjusted to be consistent with those of the Model 49 units.

Note 2: The preliminary Model 49 programming and setup adjustments should be performed in the service shop before installation at the permanent site.

❑ 6. Trunk adjustments:

Refer to Section 4, Adjustment Procedures for details on adjusting the incoming (FROM TEL), outgoing (TO TEL), and hybrid balance levels (BAL R & BAL C) on each of your trunk lines.

Note: This balance adjustment will change if you or your telephone company changes any telephone wiring.

❑ 7. Test and verify operations by placing Interconnect and Dispatch calls using a mobile or hand-held radio that has been configured in Netbase as a valid user (Step 1).

NOTE

Some specific installation examples of FASTNet trunk interfaces are provided, step-by-step, in Section 7 (Practical Examples) of this manual. A wire list of the examples from Section 7 is provided in Appendix E, to illustrate both the complexity, and proper connections for each of the interface types.

4. TRUNK CARDS AND CONNECTIONS

SELECTING A PHONE LINE

This section provides information that relates to the telco side of the FASTNet Switch. Detailed connection listings are given which show the telco terminations of the RJ21X Split-Block terminals from the FASTNet Switch. These RJ21X terminations are then cabled to the RJ2EX 50-pin connectors, which in turn connect to the FASTNet Switch backplane.

This section also tells how to select and configure trunk cards for DID, End-End Loop or Ground Start, E&M 2-Wire, or E&M 4-Wire operation. Adjustment procedures are given for the trunk cards as well as for the optional dial click cards.

This section should help provide an appropriate telephone connection for a particular application. Engineers at Zetron are also available to help with the telephone interface installation and troubleshooting process.

Different types of phone lines can be connected to the FASTNet Switch, requiring specific trunk interface cards and settings:

Dual Telco Card:

- End-to-End Loop Start
- End-to-End Ground Start
- DID (Inbound only trunk)
- E&M 2-Wire (Tie-Trunk)
- Local Telephone
- Zetron Ring Box

Dual 4-Wire Card:

- E&M 4-Wire Type I
- Model 810 Digital Hybrid Interface
- Model 49 Repeater Manager Interface
- Uniden MRS804ZX Repeater Interface
- Microwave Link
- RF Link

See the appropriate following subsections for the different phone line types.

TELCO CONNECTIONS

An RJ21X split-block type punchdown block (Zetron Part No. 802-0263 or equivalent) is recommended for connecting the backplane RJ2EX 50-pin connectors to telephone company supplied registered jacks. Backplane pinouts for these terminations are listed in "TELCO SPLIT-BLOCK TERMINATIONS" and "FASTNet SPLIT-BLOCK TERMINATIONS" in this section.

The Zetron wiring kit p/n 950-9385 includes the 50-pin connectors, cables, and RJ21X Split-Blocks for J19, J20, and J23, as well as the two RJ66M425 terminals required to provide keyed miniature jacks for telco and Model 49 (Zetron Repeater Manager) interfacing.

We recommend pre-assembling all of this telco interfacing hardware neatly onto a painted plywood sheet at the service facility so that this FASTNet Switch and interfacing circuitry may be pre-tested prior to final installation. (Final installation would involve mounting the plywood sheet, etc.)

For End-to-End Loop Start, End-to-End Ground Start, or DID trunks, cross connect only the RING/TIP pair from the FASTNet Switch to the phone company installed jacks. This is usually one or two RJ21X type jacks supplied by the phone company. For these interfaces, TIP1, RING1, E, and M are unused. If miniature keyed (modular) jacks are provided by the telco service, directly connect them to the RJ66M425 keyed miniature jacks using standard 4-wire (telephone-to-wall) cables, available at various retail stores, or use the Zetron 6-wire cables (Part No. 709-7000).

For E&M 2-Wire trunks, cross connect the RING/TIP and E/M pairs to the desired equipment or directly terminate the RJ21X jack of the FASTNet Switch to the phone company installed RJ21X registered jacks. This is usually three or four RJ21X type jacks supplied by the phone company. For these terminations, TIP1 and RING1 are often unused. If miniature keyed (modular) jacks are provided by the telco service, directly connect them to the RJ66M425 keyed miniature jacks using standard 6-Wire cables, available from Zetron (p/n 709-7000).

For E&M 4-Wire trunks, cross connect the RING/TIP (TO TELCO signaling), the RING1/TIP1 (FROM TELCO signaling), and E/M pairs to the desired equipment, or directly terminate the RJ21X jack of the FASTNet Switch to the phone company installed RJ21X registered jacks. This is usually three or four RJ21X type jacks supplied by the phone company. For these terminations all six interface lines are used. If miniature keyed (modular) jacks are provided by the telco service, directly connect them to the RJ66M425 keyed miniature jacks using standard 6-Wire cables, available from Zetron (p/n 709-7000). Also, since FASTNet is designed to work with Type I trunks, which utilize ground-referenced E /M leads, a separate *ground reference* wire must be provided from FASTNet to the telco interface terminal ground. Failure to wire this connection results in unreliable "Wink Start" performance. *This wire is NOT a lightning ground.* Refer to "Signal Grounding" in Section 3 of this manual.

REPEATER CONTROL

The Model 49 Trunking Repeater Manager (or Uniden MRS804ZX Repeater) interfaces to the FASTNet Switch via an E&M 4-Wire Trunk, using all six lines connected through a 6-wire "modular" TELCO patch cord (Zetron Part No. 709-7000). This requires either (1) installation of the RJ66M425 TELCO Jack Terminals which are included in the FASTNet Cable Kit (950-9385), or (2) connecting the 6-wire modular plugs directly to the modular connectors provided on the bottom of the Dual 4-Wire Card assembly (on the Audio Daughter Board). We recommend using the FASTNet Cable Kit interface because the jacks located on the bottom of the Dual 4-Wire Card are awkward to reach. The FRONT (closest to face) jack on the bottom of the Dual 4-Wire Card connects to TRUNK A; the REAR jack connects to TRUNK B.

The RJ21X to RJ66M425 cross-wiring wire lists and the resultant wire connections are provided later in this section, under the heading of "Cross-Wiring". Additionally, jumpers must be configured to properly interface both the Model 49 (MRS804ZX) E&M Card *and* the FASTNet Dual 4-Wire Card. These required jumper settings are provided in "FASTNet Switch to Model 49 or TELCO, Cross-Wiring" on page 4-19.

MICROWAVE AND RF LINKS

Microwave and RF-Link interfaces to the FASTNet system are essentially identical to the Model 49 configuration, except that "E-Lead" functions are translated to "carrier detect" or "COR" signaling, and "M-Lead" functions equate to "PTT" for many of these radio links.

MODEL 810 INTERFACES

Model 810 interfaces to the FASTNet system are similar to the Model 49 interface except that the RJ66M425 interface is the only "convenient" way to wire this configuration. (The bottom jacks of the Dual 4-Wire card *can* be used, but require cable customization in the 6-wire modular cable.) The cross-wiring for the Model 810 differs significantly because the Model 810 RJ11 jack is wired with the audio pairs reversed. Additionally, the Model 810 E/M leads must be reversed in the wiring to the FASTNet Switch. Please refer to the appropriate tables in "FASTNet Switch to Model 810 Cross-Wiring" on page 4-20 for jumper settings and termination wiring.

LIGHTNING PROTECTION

See the interface diagram (Figure 3-8 in Section 3) for a typical FASTNet Switch configuration. Although the illustration only shows primary lightning suppression, both primary and secondary lightning/surge protection are highly recommended.

Primary systems are typically connected to telco lines, antenna cables, power lines, and other "outside" interfaces.

Secondary systems help to further protect your investment from non-warranteed irreparable damages via interfaces within your facility's system (Zetron part number 950-9040 or equivalent recommended for each RJ2EX connector cable used).

TELCO SPLIT-BLOCK TERMINATIONS

The telco interface to a Central Office (CO) or Private Access Branch Exchange (PABX) typically is provided via a 25-pair RJ66 or RJ21X punch-down terminal which has CO/PABX wiring on one side and open terminals on the other side.

RJ21X terminals are wired to a 25-pair connector jack on the side of the terminal block. A 25-pair connectorized cable interfaces from the terminal block jack to the CO/PABX equipment.

RJ66 terminals are punched directly to cabling on both sides, eliminating the 25-pair cable connectors.

Both RJ66 and RJ21X Split-Blocks are configured with 4 terminals side to side by 50 terminals top to bottom. From side to side, the *two left* terminals in each row are electrically identical, and the *two right* terminals are electrically identical. The *two left* terminals are isolated, however, from the *two right* terminals. Normally, "bridging" clips are installed onto the *two center* terminals in order to connect the right-side wiring to the left-side circuits. This provides a means of "opening" circuits (by removing bridging clips) or temporarily re-routing lines (by cross-wiring different circuits) for test purposes.

Also, paired bridging clips (convenience) and fused bridging clips (surge protection) are available from other vendors to facilitate these circuit terminals.

Table 4-1: Typical TELCO E&M 4-Wire Type I Interface and Table 4-2: Typical TELCO 2-Wire Interface provide examples of common pinouts for telco wiring blocks.

FASTNet SPLIT-BLOCK TERMINATIONS

The backplane pinouts of Table 4-3 through Table 4-8 detail the pinouts for the RJ21X Split-Block Terminations for TELCO E&M 4-Wire and for FASTNet interface ports. Each page specifies one Split-Block / Cable / RJ2EX 50-pin Connector assembly for J19, J20, or J23 of Model 2540 and Model 2540EX. Wire colors are shown for standard 25-pair telco cabling. Be sure to reference the backplane pinout for the exact assembly which you are interfacing.

Table 4-1: Typical TELCO E&M 4-Wire Type I Interface

RJ21X pinout	Relative Trunk No	Signal Name	Wire Color (Body/Stripe)	RJ21X pinout	Relative Trunk No	Signal Name	Wire Color (Body/Stripe)
1	1	RING	BLU / WHI	26	1	TIP	WHI / BLU
2	1	RING1	ORG / WHI	27	1	TIP1	WHI / ORG
3	1	M	GRN / WHI	28	1	E	WHI / GRN
4	2	RING	BRN / WHI	29	2	TIP	WHI / BRN
5	2	RING1	SLA / WHI	30	2	TIP1	WHI / SLA
6	2	M	BLU / RED	31	2	E	RED / BLU
7	3	RING	ORG / RED	32	3	TIP	RED / ORG
8	3	RING1	GRN / RED	33	3	TIP1	RED / GRN
9	3	M	BRN / RED	34	3	E	RED / BRN
10	4	RING	SLA / RED	35	4	TIP	RED / SLA
11	4	RING1	BLU / BLK	36	4	TIP1	BLK / BLU
12	4	M	ORG / BLK	37	4	E	BLK / ORG
13	5	RING	GRN / BLK	38	5	TIP	BLK / GRN
14	5	RING1	BRN / BLK	39	5	TIP1	BLK / BRN
15	5	M	SLA / BLK	40	5	E	BLK / SLA
16	6	RING	BLU / YEL	41	6	TIP	YEL / BLU
17	6	RING1	ORG / YEL	42	6	TIP1	YEL / ORG
18	6	M	GRN / YEL	43	6	E	YEL / GRN
19	7	RING	BRN / YEL	44	7	TIP	YEL / BRN
20	7	RING1	SLA / YEL	45	7	TIP1	YEL / SLA
21	7	M	BLU / VIO	46	7	E	VIO / BLU
22	8	RING	ORG / VIO	47	8	TIP	VIO / ORG
23	8	RING1	GRN / VIO	48	8	TIP1	VIO / GRN
24	8	M	BRN / VIO	49	8	E	VIO / BRN
25	CHASSIS GROUND		SLA / VIO	50	CHASSIS GROUND		VIO / SLA

NOTES:

1. Colors are abbreviated as follows:

   BLU = Blue GRN = Green SLA = Slate (grey) VIO = Violet
   ORG = Orange BRN = Brown BLK = Black RED = Red

2. E : "TO_TELCO" supervision line.
   M : "FROM TELCO" supervision line.
3. RING / TIP : Two-Way audio pair for DID, End-to-End, and E&M 2-Wire Tie Trunk Lines.
   : "TO-TELCO" audio pair for E&M 4-Wire to CO trunks.
4. RING1 / TIP1 : Not used for DID, End-to-End, and most E&M 2-Wire tie-trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to CO trunks.
5. RJ21X Connector interfaces to eight E&M 4-Wire Type I trunks.

Table 4-2: Typical TELCO 2-Wire Interface

J19 pinout	Relative Trunk No	Signal Name	Wire Color (Body/Stripe)	J19 pinout	Relative Trunk No	Signal Name	Wire Color (Body/Stripe)
1	1	RING 1	BLU / WHI	26	1	TIP 1	WHI / BLU
2	2	RING 2	ORG / WHI	27	2	TIP 2	WHI / ORG
3	3	RING 3	GRN / WHI	28	3	TIP 3	WHI / GRN
4	4	RING 4	BRN / WHI	29	4	TIP 4	WHI / BRN
5	5	RING 5	SLA / WHI	30	5	TIP 5	WHI / SLA
6	6	RING 6	BLU / RED	31	6	TIP 6	RED / BLU
7	7	RING 7	ORG / RED	32	7	TIP 7	RED / ORG
8	8	RING 8	GRN / RED	33	8	TIP 8	RED / GRN
9	9	RING 9	BRN / RED	34	9	TIP 9	RED / BRN
10	10	RING 10	SLA / RED	35	10	TIP 10	RED / SLA
11	11	RING 11	BLU / BLK	36	11	TIP 11	BLK / BLU
12	12	RING 12	ORG / BLK	37	12	TIP 12	BLK / ORG
13	13	RING 13	GRN / BLK	38	13	TIP 13	BLK / GRN
14	14	RING 14	BRN / BLK	39	14	TIP 14	BLK / BRN
15	15	RING 15	SLA / BLK	40	15	TIP 15	BLK / SLA
16	16	RING 16	BLU / YEL	41	16	TIP 16	YEL / BLU
17	17	RING 17	ORG / YEL	42	17	TIP 17	YEL / ORG
18	18	RING 18	GRN / YEL	43	18	TIP 18	YEL / GRN
19	19	RING 19	BRN / YEL	44	19	TIP 19	YEL / BRN
20	20	RING 20	SLA / YEL	45	20	TIP 20	YEL / SLA
21	21	RING 21	BLU / VIO	46	21	TIP 21	VIO / BLU
22	22	RING 22	ORG / VIO	47	22	TIP 22	VIO / ORG
23	23	RING 23	GRN / VIO	48	23	TIP 23	VIO / GRN
24	24	RING 24	BRN / VIO	49	24	TIP 24	VIO / BRN
25	CHASSIS GROUND		SLA / VIO	50	CHASSIS GROUND		VIO / SLA

NOTES:

1. Colors are abbreviated as follows:

   BLU = Blue GRN = Green SLA = Slate (grey) VIO = Violet
   ORG = Orange BRN = Brown BLK = Black RED = Red

2. E : "TO_TELCO" supervision line.
   M : "FROM TELCO" supervision line.
3. RING / TIP : Two-Way audio pair for DID, End-to-End, and E&M 2-Wire Tie Trunk Lines.
   : "TO-TELCO" audio pair for E&M 4-Wire to CO trunks.
4. RING1 / TIP1 : Not used for DID, End-to-End, and most E&M 2-Wire tie-trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to CO trunks.
5. RJ21X Connector interfaces to eight E&M 4-Wire Type I trunks.
6. CHASSIS GROUND may not actually be connected to telco earth ground - use caution.

Table 4-3: FASTNet Model 2540 Backplane Pinout for J19

J19 pinout	Chassis Card Slot	Signal Name	Wire Color (Body/Stripe)	J19 pinout	Chassis Card Slot	Signal Name	Wire Color (Body/Stripe)
1	7	RING 7A	BLU / WHI	26	7	TIP 7A	WHI / BLU
2	7	RING1 7A	ORG / WHI	27	7	TIP1 7A	WHI / ORG
3	7	M 7A	GRN / WHI	28	7	E 7A	WHI / GRN
4	7	RING 7B	BRN / WHI	29	7	TIP 7B	WHI / BRN
5	7	RING1 7B	SLA / WHI	30	7	TIP1 7B	WHI / SLA
6	7	M 7B	BLU / RED	31	7	E 7B	RED / BLU
7	8	RING 8A	ORG / RED	32	8	TIP 8A	RED / ORG
8	8	RING1 8A	GRN / RED	33	8	TIP1 8A	RED / GRN
9	8	M 8A	BRN / RED	34	8	E 8A	RED / BRN
10	8	RING 8B	SLA / RED	35	8	TIP 8B	RED / SLA
11	8	RING1 8B	BLU / BLK	36	8	TIP1 8B	BLK / BLU
12	8	M 8B	ORG / BLK	37	8	E 8B	BLK / ORG
13	9	RING 9A	GRN / BLK	38	9	TIP 9A	BLK / GRN
14	9	RING1 9A	BRN / BLK	39	9	TIP1 9A	BLK / BRN
15	9	M 9A	SLA / BLK	40	9	E 9A	BLK / SLA
16	9	RING 9B	BLU / YEL	41	9	TIP 9B	YEL / BLU
17	9	RING1 9B	ORG / YEL	42	9	TIP1 9B	YEL / ORG
18	9	M 9B	GRN / YEL	43	9	E 9B	YEL / GRN
19	10	RING 10A	BRN / YEL	44	10	TIP 10A	YEL / BRN
20	10	RING1 10A	SLA / YEL	45	10	TIP1 10A	YEL / SLA
21	10	M 10A	BLU / VIO	46	10	E 10A	VIO / BLU
22	10	RING 10B	ORG / VIO	47	10	TIP 10B	VIO / ORG
23	10	RING1 10B	GRN / VIO	48	10	TIP1 10B	VIO / GRN
24	10	M 10B	BRN / VIO	49	10	E 10B	VIO / BRN
25	CHASSIS GROUND		SLA / VIO	50	CHASSIS GROUND		VIO / SLA

NOTES:

1. "—" represents *no* connection.
2. Signal Names ending in "A" denote Trunk A connections, and Signal Names ending in "B" denote Trunk B connections for both the Dual 4-Wire Card (702-9460), and the Dual TELCO Card (702-9457).

   Example: "RING 10A" is the [telco] RING signal from 'TRUNK A' of the dual trunk card plugged into 'SLOT 10' of the chassis.
3. RING / TIP : Two-Way audio pair for DID, End-to-End, and E&M 2-Wire Tie Trunk Lines.
   : "TO-TELCO" audio pair for E&M 4-Wire to CO trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to Zetron Model 49 interfaces.
4. RING1 / TIP1 : Not used for DID, End-to-End, and most E&M 2-Wire tie-trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to CO trunks.
   : "TO-TELCO" audio pair for E&M 4-Wire to Zetron Model 49 interfaces.
5. Connector J19 interfaces dual trunk cards plugged into SLOTS 7, 8, 9, 10 of the Main Chassis. This equates to eight trunks.

Table 4-4: FASTNet Model 2540 Backplane Pinout for J20

J20 pinout	Chassis Card Slot	Signal Name	Wire Color (Body/Stripe)	J20 pinout	Chassis Card Slot	Signal Name	Wire Color (Body/Stripe)
1	11	RING 11A	BLU / WHI	26	11	TIP 11A	WHI / BLU
2	11	RING1 11A	ORG / WHI	27	11	TIP1 11A	WHI / ORG
3	11	M 11A	GRN / WHI	28	11	E 11A	WHI / GRN
4	11	RING 11B	BRN / WHI	29	11	TIP 11B	WHI / BRN
5	11	RING1 11B	SLA / WHI	30	11	TIP1 11B	WHI / SLA
6	11	M 11B	BLU / RED	31	11	E 11B	RED / BLU
7	12	RING 12A	ORG / RED	32	12	TIP 12A	RED / ORG
8	12	RING1 12A	GRN / RED	33	12	TIP1 12A	RED / GRN
9	12	M 12A	BRN / RED	34	12	E 12A	RED / BRN
10	12	RING 12B	SLA / RED	35	12	TIP 12B	RED / SLA
11	12	RING1 12B	BLU / BLK	36	12	TIP1 12B	BLK / BLU
12	12	M 12B	ORG / BLK	37	12	E 12B	BLK / ORG
13	13	RING 13A	GRN / BLK	38	13	TIP 13A	BLK / GRN
14	13	RING1 13A	BRN / BLK	39	13	TIP1 13A	BLK / BRN
15	13	M 13A	SLA / BLK	40	13	E 13A	BLK / SLA
16	13	RING 13B	BLU / YEL	41	13	TIP 13B	YEL / BLU
17	13	RING1 13B	ORG / YEL	42	13	TIP1 13B	YEL / ORG
18	13	M 13B	GRN / YEL	43	13	E 13B	YEL / GRN
19	14	RING 14A	BRN / YEL	44	14	TIP 14A	YEL / BRN
20	14	RING1 14A	SLA / YEL	45	14	TIP1 14A	YEL / SLA
21	14	M 14A	BLU / VIO	46	14	E 14A	VIO / BLU
22	14	RING 14B	ORG / VIO	47	14	TIP 14B	VIO / ORG
23	14	RING1 14B	GRN / VIO	48	14	TIP1 14B	VIO / GRN
24	14	M 14B	BRN / VIO	49	14	E 14B	VIO / BRN
25	CHASSIS GROUND		SLA / VIO	50	CHASSIS GROUND		VIO / SLA

NOTES:

1. "—" represents *no* connection.
2. Signal Names ending in "A" denote Trunk A connections, and Signal Names ending in "B" denote Trunk B connections for both the Dual 4-Wire Card (702-9460), and the Dual TELCO Card (702-9457).

   Example: "RING 10A" is the [telco] RING signal from 'TRUNK A' of the dual trunk card plugged into 'SLOT 10' of the chassis.
3. RING / TIP : Two-Way audio pair for DID, End-to-End, and E&M 2-Wire Tie Trunk Lines.
   : "TO-TELCO" audio pair for E&M 4-Wire to CO trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to Zetron Model 49 interfaces.
4. RING1 / TIP1 : Not used for DID, End-to-End, and most E&M 2-Wire tie-trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to CO trunks.
   : "TO-TELCO" audio pair for E&M 4-Wire to Zetron Model 49 interfaces.
5. Connector J19 interfaces dual trunk cards plugged into SLOTS 7, 8, 9, 10 of The Main Chassis. This equates to eight trunks.

Table 4-5: FASTNet Model 2540 Backplane Pinout for J23

J23 pinout	Chassis Card Slot	Signal Name	Wire Color (Body/Stripe)	J23 pinout	Chassis Card Slot	Signal Name	Wire Color (Body/Stripe)
1	15	RING 15A	BLU / WHI	26	15	TIP 15A	WHI / BLU
2	15	RING1 15A	ORG / WHI	27	15	TIP1 15A	WHI / ORG
3	15	M 15A	GRN / WHI	28	15	E 15A	WHI / GRN
4	15	RING 15B	BRN / WHI	29	15	TIP 15B	WHI / BRN
5	15	RING1 15B	SLA / WHI	30	15	TIP1 15B	WHI / SLA
6	15	M 15B	BLU / RED	31	15	E 15B	RED / BLU
7	16	RING 16A	ORG / RED	32	16	TIP 16A	RED / ORG
8	16	RING1 16A	GRN / RED	33	16	TIP1 16A	RED / GRN
9	16	M 16A	BRN / RED	34	16	E 16A	RED / BRN
10	16	RING 16B	SLA / RED	35	16	TIP 16B	RED / SLA
11	16	RING1 16B	BLU / BLK	36	16	TIP1 16B	BLK / BLU
12	16	M 16B	ORG / BLK	37	16	E 16B	BLK / ORG
13	---		GRN / BLK	38	---		BLK / GRN
14	---		BRN / BLK	39	---		BLK / BRN
15	---		SLA / BLK	40	---		BLK / SLA
16	---		BLU / YEL	41	---		YEL / BLU
17	---		ORG / YEL	42	---		YEL / ORG
18	---		GRN / YEL	43	---		YEL / GRN
19	---		BRN / YEL	44	---		YEL / BRN
20	---		SLA / YEL	45	---		YEL / SLA
21	---		BLU / VIO	46	---		VIO / BLU
22	---		ORG / VIO	47	---		VIO / ORG
23	---		GRN / VIO	48	---		VIO / GRN
24	---		BRN / VIO	49	---		VIO / BRN
25	CHASSIS GROUND		SLA / VIO	50	CHASSIS GROUND		VIO / SLA

NOTES:

1. "—" represents *no* connection.
2. Signal Names ending in "A" denote Trunk A connections, and Signal Names ending in "B" denote Trunk B connections for both the Dual 4-Wire Card (702-9460), and the Dual TELCO Card (702-9457).

   Example: "RING 10A" is the [telco] RING signal from 'TRUNK A' of the dual trunk card plugged into 'SLOT 10' of the chassis.
3. RING / TIP : Two-Way audio pair for DID, End-to-End, and E&M 2-Wire Tie Trunk Lines.
   : "TO-TELCO" audio pair for E&M 4-Wire to CO trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to Zetron Model 49 interfaces.
4. RING1 / TIP1 : Not used for DID, End-to-End, and most E&M 2-Wire tie-trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to CO trunks.
   : "TO-TELCO" audio pair for E&M 4-Wire to Zetron Model 49 interfaces.
5. Connector J19 interfaces dual trunk cards plugged into SLOTS 7, 8, 9, 10 of The Main Chassis. This equates to eight trunks.

Table 4-6: FASTNet Model 2540EX Backplane Pinout for J19

J19 pinout	Chassis Card Slot	Signal Name	Wire Color (Body/Stripe)	J19 pinout	Chassis Card Slot	Signal Name	Wire Color (Body/Stripe)
1	4	RING 4A	BLU / WHI	26	4	TIP 4A	WHI / BLU
2	4	RING1 4A	ORG / WHI	27	4	TIP1 4A	WHI / ORG
3	4	M 4A	GRN / WHI	28	4	E 4A	WHI / GRN
4	4	RING 4B	BRN / WHI	29	4	TIP 4B	WHI / BRN
5	4	RING1 4B	SLA / WHI	30	4	TIP1 4B	WHI / SLA
6	4	M 4B	BLU / RED	31	4	E 4B	RED / BLU
7	5	RING 5A	ORG / RED	32	5	TIP 5A	RED / ORG
8	5	RING1 5A	GRN / RED	33	5	TIP1 5A	RED / GRN
9	5	M 5A	BRN / RED	34	5	E 5A	RED / BRN
10	5	RING 5B	SLA / RED	35	5	TIP 5B	RED / SLA
11	5	RING1 5B	BLU / BLK	36	5	TIP1 5B	BLK / BLU
12	5	M 5B	ORG / BLK	37	5	E 5B	BLK / ORG
13	6	RING 6A	GRN / BLK	38	6	TIP 6A	BLK / GRN
14	6	RING1 6A	BRN / BLK	39	6	TIP1 6A	BLK / BRN
15	6	M 6A	SLA / BLK	40	6	E 6A	BLK / SLA
16	6	RING 6B	BLU / YEL	41	6	TIP 6B	YEL / BLU
17	6	RING1 6B	ORG / YEL	42	6	TIP1 6B	YEL / ORG
18	6	M 6B	GRN / YEL	43	6	E 6B	YEL / GRN
19	7	RING 7A	BRN / YEL	44	7	TIP 7A	YEL / BRN
20	7	RING1 7A	SLA / YEL	45	7	TIP1 7A	YEL / SLA
21	7	M 7A	BLU / VIO	46	7	E 7A	VIO / BLU
22	7	RING 7B	ORG / VIO	47	7	TIP 7B	VIO / ORG
23	7	RING1 7B	GRN / VIO	48	7	TIP1 7B	VIO / GRN
24	7	M 7B	BRN / VIO	49	7	E 7B	VIO / BRN
25	CHASSIS GROUND		SLA / VIO	50	CHASSIS GROUND		VIO / SLA

NOTES:

1. "---" represents *no* connection.
2. Signal Names ending in "A" denote Trunk A connections, and Signal Names ending in "B" denote Trunk B connections for both the Dual 4-Wire Card (702-9460), and the Dual TELCO Card (702-9457).

   Example: "RING 10A" is the [telco] RING signal from 'TRUNK A' of the dual trunk card plugged into 'SLOT 10' of the chassis.
3. RING / TIP : Two-Way audio pair for DID, End-to-End, and E&M 2-Wire Tie Trunk Lines.
   : "TO-TELCO" audio pair for E&M 4-Wire to CO trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to Zetron Model 49 interfaces.
4. RING1 / TIP1 : Not used for DID, End-to-End, and most E&M 2-Wire tie-trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to CO trunks.
   : "TO-TELCO" audio pair for E&M 4-Wire to Zetron Model 49 interfaces.
5. Connector J19 interfaces dual trunk cards plugged into SLOTS 7, 8, 9, 10 of The Main Chassis. This equates to eight trunks.

Table 4-7: FASTNet Model 2540EX Backplane Pinout for J20

J20 pinout	Chassis Card Slot	Signal Name	Wire Color (Body/Stripe)	J20 pinout	Chassis Card Slot	Signal Name	Wire Color (Body/Stripe)
1	8	RING 8A	BLU / WHI	26	8	TIP 8A	WHI / BLU
2	8	RING1 8A	ORG / WHI	27	8	TIP1 8A	WHI / ORG
3	8	M 8A	GRN / WHI	28	8	E 8A	WHI / GRN
4	8	RING 8B	BRN / WHI	29	8	TIP 8B	WHI / BRN
5	8	RING1 8B	SLA / WHI	30	8	TIP1 8B	WHI / SLA
6	8	M 8B	BLU / RED	31	8	E 8B	RED / BLU
7	9	RING 9A	ORG / RED	32	9	TIP 9A	RED / ORG
8	9	RING1 9A	GRN / RED	33	9	TIP1 9A	RED / GRN
9	9	M 9A	BRN / RED	34	9	E 9A	RED / BRN
10	9	RING 9B	SLA / RED	35	9	TIP 9B	RED / SLA
11	9	RING1 9B	BLU / BLK	36	9	TIP1 9B	BLK / BLU
12	9	M 9B	ORG / BLK	37	9	E 9B	BLK / ORG
13	10	RING 10A	GRN / BLK	38	10	TIP 10A	BLK / GRN
14	10	RING1 10A	BRN / BLK	39	10	TIP1 10A	BLK / BRN
15	10	M 10A	SLA / BLK	40	10	E 10A	BLK / SLA
16	10	RING 10B	BLU / YEL	41	10	TIP 10B	YEL / BLU
17	10	RING1 10B	ORG / YEL	42	10	TIP1 10B	YEL / ORG
18	10	M 10B	GRN / YEL	43	10	E 10B	YEL / GRN
19	11	RING 11A	BRN / YEL	44	11	TIP 11A	YEL / BRN
20	11	RING1 11A	SLA / YEL	45	11	TIP1 11A	YEL / SLA
21	11	M 11A	BLU / VIO	46	11	E 11A	VIO / BLU
22	11	RING 11B	ORG / VIO	47	11	TIP 11B	VIO / ORG
23	11	RING1 11B	GRN / VIO	48	11	TIP1 11B	VIO / GRN
24	11	M 11B	BRN / VIO	49	11	E 11B	VIO / BRN
25	CHASSIS GROUND		SLA / VIO	50	CHASSIS GROUND		VIO / SLA

NOTES:

1. "—" represents *no* connection.
2. Signal Names ending in "A" denote Trunk A connections, and Signal Names ending in "B" denote Trunk B connections for both the Dual 4-Wire Card (702-9460), and the Dual TELCO Card (702-9457).

   Example: "RING 10A" is the [telco] RING signal from 'TRUNK A' of the dual trunk card plugged into 'SLOT 10' of the chassis.
3. RING / TIP : Two-Way audio pair for DID, End-to-End, and E&M 2-Wire Tie Trunk Lines.
   : "TO-TELCO" audio pair for E&M 4-Wire to CO trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to Zetron Model 49 interfaces.
4. RING1 / TIP1 : Not used for DID, End-to-End, and most E&M 2-Wire tie-trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to CO trunks.
   : "TO-TELCO" audio pair for E&M 4-Wire to Zetron Model 49 interfaces.
5. Connector J19 interfaces dual trunk cards plugged into SLOTS 7, 8, 9, 10 of The Main Chassis. This equates to eight trunks.

Table 4-8: FASTNet Model 2540EX Backplane Pinout for J23

J23 pinout	Chassis Card Slot	Signal Name	Wire Color (Body/Stripe)	J23 pinout	Chassis Card Slot	Signal Name	Wire Color (Body/Stripe)
1	12	RING 12A	BLU / WHI	26	12	TIP 12A	WHI / BLU
2	12	RING1 12A	ORG / WHI	27	12	TIP1 12A	WHI / ORG
3	12	M 12A	GRN / WHI	28	12	E 12A	WHI / GRN
4	12	RING 12B	BRN / WHI	29	12	TIP 12B	WHI / BRN
5	12	RING1 12B	SLA / WHI	30	12	TIP1 12B	WHI / SLA
6	12	M 12B	BLU / RED	31	12	E 12B	RED / BLU
7	13	RING 13A	ORG / RED	32	13	TIP 13A	RED / ORG
8	13	RING1 13A	GRN / RED	33	13	TIP1 13A	RED / GRN
9	13	M 13A	BRN / RED	34	13	E 13A	RED / BRN
10	13	RING 13B	SLA / RED	35	13	TIP 13B	RED / SLA
11	13	RING1 13B	BLU / BLK	36	13	TIP1 13B	BLK / BLU
12	13	M 13B	ORG / BLK	37	13	E 13B	BLK / ORG
13	---		GRN / BLK	38	---		BLK / GRN
14	---		BRN / BLK	39	---		BLK / BRN
15	---		SLA / BLK	40	---		BLK / SLA
16	---		BLU / YEL	41	---		YEL / BLU
17	---		ORG / YEL	42	---		YEL / ORG
18	---		GRN / YEL	43	---		YEL / GRN
19	---		BRN / YEL	44	---		YEL / BRN
20	---		SLA / YEL	45	---		YEL / SLA
21	---		BLU / VIO	46	---		VIO / BLU
22	---		ORG / VIO	47	---		VIO / ORG
23	---		GRN / VIO	48	---		VIO / GRN
24	---		BRN / VIO	49	---		VIO / BRN
25	CHASSIS GROUND		SLA / VIO	50	CHASSIS GROUND		VIO / SLA

NOTES:

1. "---" represents *no* connection.
2. Signal Names ending in "A" denote Trunk A connections, and Signal Names ending in "B" denote Trunk B connections for both the Dual 4-Wire Card (702-9460), and the Dual TELCO Card (702-9457).

   Example: "RING 10A" is the [telco] RING signal from 'TRUNK A' of the dual trunk card plugged into 'SLOT 10' of the chassis.
3. RING / TIP : Two-Way audio pair for DID, End-to-End, and E&M 2-Wire Tie Trunk Lines.
   : "TO-TELCO" audio pair for E&M 4-Wire to CO trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to Zetron Model 49 interfaces.
4. RING1 / TIP1 : Not used for DID, End-to-End, and most E&M 2-Wire tie-trunks.
   : "FROM-TELCO" audio pair for E&M 4-Wire to CO trunks.
   : "TO-TELCO" audio pair for E&M 4-Wire to Zetron Model 49 interfaces.
5. Connector J19 interfaces dual trunk cards plugged into SLOTS 7, 8, 9, 10 of The Main Chassis. This equates to eight trunks.

Split-Block Terminal Layout

Both FASTNet and telco E&M 4-Wire split-blocks are arranged the same, with regards to the electrical wire assignments of the E&M interface.

The FASTNet is further identified by Trunk Card ***Slot*** number and *backplane connector* number to identify exactly which circuit is being wired or analyzed to/from the FASTNet Switch. These backplane connector and slot relationships are mapped in Figure 4-1 along the right side of the illustration. Main (Model 2540) and Expand (Model 2540EX) Chassis slot numbers are separated by columns, and listed per trunk wire-group, in the form of {backplane connector ; card slot (A or B trunk)}

The *SLOT* number refers to the hardware slot in which the dual trunk card is *physically* inserted. These slot numbers are shown in Figure 3-1: Model 2540 Card Slot Assignments, and Figure 3-2: Model 2540EX Card Slot Assignments, as well as being silk-screened onto the top horizontal rail of either chassis cardcage. Please observe that the Model 2540 and Model 2540EX chassis slot numbers are not the same: Model 2540 dual trunks are inserted into slots 7-16, whereas Model 2540EX dual trunks are inserted into slots 4-13. Additionally, when programming the dual trunk cards, the card "address" is a function of the DIP switches on each card, and *NOT* related to the physical *slot* location of the card. The physical slot location *does*, however, determine the hardwired circuit which is interfaced to each trunk card via the *backplane connector* (J19, J20, or J23) and the RJ21X and/or RJ66M425 FASTNet terminal. This is illustrated in Figure 4-2.

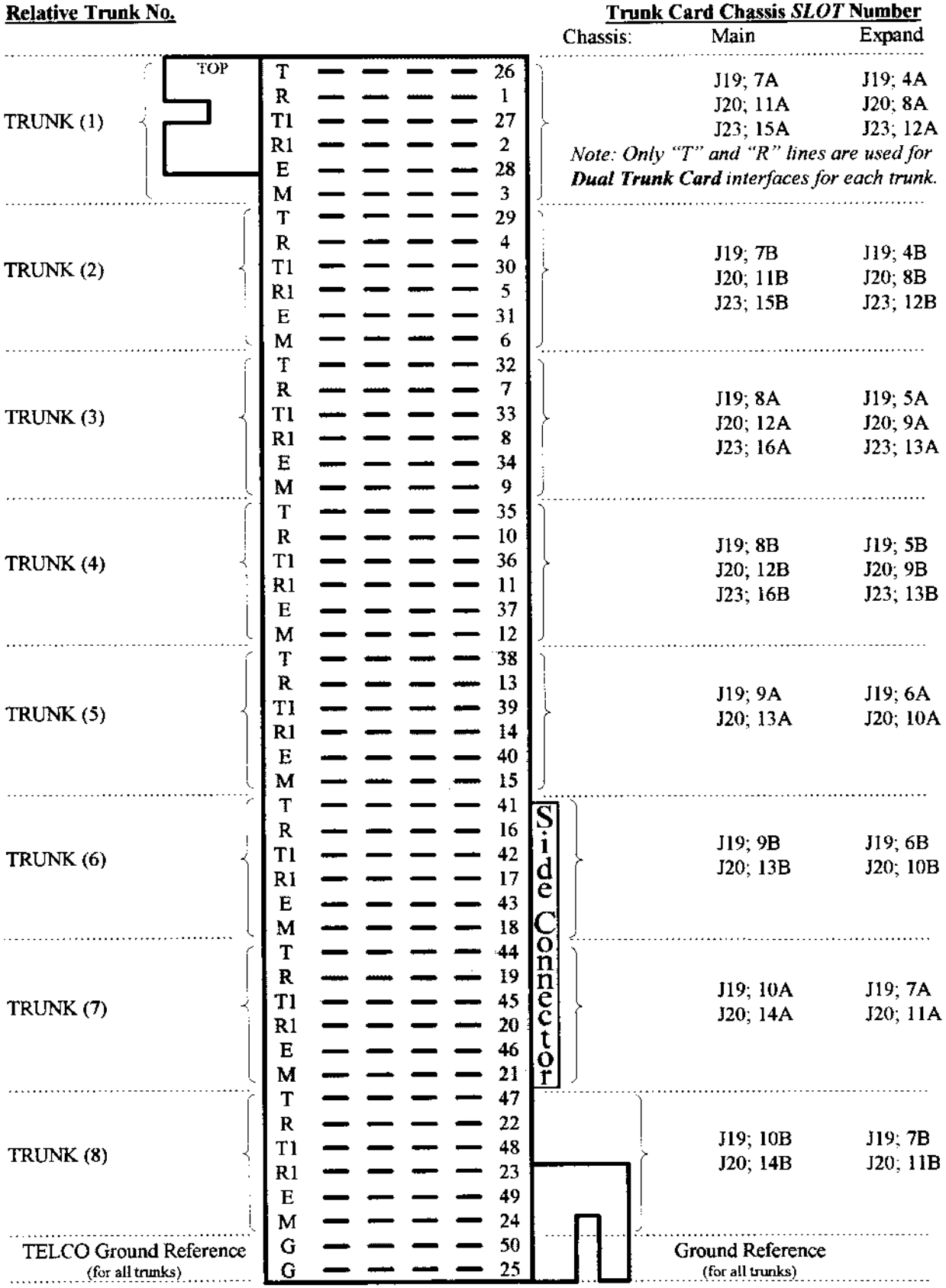


Figure 4-1. RJ21X Block Pin-Out - TELCO and FASTNet E&M 4-Wire

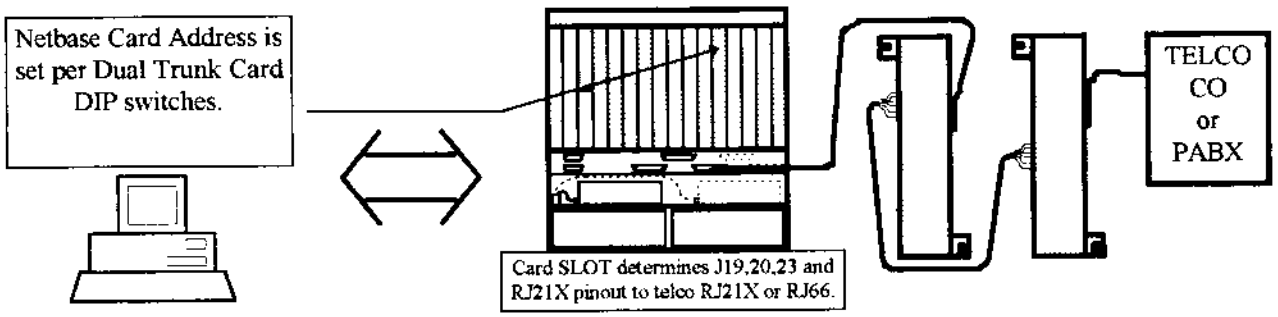


Figure 4-2. FASTNet Card Address vs Card Slot

The front view of a typical RJ21X Split-Block Terminal (802-0263), shown in Figure 4-1, is essentially identical to an RJ66 Block (the RJ66 has no pre-wired connector on the side). *No labels exist on the RJ21X or RJ66 terminal blocks as shipped. It is VERY much worthwhile to take a few moments and label these terminals prior to wiring, to avoid confusion.* The numbers illustrated on the right of the block-face represent the side-connector pinouts for an RJ21X terminal block. These numbers also represent the pinouts at J19, J20, and/or J23 of the FASTNet Model 2540 or Model 2540EX chassis, as appropriate. The labels illustrated on the left of the block-face represent the E&M 4-wire functions of each trunk, relative to the telco end of the line. FASTNet wire function labels are identical to "telco" labels, so that 1:1 cross connection is used, and *no* wire pair 'reversals' nor other inconveniences are required. TELCO RJ21X terminations would appear identical to this for E&M 4-Wire interfaces.

Figure 4-1 lists "Relative Trunk No." on the left of the illustration to further emphasize that only eight FASTNet trunks (four "dual trunk" cards) are interfaced per RJ21X block. These 'relative' numbers are not important for anything other than this discussion. This is why the FASTNet utilizes 2-½ blocks for 20 trunks (10 dual trunk cards) per chassis. A sixty trunk FASTNet Switch would therefore utilize nine RJ21X blocks of interface wiring, which must be clearly labeled or documented for sanity' sake. Photocopies of Figure 4-1 would be useful for any future troubleshooting, if labeled with installation and termination notes.

RJ21X terminations, from telco or FASTNet to each block, would be wired to the right side of the terminal block via the side connector and cable interface. Therefore, *all cross-connection wiring is connected between the left-hand sides of these terminal blocks,* from telco block to FASTNet block, etc.

CROSS-WIRING

TELCO Cross-Wiring

Verify final telco-side wiring for the particular installation with the telco technician who performed the installation. There is a high probability that Table 4-1 will provide the correct E&M 4-Wire pinouts, or that Table 4-2 will provide the correct End-to-End pinouts for the RJ21X or RJ66 terminal(s). Specific trunk number ("telephone number") assignments should also be noted at that time, for future service purposes.

RJ21X (802-0263) to RJ66M425 (802-0264) Cross-Wiring

The RJ66M425 (802-0264) terminal block is provided with the FASTNet Custom Wiring Harness Kit (950-9385) in order to ease the interconnection from FASTNet to the "Real" world of RJ11-type four-wire, six-wire, and eight-wire interfaces, as required.

The 12 'modular' 8-wire connectors of the RJ66M425 terminal are numbered from 1 to 6 down each side, and are pre-wired to punch-down terminations. These punch-down terminations are cross-wired by the installation technician to the RJ21X split-block terminals of the FASTNet Switch, thereby providing a signal path via 4-wire, 6-wire, or 8-wire modular cable to/from FASTNet trunks as required.

The electrical pinouts and front view are provided in Figure 4-3. Using the socket pinout at left, identify the TIP/RING pair required, and then punch that pair into the terminal block as identified from the RJ66M425 block diagram at the right of Figure 4-3.

Example: To punch down a typical 2-wire trunk for "modular" cable interface to the telco equipment:

(1) Standard telco wiring uses the "P1" pair (center pair of a 4-wire or 6-wire plug) for the TIP/RING lines of a 2-wire trunk interface.

(2) Determine the socket to be used for this interface; e.g. Left side J4. Locate J4, P1 on the left side of the block (9^{th} punch row up from bottom, or 16^{th} row down from top)

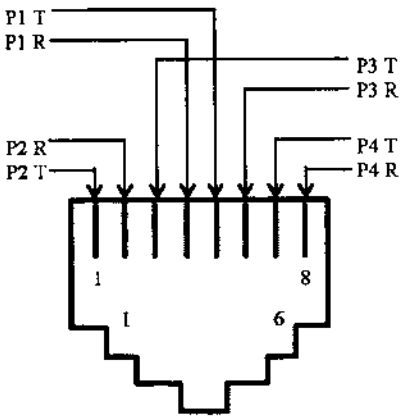
(3) Connect the left (T) terminal to the TIP lead of the FASTNet 2-wire Trunk to be interfaced, and the second-from-left (R) terminal to the RING lead.

(4) Plug in the telco cable and proceed to the "Adjustment Procedures" for that telco 2-wire trunk type.

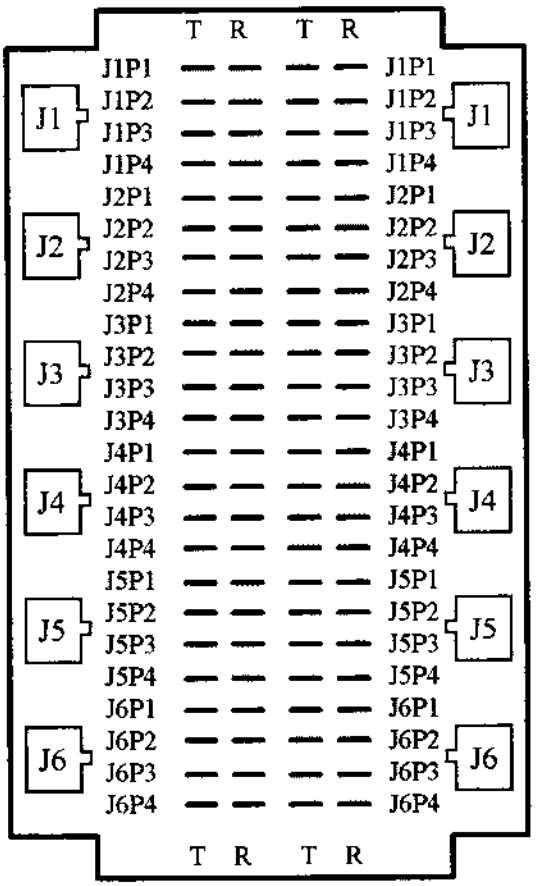
Also, be sure FASTNet has been programmed for the appropriate trunk operation to facilitate the line. Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270).

Programming a 4-wire trunk would be similar to the 2-wire example cited, but would utilize all of the six center lines (P2 R through P4 T) in the socket, represented by the shaded area in the socket diagram of Figure 4-3. These 6 wires are identified by the 8-wire jack pair

designations, and by the 6-wire pinouts in the next two subsections. Cross-wiring color pairs and point-to-point punch-down connections for each of these specific interfaces are also provided in the next subsection.



8-Wire Miniature
Keyed Jacks (12 each)
Front (Insertion) View



Notes:

1. P1, P2, P3, P4 above refer to the 8-wire miniature jack "pair" used.
2. T, R above refer to the "TIP" and "RING" designations of the wires in each pair.
3. The punch-down terminals, shown as horizontal bars in the drawing at right, are shaded to emphasize the relationship to corresponding miniature jacks. Right-side and left-side jacks are *NOT* parallel wired.
4. Each miniature jack will properly seat either a 4-wire, a 6-wire, or an 8-wire "modular" plug. The 6-wire plug position and pinout, typically used with FASTNet E&M 4-Wire applications, has been shaded above for convenience of the installation technician.

