OPERATING MANUAL

MODEL PK-90 PACKET RADIO CONTROLLER

ADVANCED ELECTRONIC APPLICATIONS, INC

PREFACE TO THE PK-90 PACKET RADIO CONTROLLER MANUAL

Please read this preface in its entirety. It contains information about how to receive warranty service from AEA, the current software installed in your PK-90, AEA's software update policy and how to get involved in the digital radio community.

RF Interference Information To User

This PK-90 has been certified under Subpart J of Part 15 of the FCC rules.

This equipment generates and uses radio frequency energy. If it is not installed and used properly, that is, in strict accordance with AEA's instructions, it may cause interference to radio and TV reception. It has been type-tested and has been found to comply with the limits of a Class B computing device in accordance with the specifications in Subpart J of Part 15 of the FCC rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or TV reception, which can be determined by turning the PK-90 on and off, the user is encouraged to try and correct the interference using one or more of the following measures:

- Reorient the antenna of the device receiving interference.
- Relocate the computer with respect to this device.
- Plug the computer into a different outlet so the computer and the device are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/TV technician for additional suggestions. The user may find 'How to Identify and Resolve Radio-TV Interference Problems,' a booklet prepared by the FCC, helpful.

USE SHIELDED CABLE FOR ALL RS-232 CONNECTIONS

As part of its continuing program of product improvement, AEA reserves the right to make changes in this product's specifications. Changes will be made periodically to the information in this document. These changes will be incorporated in new issues of this manual.

There may be technical inaccuracies or typographical errors in this document. Please address comments and corrections to AEA Incorporated, PO Box C2160, Lynnwood, WA 98036-0918. AEA reserves the right to incorporate and issue any information thus supplied in whatever manner it deems suitable without incurring any obligations whatever.

THIRD ISSUE (DECEMBER 1987)

Welcome

Congratulations on your purchase of another fine AEA product.

PLEASE COMPLETE AND RETURN the Warranty Registration Card packed with your PK-90 system.

AEA WILL NOT BE ABLE TO FURNISH YOU WITH ANY UPDATES TO THE SOFTWARE IF YOU DO NOT RETURN THE ABOVE DOCUMENT. AS NEW FEATURES ARE DEVELOPED, WE ARE SURE YOU WILL WANT TO BE ABLE TO OBTAIN THEM.

If you call for any kind of customer assistance, we will ask for the serial number on your warranty card. Because of the numerous situations in which our product is used by an unauthorized third party, we MUST verify that you are the licensed user. We may choose to call you at the phone number listed in our records to verify your identity. THANK YOU for your patience.

Product Update Policy

From time to time AEA will make available updates to the design of its products. These sometimes are made available to the user who has previously purchased its products. We can only tell you about these updates if we have your warranty card. PLEASE SEND IT IN If you have not already done so. Future versions of software for the PK-90 will most likely become available. AEA will make these updates available, if possible.

In Case of Trouble

Application and troubleshooting assistance may be had by calling AEA during our 8-12, 1-4:30 working hours in Seattle WA. Ask for the Customer Service Department. The phone number is (206) 775-7373. Please have your product serial number, and version date of the software available. The version date is on the first screen that comes up when you turn on the PK-90. We will also need to know the nature of any other equipment connected to the PK-90.

Please attempt to solve problems locally or ask an AEA dealer. Substituting a PK-80 or other TNC that you know is working properly for your questionable one is a diagnostic technique that will check out the rest of your station. Also try running your PK-90 in another station.

Many of the AEA products that are sent to us for repair are in perfectly good order when we receive them. Please perform whatever steps are applicable from the information on installation and troubleshooting.

If you call for assistance, please have your PK-90 configured and operating near the phone. Our service technician may ask you to perform certain keyboard routines to aid in diagnosis. If you have a voltmeter handy, you might have the PK-90 open so you can report measurements to the service technician.

PLEASE DO NOT RETURN THE PK-90 TO US WITHOUT FIRST CONTACTING US FOR PERMISSION. WE WOULD LIKE THE OPPORTUNITY TO TROUBLESHOOT THE PROBLEM OVER THE PHONE FIRST, SAVING YOU BOTH TIME AND MONEY.

If you return the PK-90 to us by United Parcel Service or other freight carriers, the PK-90 must be sent to our street address, not to our post office box number. Our street address is:

AEA. Inc.
2006 196th St. SW
Lynnwood, WA 98036
USA

We will need YOUR street address for proper return shipment. Be sure to include your shipping or mailing address.

For domestic customers, United Parcel Service Surface (Brown Label) takes 7-8 days; Blue takes 2-3 days and Red is presently available on the West Coast only. Red is an expensive overnight service. Send the PK-90 in a way that it can be traced if we cannot verify receipt of shipment. We suggest United Parcel Service, Federal Express or insured postal shipment.

If the PK-90 is still under the original owners warranty, AEA will pay the cost of the return shipment. The current policy is that it will be returned UPS Brown if received Brown or by US Mail; returned UPS Blue if received Blue or by overnight service; or returned as the owner states in his letter if he furnishes the return cost for the method he selects.

If the PK-90 is out of warranty, it will be returned by UPS Brown COD unless: 1) It was received UPS Blue/Red in which case it will go back UPS Blue COD, or 2) If you designate billing to VISA or MASTERCARD, or 3) you enclose a BLANK personal check endorsed 'not to exceed ...$,' or 4) you specify some other method of return.

We will typically service the product in two or three days if we have all the facts. It may take longer if we must call you. PLEASE, if you send it in, include a letter stating the problem and where you can be reached. If you can be reached by phone in the evening on the East Coast, let us know where. Our current rate for out-of-warranty service is $40/hour with a 3/4 hour minimum. Parts and shipping are extra.

AEA is not responsible for damage such as caused by lightning, nonprofessional alterations, poor storage/handling, etc.

Should your warranty card not be on file at AEA, you need to send the proof of purchase date to receive warranty service. Typically a copy of your bill of sale from an AEA dealer will suffice.

The warranty is for the original owner only and is not transferable.

INTRODUCTION

Welcome to the world of digital radio! Your AEA PK-90 Packet Radio Controller is the connection between your computers and radios. The PK-90 performs all functions required to establish and maintain packet radio data and text communications between your station and many other packet communication facilities.

Acknowledgement

AEA, Inc. gratefully acknowledges the Tucson Amateur Packet Radio Corporation, Tucson, AZ, for permission to include excerpts from their TNC-2 documentation in this manual, and to Mike Chepponis and Phil Karn for their specifications for the KISS code.

Norm Sternberg and Barbara Argilo developed, wrote and edited this Operating Manual on Tandy 1000HD/SX computers with IBM's Display-Write 3 V1.1 program. Our thanks to Dr. Alan Chandler, John Gates, Steve Stuart, Andy Madsen, Steve Zopfi, Joe Schimmel, Jeff Jacobsen, Brian Riley, Phil Karn and Mike Chepponis for their invaluable help.

AEA, Inc. dedicates itself to the advancement of digital radio communications.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The PK-90 Operating Manual describes the general characteristics and operation of your AEA PK-90 Packet Radio Controller. This Operating Manual will help you to install, adjust and operate the system.

1.1.1 Scope

The Operating Manual provides detailed information on installation and operation of the PK-90. The manual describes the PK-90's features, system components and basic operation on Packet Radio. Technical information on theory of operation, hardware and software descriptions, protocols and troubleshooting instructions is also available.

1.1.2 General

The PK-90 is designed and manufactured by AEA, Inc. for use with any standard communications terminal or computer equipped with an RS-232C serial data port and an appropriate communications program or terminal emulator. For information on operation with nonstandard interfaces or terminals, please contact AEA.

1.1.3 Application

The PK-90 Packet Radio Controller is digital link between your radio and your computer or terminal. The PK-90 provides all decoding, encoding and transmitter control routines needed to send and receive packet radio. You can use your computer or data terminal with the same communications program or terminal emulator that you use with a telephone line modem.

1.2 Specifications

As part of its program of product improvement, AEA reserves the right to make changes in this product's specifications. Changes will be made to the information in this document and incorporated in revisions to this manual. Specifications are subject to change without notice.

1.2.1 Description

AEA's Model PK-90 is an asynchronous PAD (Packet Assembler/Disassembler) or data controller that includes a built-in modem for packet radio operation. The PK-90's hardware HDLC system converts serial, asynchronous, ASCII data to the internationally accepted AX.25 packet radio protocol via an EIA standard RS-232 serial port. In addition, a Host mode, raw HDLC and KISS ('Keep It Simple, Stupid') TNC protocols are available for applications other than AX-25 protocols.

Operating Modes:	Packet Radio per AX.25, half- or full-duplex. Host Mode with Raw HDLC and KISS TNC protocol for service with TCP/IP and other applications.

1.2.2 Modem Characteristics

Modulator/Demodulator:	AMD 7910 'World Chip' modem.
Data format:	Serial, asynchronous
Modem Tones:	Bell 103 and Bell 202, or CCITT V.21 and CCITT V.23, or optional CCITT V.26
Transmitter:	
Modulation method:	Binary, phase-coherent FSK
Frequency accuracy:	Bell 202 (mark) +/- 1Hz All others (mark) +/- 0.4 Hz
Harmonics:	45 dB below fundamental, single tone
Receiver:	
Demodulation method:	Differential FM detection
Output Level:	5 to 100 millivolts RMS, adjustable by rear-panel control

1.2.3 Processor System

Protocol conversion:	Zilog Z-80 microprocessor
RAM:	16 kilobytes
ROM:	Up to 48 kilobytes of ROM may be used
Hardware HDLC:	Zilog 8530 SCC

1.2.4 Input/Output Connections

Radio Interface:	Five-pin DIN-standard connector
Input/Output Lines	Receive audio Transmit audio Push-To-Talk (PTT) External squelch input Ground
External Modem Interface:	Five-pin DIN-standard connector
Input/Output Lines	Receive data (RXD) Transmit data (TXD) Transmit Clock (TXC) Data Carrier Detect (DCD) Ground
Terminal Interface:	Standard RS-232C 25-pin DB25 connector
Input/Output Lines	RS-232C (CCITT V.24/V.28) with full handshake (hardware and software)
Terminal Data Rates	Auto-baud selection of 300, 1200, 2400, 4800 and 9600 BPS. TBAUD adds 45, 50, 57, 75, 100, 110, 150, 200 and 600 BPS.

1.2.5 Controls and Indicators

Front Panel Controls:	Power Switch
Status and Mode Indicators:	CONV, TRANS, CMD, SEND, DCD, STA, CON, MULT

1.2.6 General

Power Requirements:	+13 VDC (12 to 16 VDC) at 520 mA. Internally fused, with reverse-polarity protection.
Mechanical:	Extruded aluminum case 10 inches by 6 inches by 1.5 inches (25.4 mm by 15.2 mm by 3.8 mm) Weight 2.75 pounds (4.4 kilograms)
Environmental:	
Ambient Temperature:	Operating: 0 C to +55 C Storage: -40 C to +60 C
Humidity:	3 days @ 50 C, 95% relative humidity
Altitude:	30,000 feet (9100 meters)
Vibration:	3 axis, 15 min, .025-inch p-p, 10-55 Hz
Shock:	100 G, +-sine, 2 msec, 3 axis 12 shocks

Certified under FCC Part 15, Subpart J, for Class B computing devices

1.3 Features

The PK-90 presents all of the features most frequently demanded by today's sophisticated packet radio operator:

- o Packet radio AX.25 international packet protocol
- o AX25 Level 2 Versions 1 and 2
- o KISS TNC protocol permits immediate TCP/IP applications
- o Host Mode with raw HDLC provides developers with facilities for efficient terminal operation and development of specialized program applications
- o SMR/Trunked Radio operation uses special software or hardware handshake
- o Remote control over radio link permits total system control and remote troubleshooting
- o Password protection prevents unauthorized access to remote link setup and service commands
- o Remote-access link and data encryption provides improved security
- o New commands permit restricting access to your station's connect and digipeat functions
- o Complete software control allows remote selection of all system operating parameters and status, link rates, modem tones, etc.
- o Programmable command macros reduce operator training requirements
- o Modem disconnect and bypass circuits ensure compatibility with future high-speed modem developments and applications
- o Zilog 8530 SCC provides dependable hardware HDLC for reliable operation at higher link speeds.
- o AMD 7910 'World Chip' for reliable, field-proven, high-quality modem performance without calibration
- o 'Autobaud' selection of terminal data rates: 300, 1200, 2400, 4800 and 9600 BPS
- o Separate software commands provide selection of:
  - standard terminal rates from 45 to 9600 BPS
  - radio link NRZI data rates from 45 to 9600 BPS
  - Bell 103 Answer and Originate tones
  - Bell 202 modem tones with and without equalization
  - CCITT V.21/V.23 tones selected by strap options
  - Optional plug-in V.26 2400 BPS modem available
- o High receiver sensitivity and wide dynamic range (5 to 770 millivolts RMS) without overload
- o Rear-panel output level adjustment from 5 to 100 millivolts RMS
- o One-minute hardware watchdog timer provides system security for unattended host computer and digipeater operation
- o Full RS-232C I/O configuration for hardware flow control and connect-status indication required for PBBS and host applications.
- o Time-of-day clock
- o Front-panel LEDs show Converse, Transparent, Command, Multiple connects, Data Carrier Detect. Push-to-Talk, Status and Connect.
- o Low power consumption (6 watts) for portable/mobile operation

1.3.1 Optional 2400-BPS V.26 Modem Board

Operation at 2400 BPS is achieved by replacing the Am7910 modem chip at location U14 with an optional 3.5 by 4-inch PC board that contains a DPSK modem chip and supporting circuitry. When equipped with the DPSK modem, the PK-90 operates only at 2400 BPS and communicates only with similarly equipped PK-90s. Standard FM channels witrh 25-KHz spacing can be used. HF/SSB operation at 2400 BPS is not recommended.

The optional 2400-BPS modem complies with CCITT Recommmendation V.26.

1.4 System Components

The PK-90 Packet Radio Controller package contains the following items:

- One PK-90 Packet Radio Controller
- Five-conductor shielded cable with a single five-pin DIN connector at one end
- Unassembled five-pin DIN connector for external modems
- Power cable with single 3.5-mm coaxial connector
- Operating Manual

1.5 Input/Output Devices

The PK-90 can be used with a any standard ASCII data terminal or computer equipped with an RS-232C serial data port and a communications program or terminal emulator. Data and control signals are exchanged between the PK-90 and the computer or terminal at standard RS-232C (CCITT V.24/V.28) levels.

Your computer and terminal program and their associated tape, disk and printer I/O devices provide the means to store messages received and retrieve messages for transmission. Although highly desirable, these peripheral or I/O devices are not needed for PK-90 operation.

Note In this Operating Manual, 'computer' and 'terminal' mean the same thing - the keyboard and monitor or printer with which you communicate with the PK-90.

1.6 System Transmitter/Receiver Performance Requirements

Most modern radio transceivers are capable of excellent performance in packet radio. Radio switching and other delays can be compensated by parameter adjustments to the PK-90.

The PK-90 provides software-controlled timing variations that permit operation with almost all HF and VHF/UHF radios in general use today.

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CHAPTER 2

INSTALLATION

2.1 Preliminary Information

This section contains instructions for a 'generic' installation and system checkout to install and verify the PK-90's operation with both VHF-FM and HF SSB radios.

2.1.1 Equipment Required

A complete PK-90 Packet Radio Controller system consists of the PK-90 and a 12 to 16-volt DC power supply, a computer, a terminal emulator or communication program for the computer, a radio transceiver or receiver/transmitter combination and its power supply.

AEA supplies the cables for connecting the PK-90 Packet Radio Controller to your radio and to an external power supply. You must add the microphone connector required by your radio, the power supply and the RS-232 cable that connects the PK-90 to your computer.

RAM battery backup is provided by an internal lithium battery.

2.1.2 Precautions

AEA strongly recommends that all RS-232 cables and connectors be made with the best commercial-quality shielded materials, and that careful and correct grounding and bonding procedures be observed in the installation of the radio equipment being used with the PK-90.

2.2 Installation

The following sections describe the connectors and their connections to your computer and your radio.

2.2.1 Power Connections

Power is connected to the PK-90's rear-panel coaxial power receptacle from any well regulated 12-volt DC power supply (12 to 16 VDC) capable of supplying at least 600 milliamperes. AEA's optional Model AC-1 wall adapter power supply can be used.

- Be sure your power supply can furnish the required current with ripple voltage less than one volt peak to peak.
- Be sure you connect the positive voltage to the center pin of the coaxial power plug.

If you accidentally invert the power power cable, an internal fuse will open to protect the PK-90 from reverse-voltage damage. If this occurs, open the PK-90 and replace the internal fuse with an identical one-ampere unit.

2.2.2 Radio Input and Output Connections (See Table 2-1)

AEA has supplied a shielded cable for connecting the PK-90 to your radio. One end is already prewired with a five-pin DIN-type plug. You must supply and connect the plug for the end that connects to your radio's microphone receptacle or PTT and phone patch and tone inputs.

NOTE: Do not prepare your cable yet. You will use the radio cable in a special test configuration during your first 'loopback' experiments with packet operation.

The following signals at five-pin receptacle J3 pass between the PK-90 and the radio. The pin wiring is shown in Table 2-1.

Pin	Signal Name	Description
1	Microphone audio	AFSK from PK-90 to transmitter
2	Ground	Audio and PTT common return
3	Push-To-Talk	PK-90 keys transmitter
4	Receive audio	AFSK from receiver to PK-90
5	Squelch input	Allows PK-90 to detect activity on a shared-mode channel (optional)

Table 2-1 J3 Radio Port Connector

2.2.3 Computer Connections (See Table 2-2)

The PK-90's rear-panel serial port connector carries data and control signals between your computer and the PK-90. The minimum number of pins that must be connected is shown in Table 2-2.

The PK-90 is connected to a computer just like you connect a RS-232C modem. If you now use your computer with a modem, connect the PK-90 the same way. Use any terminal program you now use with your modem.

IMPORTANT NOTE

The following connections are the least number of wires needed to use the PK-90 with any computer or terminal. This three-wire connection does not permit hardware flow control. In this case, software flow control (XON-XOFF) must be provided by the terminal program.

Pin	Signal Name	Description
2	Transmit Data	Serial data from computer to PK-90
3	Receive Data	Serial data from PK-90 to computer
7	Signal Ground	Common ground for both data lines

Table 2-2 Minimum Serial Port Connections Required by PK-90

2.2.4 Installation of Optional 2400-BPS Modem Board

These instructions for installation of the DPSK modem apply only to PK-90 units with serial numbers above 293 (Revision B boards). To install the DPSK modem on earlier PK-90 systems, please call AEA for instructions.

2.2.4.1 PK-90 Disassembly

1. Disconnect the power source and all cables from the PK-90.
2. Remove the two front panel screws and the two bottom screws.
3. Slide the PK-90 board out case through the front of the case.

2.2.4.2 Board Installation

1. Using a chip extractor or small screwdriver, carefully lift out the Am7910 chip at location (U14). Save the 7910 modem chip in a static-free storage container for future re-installation for 300 or 1200-baud operation.
2. Lift out the LS393 chip at location U20 and store it with the 7910 modem chip.
3. Place a shorting plug over both pins at Jumper JP10
4. Position the DPSK modem board over the PK-90 board so that the hex standoff is directly over the hole in the PK-90 board inside the white-marked rectangle next to the U19 regulator.
5. Align the DIP connector on the underside of the DPSK modem board with the U14 socket on the PK-90 board and carefully insert the DPSK modem board into the U14 socket on the PK-90 board.
6. Secure the DPSK modem board to the PK-90 board by inserting the supplied screw into the standoff from the bottom of the PK-90 board. NOTE: Leave the red mylar material on the bottom of the DPSK modem board in place as insulation against possible short circuits.

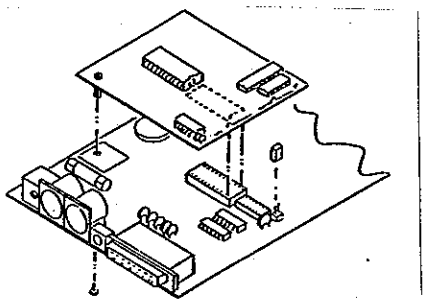


Figure 2-1 DPSK Board Installation

2.2.4.3 Reassembly and Initialization

1. Reassemble the PK-90 by reversing the disassembly instructions.
2. Connect the power source and an RS-232 terminal or computer to the PK-90.
3. Apply power to the PK-90. Proceed as described in Section 2.7.1 in the System Setup and Verification portion of this manual.

2.3 Controls and Indicators

The PK-90 has a single front-panel control:

- o POWER ON/OFF push switch - disconnects power from external supply

2.4 Status LEDs

The PK-90's front panel has the following LED (Light Emitting Diode) indicators:

CONV	System is in Converse Mode
TRANS	System is in Transparent Mode
CMD	System is in Command Mode
SEND	Transmitter Push-to-Talk line is enabled
DCD	Data Carrier Detect
STA	Packet frame(s) unacknowledged
CON	Packet link is in connected state
MULT	Multiple Connection in progress

2.5 Serial Port Configuration

Verify that the PK-90's serial port and data words are set up properly for your computer. Should your monitor display garbled or incorrect characters or 'funny' graphic symbols, you can change the PK-90's serial port parity and word length. The common parity and word length combination is seven data bits, even parity, one stop bit.

Your computer will probably accept the PK-90's default setting, even if it actually uses a different setting. If your computer requires eight data bits, you may have to set parity to 'none'; otherwise text may be interpreted as graphics or other special characters.

To set eight bits, no parity, type:

AWLEN 8 (eight-bit words) PARITY 0 (no parity bit)

To return to seven bits, even parity, type:

AWLEN 7 (seven-bit words) PARITY 3 (even parity)

One of these combinations will satisfy most computers. You are more likely to require a different setting if you have a 'dumb' terminal rather than a computer, or if you have configured your computer's serial port for some special application. If your computer needs odd parity, set PARITY to 1.

If you see framing errors, try this for shorter characters:

AWLEN 7 (seven-bit words) PARITY 0 (no parity bit)

For longer characters try:

AWLEN 8 (eight-bit words) PARITY 1 or PARITY 3

2.6 Screen Displays

Some computers and terminal programs are configured to certain default characteristics that may at first seem incompatible with the PK-90. Follow these hints as you begin to 'dialogue' with your new TNC.

2.6.1 Echoes

If you see two characters on your screen for each character you type, then your computer and the PK-90 are echoing your typed characters.

```
cmd:RREESSEETT
```

- Type: ECHO OFF to stop the PK-90's echoes.

If you later use the PK-90 with a different terminal program, you may see nothing displayed when you type. In that case, set ECHO ON.

2.6.2 Line Feeds and Carriage Returns

If lines displayed appear to be double spaced, your computer is adding an extra line feed <LF> when it displays a carriage return <CR>.

- Set ALFDISP OFF to stop the PK-90 from adding an <LF>.

If you change terminal equipment you may have to set ALFDISP ON to restore the PK-90's automatic line feeds.

2.6.3 Screen Width

If ALFDISP is ON, the PK-90 sends an extra <CR>, or <CR><LF> to your terminal when 80 characters have been displayed on a line. The screen width default value is 80, the width of most CRT displays.

If your computer does not automatically break long lines:

- Set ACRDISP (the screen width) to the width of your display.
- For a computer using a TV set for a display, set ACRDISP to 40.

If your computer does automatically break long lines:

- Set ACRDISP to 0 to disable this feature. Otherwise, you will get two <CR>s when the line wraps around.

2.6.4 Display Speeds

A few computers will lose the first characters of a line when several lines are displayed in rapid succession.

- Set NUCR ON (delay after <CR>), or NULF ON (delay after <LF>) to give the computer more time between lines.

The delay is adjusted by NULLS, which sets the number of character times for the delay.

2.7 System Setup and Verification

DISCONNECT POWER BEFORE MAKING ANY OTHER CONNECTIONS!

Do these steps before connecting any cables between the PK-90 and your radio.

1. Connect the PK-90 to your computer via the RS-232 cable.
2. Apply power to your computer. Load and run your communications program.
3. Connect the wires from the PK-90's J3 pins 1 and 4 to each other.
4. Connect the PK-90 to a regulated 12-volt DC power supply.
5. Press the PK-90's power switch to the ON position.
6. Set your computer's data rate to 1200 bauds, 7 bits, even parity if possible.

   If your serial port is operating at 1200 bauds, you will see the following message right away:

   Please type a star (*) for autobaud routine.

   If this message appears, go to Step 8 now.

7. If you are using your computer or terminal at a different data rate, word length or parity, your screen may show meaningless 'garbage' or mutilated characters, or nothing at all. If true, go to Step 8 now.

   (Don't worry! - the PK-90 is doing its 'auto-baud' routine. It measures your computer's data rate, digital word length, parity, and then sets itself accordingly. The PK-90 automatically scans baud rates of 300, 1200, 2400, 4800 and 9600 bauds.)

8. Type several asterisks (*) at intervals of one second.

   If the cable and connections between the PK-90 and your computer are correct, the MULT LED will be extinguished and other LEDs will be lit as the PK-90 does its 'auto-baud' routine. As soon as the PK-90 has recognized your data rate and set itself to your data rate, the CMD LED is lit and your screen displays the sign--on message ending with the "cmd:" command prompt:

```
PK-90 is using default values.

AEA PK-90 Packet Controller
AX.25 Level 2 Version 2.0
Copyright (C) 1986, 1987 by
Advanced Electronic Applications, Inc.
Release 18.SEP.87
Checksum $6C
cmd:
```

NOTE: The date and checksum shown above will change as the PK-90's firmware is revised or updated.

9. Do not turn on your radio yet!

10. Type 'MY AAA' followed by a RETURN (or ENTER key). Your monitor should display:

```
cmd:my aaa
MYCALL   was PK-90
MYCALL   now AAA
```

11. Type 'C AAA' followed by a RETURN. After a few moments, your monitor should display:

```
cmd:c aaa
*** CONNECTED to AAA
```

12. Type a few characters, any characters, followed by a RETURN. After a few moments, your monitor should echo the same characters that you have just typed.

13. Type '(CONTROL-C)' (type 'C' while pressing the CONTROL key down) Your monitor should respond with:

```
cmd:
```

15. Type 'HB 300' followed by a RETURN. Your monitor should respond with:

```
HBAUD    was 1200
HBAUD    now 300
```

16. Type 'K' followed by a RETURN. Your monitor should echo the characters you've just typed.

17. Type '(CONTROL-C).' Your monitor should respond with:

```
cmd:
```

18. Type 'D' followed by a RETURN. Your monitor should respond with:

```
cmd:d
*** DISCONNECTED: AAA
```

19. If you have done all these steps successfully, you have completed the system installation and you are ready to begin operating.

20. If you have problems with the steps shown above, return to Step 1 AFTER checking all cables and connectors. Read each step again carefully. If you still have problems, shut down the PK-90 and contact AEA's Customer Service Department as suggested in the front of this manual.

2.7.1 Optional DPSK Modem Setup and Verification

DISCONNECT POWER BEFORE MAKING ANY OTHER CONNECTIONS!

Do these steps before connecting any cables between the PK-90 and your radio.

2.7.1.1 Initial Test

1. Connect a jumper between pins 1 and 4 of J3.
2. Adjust the rear panel AFSK control to mid-range.
3. Enter HBAUD 2400 at the command prompt (cmd:) to change the radio baud rate.
4. Enter the Converse mode from Command mode by typing CONV or K.
5. Press <CR> repeatedly and observe that the DCD LED flashes in synchronization with the SEND LED and that you see "MYCALL>CQ" on the terminal or computer.
6. Remove the jumper from pins 1 and 4 of J3 and follow all other test and setup instructions shown for the standard model PK-90.

2.7.1.2 Operating Suggestions for 2400-BPS Services

- Use the PACL command to set the longest packet frame data field length possible to maximize the faster radio data rate.
- Choose a radio with the fastest receive/transmit switching time available, that is, the shortest possible time delay between the PTT signal from the PK-90 and the instant when the radio is ready to transmit the packet frame. You are trying to minimize the setting of TXDELAY.
- Try progressively shorter TXDAY settings until the packets are no longer copied at the other end of the link; then lengthen TXD a bit.
- If you want to operate on an FM link using 4800 or 9600 BPS, please contact the Commercial Division at AEA for application information, radio choices and government regulatory limitations.

2.8 Radio Connections and Setup

DISCONNECT ALL POWER BEFORE MAKING ANY OTHER CONNECTIONS! Refer to the Appendices at the end of this manual for suggestions for connecting some specific radios.

Use this simple step-by-step routine to verify that all cables and connectors are properly installed, and that the PK-90 Packet Radio Controller is operating correctly. The procedure will also help you become familiar with the software commands and responses.

If you cannot solve a problem after carefully reading this manual and checking all cables and connectors, please refer to the instructions for calling AEA in the beginning of the manual.

During these initial checkout procedures, do not connect the PK-90's PTT and AFSK lines to your radio until instructed to do so. Make all the other connections as described below.

After all the cables between the PK-90, your radio and your computer have been installed, apply power to your equipment in this order: radio, computer, PK-90.

The installation procedure uses the simplest method of connecting the PK-90 to your radio, via the radio's microphone jack. However, unless you have an auxiliary speaker-mike jack, you may not be able to monitor the channel or conveniently use the radio on voice.

This type of connection may also be susceptible to RFI from nearby transmitters. After your first trials with the installation routines in an initial test phase, you can consider alternate methods shown later in this Operating Manual for permanent station installation.

Use only shielded wire for microphone audio circuits. If you notice significant hum in the monitored audio during modulation adjustments, verify ground and shield connections in the cable between the radio and the PK-90. The cable supplied with the PK-90 is shielded for these applications.

This method requires a second receiver at the same site so that you can listen to your own signal. Read the remainder of this chapter carefully before connecting the PK-90 to your radio.

In this method, the PK-90 is connected directly to the radio; initial tests are performed without making any adjustments in the radio or adding any signal-level balancing devices in the cables.

This procedure is is divided into separate sections for FM and SSB radios. Follow these steps exactly in order to:

- Verify that your radio and PK-90 are connected as shown in Table 2-1 earlier in this manual, and Figure 2-2 below.
- Connect the PK-90's AFSK audio output to your radio's microphone receptacle or similarly-configured auxiliary input jack.
- Adjust the PK-90's rear-panel output-level control to obtain proper modulation.
- Take the receiver's audio output from an ear-phone plug or speaker jack and feed the audio directly to the PK-90.

Insert the five-pin DIN connector into J3 on the PK-90's rear panel and connect the microphone plug to your radio's microphone jack.

2.8.1 PTT (Push-to-Talk) Configuration

The PK-90 is configured at the factory for positive PTT. This seems to work with most modern radios. However, you can change the polarity of the PTT configuration as needed. Follow these steps:

- Remove four screws from the sides of the PK-90 and lift off the cover.
- Viewed from the front, jumper post JP2 is located at the rear right-hand side of the board, between diode D3 and transistor Q6. JP2 is a three-pin jumper post on which you install a slip-on jumper to connect the center pin to one of the outside pins.
- To change to negative PTT polarity, move the jumper block to the opposite center-end pair of pins, that is towards the PK-90's front panel.
- Reinstall the cover and replace the four side screws.

2.8.2 Data Carrier Detect (DCD Pin 8) Jumper JP6

Certain applications may require that the connected state raises the Data Carrier Detect (DCD) signal on Pin 8 of the RS-232 interface at rear-panel connector J2. Jumper post JP6, located at the left-hand rear corner of the PK-90 (viewed from the front) is factory set so that DCD Pin 8 is permanently pulled high.

If DCD is required active in the connected state only, move the JP-6 jumper plug to the opposite position (towards the rear panel).

See the PK-90 schematic diagram in the Appendices section for further details on JP-6.

2.8.3 FM Installation and Adjustment

Disconnect power before making any other connections.

1. Connect the PK-90 and FM radio as shown in Figure 2-2.

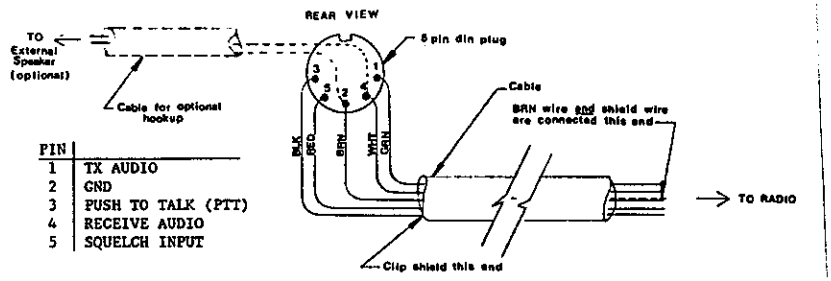


Figure 2-2 Radio-to-PK-90 Connections

2. Apply power to your computer and PK-90 and start your terminal program.

3. Connect the radio to a dummy load; be prepared to monitor your transmissions with another nearby radio.

4. Enter the Calibrate mode by typing 'CAL <RETURN>'.

   Ignore the 'zeros' scrolling down the left side of your screen. The self-contained 7910 modem chip does not require calibration or tone adjustments. The 'zeros' appear only to show that the PK-90 is in the 'Calibrate' mode for the purpose of keying the transmitter and applying steady-state tone modulation for transmitter adjustment.

   NOTE: In the Calibrate mode only, the 'K' key toggles the transmitter PTT line on and off. The 'SPACE BAR' toggles the PK-90's AFSK tone generator from 'Mark' (Stop Polarity, the lower-pitched tone) to 'Space' (Start Polarity, the higher-pitched tone). The PK-90's transmit watchdog timer circuit unkeys your transmitter automatically after sixty (60) seconds. As you perform the following adjustments, unkey periodically, then rekey the transmitter by typing 'K'.

5. Press the 'K' key on the keyboard to key the transmitter. You should hear a continuous tone in the monitor receiver.

6. Tap the space bar several times until you hear the higher-pitched of the two tones ('Space' or Start Polarity).

7. With the PK-90 keying the transmitter, adjust the transmit audio level as follows:

   - o Listen to the monitor receiver; turn the PK-90's rear-panel AFSK Output Level adjustment screw clockwise (CW) until you hear no increase in output level in the monitoring receiver.

   - o Rotate the AFSK Output Level adjustment screw counterclockwise until the audio signal on the monitoring receiver is slightly but noticeably reduced from the maximum level.

8. Type 'K' again to return to the receive mode.

9. Type 'Q' to 'Quit' (exit) the calibration routine.

   You have set your FM transmitter's deviation to the approximate level which will be adequate for initial operation. However, an accurate setting will require a standard FM deviation meter, in accordance with the emission type and bandwidth shown on your station operating license.

   For best results with VHF/UHF transceivers at 1200 BPS, set the transmitter deviation so that deviation on the higher tone does not exceed 4.0 KHz peak. With standard pre-emphasis, most transmitters will produce approximately 2.5 KHz deviation on the lower (Mark/Stop) tone. Excessive devation is likely to cause decoding errors at the receiving station.

   If your transmitter has an easily accessible microphone gain control, increase the setting of the "deviation control" and reduce the gain of the transmitter microphone circuit. This usually prevents excessive devation limiting and bad mark-to-space tone amplitude ratios.

10. With your radio in the receive mode, open the squelch control so that a steady hiss or noise is heard on a speaker.

11. Set the receiver's volume control so the DCD LED on the PK-90 just lights with the receiver un-squelched.

    This is the approximate proper audio level for best receive performance from the PK-90's modem.

7. Reset your receiver's squelch control for normal operation.

2.8.4 SSB Installation and Adjustment

Installation and adjustment of the PK-90 with SSB radios is usually simpler and more direct than with FM equipment. You will use the same kind of cables and connectors that you use with your FM gear.

Digital modes with an SSB radio require some different settings of the radio's operating controls for proper packet operation. Be sure to observe the following precautions:

- Set VOX to OFF.
- Set speech compression to OFF.
- Set AGC to FAST (if available).
- Disconnect the ALC cables between your SSB radio and any external RF amplifier you wish to use in packet radio service.

NOTE: Make all connections with power off.

If your radio has a phone patch input and external PTT connections, the PK-90 AFSK output can be connected to those input jacks, leaving the microphone jack for normal service. However, some microphones are connected at all times (regardless of the PTT line's state. In this case, disconnect the microphone to prevent inadvertent loading of the audio input circuit. If the phone patch jack has a series isolating resistor, your microphone can remain connected.

1. Connect the PK-90 and SSB radio as shown in Figure 2-2.

2. Apply power to the PK-90 and your computer and start the terminal program.

3. Connect your SSB radio to a dummy load.

4. If your SSB radio has a 'monitor' facility, i.e., an audio output that lets you listen to the audio signals entering the microphone or phone patch jacks, turn that monitor circuit on.

5. Set the radio MODE selector to either USB (upper sideband) or LSB (lower sideband). Because packet radio uses NRZI data on the radio link, the sideband used does not affect the data sense or polarity. However, the radio's tuning calibration or frequency display will vary depending on which sideband is selected.

6. Set the radio's meter switch to the 'ALC' position. If the radio doesn't have an 'ALC' indication, set the meter switch to 'IP' to read output device or plate current. If an output device or plate current reading isn't available, set the meter to indicate power output.

7. Set the PK-90's TONE value to either TONE 0 for the low tone pair or TONE 1 for the high tone pair.

8. Set HBAUD to 300.

9. Enter the Calibrate mode by typing 'CAL <RETURN>'.

   Ignore the 'zeros' scrolling down the left side of your screen. The self-contained 7910 modem chip does not require calibration or tone adjustments. The 'zeros' appear only to show that the PK-90 is in the 'Calibrate' mode for the purpose of keying the transmitter and applying steady-state tone modulation for transmitter adjustment.

   NOTE: In the Calibrate mode only, the 'K' key toggles the transmitter PTT line on and off. The 'SPACE BAR' toggles the PK-90's AFSK tone generator from 'Mark' (Stop Polarity, the lower-pitched tone) to 'Space' (Start Polarity, the higher-pitched tone). The PK-90's transmit watchdog timer circuit unkeys your transmitter automatically after sixty (60) seconds. As you perform the following adjustments, unkey periodically, then re-key the transmitter by typing 'K'.

10. Press the 'K' key on the keyboard to key the transmitter. You should hear a continuous tone in the monitor output.

11. Tap the space bar several times until you hear the higher-pitched of the two tones ('Space').

12. With the PK-90 keying the transmitter, adjust the transmit audio level as follows:

    - Rotate the microphone gain control clockwise to about one-quarter open.

    - Turn the PK-90's rear-panel AFSK Output Level adjustment screw clockwise (CW) until until the ALC meter shows a small deflection from the unmodulated reading. Check the radio's output device current or output power indicators.

    NOTE: Verify the radio manufacturer's output device current specifications.

    - Adjust the AFSK Output Level control until the radio's indicators show approximately thirty percent (30%) of the manufacturer's rated full-power reading.

    EXAMPLE: If the radio's output device current specification for CW operation is 200 mA, set the AFSK Output Level control and your microphone gain control so that the output device current indicates approximately 75 mA.

    You have now set the PK-90's transmit audio output level and the SSB radio's microphone gain control to an approximately correct level for packet radio operation.

13. With your radio in receive mode, tune the receiver to a clear, unoccupied frequency.

14. Set the receiver's audio volume control (AF Gain) to the position you would normally use for CW reception, or to a position such that the DCD LED on the PK-90 is just lit by the output noise signals from your receiver.

    This is the approximate receiver audio output level for best receive performance from the PK-90's modem.

2.9 Command List Displays

Type the command word 'display.' Your screen will show:

```
cmd:display
DISPLAY  A,C,I,L,M,T,Z
```

2.9.1 Display Complete Command List

At the 'cmd:' prompt, type the command word 'DISPLAY Z.' The PK-90 displays the entire list as shown in APPENDIX A.

The 'DISPLAY Z' command shows the complete command list and the ROM default values installed at time of manufacture, assigned to those parameters that take values. The defaults shown below are in effect when the PK-90 is turned on for the first time, and each time that you type the 'RESET' command.

2.9.2 Display Partial Command Lists

The command list can be displayed in sections according to the class of parameter or function you wish to see. The DISPLAY function is divided into the following seven classes:

A	Asynchronous port parameters
C	Special characters
I	Identification parameters
L	Link parameters
M	Monitor parameters
T	Timing parameters
Z	All parameters displayed

2.9.3 Display Asynchronous Port Parameters

```
cmd:disp a
8BITCONV  OFF        Strip bit 7 in CONVERSE
ACRDISP   80         Screen width
ALFDISP   ON         Send <LF> after <CR> to terminal
AWLEN     8          Data bits per word, to terminal (autobaud)
CASEDISP  0 (as is)  Select character case to terminal
ECHO      ON         Echo typed keyboard characters
ESCAPE    OFF        Send ESC character $1B as $24
FLOW      ON         Stop echo to screen while typing
ILFPACK   OFF        Ignore all <LFs> from terminal
NUCR      OFF        Nulls to terminal after <CR>
NULF      OFF        Nulls to terminal after <LF>
NULLS     0          Number of nulls for NUCR & NULF
PARITY    0 (none)   Terminal program parity (0-3, autobaud)
TBAUD     1200       Terminal baud rate (autobaud)
TRFLOW    OFF        Terminal flow control in Transparent mode
TXFLOW    OFF        PK-90 flow control in Transparent mode
XFLOW     ON         Software flow control
```

2.9.4 Display Special Characters

```
cmd:disp c
BKONDEL   ON            Send <BS> <SP> <BS> for DELETE char.
CANLINE   $18 (CTRL-X)  LINE DELETE character
CANPAC    $19 (CTRL-Y)  PACKET DELETE character
CHCALL    OFF           Show call sign after channel ID
CHDOUBLE  OFF           Show CHSWITCH character twice
CHSWITCH  $00           Channel-select (Link) character
COMMAND   $03 (CTRL-C)  Character escape to COMMAND Mode
DELETE    OFF           Use <BS> ($08), not <DEL> ($7F)
PASS      $16 (CTRL-V)  Pass input editing character
REDISPLA  $12 (CTRL-R)  Re-display current input buffer
SENDPAC   $0D (CTRL-M)  Character that 'sends' a packet
START     $11 (CTRL-Q)  Resume sending data to terminal
STOP      $13 (CTRL-S)  Stop sending data to terminal
TIME      $14 (CTRL-T)  Insert 'sent time' in text
XOFF      $13 (CTRL-S)  Stop sending data to terminal
XON       $11 (CTRL-Q)  Resume sending data to terminal
```

2.9.5 Display Identification Parameters

```
cmd:disp i
UNPROTO   CQ              Path/address to send UI frames
BEACON    EVERY 0         Set beacon timing (X10 seconds)
BTEXT     (empty)         120 byte (maximum) BEACON text
CBELL     OFF             Beep on connect and disconnect
CMSG      OFF             Send CTEXT message to caller
CTEXT     AEA PK-90 (etc) 120 byte (maximum) CONNECT text
HID       OFF             Send ID UI packet every 9.5 mins
MYALIAS   none            Alternate MYCALL
MYCALL    PK-90            Your call sign for packet address
PASSWORD  (empty)         Password for control security
```

2.9.6 Display Link Parameters

```
cmd:disp l
CONNECT  Link state is: DISCONNECTED
ACRPACK  ON                    Add <CR> to packet
ALFPACK  OFF                   Send <LF> after <CR>, packet
AX25L2V2 ON                    Operate as AX.25 Version 2.0
CFROM    all                   Connect requests from list of calls
CONMODE  CONVERSE              Mode to enter when link starts
CONPERM  OFF                   Never disconnect this link
DFROM    all                   Digipeat these call signs only
FULLDUP  OFF                   Full-Duplex terminal operation
HBAUD    1200                  Packet link (radio) baud rate
MAXFRAME 4                     Maximum un-ACK'd frames allowed
NEWMODE  ON                    Return to Command Mode at DISC
NOMODE   OFF                   Never switch modes without command
PACLEN   128                   Maximum information bytes in packet
PASSALL  OFF                   Ignore CRC in HDLC ('Junk Mode')
RELINK   OFF                   Reconnect after re-trying out
REMOTE   OFF                   Allow remote access by radio link
RETRY    10                    Maximum number of frame repeats
SQUELCH  OFF                   Select receiver squelch polarity
TONE     3 (1200/2200 eq)      Bell 202 modem tones, equalizer ON
TRIES    0                     Show or force retry count
USERS    1                     Maximum multiple connections
XMITOK   ON                    PTT line can be keyed
```

2.9.7 Display Monitor Parameters

```
cmd:disp m
CONSTAMP OFF                   Mark connections with time/date
DAYSTAMP OFF                   Include DATE in time-stamp
HEADERLN ON                    Insert <CR> after headers
MBELL    OFF                   Beep if selected station is heard
MBX      none                  Monitor channel without headers
MCON     0 (none)              Monitor while connected (0-6)
MDIGI    OFF                   Monitor digipeated frames
MFILTER  $80                   Filter all received control
                               characters except CTRL-M (C/R),
                               CTRL-J (L/F) and TAB (CTRL-I)
MFROM    all                   Monitor source
MONITOR  4 (UA DM C D I UI)    Monitor mode level select (0-6)
MPROTO   OFF                   Monitor I-frames with PID $F0
MRPT     ON                    Show digipeaters in headers
MSTAMP   OFF                   Time-stamp monitored frames
MTO      none                  Monitor destination
STATUS   ON                    Send prompts/responses to terminal
TRACE    OFF                   Hex dump of packet frame
```

2.9.8 Display Timing Parameters

```
cmd:disp t
AXDELAY  0 (00 msec.)          Repeater key-up delay (X10 ms)
AXHANG   0 (000 msec.)         Repeater hang time (X10 ms)
BXDELAY  0 (00 msec.)          Trunked radio system PTT delay
CHECK    30 (300 msec.)        Idle link timeout (X10 seconds)
CLKADJ   0                     Correction for real-time clock
CMDTIME  10 (1000 msec.)       Transparent Mode escape timer
CPACTIME OFF                   Use packet timeout in Converse
DWAIT    16 (160 msec.)        Delay for digi repeat (X10 ms)
FRACK    3 (3 sec)             Time (X1 seconds.) to wait for ACK
HHANG    0 (000 msec.)         Repeater channel burst rate
PACTIME  AFTER 10 (1000 msec)  Packet transmit timer (X100 ms)
PERSIST  127                   P-persistent CSMA threshold
PPERSIST OFF                   P-persistent CSMA instead of DWAIT
RESPTIME 10 (1000 msec.)       Minimum delay before sending ACK
RQTIME   20 (20 sec.)          Channel grant timeout if BXDELAY> 0
SLOTTIME 10 (100 msec.)        P-persistent slot time (X10 ms)
TXDELAY  30 (300 msec.)        PTT key-to-data delay (X10 ms)
```

2.10 Immediate Commands

The 'immediate' commands do not have default values.