Figure 4-3: RJ66M425 Electrical Connections

FASTNet Switch to Model 49 or TELCO, Cross-Wiring

FASTNet to CO or PABX E&M 4-Wire interfaces should be wired to the RJ66M425 terminal blocks using the Model 49 cross-wiring configuration as shown in Table 4-9. Microwave and RF link interfaces also will be similar to the Model 49. The interface wiring shown in Table 4-10 results from the cross-wiring listed in Table 4-9. The "↔" column indicates the direction of signal flow for the interface.

Table 4-11 specifies jumper configurations for the Model 49 or telco interface. Revision levels of the trunk card hardware should be verified as noted in the table.

The jumper(s) on the Dual 4-Wire Card may require re-setting (refer to the Dual 4-Wire Card discussion later in this section), dependent upon the signaling requirements of the equipment at the other end of the trunk circuit.

Table 4-9: FASTNet to Model 49 or TELCO Cross-Wiring

FASTNet Switch RJ21X Split-Block	Line Function	RJ66M425 (Selected Jack)	Wire Color Code (from 6-wire cable)
T	AUDIO TO: TELCO, M49, etc.	P1 T	White / Blue stripe
R	AUDIO TO: TELCO, M49, etc.	P1 R	Blue / White stripe
T1	AUDIO FROM: TELCO, M49,...	P3 T	White / Orange stripe
R1	AUDIO FROM: TELCO, M49,...	P3 R	Orange / White stripe
E	Supervision FROM FASTNet	P2 R	White / Green stripe
M	Supervision TO FASTNet	P4 T	Green / White stripe

NOTE: These connections are repeated for each and every trunk of this type to be used.

Table 4-10: E&M 4-Wire "Modular" Connections - Model 49 vs FASTNet

Model 49		↔	FASTNet Switch			
J1 Pin	E&M 4-Wire Card Function	?	Dual 4-Wire Trunk Function		J1/J2	RJ466M425 (6-Wire Plug)
6	M; Jumper for INPUT	←	E;	Supervision OUTPUT	1	P2 R (1)
5	R2; TO FASTNet - RING	→	T1;	Rx Audio - TIP	2	P3 T (2)
4	T1; FROM FASTNet - TIP	←	R;	Tx Audio - RING	3	P1 R (3)
3	R1; FROM FASTNet - RING	←	T;	Tx Audio - TIP	4	P1 T (4)
2	T2; TO FASTNet- TIP	→	R1;	Rx Audio- RING	5	P3 R (5)
1	E; Jumper for OUTPUT	→	M;	Supervision INPUT	6	P4 T (6)

Table 4-11: Jumper Settings for FASTNet - Model 49 Interface

Jumper Number	Jumper Position Required				
	Dual 4-Wire Card Audio Daughter Board Rev A	Dual 4-Wire Card Audio Daughter Board Rev B		Model 49 E&M 4-Wire TELCO Card	
		Trunk A	Trunk B	702-9228 OR 702-9445B	702-9445C
1	A	A	---	BB	BB
2	---	---	A	A	A
3	---	A	---	A	A
4	---	---	A	A	A
5	---	A	---	---	A
6	---	---	A	---	A

FASTNet Switch to Model 810 Cross-Wiring

Model 810 trunk circuits should be cross-wired per Table 4-12. These circuits require TIP and RING of each audio pair to be twisted, and the E/M pair to be twisted, to compensate for the twist effects of the modular telco cable (Part No. 709-7000) connecting Model 810 to FASTNet. Table 4-13 shows the resultant circuit wiring listed in Table 4-12. The "↔" column indicates the direction of signal flow for the interface.

For the jumper settings for FASTNet–Model 810 interface, see Table 4-14.

Table 4-12: FASTNet to Model 810 Cross-Wiring

FASTNet Switch RJ21X Split-Block	Line Function	RJ66M425 (Selected Jack)	Wire Color Code (from 6-wire cable)
T	AUDIO TO: TELCO, M49, etc.	P3 R	White / Blue stripe
R	AUDIO TO: TELCO, M49, etc.	P3 T	Blue / White stripe
T1	AUDIO FROM: TELCO, M49,...	P1 R	White / Orange stripe
R1	AUDIO FROM: TELCO, M49,...	P1 T	Orange / White stripe
E	Supervision FROM FASTNet	P4 T	White / Green stripe
M	Supervision TO FASTNet	P2 R	Green / White stripe

NOTE: These connections are repeated for each and every trunk of this type to be used.

Table 4-13: E&M 4-Wire "Modular" Connections - Model 810 vs FASTNet

Model 810			↔	FASTNet Switch			
J1 Pin	E&M 4-Wire Card Function		?	Dual 4-Wire Trunk Function		J1/J2	RJ466M425 (6-Wire Plug)
1	E;	Jumper for OUTPUT	←	E;	Supervision OUTPUT	1	P4 T (6)
4	T1;	TO FASTNet - TIP	→	T1;	Rx Audio - TIP	2	P1 R (3)
5	R2;	FROM FASTNet - RING	←	R;	Tx Audio - RING	3	P3 T (2)
2	T2;	FROM FASTNet- TIP	←	T;	Tx Audio - TIP	4	P3 R (5)
3	R1;	TO FASTNet - RING	→	R1;	Rx Audio- RING	5	P1 T (4)
6	M;	Jumper for INPUT	→	M;	Supervision INPUT	6	P2 R (1)

Table 4-14: Jumper Settings for FASTNet - Model 810 Interface

Jumper Number	Jumper Position Required				
	Dual 4-Wire Card Audio Daughter Board Rev A	Dual 4-Wire Card Audio Daughter Board Rev B		Model 810 Digital Hybrid	
		Trunk A	Trunk B	E-E 702-9375 or DID 702-9387	E-E 702-9461 or DID 702-9462
1	A	A	---	B	IN
2	---	---	A	B	A
3	---	A	---	---	C
4	---	---	A	---	C
5	---	A	---	---	A
6	---	---	A	---	OPEN
7	---	---	---	---	B
8	---	---	---	---	A or B
9	---	---	---	---	OPEN

RELABELING

The FASTNet Switch will not, of course, generate regular problems. However, even the most well-protected properly installed circuits can occasionally succumb to lightning, corroded terminal connections, failed CO trunks, etc.

Due to the inherent complexity of a complete FASTNet System, service personnel may become overwhelmed when the first urgent situation arises requiring system troubleshooting. Labeling all of the trunk connections carefully at the time of installation and "Mapping" the trunk interfaces is beneficial for system management and provides a "backup" in the rare event that applied labeling should accidentally be removed.

Zetron suggests relabeling the FASTNet slots, RJ21X terminals, and RJ66M425 jacks to correspond with the NetBase and TCE Programming assignments (Trunk Card Addresses) as listed in Table 4-15.

Table 4-15: Recommended FASTNet SLOT / TRUNK ADDRESS Assignments

Main Chassis		Expand Chassis #1		Expand Chassis #2	
NetBase or TCE Address	**Recommended Slot Number**	**NetBase or TCE Address**	**Recommended Slot Number**	**NetBase or TCE Address**	**Recommended Slot Number**
1A 1B	7	11A 11B	4	21A 21B	4
2A 2B	8	12A 12B	5	22A 22B	5
3A 3B	9	13A 13B	6	23A 23B	6
4A 4B	10	14A 14B	7	24A 24B	7
5A 5B	11	15A 15B	8	25A 25B	8
6A 6B	12	16A 16B	9	26A 26B	9
7A 7B	13	17A 17B	10	27A 27B	10
8A 8B	14	18A 18B	11	28A 28B	11
9A 9B	15	19A 19B	12	29A 29B	12
10A 10B	16	20A 20B	13	30A 30B	13

Suggested Relabeling for RJ21X Terminal Blocks

Figure 4-1 illustrates the face of a FASTNet RJ21X terminal. Along the right side of the illustration, separated by dashed lines corresponding to shaded regions, are all of the appropriate FASTNet chassis SLOT NUMBERS in columnar form. The left column relates Model 2540 Main Chassis slot numbers, dependent upon which backplane connector (J19, J20, J23) is connected to the RJ21X. The right column relates corresponding data for Model 2540EX Expand Chassis slot numbers. By carefully cross-referencing the information from Table 4-15 with Figure 4-1, each trunk can be specifically labeled on the orange covers for the RJ21X blocks, using a permanent marker (These marks can be removed with a pink eraser, later). It is best to label the inside of the orange cover, since that side will be visible when servicing the trunks. The outside of the orange cover may most appropriately be labeled with the FASTNet chassis and backplane connector designations (i.e. "Expand Chassis 1-J23" for the first expansion chassis, RJ21X connector wired to J23, in a 60-trunk system).

Information which is useful for troubleshooting, and may be desirable for service purposes, includes:

- FASTNet Card Address;
- FASTNet Card Slot Number;
- FASTNet Backplane Connector Number;
- trunk telephone number or destination device

  (Model 49/Repeater Number, μWave, etc.);
- trunk type (E-E, DID, E&M);
- T, R, T1, R1, E, M as appropriate.

If all of the FASTNet trunks are cross-wired to the RJ66M425 terminals to provide 6-wire modular cable interfaces to all of the external devices, these labels can be carried forward in a neat and organized manner as illustrated in Figures 4-4, 4-5, and 4-6. The installation technician must be careful to cross-wire the correct FASTNet RJ21X lines to the correct RJ66M425 Jacks. Refer to Figure 4-3 on page 4-18 for the factory pinouts of the RJ66M425 terminals.

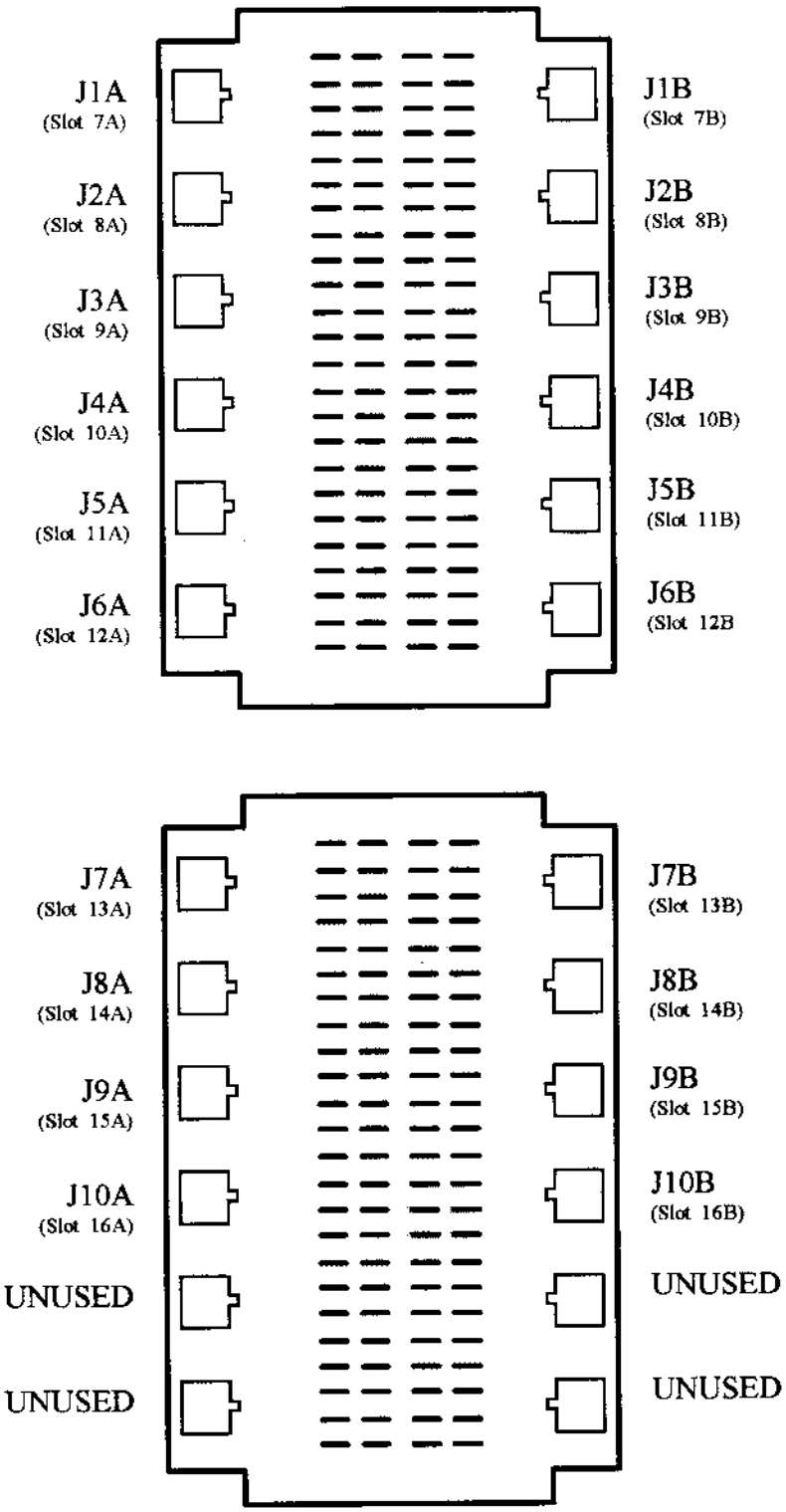


Figure 4-4: Recommended Model 2540 RJ66M425 Labels, Addresses 1-10

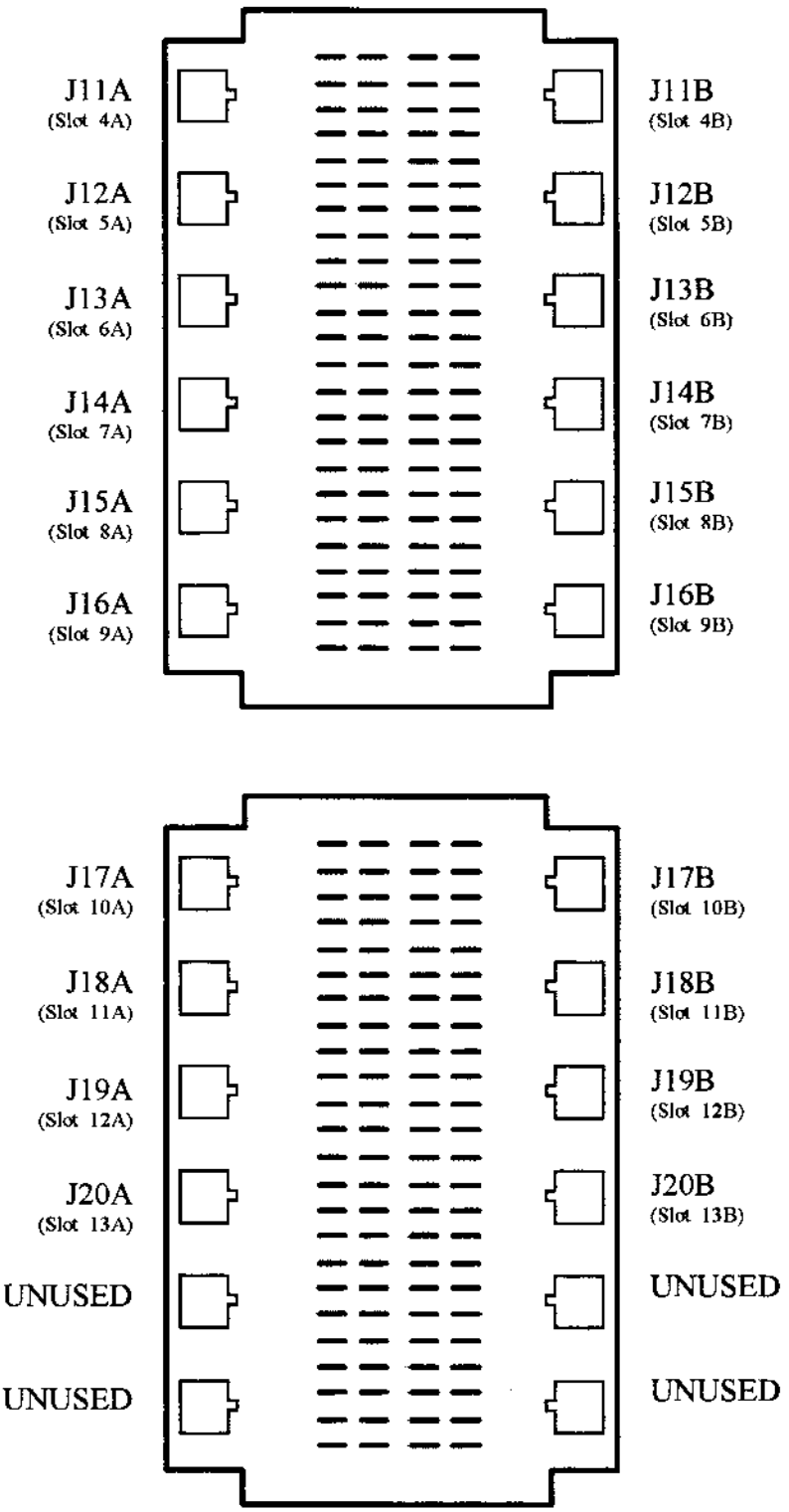


Figure 4-5: Recommended Model 2540EX RJ66M425 Labels, Addresses 11-20

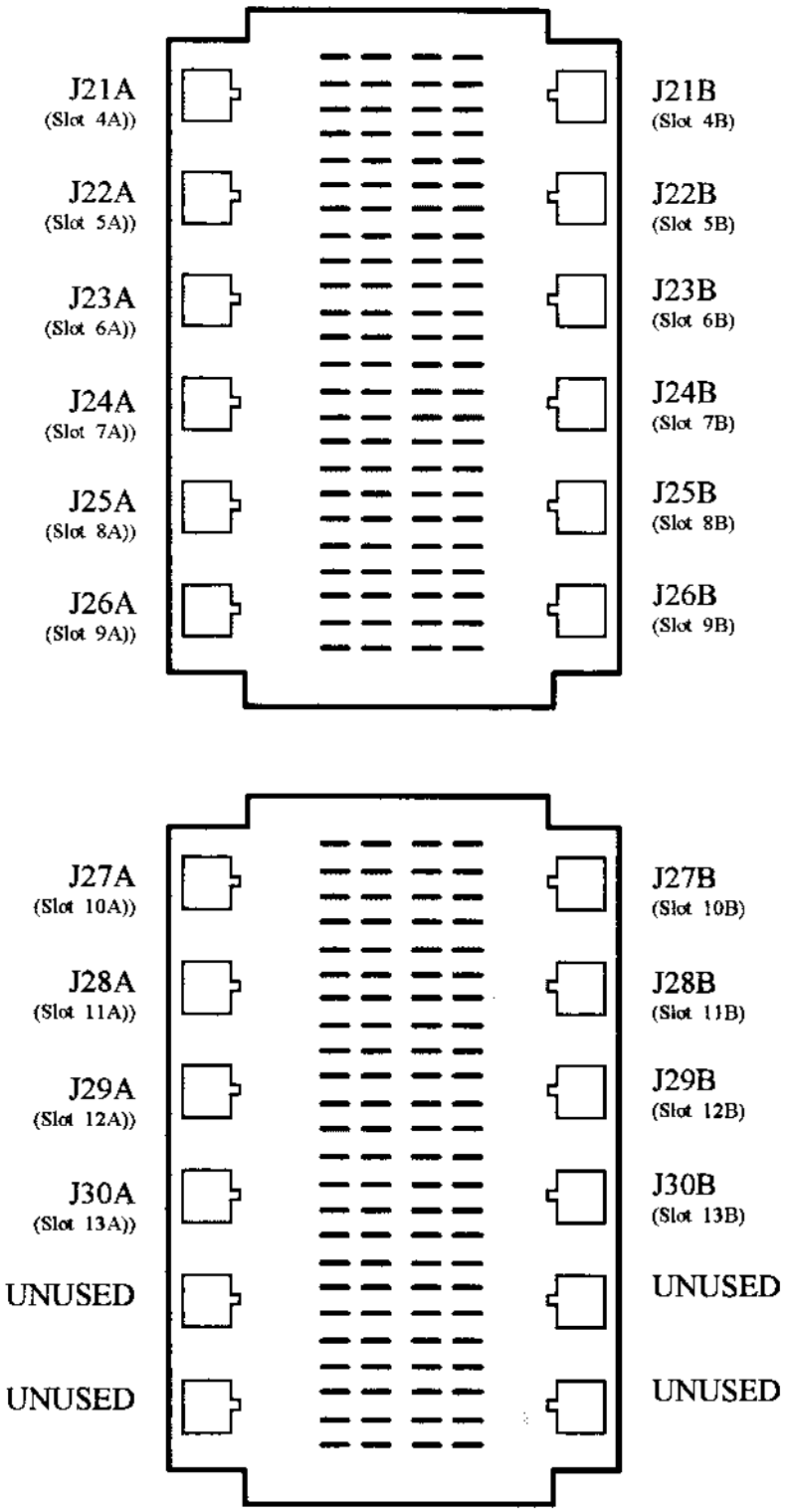


Figure 4-6: Recommended Model 2540EX RJ66M425 Labels, Addresses 21-30

DUAL TRUNK CARD CONFIGURATION

Overview

There are two types of dual trunk cards available:

(1) Dual Telco Card: (702-9457)

- End-to-End Loop Start trunks (a.k.a.: E-E, DOD, POTS)
- End-to-End Ground Start trunks
- DID trunks; DTMF, Dial Pulse, or MF Feed Digits (requires MF Decoder Option (702-9197 Card)
- E&M 2-Wire configuration (4 wires used).
  - 1 pair: Hybridized Full-duplex Audio
  - E Lead: TO TELCO supervision
  - M Lead: FROM TELCO supervision

(2) Dual 4-Wire Card: (702-9460)

- E&M 4-Wire configuration (6 wires used).
  - 1 pair: TO TELCO 600Ω balanced audio
  - 1 pair: FROM TELCO 600Ω balanced audio
  - E Lead: TO TELCO supervision
  - M Lead: FROM TELCO supervision

NOTICE

Trunk cards will not be operational until the Trunk Card Editor files have been edited to correspond with the hardware address and line-type configuration for each trunk (A or B) of any dual trunk card.

Refer to *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) .

Characteristics *common to both types of trunk cards* will be discussed first, and then unique features for each type will be discussed separately.

This subsection provides detailed information concerning:

- Revision Identification
- Adjustments
- Test Points
- Trunk Card Addressing
- Trunk Type Configuration

Dual Trunk Card Revision Identification

The revision level of the circuit board may be identified by observing the top rear corner of the board (as viewed from installation position) when NOT installed into the card cage (turn power off before removing card). The Zetron part number, "702-9457" (Dual TELCO Card) or "702-9260" (Dual 4-Wire Card), should be visible and immediately followed by a *letter*, which indicates the revision level.

Adjustments

Each telephone trunk interface, A or B, has four adjustments:

(1)	FROM TEL:	audio level from the telco CO or other device wired to the TIP1/RING1 audio pair
(2)	TO TEL:	audio level to the telco CO or other device wired to the TIP/RING audio pair
(3)	BAL R:	resistive line Hybrid balance (NOT installed for Dual 4-Wire trunks)
(4)	BAL C:	capacitive (reactive) line Hybrid balance (NOT installed for Dual 4-Wire trunks)

These adjustments have been factory preset to specific levels for *ideal* line impedances. These settings may be satisfactory to operate upon initial installation of the dual trunk card. Careful alignment **while connected to the permanent (telco) trunk lines** is required to assure consistent audio quality to system users.

The adjustments outlined in the following instruction sets are important. They affect the general audio quality, the signal-to-noise ratio, the decoding of DTMF, and VOX disconnect features (if used). These procedures have been 'personalized' for particular interface types, and should be performed very carefully. Erroneous adjustments may result in seriously degraded audio quality and/or trunk performance.

FASTNet telco interconnect circuitry has been labeled to be consistent with CFR 47, Part 68. As an example, "RING" leads for a given 4-wire trunk are defined under Part 68 as follows:

"RING" = Transmit (Tx) Audio to telco connector RING lead

"RING1" = Receive (Rx) Audio from telco connector RING lead

The "TIP" and "RING" leads are used for full-duplex (hybrid) audio of the 2-Wire trunks, so that the "TIP1" / "RING1" pair is *only* used for Dual 4-Wire receive audio to FASTNet.

Test Points

The Test Points on the front of both dual trunk cards are arranged as indicated in Figure 4-7.

The AGC circuits for Trunk A and Trunk B must be disabled while setting levels. This is accomplished by shorting pins 2 & 4 for Trunk A, and pins 6 & 8 for Trunk B. Shorting may be accomplished using a BERG-type jumper (Zetron 402-3040), or preferably by installing the Model 2540 Trunk Card Monitoring Board (702-9598) and selecting "DISABLE" for SW1 (Trunk A) or SW2 (Trunk B) as appropriate.

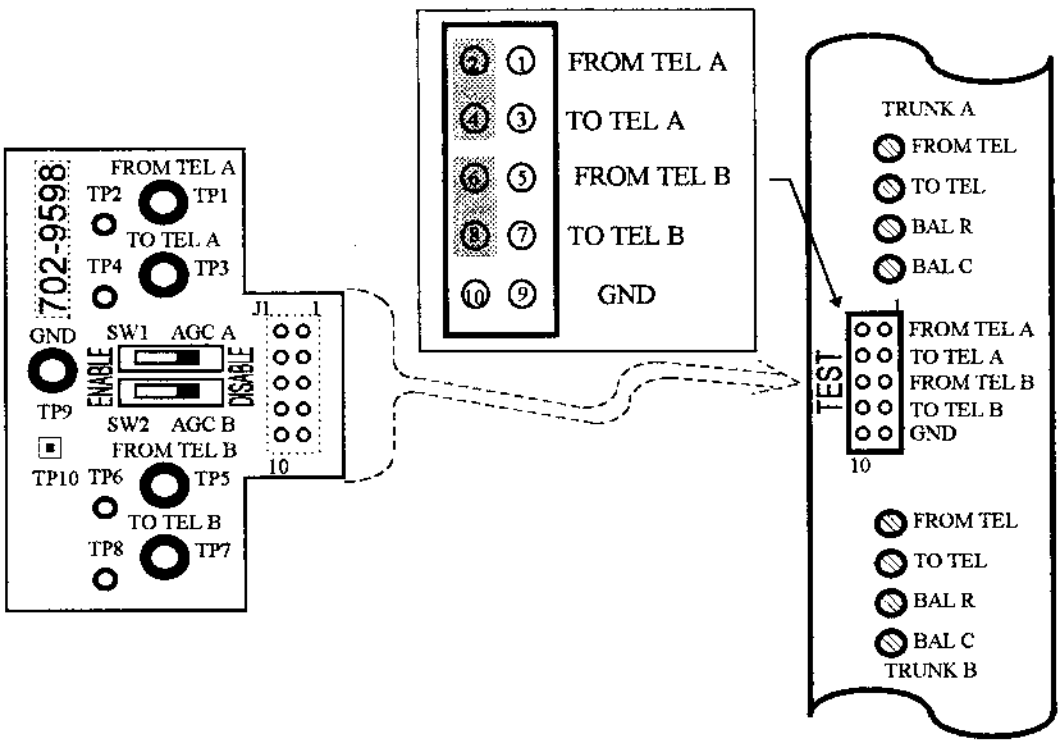


Figure 4-7: Dual TELCO Card Test Points

Meter (Oscilloscope) probes must be carefully attached to the appropriate odd-numbered pins of the test port, so as NOT to short to other pins or chassis. This interface is most safely accomplished via the Model 2540 Trunk Card Monitoring Board (702-9598), which acts as a 'breakout' interface to the test points on the trunk card. Figure 4-7 illustrates the trunk card pinouts and their labels, as well as the layout of the monitoring board. On the monitoring board TP1, TP3, TP5, TP7, and TP9 correspond numerically *and* functionally with Test Port pins 1, 3, 5, 7, and 9.

Additionally, Zetron has provided redundant test points TP2 (TP1), TP4(TP3), TP6(TP5), TP8(TP7), and TP10(TP9). The odd-numbered test points best facilitate meter probe tips; whereas the even-numbered test points serve the oscilloscope probes best, or alternately facilitate direct solder connections to test equipment.

Note: When using the Monitor Board, it is necessary to "strain relief" all test leads connected to the monitor board test points, in order to prevent the board from falling and disconnecting or possibly shorting TP7 to the faceplate of the trunk card. Strain relief for the test leads can be attained by looping the leads over the top of the lock buttons at the top of the trunk card(s).

Dial Click Decoder Option

TELCO service in some areas requires use of the optional Dual Dial Click Decoder Card (702-9119) to decode inbound dialing which is encoded in "dial clicks". *Dial Pulses* are always decodable without this option. *Dial Clicks* are distinctly different from *Dial Pulses* when observed using an oscilloscope: *Dial Pulses* are switched-DC 'square waves' which are sourced from a telco switch circuit directly to the customer's line termination equipment, whereas *Dial Clicks* are transformer or capacitor-coupled signals which originated as dial pulses. *Dial Clicks may be thought of as integrated, or AC coupled Dial Pulses.*

The Dual Dial Click Decoder installs 'piggy-back' onto either the Dual TELCO Card or the Dual 4-Wire Card connector J5, which is a white female connector, vertically mounted near the center of either type trunk card. The Dual Dial Click Decoder installs so that it extends toward the bottom of the trunk card, as viewed from the "front".

On Dual 4-Wire Cards, the center kept nut must be removed from the Audio Daughter Board prior to installation of the Dual Dial Click Decoder Card. The Dual Dial Click Decoder will then lay neatly across the top of the Audio Daughter Board when installed.

MF Decoder Option

The Dual MF Decoder Card (702-9197) is required for some DID applications (including some Type I E&M 4-Wire DID/DOD installations) to decode inbound 'feed digits' from the Central Office, which are transmitted in telco "Multi-Frequency" or "MF" protocol. This protocol may sound like DTMF when monitored by speaker because it is composed of paired frequency signals, like DTMF. MF protocol is quite different from DTMF, however, and will not properly be decoded by the FASTNet DTMF decoder circuitry. MF protocol involves rigid time constraints and tone pair sequences, whereas DTMF digits can occupy random time durations and inter-digit intervals. The tone pairs for each of these protocols are provided in Section 2, under the MF Decoder Option discussion, in order to emphasize the differences in these two communications protocols.

The Dual MF Decoder Card installs 'piggy-back' onto either the Dual TELCO Card or the Dual 4-Wire Card connector J6, which is a dual row 34-pin header, vertically mounted near the center of either type trunk card. The Dual Dial Click Decoder installs so that it extends toward the top of the trunk card, as viewed from the "front".

Trunk Card Addressing

The Dual Trunk Card must be properly addressed by the FASTNet Switch in order to process calls correctly. Hardware addressing is accomplished through "ADDRESS" switches 1, 2, 3, 4, and JP5. Refer to Table 4-16: Dual Trunk Card Addressing. JP5 is the most significant bit; located at the rear of the trunk card just below the PC BUS (top) edge connector. The FASTNet Switch must be powered OFF, and the trunk card must be removed from the card cage to access JP5. Corresponding software addressing is performed in the Trunk Card Editor program.

"EXPANDED" FASTNet Switch Configuration

Locate jumper JP1 on either type dual trunk card. This jumper lies near the center of the circuit board, 1-¼ inch behind the face plate. *These jumpers must be the same for all trunk cards installed in a given FASTNet switch.* The PCM time slot encode/decode functions are defined by this jumper.

WARNING

Improper setting of jumper JP1 may result in normal front panel LED indications without audio interfacing.

Verify JP1 is set as follows for all trunk cards in a particular system:

- For systems containing up to 40 trunks: JP1 must be OUT.
- For 60 trunk systems: JP1 must be IN.

Table 4-16: Dual Trunk Card Addressing

Card Address	JP5	SW4	SW3	SW2	SW1
(Reserved) 0	IN	A	A	A	A
1	IN	A	A	A	B
2	IN	A	A	B	A
3	IN	A	A	B	B
4	IN	A	B	A	A
5	IN	A	B	A	B
6	IN	A	B	B	A
7	IN	A	B	B	B
8	IN	B	A	A	A
9	IN	B	A	A	B
10	IN	B	A	B	A
11	IN	B	A	B	B
12	IN	B	B	A	A
13	IN	B	B	A	B
14	IN	B	B	B	A
15	IN	B	B	B	B
16	OUT	A	A	A	A
17	OUT	A	A	A	B
18	OUT	A	A	B	A
19	OUT	A	A	B	B
20	OUT	A	B	A	A
21	OUT	A	B	A	B
22	OUT	A	B	B	A
23	OUT	A	B	B	B
24	OUT	B	A	A	A
25	OUT	B	A	A	B
26	OUT	B	A	B	A
27	OUT	B	A	B	B
28	OUT	B	B	A	A
29	OUT	B	B	A	B
30	OUT	B	B	B	A

Notes:
1. DO NOT use address "0"; this is reserved for factory test purposes and is of no use during normal operation.
2. Binary Addresses may be interpreted as follows:
   "A" or "IN" = "0"
   "B" or "OUT" = "1"
   JP5 is most significant bit; SW1 is least significant bit.
3. Address Switches 5-8 are unused, and should remain parked at position "A".

Dual TELCO Card (702-9457)

Type Configuration

The Dual telco Card may be configured to interface to the following telco line types:

- DID (Inbound only trunk)
- End-to-End Loop Start
- End-to-End Ground Start
- E&M 2-Wire (Tie-Trunk)
- Zetron Ring Box

In order to facilitate these configurations, there are two "Matrix" cards (Zetron 702-9122) which provide analog patching to properly select the Dual telco Card's circuitry as required for each line type. All of these trunk configurations utilize audio hybrid circuitry. Differences primarily are related to battery and supervision lines. One Matrix card or plug is used for each trunk of this card, so that each trunk may be configured independently.

The Matrix cards plug into **J3 (Trunk A)** and **J4 (Trunk B)** of the Dual telco Card. When handling these cards, PLEASE DO NOT HANDLE THE GOLD CONTACT SURFACES with your fingers. This will prevent future corrosion of the Matrix Cards and jacks.

Close examination of these Matrix Cards will reveal configuration labels at each PIN 1 position. (Four faces = four configurations) Note that PIN 1 of J3 and J4 are toward the *bottom* of the Dual telco Card assembly.

Refer to Table 4-17 for the Matrix Card position and alignment procedure required for each line-type configuration.

Table 4-17: Dual TELCO Card Matrix Plug Installation

TELCO Line Type Configured	Matrix Card Position J3 = Trunk A J4 = Trunk B	Alignment Method to Use DTMF Access OR Local Computer
DID telco line	DID	DTMF Access ONLY
End-to-End Loop Start	E-E	either method
End-to-End Ground Start	GND ST	either method
E&M 2-Wire	E+M	either method
Zetron Ring Box	E-E	either method

For a simplified schematic of each configuration, refer to Section 2 of this manual.

Dual 4-Wire Card (702-9460)

Type Configuration

The following interfaces are all supported by the Dual 4-Wire Card Assembly (702-9460D):

- E&M 4-Wire Type I telco Interface
- Model 810 Digital Hybrid Interface
- Model 49 Repeater Manager Interface
- Uniden MRS804ZX Repeater Interface
- Generic Radio / Microwave Link Interface

Specific jumper settings and wiring interfaces are used for each configuration listed above, as explained in the following pages.

Dual 4-Wire Card Audio Daughter Board (702-9319)

This circuit board is a required subassembly of the Dual 4-Wire Card (702-9460). This circuit translates the Dual 4-Wire balanced audio (600Ω) signaling from the external [telco] interface into Dual 4-Wire ground-referenced audio, which is then routed through the internal audio circuitry of the FASTNet Switch.

Dual 4-Wire Card, Audio Daughter Board J1, J2 Connections

Two modular jacks are present on this card: J1 for Trunk A; J2 for Trunk B. These are not normally used, but are functional. These two jacks may be used for Type I E&M 4-Wire TELCO trunks, or for Model 49 interfaces, but *will not* function properly for Model 810 interfaces without a custom 6-wire cable. Model 810 applications are much simpler when interfaced via the FASTNet Custom Wire Harness Kit (950-9385), using the cross-wiring provided in Table 4-12: FASTNet to Model 810 Cross-Wiring.

The pin-outs for J1 and J2 are illustrated in Figure 4-8, as viewed from the bottom of the E&M 4-Wire Card Assembly. These are standard subminiature 6-wire, "RJ" type jacks. Pin functions are listed in Table 4-18: Audio Daughter Board TELCO Pinouts for J1 and J2.

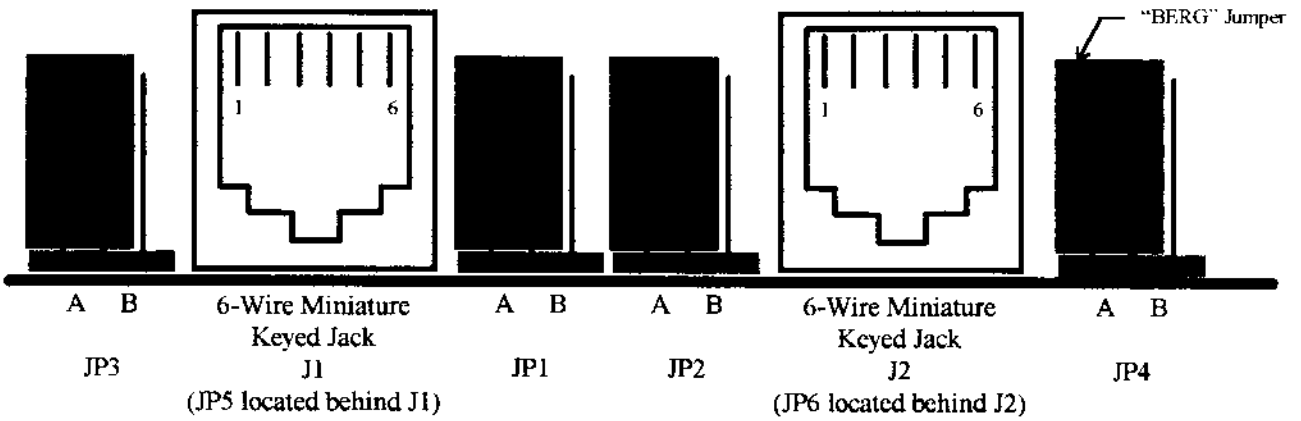


Figure 4-8: Dual 4-Wire Audio Daughter Board, Bottom View

Table 4-18: Audio Daughter Board TELCO Pinouts for J1 and J2

Pin Number	FASTNet Label	Function	
J1-1	EA	Trunk A:	E-Lead (Outbound)
J1-2	TIP 1 REC	Trunk A:	FROM TEL "TIP 1"
J1-3	RING 1 TX	Trunk A:	TO TEL "RING"
J1-4	TIP 1 TX	Trunk A:	TO TEL "TIP"
J1-5	RING 1 REC	Trunk A:	FROM TEL "RING 1"
J1-6	MA	Trunk A:	M-Lead (Inbound)
J2-1	EB	Trunk B:	E-Lead (Outbound)
J2-2	TIP 2 REC	Trunk B:	FROM TEL "TIP 1"
J2-3	RING 2 TX	Trunk B:	TO TEL "RING"
J2-4	TIP 2 TX	Trunk B:	TO TEL "TIP"
J2-5	RING 2 REC	Trunk B:	FROM TEL "RING 1"
J2-6	MB	Trunk B:	M-Lead (Inbound)

Audio Daughter Board / Dual 4-Wire Card Configuration

The Audio Daughter Board/ Dual 4-Wire Card is factory configured for interface to a telco E&M Type I Trunk. Several non-telco interfaces are also supported by this trunk interface card.

This card will *NOT* directly support Type II supervision. Type II supervision involves contact closures for the E/M leads which are not ground-referenced, and therefore require two additional trunk wires (i.e. an 8-wire interface): "SG" is switched to the E-Lead for TO TELCO supervision; "SB" and the M-lead conduct supervision current for FROM TELCO signaling.

Audio Daughter Board Revisions

For Revision "D" Dual 4-Wire Cards (702-9460D) and later, the Audio Daughter Board may be either revision "A.1" or "B". The Audio Daughter Board revision level is the letter/number combination which follows the Zetron part number (702-9319) in the white bubble, printed on the Audio Daughter Board itself. These board revisions basically operate the same, except that the revision "B" board is more adaptable for supervision voltage configuration.

Audio Daughter Board Rev A.1

JP1 on the Audio Daughter Board must be set in order to provide proper supervision voltages to the E/M pair. Refer to Table 4-19: Rev A.1 Audio Daughter Board Jumper Functions.

For this revision, E Lead output is the dry contact of a Normally Open (N.O.) relay. The supervision voltage is only applied during the Off-Hook state, requiring IDLE (On-Hook) bias to be applied at the telco CO or Radio Interface.

The M lead must be electrically forced to the Off-Hook state at the telco CO or Radio Interface, causing current flow through the opto-isolator sensor, in order to cause an Off-Hook status detection. During the IDLE state, the telco CO or Radio Interface must become "N.O." or biased to MATCH the JP1 voltage selected.

For a simplified schematic of the Rev A.1 Audio Daughter Board E&M 4-Wire Type I interface, refer to Section 2, E&M 4-Wire Type I - Using Rev A Audio Daughter Board.

Table 4-19: Rev A.1 Audio Daughter Board Jumper Functions

JP1 Position (Audio Daughter Bd)	Idle Voltage (ON-Hook)	Active Voltage (OFF-Hook)
A	M = -48 V_{DC} Output Bias Voltage E = Open Circuit	M = 0 V_{DC} forced at TELCO E = -48 V_{DC} Output TO TELCO
B	M = 0 V_{DC} Output Bias Voltage E = Open Circuit	M = -48 V_{DC} forced at TELCO E = 0 V_{DC} Output TO TELCO

Audio Daughter Board Rev B

The Rev B Audio Daughter Board provides six (6) jumpers which allow each trunk (A, B) interface to be configured independently. Furthermore, E and M functions for *each* trunk are configured independently. This allows greater flexibility for FASTNet interface applications. Refer to Table 4-20: Rev B Audio Daughter Board Jumper Functions.

JP1, JP3, JP5 on the Audio Daughter Board must be set in order to provide proper supervision voltages to the "Trunk A" E/M pair.

JP2, JP4, JP6 on the Audio Daughter Board must be set in order to provide proper supervision voltages to the "Trunk B" E/M pair.

E Lead output of either trunk (A or B) is the dry contact of a Normally Open (N.O.) or Normally Closed (N.C.) relay closure, as defined by jumpers JP5 / JP6:

N.O. Supervision voltage is only **applied** during the Off-Hook state, requiring IDLE (On-Hook) bias to be applied at the telco CO or Radio Interface. *Most interfaces use N.O. supervision circuitry.*

N.C. Supervision is **dropped** during the Off-Hook state.

The E lead supervision voltage is selected via JP3 / JP4. These jumpers select either (current-limited) -48 VDC, or 0 VDC to be applied to the E lead drive relay "common" terminal, and then to the E lead output (through JP5 / JP6) when the drive relay is closed.

The M lead must be electrically forced to the Off-Hook state at the telco CO or Radio Interface, causing current flow through the opto-isolator sensor, in order to cause an Off-Hook status detection. During the IDLE or On-Hook state, the telco CO or Radio Interface must become "N.O." or biased to MATCH the JP1 / JP2 voltage selected so that *no current flows.*

Table 4-20: Rev B Audio Daughter Board Jumper Functions

Trunk Affected	Jumper Position (Audio Daughter Bd)		Idle Voltage (ON-Hook)	Active Voltage (OFF-Hook)
A	JP1	A	M = -48 V_{DC} Output or N.O.	M = 0 V_{DC} forced at TELCO
		B	M = 0 V_{DC} Output or N.O.	M = -48 V_{DC} forced at TELCO
	JP3	A	E = N.O. or -48 V_{DC}	E = -48 V_{DC} or N.O.
		B	E = N.O. or 0 V_{DC} *(Output dependent upon JP5)*	E = 0 V_{DC} or N.O. *(Output dependent upon JP5)*
	JP5	A	E = N.O.	E = CLOSED Output *(see JP3)*
		B	E = N.C. *(see JP3)*	E = OPEN Output
B	JP2	A	M = -48 V_{DC} Output or N.O.	M = 0 V_{DC} forced at TELCO
		B	M = 0 V_{DC} Output or N.O.	M = -48 V_{DC} forced at TELCO
	JP4	A	E = N.O. or -48 V_{DC}	E = -48 V_{DC} or N.O.
		B	E = N.O. or 0 V_{DC} *(Output dependent upon JP6)*	E = 0 V_{DC} or N.O. *(Output dependent upon JP6)*
	JP6	A	E = N.O.	E = CLOSED Output *(see JP4)*
		B	E = N.C. *(see JP4)*	E = OPEN Output

For a simplified schematic, refer to Section 2, E&M 4-Wire Type I - Using Rev B Audio Daughter Board.

Specific Dual 4-Wire Configurations

The FASTNet is typically interfaced with several specific types of equipment. The Audio Daughter Board jumper settings are provided for these configurations in

The jumper function tables (Table 4-19 and Table 4-20) used in conjunction with the telco wiring and backplane connector pinouts (Table 4-1 through Table 4-8) and cross-wiring tables (Table 4-9 and Table 4-12) should provide all of the wiring information needed for most interconnect configurations encountered. The information in these tables should be sufficient to deduce any other configurations required for other termination equipment not specifically described in this text.

For dual 4-wire audio daughter board jumper settings for typical interfaces, see Table 4-21.

If the use of these tables is confusing, Zetron will gladly provide technical support. Contact Zetron at (206) 820-6363.

Table 4-21: Dual 4-Wire Audio Daughter Board Jumper Settings for Typical Interfaces

Application		Rev A	Rev B		
Equipment	**Notes**	**JP1**	**JP1 / JP2**	**JP3 / JP4**	**JP5 / JP6**
E&M Type I telco	per telco installation technician.	A	A	A	A
Model 49 (MRS804ZX)	JP1 = BB JP2 = A JP3 = A JP4 = A	A	A	A	A
Model 810	702-9375 units: JP1 = B JP2 = B JP3 = A or B 702-9461 units: JP1 = IN JP2 = A JP3 = C JP4 = C JP5 = A JP6 = OPEN JP7 = B JP8 = A JP9 = OPEN	A	A	A	A
µWave	E lead active at (0 V_{DC}), idle is N.O. M lead active at (0 V_{DC})	B	B	B	A

ADJUSTMENT PROCEDURES

General Description

The To/From telco levels are adjusted at the factory for test purposes and are preset for "ideal" telephone line impedances. Real circuitry connected to these line interfaces will require re-adjustment, once they arrive at their final destination.

CAUTION

Because of the complex nature of the FASTNet Switch and associated circuit interfacing, high quality test equipment and meticulous alignment procedures must be used for FCC compliance.

Refer to Appendix A for minimal test equipment requirements.

Measurement Conventions

All trunk level readings are expressed in decibels (dB) and AC volts RMS (Vrms).

Note: We are *not* measuring dBm because we do not know the line termination to necessarily *be* 600 ohm.

All dB readings have been determined using a bridging (High Impedance) AC voltmeter calibrated in decibels referenced to 1 milliwatt dissipated into a 600 ohm load (dBm).

Field technicians MUST be sure lines are connected (terminated) properly before setting adjustments.

All voltage readings have been obtained using an AC True RMS Voltmeter measuring sinusoidal waveforms.

Two distinct alignment methods are outlined for the installation technician to follow - only one of which may be used for DID trunks. Locate the appropriate instructions and review carefully prior to servicing your FASTNet Switch. Be sure to obtain any required equipment before starting. Thorough understanding of these procedures will prevent mid-adjustment crisis conditions.

If any help is needed, contact Zetron at (206) 820-6363 for assistance.

Recommended Adjustment Sequence

We recommend proceeding in the following order of alignment to prevent confusion during this extensive process. REMEMBER: DO NOT RUSH!

- ❑ 1. Pre-Adjustment Setup (Software and Hardware)
  Optionally: It may be desireable to perform hardware modifications outlined in Appendix H:Model 49 and MRS804ZX Performance Improvements.
- ❑ 2. Dual TELCO Card DID trunks
- ❑ 3. Dual TELCO Card End-to-End Loop Start trunks
- ❑ 4. Dual TELCO Card End-to-End Ground Start trunks
- ❑ 5. Dual TELCO Card E&M 2-Wire trunks
- ❑ 6. Dual 4-Wire Card E&M 4-Wire Type I telco trunks
- ❑ 7. Dual 4-Wire Card Model 810 trunks
- ❑ 8. Dual 4-Wire Card Model 49 trunks
- ❑ 9. Dual 4-Wire Card Uniden MRS804ZX trunks
- ❑ 10. Dual 4-Wire Card Microwave or RF Link trunks

Take time to identify the exact procedures your installation requires and preview those procedures *before* going to the site. This may help to avoid the situation in which one or more critical piece of alignment equipment has been left behind at the service base.

Remember to take this manual to the installation site with you when you perform maintenance services, or purchase an extra manual to keep at the site.

Additionally, a *Model 49 Trunking Repeater Manager Operation and Installation Manual* (Part No. 025-9108) or *Model 49 Trunking Repeater Manager (Main Board Revision S and Higher) Operation and Installation Manual* (Part No. 025-9313) may be required.