These commands take effect as soon as you type them (and a <RETURN>), to start, stop or acti-vate a specific PK-90 function.

NOTE: Like all other PK-90 commands, the immediate commands can be typed with a short mnemonic or abbreviated form. See the command descriptions in Chapter 7, 'Command Summary'.

```
CONNECT    Send connect request to <Call>
CONVERSE   Start Converse Mode from Command
CSTATUS    Show status of channels (links)
DISCONNE   Send DISC to distant station
DISPLAY    Show PK-90 parameters/classes
ID         Force ID packet via Unproto path
MHEARD     Display call signs heard
PACKET     Start Packet Mode
RESET      RESET bbRAM to factory defaults
RESTART    Same as power-on/off reset
TCLEAR     Clear the Transmit Buffer
TRANS      Start Transparent Data Mode
```

2.10.1 Unlisted Commands

The following commands do not appear in the usual displayed command list:

```
ADDRESS   IO   KEYWORD   MEMORY   RKEYWORD  SETPASS
```

These commands are explained in the Command Summary in Chapter 7.

2.11 Detailed Connections for Specific Computers

Many computers require a serial port adapter card that incorporates the necessary interface circuitry. Some popular computers in this category are the Apple // series, the IBM PC (and many compatibles), the Tandy 1000, 1200 and 3000-series computers and the Sanyo MBC-55X series. If you are using one of these computers refer to the section, 'Other Computers with Nonstandard Serial Ports.'

Computers that do not have a serial port and do not permit use of a suitable adapter or level converter cannot be used with the PK-90.

2.11.1 Available Serial Interfaces

Most manufacturers of personal and desktop computers provide optional serial interface boards that can be installed by the user. Here is a partial list of these makes and models.

MANUFACTURER	MODEL
Apple	MacintoshTM
	Apple II, II+, II-E
Commodore	Vic 20TM
	64TM
	64/CTM
	128TM
IBM	PCjrTM
	PC-XT
	PC-AT
	Most compatibles and clones
Tandy	Color ComputerTM
	1000, 1000HD, 1000EX and 1000SX
	1200, 2000, 3000HL, 3000
	Model 100TM
	Model 102TM
NEC	8201

2.11.2 Computers with Specific Serial Interfaces

Apple Macintosh

The Macintosh serial port is compatible with the RS-422 standard, but can be used with the RS-232C port on the PK-90.

Wire a cable as shown below:

MACINTOSH (DB9P)		PK-90 (DB25P)
1	.....	1
5	.....	2
9	.....	3
3	.....	7
7	.....	8
6	.....	20

Note that pin 1 is not connected inside the Macintosh. Use a shielded serial cable and connect both pins numbered '1' to the shield. Connect pin 1 at the Macintosh end to the main ground on the computer.

2.11.3 Commodore 64, 64C, 128, VIC 20

Commodore and other manufacturers sell a signal level converter that is installed in the User Port Connector on the rear of the computer. The converter changes the computer's internal TTL voltage levels to the proper RS-232-C voltage levels and polarities. Unless you are very familiar with the inner workings of your computer, you should purchase a level converter rather than trying to 'do it yourself.'

2.11.4 IBM PCjr

The PCjr uses standard RS-232-C voltage levels; however, the connector is not standard and is sometimes hard to find. Pin-out information can be found in the IBM PCjr Technical Reference Manual.

Some computer dealers sell an 'IBM PCjr Adapter Cable for Serial Devices' that converts the connector on the PCjr to standard RS-232C. The cable is attached directly between the PCjr and the PK-90. The cable is only about three inches long; you may want to get a male-to-female RS-232C extension cable.

2.11.5 Tandy Color Computer

The CoCo series (except for the Micro Color Computer) uses a four-pin DIN connector for its serial interface. Wire a cable as shown below. All necessary parts should be available from your Radio Shack dealer.

CoCo	PK-90 (DB25P)
4	2
2	3
3	7

2.11.6 Tandy Model 100/102, Kyocera KC-85 and NEC 8201

The Model 100/102, Kyocera KC-85 and NEC 8201 have built-in standard RS-232C serial ports which are compatible with the PK-90. You will need a standard male-to-male RS-232C extension cable to connect the computer and the PK-90.

2.11.7 Other Computers with 25-Pin RS-232-C Ports

If your computer has a 25-pin RS-232C port, consult your computer or accessory manual to see which pins are used for Send and Receive data, as well as which pin is used for signal common. Read the manufacturer's recommendations for connecting the serial port to a modem and connect the PK-90 in the same way.

The PK-90 is configured as Data Communications Equipment (DCE), the technical term for an RS-232C modem. Most computers and terminals are configured as Data Terminal Equipment (DTE).

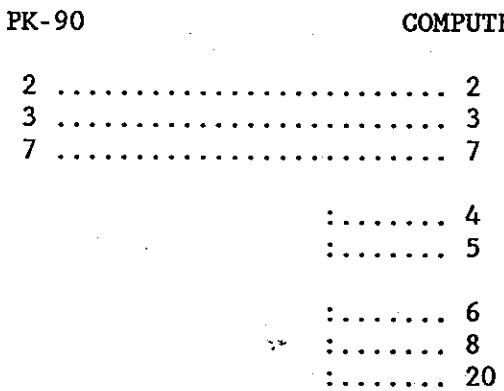
- If your computer is configured as DTE:

  Wire pin 2 of the PK-90 connector to pin 2 of the computer's RS-232C port, pin 3 to pin 3 and pin 7 to pin 7. Use a standard 3-wire male-to-female or male-to-male (depending on whether your computer has a DB25S or DB25P connector) RS-232C extension cable.

- If your computer is configured as DCE:

  Wire pin 2 of the PK-90 to pin 3 of the computer connector.
  Wire pin 2 of the computer connector to pin 3 of the PK-90.
  Wire pin 7 to pin 7.

Some computers require pin 5 of the computer's serial port connector to be connected to an appropriate signal. Others may require connections for pin 8 and pin 20. You can use the computer's output signals on pins 4 and 6 as indicated below:



2.11.8 Other Computers with Non-Standard Serial Ports

Computers with non-standard serial ports must meet the following conditions:

- Signal levels must be compatible with RS-232C or CCITT Recommendations V.24/V.28. The PK-90 requires the voltage levels from the computer be greater than about +3 volts in one state and less than 0 volts in the other state.
- Signal polarity must conform to the RS-232C/V.24/V.28 standard. The low-voltage state must correspond to logical '1'; the high-voltage state to logical '0.'
- The computer must be able to correctly receive signals that meet RS-232C/V.24/V.28 specifications. The PK-90 meets these specifications.

Make or buy a cable that provides the following connections:

- The computer's serial port common pin must be connected to the PK-90's serial port connector pin 7.
- The pin on which the computer SENDS data must be connected to the PK-90's connector pin 2.
- The pin on which the computer RECEIVES data must be connected to the PK-90's connector pin 3.

If your computer requires any other signals, you must arrange to provide them. The documentation provided with your computer or serial card should clarify any special requirements.

2.12 Terminal (Modem) Software for Specific Computers

Any communications program that enables your computer to emulate or act as an ASCII terminal with a telephone modem should work with the PK-90. If you have a familiar program you have used successfully, use it to communicate with the PK-90.

2.12.1 Apple Macintosh

Apple dealers sell a communications program called 'MacTerm' that will work well with the PK-90. Set the program options as listed below:

COMPATIBILITY:
1200 bauds, 7 bits/character, even parity, Handshake XON/XOFF, Modem connection, 'telephone' port.

TERMINAL:
VT100, ANSI, UNDERLINE, US, 80 columns, ON LINE, AUTOREPEAT.

2.12.2 Apple II, II+, IIE and IIC

The PK-90 operates well with the Apple II family of computers using both Apple-supplied and third-party serial interface cards. Terminal programs used successfully include ASCII EXPRESS PRO, Hayes SMARTCOMM IIE, and DataCapture 4.0

2.12.3 Commodore 64, 64C, 128, Vic 20

A BASIC communications program is printed in the Programmer's Reference Guide published by Commodore. Use the program listing for 'True ASCII'; Commodore computers use a modified ASCII format internally. We suggest you operate the PK-90 at 300 bauds with these computers to avoid possible data speed difficulties.

2.12.4 IBM PCjrTM

The PCjr's BASIC cartridge contains a terminal program. Start the program by typing 'TERM.' Refer to the PCjr's BASIC manual for details on the program. For best results with the PCjr do not run the PK-90's serial port baud rate faster than 1200 bauds.

2.12.5 Tandy Color Computer

Several terminal programs are available for the CoCo. We suggest that you use a commercial program rather than writing your own. The CoCo's 'software UART' may be difficult to program in BASIC.

2.12.6 Tandy Model 100/102, Kyocera KC-85 and NEC 8201

These portable computers have built-in terminal programs in ROM. Consult the computer documentation for instructions in their use.

2.12.7 IBM PCs, 'Clones' and True Compatibles

There are many commercial, 'shareware' and public-domain communications and terminal programs available for the IBM PC family and compatible MS-DOS computers. Almost any of these programs can be used successfully with the PK-90.

Specialized terminal programs for packet radio and electronic mail or packet bulletin board service can be found throughout the packet radio community and can be downloaded from Compuserve, GEnie and from many telephone bulletin boards.

A partial list of PC programs tested successfully with the PK-90 includes:

CROSSTALK-XVI, SMARTCOM, ASCII EXPRESS, BITCOM, RELAY, QMODEM, CTERM, PROCOMM, PC-TALK, HAMCOM, PACKCOMM, PACKTALK, HAMPAC, and YAPP.

2.13 Electronic Mail and File Server Program Compatibility

The PK-90 is used successfully with a variety of electronic mail programs, as well as with several PBBS (Packet Bulletin Board) programs written for the PC/MS-DOS computers.

The PK-90 also performs well with several applications that use the TCP/IP protocols available in the packet radio community.

See Chapter 6 for information on Host Mode and KISS TNC protocols for use with TCP/IP and other special applications.

Please consult the authors of these applications programs directly for information on operating the PK-90 with their programs. AEA Customer Service Department cannot provide this information.

The following default parameters should be considered as initial or experimental settings for these host applications:

8BITCONV	ON
ACRDISP	0
ALFDISP	OFF
AWLEN	8
AX25L2V2	ON
CANLINE	$00
CANPAC	$00
CHSWITCH	$00
DELETE	OFF
ECHO	OFF
FLOW	OFF
NEWMODE	OFF
NOMODE	ON
PARITY	0
RELINK	OFF
START	$00
STOP	$00
TXFLOW	OFF
XFLOW	OFF
XOFF	$00
XON	$00

2.13.1 Data Carrier Detect (DCD) Requirements

Certain host computer application programs require that Pin 8, 'DCD' (Data Carrier Detect) be asserted during connected state. IN such cases, Pin 8 must be wired between the computer and the PK-90.

The PK-90's jumper JP6 must be set to force Pin 8 to follow the PK-90's connect status. This requires a change from the factory-set jumper position. See paragraph 2.8.2 for jumper JP6 details.

In some cases NOMODE should be set ON.

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CHAPTER 3

BASIC OPERATION

3.1 Exploring the PK-90 Program

This chapter shows you how to use the PK-90, describes the keyboard commands you will use to 'talk' to the PK-90, and the answers, prompts and error messages you will receive from the PK-90.

3.2 LED Status and Mode Indicators

The PK-90's front-panel LEDs show you the operating mode and system status at any moment. Each LED is marked with an abbreviated name. Starting at the upper left corner, scan the PK-90's front panel as we review the LEDs and their meanings.

The following LEDs show the operating mode:

CONV	Converse	Lit when in Converse Mode
TRANS	Transparent	Lit when in Transparent Mode
CMD	Command	Lit when in Command Mode

3.2.1 Status Indicator LEDs

The following LEDs show system status:

SEND	Send	Lit when PTT line is enabled
DCD	Data Carrier Detect	Lit when receiving signal
STA	Status	Lit when unacknowledged frames exist
CON	Connected	Lit when valid connect state exists
MULT	Multiple	Lit when multiple connection exists

3.2.2 The DCD LED - Data Carrier Detect

The DCD LED is an indicator of channel activity. The PK-90 detects activity on the channel (busy condition) by monitoring the demodulator's lock-detect signal and lighting the DCD LED when a valid signal exists. When the other station transmits, the DCD LED on the PK-90 should be lit for the duration of the received packet frame.

If the DCD LED is lit by random noises, reduce your receiver's output volume control until the DCD LED is extinguished. Valid packets received should always light the DCD LED.

3.2.3 LEDs at System Start

The PK-90 always starts in the Command Mode. After the PK-90 has been initialized at system start, or each time you type the RESTART command, the PK-90 shows its status on the front-panel LEDs:

CMD lit The PK-90 is in Command Mode.

3.3 PK-90 Commands

The PK-90 Packet Radio Controller is a command driven system. All control functions are performed by typing single- and multiple-character command from your computer's keyboard. Menus are not used.

Commands can specify the variable values of the parameters that affect the PK-90's general operation and its performance during specific actions.

3.3.1 Entering Commands

Commands are entered after the Command Mode prompt: cmd:

NOTE: Type <CTRL-C> if 'cmd:' is not displayed.

You will use English-like words or abbreviations to change the value of parameters and issue instructions to the PK-90.

- Commands are keywords or mnemonics (special abbreviations that trigger your memory) composed of strings of characters chosen by the user.

You will probably never change the values of some parameters; however, each user has maximum flexibility to adapt the PK-90 to the local environment and operating conditions.

- Use either UPPER CASE (capital letters) or lower case (small letters) when entering commands.
- End the command with a carriage return <CR>. Carriage returns are not shown in the examples below.
- Correct your typing mistakes or cancel the line completely before you type the final <CR> of your command.
- See Chapter 3 for a discussion of line editing.

Sample screen displays are shown in bold face type.

3.3.2 Command Responses

Whenever the PK-90 accepts a command that changes a value, the PK-90 responds with the previously stored value. For example, while in the Command mode, if you type

```
cmd:xflow off
```

and 'XFLOW' was 'ON' you'll see the display

```
XFLOW    was ON
XFLOW    now OFF
```

This message tells you that the value has been changed successfully.

3.3.3 Error Messages

If the PK-90 cannot understand what you have typed, you will receive an error message in English telling you the nature of the error.

- If you type an unrecognized command:

  ```
  ?What?
  ```

- If the command name is correct, but the arguments are wrong:

  ```
  ?bad
  ```

- If you type a numerical value that is not within the proper range for that parameter:

  ```
  ?range
  ```

- If you set the BEACON timing too often for busy channels:

  ```
  WARNING: BEACON too often
  ```

Here are a few more examples:

```
cmd:ASDFASDF
?What?              This is not a recognized command.

cmd:BEACON E
?bad                A parameter was left out.

cmd:PACLEN 265
?range              Unacceptable numerical value.

cmd:DAY
?clock not set      You did not set the PK-90's clock.
```

3.3.4 Command Names

The command name is the full word you can type to tell the PK-90 to execute this command. You can also give instructions to the PK-90 by typing a minimum abbreviation called a 'mnemonic' instead of the full word. You may always type out the entire command word, or any abbreviation longer than the minimum abbreviation. For example:

- The command MYCALL can be entered by simply typing 'MY.' (Note: DO NOT type the 'quotation marks' - we show these for clarity in identifying the letters you will type.)

The abbreviation 'M' is not enough (and will be interpreted as another command), but 'MY,' 'MYC,' 'MYCA,' 'MYCAL' or 'MYCALL' are acceptable.

If a command requires parameters, the type of parameter is indicated after the command name as well as the default value. For example:

- 'n' means the command takes a numerical parameter value.

3.3.5 Default Values

Some commands have initial values that the PK-90 assumes as defaults or 'used most often.' These defaults are stored in EPROM and loaded into RAM when the system is first powered up - or when you give the RESET command.

3.3.6 Parameters, Arguments and Values

Some commands need additional information before they can be executed. This type of command has 'parameters' or requires 'arguments.'

For example, a command such as FULLDUP has a Boolean parameter:

- The value that fills this parameter is either ON or OFF.

When you type FULLDUP ON, FULLDUP is the command, ON is its argument - the value you want the PK-90 to use to execute the command FULLDUP.

- Immediate commands such as ID have no parameters. Typing only 'ID' causes the PK-90 to execute the command.

Some commands such as CONNECT have optional parameters.

- If you enter CONNECT without an argument, the PK-90 displays the current status of the link.

However, if you enter CONNECT WAA111, the PK-90 issues the connect request and tries to establish the link to WAA111.

Some commands such as MFILTER can use several arguments at the same time. MFILTER accepts from 1 to 4 numerical arguments. You can type MFILTER 12 or MFILTER 12, 26. Both are legal commands.

Three different types of parameters are used: Boolean, numeric, and text or string.

Boolean Parameters

Boolean parameters have only two possible values, such as ON and OFF, YES or NO, or EVERY and AFTER. When a parameter is Boolean, its two possible choices are shown separated by a vertical bar. These values can be "toggled", or alternately switched.

Numeric Parameters

A parameter designated as 'n' is a numeric value. Numeric values can be entered as the familiar decimal numbers, or optionally, as hexadecimal numbers. When using hexadecimal notation, you must prefix the number you type with a '$' character.

The PK-90 displays some of these numeric parameters (those which set special characters) in hexadecimal format. Here is a brief explanation of 'hex' numbers:

The 'digits' of a hex number represent powers of 16 in the same manner as the powers of 10 represented by a decimal number. The decimal numbers 10 through 15 are hexadecimal digits A through F. For example:

$1B = (1 x 16) + (11 x 1) = 27 (decimal)
$120 = (1 x 256) + (2 x 16) + (0 x 1) = 288 (decimal)

Text or String Parameters

A parameter designated as text, such as the argument or 'message' for BTEXT (your 'beacon' message) or CTEXT ('connect' message), can be entered in either upper or lower case.

A text parameter can include numbers, spaces, and punctuation. The text is accepted exactly as you type it.

Some commands require call signs as parameters. Such parameters are usually call signs, but may be any string of numbers and at least one letter, up to six characters. The character strings identify stations sending and receiving packets.

A call sign can also include a substation identifier (SSID), a decimal number from 0 to 15 used to distinguish two or more stations on the air with the same call sign (such as a base station and a digital repeater or 'digipeater').

The call sign and SSID are entered and displayed as 'call-n.' If an SSID is not entered, the system sets it to 0 (zero); SSID '0' is not displayed by the PK-90.

Certain commands have parameters which are actually lists of call signs:

- The MFROM and MTO commands allow you to specify from one to eight call signs for selective monitoring.

- You must separate multiple call sign lists with either blank spaces or commas.

Some examples will help you understand these explanations.

- BEACON EVERY|AFTER 'n'

The BEACON command requires both Boolean and numeric arguments. You must specify either EVERY or AFTER (abbreviated to E or A), followed by an argument 'n' chosen from some range of values.

An appropriate entry would be BEACON EVERY 180 (this tells the PK-90 to send a beacon every 180 X 10 seconds, every 30 minutes), or BEACON EVERY 0 (tells the PK-90 to never send the beacon at all).

- CONNECT call1 [VIA call2[,call3...,call9]]

The CONNECT command requires a string argument 'call1.'

You may include the keyword VIA, followed by a list of from one to eight call signs, 'call2' through 'call9.'

Multiple call signs in the list must be separated by commas (as shown below) or by blank spaces.

An acceptable entry would be:

```
cmd:C XAAA V XBBB,XCCC
```

3.3.7 Using Commands Without Arguments

If you type a command name without an argument, the current value of the command's arguments is displayed. For example:

```
cmd:mdigi           Command typed without argument
MDIGI   ON          Displays the present value.

cmd:MDIGI Y         Sets the value to YES (ON)
MDIGI    was OFF    Displays the previous value
MDIGI    now ON     Displays the new value
```

NOTE: The DISPLAY command shows you the values of all parameters or groups of related parameters.

3.4 Controller Messages

The PK-90 will frequently send you messages during normal operating sessions. This section shows you typical messages and discusses the circumstances under which they can appear.

3.4.1 General Messages

```
AEA PK-90 Packet Controller
AX.25 Level 2 Version 2.0
Copyright (C) 1986, 1987 by
Advanced Electronic Applications, Inc.
Release 18.SEP.87
Checksum $6C
cmd:
```

This 'sign-on' message appears when you apply power to the PK-90, or when you issue the RESTART and RESET command. The release date will change in each new firmware release. The checksum is a hexadecimal number that you can compare against the correct check-sum given for the firmware version you are using. You can verify the correct checksum by contacting AEA and identifying the release date of your firmware.

```
PK-90 is using default values.
```

This message appears with the signon message shown above if the bbRAM (battery-backed RAM) checksum verification fails at the time power is applied. This causes the PK-90 to load the default parameters from ROM. (You will see this message the first time you apply power to the PK-90.) This message appears if the PK-90 loads the defaults in response to the RESET command, or when the firmware version is changed.

```
cmd:
```

This Command Mode prompt tells you that the PK-90 is waiting for you to issue a command. Anything you type after this prompt is read by the PK-90's command interpreter as a command to the PK-90. If a monitored packet is being shown, the prompt may not be visible, even though you are in Command Mode. If this happens, type the redisplay-line character (set by the REDISPLA command) to retype the prompt.

```
?What?
```

The PK-90 did not understand what you typed. ?What? is the response displayed any time you give the PK-90 an invalid command - an instruction that is not understood by its command interpreter.

```
was
now
```

The previous value is displayed whenever you change the value of one of the PK-90's parameters. The was and now responses confirm that the PK-90 properly interpreted your command, and remind you of what you have done.

3.4.2 Command Mode Error Messages

If you make a mistake typing a command to the PK-90, an error message is displayed. Depending on the type of error you have made, you may see the following messages:

```
?bad
```

You typed a command correctly, but the parameters, arguments or values in the command line could not be interpreted.

```
?VIA
```

You typed more than one call sign for the CONNECT or UNPROTO commands without the VIA keyword.

```
?callsign
```

You typed a call sign in a manner that does not meet the PK-90's requirements for call signs. A call sign may be any string of numbers and letters, including at least one letter. Punctuation and spaces are not allowed. Any substation ID used must be a decimal number from 0 to 15, separated from the call by a hyphen.

```
?clock not set
```

You typed the command DAYTIME to display the date and time, but you had not previously set the clock. DAYTIME sets the clock if it is typed with the daytime parameters, and displays the date and time if it is typed without parameters.

```
?not enough
```

You did not type enough arguments for a command that expects several parameters.

```
?need ALL/NONE/YES/NO
```

You did not type the arguments needed for CFROM, DFROM, MFROM and MTO.

```
?too many
```

You typed too many arguments for a command that expects several parameters. For example, MFILTER can have up to 4 arguments.

```
cmd:mfilter $1B,$0C,$1A,$03,$07
?too many
```

```
?too long
```

You typed too long a command line; the line was ignored. This might happen if you type a BTEXT or CTEXT message with more than 120 characters. The previous entry is not changed; your new entry is ignored.

?not while connected

You tried to change MYCALL or AX25L2V2 while already connected or in while trying to establish a connection.

?range

You typed a numeric argument too large for the specific command.

too many packets outstanding

This message appears after a CONVERSE or TRANS command if you have already typed packet data, filled the transmit buffer and then tried to return to the Command Mode. You can enter the mode after some of the packets have been successfully transmitted.

3.4.3 Link Status Messages

Link status messages show the status of packet AX.25 connections in which the PK-90 may be involved. You can ask for link status at any time from the Command Mode by typing the CONNECT command without parameters.

If you type a CONNECT command while the PK-90 is in connected state, your monitor will display the link status but the PK-90 will not take any other action.

The following messages appear in response to the CONNECT command.

Link state is: CONNECTED to call1
[VIA call2[,call3...,call9]]

Your station is connected to a distant station. The message shows the digipeater path in use, if any. The call sign sequence is the same sequence you would type to start the connection.

Link state is: DISCONNECTED

There is no link or connection at this time. You may type the CONNECT command to initiate a connection.

Link state is: CONNECT in progress

You typed a connect request, but the acknowledgment from the distant station has not been received. If you type the DISCONNE command, the connect process will be canceled.

Link state is: DISCONNECT in progress

You typed a disconnect request, but the acknowledgment from the distant station has not been received. If you type the DISCONNE command again the PK-90 is disconnected immediately.

Link state is: FRMR in progress

The PK-90 is connected to a distant station but a protocol error has occurred. This should never happen when AEA AX.25 systems are connected. An improper implementation of the AX.25 protocol could cause this condition. The PK-90 will try to re-synchronize frame numbers with the distant TNC, although a disconnect may result. Connections are invalid in this state; a disconnect command starts the disconnect process.

The PK-90 tells you whenever the link status changes. Link status may change in response to a command given the PK-90 (CONNECT or DISCONNE), a connect or disconnect request packet from a distant station, a disconnect resulting from exceeding the retry count, an automatic time-out disconnect (CHECK), or a protocol error.

* CONNECTED to: call1 [VIA call2[,call3...,call9]]

This message appears when the PK-90 changes from the 'disconnected' or 'connect in progress' state to the connected state. The connection may be a result of a CONNECT command typed by you, or a connect request packet received from a distant station.

* Connect request: call1 [VIA call2[,call3...,call9]]

The PK-90 has received but not accepted a connect request from a distant station. This can happen if you have set CFROM to NONE, or if you are already connected to another station. When the PK-90 displays this message, it also sends a DM packet (busy signal) to the station that initiated the connect request. If the PK-90 rejects a connect request because CFROM is set to NONE, you can issue your own connect request to the other station.

* DISCONNECTED: <call sign>

The PK-90 has changed to the disconnected state from any other link state. This message may be preceded by a message explaining the reason for the disconnect, as shown below.

* Retry count-exceeded
* DISCONNECTED: <call sign>

The PK-90 has disconnected because of a retry failure rather than a disconnect request from one of the stations.

* <call sign>-busy
* DISCONNECTED: <call sign>

Your connect request was rejected by a DM packet (busy signal) from the other station. The PK-90 rejects connect requests if CFROM is set to NONE, or if you are already connected to another station.

FRMR sent: xx xx xx

The PK-90 is connected but a protocol error has occurred. The PK-90 has sent a special FRMR packet and is trying to re-synchronize frame numbers with the distant station. The string xxxxxx is replaced with the hex codes for the three bytes sent in the information part of the FRMR frame. This message will not appear if the PK-90 is in Transparent Mode.

FRMR rcvd: xx xx xx

The PK-90 has received an FRMR protocol error described above. This message will not appear if the PK-90 is in Transparent Mode.

3.5 Special Keyboard Control Codes

Special uses have been assigned to certain keyboard characters. These characters are usually typed from the Command Mode. See the Command Summary in Chapter 7 for details on these control key commands.

CANLINE	CTRL-X	$18
CANPAC	CTRL-Y	$19
COMMAND	CTRL-C	$03
PASS	CTRL-V	$16
REDISPLA	CTRL-R	$12
SENDPAC	CTRL-M	$0D
START	CTRL-Q	$11
STOP	CTRL-S	$13
TIME	CTRL-T	$14
XOFF	CTRL-S	$13
XON	CTRL-Q	$11

3.6 Clear String Commands

The following commands can be cleared while in Command Mode by typing the command word followed by a single percent sign (%), an ampersand (&) or 'N,' 'NO,' 'NONE,' 'OFF' as the command's argument.

BTEXT	CFROM	CTEXT	DFROM	MBX	MFROM
MHEARD	MTO	MYALIAS	PASSWORD	SETPASS	

3.7 Detailed Command Descriptions

Chapter 7, Command Summary, presents detailed descriptions of each command contained in the PK-90's operating system software. You will find more information on the meaning, use and effects of each command, its parameters and mnemonics, default values and arguments. Examples of command usage are included.

3.8 General Operating Information

Before discussing the specifics of each the PK-90's operating modes, here are some command concepts applicable to all packet modes.

3.8.1 Formatting Commands

These commands affect transmitted or displayed signals, or both.

3.8.1.1 Screen Line Length (ACRDISP n)

The ACRDISP command (default 80) formats your computer's screen display. A <CR> (or <CR><LF> sequence when ALFDISP is ON) is sent to your computer at the end of a line when 'n' characters have been displayed.

- If your computer formats or wraps output lines, set ACRDISP to zero (0) to disable the PK-90's word-wrap function.

3.8.1.2 Monitor Echo (ECHO)

The ECHO command controls local echo by the PK-90 except in Transparent Mode. If the characters you type are correctly displayed, the ECHO function is set properly.

- If you do not see your typing on your display, set ECHO to ON.
- If you see each typed character doubled, set ECHO to OFF.

3.8.1.3 Line Feed (<CTRL-J>)

<CTRL-J> is part of the standard terminal keyboard 'RETURN' or 'ENTER' key operation and is normally sent with a carriage return.

You can insert '<CTRL-J>' in any text where you need an isolated line feed function without an associated carriage return. This is known as an 'index' function in word processing, and can be useful when formatting text files in your buffers.

3.8.1.4 Carriage Return (<CTRL-M>)

<CTRL-M> is part of the standard terminal keyboard 'RETURN' or 'ENTER' key operation and is normally transmitted together with a line feed.

You can insert '<CTRL-M>' in any text where you need an isolated carriage return function without an associated line feed. This is also known as a 'Zero-Index Carriage Return (ZICR)' function in word processing, and can be useful when formatting text files in your message buffers.

3.8.1.5 Backspace and Delete (<DEL>)

Use your keyboard's <BACKSPACE> to backspace. Depending on how you have set the 'BKONDEL' and 'DELETE' parameters, your BACKSPACE key may be a 'destructive' backspace key.

- If 'DELETE' is ON, typing <BACKSPACE> erases the characters from the screen and from the transmit buffer as well.

3.9 Escape Functions (<ESC>)

The echoed ESCAPE character can be either your keyboard's ESCAPE ($1B, ASCII 27) key, or the '$' dollar sign character ($24, ASCII 36). The default is the ESCAPE key.

This option is provided because some terminals and computer terminal emulator programs may interpret the ESCAPE character as a special command prefix. These terminals change display functions depending on the characters that follow the ESCAPE key.

- If your computer presents this problem, set ESCAPE to ON.
- See the MFILTER command which lets you strip or filter out any received characters and prevent them from reaching your computer or terminal.

3.10 Send Time of Day (<CTRL-T>)

Use the character specified by the TIME command (default <CTRL-T>) to insert the time of day in the text you type into the transmit buffer, or into a text file stored on disk.

The PK-90 reads the control code and sends the time to your radio in the data transmission code in use at that time, in format HH:MM, where 'HH' is the hour in the 24-hour system and 'MM' is the minute.

- If DAYSTAMP is ON the date is included with the time.

3.11 Clear Transmit Buffer (TCLEAR)

Use the TCLEAR command to clear the PK-90's transmit buffer and cancel any further transmission of data.

Type 'TCLEAR' or 'TC' followed by a <RETURN>.

- You must be in the Command Mode to use TCLEAR.
- Use <CTRL-C> (default) command to return to Command Mode.
- Type 'TCLEAR <RETURN>' or 'TC <RETURN>' to clear the transmit buffer.

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CHAPTER 4

PACKET OPERATION

4.1 General Information

This section describes basic packet operation. For your first packet practice, the PK-90 is connected in a 'loopback' circuit so that it 'talks to itself.' You will have a chance become familiar with packet operation before you actually go on the air.

We will describe commands used for routine packet operations. These commands will get you ready for the section, 'Your First Packet Session.' The 'Special Input Characters' section contains information on editing from your keyboard and special characters used by the PK-90.

Most commands can be abbreviated by typing only the first two or three characters. The mnemonics or minimum abbreviations for each command are shown in Chapter 7, the 'Command Summary' chapter, along with a full description of each command.

The PK-90 automatically enters the Command Mode when you first apply power or type the RESET command. If you have been in any other mode, type 'CONTROL-C' followed by a <RETURN>. The PK-90 answers with the following prompt:

```
cmd:
```

4.1.1 Change Radio Link Data Rate

The PK-90 provides radio link rates of 45, 50, 57, 75, 100, 110, 150, 200, 300, 600, 1200, 2400, 4800 and 9600 BPS. The default data rate is set at the factory for 1200 BPS, except in PK-90 units ordered with the optional DPSK modem board for 2400-BPS operation. Note that the DPSK-equipped units will operate only at 2400 BPS.

Use the HBAUD command from Command Mode to read or change the packet link data rate.

To read the present baud rate, type 'HBAUD <RETURN>' or 'HB <RETURN>.' The PK-90 responds with:

```
HBAUD    1200
```

To change the link rate, type 'HBAUD' followed two or three digits and a <RETURN>.

```
cmd:HBAUD 300<RETURN>
```

The PK-90 accepts the new baud rate and responds with the old baud rate:

```
HBAUD    was 1200
HBAUD    now 300
```

The number you enter becomes the new data rate and replaces the value previously stored in RAM. You can also change the baud rate one step at a time. For up type 'HB U' and for down type 'HB D'. The PK-90 responds with the previous rate, adopts and displays the new rate.

4.1.2 Station Identification

You must use the MYCALL command to install your station identification (call sign) in the PK-90's memory (see next section). If you intend to operate more than one station with the same call sign, the packet controllers must use some means of telling the difference between two operations under that same call sign - two stations cannot have identical station identifications. If they do, packet protocol will fail.

4.1.2.1 MYCALL Required at System Start-Up

When you start the PK-90 for the first time, the system is loaded from EPROM. All system parameters and values are those loaded at time of manufacture. MYCALL is initialized using PK90 as its default. You must use the MYCALL command to install your call sign in the PK-90. You cannot operate until you have done this. If you try to connect to a station without installing your call sign, the PK-90 will not transmit, but instead sends you this error message:

```
?need MYCALL
```

4.1.2.2 Substation Identifiers (SSIDs)

You can identify additional stations with the Secondary Station ID, or SSID - a number from 0 to 15, appended to the call sign by a dash:

```
cmd:MYCALL KXX123-1
```

If you do not specify the SSID extension, the PK-90 retains its default value of zero (0) and the SSID is not displayed. You must specify the SSID to connect to a station with a SSID other than 0 or use such a station as a digipeater:

```
cmd:CONNECT WAA555-2 (or)
cmd:CONNECT WXX111 VIA WBB555-2
```

4.1.2.3 Automatic Identification

The PK-90 can send an automatic identification (ID) packet every 9.5 minutes when your station is operating as a digipeater. You can turn this feature on with the command HID ON. ID packets are displayed like this:

```
KXX123>ID:KXX123 digipeater (or)
KXX123<ID:(MYALIAS), KXX123 digipeater
```

When you shut down, you can command a final ID with the ID command. The PK-90 sends these ID packets only if it has been digipeating.

4.2 Set Up Loopback Test Circuit

Do these steps in the exact order shown:

1. Get the shielded radio cable you set aside in Chapter 2.
2. Strip and tin the wires at the radio end of the cable.
3. Join the wires coming from Pins 1 and 4.
4. Insert the DIN plug end of the cable into the J3 connector on the PK-90's rear panel.

You have connected the PK-90's transmit audio output to its receive audio input. The PK-90 can now 'talk to itself' in 'loopback.'

4.2.1 'Connect' and 'Disconnect'

Packet radio contacts begin with a connect process that sets up the 'handshaking' between the two stations to insure error-free communications. Contacts or connections are ended by a disconnect process that leaves both stations free to start new contacts.

Packet connections can also use digipeaters - other packet stations that automatically relay packets from one station to another over a specified route. We are going to 'connect' the PK-90 to itself to see how this works. You have already set up the PK-90 in loopback; therefore, the PK-90 will receive as well as send packets.

4.2.2 LED Status and Mode Indicators

The PK-90's front-panel LEDs show you the operating mode and system status at any moment. Each LED is marked with an abbreviated name. Some LEDs have two name markings. All markings referring to packet operation are below the LEDs.

CONV	Converse	Lit when in the Converse Mode
TRANS	Transparent	Lit when in the Transparent Mode
CMD	Command	Lit when in the Command Mode
SEND	Send	Lit when PTT line is active
DCD	Data Carrier Detect	Lit when valid data signals received
STA	Status	Lit when unacknowledged frames exist
CON	Connect	Lit when valid connection exists
MULT	Multiple	Lit when multiple connection exists (Blinks when receive buffer is full)

4.2.3 LEDs at System Start or RESET

The PK-90 shows its status on the front-panel LEDs when you start the system:

CMD lit: The PK-90 is in Command Mode

4.3 System Loopback Test Connection

This first test uses your own call sign. Type 'CONNECT (MYCALL)'

```
cmd:CONNECT (MYCALL)
* CONNECTED te (MYCALL)
```

The LEDs change to show the PK-90 in Packet Mode, in CONNECTED state and in CONVERSE Mode.

STATUS: CONV lit, CON lit

The PK-90 sends special packets to set up a connection. These packets are now leaving the PK-90 on J3's Pin 1 and returning on Pin 4 without being transmitted over your radio.

4.3.1 Connect Message

* CONNECTED to MYCALL shows that the connection is established. The CON LED is now lit; the cmd: prompt does not appear on the next line. You are connected to yourself in Converse Mode, ready to begin. Try it. Type your message, ending the line with a <CR>:

```
Hello, there.
Hello, there. (Underscore here indicates received data)
```

4.3.2 Send Packet Character

<CR> tells the PK-90 to assemble your typed characters in a packet and transmit them. (We will explain how to use a different character to send packets in Chapter 7, the 'Command Summary' chapter.) In the Converse Mode, everything you type is assembled into packets, addressed and sent to the station to which you are connected. If a connect does not exist, the packet is addressed to CQ or whatever address you have typed into the UNPROTO field.

The PK-90 automatically enters Converse Mode when the connection is established. You can also command the PK-90 to move back and forth between Command and Converse Modes.

4.3.3 Return to Command Mode

Type '<CTRL-C>' (or whatever character you previously set ($00-$7F)) to return to Command Mode. The PK-90 does not echo the <CTRL-C>, but you should immediately see the Command Mode (cmd:) prompt.

You can return to Command Mode with the <BREAK> key. BREAK is a break in transmission (not an ASCII character) - your keyboard may have it.

If <CTRL-C> interferes with or stops your terminal program and you cannot send the BREAK signal, change the character that returns you to Command Mode. See 'COMMAND' in the Chapter 7, the 'Command Summary' chapter.

4.3.4 Return to Converse Mode

Type 'CONVERSE' to return to Converse Mode.

```
<CTRL-C>
cmd:CONVERSE
Whatever I type in Converse Mode is transmitted.
Whatever I type in Converse Mode is transmitted.
<CTRL-C>
cmd:
```

4.3.5 Terminate the Link - Disconnect

Type 'DISCONNE' (or 'D') to terminate the link or connection. The PK-90 transmits a special packet that ends the contact and notifies you when the link is disconnected:

```
cmd:DISCONNE
*** DISCONNECTED: (call sign)
```

An actual communication may be terminated by the other station. In that case, you will see the *** DISCONNECTED (call sign) message without having typed the command at your station.

You have now accomplished the basic operations of a packet communication:

- o You connected to the desired station to begin the communication.
- o You sent and received messages.
- o You disconnected from the distant station at the end of the communication.

4.4 Your First Packet Communication Session

There are more features you should be familiar with for comfortable packet operation - but you probably want to begin using the PK-90.

If possible, get help from an experienced packet operator to get you started. Be sure that the distant station is close enough to ensure good noise-free reception for your first 'on-the-air' communication.

4.4.1 System Cable and Switch Check

Before actually trying your first connection, take one more minute to verify your system setup:

1. Verify that the cable from the J3 connector is correctly wired to your radio's microphone jack.
2. Connect your radio to the PK-90 using the J3 jack.
3. Be sure you have adjusted the PK-90 and your radio using the installation procedure described earlier in this manual.

4.4.2 Starting the Communication

You are ready to try a connection. We will use XAAA in place of your call sign, and XBBB for the distant station's call sign.

Type '<CTRL-C>' to verify that you are in Command Mode. Type 'CONNECT XBBB' after the cmd: prompt. After a moment you should see:

```
cmd:connect xbbb
*** CONNECTED to XBBB
```

You have begun your first packet communication. The PK-90 and the packet controller at the distant station are automatically switched to Converse Mode. The other station sees:

```
*** CONNECTED to XAAA
```

Exchange several messages to get the feel of packet radio. Watch your radio's transmit indicators and, if possible, listen to the audio from both radios; you will get a better idea of what is happening. Your radio is inactive most of the time, even while you are typing.

When you reach the end of a line and type <CR>, your radio is keyed briefly. The distant station hears 'brrrraaaap' on his speaker. As your message is displayed on his computer, his radio will be keyed for an even shorter burst; you will hear 'brraap' on your speaker. This is the ACK, the packet acknowledgment coming back.

The PK-90 notes that the packet was received correctly, but does not display anything on your screen. This is normal operation. If your system still had any unacknowledged packets outstanding, the PK-90's STA (Status) LED would be lit - but it is not. (Unless you have set MCON to a value higher than '4,' your terminal will not display ACK frames.)

4.4.3 What If....?

If you have trouble connecting, take a few minutes to verify each of the following items. Verify that:

- The PK-90's AFSK Output Level control, your microphone gain and deviation are set properly as shown and discussed in Chapter 2.
- All cables and connectors are properly installed.
- Your radio's volume and squelch are set for local conditions.
- You are in Command Mode. (Type '<CTRL-C>' to confirm this. You must see the cmd: prompt.)
- If the cmd: prompt does not appear, press the PK-90's POWER switch off and then on again. You should get the normal sign-on message.
- TONE is set to 3 (or 2) for VHF, 0 or 1 for HF.
- HBAUD is 1200 if on VHF; 300 if on HF.
- CFROM is set to ALL.

Ask one of your area's more experienced packet operators to listen to your transmissions and monitor with his TNC. Both you and the distant station should set MONITOR and MCON to '5,' enter Converse Mode and send some packets. Each station should display packets sent by the other.

- o If only one station is 'hearing' properly, verify the modulator and transmitter of that station and the demodulator and receiver of the other station.
- o Experiment with the TXDELAY timing parameter for the sending TNC. Set TXDELAY 64 for a long delay. If this solves the problem, decrease TXDELAY to the smallest value that works all the time.

4.5 Automatic Operation

The PK-90 offers a variety of automatic operating features including beacon operation, digipeater function and auto-answer messages.

Your packet station can be a digipeater for relaying packets to a more remote destination. Functions like CONNECT MESSAGE take care of situations not easily solved in modes other than packet. See the 'Command Summary' chapter for full details on the PK-90's commands.

4.5.1 Beacon Operation

The PK-90 can send an automatic beacon message at specified intervals. A beacon can be special announcements, or the MAIL FOR list in a bulletin board operation. The values '0' to '250' set the beacon timing in 10-second intervals. '0' turns off the beacon.

- o Set your beacon text using the BTEXT command.
- o Set the beacon timing interval using the BEACON EVERY or BEACON AFTER command.

For example, to transmit your beacon at 15-minute (15 X 60 seconds) intervals, type:

```
cmd:BEACON EVERY 90 (Beacon is sent every 900 seconds)
cmd:BEACON EVERY 0  (Beacon is disabled)
```

EVERY sends your beacon text at regular intervals. AFTER sends your beacon once after the specified interval after the last packet activity on the channel.

A beacon frame may be sent directly, and also sent via the digipeat addresses specified by the UNPROTO command.

Proper beacon timing avoids cluttering a busy channel with unnecessary transmissions. Used with discretion, the automatic beacon function can be useful to verify propagation conditions and show useable radio paths. However, excessive beacons can be a source of interference to good traffic flow. Use your beacon with consideration for others on the channel.

If you set the BEACON timing at a value considered too small for busy channels (less than '90'), you will see:

WARNING: BEACON too often

This warning appears in the Command Mode each time you type a command to remind you that your beacon interval may too short; your beacon may be bothering other channel users and it needs your attention.

4.5.2 Will You Accept Connections?

CFROM determines if call requests are accepted or rejected, which calls are accepted and which are rejected. You can also use synonyms CONOK ON and CONOK OFF in place of CFROM ALL and CFROM NONE. CFROM has four arguments: ALL, NONE, YES and NO.

ALL and NONE are used alone in the following manner:

- ALL - the PK-90 accepts connect requests from all callers;
- NONE - the PK-90 rejects connect requests from all callers.

YES and NO require a list of call signs:

- YES (list) - up to eight call signs whose call requests will be accepted;
- NO (list) - up to eight call signs whose call requests will be rejected.

CFROM's default argument is ALL. If ALL, the PK-90 will accept connect requests from any station that sends you a connect request.

Type 'CFROM NONE' or 'CONOK OFF' to reject connect requests from all stations. If the PK-90 receives a connect request when CFROM is set to NONE, your monitor displays:

*** Connect request: <call sign>

Your PK-90 sends the calling station a DM packet, or 'busy signal.' The caller sees:

*** MYCALL busy
*** DISCONNECTED: (call sign)

You can set the CFROM field to accept or reject call requests from specific stations.

To accept calls from one or more specific stations, type 'CFROM YES' (plus a list of calls signs). Connect requests will be accepted only from listed callers.

To reject calls from one or more specific stations, type 'CFROM NO' (plus a list of call signs). Connect requests will be rejected only from stations whose call signs are listed.

Type CFROM to display the ALL/NONE/YES list/NO list status of station call signs to be rejected or accepted. You can use the abbreviated command form or mnemonic:

```
cmd:cfrom                          cmd:cf
CFROM    yes XBBB, XCCC, XCCC-5    CFROM    all
```

You can include SSIDs as '-n' after the call sign.

- If CFROM is set to NO XAAA or YES XAAA, any combination XAAA, XAAA-1,...XAAA-15 will be matched and processed.
- If CFROM is set to YES XAAA-1 or NO XAAA-1, then only XAAA-1 will match and be processed.

You can send your own connect command if you wish to communicate with the calling station even though his call request has been rejected.

Clear CFROM with '%,' '&,' or 'OFF' as arguments.