After reading this manual, if you have questions, call Zetron at (206) 820-6363 for assistance.

Pre-Adjustment Setups

The following system installations and/or adjustments *must* be performed prior to setting levels to/from the FASTNet Trunk Cards to ensure proper audio performance.

Some prior set-up in Netbase programming is required for new FASTNet Nodes. Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270).

❑ 1. Note the following pre-programmed parameters before starting the alignment procedure:

- ❑ a. Access Code = _____
  (Required for Test Mode access to all systems).
- ❑ b. Voice Prompts Access telephone number = _____
  (Required for DTMF Access adjustment method only).

These parameters must be defined by the system programmer during initial FASTNet configuration.

❑ 2. Verify the jumper and DIP switch settings for the Dual TELCO Card (702-9457) or Dual 4-Wire Card (702-9460) CAUTION: Power-down the FASTNet Switch prior to removal or insertion of any circuit cards. This equipment will not tolerate "Hot Insertion" of circuit boards.

- ❑ a. Trunk Card Address set properly?
  See Table 4-16: Dual Trunk Card Addressing
- ❑ b. Is JP1 set properly for system size?
  See "EXPANDED" FASTNet Switch Configuration on page 4-31.
- ❑ c. Dual TELCO Trunk *type* properly configured?
  See page 4-33 for type configuration instructions.
- ❑ d. Dual 4-Wire Card E & M leads configured properly?
  See Table 4-19 or Table 4-20 for jumper settings, dependant upon Audio Daughter Board revision used.

SET-UP Trunks into FASTNet

❑ 3. Verify other end of trunk is operational and configured properly. Use 3 a,b,c as appropriate to verify trunk-side operation.

❑ a. **telco lines**: have been installed and tested by telco technician. Obtain and record critical line parameters from the telco technician, such as:

- End-to-End lines: *Loop* or *Ground* start type
- DID lines: number of feed digits from telco
- DID lines: DTMF, MF, or Dial Pulse feed digits from telco
- E&M 4-Wire Type I: E Lead on/off hook voltages
  M Lead on/off hook voltages
  Verify pinouts from telco

❑ b. **Model 49 E&M 4-Wire** jumpers configured properly?
See TELCO CONNECTIONS, subheading Model 49 Trunking Repeater Manager for discussion.
See Table 4-10: E&M 4-Wire "Modular" Connections - Model 49 vs FASTNet on page 4-19.
See Table 4-11: Jumper Settings for FASTNet - Model 49 Interface on page 4-20.
See Table 4-21: Dual 4-Wire Audio Daughter Board Jumper Settings for Typical Interfaces on page 4-39.

❑ c. **Model 810 Interface** from DID or End-to-End lines into FASTNet E&M 4-Wire trunk - 4-Wire interface jumpered correctly?
See TELCO CONNECTIONS, subheading Model 810 Interfaces for discussion.
See Table 4-13: E&M 4-Wire "Modular" Connections - Model 810 vs FASTNet on page 4-21.
See Table 4-21: Dual 4-Wire Audio Daughter Board Jumper Settings for Typical Interfaces on page 4-39.

RF Equipment Levels

❑ 4. Adjust the Model 49, Repeater Controller, or μWave/RF Link interface levels in/out of the FASTNet System.

❑ 4.a Repeater Alignment

Verify that each repeater meets all manufacturer specifications before proceeding further (Carrier Frequency, Rx Sensitivity, Rx Selectivity, etc.)

Verify Transmit Modulation Limiter operation as follows:

❑ 4.a.1 Inject 1 KHz audio tone to Tx Audio input of the repeater where the Model 49 normally connects, using an audio tone generator. (MRS804ZX / ARX800B TP5, 600Ω input)

❑ 4.a.2 Key the transmitter, and increase the generator output until the transmitter "limits" the audio signal.

❑ 4.a.3 Double the audio generator output to push the transmitter into "hard limiting", and adjust the transmit modulation limiter (VR105 of MRS804ZX; VR104 may need to be max also) for ±4KHz carrier deviation if using a 5KHZ total deviation spectrum; set for 1.5 KHz in RF systems using 2.5 KHz total deviation.

❑ 4.b Model 49 (also MRS804ZX) RF Pre-Adjustments:

❑ 4.b.1 **Transmitter:**

- Before starting, if using V6.0-V6.22 Model 49 firmware, verify the software tone levels are set as follows:
  (Edit49 / Site config / Edit Prompts = (Y) / 1. Welcome Message = **7**, *AND*
  Edit49 / Site config / Edit Prompts (Y) / 3. Thank You, Ringing = **7**)
  Update the Model 49 if necessary …
  (V6.24 and higher firmware always generate test tones at maximum levels.)
- Verify that the hardware components specified in Appendix H have been installed into the Model 49 or MRS804ZX units. Also be sure that the Model 49 (Rev S+ only) PH TONE and TX TONE pots have been pre-set and sealed per Appendix H.
- Place Model 49 into *Test Mode* by placing SW1-1 up, press and hold the CONNECT/DISCONNECT switch for about 2 seconds until the LEDs flash.
  Note: If SW1-2 is up, the repeater transmits BUSY ID code 253; If SW1-2 is down, TEST ID is transmitted.

- Once into test mode, each double-press of the front panel CONNECT/DISCONNECT switch steps (rotates) to the next "test mode"(1, 2, 3, 4, 1, ...). Double-pressing the switch too frequently resets the Model 49 logic - wait 5 seconds between mode selections.

  Test Mode 1: Transmit Zetron Ringing with Data
  Test Mode 2: Transmit Data Only
  Test Mode 3: Transmit 1 KHz Test Tone with Data
  Test Mode 4: Transmit 1 KHz Test Tone Only

❑ 4.b.2 While operating in Test Mode 2 (Tx Data only), adjust the *TX DATA* pot (VR103 of MRS804ZX Exciter Module) for about 950 Hz carrier deviation.

❑ 4.b.3 While operating in Test Mode 4 (Tx 1 KHz only), adjust the *TX AUD* pot to attain 2.5 KHz carrier deviation.

For MRS804ZX units only: VR104 of the Exciter Module adjusts this level. It is highly recommended that steps 4a, 4.b.2, and 4.b.3 be repeated until no significant changes are noted, since these adjustments are interdependent.

❑ 4.b.4 **Receiver:**

(the Model 49 may or may not be in test mode - unimportant)

- Connect the Service Monitor directly to the Repeater Rx port.
- With <u>no</u> carrier applied to the repeater, adjust the Model 49 Squelch (with COR set to midpoint) counterclockwise from fully clockwise until the Carrier LED just goes OFF steady.
  (If using external COR, only adjust COR potentiometer)
  (MRS804ZX Squelch is R108 of ARX800BZ Control Bd.)
- Inject Rx Carrier frequency at 1 mV_{rms}, modulated by a 1 KHz Sinewave test tone at 4.0 KHz deviation. Adjust the Model 49 RX AUD (R109 of MRS804ZX Control Bd.) potentiometer until 1 V_{P-P} (354 mVrms) is attained at TP5 for systems operating at 5 KHz maximum deviation; Adjust to 0.5 V_{P-P} (177 mVrms) for systems limited to 2.5 KHz maximum carrier deviation.
  (Measure at TP6 for MRS804ZX Control Bd).
- Modulate the RX carrier with 100 Hz sinewave at 0.8 KHz deviation. Verify approximately 200 mV_{P-P} at TP5. Note that this level is the same for 2.5 KHz Dev as for 5 KHz Dev systems, if Appendix H modifications were implemented.
  (Observe signal at TP6 for MRS804ZX Control Bd).

- For Rev H-Q Model 49 units only, adjust the RX data pot on the Protocol PCB slowly clockwise (from *fully CCW*) until the (+) and (-) peak indicator LEDs (#2, #3 from left) both flash with equal intensity and duration (these may *appear* to be lit steady).
- Remove the Service Monitor from the Rx antenna port and reconnect the antenna cable. Place the Model 49 into normal operating mode.

❑ 4.c **Microwave or RF Links:**

- Set the TX and RX parameters per manufacturer specifications.
- Typical I/O levels for these types of equipment are -16 dBm input to the link and +7 dBm output from the link. These levels should be verified.
- Typical E & M signaling is 12 V_{DC} or 24 V_{DC} levels while idle; pulled to ground for active (OFF HOOK) status. These functions should be verified. (FASTNet can be configured to accommodate variations.)

Overview of Alignment Methods

There are two general methods of trunk card alignment:

1. "DTMF Access" Alignment Method* (page 4-48): The technician gains access to the set-up programming through the Voice Prompts Programming, and invokes specific Test Modes via DTMF key entry from a telephone *(The FASTNet System must be connected to a working telephone trunk).* The technician must know two previously programmed telephone numbers in order to accomplish this operation:

   (1) The system programmer must allocate one telephone number to be used for service purposes only, through the NetBase programming.
   The technician will dial into FASTNet via that telephone number, in order to access test/alignment mode. Access is not gained, however until the 'security' number is entered (item 2, following).

   (2) The system programmer must also setup a 4-digit Voice Prompts Security [access] Code in NetBase programming.
   The technician will gain access to the test/alignment mode by entering the security code when FASTNet answers the dialed test phone number.

   * This method *must* be used for DID Trunks.

2. Local Computer Access Alignment Method**(page 4-54):

   (1) The technician gains access to the set-up programming via the Local RS-232C Port of the FASTNet Switch, and the "NETLINK" software program which is provided on the "Trunk Card Editor" diskette. Refer to Section 2: RS-232 Interface with the CPU Card for hardware operational details.

   (2) A security code can be programmed into the FASTNet Switch, which may be required to access the switch via the local interface, if the CPU switches are properly configured.

   ** This method is *NOT* accessible for DID Trunks.

These methods are detailed in the following pages. Both methods involve injecting a test tone into the "FROM TELCO" audio pair (T1 / R1) using a balanced 600Ω generator, which has been DC-isolated from the telco line as shown in Appendix A. Both procedures refer to Table 4-22 for the specific adjustment values to be set. The table contains all of the recommended levels for the interfaces listed in this subsection.

Microwave or RF Link levels should be dictated by the published level requirements of the particular equipment used. Refer to the manufacturer specifications for those values.

Table 4-22: Typical FASTNet Trunk Level Settings

Trunk Type	Trunk Card Used	TO-TELCO Trunk Card Settings		FROM-TELCO Trunk Card Settings	
		Set Level (at TO-TEL Test Point)	**Verify Level** (at TIP / RING)	**Set Level** (at FROM-TEL Test Point)	**Injection Level** (at circuit noted below)
Dedicated Inbound Dialing (DID)	Dual TELCO Card 702-9457	-3.2 dB (0.536 V_{rms}) (1.52 V_{P-P})	-10 dB (0.245 V_{rms}) (0.693 V_{P-P})	0 dB (0.775 V_{rms}) (2.19 V_{P-P})	-20 dB (at TIP / RING) (77.4 mV_{rms}) (0.219 V_{P-P})
End-to-End, Loop or Ground Start	Dual TELCO Card 702-9457	-3.2 dB (0.536 V_{rms}) (1.52 V_{P-P})	-10 dB (0.245 V_{rms}) (0.693 V_{P-P})	0 dB (0.775 V_{rms}) (2.19 V_{P-P})	-20 dB (at TIP / RING) (77.4 mV_{rms}) (0.219 V_{P-P})
E&M 2-Wire	Dual TELCO Card 702-9457	-3.2 dB (0.536 V_{rms}) (1.52 V_{P-P})	-10 dB (0.245 V_{rms}) (0.693 V_{P-P})	0 dB (0.775 V_{rms}) (2.19 V_{P-P})	-20 dB (at TIP / RING) (77.4 mV_{rms}) (0.219 V_{P-P})
E&M 4-Wire TELCO Type I or Type II	Dual 4-Wire Card 702-9460	-3.2 dB (0.536 V_{rms}) (1.52 V_{P-P})	-10 dB (0.245 V_{rms}) (0.693 V_{P-P})	0 dB (0.775 V_{rms}) (2.19 V_{P-P})	-20 dB (at TIP1 / RING1) (77.4 mV_{rms}) (0.219 V_{P-P})
Model 810	Dual 4-Wire Card 702-9460	-3.2 dB (0.536 V_{rms}) (1.52 V_{P-P})	-10 dB (0.245 V_{rms}) (0.693 V_{P-P})	0 dB (0.775 V_{rms}) (2.19 V_{P-P})	-20 dB (at telco TIP / RING pair, 2-Wire side of Model 810) (77.4 mV_{rms}) (0.219 V_{P-P})
Model 49 or MRS804ZX	Dual 4-Wire Card 702-9460	0 dB (0.775 V_{rms}) (2.19 V_{P-P})	-6.8 dB (0.354 V_{rms}) (1.00 V_{P-P})	0 dB (0.775 V_{rms}) (2.19 V_{P-P})	-10 dB (at TIP1 / RING1) (245 mV_{rms}) (0.693 V_{P-P})
Microwave / RF Link Typical Values	Dual 4-Wire Card 702-9460	-9.2 dB (0.269 V_{rms}) (0.761 V_{P-P})	-16 dB (0.123 V_{rms}) (0.347 V_{P-P})	0 dB (0.775 V_{rms}) (2.19 V_{P-P})	+7 dB (at TIP1 / RING1) (1.74 V_{rms}) (4.92 V_{P-P})

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DTMF Access Alignment Method

This is a general procedural outline for this level adjustment method. Recommended specific level settings are provided in Table 4-22 for several typical interfaces.

NOTE
This is the ONLY method for adjusting DID trunks.

TO TEL Audio Levels (Outbound Audio to FASTNet Trunks)

- ❑ 5. Dial into the FASTNet "Voice Prompt Access" number listed in step 1.a. on page 4-42
- ❑ 6. If an access code has been programmed into the FASTNet Switch, enter your security pass code (4-digit), as previously configured in Netbase, from step 1.b. on page 4-42.
- ❑ 7. Enter "999" to access test tone mode.
  - If dialing into a DID trunk in order to set-up that trunk, GO TO STEP 10.
- ❑ 8. After the "beep" is heard, enter "#ttu" to remote-control a *second* trunk to be tested, from the dialed trunk. This enables testing of all other trunks which can be dialed-out (*not* DID types) from this single trunk access.

  Where:

  # = DTMF "#" entered from the Test Telephone
  tt = Trunk Card Address as is set on the Trunk Card SW1-1 and JP5
  u = "0" for trunk circuit A, or "1" for trunk circuit B

  Example: entering "#171"
  -accesses trunk card addressed as "17"
  -routes to trunk circuit "B"

- ❑ 9. Enter the telephone number *to be dialed* by trunk circuit "ttu" (Quiet Termination, etc.)
- ❑ 10. Here from step 7 if testing the originally-dialed DID trunk, or from step 9 if remotely controlling a second trunk circuit.

  Subsequent number entries activate the tone generator functions for TO TEL audio as listed below:

  Enter "4" Toggles 1 KHz Test Tone ON (maximum audio level)
  Enter "0" Toggles 1 KHz Test Tone OFF

- ❑ 10.a. Turn on the 1 KHz Test Tone and set the TO TEL level, as measured at either (1) the test point or (2) the TIP / RING trunk pair for the trunk (A or B) under test as appropriate.
  - Refer to page 4-48, Table 4-22 for specific levels recommended for most common interfaces.
- ❑ 10.b. For Model 49 (MRS804ZX) trunks:
  (FASTNet *TO TEL* adjustments to the 'Model 49' inputs)
  - ❑ 10.b.1 While the FASTNet TO-TEL Test Tone is on (and set to 0dB per Table 4-22), place the Model 49 SW1-1 UP (MRS804ZX SW2-1 forward) and reset the unit to initiate Test Mode, and then short U1 pins 4, 5 of the 4-Wire Card to cause the Model 49 to answer the phone line and drop into Telco Test Mode. Telco Test Mode is similar to the transmit Test Mode, except that the four modes are as follows:
    Telco Test Mode 1: 600 Hz steady sinewave tone TO TEL
    Telco Test Mode 2: 1.0 KHz steady sinewave tone TO TEL
    Telco Test Mode 3: 2.5 KHz steady sinewave tone TO TEL
    Telco Test Mode 4: silence TO TEL
    - For verification, these tones should be present at the FASTNet FROM TEL test point on the trunk card.
    - Select Telco Test Mode 4 (silence).
  - ❑ 10.b.2 Model 49 Rev H-Q units;
    Monitor TP12 and adjust the 4-Wire Card *FROM TEL* pot until 0.25 V_{P-P} (88.4 mV_{RMS} , -18.9 dB) is attained.
    (Be sure Appendix H modifications are installed to 702-9228 4-Wire Card)
  - ❑ 10.b.3 Model 49 Rev S+ units;
    - Set the Model 49 Main Board FROM TEL pot (R51) fully clockwise to maximum.
    - Monitor the FROM TEL test point (TP12) and adjust the *FROM TEL* pot on the 4-Wire Card until 1.5 V_{P-P} (530 mV_{RMS} , -3.2 dB) is attained. (4-Wire Card p/n 702-9445; be sure Appendix H modifications are installed)
    - Adjust the Main Board *FROM TEL* (R51) pot for 1 V_{P-P} at TP12 (354 mV_{RMS} , -6.8 dB).

- ❑ 10.b.4 MRS804ZX Repeaters;
  - Set the *FROM TEL* pot (R87) of the ARX790 Interconnect Board to the maximum (fully clockwise) position.
  - Monitor U24 pin 1 (TP2) and adjust the *FROM TEL* pot on the 4-Wire Card until a signal level of 693 mV_{P-P} (245 mV_{RMS}, -10 dB) is attained. (4-Wire Card p/n 702-9445; be sure Appendix H modifications are installed)
- ❑ 10.b.5 Reset the Model 49 (MRS804ZX) to normal mode.
- ❑ 10.b.6 Turn off the TO TEL test tone from FASTNet.

❑ 10.c. Repeat step 10 for each trunk to set the FASTNet "TO TEL" levels.

FROM TEL Audio Levels (Inbound Audio to FASTNet Trunks)

❑ 11. Connect the Isolated Audio Tone Generator circuit described in Appendix A across the appropriate audio pair as specified in Table 4-22, on page 4-48. The Trunk Card Test Points and Trunk Card Monitoring Board are described in Figure 4-7: Dual TELCO Card Test Points on page 4-29.

- ❑ 11.a. Short the AGC disable pins using a BERG-type jumper *or* set the switch to "disable" on the Trunk Card Monitoring Board (702-9598).
- ❑ 11.b. Inject a 1 KHz sinewave tone, from the generator, at the required "FROM TELCO" test level for the trunk type under test. Typical line levels used are provided in Table 4-22 on page 4-48.
- ❑ 11.c. For Model 49 (MRS804ZX) units:
  (FASTNet *FROM TEL* adjustments from the 'Model 49' outputs)
  - ❑ 11.c.1 Place the Model 49 into Test Mode and short U1 pins 4,5 of the 4-Wire Card to cause the Model 49 (MRS804ZX) to answer the phone line and drop into Telco Test Mode (as previously described in step 10.b.1).
    - Select Telco Test Mode 2 (1 KHz tone).

    Note: This tone output level is approximately 3 dB below maximum voice output for the 'Model 49' circuits.
  - ❑ 11.c.2 Model 49 Rev H-Q;
    - Adjust the *TO TEL* pot of the 4-Wire Card to attain approximately -10 dB (693 mV_{P-P} , 245 mV_{RMS}) across the 4-Wire Card T2/R2 pair (FASTNet T1/R1 pair) This can be measured easiest at the 4-Wire Card jack J1/J2 pins 2, 5.
      Note: If using an oscilloscope, then this measurement must be performed using two probes in differential mode, so as not to load the line via the "scope ground" lead.
      (Be sure Appendix H modifications are installed to 702-9228 4-Wire Card)

❑ 11.c.3 Model 49 Rev S+;

- Adjust the *TO TEL* pot of the 4-Wire Card to attain approximately -10 dB (693 mV_{P-P} , 245 mV_{RMS}) across the 4-Wire Card T2/R2 pair (FASTNet T1/R1 pair) This can be measured at the 4-Wire Card jack J1/J2 (pins 2, 5), or at the RJ21X Split-Block Terminal (see Figure 4-1 on page 4-15).

  Note: If using an oscilloscope, then this measurement must be performed using two probes in differential mode, so as not to load the line via the "scope ground" lead.

  (Be sure Appendix H modifications are installed to 702-9445 4-Wire Card)
- On the associated FASTNet trunk, with the AGC disabled (refer to Test Points on page 4-29), adjust the FASTNet FROM TEL pot to obtain 2.19 V_{P-P} (775 V_{RMS} , 0dB) at the FASTNet FROM TEL test point for that trunk.
- Drop FASTNet and the Model 49 out of test modes and establish a phone call through this Model 49 / repeater channel to a "quiet line" (refer to Appendix A), using a simplex ID code with compandor/expandor disabled. Leave the FASTNet trunk AGC disabled at this time.

  Using a Service Monitor, generate this ID (@ 1 KHz Dev.) with a 1 KHz Audio Sinewave (@ 4 KHz Dev.).

  Adjust the Main Board *TO TEL* pot (R52) to attain -9 dB (777 mV_{P-P} , 275 mV_{RMS}) across the to-tel audio pair at J1/J2 (pins 2,5) of the 4-Wire Card, or at the RJ21X Split-Block terminal.

❑ 11.c.4 MRS804ZX Repeater;

- Adjust the *TO TEL* pot of the 4-Wire Card to attain approximately -10 dB (693 mV_{P-P} , 245 mV_{RMS}) across the 4-Wire Card T2/R2 pair (FASTNet T1/R1 pair) This can be measured at the 4-Wire Card jack J1/J2 (pins 2, 5), or at the RJ21X Split-Block Terminal (see Figure 4-1 on page 4-15).

  Note: If using an oscilloscope, then this measurement must be performed using two probes in differential mode, so as not to load the line via the "scope ground" lead.

  (Be sure Appendix H modifications are installed to 702-9445 4-Wire Card)
- On the associated FASTNet trunk, with the AGC disabled (refer to Test Points on page 4-29), adjust the FASTNet FROM TEL pot to obtain 2.19 V_{P-P} (775 V_{RMS} , 0dB) at the FASTNet FROM TEL test point for that trunk.

- Drop FASTNet and the MRS804ZX out of test modes and establish a phone call through this repeater channel to a "quiet line" (refer to Appendix A), using a simplex ID code with compandor/expandor disabled. Leave the FASTNet trunk AGC disabled at this time.

  Using a Service Monitor, generate this ID (@ 1 KHz Dev.) with a 1 KHz Audio Sinewave (@ 4 KHz Dev.).

  Adjust the Main Board *TO TEL* pot (R52) to attain a level of 777 mV_{P-P} (-9 dB, 275 mV_{RMS}) across the to-tel audio pair at J1/J2 (pins 2,5) of the 4-Wire Card, or at the RJ21X Split-Block terminal.

❑ 11.d. Repeat steps 11 a-c until the FROM TEL levels of all the trunks are set.

❑ 12. Model 810 Hybrid Null: GO TO STEP 13 if not using Model 810 units.

- ❑ 12.a. Short the AGC disable pins using a BERG-type jumper *or* set the switch to "disable" on the Trunk Card Monitoring Board (702-9598).
  - Refer to Figure 4-7: Dual TELCO Card Test Points to locate these pins.
- ❑ 12.b. Place the Model 810 into Mode 7 to generate a composite test tone for hybrid balancing. Select Mode 7 by rotating the "MODE" switch until the 7 is in the 9 o'clock position, and wait three seconds.
- ❑ 12.c. While monitoring the FROM TEL test point of the trunk under test, alternately adjust "SETUP" potentiometers "A" and "B" until a minimum amplitude is attained. Repeat as needed.
- ❑ d. Set the Model 810 to Mode 0.

❑ 13. Remove the shorting jumper from the AGC disabling pins of the trunk under test.

❑ 14. Hang-up line to terminate set-up operation.

Trunk Test

❑ 15. Place a telephone call through the trunk just tested and establish conversation mode.

- Verify audio is clear of distortion and noise.
- If a Model 810 is in use for that trunk, rotate the MODE selector switch through positions 0 ↔ 5, waiting at least 3 seconds for each mode selection to activate. Choose the least noisy position.

❑ 16. Hang up the line. The trunks are ready for use.

Local Computer Access Alignment Method

This is a general procedural outline for this level adjustment method. Specific level settings are provided in Table 4-22 on page 4-48 for several typical interfaces .

This method is preferred for *non*-DID trunks.

TO TEL Audio Levels (Outbound Audio to Trunks)

❑ 5. Connect Lap-top or Local resident computer (IBM PC compatible as specified in Section 1 of this manual) to P2 of the lower backplane board in the Model 2540 chassis.

This requires use of a Zetron serial cable (709-7086; dot at computer end), or an equivalent constructed per the wire list shown in Table 2-1.

❑ 6. Enter "NETLINK L4800 X 1"

where:

"X" NETLINK password; Fill with any letter if password *DISABLED* by CPU Card DIP switch SW1-1, labeled "C1" (B = password required).

"1" represents COM PORT 1 (Substitute 2, 3, 4 as needed for your Local Computer)

❑ 7. Enter "SETUP ttu (tel#) D" where:

tt = Trunk Card Address (refer to Section 2; Dual telco Card)

u = A or B for specific trunk circuit of said card.

(tel#) = Telephone number to dial for testing (termination).
This will not be entered if a direct connection (via RF or μWave Link) to a Model 42 or Model 49 controller.

D = Dialing signal format to be used
D = DTMF Dialing (**Default** if not specified)
M = MF Dialing
P = Pulse Dialing

Example: Entering "SETUP 17B 9991234567 D" causes the following:

- FASTNet would access the trunk card located at address "17".
- Trunk "B" (1) of the card addressed "17" would be accessed.
- Via this trunk, the FASTNet Switch would dial (999) 123-4567.
- This number would dial via DTMF protocol.

- ❑ 8. Enter "TONEON" to generate 1 KHz Test Tone (LAST trunk accessed).
  - ❑ a. Set the TO TEL level, as measured at either (1) the TO TEL A/B test point, or (2) the TIP/RING trunk pair for the trunk under test (A / B) as appropriate.
    - Refer to Table 4-22 for specific levels recommended for most common interfaces.
  - ❑ b. Enter "TONEOFF" to cease Test Tone generation.
  - ❑ c. Repeat step 8 for each trunk to set the "TO TEL" levels.

***** WARNING *****

ALL trunks CAN be accessed and placed into "TEST MODE" simultaneously using this method (ONE trunk at a time). These trunks MUST be removed from test mode (ONE at a time) prior to abandonment in order for users to gain access to trunks WHILE you are servicing other trunks. Therefore, we recommend only aligning one trunk at a time.

FROM TEL Audio Levels (Inbound Audio to Trunks)

- ❑ 9. Connect the Isolated Audio Tone Generator circuit described in Appendix A across the appropriate audio pair as specified in Table 4-22.
  - ❑ a. Short the AGC disable pins using a BERG-type jumper *or* set the switch to "disable" on the Trunk Card Monitoring Board (702-9598).
    - Refer to Figure 4-7: Dual TELCO Card Test Points to locate these pins.
  - ❑ b. Inject a 1 KHz sinewave tone, from the generator, at the required "FROM TELCO" test level for the trunk type under test (See Table 4-22).
  - ❑ c. While measuring the level at the "TO TEL" test point of the trunk card under test, adjust the TO TEL (A or B) for 0 dB.
    - Refer to page 4-29, Figure 4-7: Dual TELCO Card Test Points
    - Refer to page 4-48, Table 4-22.
  - ❑ d. Repeat steps 9 a-c until the FROM TEL levels of all the trunks are set.

- ❑ 10. Model 810 Hybrid Null: GO TO STEP 11 if not using Model 810 units.
  - ❑ a. Short the AGC disable pins using a BERG-type jumper *or* set the switch to "disable" on the Trunk Card Monitoring Board (702-9598).
    - Refer to Figure 4-7: Dual TELCO Card Test Points to locate these pins.
  - ❑ b. Place the Model 810 into Mode 7 to generate a composite test tone for hybrid balancing. Select Mode 7 by rotating the "MODE" switch until the 7 is in the 9 o'clock position, and wait three seconds.
  - ❑ c. While monitoring the FROM TEL test point of the trunk under test, alternately adjust "SETUP" potentiometers "A" and "B" until a minimum amplitude is attained. Repeat as needed.
  - ❑ d. Set the Model 810 to Mode 0.

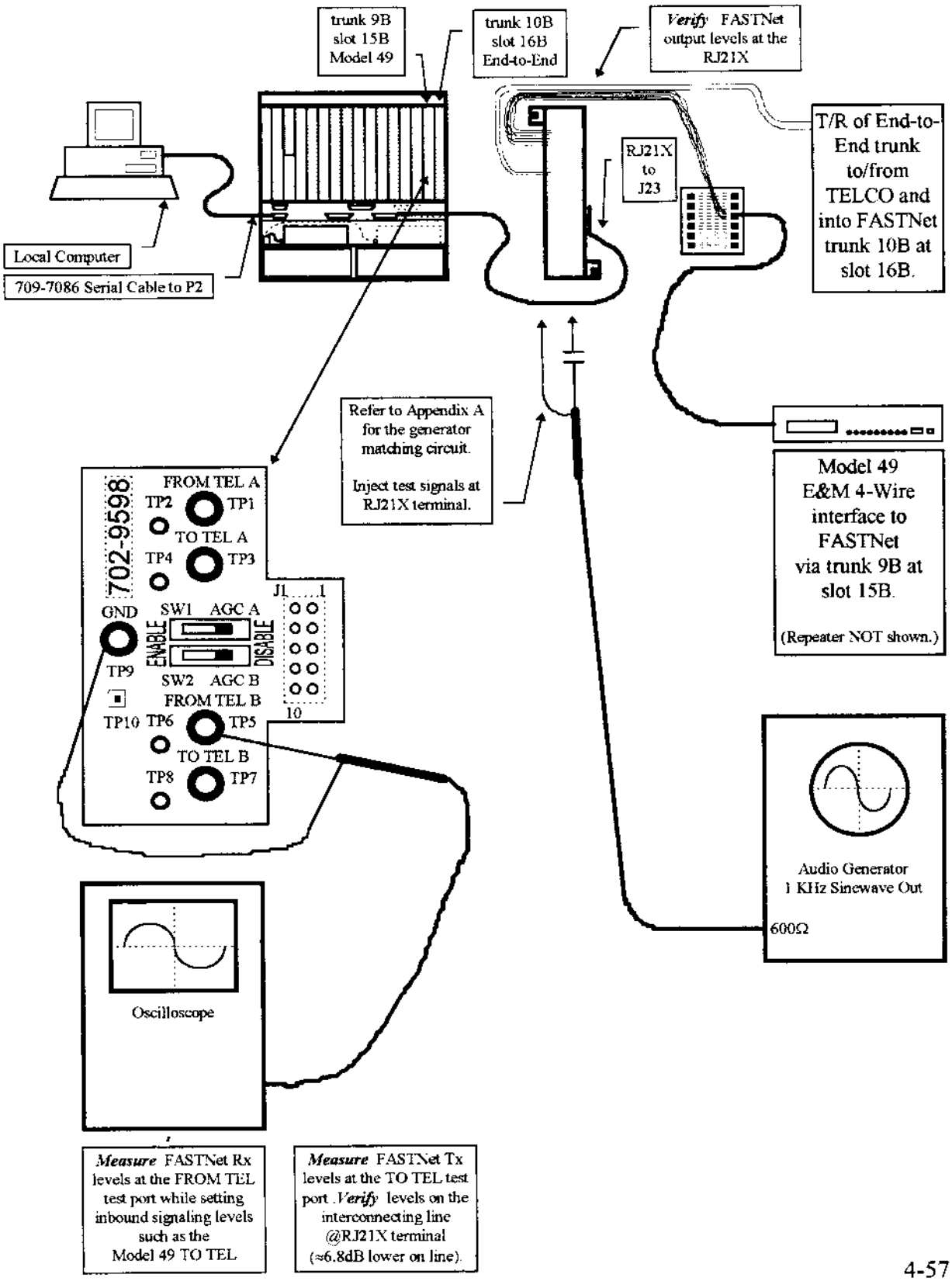
- ❑ 11. Remove the shorting jumper from the AGC disabling pins of the trunk under test.
- ❑ 12. Hang-up line to terminate set-up operation.

Trunk Test

- ❑ 13. Place a telephone call through the trunk just tested and establish conversation mode. Verify audio is clear of distortion and noise.
  - ❑ a. If a Model 810 is in use for that trunk, rotate the MODE selector switch through positions 0 ↔ 5, waiting at least 3 seconds for each mode selection to activate. Choose the least noisy position.

- ❑ 14. Hang-up line to terminate operation.

Trunk Test Configurations



5.ADPCM VOICE STORAGE SYSTEM

GENERAL DESCRIPTION

The ADPCM (Adaptive Differential Pulse Coded Modulation) Voice Storage feature of the Model 2540 FASTNet Switch consists of system software, a Voice Card (702-9459), active RAM area allocated on the Voice Card, and storage space allocated on a SCSI Hard Disc. Basic service provided with the FASTNet Switch includes 2-Hour storage time and four channel operation. Various options are available to expand Voice Storage capacity and simultaneous-use capability.

The ADPCM format was developed for use, instead of PCM storage, in order to reduce disk access time and provide file compression, and therefore more storage capacity.

To facilitate high traffic volumes, multiple channels can record or play simultaneously, even the same message in parallel. For example, if several interconnected (telephone) trunks are accessed at once, or in overlapping sequence, all will receive the same "Voice Messaging prompt" immediately, and independent of the others. If another trunk is answered halfway through the prompt message, that trunk will also hear the "Voice Messaging prompt" completely, and without waiting. There is no wrap-around effect. No caller is forced to wait for messages, because each caller is assigned a dedicated playback channel for each call. Following the "Voice Mail" prompt message, the Voice Card switches to storage mode and begins recording each caller. When finished recording, and the phone is hung-up, the Voice Card will answer other trunks and repeat the cycle. Four channels are provided with the basic FASTNet Switch package. These may be expanded in four-channel increments up to sixteen channels as needed.

Voice storage is performed via SCSI Hard Disc drives. Various sizes are available so that cost and needs may be balanced per system traffic requirements. These drives provide non-volatile storage of files which can vary significantly in length. The only limitation of file length is the actual disc capacity. Files are only as large as required, minimizing wasted disc space. Furthermore, silent gaps in conversation are deleted through Zetron's Pause Compression feature, economizing both disk access time and storage space. This feature provides for timing duration and attenuation level adjustments for elimination of "quiet" intervals.

Some voice storage systems trade-off audio quality for storage capacity. Zetron's Voice Messaging utilizes an audio bandwidth capability which exceeds that of standard TELCO lines, ensuring playback fidelity equal to the original message. Even when utilizing Pause Compression, audio is clean, and the silent gaps are not missed.

THEORY OF OPERATION

The Voice Card is the principal element of the ADPCM Voice Storage System. This system also includes the SCSI Hard Disk, portions of CPU RAM memory, FASTNet system software, and PCM Bus encoding/decoding circuitry on the trunk cards. Audio signaling is translated between PCM and true audio by the trunk cards. The PCM signaling is then converted into ADPCM by the ADPCM Voice Card, which is stored/recalled from RAM memory. The RAM memory data is stored/recalled into Hard Disk memory.

This system provides recording or playback of voice messages and prompts, on any one of the ADPCM or PCM channels at any time. Simultaneous playback of the same message on two or more ADPCM/PCM channels is not a problem because of the digitized audio storage, even if these playbacks are not synchronized.

To RECORD a message, the FASTNet software selects an available channel, routes the audio from the trunk card PCM bus to the ADPCM Card, and then stores the digitized audio into the ADPCM RAM buffers. When the RAM buffers are filled, the ADPCM downloads that data onto the hard disk for permanent storage (until erased). After the message being recorded is completed, an 'end of message' is recorded onto the hard disk. The next message recorded is stored into the next adjacent byte on the hard disk, hence there is no space wasted from partitioning message recordings. The "MEM" LED is on during this activity.

To PLAYBACK a message, operation is almost reverse of the record method. When the ADPCM Card receives a playback command, the ADPCM RAM buffer is loaded, and the data is regenerated into the PCM Bus, where the trunk cards can access the data. The trunk cards then convert the PCM data into voice signals. This process repeats, buffer by buffer, until the end of message marker is encountered. At that time the ADPCM highway is muted, disk reading is ceased, and the CPU is signaled to reassign the ADPCM channel to the next user. The "MEM" LED is on during this activity.

The ADPCM Voice Card operates as a slave to the CPU, therefore requiring no special commands for normal operation. This card merely reacts to CPU instructions present on the IBM-PC Bus.

Pause Compression

This mode of operation is optional. It is enabled and configured from data compiled in the Trunk Card Editor file, which is normally programmed by the person responsible for FASTNet Operations. This file is then loaded into the ADPCM Voice Card during a System Reset cycle.

When enabled, the ADPCM Voice Card removes the silent gaps in the message. This function can be fine tuned to be very soft and polite so that it is nearly impossible to tell that deletion has occurred. Alternately, the software may be programmed more aggressively to yield abrupt and broken-sounding speech if desired. The primary advantage to utilizing this option is to significantly reduce voice airtime during playback, and to minimize message storage memory

size. Typical compressed messages range from 10% to 50% in length as compared to the original messages.

Three characteristics are used to describe the Pause Compression feature:

1. Attack; ADPCM Voice Card response rate following silence;
2. Decay; ADPCM Voice Card "speed", is the length of time recording continues after the last sound is detected;
3. Audio Level; defines the detector threshold for silence/audio.

"Attack" is factory set to 4.5 msec on the ADPCM Voice Card, which is fast enough to prevent chopping the leading edges from syllables, while being slow enough to ignore random noise spikes in the audio signaling.

The Pause Compression "decay" or "speed" can be programmed for any one of three settings. These can be experimented with during installation to decide which is preferred.

The "audio level" is fixed at a preset value on the ADPCM Voice card and is not field adjustable.

ADPCM VOICE CARD INSTALLATION

Slot Assignment

The ADPCM Voice Card (702-9459) is normally installed into Slot 6 of the Model 2540 FASTNet Switch. Refer to Figure 3-1 for illustration.

CPU Addressing

In order to properly address the ADPCM card from the CPU, be sure that jumper JP1 is set in the "A" position.

Pause Compression Mode Selection

Operational modes of the Pause Compression feature are selected via set-up software, and are loaded into the card during the system reset cycle following power-up or a soft reset. Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

Audio Level

No audio level adjustments are provided on the ADPCM Voice Card. Only digitized signaling is passed through this card. Level adjustments are solely a function of the trunk interface cards (i.e.: Dual TELCO Card and Dual 4-Wire Card). If the Pause Compression Option is enabled, then the trunk cards must be set to a level where the background noise is not so loud as to cause the Voice Card to continuously record. During normal use, the busy indicators should be off, except when recording or playing-back messages. Noise should not light these LEDs.

INDICATORS

The ADPCM card indicators are listed in Table 5-1.

Table 5-1: ADPCM Card Indicators

ADPCM Card Front Panel Label	Purpose of Indicator
MEM	Used to indicate that voice mapped onto the ADPCM Bus is available to the RAM storage.
PRG	Used to indicate that Program Memory or Control/Status data are present on the IBM-PC Bus.
TS1	Illuminated whenever at least one channel is recording a message.
TS2	Used to indicate message playback on at least one ADPCM Channel.
1/4	25% of available ADPCM Bus channels are busy;
1/2	50% of available ADPCM Bus channels are busy;
3/4	75% of available ADPCM Bus channels are busy;
1/1	100% (ALL) available ADPCM Bus channels are busy.

NOTE: "MEM" and "PRG" are illuminated almost continuously during normal operation

TEST PINS

Five test points are available on the front of the ADPCM Voice Card, near the bottom. These are useful to establish life or death of the card during troubleshooting. Care should be taken that these pins are not bent into each other, nor into the chassis at any time. The functions of each are listed in Table 5-2.

Table 5-2: ADPCM Card Test Pins

ADPCM Front Label	Test Pin Number	Purpose
4 MHz	J1-5	4.00 MHz clock produced by the circuit logic. This is a 50% duty cycle signal, at a level of about 3.5 VDC, with ringing. This TTL signal is one-fourth of the 16 MHz crystal oscillator frequency.
MEM	J1-4	Low TTL signal whenever a "system access" of the Voice Storage RAM (READ or WRITE) occurs.
SYN	J1-3	TTL synchronization signal for monitoring the voice program.
SEL	J1-2	TTL signal is low when the CPU system program is performing a read/write operation to the dual ported memory area.
GND	J1-1	Signal Ground Reference

UPGRADES

Software upgrades to the ADPCM Voice Card (702-9053) are performed like other Model 2540 upgrades; via telephone modem from Zetron Applications Engineers.

Hardware Upgrades to add ADPCM Voice Channels are available in sets of four channels, up to a maximum of sixteen voice channels. Each bank of four channels includes four RAM IC chips to be added by the service technician, and one PAL IC as indicated in Table 5-3.

Table 5-3: ADPCM RAM Chips vs. Enabled Channels

No. of ADPCM Channels Available for Use	RAM Chips Installed	PAL (U4) Suffix Letter
4	U21, U22, U23, U24	A
8	U17, U18, U19, U20 U21, U22, U23, U24	B
12	U13, U14, U15, U16 U17, U18, U19, U20 U21, U22, U23, U24	C
16	U9, U10, U11, U12 U13, U14, U15, U16 U17, U18, U19, U20 U21, U22, U23, U24	D

6. TROUBLESHOOTING AND REPAIR PROCEDURES

OVERVIEW

This section is provided to assist FASTNet Switch owners/technicians in troubleshooting their system to circuit board level, whereupon the faulty board may be adjusted, repaired, or replaced as required.

This procedure is outlined in flowchart format so that the technician may jump into or out of the mainline troubleshooting procedure to perform subroutine testing as required. The primary objective of this approach is to maintain direction and simplicity while analyzing fault conditions within the highly complex operations of the FASTNet Switch.

Although the technician may jump in and out of the mainline troubleshooting procedure, unless previous experience has been accrued with this product, it is strongly recommended that this procedure be closely adhered to.

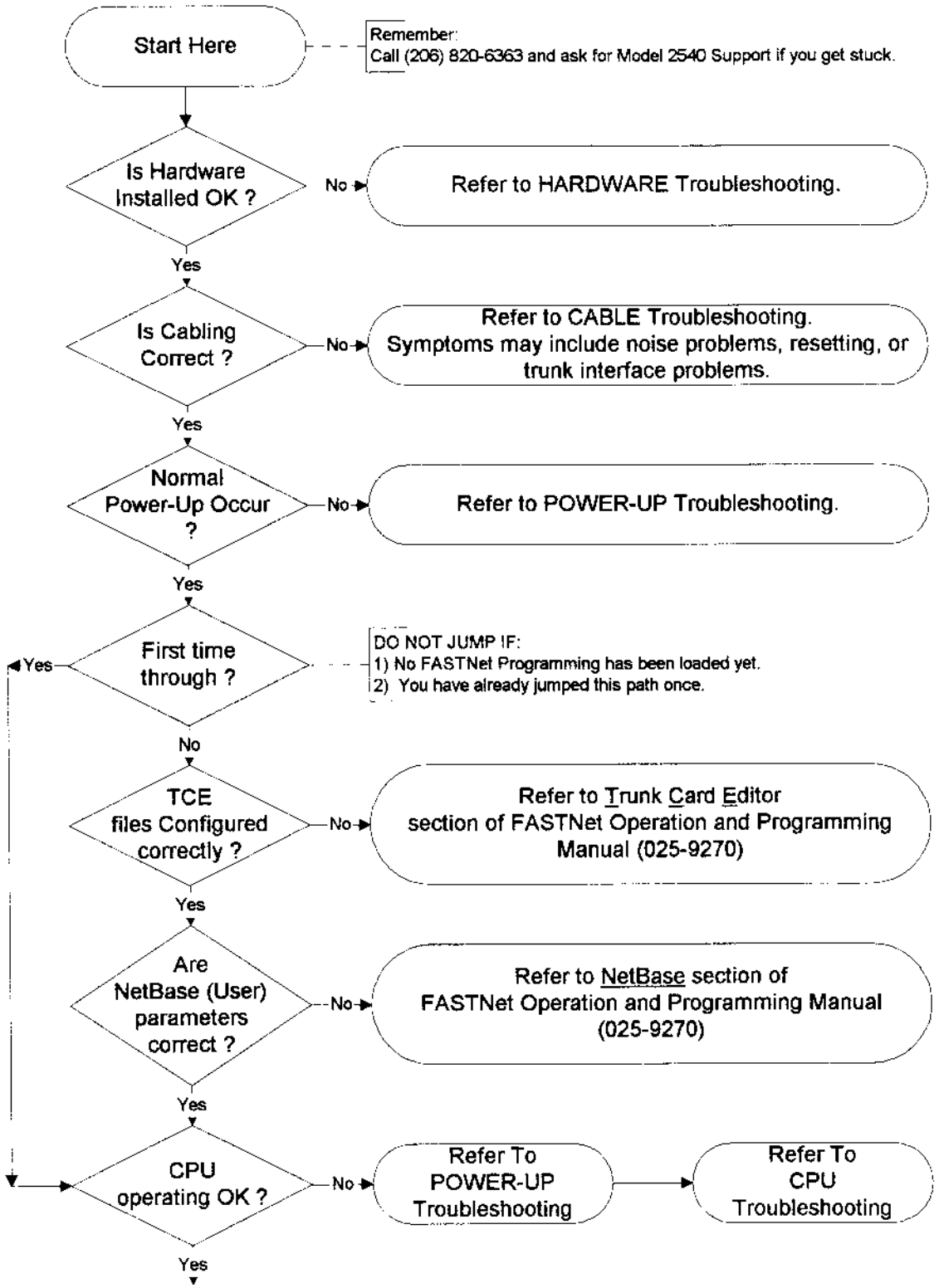
General Procedure

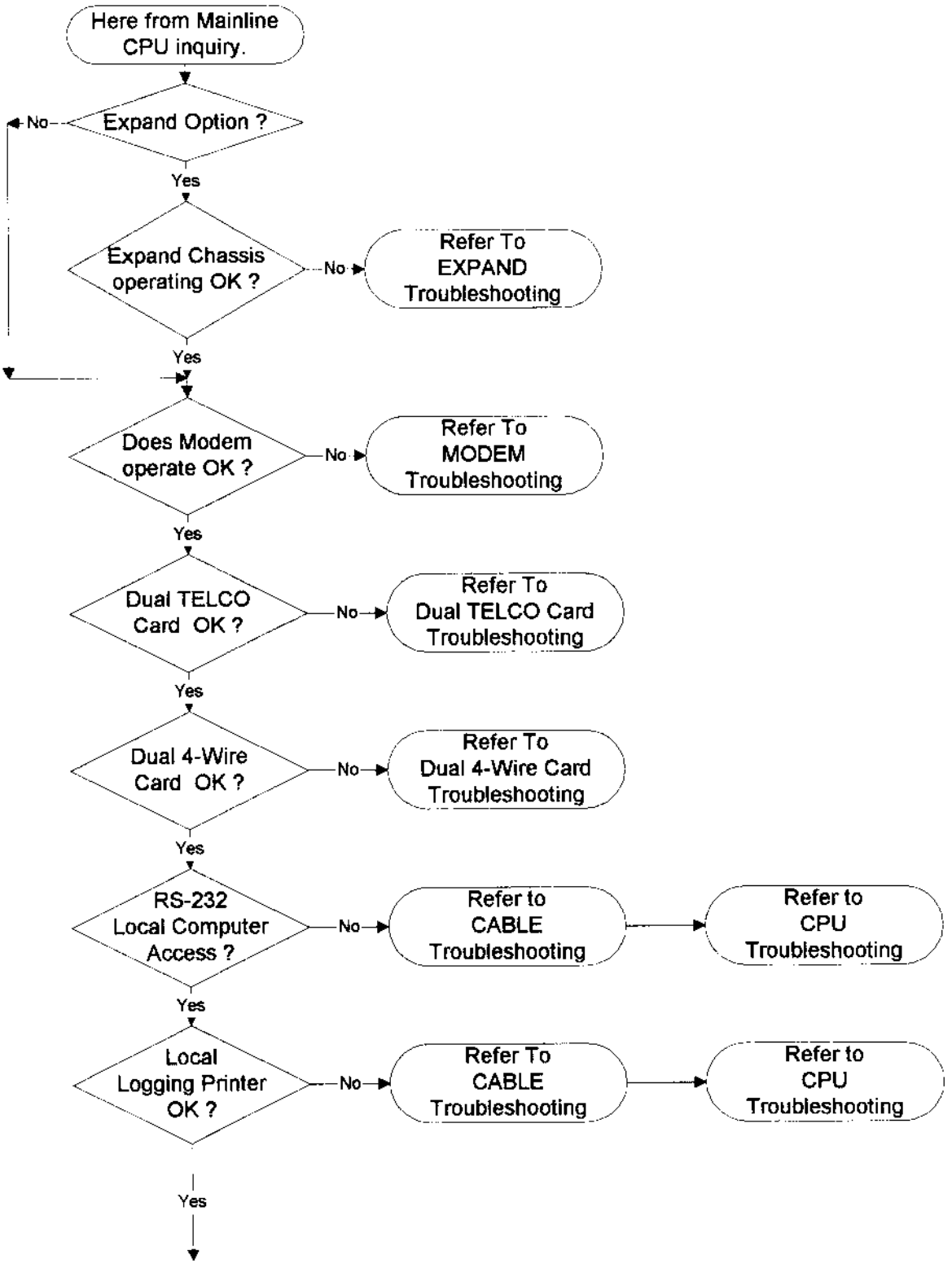
- ❑ 1. Obtain necessary test equipment as noted in Appendix A.
- ❑ 2. Start by following the "Mainline Troubleshooting" flowchart.
    - Each question (◊) refers to one or more subroutine troubleshooting flowcharts which relate to the interrogated function.
    - Follow subroutines as required.
- ❑ 3. When a suspect or defective component has been identified, double-check to verify findings, and then try replacing the component with a known "good" unit, and re-test. Alternately, contact Zetron for a service "loaner" if needed while we service your card.