Error messages will result from invalid commands. Here are some examples:

```
cmd:cfrom all xaaa
?too many                 (calls not allowed with ALL or NONE)

cmd:cfrom no
?not enough               (NO and YES require call sign list)

cmd:cfrom xaaa
?need ALL/NONE/YES/NO     (Calls must follow YES or NO)
```

4.5.3 Are You Available to Chat?

Set CMSG ON (default is OFF) and use the CTEXT command to enter the type of message you might put in a telephone answering machine. If you are not available to answer connect requests, the PK-90 automatically sends the CTEXT message to each station that connects to your system.

The CTEXT message can be any text string up to 120 characters. You can include <CR>s by prefixing them with the pass character (<CTRL-V> is the default):

```
cmd:CTEXT Sorry, I cannot talk right now.<CTRL-V><CR>
I will be on the air again after 8 PM.<CTRL-V><CR>
Joe
```

CFROM must be set to ALL (default) so that the connection takes place in order that this message be sent to stations connecting to you.

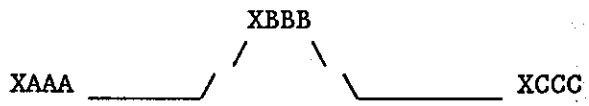
4.5.4 Do You Want to Transmit?

If you want to leave your station on to monitor and perhaps record the activity on the channel, but prevent your station from transmitting, set XMITOK OFF. In this case, you would probably want to set CFROM to NONE as well.

Type 'XMITOK OFF'
Type 'CFROM NONE'

4.6 Digipeater Details

You may wish to connect to a packet station that is beyond your direct radio range. If a third packet station is on the air and both you and the station you want to talk to are in range of that third station, the third station can relay or 'digipeat' your packets. You set up the 'digipeater' routing when you request the connection. The PK-90 automatically includes the necessary routing information in the transmitted packets. Here is a sketch that shows how digipeating can solve problems:



You are station XAAA - you want to have a packet communication with XCCC. But there is a mountain between you and XCCC; you are out of range of each other. However, you know that there is a packet station located on the ridge - XBBB - which is in range of you and XCCC.

Instruct the PK-90 to set up a connection to XCCC using XBBB as an intermediate digipeater. After the cmd: prompt, type: 'CONNECT XCCC VIA XBBB.'

You can specify a routing list of up to eight intermediate stations. For example, consider a modification of the example above:

XBBB has turned off his station, but you can still contact XCCC by going around the mountain through XDDD and XEEE. This time, type the connect command like this:

cmd:CONNECT XCCC VIA XDDD,XEEE

Type the digipeaters' call signs in the exact order of the intended path from your station to the station with which you wish to connect.

4.6.1 Are You a Digipeater?

Your station can be a digipeater for other stations. You do not have to 'do' anything. Your PK-90 digipeats other stations - unless you tell it not to! See the DFROM command in the Command Summary chapter.

The default argument of DFROM is ALL. If your transmitter is keyed when you are not using it, or during lulls in your own conversations, your PK-90 is being used as a digipeater by some other stations. This will not bother your communication with the distant station.

Set MDIGI to ON (default is OFF). The packet headers on your monitor will show the call signs of the stations that are using your station as a digipeater, and the data being transmitted.

If MRPT is ON (default), you will also see your call sign in the packet header, showing the digipeater path in which you are included. The call sign of the station whose packet is being decoded is marked with as asterisk. Assume that your call sign is 'XBBB'. Here is a sample taken with Monitor 4 (default), MDIGI ON and MRPT ON:

```
XAAA*>XBBB>XCCC:
What time is the meeting?
XCCC*>XBBB>XAAA<RR>
```

4.6.2 Do You Want to be a Digipeater?

Many operators use their stations as digipeaters to provide a simple form of packet networking. If local circumstances prevent you from being a digipeater, you can disable the digipeat function.

DFROM's default argument is ALL. ALL means that the PK-90 will normally repeat packets from any station that includes your station's call sign in their digipeat path.

You can also use synonyms DIGIPEAT ON and DIGIPEAT OFF in place of DFROM ALL and DFROM NONE.

Type 'DFROM NONE' if you do not want to be used as a digipeater.

DFROM determines if your station will digipeat other stations, and which stations packets will be digipeated.

DFROM works with four arguments: ALL/NONE or YES/NO.

ALL and NONE are used alone and work in the following manner:

- ALL - your PK-90 will repeat packets from any station;
- NONE - your PK-90 will not repeat packets from any station.

YES and NO work with a list of call signs:

- YES (list) - call signs of up to eight stations whose packets will be repeated;
- NO (list) - call signs of up to eight stations whose packets will be not be repeated.

To repeat packets from one or more specific stations:

- Type 'DFROM YES' (plus a list of calls signs). Packets will be repeated only to and from listed callers.

To reject packets from one or more specific stations:

- Type 'DFROM NO' (plus a list of call signs). Packets will not be blocked only to and from stations whose call signs are listed.

Type 'DFROM' to display the ALL/NONE/YES list/NO list status of station call signs whose packets will or will not be repeated. You can use the abbreviated command form or mnemonic:

```
cmd:dfrom
DFROM    all

cmd:df
DFROM    yes XAAA, XBBB, XCCC, XDDD
```

You can add SSIDs as '-n' after the call sign.

- If DFROM is set to NO XAAA or YES XAAA, any combination of XAAA, XAAA-1,...XAAA-15 will be matched and processed.
- If DFROM is set to YES XAAA-1 or NO XAAA-1 then only XAAA-1 will match and be processed.

Clear DFROM with '%,' '&,' or 'OFF' as the argument.

Error messages will result from invalid commands. Here are some examples:

```
cmd:dfrom all xbbb
?too many                (calls not allowed with ALL or NONE)

cmd:dfrom no
?not enough              (NO and YES require call sign list)

cmd:dfrom xbbb
?need ALL/NONE/YES/NO    (Calls must follow YES or NO)
```

4.7 Unsuccessful Connections and Retries

Sometimes your attempt to connect to another station will fail; the desired station may not be on the air, it might be out of range, or you could have typed the other station's call sign incorrectly. If the distant station does not respond to your first connect request packet, your PK-90 will try again.

Use the RETRY command to control the number of times the PK-90 will repeat the connect request. The default value is 10. If your PK-90 does not get an ACK after that number (RETRIES) of repeats, it quits and shows:

```
*** Retry count exceeded
*** DISCONNECTED: (call sign)
```

4.7.1 Retries While Connected

The same retry mechanism and count continues after the connection is established, you are in Converse Mode and the communication has begun. Each packet frame sent by your PK-90 must be acknowledged or 'ACKed' by the other station, and vice versa. ACK means that the packet was received correctly at the distant station; the error-detection protocol indicated it was received without errors. (This is how packet radio provides error-free communication.)

At times a packet will not be received correctly by the other station because of collisions with packet signals from other stations, or because of channel noise. If your PK-90 does not get an ACK within a specific time, it sends the same packet again and increments the retry count. If the count set by RETRY is exceeded, your PK-90 disconnects and displays:

```
*** Retry count exceeded
*** DISCONNECTED: (call sign)
```

The automatic disconnect feature avoids excessive retransmitting of useless packets. The disconnect prevents a 'hopeless' condition from tying up the channel if, for example, the other operator turns off his station without disconnecting, or your path is through a digipeater that stops operating, or the RF channel deteriorates to the point of being unusable.

If you are operating under special conditions such as a marginal HF channel, you can set RETRY to 0 (zero) to disable all automatic disconnects - the number of retry attempts is not limited. Use this zero value (infinite retries) with discretion.

4.8 Monitoring Activity on the Channel

This section describes the monitor functions.

In addition to displaying data from the station to which you are connected, you can monitor all packet activity on the channel or display packets flowing between other stations. The PK-90 will also store the call signs of all stations heard on the channel.

4.8.1 Monitoring Other Stations

Use the MONITOR parameter to set the monitoring method; what stations will or will not be monitored and the type and amount of information shown by the monitor.

MONITOR takes a numerical value between zero (0) and six (6). Each higher number adds more detail to the monitoring. As the value of MONITOR settings is increased, additional functions are included in the monitoring sequences.

The meanings of the MONITOR numbers are:

0 Monitoring is disabled.

1 Only unnumbered, 'unconnected' frames are displayed. Use 1 for 'unprotocolled,' communication with multiple stations. Other connected stations using the frequency are not displayed. This setting will also display beacons.

2 Numbered (I) frames are also displayed. I-frames are numbered in order of generation and appear in a connected transmission. Use this to monitor connected conversations in progress.

3 Connect request (C) frames and disconnect (D) frames are also displayed with the headers.

4 This is the PK-90's default value. Unnumbered acknowledgement (UA) of connect and disconnect frames are also displayed with either the characters UA or DM and a header.

5 Receive Ready (RR), Receive Not Ready (RN), Reject (RJ), Frame Reject (FR) and I-Frames (I) are also displayed.

6 Poll/Final bit and sequence numbers are also displayed.

Before this next step, verify that your loopback test cable is still connected to the PK-90's J3 RADIO connector.

- Type: <CTRL-C> D <RETURN> to make sure you are DISCONNECTED.
- Type: MONITOR 4. The PK-90 responds with: MONITOR was 4.
- Type: CONVERSE, then type: 'This is a test packet.'

Your monitor now shows:

```
MYCALL>CQ:This is a test packet.
```

Because the UNPROTO parameter is defaulted to the address CQ, your packets are sent to CQ - you are not connected to any other station. Your packet was 'heard' and decoded by the PK-90 and displayed with the packet header containing the sending station's call sign and the destination.

4.8.2 Monitoring Digipeaters - The MRPT Command

Set MRPT ON to see any digipeater stations being used. This feature is useful if you want to connect to a station you are monitoring and need to know a digipeater route in order to reach it. For example, you might see the following:

```
XAAA*>XBBB>XCCC:Hello, Bill!
```

This packet went from XAAA via XBBB to XCCC. The '*' shows you which station you actually heard. If the PK-90 had decoded the packet from XBBB, the display would have shown:

```
XAAA>XBBB*>XCCC:Hello, Bill!
```

If several digipeaters are active, or if the message lines are long, the display may be difficult to read. You can put the header on a separate line from the text by setting HEADERLN ON:

```
XAAA*>XBBB>XCCC:
Hello, Bill!
```

4.8.3 Monitoring Other Stations While Connected

Use the MCON command for selective monitoring of other traffic on the channel while connected to a distant station. MCON works like MONITOR, but affects your display while in the connected state. As the value of MCON is increased, additional functions are included in the monitoring sequences.

The PK-90's default (MCON 0) tells your system not to show packets from other stations while you are connected to any station. This lets you converse without interruption and confusion caused by the mixture of everyone else's packets and those of the distant station.

You might use MCON set to 1 to monitor the Mail List beacons from a PBBS while holding connected conversations with the distant stations on the channel. Whenever a beacon is sent, that message is displayed while you are connected to another station. (See previous sections.)

4.9 Selective Monitoring

The MFROM, MTO and MONITOR commands provide certain monitor features not previously available. You can use these commands in combination to display or hide traffic to and from any stations or combination of stations as required. You might want to inhibit display of a busy electronic mail system while you are monitoring other conversations.

4.9.1 The MFROM Command

MFROM uses arguments to determine how the PK-90 monitors packet channels and displays information - which stations' packets will be displayed and which stations' packets will be masked or hidden.

MFROM is set to ALL when you start the PK-90 for the first time.

- Type MFROM to display the ALL/NONE/YES list/NO list status of call signs of stations from whom packets will or will not be displayed. You can use the abbreviated command form or mnemonic:

```
cmd:mfrom
MFROM    all

cmd:mf
MFROM    yes XAAA, XBBB, XCCC, XDDD
```

- To stop display of all packets:

  type 'MFROM NONE' and 'MTO NONE'

  This has the same effect as setting MONITOR to zero (0).

- To display packets only from one or more specific stations:

  type 'MFROM YES' (followed by a list of calls signs).

  Only packets from stations whose call signs are listed after YES will be displayed. MTO should be NONE.

- To hide or mask packets only from one or more specific stations:

  type 'MFROM NO' (followed by a list of call signs).

  Only packets from stations whose call signs are listed after NO will not be displayed.

You can add optional SSIDs specified as '-n' after the call sign. If MFROM is set to NO WAA12 or YES WAA12, any combination of WAA12, WAA12-1, WAA12-15 will be matched and processed. If MFROM is set to YES WAA12-1 or NO WAA12-1, then only WAA12-1 will match and be processed.

When MFROM and MTO contain different types of arguments, to avoid any possible conflict, the arguments take the following priority:

ALL, NO-list, YES-list, NONE

Clear the MFROM field by typing '%,' '&,' or 'OFF' as the argument.

Error messages will result from invalid commands. Here are some examples:

```
cmd:mfrom all waa12
?too many                (calls are not allowed with ALL or NONE)

cmd:mfrom no
?not enough              (NO and YES require call sign list)

cmd:mfrom waa12
?need ALL/NONE/YES/NO    (Calls must follow YES or NO)
```

4.9.2 The MTO Command

MTO functions like MFROM and uses identical arguments to determine how the PK-90 monitors the packet channels and displays information; the stations whose packets will be displayed or hidden. MTO is set to NONE when you start the PK-90 for the first time.

- To display the ALL/NONE/YES list/NO list status of call signs of stations to whom packets will or will not be displayed:

  type 'MTO'

  You can use the abbreviated command form or mnemonic:

  ```
  cmd:mto
  MTO    all

  cmd:mt
  MTO    yes XAAA, XBBB, XCCC, XDDD
  ```

- To stop display of all packets:

  type 'MFROM NONE' and 'MTO NONE'

  This has the same effect as setting MONITOR to 0 (zero).

- To display packets only to one or more specific stations:

  type 'MTO YES' (followed by a list of calls signs).

  Only packets from stations whose call signs are listed after YES will be displayed. MFROM should be NONE.

- To hide or mask packets only to one or more specific stations:

  type 'MTO NO' (followed by a list of call signs).

  Only packets to stations whose call signs are listed after NO will not be displayed.

You can add optional SSIDs specified as '-n' after the call sign. If MTO is set to NO WBB2 or YES WBB2, any combination of WBB2, WBB2-1, WBB2-15 will be matched and processed. If MTO is set to YES WBB2-1 or NO WBB2-1, then only WBB2-1 will match and be processed.

When MFROM and MTO contain different types of arguments, to avoid any possible conflict, the arguments take the following priority:

ALL, NO list, YES list, NONE

Clear MTO with '%,' '&,' or 'OFF' as the argument.

Error messages will result from invalid commands. Here are some examples:

```
cmd:mto all wbb2
?too many                (calls are not allowed with ALL or NONE)

cmd:mto no
?not enough              (NO and YES require call sign list)

cmd:mto wbb2
?need ALL/NONE/YES/NO    (Calls must follow YES or NO)
```

4.9.3 The MCON Command

Use the MCON command for selective monitoring of other traffic on the channel while connected to a distant station. Use this feature to 'listen' for a specific station while you are connected to someone else.

Set MCON to 0 or OFF to monitor packet activity when your station is not connected, but have all monitoring automatically cease when you are connected to someone.

MCON works like MONITOR but affects your display while connected. As MCON settings are increased, more functions are added in monitoring sequences. The meanings of the parameter values are identical to those shown for the MONITOR command.

4.9.4 The MFILTER Command

Use the MFILTER command to 'filter' selected characters from packets received. For example, you can command the PK-90 system to filter out form feeds or bell characters that may be sent by the station with which you are connected, but which may interfere with your display or otherwise disturb your operations. You can specify up to four characters by giving the ASCII character codes in either hexadecimal or decimal numbers.

The default value of $80 (hex) filters all received control characters except <CTRL-M>, the carriage return, <CTRL-J>, the line feed, and <CTRL-I>, the TAB character.

When entering hexadecimal numbers, be sure to prefix the number with the '$' sign. Some examples follow:

- To prevent a <CTRL-L> character from clearing your screen, set MFILTER to 12.
- To eliminate <CTRL-Z> characters, which some computers interpret as end-of-file markers, set MFILTER to 26.
- To prevent <CTRL-G> characters from 'beeping' your computer or terminal, set MFILTER to 7.

Enter the ASCII or hexadecimal values of the selected characters separating each value with a comma:

```
cmd:MFILTER $07, $13
```

4.9.5 The MHEARD Monitor Buffer

Use the MHEARD command to display a list of stations heard since the last time you applied power to the PK-90, or since the last time the MHEARD buffer was cleared. Entries in the 'heard' report are also time stamped if the date and time has been set.

Clear the MHEARD buffer by typing either a 'percent sign' (%), an ampersand (&), 'N,' 'NO,' 'NONE' or 'OFF' after the command word.

- Stations heard directly are marked with a '*.'
- Stations heard through a digipeater are not marked.

4.9.6 MSTAMP - The Monitor Time-Stamp Command

Monitored packets can be time-stamped if DAYTIME has been set. To enable this function, set MSTAMP ON. You can also time-stamp connect and disconnect messages with the command CONSTAMP ON.

- If DAYSTAMP is OFF, CONSTAMP and MSTAMP show only TIME.
- If DAYSTAMP is ON, the DATE is included in CONSTAMP and MSTAMP.

Set DAYSTAMP ON when you want a dated record of packet channel activity, or when you are unavailable for local packet operation.

4.9.7 DAYTIME - Set the Real-Time Clock

Use the DAYTIME command to activate the PK-90's real-time clock by setting the date and time. The PK-90 displays current date and time information.

After the clock is set, you can display the time by entering DAYTIME without parameters. If you have removed power from the PK-90 since the last time you entered DAYTIME, you will have to reset the clock. The PK-90's time is updated continually as long as power is applied.

The clock is not set when the PK-90 is turned on. The DAYTIME command will display the following error message:

```
cmd:daytime
?clock not set
```

You must reset the date and time each time you RESET or remove power from the PK-90. Otherwise CONSTAMP and MSTAMP will not 'stamp' the time. The format of the display is dd-mm-yy hh:mm:ss.

```
DAYTIME  03-Feb-87  06:57:33
```

The format for entering the date and time is 'yymmddhhmmss,' where:

```
yy is the last two digits of the year
mm is the two-digit month code (01-12)
dd is date (01-31)
hh is the hour (00-23)
mm is the minutes after the hour (00-59)
ss is the seconds after the minute (00-59)
```

Example:
```
cmd:daytime 870628145040
DAYTIME  28-Jun-87  14:50:40
```

4.10 Packet Formatting

The PK-90 uses certain special characters to control its operations. Many of these special characters can be used to edit commands and text as you type. You can personalize these features to suit yourself and your computer. Most of the special input characters are active in both Command and Converse modes; any exceptions will be noted.

Some of the PK-90's command parameters affect how your packets are formatted - how your typing appears to other stations. Other commands permit correction of typing errors before your packet is sent, cancel lines, and cancel entire packets if necessary.

If the default command character is unsuitable for your computer's terminal program, you can redefine each function using any ASCII character appropriate to your needs.

See Chapter 7, the 'Command Summary' chapter for full details on how to define these formatting and control features and commands.

4.10.1 PACLEN - Long or Short?

PACLEN sets the maximum length of your packet - the largest number of typed characters that can fit in one packet. If you type more than the maximum number of characters (default 128) without typing a 'send--packet' character (default <CR>), the PK-90 will send a maximum-length packet.

Experimental evidence shows that reducing PACLEN to 64 or even 32 can improve throughput under difficult conditions such as on HF radio.

In Transparent Mode, a packet is sent if the maximum number of characters is typed before the timer set by PACTIME forces a packet to be sent.

NOTE: Some other packet systems may be unable to accept packets longer than 128 characters.

4.10.2 Backspace and Delete

You can erase typing errors with your <BACKSPACE> key. If your terminal lacks <BACKSPACE>, set DELETE ON to erase characters with the <DELETE> key; set DELETE OFF to use the <BACKSPACE> key.

You will probably want to use the same key your computer normally uses to 'rub out' typing. If you are not sure what your rubout key does, try both settings of the DELETE command and see which works.

When you rub out typing errors, the PK-90 tries to correct the screen display. This works with most computers and display-type terminals. It will not work for hardcopy-type terminals. If your display does not look right after you rub out a character, try setting BKONDEL OFF. The PK-90 will not correct the display but will show the rubout with a '\' character (<BACKSLASH>). Restore the display correction by setting BKONDEL ON.

4.10.3 Cancel Line

If you make several mistakes in a line, or if you change your mind, you can cancel the whole line rather than rubbing out the characters one at a time. Your monitor displays a <BACKSLASH> and a <CR>.

Type <CTRL-X> to cancel the line. If you are in Command Mode, a new prompt appears:

```
cmd:Hi, John, how are you?<CTRL-X>\
[You started typing text while in Command Mode.]
cmd:CONVERSE
Hi, John, how are you?
```

4.10.4 Redisplay

If you have erased and retyped lots of characters, you may want to see 'fresh' input, especially if BKONDEL is OFF. The PK-90 shows the line you are entering when you type <CTRL-R>:

```
cmd:CONNECT ZAA#\\\ZAA#<CTRL-R>\
[You mis-typed the call sign.]
cmd:CONNECT WAA123
```

Here you mis-typed the first letters of the call and rubbed them out. The PK-90 displayed '\' for each letter erased. You then retyped the call and redisplayed the characters on the new line.

4.10.5 XON/XOFF, START/STOP - Display Flow Control

Type <CTRL-S> to stop the display if your monitor scrolls the data faster than you can read it.

Type <CTRL-Q> to resume output from the PK-90 to your computer.

4.10.6 The PASS Character

You may want to include a special input character in a packet. For example, to send several lines in the same packet, you must include <CR> at the end of each line, bypassing its 'send-packet' function except at the intended end of the packet. You can include any character in a packet (including all special characters) by prefixing that character with the pass character, <CTRL-V>:

```
I was not at the meeting.<CTRL-V><CR>
What happened?
```

Without the PASS character, this message would go as two packets. By prefixing the first <CR> with <CTRL-V>, you send it all at once, but maintain the <CR> in the text.

4.10.7 More Carriage Returns and Line Feeds

If you have set the send-packet character to <CR>, you will probably want the <CR> to be included in the packet for display at the other end.

If you set the send-packet character to a non-printing character, you will probably want that character to be treated only as a command. The ACRPACK command determines whether the send-packet character is echoed and included in the packet.

Set ALFPACK to ON to add a <LF> after the <CR> in your packets. If the other station reports that lines are overprinted on his display and he cannot change it at his end, set ALFPACK to ON.

These formatting features and commands are described in full detail in Chapter 7, the 'Command Summary' chapter.

4.11 Multiple Connections

Multiple connections are a powerful addition to the PK-90's operation. This feature can be very useful for message net operation, multi-user electronic mail and host computer systems, path checking and conversations with multiple stations.

A multiple connection is not the same as a 'multi-way' contact. In a multiple connection, you can establish separate 'point-to-point' links with several different stations. In a multi-way contact (this feature is not available yet), several stations are simultaneously connected to each other, a network in which each station sees all of the data passed from any station in the group, with full error correction in effect.

4.11.1 Default Multiple-Connect Conditions

At start-up time and until you change it, the PK-90 defaults to the following multiple-connect conditions:

CONPERM	OFF	CHCALL	OFF	CHDOUBLE	OFF
CHSWITCH	$00	USERS	1		

These defaults set the PK-90 to operate exactly as would a TNC without the multiple-connect feature. The key to setting 'normal' operation is the value USERS = 1.

4.11.2 The USERS Command - Multiple-Connect Active

The USERS command affects only the manner in which incoming connect requests are handled, and has no effect on the number of connections you initiate with the PK-90.

A numerical value 'n' from 0 to 10 specifies the number of active simultaneous connections that can be established with the PK-90. For example:

USERS 0	allows incoming connections on any free logical channel
USERS 1	allows incoming connections on logical channel 0 only
USERS 2	allows incoming connections on logical channels 0 and 1
USERS 3	allows incoming connections on logical channels 0, 1 and 2

and so on, through USERS 10.

4.11.3 CHSWITCH Character Selection

CHSWITCH selects the character that shows that a new multiple-connect channel is being addressed. The value 'n' 0 to $FF (0 to 255 decimal) specifies an ASCII character.

- CHSWITCH characters must not be channel numbers (0 to 9).

The PK-90's default for CHSWITCH is $00, which disables the function. This default was selected to prevent conflicts with characters found in some network maps. If you are using the PK-90 as the TNC for an electronic mail system, the default value of $00 is recommended.

A suggestion: Set the CHSWITCH character to any hexadecimal value from $80 to $FF, for any character that you will not normally use. You can switch 'logical channels' in a multiple-connect situation by typing the CHSWITCH character even when in the Converse Mode.

The CHSWITCH character can be PASSed in CONVERS mode, and is always ignored as a user-initiated channel switch in TRANSPARENT mode; it just flows through as data. However, the outgoing channel cannot be changed while active or 'on-line' in TRANSPARENT mode.

4.11.4 The CHCALL Command - Display Multiple-Connect Call Signs

CHCALL displays the call sign of the 'connected-to' station after the channel identifier. CHCALL is especially useful when operating with multiple connections. Using CHCALL is similar to using MRPT to show digipeat paths when monitoring the channel.

Set CHCALL ON if you intend to operate multiple connections.

4.11.5 The CHDOUBLE Command - Display Doubled Characters

When CHDOUBLE is set ON, your monitor displays received characters as doubled characters if they are the same as your CHSWITCH character.

Set CHDOUBLE ON when operating with multiple connections to tell the difference between CHSWITCH characters received from other stations and CHSWITCH characters generated by the PK-90.

4.11.6 General Hints on Multiple-Connect Operation

Here are some general suggestions on multi-connect operation.

1. Choose the equals sign (=) as your switch character.

   Type 'CHSWITCH $3D' to enter the = sign. Type 'CHSWITCH'<CR> to verify acceptance. Your monitor displays: CHSWITCH $3D.

2. To see the call signs of the stations with whom you are connected, type 'CHCALL ON.'

3. To accept the maximum number of permissible multi-connects, type 'USERS 10.'

4. Assume you want to connect to XAAA and XBBB. From Command mode, type:

   ```
   cmd:=0 CONNECT XAAA
            and
   cmd:=1 CONNECT XBBB
   ```

   If you are not successful with either call, the PK-90 displays:

   ```
   cmd:=0: *** Retry count exceeded
   *** DISCONNECTED: XAAA
   =1: *** Retry count exceeded
   *** DISCONNECTED: XBBB
   ```

5. After you are connected, you can tell who's talking to you:

   ```
   =0:XAAA:  hello headquarters
   =1:XBBB:  ready with new data
   ```

6. To talk with XAAA in Converse mode, type:

   ```
   =0 hello base 4
   ```

   To talk with XBBB, do the same thing for his channel:

   ```
   =1 go ahead camp 2
   ```

7. To disconnect from XAAA, type:

   ```
   <CTRL-C>=0DISCONNECT
   ```

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CHAPTER 5

ADVANCED OPERATION

5.1 Introduction

This chapter describes special aspects and advanced concepts beyond those used in routine keyboard-to-keyboard or conversational operation.

Read this chapter carefully if you intend to use the PK-90 for:

- An electronic mail system (EMS)
- A packet bulletin board system (PBBS)
- Binary file transfers
- A 'host' program or host computer
- Remotely-controlled repeater operation
- Macro command or data strings
- Special timing or other requirements needed by your radio

5.1.1 Using Hex Notation

If you reassign parameter values in hexadecimal numbers, observe some simple rules:

- Begin the number with a '$.'
- Digits of a hexadecimal number represent multiples of powers of 16. The values 10 through 15 are represented by the letters A through F.
- Letters can be typed in upper or lower case. For example:

$1B = (1 x 16) + (11 x 1) = 27 (decimal)

5.2 Command Mode

The PK-90 has three operating modes. We discussed the Command and Converse Modes briefly in Chapter 4.

- Transparent Mode, the third mode, is a data mode like Converse Mode, but is intended primarily for computer data interchange rather than human conversation. Transparent Mode is discussed later in this chapter.

Command Mode provides the human dialogue between your keyboard and the PK-90; nothing goes to the 'outside world.'

- You must use Command Mode to change the values of the PK-90's operating parameters.

When the PK-90 is in Command Mode, the Command Mode prompt is shown at the beginning of each input line.

```
cmd:
```

(Note that the cmd: prompt may have scrolled off the screen if the PK-90 has received and displayed packets.)

The PK-90 always enters Command Mode after RESTART, RESET or a power cycle. After a power-off/power-on sequence, the PK-90's PROM software reinitializes the PK-90's operating parameters.

After the RESET command is issued, all operating parameters are reset to the default values stored in PROM. The values of most parameters are stored in RAM and can be easily changed.

5.2.1 Data Transfer Modes

Data transfer modes can be entered several ways from Command Mode.

- Type 'CONVERS' (or 'K') to enter Converse Mode.

- Type 'TRANS' (or 'T') to enter Transparent Mode.

If you are in Command Mode when another station connects to your station, your PK-90 automatically switches to the data transfer mode set with the CONMODE command. Use the CONMODE command to specify the data transfer mode to be used at automatic entry.

- CONMODE TRANS automatically selects Transparent Mode

- CONMODE CONVERS returns to the default choice of Converse Mode

Timing of automatic entry into data transfer mode depends upon which station in the link initiated the connection.

If your PK-90 accepts a connect request, your system always enters the data transfer mode at the moment your PK-90 sends the connect acknowledgment (ACK) and displays the '*** CONNECTED to <call sign>' message.

- Unless NOMODE is set ON, the PK-90 always switches to the data transfer mode at the moment of connection.

Any text sent to the PK-90 is queued into packets waiting for a valid connection before being sent. If the connect attempt fails, your system returns to Command Mode. The system also automatically returns to Command Mode when either station disconnects the session.

5.2.2 Special Characters Used in Command Mode

The following commands set special characters which are active in the Command Mode. For detailed descriptions of these commands see the Chapter 7, the 'Command Summary' chapter.

COMMAND	DESCRIPTION
CANLINE	Cancel current line
CANPAC	Cancel packet output
CHSWITCH	Change logical channel
COMMAND	Enter Command Mode
DELETE	Delete character with destructive backspace
MFILTER	Characters to be filtered in monitored packets
PASS	Insert after special character
REDISPLA	Redisplay current typed line
SENDPAC	Transmit the packet
START, STOP	Computer flow control characters (sent to PK-90)
XOFF, XON	PK-90 flow control characters (sent to computer)

5.2.3 Display Control in Command Mode

The following commands affect display features which are active in the Command Mode. For detailed descriptions of these commands see Chapter 7, the 'Command Summary' chapter.

COMMAND	DESCRIPTION
ACRDISP	Automatic <CR> insertion after n characters
ALFDISP	Add <LF> after <CR> in data sent to terminal
BKONDEL	Echo after character deletion
CASEDISP	Change or ignore case of received characters
ECHO	Automatic echo of serial port input
FLOW	Type-in flow control
HEADERLN	Insert <CR><LF> after packet header
MONITOR	Set monitor activity level
NUCR	Nulls after <CR>
NULF	Nulls after <LF>
NULLS	Null count
STATUS	Display or suppress PK-90 command responses

5.3 Flow Control

Whenever data is transferred between computers or terminals, the data may be received faster than the receiving system can handle it. Some programs deal with this by providing data buffers for storing incoming data until the program is ready for it. This sometimes only postpones the problem; all buffers have size limitations.

To prevent loss of data, the computer commands data flow by telling the other device to stop sending data until the computer can empty its buffer. When the computer's buffer has been flushed and is available again, the computer tells the other device to resume sending data. You are probably already familiar with flow control that allows you to stop the output from the computer while you read the data, and restart the output when you are ready for more.

5.3.1 Type-in Flow Control

Type-in flow control (set by the FLOW parameter) is a display feature. When FLOW is ON, the PK-90 does not allow incoming packets to interrupt when you are typing a command or outgoing packet.

When you type the first character of a word (except for echoing your typing) the PK-90 'holds' output going to the computer. This 'hold' remains in effect until you type <CR> to end the command, type the send-packet character to mark the end of a packet, or erase or redisplay the line you have started.

Some computers have difficulty simultaneously sending and receiving characters over the serial port. This is most commonly the case for computers with 'software UARTs.' Type-in flow control improves operation of such computers with the PK-90.

5.3.2 Data Flow Control

In Command Mode, the PK-90's input buffer may fill up if you try to type a command that is too long.

In Converse Mode the buffer may fill up for any of several reasons:

- o You may be using a faster serial port baud rate than the radio data rate.
- o Radio data transmission may have slowed down because of noise or other users on the channel.
- o The other person or computer may have stopped output from that system.

The PK-90 signals the computer to stop sending data when the buffer has space for only about 80 characters. When the buffer fills up entirely, data will be lost. When the buffer empties to the point where there is room for at least 270 characters, the PK-90 signals the computer to start sending data again.

Some less-sophisticated computer file transfer programs may be unable to process data fast enough to keep up with the PK-90's output. The computer must respond to interrupts from its I/O devices in order to read every character. Some simple programs may poll the input register for new data and data may be lost if the polling is not done often enough. Some computers disable interrupts during disk accesses. If the program enters a routine which does not allow it to check for data or respond to it, the computer should signal the PK-90 to stop sending data.

The PK-90 provides two methods of flow control:

- XON/XOFF flow control, sometimes called 'software flow control,' sends a special character (default <CTRL-S>) to stop the output and another special character (default <CTRL-Q>) to restart the output.

- Hardware flow control requires that both the PK-90 and the computer use the CTS (Clear To Send) and RTS (Request To Send) lines of the RS-232C serial interface standard.

Some commonly used file transfer and terminal programs for home computers do not provide flow control in software; some serial ports do not support hardware flow control. Although the RTS and CTS lines appear at the connector, they may not be used on some computers unless the software reads the state of the CTS line. If the PK-90 seems to lose data during file transfers, flow control is probably the problem.

5.3.3 XON/XOFF (Software) Flow Control

If your terminal program does not provide CTS/RTS (hardware) flow control, set XFLOW ON to use XON/XOFF flow control.

The PK-90 default flow control characters are <CTRL-S> and <CTRL-Q>. These characters can be changed to suit your needs.

- The XON and XOFF commands define the characters sent to the computer by the PK-90.

- The START and STOP commands define the characters sent to the PK-90 by the computer.

After sending a STOP character, your computer may receive as many as four characters from the PK-90; some characters may already be 'en route' through serial I/O chips.

A STOP/START character sent to the PK-90 will be ignored if the PK-90 is already stopped/started. If the STOP/START characters are the same, that character 'switches' the output, turning it off when it is on, and on when it is off.

You can disable XON/XOFF flow control in one direction only by setting the appropriate flow control characters to 0 (zero). The PK-90 automatically uses CTS flow control to stop input from the computer.

In Transparent Mode, XON/XOFF flow control is normally disabled; all characters are treated as data. If DTR/RTS flow control is not available, set TXFLOW ON and XFLOW ON to activate the XON and XOFF characters (the commands from the PK-90 to the terminal).

In Transparent Mode, set TRFLOW ON to activate START and STOP characters (the commands to the PK-90 from the terminal). Note that this mode is no longer truly 'transparent' when the flow-control feature is enabled.

5.3.4 Hardware Flow Control

Transparent Mode usually uses RS-232 RTS and CTS lines for flow control signals. Hardware flow control is usually less dependent on the way a given communication terminal program is written.

The XFLOW OFF parameter activates hardware flow control in Converse Mode and Command Mode. Your computer may receive a few characters after it signals the PK-90 to stop sending; some characters may be 'en route' already through serial I/O chips.

5.4 Converse Mode

Converse Mode is the data transfer mode most often used for routine keyboard-to-keyboard communication and message handling. The PK-90 assembles your typed data in packets and sends the data to the radio.

To return to Command Mode from Converse Mode:

- Type the Command Mode entry character (default CTRL-C), or
- Send a BREAK signal to the serial port.

Although BREAK is not a regular ASCII character, it can frequently be sent by typing a special key on the keyboard.

- A BREAK signal is a usually either a polarity reversal or continuous 'mark' or 'space' signal on the serial port's Transmit Data (TXD) line for more that 200 milliseconds.

The timing of the BREAK signal is not critical. Many serial ports recognize a BREAK if the 'steady-state' signal lasts significantly longer than the time required for transmission of a character. Because the BREAK signal is easily generated with circuitry outside the computer, return to Command Mode is guaranteed in automatic station operation.

5.4.1 SENDPAC Character

Use the SENDPAC command to select a character as the send-packet command. You can include or exclude the send-packet character in the transmitted packet.

The send-packet character forms the typed characters into packets for transmission. The default SENDPAC character is the <CR>. The default PACLEN is 128 characters.

If you type a full-length packet (128 characters PACLEN value) without typing the send-packet character <CR>, your typed characters are assembled with synchronization, address, control and error-correction information and sent after the 128th typed character.

With <CR> as the send-packet character, it is natural to include it in the packet text as well as interpreting <CR> as a command.

- Set ACRPACK ON to send the <CR>

If you use some other character to force packet transmission, you may want to set ACRPACK OFF and inhibit transmission of the send-packet character.

5.4.2 CANPAC Character

Use the CANPAC parameter to select the cancel-packet character.

If you set the send-packet character to something other than <CR>, use the cancel-packet character to cancel packets of more than one line.

Single-line packets can be canceled with either the cancel-line character or the cancel-packet character.

5.4.3 Special Characters in Converse Mode

The following commands set special characters which are active in Converse Mode. For detailed descriptions of commands see Chapter 7, the 'Command Summary' chapter.

COMMAND	DESCRIPTION
CANLINE	Cancel current line
CANPAC	Cancel packet output
CHSWITCH	Change logical channel
COMMAND	Enter Command Mode
DELETE	Delete character with destructive backspace
MFILTER	Characters to be filtered in monitored packets
PASS	Insert after special character
REDISPLA	Re-display current typed line
SENDPAC	Transmit the packet
START, STOP	Computer flow control characters (sent to PK-90)
XOFF, XON	PK-90 flow control characters (sent to computer)

5.4.4 Display Features in Converse Mode

The following commands activate the display features which are active in Converse Mode. For details refer to the discussions of these commands in Chapter 7, the 'Command Summary' chapter.

COMMAND	DESCRIPTION
8BITCONV	Retain high-order bit from serial port
ALFDISP	Add <LF> after <CR>
BKONDEL	Echo after character deletion
ECHO	Automatic echo of serial input
ESCAPE	<ESCAPE> character translation
FLOW	Type-in flow control
LCOK	Lower case translation
NUCR	Null characters after <CR>
NULF	Null characters after <LF>
NULLS	Null count
ACRDISP	Automatic <CR> insertion after n characters

5.5 Transparent Mode

Use the Transparent Mode to transfer eight-bit data files, executable or object code files such as CP/M 'CMD' or 'COM' and PC/MS-DOS 'COM', 'EXE' or 'ARC' files. These files contain characters that conflict with control characters used in Converse Mode. BASIC program listings and documents created with word processors that write binary or non-ASCII files can also pose this problem.

Packet radio can be ideal for transferring data and programs between computers. While Converse Mode works well for transferring ASCII text files, executable object code and some types of data files use eight bits in each byte, rather than the seven bits used in ASCII code.

Like Converse Mode, Transparent Mode is a data transfer mode. But, in Transparent Mode 'special' characters do not exist - everything you type (or everything your computer sends to the PK-90) is transmitted exactly as you send it to the PK-90.

5.5.1 Input Editing and Packet Timing

Use the PACTIME command to set the time intervals at which the data is formed into packets and transmitted.

Transparent Mode does not permit input editing. The send-packet character is not used. Packets are sent at a programmed, timed, regular interval, or when a full packet of information (PACLEN = 128 bytes) is ready.

5.5.2 Display Features in Transparent Mode

Transparent Mode modifies the PK-90's monitor display characteristics. Data is sent to the computer exactly as received over the radio, with all eight bits of each byte received. Auto-linefeed insertion and screen wrap are disabled, as is echoing of input characters.

The parameters controlling these latter features in the Command and Converse Modes are not changed on entry into Transparent Mode; all display features are reestablished when the PK-90 is returned to Command Mode.

Transparent Mode also disables most of the link status messages that appear as the PK-90 cycles between disconnected and connected states.

5.5.3 Escape or Exit from Transparent Mode

In order for the Command Mode entry character (default <CTRL-C>) to be transmitted freely in Transparent Mode, switching from Transparent Mode to Command Mode is a bit more complicated.

- Use BREAK to return to Command mode, just as in Converse Mode.
- Use the Command Mode entry character (<CTRL-C>) as follows:

  1. Wait a moment after typing the last character being sent. The minimum required wait is set by the CMDTIME parameter.
  2. Type three Command Mode entry characters (<CTRL-C>) within an interval CMDTIME of each other.

After a final CMDTIME interval during which no characters are typed, you will see the command prompt. The default value of CMDTIME is one second. Note that you cannot escape from Transparent Mode using this second procedure if CMDTIME is set to zero.

If any characters are typed during this interval (even Command Mode entry characters), the escape will be aborted; all Command Mode entry characters you have typed are sent as packet data.

5.6 Commands That Affect Protocol

Certain commands affect the operation of the packet protocol. A full copy of the AX.25 protocol can be obtained from sources listed in the bibliography in the Appendices at the end of this manual.

5.6.1 AX25L2V2 - On or Off?

The PK-90 uses the AX.25 Level 2 protocol, rules by which the PK-90 communicates with other packet systems.

- Set AX25L2V2 ON to operate in Version 2.0
- Set AX25L2V2 OFF to operate in Version 1.0

Digipeating may not work if a Version 2.0 packet is sent through a digipeater using certain older packet controllers or TNCs.

The CHECK parameter controls a timing function that depends on the protocol version selected.

5.6.2 UNPROTO Address

UNPROTO permits you to address 'unconnected' packets, as well as route your beacon and ID packets through digipeaters. The default address for unconnected packets is CQ. The format is similar to that of the CONNECT command:

```
cmd:UNPROTO QTC VIA WAA123
```

For example, if you set UNPROTO to QTC other stations will see your beacon like this:

```
MYCALL>QTC
```

5.6.3 PASSALL - The 'Junk Mode'

When PASSALL is ON the PK-90 ignores error checking. That function of the protocol is disabled for all packets monitored. When PASSALL is ON, any 'packet' is displayed that meets the following conditions:

- The packet must start with a flag field.
- The packet must contain an integral number of eight-bit bytes, up to 330 bytes.

PASSALL is sometimes known as the 'junk' mode. PASSALL is useful in diagnosing connection failures and protocol problems. It is not really useful in ordinary packet operations.

5.7 Packet Timing Functions

The PK-90 obeys timing instructions built in to the protocol. Timing is adjustable to compensate for variable operating conditions, local circumstances and goals. The default timing values can be changed at any time for experimentation, and then returned to the original values as needed.

Experiment with other values for these parameters. You cannot harm the PK-90 by changing timing values. On the contrary, you may improve its performance.

5.7.1 TXDELAY

TXDELAY controls the delay between the transmitter's PTT line is set active the moment when the PK-90 starts sending data. The PK-90 transmits a series of contiguous synchronizing signals (flags) while holding PTT active but not sending data.

Radios vary greatly in the time delays that occur when switching from receive to transmit and from transmit to receive. These switching-time delays affect both ends of the packet link:

- o Time for your transmitter to deliver power to the antenna, starting from the moment when the PK-90 keys the PTT.
- o Time for the distant station's receiver to recover full sensitivity and overcome squelch/AGC rise-time characteristics.
- o Transmitter and receiver synthesizer or phase-lock loop settling times at both ends of the link.

If the PK-90 starts sending data before your transmitter is producing power, or before the distant station's receiver has recovered from transmitting and synchronized to the incoming signal, the packet will not be received properly at the distant end.

TXDELAY must be taken into account in cases where external amplifiers use RF-driven switching.

5.7.2 AXDELAY and AXHANG

The AXDELAY parameter permits additional delay in the PK-90 so that the repeater receiver and transmitter have time to lock up.

The AXHANG parameter sets the time the PK-90 assumes is needed for the repeater to drop.

You may require a longer key-up delay when sending packets through a voice repeater than normally needed for direct communications. However, the extra key-up delay is not required if the repeater has not had time to 'drop' since the last transmission.

If the PK-90 has detected channel activity recently enough so that the repeater transmitter might still be on, it will wait only TXDELAY time before sending data, rather than adding AXDELAY time as well.

TXDELAY and AXDELAY set times in units of 10 milliseconds. AXHANG sets time units of 100 milliseconds.

If AXDELAY is in effect the total key-up delay is:

Key-up delay = (TXDELAY + AXDELAY) x 10 milliseconds.

If activity has been heard more recently than AXHANG x 10 milliseconds ago, the key-up delay will only be

Key-up delay = TXDELAY x 10 milliseconds.

5.7.3 BXDELAY

The BXDELAY parameter is used in a trunked radio system in conjunction with the SQUELCH input line on the PK-90's J3 Pin. When BXDELAY is set to 0 (zero), J3 Pin 5 is a true SQUELCH input as described under the SQUELCH command.

When BXDELAY is set to any value between 1 and 120, Pin 5 becomes a "grant" or "OK TO SEND A DATA FRAME" line. An active-going transition on Pin 5 initializes the BXDELAY counter. An inactive-going transition disables the BXDELAY counter. If the countdown reaches a value of zero, the frame is sent. The value of 'n' in 10-millisecond increments sets a time value. If the grant on Pin 5 lasts longer than the BXDELAY time, the frame is sent. If the grant never occurs, or does occur but doesn't last longer than BXDELAY, a command called RQTIME will cause the cycle, starting with PTT, to occur once again.

5.7.4 HHANG

Repeaters both trunked and standard vary widely in the switching delays between receive and transmit. This imposes additional special requirements on a packet radio controller. The HHANG parameter aids in handling operation with these repeaters.

When in a connected state, if HHANG is set to any value other than 0 (zero), the PK-90 keys the PTT line and sends bursts of sync flag at regular intervals. This keeps the channel active and the repeater keyed.

When there is activity on the channel, bursts are not sent. The PK-90 waits HHANG times 100 milliseconds after the last channel activity, sends a burst and then repeats it every HHANG times 100 milliseconds. Bursts are not sent while in the disconnected state or if HHANG is set to 0 (zero).

The length of the HHANG burst is set by the value assigned to TXDELAY.