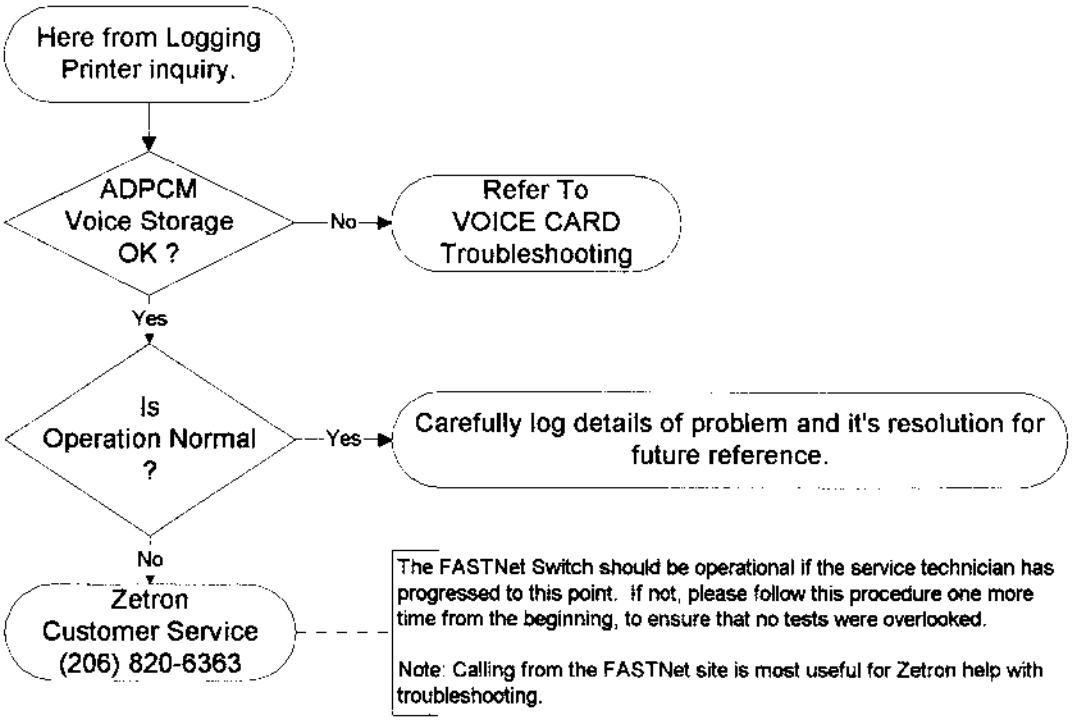
The majority of FASTNet difficulties to date, in new installations, have been related to either (a) incorrect programming of one or more parameters, or (b) improper or missing signal grounding. The signal grounding is especially critical for E&M 4-Wire applications, because the line supervision is telco "Type I" signaling, which is *single-ended* and *ground referenced.*

"Type II" signaling (2-wire contact "closures" each direction) can be facilitated with FASTNet, *if* external "drive" relays are connected to the Type I FASTNet outputs, *and if* one side of the Type II inputs are connected to battery or ground as appropriate. Appendix G provides an example of how to wire this interface.

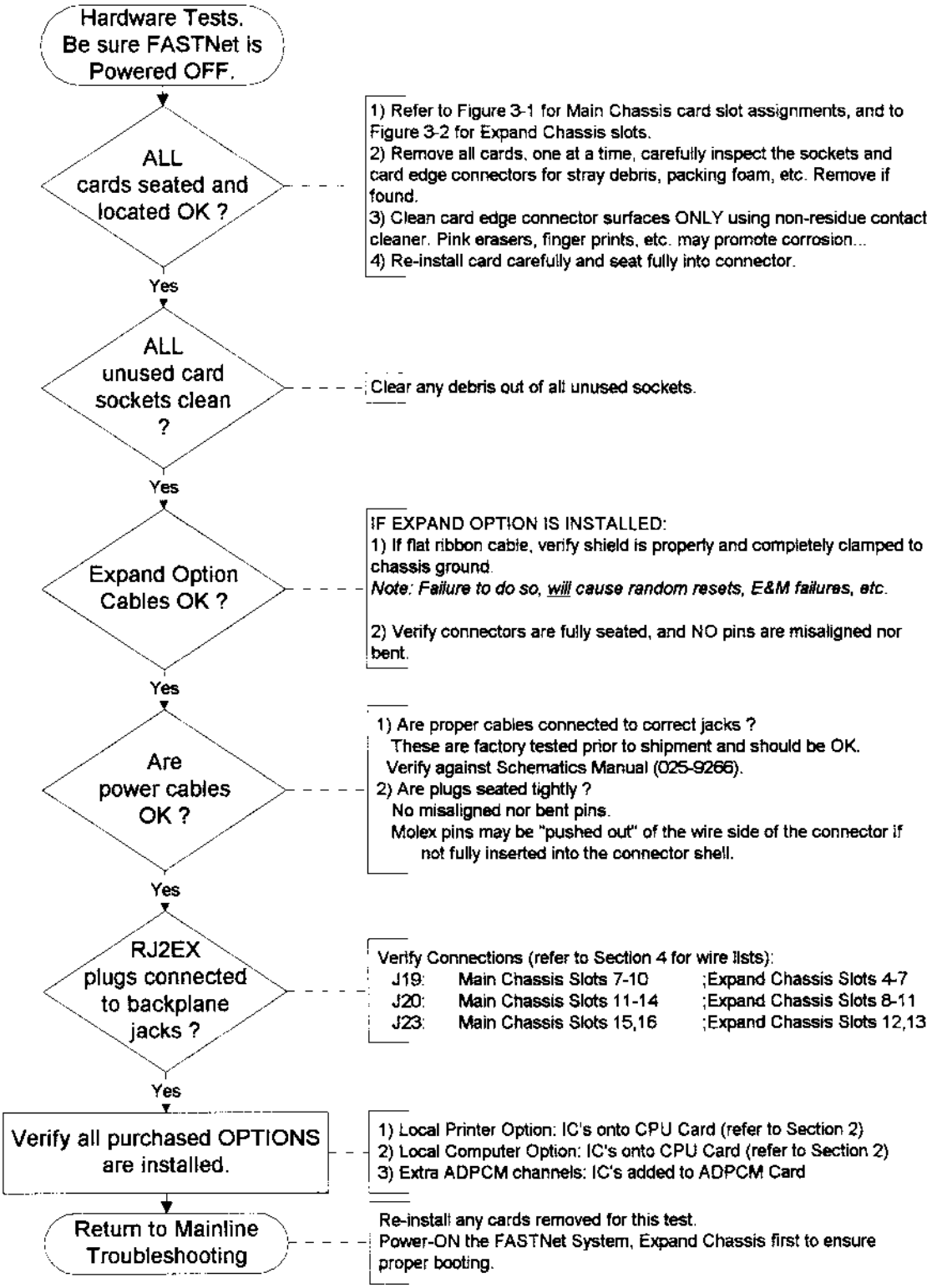
MAINLINE TROUBLESHOOTING



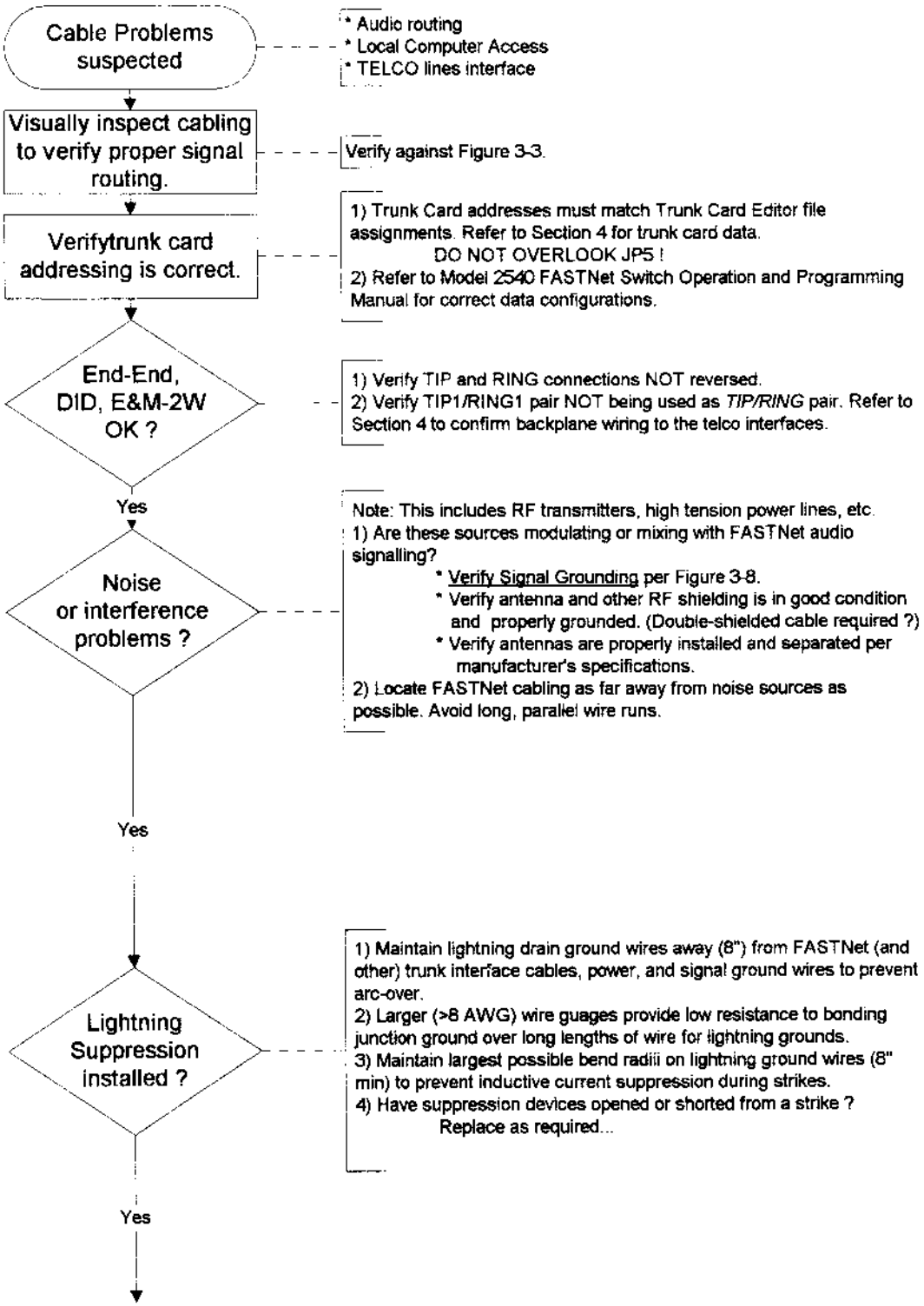

Here from Mainline CPU inquiry.
Expand Option ?
No
Yes
Expand Chassis operating OK ?
No
Refer To EXPAND Troubleshooting
Yes
Does Modem operate OK ?
No
Refer To MODEM Troubleshooting
Yes
Dual TELCO Card OK ?
No
Refer To Dual TELCO Card Troubleshooting
Yes
Dual 4-Wire Card OK ?
No
Refer To Dual 4-Wire Card Troubleshooting
Yes
RS-232 Local Computer Access ?
No
Refer to CABLE Troubleshooting
Refer to CPU Troubleshooting
Yes
Local Logging Printer OK ?
No
Refer To CABLE Troubleshooting
Refer to CPU Troubleshooting
Yes

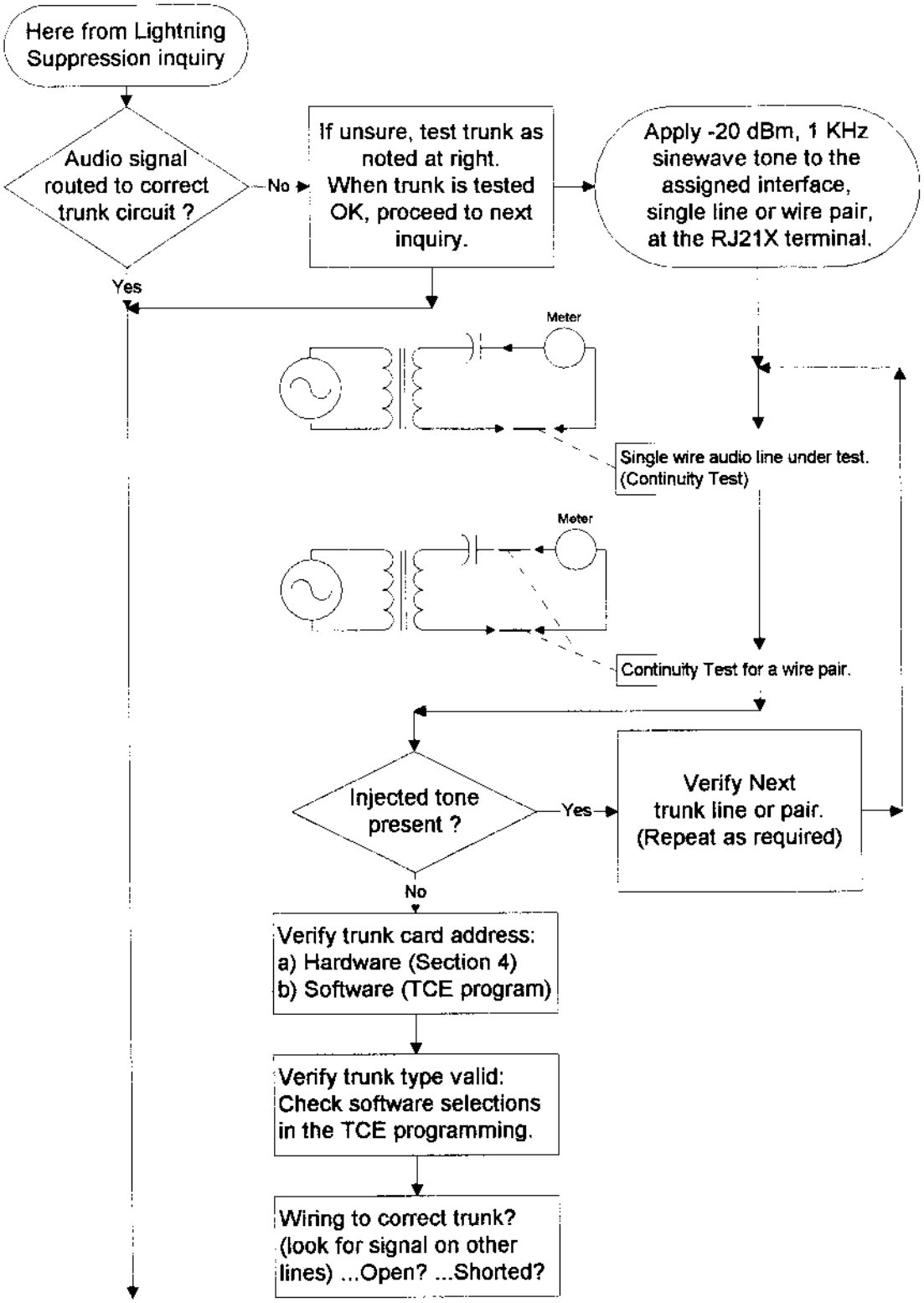

Here from Logging Printer inquiry.
ADPCM Voice Storage OK ?
No
Refer To VOICE CARD Troubleshooting
Yes
Is Operation Normal ?
Yes
Carefully log details of problem and it's resolution for future reference.
No
Zetron Customer Service (206) 820-6363
The FASTNet Switch should be operational if the service technician has progressed to this point. If not, please follow this procedure one more time from the beginning, to ensure that no tests were overlooked.
Note: Calling from the FASTNet site is most useful for Zetron help with troubleshooting.

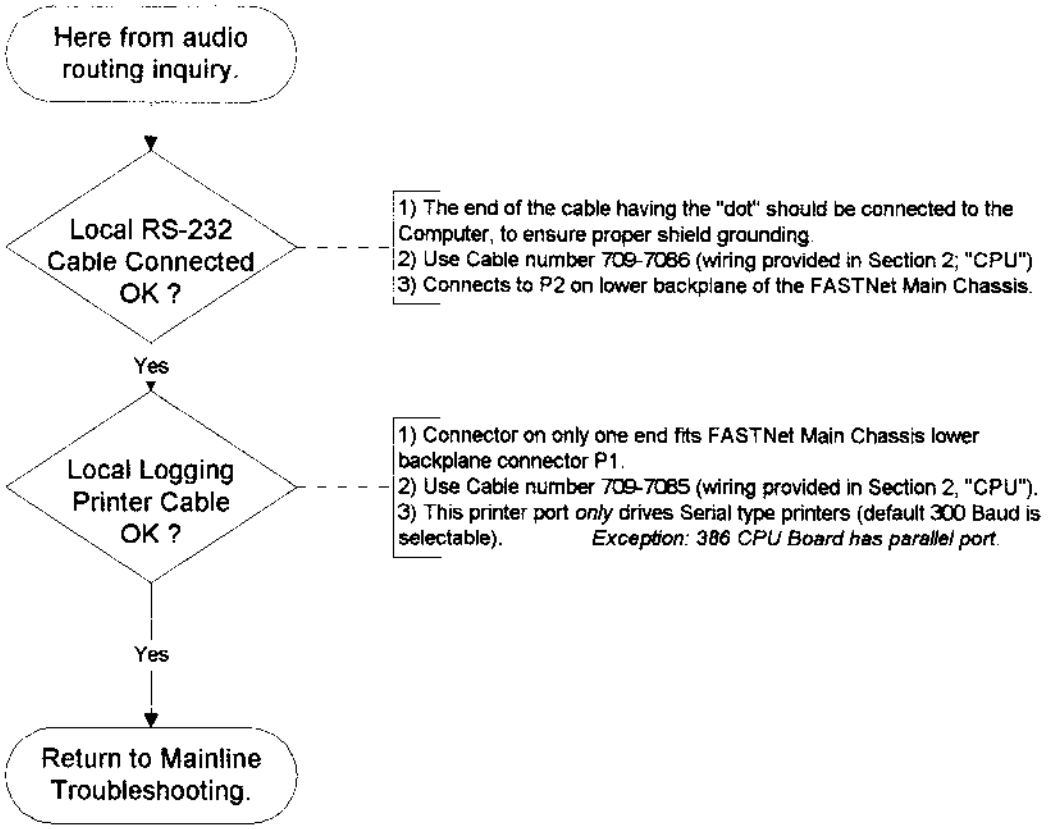
HARDWARE TROUBLESHOOTING



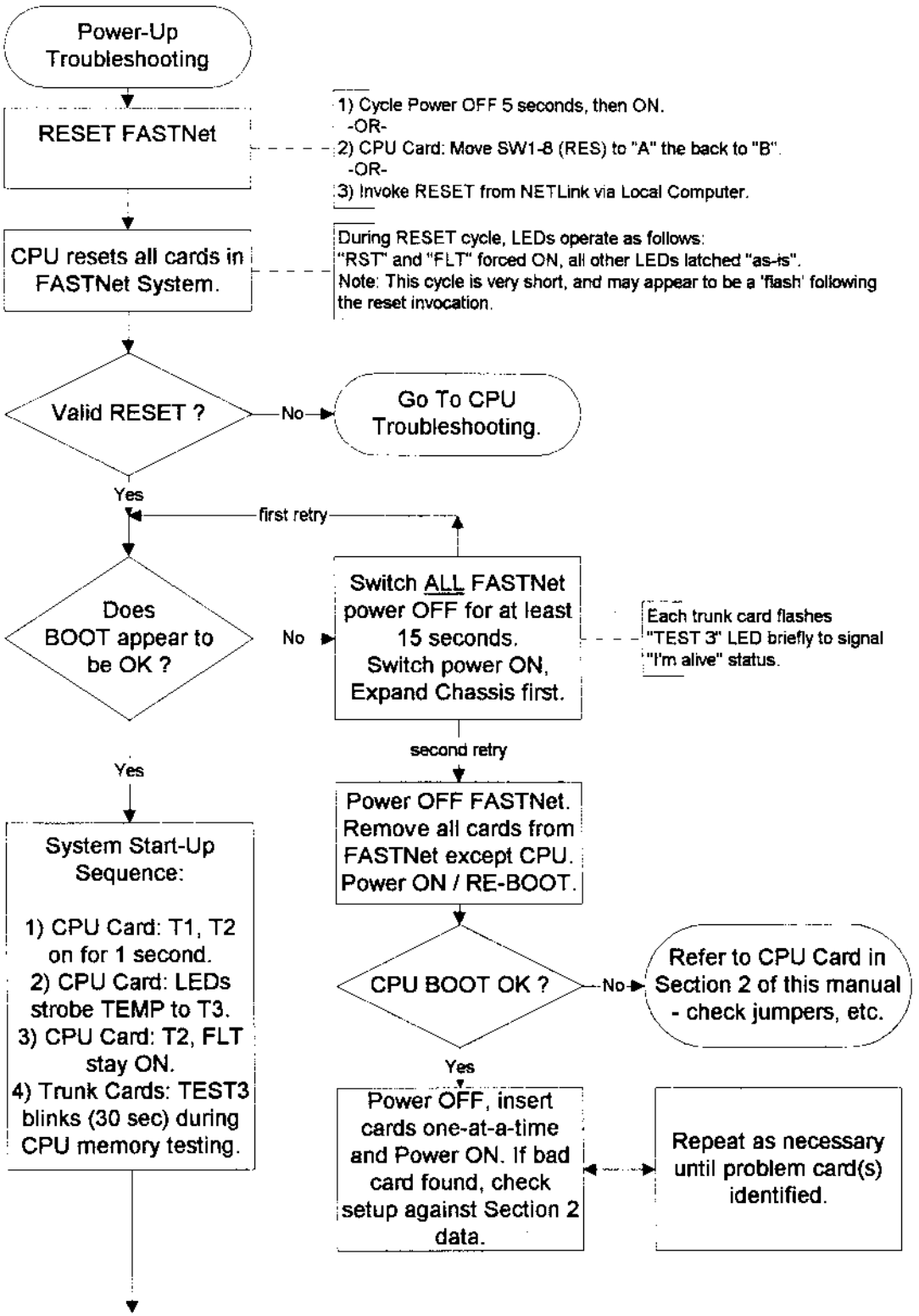
CABLE TROUBLESHOOTING



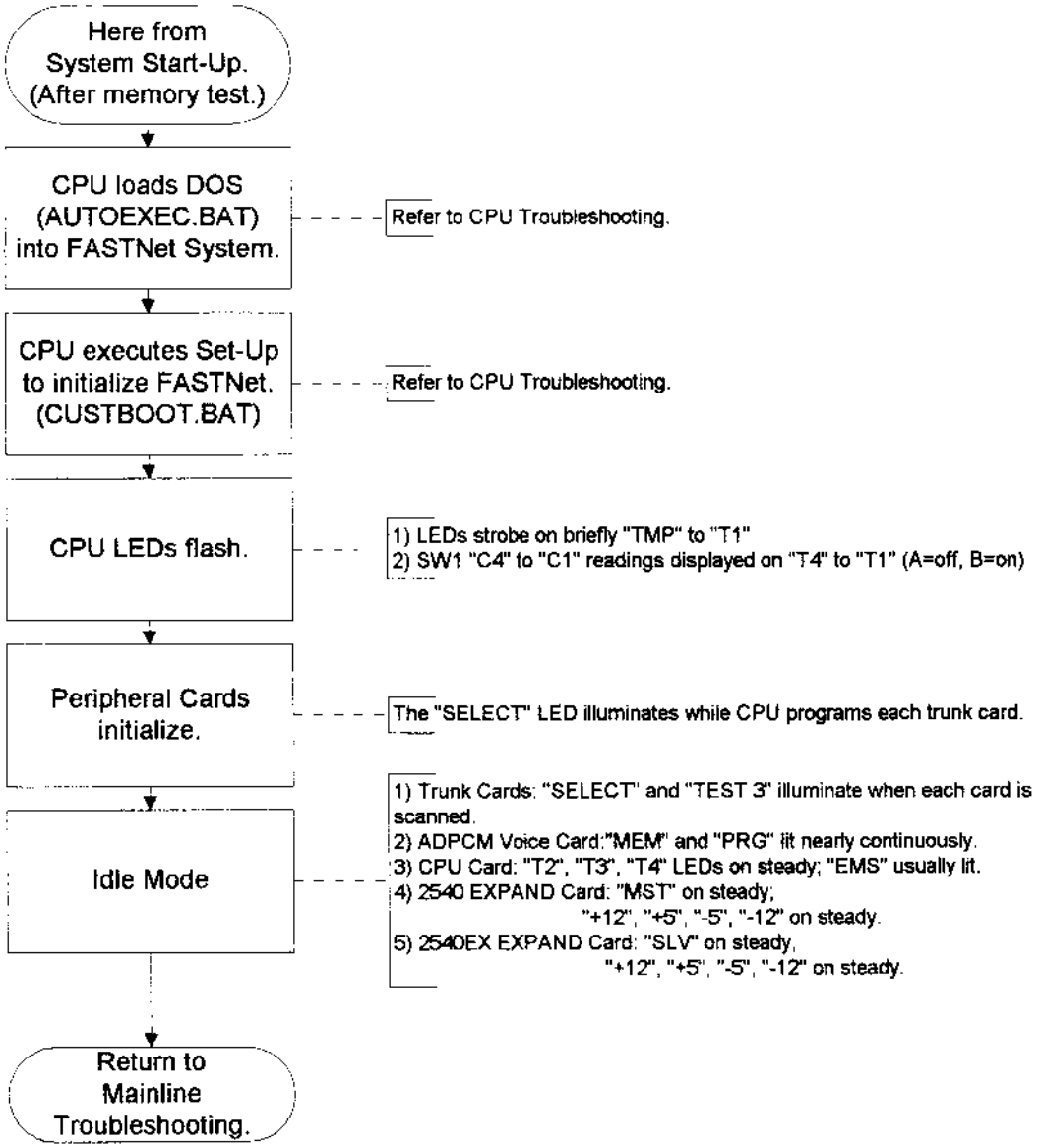

Here from Lightning Suppression inquiry
Audio signal routed to correct trunk circuit ?
No
If unsure, test trunk as noted at right. When trunk is tested OK, proceed to next inquiry.
Apply -20 dBm, 1 KHz sinewave tone to the assigned interface, single line or wire pair, at the RJ21X terminal.
Yes
Meter
Single wire audio line under test. (Continuity Test)
Meter
Continuity Test for a wire pair.
Injected tone present ?
Yes
Verify Next trunk line or pair. (Repeat as required)
No
Verify trunk card address: a) Hardware (Section 4) b) Software (TCE program)
Verify trunk type valid: Check software selections in the TCE programming.
Wiring to correct trunk? (look for signal on other lines) ...Open? ...Shorted?


Here from audio routing inquiry.
Local RS-232 Cable Connected OK ?
1) The end of the cable having the "dot" should be connected to the Computer, to ensure proper shield grounding.
2) Use Cable number 709-7086 (wiring provided in Section 2; "CPU")
3) Connects to P2 on lower backplane of the FASTNet Main Chassis.
Yes
Local Logging Printer Cable OK ?
1) Connector on only one end fits FASTNet Main Chassis lower backplane connector P1.
2) Use Cable number 709-7085 (wiring provided in Section 2, "CPU").
3) This printer port only drives Serial type printers (default 300 Baud is selectable). Exception: 386 CPU Board has parallel port.
Yes
Return to Mainline Troubleshooting.

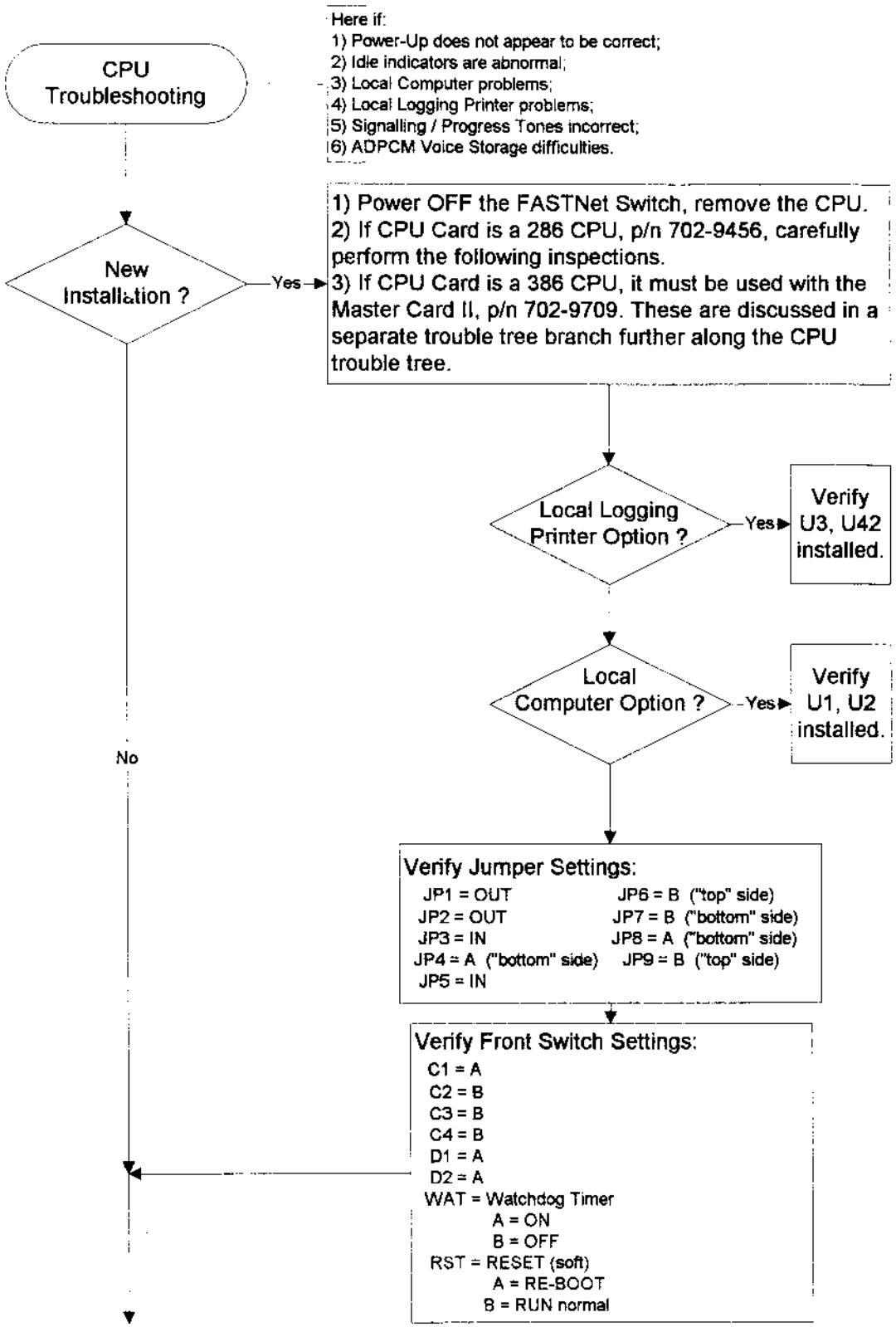
POWER-UP TROUBLESHOOTING

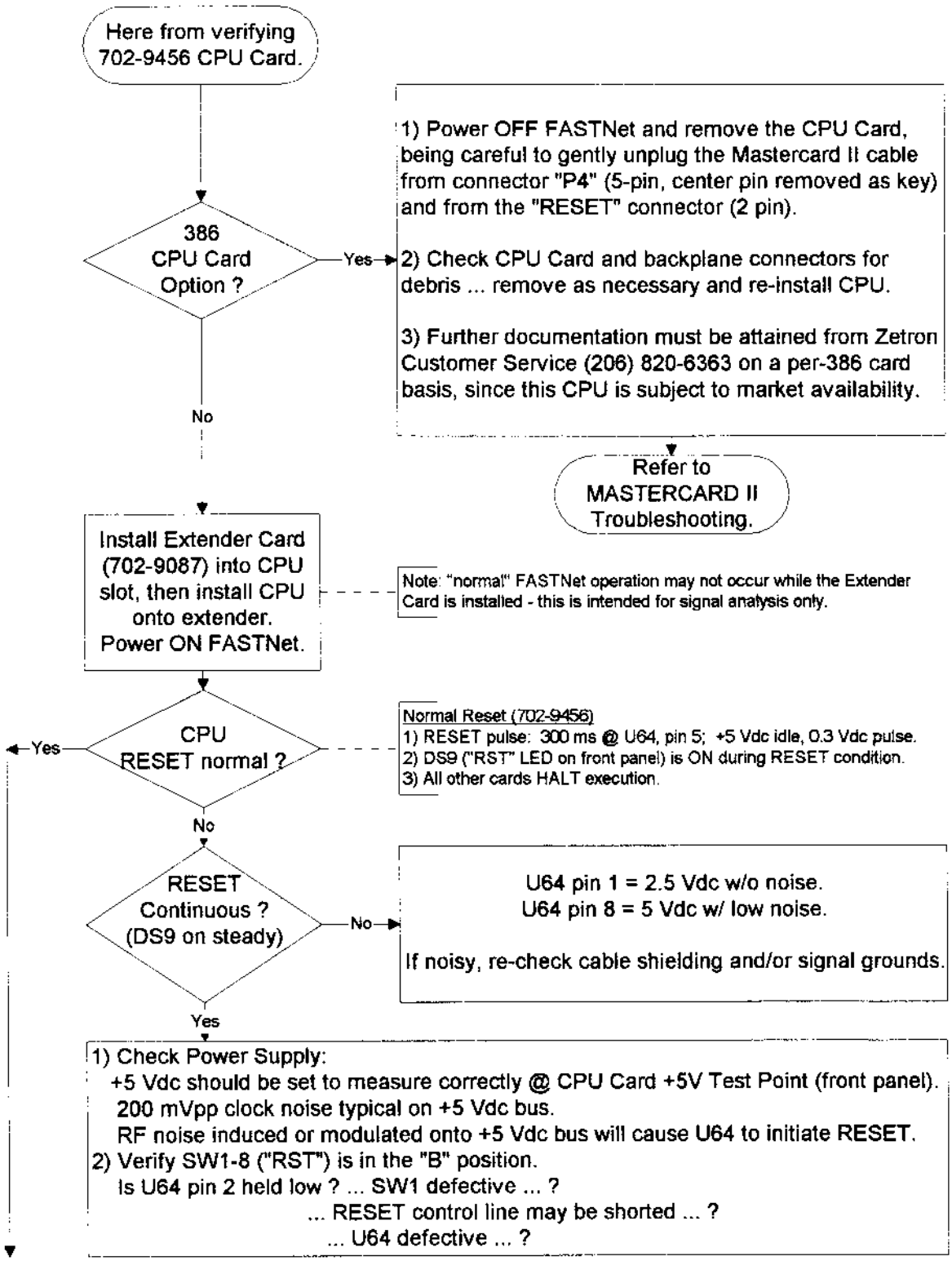


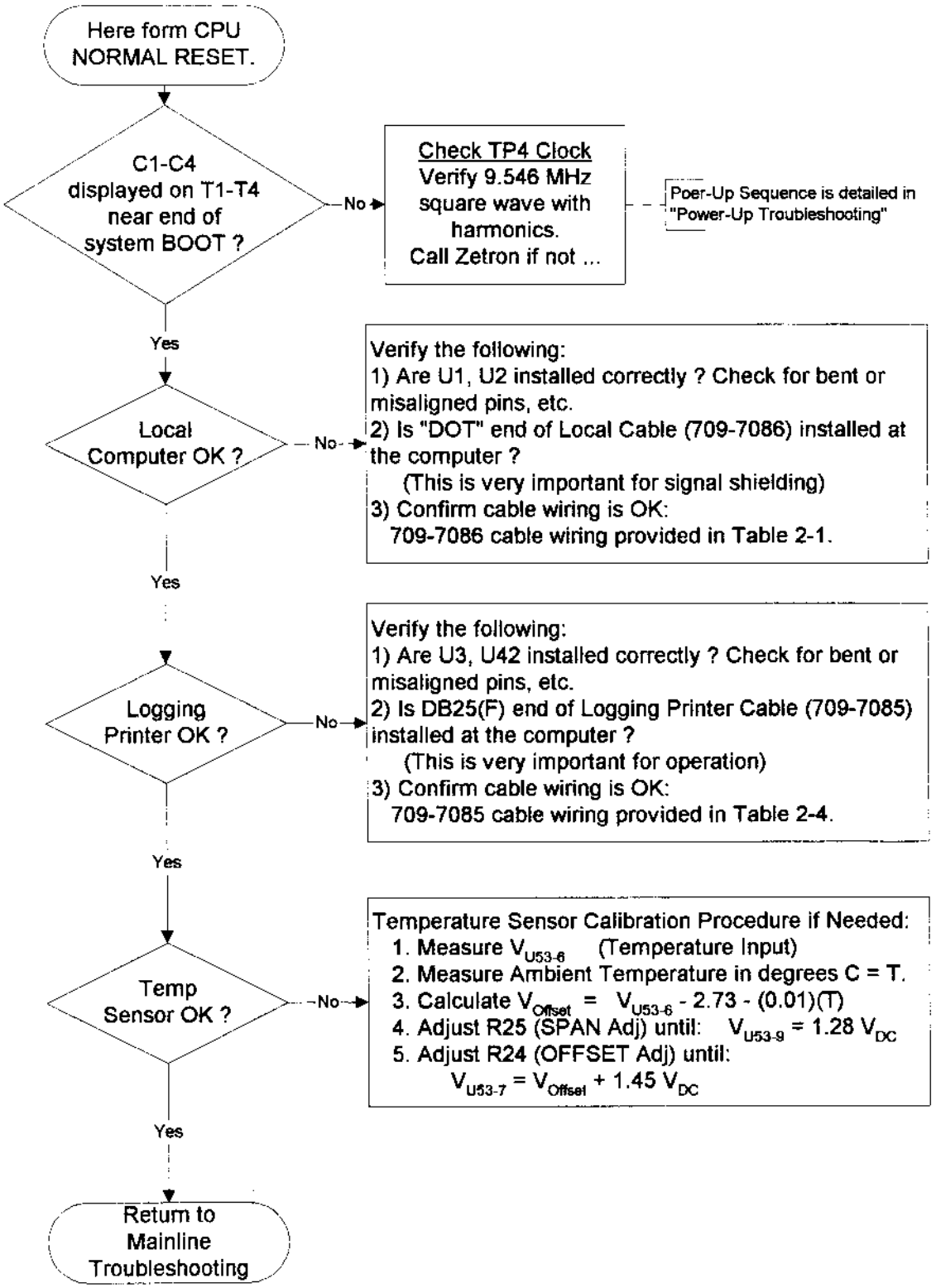
Power-Up


Here from System Start-Up. (After memory test.)
CPU loads DOS (AUTOEXEC.BAT) into FASTNet System.
Refer to CPU Troubleshooting.
CPU executes Set-Up to initialize FASTNet. (CUSTBOOT.BAT)
Refer to CPU Troubleshooting.
CPU LEDs flash.
1) LEDs strobe on briefly "TMP" to "T1"
2) SW1 "C4" to "C1" readings displayed on "T4" to "T1" (A=off, B=on)
Peripheral Cards initialize.
The "SELECT" LED illuminates while CPU programs each trunk card.
Idle Mode
1) Trunk Cards: "SELECT" and "TEST 3" illuminate when each card is scanned.
2) ADPCM Voice Card:"MEM" and "PRG" lit nearly continuously.
3) CPU Card: "T2", "T3", "T4" LEDs on steady; "EMS" usually lit.
4) 2540 EXPAND Card: "MST" on steady;
"+12", "+5", "-5", "-12" on steady.
5) 2540EX EXPAND Card: "SLV" on steady,
"+12", "+5", "-5", "-12" on steady.
Return to Mainline Troubleshooting.

CPU TROUBLESHOOTING




Here from verifying 702-9456 CPU Card.
386 CPU Card Option ?
Yes
1) Power OFF FASTNet and remove the CPU Card, being careful to gently unplug the Mastercard II cable from connector "P4" (5-pin, center pin removed as key) and from the "RESET" connector (2 pin).
2) Check CPU Card and backplane connectors for debris ... remove as necessary and re-install CPU.
3) Further documentation must be attained from Zetron Customer Service (206) 820-6363 on a per-386 card basis, since this CPU is subject to market availability.
Refer to MASTERCARD II Troubleshooting.
No
Install Extender Card (702-9087) into CPU slot, then install CPU onto extender. Power ON FASTNet.
Note: "normal" FASTNet operation may not occur while the Extender Card is installed - this is intended for signal analysis only.
CPU RESET normal ?
Yes
Normal Reset (702-9456)
1) RESET pulse: 300 ms @ U64, pin 5; +5 Vdc idle, 0.3 Vdc pulse.
2) DS9 ("RST" LED on front panel) is ON during RESET condition.
3) All other cards HALT execution.
No
RESET Continuous ? (DS9 on steady)
No
U64 pin 1 = 2.5 Vdc w/o noise.
U64 pin 8 = 5 Vdc w/ low noise.
If noisy, re-check cable shielding and/or signal grounds.
Yes
1) Check Power Supply:
+5 Vdc should be set to measure correctly @ CPU Card +5V Test Point (front panel).
200 mVpp clock noise typical on +5 Vdc bus.
RF noise induced or modulated onto +5 Vdc bus will cause U64 to initiate RESET.
2) Verify SW1-8 ("RST") is in the "B" position.
Is U64 pin 2 held low ? ... SW1 defective ... ?
... RESET control line may be shorted ... ?
... U64 defective ... ?


Here form CPU NORMAL RESET.
C1-C4 displayed on T1-T4 near end of system BOOT ?
No
Check TP4 Clock
Verify 9.546 MHz square wave with harmonics.
Call Zetron if not ...
Poer-Up Sequence is detailed in "Power-Up Troubleshooting"
Yes
Local Computer OK ?
No
Verify the following:
1) Are U1, U2 installed correctly ? Check for bent or misaligned pins, etc.
2) Is "DOT" end of Local Cable (709-7086) installed at the computer ?
(This is very important for signal shielding)
3) Confirm cable wiring is OK:
709-7086 cable wiring provided in Table 2-1.
Yes
Logging Printer OK ?
No
Verify the following:
1) Are U3, U42 installed correctly ? Check for bent or misaligned pins, etc.
2) Is DB25(F) end of Logging Printer Cable (709-7085) installed at the computer ?
(This is very important for operation)
3) Confirm cable wiring is OK:
709-7085 cable wiring provided in Table 2-4.
Yes
Temp Sensor OK ?
No
Temperature Sensor Calibration Procedure if Needed:
1. Measure V_{U53-6} (Temperature Input)
2. Measure Ambient Temperature in degrees C = T.
3. Calculate V_{Offset} = V_{U53-6} - 2.73 - (0.01)(T)
4. Adjust R25 (SPAN Adj) until: V_{U53-9} = 1.28 V_{DC}
5. Adjust R24 (OFFSET Adj) until:
V_{U53-7} = V_{Offset} + 1.45 V_{DC}
Yes
Return to Mainline Troubleshooting

EXPAND TROUBLESHOOTING

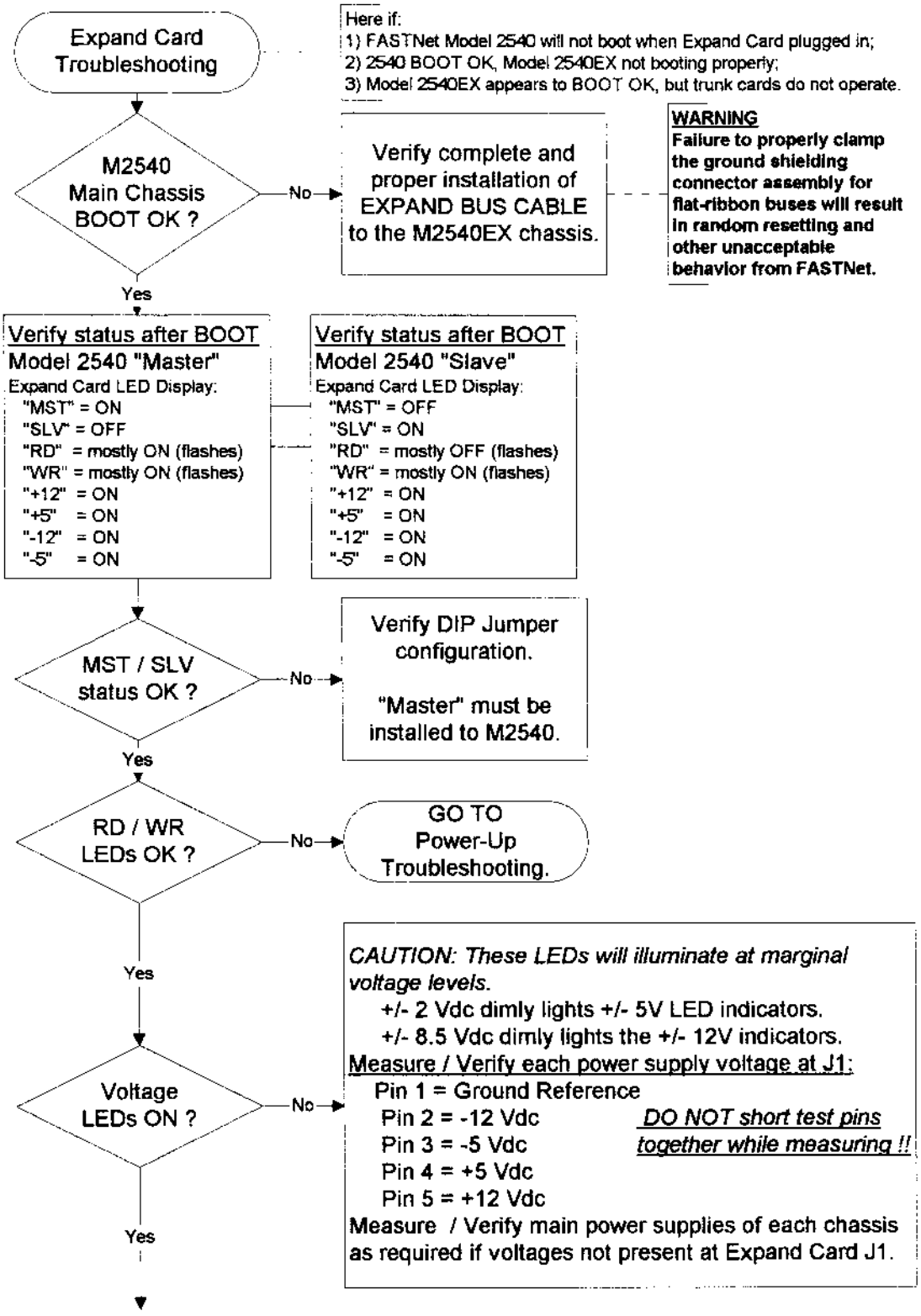
Please refer to below for locations of DIP Jumper packs, LED's, etc.