5.7.5 FRACK and RETRY

The AX.25 protocol retransmits packets when an acknowledgment frame is not received from the distant end of the link within a specified time. The FRACK parameter (FRame ACKnowledge time) sets the a delay before the originating station retransmits the packet.

A packet might not be acknowledged because of noise or collision with another packet transmission. If other stations are on the channel, your link partner may not be able to acknowledge the received packet immediately.

The RETRY parameter sets the maximum number of retransmissions before the originating station abandons further retries and terminates the connection. The maximum number of packet transmissions is RETRY+1; the initial transmission does not count as a retransmission.

Setting RETRY to 0 (zero) specifies an infinite number of retries.

FRACK is automatically corrected for the additional time required for digipeating. The time interval before the PK-90 retransmits an unacknowledged packet is

Retry interval = FRACK x (2 x n + 1) seconds

where 'n' is the number of digipeaters used for this connection.

5.7.6 DWAIT

The DWAIT parameter sets the PK-90's wait time in ten-millisecond intervals. If digipeating is not being done by anyone in your local area, this parameter can be set to 0 (zero). In any event it should be set to the same value by all members of a local area packet group.

Digipeated packets require an end-to-end acknowledgment. Digipeaters do not acknowledge the packets they relay. If a link includes several digipeaters, the possibility of losing either the original packet or the acknowledgment increases drastically.

To help alleviate this problem, an automatic wait time can be imposed on any station not transmitting a digipeated packet. Stations waiting for a clear channel to transmit packets wait for this time interval after the channel clears before transmitting. This wait does not apply if the station is transmitting one or more digipeated packets. This usually gives the digipeater a clear chance at the channel.

To minimize unnecessary retries, the PK-90 applies a collision-avoidance strategy to all packets except those being digipeated. On the second and subsequent transmissions of a given packet, the PK-90 waits additional random time after detecting a clear channel before transmitting. This prevents repeated collisions of transmissions by the same two stations. The random time is a multiple (0 to 15) of the TXDELAY time.

For the first transmission of a packet, the time between the PK-90's detection of loss of carrier and activation of the PTT line is:

Wait time = DWAIT x 10 milliseconds

For retries of the same packet, the interval is:

Wait time = (DWAIT + r x TXDELAY) x 100/16 milliseconds,

where 'r' is a random number from 0 to 15. Therefore, the longest amount of time added randomly is 0.094 x TXDELAY seconds. For the default value of TXDELAY = 30, the longest time added is 2.8 seconds.

NOTE: DWAIT is inoperative if PPERSIST is ON. Channel access is then controlled by p-persistent CSMA instead of DWAIT (1-persistent CSMA).

5.7.7 MAXFRAME

The MAXFRAME parameter sets the maximum number of packets which the PK-90 will send before waiting for acknowledgment. (This does not mean that the PK-90 will wait until several packets have been typed before transmitting.)

The AX.25 protocol permits the transmission of several packets without waiting for an acknowledgment. The number of packets that can be sent before acknowledgement is known as the 'window.' The window concept permits more efficient channel use if large amounts of data are being transferred.

MAXFRAME, in combination with the PACLEN parameter (which sets the maximum number of characters in a packet), determines how much information can be sent in a single burst transmission. The best combination for efficient data transfer depends upon channel quality and the rate at which the terminal can process data.

For a 1200-baud terminal data rate, begin with a combination that produces about 300 characters outstanding at one time. As MAXFRAME is increased, it may be necessary to increase FRACK to allow proper response time for ACKs from the distant end.

5.7.8 CHECK and RELINK

The CHECK parameter is a timeout function that prevents the PK-90 from remaining connected to a distant station when the other station disappears for longer than the specified time.

CHECK sets a connection timeout specified in multiples of ten-second intervals. The PK-90 uses this time somewhat differently, depending on the settings of AX25L2V2 and RELINK.

If AX25L2V2 is OFF and RELINK is ON, the link is preserved by initiating a reconnect call; the PK-90 returns to the 'connect-in-progress' state and sends connect request (SABM) frames. In addition, the PK-90 adds a random time of up to 30 seconds each time CHECK occurs in a given connection.

When RELINK is OFF, the PK-90 goes to the 'disconnected' state and sends a disconnect (DISC) frame.

If AX25L2V2 is ON the PK-90 polls the distant station with RR frames RETRY times. If there is no answer, the PK-90 goes to either the 'disconnected' state or 'connect in progress' state, depending on the setting of RELINK.

5.7.9 RESPTIME

The RESPTIME parameter sets a delay between the receipt of a packet and the transmission of the acknowledgment packet. This delay helps prevent collisions between an acknowledgment and another packet from the sending station. RESPTIME's value is primarily in file transfers. For normal service, RESPTIME is best set to 0 (zero) by the station sending the file.

The station receiving the file in a file transfer should set RESPTIME to 10 (default) or 12.

5.7.10 PACTIME

The PACTIME parameter sets packet transmission timing in the Transparent Mode. You can choose the way packet transmission is timed. It is best to send packets at regular intervals if you are typing manually to a remote computer.

If your computer is operating a remote host or bulletin board program, send packets after an interval without further input from the host or computer.

Use the CPACTIME parameter to enable PACTIME in Converse Mode.

5.7.11 RQTIME

The RQTIME parameter is active only if BXDELAY is greater than zero.

RQTIME is used in trunked radio systems in conjunction with BXDELAY in a situation where the radio never delivers a "grant" signal to Pin 5 of J3. For example, if the trunked system is busy and never delivers a channel for the packet user, it's desirable that the "PTT, grant, send packet frame" sequence be repeated. Some trunking systems will not search for a channel again after failing to find a channel the first time unless the PK-90 sends a new PTT signal to the radio. Then RQTIME will cause a timeout that will recycle the sequence.

RQTIME is specified in 1 to 250 intervals of one (1) second and has a default value of 20 seconds.

If RQTIME is 1 or greater, if a "grant" signal does not occur on Pin 5 of J3 during connected or calling modes, the PK-90 drops the PTT line and waits the FRACK time interval until the next retry.

5.8 Macros and Command Strings

The PK-90 can store up to ten macro command or data strings numbered from 0 (zero) to 9.

A macro is a string of alphanumeric characters that can be "recorded" and stored for future use. Macros are usually called or activated by a single keystroke.

The System Administrator can create macros containing frequently-used commands or system instructions to improve the efficiency of operation by non-technical personnel.

- All PK-90 macro commands start with a numeric character 0-9.
- You can make 10 macros of about 51 bytes each.
- A total of 10 macros can be created.
- Ten macros may not exceed a total of 512 bytes. One byte equals one character.

To set the macro's contents, type the following sequence:

- The macro number;
- The letter M;
- space bar;
- the macro contents;
- carriage return.

For example, at the command prompt, type:

cmd:2M connect ABC123 (CR)

From this point on, if you type 2M at the cmd: prompt in the command mode, the PK-90 will display the contents of macro number 2.

```
cmd: 2M
connect ABC123
```

To execute the macro, type only the macro number at the cmd: command prompt:

```
cmd: 2
connect ABC123
```

To erase a macro:

- Type a new macro over it or
- Enter the number, M, a space, %, followed by (CR).

You can also use &, OFF, N and NO.

You can install an entire string of commands in a single macro.

Type the macro number and M, followed by the commands separated by a slant bar (/) or (CR). For example, typing "macro number 3":

```
cmd:3M AX25L2V2 ON/TXDELAY 50/FRACK 4 (CR)
```

If you wish to use the (CR) as a separator, you must type the PASS character (default CTRL-V) before each carriage return to avoid ending the macro command. For example:

```
cmd:3M AX ON <CTRL-V> (CR) TXD 5 <CTRL-V> (CR) FR 4 (CR)
```

The entering of a macro command is subject to the same 128 character limit as any normal command.

After a macro command has placed the PK-90 in CONVERSE or TRANSPARENT mode, you cannot use a macro to return to the COMMAND mode. The usual exit command string:

<CTRL-V><CTRL-C><CTRL-V><CTRL-C><CTRL-V><CTRL-C>

does not operate from within a macro. You must have the PK-90 set to revert to COMMAND mode by itself, for example, using the WDISCONN command, or you must enter the COMMAND character manually.

Macros cannot be executed remotely using the REMOTE command over a radio link.

Macros cannot be used recursively, that is, you cannot use a macro to set or execute another macro.

5.9 Remote Control and Secure Operation

The PK-90 can be controlled remotely over the same radio link on which it operates as a data controller or digital data repeater. The System Administrator can configure the PK-90 for remote access with password protection and data encryption. You may wish to restrict operations by non-technical operators or operation by unauthorized persons.

Access to most of the PK-90's commands and parameter values can be restricted by the use of PASSWORD and SETPASS (discussed later in this chapter). In addition, all data and commands transferred over the radio link can be encrypted to prevent disclosure of information to casual observers or unauthorized parties. See the special cautions below under REMOTE and also in the Command Summary chapter.

5.9.1 REMOTE

The REMOTE command provides a remote-control port which is activated when the PK-90 is addressed as MYCALL with an extension of -15.

Set REMOTE ON to enable remote control of the PK-90 by radio commands. When REMOTE is set ON and the PK-90 is addressed as MYCALL-15, the PK-90 answers connect requests as a remotely-controlled TNC, as well as normal connect requests addressed to MYCALL. When REMOTE is set OFF, the PK-90 answers only normal Connect Requests sent to MYCALL.

To acquire control of the remote PK-90 whose operational callsign is XAAA, use the following connect request sequence:

```
cmd:connect XAAA-15
```

5.9.2 PASSWORD

A PASSWORD is a string of up to eight (8) alphanumeric characters in either upper or lower case. The PK-90 ignores case in passwords.

If PASSWORD and SETPASS are set (activated), the user must enter the PASSWORD to acquire control of the PK-90. This applies to both local and remote operation. If SETPASS is not empty, PASSWORD must match SETPASS to obtain access.

PASSWORD and SETPASS are effective when using remote control by radio link. See the 'Command Summary' in Chapter 7 for further information on REMOTE, KEYWORD and RKEYWORD for details on encryption of the command link.

Caution: After using privileged or password-protected commands, the user should clear PASSWORD to prevent subsequent users from seeing the PASSWORD - the contents of PASSWORD can be displayed on the screen.

Do not DISCONNECT the remote link from the remote PK-90. Return to the COMMAND mode at your local PK-90 and send the "D" (DISCONNECT) command to the remote PK-90.

Clear PASSWORD with any one of the following: %, &, OFF, N, NO, NONE.

5.9.3 SETPASS

SETPASS is a string of up to eight (8) alphanumeric characters in either upper or lower case. The PK-90 ignores case in SETPASS.

You may wish restrict access to the PK-90 commands by non-technical operators, or prevent operation by unauthorized persons. Access to most of the PK-90's commands and parameter values can be restricted by the use of SETPASS and PASSWORD (discussed earlier in this chapter).

SETPASS is typed into the PK-90 by the System Administrator. This sets the PASSWORD for privileged commands.

If SETPASS is not empty, PASSWORD must match SETPASS to obtain access.

If SETPASS and PASSWORD are both set (activated), the user must enter the PASSWORD to match SETPASS in order to acquire control of the PK-90 or to execute privileged commands. This applies to both local and remote operation.

If PASSWORD does not match SETPASS, SETPASS may not be set or read.

Caution: After using privileged or password-protected commands, the user should clear PASSWORD to prevent subsequent users from seeing the PASSWORD - the contents of PASSWORD can be displayed on the screen.

The following commands are not privileged:

BEACON	DISPLAY
BTEXT	K
CONNECT	MHEARD
CONVERSE	PASSWORD
CSTATUS	RESTART
CTEXT	TRANS
DAYTIME	UNPROTO
DISCONNE	WDISCONN

Setting a macro is privileged; executing a macro is not.

Setting character values such as CANLINE or CANPAC is privileged; using the characters is not.

Clear SETPASS with any one of the following: %, &, OFF, N, NO, NONE.

5.9.4 KEYWORD

You may wish to encrypt private conversations on the radio link, or to encrypt sensitive remote-control functions.

When a PK-90 is addressed as MYCALL with any extension or SSID from 0 to 14, it uses KEYWORD on the link.

When a PK-90 is addressed as MYCALL-15, it uses RKEYWORD on the link.

KEYWORD is any numeric value from 0 (zero) to 65535. KEYWORD specifies the encryption key to be used in encoding and decoding data.

When KEYWORD is set to 0 (zero), encryption is disabled and plain text is transmitted over the radio link.

When KEYWORD is set to any decimal value between 1 and 65535, encryption is enabled.

When KEYWORD is set to the same value in the PK-90s at each end of the link and a "-15" address is not used to call the remote PK-90, then the data typed by the users on the radio link will be encrypted.

When a remote PK-90 is addressed as a "MYCALL-15" and RKEYWORD is set to the same value as KEYWORD in the other PK-90, then all commands and data on the radio link will be encrypted.

Note: Both ends of the link must use the same numerical key. See the following RKEYWORD command discussion in this chapter.

Observers not involved in the encrypted link or unauthorized persons monitoring the link between the two PK-90s will see normal packet address headers. However, the user data or information contained in the packet frame is displayed as apparently random ASCII characters, unless KEYWORD matches that used by the linked PK-90s. For example, a supervisor might wish to monitor the link.

Some of the received characters will be interpreted by the observer's system as control characters and cause erratic display behavior. The casual viewer may see random line feeds and carriage returns, clear-screen commands and meaningless screen effects.

Other users on the same channel may monitor the channel for their own traffic and block out the apparently unintelligible screen information. These users can use the MTO NO and MFROM NO command with the callsigns shown in the packet headers between the encrypted stations.

NOTE: Intentional encryption of either data or control functions is not allowed in the Amateur Radio Service.

5.9.5 RKEYWORD

RKEYWORD operates with the remote access functions when a caller connects to the PK-90's MYCALL call-sign with "-15" appended to MYCALL.

You may wish to use encryption when controlling a PK-90 remotely over the radio link. The PK-90 uses RKEYWORD on the link when addressed as MYCALL-15. When the PK-90 is addressed as MYCALL with any extension or SSID from 0 to 14, it uses KEYWORD on the link.

RKEYWORD is any numeric value from 0 (zero) to 65535, and specifies the encryption key to be used in encoding and decoding data. When RKEYWORD is set to 0 (zero), encryption is disabled and plain text is transmitted over the radio link. When RKEYWORD is set to any decimal between 1 and 65535, encryption is enabled.

Set RKEYWORD greater than 0 (zero) to enable data encryption. Any value greater than zero encodes the data so that it cannot be read by the casual observer. RKEYWORD and KEYWORD do not use a highly-sophisticated encryption algorithm.

RKEYWORD is set at the controlled remote PK-90, while KEYWORD is set at the controlling PK-90. RKEYWORD cannot be changed remotely.

Packet protocol headers are transmitted in clear text. Only the user data field or information typed by the user is encrypted.

For additional information on RKEYWORD and encryption, see the discussion of the KEYWORD and REMOTE commands in this chapter.

NOTES: Both ends of the link must use the same numerical key. See the KEYWORD command discussion earlier in this chapter.

Intentional encryption of information is not allowed in the Amateur Radio Service.

5.9.6 Operating Restrictions

Do not set the remote PK-90 MYCALL with an SSID of -15. Do not set any values in the remote PK-90 that could cause you to lose control. Do not set TXD to 0, or XMITOK to OFF. Set MCON to 5 or less, preferably 0, on the remote PK-90.

If the remote PK-90 is in the CONVERSE mode and you wish to return it to the COMMAND mode, type the PASS character <CTRL-V> before the COMMAND character so that the COMMAND character is not interpreted as a "return to Command Mode" instruction by your PK-90.

The PASS character <CTRL-V> will not return the remote PK-90 to the Command Mode from Transparent Mode. First, set your COMMAND character to something other than the COMMAND character used on the remote PK-90. Then sent the "escape" sequence shown in the CMDTIME command description, using the COMMAND character set in the remote PK-90. Then reset your COMMAND character to its original value if necessary.

CHAPTER 6

HOST MODE AND SPECIAL APPLICATIONS

6.1 Introduction to Host Mode

In conventional AX.25 packet operation, the PK-90 presents a reasonably 'user-friendly' verbose human interface that uses plain-language command words of up to eight letters that actually spell out a word.

The CONNECT command, for example, describes exactly what the command does; the PK-90 transmits a Connect Request (SABM) frame. In addition, when you want to know the connect path and other connection characteristics, you type CONNECT and the PK-90 sends your computer the following:

```
Link state is: CONNECTED to XAAA via XBBB; v2; 1 unACKed
```

all of which tells you that:

- you are connected to XAAA through the XBBB digipeater;
- you have AX25L2V2 set to ON;
- you have sent one frame to XAAA which he has not acknowledged yet.

6.1.1 Why Do We Need a Host Mode

You may wish to write a program that permits your computer to control the PK-90. You could write a program that provides a split screen with status windows. You might want to include a personal mailbox, an electronic mail server, a multi-user bulletin board system, an automatic calling routine, with tutorials, or help screens. You may also wish to experiment with TCP, IP, high-level protocols or techniques other than AX.25 Level 2. Your program could be written to take on much of the burden of operating a data controller and free you from the need to memorize the PK-90 commands and possibly permit fully-automatic system operation.

When working with conventional, human-oriented data controllers and packet TNCs, your hypothetical program must interpret and translate all the verbose, human-interface information sent in either direction over the serial interface between your computer and the PK-90. All of the PK-90's command and response features that permit convenient human operating unfortunately produce difficulties for a computer.

For example, your computer and program must:

- decide if the PK-90 is in command mode or converse mode;
- sort through status messages in human language;
- accept any data or status from the PK-90 at any time.

6.1.2 How Does Host Mode Help Us?

Host mode does not use human-type dialog. By communicating directly with the "host" or computer, Host mode provides the computer with much greater direct control over the PK-90. Host mode permits programmers to eliminate, reduce or greatly simplify the transfer and subsequent encoding and decoding of critical information, eliminating wasteful and redundant information. In Host Mode, the PK-90 is 'unfriendly'; humans would find it difficult to operate the PK-90 in Host mode.

Host mode uses the normal RS-232 serial link between the PK-90 and the computer, but provides a more efficient link with fewer characters necessary.

In Host mode, the PK-90 sends data to the computer only when the computer requests data. This feature is selectable by the user (see HPOLL below).

6.1.3 Entering Host Mode

From the Command Mode, enter Host mode by typing the following:

```
AWLEN 8 <CR>
PARITY 0 <CR>
8BITCONV ON <CR>
RESTART <CR>
```

Verify that your computer's serial interface driver is also set to eight bits, no parity, and that you have set your system for hardware flow control by disabling XON/XOFF and enabling RTS/CTS/DTR.

Type: HOST ON <CR>

If you wish to apply power to your computer and Host mode immediately, be aware that power transients may cause random data to be sent to the PK-90.

- To ensure correct entry into Host mode, send the XON, CANLINE, and COMMAND characters first, as shown below with the hexadecimal representation of each character listed above each its acronym or literal. (Note: 'sp' is the 'space bar' character.)

$11	$18	$03	$48	$4F	$53	$54	$20	$59	$0D
XON	CAN	COM	H	O	S	T	sp	Y	CR

Follow these steps:

1. Send $01 (CTRL-A).
2. Send the sequence: $01 $4F $47 $47 $17
3. If you receive the response: $01 $4F $47 $47 $00 $17

you have successfully entered the Host mode. If you receive any other response, go to Step 2.

6.1.4 Leaving Host Mode

To leave the Host mode and return to conventional or verbose mode, type:

	$01	$4F	$48	$4F	$4E	$17
or	CTRL-A	O	H	O	N	CTRL-W

or transmit three <CTRL-C> characters within the CMDTIME interval.

6.1.5 The Host Mode Dialog

The host computer and PK-90 communicate in blocks of characters:

- Each block starts with the SOH (Start of Header) character, which is hex $01 or CTRL-A.
- The next character is a special data-type identification byte, called the CTL (control) character that indicates whether the following characters are a command, status, or data.
- Next come the literal command or data characters.
- Each block ends with hex $17 or CTRL-W, the ETB (End of Transmission Block) character.

Therefore, in Host mode, each block appears as follows:

[SOH] [CTL] [data] [ETB]

In addition, DLE (Data Link Escape), ASCII $10 may be used as a pass character.

- If one of the data field characters is SOH ($01), DLE ($10), or ETB ($17), the pass character DLE ($10) is inserted before the data character.

For example, data consisting of the bytes $04, $01, $05, $10, $12 is sent to channel 0 in this block:

$01	$20	$04	$10	$01	$05	$10	$10	$12	$17
SOH	CTL	data	DLE	data	data	DLE	data	data	ETB

This occurs in either direction, from the computer to the PK-90 or from the PK-90 to the computer.

6.1.6 Host Mode Recovery

If it becomes necessary to recover from a problem on the RS-232 link, send any command, with TWO SOH characters to start the block. This makes sure the PK-90 goes to a known state where it is processing commands. A suggestion:

$01	$01	$4F	$47	$47	$17
SOH	SOH	O	G	G	ETB

6.2 Host Computer Commands

The host computer sends blocks to the PK-90 using these CTL bytes in the byte position after the SOH:

$2x: Data to channel x, where x = 0-9.
$4x: Command to channel x.
$4F: Command, no change to input channel.

The computer sends commands to the PK-90 in the following format:

SOH $4F a b (any data) ETB

where "a" and "b" are the two-character Host mode mnemonic or abbreviation for that command.

- When setting a parameter, do not send the SPACE character between the command and the first argument.
- Arguments are entered just as in the verbose mode, with space characters or commas between arguments.
- The command ends with ETB, without a carriage return before it, except for BTEXT and CTEXT.

6.2.1 Unsupported Commands

The PK-90 does not accept these commands in Host mode:

CALIBRATE
CONOK
CONVERSE
CR
CSTATUS
DIGIPEAT
DISPLAY
HELP
K
TRANS

6.2.2 Host Mode Mnemonic Indicators

Each command in the Host mode can be sent by issuing a unique mnemonic or abbreviation ion the form of a two-letter character group. These mnemonics are shown in the following list before each command.

8B 8BITCONV	AA ACRDISP	AK ACRPACK	AE ADDRESS	AI ALFDISP
AP ALFPACK	AW AWLEN	AV AX25L2V2	AX AXDELAY	AH AXHANG
BE BEACON	BK BKONDEL	BT BTEXT	BX BXDELAY	CL CANLINE
CP CANPAC	CX CASEDISP	CU CBELL	CF CFROM	CB CHCALL
CD CHDOUBLE	CK CHECK	CH CHSWITCH	CZ CLKADJ	CQ CMDTIME
CM CMSG	CN COMMAND	CE CONMODE	CO CONNECT	CY CONPERM
CG CONSTAMP	CI CPACTIME	CR CR	CT CTEXT	DS DAYSTAMP
DA DAYTIME	DL DELETE	DF DFROM	DI DISCONNE	DW DWAIT
EC ECHO	ES ESCAPE	FL FLOW	FR FRACK	FU FULLDUP
HB HBAUD	HD HEADERLN	HH HHANG	HI HID	HO HOST
HP HPOLL	ID ID	IL ILFPACK	IO IO	KE KEYWORD
KI KISS	MX MAXFRAME	ME MBELL	MB MBX	MC MCON
MD MDIGI	MM MEMORY	MI MFILTER	MF MFROM	MH MHEARD
MN MONITOR	MQ MPROTO	MR MRPT	MS MSTAMP	MT MTO
MA MYALIAS	ML MYCALL	NE NEWMODE	NO NOMODE	NR NUCR
NF NULF	NU NULLS	PL PACLEN	PT PACTIME	PR PARITY
PS PASS	PX PASSALL	PW PASSWORD	PE PERSIST	GG POLL
PP PPERSIST	RW RAWHDLC	RD REDISPLA	RL RELINK	RM REMOTE
RS RESET	RP RESPTIME	RT RESTART	RY RETRY	RK RKEYWORD
RQ RQTIME	SP SENDPAC	SE SETPASS	SL SLOTTIME	SQ SQUELCH
ST START	SS STATUS	SO STOP	TB TBAUD	TC TCLEAR
TM TIME	TO TONE	TR TRACE	TW TRFLOW	TI TRIES
TD TXDELAY	TF TXFLOW	UN UNPROTO	UR USERS	WD WDISCONN
XW XFLOW	XO XMITOK	XF XOFF	XN XON	

For example, whereas in verbose mode, the human operator types:

```
MFILTER 7, 19
```

in host mode the computer sends the same command as:

$01	$4F	$4D	$49	$37	$2C	$31	$39	$17
SOH	CTL	M	I	7	,	1	9	ETB

6.2.3 CONNECT and DISCONNECT

Send the CONNECT (CO) and DISCONNECT (DI) commands with:

CTL byte = $4x, where x is the channel 0-9.

6.2.4 ON/OFF Booleans or Switches

To set an ON/OFF switch, the only argument is an ASCII Y or N for YES or NO respectively.

- Y or N is returned in response to a query command.

For example, to set MRPT ON, send:

SOH $4F M R Y ETB

6.2.5 Numerical Values

To set a numerical value, the value must be in ASCII, not binary.

- To set TXDELAY to 40, send:

$01	$4F	$54	$44	$34	$30	$17
SOH	CTL	T	D	4	0	ETB

6.2.6 Character Values

To set SENDPAC to $0D, send:

$01	$4F	$53	$50	$24	$30	$44	$17
SOH	CTL	S	P	$	0	D	ETB

6.2.7 Interrogation or Query Commands

Query commands are similar to the human or verbose mode in that the two-letter command to the PK-90 is not followed by arguments, that is, the command is followed by ETB.

6.3 PK-90 Responses

The PK-90 always issues a response to each command.

- The computer should always wait for the response before issuing another command.

The PK-90 sends blocks to the computer using these CTL bytes:

$3x: Data from channel x.
$3F: Monitored frames.
$4x: Link status from channel x (response to CONNECT command).
$4F: Response to command.
$5x: Link messages from channel x.
$5F: Status errors.

NOTE: Channel 'x' (0-9) refers to the packet multi-connect channel that would be available in verbose (human) mode by using the CHSWITCH character. Only channel 0 is used in all communications modes other than packet mode.

The PK-90's response structure is:

SOH $4F a b c ETB

where "a" and "b" are the two-letter host command received from the computer, and "c" is:

$00	acknowledge, no error
$01	bad
$02	too many
$03	not enough
$04	too long
$05	range
$06	callsign
$07	unknown command
$08	VIA
$09	not while connected
$0A	need MYCALL
$0C	already connected
$0D	not while disconnected
$0E	different connectees
$0F	too many packets outstanding
$10	clock not set
$11	need ALL/NONE/YES/NO

Other errors are:

SOH $5F X X W ETB	bad block
SOH $5F X X Y ETB	bad CTL in block

6.3.1 Responses to Interrogation or Query Commands

Responses to query commands consist of the following block:

SOH $4F a b (value) ETB

where the value is:

for a switch: Y or N
for BEACON or PACTIME: E or A, space, and a number
for CONMODE: C or T
for all other commands: the same as in the verbose mode, except for CONNECT, which is discussed later in this chapter.

For example, to read the state of MRPT, send:

SOH $4F M R ETB

The reply should be:

SOH $4F M R Y ETB

6.3.2 Link Status Request Response

Use the CONNECT command to query the link state of channel x:

SOH $4x C O ETB

The PK-90 response is:

SOH $4x C O a b c d e path ETB

where a, b, c, d, and e are values $0-$F, ORed with $30:

a = the link state-1, e.g., S05 is sent as $34.
b = $31 if the link is AX.25 L2 version 2, $30 if pre-version 2.
c = the number of outstanding (unacknowledged) packets.
d = the number of retries done at this time.
e = $31 if CONPERMed, $30 otherwise.
path = the callsign of the connectee, followed by the digipeater callsigns.

6.3.3 Callsign Formats

While in Host Mode call signs are passed in literal form just as in the verbose or 'human' mode, rather than encoded form.

Examples of the callsign format are:

XAAA XAAA-1 XAAAA-1
XAAA-1 via XBBB, XCCC-1

6.4 Sending Data to the PK-90

Send data to channel 'x' as follows:

SOH $2x (data) ETB

This type of block does not produce an immediate acknowledgement as does a command block. The data acknowledgement from the PK-90 is sent as a result of a data poll (see below) and produces the following response when the PK-90 can process the data:

SOH $5F X X $00 ETB

If the PK-90 is busy, the response is delayed until the data can be processed. The host computer should wait for each data ACK before sending more data.

6.4.1 Data Polling

The computer can poll the PK-90 for information such as channel data or status, link messages, data acknowledgements, or monitored frames. To poll the PK-90, send the poll command as follows:

SOH $4F G G ETB

If the PK-90 has nothing to send to the computer, the response is:

SOH $4F G G $00 ETB

If the PK-90 has data to send and information is waiting to be sent, the response is shown below. Only one block is sent for each poll.

SOH $2F . . . ETB	echoed data
SOH $3x . . . ETB	data
SOH $3F . . . ETB	monitored data
SOH $4x . . . ETB	link status
SOH $5x . . . ETB	link messages
SOH $5F X X . ETB	status errors
SOH $5F X X $00 ETB	data acknowledgement

Here is an example of the Host mode dialog between the computer and the PK-90:

Computer:	SOH $20 (data) ETB	data sent
Computer:	SOH $4F G G ETB	poll
PK-90:	SOH $4F G G $00 ETB	nothing yet
Computer:	SOH $4F G G ETB	poll
PK-90:	SOH $5F X X $00 ETB	data acknowledged

6.4.2 The HPOLL Command

The HPOLL command determines whether the host computer must constantly poll the PK-90.

- If HPOLL is ON, the host must poll for everything, as described above.
- If HPOLL is OFF, the PK-90 sends all blocks to the host computer when they are formed, and the data poll ($4F G G) is not needed.

6.4.3 Link Messages

Link messages have the following format:

SOH $5x (message) ETB

Some of these link messages are:

CONNECTED to <callsign>
<callsign> busy
Connect request: <callsign>
FRMR sent: xx yy zz
FRMR rcvd: xx yy zz
Retry count exceeded
DISCONNECTED: <callsign>
LINK OUT OF ORDER, possible data loss
(3 bell characters, output from CBELL)
Transmit data remaining

6.5 Host Mode and Special Packet Applications

Certain differences exist when operating in packet mode using the Host mode.

- Data is packetized only after the ETB character.
- PACTIME and CPACTIME are ignored.

The Host mode permits the use of special machine-oriented interfaces that are inappropriate for direct interpretation by human users.

6.6 Raw HDLC

Raw HDLC is available only in Host mode. When RAWHDLC is set to ON, data sent from the computer to the PK-90 is converted to pure packet frames without adding headers or protocol bytes.

In Raw HDLC, the host computer must provide the AX.25 header with each outgoing frame. Raw HDLC moves the AX.25 protocol from the PK-90 to the host computer, permitting the system operator to create his own version of AX.25, with possible inclusion of Layer 3 and higher-level protocols, as well as protocols other than AX.25.

Data from the PK-90 to the computer includes every byte in the received frame, minus flags and checksum.

In Raw HDLC, data is sent from the computer to the PK-90 using a CTL byte of $20 (data to channel 0). Received data from the PK-90 uses $3F (monitored data).

Very little error checking is done in the RAWHDLC mode.

- Do not send commands such as CONNECT and DISCONNECT that could possibly create problems. Construct your own Connect, Disconnect and Acknowledgement frames.

Enter Raw HDLC from the human or verbose mode by typing the following commands and parameter values:

```
AWLEN 8
PARITY 0
RESTART
TRACE OFF
CONMODE TRANS
HID OFF
BEACON EVERY 0
RAWHDLC ON
KISS OFF
HOST ON
```

From the Host mode, send the Host mode equivalents.

6.7 "KISS" TNC Asynchronous Packet Protocol

The PK-90 provides a simple, asynchronous, computer-to-TNC protocol for a raw HDLC TNC or "KISS" ("Keep It Simple, Stupid") TNC developed by Phil Karn (KA9Q). The computer must provide all AX.25 headers and timing functions.

KISS protocol is similar to the Raw HDLC protocol described earlier, with a few exceptions:

- o The frame delimiter characters.
- o The commands available.
- o The method of determining the proper time to transmit.
- o The KISS protocol does not use the Host mode [SOH CTL ... ETB] described earlier. Host mode commands and responses described before this "KISS" section do not apply when KISS is active.

6.7.1 Starting "KISS" TNC Operation

Before entering the KISS mode, set the PK-90 for hardware flow control on the host side of the RS-232 link.

Type the following parameter values from the human or verbose mode:

```
AWLEN    8
PARITY   0
RESTART
CONMODE  TRANS
TRACE    OFF
HID      OFF
BEACON   EVERY 0
RAWHDLC  ON
HPOLL    OFF
PPERSIST ON
KISS     ON
HOST     ON
```

6.7.2 "KISS" TNC Special Characters

The special "KISS" TNC characters are:

```
FEND (Frame End)                 $C0
FESC (Frame Escape)              $DB
TFEND (Transposed Frame End)     $DC
TFESC (Transposed Frame Escape) $DD
```

6.7.3 "KISS TNC Frame Structure

Each KISS frame or block of characters begins with a FEND (Frame End) character.

- The next character is like the original PK-90 CTL character in that it defines whether the following characters are data or commands.
- The literal data or parameter value follows the CTL character.
- Each block ends with another FEND character.

The FESC (Frame Escape) character is the pass character.

- If any data character is a FEND, that character is translated into the two-byte sequence FESC TFEND (Frame Escape, Transposed Frame End).
- If any data character is a FESC, that character is replaced by the two-character sequence FESC TFESC (Frame Escape, Transposed Frame Escape).
- If any data character is a TFEND or TFESC, that character is not changed.

6.7.4 "KISS" TNC Commands

There are only six commands in the "KISS" TNC protocol.

6.7.4.1 TXDELAY: CTL = $01

TXDELAY in the "KISS" TNC protocol has the same meaning as in traditional packet controllers: TXDELAY determines how long the TNC waits between activating the PTT line and the start of HDLC data.

The KISS command is:

```
$C0  $01  n  $C0
FEND CTL TXD FEND
```

where n is a binary number expressing TXDELAY in units of 10 milliseconds.

6.7.4.2 PERSISTENCE: CTL = $02

PERSISTENCE (P) and SLOTTIME work together to establish the time at which the PK-90 will transmit.

PERSISTENCE is best described by quoting Phil Karn (KA9Q) directly from his "Raw TNC Functional Spec".

"Whenever the host has queued data for transmission, the TNC begins monitoring the carrier detect signal from the modem. It waits indefinitely for this signal to go inactive. Once the channel is clear, the TNC generates a random number between 0 and 255. If this number is less than or equal to P, the TNC asserts the transmitter PTT line, waits .01 * TXDELAY seconds, and transmits all frames in its queue. The TNC then releases PTT and goes back to the idle state. If the random number is greater than P, the TNC delays .01 * SLOTTIME seconds and repeats the procedure. (If the carrier detect signal has gone active in the meantime, the TNC again waits for it to clear before continuing.) Note that P=255 means always transmit as soon as possible, regardless of the random number.

"The result is that the TNC waits for an exponentially-distributed random interval after sensing that the channel has gone clear before attempting to transmit. The idea here is that with proper tuning of the parameters P and SLOTTIME, several stations with traffic to send are much less likely to collide with each other when they simultaneously see the channel go clear."

The form of the command is:

```
$C0  $02  n  $C0
FEND CTL  p  FEND
```

where n can be 0-255; the persistence parameter p is the fraction:

```
(n + 1)/256

If n = 0,    p = 1/256.                (lowest value)
If n = 255,  p = (255+1)/256  =  1.0   (highest value)
```

6.7.4.3 SLOTTIME: CTL = $03

The SLOTTIME command controls the slot interval as described above in the PERSISTENCE command.

The form of the command is:

```
$C0  $03  n  $C0
FEND CTL SLO FEND
```

where n is the slot interval in units of 10 milliseconds.

6.7.4.4 TXTAIL: CTL = $04

In both the PK-90's human or verbose mode and the original Host mode, the length of time between the end of data and the release of the PTT line is determined automatically by the baud rate (HBAUD).

In the KISS protocol, the computer controls this interval.

The form of the command is:

```
$C0  $04  n  $C0
FEND CTL TXT FEND
```

where n is the binary value of "TX Tail" time in units of 10 milli-seconds.

6.7.4.5 FULLDUP: CTL = $05

The FULLDUP command has the same meaning as in conventional TNCs, that of full duplex operation.

When FULLDUP is ON, the PK-90 transmits without checking to see if the channel is clear.

```
$C0  $05  n  $C0
FEND CTL FUL FEND
```

where n is $00 for FULLDUP OFF, and $01 for FULLDUP ON.

6.7.4.6 HOST OFF: CTL = $FF

The HOST OFF command returns the PK-90 to the human or verbose mode. HOST OFF has no arguments.

```
$C0  $FF  $C0
FEND CTL  FEND
```

6.7.4.7 DATA: CTL = $00

The DATA block is used to send data from the computer to the PK-90, or from the PK-90 to the computer. There is no data acknowledgement.

```
$C0  $00  (data)  $C0
FEND CTL          FEND
```

NOTE: Data characters that are FEND or FESC characters must be translated to two-byte sequences.

The data must include all AX.25 headers and control bytes. Except for HDLC flags at the beginning and end of the frame and the SDLC check-sum, the PK-90 adds nothing to the data transmitted.

6.8 Maximum Block Size

For blocks sent by the host computer to the PK-90, maximum block size is 330 characters, not including SOH, CTL, DLE and ETB.

For blocks sent by the PK-90 to the host, maximum block size depends on the communications mode.

- The worst case is a monitored frame containing the addresses of eight digipeaters and 256 bytes of data, with the PK-90's MSTAMP, DAYSTAMP and MRPT parameters all set to ON, and MONITOR set to 6.

This worst-case configuration produces a maximum of 136 + 256, or 392 bytes, not including SOH, CTL, DLE and ETB. Byte stuffing could add as many as 256 additional DLE characters, for a total of 648 bytes.

If CONMODE is CONVERSE, linefeed characters may be appended to carriage returns because ALFDISP is active. Theoretically, a packet containing 256 carriage returns would result in a block of 136 + 256 + 256, or 648 bytes, plus SOH, CTL and ETB.

6.9 MEMORY, I/O and ADDRESS Commands

The MEMORY and IO commands work with the ADDRESS command to permit host access to the PK-90's memory and I/O locations.

6.9.1 MEMORY Command

To use the Memory command:

- Set the memory address into the ADDRESS command.
- Use the MEMORY command without arguments to read memory locations one after another.
- Use MEMORY with one argument 0-$FF to write to memory locations. After each MEMORY command, the PK-90 adds 1 to the value of the ADDRESS.

PK-90 RAM locations are $C000-$FFFF. ROM begins at $0000.

6.9.2 I/O Command

To access I/O locations, set ADDRESS as follows:

ADDRESS $aabb

or SOH $4F A E $ a a b b ETB (host mode)

where "aa" is the device address:

7C = 8530 terminal CTRL port
7E = 8530 HDLC CTRL port
BF = 8536 timer/parallel CTRL port

and "bb" is the register address on the device.

Use the IO command without arguments to read an I/O location, and with one argument 0-$FF to write to an I/O location. The value in ADDRESS is not incremented after using the IO command.

Load ADDRESS with these values for easy access:

$BF0D	Parallel port A data
$BF0E	Parallel port B data
$BF0F	Parallel port C data
$7C08	Terminal data
$7E08	HDLC data
$7E00	HDLC RR0

HDLC RR0 is the status register of the radio interface. The following information can be read from RR00:

bit 7	Break/Abort
bit 6	Tx Underrun/End of message
bit 5	CTS (Read data)
bit 4	Sync/Hunt
bit 3	DCD
bit 2	Transmit buffer empty
bit 1	Zero count
bit 0	Receive character available

6.10 Converse and Transparent Modes

In Host mode, data is sent using the setting of CONMODE.

- Do not send the CONVERSE or TRANS commands to the PK-90.
- If CONMODE is CONV, then parameters 8BITCONV, ALFPACK, ALFDISP and ESCAPE are active.
- If CONMODE is TRANS, all characters are passed without modification.

These are the only differences between CONV and TRANS while in Host mode.

6.11 MHEARD Command in Host Mode

The MH command has been altered in Host mode because the verbose mode MHEARD response is potentially too long for the limited Host mode response buffer.

The MHEARD response is divided into lines numbered 0-17. The MHEARD list must be polled on a line-by-line basis.

- Use the host command MH0 (SOH $4F M H $30 ETB), then MH1, MH2, etc. until you get an empty response (SOH $4F M H $00 ETB), or until you reach the last (MH17) line.

CAUTION: If the PK-90 receives a packet frame while the computer is polling the middle of the MHEARD list, the list entries may be garbled. One possible solution would be to temporarily set HBAUD to 110 to disable packet, poll the 18 MHEARD lines, then set HBAUD back to 1200.

CHAPTER 7

COMMAND SUMMARY

7.1 Introduction

This chapter explains and illustrates the PK-90's commands. You will use some commands to control the PK-90's performance under specific conditions, and others to specify the values of parameters used during the PK-90's general operation.

The PK-90 is a 'command-driven' system; it does not provide 'menus'. You control the functions of the PK-90 by typing single or multiple--character commands at your computer's keyboard,

We will use UPPER CASE in this chapter to show the commands, and lower case to explain the text. Sample displays are shown in boldface type.

7.1.1 Entering Commands

Commands are entered after the Command Mode prompt:

```
cmd:
```

You will use English-like words or abbreviations to change the value of parameters and issue instructions to the PK-90.

- Commands are either keywords or mnemonics (special abbreviations) made up of strings of characters that you type.

You might not want to change the values of some parameters. However, you have maximum flexibility to adapt the PK-90 to your local environment and operating conditions.

- Use either upper case (capital letters) or lower case (small letters) when typing commands.
- End the command with a carriage return <CR>. Carriage returns are not shown in the examples below.
- Correct your typing mistakes or cancel the line completely before typing the final <CR> of your command.
- See Chapter 3 for a discussion of line editing.

7.1.2 Command Responses

Whenever the PK-90 accepts a command that changes a value, the PK-90 responds with the previously stored value.

For example, assume that 'XFLOW' is 'ON' and you type 'XFLOW OFF'; you will see the display:

```
XFLOW was ON
```

This message confirms that the value has been changed successfully.

7.1.3 Error Messages

If the PK-90 cannot understand what you have typed, you will see an error message in plain language reporting the nature of the error.

- If you type a command the PK-90 cannot understand - you will see:

  ```
  ?What?
  ```

- If you type a correct command word with a wrong argument:

  ```
  ?bad
  ```

- If you type a numerical value outside a parameter's range:

  ```
  ?range
  ```

- If you set the BEACON interval too short for busy channels:

  ```
  WARNING: BEACON too often
  ```

Here are a few more examples:

```
cmd:ASDFASDF          -   This is not a command.
?What?

cmd:BEACON E          -   A parameter was omitted.
?bad

cmd:PACLEN 265        -   Unacceptable numerical value.
?range

cmd:DAY               -   You did not set the PK-90's clock
?clock not set
```

7.2 Command List

Commands are listed alphabetically in the following detailed command descriptions.

Each command entry contains several sections:

- Command name
- Command abbreviation or mnemonic
- Default value
- Parameters

7.2.1 Command Names

The command name at the beginning of the description is the full word you can type to execute that command. After the command you will see the minimum abbreviation or the mnemonic that you can use instead of the full word. You can always type the entire command word, or any abbreviation longer than the minimum abbreviation.

For example, consider the MYCALL command:

- Enter the command MYCALL by simply typing 'MY.' (Note: DO NOT type the 'quotation marks' - we use these for clarity in showing the letters to be typed.)

The abbreviation 'M' is not sufficient and will be interpreted as the MONITOR command. However, 'MY,' 'MYC,' 'MYCA,' 'MYCAL' or 'MYCALL' are all acceptable.

If a command requires parameters, the type of parameter is indicated after the command name as well as the default value. For example:

- 'n' means the command takes a numerical parameter value.

7.2.2 Default Values

Some commands have initial values that the PK-90 assumes as defaults or values used most often. These defaults are stored in EPROM and loaded into RAM when power is first applied to the PK-90, or when you type the RESET command.

7.3 Parameters, Arguments and Values:

Some commands need additional information before they can be executed. This type of command has 'parameters' or requires 'arguments'.

For example, a command such as FULLDUP has a Boolean parameter. When you type 'FULLDUP ON', FULLDUP is the command, ON is its argument - the value you want the PK-90 to use to execute the command FULLDUP.

- The value that fills this parameter is either ON or OFF.
- Immediate commands such as 'ID' have no parameters. Typing only 'ID' causes the PK-90 to execute the command.

Some commands such as 'CONNECT' have optional parameters.

- If you type 'CONNECT' without an argument, the PK-90 displays the current status of the link.

However, if you type 'CONNECT KHN1710,' the PK-90 issues the connect request and tries to establish the link to KHN1710.

Some commands such as MFILTER can use several arguments at the same time. MFILTER accepts from one to four numerical arguments. You can type MFILTER 12 or MFILTER 12, 26. Both are legal commands.

7.3.1 Parameters

Three different types of parameters are used: Boolean, numeric and text or string.

7.3.1.1 Boolean Parameters

Boolean parameters use one value out of a choice of only two possible values, such as ON or OFF, YES or NO, or EVERY or AFTER. Boolean parameters can also be toggled with an argument of 'TOGGLE' or 'T.' This is useful, for example, in the case of XFLOW, FLOW, NEWMODE, etc.

- When a parameter is Boolean, its two possible choices are shown separated by a vertical bar.

7.3.1.2 Numeric Parameters

A parameter designated as 'n' is a numeric value.

- Numeric values can be entered by typing familiar decimal numbers, or optionally in hexadecimal numbers.

In using hexadecimal notation, you must prefix the number you type with a '$' character.

The PK-90 displays some numeric parameters (those which set special characters) in hexadecimal format. Here's a brief explanation of 'hex' numbers:

- The 'digits' of a hex number represent powers of 16 in the same manner as the powers of 10 represented by a decimal number.

- The numbers 10 through 15 are indicated by hexadecimal digits A through F. For example:

  $1B = (1 x 16) + (11 x 1) = 27 (decimal)
  $120 = (1 x 16 x 16) + (2 x 16) + (0 x 1) = 288 (decimal)

For numeric parameters in the range 0 to 255, arguments 'ON' or 'Y' set the value of the parameter to their ROM default values. Arguments 'OFF' or 'N' set the value to 0 (zero).

Baud-rate parameters can use arguments UP (U) or DOWN (D) to select the next higher or lower link or terminal baud rate.

7.3.1.3 Text or String Parameters

A text parameter such as the argument or 'message' for BTEXT (your 'beacon' message) or CTEXT (your 'connect' message), can be typed in upper or lower case.

- A text parameter can include numbers, spaces, and punctuation.

- The text is accepted exactly as you type it.

Some commands require call signs as parameters. The parameters may be any string of numbers or letters, up to six characters; character strings are used to identify stations sending and receiving packets.

A call sign can also include an alphanumeric extension or substation identifier (SSID). These extensions distinguish between two or more stations on the same channel with the same call (such as a base station and a 'digipeater').

The call sign and any required extensions or SSIDs are entered and displayed as 'call-n,' e.g., 'KAAA-12', or 'WXXX-1'. If an SSID or extension is not entered, the system assumes an SSID or extension of '0' (zero). The zero SSID is not normally displayed by the PK-90.

Some commands have parameters which are really lists of call signs:

- CFROM, MFROM, MTO and DFROM commands allow you to specify from one to eight call signs for selective or restrictive operations.

- You must separate multiple call signs with either blank spaces or commas.

The following examples will help you understand these explanations.

o BEACON EVERY|AFTER 'n'

The BEACON command requires an argument;

- You must specify either EVERY or AFTER (abbreviated to E or A), and an argument 'n' which you may choose from a range of values.

A typically appropriate entry would be BEACON EVERY 180. In this case, a beacon is sent every (180 times 10) seconds, every 30 minutes. If BEACON EVERY 0, the beacon is not transmitted.

o CONNECT call1 [VIA call2[,call3...,call9]]

The CONNECT command requires a call sign argument 'call1.'

- You may optionally include the keyword VIA, followed by a list of one to eight call signs, 'call2' through 'call9'.

- Multiple call signs in the list must be separated by commas (as shown) or by blank spaces.

An acceptable entry would be: 'C WXX123 V WXX456,WXX789.'

7.3.2 Using Commands Without Arguments

If you type the command name without any arguments, the current value of the command's arguments is displayed. For example:

cmd:MRPT	-	Command typed without arguments
MRPT ON	-	displays the present value.
cmd:MRPT Y	-	Sets the value to YES (ON)
MRPT was OFF	-	Displays the previous value

NOTE: The DISPLAY command shows you the values of all parameters or groups of related parameters.

7.4 Controller Messages

This section describes the PK-90's messages and circumstances in which the messages can appear. The messages are shown in boldface type.

7.4.1 General

Sign-On Message

```
AEA PK-90 Packet Controller
AX.25 Level 2 Version 2.0
Copyright (C) 1986, 1987 by
Advanced Electronics Applications, Inc.
Release 18.SEP.87
Checksum $6C
cmd:
```

This sign-on message appears when you apply power to the PK-90, or when you type 'RESET'. The release number is updated whenever the firmware is changed. The checksum is a hexadecimal number that represents the correct checksum given for the firmware version installed.

```
PK-90 is using default values
```

This message appears along with the sign-on message above if the bbRAM checksum verification fails at the time power is applied. This causes the PK-90 to load the default parameters from ROM. This will happen the first time you apply power to the PK-90.

This message also appears if the PK-90 loads the defaults in response to the RESET command.

```
cmd:
```

This is the Command Mode prompt. When this prompt appears, the PK-90 is waiting for you to issue a command. Anything you type after this prompt, up to and including the first <CR> is interpreted as a command to the PK-90. If a monitored packet has been displayed, the prompt may not be visible, even though you are in Command Mode. You can type the redisplay-line character (set by REDISPLA) to retype the prompt.

```
was
now
```

Whenever you change one of the PK-90's parameters, the previous value and the new value will both be displayed. This confirms that the PK-90 properly interpreted your command, and reminds you of what you have done.

too many packets outstanding

This message appears in special circumstances in response to a CONVERS or TRANS command. For example, if you have already typed packet data and filled the outgoing buffer in the Converse Mode or Transparent Mode and then tried to return to the Command Mode, this message would appear. You will be allowed to enter one of these modes when some of the packets have been successfully transmitted.

7.4.2 Command Mode Error Messages

An error message is displayed if you make a mistake typing a command to the PK-90.

?bad

You typed a command correctly, but the remainder of the command line couldn't be interpreted.

?callsign

You typed a call sign that does not meet the PK-90's requirements for call signs. A call sign may be any string of numbers and letters. Punctuation and spaces are not allowed. The SSID or extension, if given, can be a combination of alphanumeric characters, separated from the call by a hyphen.

?clock not set

You typed the command DAYTIME to display the date and time, but you have not yet set the clock. DAYTIME sets the clock if the command is typed with the daytime parameters, and displays the date and time if it typed without parameters.

?What?

Your first entry is not a command or a command abbreviation. The PK-90 did not understand the instructions.

?not enough

You did not type enough arguments for a command that expects several parameters. For example, 'CONNECT WXX123 VIA.'

?not while connected

You attempted to change MYCALL or AX25L2V2 while in a connected or connecting state.

?range

You typed too large or too small a numeric argument.

```
?too long
```

You typed too-long a command line; the line is ignored. For example, you will see this message if you try to type too long a BTEXT or CTEXT message. The previous text entry is not changed when you see this specific error message.

```
?too many
```

You typed too many arguments for a command that expects several parameters. For example, MFILTER can have up to four arguments.

```
cmd:MFILTER $1B,$0C,$1A,$03,$07
?too many
```

```
?VIA
```

You typed more than one call sign for the CONNECT or UNPROTO commands without the VIA keyword.

```
?not while disconnected
```

You tried to set CONPERM while disconnected.

```
?channel must be 0-9
```

You typed an invalid character after the CHSWITCH character.

```
?already connected
```

You tried to CONNECT to a station to which you are already connected.

```
?different connectees
```

You tried to CONNECT to more than one station on the same logical channel.

7.4.3 Link Status Messages

Link status messages show you the status of AX.25 connections in which the PK-90 may be involved.

You can ask for link status at any time from the Command Mode by typing the CONNECT command without parameters.

If you attempt a connection when the PK-90 is not in the disconnected state, you see the link status but the PK-90 takes no other action.

The following messages appear in response to the CONNECT command.

```
Link state is: CONNECTED to call1
               [VIA call2[,call3...,call9]]
```

Your station is connected to a distant station - you'll see the digipeater path in use, if any. The call sign sequence is the same sequence you would type to initiate the connection.

```
Link state is: CONNECTED to call1; v2; 2 unACKed
               [VIA call2[,call3...,call9]]
```

You are connected to a station using Version 2; two frames remain unacknowledged.

```
Link state is: DISCONNECTED
```

No link or connection exists right now. You may type the CONNECT command to initiate a connection.

```
Link state is: CONNECT in progress:
               call1 [VIA call2[,call3...,call9]]
```

You have already typed a connect request but have not received the acknowledgment from the other station. Type the DISCONNE command to cancel the connect process.

```
Link state is: DISCONNECT in progress
          call1 [VIA call2[,call3...,call9]]
```

You have typed a disconnect request but have not received the acknowledgment from the other station. Type a second DISCONNE command to place the PK-90 immediately in the disconnected state.

```
Link state is: FRMR in progress
               call1 [VIA call2[,call3...,call9]]
```

The PK-90 is connected to a distant station but a protocol error has occurred. This should never happen when AEA AX.25 systems are connected. An improper implementation of the AX.25 protocol could cause this condition. Your PK-90 will try to resynchronize frame numbers with the PK-90 on the other end although a disconnect may result. Connections are not valid in this state; a disconnect will start the disconnect process.

The PK-90 will tell you whenever the link status changes. Link status may change in response to:

- o commands you have typed (CONNECT or DISCONNE)
- o connect or disconnect requests from a distant station
- o a disconnect because of the retry count being exceeded
- o automatic timeout disconnect (CHECK)
- o protocol errors

* CONNECTED to: call1 [via call2[,call3...,call9]]

This message appears when the PK-90 switches from the 'disconnected' or 'connect in progress' state to the connected state. The connection may be a result of a CONNECT command typed by you, or a connect request packet received from a distant station.

* Connect request: call1 [via call2[,call3...,call9]]

Your PK-90 has received but not accepted a connect request from a distant station. This can happen if you have set CFROM to NONE, or if you are already connected to another station.

When the PK-90 displays this message, it also sends a DM packet (busy signal) to the station that initiated the connect request. If the PK-90 rejects a connect request because you've set CFROM to NONE or OFF, you can issue your own connect request to the other station.

* DISCONNECTED: (call sign)

The PK-90 has switched to disconnected state from a different link state. This message may be preceded by a message explaining the reason for the disconnect, as shown below.

* Retry count-exceeded
* DISCONNECTED: (call sign)

The PK-90 has disconnected because of a retry failure rather than a disconnect request from one of the stations.

* (call sign)-busy
* DISCONNECTED: (call sign)

Your connect request was rejected by a DM packet (busy signal) from the other station. The PK-90 will reject a connect request if CFROM is set to NONE, or if you are already connected to another station.

FRMR sent: xx xx xx

The PK-90 is connected but a protocol error has occurred. Your PK-90 has transmitted a special FRMR packet and is trying to resynchronize frame numbers with the distant station's system. The string xxxxxx is replaced with the hexadecimal codes for three bytes sent in the information part of the FRMR frame. This message will not appear if the PK-90 is in Transparent Mode.

FRMR rcvd: xx xx xx

Your PK-90 has received an FRMR (protocol error described above) and displays the FRMR packet in hexadecimal format. This message will not appear if the PK-90 is in Transparent Mode.

7.5 Clear String Commands

While in Command Mode, the following commands can be cleared by typing the command word followed by a single percent sign (%), an ampersand (&) or 'N,' 'NO,' 'NONE,' 'OFF' as the command's argument.

BTEXT	CFROM	CTEXT	DFROM	MBX	MYALIAS
MHEARD	MFROM	MTO	PASSWORD	SETPASS	

7.6 Specific Commands and Summary

The following section contains detailed descriptions of the meaning, use and effects of each command and parameter, the default values and arguments. Examples of command usage are included.

Appendix A contains a concise list of all commands and parameters, mnemonics, defaults and definitions.

8BITCONV ON|OFF Mnemonic: 8B Default: OFF

Parameters:

ON - The highorder bit IS NOT stripped in Converse Mode.
OFF - The highorder bit IS stripped in Converse Mode.

8BITCONV permits packet transmission of eight-bit data in the Converse Mode.

If 8BITCONV is OFF, the high-order bit (bit seven) of characters received from the terminal is removed before the characters are transmitted in a packet.

The standard ASCII character set requires only seven bits - the eighth or final bit is used as a parity bit or ignored.

- Setting bit seven in text characters transmitted over the air may cause confusion at the other end.

If you need to transmit eight-bit data but don't want all the features of Transparent Mode, set 8BITCONV ON and AWLEN 8. This may be desirable if you're using a special non-ASCII character set.

Because commands require only the standard seven-bit ASCII character set, bit seven is always removed in Command Mode.

ACRDISP 'n' Mnemonic: ACRD Default: 80

Parameters:

'n' - 0 to 255 specifies the screen or printer width, in number of columns or characters.

0 (zero) disables the function.

The numerical value sets the proper terminal output format for your specific needs. The PK-90 sends a <CR><LF> sequence to your computer or terminal at the end of a line in the Command and Converse Modes when 'n' characters have been printed.

- Set ACRDISP to '0' (zero) if your computer or terminal automatically formats output lines. This avoids conflict between the two formats.

ACRPACK ON|OFF Mnemonic: ACRP Default: ON

Parameters:

ON - The send-packet character, normally <CR>, IS added to all packets sent in Converse Mode.
OFF - The send-packet character is NOT added to packets.

ACRPACK is synonymous with CR and is used in the same manner as the older command. Either command word has the same effect.

When ACRPACK is ON, all packets sent in Converse Mode include, as the last character of the packet, the send-packet character which forces the packet to be sent.

When ACRPACK is OFF, the send-packet character is interpreted only as a command to the PK-90, not as data to be included in the packet; the character is not echoed to the terminal.

Set ACRPACK ON and SENDPAC $0D to produce natural conversational mode. Each line is sent when a <CR> is entered, and arrives at its destination with a <CR> at the end of the line.

If the distant station reports overprinting of lines on his display, set ALFPACK ON, or the other station can set ALFDISP ON.

ADDRESS 'n' Mnemonic: ADD Default: none

Parameters:

n - a hexadecimal address used with the MEMORY and I/O commands to access the PK-90's memory and I/O locations, or to read values stored at a specified address.

The ADDRESS command permits access to memory and I/O locations as follows:

```
    ADDRESS $aabb
or  SOH $4F  A  E  $  a  a  b  b  ETB (in the HOST mode).
```

where "aa" is the device address, and "bb" is the register address on the device.

Set the hexadecimal address as shown above and then use the MEMORY command to read the contents of that address. The ADDRESS counter is incremented or increased by 1 each time the MEMORY command is typed.

ALFDISP ON|OFF Mnemonic: ALFD Default: ON

Parameters:

ON - A line feed character <LF> IS sent to the terminal after each carriage return character <CR>.

OFF - A <LF> is NOT sent to the terminal after each <CR>.

ALFDISP controls the display of carriage return characters received in packets as well as echoing those that are typed in.

When ALFDISP is ON, the PK-90 adds a line feed <LF> to each carriage return <CR> received. Each line feed received is ignored. Use the PK-90's sign-on message to determine how carriage returns are being displayed.

- Set ALFDISP ON if the PK-90's sign-on message lines are typed over each other.
- Set ALFDISP OFF if the PK-90's sign-on message is double spaced.

ALFDISP is set correctly if the PK-90's sign-on message is single spaced. ALFDISP affects your local display. It does not affect the data sent in any mode.

ALFPACK ON|OFF Mnemonic: ALFP Default: OFF

Parameters:

ON - A <LF> character IS added to outgoing packets following each <CR> transmitted in the packet. Line feeds from the terminal are ignored.

OFF - A <LF> is NOT added to outgoing packets.

ALFPACK is similar to ALFDISP, except that the <LF> characters are added to outgoing packets, rather than only to text displayed locally.

ALFPACK is included to maintain compatibility with other packet radio controllers.

- If the person you are talking to reports overprinting of packets from your station set ALFPACK ON. Character insertion is disabled in Transparent Mode.

AWLEN 'n' Mnemonic: AW Default: 7

Parameters:

'n' - 7 or 8 specifies the number of data bits per word.

The parameter value defines the digital word length used by the serial input/output (IO) terminal port and your computer or terminal program.

- Set AWLEN to 7 for most packet operations, such as conversation, working electronic mail and bulletin board systems and transmission of ASCII files.

If eight-bit words are sent to the PK-90 in the Command or Converse Modes, the eighth bit is normally removed, leaving a standard ASCII character, regardless of the setting of AWLEN.

All eight data bits of each character must be retained to send executable files or other special data.

- Set AWLEN to 8 and use the Transparent Mode.

You can also use Converse Mode and set AWLEN 8 and 8BITCONV ON. However, you must precede the Converse Mode special characters with the PASS character in the data you send.

AX25L2V2 ON|OFF Mnemonic: A Default: ON

Parameters:

ON - The PK-90 uses AX.25 Level 2 Version 2.0 protocol.

OFF - The PK-90 uses AX.25 Level 2 Version 1.0 protocol.

Some implementations of the earlier version of AX.25 protocol will not repeat Version 2.0 AX.25 packets properly. This command provides compatibility with those older packet controllers.

Set AX25L2V2 to OFF if you suspect that local area systems are using Version 1.0 protocol.

AXDELAY 'n' Mnemonic: AXD Default: 0

Parameters:

'n' 0 to 180 specifies a key-up delay for voice repeater operation in ten-millisecond intervals.

AXDELAY specifies the period of time the PK-90 will wait (in addition to the normal delay set by TXDELAY) after keying the transmitter and before data is sent.

Repeaters with slow electromechanical relays, split sites, auxiliary links (or other circuits which delay transmission for some time after the RF carrier is present) require some amount of time to get RF on the air.

If you are using a repeater that has not been used for packet operations before, try various values to find the best value for 'n.'

If other packet stations have been using the repeater, check with them for the proper setting.

AXDELAY acts in conjunction with AXHANG.

AXHANG 'n' Mnemonic: AXH Default: 0

Parameters:

'n' - 0 to 20 specifies voice repeater hang time in 100-millisecond intervals.

The numeric value can be used to increase channel efficiency when an audio repeater has a hang time greater than 100 milliseconds. For a repeater with a long hang time, it is not necessary to wait for the repeater key-up delay after keying the transmitter if the repeater is still transmitting.

When the PK-90 has heard a packet sent within the hang period, it does not add the repeater key-up delay (AXDELAY) to the key-up time. If you are using a repeater that hasn't been used for packet operations before, try various values to find the best value for 'n.'

If other packet stations have been using the repeater, ask them for the appropriate setting.

BEACON EVERY|AFTER 'n' Mnemonic: B Default: EVERY 0

Parameters:

EVERY	-	Send the beacon at regular intervals.
AFTER	-	Send the beacon once after the specified time interval without packet activity.
'n'	-	0 to 250 specifies timing in ten-seecond intervals.
0	-	Zero disables off the beacon function.

The BEACON command sets the conditions under which your packet beacon will be transmitted.

- A beacon frame contains the text you have typed into the BTEXT message in a packet addressed to 'CQ' or other UNPROTO address.
- A beacon frame may be sent directly, and also sent via the digipeat addresses specified by the UNPROTO command.

When the keyword EVERY is specified, a beacon packet is sent every n times 10 seconds. This mode can be used to transmit packets for testing purposes.

When AFTER is specified, a beacon is sent after n times 10 seconds have passed without packet activity.

- The beacon is sent only once until further activity is detected.

This mode can be used to send announcements or test messages only when packet stations are on the air.

- Proper choice of 'n' avoids cluttering a busy channel with lots of unnecessary transmissions.

Beacon frames from other packet stations can be monitored by setting MONITOR in the range 1-6.

- If you set the BEACON timing at less than '90,' a value judged by most authoritative sources as too small for busy channels, you will see the message:

    WARNING: BEACON too often

This message appears in the Command Mode each time a new command is typed.

BKONDEL ON|OFF Mnemonic: BK Default: ON

Parameters:

ON - The sequence <BACKSPACE><SPACE><BACKSPACE> is echoed when a character is deleted from the input line.

OFF - The <BACKSLASH> character <\> is echoed when a character is deleted.

BKONDEL determines how character deletion is displayed in Command or Converse Mode.

The <BACKSPACE><SPACE><BACKSPACE> sequence updates the video display screen.

- Set BKONDEL ON if you are using a video display terminal or computer.

On a printing terminal the <BACKSPACE><SPACE><BACKSPACE> sequence will result in over-typed text.

- Set BKONDEL OFF if you have a paper output display, or if your terminal does not respond to the <BACKSPACE> character <CTRL-H>.

The PK-90 displays a <BACKSLASH> for each character you delete. You can see a display of the corrected input by typing the redisplay-line character set by the command REDISPLA.

BTEXT text Mnemonic: BT Default: Empty

Parameters:

text Any combination of characters and spaces, up to a maximum length of 120 characters.

BTEXT is the content of the data portion of a beacon packet. The default text is an empty string (no message).

- Beacon packets are discussed in more detail under the BEACON command.

You can send multiple-line messages in your beacon by including <CR> characters in the text. <CR> is inserted by typing the PASS character before the <CR>

- The PASS character is set by the PASS command.

If you enter a text string longer than 120 characters, the command is ignored and the following error message appears:

```
?too long
```

An electronic mail system program may set the beacon text to a message like this, updating the text after each connection:

```
MAIL for:  WXX123 WXX456 XBE555 KZZ999
```

- Use a '%,' '&,' 'N,' 'NO,' 'NONE,' or OFF as the first characters in the text to clear the BTEXT text without issuing the RESET command.

- The normal packet header shows the call sign.

- Avoid filling your BTEXT with screen graphics such as asterisks, parentheses, colons and semicolons, etc. Use BTEXT for significant information.

- Avoid using BTEXT to send unimportant information. Put casual information in your CTEXT message so that it is seen only by the station that connects to you - the only one who can make use of the information.

BXDELAY n	Mnemonic: BXD	Default: 0 (zero)

Parameters:

'n' - 0: The SQUELCH input line on Pin 5 of J3 is used as a true squelch input, as described under the SQUELCH command.

1 - 120: 'n' in 10-millisecond intervals sets Pin 5 of J3 to be used as a "grant" or "OK to send a data frame" line.

An active-going transition initializes the BXDELAY counter; an inactive-going transition disables the BXDELAY countdown. If the countdown reaches a value of zero, the frame is sent. 'n' (in 10-millisecond increments) sets a time value.

If the grant on Pin 5 lasts longer than the BXDELAY time, the frame will be sent. If the grant does not occur or occurs but does not last longer than BXDELAY, the RQTIME command will cause the cycle starting with PTT to occur again. The SQUELCH command will accommodate reverse logic polarities.

CALIBRATE	Mnemonic: CAL	Immediate Command

CALIBRATE is an immediate command that provides a means to key your transmitter and send continuous ASFK tone modulation.

Use the CALIBRATE command to measure transmitter modulation and other performance characteristics.

Because the AMD7910 chip does not require adjustment of transmitted or received tone frequencies, the '0' display is not significant and is presented only to show that the calibration mode is in effect.

Calibration may be checked at any time without altering the state of the existing link.

Commands available in the calibration routine are:

<SPACE>	Toggles the transmitted audio between 'mark' (low) and 'space' (high) tones.
D	Alternates the transmitted mark and space tones at a rate set by the radio baud (HB) rate.
K	Toggles the PTT line between ON and OFF.
Q	Quits the calibration routine.

NOTE: Set 'D" OFF to transmit a continuous mark or space tone.

CANLINE 'n' Mnemonic: CAN Default: $18 <CTRL-X>

Parameters:

'n' - 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

CANLINE changes the CANCEL-LINE input editing command character. Like all other input editing features, line cancellation is disabled in Transparent Mode.

The parameter 'n' is the ASCII code for the character you want to use to cancel an input line. You can enter the code in either hex or decimal. For example, either of the following commands sets the cancel--line character to <CTRL- U>.

- CANLINE $15 (hex), CANLINE 21 (decimal)

When you use the CANLINE character to cancel an input line in Command Mode, the line is terminated with a <BACKSLASH> character and new prompt (cmd:) appears.

When you cancel a line in Converse Mode, only the <BACKSLASH> and a new line appear.

- You can cancel only the line you are currently typing.
- Once <CR> has been typed, you cannot cancel an input line using the cancel-line character.
- Use the CANPAC character to cancel the entire packet.

NOTE: If your send-packet character is not <CR>, the cancel-line character cancels only the last line of a multi-line packet.

CANPAC 'n' Mnemonic: CANP Default: $19 <CTRL-Y>

Parameters:

'n' - 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

CANPAC changes the CANCEL-PACKET input editing command character.

The parameter 'n' is the ASCII code for the character you want to type in order to cancel an input packet.

- You can enter the code in either hex or decimal.

When you cancel a packet in Converse Mode, the line is terminated with a <BACKSLASH> character and a new line.

- You can only cancel the packet that is currently being entered.

Once you have typed the send-packet character, or waited PACTIME (if CPACTIME is enabled), the packet cannot be canceled even if it has not been transmitted.

Like other input editing features, packet cancellation is disabled in Transparent Mode.

The CANCEL-PACKET character also cancels the display output in Command Mode. If you are in Command Mode and type the CANCEL-PACKET character, any characters that would be typed on the screen (except those echoed) are 'thrown away' by the PK-90.

- Typing the cancel-output character a second time restores normal output.
- To see how this works type DISPLAY, then type a <CTRL-Y>.

The command list display will stop. You won't see any response from the PK-90 to commands.

To verify that the display is back to normal, type <CTRL-Y>, and then type DISPLAY again.

Use the CANCEL-DISPLAY feature if you inadvertently do something that causes the PK-90 to generate large amounts of output to the terminal, such as giving the DISPLAY command or setting TRACE ON.

- If you are in Converse or Transparent Mode and want to cancel display output, you must exit to Command Mode and then type the CANCEL-PACKET character.

CASEDISP 'n' Mnemonic: CAS Default: 0 (as is)

Parameters:

'n' - 0 to 2 specifies how the PK-90 sends characters to your terminal.

CASEDISP allows you to set the case of the characters the PK-90 sends to your terminal. This may be helpful with certain terminal programs. CASEDISP is disabled in Transparent mode.

CASEDISP offers three choices:

CASEDISP 0 'As is' - received characters are not changed.

CASEDISP 1 Received characters are forced to lower case.

CASEDISP 2 Received characters are forced to upper case.

CASEDISP has no effect on your transmitted data.

CBELL ON/OFF Mnemonic: CB Default: OFF

Parameters:

ON - Three BELL characters <CTRL-G> ($07) are sent to your terminal with the '*** CONNECTED to (call sign)' message.

OFF - BELLS are NOT sent with the CONNECTED message.

- Set CBELL ON if you want to be notified whenever someone connects to your station.
- If CBELL is ON and MFILTER contains the character ($07), you can be sure that whenever your terminal beeps there is a connection for you. At no other time will you hear a beep while you are in packet mode.

CFROM all,none,yes/no call1[,call2..] Mnemonic: CF Default: all

---

Parameters:

call - all, none, YES_list, NO_list.
list of up to eight call signs, separated by commas.

CFROM uses arguments to determine how the PK-90 responds to connect requests - which calls are accepted and which calls are rejected. CFROM is set to 'all' when you start the PK-90 for the first time.

CFROM ALL/NONE is synonymous with the CONOK ON/OFF command used in older packet controllers and can be used interchangeably if required.

Type CFROM to display the ALL/NONE/YES_list/NO_list status of station call signs to be rejected or accepted. You can use the abbreviated command form or mnemonic:

```
cmd:cfrom
CFROM    all
cmd:cf
CFROM    yes XAAA,XBBB,XCCC,XDDD
```

To reject all call requests, type CFROM NONE. Your PK-90 sends the calling station a DM packet, or 'busy signal.' The caller sees:

```
*** MYCALL busy
*** DISCONNECTED: (call sign)
```

Your PK-90 notifies you of these call requests:

```
*** Connect request: XAAA
```

To accept calls from one or more specific stations, type CFROM (YES followed by a list of calls signs). Connect requests will be accepted from stations whose call signs are listed.

To reject calls from one or more specific stations, type CFROM (NO followed by a list of call signs). Connect requests will be rejected from stations whose call signs are listed.

You can include optional SSIDs or extensions specified as '-n' after the call sign. If CFROM is set to 'no ABC123' or 'yes ABC123,' any combination ABC123, ABC123-1,...ABC123-15 will be matched and processed. If CFROM is set to 'yes ABC123-1' or 'no ABC123-1,' then only ABC123-1 will match and be processed.

You can send your own connect command if you wish to chat with the calling station even though his/her call request has been rejected.

Clear CFROM with '%,' '&,' or 'OFF' as arguments.

CHCALL ON|OFF Mnemonic: CHC Default: OFF

Parameters:

ON - Call sign of the distant station IS displayed in multiple connection operation.

OFF - Call sign of the distant station is NOT displayed

CHCALL displays the call sign of the 'connected-to' station after the channel identifier.

Set CHCALL ON if you intend to operate multiple connections (as opposed to having your 'host' computer operate multiple connections).

CHCALL is especially useful when operating with multiple connections. Using CHCALL is similar to using MRPT to show digipeat paths when monitoring the channel.

In the following examples, the 'equals sign' (=) is assumed to be the channel-changing character selected using the CHSWITCH command (in this case, CHSWITCH is set to decimal value 61).

o CHCALL OFF - the monitored activity looks like this:

```
=0: hello central
 hello camp2 do you have data ready?
=1: *** CONNECTED to AGXD
=1: good evening central
=1: stand by all stations
=1: ok call when ready
```

o CHCALL ON - the same activity looks like the following example.

```
=0:XABC: hello central
 hello camp 2 do you have data ready?
=1:AGXD: *** CONNECTED to AGXD
=1: good evening central
=1: stand by all stations
=1:AGXD: ok call when ready
```

With CHCALL ON, '=1' becomes '=1:<call sign>:'

NOTE: To switch channels during your multi-connect conversations, type CHSWITCH characters '=0' and '=1' without a ':' after them.

CHDOUBLE ON|OFF Mnemonic: CHD Default: OFF

Parameters:

ON - Received CHSWITCH characters appear twice (doubled).

OFF - Received CHSWITCH characters appear once (not doubled).

CHDOUBLE displays received CHSWITCH characters as doubled characters.

In the following example CHDOUBLE is ON and CHSWITCH is set to '|':

|| this is a test.

The sending station actually transmitted:

| this is a test.

The same frame received with CHDOUBLE OFF would be displayed as:

| this is a test.

o Set CHDOUBLE ON When operating with multiple connections to tell the difference between CHSWITCH characters received from other stations and CHSWITCH characters generated by your PK-90.

NOTE: CHSWITCH characters must not be one of the channel numbers (0 to 9).

CHECK 'n'	Mnemonic: CH	Default: 30

Parameters:

'n' - 0 to 250 specifies the check time in ten-second intervals.

0 - Zero disables this feature.

CHECK sets a timeout value for a packet connection, and depends on the setting of AX25L2V2.

Without the CHECK feature, if your PK-90 were linked or 'connected' to another station and the other station seemed to 'disappear,' your PK-90 would remain in the connected state indefinitely, refusing connections from other stations.

This might happen if propagation changes unexpectedly or an intermediate digipeater station fails or is shut down while you and the distant station are connected 'via' that digipeater.

Your PK-90 tries to prevent this situation from occurring by sending a new connect request packet when RELINK is ON and the specified time elapses without any packets being heard from the other TNC.

If RELINK is ON, when a pre-Version 2 link is inactive for (CHECK times ten seconds), your PK-90 tries to save the link by starting a reconnect sequence. The PK-90 enters the 'connect in progress' state and sends SABM (Connect Request) frames. In addition, the PK-90 adds a random time of up to 30 seconds each time CHECK is used.

- If AX25L2V2 is ON and packets have not been heard from the distant end for 'n' times 10 seconds, your PK-90 sends a 'check packet' to test if the link still exists to the other station.

The 'check' packet frame contains no information, but is interpreted by the distant station's TNC to see if it is still connected. If the distant station's TNC is still connected, the distant station sends an appropriate response packet.

If your PK-90 initiates the 'check' and does not get an answer after RETRY+1 attempts, the PK-90 starts a reconnect sequence just as if you had typed the CONNECT command. If RELINK is OFF, the PK-90 goes to a disconnected state.

- If AX25L2V2 is OFF and the other station has not been heard for 'n' times 10 seconds, your PK-90 does not test the link to the distant station; your PK-90 sends a reconnect packet just as if you had typed the CONNECT command.

CHSWITCH 'n' Mnemonic: CHS Default: $00

Parameters:

'n' - 0 to $FF (0 to 255 decimal) specifies an ASCII character code.

CHSWITCH selects the characters used by both the PK-90 and the user to show that a new connection channel is being addressed.

The character can be PASSed in CONVERS mode. This character is always ignored as a user-initiated channel switch in TRANSPARENT mode; it just flows through as data.

- o The outgoing channel cannot be changed while active or 'on-line' in TRANSPARENT mode.
- o To switch channels, ESCAPE to Command Mode, then enter Converse Mode to use the CHSWITCH command.

NOTE: If the PK-90 is being used as the TNC for an electronic mail system or other type of host computer or file server, change the CHSWITCH character to $00 to avoid possible conflict or problems with the characters frequently found in some types of data files.

See CHDOUBLE and CHCALL for further use of CHSWITCH.

CLKADJ n Mnemonic: CLK Default: 0 (zero)

Parameters:

'n' - 0 to 65535 specifies a correction factor to be applied to the real-time clock routine

---

CLKADJ provides a limited ability to correct the PK-90's real-time clock.

A value of '0' (zero) is a special case and means that NO correction will be applied. If the value of CLKADJ is anything other than zero, then the correction factor is calculated as:

relative clock speed in % = 100 - (9.16667 * 1/n)

The real-time clock routine keeps track of year, month, day, hour, minute and second as specified in the DAYTIME command.

NOTE: The real-time clock is not intended to serve as your station reference clock; it is useful for approximate time-stamping information in packet operation.

CMDTIME 'n' Mnemonic: CM Default: 10

Parameters:

'n' - 0 to 250 specifies timeout value in 100-millisecond intervals while in Transparent Mode.

If 'n' is 0 (zero), exit from Transparent Mode requires sending the BREAK signal or interrupting power to the PK-90.

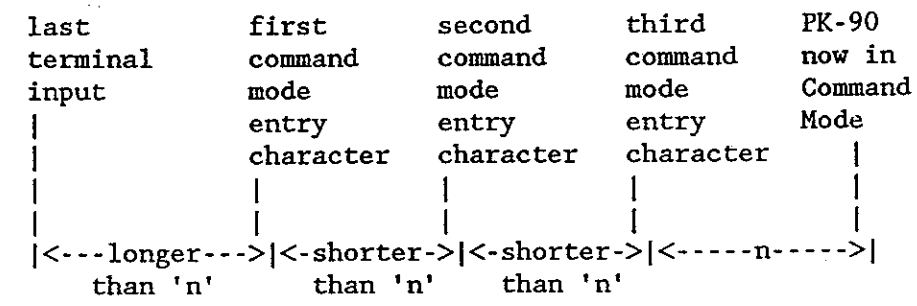
CMDTIME sets the timeout value in Transparent Mode. A guard time of 'n' seconds allows escape to Command Mode from Transparent Mode, while permitting any character to be sent as data.

The same Command Mode entry character (default <CTRL-C>) used to exit from the Converse Mode is used to exit Transparent Mode, although the procedure is different.

- The Command Mode entry character is set by COMMAND.
- Three Command Mode entry characters must be entered less than 'n' seconds apart, with no intervening characters, after a delay of 'n' seconds following the last characters typed.
- After a final delay of 'n' seconds, the PK-90 exits Transparent Mode and enters Command Mode.
- You will then see the normal Command Mode prompt:

  cmd:

The following diagram illustrates this timing:



CMSG ON|OFF Mnemonic: CMS Default: OFF

Parameters:

ON - The stored CTEXT message is sent as the first packet after a connection is established by a connect request from a distant station.

OFF - The text message is not sent at all.

CMSG enables or disables automatic transmission of the CTEXT message when your PK-90 accepts a connect request from another station.

- Set CMSG ON to tell callers that you are not available to answer calls manually when they connect to your PK-90.

- Set CMSG OFF when available to operate or answer calls manually.

COMMAND 'n' Mnemonic: COM Default: $03 <CTRL-C>

Parameters:

'n' - 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

COMMAND is used to change the Command Mode entry character. You can enter the code in either hexadecimal or decimal numbers.

Type the COMMAND character to enter Command Mode from Converse Mode. No response is seen if you type the Command Mode entry character while you are already in Command Mode.

- Enter Converse Mode by typing: CONVERSE

Now, all characters typed on the keyboard and characters send from a disk or tape file are transmitted as packet data.

Type <CTRL-C>. The Command Mode prompt appears, indicating successful exit to Command Mode. The display might look like this:

```
cmd:CONVERSE
Attention all!  This is a test transmission.  [type <CTRL-C>]
cmd:
```

See CMDTIME or the discussion of Transparent Mode for instructions on the Command Mode entry character to escape from Transparent Mode.

CONMODE CONVERS|TRANS Mnemonic: CONM Default: CONVERS

Parameters:

CONVERS - The PK-90 automatically enters Converse Mode when a connection is established.

TRANS - The PK-90 automatically enters Transparent Mode when a connection is established.

CONMODE selects the mode the PK-90 uses after entering the CONNECTED state.

The connection may result either from a connect request received from a distant station, or a connection initiated by a CONNECT command that you've typed.

- Set CONMODE to CONVERS for most packet operations.
- Set CONMODE to TRANS if you are using Transparent Mode for a bulletin board program, so that the correct mode will be entered when your bulletin board receives a connect request.
- If the PK-90 is already in Converse or Transparent Mode when the connection is completed, the mode will not be changed.

CONNECT call1 [VIA call2[,call3...,call9]] Immediate Command

Parameters:

call1	-	Call sign of the distant station to which you wish to be connected.
call2	-	Optional call sign(s) of up to eight digipeaters via which you'll be repeated to reach the distant station.

CONNECT sends a connect request to station 'call1,' directly or via one or more digipeaters. Each call sign can include an optional SSID or extension 'n,' immediately after the call sign.

The part of the command line shown in brackets below is optional. The double-bracketed text ,'call3...,call9' is also optional and is used only when 'VIA call2' is used, that is, when connecting through one or more digipeaters. (The brackets and quotation marks are used in this text only for clarity - please don't type them!)

VIA call2[, call3...,call9]

o Type the digipeater fields in the exact sequence you wish to use to route your packets to destination station 'call1.'

If you type CONNECT while the PK-90 is connected, or trying to connect to or disconnect from a distant station, your monitor will show:

Link state is: CONNECT in progress

If the distant station does not 'ack' your connect request after the number of tries specified by RETRY, the CONNECT command is canceled. Your monitor displays:

*** Retry count exceeded
*** DISCONNECTED: (call sign)

To connect directly to XAAA, you would type:

cmd:CONNECT XAAA (or C XAAA)

To connect to XAAA using XBBB (with whom you can easily connect) and XCCC (who is near XAAA) as digipeaters, you would type:

cmd:CONNECT XAAA VIA XBBB,XCCC

Type CONNECT or 'C' without arguments to see the link status and the number of unacknowledged, outstanding packets.

CONOK ON|OFF Mnemonic: CONO Default: ON

Parameters:

ON - Functions identically to CFROM ALL.

OFF - Functions identically to CFROM NONE.

CONOK ON/OFF is synonymous with CFROM ALL/NONE and is provided for compatibility with terminal programs and other applications requiring this specific command used in older packet controllers.

CFROM must have been previously set to either ALL or NONE to use this command.

CONPERM ON|OFF Mnemonic: CONP Default: OFF

Parameters:

ON - The current connection on the current channel is not allowed to enter the disconnected state.

OFF - The current channel can be connected to and disconnected from other stations.

When ON, CONPERM forces the PK-90 to maintain the current connection, even when frames to the other station exceed RETRY attempts for an acknowledgement. RESTART and power off/on cycling do not affect this connected state.

CONPERM can be set only when a connection is established or when a connection is in progress (being established). CONPERM functions on a channel-by-channel basis when multiple connections are allowed.

CONPERM allows connections on other channels to operate normally. For example, automatic disconnect based on RETRY, when used under conditions such as:

- Certain networking applications
- Other noisy, less reliable links

CONSTAMP ON|OFF Mnemonic: CONS Default: OFF

Parameters:

ON - Connect status messages ARE time stamped.

OFF - Connect status messages are NOT time stamped.

CONSTAMP activates time stamping of *** CONNECTED status messages.

If CONSTAMP is ON and DAYTIME (the PK-90's internal clock) is set, date and time information generated in the PK-90 is available for electronic mail programs or other host computer applications.

Date and time must be set initially by the DAYTIME command before time stamping will occur. For example, if CONSTAMP is ON and the date and time have been set in the PK-90, a connect and disconnect sequence appears as follows:

```
cmd:connect wxx123
10:55:23  *** CONNECTED to WXX123

cmd:disconnect
10:55:59  *** DISCONNECTED: WXX123
```

The CONNECT and DISCONNECT command can be abbreviated as shown below. The results are identical.

```
cmd:c wxx123
10:56:22  *** CONNECTED to WXX123

cmd:d
10:56:32  *** DISCONNECTED: WXX123
```

CONVERSE Mnemonic: CONV or K Immediate Command

CONVERSE is an immediate command that causes the PK-90 to switch from the Command Mode into the Converse Mode.

When the PK-90 is in the Converse Mode, all characters typed from the keyboard or sent from a disk file are processed and transmitted by your radio.

- To return the PK-90 to the Command Mode from the Converse Mode, type the Command Mode entry character (default is <CTRL-C>).

CPACTIME ON|OFF Mnemonic: CP Default: OFF

Parameters:

ON - Packet transmit timer IS used in Converse Mode.
OFF - Packet transmit timer is NOT used in Converse Mode.

CPACTIME activates automatic, periodic transmission of packets while in Converse Mode.

CPACTIME can be used for several types of computer communications such as electronic mail systems, bulletin board or host computer operation when full Transparent Mode features are not desired.

When CPACTIME is ON, characters are packetized and transmitted periodically as they are in Transparent Mode. Local keyboard editing and display features of the Converse Mode are available; software flow control can be used.

- See the PACTIME command, (which controls the rate and mode of packet assembly) for a discussion of how periodic packetizing works.
- Set ACRPACK OFF in this mode.

When ACRPACK is ON, the send-packet character is inserted in the data being packetized even though it was not typed.

- To include <CR> characters in transmitted packets, set SENDPAC to a character not normally used (e.g., <CTRL-P>); the PK-90 then treats a <CR> as an ordinary character.
- Set CPACTIME ON for an operation similar to full break-in CW.

Setting CPACTIME ON transmits your text soon after you type it, in short bursts of a few characters. The other station may break in at will. Some operators find it easier to chat in this mode. Delays are eliminated while long packets are being typed.

CR ON|OFF Mnemonic: CR Default: ON

Parameters:

ON - The send-packet character, normally <CR>, IS added to all packets sent in Converse Mode.
OFF - The send-packet character is NOT added to packets.

CR is synonymous with ACRPACK and is used in the same manner as the newer command. Either command word has the same effect.

CSTATUS Mnemonic: CS Immediate Command

CSTATUS is an immediate command used in multiple connections. When CSTATUS is typed, your monitor displays:

- o The number of each logical channel.
- o The link state of all ten logical channels.
- o The current input/output channel - the one you're using.
- o Whether each channel connection is 'permanent.' (See CONPERM.)

Depending on your use of multiple connections and the USERS command, CSTATUS will show you the following displays:

```
NOT CONNECTED TO ANY STATION
cmd:cs
Ch. 0 - IO DISCONNECTED
Ch. 1 -    DISCONNECTED
Ch. 2 -    DISCONNECTED
Ch. 3 -    DISCONNECTED
Ch. 4 -    DISCONNECTED
Ch. 5 -    DISCONNECTED
Ch. 6 -    DISCONNECTED
Ch. 7 -    DISCONNECTED
Ch. 8 -    DISCONNECTED
Ch. 9 -    DISCONNECTED
```

```
CONNECTED TO ONLY 1 STATION
cmd:cs
Ch. 0 - IO CONNECTED to XAAA
Ch. 1 -    DISCONNECTED
Ch. 2 -    DISCONNECTED
Ch. 3 -    DISCONNECTED
Ch. 4 -    DISCONNECTED
Ch. 5 -    DISCONNECTED
Ch. 6 -    DISCONNECTED
Ch. 7 -    DISCONNECTED
Ch. 8 -    DISCONNECTED
Ch. 9 -    DISCONNECTED
```

If you're connected to several stations, the CSTATUS command shows your connect status as follows:

```
CONNECTED TO SEVERAL STATIONS
cmd:cs
Ch. 0 - IO CONNECTED to XAAA
Ch. 1 -    CONNECTED to XBBB P
Ch. 2 -    CONNECTED to XCCC
Ch. 3 -    CONNECTED to XDDD
Ch. 4 -    CONNECT in progress
Ch. 5 -    DISCONNECTED
Ch. 6 -    DISCONNECTED
Ch. 7 -    CONNECTED to XEEE via XFFF
Ch. 8 -    DISCONNECTED
Ch. 9 -    DISCONNECTED
```

This sample display shows that:

- o CHANNEL 0 has the input and output channels - you're using it!
- o CHANNEL 1 is connected to XBBB 'permanently.'
- o All other channels' states are shown as they might appear with multiple connections.

CTEXT text Mnemonic: CT Default: See sample

Parameters:

text Any combination of characters and spaces up to a maximum of 120 characters.

CTEXT is the 'automatic answer' text you type in to a special section of the PK-90's memory.

The default text says, 'Please leave a message, then disconnect.'

If CMSG is set ON:

- The CTEXT message is sent as soon as another station connects to your station.

To type multiple-line CTEXT messages and include a carriage return (<CR>) character in your text, use the PASS character (<CTRL-V> is the default value) immediately preceding the carriage return (see the PASS command).

A typical CTEXT message might be:

```
Main base closed for the weekend. <CTRL-V> <CR>
Please leave your message, then disconnect <CR>
```

- If you enter a text string longer than 120 characters, an error message appears and the command is ignored.

```
?too long
cmd:
```

- Use a percent sign (%), an ampersand (&), 'N,' 'NO,''NONE,' or 'OFF' as the first characters in the CTEXT message to clear the previous message without having to type a RESET command.

DAYTIME date&time Mnemonic: DA Default: not set

Parameters:

date&time - Current DATE and TIME to set.

DAYTIME sets the PK-90's internal clock current date and time. The date&time parameter is used in Packet Mode by the commands CONSTAMP and MSTAMP to 'time stamp' received and monitored messages.

Entries in the 'heard' (displayed by MHEARD) are also time stamped if date&time has been set. The PK-90's time is updated continuously, as long as it is powered up.

The clock is not set when the PK-90 is turned on. The DAYTIME command displays the following error message:

```
cmd:day
?clock not set
```

- You must reset date and time each time you turn on the PK-90. Otherwise CONSTAMP and MSTAMP will not 'stamp' the time.

If you type DAYTIME without a parameter, the PK-90 displays current date and time information. The format of the display is:

```
                dd-mm-yy hh:mm:ss
cmd:day
DAYTIME  08-Jul-86  06:57:33
```

- The format for entering the date&time is:

```
                   yymmddhhmm
cmd:daytime 8607080659
```

where:

yy is the last two digits of the year
mm is the two-digit month code (01-12)
dd is date (01-31)
hh is the hour (00-23)
mm is the minutes after the hour (00-59)

- Enter the numbers 0-9 with leading zeros; codes must be exactly two digits.

- Be aware of the month when you set the date - the PK-90 does not check for the correct number of days in a month.

DAYSTAMP ON|OFF Mnemonic: DAYS Default: OFF

Parameters:

ON - The DATE is included in CONSTAMP and MSTAMP.