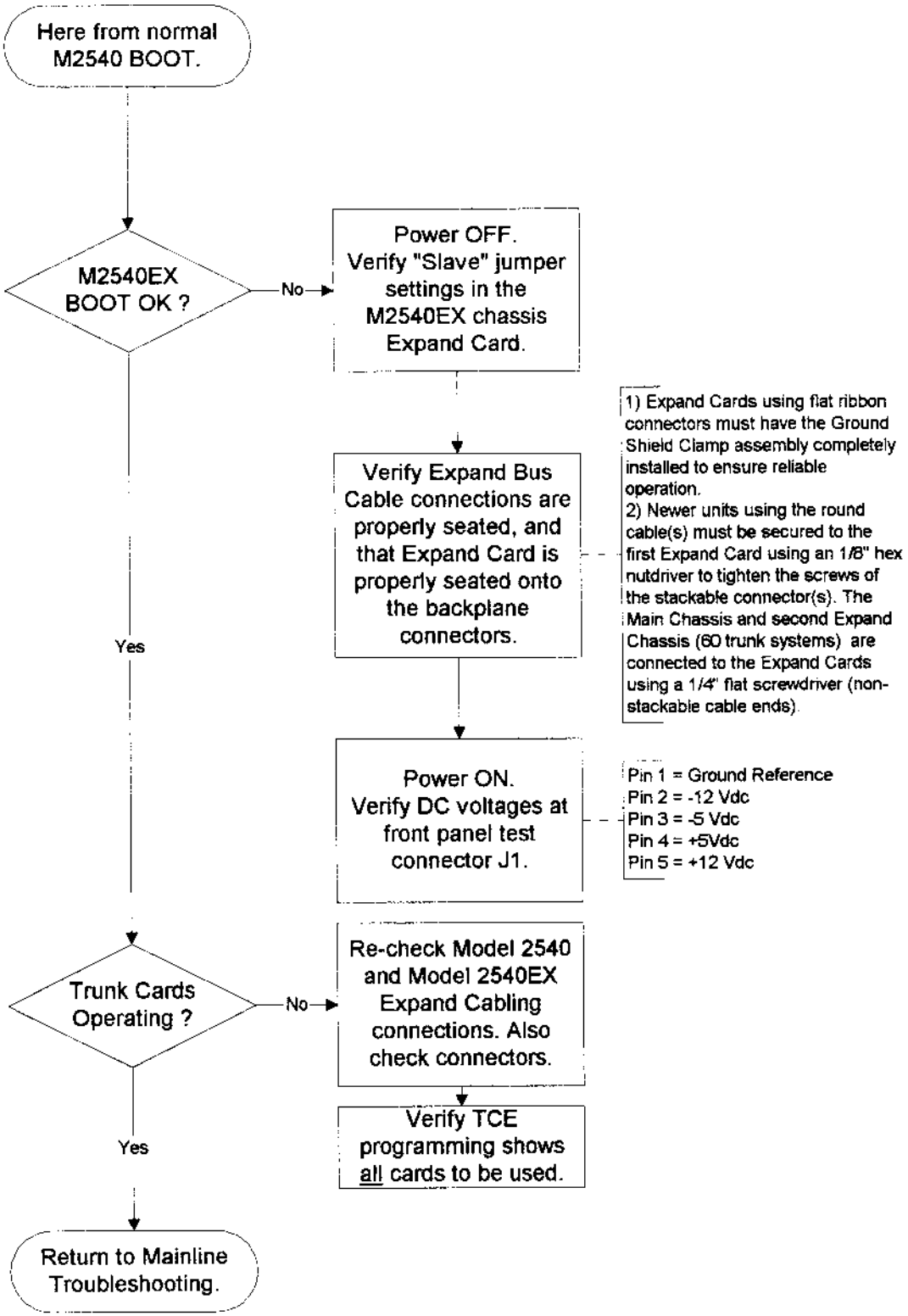
EXPAND CARD (702-9458) 'Revision C' operational theory is discussed in Section 2 of this Manual. 'Revision B' is discussed in the Practical examples of Section 7 of this manual. Installation is discussed in Section 3.

Board Outlines for both Expand Card revisions B and C, are provided in Section 7. Rev B boards use the 60-pin shielded flat-ribbon assembly. Rev C boards use the 68-pin micro-D type connector with round shielded cable.

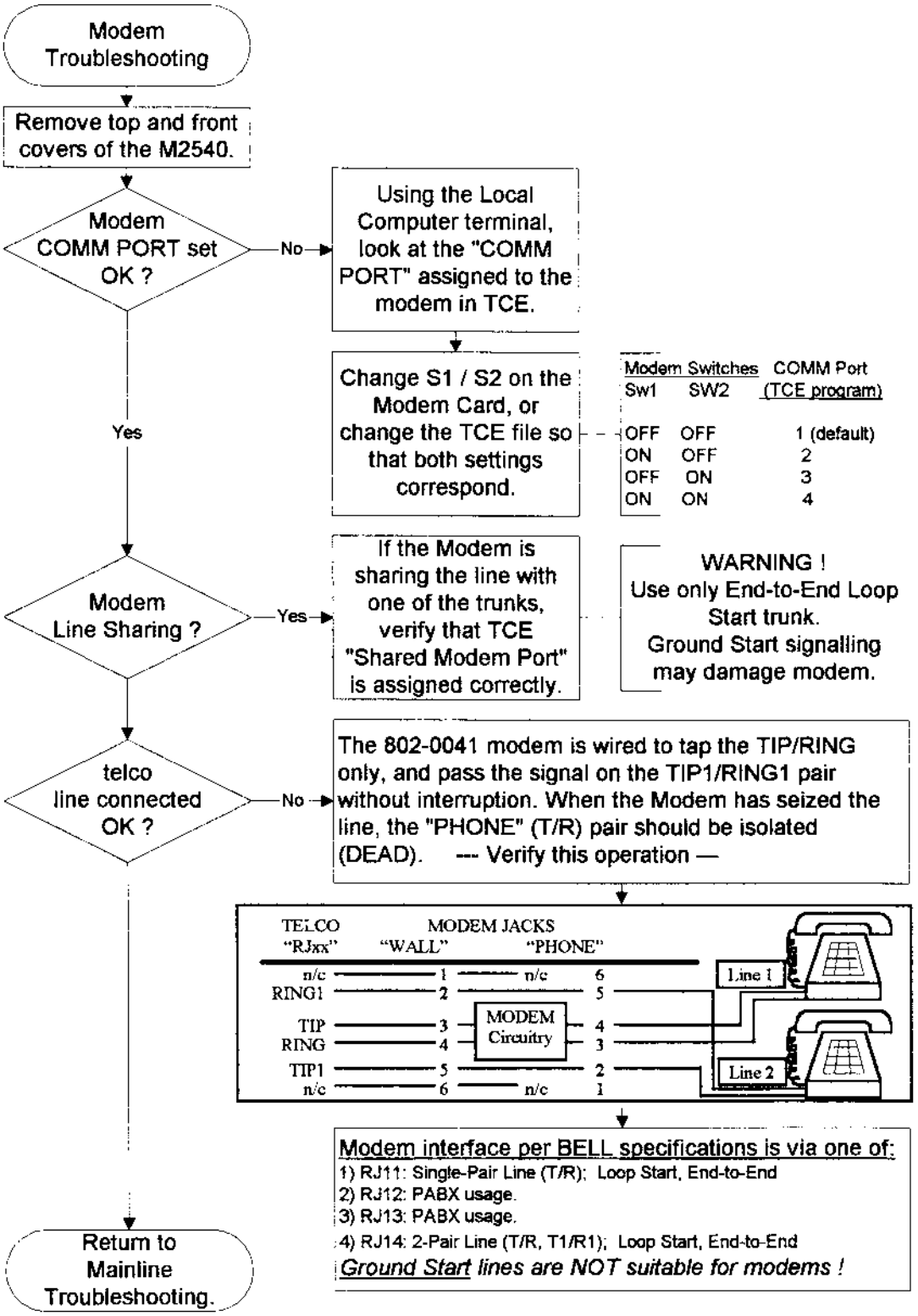
The flat-ribbon connector assemblies for the Rev B Expand Cards require careful installation attention for reliable operation. To unplug the cable from the circuit card, these connector assemblies should be gently pried from the circuit board header after the ground shield clamp is removed. Never pull the connector from the board by grasping the flat ribbon cable, since this may result in separation of the connector from the ribbon cable wires.

Use of the Extender Card aids in tracing signal flow through the circuit board, but may cause signal problems on the IBM-PC (top backplane), resulting in a system crash.

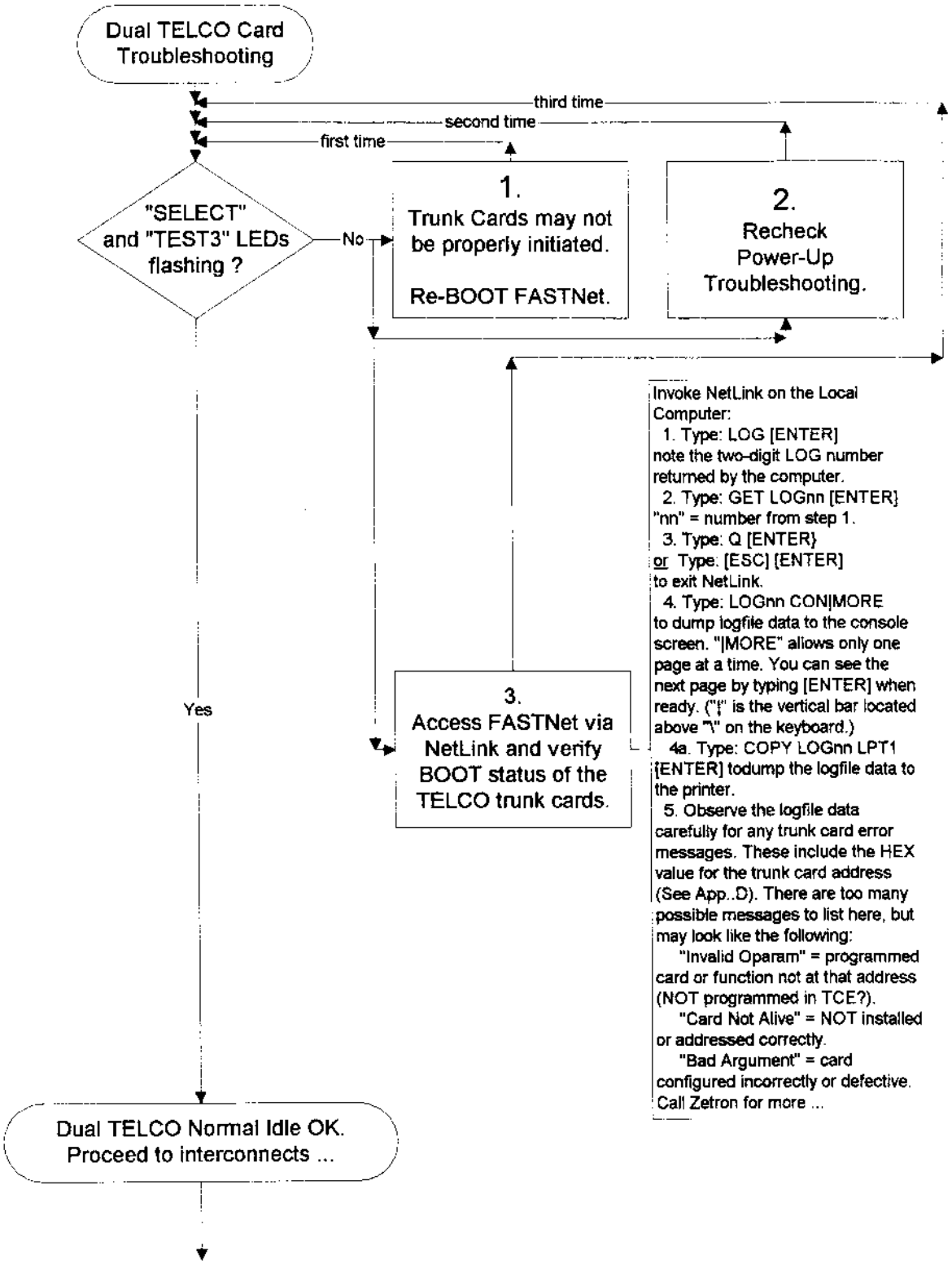

Expand Card Troubleshooting
Here if:
1) FASTNet Model 2540 will not boot when Expand Card plugged in;
2) 2540 BOOT OK, Model 2540EX not booting properly;
3) Model 2540EX appears to BOOT OK, but trunk cards do not operate.
M2540 Main Chassis BOOT OK ?
No
Verify complete and proper installation of EXPAND BUS CABLE to the M2540EX chassis.
WARNING
Failure to properly clamp the ground shielding connector assembly for flat-ribbon buses will result in random resetting and other unacceptable behavior from FASTNet.
Yes
Verify status after BOOT
Model 2540 "Master"
Expand Card LED Display:
"MST" = ON
"SLV" = OFF
"RD" = mostly ON (flashes)
"WR" = mostly ON (flashes)
"+12" = ON
"+5" = ON
"-12" = ON
"-5" = ON
Verify status after BOOT
Model 2540 "Slave"
Expand Card LED Display:
"MST" = OFF
"SLV" = ON
"RD" = mostly OFF (flashes)
"WR" = mostly ON (flashes)
"+12" = ON
"+5" = ON
"-12" = ON
"-5" = ON
MST / SLV status OK ?
No
Verify DIP Jumper configuration.
"Master" must be installed to M2540.
Yes
RD / WR LEDs OK ?
No
GO TO Power-Up Troubleshooting.
Yes
CAUTION: These LEDs will illuminate at marginal voltage levels.
+/- 2 Vdc dimly lights +/- 5V LED indicators.
+/- 8.5 Vdc dimly lights the +/- 12V indicators.
Measure / Verify each power supply voltage at J1:
Pin 1 = Ground Reference
Pin 2 = -12 Vdc
Pin 3 = -5 Vdc
Pin 4 = +5 Vdc
Pin 5 = +12 Vdc
DO NOT short test pins together while measuring !!
Voltage LEDs ON ?
No
Measure / Verify main power supplies of each chassis as required if voltages not present at Expand Card J1.
Yes

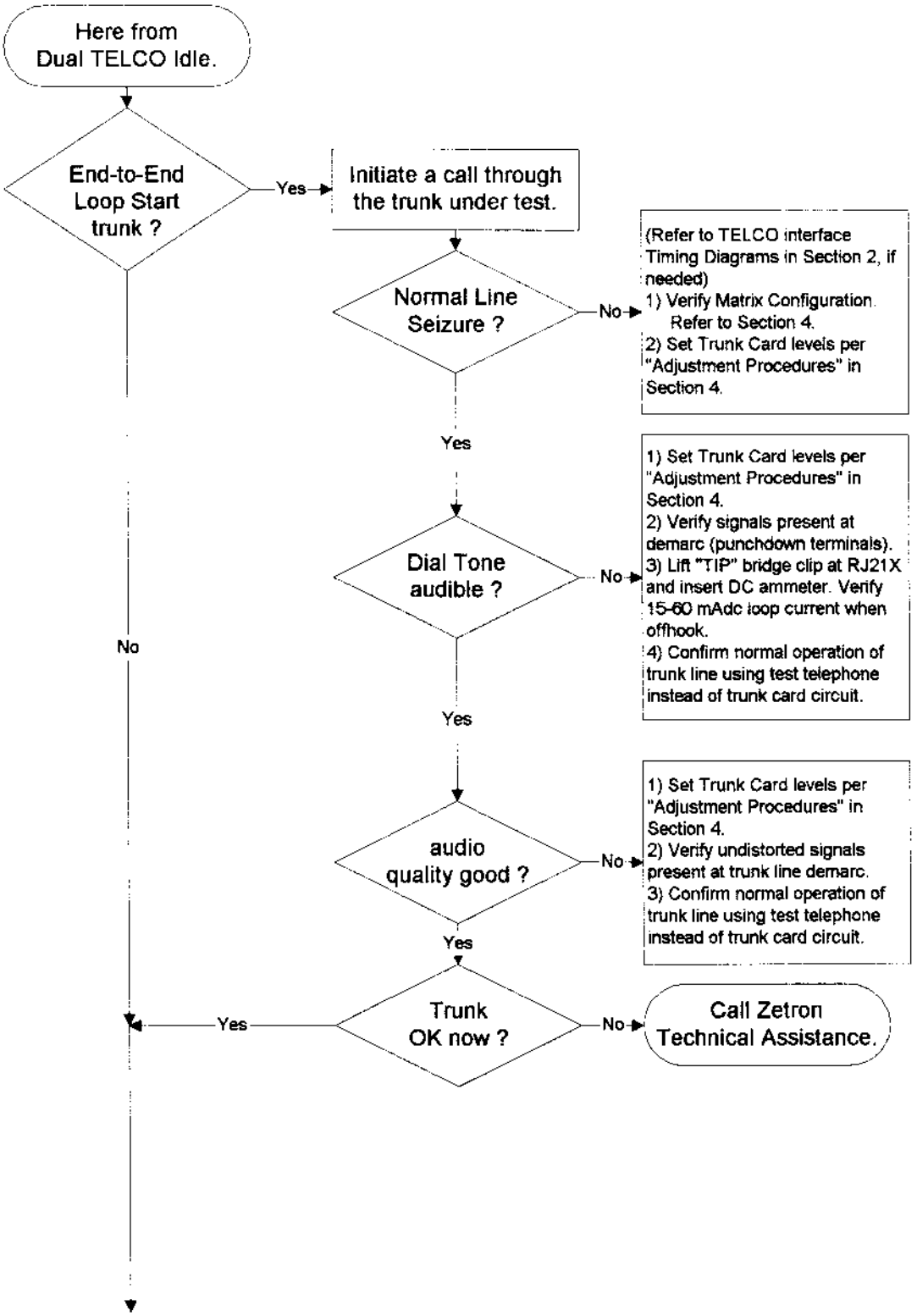

Here from normal M2540 BOOT.
M2540EX BOOT OK ?
No
Power OFF. Verify "Slave" jumper settings in the M2540EX chassis Expand Card.
Verify Expand Bus Cable connections are properly seated, and that Expand Card is properly seated onto the backplane connectors.
1) Expand Cards using flat ribbon connectors must have the Ground Shield Clamp assembly completely installed to ensure reliable operation.
2) Newer units using the round cable(s) must be secured to the first Expand Card using an 1/8" hex nutdriver to tighten the screws of the stackable connector(s). The Main Chassis and second Expand Chassis (60 trunk systems) are connected to the Expand Cards using a 1/4" flat screwdriver (non-stackable cable ends).
Yes
Power ON. Verify DC voltages at front panel test connector J1.
Pin 1 = Ground Reference
Pin 2 = -12 Vdc
Pin 3 = -5 Vdc
Pin 4 = +5Vdc
Pin 5 = +12 Vdc
Trunk Cards Operating ?
No
Re-check Model 2540 and Model 2540EX Expand Cabling connections. Also check connectors.
Verify TCE programming shows all cards to be used.
Yes
Return to Mainline Troubleshooting.

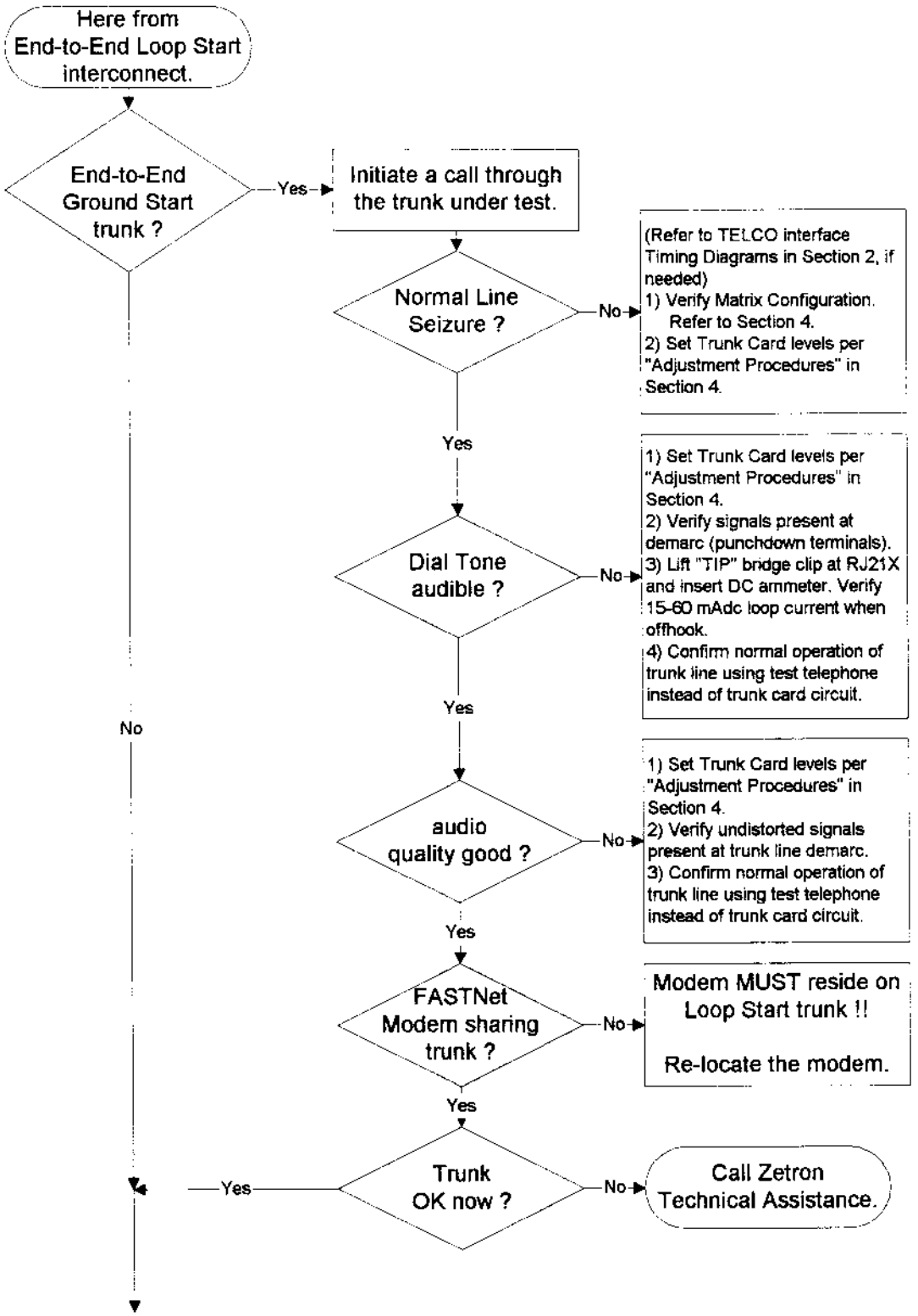
MODEM TROUBLESHOOTING

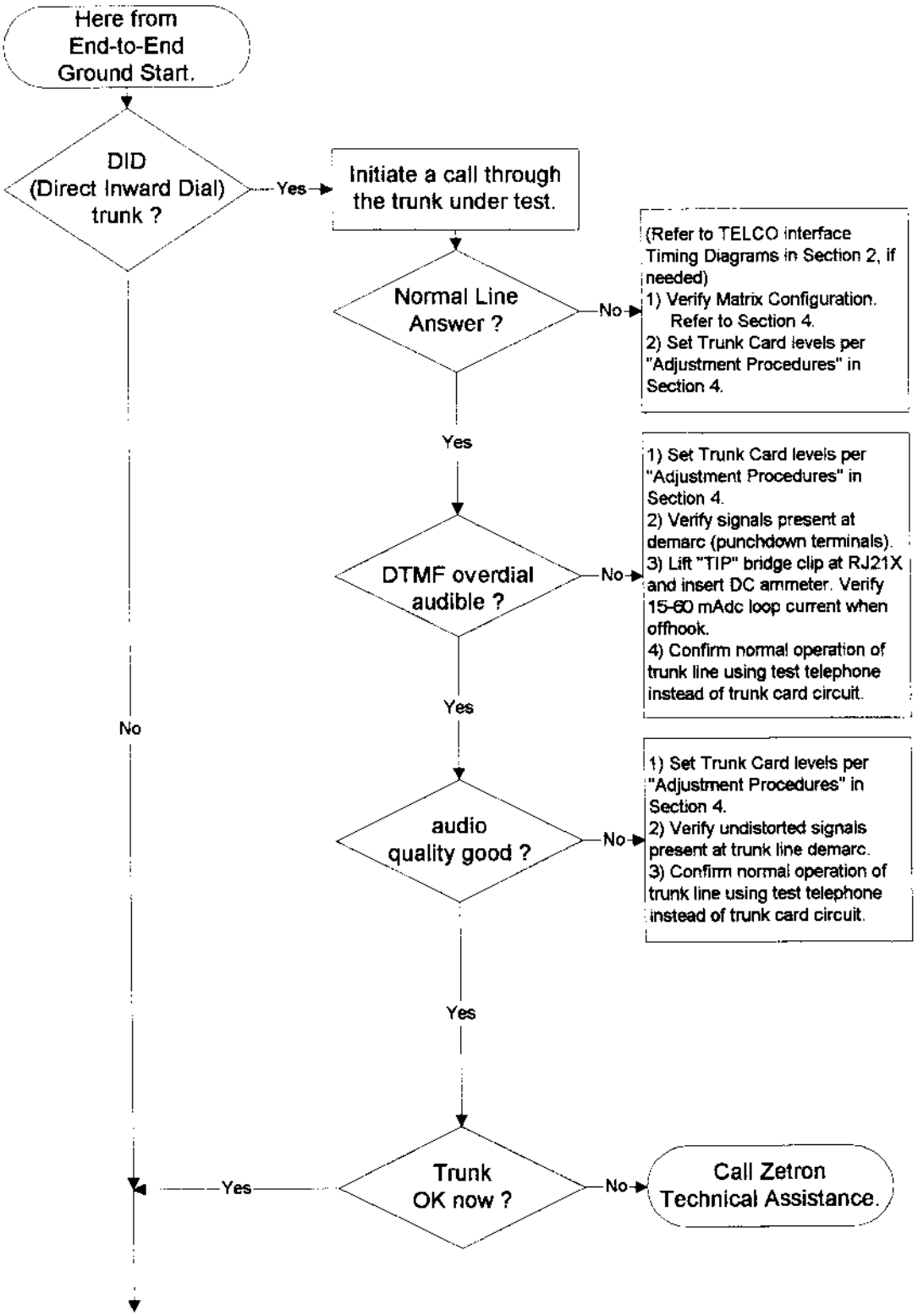


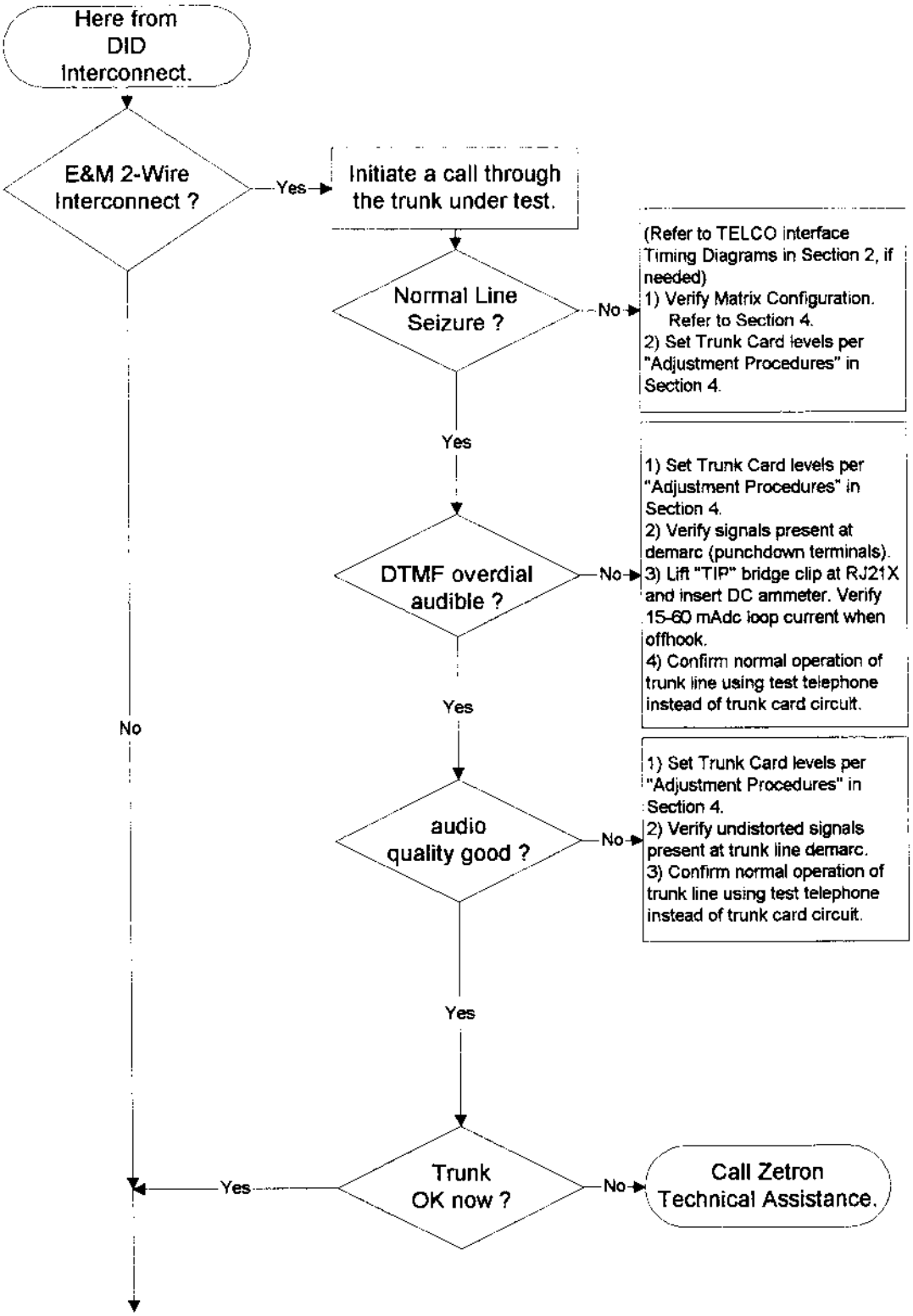
DUAL TELCO CARD (702-9457) TROUBLESHOOTING

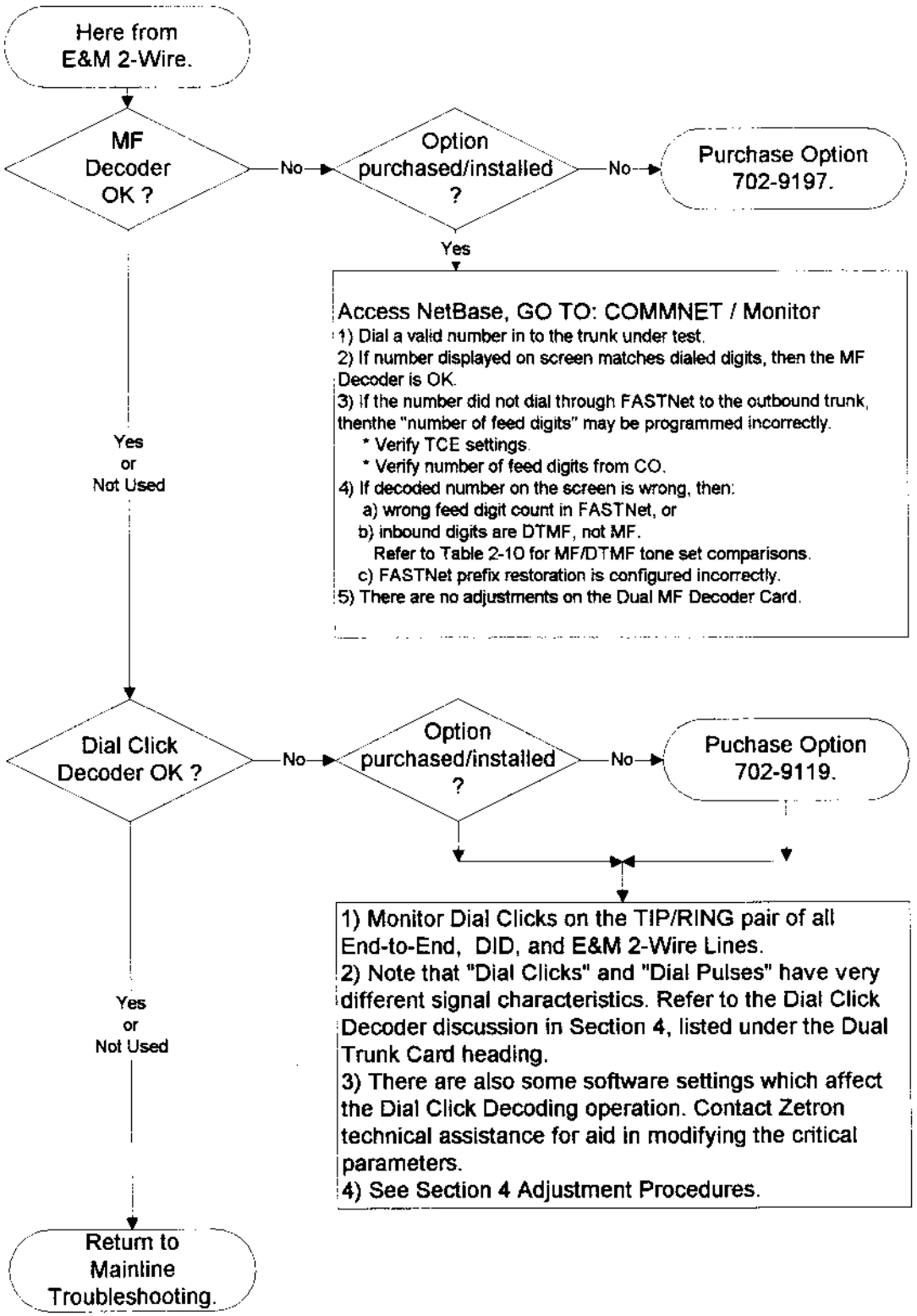



Here from Dual TELCO Idle.
End-to-End Loop Start trunk ?
Yes
Initiate a call through the trunk under test.
Normal Line Seizure ?
No
(Refer to TELCO interface Timing Diagrams in Section 2, if needed)
1) Verify Matrix Configuration. Refer to Section 4.
2) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
Yes
Dial Tone audible ?
No
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify signals present at demarc (punchdown terminals).
3) Lift "TIP" bridge clip at RJ21X and insert DC ammeter. Verify 15-60 mAdc loop current when offhook.
4) Confirm normal operation of trunk line using test telephone instead of trunk card circuit.
Yes
audio quality good ?
No
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify undistorted signals present at trunk line demarc.
3) Confirm normal operation of trunk line using test telephone instead of trunk card circuit.
Yes
Trunk OK now ?
No
Call Zetron Technical Assistance.
Yes
No

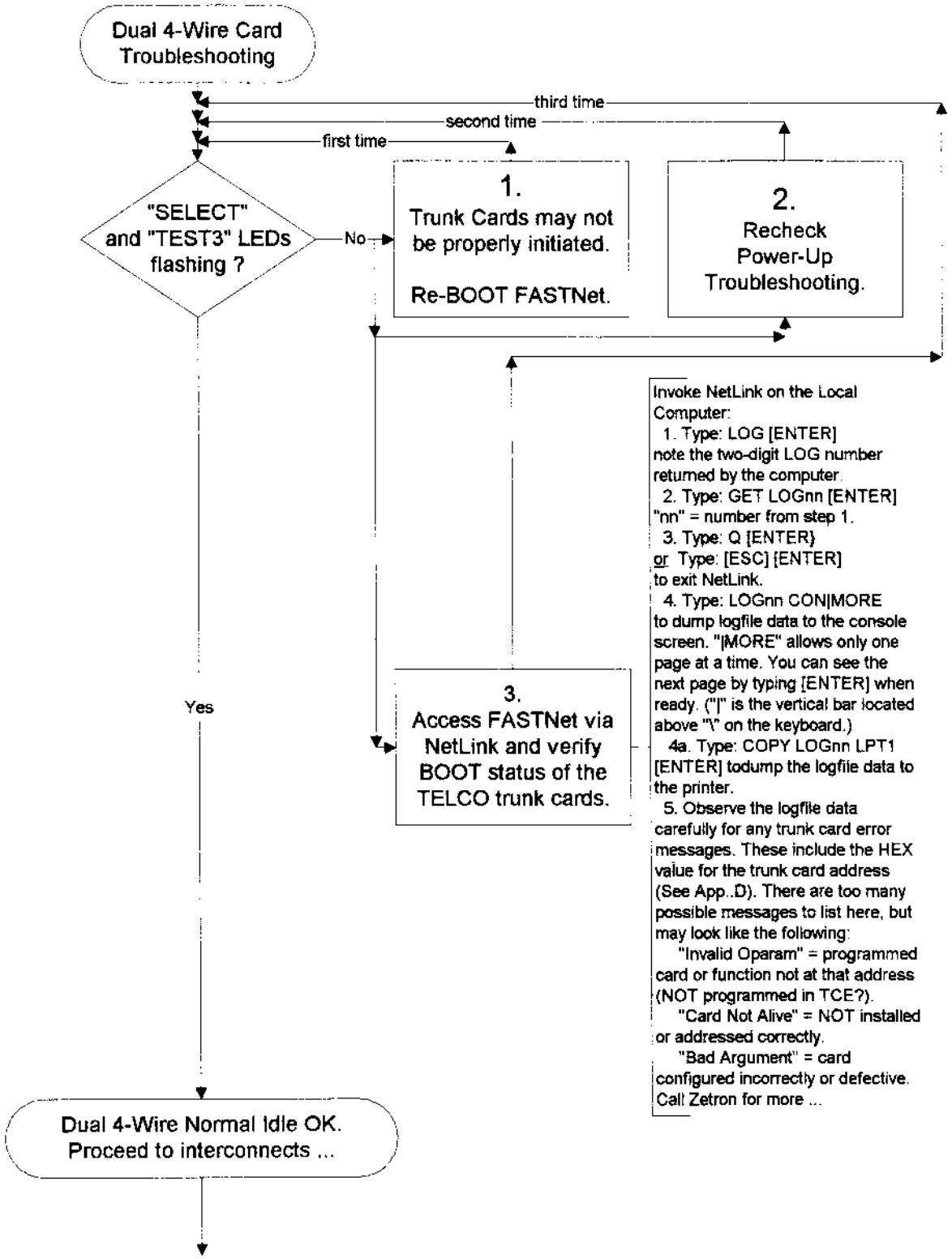

Here from End-to-End Loop Start interconnect.
End-to-End Ground Start trunk ?
Yes
Initiate a call through the trunk under test.
Normal Line Seizure ?
No
(Refer to TELCO interface Timing Diagrams in Section 2, if needed)
1) Verify Matrix Configuration. Refer to Section 4.
2) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
Yes
Dial Tone audible ?
No
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify signals present at demarc (punchdown terminals).
3) Lift "TIP" bridge clip at RJ21X and insert DC ammeter. Verify 15-60 mAdc loop current when offhook.
4) Confirm normal operation of trunk line using test telephone instead of trunk card circuit.
Yes
No
audio quality good ?
No
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify undistorted signals present at trunk line demarc.
3) Confirm normal operation of trunk line using test telephone instead of trunk card circuit.
Yes
FASTNet Modem sharing trunk ?
No
Modem MUST reside on Loop Start trunk !!
Re-locate the modem.
Yes
Trunk OK now ?
Yes
No
Call Zetron Technical Assistance.

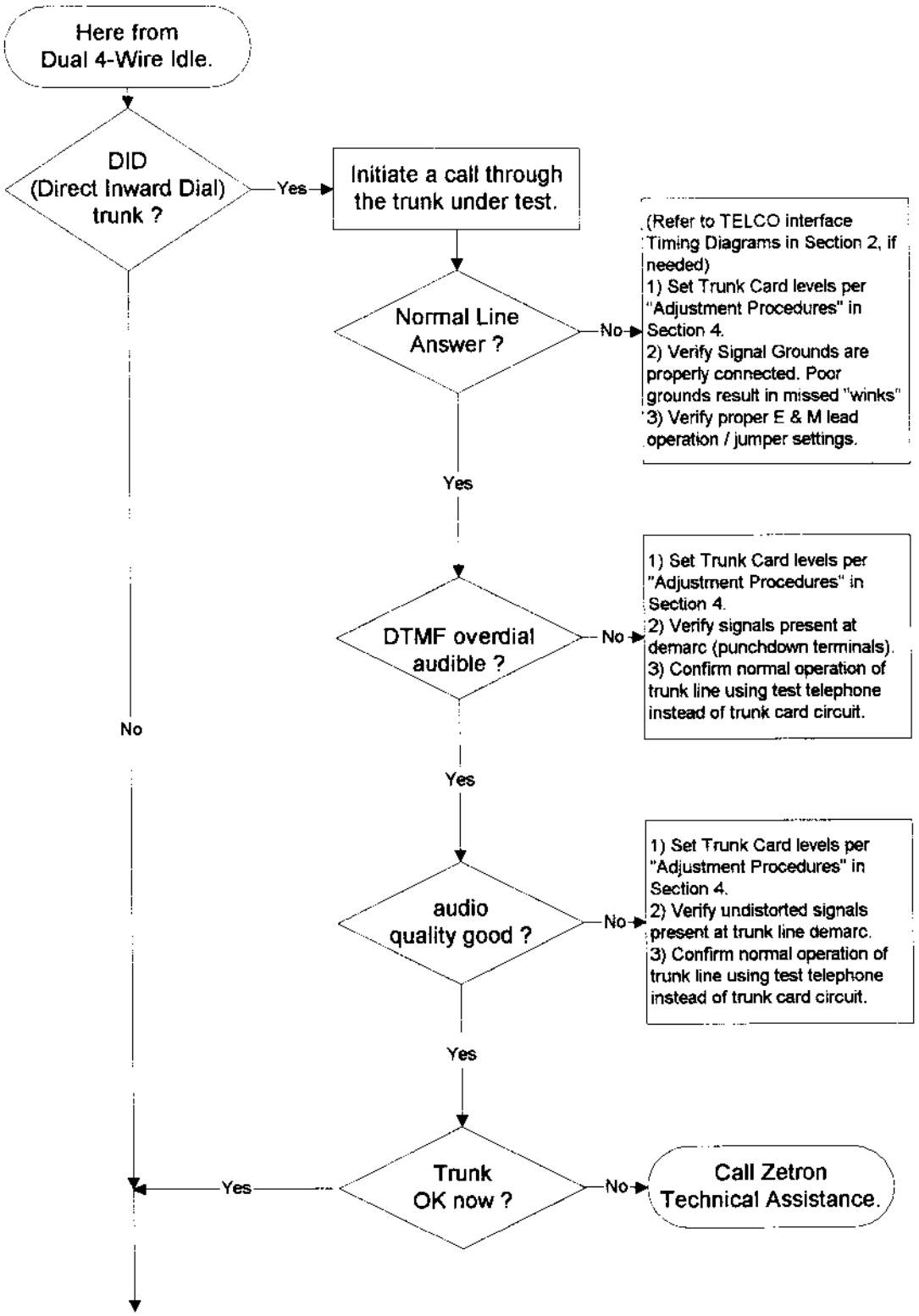

Here from End-to-End Ground Start.
DID (Direct Inward Dial) trunk ?
Yes
Initiate a call through the trunk under test.
Normal Line Answer ?
No
(Refer to TELCO interface Timing Diagrams in Section 2, if needed)
1) Verify Matrix Configuration. Refer to Section 4.
2) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
Yes
DTMF overdial audible ?
No
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify signals present at demarc (punchdown terminals).
3) Lift "TIP" bridge clip at RJ21X and insert DC ammeter. Verify 15-60 mAdc loop current when offhook.
4) Confirm normal operation of trunk line using test telephone instead of trunk card circuit.
Yes
audio quality good ?
No
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify undistorted signals present at trunk line demarc.
3) Confirm normal operation of trunk line using test telephone instead of trunk card circuit.
Yes
No
Trunk OK now ?
Yes
No
Call Zetron Technical Assistance.

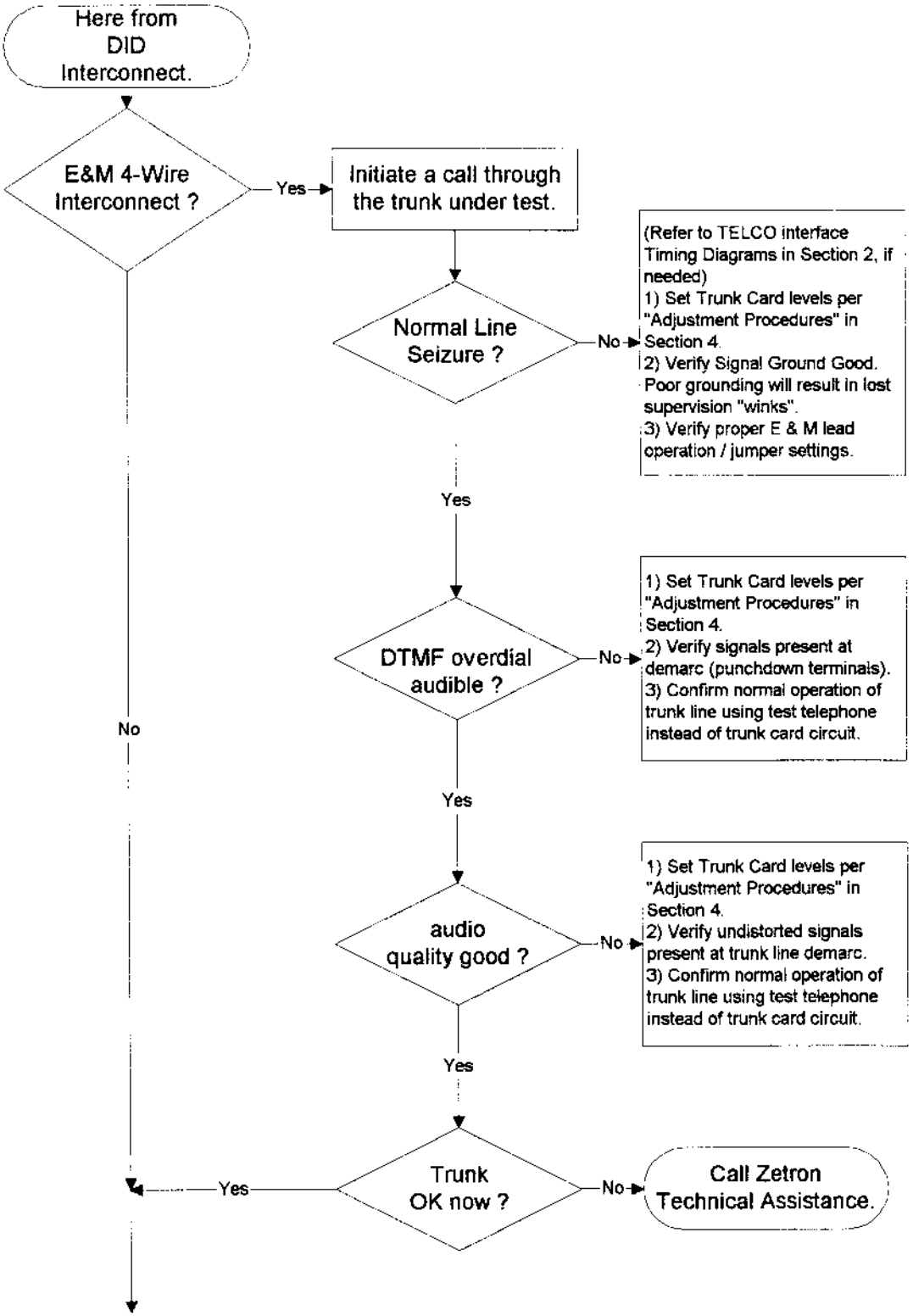

Here from DID Interconnect.
E&M 2-Wire Interconnect ?
Yes
Initiate a call through the trunk under test.
Normal Line Seizure ?
No
(Refer to TELCO interface Timing Diagrams in Section 2, if needed)
1) Verify Matrix Configuration. Refer to Section 4.
2) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
Yes
DTMF overdial audible ?
No
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify signals present at demarc (punchdown terminals).
3) Lift "TIP" bridge clip at RJ21X and insert DC ammeter. Verify 15-60 mAdc loop current when offhook.
4) Confirm normal operation of trunk line using test telephone instead of trunk card circuit.
Yes
audio quality good ?
No
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify undistorted signals present at trunk line demarc.
3) Confirm normal operation of trunk line using test telephone instead of trunk card circuit.
Yes
No
Trunk OK now ?
Yes
No
Call Zetron Technical Assistance.