OFF - Only the TIME is included in CONSTAMP and MSTAMP.

DAYSTAMP activates the date in CONSTAMP and MSTAMP.

- Set DAYSTAMP ON when you want a dated record of packet channel activity, or when you are unavailable for local packet operation.

DELETE ON|OFF Mnemonic: DEL Default: OFF

Parameters:

ON - The <DELETE> ($7F) key is used for editing your typing.

OFF - The <BACKSPACE> ($08) key is used for editing your typing.

Use the DELETE command to select the key to use for deleting while editing.

- Type the selected DEL key to delete the last character from the input line.

You cannot use the DEL key to delete text before the beginning of a line. Use the PASS character to delete <CR> characters that have been typed into the text.

- The BKONDEL command controls how the PK-90 indicates deletion.

- To see a corrected display of the current line after deleting characters, type the redisplay-line character, which is set by the REDISPLA command.

DFROM all,none,yes/no call1[,call2..] Mnemonic: DF Default: all

---

Parameters:

call - all, none, YES list, NO list.
list of up to eight call signs, separated by commas.

DFROM uses arguments to determine how the PK-90 responds to stations trying to use your station as a digipeater - which stations will be repeated and which stations will not be repeated. DFROM is set to 'all' when you start the PK-90 for the first time.

DFROM ALL/NONE is synonymous with the DIGIPEAT ON/OFF command used in older packet controllers and can be used interchangeably as required.

Type DFROM to display the ALL/NONE/YES_list/NO_list status of station call signs whose packets will or will not be repeated. You can use the abbreviated command form or mnemonic:

```
cmd:dfrom
DFROM    all
cmd:df
DFROM    yes XAAA,XBBB,XCCC,XDDD
```

To prevent all stations from using your station as a digipeater, type DFROM NONE.

To permit one or more specific stations to digipeat through your station, type DFROM (YES followed by a list of calls signs). Packets will be digipeated only from and to stations whose call signs are listed.

To prevent one or more specific stations from digipeating through your station, type DFROM (NO followed by a list of call signs). Packets will not be digipeated only from and to stations whose call signs are listed.

You can include optional SSIDs or extensions specified as '-n' after the call sign.

If DFROM is set to 'no XBE555' or 'yes XBE555', combinations XBE555, XBE555-1,...XBE555-15 will be matched and processed.

If DFROM is set to 'yes XBE555-1' or 'no XBE555-1,' then only XBE555-1 will match and be processed.

Clear DFROM with '%,' '&,' or 'OFF' as arguments.

DIGIPEAT Mnemonic: DIG Default: ON

Parameters:

ON - Equivalent to DFROM ALL

OFF - Equivalent to DFROM NONE

In host computer applications that use a Boolean parameter switching routine rather than numeric values, the DIGIPEAT command can be used with ON and OFF instead of ALL or NONE.

This alternate DIGIPEAT command is appropriate in certain electronic mail and bulletin board systems.

Note that DIGIPEAT ON and OFF as Boolean commands do not provide the same capability for selective digipeating as with DFROM YES(calls) and DFROM NO(calls).

DISCONNE Mnemonic: D Immediate Command

DISCONNE is an immediate command that initiates a disconnect request to the station to which you are connected.

If your disconnect command is successful, your monitor will display:

*** DISCONNECTED: (call sign)

Other commands can be entered while a disconnect is in progress. New connections are not allowed until the disconnect is completed.

- If the retry count is exceeded while waiting for the distant station to acknowledge your disconnect command, your PK-90 switches to the disconnected state.

- If another disconnect command is entered while your PK-90 is trying to disconnect, the retry count is immediately set to the maximum number. In either case, your monitor displays:

  *** Retry count exceeded
  *** DISCONNECTED: (call sign)

  Disconnect messages are not displayed when the PK-90 is in the Transparent Mode.

DISPLAY [class] Mnemonic: DISP Immediate Command

Parameters:

class - Optional parameter identifier, one of the following:

(A)sync	display asynchronous port parameters
(C)haracter	display special characters
(I)d	display ID parameters
(L)ink	display link parameters
(M)onitor	display monitor parameters
(T)iming	display timing parameters
(Z)	display the entire command/parameter list

DISPLAY is an immediate command.

When DISPLAY is typed without a parameter, the PK-90 responds with:

```
cmd:DISPLAY A,C,I,L,M,T,Z
cmd:
```

You can display subgroups of related system parameters by specifying the optional class parameter:

```
cmd:disp a
8BITCONV OFF
ACRDISP  80
ALFDISP  OFF
AWLEN    7
CASEDISP 0
ECHO     ON
ESCAPE   OFF
FLOW     ON
ILFPACK  OFF
NUCR     OFF
NULF     OFF
NULLS    0
PARITY   3
TBAUD    1200
TRFLOW   OFF
TXFLOW   OFF
XFLOW    ON
cmd:
```

Individual system parameter values can be displayed by entering the parameter name without options.

```
cmd: mycall        cmd:frack      cmd:dwait
MYCALL XAAA        FRACK   3      DWAIT   16
```

DWAIT 'n' Mnemonic: DW Default: 16

Parameters:

'n' - 0 to 250 specifies default wait time in ten-millisecond intervals.

DWAIT helps to avoid collisions with digipeated packets.

Unless the PK-90 is waiting to transmit digipeated packets, DWAIT forces the PK-90 to pause after last hearing data on the channel, for the duration of the DWAIT (Default Wait) time, before it begins its transmitter key-up sequence.

Wherever possible, the value of DWAIT should be agreed on by all stations in a local area when digipeaters are used in the area. The best value will be determined by experimenting.

DWAIT is a function of the key-up time (TXDELAY) of the digipeater stations and helps alleviate the drastic reduction of throughput that occurs on a channel when digipeated packets suffer collisions.

DWAIT is necessary because digipeated packets are not retried by the digipeater, but are always restarted by the originating station. When all stations specify a default wait time, and the right value of 'n' is chosen, the digipeater captures the frequency every time it has data to send - digipeated packets are sent without this delay.

Recommended settings of DWAIT for different types of packet station operation are:

TYPE OF OPERATION	TIME (in ms)	DWAIT VALUE
Digipeaters	0	0
Local keyboards	160	16 (default)
PBBSs, Hosts	320	32
File transfers	480	48

Your PK-90 always uses a DWAIT value of 0 (zero) when you digipeat someone else's packet. If DWAIT is set to any other value, the PK-90 simply ignores it.

ECHO ON|OFF Mnemonic: E Default: ON

Parameters:

ON - Characters received from the computer or terminal ARE echoed by the PK-90.

OFF - Characters are NOT echoed.

The ECHO command controls local echoing by the PK-90 when it is in Command or Converse Mode. Local echoing is disabled in Transparent Mode.

- Set ECHO ON if you do not see your typing appear on your display.
- Set ECHO OFF if you see each character you type doubled.

ECHO is set correctly when you see the characters you type displayed correctly.

ESCAPE ON|OFF Mnemonic: ES Default: OFF

Parameters:

ON - The <ESCAPE> character ($1B) is output as '$' ($24).

OFF - The <ESCAPE> character is output as <ESCAPE> ($1B).

The ESCAPE command selects the character to be output when an <ESCAPE> character is to be sent to the terminal. The <ESCAPE> translation is disabled in Transparent Mode.

The ESCAPE character selection is provided because some computers and terminal emulators interpret the <ESCAPE> character as a special command prefix. Such terminals may alter their displays depending on the characters following the <ESCAPE>.

- Set ESCAPE ON if your terminal requires it to avoid unexpected text strings from other packet operators.
- See the MFILTER command for information on character stripping (rather than character translation) in monitored packets.

FLOW ON|OFF Mnemonic: F Default: ON

Parameters:

ON - Type-in flow control IS active.

OFF - Type-in flow control is NOT active.

When FLOW is ON, type-in flow control is active. Any character typed on your keyboard causes output from the PK-90 to the terminal to stop until any of the following conditions exist:

- A packet is forced (in Converse Mode)
- A line is completed (in Command Mode)
- The packet length (See PACLEN) is exceeded
- The terminal output buffer fills up

Cancelling the current command or packet or typing the redisplay-line character also causes output to resume. Type-in flow control is not used in Transparent Mode.

Setting FLOW ON prevents inbound or received data from interfering with your keyboard data entry. If you (and the person you are talking to) normally wait for a packet from the other end before starting to respond, you can set FLOW OFF.

- Some electronic mail system programs may work best with FLOW set to OFF.
- Some interface boards or computers with 'software UARTs' may be unable to send and receive data at the same time. If you are using that type of computer, set FLOW to ON.

FRACK 'n' Mnemonic: FR Default: 3

Parameters:

'n' - 1 to 15, specifying frame acknowledgment time-out in one-second intervals.

FRACK is the FRame ACKnowledgement time in seconds that your PK-90 will wait for acknowledgement of the last-sent protocol frame before resending or 'retrying' that frame.

After sending a packet requiring acknowledgment, the PK-90 waits for FRACK seconds timeout before incrementing the retry counter and sending the frame again. If the packet address includes digipeat instructions, the time between retries is adjusted to:

Retry interval = 'n' x (2 x m + 1)
where m is the number of intermediate relay stations.

When a packet is retried, a random wait time is added to any other wait times in use. This avoids lockups in which two packet stations repeatedly send packets which collide with each other.

FULLDUP ON|OFF Mnemonic: FU Default: OFF

Parameters:

ON - Full duplex mode is ENABLED.
OFF - Full duplex mode is DISABLED.

When full-duplex mode is disabled (default), the PK-90 uses the DCD (Data Carrier Detect) signal from its modem to avoid collisions; the PK-90 acknowledges multiple packets in a single transmission with a single acknowledgment.

When full-duplex mode is enabled, the PK-90 ignores the DCD signal and acknowledges packets individually.

Full-duplex operation is useful for full-duplex radio operation, such as through OSCAR 10 or dedicated traffic trunks. It should not be used unless both your station and the distant station can operate in full-duplex.

You may also find full-duplex mode useful for some testing operations, such as analog or digital loopback tests.

HBAUD 'n' Mnemonic: HB Default: 1200 bauds

Parameters:

'n' values specifying the rate or signalling speed in bauds from the PK-90 to the radio.

Available HDLC packet data rates 'n' include 45, 50, 57, 75, 100, 110, 150, 200, 300, 600, 1200, 2400, 4800 and 9600 bits per second.

o Example: HBAUD 300

HBAUD sets the radio ('on-air') baud rate only in the packet operating mode. HBAUD has no relationship to your computer terminal program's baud rate.

You must use the same radio data rate as the distant station.

NOTE: Modern commercial terminology no longer refers to the speeds or data rates in 'WPM.' The term 'bauds' is now universally accepted for FSK and AFSK operations using mono-bit data. In these cases, the terms 'bauds' and 'bits per second' mean the same thing. Either term may be used.

HEADERLN ON|OFF Mnemonic: HEA Default: OFF

Parameters:

ON - The header for a monitored packet is printed on a separate line from the packet text.
OFF - The header and the text of monitored packets are printed on the same line.

HEADERLN affects the display of monitored packets. When HEADERLN is OFF, the address information is shown on the same line as the packet text:

XAAA>XBBB: Go ahead and transfer the file.

When HEADERLN is ON, the address is shown, followed by a <CR><LF> that puts the packet text on a separate line:

XAAA>XBBB:
Go ahead and transfer the file.

If MRPT or MSTAMP are ON, set HEADERLN ON; long headers may extend across your screen or page when these functions are active.

HELP Mnemonic: H Immediate Command

While in Command Mode, type the command 'H' to read the abbreviated on-line HELP file.

Your monitor displays the following brief list:

```
cmd:help
HELP:
CONNECT   DISCONNE
CONVERSE  TRANS
DISPLAY   CALIBRAT
MHEARD    CSTATUS
RESTART   RESET
TCLEAR
cmd:
```

You can exit from your present operating mode and enter Command Mode at any time to list the HELP text.

HHANG 'n' Mnemonic: HH Default: 0 (zero)

Parameters:

'n' - 0 to 250 specifies a flag burst repetition rate in intervals of 100 milliseconds.

Repeaters both trunked and standard vary widely in the switching delays between receive and transmit. This imposes additional special requirements on a packet radio controller. The HHANG parameter aids in handling operation with these repeaters.

When in a connected state, if HHANG is set to any value other than 0 (zero), the PK-90 keys the PTT line and sends bursts of sync flag at regular intervals. This keeps the channel active and the repeater keyed.

When there is activity on the channel, bursts are not sent. The PK-90 waits HHANG times 100 milliseconds after the last activity on the channel, sends a burst and then repeats it every HHANG times 100 milliseconds. Bursts are not sent while in the disconnected state or if HHANG is set to 0 (zero).

The length of the HHANG burst is set by the value assigned to TXDELAY.

NOTE: TXDELAY must be less than HHANG.

HID ON|OFF Mnemonic: HI Default: OFF

Parameters:

ON - The PK-90 sends HDLC identification as a digipeater.
OFF - The PK-90 does not send HDLC identification.

The HID command activates or disables the PK-90's automatic periodic transmission of identification packets when operating as a digipeater. This identification consists of an unsequenced I-frame with your station identification (MYCALL) and MYALIAS in the data field.

- Set HID ON to force the PK-90 to send an ID packet every 9.5 minutes while used as a digipeater.
- Set HID OFF to stop the PK-90 from sending any ID packets.
- The HID identification packet is addressed to "ID".
- Your station identification is the call sign set with the MYCALL command, with 'digipeater' appended.

For example, you've set MYCALL to KAA999-8 and HID is ON. The resulting automatic identification transmission looks like:

```
KAA999-8>ID
(MYALIAS), KAA999 digipeater
```

NOTE: You cannot change the 9.5-minute automatic interval timing.

HOST Mnemonic: HOST Default: OFF

Parameters:

ON - The PK-90 operates with a host computer or other special application program.
OFF - The PK-90 operates as a normal TNC.

The HOST command permits the PK-90 to operate in the Host Mode, a 'computer-friendly' communications mode, over the RS-232 link between the PK-90 and a host computer.

In the Host Mode, the PK-90 sends data to the computer only when the computer requests data. The data are prefaced with a special header that identifies the type of information being sent.

To cancel HOST mode, type three <CTRL-C> characters, or the sequence <CTRL-A> O H O N <CTRL-W>. The BREAK character will not cancel HOST.

See Chapter 6, Host Mode and Special Applications, for more details.

HPOLL ON|OFF Mnemonic: HP Default: ON

Parameters:

ON - In Host Mode, the host computer must poll the PK-90 for all data.

OFF - The PK-90 sends data blocks to the host computer as they are formed. Data poll is unnecessary.

The HPOLL command functions only in Host Mode and depends on specific characteristics of each application operating in the host computer or server.

Some application programs will poll the data controller as required. In such cases, set HPOLL to OFF.

ID Mnemonic: I Immediate Command

ID is an immediate command that sends a special identification packet. The ID command allows you to send a final identification packet when you take your station off the air. Note that HID must be set ON.

ID forces a final identification packet to be sent when a digipeater station is taken off the air. The identification consists of an unnumbered I-Frame, with its data field containing your MYALIAS (if any) and your MYCALL station identification and the word 'digipeater.'

- The ID identification packet is sent only if the digipeater has transmitted since the last automatic identification.
- The ID identification packet is addressed to 'ID.'
- Your station identification is the call sign you set with the MYCALL command, with your MYALIAS, your main call sign and the word 'digipeater' appended. The following example is shown as seen with and without a MYALIAS, with MONITOR set to 6.

WXX123*>ID <UI>	WXX123*>ID <UI>
WXX123 digipeater	HQ, WXX123 digipeater

ILFPACK ON|OFF Mnemonic: IL Default: ON

Parameters:

ON - The PK-90 suppresses line feeds from the terminal.
OFF - The PK-90 transmits line feeds from the terminal

Use ILFPACK ON when transmitting a computer file containing line feeds if the distant station does not want line feeds.

IO 'n' Mnemonic: IO Default: none

Parameters:

n - a hexadecimal value used with the I/O command to access the PK-90's memory and I/O locations, or read values stored at a specified address.

The I/O command works with the ADDRESS command and permits acess to memory and I/O locations as follows:

ADDRESS $aabb
or SOH $4F A E $ a a b b ETB (in the HOST mode).

where "aa" is the device address, and "bb" is the register address on the device.

Use the I/O command without arguments to read an I/O location, and with one argument $0 to $FF to write to an I/O location. The value in ADDRESS is not incremented after using the I/O command.

K Mnemonic: K or CONV Immediate Command

The K command is synonymous with the CONVERSE command and places the PK-90 in the Converse mode.

When the PK-90 is in the Converse Mode, all characters typed from the keyboard or sent from a disk file are processed and transmitted by your radio.

o To return the PK-90 to the Command Mode from the Converse Mode, type the Command Mode entry character (default is <CTRL-C>).

APPENDIX A

PK-90 COMPLETE COMMAND LIST

NOTE: Certain commands and parameters shown in the following alphabetical listing do not appear in response to the DISPLAY command.

COMMAND	MNEMONIC	DEFAULT	FUNCTION
8BITCONV	8B	OFF	Strip bit 7 in CONVERSE
ACRDISP	ACRD	80	Screen width
ACRPACK	ACRP	ON	Add <CR> to packet
ADDRESS	ADD	Enter hex addresses	For MEMORY & IO commands
ALFDISP	ALFD	ON	Send LF after <CR> to terminal
ALFPACK	ALFP	OFF	Send LF after <CR>, packet
AWLEN	AW	8 (set by autobaud)	Data bits per word, to terminal
AX25L2V2	A	ON	Operate as AX.25 Version 1.0
AXDELAY	AXD	0 (00 msec.)	Repeater key-up delay (X10 ms)
AXHANG	AXH	0 (000 msec.)	Repeater hang time (X10 ms)
BEACON	B	EVERY 0 (00 sec.)	Set beacon timing (X10 seconds)
BKONDEL	BK	ON	Send BS SP BS for DELETE char.
BTEXT	BT	(Empty)	120-byte BEACON message text
BXDELAY	BXD	0 (00 msec.)	Set delay after squelch active
CALIBRA	CAL	Immediate Command	Start calibrate mode
CANLINE	CAN	$18 <CTRL-X>	Line delete character
CANPAC	CANP	$19 <CTRL-Y>	Packet delete character
CASEDISP	CAS	0 (as is)	Display case (as is/lower/UPPER)
CBELL	CB	OFF	Enable 'Connect' bell
CFROM	CF	all	Connect request accept/reject
CHCALL	CHC	OFF	Show call sign after channel ID
CHDOUBLE	CHD	OFF	Show CHSWITCH character twice
CHECK	CH	30 (300 sec.)	Idle link timeout (X10 seconds)
CHSWITCH	CHS	$00	Channel-select (Link) character
CLKADJ	CLK	0	Correction to real-time clock
CMDTIME	CM	10 (1000 msec.)	Transparent Mode escape timer
CMSG	CMS	OFF	Send CTEXT message to caller
COMMAND	COM	$03 <CTRL-C>	Character escape to COMMAND Mode
CONMODE	CONM	CONVERSE	Mode to enter when link starts
CONNECT	C	Immediate Command	Send connect request to <call>
CONOK	CONO	ON	Synonym for CFROM ALL
CONPERM	CONP	OFF	Never disconnect this link
CONSTAMP	CONS	OFF	Mark connections with time/date
CONVERSE	CONV or K	Immediate Command	Start Converse Mode from Command
CPACTIME	CP	OFF	Use packet timeout in Converse
CR	CR	ON	Synonym for ACRPACK
CSTATUS	CS	Immediate Command	Show status of channels (links)
CTEXT	CT	(Text)	120-byte CONNECT message text
DAYSTAMP	DAYS	OFF	Include DATE in time stamp
DAYTIME	DA	None	Set/read PK-90 internal clock
DELETE	DEL	OFF	Use BS ($08), not DEL ($7F)

PK-90 COMPLETE COMMAND LIST (Continued)

COMMAND	MNEMONIC	DEFAULT	FUNCTION
DFROM	DF	ALL	Selective digipeat call list
DISCONNE	D	Immediate Command	Send DISC to distant station
DISPLAY	DISP	Immediate Command	Show PK-90 parameters/classes
DWAIT	DW	16 (160 msec.)	Delay for digi repeat (X10 ms)
ECHO	E	ON	Echo typed keyboard characters
ESCAPE	ES	OFF	Send ESC character $1B as $24
FLOW	F	ON	Stop echo to screen while typing
FRACK	FR	3 (3 sec.)	Time (X1 sec) to wait for ACK
FULLDUP	FU	OFF	Full-Duplex terminal operation
HBAUD	HB	1200	Packet link (radio) baud rate
HEADERLN	HE	ON	Insert <CR> after headers
HELP	H	None	Show brief HELP text on screen
HHANG	HH	0 (000 msec.)	Send flag bursts to repeater
HID	HI	OFF	Send ID UI packet every 9.5 mins
HOST	HOST	OFF	Host/terminal interface
HPOLL	HPOLL	ON	Host poll, packet mode
ID	I	Immediate Command	Force ID packet via Unproto path
ILFPACK	IL	ON	Ignore line feeds in packet xmit
IO	IO	Enter hex addresses	Read/write IO register
K	K	Immediate Command	Same as CONVERSE
KEYWORD	KE	none	Set numeric key for encryption
KISS	KI	OFF	Use KISS TNC protocol
MACRO	nM	none	Create/use macro command strings
MAXFRAME	MAX	4	Maximum un-ACK'd frames allowed
MBELL	MBE	OFF	Beep if selected call is heard
MBX	MB	none, (enter calls)	Monitor channel without headers
MCON	MC	0 (zero)	Monitor while connected (0-6)
MDIGI	MD	OFF	Monitor digipeated frames
MEMORY	ME	Enter hex addresses	Read/write memory location
MFILTER	MFI	$80	Filter controls less CR, LF, TAB
MFROM	MF	all	Monitor MFROM call signs
MHEARD	MH	Immediate Command	Display call signs heard
MONITOR	M	4 (UA DM C D I UI)	Monitor mode level select (0-6)
MPROTO	MP	OFF	Monitor I-frames with PID $F0
MRPT	MR	ON	Show digipeaters in headers
MSTAMP	MS	OFF	Time-stamp monitored frames
MTO	MT	none	Monitor MTO call signs
MYALIAS	MYA	none; enter yours	Alternate MYCALL
MYCALL	MY	PK90; enter yours	Your call sign packet address
NEWMODE	NE	ON	Return to Command mode at DISC
NOMODE	NO	OFF	Don't change modes unless told
NUCR	NU	OFF	Nulls to terminal after <CR>
NULF	NUL	OFF	Nulls to terminal after <LF>
NULLS	NULL	0 (zero)	Number of nulls for NUCR & NULF
PACLEN	PACL	128	# of user-typed bytes in packet
PACTIME	PACT	AFTER 10 (1000 msec.)	Packet transmit timer (X100 ms)

PK-90 COMPLETE COMMAND LIST (Continued)

COMMAND	MNEMONIC	DEFAULT	FUNCTION
PARITY	PAR	0 (none) (autobaud)	Terminal program parity (0-3)
PASS	PAS	$16 <CTRL-V>	Pass input editing character
PASSALL	PASSA	OFF	Ignore CRC in HDLC ('Junk Mode')
PASSWORD	PASSW	none	Enter security password string
PERSIST	PE	127	P-persistent CSMA threshold
PPERSIST	PP	OFF	p-persistence instead of DWAIT
RAWHDLC	RAW	OFF	Raw HDLC mode
REDISPLA	RED	$12 <CTRL-R>	Redisplay current input buffer
RELINK	REL	OFF	Reconnect after retrying out
REMOTE	REM	OFF	Enable remote control via link
RESET	RESET	Immediate Command	RESET bbRAM to factory defaults
RESPTIME	RES	10 (1000 msec.)	Minimum delay before sending ACK
RESTART	RESTART	Immediate Command	Same as power-on/off reset
RETRY	RE	10	Maximum number of frame repeats
RKEYWORD	RK	none	Set numeric key for encryption
RQTIME	RQ	20 (20 sec.)	Channel request timeout in secs
SENDPAC	SE	$0D <CTRL-M>	Character that 'sends' a packet
SETPASS	SETP	none	Master security password string
SLOTTIME	SL	10 (100 msec.)	P-persistent slot time in msecs
SQUELCH	SQ	OFF	Select receiver squelch polarity
START	STA	$11 <CTRL-Q>	Resume sending data to terminal
STATUS	STAT	ON	Send link status to terminal
STOP	STO	$13 <CTRL-S>	Stop sending data to terminal
TBAUD	TB	1200 (autobaud)	Set terminal data rate
TCLEAR	TC	Immediate Command	Clear Transmit Buffer
TIME	TI	$14 <CTRL-T>	Insert 'send time' in text
TONE	TO	3 (1200/2200 eq)	Select modem tone pairs
TRACE	TRAC	OFF	Hex dump of packet frame
TRANS	T	Immediate Command	Start Transparent Data Mode
TRFLOW	TRF	OFF	Terminal flow ctrl - Transparent
TRIES	TRI	0 (zero)	Show or force retry count
TXDELAY	TX	30 (300 msec.)	PTT key-to-data delay (X10 ms)
TXFLOW	TXF	OFF	PK-90 flow control - Transparent
UNPROTO	U	CQ	Path/address to send UI frames
USERS	US	1	# of multi-connections allowed
WDISCONN	W	Immediate Command	Disconnect after final ACK
XFLOW	XF	ON	Software flow control
XMITOK	XMITO	ON	PTT line can be keyed
XOFF	XO	$13 <CTRL-S>	Stop sending data to terminal
XON	XON	$11 <CTRL-Q>	Resume sending data to terminal

APPENDIX B

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KEYWORD 'n'	Mnemonic: KE	Default: none

Parameters:

'n' 1 to 65535 enables encryption and specifies the key to be used in encoding and decoding data.

'n' 0 (zero) disables encryption and produces plain text

You may wish to use encryption when controlling a PK-90 remotely by radio link, or when users of the link wish to communicate privately.

Use KEYWORD greater than 0 (zero) to enable data encryption.

KEYWORD is used in the controlling PK-90, while RKEYWORD is used at the controlled remote PK-90.

Note: Both ends of the link must use the same numerical key. See the RKEYWORD command discussion in this chapter.

Observers not involved in the encrypted link or unauthorized persons monitoring the link between the two PK-90s will see normal packet address headers. However, the user data or information contained in the packet frame is displayed as apparently random ASCII characters.

Some of the received characters will be interpreted by the observer's system as control characters and cause erratic display behavior. The casual viewer may see random line feeds and carriage returns, clear-screen commands and meaningless screen effects.

Other users on the same channel may monitor the channel for their own traffic and block out the apparently unintelligible screen information. These users can use the MTO NO and MFROM NO command with the callsigns shown in the packet headers between the encrypted stations.

Note that data encryption is not allowed in the Amateur Radio Service.

See the REMOTE command discussion in this chapter.

KISS ON|OFF Mnemonic: KI Default: OFF

Parameters:

ON - The PK-90 operates as a KISS TNC in Host Mode.
OFF - The PK-90 operates as a normal AX.25 Level 2 TNC

Normal PK-90 software was written for human users and is inefficient for host computer service, especially with electronic mail servers and other host applications. Experimentation with different protocols is greatly hampered; there may be no way to send or receive frames in the desired format without reprogramming the PK-90.

The KISS function solves the problems of software written for human users by eliminating much of the PK-90 software, giving the host complete control of the contents of the HDLC frames sent and received over the air.

In KISS TNC mode, the PK-90 converts synchronous HDLC on the half-duplex radio channel to and from a special asynchronous, full-duplex frame format spoken on the host/PK-90 link. Frames received on the HDLC link are passed intact to the host after translation to the asynchronous format. Asynchronous frames from the host are transmitted on the radio channel after conversion to HDLC format. See Chapter 6 for details on the use of KISS TNC protocol in the Host Mode.

To use the KISS TNC protocol, type the following commands as shown in either complete form or using the command and parameter mnemonics.

```
cmd: awlen 8                    aw 8
     parity 0                   par 0
     restart                    restart
     trace off                  trac n
     conmode transparent        conm t
     hid off                    hid n
     beacon every 0             b e 0
     hpoll off                  hp n
     kiss on                    ki y
     rawhdlc on                 raw y
     ppersist on                pp y
     host on                    host y
```

After entering Host Mode, you cannot use the normal human language or verbose commands, nor will you see normal responses from the PK-90. The host computer and its application program must assume control of the PK-90. AX.25, TCP/IP or other protocols must be executed in the host.

To quit the KISS mode, you must return to Command mode from Host mode in order to use the KISS OFF command.

---

nM(ACRO) xx...xxx (CR) Mnemonic: nM Default: none

Parameters:
'n' - 0 through 9 identifies a macro command or data string.

All PK-90 macro commands start with a numeric character 0-9. Ten macros can be created. You may make 10 macros of about 51 bytes each. Ten macros may not exceed a total of 512 bytes. One byte is equal to one character.

To set the macro's contents, type the following sequence:
- o The macro number;
- o The letter M;
- o space bar;
- o the macro contents;
- o carriage return.

For example, at the command prompt, type:

```
cmd:2M connect ABC123 (CR)
```

From this point on, if you type 2M at the cmd: prompt in the command mode, the PK-90 will display the contents of macro number 2.

```
cmd: 2M
connect ABC123
```

To execute the macro, type only the macro number at the cmd: command prompt:

```
cmd: 2
connect ABC123
```

To erase a macro, type a new macro over it or enter the number, M, a space, %, followed by (CR). You can also use &, OFF, N and NO. You can install an entire string of commands in a single macro. Type the macro number and M, followed by the specific commands separated by a slant bar (/) or (CR). If you wish to use the (CR) as a separator, you must type the PASS character (default CTRL-V) before each (CR) to avoid ending the macro command. For example:

```
cmd:3M AX25L2V2 ON/TXDELAY 50/FRACK 4 (CR)
```

The entering of a macro command is subject to the same 128 character limit as any normal command.

After a macro command has placed the PK-90 in CONVERSE or TRANSPARENT mode, you cannot use a macro to return to the COMMAND mode. The usual exit command string:

```
<CTRL-V><CTRL-C><CTRL-V><CTRL-C><CTRL-V><CTRL-C>
```

does not operate from within a macro. You must have the PK-90 set to revert to COMMAND mode by itself, for example, using the WDISCONN command, or you must enter the COMMAND character manually.

Macros cannot be executed remotely using the REMOTE command over a radio link. Macros cannot be used recursively, that is, you cannot use a macro to set or execute another macro.

MAXFRAME 'n' Mnemonic: MAX Default: 4

Parameters:

'n' - 1 to 7 specifies a number of packet frames.

MAXFRAME sets an upper limit on the maximum number of unacknowledged packets the PK-90 permits on the radio link at any one time.

MAXFRAME also sets the maximum number of contiguous packets the PK-90 will send during any given transmission.

If some, but not all, of the outstanding packets are acknowledged, a smaller number may be transmitted the next time, or new frames may be included in the retransmission, so that the total number of unacknowledged packet frames does not exceed 'n.'

The 'best' value of MAXFRAME depends on your local channel conditions. In most cases of keyboard-to-keyboard direct or local operation (links that don't require going through digipeaters), you can use the default value MAXFRAME 4.

Note: The FRACK counter begins counting from the first flag of each frame. If MAXFRAME is set to 7 and PACLEN is set to maximum (0), FRACK should be lengthened to prevent the distant station's ACK from colliding with a possibly-premature retry.

When the amount of packet traffic, the path in use, the digipeaters involved - or other variables not under your control - make packet operation difficult (as shown by lots of retries!), you can improve your throughput by reducing MAXFRAME.

Experimental evidence indicates that MAXFRAME 1 can sometimes produce best throughput, especially on HF radio, when operating in conditions of multipath propagation and numerous collisions.

- o If packet traffic is heavy or the path is poor, reduce MAXFRAME to 3 or 2.

- o If the radio link is good, an optimal relationship exists between the parameters set by these commands. The maximum number of data characters outstanding should not exceed the receive buffer space of the TNC receiving the data.

MBELL ON|OFF Mnemonic: MBE Default: OFF

Parameters:

ON - Ring the terminal when packets appear from callsigns listed in MFROM or MTO.

OFF - Don't ring the terminal when packets appear from callsigns listed in MFROM or MTO.

MBELL permits the terminal operator to be alerted when packet frames from a selected station or group of stations appears on the monitored radio link.

When MBELL is set to OFF, packet frames are monitored normally according to the MFROM and MTO callsign lists.

When MBELL is set to ON, packet frames are monitored FROM and TO all. If callsigns in the monitored headers match the MFROM or MTO lists, the PK-90 sends three BELL characters <CTRL-G> to the terminal.

Use MBELL ON to alert the operator to the presence of a specific station on the radio channel. Examples of typical applications are:

To detect when station KXXX is present, set:
- o MBELL ON
- o MONITOR 4
- o MFROM YES KXXX
- o MTO NONE.

To detect a beacon or CQ call, set:
- o MBELL ON
- o MONITOR 4
- o MFROM NONE
- o MTO YES CQ,BEACON

To return to normal operation, set:
- o MBELL OFF
- o MONITOR 4
- o MFROM ALL
- o MTO NONE

Note that if MBX is active and MBELL is ON, because of redundant I-frames, the PK-90 may send BELLS even when no data is displayed.

MBX call1[,call2][-'n'] Mnemonic: MB Default: empty

Parameters:
call - The call signs of one or two stations to be monitored.
'n' - alphanumerics indicating an optional SSID or extension.

The MBX command permits you to read or record useful or needed data without having to connect or log on to the source station(s). Channel occupancy and bandwidth are conserved on busy channels.

MBX filters the received packet data stream so that only packets from the selected station(s) are shown, without headers, codes or repeated frames. MBX overrides normal monitor functions and can show one or both sides of a conversation. You can enter a single call sign, or two call signs, separated by a comma:

cmd:MBX XBE555
or
cmd:MBX WXX123-4,WXX456-4
(NOTE: These stations must be connected to each other for this feature to work. Use two call signs if you suspect that your target station may be in a multiple connection.)

Use the MBX feature to:

- Read or record transmissions from any packet station, without any extraneous material;
- Read or record transmissions from an electronic mail system or central file server while another station is downloading files or messages;
- Read or record traffic between two connected packet stations or two electronic mail systems during mail forwarding operations.

The resulting information is free of all headers, frame identifier codes, repeats and improperly sequenced lines. This eliminates most editing usually needed to manually purge unwanted information.

NOTE: When using the MBX feature, your station is not part of the protocol handshake between the originating and receiving stations. If noise bursts or interfering packets collide with the data being transferred between the two distant stations, you may miss one or more packets and lose one or more lines of text.

Use the MBX feature when channel conditions are at their best and the source station originating the transmissions is strong.

- An inbound connection deactivates the MBX command.

Clear MBX with '%,' '&,' 'N,' 'NO,' 'NONE' or 'OFF' as arguments.

MCON 'n'	Mnemonic: MC	Default: 0 (zero)

Parameters:

'n' - 0 to 6 specifies various levels of monitor indications

Use MCON for selective monitoring of other traffic while connected to a distant station.

MCON works in similar fashion to MONITOR, but affects your display while in the connected state.

As the value of MCON settings is increased, additional functions are included in the monitoring sequences.

Frames meant for you are displayed as though monitoring was OFF. You will see only the data. When MCON is set to '6,' frames meant for you are displayed as any other monitored frame. The headers appear together with the data.

The meanings of the parameter values are:

0 Monitoring while connected is disabled.

1 Only unnumbered (UI) frames resulting from an unconnected transmission are displayed. Use this for an 'unproto,' round-table type contacts. Other mutually connected stations using the frequency are also displayed. This setting also display beacons.

2 Numbered (I) frames are also displayed. I-frames are numbered in order of generation and result from a connected transmission. Use this to monitor connected conversations in progress.

3 Connect request (SABM or 'C') frames and disconnect (DISC or 'D') frames are also displayed with the headers.

4 Unnumbered acknowledgement (UA) of connect- and disconnect-state frames are also displayed with either the characters 'UA' or 'DM' and a header.

5 Receive Ready (RR), Receive Not Ready (RNR), Reject (RJ), Frame Reject (FRMR) and (I)-Frames are also displayed.

6 Poll/Final bit and sequence numbers are also displayed.

Monitored frame protocols are shown by the type of brackets:
< > indicates AX.25 Level 2 Version 1 frames
[ ] indicates AX.25 Level 2 Version 2 command frames
( ) indicates AX.25 Level 2 Version 2 response frames

MDIGI ON|OFF Mnemonic: MD Default: OFF

Parameters:

ON - I and UI frames having your call sign (MYCALL or MYALIAS) as the next digipeater in the digipeater field are displayed, whether you are connected or disconnected.

OFF - Normal monitoring as determined by the monitoring mode commands

---

MDIGI permits you to display packet frames that your monitor would normally not show when another station uses your station as a digipeater. MDIGI helps you to better understand the digipeating paths that may involve your station, even when you've been unaware of what's happening on the channel.

Use MDIGI to see why your transmitter is being keyed when you're not actively involved in a communication session, or when your system is more active than you would expect.

When MDIGI is OFF you will see those frames that include your station as one of the digipeaters only if your monitor modes have been set this way. If your monitor modes have not been set so you can see these frames, set MDIGI ON to display them.

MEMORY 'n' Mnemonic: ME Default: none

Parameters:

n - a hexadecimal address used with the ADDRESS and I/O commands to access the PK-90's memory and I/O locations, or to read values stored at a specified address.

The MEMORY command permits access to memory and I/O locations.

To use the Memory command:

- Set the memory address into the ADDRESS command.
- Use the MEMORY command without arguments to read memory locations one after another.
- Use MEMORY with one argument 0-$FF to write to memory locations. After each MEMORY command, the PK-90 adds 1 to the value of the ADDRESS.

PK-90 RAM locations are $C000-$FFFF. ROM begins at $0000.

The MEMORY command increments the ADDRESS counter by 1 each time MEMORY is typed.

MFILTER n1[,n2[,n3[,n4]]] Mnemonic: MFI Default: $80

Parameters:

'n' - 0 to $80 (0 to 128 decimal) specifies an ASCII character code. Up to four characters may be specified.

Use MFILTER to select characters to be 'filtered,' or excluded from monitored packets. Parameters 'n1,' 'n2,' etc., are the ASCII codes for the characters you want to filter. You can enter up to four characters in either hex or decimal.

The default value $80 filters all received control characters except <CTRL-J> the line feed, <CTRL-M>, the carriage return, and <CTRL-I>, the HORIZONTAL TAB.

Use MFILTER selectively to remove specific characters from the data stream to the terminal or computer. Here are typical applications.

- To prevent a <CTRL-L> character from clearing your screen, set MFILTER 12.
- To eliminate <CTRL-Z> characters, which some computers interpret as end-of-file markers and some terminals interpret as a Clear Screen command, set MFILTER 26.
- To eliminate <CTRL-G> characters, which beep your computer or terminal, set MFILTER 7.

MFROM all,none,yes/no call1[,call2..] Mnemonic: MF Default: all

---

Parameters:

call - all, none, YES_list, NO_list.
list of up to eight call signs, separated by commas.

MFROM uses arguments to determine how the PK-90 monitors the packet channels and displays information - which stations' packets will be displayed and which stations' packets will be masked or hidden. MFROM is set to 'all' when you start the PK-90 for the first time.

Type MFROM to display the ALL/NONE/YES_list/NO_list status of station call signs whose packets will or will not be displayed. You can use the abbreviated command form or mnemonic:

```
cmd:mfrom
MFROM    all
cmd:mf
MFROM    yes XAAA,XBBB,XCCC,XDDD
```

To stop any packets from being displayed, type MFROM NONE.

To display packets from one or more specific stations type MFROM (YES followed by a list of calls signs). Packets will be displayed only from stations whose call signs are listed after YES.

To hide or mask packets from one or more specific stations, type MFROM (NO followed by a list of call signs). Packets from stations whose call signs are listed after NO will not be displayed.

You can include optional SSIDs or extensions specified as '-n' after the call sign.

If MFROM is set to 'no XAAA' or 'yes XAAA,' any combination XAAA, XAAA-1,...XAAA-15 will be matched and processed. If MFROM is set to 'yes XAAA-1' or 'no XAAA-1,' then only XAAA-1 will match and be processed.

When MFROM and MTO contain different types of arguments, to avoid any possible conflict, the arguments take the following priority:

1. ALL
2. NO list
3. YES list
4. NONE

Clear MFROM with '%,' '&,' or 'OFF' as arguments.

MHEARD Mnemonic: MH Immediate Command

MHEARD is an immediate command that displays a list of stations heard since the last time the MHEARD buffer was cleared.

Use a percent sign (%), an ampersand (&), 'N,' 'NO,''NONE,' or 'OFF' after the command word to clear the MHEARD buffer.

The maximum number of heard stations that can be logged is 18. If more stations are heard, earlier entries are discarded.

- o Stations that are heard directly are marked with a * in the heard log.
- o Stations that have been repeated by a digipeater are not marked.
- o If you clear the list of stations heard at the beginning of a session, you can use this command to keep track of the stations that are active during that period.
- o Logging of stations heard is disabled when PASSALL is ON.

When DAYTIME has been used to set the date and time, entries in the heard log are time stamped. When DAYSTAMP is ON, the date is shown before the time. Here is an example of the MHEARD function with the clock set:

DAYSTAMP ON

```
cmd:mh
05-Jul-86  21:42:27  XAFJW
05-Jul-86  21:42:24  XAIXU*
05-Jul-86  21:32:18  XBAA-5
05-Jul-86  21:27:57  XBPM-4*
05-Jul-86  21:26:41  XBAA-4
05-Jul-86  21:26:38  XBUP-9
05-Jul-86  21:21:24  XAEOU*
05-Jul-86  21:21:23  XBUP-4*
05-Jul-86  21:05:07  XBHAA
05-Jul-86  20:56:40  XALGQ
05-Jul-86  14:45:57  XASNA-1
05-Jul-86  14:45:53  XVPBB
05-Jul-86  14:45:47  XFXM
05-Jul-86  14:28:16  XBANH
05-Jul-86  14:23:32  XBNYC
05-Jul-86  14:23:19  XBEUL
05-Jul-86  13:55:26  XBWE
05-Jul-86  13:50:28  XABB-1*
cmd:
```

DAYSTAMP OFF

```
cmd:mh
21:42:27  XAFJW
21:42:24  XAIXU*
21:32:18  XBAA-5
21:27:57  XBPM-4*
21:26:41  XBAA-4
21:26:38  XBUP-9
21:21:24  XAEOU*
21:21:23  XBUP-4*
21:05:07  XBHAA
20:56:40  XALGQ
14:45:57  XASNA-1
14:45:53  XVPBB
14:45:47  XFXM
14:28:16  XBANH
14:23:32  XBNYC
14:23:19  XBEUL
13:55:26  XBWE
13:50:28  XABB-1*
cmd:
```

MONITOR 'n' Mnemonic: M Default: 4

Parameters:

'n' - 0 to 6 specifies various levels of monitor indications

As the value of MONITOR settings is increased, additional functions are included in the monitoring sequences.

The meanings of the parameter values are:

0 All packet monitoring functions are disabled.

1 Only unnumbered (UI) frames resulting from an unconnected transmission are displayed. Use this for an 'unproto,' round-table type contact. Other mutually connected stations using the frequency are not displayed. This setting also displays beacons.

2 Numbered (I) frames are also displayed. I-frames are numbered in order of generation and result from a connected transmission. Use this to monitor connected conversations in progress.

3 Connect request (SABM or 'C') frames and disconnect (DISC or 'D') frames are also displayed with the headers.

4 Unnumbered acknowledgement (UA) of connect- and disconnect-state frames are also displayed with either the characters 'UA' or 'DM' and a header.

5 Receive Ready (RR), Receive Not Ready (RNR), Reject (RJ), Frame Reject (FRMR) and (I)-Frames are also displayed.

6 Poll/Final bit and sequence numbers are also displayed.

Monitored frame protocols are shown by the type of brackets:

< > indicates AX.25 Level 2 Version 1 frames

[ ] indicates AX.25 Level 2 Version 2 command frames

( ) indicates AX.25 Level 2 Version 2 response frames

MONITOR ON|OFF Mnemonic: M Default: ON (4)

Parameters:

ON - Equivalent to MONITOR 4

OFF - Equivalent to MONITOR 0

In host computer applications that use a parameter value switching routine rather than numeric values, the MONITOR command can be used with ON and OFF instead of numbers 0 through 6.

This alternate MONITOR command is appropriate in certain electronic mail and bulletin board systems.

When MONITOR is set to ON, the response message will indicate the numeric value 4. When MONITOR is set to OFF, the response message will indicate the numeric value 0.

```
cmd:mon off                          cmd:mon on
MONITOR  was 4 (UA DM C D I UI)      MONITOR  was 0 (none)
MONITOR  now 0 (none)                MONITOR  now 4 (UA DM C D I UI)
```

MPROTO ON|OFF Mnemonic: MP Default: OFF

Parameters:

ON - Monitor all I-frames regardless of PID byte

OFF - Monitor only I-frames with PID byte F0

Use the MPROTO command to restrict monitoring and screen display when sharing radio channels with systems or packet nodes using higher-level protocols.

Certain Level 3 packet node switching systems send frames containing control characters with a Protocol Identifier Byte (PID) of $CF or other values. With the default value of MPROTO OFF, these Level 3 frames will not be displayed.

MRPT ON|OFF Mnemonic: MR Default: ON

Parameters:

ON - Show digipeaters in the header; stations heard directly are marked with asterisk.
OFF - Show packets only from originating and destination stations.

MRPT affects the way monitored packets are displayed. When MRPT is OFF, only packets from the originating station and the destination are displayed as they appear with MONITOR set to 6.

```
WXX123*>KAA111 <I;0,3>:
```

When MRPT is ON, the call signs of all stations in the entire digipeat path are displayed. The call sign of the stations heard directly are }flagged with an asterisk (*):

```
WXX123*>XBE555>WXX456>KAA111 <I;0,3>:
```

MSTAMP ON|OFF Mnemonic: MS Default: OFF

Parameters:
ON - Monitored frames ARE time stamped.
OFF - Monitored frames ARE NOT time stamped.

The MSTAMP command activates or disables time stamping of monitored packets. When the PK-90's internal software clock is set, date and time information is available for automatic logging of packet activity or other applications.

When MSTAMP is OFF, the packet header display looks like this:

```
WXX123*>KAA111>XBE555 <I;2,2>:
```

When MSTAMP is ON and DAYSTAMP is OFF, the display looks like this:

```
22:51:33  WXX123*>KAA111>XBE555 <I;1,7>:
```

When both MSTAMP and DAYSTAMP are ON, the display looks like this:

```
10-Jul-86  22:54:25  WXX123*>KAA111>XBE555 <I;2,2>:
```

Set the date and time with the DAYTIME command. Setting MSTAMP ON increases the length of the address display. Set HEADERLN ON to display this information on a separate line.

MTO all,none,yes/no call1[,call2..] Mnemonic: MT Default: none

---

Parameters:

call - all, none, YES_list, NO_list.
list of up to eight call signs, separated by commas.

MTO uses arguments to determine how the PK-90 monitors the packet channels and displays information - which stations' packets will be displayed and which stations' packets will be masked or hidden. MTO is set to 'none' when you start the PK-90 for the first time.

Type MTO to display the ALL/NONE/YES list/NO list status of call signs of stations to which addressed packets will or will not be displayed. You can use the abbreviated command form or mnemonic:

```
cmd:mto
MTO    all
cmd:mt
MTO    yes XAAA,XBBB,XCCC,XDDD
```

To stop packets addressed to all stations from being displayed, type MTO ALL.

To display only packets addressed TO one or more specific stations, type MTO (YES followed by a list of calls signs). Packets will be displayed only if addressed to stations whose call signs are listed after YES.

To hide or mask packets addressed to one or more specific stations, type MTO (NO followed by a list of call signs). Packets addressed to stations whose call signs are listed after NO will not be displayed.

You can include optional SSIDs or extensions specified as '-n' after the call sign. If MTO is set to 'no XAAA or 'yes XAAA,' any combination XAAA, XAAA-1,...XAAA-15 will be matched and processed. If MTO is set to 'yes XAAA-1' or 'no XAAA-1,' then only XAAA-1 will match and be processed.

When MFROM and MTO contain different types of arguments, to avoid any possible conflict, the arguments take the following priority:

1. ALL
2. NO list
3. YES list
4. NONE

Clear MTO with '%,' '&,' or 'OFF' as arguments.

MYALIAS call[-n] Mnemonic: MYA Default: empty

Parameters:

call	Alternate identity of the PK-90.
'n'	alphanumeric optional substation ID (SSID) or extension.

MYALIAS specifies an alternate call sign (in addition to the call sign specified in MYCALL) for use as a digipeater only.

MYALIAS permits both normal HID identification and an alias alternate, repeater-only 'call sign.'

Wide-coverage digipeater operators in some areas change their call sign to a shorter and (usually) easier to remember identifier.

Identifiers used include International Civil Aviation Organization (ICAO) airport IDs, sometimes combined with telephone area codes.

MYCALL call[-'n'] Mnemonic: MY Default: PK-90

Parameters:

call	-	Your call sign.
'n'	-	alphanumerics indicating an optional substation ID (SSID) or extension.

NOTE: The PK-90 will not operate in the Packet Mode until you have installed your own call sign in place of 'PK-90.'

Use the MYCALL command to load your call sign into the PK-90's RAM. Your call sign is inserted automatically in the FROM address field for all packets originated by the PK-90. MYCALL is also used for identification packets (see HID and ID).

The PK-90 accepts connect request frames with your MYCALL in the TO field and repeats frames with this call sign in the digipeat field.

The 'PK-90' default call sign is present in the PK-90's RAM when the system is manufactured. This 'artificial call' must be changed for proper operation of the packet protocols.

Two or more stations cannot use the same call sign (including SSID or extension) on the air at the same time.

- Use the SSID or extension to distinguish two stations with the same call.
- The SSID or extension will be zero (0) unless explicitly set to another value.

Although there is no standardization of SSIDs at present, most packet radio operators use SSID 0 (zero) for manual or local keyboard operation of their main station, and an SSID of (-1) or (-2) for a secondary station or dedicated digipeater under their responsibility.

Local area networks operated or maintained by a given organization may use the same call sign for several stations in their network, each node or unit being identified with a different SSID or extension.

As packet networks grow and become more complex, with multi-port and gateway systems and frequency translation between bands, SSIDs or extensions become especially significant. For example look at the hypothetical case:

```
WXX123>WXX123-1>XBE555-1>XBE555-2>XBE555-4
155.00  155.00  461.00  461.00  155.00
```

In this example, WXX123 is linked to XBE555-4 via three digipeaters, each having a distinctive SSID.

NEWMODE ON|OFF Mnemonic: NE Default: ON

Parameters:

ON - The PK-90 automatically returns to the Command Mode at disconnect.

OFF - The PK-90 does not return to Command Mode at disconnect.

NEWMODE determines how the PK-90 behaves when the link is broken.

The PK-90 always switches to a data transfer mode at the time of connection, unless NOMODE is ON.

Set NEWMODE for the type of operation most suitable to your needs.

If NEWMODE is OFF and the link is disconnected, the PK-90 remains in Converse or Transparent Mode unless you have forced it to return to Command Mode.

When NEWMODE is ON and the link is disconnected, or if the connect attempt fails, the PK-90 returns to Command Mode.

Electronic mail, bulletin board or other host computer programs designed to operate with earlier TNC systems may require NEWMODE to be set OFF.

NOMODE ON|OFF Mnemonic: NO Default: OFF

Parameters:

ON - The PK-90 switch modes (Command, Converse, Transparent) only upon explicit command. NEWMODE function is ignored.

OFF - The PK-90 changes modes according to NEWMODE.

When NOMODE is ON, the PK-90 never switches from Converse or Transparent Mode to Command Mode (or vice versa) by itself. Only specific commands (CONVERSE, K, TRANS, or <CTRL-C>) typed by you can change the operating mode.

When NOMODE is OFF, the PK-90 switches modes automatically according to the way NEWMODE is set.

NUCR ON|OFF Mnemonic: NU Default: OFF

Parameters:

ON - <NULL> characters ARE sent to the terminal following <CR> characters.

OFF - <NULL> characters ARE NOT sent to the terminal following <CR> characters.

Some of the older electromechanical terminals (Teletypetm machines) and printer terminals require some extra time for the printing head to do a line feed and return to the left margin. NUCR ON solves this problem by making the PK-90 send <NULL> characters (ASCII code $00) to your computer or terminal. This introduces any necessary delay after any <CR> sent to the terminal.

The NULLS command sets the number of individual <NULL> characters that are to be sent when NUCR is ON.

o Set NUCR ON if your terminal or printer misses one or more characters after responding to a <CR>. If this is the case, you will sometimes see overtyped lines.

NULF ON|OFF Mnemonic: NUL Default: OFF

Parameters:

ON - <NULL> characters are sent to the terminal following <LF> characters.

OFF - <NULL> characters are not sent to the terminal following <LF> characters.

Some of the older electromechanical terminals (Teletypetm machines) and printer terminals require some extra time for the printing head to do a line feed and return to the left margin. NULF ON solves this problem my making the PK-90 send <NULL> characters (ASCII code $00) to your computer or terminal. This introduces any necessary delay after any <LF> sent to the terminal.

The NULLS command sets the number of individual <NULL> characters that are to be sent when NULF is ON.

Set NULF ON if your terminal or printer misses one or more characters at the beginning of a new line after responding to a <LF>.

NULLS 'n' Mnemonic: NULL Default: 0 (zero)

Parameters:

'n' - 0 to 30 specifies the number of <NULL> characters to be sent to your computer or terminal after <CR> or <LF> when NUCR or NULF are set ON.

NULLS specifies the number of <NULL> characters (ASCII code $00) to be sent to the terminal after a <CR> or <LF> is sent.

o NUCR and/or NULF must be set to indicate whether nulls are to be sent after <CR>, <LF> or both.

Devices requiring nulls after <CR> are typically hard-copy devices requiring time for carriage movement. This applies to most of the older electromechanical teleprinters and computer printers.

Devices requiring nulls after <LF> are usually slow-scrolling CRTs.

The null characters are sent from the PK-90 to your computer only in Converse and Command Modes.

PACLEN 'n' Mnemonic: PACL Default: 128

Parameters:

'n' - 0 to 255 specifies the maximum length of the data portion of a packet.

0 - Zero is equivalent to 256.

PACLEN sets the maximum number of user data bytes to be carried in each packet's 'information field.' 'User data' means the characters you actually type at your keyboard (or send from a stored file).

The PK-90 automatically transmits a packet when the number of characters you type (or send from disk) for a packet equals 'n.' This value is used in both Converse and Transparent Modes.

Most keyboard-to-keyboard operators use the default value of 128 bytes for routine VHF/UHF packet services.

Experiment with different values for MAXFRAME and PACLEN to find the combination best suited to your operating conditions - especially if you are transferring files.

- The lower the value of PACLEN, the greater the probability of getting packets though the link without 'hits' or retries.
- Increase PACLEN to 256 byes (set 0) if transferring files to a nearby station over a high quality path.
- Reduce PACLEN to 64, or even 32 when working 'difficult' HF radio paths.
- If the radio link is good, an optimal relationship will exist between the parameters set by these commands. Set PACLEN so that the maximum number of characters outstanding doesn't exceed the receive buffer space of the TNC receiving the data.

It is not necessary that two TNCs be set to the same PACLEN value to exchange data; however, some TNCs may not be compatible when frames contain more than 128 data characters.

Note: The FRACK counter begins counting from the first flag of each frame. If MAXFRAME is set to 7 and PACLEN is set to maximum (0), FRACK should be lengthened to prevent the distant station's ACK from colliding with your possibly-premature retry.

PACTIME EVERY|AFTER 'n' Mnemonic: PACT Default: AFTER 10

Parameters:

'n'	-	0 to 250 specifies 100-millisecond intervals.
EVERY	-	Packet timeout occurs every 'n' times 100 milliseconds.
AFTER	-	Packet timeout occurs when 'n' time 100 milliseconds elapse without input from the computer or terminal.

A PACTIME parameter is always used in Transparent Mode. PACTIME is also used in Converse Mode if CPACTIME is ON.

- When EVERY is specified, the characters you type or send from disk are packaged and queued for transmission every 'n' times 100 milliseconds.
- When AFTER is specified, the characters you type or send from disk are packaged when input from the terminal stops for 'n' times 100 milliseconds.

A zero-length packet will never be produced. The timer is not started until the first character or byte is entered.

A value of 0 (zero) for 'n' is allowed; zero means packets are sent with no wait time.

PARITY 'n' Mnemonic: PAR Default: 3 (even)

Parameters:

'n' - 0 to 3 selects a parity option from the table below.

PARITY sets the PK-90's data parity for terminal or computer data transfer according to the following table:

0 = no parity
1 = odd parity
2 = no parity
3 = even parity

The parity bit, if present, is stripped automatically on input, and is not checked in Command and Converse Modes.

In Transparent Mode all eight bits (including parity) are transmitted in packets. When 'no parity' is set and AWLEN is 7, the eighth bit is set to 0 (zero).

PASS 'n' Mnemonic: PAS Default: $16 <CTRL-V>

Parameter:

'n' - 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

PASS selects the ASCII character used for the 'pass' input editing command.

The parameter 'n' is the numeric ASCII code for the character you'll use to signal that the character immediately following it is to be included in a packet or text string.

o You can enter the code in either hex or decimal.

Use the PASS character (default <CTRL-V>) to send characters that usually have special functions.

A common use for the pass character is to allow <CR> to be included in the BTEXT and CTEXT messages so that the transmitted information appears on several short lines rather than a single longer line.

Use the PASS character to insert <CRs> at the end of a short line:

```
cmd:BT Notice:<CTRL-V><CTRL-M>
Meeting at Headquarters tonight <CTRL-V><CTRL-M>
at 8:00 PM. Please arrive on time. <CR>
```

The distant station's monitor shows:

```
Notice:
Meeting at Headquarters tonight
at 8:00 PM. Please arrive on time.
```

Without the PASS character, the message would probably look like this:

```
Notice: Meeting at the Firehouse tonight at 8:00 PM. All welcome!
```

In like manner, you can include <CR> in text when you are in Converse Mode, to send multi-line packets. (The default send-packet character is <CR>.)

PASSALL ON|OFF Mnemonic: PASSA Default: OFF

Parameters:

ON - The PK-90 will accept packets with invalid CRCs.

OFF - The PK-90 will only accept packets with valid CRCs.

PASSALL permits the PK-90 to display packets received with invalid CRC fields; the error-detecting mechanism is turned off.

Packets are accepted for display despite CRC errors if they consist of an even multiple of eight bits and are up to 330 bytes. The PK-90 attempts to decode the address field and displays the call sign(s) in the standard monitor format, followed by the text of the packet.

PASSALL is normally turned off; therefore, the protocol ensures that received packet data is error-free by rejecting packets with invalid CRC fields.

PASSALL (sometimes called 'Garbage Mode') may be useful for testing a marginal RF link or during operation under other unusual conditions or circumstances.

When you set PASSALL ON while monitoring a moderately noisy channel, 'packets' are displayed periodically because there is no basis for distinguishing between actual packets and random noise.

- When PASSALL is ON, logging of stations heard (for display by MHEARD) is disabled; the call signs detected may be incorrect.

PASSWORD 'n' Mnemonic: PAS Default: none

Parameter:

'n' - Any characters up to a total of eight (8), case insensitive.

You may wish to place certain restrictions on non-technical operators' use of the PK-90 command set, or operation by unauthorized persons. Access to most of the PK-90's commands and parameter values can be restricted by the use of PASSWORD and SETPASS (discussed later in this chapter).

If PASSWORD and SETPASS are set (activated), the user must enter the PASSWORD to acquire control of the PK-90.

If SETPASS is not empty, PASSWORD must match SETPASS to obtain access.

Caution: After using privileged or password-protected commands, the user should clear PASSWORD to prevent subsequent users from discovering the PASSWORD - the contents of PASSWORD can be displayed on the screen.

PASSWORD and SETPASS are effective when using remote control by radio link. See the discussion of REMOTE, KEYWORD and RKEYWORD for details on encryption of the command link.

Clear PASSWORD with any one of the following: %, &, OFF, N, NO, NONE.

PERSIST 'n' Mnemonic: PE Default: 127

Parameters:

'n' - 0 to 255 specifies the threshold value for a random-number attempt to transmit.
'0' - Signifies a 1/256th chance of transmitting every SLOTTIME.
'255'- Signifies 'transmit right away without delay'.

The PERSIST parameter works with the P-PERSIST and SLOTTIME parameters to achieve true p-persistent CSMA (Carrier-Sense Multiple Access) in KISS TNC mode and in normal AX.25 operation. However, no real advantage will be obtained in AX.25 operation unless the other stations on the channel are also using PERSIST and SLOTTIME.

When the host (your computer) has queued data for transmission, the PK-90 monitors the DCD (Data Carrier Detect) signal from its internal modem. The PK-90 waits indefinitely for DCD to go inactive.

When the channel is clear, the PK-90 generates a random number between 0 and 255. If this number is less-than or equal to 'P', the PK-90 keys the radio's PTT line, waits .01 * TXDELAY seconds, and then transmits all frames in its queue. The PK-90 then unkeys the PTT line and returns to the idle state.

If the random number is greater than 'P', the PK-90 waits .01 * SLOTTIME seconds and repeats the procedure. If the DCD signal has gone active in the meantime, the PK-90 again waits for DCD to clear before continuing.

The PK-90 waits an exponentially-distributed random interval after sensing that the channel is clear before trying to transmit. With proper 'tuning' of the PERSIST and SLOTTIME parameters, several stations sending traffic are much less likely to collide with each other when they simultaneously see that the channel is clear.

NOTE: P=255 means 'always transmit as soon as possible, regardless of the random number'.

See Chapter 6 for additional information on p-persistent operation.

PPERSIST ON|OFF Mnemonic: PP Default: OFF

Parameters:

ON - The PK-90 uses PERSIST and SLOTTIME parameters in executing p-persistent CSMA (Carrier Sense Multiple Access).

OFF - The PK-90 uses DWAIT for AX.25-type 1-persistent CSMA.

Use the PPERSIST command to switch the PK-90 from 1-persistent CSMA operation based on the DWAIT value to p-persistent CSMA operation. This is required when using host computer applications based on the TCP/IP protocols and in certain electronic mail and bulletin board programs.

When PPSERSIST is set ON, the PK-90 uses the PERSIST and SLOTTIME parameters for p-persistent CSMA instead of the normal AX.25 protocol DWAIT procedure to achieve CSMA operation.

PPSERSIST can be used in both KISS TNC and, under certain specific conditions, in normal AX.25 operation.

See PERSIST and SLOTTIME in this chapter.

See Chapter 6 for additional information on p-persistent operation.

RAWHDLC ON|OFF Mnemonic: RAW Default: OFF

Parameters:

ON - The PK-90 functions as a direct or raw HDLC controller.

OFF - The PK-90 functions as a normal AX.25 controller.

Some host computer applications do not use AX.25 protocols. In such cases, the PK-90 can be operated as a raw HDLC controller, allowing the host to provide all protocol commands and responses. Applications may include some types of electronic mail systems, bulletin board programs and computers operating with TCP/IP and other communication protocols.

Use the RAWHDLC command to disable AX.25 protocols and permit the host system direct access to the PK-90's HDLC integrated circuit.

RAWHDLC must be set ON when using KISS TNC protocols with TCP/IP.

REDISPLA 'n' Mnemonic: RED Default: $12 <CTRL-R>

Parameters:

'n' - 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

REDISPLA changes the redisplay-line input editing character.

Parameter 'n' is the numeric ASCII code for the character to use when you want to re-display the current input line. You can enter the code in either hexadecimal or decimal numbers.

Type the REDISPLA character to redisplay a line you've just typed. The following things happen:

- Type-in flow control is temporarily turned off (if it had been active). Any incoming packets that are pending are displayed.
- A <BACKSLASH> is appended to the line you've just typed and the line is shown below it. Only the final form of the line is shown if you have deleted or or changed any characters.

You can now continue typing where you left off.

Use the REDISPLA command to see a 'clean' copy of your input if you are using a printing terminal and you have deleted characters. Use the REDISPLA command if a packet is received while you're typing a message in Converse Mode. You can see the incoming message before you send your packet without canceling your input.

If BKONDEL is set OFF, deletions are designated with <BACKSLASH> characters, rather than by trying to correct the input line display. The redisplayed line is the corrected text.

RELINK ON|OFF Mnemonic: REL Default: OFF

Parameters:

ON - In AX.25 Versions 1 and 2, the PK-90 will automatically try to reconnect the distant station after the link has timed out on retries.

OFF - The PK-90 will not attempt to reestablish the failed link.

When RELINK is ON, the PK-90 attempts to reconnect by sending SABM frames (Connect Requests) after retrying out. When RELINK is OFF, the PK-90 forces a disconnect by sending a DISC frame (Disconnect Command) after retrying out.

Set RELINK to OFF when using the PK-90 with host computer applications, computer-based message systems and electronic mail programs.

Please refer to the related CHECK command.

REMOTE ON|OFF Mnemonic: REM Default: OFF

Parameters:

ON - When addressed as MYCALL-15, the PK-90 responds to Connect Requests as a remotely-controlled TNC, as well as normal Connect Requests addressed to MYCALL.

OFF - The PK-90 responds only to normal Connect Requests addressed to MYCALL.

The REMOTE command provides a remote-control port which is accessible when the PK-90 is addressed as MYCALL with an extension of -15. Set REMOTE to ON for remote control of the PK-90 by radio link commands.

If a remote PK-90 has a MYCALL of HIM123 and its REMOTE is ON, your PK-90 can connect to HIM123 and issue commands to HIM123 as if your terminal were connected to his PK-90. Your screen "becomes" his screen. The command prompt on your (his) screen for a remote connect is "rem:" rather than "cmd:" in order to distinguish between local and remote commands. Your PK-90 need not have REMOTE on.

The following sample connection assumes that your PK-90 "YOU789" will be connected to "HIM123". Your screen displays:

```
cmd:txd
TXDELAY  30 (300 msec.)
cmd:c HIM123-15
cmd:*** CONNECTED to HIM123-15
rem:*** CONNECTED to YOU789
txd
TXDELAY  30 (300 msec.)
rem:txd 50
TXDELAY  was 30 (300 msec.)
TXDELAY  now 50 (500 msec.)
rem: <CTRL-C> cmd:d
cmd:*** DISCONNECTED: HIM123-15
txd
TXDELAY  30 (300 msec.)
cmd:
```

MYCALL, RKEYWORD and KEYWORD cannot be changed remotely. CALIBRAT, RESET, and macros cannot be executed remotely. RESTART will clear the remote PK-90 should it become stuck in a problem.

CAUTION: Do not install the remote PK-90's MYCALL with an extension or SSID of "-15". Do not execute any commands that could disable normal PK-90 functions or lose control over the radio link. Never set TXD to 0; never set XMITOK to OFF. Set MCON to a value less than 5, preferably 0. See Section 5.9 for more details on REMOTE operation.

RESET Mnemonic: RESET Immediate Command

RESET is an immediate command that resets all parameters to default settings and reinitializes the PK-90.

CAUTION:

All personalized parameters and monitor lists are lost!

To reinitialize the PK-90 using the parameter values in bbRAM, turn the PK-90 OFF then ON, or use the RESTART command.

RESPTIME 'n' Mnemonic: RES Default: 10

Parameters:

'n' - 0 to 250 specifies 100-millisecond intervals.

RESPTIME adds a minimum delay before the PK-90 sends acknowledgment packets. This delay may run concurrently with the default wait time set by DWAIT and any random wait in effect.

Use RESPTIME delay to increase throughput during operations such as file transfer when the sending TNC usually sends the maximum number of full-length packets.

Occasionally, the sending TNC may not have a packet ready in time to prevent transmission from being stopped temporarily, with the result that the acknowledgment of earlier packets collides with the final packet of the series.

Set RESPTIME to 10 to avoid these collisions.

RESTART Mnemonic: RESTART Immediate Command

RESTART is an immediate command that reinitializes the PK-90 using the defaults stored in the PK-90's bbRAM. Your personalized parameter settings are retained unchanged.

The effect of the RESTART command is the same as turning the PK-90 OFF, then ON again. RESTART can be used remotely over the radio link to restart a PK-90 when required.

RESTART does not reset the parameter values in bbRAM. See the RESET command.

RETRY 'n' Mnemonic: RE Default: 10

Parameter:

'n' - 0 to 15 specifies the maximum number of packet retries.

The AX.25 protocol uses retries - retransmission of frames that have not been acknowledged. Frames are retransmitted 'n' times before the link is disconnected. A value of 0 for 'n' specifies an infinite number of retries.

The FRACK command sets the time between retries. See the FRACK command.

If the number of designated retries is exceeded, the PK-90 enters either the 'connect in progress' or 'disconnected' state depending on the setting of RELINK.

If you are not in Transparent Mode, the following message is shown:

*** Retry count exceeded

RKEYWORD n Mnemonic: RK Default: none

Parameters:

'n' 1 to 65535 enables encryption and specifies the key to be used in encoding and decoding data in Remote Mode.

'n' 0 (zero) disables encryption and produces plain text

You may wish to use encryption when controlling a PK-90 remotely by radio link.

Set RKEYWORD greater than 0 (zero) to enable control link encryption. Any value greater than zero encodes the data so that it cannot be read by the casual observer. RKEYWORD and KEYWORD do not use a highly-sophisticated encryption algorithm.

RKEYWORD is set at the controlled remote PK-90, while KEYWORD is set at the controlling PK-90. RKEYWORD cannot be changed remotely.

Packet protocol headers are transmitted in clear text. Only the data typed by the user is encrypted.

Note: Both ends of the link must use the same numerical key.

For additional information on RKEYWORD and encryption, see the discussion of the KEYWORD and REMOTE commands in this chapter.

Data encryption is not allowed in the Amateur Radio Service.

RQTIME 'n' Mnemonic: RQ Default: 20 (seconds)

Parameters:

'n' - 1 to 250 intervals of one second; specifies timeout delay. During connected or calling modes, if a "grant" signal never occurs on Pin 5 of J3, the PK-90 will time out and recycle the PTT sequence after FRACK time.

RQTIME can be used in a trunked radio system in conjunction with the BXDELAY comamand in a situation where the radio never delivers a "grant" signal to Pin 5 of J3 (such as might be the case if the trunked system were busy and never came up with a channel for the packet user). In this event, it is desirable that the "PTT, grant, send packet frame" sequence be repeated.

Some trunking systems will not search for a channel again after failing to find a channel the first time unless the radio gets a new PTT from the PK-90. RQTIME will cause a timeout which will cause the sequence to recycle.

SENDPAC 'n' Mnemonic: SE Default: $0D <CTRL-M>

Parameters:

'n' - 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

The SENDPAC command selects the character used to cause a packet to be sent while in Converse Mode. The parameter 'n' is the numeric ASCII code for the character that packetizes the characters you type and queues them for transmission. You can enter the code in either hexadecimal or decimal numbers.

The default SENDPAC value $0D is fine for ordinary conversation with CR ON. This sends packets at natural intervals with <CRs> included in the packet.

When setting CPACTIME ON, set SENDPAC to some value not ordinarily used (for example <CTRL-A>), with CR OFF). This causes packets to be sent without extra <CR> characters included in the text.

The SENDPAC character is not necessarily treated as a <CR> unless it really is a carriage return.

SETPASS 'n' Mnemonic: SETP Default: none

Parameters:

'n' - Any characters up to a total of eight (8), case insensitive.

You may wish restrict access to the PK-90 commands by non-technical operators, or prevent operation by unauthorized persons. Access to most of the PK-90's commands and parameter values can be restricted by the use of SETPASS and PASSWORD (discussed earlier in this chapter).

SETPASS is typed into the PK-90 by the System Operator. This sets the PASSWORD for privileged commands.

If SETPASS is not empty, PASSWORD must match SETPASS to obtain access.

If SETPASS and PASSWORD are both set (activated), the user must enter the PASSWORD to match SETPASS in order to acquire control of the PK-90 or to execute privileged commands.

If PASSWORD does not match SETPASS, SETPASS may not be set or read.

Caution: After using privileged or password-protected commands, the user should clear PASSWORD to prevent subsequent users from discovering the PASSWORD - the contents of PASSWORD can be displayed on the screen.

The following commands are not privileged:

BEACON	DISPLAY
BTEXT	K
CONNECT	MHEARD
CONVERSE	PASSWORD
CSTATUS	RESTART
CTEXT	TRANS
DAYTIME	UNPROTO
DISCONNE	WDISCONN

Setting a macro is privileged; executing a macro is not.

Setting character values such as CANLINE or CANPAC is privileged; using the characters is not.

PASSWORD and SETPASS are effective when using remote control by radio link. See the discussion of REMOTE, KEYWORD and RKEYWORD for details on encryption of the command link.

Clear SETPASS with any one of the following: %, &, OFF, N, NO, NONE.

SLOTTIME 'n' Mnemonic: SL Default: 10 (100 ms)

Parameters:

'n' - 0 to 250 specifies the time in ten-millisecond intervals during which the PK-90 waits between generating random numbers to see if it can transmit.

The SLOTTIME parameter works with the PPERSIST and PERSIST parameters to achieve true p-persistent CSMA (Carrier-Sense Multiple Access) in KISS TNC mode and in normal AX.25 operation. However, no real advantage will be obtained in AX.25 operation unless the other stations on the channel are also using PERSIST and SLOTTIME.

See Chapter 6 for further discussion of SLOTTIME, PERSIST and KISS TNC protocols.

SQUELCH ON|OFF Mnemonic: SQ Default: OFF

Parameters:

ON - The PK-90 responds to positive-going squelch voltage.

OFF - The PK-90 responds to negative-going squelch voltage.

Normally, to decide if the channel is clear so that it can transmit, the PK-90 uses its CSMA (Carrier Sense Multiple Access) circuit by sensing audio mark and space tones from your packet receiver.

If there are signals other than packet on the channel you're using (such as voice operation), it's possible that the PK-90 might not be quite as polite as it is normally and transmit on top of the other signals.

The PK-90 can use true RF-carrier CSMA by monitoring the squelch line voltage from your radio. This line can be easily connected in many radios to the 'busy' light or indicator on the radio's front panel, or to other circuit locations that indicate the presence or absence of carrier or received signals. Because your carrier-sensing signal can be active-low or active-high (depending on the individual radio manufacturer's design), you can set the PK-90 to sense either positive or negative squelch voltages.

START 'n' Mnemonic: STA Default: $11 <CTRL-Q>

Parameters:

'n' - 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

Use the START command to choose the User Start character you want to use to restart output from the PK-90 to the terminal after it has been halted by typing the User Stop character.

o The User Stop character is set by the STOP command.

o You can enter the value in either hex or decimal.

If the User Start and User Stop characters are set to $00 or XFLOW is set to OFF, software flow control to the PK-90 is disabled; the PK-90 will only respond to hardware flow control (CTS/RTS).

If the same character is used for both the User Start and User Stop characters, the PK-90 alternately starts and stops transmission on receipt of the character ('toggles').

STATUS ON/OFF Mnemonic: STAT Default: ON

Parameters:

ON - Display link status messages normally

OFF - Link status messages are not displayed

STATUS enables or disables unrequested or unexpected non-data displays from the TNC to the terminal.

The following responses are suppressed when STATUS is OFF:

```
'PK-87 is using default values'
'cmd:'
'*** (callsign) BUSY'
'FRMR sent'
'FRMR rcvd'
'*** Connect request: (callsign)'
'*** Link out of order'
'*** CONNECTED to (callsign)'
'*** DISCONNECTED'
'*** Retry count exceeded'
Connect Bell
```

STOP 'n' Mnemonic: STO Default: $13 <CTRL-S>

Parameters:

'n' - 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

Use the STOP command to select the User Stop character you want to use to stop output from the PK-90 to the terminal. Type this character to halt the PK-90's output to your monitor so that you can read the received text before it scrolls off your screen display.

Output is restarted with the User Start character.

- The User Start character is set by the START command.
- You can enter the value in either hex or decimal.

If the User Start and User Stop characters are set to $00 or XFLOW is set to OFF, software flow control to the PK-90 is disabled; the PK-90 will only respond to hardware flow control (CTS/RTS).

If the same character is used for both the User Start and User Stop characters, the PK-90 alternately starts and stops transmission upon receipt of the character ('toggles').

TBAUD 'n' Mnemonic: TB Default: 1200 bauds

Parameters:

'n' - Specifies the serial I/O port (terminal) data rate in bauds.

TBAUD displays the baud rate set by the autobaud routine when you first apply power to the PK-90, or after typing 'RESET.'

Use TBAUD to set terminal rates not covered by the autobaud routine, such as 75, 110 and 600 bauds. The new rate will become active at the next power-on or RESTART. A warning message reminds you of this.

If you plan to change terminals, but want to retain all the RAM parameter values, set TBAUD, AWLEN and PARITY to the new terminal's characteristics while you are still connected to the old terminal. Next, turn off the PK-90, change the terminal and turn the PK-90 on again.

TCLEAR Mnemonic: TC Immediate Command

The TCLEAR command clears the PK-90's transmit buffer and cancels further transmission of data except for a few remaining packets.

- o You must be in the Command Mode to use TCLEAR.
- o Use the <CTRL-C> (default) command to return to Command Mode.
- o Type 'TC' to clear the transmit buffer.

TIME Mnemonic: TI Default: $14 <CTRL-T>

Parameters:

'n' - 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

The TIME command specifies a control character in the text you type into the transmit buffer or into a text file stored on disk.

- o Type <CTRL-T> to embed the TIME command in your text or file.

At transmit time, the PK-90 reads the embedded control code (default <CTRL-T>), reads the time of day from the PK-90's internal clock and then sends the time to the radio in the data transmission code in use at that time.

When DAYSTAMP is set ON, the date is transmitted with the time.

NOTE: The TIME command cannot be embedded in CTEXT OR BTEXT.

TONE Mnemonic: TO Default: 3 (BELL 202)

Parameters:

'n' - 0 to 3 specifies an ASCII transmit and receive modem tones.

The TONE command sets the modem send and receive tones, shift and data rate. Three different modem tone combinations are available:

TONE	Specification	Stop Mark	Start Space	Type of Service
0	Bell 103 Originate	1070 Hz	1270 Hz	HF 300 bauds
1	Bell 103 Answer	2025 Hz	2225 Hz	HF 300 bauds
2	Bell 202	1200 Hz	2200 Hz	VHF 1200 bauds
3	Bell 202 Equalized	1200 Hz	2200 Hz	VHF 1200 bauds

TONE 3 provides a significant degree of frequency response equalization in the modem receiver. TONE 3 may be beneficial when working with radio receivers whose high frequency audio response is less than adequate.

In general practice, use Bell 103 tones at the lower data rates for HF radio, and Bell 202 tones for higher data rates authorized above 28 MHz in many countries.

PK-90 units can be programmed in the field for CCITT tones instead of Bell tones. When strapped for CCITT tones, the following tone pairs are used:

TONE	Specification	Stop Mark	Start Space	Type of Service
0	V.21 Originate	1180	980	HF 300 bauds
1	V.21 Answer	1850	1650	HF 300 bauds
2	V.23 Mode 2	2100	1300	VHF 1200 bauds
3	V.23 Mode 2 equalized	2100	1300	VHF 1200 bauds

TRACE ON|OFF Mnemonic: TRAC Default: OFF

Parameters:

ON - Trace function is activated

OFF - Trace function is disabled.

The TRACE command activates the AX.25 protocol display. If TRACE is ON, all received frames are displayed in their entirety, including all header information.

NOTE: Be careful using the mnemonic - don't use 'TRA'! The PK-90 will change to Transparent Mode!

The TRACE display is shown as it appears on an 80-column display. The following monitored frame is a sample:

```
WXX123*>TESTER <UI>:
This is a test message packet.

Byte                Hex                          Shifted ASCII        ASCII

000: A88AA6A8 8AA460AE 6494AAA0 406103F0  TESTER0WXX1230.x  ......'.d...@a..
010: 54686973 20697320 61207465 7374206D  *449.49.0.:29:.6  This is a test m
020: 65737361 67652070 61636B65 742E0D    299032.80152:..   essage packet..
```

The byte column shows the offset into the packet of the beginning byte of the line.

The hex display column shows the next 16 bytes of the packet, exactly as received, in standard hex format. The shifted ASCII column decodes the high-order seven bits of each byte as an ASCII character code.

The ASCII column decodes the low-order seven bits of each byte as an ASCII character code.

In a standard AX.25 packet,

- o The call sign address field is displayed correctly in the shifted ASCII column.
- o A text message is displayed correctly in the ASCII column.
- o Non-printing characters and control characters are displayed in both ASCII fields as a period ('.').

You can examine the hex display field to see the contents of the SSID or extension byte and the control bytes used by the protocol.

TRANS Mnemonic: T Immediate Command

TRANS is an immediate command that switches the PK-90 switch from the Command Mode to Transparent Mode. The current state of the radio link is not affected.

Transparent Mode is primarily useful for computer communications. In Transparent Mode, 'human interface' features such as input editing, echoing of input characters, and type-in flow control are disabled.

o Use Transparent Mode for transferring binary or other non-text files.

TRFLOW ON|OFF Mnemonic: TRF Default: OFF

Parameters:

ON - Software flow control for the computer or terminal can be activated in Transparent Mode.

OFF - Software flow control for the computer or terminal is disabled in Transparent Mode.

If TRFLOW is ON, the type of flow control used in Transparent Mode is determined by how START and STOP are set.

If TRFLOW is OFF, only 'hardware' flow control (CTS, RTS) is available to the computer and all characters received by the PK-90 are transmitted as data.

If START and STOP are set to $00, the User Stop and User Start characters are disabled - hardware flow control must be used by the computer.

If TRFLOW is ON, and START and STOP are set to values other than zero, software flow control is enabled for the user's computer or terminal. The PK-90 responds to the User Start and User Stop characters (set by START and STOP) while remaining transparent to all other characters from the terminal.

Unless TXFLOW is also ON, only hardware flow control is available to the PK-90 to control output from the terminal.

TRIES 'n'	Mnemonic: TRI	Default: 0

Parameters:

'n' - 0 to 15 specifies the current RETRY level on the selected input channel.

TRIES retrieves (or forces) the count of 'tries' on the data channel presently selected.

If you type TRIES without an argument, the PK-90 returns the current number of tries if an outstanding unacknowledged frame exists. If no outstanding unacknowledged frame exists, the PK-90 returns the number of tries required to get an ACK for the previous frame.

If RETRY is set to zero (0), the TRIES command always returns zero (0).

Use TRIES for gathering statistics on a given path or channel. TRIES is especially useful for computer-operated stations (such as automatic message-forwarding stations) using less-than-optimal, noisy HF or satellite channels or paths.

Using TRIES under these conditions automatically optimizes the PACLEN and MAXFRAME parameters.

If you type TRIES with an argument, the 'tries' counter is forced to the entered value. Using this command to force a new count of tries is not recommended.

TXDELAY 'n' Mnemonic: TX Default: 30 (300 ms)

Parameters:

'n' - 0 to 120 specifies ten-millisecond intervals.

The TXDELAY command tells the PK-90 how long to wait before sending packet frame data after keying your transmitter's PTT line.

All transmitters need some amount of start-up time to put a signal on the air; some need more, some need less. Some general rules apply:

- Crystal-controlled radios with diode T/R switches are faster;
- Synthesized radios need time for phase-lock-loops (PLLs) to lock;
- Radios with mechanical T/R relays need more time.

Experiment to determine the best TXDELAY value for a specific radio.

TXDELAY can also compensate delays in the distant station's radio:

- If the distant station's radio has slow recovery or release times when switching from transmit to receive, increasing your TXDELAY may permit improved throughput by retarding the start of your data until the distant receiver has reached full sensitivity.

TXFLOW ON|OFF Mnemonic: TXF Default: OFF

Parameters:

ON - Software flow control for the PK-90 can be activated in Transparent Mode.

OFF - Software flow control for the PK-90 is disabled in Transparent Mode.

When TXFLOW is ON, the setting of XFLOW determines the type of flow control used in Transparent Mode.

When TXFLOW is OFF, the PK-90 uses only hardware flow control; all data sent to the terminal remains fully transparent.

When TXFLOW and XFLOW are ON, the PK-90 uses the Start and Stop characters (set by XON and XOFF) to control the input from the terminal.

Unless TRFLOW is also ON, only hardware flow control is available to the computer or terminal to control output from the PK-90.

If the PK-90 Start and Stop characters are set to $00, hardware flow control will always be selected regardless of the setting of TXFLOW.

UNPROTO call1 [VIA call2[,call3...,call9]] Mnemonic: U Default: CQ

Parameters:

call1 - Call sign to be placed in the TO address field.

call2-9 - Optional digipeater call list, up to eight calls.

UNPROTO sets the digipeat and destination address fields of packets sent in the unconnected (unprotocol) mode.

Unconnected packets are sent as unsequenced I-frames with the destination and digipeat fields taken from 'call1' through 'call9' options. When a destination is not specified, unconnected packets are sent to 'CQ.'

Unconnected packets sent from other packet stations can be monitored by setting MONITOR to a value greater than '1' and setting MFROM to ALL.

The digipeater list can also be used for beacon packets.

To send a beacon message through one or more digipeaters, type the following:

```
cmd:UNPROTO BEACON VIA XAAA,XBBB,XCCC
```

Your beacon is routed to and repeated by each of the digipeaters in the order listed.

USERS 'n' Mnemonic: US Default: 1

Parameters:

'n' - 0 to 10 specifies the number of active simultaneous connections that can be established with the PK-90.

USERS only affects the way that incoming connect requests are handled. It does not affect the number of connections you initiate with the PK-90. For example:

USERS 0 allows incoming connections on any free logical channel
USERS 1 allows incoming connections on logical channel 0 only
USERS 2 allows incoming connections on logical channels 0 and 1
USERS 3 allows incoming connections on logical channels 0, 1 and 2, and so on, through USERS 10.

WDISCONN Mnemonic: W Immediate Command

WDISCONN is an immediate command used in the command mode, which stands for "Wait for Acknowledgement and Disconnect". WDISCONN initiates a disconnect request with the currently-connected station after all data sent by the PK-90 has been acknowledged. At least one data packet must have been sent and acknowledged before the disconnect will start.

By way of illustration, if you connect to another PK-90, get the "*** CONNECTED" message, return to Command mode using the COMMAND sequence, enter "W", return to Converse mode by entering "K", and then send a packet to the other PK-90, you will find that your PK-90 will disconnect after you receive the acknowledgement.

WDISCONN is useful as part of a macro. If you wish to connect to a PK-90, report on an event and disconnect, the process can be automated with a macro.

For example, to connect to HIM123, send data and disconnect, set up macro 6:

6M C HIM123/W/K/Event took place at <CTRL-T> PST. <CR>

Execute the macro by pressing 6 on your PK-90. <CTRL-T> is the character set by the TIME command; it sends the time at the moment the macro is executed. The WDISCONN command was placed before the K because the PK-90 is in the Command mode until the K. Also, there is no way for the macro to cause a return to Command mode.

If NEWMODE is ON,, WDISCONN will not work in a macro because the PK-90 will go back to Converse mode as soon as the CONNECT command is executed and WDISCONN needs to be executed from Command mode. However, the macro can first turn NEWMODE OFF and then back ON:

6M NEW N/C HIM123/W/NEW Y/K/(data) <CR>

If NOMODE is OFF, the PK-90 will go back into Command mode.

XFLOW ON|OFF Mnemonic: XF Default: ON

Parameters:

ON - XON/XOFF (software) flow control is activated.

OFF - XON/XOFF flow control is disabled - hardware flow control is enabled.

When XFLOW is ON, software flow control is in effect - it's assumed that the computer or terminal will respond to the PK-90's Start and Stop characters defined by the XON and XOFF commands.

When XFLOW is OFF, the PK-90 uses hardware flow control commands on the CTS and RTS line.

For full hardware control in both directions, set XFLOW to OFF.

This type of hardware flow control is frequently required by certain host computer applications, electronic mail and some bulletin board systems.

XMITOK ON|OFF Mnemonic: XMITO Default: ON

Parameters:

ON - Transmit functions (PTT line) are active.

OFF - Transmit functions (PTT line) are disabled.

When XMITOK is OFF, the PTT line to your transmitter is disabled - the transmit function is inhibited. All other PK-90 functions remain the same. The PK-90 generates and sends packets as requested, but does not key the radio's PTT line.

Use the XMITOK command at any time to ensure that the PK-90 does not transmit.

Set XMITOK OFF if you're absent and wish to leave the PK-90 on as a channel activity monitor.

Set XMITOK OFF for testing in loopback or direct wire connections when PTT operation is not required.

XOFF 'n' Mnemonic: XO Default: $13 <CTRL-S>

Parameters:

'n' - 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

Use XOFF to select the Stop character to be used to stop input from the computer or terminal.

o You can enter the code in either hex or decimal.

The Stop character default value is <CTRL-S> for computer data transfers.

If you're operating in Converse Mode, and there is a chance that activity might fill the PK-90's buffers, you can define the Stop character as <CTRL-G> ($07), which 'beeps' many terminals.

XON 'n' Mnemonic: XON Default: $11 <CTRL-Q>

Parameters:

'n' - 0 to $7F (0 to 127 decimal) specifies an ASCII character code.

XON selects the PK-90 Start character that is sent to the computer or terminal to restart input from that device.

o You can enter the code in either hex or decimal.

The Start character default value is <CTRL-Q> for computer data transfers.

If you're operating in Converse Mode, and there is a chance that activity might fill the PK-90's buffers, you can define the Stop character as <CTRL-G> ($07), which 'beeps' many terminals.

CHAPTER 8

FUNCTIONAL DESCRIPTION AND THEORY

8.1 General Description

The AEA PK-90 Packet Radio Controller is divided into digital, I/O (input/output) and power distribution blocks.

Please refer to the PK-90 Functional Block Diagram. Each block has its own distinct functions as described below.

8.1.1 Digital Section

The digital section consists of:

- Z80A Microprocessor (CPU) U1;
- Z8530A Serial Communications Controller (SCC) U5
- 27256 Read-Only Memory (ROM) U2;
- 6264 Random Access Memory (RAM) U3 and U4;
- a crystal-controlled clock generator;
- devices that gate and isolate the digital signals.

8.1.2 Input/Output Section

The I/O section's Z8530 Serial Communications Controller (SCC) has two serial communications ports. Port A is the HDLC (High-Level Data Link Control) port for packet radio and also provides PTT (push-to-talk) switching voltages for the associated transmitter.

The 8530 SCC's Port B provides a standard serial data path per EIA RS-232-C and CCITT Recommendations V.24/V.28, between the PK-90 and the associated computer or terminal.

The PK-90 uses the Am7910 "World Chip" modem. This single-chip modem provides both VHF and HF tone modulation and demodulation functions and eliminates many discrete components.

The front panel LED display is also part of the I/O section. Eight LEDs provide a continual indication of system status. The display system consists of the eight LEDs and a latching driver chip.

The I/O section also isolates input and output signals and provides circuits for connecting an external modem. All control signals and communication data to and from the PK-90 pass through the I/O section.

8.1.3 Power Distribution Section

The power distribution section consists of:

- 317T voltage regulator U18;
- 7905 voltage regulator U19;
- 556 DC-to-DC converter U21;
- a lithium battery for maintaining the data stored in RAM.

8.2 Functional Description

Please refer to the PK-90 Schematic Diagram in the Appendix. The diagrgam includes:

- Z80A Microprocessor U1;
- Z8530A Serial Communications Contoller U5;
- 27256 Read Only Memory (ROM) U2;
- 6264 Random Access Memory (RAM) U3 and U4;
- Am7910 modem chip U14;
- Watchdog timer Q7 and Q8;
- Keying circuits Q4, Q5 and Q6;
- Clock and divider display logic;
- Logic associated with the digital communications between the PK-90 and the terminal.

8.2.1 Z80A Central Processing Unit

The PK-90 uses a Z80A microprocessor at location U1, operating at a clock rate of 4.9152 MHz.

The 8530A Serial Communications Controller and peripheral chip at location U5 provides system interrupts using the CPU's INT* input (pin 16). The NMI* and BUSRQ* inputs are unused, as are the RFSH, HALT and BUSAK outputs.