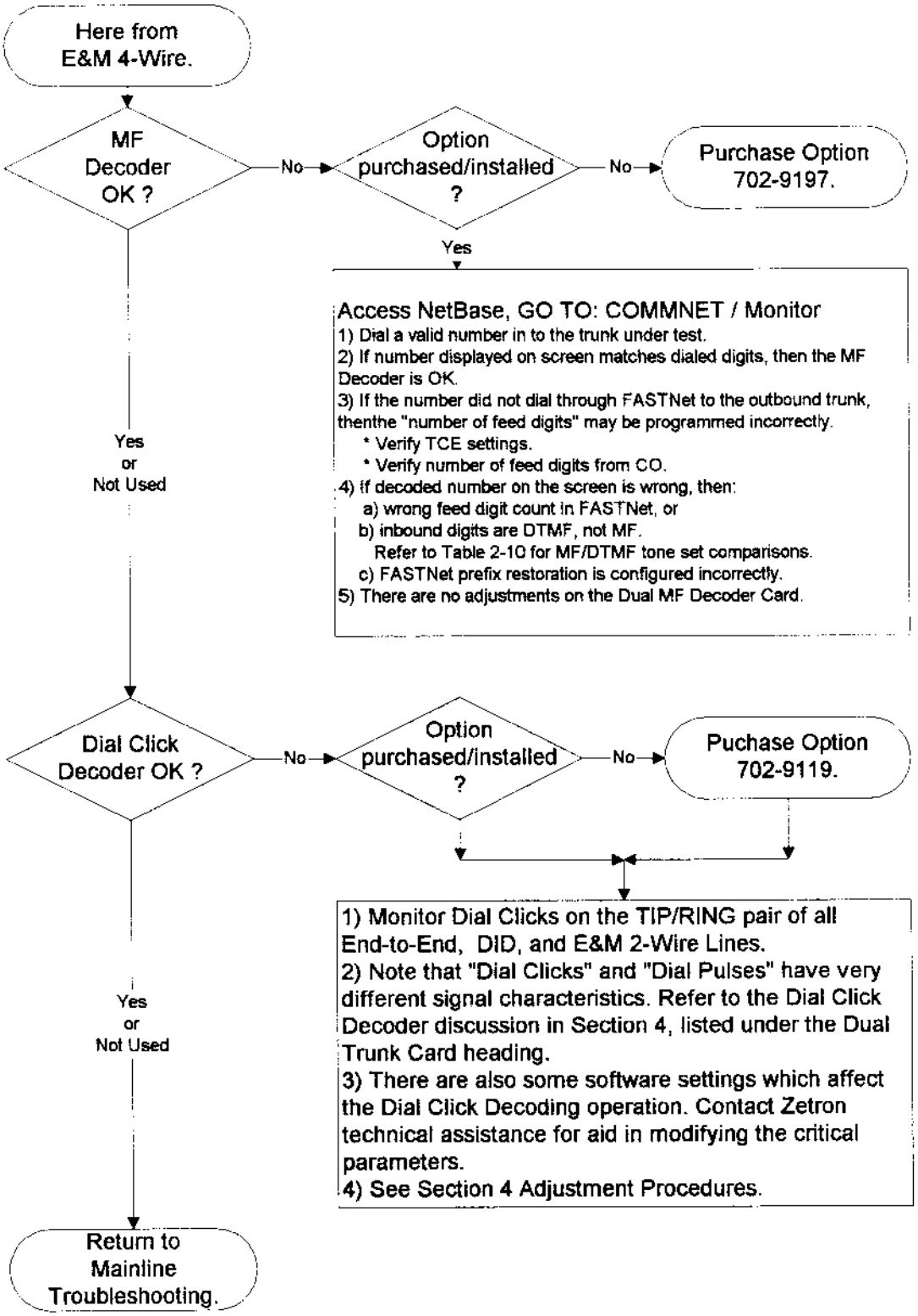

Here from E&M 2-Wire.
MF Decoder OK ?
No
Option purchased/installed ?
No
Purchase Option 702-9197.
Yes
Access NetBase, GO TO: COMMNET / Monitor
1) Dial a valid number in to the trunk under test.
2) If number displayed on screen matches dialed digits, then the MF Decoder is OK.
3) If the number did not dial through FASTNet to the outbound trunk, thenthe "number of feed digits" may be programmed incorrectly.
* Verify TCE settings.
* Verify number of feed digits from CO.
4) If decoded number on the screen is wrong, then:
a) wrong feed digit count in FASTNet, or
b) inbound digits are DTMF, not MF.
Refer to Table 2-10 for MF/DTMF tone set comparisons.
c) FASTNet prefix restoration is configured incorrectly.
5) There are no adjustments on the Dual MF Decoder Card.
Yes or Not Used
Dial Click Decoder OK ?
No
Option purchased/installed ?
No
Puchase Option 702-9119.
1) Monitor Dial Clicks on the TIP/RING pair of all End-to-End, DID, and E&M 2-Wire Lines.
2) Note that "Dial Clicks" and "Dial Pulses" have very different signal characteristics. Refer to the Dial Click Decoder discussion in Section 4, listed under the Dual Trunk Card heading.
3) There are also some software settings which affect the Dial Click Decoding operation. Contact Zetron technical assistance for aid in modifying the critical parameters.
4) See Section 4 Adjustment Procedures.
Yes or Not Used
Return to Mainline Troubleshooting.

DUAL 4-WIRE CARD (702-9460) TROUBLESHOOTING

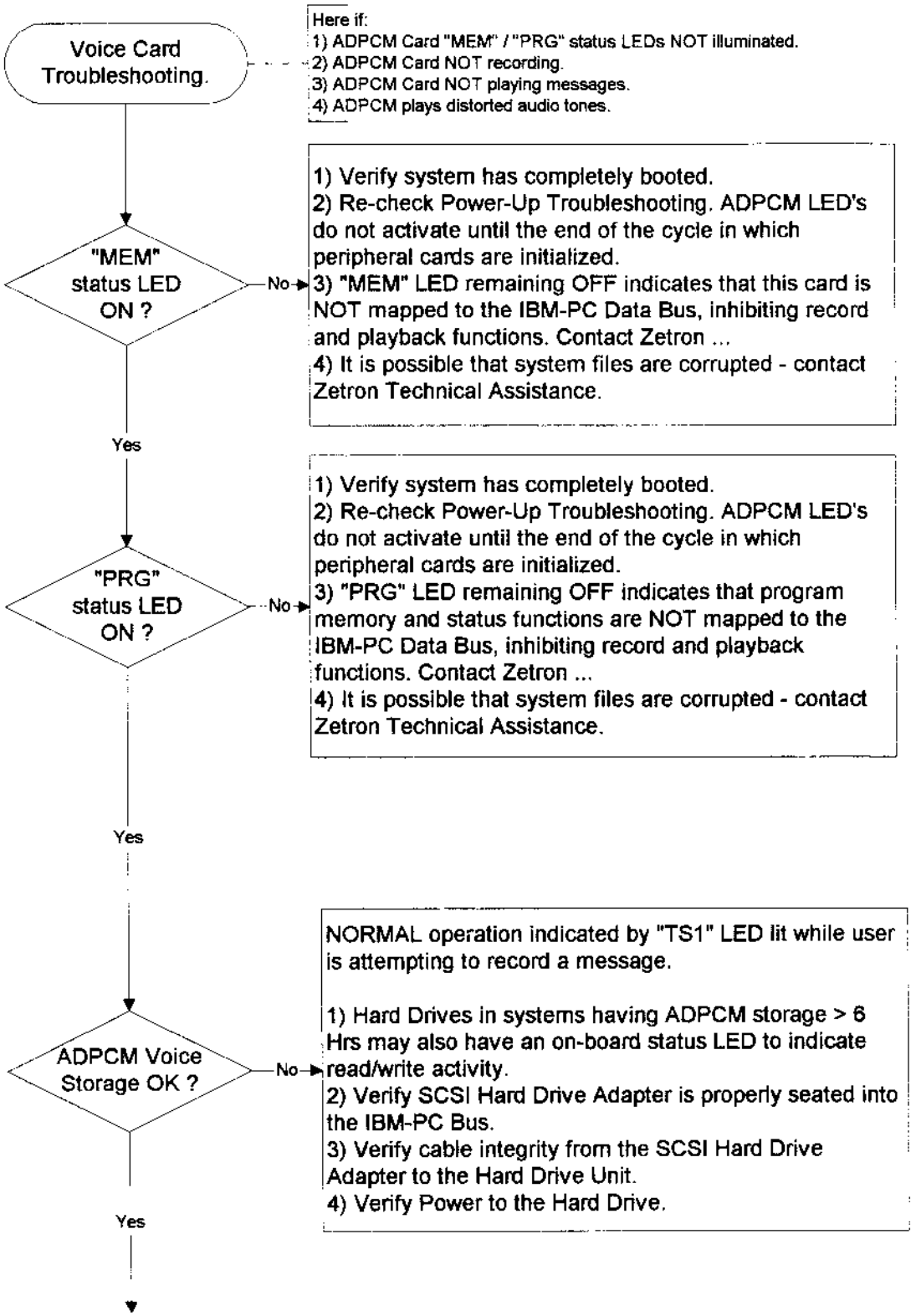


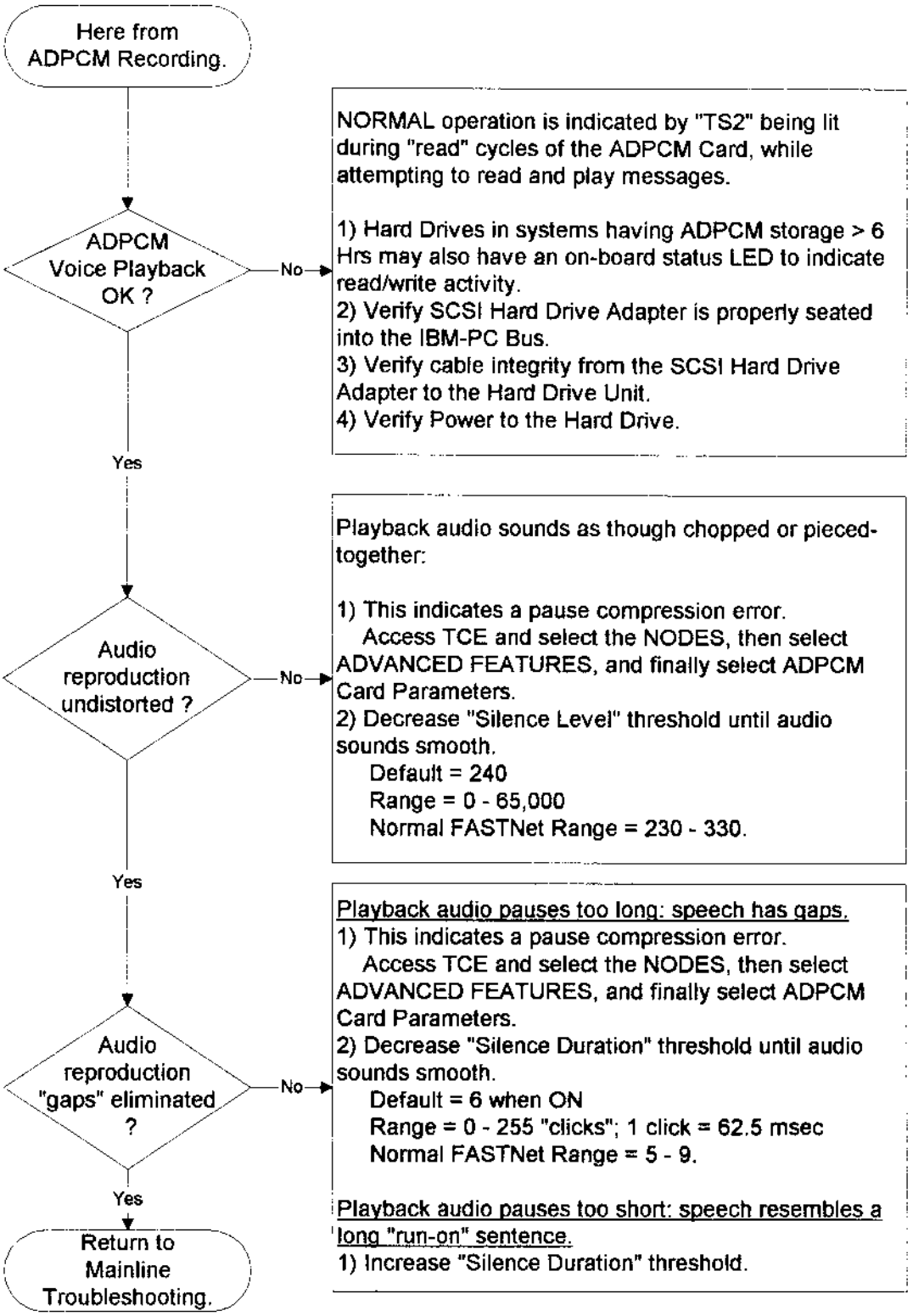

Here from Dual 4-Wire Idle.
DID (Direct Inward Dial) trunk ?
Yes
Initiate a call through the trunk under test.
Normal Line Answer ?
No
(Refer to TELCO interface Timing Diagrams in Section 2, if needed)
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify Signal Grounds are properly connected. Poor grounds result in missed "winks"
3) Verify proper E & M lead operation / jumper settings.
Yes
DTMF overdial audible ?
No
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify signals present at demarc (punchdown terminals).
3) Confirm normal operation of trunk line using test telephone instead of trunk card circuit.
Yes
audio quality good ?
No
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify undistorted signals present at trunk line demarc.
3) Confirm normal operation of trunk line using test telephone instead of trunk card circuit.
Yes
Trunk OK now ?
No
Call Zetron Technical Assistance.
Yes
No


Here from DID Interconnect.
E&M 4-Wire Interconnect ?
Yes
Initiate a call through the trunk under test.
Normal Line Seizure ?
No
(Refer to TELCO interface Timing Diagrams in Section 2, if needed)
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify Signal Ground Good. Poor grounding will result in lost supervision "winks".
3) Verify proper E & M lead operation / jumper settings.
Yes
DTMF overdial audible ?
No
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify signals present at demarc (punchdown terminals).
3) Confirm normal operation of trunk line using test telephone instead of trunk card circuit.
Yes
audio quality good ?
No
1) Set Trunk Card levels per "Adjustment Procedures" in Section 4.
2) Verify undistorted signals present at trunk line demarc.
3) Confirm normal operation of trunk line using test telephone instead of trunk card circuit.
Yes
Trunk OK now ?
No
Call Zetron Technical Assistance.
Yes
No


Here from E&M 4-Wire.
MF Decoder OK ?
No
Option purchased/installed ?
No
Purchase Option 702-9197.
Yes
Access NetBase, GO TO: COMMNET / Monitor
1) Dial a valid number in to the trunk under test.
2) If number displayed on screen matches dialed digits, then the MF Decoder is OK.
3) If the number did not dial through FASTNet to the outbound trunk, thenthe "number of feed digits" may be programmed incorrectly.
* Verify TCE settings.
* Verify number of feed digits from CO.
4) If decoded number on the screen is wrong, then:
a) wrong feed digit count in FASTNet, or
b) inbound digits are DTMF, not MF.
Refer to Table 2-10 for MF/DTMF tone set comparisons.
c) FASTNet prefix restoration is configured incorrectly.
5) There are no adjustments on the Dual MF Decoder Card.
Yes or Not Used
Dial Click Decoder OK ?
No
Option purchased/installed ?
No
Puchase Option 702-9119.
1) Monitor Dial Clicks on the TIP/RING pair of all End-to-End, DID, and E&M 2-Wire Lines.
2) Note that "Dial Clicks" and "Dial Pulses" have very different signal characteristics. Refer to the Dial Click Decoder discussion in Section 4, listed under the Dual Trunk Card heading.
3) There are also some software settings which affect the Dial Click Decoding operation. Contact Zetron technical assistance for aid in modifying the critical parameters.
4) See Section 4 Adjustment Procedures.
Yes or Not Used
Return to Mainline Troubleshooting.

ADPCM VOICE CARD TROUBLESHOOTING




Here from ADPCM Recording.
ADPCM Voice Playback OK ?
No
NORMAL operation is indicated by "TS2" being lit during "read" cycles of the ADPCM Card, while attempting to read and play messages.
1) Hard Drives in systems having ADPCM storage > 6 Hrs may also have an on-board status LED to indicate read/write activity.
2) Verify SCSI Hard Drive Adapter is properly seated into the IBM-PC Bus.
3) Verify cable integrity from the SCSI Hard Drive Adapter to the Hard Drive Unit.
4) Verify Power to the Hard Drive.
Yes
Audio reproduction undistorted ?
No
Playback audio sounds as though chopped or pieced-together:
1) This indicates a pause compression error.
Access TCE and select the NODES, then select ADVANCED FEATURES, and finally select ADPCM Card Parameters.
2) Decrease "Silence Level" threshold until audio sounds smooth.
Default = 240
Range = 0 - 65,000
Normal FASTNet Range = 230 - 330.
Yes
Audio reproduction "gaps" eliminated ?
No
Playback audio pauses too long: speech has gaps.
1) This indicates a pause compression error.
Access TCE and select the NODES, then select ADVANCED FEATURES, and finally select ADPCM Card Parameters.
2) Decrease "Silence Duration" threshold until audio sounds smooth.
Default = 6 when ON
Range = 0 - 255 "clicks"; 1 click = 62.5 msec
Normal FASTNet Range = 5 - 9.
Playback audio pauses too short: speech resembles a long "run-on" sentence.
1) Increase "Silence Duration" threshold.
Yes
Return to Mainline Troubleshooting.

7. PRACTICAL EXAMPLES

OVERVIEW

In this section, we will install the hardware for a typical FASTNet Switch, one piece at a time. References to other manuals and to other sections of this manual will be provided as needed.

WARNING:

To prevent expensive and unwarranted damage to your FASTNet Switch System, disconnect (turn off) electrical power from the switch prior to removing or installing ANY cards at any time.

This section will be broken down into installation of the following hardware:

- Model 2540 Chassis
- Model 2540EX Chassis:

  Expand Cards (702-9458)
- ADPCM Storage Disk Option

  Hard Disc Card (815-9127) ;Standard Equipment

  Hard Disk Drive (950-9404) ;6-Hour Storage

  Hard Disk Drive (950-9332) ;12-Hour Storage

  Hard Disk Drive (950-9333) ;24-Hour Storage

  Hard Disk Drive (950-9336) ;48-Hour Storage
- Modem Installation:

  Independent TELCO Line feed

  Shared TELCO Line feed
- Local Computer and Printer Installation
- Trunk Cards:

  FASTNet Interface to a TELCO CO DID Line

  FASTNet Interface to a TELCO CO End-to-End Loop Start Line

  FASTNet Interface to a Zetron Model 810 and CO End-to-End Loop Start line

  FASTNet Interface to a TELCO CO E&M 4-Wire Line

  FASTNet Interface to a Zetron Model 49

  FASTNet Interface to a Uniden MRS804ZX Repeater

  FASTNet Interface to a Zetron Ring Box

General Method for Trunk Installation

The following overall methodology should be employed to install each trunk card to the FASTNet Switch. Section 7 demonstrates this method as a tutorial session for one of each type of FASTNet trunk commonly used.

❑ 1. Observe FASTNet Switch hardware to be installed. Note the following:

- Types of trunks to be used immediately and quantity of each.
- Types of trunks to be possibly used in the foreseeable future, and quantity of each.

❑ 2. Group same-type trunks (as well as empty slots for future trunks) together in the available chassis slots. Empty slots between groups are desirable for future expansion.

Adding trunks later into these arbitrary groups is easy if empty slots are available. If cards must be relocated to other slots later to maintain groupings, then re-wiring will be required. Scan time efficiency is optimized if the trunk cards are maintained in groups of similar types. The order in which trunk-type groups are arranged is not important, only that the types *are in fact grouped together*.

Failure to group these cards will *in no way adversely affect normal operation* of the FASTNet Switch.

❑ 3. Note the *Slot Number* of *each chassis* (especially if 40 or 60 trunk system in use) into which *each trunk card is to be installed*.

Figure 3-1 (Model 2540) and Figure 3-2 (Model 2540EX) illustrate the slots and associated numbers for each type of chassis.

Figures 4-4 through 4-6 illustrate suggested 6-wire jack assignments (assigned jack number = assigned address) for the FASTNet trunks via the (950-9385) Custom Wire Harness Kits (1 kit per FASTNet chassis), including the corresponding hardware card slot number.

Construction of a table similar to that shown in Appendix E is useful from here forward. The technician can fill-in the blanks when planning the installation, and then maintain an "as-built" copy for permanent record.

❑ 4. Refer to Figures 4-7 through 4-12 to identify the RJ21X *Connector* (J19, J20, or J23) to be used for each trunk card (and trunk A or B), *and* the associated pinouts on that RJ21X [punch-down] Terminal Block. Also note whether the chassis is the main chassis, expansion chassis 1, or expansion chassis 2.

❑ a. These connector/pinout assignments then can be equated to the *Suggested Card Addresses* and RJ66M425 [modular] *jack assignments* provided in figures 4-4 through 4-6.

- The hardware slot numbers are noted at each jack, in each illustration.
- The assigned address = assigned jack number.

Note the wire colors assigned to the RJ21X↔FASTNet Chassis Backplane cable:

These colors are listed for troubleshooting purposes only, if required at some later date, and are not visible while connector covers are installed.

❑ 5. *Program* the assigned addresses from Step 4 (including the "A" or "B" trunk status) into the FASTNet Switch using TCE. Each trunk card type and operational parameters will be programmed also at this time.

❑ 6. Set the addresses on each trunk card as assigned. Refer to *Dual Trunk Card Configuration* in Section 4 of this manual.

❑ 7. Configure the trunk cards (matrix plugs, jumpers, etc.) for the 'grouped' *types* as initially defined. Also, remember to set *all* trunk cards for the appropriate expansion status applicable to the particular system.

❑ 8. Install all trunk cards and boot system. Set audio levels to/from each trunk card per one of the two procedures provided at the end of Section 4:

❑ a. DTMF Alignment Method

- *ONLY* method for DID trunks.
- requires at least one functional telephone trunk connected for test control of all non-DID trunks.

❑ b. Local Computer Access Alignment Method

- can control all non-DID trunks for test purposes and level setting

❑ 9. Program all of the system users via NetBase and upload the database to the FASTNet Switch. Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270).

❑ 10. Test the FASTNet Switch using hand-held or mobile transceivers which have been pre-programmed with *valid* (assigned) ID codes.

MODEL 2540 MAIN CHASSIS SET-UP

Detailed hardware-mounting instructions are located in Section 3, listed under "Installation Checklist". Please note that the Main Chassis is larger than the Expansion Chassis, and that separate dimensional drawings are provided for each installation.

After unpacking and confirming all equipment has been delivered, Zetron recommends that the FASTNet Switch be assembled and tested, the first time, in the service shop facility.

It is recommended to attach the Model 2540 Chassis to a sheet of plywood, and to attach the Cable kit components (Split-Block Terminal #802-0263, RJ66M425 Terminal #802-0264, Wire Distribution Spools, etc.)

A photocopy of Appendix F from this manual would be very useful for illustrating a complete 40 trunk system. Please note that this illustration correctly shows slot assignments for the FASTNet Switch cards.

One may elect to not use the RJ66M425 terminals for interfacing to/from the TELCO CO lines at the final FASTNet site. However, If the local CO can provide the miniature keyed jacks as interfaces from their equipment, then it is much simpler to interface to the FASTNet Switch using 6-Wire Miniature Plug cables (Zetron p/n 709-7000).

Zetron highly recommends use of the RJ66M425 terminals to interface to a Zetron Model 49 Repeater Manager, an MRS804ZX Repeater, or a Zetron Model 810 Digital Hybrid. The RJ66M425 terminal facilitates the use of the standard Zetron 6-wire modular telephone cable (709-7000) to interconnect these devices with FASTNet in the simplest manner.

Figure 3-3 shows Zetron Lightning Protection Kit #950-9040 in-line with each trunk interface cable. This particular kit is only designed as a secondary protection system, and as such only protects the TIP and RING lines. This should be used to prevent damage, but primary protection is required to ensure longevity and continued service. Primary protection should be applied to *ALL* lines entering or exiting the FASTNet site, including (but not limited to): Power Lines (220 or 110 VAC); RF Cables; Telephone Lines (including E, M). Each lightning suppression device should be connected to a unique large-sized (4-8 AWG best) wire which is routed directly to ground, with minimal bends (each having 8" or larger radius) to avoid inductive current blocking, and with maximum void space for isolation from other cabling to prevent arc-over during strikes. All of these considerations represent obstacles and/or trade-offs when designing a final layout. One possible layout for a 60 trunk FASTNet system is illustrated in Figure 7-1 on page 7-5.

The Wire Distribution Spools #265-0041 are provided to aid in assembling an orderly and "professional" finished product. A "wire distribution spool" is a white plastic item resembling a wire spool which is missing one end, and measures 3 inches in length by 1-3/4 inches at the wide end. These are mounted by dropping a panhead Phillips wood screw into the center hole of the large end, and then fastening this assembly to the plywood sheet using a No. 2 Phillips Driver having a shaft length of 2-3/4 inches or longer.

These distribution spools are used as "corners" for intended wire routes on the plywood sheet. The punch-down wire pairs or sets from the Split-Block terminal are then wrapped around the outside (not a complete "circular" wrap) of the spool to form corners when stringing the wire to the punch terminals of the RJ66M425 Terminals or to the CO Punch-Blocks if provided.

The actual wiring of these punch blocks will be discussed with the Trunk Cards in this section.

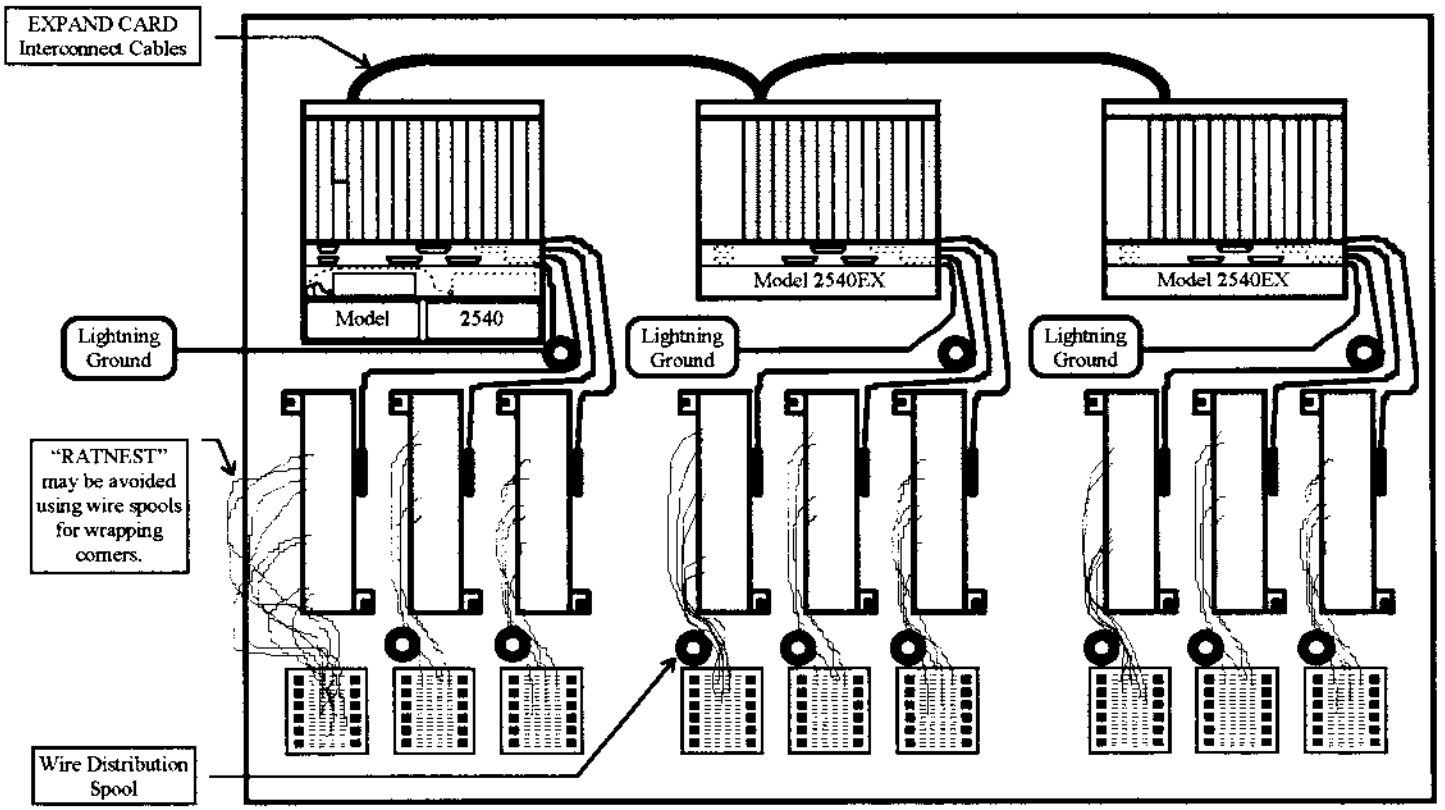


Figure 7-1: Sample FASTNet Layout on Plywood Sheet

MODEL 2540EX CHASSIS SET-UP

The detailed installation procedures for this chassis are located in Section 3, Model 2540EX Installation. Please note that this chassis is physically smaller than the main chassis.

SPECIFIC WARNINGS:

1. If using 702-9458B Expand Cards: Once you install the ribbon connectors onto the EXPAND Cards, these connectors are very difficult to remove. Removal is best accomplished by gently prying the connector away from the jack, alternating ends, and being careful NOT to lift very far at a time. Use a small flat-blade screwdriver to perform this task.

   If using 702-9458C Expand Cards: The top edge connectors and interconnect cables have been redesigned to accommodate shielded round cable into/out of a 68-pin micro-D type connector.

2. When removing ribbon connectors, prying one end entirely off, and then prying off the other end WILL result in badly bent and mis-aligned connector pins on the Expand Card.

3. Attempting to remove the Ribbon Connector from the Expand Card by pulling on the ribbon cable WILL result in separation of the ribbon connector requiring cable replacement.

4. Be sure that the MASTER Expand Card is installed in the Model 2540 card rack, slot 5; and that the SLAVE Expand Card is installed into the Model 2540EX Chassis slot 1. MASTER/SLAVE configuration of these cards is detailed on the following page of this discussion.

It is necessary to install this optional expansion chassis alongside (either side as preferred), above, or below the main Model 2540 chassis. Separation distance is limited by the length of the ribbon cable (709-7108) used with Rev B Expand Cards, or the round shielded cable (709-7298) used with Rev C Expand Cards, which interconnects between the Expand Cards (702-9458) of each chassis. To establish this separation distance, it is probably easiest to layout the plywood sheet on the floor (as noted in the previous subsection). Temporarily assemble the shielded flat ribbon or round cabling through all TOP or BOTTOM sheet metal covers having slots for this cable. Mark the plywood sheet according to fit, ease of service, cable access, as well as neat and organized appearance.

Mount the Lightning Protection Kits (if purchased) and TELCO line interface cable kit 950-9358 (RJ21X Split-Block Terminals, RJ66M425 Terminals, and Cabling). Remember that each lightning suppression device should be connected to a unique large-sized wire which is routed directly to ground, with minimal bends to avoid inductive current blocking, and with maximum void space for isolation from other cabling to prevent arc-over during strikes. All of these considerations represent obstacles and/or trade-offs when designing a final layout. One possible layout for a 60 trunk FASTNet system is illustrated in Figure 7-1 on page 7-5.

Mount "Wire Distribution Spools" as desired to route wires neatly between RJ21X, RJ66M425, and telco interface terminal blocks. Typically, the telco terminal blocks for a given facility will all be located together, and may be far from the FASTNet equipment. In that case, the cross-wiring from the telco RJ66 or RJ21X demarcation to the FASTNet RJ21X terminals would be connected via 25-pair cables (3 per 10-trunk FASTNet chassis) and "punched" at each end (720 terminations plus grounds if all were E&M 4-Wire). This segment of the telco wiring requires a significant portion of installation time, and is easily blundered. Careful cable labeling and documentation is essential for sanity during installation, as well as when troubleshooting in the future.

As with the Model 2540 Main Chassis, actual wiring between the Split-Block Terminals and the RJ66M425 Miniature Jack Terminals will be discussed in the trunk cards portion of this section.

Expand Card Configuration

The 702-9458 Expand Card is used for both "Master" and "Slave" operation. Rev B or Rev C boards (702-9458B or 702-9458C) both function identically, but utilize different cabling. If upgrading a FASTNet Switch to 60-trunk capability, and Rev B Expand Cards are currently used in the system, then it will be necessary to replace the Expand Cards and cables with Rev C equipment. For 20 and 40 trunk systems, Rev B and Rev C hardware both function equally well, if properly installed.

The Rev C Expand Card layout is illustrated in Figure 7-2. J2 is a right angle 68-pin micro-D type connector. Configuration of the jumpers (JPn) and resistor packs (RPn) is detailed in Section 2 of this manual.

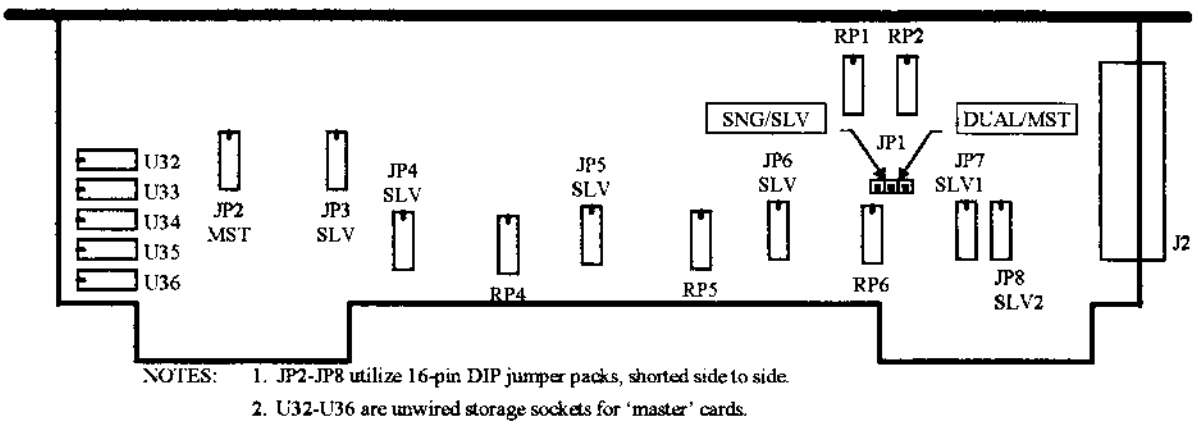


Figure 7-2: Rev C Expand Card Jumper Locations

For Rev B cards, the ribbon connector, P3, consists of a dual row 60-pin plug header which stands vertically on the board. *Additionally, a shield clamp assembly is installed onto the [P3] end of the circuit board, which must be secured to the flat ribbon cable shielding to ensure proper operation of the FASTNet Switch System.* Failure to properly install this shield clamp at both ends of the cable usually results in "random" reset occurrences and/or trunk signaling difficulties. The layout of the Rev B Expand Card is mapped in Figure 7-3.

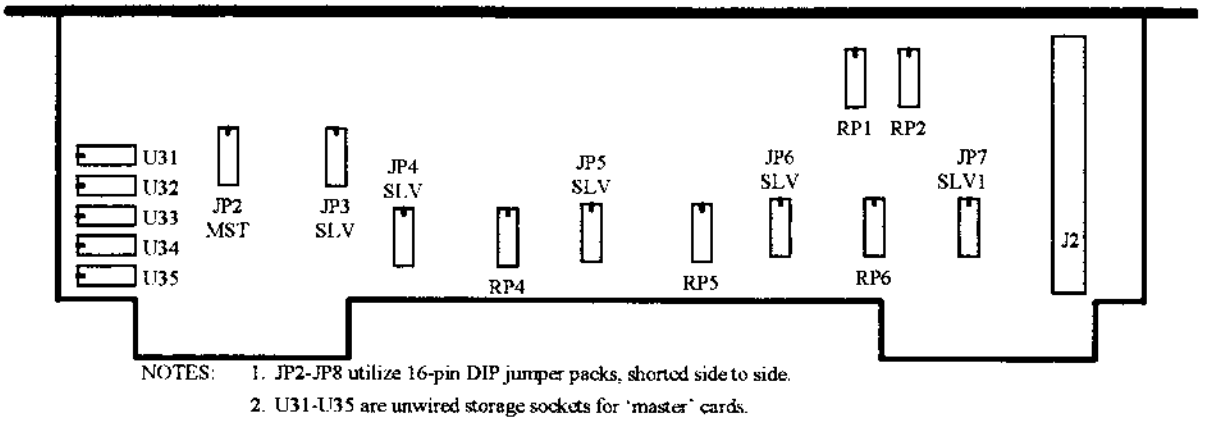


Figure 7-3: Rev B Expand Card Jumper Locations

Master Operation - Rev B Expand Cards

The Model 2540 Main Chassis should contain the "Master" Expand Card (702-9458) for the FASTNet Switch System, located in Slot 5 of the card cage. In order to determine the hardware configuration as wired, power-off the Model 2540, and then remove the Expand Card from Slot 5 to observe the jumper DIP-packs.

The Expand Card sockets labeled "U31" through "U35" exist only as storage facilities for unused DIP jumper packs, and therefore are of NO electronic significance.

A "Master" card should have four jumper packs stored in U31-U35, and MUST have one installed for "JP2". Please refer to Figure 7-3 to locate these IC DIP sockets.

The location of the Rev B Expand Card (702-9458B) DIP jumpers are shown in Figure 7-3, and those for the Rev C Expand Card (702-9458C) are shown in Figure 7-2.

Slave Operation - Rev B Expand Cards

The Model 2540EX Expand Chassis should contain the "Slave" Expand Card (702-9458) for the FASTNet Switch System, located in Slot 1 of the card cage. In order to determine the hardware configuration as wired, remove the Expand Card from Slot 1 and observe the jumper DIP-packs. A "Slave" card has jumper packs installed into all of JP3-JP7, with JP2 remaining unused (empty).

Resistor packs RP1, RP2, RP4, RP5, and RP6 do not need to be reconfigured for Rev B cards.

ADPCM VOICE STORAGE SET-UP

The standard equipment shipped with the FASTNet Switch for this option is the SCSI Hard Disk Card (702-9127). This unit supports the "Two-Hour Voice Storage" voice message package.

"Four-Hour Voice Storage" is also available, and uses this same card assembly, with a different software program for FASTNet.

Installation of this unit consists of plugging the 702-9127 assembly into Slot 1 of the Model 2540 Main Chassis card cage, when power is OFF. Detailed procedures for this installation are provided in Section 3, SCSI Hard Disk Card Mounting Information.

This assembly is packaged separately from the remainder of the Model 2540 chassis in order to prevent damage to the Hard Disk media, or to the drive heads.

For optional storage times of 6, 12, 24, or 48 hours the installation is slightly more complex. Each of these options uses different hardware as noted in Table 7-1.

Table 7-1: ADPCM Hardware Requirements

ADPCM Voice Storage Capacity (Hours)	CPU Memory Required	Disk Hardware Required	
2/4	1 Mb	815-9127	SCSI Hard Card
6	1 Mb	950-9404	SCSI Hard Drive (170 Mb HD)
12	1 Mb	950-9332	SCSI Hard Drive (234 Mb HD)
24	2 Mb (1 Mb Added to CPU Card)	950-9333	SCSI Hard Drive (422 Mb HD)
48	2 Mb (1 Mb Added to CPU Card)	950-9336	SCSI Hard Drive (1 Gb HD)

The installation technician should verify correct hardware per option purchased (compare to sales invoice and/or shipping documentation).

All of these options are installed identically, and utilize the same SCSI Hard Drive Adapter Card (802-0850). Installation into the Model 2540 Main Chassis is detailed in Section 3, SCSI Hard Disk Card Mounting Information.

MODEM SET-UP

The FASTNet Switch modem is used to access the FASTNet Switch for programming trunk configuration, and user identification data.

The Modem Card (802-0039) should be inserted into the TOP bus (IBM-PC Bus) connector of Slot 3 in the Model 2540 Main Chassis. The top of the Modem Card has two TELCO Miniature Keyed 6-Wire connectors and one DIP switch exposed.

Refer to Section 2 for a discussion of the operational theory of the Modem Card (802-0039).

The Modem Card TOP panel is illustrated in Figure 7-4 as viewed from the top. The configuration DIP switches are accessible from the top side of the card cage, where the TELCO jacks of the Modem are located. The "Comm Port" selected by the Modem hardware MUST match the software address defined in the Trunk Card Editor file. Set the DIP switches as shown in Table 7-2.

Table 7-2: Modem DIP Switches

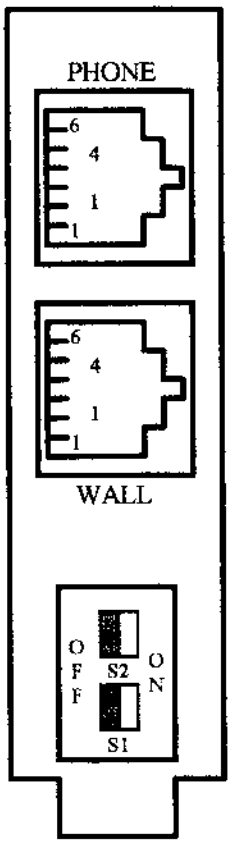
Switch Settings		Functional Description
S1	S2	
OFF	OFF	Comm Port 1 (Default)
ON	OFF	Comm Port 2
OFF	ON	Comm Port 3
ON	ON	Comm Port 4

The Modem Card baud rate is selected through software programming using the Zetron Trunk Card Editor Program.

WARNING:

This Modem is NOT compatible with "GROUND START" TELCO lines!

Use ONLY "LOOP START", End-to-End lines.



Notes:
1. The shaded regions of the 'Phone' and 'Wall' jacks illustrate the 4-Wire telco cable pinouts.
2. S1 and S2 are shown in the default 'off' position. (Shaded area represents switch tab)
3. "PHONE" may be labeled as "LINE"

Figure 7-4: Modem Card - Top View

There are two possible methods of configuring the Modem Card. Both of these configurations require that the TELCO line be connected to the "WALL" jack of the Modem Card.

1. The modem may "Share" a TELCO End-to-End Loop-Start line with a Dual TELCO Card trunk within the FASTNet Switch System.

   Option 1 will allow customer use of the TELCO line when not in use by the modem, but also may be conversely viewed as obstructing customer access during modem access time. In order for this configuration to function effectively, it is necessary to utilize a *DOD* End-to-End trunk (outbound only) so that inbound dialing will be ignored by FASTNet trunk cards, and answered by the Modem. Obviously, no one may use the telephone trunk if the Modem has it busied for billing transfers, etc.

2. The modem may occupy a TELCO End-to-End Loop Start line which is separate from the trunks of the FASTNet Switch.

   Option 2 will provide a modem access path independent of trunking cards, which may also be used as a local telephone for the service technician (when the modem is not in use) by connecting a "standard," or "over-the-counter" telephone to the "PHONE" jack of the Modem Card. The system modem access is protected from local interruption during programming sessions because the modem disconnects the local phone during these periods.

   This option is particularly useful to the service technician during FASTNet site visits. Service calls to the dispatch center or other places will *not* impede FASTNet TELCO traffic, preventing a loss of income to system owners, since one telco line would not be taken out of customer service for maintenance use by shop personnel.

LOCAL COMPUTER AND PRINTER SET-UP

Local Computer

The Local Computer access is highly valuable to the service technician who must install, align, or troubleshoot the FASTNet Switch. Most troubleshooting requires use of a PC either operated remotely by a second party, or operated locally by the service technician.

If the FASTNet Switch is located at the business office of the communications company, then this simply interfaces directly to the office computer, if compatible, via serial interface as specified in Section 2, under the heading of "RS-232 Interface with the CPU Card".

CPU interface to the Local Computer is buffered through Hex Inverter/Driver U42 and DUART U3 on the CPU Card.

Required Local Computer Equipment

- IBM (or compatible) Desk-Top, Lap-Top, or other portable computer provided by FASTNet Switch purchaser.

  PC / XT / AT Type Computer; Lap-Top, Notebook, or Desk-Top.

  286 / 386 / 486

  Minimum of 20 Megabyte Hard Drive required

  Minimum of 640 Kbyte RAM installed required

- RS-232C Serial Interface Cable p/n 709-7086

  60 feet in length

  provided by Zetron with the FASTNet Switch

Local Computer Set-up Procedure

- ❑ 1. Connect the [NO DOT] end of the 709-7086 RS-232C Cable to the "LOCAL" connector [P2] of the Model 2540 Main Chassis.
- ❑ 2. Route the cable to the location where the computer shall reside.
- ❑ 3. Connect the [DOT] end of the cable to the computer RS-232C Serial Port. Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for specific software set-ups for this computer.
- ❑ 4. An optional local printer *connected to this computer* may be very useful for dumping data files, log files, or configuration data.

Local (Logging) Printer

This option is provided for those who choose to maintain a logging printer at their FASTNet Switch site. The printer will run continuously, without need of an intermediary computer interface.

For most systems, this is not needed nor desired, since occasional print-outs of activity logs may be obtained from the "Local Computer" via attached-printer or diskette.

Refer to the CPU Card discussion in Section 2 for more details.

Required Local Printer Equipment

- Local Logging Printer Interface (950-9118) which includes:
  Local Logging Printer Cable (709-7085)
  One MC16450 DUART; 40-pin IC chip for U2.
  One MC145406 Hex Inverter/Driver; 16-pin IC chip for U1.
- Serial Interface Printer

Local Printer Set-up Procedure

- ❑ 1. Install RS-232C Serial Cable [NO DOT] end onto Model 2540 Main Chassis "PRINTER" connector [P1].
- ❑ 2. Route cable to printer residence location.
- ❑ 3. Install [DOT] end of cable onto Printer Connector.
- ❑ 4. Verify Trunk Card Editor File is configured for a "Local Printer". Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

TRUNK CARDS SET-UP

There are two types of Trunk Cards, which may be configured to handle a wide variety of FASTNet Switch interfaces. Each of the two trunk card types only facilitates certain interfaces, which simply means that the Installation Technician and System Engineer must specifically define ALL required system I/O connections before ordering FASTNet hardware for their switch.

Specific characteristics and requirements for the Dual TELCO Card (702-9457) and for the Dual 4-Wire Card (702-9460), are provided in Section 4 of this manual. Details of signaling protocol are provided in the form of Call Sequence flow charts and timing diagrams in Section 2 of this manual.

In the discussion here, we will step through installation procedures for the FASTNet interfaces to the following:

- FASTNet interface to a CO DID Line
- FASTNet interface to a CO End-to-End Loop Start Line

  Modem Line Sharing discussed.
- FASTNet interface to a CO End-to-End Loop Start Line

  VIA a Zetron Model 810 Digital Hybrid
- FASTNet interface to a Zetron Model 49 Repeater Manager
- FASTNet interface to a Uniden MRS804ZX Repeater
- FASTNet interface to a CO E&M 4-Wire Line
- FASTNet interface to a Zetron Ring Box (901-9212)

Appendix E provides a table of the above installation wire lists, as they would be wired per the examples. The table of Appendix E is intended as a summary wire list of the example FASTNet System discussed throughout Section 7.

FASTNet Interface to a CO DID Line

❑ 1. Obtain a Model 2540 Dual TELCO Card (702-9457).

Please note that this *card* actually services TWO (2) FASTNet trunks, and that this *installation* utilizes only ONE (1) of them.

Also, simplified schematics are provided in Section 2. Some confusion may be averted by studying the DID Configuration Diagram (024-0010) and associated text.

❑ 2. Referring to Section 4, set the hardware configurations for the items listed below:

- ❑ a. Dual Trunk Card Configuration,
  - Trunk Card Address (SW1-4, JP5)
  - Correlate address selected to Card Cage Slot and RJ66M425 Jack per the suggested labeling found in Section 4, Suggested Relabeling (and Appendix E for this example)
  - Dial Click Option Installed if required
  - MF Option installed if required
- ❑ b. Dual Telco Card (702-9457) Adjustments and Configuration,
  - Matrix Plug Insertion (Trunk type selection)
    In this case, the minuscule "DID" label should be right-reading above J3 (Trunk A) or J4 (Trunk B), at the "bottom" end, when viewed from the front of the Dual TELCO Card assembly.

❑ 3. Program **NETBASE** parameters required by FASTNet Switch to operate trunk card properly.

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 4. Program the **Zetron Trunk Card Editor** data required by the FASTNet Switch to operate this trunk card properly. Some critical parameters include, but are not limited to:

- Trunk Card Address; MUST match hardware setting!
- Trunk Card Type; MUST match trunk card type AND Matrix setting!
- Line Parameters; wink start, etc.
- Trunk Groups

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 5. BE SURE POWER IS OFF:

Install the Dual TELCO Card into the FASTNet card cage. The exact slot used, whether located in the Model 2540 (slots 7-16) or Model 2540EX (slots 4-13), is not critical since these cards utilize parallel bus configurations; **EXCEPT** that it must be the slot where the TELCO trunk is currently wired, or is desired to be wired at the completion of this process. *(Slot 11 of the Main Chassis for this example)*

❑ 6. Connect the **TELCO DID Trunk Line Pair** to the **FASTNet Switch Card Slot Pair** (if not previously done) for the EXACT card slot desired. The backplane pinouts for this function are provided in Section 4.

Specifically, the RJ21X Split-Block (802-0263) pin-outs from the card cage slots are defined on the pages noted below:

- 802-0263 RJ21X Split-Block Terminal Layout; Figure 4-1, page 4-15
- Model 2540 Main Chassis (10 trunk cards / 20 trunks maximum)
  - J19: Slots 7A - 10B (8 trunks) Table 4-3, page 4-8
  - J20: Slots 11A - 14B (8 trunks) Table 4-4, page 4-9
  - J23: Slots 15A - 16B (4 trunks) Table 4-5, page 4-10
- Model 2540EX Expansion Chassis (10 trunk cards / 20 trunks added)
  - J19: Slots 4A - 7B (8 trunks) Table 4-6, page 4-11
  - J20: Slots 8A - 11B (8 trunks) Table 4-7, page 4-12
  - J23: Slots 12A - 13B (4 trunks) Table 4-8, page 4-13
- RJ21X (802-0263) to RJ66M425 (802-0264) Cross-Wiring
  - RJ66M425 Terminal Block Wiring Layout Figure 4-3, page 4-18
  - Cross-wiring to Zetron Model 49 or telco Table 4-9, page 4-19
  - Cross-wiring to Zetron Model 810 Table 4-12, page 4-20
- RJ66M425 SUGGESTED jack labeling Pages 4-22 through 4-26.
  These labels should agree with Trunk Card Addresses, if the installation technician is careful to insert all trunk cards in ascending order (address), from left to right, in each Model 2540 and/or Model 2540(EX) chassis. Refer to Appendix E: Finished Trunk Wiring Sample.