8.2.2 8530A SCC Serial Communications Controller

An 8530A SCC (Serial Communications Controller) at location U5 provides two serial communications ports. The 8530A chip uses the 4.9152 MHz system clock.

- Port A is the HDLC port for packet radio.
- Port A interfaces with the Am7910 Modem.
- Port B is the RS-232 interface to the host computer or terminal.

The 8530A SCC receives address bits A0 and A1 from the CPU, and a signal from the 74LS139 decoder at location U8, signifying that address bits A2 and A3 are both 0.

The PK-90 firmware addresses the 8530A by forcing all other address bits high, yielding these addresses:

$F0 - Terminal (Port B) control
$F1 - Terminal (Port B) data
$F2 - HDLC (Port A) control
$F3 - HDLC (Port A) data

Serial interface signals TXD (J2 pin 2) and RTS (pin 4) flow from the RS-232 connector through the drivers on the 1489 chip at location U6 to the 8530's RXDB and CTSB pins respectively.

8530A output pins TXDB and RTSB pins are buffered by the drivers on the 1488 RS-232 Line Driver at location U7 to the J2 pins RXD (3) and CTS (5) respectively. The RTS (J2 pin 4) signal must be high for the 8530A to send data on the RS-232 link.

DCD (Data Carrier Detect) J2 pin 8 may be strapped permanently high, or used as an active-high packet Connect indicator for host computer or mailbox software. As shipped, jumper JP6 pulls pin 8 permanently high. For "high-when-connected" DCD assertion, move the JP-6 plug to the opposite position (towards the read panel).

DSR (Data Set Ready) J2 pin 6 is permanently pulled high. J2 pin 1 is frame ground and J2 pin 7 is signal ground. The remaining J2 pins are not used.

U5's TRXCA output (pin 14) is the "times 32" clock. This clock can also be used with an external modem. This signal is connected to an input on U20, passes through five divide-by-2 stages, and brought out to U5's RTXCA input (pin 12) as the "times 1" clock.

The RTSA output (pin 17) is the PTT signal, active low.

74LS164 eight-bit shift register at location U9, 74LS11 triple 3-input AND gate at location U11, and 74LS04 hex inverter at location U17, form a state machine for operating the 8530A SCC with the Z80A CPU.

This circuit provides a Wait signal to the CPU, and I/O Request and Interrupt Acknowledge signals to the 8530A SCC whenever the CPU begins an Interrupt Acknowledge cycle.

The SYNCB input (pin 29) receives a 600 Hz clock frequency from the HCT4020 clock divider chip at location U12. This signal provides the PK-90's software real-time clock.

8.2.3 Memory

The PK-90's operating system program is stored in a 27256 32K EPROM at location U2. At system start, the program is automatically loaded into the two 6264 static RAMs at locations U3 and U4. A lithium battery cell holds RAM contents when power is removed from the system.

The 27256 EPROM (U2) occupies the 32Kbyte address space between $0000 and $7FFF.

The read-write memory consists of two 6264 8K volatile static RAMs at locations U3 and U4. These RAMs provide a total of 16K of read-write memory and are backed up by a board-mounted lithium battery cell to retain system parameters when the power source is disconnected.

- U3 occupies addresses $8000-9FFF
- U4 occupies addresses $A000-BFFF.

The 74LS139 expandable 2/4 address decoder at location U8 receives address bits A13, A14 and A15 from the CPU, and provides chip enable signals for RAMs U3 and U4. Address bit A15 is used directly as the chip enable for the U2 EPROM at address $0000.

U10 pin 8 provides a Memory Read (OE*) line for EPROM U2 and RAMs U3 and U4; U10 pin 11 is the Memory Write (WE*) line for RAMs U3 and U4.

Half of the 74LS139 address decoder at location U8 receives address bits A13, A14 and A15 from the CPU, and provides chip enables for U3 and U4.

Address bit A15 is used directly as the chip enable for the U2 EPROM at address $0000.

8.2.4 Clock and Timing

The PK-90's master or system clock is provided by crystal Y1 operating at 4.9152 MHz, in a circuit with capacitors C2 through C6, resistors R7 and R8, and a 74LS04 hex inverter at location U16. This clock is used by both the Z80A CPU and the 8530A SCC.

The HCT4020 14-stage binary/ripple counter divider at location U12 divides the master frequency to 2.4576 MHz for the Am7910 modem chip, and also to 600 Hz for the 8530A SCC.

In HDLC operation, an internal phase-locked loop is driven by a clock at 32 times the packet baud rate.

The transmitter is driven by a clock at the packet (radio link) baud rate. The divide-by-32 function is performed by the 74LS393 at location U20.

The 8530's (U5) TRXCA output (pin 14) is the "times 32" clock for an external modem. This signal is connected to an input on U20, processed by five divide-by-two stages and brought out to U5's RTXCA input (pin 12) as the "times 1" clock.

8.3 I/O Section

The I/O Section includes the Z8530A Serial Communications Controller (SCC), RS-232 drivers and receivers, Am7910 modem chip, Watchdog Timer and Push To Talk (PTT), and the Status Indicators.

The 74LS139 address decoder at U8 receives address bits A2 and A3 from the CPU and provides chip enables for the 8530A. Address bits A0 and A1 are used directly by the 8530A to address Port A as the HDLC port for packet radio and Port B as the RS-232 terminal interface.

The 8530A SCC receives address bits A0, A1, A2 and A3 from the CPU and the 74LS139. The PK-90 firmware addresses the 8530A by forcing all other address bits high, yielding these addresses:

$FC - Terminal (Port B) control
$FD - Terminal (Port B) data
$FE - HDLC (Port A) control
$FF - HDLC (Port A) data

8.3.1 I/O Address Decoding

The PK-90 uses half of the 74LS139 decoder at location U8 to decode memory addresses. The other half of U8 decodes I/O addresses.

Address bits 2 and 3 combine with an I/O Request signal to yield these I/O enable signals:

A3	A2	I/O location	U8 pin	Function
0	0	$F0-F3	12	8530A chip enable
0	1	$F4	11	LED write
1	0	$F8	10	Watchdog timer pulse

8.3.2 Serial I/O Port J2

Serial interface signals TXD (J2 pin 2) and RTS (4) are passed from the RS-232 connector through the 1489 Line Receiver at location U6 to the 8530A's RXDB and CTSB pins respectively.

8530A output pins TXDB and RTSB pins are buffered by the 1488 Line Driver at location U7 to J2 pins RXD (3) and CTS (5) respectively.

When hardware flow control is used, the RTS (J2 pin 4) signal is pulled high through a 10K resistor to enable the 8530A to send data on the RS-232 link. J2 pin 6 (DSR) is permanently pulled high.

J2 pin 8 (DCD) may be used as an active-high packet "Connect" indicator for "mailbox" software when jumper JP6 is in the B position.

J2 pin 1 is frame ground; J2 pin 7 is signal ground.

8.4 Am7910 Modem Chip

The Am7910 modem chip (U14) is a single-chip asynchronous Frequency Shift Keying (FSK) voiceband modem. It is pin selectable for baud rates of 300, 600 or 1200 bits per second and is compatible with applicable Bell standards for 103/113/108, 202, and CCITT Recommendations V.21 and V.23. Five mode control lines select a desired modem configuration.

The Am7910 uses digital signal processing for all major functions such as modulation, demodulation and filtering. The Am7910 contains on-chip analog-to-digital and digital-to-analog converter circuits to minimize external components. The Am7910 includes RS-232/CCITT V.24 terminal control signals at TTL levels. The Am7910 clock frequency of 2.4576 MHz is derived from U12.

The PK-90's TONE command selects the Am7910's audio tone pairs. Bell 103 and 202 tone pairs are thus selected by software command. All audio tones to and from the transceiver are buffered by a TL-082 Operational Amplifier at locatioln U15.

The Am7910 communicates directly with the 8530A SCC, whose DTRA and DTRB pins provide parallel output bits under software control to determine the tone pairs used by the Am7910. Port A interfaces either with the Am7910 modem chip (U14), or with the Modem Disconnect port (J4), depending on the positions of jumpers JP3, JP4 and JP5. The signals going to the Am7910 are:

Signal	U5 pin	Am7910 pin	J4 pin	Jumper
TXD	15	10	1	JP3
RXD	13	26	4	JP4
DCD	19	25	5	JP5
RTS	17	12		
CTS	18	13		

Without a jumper installed at JP7, Bell standard tones are in effect:

DTRB (pin 24)	DTRA (pin 16)	Tone Frequencies and Application	
0	0	1070/1270 Hz	Bell 103 Originate
0	1	2025/2225 Hz	Bell 103 Answer
1	0	1200/2200 Hz	Bell 202
1	1	1200/2200 Hz	Bell 202 equalized

When a jumper is installed at JP-7, CCITT tone specifications are in effect and the tone pairs become:

DTRB (pin 24)	DTRA (pin 16)	Tone Frequencies and Application	
0	0	980/1180 Hz	CCITT V.21 Originate
0	1	1650/1850 Hz	CCITT V.21 Answer
1	0	1300/2100 Hz	CCITT V.23 Mode 2
1	1	1300/2100 Hz	CCITT V.23 equalized

8.5 Watchdog Timer and Push-to-Talk (PTT)

The Push-to-Talk signal is derived directly from the 8530A RTSA line (pin 17) and fed to both the Am7910 Modem chip and to transistor Q4. Transistor Q4 controls transistors Q5 and Q6 which provide negative and positive PTT keying respectively. Positive or negative transmitter keying is selected by jumper JP2.

The Watchdog Timer circuit consists of Q7 and Q8 which are pulsed by the PK-90 firmware's main program loop through a 74LS139 dual decoder at location U8. This PTT-enable signal is present as long as pulses from U8 refresh the timeout circuits in Q7 and Q8. If the CPU fails, or if the program fails or becomes disabled, the timeout circuitry prevents the PTT line from being activated.

The RTSA output (pin 17) is the active low PTT signal.

If PTT is to remain active for any length of time, the decoder output (U8 pin 10) must furnish a constantly-oscillating signal. This signal goes to the watchdog timer circuit.

Should the oscillating signal stop, the PTT will become inactive after a period determined by the time constant of R35 (10K) and C14 (47 uf). To this end, decoder output (A3=1, A2=0) is pulsed low (I/O address $F8 is read) every pass through the main loop of the PK-90 firmware.

The 74HCT4040 chip at location U12 divides the 4.9152 MHz system clock by 4096 to yield a 600 Hz signal at location U12 pin 2. This signal is connected to the 8530A's SYNCB input (pin 29) and causes the 8530A to generate interrupts 1200 times a second. The PK-90 firmware uses these interrupts to build the system's basic timing intervals.

The 8530A chip operates with the Z80A CPU through a state machine consisting of U9 (74LS164), U11 (74LS11) and U17 (74LS04).

This circuit provides a Wait signal to the CPU, and I/O Request and Interrupt Acknowledge signals to the 8530A at proper times, whenever the CPU begins an Interrupt Acknowledge cycle.

8.6 Status Indicators

Eight LED front panel Status Indicators are driven by an HCT374 at location U13, controlled directly by the Z80A processor.

U13 is selected through the 74LS139 at location U8 when Address bits A2 and A3 are high and low respectively.

The Status LED driver 74HCT574 at location U13 is accessed through the U8 decoder by the firmware writing data to I/O address $F4.

A logical 1 written to each data bit causes the associated LED to be lit.

Data bit	LED
0	CONV
1	TRANS
2	CMD
3	SEND
4	DCD
5	STA
6	CON
7	MULT

8.7 Power Section

The Power Section consists of +5-volt DC regulator, a +/-10 volt DC generator and a -5-volt DC regulator. A three-volt lithium battery provides backup for the static RAMs.

8.7.1 Positive 5-Volt Regulator

An LM-317 regulator (U18), resistors R44 and R45 and diodes D15 and D16 are used to regulate the +13 VDC to 5.0 VDC.

8.7.2 Positive and Negative 10-Volt Generator

A 556 Dual Timer at location U21 generates positive and negative 10 volts DC for the 1488 RS-232 driver chip at location U7.

This is accomplished by switching the +13-volt DC supply voltage at approximately six KHz and rectifying and filtering the output.

8.7.3 Negative 5-Volt Regulator

A 7905 negative 5-volt DC regulator at location U19 regulates the negative 10-volt level produced by the voltage generator. Regulated negative voltage is supplied to the Am7910 Modem and also to the TL082 Operational Amplifier.

8.7.4 Three-Volt Lithium Battery

A three-volt lithium battery (B1) supplies voltage to Static RAMs U3 and U4 when power is removed from the PK-90.

8.8 Technical References

For additional information on the Am7910 "World Chip" Modem, refer to the Am7910 Product Specification, available from Advanced Micro Devices, Inc.

For further details on the Z8530A, please refer to the Z8530A SCC Serial Communications Controller Technical Manual, available directly from Zilog, Inc.

For information on the XR2123 V.26 2400-BPS Modem chip used in the optional DPSK modem board, please refer to the product guide and application notes available from the EXAR Corporation..pa

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CHAPTER 9

TROUBLESHOOTING

9.1 Introduction

WARNING!!

NEVER REMOVE OR INSERT AN INTEGRATED CIRCUIT DEVICE WITH POWER APPLIED

The AEA PK-90 is a complex piece of electronic equipment. Servicing must be performed in a logical manner. Prepare for troubleshooting by studying the circuit description in Chapter 8 and the circuit diagrams in the appendices.

Although it is not possible to present all possible problems, symptoms and probable solutions, this section offers general troubleshooting directions based on our experience.

9.2 General Tests

In most cases, careful visual inspection combined with simple measurements usually reveals the problem.

The single most-useful tool for troubleshooting is a digital voltmeter (DVM) for reading AC and DC voltages, one that permits nondestructive resistance measurements while the integrated circuits are still in their sockets.

Although certain tests can be done without the aid of an oscilloscope, it will be required to verify signals at various points on the board if the problem cannot be located by visual means or with a meter.

Avoid short-circuiting pins on integrated circuits when connecting meter or oscilloscope probes to the board. It is good practice to attach a secure ground wire to the meter or oscilloscope, some point that cannnot accidentally short-circuit components on the board.

A good point to pick up this ground is on the threads of the screws that attach the RS-232 connector at the rear of the printed-circuit board.

9.2.1 Power Supply

Verify Fuse F1. If the fuse is intact, then verify the power supply for correct operation. Verify power supply levels at the outputs of voltage regulators U18 and U19, and DC-to-DC converter U21.

- o Are the voltages close to their nominal values?
- o Do all the integrated circuits in the suspected area have the proper voltage on their power pins?
- o Is there excessive ripple in any of the DC voltage lines?
- o If so, verify the regulator and associated components, working backwards toward the input power source.
- o If the voltage is low in conjunction with a hot regulator, suspect a short circuit on the board, or defective (hot) integrated circuit.

9.2.2 Obvious Problems

Look for any unusual physical symptoms.

- o Are any components discolored?
- o Does something smell burned?
- o Do any of the parts seems excessively warm?

9.2.3 Assembly Problems

Carefully inspect the PC board and component installation.

- o Are all the socketed integrated circuits firmly seated in their sockets?
- o Are any integrated circuit leads folded under the chip or bent so that they aren't making proper contact with the integrated circuit socket?

9.2.4 Cabling Problems

Inspect the interconnection cabling. Where possible, substitute a spare PK-90 or other compatible packet radio controller and attempt normal operation.

- o Do the cables perform correctly with another controller?
- o Has the radio and/or terminal been successfully used with this or another controller?
- o Are all the connections tight?
- o Does the cable appear frayed or broken?

9.3 Specific Symptoms

Although the above steps may seem obvious, careful visual inspection often points to a problem or provides significant indications as to the PK-90's most suspect area.

Proceed to more specific analysis after completing the physical inspection and delaing with the apparent problems.

9.3.1 Symptom: PK-90 appears dead

If no LEDS are lit at startup or reset:

- Verify that the external power source is properly connected.
- Verify that the external power supply has sufficient current capacity to drive the PK-90.
- Verify the 74HCT574 LED driver device at location U13.
- Verify that system clock crystal oscillator Y1 is operating and that a square wave signal (4.9152 MHz, 0 to +5 volts) exists at U16 pin 6. The clock signal should be a moderately-distorted square wave.

If the PK-90 responds to initial power application with ALL the LEDS lit but fails to respond to any commands:

- Verify that the 27256 EPROM at locations U2 is correctly installed with the indicator notch position matching the marking on the printed-circuit board marking.
- Verify that the PK-90's power source can provide at least 500 millamperes continuous current at 13 volts.

If the PK-90 responds to initial power application with only the MULT LED lit but fails to respond to any commands:

- Suspect the terminal port at this point. The processor and the software in EPROM are probably operating correctly.
- Verify all cables and connections between the PK-90 and the terminal.
- Verify logic levels according to the terminal interface troubleshooting section in this chapter.

Digital Logic Lines

All logic circuits operate at standard TTL levels. "Low" is less than +0.8 V; "High" is greater than +2.4 volts. All digital inputs and outputs alternate between these two levels.

NOTE: Make these measurements ONLY with an oscilloscope!

- o If logic signals are alternating between 0 and perhaps 1 volt, there is a problem, usually a short circuit.
- o Do not mistake switching transients on digital logic lines for improper operation - such transients appear as ringing and other distortions.
- o Verify with the oscilloscope that activity exists on the following lines:

ADDRESS LINE A0	U1	Pin 30
DATA LINE D0	U1	Pin 14
CHIP ENABLE CE*	U2	Pin 20
OUTPUT ENABLE OE*	U2	Pin 22
READ LINE RD*	U1	Pin 21
WRITE LINE WR*	U1	Pin 22
PCLK	U5	Pin 20
CLOCK TRXCA	U5	Pin 14
CLOCK RTXCA	U5	Pin 12

Each of these lines should show activity. If any line is inactive, this is a sign of trouble.

Logic lines that do not show activity can often be traced to a short circuit on the printed circuit board.

Short circuits on the address and data lines can also appear as lack of activity on the control bus lines, especially device select lines.

- o Verify each of the 16 address and 8 data lines for activity. Any lines showing a lack of activity are not operating properly.
- o Remove all memory chips if you suspect problems with address or data lines. Each address and data line will now show a distinct pattern. The address lines should be (possibly distorted) square waves whose periods increase by a factor of two on successive lines as you move line by line from A0 to A15.
- o Use a low-voltage, low-current test instrument if you decide to use an ohmmeter to verify short-circuited lines. Most modern digital voltmeters are adequate for such tests. Disconnect the power source and remove any integrated circuits connected to the lines being measured if in doubt.
- o Verify the high-density areas of the printed circuit board for the problem if you suspect a short circuit. In most cases the short will be found there.

9.3.2 Symptom: Transmitter cannot be keyed

If the transmitter cannot be keyed and the DCD LED is not lit:

- o Verify the watchdog timer circuit at Q7 and Q8.
- o Verify PTT driver transistors Q4, Q5 and Q6.
- o Verify timing capacitor C14.

9.3.3 Symptom: Transmitted signals not copyable by other stations

If stations are unable to decode your transmissions when using VHF FM:

- o Verify your transmitter's deviation or modulation index. Verify that peak deviation at any tone does not exceed 4 KHz.
- o Verify that your transmitter's modulation limiting circuits are not being driven into limiting or clipping, and that both tones are being transmitted in the correct amplitude ratio. A standard deviation meter should show the higher (Space or Start) tone to be higher in amplitude than the lower (Mark or Stop) tone.
- o Adjust the PK-90's AFSK output level with R42 to produce the correct transmitter deviation.

If stations are unable to decode your transmissions when using SSB:

- o Verify that you're using the same sideband used by the other stations in your network. (Although packet radio produces the same results on either sideband, the choice of LSB or USB may affect your radio tuning display or calibration.)
- o Verify that the transmitter's audio input stage and ALC systems are not being overdriven.
- o Adjust the transmitter's microphone gain in accordance with the radio manuafacturer's duty-cycle, plate current and power dissipation specifications.
- o If reducing the radio's gain control does not solve the problem, adjust the PK-90's AFSK output level with R42 to produce the correct transmitter operating conditions.

9.3.4 Symptom: Received signals not copyable

If unable to correctly decode signals from other stations:

- o Verify that the PK-90 is set for the proper operating mode.
- o Verify that the PK-90 is set to the proper HBAUD link rate.
- o Verify that VHF to set properly for the mode in use.
- o Inject a 1200-Hz test tone into Pin 4 of J3.
- o Verify audio signal flow through C12, R43, U15 Pins 5 and 7, and that the audio tone appears at U14 Pin 5.

9.4 Terminal Interface Troubleshooting

If the PK-90 does not appear to start, respond to commands, or accept data from the terminal or computer, the problem may be in the RS-232C interface.

The following troubleshooting suggestions can aid in resolving problems related to the RS-232C port.

9.4.1 Symptom: PK-90 does not communicate with the terminal.

Use a 'breakout box' or oscilloscope to verify that correct control voltages are present on pins 4, 5, 6, 8 and 20 of J2, the RS-232 I/O connector.

- Verify that the RTS line on Pin 4 of J2 (the RS-232 I/O connector) are not being held low.

If the PK-90 software flow control is disabled by setting START, STOP, XON and XOFF to $00 (hex) and XFLOW to OFF, the controller will not send data to the terminal unless RTS is asserted.

If the computer or terminal does not provide the DTR/CTS protocol or "handshake", the DTR/CTS lines (pins 20 and 5 on J2) should not be connected .

- Verify that the voltages on the PK-90 are correct.

If the tests are valid, verify the signal on U5 pin 27 with an oscilloscope.

- Recycle the power switch on the PK-90. Transitions on this pin shortly after reset indicate that the PK-90 is sending data.
- Verify that transitions are also present on U19 pin 1.

9.4.2 Symptom: PK-90 signs on with mutilated data

If the terminal displays strange characters, 'garbage', graphics, etc., one or more of the following parameter values is incorrectly set and does not agree between the terminal and the PK-90:

data rate (TBAUD)
data word length (AWLEN)
parity (PARITY)
number of start and stop bits

- Set the terminal rate to 1200 bauds if possible, seven data bits, even parity, and one stop bit. These are the default settings stored in the PK-90's EPROM.
- Restart the PK-90 by cycling the power switch OFF then ON (out then in). The sign on message should appear.

If the PK-90 still prints gibberish:

- o Verify that the terminal is set to 1200 bauds and recycle the power switches on both the PK-90 and terminal.

If the sign-on message still fails to appear:

- o Verify signals with an oscilloscope connected to TXD pin 25 of U5, the Z8530A chip, and then at the X32 baud rate clock (38.4 KHz at 1200 bauds) on pin 14 of U5.

9.4.3 Symptom: PK-90 does not respond or accept commands.

Type a command such as MYCALL or any other command. If the default settings are in effect, the PK-90 should echo typed characters back to the screen.

- o Verify that U5 pin 21 shows a positive voltage level.

If the above tests are valid:

- o Type any keys on the terminal and verify that data is present on U5 pin 27 and U6 pin 11.

If data is not seen, the data is not reaching the PK-90 from the terminal.

- o Verify J2, the cable, and U6 again.

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APPENDIX A

PK-90 COMPLETE COMMAND LIST

NOTE: Certain commands and parameters shown in the following alphabetical listing do not appear in response to the DISPLAY command.

COMMAND	MNEMONIC	DEFAULT	FUNCTION
8BITCONV	8B	OFF	Strip bit 7 in CONVERSE
ACRDISP	ACRD	80	Screen width
ACRPACK	ACRP	ON	Add <CR> to packet
ADDRESS	ADD	Enter hex addresses	For MEMORY & IO commands
ALFDISP	ALFD	ON	Send LF after <CR> to terminal
ALFPACK	ALFP	OFF	Send LF after <CR>, packet
AWLEN	AW	8 (set by autobaud)	Data bits per word, to terminal
AX25L2V2	A	ON	Operate as AX.25 Version 1.0
AXDELAY	AXD	0 (00 msec.)	Repeater key-up delay (X10 ms)
AXHANG	AXH	0 (000 msec.)	Repeater hang time (X10 ms)
BEACON	B	EVERY 0 (00 sec.)	Set beacon timing (X10 seconds)
BKONDEL	BK	ON	Send BS SP BS for DELETE char.
BTEXT	BT	(Empty)	120-byte BEACON message text
BXDELAY	BXD	0 (00 msec.)	Set delay after squelch active
CALIBRA	CAL	Immediate Command	Start calibrate mode
CANLINE	CAN	$18 <CTRL-X>	Line delete character
CANPAC	CANP	$19 <CTRL-Y>	Packet delete character
CASEDISP	CAS	0 (as is)	Display case (as is/lower/UPPER)
CBELL	CB	OFF	Enable 'Connect' bell
CFROM	CF	all	Connect request accept/reject
CHCALL	CHC	OFF	Show call sign after channel ID
CHDOUBLE	CHD	OFF	Show CHSWITCH character twice
CHECK	CH	30 (300 sec.)	Idle link timeout (X10 seconds)
CHSWITCH	CHS	$00	Channel-select (Link) character
CLKADJ	CLK	0	Correction to real-time clock
CMDTIME	CM	10 (1000 msec.)	Transparent Mode escape timer
CMSG	CMS	OFF	Send CTEXT message to caller
COMMAND	COM	$03 <CTRL-C>	Character escape to COMMAND Mode
CONMODE	CONM	CONVERSE	Mode to enter when link starts
CONNECT	C	Immediate Command	Send connect request to <call>
CONOK	CONO	ON	Synonym for CFROM ALL
CONPERM	CONP	OFF	Never disconnect this link
CONSTAMP	CONS	OFF	Mark connections with time/date
CONVERSE	CONV or K	Immediate Command	Start Converse Mode from Command
CPACTIME	CP	OFF	Use packet timeout in Converse
CR	CR	ON	Synonym for ACRPACK
CSTATUS	CS	Immediate Command	Show status of channels (links)
CTEXT	CT	(Text)	120-byte CONNECT message text
DAYSTAMP	DAYS	OFF	Include DATE in time stamp
DAYTIME	DA	None	Set/read PK-90 internal clock
DELETE	DEL	OFF	Use BS ($08), not DEL ($7F)

PK-90 COMPLETE COMMAND LIST (Continued)

COMMAND	MNEMONIC	DEFAULT	FUNCTION
DFROM	DF	ALL	Selective digipeat call list
DISCONNE	D	Immediate Command	Send DISC to distant station
DISPLAY	DISP	Immediate Command	Show PK-90 parameters/classes
DWAIT	DW	16 (160 msec.)	Delay for digi repeat (X10 ms)
ECHO	E	ON	Echo typed keyboard characters
ESCAPE	ES	OFF	Send ESC character $1B as $24
FLOW	F	ON	Stop echo to screen while typing
FRACK	FR	3 (3 sec.)	Time (X1 sec) to wait for ACK
FULLDUP	FU	OFF	Full-Duplex terminal operation
HBAUD	HB	1200	Packet link (radio) baud rate
HEADERLN	HE	ON	Insert <CR> after headers
HELP	H	None	Show brief HELP text on screen
HHANG	HH	0 (000 msec.)	Send flag bursts to repeater
HID	HI	OFF	Send ID UI packet every 9.5 mins
HOST	HOST	OFF	Host/terminal interface
HPOLL	HPOLL	ON	Host poll, packet mode
ID	I	Immediate Command	Force ID packet via Unproto path
ILFPACK	IL	ON	Ignore line feeds in packet xmit
IO	IO	Enter hex addresses	Read/write IO register
K	K	Immediate Command	Same as CONVERSE
KEYWORD	KE	none	Set numeric key for encryption
KISS	KI	OFF	Use KISS TNC protocol
MACRO	nM	none	Create/use macro command strings
MAXFRAME	MAX	4	Maximum un-ACK'd frames allowed
MBELL	MBE	OFF	Beep if selected call is heard
MBX	MB	none, (enter calls)	Monitor channel without headers
MCON	MC	0 (zero)	Monitor while connected (0-6)
MDIGI	MD	OFF	Monitor digipeated frames
MEMORY	ME	Enter hex addresses	Read/write memory location
MFILTER	MFI	$80	Filter controls less CR, LF, TAB
MFROM	MF	all	Monitor MFROM call signs
MHEARD	MH	Immediate Command	Display call signs heard
MONITOR	M	4 (UA DM C D I UI)	Monitor mode level select (0-6)
MPROTO	MP	OFF	Monitor I-frames with PID $F0
MRPT	MR	ON	Show digipeaters in headers
MSTAMP	MS	OFF	Time-stamp monitored frames
MTO	MT	none	Monitor MTO call signs
MYALIAS	MYA	none; enter yours	Alternate MYCALL
MYCALL	MY	PK90; enter yours	Your call sign packet address
NEWMODE	NE	ON	Return to Command mode at DISC
NOMODE	NO	OFF	Don't change modes unless told
NUCR	NU	OFF	Nulls to terminal after <CR>
NULF	NUL	OFF	Nulls to terminal after <LF>
NULLS	NULL	0 (zero)	Number of nulls for NUCR & NULF
PACLEN	PACL	128	# of user-typed bytes in packet
PACTIME	PACT	AFTER 10 (1000 msec.)	Packet transmit timer (X100 ms)

PK-90 COMPLETE COMMAND LIST (Continued)

COMMAND	MNEMONIC	DEFAULT	FUNCTION
PARITY	PAR	0 (none) (autobaud)	Terminal program parity (0-3)
PASS	PAS	$16 <CTRL-V>	Pass input editing character
PASSALL	PASSA	OFF	Ignore CRC in HDLC ('Junk Mode')
PASSWORD	PASSW	none	Enter security password string
PERSIST	PE	127	P-persistent CSMA threshold
PPERSIST	PP	OFF	p-persistence instead of DWAIT
RAWHDLC	RAW	OFF	Raw HDLC mode
REDISPLA	RED	$12 <CTRL-R>	Redisplay current input buffer
RELINK	REL	OFF	Reconnect after retrying out
REMOTE	REM	OFF	Enable remote control via link
RESET	RESET	Immediate Command	RESET bbRAM to factory defaults
RESPTIME	RES	10 (1000 msec.)	Minimum delay before sending ACK
RESTART	RESTART	Immediate Command	Same as power-on/off reset
RETRY	RE	10	Maximum number of frame repeats
RKEYWORD	RK	none	Set numeric key for encryption
RQTIME	RQ	20 (20 sec.)	Channel request timeout in secs
SENDPAC	SE	$0D <CTRL-M>	Character that 'sends' a packet
SETPASS	SETP	none	Master security password string
SLOTTIME	SL	10 (100 msec.)	P-persistent slot time in msecs
SQUELCH	SQ	OFF	Select receiver squelch polarity
START	STA	$11 <CTRL-Q>	Resume sending data to terminal
STATUS	STAT	ON	Send link status to terminal
STOP	STO	$13 <CTRL-S>	Stop sending data to terminal
TBAUD	TB	1200 (autobaud)	Set terminal data rate
TCLEAR	TC	Immediate Command	Clear Transmit Buffer
TIME	TI	$14 <CTRL-T>	Insert 'send time' in text
TONE	TO	3 (1200/2200 eq)	Select modem tone pairs
TRACE	TRAC	OFF	Hex dump of packet frame
TRANS	T	Immediate Command	Start Transparent Data Mode
TRFLOW	TRF	OFF	Terminal flow ctrl - Transparent
TRIES	TRI	0 (zero)	Show or force retry count
TXDELAY	TX	30 (300 msec.)	PTT key-to-data delay (X10 ms)
TXFLOW	TXF	OFF	PK-90 flow control - Transparent
UNPROTO	U	CQ	Path/address to send UI frames
USERS	US	1	# of multi-connections allowed
WDISCONN	W	Immediate Command	Disconnect after final ACK
XFLOW	XF	ON	Software flow control
XMITOK	XMITO	ON	PTT line can be keyed
XOFF	XO	$13 <CTRL-S>	Stop sending data to terminal
XON	XON	$11 <CTRL-Q>	Resume sending data to terminal

APPENDIX B

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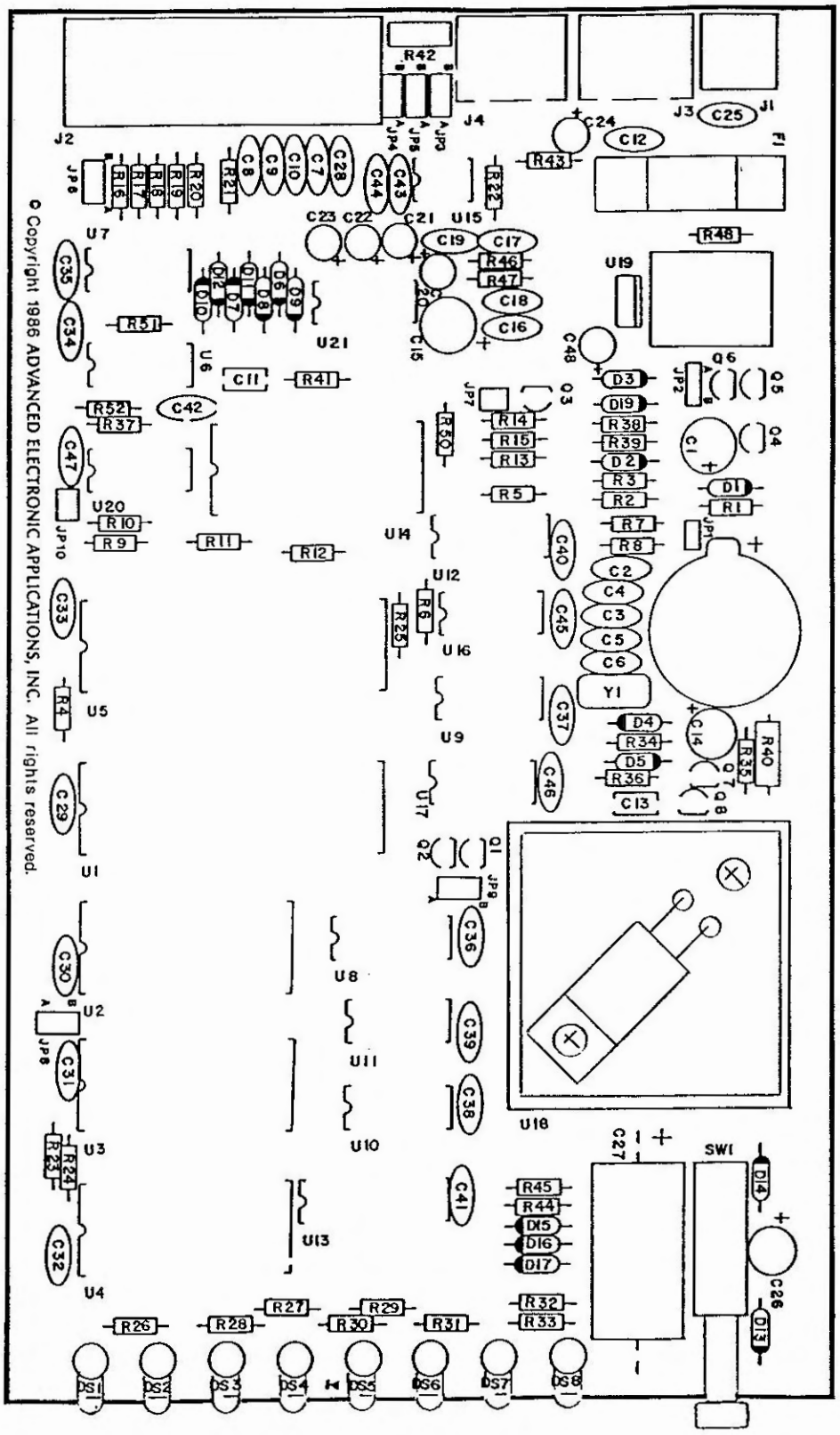
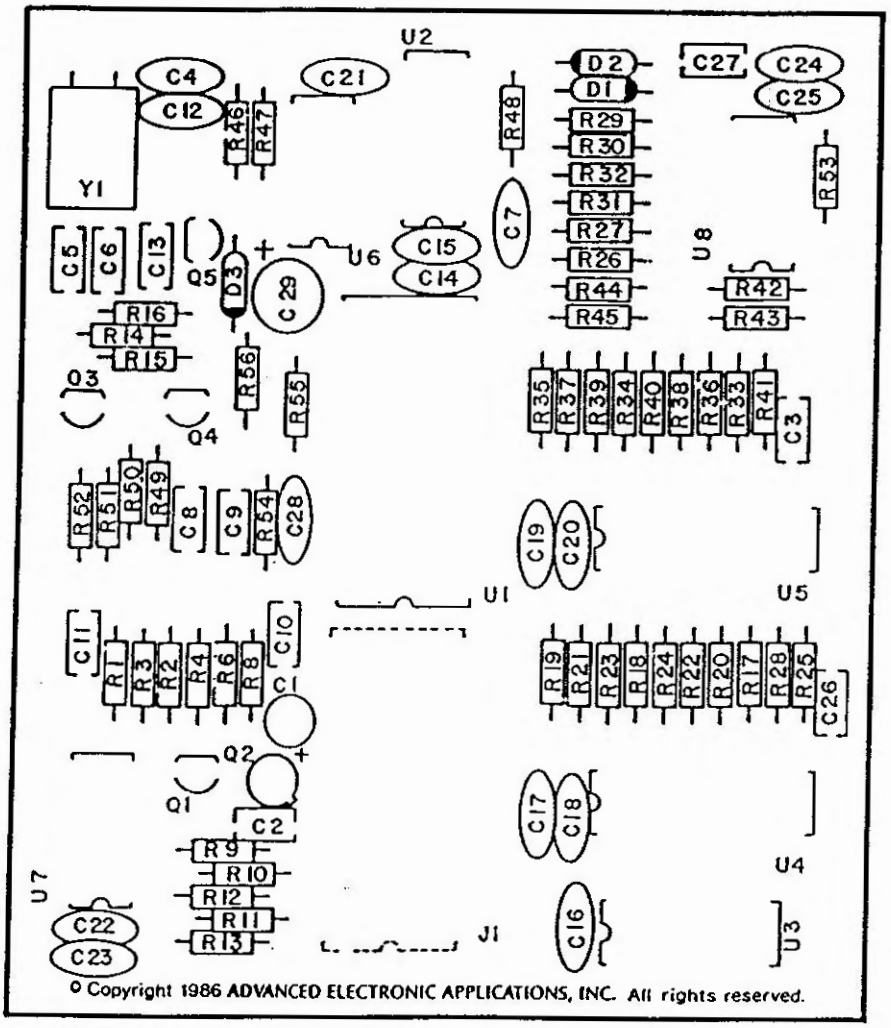
PARTS PICTORIAL
PK-90



PARTS PICTORIAL
DPSK MODEM



PARTS LIST PK-90

PART NO.	DESCRIPTION	QTY	REF. DESIG
013-072	PCB PK-90	1	
110-102	CAP MY 102P 10% 50V	1	C17
110-103	CAP MY 103P 10% 50V	2	C18,C19
110-104	CAP MY 104P 10% 50V	2	C12,C13
111-202	CAP CE 202P 5% 50V	1	C11
121-102	CAP CE 102P 50V	5	C7-C10,C28
121-103	CAP CE 103P 50V	2	C2,C4
121-104	CAP CE 104P 50V	21	C16,C25,C29-C47
130-106	CAP EL 106P RAD 25V	4	C20-C23
130-107	CAP EL 107P RAD 25V	2	C1,C26
130-486	CAP EL 476P RAD 35V	2	C15,C14
131-108	CAP EL 108P AX 35V	1	C27
140-105	CAP TA 105P 25V	1	C24
140-685	CAP TA 685P 25V	1	C48
150-330	CAP SIL MICA 33P	1	C6
150-331	CAP SIL MICA 330P	1	C5
150-201	CAP SIL MICA 220P	1	C3
210-100	RES 1/4W 5% 10	1	R48
210-101	RES 1/4W 5% 100	6	R16-R19,R41,R21
210-102	RES 1/4W 5% 1K	4	R3,R7,R8,R36
210-103	RES 1/4W 5% 10K	12	R4,R9,R10,R11,R12,R25, R22,R43,R37,R39,R50,R52
210-104	RES 1/4W 5% 100K	3	R47,R14,R15
210-331	RES 1/4W 5% 330	10	R26-R33,R5,R6
210-472	RES 1/4W 5% 4.7K	8	R1,R2,R34,R25,R20,R38, R13,R46
210-512	RES 1/4W 5% 5.1K	2	R23,R24
211-241	RES 1/4W 1% 243	1	R45
211-841	RES 1/4W 1% 845	1	R44
220-681	RES 1/2W 5% 680	1	R40
251-103	TRIM POT 10K	1	R42
310-001	DIODE SIGNAL 1N4448	13	D1,D2,D4,D6-D13,D16,D17
311-003	DIODE POWER 1N4003	4	D3,D14,D15,D19
312-471	DIODE ZENER 1N751	1	D5
314-005	L.E.D. RED TLHR5600	8	DS1-DS8
320-001	XISTOR NPN 2N3904	3	Q3,Q4,Q7
320-011	XISTOR NPN MPS6521	1	Q8
320-012	XISTOR NPN MPS6561	1	Q6
320-202	XISTOR PFET VN10LM	2	Q1,Q2
320-501	XISTOR PNP 2N3906	1	Q5
330-006	I.C. UA79L05	1	U19
330-009	I.C. LM317T	1	U18
330-011	I.C. NE556N	1	U21
330-016	I.C. XR082CP	1	U15
331-004-1	I.C. 74LS04	1	U16
331-011-1	I.C. 74LS11	1	U11
331-014-1	I.C. 74LS14	1	U17
331-032-1	I.C. 74LS32	1	U10
331-139	I.C. 74HCT139	1	U8
331-164-1	I.C. 74LS164	1	U9
331-393	I.C. 74LS393	1	U20
331-574-1	I.C. 74HCT574	1	U13
332-256	I.C. 27256	1	U2
332-264	I.C. 6264	2	U3,U4
333-015	I.C. Z80A	1	U1
333-018	I.C. Z8530	1	U5
333-110	I.C. 7910	1	U14
334-020	I.C. CD4020B	1	U12
350-488	I.C. MC1488	1	U7
350-489	I.C. MC1489	1	U6
400-028	DIP SOCKET 28 PIN	4	U14,U2,U3,U4
410-102	HEADER, STR. 2 POS	3	JP1,JP7,JP10
410-103	HEADER, STR. 3 POS	7	JP2-JP6,JP8,JP9
412-125	HDR R/A "D" 25 POS	1	J2
420-001	JACK POWER 2.1MM	1	J1
420-039	CONN R/A DIN 5 PIN	2	J3,J4
500-002	SW P-P 2P2T	1	SW1
650-491	CRYSTAL 4.9152 MHZ	1	Y1
750-004	HEATSINK 3/4"	1	U18
760-001	SW KNOB BLK .4X.2	1	SW1
762-003	FUSE CLIP PCB	2	F1
762-103	LITH BAT 3V	1	B1
763-001	FUSE 1 AMP	1	F1
779-001	SHORTING PLUG	10	JP1-JP10
062-079-1	EXTRUSION PK-90	1	
062-079-2	BEZEL PK-90	2	
063-077	FRONT PANEL PK-90	1	
063-078	REAR PANEL PK-90	1	
769-003	CABLE W/POWER PLUG 5'	1	
769-025	CABLE ASSY PK-90	1	
040-036	OPERATING MANUAL PK-90	1	

PARTS LIST DPSK MODEM

PART NO.	DESCRIPTION	QTY	REF. DESIG
013-075	PCB DPSK MODEM 90	1	
110-103	CAP MY 103P 10% 50V	1	C2
110-104	CAP MY 104P 10% 50V	4	C7,C8,C3,C26
112-122	CAP MY 122P 2% 50V	1	C27
121-103	CAP CR 103P 50V	3	C4,C12,C28
121-104	CAP CR 104P 50V	12	C14-C25
130-106	CAP EL 106P RAD 25V	1	C1
130-486	CAP EL 476P RAD 35V	1	C29
150-181	CAP SILVER MICA 180P	1	C6
150-330	CAP SILVER MICA 33P	1	C5
150-331	CAP SILVER MICA 330P	2	C9,C13
150-500	CAP SILVER MICA 50P	1	C11
150-821	CAP SILVER MICA 820P	1	C10
210-102	RES 1/4W 5% 1K	3	R3,R46,R47
210-103	RES 1/4W 5% 10K	13	R4,R9,R25,R48, R28-R32,R41, R42,R54,R55
210-104	RES 1/4W 5% 100K	6	R1,R6,R11,R13, R20,R53
210-105	RES 1/4W 5% 1M	1	R49
210-124	RES 1/4W 5% 120K	2	R24,R17
210-155	RES 1/4W 5% 1.5M	1	R43
210-202	RES 1/4W 5% 2K	5	R2,R26,R27,R44, R45
210-203	RES 1/4W 5% 20K	4	R14,R15,R16,R10
210-273	RES 1/4W 5% 27K	1	R33
210-394	RES 1/4W 5% 390K	3	R36,R37,R40
210-473	RES 1/4W 5% 47K	3	R8,R12,R56
210-514	RES 1/4W 5% 510K	1	R53
210-823	RES 1/4W 5% 82K	1	R21
211-103	RES 1/4W 1% 10K	2	R35,R39
211-124	RES 1/4W 1% 127K	3	R50-R52
211-273	RES 1/4W 1% 27.4K	1	R34
211-280-3	RES 1/4W 1% 28.0K	1	R38
211-402	RES 1/4W 1% 40.2K	1	R18
211-492	RES 1/4W 1% 4.99K	2	R19,R23
211-604-3	RES 1/4W 1% 60.4K	1	R22
310-001	DIODE SIGNAL 1N4448	3	D1,D2,D3
320-011	TRANSISTOR MPS6521	2	Q3,Q5
320-203	TRANSISTOR 2N4861	1	Q2
320-501	TRANSISTOR 2N3906	2	Q1,Q4
330-018	I.C. MC34074P	1	U8
330-038	I.C. 347N	1	U7
330-048	I.C. MF-10	2	U4,U5
330-053	I.C. XR2123A	1	U1
331-004-1	I.C. 74LS04	1	U6
331-193	I.C. 74LS193	1	U2
334-040	I.C. CD4040B	1	U3
400-028	DIP SOCKET 28 PIN	1	J1 (ON REAR)
420-040	DIP PLUG 28 PIN	1	J1 (ON REAR)
650-460	CRYSTAL 4.608 MHZ	1	Y1