The Installation Technician will have to cross-wire the Split-Block terminal to the RJ66M425 Terminal for each specific trunk interface.

❑ a. Example:

Connect a DID TELCO trunk to the FASTNet Switch Model 2540 chassis slot 11B, using the miniature-plug jacks (RJ66M425) provided. This will permit interface to the telco trunk via a standard 4-conductor or 6-conductor (Zetron 709-7000) 'modular' cable assembly.

(Alternatively, the RJ66M425 cross-wiring could be ignored, and the TIP/RING pair of the DID trunk could be wired directly from the FASTNet RJ21X terminal to the telco RJ21X or RJ66 terminal, if provided.)

Do the following:

- a.1 Look at Table 4-4 on page 4-9: Slot 11B

  Since Slot 11B is the fifth trunk card slot of the Model 2540 main chassis, the suggested address = 5B, and is wired through **J20 cabling** (per Table 4-4) as noted:

RING	J20-4	Brown w/ White Stripe
RING1	J20-5	Slate w/ White Stripe
M	J20-6	Blue w/ Red Stripe
TIP	J20-29	White w/ Brown Stripe
TIP1	J20-30	White w/ Slate Stripe
E	J20-31	Red w/ Blue Stripe

  Please note also that care must be taken to access the RJ21X Terminal ATTACHED TO J20 and not one of the other Split-Block Terminals of the FASTNet Switch. Meticulous Labeling will avert catastrophe and confusion.

- a.2 *Program* Address (5B) as DID in Trunk Card Editor and Netbase programming files. Configure per TELCO Feed and Line Type requirements.

- a.3 By observing the simplified schematic (DID Configuration 024-0010) in Section 2 of this manual, you will note that ONLY the RING, TIP, +48V, and -48V are required for this interface. Furthermore, the ±48V power is provided by the FASTNet power supply via the backplane, leaving only the TIP/RING pair to be concerned about.

  Therefore, DO NOT connect RING1, M, TIP1, or E at the RJ21X Terminal with bridge clips. Install bridge clips for J20-4 (RING) and J20-29 (TIP) onto the center two terminals of the Split-Block Terminal.

  This will provide TIP and RING circuitry only to the FASTNet Switch for circuit 11B, addressed as 5B.

- a.4 Choose the RJ66M425 jack desired (Refer to Suggested Relabeling in Section 4; use J5B) and Punch down the Cross-Connect wires from the Split-Block to the R66M425 Terminal as follows, using the 3-Pair cabling (408-0038) provided with your switch:

Split-Block Terminal (Left Side)		R66M425 Terminal (J5B)
RING	= J20-4 (7th down from top)	P1-R:Blue / White stripe
RING1	= J20-5 (-9 from top)	P3-R:Orange / White str.
M	= J20-6 (-11 from top)	P4-T:Green / White str.
TIP	= J20-29 (-8 from top)	P1-T:White / Blue str.
TIP1	= J20-30; -10 from top	P3-T:White / Orange str.
E	= J20-31; -12 from top	P2-R:White / Green str.

- a.5 Install the 6-wire "Modular" TELCO cable (709-7000) from the RJ66M425 jack J5B to the TELCO equipment jack provided by your TELCO CO.

-OR- Ignore Step "a.4" and wire from the Split-Block RING (J20-4; seventh terminal down, left side)to the TELCO "RING" terminal; then from the Split-Block TIP (J20-29; eighth terminal down, left side) to the TELCO "TIP" terminal. Be sure to install bridging clips (265-0030) across the center terminals of the RJ21X Split-Block Terminal (802-0263).

CAUTION: The most common cause for the DID interface to NOT function is the reversal of the TIP and RING wiring, especially if a "Ground Start" configuration is used.

❑ 7. Apply power to the FASTNet Switch System. Power-up the Model 2540EX expansion chassis first.

- The Model 2540EX Expansion Chassis power switch is located on the front, left-side of the card cage behind the front cover plate.
- Model 2540 Main Chassis power switch is located on the lower right external side of the chassis cabinet.

❑ 8. Refer to the Adjustment procedures in Section 4 to set inbound and outbound audio levels for the DID interface.

You will note that two separate procedures are provided for most of these interfaces, but only one is provided for the TELCO DID. This is because the "Local Computer Method" invokes outbound dialing, which is NOT supported by the DID interface.

❑ 9. After completing the alignment procedure, the DID Interface into the FASTNet Switch is ready for use.

FASTNet Interface to a CO End-to-End Loop Start Line

❑ 1. Obtain a Model 2540 Dual TELCO Card (702-9457).

Please note that this card actually services TWO (2) FASTNet trunks, and that this installation utilizes only ONE (1) of them.

Also, simplified schematics are provided in Section 2. Some confusion may be averted by studying the Central Office End-to-End, Loop Start Configuration Diagram (024-0009) and associated text.

❑ 2. Referring to Section 4, set the hardware configurations for the items listed below:

- ❑ a. Dual Trunk Card Configuration
  - Trunk Card Address (SW1-4, JP5)
  - Correlate address selected to Card Cage Slot and RJ66M425 Jack per the suggested labeling found in Section 4, Relabeling and Appendix E.
  - Dial Click Option Installed if required
  - MF Option installed if required
- ❑ b. Dual Telco Card (702-9457) Adjustments and Configuration,
  - Matrix Plug Insertion (Trunk type selection)
    In this case, the minuscule "E-E" label should be right-reading above J3 (Trunk A) or J4 (Trunk B), at the "bottom" end, when viewed from the front of the Dual TELCO Card assembly.

❑ 3. Program **NETBASE** parameters required by FASTNet Switch to operate trunk card properly.

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 4. Program the **Zetron Trunk Card Editor** data required by the FASTNet Switch to operate this trunk card properly. Some critical parameters include, but are not limited to:

- Trunk Card Address; MUST match hardware setting!
- Trunk Card Type; MUST match trunk card type AND Matrix setting!
- Line Parameters; Loop Start, etc.
- Trunk Groups

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 5. BE SURE POWER IS OFF:

Install the Dual TELCO Card into the FASTNet card cage. The exact slot used, whether located in the Model 2540 (slots 7-16) or Model 2540EX (slots 4-13), is not critical since these cards utilize parallel bus configurations; EXCEPT that it must be the slot where the TELCO trunk is currently wired, or is desired to be wired at the completion of this process. *(Slot 5 of the Expand Chassis for this example)*

❑ 6. Connect the **TELCO End-to-End Trunk Line Pair** to the **FASTNet Switch Card Slot Pair** (if not previously done) for the EXACT card slot desired. The detailed wire lists for this function are provided in Section 4 of this manual.

Specifically, the RJ21X Split-Block (802-0263) pin-outs from the card cage slots are defined on the pages noted below:

- 802-0263 RJ21X Split-Block Terminal Layout; Figure 4-1, page 4-15
- Model 2540 Main Chassis (10 trunk cards / 20 trunks maximum)
  - J19: Slots 7A - 10B (8 trunks) Table 4-3, page 4-8
  - J20: Slots 11A - 14B (8 trunks) Table 4-4, page 4-9
  - J23: Slots 15A - 16B (4 trunks) Table 4-5, page 4-10
- Model 2540EX Expansion Chassis (10 trunk cards / 20 trunks added)
  - J19: Slots 4A - 7B (8 trunks) Table 4-6, page 4-11
  - J20: Slots 8A - 11B (8 trunks) Table 4-7, page 4-12
  - J23: Slots 12A - 13B (4 trunks) Table 4-8, page 4-13
- RJ21X (802-0263) to RJ66M425 (802-0264) Cross-Wiring
  - RJ66M425 Terminal Block Wiring Layout Figure 4-3, page 4-18
  - Cross-wiring to Zetron Model 49 or telco Table 4-9, page 4-19
  - Cross-wiring to Zetron Model 810 Table 4-12, page 4-20
- RJ66M425 SUGGESTED jack labeling Pages 4-22 through 4-26.
  These labels should agree with Trunk Card Addresses, if the installation technician is careful to insert all trunk cards in ascending order (address), from left to right, in each Model 2540 and/or Model 2540(EX) chassis. Refer to Appendix E: Finished Trunk Wiring Sample.

The Installation Technician will have to cross-wire the Split-Block terminal to the RJ66M425 Terminal for each specific trunk interface.

❑ a. Example:

To connect an End-to-End Loop Start TELCO trunk to the FASTNet Switch Model 2540EX Chassis slot 5A using (or not) the miniature-plug jacks (RJ66M425) provided, do the following:

- a.1 Look at Table 4-10 page 4-15: Slot 5A

  Since Slot 5(A) is the second slot of the first Expand Chassis, which is also the *twelfth FASTNet System trunk card slot*, the suggested Address = 12A, and is wired through the Model 2540EX Expansion Chassis **J19 cabling** as noted:

RING	J19-7	Orange w/Red Stripe
RING1	J19-8	Green w/Red Stripe
M	J19-9	Brown w/ Red Stripe
TIP	J19-32	Red w/Orange Stripe
TIP1	J19-33	Red w/Green Stripe
E	J19-34	Red w/ Brown Stripe

  Use care to connect to the proper RJ21X terminal block.

- a.2 Program Address (12A) as End-to-End Loop Start in the Trunk Card Editor and Netbase programming files. Configure per TELCO Feed and Line Type requirements.

  a.3 By observing the simplified schematic (E-E Configuration 024-0009) in Section 2 of this manual, you will note that ONLY the RING and TIP are required for this interface.

  Therefore, DO NOT connect RING1, M, TIP1, or E at the Split-Block Terminal (J19) using bridge clips, since they are not needed

  Install bridge clips for J19-7 (RING) and J19-32 (TIP) onto the center two terminals of the Split-Block Terminal.

  This will provide TIP and RING circuitry only to the FASTNet switch for Expand circuit 5A, addressed as 12A.

a.4 Choose the RJ66M425 jack desired (Refer to Suggested Relabeling in Section 4; use J12A) and Punch down the Cross-Connect wires from the Split-Block to the R66M425 Terminal as follows, using the 3-Pair cabling (408-0038) provided with your switch:

Split-Block Terminal (Left Side)		RJ66M425 Jack (J12A)
RING	= J19-7 (-13 from top)	P1-R:Blue / White stripe
RING1	= J19-8 (-15 from top)	P3-R:Orange / White str.
M	= J19-9 (-17 from top)	P4-T:Green / White str.
TIP	= J19-32 (-14 from top)	P1-T:White / Blue str.
TIP1	= J19-33 (-16 from top)	P3-T:White / Orange str.
E	= J19-34 (-18 from top)	P2-R:White / Green str.

- a.5 Install the 6-wire "Modular" TELCO cable (709-7000) from the RJ66M425 jack to the TELCO equipment jack .

-OR- Ignore step "a.4" above and wire from the RJ21X RING (J19-7; thirteenth terminal down, left side) to the TELCO "RING" terminal; then from the Split-Block TIP (J19-32; fourteenth terminal down, left side) to the TELCO "TIP" terminal. Be sure to install bridging clips (265-0030) across the center terminals of the RJ21X Split-Block (802-0263).

CAUTION: The most common cause for the E-E interface to NOT function is the reversal of the TIP and RING wiring.

❑ 7. Apply power to the FASTNet Switch System. Power-up the Model 2540EX expansion chassis first.

- The Model 2540EX Expansion Chassis power switch is located on the front, left-side of the card cage behind the front cover plate.
- Model 2540 Main Chassis power switch is located on the lower right external side of the chassis cabinet.

❑ 8. Refer to the Adjustment procedures in Section 4 to set inbound and outbound audio levels for the End-to-End interface. You will note that two separate procedures are provided for these interfaces:

❑ a. "Voice Prompts Method" in which the technician dials into the FASTNet Switch from an "outside" line, and then executes the "Test Mode" via the Voice Prompt Programming access.

❑ b. "Local Computer Method" which allows "Test Mode" access via the Local RS-232C Port of the Model 2540. This method requires outbound dialing from the trunk under test.

❑ 9. After completing the alignment procedure, the End-to-End Interface to/from the FASTNet Switch is ready for use.

FASTNet Interface to a CO E&M 4-Wire Line

❑ 1. Obtain a Model 2540 Dual 4-Wire Card (702-9460).

Please note that this card actually services TWO (2) FASTNet trunks, and that this installation utilizes only ONE (1) of them.

Also, simplified schematics are provided in Section 2. Some confusion may be averted by studying the E&M 4-Wire Configuration Diagram (024-0089) and associated text.

❑ 2. Referring to Section 4, set the hardware configurations for the items listed below:

- ❑ a. Dual Trunk Card Configuration
  - Trunk Card Address (SW1-4, JP5)
  - Correlate address selected to Card Cage Slot and RJ66M425 Jack per the suggested labeling found in Section 4, Relabeling and Appendix E.
  - Dial Click Option Installed if required
  - MF Option installed if required
- ❑ b. Dual 4-Wire Card (702-9460) Configuration,
  - Audio Daughter Board Jumpers set per trunk requirements.

❑ 3. Program **NETBASE** parameters required by FASTNet Switch to operate trunk card properly.

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 4. Program the **Zetron Trunk Card Editor** data required by the FASTNet Switch to operate this trunk card properly. Some critical parameters include, but are not limited to:

- Trunk Card Address; MUST match hardware setting!
- Trunk Card Type; MUST match trunk card type AND Matrix setting!
- Line Parameters; wink start, etc.
- Trunk Groups

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 5. BE SURE POWER IS OFF:

Install the Dual TELCO Card into the FASTNet card cage. The exact slot used, whether located in the Model 2540 (slots 7-16) or Model 2540EX (slots 4-13), is not critical since these cards utilize parallel bus configurations; **EXCEPT** that it must be the slot where the TELCO trunk is currently wired, or is desired to be wired at the completion of this process.

❑ 6. Connect the **TELCO E&M 4-Wire Trunk Line Pairs** (3 pairs) to the **FASTNet Switch Card Slot Pairs** (if not previously done) for the EXACT card slot desired. The detailed wire lists for this function are provided in **Section 4** of this manual.

Specifically, the RJ21X Split-Block (802-0263) pin-outs from the card cage slots are defined on the pages noted below:

- 802-0263 RJ21X Split-Block Terminal Layout; Figure 4-1, page 4-15
- Model 2540 Main Chassis (10 trunk cards / 20 trunks maximum)
  - J19: Slots 7A - 10B (8 trunks) Table 4-3, page 4-8
  - J20: Slots 11A - 14B (8 trunks) Table 4-4, page 4-9
  - J23: Slots 15A - 16B (4 trunks) Table 4-5, page 4-10
- Model 2540EX Expansion Chassis (10 trunk cards / 20 trunks added)
  - J19: Slots 4A - 7B (8 trunks) Table 4-6, page 4-11
  - J20: Slots 8A - 11B (8 trunks) Table 4-7, page 4-12
  - J23: Slots 12A - 13B (4 trunks) Table 4-8, page 4-13
- RJ21X (802-0263) to RJ66M425 (802-0264) Cross-Wiring
  - RJ66M425 Terminal Block Wiring Layout Figure 4-3, page 4-18
  - Cross-wiring to Zetron Model 49 or telco Table 4-9, page 4-19
  - Cross-wiring to Zetron Model 810 Table 4-12, page 4-20
- RJ66M425 SUGGESTED jack labeling Pages 4-22 through 4-26.
  These labels should agree with Trunk Card Addresses, if the installation technician is careful to insert all trunk cards in ascending order (address), from left to right, in each Model 2540 and/or Model 2540(EX) chassis. Refer to Appendix E: Finished Trunk Wiring Sample.

The Installation Technician will have to cross-wire the Split-Block terminal to the RJ66M425 Terminal for each specific trunk interface. An example is provided on the following page for this End-to-End Loop Start Line configuration.

❑ a. Example:

To connect an E&M 4-Wire TELCO trunk to the FASTNet Switch Model 2540EX Chassis slot 9A using (or not) the miniature-plug jacks (RJ66M425) provided, do the following:

- a.1 Look at Table 4-7 on page 4-12: Slot 9A

  Since Slot 9A is the sixth slot of the first Expand Chassis, which is also the *sixteenth FASTNet System trunk card slot*, the suggested Address = 16A, and is wired through the Model 2540EX Expansion Chassis **J20 cabling** as noted:

RING	J20-7	Orange w/ Red Stripe
RING1	J20-8	Green w/ Red Stripe
M	J20-9	Brown w/ Red Stripe
TIP	J20-32	Red w/Orange Stripe
TIP1	J20-33	Red w/Green Stripe
E	J20-34	Red w/ Brown Stripe

- a.2 Program Address (16A) as E&M 4-Wire interface in the Trunk Card Editor and Netbase programming files. Configure per TELCO Feed and Line Type requirements.
- a.3 By observing the simplified schematic (E&M 4-Wire Configuration 024-0089) in Section 2 of this manual, you will note that RING/TIP (To TELCO Audio Pair), RING1/TIP1 (From TELCO Audio Pair), M (From TELCO Supervision), and E (To TELCO Supervision) are ALL required for this interface. Install a bridge clip onto the center two terminals of the RJ21X Split-Block Terminal (802-0263) for each line: J20-7 (RING), J20-32 (TIP), J20-8 (RING1), J20-33 (TIP1), J20-9 (M), and J20-34 (E).

  All six of the trunk lines will be utilized for the E&M 4-Wire interface of Expand circuit 9A, addressed as 16A.

- a.4 Choose the RJ66M425 jack desired (Refer to Suggested Relabeling in Section 4; use J16A) and Punch down the Cross-Connect wires from the Split-Block to the R66M425 Terminal as follows, using the 3-Pair cabling (408-0038) provided with your switch:

Split-Block Terminal (Left Side)	R66M425 Jack (J16A)
RING = J20-7 (-13 from the top)	P1-R:Blue / White stripe
RING1 = J20-8 (-15 from top)	P3-R:Orange / White str.
M = J20-9 (-17 from top)	P4-T:Green / White str.
TIP = J20-32 (-14 from top)	P1-T:White / Blue str.
TIP1 = J20-33 (-16 from top)	P3-T:White / Orange str.
E = J20-34 (-18 from top)	P2-R:White / Green str.

- a.5 Install the 6-wire "Modular" TELCO cable (709-7000) from the RJ66M425 jack to the TELCO equipment jack provided by your TELCO CO.

-OR- Ignore step "a.4" above and wire directly from terminations on the left side of the Split-Block (as noted above) to the TELCO terminations provided. Be sure to install all six bridging clips (265-0030) across the center terminals of the RJ21X Split-Block Terminal (802-0263).

-OR- Ignore step "a.4" and use J1 (front) of the Audio Daughter Board on the Dual 4-Wire Card directly to the telco jack.

❑ 7. Apply power to the FASTNet Switch System. Power-up the Model 2540EX expansion chassis first.

- The Model 2540EX Expansion Chassis power switch is located on the front, left-side of the card cage behind the front cover plate.
- Model 2540 Main Chassis power switch is located on the lower right external side of the chassis cabinet.

❑ 8. Refer to the Adjustment Procedures of Section 4 to set inbound and outbound audio levels for the E&M 4-Wire Type I interface. You will note that two separate procedures are provided for these interfaces:

❑ a. "Voice Prompts Method" in which the technician dials into the FASTNet Switch from an "outside" line, and then executes the "Test Mode" via the Voice Prompt Programming access.

-OR-

❑ b. "Local Computer Method" which allows "Test Mode" access via the Local RS-232C Port of the Model 2540. This method requires outbound dialing from the trunk under test.

❑ 9. After completing the alignment procedure, the E&M 4-Wire Interface to/from the FASTNet Switch is ready for use.

FASTNet Interface to a Model 810 and a CO E-E Loop Start Line

❑ 1. Obtain a Model 2540 Dual 4-Wire Card (702-9460).

Please note that this card actually services TWO (2) FASTNet trunks, and that this installation utilizes only ONE (1) of them.

The Model 810 Digital Hybrid, End-to-End TELCO interface actually connects an End-to-End TELCO Trunk to a FASTNet Switch E&M 4-Wire Trunk Card, which has been uniquely hardware cross-wired (step 6) **and software configured** (step 4)**.**

Simplified schematics are provided in Section 2 for the FASTNet E&M 4-Wire interface. Some confusion may be averted by studying the E&M 4-Wire Configuration Diagram (024-0089) and associated text, as well as by studying the *Model 810 Digital Hybrid GE-MARC 4-Wire Interface Instruction Manual* (Part No. 025-9195).

Note: The Model 810 DID Interface is nearly identical to this example, except that step 4 parameters are slightly different.

❑ 2. Referring to Section 4, set the hardware configurations for the items listed below:

- ❑ a. Dual Trunk Card Configuration
  - Trunk Card Address (SW1-4, JP5)
    Correlate address selected to Card Cage Slot and RJ66M425 Jack per the suggested labeling found in Section 4, Relabeling and Appendix E.
  - Dial Click Option Installed if required
  - MF Option installed if required
- ❑ b. Dual 4-Wire Card (702-9460) Configuration (Also see Cross-Wiring)
  - Audio Daughter Board Jumpers set per Model 810 requirements
- ❑ c. Model 810 Jumpers set per Section 4, Cross-Wiring notes.

❑ 3. Program **NETBASE** parameters required by FASTNet Switch to operate trunk card properly.

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 4. Program the **Zetron Trunk Card Editor** data required by the FASTNet Switch to operate this trunk card properly. Some critical parameters include, but are not limited to:

- Trunk Card Address; MUST match hardware setting!
- Trunk Card Type; MUST match trunk card type AND Matrix setting!
- Line Parameters; wink start, etc.
- Trunk Groups
- Model 810 special parameters

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 5. BE SURE POWER IS OFF:

Install the Dual TELCO Card into the FASTNet card cage. The exact slot used, whether located in the Model 2540 (slots 7-16) or Model 2540EX (slots 4-13), is not critical since these cards utilize parallel bus configurations; **EXCEPT** that it must be the slot where the TELCO trunk is currently wired, or is desired to be wired at the completion of this process.

❑ 6. Connect the **TELCO E&M 4-Wire Trunk Line Pairs** (3 pairs) to the **FASTNet Switch Card Slot Pairs** (if not previously done) for the EXACT card slot desired. The detailed wire lists for this function are provided in **Section 4** of this manual.

Specifically, the RJ21X Split-Block (802-0263) pin-outs from the card cage slots are defined on the pages noted below:

- 802-0263 RJ21X Split-Block Terminal Layout; Figure 4-1, page 4-15
- Model 2540 Main Chassis (10 trunk cards / 20 trunks maximum)
  - J19: Slots 7A - 10B (8 trunks) Table 4-3, page 4-8
  - J20: Slots 11A - 14B (8 trunks) Table 4-4, page 4-9
  - J23: Slots 15A - 16B (4 trunks) Table 4-5, page 4-10
- Model 2540EX Expansion Chassis (10 trunk cards / 20 trunks added)
  - J19: Slots 4A - 7B (8 trunks) Table 4-6, page 4-11
  - J20: Slots 8A - 11B (8 trunks) Table 4-7, page 4-12
  - J23: Slots 12A - 13B (4 trunks) Table 4-8, page 4-13
- RJ21X (802-0263) to RJ66M425 (802-0264) Cross-Wiring
  - RJ66M425 Terminal Block Wiring Layout Figure 4-3, page 4-18
  - Cross-wiring to Zetron Model 49 or telco Table 4-9, page 4-19
  - Cross-wiring to Zetron Model 810 Table 4-12, page 4-20
- RJ66M425 SUGGESTED jack labeling Pages 4-22 through 4-26.
  These labels should agree with Trunk Card Addresses, if the installation technician is careful to insert all trunk cards in ascending order (address), from left to right, in each Model 2540 and/or Model 2540(EX) chassis. Refer to Appendix E: Finished Trunk Wiring Sample.

The Installation Technician will have to cross-wire the Split-Block terminal to the RJ66M425 Terminal for each specific trunk interface. An example is provided on the following page for this End-to-End Loop Start Line configuration.

❑ a. Example:

To connect a Zetron Model 810 to the FASTNet Switch Model 2540 Chassis slot 7B using (or not) the miniature-plug jacks (RJ66M425) provided, do the following:

- a.1 Look at Table 4-3 on page 4-8: Slot 7B

  Since Slot 7B is the first slot of the Main Chassis, which is also the *first FASTNet System trunk card slot*, the suggested address is 1B, which is wired through the Model 2540 Main Chassis **J19 cabling** as noted:

RING	J19-4	Brown w/ White Stripe
RING1	J19-5	Slate w/ White Stripe
M	J19-6	Blue w/ Red Stripe
TIP	J19-29	White w/ Brown Stripe
TIP1	J19-30	White w/ Slate Stripe
E	J19-31	Red w/ Blue Stripe

- a.2 Program Address (1B) as End-to-End (Model 810) interface in the Trunk Card Editor and Netbase programming files. Configure per TELCO Feed and Line Type requirements.
- a.3 By observing the simplified schematic (E&M 4-Wire Configuration 024-0089) in Section 2 of this manual, you will note that RING/TIP (To TELCO Audio Pair), RING1/TIP1 (From TELCO Audio Pair), M (From TELCO Supervision), and E (To TELCO Supervision) are ALL required for this interface.

  Install bridge clips onto the center two terminals of the Split-Block Terminal for: J19-4 (RING), J19-29 (TIP), J19-5 (RING1), J19-30 (TIP1), J19-6 (M), and J19-31 (E).

  All six of the trunk lines are utilized for the E&M 4-Wire to Model 810 interface of Main Chassis circuit 7B, addressed as 1B.

- a.4 Choose the RJ66M425 jack desired (Refer to Suggested Relabeling in Section 4; use J1B to correspond to suggested assigned address 1B) and Punch down the Cross-Connect wires from the Split-Block to the R66M425 Terminal as follows, using the 3-Pair cabling (408-0038) provided with your switch:

Split-Block Terminal (Left Side)	R66M425 Terminal (J1B)
RING = J19-4 (-7 from the top	P3-T:Blue / White stripe
RING1 = J19-5 (-9 from top)	P1-T:Orange / White str.
M = J19-6 (-11 from top)	P2-R:Green / White str.
TIP = J19-29 (-8 from top)	P3-R:White / Blue str.
TIP1 = J19-30 (-10 from top)	P1-R:White / Orange str.
E = J19-31 (-12 from top)	P4-T:White / Green str.

- a.5 Install the 6-wire "Modular" TELCO cable (709-7000) from the RJ66M425 jack to the TELCO equipment jack provided by your TELCO CO.

-OR- Ignore step "a.4" above and wire directly from terminations on the left side of the Split-Block (as noted in "a.4" above) to the TELCO terminations provided.

Note: DO NOT USE the J1/J2 trunk connectors on the Audio Daughter Board of the Dual 4-Wire Card for the Model 810.

❑ 7. Apply power to the FASTNet Switch System. Power-up the Model 2540EX expansion chassis first.

- The Model 2540EX Expansion Chassis power switch is located on the front, left-side of the card cage behind the front cover plate.
- Model 2540 Main Chassis power switch is located on the lower right external side of the chassis cabinet.

❑ 8. Refer to the Adjustment Procedures of Section 4 to set inbound and outbound audio levels for the E&M 4-Wire Type I interface. You will note that two separate procedures are provided for these interfaces:

❑ a. "Voice Prompts Method" in which the technician dials into the FASTNet Switch from an "outside" line, and then executes the "Test Mode" via the Voice Prompt Programming access.

-OR-

❑ b. "Local Computer Method" which allows "Test Mode" access via the Local RS-232C Port of the Model 2540. This method requires outbound dialing from the trunk under test.

❑ 9. After completing the alignment procedure, the E&M 4-Wire Interface to/from the FASTNet Switch is ready for use.

FASTNet Interface to a Zetron Model 49 Repeater Manager

❑ 1. Obtain a Model 2540 Dual 4-Wire Card (702-9460).

Please note that this card actually services TWO (2) FASTNet trunks, and that this installation utilizes only ONE (1) of them.

Also, simplified schematics are provided in Section 2. Some confusion may be averted by studying the E&M 4-Wire Configuration Diagram (024-0089) and associated text.

Furthermore, the Model 49 must be configured with an E&M 4-Wire TELCO Card Option (950-9253).

Finally, disable the Model 49 TELCO Power Limiter by removing R11 for *Rev S+* units only as noted in Appendix H, to avoid audio level adjustment problems.

❑ 2. Referring to Section 4, set the hardware configurations for the items listed below:

- ❑ a. Dual Trunk Card Configuration
  - Trunk Card Address (SW1-4, JP5)
    Correlate address selected to Card Cage Slot and RJ66M425 Jack per the suggested labeling found in Section 4, Relabeling and Appendix E.
  - Dial Click Option Installed if required
  - MF Option installed if required
- ❑ b. Dual 4-Wire Card (702-9460) Configuration (Also see "Cross-Wiring" in Section 4)
  - Audio Daughter Board Jumpers set per Model 49 requirements
- ❑ c. Model 49 E&M Card Configuration per Section 4, Cross-Wiring notes.

❑ 3. Program **NETBASE** parameters required by FASTNet Switch to operate trunk card properly.

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 4. Program the **Zetron Trunk Card Editor** data required by the FASTNet Switch to operate this trunk card properly. Some critical parameters include, but are not limited to:

- Trunk Card Address; MUST match hardware setting!
- Trunk Card Type; MUST match trunk card type AND Matrix setting!
- Line Parameters; wink start, etc.
- Trunk Groups

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 5. BE SURE POWER IS OFF:

Install the Dual TELCO Card into the FASTNet card cage. The exact slot used, whether located in the Model 2540 (slots 7-16) or Model 2540EX (slots 4-13), is not critical since these cards utilize parallel bus configurations; **EXCEPT** that it must be the slot where the TELCO trunk is currently wired, or is desired to be wired at the completion of this process.

❑ 6. Connect the **TELCO E&M 4-Wire Trunk Line Pairs** (3 pairs) to the **FASTNet Switch Card Slot Pairs** (if not previously done) for the EXACT card slot desired. The detailed wire lists for this function are provided in **Section 4** of this manual.

Specifically, the RJ21X Split-Block (802-0263) pin-outs from the card cage slots are defined on the pages noted below:

- 802-0263 RJ21X Split-Block Terminal Layout; Figure 4-1, page 4-15
- Model 2540 Main Chassis (10 trunk cards / 20 trunks maximum)
  - J19: Slots 7A - 10B (8 trunks) Table 4-3, page 4-8
  - J20: Slots 11A - 14B (8 trunks) Table 4-4, page 4-9
  - J23: Slots 15A - 16B (4 trunks) Table 4-5, page 4-10
- Model 2540EX Expansion Chassis (10 trunk cards / 20 trunks added)
  - J19: Slots 4A - 7B (8 trunks) Table 4-6, page 4-11
  - J20: Slots 8A - 11B (8 trunks) Table 4-7, page 4-12
  - J23: Slots 12A - 13B (4 trunks) Table 4-8, page 4-13
- RJ21X (802-0263) to RJ66M425 (802-0264) Cross-Wiring
  - RJ66M425 Terminal Block Wiring Layout Figure 4-3, page 4-18
  - Cross-wiring to Zetron Model 49 or telco Table 4-9, page 4-19
  - Cross-wiring to Zetron Model 810 Table 4-12, page 4-20
- RJ66M425 SUGGESTED jack labeling Pages 4-22 through 4-26.
  These labels should agree with Trunk Card Addresses, if the installation technician is careful to insert all trunk cards in ascending order (address), from left to right, in each Model 2540 and/or Model 2540(EX) chassis. Refer to Appendix E: Finished Trunk Wiring Sample.

The Installation Technician will have to cross-wire the Split-Block terminal to the RJ66M425 Terminal for each specific trunk interface. An example is provided on the following page for this End-to-End Loop Start Line configuration.

❑ a. Example:

To connect a Model 49 trunk to the FASTNet Switch Model 2540EX Chassis slot 13A using (or not) the miniature-plug jacks (RJ66M425) provided, do the following:

- a.1 Look at Table 4-8 on page 4-13: Slot 13A

  Since Slot 13A is the tenth slot of the first Expand Chassis, which is also the *twentieth FASTNet System trunk card slot*, the suggested address = 20A, and is wired through the Model 2540EX Expansion Chassis **J23 cabling** as noted:

RING	J23-7	Orange w/ Red Stripe
RING1	J23-8	Green w/ Red Stripe
M	J23-9	Brown w/ Red Stripe
TIP	J23-32	Red w/ Orange Stripe
TIP1	J23-33	Red w/ Green Stripe
E	J20-34	Red w/ Brown Stripe

- a.2 Program Address (20A) as E&M 4-Wire interface in the Trunk Card Editor and Netbase programming files. Configure per TELCO Feed and Line Type requirements.
- a.3 By observing the simplified schematic (E&M 4-Wire Configuration 024-0089) in Section 2 of this manual, you will note that RING/TIP (To TELCO Audio Pair), RING1/TIP1 (From TELCO Audio Pair), M (From TELCO Supervision), and E (To TELCO Supervision) are ALL required for this interface.

  Install bridge clips onto the center two terminals of the Split-Block Terminal for: J23-7 (RING), J23-32 (TIP), J23-8 (RING1), J23-33 (TIP1), J23-9 (M), and J23-34 (E).

  All six of the trunk lines are utilized for the E&M 4-Wire to Model 49 interface of Expand circuit 10A, addressed as 20A.

- a.4 Choose the RJ66M425 jack desired (Refer to Suggested Relabeling in Section 4; use J20A to correspond to suggested assigned address 20A) and Punch down the Cross-Connect wires from the Split-Block to the R66M425 Terminal as follows, using the 3-Pair cabling (408-0038) provided with your switch:

Split-Block Terminal (Left Side)	R66M425 Jack (J20A)
RING = J23-7 (-13 from the top)	P1-R:Blue / White stripe
RING1 = J23-8 (-15 from top)	P3-R:Orange / White str.
M = J23-9 (-17 from top)	P4-T:Green / White str.
TIP = J23-32 (-14 from top)	P1-T:White / Blue str.
TIP1 = J23-33 (-16 from top)	P3-T:White / Orange str.
E = J23-34 (-18 from top)	P2-R:White / Green str.

- a.5 Install the 6-wire "Modular" TELCO cable (709-7000) from the RJ66M425 jack to the TELCO equipment jack provided by your TELCO CO.

-OR- Ignore step "a.4" above and wire directly from terminations on the left side of the Split-Block (as noted in "a.4" above) to the TELCO terminations provided.

-OR- Ignore step "a.4" and use J1 (front) of the Audio Daughter Board trunk A on the Dual 4-Wire Card.

❑ 7. Apply power to the FASTNet Switch System. Power-up the Model 2540EX expansion chassis first.

- The Model 2540EX Expansion Chassis power switch is located on the front, left-side of the card cage behind the front cover plate.
- Model 2540 Main Chassis power switch is located on the lower right external side of the chassis cabinet.

❑ 8. Refer to the Adjustment Procedures of Section 4 to set inbound and outbound audio levels for the E&M 4-Wire Type I interface. You will note that two separate procedures are provided for these interfaces:

❑ a. "Voice Prompts Method" in which the technician dials into the FASTNet Switch from an "outside" line, and then executes the "Test Mode" via the Voice Prompt Programming access.

-OR-

❑ b. "Local Computer Method" which allows "Test Mode" access via the Local RS-232C Port of the Model 2540. This method requires outbound dialing from the trunk under test.

❑ 9. After completing the alignment procedure, the E&M 4-Wire Interface to/from the FASTNet Switch is ready for use.

FASTNet Interface to a Uniden MRS804ZX Repeater

This interface is virtually identical to the Model 49 interface, excepting unique trunk addresses, of course.

❑ 1. Obtain a Model 2540 Dual 4-Wire Card (702-9460).

Please note that this card actually services TWO (2) FASTNet trunks, and that this installation utilizes only ONE (1) of them.

Also, simplified schematics are provided in Section 2. Some confusion may be averted by studying the E&M 4-Wire Configuration Diagram (024-0089) and associated text.

Furthermore, the Uniden MRS804ZX Repeater must be configured with an E&M 4-Wire TELCO Card Option (950-9253).

Disable the ARX790 TELCO Power Limiter by shorting R108 as noted in Appendix H, to avoid audio level adjustment problems.

❑ 2. Referring to Section 4, set the hardware configurations for the items listed below:

- ❑ a. Dual Trunk Cards
  - Trunk Card Address (SW1-4, JP5)
    Correlate address selected to Card Cage Slot and RJ66M425 Jack per the suggested labeling found in Section 4, Relabeling and Appendix E.
  - Dial Click Option Installed if required
  - MF Option installed if required
- ❑ b. Dual 4-Wire Card (702-9460) Configuration (Also see "Cross-Wiring" in Section 4)
  - Audio Daughter Board Jumpers set per MRS804ZX requirements.
- ❑ c. MRS804ZX E&M Card Configuration per Section 4, Cross-Wiring notes.

❑ 3. Program **NETBASE** parameters required by FASTNet Switch to operate trunkcard.

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 4. Program the **Zetron Trunk Card Editor** data required by the FASTNet Switch to operate this trunk card properly. Some critical parameters include, but are not limited to:

- Trunk Card Address; MUST match hardware setting!
- Trunk Card Type; MUST match trunk card type AND Matrix setting!
- Line Parameters; wink start, etc.
- Trunk Groups

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 5. BE SURE POWER IS OFF:

Install the Dual TELCO Card into the FASTNet card cage. The exact slot used, whether located in the Model 2540 (slots 7-16) or Model 2540EX (slots 4-13), is not critical since these cards utilize parallel bus configurations; EXCEPT that it must be the slot where the TELCO trunk is currently wired, or is desired to be wired at the completion of this process.

❑ 6. Connect the TELCO E&M 4-Wire Trunk Line Pairs (3 pairs) to the FASTNet Switch Card Slot Pairs (if not previously done) for the EXACT card slot desired. The detailed wire lists for this function are provided in Section 4 of this manual.

Specifically, the RJ21X Split-Block (802-0263) pin-outs from the card cage slots are defined on the pages noted below:

- 802-0263 RJ21X Split-Block Terminal Layout; Figure 4-1, page 4-15
- Model 2540 Main Chassis (10 trunk cards / 20 trunks maximum)
  - J19: Slots 7A - 10B (8 trunks) Table 4-3, page 4-8
  - J20: Slots 11A - 14B (8 trunks) Table 4-4, page 4-9
  - J23: Slots 15A - 16B (4 trunks) Table 4-5, page 4-10
- Model 2540EX Expansion Chassis (10 trunk cards / 20 trunks added)
  - J19: Slots 4A - 7B (8 trunks) Table 4-6, page 4-11
  - J20: Slots 8A - 11B (8 trunks) Table 4-7, page 4-12
  - J23: Slots 12A - 13B (4 trunks) Table 4-8, page 4-13
- RJ21X (802-0263) to RJ66M425 (802-0264) Cross-Wiring
  - RJ66M425 Terminal Block Wiring Layout Figure 4-3, page 4-18
  - Cross-wiring to Zetron Model 49 or telco Table 4-9, page 4-19
  - Cross-wiring to Zetron Model 810 Table 4-12, page 4-20
- RJ66M425 SUGGESTED jack labeling Pages 4-22 through 4-26.
  These labels should agree with Trunk Card Addresses, if the installation technician is careful to insert all trunk cards in ascending order (address), from left to right, in each Model 2540 and/or Model 2540(EX) chassis. Refer to Appendix E: Finished Trunk Wiring Sample.

The Installation Technician will have to cross-wire the Split-Block terminal to the RJ66M425 Terminal for each specific trunk interface. An example is provided on the following page for this End-to-End Loop Start Line configuration.

❑ a. Example:

To connect an MRS804ZX Repeater trunk to the FASTNet Switch Model 2540EX Chassis slot 10B using (or not) the miniature-plug jacks (RJ66M425) provided, do the following:

- a.1 Look at Table 4-7 on page 4-12: Slot 10B

  Since Slot 10B is the seventh slot of the first Expand Chassis, which is also the *seventeenth FASTNet System trunk card slot,* the suggested Address = 17B, and is wired through the Model 2540EX Expansion Chassis **J20 cabling** as noted:

RING	J20-16	Blue w/ yellow Stripe
RING1	J20-17	Orange w/ Yellow Stripe
M	J20-18	Green w/ Yellow Stripe
TIP	J20-41	Yellow w/ Blue Stripe
TIP1	J20-42	Yellow w/ Orange Stripe
E	J20-43	Yellow w/ Green Stripe

- a.2 Program Address (17B) as E&M 4-Wire interface in the Trunk Card Editor and Netbase programming files. Configure per TELCO Feed and Line Type requirements.
- a.3 By observing the simplified schematic (E&M 4-Wire Configuration 024-0089) in Section 2 of this manual, you will note that RING/TIP (To TELCO Audio Pair), RING1/TIP1 (From TELCO Audio Pair), M (From TELCO Supervision), and E (To TELCO Supervision) are ALL required for this interface.

  Install bridge clips onto the center two terminals of the Split-Block Terminal for: J20-7 (RING), J20-32 (TIP), J20-8 (RING1), J20-33 (TIP1), J20-9 (M), and J20-34 (E).

  All six of the trunk lines are utilized for the E&M 4-Wire to MRS804ZX interface of Expand circuit 10B, addressed 17B.

- a.4 Choose the RJ66M425 jack desired (Refer to Suggested Relabeling in Section 4; use J17B to correspond to suggested assigned address 17B) and Punch down the Cross-Connect wires from the Split-Block to the R66M425 Terminal as follows, using the 3-Pair cabling (408-0038) provided with your switch:

Split-Block Terminal (Left Side)	R66M425 Jack (J17B)
RING = J20-16 (-31 from the top)	P1-R:Blue / White stripe
RING1 = J20-17; -33 from top)	P3-R:Orange / White str.
M = J20-18 (-35 from top)	P4-T:Green / White str.
TIP = J20-41 (-32 from top)	P1-T:White / Blue str.
TIP1 = J20-42 (-34 from top)	P3-T:White / Orange str.
E = J20-43 (-36 from top)	P2-R:White / Green str.

- a.5 Install the 6-wire "Modular" TELCO cable (709-7000) from the RJ66M425 jack to the TELCO equipment jack provided by your TELCO CO.

-OR- Ignore step "a.4" above and wire directly from terminations on the left side of the Split-Block (as noted in "a.4" above) to the TELCO terminations provided.

-OR- Ignore step "a.4" and use J2 (rear) of the Audio Daughter Board trunk B on the Dual 4-Wire Card.

❑ 7. Apply power to the FASTNet Switch System. Power-up the Model 2540EX expansion chassis first.

- The Model 2540EX Expansion Chassis power switch is located on the front, left-side of the card cage behind the front cover plate.
- Model 2540 Main Chassis power switch is located on the lower right external side of the chassis cabinet.

❑ 8. Refer to the Adjustment Procedures of Section 4 to set inbound and outbound audio levels for the E&M 4-Wire Type I interface. You will note that two separate procedures are provided for these interfaces:

❑ a. "Voice Prompts Method" in which the technician dials into the FASTNet Switch from an "outside" line, and then executes the "Test Mode" via the Voice Prompt Programming access.

-OR-

❑ b. "Local Computer Method" which allows "Test Mode" access via the Local RS-232C Port of the Model 2540. This method requires outbound dialing from the trunk under test.

❑ 9. After completing the alignment procedure, the E&M 4-Wire Interface to/from the FASTNet Switch is ready for use.

FASTNet Interface to a Zetron Ring Box

❑ 1. Obtain a Model 2540 Dual TELCO Card (702-9457).

Please note that this card actually services TWO (2) FASTNet trunks, and that this installation utilizes only ONE (1) of them.

Also, simplified schematics are provided in Section 2. Some confusion may be averted by studying the DID Configuration Diagram (024-0010) and associated text.

The Zetron Ring Box utilizes the DID hardware, which provides -48V battery, with special Ring Box software parameters in the Trunk Card Editor program to create a unique two-way telephone interface. This provides the FASTNet Site with telephone extensions which are not "line-sharing" with any other users.

❑ 2. Referring to Section 4, set the hardware configurations for the items listed below:

- ❑ a. Dual Trunk Card
  - Trunk Card Address (SW1-4, JP5)
    Correlate address selected to Card Cage Slot and RJ66M425 Jack per the suggested labeling found in Section 4, Relabeling and Appendix E.
  - Dial Click Option Installed if required
  - MF Option installed if required
- ❑ b. Dual TELCO Card (702-9457) Adjustments and Configuration,
  - Matrix Plug Insertion (Trunk type selection)
    In this case, the minuscule "DID" label should be right-reading above J3 (Trunk A) or J4 (Trunk B), at the "bottom" end, when viewed from the front of the Dual TELCO Card assembly.

❑ 3. Program **NETBASE** parameters required by FASTNet Switch to operate trunk card properly.

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 4. Program the **Zetron Trunk Card Editor** data required by the FASTNet Switch to operate this trunk card properly. Some critical parameters include, but are not limited to:

- Trunk Card Address; MUST match hardware setting!
- Trunk Card Type; MUST match trunk card type AND Matrix setting!
- Line Parameters; wink start, etc.
- Trunk Groups

Refer to the *Model 2540 FASTNet Switch Operation and Programming Manual* (Part No. 025-9270) for details.

❑ 5. BE SURE POWER IS OFF:

Install the Dual TELCO Card into the FASTNet card cage. The exact slot used, whether located in the Model 2540 (slots 7-16) or Model 2540EX (slots 4-13), is not critical since these cards utilize parallel bus configurations; EXCEPT that it must be the slot where the TELCO trunk is currently wired, or is desired to be wired at the completion of this process.

❑ 6. Connect the TELCO DID Trunk Line Pair to the FASTNet Switch Card Slot Pair (if not previously done) for the EXACT card slot desired. The detailed wire lists for this function are provided in Section 4 of this manual.

Specifically, the RJ21X Split-Block (802-0263) pin-outs from the card cage slots are defined on the pages noted below:

- 802-0263 RJ21X Split-Block Terminal Layout; Figure 4-1, page 4-15
- Model 2540 Main Chassis (10 trunk cards / 20 trunks maximum)
  - J19: Slots 7A - 10B (8 trunks) Table 4-3, page 4-8
  - J20: Slots 11A - 14B (8 trunks) Table 4-4, page 4-9
  - J23: Slots 15A - 16B (4 trunks) Table 4-5, page 4-10
- Model 2540EX Expansion Chassis (10 trunk cards / 20 trunks added)
  - J19: Slots 4A - 7B (8 trunks) Table 4-6, page 4-11
  - J20: Slots 8A - 11B (8 trunks) Table 4-7, page 4-12
  - J23: Slots 12A - 13B (4 trunks) Table 4-8, page 4-13
- RJ21X (802-0263) to RJ66M425 (802-0264) Cross-Wiring
  - RJ66M425 Terminal Block Wiring Layout Figure 4-3, page 4-18
  - Cross-wiring to Zetron Model 49 or telco Table 4-9, page 4-19
  - Cross-wiring to Zetron Model 810 Table 4-12, page 4-20
- RJ66M425 SUGGESTED jack labeling Pages 4-22 through 4-26.
  These labels should agree with Trunk Card Addresses, if the installation technician is careful to insert all trunk cards in ascending order (address), from left to right, in each Model 2540 and/or Model 2540(EX) chassis. Refer to Appendix E: Finished Trunk Wiring Sample.

The Installation Technician will have to cross-wire the Split-Block terminal to the RJ66M425 Terminal for each specific trunk interface. An example is provided on the following page for this DID Line configuration.

❑ a. Example:

To connect a DID TELCO trunk to the FASTNet Switch Model 2540 chassis slot 7A, using (or not) the miniature-plug jacks (RJ66M425) provided, do the following:

- a.1 Look at Table 4-3 on page 4-8: Slot 7A

  Since Slot 7 is the first card slot of the Main Chassis, which is also the *first FASTNet System trunk card slot,* the suggested address = 1A, and is wired through **J19 cabling** as noted:

RING	J19-1	Blue w/ White Stripe
RING1	J19-2	Orange w/ White Stripe
M	J19--6	Green w/ White Stripe
TIP	J19-26	White w/ Blue Stripe
TIP1	J19-27	White w/ Orange Stripe
E	J19-28	White w/ Green Stripe

- a.2 Program Address (5B) as DID in Trunk Card Editor and Netbase programming files. Configure per TELCO Feed and Line Type requirements.
- a.3 By observing the simplified schematic (DID Configuration 024-0010) in Section 2 of this manual, you will note that ONLY the RING, TIP, +48V, and -48V are required for this interface. Furthermore, the ±48V power is provided by the FASTNet power supply via the backplane.

  Therefore, DO NOT connect RING1, M, TIP1, or E at the Split-Block Terminal with bridge clips, since these are not required.

  Install a bridge clip for J19-1 (RING) and J19-26 (TIP) onto the center two terminals of the Split-Block Terminal. J19-1 is the top terminal; J19-26 is the second one down.

  This will provide TIP and RING circuitry only to the Ring Box / DID trunk on Main Chassis circuit 7A, addressed as 1A.

- a.4 Choose the RJ66M425 jack desired (suggested 5B to match address) and Punch down the Cross-Connect wires from the Split-Block to the R66M425 Terminal as follows, using the 3-Pair cabling (408-0038) provided with your switch:

Split-Block Terminal (Left Side)	R66M425 Terminal (J1A)
RING = J19-1 (TOP Terminal)	P1-R:Blue / White stripe
RING1 = J19-2 (-3 from top)	P3-R:Orange / White str.
M = J19-3 (-5 from top)	P4-T:Green / White str.
TIP = J19-26 (-2 from top)	P1-T:White / Blue str.
TIP1 = J19-27 (-4 from top)	P3-T:White / Orange str.
E = J19-28 (-6 from top)	P2-R:White / Green str.

- a.5 Install the 6-wire "Modular" TELCO cable (709-7000) from the RJ66M425 jack to the TELCO equipment jack.

-OR- Ignore step "a.4" above and wire from the Split-Block RING (J19-4; seventh terminal down, left side) to the TELCO "RING" terminal; then from the Split-Block TIP (J19-29; eighth terminal down, left side) to the TELCO "TIP" terminal. Be sure to install bridging clips (265-0030) across the center terminals of the RJ21X Split-Block (802-0263).

CAUTION: The most common cause for the DID interface to NOT function is the reversal of the TIP and RING wiring, especially if a "Ground Start" configuration is used.

❑ 7. Apply power to the FASTNet Switch System. Power-up the Model 2540EX expansion chassis first.

- The Model 2540EX Expansion Chassis power switch is located on the front, left-side of the card cage behind the front cover plate.
- Model 2540 Main Chassis power switch is located on the lower right external side of the chassis cabinet.

❑ 8. Refer to the Adjustment Procedures of Section 4 to set inbound and outbound audio levels for the E&M 4-Wire Type I interface. You will note that two separate procedures are provided for these interfaces:

❑ a. "Voice Prompts Method" in which the technician dials into the FASTNet Switch from an "outside" line, and then executes the "Test Mode" via the Voice Prompt Programming access.

-OR-

❑ b. "Local Computer Method" which allows "Test Mode" access via the Local RS-232C Port of the Model 2540. This method requires outbound dialing from the trunk under test.

❑ 9. After completing the alignment procedure, the E&M 4-Wire Interface to/from the FASTNet Switch is ready for use.

8. APPENDICES

APPENDIX A: SUGGESTED TEST EQUIPMENT

1. AC Voltmeter having sensitivity down to 0.01 Volts True rms at 1 KHz.
   May use Analog or Digital multi-meter calibrated in Volts (Vrms) or Decibels (dB).
2. Audio Oscillator with isolation circuit as illustrated in Figure 8-1:

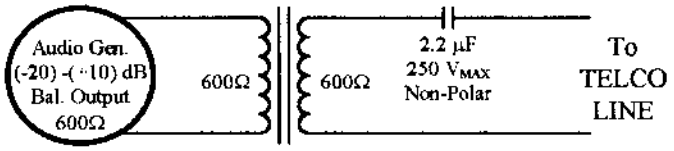


Figure 8-1: Audio Generator With Isolation

3. Telephone Test Set connected to an outside TELCO line to enable dialing into specific FASTNet Trunks.

   This should be a "Lineman's" type of test set which can clip onto the RJ21X terminal block of the FASTNet Switch system, provide DTMF and pulse dialing, receive audio (earpiece), and transmit audio (microphone).

   An outside line may be a line not 'presently' under test, and having associated bridge clips removed from the RJ21X Split-Block (which thereby isolates the line from the FASTNet Switch).

4. A quiet termination line which may be called from FASTNet.
   This may be a specific CO Test Number (which you may or may not be successful at coercing from your local TELCO Service Technician),

-OR-

   You can remove the microphone (transmitter) element from a telephone connected to an outside End-End Loop Start TELCO line (which you know the telephone number of).

5. Adjustment Tools:
   - 1/8" Slotted Screwdriver
   - Subminiature Potentiometer Alignment Tool (Zetron #108-0000)
6. Oscilloscope: 60 MHz (Minimum BW) Dual Trace with two 10X probes is best for troubleshooting RF/Audio systems.
7. FASTNet Switch Extender Card: Zetron Number 702-9087
8. TELCO Punch Down Tool: Zetron Number 280-0002 or equivalent
   Used for punching single wires into the RJ21X Split-Block terminals.
9. 8-Wire Modular Cable BreakOut Adapter
   Siemon MODAPT or equivalent (Available from GrayBar, Inc.).

APPENDIX B: FASTNET ASSEMBLY PART NUMBERS

Model 2540 Chassis Assembly

IBM-PC Bus Backplane (Top)	702-9072
Z-Bus Backplane (Bottom)	702-9497
Enclosure	815-9121
Enclosure Front Panel	815-9120
48 VDC Power Supply	702-9339
SCSI Hard Drive	Refer to Voice Storage Options
Modem Card	802-0039
Zetron CPU	702-9456
1 Meg Additional RAM	950-9161
ADPCM Voice Card	702-9459
4 Additional ADPCM Voice Channels	950-9063
Expand Card (Option)	702-9458

Model 2540EX Chassis Assembly

IBM-PC Bus Backplane (Top)	702-9219
Z-Bus Backplane (Bottom)	702-9510
Enclosure	815-9123
Enclosure Front Panel Assembly	815-9122
48 VDC power Supply	702-9339
Expand Card (Option)	702-9458

Trunk Cards and Options

Dual TELCO Card	702-9457A
Matrix Card, Standard (for DUAL TELCO Card configuration)	702-9122C
Dual Dial Click Decoder Card	702-9119C
Dual MF Decoder Card	702-9197B.1
Dual 4-Wire Card	702-9460D
Audio Daughter Board:	
With one configuration jumper	702-9319A.1
With six configuration jumpers	702-9319B
Dual Dial Click Decoder Card	702-9119C
Dual MF Decoder Card	702-9197B.1

Voice Storage Options

NOTE: The following lists do NOT include misc. mounting hardware.

2 Hour Storage: Hard Card Assembly	815-9127
6 Hour Storage 950-9404 includes:	
SCSI Hard Drive Adapter	802-0850
Ribbon Cable Assembly	709-7092
Hard Drive: 170 Mb	802-1240
Hard Drive Power Cable Assembly	709-7048
12 Hour Storage 950-9332 includes:	
SCSI Hard Drive Adapter	802-0850
Ribbon Cable Assembly	709-7092
Hard Drive: 234 Mb	802-0241
Hard Drive Power Cable Assembly	709-7048
24 Hour Storage 950-9333 includes:	
SCSI Hard Drive Adapter	802-0850
Ribbon Cable Assembly	709-7092
Hard Drive: 422 Mb	802-0240
Hard Drive Power Cable Assembly	709-7048
1 Mb CPU RAM Kit (9 ea. 321-1000 RAM IC)	950-9161
48 Hour Storage 950-9336 includes:	
SCSI Hard Drive Adapter	802-0850
Ribbon Cable Assembly	709-7092
Hard Drive: 1 Gb	802-0238
Hard Drive Power Cable Assembly	709-7048
1 Mb CPU RAM Kit (9 ea. 321-1000 RAM IC)	950-9161

Options and Accessories

FASTNet Quick Reference Card		(100 ea./pkg)	950-9438
FASTNet Custom Wiring Harness Kit			950-9385
Includes:			
J19, J20, J23 Cables to Split-Block	(3 used)		709-0004
RJ21X Split-Block Terminal Assembly	(3 used)		802-0263
RJ66M425 Terminal Block	(2 Used)		802-0264
(Miniature Keyed Jack (12) Bank to Punch-Down)			
TELCO 3-Pair 24 AWG Soft Copper Wire			408-0038
(1200" = 100' = 5' per each of 20 trunks)			
(Used for cross-connecting RJ21X to RJ66M425)			
Signal Grounding Wire (GreeN, 16 AWG)	(480")		408-1608
(480" = 40')	Ring Terminal on one end		401-0156
Wire Distribution Spool	(4 used)		265-0041
(used to route wire at corners)			
8 x 3/4" Wood screw, Rnd Head Phil.	(14 pcs)		220-0216
Punch-Down Tool (NOT spring-loaded type)			280-0002
Bridge Clips	(200 pcs)		265-0030

FASTNet Lightning Protection Kit	950-9040C
(Sufficient for secondary protection)	
Model 2540 Floor Mounts Kit	950-9064B
Model 2540 Wall Mounts Kit	950-9081A
Signal Grounding Wire	408-1608
(Included in FASTNet Wiring Harness Kit)	
Ring Terminal for Signal Grounding Wire	401-0156
(Included in FASTNet Wiring Harness Kit)	
Card Cage Extender Card	702-9087
TELCO Punch-Down Tool (NOT spring-loaded type)	280-0002
(Included in FASTNet Wiring Harness Kit)	
Bridge Clips (200) for Split-Block Terminals	265-0030
"Modular" 6-Wire TELCO Cable (10')	709-7000

APPENDIX C: POWER CONVERSION TABLE FOR 600Ω LOAD

Power		Single Tone		Dual Tone	
(dBm)	(mW)	(V_{P-P})	(V_{RMS})	(V_{P-P})	(V_{RMS})
10	10.00	6.93	2.45	9.80	3.47
9	7.94	6.17	2.18	8.73	3.09
8	6.31	5.50	1.95	7.78	2.75
7	5.01	4.90	1.73	6.94	2.45
6	3.98	4.37	1.55	6.18	2.19
5	3.16	3.90	1.38	5.51	1.95
4	2.51	3.47	1.23	4.91	1.74
3	2.00	3.09	1.09	4.38	1.55
			(mV_{RMS})		
2	1.59	2.76	975	3.90	1.38
1	1.26	2.46	869	3.48	1.23
	(µW)				
0	1,000.00	2.19	775	3.10	1.10
					(mV_{RMS})
-1	794.3	1.95	690	2.76	976
-2	631.0	1.74	615	2.46	870
-3	501.2	1.55	548	2.19	774
-4	398.1	1.38	489	1.96	693
-5	316.2	1.23	436	1.74	615
-6	251.2	1.10	388	1.55	548
		(mV_{P-P})			
-7	199.5	979	346	1.38	488
-8	158.5	872	308	1.23	435
-9	125.9	777	275	1.10	389
				(mV_{P-P})	
-10	100.0	693	245	980	347
-12	63.1	550	195	778	275
-14	39.8	437	155	618	219
-16	25.1	347	123	491	174
-18	15.9	276	97.5	390	138
-20	10.0	219	77.4	310	110
-22	6.31	174.0	61.5	246	87.0
-24	3.98	138.2	48.9	196	69.3
-26	2.51	109.8	38.8	155	54.8
-28	1.59	87.2	30.8	123	43.5
-30	1.00	69.3	24.5	98.0	34.7

APPENDIX D: HEXADECIMAL/BINARY/DECIMAL EQUIVALENCY TABLE

Decimal Number	Binary Equivalent	Hexadecimal
0	0000 0000	00
1	0000 0001	01
2	0000 0010	02
3	0000 0011	03
4	0000 0100	04
5	0000 0101	05
6	0000 0110	06
7	0000 0111	07
8	0000 1000	08
9	0000 1001	09
10	0000 1010	0A
11	0000 1011	0B
12	0000 1100	0C
13	0000 1101	0D
14	0000 1110	0E
15	0000 1111	0F
16	0001 0000	10
17	0001 0001	11
18	0001 0010	12
19	0001 0011	13
20	0001 0100	14
21	0001 0101	15
22	0001 0110	16
23	0001 0111	17
24	0001 1000	18
25	0001 1001	19
26	0001 1010	1A
27	0001 1011	1B
28	0001 1100	1C
29	0001 1101	1D
30	0001 1110	1E
31	0001 1111	1F
32	0010 0000	20

APPENDIX E: FASTNET SWITCH FINAL WIRING LIST SAMPLE

This appendix is provided to clarify and summarize the total scope of the sophisticated FASTNet Switch. This appendix contains a compilation of all that is discussed in Section 7. Please refer to Section 7 for explanations.

The table on the following page is a compilation of data from Sections 3, 4, and 7. Each of the examples from Section 7 has been mapped in this table. A similar table would be useful to the system planner/designer/installer of the FASTNet System at the final site.

If you need assistance, please call Zetron at (206) 820-6363.

Color abbreviations used in the table are as follows:

Note: The color which is listed second in each pair [in the table] is the stripe color.

BLU = Blue

BRN = Brown

GRN = Green

ORG = Orange

RED = Red

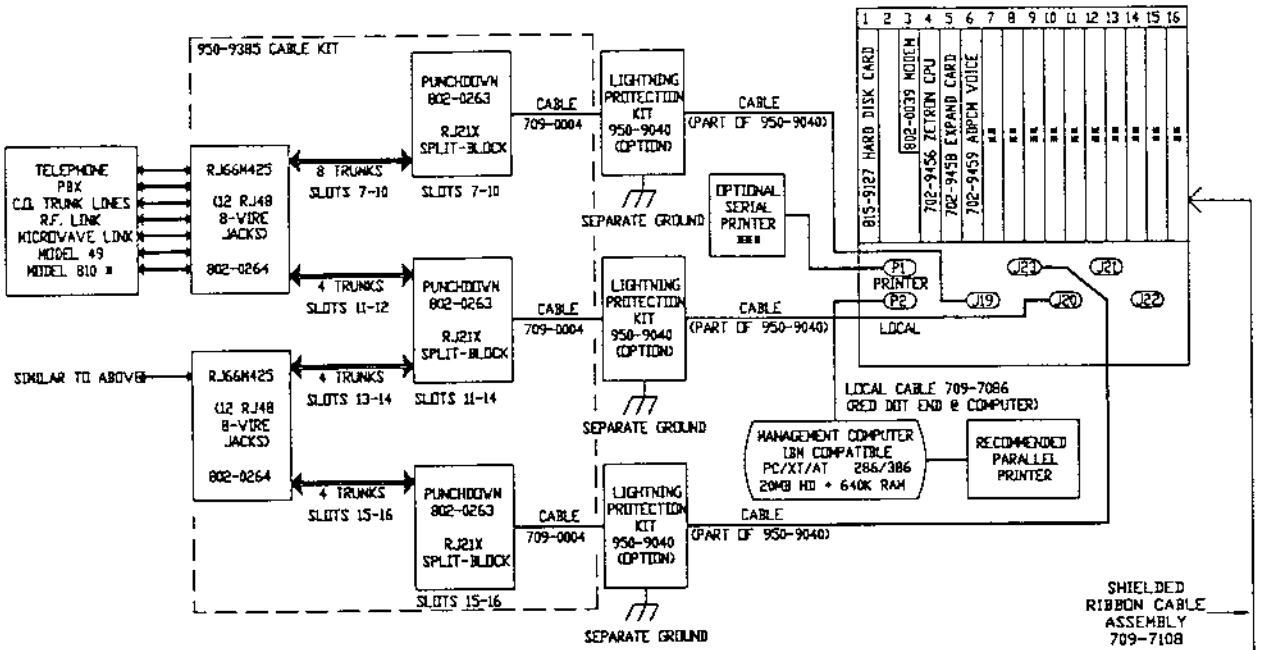
SLA = Slate (gray)

WHI = White

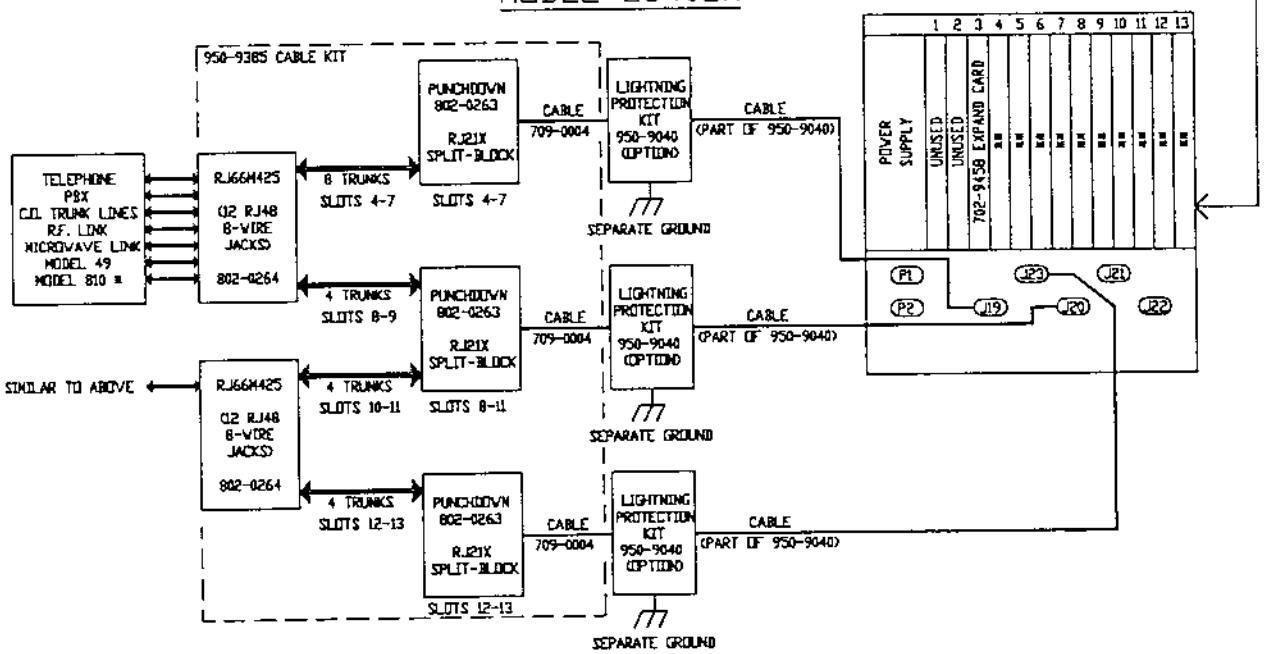
YEL = Yellow

Page	Trunk Interface Type			RJ66M425 (802-0264)				RJ21X Split-Block (802-0263)		
No.	Label	Card Slot	Line	Jack	Pair	Line	Crossover	Trunk Addr.	Line	Wire Color
7-16	TELCO DID Line	11B Main Chassis DUAL TELCO DID	RING TIP 	J5B	P1-R P3-R P4-T P1-T P3-T P2-R	RING RING1 M TIP TIP1 E	BLU / WHI ORG / WHI GRN / WHI WHI / BLU WHI / ORG WHI / GRN	5B	RING RING1 M TIP TIP1 E	BRN / WHI SLA / WHI BLU / RED WHI / BRN WHI / SLA RED / BLU
7-20	TELCO End-to-End Loop Start Line	5A Expand Chassis DUAL TELCO E-E	RING TIP 	J12A	P1-R P3-R P4-T P1-T P3-T P2-R	RING RING1 M TIP TIP1 E	BLU / WHI ORG / WHI GRN / WHI WHI / BLU WHI / ORG WHI / GRN	12A	RING RING1 M TIP TIP1 E	ORG / RED GRN / RED BRN / RED RED / ORG RED / GRN RED / BRN
7-24	TELCO Type I E&M 4-Wire (DID/DOD)	9A Expand Chassis DUAL 4-WIRE	RING RING1 M TIP TIP1 E	J16A	P1-R P3-R P4-T P1-T P3-T P2-R	RING RING1 M TIP TIP1 E	BLU / WHI ORG / WHI GRN / WHI WHI / BLU WHI / ORG WHI / GRN	16A	RING RING1 M TIP TIP1 E	ORG / RED GRN / RED BRN / RED RED / ORG RED / GRN RED / BRN
7-28	Zetron Model 810 End-to-End Option	7B Main Chassis DUAL 4-WIRE	RING RING1 M TIP TIP1 E	J1B	P3-T P1-T P2-R P3-R P1-R P4-T	RING RING1 M TIP TIP1 E	BLU / WHI ORG / WHI GRN / WHI WHI / BLU WHI / ORG WHI / GRN	1B	RING RING1 M TIP TIP1 E	BRN / WHI SLA / WHI BLU / RED WHI / BRN WHI / SLA RED / BLU
7-32	Zetron Model 49 E&M 4-Wire	13A Expand Chassis DUAL 4-WIRE	RING RING1 M TIP TIP1 E	J20A	P1-R P3-R P4-T P1-T P3-T P2-R	RING RING1 M TIP TIP1 E	BLU / WHI ORG / WHI GRN / WHI WHI / BLU WHI / ORG WHI / GRN	20A	RING RING1 M TIP TIP1 E	ORG / RED GRN / RED BRN / RED RED / ORG RED / GRN RED / BRN
7-36	Uniden MRS804ZX Repeater E&M 4-Wire	10B Expand Chassis DUAL 4-WIRE	RING RING1 M TIP TIP1 E	J17B	P1-R P3-R P4-T P1-T P3-T P2-R	RING RING1 M TIP TIP1 E	BLU / WHI ORG / WHI GRN / WHI WHI / BLU WHI / ORG WHI / GRN	17B	RING RING1 M TIP TIP1 E	BLU / YEL ORG / YEL GRN / YEL YEL / BLU YEL / ORG YEL / GRN
7-40	Zetron Ring Box	7A Main Chassis DUAL TELCO DID	RING TIP 	J1A	P1-R P3-R P4-T P1-T P3-T P2-R	RING RING1 M TIP TIP1 E	BLU / WHI ORG / WHI GRN / WHI WHI / BLU WHI / ORG WHI / GRN	1A	RING RING1 M TIP TIP1 E	BLU / WHI ORG / WHI GRN / WHI WHI / BLU WHI / ORG WHI / GRN

APPENDIX F: TOTAL FASTNET SWITCH DIAGRAM



MODEL 2540EX



NOTES:
* MODEL 810 MAY INTERFACE TO C.O. TRUNKS, RF OR MICROWAVE LINKS, ETC. ON SIDE OPPOSITE RJ66M425.
** TRUNK CARDS MAY BE (A) DUAL TELCO 702-9457 OR (B) DUAL 4-WIRE 702-9460.

024-0099A

APPENDIX G: E&M TYPE II INTERFACE TO FASTNET

The FASTNet Switch is designed to be compatible with E&M Type I circuits via either the Dual TELCO Card E&M 2-Wire configuration, or the Dual 4-Wire Card E&M 4-Wire configuration. Type I E&M circuitry utilizes *ground-referenced* circuitry for supervision signaling on the "E" and "M" leads. Since the earth ground serves as signal reference level, it is critically important that a good ground connection be established at the telco termination equipment, or else the supervision signaling may nor be detectable.

Type I signaling is typically six wires, plus a chassis ground:

- E Lead = To-TELCO supervision (1 wire);
- TIP/RING = To-TELCO audio pair (2 wires);
- TIP1/RING1 = From-TELCO audio pair (2 wires);
- M Lead = From-TELCO supervision (1 wire).

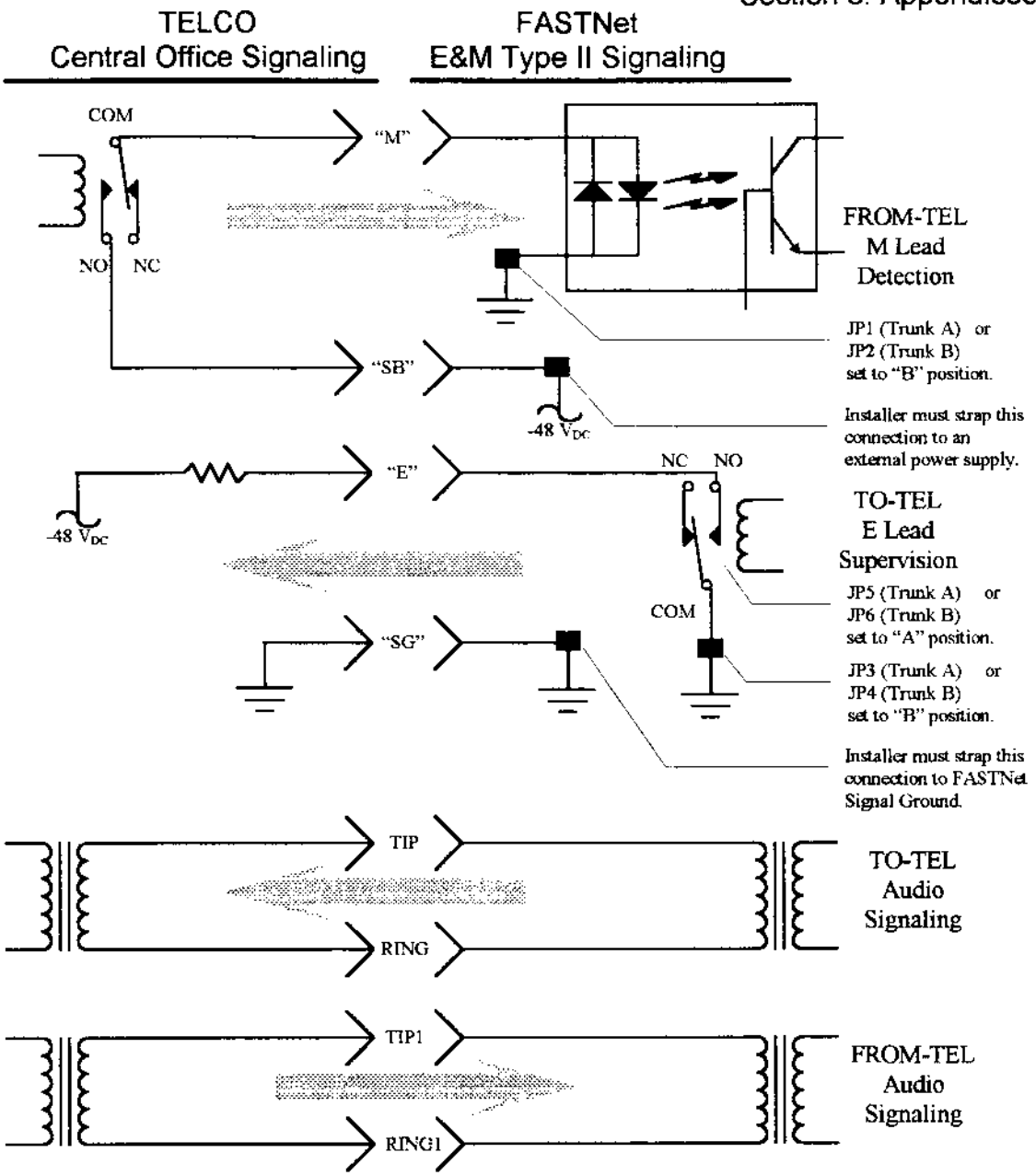
Type II E&M supervision signaling is *NOT* ground-referenced, but instead uses a pair of wires for "E" signaling, and a pair of wires for "M" signaling. Consequently, Type II interface circuits utilize 8 wires:

- E / SG pair = To-TELCO supervision (2 wires);
- TIP/RING = To-TELCO audio pair (2 wires);
- TIP1/RING1 = From-TELCO audio pair (2 wires);
- M / SB pair = From-TELCO supervision (2 wires).

A typical Type II E&M circuit is wired as illustrated in Figure 8-2: Type II E&M Interface to FASTNet. This interface requires an external -48 V_{DC} power supply to enable the "M" lead signaling from telco. Additionally, the "E" lead signaling requires that the "SG" ground reference be connected to the FASTNet signal ground.

In the rare event that the telco lines experience problems from being connected together at the FASTNet chassis, the installation technician will then be required to install external drive relays for the E / SG signaling. These will require a power supply, suitable for the total voltage and current requirements of the relays selected. Connect them as follows:

- Configure FASTNet per Figure 8-2 of this appendix.
- Connect the NO relay contact to the "E" lead
- Connect the COM relay contact to the "SG" lead.
- Connect one side of the relay coil to the external power supply (+).
- Connect the other side of the relay coil to the FASTNet "E" lead.
- Connect the external power supply (-) to the FASTNet chassis ground.



Notes: 1. The FASTNet Jumpers noted above are shown for Rev B Audio Daughter Boards.
2. Rev A Audio Daughter Boards require JP1 set to position "B". (This sets BOTH trunks)

Figure 8-2: Type II E&M Interface to FASTNet

APPENDIX H: MODEL 49 AND MRS804ZX PERFORMANCE IMPROVEMENTS

The information provided in this appendix will significantly improve overall system signaling levels and performance for FASTNet users, particularly where DTMF overdialing into telco lines may have been a problem for some system users . The system operator's modem access to the Model 49 through FASTNet should also be subsequently improved.

Model 49 Rev H-Q Models

Verify that the following resistor values are installed into the Main Board. Figure 8-3 shows the approximate board locations of these resistors.

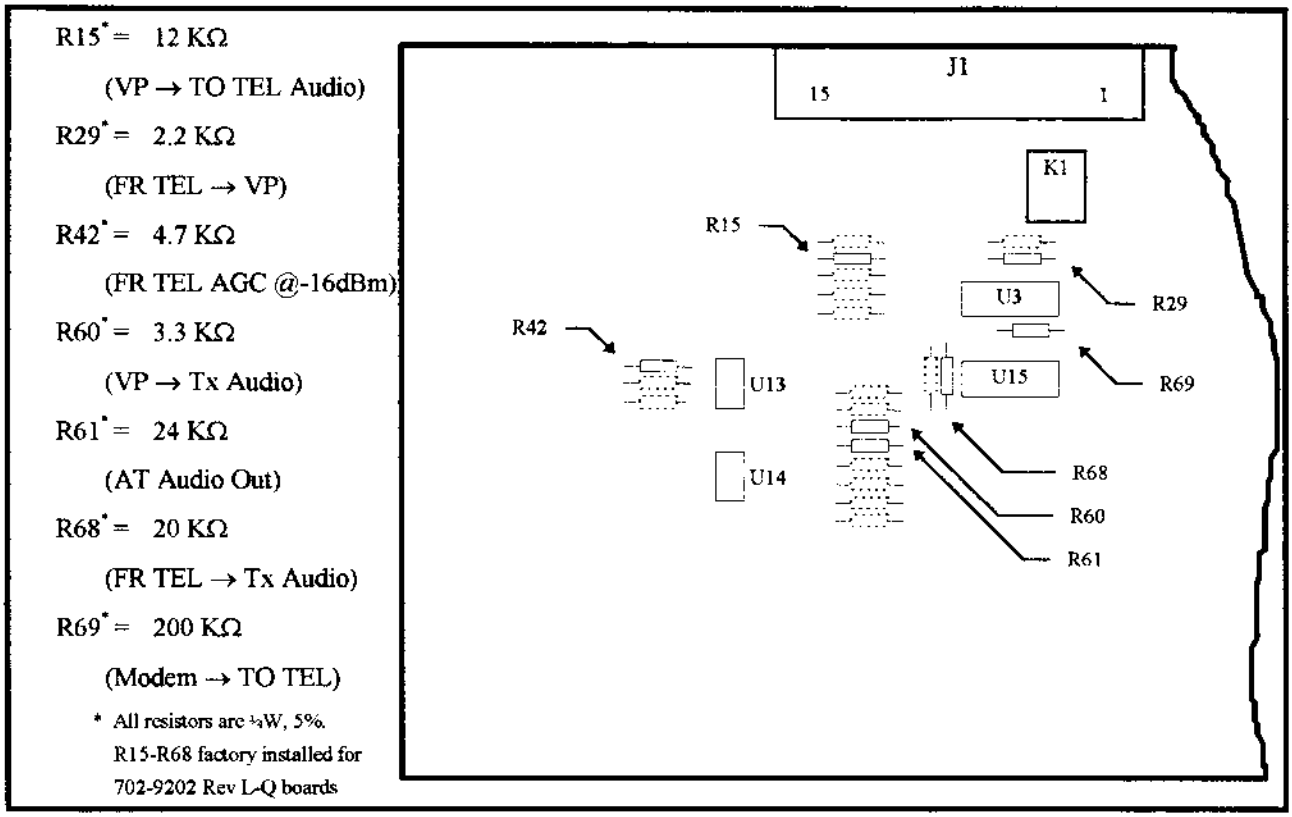


Figure 8-3: Model 49 Rev H-Q Resistor Locations

Additionally, if using the optional Compandor Card, and the Compandor Card is Rev A or B, then remove R11 & R16, and replace R1 with a 10 KΩ, ¼W, 5% resistor.

Model 49 Rev S-X Models

R75 must be replaced as noted in to increase audio output to the phone line. R96 must be replaced to ensure a 1:1 ratio for repeat audio input/output.

Model 49 operators subject to FCC (USA) control must use the telco power limiter circuitry to comply with Part 68 of the FCC regulations. This circuit allows for occasional audio peaks above 0 dBm to be transmitted down phone lines, but sustained high level signals must be decreased (≈10 dBm) by the power limiter. Model 49 operators should correct the power limiter delay timing (from 0.5 sec to 1.5 sec) by replacing C11 as noted in Figure 8-4.

Model 49 operators outside of the jurisdiction of the FCC (USA) may not need to utilize the telco power limiter circuitry (TO TEL). This circuit can be defeated as noted in Figure 8-4.

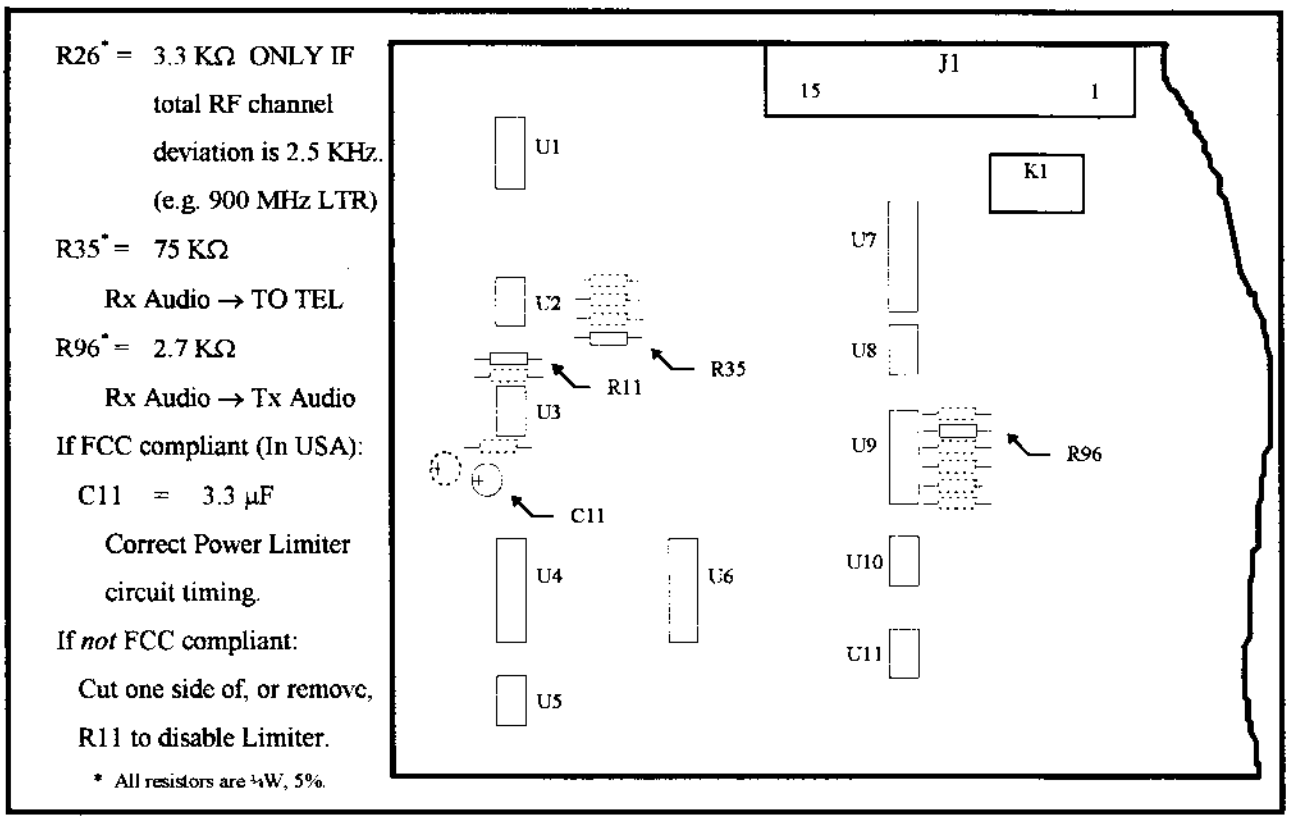


Figure 8-4: Model 49 Rev S-X Resistor Locations

Pre-Setting Model 49 Rev S+ Tone Generator Levels

In order to make the prompt tone levels track the voice levels in a realistic manner, please follow this procedure carefully.

❑ 1. Verify that the Model 49 *software* tone levels are set to maximum:

(Edit49 / Site config / Edit Prompts = (Y) / 1. Welcome Message = **7**, *AND*

Edit49 / Site config / Edit Prompts (Y) / 3. Thank You, Ringing = **7**)

Update the Model 49 if necessary …

❑ 2. Verify that the hardware components specified in Appendix H have been installed into the Model 49 units.

❑ 3. Place Model 49 into *Test Mode* by placing SW1-1 up, press and hold the CONNECT/DISCONNECT switch for about 2 seconds until the LEDs flash.

Note: If SW1-2 is up, the repeater transmits BUSY ID code 253; If SW1-2 is down, TEST ID is transmitted.

- Once into test mode, each double-press of the CONNECT/DISCONNECT switch steps (rotates) to the next "test mode"(1, 2, 3, 4, 1, …). Double-pressing the switch too frequently resets the Model 49 logic - wait 5 seconds between mode selections.

Test Mode 1: Transmit Zetron Ringing with Data

Test Mode 2: Transmit Data Only

Test Mode 3: Transmit 1 KHz Test Tone with Data

Test Mode 4: Transmit 1 KHz Test Tone Only

❑ 4. Pre-Set TX TONE potentiometer level: (Skip if already done)

Step to Test Mode 3 or 4 (1 KHz with or w/o data). Monitor U7 pin 14 and set the *TX TONE* level to 1.95 V_{P-P} (-1 dB; 794 mV_{RMS}). Seal the *TX TONE* pot using tape, glyptol, nail polish, etc. *Do not further adjust this pot.*

❑ 5. Pre-set PH TONE potentiometer level: (Skip if already done)

- While the Model 49 is still in Test Mode, short the Model 49 E-Lead (pin 1 of J1/J2 on the E&M Card) to ground (chassis) briefly, using a jumper wire or clip lead, etc. *This will make the Model 49 "answer" the faked inbound call from FASTNet and drop into the Model 49 Telco Test Mode*. This is similar to the Tx Test Mode except that the tones into the phone line (TO TEL) are as follows:

Telco Test Mode 1: 600 Hz steady sinewave tone TO TEL

Telco Test Mode 2: 1 KHz Hz steady sinewave tone TO TEL

Telco Test Mode 3: 2.5 KHz Hz steady sinewave tone TO TEL

Telco Test Mode 4: silence TO TEL

Select Telco Test Mode 2 and proceed. Look at TP11 with an oscilloscope or frequency counter to determine the 1 KHz (t = 1 msec) frequency mode.

- ❑ 5.a With FCC Power Limiter operational in the Model 49:
  - Set the Model 49 *TO TEL* fully clockwise for maximum output.
  - Be sure limiter is active by adjusting *PH TONE* up from minimum until the limiter decreases the level, then set to 0.5 V_{P-P} at TP11 (177 mV_{RMS}). Seal the *PH TONE* pot using tape, glyptol, nail polish, etc. *Do not further adjust this pot.*

- ❑ 5.b w/o FCC Power Limiter circuit:
  - Set the Model 49 *TO TEL* fully clockwise for maximum output.
  - Adjust *PH TONE* up from minimum until 3 V_{P-P} (1.06 V_{RMS}) is measured at TP11. Seal the *PH TONE* pot using tape, glyptol, nail polish, etc. *Do not further adjust this pot.*

❑ 6. Return DIP switches B-1,2 of the Model 49 to their original positions and reset the unit to normal operational mode. This concludes the Model 49 level pre-setting.

MRS804ZX Repeaters

These changes apply to all MRS804ZX Repeater ARX800B Control Boards, Rev.A-E.5. The units will function without these changes in 800 MHz operation, but will yield improved audio performance with these minor changes.

On the ARX800BZ Main Board, R18 ensures Rx/Tx repeat audio levels are 1:1. R66 corrects compandored audio levels vs non-compandored levels to be equal. These modifications are shown in

ARX790 Interconnect Boards require R91 be replaced to correct prompt tone and DTMF levels relative to voice levels for TO TEL signaling. This may have been performed previously. The location and value for R91 are indicated in Figure 8-6.

MRS804ZX operators subject to FCC (USA) control must use the telco power limiter circuitry on the ARX790 Card to comply with Part 68 of the FCC regulations. This circuit allows for occasional audio peaks above 0 dBm to be transmitted down phone lines, but sustained high level signals must be decreased (≈10 dBm) by the power limiter. MRS804ZX operators having Rev A-F ARX790 cards should correct the power limiter operation by replacing R105 and rewiring as noted in Figure 8-6. The board revision is the letter following the 702-9398 part number written along the left rear edge of the card, visible with the repeater drawer pulled out.

MRS804ZX operators outside of the jurisdiction of the FCC (USA) may not need to utilize the telco power limiter circuitry (TO TEL). This circuit can be defeated by jumpering R108 of the ARX790 card with a wire (power off), as noted in the text of Figure 8-6.

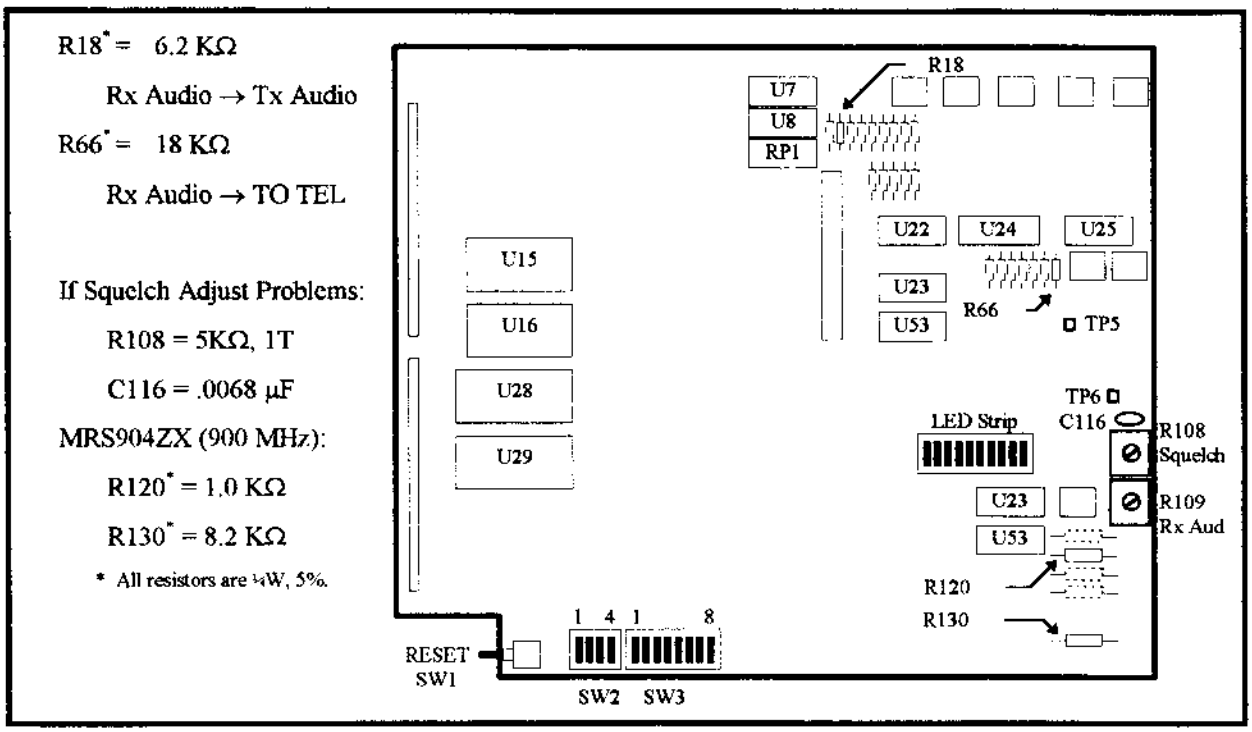


Figure 8-5: MRS804ZX Repeater, ARX800BZ Main Board

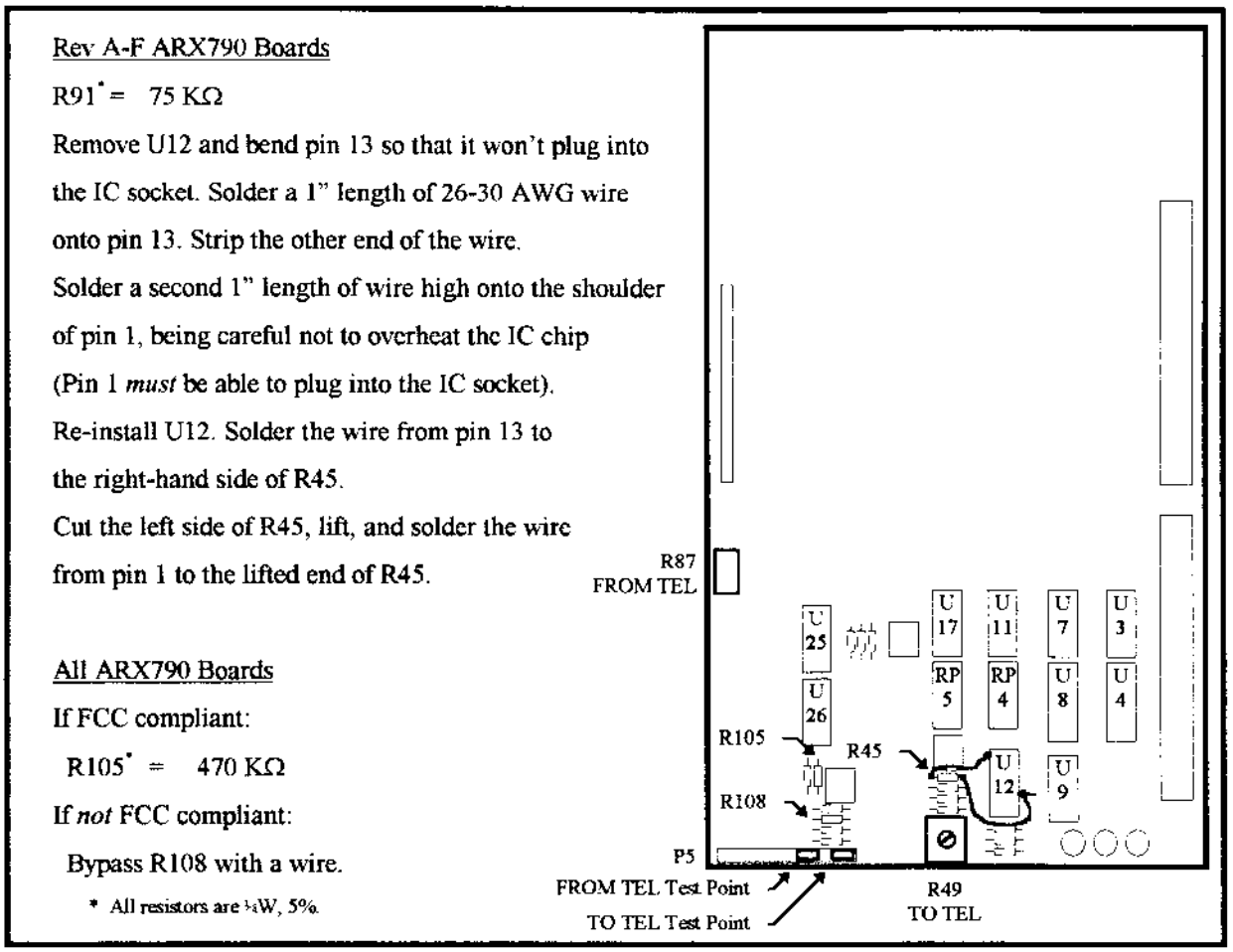


Figure 8-6: MRS804ZX Repeater, ARX790 Interconnect Board

MRS904ZX Repeaters

For 900 MHz applications, the ratio of *audio : data* is lower, requiring the receive audio squelch circuitry to be modified slightly, as noted in Figure 8-5. Replacing R108 and C116 will increase the squelch sensitivity, while replacing R120 and R130 will increase the Receive Audio sensitivity.

Transmit signal level changes for 900 MHz signalling are handled adequately by the Transmit Exciter Module adjustments.

CHANGE INFORMATION

At Zetron, we continually strive to improve our products by updating hardware components and software as soon as they are developed and tested.

Due to printing and shipping requirements, this manual may include information about the latest changes on the following pages.